

# Mark Richardson

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## 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.

## Education

2010–2014

### **University of Reading (PhD)**

Snow Observations and Modelling. Supervisor: Professor Robert Gurney. Funded by NERC NCEO studentship.

My PhD combined fieldwork in northern Scandinavia with computer modelling of snow to help improve satellite retrievals of snow mass. During my PhD I also acted as a teaching assistant for undergraduate and Masters' meteorology classes and authored papers, including one which was tweeted by the accounts of President Barack Obama and Elon Musk, the founder of Paypal, SpaceX and Tesla Motors.

2006–2010

### **University of Durham (MPhys)**

Master of Physics, Classification: First (Hons.) Masters project in current-voltage characteristics of cadmium telluride photovoltaic cells.

## Employment and Internships

Jan 2015–present

### **NASA Jet Propulsion Laboratory/Caltech**

Postdoctoral scholar developing a cloud-thickness retrieval using multiple satellites including OCO-2, retrieval and analysis of precipitation and clouds from Cloudsat and Calipso, and application to climate feedbacks and climate sensitivity.

Feb–May 2014

### **Parliamentary Office of Science and Technology**

3-month internship producing a note on the scientific and technical issues associated with the UN Reducing Emissions from Deforestation and Forest Degradation scheme.

## Skills

### Computing

- OS:** Windows, Unix, Linux.
- Programming:** Python, Fortran, limited experience with R, Matlab, Cshell.
- Other:** LaTeX, Microsoft Office, batch processing, remote access, big data.

### 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.

### Technical

- 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.

### 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), intermediate Italian and basic French.

## Referees

### Professor Robert Gurney (PhD Supervisor)

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

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### Professor Liz Morris

Scott Polar Research Institute  
University of Cambridge  
Lensfield Road  
Cambridge  
CB2 1ER  
UK

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## 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.

### Conferences, Presentations and Courses Attended

- AGU Fall Meeting, San Francisco, CA, USA. 14–18th December 2015. I presented a **poster**
- AGU Fall Meeting, San Francisco, CA, USA. 3–7th December 2012. I presented a **poster**
- Micro-DICE Summer School on Microstructures of Ice and Snow, Obergurgl, Austria. 27th August–1st September, 2012. I presented a **poster**.

- ESA-CliC-EGU Earth Observation and Cryosphere Science Conference, Frascati, Italy. 13–16th November, 2012. I presented a **poster**.
- 2012 NCEO/CEOI Joint Science Conference, Nottingham, UK. 18–20th September, 2012. I presented a **presentation** and a **poster**.
- 2012 NCEO/CEOI Joint Early Career Science Conference, Leicester, UK. 16–18th April, 2012. I presented a **presentation** and a **poster**.
- 2011 NCEO Science Conference, Warwick, UK. 5–8th September, 2011. I presented a **presentation** and a **poster**.
- 2011 UK Polar Network Summer School: Remote Sensing for Polar Scientists, Reading, UK. 20–22nd July, 2011.

### Fully-Reviewed Publications

- 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.2012.08.008.

### Non-Peer-Reviewed 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

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