

# Mark Richardson

Jet Propulsion Laboratory, M/S 233-300, 4800 Oak Grove Drive,  
Pasadena, CA 91101, U.S.A.

**Tel:** 818-354-4270      **e-mail:** markr@jpl.nasa.gov

## Research Interests

I am interested in the large scale societal impacts and attribution of climate change, remote sensing, climate feedbacks and public communication. My current research is in satellite measurements of clouds and precipitation and relating these to climate change.

## Employment and Internships

- |                   |  |
|-------------------|--|
| Jan 2018–present  | <b>NASA JPL/UCLA JIFRESSE - Research Assistant II</b><br>I am continuing work with OCO-2 A-band cloud property retrievals and applied climate research.  |
| Jan 2015–Jan 2018 | <b>NASA JPL/Caltech - Postdoctoral Scholar</b><br>I developed a cloud-thickness retrieval using multiple satellites including OCO-2, analysed of climate models and satellite data for application to climate feedbacks and climate sensitivity. |
| Feb–May 2014      | <b>Parliamentary Office of Science and Technology - NERC Fellow</b><br>I produced a note on the scientific and technical issues associated with the UN Reducing Emissions from Deforestation and Forest Degradation scheme.                      |

## Education

- |           |   |
|-----------|---|
| 2010–2014 | <b>University of Reading (PhD)</b><br>Snow Observations and Modelling. Supervisor: Professor Robert Gurney.<br>Funded by NERC NCEO studentship.<br><br>My PhD combined fieldwork in northern Scandinavia with computer modelling of snow to help improve satellite retrievals of snow mass. |
| 2006–2010 | <b>University of Durham (MPhys)</b><br>Master of Physics, Classification: First (Hons.) Masters project in current-voltage characteristics of cadmium telluride photovoltaic cells.   |

## Skills

### Technical

- Computing:** Linux and Windows; LaTeX and Office suites; most programming in Python including big data analysis, physical modelling and satellite retrieval development. Experience with other languages including Fortran.
- Fieldwork:** Planned and executed a fieldwork experiment during cold conditions to test a specific hypothesis. Included successful competition for equipment loan.
- Modelling:** Produced and modified physical models and applied the results of CMIP5 and climate reanalyses.
- Satellite Data:** Generated maps and statistics from AMSR-E, Cloudsat and Calipso L2 data, used OCO-2 L1B radiance data.
- Statistics:** Analysis of both experimental and modelled errors using standard procedure, tests for normality, spatial and temporal autocorrelation
- Presentation:** Have presented online instruction videos, posters at international science conferences and talks at national science conferences.
- Adaptability:** Have published papers on the carbon cycle, scientific consensus on climate change, radiative forcing of climate by CFCs, climate sensitivity and assimilation of passive microwaves for snow mass estimation.

### Teaching and Science Communication

- Teaching:** Scripted and presented lessons for EdX online course DENIAL101X: *Making Sense of Climate Science Denial* produced by the University of Queensland. Moderator for United Nations Institute for Training and Research climate science section in *Climate Change Diplomacy* course. Postgraduate demonstrator for courses in python, experimental physics and meteorology at the University of Reading.
- Writing:** Written for the climate science blog [skepticalscience.com](http://skepticalscience.com), winner of a 2011 *Australian Museum Eureka Award* and 2016 *National Center for Science Education Friend of the Planet Award*. Produced a POSTnote for the UK's Parliamentary Office of Science and Technology to help inform policymakers.
- Communication:** Have been interviewed by phone and email by journalists, including from Reuters, regarding published work. Have interviewed academics as part of Parliamentary Office of Science and Technology research note. A pair of my co-authored papers have 1,000,000 combined downloads.

### Collaboration and organisation

- Deadlines:** Devised and met timetables throughout PhD, including for time-sensitive seasonal fieldwork project.
- Lead authoring:** Lead authored papers and organised work from co-authors.
- Collaboration:** Co-authored as part of a multinational, interdisciplinary team. One paper was planned, written and communicated using modern internet crowd sourcing techniques.

## Languages

English (mother tongue), competent Italian, basic French.

## Referees

### Professor Robert Gurney (PhD Supervisor)

ESSC, University of Reading  
PO Box 238, 3 Earley Gate  
Reading  
RG6 6AL  
UK

**e-mail** r.j.gurney@reading.ac.uk

### Dr Brian Kahn

Jet Propulsion Laboratory  
M/S 233-304  
4800 Oak Grove Drive  
Pasadena  
CA 91101  
USA

**e-mail** brian.h.kahn@jpl.nasa.gov

## Appendix

### Detailed Synopsis of Research

The amount of future global warming depends mostly on two things: the heating factors that Earth's climate experiences, which have recently been dominated by human emissions of greenhouse gases, and the sensitivity of the climate to these factors. Better estimates of this sensitivity would allow a better calculation of the risks associated with a given amount of greenhouse gas emissions.

The amount of warming depends on how Earth changes in response to heating, particularly in ways that affect the way in which heat flows through the system. My current research projects include:

- Developing a cloud thickness retrieval algorithm using OCO-2 and other satellites, and applying it to marine stratocumulus clouds which are a common cloud type that have a strong cooling effect on Earth's surface.
- Combining measurements from Calipso and Cloudsat to test global precipitation and cloud-height patterns, which are expected to change in response to global warming and affect how heat moves through the atmosphere.
- Developing tools to perform like-with-like comparisons between measurements of Earth's temperature and computer simulations of Earth's climate, in order to test simple "energy budget" calculations of Earth's climate sensitivity.

My PhD included fieldwork in Arctic conditions and physics-based models of snow to help improve aspects of satellite measurements of snow amount on the ground which is useful information for water planners and, with a longer term record, could allow analysis of changes in snow amount in response to global warming. As part of my PhD I successfully applied for a joint NERC/BBSRC policy internship at the UK's Parliamentary Office of Science and Technology and produced a note on the technical issues associated with the UN Reducing Emissions from Deforestation and Forest Degradation (UN REDD+) scheme.

### Fully-Reviewed Publications

- Behrangi A, **Richardson M** (2018) Observed high-latitude precipitation amount and pattern and CMIP5 model projections *Remote Sensing* doi: 10.3390/rs10101583
- Chen C, Li J-L F, **Richardson M**, Lee W-L, Fetzer E, Stephens GL, Hsu H-H, Wang Y-H, Yu J-Y (2018) Falling snow radiative effects enhance the global warming response of the Tropical Pacific atmosphere *JGR Atmospheres* doi: 10.1029/2018JD028655

- **Richardson M**, Cowtan K, Millar R (2018) Global temperature definition affects achievement of long-term climate goals *Environmental Research Letters* doi: 10.1088/1748-9326/aab305
- **Richardson M**, Stephens GL (2018) Information content of OCO-2 oxygen A-band channels for retrieving marine liquid cloud properties *Atmospheric Measurement Techniques* doi: 10.5194/amt-11-1-2018
- Li J-L F, Suhas E, **Richardson M**, Lee W-L, Wang Y-H, Yu J-Y, Lee T, Fetzer E, Stephens G, Shen M-H (2018) The Impacts of Bias in Cloud-Radiation-Dynamics Interactions on Central-Pacific Seasonal and El Nino Simulations in Contemporary GCMs *Earth and Space Science* doi: 10.1002/2017EA000304
- **Richardson M**, McDuffie J, Cronk H, Taylor T, Stephens G (2017) The OCO-2 Oxygen A-Band response to Liquid Marine Cloud Properties from CALIPSO and MODIS. *JGR Atmospheres* doi: 10.1002/2017JD026561
- Li F, **Richardson M**, Hong Y, Lee W-L, Wang Y-H, Yu J-Y, Fetzer E, Stephens G, Liu Y (2017) Improved simulation of Antarctic sea ice due to the radiative effects of falling snow *Environmental Research Letters*, doi: 10.1088/1748-9326/aa7a17
- Skuce A, Cook J, **Richardson M**, Winkler B, Rice K, Green S, Jacobs P, Nuccitelli D (2017) Does It Matter if the Consensus on Anthropogenic Global Warming Is 97% or 99.99%? *Bulletin of Science, Technology & Society* doi: 10.1177/0270467617702781
- Hausfather Z, Cowtan K, Clarke DC, Jacobs P, **Richardson M**, Rohde R (2017) Assessing Recent Warming Using Instrumentally-Homogeneous Sea Surface Temperature Records. *Science Advances* doi: 10.1126/sciadv.1601207
- Li J-L F, Lee W-L, Wang Y-H, Suhas E, Yu J-Y, **Richardson M**, Fetzer E, Lo M-H, Yue Q (2016) Assessing the Radiative Impacts of Precipitating Clouds on Winter Surface Air Temperatures and Land Surface Properties in GCMs Using Observations. *JGR Atmospheres* doi: 10.1002/2016JD025175
- **Richardson M**, Cowtan K, Hawkins E, Stolpe MB (2016) Reconciled climate response estimates from climate models and the energy budget of Earth. *Nature Climate Change* doi: 10.1038/nclimate3066
- Stephens G, Kahn B, **Richardson M** (2016) The Super Greenhouse effect in a changing climate. *Journal of Climate* doi: 10.1175/JCLI-D-15-0234.1
- Behrangi A, Christensen M, **Richardson M**, Lebsock M, Stephens G, Huffman G, Bolvin D, Adler R, Gardner A, Labrigtsen BH, Fetzer EJ (2016) Status of High latitude precipitation estimates from observations and reanalyses. *JGR Atmospheres* doi: 10.1002/2015JD024546
- Cook J, Oreskes N, Doran P, Anderegg W, Verheggen B, Maibach E, Carlton S, Lewandowsky S, Skuce A, Green S, Nuccitelli D, Jacobs P, **Richardson M**, Winkler B, Painting R, Rice K (2016) Consensus on consensus: a synthesis of estimates on human-caused global warming. *Environmental Research Letters* doi: 10.1088/1748-9326/11/4/048002
- **Richardson M**, Hausfather Z, Nuccitelli D, Rice K, Abraham J (2015) Misdiagnosis of Earth climate sensitivity based on energy balance model results. *Science Bulletin* doi:10.1007/s11434-015-0806-z
- **Richardson M**, Stolpe MB, Jacobs P, Jokimäki, Cowtan K (2014) Comment on “Quantitatively evaluating the effects of CO<sub>2</sub> emission on temperature” *Quaternary International* doi: 10.1016/j.quaint.2014.04.054

- Cook J, Nuccitelli D, Green SA, **Richardson M**, Winkler B, Painting R, Way R, Jacobs P, Skuce A (2013) Quantifying the consensus on anthropogenic global warming in the scientific literature. *Environmental Research Letters* **8** (2) doi: 10.1088/1748-9326/8/2/024024.
- **Richardson M**, Davenport I, Gurney J (2013) Global Snow Mass Measurements and the Effect of Stratigraphic Detail on Inversion of Microwave Brightness Temperatures. *Surveys in Geophysics* doi: 10.1007/s10712-013-9263-x
- Nuccitelli D, Cowtan K, Jacobs P, **Richardson M**, Way R, Blackburn A-M, Stolpe MB, Cook J (2013) Comment on “Cosmic-Ray Driven Reaction and Greenhouse Effect of Halogenated Molecules: Culprits for Atmospheric Ozone Depletion and Global Climate Change”. *International Journal of Modern Physics B* doi: 10.1142/S0217979214820037
- **Richardson M** (2013) Comment on “The phase relation between atmospheric carbon dioxide and global temperature” by Humlum, Stordahl and Solheim. *Global and Planetary Change* **107** 226-228 doi: 10.1016/j.gloplacha.2012.08.011.

### Non-Peer-Reviewed or Under-Review Publications

- **Richardson M** (2014) Errors in Predicting Snow’s Near-Infrared Optical Grain Size *PhD Thesis, University of Reading, UK.*
- Cook J, Nuccitelli D, Skuce A, Jacobs P, Painting R, Honeycutt R, Green SA, Lewandowsky S, **Richardson M**, Way RG (2013) Reply to “Quantifying the consensus on anthropogenic global warming in the scientific literature: A re-analysis” *Energy Policy* doi: 10.1016/j.enpol.2014.06.002
- **Richardson M** (2014) Reducing Emissions from Deforestation and Forest Degradation (REDD+). *POSTnote Number 466, Parliamentary Office of Science and Technology, UK.*

### Awards, Fellowships and Grants

- NERC NCEO PhD studentship grant 2010-2014.
- NERC Field Spectroscopy Facility equipment loan of ASD Fieldspec Pro Spectroradiometer (loan valued at £5,500).
- Parliamentary Office of Science and Technology NERC-funded fellowship, 3 months.

### Professional Memberships and Community Contributions

Associate Member, Institute of Physics; Member, American Geophysical Union.

- Member, American Geophysical Union
- Convener of AGU Fall Meeting session “Climate Sensitivity and Feedbacks: Advances and New Paradigms” in 2016 and 2017
- Reviewer for journals including *Nature Climate Change* and *Nature Geoscience*
- Oral or poster presentations at meetings of groups including AGU, CFMIP, NCEO/CEOI, the OCO-2 Science Team and CloudSat Algorithm Development Working Group
- Invited speaker to NASA Museum Alliance and Solar System Ambassadors
- IPCC contributing author for Special Report on 1.5°C warming