



Radiance assimilation over the extra-tropics and polar regions: Impact on the simulation of Indian Summer Monsoon

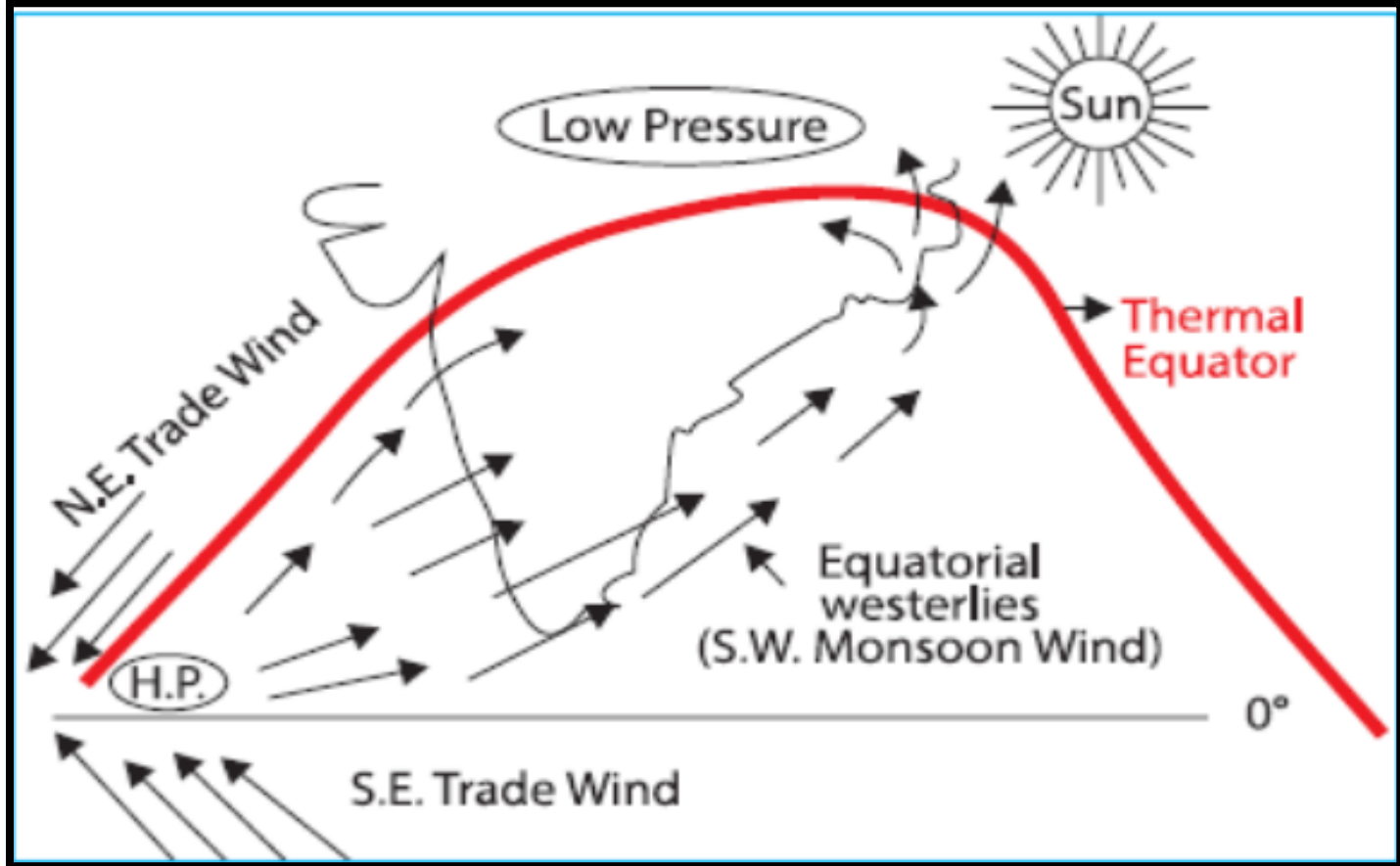
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²National Centre for Polar and Ocean Research (NCPOR), MoES



Indian Summer Monsoon





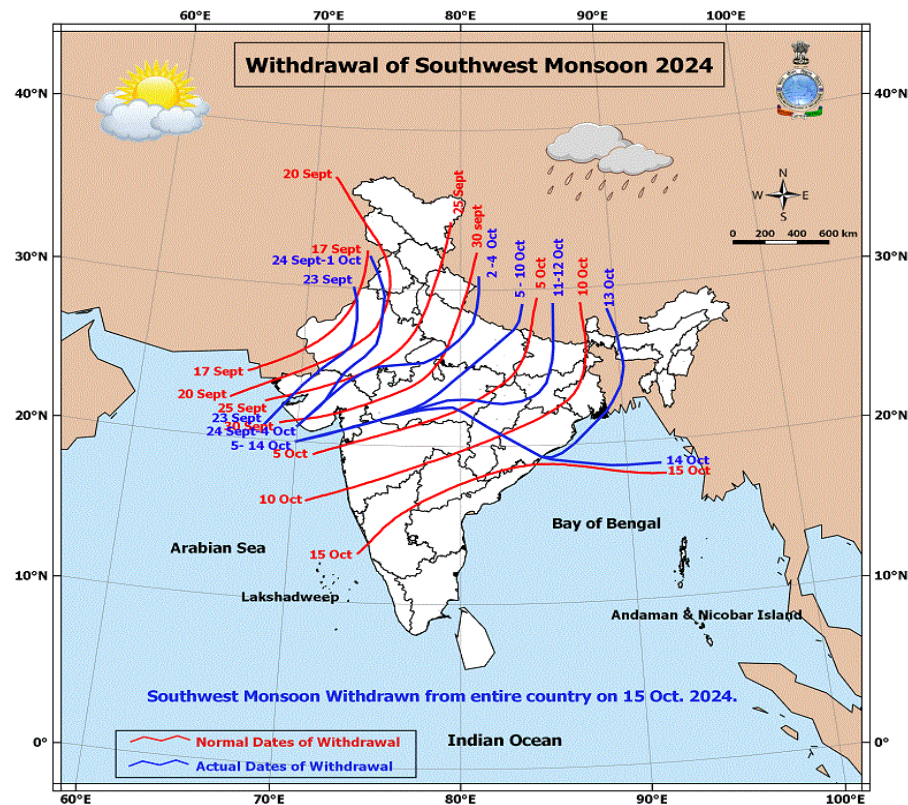
Advance of Southwest Monsoon 2024

SW Monsoon covered the entire country on 2 July 2024

Normal Dates of Onset

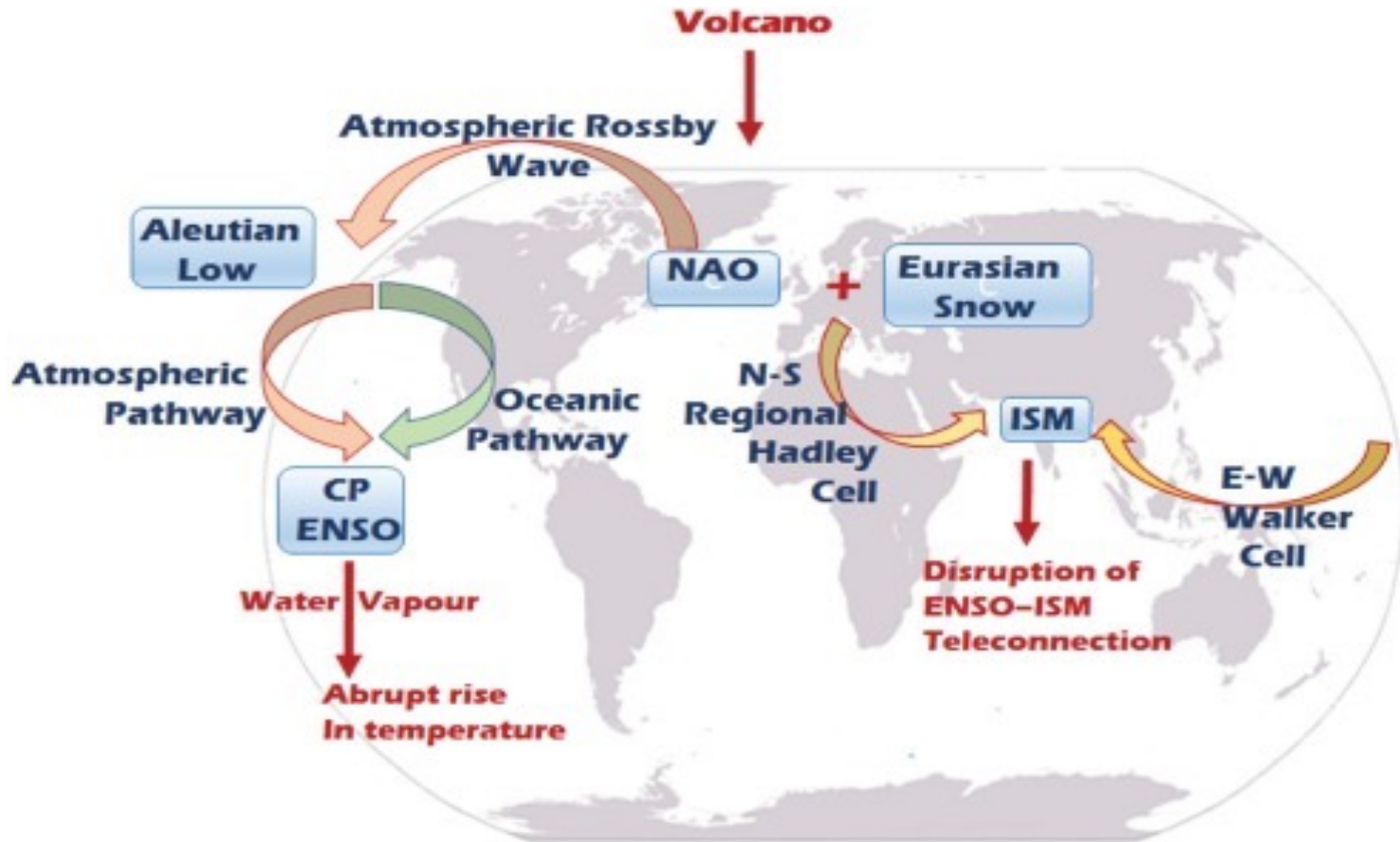
Actual Dates of Onset

0 200 400 600 km



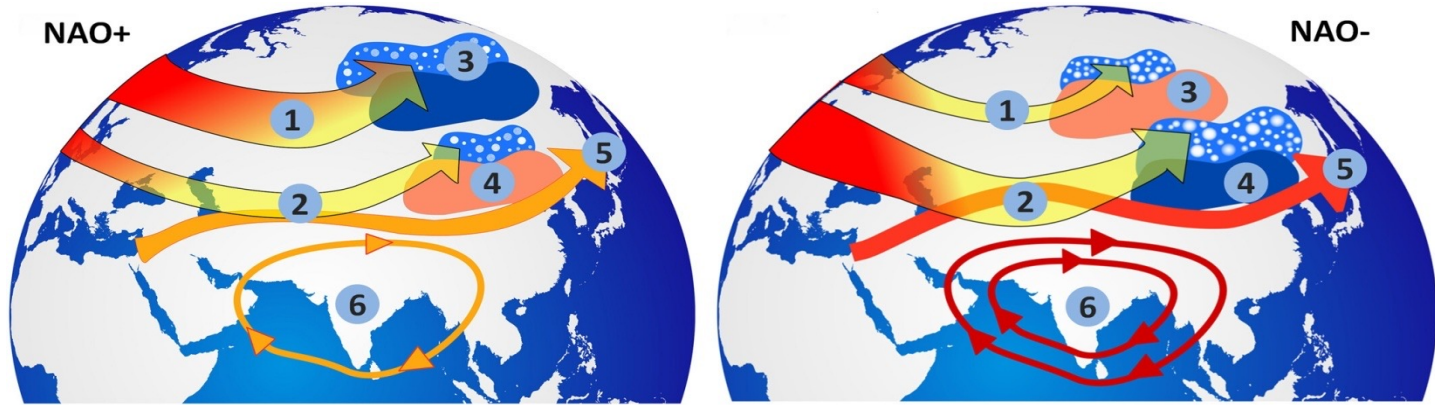


Monsoon Teleconnections





Teleconnections



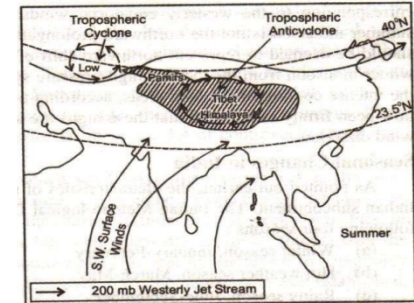
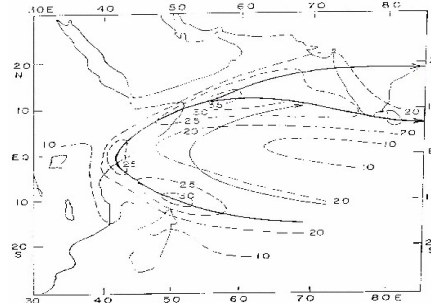
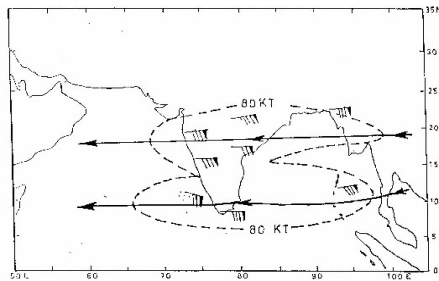
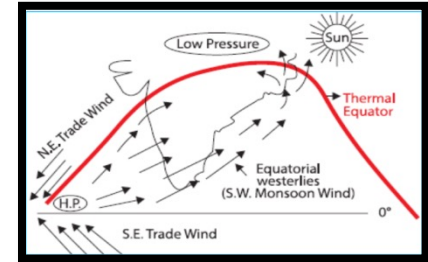
(1) Positive NAO anomalies result in higher moisture flux to north of 60°N and (2) reduced moisture flux to south of 50°N during winter-spring, leading to (3) heavy winter-spring snowfall in North Siberia and (4) less snowfall in South Siberia/Mongolia. The melting of snow in early summer lead to wet-and-cold (dry-and-warm) anomalies on the land over north Siberia (south Siberia/Mongolia). Resulting thermal contrast leads to weakening of sub-tropical westerly jet (5), negatively impacting the upper-level monsoon flow during summer, resulting in weaker monsoon circulation and below normal monsoon seasonal rainfall over central India (6).

(1) Negative NAO anomalies result in reduced moisture flux to north of 60°N and (2) enhanced moisture flux to south of 50°N during winter-spring leading to (3) less winter-spring snowfall in North Siberia and (4) heavy snowfall in South Siberia/Mongolia. The melting of snow in early summer lead to dry-and-warm (wet-and-cold) anomalies on the land over north Siberia (south Siberia/Mongolia). Resulting thermal contrast leads to strengthening of sub-tropical westerly jet (5), positively impacting the upper-level monsoon flow during summer, resulting in stronger monsoon circulation and above normal monsoon seasonal rainfall over central India (6).



Indian Summer monsoon characteristics:

- The onset, propagation and cessation
- Global Teleconnections
- Semi-permanent systems like
 1. Monsoon Trough
 2. Heat Low
 3. Tibetan Anticyclone
 4. Low-Level Jet
 5. Tropical Easterly Jet





Present Study: Radiance assimilation over the Extra-Tropics and Polar regions and its impact on the simulation of Indian SW monsoon circulation features

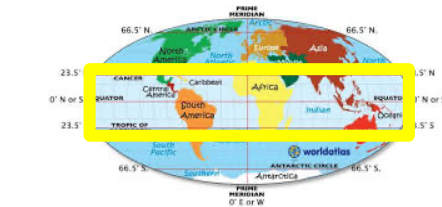


Experiment Set Up (July 2023)

1. **Full Sat (G)** : Surface, RS/RW, Aircraft, AMVs, Scatterometer winds, ATOVS (N-15, 18, 19, M-B and M-C), ATMS (NPP, NOAA-20)



2. **Sat_Tropics (T)** : Full sat, but no ATOVS and ATMS north of 30°N and south of 30°s

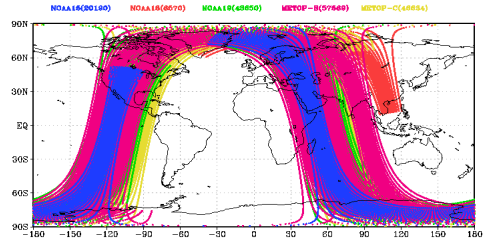
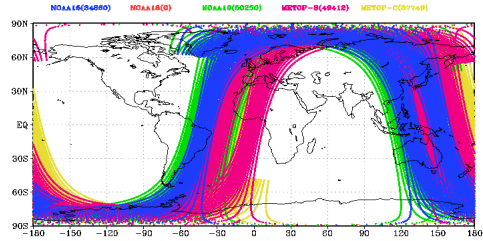
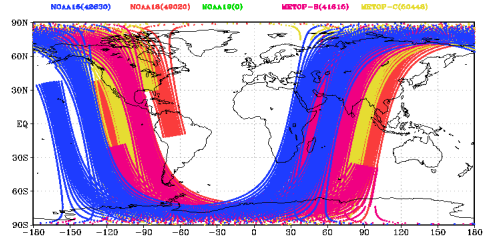
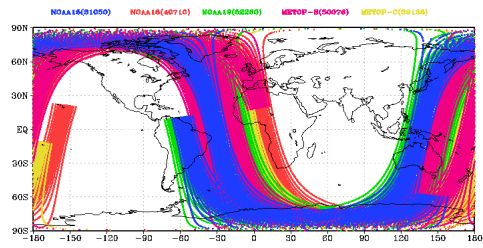


3. **Sat_Exyratropics (E)**: Full sat, but no ATOVS and ATMS between $\pm 30^\circ$

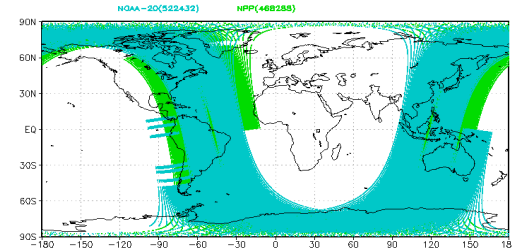
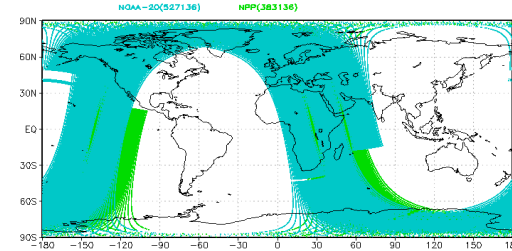
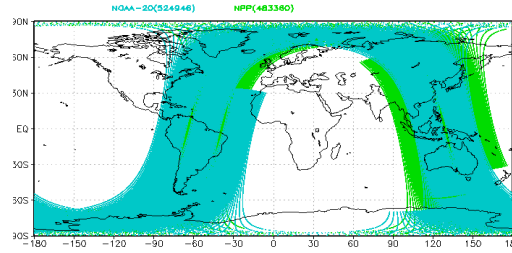
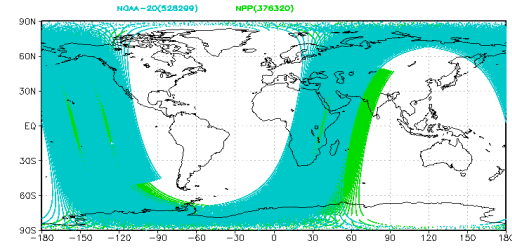




ATOVS



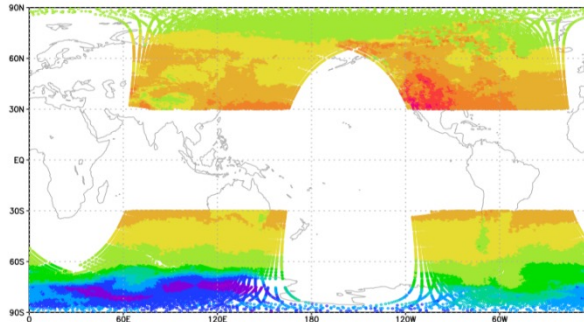
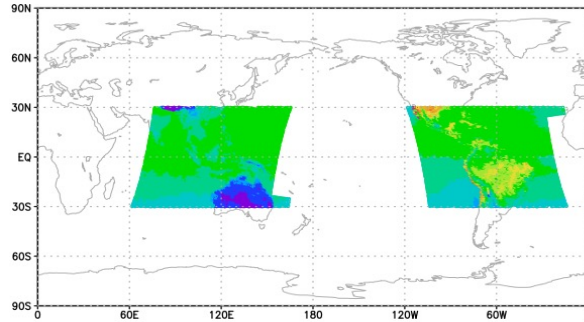
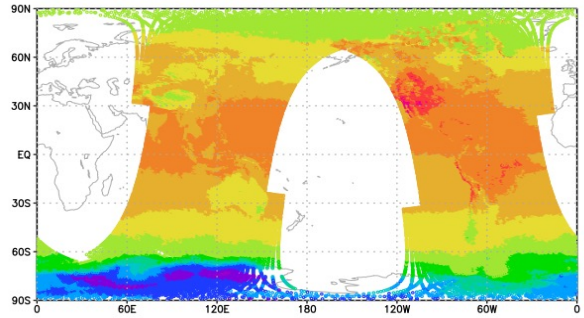
ATMS



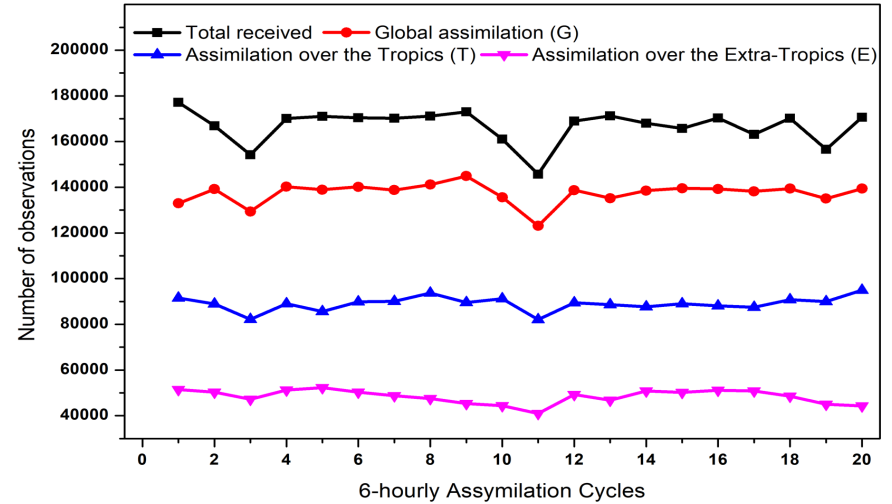
Observation
Coverage



Assimilation Statistics: ATMS

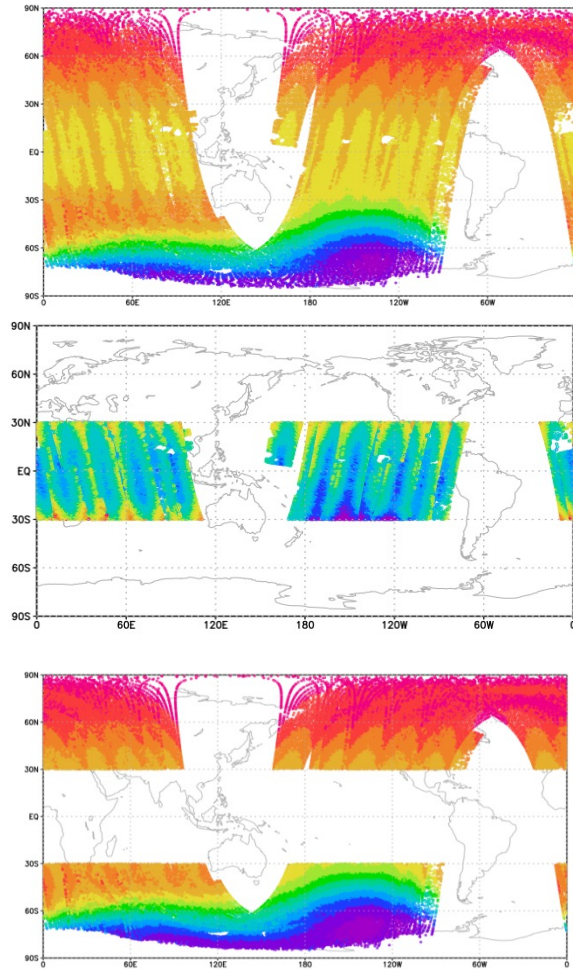


Number of ATMS radiances (profiles) : Reception and Assimilation

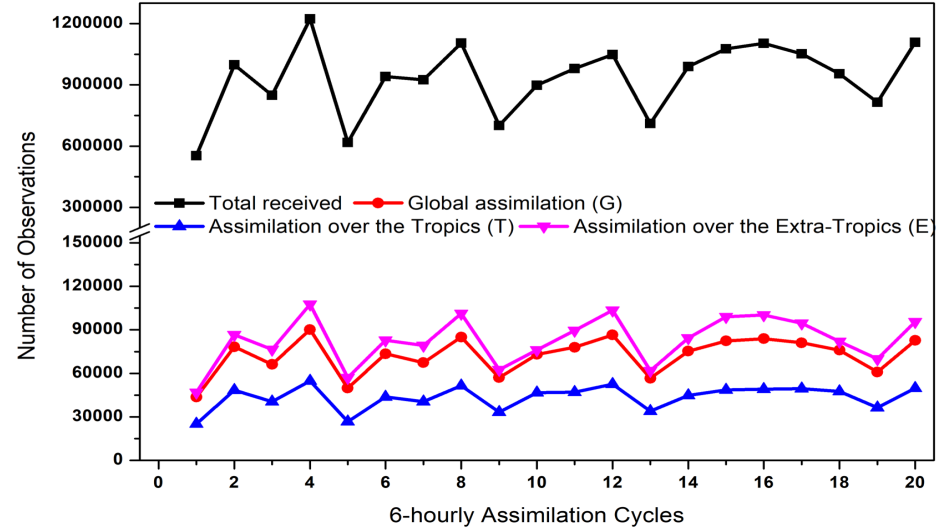




Assimilation Statistics: ATOVS

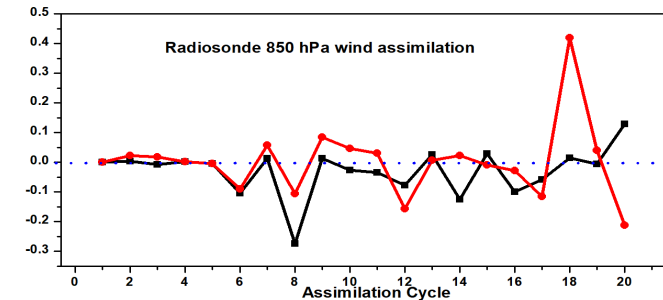
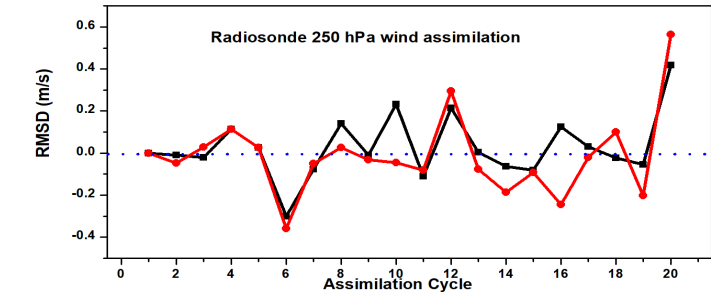
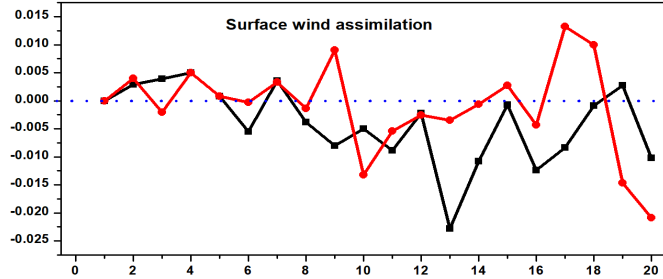
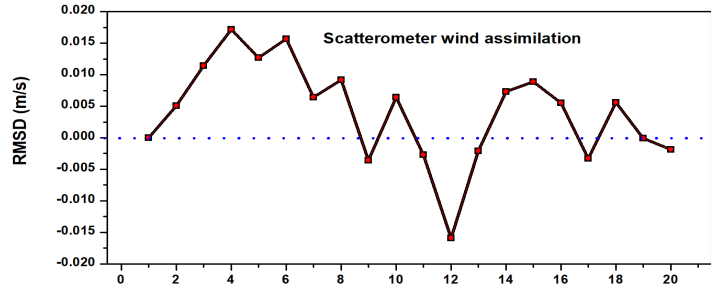
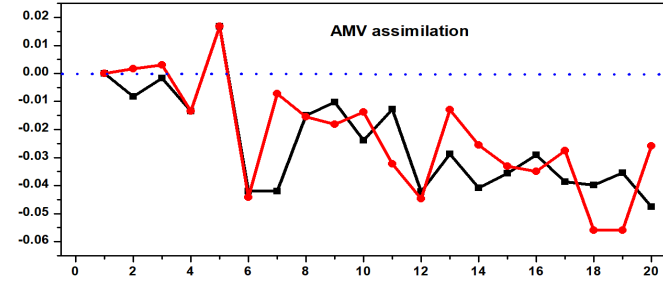
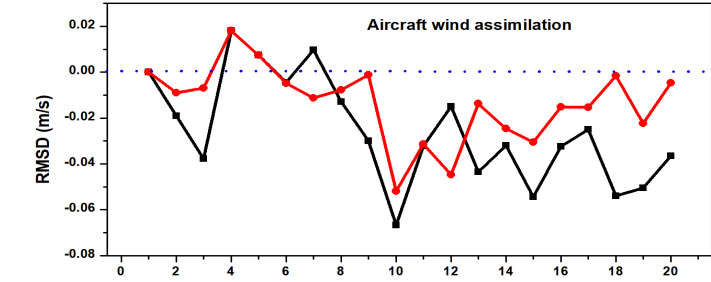


Number of ATOVS radiances (profiles) : Reception and Assimilation





Assimilation Impact: Conventional Observations



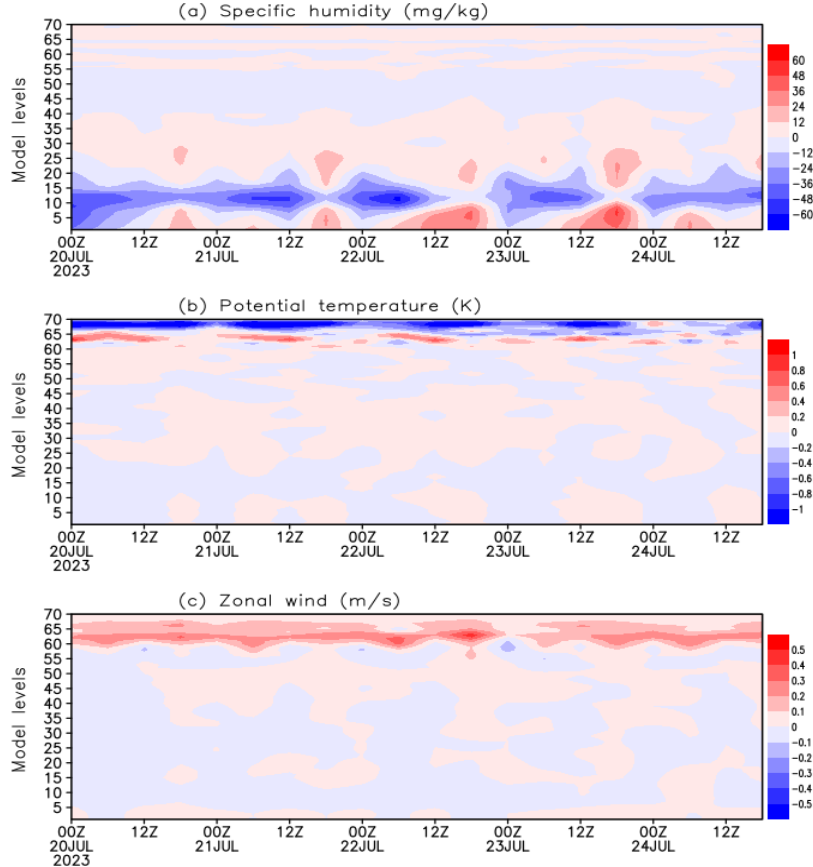
Global – Tropics

Global - Extratropics

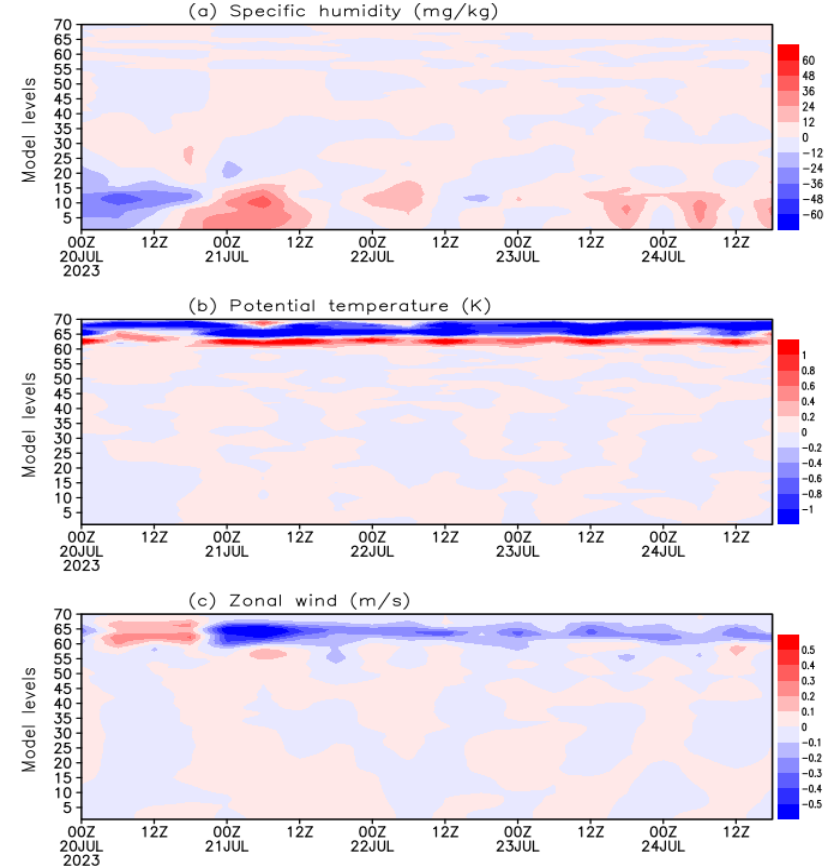


Changes in Analysis Increments: Global average

No assimilation over the Tropics



No Assimilation over the Extratropics

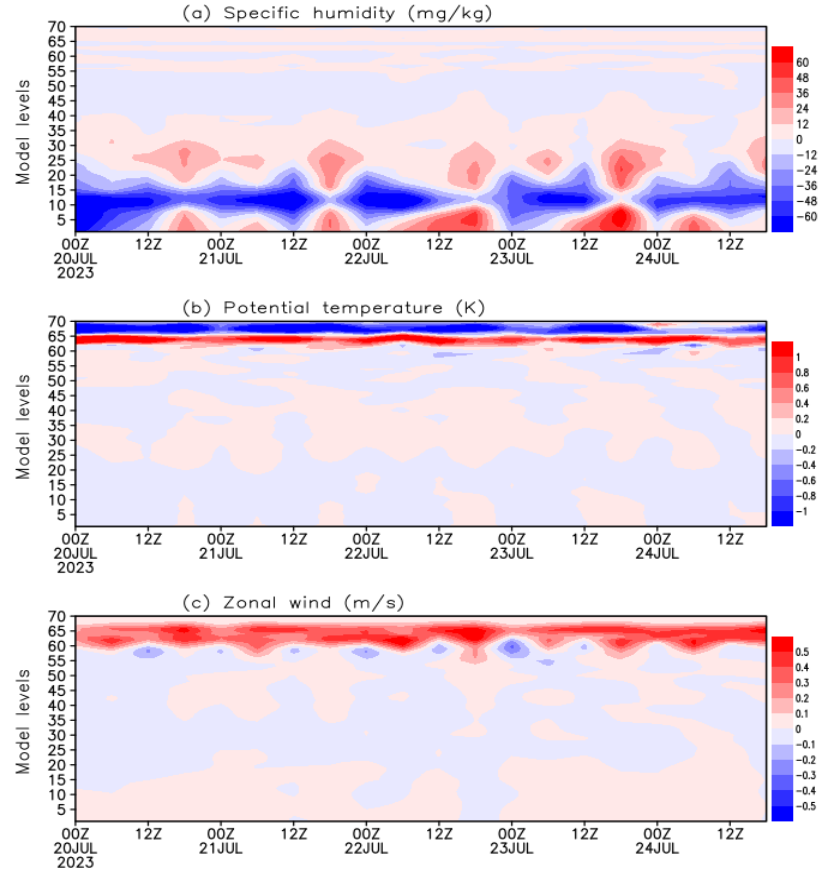




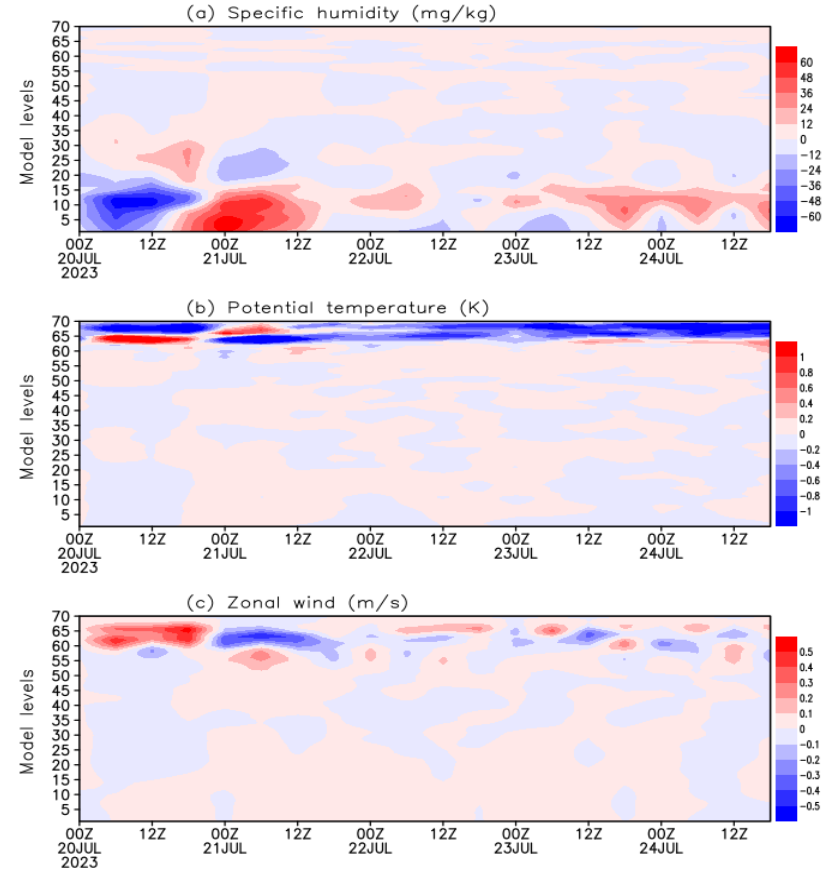
Changes in Analysis Increments: Average over the Tropics



No assimilation over the Tropics



No Assimilation over the Extratropics



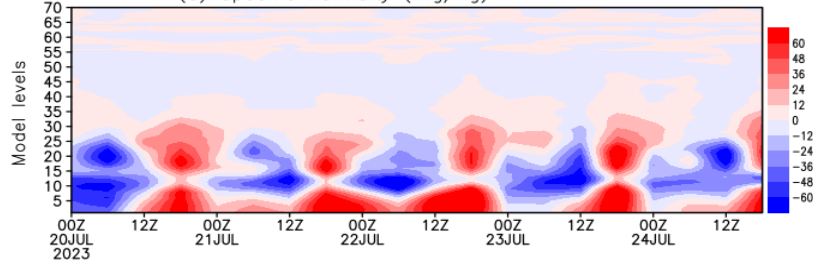


Changes in Analysis Increments: Average over the Indian region

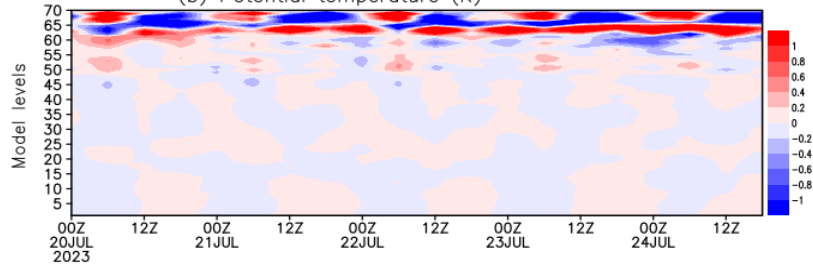


No assimilation over the Tropics

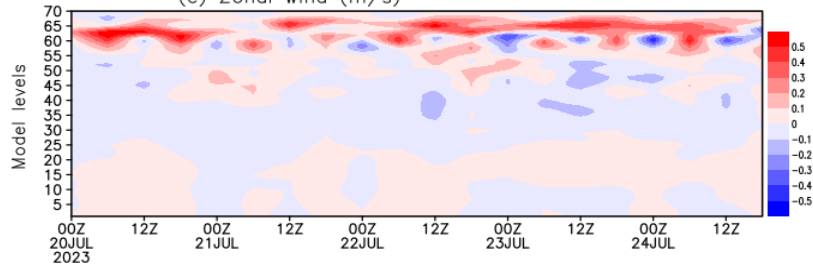
(a) Specific humidity (mg/kg)



(b) Potential temperature (K)

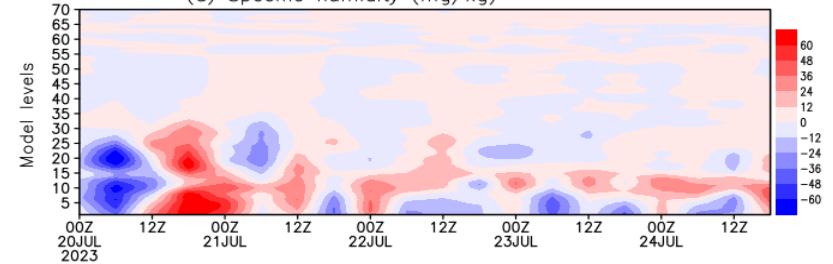


(c) Zonal wind (m/s)

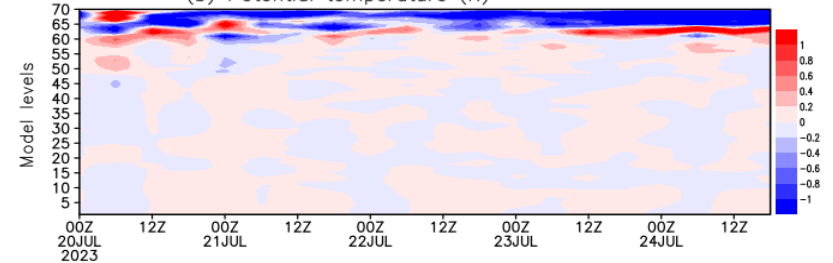


No Assimilation over the Extratropics

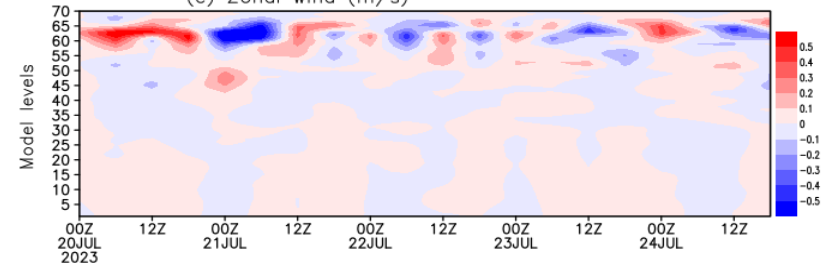
(a) Specific humidity (mg/kg)



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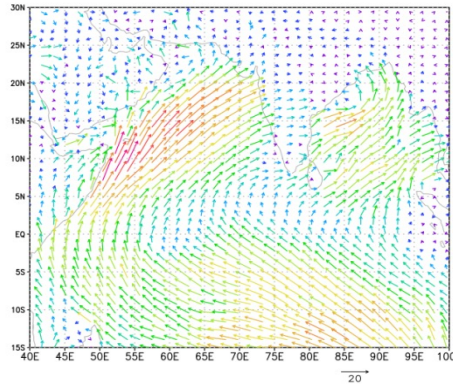
(c) Zonal wind (m/s)



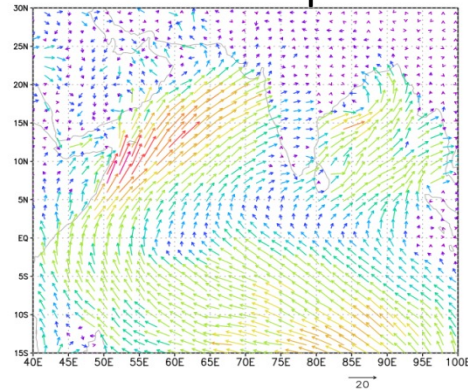


Monsoon Low Level Jet (LLJ)

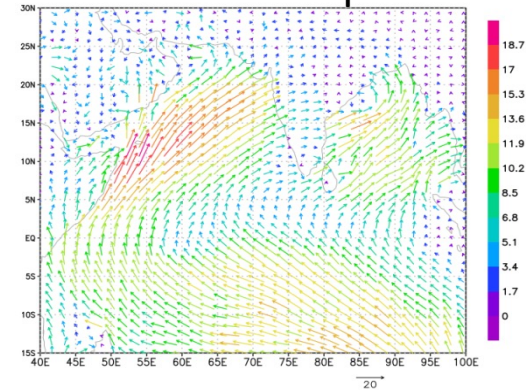
Global sat



Sat Tropics

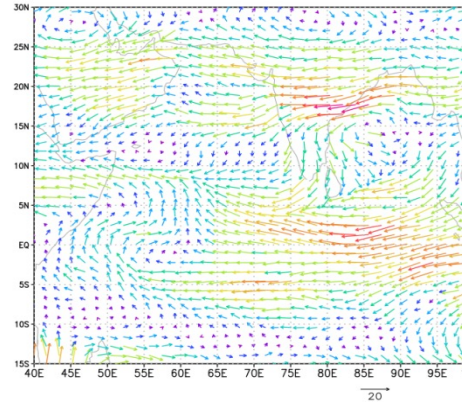


Sat Extra-tropics

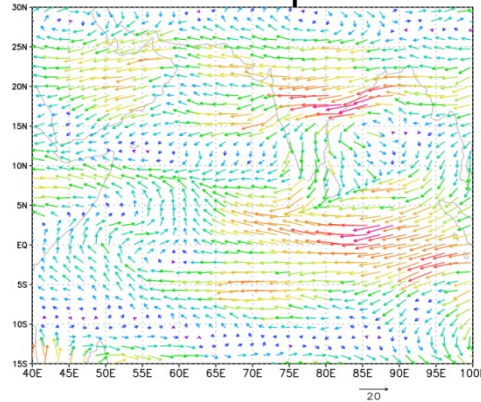


Tropical Easterly Jet (TEJ)

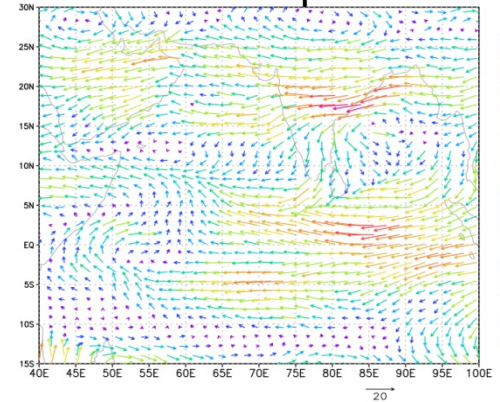
Global sat



Sat Tropics



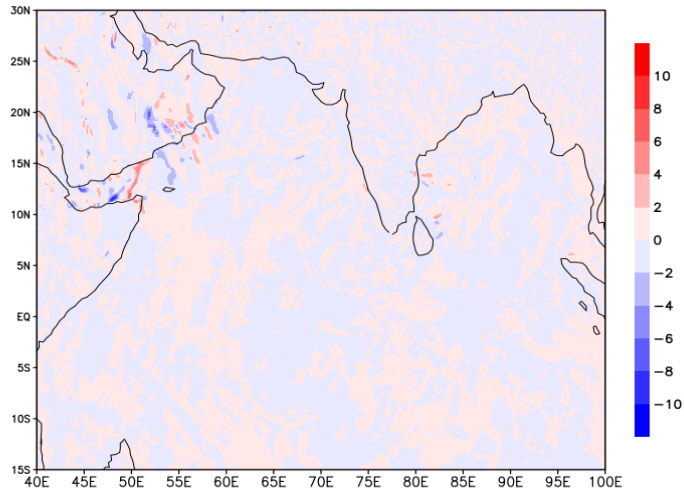
Sat Extra-tropics



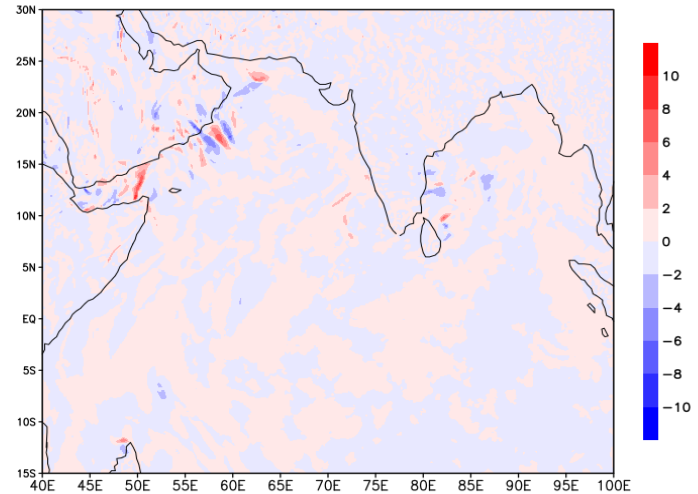


Strength of Monsoon Low Level Jet (LLJ)

Sat Global – Sat Tropics



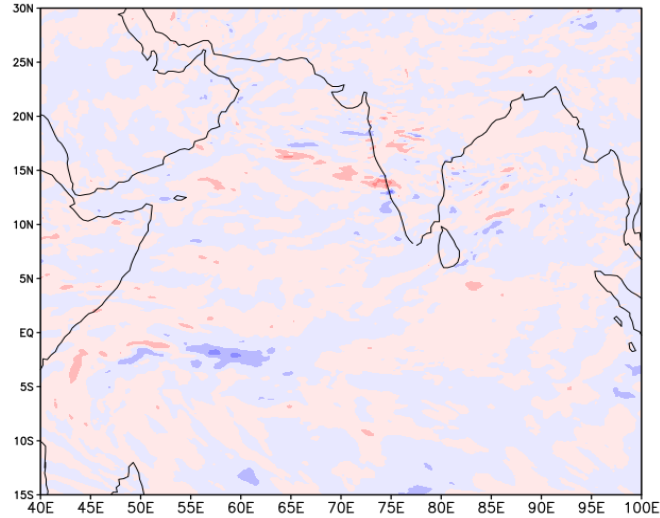
Sat Global – Sat ExtraTropics



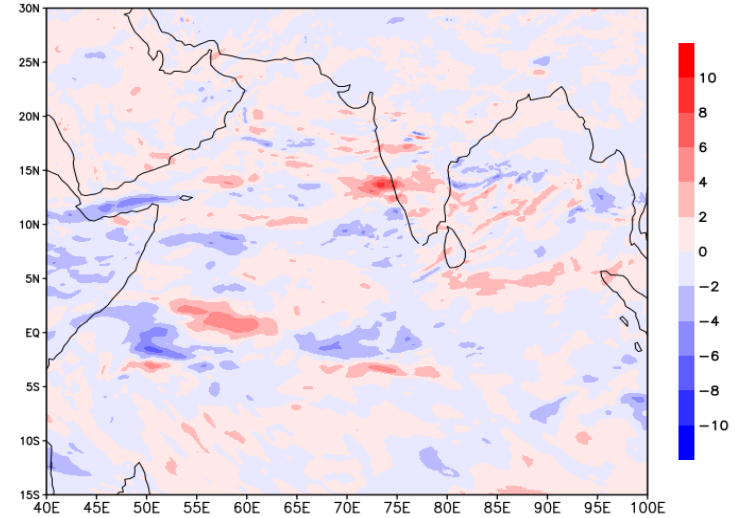


Strength of Tropical Easterly Jet (TEJ)

Sat Global – Sat Tropics



Sat Global – Sat ExtraTropics





Summary



- The Indian summer monsoon (South-West monsoon) is characterized by many semi-permanent circulation system and influenced by global teleconnections
- Present study analysed the impact of ATOVS and ATMS assimilation on the simulation of the two semi-permanent circulation systems, the Low Level Jet (LLJ) and Tropical Easterly Jet (TEJ)
- Assimilation of satellite sounding radiances over the Tropics and the Extra-tropics & Polar regions has showed clear impact on the simulation of the strength of LLJ and TEJ
- Since the upper atmosphere is interacting more with the extra-tropical systems, the assimilation of ATOVS and ATMS over the extra-tropics play crucial role for the simulation of TEJ

Future Aspects

- Influence of ATOVS and ATMS assimilation on other semi-permanent systems associated with the Indian summer monsoon
- Assimilation of Arctic Weather Satellite (AWS) data



Thank you

