Relationship between prediction skill of surface winds in average of weeks 1 to 4 and interannual variability over the Western Pacific and Indian Ocean

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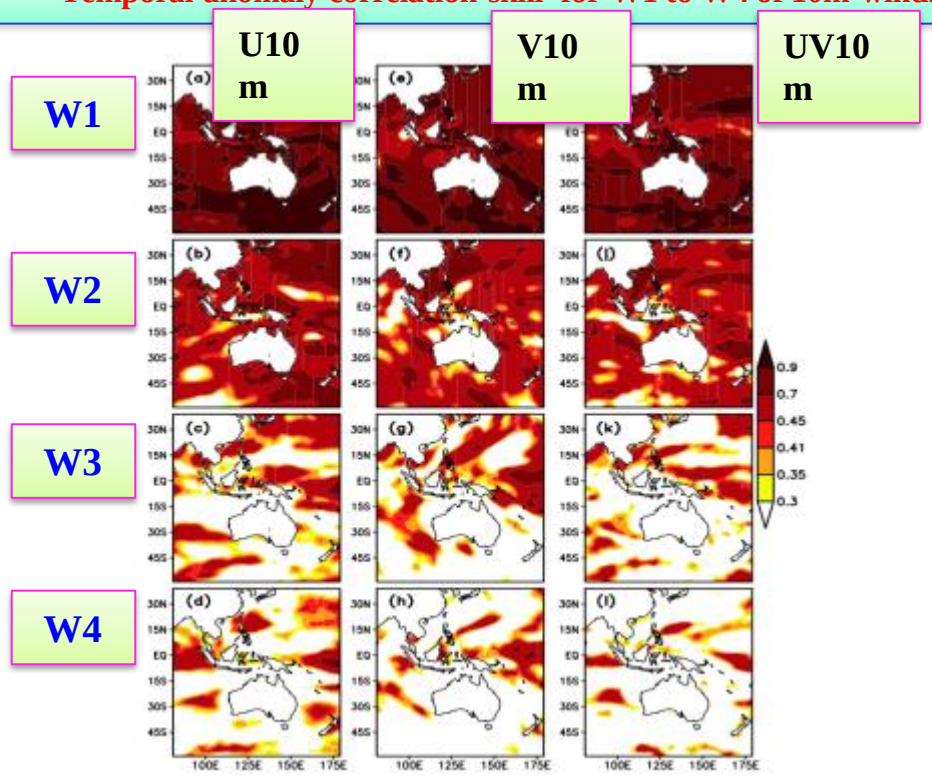
NOAA's 46th Climate Diagnostics & Prediction Workshop
Virtual Workshop
26–28 October 2021

Shukla R. P. and J. L. Kinter **(2021)** Relationship between prediction skill of surface winds in average of weeks 1 to 4 and interannual variability over the Western Pacific and Indian Ocean. **Weather and Forecasting.** https://doi.org/10.1175/WAF-D-20-0181.1

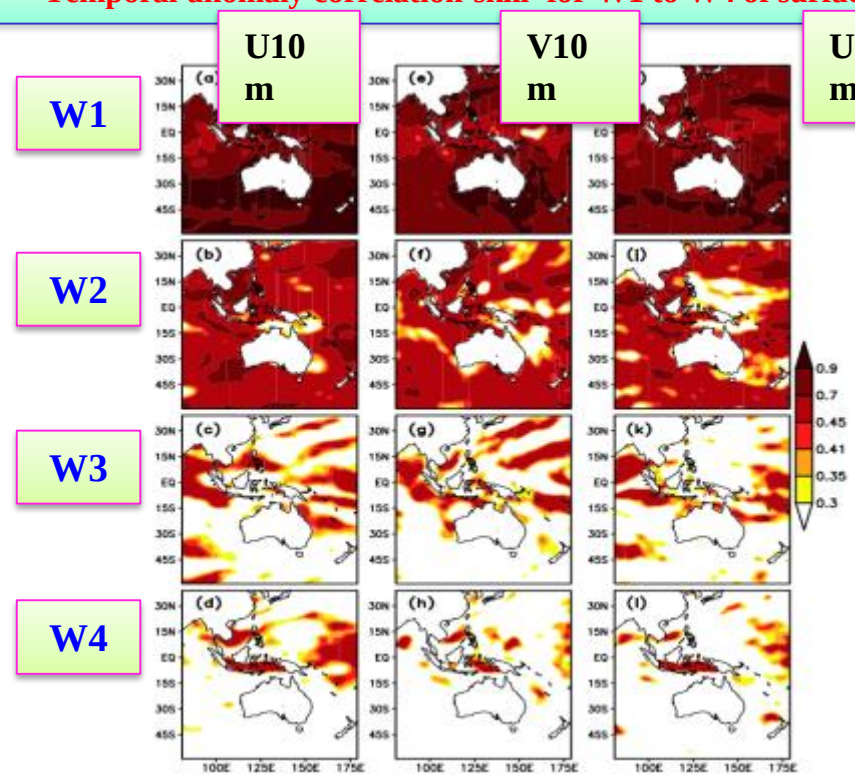
Model and Experimental Design:

- **Model: National Centers for Environmental Prediction (NCEP) Coupled Forecast System version-2 (CFSv2)**
- **January initialized reforecasts (JIR) and May initialized reforecasts (MIR) for period 1979-2008**
- **Ocean initial conditions (OICs)**:Climate Forecast System Reanalysis **(CFSR)**, Global Ocean Data Assimilation System **(GODAS)**, European Centre for Medium-Range Weather Forecasts (ECMWF) Ocean Reanalysis System 3 **(ORA-S3)**, and ECMWF Comprehensive Modelling of the Earth System for Better Climate Prediction and Projection **(COMBINE-NV).**
- **The land, atmosphere, and sea ice ICs**: Climate Forecast System Reanalysis (CFSR)
- The analysis region is a portion of the **Western Pacific and Indian Oceans** (WP-IO; 80°E-180°E; 60°S-40°N) with a grid resolution of 1°x1°.
- The results discussed in the paper are based on the mean of the 16 ensemble members daily instantaneous values (00Z) in both **JIR** and **MIR**.
- The **ECMWF ERA-Interim** instantaneous fields at **00Z for the 30-year period (1979-2008)** are used to verify the model output.
- **Week 1** (**W1**), **week 2** (**W2**), **week 3** (**W3**), and **week 4** (**W4**) for **JIR** are the averages of **1-7 January**, **8-14 January**, **15-21 January** and **22-28 January**, respectively, and average of **weeks 3-4 (W3-4)** is defined as the average of **15-28 January**. A similar convention is adopted for **MIR**.
- **zonal wind at 10m**: **U10m**, **meridional winds at 10m**: **V10m, and magnitude of 10m-winds**: **UV10m**

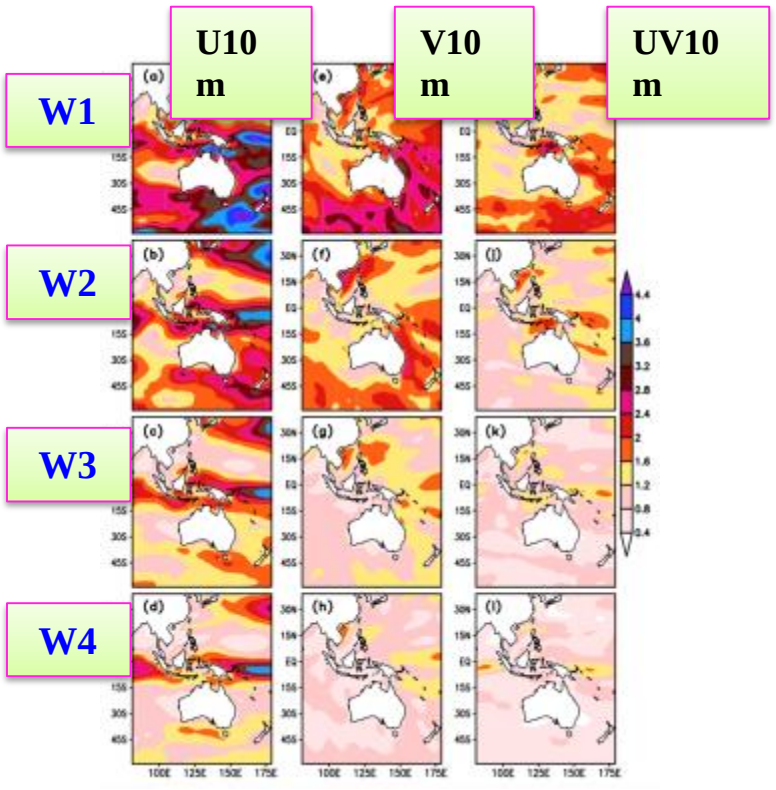
Temporal anomaly correlation skill for W1 to W4 of 10m-winds (JIR)



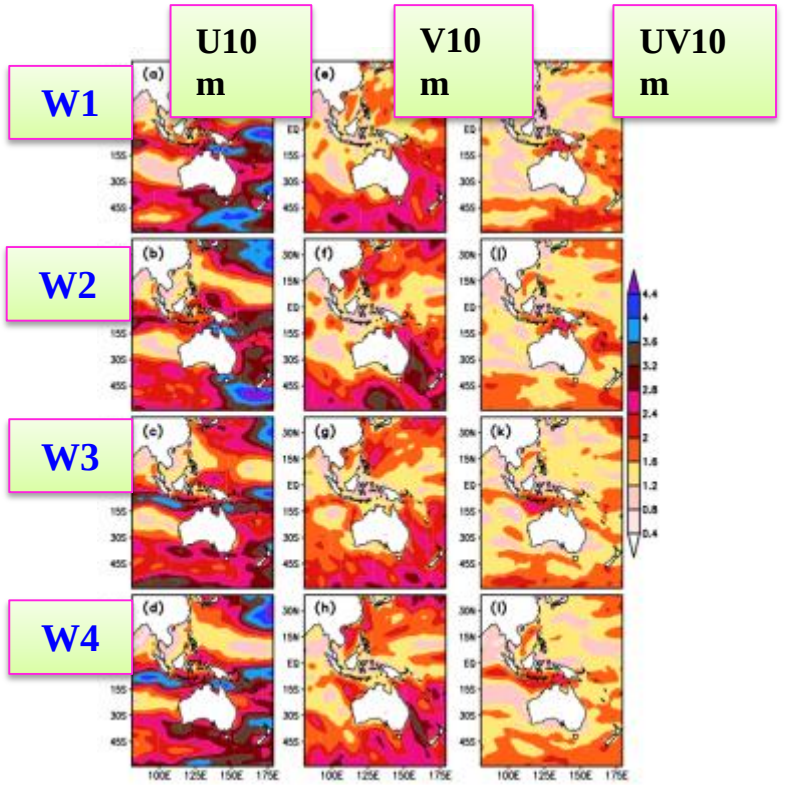
Temporal anomaly correlation skill for W1 to W4 of surface winds (MIR)



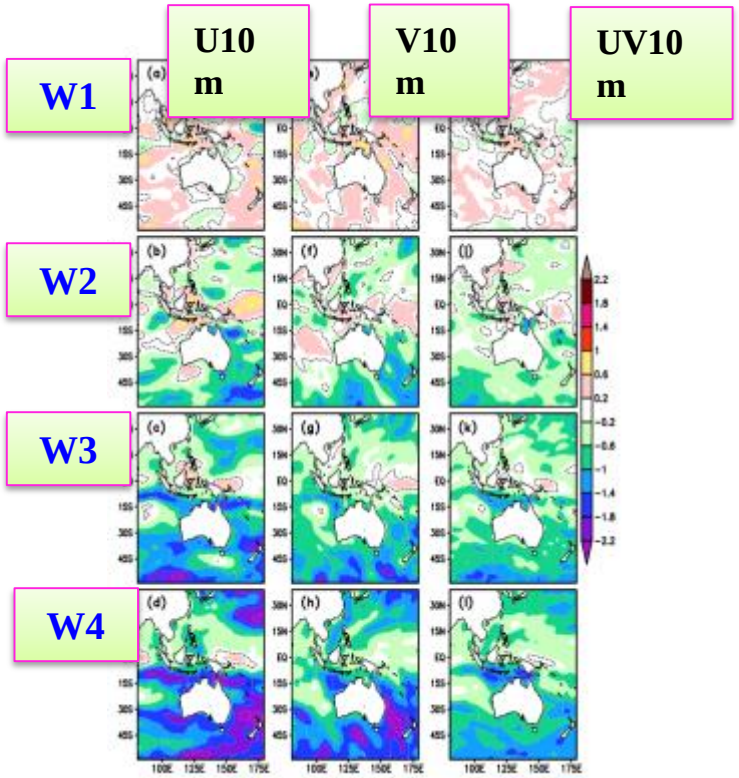
Inter-annual variability (IAV) for W1 to W4 of 10m-winds (JIR)



Inter-annual variability for W1 to W4 of 10m-winds in January (ERA-Interim)



Climatological bias of IAV for W1 to W4 of 10m-winds (JIR - ERA-Interim (Jan))

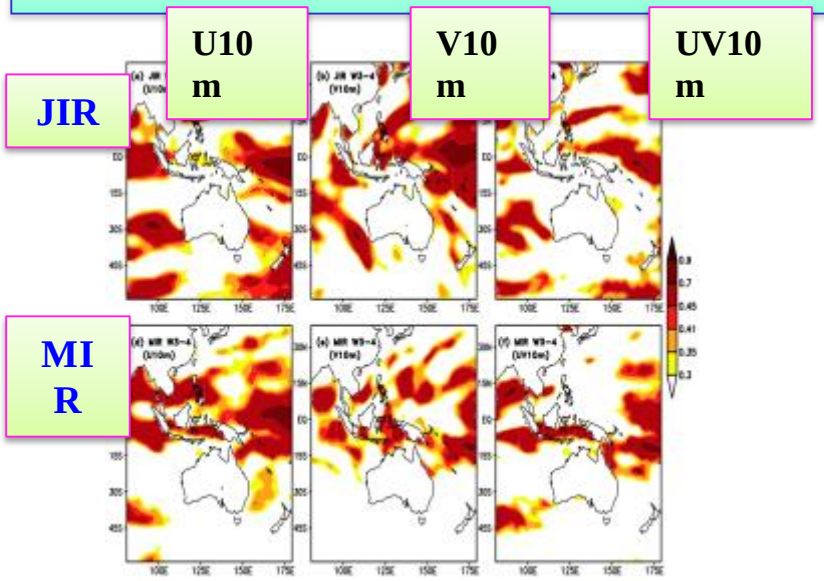


The interannual variability of U10m, V10m and UV10m over the Western Pacific and Indian Ocean (WP-IO) has nearly the same magnitude in JIR and the ERA-Interim reanalysis in W1 for January. Therefore the IAV bias is relatively small in W1 of January.

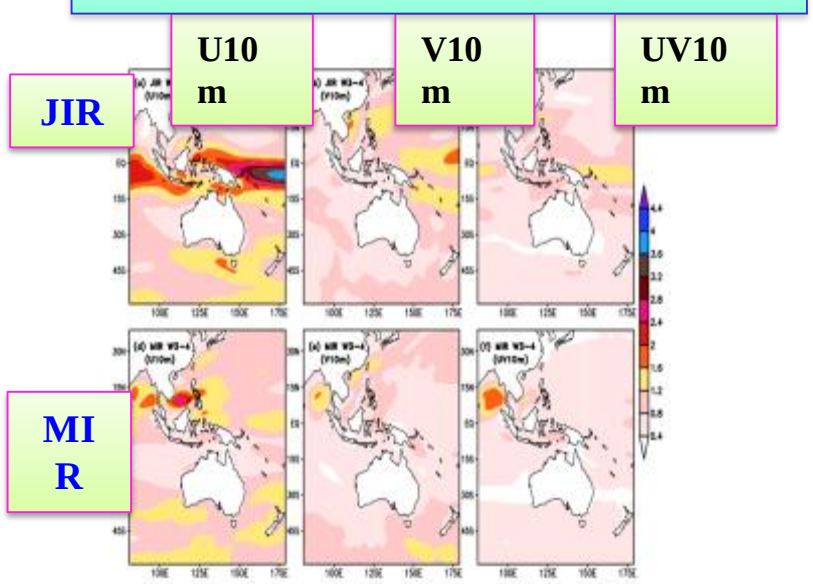
As lead-time increase, the amplitude of weekly average IAV in JIR decreases gradually in the WP-IO mainly over the Southern Ocean, while the IAV in the ERA-Interim reanalysis remains roughly the same over each 4-week period of January.

Therefore, there is much larger weekly average IAV bias in W3 and W4 as a result in JIR over the WP-IO region.

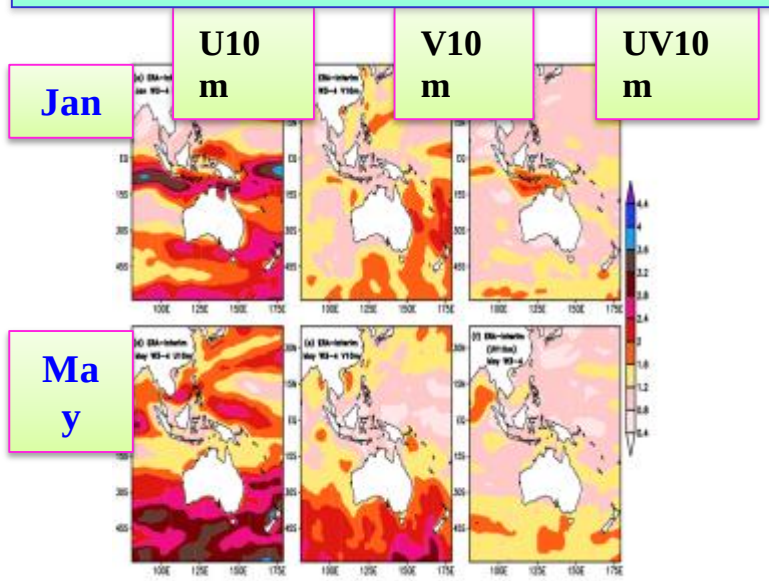
Temporal anomaly correlation skill for W3-4 of 10m-winds in JIR and MIR



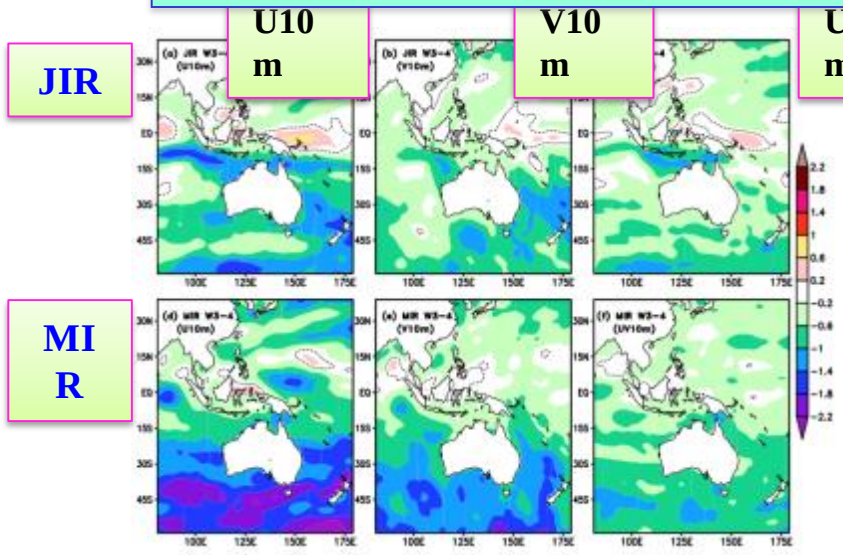
Inter-annual variability (IAV) for W3-4 of 10m-winds in JIR and MIR



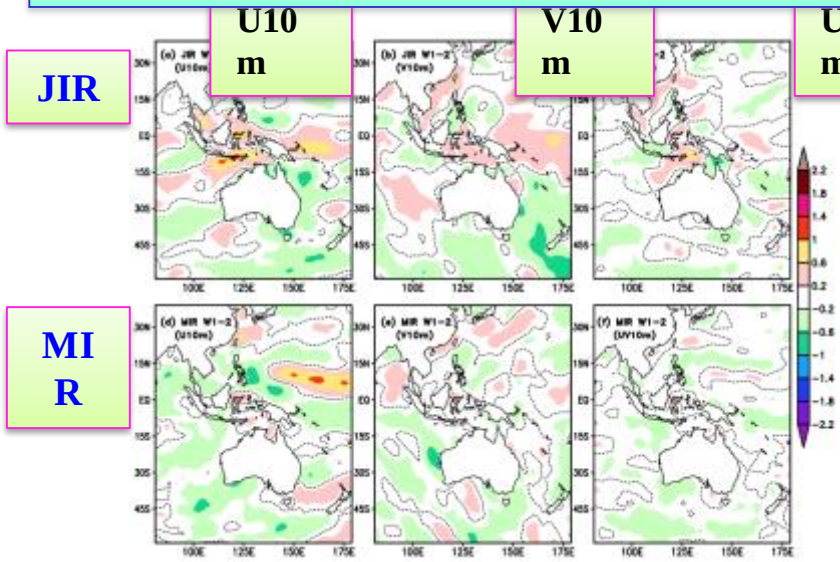
IAV for W3-4 of 10m-winds of January and May in ERA-Interim



Climatological bias of IAV for W3-4 of 10m-winds in JIR and MIR



Climatological bias of IAV for average of weeks 1-2 (W1-2) of 10m-winds in JIR and MIR



Conclusion:

- There is large temporal correlation between forecasts and reanalyses for zonal, meridional and total wind magnitudes at 10m over most of Western Pacific and Indian Ocean (WP-IO) for average of weeks 1 and 2 (W1 and W2) in reforecasts initialized in January (JIR) and May (MIR).
- The model has some correlations that exceed 95% confidence in some portions of WP-IO in week 3 (W3) but no skill in week 4 (W4) over most of the region.
- Model depicts prediction skill in 14-day average of weeks 3-4 (W3-4) over portions of WP-IO, similar to level of skill in W3. The places where temporal anomaly correlation coefficient (TACC) is exceeding 95% confidence in W3-4 coincide with the places where the TACC is larger in W3.
- The amplitude of interannual variability (IAV) for 10m-winds in W1 of JIR and MIR is close to that in reanalyses. As lead-time increases, amplitude of IAV of 10m-winds gradually decreases over WP-IO in reforecasts; in contrast to behavior in reanalyses.
- The amplitude of IAV of predicted 10m-winds in W3-4 over WP-IO is equivalent to that in W3 and W4 in reforecasts. In contrast, the amplitude of IAV in W3-4 in January and May of reanalysis is much smaller than IAV of W3 and W4.
- Therefore, one of the possible causes for prediction skill in W3-4 over sub-regions of WP-IO is due to reduction of IAV bias in W3-4 in comparison to IAV bias in W3 and W4.
- The results of this paper provide the importance of interannual variability of 10m-winds in the sub-seasonal prediction in the state-of-the-art coupled general circulation model reforecasts.