Overview of Aircraft Observations in DYNAMO: Emerging Science in MJO

Shuyi S. Chen[1], Brandon Kerns[1], David Jorgensen[2], Julien Delanoë[3], Chia-Ying Lee[1], Falko Judt[1], Nick Guy[2], Nicolas Viltard[3], Emmanuel Fontaine[3], and Chris Zappa[4]

[1]RSMAS/University of Miami
[2]National Sever Storms Lab/NOAA
[3]LATMOS-Institute Pierre Simon Laplace, France
[4]LDEO/University of Columbia

The Madden-Julian Oscillation (MJO) is known to have a major impact on global weather systems such as heat waves, tropical cyclones, and winter storms. The intraseasonal/planetary time/spatial scales make MJO a critical link between the global weather and climate systems. However, the current global weather and climate models have little skill in predictions of MJO. One of the most challenging problems in predicting MJO is the initiation of large-scale convective activity associated with MJO over the tropical Indian Ocean. The lack of observations has been a main obstacle until recently. The Dynamics of MJO (DYNAMO) field campaign has collected unprecedented observations from airborne, land and ship based platforms from October 2011-February 2012. Here we provide an overview of the aircraft observations in DYNAMO, which captured the second MJO initiation event from November-December 2011. The NOAA WP-3D aircraft was stationed in Diego Garcia and the French Falcon-20 aircraft at the Gan Island in the Maldives. Observations from the two aircraft provide a unique data set of three-dimensional structure of convective cloud systems and their environment from the flight level, airborne Doppler radar, ocean surface imaging, GPS dropsonde and AXBT data. This overview focuses on some key aspects of the aircraft observations that contribute directly to better understanding of convective cloud systems and their interaction with environmental moisture and the ocean during MJO initiation over the tropical Indian Ocean:

- ***Large-scale structure of water vapor and wind fields during convectively suppressed, transition, and active phases of MJO***. Vertical cross sections of low-mid tropospheric water vapor, temperature, and wind from the GPS dropsondes deployed from the WP-3D aircraft during its long transect flights provided an important link between the four monitoring sites, Diego Garcia, Gan Island, R/V Revelle, and R/V Mari, in DYNAMO. In addition, the dropsonde data captures some large-scale features such as sharp boundaries between the equatorial moist air and intruding extratropical dry air as well as a strong equatorial, mid-low level jet during the initiation of the 2nd MJO event in DYNAMO.
- ***Convective clouds systems and their interaction with the ocean surface and atmospheric boundary layer***. Convective downdrafts and fresh water pools from the rain induce a large spatial and temporal variability in the sea surface temperature (SST), which in turn affect the development of convective cloud systems and air-sea fluxes. Aircraft data are used to characterize the structure of convective cold pools and the surface/boundary layer recovery during the convectively suppressed and active phases of MJO.
- ***Full three-dimensional structure of convective cloud systems***. The WP-3D and Falcon aircraft have flown a coordinated mission on 8 December 2011. It is designed to characterize the three-dimensional structure of convective cloud systems including the dynamic, thermodynamic, and microphysical properties, which will provide a unique data set for model evaluation and verification of MJO predictions.