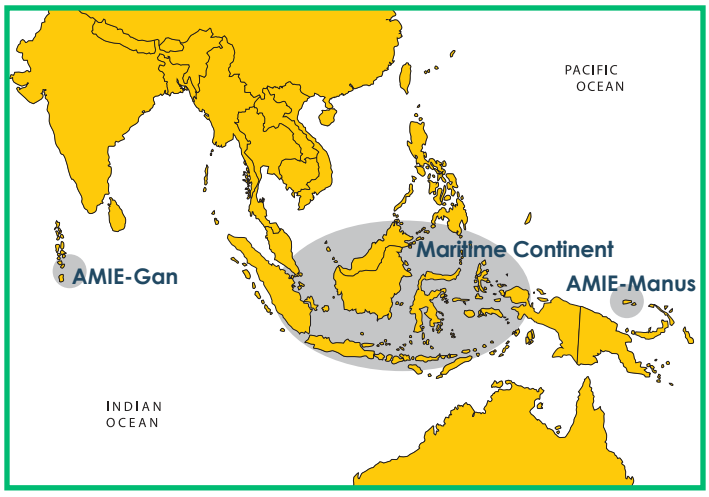
ARM Madden-Julian Oscillation Investigation Experiment

From October 2011 through March 2012, the Atmospheric Radiation Measurement (ARM) Climate Research Facility obtained data at two locations in the tropics for the ARM Madden-Julian Oscillation Investigation Experiment, or AMIE. The second ARM Mobile Facility (AMF2) was located on Gan Island in the Maldives, measuring the Madden-Julian Oscillation (MJO) as it moved eastward. Instruments at ARM's research site on Manus Island in Papua New Guinea, which operated from 1996 to 2014, obtained additional measurements of the MJO as it began to strengthen after passing through the Maritime Continent area of southeast Asia.

Tropical convection plays an important role in the MJO. In the tropics, atmospheric convection creates a pattern of warm air rising, often with clouds forming, and cool air sinking. It is one of the prime methods of transporting solar energy from the equator to the polar regions, and it causes the daily rainstorms common in regions located around the equator. The two AMIE campaigns, along with other related collaborative campaigns, produced a data set that scientists can use to better understand the physical mechanisms behind the MJO and improve the earth system models that simulate its effect on Earth.

Scientific Objective

The Madden-Julian Oscillation (MJO) is a 30- to 60-day wave that propagates eastward. In the western Pacific, an MJO



cycle includes a convectively active phase with widespread maritime convection, increased precipitation, and very cloudy conditions, and a suppressed phase with reduced convective activity and less precipitation.

The MJO dominates tropical intraseasonal variability, but earth system models have difficulty predicting its occurrence, as well as its effects and its interactions with regional monsoons and El Niño. ARM's unique instrumentation, including the 3D cloud and precipitation radars, allowed for the study of the initiation, propagation, and evolution of convective clouds within the framework of the MJO.

Collaborations

AMIE, sponsored by the U.S. Department of Energy, took place in conjunction with the Dynamics of the Madden-Julian Oscillation (DYNAMO) and Cooperative Indian Ocean experiment in intraseasonal variability in the Year 2011 (CINDY2011) campaigns. Key collaborators included:

- Maldivian Meteorological Service
- National Science Foundation/National Center for Atmospheric Research
- Office of Naval Research
- National Oceanic and Atmospheric Administration
- National Aeronautics and Space Administration
- Japan Agency for Marine-Earth Science and Technology
- Indian National Institute of Oceanography

Research Instrumentation

Each mobile facility consists of operations shelters, instrumentation, and data and communications systems for earth system studies. The AMF2 also provides ocean meteorology and sea state instrumentation to support shipborne deployments. Trained onsite operators monitor and maintain the facility to ensure that the best and most complete data set is acquired during each deployment. Data are collected 24 hours a day, seven days a week.

Operations Shelters. Shipping containers serve as operations shelters, hosting a number of instruments and data systems. They also provide working space for onsite personnel and spare parts storage. Other instruments are contained in individual modules with integrated data systems.

Measurement Capabilities. Measurement capabilities include the standard meteorological instrumentation, broadband and spectral radiometer suites, and remote-sensing instruments. Additional instruments for measuring ocean meteorology, sea state, bulk aerodynamic fluxes, and ship disposition are available for shipborne deployments.

- W-Band Scanning ARM Cloud Radar
- High Spectral Resolution Lidar
- Micropulse Lidar and Laser Ceilometer
- X- and Ka-Band Scanning ARM Cloud Radar
- Microwave Radiometer
- Atmospheric Emitted Radiance Interferometer
- Multifilter Rotating Shadowband Radiometer
- Sky Radiation System – a collection of radiometers to measure visible diffuse, global, and direct visible and infrared solar radiation
- Ground Radiation System – a collection of radiometers to measure visible and infrared radiation coming from the ground
- Balloon-Borne Sounding System – sondes launched each day at regular intervals
- Radar Wind Profiler
- Total Sky Imager
- Aerosol Observing System
- Surface Meteorology Station

The second ARM Mobile Facility traveled to Gan Island in the Maldives to observe tropical convection for the ARM Madden-Julian Oscillation Investigation Experiment.

Data and Communication System. Continuous measurements obtained by the sensors and instruments are collected by integrated data systems. These data are routinely checked for quality and transmitted to the ARM Data Center for storage and availability to the scientific community.

Using an ARM Mobile Facility. The AMFs are available to collaborate with experiments (especially those involving aircraft) from other agencies. They can accommodate instruments in addition to, or in place of, the baseline collection. Scientific organizations interested in using an AMF are encouraged to submit proposals at the following web page: ***www.arm.gov/research/campaign-proposal***.

Sponsor

The AMFs were developed through funding from the DOE Office of Science, Office of Biological and Environmental Research. Nine national laboratories are responsible for the science, engineering, and operation of the AMFs, which are managed by the ARM Climate Research Facility.

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Additional information is available on the ARM website at www.arm.gov.