1. MOTIVATION AND BACKGROUND: THE CCKWs

Why are CCKWs important?
- They contribute significantly to the variability of the ITCZ and might also influence its structure.
- As with the ITCZ, model representation varies with different physics schemes, in particular cumulus and boundary layer.

The observed CCKW began to be studied in the 1980s, referred as "SUPERCLUSTERS" or "SUPER CLOUD CLUSTERS" (SCC) propagating eastward at the equator in the 1980s, referred as “SUPERCLUSTERS” or “SUPER CLOUD CLUSTERS” (SCC) propagating eastward at the equator.

More recently, studies apply a filtering in the k-x space to isolate CCKWs.

Within the SCC individual cloud clusters move westward.

2. WRF IDEALIZED SIMULATIONS: MODEL SETUP AND SCHEMES

The model configuration:
- equatorial β-channel
- no topography, ocean only
- 64 vertical levels
- spin-up time = 1 year
- "observed" SST profile (exponential intercomparison project: bike and Holtslag, 2003)

Simulations are performed with either:
1) convection parameterized everywhere
2) convection treated explicitly in the tropics through grid nesting
A) Beta-Miller-Janjić (BM): cumulus scheme (based on most convective adjustment)
B) Kim-Fritsch (KF): cumulus scheme (based on entraining/detraining plume)

4 experiments: BM, BM-NC, KF, KF-NC

3. METHODOLOGY: TRACKING THE CCKWs

An algorithm is implemented to track the axis associated with the CCKWs using different parameters and variables. The chosen variable is surface pressure, PSFC. Below, an example for the BM simulation.

More recently, studies apply a filtering in the k-x space to isolate CCKWs.

4. RESULTS: COMPOSITES

With reference to the maximum PSFC (tracker of the CCKW), all 2D and 3D variables are shifted in the E-W direction and averaged in time. The axis of the composited CCKW is relocated to the center of the domain. The zonal mean of the composite (time and zonal mean of raw variable) is subtracted to obtain the perturbation composite. Horizontal fields at different levels and vertical slices at the equator are shown.

What causes different values of Cx?
- Algorithm for tracking CCKWs finds propagation speeds ~ 13-17 m/s.
- The dynamic fields associated to the CCKWs are in agreement with previous studies:
  - At low levels: weaker, convergence ahead, and divergence behind.
  - At high levels: eastertlies, divergence ahead, and convergence behind, with well-defined easterlies over both hemispheres.
  - Vertical cross sections at the equatorial shear layer: deep structures, westward phase tilt with height (max/div.), boomerang-like shape for u
  - KF simulations have stronger wave propagation and weaker signal in the perturbation composite.
  - Significant differences in the tropics between BM NC and KF NC because of the influence of extratropics.

4. RESULTS: PROPAGATION SPEEDS

The axis of the CCKW propagates with varying speed along the tropical channel.

The average CCKW phase speed (Cx) for the simulations are: BM = 17.0 m/s KF = 13.0 m/s BM NC = 16.3 m/s KF NC = 14.5 m/s.

5. SUMMARY

- Algorithm for tracking CCKWs finds propagation speeds ~ 13-17 m/s.
- The dynamic fields associated to the CCKW are in agreement with previous studies:
  - At low levels: weaker, convergence ahead, and divergence behind.
  - At high levels: easterlies, divergence ahead, and convergence behind, with well-defined easterlies over both hemispheres.
  - Vertical cross sections at the equatorial shear layer: deep structures, westward phase tilt with height (max/div.), boomerang-like shape for u.
  - KF simulations have stronger wave propagation and weaker signal in the perturbation composite.
  - Significant differences in the tropics between BM NC and KF NC because of the influence of extratropics.

6. FUTURE WORK

- Understanding the different wave speeds and structures particularly with and without cumulus parameterization.
- More WRF experiments.
- Filtering in the frequency-wavenumber space.

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SENSITIVITY OF SIMULATED CONVECTIVELY COUPLED KELVIN WAVES TO PHYSICS SCHEMES AND RESOLUTION WITH AN IDEALIZED TROPICAL CHANNEL

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