

Dr. Benjamin M. Sanderson

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Professional Experience

2018–	Research Scientist (PI, RISCCI), CERFACS, Toulouse, France
2018–	Affiliate Scientist, National Center for Atmospheric Research, Boulder CO, USA
2016–2018	Project Scientist II, National Center for Atmospheric Research
2011–2016	Project Scientist I, National Center for Atmospheric Research
2008–2011	Postgraduate Scientist, National Center for Atmospheric Research

Education

2004–2007	DPhil Atmospheric Science, Oxford University, 2007
2003–2004	MPhys in Atmospheric and GeoPhysics, Oxford University (1st Hons), UK, 2004
2000–2003	BSc Physics (1st Hons), Oxford University.

Scientific Output (as of 1/1/2021)

Number of publications: 54 (20 first author)

Citations 4406

h-index 36

Supervision and leadership

- 2019- Supervisor for Saloua Peatier, Doctoral Student at CERFACS, Toulouse France
- PhD co-Supervisor of Nadja Herger, PhD (UNSW) (2015-2017)
- Supervisor of Alexandra Jonko, post-doc, NCAR (2012-2015)
- co-Supervisor of Elias Shiferaw, PhD student from Addis Ababa University studying future river flow in Ethiopia (2013-2015)

Recent Grants and Fellowships

- EU H2020 "ESM2025", funded December 2020, CT lead on "Improving IAM-ESM land use representation" (EUR 3m section of EUR 12m project, multi-institution project)
- EU H2020 "PROVIDE", funded December 2020, institutional partner (EUR 10m, multi-institution project)
- French National Research Agency "RISCCI" - (EUR 1m, PI 5 year individual project)
- US-Department of Energy "CATALYST" - WP lead on Scenarios and Uncertainty Quantification (5 years, USD 10m, institutional project)

National and International leadership

- Lead Author for US Climate Science Special Report 2016-2017.
- Co-author for ScenarioMIP/CMIP6 experimental design 2015-2017
- "Make Our Planet Great Again" laureate, Agence nationale de la recherche, France, 2018
- Steering Committee MESH Human-Earth System working group 2019-present
- Contributing author and reviewer for the 6th Assessment Report of the IPCC
- Associate Editor, 'Journal of Climate' and 'Atmosphere'

Publications

1. Claudia Tebaldi, Kevin Debeire, Veronika Eyring, Erich Fischer, John Fyfe, Pierre Friedlingstein, Reto Knutti, Jason Lowe, Brian O'Neill, Benjamin Sanderson, et al. Climate model projections from the scenario model intercomparison project (scenariomip) of cmip6. *Earth System Dynamics*, 12(1):253–293, 2021
2. Peter Uhe, Dann Mitchell, Paul D Bates, Myles R Allen, Richard A Betts, Chris Huntingford, Andrew D King, Benjamin M Sanderson, and Hideo Shiogama. Method uncertainty is essential for reliable confidence statements of precipitation projections. *Journal of Climate*, 34(3):1227–1240, 2021
3. Katherine Dagon, Benjamin M Sanderson, Rosie A Fisher, and David M Lawrence. A machine learning approach to emulation and biophysical parameter estimation with the community land model, version 5. *Advances in Statistical Climatology, Meteorology and Oceanography*, 6(2):223–244, 2020
4. Benjamin M. Sanderson. The role of prior assumptions in carbon budget calculations. *Earth Syst. Dyn.*, 11(2):563–577, Jun 2020
5. Benjamin M Sanderson and Brian C O'Neill. Assessing the costs of historical inaction on climate change. *Scientific reports*, 10(1):1–12, 2020
6. Benjamin M. Sanderson and Rosie A. Fisher. A fiery wake-up call for climate science. *Nat. Clim. Change*, 10(3):175–177, Feb 2020
7. Katherine Dagon, Benjamin M Sanderson, Rosie A Fisher, and David M Lawrence. A machine learning approach to emulation and biophysical parameter estimation with the community land model, version 5. *Advances in Statistical Climatology, Meteorology and Oceanography*, 6(2):223–244, 2020

8. Benjamin M. Sanderson. Relating climate sensitivity indices to projection uncertainty. *Earth System Dynamics*, 11(3):721–735, 2020
9. Benjamin Sanderson. The End of the Wait for Climate Sensitivity? *Geophys. Res. Lett.*, 46(21):12289–12292, Nov 2019
10. Benjamin M. Sanderson, Cameron Wobus, Dave Mills, Claire Zarakas, Allison Crimmins, Marcus C. Sarofim, and Chris Weaver. Informing Future Risks of Record-Level Rainfall in the United States. *Geophys. Res. Lett.*, 46(7):3963–3972, Apr 2019
11. Stefano Castruccio, Ziqing Hu, Benjamin Sanderson, Alicia Karspeck, and Dorit Hammerling. Reproducing Internal Variability with Few Ensemble Runs. *J. Clim.*, 32(24):8511–8522, Dec 2019
12. David M. Lawrence, Rosie A. Fisher, Charles D. Koven, Keith W. Oleson, Sean C. Swenson, Gordon Bonan, Nathan Collier, Bardan Ghimire, Leo van Kampenhout, Daniel Kennedy, Erik Kluzek, Peter J. Lawrence, Fang Li, Hongyi Li, Danica Lombardozzi, William J. Riley, William J. Sacks, Mingjie Shi, Mariana Vertenstein, William R. Wieder, Chonggang Xu, Ashehad A. Ali, Andrew M. Badger, Gautam Bisht, Michiel van den Broeke, Michael A. Brunke, Sean P. Burns, Jonathan Buzan, Martyn Clark, Anthony Craig, Kyla Dahlin, Beth Drewniak, Joshua B. Fisher, Mark Flanner, Andrew M. Fox, Pierre Gentine, Forrest Hoffman, Gretchen Keppel-Aleks, Ryan Knox, Sanjiv Kumar, Jan Lenaerts, L. Ruby Leung, William H. Lipscomb, Yaqiong Lu, Ashutosh Pandey, Jon D. Pelletier, Justin Perket, James T. Randerson, Daniel M. Ricciuto, Benjamin M. Sanderson, Andrew Slater, Zachary M. Subin, Jinyun Tang, R. Quinn Thomas, Maria Val Martin, and Xubin Zeng. The Community Land Model Version 5: Description of New Features, Benchmarking, and Impact of Forcing Uncertainty. *J. Adv. Model. Earth Syst.*, 11(12):4245–4287, Dec 2019
13. Rosie A. Fisher, William R. Wieder, Benjamin M. Sanderson, Charles D. Koven, Keith W. Oleson, Chonggang Xu, Joshua B. Fisher, Mingjie Shi, Anthony P. Walker, and David M. Lawrence. Parametric Controls on Vegetation Responses to Biogeochemical Forcing in the CLM5. *J. Adv. Model. Earth Syst.*, 11(9):2879–2895, Sep 2019
14. Veronika Eyring, Peter M. Cox, Gregory M. Flato, Peter J. Gleckler, Gab Abramowitz, Peter Caldwell, William D. Collins, Bettina K. Gier, Alex D. Hall, Forrest M. Hoffman, George C. Hurtt, Alexandra Jahn, Chris D. Jones, Stephen A. Klein, John P. Krasting, Lester Kwiatkowski, Ruth Lorenz, Eric Maloney, Gerald A. Meehl, Angeline G. Pendergrass, Robert Pincus, Alex C. Ruane, Joellen L. Russell, Benjamin M. Sanderson, Benjamin D. Santer, Steven C. Sherwood, Isla R. Simpson, Ronald J. Stouffer, and Mark S. Williamson. Taking climate model evaluation to the next level. *Nat. Clim. Change*, 9(2):102–110, Jan 2019
15. C. Wobus, C. Zarakas, P. Malek, B. Sanderson, A. Crimmins, M. Kolian, M. Sarofim, and C. P. Weaver. Reframing Future Risks of Extreme Heat in the United States. *Earth’s Future*, 6(9):1323–1335, Sep 2018
16. Travis Aeronson, Claudia Tebaldi, Ben Sanderson, and Jean-François Lamarque. Changes in a suite of indicators of extreme temperature and precipitation under 1.5 and 2 degrees warming. *Environ. Res. Lett.*, 13(3):035009, Mar 2018
17. Brian C. O’Neill, James M. Done, Andrew Gettelman, Peter Lawrence, Flavio Lehner, Jean-Francois Lamarque, Lei Lin, Andrew J. Monaghan, Keith Oleson, Xiaolin Ren, Benjamin M. Sanderson, Claudia Tebaldi, Matthias Weitzel, Yangyang Xu, Brooke Anderson, Miranda J. Fix, and Samuel Levis. The Benefits of Reduced Anthropogenic Climate change (BRACE): a synthesis. *Clim. Change*, 146(3):287–301, Feb 2018
18. Flavio Lehner, Clara Deser, and Benjamin M. Sanderson. Future risk of record-breaking summer temperatures and its mitigation. *Clim. Change*, 146(3):363–375, Feb 2018

19. Yangyang Xu, Jean-François Lamarque, and Benjamin M. Sanderson. The importance of aerosol scenarios in projections of future heat extremes. *Clim. Change*, 146(3):393–406, Feb 2018
20. K. W. Oleson, G. B. Anderson, B. Jones, S. A. McGinnis, and B. Sanderson. Avoided climate impacts of urban and rural heat and cold waves over the U.S. using large climate model ensembles for RCP8.5 and RCP4.5. *Clim. Change*, 146(3):377–392, Feb 2018
21. Michael Wehner, D Stone, Dann Mitchell, Hideo Shiogama, Erich Fischer, Lise S. Graff, Viatcheslav V. Kharin, Ludwig Lierhammer, Benjamin Sanderson, and Harinarayan Krishnan. Changes in extremely hot days under stabilized 1.5 and 2.0C global warming scenarios as simulated by the HAPPI multi-model ensemble. *Earth Syst. Dyn.*, 9(1):299–311, Mar 2018
22. Nadja Herger, Gab Abramowitz, Reto Knutti, Oliver Angéllil, Karsten Lehmann, and Benjamin M. Sanderson. Selecting a climate model subset to optimise key ensemble properties. *Earth Syst. Dyn.*, 9(1):135–151, Feb 2018
23. Angeline G. Pendergrass, Reto Knutti, Flavio Lehner, Clara Deser, and Benjamin M. Sanderson. Precipitation variability increases in a warmer climate. *Sci. Rep.*, 7(17966):1–9, Dec 2017
24. Benjamin M. Sanderson, Michael Wehner, and Reto Knutti. Skill and independence weighting for multi-model assessments. *Geosci. Model Dev.*, 10(6):2379–2395, Jun 2017
25. Benjamin M. Sanderson, Yangyang Xu, Claudia Tebaldi, Michael Wehner, Brian O’Neill, Alexandra Jahn, Angeline G. Pendergrass, Flavio Lehner, Warren G. Strand, Lei Lin, Reto Knutti, and Jean Francois Lamarque. Community climate simulations to assess avoided impacts in 1.5 and 2.0C futures. *Earth Syst. Dyn.*, 8(3):827–847, Sep 2017
26. Flavio Lehner, Sloan Coats, Thomas F. Stocker, Angeline G. Pendergrass, Benjamin M. Sanderson, Christoph C. Raible, and Jason E. Smerdon. Projected drought risk in 1.5C and 2C warmer climates. *Geophys. Res. Lett.*, 44(14):7419–7428, Jul 2017
27. Brian C. O’Neill, James M. Done, Andrew Gettelman, Peter Lawrence, Flavio Lehner, Jean-Francois Lamarque, Lei Lin, Andrew J. Monaghan, Keith Oleson, Xiaolin Ren, Benjamin M. Sanderson, Claudia Tebaldi, Matthias Weitzel, Yangyang Xu, Brooke Anderson, Miranda J. Fix, and Samuel Levis. The Benefits of Reduced Anthropogenic Climate change (BRACE): a synthesis. *Clim. Change*, 146(3):287–301, Feb 2018
28. Benjamin M. Sanderson, Brian C. O’Neill, and Claudia Tebaldi. What would it take to achieve the Paris temperature targets? *Geophys. Res. Lett.*, 43(13):7133–7142, Jul 2016
29. Reto Knutti, Jan Sedláček, Benjamin M. Sanderson, Ruth Lorenz, Erich M. Fischer, and Veronika Eyring. A climate model projection weighting scheme accounting for performance and interdependence. *Geophys. Res. Lett.*, 44(4):1909–1918, Feb 2017
30. Benjamin M. Sanderson and Reto Knutti. Delays in US mitigation could rule out Paris targets. *Nat. Clim. Change*, 7(2):92–94, Dec 2016
31. Allison H. Baker, Dorit M. Hammerling, Sheri A. Mickelson, Haiying Xu, Martin B. Stolpe, Phillipe Naveau, Ben Sanderson, Imme Ebert-Uphoff, Savini Samarasinghe, Francesco De Simone, Francesco Carbone, Christian N. Gencarelli, John M. Dennis, Jennifer E. Kay, and Peter Lindstrom. Evaluating lossy data compression on climate simulation data within a large ensemble. *Geosci. Model Dev.*, 9(12):4381–4403, Dec 2016
32. Brian C. O’Neill, Claudia Tebaldi, Detlef P. van Vuuren, Veronika Eyring, Pierre Friedlingstein, George Hurtt, Reto Knutti, Elmar Kriegler, Jean-Francois Lamarque, Jason Lowe, Gerald A. Meehl, Richard Moss, Keywan Riahi, and Benjamin M. Sanderson. The Scenario Model Intercomparison Project (ScenarioMIP) for CMIP6. *Geosci. Model Dev.*, 9(9):3461–3482, Sep 2016

33. S. Tilmes, B. M. Sanderson, and B. C. O'Neill. Climate impacts of geoengineering in a delayed mitigation scenario. *Geophys. Res. Lett.*, 43(15):8222–8229, Aug 2016
34. Benjamin M. Sanderson, Reto Knutti, and Peter Caldwell. A Representative Democracy to Reduce Interdependency in a Multimodel Ensemble. *J. Clim.*, 28(13):5171–5194, Jul 2015
35. Angeline G. Pendergrass, Flavio Lehner, Benjamin M. Sanderson, and Yangyang Xu. Does extreme precipitation intensity depend on the emissions scenario? *Geophys. Res. Lett.*, 42(20):8767–8774, Oct 2015
36. Benjamin M. Sanderson, Reto Knutti, and Peter Caldwell. Addressing Interdependency in a Multimodel Ensemble by Interpolation of Model Properties. *J. Clim.*, 28(13):5150–5170, Jul 2015
37. Nadja Herger, Benjamin M. Sanderson, and Reto Knutti. Improved pattern scaling approaches for the use in climate impact studies. *Geophys. Res. Lett.*, 42(9):3486–3494, May 2015
38. Peter M. Caldwell, Christopher S. Bretherton, Mark D. Zelinka, Stephen A. Klein, Benjamin D. Santer, and Benjamin M. Sanderson. Statistical significance of climate sensitivity predictors obtained by data mining. *Geophys. Res. Lett.*, 41(5):1803–1808, Mar 2014
39. Gerald A. Meehl, Warren M. Washington, Julie M. Arblaster, Aixue Hu, Haiyan Teng, Jennifer E. Kay, Andrew Gettelman, David M. Lawrence, Benjamin M. Sanderson, and Warren G. Strand. Climate Change Projections in CESM1(CAM5) Compared to CCSM4. *J. Clim.*, 26(17):6287–6308, Sep 2013
40. Benjamin M. Sanderson. On the estimation of systematic error in regression-based predictions of climate sensitivity. *Clim. Change*, 118(3):757–770, Jun 2013
41. Alexandra K. Jonko, Karen M. Shell, Benjamin M. Sanderson, and Gokhan Danabasoglu. Climate Feedbacks in CCSM3 under Changing CO₂ Forcing. Part II: Variation of Climate Feedbacks and Sensitivity with Forcing. *J. Clim.*, 26(9):2784–2795, May 2013
42. Benjamin M. Sanderson and Karen M. Shell. Model-Specific Radiative Kernels for Calculating Cloud and Noncloud Climate Feedbacks. *J. Clim.*, 25(21):7607–7624, Nov 2012
43. Benjamin M. Sanderson and Reto Knutti. On the interpretation of constrained climate model ensembles. *Geophys. Res. Lett.*, 39(16), Aug 2012
44. Gerald A. Meehl, Aixue Hu, Claudia Tebaldi, Julie M. Arblaster, Warren M. Washington, Haiyan Teng, Benjamin M. Sanderson, Toby Ault, Warren G. Strand, and James B. White. Relative outcomes of climate change mitigation related to global temperature versus sea-level rise. *Nat. Clim. Change*, 2(8):576–580, Jul 2012
45. Alexandra K. Jonko, Karen M. Shell, Benjamin M. Sanderson, and Gokhan Danabasoglu. Climate Feedbacks in CCSM3 under Changing CO₂ Forcing. Part I: Adapting the Linear Radiative Kernel Technique to Feedback Calculations for a Broad Range of Forcings. *J. Clim.*, 25(15):5260–5272, Aug 2012
46. Gerald A. Meehl, Warren M. Washington, Julie M. Arblaster, Aixue Hu, Haiyan Teng, Claudia Tebaldi, Benjamin N. Sanderson, Jean-Francois Lamarque, Andrew Conley, Warren G. Strand, and James B. White. Climate System Response to External Forcings and Climate Change Projections in CCSM4. *J. Clim.*, 25(11):3661–3683, Jun 2012
47. Daniel J. Rowlands, David J. Frame, Duncan Ackerley, Tolu Aina, Ben B. B. Booth, Carl Christensen, Matthew Collins, Nicholas Faull, Chris E. Forest, Benjamin S. Grandey, Edward Gryspeerdt, Eleanor J. Highwood, William J. Ingram, Sylvia Knight, Ana Lopez, Neil Massey,

Frances McNamara, Nicolai Meinshausen, Claudio Piani, Suzanne M. Rosier, Benjamin M. Sanderson, Leonard A. Smith, Dáithí A. Stone, Milo Thurston, Kuniko Yamazaki, Y. Hiro Yamazaki, and Myles R. Allen. Broad range of 2050 warming from an observationally constrained large climate model ensemble. *Nat. Geosci.*, 5(4):256–260, Mar 2012

48. Erich M. Fischer, David M. Lawrence, and Benjamin M. Sanderson. Quantifying uncertainties in projections of extremes—a perturbed land surface parameter experiment. *Clim. Dyn.*, 37(7):1381–1398, Oct 2011
49. Benjamin M. Sanderson, Brian C. O’Neill, Jeffrey T. Kiehl, Gerald A. Meehl, Reto Knutti, and Warren M. Washington. The response of the climate system to very high greenhouse gas emission scenarios. *Environ. Res. Lett.*, 6(3):034005, Jul 2011
50. Benjamin M. Sanderson. A Multimodel Study of Parametric Uncertainty in Predictions of Climate Response to Rising Greenhouse Gas Concentrations. *J. Clim.*, 24(5):1362–1377, Mar 2011
51. Benjamin M. Sanderson, Karen M. Shell, and William Ingram. Climate feedbacks determined using radiative kernels in a multi-thousand member ensemble of AOGCMs. *Clim. Dyn.*, 35(7):1219–1236, Dec 2010
52. Benjamin M. Sanderson, R. Knutti, T. Aina, C. Christensen, N. Faull, D. J. Frame, W. J. Ingram, C. Piani, D. A. Stainforth, D. A. Stone, and M. R. Allen. Constraints on Model Response to Greenhouse Gas Forcing and the Role of Subgrid-Scale Processes. *J. Clim.*, 21(11):2384–2400, Jun 2008
53. Benjamin M. Sanderson, C. Piani, W. J. Ingram, D. A. Stone, and M. R. Allen. Towards constraining climate sensitivity by linear analysis of feedback patterns in thousands of perturbed-physics GCM simulations. *Clim. Dyn.*, 30(2):175–190, Feb 2008
54. C. Piani, B. Sanderson, F. Giorgi, D. J. Frame, C. Christensen, and M. R. Allen. Regional probabilistic climate forecasts from a multithousand, multimodel ensemble of simulations. *J. Geophys. Res. Atmos.*, 112(D24), Dec 2007
55. Christopher G. Knight, Sylvia H. E. Knight, Neil Massey, Tolu Aina, Carl Christensen, Dave J. Frame, Jamie A. Kettleborough, Andrew Martin, Stephen Pascoe, Ben Sanderson, David A. Stainforth, and Myles R. Allen. Association of parameter, software, and hardware variation with large-scale behavior across 57,000 climate models. *Proc. Natl. Acad. Sci. U.S.A.*, 104(30):12259–12264, Jul 2007

Book Chapters

1. Benjamin M. Sanderson. Uncertainty quantification in multi-model ensembles. In *Oxford Research Encyclopedia of Climate Science*. Oxford University Press, 2018
2. Ben Sanderson and Reto Knutti. Climate change projections: Characterizing uncertainty using climate models. In *Encyclopedia of Sustainability Science and Technology*, pages 235–259. Springer, 2012

Recent Invited Talks

- MPI Hamburg, March 2020 ”Constraining climate response on long timescales: is there a risk of extended warming after net zero emissions?” (awaiting post-COVID reschedule)
- ETH Zurich, March 2020 ”Detection of response to greenhouse gas forcing on a range of timescales” (awaiting post-COVID reschedule)

- National Center for Atmospheric Research, July 2019 "Towards robust carbon budgeting"
- UK Met Office, June 2019 "Does the post-industrial temperature record constrain future warming?"
- Meteo France, January 2019 "A practical approach for estimating climate feedbacks on multiple timescales"
- AAAS, Austin, Texas 2018: "Scenario Projections in the Fourth U.S. National Climate Assessment"
- The International Detection and Attribution Group (IDAG), Berkeley CA, March 2018, "Rethinking Optimal Fingerprinting"
- DLR, Munich, Germany, December 2017 "Emergent constraints on aerosol forcing"
- U.S. State Department, December 2016 "Uncertainty in Projections of Climate"
- AGU invited talks: 2018, 2017, 2015, 2014, 2012, 2011
- Invited speaker at ETH Zurich (2008,2010,2013), University of Edinburgh (2011), Oxford University (2010),IUGG (2012), University of Texas (2011), University of Washington (2012), SIAM (2014), Los Alamos National Lab (2013), Lawrence Livermore National Lab (2014), IUGG (2011)

Teaching Experience

- Lecturer in 2017 NCAR Summer workshop: 'The interaction of precipitation with orography (IPRO)'
- Lecturer NCAR CESM tutorial, NCAR - 2016: model calibration and uncertainty
- Lecturer in CMIP Analysis Workshop, NCAR, 2016
- Lecturer NCAR CESM tutorial, NCAR - 2015: land/atmosphere interactions
- Lecturer in NCAR workshop 'UNCERTAINTY IN CLIMATE CHANGE RESEARCH: AN INTEGRATED APPROACH', NCAR 2014
- Masters course Tutor (Atmospheric Physics Module), Lincoln College Oxford, 2007-2008