Description of the objective analysis of large scale forcing data at Revelle during AMIE-Gan/DYNAMO field campaign

1. Overview

The constrained variational objective analysis approach described in Zhang and Lin [1997] and Zhang et al. [2001] was used to derive the large-scale single-column/cloud resolving model forcing and evaluation data set from the observational data collected during the Dynamics of the Madden-Julian Oscillation (DYNAMO) - ARM MJO Investigation Experiment (AMIE), which was conducted during October 2011 to March 2012 over Indian Ocean. The analysis data cover the period from **00Z October 2 - 21Z December 31 2011**. The forcing data represent an average over the analysis domain centered at Revelle ship with a diameter of 300 km as shown in Figure 1.

Due to the lack of a sounding array at Revelle, the forcing data was developed based on ECMWF analyses, which were then constrained with observed surface rainfall through the constrained variational objective analysis. Two versions of the forcing data are provided, which were constrained by surface precipitation retrieved from CSU TOGA radar and TRMM precipitation radar measurements (3B42 dataset), respectively, to address uncertainties in surface rainfall.

The data here are in both ASCII and netCDF formats for the 300km domain.

Standard vertical resolution (25mb) data

There are two standard resolution (25mb) ASCII data files for layered variables and surface variables, respectively for each of the domain. They are:

>*rev180varanaecmwfanaradarsurface_v0_C1.c1.20111002.000000.dat*
>*rev180varanaecmwfanaradarlayer_v0_C1.c1.20111002.000000.dat*
>
>*rev180varanaecmwfanatrmmsurface_v0_C1.c1.20111002.000000.dat*
>*rev180varanaecmwfanatrmmlayer_v0_C1.c1.20111002.000000.dat*

These ASCII data files can be read using following FORTRAN files

>*read_layer.for*
>*read_surface.for*

The netCDF files that include all the variables contained in the two ASCII data files are also provided:

>*rev180varanaecmwfanaradar_v0_C1.c1.20111002.000000.cdf*
>*rev180varanaecmwfanatrmm_v0_C1.c1.20111002.000000.cdf*

To see the quick look plots of the data please go to:

http://portal.nersc.gov/project/capt/ARMForcingData/dynamo-revelle/

2. Some details of the analysis

The objective analysis domains used for analyzing the Revelle data are shown in Figure 1.

The domain-averaged surface and TOA radiative fluxes and surface heat fluxes constraints required by the variational analysis were obtained from ECMWF analysis data.

TRMM precipitation data is based on 3B42 data. We use the precipitation retrieval based on TOGA radar measurements from Dr. Weixin Xu at Colorado State University.

3. References

Cressman, G. P., (1959), *An operational objective analysis scheme.* Mon. Wea. Rev., 87, 367-374.

Hume, T. (2007), *Radiation Dry Bias in the TWP-ICE Radiosonde Soundings*. The 17th ARM Science Team Meeting.

Miloshevich, L. M., H. Vomel, D. N. Whiteman, and T. Leblanc., 2009: Accuracy assessment and correction of Vaisala RS92 radiosonde water vapor measurements. *J. Geophys. Res.*, *114*, D11305, doi:10.1029/2008JD011565.

Voemel et al. (2007), *Radiation Dry Bias of the Vaisala RS92 Humidity Sensor*, J. Atmos. Ocean. Tech., 24, 953-963.

Xie et al. (2007), *Objective Variational Analysis for the Tropical Warm Pool International Cloud Experiment.* The 17th ARM Science Team Meeting.

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

Zhang, M. H., J. L. Lin, R. T. Cederwall, J. J. Yio, and S. C. Xie (2001), *Objective analysis of ARM IOP Data: Method and sensitivity.* Mon. Weather Rev., 129, 295-311.

AMIE Homepage: http://campaign.arm.gov/amie/
Revelle forcing data page on LLNL ARM Team page:
http://portal.nersc.gov/project/capt/ARMForcingData/dynamo-revelle/

4. Acknowledgement

5. Contacts

For questions, or to report data problems, please contact:

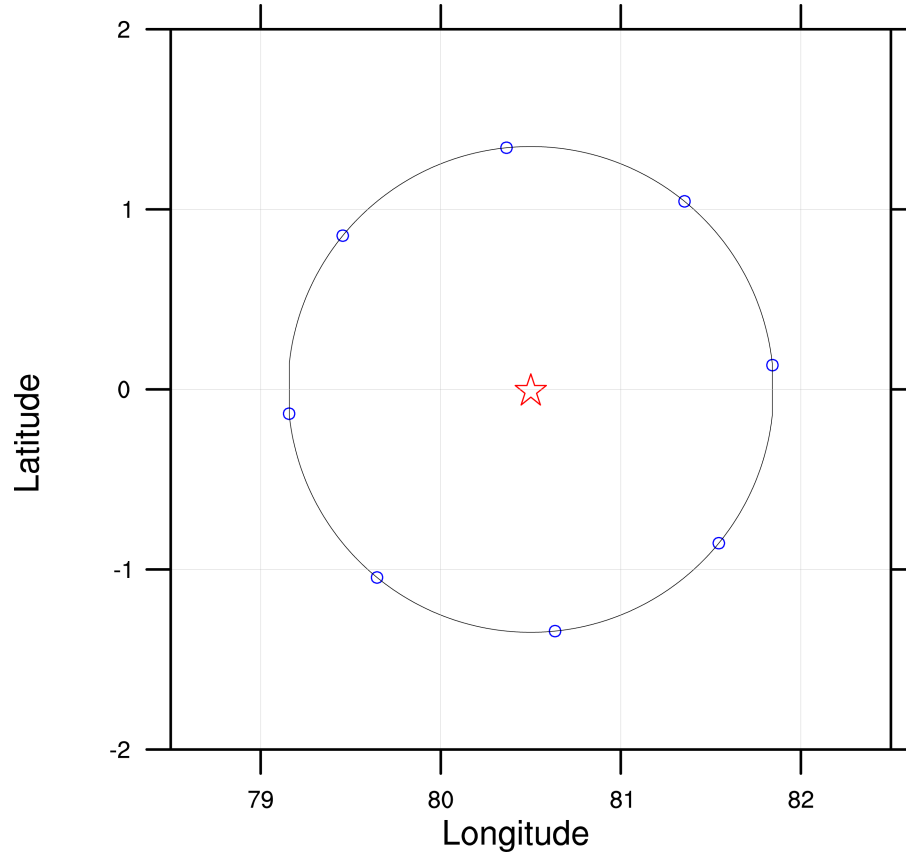*Shaocheng Xie:*   *xie2@llnl.gov*
Yunyan Zhang: *zhang25@llnl.gov*

Figure 1: Analysis domain for Revelle, with diameters of 300 km. The red star denote the ship location.

Omega

vertical velocity   mb/hour

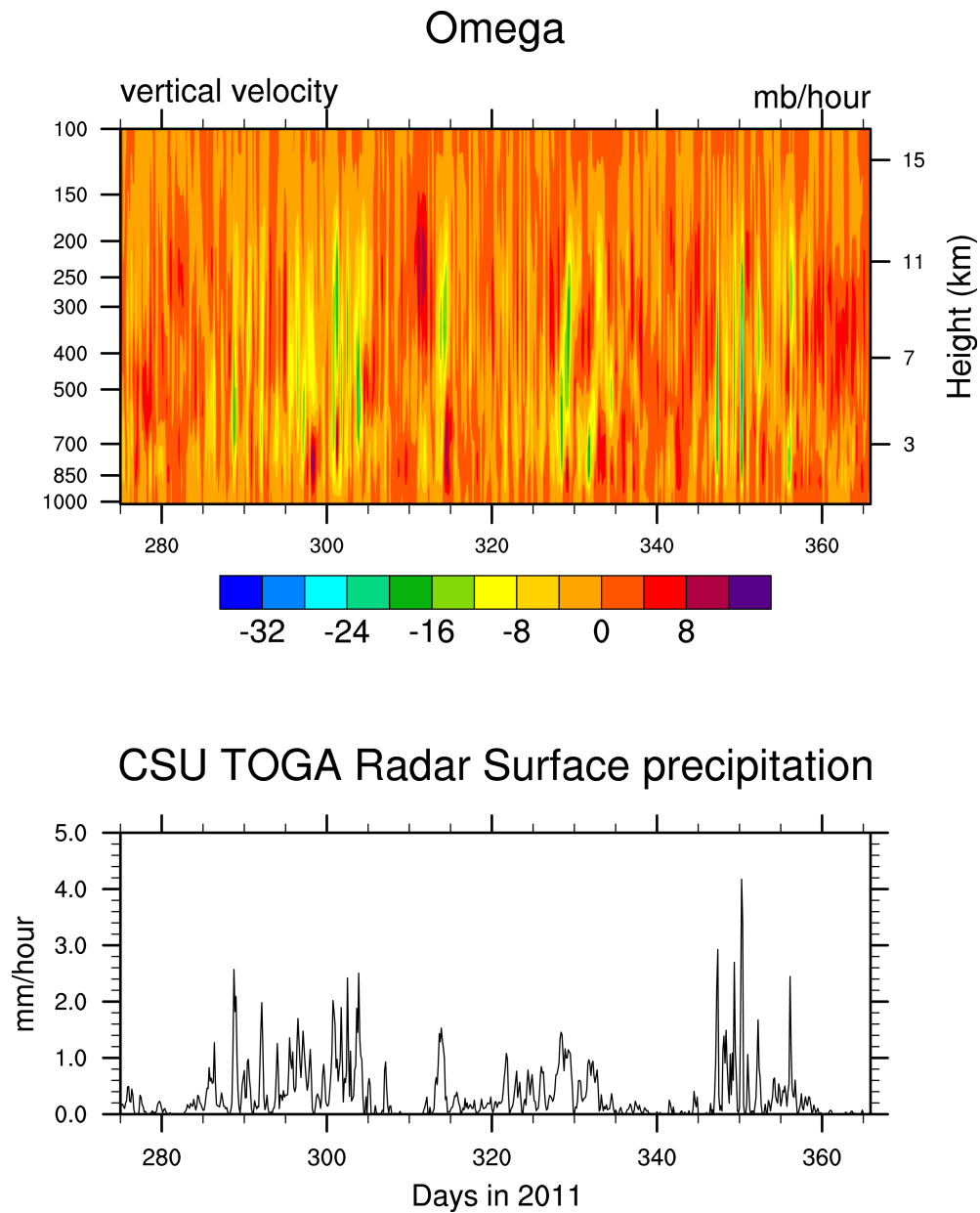# CSU TOGA Radar Surface precipitation

Days in 2011

Figure 2: Surface precipitation measurements retrieved from Colorado State University's Tropical Ocean Global Atmosphere, or TOGA, radar and the corresponding vertical velocity based on variational analysis.