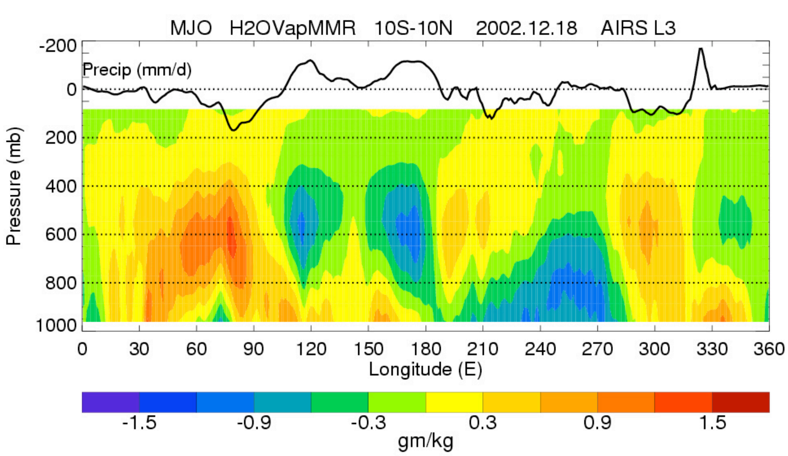
# TO CATCH A WAVE

In 1971 while studying zonal winds in the tropical Pacific, Roland Madden and Paul Julian of the National Center for Atmospheric Research noticed what appeared to be the signature of a large-scale wave moving through the atmosphere. Now referred to as the Madden-Julian Oscillation, or simply MJO, this slow eastward-moving wave was found to stretch almost halfway around the world in a band that spanned the equator. In one phase of the wave, air slowly rises, triggering showers and thunderstorms, while in the other phase air slowly sinks, inhibiting clouds and rainfall. Changes between these phases occur approximately every 25-30 days.

The MJO wields its greatest influence in the Indian and western Pacific oceans where it affects the onset and break activity of the Asian-Australian monsoon system. But more than being a major factor in weather fluctuations in the tropics, the MJO can affect the winter jet stream and atmospheric circulation in the northern Pacific and western North America, causing anomalies that can lead to extreme rainfall events. In the summer, the oscillation can cause changes in rainfall patterns in parts of Mexico and South America. The MJO is even being looked at as playing a role in triggering variations in the El Niño Southern Oscillation.

Because of the wide range of weather phenomena associated with the MJO and the profound impacts these phenomena can have, it becomes essential that weather prediction supercomputers contain an accurate model of the wave. And a good model of the MJO will help forecasters better predict its effects, allowing people to better prepare for what's to come. But because of its complex nature, this has been no easy task.

Enter Duane Waliser and Baijun Tian. Duane, a Principal Scientist at the Jet Propulsion Laboratory and Baijun, a staff scientist at CalTech, are working together with members of JPL's AIRS science team to shoulder the task. The two have taken on the job of trying to properly represent the MJO in the general circulation models (GCMs) used for weather prediction and climate simulation. The most difficult challenge has come from trying to model the wave's hydrological components: water vapor and cloud, condensation, and evaporation processes. Most of the research on this problem has involved analysis of data in two dimensions—a horizontal plane in either the upper or lower troposphere. But Duane and Baijun are coming at the problem with something new—3-dimensional data from the Atmospheric Infrared Sounder.




This longitude-height cross-section plot shows the longitudinal and vertical structure of atmospheric water vapor anomaly associated with MJO rainfall anomaly.

The 3D structure of the high-resolution AIRS data may be the net that best traps the imprint of the MJO. Duane and Baijun are working to capture its signature in the AIRS data to create a depiction of the wave that can be compared to the model currently contained in the GCMs. The difference between the two should identify how the GCM should be corrected to properly represent the tricky MJO.

If Duane and Baijun meet with success, it could be hard to calculate what the improvement in forecast prediction could save in both money and lives. You could say there's a lot riding on the wave.

## SUPPLEMENTAL

**CDC Experimental MJO Projects**
www.cdc.noaa.gov/MJO

**NOAA Monitoring Intraseasonal Oscillations**
www.cpc.noaa.gov/products/precip/CWlink/mjo_iso.html

**Intraseasonal Variability of the Atmosphere-Ocean Climate System**
Lau, W. K. M. and D. E. Waliser, Eds., 2005, Springer, Heidelberg, Germany, 474 pp.

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