CAUSES

(Clouds Above the United States and Errors at the Surface)

"A new project with an observationally-based focus,
which evaluates the role of clouds, radiation and precipitation processes
in contributing to the surface temperature biases in the region of the central United States and
which are seen in several weather and climate models."

Cyril Morcrette, Jon Petch, **Met Office, Exeter, United Kingdom.**

Hsi-Yen Ma, Stephen Klein, Shaocheng Xie, **Program for Climate Model Diagnosis and Intercomparison, Livermore, California, United States.**

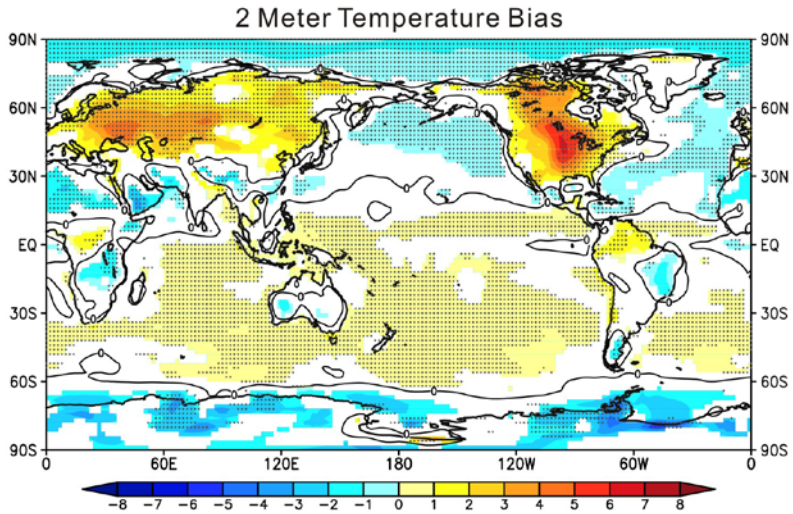
And you!

Please get in touch if you wish to participate

Introduction (1)

Aims:

A joint GASS/ASR comparison project aiming to evaluate clouds and radiation in several weather and climate models using ground-based observations.



The warm bias over the US in summer is common to many GCMs.

It is seen in several climate models' long-term climate mean and it shows up as a bias within a few days when running climate models from analysis in NWP mode.

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Introduction (2)

We hypothesize that the US warm bias is due to a combination of errors involving the land and atmosphere.

Potential issues include:

- the diurnal cycle of convection,
- timing of precipitation and how much evaporates,
- soil moisture,
- surface fluxes,
- organization and propagation of convection,
- shallow convection,
- radiative impact of convective cores, detrained cloud and anvils.

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Introduction (3)

In this project, we aim to understand the role of errors in the atmosphere model in contributing to the warm bias seen in climate models. Specifically, we are proposing study of two areas of investigation:

Part I) Focus on the errors in clouds and radiation

- What is the contribution of radiation errors to the temperature errors?
- How much of the errors in radiation result from errors in clouds and their properties?
- Which cloud regimes contribute most to the radiation errors?
- Based on method in Morcrette *et al.* (2012) - This effort will be led Cyril Morcrette.

RMetS
Royal Meteorological Society

Evaluation of two cloud parametrization schemes using ARM and Cloud-Net observations

Cyril J. Morcrette,[a*†] Ewan J. O'Connor[b,c] and Jon C. Petch[a†]
[a]*Met Office, Exeter, UK*
[b]*Finnish Meteorological Institute, Finland*
[c]*University of Reading, UK*

*Correspondence to: C. J. Morcrette, Met Office, FitzRoy Road, Exeter EX1 3PB, UK.
E-mail: cyril.morcrette@metoffice.gov.uk
†The contribution of these authors was written in the course of their employment at the Met Office, UK, and is published with the permission of the Controller of HMSO and the Queen's Printer for Scotland.

SGP Liquid and Ice Cloud Fraction

ARM

UKMO 1

UKMO 2

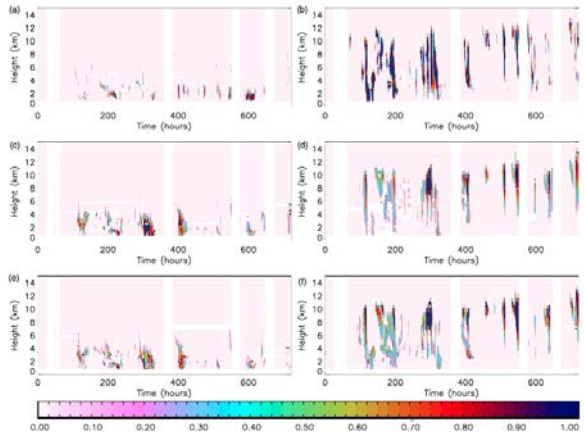

Figure 1. Time–height plots of (a, c, e) liquid cloud fraction and (b, d, f) ice cloud fraction for April 2007 at the Southern Great Plains site in Oklahoma. (a, b) show observed cloud fraction, (c, d) forecast using a diagnostic cloud scheme, and (e, f) forecast using a prognostic cloud scheme. This figure is available in colour online at wileyonlinelibrary.com/journal/qj

Mean Amount

Amount when Present

Frequency of Occurrence

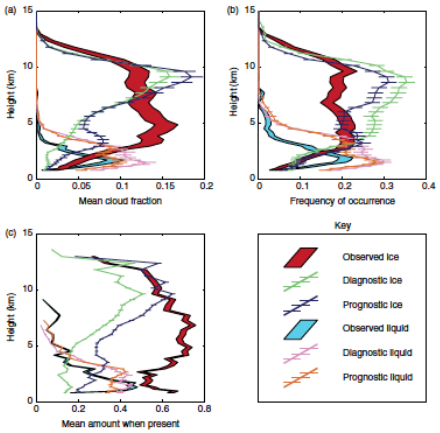

Figure 2. Mean profiles of cloud fraction for April 2007 at the Southern Great Plains site in Oklahoma: (a) mean cloud fraction, (b) frequency of occurrence (FOO) of cloud fraction > 2%, and (c) mean amount when present (AWP, i.e. mean cloud fraction when cloud fraction > 2%). The error bars and half-width of the shading indicates an estimate of the error in the mean, calculated as one standard deviation divided by the square root of the number of hourly profiles contributing to the mean. This figure is available in colour online at wileyonlinelibrary.com/journal/qj

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Met Office
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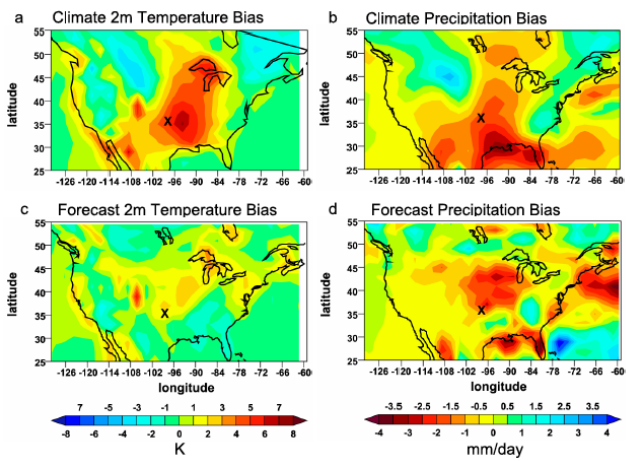
Introduction (4)

Part II) Focus on the simulated precipitation and surface energy balance

- What is the relative contribution of precipitation errors to the temperature errors?
- Does the atmosphere provide the correct amount of precipitation for the soil?
- Which type of precipitating convection systems dominate the errors in the surface precipitation?
- Does the surface energy balance reveal signs that evaporation is underestimated due to the lack of soil moisture?
- Based largely upon Klein *et al.* (2006) - This effort will be led by Hsi-Yen Ma.



GEOPHYSICAL RESEARCH LETTERS, VOL. 33, L18805, doi:10.1029/2006GL027567, 2006

Click Here for Full Article

Diagnosis of the summertime warm and dry bias over the U.S. Southern Great Plains in the GFDL climate model using a weather forecasting approach

Stephen A. Klein,[1] Xianan Jiang,[2] Jim Boyle,[1] Sergey Malyshev,[3] and Shaocheng Xie[1]

Received 13 July 2006; revised 8 August 2006; accepted 14 August 2006; published 22 September 2006.

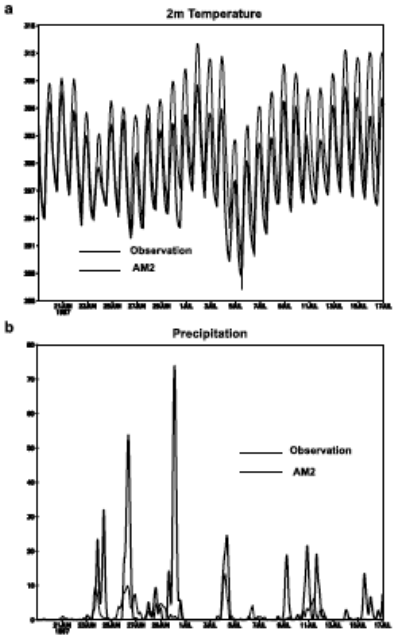


Figure 2. (a) Temperature at 2 meters (units: Kelvin) and (b) precipitation (units: mm day^{-1}) from ARM observations (thick line) and hours 12 to 36 of AM2 forecasts (thin lines) at the Southern Great Plains site.

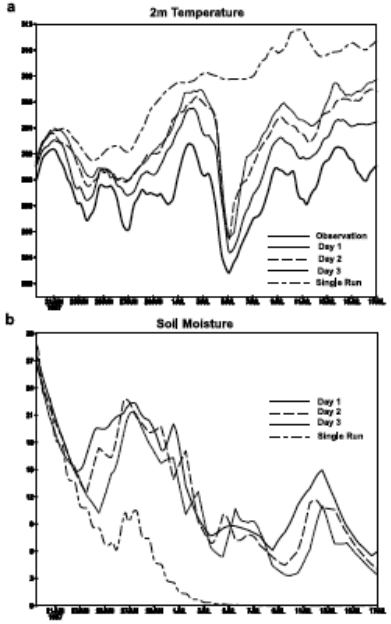


Figure 3. (a) 24-hour running mean temperature (units: Kelvin) and (b) soil moisture (units: kg m^{-2}) from ARM observations (thick line) and AM2 forecasts for hours 0 to 24 (solid line), hours 24 to 48 (dashed line), and hours 48 to 72 (dotted line) at the Southern Great Plains site. Also shown are the temperature and soil moisture from a single 30 day forecast which begins on 19 June (short-long dashed line).

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Region and Period of Analysis

The **investigation will be focussed on the American mid-west and use observations obtained from the SGP site (36.61 N, 97.49 W).**

The period we have chosen is the warm season of 2011, which at its start featured a major ARM field campaign: the Midlatitude Continental Convective Cloud Exeperiment (**MC3E, 22 April to 6 June 2011**).

Please get in touch if you wish to participate

Model Simulations

All models to be run in weather forecasting (NWP) mode.

We aim to look at the growth of the errors as a function of lead time.

Initially we will focus on the period T+00 to T+72, with daily re-initialization from analyses (i.e. ECMWF, 00Z analyses)

We may also look at some longer range hindcasts such as 30-day simulations started on the first of the month, to study how the model drift from its day-3 bias to its climate-mean bias.

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Model Output Requested (this is open to discussion)

Hourly, 2d fields for the region of the MC3E experiment (roughly 400 km x 400 km, centred on SGP site).

- Surface SW (diffuse & direct)
- Surface LW
- TOA (SW, LW)
- WVP, LWP, IWP
- Sfc sensible heat flx, sfc latent heat flx, soil moisture

Hourly, 2d fields for continental US (to put ARM-SGP site into context).

- MSLP (hPa)
- sfc precip (mm/hr)
- 2m temperature

15-minute (or every timestep, if timestep>15 mins) frequency single-column output for the SGP site of:

- Temperature, specific humidity, pressure
- LWC, IWC, cloud fraction (separate liq & ice if appropriate)

Anything else?

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We need you!

MODELERS:

So far we have heard expressions of interest from groups running:

- Unified Model/HadGEM
- CAM
- NASA-GISS
- ECMWF? ECHAM?

Model/Gridlength	250-200km	200-75km	75-25km	25-10km	< 10 km
NASA-GISS	2.5 deg	1 deg (maybe)			
CAM		1 deg		12 km	
MetOffice		N96(140km)	N216(60km)	12 km	4 & 1 km

OBSERVATIONALISTS:

We are keen for this project to be an opportunity to bring model people and observations people together.

Anyone else?

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