AMIE/DYNAMO/CINDY: From process level understanding to model evaluation and improvement

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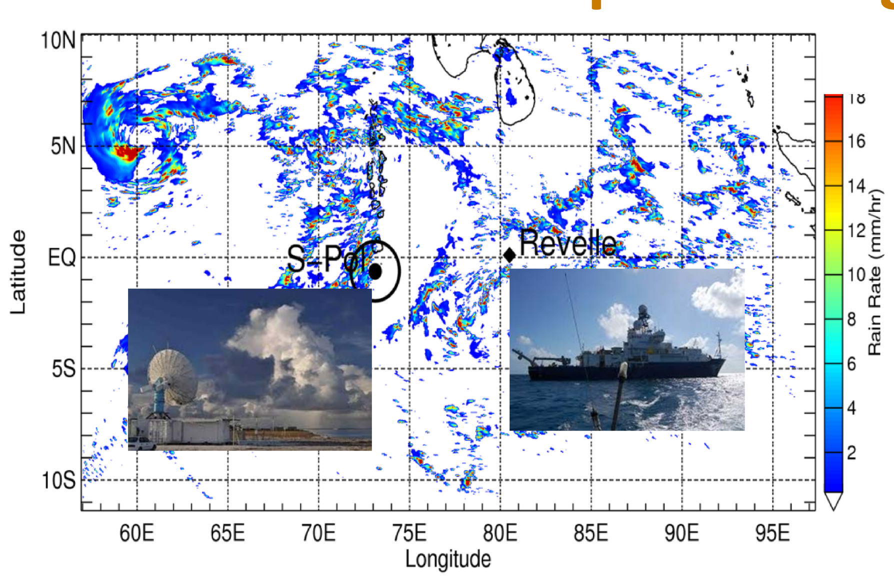
Introduction

Data collected during the 2011 AMIE/DYNAMO/CINDY field campaign over the Indian Ocean is used to:

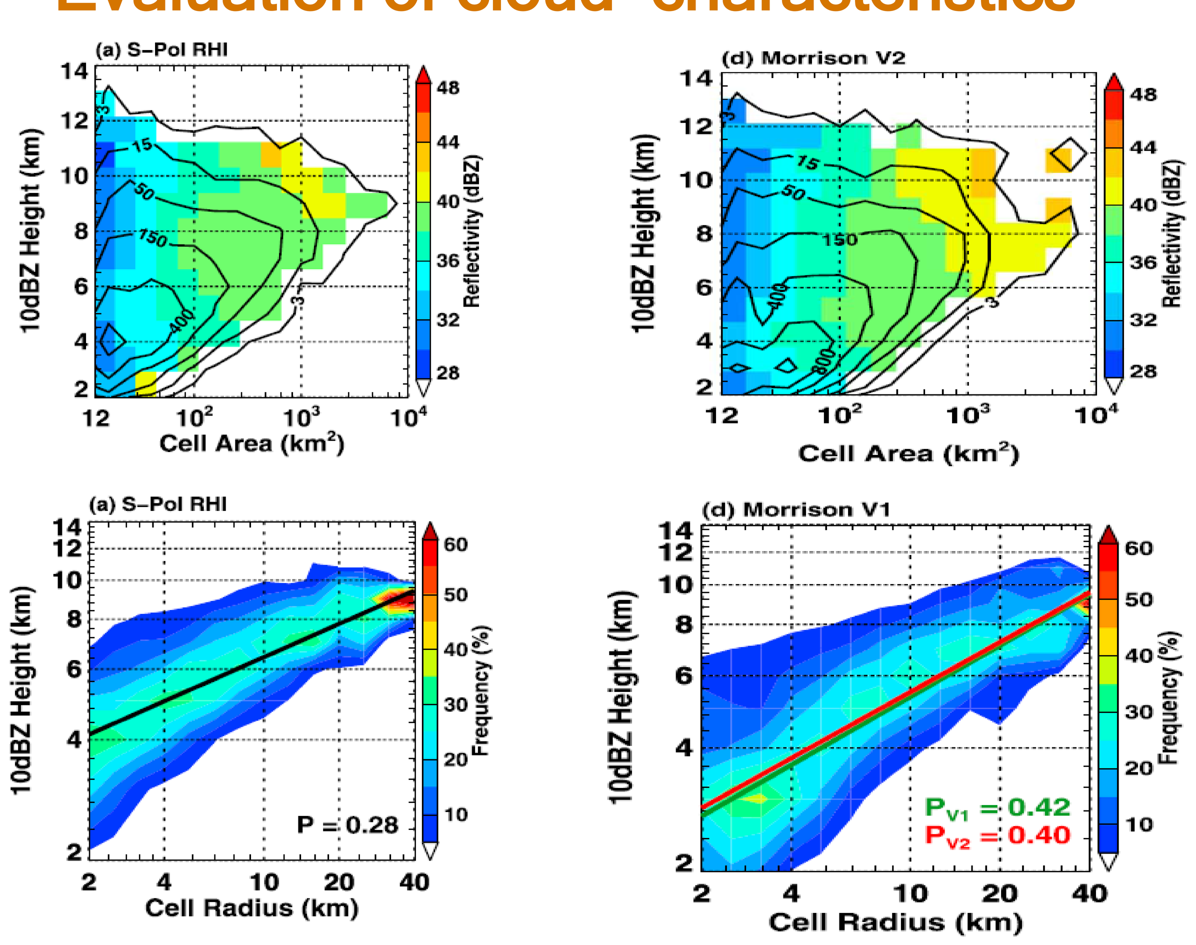
- ▶ Evaluate various state of the art microphysical schemes and cumulus parameterizations.
- ▶ Understand the processes responsible for the rapid shallow to deep convection transition that are observed during the initiation and eastward propagation of MJO.

Evaluation of cloud permitting simulations



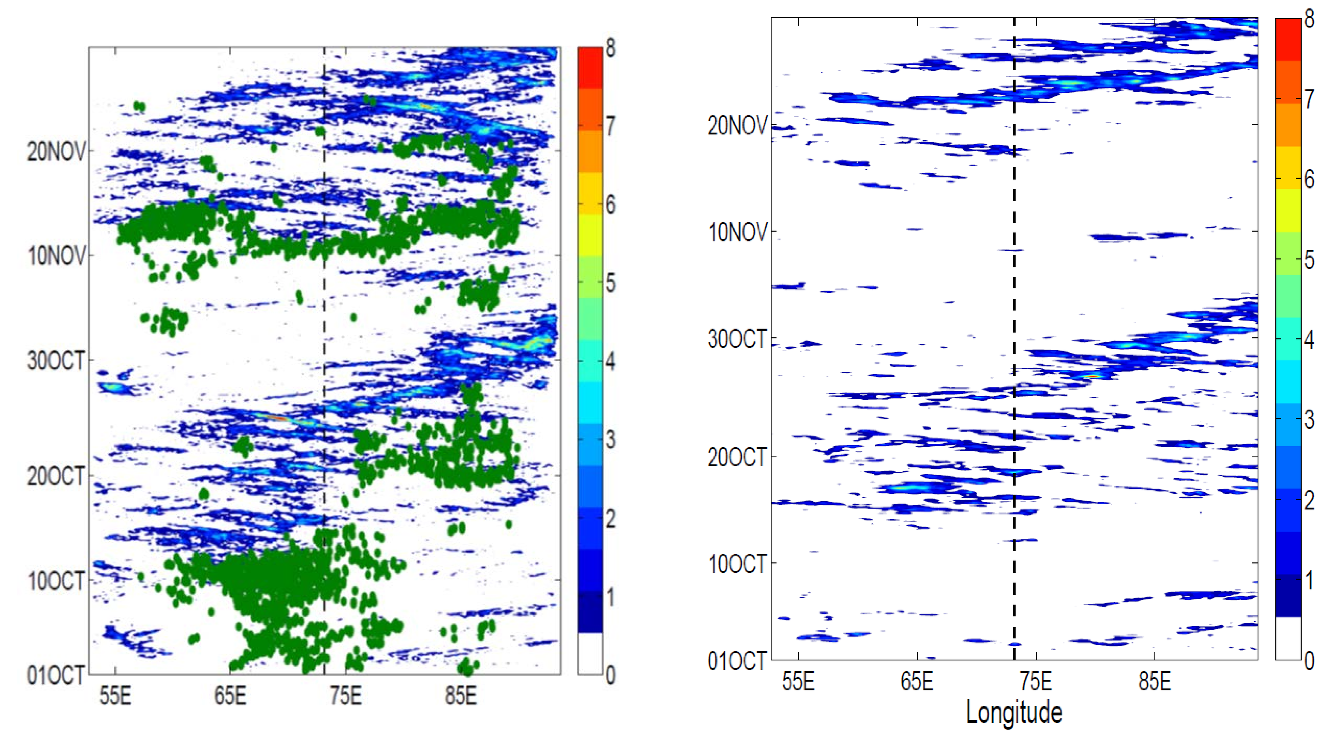
▶ Several WRF simulations with various microphysical schemes are run at 2 km (with various microphysics schemes) and 30 km (with various cumulus parameterizations) grid spacings.

Evaluation of cloud characteristics

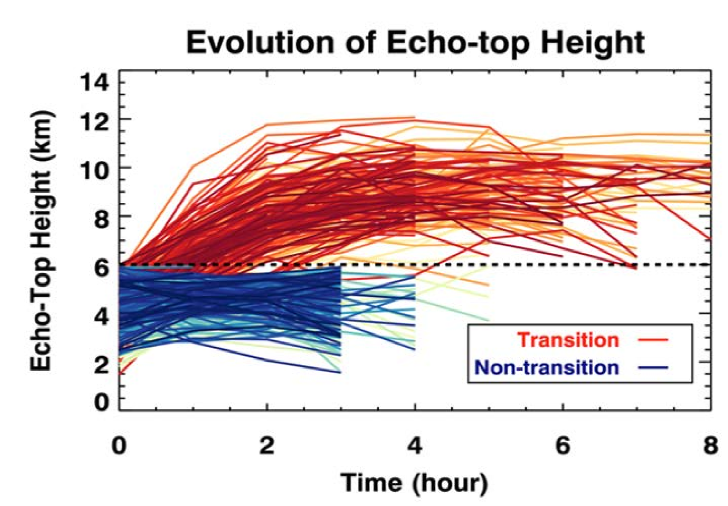


▶ Larger clouds are deeper and rain more. These features are well represented by the various microphysical schemes evaluated. But most overestimate the convective rain from deep large cells.

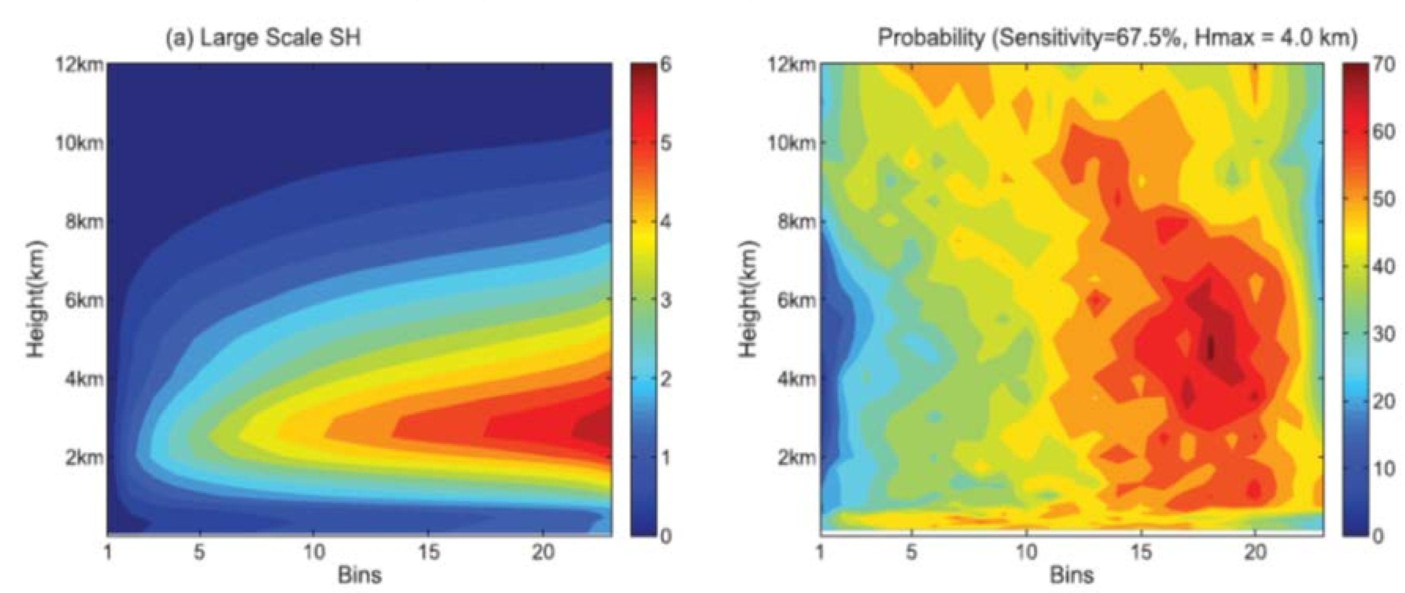
Shallow to deep convection transitions in MJO



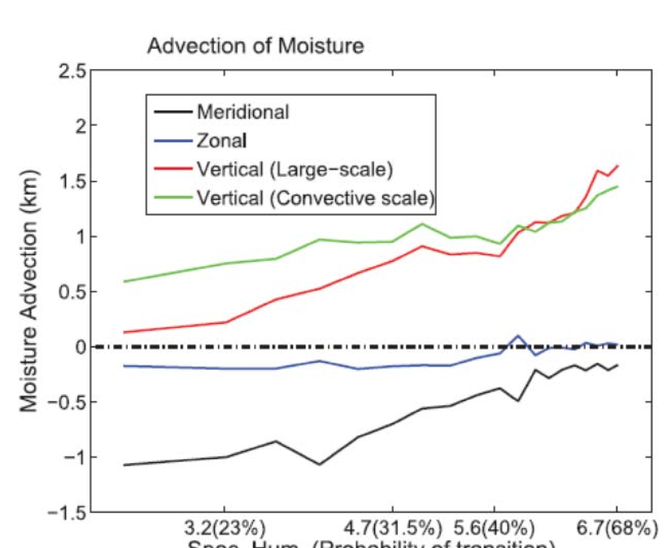
▶ Transitions are associated with both initiation and propagation of the MJO episodes are tracked.



▶Evolution of echo-top heights for the tracked convective clusters. Transitioning cells are marked by the green dots above.



▶ Large-scale mean specific humidity at about 4 km level six hours ahead is a good predictor of transition.

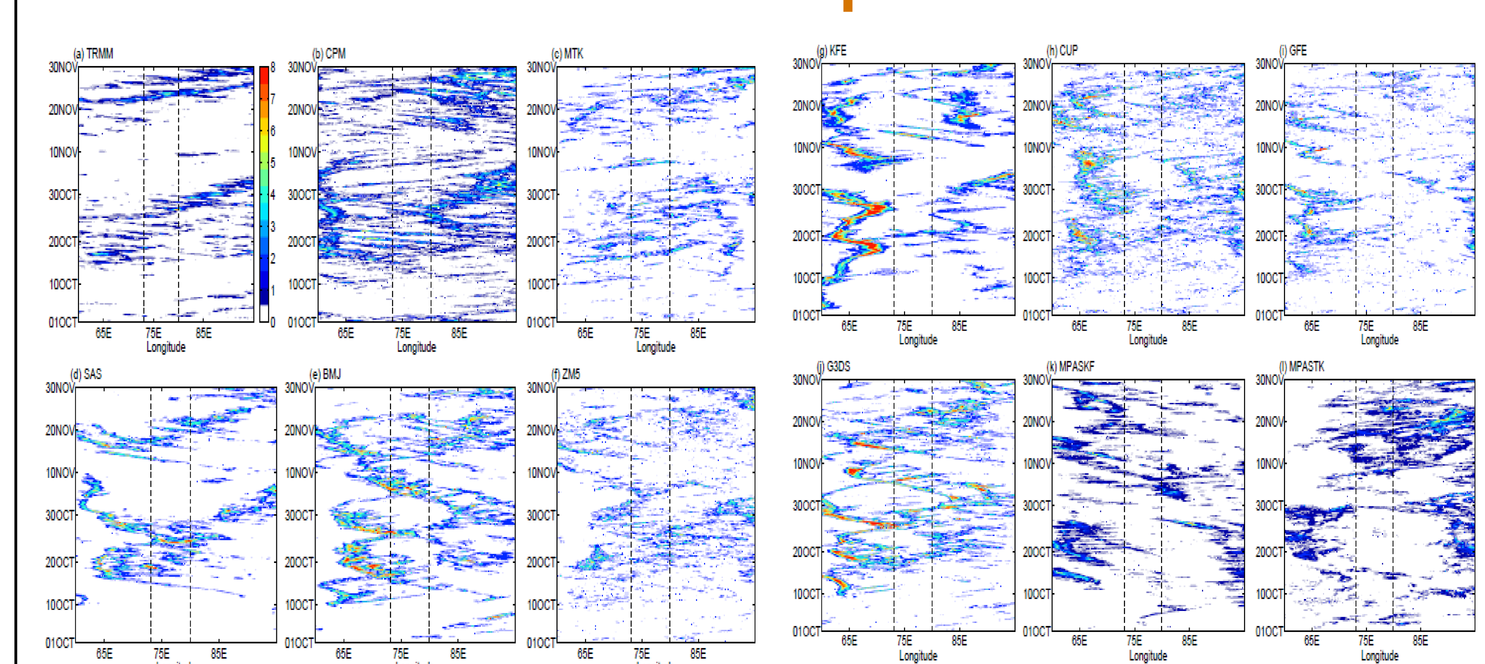


▶Large-scale vertical advection of moisture and the decline of meridional advection of dry air contribute most to the moistening at 4km level.

Summary

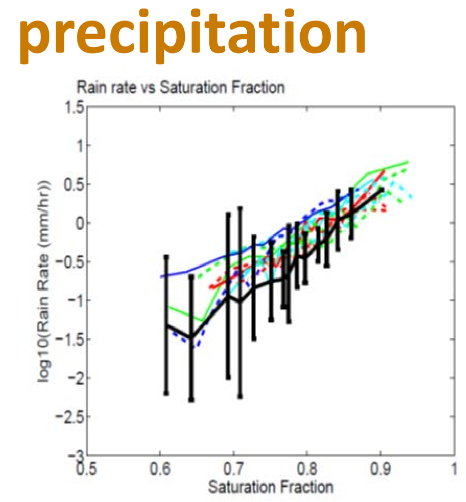
- ▶ Cloud permitting model simulations show good representation of observed organization of clouds in MJO.
- ▶ The shallow to deep convection transitions observed in MJO are found to be linked to increase in mid-level specific humidity by large-scale vertical advection and decline in the meridional advection of dry air.
- ▶ In simulations with cu parameterization, biases associated with the precipitation dependence on saturation fraction are important.

Evaluation of cumulus parameterizations

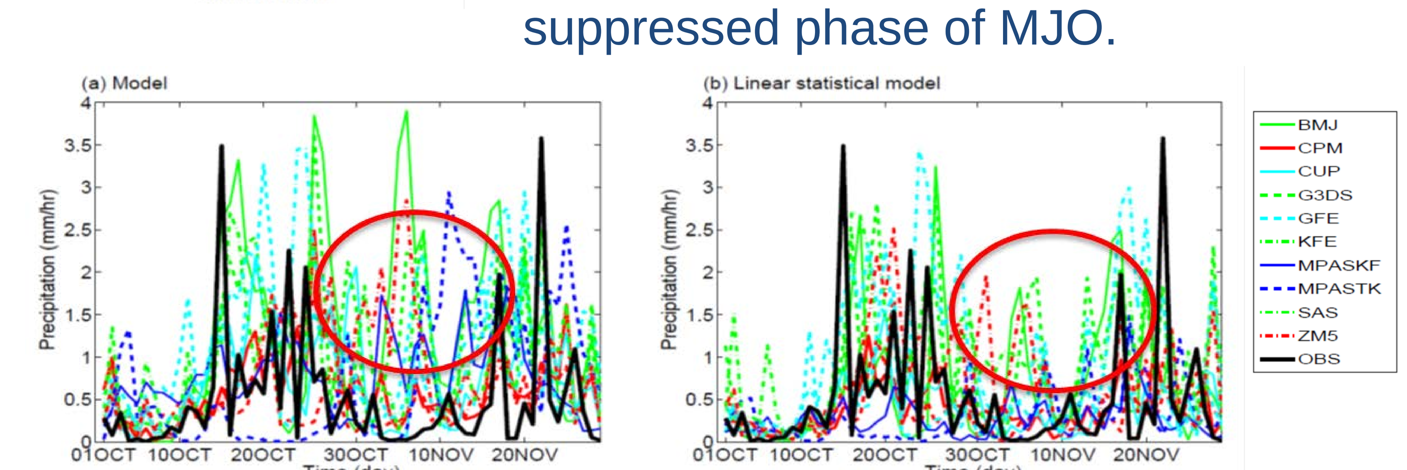


▶Excessive precipitation during suppressed period is a fairly common bias in the simulations.

The link between environmental moisture and precipitation



- ▶For the same saturation fraction, the model parameterizations tend to produce more precipitation than is observed especially at low-saturation fraction values.
- ▶This bias account up to 30% of the model bias in precipitation. It is particularly significant during what is otherwise suppressed phase of MJO.



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