# Predictability of Two Types of El Niño Assessed by ECMWF System 5 and its Impacts on Western North American Climate


**Muhammad Azhar Ehsan**[1,2]

1) International Research Institute for Climate and Society (IRI), Columbia University, NY, US.
2) The Center of Excellence for Climate Change Research (CECCR) King Abdulaziz University, Jeddah Saudi Arabia.


International Research Institute for Climate and Society
Earth Institute | Columbia University

## Abstract


Predictability of El Nino-Southern Oscillation (ENSO) is examined using an ensemble hindcasts data obtained from the new seasonal forecasting system (system-5) of the European Centre for Medium Range Weather Forecast (ECMWF). Particular attention is paid to differences in predictive skill for two prominent types of El Nino: the canonical eastern Pacific (EP) El Nino and the central Pacific (CP) El Nino, the latter having a maximum warming around the date line. The system-5 shows a significant ability to predict ENSO with a lead time of more than half a year. However, composite analyses of each type of El Nino reveal that, compared to EP El Nino, the ability to predict CP El Nino is limited and has shorter lead time. This is because CP El Nino have relatively small amplitude, and thus they are more affected by atmospheric noise, which can limit its predictability. Finally, the sensitivity of Western North American climate to EP/CP type El Nino is also discussed during boreal winter season.


## Obs. & Reforecast Datasets

**Observation:**

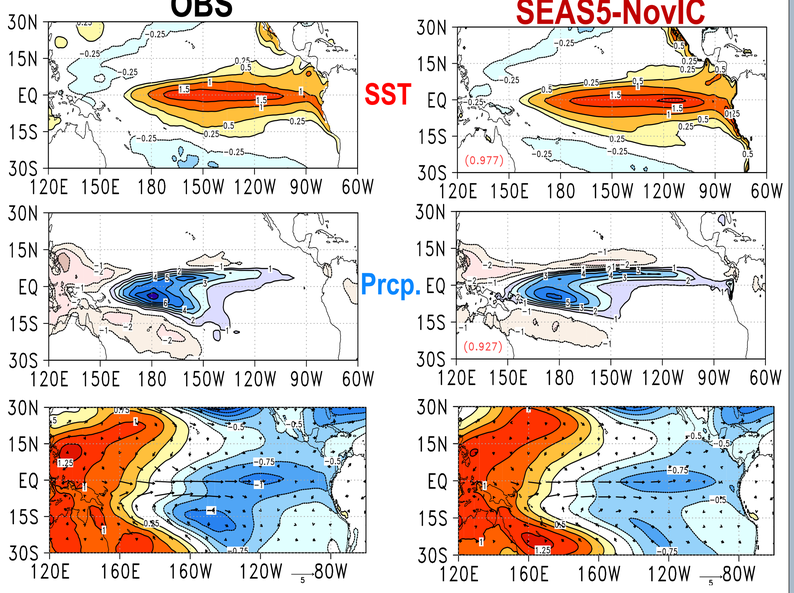
- ✧ **Period:** 1981 to 2018, 37 years,
- ✧ **Season:** Boreal Winter from Dec to Feb (DJF),
- ✧ **SST:** NOAA Optimum Interpolation v2 (OISST),
- ✧ **Prcp:** CPC Merged Analysis of Precipitation (CMAP)
- ✧ **MSLP, Winds, GPH:** Climate Reanalysis by ECMWF (ERA5) and NCEP/DOE Reanalysis II by NOAA/ESRL.

**Model:**

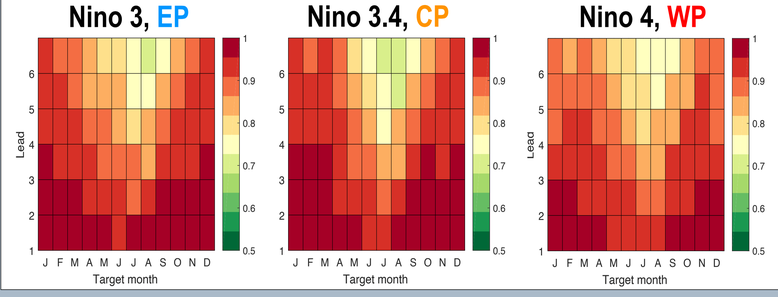
- ✧ ECMWF System 5 (SEAS5) for All Starts and Leads as well as Nov, Oct and Sep based ICs.

## All Warm Events & Nino Indices

### ENSO Compo. (Warm Events) for DJF

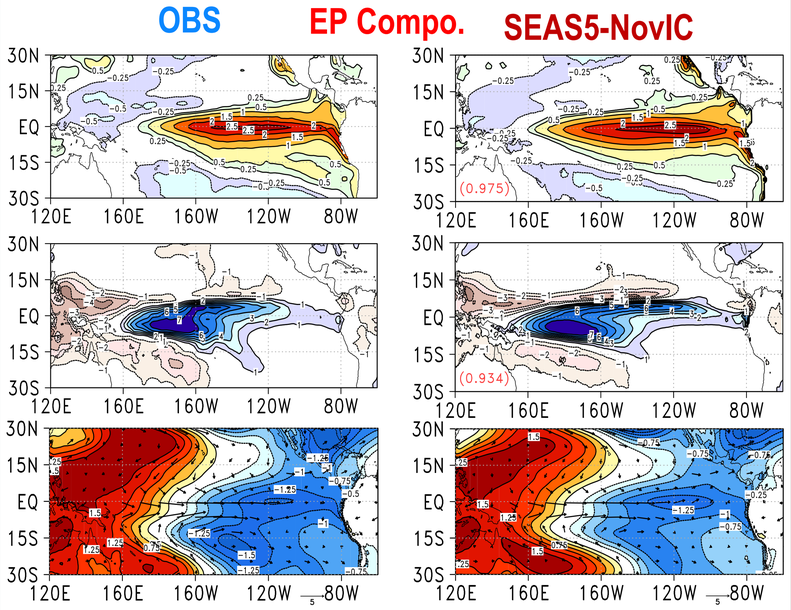



### Anomaly Correlation of Ensemble mean Forecast and Observed Anomalies as a Function of Target Month and Lead Time in Months over,




## Warm Events Decomposition in Obs. & SEAS5

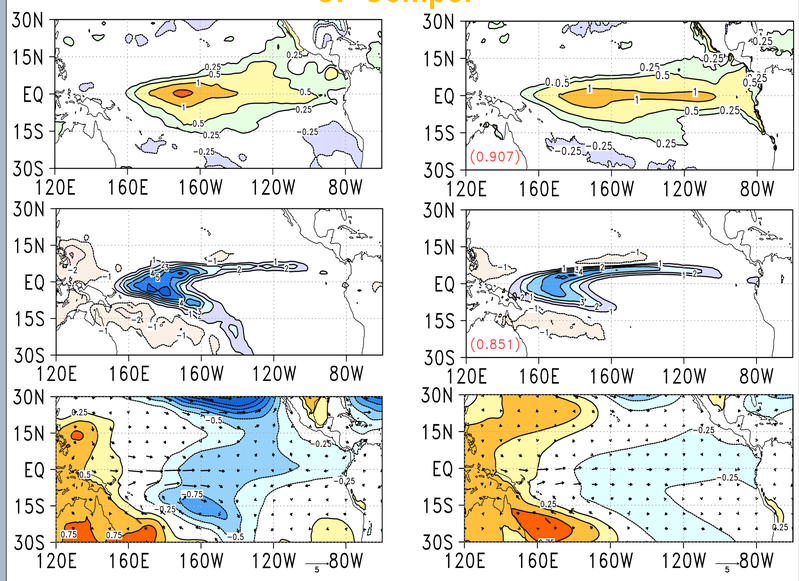
| Type | Winters | Number |
|---|---|---|
| EP | 1982/83, 1986/87, 1991/92, 1997/98, 2006/07, **2015/16*** | 6 |
| CP | 1987/88, 1994/95, 2002/03, 2004/05, 2009/10, **2014/15*** | 6 |




### Tropical SST & Prcp patterns are well reproduced by the model in case of EP

- ✓ PCC is 0.975 (0.934) for SST (Prcp) over the domain, and marginally decreases in Oct and Sep based forecast.
- ✓ MSLP and 850hPa wind pattern is also well reproduced.
- ✓ Strong westerly wind burst is evident.

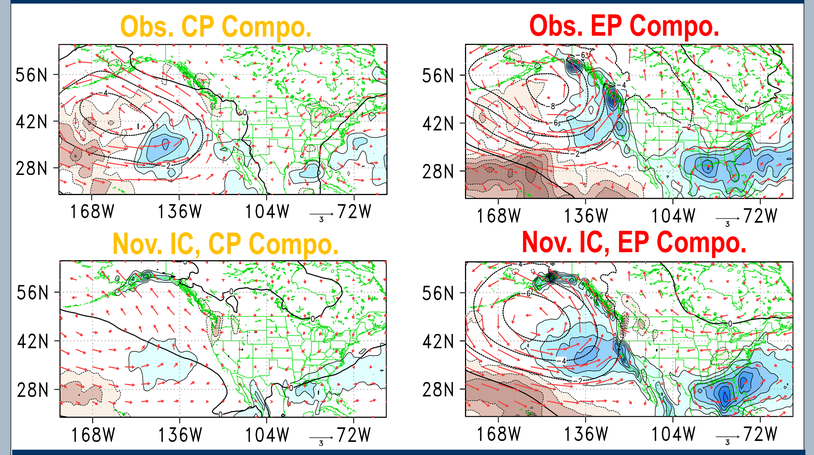
### CP Compo.



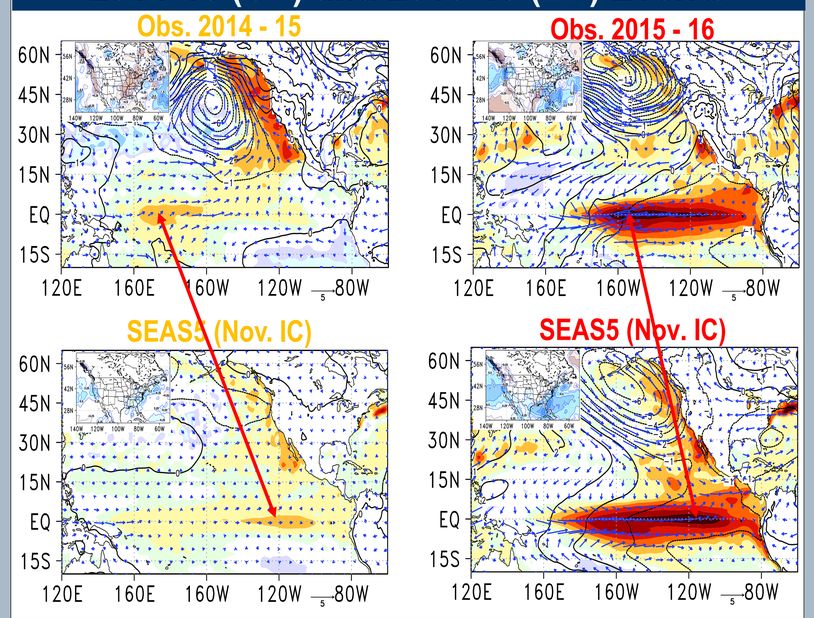

### Tropical SST & Prcp patterns are captured but magnitude is reduced by the model in case of CP.

- ✓ PCC is 0.907 (0.851) for SST (Prcp) over the domain, and rapidly decreases in Oct and Sep based forecast.
- ✓ Model shows weaker MSLP and 850hPa wind pattern as compared to observation.
- ✓ Relatively weak westerly wind burst is evident.
- ✓ These results are similar to earlier studies e.g., Ren et al. 2019.

## Impacts on Western North American Climate

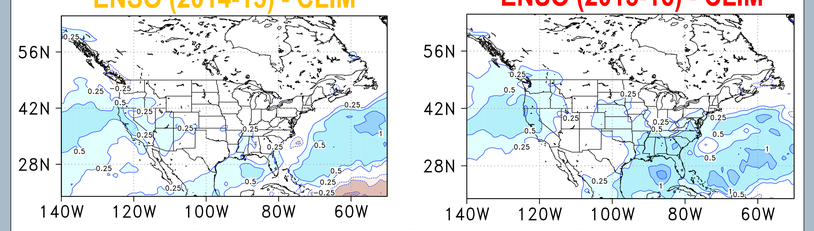



## 2014-15 (CP) and 2015-16 (EP) Events




## Idealized AGCM Exps.

### Diff. of Prcp for Jan-April: JFMA




**Saudi-KAU Global Climate Model (AGCM) is used for Idealized experiments.**

1) SST-Climatology EXP (CLIM: 36 Years).
2) 2015 and 2016 winter SST pattern imposed on CLIM (36 Years).
3) The difference between the (2) and (1), provide us the response of the ENSO idealized pattern.
4) SST forced (**AGCM**) and SEAS5 (**CGCM**) looks quite similar!

## Summary Points

This study investigates the predictability of two types of ENSO events in winter to examine whether dynamical predictions can distinguish the two spatial patterns at different lead times. Three point summery results are;

- ✓ **CP Type events** show weaker magnitude of SST, precipitation and lower level winds as compared to observation in SEAS5 for Nov. based forecast.
- ✓ **Impact over Western US** show noisy pressure and winds pattern as compared to EP composite.
- ✓ For selected **CP** and **EP** events, idealized AGCM simulations shows similar results as the coupled model predictions. This warrants further research on this topic.


**AMS100 at Boston MA, 13 Jan 2020: Poster # 140**