Northern Arabian Sea Circulation Autonomous research (NASCar)

Air-sea interaction in the Arabian Sea: Improving ocean and atmospheric forecasts

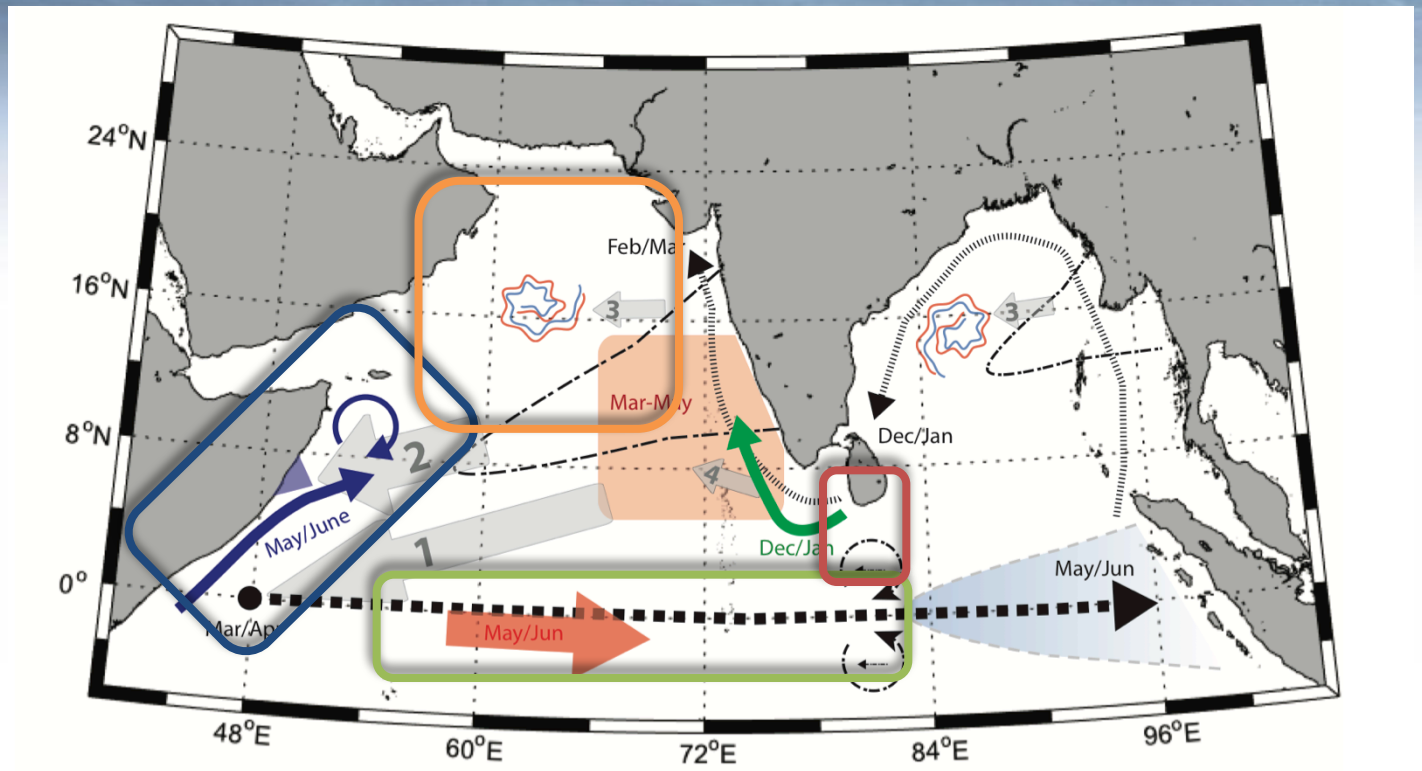
- Strong atmospheric forcing and ocean response
- Frequent and strong occurring SST anomalies
- Dynamics of seasonal-reversing currents
- Piracy has limited modern observations for many years

Need for improved atmosphere/ocean predictions

- Densely populated area affected by the monsoon
- Navy operations and civilian navigation in the region

Major fieldwork 2017 – now mostly in analysis phase

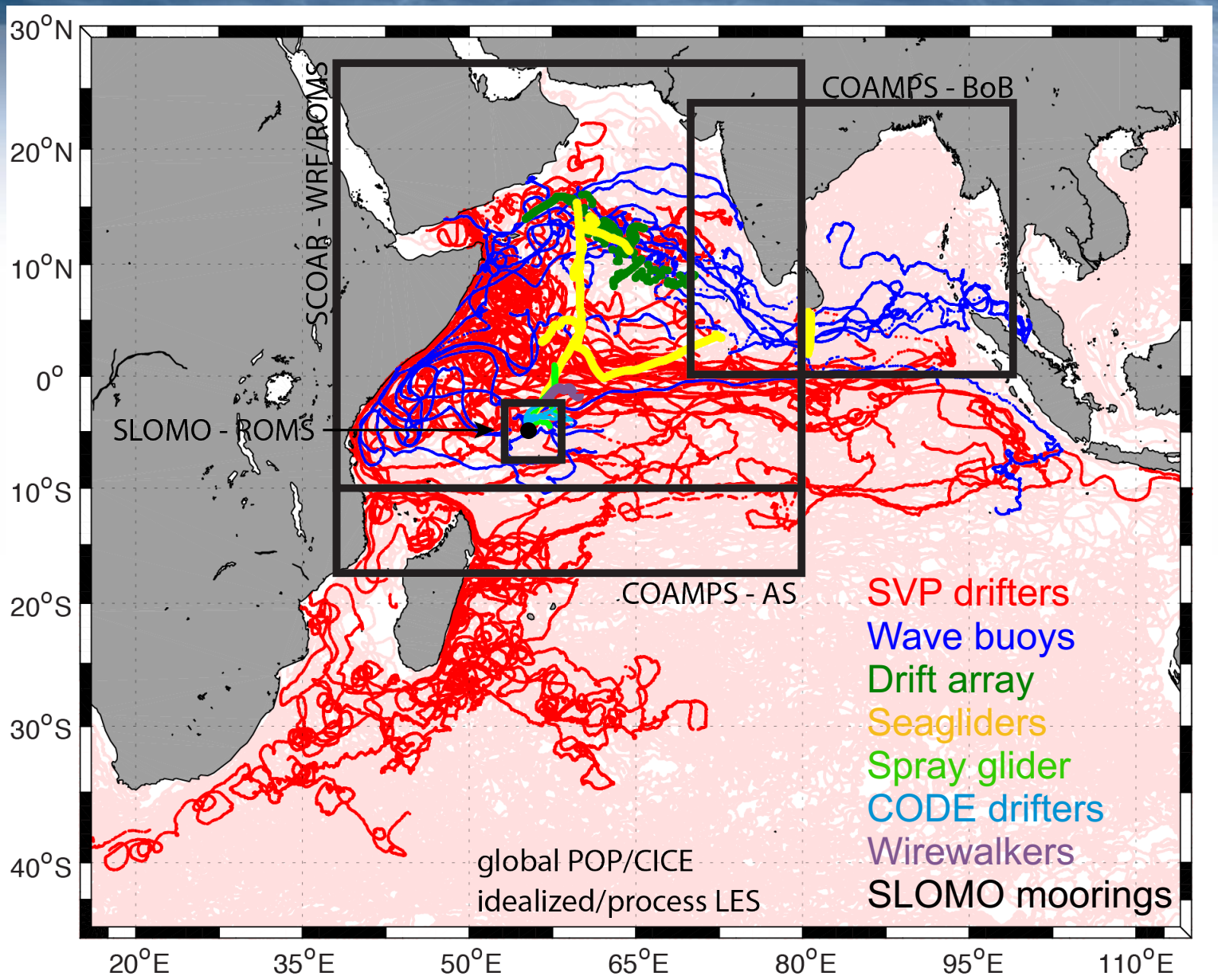
NASCar regional foci



NASCar addresses the accessibility and basic research gap with

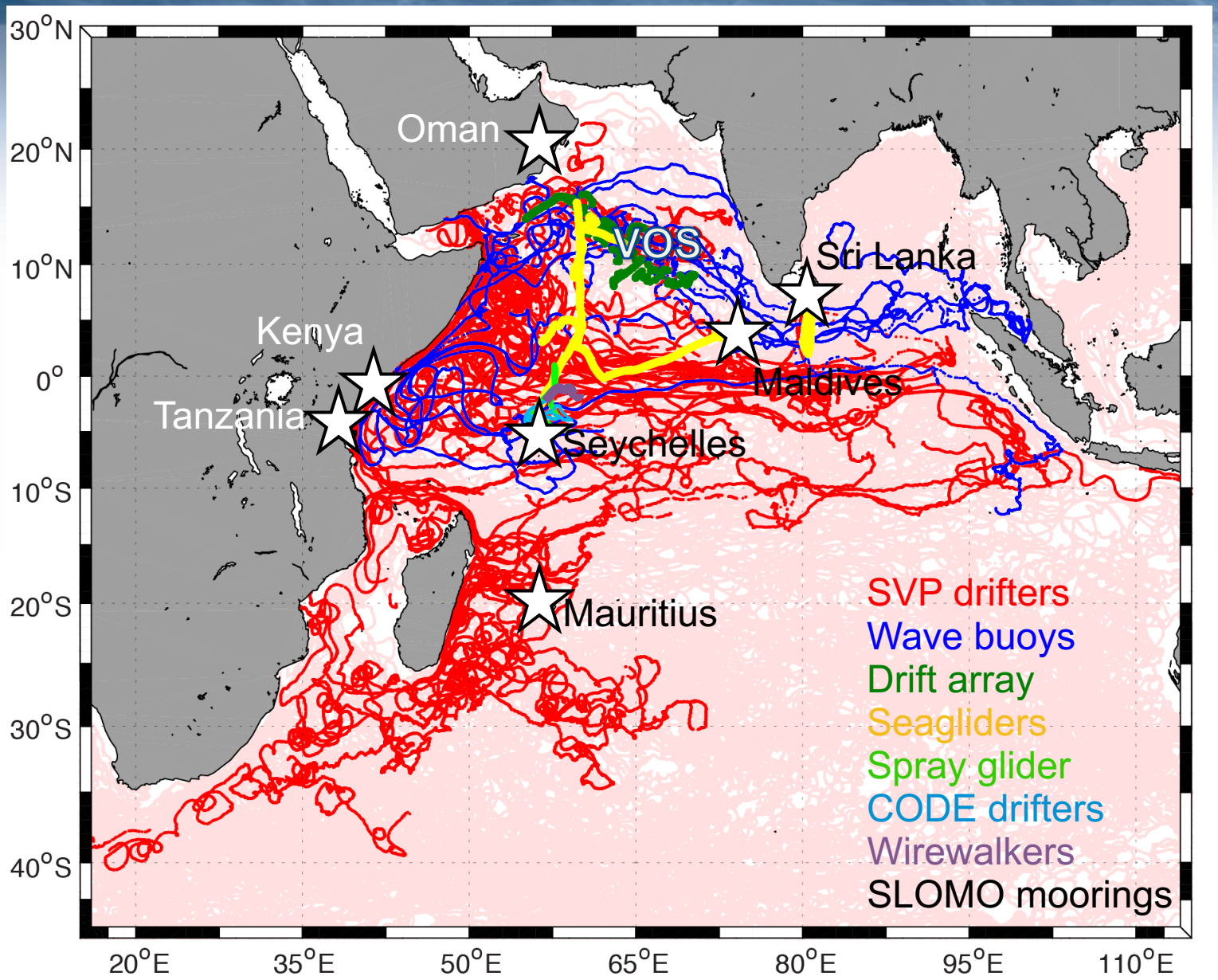
- **state-of-the-art dedicated autonomous assets**
- **remote sensing**
- **numerical models**

NASCar assets deployed



NO RVs

Partnerships

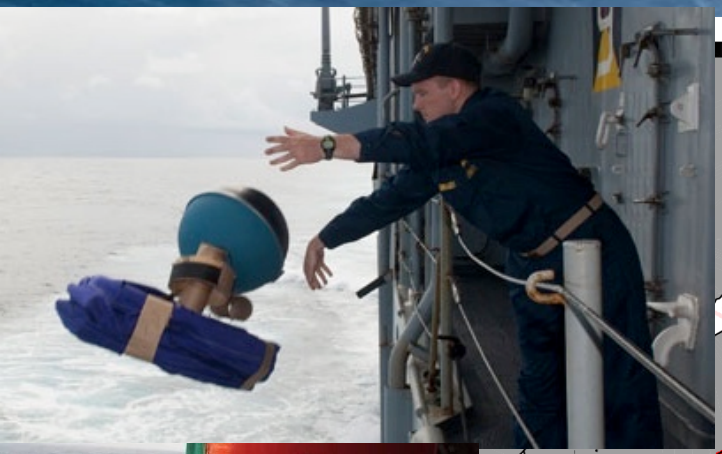


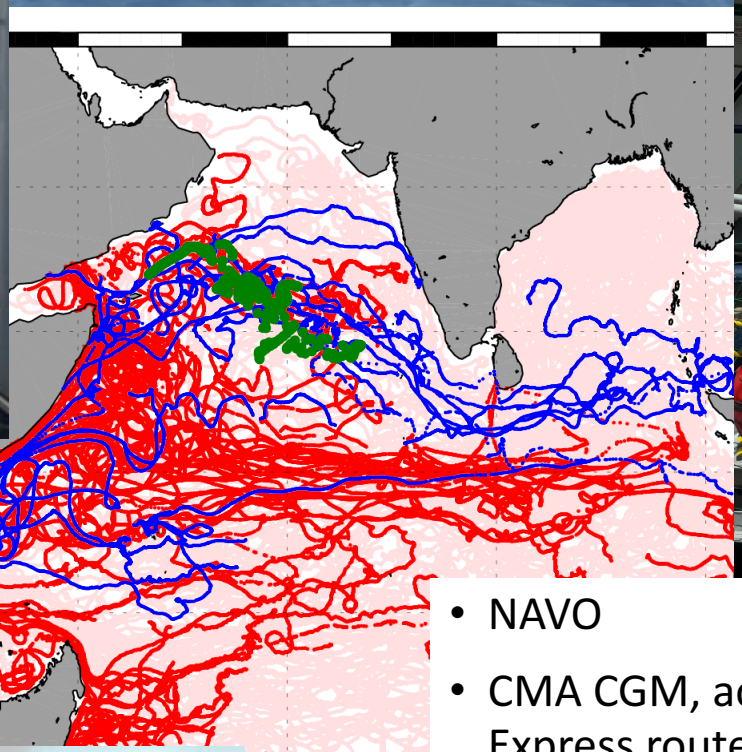
Partnerships - Seychelles

Thanks to Sarah Giddings

- Better Life Foundation (NGO)
- Seychelles National Meteorological Service
- Seychelles Fishing Authority
- Seychelles Coast Guard
- Small Island Developing States Youth AIMS Hub
- Global Vision International
- University of the Seychelles
- Seychelles Maritime Academy

Partnerships – Voluntary Observing Ships (VOS)

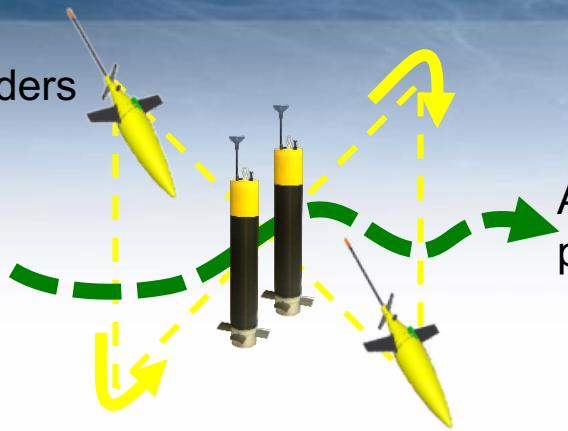




- NAVO
- CMA CGM, access to the Swahili Express route (M/V La Tour, thanks to JCOMOPPS and METEOFrance, Brest Office, for facilitation of CMA CGM)
- American President's Line (APL, M/V Dublin / Sentosa)
- Australian Navy
- Semester at Sea

Coordinated Lagrangian drift (4 March – 23 April 2017)

Seagliders

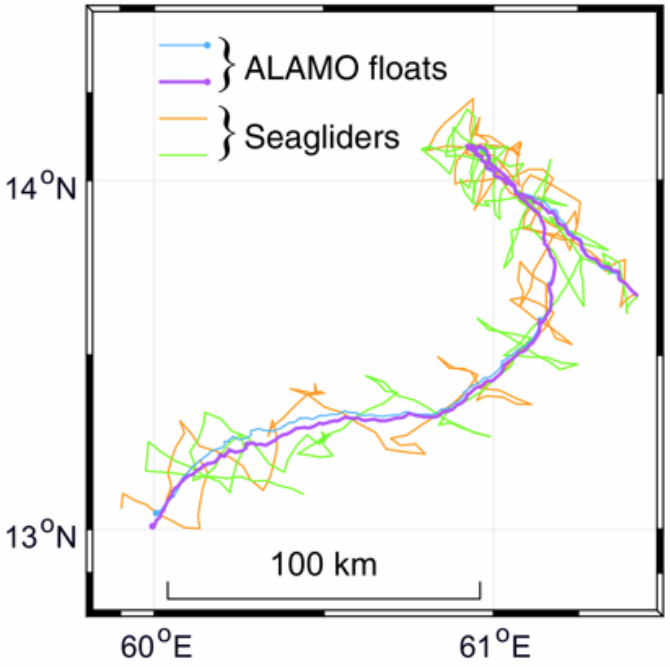


ALAMO profiling floats

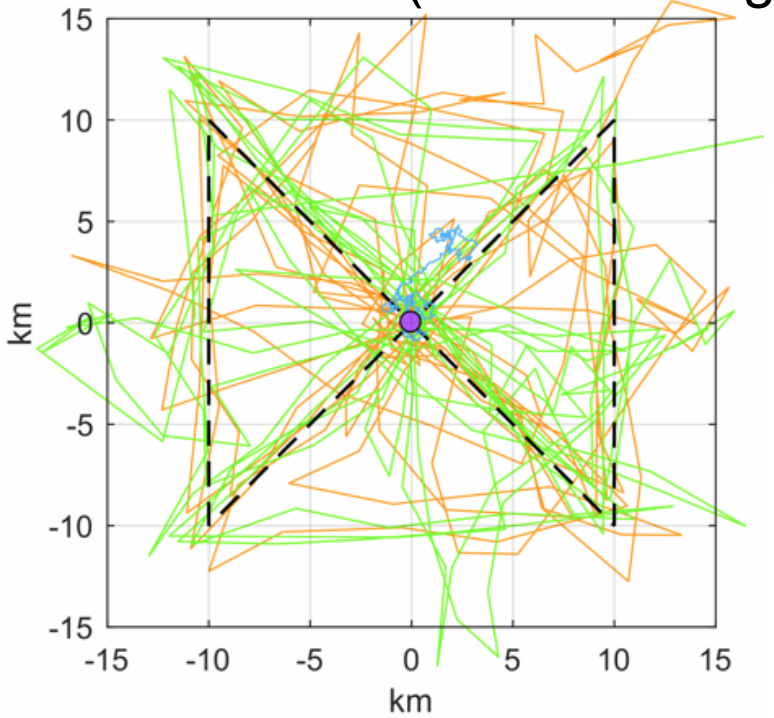
SVP drifters

APEX profiling floats

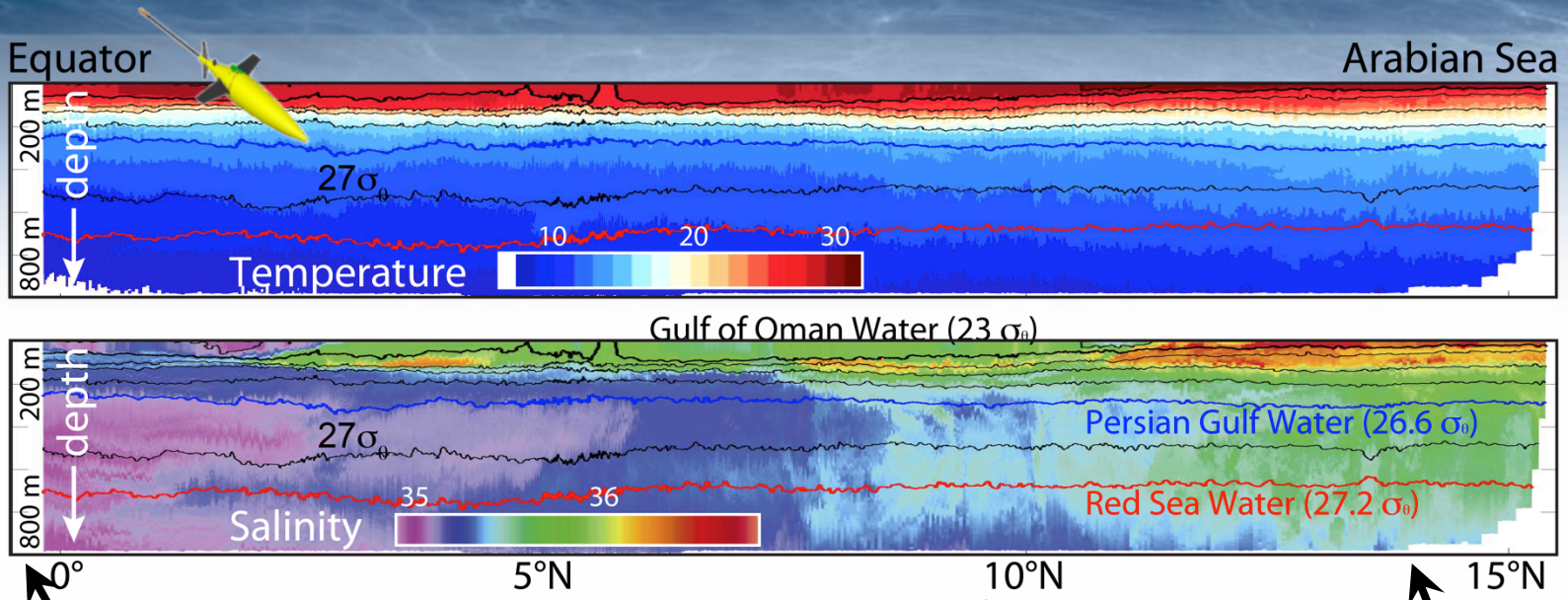
geographic coordinates



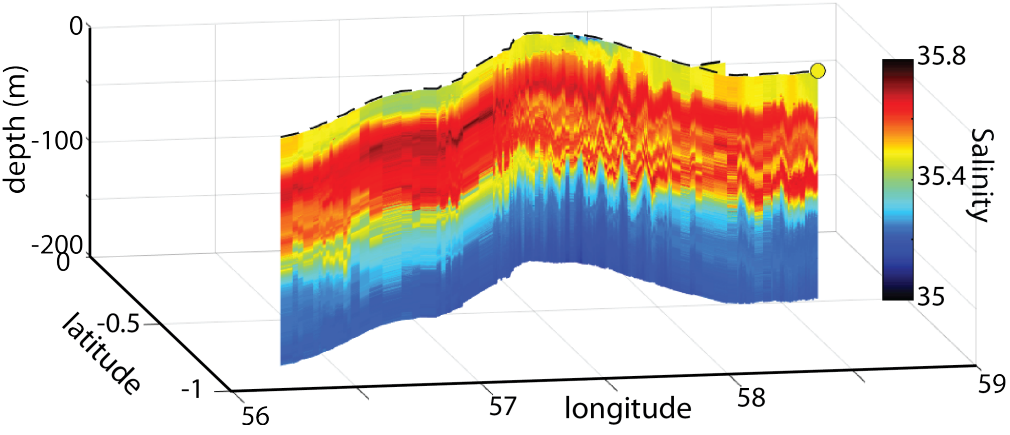
reference frame following the ALAMO floats (flow-following)

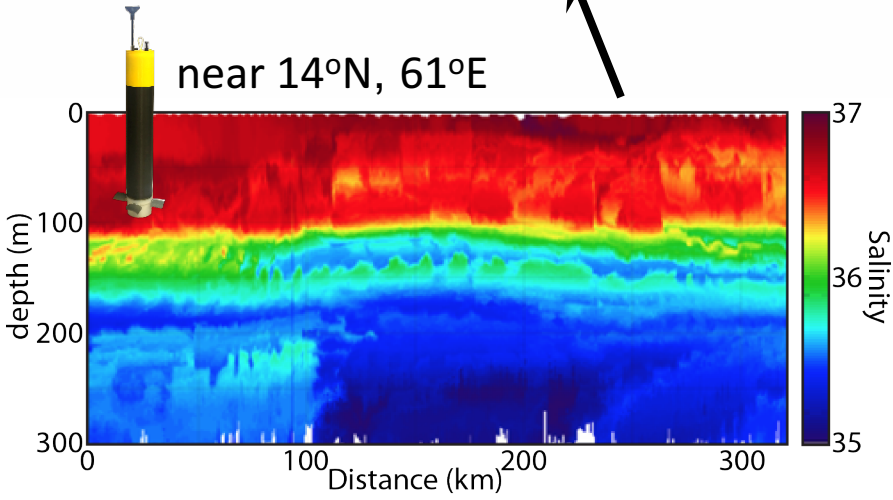


Thermohaline Structure



Wirewalker track near equator





Complex thermohaline structure in a restratifying mixed layer

Achievements

Developing coordination with NAVO and advancing a **network of international partnerships** and collaborations

Developing new technologies and sampling strategies - testing new capability for unattended "intelligent" navigation and cooperation of a fleet of unmanned systems

Autonomous observations are used to map time-evolving oceanic structure - temperature, salinity, density, mixed layer variability, frontal structures, and as inputs to data assimilation

- Thermohaline structure – interleaving salinity structures
- Coastal circulation – Somail Current/ Great Whirl / upwelling wedges
- Basin circulation – PV structure, Rossby waves, and BoB exchange

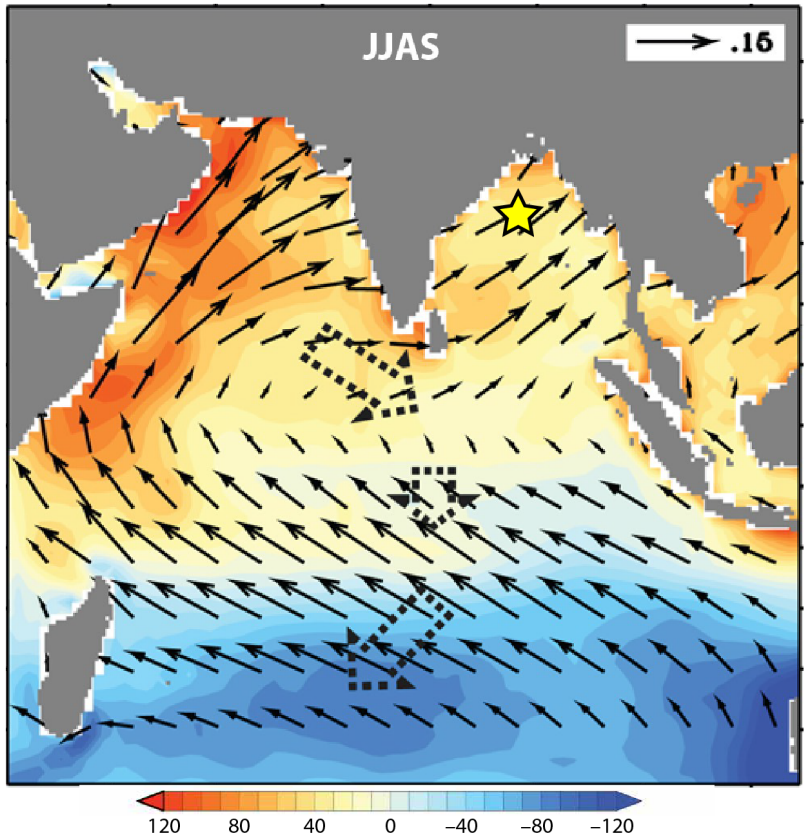
Developing **environmental predictive capabilities** in an inaccessible region

MISO-BoB

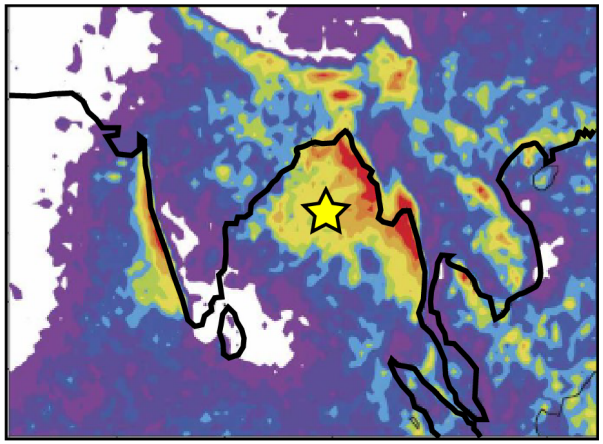
Oceanic Control of Monsoon Intra-seasonal Oscillations in the Tropical Indian Ocean and the Bay of Bengal

Strongest rain and convective heating in **Summer Monsoon** is centered in the Northern Bay of Bengal
These play a large role in driving the monsoon

Wind Stress & Heat Flux



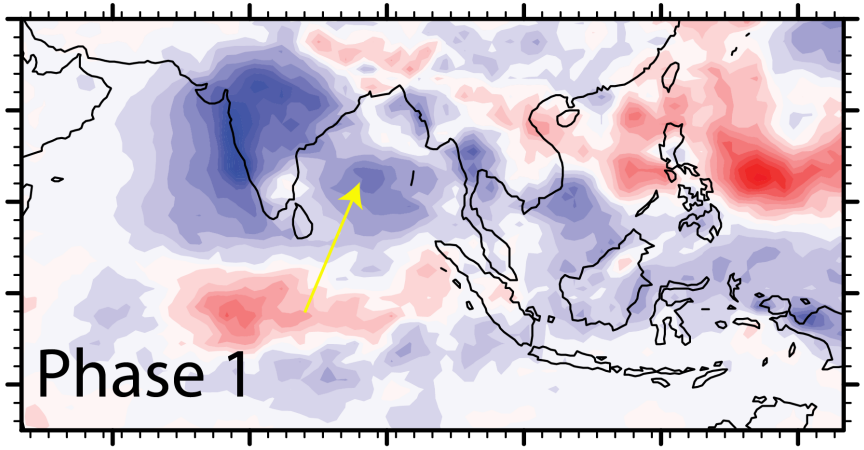
Precipitation

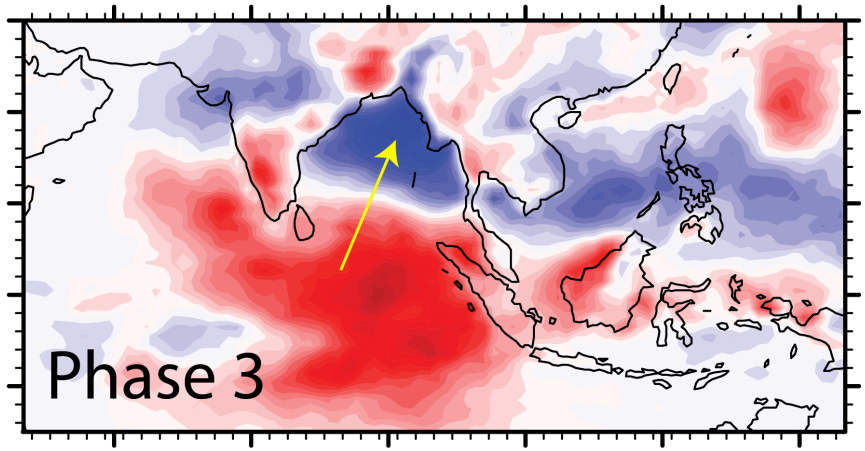


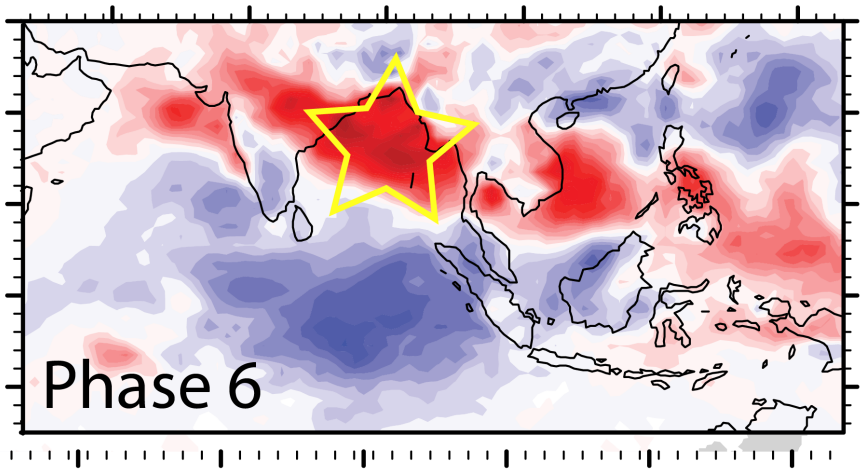
MISO Precipitation Anomaly cycle

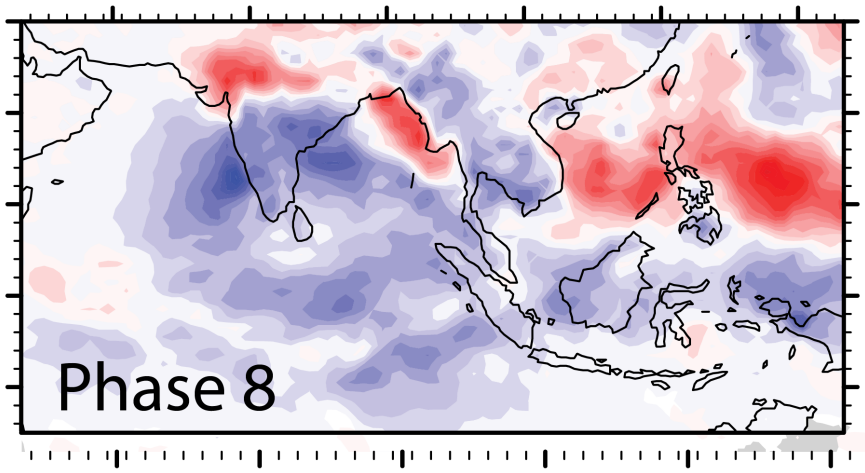
Propagate northward @ ~ 1m/s
30-60 day cycle

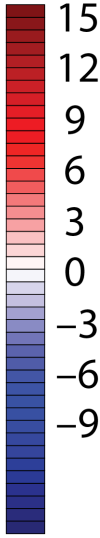
Also concentrated in
Bay of Bengal
(& not at mountains)





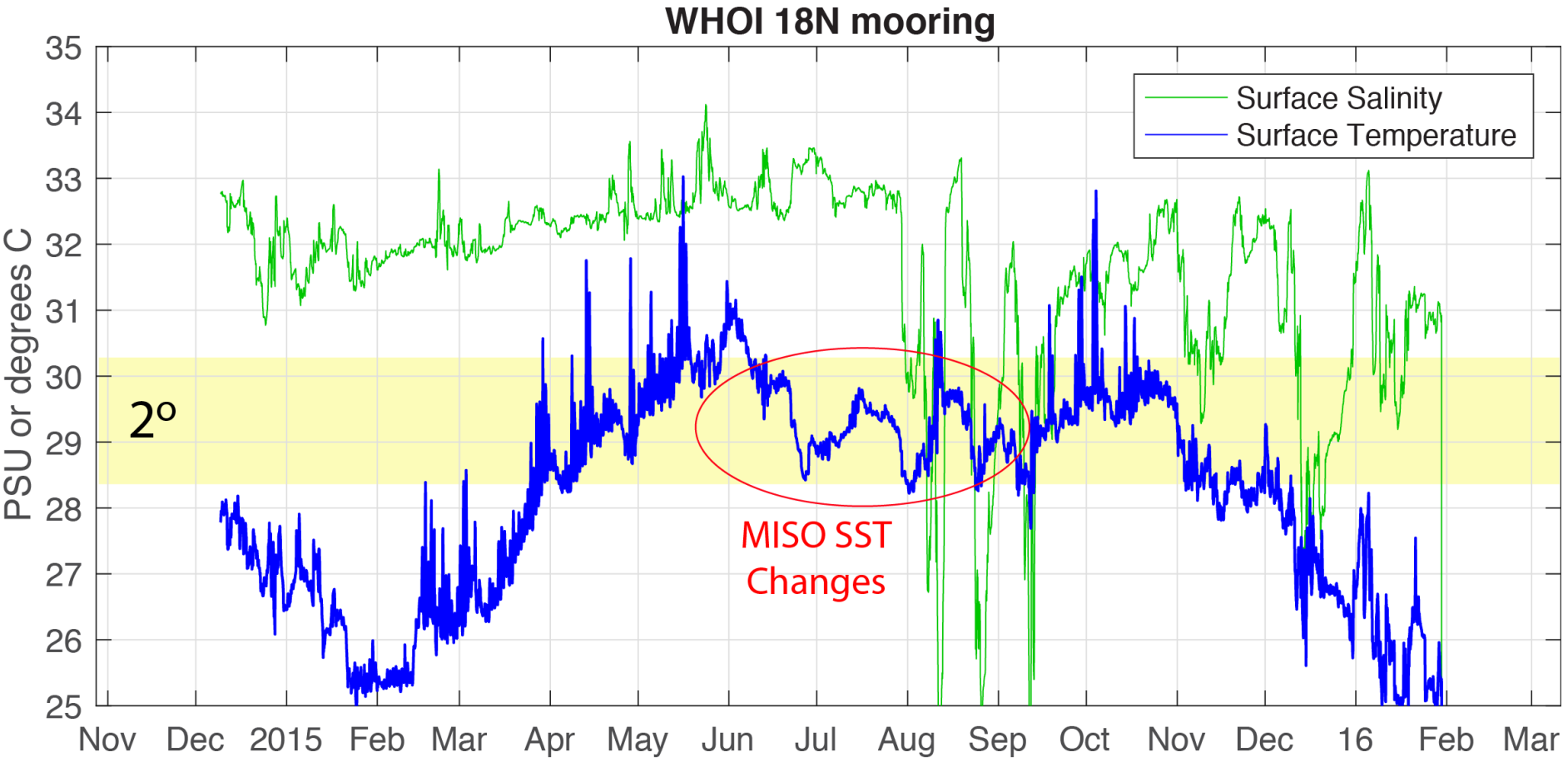






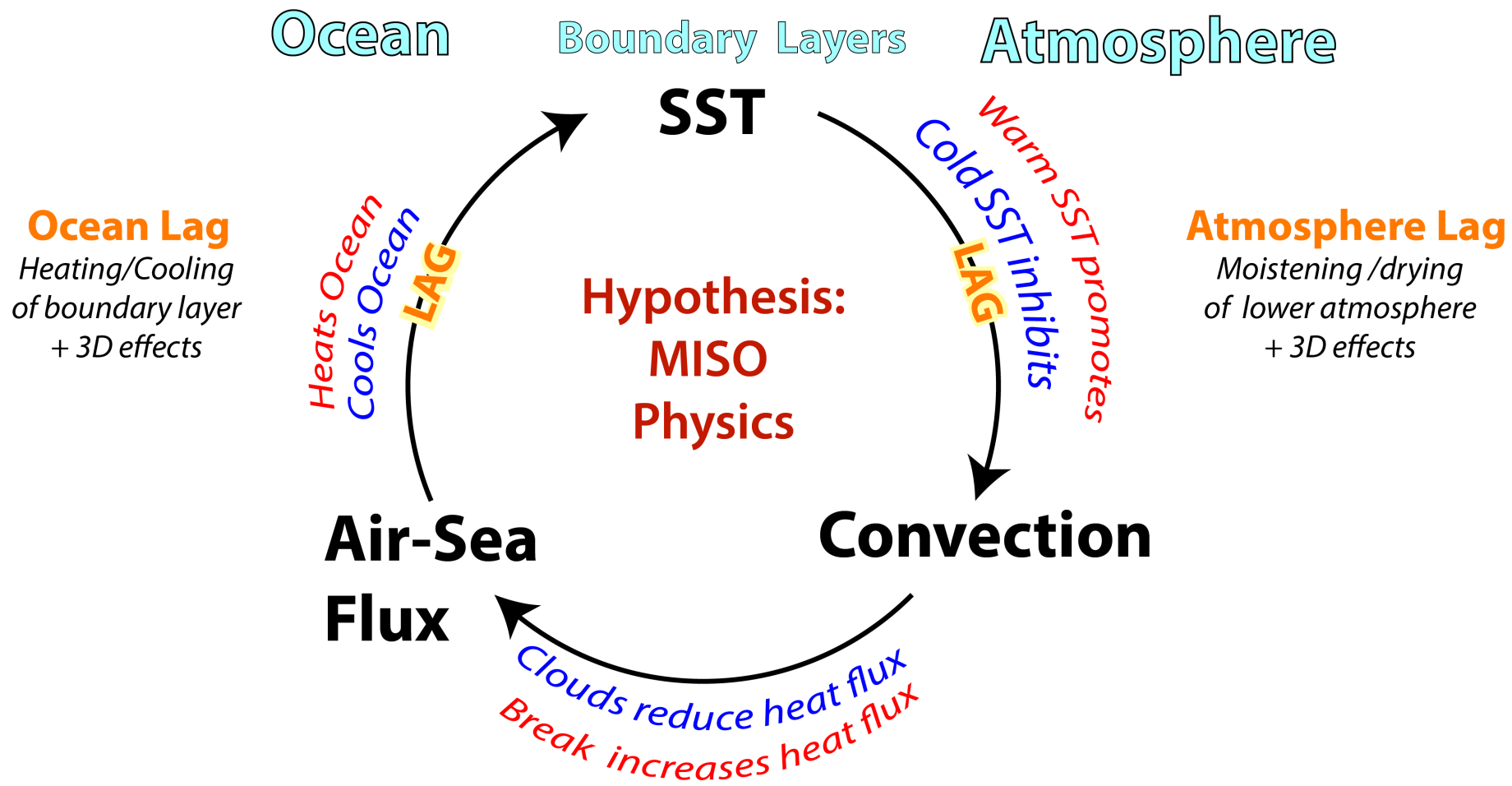
Eight phase composites of precipitation (mm / day) from the Tropical Rainfall Measuring Mission (TRMM) satellite based on the MISO1 and MISO2 indices (Suhas et al., 2013) indicating the evolution of the monsoon intraseasonal oscillations (MISOs) and their northward propagation. (modified here)

The oceanographic problem



Understand MISO SST changes!

Ocean-Atmosphere Feedback with Time Lags



MISO BoB

Anticipated field activities

Bay of Bengal 2018-2019

- Ocean SST response to monsoon variations
  Ocean boundary layer & air-sea flux physics
- Monsoon responses to ocean SST variations
  Atmospheric boundary layer & convective physics
- Program is collaborative with India, and, Sri Lanka
  Cruises, moorings, floats, gliders, drifters
  Oceanographic and coupled models