# Air-Sea Interaction Influence of MJO Forecast Plan for Real-Time COAMPS Forecast for ONR-DRI/DYNAMO/CINDY

Sue Chen Maria Flatau (PI), Tommy Jensen, Toshiaki Shinoda, James Cummings Naval Research Laboratory

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# COAMPS<sup>®1</sup>



COAMPS is a globally relocatable air-sea-wave coupled limited-area forecast and analysis system

Coupled **Microphysics Tropical Cyclone** Air/Ocean/Wave Structure & Intensity Cloud radar assimilation Modeling **Refractivity**/ Marine & Ocean Acoustic **Boundary Layer Dynamics** Chem/Bio Transport & **Orographic Flow** Dispersion **Dynamics** Ocean Bio Large Eddy Simulations Numerical Techniques **Forecast Validation** Land-Surface/Urban Interactive Aerosols Modeling



# Forecast and Assimilation System







### **Forecast Components**







### **Current Plans**



**Retrospective Process Studies** 

Real-time COAMPS forecast

- Atmospheric model: 27 km outer nest
  - 1 or 3 km over the ONR DRI/CINDY/DYNAMO array
- Ocean (NCOM, 1/8 degree, or 3 km)
- ➤ Wave (SWAN/WAVEWATCH III, 1/4 deg)
- 3DVAR data assimilation in the atmosphere and ocean
- Coupling interval 6-12 min.
- Weekly forecast during 6-8 weeks IOP (Nov-Dec)
  - High-resolution in the atmospheric boundary layer and ocean mixed layer
  - Assimilating field observations through GTS
  - Wish list for the real-time model products

Post field phase modeling studies

Reanalysis, hindcast, and data assimilation experiments



# **Process Studies**



- 1. Influence of air-sea interaction on MJO formation in the Indian Ocean and eastward propagation of MJO into the Maritime Continent
- 2. Understand the onset of convection during the transition period from suppressed to active phase through small scale air-sea interaction
- 3. Develop mesoscale MJO metrics for evaluation of the medium range (5-10 days) MJO forecasts (by projecting the wind, rainfall, and OLR anomalies on MJO normal modes)
- 4. Perform predictability studies (coupled ensemble prediction system using the ensemble transformation technique) to:
  - provide estimates of the variability of forecasts associated with errors in the initial conditions
  - diagnose changes to the deterministic model improve physical parameterizations
  - determine optimal use of ocean observations in the coupled system, using data denial experiments to determine value added of new observations during CINDY



### **COAMPS Simulation of MJO**







# **TMI Cloud Liquid Water**





#### Classic MJO: transition of active and suppressed convection phase in the Eastern Indian Ocean http://www.ssmi.com/tmi

Cindy2011.DYNAMO Operation Planning Workshop, Nov 8-10, Yokohama, Japan

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# **COAMPS** Precipitation





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– RAMA (0 N 80.5 E)



Cindy2011.DYNAMO Operation Planning Workshop, Nov 8-10, Yokohama, Japan

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### **RAMA Ocean Temperature**



Suppressed phase (April 6, 20-26 and 30) – large diurnal cycle, up to 1.5°C between surface and 5 m, diurnal mixing to 5 m or 10 m at night
Active phase (April 8 – 16) ocean temperature well mixed to 10 m



# **COAMPS at RAMA Buoy location**



•COAMPS forecast of upper ocean temperature is sensitive to the interaction of radiation and cloud parameterizations

•Gradual deepening of the mixed layer





•COAMPS develops Wyrtki Jet along the equator on April 16 and the jet continue to exist into the suppress phase

•High waves over the Southern Indian Ocean during the active convection period



### **Mesoscale MJO Index**



First two EOFs of the TRMM precipitation (eastward moving component, spring)



Precipitation dipole between central IO and WP and precipitation maximum west of Sumatra are essential features of this pattern



#### MJO phase from Real-Time Multivariate MJO index (1<sup>st</sup> and 2<sup>nd</sup> PC)







•Principal components of the first 2 EOFs describe the behavior of convection in the model •COAMPS MJO index magnitude is similar to the observations •COAMPS MJO transition from **Indian Ocean to Maritime Continent is not** as abrupt as the observation



### **Future Plans**



≻Continue the April 2009 sensitivity studies including:

➤30 days forecast without assimilation

>New version of KF cumulus scheme & microphysics upgrade

>5-7 forecast with assimilation in the atmosphere and ocean

>Uncoupled and 1-way coupled tests

≻Add a second time period (Oct 2009)

Idealized (MISMO mean sounding from Simon de Szoeke & Eric Skyllingsted) & real coupled COAMPS (1-27 km) simulations to exam the impact of horizontal grid resolution on the simulated convection structure

≻Test COAMPS real-time configuration for 2011 field campaign

Develop real-time COAMPS forecast model products