

(1) Project Title: Collaborative Research: CPT for improving the representation of the stratocumulus to cumulus transition in climate models

PI: Sungsu Park

Progress Report Year: 2

(2) Results and Accomplishments:

- *Testing Unified Convection Scheme (UNICON) in CAM5*

One of the future development plans for the next generation NCAR Community Atmosphere Model, CAM6 is to develop a unified convection scheme (UNICON from now on) that can replace separate deep convection and shallow convection schemes in the current CAM5. Sungsu Park (Scientist II) has been developing, improving and testing UNICON with a financial support from CPT. As shown in the below Fig.1 and Fig.2, most recent test using UNICON show very successful simulations of the timing of diurnal cycle of precipitation over continent (Fig.1) and the right signals of Madden-Julian Oscillation (Fig.2), which have been long-standing unsolved issues during the last 30 years in the entire community. This unprecedented success is coming from the capability of UNICON to simulate subtle feedback among convective updraft, convective downdraft and meso-scale organized flows in a physically reasonable way.

- *PDF-Based Cloud Macrophysics (collaborating with Peter Caldwell at LLNL and Chris Bretherton at UW)*

Caldwell, Park, Klein and Bretherton have collaborated in developing PDF-based stratiform cloud macrophysics for CAM5. We have implemented the PDF-macrophysics into the CAM5 and have done simulations both in the single-column and global-simulation modes. The PDF-macrophysics scheme showed the reduction of computation time with more transparent inter-process consistencies and comparable performance with CAM5.

- *Comparison of CAM5 and GFS global simulations (collaborating with Heng Xiao (UCLA) and Ruiyu Sun (NCEP))*

NCAR, NCEP and UCAL team compared global coupled simulation results from the most recent NCAR coupled GCM (CESM1) and NCEP GFS with the observations. This comparison clearly revealed relative strength and weakness of each model and provided a clear way for future model improvement. Heng Xiao at UCLA is in the process of writing a paper on this subject.

(3) Highlights of Accomplishments

- *Testing UNICON in CAM5 – Successful Simulation of Diurnal Cycle and MJO*
- *Developing and Implementing PDF-Based Cloud Macrophysics into CAM5*
- *Comparison of CAM5 and GFS global simulations*

(4) Publications from the Project

In preparation for submission during Aug-Sep 2012.

Park, 2012: A Unified Convection Scheme. Part I. Formulation.

Will be submitted to Journal of Atmospheric Sciences.

Park, 2012: A Unified Convection Scheme . Part II. Single-Column and Global Simulations.

Will be submitted to Journal of Atmospheric Sciences.

(5) PI Contact Information

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(6) Budget for Coming Year

- Total funding to NCAR : \$92,752
(see attached budget for breakdown)

(7) Future Work

- Testing UNICON in the coupled and high-resolution modes
- Testing and further validating PDF Cloud Macrophysics scheme
- Rigorous tuning by combining both UNICON and PDF Cloud Macrophysics.

Diurnal Cycle of Precipitation. JJA.

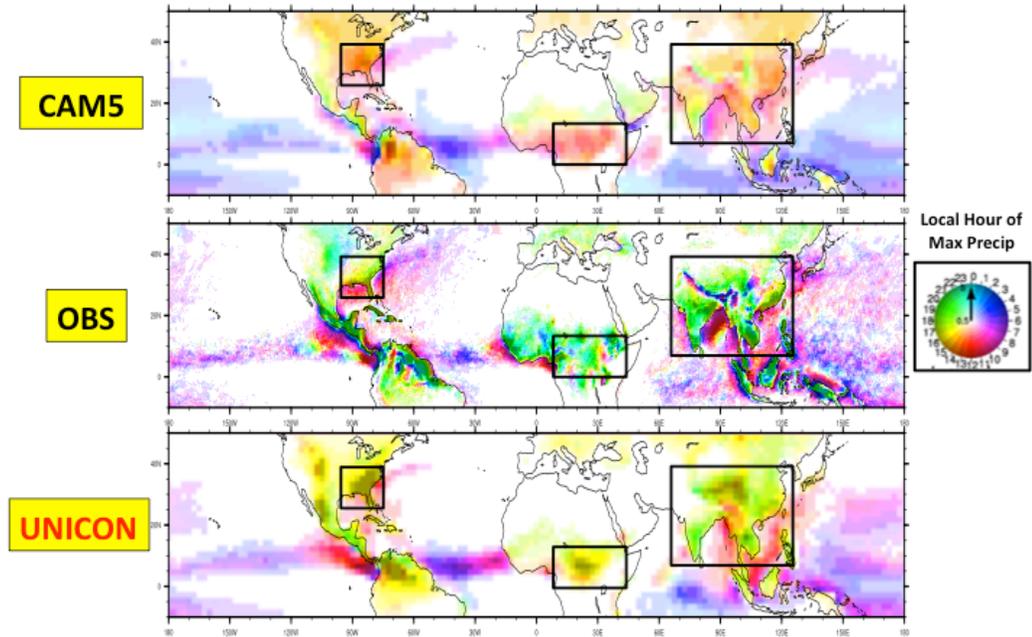


Fig.1. The timing and intensity of the diurnal cycle of precipitation during JJA from CAM5 (upper), Observation (middle) and UNICON (lower). UNICON shows unprecedented successful simulation of diurnal cycle of precipitation.

Madden-Julian Oscillation

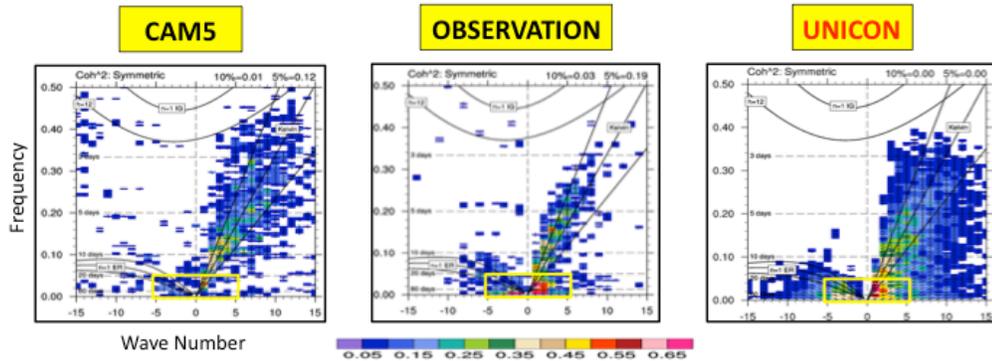


Fig.2. The Madden-Julian Oscillation simulated by CAM5 (upper), Observation (middle) and UNICON (lower). UNICON shows unprecedented successful simulation of MJO.