# Field Project Fact Sheet #2

## DYNAMO: Dynamics of the Madden-Julian Oscillation

### Science Mission

As the global climate changes, it becomes more urgent to understand how the oceans and atmosphere work together to regulate the Earth's temperature and respond to long-term changes. The study of climate aims to better understand what will happen when global temperatures change. An example of this is sea level rise; scientists would like to know how much temperatures are rising and how that is impacting something like sea level rise. This information can be used by national and local governments, and individuals in order to plan ways to mitigate and adapt to climate change. Mitigation means limiting global warming by reducing the amount of greenhouse gases in the atmosphere. Adaptation means making changes to cope with impacts of climate change such as extreme heat, severe storms, sea level rise, drought, and flooding. Studying the ocean and atmosphere in the tropics will provide the information we need to make informed decisions.

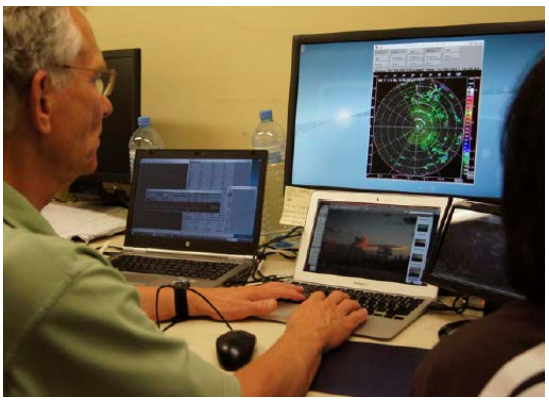
### About DYNAMO

A group of meteorologists, oceanographers, and climate scientists from 13 countries gathered in the Indian Ocean for a research project to observe the developmental phases of the Madden-Julian Oscillation (MJO) at its source. This project is called DYNAMO, which stands for Dynamics of the Madden-Julian Oscillation.

### What is the MADDEN-JULIAN OSCILLATION?

The Indian Ocean is one of the Earth's most sensitive regions where ocean and atmosphere interact, affecting the global climate. What happens here sends impulses out over much of the globe via a phenomenon called the Madden-Julian Oscillation, or MJO.

The MJO is a 30 to 90 day tropical weather cycle that starts over the Indian Ocean near the equator and moves eastward into the western Pacific Ocean, alternating between large, strong rain storms and quiet periods, covering a large region of several thousands of kilometer across the ocean. The region over the Indian Ocean where the MJO begins typically has cooler sea surface temperatures, and as the system progresses, it moves eastward into the warmer waters of the western Pacific Ocean. Cloud systems then build up due to heat and moisture from the ocean. The storm systems moving through the equatorial regions affect the weather in both the Northern and Southern Hemispheres. Scientists are very interested in the way this weather cycle begins, as the MJO has far reaching impacts on both global climate and weather. The data they collect will be studied and entered into climate models.



If scientists and researchers can determine what environmental conditions are present to make the MJO start, the climate models and forecasters can better predict global weather and climate patterns.

*Activity by Becca Hatheway, UCAR Center for Science Education and Alison Rockwell, Earth Observing Laboratory, NCAR*







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**More about the MADDEN-JULIAN OSCILLATION**

This forecast is based on the “current” conditions of the Madden-Julian Oscillation in the equa-torial Indian Ocean. Conditions in the Indian Ocean have a ”domino-like” effect on weather and climate all over the world.

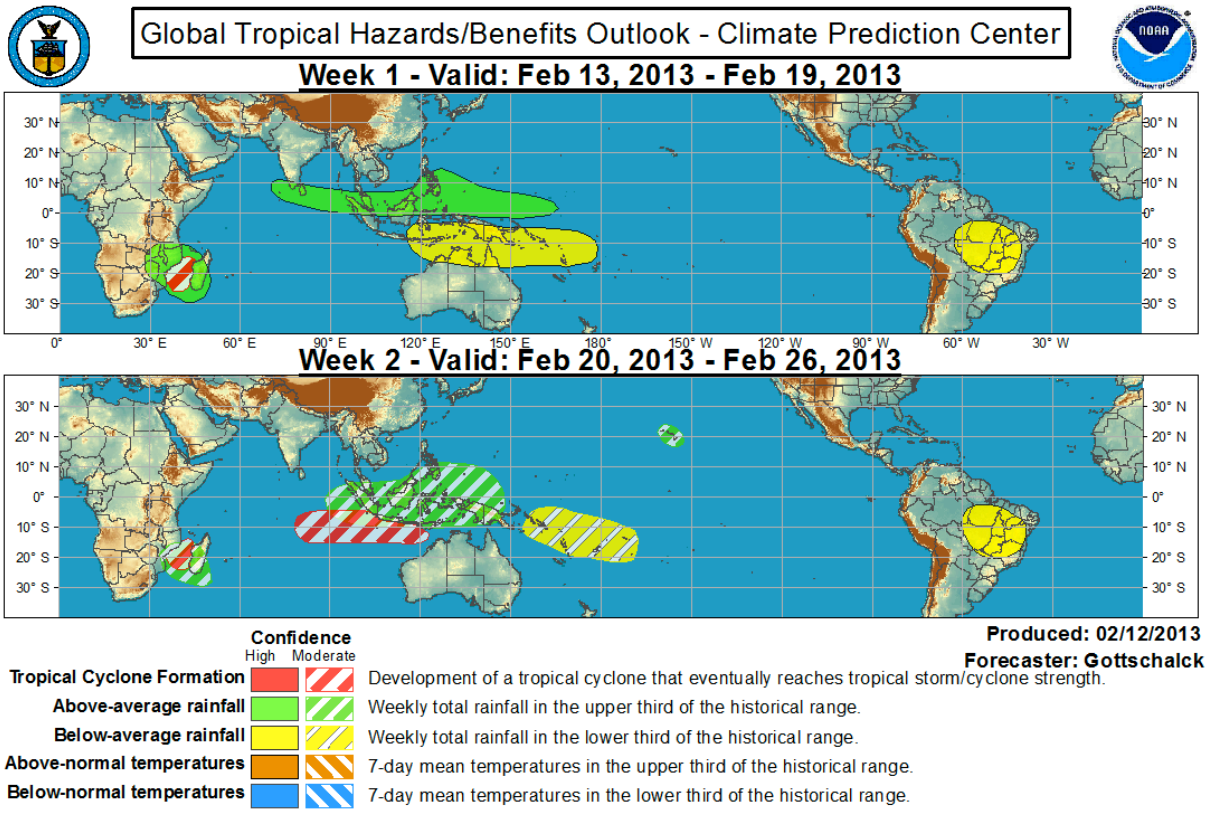
**Week 1:**

The MJO remained active over the past week with above average rainfall, moving east from the Central Indian Ocean towards the central Pacific Ocean (green). This resulted in below average rainfall (yellow) for most of the Indian Ocean and South-east Asia. In northeastern Brazil, dry conditions are predicted.

**Week 2:**

With the MJO active during Week 1, predicted conditions for Week 2 look to be a bit more hazardous. Southeast Asia will see much higher than normal total rainfall levels (hashed green), while the area just south of that will have a greater chance of tropical storms (hashed red). Northeastern Brazil will continue to have below-average rainfall (yellow), and dry conditions.

Find out what the global conditions are today: http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ghazards/

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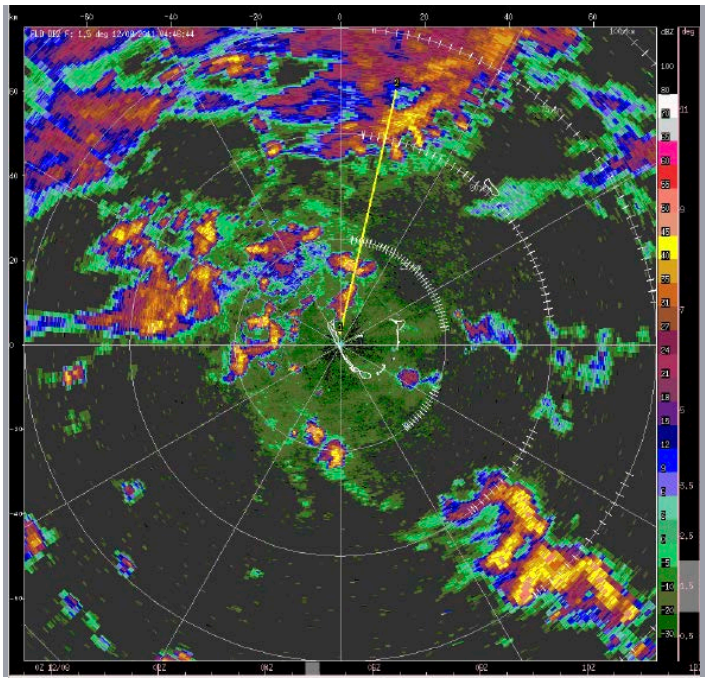
### More about DYNAMO



### Sample Data from DYNAMO

This image shows precipitation data from the S-Pol radar when it was in the Maldive Islands, during the DYNAMO field project. The radar is located at the center of the circular map grid, and can "see" about 150 kilometers in every direction.

The radar data show very detailed data of precipitation (rain) storms passing over the island, located in the center of the map. The radar is able to "see" into the middle of the clouds and determine rain drop sizes and movements. Combined with data from other types of research equipment, these data provide scientists with valuable information about how the ocean and atmosphere work together, and hopefully determine what environmental conditions are present when the MJO starts.

This island is located very near the Equator, where winds and storms typically travel from west to east.

### Instruments & Platforms

- High-flying Research Aircraft
- Research Ship
- Land-based Radar
- Ship-based Radar
- Dropsonde
- Weather Balloon
- Solar Radiation Sensor
- Fixed Buoys System
- Ocean Salinity & Temperature Sensor
- Particle Sensor

### Data Discussion Questions

1. *Where in this data do you see the heaviest rain-fall, represented by yellow and pink?*
2. *What do you think is the distance between the circles on the map?*
3. *In each cloud system, where is the rain the heaviest?*

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**Research Summary of DYNAMO**


DYNAMO was an international field project that took place in the tropical Indian Ocean and its surrounding regions in October 2011 - March 2012. Using ships, airplanes, and ground instruments such as radars, the field project collected observations needed to advance our understanding and prediction of a phenomenon known as the Madden-Julian Oscillation (MJO). The MJO represent enhanced rainfall over a large area (thousands of kilometers across) that moves from the Indian Ocean to the Pacific. It affects weather and climate in many regions of the world, including extreme events such as flood, tropical cyclones, El Nino, etc. A better prediction of the MJO would lead to tremendous societal benefit.

It can take up to five to ten years to organize, analyze, and examine the relationships, patterns, trends, etc., of the millions of data points collected during this huge field project. Scientists are still in the process of analyzing the data from this research project.

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