

ACKNOWLEDGMENTS

The report's editors wish to thank the AMS Journals editorial staff, in particular Melissa Fernau, for facilitating the document, and to the NCEI graphics team for laying the document out and executing the countless number of technical edits needed. We also wish to express our sincere and deep gratitude to Dr. Rick Rosen, who served as the AMS special editor for this report. Dr. Rosen's handling of the reviews was at the same time rigorous and responsive, and greatly improved the document.

Chapter 2:

- The chapter editors thank David Parker, Mark McCarthy, and John Kennedy for providing detailed and comprehensive internal reviews of this chapter.
- The chapter authors also thank Paul Berrisford (ECMWF), Mike Bosilovich (NASA) and Shinya Kobayashi (JMA) for timely provision of reanalysis data.
- Robert Dunn, Rob Allan, Chris Folland, Colin Morice, and Kate Willett were supported by the Joint UK BEIS/Defra Met Office Hadley Centre Climate Programme (GA01101).
- R. Iestyn Woolway was funded by EUSTACE (EU Surface Temperature for All Corners of Earth) which received funding from the European Union's Horizon 2020 Programme for Research and Innovation, under Grant Agreement 640171.
- Laura Carrea was funded by Natural Environment Research Council Globolakes project. Lake location data used for the satellite data processing were derived from the European Space Agency Climate Change Initiative Land Cover Project.
- Svetlana Shimaraeva, Eugene Silow, and Maxim Timofeev were supported by a Russian Ministry of education and science project 6.1387.2017 and by a private grant from "Lake Baikal" foundation (<https://baikalfoundation.ru>).
- David Robinson acknowledges Thomas Estilow and the NOAA National Centers for Environmental Information Climate Data Record Program for support.
- Hyungjun Kim was supported by the Japan Society for the Promotion of Science KAKENHI (16H06291) for this contribution.
- Research in section 2d7 was supported by grants from NASA's GRACE and GRACE-FO Science Team.
- The ESA CCI SM datasets and the authors were supported by ESA's Climate Change Initiative for

Soil Moisture (Contract No. 4000104814/11/I-NB and 4000112226/14/I-NB) and the European Union's FP7 EartH2Observe "Global Earth Observation for Integrated Water Resource Assessment" project (grant agreement number 331 603608). Wouter Dorigo is supported by the "TU Wien Science Award 2015", awarded by the Vienna University of Technology.

- Tim Osborn received funding from UK NERC (NE/P006809/1).
- Jonathan Barichivich received funding from (CR)² Chile (CONICYT/FONDAP/15110009).
- Ian Harris received funding from UK National Centre for Atmospheric Science (NCAS).
- Diego G. Miralles acknowledges support from the European Research Council (ERC) under grant agreement 715254 (DRY-2-DRY).
- The GFASv1.3 dataset was provided by the GFAS-CLIM project, funded by the German Bundesministerium für Wirtschaft und Energie (BMWi FKZ 50EE1543).
- David Kass's contribution was performed at the Jet Propulsion Laboratory, California Institute of Technology, under contract with the National Aeronautics and Space Administration. Government sponsorship acknowledged.

Chapter 3:

- The editor thanks NOAA/PME's Sandra Bigley for her very helpful work in assembling and copy editing Chapter 3. I couldn't do it without her help.

section 3h:

- The GPCP SG combined precipitation data were developed and computed at the NASA/Goddard Space Flight Center's Mesoscale Atmospheric Processes Laboratory – Atmospheres as a contribution to the GEWEX Global Precipitation Climatology Project.
- Data from the RAPID-WATCH MOC monitoring project are funded by the Natural Environment Research Council and are freely available from www.rapid.ac.uk/rapidmoc.
- JRA-55 Data Japan Meteorological Agency/Japan. 2013. JRA-55: Japanese 55-year Reanalysis, Daily 3-Hourly and 6-Hourly Data. Research Data Archive at the National Center for Atmospheric Research, Computational and Information Systems Laboratory. See more at: <https://climatedataguide.ucar.edu/climate-data/jra-55#sthash.zj1XmMQq.dpuf>.

- MOVE contributions were made under award NA15OAR4320071 from the Climate Observations Division, National Oceanic and Atmospheric Administration, U.S. Department of Commerce. Previously, MOVE was funded by the German Bundesministerium für Bildung und Forschung (Grants 03F0246A and 03F0377B). MOVE data are freely available via the international OceanSITES program (<http://www.oceansites.org/data/>).

Chapter 4:

The editors extend their thanks to the following individuals for assisting with the initial internal reviews of the Chapter. Their comments, insights, and careful editing eyes were instrumental in producing a very good chapter.

- Andrew Hagen, NOAA/National Weather Service, Miami, FL
- Ben Schenkel, Princeton University and NOAA/GFDL, Princeton, NJ
- Bill Ward, NOAA/National Weather Service, Honolulu, HI

Chapter 5:

- V. Romanovsky and coauthors of the permafrost essay (section 5i) acknowledge the support of the State of Alaska, the National Science Foundation (grants PLR-0856864 and PLR-1304271 to the University of Alaska Fairbanks; PLR-1002119 and PLR-1304555 to the George Washington University), and by Geological Survey of Canada and Natural Resources Canada. Support was also provided by the Russian Science Foundation (projects RNF 16-17-00102, 13-05-41509 RGO, 13-05-00811, 13-08-91001, 14-05-00956, 14-17-00037, and 15-55-71004) and by the government of the Russian Federation.

- The chapter editors thank the authors for their contributions and the reviewers for their thoughtful and constructive comments.
- This publication (specifically support to J. Richter-Menge for coordination and editing) is the result in part of research sponsored by the Cooperative Institute for Alaska Research with funds from the National Oceanic and Atmospheric Administration under cooperative agreement NA13OAR4320056 with the University of Alaska.
- J. Overland, lead author of the surface air temperature section (section 5b), was supported by the Arctic Research Project of the NOAA Climate Program Office.
- M. Tedesco, lead author of the Greenland section (section 5e), acknowledges support from

the NASA Cryosphere Program, the NASA IDS program (NNX14AD98G), and the Office of Polar Programs at the National Science Foundation (OPP 1643187).

- H. Epstein and coauthors of the tundra greenness section (section 5h) acknowledge support from the NASA Land Cover Land Use Change synthesis program (NNX14AD906).
- G. Bernhard and coauthors of section 5j acknowledge the U.S. National Science Foundation for supporting UV measurements at Barrow and Summit, a Research Council of Norway Centres of Excellence award (Project 223268/F50) to the Norwegian Radiation Protection Authority, the Academy of Finland for supporting UV measurements through the FARPOCC, SAARA, and ILMA pilot projects, and the ESA Living Planet program for funding the ILMA project (Contract No.: 4000112796/15/I-SBo).
- SEARCH, highlighted in sidebar 5.1, is funded by the National Science Foundation. B. P. Kelly, author of the sidebar, thanks SEARCH's Scientific Steering Committee, and Action Teams. Allen Pope and Matthew Druckenmiller provided graphics and many good ideas.

Chapter 6:

- The editors acknowledge and thank the authors for their timely contributions, with additional special thanks to the internal and external reviewers and document editors for their thoughtful and constructive comments. The editors also wish to thank Dr. Sam Batzli of the University of Wisconsin-Madison's Space Science and Engineering Center for generating Figure 6.1.
- Sharon Stammerjohn was supported under NSF PLR 1440435; she also thanks the Institute of Arctic and Alpine Research and the National Snow and Ice Data Center, both at the University of Colorado Boulder, for institutional and data support.
- Ted Scambos was supported under NASA grant NNX14AM54G and NSF ANT 0944763, the Antarctic Glaciological Data Center.
- Linda Keller and Matthew Lazzara were supported by the Automatic Weather Station Program, National Science Foundation, ANT-1245663 and PLR-1543305.
- The work of Rob Massom, Phil Reid, Jan Lieser, and Steve Rintoul was supported by the Australian Government's Cooperative Research Centre program through the Antarctic Climate & Ecosystems CRC, and contributes to AAS Project 4116.

Phil Reid was also supported through the Bureau of Meteorology. Jan Lieser was supported under Australian Research Council's Special Research Initiative for Antarctic Gateway Partnership (Project ID SR140300001).

- Jean-Baptiste Sallée was supported by the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation program (Grant Agreement no 637770); Mike Meredith received funding from the Natural Environment Research Council via award NE/N018095/1.
- SOCCOM is supported by the National Science Foundation under NSF Award PLR-1425989. ORCHESTRA is funded by the Natural Environment Research Council, and is a joint program of the British Antarctic Survey, National Oceanography Centre, Plymouth Marine Laboratory, British Geological Survey, Sea Mammal Research Unit, Centre for Polar Observation and Modelling, and the UK Met Office. The authors thank the teams of scientists from these centres that are contributing to the programs.

Chapter 7:

North America / Canada:

- The authors express their thanks to Neil Taylor, Curtis Mooney with Environment and Climate Change Canada; Renee Beaulac with the Western Partnership for Wildland Fire Science at the University of Alberta; and Nyree Sharp for their helpful comments and suggestions.

Europe:

- Valuable climate information was provided by National Meteorological and Hydrological Services of the WMO RA VI Region, either by direct submission to the authors or via the web.
- The authors of Sidebar 7.3 acknowledge the data providers in the ECA&D project: <http://www.ecad.eu>.

Oceania:

- The Australian authors thank their tolerant, wonderful, and supportive colleagues. We love you.

ACRONYMS AND ABBREVIATIONS

BASS:	Blended Analysis of Surface Salinity (NOAA)	KNMI:	Royal Netherlands Meteorological Institute
BOM:	Bureau of Meteorology (Australia)	MLO:	Mauna Loa Observatory (Hawaii, US)
CCI:	Climate Change Initiative	MRI/JMA:	Meteorological Research Institute/ Japan Meteorological Agency
CDAS:	Climate Data Analysis System (NCAR)	NASA:	National Aeronautics and Space Administration (US)
CEMADEN:	Centro Nacional de Monitoramento e Alerta de Desastres Naturais (Brazil)	NCAR:	National Center for Atmospheric Research (US)
CERES:	Clouds and the Earth's Radiant Energy Systems	NCEI:	National Centers for Environmental Information (NOAA)
CFSR:	Climate Forecast System Reanalysis (NCEP)	NCEP:	National Centers for Environmental Prediction (NOAA)
CIIFEN:	Centro Internacional para la Investigación del Fenómeno El Niño (Ecuador)	NOAA:	National Oceanic and Atmospheric Administration (US)
CLIVAR:	Climate Variability and Predictability	NSIDC:	National Snow and Ice Data Center (US)
CMAP:	CPC Merged Analysis of Precipitation	OLR:	outgoing longwave radiation
CMEMS:	Copernicus Marine and Environment Monitoring Service	PMEL/JPL/JIMAR:	(US) Pacific Marine Environmental Laboratory/Jet Propulsion Laboratory/ Joint Institute for Marine and Atmospheric Research
CPC:	Climate Prediction Center (NOAA)	RAPID-MOC/MOCHA/WBTS:	(International, UK-led) RAPID Climate Change Programme-Meridional Overturning Circulation Meridional Overturning Circulation and Heatflux Array Western Boundary Time Series
CSIRO/ACE CRC/IMAS-UTAS:	(Australia) Commonwealth Scientific and Industrial Research Organisation Antarctic Climate & Ecosystems Cooperative Research Centre Institute for Marine and Antarctic Studies - University of Tasmania	RSW:	reflected shortwave
DWD:	Deutscher Wetterdienst	SENAMHI-Bolivia:	Servicio Nacional de Meteorología e Hidrología (La Paz)
ECV:	Essential Climate Variable	SENAMHI-Peru:	Servicio Nacional de Meteorología e Hidrología (Lima)
ESA:	European Space Agency	TOA:	top of atmosphere
ESRL:	Earth System Research Laboratory (NOAA)	TRMM:	Tropical Rainfall Measuring Mission
FLASHFlux:	Fast Longwave And Shortwave Radiative Fluxes	TSI:	total solar irradiance
GUIB:	Geographisches Institut der Universität Bern (Switzerland)	WOA:	World Ocean Atlas
GO-SHIP:	Global Ocean Ship-based Hydrographic Investigations Program	WOCE:	World Ocean Circulation Experiment
GODAS:	Global Ocean Data Assimilation System	Additional acronyms and abbreviations can be found at this AMS website: https://www.ametsoc.org/ams/index.cfm/publications/authors/journal-and-bams-authors/author-resources/list-of-acronyms-and-abbreviations/	
GPCP:	Global Precipitation Climatology Project		
GRACE:	Gravity Recovery and Climate Experiment		
INMET:	Instituto Nacional de Meteorología (Brazil)		

REFERENCES

- Abbott, B. W., and Coauthors, 2016: Biomass offsets little or none of permafrost carbon release from soils, streams, and wildfire: An expert assessment. *Environ. Res. Lett.*, **11**, 034014, doi:10.1088/1748-9326/11/3/034014.
- Ackerman, S. A., R. E. Holz, R. Frey, E. W. Eloranta, B. C. Maddux, and M. McGill, 2008: Cloud detection with MODIS. Part II: Validation. *J. Atmos. Oceanic Technol.*, **25**, 1073–1086, doi:10.1175/2007jtecha1053.1.
- Adler, R. F., and Coauthors, 2003: The version-2 Global Precipitation Climatology Project (GPCP) monthly precipitation analysis (1979–present). *J. Hydrometeor.*, **4**, 1147–1167, doi:10.1175/1525-7541(2003)004<1147:tvgpcp>2.0.co;2.
- Aiyyer, A., and J. Molinari, 2008: MJO and tropical cyclogenesis in the Gulf of Mexico and eastern Pacific: Case study and idealized numerical modeling. *J. Atmos. Sci.*, **65**, 2691–2704, doi:10.1175/2007jas2348.1.
- Albergel, C., and Coauthors, 2013: Skill and global trend analysis of soil moisture from reanalyses and microwave remote sensing. *J. Hydrometeor.*, **14**, 1259–1277, doi:10.1175/jhm-d-12-0161.1.
- Allan, R. J., and R. D. D'Arrigo, 1999: ‘Persistent’ ENSO sequences: How unusual was the 1990–1995 El Niño? *Holocene*, **9**, 101–118, doi:10.1191/095968399669125102.
- , and T. Ansell, 2006: A new globally complete monthly historical gridded mean sea level pressure dataset (HadSLP2): 1850–2004. *J. Climate*, **19**, 5816–5842, doi:10.1175/jcli3937.1.
- , J. A. Lindesay, and D. E. Parker, 1996: *El Niño Southern Oscillation and Climatic Variability*. CSIRO Publications, 405 pp.
- , C. J. C. Reason, J. A. Lindesay, and T. J. Ansell, 2003: ‘Protracted’ ENSO episodes and their impacts in the Indian Ocean region. *Deep-Sea Res. II*, **50**, 2331–2347, doi:10.1016/S0967-0645(03)00059-6.
- Amador, J. A., 1998: A climatic feature of the tropical Americas: The trade wind easterly jet. *Top. Meteor. Oceanogr.*, **5**, 91–102.
- , E. J. Alfaro, O. G. Lizano, and V. O. Magaña, 2006: Atmospheric forcing of the eastern tropical Pacific: A review. *Prog. Oceanogr.*, **69**, 101–142, doi:10.1016/j.pocean.2006.03.007.
- , —, H. G. Hidalgo, and B. Calderón, 2011: Central America [in “State of the Climate in 2010”]. *Bull. Amer. Meteor. Soc.*, **92** (6), S182–S183, doi:10.1175/1520-0477-92.6.s1.
- Andela, N., and G. R. van der Werf, 2014: Recent trends in African fires driven by cropland expansion and El Niño to La Niña transition. *Nat. Climate Change*, **4**, 791–795, doi:10.1038/nclimate2313.
- Anderson, M. C., and Coauthors, 2011: Mapping daily evapotranspiration at field to continental scales using geostationary and polar orbiting satellite imagery. *Hydrol. Earth Syst. Sci.*, **15**, 223–239, doi:10.5194/hess-15-223-2011.
- Anderson, R. G., and Coauthors, 2015: Using satellite-based estimates of evapotranspiration and groundwater changes to determine anthropogenic water fluxes in land surface models. *Geosci. Model Dev.*, **8**, 3021–3031, doi:10.5194/gmd-8-3021-2015.
- Andersson, S. M., and Coauthors, 2015: Significant radiative impact of volcanic aerosol in the lowermost stratosphere. *Nat. Comm.*, **6**, 7692, doi:10.1038/ncomms8692.
- Andreassen, L. M., H. Elvehøy, B. Kjøllmoen, and R. V. Engeset, 2016: Reanalysis of long-term series of glaciological and geodetic mass balance for 10 Norwegian glaciers. *Cryosphere*, **10**, 535–552, doi:10.5194/tc-10-535-2016.
- Andres, M., 2016: On the recent destabilization of the Gulf Stream path downstream of Cape Hatteras. *Geophys. Res. Lett.*, **43**, 9836–9842, doi:10.1002/2016GL069966.
- Aquila, V., W. H. Swartz, D. W. Waugh, P. R. Colarco, S. Pawson, L. M. Polvani, and R. S. Stolarski, 2016: Isolating the roles of different forcing agents in global stratospheric temperature changes using model integrations with incrementally added single forcings. *J. Geophys. Res. Atmos.*, **121**, 8067–8082, doi:10.1002/2015JD023841.
- Arbesser, T. E., A. H. Lynch, and D. A. Bailey, 2004: Relationship between synoptic forcing and polynya formation in the Cosmonaut Sea: 1. Polynya climatology. *J. Geophys. Res.*, **109**, C04022, doi:10.1029/2003JC001837.
- Argüez, A., T. R. Karl, M. F. Squires, and R. S. Vose, 2013: Uncertainty in annual rankings from NOAA’s global temperature time series. *Geophys. Res. Lett.*, **40**, 5965–5969, doi:10.1002/2013GL057999.
- Arkin, P. A., 1982: The relationship between interannual variability in the 200 mb tropical wind field and the southern oscillation. *Mon. Wea. Rev.*, **110**, 1393–1404, doi:10.1175/1520-0493(1982)110<1393:trbivi>2.0.co;2.
- Armstrong, R., K. Knowles, M. J. Brodzik, and M. A. Hardman, 1994, updated 2016: DMSP SSM/I-SSMIS Pathfinder Daily EASE-Grid Brightness Temperatures. 2 ed., National Snow and Ice Data Center, doi:10.5067/3EX2U1DV3434.
- Ashok, K., and T. Yamagata, 2009: Climate change: The El Niño with a difference. *Nature*, **461**, 481–484, doi:10.1038/461481a.
- Azorin-Molina, C., and Coauthors, 2014: Homogenization and assessment of observed near-surface wind speed trends over Spain and Portugal, 1961–2011. *J. Climate*, **27**, 3692–3712, doi:10.1175/jcli-d-13-00652.1.
- , J.-A. Guijarro, T. R. McVicar, S. M. Vicente-Serrano, D. Chen, S. Jerez, and F. Espírito-Santo, 2016: Trends of daily peak wind gusts in Spain and Portugal, 1961–2014. *J. Geophys. Res. Atmos.*, **121**, 1059–1078, doi:10.1002/2015JD024485.

- , S. M. Vicente-Serrano, T. R. McVicar, J. Revuelto, S. Jerez, and J.-I. López-Moreno, 2017: Assessing the impact of measurement time interval when calculating wind speed means and trends under the stilling phenomenon. *Int. J. Climatol.*, **37**, 480–492, doi:10.1002/joc.4720.
- Bakker, D. C. E., and Coauthors, 2016: A multi-decade record of high-quality fCO₂ data in version 3 of the Surface Ocean CO₂ Atlas (SOCAT). *Earth Syst. Sci. Data*, **8**, 383–413, doi:10.5194/essd-8-383-2016.
- Banzon, V. F., and R. W. Reynolds, 2013: Use of WindSat to extend a microwave-based daily optimum interpolation sea surface temperature time series. *J. Climate*, **26**, 2557–2562, doi:10.1175/jcli-d-12-00628.1.
- Baringer, M. O., M. Lankhorst, D. Volkov, S. Garzoli, S. Dong, U. Send, and C. Meinen, 2016: Meridional oceanic overturning circulation and heat transport in the Atlantic Ocean [in “State of the Climate in 2015”]. *Bull. Amer. Meteor. Soc.*, **97** (8), S84–S87, doi:10.1175/BAMS-2015BAMSStateoftheClimate.1.
- Barrio, I. C., and Coauthors, 2016: Biotic interactions mediate patterns of herbivore diversity in the Arctic. *Global Ecol. Biogeogr.*, **25**, 1108–1118, doi:10.1111/geb.12470.
- Bastos, A., S. W. Running, C. Gouveia, and R. M. Trigo, 2013: The global NPP dependence on ENSO: La Niña and the extraordinary year of 2011. *J. Geophys. Res. Biogeosci.*, **118**, 1247–1255, doi:10.1002/jgrg.20100.
- Bates, N. R., 2015: Assessing ocean acidification variability in the Pacific-Arctic region as part of the Russian-American long-term census of the Arctic. *Oceanography*, **28** (3), 36–45, doi:10.5670/oceanog.2015.56.
- , M. I. Orchowska, R. Garley, and J. T. Mathis, 2013: Summertime calcium carbonate undersaturation in shelf waters of the western Arctic Ocean – how biological processes exacerbate the impact of ocean acidification. *Biogeosciences*, **10**, 5281–5309, doi:10.5194/bg-10-5281-2013.
- Bauer-Marschallinger, B., W. A. Dorigo, W. Wagner, and A. I. J. M. van Dijk, 2013: How oceanic oscillation drives soil moisture variations over mainland Australia: An analysis of 32 years of satellite observations. *J. Climate*, **26**, 10,159–10,173, doi:10.1175/jcli-d-13-00149.1.
- Baxter, S., S. Weaver, J. Gottschalck, and Y. Xue, 2014: Pentad evolution of wintertime impacts of the Madden-Julian oscillation over the contiguous United States. *J. Climate*, **27**, 7356–7367, doi:10.1175/jcli-d-14-00105.1.
- Becker, A., P. Finger, A. Meyer-Christoffer, B. Rudolf, K. Schamm, U. Schneider, and M. Ziese, 2013: A description of the global land-surface precipitation data products of the Global Precipitation Climatology Centre with sample applications including centennial (trend) analysis from 1901–present. *Earth Syst. Sci. Data*, **5**, 71–99, doi:10.5194/essd-5-71-2013.
- Beckmann, A., R. Timmermann, A. F. Pereira, and C. Mohn, 2001: The effect of flow at Maud Rise on the sea-ice cover – Numerical experiments. *Ocean Dyn.*, **52**, 11–25, doi:10.1007/s10236-001-8173-5.
- Behrenfeld, M. J., and Coauthors, 2006: Climate-driven trends in contemporary ocean productivity. *Nature*, **444**, 752–755, doi:10.1038/nature05317.
- , D. A. Siegel, and R. T. O’Malley, 2008: Global ocean phytoplankton [in “State of the Climate in 2007”]. *Bull. Amer. Meteor. Soc.*, **89** (7), S56–S61, doi:10.1175/BAMS-89-7-StateoftheClimate.
- , —, —, and S. Maritorena, 2009: Global ocean phytoplankton [in “State of the Climate in 2008”]. *Bull. Amer. Meteor. Soc.*, **90** (8), S68–S72, doi:10.1175/BAMS-90-8-StateoftheClimate.
- , and Coauthors, 2016: Reevaluating ocean warming impacts on global phytoplankton. *Nat. Climate Change*, **6**, 323–330, doi:10.1038/nclimate2838.
- Behringer, D. W., M. Ji, and A. Leetmaa, 1998: An improved coupled model for ENSO prediction and implications for ocean initialization. Part I: The ocean data assimilation system. *Mon. Wea. Rev.*, **126**, 1013–1021, doi:10.1175/1520-0493(1998)126<1013:acimfe>2.0.co;2.
- Bell, G. D., and M. Chelliah, 2006: Leading tropical modes associated with interannual and multidecadal fluctuations in North Atlantic hurricane activity. *J. Climate*, **19**, 590–612, doi:10.1175/jcli3659.1.
- , M. S. Halpert, V. E. Kousky, M. E. Gelman, C. F. Ropelewski, A. V. Douglas, and R. C. Schnell, 1999: Climate Assessment for 1998. *Bull. Amer. Meteor. Soc.*, **80** (5), S1–S48, doi:10.1175/1520-0477(1999)080<1040:caf>2.0.co;2.
- , and Coauthors, 2000: The 1999 North Atlantic and eastern North Pacific hurricane season [in “Climate Assessment for 1999”]. *Bull. Amer. Meteor. Soc.*, **81** (6), S19–S22, doi:10.1175/1520-0477(2000)081<1328:caf>2.3.co;2.
- , E. S. Blake, T. B. Kimberlain, C. W. Landsea, J. Schemm, R. J. Pasch, and S. B. Goldenberg, 2011: Tropical cyclones: Atlantic basin [in “State of the Climate in 2010”]. *Bull. Amer. Meteor. Soc.*, **92** (6), S115–S121, doi:10.1175/1520-0477-92.6.s1.
- , —, C. W. Landsea, T. B. Kimberlain, S. B. Goldenberg, J. Schemm, and R. J. Pasch, 2012: Tropical cyclones: Atlantic basin [in “State of the Climate in 2011”]. *Bull. Amer. Meteor. Soc.*, **93** (7), S99–S105, doi:10.1175/2012BAMSStateoftheClimate.1.
- , C. W. Landsea, S. B. Goldenberg, R. J. Pasch, E. S. Blake, J. Schemm, and T. B. Kimberlain, 2014: Tropical cyclones: Atlantic basin [in “State of the Climate in 2013”]. *Bull. Amer. Meteor. Soc.*, **95** (7), S86–S90, doi:10.1175/2014BAMSStateoftheClimate.1.

- , —, E. S. Blake, J. Schemm, S. B. Goldenberg, T. B. Kimberlain, and R. J. Pasch, 2015: Tropical cyclones: Atlantic basin [in “State of the Climate in 2014”]. *Bull. Amer. Meteor. Soc.*, **96** (7), S105–S107, doi:10.1175/2015BAMSStateoftheClimate.1.
- , M. Halpert, and M. L’Heureux, 2016: ENSO and the tropical Pacific: A climate perspective [in “State of the Climate in 2015”]. *Bull. Amer. Meteor. Soc.*, **97** (8), S93–S98, doi:10.1175/2016BAMSStateoftheClimate.1.
- Bell, R. J., J. A. Hare, J. P. Manderson, and D. E. Richardson, 2014: Externally driven changes in the abundance of summer and winter flounder. *ICES J. Marine Sci.*, **71**, 2416–2428, doi:10.1093/icesjms/fsu069.
- Benedetti, A., F. D. Giuseppe, J. Flemming, A. Inness, M. Parrington, S. Rémy, and J. R. Ziemke, 2016: Atmospheric composition changes due to the extreme 2015 Indonesian fire season triggered by El Niño [in “State of the Climate in 2015”]. *Bull. Amer. Meteor. Soc.*, **97** (8), S56–S57, doi:10.1175/2016BAMSStateoftheClimate.1.
- Berman, M., C. Nicolson, G. Kofinas, J. Tetlichi, and S. Martin, 2004: Adaptation and sustainability in a small Arctic community: Results of an agent-based simulation model. *Arctic*, **57**, 401–414.
- Bernhard, G., and Coauthors, 2015: Comparison of OMI UV observations with ground-based measurements at high northern latitudes. *Atmos. Chem. Phys.*, **15**, 7391–7412, doi:10.5194/acp-15-7391-2015.
- Berry, D. I., and E. C. Kent, 2009: A new air-sea interaction gridded dataset from ICOADS with uncertainty estimates. *Bull. Amer. Meteor. Soc.*, **90**, 645–656, doi:10.1175/2008bams2639.1.
- and —, 2011: Air-sea fluxes from ICOADS: The construction of a new gridded dataset with uncertainty estimates. *Int. J. Climatol.*, **31**, 987–1001, doi:10.1002/joc.2059.
- and —, 2017: Assessing the health of the in situ global surface marine climate observing system. *Int. J. Climatol.*, **37**, 2248–2259, doi:10.1002/joc.4914.
- Betts, R. A., C. D. Jones, J. R. Knight, R. F. Keeling, and J. J. Kennedy, 2016: El Niño and a record CO₂ rise. *Nat. Climate Change*, **6**, 806–810, doi:10.1038/nclimate3063.
- Bhartia, P. K., and C. W. Wellemeyer, 2002: TOMS-V8 total O₃ algorithm. OM Algorithm Theoretical Basis Document Vol. II, 15–31 pp.
- Bhatt, U., and Coauthors, 2013: Recent declines in warming and vegetation greening trends over pan-Arctic tundra. *Remote Sens.*, **5**, 4229, doi:10.3390/rs5094229.
- Bichet, A., M. Wild, D. Folini, and C. Schär, 2012: Causes for decadal variations of wind speed over land: Sensitivity studies with a global climate model. *Geophys. Res. Lett.*, **39**, L11701, doi:10.1029/2012GL051685.
- Bieniek, P., and Coauthors, 2015: Climate drivers linked to changing seasonality of Alaska coastal tundra vegetation productivity. *Earth Interact.*, **19** (19), 1–29, doi:10.1175/ei-d-15-0013.1.
- Birkett, C., C. Reynolds, B. Beckley, and B. Doorn, 2011: From research to operations: The USDA global reservoir and lake monitor. *Coastal Altimetry*, S. Vignudelli, A. G. Kostianoy, P. Cipollini, and J. Benveniste, Eds., Springer, 19–50.
- Biskaborn, B. K., J. P. Lanckman, H. Lantuit, K. Elger, D. A. Streletschi, W. L. Cable, and V. E. Romanovsky, 2015: The new database of the global terrestrial network for permafrost (GTN-P). *Earth Syst. Sci. Data*, **7**, 245–259, doi:10.5194/essd-7-245-2015.
- Bister, M., and K. A. Emanuel, 1998: Dissipative heating and hurricane intensity. *Meteor. Atmos. Phys.*, **65**, 233–240, doi:10.1007/bf01030791.
- Bjerke, J. W., and Coauthors, 2014: Record-low primary productivity and high plant damage in the Nordic Arctic region in 2012 caused by multiple weather events and pest outbreaks. *Environ. Res. Lett.*, **9**, 084006, doi:10.1088/1748-9326/9/8/084006.
- Bjerknes, J., 1969: Atmospheric teleconnections from the equatorial Pacific. *Mon. Wea. Rev.*, **97**, 163–172, doi:10.1175/1520-0493(1969)097<0163:attfp>2.3.co;2.
- Blake, E., E. J. Gibney, D. P. Brown, M. Mainelli, J. L. Franklin, and T. B. Kimberlain, 2009: Tropical cyclones of the eastern North Pacific basin, 1949–2006. Historical Climatology Series 6–5, 162 pp.
- Bliss, A., R. Hock, and V. Radić, 2014: Global response of glacier runoff to twenty-first century climate change. *J. Geophys. Res. Earth Surf.*, **119**, 717–730, doi:10.1002/2013JF002931.
- Blok, D., M. M. P. D. Heijmans, G. Schaepman-Strub, A. V. Kononov, T. C. Maximov, and F. Berendse, 2010: Shrub expansion may reduce summer permafrost thaw in Siberian tundra. *Global Change Biol.*, **16**, 1296–1305, doi:10.1111/j.1365-2486.2009.02110.x.
- Blunden, J., and D. S. Arndt, 2016: State of the Climate in 2015. *Bull. Amer. Meteor. Soc.*, **97** (8), S1–S275, doi:10.1175/2016BAMSStateoftheClimate.1.
- Bockheim, J. G., and K. M. Hinkel, 2007: The importance of “Deep” organic carbon in permafrost-affected soils of Arctic Alaska. *Soil Sci. Soc. Amer. J.*, **71**, 1889–1892, doi:10.2136/sssaj2007.0070N.
- Boden, T. A., G. Marland, and R. J. Andres, 2015: Global, Regional, and National Fossil-Fuel CO₂ Emissions. Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, doi:10.3334/CDIAC/00001_V2015.
- Bodhaine, B. A., B. G. Mendonca, J. M. Harris, and J. M. Miller, 1981: Seasonal variations in aerosols and atmospheric transmission at Mauna Loa observatory. *J. Geophys. Res.*, **86**, 7395–7398, doi:10.1029/JC086iC08p07395.

- Boening, C., J. K. Willis, F. W. Landerer, R. S. Nerem, and J. Fasullo, 2012: The 2011 La Niña: So strong, the oceans fell. *Geophys. Res. Lett.*, **39**, L19602, doi:10.1029/2012GL053055.
- Bojinski, S., M. Verstraete, T. C. Peterson, C. Richter, A. Simmons, and M. Zemp, 2014: The concept of essential climate variables in support of climate research, applications, and policy. *Bull. Amer. Meteor. Soc.*, **95**, 1431–1443, doi:10.1175/bams-d-13-00047.1.
- Bokhorst, S., J. W. Bjerke, L. E. Street, T. V. Callaghan, and G. K. Phoenix, 2011: Impacts of multiple extreme winter warming events on sub-Arctic heathland: phenology, reproduction, growth, and CO₂ flux responses. *Global Change Biol.*, **17**, 2817–2830, doi:10.1111/j.1365-2486.2011.02424.x.
- Bond, N. A., M. F. Cronin, H. Freeland, and N. Mantua, 2015: Causes and impacts of the 2014 warm anomaly in the NE Pacific. *Geophys. Res. Lett.*, **42**, 3414–3420, doi:10.1002/2015GL063306.
- Bonjean, F., and G. S. E. Lagerloef, 2002: Diagnostic model and analysis of the surface currents in the tropical Pacific Ocean. *J. Phys. Oceanogr.*, **32**, 2938–2954, doi:10.1175/1520-0485(2002)032<2938:dmaao>2.0.co;2.
- Borge, A. F., S. Westermann, I. Solheim, and B. Etzelmüller, 2017: Strong degradation of palsas and peat plateaus in northern Norway during the last 60 years. *Cryosphere*, **11**, 1–16, doi:10.5194/tc-11-1-2017.
- Bosilovich, M. G., and Coauthors, 2015: MERRA-2: Initial evaluation of the climate. NASA/TM-2015-104606, Vol. 43, 136 pp. [Available online at <http://gmao.gsfc.nasa.gov/reanalysis/MERRA-2/docs/>.]
- , F. R. Robertson, L. Takacs, and A. Molod, 2017: Atmospheric water balance and variability in the MERRA-2 reanalysis. *J. Climate*, **30**, 1177–1196, doi:10.1175/jcli-d-16-0338.1.
- Boucher, O., and Coauthors, 2013: Clouds and aerosols. *Climate Change 2013: The Physical Science Basis*, T. F. Stocker et al., Eds., Cambridge University Press, 571–658.
- Bourassa, A. E., and Coauthors, 2014: Trends in stratospheric ozone derived from merged SAGE II and Odin-OSIRIS satellite observations. *Atmos. Chem. Phys.*, **14**, 6983–6994, doi:10.5194/acp-14-6983-2014.
- Box, J. E., and Coauthors, 2012: Greenland ice sheet. *Arctic Report Card 2012*, NOAA's Arctic Program, 146–158. [Available online at http://ftp.oar.noaa.gov/arctic/documents/ArcticReportCard_full_report2012.pdf.]
- , D. van As, K. Steffen, 2017: Greenland, Canadian and Icelandic land ice albedo grids (2000–2016). *Geol. Surv. Den. Greenl. Bull.*, **38**, 69–72.
- Boyer, T. P., and Coauthors, 2013: World ocean database 2013. NOAA Atlas NESDIS 72, 209 pp. [Available online at <http://www.nodc.noaa.gov/OC5/WOD13/>.]
- , S. Levitus, J. I. Antonov, J. R. Reagan, C. Schmid, and R. Locarnini, 2012: Subsurface salinity [in “State of the Climate in 2011”]. *Bull. Amer. Meteor. Soc.*, **93** (7), S72–S75, doi:10.1175/2012BAMSStateoftheClimate.1.
- Brasnett, B., 1999: A global analysis of snow depth for numerical weather prediction. *J. Appl. Meteor.*, **38**, 726–740, doi:10.1175/1520-0450(1999)038<0726:agaosd>2.0.co;2.
- Bret-Harte, M. S., and Coauthors, 2013: The response of Arctic vegetation and soils following an unusually severe tundra fire. *Philos. Trans. Roy. Soc. London*, **368B**, 20120490, doi:10.1098/rstb.2012.0490.
- Bromwich, D. H., A. J. Monaghan, and Z. Guo, 2004: Modeling the ENSO modulation of Antarctic climate in the late 1990s with the polar MM5. *J. Climate*, **17**, 109–132, doi:10.1175/1520-0442(2004)017<0109:mtemoa>2.0.co;2.
- , R. L. Fogt, K. I. Hodges, and J. E. Walsh, 2007: A tropospheric assessment of the ERA-40, NCEP, and JRA-25 global reanalyses in the polar regions. *J. Geophys. Res.*, **112**, D10111, doi:10.1029/2006JD007859.
- , J. P. Nicolas, and A. J. Monaghan, 2011: An assessment of precipitation changes over Antarctica and the Southern Ocean since 1989 in contemporary global reanalyses. *J. Climate*, **24**, 4189–4209, doi:10.1175/2011jcli4074.1.
- Brönnimann, S., J. L. Annis, C. Vogler, and P. D. Jones, 2007: Reconstructing the quasi-biennial oscillation back to the early 1900s. *Geophys. Res. Lett.*, **34**, L22805, doi:10.1029/2007GL031354.
- Brosius, L. S., K. M. W. Anthony, G. Grosse, J. P. Chanton, L. M. Farquharson, P. P. Overduin, and H. Meyer, 2012: Using the deuterium isotope composition of permafrost meltwater to constrain thermokarst lake contributions to atmospheric CH₄ during the last deglaciation. *J. Geophys. Res.*, **117**, G01022, doi:10.1029/2011JG001810.
- Brown, D. P., 2017: Hurricane Otto (AL162016, EP22016): 20–26 November 2016. Natl. Hurricane Center, Tropical Cyclone Rep., 28 pp. [Available online at http://www.nhc.noaa.gov/data/tcr/AL162016_Otto.pdf.]
- Brown, J., O. J. Ferrians Jr., J. A. Heginbottom, and E. S. Melnikov, 1998, Revised February 2001: Circum-Arctic map of permafrost and ground ice conditions. National Snow and Ice Data Center. [Available online at http://nsidc.org/data/docs/fcdc/ggd318_map_circumarctic/.]
- Brutsaert, W., 2016: Global land surface evaporation trend during the past half century: Corroboration by Clausius-Clapeyron scaling. *Adv. Water Res.*, **Early Online**, doi:10.1016/j.advwatres.2016.08.014.
- Butchart, N., and E. E. Remsberg, 1986: The area of the stratospheric polar vortex as a diagnostic for tracer transport on an isentropic surface. *J. Atmos. Sci.*, **43**, 1319–1339, doi:10.1175/1520-0469(1986)043<1319:taotsp>2.0.co;2.

- Calvo, N., R. R. Garcia, W. J. Randel, and D. R. Marsh, 2010: Dynamical mechanism for the increase in tropical upwelling in the lowermost tropical stratosphere during warm ENSO events. *J. Atmos. Sci.*, **67**, 2331–2340, doi:10.1175/2010jas3433.1.
- Camargo, S. J., and A. H. Sobel, 2005: Western North Pacific tropical cyclone intensity and ENSO. *J. Climate*, **18**, 2996–3006, doi:10.1175/jcli3457.1.
- , K. A. Emanuel, and A. H. Sobel, 2007: Use of a genesis potential index to diagnose ENSO effects on tropical cyclone genesis. *J. Climate*, **20**, 4819–4834, doi:10.1175/jcli4282.1.
- , M. C. Wheeler, and A. H. Sobel, 2009: Diagnosis of the MJO modulation of tropical cyclogenesis using an empirical index. *J. Atmos. Sci.*, **66**, 3061–3074, doi:10.1175/2009jas3101.1.
- Cappelen, J., B. M. Vinther, C. Kern-Hansen, E. V. Laursen, and P. V. Jørgensen, 2017: Greenland - DMI Historical Climate Data Collection 1784-2016. DMI Report 17-04, 108 pp. [Available online at http://www.dmi.dk/fileadmin/user_upload/Rapporter/TR/2017/DMIRep17-04.pdf.]
- Carpenter, L. J., and Coauthors, 2014: Update on ozone-depleting substances (ODSs) and other gases of interest to the Montreal Protocol. *Scientific Assessment of Ozone Depletion: 2014*, World Meteorological Organization, 1.1–1.101.
- Carrea, L., O. Embury, and C. J. Merchant, 2015: Datasets related to in-land water for limnology and remote sensing applications: Distance-to-land, distance-to-water, waterbody identifier and lake-centre co-ordinates. *Geosci. Data J.*, **2**, 83–97, doi:10.1002/gdj3.32.
- Carsey, F. D., 1980: Microwave observation of the Weddell polynya. *Mon. Wea. Rev.*, **108**, 2032–2044, doi:10.1175/1520-0493(1980)108<2032:mootwp>2.0.co;2.
- Carter, B. R., and Coauthors, 2017: Two decades of Pacific anthropogenic carbon storage and ocean acidification along Global Ocean Ship-based Hydrographic Investigations Program sections P16 and P02. *Global Biogeochem. Cycles*, **31**, 306–327, doi:10.1002/2016GB005485.
- Carton, J. A., S. A. Cunningham, E. Frajka-Williams, Y.-O. Kwon, D. P. Marshall, and R. Msadek, 2014: The Atlantic overturning circulation: More evidence of variability and links to climate. *Bull. Amer. Meteor. Soc.*, **95** (8), ES163–ES166, doi:10.1175/bams-d-13-00234.1.
- Cassou, C., 2008: Intraseasonal interaction between the Madden-Julian oscillation and the North Atlantic oscillation. *Nature*, **455**, 523–527, doi:10.1038/nature07286.
- Castro de la Guardia, L., X. Hu, and P. G. Myers, 2015: Potential positive feedback between Greenland Ice Sheet melt and Baffin Bay heat content on the West Greenland Shelf. *Geophys. Res. Lett.*, **42**, 4922–4930, doi:10.1002/2015GL064626.
- Cavalieri, D. J., C. L. Parkinson, P. Gloersen, and H. Zwally, 1996, updated yearly: Sea Ice Concentrations From Nimbus-7 SMMR and DMSP SSM/I-SSMIS Passive Microwave Data (1981–2011). National Snow and Ice Data Center, doi:10.5067/8GQ8LZQVL0VL.
- Cazenave, A., and Coauthors, 2012: Estimating ENSO influence on the global mean sea level, 1993–2010. *Mar. Geod.*, **35** (Supl), 82–97, doi:10.1080/01490419.2012.718209.
- Chambers, D. P., and Coauthors, 2017: Evaluation of the global mean sea level budget between 1993 and 2014. *Surv. Geophys.*, **38**, 309–327, doi:10.1007/s10712-016-9381-3.
- Chan, J. C. L., 2000: Tropical cyclone activity over the western North Pacific associated with El Niño and La Niña events. *J. Climate*, **13**, 2960–2972, doi:10.1175/1520-0442(2000)013<2960:tcaotw>2.0.co;2.
- Chandra, S., J. R. Ziemke, W. Min, and W. G. Read, 1998: Effects of 1997–1998 El Niño on tropospheric ozone and water vapor. *Geophys. Res. Lett.*, **25**, 3867–3870, doi:10.1029/98GL02695.
- , —, B. N. Duncan, T. L. Diehl, N. J. Livesey, and L. Froidevaux, 2009: Effects of the 2006 El Niño on tropospheric ozone and carbon monoxide: Implications for dynamics and biomass burning. *Atmos. Chem. Phys.*, **9**, 4239–4249, doi:10.5194/acp-9-4239-2009.
- Chen, Y., and Coauthors, 2013: Long-term trends and interannual variability of forest, savanna and agricultural fires in South America. *Carbon Management*, **4**, 617–638, doi:10.4155/cmt.13.61.
- Chia, H. H., and C. F. Ropelewski, 2002: The interannual variability in the genesis location of tropical cyclones in the northwest Pacific. *J. Climate*, **15**, 2934–2944, doi:10.1175/1520-0442(2002)015<2934:tigtc>2.0.co;2.
- Chiodi, A. M., and D. E. Harrison, 2013: El Niño impacts on seasonal U.S. atmospheric circulation, temperature, and precipitation anomalies: The OLR-event perspective. *J. Climate*, **26**, 822–837, doi:10.1175/jcli-d-12-00097.1.
- Chiou, E. W., and Coauthors, 2014: Comparison of profile total ozone from SBUV (v8.6) with GOME-type and ground-based total ozone for a 16-year period (1996 to 2011). *Atmos. Meas. Tech.*, **7**, 1681–1692, doi:10.5194/amt-7-1681-2014.
- Christiansen, H. H., and Coauthors, 2010: The thermal state of permafrost in the nordic area during the international polar year 2007–2009. *Permafro. Periglac. Process.*, **21**, 156–181, doi:10.1002/ppp.687.
- Christy, J., 2014: Lower tropospheric temperature [in “State of the Climate in 2013”]. *Bull. Amer. Meteor. Soc.*, **95** (7), S10–S11, doi:10.1175/2014BAMSStateoftheClimate.1.
- , 2016: Lower and midtropospheric temperature [in “State of the Climate in 2015”]. *Bull. Amer. Meteor. Soc.*, **97** (8), S13–S15, doi:10.1175/2016BAMSStateoftheClimate.1.

- , and R. T. McNider, 1994: Satellite greenhouse signal. *Nature*, **367**, 325–325, doi:10.1038/367325a0.
- , R. W. Spencer, and W. B. Norris, 2011: The role of remote sensing in monitoring global bulk tropospheric temperatures. *Int. J. Remote Sens.*, **32**, 671–685, doi:10.1080/01431161.2010.517803.
- Chrysanthou, A., G. van der Schrier, E. J. M. van den Besseelaar, A. M. G. Klein Tank, and T. Brandsma, 2014: The effects of urbanization on the rise of the European temperature since 1960. *Geophys. Res. Lett.*, **41**, 7716–7722, doi:10.1002/2014GL061154.
- Chu, J.-H., C. R. Sampson, A. S. Levine, and E. Fukada, 2002: The Joint Typhoon Warning Center tropical cyclone best-tracks, 1945–2000. Ref. NRL/MR/7540-02-16, Naval Research Laboratory. [Available online at http://www.usno.navy.mil/NOOC/nmfc-ph/RSS/jtvc/best_tracks/TC_bt_report.html.]
- Chung, E.-S., B. J. Soden, and V. O. John, 2013: Intercalibrating microwave satellite observations for monitoring long-term variations in upper- and midtropospheric water vapor. *J. Atmos. Oceanic Technol.*, **30**, 2303–2319, doi:10.1175/jtech-d-13-00001.1.
- , —, X. Huang, L. Shi, and V. O. John, 2016: An assessment of the consistency between satellite measurements of upper tropospheric water vapor. *J. Geophys. Res. Atmos.*, **121**, 2874–2887, doi:10.1002/2015JD024496.
- Clancy, R. T., and Coauthors, 2000: An intercomparison of ground-based millimeter, MGS TES, and Viking atmospheric temperature measurements: Seasonal and interannual variability of temperatures and dust loading in the global Mars atmosphere. *J. Geophys. Res.*, **105**, 9553–9571, doi:10.1029/1999JE001089.
- Coelho, C. A. S., D. H. F. Cardoso, and M. A. F. Firpo, 2016a: Precipitation diagnostics of an exceptionally dry event in São Paulo, Brazil. *Theor. Appl. Climatol.*, **125**, 769–784, doi:10.1007/s00704-015-1540-9.
- , and Coauthors, 2016b: The 2014 southeast Brazil austral summer drought: Regional scale mechanisms and teleconnections. *Climate Dyn.*, **46**, 3737–3752, doi:10.1007/s00382-015-2800-1.
- Coldewey-Egbers, M., and Coauthors, 2015: The GOME-type total ozone essential climate variable (GTO-ECV) data record from the ESA Climate Change Initiative. *Atmos. Meas. Tech.*, **8**, 3923–3940, doi:10.5194/amt-8-3923-2015.
- Comiso, J. C., R. A. Gersten, L. V. Stock, J. Turner, G. J. Perez, and K. Cho, 2017: Positive trend in the Antarctic sea ice cover and associated changes in surface temperature. *J. Climate*, **30**, 2251–2267, doi:10.1175/jcli-d-16-0408.1.
- Cook, B. I., K. J. Anchukaitis, R. Touchan, D. M. Meko, and E. R. Cook, 2016: Spatiotemporal drought variability in the Mediterranean over the last 900 years. *J. Geophys. Res. Atmos.*, **121**, 2060–2074, doi:10.1002/2015JD023929.
- Cooper, O. R., and J. R. Ziemke, 2013: Tropospheric ozone [in “State of the Climate in 2012”]. *Bull. Amer. Meteor. Soc.*, **94** (8), S38–S39, doi:10.1175/2013BAMSStateoftheClimate.1.
- , and —, 2014: Tropospheric ozone [in “State of the Climate in 2013”]. *Bull. Amer. Meteor. Soc.*, **95** (7), S42, doi:10.1175/2014BAMSStateoftheClimate.1.
- , and —, 2015: Tropospheric ozone [in “State of the Climate in 2014”]. *Bull. Amer. Meteor. Soc.*, **96** (7), S48–S49, doi:10.1175/2015BAMSStateoftheClimate.1.
- , and Coauthors, 2014: Global distribution and trends of tropospheric ozone: An observation-based review. *Elementa: Sci. Anthropocene*, **2**, 29, doi:10.12952/journal.elementa.000029.
- Cross, J.N., J.T. Mathis, R.S. Pickart, and N.R. Bates, 2017: Formation and transport of corrosive water in the Pacific Arctic region. *Deep-Sea Res. II, Special issue: Synthesis of Arctic Research (SOAR)*, Submitted.
- Cruz, M. G., A. L. Sullivan, J. S. Gould, N. C. Sims, A. J. Bannister, J. J. Hollis, and R. J. Hurley, 2012: Anatomy of a catastrophic wildfire: The Black Saturday Kilmore East fire in Victoria, Australia. *For. Ecol. Manage.*, **284**, 269–285, doi:10.1016/j.foreco.2012.02.035.
- Curtis, S., and R. Adler, 2000: ENSO indices based on patterns of satellite-derived precipitation. *J. Climate*, **13**, 2786–2793, doi:10.1175/1520-0442(2000)013<2786:eibopo>2.0.co;2.
- Dai, A., 2006: Recent climatology, variability, and trends in global surface humidity. *J. Climate*, **19**, 3589–3606, doi:10.1175/jcli3816.1.
- , 2013: Increasing drought under global warming in observations and models. *Nat. Climate Change*, **3**, 52–58, doi:10.1038/nclimate1633.
- , T. Qian, K. E. Trenberth, and J. D. Milliman, 2009: Changes in continental freshwater discharge from 1948 to 2004. *J. Climate*, **22**, 2773–2792, doi:10.1175/2008jcli2592.1.
- Davidson, E. A., and I. A. Janssens, 2006: Temperature sensitivity of soil carbon decomposition and feedbacks to climate change. *Nature*, **440**, 165–173, doi:10.1038/nature04514.
- Davis, S. M., K. H. Rosenlof, D. F. Hurst, and H. B. Selkirk, 2016a: Stratospheric water vapor [in “State of the Climate in 2015”]. *Bull. Amer. Meteor. Soc.*, **97** (8), S51–S53, doi:10.1175/2016BAMSStateoftheClimate.1.
- Davis, S. M., and Coauthors, 2016b: The stratospheric water and ozone satellite homogenized (SWOOSH) database: A long-term database for climate studies. *Earth Syst. Sci. Data*, **8**, 461–490, doi:10.5194/essd-8-461-2016.
- Dee, D. P., and Coauthors, 2011: The ERA-Interim reanalysis: Configuration and performance of the data assimilation system. *Quart. J. Roy. Meteor. Soc.*, **137**, 553–597, doi:10.1002/qj.828.

- Deeter, M. N., and Coauthors, 2013: Validation of MOPITT Version 5 thermal-infrared, near-infrared, and multispectral carbon monoxide profile retrievals for 2000–2011. *J. Geophys. Res. Atmos.*, **118**, 6710–6725, doi:10.1002/jgrd.50272.
- de Jong, M. F., and L. de Steur, 2016: Strong winter cooling over the Irminger Sea in winter 2014–2015, exceptional deep convection, and the emergence of anomalously low SST. *Geophys. Res. Lett.*, **43**, 7106–7113, doi:10.1002/2016GL069596.
- de Lavergne, C., J. B. Palter, E. D. Galbraith, R. Bernardello, and I. Marinov, 2014: Cessation of deep convection in the open Southern Ocean under anthropogenic climate change. *Nat. Climate Change*, **4**, 278–282, doi:10.1038/nclimate2132.
- DeMaria, M., M. Mainelli, L. K. Shay, J. A. Knaff, and J. Kaplan, 2005: Further improvements to the statistical hurricane intensity prediction scheme (SHIPS). *Wea. Forecasting*, **20**, 531–543, doi:10.1175/waf862.1.
- de Pablo, M. A., M. Ramos, and A. Molina, 2017: Snow cover evolution, on 2009–2014, at the Limnopolar Lake CALM-S site on Byers Peninsula, Livingston Island, Antarctica. *CATENA*, **149** Part 2, 538–547, doi:10.1016/j.catena.2016.06.002.
- DerkSEN, C., R. Brown, L. Mudryk, and K. LuoJus, 2016: Terrestrial snow [in “State of the Climate in 2015”]. *Bull. Amer. Meteor. Soc.*, **97** (8), S145–S147, doi:10.1175/2016BAMSStateoftheClimate.1.
- Desbruyères, D. G., S. G. Purkey, E. L. McDonagh, G. C. Johnson, and B. A. King, 2016: Deep and abyssal ocean warming from 35 years of repeat hydrography. *Geophys. Res. Lett.*, **43**, 10,356–10,365, doi:10.1002/2016GL070413.
- Dewitte, S., D. Crommelynck, and A. Joukoff, 2004: Total solar irradiance observations from DIARAD/VIRGO. *J. Geophys. Res.*, **109**, A02102, doi:10.1029/2002JA009694.
- Diamond, H. J., Ed., 2013: The tropics [in “State of the Climate in 2012”]. *Bull. Amer. Meteor. Soc.*, **94** (8), S79–S110, doi:10.1175/2013BAMSStateoftheClimate.1.
- , 2014: The tropics [in “State of the Climate in 2013”]. *Bull. Amer. Meteor. Soc.*, **95** (7), S81–S114, doi:10.1175/2014BAMSStateoftheClimate.1.
- , 2015: The tropics [in “State of the Climate in 2014”]. *Bull. Amer. Meteor. Soc.*, **96** (7), S91–S126, doi:10.1175/2015BAMSStateoftheClimate.1.
- , and C. J. Schreck III, Eds., 2016: The tropics [in “State of the Climate in 2015”]. *Bull. Amer. Meteor. Soc.*, **97** (8), S93–S130, doi:10.1175/2016BAMSStateoftheClimate.1.
- , A. M. Lorrey, K. R. Knapp, and D. H. Levinson, 2012: Development of an enhanced tropical cyclone tracks database for the southwest Pacific from 1840 to 2010. *Int. J. Climatol.*, **32**, 2240–2250, doi:10.1002/joc.2412.
- Di Girolamo, L., A. Menzies, G. Zhao, K. Mueller, C. Moroney, and D. J. Diner, 2010: Multi-angle imaging spectroradiometer level 3 cloud fraction by altitude algorithm theoretical basis document. JPL Publ. D-62358, 23 pp.
- Ding, J., and Coauthors, 2016: The permafrost carbon inventory on the Tibetan Plateau: A new evaluation using deep sediment cores. *Global Change Biol.*, **22**, 2688–2701, doi:10.1111/gcb.13257.
- Slugokenky, E. J., E. G. Nisbet, R. Fisher, and D. Lowry, 2011: Global atmospheric methane: Budget, changes and dangers. *Philos. Trans. Roy. Soc. London*, **369A**, 2058–2072, doi:10.1098/rsta.2010.0341.
- Dohan, K., G. Goni, and R. Lumpkin, 2015: Surface currents [in “State of the Climate in 2014”]. *Bull. Amer. Meteor. Soc.*, **96** (7), S76–S78, doi:10.1175/2015BAMSStateoftheClimate.1.
- Doherty, R. M., D. S. Stevenson, C. E. Johnson, W. J. Collins, and M. G. Sanderson, 2006: Tropospheric ozone and El Niño–Southern Oscillation: Influence of atmospheric dynamics, biomass burning emissions, and future climate change. *J. Geophys. Res.*, **111**, D19304, doi:10.1029/2005JD006849.
- Domingues, C. M., J. A. Church, N. J. White, P. J. Gleckler, S. E. Wijffels, P. M. Barker, and J. R. Dunn, 2008: Improved estimates of upper-ocean warming and multi-decadal sea-level rise. *Nature*, **453**, 1090–1093, doi:10.1038/nature07080.
- Domingues, R., and Coauthors, 2015: Upper ocean response to Hurricane Gonzalo (2014): Salinity effects revealed by targeted and sustained underwater glider observations. *Geophys. Res. Lett.*, **42**, 7131–7138, doi:10.1002/2015GL065378.
- Donat, M. G., L. V. Alexander, H. Yang, I. Durre, R. Vose, and J. Caesar, 2013: Global land-based datasets for monitoring climatic extremes. *Bull. Amer. Meteor. Soc.*, **94**, 997–1006, doi:10.1175/bams-d-12-00109.1.
- , R. J. H. Dunn, and S. E. Perkins-Kirkpatrick, 2016: Temperature extreme indices [in “State of the Climate in 2015”]. *Bull. Amer. Meteor. Soc.*, **97** (8), S19–S20, doi:10.1175/2016BAMSStateoftheClimate.1.
- Dong, S., M. O. Baringer, G. J. Goni, C. S. Meinen, and S. L. Garzoli, 2014: Seasonal variations in the South Atlantic meridional overturning circulation from observations and numerical models. *Geophys. Res. Lett.*, **41**, 4611–4618, doi:10.1002/2014GL060428.
- , G. Goni, and F. Bringas, 2015: Temporal variability of the South Atlantic meridional overturning circulation between 20°S and 35°S. *Geophys. Res. Lett.*, **42**, 7655–7662, doi:10.1002/2015GL065603.
- Dorigo, W. (A.), and R. de Jeu, 2016: Satellite soil moisture for advancing our understanding of Earth system processes and climate change. *Int. J. Appl. Earth Obs. Geoinf.*, **48**, 1–4, doi:10.1016/j.jag.2016.02.007.

- , —, D. Chung, R. Parinussa, Y. Liu, W. Wagner, and D. Fernández-Prieto, 2012: Evaluating global trends (1988–2010) in harmonized multi-satellite surface soil moisture. *Geophys. Res. Lett.*, **39**, L18405, doi:10.1029/2012GL052988.
- , and Coauthors, 2015a: Soil moisture [in “State of the Climate in 2014”]. *Bull. Amer. Meteor. Soc.*, **96** (7), S28–S29, doi:10.1175/2015BAMSStateoftheClimate.1.
- , and Coauthors, 2015b: Evaluation of the ESA CCI soil moisture product using ground-based observations. *Remote Sens. Environ.*, **162**, 380–395, doi:10.1016/j.rse.2014.07.023.
- , and Coauthors, 2016: Soil moisture [in “State of the Climate in 2015”]. *Bull. Amer. Meteor. Soc.*, **97** (8), S31–S32, doi:10.1175/2016BAMSStateoftheClimate.1.
- Drozdov, D., and Coauthors, 2015: Monitoring of permafrost in Russia and the international GTN-P project. *Proc. 68th Canadian Geotechnical Conf. and Seventh Canadian Conf. on Permafrost (GEOQuébec 2015)*, Quebec, Canada, GEOQuébec 2015, Paper 617.
- Duchez, A., and Coauthors, 2014: A new index for the Atlantic meridional overturning circulation at 26°N. *J. Climate*, **27**, 6439–6455, doi:10.1175/jcli-d-13-00052.1.
- , and Coauthors, 2016: Drivers of exceptionally cold North Atlantic Ocean temperatures and their link to the 2015 European heat wave. *Environ. Res. Lett.*, **11**, 074004, doi:10.1088/1748-9326/11/7/074004.
- Dunkerton, T. J., 2016: The quasi-biennial oscillation of 2015–2016: Hiccup or death spiral? *Geophys. Res. Lett.*, **43**, 10,547–10,552, doi:10.1002/2016GL070921.
- Dunn, R. J. H., and Coauthors, 2012: HadISD: A quality-controlled global synoptic report database for selected variables at long-term stations from 1973–2011. *Climate Past*, **8**, 1649–1679, doi:10.5194/cp-8-1649-2012.
- , C. Azorin-Molina, C. A. Mears, P. Berrisford, and T. R. McVicar, 2016a: Surface winds [in “State of the Climate in 2015”]. *Bull. Amer. Meteor. Soc.*, **97** (8), S38–S40, doi:10.1175/2016BAMSStateoftheClimate.1.
- , K. M. Willett, D. E. Parker, and L. Mitchell, 2016b: Expanding HadISD: Quality-controlled, sub-daily station data from 1931. *Geosci. Instrum. Method. Data Syst.*, **5**, 473–491, doi:10.5194/gi-5-473-2016.
- Durack, P. J., S. E. Wijffels, and P. J. Gleckler, 2014: Long-term sea-level change revisited: The role of salinity. *Environ. Res. Lett.*, **9**, 114017, doi:10.1088/1748-9326/9/11/114017.
- Dutton, E. G., 1992: A coherence between the QBO and the amplitude of the Mauna Loa atmospheric transmission annual cycle. *Int. J. Climatol.*, **12**, 383–396, doi:10.1002/joc.3370120406.
- , and B. A. Bodhaine, 2001: Solar irradiance anomalies caused by clear-sky transmission variations above Mauna Loa: 1958–99. *J. Climate*, **14**, 3255–3262, doi:10.1175/1520-0442(2001)014<3255:siacbc>2.0.co;2.
- , J. J. Deluisi, and P. Arne, 1985: Interpretation of Mauna Loa atmospheric transmission relative to aerosols, using photometric precipitable water amounts. *J. Atmos. Chem.*, **3**, 53–68, doi:10.1007/bf00049368.
- Ebita, A., and Coauthors, 2011: The Japanese 55-year reanalysis “JRA-55”: An interim report. *SOLA*, **7**, 149–152, doi:10.2151/sola.2011-038.
- Edson, J. B., and Coauthors, 2013: On the exchange of momentum over the open ocean. *J. Phys. Oceanogr.*, **43**, 1589–1610, doi:10.1175/jpo-d-12-0173.1.
- Ekstrom, J. A., and Coauthors, 2015: Vulnerability and adaptation of US shellfisheries to ocean acidification. *Nat. Climate Change*, **5**, 207–214, doi:10.1038/nclimate2508.
- Ellis, H. T., and R. F. Pueschel, 1971: Solar radiation: Absence of air pollution trends at Mauna Loa. *Science*, **172**, 845–846, doi:10.1126/science.172.3985.845.
- Emanuel, K. A., 1986: An air-sea interaction theory for tropical cyclones. Part I: Steady-state maintenance. *J. Atmos. Sci.*, **43**, 585–605, doi:10.1175/1520-0469(1986)043<0585:aasitf>2.0.co;2.
- , 1988: The maximum intensity of hurricanes. *J. Atmos. Sci.*, **45**, 1143–1155, doi:10.1175/1520-0469(1988)045<1143:tmioh>2.0.co;2.
- , and D. S. Nolan, 2004: Tropical cyclone activity and the global climate system. *Proc. 26th Conf. on Hurricanes and Tropical Meteor.*, Miami, FL, Amer. Meteor. Soc., 10A.12. [Available online at http://ams.confex.com/ams/26HURR/techprogram/paper_75463.htm.]
- Enfield, D. B., and A. M. Mestas-Nuñez, 1999: Multi-scale variabilities in global sea surface temperatures and their relationships with tropospheric climate patterns. *J. Climate*, **12**, 2719–2733, doi:10.1175/1520-0442(1999)012<2719:mvigss>2.0.co;2.
- England, M. H., and Coauthors, 2014: Recent intensification of wind-driven circulation in the Pacific and the ongoing warming hiatus. *Nat. Climate Change*, **4**, 222–227, doi:10.1038/nclimate2106.
- Epstein, H. E., M. K. Reynolds, D. A. Walker, U. S. Bhatt, C. J. Tucker, and J. E. Pinzon, 2012: Dynamics of aboveground phytomass of the circumpolar Arctic tundra during the past three decades. *Environ. Res. Lett.*, **7**, 015506, doi:10.1088/1748-9326/7/1/015506.
- Ershadi, A., M. F. McCabe, J. P. Evans, N. W. Chaney, and E. F. Wood, 2014: Multi-site evaluation of terrestrial evaporation models using FLUXNET data. *Agric. Forest Meteor.*, **187**, 46–61, doi:10.1016/j.agrformet.2013.11.008.

- Esaias, W. E., and Coauthors, 1998: An overview of MODIS capabilities for ocean science observations. *IEEE Trans. Geosci. Remote Sens.*, **36**, 1250–1265, doi:10.1109/36.701076.
- Escurra, J. J., V. Vazquez, R. Cestti, E. De Nys, and R. Srinivasan, 2014: Climate change impact on countrywide water balance in Bolivia. *Regional Environ. Change*, **14**, 727–742, doi:10.1007/s10113-013-0534-3.
- Estilow, T. W., A. H. Young, and D. A. Robinson, 2015: A long-term Northern Hemisphere snow cover extent data record for climate studies and monitoring. *Earth Syst. Sci. Data*, **7**, 137–142, doi:10.5194/essd-7-137-2015.
- Evans, W., and Coauthors, 2015: Sea-air CO₂ exchange in the western Arctic coastal ocean. *Global Biogeochem. Cycles*, **29**, 1190–1209, doi:10.1002/2015GB005153.
- Ezer, T., L. P. Atkinson, W. B. Corlett, and J. L. Blanco, 2013: Gulf Stream's induced sea level rise and variability along the U.S. mid-Atlantic coast. *J. Geophys. Res. Oceans*, **118**, 685–697, doi:10.1002/jgrc.20091.
- Falkowski, P. G., R. T. Barber, and V. Smetacek, 1998: Biogeochemical controls and feedbacks on ocean primary production. *Science*, **281**, 200–206, doi:10.1126/science.281.5374.200.
- Fang, L., C. R. Hain, X. Zhan, and M. C. Anderson, 2016: An inter-comparison of soil moisture data products from satellite remote sensing and a land surface model. *Int. J. Appl. Earth Obs. Geoinf.*, **48**, 37–50, doi:10.1016/j.jag.2015.10.006.
- Farbrot, H., K. Isaksen, B. Etzelmüller, and K. Gisnås, 2013: Ground thermal regime and permafrost distribution under a changing climate in northern Norway. *Periglac. Process.*, **24**, 20–38, doi:10.1002/ppp.1763.
- Fasullo, J. T., C. Boening, F. W. Landerer, and R. S. Nerem, 2013: Australia's unique influence on global sea level in 2010–2011. *Geophys. Res. Lett.*, **40**, 4368–4373, doi:10.1002/grl.50834.
- Fay, G., J. S. Link, and J. A. Hare, 2017: Assessing the effects of ocean acidification in the Northeast US using an end-to-end marine ecosystem model. *Ecolog. Modell.*, **347**, 1–10, doi:10.1016/j.ecolmodel.2016.12.016.
- Fennig, K., A. Andersson, S. Bakan, C.-P. Klepp, and M. Schröder, 2012: Hamburg Ocean Atmosphere Parameters and Fluxes from Satellite Data - HOAPS 3.2 - Monthly Means / 6-Hourly Composites. Satellite Application Facility on Climate Monitoring (CM SAF), doi:10.5676/EUM_SAF_CM/HOAPS/V001.
- Ferraro, A. J., M. Collins, and F. H. Lambert, 2015: A hiatus in the stratosphere? *Nat. Climate Change*, **5**, 497–498, doi:10.1038/nclimate2624.
- Fetterer, F., K. Knowles, W. Meier, and M. Savoie, 2002, updated daily: Sea Ice Index. National Snow and Ice Data Center, doi:10.7265/N5QJ7F7W.
- Field, C. B., and M. R. Raupach, Eds., 2004: *The Global Carbon Cycle: Integrating Humans, Climate, and the Natural World*. Island Press, 568 pp.
- , M. J. Behrenfeld, J. T. Randerson, and P. Falkowski, 1998: Primary production of the biosphere: Integrating terrestrial and oceanic components. *Science*, **281**, 237–240, doi:10.1126/science.281.5374.237.
- Fioletov, V. E., G. E. Bodeker, A. J. Miller, R. D. McPeters, and R. Stolarski, 2002: Global and zonal total ozone variations estimated from ground-based and satellite measurements: 1964–2000. *J. Geophys. Res.*, **107**, 4647, doi:10.1029/2001JD001350.
- , and Coauthors, 2008: Performance of the ground-based total ozone network assessed using satellite data. *J. Geophys. Res.*, **113**, D14313, doi:10.1029/2008JD009809.
- Fisher, J. B., K. P. Tu, and D. D. Baldocchi, 2008: Global estimates of the land–atmosphere water flux based on monthly AVHRR and ISLSCP-II data, validated at 16 FLUXNET sites. *Remote Sens. Environ.*, **112**, 901–919, doi:10.1016/j.rse.2007.06.025.
- Flannigan, M. D., and B. M. Wotton, 2001: Climate, weather and area burned. *Forest Fires: Behaviour and Ecological Effects*, E. A. Johnson, and K. Miyanishi, Eds., Academic Press, 335–357.
- Flato, G., and Coauthors, 2013: Evaluation of climate models. *Climate Change 2013: The Physical Science Basis*, T. F. Stocker et al., Eds., Cambridge University Press, 741–866.
- Flemming, J., and Coauthors, 2017: The CAMS interim reanalysis of carbon monoxide, ozone and aerosol for 2003–2015. *Atmos. Chem. Phys.*, **17**, 1945–1983, doi:10.5194/acp-17-1945-2017.
- Fofonoff, N. P., and E. L. Lewis, 1979: A practical salinity scale. *J. Oceanogr. Soc. Japan*, **35**, 63–64, doi:10.1007/bf02108283.
- Fogarty, M., L. Incze, K. Hayhoe, D. Mountain, and J. Manning, 2008: Potential climate change impacts on Atlantic cod (*Gadus morhua*) off the northeastern USA. *Mitigation Adapt. Strategies Global Change*, **13**, 453–466, doi:10.1007/s11027-007-9131-4.
- Fogt, R. L., D. H. Bromwich, and K. M. Hines, 2011: Understanding the SAM influence on the South Pacific ENSO teleconnection. *Climate Dyn.*, **36**, 1555–1576, doi:10.1007/s00382-010-0905-0.
- Folland, C. K., J. Knight, H. W. Linderholm, D. Fereday, S. Ineson, and J. W. Hurrell, 2009: The summer North Atlantic oscillation: Past, present, and future. *J. Climate*, **22**, 1082–1103, doi:10.1175/2008jcli2459.1.
- Foltz, G. R., and K. Balaguru, 2016: Prolonged El Niño conditions in 2014–2015 and the rapid intensification of Hurricane Patricia in the eastern Pacific. *Geophys. Res. Lett.*, **43**, 10,347–10,355, doi:10.1002/2016GL070274.

- Font, J., and Coauthors, 2013: SMOS first data analysis for sea surface salinity determination. *Int. J. Remote Sens.*, **34**, 3654–3670, doi:10.1080/01431161.2012.716541.
- Ford, J. D., and T. Pearce, 2010: What we know, do not know, and need to know about climate change vulnerability in the western Canadian Arctic: A systematic literature review. *Environ. Res. Lett.*, **5**, 014008, doi:10.1088/1748-9326/5/1/014008.
- Forget, F., and Coauthors, 1999: Improved general circulation models of the Martian atmosphere from the surface to above 80 km. *J. Geophys. Res.*, **104**, 24,155–24,175, doi:10.1029/1999JE001025.
- Foster, M. J., and A. Heidinger, 2013: PATMOS-x: Results from a diurnally corrected 30-yr satellite cloud climatology. *J. Climate*, **26**, 414–425, doi:10.1175/jcli-d-11-00666.1.
- Frajka-Williams, E., 2015: Estimating the Atlantic overturning at 26°N using satellite altimetry and cable measurements. *Geophys. Res. Lett.*, **42**, 3458–3464, doi:10.1002/2015GL063220.
- , and Coauthors, 2016: Compensation between meridional flow components of the Atlantic MOC at 26°N. *Ocean Sci.*, **12**, 481–493, doi:10.5194/os-12-481-2016.
- Francis, J. A., and S. J. Vavrus, 2015: Evidence for a wavier jet stream in response to rapid Arctic warming. *Environ. Res. Lett.*, **10**, 014005, doi:10.1088/1748-9326/10/1/014005.
- Frank, W. M., and P. E. Roundy, 2006: The role of tropical waves in tropical cyclogenesis. *Mon. Wea. Rev.*, **134**, 2397–2417, doi:10.1175/mwr3204.1.
- Franz, B. A., M. J. Behrenfeld, D. A. Siegel, and P. J. Werdell, 2013: Global ocean phytoplankton [in “State of the Climate in 2012”]. *Bull. Amer. Meteor. Soc.*, **94** (8), S75–S78, doi:10.1175/2013BAMSStateoftheClimate.1.
- , —, —, and S. R. Signorini, 2016: Global ocean phytoplankton [in “State of the Climate in 2015”]. *Bull. Amer. Meteor. Soc.*, **97** (8), S87–S89, doi:10.1175/2016BAMSStateoftheClimate.1.
- Free, M., D. J. Seidel, J. K. Angell, J. Lanzante, I. Durre, and T. C. Peterson, 2005: Radiosonde atmospheric temperature products for assessing climate (RATPAC): A new data set of large-area anomaly time series. *J. Geophys. Res.*, **110**, D22101, doi:10.1029/2005JD006169.
- Friedland, K. D., and J. A. Hare, 2007: Long-term trends and regime shifts in sea surface temperature on the continental shelf of the northeast United States. *Cont. Shelf Res.*, **27**, 2313–2328, doi:10.1016/j.csr.2007.06.001.
- Frisch, L. C., J. T. Mathis, N. P. Kettle, and S. F. Trainor, 2015: Gauging perceptions of ocean acidification in Alaska. *Marine Policy*, **53**, 101–110, doi:10.1016/j.marpol.2014.11.022.
- Frith, S. M., N. A. Kramarova, R. S. Stolarski, R. D. McPeters, P. K. Bhartia, and G. J. Labow, 2014: Recent changes in total column ozone based on the SBUV version 8.6 merged ozone data set. *J. Geophys. Res. Atmos.*, **119**, 9735–9751, doi:10.1002/2014JD021889.
- Froidevaux, L., and Coauthors, 2015: Global ozone chemistry and related trace gas data records for the stratosphere (GOZCARDS): Methodology and sample results with a focus on HCl, H₂O, and O₃. *Atmos. Chem. Phys.*, **15**, 10,471–10,507, doi:10.5194/acp-15-10471-2015.
- Fung, I., J. John, J. Lerner, E. Matthews, M. Prather, L. P. Steele, and P. J. Fraser, 1991: Three-dimensional model synthesis of the global methane cycle. *J. Geophys. Res.*, **96**, 13,033–13,065, doi:10.1029/91JD01247.
- Gan, T. Y., A. K. Gobena, and Q. Wang, 2007: Precipitation of southwestern Canada: Wavelet, scaling, multifractal analysis, and teleconnection to climate anomalies. *J. Geophys. Res.*, **112**, D10110, doi:10.1029/2006JD007157.
- Gardner, A. S., and Coauthors, 2011: Sharply increased mass loss from glaciers and ice caps in the Canadian Arctic archipelago. *Nature*, **473**, 357–360, doi:10.1038/nature10089.
- , and Coauthors, 2013: A reconciled estimate of glacier contributions to sea level rise: 2003 to 2009. *Science*, **340**, 852–857, doi:10.1126/science.1234532.
- Garreaud, R., and Coauthors, 2017: The 2010–2015 mega drought in central Chile: Impacts on regional hydroclimate and vegetation. *Hydrol. Earth Syst. Sci. Discuss.*, **2017**, doi:10.5194/hess-2017-191.
- Gawarkiewicz, G. G., R. E. Todd, A. J. Plueddemann, M. Andres, and J. P. Manning, 2012: Direct interaction between the Gulf Stream and the shelfbreak south of New England. *Sci. Rep.*, **2**, 553, doi:10.1038/srep00553.
- GCOS, 2003: The second report on the adequacy of the global observing systems for climate in support of the UNFCCC. GCOS-82 (WMO/TD-1143). World Meteorological Organization, 74 pp. [Available online at http://www.wmo.int/pages/prog/gcos/Publications/gcos-82_2AR.pdf.]
- GCOS, 2010: Implementation plan for the global observing system for climate in support of the UNFCCC (2010 Update). GCOS-138 (GOOS-184, GTOS-76, WMO/TD-1523). World Meteorological Organization, 180 pp. [Available online at <http://www.wmo.int/pages/prog/gcos/Publications/gcos-138.pdf>.]
- Gelaro, R., and Coauthors, 2017: The Modern-Era Retrospective Analysis for Research and Applications, version 2 (MERRA-2). *J. Climate*, **30**, 5419–5454, doi:10.1175/JCLI-D-16-0758.1.
- Gergis, J. L., and A. M. Fowler, 2009: A history of ENSO events since A.D. 1525: Implications for future climate change. *Climatic Change*, **92**, 343–387, doi:10.1007/s10584-008-9476-z.
- Ghilain, N., A. Arboleda, and F. Gellens-Meulenberghs, 2011: Evapotranspiration modelling at large scale using near-real time MSG SEVIRI derived data. *Hydrol. Earth Syst. Sci.*, **15**, 771–786, doi:10.5194/hess-15-771-2011.
- Global Carbon Project, cited 2016: Carbon budget and trends 2016. [Available online at <http://www.globalcarbonproject.org/carbonbudget/index.htm>.]

- Gobron, N., and M. Robustelli, 2013: Monitoring the state of the global terrestrial surfaces. *Proc. 2013 ESA Living Planet Symp.*, Edinburgh, United Kingdom, European Space Agency, SP-722.
- , A. Belward, B. Pinty, and W. Knorr, 2010: Monitoring biosphere vegetation 1998–2009. *Geophys. Res. Lett.*, **37**, L15402, doi:10.1029/2010GL043870.
- Goldenberg, S. B., and L. J. Shapiro, 1996: Physical mechanisms for the association of El Niño and West African rainfall with Atlantic major hurricane activity. *J. Climate*, **9**, 1169–1187, doi:10.1175/1520-0442(1996)009<1169:pmftao>2.0.co;2.
- , C. W. Landsea, A. M. Mestas-Nuñez, and W. M. Gray, 2001: The recent increase in Atlantic hurricane activity: Causes and implications. *Science*, **293**, 474–479, doi:10.1126/science.1060040.
- Goni, G. J., and J. A. Trinanes, 2003: Ocean thermal structure monitoring could aid in the intensity forecast of tropical cyclones. *Eos, Trans. Amer. Geophys. Union*, **84**, 573–578, doi:10.1029/2003EO510001.
- , S. Kamholz, S. Garzoli, and D. Olson, 1996: Dynamics of the Brazil–Malvinas confluence based on inverted echo sounders and altimetry. *J. Geophys. Res.*, **101**, 16,273–16,289, doi:10.1029/96JC01146.
- , and Coauthors, 2009: Applications of satellite-derived ocean measurements to tropical cyclone intensity forecasting. *Oceanography*, **22** (3), 190–197, doi:10.5670/oceanog.2009.78.
- , G. J., F. Bringas, and P. N. DiNezio, 2011: Observed low frequency variability of the Brazil Current front. *J. Geophys. Res.*, **116**, C10037, doi:10.1029/2011JC007198.
- , J. A. Knaff, and I-I Lin, 2016: Tropical cyclone heat potential [in “State of the Climate in 2015”]. *Bull. Amer. Meteor. Soc.*, **97** (8), S120–S123, doi:10.1175/BAMSStateoftheClimate.1.
- Goni, J. G., and J. A. Knaff, 2009: Tropical cyclone heat potential [in “State of the Climate in 2008”]. *Bull. Amer. Meteor. Soc.*, **90** (8), S54–S56, doi:10.1175/BAMS-90-8-StateoftheClimate.
- Gorham, E., 1991: Northern peatlands: Role in the carbon cycle and probable responses to climatic warming. *Ecol. Appl.*, **1**, 182–195, doi:10.2307/1941811.
- Graglia, E., R. Julkunen-Tiitto, G. R. Shaver, I. K. Schmidt, S. Jonasson, and A. Michelsen, 2001: Environmental control and intersite variations of phenolics in *Betula nana* in tundra ecosystems. *New Phytologist*, **151**, 227–236, doi:10.1046/j.1469-8137.2001.00149.x.
- Granier, C., and Coauthors, 2011: Evolution of anthropogenic and biomass burning emissions of air pollutants at global and regional scales during the 1980–2010 period. *Climatic Change*, **109**, 163, doi:10.1007/s10584-011-0154-1.
- Gray, W. M., 1968: Global view of the origin of tropical disturbances and storms. *Mon. Wea. Rev.*, **96**, 669–700, doi:10.1175/1520-0493(1968)096<0669:gvotoo>2.0.co;2.
- Grosse, G., S. Goetz, A. D. McGuire, V. E. Romanovsky, and E. A. G. Schuur, 2016: Changing permafrost in a warming world and feedbacks to the Earth system. *Environ. Res. Lett.*, **11**, 040201, doi:10.1088/1748-9326/11/4/04021.
- Guglielmin, M., M. R. Balks, and K. Seybold, 2016: Permafrost thermal snapshot: Marble Point and Wright Valley, Ross Sea Region, Antarctica. *XI. Int. Conf. Permafrost*, Potsdam, Germany, Bibliothek Wissenschaftspark Albert Einstein.
- Guhathakurta, P., M. Rajeevan, D. R. Sikka, and A. Tyagi, 2015: Observed changes in southwest monsoon rainfall over India during 1901–2011. *Int. J. Climatol.*, **35**, 1881–1898, doi:10.1002/joc.4095.
- Guo, Y., X. Jiang, and D. E. Waliser, 2014: Modulation of the convectively coupled Kelvin waves over South America and the tropical Atlantic Ocean in association with the Madden–Julian oscillation. *J. Atmos. Sci.*, **71**, 1371–1388, doi:10.1175/jas-d-13-0215.1.
- Haas, C., S. Hendricks, H. Eicken, and A. Herber, 2010: Synoptic airborne thickness surveys reveal state of Arctic sea ice cover. *Geophys. Res. Lett.*, **37**, L09501, doi:10.1029/2010GL042652.
- Haeberli, W., J. Cihlar, and R. G. Barry, 2000: Glacier monitoring within the Global Climate Observing System. *Ann. Glaciol.*, **31**, 241–246, doi:10.3189/172756400781820192.
- Haimberger, L., C. Tavolato, and S. Sperka, 2012: Homogenization of the global radiosonde temperature dataset through combined comparison with reanalysis background series and neighboring stations. *J. Climate*, **25**, 8108–8131, doi:10.1175/jcli-d-11-00668.1.
- Halpert, M. S., and C. F. Ropelewski, 1992: Surface temperature patterns associated with the southern oscillation. *J. Climate*, **5**, 577–593, doi:10.1175/1520-0442(1992)005<0577:stpawt>2.0.co;2.
- Hamlington, B. D., M. W. Strassburg, R. R. Leben, W. Han, R. S. Nerem, and K. Y. Kim, 2014: Uncovering an anthropogenic sea-level rise signal in the Pacific Ocean. *Nat. Climate Change*, **4**, 782–785, doi:10.1038/nclimate2307.
- , S. H. Cheon, P. R. Thompson, M. A. Merrifield, R. S. Nerem, R. R. Leben, and K. Y. Kim, 2016: An ongoing shift in Pacific Ocean sea level. *J. Geophys. Res. Oceans*, **121**, 5084–5097, doi:10.1002/2016JC011815.
- Hanna, E., J. M. Jones, J. Cappelen, S. H. Mernild, L. Wood, K. Steffen, and P. Huybrechts, 2013: The influence of North Atlantic atmospheric and oceanic forcing effects on 1900–2010 Greenland summer climate and ice melt/runoff. *Int. J. Climatol.*, **33**, 862–880, doi:10.1002/joc.3475.

- Hansen, J., R. Ruedy, M. Sato, and K. Lo, 2010: Global surface temperature change. *Rev. Geophys.*, **48**, RG4004, doi:10.1029/2010RG000345.
- , and Coauthors, 2016: Young people's burden: Requirement of negative CO₂ emissions. *Earth Syst. Dyn. Discuss.*, **2016**, 1–40, doi:10.5194/esd-2016-42.
- Hare, J. A., M. A. Alexander, M. J. Fogarty, E. H. Williams, and J. D. Scott, 2010: Forecasting the dynamics of a coastal fishery species using a coupled climate–population model. *Ecolog. Appl.*, **20**, 452–464, doi:10.1890/08-1863.1.
- , and Coauthors, 2016: Northeast regional action plan—NOAA Fisheries climate science strategy. NOAA Tech. Memo. NMFS-NE-239, 94 pp. [Available online at <http://www.nefsc.noaa.gov/publications/tm/tm239/>.]
- Harris, J. M., and J. D. Kahl, 1990: A descriptive atmospheric transport climatology for the Mauna Loa Observatory, using clustered trajectories. *J. Geophys. Res.*, **95**, 13,651–13,667, doi:10.1029/JD095iD09p13651.
- Harris, N. R. P., and Coauthors, 2014: Scenarios and information for policymakers. *Scientific Assessment of Ozone Depletion: 2014*, World Meteorological Organization, 5.1–5.58.
- Harrison, D. E., and N. K. Larkin, 1998: Seasonal U.S. temperature and precipitation anomalies associated with El Niño: Historical results and comparison with 1997–98. *Geophys. Res. Lett.*, **25**, 3959–3962, doi:10.1029/1998GL900061.
- Hart, R. E., D. R. Chavas, and M. P. Guishard, 2016: The arbitrary definition of the current Atlantic major hurricane landfall drought. *Bull. Amer. Meteor. Soc.*, **97**, 713–722, doi:10.1175/bams-d-15-00185.1.
- Hartmann, D. L., and Coauthors, 2013: Observations: Atmosphere and surface. *Climate Change 2013: The Physical Science Basis*, T. F. Stocker et al., Eds., Cambridge University Press, 159–254.
- Hausfather, Z., K. Cowtan, D. C. Clarke, P. Jacobs, M. Richardson, and R. Rohde, 2017: Assessing recent warming using instrumentally homogeneous sea surface temperature records. *Sci. Adv.*, **3**, e1601207, doi:10.1126/sciadv.1601207.
- Haylock, M. R., N. Hofstra, A. M. G. Klein Tank, E. J. Klok, P. D. Jones, and M. New, 2008: A European daily high-resolution gridded data set of surface temperature and precipitation for 1950–2006. *J. Geophys. Res.*, **113**, D20119, doi:10.1029/2008JD010201.
- Heidinger, A. K., M. J. Foster, A. Walther, and X. Zhao, 2014: The Pathfinder atmospheres–extended AVHRR climate dataset. *Bull. Amer. Meteor. Soc.*, **95**, 909–922, doi:10.1175/bams-d-12-00246.1.
- Held, I. M., and B. J. Soden, 2000: Water vapor feedback and global warming. *Annu. Rev. Energy Environ.*, **25**, 441–475, doi:10.1146/annurev.energy.25.1.441.
- Helfrich, S. R., D. McNamara, B. H. Ramsay, T. Baldwin, and T. Kasheta, 2007: Enhancements to, and forthcoming developments in the Interactive Multisensor Snow and Ice Mapping System (IMS). *Hydrol. Proc.*, **21**, 1576–1586, doi:10.1002/hyp.6720.
- Hendon, H. H., C. Zhang, and J. D. Glick, 1999: Interannual variation of the Madden–Julian oscillation during austral summer. *J. Climate*, **12**, 2538–2550, doi:10.1175/1520-0442(1999)012<2538:ivotmj>2.0.co;2.
- Hersbach, H., and Coauthors, 2017: The potential value of early (1939–1967) upper-air data in atmospheric climate reanalysis. *Quart. J. Roy. Meteor. Soc.*, **143**, 1197–1210, doi:10.1002/qj.3040.
- Higgins, R. W., A. Leetmaa, and V. E. Kousky, 2002: Relationships between climate variability and winter temperature extremes in the United States. *J. Climate*, **15**, 1555–1572, doi:10.1175/1520-0442(2002)015<1555:rbcvaw>2.0.co;2.
- Ho, S.-P., Y.-H. Kuo, W. Schreiner, and X. Zhou, 2010a: Using SI-traceable global positioning system radio occultation measurements for climate monitoring [in “State of the Climate in 2009”]. *Bull. Amer. Meteor. Soc.*, **91** (7), S36–S37, doi:10.1175/BAMS-91-7-StateoftheClimate.
- , X. Zhou, Y.-H. Kuo, D. Hunt, and J.-H. Wang, 2010b: Global evaluation of radiosonde water vapor systematic biases using GPS radio occultation from COSMIC and ECMWF analysis. *Remote Sens. Environ.*, **2**, 1320–1330, doi:10.3390/rs2051320.
- Hobbs, W. R., and J. K. Willis, 2012: Midlatitude North Atlantic heat transport: A time series based on satellite and drifter data. *J. Geophys. Res.*, **117**, C01008, doi:10.1029/2011JC007039.
- Hoffman, M. J., and Coauthors, 2010: An ensemble Kalman filter data assimilation system for the Martian atmosphere: Implementation and simulation experiments. *Icarus*, **209**, 470–481, doi:10.1016/j.icarus.2010.03.034.
- Hofmann, D. J., and S. A. Montzka, 2009: Recovery of the ozone layer: The ozone depleting gas index. *Eos, Trans. Amer. Geophys. Union*, **90**, 1–2, doi:10.1029/2009EO010001.
- , J. H. Butler, E. J. Dlugokencky, J. W. Elkins, K. Masarie, S. A. Montzka, and P. Tans, 2006: The role of carbon dioxide in climate forcing from 1979 to 2004: Introduction of the annual greenhouse gas index. *Tellus*, **58B**, 614–619, doi:10.1111/j.1600-0889.2006.00201.x.
- Hogewind, F., and P. Bissolli, 2011: Operational maps of monthly mean temperature for WMO Region VI (Europe and Middle East). *Időjárás, J. Hungarian Meteor. Soc.*, **115**, 31–49. [Available online at <http://www.met.hu/downloads.php?fn=/metadmin/newspaper/2012/06/115-1-2-3-hogewind.pdf>.]
- Holland, D. M., 2000: Transient sea-ice polynya forced by oceanic flow variability. *Prog. Oceanogr.*, **48**, 403–460, doi:10.1016/S0079-6611(01)00010-6.

- Hook, S. R., R. C. Wilson, S. MacCallum, and C. J. Merchant, 2012: Lake surface temperature [in "State of the Climate in 2011"]. *Bull. Amer. Meteor. Soc.*, **93** (7), S18–S19, doi:10.1175/2012BAMSStateoftheClimate.1.
- Hrbáček, F., K. Láska, D. Nývlt, Z. Engel, and M. Oliva, 2016: Active layer thickness variability on James Ross Island, Eastern Antarctic Peninsula. *XI. Int. Conf Permafrost*, Potsdam, Germany, Bibliothek Wissenschaftspark Albert Einstein.
- Huang, B., and Coauthors, 2015: Extended reconstructed sea surface temperature version 4 (ERSST.v4). Part I: Upgrades and intercomparisons. *J. Climate*, **28**, 911–930, doi:10.1175/jcli-d-14-00006.1.
- , M. L'Heureux, Z.-Z. Hu, and H.-M. Zhang, 2016a: Ranking the strongest ENSO events while incorporating SST uncertainty. *Geophys. Res. Lett.*, **43**, 9165–9172, doi:10.1002/2016GL070888.
- , and Coauthors, 2016b: Further exploring and quantifying uncertainties for extended reconstructed sea surface temperature (ERSST) version 4 (v4). *J. Climate*, **29**, 3119–3142, doi:10.1175/jcli-d-15-0430.1.
- Huang, C.-Y., W.-H. Teng, S.-P. Ho, and Y.-H. Kuo, 2013: Global variation of COSMIC precipitable water over land: Comparisons with ground-based GPS measurements and NCEP reanalyses. *Geophys. Res. Lett.*, **40**, 5327–5331, doi:10.1002/grl.50885.
- Huffman, G. J., R. F. Adler, D. T. Bolvin, and G. Gu, 2009: Improving the global precipitation record: GPCP Version 2.1. *Geophys. Res. Lett.*, **36**, L17808, doi:10.1029/2009GL040000.
- Hugelius, G., and Coauthors, 2014: Estimated stocks of circumpolar permafrost carbon with quantified uncertainty ranges and identified data gaps. *Biogeosciences*, **11**, 6573–6593, doi:10.5194/bg-11-6573-2014.
- Huisman, J., H. C. P. Matthijs, and P. M. Visser, Eds., 2005: *Harmful Cyanobacteria*. Springer, 243 pp.
- Hupp, J. W., D. H. Ward, M. E. Whalen, and J. M. Pearce, 2015: Changing Arctic ecosystems—What is causing the rapid increase of snow geese in northern Alaska? U.S. Geologic Survey Fact Sheet 2015-3062, 2 pp.
- Isaksen, K., and Coauthors, 2011: Degrading mountain permafrost in southern Norway: Spatial and temporal variability of mean ground temperatures, 1999–2009. *Permaf. Periglac. Process.*, **22**, 361–377, doi:10.1002/ppp.728.
- Ishihara, K., 2006: Calculation of global surface temperature anomalies with COBE-SST. *Sokko-jiho [Weather Service Bull.]*, **73** (Special Issue), S19–S25, (in Japanese).
- Ishii, M., and M. Kimoto, 2009: Reevaluation of historical ocean heat content variations with time-varying XBT and MBT depth bias corrections. *J. Oceanogr.*, **65**, 287–299, doi:10.1007/s10872-009-0027-7.
- Jacob, T., J. Wahr, W. T. Pfeffer, and S. Swenson, 2012: Recent contributions of glaciers and ice caps to sea level rise. *Nature*, **482**, 514–518, doi:10.1038/nature10847.
- Jacobson, A. R., S. E. Mikaloff Fletcher, N. Gruber, J. L. Sarmiento, and M. Gloo, 2007: A joint atmosphere-ocean inversion for surface fluxes of carbon dioxide: 1. Methods and global-scale fluxes. *Global Biogeochem. Cycles*, **21**, GB1019, doi:10.1029/2005GB002556.
- Janowiak, J. E., and P. Xie, 1999: CAMS-OPI: A global satellite-rain gauge merged product for real-time precipitation monitoring applications. *J. Climate*, **12**, 3335–3342, doi:10.1175/1520-0442(1999)012<3335:coagsr>2.0.co;2.
- Jiménez-Muñoz, J. C., and Coauthors, 2016: Record-breaking warming and extreme drought in the Amazon rainforest during the course of El Niño 2015–2016. *Sci. Rep.*, **6**, 33130, doi:10.1038/srep33130.
- Jin, X., and L. Yu, 2013: Assessing high-resolution analysis of surface heat fluxes in the Gulf Stream region. *J. Geophys. Res. Oceans*, **118**, 5353–5375, doi:10.1002/jgrc.20386.
- Jobbágy, E. G., and R. B. Jackson, 2000: The vertical distribution of soil organic carbon and its relation to climate and vegetation. *Ecol. Appl.*, **10**, 423–436, doi:10.1890/1051-0761(2000)010[0423:TVDOSO]2.0.CO;2.
- John, V. O., and B. J. Soden, 2007: Temperature and humidity biases in global climate models and their impact on climate feedbacks. *Geophys. Res. Lett.*, **34**, L18704, doi:10.1029/2007GL030429.
- , G. Holl, R. P. Allan, S. A. Buehler, D. E. Parker, and B. J. Soden, 2011: Clear-sky biases in satellite infrared estimates of upper tropospheric humidity and its trends. *J. Geophys. Res.*, **116**, D14108, doi:10.1029/2010JD015355.
- , L. Shi, and E.-S. Chung, 2016: Upper tropospheric humidity [in "State of the Climate in 2015"]. *Bull. Amer. Meteor. Soc.*, **97** (8), S27, doi:10.1175/2016BAMSStateoftheClimate.1.
- Johns, W. E., and Coauthors, 2011: Continuous, array-based estimates of Atlantic Ocean heat transport at 26.5°N. *J. Climate*, **24**, 2429–2449, doi:10.1175/2010jcli3997.1.
- Johnson, G. C., 2008: Quantifying Antarctic bottom water and North Atlantic Deep Water volumes. *J. Geophys. Res.*, **113**, C05027, doi:10.1029/2007JC004477.
- , and J. M. Lyman, 2012: Sea surface salinity [in "State of the Climate in 2011"]. *Bull. Amer. Meteor. Soc.*, **93** (7), S68–S69, S72, doi:10.1175/2012BAMSStateoftheClimate.1.
- , and A. N. Birnbaum, 2017: As El Niño builds, Pacific warm pool expands, ocean gains more heat. *Geophys. Res. Lett.*, **44**, 438–445, doi:10.1002/2016GL071767.
- , and Coauthors, 2014: Sea surface salinity [in "State of the Climate in 2013"]. *Bull. Amer. Meteor. Soc.*, **93** (7), S54–S57, doi:10.1175/2013BAMSStateoftheClimate.1.

- , and Coauthors, 2015a: Ocean heat content [in “State of the Climate in 2014”]. *Bull. Amer. Meteor. Soc.*, **96** (7), S64–S66, S68, doi:10.1175/2014BAMSStateoftheClimate.1.
- , J. M. Lyman, and S. G. Purkey, 2015b: Informing Deep Argo array design using Argo and full-depth hydrographic section data. *J. Atmos. Oceanic Technol.*, **32**, 2187–2198, doi:10.1175/jtech-d-15-0139.1.
- , and Coauthors, 2016: Ocean heat content [in “State of the Climate in 2015”]. *Bull. Amer. Meteor. Soc.*, **96** (7), S66–S70, doi:10.1175/2015BAMSStateoftheClimate.1.
- Jones, P. D., D. H. Lister, T. J. Osborn, C. Harpham, M. Salmon, and C. P. Morice, 2012: Hemispheric and large-scale land-surface air temperature variations: An extensive revision and an update to 2010. *J. Geophys. Res.*, **117**, D05127, doi:10.1029/2011JD017139.
- Joyce, R. J., J. E. Janowiak, P. A. Arkin, and P. Xie, 2004: CMORPH: A method that produces global precipitation estimates from passive microwave and infrared data at high spatial and temporal resolution. *J. Hydrometeor.*, **5**, 487–503, doi:10.1175/1525-7541(2004)005<0487:camptg>2.0.co;2.
- Jung, M., and Coauthors, 2010: Recent decline in the global land evapotranspiration trend due to limited moisture supply. *Nature*, **467**, 951–954, doi:10.1038/nature09396.
- Kaiser, J. W., and Coauthors, 2012: Biomass burning emissions estimated with a global fire assimilation system based on observed fire radiative power. *Biogeosciences*, **9**, 527–554, doi:10.5194/bg-9-527-2012.
- Kalnay, E., and Coauthors, 1996: The NCEP/NCAR 40-year reanalysis project. *Bull. Amer. Meteor. Soc.*, **77**, 437–471, doi:10.1175/1520-0477(1996)077<0437:tnyrp>2.0.co;2.
- Kaplan, A., 2011: Patterns and indices of climate variability [in “State of the Climate in 2010”]. *Bull. Amer. Meteor. Soc.*, **92** (6), S20–S25, doi:10.1175/1520-0477-92.6.s1.
- Karl, T. R., and Coauthors, 2015: Possible artifacts of data biases in the recent global surface warming hiatus. *Science*, **348**, 1469–1472, doi:10.1126/science.aaa5632.
- Karlsson, K. G., and Coauthors, 2017: CLARA-A2: The second edition of the CM SAF cloud and radiation data record from 34 years of global AVHRR data. *Atmos. Chem. Phys.*, **17**, 5809–5828, doi:10.5194/acp-17-5809-2017.
- Kass, D. M., A. Kleinböhl, D. J. McCleese, J. T. Schofield, and M. D. Smith, 2016: Interannual similarity in the Martian atmosphere during the dust storm season. *Geophys. Res. Lett.*, **43**, 6111–6118, doi:10.1002/2016GL068978.
- Kato, S., and Coauthors, 2013: Surface irradiances consistent with CERES-derived top-of-atmosphere shortwave and longwave irradiances. *J. Climate*, **26**, 2719–2740, doi:10.1175/jcli-d-12-00436.1.
- Kayano, M. T., and V. E. Kousky, 1999: Intraseasonal (30–60 day) variability in the global tropics: Principal modes and their evolution. *Tellus*, **51A**, 373–386, doi:10.3402/tellusa.v51i3.13459.
- Kennedy, J. J., and Coauthors, 2010: How do we know the world has warmed? [in “State of the Climate in 2009”]. *Bull. Amer. Meteor. Soc.*, **91** (7), S26–S27, doi:10.1175/BAMS-91-7-StateoftheClimate.
- , N. A. Rayner, R. O. Smith, D. E. Parker, and M. Saunby, 2011a: Reassessing biases and other uncertainties in sea surface temperature observations measured in situ since 1850: 1. Measurement and sampling uncertainties. *J. Geophys. Res.*, **116**, D14103, doi:10.1029/2010JD015218.
- , —, —, —, and —, 2011b: Reassessing biases and other uncertainties in sea surface temperature observations measured in situ since 1850: 2. Biases and homogenization. *J. Geophys. Res.*, **116**, D14104, doi:10.1029/2010JD015220.
- Kent, E. C., D. I. Berry, J. Prytherch, and J. B. Roberts, 2014: A comparison of global marine surface-specific humidity datasets from in situ observations and atmospheric reanalysis. *Int. J. Climatol.*, **34**, 355–376, doi:10.1002/joc.3691.
- Khatiwala, S., and Coauthors, 2013: Global ocean storage of anthropogenic carbon. *Biogeosciences*, **10**, 2169–2191, doi:10.5194/bg-10-2169-2013.
- Kiladis, G. N., and K. M. Weickmann, 1992: Circulation anomalies associated with tropical convection during northern winter. *Mon. Wea. Rev.*, **120**, 1900–1923, doi:10.1175/1520-0493(1992)120<1900:caawtc>2.0.co;2.
- , K. H. Straub, and P. T. Haertel, 2005: Zonal and vertical structure of the Madden–Julian oscillation. *J. Atmos. Sci.*, **62**, 2790–2809, doi:10.1175/jas3520.1.
- , M. C. Wheeler, P. T. Haertel, K. H. Straub, and P. E. Roundy, 2009: Convectively coupled equatorial waves. *Rev. Geophys.*, **47**, RG2003, doi:10.1029/2008RG000266.
- Kim, B.-M., and Coauthors, 2017: Major cause of unprecedented Arctic warming in January 2016: Critical role of an Atlantic windstorm. *Sci. Rep.*, **7**, 40051, doi:10.1038/srep40051.
- Kim, H., 2016: River discharge [in “State of the Climate in 2015”]. *Bull. Amer. Meteor. Soc.*, **97** (8), S29–S30, doi:10.1175/2016BAMSStateoftheClimate.1.
- , P. J. F. Yeh, T. Oki, and S. Kanae, 2009: Role of rivers in the seasonal variations of terrestrial water storage over global basins. *Geophys. Res. Lett.*, **36**, L17402, doi:10.1029/2009GL039006.
- Kim, J., and K. Paik, 2015: Recent recovery of surface wind speed after decadal decrease: A focus on South Korea. *Climate Dyn.*, **45**, 1699–1712, doi:10.1007/s00382-015-2546-9.
- Kimura, N., and M. Wakatsuchi, 2011: Large-scale processes governing the seasonal variability of the Antarctic sea ice. *Tellus*, **63A**, 828–840, doi:10.1111/j.1600-0870.2011.00526.x.

- Kistler, R., and Coauthors, 2001: The NCEP–NCAR 50-year reanalysis: Monthly means CD–ROM and documentation. *Bull. Amer. Meteor. Soc.*, **82**, 247–267, doi:10.1175/1520-0477(2001)082<0247:tnnyrm>2.3.co;2.
- Kjøllmoen, B., (Ed.), L. M. Andreassen, H. Elvehøy, M. Jackson, and R. H. Giesen, 2016: Glaciological investigations in Norway (Glasiologiske undersøkelser i Norge). NVE Rapport 88, 171+ pp. [Available online at http://publikasjoner.nve.no/rapport/2016/rapport2016_88.pdf.]
- Klein, S. A., B. J. Soden, and N.-C. Lau, 1999: Remote sea surface temperature variations during ENSO: Evidence for a tropical atmospheric bridge. *J. Climate*, **12**, 917–932, doi:10.1175/1520-0442(1999)012<0917:rsstvd>2.0.co;2.
- Kleinböhl, A., and Coauthors, 2009: Mars Climate Sounder limb profile retrieval of atmospheric temperature, pressure, and dust and water ice opacity. *J. Geophys. Res.*, **114**, E10006, doi:10.1029/2009JE003358.
- , J. T. Schofield, W. A. Abdou, P. G. J. Irwin, and R. J. de Kok, 2011: A single-scattering approximation for infrared radiative transfer in limb geometry in the Martian atmosphere. *J. Quant. Spectrosc. Radiat. Transfer*, **112**, 1568–1580, doi:10.1016/j.jqsrt.2011.03.006.
- , A. J. Friedson, and J. T. Schofield, 2017: Two-dimensional radiative transfer for the retrieval of limb emission measurements in the martian atmosphere. *J. Quant. Spectrosc. Radiat. Transfer*, **187**, 511–522, doi:10.1016/j.jqsrt.2016.07.009.
- Kleisner, K. M., and Coauthors, 2016: The effects of sub-regional climate velocity on the distribution and spatial extent of marine species assemblages. *PLoS One*, **11**, e0149220, doi:10.1371/journal.pone.0149220.
- Knapp, K. R., M. C. Kruk, D. H. Levinson, H. J. Diamond, and C. J. Neumann, 2010: The international best track archive for climate stewardship (IBTrACS). *Bull. Amer. Meteor. Soc.*, **91**, 363–376, doi:10.1175/2009bams2755.1.
- , J. A. Knaff, C. R. Sampson, G. M. Riggio, and A. D. Schnapp, 2013: A pressure-based analysis of the historical western North Pacific tropical cyclone intensity record. *Mon. Wea. Rev.*, **141**, 2611–2631, doi:10.1175/mwr-d-12-00323.1.
- Knutson, T. R., and K. M. Weickmann, 1987: 30–60 Day atmospheric oscillations: Composite life cycles of convection and circulation anomalies. *Mon. Wea. Rev.*, **115**, 1407–1436, doi:10.1175/1520-0493(1987)115<1407:daocl>2.0.co;2.
- Ko, M. K. W., P. A. Newman, S. Reimann, and S. E. Strahan, 2013: Recommended values for steady-state atmospheric lifetimes and their uncertainties. *SPARC Report on the Lifetimes of Stratospheric Ozone-Depleting Substances, Their Replacements, and Related Species*, 6.1–6.21.
- Kobayashi, S., and Coauthors, 2015: The JRA-55 reanalysis: General specifications and basic characteristics. *J. Meteor. Soc. Japan*, **93**, 5–48, doi:10.2151/jmsj.2015-001.
- Kopp, G., and J. L. Lean, 2011: A new, lower value of total solar irradiance: Evidence and climate significance. *Geophys. Res. Lett.*, **38**, L01706, doi:10.1029/2010GL045777.
- Kossin, J. P., and D. J. Vimont, 2007: A more general framework for understanding Atlantic hurricane variability and trends. *Bull. Amer. Meteor. Soc.*, **88**, 1767–1781, doi:10.1175/bams-88-11-1767.
- Kosten, S., and Coauthors, 2012: Warmer climates boost cyanobacterial dominance in shallow lakes. *Global Change Biol.*, **18**, 118–126, doi:10.1111/j.1365-2486.2011.02488.x.
- Koumoutsaris, S., I. Bey, S. Generoso, and V. Thouret, 2008: Influence of El Niño–Southern Oscillation on the interannual variability of tropospheric ozone in the northern midlatitudes. *J. Geophys. Res.*, **113**, D19301, doi:10.1029/2007JD009753.
- Kousky, V. E., and M. T. Kayano, 1994: Principal modes of outgoing longwave radiation and 250-mb circulation for the South American sector. *J. Climate*, **7**, 1131–1143, doi:10.1175/1520-0442(1994)007<1131:pmoolr>2.0.co;2.
- Kratz, D. P., P. W. S. Jr., S. K. Gupta, A. C. Wilber, P. Sawaengphokhai, and G. R. McGarragh, 2014: The fast longwave and shortwave flux (FLASHFlux) data product: Single-scanner footprint fluxes. *J. Appl. Meteor. Climatol.*, **53**, 1059–1079, doi:10.1175/jamc-d-13-061.1.
- Krishnamurti, T. N., and D. Subrahmanyam, 1982: The 30–50 day mode at 850 mb during MONEX. *J. Atmos. Sci.*, **39**, 2088–2095, doi:10.1175/1520-0469(1982)039<2088:TDMAMD>2.0.CO;2.
- Kwok, R., and D. A. Rothrock, 2009: Decline in Arctic sea ice thickness from submarine and ICESat records: 1958–2008. *Geophys. Res. Lett.*, **36**, L15501, doi:10.1029/2009GL039035.
- , and G. F. Cunningham, 2015: Variability of Arctic sea ice thickness and volume from CryoSat-2. *Philos. Trans. Roy. Soc. London*, **373A**, 20140157, doi:10.1098/rsta.2014.0157.
- L’Heureux, M. L., and Coauthors, 2016: Observing and predicting the 2015–16 El Niño. *Bull. Amer. Meteor. Soc. Early Online Release*, doi:10.1175/bams-d-16-0009.1.
- Landschützer, P., and Coauthors, 2013: A neural network-based estimate of the seasonal to inter-annual variability of the Atlantic Ocean carbon sink. *Biogeosciences*, **10**, 7793–7815, doi:10.5194/bg-10-7793-2013.
- , N. Gruber, D. C. E. Bakker, and U. Schuster, 2014: Recent variability of the global ocean carbon sink. *Global Biogeochem. Cycles*, **28**, 927–949, doi:10.1002/2014GB004853.
- Landsea, C. W., and J. L. Franklin, 2013: Atlantic hurricane database uncertainty and presentation of a new database format. *Mon. Wea. Rev.*, **141**, 3576–3592, doi:10.1175/mwr-d-12-00254.1.
- Lau, W. K.-M., and D. E. Waliser, 2012: *Intraseasonal Variability in the Atmosphere–Ocean Climate System*. Springer, 642 pp.

- Laxon, S. W., and Coauthors, 2013: CryoSat-2 estimates of Arctic sea ice thickness and volume. *Geophys. Res. Lett.*, **40**, 732–737, doi:10.1002/grl.50193.
- Lazzara, M. A., G. A. Weidner, L. M. Keller, J. E. Thom, and J. J. Cassano, 2012: Antarctic automatic weather station program: 30 years of polar observation. *Bull. Amer. Meteor. Soc.*, **93**, 1519–1537, doi:10.1175/bams-d-11-00015.1.
- Lee, H.-T., 2014: Climate algorithm theoretical basis document (C-ATBD): Outgoing longwave radiation (OLR) - daily. NOAA's Climate Data Record (CDR) Program, CDRP-ATBD-0526, 46 pp. [Available online at <http://www1.ncdc.noaa.gov/pub/data/sds/cdr/CDRs/Outgoing%20Longwave%20Radiation%20-%20Daily/AlgorithmDescription.pdf>.]
- , and NOAA CDR Program, 2011: NOAA Climate Data Record (CDR) of Monthly Outgoing Longwave Radiation (OLR), Version 2.2-1. Feb 2000-Dec 2015. NOAA National Centers for Environmental Information, doi:10.7289/V5222RQP.
- Lenaarts, J. T. M., and M. R. van den Broeke, 2012: Modeling drifting snow in Antarctica with a regional climate model: 2. Results. *J. Geophys. Res.*, **117**, D05109, doi:10.1029/2010JD015419.
- Lentini, C. A. D., G. J. Goni, and D. B. Olson, 2006: Investigation of Brazil Current rings in the confluence region. *J. Geophys. Res.*, **111**, C06013, doi:10.1029/2005JC002988.
- Le Quéré, C., and Coauthors, 2016: Global carbon budget 2016. *Earth Syst. Sci. Data*, **8**, 605–649, doi:10.5194/essd-8-605-2016.
- Leuliette, E. W., 2015: The balancing of the sea-level budget. *Current Climate Change Reports*, **1**, 185–191, doi:10.1007/s40641-015-0012-8.
- , and J. K. Willis, 2011: Balancing the sea level budget. *Oceanography*, **24** (2), 122–129, doi:10.5670/oceanog.2011.32.
- Leung, F.-Y. T., J. A. Logan, R. Park, E. Hyer, E. Kasischke, D. Streets, and L. Yurganov, 2007: Impacts of enhanced biomass burning in the boreal forests in 1998 on tropospheric chemistry and the sensitivity of model results to the injection height of emissions. *J. Geophys. Res.*, **112**, D10313, doi:10.1029/2006JD008132.
- Le Vine, D. M., E. P. Dinnat, G. S. E. Lagerloef, P. de Matthaeis, S. Abraham, C. Utku, and H. Kao, 2014: Aquarius: Status and recent results. *Radio Science*, **49**, 709–720, doi:10.1002/2014RS005505.
- Levitus, S., and Coauthors, 2012: World ocean heat content and thermosteric sea level change (0–2000 m), 1955–2010. *Geophys. Res. Lett.*, **39**, L10603, doi:10.1029/2012GL051106.
- Levy, R. C., S. Mattoo, L. A. Munchak, L. A. Remer, A. M. Sayer, F. Patadia, and N. C. Hsu, 2013: The Collection 6 MODIS aerosol products over land and ocean. *Atmos. Meas. Tech.*, **6**, 2989–3034, doi:10.5194/amt-6-2989-2013.
- Lewis, S. R., P. L. Read, B. J. Conrath, J. C. Pearl, and M. D. Smith, 2007: Assimilation of thermal emission spectrometer atmospheric data during the Mars Global Surveyor aerobraking period. *Icarus*, **192**, 327–347, doi:10.1016/j.icarus.2007.08.009.
- , D. P. Mulholland, P. L. Read, L. Montabone, R. J. Wilson, and M. D. Smith, 2016: The solsticial pause on Mars: 1. A planetary wave reanalysis. *Icarus*, **264**, 456–464, doi:10.1016/j.icarus.2015.08.039.
- Li, B., M. Rodell, and J. S. Famiglietti, 2015: Groundwater variability across temporal and spatial scales in the central and northeastern U.S. *J. Hydrol.*, **525**, 769–780, doi:10.1016/j.jhydrol.2015.04.033.
- Liebmann, B., and C. A. Smith, 1996: Description of a complete (interpolated) outgoing longwave radiation dataset. *Bull. Amer. Meteor. Soc.*, **77**, 1275–1277.
- Lin, H., G. Brunet, and J. Derome, 2009: An observed connection between the North Atlantic oscillation and the Madden–Julian oscillation. *J. Climate*, **22**, 364–380, doi:10.1175/2008jcli2515.1.
- Lin, I-I, and J. C. L. Chan, 2015: Recent decrease in typhoon destructive potential and global warming implications. *Nat. Comm.*, **6**, 7182, doi:10.1038/ncomms8182.
- , C.-C. Wu, I.-F. Pun, and D.-S. Ko, 2008: Upper-ocean thermal structure and the western North Pacific category 5 Typhoons. Part I: Ocean features and the category 5 typhoons' intensification. *Mon. Wea. Rev.*, **136**, 3288–3306, doi:10.1175/2008mwr2277.1.
- , and Coauthors, 2013: An ocean coupling potential intensity index for tropical cyclones. *Geophys. Res. Lett.*, **40**, 1878–1882, doi:10.1002/grl.50091.
- , I.-F. Pun, and C.-C. Lien, 2014: “Category-6” Supertyphoon Haiyan in global warming hiatus: Contribution from subsurface ocean warming. *Geophys. Res. Lett.*, **41**, 8547–8553, doi:10.1002/2014GL061281.
- Lin, M., L. W. Horowitz, S. J. Oltmans, A. M. Fiore, and S. Fan, 2014: Tropospheric ozone trends at Mauna Loa Observatory tied to decadal climate variability. *Nat. Geosci.*, **7**, 136–143, doi:10.1038/ngeo2066.
- , —, R. Payton, A. M. Fiore, and G. Tonnesen, 2017: US surface ozone trends and extremes from 1980 to 2014: Quantifying the roles of rising Asian emissions, domestic controls, wildfires, and climate. *Atmos. Chem. Phys.*, **17**, 2943–2970, doi:10.5194/acp-17-2943-2017.
- Lindsay, R., and A. Schweiger, 2015: Arctic sea ice thickness loss determined using subsurface, aircraft, and satellite observations. *Cryosphere*, **9**, 269–283, doi:10.5194/tc-9-269-2015.
- Link, J. S., R. Griffis, and S. Busch, 2015: NOAA Fisheries climate science strategy. NOAA Tech. Memo. NMFS-F/SPO-155, 70 pp. [Available online at <http://www.st.nmfs.noaa.gov/ecosystems/climate/national-climate-strategy>.]

- Liu, H., L. Wang, and K. C. Jezek, 2005: Wavelet-transform based edge detection approach to derivation of snowmelt onset, end and duration from satellite passive microwave measurements. *Int. J. Remote Sens.*, **26**, 4639–4660, doi:10.1080/01431160500213342.
- , —, and —, 2006: Spatiotemporal variations of snowmelt in Antarctica derived from satellite scanning multichannel microwave radiometer and special sensor microwave imager data (1978–2004). *J. Geophys. Res.*, **111**, F01003, doi:10.1029/2005JF000318.
- Liu, W., S.-P. Xie, Z. Liu, and J. Zhu, 2017: Overlooked possibility of a collapsed Atlantic meridional overturning circulation in warming climate. *Sci. Adv.*, **3**, e1601666, doi:10.1126/sciadv.1601666.
- Liu, Y. Y., and Coauthors, 2012: Trend-preserving blending of passive and active microwave soil moisture retrievals. *Remote Sens. Environ.*, **123**, 280–297, doi:10.1016/j.rse.2012.03.014.
- Loeb, N. G., and Coauthors, 2009: Toward optimal closure of the Earth's top-of-atmosphere radiation budget. *J. Climate*, **22**, 748–766, doi:10.1175/2008jcli2637.1.
- , and Coauthors, 2012: Advances in understanding top-of-atmosphere radiation variability from satellite observations. *Surv. Geophys.*, **33**, 359–385, doi:10.1007/s10712-012-9175-1.
- Loew, A., T. Stacke, W. Dorigo, R. de Jeu, and S. Hagemann, 2013: Potential and limitations of multidecadal satellite soil moisture observations for selected climate model evaluation studies. *Hydrol. Earth Syst. Sci.*, **17**, 3523–3542, doi:10.5194/hess-17-3523-2013.
- Loranty, M. M., W. Lieberman-Cribbin, L. T. Berner, S. M. Natali, S. J. Goetz, H. D. Alexander, and A. L. Kholodov, 2016: Spatial variation in vegetation productivity trends, fire disturbance, and soil carbon across Arctic-boreal permafrost ecosystems. *Environ. Res. Lett.*, **11**, 095008, doi:10.1088/1748-9326/11/9/095008.
- Lu, M.-M., C.-T. Lee, and B. Wang, 2013: Seasonal prediction of accumulated tropical cyclone kinetic energy around Taiwan and the sources of the predictability. *Int. J. Climatol.*, **33**, 2846–2854, doi:10.1002/joc.3634.
- Lumpkin, R., and S. Garzoli, 2011: Interannual to decadal changes in the western South Atlantic's surface circulation. *J. Geophys. Res.*, **116**, C01014, doi:10.1029/2010JC006285.
- , G. Goni, and K. Dohan, 2012: Surface currents [in “State of the Climate in 2011”]. *Bull. Amer. Meteor. Soc.*, **93** (7), S75–S78, doi:10.1175/2012BAMSStateoftheClimate.1.
- Luo, G. B., G. L. Zhang, and Z. T. Gong, 2000: Areal evaluation of organic carbon pools in cryic soils of China. *Global Climate Change and Cold Regions Ecosystems*, R. Lal, J. M. Kimble, and B. A. Stewart, Eds., Lewis Publishers, 211–222.
- Luo, J.-J., 2011: Indian Ocean dipole [in “State of the Climate in 2010”]. *Bull. Amer. Meteor. Soc.*, **92** (6), S138–S140, doi:10.1175/1520-0477-92.6.s1.
- , S. Masson, S. Behera, and T. Yamagata, 2007: Experimental forecasts of the Indian Ocean dipole using a coupled OAGCM. *J. Climate*, **20**, 2178–2190, doi:10.1175/jcli4132.1.
- , R. Zhang, S. K. Behera, Y. Masumoto, F.-F. Jin, R. Lukas, and T. Yamagata, 2010: Interaction between El Niño and extreme Indian Ocean dipole. *J. Climate*, **23**, 726–742, doi:10.1175/2009jcli3104.1.
- , W. Sasaki, and Y. Masumoto, 2012: Indian Ocean warming modulates Pacific climate change. *Proc. Natl. Acad. Sci. USA*, **109**, 18,701–18,706, doi:10.1073/pnas.1210239109.
- Lyman, J. M., and G. C. Johnson, 2014: Estimating global ocean heat content changes in the upper 1800 m since 1950 and the influence of climatology choice. *J. Climate*, **27**, 1945–1957, doi:10.1175/jcli-d-12-00752.1.
- Lynch, C. M., I. D. Barr, D. Mullan, and A. Ruffell, 2016: Rapid glacial retreat on the Kamchatka Peninsula during the early 21st century. *Cryosphere*, **10**, 1809–1821, doi:10.5194/tc-10-1809-2016.
- Ma, Z., J. Xu, W. Quan, Z. Zhang, W. Lin, and X. Xu, 2016: Significant increase of surface ozone at a rural site, north of eastern China. *Atmos. Chem. Phys.*, **16**, 3969–3977, doi:10.5194/acp-16-3969-2016.
- MacCallum, S. N., and C. J. Merchant, 2012: Surface water temperature observations of large lakes by optimal estimation. *Canadian J. Remote Sens.*, **38**, 25–45, doi:10.5589/m12-010.
- Macias Fauria, M., and E. A. Johnson, 2006: Large-scale climatic patterns control large lightning fire occurrence in Canada and Alaska forest regions. *J. Geophys. Res.*, **111**, G04008, doi:10.1029/2006JG000181.
- Madden, R. A., and P. R. Julian, 1971: Detection of a 40–50 day oscillation in the zonal wind in the tropical Pacific. *J. Atmos. Sci.*, **28**, 702–708, doi:10.1175/1520-0469(1971)028<0702:doadoi>2.0.co;2.
- , and —, 1972: Description of global-scale circulation cells in the tropics with a 40–50 day period. *J. Atmos. Sci.*, **29**, 1109–1123, doi:10.1175/1520-0469(1972)029<1109:dogscc>2.0.co;2.
- , and —, 1994: Observations of the 40–50-day tropical oscillation—A review. *Mon. Wea. Rev.*, **122**, 814–837, doi:10.1175/1520-0493(1994)122<0814:ootdto>2.0.co;2.
- Mahaffy, P. R., and Coauthors, 2013: Abundance and isotopic composition of gases in the Martian atmosphere from the Curiosity rover. *Science*, **341**, 263–266, doi:10.1126/science.1237966.

- Mainelli, M., M. DeMaria, L. K. Shay, and G. Goni, 2008: Application of oceanic heat content estimation to operational forecasting of recent Atlantic category 5 hurricanes. *Wea. Forecasting*, **23**, 3–16, doi:10.1175/2007waf2006111.1.
- Malkova, G. V., M. R. Sadurtdinov, A. G. Skvortsov, and A. M. Tsarev, 2016: Thermal state of permafrost in disturbed and undisturbed cryogenic geosystems in the European North. *XI. Int. Conf. Permafrost*, Potsdam, Germany, Bibliothek Wissenschaftspark Albert Einstein.
- Maloney, E. D., and D. L. Hartmann, 2001: The Madden-Julian oscillation, barotropic dynamics, and North Pacific tropical cyclone formation. Part I: Observations. *J. Atmos. Sci.*, **58**, 2545–2558, doi:10.1175/1520-0469(2001)058<2545:tmjobjd>2.0.co;2.
- Manabe, S., and F. Möller, 1961: On the radiative equilibrium and heat balance of the atmosphere. *Mon. Wea. Rev.*, **89**, 503–532, doi:10.1175/1520-0493(1961)089<0503:otreah>2.0.co;2.
- Manney, G. L., and Z. D. Lawrence, 2016: The major stratospheric final warming in 2016: Dispersal of vortex air and termination of Arctic chemical ozone loss. *Atmos. Chem. Phys.*, **16**, 15,371–15,396, doi:10.5194/acp-16-15371-2016.
- , and Coauthors, 2011: Unprecedented Arctic ozone loss in 2011. *Nature*, **478**, 469–475, doi:10.1038/nature10556.
- Mantua, N. J., S. R. Hare, Y. Zhang, J. M. Wallace, and R. C. Francis, 1997: A Pacific interdecadal climate oscillation with impacts on salmon production. *Bull. Amer. Meteor. Soc.*, **78**, 1069–1079, doi:10.1175/1520-0477(1997)078<1069:apicow>2.0.co;2.
- Marengo, J.A., L.M. Alves, R.C.S. Alvala, A.P. Cunha, S. Brito, and O.L.L. Moraes, 2017: Climatic characteristics of the 2010–2016 drought in the semiarid Northeast Brazil region. *Ann. Brazilian Acad. Sci.*, accepted.
- Marinov, I., A. Gnanadesikan, J. R. Toggweiler, and J. L. Sarmiento, 2006: The Southern Ocean biogeochemical divide. *Nature*, **441**, 964–967, doi:10.1038/nature04883.
- Marengo, J.A., L.M. Alves, R.C.S. Alvala, A.P. Cunha, S. Brito, and O.L.L. Moraes, 2017: Climatic characteristics of the 2010–2016 drought in the semiarid Northeast Brazil region. *Ann. Brazilian Acad. Sci.*, accepted.
- Marshall, G. J., 2003: Trends in the southern annular mode from observations and reanalyses. *J. Climate*, **16**, 4134–4143, doi:10.1175/1520-0442(2003)016<4134:itsam>2.0.co;2.
- Marshall, J., and K. Speer, 2012: Closure of the meridional overturning circulation through Southern Ocean upwelling. *Nat. Geosci.*, **5**, 171–180, doi:10.1038/ngeo1391.
- Martens, B., and Coauthors, 2017: GLEAM v3: Satellite-based land evaporation and root-zone soil moisture. *Geosci. Model Dev.*, **10**, 1903–1925, doi:10.5194/gmd-10-1903-2017.
- Martin, R. V., B. Sauvage, I. Folkins, C. E. Sioris, C. Boone, P. Bernath, and J. Ziemke, 2007: Space-based constraints on the production of nitric oxide by lightning. *J. Geophys. Res.*, **112**, D09309, doi:10.1029/2006JD007831.
- Marzeion, B., J. G. Cogley, K. Richter, and D. Parkes, 2014: Attribution of global glacier mass loss to anthropogenic and natural causes. *Science*, **345**, 919–921, doi:10.1126/science.1254702.
- Maslanik, J., J. Stroeve, C. Fowler, and W. Emery, 2011: Distribution and trends in Arctic sea ice age through spring 2011. *Geophys. Res. Lett.*, **38**, L13502, doi:10.1029/2011GL047735.
- Mathis, J. T., J. N. Cross, W. Evans, and S. C. Doney, 2015a: Ocean acidification in the surface waters of the Pacific–Arctic boundary regions. *Oceanography*, **28** (2), 122–135, doi:10.5670/oceanog.2015.36.
- , and Coauthors, 2015b: Ocean acidification risk assessment for Alaska’s fishery sector. *Prog. Oceanogr.*, **136**, 71–91, doi:10.1016/j.pocean.2014.07.001.
- Matthias, V., A. Dörnbrack, and G. Stober, 2016: The extraordinarily strong and cold polar vortex in the early northern winter 2015/2016. *Geophys. Res. Lett.*, **43**, 12,287–12,294, doi:10.1002/2016GL071676.
- Mattingly, K. S., C. A. Ramseyer, J. J. Rosen, T. L. Mote, and R. Muthyalu, 2016: Increasing water vapor transport to the Greenland Ice Sheet revealed using self-organizing maps. *Geophys. Res. Lett.*, **43**, 9250–9258, doi:10.1002/2016GL070424.
- Maurer, J. M., S. B. Rupper, and J. M. Schaefer, 2016: Quantifying ice loss in the eastern Himalayas since 1974 using declassified spy satellite imagery. *Cryosphere*, **10**, 2203–2215, doi:10.5194/tc-10-2203-2016.
- Mayer, M., K. E. Trenberth, L. Haimberger, and J. T. Fasullo, 2013: The response of tropical atmospheric energy budgets to ENSO. *J. Climate*, **26**, 4710–4724, doi:10.1175/jcli-d-12-00681.1.
- , L. Haimberger, and M. A. Balmaseda, 2014: On the energy exchange between tropical ocean basins related to ENSO. *J. Climate*, **27**, 6393–6403, doi:10.1175/jcli-d-14-00123.1.
- Mazloff, M. R., P. Heimbach, and C. Wunsch, 2010: An eddy-permitting Southern Ocean state estimate. *J. Phys. Oceanogr.*, **40**, 880–899, doi:10.1175/2009jpo4236.1.
- McCabe, M. F., A. Ershadi, C. Jimenez, D. G. Miralles, D. Michel, and E. F. Wood, 2016: The GEWEX LandFlux project: Evaluation of model evaporation using tower-based and globally gridded forcing data. *Geosci. Model Dev.*, **9**, 283–305, doi:10.5194/gmd-9-283-2016.
- McCarthy, G. D., I. D. Haigh, J. J.-M. Hirschi, J. P. Grist, and D. A. Smeed, 2015: Ocean impact on decadal Atlantic climate variability revealed by sea-level observations. *Nature*, **521**, 508–512, doi:10.1038/nature14491.

- McClain, C. R., 2009: A decade of satellite ocean color observations. *Ann. Rev. Marine Sci.*, **1**, 19–42, doi:10.1146/annurev.marine.010908.163650.
- McCleese, D. J., and Coauthors, 2007: Mars Climate Sounder: An investigation of thermal and water vapor structure, dust and condensate distributions in the atmosphere, and energy balance of the polar regions. *J. Geophys. Res.*, **112**, E05S06, doi:10.1029/2006JE002790.
- McLeod, J. T., and T. L. Mote, 2016: Linking interannual variability in extreme Greenland blocking episodes to the recent increase in summer melting across the Greenland ice sheet. *Int. J. Climatol.*, **36**, 1484–1499, doi:10.1002/joc.4440.
- McVicar, T. R., T. G. Van Niel, L. T. Li, M. L. Roderick, D. P. Rayner, L. Ricciardulli, and R. J. Donohue, 2008: Wind speed climatology and trends for Australia, 1975–2006: Capturing the stilling phenomenon and comparison with near-surface reanalysis output. *Geophys. Res. Lett.*, **35**, L20403, doi:10.1029/2008GL035627.
- , and Coauthors, 2012: Global review and synthesis of trends in observed terrestrial near-surface wind speeds: Implications for evaporation. *J. Hydrol.*, **416–417**, 182–205, doi:10.1016/j.jhydrol.2011.10.024.
- Mears, C. A., and F. J. Wentz, 2009: Construction of the RSS V3.2 lower-tropospheric temperature dataset from the MSU and AMSU microwave sounders. *J. Atmos. Oceanic Technol.*, **26**, 1493–1509, doi:10.1175/2009jtech1237.1.
- Meehl, G. A., A. Hu, J. M. Arblaster, J. Fasullo, and K. E. Trenberth, 2013: Externally forced and internally generated decadal climate variability associated with the interdecadal Pacific oscillation. *J. Climate*, **26**, 7298–7310, doi:10.1175/jcli-d-12-00548.1.
- Meier, W. N., and Coauthors, 2014: Arctic sea ice in transformation: A review of recent observed changes and impacts on biology and human activity. *Rev. Geophys.*, **52**, 185–217, doi:10.1002/2013RG000431.
- Menemenlis, D., P. Heimbach, C. Hill, T. Lee, A. Nguyen, M. Schodlok, and H. Zhang, 2008: ECCO2: High-resolution global ocean and sea ice data synthesis. *Mercator Ocean Quarterly Newsletter*, No. **31**, Mercator-Ocean, Ramonville, Saint-Agne, France, 13–21. [Available online at http://ecco2.org/manuscripts/reports/ECCO2_Mercator.pdf.]
- Menezes, V. V., A. M. Macdonald, and C. Schatzman, 2017: Accelerated freshening of Antarctic bottom water over the last decade in the southern Indian Ocean. *Sci. Adv.*, **3**, e1601426, doi:10.1126/sciadv.1601426.
- Menne, M. J., I. Durre, R. S. Vose, B. E. Gleason, and T. G. Houston, 2012: An overview of the global historical climatology network-daily database. *J. Atmos. Oceanic Technol.*, **29**, 897–910, doi:10.1175/jtech-d-11-00103.1.
- Menzel, W. P., R. A. Frey, E. E. Borbas, N. Bearson, B. Baum, R. Chen, and C. Cao, 2014: Recalibrating HIRS sensors to produce a 30 year record of radiance measurements. *Proc. EUMETSAT Meteorological Satellite Conf.*, Geneva, Switzerland, EUMETSAT.
- Merrifield, M. A., 2011: A shift in western tropical Pacific sea level trends during the 1990s. *J. Climate*, **24**, 4126–4138, doi:10.1175/2011jcli3932.1.
- , P. R. Thompson, and M. Lander, 2012: Multidecadal sea level anomalies and trends in the western tropical Pacific. *Geophys. Res. Lett.*, **39**, L13602, doi:10.1029/2012GL052032.
- Miller, B. R., and Coauthors, 2010: HFC-23 (CHF_3) emission trend response to HCFC-22 (CHClF_2) production and recent HFC-23 emission abatement measures. *Atmos. Chem. Phys.*, **10**, 7875–7890, doi:10.5194/acp-10-7875-2010.
- Minnis, P., and Coauthors, 2008: Cloud detection in nonpolar regions for CERES using TRMM VIRS and Terra and Aqua MODIS data. *IEEE Trans. Geosci. Remote Sens.*, **46**, 3857–3884, doi:10.1109/TGRS.2008.2001351.
- , and Coauthors, 2016: A consistent long-term cloud and clear-sky radiation property dataset from the Advanced Very High Resolution Radiometer (AVHRR). CDRP-ATBD-0826 Rev 1, 159 pp. [Available online at <http://dx.doi.org/10.789/V5HT2M8T.1>.]
- Miralles, D. G., T. R. H. Holmes, R. A. M. De Jeu, J. H. Gash, A. G. C. A. Meesters, and A. J. Dolman, 2011: Global land-surface evaporation estimated from satellite-based observations. *Hydrol. Earth Syst. Sci.*, **15**, 453–469, doi:10.5194/hess-15-453-2011.
- , A. J. Teuling, C. C. van Heerwaarden, and J. Vila-Guevara de Arellano, 2014a: Mega-heatwave temperatures due to combined soil desiccation and atmospheric heat accumulation. *Nat. Geosci.*, **7**, 345–349, doi:10.1038/ngeo2141.
- , and Coauthors, 2014b: El Niño–La Niña cycle and recent trends in continental evaporation. *Nat. Climate Change*, **4**, 122–126, doi:10.1038/nclimate2068.
- , and Coauthors, 2016: The WACMOS-ET project – Part 2: Evaluation of global terrestrial evaporation data sets. *Hydrol. Earth Syst. Sci.*, **20**, 823–842, doi:10.5194/hess-20-823-2016.
- Mishra, U., and W. J. Riley, 2012: Alaskan soil carbon stocks: spatial variability and dependence on environmental factors. *Biogeosciences*, **9**, 3637–3645, doi:10.5194/bg-9-3637-2012.
- Mo, K. C., 2000: The association between intraseasonal oscillations and tropical storms in the Atlantic basin. *Mon. Wea. Rev.*, **128**, 4097–4107, doi:10.1175/1520-0493(2000)129<4097:tabioa>2.0.co;2.
- , and V. E. Kousky, 1993: Further analysis of the relationship between circulation anomaly patterns and tropical convection. *J. Geophys. Res.*, **98**, 5103–5113, doi:10.1029/92JD02952.

- Moat, B. I., and Coauthors, 2016: Major variations in subtropical North Atlantic heat transport at short (5 day) timescales and their causes. *J. Geophys. Res. Oceans*, **121**, 3237–3249, doi:10.1002/2016JC011660.
- Monks, P. S., and Coauthors, 2015: Tropospheric ozone and its precursors from the urban to the global scale from air quality to short-lived climate forcer. *Atmos. Chem. Phys.*, **15**, 8889–8973, doi:10.5194/acp-15-8889-2015.
- Morice, C. P., J. J. Kennedy, N. A. Rayner, and P. D. Jones, 2012: Quantifying uncertainties in global and regional temperature change using an ensemble of observational estimates: The HadCRUT4 data set. *J. Geophys. Res.*, **117**, D08101, doi:10.1029/2011JD017187.
- Morrison, W. E., and V. Termini, 2016: A review of potential approaches for managing marine fisheries in a changing climate. NOAA Tech. Memo. NMFS-OSF-6, 35 pp. [Available online at http://www.nmfs.noaa.gov/sfa/publications/technical-memos/nmfs_osf_tm6.pdf.]
- Mote, T. L., 2007: Greenland surface melt trends 1973–2007: Evidence of a large increase in 2007. *Geophys. Res. Lett.*, **34**, L22507, doi:10.1029/2007GL031976.
- Mu, C., and Coauthors, 2015: Editorial: Organic carbon pools in permafrost regions on the Qinghai–Xizang (Tibetan) Plateau. *Cryosphere*, **9**, 479–486, doi:10.5194/tc-9-479-2015.
- Mu, Q., M. Zhao, J. S. Kimball, N. G. McDowell, and S. W. Running, 2013: A remotely sensed global terrestrial drought severity index. *Bull. Amer. Meteor. Soc.*, **94**, 83–98, doi:10.1175/bams-d-11-00213.1.
- Mudryk, L. R., P. J. Kushner, C. Derksen, and C. Thackeray, 2017: Snow cover response to temperature in observational and climate model ensembles. *Geophys. Res. Lett.*, **44**, 919–926, doi:10.1002/2016GL071789.
- Mühle, J., and Coauthors, 2010: Perfluorocarbons in the global atmosphere: Tetrafluoromethane, hexafluoroethane, and octafluoropropane. *Atmos. Chem. Phys.*, **10**, 5145–5164, doi:10.5194/acp-10-5145-2010.
- Mullan, A. B., 2014: Intertropical convergence zones [in “State of the Climate in 2013”]. *Bull. Amer. Meteor. Soc.*, **95** (7), S103–S104, doi:10.1175/2014BAMSStateoftheClimate.1.
- Müller, R., J. U. Groß, C. Lemmen, D. Heinze, M. Dameris, and G. Bodeker, 2008: Simple measures of ozone depletion in the polar stratosphere. *Atmos. Chem. Phys.*, **8**, 251–264, doi:10.5194/acp-8-251-2008.
- Münnich, M., and J. D. Neelin, 2005: Seasonal influence of ENSO on the Atlantic ITCZ and equatorial South America. *Geophys. Res. Lett.*, **32**, L21709, doi:10.1029/2005GL023900.
- Murphy, B. F., and J. Ribbe, 2004: Variability of southeastern Queensland rainfall and climate indices. *Int. J. Climatol.*, **24**, 703–721, doi:10.1002/joc.1018.
- Murray, L. T., J. A. Logan, and D. J. Jacob, 2013: Interannual variability in tropical tropospheric ozone and OH: The role of lightning. *J. Geophys. Res. Atmos.*, **118**, 11,468–11,480, doi:10.1002/jgrd.50857.
- Myers-Smith, I. H., and D. S. Hik, 2013: Shrub canopies influence soil temperatures but not nutrient dynamics: An experimental test of tundra snow–shrub interactions. *Ecol. Evol.*, **3**, 3683–3700, doi:10.1002/ece3.710.
- , and Coauthors, 2015: Climate sensitivity of shrub growth across the tundra biome. *Nat. Climate Change*, **5**, 887–891, doi:10.1038/nclimate2697.
- Myhre, G., and Coauthors, 2013: Anthropogenic and natural radiative forcing. *Climate Change 2013: The Physical Science Basis*, T. F. Stocker et al., Eds., Cambridge University Press, 659–740.
- Nakazawa, T., and S. Hoshino, 2009: Intercomparison of Dvorak parameters in the tropical cyclone datasets over the western North Pacific. *SOLA*, **5**, 33–36, doi:10.2151/sola.2009-009.
- Nash, E. R., and Coauthors, 2016: Antarctic ozone hole [in “State of the Climate in 2015”]. *Bull. Amer. Meteor. Soc.*, **97** (8), S168–S172, doi:10.1175/2016BAMSStateoftheClimate.1.
- National Research Council, 2003: Cloud, water vapor, and lapse rate feedbacks. *Understanding Climate Change Feedbacks*, National Academies Press, 21–40.
- Nemani, R. R., and S. W. Running, 1989: Estimation of regional surface resistance to evapotranspiration from NDVI and thermal-IR AVHRR data. *J. Appl. Meteor.*, **28**, 276–284, doi:10.1175/1520-0450(1989)028<0276:eoersrt>2.0.co;2.
- Nerem, R. S., D. P. Chambers, E. W. Leuliette, G. T. Mitchum, and B. S. Giese, 1999: Variations in global mean sea level associated with the 1997–1998 ENSO event: Implications for measuring long term sea level change. *Geophys. Res. Lett.*, **26**, 3005–3008, doi:10.1029/1999GL002311.
- Neu, J. L., T. Flury, G. L. Manney, M. L. Santee, N. J. Livesey, and J. Worden, 2014: Tropospheric ozone variations governed by changes in stratospheric circulation. *Nat. Geosci.*, **7**, 340–344, doi:10.1038/ngeo2138.
- Newman, C. E., S. R. Lewis, P. L. Read, and F. Forget, 2002: Modeling the Martian dust cycle, 1. Representations of dust transport processes. *J. Geophys. Res.*, **107**, 5123, doi:10.1029/2002JE001910.
- Newman, P. A., J. S. Daniel, D. W. Waugh, and E. R. Nash, 2007: A new formulation of equivalent effective stratospheric chlorine (EESC). *Atmos. Chem. Phys.*, **7**, 4537–4552, doi:10.5194/acp-7-4537-2007.
- , and Coauthors, 2015: Ozone depletion [in “State of the Climate in 2014”]. *Bull. Amer. Meteor. Soc.*, **96** (7), S165–S167, doi:10.1175/2015BAMSStateoftheClimate.1.

- , L. Coy, S. Pawson, and L. R. Lait, 2016: The anomalous change in the QBO in 2015–2016. *Geophys. Res. Lett.*, **43**, 8791–8797, doi:10.1002/2016GL070373.
- Newton, B. W., T. D. Prowse, and B. R. Bonsal, 2014a: Evaluating the distribution of water resources in western Canada using synoptic climatology and selected teleconnections. Part 1: Winter season. *Hydrol. Proc.*, **28**, 4219–4234, doi:10.1002/hyp.10233.
- , —, and —, 2014b: Evaluating the distribution of water resources in western Canada using synoptic climatology and selected teleconnections. Part 2: Summer season. *Hydrol. Proc.*, **28**, 4235–4249, doi:10.1002/hyp.10235.
- Nghiem, S. V., and Coauthors, 2012: The extreme melt across the Greenland ice sheet in 2012. *Geophys. Res. Lett.*, **39**, L20502, doi:10.1029/2012GL053611.
- NOAA, cited 2017: State of the climate: Drought for annual 2016. [Available online at <http://www.ncdc.noaa.gov/sotc/drought/201613>.]
- Nobre, P., and J. Shukla, 1996: Variations of sea surface temperature, wind stress, and rainfall over the tropical Atlantic and South America. *J. Climate*, **9**, 2464–2479, doi:10.1175/1520-0442(1996)009<2464:vosstw>2.0.co;2.
- O’Malley, R. T., M. J. Behrenfeld, D. A. Siegel, and S. Maritorena, 2010: Global ocean phytoplankton [in “State of the Climate in 2009”]. *Bull. Amer. Meteor. Soc.*, **91** (7), S75–S78, doi:10.1175/BAMS-91-7-StateoftheClimate.
- O'Reilly, C. M., S. R. Alin, P.-D. Plisnier, A. S. Cohen, and B. A. McKee, 2003: Climate change decreases aquatic ecosystem productivity of Lake Tanganyika, Africa. *Nature*, **424**, 766–768, doi:10.1038/nature01833.
- , and Coauthors, 2015: Rapid and highly variable warming of lake surface waters around the globe. *Geophys. Res. Lett.*, **42**, 10,773–10,781, doi:10.1002/2015GL066235.
- Oliva, M., and Coauthors, 2017: Recent regional climate cooling on the Antarctic Peninsula and associated impacts on the cryosphere. *Sci. Total Environ.*, **580**, 210–223, doi:10.1016/j.scitotenv.2016.12.030.
- Oltmans, S. J., and Coauthors, 2006: Long-term changes in tropospheric ozone. *Atmos. Environ.*, **40**, 3156–3173, doi:10.1016/j.atmosenv.2006.01.029.
- Onogi, K., and Coauthors, 2007: The JRA-25 reanalysis. *J. Meteor. Soc. Japan*, **85**, 369–432, doi:10.2151/jmsj.85.369.
- Oozeva, C., C. Noongwook, G. Noongwook, C. Alowa, and I. Krupnik, 2004: *Watching Ice and Weather Our Way [Sikumengllu Eslamengllu Esghapalleghput]*. I. Krupnik, H. Huntington, C. Koonooka, and G. Noongwook, Eds. Arctic Studies Center, Smithsonian Institution, 208 pp.
- Osborn, T. J., J. Barichivich, I. Harris, G. van der Schrier, and P. D. Jones, 2016: Monitoring global drought using the self-calibrating Palmer drought severity index [in “State of the Climate in 2015”]. *Bull. Amer. Meteor. Soc.*, **97** (8), S32–S36, doi:10.1175/2016BAMSStateoftheClimate.1.
- Osprey, S. M., and Coauthors, 2016: An unexpected disruption of the atmospheric quasi-biennial oscillation. *Science*, **353**, 1424–1427, doi:10.1126/science.aah4156.
- Otto, F. E. L., and Coauthors, 2015: Factors other than climate change, main drivers of 2014/15 water shortage in southeast Brazil. *Bull. Amer. Meteor. Soc.*, **96** (12), S35–S40, doi:10.1175/bams-d-15-00120.1.
- Oudrari, H., and Coauthors, 2015: Prelaunch radiometric characterization and calibration of the S-NPP VIIRS sensor. *IEEE Trans. Geosci. Remote Sens.*, **53**, 2195–2210, doi:10.1109/TGRS.2014.2357678.
- Overland, J. E., and M. Wang, 2016: Recent extreme Arctic temperatures are due to a split polar vortex. *J. Climate*, **29**, 5609–5616, doi:10.1175/jcli-d-16-0320.1.
- Palmer, M. D., K. Haines, S. F. B. Tett, and T. J. Ansell, 2007: Isolating the signal of ocean global warming. *Geophys. Res. Lett.*, **34**, L23610, doi:10.1029/2007GL031712.
- Panda, D. K., and J. Wahr, 2016: Spatiotemporal evolution of water storage changes in India from the updated GRACE-derived gravity records. *Water Resour. Res.*, **52**, 135–149, doi:10.1002/2015WR017797.
- Park, S., and Coauthors, 2012: Trends and seasonal cycles in the isotopic composition of nitrous oxide since 1940. *Nat. Geosci.*, **5**, 261–265, doi:10.1038/ngeo1421.
- Park, T., and Coauthors, 2016: Changes in growing season duration and productivity of northern vegetation inferred from long-term remote sensing data. *Environ. Res. Lett.*, **11**, 084001, doi:10.1088/1748-9326/11/8/084001.
- Parker, T. C., J.-A. Subke, and P. A. Wookey, 2015: Rapid carbon turnover beneath shrub and tree vegetation is associated with low soil carbon stocks at a subarctic treeline. *Global Change Biol.*, **21**, 2070–2081, doi:10.1111/gcb.12793.
- Parrish, D. D., and Coauthors, 2014: Long-term changes in lower tropospheric baseline ozone concentrations: Comparing chemistry-climate models and observations at northern midlatitudes. *J. Geophys. Res. Atmos.*, **119**, 5719–5736, doi:10.1002/2013JD021435.
- Pawson, S., and Coauthors, 2014: Update on global ozone: Past, present, and future. *Scientific Assessment of Ozone Depletion: 2014*, World Meteorological Organization, 2.1–2.66.
- Pedersen, Å. Ø., J. D. M. Speed, and I. M. Tombre, 2013: Prevalence of pink-footed goose grubbing in the Arctic tundra increases with population expansion. *Polar Biol.*, **36**, 1569–1575, doi:10.1007/s00300-013-1374-9.
- Pellichero, V., J.-B. Sallée, S. Schmidtko, F. Roquet, and J.-B. Charrassin, 2017: The ocean mixed layer under Southern Ocean sea-ice: Seasonal cycle and forcing. *J. Geophys. Res. Oceans*, **122**, 1608–1633, doi:10.1002/2016JC011970.
- Pelto, M. S., 2010: Forecasting temperate alpine glacier survival from accumulation zone observations. *Cryosphere*, **4**, 67–75, doi:10.5194/tc-4-67-2010.

- PERMOS, 2016: Permafrost in Switzerland 2010/2011 to 2013/2014. Glaciological Report (Permafrost) No. 12-15 of the Cryospheric Commission of the Swiss Academy of Sciences, 85 pp. [Available online at <http://www.permos.ch/downloads/permisos10-14.pdf>.]
- Pershing, A. J., and Coauthors, 2015: Slow adaptation in the face of rapid warming leads to collapse of the Gulf of Maine cod fishery. *Science*, **350**, 809–812, doi:10.1126/science.aac9819.
- Peterson, D. A., E. J. Hyer, J. R. Campbell, M. D. Fromm, J. W. Hair, C. F. Butler, and M. A. Fenn, 2015: The 2013 Rim Fire: Implications for predicting extreme fire spread, pyroconvection, and smoke emissions. *Bull. Amer. Meteor. Soc.*, **96**, 229–247, doi:10.1175/bams-d-14-00060.1.
- Peterson, T. C., and R. S. Vose, 1997: An overview of the global historical climatology network temperature database. *Bull. Amer. Meteor. Soc.*, **78**, 2837–2849, doi:10.1175/1520-0477(1997)078<2837:aootgh>2.0.co;2.
- Petty, A. A., P. R. Holland, and D. L. Feltham, 2014: Sea ice and the ocean mixed layer over the Antarctic shelf seas. *Cryosphere*, **8**, 761–783, doi:10.5194/tc-8-761-2014.
- Pfeffer, W. T., and Coauthors, 2014: The Randolph Glacier inventory: A globally complete inventory of glaciers. *J. Glaciol.*, **60**, 537–552, doi:10.3189/2014JoG13J176.
- Phoenix, G. K., and J. W. Bjerke, 2016: Arctic browning: Extreme events and trends reversing Arctic greening. *Global Change Biol.*, **22**, 2960–2962, doi:10.1111/gcb.13261.
- Picaut, J., M. Ioualalen, C. Menkes, T. Delcroix, and M. J. McPhaden, 1996: Mechanism of the zonal displacements of the Pacific warm pool: Implications for ENSO. *Science*, **274**, 1486–1489, doi:10.1126/science.274.5292.1486.
- Ping, C. L., G. J. Michaelson, J. M. Kimble, V. E. Romanovsky, Y. L. Shur, D. K. Swanson, and D. A. Walker, 2008: Cryogenesis and soil formation along a bioclimate gradient in Arctic North America. *J. Geophys. Res.*, **113**, G03S12, doi:10.1029/2008JG000744.
- Pinsky, M. L., and M. Fogarty, 2012: Lagged social-ecological responses to climate and range shifts in fisheries. *Climatic Change*, **115**, 883–891, doi:10.1007/s10584-012-0599-x.
- Pinty, B., 2012: Land surface albedo [in "State of the Climate in 2011"]. *Bull. Amer. Meteor. Soc.*, **93** (7), S52–S53, doi:10.1175/2012BAMSStateoftheClimate.1.
- , and Coauthors, 2011a: Exploiting the MODIS albedos with the two-stream inversion package (JRC-TIP): 1. Effective leaf area index, vegetation, and soil properties. *J. Geophys. Res.*, **116**, D09105, doi:10.1029/2010JD015372.
- , and Coauthors, 2011b: Exploiting the MODIS albedos with the two-stream inversion package (JRC-TIP): 2. Fractions of transmitted and absorbed fluxes in the vegetation and soil layers. *J. Geophys. Res.*, **116**, D09106, doi:10.1029/2010JD015373.
- Pinzon, J., and C. Tucker, 2014: A non-stationary 1981–2012 AVHRR NDVI3g time series. *Remote Sens.*, **6**, 6929, doi:10.3390/rs6086929.
- Pitts, M. C., L. R. Poole, and L. W. Thomason, 2009: CALIPSO polar stratospheric cloud observations: Second-generation detection algorithm and composition discrimination. *Atmos. Chem. Phys.*, **9**, 7577–7589, doi:10.5194/acp-9-7577-2009.
- Post, E., and Coauthors, 2013: Ecological consequences of sea-ice decline. *Science*, **341**, 519–524, doi:10.1126/science.1235225.
- Post, W. M., W. R. Emanuel, P. J. Zinke, and A. G. Stangerberger, 1982: Soil carbon pools and world life zones. *Nature*, **298**, 156–159, doi:10.1038/298156a0.
- Price, J. C., 1982: Estimation of regional scale evapotranspiration through analysis of satellite thermal-infrared data. *IEEE Trans. Geosci. Remote Sens.*, **GE-20**, 286–292, doi:10.1109/TGRS.1982.350445.
- Price, J. F., 1981: Upper ocean response to a hurricane. *J. Phys. Oceanogr.*, **11**, 153–175, doi:10.1175/1520-0485(1981)011<0153:uorhah>2.0.co;2.
- Pryor, S. C., and Coauthors, 2009: Wind speed trends over the contiguous United States. *J. Geophys. Res.*, **114**, D14105, doi:10.1029/2008JD011416.
- Pun, I.-F., I-I Lin, and M.-H. Lo, 2013: Recent increase in high tropical cyclone heat potential area in the western North Pacific Ocean. *Geophys. Res. Lett.*, **40**, 4680–4684, doi:10.1002/grl.50548.
- Punt, A. E., D. Poljak, M. G. Dalton, and R. J. Foy, 2014: Evaluating the impact of ocean acidification on fishery yields and profits: The example of red king crab in Bristol Bay. *Ecol. Model.*, **285**, 39–53, doi:10.1016/j.ecolmodel.2014.04.017.
- , R. J. Foy, M. G. Dalton, W. C. Long, and K. M. Swiney, 2016: Effects of long-term exposure to ocean acidification conditions on future southern Tanner crab (*Chionoecetes bairdi*) fisheries management. *ICES J. Marine Sci.*, **73**, 849–864, doi:10.1093/icesjms/fsv205.
- Purkey, S. G., and G. C. Johnson, 2010: Warming of global abyssal and deep Southern Ocean waters between the 1990s and 2000s: Contributions to global heat and sea level rise budgets. *J. Climate*, **23**, 6336–6351, doi:10.1175/2010jcli3682.1.
- , and —, 2013: Antarctic bottom water warming and freshening: Contributions to sea level rise, ocean freshwater budgets, and global heat gain. *J. Climate*, **26**, 6105–6122, doi:10.1175/jcli-d-12-00834.1.
- Qi, D., and Coauthors, 2017: Increase in acidifying water in the western Arctic Ocean. *Nat. Climate Change*, **7**, 195–199, doi:10.1038/nclimate3228.
- Rachold, V., and Coauthors, 2007: Nearshore Arctic subsea permafrost in transition. *Eos, Trans. Amer. Geophys. Union*, **88** (13), 149–150, doi:10.1029/2007EO130001.

- Raga, G. B., B. Bracamontes-Cevallos, L. M. Farfán, and R. Romero-Centeno, 2013: Landfalling tropical cyclones on the Pacific coast of Mexico: 1850–2010. *Atmosfera*, **26**, 209–220, doi:10.1016/S0187-6236(13)71072-5.
- Rahmani, A., S. Golian, and L. Brocca, 2016: Multiyear monitoring of soil moisture over Iran through satellite and reanalysis soil moisture products. *Int. J. Appl. Earth Obs. Geoinf.*, **48**, 85–95, doi:10.1016/j.jag.2015.06.009.
- Rahmstorf, S., J. E. Box, G. Feulner, M. E. Mann, A. Robinson, S. Rutherford, and E. J. Schaffernicht, 2015: Exceptional twentieth-century slowdown in Atlantic Ocean overturning circulation. *Nat. Climate Change*, **5**, 475–480, doi:10.1038/nclimate2554.
- Ramella-Pralungo, L., L. Haimberger, A. Stickler, and S. Brönnimann, 2014: A global radiosonde and tracked balloon archive on 16 pressure levels (GRASP) back to 1905 – Part 1: Merging and interpolation to 00:00 and 12:00 GMT. *Earth Syst. Sci. Data*, **6**, 185–200, doi:10.5194/essd-6-185-2014.
- Ramos, M., G. Vieira, M. A. de Pablo, A. Molina, A. Abramov, and G. Goyanes, 2017: Recent shallowing of the thaw depth at Crater Lake, Deception Island, Antarctica (2006–2014). *CATENA*, **149**, Part 2, 519–528, doi:10.1016/j.catena.2016.07.019.
- Randel, W. J., R. R. Garcia, N. Calvo, and D. Marsh, 2009: ENSO influence on zonal mean temperature and ozone in the tropical lower stratosphere. *Geophys. Res. Lett.*, **36**, L15822, doi:10.1029/2009GL039343.
- Rasmusson, E. M., and T. H. Carpenter, 1982: Variations in tropical sea surface temperature and surface wind fields associated with the Southern Oscillation/El Niño. *Mon. Wea. Rev.*, **110**, 354–384, doi:10.1175/1520-0493(1982)110<0354:vitsst>2.0.co;2.
- , and J. M. Wallace, 1983: Meteorological aspects of the El Niño/Southern Oscillation. *Science*, **222**, 1195–1202, doi:10.1126/science.222.4629.1195.
- Ravishankara, A. R., S. Solomon, A. A. Turnipseed, and R. F. Warren, 1993: Atmospheric lifetimes of long-lived halogenated species. *Science*, **259**, 194–199, doi:10.1126/science.259.5092.194.
- , J. S. Daniel, and R. W. Portmann, 2009: Nitrous oxide (N_2O): The dominant ozone-depleting substance emitted in the 21st century. *Science*, **326**, 123–125, doi:10.1126/science.1176985.
- Rayner, N. A., and Coauthors, 2003: Global analyses of sea surface temperature, sea ice, and night marine air temperature since the late nineteenth century. *J. Geophys. Res.*, **108**, 4407, doi:10.1029/2002JD002670.
- Raynolds, M. K., D. A. Walker, H. E. Epstein, J. E. Pinzon, and C. J. Tucker, 2012: A new estimate of tundra-biome phytomass from trans-Arctic field data and AVHRR NDVI. *Remote Sens. Lett.*, **3**, 403–411, doi:10.1080/01431161.2011.609188.
- Read, P. L., and S. R. Lewis, 2004: *The Martian Climate Revisited: Atmosphere and Environment of a Desert Planet*. Springer, 326 pp.
- , —, and D. P. Mulholland, 2015: The physics of Martian weather and climate: A review. *Rep. Prog. Phys.*, **78**, 125901, doi:10.1088/0034-4885/78/12/125901.
- Reagan, J., T. Boyer, C. Schmid, and R. Locarnini, 2016: Subsurface salinity [in “State of the Climate in 2015”]. *Bull. Amer. Meteor. Soc.*, **97** (8), S72–S73, doi:10.1175/2016BAMSStateoftheClimate.1.
- Reager, J. T., A. S. Gardner, J. S. Famiglietti, D. N. Wiese, A. Eicker, and M.-H. Lo, 2016: A decade of sea level rise slowed by climate-driven hydrology. *Science*, **351**, 699–703, doi:10.1126/science.aad8386.
- Reid, P. A., and R. A. Masson, 2015: Successive Antarctic sea ice extent records during 2012, 2013, and 2014 [in “State of the Climate in 2014”]. *Bull. Amer. Meteor. Soc.*, **96** (7), S163–S164, doi:10.1175/2015BAMSStateoftheClimate.1.
- , —, S. Stammerjohn, S. Barreira, J. Lieser, and T. Scambos, 2016: Sea ice extent and concentration [in “State of the Climate in 2015”]. *Bull. Amer. Meteor. Soc.*, **97** (8), S163–S166, doi:10.1175/2016BAMSStateoftheClimate.1.
- Remer, L. A., and Coauthors, 2005: The MODIS aerosol algorithm, products, and validation. *J. Atmos. Sci.*, **62**, 947–973, doi:10.1175/jas3385.1.
- Remy, S., and J. W. Kaiser, 2014: Daily global fire radiative power fields estimation from one or two MODIS instruments. *Atmos. Chem. Phys.*, **14**, 13,377–13,390, doi:10.5194/acp-14-13377-2014.
- Reynolds, R. W., N. A. Rayner, T. M. Smith, D. C. Stokes, and W. Wang, 2002: An improved in situ and satellite SST analysis for climate. *J. Climate*, **15**, 1609–1625, doi:10.1175/1520-0442(2002)015<1609:aiias>2.0.co;2.
- , T. M. Smith, C. Liu, D. B. Chelton, K. S. Casey, and M. G. Schlax, 2007: Daily high-resolution-blended analyses for sea surface temperature. *J. Climate*, **20**, 5473–5496, doi:10.1175/2007jcll1824.1.
- Rhein, M., and Coauthors, 2013: Observations: Ocean. *Climate Change 2013: The Physical Science Basis*, T. F. Stocker et al., Eds., Cambridge University Press, 255–316.
- Riahi, K., and Coauthors, 2011: RCP 8.5—A scenario of comparatively high greenhouse gas emissions. *Climatic Change*, **109**, 33–57, doi:10.1007/s10584-011-0149-y.
- Richter-Menge, J., J. E. Overland, and J. T. Mathis, Eds., 2016: *Arctic Report Card 2016*. NOAA’s Arctic Program, various pp.
- Riddle, E. E., M. B. Stoner, N. C. Johnson, M. L. L’Heureux, D. C. Collins, and S. B. Feldstein, 2013: The impact of the MJO on clusters of wintertime circulation anomalies over the North American region. *Climate Dyn.*, **40**, 1749–1766, doi:10.1007/s00382-012-1493-y.

- Ridley, D. A., and Coauthors, 2014: Total volcanic stratospheric aerosol optical depths and implications for global climate change. *Geophys. Res. Lett.*, **41**, 7763–7769, doi:10.1002/2014GL061541.
- Riser, S. C., and Coauthors, 2016: Fifteen years of ocean observations with the global Argo array. *Nat. Climate Change*, **6**, 145–153, doi:10.1038/nclimate2872.
- Robson, J., P. Ortega, and R. Sutton, 2016: A reversal of climatic trends in the North Atlantic since 2005. *Nat. Geosci.*, **9**, 513–517, doi:10.1038/ngeo2727.
- Rodell, M., I. Velicogna, and J. S. Famiglietti, 2009: Satellite-based estimates of groundwater depletion in India. *Nature*, **460**, 999–1002, doi:10.1038/nature08238.
- Rödenbeck, C., and Coauthors, 2015: Data-based estimates of the ocean carbon sink variability – first results of the Surface Ocean $p\text{CO}_2$ Mapping intercomparison (SOCOM). *Biogeosciences*, **12**, 7251–7278, doi:10.5194/bg-12-7251-2015.
- Roderick, M. L., L. D. Rotstayn, G. D. Farquhar, and M. T. Hobbins, 2007: On the attribution of changing pan evaporation. *Geophys. Res. Lett.*, **34**, L17403, doi:10.1029/2007GL031166.
- Roemmich, D., and J. Gilson, 2009: The 2004–2008 mean and annual cycle of temperature, salinity, and steric height in the global ocean from the Argo Program. *Prog. Oceanogr.*, **82**, 81–100, doi:10.1016/j.pocean.2009.03.004.
- , and —, 2011: The global ocean imprint of ENSO. *Geophys. Res. Lett.*, **38**, L13606, doi:10.1029/2011GL047992.
- , J. Church, J. Gilson, D. Monselesan, P. Sutton, and S. Wijffels, 2015: Unabated planetary warming and its ocean structure since 2006. *Nat. Climate Change*, **5**, 240–245, doi:10.1038/nclimate2513.
- Rogers, J. C., and J. L. Morack, 1980: Geophysical evidence of shallow nearshore permafrost, Prudhoe Bay, Alaska. *J. Geophys. Res.*, **85**, 4845–4853, doi:10.1029/JB085iB09p04845.
- Rohde, R., and Coauthors, 2013: A new estimate of the average Earth surface land temperature spanning 1753 to 2011. *Geoinfor. Geostat. Overview*, **1** (1), doi:10.4172/2327-4581.1000101.
- Romanovsky, V. E., W. L. Cable, and A. L. Kholodov, 2015: Changes in permafrost and active-layer temperatures along an Alaskan permafrost-ecological transect. *Proc. 68th Canadian Geotechnical Conf. and Seventh Canadian Conf. on Permafrost (GEOQuébec 2015)*, Quebec, Canada, GEOQuébec 2015, Paper 479.
- Ropelewski, C. F., and M. S. Halpert, 1986: North American precipitation and temperature patterns associated with the El Niño/Southern Oscillation (ENSO). *Mon. Wea. Rev.*, **114**, 2352–2362, doi:10.1175/1520-0493(1986)114<2352:na>2.0.co;2.
- , and —, 1987: Global and regional scale precipitation patterns associated with the El Niño/Southern Oscillation. *Mon. Wea. Rev.*, **115**, 1606–1626, doi:10.1175/1520-0493(1987)115<1606:garspp>2.0.co;2.
- , and —, 1989: Precipitation patterns associated with the high index phase of the southern oscillation. *J. Climate*, **2**, 268–284, doi:10.1175/1520-0442(1989)002<0268:ppawth>2.0.co;2.
- Rosenfeld, D., M. Fromm, J. Trentmann, G. Luderer, M. O. Andreae, and R. Servranckx, 2007: The Chisholm firestorm: Observed microstructure, precipitation and lightning activity of a pyro-cumulonimbus. *Atmos. Chem. Phys.*, **7**, 645–659, doi:10.5194/acp-7-645-2007.
- Saba, V. S., and Coauthors, 2016: Enhanced warming of the northwest Atlantic Ocean under climate change. *J. Geophys. Res. Oceans*, **121**, 118–132, doi:10.1002/2015JC011346.
- Saha, S., and Coauthors, 2010: The NCEP climate forecast system reanalysis. *Bull. Amer. Meteor. Soc.*, **91**, 1015–1057, doi:10.1175/2010bams3001.1.
- , and Coauthors, 2014: The NCEP climate forecast system version 2. *J. Climate*, **27**, 2185–2208, doi:10.1175/jcli-d-12-00823.1.
- Saji, N. H., B. N. Goswami, P. N. Vinayachandran, and T. Yamagata, 1999: A dipole mode in the tropical Indian Ocean. *Nature*, **401**, 360–363.
- Sallée, J.-B., and Coauthors, 2016: Southern Ocean [in “State of the Climate in 2015”]. *Bull. Amer. Meteor. Soc.*, **97** (8), S166–S168, doi:10.1175/2016BAMSSStateoftheClimate.1.
- Sallenger, A. H., K. S. Doran, and P. A. Howd, 2012: Hotspot of accelerated sea-level rise on the Atlantic coast of North America. *Nat. Climate Change*, **2**, 884–888, doi:10.1038/nclimate1597.
- Sauvage, B., R. V. Martin, A. van Donkelaar, and J. R. Ziemke, 2007: Quantification of the factors controlling tropical tropospheric ozone and the South Atlantic maximum. *J. Geophys. Res.*, **112**, D11309, doi:10.1029/2006JD008008.
- Schaaf, C. B., and Coauthors, 2002: First operational BRDF, albedo nadir reflectance products from MODIS. *Remote Sens. Environ.*, **83**, 135–148, doi:10.1016/S0034-4257(02)00091-3.
- Schanze, J. J., R. W. Schmitt, and L. L. Yu, 2010: The global oceanic freshwater cycle: A state-of-the-art quantification. *J. Mar. Res.*, **68**, 569–595, doi:10.1357/002224010794657164.
- Schauffler, S. M., and Coauthors, 2003: Chlorine budget and partitioning during the stratospheric aerosol and gas experiment (SAGE) III ozone loss and validation experiment (SOLVE). *J. Geophys. Res.*, **108**, 4173, doi:10.1029/2001JD002040.
- Schirrmeister, L., C. Siegert, V. V. Kunitzky, P. M. Grootes, and H. Erlenkeuser, 2002: Late Quaternary ice-rich permafrost sequences as a paleoenvironmental archive for the Laptev Sea Region in northern Siberia. *Int. J. Earth Sci.*, **91**, 154–167, doi:10.1007/s005310100205.

- , G. Grosse, S. Wetterich, P. P. Overduin, J. Strauss, E. A. G. Schuur, and H.-W. Hubberten, 2011: Fossil organic matter characteristics in permafrost deposits of the northeast Siberian Arctic. *J. Geophys. Res.*, **116**, G00M02, doi:10.1029/2011JG001647.
- Schmidtko, S., K. J. Heywood, A. F. Thompson, and S. Aoki, 2014: Multidecadal warming of Antarctic waters. *Science*, **346**, 1227–1231, doi:10.1126/science.1256117.
- Schneider, P., and S. J. Hook, 2010: Space observations of inland water bodies show rapid surface warming since 1985. *Geophys. Res. Lett.*, **37**, L22405, doi:10.1029/2010GL045059.
- Schneider, T., T. Bischoff, and G. H. Haug, 2014: Migrations and dynamics of the intertropical convergence zone. *Nature*, **513**, 45–53, doi:10.1038/nature13636.
- Schneider, U., A. Becker, P. Finger, A. Meyer-Christoffer, and M. Ziese, 2015: GPCC Monitoring Product: Near Real-Time Monthly Land-Surface Precipitation From Rain-Gauges Based on SYNOP and CLIMAT Data. Global Precipitation Climatology Centre (GPCC), Ed., Deutscher Wetterdienst, doi:10.5676/DWD_GPCC/MP_M_V5_100.
- Schofield, O., L. Newman, P. Bricher, A. Constable, S. Swart, and A. Wählén, 2016: Moving towards implementation of a Southern Ocean observing system. *Mar. Technol. Soc. J.*, **50** (3), 63–68, doi:10.4031/MTSJ.50.3.8.
- Schreck, C. J., 2015: Kelvin waves and tropical cyclogenesis: A global survey. *Mon. Wea. Rev.*, **143**, 3996–4011, doi:10.1175/mwr-d-15-0111.1.
- , 2016: Convectively coupled Kelvin waves and tropical cyclogenesis in a semi-Lagrangian framework. *Mon. Wea. Rev.*, **144**, 4131–4139, doi:10.1175/mwr-d-16-0237.1.
- , and J. Molinari, 2011: Tropical cyclogenesis associated with Kelvin waves and the Madden-Julian oscillation. *Mon. Wea. Rev.*, **139**, 2723–2734, doi:10.1175/mwr-d-10-05060.1.
- , —, and A. Aiyer, 2012: A global view of equatorial waves and tropical cyclogenesis. *Mon. Wea. Rev.*, **140**, 774–788, doi:10.1175/mwr-d-11-00110.1.
- , J. M. Cordeira, and D. Margolin, 2013: Which MJO events affect North American temperatures? *Mon. Wea. Rev.*, **141**, 3840–3850, doi:10.1175/mwr-d-13-00118.1.
- , K. R. Knapp, and J. P. Kossin, 2014: The impact of best track discrepancies on global tropical cyclone climatologies using IBTrACS. *Mon. Wea. Rev.*, **142**, 3881–3899, doi:10.1175/mwr-d-14-00021.1.
- Schuur, E. A. G., and Coauthors, 2008: Vulnerability of permafrost carbon to climate change: Implications for the global carbon cycle. *BioScience*, **58**, 701–714, doi:10.1641/B580807.
- , and Coauthors, 2013: Expert assessment of vulnerability of permafrost carbon to climate change. *Climatic Change*, **119**, 359–374, doi:10.1007/s10584-013-0730-7.
- , and Coauthors, 2015: Climate change and the permafrost carbon feedback. *Nature*, **520**, 171–179, doi:10.1038/nature14338.
- Schwietzke, S., and Coauthors, 2016: Upward revision of global fossil fuel methane emissions based on isotope database. *Nature*, **538**, 88–91, doi:10.1038/nature19797.
- Seddon, A. W. R., M. Macias-Fauria, P. R. Long, D. Benz, and K. J. Willis, 2016: Sensitivity of global terrestrial ecosystems to climate variability. *Nature*, **531**, 229–232, doi:10.1038/nature16986.
- Semiletov, I., and Coauthors, 2016: Acidification of East Siberian Arctic shelf waters through addition of freshwater and terrestrial carbon. *Nat. Geosci.*, **9**, 361–365, doi:10.1038/ngeo2695.
- Send, U., M. Lankhorst, and T. Kanzow, 2011: Observation of decadal change in the Atlantic meridional overturning circulation using 10 years of continuous transport data. *Geophys. Res. Lett.*, **38**, L24606, doi:10.1029/2011GL049801.
- Serreze, M. C., A. D. Crawford, J. C. Stroeve, A. P. Barrett, and R. A. Woodgate, 2016: Variability, trends, and predictability of seasonal sea ice retreat and advance in the Chukchi Sea. *J. Geophys. Res. Oceans*, **121**, 7308–7325, doi:10.1002/2016JC011977.
- Shay, L. K., G. J. Goni, and P. G. Black, 2000: Effects of a warm oceanic feature on Hurricane Opal. *Mon. Wea. Rev.*, **128**, 1366–1383, doi:10.1175/1520-0493(2000)128<1366:eoawof>2.0.co;2.
- Sherwood, S. C., and N. Nishant, 2015: Atmospheric changes through 2012 as shown by iteratively homogenized radiosonde temperature and wind data (IUKv2). *Environ. Res. Lett.*, **10**, 054007, doi:10.1088/1748-9326/10/5/054007.
- Shi, L., and J. J. Bates, 2011: Three decades of intersatellite-calibrated high-resolution infrared radiation sounder upper tropospheric water vapor. *J. Geophys. Res.*, **116**, D04108, doi:10.1029/2010JD014847.
- Siegel, D. A., S. Maritorena, N. B. Nelson, M. J. Behrenfeld, and C. R. McClain, 2005: Colored dissolved organic matter and its influence on the satellite-based characterization of the ocean biosphere. *Geophys. Res. Lett.*, **32**, L20605, doi:10.1029/2005GL024310.
- , and Coauthors, 2012: Global ocean phytoplankton [in “State of the Climate in 2011”]. *Bull. Amer. Meteor. Soc.*, **93** (7), S89–S92, doi:10.1175/2012BAMSStateoftheClimate.1.
- , and Coauthors, 2013: Regional to global assessments of phytoplankton dynamics from the SeaWiFS mission. *Remote Sens. Environ.*, **135**, 77–91, doi:10.1016/j.rse.2013.03.025.
- Simmonds, I., 2015: Comparing and contrasting the behaviour of Arctic and Antarctic sea ice over the 35 year period 1979–2013. *Ann. Glaciol.*, **56**, 18–28, doi:10.3189/2015AoG69A909.

- Simmons, A. J., and P. Poli, 2015: Arctic warming in ERA-Interim and other analyses. *Quart. J. Roy. Meteor. Soc.*, **141**, 1147–1162, doi:10.1002/qj.2422.
- , K. M. Willett, P. D. Jones, P. W. Thorne, and D. P. Dee, 2010: Low-frequency variations in surface atmospheric humidity, temperature, and precipitation: Inferences from reanalyses and monthly gridded observational data sets. *J. Geophys. Res.*, **115**, D01110, doi:10.1029/2009JD012442.
- , P. Berrisford, D. P. Dee, H. Hersbach, S. Hirahara, and J. N. Thépaut, 2017: A reassessment of temperature variations and trends from global reanalyses and monthly surface climatological datasets. *Quart. J. Roy. Meteor. Soc.*, **143**, 101–119, doi:10.1002/qj.2949.
- Singh, O. P., T. M. Ali Khan, and M. S. Rahman, 2000: Changes in the frequency of tropical cyclones over the north Indian Ocean. *Meteor. Atmos. Phys.*, **75**, 11–20, doi:10.1007/s007030070011.
- Skliris, N., R. Marsh, S. A. Josey, S. A. Good, C. Liu, and R. P. Allan, 2014: Salinity changes in the World Ocean since 1950 in relation to changing surface freshwater fluxes. *Climate Dyn.*, **43**, 709–736, doi:10.1007/s00382-014-2131-7.
- Slade, S. A., and E. D. Maloney, 2013: An intraseasonal prediction model of Atlantic and east Pacific tropical cyclone genesis. *Mon. Wea. Rev.*, **141**, 1925–1942, doi:10.1175/mwr-d-12-00268.1.
- Smeed, D. A., G. D. McCarthy, D. Rayner, B. I. Moat, W. E. Johns, M. O. Baringer, and C. S. Meinen, 2015: Atlantic Meridional Overturning Circulation Observed by the RAPID-MOCHA-WBTS (RAPID-Meridional Overturning Circulation and Heatflux Array-Western Boundary Time Series) Array at 26°N From 2004 to 2014. British Oceanographic Data Centre–Natural Environment Research Council, doi:10.6qb. [Available online at http://www.bodc.ac.uk/data/published_data_library/catalogue/10.5285/1a774e53-7383-2e9a-e053-6c86abc0d8c7/.]
- Smith, S. (L.), and J. Brown, 2009: Assessment of the status of the development of the standards for the Terrestrial Essential Climate Variables (T7): Permafrost and seasonally frozen ground. Global Terrestrial Observing System Rep. 62, 24 pp. [Available online at <http://www.fao.org/gtos/doc/ecvs/t07/t07.pdf>.]
- , A. G. Lewkowicz, C. Duchesne, and M. Ednie, 2015: Variability and change in permafrost thermal state in northern Canada. *Proc. 68th Canadian Geotechnical Conf. and Seventh Canadian Conf. on Permafrost (GEOQuébec 2015)*, Quebec, Canada, GEOQuébec 2015, Paper 237.
- , J. Chartrand, C. Duchesne, and M. Ednie, 2016: Report on 2015 field activities and collection of ground thermal and active layer data in the Mackenzie Corridor, Northwest Territories. Geological Survey of Canada Open File 8125, 133 pp. [Available online at <http://dx.doi.org/10.4095/299296>.]
- Smith, T. M., and R. W. Reynolds, 1998: A high-resolution global sea surface temperature climatology for the 1961–90 base period. *J. Climate*, **11**, 3320–3323, doi:10.1175/1520-0442(1998)011<3320:ahrgss>2.0.co;2.
- , —, T. C. Peterson, and J. Lawrimore, 2008: Improvements to NOAA's historical merged land–ocean surface temperature analysis (1880–2006). *J. Climate*, **21**, 2283–2296, doi:10.1175/2007jcli2100.1.
- Smol, J. P., and M. S. V. Douglas, 2007: Crossing the final ecological threshold in high Arctic ponds. *Proc. Natl. Acad. Sci. USA*, **104**, 12,395–12,397, doi:10.1073/pnas.0702777104.
- , and Coauthors, 2005: Climate-driven regime shifts in the biological communities of Arctic lakes. *Proc. Natl. Acad. Sci. USA*, **102**, 4397–4402, doi:10.1073/pnas.0500245102.
- Solomon, S., J. S. Daniel, R. R. Neely, J.-P. Vernier, E. G. Dutton, and L. W. Thomason, 2011: The persistently variable “background” stratospheric aerosol layer and global climate change. *Science*, **333**, 866–870, doi:10.1126/science.1206027.
- , D. J. Ivy, D. Kinnison, M. J. Mills, R. R. Neely, and A. Schmidt, 2016: Emergence of healing in the Antarctic ozone layer. *Science*, **353**, 269–274, doi:10.1126/science.aae0061.
- Solorzano, N. N., J. N. Thomas, and R. H. Holzworth, 2008: Global studies of tropical cyclones using the world wide lightning location network. *Third Conf. Meteorological Applications of Lightning Data*, New Orleans, LA, Amer. Meteor. Soc. [Available online at <http://ams.confex.com/ams/88Annual/webprogram/Paper134367.html>.]
- Song, J.-J., Y. Wang, and L. Wu, 2010: Trend discrepancies among three best track data sets of western North Pacific tropical cyclones. *J. Geophys. Res.*, **115**, D12128, doi:10.1029/2009JD013058.
- Soruco, A., C. Vincent, A. Rabatel, B. Francou, E. Thibert, J. E. Sicart, and T. Condom, 2015: Contribution of glacier runoff to water resources of La Paz city, Bolivia (16°S). *Ann. Glaciol.*, **56**, 147–154, doi:10.3189/2015AoG70A001.
- SPARC, 2016: SPARC Report on the mystery of carbon tetrachloride. SPARC Report No. 7, WCRP-13/2016, 52 pp. [Available online at <http://www.sparc-climate.org/publications/sparc-reports/sparc-report-no7>.]
- Spencer, R. W., J. R. Christy, and W. D. Braswell, 2017: UAH Version 6 global satellite temperature products: Methodology and results. *Asia-Pacific J. Atmos. Sci.*, **53**, 121–130, doi:10.1007/s13143-017-0010-y.
- Spreen, G., L. Kaleschke, and G. Heygster, 2008: Sea ice remote sensing using AMSR-E 89-GHz channels. *J. Geophys. Res.*, **113**, C02s03, doi:10.1029/2005JC003384.

- Srokosz, M. A., and H. L. Bryden, 2015: Observing the Atlantic meridional overturning circulation yields a decade of inevitable surprises. *Science*, **348**, 1255575, doi:10.1126/science.1255575.
- , and Coauthors, 2012: Past, present, and future changes in the Atlantic meridional overturning circulation. *Bull. Amer. Meteor. Soc.*, **93**, 1663–1676, doi:10.1175/bams-d-11-00151.1.
- Stackhouse, P. W., D. P. Kratz, G. R. McGarragh, S. K. Gupta, and E. B. Geier, 2006: Fast longwave and shortwave radiative flux (FLASHFlux) products from CERES and MODIS measurements. *Proc. 12th Conf. Atmospheric Radiation*, Madison, WI, Amer. Meteor. Soc., P1.10. [Available online at <http://ams.confex.com/ams/pdffpapers/113479.pdf>.]
- , T. Wong, D. P. Kratz, P. Sawaengphokhai, A. C. Wiber, S. K. Gupta, and N. G. Loeb, 2016: Earth radiation budget at top-of-atmosphere [in “State of the Climate in 2015”]. *Bull. Amer. Meteor. Soc.*, **97** (8), S41–S43, doi:10.1175/2016BAMSStateoftheClimate.1.
- Stammerjohn, S. (E.), Ed., 2016: Antarctica [in “State of the Climate in 2015”]. *Bull. Amer. Meteor. Soc.*, **97** (8), S155–S172, doi:10.1175/2016BAMSStateoftheClimate.1.
- , D. G. Martinson, R. C. Smith, X. Yuan, and D. Rind, 2008: Trends in Antarctic annual sea ice retreat and advance and their relation to El Niño–Southern Oscillation and southern annular mode variability. *J. Geophys. Res.*, **113**, C03S90, doi:10.1029/2007JC004269.
- Steele, L. J., S. R. Lewis, M. R. Patel, F. Montmessin, F. Forget, and M. D. Smith, 2014: The seasonal cycle of water vapour on Mars from assimilation of thermal emission spectrometer data. *Icarus*, **237**, 97–115, doi:10.1016/j.icarus.2014.04.017.
- Steinbrecht, W., and Coauthors, 2009: Ozone and temperature trends in the upper stratosphere at five stations of the network for the detection of atmospheric composition change. *Int. J. Remote Sens.*, **30**, 3875–3886, doi:10.1080/01431160902821841.
- Steneck, R. S., and R. A. Wahle, 2013: American lobster dynamics in a brave new ocean. *Canadian J. Fish. Aquatic Sci.*, **70**, 1612–1624, doi:10.1139/cjfas-2013-0094.
- Strahan, S. E., A. R. Douglass, P. A. Newman, and S. D. Steenrod, 2014: Inorganic chlorine variability in the Antarctic vortex and implications for ozone recovery. *J. Geophys. Res. Atmos.*, **119**, 14,098–14,109, doi:10.1002/2014JD022295.
- , L. D. Oman, A. R. Douglass, and L. Coy, 2015: Modulation of Antarctic vortex composition by the quasi-biennial oscillation. *Geophys. Res. Lett.*, **42**, 4216–4223, doi:10.1002/2015GL063759.
- Strauss, J., L. Schirrmeister, G. Grosse, S. Wetterich, M. Ulrich, U. Herzschuh, and H.-W. Hubberten, 2013: The deep permafrost carbon pool of the Yedoma region in Siberia and Alaska. *Geophys. Res. Lett.*, **40**, 6165–6170, doi:10.1002/2013GL058088.
- Stroh, J. N., G. Panteleev, S. Kirillov, M. Makhotin, and N. Shakhova, 2015: Sea-surface temperature and salinity product comparison against external in situ data in the Arctic Ocean. *J. Geophys. Res. Oceans*, **120**, 7223–7236, doi:10.1002/2015JC011005.
- Su, Z., 2002: The surface energy balance system (SEBS) for estimation of turbulent heat fluxes. *Hydrol. Earth Syst. Sci.*, **6**, 85–100, doi:10.5194/hess-6-85-2002.
- Sudo, K., and M. Takahashi, 2001: Simulation of tropospheric ozone changes during 1997–1998 El Niño: Meteorological impact on tropospheric photochemistry. *Geophys. Res. Lett.*, **28**, 4091–4094, doi:10.1029/2001GL013335.
- Sun, L., and Coauthors, 2016: Significant increase of summertime ozone at Mount Tai in central eastern China. *Atmos. Chem. Phys.*, **16**, 10,637–10,650, doi:10.5194/acp-16-10637-2016.
- Sun, W., P. Hess, and B. Tian, 2014: The response of the equatorial tropospheric ozone to the Madden–Julian Oscillation in TES satellite observations and CAM-chem model simulation. *Atmos. Chem. Phys.*, **14**, 11,775–11,790, doi:10.5194/acp-14-11775-2014.
- Sweet, W. V., and J. Park, 2014: From the extreme to the mean: Acceleration and tipping points of coastal inundation from sea level rise. *Earth’s Future*, **2**, 579–600, doi:10.1002/2014EF000272.
- , —, J. J. Marra, C. Zervas, and S. Gill, 2014: Sea level rise and nuisance flood frequency changes around the United States. NOAA Tech. Rep. NOS CO-OPS 73, 58 pp. [Available online at http://tidesandcurrents.noaa.gov/publications/NOAA_Technical_Report_NOS_COOPS_073.pdf.]
- , M. Menendez, A. Genz, J. Obeysekera, J. Park, and J. J. Marra, 2016: In tide’s way: Southeast Florida’s September 2015 sunny-day flood [in “Explaining Extreme Events of 2015 From a Climate Perspective”]. *Bull. Amer. Meteor. Soc.*, **97** (12), S25–S30, doi:10.1175/bams-d-16-0117.1.
- Takala, M., and Coauthors, 2011: Estimating Northern Hemisphere snow water equivalent for climate research through assimilation of space-borne radiometer data and ground-based measurements. *Remote Sens. Environ.*, **115**, 3517–3529, doi:10.1016/j.rse.2011.08.014.
- Talmage, S. C., and C. J. Gobler, 2010: Effects of past, present, and future ocean carbon dioxide concentrations on the growth and survival of larval shellfish. *Proc. Natl. Acad. Sci. USA*, **107**, 17,246–17,251, doi:10.1073/pnas.0913804107.

- Tanskanen, A., A. Arola, and J. Kujanpaa, 2003: Use of the moving time-window technique to determine surface albedo from TOMS reflectivity data. *Proc. SPIE*, **4896**, 239–250, doi:10.1117/12.483407.
- Tapley, B. D., S. Bettadpur, J. C. Ries, P. F. Thompson, and M. M. Watkins, 2004: GRACE measurements of mass variability in the Earth system. *Science*, **305**, 503–505, doi:10.1126/science.1099192.
- Tarnocai, C., J. G. Canadell, E. A. G. Schuur, P. Kuhry, G. Mazhitova, and S. Zimov, 2009: Soil organic carbon pools in the northern circumpolar permafrost region. *Global Biogeochem. Cycles*, **23**, GB2023, doi:10.1029/2008GB003327.
- Taylor, C. C., H. B. Bigelow, and H. W. Graham, 1957: Climatic trends and the distribution of marine animals in New England. *Fisheries Bull.*, **57** (115), 293–345.
- Tedesco, M., 2009: Assessment and development of snow-melt retrieval algorithms over Antarctica from K-band spaceborne brightness temperature (1979–2008). *Remote Sens. Environ.*, **113**, 979–997, doi:10.1016/j.rse.2009.01.009.
- , and A. J. Monaghan, 2009: An updated Antarctic melt record through 2009 and its linkages to high-latitude and tropical climate variability. *Geophys. Res. Lett.*, **36**, L18502, doi:10.1029/2009GL039186.
- , X. Fettweis, T. Mote, J. Wahr, P. Alexander, J. E. Box, and B. Wouters, 2013: Evidence and analysis of 2012 Greenland records from spaceborne observations, a regional climate model and reanalysis data. *Cryosphere*, **7**, 615–630, doi:10.5194/tc-7-615-2013.
- , and Coauthors, 2016a: Greenland ice sheet. *Arctic Report Card 2016*, NOAA's Arctic Program, various paging. [Available online at <http://www.arctic.noaa.gov/Report-Card/Report-Card-2016>.]
- , and Coauthors, 2016b: Greenland ice sheet [in "State of the Climate in 2015"]. *Bull. Amer. Meteor. Soc.*, **97** (8), S140–S142, doi:10.1175/2016BAMSStateoftheClimate.1.
- , and Coauthors, 2016c: Arctic cut-off high drives the poleward shift of a new Greenland melting record. *Nat. Comm.*, **7**, 11723, doi:10.1038/ncomms11723.
- Teng, W.-H., C.-Y. Huang, S.-P. Ho, Y.-H. Kuo, and X.-J. Zhou, 2013: Characteristics of global precipitable water in ENSO events revealed by COSMIC measurements. *J. Geophys. Res. Atmos.*, **118**, 8411–8425, doi:10.1002/jgrd.50371.
- Thackeray, C., C. Fletcher, L. Mudryk, and C. Derksen, 2016: Quantifying the uncertainty in historical and future simulations of Northern Hemisphere spring snow cover. *J. Climate*, **29**, 8647–8663, doi:10.1175/jcli-d-16-0341.1.
- Thompson, P. R., M. A. Merrifield, J. R. Wells, and C. M. Chang, 2014: Wind-driven coastal sea level variability in the northeast Pacific. *J. Climate*, **27**, 4733–4751, doi:10.1175/jcli-d-13-00225.1.
- , C. G. Piecuch, M. A. Merrifield, J. P. McCreary, and E. Firing, 2016: Forcing of recent decadal variability in the equatorial and north Indian Ocean. *J. Geophys. Res. Oceans*, **121**, 6762–6778, doi:10.1002/2016JC012132.
- Thomson, L., M. Zemp, L. Copland, J. Cogley, and M. Ecclestone, 2017: Comparison of geodetic and glaciological mass budgets for White Glacier, Axel Heiberg Island, Canada. *J. Glaciol.*, **63**, 55–66, doi:10.1017/jog.2016.112.
- Tilling, R. L., A. Ridout, A. Shepherd, and D. J. Wingham, 2015: Increased Arctic sea ice volume after anomalously low melting in 2013. *Nat. Geosci.*, **8**, 643–646, doi:10.1038/ngeo2489.
- Timmermans, M.-L., and A. Proshutinsky, 2015: Sea surface temperature [in "State of the Climate in 2014"]. *Bull. Amer. Meteor. Soc.*, **96** (7), S147–S148, doi:10.1175/2015BAMSSStateoftheClimate.1.
- , and —, 2016: Sea surface temperature [in "State of the Climate in 2015"]. *Bull. Amer. Meteor. Soc.*, **97** (8), S137–S138, doi:10.1175/2016BAMSSStateoftheClimate.1.
- Tippett, M. K., S. J. Camargo, and A. H. Sobel, 2011: A Poisson regression index for tropical cyclone genesis and the role of large-scale vorticity in genesis. *J. Climate*, **24**, 2335–2357, doi:10.1175/2010jcli3811.1.
- Torbick, N., B. Ziniti, S. Wu, and E. Linder, 2016: Spatio-temporal lake skin summer temperature trends in the northeast United States. *Earth Interact.*, **20** (25), 1–21, doi:10.1175/ ei-d-16-0015.1.
- Trenberth, K. E., A. Dai, R. M. Rasmusson, and D. B. Parsons, 2003: The changing character of precipitation. *Bull. Amer. Meteor. Soc.*, **84**, 1205–1217, doi:10.1175/bams-84-9-1205.
- Trepte, Q. Z., P. Minnis, C. R. Trepte, S. Sun-Mack, and R. Brown, 2010: Improved cloud detection in CERES edition 3 algorithm and comparison with the CALIPSO vertical feature mask. *Proc. 13th Conf. Atmospheric Radiation and Cloud Physics*, Portland, OR, Amer. Meteor. Soc., JP1.32.
- Tschudi, M., C. Fowler, J. Maslanik, and J. Stroeve, 2010: Tracking the movement and changing surface characteristics of Arctic sea ice. *IEEE J. Sel. Topics Appl. Earth Obs. Remote Sens.*, **3**, 536–540, doi:10.1109/JSTARS.2010.2048305.
- , —, and —, 2015: EASE-Grid Sea Ice Age, Version 2. National Snow and Ice Data Center, doi:10.5067/1UQJWCYPVX61.
- Turner, J., and Coauthors, 2004: The SCAR READER project: Toward a high-quality database of mean Antarctic meteorological observations. *J. Climate*, **17**, 2890–2898, doi:10.1175/1520-0442(2004)017<2890:tsrpta>2.0.co;2.
- , and Coauthors, 2016: Absence of 21st century warming on Antarctic Peninsula consistent with natural variability. *Nature*, **535**, 411–415, doi:10.1038/nature18645.

- Tweedy, O. V., and Coauthors, 2017: Response of trace gases to the disrupted 2015–2016 quasi-biennial oscillation. *Atmos. Chem. Phys.*, **17**, 6813–6823, doi:10.5194/acp-17-6813-2017.
- van As, D., R. S. Fausto, J. Cappelen, R. S. W. Van de Wal, R. J. Braithwaite, H. Machguth, and PROMICE project team, 2016: Placing Greenland ice sheet ablation measurements in a multi-decadal context. *Geol. Surv. Denmark Greenland Bull.* **35**, 71–74 pp. [Available online at http://www.geus.dk/DK/publications/geol-survey-dk-gl-bull/35/Documents/nr35_p71-74.pdf.]
- van de Wal, R. S. W., W. Greuell, M. R. van den Broeke, C. H. Reijmer, and J. Oerlemans, 2005: Surface mass-balance observations and automatic weather station data along a transect near Kangerlussuaq, West Greenland. *Ann. Glaciol.*, **42**, 311–316, doi:10.3189/172756405781812529.
- , W. Boot, C. J. P. P. Smeets, H. Snellen, M. R. van den Broeke, and J. Oerlemans, 2012: Twenty-one years of mass balance observations along the K-transect, West Greenland. *Earth Syst. Sci. Data*, **4**, 31–35, doi:10.5194/essd-4-31-2012.
- van der A, R. J., M. A. F. Allaart, and H. J. Eskes, 2015: Extended and refined multi sensor reanalysis of total ozone for the period 1970–2012. *Atmos. Meas. Tech.*, **8**, 3021–3035, doi:10.5194/amt-8-3021-2015.
- van der Schrier, G., J. Barichivich, K. R. Briffa, and P. D. Jones, 2013a: A scPDSI-based global data set of dry and wet spells for 1901–2009. *J. Geophys. Res. Atmos.*, **118**, 4025–4048, doi:10.1002/jgrd.50355.
- , E. J. M. van den Besselaar, A. M. G. Klein Tank, and G. Verver, 2013b: Monitoring European average temperature based on the E-OBS gridded data set. *J. Geophys. Res. Atmos.*, **118**, 5120–5135, doi:10.1002/jgrd.50444.
- , J. Barichivich, I. Harris, P. D. Jones, and T. J. Osborn, 2015: Monitoring global drought using the self-calibrating Palmer Drought Severity Index [in “State of the Climate in 2014”]. *Bull. Amer. Meteor. Soc.*, **96** (7), S30–S31, doi:10.1175/2015BAMSStateoftheClimate.1.
- van der Werf, G. R., and Coauthors, 2010: Global fire emissions and the contribution of deforestation, savanna, forest, agricultural, and peat fires (1997–2009). *Atmos. Chem. Phys.*, **10**, 11,707–11,735, doi:10.5194/acp-10-11707-2010.
- Vautard, R., J. Cattiaux, P. Yiou, J.-N. Thepaut, and P. Ciais, 2010: Northern Hemisphere atmospheric stilling partly attributed to an increase in surface roughness. *Nat. Geosci.*, **3**, 756–761, doi:10.1038/ngeo979.
- Velders, G. J. M., S. O. Andersen, J. S. Daniel, D. W. Fahey, and M. McFarland, 2007: The importance of the Montreal Protocol in protecting climate. *Proc. Natl. Acad. Sci. USA*, **104**, 4814–4819, doi:10.1073/pnas.0610328104.
- Velicogna, I., T. C. Sutterley, and M. R. van den Broeke, 2014: Regional acceleration in ice mass loss from Greenland and Antarctica using GRACE time-variable gravity data. *Geophys. Res. Lett.*, **41**, 8130–8137, doi:10.1002/2014GL061052.
- Ventrice, M. J., C. D. Thorncroft, and M. A. Janiga, 2012a: Atlantic tropical cyclogenesis: A three-way interaction between an African easterly wave, diurnally varying convection, and a convectively coupled atmospheric Kelvin wave. *Mon. Wea. Rev.*, **140**, 1108–1124, doi:10.1175/mwr-d-11-00122.1.
- , —, and C. J. Schreck, III, 2012b: Impacts of convectively coupled Kelvin waves on environmental conditions for Atlantic tropical cyclogenesis. *Mon. Wea. Rev.*, **140**, 2198–2214, doi:10.1175/mwr-d-11-00305.1.
- Vernier, J. P., and Coauthors, 2011: Major influence of tropical volcanic eruptions on the stratospheric aerosol layer during the last decade. *Geophys. Res. Lett.*, **38**, L12807, doi:10.1029/2011GL047563.
- Vicente-Serrano, S. M., S. Beguería, and J. I. López-Moreno, 2010: A multiscalar drought index sensitive to global warming: The standardized precipitation evapotranspiration index. *J. Climate*, **23**, 1696–1718, doi:10.1175/2009jcli2909.1.
- Vieira, G., and Coauthors, 2016: Thermal state of permafrost and recent active layer dynamics in the South Shetlands, Antarctica. *XI. Int. Conf. Permafrost*, Potsdam, Germany, Bibliothek Wissenschaftspark Albert Einstein.
- Vigouroux, C., and Coauthors, 2015: Trends of ozone total columns and vertical distribution from FTIR observations at eight NDACC stations around the globe. *Atmos. Chem. Phys.*, **15**, 2915–2933, doi:10.5194/acp-15-2915-2015.
- Vimont, D. J., and J. P. Kossin, 2007: The Atlantic meridional mode and hurricane activity. *Geophys. Res. Lett.*, **34**, L07709, doi:10.1029/2007GL029683.
- Vincent, D. G., 1994: The South Pacific convergence zone (SPCZ): A review. *Mon. Wea. Rev.*, **122**, 1949–1970, doi:10.1175/1520-0493(1994)122<1949:tspcza>2.0.co;2.
- Vinukollu, R. K., R. Meynadier, J. Sheffield, and E. F. Wood, 2011: Multi-model, multi-sensor estimates of global evapotranspiration: Climatology, uncertainties and trends. *Hydrol. Proc.*, **25**, 3993–4010, doi:10.1002/hyp.8393.
- Vivier, F., D. Iudicone, F. Busdraghi, and Y.-H. Park, 2010: Dynamics of sea-surface temperature anomalies in the Southern Ocean diagnosed from a 2D mixed-layer model. *Climate Dyn.*, **34**, 153–184, doi:10.1007/s00382-009-0724-3.
- Von Storch, H., and F. W. Zwiers, 1999: *Statistical Analysis in Climate Research*. Cambridge University Press, 484 pp.

- Voulgarakis, A., P. Hadjinicolaou, and J. A. Pyle, 2011: Increases in global tropospheric ozone following an El Niño event: Examining stratospheric ozone variability as a potential driver. *Atmos. Sci. Lett.*, **12**, 228–232, doi:10.1002/asl.318.
- Wagner, W., W. Dorigo, R. d. Jeu, D. Fernandez-Prieto, J. Benveniste, E. Haas, and M. Ertl, 2012: Fusion of active and passive microwave observations to create an essential climate variable data record on soil moisture. *Proc. XXIII SPRS Congress*, Melbourne, Australia, Intl. Society for Photogrammetry and Remote Sensing, doi:10.5194/isprsannals-I-5197-5315-2012.
- Waliser, D. E., and C. Gautier, 1993: A satellite-derived climatology of the ITCZ. *J. Climate*, **6**, 2162–2174, doi:10.1175/1520-0442(1993)006<2162:asd>2.0.co;2.
- Walsh, J. E., P. A. Bieniek, B. Brettschneider, E. S. Euskirchen, R. Lader, and R. L. Thoman, 2017: The exceptionally warm winter of 2015/16 in Alaska. *J. Climate*, **30**, 2069–2088, doi:10.1175/jcli-d-16-0473.1.
- Walter Anthony, K. M., and Coauthors, 2014: A shift of thermokarst lakes from carbon sources to sinks during the Holocene epoch. *Nature*, **511**, 452–456, doi:10.1038/nature13560.
- Walter, K. M., M. E. Edwards, G. Grosse, S. A. Zimov, and F. S. Chapin III, 2007: Thermokarst lakes as a source of atmospheric CH₄ during the last deglaciation. *Science*, **318**, 633–636, doi:10.1126/science.1142924.
- Wan, H., X. L. Wang, and V. R. Swail, 2010: Homogenization and trend analysis of Canadian near-surface wind speeds. *J. Climate*, **23**, 1209–1225, doi:10.1175/2009jcli3200.1.
- Wang, B., and J. Chan, 2002: How strong ENSO events affect tropical storm activity over the western North Pacific. *J. Climate*, **15**, 1643–1658, doi:10.1175/1520-0442(2002)015<1643:hseat>2.0.co;2.
- , and Q. Ding, 2008: Global monsoon: Dominant mode of annual variation in the tropics. *Dyn. Atmos. Oceans*, **44**, 165–183, doi:10.1016/j.dynatmoe.2007.05.002.
- , J. Liu, H.-J. Kim, P. J. Webster, and S.-Y. Yim, 2012: Recent change of the global monsoon precipitation (1979–2008). *Climate Dyn.*, **39**, 1123–1135, doi:10.1007/s00382-011-1266-z.
- Wang, C., 2015: Atlantic warm pool [in “State of the Climate in 2014”]. *Bull. Amer. Meteor. Soc.*, **96** (7), S123–S124, doi:10.1175/2015BAMSStateoftheClimate.1.
- Wang, G., Y. Li, Y. Wang, and Q. Wu, 2008: Effects of permafrost thawing on vegetation and soil carbon pool losses on the Qinghai-Tibet Plateau, China. *Geoderma*, **143**, 143–152, doi:10.1016/j.geoderma.2007.10.023.
- Wang, J., L. Zhang, A. Dai, T. Van Hove, and J. Van Baelen, 2007: A near-global, 2-hourly data set of atmospheric precipitable water from ground-based GPS measurements. *J. Geophys. Res.*, **112**, D11107, doi:10.1029/2006JD007529.
- , A. Dai, and C. Mears, 2016: Global water vapor trend from 1988 to 2011 and its diurnal asymmetry based on GPS, radiosonde, and microwave satellite measurements. *J. Climate*, **29**, 5205–5222, doi:10.1175/jcli-d-15-0485.1.
- Wang, S., X. Mo, S. Liu, Z. Lin, and S. Hu, 2016: Validation and trend analysis of ECV soil moisture data on cropland in North China Plain during 1981–2010. *Int. J. Appl. Earth Obs. Geoinf.*, **48**, 110–121, doi:10.1016/j.jag.2015.10.010.
- Wang, T., L. Xue, P. Brimblecombe, Y. F. Lam, L. Li, and L. Zhang, 2017: Ozone pollution in China: A review of concentrations, meteorological influences, chemical precursors, and effects. *Sci. Total Environ.*, **575**, 1582–1596, doi:10.1016/j.scitotenv.2016.10.081.
- Wanninkhof, R., 2014: Relationship between wind speed and gas exchange over the ocean revisited. *Limnol. Oceanogr.: Methods*, **12**, 351–362, doi:10.4319/lom.2014.12.351.
- , and J. Triñanes, 2017: The impact of changing wind speeds on gas transfer and its effect on global air-sea CO₂ fluxes. *Global Biogeochem. Cycles*, **31**, 961–974, doi:10.1002/2016GB005592.
- Weatherhead, B., A. Tanskanen, and A. Stevermer, 2005: Ozone and ultraviolet radiation. *Arctic Climate Impact Assessment*, Cambridge University Press, 151–182.
- Weber, M., and Coauthors, 2011: The Brewer-Dobson circulation and total ozone from seasonal to decadal time scales. *Atmos. Chem. Phys.*, **11**, 11,221–11,235, doi:10.5194/acp-11-11221-2011.
- Wells, N., S. Goddard, and M. J. Hayes, 2004: A self-calibrating Palmer drought severity index. *J. Climate*, **17**, 2335–2351, doi:10.1175/1520-0442(2004)017<2335:aspdsi>2.0.co;2.
- Wentz, F. J., 1997: A well-calibrated ocean algorithm for special sensor microwave / imager. *J. Geophys. Res.*, **102**, 8703–8718, doi:10.1029/96JC01751.
- , L. Ricciardulli, K. Hilburn, and C. Mears, 2007: How much more rain will global warming bring? *Science*, **317**, 233–235, doi:10.1126/science.1140746.
- Wever, N., 2012: Quantifying trends in surface roughness and the effect on surface wind speed observations. *J. Geophys. Res.*, **117**, D11104, doi:10.1029/2011JD017118.
- WGMS, 2015: Global Glacier Change Bulletin No. 1 (2012–2013). M. Zemp et al., Eds., World Glacier Monitoring Service, 230 pp.
- , cited 2017: Latest glacier mass balance data, World Glacier Monitoring Service. [Available online at <http://wgms.ch/latest-glacier-mass-balance-data/>.]
- Wheeler, M. C., and G. N. Kiladis, 1999: Convectively coupled equatorial waves: Analysis of clouds and temperature in the wavenumber-frequency domain. *J. Atmos. Sci.*, **56**, 374–399, doi:10.1175/1520-0469(1999)056<0374:ccewao>2.0.co;2.

- , and H. H. Hendon, 2004: An all-season real-time multivariate MJO index: Development of an index for monitoring and prediction. *Mon. Wea. Rev.*, **132**, 1917–1932, doi:10.1175/1520-0493(2004)132<1917:aarmmi>2.0.co;2.
- WHO, 2002: Global solar UV index: A practical guide. WHO/SDE/OEH/02.2, 28 pp. [Available online at <http://www.who.int/uv/publications/en/GlobalUVI.pdf>.]
- , 2013: Review of evidence on health aspects of air pollution – REVIHAAP project: Final technical report. 302 pp. [Available online at http://www.euro.who.int/__data/assets/pdf_file/0004/193108/REVIHAAP-Final-technical-report-final-version.pdf?ua=1.]
- Widlansky, M. J., A. Timmermann, S. McGregor, M. F. Stuecker, and W. Cai, 2014: An interhemispheric tropical sea level seesaw due to El Niño taimasa. *J. Climate*, **27**, 1070–1081, doi:10.1175/jcli-d-13-00276.1.
- Wielicki, B. A., B. R. Barkstrom, E. F. Harrison, R. B. Lee III, G. L. Smith, and J. E. Cooper, 1996: Clouds and the Earth's radiant energy system (CERES): An Earth observing system experiment. *Bull. Amer. Meteor. Soc.*, **77**, 853–868, doi:10.1175/1520-0477(1996)077<0853:catere>2.0.co;2.
- , and Coauthors, 1998: Clouds and the Earth's radiant energy system (CERES): Algorithm overview. *IEEE Trans. Geosci. Remote Sens.*, **36**, 1127–1141, doi:10.1109/36.701020.
- Wijffels, S., D. Roemmich, D. Monselesan, J. Church, and J. Gilson, 2016: Ocean temperatures chronicle the ongoing warming of Earth. *Nat. Climate Change*, **6**, 116–118, doi:10.1038/nclimate2924.
- Wild, J. D., S.-K. Yang, and C. S. Long, 2016: Ozone profile trends: An SBUV/2 perspective. *Quadrennial Ozone Symp. 2016*, Edinburgh, United Kingdom, QOS2016-2133.
- Wilks, D., 2011: *Statistical Methods in the Atmospheric Sciences*. 3rd ed. Vol. 100, International Geophysics, Academic Press, 704 pp.
- Willett, K. M., P. D. Jones, N. P. Gillett, and P. W. Thorne, 2008: Recent changes in surface humidity: Development of the HadCRUH dataset. *J. Climate*, **21**, 5364–5383, doi:10.1175/2008jcli2274.1.
- , and Coauthors, 2013: HadISDH: An updateable land surface specific humidity product for climate monitoring. *Climate Past*, **9**, 657–677, doi:10.5194/cp-9-657-2013.
- , and Coauthors, 2014: HadISDH land surface multi-variable humidity and temperature record for climate monitoring. *Climate Past*, **10**, 1983–2006, doi:10.5194/cp-10-1983-2014.
- Willis, J. K., 2010: Can in situ floats and satellite altimeters detect long-term changes in Atlantic Ocean overturning? *Geophys. Res. Lett.*, **37**, L06602, doi:10.1029/2010GL042372.
- , D. Roemmich, and B. Cornuelle, 2004: Interannual variability in upper ocean heat content, temperature, and thermosteric expansion on global scales. *J. Geophys. Res.*, **109**, C12036, doi:10.1029/2003JC002260.
- Winker, D. M., W. H. Hunt, and M. J. McGill, 2007: Initial performance assessment of CALIOP. *Geophys. Res. Lett.*, **34**, L19803, doi:10.1029/2007GL030135.
- WMO, 2014: Scientific assessment of ozone depletion, 2014. Global Ozone Research and Monitoring Project—Report No. 55, various pp. [Available online at http://www.wmo.int/pages/prog/gaw/ozone_2014/ozone_asst_report.html.]
- WMO, 2017: WMO Statement on the state of the global climate in 2016. WMO 1189, World Meteorological Organization, 24 pp. [Available online at https://library.wmo.int/opac/doc_num.php?explnum_id=3414.]
- WMO-GNR, 2017: German national report. *10th meeting of WMO/UNEP Ozone Research Managers*, Geneva, Switzerland, DWD Hohenpeissenberg, 23 pp. [Available online at http://conf.montreal-protocol.org/meeting/orm/10orm/presession/SiteAssets/Germany_National_Report_2017.pdf.]
- Wolter, K., and M. S. Timlin, 1993: Monitoring ENSO in COADS with a seasonally adjusted principal component index. *Proc. 17th Climate Diagnostics Workshop*, Norman, OK, NOAA/NMC/CAC, NSSL, Oklahoma Climate Survey, CIMMS, and the School of Meteor., Univ. of Oklahoma, 52–57.
- , and —, 1998: Measuring the strength of ENSO events: How does 1997/98 rank? *Weather*, **53**, 315–324, doi:10.1002/j.1477-8696.1998.tb06408.x.
- Woods, C., and R. Caballero, 2016: The role of moist intrusions in winter Arctic warming and sea ice decline. *J. Climate*, **29**, 4473–4485, doi:10.1175/jcli-d-15-0773.1.
- Woolway, R. I., and Coauthors, 2016: Lake surface temperatures [in “State of the Climate in 2015”]. *Bull. Amer. Meteor. Soc.*, **97** (8), S17–S18, doi:10.1175/2016BAMSStateoftheClimate.1.
- Woosley, R. J., F. J. Millero, and R. Wanninkhof, 2016: Rapid anthropogenic changes in CO₂ and pH in the Atlantic Ocean: 2003–2014. *Global Biogeochem. Cycles*, **30**, 70–90, doi:10.1002/2015GB005248.
- Worden, H. M., and Coauthors, 2013: Decadal record of satellite carbon monoxide observations. *Atmos. Chem. Phys.*, **13**, 837–850, doi:10.5194/acp-13-837-2013.
- Wu, J., J. Zha, and D. Zhao, 2016: Estimating the impact of the changes in land use and cover on the surface wind speed over the East China Plain during the period 1980–2011. *Climate Dyn.*, **46**, 847–863, doi:10.1007/s00382-015-2616-z.

- Wu, Lia., Z. Wen, R. Huang, and R. Wu, 2012: Possible linkage between the monsoon trough variability and the tropical cyclone activity over the western North Pacific. *Mon. Wea. Rev.*, **140**, 140–150, doi:10.1175/mwr-d-11-00078.1.
- Wu, Lix., and Coauthors, 2012: Enhanced warming over the global subtropical western boundary currents. *Nat. Climate Change*, **2**, 161–166, doi:10.1038/nclimate1353.
- Wu, M.-C., K.-H. Yeung, and W.-L. Chang, 2006: Trends in western North Pacific tropical cyclone intensity. *Eos, Trans. Amer. Geophys. Union*, **87**, 537–538, doi:10.1029/2006EO480001.
- Wylie, D., D. L. Jackson, W. P. Menzel, and J. J. Bates, 2005: Trends in global cloud cover in two decades of HIRS observations. *J. Climate*, **18**, 3021–3031, doi:10.1175/jcli3461.1.
- Xie, P., and P. A. Arkin, 1997: Global precipitation: A 17-year monthly analysis based on gauge observations, satellite estimates, and numerical model outputs. *Bull. Amer. Meteor. Soc.*, **78**, 2539–2558, doi:10.1175/1520-0477(1997)078<2539:gpayma>2.0.co;2.
- , and Coauthors, 2014: An in situ-satellite blended analysis of global sea surface salinity. *J. Geophys. Res. Oceans*, **119**, 6140–6160, doi:10.1002/2014JC010046.
- Xie, S.-P., Y. Kosaka, and Y. M. Okumura, 2016: Distinct energy budgets for anthropogenic and natural changes during global warming hiatus. *Nat. Geosci.*, **9**, 29–33, doi:10.1038/ngeo2581.
- Xu, G., T. J. Osborn, A. J. Matthews, and M. M. Joshi, 2016: Different atmospheric moisture divergence responses to extreme and moderate El Niños. *Climate Dyn.*, **47**, 393–410, doi:10.1007/s00382-015-2844-2.
- Xu, H., 2006: Modification of normalised difference water index (NDWI) to enhance open water features in remotely sensed imagery. *Int. J. Remote Sens.*, **27**, 3025–3033, doi:10.1080/01431160600589179.
- Xu, M., C.-P. Chang, C. Fu, Y. Qi, A. Robock, D. Robinson, and H.-M. Zhang, 2006: Steady decline of East Asian monsoon winds, 1969–2000: Evidence from direct ground measurements of wind speed. *J. Geophys. Res.*, **111**, D24111, doi:10.1029/2006JD007337.
- Xu, W., W. Lin, X. Xu, J. Tang, J. Huang, H. Wu, and X. Zhang, 2016: Long-term trends of surface ozone and its influencing factors at the Mt. Waliguan GAW station, China – Part 1: Overall trends and characteristics. *Atmos. Chem. Phys.*, **16**, 6191–6205, doi:10.5194/acp-16-6191-2016.
- Xue, Y., and A. Kumar, 2016: Evolution of the 2015/16 El Niño and historical perspective since 1979. *Sci. China: Earth Sci.*, **First Online**, 1–17, doi:10.1007/s11430-016-0106-9.
- , Z.-Z. Hu, A. Kumar, V. Banzon, B. Huang, and J. Kennedy, 2016: Sea surface temperatures [in “State of the Climate in 2015”]. *Bull. Amer. Meteor. Soc.*, **97** (8), S63–S66, doi:10.1175/2016BAMSStateoftheClimate.1.
- Yashayaev, I., and J. W. Loder, 2016: Recurrent replenishment of Labrador Sea Water and associated decadal-scale variability. *J. Geophys. Res. Oceans*, **121**, 8095–8114, doi:10.1002/2016JC012046.
- Yim, S.-Y., B. Wang, J. Liu, and Z. Wu, 2014: A comparison of regional monsoon variability using monsoon indices. *Climate Dyn.*, **43**, 1423–1437, doi:10.1007/s00382-013-1956-9.
- Yin, Y., F. Chevallier, P. Ciais, G. Broquet, A. Fortems-Cheiney, I. Pison, and M. Saunois, 2015: Decadal trends in global CO emissions as seen by MOPITT. *Atmos. Chem. Phys.*, **15**, 13,433–13,451, doi:10.5194/acp-15-13433-2015.
- Ying, M., E.-J. Cha, and H. J. Kwon, 2011: Comparison of three western North Pacific tropical cyclone best track datasets in a seasonal context. *J. Meteor. Soc. Japan*, **89**, 211–224, doi:10.2151/jmsj.2011-303.
- Young, P. J., and Coauthors, 2013: Pre-industrial to end 21st century projections of tropospheric ozone from the atmospheric chemistry and climate model intercomparison project (ACCMIP). *Atmos. Chem. Phys.*, **13**, 2063–2090, doi:10.5194/acp-13-2063-2013.
- Yu, H., Y. Lu, P.-Y. Chen, and W.-C. Zhou, 2012: Intensity change characteristics of tropical cyclones in the western North Pacific as revealed by three different datasets. *J. Trop. Meteor.*, **18**, 119–126, doi:10.3969/j.issn.1006-8775.2012.02.002.
- Yu, L., 2011: A global relationship between the ocean water cycle and near-surface salinity. *J. Geophys. Res.*, **116**, C10025, doi:10.1029/2010JC006937.
- , and X. Jin, 2012: Buoy perspective of a high-resolution global ocean vector wind analysis constructed from passive radiometers and active scatterometers (1987–present). *J. Geophys. Res.*, **117**, C11013, doi:10.1029/2012JC008069.
- , and —, 2014: Insights on the OAFlux ocean surface vector wind analysis merged from scatterometers and passive microwave radiometers (1987 onward). *J. Geophys. Res. Oceans*, **119**, 5244–5269, doi:10.1002/2013JC009648.
- Zemp, M., and Coauthors, 2015: Historically unprecedented global glacier decline in the early 21st century. *J. Glaciol.*, **61** (228), 745–762. [Available online at <https://www.igsoc.org/journal/61/228/j15j017.pdf>.]
- Zeng, N., 1999: Seasonal cycle and interannual variability in the Amazon hydrologic cycle. *J. Geophys. Res.*, **104**, 9097–9106, doi:10.1029/1998JD200088.
- Zhang, C., 2005: Madden–Julian oscillation. *Rev. Geophys.*, **43**, RG2003, doi:10.1029/2004RG000158.
- , 2013: Madden–Julian oscillation: Bridging weather and climate. *Bull. Amer. Meteor. Soc.*, **94**, 1849–1870, doi:10.1175/bams-d-12-00026.1.
- , and J. Gottschalck, 2002: SST anomalies of ENSO and the Madden–Julian oscillation in the equatorial Pacific. *J. Climate*, **15**, 2429–2445, doi:10.1175/1520-0442(2002)015<2429:saoeat>2.0.co;2.

- Zhang, X., and J. A. Church, 2012: Sea level trends, interannual and decadal variability in the Pacific Ocean. *Geophys. Res. Lett.*, **39**, L21701, doi:10.1029/2012GL053240.
- , and Coauthors, 2011: Indices for monitoring changes in extremes based on daily temperature and precipitation data. *Wiley Interdiscip. Rev.: Climate Change*, **2**, 851–870, doi:10.1002/wcc.147.
- Zhang, Yo., and Coauthors, 2016: Multi-decadal trends in global terrestrial evapotranspiration and its components. *Sci. Rep.*, **6**, 19124, doi:10.1038/srep19124.
- Zhang, Y., J. M. Wallace, and D. S. Battisti, 1997: ENSO-like interdecadal variability: 1900–93. *J. Climate*, **10**, 1004–1020, doi:10.1175/1520-0442(1997)010<1004:eliv>2.0.co;2.
- Zhang, Yu., O. R. Cooper, A. Gaudel, A. M. Thompson, P. Nedelec, S.-Y. Ogino, and J. J. West, 2016: Tropospheric ozone change from 1980 to 2010 dominated by equatorward redistribution of emissions. *Nat. Geosci.*, **9**, 875–879, doi:10.1038/ngeo2827.
- Zhao, H., K. Higuchi, J. Waller, H. Auld, and T. Mote, 2013: The impacts of the PNA and NAO on annual maximum snowpack over southern Canada during 1979–2009. *Int. J. Climatol.*, **33**, 388–395, doi:10.1002/joc.3431.
- Zheng, Z.-W., I. I. Lin, B. Wang, H.-C. Huang, and C.-H. Chen, 2015: A long neglected damper in the El Niño–typhoon relationship: A ‘Gaia-like’ process. *Sci. Rep.*, **5**, 11103, doi:10.1038/srep11103.
- Ziemke, J. R., and O. R. Cooper, 2016: Tropospheric ozone [in “State of the Climate in 2015”]. *Bull. Amer. Meteor. Soc.*, **97** (8), S73–S75, doi:10.1175/2016BAMSStateoftheClimate.1.
- , S. Chandra, and P. K. Bhartia, 1998: Two new methods for deriving tropospheric column ozone from TOMS measurements: Assimilated UARS MLS/HALOE and convective-cloud differential techniques. *J. Geophys. Res.*, **103**, 22,115–22,127, doi:10.1029/98JD01567.
- , S. Chandra, B. N. Duncan, L. Froidevaux, P. K. Bhartia, P. F. Levelt, and J. W. Waters, 2006: Tropospheric ozone determined from Aura OMI and MLS: Evaluation of measurements and comparison with the Global Modeling Initiative’s Chemical Transport Model. *J. Geophys. Res.*, **111**, D19303, doi:10.1029/2006JD007089.
- , A. R. Douglass, L. D. Oman, S. E. Strahan, and B. N. Duncan, 2015: Tropospheric ozone variability in the tropics from ENSO to MJO and shorter timescales. *Atmos. Chem. Phys.*, **15**, 8037–8049, doi:10.5194/acp-15-8037-2015.
- Zilberman, N., and G. Maze, 2015: Report on the Deep Argo implementation workshop. Ifremer Doc. LPO-15-04, 36 pp. [Available online at <http://archimer.ifremer.fr/doc/00281/39238/37799.pdf>.]
- Zimov, S. A., E. A. G. Schuur, and F. S. Chapin III, 2006: Permafrost and the global carbon budget. *Science*, **312**, 1612–1613, doi:10.1126/science.1128908
- Zou, C.-Z., and W. Wang, 2010: Stability of the MSU-derived atmospheric temperature trend. *J. Atmos. Oceanic Technol.*, **27**, 1960–1971, doi:10.1175/2009jtecha1333.1.
- Zwally, J. H., and S. Fiegles, 1994: Extent and duration of Antarctic surface melting. *J. Glaciol.*, **40**, 463–475, doi:10.3198/1994JoG40-136-463-375.
- Zweng, M. M., and Coauthors, 2013: Salinity. Vol. 2, World Ocean Atlas 2013, NOAA Atlas NESDIS 74, 40 pp. [Available online at <http://www.nodc.noaa.gov/OC5/woa13/>.]

