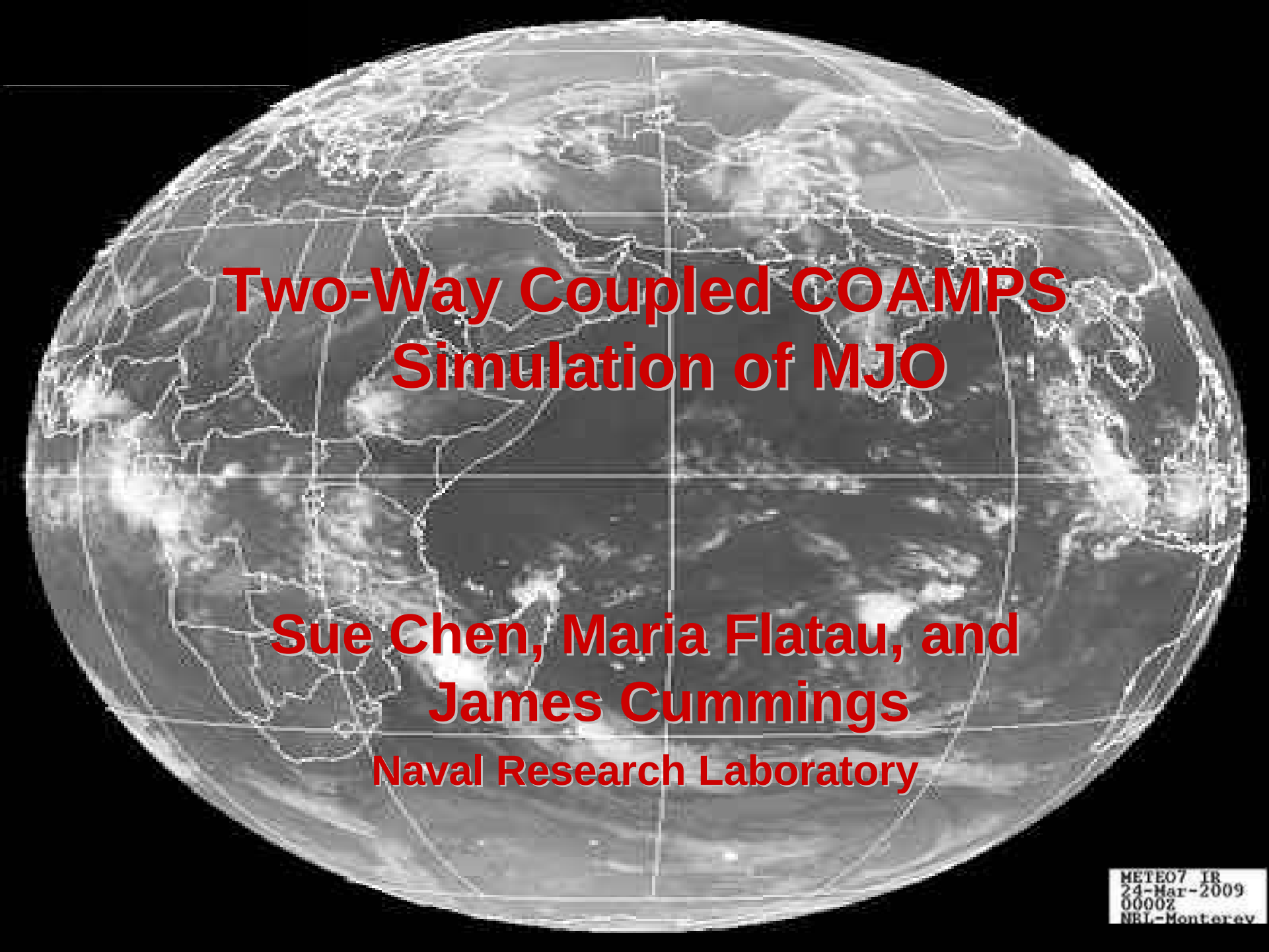


Two-Way Coupled COAMPS Simulation of MJO

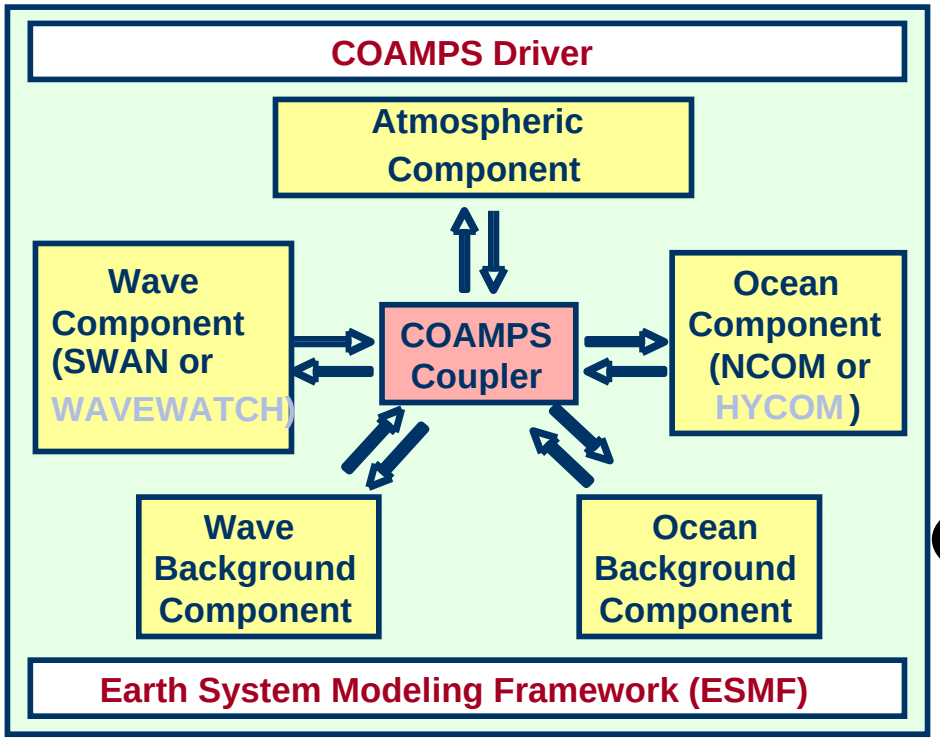
Sue Chen, Maria Flatau, and James Cummings

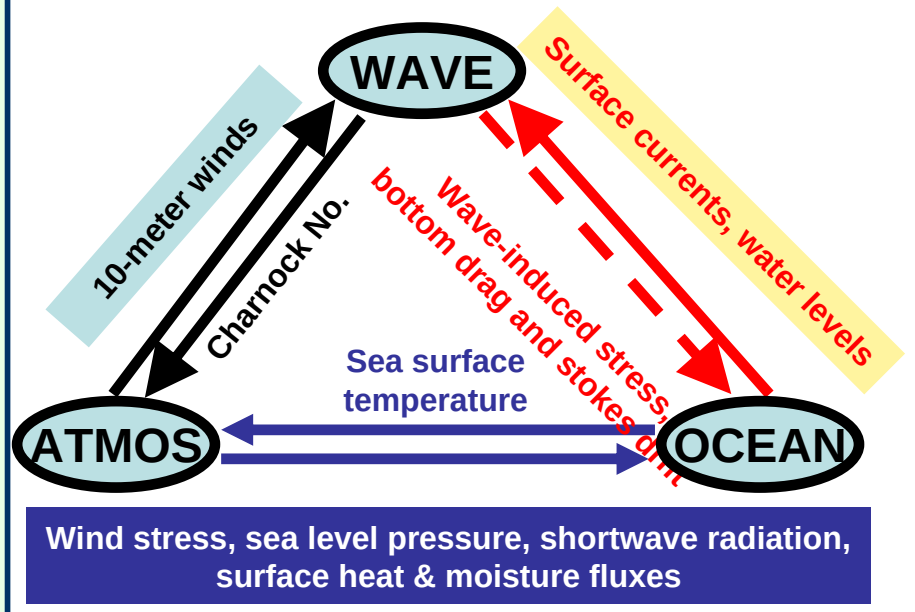
Naval Research Laboratory

Motivations

- **Can two-way tightly coupled limited area model bridge the gaps to improve the MJO forecast?**
- **What's the role of the air-sea interaction to the development of the MJO?**
- **Can we use the couple model to provide some observation guidance?**

COAMPS®[1]



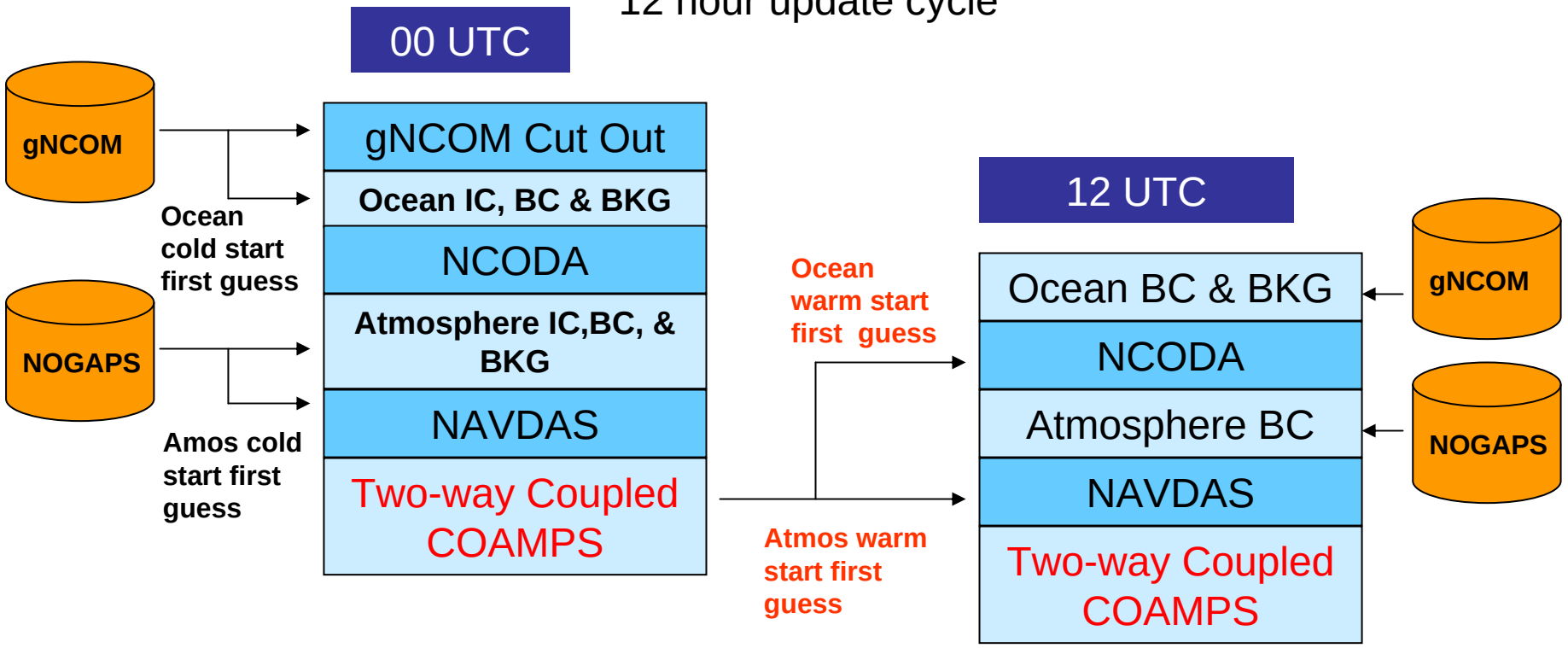


- ESMF super structure is used to couple the air, ocean, and wave components
- All data exchange between components is handled by a single multiphase coupler
- First NWP mesocale model that uses the ESMF coupling technology

[1]COAMPS® is a registered trademark of Naval Research Laboratory

Two-Way Coupled Data Assimilation System

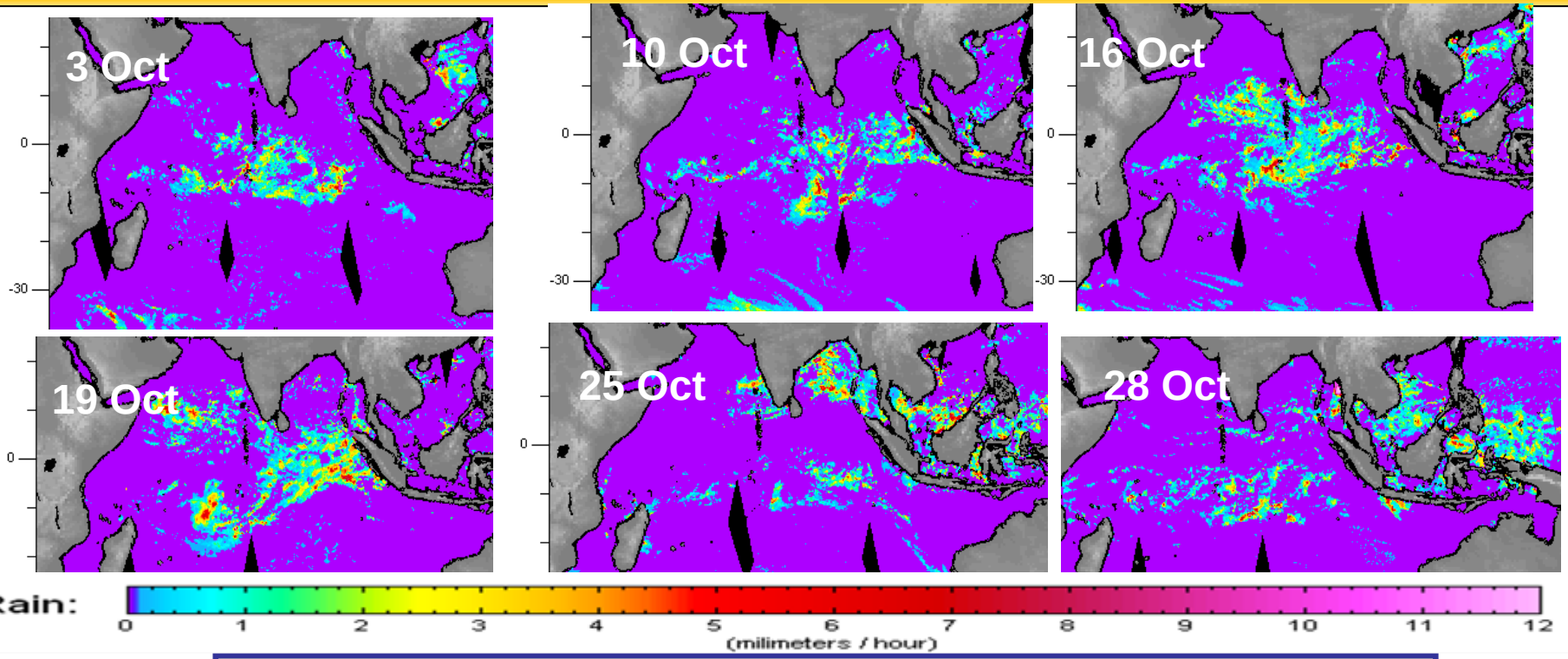
COAMPS-NCOM, NAVDAS, and NCODA



- **The coupled data assimilation system ingests 6.7 Gbytes of observations and global model data for a 12 hour update cycle**
- **The atmosphere and ocean data assimilation system are two independent system**

An MJO Event

1-31 Oct, 2008



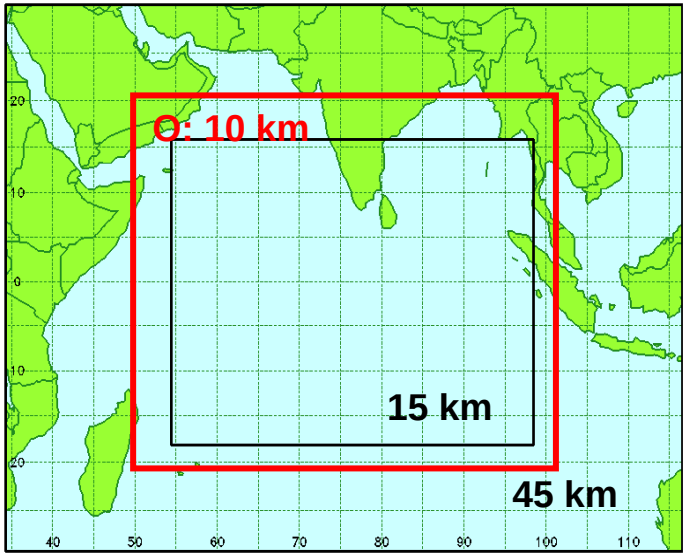
- 10 Oct: convection moves eastward to 90-120 E
- 16 Oct: convection retrieves back to 60-90 E
- 19 Oct: two twin tropical cyclones develop west of 60 E
- 25 Oct: convection quiets down in India Ocean
- 28 Oct: convection starts in Maritime Continent

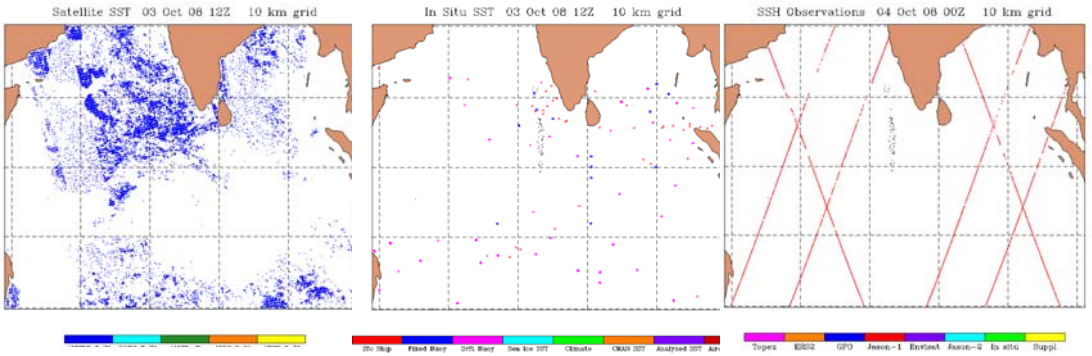
COAMPS MJO Simulation

Model Setup

Coupled Model Configuration

- 21 days continuous data assimilation in both the atmosphere (MVOI) and ocean (NCODA)
- Ocean assimilation include the altimeter data
- Twelve hour update cycle
- Two-nested atmospheric grids:
  - 45 and 15 km (201x151,322x253)
  - 30 vertical levels
- One NCOM grid
  - 10 km (572x452)
  - 40 vertical levels, 23 sigma layers
- Coupling:
  - Concurrent mode
  - Coupling interval: 10 min

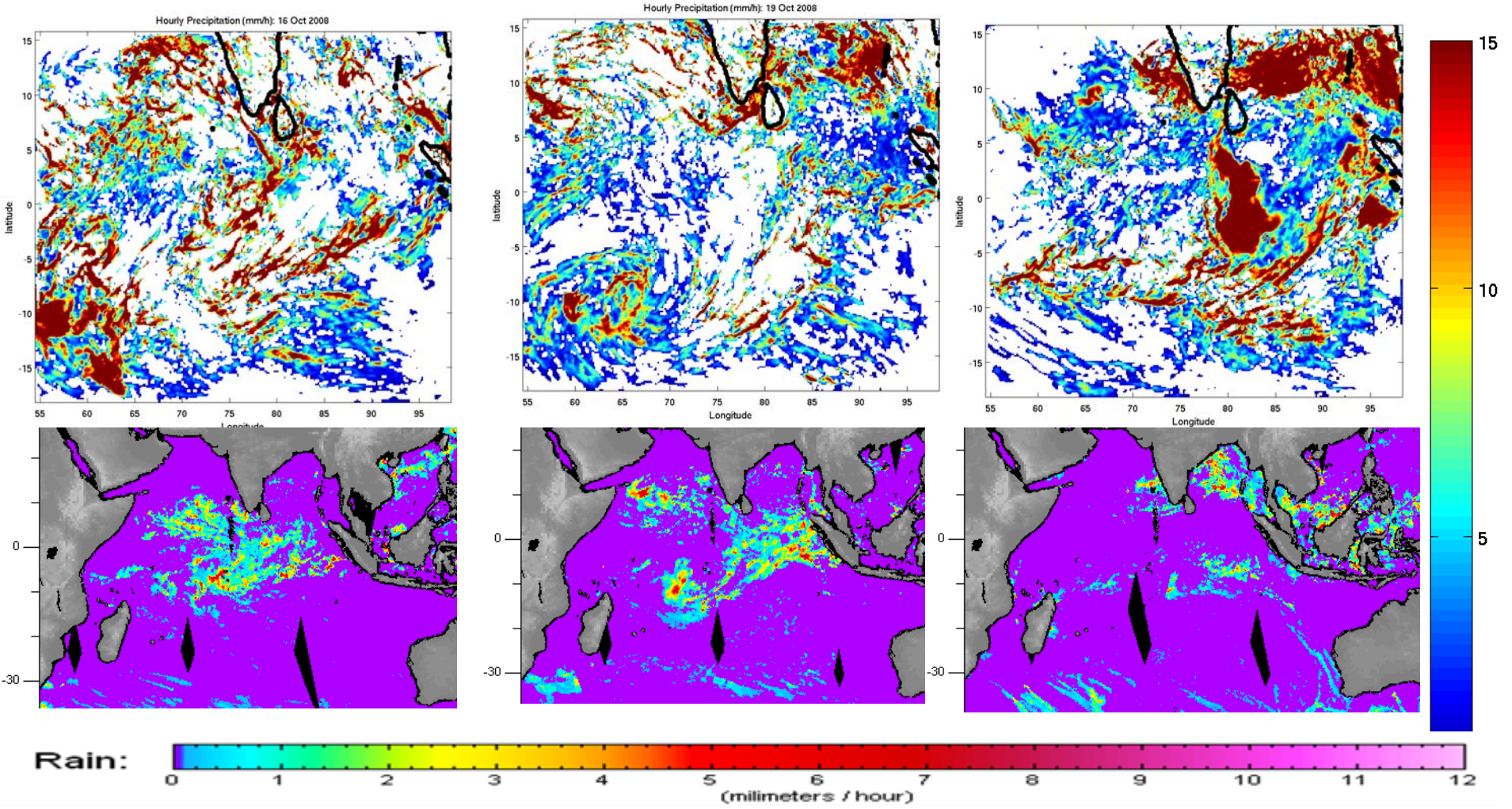




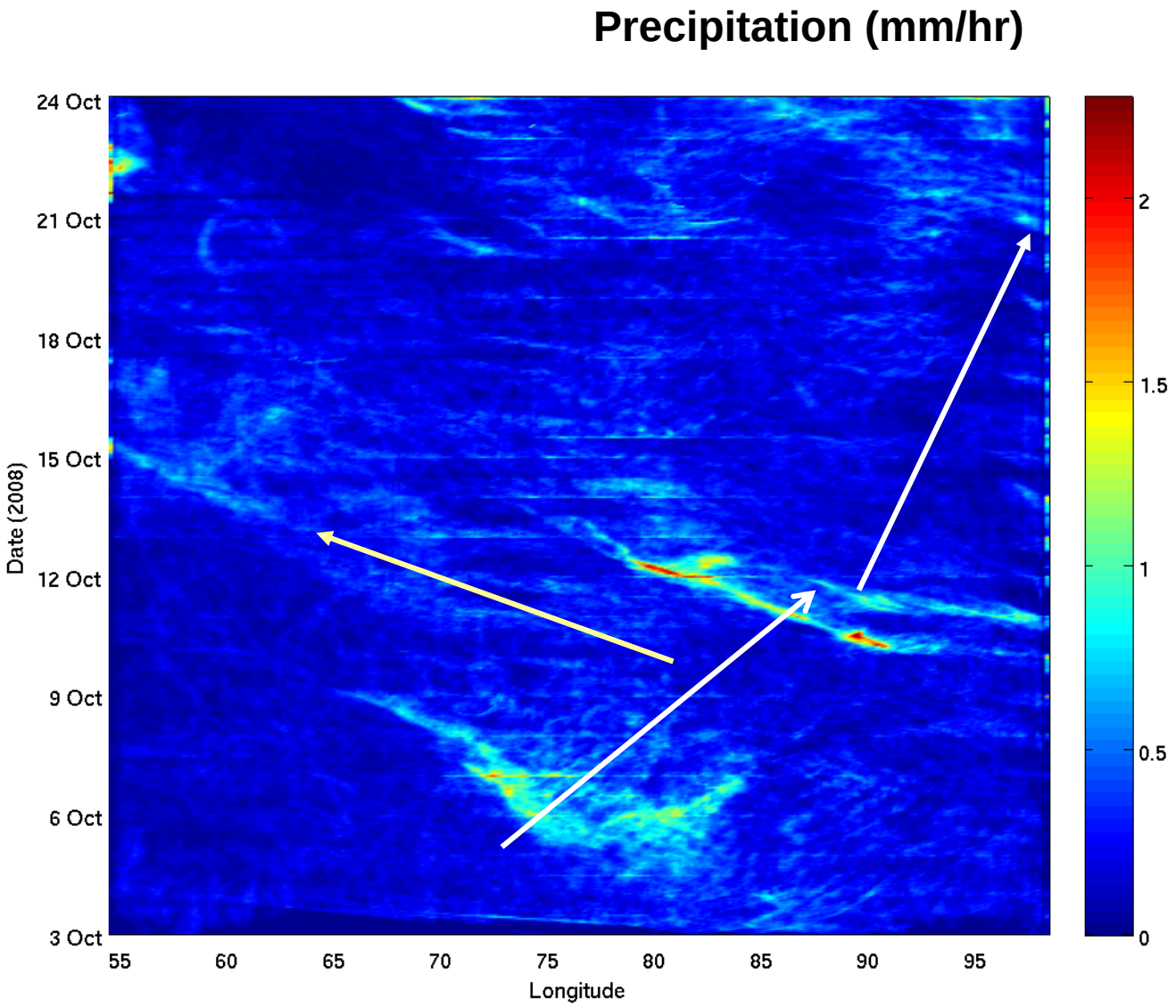
Results
Propagation of the MJO

24 H Accumulated Precipitation

16 Oct **19 Oct** **25 Oct**



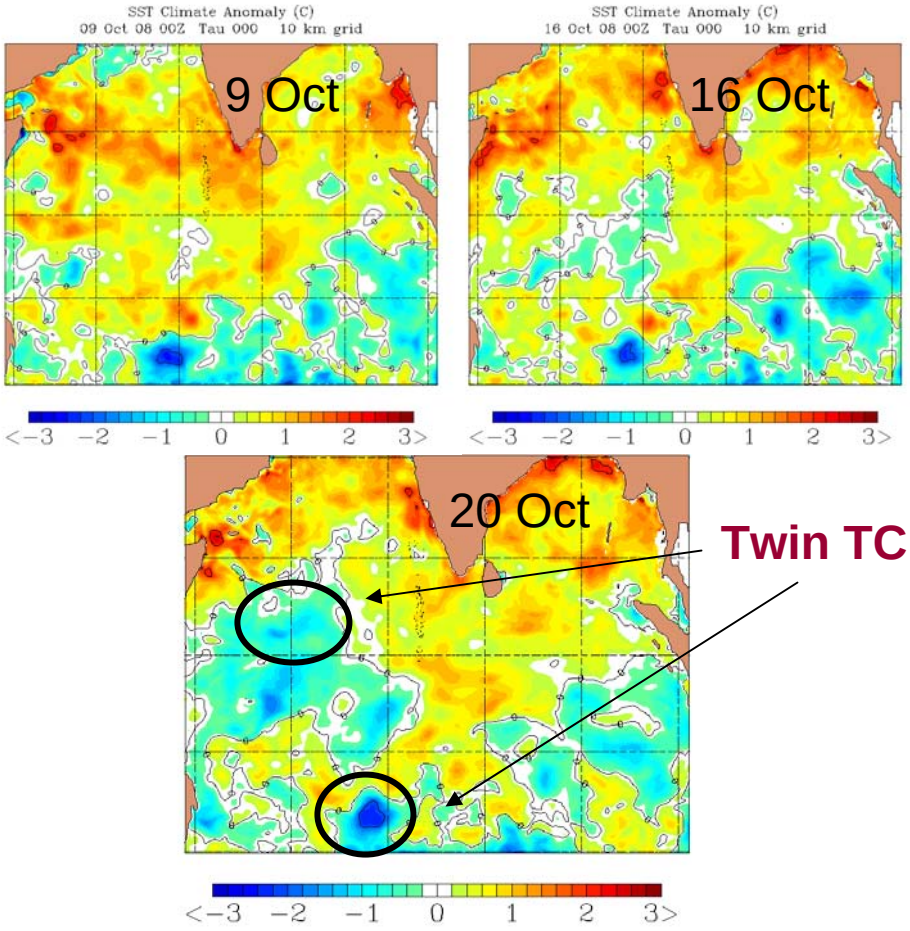
Results
Propagation of the MJO



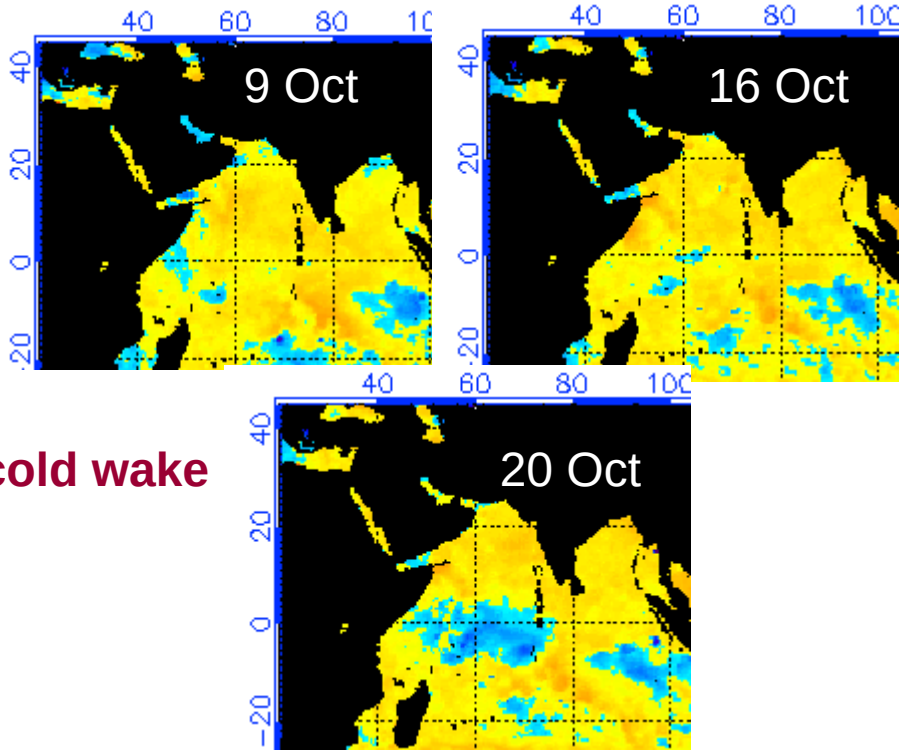
- Convection moves eastward
- Rossby wave moves westward

Results

Upper Ocean Response



NOAA/NESDIS SST Anomaly

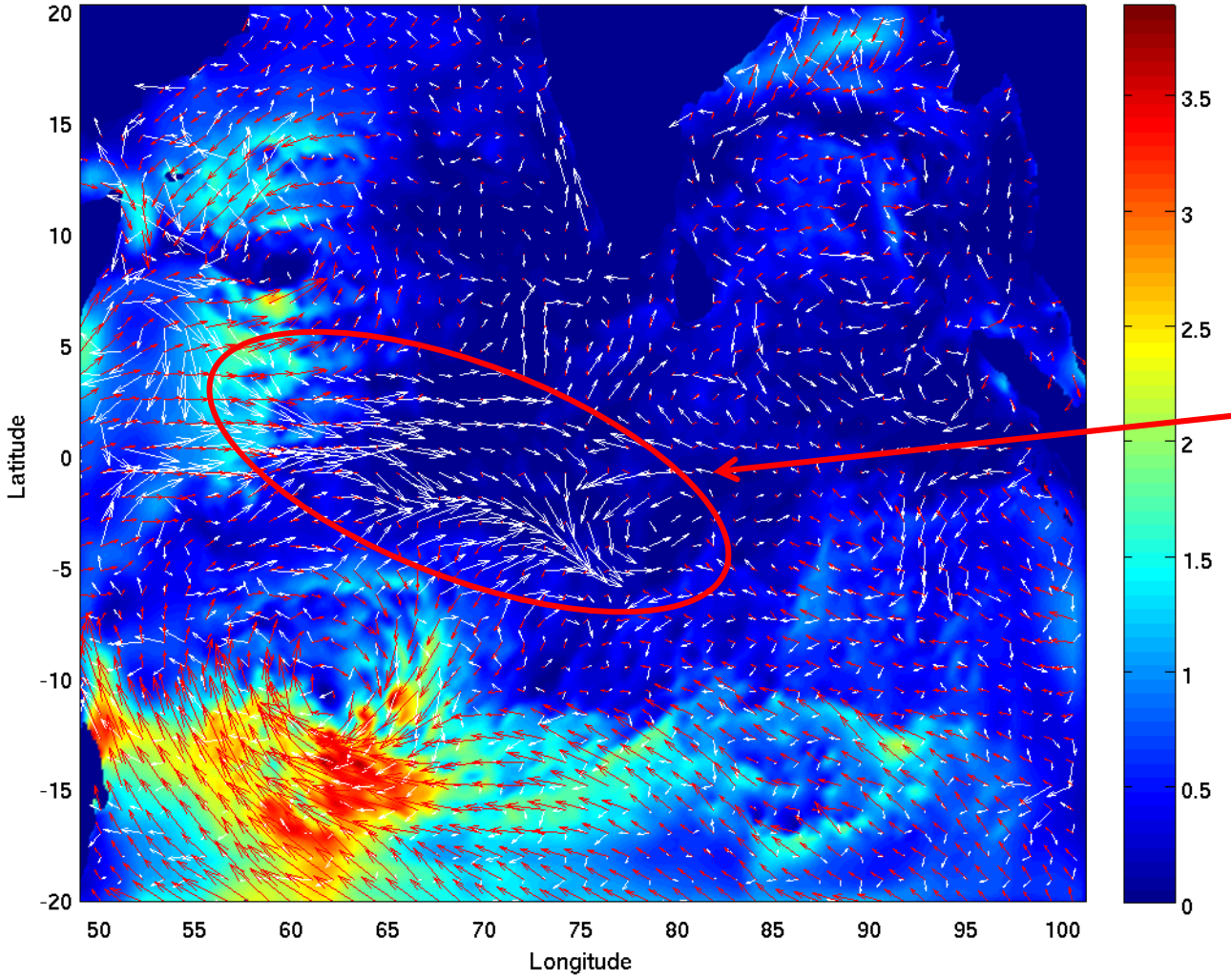


http://www.osdpd.noaa.gov/PSB/EPS/SST/climo.html

Results

Upper Ocean Response

20 Oct: Total surface stress

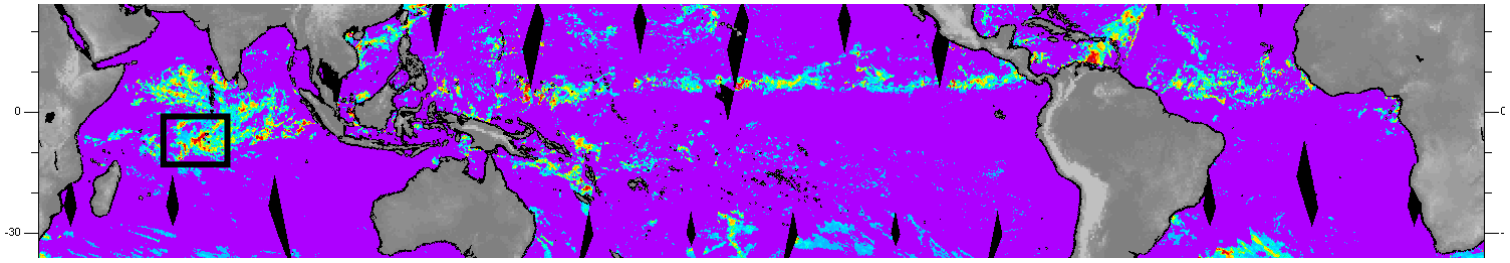


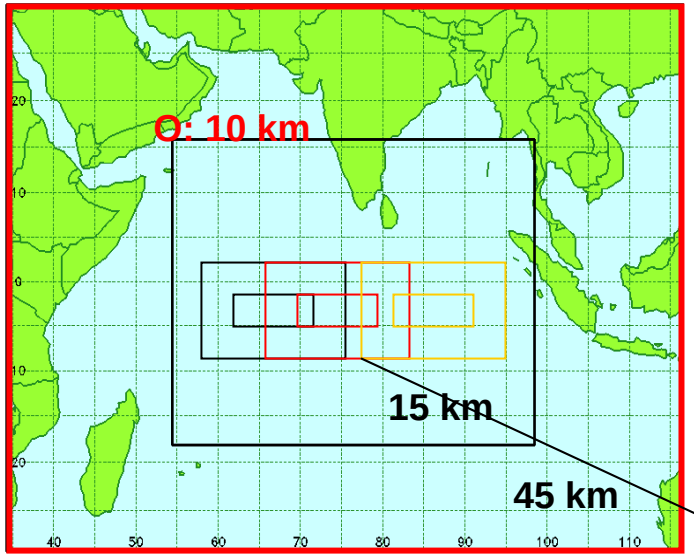
Wind stress

Current

Strong surface current forced by the convergence of the twin cyclones along the equator

MJO Modeling Strategy





- Tropical belt

(Tommy Jensen, NRL SSC)

- Basin Scale

High resolution moving domains

Futures Plans

- **Finish analyzing the coupled model results**
- **Extend the forecast to five days and add higher resolution over the convective region**
- **Perform uncoupled and 1-way coupled simulations to study the impact of air-sea interaction to the development of MJO**
- **Examine the impact of ocean data assimilation to model forecast OML structure**