The influence of subsurface conditions on the spatial and temporal variability of SST and rainfall over the global tropics in the Past 57 Years (1958–2014) reforecasts

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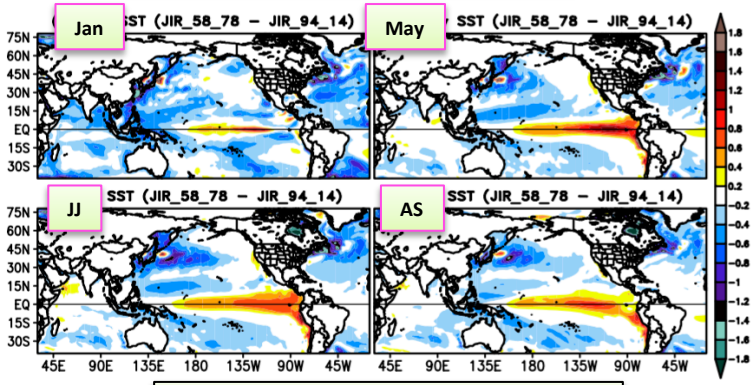
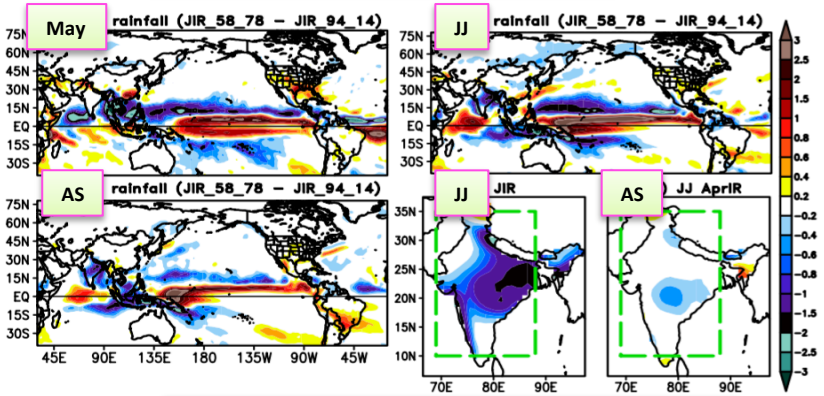
Model and Experimental Design:

- **Model:** **National Centers for Environmental Prediction (NCEP) Coupled Forecast System version-2 (CFSv2)**
- **January initialized reforecasts (JIR) and April initialized reforecasts (AprIR) for period 1958-2014**
- **Ocean initial conditions (OICs)**:European Centre for Medium Range Weather Forecasts (**ECMWF**) **Ocean Reanalysis System 4 (ORAS4)** for **1958-2014**
- **The land, atmosphere, and sea ice ICs**: Climate Forecast System Reanalysis for **1979-2014 & For 1958-1978:** Atmospheric ICs (ERA-40 reanalysis) and land ICs (Global Land Data Assimilation System, version 2.0 analysis)
- **Earlier period** (1958–1978; **P58-78**) and **later period** (1994–2014; **P94-14**)
- Mean of June to July **(JJ)** and mean of August to September **(AS)**

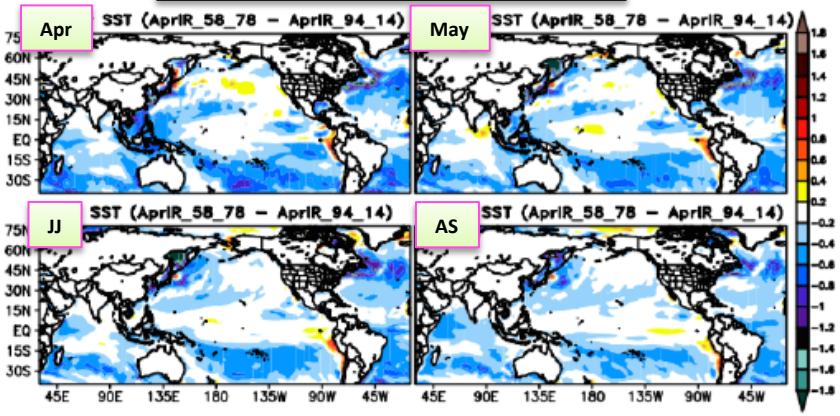
SST JIR (P58-78) – JIR (P94-14)



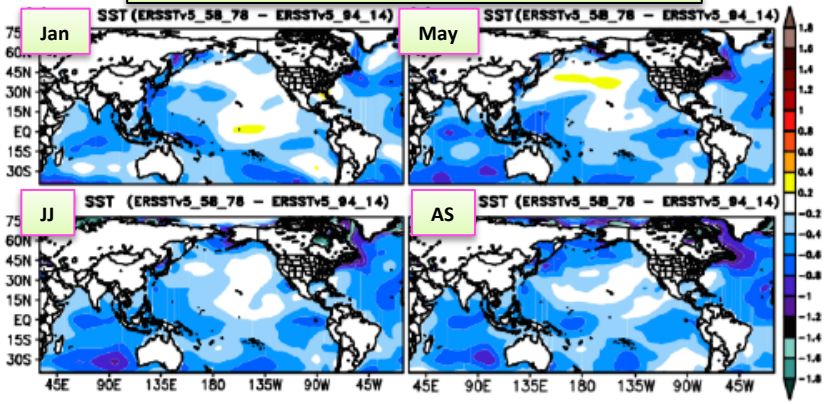
Rainfall JIR (P58-78) – JIR (P94-14)



SST AprIR (P58-78) – AprIR (P94-14)

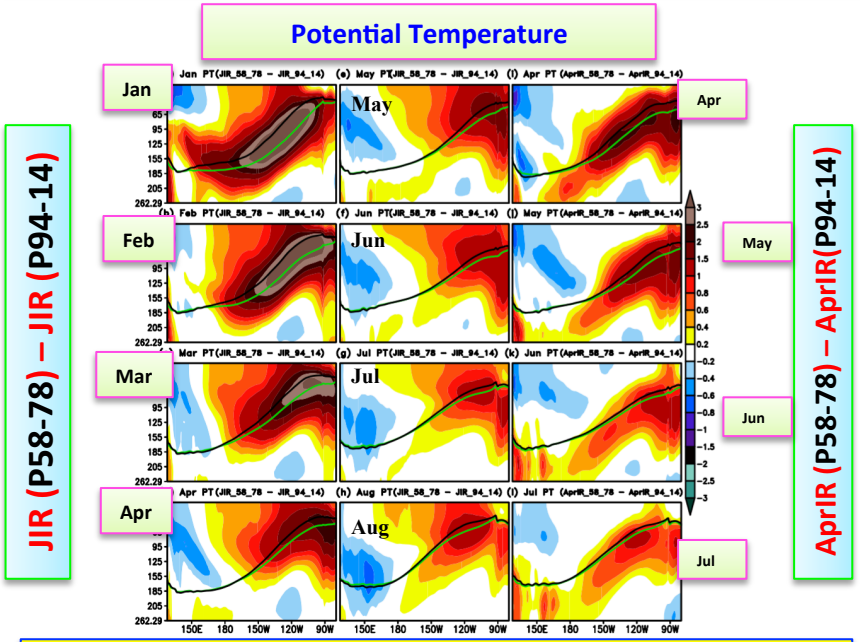


SST ERSSTv5 (P58-78) – ERSSTv5 (P94-14)



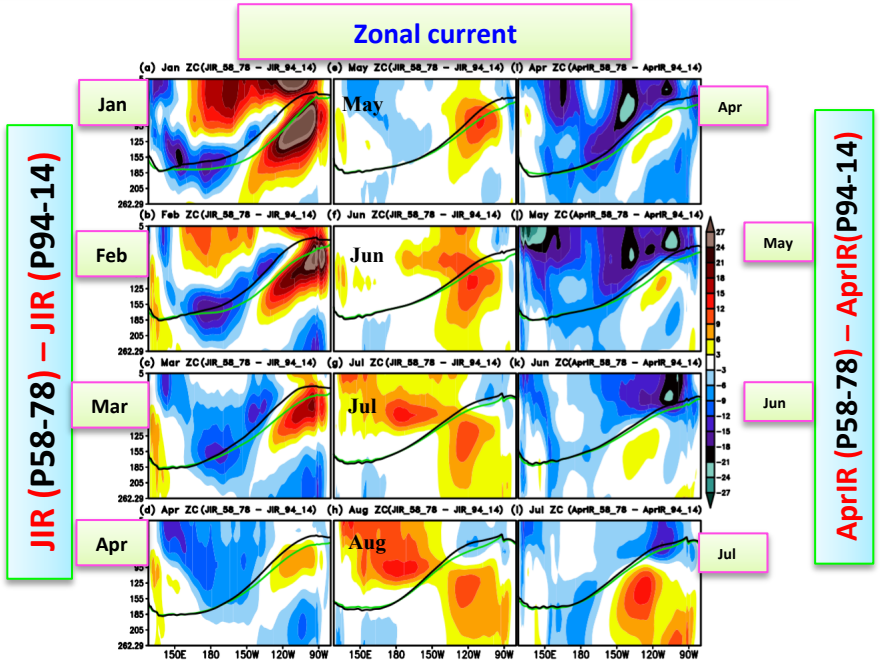
Longitude-depth section (latitude averaged from 1°S to 1°N) of climatological difference of potential temperature (PT), zonal current (ZC; cm/s) and vertical current (VC; meter/day) between JIR (AprIR) during mean of P58-78 and P94-14

Potential Temperature



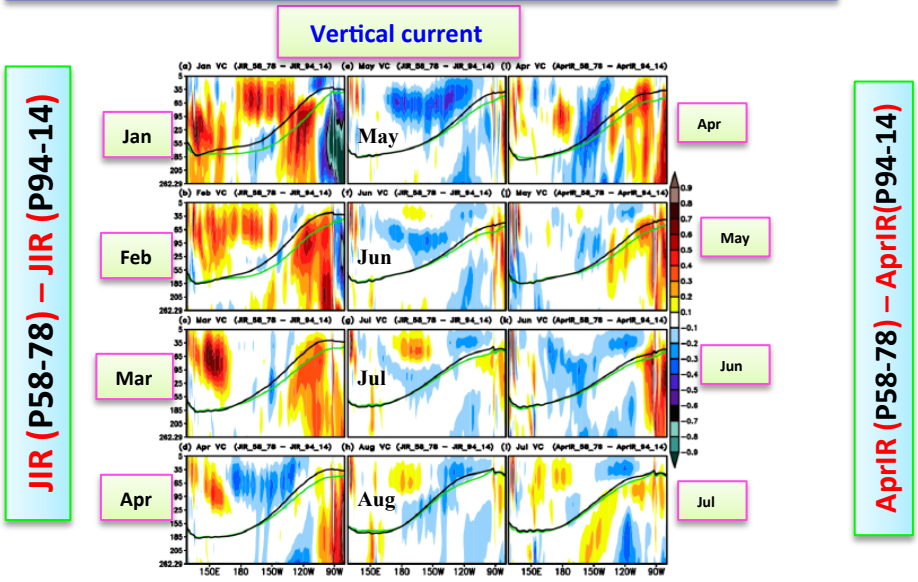
The green line (black line) indicates 20°C isotherm (Z20) in the period P58-78 (P94-14) in both JIR and AprIR.

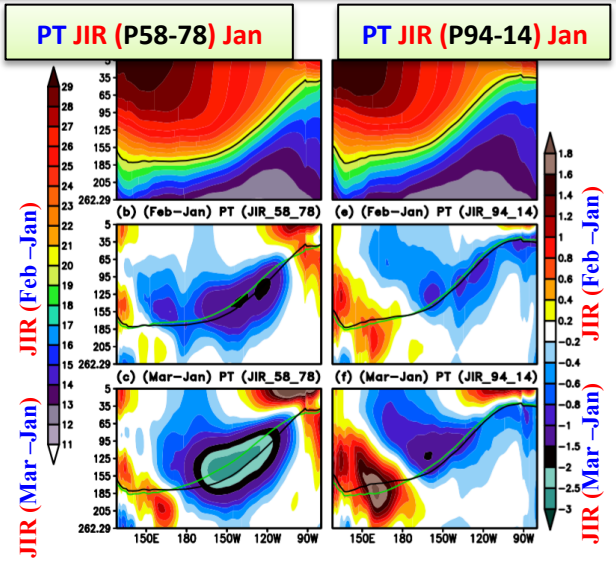
Zonal current



Longitude-depth section (latitude averaged from 1°S to 1°N) of climatological mean of potential temperature (PT) and change of PT with respect to January

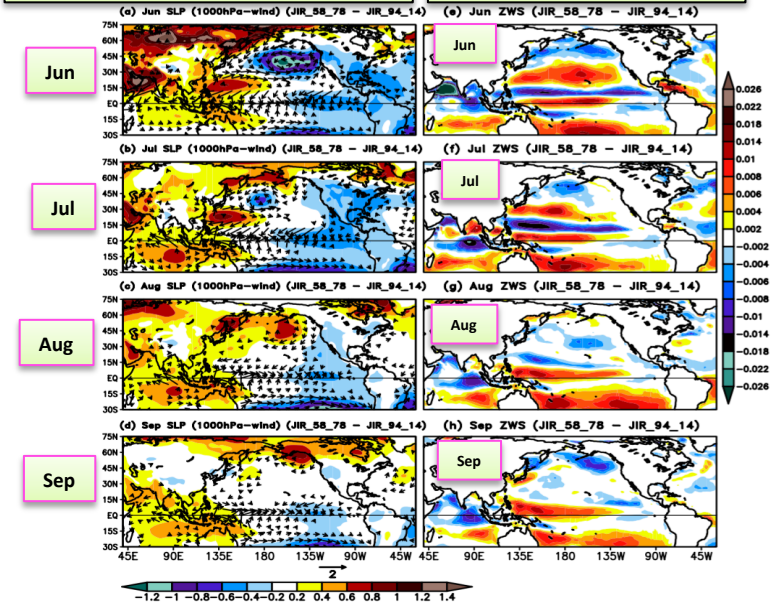
Vertical current





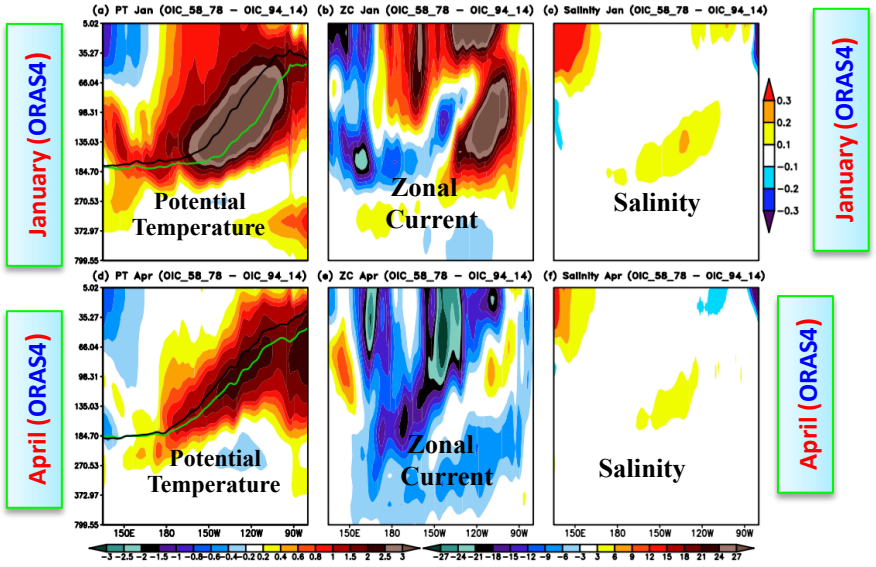
JIR (P58-78) – JIR (P94-14)

SLP (shading) and 1000hPa-winds (vector) | Zonal wind stress (ZWS; N/m²)



Longitude-depth section (latitude averaged from 1°S to 1°N) of climatological difference of OICs (ECMWF ORAS4) in January between mean of P58-78 and P94-14

ORAS4 (P58-78) – ORAS4 (P94-14)



Green line (black line) indicates 20°C isotherm in the period P58-78 (P94-14) in both January (April) ORAS4.

Conclusion:

- The climatological difference of earlier period (1958–1978) and later period (1994–2014) in JIR depicts mild-warm SST over the equatorial eastern Pacific in January but its magnitude becomes larger over there from May to August.
- The difference between JIR P58-78 and P94-14 depicts warm potential temperature up to 3°C over the equatorial central and eastern Pacific at depth from 155m to 70m in January, and magnitude of equatorial undercurrent (EUC) in JIR P58-78 is larger in the eastern Pacific at depth from 125m to 35m in January than JIR P94-14. Therefore, water upwelled to the surface through EUC was usually warm in January of JIR P58-78.
- The 20° C isotherm for period 1958-78 in January of reforecasts tends to be deeper in equatorial eastern Pacific than period 1994-14.
- As lead months increase, the center of warm potential temperature gradually moves upward in the eastern Pacific than its location in January, resulting in development of warm SST in the eastern Pacific in March.
- One of the possible causes is the larger difference of potential temperature and zonal current in January ocean initial conditions (ECMWF ORAS4) between mean of P58-78 and P94-14.