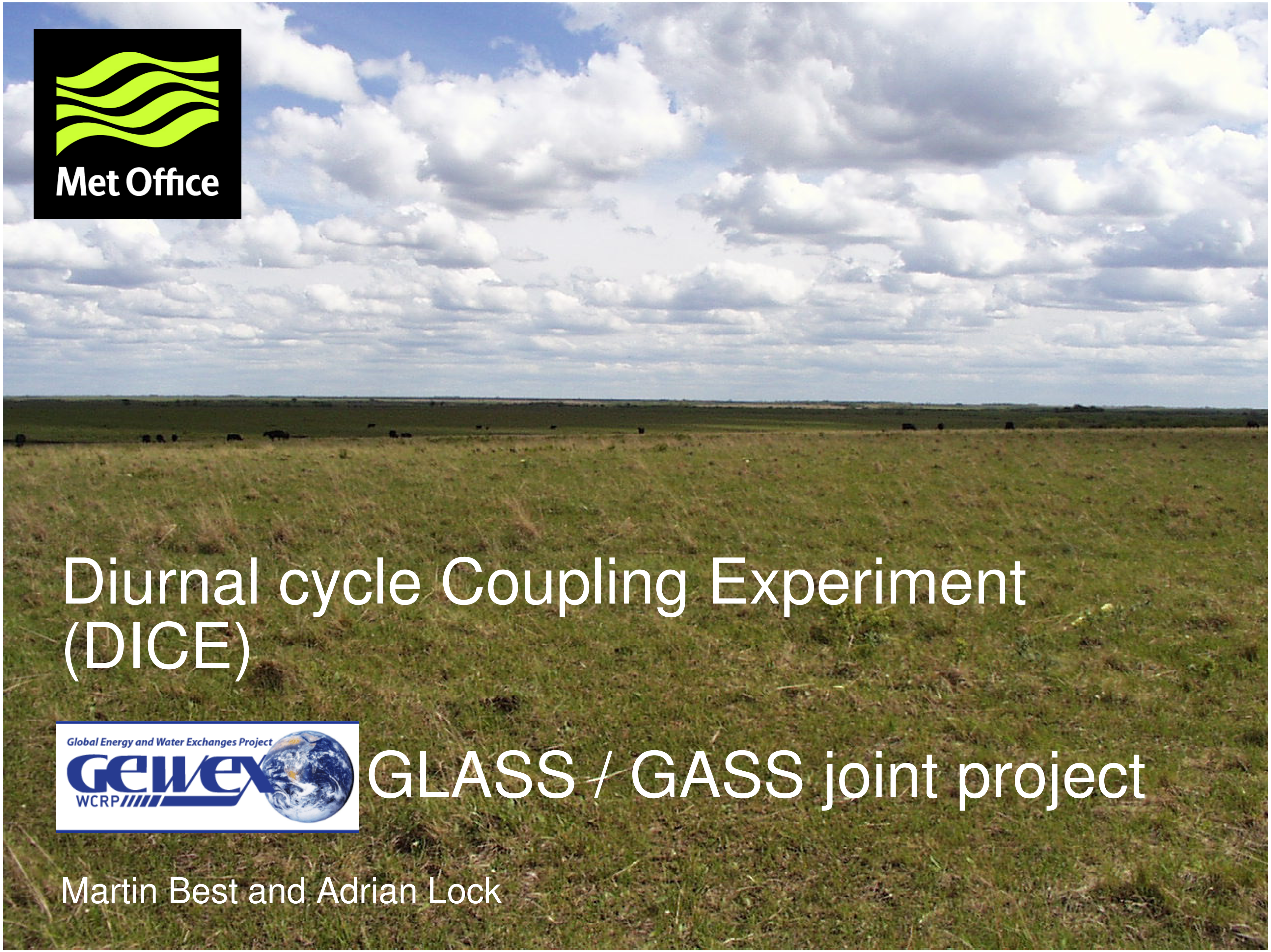
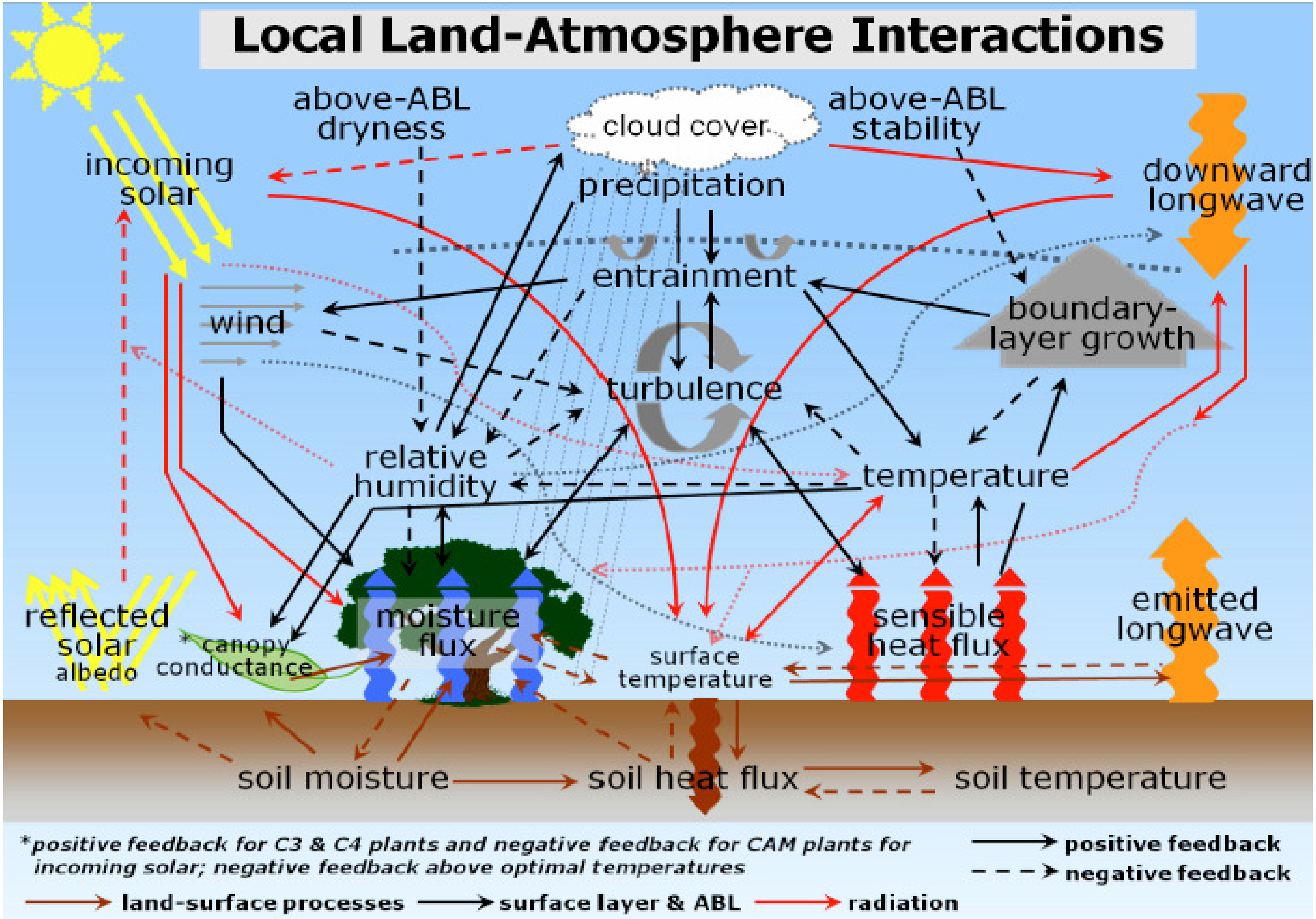


Diurnal cycle Coupling Experiment (DICE)

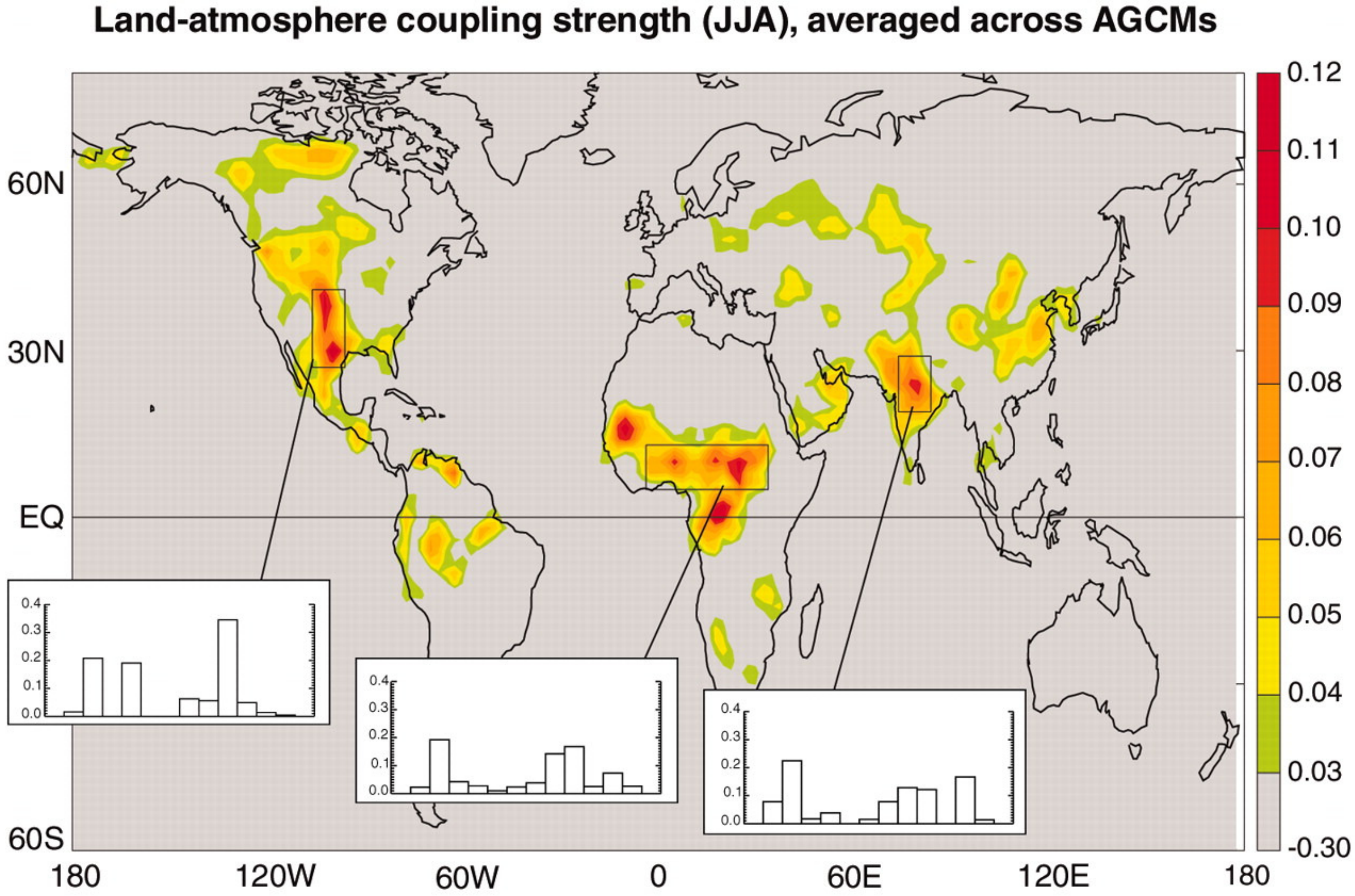
GLASS / GASS joint project

Martin Best and Adrian Lock



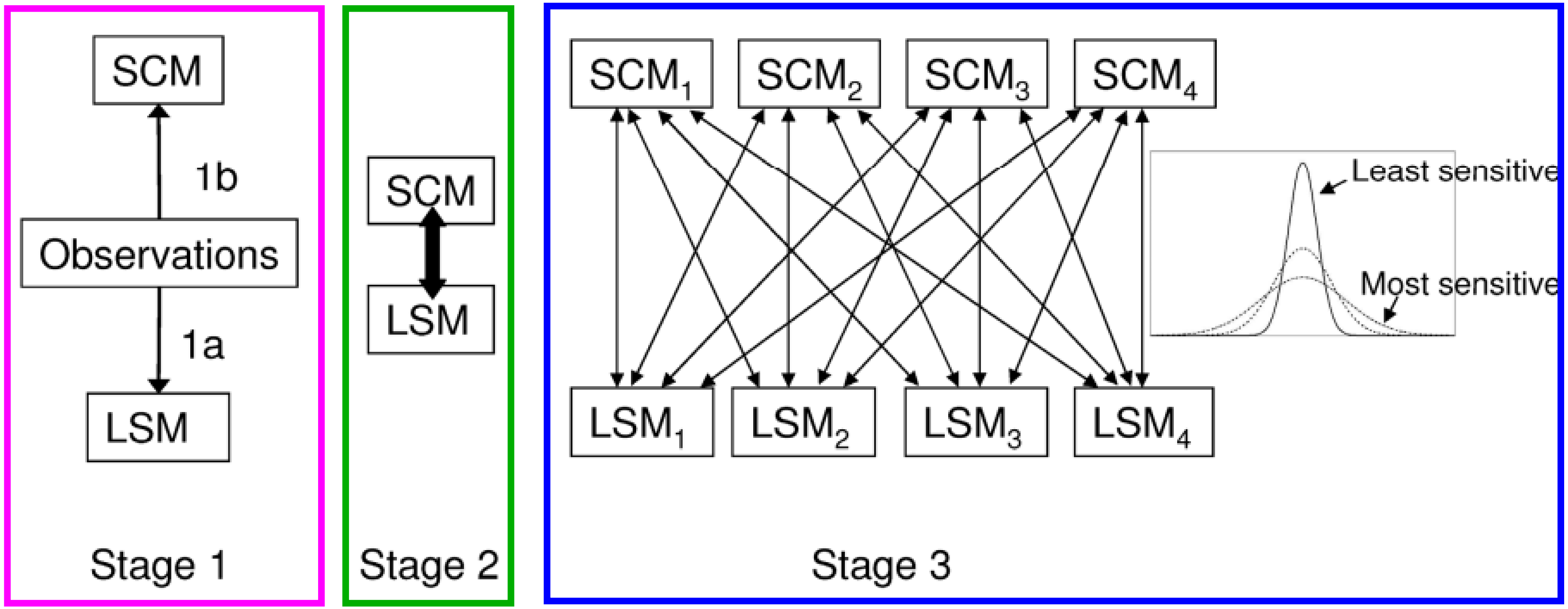
Courtesy of Mike Ek

GLACE “hotspot” regions



Koster et al (2006)

Outline of the 3 stages of DICE



LSM and SCM stand-alone performance against observations

What is the impact of coupling?

How sensitive are different LSM and SCM to variations in forcing?

CASES-99 case study

23-26 October 1999

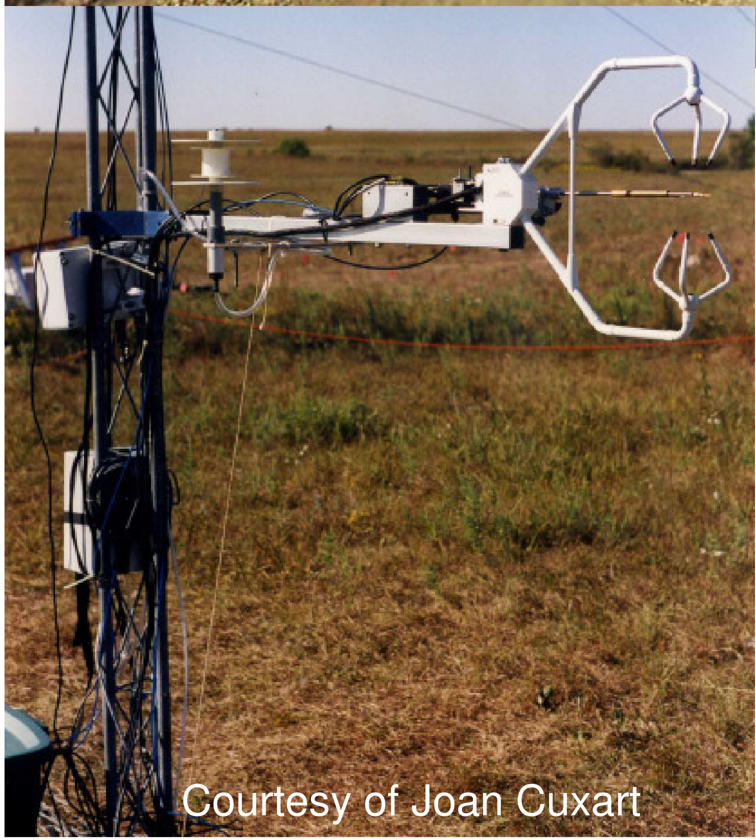
- Field experiment in Kansas, USA
- We follow Steeneveld et al (2006)
  - 3 day simulation from 2pm local time on 23rd October 1999
  - Recall GABLS II ran for from 2pm on 22nd for 2.5 days
- Clear skies throughout
- Gives 3 nights of varying character
  - intermittent turbulence
  - continuous turbulence
  - very stable, almost no turbulent fluxes

Experimental protocol

- LSM
  - Soil spin-up:
    - 9 years from saturated using WATCH forcing data
    - 10th year forcing data from local site
  - Two stage 1a experiments with forcing from 2m and 55m
  - Stage 3a LSM experiments forced with stage 1b SCM data interpolated to 20m
- SCM
  - Large-scale forcing:
    - Time-varying geostrophic wind (uniform with height)
    - Large-scale horizontal advective tendencies for T, q, u, v estimated from a simple budget analysis of the sondes
    - Subsidence for T, q
    - **No** relaxation
    - Radiation switched on in all simulations
  - SCM in stage 1b use observed sensible and latent heat fluxes and u_* (either directly or via c_D)
  - Stage 3b SCM experiments forced with stage 1a LSM surface fluxes

Participating Models

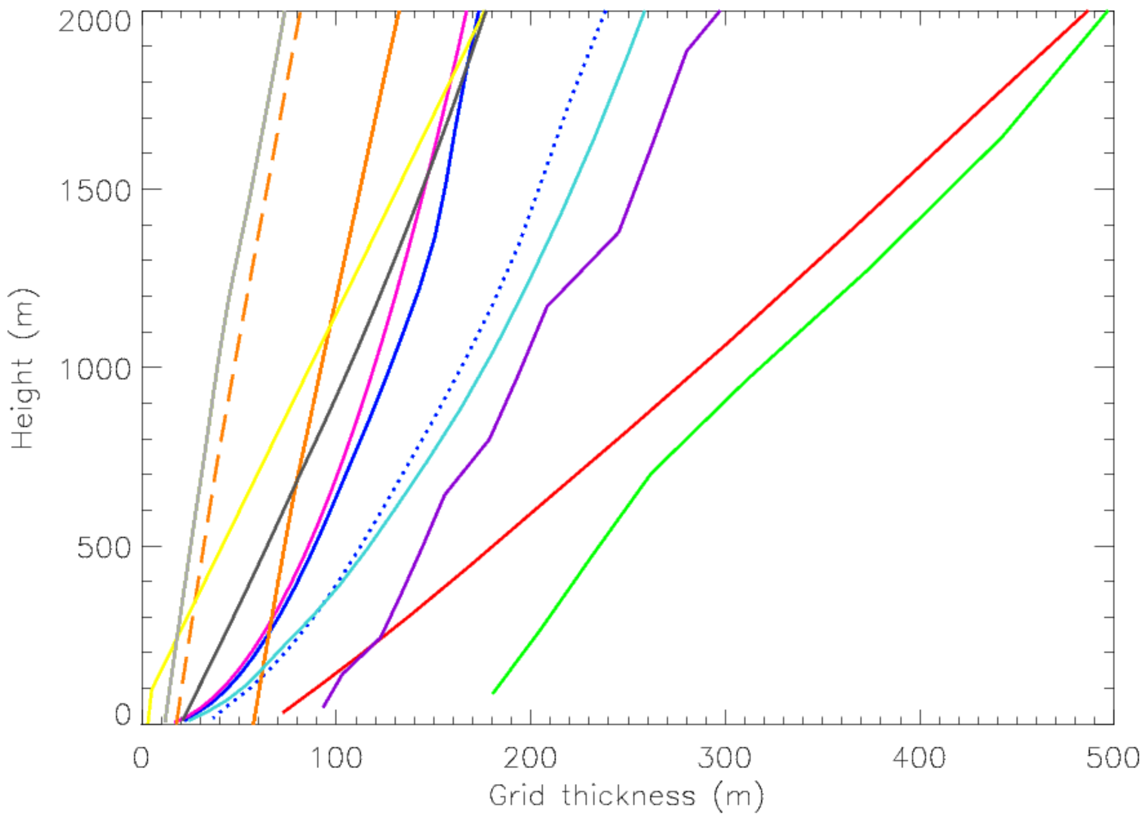
Model	Contact	Institute	Levels	Sensitivity tests
Arome & Arpege (NWP)	Eric Bazile	Meteo France	60/70	Resolution, soil
Arpege (CMIP5)	Isabelle Beau	Meteo France		
ECEARTH	Reinder Ronda, Bert Holtslag	Wageningen University	91	
GDPS3.0	Ayrton Zadra	CMC	79	Surface properties
GFDL	Sergey Malyshev, Kirsten Findell	Princeton/GFDL	24	
GISS_E2	Ann Fridlind, Andy Ackerman	GISS	40	
IFS/HTESSEL	Irina Sandu, Gianpaolo Balsamo	ECMWF	137	LAI
LMDZ, ORCHIDEE	Sonia Ait-Mesbah, Marie-Pierre Lefebvre, Frederique Cheruy	LMD	70	
MESO_NH	Maria Jimenez, Patrick LeMoigne, Joan Cuxart	IMEDEA, Meteo France, UIB	85	Bare soil
UM/JULES	Adrian Lock, Martin Best	Met Office	70	Vegetation
NCEP	Weizhong Zheng, Mike Ek	NOAA	65	z0
WRF-NOAH	Wenyan Huang, Xinyong Shen, Weiguo Wang	NUIST	60	Many
WRF	Wayne Angevine	NOAA	119	PBL scheme
CAM5, CLM4	David Lawrence, Ben Sanderson	NCAR	26	



- A challenging surface?
- October grass was largely dead
- Rain in September left soil moist
- Excessive evaporation a feature of the first round of DICE

SCM grids

- Solid lines = control model
- Dotted/dashed lines = experiment
- Lowest grid-levels range from 1.5m to 85m

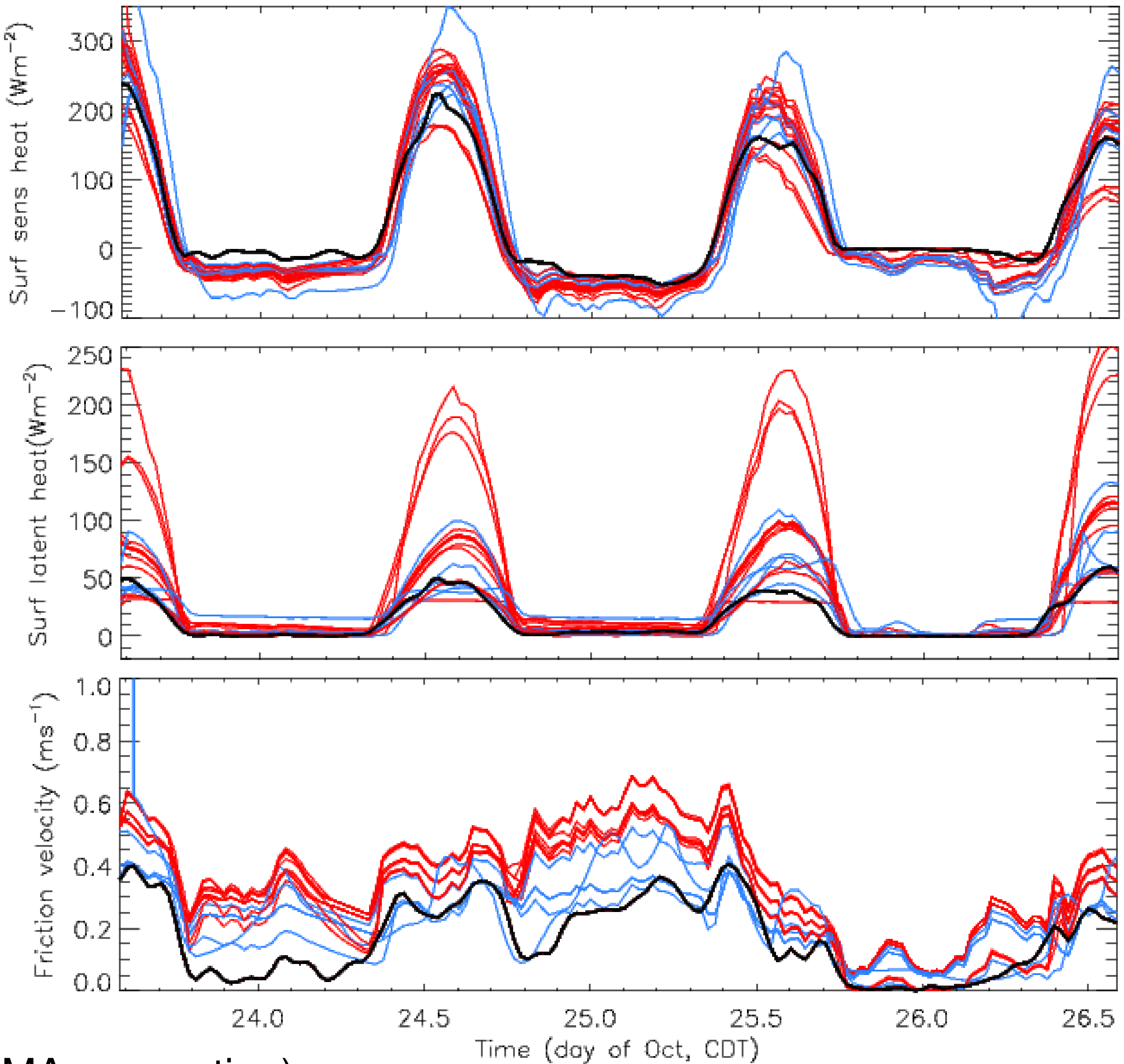


Stage 1a

Surface fluxes from 55m-forced LSMs

Round 1 data

Round 2 data



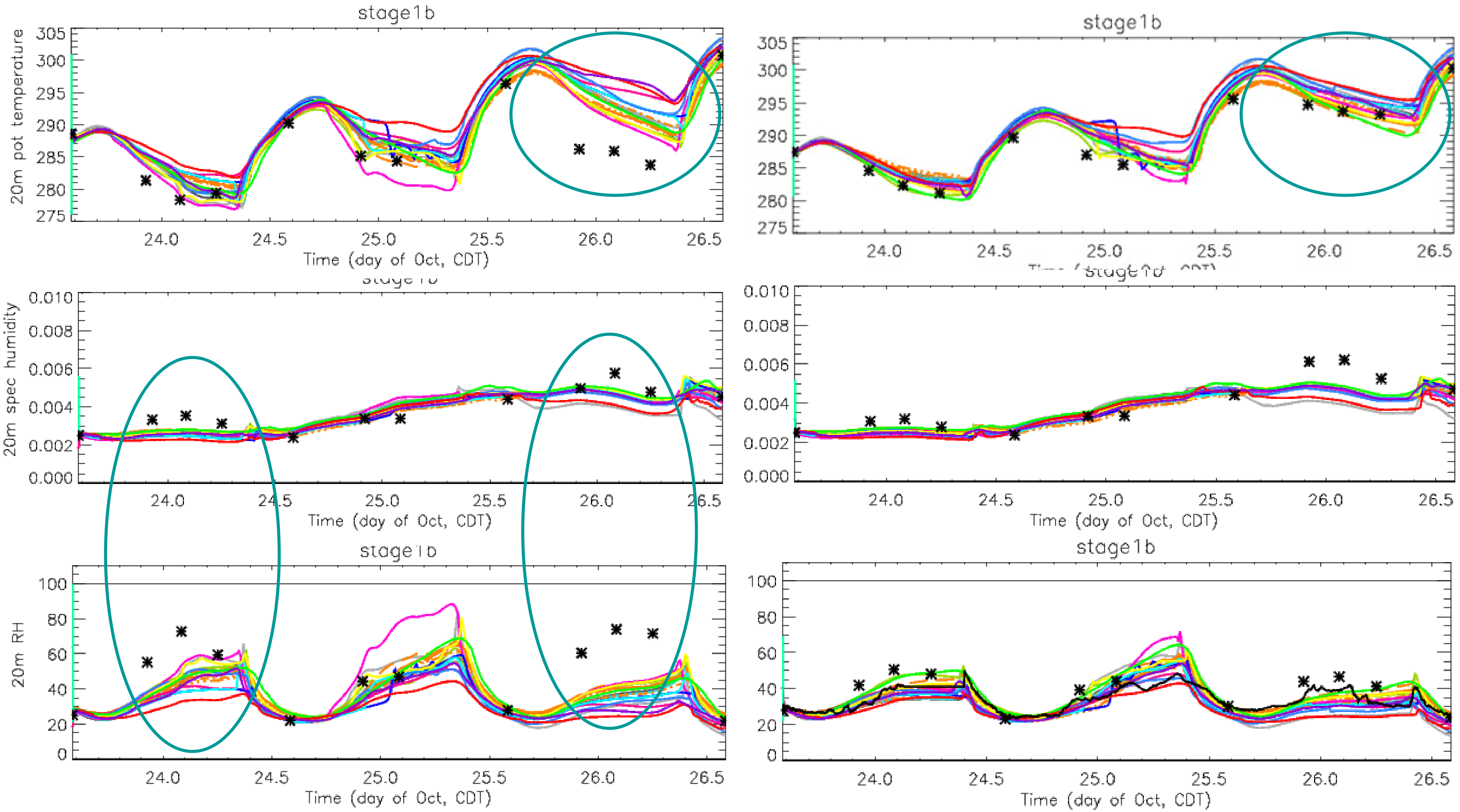
Remember these will be the SCM surface fluxes in Stage 3b

Not all LSM provided u_*
(not compulsory under ALMA convention)

Stage 1b near surface evolution

SCM driven by observed surface fluxes

20m | 55m



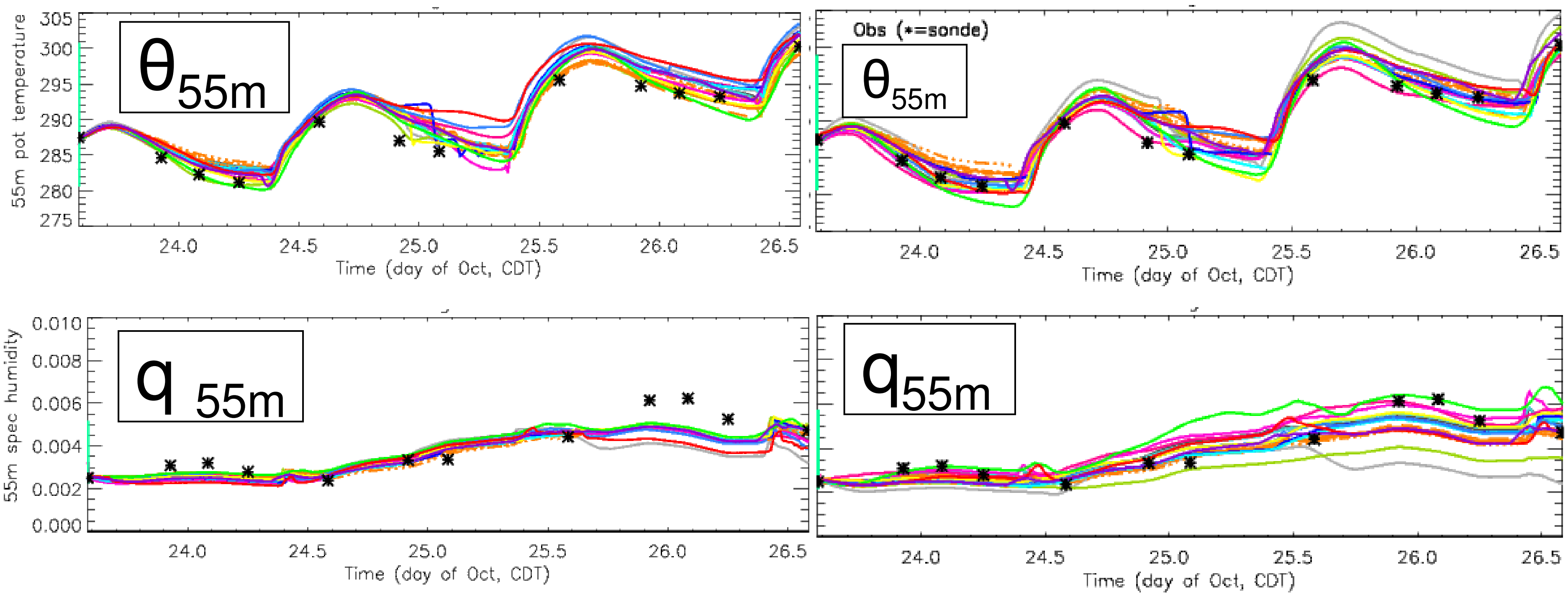
Stage 1b vs 2

Bulk PBL sensitivity (variables at 55m)

Met Office

- More spread between coupled models in stage 2 than stand-alone SCM in stage 1b
  - More degrees of freedom
  - Moisture more sensitive than temperature?

Stage 1b　　　　　　Stage 2

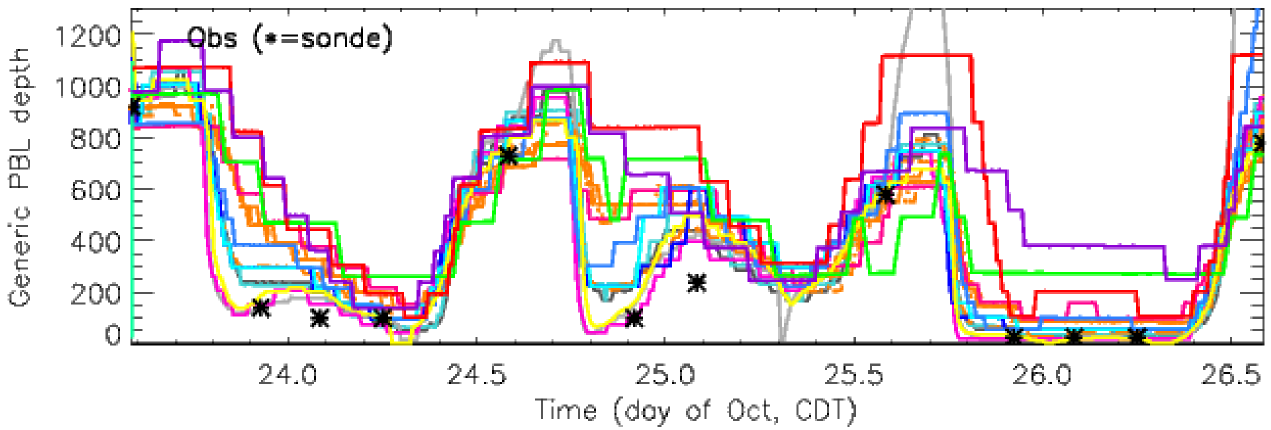


Stage 1b vs 2

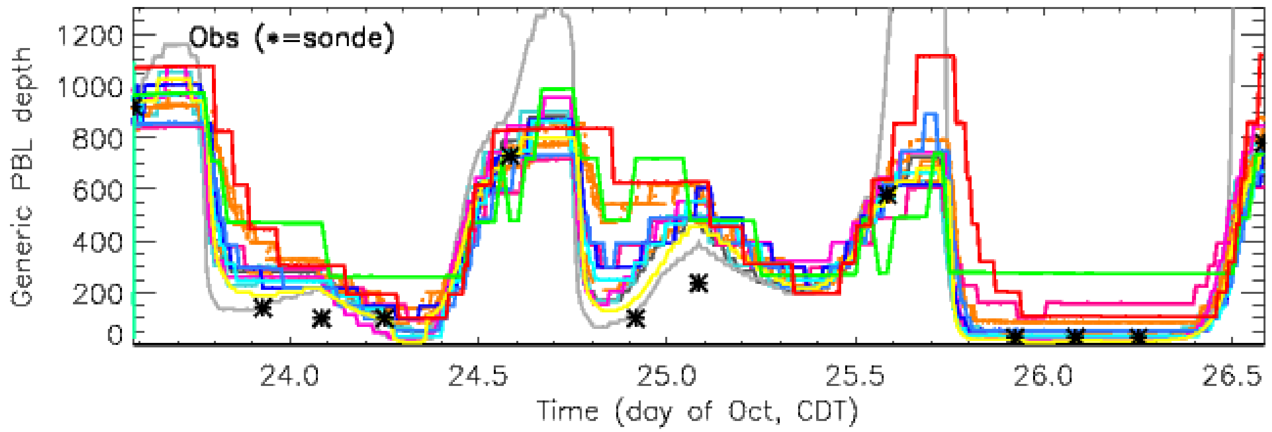
Bulk PBL depth sensitivity

- Some suggestion that PBL depth is less sensitive when coupled

Stage 1b



Stage 2

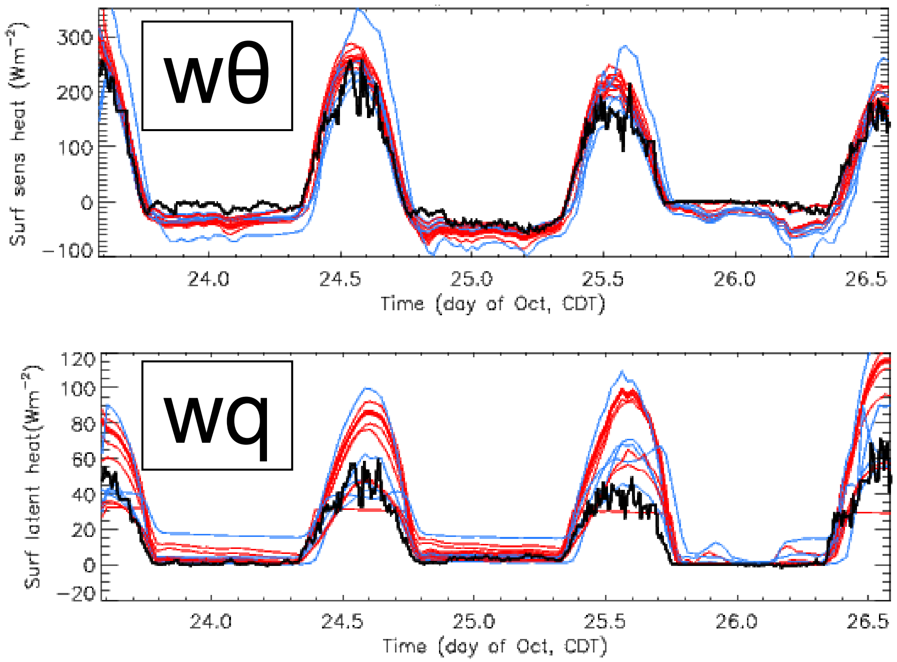


PBL depth calculated as where Ri_B=0.25

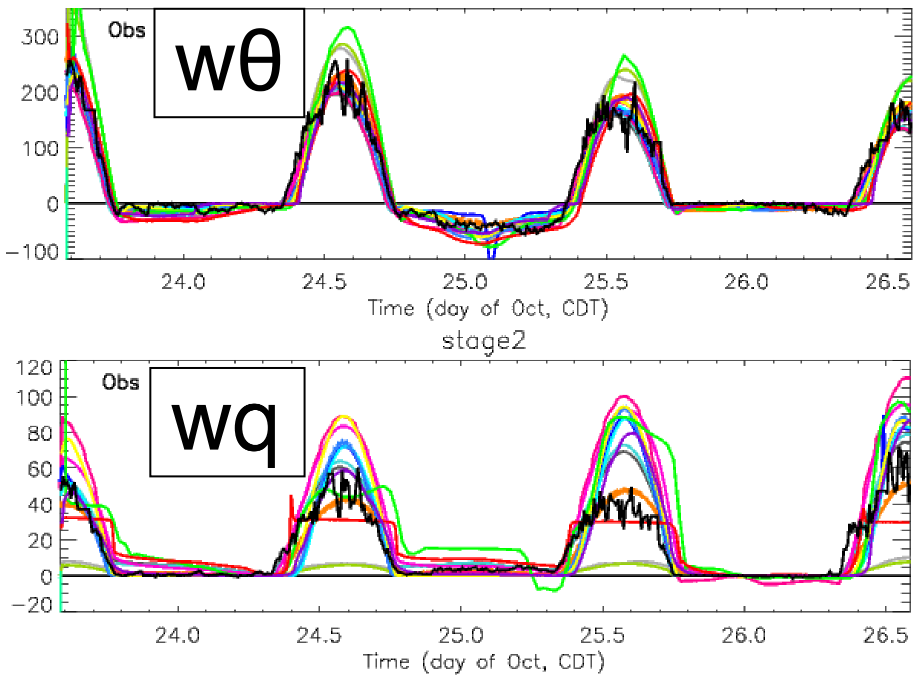
Stage 1a vs 2
Surface fluxes

- Similar surface fluxes from LSMs when coupled to their SCM, despite differences in atmospheric moisture
  - to be confirmed from stage 3a

Selected stage 1a

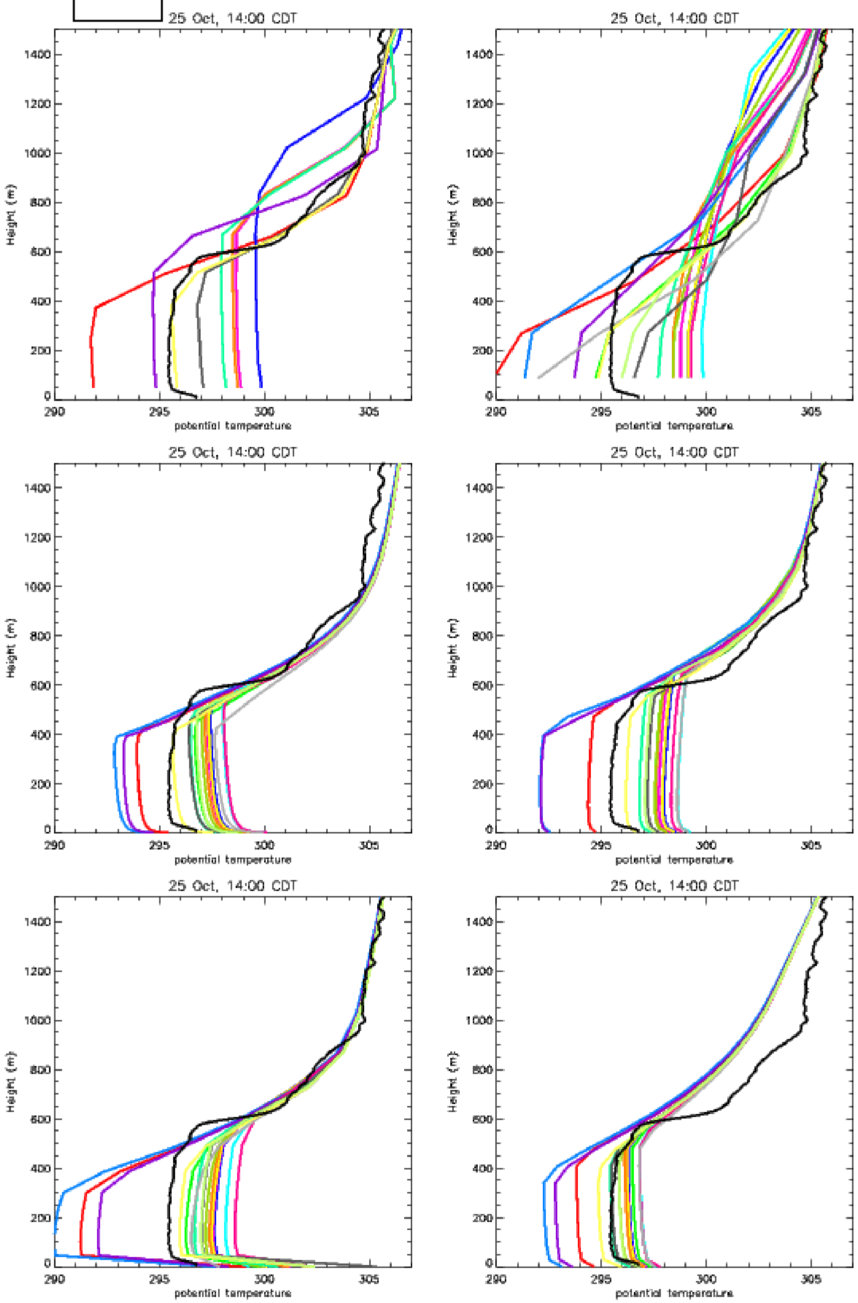


Stage 2

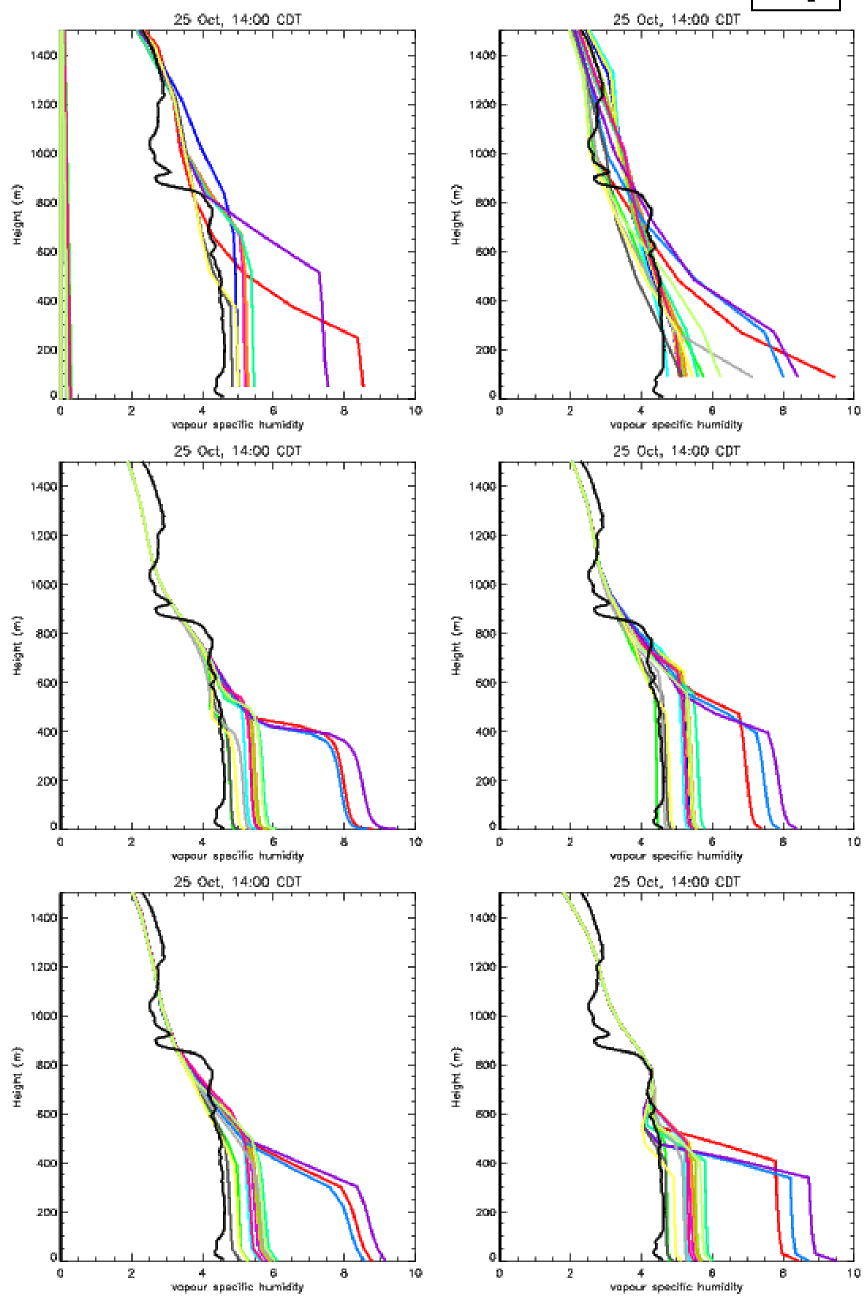


Stage 3b Daytime PBL sensitivity for 25th Oct

θ



q



DICE: summary so far

- Simple case (clear skies, no precipitation, homogeneous surface) but still a challenge for models
- Climatalogical vegetation in LSMs can lead to large errors in evaporation
  - This dominated any signal of the impact of coupling in first round
  - Second round those LSMs that needed to constrained evaporation (adjusting LAI, root depth, bare soil behaviour)
  - Further discussion/developments are required to establish the best way to improve models
- Early results indicate interesting differences in different models' sensitivity to changes in forcing that are likely to be important in GCMs and need to be understood
- Further analysis and DICE discussions at the GEWEX conference,14-17th July 2014

More details at http://appconv.metoffice.com/dice/dice.html