IASI δD and q during MJO events

Obbe Tuinenburg[1] Camille Risi[1] Jean-Lionel Lacour[2]
Matthias Schneider[3]

[1]Laboratoire de Météorologie Dynamique, Paris
[2]Université Libre de Bruxelles
[3]Karlsruhe Institute for Technology

GEWEX conference, 14 July 2014

Motivation

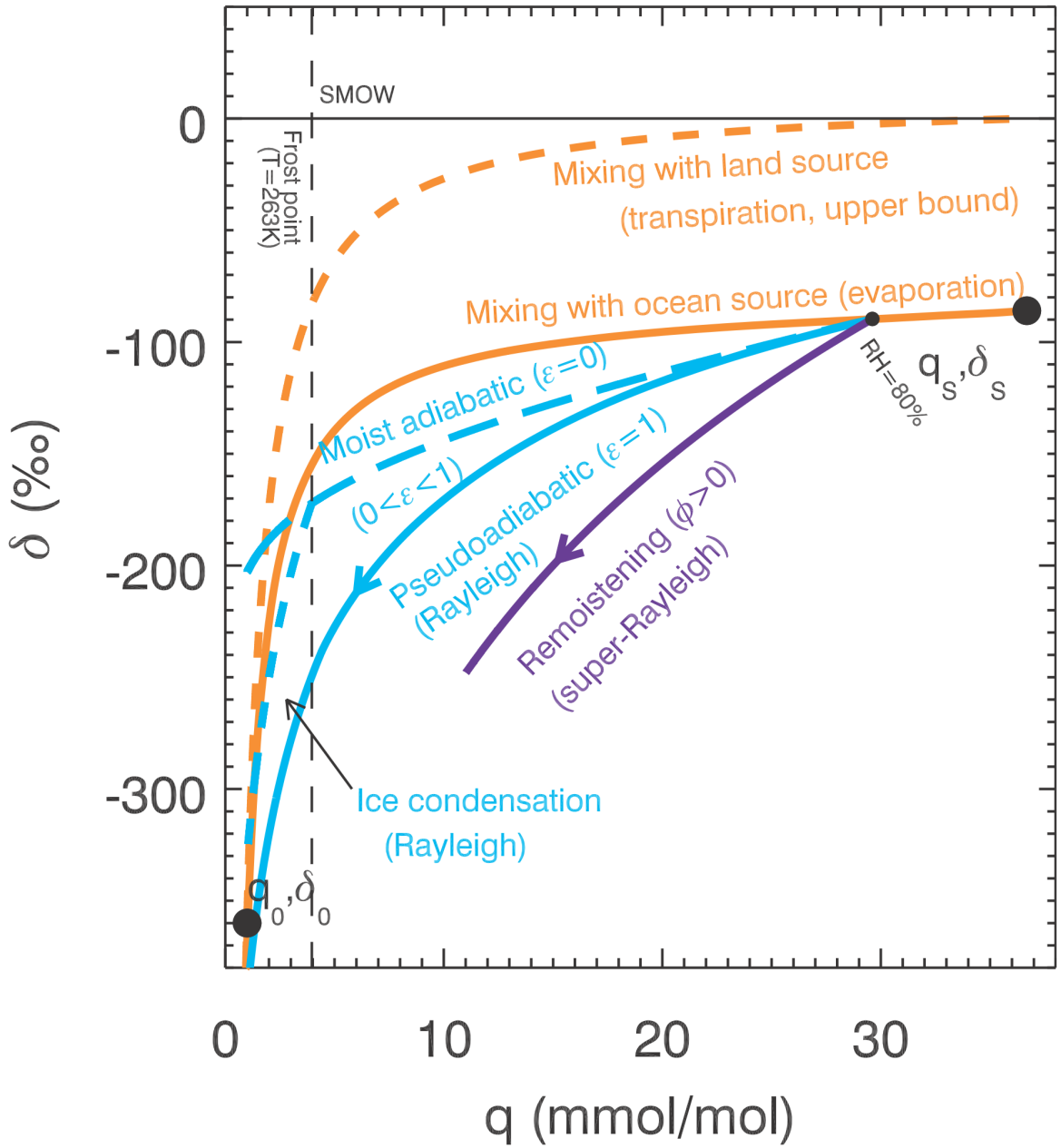
- Climate models poorly represent Madden-Julian tropical intra-seasonal oscillation (MJO)
- IASI satellite (twice daily, 400-700 hPa, 2009-)
  - water vapor (q)
  - water vapor stable isotope (δD or HDO)
- Can we use q-δD data to improve MJO understanding?
  - What are typical MJO q-δD dynamics?
  - What processes influence q-δD dynamics?
  - How do these vary in space and time?
- Can we use this understanding to improve climate models?

Outline

1. Why use water isotopes?
2. Moistening and drying processes during MJO events
3. Improving MJO representation in climate models

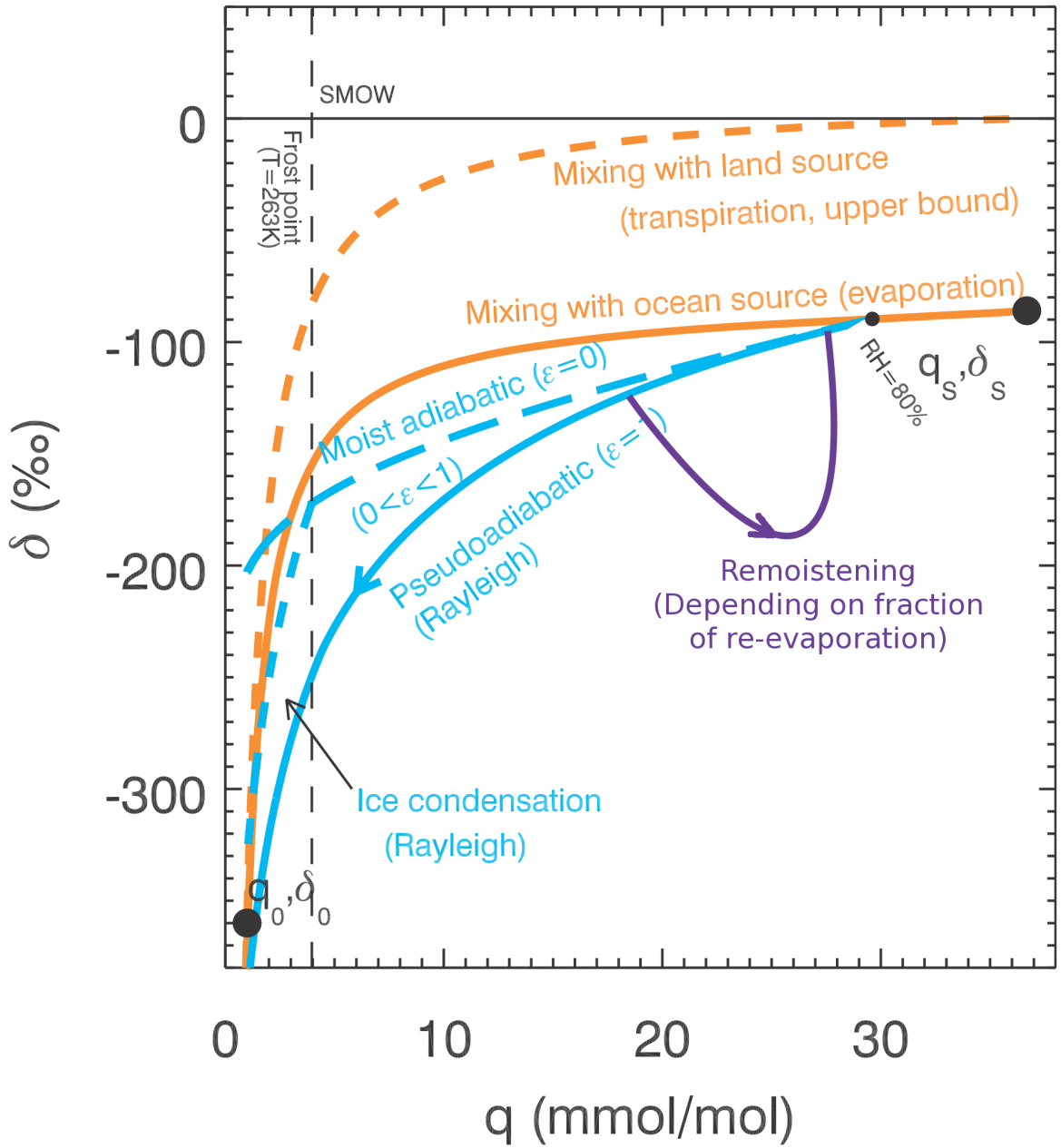
q-δD dynamics vary across processes

Noone, 2012 (JCLIM)



q-δD dynamics vary across processes

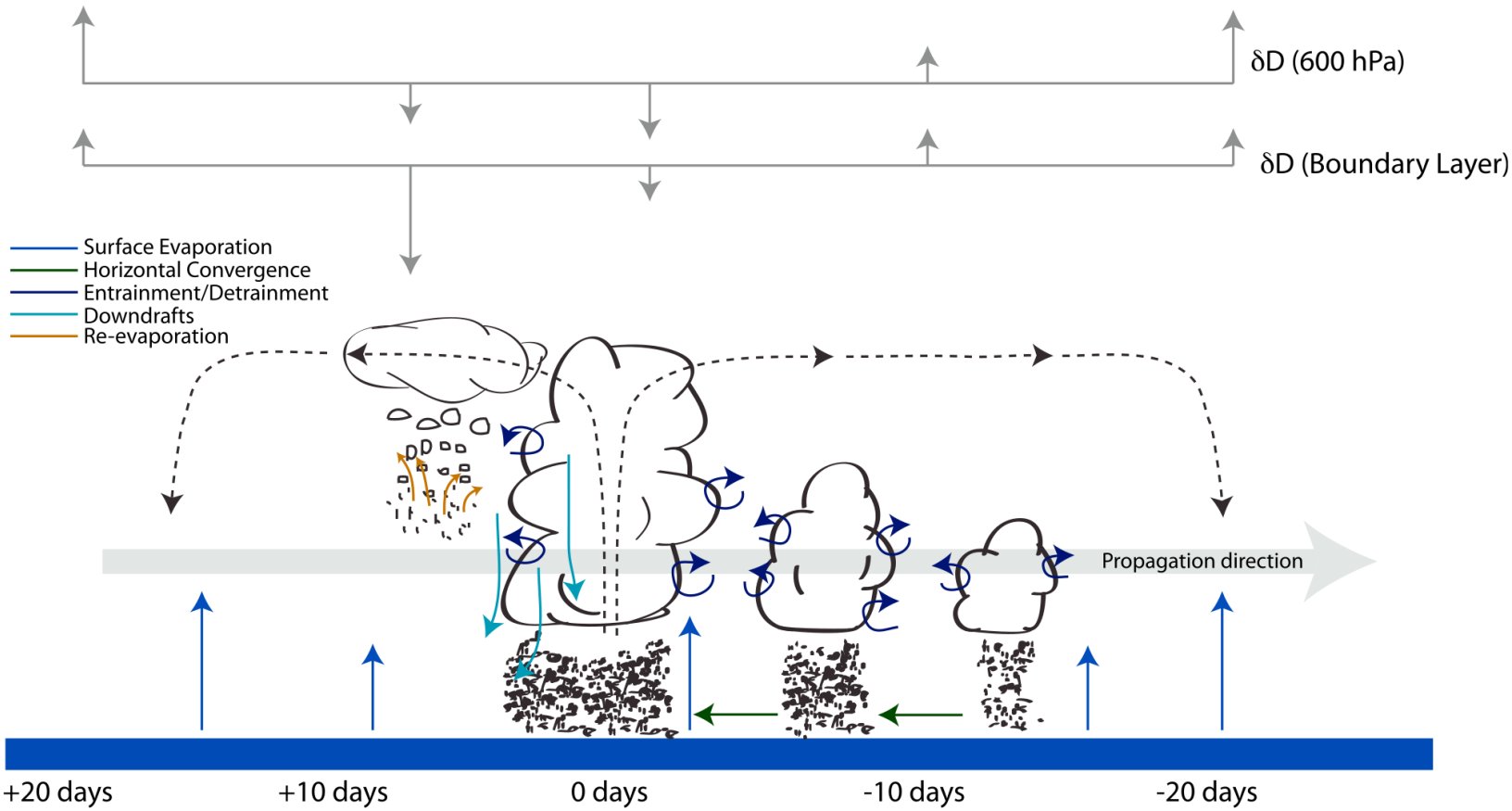
Noone, 2012 (JCLIM)



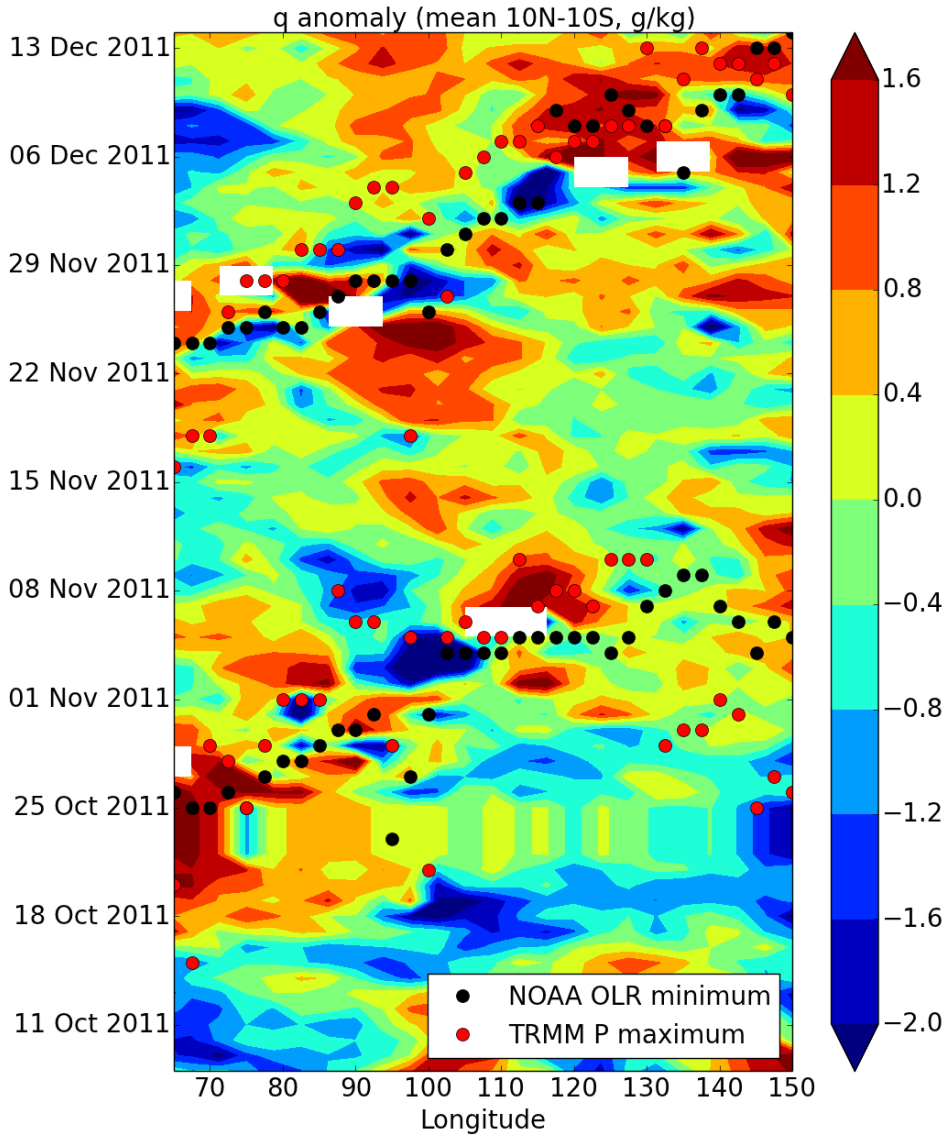
However, significant assumptions needed...

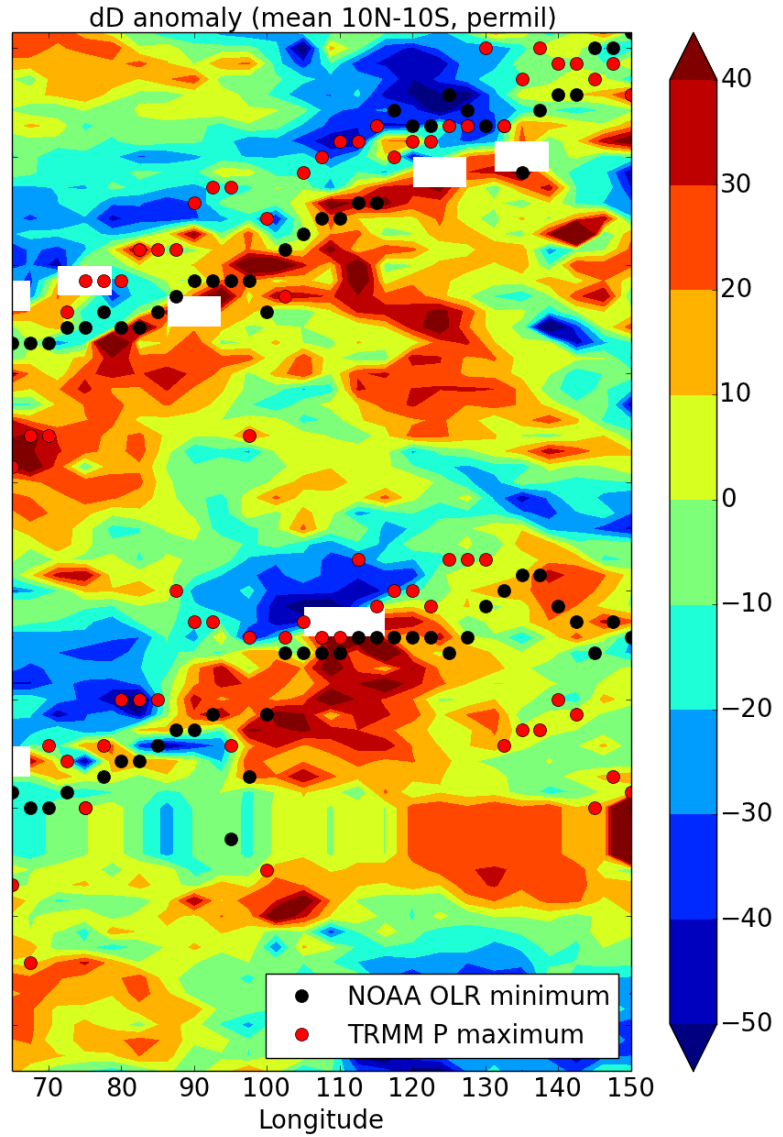
MJO q-δD dynamics

Berkelhammer et al., 2012, JGR



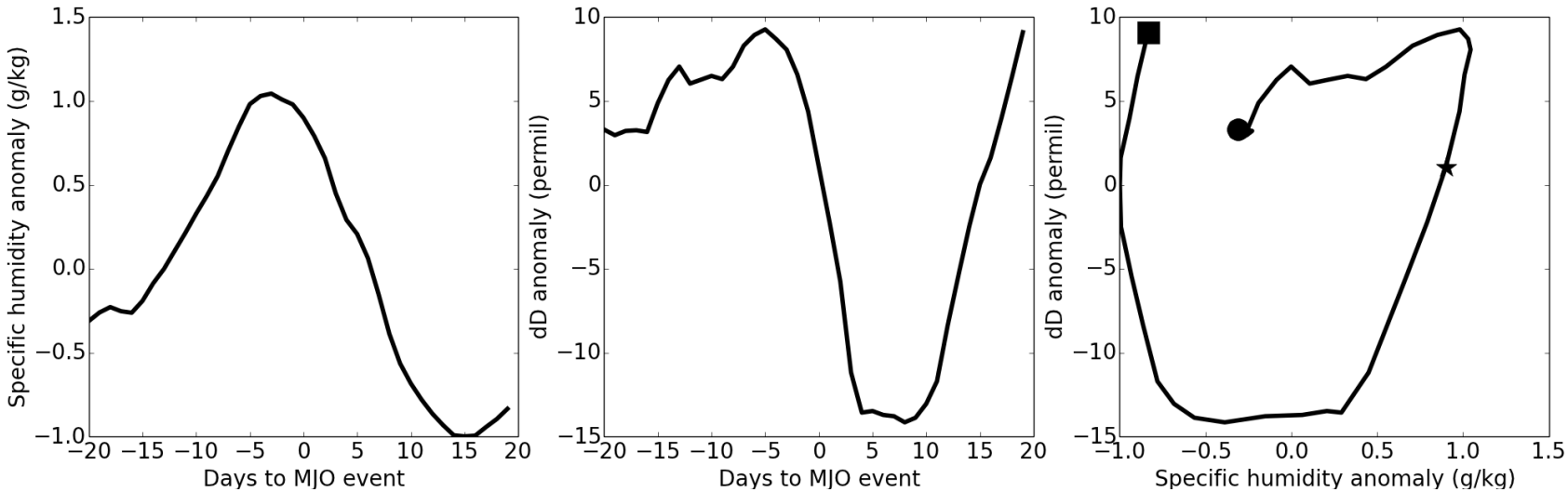
CINDY/DYNAMO MJO event (500hPa)



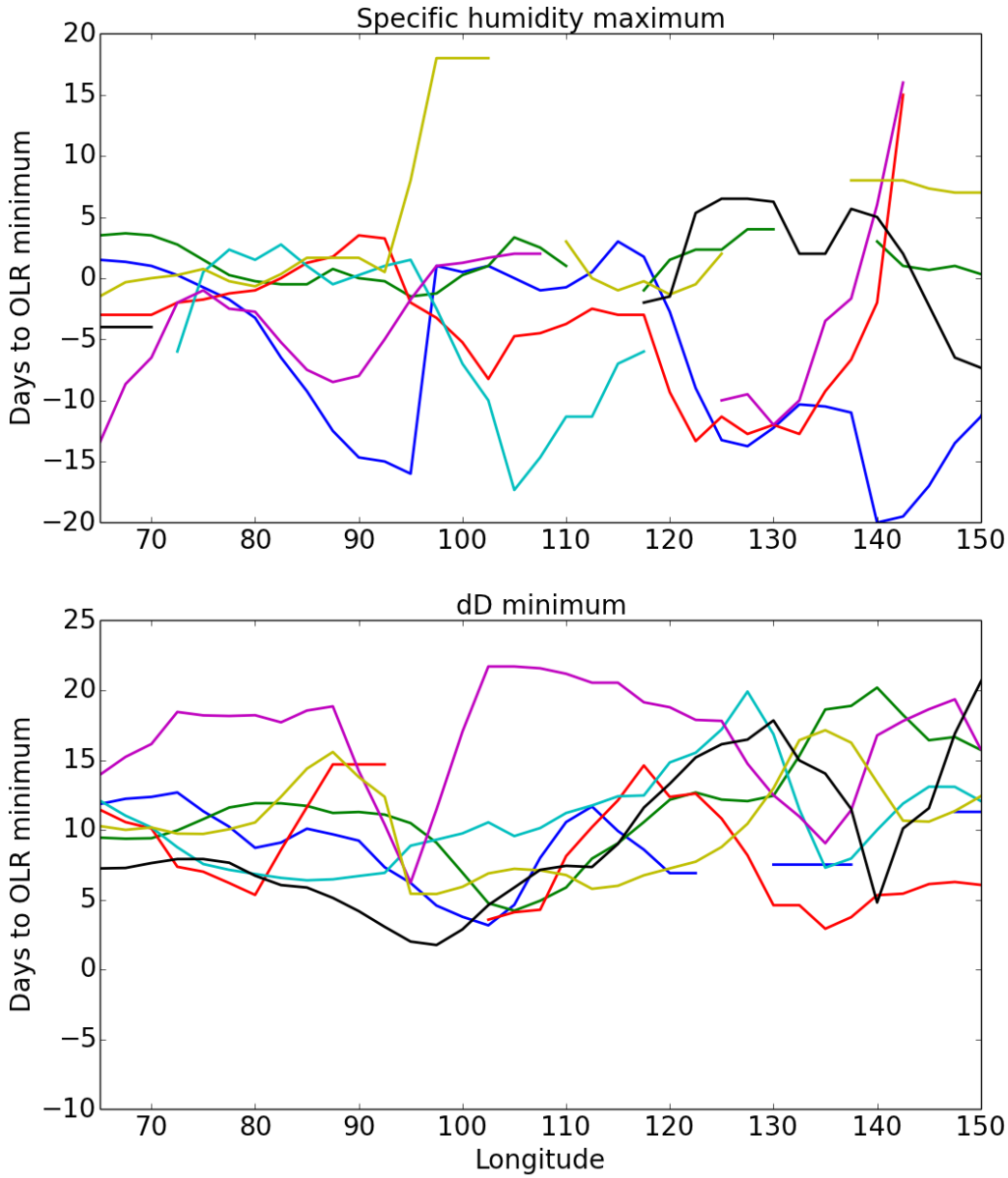


Typical MJO over Indian ocean

- Mid-troposphere (500hPa)
- 2010-2012, mean over 8 MJO events

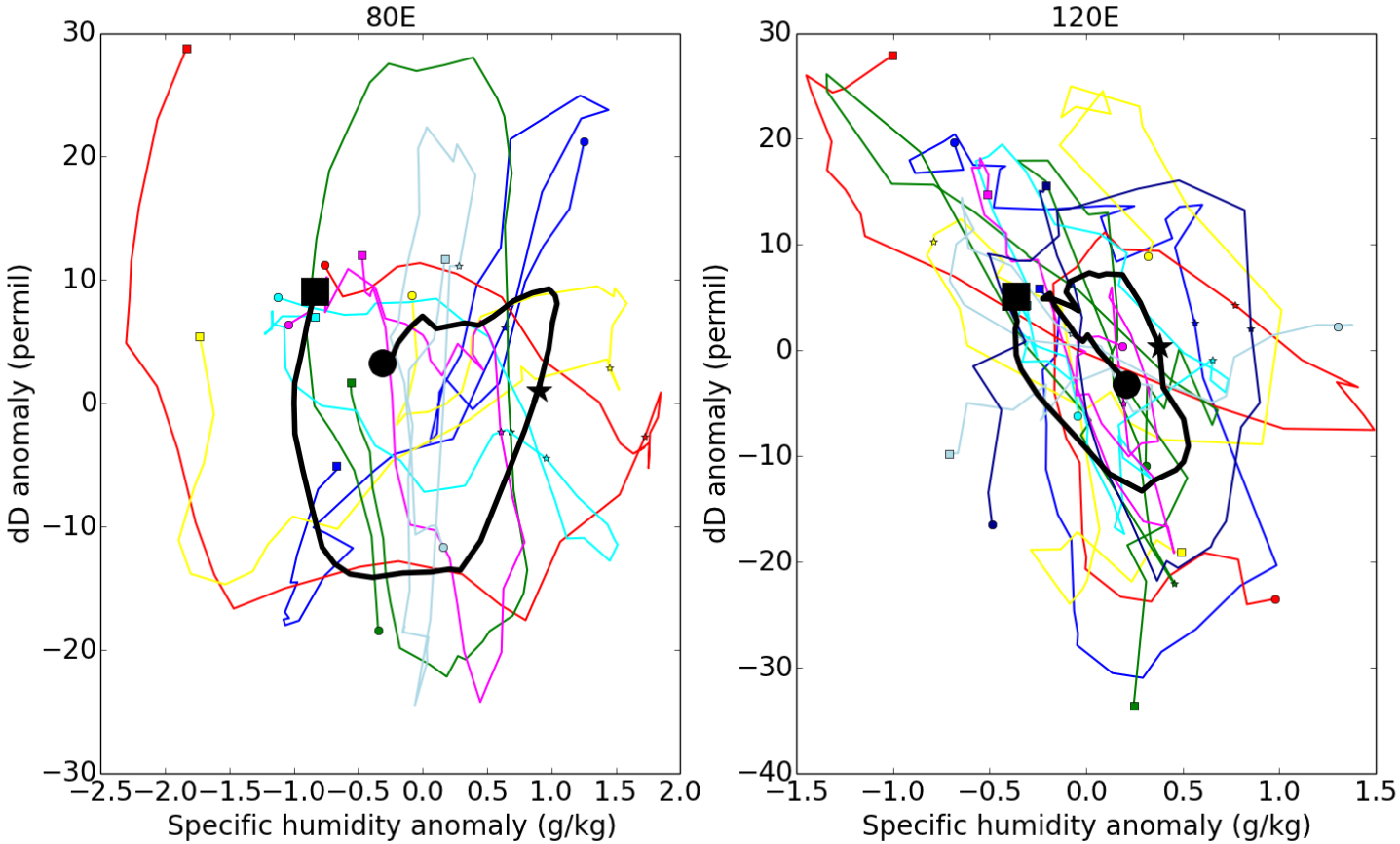


Eastward propagation of MJO events



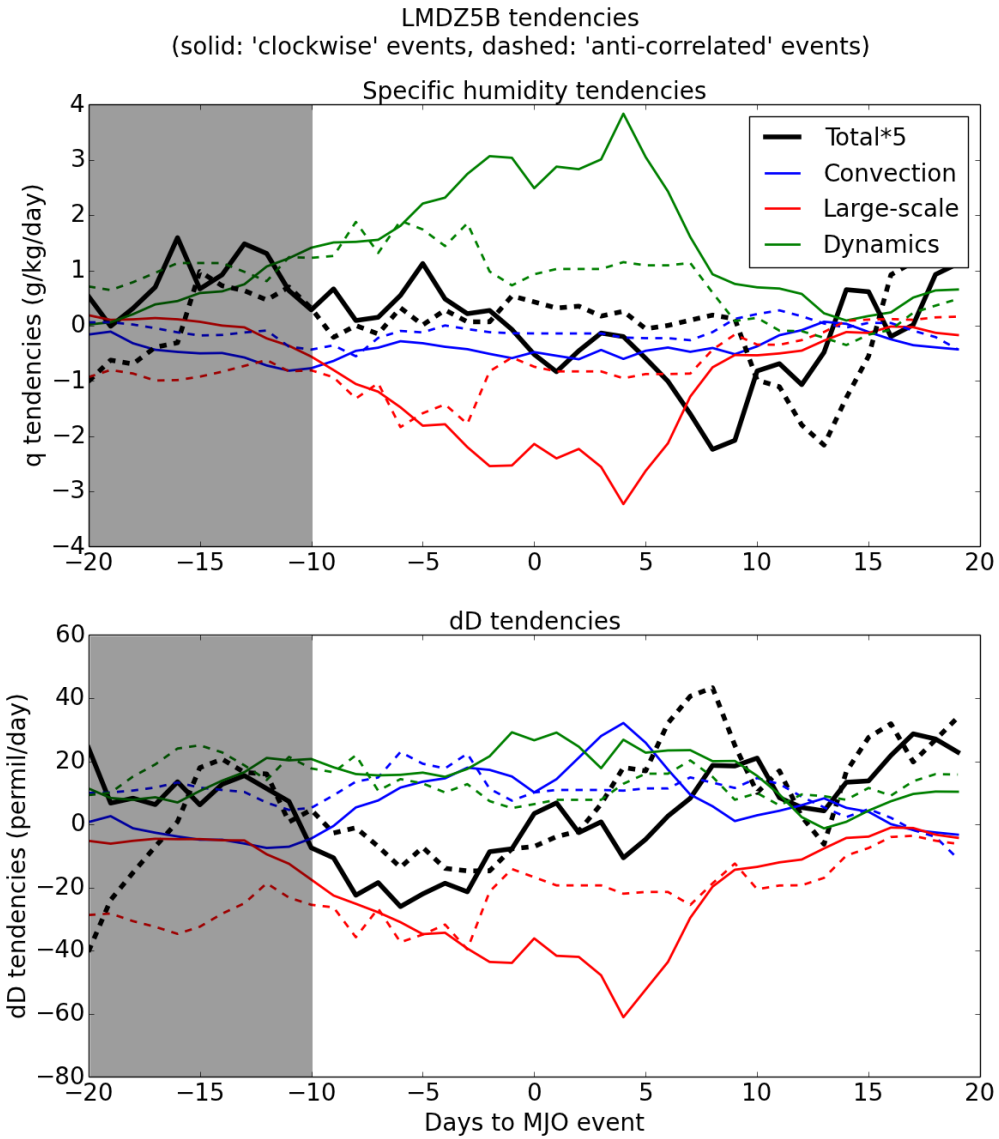
- Phasing does not change over IO
- Over Maritime continent, q-phasing changes (due to advection)
- q and δD amplitude decrease over Maritime continent

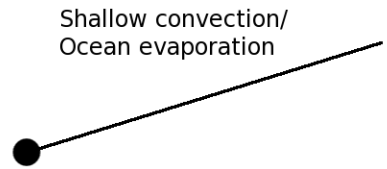
MJO over Indian ocean and Maritime continent



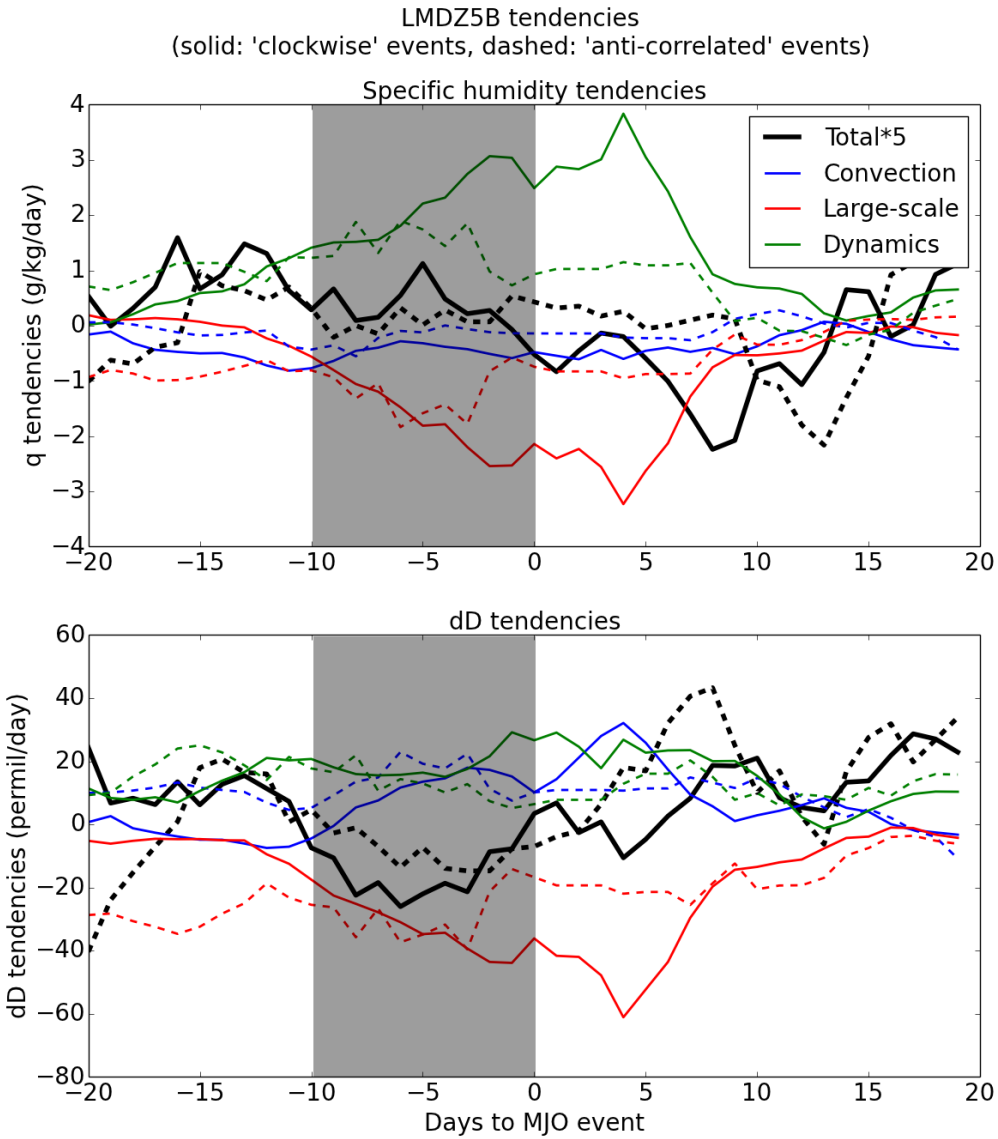
- 'Clockwise' dynamics over Indian ocean
- 'Anti-correlation' over Maritime continent

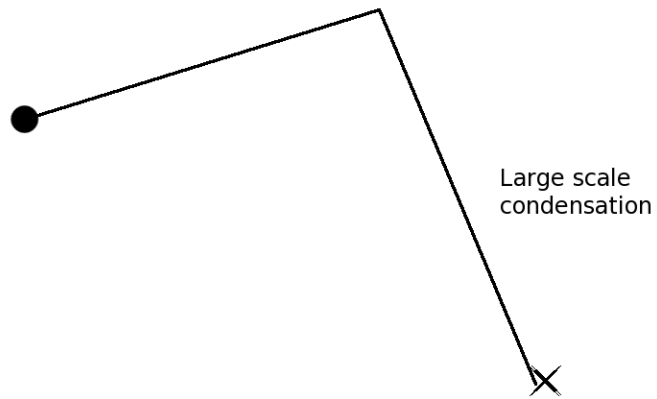
Two types of MJO events in nudged model



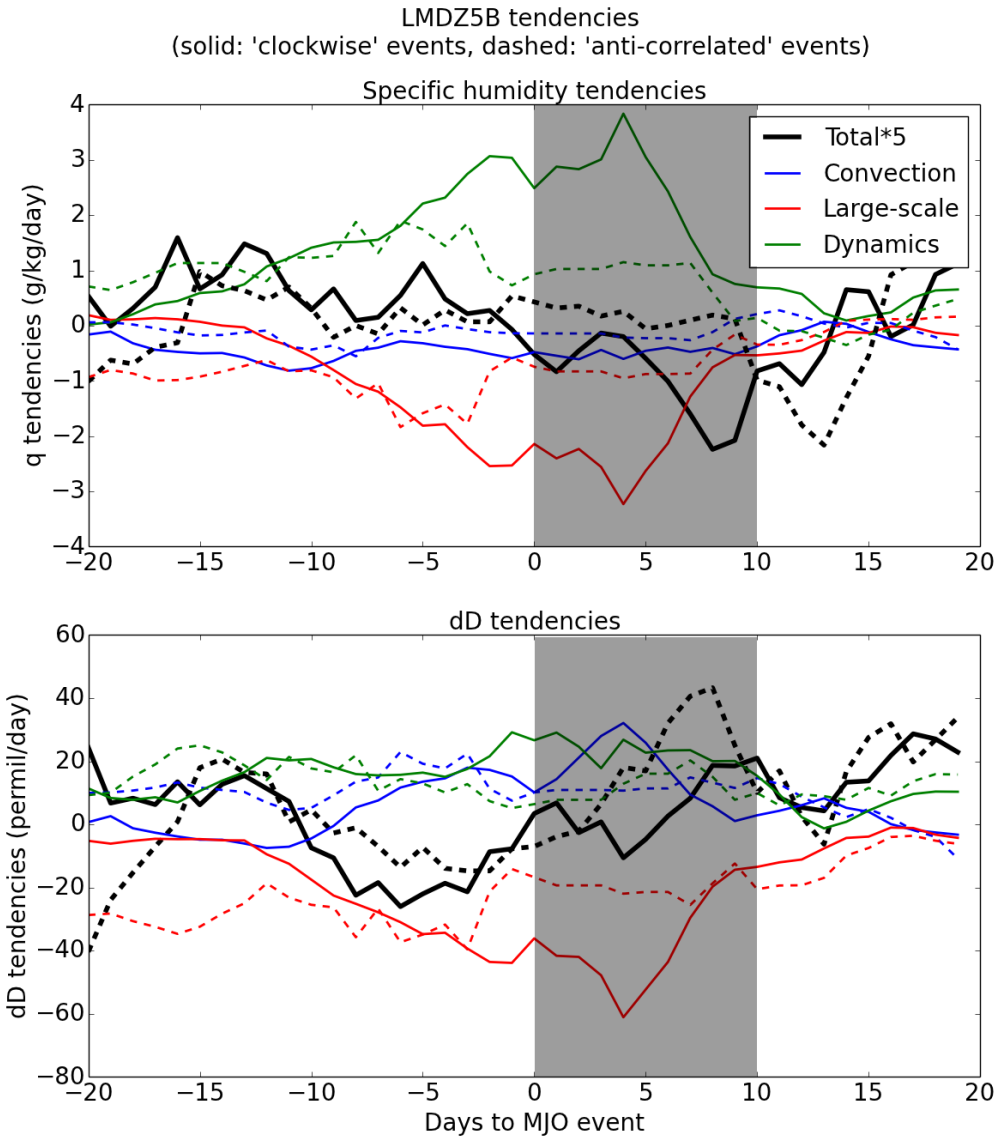


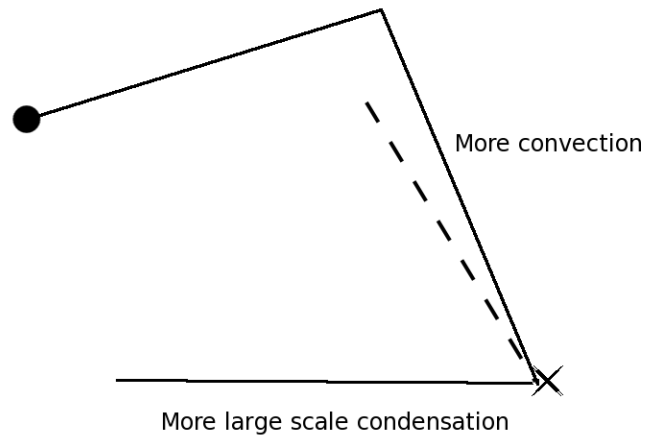
Two types of MJO events in nudged model



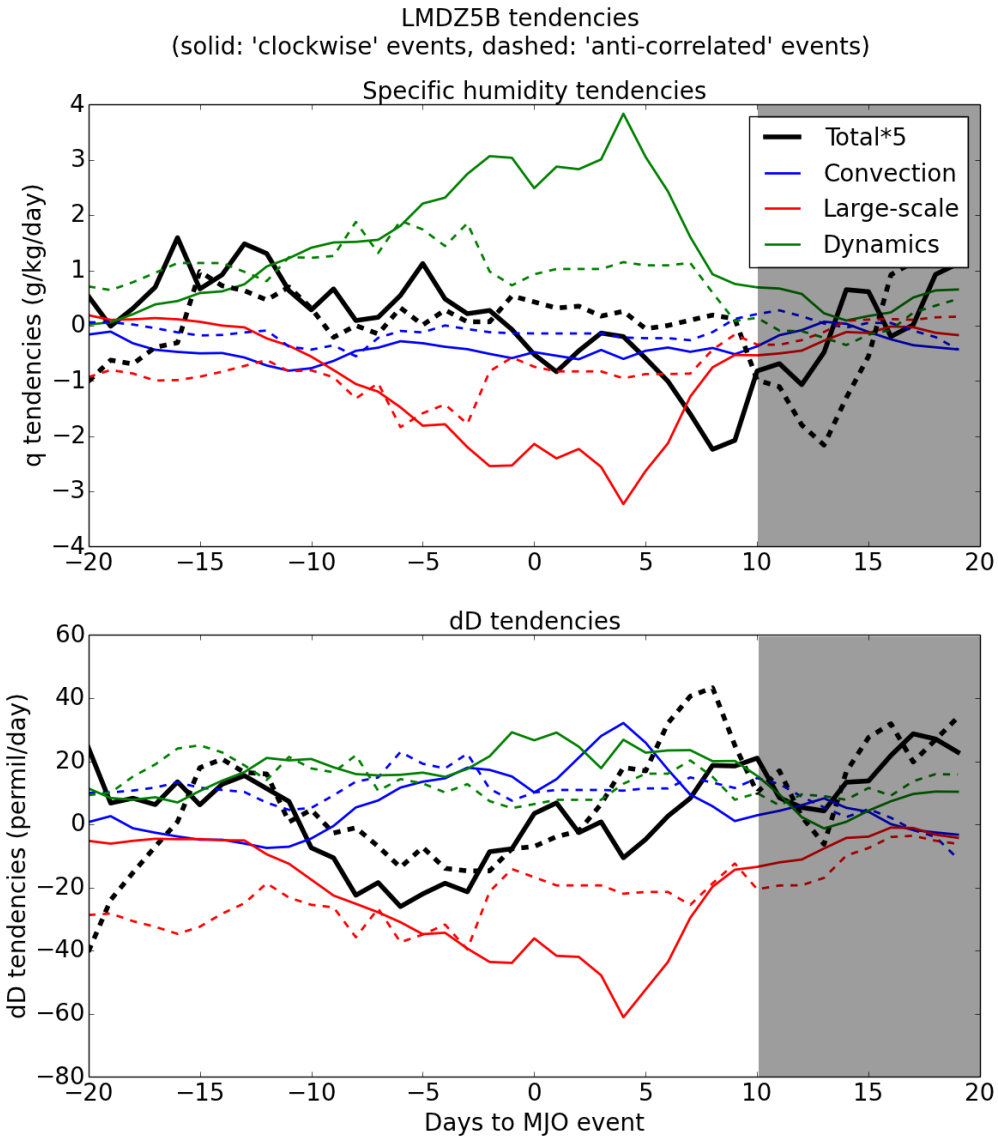


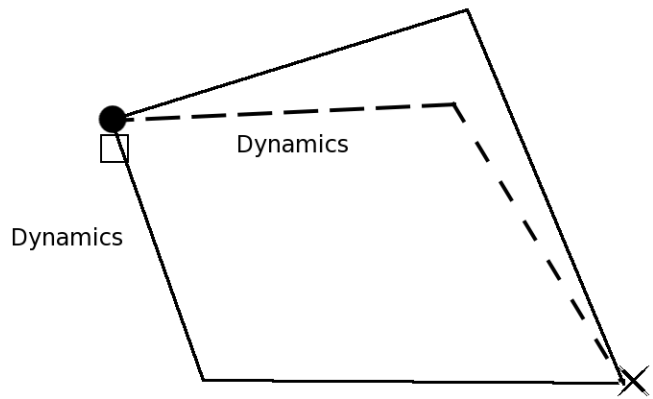
Two types of MJO events in nudged model



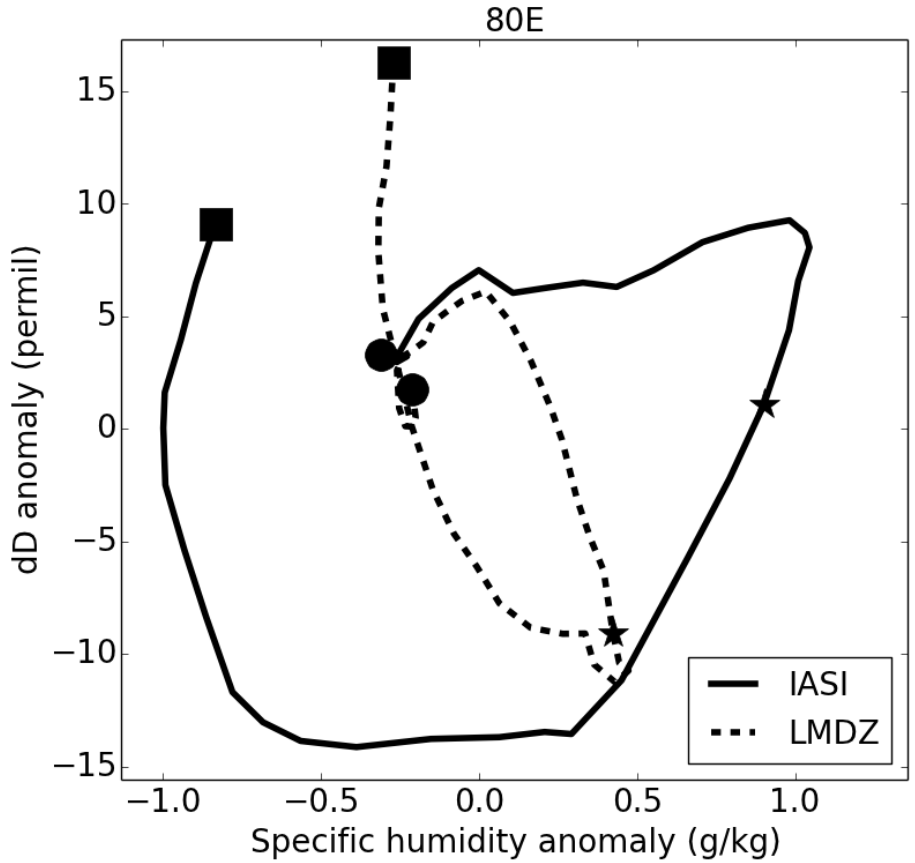


Two types of MJO events in nudged model



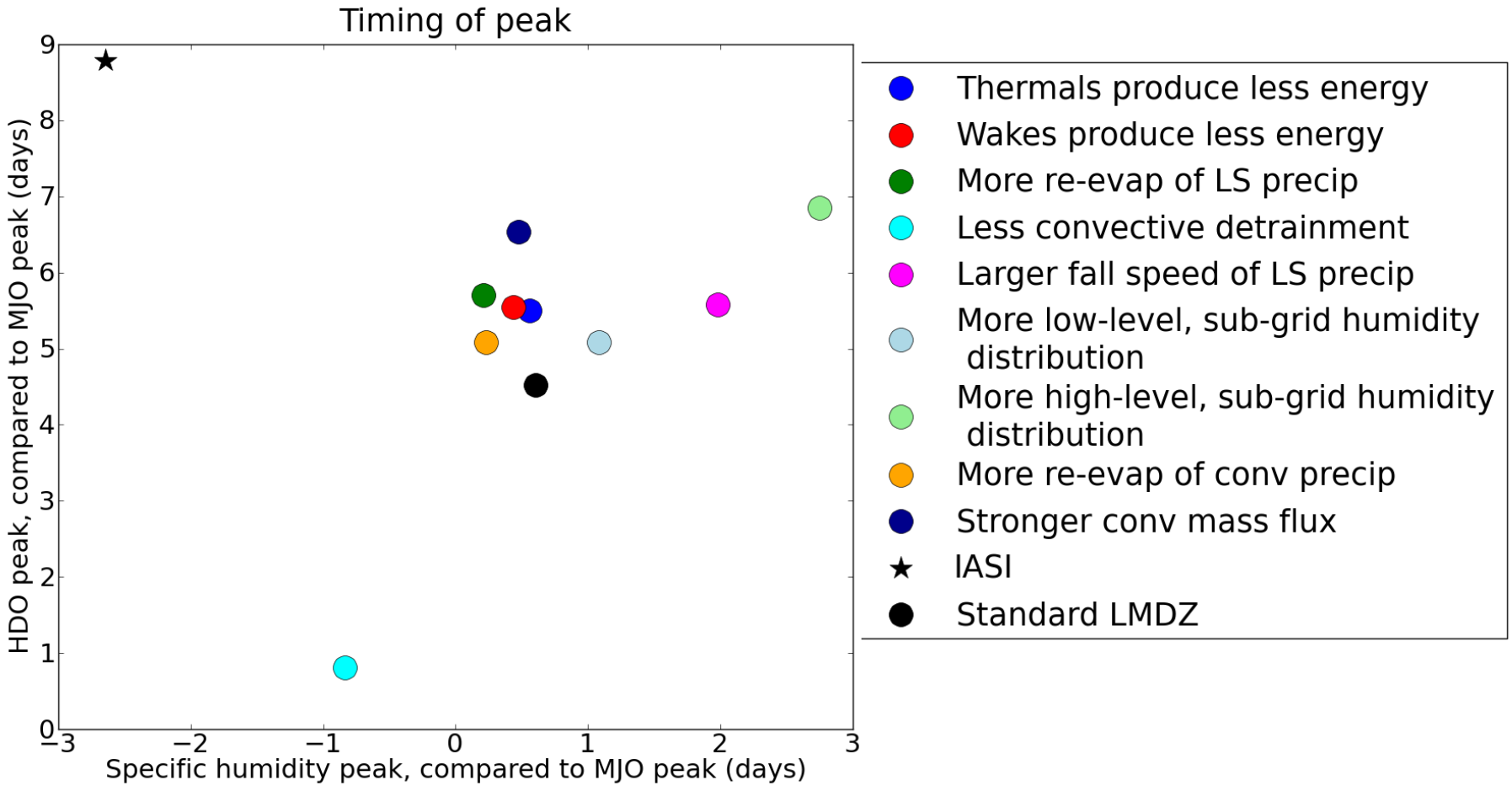


Nudged GCM (LMDZ) MJO bias



- Model too 'anti-correlated'
- Humidity maximum too close to depletion maximum
- Possible solution: modify convective scheme

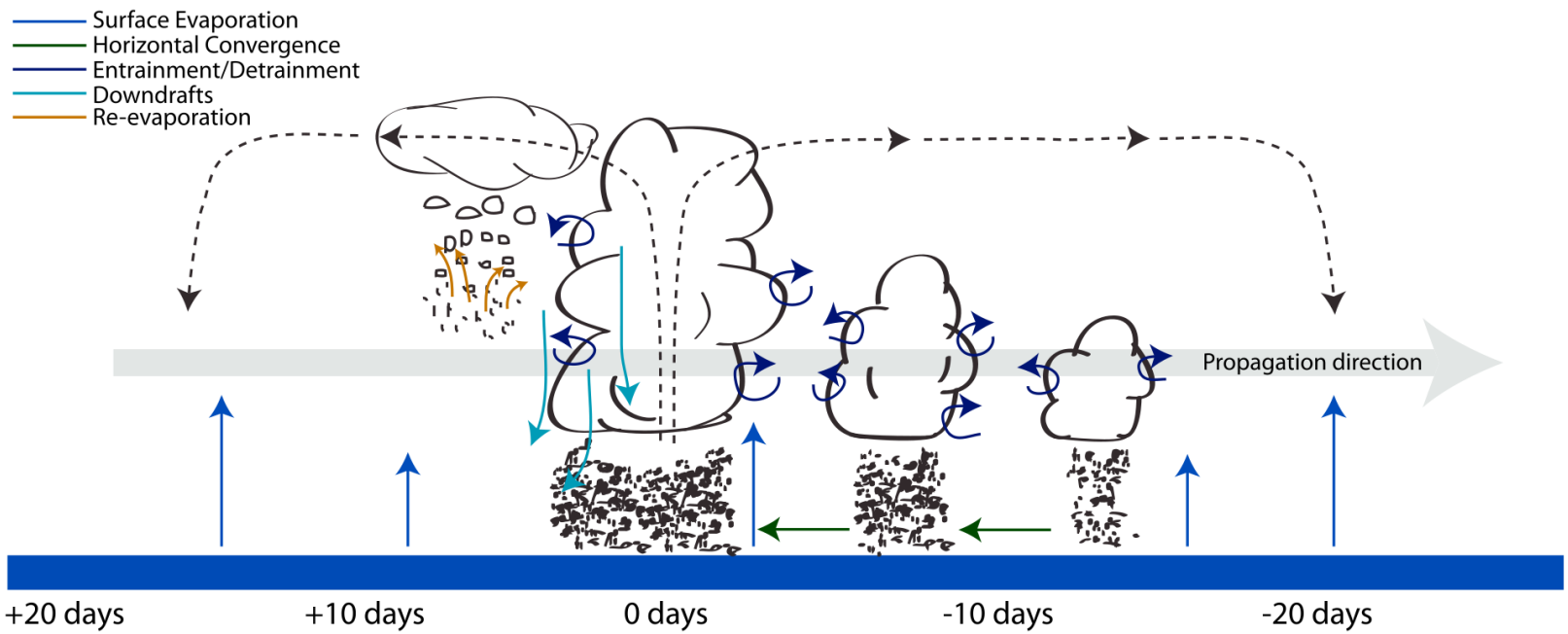
Convective scheme sensitivity tests (80E)



- First sensitivity tests show no significant improvement
- Possibly too much advection forced

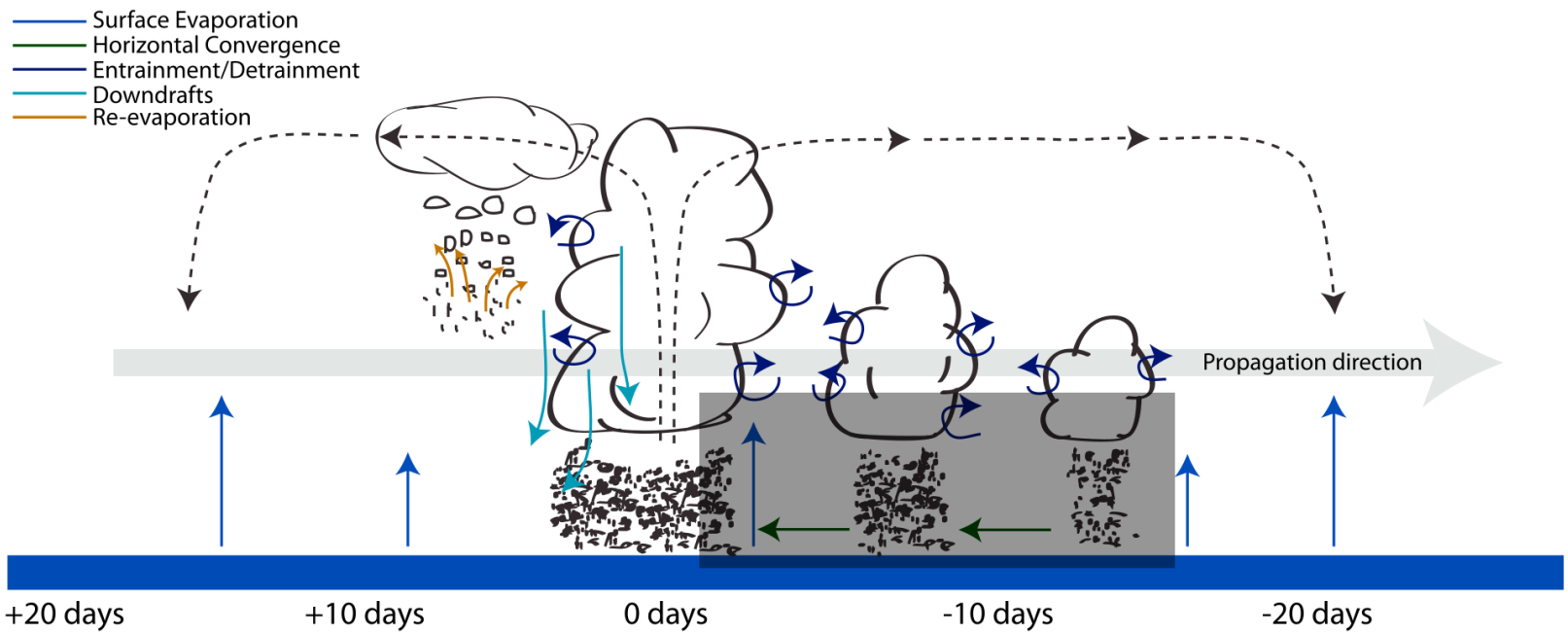
Conclusions

- Stable isotopes good to understand moisture processes
- An additional constraint on models



Conclusions

- Stable isotopes good to understand moisture processes
- An additional constraint on models
- MJO over Maritime continent dominated by variable advection



Conclusions

- Stable isotopes good to understand moisture processes
- An additional constraint on models
- MJO over Maritime continent dominated by variable advection
- MJO over Indian ocean: variability in convection-large scale condensation