



# Seasonal forecast skill of the Indian monsoon in GFDL high-resolution forecast system

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## Objectives

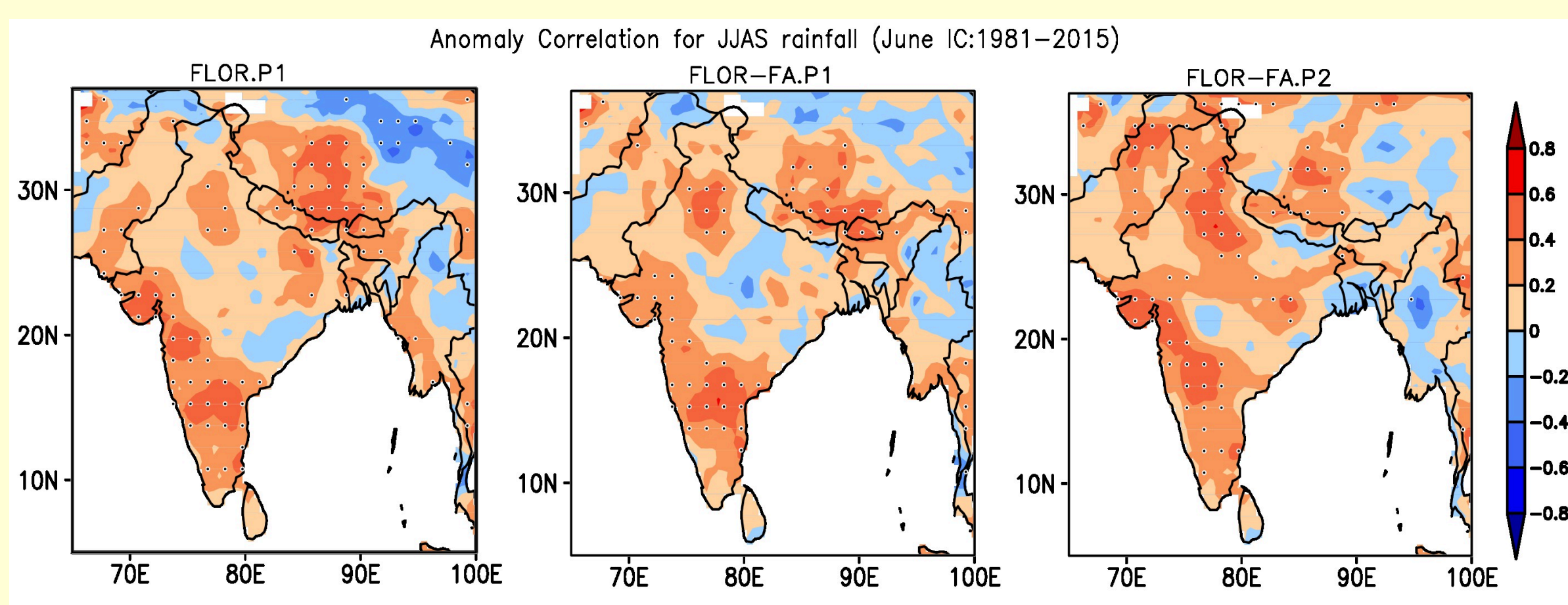
- Accurate prediction of the Indian summer monsoon is of utmost importance considering its socio-economic impacts over the subcontinent.
- Thus, we analyze seasonal forecast skill of the Indian monsoon rainfall during JJAS season based on June initialized forecasts.
- We also investigate the role of the tropical Pacific and Indian Ocean SSTs in accurate prediction of summer monsoon rainfall over India.

## Forecasts

- Observed rainfall, SST and OLR are derived from CRU, OISST and NOAA interpolated OLR, respectively.
- We make use of JJAS seasonal forecast data from below models initialized in June for the period 1981-2015.

	Atmos ICs	Ocean ICs
FLOR P1	AMIP run forced with observed SSTs	ECDA
FLOR-FA P1	AMIP run forced with observed SSTs	ECDA
FLOR-FA P2	FLOR nudged to MERRA winds and observed SSTs	ECDA

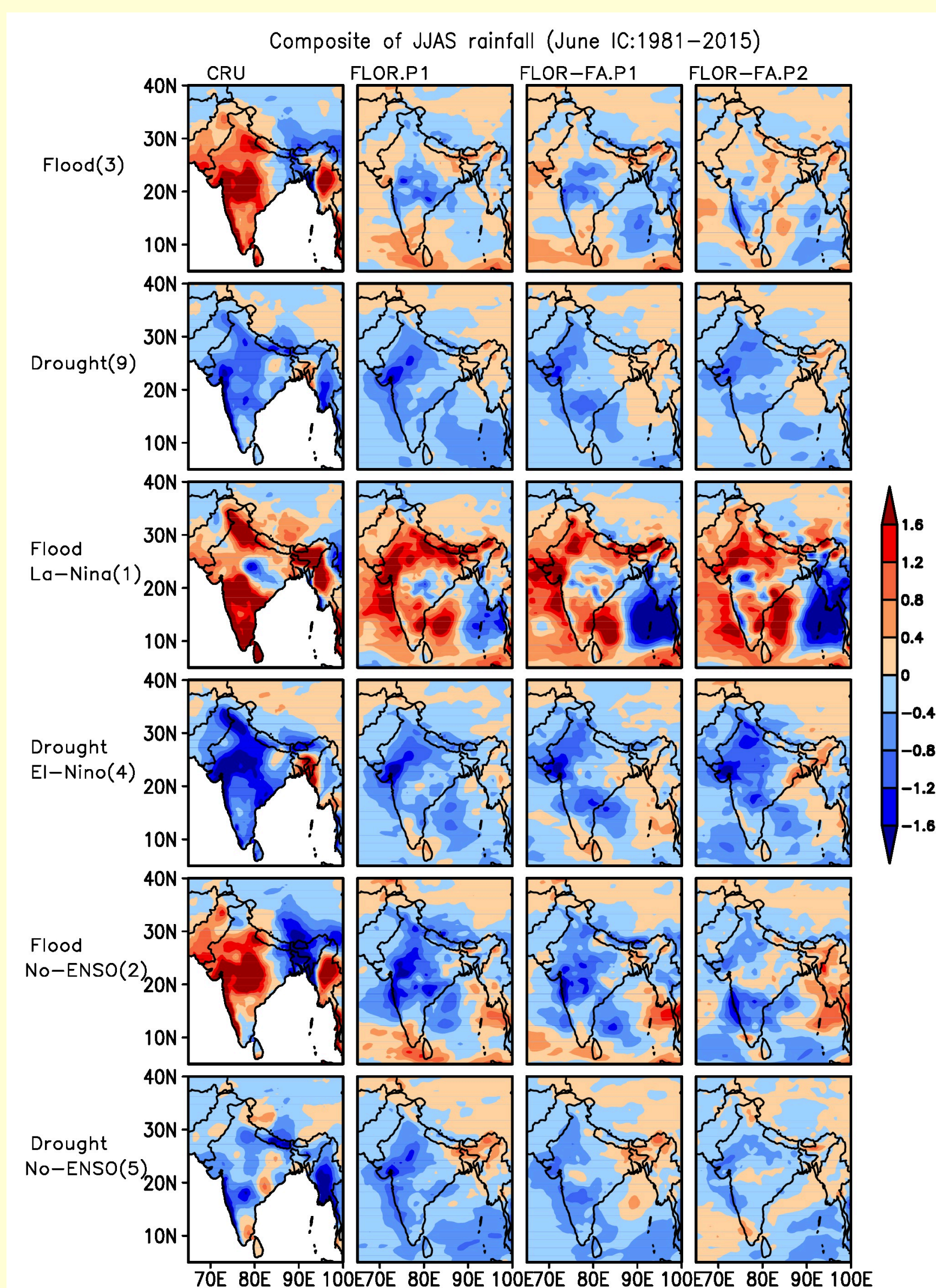
## Seasonal forecast skill of JJAS rainfall



**Fig1:** Anomaly correlation of observed CRU data and model forecasts initialized in June. Dotted regions indicate correlation values significant at 5% significance level.

- Forecast skill of GFDL models is comparable to ENSEMBLES and DEMETER projects' skill.
- Forecasts from FLOR-FA.P2, with atmospheric initialization from reanalysis perform slightly better than FLOR and FLOR-FA.P1.

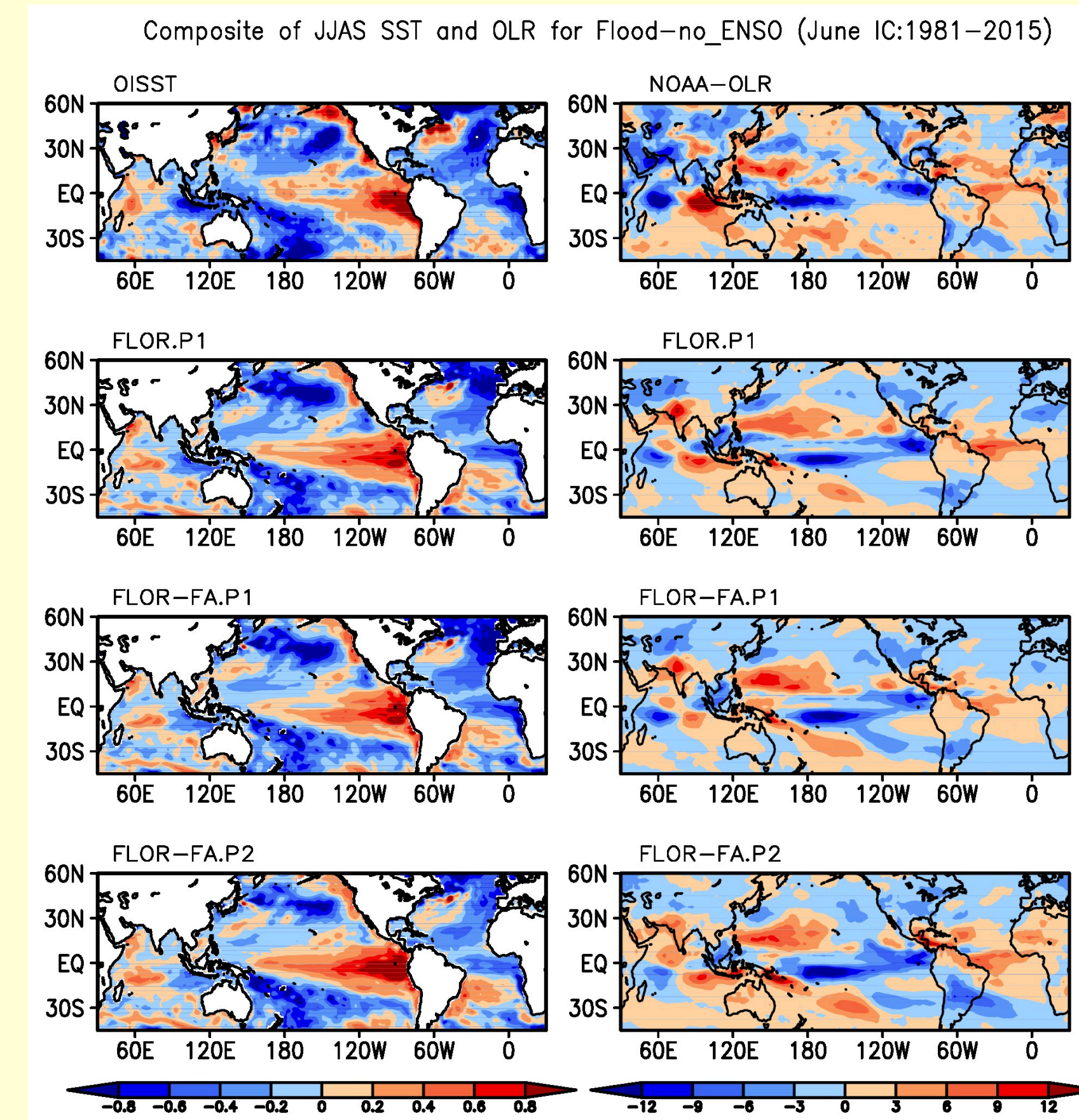
## Prediction of floods and droughts over India



- FLOR models forecast droughts accurately but fail to forecast floods in general.
- However, when accompanied by an ENSO, models forecast floods and droughts accurately.
- During non-ENSO years, they fail to predict floods and forecast weak droughts.

**Fig2:** Composite of JJAS rainfall from forecasts initialized in June. Numbers in the brackets refers to the number of years included in the composites.

## Role of the Indian Ocean Dipole and EQUINOO in forecasting floods over India



**Fig3:** Composites of JJAS SST and OLR based on forecasts initialized in June for years with floods over India but are not associated with ENSO in the tropical Pacific.

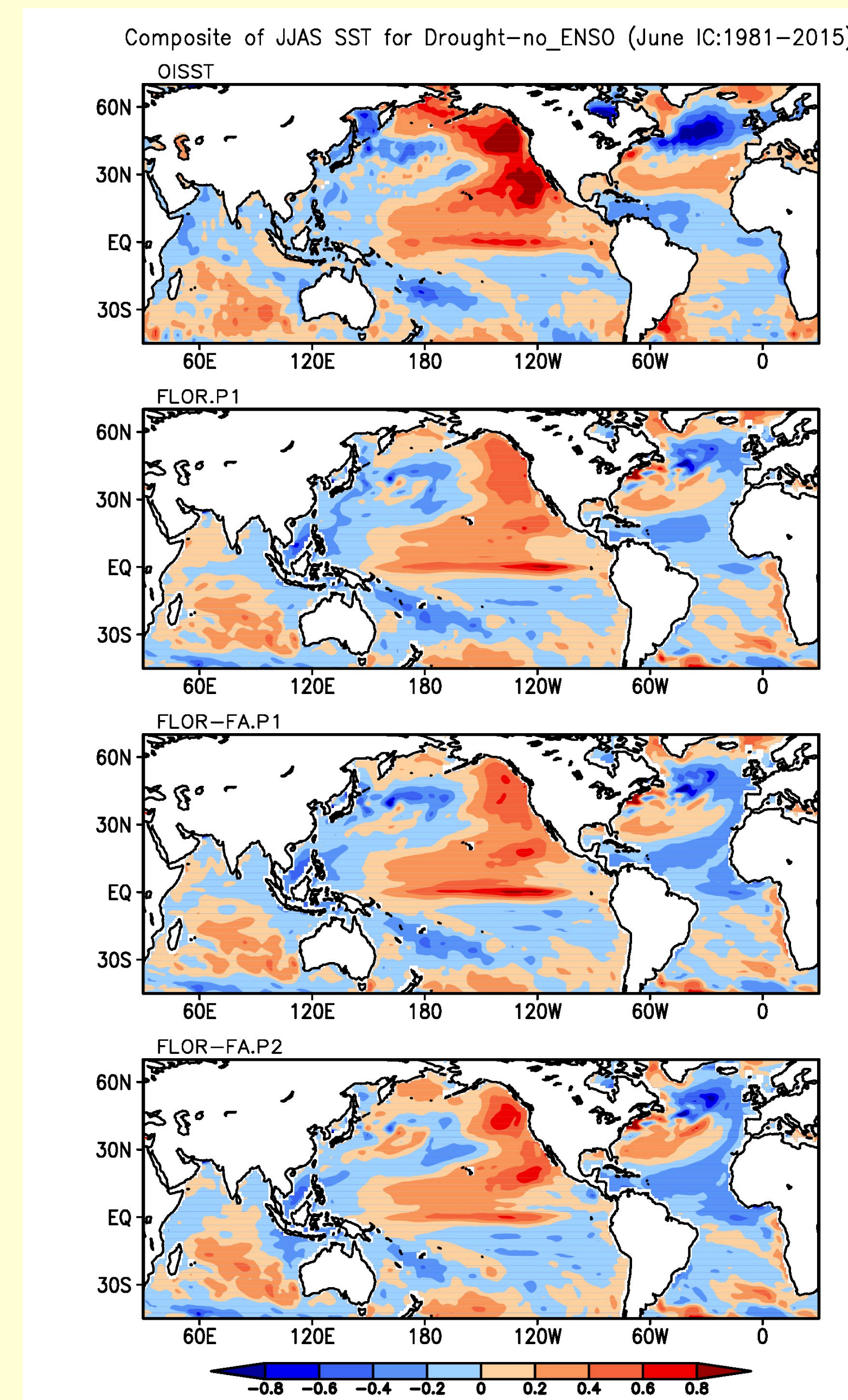
- FLOR models capture weaker eastern pole of IOD\* and EQUINOO\*\*, which may be the reason for lack thereof to forecast floods during non-ENSO years.

- Another plausible cause may be that the model erroneously forecasts El Niño in the tropical Pacific which may be leading to droughts over India rather than floods.

\*IOD – Indian Ocean Dipole.

\*\*EQUINOO – Atmospheric component of IOD.

## Role of the North Pacific SSTs in forecasting droughts over India



- Failure to capture droughts during non-ENSO years may be related to the inability of models to forecast strong warm SSTs along the west coast of North America.

- The SSTs along the west coast of America related to PDO are crucial for affecting rainfall over India via seasonal footprinting mechanism.

**Fig4:** Composites of JJAS SST based on forecasts initialized in June for years with droughts over India but are not associated with ENSO in the tropical Pacific.

## Conclusions

- GFDL models forecast floods and droughts accurately when accompanied by La Niña or El Niño in the tropical Pacific.
- Models are unable to forecast floods which may be related to weaker IOD and the associated atmospheric counterpart EQUINOO in addition to erroneous prediction of El Niño during these non-ENSO years.
- Models also predict weaker droughts over India during non-ENSO years. This may be attributed to the weaker warm SSTs over the west coast of North America over the North Pacific Ocean in the forecasts.
- Improving SST forecasts may help improve Indian monsoon prediction.