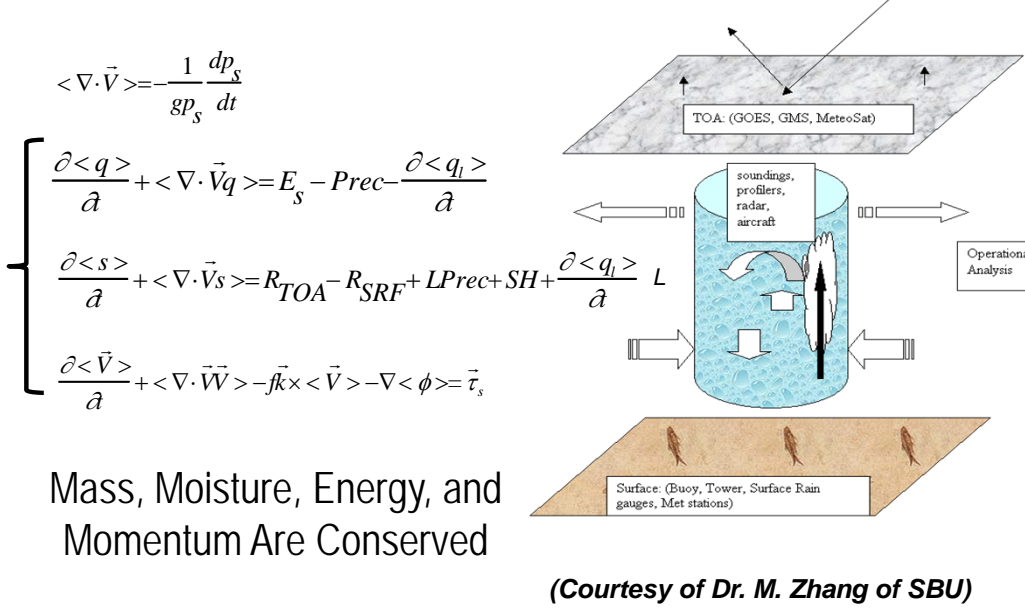


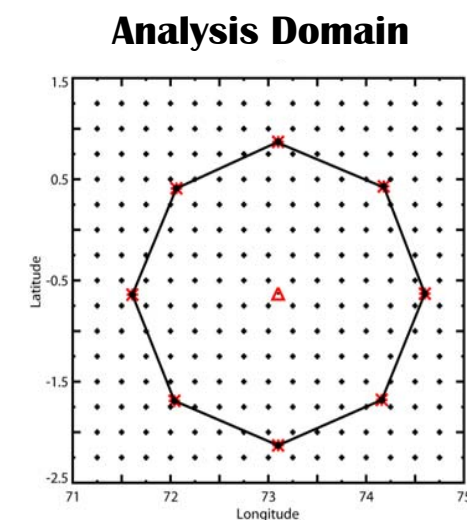
Analysis Details

Objective Analysis – The Constrained Variational Analysis (Zhang and Lin 1997)



Derived forcing from VA is dynamically and thermodynamically consistent with surface and TOA observations

Analysis Domain



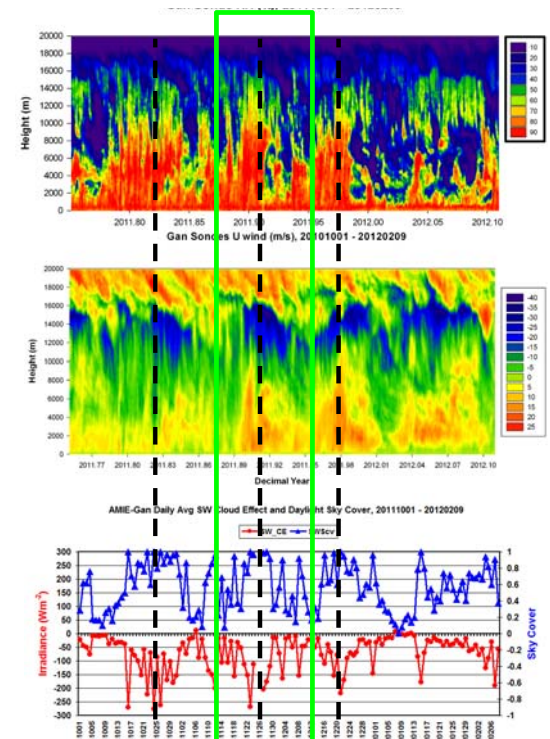
Forcing Data Product Details

- 11/13/2011 - 12/13/2011 (2nd MJO)
- Analysis done over the area covered by S-POL
- 3 hours, 25mb
- Data Used
 - ECMWF analysis as first guess
 - Precipitation from observations
 - S-POL precip
 - TRMM precip
 - Other required surface and TOA fluxes from the ECMWF model

Synoptic Conditions

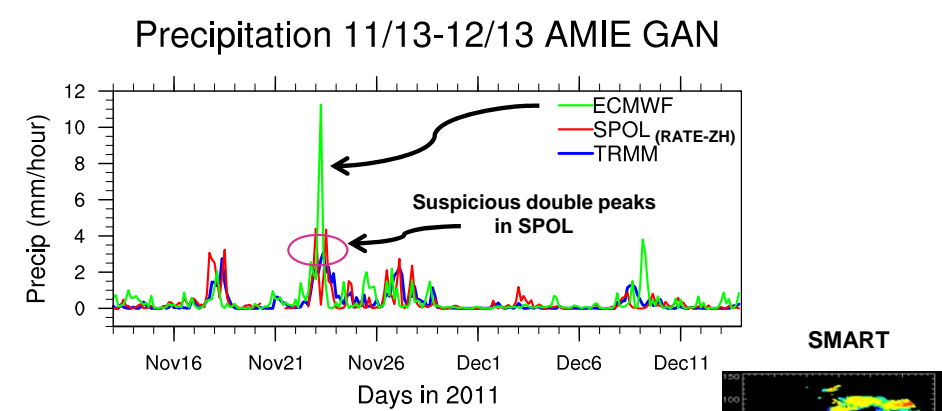
- First 2 Gan events stronger, last weaker
- Significant mid level moistening
- Increased low level westerlies, upper easterlies
- Nearly overcast skies, greater SW cloud effect

Convective Systems Over Gan Island



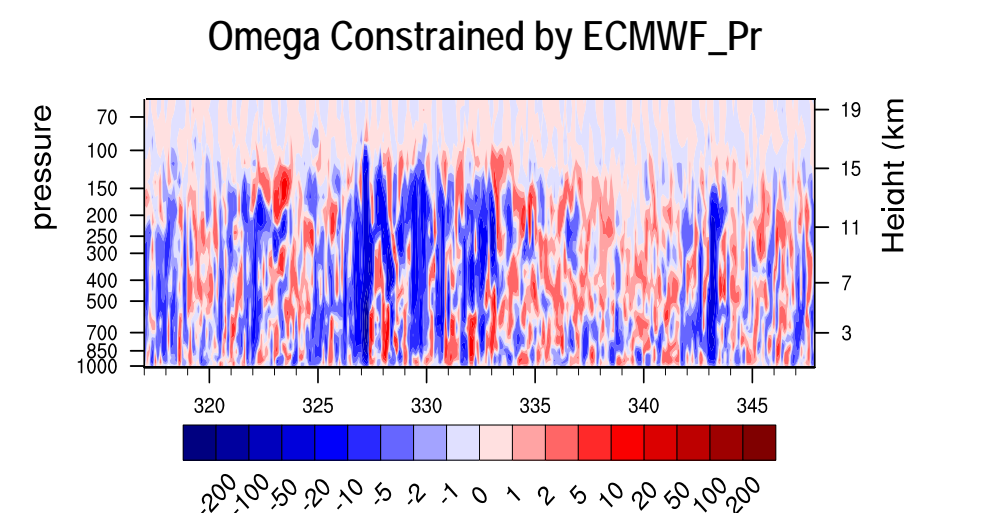
Role of Precipitation

Precipitation – ECMWF vs. OBS

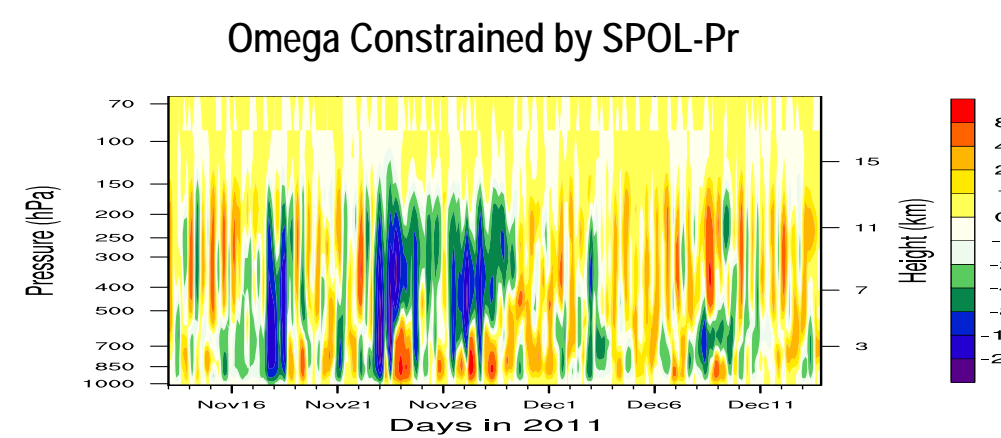


- ECMWF precip is too strong
- Notice suspicious double spikes of SPOL precip for major rain events, due to the average over only half of the domain?
- A full 360 degree integration data is needed

Impact on Forcing – Vertical Velocity

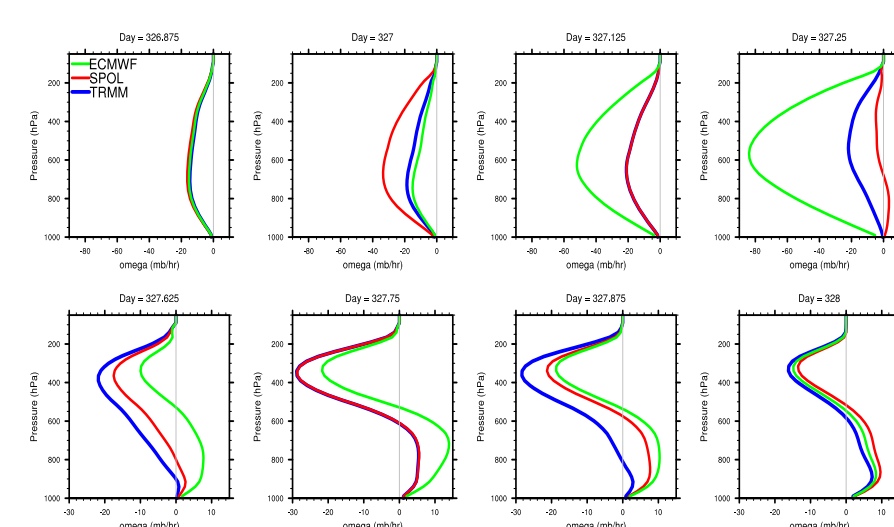


- Upward motion is too strong in ECMWF due to the very large precipitation on Nov. 23rd



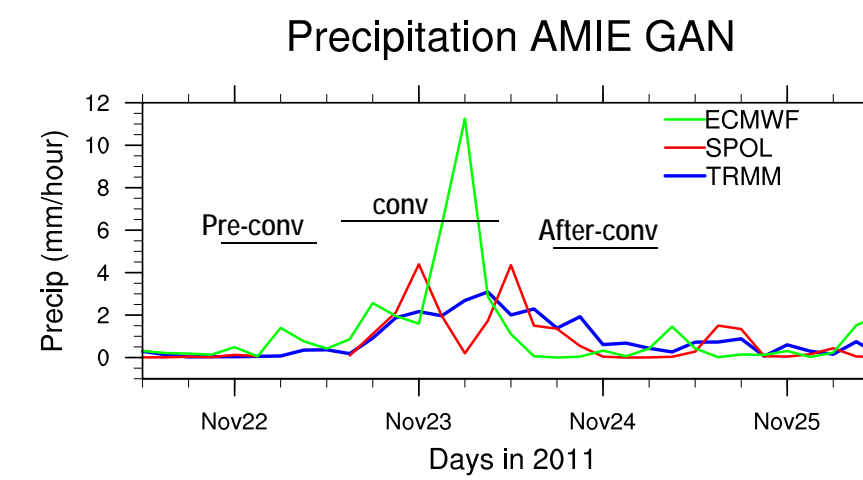
- The magnitude is significantly reduced, but suspicious double peaks are seen in the derived Omega field

OMEGA ECMWF vs. SPOL vs. TRMM

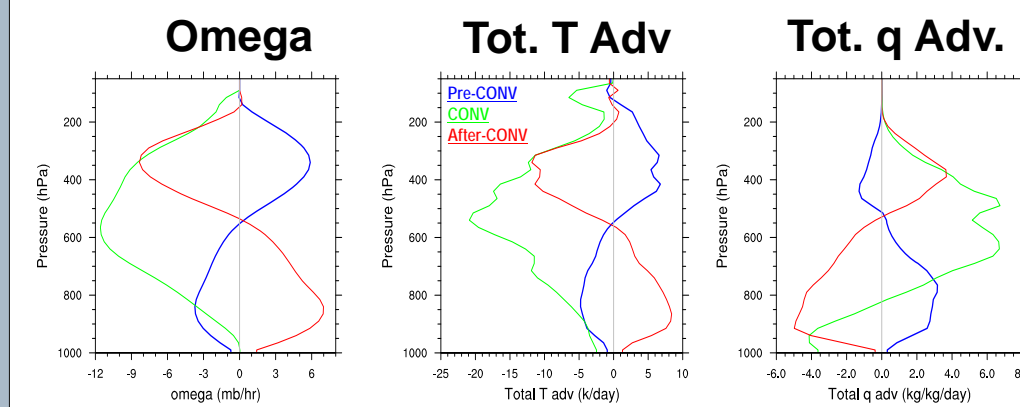


Forcing, Q1, and Q2

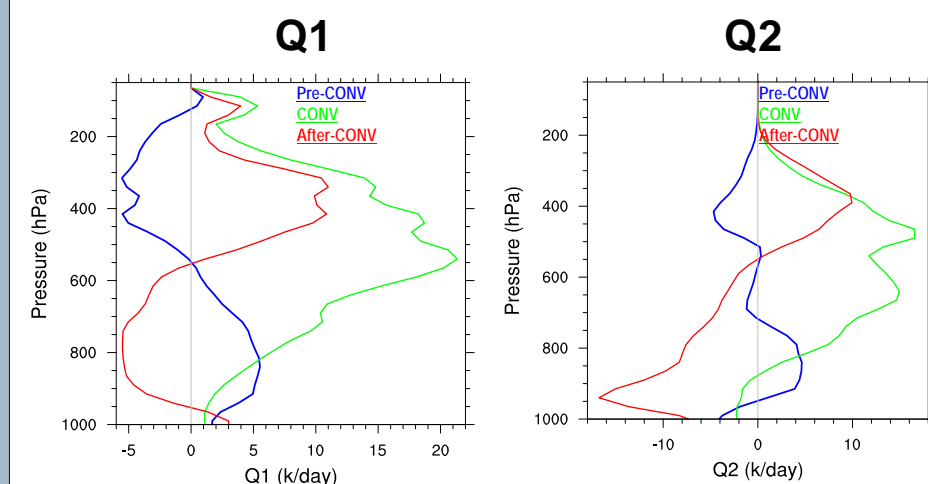
Composite Analysis



Forcing and Diabatic Heating/Moistening Profiles

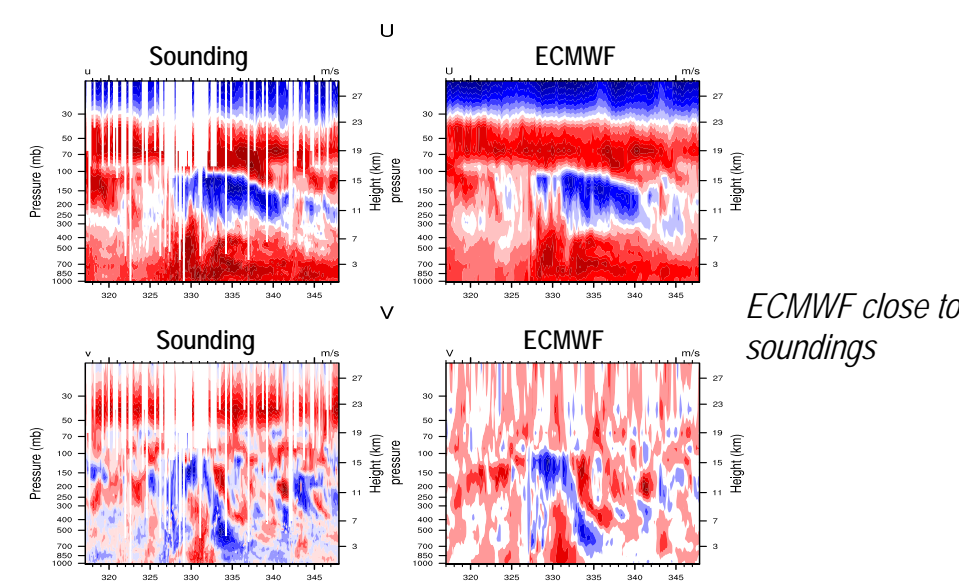


- Pre: lower layer moisture convergence with weak upward motion
- CONV: upward motion in the entire column with maximum near 600 hpa associated strong advective cooling and moistening in the middle troposphere
- After: downward motion in the lower troposphere and warming and drying there.



- Pre: low-level condensational heating and drying, high level cooling and moistening
- CONV: column condensation heating and drying
- After: low-level evaporative cooling and moistening, high level heating and drying

Quality of ECMWF Analysis



Summary

- A large scale forcing data set for AMIE-GAN is developed based ECMWF analysis
- The analysis data needs to be adjusted to balance the observed precipitation, given the large uncertainty in the model produced precipitation field
- The derived forcing and Q1/Q2 fields allow to study the characteristics of the large-scale structure and diabatic heating/moistening associated with the tropical convective systems observed during the field campaign

Future Work

- Address uncertainty in the observed precipitation
 - Double peaks in SPOL
- Incorporated more observations into the analysis:
 - Surface Radiation
 - Address uncertainties in observed precipitations and etc.
 - Possible correction with surface rain-gauge obs
 - Liquid water path from MWR
 - Incorporate sounding data as background field
 - TOA flux based satellite data?
 - ECOR surface fluxes?
- Compare with radar-derived LH profiles (from Courtney Schumacher)

References

Zhang, M. H., and J. L. Lin, 1997: Constrained variational analysis of sounding data based on column-integrated budgets of mass, heat, moisture, and momentum: Approach and application to ARM measurements. *J. Atmos. Sci.*, **54**, 1503-1524.

Acknowledgements

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