ROYAL METEOROLOGICAL SOCIETY
STUDENT CONFERENCE 2014
Manchester Museum
2\textsuperscript{nd} to 4\textsuperscript{th} July 2014

ABSTRACTS
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Programme</td>
<td>4</td>
</tr>
<tr>
<td>Keynote Speaker abstracts and biographies</td>
<td>8</td>
</tr>
<tr>
<td>Conference Dinner Speaker abstract and biography</td>
<td>14</td>
</tr>
<tr>
<td>Oral Session 1: Boundary Layer</td>
<td>15</td>
</tr>
<tr>
<td>Oral Session 2: Earth Observations and Data Assimilation</td>
<td>19</td>
</tr>
<tr>
<td>Oral Session 3: Chemistry Composition and Dispersion</td>
<td>25</td>
</tr>
<tr>
<td>Oral Session 4: Weather and Climate Impacts</td>
<td>29</td>
</tr>
<tr>
<td>Oral Session 5: Climate: Past, Present and Future</td>
<td>34</td>
</tr>
<tr>
<td>Oral Session 6: Atmospheric and Climate Modelling</td>
<td>36</td>
</tr>
<tr>
<td>Oral Session 7: Clouds and Microphysics</td>
<td>41</td>
</tr>
<tr>
<td>Oral Session 8: Oceanography and Biosphere</td>
<td>46</td>
</tr>
<tr>
<td>Oral Session 9: Weather and Small Scale Features</td>
<td>49</td>
</tr>
<tr>
<td>Poster Session - List</td>
<td>57</td>
</tr>
<tr>
<td>Poster Abstracts</td>
<td>59</td>
</tr>
</tbody>
</table>
# PROGRAMME

**Wednesday 2 July 2014 (Kanaris Lecture Theatre, Manchester Museum)**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Speaker/Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>1300</td>
<td>Welcome to Royal Meteorological Society Student Conference 2014</td>
<td>Liz Bentley, Chief Executive Royal Meteorological Society</td>
</tr>
<tr>
<td></td>
<td><strong>Keynote Speakers: Current Issues in Meteorology</strong></td>
<td></td>
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<tr>
<td></td>
<td>The Intergovernmental Panel on Climate Change Report: How to Make an Impact</td>
<td>Prof Matt Collins, FRMetS, University of Exeter, Joint Met Office Chair in Climate Change</td>
</tr>
<tr>
<td></td>
<td>What is Geoengineering? What relation has geoengineering to IPCC(AR5) and what are our options?</td>
<td>Dr Alan Gadian, FRMetS, UK National Centre for Atmospheric Sciences (NCAS), University of Leeds</td>
</tr>
<tr>
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<td>The NCAS Mobile Radar</td>
<td>Dr Lindsay Bennett, FRMetS, National Centre for Atmospheric Science, University of Leeds</td>
</tr>
<tr>
<td></td>
<td>Open Access and other publishing trends of the future</td>
<td>Prof David Schultz FRMetS, Chair of RMetS Publishing Committee and Professor of Synoptic Meteorology, Centre for Atmospheric Science, School of Earth, Atmospheric and Environmental Sciences, University of Manchester</td>
</tr>
<tr>
<td>1415</td>
<td>Panel Discussion: Current Issues in Meteorology</td>
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<tr>
<td>1445</td>
<td>Tea and Coffee and Poster Session 1</td>
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## Oral Session 1: Boundary Layer
**Chair:** Kate Fradley

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<thead>
<tr>
<th>Time</th>
<th>Title</th>
<th>Speaker/Institution</th>
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</thead>
<tbody>
<tr>
<td>1545</td>
<td>Quantifying the influence of wind advection on the urban heat island for an improvement of a climate change adaptation planning tool</td>
<td>Richard Bassett, University of Birmingham</td>
</tr>
<tr>
<td>1600</td>
<td>Boundary layer impacts of wind farms under a temperature inversion</td>
<td>Jonathan Pennells, University of Leeds</td>
</tr>
<tr>
<td>1615</td>
<td>Coastal zone wind field features based on SAR observations</td>
<td>Anna Menzikova, Russian State Hydrometeorological University</td>
</tr>
<tr>
<td>1630</td>
<td>Coupling the land surface and atmosphere: A variable blending height</td>
<td>Ruth Lewis, Met Office</td>
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</tbody>
</table>

**Thursday 3 July 2014 (Kanaris Lecture Theatre, Manchester Museum)**

## Oral Session 2: Earth Observations and Data Assimilation
**Chair:** Ruari Rhodes

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<thead>
<tr>
<th>Time</th>
<th>Title</th>
<th>Speaker/Institution</th>
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<tbody>
<tr>
<td>0900</td>
<td>Assimilation of atmospheric motion vectors at the Met Office</td>
<td>Francis Warrick, Met Office</td>
</tr>
<tr>
<td>0915</td>
<td>Radiosonde observations in the Amundsen Sea, Antarctica: Examining weather and climate over Pine Island Bay</td>
<td>Richard Jones, University of East Anglia</td>
</tr>
<tr>
<td>Time</td>
<td>Title</td>
<td>Speaker, Institution</td>
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<tr>
<td>0930</td>
<td>A comparison of different hybrid methods on the Lorenz 1963 Model</td>
<td>Michael Goodliff, University of Reading</td>
</tr>
<tr>
<td>0945</td>
<td>Filter clutter from wind turbines through advanced signal processing techniques</td>
<td>Dr Elizabeth Brock, Met Office</td>
</tr>
<tr>
<td>1000</td>
<td>Vertical profiling of the Pacific Warm Pool during CAST</td>
<td>Richard Newton, University of Manchester</td>
</tr>
<tr>
<td>1015</td>
<td>Parameterisation estimation using data assimilation</td>
<td>Matthew Lang, University of Reading</td>
</tr>
<tr>
<td>1030</td>
<td>Tea and Coffee</td>
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**Oral Session 3: Chemistry Composition and Dispersion**  
**Chair: Steven Turnock**

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<thead>
<tr>
<th>Time</th>
<th>Title</th>
<th>Speaker, Institution</th>
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<tbody>
<tr>
<td>1100</td>
<td>Evaluating European aerosol trends from 1960 to 2010 using HadGEM3-UKCA and EMEP data</td>
<td>Steven Turnock, University of Leeds</td>
</tr>
<tr>
<td>1115</td>
<td>Examining the role of aviation NOx emissions as a short lived climate forcer</td>
<td>Sarah J Freeman, Manchester Metropolitan University</td>
</tr>
<tr>
<td>1130</td>
<td>Biomass Burning Regional Haze in Brazil: Aircraft observations during SAMBBA</td>
<td>Eoghan Darbyshire, University of Manchester</td>
</tr>
<tr>
<td>1145</td>
<td>Enhancing the predictability of large scale pollution episodes throughout UK Winter</td>
<td>Chris Webber, University of Reading</td>
</tr>
<tr>
<td>1200–1300</td>
<td>Lunch</td>
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**Oral Session 4: Weather and Climate Impacts**  
**Chair: Lenka Novak**

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<thead>
<tr>
<th>Time</th>
<th>Title</th>
<th>Speaker, Institution</th>
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<tbody>
<tr>
<td>1300</td>
<td>Energy systems and climate</td>
<td>Hannah Bloomfield, University of Reading</td>
</tr>
<tr>
<td>1315</td>
<td>Geostatistical simulation of extreme European windstorm footprints</td>
<td>Laura Dawkins, University of Exeter</td>
</tr>
<tr>
<td>1330</td>
<td>Verification of automated convective cloud reports for aviation</td>
<td>Katie Brown, Met Office</td>
</tr>
<tr>
<td>1345</td>
<td>The role of meteorology in capacity management of European airspace</td>
<td>Claire Bartholomew, Met Office</td>
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<tr>
<td>1400</td>
<td>Event attribution and its potential role in loss and damage negotiations</td>
<td>Hannah Parker, University of Reading</td>
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</tbody>
</table>
Oral Session 5: Climate: Past, Present and Future  
Chair: Emma Gale

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<thead>
<tr>
<th>Time</th>
<th>Title</th>
<th>Speaker</th>
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<tbody>
<tr>
<td>1415</td>
<td>ENSO and Thailand rainfall</td>
<td>Emma Gale, University College London</td>
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<tr>
<td>1430</td>
<td>Weather, etc.' Writing Home</td>
<td>Penny Newell, King's College London</td>
</tr>
<tr>
<td>1445</td>
<td>Tea and Coffee and Poster Session 2</td>
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<tr>
<td>1545</td>
<td>Keynote Speakers: Careers</td>
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<tr>
<td></td>
<td>Jennie Campbell, Chief Executive Officer,</td>
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<td>MeteoGroup and President-elect of the Royal</td>
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<td>Meteorological Society</td>
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<td></td>
<td>Ken Mylne, FRMetS, Head of Weather Science</td>
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<td></td>
<td>Numerical Modelling, Met Office</td>
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<td>Dr Richard Dixon, Head of Catastrophe</td>
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<td>Research, Hiscox</td>
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<td>Simon King, Broadcast Meteorologist, BBC</td>
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<td>Weather (5live)</td>
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<tr>
<td>1645</td>
<td>Panel Discussion</td>
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Friday 4 July 2014 (Kanaris Lecture Theatre, Manchester Museum)

Oral Session 6: Atmospheric and Climate Modelling  
Chair: Sarah Freeman

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<thead>
<tr>
<th>Time</th>
<th>Title</th>
<th>Speaker</th>
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</thead>
<tbody>
<tr>
<td>0900</td>
<td>The role of the stratosphere in seasonal prediction</td>
<td>William Seviour, University of Oxford</td>
</tr>
<tr>
<td>0915</td>
<td>Distinguishing regimes of convective-scale predictability</td>
<td>David Flack, University of Reading</td>
</tr>
<tr>
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<td>using an appropriate convective adjustment timescale</td>
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<tr>
<td>0930</td>
<td>Energy Balance Model-based Assessment of Factors</td>
<td>Maria Gusakova, Russian State Hydrometeorological University, St. Petersburg, Russia</td>
</tr>
<tr>
<td></td>
<td>Affecting Global Surface Air Temperature</td>
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<tr>
<td>0945</td>
<td>Evaluating the ability of high resolution climate models</td>
<td>Josie Bowler, University of Reading</td>
</tr>
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<td></td>
<td>to represent damaging European Windstorms</td>
<td></td>
</tr>
<tr>
<td>1000</td>
<td>How robust are performance metric assessments of</td>
<td>Christopher May, Climatic Research Unit,</td>
</tr>
<tr>
<td></td>
<td>regional climate model skill?</td>
<td>University of East Anglia</td>
</tr>
<tr>
<td>1015</td>
<td>Tea and Coffee</td>
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Oral Session 7: Clouds and Microphysics  
Chair: Sam Hardy

<table>
<thead>
<tr>
<th>Time</th>
<th>Title</th>
<th>Speaker</th>
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<tbody>
<tr>
<td>1045</td>
<td>Retrieving the microphysics of mixed-phase regions embedded within</td>
<td>William Keat, University of Reading</td>
</tr>
<tr>
<td></td>
<td>deep ice clouds using dual polarisation radar</td>
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</tr>
<tr>
<td>1100</td>
<td>Laboratory measurements and modelling of the scattering properties of</td>
<td>Helen Rhian Smith, University of Manchester</td>
</tr>
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<td>hollow and solid ice crystals</td>
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<tr>
<td>Time</td>
<td>Title</td>
<td>Speaker</td>
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<tr>
<td>1115</td>
<td>CLOUD – The Atmospheric Simulator at CERN</td>
<td>Leonid Nichman, University of Manchester</td>
</tr>
<tr>
<td>1130</td>
<td>Evaluating Aerosol Influence on Cloud Development in Models using In-Situ Measurements during the INUPIAQ Campaign</td>
<td>Robert Farrington, Centre of Atmospheric Science (CAS), University of Manchester</td>
</tr>
<tr>
<td>1145</td>
<td>Investigating aerosol-cloud interactions in the Arctic during the ACCACIA campaign: relating the properties of atmospheric aerosol to cloud microphysics using ESEM/EDX analysis</td>
<td>Gillian Young, University of Manchester</td>
</tr>
<tr>
<td>1200</td>
<td>Lunch</td>
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**Oral Session 8: Oceanography and Biosphere**  
**Chair: Tim Slater**

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<th>Time</th>
<th>Title</th>
<th>Speaker</th>
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<tbody>
<tr>
<td>1245</td>
<td>A coupled study of sensitivity analysis and multi-objective calibration of the JULES model to find a better vegetation parameter set for simulation in Great Britain</td>
<td>Hon-man Wong, Centre for Ecology and Hydrology, University of Aberdeen</td>
</tr>
<tr>
<td>1300</td>
<td>Air-sea interactions during high winds in the Labrador Sea</td>
<td>Matthew J Amison, School of Earth and Environment, University of Leeds</td>
</tr>
<tr>
<td>1315</td>
<td>Key mechanisms of surface water pCO2 variability in the North Atlantic</td>
<td>Justin Krijnen, Met Office</td>
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**Oral Session 9: Weather and Small Scale Features**  
**Chair: Will Keat**

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<tr>
<th>Time</th>
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<th>Speaker</th>
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<tbody>
<tr>
<td>1330</td>
<td>The lifecycle of the North Atlantic Storm Track</td>
<td>Lenka Novak, Department of Meteorology, University of Reading</td>
</tr>
<tr>
<td>1345</td>
<td>A climatological study of the roles of baroclinicity and latent heat release in the life cycles of polar lows</td>
<td>Chris Fairless, University of Manchester</td>
</tr>
<tr>
<td>1400</td>
<td>Atmospheric flow over South Georgia and the impacts on regional climate - Föhn wind events</td>
<td>Daniel Bannister, British Antarctic Survey</td>
</tr>
<tr>
<td>1415</td>
<td>The generation of downwind rainbands by mountains</td>
<td>Carly J Wright, University of Reading</td>
</tr>
<tr>
<td>1430</td>
<td>Tea and Coffee</td>
<td></td>
</tr>
<tr>
<td>1500</td>
<td>The influence of cyclone propagation patterns on England and Wales extreme rainfall accumulations</td>
<td>Ruari I. Rhodes, University of Reading</td>
</tr>
<tr>
<td>1515</td>
<td>Linking weather forecast errors with the processes responsible</td>
<td>Leo Saffin, University of Reading</td>
</tr>
<tr>
<td>1530</td>
<td>Cyclone Interactions in the 23-26 September UK Floods</td>
<td>Sam Hardy, University of Manchester</td>
</tr>
<tr>
<td>1545</td>
<td>Acceleration of strong winds in idealised simulations of extratropical cyclones</td>
<td>Tim Slater, Centre for Atmospheric Science, University of Manchester</td>
</tr>
<tr>
<td>1600</td>
<td>Liz Bentley Chief Executive closing comments</td>
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<tr>
<td>1610</td>
<td>Chairs of Student Conference closing comments</td>
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Keynote Speaker Abstracts and Biographies

Current Issues in Meteorology

The Intergovernmental Panel on Climate Change Report: How to make an impact

Professor Matt Collins, FRMetS, University of Exeter,
Joint Met Office Chair in Climate Change

Abstract
The Working Group I report of the 5th Assessment of IPCC was released in late 2013. I was a Coordinating Lead Author on Chapter 12 ‘Long Term Climate Change: Projections, Commitments and Irreversibility’. This talk will give some personal reflections on the processes; how the chapter came into being, the multiple drafts and review comments and the progression from scientific papers through to chapter executive summary statements up to the Technical Summary and the Summary for Policy Makers. I will give some specific tips on how your future research might impact on the next IPCC report, should there be one, and also discuss scientific impact in general.

Biography
Mat Collins is Joint Met Office Chair in Climate Change in the College of Engineering, Mathematics and Physical Sciences at the University of Exeter. His research interests are in climate modelling, quantifying uncertainty and probabilistic climate prediction, seasonal to decadal climate predictability and in understanding climate variability. He currently leads the NERC-MoES funded SAPRISE project looking at the dynamics of the Indian Monsoon and the NERC PROBEC project looking at emergent constraints on future climate change. He has over 85 peer-reviewed publications (h-index=35). He was a Coordinating Lead Author on the IPCC 5th Assessment report. He serves on the International CLIVAR Pacific Implementation Panel.
What is Geoengineering? What relation has geoengineering to IPCC (AR5) and what are our options?

Dr Alan Gadian, FRMetS, University of Leeds, UK National Centre for Atmospheric Sciences (NCAS)

Abstract
This talk will challenge ideas and thoughts about the topic of geoengineering and climate change. What do we mean by geoengineering?

The IPCC (AR5) is noticeable in its absence of discussion about geoengineering (c.f.) AR3. Feedback effects are vitally important in climate change and are not discussed deeply in the report.

Finally one Solar Radiation Management (SRM) scheme, the non-invasive Marine Cloud Brightening (MCB) will be briefly discussed.

Biography
Alan Gadian is a senior scientist at the UK National Centre for Atmospheric Sciences (NCAS) and is currently based at the University of Leeds. Since completing his PhD in Meteorology at Imperial College, he has spent the last 30 years researching into the dynamics of the atmosphere, cloud microphysics and numerical methods in Numerical Weather Prediction and Climate Models.

For the past few years he has been working on Marine Cloud Brightening (MCB), with scientists around the world, from the theoretical and computational viewpoint. In recent years he has been editor in chief of the Royal Meteorological Society Journal, Atmospheric Science Letters and external examiner for the University of East Anglia undergraduate course in Meteorology and Atmospheric Sciences. He has supervised meteorology field course experiments and organises the European WRF tutorial courses. He collaborates with scientists from NCAR and Europe.

He is now working on the WISER project (Weather Impact Studies at Extreme Resolution), gravity wave propagation generated by South Georgia, and development of new numerical models in meteorology, impacts of rainfall on flooding and dams.
The NCAS Mobile Radar

Dr Lindsay Bennett, FRMetS, NCAS Instrument Scientist, University of Leeds

Abstract
The National Centre for Atmospheric Science acquired an X-band mobile Doppler, dual-polarisation radar from Selex Gematronik in January 2012 for cloud and precipitation research. The radar is mounted on a towable trailer and is capable of being operated remotely. The 2.4 m antenna provides a beamwidth of 1 degree, to achieve a resolution comparable with other operational radars. The radar can scan up to 36 degrees per second providing full volumes out to 150 km every few minutes and measures areal precipitation, radial winds and polarisation parameters. The radar participated in its first major field project, the COnvective Precipitation Experiment (COPE), during summer 2013, collecting a unique dataset of the development of precipitation in convective clouds. This talk will provide an overview of the radar's capability, examples of the data collected during COPE and plans for the future.

Biography
Since October 2011 Lindsey has been working as an Instrument Scientist for the Facility for Ground based Atmospheric Measurement (FGAM), part of the National Centre for Atmospheric Science (NCAS). Lindsey is responsible for FGAM's mobile X-band radar, the first of its kind in the UK. The radar will be used to examine the microphysics and dynamics of convective clouds, investigating the key processes that control rainfall intensity.

Lindsey received a BSc (Hons) in Meteorology and Oceanography from the University of East Anglia in July 2003, studying abroad at the University of Colorado, in Boulder, in 2001/2002. Lindsey undertook a 10-week internship at the National Center for Atmospheric Research (NCAR) during summer 2002, working on a research project examining strong winds associated with squall lines.

Lindsey joined the School of Earth and Environment in September 2003 as a postgraduate research student working with Prof. Alan Blyth on the Convective Storm Initiation Project (CSIP), funded by the Natural Environment Research Council (NERC). Lindsey also worked with Dr Tammy Weckwerth on data from the International H2O Project (IHOP_2002) through a Co-operative Award in Science and Engineering (CASE) with NCAR.

From June 2008 to October 2011 Lindsey worked with Prof. Blyth and Dr. Weckwerth on the Convective and Orographically-Induced Precipitation Study (COPS) that took place in southwest Germany and eastern France during summer 2007. The project aimed to improve understanding and prediction of heavy convective precipitation in complex terrain. I analysed case studies using data from ground-based remote sensing instrumentation with a focus on the Doppler on Wheels (DOW) mobile radar data and simulations from the Weather Research and Forecasting (WRF) model.
Open Access and other publishing trends of the future

Professor David Schultz FRMetS, Chair of RMetS Publishing Committee and Professor of Synoptic Meteorology Centre for Atmospheric Science, School of Earth, Atmospheric and Environmental Sciences, University of Manchester

Abstract
Who pays for research articles to be published? Probably not a question that you've thought much about until you were trying to download an article at home and were asked to pay $35 to read it. Indeed, you are not the only one asking this question. The Research Councils UK who fund most scientific research recently changed their rules about how scientific research is made available to the funders of scientific research, the UK taxpayer. You need to know about open access as it may pertain to how you publish the research from your dissertation. As part of this discussion, we will also discuss open data initiatives and other news from the RMetS journals and the scientific publishing world.

Biography
David Schultz is Professor of Synoptic Meteorology, University of Manchester. He was born in Pittsburgh, got his BSc from MIT, MSc from University of Washington, and PhD from University at Albany, State University of New York. Previously, he worked for the NOAA/National Severe Storms Laboratory and the University of Oklahoma and the University of Helsinki and the Finnish Meteorological Institute. He won the American Meteorological Society Editor's Award for Monthly Weather Review in 2001, where he serves as the Chief Editor since 2008. He is a former Vice President of the Royal Meteorological Society and currently serves as the Chair of the Publishing Committee. He has published over 110 peer-reviewed articles and book chapters on synoptic and mesoscale meteorology, forecasting, scientific publishing, and education. He is a Fellow of the UK Higher Education Academy and winner of the student-led Manchester Teaching Awards (2012) and the University of Manchester Teaching Excellence Award (2014). He is also the author of Eloquent Science: A Practical Guide to Becoming a Better Writer, Speaker, and Atmospheric Scientist. He blogs at www.eloquentscience.com and tweets at @EloquentScience.
Keynote Speaker Careers Session Biographies

Jenny Campbell, Chief Executive Officer, MeteoGroup and President-elect of the Royal Meteorological Society
Jennie Campbell graduated from Nottingham University in 1984 and shortly afterwards joined Listing Ltd, an independent production company supplying page-ready information services to the press. Her involvement with weather started here where she managed the production of daily weather panels for national and regional newspapers. Jennie went on to become Operations Director of Listings Ltd and was a key member of the team of directors who built the business and sold it to the Press Association in 1996.

After the sale of Listings Ltd, Jennie joined the Press Association as Director of PA’s Enterprises Division and was involved in the set-up of the PA WeatherCentre, a joint venture with Meteo Consult, a Dutch-owned weather business, which was established to provide weather services to corporate and industrial customers as well as the media. Jennie subsequently became a Director of the PA WeatherCentre (now MeteoGroup UK) and in 2005 when the Press Association acquired Meteo Consult she took over as Managing Director of the entire Weather Group.

In 2006 the Meteo Consult business was re-branded MeteoGroup and is now Europe’s largest private sector weather business. MeteoGroup has operations in 11 European countries as well as Asia and the USA, it employs almost 400 staff, including 150 meteorologists, and has customers worldwide.

At the end of 2013 MeteoGroup was acquired by global growth investment firm, General Atlantic and Jennie became CEO. Jennie is Chairman of PRIMET, the European Association of Private Meteorological Services, and President-elect of The Royal Meteorological Society.

Ken Mylne, FRMetS, Head of Weather Science Numerical Modelling, Met Office
The Met Office vision to be the Best Weather and Climate Service in the World provides a unique opportunity to develop a wide, varied and fascinating career in Meteorology and all its related topics. Ken’s own career, starting in 1984 with a first degree in Physics including Atmospheric Physics from Oxford University, has provided a wide range but with common threads. In his initial research role Ken conducted field experiments in pollution dispersion measuring the rapid turbulent fluctuations in concentration in a pollutant plume – this gave him his first experience of collaboration with academia, working with Julian Hunt at Cambridge University. After 7 years Ken switched direction completely to operational forecasting, and spent 6 years on shifts writing aviation and shipping forecasts, but also exploited his background in dispersion to manage the emergency response activities for pollution incidents – this included international responsibilities for major nuclear incidents which introduced me to the World Meteorological Organisation (WMO). Ken then returned to research in ensemble forecasting where his understanding of statistical descriptions of turbulence stimulated ideas for understanding forecast uncertainty.

Over 15 years Ken led the development of the Met Office’s world-leading high-resolution ensemble forecasting system, MOGREPS, and ended up chairing the WMO Expert Team on the use of ensembles. After a short excursion to lead a new initiative to forecast weather impacts for use in risk-based warnings, Ken now heads the development and application of operational weather forecast systems. A common theme throughout his career has been academic collaboration, mainly with UK universities but also with US colleagues. The Met Office conducts a lot of wide-ranging and varied research, but the difference from academia is that the vast majority of it has to be focused on delivering improved forecast systems or providing specific scientific advice to Government or customers. That said, we cannot be the Best Weather and Climate Service in the World without also pulling in the expertise and free-thinking research available in academia, and over recent years we have greatly expanded our academic collaborations through the Met office Academic Partnership (MOAP) and the Joint Weather and Climate Research Programme (JWCRP) with NERC, among others.
Dr Richard Dixon, Head of Catastrophe Research, Hiscox
Richard studied meteorology at the University of Reading, culminating in a PhD in the topic of extratropical cyclones in 1999. In 2000, he moved into the insurance industry, working at a leading catastrophe modelling company (Risk Management Solutions) in diverse topics such as building hurricane models, researching how numerical weather prediction could be used in building catastrophe models and also helping insurers understand and estimate post-event catastrophe losses. Since 2006, he has worked at a reinsurance broker (Aon Benfield), a reinsurer (Renaissance Re) and is currently at an insurer/reinsurer (Hiscox) where he is Head of Catastrophe Research. Much of his work in the last 8 years has been involved in the understanding and evaluation of natural catastrophe models to help better define risk from natural catastrophes. He also lectures on the UCL “Natural Hazards for Insurers” course and helps to supervise two PhD students at Reading University.

Simon King, Broadcast Meteorologist, BBC Weather (5Live)
Simon has had an interest in the weather since he was a school boy and shaped his education around the subjects and qualifications he needed to pursue a career in Meteorology.

He went to the University of Reading and completed a B.Sc (Hons) in Environmental Science of the Earth and Atmosphere followed by an M.Sc in Applied Meteorology with distinction. After a small stint as a flood forecaster at the Environment Agency, Simon joined the Met Office in 2005 as a Mobile Met Unit (MMU) forecaster.

As an MMU forecaster, Simon also had to undertake formal RAF Officer training at RAF Cranwell, which enables Met Office forecasters to be deployed with the Armed Forces on operations around the world in uniform providing military specific forecasts.

While continuing with his role in the reserves, he joined the BBC Weather Centre in 2008 as a weather presenter. Based at television centre he presented national and world weather across a range of BBC TV and radio stations. More recently he made the move up to the new studios at MediaCity in Salford Quays and now takes a more regular slot on BBC 5live breakfast throughout the week.
Conference Dinner Speaker

Wet, windy and occasionally wonderful – a career in meteorology

Professor Christopher George Collier. B.Sc., Ph.D, DSc., HonFRMetrS., CMet, CEnv
Professor of Atmospheric Science and the National Centre for Atmospheric Science Head
of Strategic Partnerships, University of Leeds

Abstract:
Most of my career has been concerned with meteorological measurements in one way or another first in the Met Office, a very different place than it is now, and then in academia. Rain has featured considerably, although measurements of boundary layer wind have provided the occasional interlude. Weather radar has been a feature of much activity. In addition there have been brushes with industry. Opportunities to dabble in hydrometeorology, usually resulting in burnt fingers, have been taken. Amusing, and some not so amusing, anecdotes will be recalled involving a number of incidents, equipment and people.

Biography:
Professor Collier obtained a BSc in Physics from Imperial College, London, and a PhD and DSc from the University of Salford. He joined the University of Leeds as NCAS Head of Strategic Partnerships and Professor of Atmospheric Science in 2009, subsequent to leaving the University of Salford, which he joined in 1995 after 27 years in the UK Met Office. He has over 30 years experience in the weather radar field, and has published over 90 refereed journal papers, two books on radar and its applications in meteorology and hydrology and over 100 conference papers and reports.

In 1982 he was awarded the Royal Meteorological Society High Robert Mill Medal for his work on the use of radar for QPE, in 1984 he received the UK Met Office L.G.Groves Prize for leading the UK operational weather radar network development and in 1986 he was awarded the First World Meteorological Organisation Vaisala Prize for papers on QPE using radar. From 2004 to 2006 Professor Collier was President of the Royal Meteorological Society. In 2012 he was awarded Honorary Fellowship of the Royal Meteorological Society.

He has participated in EU COST Projects on radar (chairing the Management Committee of COST-73 International Radar Networking which laid the foundation for the operational exchange of weather radar data throughout Europe), and he has been involved an EU Framework 3, 4, 5 and 6 Projects coordinating the FP5 MANTISSA Project.

Professor Collier has supervised successfully eight PhD students, and has been a PI and CO-PI in a number of NERC-funded projects most recently NCAS UFAM (2008-2009 £69.59k), COPS (2007-2009 £238.796k), CSIP (2003-2006 £116.947k) and Dual Microwave Links (1998-2007 £55.533). Currently he was Science Coordinator of the UK Natural Environment Research Council directed R&D programme Flood Risk from Extreme Events (FREE). He has been a member of several national and international committees, currently the ICE Reservoir Safety Committee and the Inter-Agency Committee for Hydrological Uses of Radar. Professor Collier is married with two sons.
Oral Session 1: Boundary Layer

Quantifying the influence of wind advection on the urban heat island for an improvement of a climate change adaptation planning tool

Presenter: Richard Bassett, University of Birmingham

The urban heat island (UHI) is a phenomenon whereby an urban area can be warmer than the surrounding rural areas. This is due to an alteration of the surface energy balance, caused by anthropogenic changes to morphology. Alterations to variables such as albedo and sky-view factors have been shown to cause a nocturnal UHI in excess of 6°C in Birmingham compared to surrounding rural areas. In order to quantify and demonstrate the spatial pattern of the UHI past techniques include observational approaches, satellite monitoring and modelling approaches. A review of prior techniques used in Birmingham can be found in Tomlinson et al. (2013).

Whilst each technique has its merits, observational approaches are unable to capture the UHI’s spatial aspect, satellite observations are confined to clear sky conditions and capture the surface skin temperatures, and current modelling approaches tend to be limited by a lack of available data to evaluate their performance. In addition local equilibrium models do not consider heat and momentum transport between grid cells (i.e. the processes in one cell do not affect the adjacent cells). This in essence reproduces a static UHI when in reality wind moves the UHI centre downwind.

In this study the 3D dynamical Weather Research and Forecasting (WRF) model will be coupled with the Building Effect Parameterisation scheme (Martilli et al. 2002) to capture the non-stationary aspects of the UHI. The model’s suitability for assessing the influence of wind has already been demonstrated by Heaviside et al. (2013) where wind advected from the city centre can intensify temperatures downwind by 2°C for the 2003 heatwave period. The wind effect simulations will be evaluated at a high spatial resolution using the multi-scale urban climate dataset, HiTemp. This consists of over 200 sensors in and around Birmingham alongside 30 fully automatic weather stations. This will provide a means of evaluating an urban scheme within a numerical model with a fine spatial resolution. By quantifying wind advection using a 3D dynamical model, a generic methodology of adjusting UHI patterns from local-equilibrium models can be developed by incorporating the wind advection effect through a spatial-lag correlation. This methodology will be beneficial to land surface model development.

Impact will be generated through an on-going partnership with Birmingham City Council (BCC) to deliver improvement of an existing risk mapping tool: the BUCCANEER (Birmingham Urban Climate Change with Neighbourhood Estimates of Environmental Risk). The tool includes UHI, climate and social-environment data displayed through visual mapping to conduct a spatial risk assessment that will feed into policy development at BCC.

References
Boundary layer impacts of wind farms under a temperature inversion

Presenter: Jonathan Pennells, University of Leeds

The ever increasing demand for wind power has led to an increased desire to understand the impact of wind turbines on local meteorology. With field data scarce to come by, most of our understanding of how wind farms impact their surroundings has come from numerical simulations or analytical models. The analytical work of Smith (2009) demonstrated how gravity waves can be generated by a large wind farm with the presence of a temperature inversion (Smith, 2009). The propagation of these gravity waves is dependent on the strength of the inversion, with subcritical flow generating upstream gravity waves on the inversion whereas super-critical can not. Also of interest is the phenomenon of ‘choking’; with a Froude number close to unity, the gravity waves and pressure gradient can result in a significant reduction of winds within the wind farm. The analytical model used in this study is relatively simple though, and the results have not been confirmed with observations or with more detailed numerical simulations. The aim of this work is to address this.

Using the BLASIUS model from the UK Met Office, a wind farm parametrisation (based on Fitch et al 2012), has been implemented using a TKE source and momentum deficit. Numerical simulations have been undertaken using this scheme to reproduce the work of Smith (2009) and investigate the impact of a more detailed representation of the boundary layer and the wind turbines on the results. The work is then extended to regimes where the analytical solution of Smith (2009) is no longer valid. The results are important, both in terms of understanding the impact of wind turbines on local meteorology and gravity wave production, but also because the ‘choking’ phenomena could have significant impact on the power output of wind farms under the wrong conditions.
Coastal zone wind field features based on SAR observations.

Presenter: Anna Monzikova, Russian State Hydrometeorological University, St. Petersburg, Russia

Proper description of wind field features in the coastal zone is important for many different practical applications including offshore wind energy resource assessment, ocean and atmosphere modelling and also advancing in the physical understanding of the wind transformations that take place across the water-land boundary. Advantage of synthetic aperture radar (SAR) data is their ability to resolve small-scale wind field features (with spatial resolution of 150 meters and larger) caused by wind transformation due to abrupt change of the surface roughness and surface temperature at the land-sea transition. Analysis of wind transformation in the coastal zone of the Gulf of Finland using ENVISAT SAR data is presented in this study. In total more than 25 SAR images covering various scenarios of wind field transformations are considered. The data are analyzed using semi-empirical model of the atmospheric boundary layer transformation. Several “typical” cases of wind transformation at various meteorological conditions and the atmospheric stratifications are considered and interpreted. Relevance of observed phenomena to the offshore wind energy resource assessment is discussed.
Coupling the land surface and atmosphere: A variable blending height

Presenter: Ruth Lewis MSci, Met Office

The blending height is the height above which variations in air flow due to changes in the surface conditions are no longer distinguishable. Instead, they have merged to form an overall profile which represents the surface conditions of a large area. By assuming that the blending height is at, or below, the lowest atmospheric model level, a heterogeneous surface can be coupled to a single, homogeneous boundary layer. However, under regimes such as shallow stable boundary layers, there is a need to increase near-surface resolution in order to improve the representation of strong, low-level gradients in temperature, winds or pollutant concentrations. While a general parametrization for the blending height is still the subject of research, it is clear that the assumption that the blending height is at the lowest model grid level will then break down. We are therefore implementing a new method of implicitly coupling the land surface and the atmosphere at very high resolutions that enables a variable blending height. Results from preliminary simulations will be presented that show the impact of this change.
Atmospheric Motion Vectors (AMVs) are wind observations derived by tracking a tracer (a cloud or water vapour feature) through a sequence of satellite images. Imagery from geostationary and polar-orbiting satellites can be used, and the vectors are usually derived by the satellite operators. The information provided by the AMVs on the global wind field is useful for constraining Numerical Weather Prediction (NWP) analyses, particularly where conventional observations are sparse. There are gaps in AMV data coverage at roughly 50-70 N/S between the data provided by geostationary and polar satellites. These AMV data gaps are generally not well covered by other wind datasets and are located in meteorologically interesting areas. Improving wind coverage could, in particular, help to better constrain the polar front jets. Two datasets with the potential to fill this data gap have been analysed. One dataset produced by EUMETSAT is derived by tracking features between pairs of polar satellite images. This increases coverage as there is a greater area of overlap between two polar overpasses than between the three overpasses conventionally used. A second dataset, known as the LeoGeo winds, is produced by CIMSS. They use composite imagery from a mix of geostationary and polar satellites to track features in the data gap. This presentation will show results of an analysis of these new datasets and their impact on Met Office NWP forecasts.
Radiosonde observations in the Amundsen Sea, Antarctica: Examining weather and climate over Pine Island Bay.

Presenter: Richard Jones, University of East Anglia

The Amundsen Sea sector of Antarctica has been the focus of much polar research in recent years. Many of the regions glaciers including Pine Island and Thwaites have been both thinning and retreating, and therefore making a significant contribution to global sea level rise (Shepherd et al, 2001; Shepherd and Wingham, 2007). The ice sheet stability research programme (iSTAR) aims to investigate the causes of the rapid retreat of Pine Island Glacier from an oceanographic, meteorological and glaciological perspective.

Meteorological observations in the Amundsen Sea are very sparse with just a handful of coastal automatic weather stations maintained. For this reason it is very difficult to evaluate the skill of meteorological reanalysis products in this area. Here, we present a new, unique data set from 38 radiosonde balloons launched from RRS James Clark Ross between January and March 2014. The data set will not only be valuable for evaluating reanalysis data but also provide insights into polar meteorology. The Antarctic continent bounds Pine Island Bay on its southern and eastern sides; orographic winds blowing downslope off the continent were a feature on numerous days throughout the science cruise. Several radiosonde time series (3-5 radiosonde launches approximately 3 hours apart) were performed to analyse both these orographic winds and the development of a polar boundary layer.

The overall aim is to describe the key features of this unique observational data set from the Amundsen Sea with a focus on the radiosonde time series events where more insight into the processes taking place can be obtained.

Resources
A comparison of different hybrid methods on the Lorenz 1963 Model

Presenter: Michael Goodliff, University of Reading

Hybrid data assimilation schemes are becoming more widely used in Numerical Weather Prediction (NWP). These methods combine ideas from successful schemes such as 4DVAR and the ensemble transform Kalman filter (ETKF). The motivation behind hybrid schemes is to make use of a flow-dependent background error covariance matrix (Pb) in a variational setting. Although some of these hybrid schemes are being used operationally now, several basic questions on the reasons behind their performance are still open. Hybrid methods mainly differ in their use of Pb. Here we study 3 formulations. The first scheme, ETKF-4DVAR, uses Pb from the ETKF and combines it (weighted) with the climatological background error covariance matrix in 4DVAR (Bclim), at the start of each assimilation window. The second scheme, 4DVAR-BEN, is similar to ETKF-4DVAR but has zero weighting on Bclim. The third scheme, 4DENVAR, uses a the 4-dimensional covariance from the ensemble that alleviates the need for the tangent-linear and adjoint model in the 4DVar. We systematically compare the performance of ETKF-4DVAR, 4DVAR-BEN and 4DENVAR with respect to two traditional schemes (4DVAR and ETKF) on the Lorenz 1963 model. Using the analysis root mean square error (RMSE) as a metric, these schemes have been compared considering assimilation window length and observation interval size.

For short assimilation windows, hybrid schemes are shown to outperform traditional methods. As the assimilation window length increases, sequential schemes become more accurate over both traditional variational and hybrid schemes which use an adjoint model. The 4DENVAR scheme performs slightly better in most cases than the ETKF over longer assimilation windows, which suggests that replacing the adjoint model by 4D-covariances from sequential schemes can increase the accuracy of variational schemes.
Filter clutter from wind turbines through advanced signal processing techniques

Presenter: Dr Elizabeth Brock, Met Office

Reflectivity and velocity information from weather radars is vital for monitoring hazardous weather and winds at high resolution. Clutter from wind turbines can result in spurious high precipitation rates and noisy Doppler winds and is not satisfactorily filtered by existing operational techniques. This is because clutter from wind turbines can have both a stationary component (from the turbine tower and hub) and a rotational component, which is dependent on both the turbine blades’ velocity and orientation. Super refraction of the radar beam can result in clutter from wind turbines that would not occur under normal propagation conditions, meaning that simply knowing turbine location does not result in direct filtering of clutter.

Raw signals collected in a variety of meteorological conditions are analysed and used to investigate the possibility of filtering clutter from wind turbines. Inspection of the power spectrum from areas in close proximity to wind turbines reveals that clutter is not always Gaussian in profile.

The Met Office is testing a frequency domain adaptive signal processing technique that uses a weather and clutter model to remove ground clutter over a variable number of spectral components. The model is applied to the power spectrum and used to interpolate over the components which have been removed from the spectrum. In this way biasing of weather signals, introduced by the clutter filter, is minimized. Initial results are shown.
Vertical profiling of the Pacific Warm Pool during CAST

Presenter: Richard Newton, University of Manchester

The Coordinated Airborne Studies in the Tropics (CAST) Campaign aimed to study the transport of short lived chemical species from the ocean to the tropical tropopause layer by deep convection, taking place in January and February 2014. The campaign was split into an aircraft section consisting of the FAAM BAe 146, the NCAR Gulfstream V and the NASA Global Hawk aeroplanes based in Guam, and a ground-based section launching ozonesondes attached to radiosondes and also measuring ground-level O3, CH4, CO, CO2, H2O and halocarbons based on Manus Island, Papua New Guinea. Both Guam and Manus Island are in close proximity to the West Pacific Warm Pool, a body of water characterized by high sea surface temperatures, where some of the deepest convective storms on Earth occur. The campaign allowed the intercomparison of ozonesonde data with the aircraft and ground data, which is an important validation of the integrity of the datasets.

The ozonesonde launches provided a unique opportunity to obtain ozone profiles from the ground to ~30 km within the regions of deep convection. In total, thirty-nine ozonesondes were launched from 2nd February to 25th February 2014, giving us an extensive dataset covering several different meteorological régimes, which is important to enhancing our knowledge of how ozone profiles differ in different régimes in the tropics.

The preliminary results suggest the existence of low ozone in the tropical tropopause layer during periods of monsoon conditions, when the atmosphere is expected to be well mixed. Back-trajectory analysis of the low ozone “bubbles” in the tropical tropopause layer was used to investigate the origin of the low ozone.
Parameterisation estimation using data assimilation

Presenter: Matthew Lang, University of Reading

In Numerical Weather Prediction (NWP), parameterisations are used to compensate for errors in the model. Errors in NWP models can be due to a lack of scientific understanding or a lack of computing power available to address all known physical processes. Parameterisations are sources of large uncertainty in a model as parameter values used in them are often not well known and/or unmeasurable quantities.

Whilst there are many efficient and effective methods for state/parameter estimation in data assimilation, most are based upon linearisations and there are few methods for estimating parameters that can be extended to the estimation of parameterisations. This is due to the fact that in order to estimate parameterisations, we also need to deduce the structure of the model errors. The method we propose has the potential to utilise these structures and hence estimate parameterisations.

We propose a new method for estimating parameters that uses a model trajectory given from a data assimilation method to estimate the model error. The method compares a pure model run to the analysed data assimilation trajectory and examines the differences in trajectories to get estimates of the parameters.

This method has been applied to estimate parameters in the advection equation. Numerical experiments on the linear and non-linear advection equation will be presented. Furthermore, the method has been used to estimate simple parameterisations in numerical experiments. These results will illustrate the advantages and disadvantages of this method.
Atmospheric aerosols are an important component of the Earth system, interacting strongly with its radiative balance and climate. Substantial changes in anthropogenic aerosol emissions (and their precursors) have occurred in the last few decades due to the implementation of air pollution control legislation and economic growth. Further large changes are anticipated in the future due to additional mitigation measures. The response of atmospheric aerosols to these changes and the impact on climate are poorly constrained, particularly in studies using detailed aerosol chemistry climate models.

We use the HadGEM3-UKCA coupled chemistry-climate model to simulate changes in atmospheric aerosol concentrations over the period 1960 to 2010. The model includes a modal aerosol microphysics scheme and online tropospheric chemistry. Anthropogenic emissions are from the MACCity inventory and the model is nudged to reanalysis meteorology from ECMWF. We present an evaluation of simulated total and sulphate particulate matter against selected monitoring sites from the European Monitoring and Evaluation Programme (EMEP). The average Normalised Mean Bias Factor (NMBF) for total aerosol mass was -1.05. This was particularly evident in southern Europe where a strong low bias existed in both seasons, becoming less negative over time. The average NMBF for sulphate mass was -0.43, with a significant low wintertime bias obtained at all sites.

The average rate of decline in total aerosol mass concentrations over the period 1978-2010 was 1.0 µg m⁻³ per annum in the observations and 0.31 µg m⁻³ per annum in the model. For sulphate mass concentrations, the average rate of decline over the period was 0.05 µg S m⁻³ per annum in the both the observations and model.

We discuss potential explanations for the low model bias including insufficient wintertime oxidants, a lack of secondary organic aerosol from anthropogenic sources, the absence of small scale combustion emissions, or inadequate trends in mineral dust.

An evaluation is also made of the impact of air pollution control legislation on climate by investigating long term trends in radiative forcing over the 1960 to 2010 period.
Examining the role of aviation NOx emissions as a short lived climate forcer

Presenter: Sarah J Freeman, Manchester Metropolitan University

Aviation impacts the atmosphere on a global scale both in the short and long term. In the long term, persistent carbon dioxide (CO₂) emissions are contributing to a warming of the global climate. In the shorter term, more local impacts are resulting from nitrogen oxides (NOₓ), methane (CH₄) and aerosols at the Upper-Troposphere Lower-Stratosphere (UTLS) region (8-12km). Aviation NOₓ has the direct effect of increasing ozone concentration (contributing a positive Radiative Forcing (RF)) and decreasing methane concentrations (negative RF).

Although there have been studies which model the effects of aviation, results still contain large uncertainty and spread, highlighting the need for further research. In recent years the aviation industry has grown strongly. Between 2000 and 2007 passenger traffic increased by 38%, despite events affecting the industry throughout the decade. Scenarios produced by the IPCC (2007) estimate aviation fuel consumption to increase by factors of 2.7 – 3.9 by 2050. International aviation is currently not included in the Kyoto protocol, and as a result is also not included in international emissions reductions policies.

This study will use a suite of models and international aviation fuel inventories to examine the effects of aviation over different time scales. The main aim is to examine the role of aviation NOₓ emissions as a short lived climate forcer. Also, to determine what effect a reduction of Short-Lived Climate Forcers (SLCFs) such as aircraft NOₓ, at the expense of CO₂ emissions, might have on longer term (> 100 years) global climate, and therefore examine whether controlling aviation NOₓ emissions would reduce or limit global warming.
Aerosols associated with large scale biomass burning (BB) impact upon weather, climate, human health and ecosystems at global and regional scales. However, quantitative evaluation of these effects is impeded by a limited understanding of BB processes and a dearth of direct measurements of aerosol properties. These result in large model uncertainties, especially over data poor regions such as Brazil, where intense burning is widespread throughout the dry season. Thus, the South American Biomass Burning Analysis (SAMBBA) field experiment of 2012 was timely, offering the chance to reduce these uncertainties.

This particular work focusses on regional haze, a complex and inhomogeneous accumulation of aged BB aerosols capped within the boundary layer, present across swathes of South America. This pollution has a substantial impact on the regional radiation budget through direct and indirect effects. We utilise measurements from the suite of in-situ instrumentation onboard the UK Facility for Airborne Atmospheric Measurement (FAMM) BAe-146 research aircraft, including an Aerodyne Aerosol Mass Spectrometer (AMS) and a DMT Single Particle Soot Photometer (SP2). Flights were undertaken from a base in Porto Velho, Brazil, throughout September and October 2012. Haze was defined as any point within the boundary layer that was not a plume, as identified by a low-pass filter.

To contextualize the aircraft measurements, the temporal and spatial variability of the regional haze was investigated using Aerosol Optical Depth (AOD) retrievals from MODIS and AERONET. Both measurements were consistent: AOD was elevated (> 1) across much of Brazil at the start of the SAMBBA period, however this diminished throughout the remainder of the campaign as the transition toward the wet season began, with frontal activity causing wet removal and advection. Aerosol mass and number concentrations from the aircraft measurements decreased concurrently with this meteorological forcing, however the relative atmospheric structure, composition and optical properties remained similar, where comparative data was available. For instance the ratio of OA:BC (Organic Aerosol: Black Carbon) throughout the atmospheric column was maintained close to 10:1 during the campaign, regardless of BB type or meteorological drivers. Likewise, the vertical structure of aerosol remained similar, with an elevated maxima in mass and number concentrations at ~1km. It was only the absolute concentrations which fluctuated.

Of significance for regional aerosol forcing was the observed contrast in haze optical characteristics between the western regions of Brazil (Rondônia) and eastern areas (Tocantins). In the east, much greater mass loadings of black carbon resulted in a mean single scattering albedo of 0.84 compared to 0.91 across western regions, reducing the magnitude of negative forcing from the direct radiative effect. Such differences are the result of flaming vs. smouldering combustion, as observed near source, in addition to surface albedo.

This work presents a synthesis of the state of the Amazonian atmosphere during the dry season, as measured in-situ by a research aircraft. This includes descriptions of atmospheric thermodynamics and gas phase mixing ratios, but focuses on aerosol physical and chemical properties.
Much of the industrialised world is effected by large scale pollution episodes, which have implications upon human health, the environment and quality of living. While Asian events are most documented, within the UK during a time where tighter restrictions on fuel and emissions are continuously being implemented, exceedences of harmful tropospheric pollutants still occur. Epidemiological studies have identified two of the pollutants presenting the greatest hazard to human health as ozone and particulate matter, which are pollutants that exceed their respective daily limit values within the UK during pollution episodes, therefore motivating the pollutants analysed in this study as ozone and PM10 (Particulate matter with an aerodynamic diameter $\leq 10\mu m^{-3}$). The aim of this study is to establish a framework for predicting large scale pollution episodes by using synoptic scale meteorology. Rossby-wave breaking is a phenomenon that can lead to blocking high pressure systems, which are invariably associated with such pollution episodes. By exploiting an indices called the blocking index, important information can be inferred as to not only the weather conditions over the site of interest, but also of the surrounding synoptic picture. Early results suggest some skill in predicting advected pollution and stagnant events leading to pollution episodes in the UK, by inferring characteristics of the blocking index.
With increasing electricity generation from renewable energy resources, the amount of weather
dependence within a power system will increase. Weather dependence comes from investment in
technologies such as wind, solar and hydropower which are dependent on wind speed, incoming
short wave radiation and precipitation respectively. Demand is also weather dependent, relying
on temperature, the previous days temperature, wind chill and cloud cover. This project will
attempt to quantify the effect that increased proportions of these weather dependent generation
units will have on the power system as a whole.

Surface wind speeds and temperatures from the HiGEM climate model will be validated against
MERRA data to see if similar daily variability is reproduced. Load duration curves for demand and
demand net wind will be constructed to show how variability effects the capacity requirements of
the power system. Initial work has involved using a simple optimisation model of the UK power
system to investigate potential constraints. Initial runs driven by reanalysis data suggest that
wind-induced power ramping constraints may be of secondary importance to determining the
aggregate energy mix at the national level beyond the day-ahead balancing timescale.

This work will later feed into a more complex, weather dependent energy system model.
Understanding quantitatively the effect of variability would be of great value to policy makers and
power system operators alike.
Windstorms, or extra-tropical cyclones with intense surface wind speeds, are a major source of risk for European people. Windstorms can cause aggregate insured losses comparable to that of US landfall hurricanes: for example, the cluster of three storms Anatol, Lothar and Martin in December 1999 led to insured losses of €8 billion.

A geostatistical model has been developed to simulate synthetic windstorm footprints. The footprint of a windstorm is defined as the maximum 3 second gust at each grid point in the model domain over a 72 hour period covering the passage of the windstorm. The geostatistical model is based on the footprints of 50 extreme historical windstorms taken from the Extreme Wind Storms (XWS) catalogue developed by scientists, including myself, at the Met Office, the University of Reading and the University of Exeter.

The method for developing this geostatistical model will be explained. Preliminary results from a sensitivity analysis exercise, aiming to identify to which windstorm footprint characteristic insurance loss is most sensitive, will also be presented.
Verification of automated convective cloud reports for aviation

Presenter: Katie Brown MSci ARAeS, Met Office

AutoCB’s are automated convective cloud and sferic reports produced as part of the AutoMETAR project at the Met Office. The reports are currently generated operationally every 5 minutes at 8 airfields across the UK (Glasgow, Edinburgh, Stansted, Gatwick, Cardiff, Luton, Heathrow and Manchester). Following a trial run from June to November 2010 (inclusive) which concluded that the automated method was a fair way of representing the manual observations, the AutoCB service was made operational.

This presentation discusses verification of the service, some of the challenges faced in verifying the product against manual METARs and why the method used was chosen. The results of the study are presented and conclude that the automated system performs well according to the current specification particularly considering the human observer subjectivity in producing cloud or sferic reports.
The role of meteorology in capacity management of European airspace

Presenter: Claire Bartholomew, Met Office

The constant increase in global air travel, alongside environmental restrictions, means that capacity management of airspace will continue to be an ongoing challenge and key focus for the aviation community. Meteorology is integral to this as disruptive weather events can be of huge significance to network capacity, whether from impacts at airports or during the en-route phase of flight. Capacity reduction due to bad weather is highly influenced by the preparedness of airports and air traffic management (ATM) having processes and equipment in place to deal with such events. Accurate forecasts can therefore help to prepare for, and mitigate against, negative impacts due to weather conditions.

Probabilistic forecasting is a relatively new concept for applications within the aviation industry and so an aim of this work has been to make more of the full potential that this type of met information has to offer to ATM. It can help to provide a better indication of not only the probable, but also the possible, weather conditions that may occur and cause disruption. In doing so, it gives far more relevant and valuable information for decision-making and planning purposes.

This presentation will look at the key weather conditions affecting network capacity reduction across Europe, proposing the most suited approach for the integration of probabilistic weather information into impact assessment. This work comes under the Single European Sky ATM Research (SESAR) Joint Undertaking, which is a European-wide programme with the mission ‘to develop a modernized air traffic management system for Europe, which will prevent crippling congestion of the European sky and reduce the environmental impact of air transport’.
Event attribution and its potential role in loss and damage negotiations

Presenter: Hannah Parker, University of Reading

There is currently limited knowledge about how specific extreme weather events are being affected by climate change. The emerging science of probabilistic event attribution aims to quantify the impact of external climate drivers on extreme events, by assessing changes in the probabilities of particular events occurring. The most extreme events are, by definition, relatively rare so large ensembles of simulations are carried out to calculate the probabilities of an event occurring in climates both with and without a particular climate driver, such as anthropogenic greenhouse gas emissions.

The United Nations Framework Convention on Climate Change Loss and Damage workstream aims to address loss and damage associated with climate change in developing countries vulnerable to these impacts. As an international mechanism to address loss and damage becomes more established, questions are raised around whether policy makers are aware of the science associated with attributing extreme weather events to climate change. With some developing countries calling for compensation for loss and damage, will scientific evidence of links between extreme weather events and climate change be necessary for these countries to access finance? Could probabilistic event attribution provide this evidence? In this talk I will review the perceptions of event attribution from those working at the science-policy interface, and whether it is has a role to play in the Loss and Damage workstream.
Several studies have reported links between ENSO and Thailand rainfall. Indeed La Niña is widely believed to have contributed to the record Thailand floods in 2011. However, the strength, significance and stationarity of these links remains unclear. We quantify the influence of ENSO on Thailand rainfall using monthly records of the Southern Oscillation Index (SOI) 1901-2011, monthly records of the Oceanic Niño Index (ONI) 1951-2011 and monthly records of Thailand rainfall on a 0.5° grid 1901-2011. Robust annual (Jan-Dec) and monsoon-season (May-Oct) SOI and ONI time series are created by weighting using normalized monthly climatological Thailand rainfall totals. La Niña and El Niño events are selected using quartile and tercile thresholds. Analyses are performed separately for annual and monsoon-seasons for each time period 1901-2011, 1901-1950 and 1951-2011. We find that ENSO events which persist with the same anomaly sign for more than one year are associated with larger and more significant annual and monsoon-season rainfall totals across most of Thailand. The effect appears strongest for La Niña and is seen similarly in each temporal split. Thailand rainfall totals for second/multi year La Niña events are, on average, double or three-times greater than rainfall totals for first/single year La Niña events. With 2011 being a second year La Niña event it would appear likely that this effect contributed to the excessive rainfall totals and flooding.
Weather, etc.' Writing Home

Presenter: Penny Newell BA MA AKC, King’s College London, PhD Candidate In English

This paper will argue toward a transformation of our understanding of the importance of picture postcards in citizen weather mapping. ‘Weather, etc.’ is an artistic venture to build a map of changing cultural conceptions of regional climate. This project began some months ago, when I found a trunk on a market in London, crammed with unwanted, tattered and sent picture postcards. Reading through these postcards I began to realise the significant role that archival materials such as postcards might perform in forming our understanding of citizen engagement with the weather. I have since been collecting postcards, sent from locations across the globe to ‘home’ in the UK.

Before social media, such as pinning, blogging, tweeting, Instagram or email, postcards have been functioning as singularly succinct platforms for citizen engagement with the weather, containing details that might allow us to build new forms of weather maps. Each postcard contains a date, in the form of a postmark, an origin, a destination, and a comment upon the weather. The details contained on each postcard thus permit it to form a line, tracing a weather message between two locations. This might be said to give an insight into the weather at the point of origin, wherein the postcard functions as a data-set of weather conditions. However, this paper will also argue that each message on the back of each postcard is imbued with data of cultural expectations and beliefs about global climate. I will argue that what we choose to write ‘home’ about the weather from a distant location reveals as much about the weather at home as it does the place of postcard composition, focusing both through the lens of cultural conceptions of climate. This is a project about how we perceive the weather, and our heightened awareness of weather conditions when away from our ‘home’ environment.

Whilst arguing toward a reappraisal of the information revealed by postcards, this paper also offers an overview of the potential methodologies that I am exploring to catalogue and organise these artefacts. Setting the parameters of date boundaries and grouping postcards in various ways produces different forms of weather maps. Ultimately, this paper will offer an insight into my artistic vision of creating a website, containing an interactive historical weather map, modelled on these postcards.
Seasonal prediction is the difficult task of attempting to forecast average weather conditions several months in advance. Any accuracy in doing this requires the presence of low-frequency, predictable signals in the climate system. A potential source of these signals is the stratosphere - particularly in the Southern Hemisphere - where anomalies can persist for more than two months. Despite this, most operational seasonal forecast systems have included only a very poor representation of the stratosphere.

As part of a CASE studentship with the Met Office, I have investigated the skill of the latest Met Office Global Seasonal Forecast System (GloSea5) using a set of historical re-forecasts. Importantly, this system includes a full representation of the stratosphere. I found that the system has significant skill in the prediction of large scale Southern Hemisphere surface weather patterns up to four months ahead during spring. By studying the variation of this skill with time and altitude, I have demonstrated that it largely results from long-lived stratospheric anomalies which descend with time. Together, these results represent a significant advance in the skill of seasonal forecasts of the Southern Hemisphere and highlight the importance of accurate modelling and observation of the stratosphere in producing long-range forecasts.
Distinguishing regimes of convective-scale predictability using an appropriate convective adjustment timescale

Presenter: David Flack, University of Reading

Convection permitting models are now being used operationally and consequently fine-scale data assimilation techniques are being implemented. This could lead to improvement in the forecasts of convective events. Here, work is presented which tests the hypothesis that the balance between the improvement of forecast skill from a larger ensemble size compared with the use of a higher resolution model is regime dependent. The separation between the regimes of convective quasi-equilibrium and triggered convection is performed by applying a convective adjustment timescale. This timescale is shown to be sensitive to the averaging technique used in its calculation; regime classification is affected by whether the timescale is calculated using the average of the precipitation field over areas where it is raining or the average over the entire environment (both approaches have been used in previously published research by other authors). This work also shows that the sensitivity is more pronounced for a triggered convective event compared to one in quasi-equilibrium. This diagnostic paves the way for testing the above hypothesis and examining the link between regime and convective scale error growth in convection permitting ensembles.
Energy balance model-based assessment of factors affecting global surface air temperature

Presenter: Maria Gusakova, Russian State Hydrometeorological University, St. Petersburg, Russia

The variability of basic climatic factors (total solar irradiance, albedo, greenhouse gases including water vapor, cloudiness and aerosol) were investigated to assess their contribution to inter-annual global surface air temperature changes. To evaluate the contribution of each factor an energy balance model was developed. As is known, fluctuations of cloudiness and amount of aerosol particles can lead to global albedo changes while increase or decrease of greenhouse effect depends on greenhouse gases, water vapour concentration and cloudiness. The analysis of greenhouse effect components made it possible to carry out parameterization of greenhouse effect to assess contribution of cloudiness, greenhouse gases, including water vapor, to global surface air temperature changes. The results obtained show that water vapor plays a dominant role in changes in global surface air temperature caused by greenhouse effect. The contribution of aerosol and cloudiness on inter-annual global albedo changes was investigated which made it possible to assess albedo’s effect on global surface air temperature. The results show that even the smallest fluctuations in total solar irradiance and global albedo intensify both positive and negative feedback in the atmosphere which gives rise to considerable changes in global surface air temperature.
Evaluating the ability of high resolution climate models to represent damaging European Windstorms

Presenter: Josie Bowler, University of Reading

The characteristics of high insurance loss windstorms over Western Europe are compared between observational reanalysis data (the XWS extreme European windstorm catalog) and data from the HiGEM high resolution coupled climate model HiGEM. Storms are identified and selected based upon the i) cost of insurance damage created by the storm and ii) different meteorological indices. The comparison characteristics are then chosen, including the windstorm footprint, the geometric centre of the windstorm footprint, the location of maximum wind-speed and the cumulative wind speed distributions. The comparison methods are applied to both the XWS and HiGEM data to evaluate whether the HiGEM data accurately represents characteristics of these 'high-loss' windstorms which has implications for improving risk analysis for insurance purposes.
Performance metrics are a quantitative approach to assess climate model skill through comparison with observations. Output from such evaluations can be used for model development purposes by highlighting areas of simulation error, or for constructing future climate change projections through methods such as model elimination or ensemble weighting with the overall objective of reducing the range of projection uncertainty. There are four main choices to make before applying a performance metric: variable, temporal-spatial domain, statistical test and observed reference data set. Many past studies have investigated model skill using performance metrics with somewhat ad hoc approaches, without full regard to the effect that these choices may have on the outcome. It is important therefore to assess the degree of sensitivity of performance metrics to variations in each of the four metric components to increase confidence in the robustness of metric output, and any further use thereof. To this end, regional climate model (RCM) data from the European ENSEMBLES project is being utilised in conjunction with the E-OBS observational dataset to assess sensitivity to the first three aspects. The analysis is designed to assess the degree to which absolute and relative (compared with other models in the ensemble) model performance is affected by changes in evaluation methodology, in addition to the possibility and consequences of redundancy in different choices. The overall aim of this research is to increase the level of objectivity in the use of performance metrics. Future work will investigate approaches to combine individual metric output into single generalised performance indicators, as well as the stationarity of metric performance in climate change projections.
Oral Session 7: Clouds and Microphysics

Retrieving the microphysics of mixed-phase regions embedded within deep ice clouds using dual polarisation radar

Presenter: William Keat, University of Reading

Mixed phase clouds are fundamental in the production of precipitation, and are known to exert a key role on Earth’s radiation budget. Yet our understanding of the spatial and temporal extent of these conditions remains poorly understood, primarily due to a lack of observations. In the presence of supercooled liquid water (SLW), pristine oriented crystals grow rapidly by the Bergereon-Findeison mechanism and so can be used to infer its presence (Hogan et. al., 2003). Since pristine oriented crystals preferentially fall with their major axis horizontally aligned, these crystals are observable from dual polarisation radar as regions of elevated differential reflectivity (ZDR). This is straightforward where they are the dominant crystal type; observing their signal when they exist amongst larger aggregates is challenging because the aggregates mask the signal from the pristine crystals (Bader et al 1987). Here, we present a method to identify and retrieve the microphysics of these embedded mixed-phase regions using observations from the S-band Chilbolton Advanced Meteorological Radar (CAMRa). The quantitative use of the co-polar correlation coefficient ($\rho_{hv}$) which characterises the mixture of particle shapes in a sample volume to reveal these crystals is demonstrated for the first time. By combining observations of ZDR and $\rho_{hv}$ with a two-population forward model, the fraction of horizontal radar reflectivity from the pristine crystals and aggregates, and the intrinsic differential reflectivity (ZDRI) of the pristine crystals can be retrieved. Preliminary retrieval results for ZDRI are consistent with laboratory experiments of pristine crystal growth.
In 2013, the International Panel on Climate Change (IPCC), concluded that the coupling of clouds with the Earth's atmosphere is the biggest uncertainty in predicting climate change today. By reflecting incoming solar radiation and trapping outgoing terrestrial radiation, clouds have both cooling and warming contributions. The extent of these contributions is largely governed by the microphysical composition of the cloud. As such, ice clouds are of particular interest due to the large range of crystal shapes and sizes, leading to considerable variations in the net radiative effect. In addition to this, ice clouds have an extensive global coverage of 30% and therefore play a significant role in the global climate.

This presentation discusses ongoing work in the Manchester Ice Cloud Chamber (MICC). The facility comprises a 10 meter fall tube and can produce clouds with a variety of ice crystal sizes and shapes. A ccd array spectrometer is used to measure the intensity of radiation scattered by the cloud. The cloud composition is monitored simultaneously by the use of a Cloud Particle Imager (CPI) and ice crystal replicas. By altering the humidity in the chamber, the internal structure of the ice crystals is controlled in order to produce predominantly solid or hollow ice crystals. The measured effect of hollowness on the single scattering properties is presented here alongside modelled results.
Cloud coverage is among the most significant key factors affecting earth’s climate change, particularly by its high influence on earth’s albedo - the reflection coefficient. It’s a great challenge to simulate clouds behaviour over time, all over the globe. In order to make climate prediction there is a need in a full picture of cloud processes. This goal can be partly achieved by parameterisation of experimental lab results.

The CLOUD (Cosmics Leaving OUtdoor Droplets) research project is a vigorous attempt to answer these questions by experimental work in collaboration between several leading European institutes, taking place in CERN, Switzerland. The cloud chamber in CERN accompanied by a variety of state of the art spectrometers, counters, imagers and analysers can imitate different conditions in the real atmosphere such as Ionization, Temperature, Relative humidity, Pressure and changing rates of adiabatic expansions as well as the formation of cloud seeds and ice nuclei. Our group in Manchester University uses instruments which allow differentiating the phase states, counting the concentrations, sizes and imaging the physical shapes of ice crystals. These experiments will provide a deeper understanding of different stages and mechanisms in droplets/ice formation and growth in clouds and should contribute much to our fundamental understanding of their effect on climate.
Evaluating aerosol influence on cloud development in models using in-situ measurements during the INUPIAQ Campaign

Presenter: Robert Farrington Centre of Atmospheric Science (CAS), University of Manchester

At temperatures between -35°C and 0 °C, the presence of insoluble aerosols acting as IN is the only way in which ice can nucleate under atmospheric conditions. Previous field and laboratory campaigns have suggested that nucleation of ice by mineral dust present in the atmosphere may explain the observed concentrations of ice at temperatures warmer than the homogeneous threshold of -35°C (e.g. Sassen et al. 2003, Connolly et al. 2009, Atkinson et al. 2013). However, difficulty has arisen in understanding exactly the processes which cause ice nucleation at temperatures of around -5°C, with biological aerosols and feldspar suggested to cause nucleation at higher temperatures. Due to the focus of laboratory experiments on specific aerosols, rather than those present in the atmosphere (Hoose and Mohler 2012), the need for improved in-situ measurements of ice nucleation to test models against has become clear.

As part of the Ice NUcleation Process Investigation and Quantification (INUPIAQ) project, two field campaigns were conducted in early 2013 and early 2014. Both campaigns included measurements of both droplet and crystal size distributions, number concentrations and cloud imaging at the summit of Jungfraujoch in Switzerland (3580m asl). Using data from the 2013 campaign and WRF modelling, an upwind site, located at Schilthorn (2970m asl) was determined for measuring aerosol size distributions, number concentrations and chemistry out of cloud during the 2014 campaign. The measurements of aerosols from the upwind site were then used to compare with cloud droplets and ice crystal measurements from the Jungfraujoch site and investigate the role of aerosols in the properties of the clouds at Jungfraujoch. Further measurements of the clouds, aerosols and turbulence in the air arriving at the site were taken remotely using a doppler lidar located at Kleine Scheidegg (2061m asl).

The aim of this project is to determine whether detailed aerosol information is important to determining cloud and precipitation properties downwind. To this end WRF modelling is used to compare the modelled and measured ice number concentrations, using the aerosol number concentrations measured at the Schilthorn site to initialise the model runs. These results will be presented and discussed at the meeting.

References
Investigating aerosol-cloud interactions in the Arctic during the ACCACIA campaign: relating the properties of atmospheric aerosol to cloud microphysics using ESEM/EDX analysis.

Presenter: Gillian Young, University of Manchester

The lack of observations in the Arctic currently hinders our ability to comprehend and climatologically model this region, and the interaction between aerosol and clouds in particular represents a significant uncertainty in models (e.g. Curry et al. 1996; Morrison et al. 2008). The properties of Arctic aerosol and their ability to nucleate ice is of key importance, as there is an outstanding difference in how these concentrations correlate with the cloud microphysics in this region (e.g. Prenni et al. 2007; Gayet et al. 2009). In an effort to combat this issue, the Aerosol-Cloud Coupling and Climate Interactions in the Arctic (ACCACIA) campaign of 2013 was conducted in the vicinity of the Svalbard archipelago. This campaign involved in-situ airborne and surface measurements of the polar atmosphere, providing an effective platform to study the cloud microphysics in detail. To collect an in-situ sample of the atmospheric aerosol, polycarbonate filters were exposed from the FAAM BAe 146 aircraft during the winter segment of the campaign. These filters were analysed with the Environmental Scanning Electron Microscope with Energy-Dispersive X-Ray Spectroscopy (ESEM/EDX), with the aim of determining the distribution in size and composition of the particles collected. This analysis will be presented, coupled with data from the variety of cloud-observing probes on board the aircraft, to provide an indication of which aerosol properties may be producing the ice crystal concentrations in the clouds observed.
Oral Session 8: Oceanography and Biosphere

A coupled study of sensitivity analysis and multi-objective calibration of the JULES model to find a better vegetation parameter set for simulation in Great Britain.

Presenter: Hon-man Wong, PhD candidate, Centre for Ecology and Hydrology, University of Aberdeen

Vegetation modelling is an important component of climate models because it estimates how much carbon is stored in plants and soils. The balances of energy and water cycles on land surface are also affected by vegetation.

Most vegetation models are heavily based on parameters. Although uncertainty exists, many applications of the models do not account it. That creates a problem. When model simulations suggest deviation from observed data, modelling scientists do not know which aspect of model should be investigated.

In this study, we conducted a coarse evaluation using observed data in Great Britain and found that the JULES model did not simulate the key vegetation variables well. We hypothesised that the unsatisfactory performance could be addressed if we take parametric uncertainty into account and calibrate the model. A fractional factorial experiment was done to find out which parameters are more important. We then conducted literature review and construed a semi-empirical feasibility space to account the parametric uncertainty. The Latin Hypercube Sampling strategy was deployed to take sampled parameter sets which were later applied to check if the model's performance could be improved. Our results showed that improved parameter sets could be found in the feasibility space to address the uncertainty in simulation of trees. The calibration did not offer good solution to address the deviation in simulation of grasses. We suggest from the results that the future development of JULES should be plant-specific: for trees, take parametric uncertainty into account; for grasses, conduct a more thorough investigation of the model's formulation.
Air-sea interactions during high winds in the Labrador Sea

Presenter: Matthew J Amison, School of Earth and Environment, University of Leeds

A high level of uncertainty is associated with air-sea interactions during high wind events. This uncertainty affects the ability of models to accurately predict the effect of air-sea gas exchange and aerosol production on the climate. From October 9th to November 13th 2013, the R/V Knorr undertook a research cruise in the Labrador Sea, with the aim of gaining a greater understanding of the dependence of air-sea fluxes on sea state under high wind conditions. Fluxes of momentum, heat, moisture, sea-spray aerosol and several trace gases including CO$_2$, DMS, and methanol were determined using the eddy covariance technique; multiple buoys were deployed to both measure wave spectra, and study wave breaking. The Labrador Sea was chosen due to both its regular, strong low pressure systems, creating plenty of opportunity for high wind events, and its high CO2 concentration gradient at the air-sea interface.

Here we show a comparison between the different wave measurements from waverider and spar buoys, and preliminary results on the effects of swell and wind-sea on the surface fluxes.
The North Atlantic ocean is a major sink for atmospheric CO2 storing ~ 23% of the anthropogenic CO2 in 1994. However, recent observational studies have pointed to a decrease in the oceanic CO2 sink between the mid-1990s and mid-2000s in the northern (>45° N) North Atlantic region. In addition to an apparent downward trend in the North Atlantic oceanic uptake of atmospheric CO2 there is large seasonal to inter-annual variability of the North Atlantic carbon sink. There is still considerable debate regarding the underlying mechanisms of both the long-term trend and the shorter-term variations in this oceanic CO2 sink. Using in-situ measurements of the partial pressure of CO2 (pCO2) and output from a coupled ocean-biogeochemical model, I discuss possible mechanisms that could explain the seasonal to inter-annual variability of the North Atlantic carbon sink.
The lifecycle of the North Atlantic Storm Track

Presenter: Lenka Novak, Department of Meteorology, University of Reading,

The North Atlantic eddy-driven jet exhibits latitudinal variability, with evidence of three preferred latitudinal locations: south, middle and north. Here we examine the drivers of this variability and the variability of the associated storm track. We investigate the changes in the storm track characteristics for the three jet locations, and propose a mechanism by which enhanced storm track activity, as measured by upstream heat flux, is responsible for downstream latitudinal shifts in the jet. This mechanism is based on a nonlinear relationship between baroclinicity and meridional high-frequency (periods of shorter than 10 days) eddy heat flux, which induces an oscillatory behaviour of these two quantities. Such oscillations in baroclinicity and heat flux induce variability in eddy anisotropy which is associated with the dominant type of wave breaking and the northward deflection of the jet. Our results suggest that high heat flux is conducive to a northward deflection of the jet, whereas low heat flux is conducive to a more zonal jet. Since this jet deflection effect was found to operate most prominently downstream of the storm track maximum, the storm track and the jet remain anchored at a fixed latitudinal location at the upstream side of the storm track. These cyclical changes in heat flux and storm track characteristics can be viewed as different stages of the storm track's spatio-temporal lifecycle.
A climatological study of the roles of baroclinicity and latent heat release in the life cycles of polar lows

Presenter: Chris Fairless, University of Manchester

Polar lows are intense, small-scale (200–1000 km) storms that form poleward of the main storm tracks during marine cold-air outbreaks. Their scale makes them notoriously difficult to forecast and they pose a threat to shipping, marine infrastructure and coastal communities. Their energy is drawn from baroclinic processes, latent heat release, or both. The relative importance of these mechanisms influences their structure: polar lows can resemble extratropical cyclones, hurricanes and a broad spectrum in between.

It is only very recently that long-term model simulations can be performed which resolve polar lows sufficiently well for direct, automated detection. The new Arctic System Reanalysis is used to create a climatology of polar lows for the period 2000–2012. Polar lows are diagnosed as 850-hPa vorticity maxima in polar air masses, with associated winds above 15 m s⁻¹. They are tracked at 3-hourly intervals, and identified characteristics include size, central pressure, precipitation, surface fluxes and vertical structure. The climatology is used to populate a cyclone phase space originally developed by Hart (2003) that categorises the life history of each polar low by its baroclinicity and vertical temperature profile (i.e., cold-core or warm-core) in two different layers. Polar lows can be warm-core or cold-core, and the dominant mechanisms of polar low initiation and development vary considerably between individual lows. Low-level baroclinicity in polar low formation is found to vary by region and large-scale flow, and decreases at higher latitudes, where there is a higher frequency of more convectively-driven systems.

Reference
Atmospheric flow over South Georgia and the impacts on regional climate - Föhn wind events

Presenter: Daniel Bannister, British Antarctic Survey

Average summer temperatures over South Georgia have risen by around 1 C since the 1920s, while glaciers have retreated at variable rates. In parallel with these changes, surface westerlies have increased by about 3 m/s. As South Georgia is a mountainous island, with 19 peaks over 2 km, strong downslope winds can develop on the lee side of the island causing dramatic temperature increases as the descending air warms adiabatically — this is known as the föhn effect.

In this talk, I will investigate the extent by which these observed changes are due to the föhn effect by showing results from a climatological analysis based on AWS data, and high-resolution simulations using the Weather Research and Forecasting (WRF) model.

A better understanding of these atmospheric processes will provide greater confidence in modelling regional climates in mountainous terrain, as well as producing better predictions concerning South Georgia’s terrestrial and marine environments which support rich yet delicate ecosystems.
The generation of downwind rainbands by mountains

Presenter: Carly J Wright, University of Reading

The goal of this project is to identify the conditions leading to the formation of precipitation bands downwind of mountains through different mechanisms. While relatively small in scale (a few tens of km across by up to ~100 km in length) these bands can cause localised flooding as they can be associated with intense precipitation over several hours due to the anchoring affect of orography. The focus will be on three mechanisms: lee waves, lee-side convergence and negative potential vorticity banners. The mechanisms of lee waves and lee-side convergence have been the subject of much previous research but negative potential vorticity banners have only recently been postulated as a cause of precipitation bands and their prevalence is unknown. A case study of a precipitation band that was observed, using radar data, over Scotland on the 29 December 2012 is presented. This case study was chosen due to the occurrence of heavy continuous precipitation, near orography. From radar data a clear band formed along The Great Glen Fault, which lies between the Northern Highlands and the Grampian Mountains. The deterministic convective-permitting (UKV) Met Office model forecast fails to represent the band. However, the similar banding was captured by some members of the ensemble convective-permitting (MORGREPS-UK) Met Office forecast. The local forcing of the band is assessed through divergence and convective available potential energy (CAPE). The complexities of case study analysis demonstrated here support the planned future idealised modelling approach for this project.
The influence of cyclone propagation patterns on England and Wales extreme rainfall accumulations

Presenter: Ruari I. Rhodes, University of Reading

Wide-area flooding events in England and Wales are commonly caused by high levels of rainfall accumulation from extra-tropical cyclones, over a broad range of time scales. The propagation patterns of cyclones often have direct influence on the duration and intensity of an individual rain event (e.g. stalling), and on the total accumulation over a number of storms (e.g. clustering). An evaluation of rainfall accumulations, derived from England and Wales Precipitation observations, is presented by means of case study and statistical evaluation focussing on the concepts of clustering and stalling in tracks of 850hPa relative vorticity from ERA-Interim reanalysis.
Misrepresentations of physical processes in a numerical weather prediction model will result in errors in forecasts. This can be viewed from a potential vorticity (PV) perspective. PV is conserved for adiabatic and inviscid flow and can be inverted, with suitable balance and boundary conditions, to obtain all the dynamical fields. The conservation property of PV means it is advected like a tracer. The invertibility principle means we can deduce, to a good approximation, the instantaneous wind and temperature fields from the PV distribution. By calculating the changes in PV due to the various parametrisation schemes within the model at each timestep and then advecting them as separate tracers the downstream effects of these non-conservative processes, integrated along the time of the numerical weather simulation, can be quantified. The close link between this PV tracers method and the numerical schemes means they can, in theory, be used to trace back forecast errors to the processes responsible in the model. This PV tracer method has been applied using the Met Office's Unified Model to a case of cyclogenesis observed during the DIAMET (diabatic influences on mesoscale structures in extra-tropical storms) project. The Unified Model represents radiation, microphysics, gravity-wave drag, convection and boundary layer processes through parametrisation schemes. The accumulated effects each of these processes on the PV structure near the tropopause through the stages of the cyclone development is shown using their respective PV tracers. The use of an additional ‘advection only’ tracer, which is the initial PV advected conservatively through the model run, shows that the net direct effect of diabatic processes is to strengthen the tropopause without moving it.
Cyclone Interactions in the 23-26 September UK Floods

Presenter: Sam Hardy, University of Manchester

Following the wettest summer in 100 years, major river flooding affected the UK in late September 2012 as a slow-moving extratropical cyclone brought over 100 mm of rain to parts of northern England and north Wales. The cyclone began life near the Azores on 21 September as a frontal wave disturbance to the northeast of tropical cyclone Nadine. Tropical moisture to the east and southeast of Nadine was pulled poleward as an approaching upper-level trough and thinning potential vorticity (PV) anomaly approached the tropical cyclone. This interaction facilitated the development of an extratropical low northeast of Nadine, which subsequently moved farther north-eastward away from Nadine and towards the UK on 22—23 September. The extratropical low then coupled with a second, stronger upper-level trough moving south-eastward from Iceland, resulting in a period of enhanced deepening over the UK on 24—25 September.

Weather Research and Forecasting (WRF) simulations examine the development of the cyclone in more detail. A simple control simulation (15-km grid spacing) captures the interaction between Nadine and the upper-level trough and the development of the breakaway low northeast of Nadine. The simulated low deepens as it approaches the UK, roughly following the observed track. Despite the relatively faithful simulation of the synoptic-scale interaction, some of the finer details are not adequately represented. Whereas the developing frontal wave began deepening almost immediately, albeit slowly, on 21 September near the Azores, the simulated low fails to deepen much until reaching the UK on 23 September. Furthermore, the movement of the low is too fast, which reduces the final rainfall accumulations across the UK.

Further WRF simulations increase our understanding of the physical processes responsible for the development of a breakaway extratropical low to the northeast of Nadine, and the subsequent deepening of this low over the UK. To what extent did the availability of tropical moisture to the east and southeast of Nadine enable extratropical cyclogenesis to the northeast of Nadine? How did the interaction between the extratropical low and the second upper-level trough from Iceland affect the subsequent rainfall accumulations across the UK?
Acceleration of strong winds in idealised simulations of extratropical cyclones.

Presenter: Tim Slater, Centre for Atmospheric Science, University of Manchester

The previous winter has seen Britain and Western Europe battered by storms, some of these containing winds up to 40 m/s (90 mph). An initial estimate of the combined insured losses from just three of these storms (Christian, Dirk and Xaver) exceeds 1.5 billion pounds. However, the impacts of each of these storms varied from region to region suggesting the importance of mesoscale variations within these storms.

The storms above all developed strong winds to the south of the low in association with a bent-back front (the extension of the warm front behind the cyclone centre). Studying the Great Storm of 15–16 October 1987, Browning (2004) found that the strongest surface winds occurred to the south of the low and east of a region of cloud banding at the tip of a distinctive, hooked cloud head. Observations of this banding and associated mesoscale slantwise circulations led Browning (2004) to suggest that wind maxima to the south of the low could be explained by evaporative cooling or conditional symmetric instability. However, strong winds to the south of the low can also be associated with cold conveyor belts, a large-scale airflow within the cyclone. So what are the dominant causes of strong winds south of the low centre? To investigate this question, idealised, extratropical cyclones were simulated using the Weather Research and Forecasting (WRF) model. The regions of strong winds within these extratropical cyclones were then analysed using the horizontal momentum equation, which relates the acceleration of an air parcel to the forces acting on it. Initially, the model was run dry on a horizontal grid of 20 km. The resulting simulation reproduced a rapidly-developing, Shapiro–Keyser-type cyclone with regions of strong winds developing north-east and south-west of the low. The region of strong winds south-west of the low was characterised by three airstreams; a cyclonically descending airstream, a cold conveyor belt, and a third airstream characterised by air parcels that accelerated during descent from the mid to lower troposphere. A moist simulation was also performed and will be compared to the dry simulation. In particular, the effect of the moisture on the pressure gradient in the vicinity of these airstreams will be analysed.

References:
<table>
<thead>
<tr>
<th>Poster No.</th>
<th>Session Title</th>
<th>Poster</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Atmospheric and Climate Modelling</td>
<td>Evaluation of fog in the 300m London Model Anke Finnenkoetter, Met Office</td>
</tr>
<tr>
<td>2</td>
<td>Atmospheric and Climate Modelling</td>
<td>Orographic Gravity Wave Drag and Model Bias Annelize van Niekerk, University of Reading</td>
</tr>
<tr>
<td>3</td>
<td>Atmospheric and Climate Modelling</td>
<td>Representation of the QBO in climate models Verena Schenzinger, Atmospheric, Oceanic and Planetary Physics Department, University of Oxford</td>
</tr>
<tr>
<td>4</td>
<td>Atmospheric and Climate Modelling</td>
<td>South Asian climate responses to aerosol emissions perturbations in HadGEM3 Dilshad Shawki, Imperial College London</td>
</tr>
<tr>
<td>5</td>
<td>Boundary Layer</td>
<td>Probing Manchester's boundary layer Simon Holloway, University of Manchester</td>
</tr>
<tr>
<td>6</td>
<td>Boundary Layer</td>
<td>An analysis of Foehn Winds over the Larsen Ice Shelf during 2011 Jenny Turton, British Antarctic Survey and University of Leeds</td>
</tr>
<tr>
<td>7</td>
<td>Chemistry Composition and Dispersion</td>
<td>Evaluations and projections of stratospheric ozone from ACCMIP, 1850-2100 Fernando Iglesias, Lancaster Environment Centre, Lancaster University</td>
</tr>
<tr>
<td>8</td>
<td>Chemistry Composition and Dispersion</td>
<td>The influence of fire emissions on southern African air quality: a case study with WRF-Chem Modise Wiston -Atmospheric Science, University of Manchester</td>
</tr>
<tr>
<td>9</td>
<td>Climate: Past, Present and Future</td>
<td>Investigation of cold weather extremes and analysis of rainfall trends for Ireland Ciara O'Hara, Dublin Institute of Technology, Year 3 Physics Technology Student</td>
</tr>
<tr>
<td>10</td>
<td>Climate: Past, Present and Future</td>
<td>Decline and abandonment of the Sasso Simone “City-fortress” Induced by remarkable climate adversities (AD 1566 - 1673) Alberto Venturati, Centro di Ricerca di Micropaleontologia Ambientale, Italy</td>
</tr>
<tr>
<td>11</td>
<td>Clouds and Microphysics</td>
<td>Constraining the rain drop size distribution using the co-polar correlation coefficient and differential reflectivity William Keat, University of Reading</td>
</tr>
<tr>
<td>12</td>
<td>Clouds and Microphysics</td>
<td>One case study (B792) in the Convective Precipitation Experiment (COPE) Zixia Liu, University of Manchester</td>
</tr>
<tr>
<td>13</td>
<td>Clouds and Microphysics</td>
<td>Suppression of ice formation in clouds by the presence of CCN Emma Simpson, University of Manchester</td>
</tr>
<tr>
<td>Poster No.</td>
<td>Session Title</td>
<td>Poster</td>
</tr>
<tr>
<td>-----------</td>
<td>---------------------------------------</td>
<td>---------------------------------</td>
</tr>
<tr>
<td>14</td>
<td>Earth Observations and Data Assimilation</td>
<td><strong>Climatology of tornadoes in the British Isles (1980–2012)</strong> Kelsey J. Mulder, University of Manchester</td>
</tr>
<tr>
<td>15</td>
<td>Earth Observations and Data Assimilation</td>
<td><strong>Evaluation of cost vs. impact of Met Office observing systems</strong> Rebecca Reid, Met Office</td>
</tr>
<tr>
<td>16</td>
<td>Tropical Meteorology</td>
<td><strong>Representation of the Indian Monsoon Trough Region in the Met Office Unified Model</strong> Kieran Hunt, University of Reading</td>
</tr>
<tr>
<td>17</td>
<td>Tropical Meteorology</td>
<td><strong>Understanding and Predicting Rainfall in the Indian Monsoon</strong> Peter Willetts, University of Leeds</td>
</tr>
<tr>
<td>18</td>
<td>Weather and Climate Impacts</td>
<td><strong>How are weather variables linked to faults in the telecommunication infrastructure in the UK?</strong> Alan Halford, University of Reading</td>
</tr>
<tr>
<td>19</td>
<td>Weather and Climate Impacts</td>
<td><strong>A Vehicle OverTurning (VOT) Model: How can an impact based model be verified?</strong> Rebecca Hemingway, Met Office</td>
</tr>
<tr>
<td>20</td>
<td>Weather and Small Scale Features</td>
<td><strong>The influence of cyclone propagation patterns on England and Wales extreme rainfall accumulations</strong> Ruari I. Rhodes, University of Reading</td>
</tr>
<tr>
<td>21</td>
<td>Climate: Past, Present and Future</td>
<td><strong>Where on Earth can we observe pristine aerosol?</strong> Douglas Hamilton, University of Leeds</td>
</tr>
<tr>
<td>22</td>
<td>Atmospheric and Climate Modelling</td>
<td><strong>A climatology of cold pools in the Sahel compared with a convection-permitting model</strong> Miroslav Provod, University of Leeds</td>
</tr>
</tbody>
</table>
Poster Session

Poster No. 1

Evaluation of fog in the 300m London Model

Presenter: Anke Finnenkoetter, Met Office

Business in the aviation sector is very sensitive to poor visibility, while an accurate simulation of fog is particularly challenging for numerical weather prediction models due to dependencies on unresolved processes. The Met Office started testing a 300m horizontal grid-length model covering the Greater London area to explore possible benefits of a high resolution model for visibility forecasting. Investigation of several case studies shows the London Model suffers from biases in temperature and specific humidity inherited from the driving model. On the other hand the additional detail in the surface characteristics improves the ability to model strong visibility gradients and gives a better representation of the localized character of fog.
Systematic model biases have been identified in the breakdown of the southern hemisphere vortex. These biases are largest at 60S, where there is little resolved orography, and it is suggested that a lack of orographic gravity wave drag is the cause of this bias. Models with late climatological transition of the zonal wind in the SH spring also have a cold bias in the lower stratosphere. Cold biases at high latitudes can impact the simulation of polar stratospheric clouds, which are implicated in the formation of ozone holes. High horizontal resolution runs have shown to simulate larger magnitudes of negative EP fluxes over orography compared to global models, implying that they are resolving OGWD better. As a result, short-range, high-resolution forecasts can be used to diagnose shortcomings in the parameterisation of subgrid-scale wave processes in global climate models. Results so far show that deceleration of the wind speeds in ERAinterim forecasts are too large before the point of transition to easterlies in the SH, suggesting that the ECMWF parameterisation scheme may be compensating for wintertime wind speed errors with large deceleration of winds during springtime. EP flux divergence, tendencies due to physics and GW fluxes can be used to diagnose the extent to which missing OGWD is influencing wind speeds in the stratosphere and upper troposphere. Future plans are to look at model sensitivity to OGWD parameterisation schemes by comparing the Met Office UM GA4 scheme against their new GA6 scheme using these diagnostics.
As part of getting a better understanding of the QBO and representing it adequately in climate models, the project QBOi was started. Apart from establishing a platform for scientists working specifically on this phenomenon, the project also asks for parameters of the QBO in existing models (http://users.ox.ac.uk/~astr0092/Questionnaire.html).

The work that will be presented deals with analysis of CMIP5 and CCMVal-2 models that have a reasonable QBO structure, comparing model data to reanalysis by Pascoe et. al. (2005). Parameters of the study include the length of the period, the amplitudes, descending rates and latitudinal structure of zonal mean zonal wind, as well as temperature data. One interesting topic, for example, is the seasonal structure of the QBO and its impacts on the extratropics, like the Holton-Tan relationship. Another one would be linking upwelling and momentum flux to temperature.

Understanding what mechanisms in the models lead to similarities and differences might also help to understand the ones driving the QBO on earth.
The climate of South Asia has a huge impact on the livelihoods of the population since much of their economy and culture is influenced by the monsoon rainfall. Short-lived anthropogenic species of aerosols can change the atmospheric radiative balance by scattering and absorbing solar radiation, and through changes to the microphysical properties of clouds. In particular, the black carbon and sulphate aerosol direct and indirect effects on the South Asian Summer Monsoon have been studied in the past. These studies found that aerosols may be responsible for the negative trend seen in rainfall observations over India. Using the atmosphere-only version of the HadGEM3 climate model and the CLASSIC aerosol scheme, which takes into account aerosol direct and indirect effects, we run a series of perturbation experiments. Specifically, we perturb the emissions of black carbon and sulphur dioxide globally and analyse the response in temperature, precipitation and air quality (surface concentrations of various atmospheric species.). We find that increasing black carbon (sulphur dioxide) emission leads to an increase (decrease) in South Asian temperature and precipitation. Increasing both species simultaneously results in a weaker decrease of precipitation and temperature. Using model diagnostics we examine the changes in radiative forcing, sea level pressure and circulation to help us identify the potential mechanism behind the changes in temperature and precipitation. Future work will involve deactivating the aerosol indirect effect and examining the differences in responses, as well as using the UKCA chemistry and aerosol microphysics model in order to have a more detailed treatment of emission effects on atmospheric composition and on the climate of South Asia.
Probing Manchester’s boundary layer

Presenter: Simon Holloway, University of Manchester

The atmospheric boundary layer evolves over the course of a day as a result of the diurnal radiation forcing from the ground. In the case of rural environments this radiative forcing is well understood, closely following the diurnal variation of the incident solar radiation. Within urban environments the radiative forcings are changed by the urban fabric - the greater heat capacity leading to a greater upwards heat flux. This heat flux difference leads to the urban heat island, which is most prominent during the night.

The increased heat transfer in urban environments can lead to the mixed layer of the boundary layer persisting for longer than in rural environments, and increased mixing of pollutants throughout the local environment. A convenient measure for locating the limit of the mixed layer is to consider the vertical temperature profile - the lowest temperature inversion is often defined as the limit of the mixed layer.

The Manchester Boundary Layer Temperature LIDAR seeks to investigate the evolution of the urban boundary layer during the course of a night. To this end a frequency-tripled 1 kHz Nd:YAG laser source is used to illuminate the atmosphere and two rotational Raman scattering channels are utilised in the collection optics. The ratio between the Raman signals is directly related to the temperature of the scattering atmosphere, and is determined by the rotation partition function. To date there have been issues regarding elastic breakthrough into the near-field Raman channel although a polarising filter has been fitted to address this breakthrough.
An Analysis of Foehn Winds over the Larsen Ice Shelf during 2011

Presenter: Jenny Turton BSc, MRes, PhD candidate
British Antarctic Survey and University of Leeds

The interaction of the circumpolar westerlies with the Antarctic Peninsula (AP) has profound effects on the atmosphere surrounding the region, in particular air flow over the Larsen ice shelf. Under normal conditions the flow of air is blocked by the AP mountain range. However, during particular synoptic conditions, the winds become strengthened enough to flow over the AP. In this situation, föhn winds occur, where the air is heated during descent by adiabatic warming. Measurements at an Automatic Weather Station (AWS) show on one occasion föhn winds increased the air temperature at the AWS location by 15K in less than 24 hours and brought surface temperatures to well above freezing. Föhn events are also characterised by a reduction in relative humidity which further promotes surface melt on the ice shelf.

The occurrence of föhn winds and subsequent melting processes on the Larsen Ice Shelf (LIS) are thought to have contributed to the collapse of parts of the LIS in 1995 and 2002. The interaction between the complex orography of the Antarctic Peninsula and the circumpolar westerly flow was investigated by the NERC funded project 'Orographic Flows and the Climate of the Antarctic Peninsula' (OFCAP). As part of the OFCAP campaign an AWS was installed at the foot of the AP at Cole Peninsula (-66°51'S, -63°48'W) in January 2011 and operated until March 2012.

This poster focuses on the occurrence of föhn events during 2011, identified from the AWS data at Cole Peninsula. Detection of the föhn events within the AWS data is based on a decrease in relative humidity coinciding with an increase in temperature. The AWS data will be complemented with data from the Antarctic Mesoscale Prediction System (AMPS) archive during 2011. The AMPS archive holds outputs from the Weather Research and Forecast (WRF) model, run at 4.5km resolution for a domain covering the entire AP. Föhn events will be identified in the model output based on the potential temperature profile on either side of the AP.

These criteria used to define föhn events will be presented along with an analysis of the frequency and length of föhn events within 2011. This produces two groups of föhn events to allow comparison of ‘Föhn datasets’. Complementing point measurements with outputs from the model will allow an insight into the spatial extent of the föhn effect over the whole of the LIS.
We will present an analysis and evaluation of stratospheric ozone from 1850 to 2100 from the models that took part in the Atmospheric Chemistry and Climate Model Intercomparison Project (ACCMIP), a project that was designed to evaluate the long-term atmospheric composition changes and their related climate impacts. Within uncertainty, the ozone depletion between 1980 and 2000 for the multi-model mean agrees with the observational estimate from the Total Ozone Mapping Spectrometer (TOMS), as well as with the Bodeker Scientific (BDBP) and the CCMVal-SPARC datasets. However, many individual models lie outside the observational estimate. The total column ozone in 1850 for the austral spring (SON) and Southern Hemisphere (SH) high latitudes (> 65°S) in the ACCMIP ensemble is ~50% higher than present-day (2000) values. Future model projections were performed following the four Representative Concentration Pathways (RCPs). The multi-model ensemble mean total column ozone for SON and SH high latitudes increases by 18.7% for RCP2.6, 21.2% for RCP4.5, 26.9% for RCP6.0, and 17.9% for RCP8.5 in 2030 compared to the present-day, and by 44.8-48.2% by 2100. Finally, for the large SH ozone changes during austral spring (SON, >65°S), there is a significant relationship ($r = 0.75-0.80; p < 0.05$) between the simulated stratospheric and tropospheric ozone columns, as suggested in previous studies.
This study explores an outstanding case of an intensive biomass burning (BB) activity in southern Africa in August-September 2008. Based on comprehensive satellite data and record information, we explore the important connections between air pollution and synoptic weather in this region by showing a significant weather modification and prediction of ambient air quality composition by the state-of-the-art numerical model (herein, the Weather Research and Forecasting with chemistry [WRF-Chem]) during a heavy episode of extremely high concentration of biomass-burning aerosols. The model is used in combination with a high temporal and spatial variability resolution emission inventory assembled from various global databases and the MODerate-resolution Imaging Spectroradiometer [MODIS]) satellite fire data to try quantify the effects of aerosols on individual weather events due to BB emissions from the fires that usually rage across southern Africa. The model is configured over the same domain run from 23 August to 10 September 2008 -the period that benefits the amount of observational data, and coinciding with the peak of the dry season for southern African BB activity during which biomass-burning aerosols dominate other aerosol types. Thick smoke -dubbed the ‘river of smoke’ was observed flowing into the South Indian Ocean from central and southern Africa where huge chunks of land had been raged by the ‘out-of-control’ fires that also claimed peoples’ lives. The fires were fanned by strong westerly winds in the latter period of the dry season, hence promoting direct streaming of particulate matter (PM) from the landmass into the marine environment. Chemical emissions can alter the regional aerosol and trace gas composition and impacts the atmospheric chemistry, including the radiative energy balance and bio-geochemical cycles. They can directly impact both the local and global atmospheric pollution by providing a large source of chemical gas- and particle phase aerosols (e.g. CO2, N2O, CH4 and ozone precursors such as CO, NOx and other substances). These species are sensitive to the onset and intensity of the rainy season, and can potentially result in different atmospheric outcomes depending on when and where emissions take place. For example, accumulation of organic substances on the carbon particles enhances absorption efficiency of sunlight energy by black carbon. On the other hand, reflection and absorption of solar radiation by aerosols changes the radiative balance of the lower atmosphere and may plausibly induce cloud feedbacks and the hydrological cycle through modifying precipitation and cloud albedo in the cloud microphysical processes. In this regard, the coupling of airborne chemical substances and weather suggests that southern African air quality may be quite sensitive to climate change -particularly a trend towards a warmer and drier season.
Poster No. 9

Investigation of cold weather extremes and analysis of rainfall trends for Ireland

Presenter: Ciara O'Hara, Dublin Institute of Technology, Physics Technology Student

To analyse some of the cold weather climate indices, as part of an investigation into whether winter extreme temperatures are changing. Also, to present the details of a study on rainfall changes with time. The aim of this is to determine how long it would take to be able to say with confidence that a change in the rainfall level over Ireland had occurred. This will involve investigating the significance level of any particular change relative to an average base period.
Poster No. 10

Decline and abandonment of the Sasso Simone “City-fortress” induced by remarkable climate adversities (AD 1566 - 1673)

Presenter: Alberto Venturati, Centro di Ricerca di Micropaleontologia Ambientale, Italy

The Sasso Simone (1,204 mbsl) and Sasso Simoncello (1,221 mbsl) are calcareous massifs of mid-Miocene age, located in the Marche Region (central Italy). These high calcareous massifs of rectangular box-shape, easily defensible and inaccessible were inhabited by Man since the Bronze Age. During the Renaissance (1554) the Medici, the well-noted Lords of Florence, drew up the project to build on Sasso Simone a “city-fortress” in order to better defend the borders of the Duchy of Florence. As reported in historical sources, the architects of Cosimo I de’ Medici, began the construction of the city-fortress in July 1566. The fortress was successfully built with great delays and adversity, but otherwise, it never become a real town of inhabitants (Coppi, 1975). As reported by Allegretti (1992), worsening climatic conditions, made life in the city-fortress practically impossible at such high altitudes and the population never exceeded 100. In 1647 official figures give the grand total of 46 government officials and garrisoned soldiers obliged to reside there. In 1673 the fortress was definitively dismantled.

Following Allegretti (1992) the city-fortress underwent a decline and was later abandoned due to a strong deteriorating weather conditions induced by the onset of the Little Ice Age (LIA). Nevertheless, on the basis of previous literature data, these climate variations and the development of cooling weather conditions as reported from historical sources could be caused by an interplay of natural factors as large explosive volcanic eruptions and/or periods of solar irradiance changes (Robock, 2000; Crowley, 2000; Shindell et al., 2001). In fact, during the building of the city-fortress (period 1566 – 1673) the Earth recorded several powerful volcanic activities and related drop of temperatures as inferred from dendrochronological researches (Briffa et al., 1998). Moreover, the remarkable cooling in 1641–1642 should be related to the concentration in stratosphere of sulfate plumes from three eruptions (Komaga-Take in Japan, Awu in Indonesia and Parker in Philippines), and a string of eruptions starting in 1667 and culminating in a wide tropical eruption in 1694 (Long Island, New Guinea). This large eruption occurred almost at the beginning of the coldest phase of the LIA in Europe (Briffa et al., 1998; Crowley et al., 2008). On the other hand, it’s not possible to exclude the effects of a reduced solar irradiance (Maunder Minimum) on the Earth’s climate.

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Poster No. 11

Constraining the rain drop size distribution using the co-polar correlation coefficient and differential reflectivity

Presenter: William Keat, University of Reading

The rain drop size distribution (DSD) is commonly assumed to take the form of a gamma distribution, described by three parameters: the drop number concentration (N0), median drop diameter (D0) and the shape parameter (µ). Knowledge of drop shape as a function of drop diameter allows retrieval of N0 and D0 using radar reflectivity (Z) and differential reflectivity (ZDR), leaving µ to either be assumed or constrained empirically. Dual wavelength rainfall rate retrievals, such as those from the dual wavelength Global Precipitation Mission satellite are also strongly sensitive to µ. Illingworth and Caylor (1991) first proposed the combined use of the co-polar correlation coefficient ρhv (which characterises the variety of drop shapes in a sample volume) and ZDR to estimate µ. Here, we demonstrate how this can be used to derive quantitative estimates of µ. This is achieved by constructing a new variable log10(1- ρhv) which has Gaussian error statistics. The width of the Gaussian distribution is derived as a function of the number of independent pulses, allowing us to construct a rigorous confidence interval in our estimates of ρhv. In addition we demonstrate how the imperfect co-location of the horizontal and vertical sample volumes may be accounted for. Preliminary retrievals of µ will be presented in stratiform and convective rainfall events. The retrieval is verified by direct comparison with the observed DSD from a co-located disdrometer.
In this poster, I show a case study of the microphysics of convective clouds that formed over the area of Cornwall and Devon during 3rd August, 2013. This case study was part of Convective Precipitation Experiment (COPE), which is a project that includes the large-scale dynamics of convective clouds. We made 8 flights over the whole project. In this paper data from flight B792 - one of the 8 flights, which was held on 3, August 2013, is presented to show the microphysics processes in the convective cloud.

The main goal of the COPE project is to improve the forecasts of heavy rain from cumulus clouds that may lead to flash flooding by addressing the combined issues of the microphysical processes and dynamics of precipitation. In this whole project, we focus on the origin and development of the convective cloud.

The purpose of this paper is to address origin of the ice phase. We made measurements of the properties of the aerosol particles by using the Aerosol Mass Spectrometers (AMS) one at a ground site and another in the boundary-layer on board the FAAM BAe146 plane.

In order to investigate the development of ice phase in the convective cloud, comprehensive measurements of cloud microphysics were made by the BAe146 and the Wyoming King Air aircraft. They flew through multiple clouds at different altitudes using a statistical flight pattern approach. New equipment, such as CAPS, was deployed on the BAe146. I will present measurements from BAe146 in the B792 flight.

The B792 flight lasted about 4 hours 45 minutes from 11:28 am to 16:15 pm. The altitude range was from 1300 m to 5500 m with temperature changing from 9 C to -15 C. The ice particle images are shown at several typical levels and temperatures. I will present different properties of ice particles, including number concentration, ice water content and size distribution measured from several cloud microphysics probes, such as cloud droplet probe (CDP), 2D-S probe and Cloud, Aerosol, and Precipitation Spectrometer (CAPS) probe. Each one covers a range of the particle diameters. With the combination of ice phase images, CORE data from FAAM (e.g. vertical wind speed), results from each probe and Met Office Rain Radar Data from the NIMROD System, we can examine how the convective cloud cells developed and moved, together with microphysical processes in these multiple clouds on the afternoon on 3rd August 2013.

For the next step, we will combine the measurements from the aerosol equipment to address the origin of the ice phase and to see how the different types of aerosol influence the convective cloud formation and development and how they are cloud processed. At the same time, we will also focus on the conditions in which the aerosol can be active as cloud condensation nuclei (CCN).
Poster No. 13

Suppression of ice formation in clouds by the presence of CCN

Presenter: Emma Simpson, University of Manchester

This study explores the hypothesis that ice formation in a cloud containing both ice nucleating particles and cloud condensation nuclei is suppressed compared to a cloud that only contains ice nucleating particles. Model simulations from the Aerosol-Cloud-Precipitation Interaction Model, developed at the University of Manchester, show that CCN particles (in this case ammonium sulphate) compete more effectively than ice nuclei for available water vapour in cloud conditions. This results in the IN particles not up taking sufficient water in order to freeze in the immersion mode. CCN particles uptake more water than IN particles because they are hydrophilic and require a low supersaturation in order to activate into cloud drops. The activation and subsequent growth of CCN keeps the supersaturation in the cloud below that required to activate the IN into cloud drops. IN that act in the immersion mode must first activate into cloud drops in order to be able to freeze. Without the presence of CCN the maximum supersaturation achieved in the cloud is high enough to activate the IN particles, allowing them to freeze.

Currently experiments using the Manchester Ice Cloud Chamber are under way to experimentally test the results from the model simulations. Expansions are preformed in the cloud chamber to generate clouds under controlled conditions. Experiments will involve varying the concentrations of the two types of aerosol; ammonium sulphate and IN (including SnomaxTM and K Feldspar) within the chamber during expansions. The concentration of ice in experiments containing only IN will be compared to those containing a mix of IN and ammonium sulphate.

Determining the concentration of ice in clouds is important for cloud radiative properties and precipitation. Results from these experiments aim to further our understanding of the formation of ice in the atmosphere.
We present a climatology for tornadoes in the British Isles, defined here as England, Scotland, Wales, Northern Ireland, Republic of Ireland, Channel Islands, and the Isle of Man. The climatology includes the geographic distribution, annual and diurnal cycles, seasonality, intensities, and occurrence of outbreaks in tornadoes from 1980–2012 (from Tornado and Storm Research Organisation or TORRO data) as well as environmental conditions from proximity soundings (from Met Office UK High Resolution Radiosonde data).

Over the 33-year period of study, there were 1241 tornadoes reported in the British Isles over 642 tornado days (number of days in which at least one tornado occurs). This computes to a mean of 37.6 tornadoes and 19.5 tornado days annually.

Most (78.3%) British Isles tornadoes occur in England with apparent maxima along the southern coast and in the east England. Of the remaining tornadoes in the dataset, 7.0% were in the Republic of Ireland, 6.7% in Wales, 4.8% in Scotland, 1.8% in Northern Ireland, 1.2% in the Channel Islands and 0.1% on the Isle of Man. To compare tornado occurrence between countries, the average annual tornado occurrence per 10,000 km2 was computed for each country making up the British Isles. England experiences 2.3 tornadoes per year per 10,000 km2, which compares to 3.5 tornadoes per year per 10,000 km2 in Oklahoma (1991–2010) [1].

Where intensity data is known, 95.3% of tornadoes were classified as EF0 or EF1 with the rest classified as EF2. There were no tornadoes rated EF3 or greater during this time period. Similarly, most tornadoes in the United States are on lower end of the Enhanced Fujita scale, with 95% of tornadoes in the United States rated below EF3, [1]. The United States is known to have EF5 tornadoes, but these tornadoes make up only 0.1% of the database [1]. So while tornado occurrence, at least by area, is similar to parts of the United States, central US tornadoes can be stronger than those seen in the British Isles.

In the British Isles, the maximum monthly tornado frequency occurs in November. However, seasonality based on tornado frequency can be skewed due to multiple tornadoes occurring during a single day. Therefore, a tornado day analysis was conducted. Approximately half the tornado days in the British Isles occur from June to October with 23% of all tornado days occurring in August and September. This is later than the springtime maximum in the central and southern US and mid-summer in the northern US [2, 3]. Tornado outbreaks (defined as a day in which three or more tornadoes occur) occur year-round with a maximum in November and minimum in May. The highest number of tornadoes in an outbreak during the period of study was 104 tornadoes on 23 November 1981.

Proximity soundings will be examined, with the goal of understanding the environments within which tornadoes occur in the British Isles.

Citations
Poster No. 15

Evaluation of cost vs. impact of Met Office observing systems

Presenter: Rebecca Reid, Met Office

Quantitative evaluation of the impacts of observations in NWP models is an increasingly important requirement for meteorological services. The adjoint-based Forecast Sensitivity to Observations (FSO) is a powerful tool for assessing observation impacts. FSO impacts represent individual observations’ contributions to forecast error reduction, and can be combined to assess the relative impact of whole observing networks. The ‘impact per observation’ can be a useful variable to consider, but its properties mean that it may not be the most appropriate for evaluation of observing networks.

A useful variable is the ‘cost:impact ratio’ – the average impact of an observation type divided by the overall cost of the network (for a chosen time period). This variable avoids some of the issues inherent to ‘impact per observation’, and comparisons have clear potential to provide evidence to inform network business cases. Such an analysis could even influence the overall design of the global observing system.

In this work, we suggest appropriate methods of representing the ‘cost:impact ratio’ of Met Office (UK) observing networks, starting with analysis of their impact upon 24-hour global forecasts. We also discuss the possible pitfalls in the interpretation of results, and provide insight into their proper interpretation and potential applications.
The South Asian summer monsoon provides India with 80% of its total annual rainfall, of which a significant proportion in the north of the country falls during depressions that pass through the monsoon trough region. Monsoon depressions are also modulated on time scales of a few weeks by propagating modes of boreal summer intraseasonal variability. Despite their importance, accurately simulating depressions and the trough environment through which they are steered remains a shortcoming of current numerical models, which use a range of spatial resolutions from ~25km (global NWP forecasts) to ~100km (climate simulations). Primarily, CMIP5-class models suffer large dry biases over much of India in their simulation of the monsoon. These dry biases are particularly apparent over the north of the country, highlighting the need to understand and improve the problematic simulation of the monsoon trough and depressions. In this study we make a full three-dimensional quantification of the structure of the trough region based on ERA-Interim reanalysis 0.7° x 0.7° data, which is used as a spatial and temporal benchmark comparison for CMIP model output data.

We also examine the resolution-dependence of trough structure in a suite of high-resolution versions of the Met Office Unified Model. The role of monsoon depressions is then examined through characterisation and comparison of systems in reanalysis and model data.
Global Met Office Unified Model forecasts and climate simulations show large errors in rainfall for the Indian Monsoon. Convection permitting models (resolution varying from 12 km to 1.5 km), and models with convection parametrised (resolution varying from 120 km to 8 km), were run, at The Met Office (EMBRACE project), for a 21 day period in the Indian Summer Monsoon (21st August to 9th September). The models with parametrised convection, similar to the operational forecasts, exhibit a growing wet bias over the equatorial Indian Ocean, a dry bias over India itself, and a wet bias over the Himalayas. The explicit convection runs have reduced biases over the Equatorial Indian Ocean and Central India, and appear to lack rain in areas of oceanic light rain. The amount of rainfall, averaged over the entire model domain decreases with increasing resolution, the difference appearing to come mostly from over the ocean/sea. The 1.5 km model rains significantly than the other explicit models. All the explicit models roughly capture the diurnal cycle of rainfall over land/ocean, though still peak 1-2 hours too early, whereas the parametrised convection models show a peak in rainfall at about 0600 UTC (local noon), roughly 5 hours too early. All models broadly capture the daily variability of rainfall over the 21 day period and generally lie within about 25% of the TRMM rainfall estimates.

The explicit model runs generally show a larger temperature gradient between the relatively warm land and cool ocean, when compared with the driving model and the parametrised convection models, which is inferred to lead to the observed increase in monsoon circulation in the explicit model runs. This is thought to be due to the improved timing of the diurnal cycle of rainfall/cloudiness, and the consequent effect on the heating and radiation surface fluxes.
How are weather variables linked to faults in the telecommunication infrastructure in the UK?

Presenter: Alan Halford MChem, University of Reading

The telecommunication industry underpins much of modern business practice and personal activity, increasing societal reliance on a resilient communication infrastructure. Faults in the physical telecommunication infrastructure cause disruptions in service that can have large, negative economic consequences to business operations. Climate and weather are known to be linked with the telecommunication fault rates in the UK and with the wide range of predicted changes in climate over Europe in future scenarios there are concerns with how the fault rates could change.

Understanding the relationship between different weather variables and fault rates is important for identifying the vulnerability of the infrastructure to different weather events. In the first instance, single variable regression analysis has been carried out on historical data of fault rates and weather variables. A range of different meteorological data sets along with cross-validation and bootstrapping will be used to check for a robust relationship.

This work provides a platform for a probabilistic treatment for predicting future fault rates, using ensembles of weather forecasts. These assessments will provide a resource for use by industry to make informed decisions on managing fault rates and fault response rates to reduce interruptions from faults. The impact of climate change will also be investigated, to understand how fault type and fault rate profiles might change over longer timescales.
A Vehicle OverTurning (VOT) Module has been developed as part of a Hazard Impact Model (HIM) under the auspices of the Natural Hazards Partnership, which is a collaboration between a number of UK agencies including the Cabinet Office. The aim of the HIM is to produce early warnings for severe events that allow us to generate an overall picture of the risk to society based on probability and impact. The VOT model itself uses a combination of wind hazard, vulnerability and exposure values to generate an overall risk value termed 'Risk of Disruption'. This endeavours to communicate that the model is forecasting disruption to the road network due to a vehicle overturning during a high wind event. To verify the forecasts the model output has been compared to the time and location of actual vehicle overturning incidents on the UK road network. The recent winter storms have provided a number of interesting case studies for the VOT model however extracting actual vehicle overturning events from news reports and twitter feeds has proved laborious with inconsistent and limited results. Despite this, the model performance for the St Jude's Day (28th October 2013) and 5th December 2013 storms has been positive. The vehicle overturning incidents found through media reports for these storms corresponded well to roads highlighted as medium and high Risk of Disruption by the VOT model. This suggests that the model provides useful guidance on the Risk of Disruption during high wind events however more work is required to verify the actual risk levels. Consistency between model runs has also been investigated. The model has so far demonstrated that there is a good correlation in Risk of Disruption values between model runs. It is hoped that a more time-effective method of verification, allowing continual verification, will be developed in the near future using impact data from partner agencies, the Highways Agency, the police and media reports.
Poster No. 20

The influence of cyclone propagation patterns on England and Wales extreme rainfall accumulations

Presenter: Ruari I. Rhodes, University of Reading

Wide-area flooding events in England and Wales are commonly caused by high levels of rainfall accumulation from extra-tropical cyclones, over a broad range of time scales. The propagation patterns of cyclones often have direct influence on the duration and intensity of an individual rain event (e.g. stalling), and on the total accumulation over a number of storms (e.g. clustering). An evaluation of rainfall accumulations, derived from England and Wales Precipitation observations, is presented by means of case study and statistical evaluation focussing on the concepts of clustering and stalling in tracks of 850hPa relative vorticity from ERA-Interim reanalysis.
Poster No. 21

Where on Earth can we observe pristine aerosol?

Presenter: Douglas Hamilton, University of Leeds

To understand how sensitive the climate is to greenhouse gas and aerosol emissions it is important to define the baseline from which the aerosol forcings are calculated [Carslaw et al., 2013]; but if no regions in the world are anthropogenically unaltered, where on Earth can we observe and learn about the behaviour of pristine environments? This question is relevant to both future modelling and long-term observational studies in climate science. Identification of such regions is also important if we are to fully understand climate response to natural aerosol changes [Spracklen and Rap, 2013].

Here we use a combination of model simulations and statistical emulation of the Global Model of Aerosol Processes (GLOMAP) to identify regions which are most pristine in today's atmosphere. The simulations are used to identify present day (PD) regions which have daily mean cloud condensation nuclei (CCN) concentration similar to pre-industrial (PI) levels. The emulation of an ensemble of perturbed parameter runs [Lee et al., 2013] for the PI and PD allows a full Monte Carlo variance-based sensitivity analysis of CCN to 28 different parameters, covering both natural and anthropogenic emissions and their processes, which affect the uncertainty in CCN concentrations. We use this information to assess which regions exhibit little change in the sensitivity the 28 parameters between the PI and PD. Potentially pristine environments are defined based on where both the CCN number concentration and its sensitivity to the 28 parameters have remained constant through the industrial period.

Our results indicate that the low to mid-latitude maritime southern hemisphere is the most pristine region in the PD atmosphere, especially during the austral summer. Other pristine regions include Alaska and Yukon, the Melanesian islands and the Antarctic Peninsula. Simulated anthropogenic influence on CCN has high seasonality in the southern hemisphere but low seasonality in the northern hemisphere. Finally, we highlight which regions of high cloud albedo radiative forcing have the highest number of pristine days. It is in these pre-industrial-like regions that measurements to help improve baseline calculations could be established.


A climatology of cold pools in the Sahel compared with a convection-permitting model

Presenter: Miroslav Provod, University of Leeds

Cold pools are integral components of squall-line Mesoscale Convective Systems (MCSs), but are very poorly represented in operational global models. Continental-scale convection-permitting Unified Model (UM) simulations run as part of the Cascade project have shown that cold pools also form an integral part of the West African Monsoon. Here, observations made at Niamey during the 2006 AMMA (African Monsoon Multidisciplinary Analysis) campaign are used to generate a climatology of cold-pool characteristics in order to evaluate cold-pools in the Cascade UM simulations. Thirty-eight cold pools were observed to have crossed Niamey during the 1 June to 30 September 2006 period and associated changes in surface meteorological variables were quantified. Cold pools were associated with temperature decreases of 2 to 15 °C, pressure increases of 0 to 8 hPa and wind gusts of between 3 and 25 m s⁻¹. Comparison with published values of similar variables from the Great Plains of the USA showed comparable changes. The leading part of cold pools tended to have decreased water vapor mixing ratios, with moister air 45 minutes behind the gust front associated with the commencement of precipitation. Early-season cold pools were associated with greater changes in surface variables, consistent with the drier mid-levels promoting more evaporation of precipitation, with an increased contribution from dry-adiabatic descent. Evaluation of the UM simulations showed changes similar to those observed, except that increases in mean-winds were under-estimated by a factor of 3 to 4. This was due to the less abrupt pressure changes in the modelled cold pools.