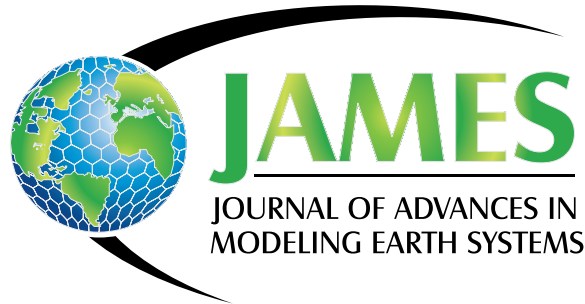


# Coupled Modeling Plans: Response to Quadrupling CO<sub>2</sub>

Peter Blossey & Chris Bretherton  
University of Washington

Builds on previous work with Matt Wyant and Marat Khairoutdinov.

# Submitted to JAMES



1

## Fast Cloud Adjustment to Increasing CO<sub>2</sub> in a Superparameterized Climate Model

*Matthew C. Wyant<sup>1</sup>, Christopher S. Bretherton<sup>1</sup>, Peter N. Blossey<sup>1</sup>, and Marat Khairoutdinov<sup>2</sup>*

<sup>1</sup>Department of Atmospheric Sciences, University of Washington, Seattle, WA, USA

<sup>2</sup>School of Marine and Atmospheric Sciences, Stony Brook University, Stony Brook, NY, USA

---

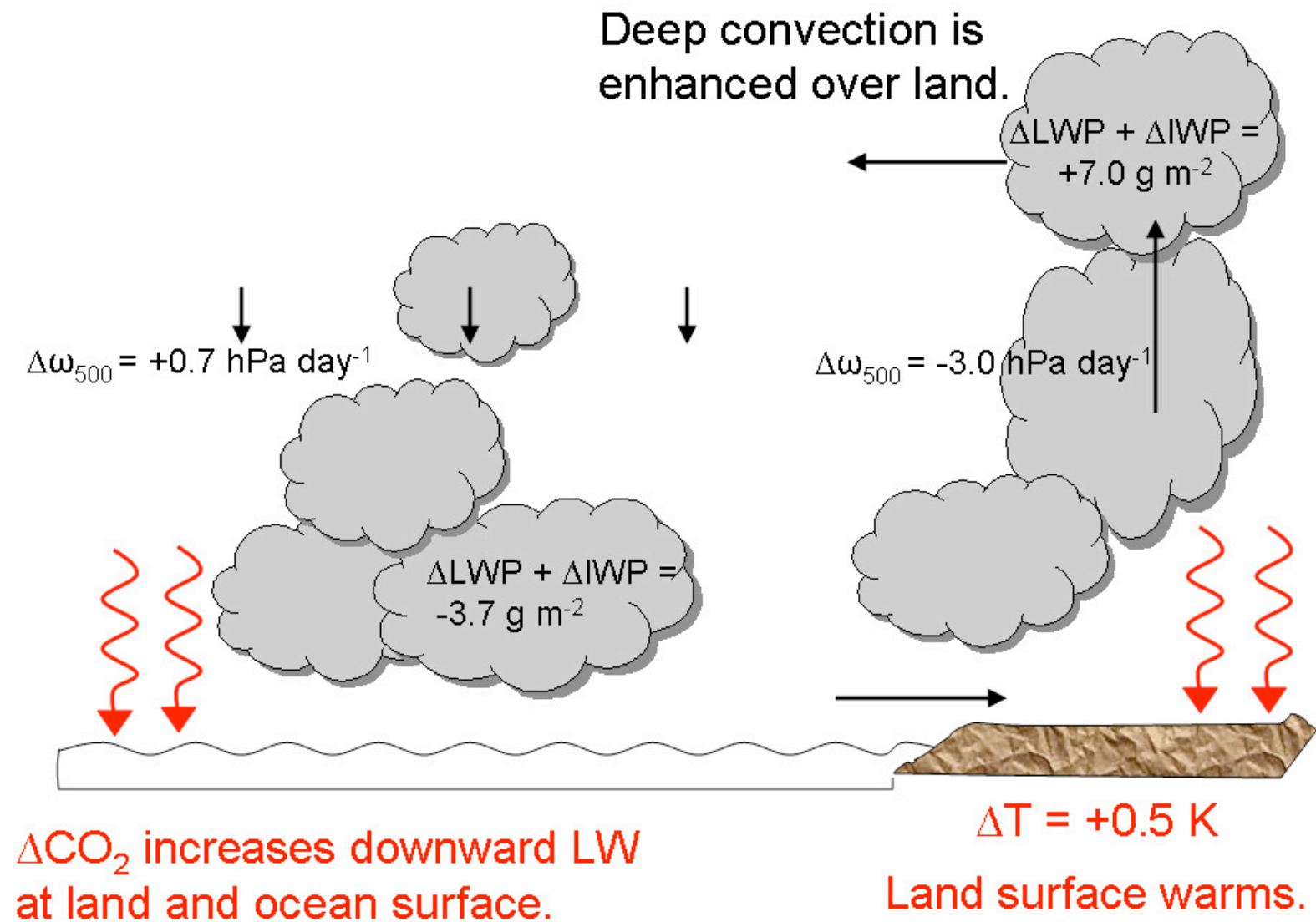
Manuscript submitted 8 July 2011

Two-year simulation experiments with a superparameterized climate model, SP-CAM, are performed to understand the fast tropical (30S-30N) cloud response to an instantaneous quadrupling of CO<sub>2</sub> concentration with SST held fixed at present-day values.

The greenhouse effect of the CO<sub>2</sub> perturbation quickly warms the tropical land surfaces by an average of 0.5 K. This shifts rising motion, surface precipitation, and cloud cover at all levels from the ocean to the land, with only small net tropical mean cloud

- Two-year SP-CAM runs over specified SSTs, with 1x and 4xCO<sub>2</sub>.
- Maritime low cloud response evaluated in single-column LES/CRM simulations.

# Results



- Tropical response dominated by monsoonal circulation:
  - increased upward motion and cloudiness over warmer land,
  - decreased upward motion and cloudiness over oceans.
- Most robust maritime low cloud response is lowering of inversion:
  - decreased entrainment due to weaker radiative cooling and increased stability overcomes reduced subsidence due to slowing-down of Hadley circulation.

# Plans

- For computational efficiency, our previous SP-CAM studies (Wyant et al 2009 and Wyant et al, submitted) used a specified SST, which does not provide a perfect predictor of coupled model response to greenhouse warming.
- We would like to perform the coupled model run pair relevant to CMIP5 that would utilize runs that Cristiana and Charlotte have already made.
- This would give a more realistic characterization of the direct effect of CO<sub>2</sub> on low clouds, as well as an estimate of climate sensitivity.
- The results could be contributed to the CMIP/CFMIP database, to represent and publicize CMMAP's efforts more broadly.