SKILL EVALUATION OF THE MJO FORECAST IN THE EXTENDED RANGE TIMESCALE USING IITM ,ECMWF & UKMO FORECAST PRODUCTS

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INTRODUCTION

- Skillful prediction of weather events in the sub-seasonal timescale is highly sought out by many areas such as including emergency sectors.
- **Madden-Julian Oscillation (MJO) is recognized as one of the dominant mode of intra-seasonal variability** with an organized envelope of tropical convection with a life cycle of about 30-60 days with strong eastward propagation in the tropical Indo-Pacific basin.
- MJO is one of the most influencing factors which can influence the onset phase of monsoon over India giving rise to early/delayed onset of summer monsoon onset over Kerala.
- Thus evaluating and improving the MJO prediction skill improves the prediction of weather events in the sub-seasonal time scale.
- Here we evaluate the MJO prediction skill in extended range using IITM CFSv2 model and UK Met Office model using the traditional EOF method.
- By analyzing the bias in OLR in the models, we try to find how the skill of models can be improved using convection.

IITM ERPAS AND EXTENDED EOF METHOD

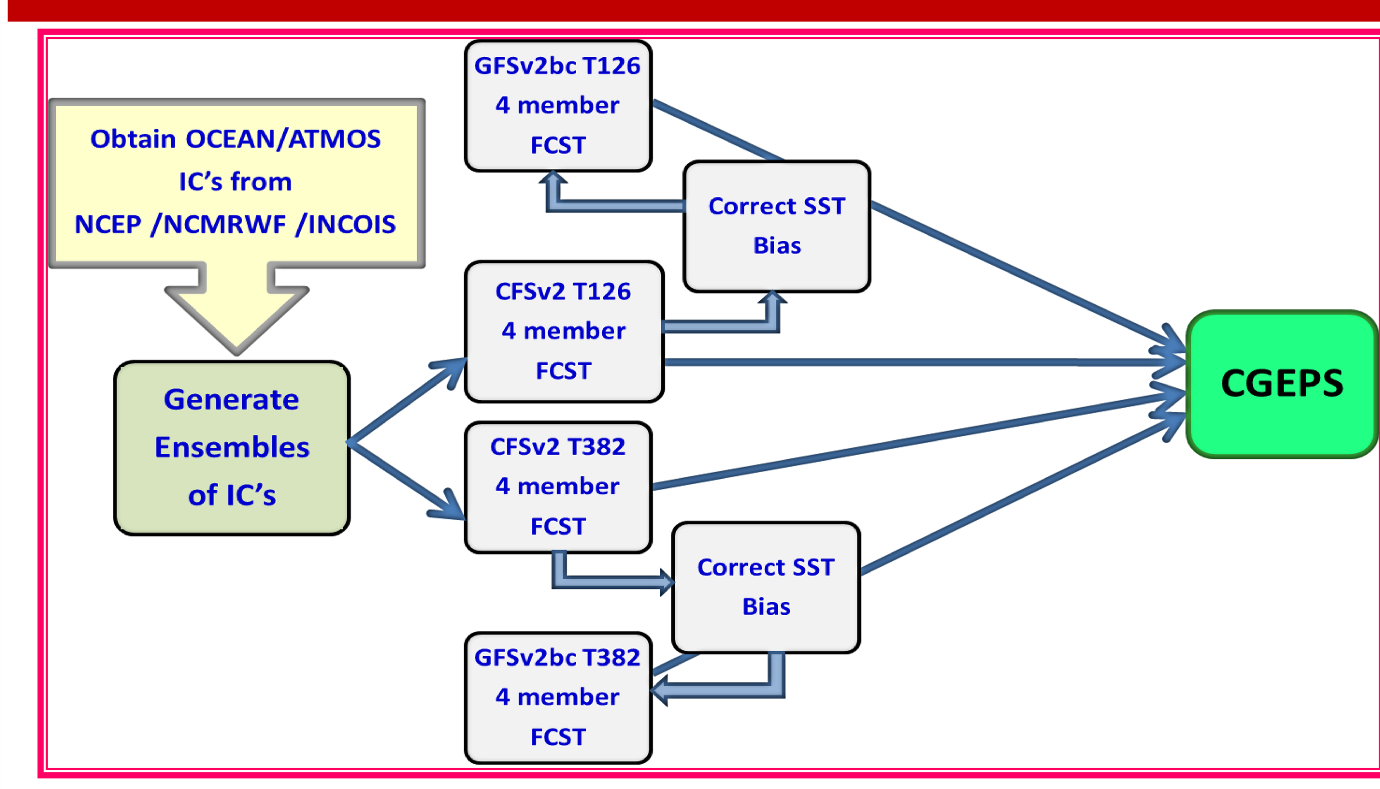


Fig 1: Current Status of IITM Extended Range Prediction System

- Operational tracking of MJO is done using seasonally independent RMM indices (Wheeler and Hendon, 2004) based on a pair of EOFs of the combined fields of **near-equatorially averaged OLR, u850 and u200**. Anomalies are projected onto these EOFs to obtain the RMM indices.
- OLR data → daily averaged values from the NOAA polar-orbiting satellites. Interpolated data is obtained from NCEP (Liebmann and Smith, 1996).
- Zonal wind → NCEP-NCAR Reanalysis dataset (Kalnay et al. 1996). Both are analysed on a $2.5^0 \times 2.5^0$ latitude-longitude grid.
- EOF is calculated using OLR and zonal wind data from a period of 1979-2001.Data from 1979-2018 is projected on to the EOF to obtain the RMM indices.
- Model data was obtained from IITM CFS v2 which has 16 ensemble members (4 each of CFST382, CFST126, GFST382 and GFST126) and UKMO model forecasted datawith 6 ensemble members.
- Data is taken for years from 2003-2018 during May-September (352 ICs) for IITM Model . For strong events with observational amplitude above 2.0 about 20 cases of IITM model and 18 cases from UKMO model data was also considered (2003-2016).

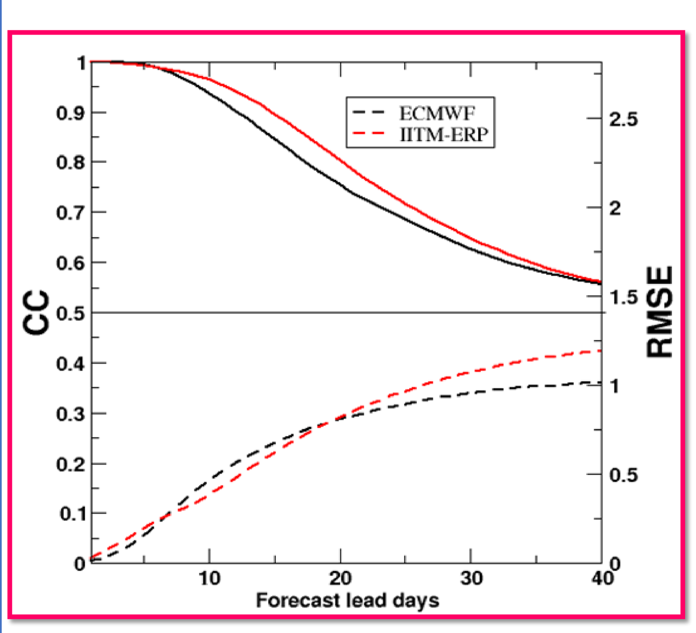


Fig 2: Predictability (ACC; solid & RMSE; dashed) for IITM-ERP (red) and ECMWF (black) as a function of lead day.

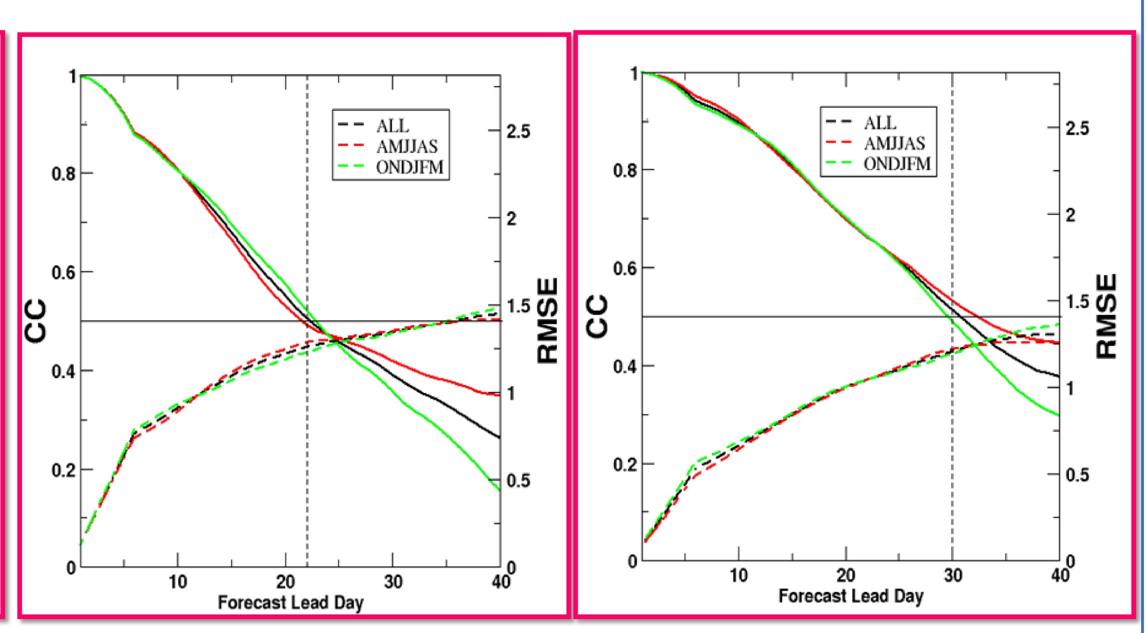


Fig 3: Bivariate Anomaly Correlation Coefficient (ACC; solid line) and Root Mean Squared Error (RMSE; dashed line) for (a) IITM-ERP (b) ECMWF.

CONCLUSIONS

- Operational Prediction skill of the ensemble mean of CFS and GFS is 21 days while the potential predictability is 40 days. The operational prediction skill of ECMWF is 30 days.
- For the strong MJO events (20 cases) **the prediction skill using the traditional Wheeler and Hendon method** was found to be :
  - CFS : **14 days**
  - GFS : **14 days**
  - Ensmean of CFS & GFS : 18 days
  - UKMO : 22 days
- The ensemble mean has increased the prediction skill by 4 days
- CFS shows a stronger tilted bias pattern over Indian Ocean with increase in lead time while CFS shows a strong bias over the Maritime continent.
- UKMO model shows a very strong bias over the Indian Ocean and western Pacific even more than the GFS and CFS.

Analysis Of Bias In Convection (OLR) Using Traditional Wheeler And Hendon Method

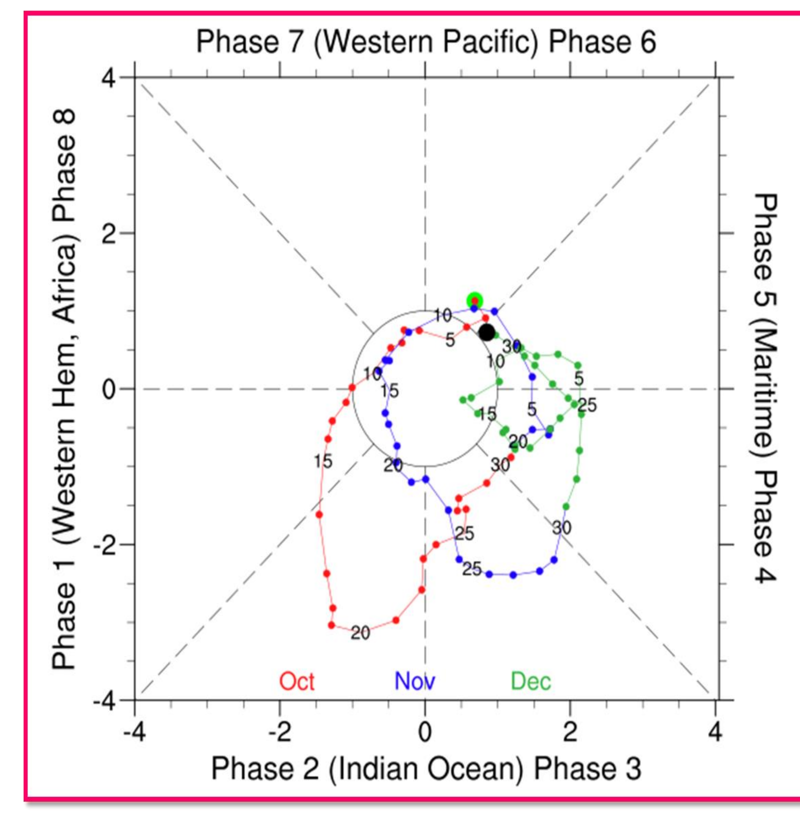


Fig 4: Track of MJO using the RMM indices (PC 1 and PC 2) during the period from 1 Oct -31 Dec 2011 (Dynamo period)

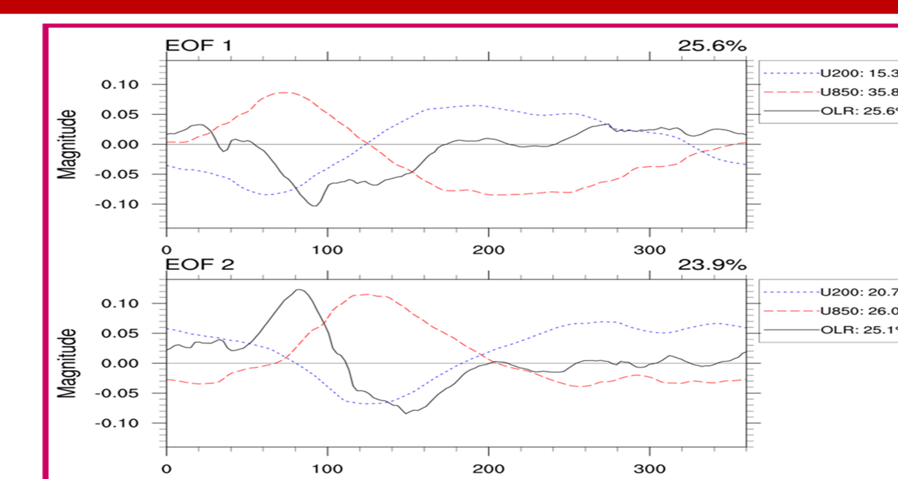


Fig 5: Spatial structures of EOFs 1 and 2 of the combined analysis of OLR and zonal winds at 850 hPa and 200hPa. The % variance explained by respective EOFs are 25.6% and 23.9 %.

(T382+T126) (T382 +T126)

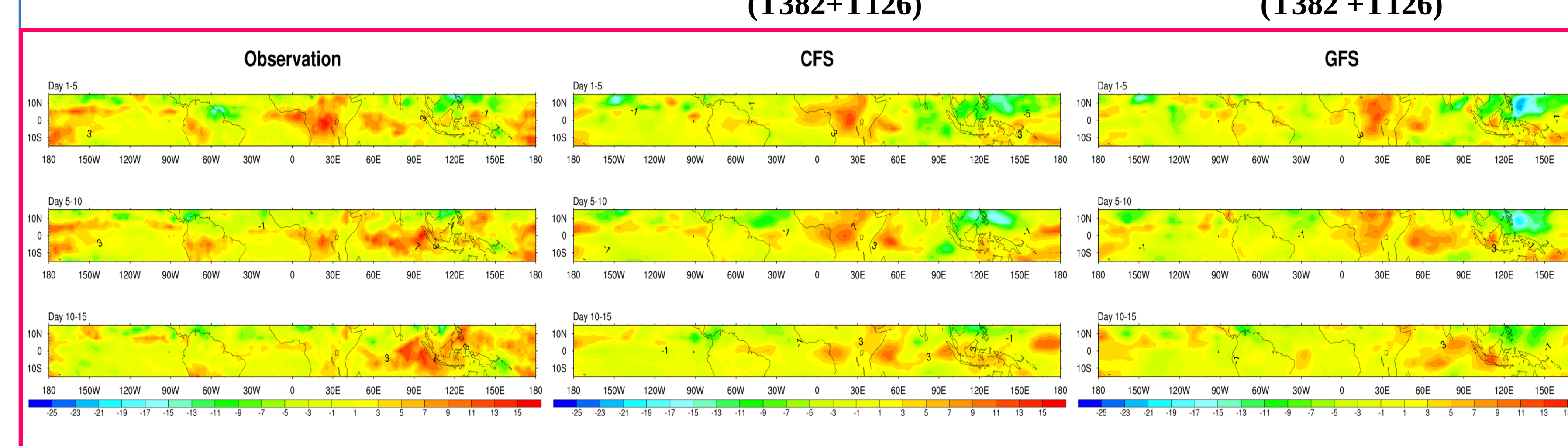


Fig 6: Spatial propagation of the strong MJO events captured using observational data and CFS and GFS forecast products.

CFS – Observation GFS - Observation

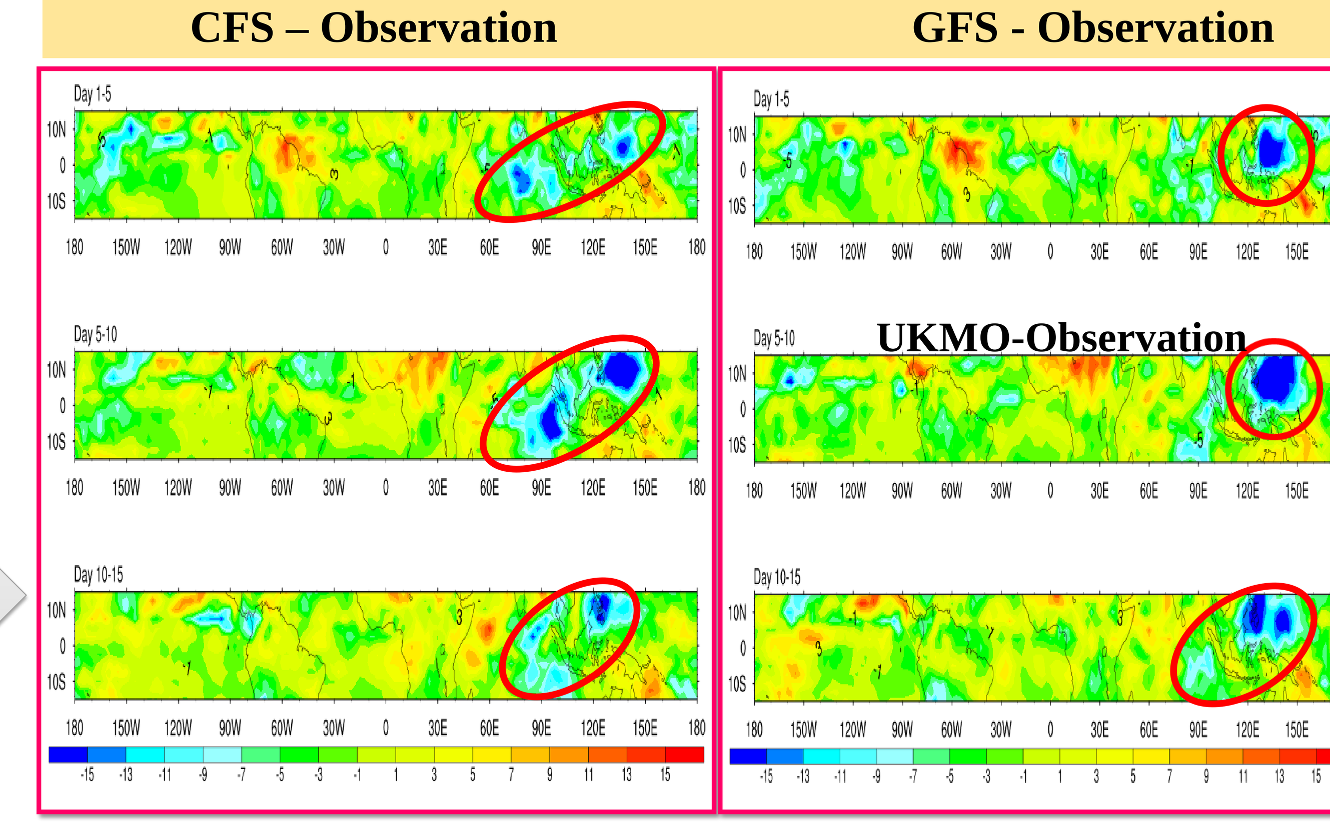


Fig 7: Difference between the anomalies from observation and the CFS and GFS forecasts of strong events.

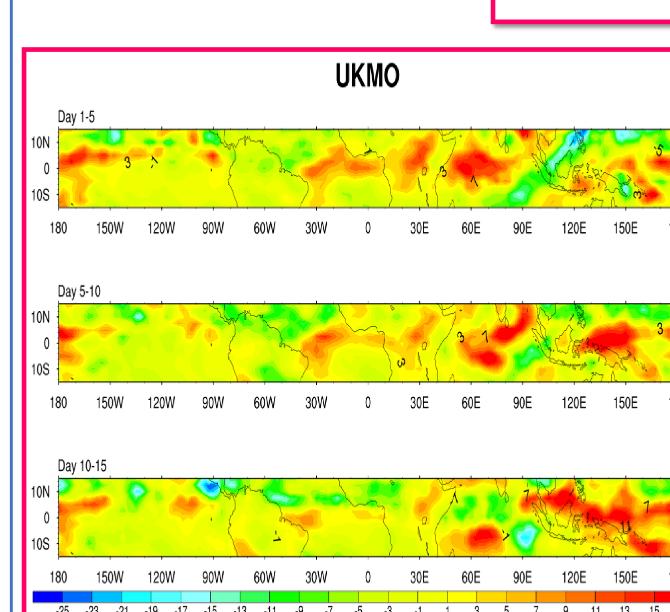
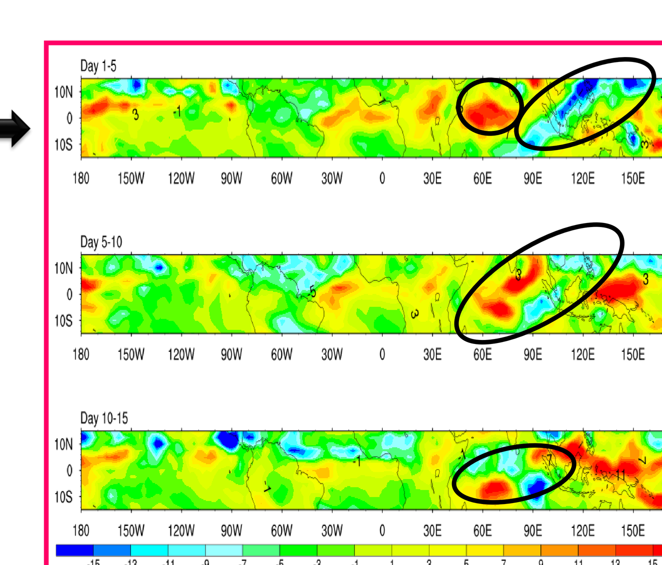


Fig 8: Spatial propagation of the strong MJO events captured using UKMO forecast products

Fig 9: Difference between the anomalies of Observation and the UKMO forecasts of strong events



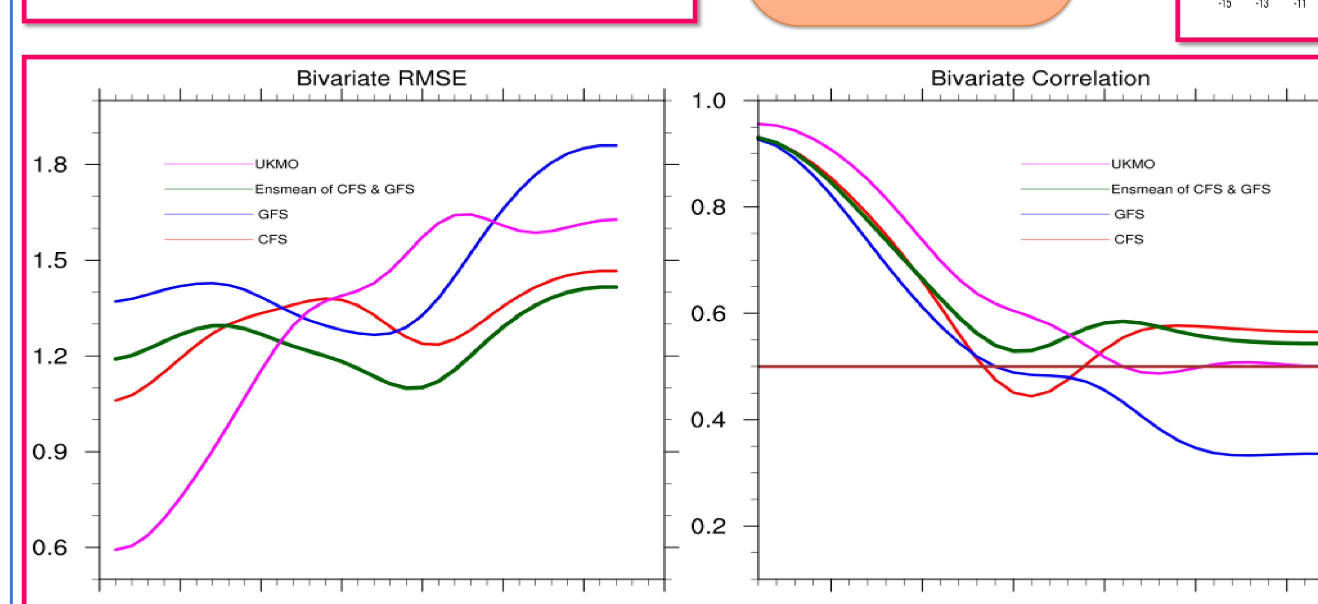


Fig 10: Bivariate RMSE & correlation of the CFS, GFS, Ensmean of CFS & GFS & UKMO forecasts with observation only for strong MJO events (~ 20 cases).

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- The observational dataset was obtained from NCEP-NCAR Reanalysis dataset and the model output was obtained from UK Met Office and ECMWF.