Towards Typhoon forecasting in the S2S time scale

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1.Motivation

- The western North Pacific (WNP) is the most active ocean basin of Tropical cyclones (TCs).
- Many studies examime that the intraseasonal oscillation (ISO) modulates TC genesis in the WNP (Nakazawa 2006; Yoshida et al., 2014; Nakano et al. 2015).
- If the large-scale flow pattern is modulated by the ISO, TC track would also be modulated.
- Considering the ISO is predictable for about a month, the modulation of TC track may be predictable.

2.Data

- The S2S reforecast data by IFS Cy43R3
  - Zonal and meridional winds and thermal net radiation at TOA
  - TC track data
- NOAA OLR
- ERA-Interim
- IBTrACS-WMO (v3r10)

3.Method

Detection of the ISV

After Kikuchi et al. (2012), a dominant mode of the ISO (MJO/BSISO) is identified for each day.

- Simulated ISO-filtered OLR is projected on the observed l eading 2 EEOFs of boreal summer (JJA) and winter (DJF), respectively.
- Larger unnormalized amplitude of the ISO mode is selected as the dominant ISO mode.

The ISO-filter

- Subtract daily model climatology from raw OLR.
- Previous 40-day mean is subtracted to remove low frequency component.
- 3-day running mean is applied to remove high frequency component.
- Observed data before the initial time of the model is used to calculate above filtered value.
- Same filter is applied for NOAA OLR then EEOF analysis is performed for JJA (BSISO) and DJF (MJO). The ISO filtered OLR is projected on the observed EEOFs to detect the ISOs in the S2S models.

By the way, what is the BSISO?

- The BSISO is the dominant ISV in the boreal summer.
- Convective envelope propagate northward/northwestward over the northern Indian Ocean and the WNP.
- In the WNP, phases 1-4 are inactive phases and phases 5-8 are active phases.

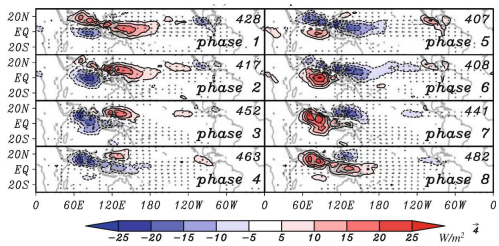

Fig.1 The BSISO composite of OLR anomaly (Fig 8b of Kikuchi et la. 2012)

TC track analysis

- TCs formed in 0-25N 100-180E during June-Octorber are analyzed.
- In the IBTrACS, max. surface wind speed ≥ 35 kt are regarded as TCs.
- In the reforecast, storms with max. surface wind speed ≥ 25 kt are regarded as TCs.
- Track for TCs formed in specific BSISO phases (active/inactive) in a month are composited on 5 deg x 5 deg grids and then dividing by the number of TCs.
- So we compare the climatological TC strike probability in specific BSISO phases (active/inactive) in a month.

References:
Kikuchi et al. (2012), Clim. Dyn., doi:10.1007/s00382-011-1159-1
Nakano et al. (2015), GRL, doi:10.1002/2014GL062479
Nakazawa (2006), SOLA, doi:10.2151/sola.2006-035
Yoshida et al. (2014), SOLA, doi:10.2151/sola.2014-004

4.Results

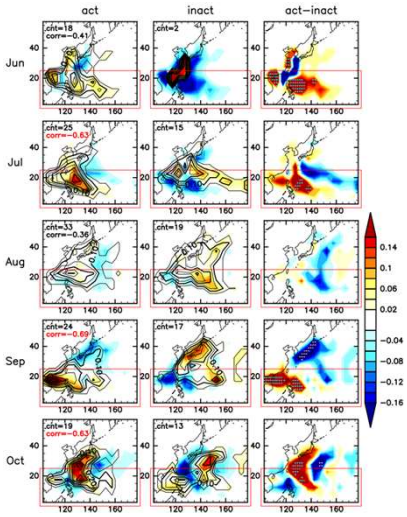

Fig. 2 Climatological TC strike probability for TCs formed in active (left) and inactive (middle)phases of the BSISO (contour) and its anomaly (shade) and difference between active and inactive phases (right). Dots in the difference shows statistical significance above the 95 % confidence level by bootstrap method.

- The impact of the BSISO is obvious for July, September and October.
- Interestingly, the impact is not clear in Aug.

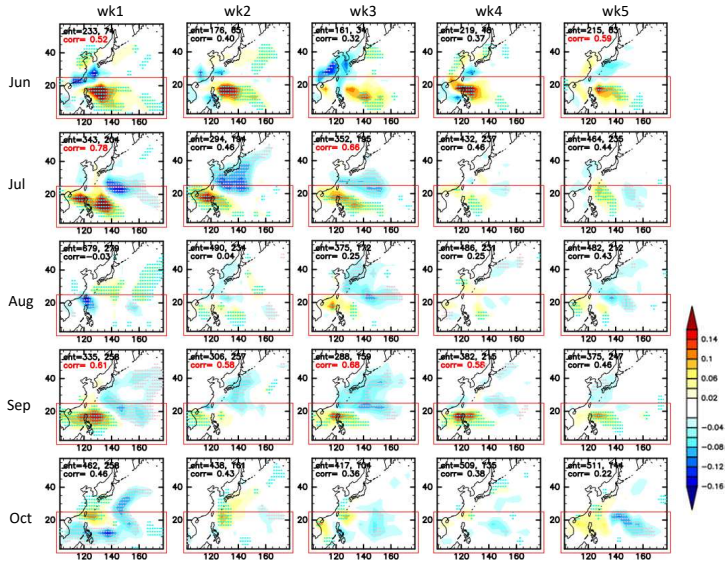

Fig. 3 Difference in TC strike probability between active and inactive phases simulated in IFS Cy43R3. Dots in the difference shows statistical significance above the 95 % confidence level by bootstrap method. Correlation coefficient between the model and the observation is shown in the panels.

- IFS keeps corr > 0.5 in week 4 in September.
- However, it is difficult to reproduce observed impact of the BSISO in July and October.

5. What is important to reproduce the difference?

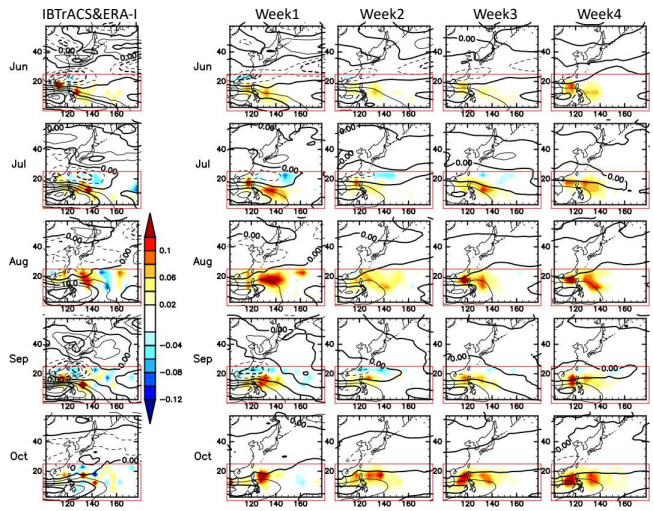

Fig. 4 (very tentative) Difference in number of TC genesis (shade) and zonal steering flow (contour with an interval of 2m/s) between active and inactive phases.

- Both the differences in TC genesis distribution and steering flow may cause the difference in TC strike probability.
- However, differences in steering flow in the north of 20N vanish after week2. ==>>Steering flow is not important??