Air-Sea Coupling in the Indian Ocean
An ONR Department Research Initiative (DRI)

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DYNAMO Workshop

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ONR's Department Research Initiatives (DRI)

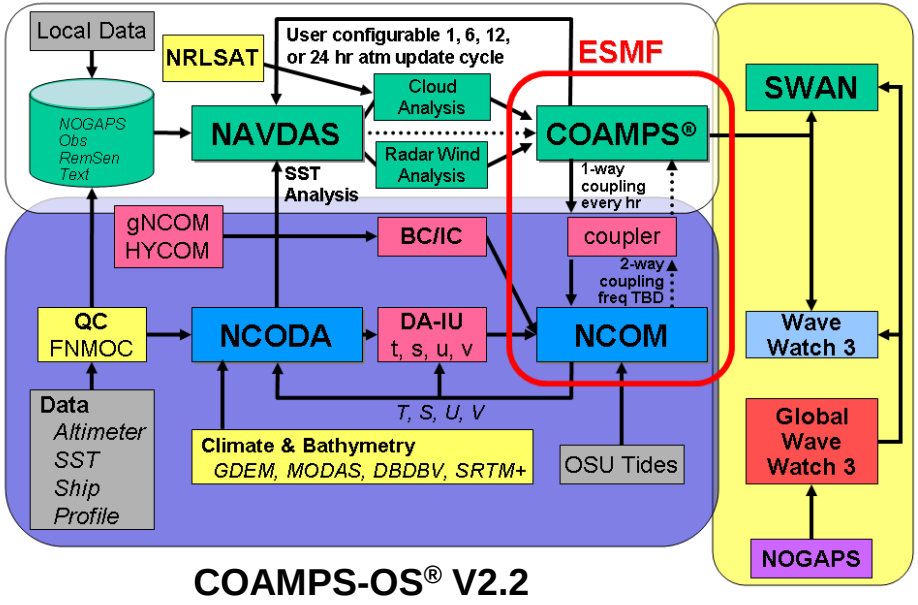
"Department Research Initiatives" are five-year efforts focused on making progress on a particular science topic. They involve interdisciplinary teams of scientists assembled by ONR that work together on a collaborative effort.

A Sampling of Recent DRIs:

- Emerging Dynamics of the Marginal Ice Zone, FY12-FY16
- Circulation Dynamics of the South China Sea and Vietnam Shelf, FY11-FY15
- Origins of the Kuroshio and Mindanao Currents, FY10-FY14
- **Air-Sea Coupling in the Indian Ocean - MJO, FY10-FY14**
- Scalable Lateral Mixing and Coherent Turbulence, FY09-FY13
- Internal Wave Generation in Straits, FY09-FY13
- Impact of Typhoons on the Ocean in the Western Pacific, FY08-FY12
- High-Resolution Wave-Air-Sea Interactions, FY07-FY11
- Philippine Archipelago Circulation and Strait Dynamics, FY06-FY10

Coupled Modeling and Prediction

Many coupled models (atm-ocean; atm-wave-ocean) have been developed and are being used for both research and operational prediction



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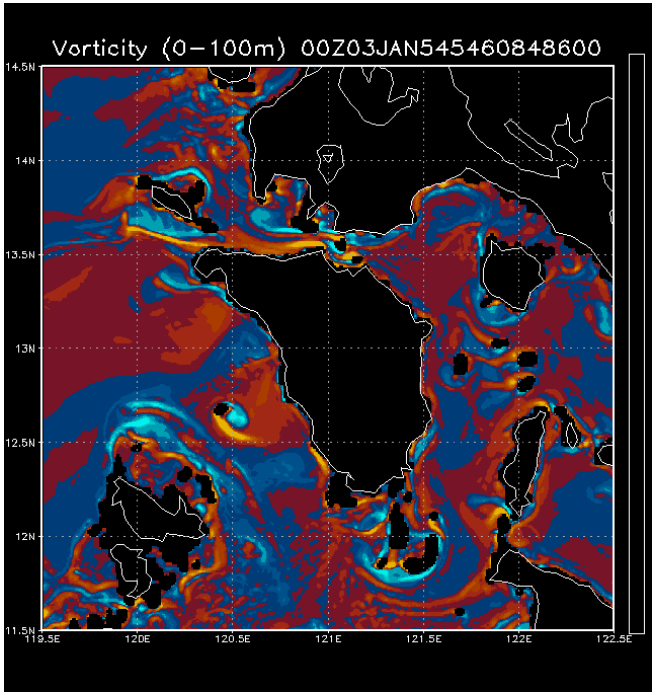

Are the relevant coupled processes adequately represented?

Can these processes be parameterized in coarser models?

MJO DRI
Air-Sea Coupling in the Indian Ocean

Goal :

A better understanding of coupled (ocean-wave-atmosphere) physical processes and the numerical representation of these modes in coupled models

Concentration will be on the detailed physics of the

- **upper ocean mixed layer**
- **surface fluxes**
- **atmospheric boundary layer**

and the role these all play in coupled mode propagation

Scientific Goals for the DRI

Through a combination of modeling and observational studies, we hope to better understand…

The submesoscale coupled processes that result in larger-scale impacts on the coupled system in the Indian Ocean

- What processes control coupled propagating features that persist? (latitude/location, background structure, planetary waves, etc)
- What are their spatial and temporal time scales?
- Includes: role of diurnal cycle, cold pools, barrier layers, organized convection, BL rolls, Langmuir cells, surface waves, etc on ocean-atmosphere feedback

How to represent the above processes in predictive models

- What vertical resolutions are required to adequately capture the processes?
- Do improved representation and parameterization lead to improved predictability?
- How to build scale-dependent parameterizations that better represent the fluxes and propagating coupled modes, across model resolutions that may only partially represent such processes

DYNAMO Hypotheses

Hypothesis I: Deep convection can be organized into an MJO convective envelope only when the moist layer has become sufficiently deep over a region of the MJO scale; the pace at which this moistening occurs determines the duration of the pre-onset state.

Hypothesis II: Specific convective populations at different stages are essential to MJO initiation.

Hypothesis III: The barrier layer, wind- and shear-driven mixing, shallow thermocline, and mixing-layer entrainment all play essential roles in MJO initiation in the Indian Ocean by controlling the upper-ocean heat content and SST, and thereby surface flux feedback.

The ONR DRI will help to test Hypothesis III with observations and models

DRI Participants: Observational Campaign

(Just lead PI's on the grants - many others also involved)

- Jim Moum, Oregon State
- Rob Pinkel, UCSD/Scripps
- Jim Edson, University of Connecticut
- Simon de Szoeke, Oregon State
- Chris Zappa, LDEO/Columbia
- Ken Melville, UCSD/Scripps

R/V Revelle

- Piotr Flatau , UCSD/Scripps
- Darek Baranowski, UCSD/Scripps

R/V Mirai

- Qing Wang, Naval Postgraduate School
- Djamal Khelif, Univ. of California, Irvine

NOAA P3 Aircraft

- Chidong Zhang, RSMAS (for coordination with DYNAMO)

DRI Participants: Modeling Effort

(Just lead PI's on the grants - many others also involved)

- Maria Flatau, NRL-Montery
- Sue Chen, NRL-Monterey
- Toshiaki Shinoda, NRL-Stennis
- Tommy Jensen, NRL-Stennis

COAMPS
NRL Coupled Model
- COAMPS (atmos)
- NCOM (ocean)
- SWAN (waves)

- Art Miller, UCSD/Scripps
- Raghu Murtuguude, University of Maryland
- Hyodae Seo, WHOI

SCOAR
SIO Coupled Model
- RSM (atmos)
- ROMS (ocean)

•Eric Skyllingstad, Oregon State

LES Modeling of the ABL

END

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