Cloud Parameterizations: How good is good enough and design of observational tests

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The Future of Cloud Parameterization
What we should go after:

Variabilities of Interest:

- Diurnal
- Synoptic
- Seasonal
- Interannual
- Climate
Role of Clouds:

Radiation

Diabatic heating
  • Radiative
  • Latent
  • Turbulent

Hydrological Process
  • Precipitation
  • Evaporation
Parameterization of Clouds

Parameterize the Roles of Clouds

Know the Roles of Clouds In Producing the Variabilities
Role of diabatic heating in tropical waves
Role of clouds and diabatic heating in baroclinic waves
TWO APPROACHES:

- One Solution to Fit All
- Customized Solutions

Identifying the roles of clouds in the variabilities

Flexible framework to address the different roles
Deduce Subgrid Scale Information
Resolved Scale: Interest of Variability

Subgrid Scale: Independent gridding
Fitting and local dynamics (CRMs)
local dynamics independent of resolved gridding

waves and transience
(WAN Wave Model)

convection
Convergent with resolution

Flexible

Subgrid scale information for a region, rather than a grid
Observational Tests

Driven by variabilities in which clouds play a role

Example:

Tropical Wave Transience
KWAJEX 7/24/99 – 9/15/99

KWAJEX Observational Network

(NASA TRMM)
v at 300 mb
Wheeler and Kaladis (1999)

Statistics: Performance evaluation

Events: Process evaluation
TOA: (GOES, GMS, MeteoSat)

soundings, profilers, radar, aircraft

Operational Analysis

Surface: (Buoy, Tower, Surface Rain gauges, Met stations)
Heating field observationally analyzed
Q1-Q2 (C/hour)
The point:

Coupled PBL-shallow convection-deep convection
Jointly produce the heating field to force the wave dynamics,
which in turn organize the physics

This is clearly a multi-scale interaction problem that current GCMs fail to simulate.
Thinking of the future

1. Role of Clouds in Different Variabilities of Interest

2. Flexible Parameterization – Two gridding system

3. Integrated Tests
   (Processes and Performances)

The above:

Theory (1) – Modeling (2) – Observations (3) integrated