Monthly climate variation over Korea in relation to the two types of ENSO evolution

The 6th session of the East Asia winter Climate Outlook Forum

Sae-Rim Yeo
APEC Climate Center

기상청

Introduction

❖ ENSO impact on East Asian climate

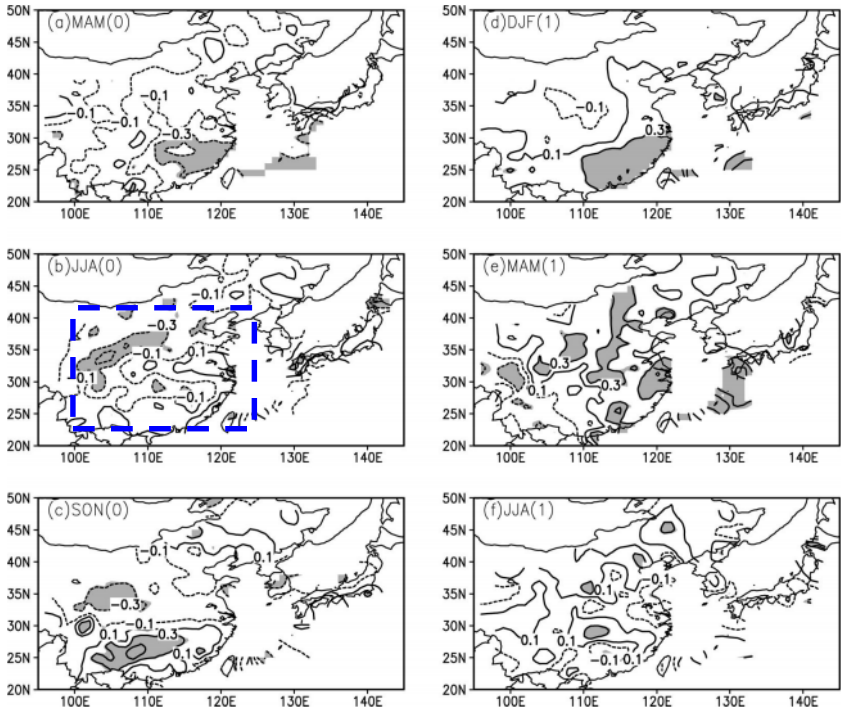
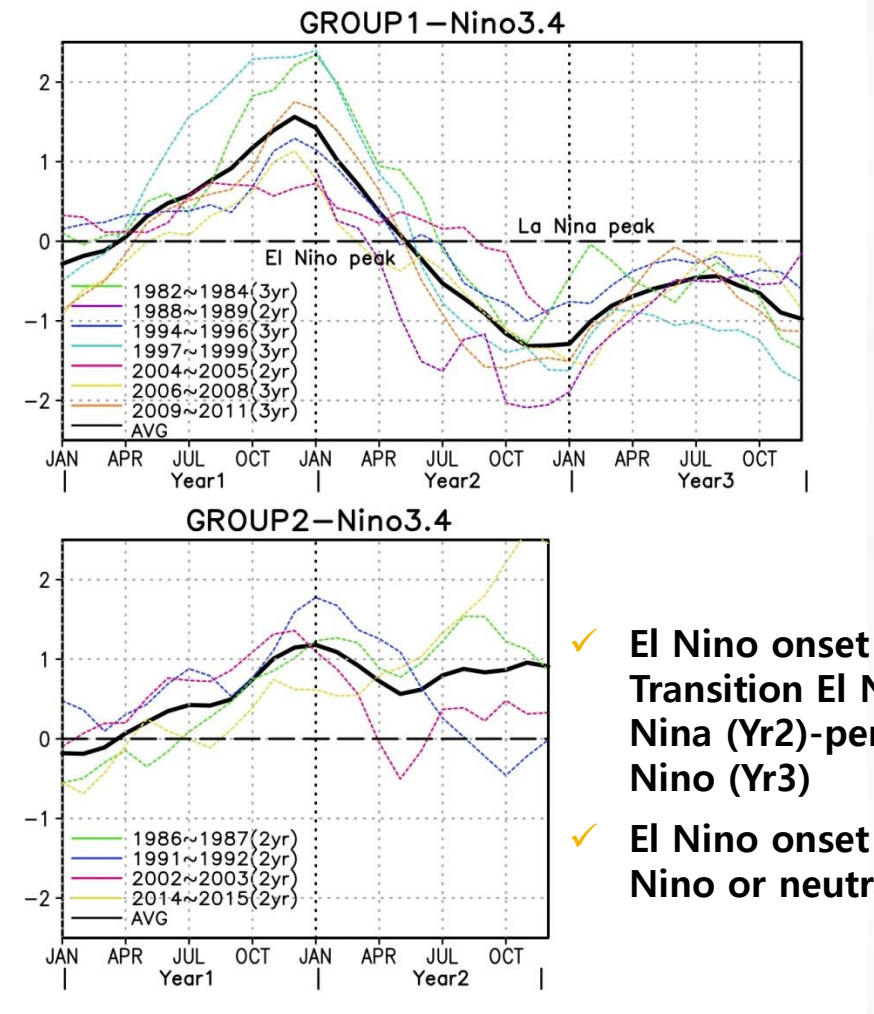


FIG. 3. Correlation of seasonal rainfall in (a) MAM(0), (b) JJA(0), (c) SON(0), (d) DJF(1), (e) MAM(1), and (f) JJA(1), with DJF(1) Niño-3.4 SST for the period of 1951–2000, where 0 and 1 in brackets refer to the ENSO developing and decaying year, respectively. Contour interval is 0.2. Shading indicates a correlation coefficient significant at 95% confidence level according to Student's *t* test. The correlation is calculated using the interannual component only.

Wu et al. 2009

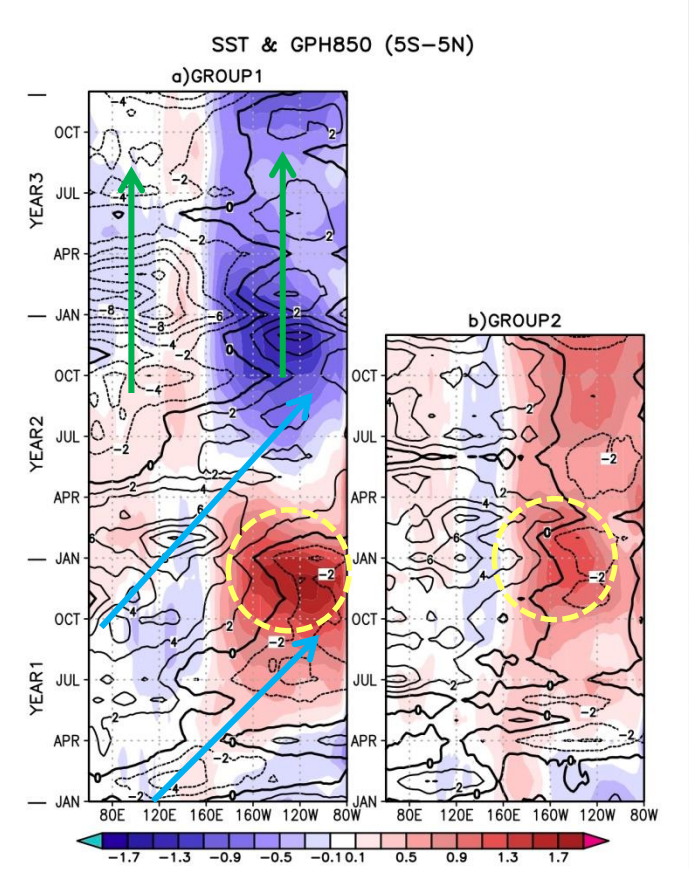
- ✓ **ENSO exerts significant impacts on East Asian climate → ex) El Nino developing phase – reduced PRCP in N. China**
- ✓ **Regional T & P are different among individual ENSO event due to inter ENSO-diversity**

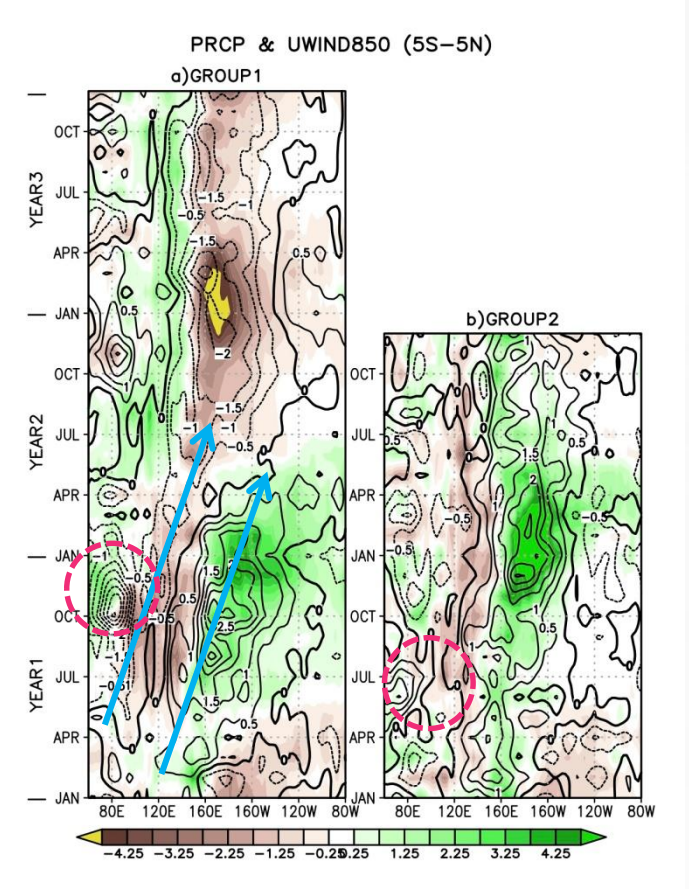
❖ Differences in ENSO evolution



- ✓ **El Nino onset (Yr1)- Transition El Nino-La Nina (Yr2)-persistent La Nino (Yr3)**
- ✓ **El Nino onset (Yr1)- El Nino or neutral (Yr2)**

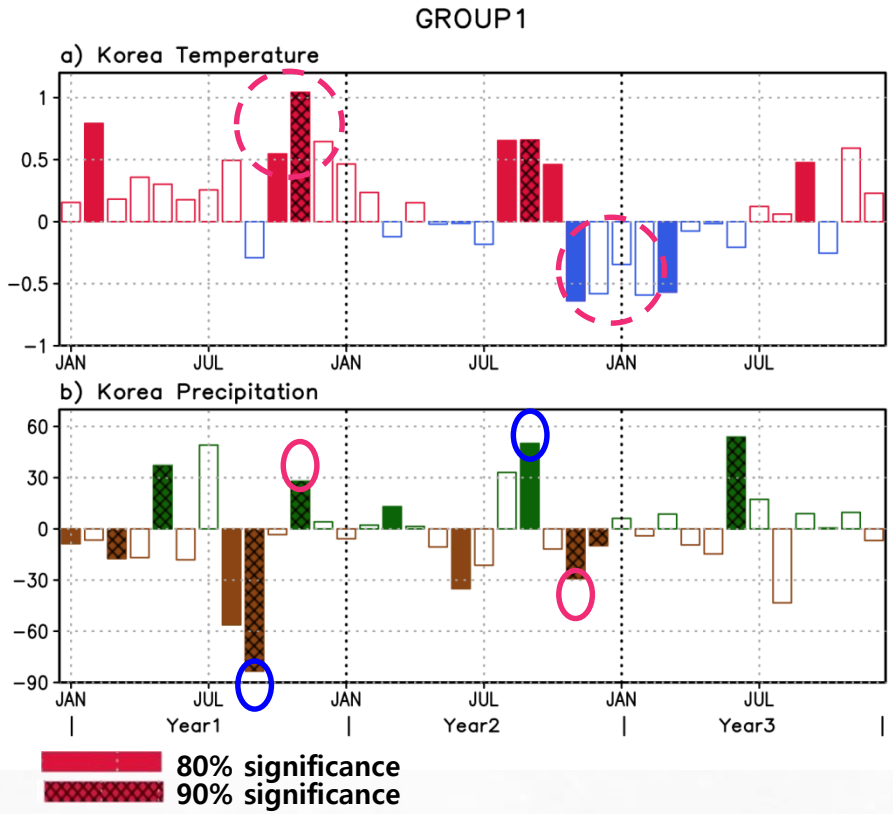
Classification of ENSO evolution





- ✓ **Group1: development of El Nino, transition to La Nina and persistence of La Nina**
  Atmosphere → propagate eastward during developing and decaying phase of El Nino, standing feature from mature phase of La Nina / Positive PRCP anomaly is related to westerly anomaly/ Negative PRCP anomaly occurs over low-level divergence region
- ✓ **Group2: mature phase of El Nino is delayed by about 2 month relative to the first group**
  Location of maximum warming is over tropical central Pacific
  Strong easterly anomaly over western Pacific is key factor for transition from El Nino to La Nina
  → no clear easterly wind over the western Pacific

Monthly Temp. and Prcp. anomaly over Korea for group1

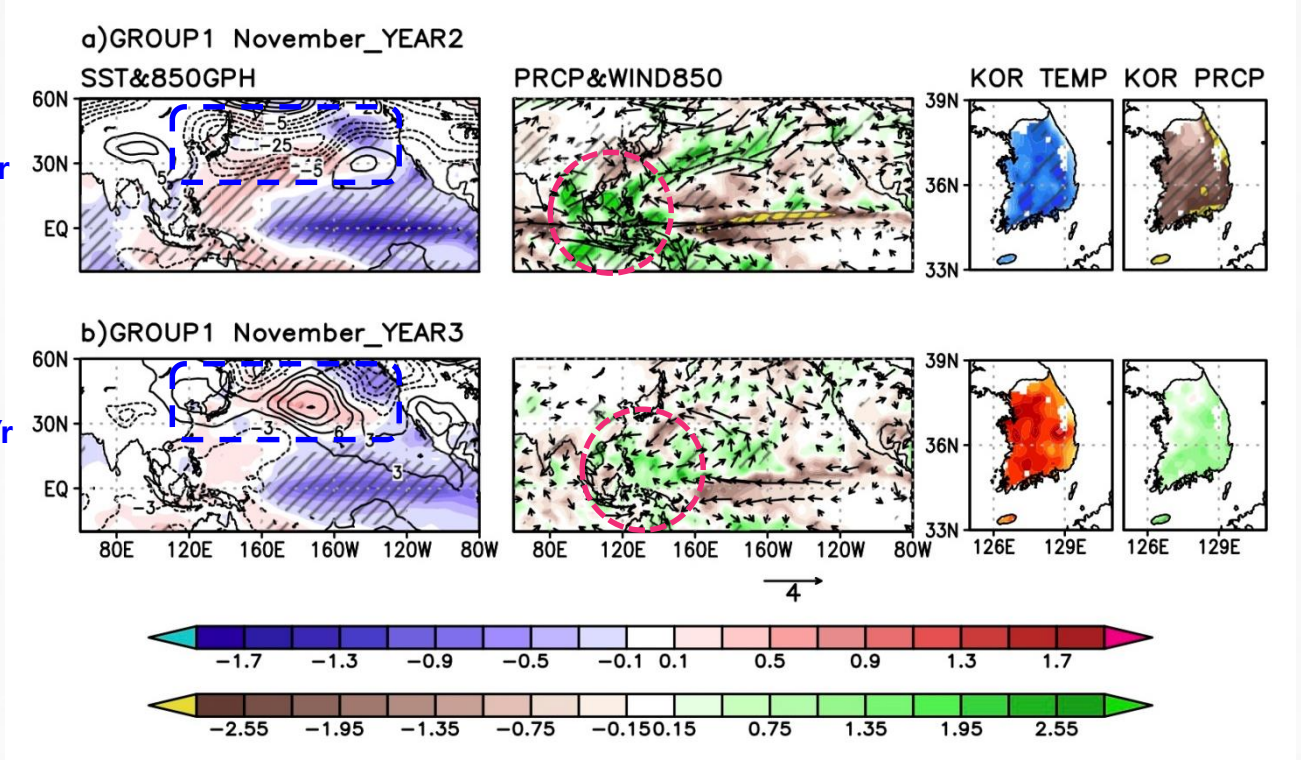


- ✓ **Composite anomalies for monthly T&P for group1**
- ✓ **El Nino developing Yr1**
  - generally warmer than normal
  February, October, November
  - wet: May, November, dry: March, September
- ✓ **Transition Yr2**
  - positive T: August-October, Negative T: November
  Some linear relationship: warm (cold) in El Nino (La Nina) peak phase
  - wet: March, September, dry: November, December
- ✓ **PRCP September, November → opposite anomalies for Yr1 and Yr2 → some linear response**
- ✓ **La Nina Persistence Yr3**
  In spite of similar La Nina structure bt Yr2 & Yr3
  Korean climate shows distinctively different anomalies
  → non-linear response of Korean climate to La Nina

Monthly Temp. and Prcp. anomaly over Korea for group1

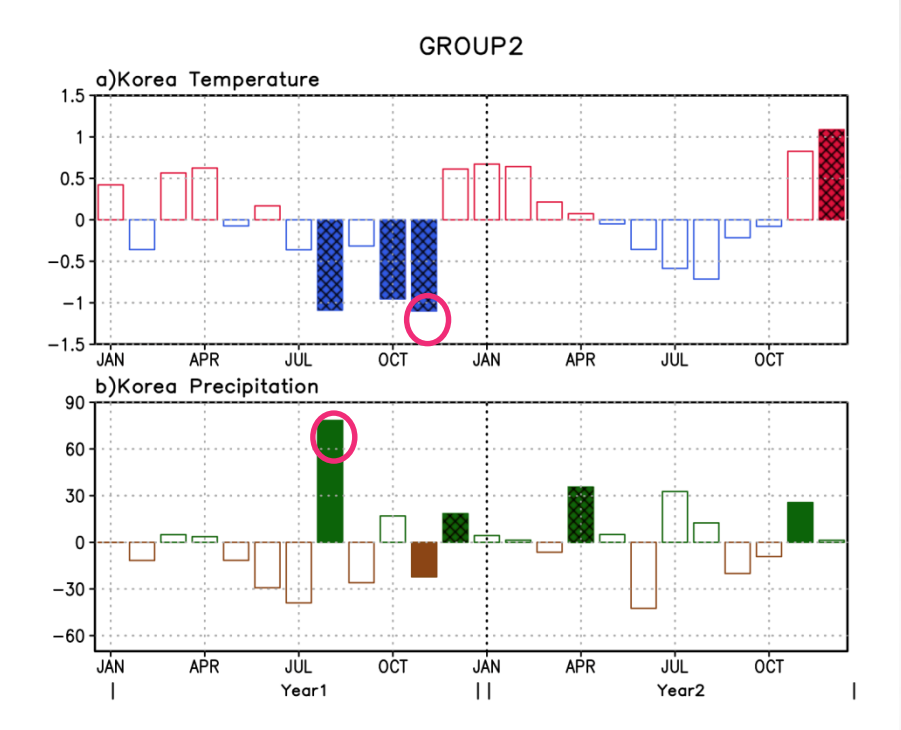
La Nina developing Yr

La Nina persistence Yr

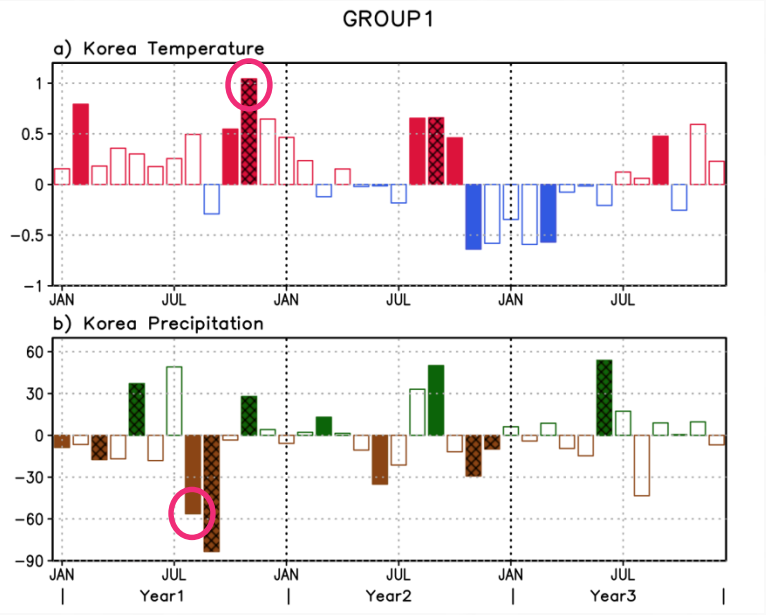


- ✓ **Yr2 and Yr3 November → Share common feature of La Nina structure**
- ✓ **Yr2 (La Nina developing) → low pressure anomaly over North Pacific → Korea is affected by cold and dry air advection from northerly flow**
- ✓ **Yr3 (La Nina persistence) → high pressure anomaly over North Pacific → Korea is affected by high pressure anomaly → warm condition**
- ✓ **Different atmospheric response → convective activity over tropical western Pacific for Yr3 is weaker than Yr2**

Monthly Temp. and Prcp. anomaly over Korea for group2



- ✓ **Composite anomalies for monthly T&P for group2**
- ✓ **El Nino developing Yr1**
  - **generally cold anomaly for second half of Yr1**
  - **wet: August, December, dry: November**
- ✓ **El Nino persistence or neutral Yr2**
  - **positive T: December**
  - **wet: April, November**
- ✓ **In spite of same El Nino developing phase, Korean T & P shows significant difference for group1 and group2**

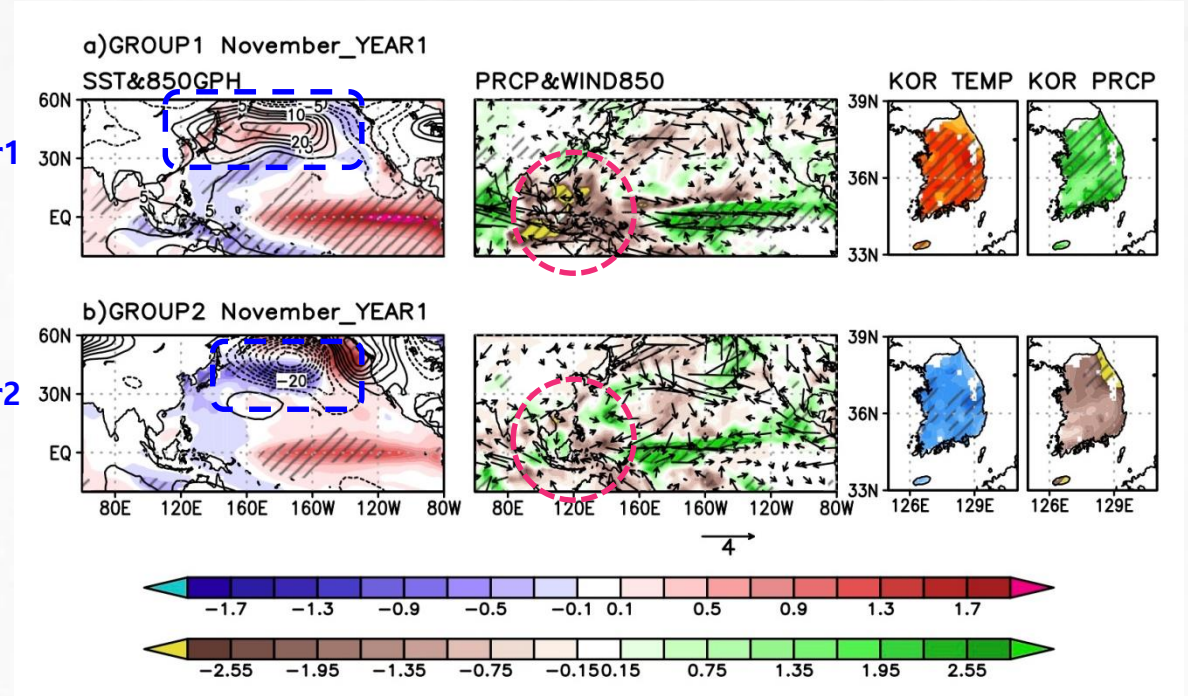


- ✓ **August → Group1: warm & dry**
  Group2: cold & wet
- ✓ **November → Group1: warm & wet**
  Group2: cold & dry

Monthly Temp. and Prcp. anomaly over Korea for group1 and group2

El Nino developing Gr1

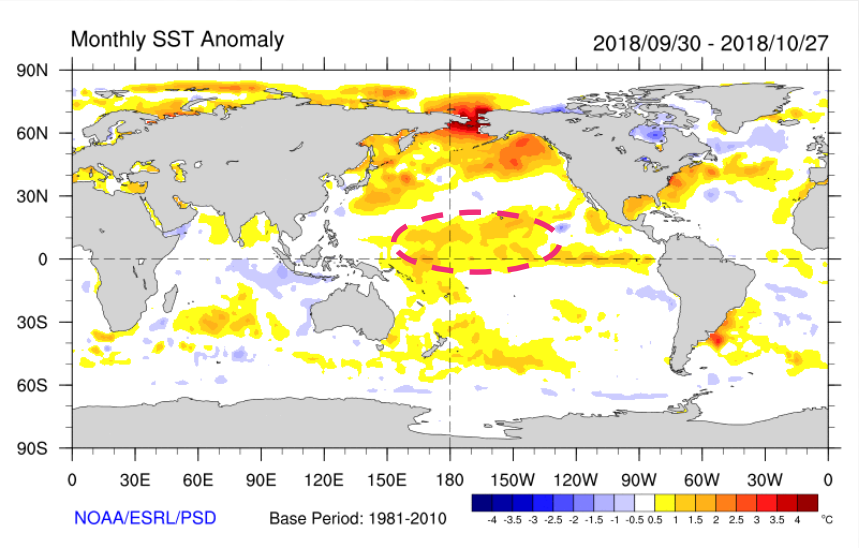
El Nino developing Gr2

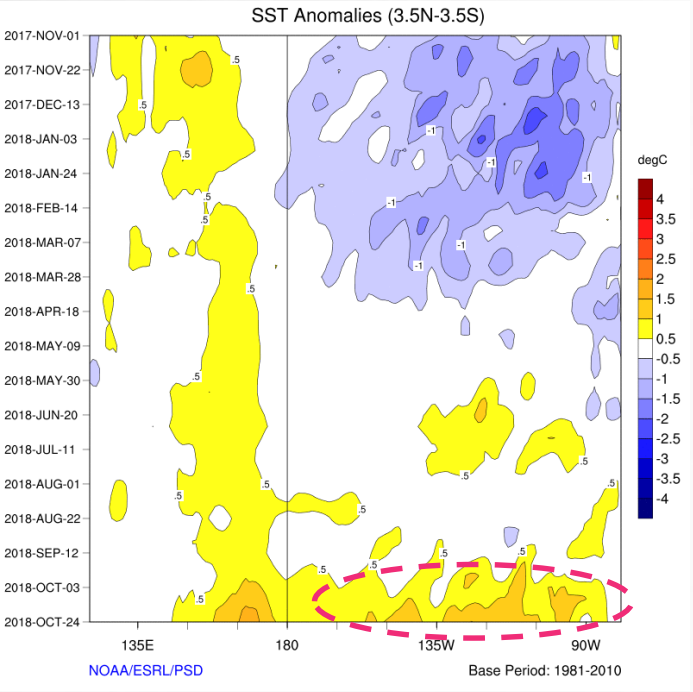


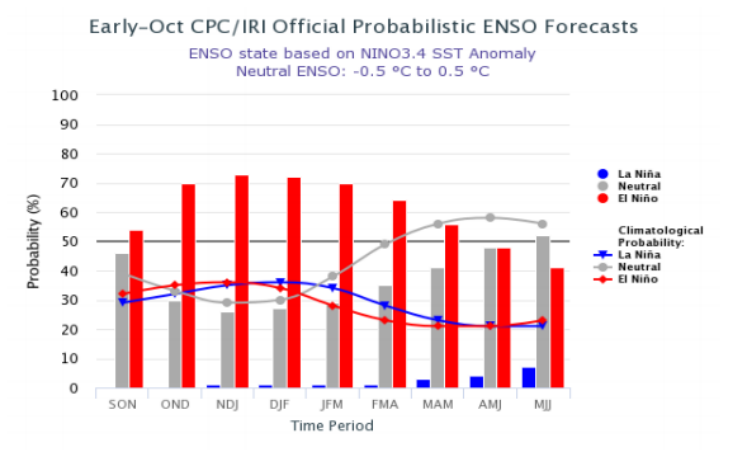
- ✓ **Group1&Group2 Yr1 November → Similar El Nino feature**
  Maximum warming center → Tropical eastern Pacific for Group1/ tropical central Pacific for Group2
- ✓ **Group1 → high pressure anomaly over North Pacific → Korea is affected by southerly wind→ warm and wet condition**
- ✓ **Group2 → low pressure anomaly over North Pacific → Korea is affected by northerly wind → cold and dry condition**
- ✓ **Differences in the convective activity over the tropical western Pacific → group1 shows much stronger and well organized suppressed convection over the tropical western Pacific than group2**

2018 ENSO activity and outlook

SST anomaly (9/30~10/27)

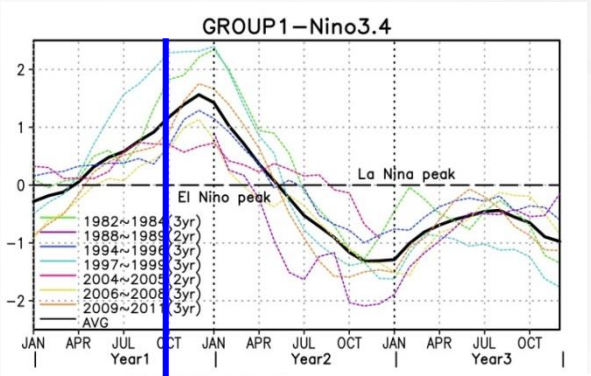


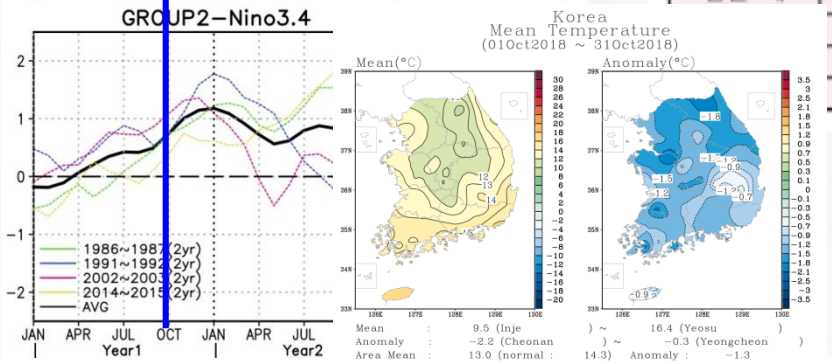




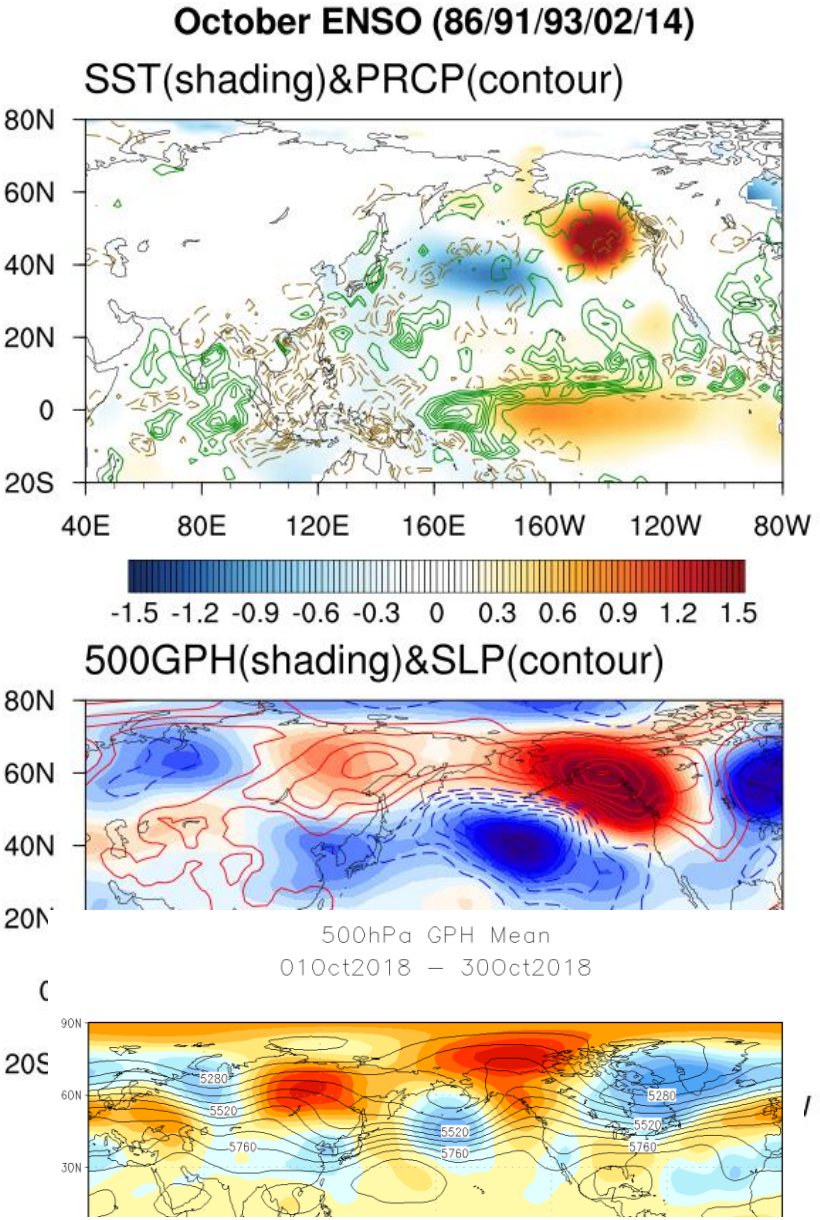
- ✓ **El Nino developing phase in 2018 Fall**
- ✓ **CPC/IRI predicts 70~75% El Nino state in winter 2018/19**
- ✓ **Warming center is located over tropical central Pacific**
- ✓ **It is not quite sure that current state of El Nino belongs to which ENSO evolution group**

2018 ENSO activity and outlook





그룹	연도	10월 기온	10월 강수
엘니뇨 발달 해 (다음 해 라니냐로 연결)	1982	0.5	75
	1994	0.2	305
	1997	-0.7	23
	2004	0.0	11
	2006	2.5	83
	2009	1.1	84
	종합		
엘니뇨 발달 해	1986	-1.8	179
	1991	-0.8	21
	1993	-1.4	86
	2002	-1.5	119
	2014	0.5	242
	종합		



- ✓ **2018 October, Korea experienced colder than normal Temp. (Korean Oct. Temp. have warming trend)**
- ✓ **El Nino developing year of group2, Korea Temp tends to be colder than normal in October**
- ✓ **Composite pattern closely resembles current atmospheric and oceanic state**
- ✓ **We should consider ENSO evolution diversity to investigate the ENSO influence on Korean climate**

Summary and conclusion

- ✓ The effect of ENSO on Korean climate is marginal and it varies with the diverse features of ENSO event
- ✓ Korean climate variability in relation to the two different ENSO evolution process
- ✓ Group1 → development of La Nina following to the El Nino onset year, La Nina persists in the subsequent year

  T & P anomalies over Korea differ between the La Nina developing phase and La Nina persistence phase although they share similar SST structure in the tropical eastern Pacific
- ✓ Group2 → prolonged El Nino or neutral conditions after the mature phase of El Nino

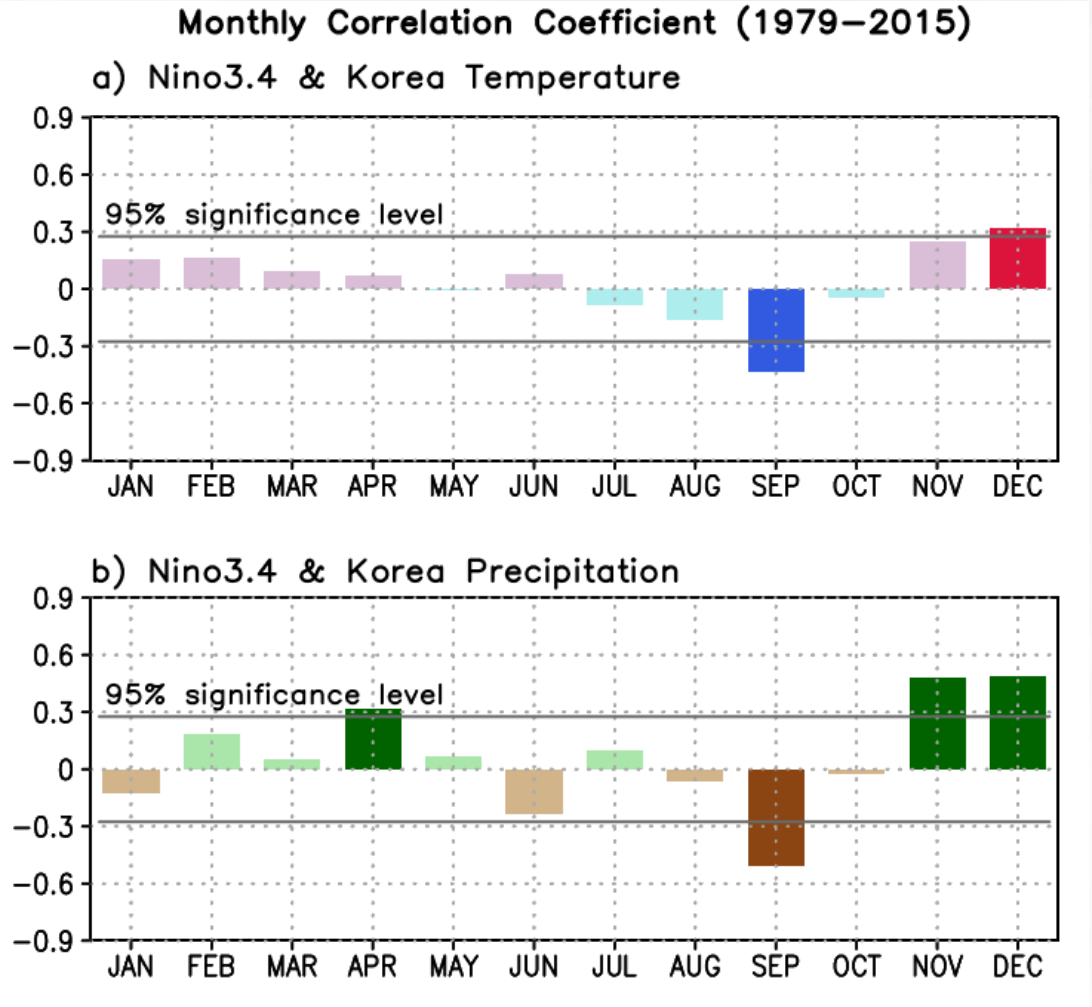
  Differences in the Korean climate between the El Nino developing year for the first and the second groups
- ✓ These non-linear response of Korean climate to the various evolution stages of ENSO cannot be identified from the linear techniques such as regression analysis or EOF analysis

THANK YOU

기상청

Table 2. The set of years used in the composites for the first group from Year1 to Year3 (left column) and the second group of Year1 and Year2 (right column). The years not included in the composites based on the MME dataset are set italics.

First group			Second group	
Year1	Year2	Year3	Year1	Year2
1982	1983	1984	1986	1987
	1988	1989	1991	1992
1994	1995	1996	2002	2003
1997	1998	1999	*2014*	*2015*
2004	2005			
2006	2007	2008		
2009	2010	*2011*		


Monthly Correlation Coefficient (1979–2015)
a) Nino3.4 & Korea Temperature
0.9
0.6
0.3
0
−0.3
−0.6
−0.9
95% significance level
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
b) Nino3.4 & Korea Precipitation
0.9
0.6
0.3
0
−0.3
−0.6
−0.9
95% significance level
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC