

# Improvement in the Prediction of Intraseasonal Oscillations through ARGO data Assimilation in Coupled GCMs

Arindam Chakraborty and T. N. Krishnamurti

Department of Meteorology, Florida State University, Tallahassee, FL 32306

## 1. Introduction

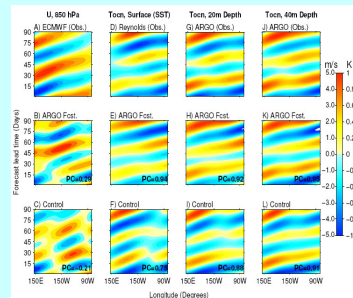
The Madden-Julian Oscillation (MJO) (Madden and Julian, 1971) is a tropically centered low frequency, eastward moving wave. MJO has a northward component during summer over the north Indian Ocean (Waliser 2006) that is responsible for the Intraseasonal Oscillation (ISO) of Indian summer monsoon. This study uses the vast ARGO (Array for Real-time Geostrophic Oceanography) data sets for better prediction of MJO and ISO.

## 2. Model and Methodology

Florida State University (FSU) coupled General Circulation Model (CGCM) was used for assimilation of ARGO temperature profiles. 90-days long forecasts were made with the FSU CGCM, starting at every month during 2003-2005, with (ARGO-Fcst) and without (Control) ARGO data assimilation that created oceanic initial condition. Ensemble simulations with 4 members of the atmospheric model were performed.

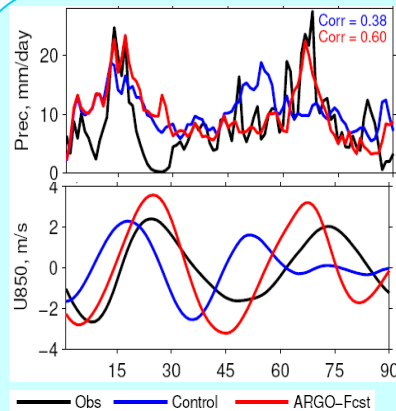
## 3. MJO over the Pacific Ocean

Alternate passage of westerly (red) and easterly (blue) zonal wind anomaly at 850 hPa and ocean temperature anomaly at the surface (SST) and at 20m and 40m depths over the Pacific Ocean is shown in this Figure. MJO forecasts were greatly improved up to 90 days in advance when ARGO assimilated oceanic state was used as initial condition in the model. The improvements in the pattern correlations (PC) in the ARGO-Fcst as compared to control were significant at 99% level.



## 4. ISO over the Indian Ocean

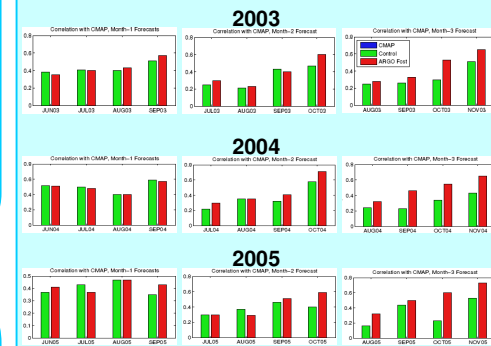
Northward propagation ISO over the Indian Ocean (65°-95°E) during June-August of 2004 is shown here. The signal of 20-60 days oscillation is coherent in the atmosphere and in the ocean. The model prediction of this ISO propagation was improved with ARGO data assimilation in the FSU CGCM.



## 5. Precipitation over the Indian region

Daily precipitation over northern Indian region (70°-90°E, 15°-25°N) shows two active monsoon periods during June-August of 2004. The phase and amplitude of both these periods were well predicted by the ARGO-Fcst. Control run could only reasonably predict the first active period. Low frequency (20-60 days) component of zonal wind at 850 hPa was coherent with the phase of active and break periods of monsoon.

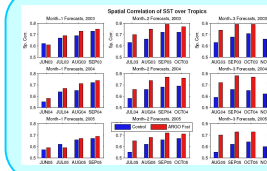
## 6. Monthly Precipitation over South Asia



Spatial pattern of precipitation over the South Asian monsoon region (50°-110°E, 10°S-35°N) was improved through month-3 of forecasts when ARGO temperature profiles were assimilated in the model to create oceanic initial state. This improvement was evident during all the three years 2003, 2004 and 2005, and was more prominent with longer lead time (month-3). This can be due to the fact that ocean has longer memory than the atmosphere and a better oceanic initial condition provides a better state of the model up to 90 days.

## 7. SST over the Tropics

Spatial pattern of sea surface temperature over the global tropics (0°-360°E, 30°S-30°N) shows that large improvement in the SST pattern can be achieved up to month-3 of forecasts when ARGO temperature profiles are assimilated in the model.



## 8. Conclusions: MJO signal is found in the subsurface oceans up to 40m depth.

This was coherent with that in the atmosphere. Assimilation of ARGO temperature profiles provided better forecast of the MJO/ISO up to 90 days in advance. This, probably through improved SST forecasts, provided a better outlook of active and break spells of monsoon over the Indian region.

Krishnamurti, T. N., A. Chakraborty, R. Krishnamurti, W. K. Dewar, and C. A. Clayson 2007: Passage of intraseasonal waves in the sub-surface oceans. *GRL*, **34**, 2007GL030496.  
Madden, R. A., and P. R. Julian, 1971: Description of a 40-50 day oscillation in the zonal wind in the tropical Pacific, *J. Atmos. Sci.*, **28**, 702-708.  
Waliser, D. E., 2006: Intraseasonal variability, in *The Asian Monsoon*, ed: B. Wang, pp. 203-257, Springer-Verlag.