# Land–Atmosphere Coupling Uncertainty due to Soil Moisture and Atmospheric Parameterization Schemes

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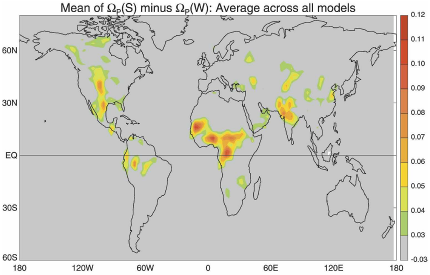
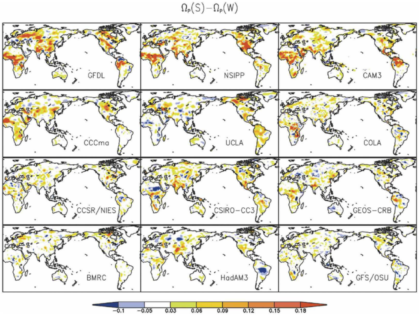
# GLACE Coupling Strength

## Multi–Model Mean




(Figure 10 from Koster *et al.* 2006 J. Hydrometeor.)

## Participating Models




(Figure 5 from Koster *et al.* 2006 J. Hydrometeor.)

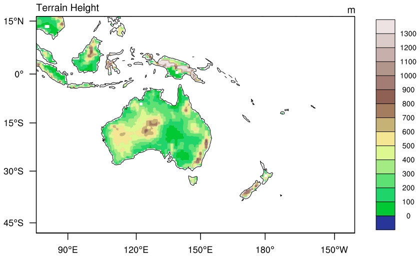
- Evaluate land-atmosphere coupling strength for the Australian summer
- Implement the GLACE methodology in WRF
- Understand the coupling uncertainty associated with soil moisture variability and model physics parametrization

- DJF - 90 day simulations
- 2 parallel ensembles: coupled and uncoupled
- Infer coupling strength by comparing coupled and uncoupled ensembles
- $\Omega =$ normalised within ensemble variance
  - $\Omega \approx 0$: Ensemble members are different
  - $\Omega \approx 1$: Ensemble members are similar
- $\Delta\Omega =$ Coupling strength, values $> 0$: uncoupled ensemble variance converges more quickly than the coupled ensemble variance

# WRF–LIS–CABLE

- 30 atmospheric levels
- Six soil layers, top layer at 0.022 m, deepest layer at 2.872 m
- Maximum of 4 tiles per grid cell
- Model time step of 180 seconds

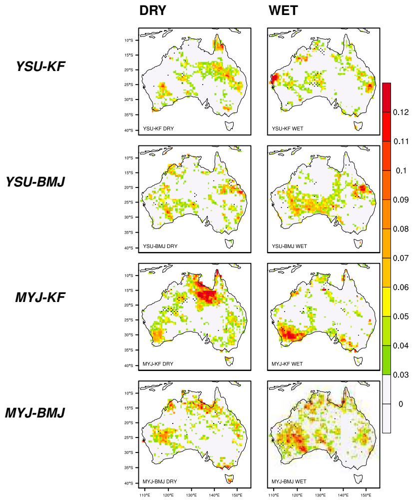
CORDEX domain
with 50 km resolution



# WRF Sensitivity

- 2 PBL schemes with different vertical mixing methods
  - Yonsei University (YSU) [Hong *et al.* 2006]
  - Mellor–Yamada–Janjic (MYJ) [Janjic 1994]
- 2 Cumulus schemes with different triggering assumptions
  - Kain–Fritsch (KF) [Kain and Fritsch 1990,1993]
  - Betts–Miller–Janjic (BMJ) [Betts and Miller 1986; Janjic 1994]
- All run for a dry (El Niño) and wet (La Niña) soil moisture condition

# Soil Moisture – Precipitation Coupling Strength



## TMAX ΔΩ | TMIN ΔΩ

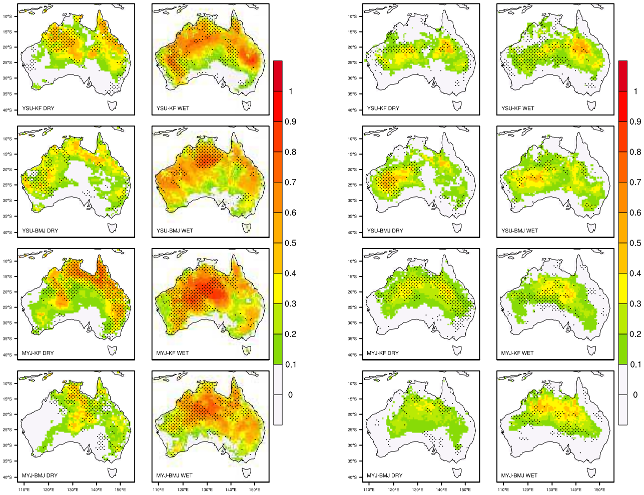
DRY | WET | DRY | WET

*YSU-KF*

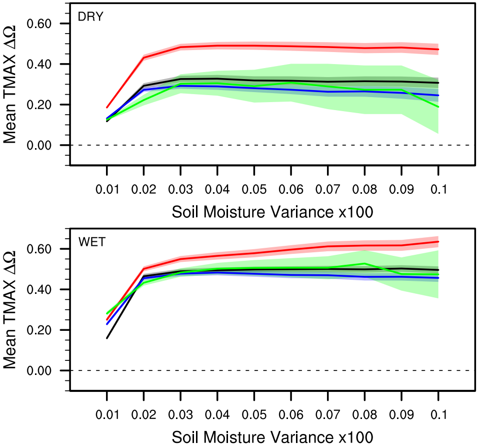
*YSU-BMJ*

*MYJ-KF*

*MYJ-BMJ*



# TMAX ΔΩ vs. Soil Moisture




Legend: **YSU-KF YSU-BMJ MYJ-KF MYJ-BMJ**

- We can produce a range of coupling strengths in one model
- TMIN coupling strength is consistent for all choices of model physics and soil moisture case
- TMAX coupling strength is a function of soil moisture variability with stronger dependence on model physics in soil moisture limited regions
- Our results suggest coupling strength estimates require a multi–model, multi–season and multi–year experimental design

**Thank you!**

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