Role of land surface feedback process and prediction skill in the S2S scale during monsoon onset in the coupled model framework

Pratibha Gautam1,2, Rajib Chattopadhyay1,4, Susmitha Joseph1, and Gill Martin3
1. Indian Institute of Tropical Meteorology, Pune 2. Savitribai Phule Pune University
3. Met Office, Exeter, UK 4. India Meteorological Department Pune, Maharashtra 411005
pratibha.gautam@tropmet.res.in

Introduction

➢Monsoon onset over Kerala (MOK) marks the beginning of the rainy season in India.
➢Extended range forecast of monsoon onset is important for agriculture planning .
➢Studies (Koster et al. (2006) ;Halder et al. 2018; Menon et al. 2018;Unnikrishnan et al., 2017) have shown the role of land surface during monsoon seasons .
➢There are very limited study on role of land surface in extended range scale. we have tried to look into it.

Objectives

- What is the role of land surface feedback in the extended range prediction of Monsoon Onset?
- How the prediction skill affected by the land surface parameter.

Methodology & Study Area

We have taken two run from UKMO model as a part of WCSSP project-

1) In one, the soil moisture was initialized from a climatology and soil temperature and snow were initialized from ERA-Interim reanalysis. (UKMO_OLD).
2) In the other, a land surface re-analysis is used which was created using the JULES land surface model forced by JRA-55 reanalysis from 1990 onwards. (UKMO_NEW).

- For observation IMD datasets, ERA5 reanalysis is used.
- UKMO IC -0517 IITM_CFS IC -0517
- **N.B. Actual MOK dates were taken from paper Joseph et al., 2015.**

Year	Actual MOK dates
2003	8th June
2004	18th May
2005	5th June
2006	26th May
2007	28th May
2008	31th May
2009	23th May
2010	31th May
2011	29th May
2012	5th June
2013	1st June
2014	6th June
2015	5th June

Joseph et al.2015

- **Neglecting these two years.**
- **Taking beyond 10 days lead time(extended range time scale)**

Results

Fig:1 Bias in rainfall from UKMO_MODEL(1) and from IITM_CFS(2) during onset(2003-2015) from UKMO and IMD-data.

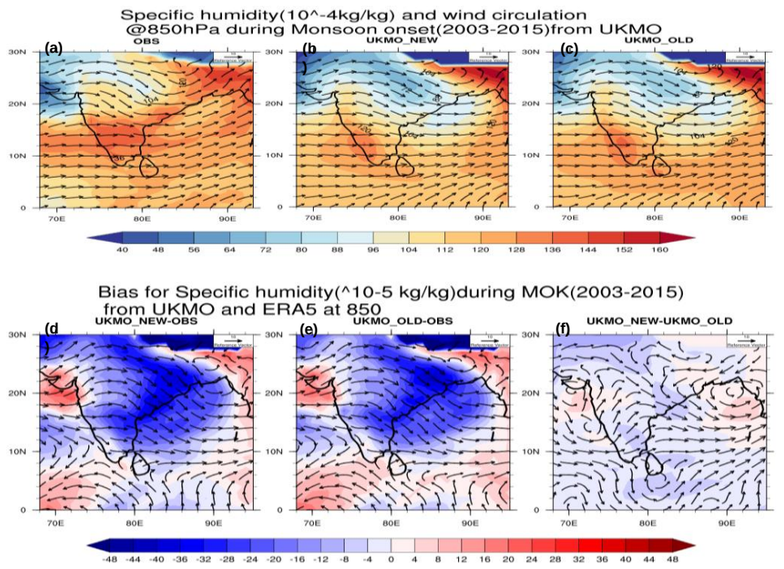

Fig:2 Specific humidity composite (a-c) and bias (d-f) during monsoon onset(2003-2015) from UKMO and IMD-data.

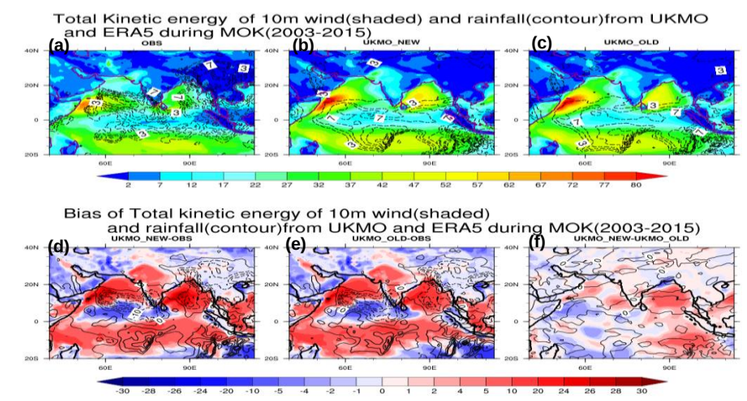

Fig:3 Total Kinetic energy of 10 m wind((shaded) and rainfall(contour) (a-c) and its bias (d-f) from UKMO and ERA5 during MOK(2003-2015).

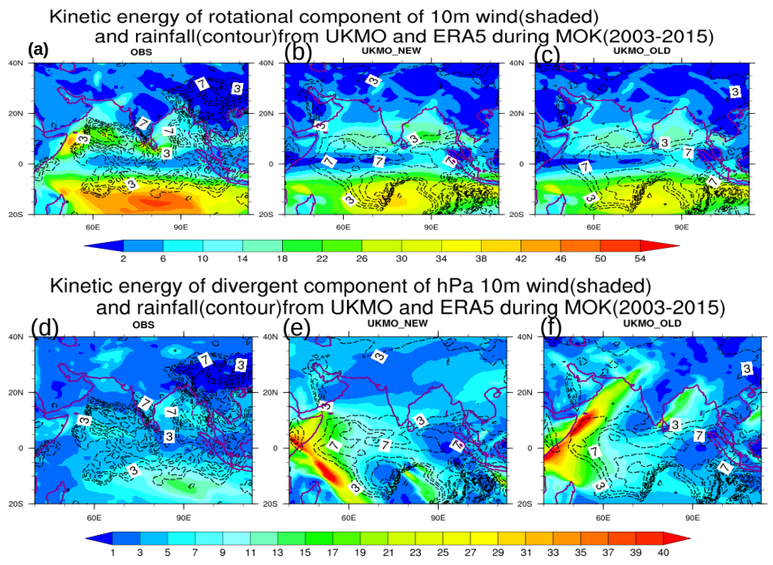

Fig:4 Rot Kinetic energy of 10 m wind((shaded) and rainfall(contour) (a-c) and div Kinetic energy (d-f) from UKMO and ERA5 during MOK(2003-2015).

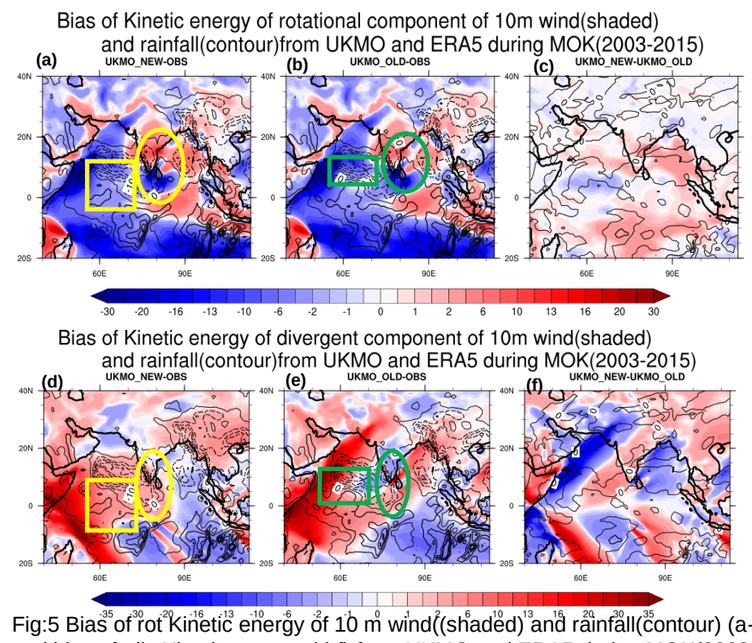

Fig:5 Bias of rot Kinetic energy of 10 m wind((shaded) and rainfall(contour) (a-c) and bias of div Kinetic energy (d-f) from UKMO and ERA5 during MOK(2003-2015).

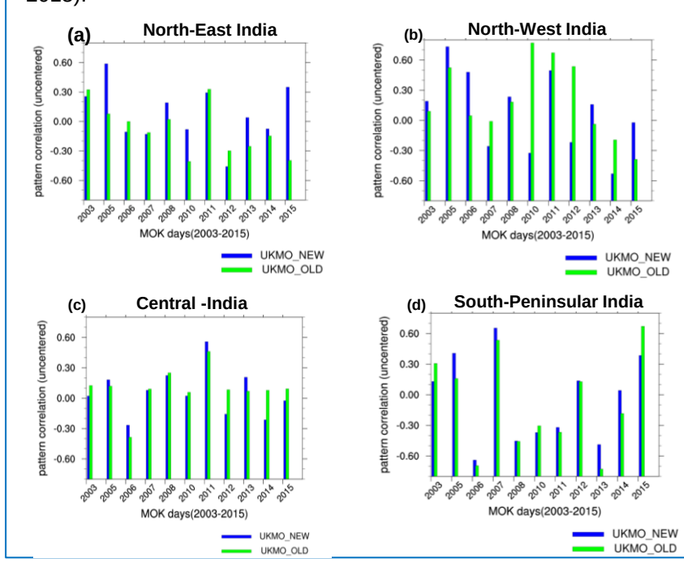

Fig:6 Pattern corr for rainfall b/w UKMO and IMD

Conclusion

- This paper examined the role of the land surface initialization feedback process during monsoon onset(2003-2015) beyond ten days lead time and its prediction skill from UKMO model.
- From fig1 both the model (UKMO_OLD and UKMO_NEW) are not able to capture the rainfall pattern.
- The plot shows that both versions(UKMO_OLD and UMO_NEW) show the dry bias for the onset date though UKMO_NEW is wetter than the UKMO_OLD on the onset date (refer to the right-most panel of Fig.1(I).
- Similarly, rainfall bias is plotted from IITM-CFS . In IITM-CFS both models are not able to capture the rainfall pattern during monsoon onset. Also, Fig.1(II) shows NCEP is wetter than NCMRWF.
- From the bias plot,2(d,e) we can see that both model biases are the same also it is not much different from observation. More of the region (except western India) is showing negative bias fig 2(d,e).
- Land –surface play an important role during monsoon onset through its feedback processes.
- And the feedback over land and over ocean is different (fig 5a and 5d , 5b and 5c)
- From the above figures we can say that if we have error in land surface it will affect near surface flux(surface wind ..etc) further it will affect the monsoon onset rain.
- From the pattern correlation((fig 6) we can say that over the north West India UKMO_NEW possesses useful prediction skill for Monsoon onset rainfall beyond 10 days lead.
- And overall UKMO_NEW shows better prediction skill beyond 10 days lead.

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References

- Halder, S., Dirmeyer, P. A., Marx, L., & Kinter III, J. L. (2018). Impact of land surface initialization and land-atmosphere coupling on the prediction of the Indian summer monsoon with the CFSv2. Frontiers in Environmental Science, 5, 92
- Menon, A., Turner, A. G., Martin, G. M., & MacLachlan, C. (2018). Modelling the moistening of the free troposphere during the northwestward progression of Indian monsoon onset. Quarterly Journal of the Royal Meteorological Society,
- Unnikrishnan, C. K., Rajeevan, M. and Vijaya Bhaskara Rao, S., 2017, “A study on the role of land-atmosphere coupling on the south Asian monsoon climate variability using a regional climate model,” Theoretical Applied Climatology,
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