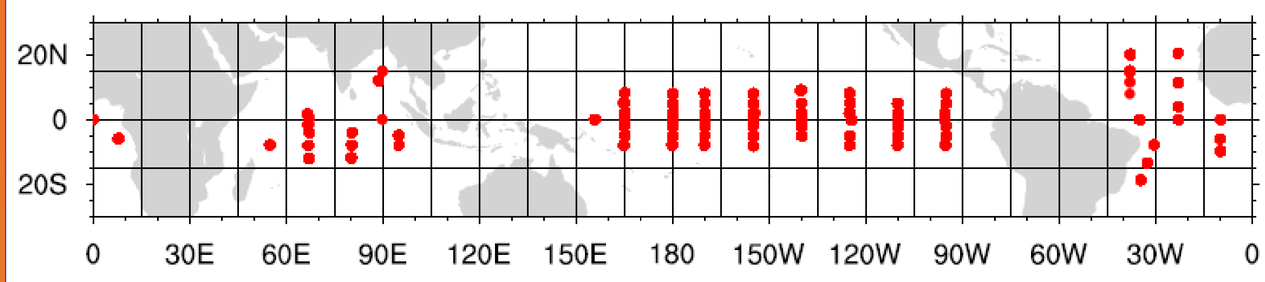
SYMPOSIUM OP'24 ADVANCING OCEAN PREDICTION SCIENCE FOR SOCIETAL BENEFITS

Observing System Experiments Focusing Monsoon Prediction

Over 10,000 Argos have been deployed by various nations under Global Ocean Observing System out of around 3,900 Argos are operating over world ocean. Considering their vast coverage, it is assumed that Argos are sufficient for ocean observations. The present study highlights the importance of tropical moored buoy observations for the seasonal prediction of Indian Summer Monsoon.

Design of OSE Experiments



Moored buoy observations excluded in Exp-2

Monsoon Mission Model: Seasonal Prediction

Atmospheric Model
GFS
T382 L64 levels

Land Model NOAH | Ice Model

COUPLER

Ocean Model
MOMv4
global
1/2°x1/2° (1/4° in tropics)
40 levels

INITIAL CONDITIONS FROM GSI

Initial conditions for Hindcast runs are obtained from CFSR

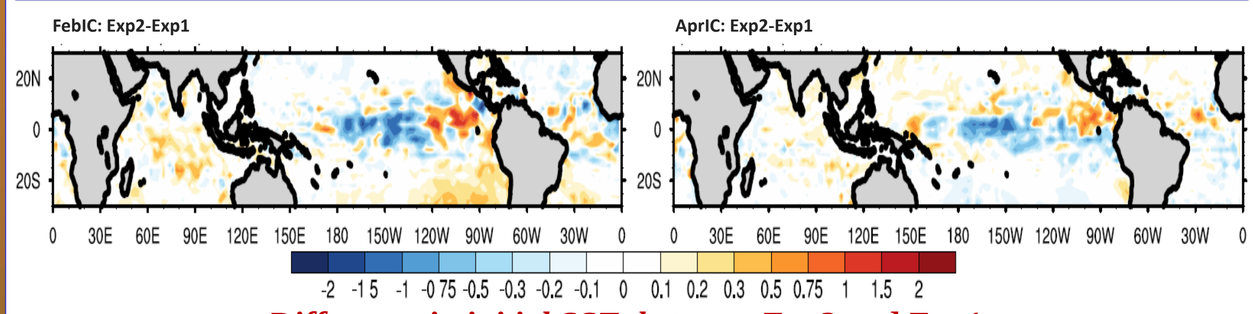
OCEAN INITIAL CONDITIONS FROM GODAS (INCOIS/IITM)

(Original model is adopted from NCEP)

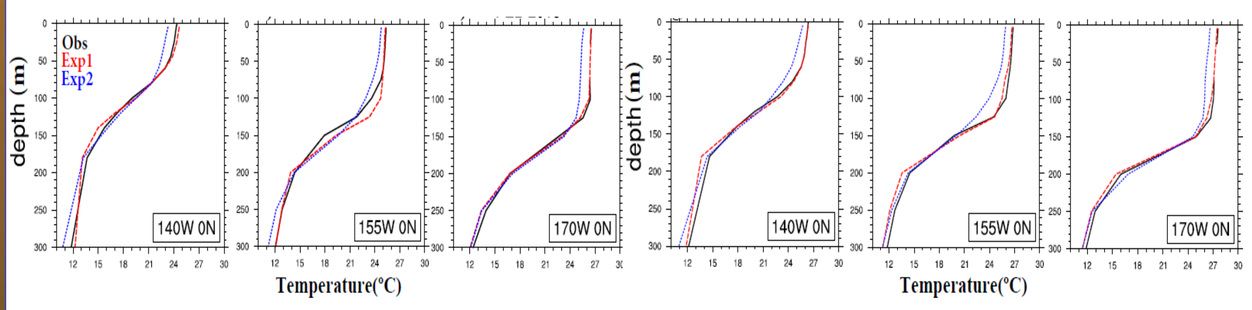
Case Year 2018 which is an extreme year for monsoon rainfall (Observed ISMR= 9.0% below long-term average)

- Exp-1: *Ocean analysis with all observations assimilated*
  Seasonal Forecasts based on same Feb and Apr IC
- Exp-2: *Ocean analysis **excluding** tropical moored buoys*
  Seasonal Forecasts based on same Feb and Apr IC
- Ocean Assimilation System: ***INCOIS GODAS***
- Atmospheric Assimilation System: N***CMRWF GDAS***
- Coupled Forecast : ***CFSv2 at T382 (~38km horizontal): Monsoon Mission***

Errors in Ocean Analysis



Difference in initial SSTs between Exp2 and Exp1



Vertical profiles of ocean temperature in Exp1 Exp2 and reanalysis.

- In absence of moored buoy observations, the assimilated surface and subsurface temperatures are cooler (by 1-1.5 degrees) over central tropical Pacific.
- The cold temperature biases are consistent in both February and April Initial conditions; however, it is weak in April initial conditions.

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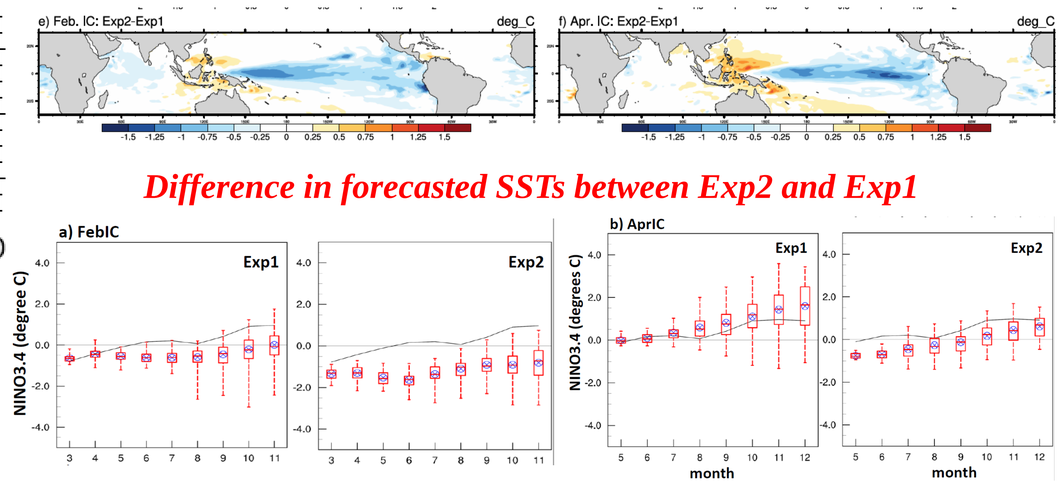
Errors in Ocean Forecast



Difference in forecasted SSTs between Exp2 and Exp1

Box-Whisker: Forecasted Niño3.4 SST anomalies depicting ensemble statistics

- In absence of moored buoy observations, the forecasted surface temperatures are cooler (by 1-1.25 degrees) over equatorial Pacific.
- The presence of moored buoys not only corrects the phase and magnitude of anomalies but also increase the spread across ensembles.

Errors in Ocean Forecast

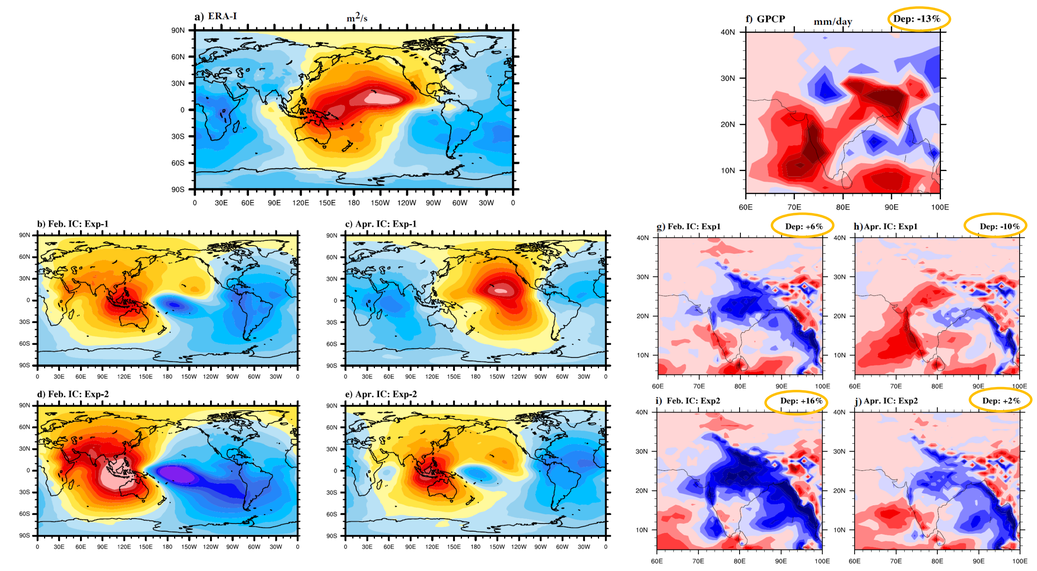
Exp1 FebIC	JJA	JAS	ASO	SON	Exp1 AprIC	JJA	JAS	ASO	SON
>2.5					>2.5				16
1.5:2.5					1.5:2.5		5	44	55
0.5:1.5					0.5:1.5	61	83	50	22
-0.5:0.5	41	58	66	75	-0.5:0.5	38	11	5	5
-1.5:-0.5	58	41	33	25	-1.5:-0.5				
-2.5:-1.5					-2.5:-1.5				
<-2.5					<-2.5				

Exp2 FebIC	JJA	JAS	ASO	SON	Exp2 AprIC	JJA	JAS	ASO	SON
>2.5					>2.5				
1.5:2.5					1.5:2.5				
0.5:1.5				2	0.5:1.5		1	5	21
-0.5:0.5		10	14	25	-0.5:0.5	36	55	71	67
-1.5:-0.5	72	72	72	55	-1.5:-0.5	63	42	23	11
-2.5:-1.5	25	17	10	14	-2.5:-1.5				
<-2.5	2		2	2	<-2.5				

Probability forecast: Niño3.4 SST anomalies

- Probability forecasts of Niño3.4 index also has larger error and suggested weak La-Niña condition when moored buoy observations are not assimilated.
- In presence of moored buoy, the forecasts are realistic and indicated weak El-Niño conditions.

Errors Monsoon Forecast



Scaled Velocity Potential Anomalies at 850 hPa (m^2/s) Rainfall Anomalies (mm/day)

- Erroneous low-level convergence (divergence) over Indian landmass and Indian Ocean (central Pacific) in absence of buoy observations
- By assimilating buoys circulation has improved with divergence over India.
- Positive (Negative) rainfall anomalies in absence (presence) of buoys.

Conclusion:

Without moored buoy observations being assimilated (keeping all other observations intact), ocean initial conditions, ocean forecasts and monsoon forecasts are adversely affected.

Ocean Predict In partnership with unesco Intergovernmental Oceanographic Commission

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