Climate change analysis for South Korea

Data analysis from

CRU, ECMWF, NCEP, TRMM, ECHAM5 and ECHAM6 (CMIP5)

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Outlines

- Data and methodology
- Trend pattern analysis
- Area weighted average
- Summary

Metadata from various datasets

Data Sources (temp & prcp)		Temporal info		Spatial info		Grids
		range	resolution	range	resolution	
CRU		1901-2009	Monthly	Global land	0.5	0.25
ECMWF		1990-2009	6-hourly	Globally	1.125	0.25
NCEP		1979-2009	6-hourly	Globally	2	0.25
TRMM		2000-2009	3-hourly	Tropical	0.25	0.25
ECHAM5 (AR4)	20C3M	1860-2100	Daily	Globally	2	0.25
	A1B	2001-2100	Daily	Globally	2	0.25
	A2	2001-2100	Daily	Globally	2	0.25
	B1	2001-2100	Daily	Globally	2	0.25
ECHAM6 (CMIP5)	piControl	1850-2100	Daily	Globally	2	0.25
	RCP26	2006-2100	Daily	Globally	2	0.25
	RCP45	2005-2100	Daily	Globally	2	0.25
	RCP85	2006-2100	Daily	Globally	2	0.25
	amip	1979-2008	Daily	Globally	2	0.25

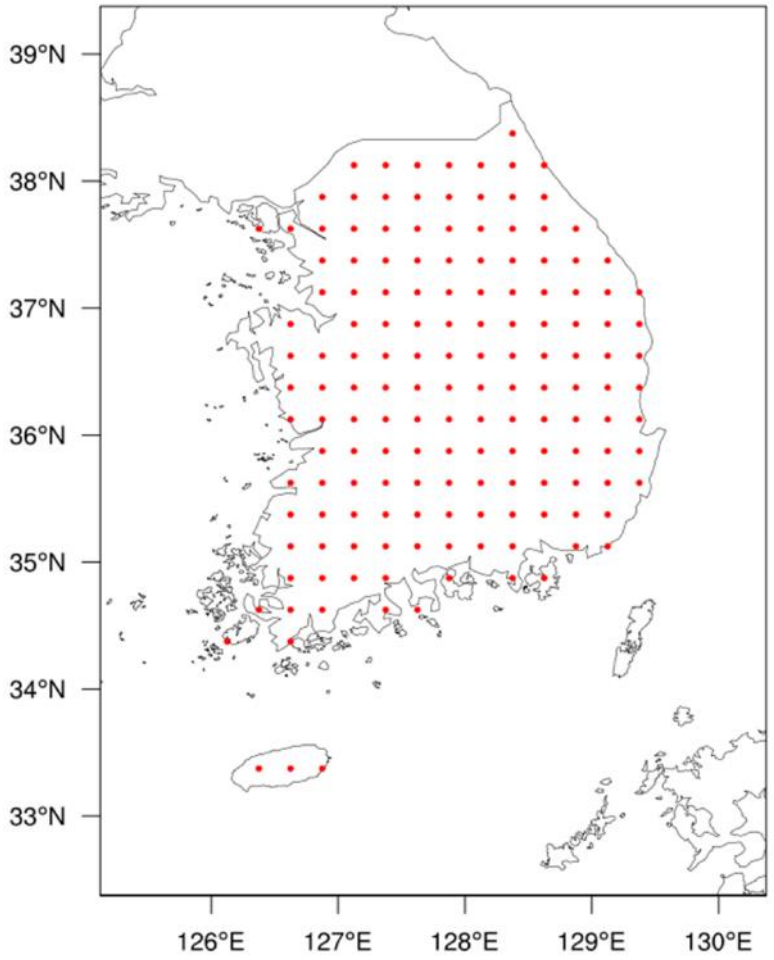
Methodology

- **Trend:** Mann-Kendall trend and t-test (95%:1.95)
- **Abrupt change analysis:** Pettitt test for change points
- **Area weighted average**

$$\text{Area weighted average} = \frac{\sum_{i=1}^{n} x_i \cdot \cos(lat(x_i))}{\sum_{i=1}^{n} \cos(lat(x_i))}$$

Study area

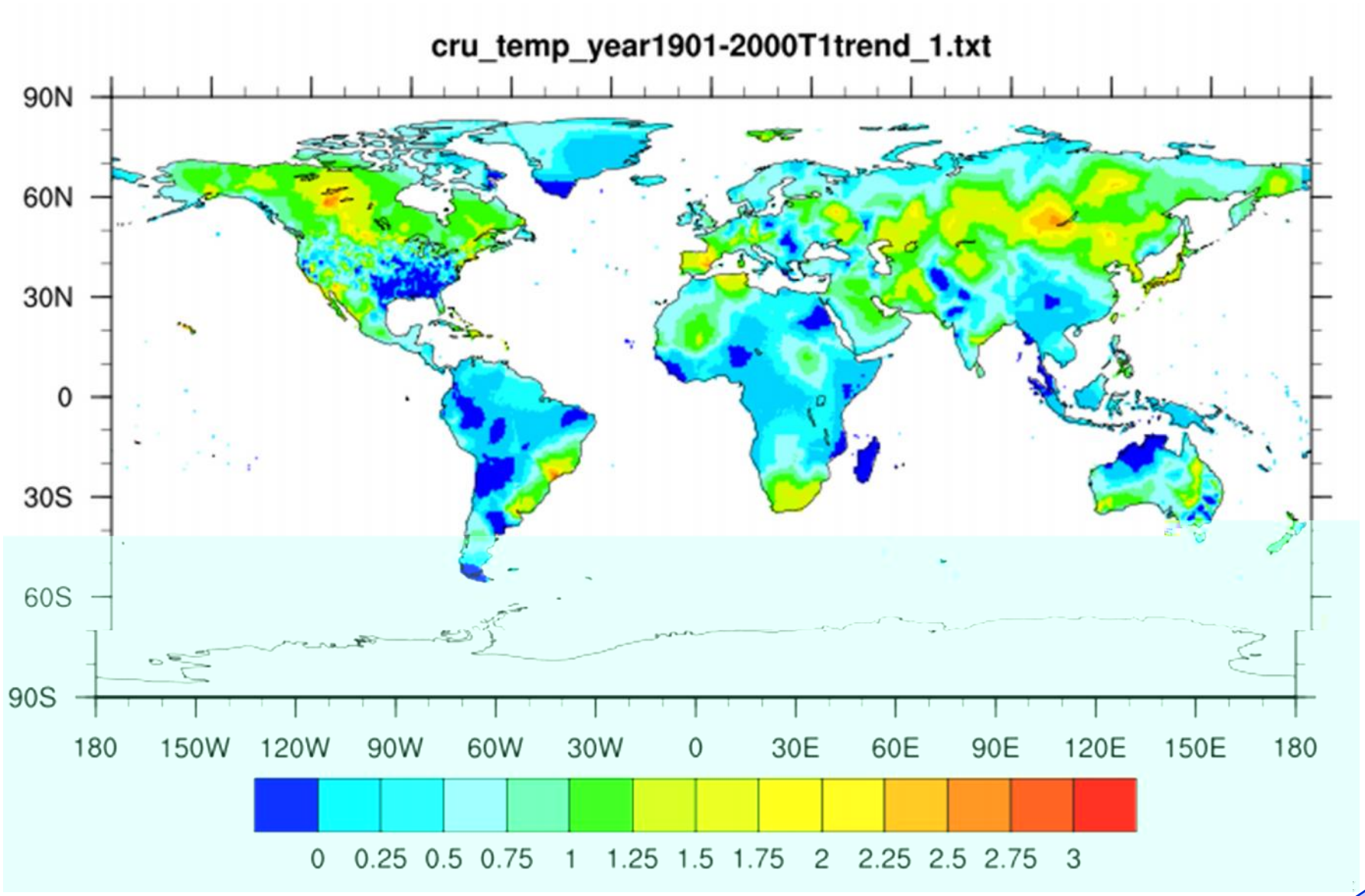
0.25 by 0.25
Grids: 156



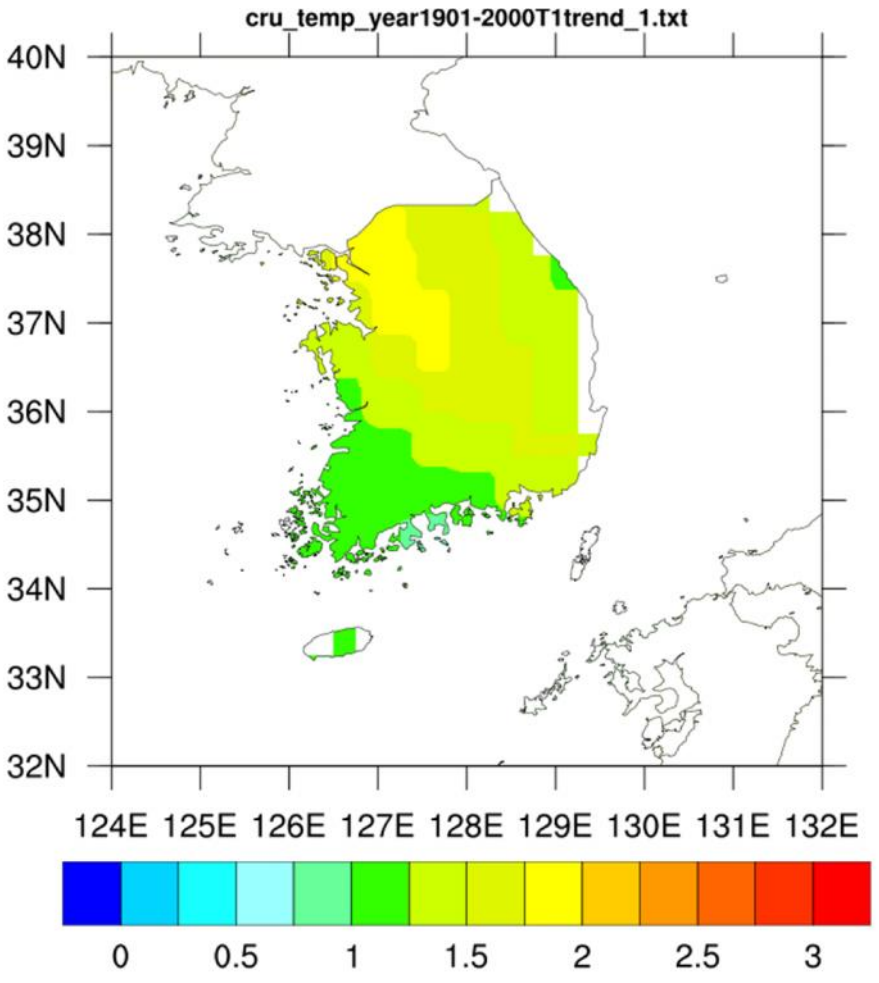
Trend pattern analysis

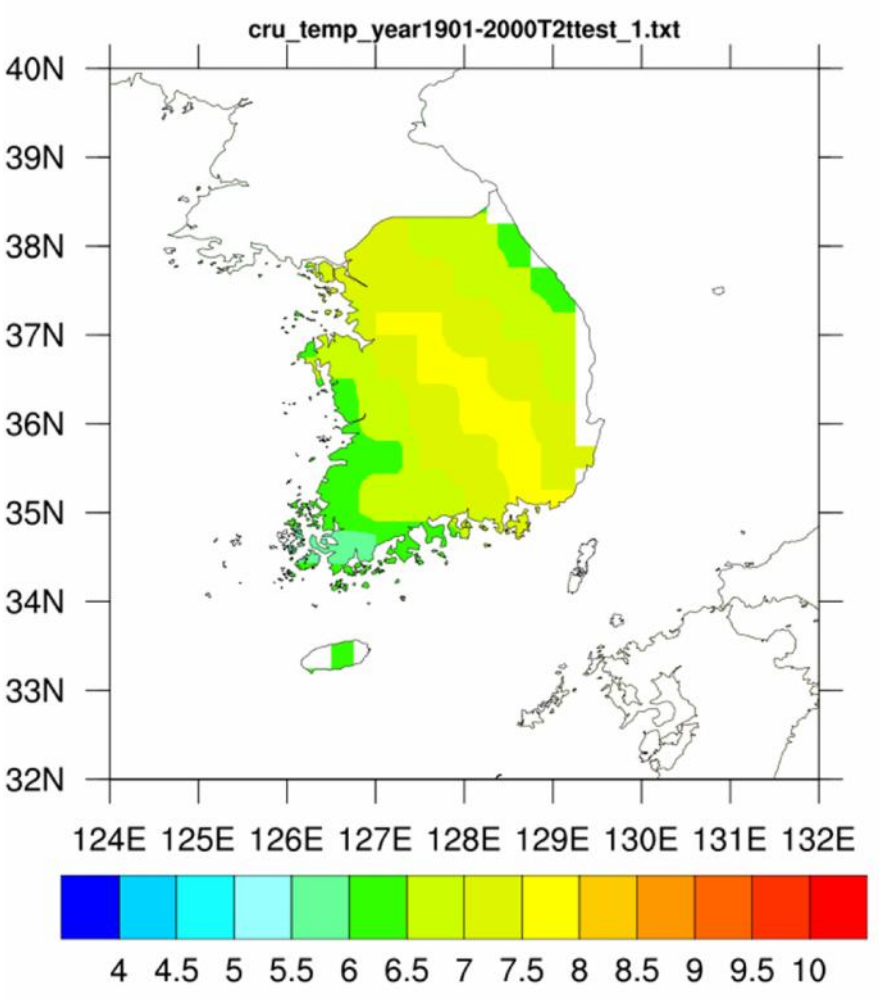
- Temperature unit: degrees C/100yr
- Precipitation unit: mm/100yr
- t-test at 95% significance: 1.96

Temperature trend (CRU)

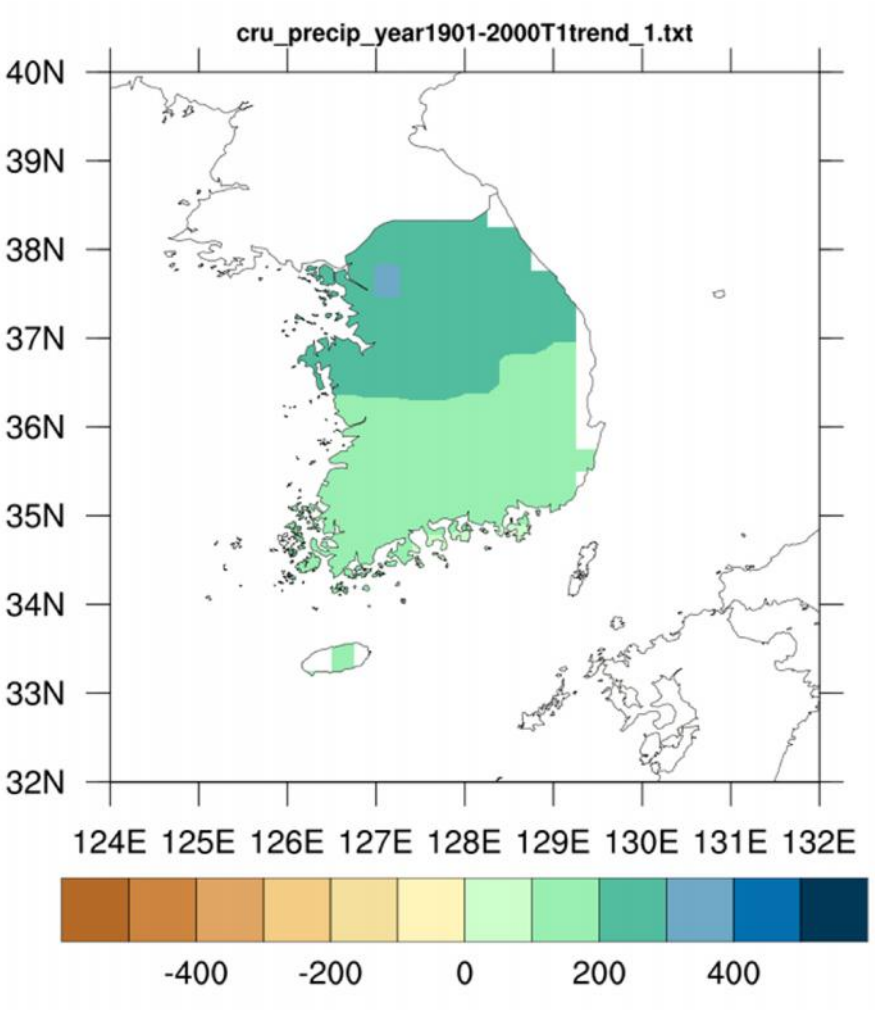


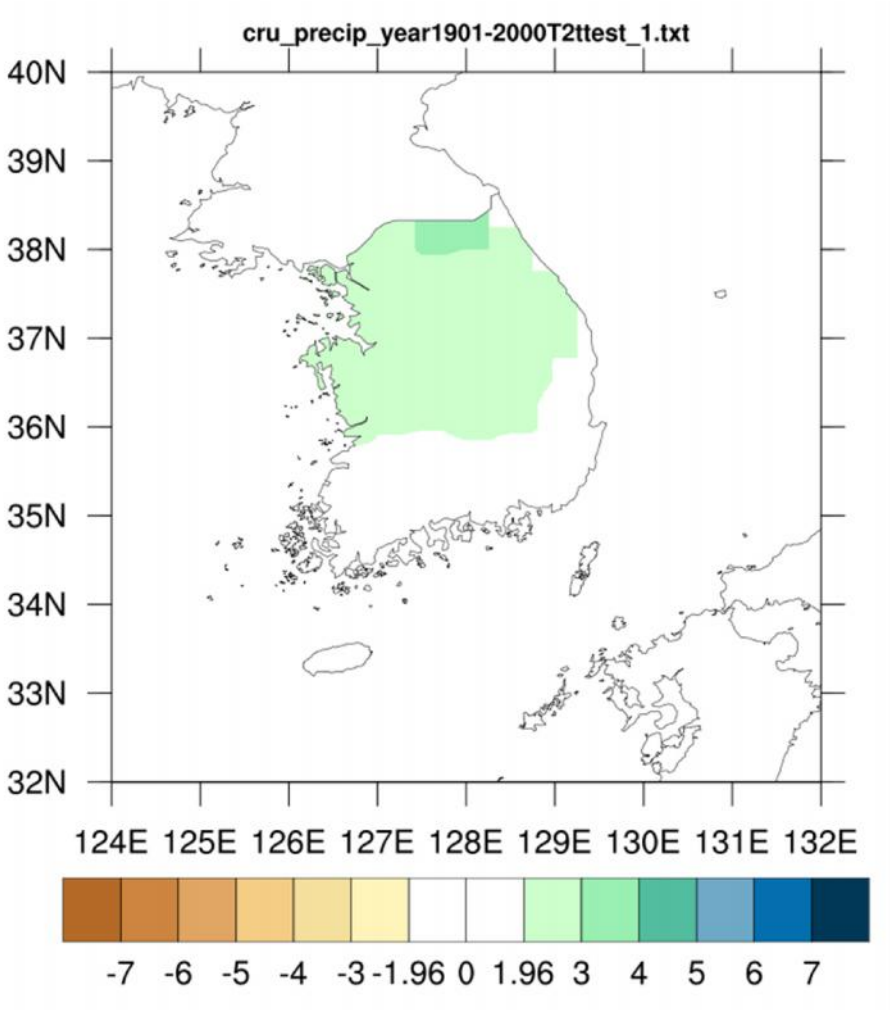
Trend patterns for Temperature



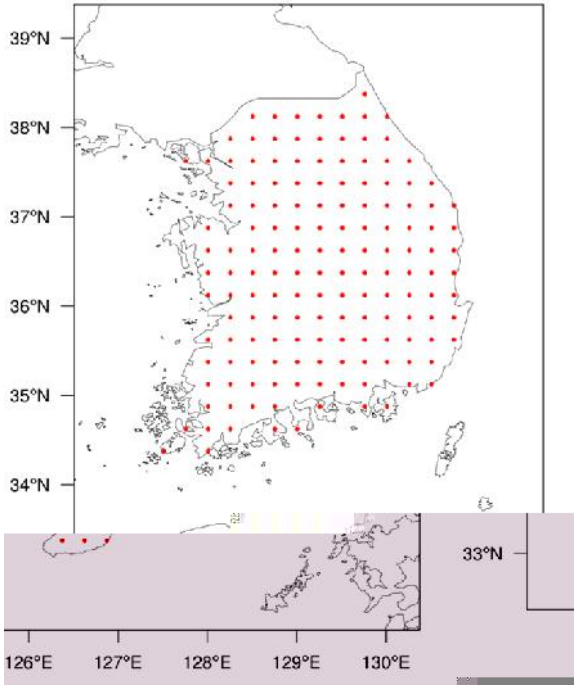


Trend patterns for Precipitation



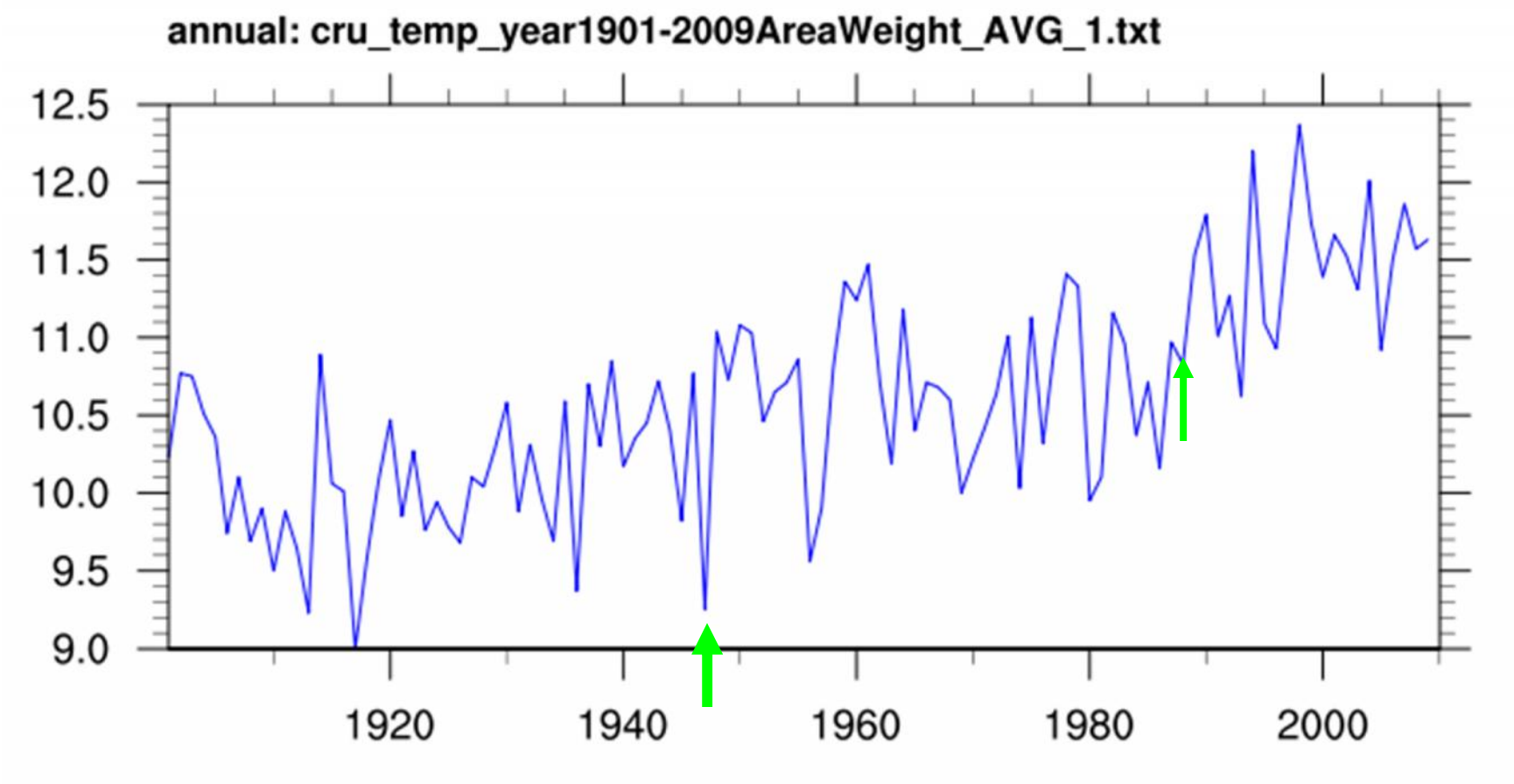


The area weighted average



Data grids for South Korea

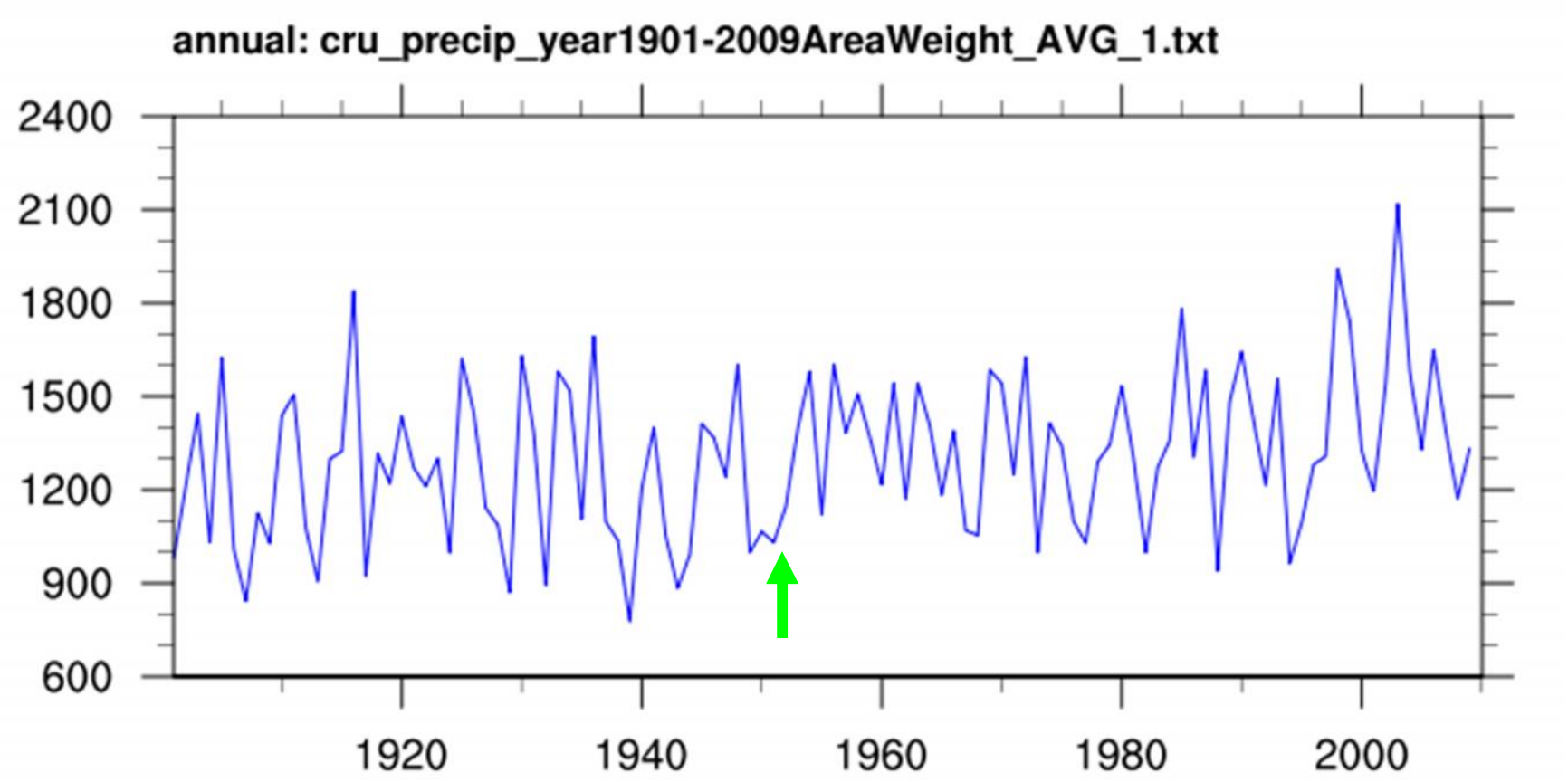
Inter-annual variation of temperature



Trend: 1.5 degC/100years (t-test=7.78 > 1.96)

Change points: 1947 up; 1988: up

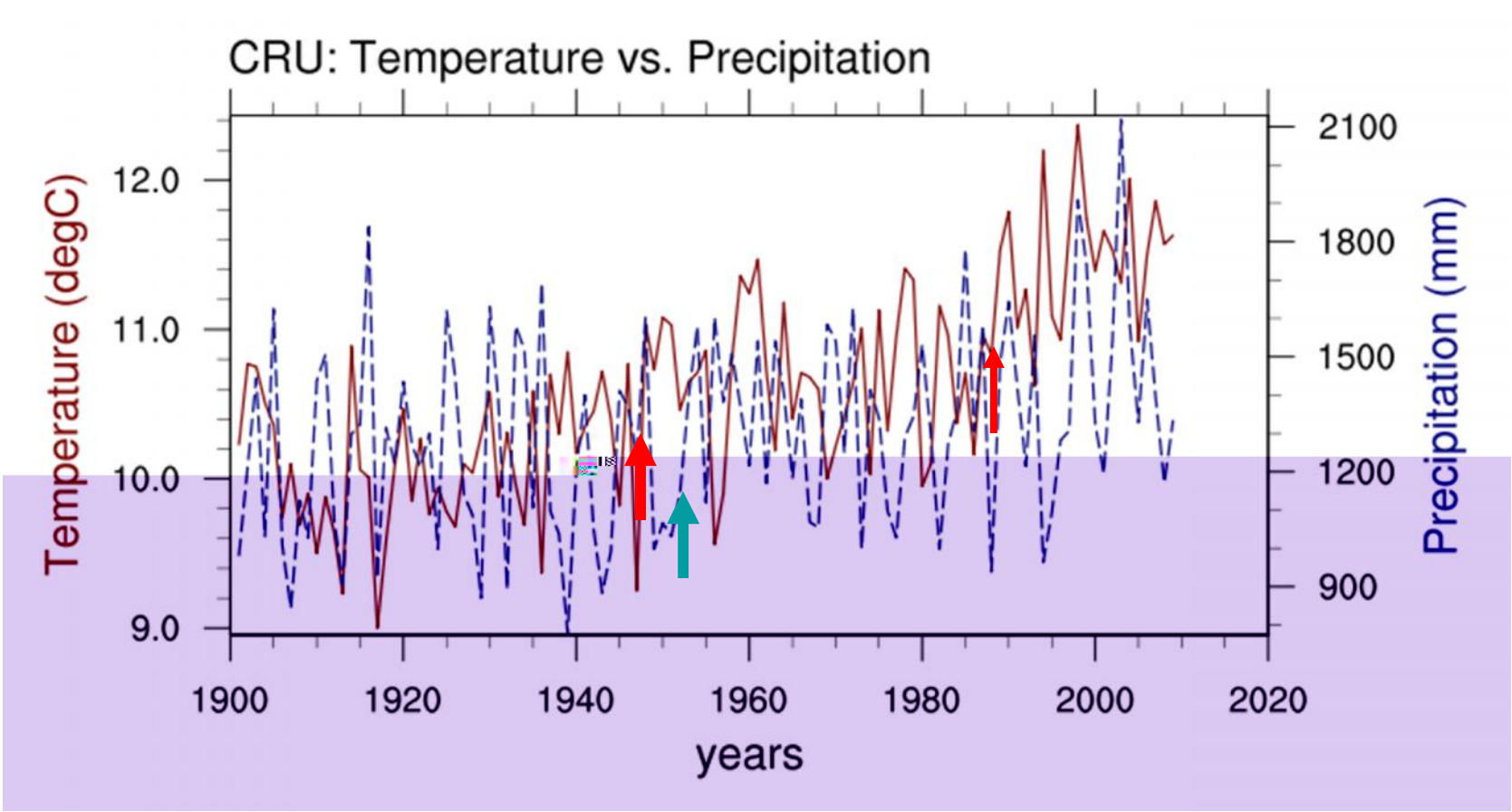
Inter-annual variation of precipitation



Trend: 228 mm/100years (t-test=2.70 > 1.96)

Change points: 1952: up

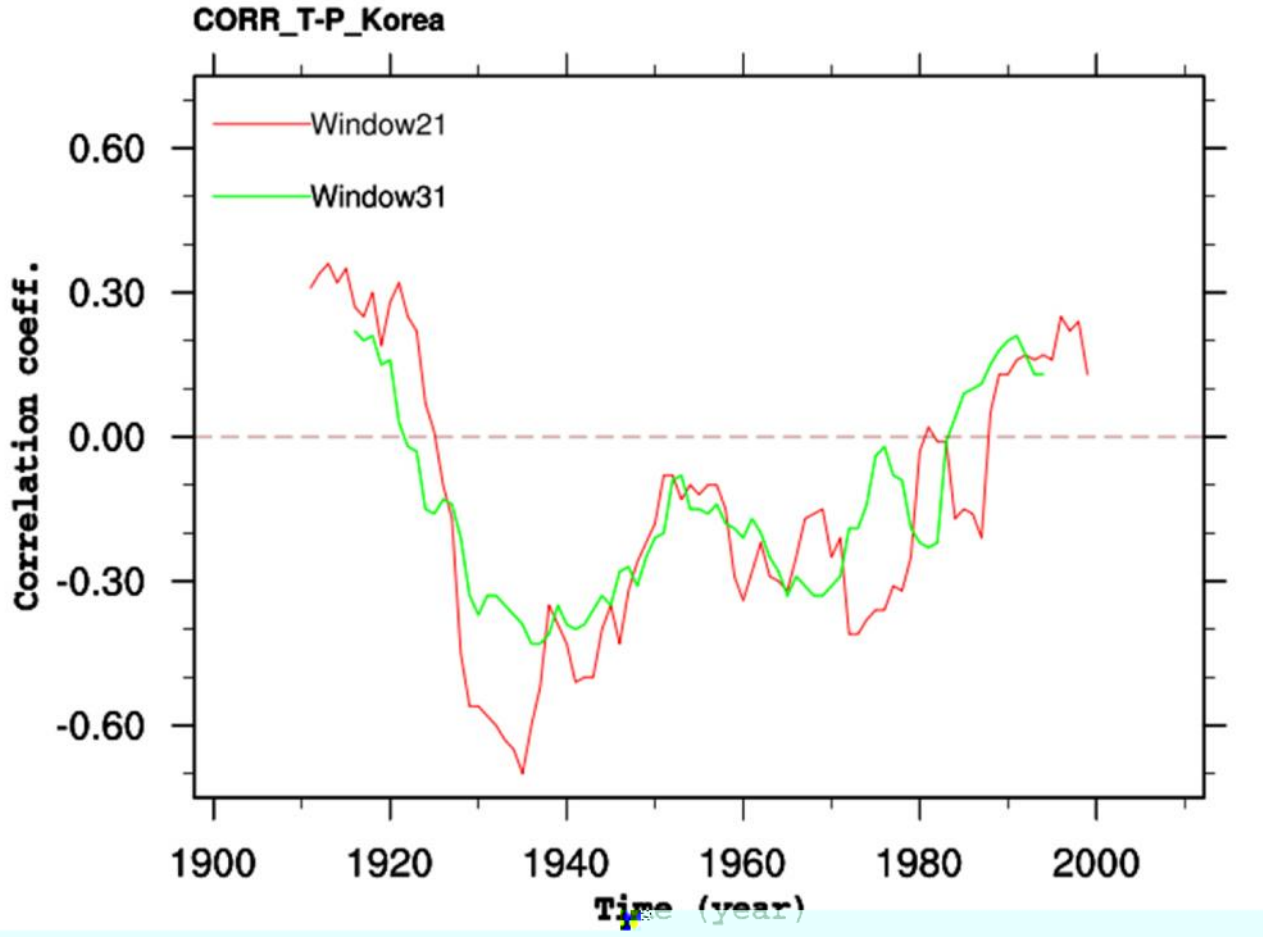
Inter-annual variation of temperature and precipitation



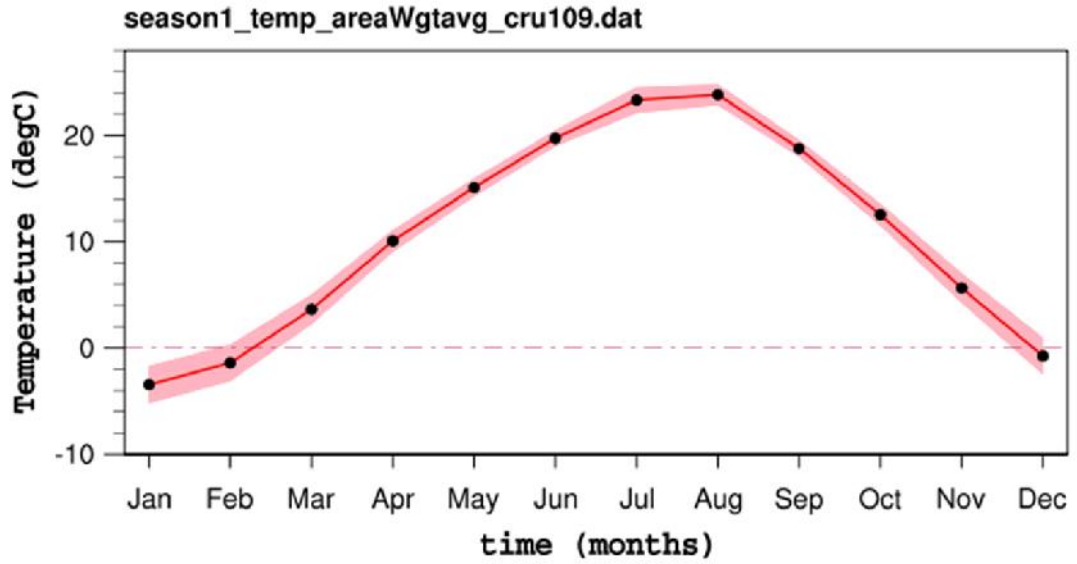
Change points for temp: 1947; 1988

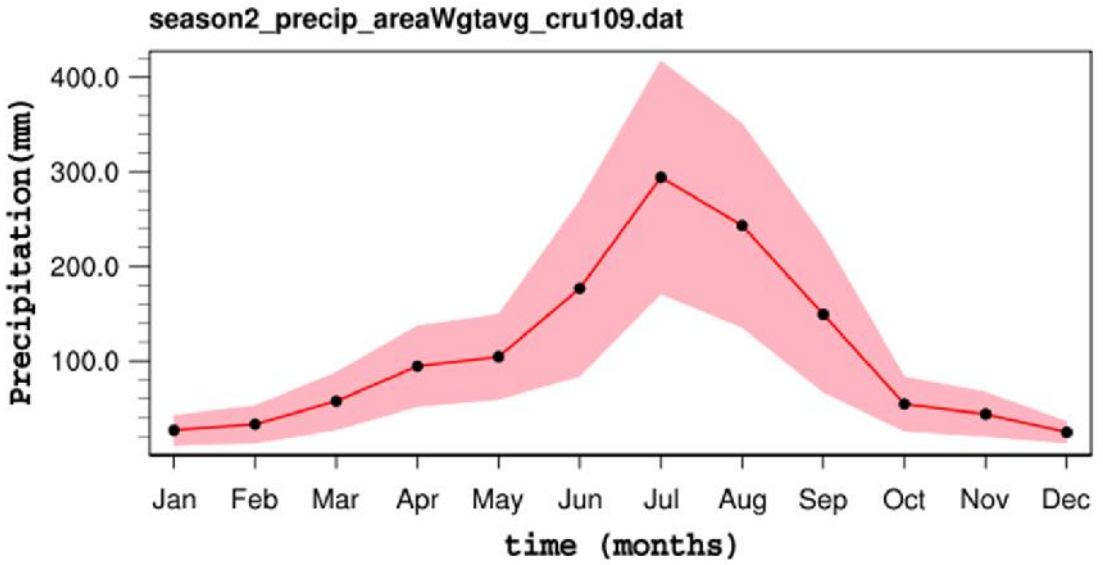
Change points for prcp: 1952

Correlation of precipitation and temperature

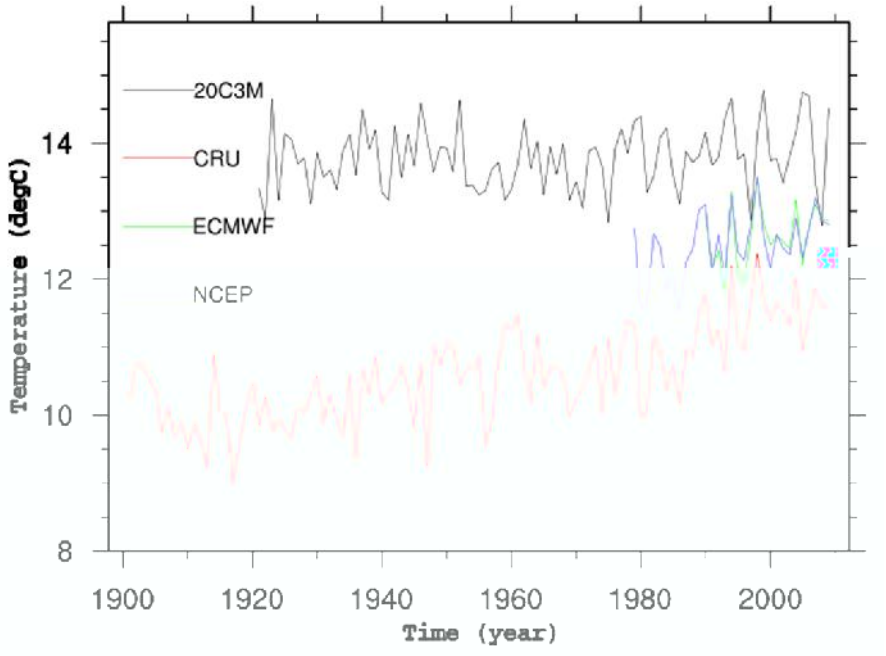


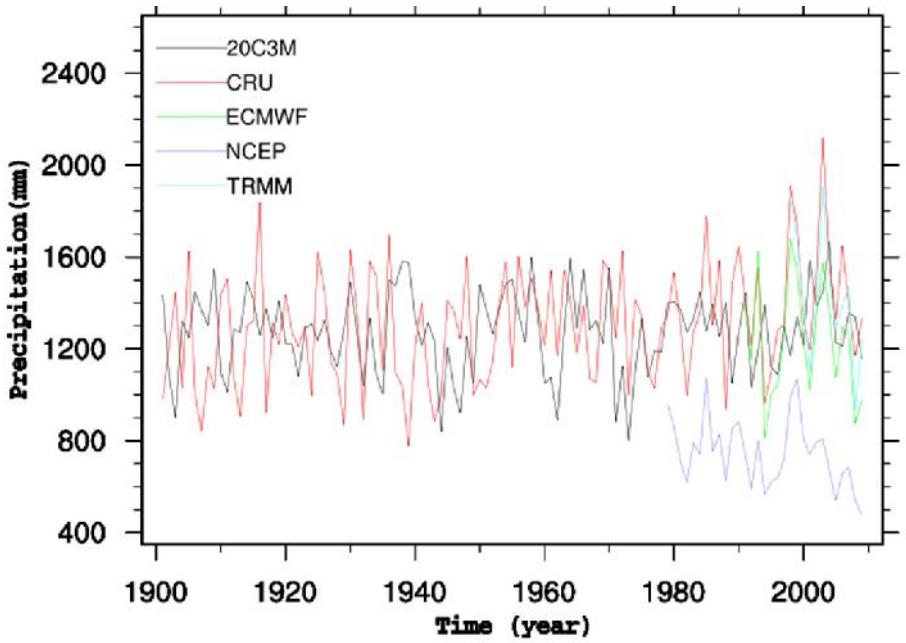
Intra-annual variation of temperature and precipitation



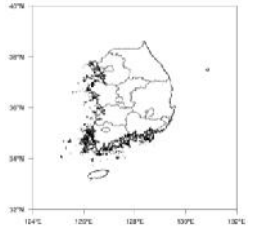


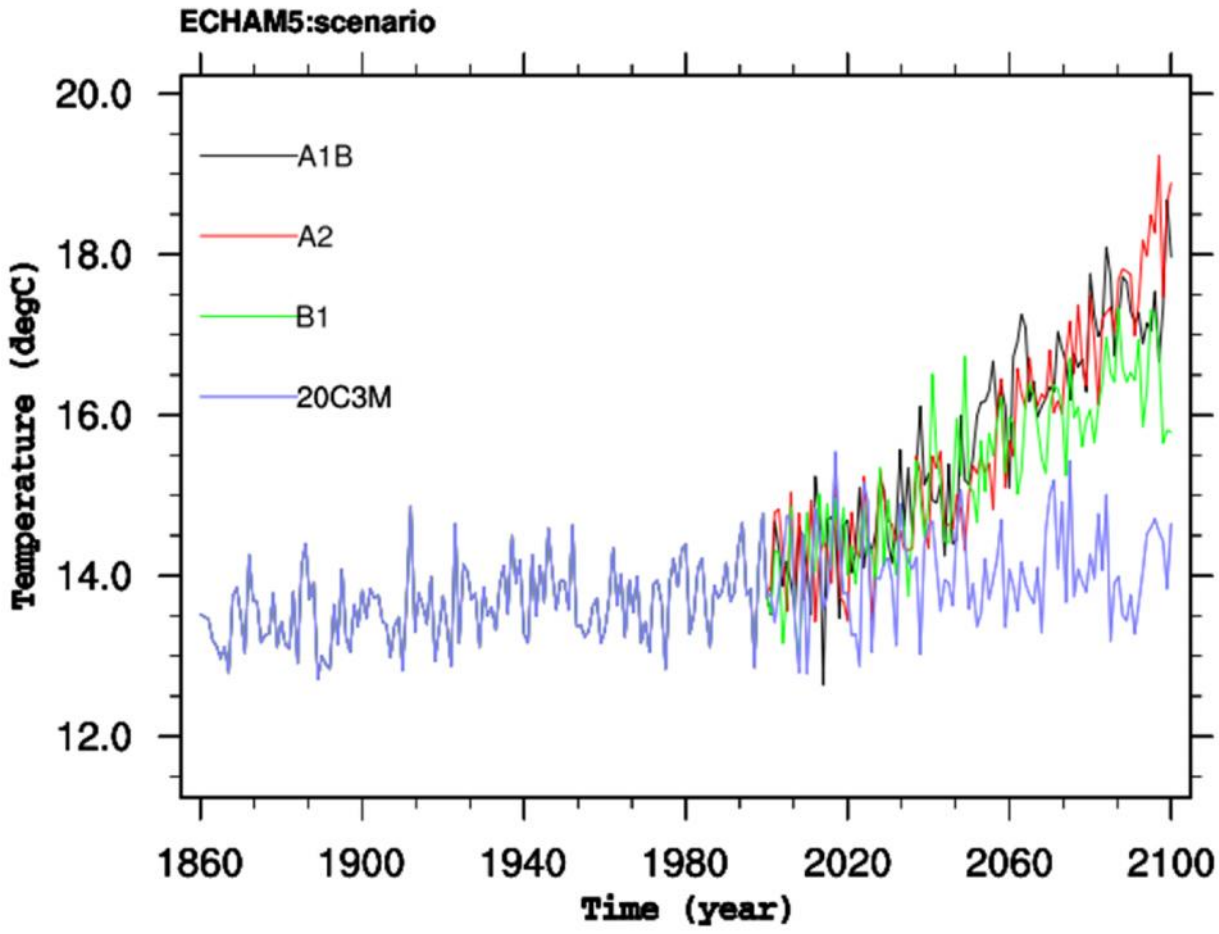
Data uncertainty (South Korea)



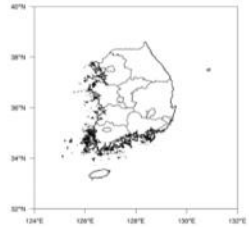


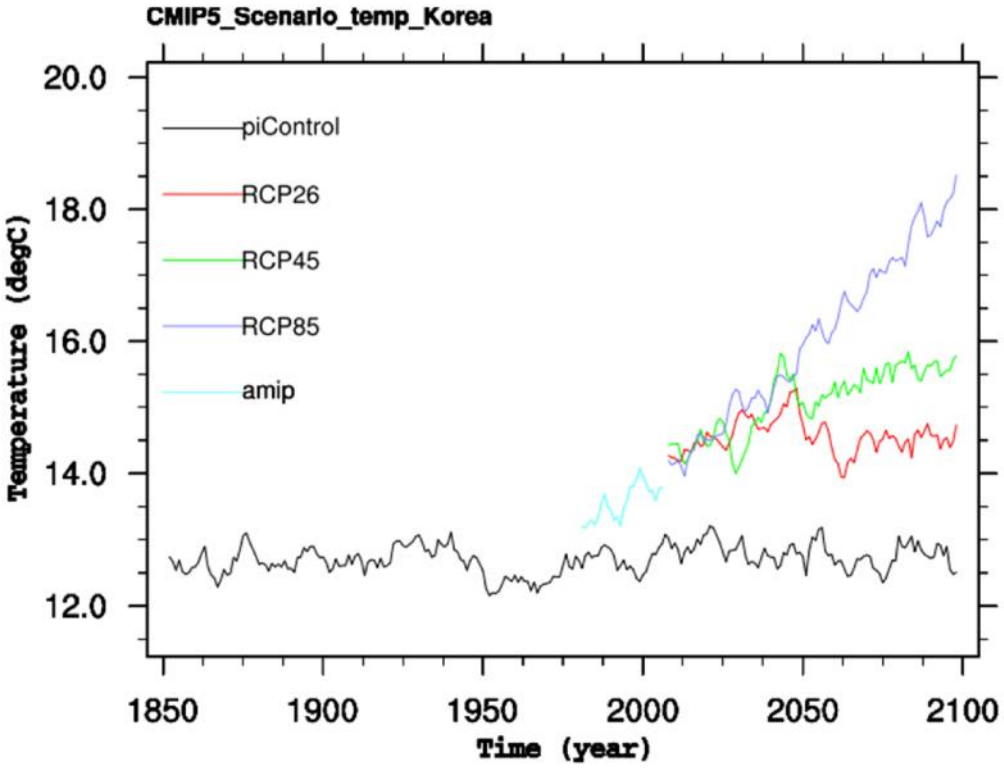
Temperature Scenarios (AR4)

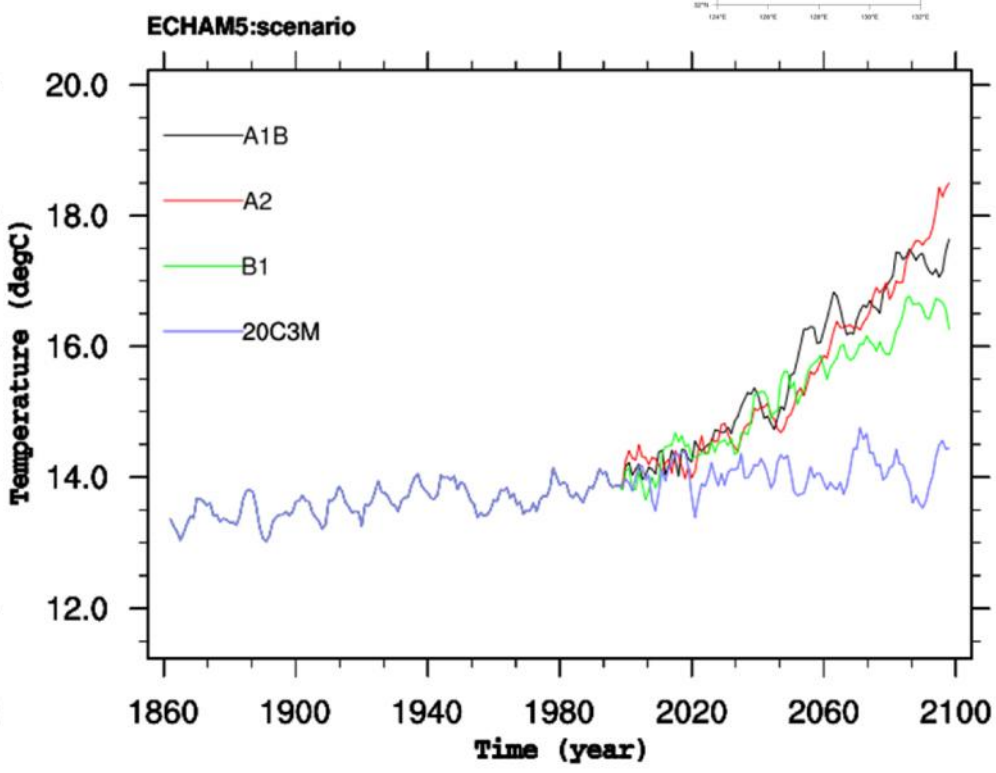




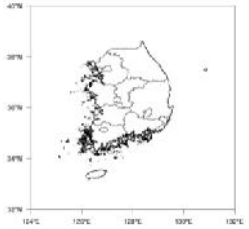
Temperature Scenarios (AR4 vs. CMIP5)

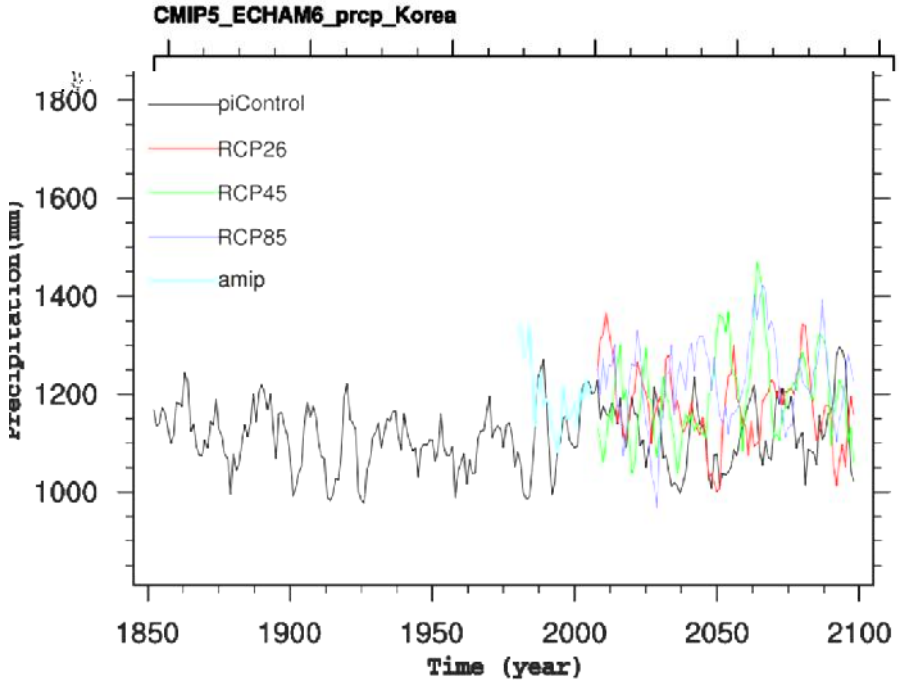


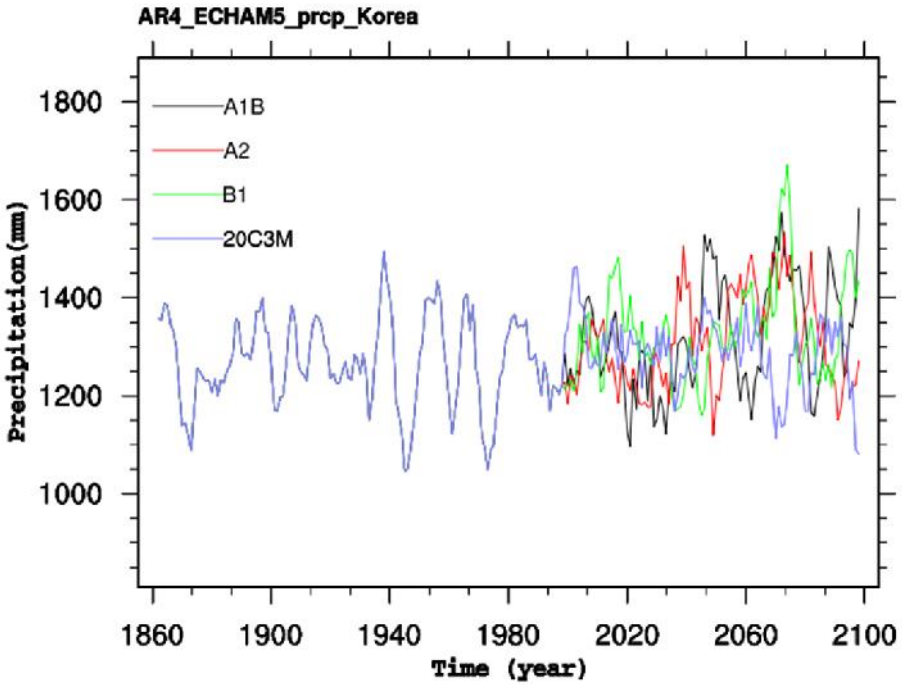




Precipitation Scenarios (AR4 vs. CMIP5)



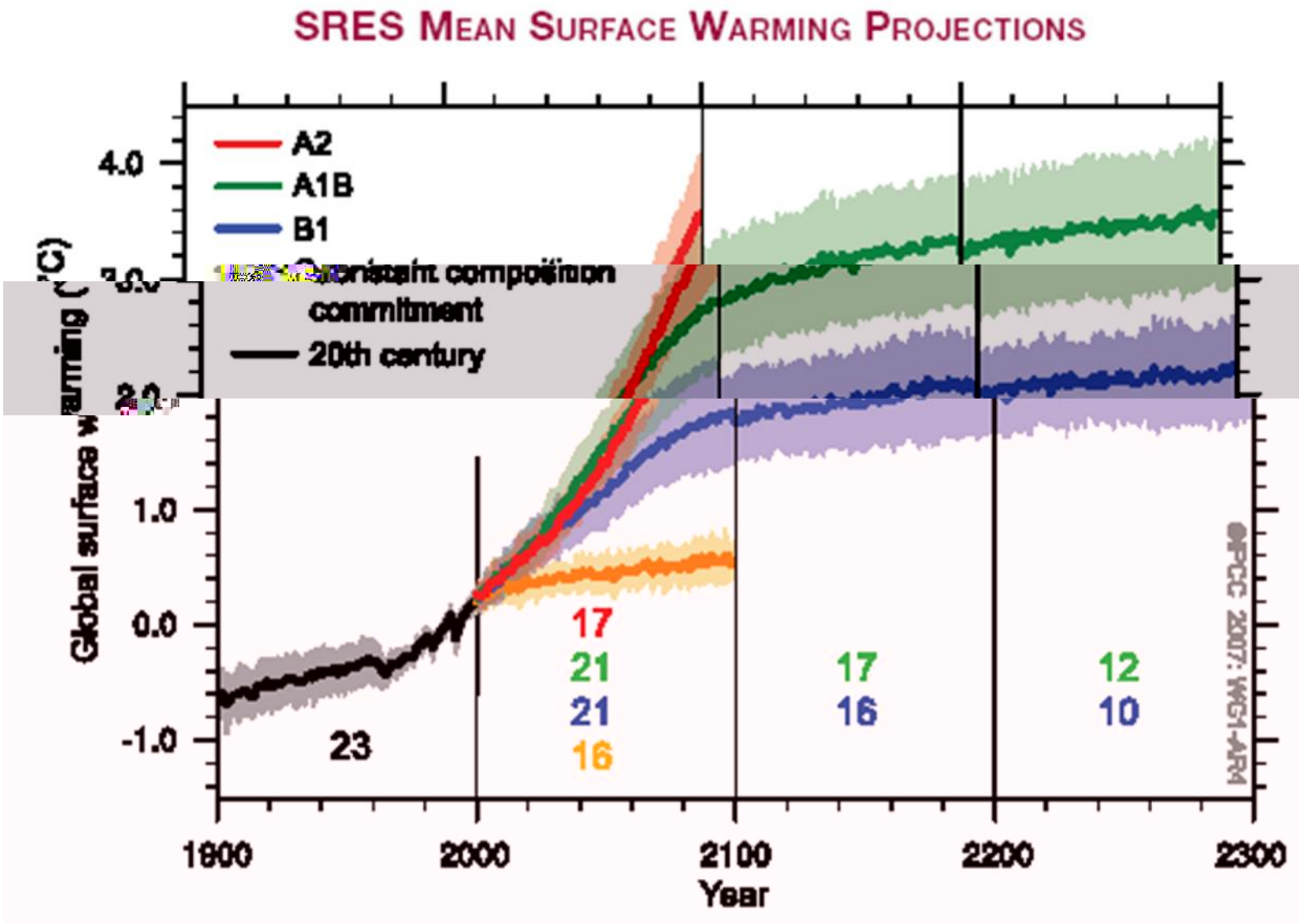




Trends (unit: mm/100yr; degC/100yr)

Data Sources (temp & prcp)		Temperature		Precipitation		Time periods
		Trend	T-test	trend	T-test	
CRU		**1.42**	**6.56**	**193.34**	**2.10**	1901-2000
ECMWF		2.33	1.30	-836.31	-0.97	1990-2009
NCEP		1.13	1.04	-811.17	-1.43	1990-2009
CRU		1.54	0.65	496.79	0.52	1990-2009
CRU		**1.53**	**7.78**	**227.61**	**2.70**	1901-2009
ECHAM5 (AR4)	20C3M	**0.32**	**2.23**	-28.23	-0.49	1901-2000
	A1B	**4.06**	**10.72**	185.36	1.77	2001-2100
	A2	**4.41**	**10.95**	83.97	0.96	2001-2100
	B1	**2.93**	**9.66**	100.47	1.30	2001-2100
ECHAM6 (CMIP5)	RCP26	0.04	0.66	-74.21	-0.99	2006-2100
	RCP45	**1.61**	**6.89**	74.89	0.72	2006-2100
	RCP85	**4.75**	**11.67**	29.48	0.59	2006-2100

Scenarios of global temperature (from IPCC AR4)



Summary 1 (temperature)

- The temperature increased by 1.4 degC in the 20th century.
- The abrupt changes of the temperature were detected respectively in 1947 and 1988.
- The temperature would increase by from 0.04 to 4.75 degC at various scenarios in South Korea.
- The temperature shows much stronger increase in South Korea than the whole East Asia.

Summary 2 (precipitation and temperature)

- The precipitation increased by 193mm in the 20th century.
- The abrupt change of the precipitation was detected in the year 1952.
- The precipitation didn’t show any significant change at various scenarios in the 21th century.
- Relationship of T and P show positive correlation in the beginning of the 20th century , then became negative correlation from 1930 to 1990, and afterwards, became positively correlated again.