CONV-ISO project: initial results and way forward

Obbe Tuinenburg

Laboratoire de Météorologie Dynamique

October 8, 2013
Outline

1. Introduction
2. MJO event
3. Degree of Aggregation of Convection
4. Conclusion and Outlook
Introduction - Goals

Goals:

- Study $q-\delta D$ dynamics of MJO events and other variability
- Understand which processes are important for MJO simulation
- Understand how MJO dynamics potentially differ from other factors:
  - Degree of organization of convection
  - Distance to convection
  - Precipitation intensity
- Use $q-\delta D$ dynamics to analyse/improve model physics
Introduction - Approach

Analyse the q-$\delta D$ structure in the Indian ocean (20S-20N,60E-140E):

- Use IASI q and $\delta D$, compared with strongly guided LMDZ simulations
- Study of Cindy/Dynamo MJO case, nov-dec 2011
- Relation with degree of aggregation of convection (preliminary)
Introduction - Approach

Analyse the q-δD structure in the Indian ocean (20S-20N,60E-140E):

- Use IASI q and δD, compared with strongly guided LMDZ simulations
- Study of Cindy/Dynamo MJO case, nov-dec 2011
- Relation with degree of aggregation of convection (preliminary)

Later:

- Relation with degree of aggregation of convection
- Study specificity of MJO, compared to other modes of variability
- Co-location with IASI-cloud data (fraction, T, pres, emiss)
MJO event - November 2011

IASI dD anomaly (permil) 500 hPa

Obbe Tuinenburg (LMD) CONV-ISO project: initial results and way forward

October 8, 2013
Composite of MJO events

Based on TES-data, for 12S-12N,90-120E (Berkelhammer,2012):
Profiles of $q$ (kg/kg) and $\delta D$ (permil) - IASI (80-85E)
Profiles of $q$ (kg/kg) and $\delta D$ (permil) - LMDZ (80-85E)

Obbe Tuinenburg (LMD) CONV-ISO project: initial results and way forward October 8, 2013 8 / 19
Temporal dynamics at 500 hPa (80-85E)

$q$ vs $\delta D$ MJO cycle opposed to Berkelhammer (2012)
Profiles of $q$ (kg/kg) and $\delta D$ (permil) - IASI, 100-105E
Profiles of $q$ (kg/kg) and $\delta D$ (permil) - LMDZ, 100-105E

Obbe Tuinenburg (LMD) CONV-ISO project: initial results and way forward October 8, 2013 11 / 19
Temporal dynamics at 400 hPa, 100-105E

Phase shift compared to IASI δD, MJO cycle similar to Berkelhammer (2012).
LMDZ tendencies at 400 hPa, 100-105E

Larger convective tendencies in LMDZ, AP.
Temporal dynamics at 600 hPa, 100-105E

Less $\delta D$ variability in IASI than in LMDZ.
LMDZ tendencies at 600 hPa, 100-105E

LMDZ,AP model tendencies in q-dD (600 hPa)

LMDZ,AP model tendencies in q-dD (600 hPa)

Larger convective tendencies in LMDZ,NP.

LMDZ,NP model tendencies in q-dD (600 hPa)
Sub-conclusions

- MJO q vs δD cycles are not always like Berkelhammer, 2012
- LMDZ bias in q, δD, but dynamics are reasonable (sometimes with phase-shift)
- LMDZ δD dynamics are at lower levels than for IASI (100E)
- These differences could lead to sensitivity tests in LMDZ physics, such as:
  - precipitation efficiency
  - entrainment speed
  - precipitation droplet fall speed
  - fraction of droplets inside/outside the cloud
  - etc.
Degree of Aggregation of Convection

Expectation:

▶ When same amount of P falls in small number of convective centres, precipitation is more intense
▶ Less re-evaporation from falling droplets
▶ Air is more depleted
▶ Possibly, convective detrainment is smaller due to smaller number of convective centres (?)
▶ In LMDZ, re-evaporation and convective detrainment tendencies will be mostly affected (?)
Profiles for extremes of DOA (preliminary)

- Probably, the signal of the amount of precipitation is still present.
- Use smaller precipitation bins, but more data needed.
Conclusions and Outlook

- Generalize analysis of MJO events for period 2010-2012
- Formulate hypothesis on LMDZ physics improvements for MJO events (based on 1D LMDZ sensitivity experiments)
- Test these hypothesis in LMDZ 3D simulations
- Extend degree of aggregation analysis to entire IASI period to improve statistics
- Use co-located IASI cloud data to test LMDZ cloud variables