

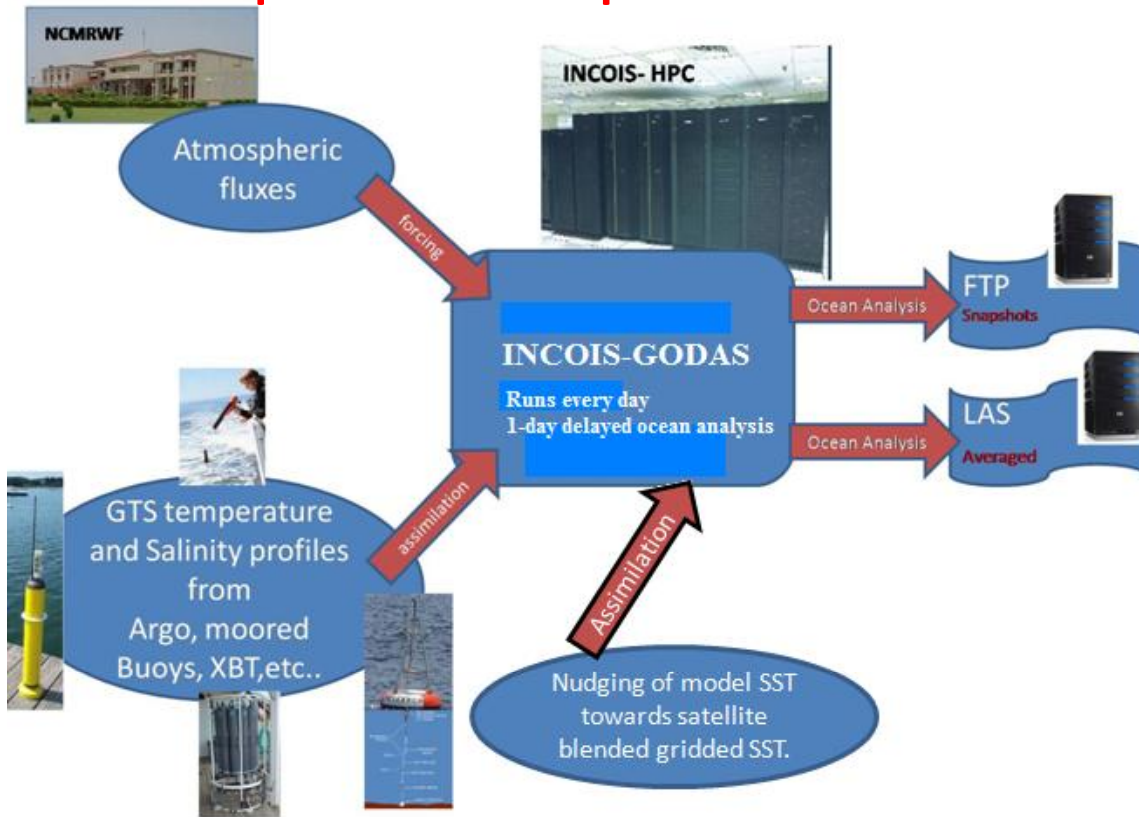
# Applications of Ocean Data Assimilation Systems

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## Operational set up of INCOIS-GODAS



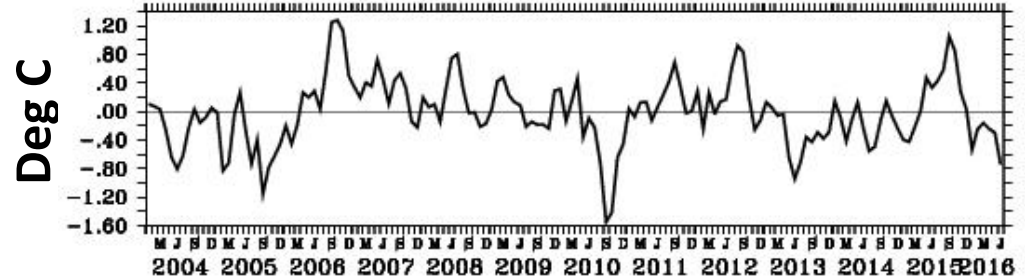
For more info: <http://www.incois.gov.in/portal/GODAS>

# Applications in the pure operational sense

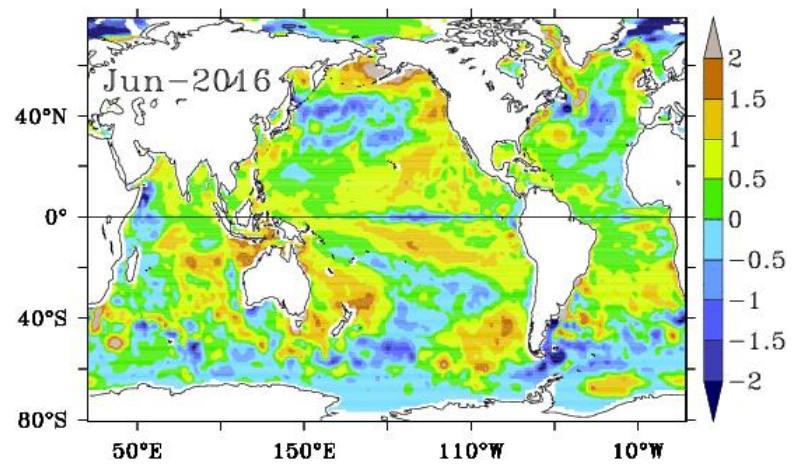
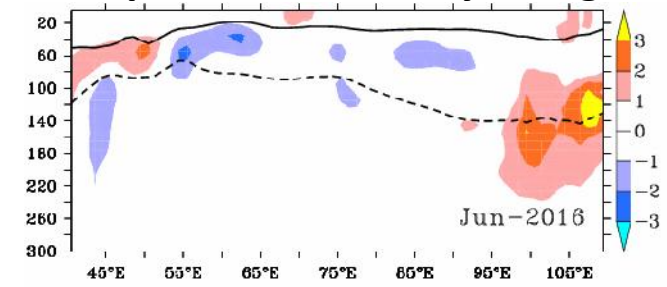
- Ocean Initial and boundary conditions improves 5-day ROMS ocean forecasts
- Ocean initial conditions provided to IITM, Pune for CFS-V2 improves seasonal prediction of monsoon
- Global maps of TCHP, SST and SST anomalies provided to IMD improves cyclone intensity and track

# Applications with regard to ensuing Climate phenomena

**IOD index**

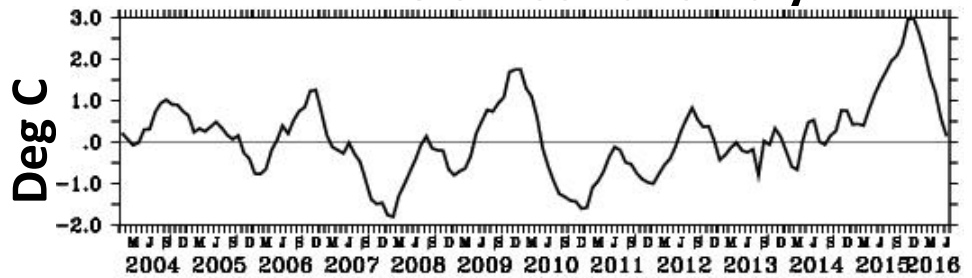


**Temperature anomaly along 5S**

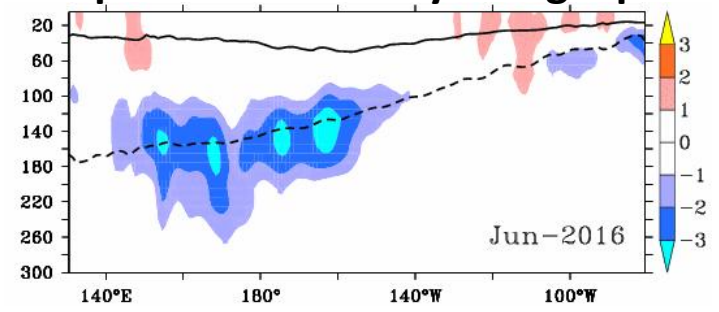


**SST (degC) anomaly**

**NiNO 3.4 SST anomaly**



**Temperature anomaly along Equator**



# Ocean Re-analysis for Research

- Ocean re-analysis from SODA, helped Vijay et al., 2015 to find a new link in the Atlantic Ocean that influences Indian summer monsoon rainfall
- Vertical variation of oxygen isotope in BoB and its relationships with water masses were examined by Sengupta et al. (2013) using ocean re-analysis from INCOIS-GODAS
- Upper ocean thermal features during tropical cyclones over BoB were studied by Ramu et al., (2012) using ocean re-analysis from INCOIS-GODAS

# Advocacy in the design and maintenance of ocean observations

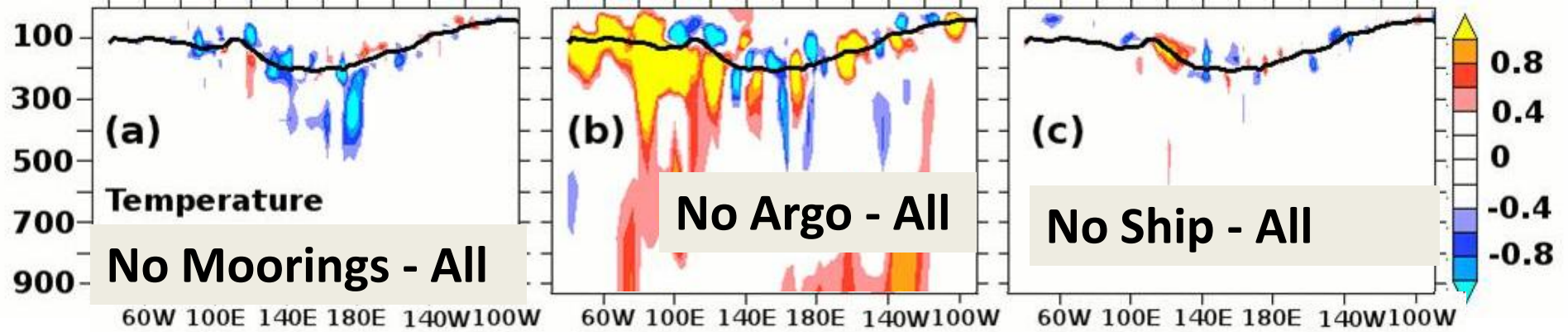
- Observation System Evaluation experiments (OSEs)
  - Uses real observations
  - Can provide quantitative assessments on the loss/gain due to the addition/denial of an observation of interest
- Observation System Simulation Experiments (OSSEs)
  - Uses virtual observations
  - Advocates the design of future observation networks, resolutions etc.

# OSEs: Methodology

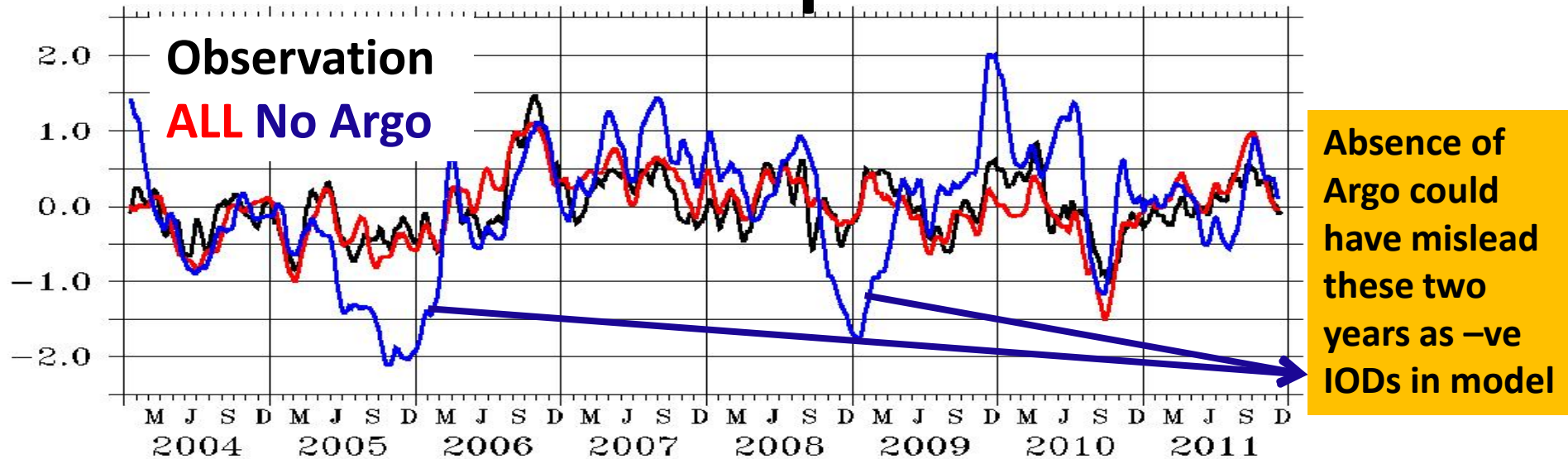
- Choose state-of-the-art assimilation system. It must represent the ocean phenomena of interest at satisfactory level.
- Conduct a reference experiment (ALL) in which all (e.g. XBTs, CTDs, Buoys, Argo etc) observations (real) are assimilated. Usually this is the default configuration of the fore-mentioned state-of-the-art assimilation system.
- Conduct a data denial (e.g. No Argo) experiment in which all observations are assimilated except the observation in query
- Compare results from data denial (e.g. No Argo) and reference (ALL) experiment to know the impact of denied observation (e.g. Argo)

# OSEs: An example

Mean difference along Equator in October 2008 between data denial and reference experiment



## Indian Ocean Dipole index



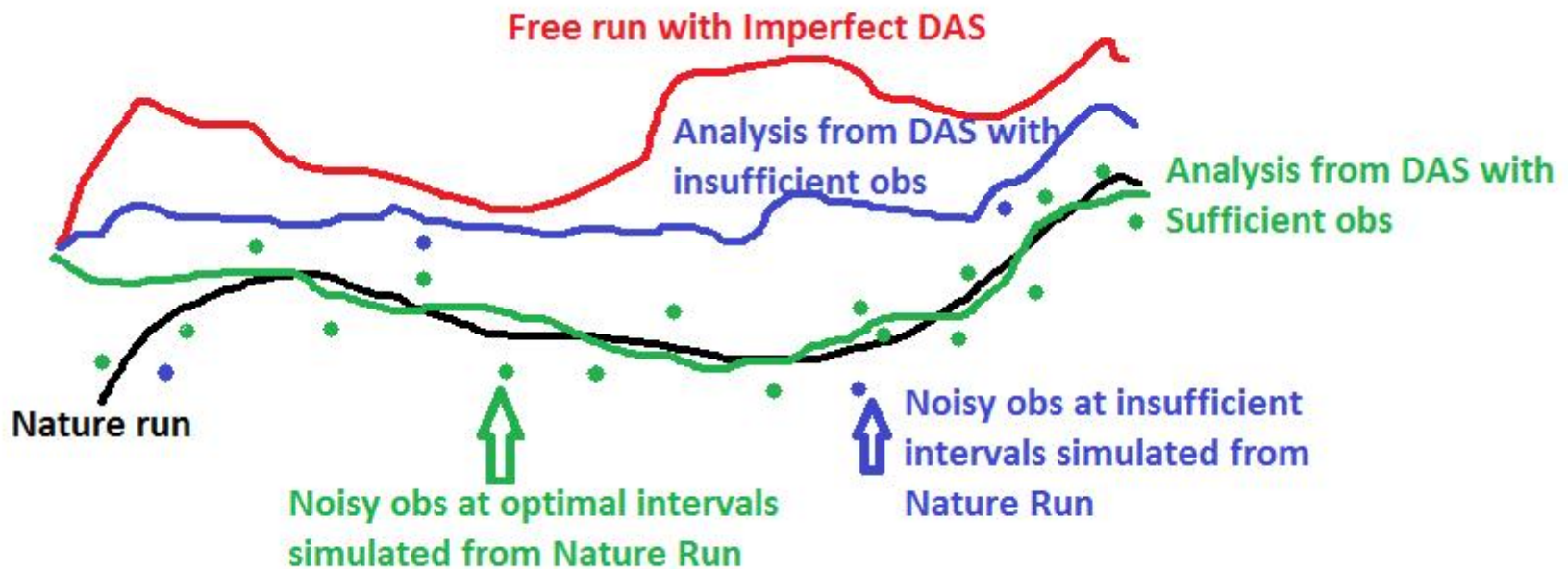
# OSSEs: Methodology and guidelines

There are three major components in OSSEs

- 1. Nature Run, the virtual world:** Usually this is from a state-of-the-art model that best represents the real world
- 2. Virtual observations** sampled/simulated from Nature Run. These observations should have noise levels close to the real observations.
- 3. Imperfect model coupled with data assimilation:** The background model should contain the variability's of the virtual world. One should make sure it is sufficiently different (not too different) from the Nature run.
  - One can opt the model used to create Nature run by tweaking the model physics, initial conditions, boundary conditions etc. This approach is close to identical twin OSSEs
  - One can opt a different DAS in the fraternity. For example, use ECMWF model for Nature and NCEP-DAS under imperfect model. This approach is called Fraternal twin OSSEs



# Schematic Representation of OSSE



Thank you

# OSSE flow diagram

