Generation of Typical Weather Data for Future Climate Change for South Korea

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Purpose

- Generate typical weather data
- Suggest future climate change needs for South Korea
- Assess the performance of buildings in the future
- Improve consistency and reliability of simulation weather data

Contents

- **Future South Korea temperature change**
- **Estimation of temperature trend for Seoul and Ulsan**
- **Climate change test reference years**

Future South Korea temperature change

mean temperature (1961-1990) average +

value of change between the 20th(1961-1990) and 21th(2070-2099) centuries according to the sixteen scenarios ×

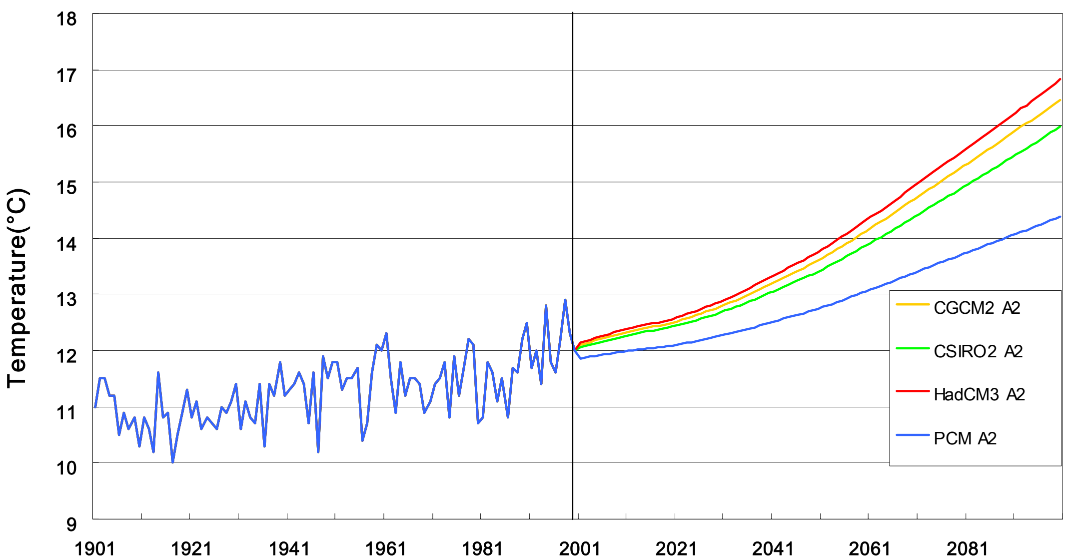
rate of change using the scalers for a period (2001-2000)

Climate Change Scenarios

	Economic development (World GDP: 10^{12}US$/yr)	Global population (2100)	Technological development	Cumulative carbon dioxide, total (1990-2100:GtC)
A1F1	Very rapid growth peak in mid-century declines thereafter (525)	Very rapid growth peak in mid-century declines thereafter (A1F1-7.1billion)	Rapid introduction of new and efficient	A1F1-2189 (2127-2538)
A2	More fragmented and slower than other scenarios (243)	Continuously increasing (15.1billion)	Fragmented and slower	1862 (1352-1938)
B1	Rapid change toward a service and information (328)	Very rapid growth peak in mid-century declines thereafter (7.0billion)	Introduction of clean and resource efficient	983 (772-1390)
B2	Intermediate level (235)	Continuously increasing (10.4billion)	Less rapid and more diverse than B1 and A1	1164 (1164-1686)

* Summary for Policymakers – Emission Scenarios

Observed(1901-2000) and alculated(2100) annual South Korea mean air temperature



Climate grids of South Korea

We have both Hadley model data (HadCM3) and Tyndall Centre data (TYN SC2.0 of Ulsan and Seoul (2001-2100))

- ● TYN SC2.0
- ■ HadCM3
  - 127.5, 37.5
  - 127.5, 35

Seoul : 127.5, 37

Ulsan : 129.5, 35.5

The Hadley Centre model (HadCM3)

- Daily weather parameters : maximum, minimum and average temperature, humidity, wind speed and downward short-wave flux (solar radiation)
- Year : 360 days, month : 30 days
- Size of each grid-box : 2.50° X 3.75°
- Weather data : 1860 to 2099

TYN SC2.0 of Ulsan and Seoul (2001-2100)) is *monthly* data from HadCM3 *(HadCM3 is daily data)*

For TYN SC2.0:

x = c + r + (p × t)

X : future meteorlogical parameter

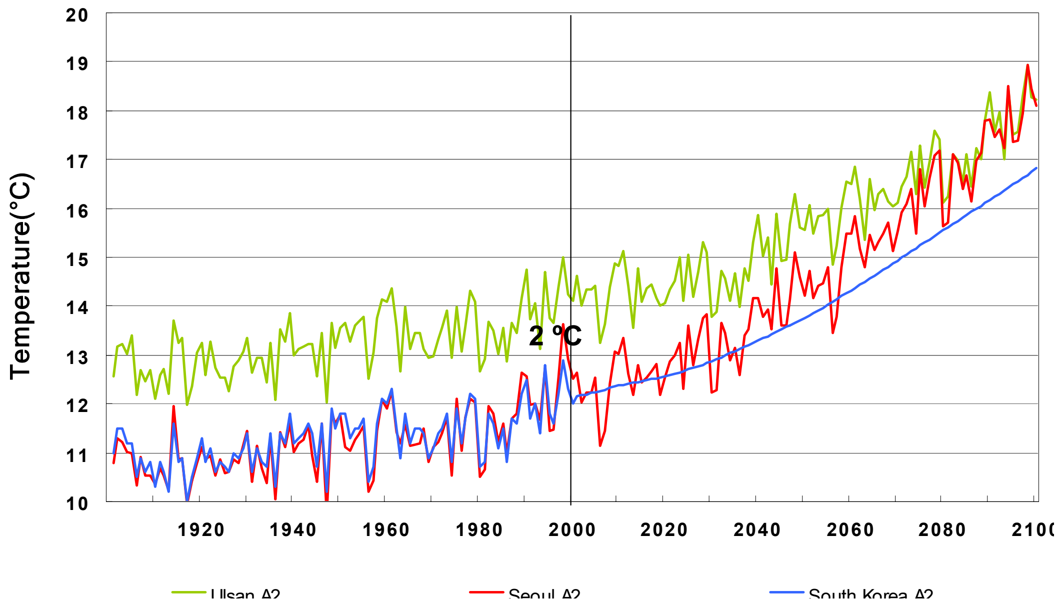
c : observed climatological mean from 1961–90

r : residual from the observations after anomalising relative to 1961–90 and detrending against global temperature

p: pattern of response to radiative forcing (expressed as anomalies relative to 1961–90, per degree of global temperature change)

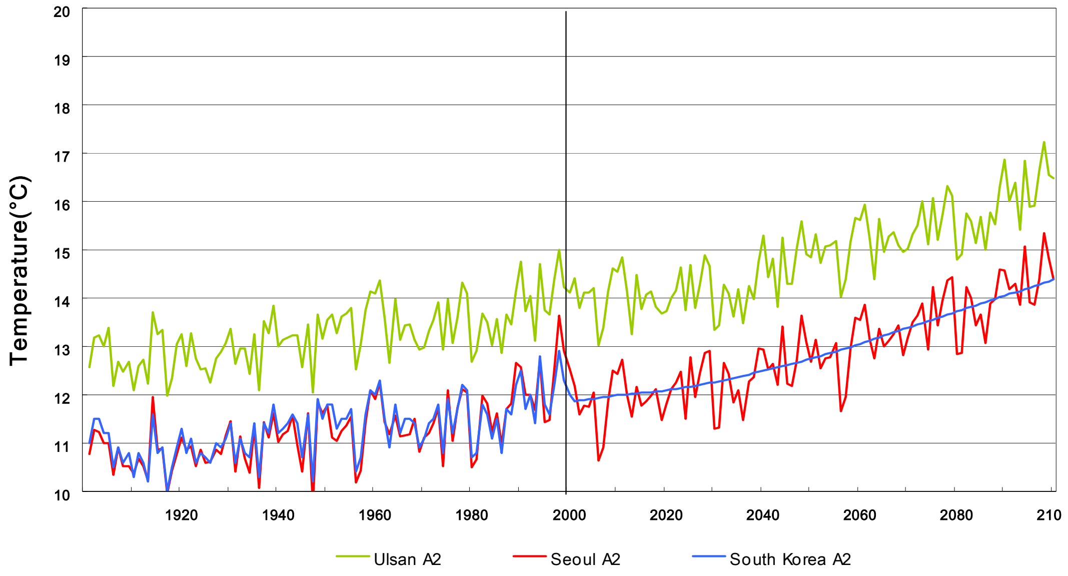
t: the global temperature change (relative to 1961–90)

Changes of the annual mean air temperature for TYN SC 2.0

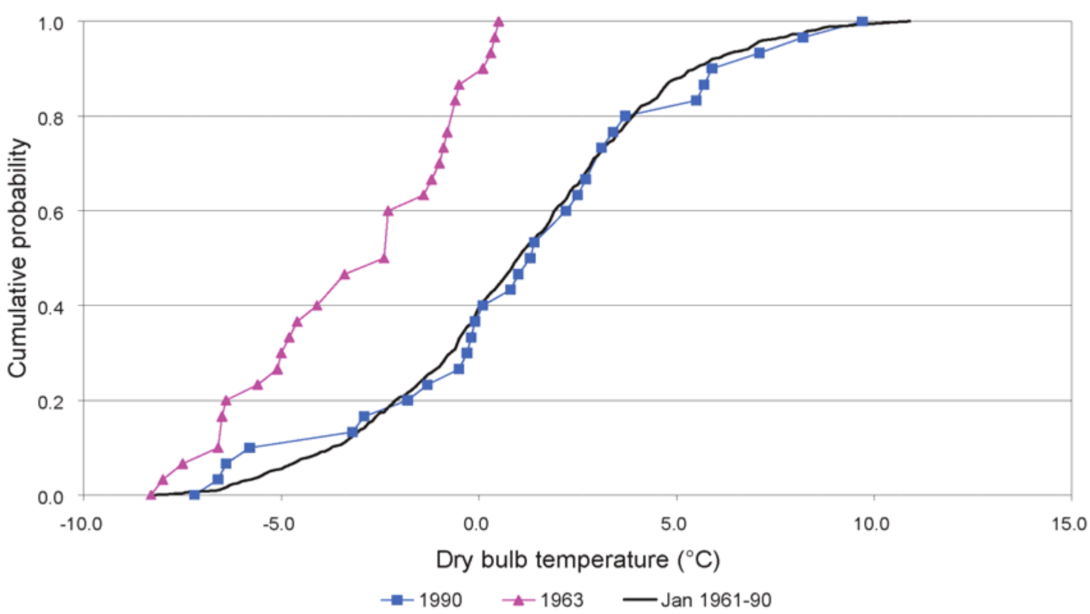


There are different climate models besides Hadley. This shows the US PCM results

(from the Tyndall Centre)



Selection of Test Ref. Year using the F-S statistic (based on the cumulative frequency distribution, CDF) CDFs for different January comparisons for Ulsan



This is the F-S method

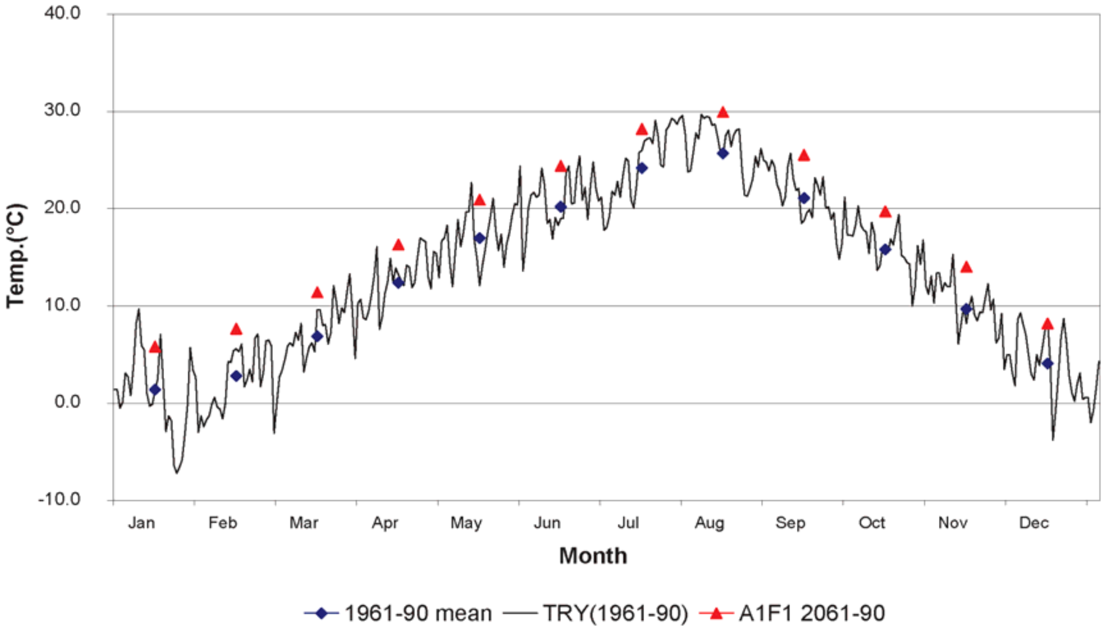
$$S_n(x) = \begin{cases} 0 & \text{for} \quad x < x_1, \\ (k-0.5)/n & \text{for} \quad x_k \le x < x_{k+1}, \\ 1 & \text{for} \quad x \ge x_n. \end{cases}$$

Finkelstein-Schafer (FS) statistics

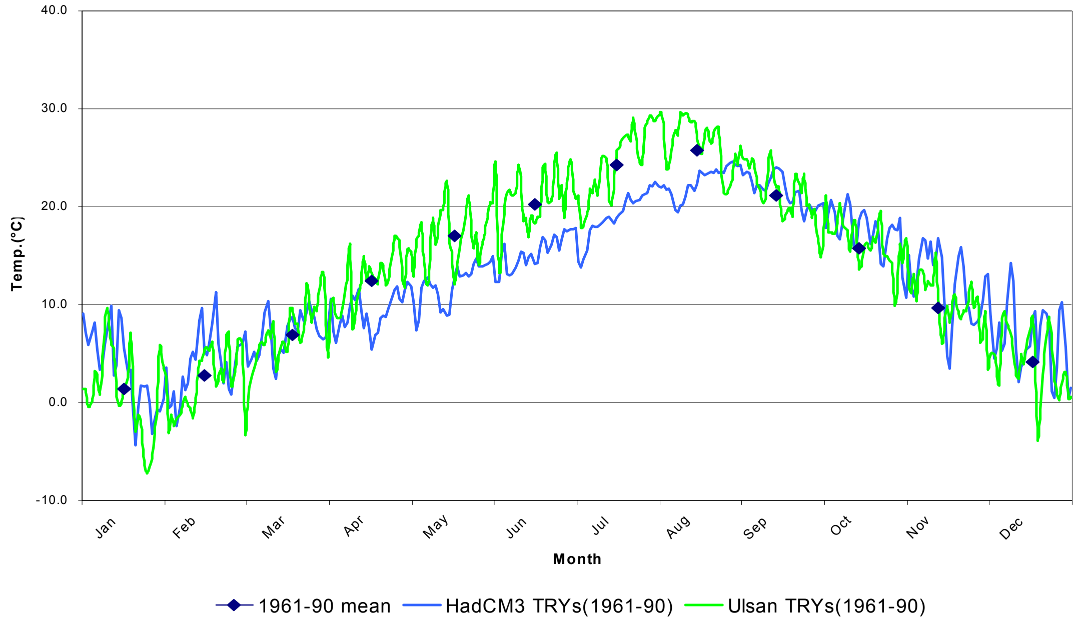
$$FS(y,m) = (\frac{1}{n})\sum_{i=1}^{n}|CDF_m(x_i) - CDF_{y,m}(x_i)|$$

TRY = min(FS)

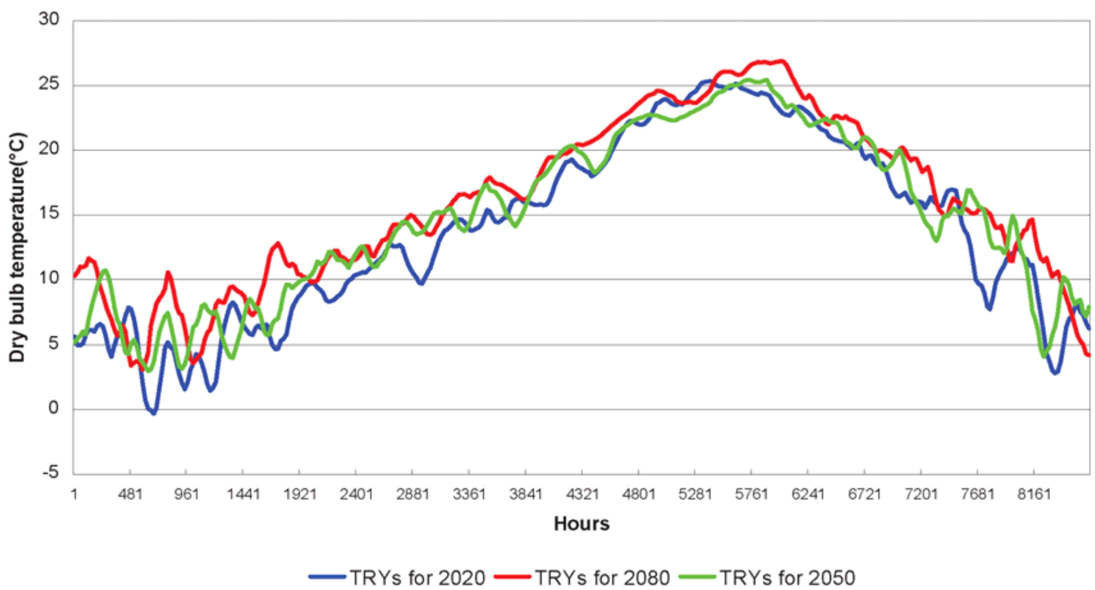
Test Reference Year(1961-1990) and climate change(2061-2090)



Comparison of Hadley data with actual data for Ulsan for 1961-1990



TRYs for 2020, 2050 and 2080 for the South Korea(127.5, 35 : HadCM3)



Mean dry bulb temperature, standard deviation and maximum hourly dbt

Grid Box	Year	Mean dry bulb temperature (dbt)	Standard deviation of dbt	Maximum hourly dbt in the TRYs
127.5, 35	1970	12.55	6.66	24.86
	2020	13.74	7.02	26.01
	2050	14.77	6.40	26.52
	2080	15.90	6.42	27.48
127.5, 37.5	1970	4.77	13.84	30.44
	2020	6.89	13.17	37.31
	2050	8.43	12.82	36.28
	2080	10.79	12.71	41.15

Conclusion

- **Global warming is happening in South Korea**
- **The trend is for the temperature in Seoul to rise faster than in Ulsan. [Seoul is further North than Ulsan, but Ulsan is near the sea.] (South Korean grid is in between).**
- **Summer maximum temperature and winter minimum temperature have been rising steeply in Seoul and Ulsan**
- **Due to the climate change there will be a substantial rise in energy consumption and CO_2 emissions due to air conditioning. Further work will establish how much.**