DYNAMO
(Dynamics of the MJO)

The US Participation in CINDY2011

(Cooperative Indian Ocean Experiment on Intraseasonal Variability in Year 2011)

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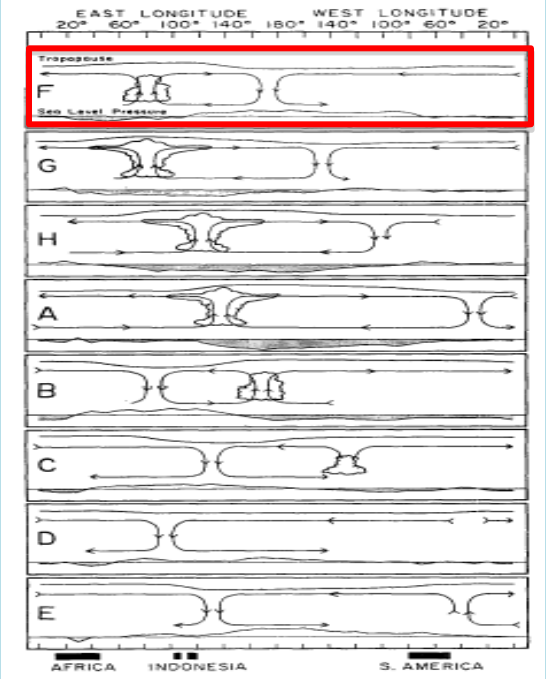


Hypotheses on MJO Initiation

A Dynamical (or external) Initiation: Perturbations from either the extratropics or upstream (west) lead to changes in the large-scale circulation and/or thermodynamics over the tropical Indian Ocean. Deep convection subsequently organizes into large-scale patterns that feed back to the large-scale circulation, giving rise to the MJO.

B Convective (or local) Initiation: The MJO is initialized over the tropical Indian Ocean through local interaction between the large-scale circulation and convective activity that self-organizes into large-scale patterns through atmospheric energy buildup, multi-scale interaction, air-sea interaction, or other processes.

Scientific Rationale for DYNAMO/CINDY2011

• Hypothesis testing and model improvement requires continuous and simultaneous time series of
– *tropospheric heating and moistening profiles*
– *structures and evolution of cloud and precipitation systems (shallow, deep, stratiform)*
– *air-sea fluxes, turbulence and mixing in the atmospheric boundary layer and upper ocean*
which are available only from field campaigns;

• No such time series in the equatorial Indian Ocean region is currently available

After TOGA COARE, Why DYNAMO?

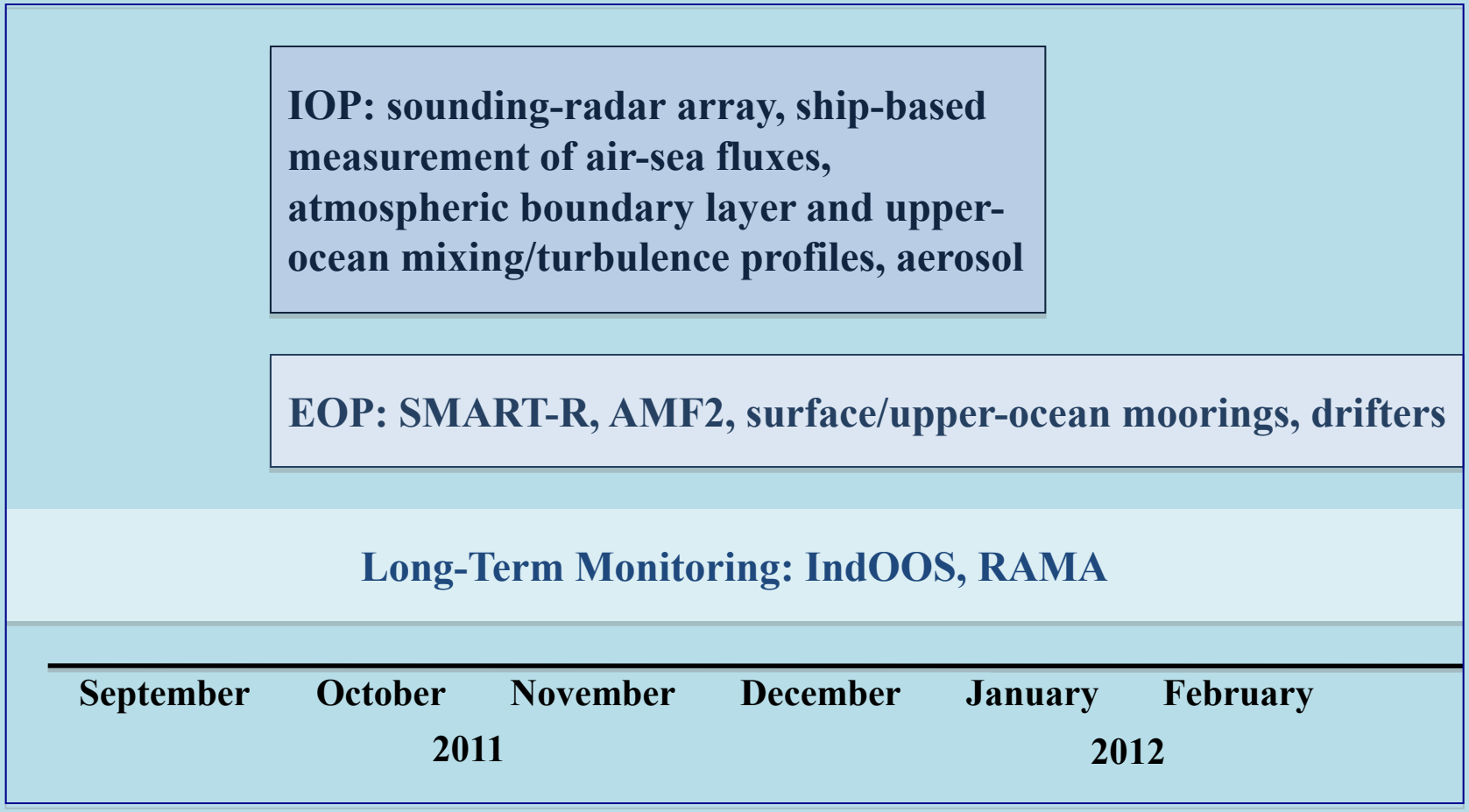
- Unique MJO life stage (initiation vs. propagation)
- Unique large-scale background (South Asian monsoon and Seychelles-Chagos thermocline dome vs. warm pool)
- Unique climate modeling challenge (in some GCMs: weak or no MJO vs. moderate MJO)
- Unique prediction challenge (very low skill vs. low skill)

CINDY2011 Observation Strategy

Intensive Observation Period (3-4 months): Sounding-Radar Array (a triangle option illustrated)

Extended Observation Period (6 months) : an island radar-sounding site, enhanced RAMA moorings, drifters

Long-Term Monitoring: RAMA, IndOOS, operational soundings

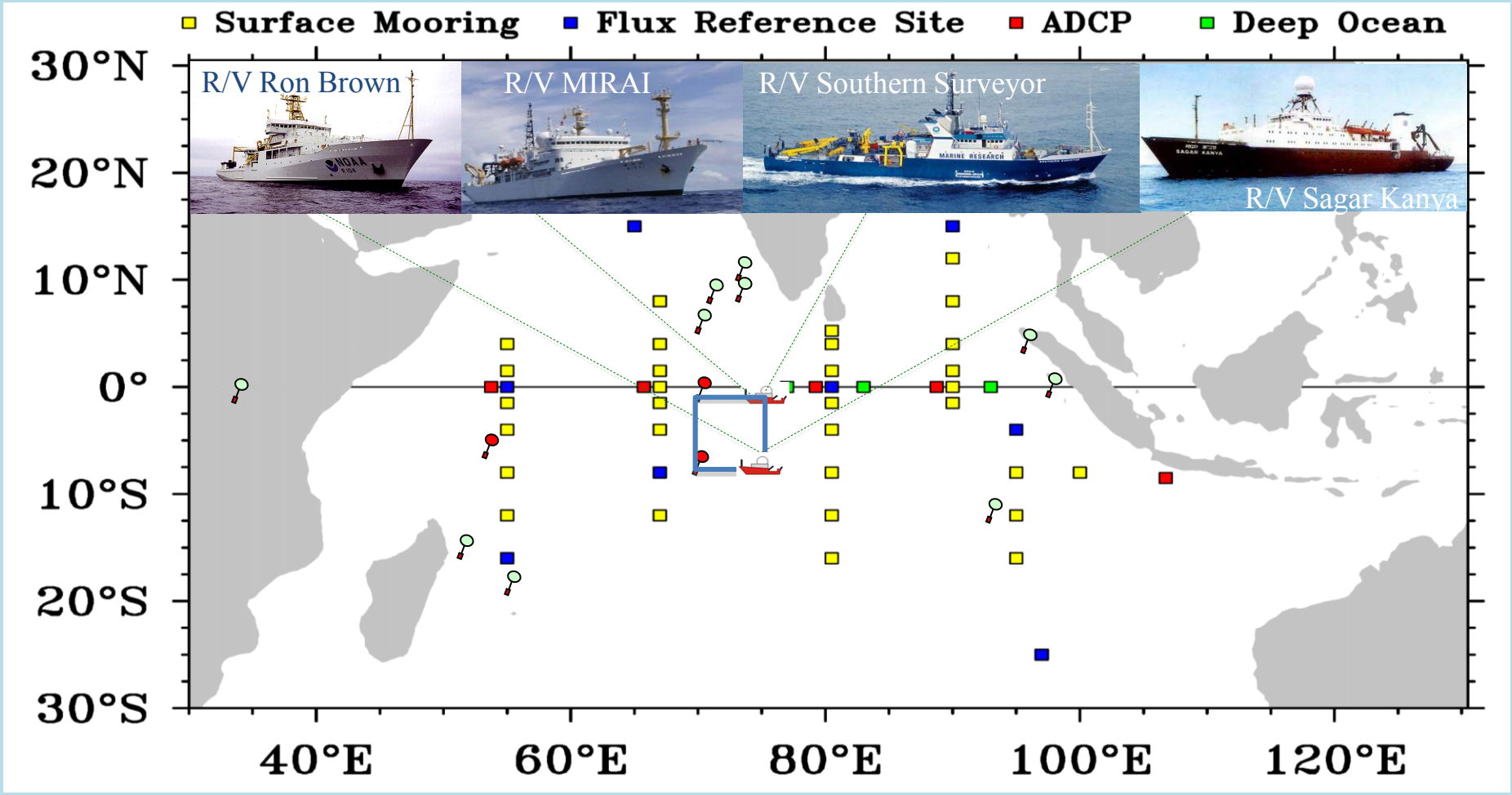


DYNAMO/CINDY2011 IOP:

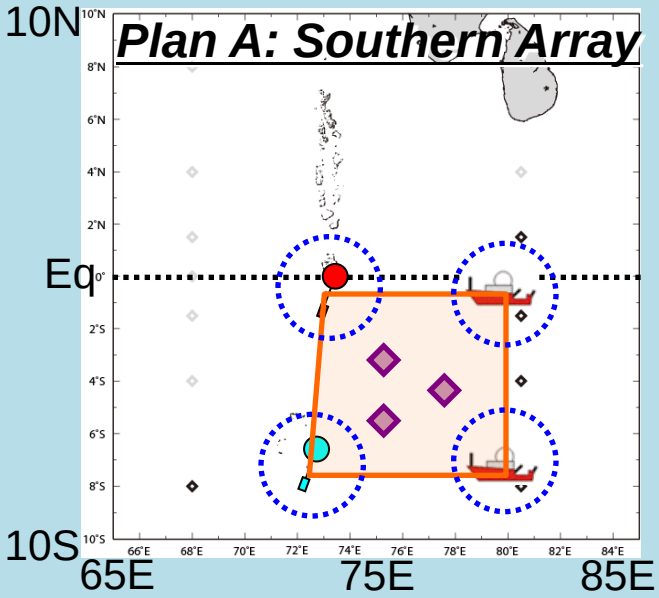
• sounding-radar array (**unsolved issues**: US ship time, availability of Diego Garcia, triangular vs. rectangular)

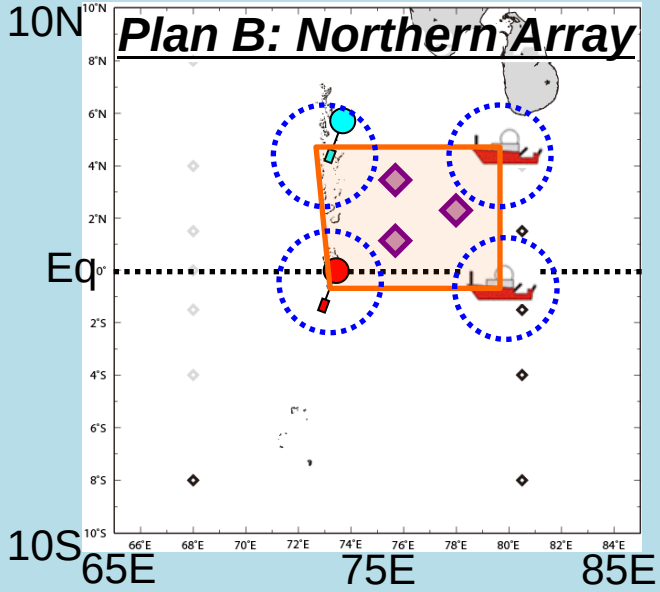
• ship-based measurement of air-sea flux, atmospheric boundary-layer and upper-ocean mixing and turbulence

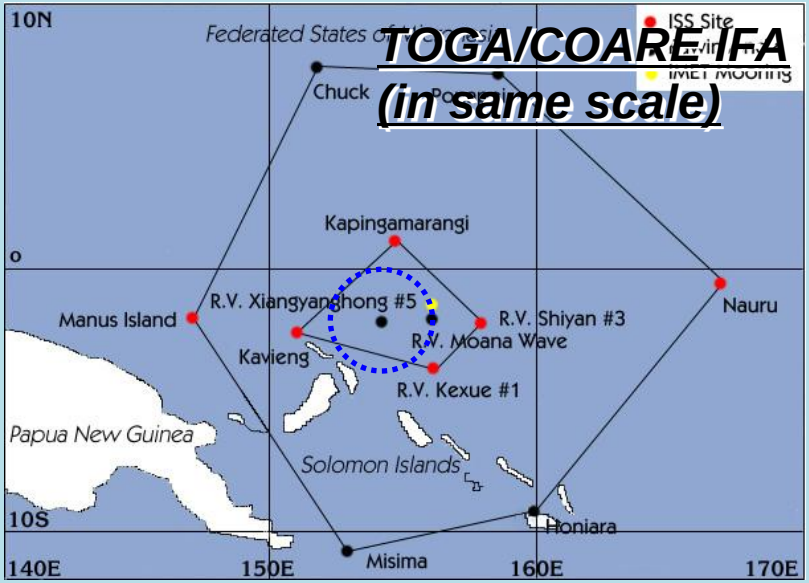
• enhanced soundings at operational sites

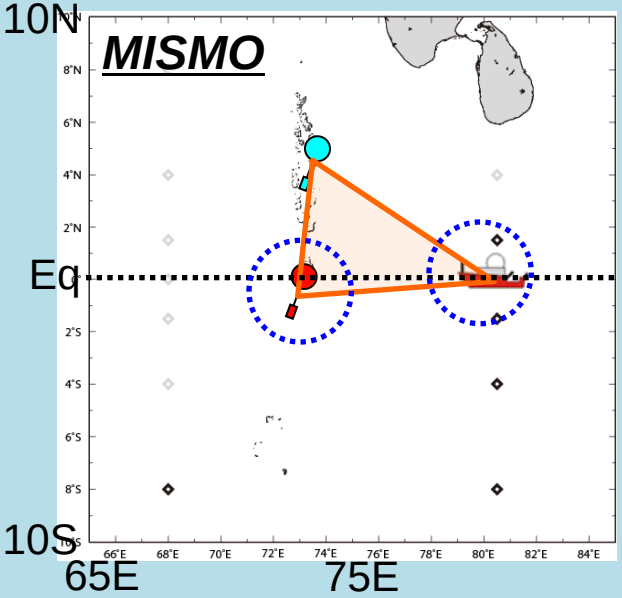


Proposed Sounding-Radar Array









Vessel with special sounding

Island with operational sounding

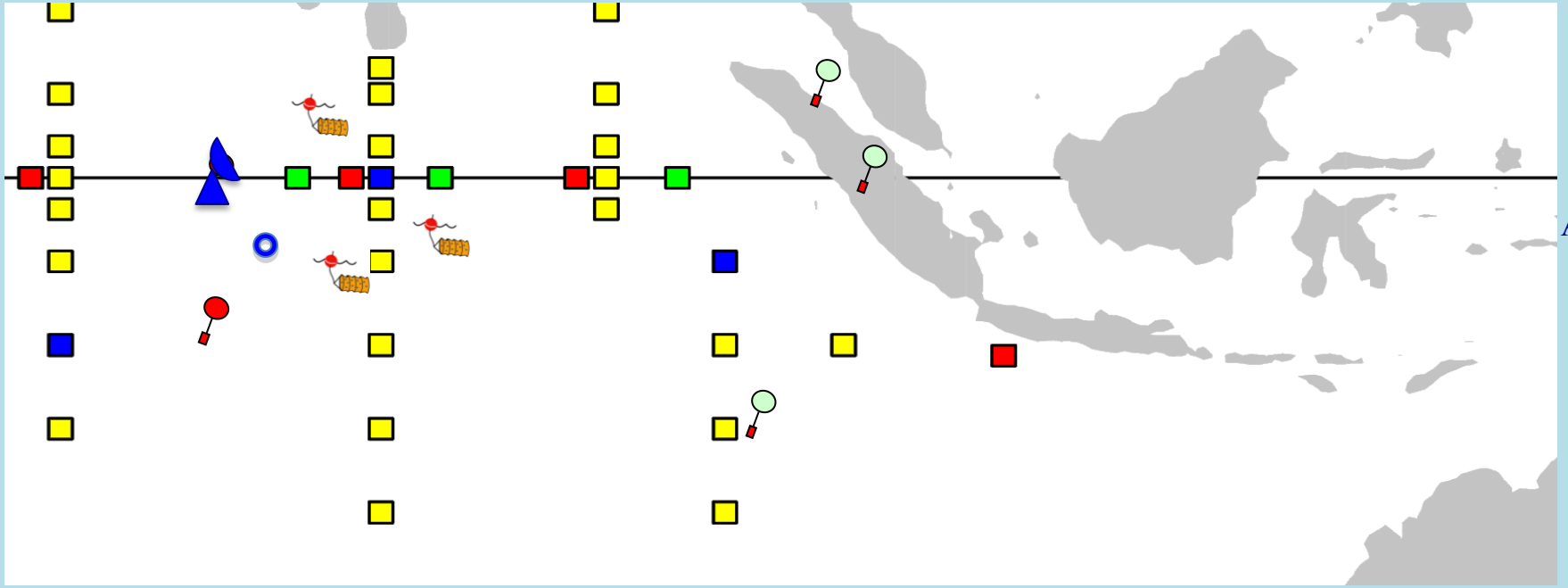
Island with special sounding

Possible radar coverage (r=200km)

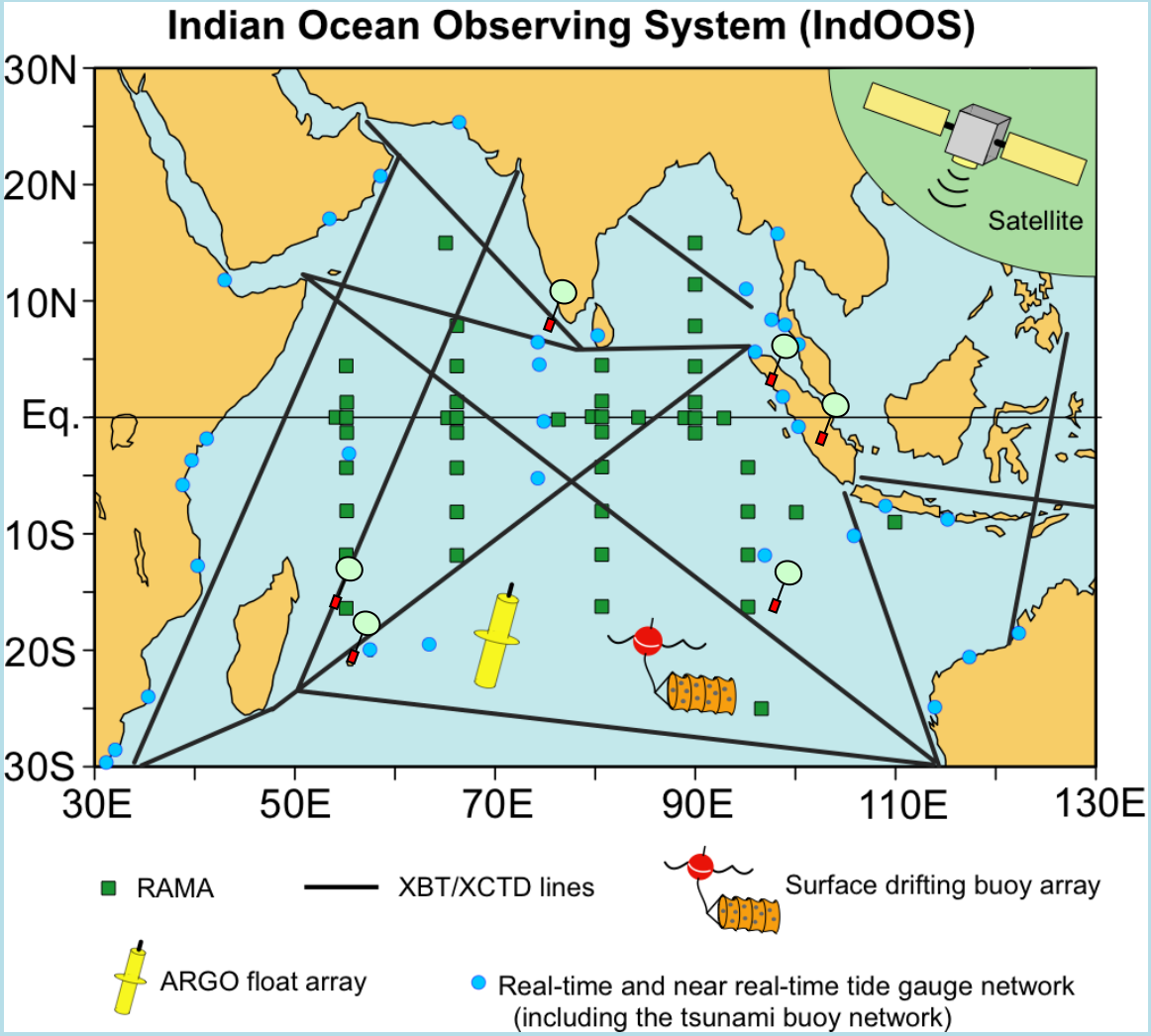
Raingauges (moored / float)

DYNAMO/CINDY2011 EOP:

- SMART C-band radar + AMF2
- surface met and upper ocean moorings
- drifters



Long-Term Monitoring in the Indian Ocean



Program Synergy

AMIE (late 2011 – early 2012): radiation, cloud, atmospheric profiles

HARIMAU (2004 - ?): cloud, atmospheric boundary layer

PAC^{3}E-SA/7SEAS (2011): aerosol, convection

ONR Air-Sea (late 2011): meso-scale air-sea-wave interaction

CINDY2011/DYNAMO (September 2011 – January 2012): atmospheric heating and moistening profiles, cloud and precipitation, air-sea interaction, aerosol

Expected Outcome of DYNAMO

(i) a unique in situ data set available to the broader research and operations communities, whose utility will match GATE and TOGA COARE data;

(ii) advancement in understanding of the MJO dynamics and initiation processes;

(iii) identification of misrepresentations of processes key to MJO initiation that are common in models and must be corrected to improve MJO simulations and predictions;

(iv) provision of baseline information to develop new physical parameterizations and quantify MJO prediction model improvements, and

(v) enhanced MJO monitoring and prediction capacities that deliver climate prediction and assessment products on intraseasonal timescales for risk management and decision making.

DYNAMO Climate Implications

- Field data to be collected will be available to all climate modeling centers;
- Research results from DYNAMO and the MJO CPT will provide targeted information for model improvement (entrainment/detrainment rates, precipitation efficiencies, heating profiles, etc.);
- Improved MJO capability may help dynamical ENSO prediction;
- **Improved MJO capability in climate models will build up our confidence in their fidelity.**