Description of UNICON Simulations

Sungsu Park

The details of UNICON physics and simulation configurations are described in the Park [2014a, *A Unified Convection Scheme (UNICON), Part I. Formulation. JAS. Nov.2014*], and in the Section 2 of Park [2014b, *A Unified Convection Scheme (UNICON), Part II. Simulation. JAS. Nov. 2014*], respectively. The global simulations used in Park (2014b) were designed for 2-degree resolution with a simplified approximation of cold pool treatment: "*the conservative scalars of the convective updrafts at the PBL top are roughly similar to the mean bulk properties of the non-cold pool area*". For the evaluation as a candidate scheme for CAM6, this simplified approximation of the cold pool treatment is refined, such that more elegant cold pool formulation is used, which was accompanied by the adjustment of several tuning parameters within UNICON. Other than this, the UNICON model physics used in this evaluation simulation is identical to the one described in the Park (2014a).

Slight modifications are made in the stratiform microphysics ('1' below) and macrophysiscs ('2' below). In addition, in order to obtain global energy balance and reasonable global AOD in the required 1-degree configuration, a couple of tuning parameters are adjusted within the physically-allowed ranges as detailed now. It should be noted that the author tried to minimize any modifications outside of UNICON (which replaces CAM5 shallow and deep convection schemes), since the refinement of the other non-convective physical processes (e.g., stratiform macro-microphysics, radiation interface, aerosol wet scavenging, incorporation of organized surface wind into the surface flux computation, etc.) is another big chunk of task that should be done in *a fully consistent and comprehensive way* in the next 5 years.

1.

A stratiform microphysics scheme used in UNICON simulation is the same as the one that is officially released as a part of CAM5, except that in order to ensure that cloud microphysics operates on consistent stratus droplet mass and number concentration, aerosol activation is performed at the beginning of stratiform microphysics rather than in the middle.

2.

Critical relative humidity for low-level and high-level liquid stratus are adjusted to 0.935 and 0.85, respectively. In addition, when convective detrainment of liquid condensate occurs, critical relative humidity for low-level stratus is reduced in proportion to the amount of detrained convective liquid condensate into the clear sky portion. This is an attempt to parameterize the enhanced variance of conservative scalar by convective detrainment in the semi PDF-based CAM5 macrophysics for liquid stratus.

3.

The aerosol scavenging factor was increased to 1 for the wet removal of cloudborne aerosols within cumulus (from 0.4) and interstitial aerosols within cumulus and stratus (from 0.1).

4.

The evaporative enhancement factor of cloud-top entrainment process is increased to 40 from 30.

5.

Within turbulent mountain stress module, the parameter ‘tms_z0fac’ is reduced to 0.01 from 0.075. This is designed to enhance near surface wind speed in CAM5 (CAM5 is known to have too weak near surface wind speed due to too strong turbulent mountain stress). Consequently, the unreasonable large original dust emission factor in CAM5 is reduced to the normal value of 1 from 2.76.