

Decadal Variation of ENSO teleconnection in the
South Asian region
On the Arabian Peninsula Precipitation

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Fred Kucharski^(2,3)**

- 1) Seoul National University, Korea
- 2) King Abdulaziz University, Saudi Arabia
- 3) ICTP, Italy

In 2010, King Abdulaziz University, Saudi Arabia established **Center of Excellence for Climate Change Research (CECCR)**

Research Fields at CECCR:

- Development of Global Climate Model based on SNU-GCM
 - Seasonal Prediction (Decadal to intra-seasonal time scale)
 - Long-term climate studies
 - Moving towards the seamless prediction
- Regional Climate Modeling studies
- Climate change
- Weather and climate extremes
- Impacts of climate change on the climate of the Arabian Peninsula

Research Facilities at CECCR:

- Aziz Super Computer (12000 cores, 7.5 Pb Storage)
- Experienced Research Team
- Graduate Students (PhD, MSc)
- Post Doctoral Researchers

CECCR is a unique center in the Arab region and it can be considered as a regional hub in the field of **Climate and Climate Change research**.

**CECCR conducted a Regional Targeted Training Workshop on Seasonal Prediction for the Arab Region
December 2014**

Lecture Session (Morning)



Practical Session (Afternoon)



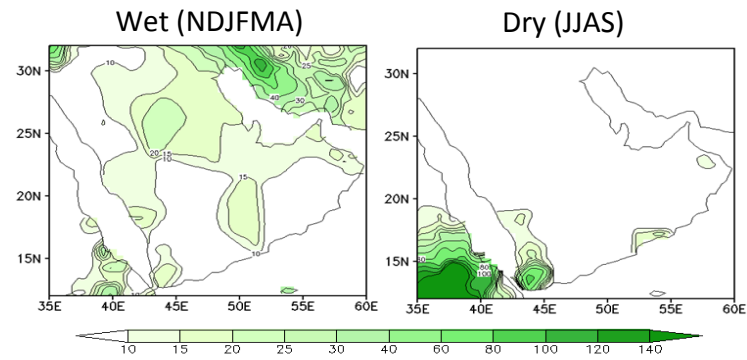
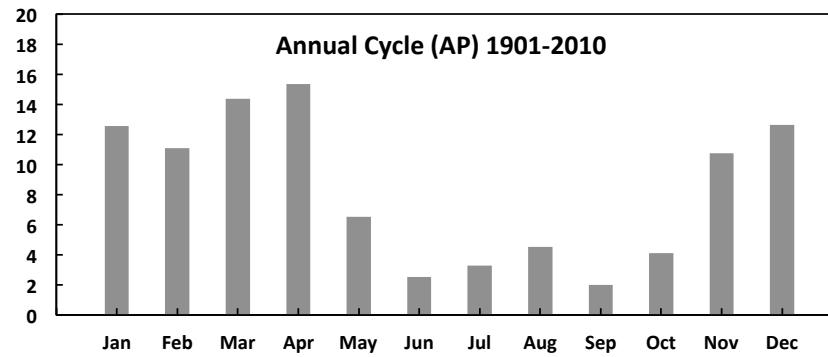
Collaborations

CECCR is collaborating with regional and international institutes including

- International Centre for Theoretical Physics (ICTP), Italy
- Columbia University, USA
- Seoul National University (SNU), South Korea
- Climatic Research Unit (CRU), University of East Anglia, UK

The Director of CECCR Prof. Mansour Almazroui is keen to work with other collaborators from home and abroad.

Precipitation Climatology in the AP region



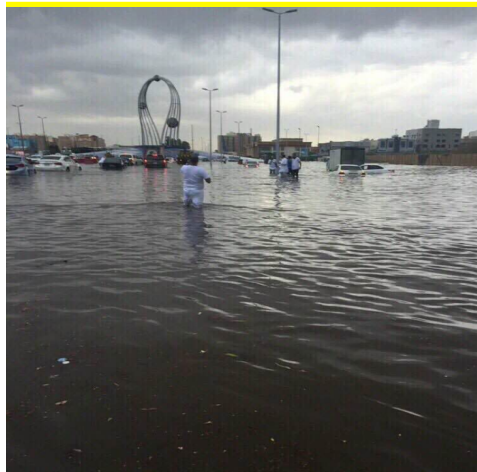
**Extreme Rainfall Event in
Jeddah: 25 NOV 2009
(111mm)**



**Extreme Rainfall Event
in Jeddah: 26 JAN 2011
(74mm)**



Extreme Rainfall Event in Jeddah: 17 NOV 2015



To: [Dr. Mansour Almazroui](#)

**Re: Transportation Information:
Airport-hotel-Airport**
Today at 19:39

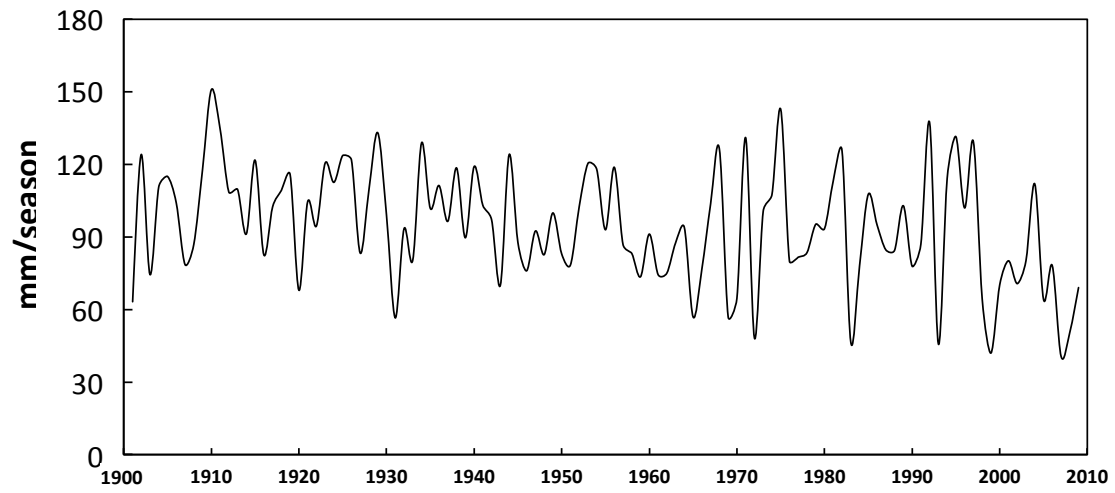
Dear Mansour

Just to be sure, do you know the name of the hotel the taxi driver is dropping me?

Wow, i never seen so much water on the street.

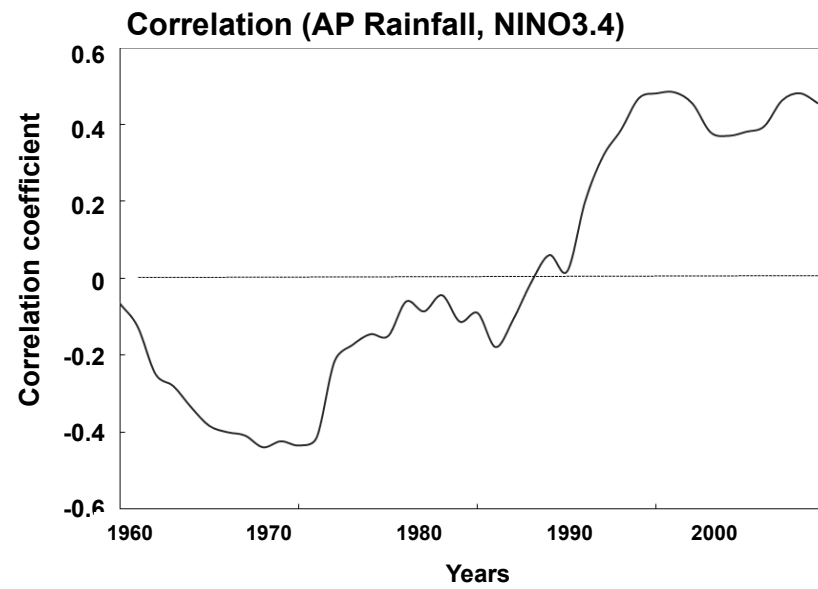
**The year 2015 is a STRONG
El Nino year!!!**

AP Regional Mean Precipitation for Wet Season
(1901-2010)

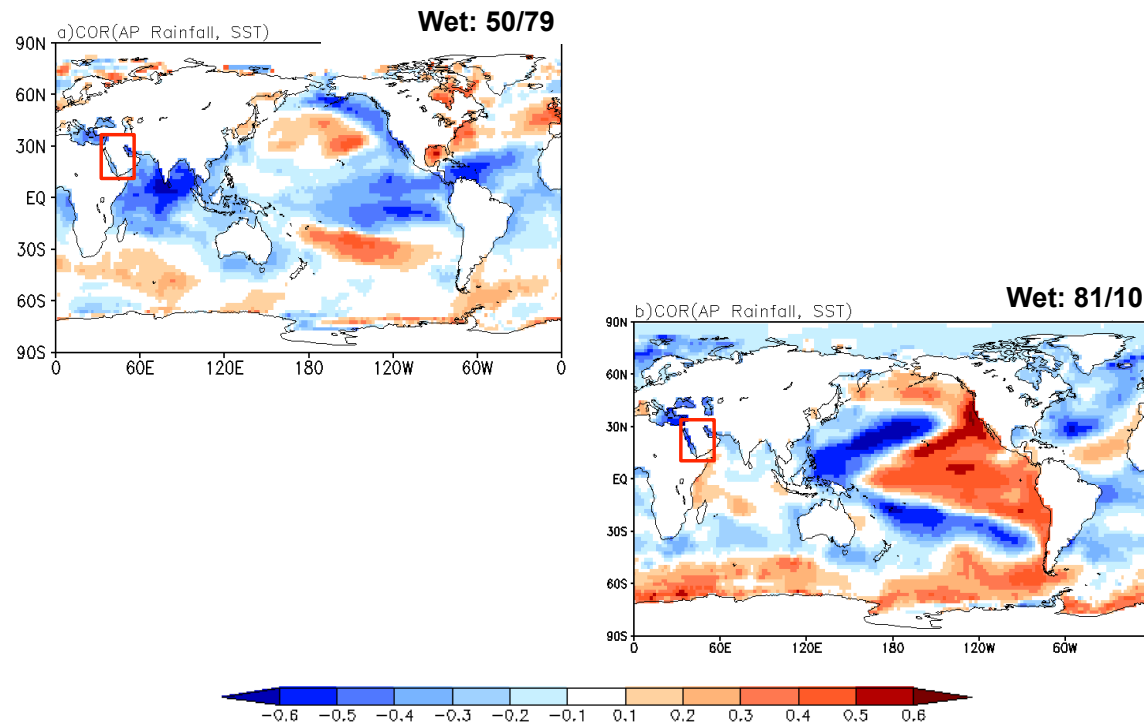


Multi-decadal relation between the AP rainfall and ENSO

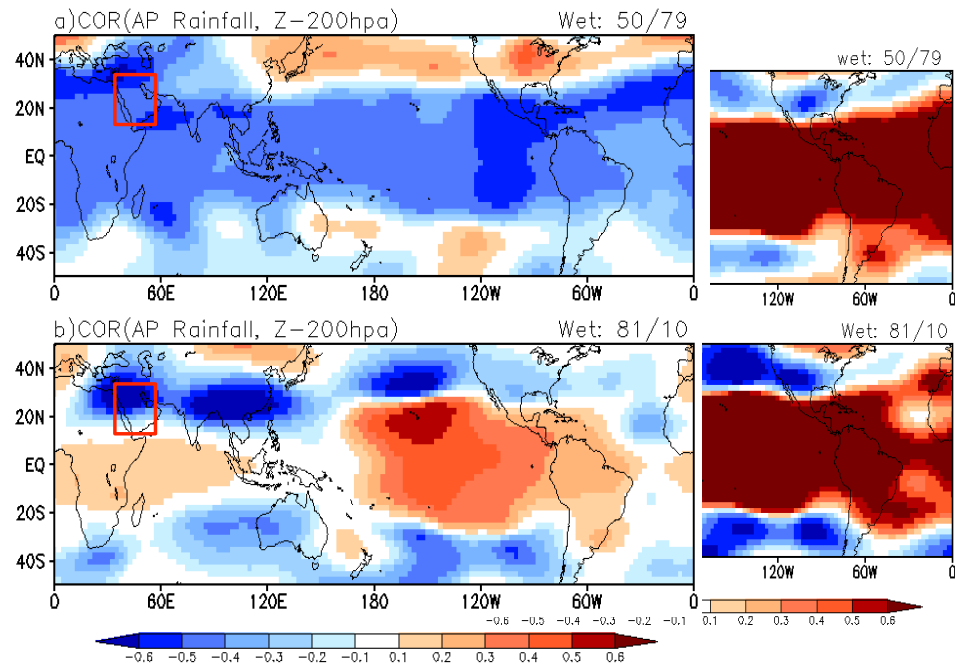
Running correlation between Arabian Rainfall and NINO 3.4 index
(21 year window)



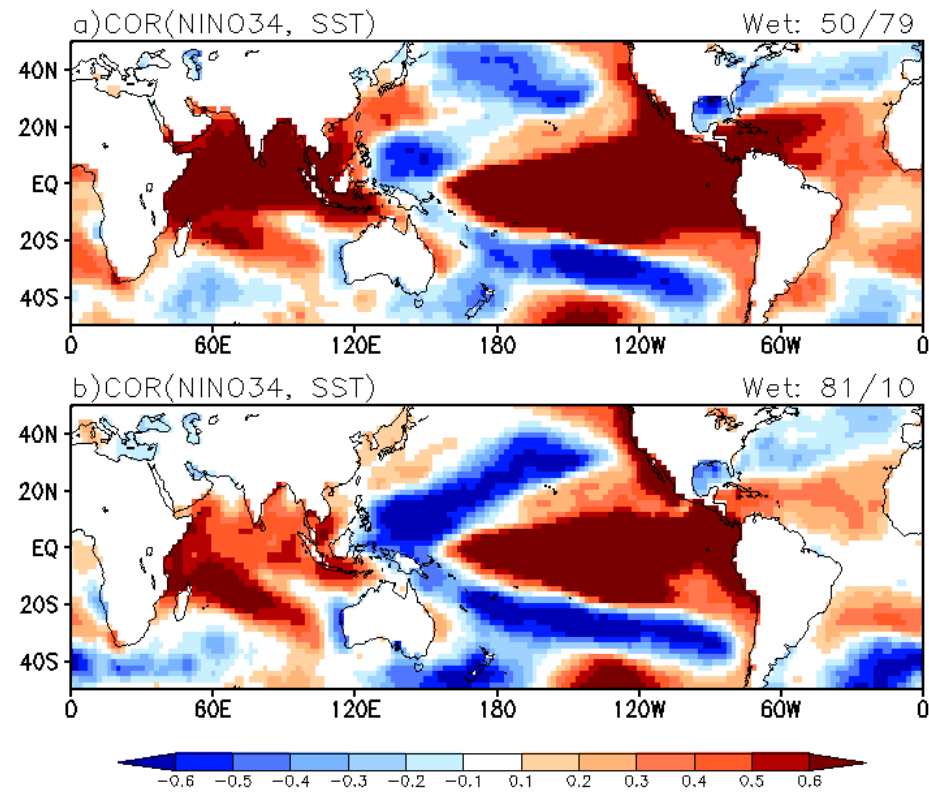
Correlation between AP Rainfall and SST for 1950-1979 and 1981-2010



Association of ENSO with Atmospheric circulation

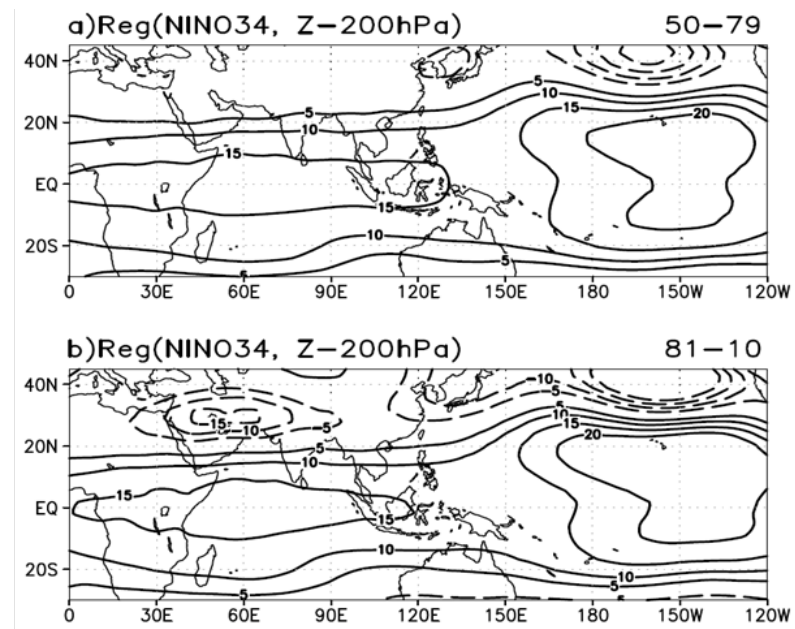


Association of ENSO with Global SST



AGCM simulation with prescribed SST boundary condition

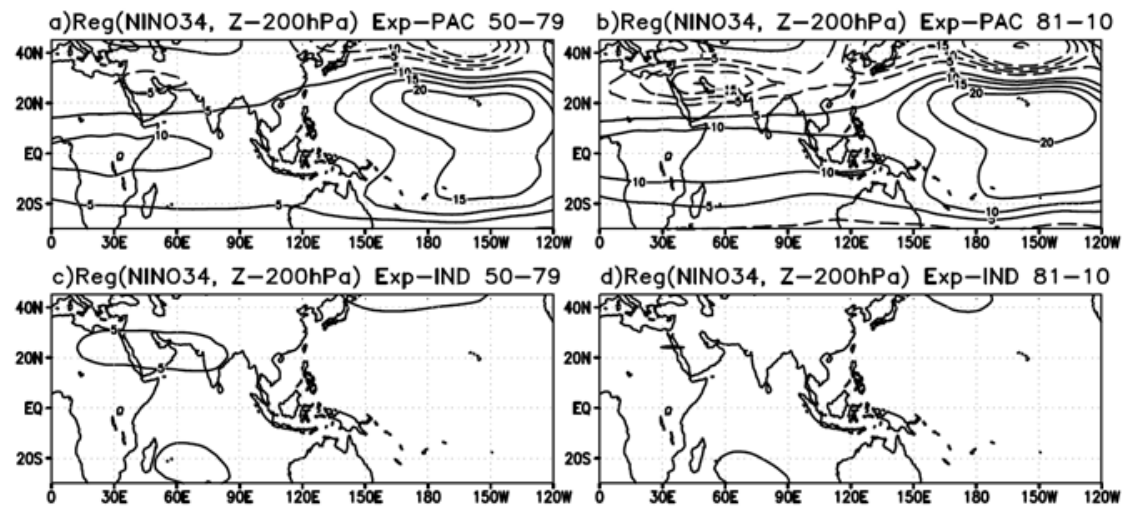
Regression maps of 200hPa GPH anomalies against the Nino3.4



Kang et al. (2015)

**AGCM simulation with the SST anomalies
for the Pacific only and Indian Ocean only**

Regression maps of 200hPa GPH anomalies against the Nino3.4



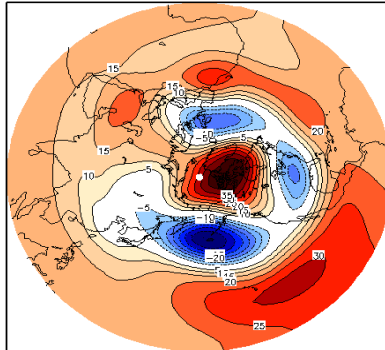
Kang et al. (2015)

**Linkage to
Decadal Changes of Global C
irculation Modes**

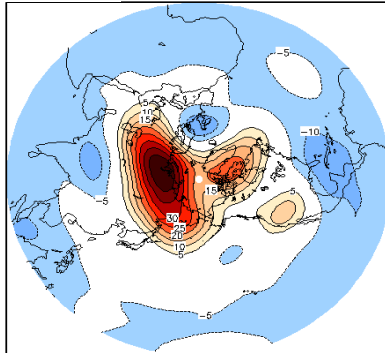
EOF of GPH(200mb) and the correlated SST anomaly pattern

(1950-1979)

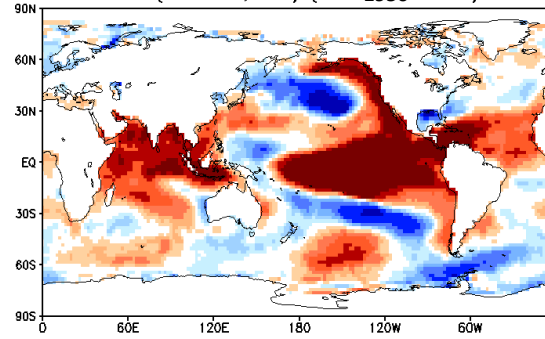
EOF1 Wet:50/79 32.5%



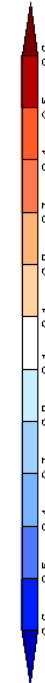
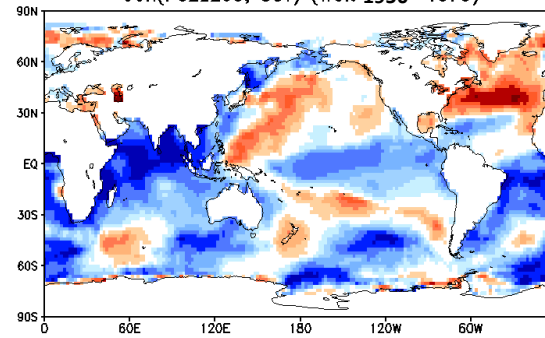
EOF2 Wet:50/79 13.8%



COR(PC1z200, SST) (Wet: 1950-1979)



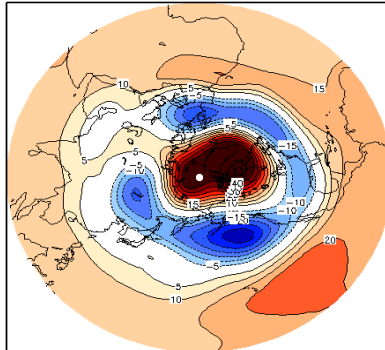
COR(PC2z200, SST) (Wet: 1950-1979)



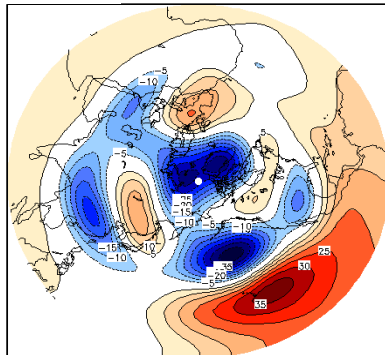
EOF of GPH(200mb) and the correlated SST anomaly pattern

1981-2010)

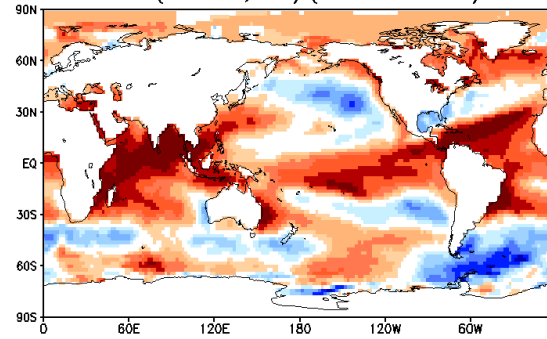
EOF1 Wet:81/10 29.8%



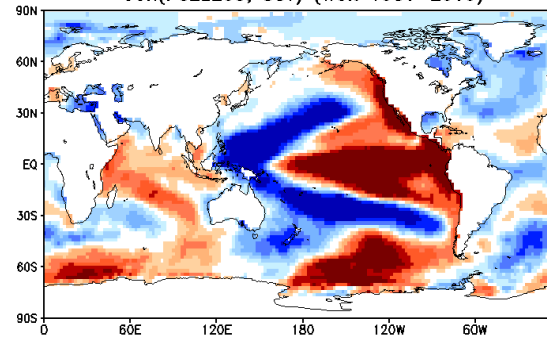
EOF2 Wet:81/10 21.5%



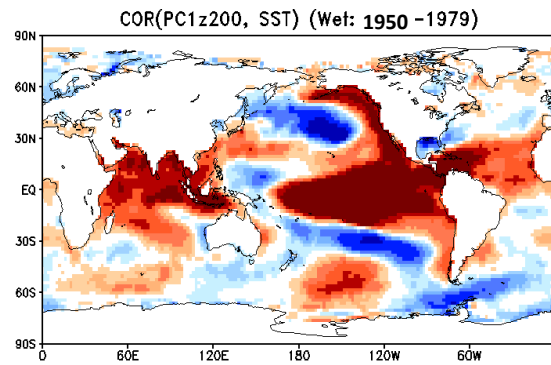
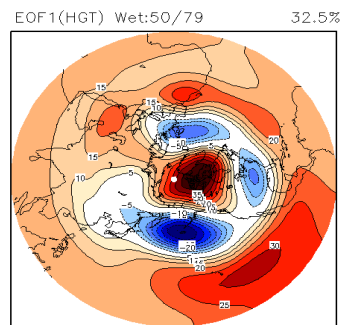
COR(PC1z200, SST) (Wet: 1981-2010)



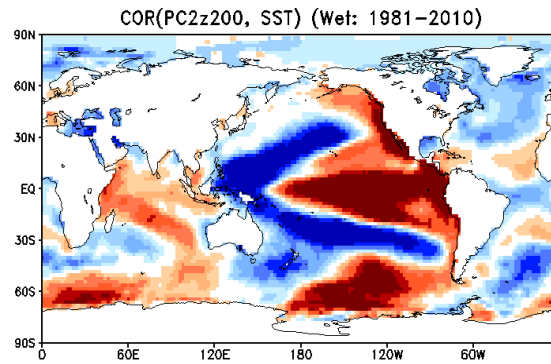
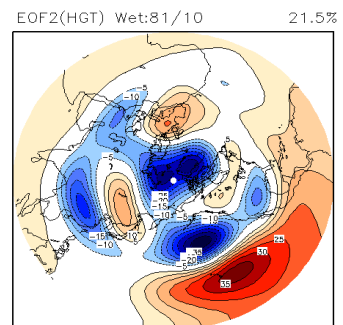
COR(PC2z200, SST) (Wet: 1981-2010)



EOF1 (1950-1979) and correlated SST anomaly pattern



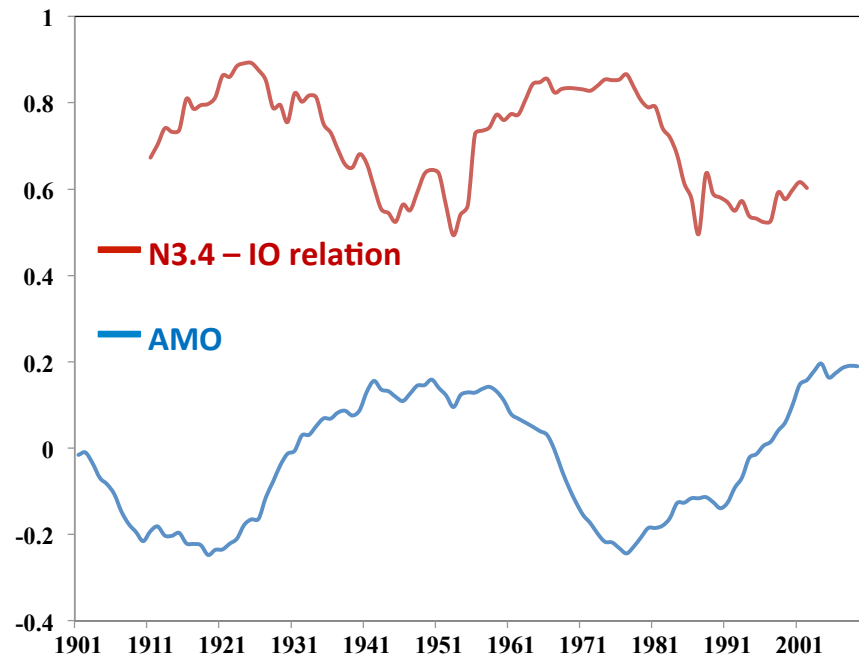
EOF2 (1981-2010) and correlated SST anomaly pattern



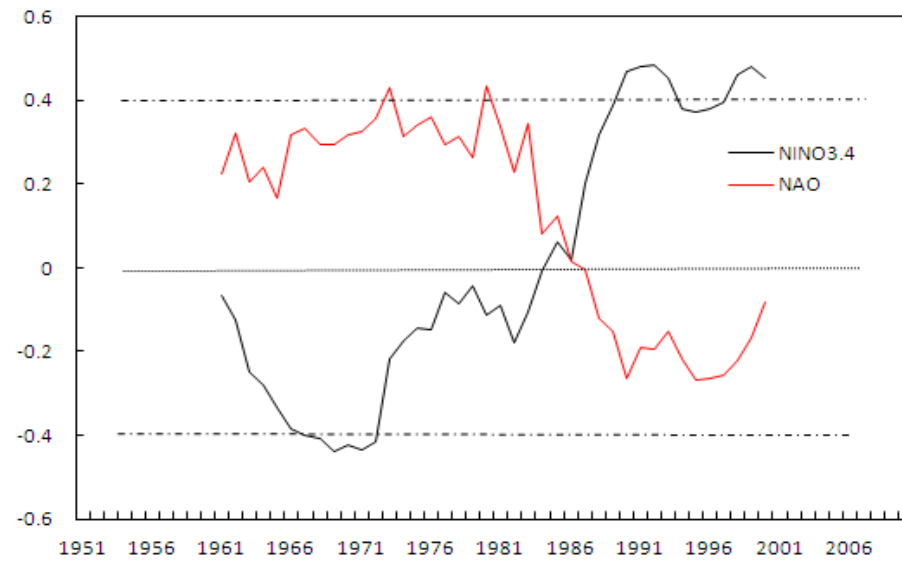
A possible reason

Atlantic influence?

AMO, NINO3.4-Indian Ocean (47E-110E, 15S-20N) Relationship



Sliding Correlation between NAO and AP Rainfall



Summary

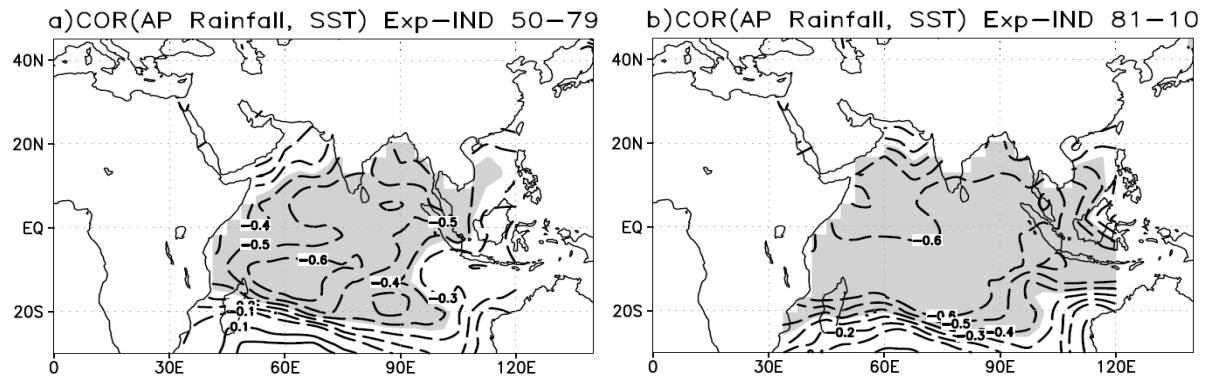
- ✓ **Multidecadal variation of ENSO teleconnection to the AP precipitation is related to the change of global circulation mode associated with ENSO**
- ✓ **Differences in SSTA over the WP and IO.**
- ✓ **Possible influence of AMO on the change of ENSO teleconnection.**

Thank you

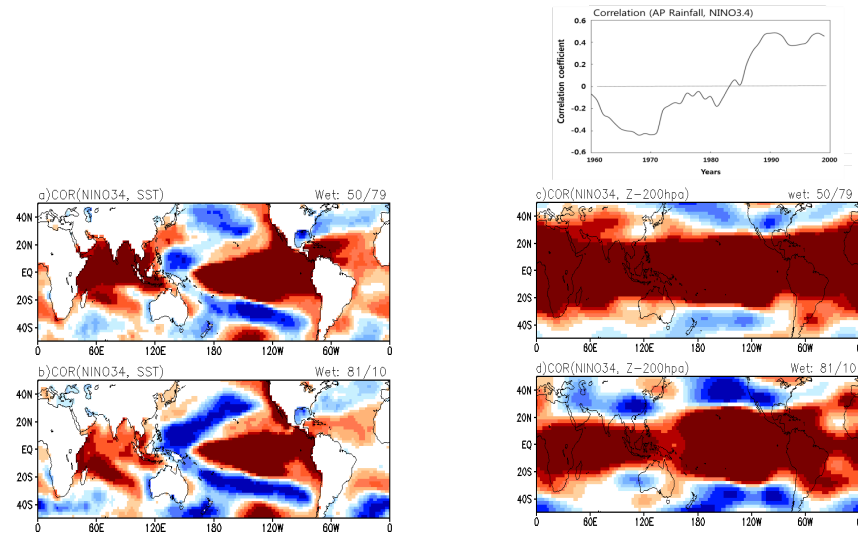
- Kang, In-Sik, Irfan Rashid, Fred Kucharski, Mansour Almazroui, Abdulrahman Khalaf, **2015: Multi-decadal changes in the relationship between ENSO and wet-season precipitation in the Arabian Peninsula, *J. Climate*, 28, 12, 4743-4752**
- Kang, in-Sik, Hyun-ho No, Fred Kucharski, **2014 : ENSO amplitude modulation associated with the mean SST changes in the tropical central Pacific induced by Atlantic Multi-decadal Oscillation *Journal of Climate*, Vol. 27, No. 20, 7911-7920 .**
- Fred Kucharski, Farah Ikram, Franco Molteni, Riccardo Farneti, In-Sik Kang, Hyun-Ho No, Martin P. King, Graziano Giuliani, Kristian Mogensen, **2015 : Atlantic forcing of Pacific decadal variability *Climate Dynamics*, DOI 10.1007/s00382-014-2376-1**

AGCM simulation with the SST anomalies for the Indian Ocean only

Correlation maps between the simulated rainfall averaged over the AP region and the SST anomalies



Kang et al. (2015)



Factors for determining ENSO teleconnection in the South Asia

- Differences in SSTA over the western Pacific and Indian Ocean
- Positive SSTA over the IO -> Deepening of GH200 in SA -> - AP rainfall
- Negative SSTA over the WP -> Cyclonic C. in SA -> + AP rainfall