D07

A QBO-Like Oscillation in a Radiative-Convective Equilibrium State Obtained with a Two-Dimensional Explicit Moist Convection Model

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We re-examine the QBO (quasi-biennial oscillation) -like structure in a two dimensional radiative-convective simulation first carried out by Held et al. (1993, hereafter H93). We also investigate the sensitivity of the QBO-like oscillations in regards of different factors such as domain size, resolution and boundary conditions (e.g., prescribed zonal wind at the top and sea surface temperature).

We use the Advanced Research WRF (Weather Research and Forecast) Modeling System Ver. 3 in a two dimensional configuration with a similar experimental design as H93. A periodic boundary condition is assumed in the horizontal direction and Coriolis parameter is set to zero. Convective parameterization is turned off in all simulations and only a cloud microphysics scheme with six classes is used to represent explicit moist convection. Short wave radiation is set as an averaged solar radiation without diurnal nor seasonal variation. A Rayleigh friction layer with an initially prescribed mean zonal wind is placed at the top boundary with a height of 5 km. Other physics options are standard ones for long wave radiations, surface fluxes, planetary boundary layer, and turbulence and diffusion.

The control experiment has a similar configuration to that of H93; 640 km domain width with horizontal resolution of 5 km, 130 vertical levels up to 26 km. The sea surface temperature (SST) is set to a constant value, 27^{o}C. Figure 1 shows the time-height section of zonal mean zonal wind. After about two-month spin up time, the mean zonal wind shows a clear QBO-like oscillation with an averaged period of 120.6 days. The oscillation starts from the bottom of the damping layer near the top boundary and propagates downward and reach the first maximum amplitude at about 17 km. The oscillation weakens around the tropopause, reaches the second maximum at about 11 km, and then decreases until to reach the surface.

Unlike the observed QBO, the oscillation has a clear signal in the troposphere, in which moist convections dominate and gravity waves are generated. Such convectively generated gravity waves propagate into the stratosphere and interact with the mean zonal flow to produce the QBO-like oscillation in the stratosphere. On the other hand, intensity and propagation of organized convective systems are modulated in accordance with the oscillation of mean zonal wind in the troposphere, particularly its vertical shear in the lower troposphere.

Our sensitivity experiments show robustness of the QBO-like oscillations insensitive to the experimental setup other than cloud microphysics. Details of the oscillating features will be reported the meeting.

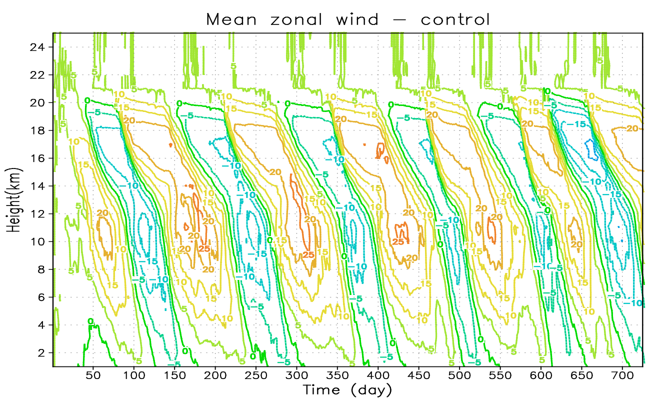

Figure 1 Time-height section of zonally-averaged zonal wind in the control experiment.