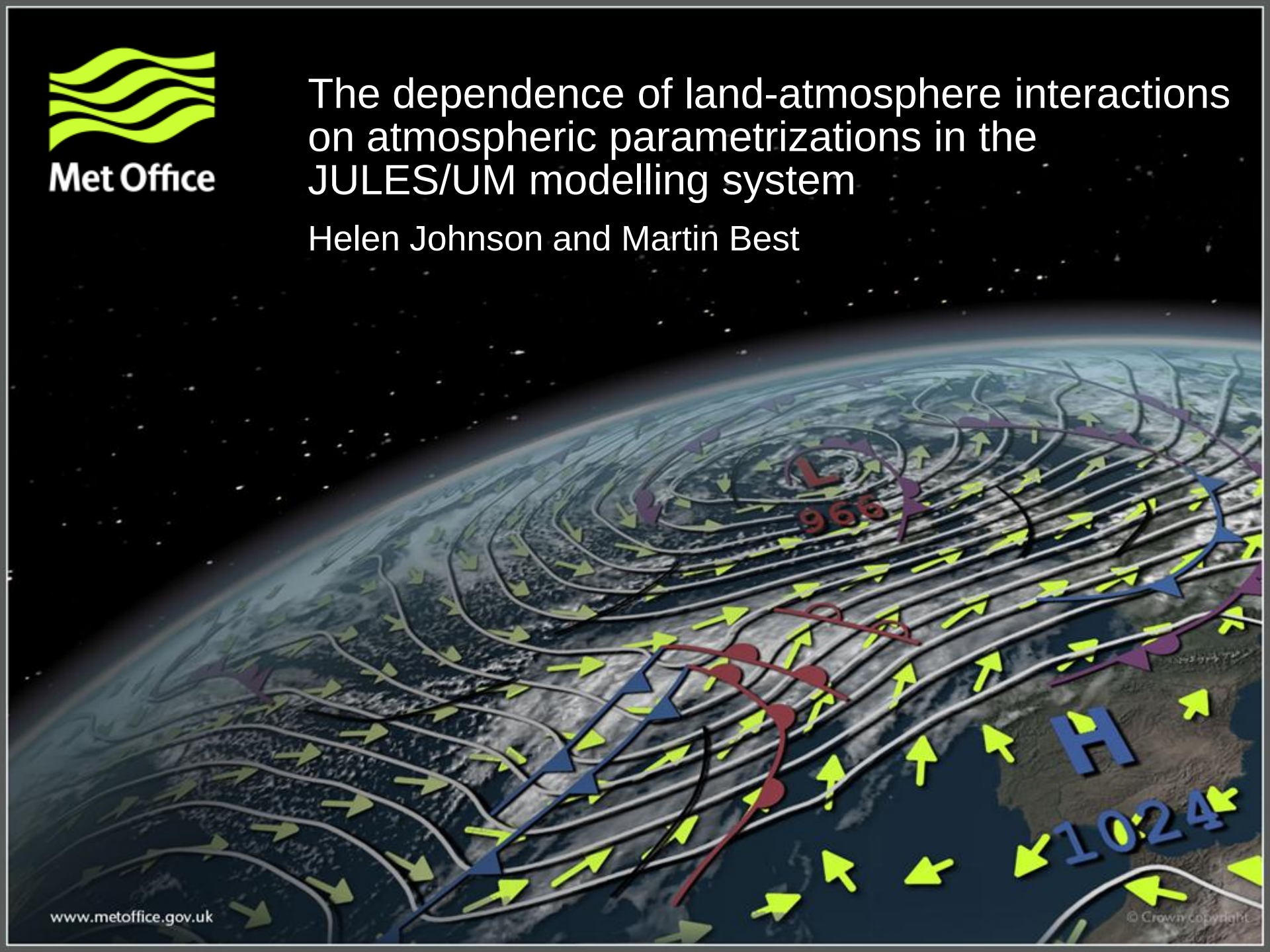
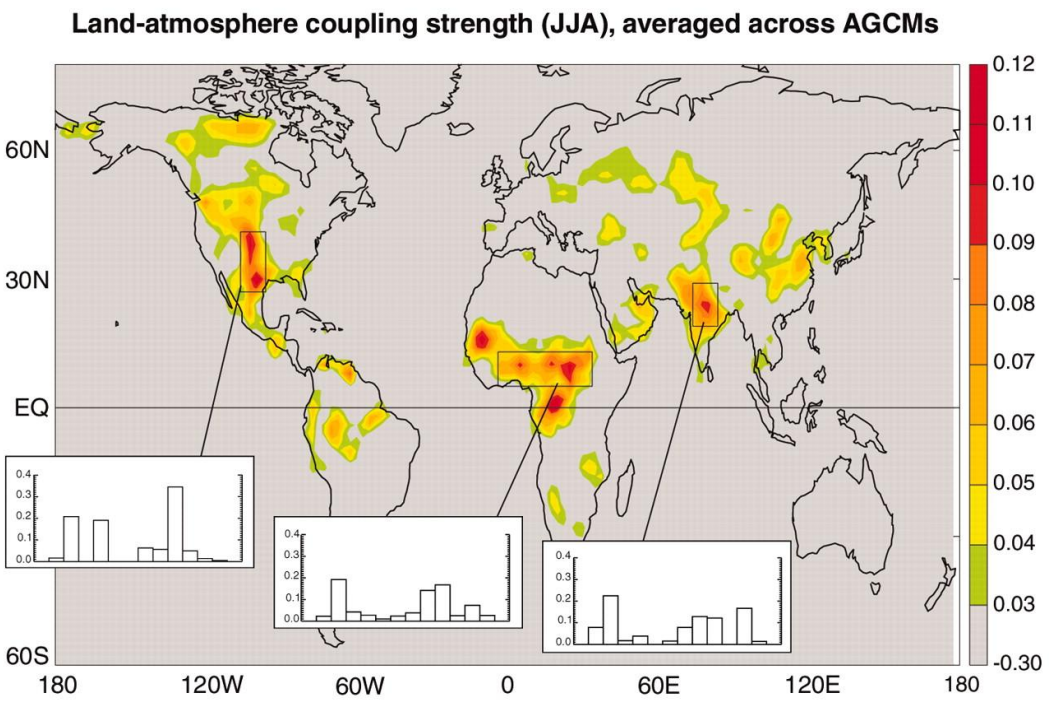
The dependence of land-atmosphere interactions on atmospheric parametrizations in the JULES/UM modelling system

Helen Johnson and Martin Best



Motivation



Koster, et al., 2004

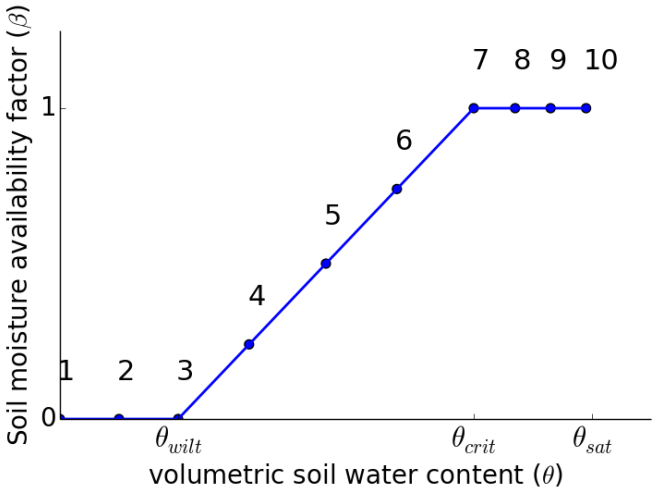
- Global Land Atmosphere Coupling Experiment (GLACE) – models agree there are certain “hotspot” locations where land-atmosphere coupling is strong.
- Differences in coupling strength between models may be due to model parametrizations.
- Diurnal Land/Atmosphere coupling Experiment (DICE) – inspiration for experimental setup.

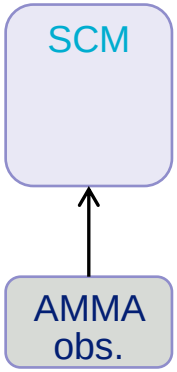
Case: Niamey, 10th July 2006

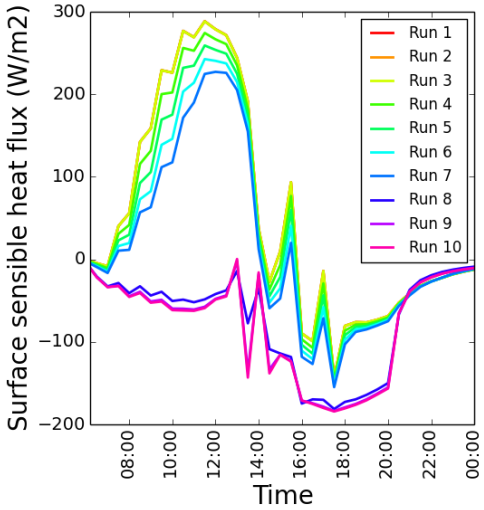
- Site: Niamey airport, Niger. In the Sahel region of West Africa.
- Region identified by GLACE as being especially responsive to changes in soil moisture.
- Observed fluxes from AMMA campaign.
- Run from 6:00am until midnight on 10th July 2006
- Weather: Transition from clear sky to shallow cumulus and then to deep convection.
- 87% vegetation, 13% bare soil.

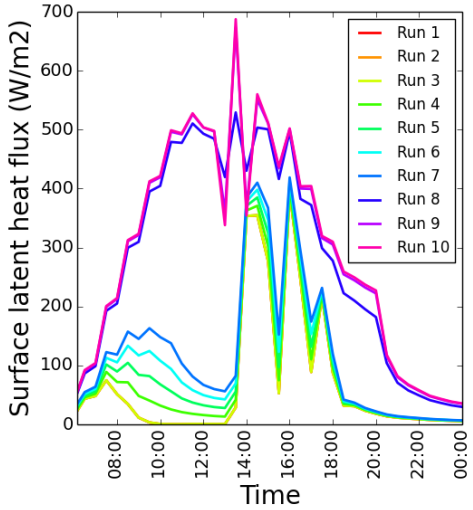
Experimental setup

- Focusing on changes to initial soil moisture.
- Run the JULES land surface model (version 4.1) 10 times with a range of different initial soil moisture conditions.
- Use sensible and latent heat fluxes from these runs to force a set of single column model (SCM) runs, thus simulating a range of different atmospheric conditions.









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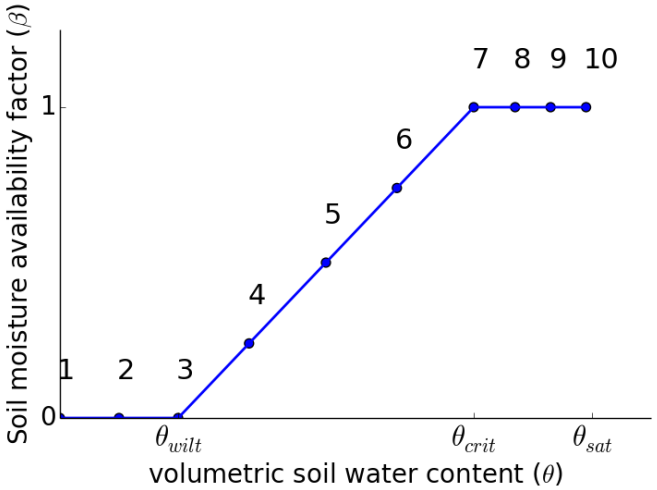

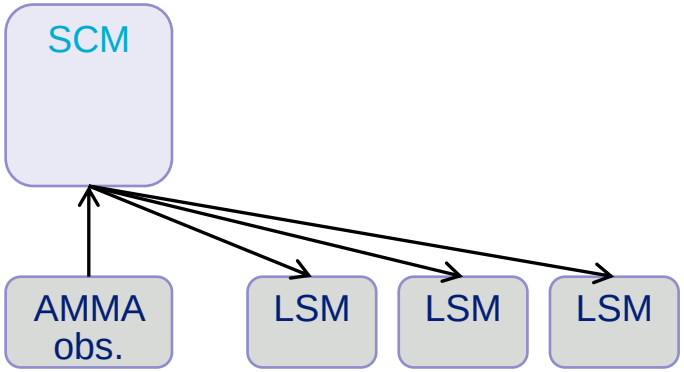

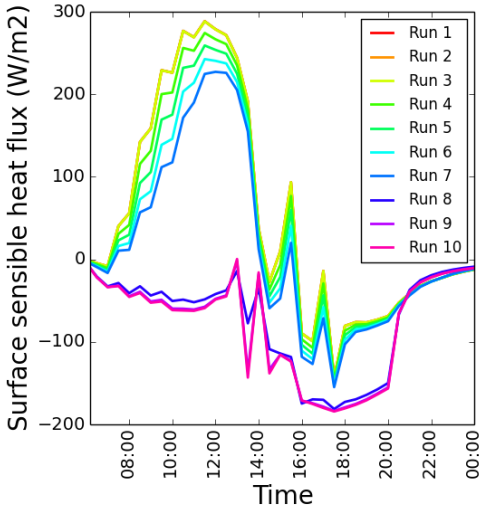

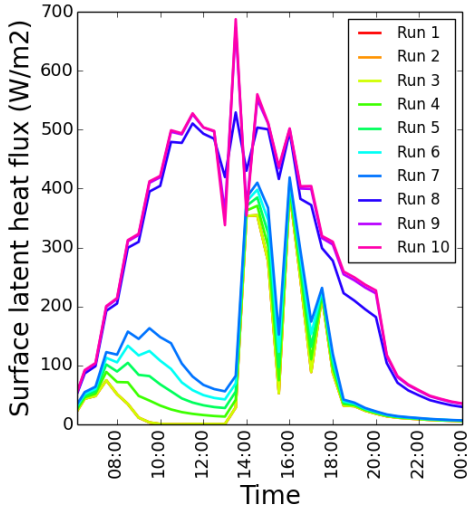

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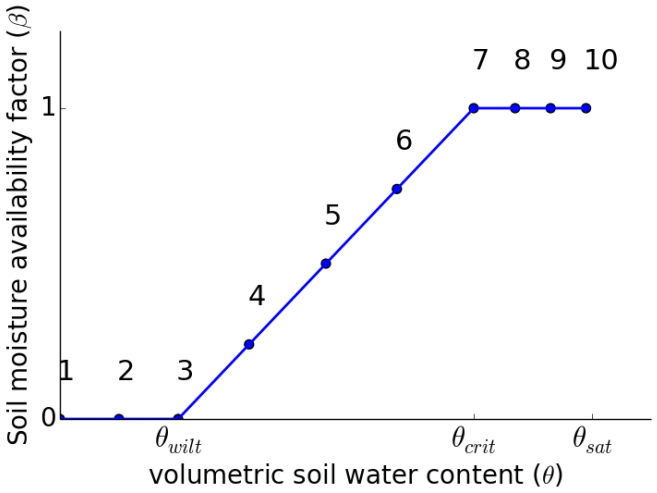
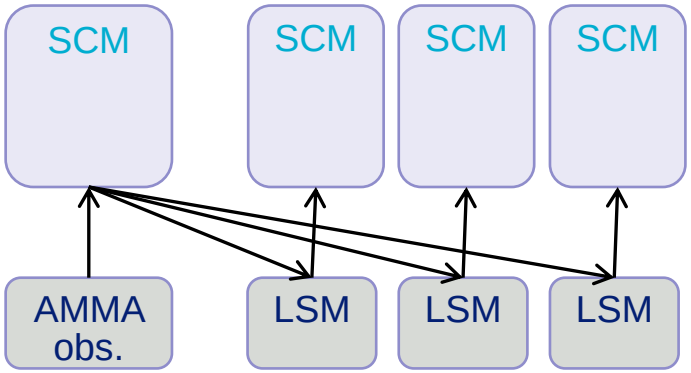
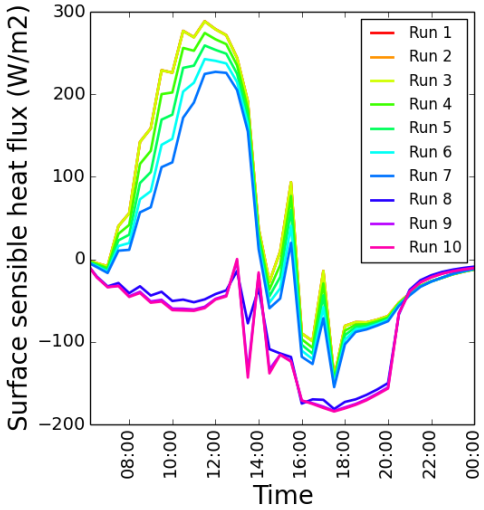
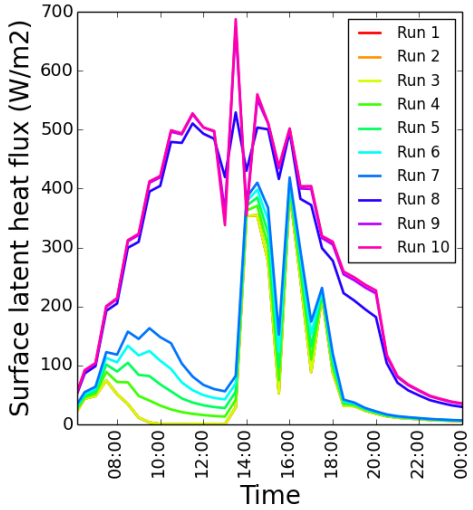




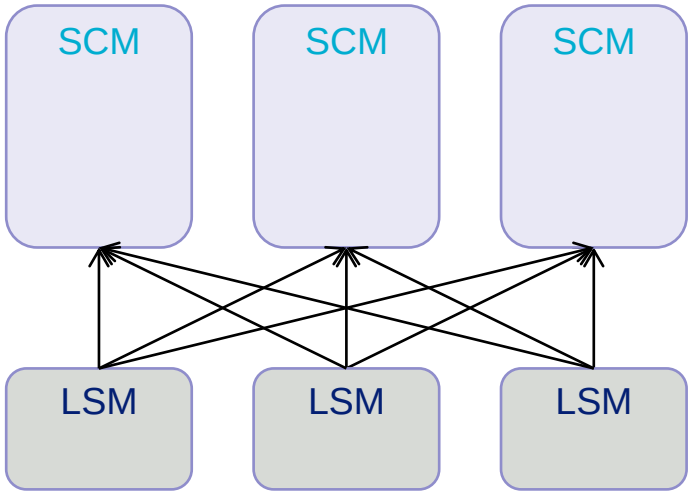




Parameters

Scheme	Parameter Name
Convection:	ent_fac_dp, amdet_fac, r_det, cca_md_knob, cca_dp_knob, cca_sh_knob, mparwtr, qlmin, fac_qsat
Boundary Layer:	zhloc_depth_fac, dec_thres_cloud, a_ent_shr_nml
Gravity Wave Drag:	gwd_frc, fbcd, gwd_fsat, gsharp, orog_drag_param, ussp_launch_factor
Cloud and Radiation:	dbsdtbs_turb_0, rad_mcica_sigma, dp_corr_strat, ice_width
Microphysics:	ai, aic, niter_bs, x1r, tnuc

- 27 parameters
- Minimum and maximum plausible values were identified for each parameter.
- An ensemble of SCMs was generated, each with one parameter set to either a minimum or maximum value and all other values left as standard.
- Each version of the SCM was run forced with fluxes from all ten initial soil moisture LSM runs.



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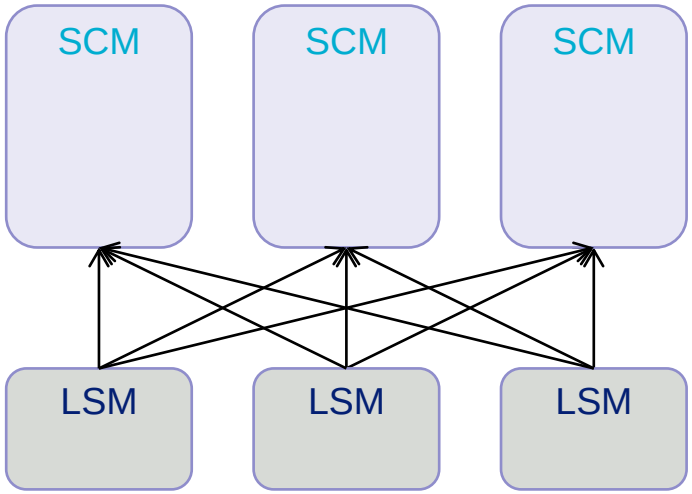


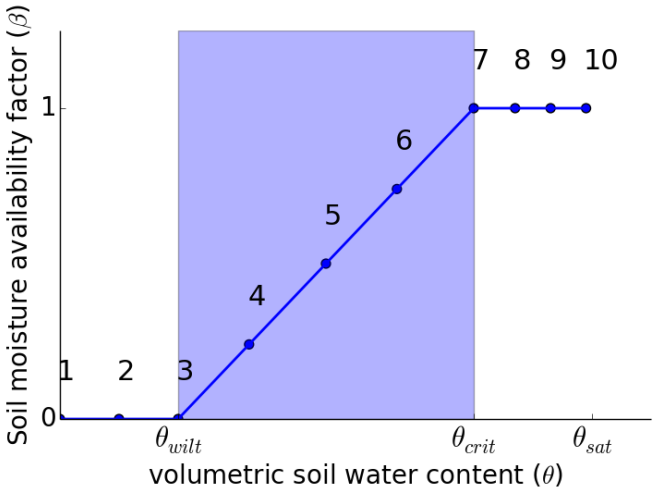
Analysis

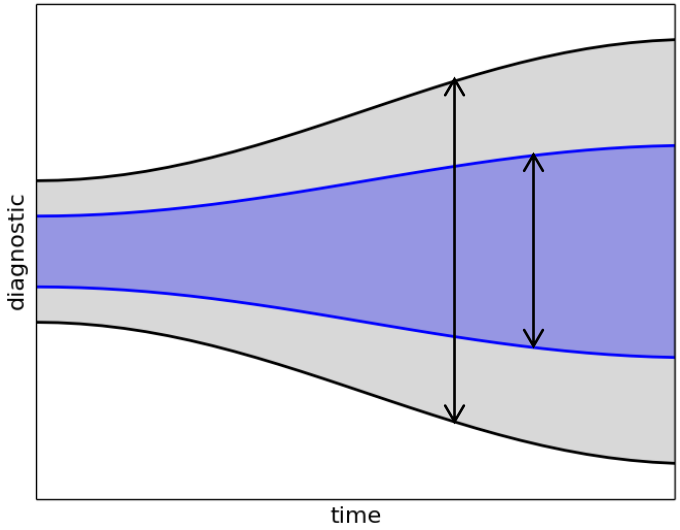
Diagnostics studied:

- Temperature
- Relative humidity

} at first model level (~37m)

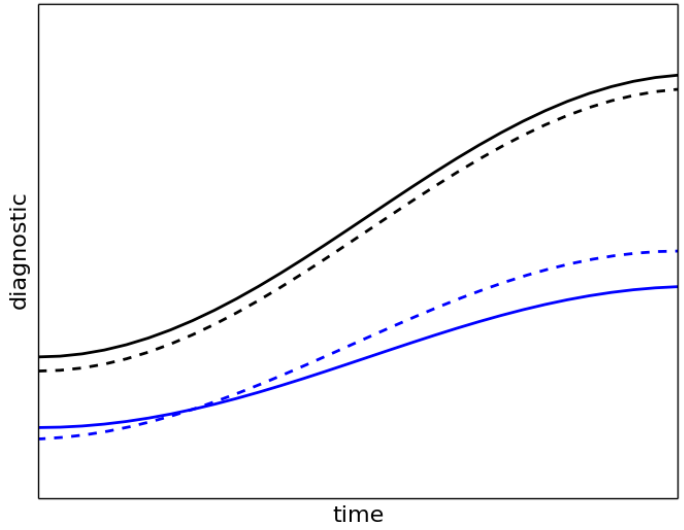
- Cumulative precipitation
- Total cloud amount





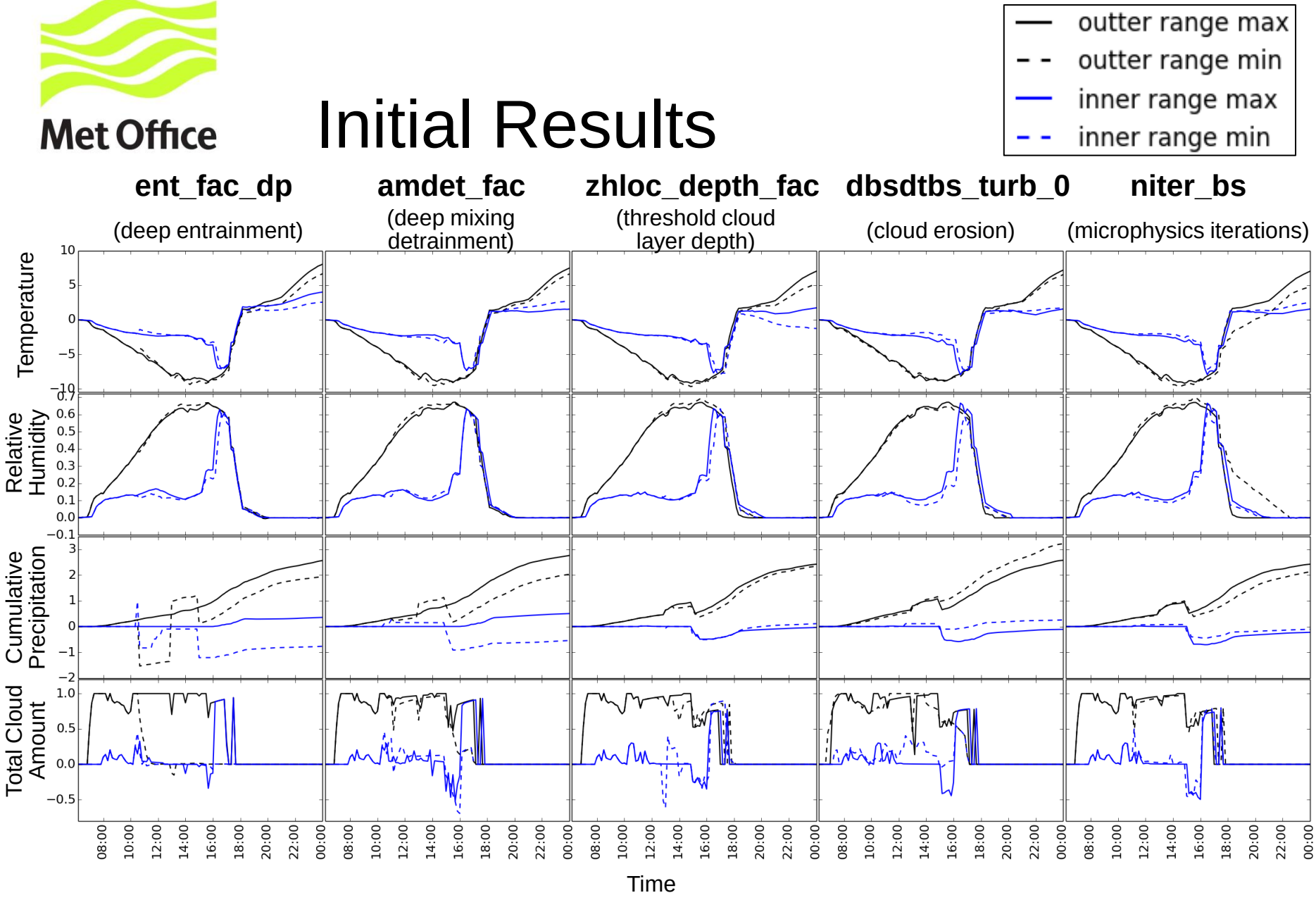
Run 10 – Run 1

Run 7 – Run 3



Solid lines → Max parameter runs
Dotted lines → Min parameter runs

Initial Results



Conclusions and Future Work

- Presented method for studying the influence of parametrizations on atmospheric model sensitivity to the land surface.
- Even when pushing the atmosphere to extreme conditions, we don't see much change in sensitivity.
    - This doesn't necessarily agree with findings in literature.

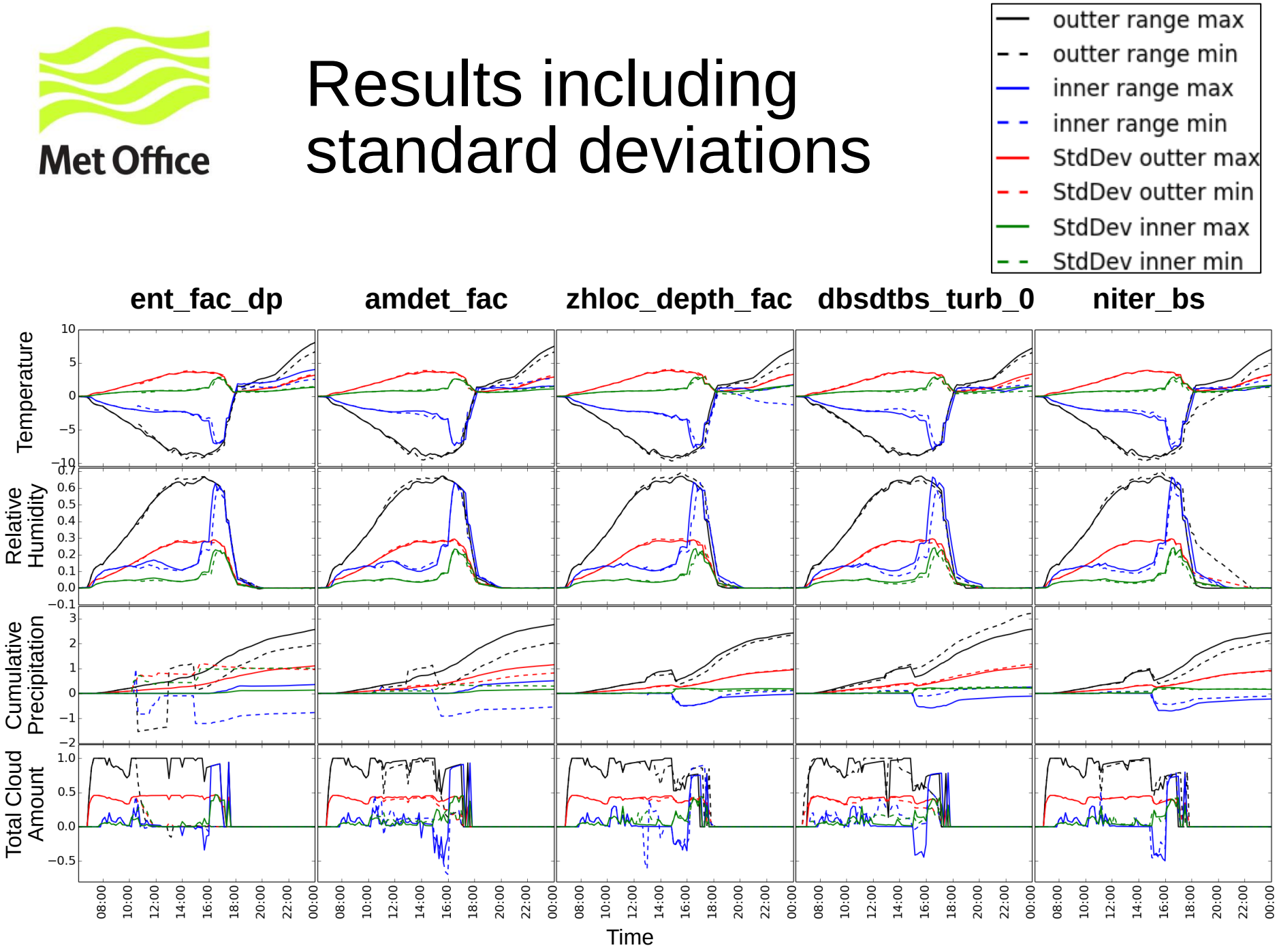
Next moves:

- Repeat for a different case.
- Try using different model physics schemes.

Met Office

Questions?

Results including standard deviations



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