Effect of Climate Change on Maximum Rainfall Intensity

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ณ โรงแรมมิราเคิล แกรนด์ คอนเวนชั่น กรุงเทพฯ

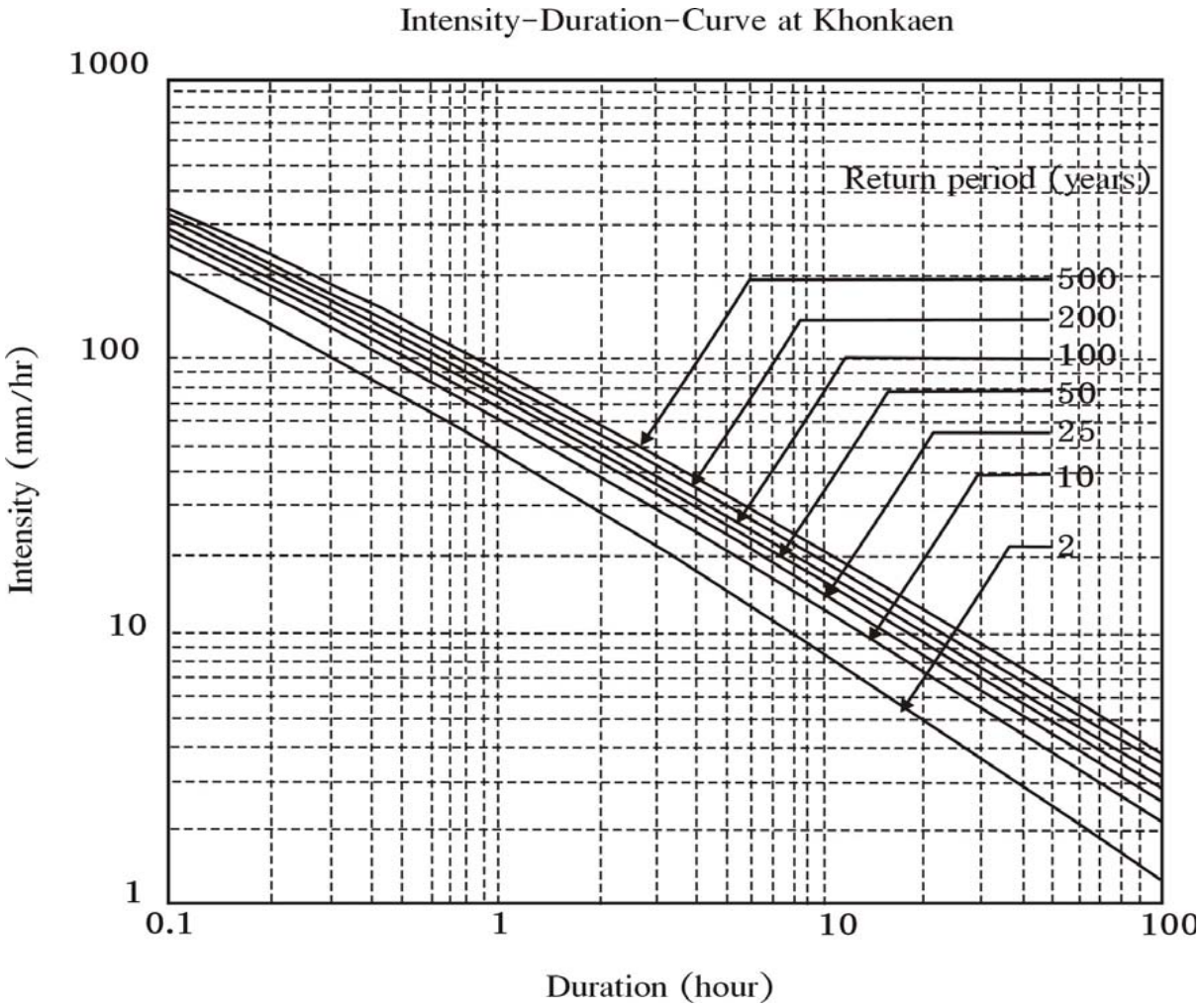
- Rainfall intensity is one of the most important parameter for hydraulic structure design and drainage design, soil and water conservation design and operations
- Incorrect rainfall intensity gives way to improper design

Whether over design or under design

Over design will damage economic

Under design will damage structures

- In design, we choose a maximum rainfall intensity at specified duration and return period normally from intensity-duration-frequency relationship (IDF curve)



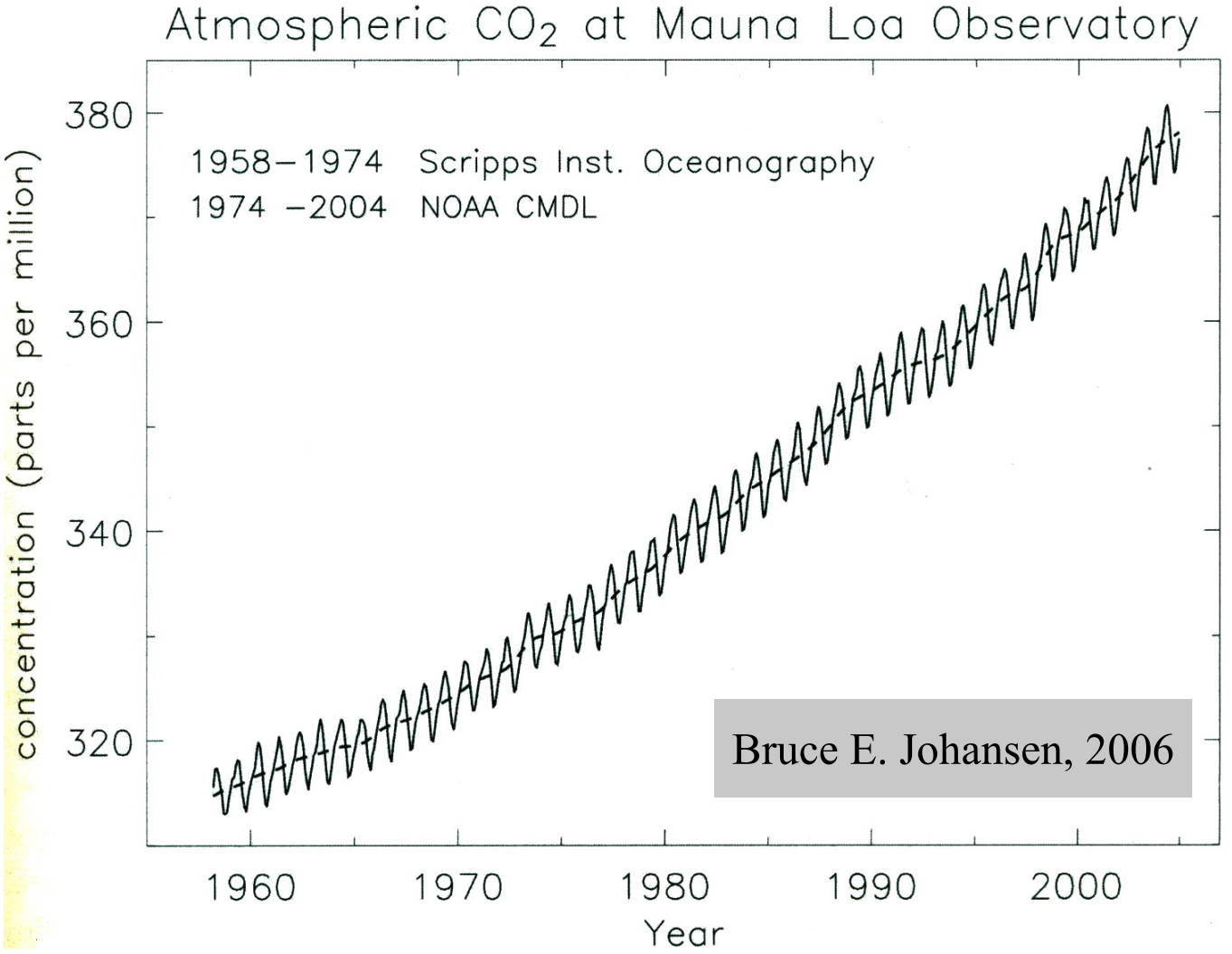
Whether in graph or table forms

อุทกวิทยา (วิชัย, 2552)

- In preparing IDF-curve we need maximum intensities at specified durations from many year as sample data
    - However in statistical samplings we assume equally likely drawn samplings
    - That means the climate environment must be the same for every year

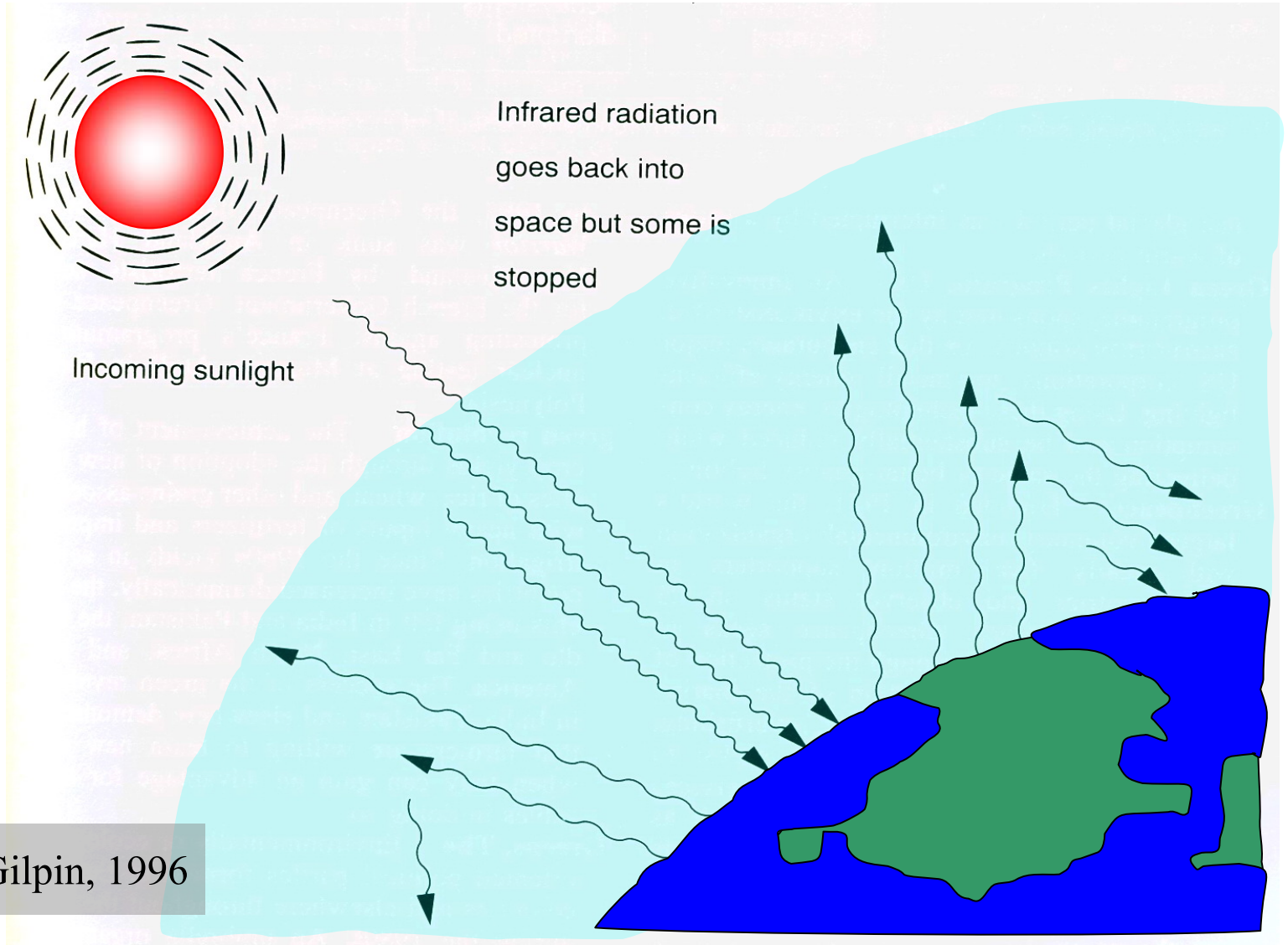
- We now feel that climate is changing due to increasing of greenhouse gases-CO_2, CH_4 1%/yr

Keeling curve show tremendous increasing in CO_2



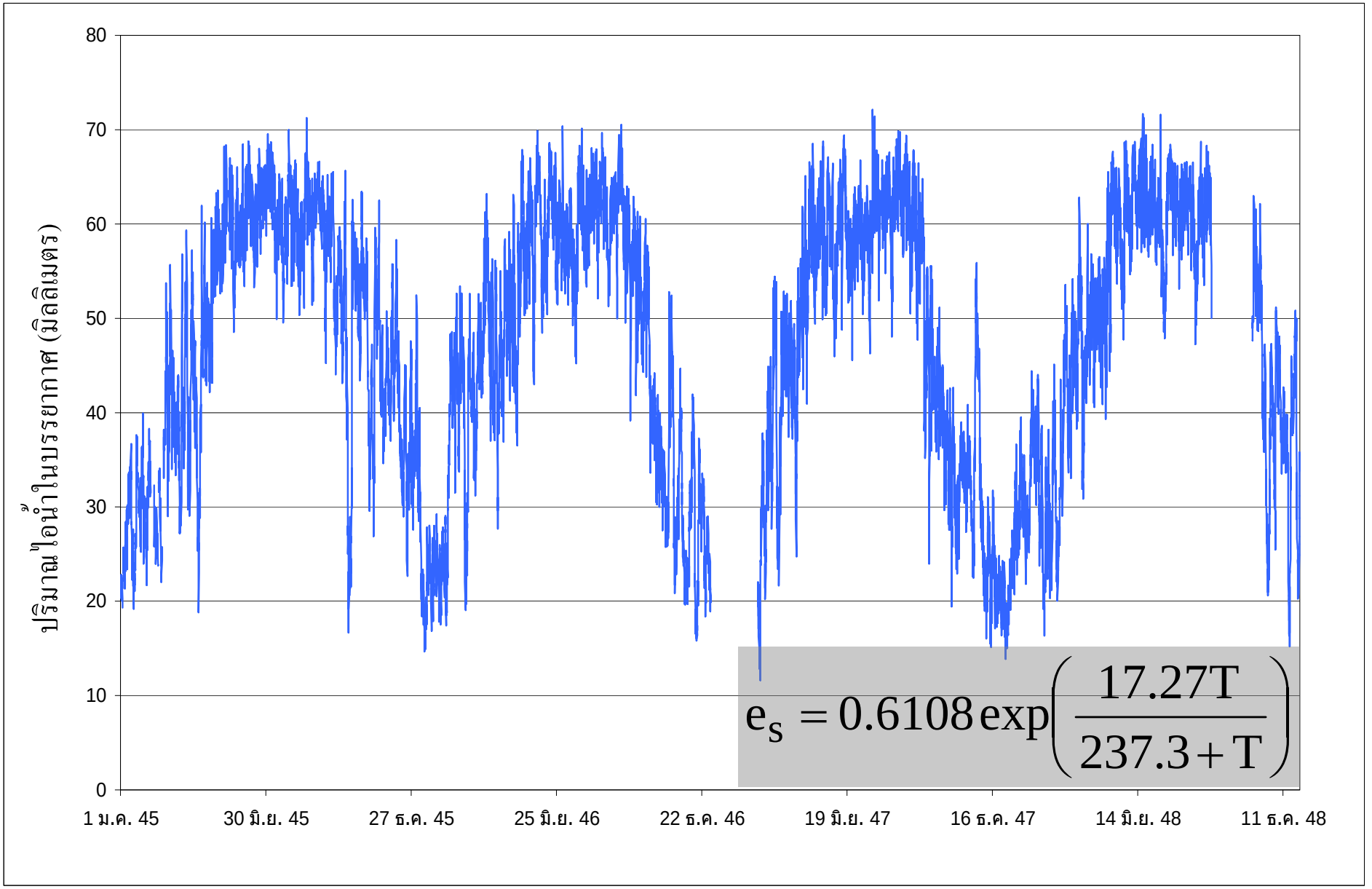
- Increasing of greenhouse gas increase earth temperature

CO_2 double increasing causes T to increase 3.8 °C

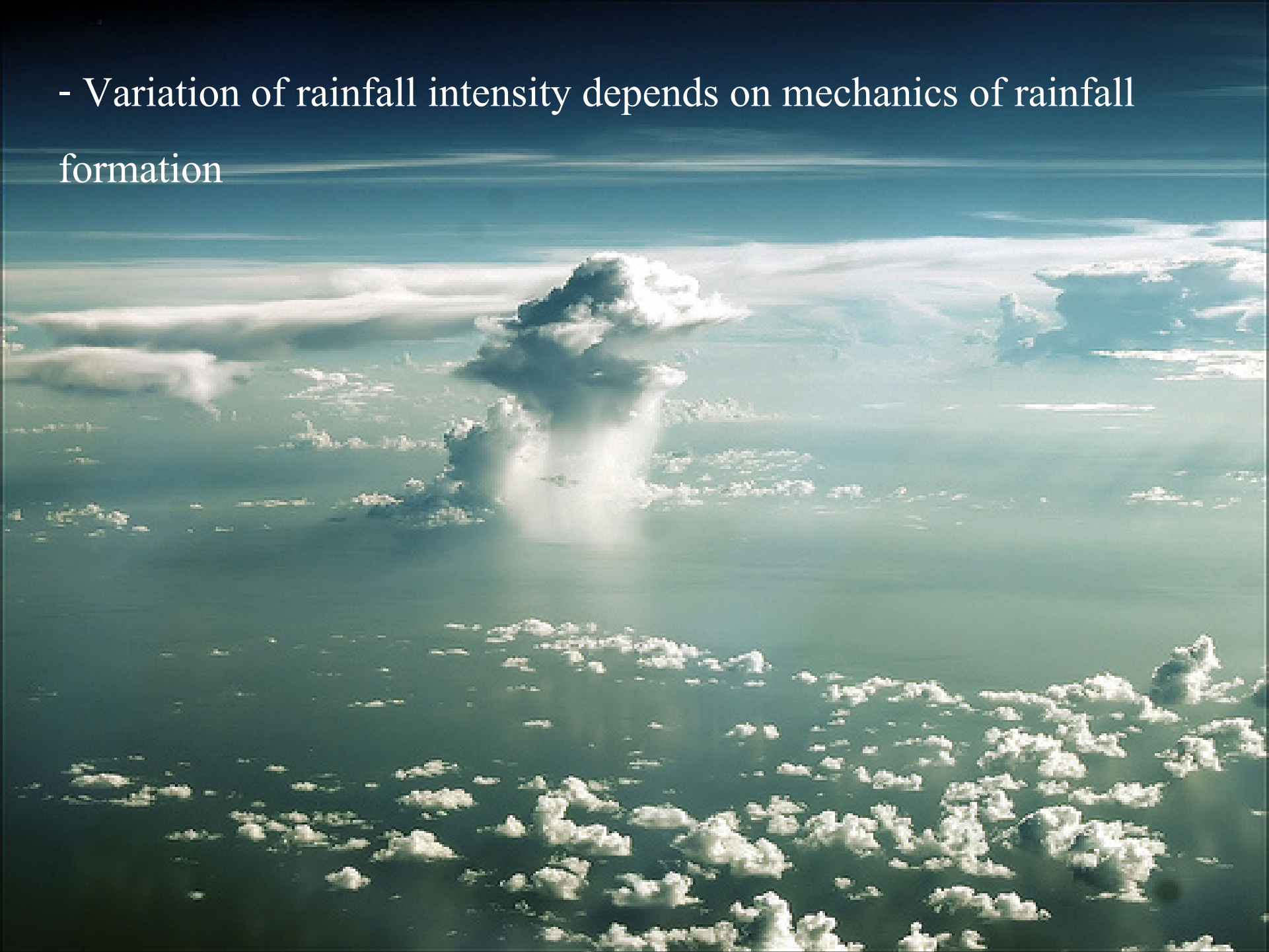


Alan Gilpin, 1996

- Higher atmosphere temperature induces air moisture content,

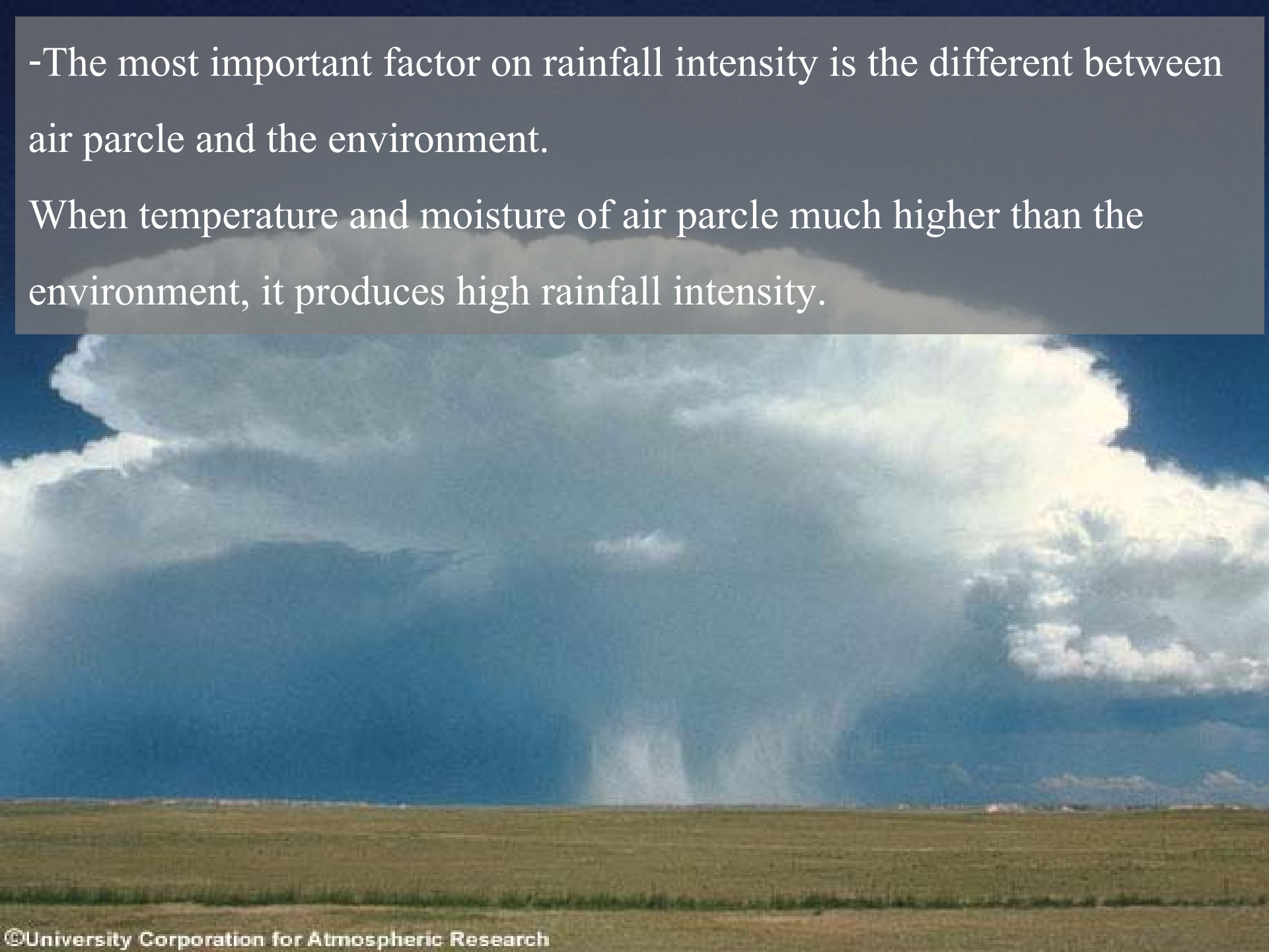


- Variation of rainfall intensity depends on mechanics of rainfall formation



-The most important factor on rainfall intensity is the different between air parcle and the environment.

When temperature and moisture of air parcle much higher than the environment, it produces high rainfall intensity.

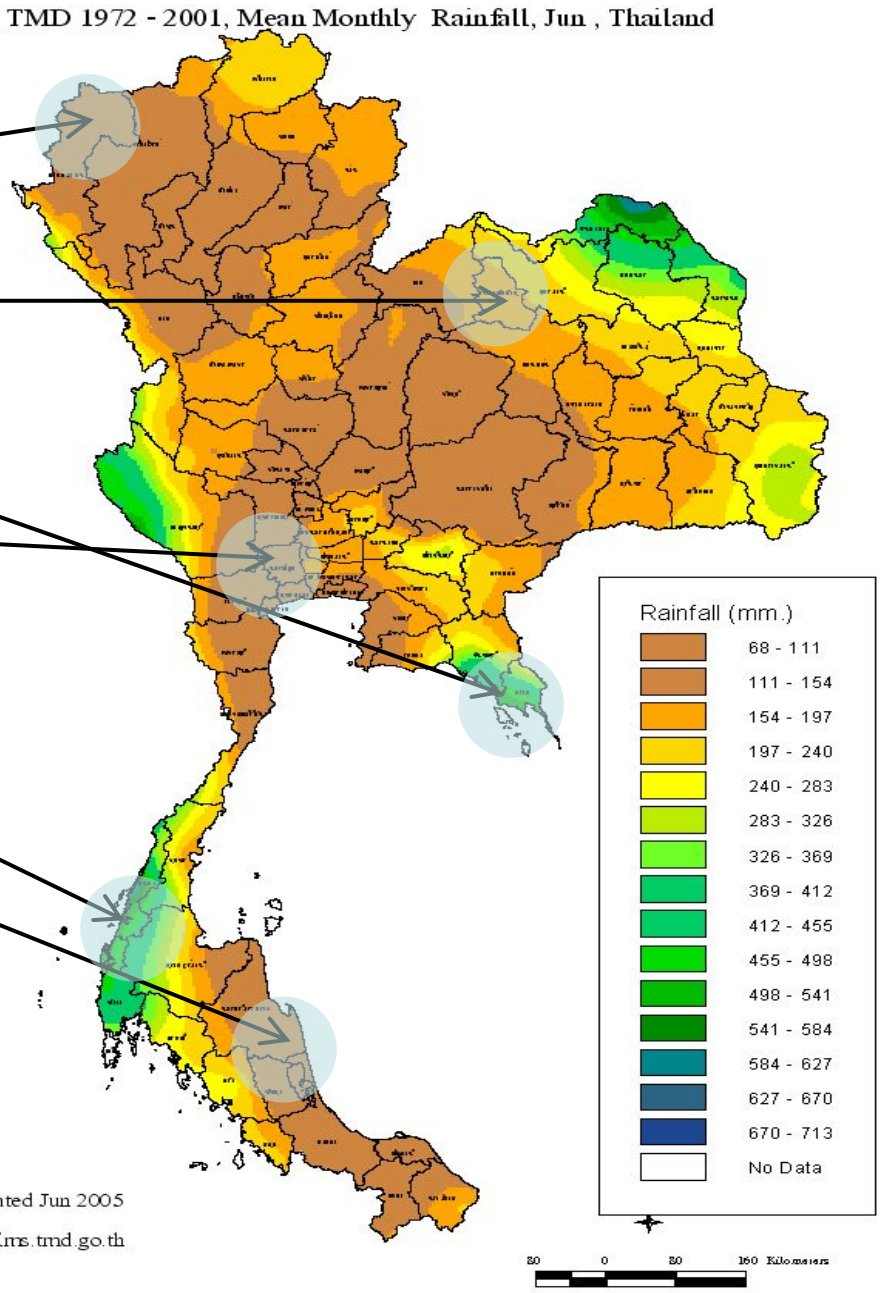


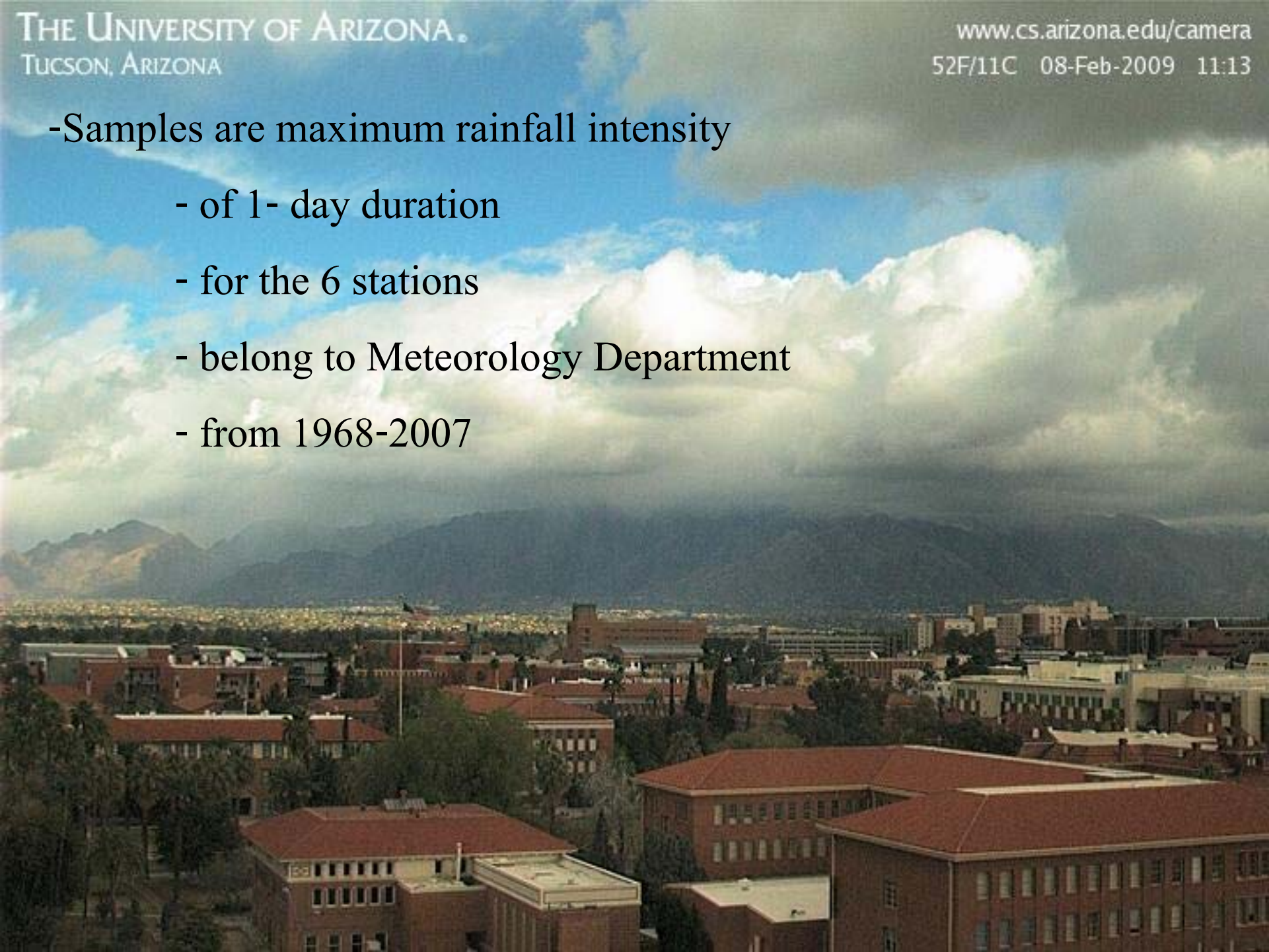
-Due to climate change, samplings are not the same situation.

- Due to slowly changing, we assumed rainfall condition during each 15-year series are similar.
- We used 15-year series to calculate maximum rainfall intensity of 100-year return period in consecutive manner from 40 year data sets.

-We chose 6 rainfall stations

- Maehongson
- Udonthani
- Chanthaburi
- Suphanburi
- Ranong
- Songkhla





-Samples are maximum rainfall intensity

- of 1- day duration
- for the 6 stations
- belong to Meteorology Department
- from 1968-2007

-Common practical in Thailand,

- maximum rainfall intensity distribution is assumed follow large extreme value distribution

- or Gumbel distribution

- first, transform random variable x to reduced variate y,

$$y = \frac{x - u}{\beta}$$

$$\beta = \frac{\sqrt{6}\sigma}{\pi}, \quad u = \mu - 0.5772\beta$$

$$F(x) = \exp(-\exp(-y))$$

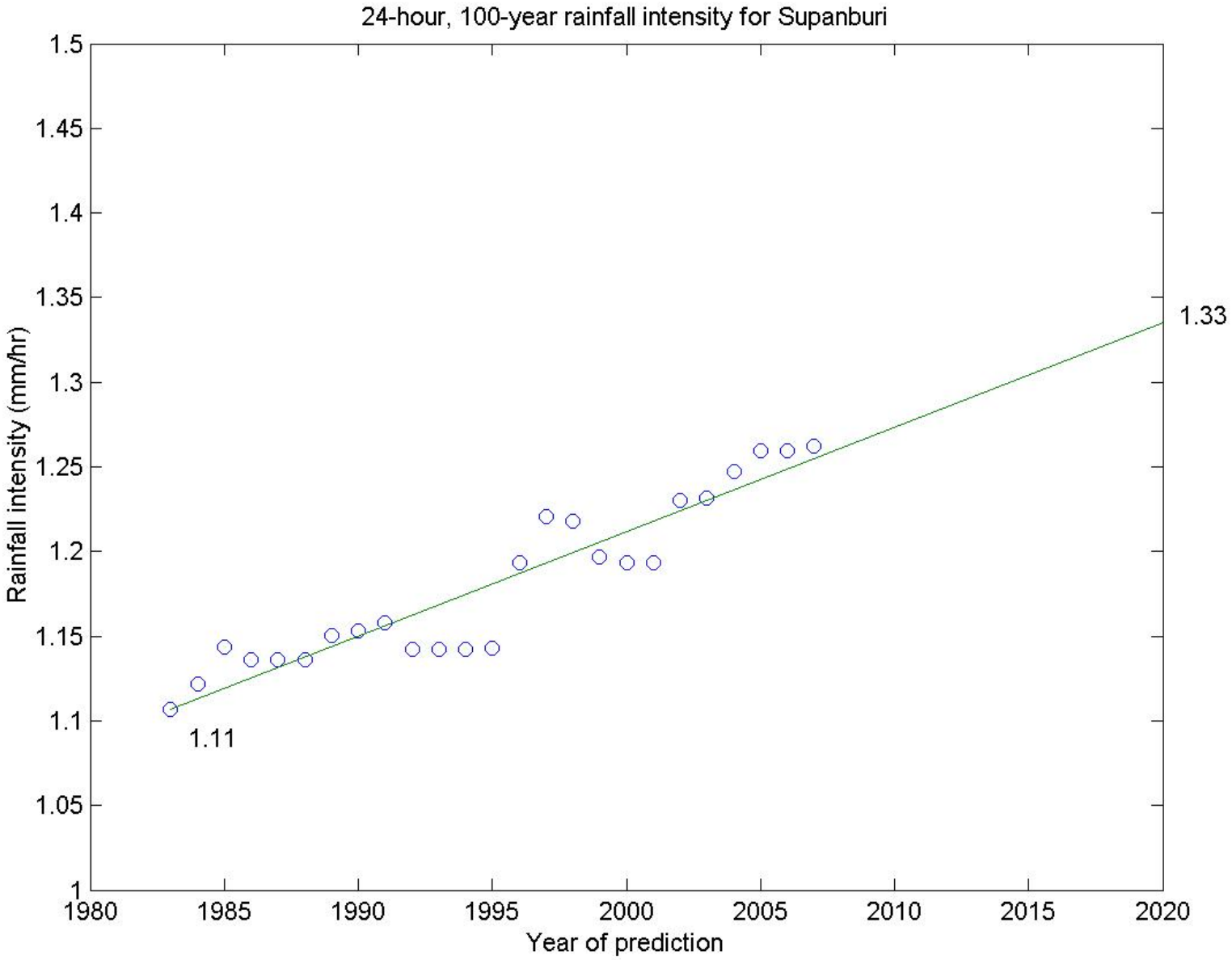
$$G(x) = 1 - F$$

$$T = \frac{1}{G(x)}$$

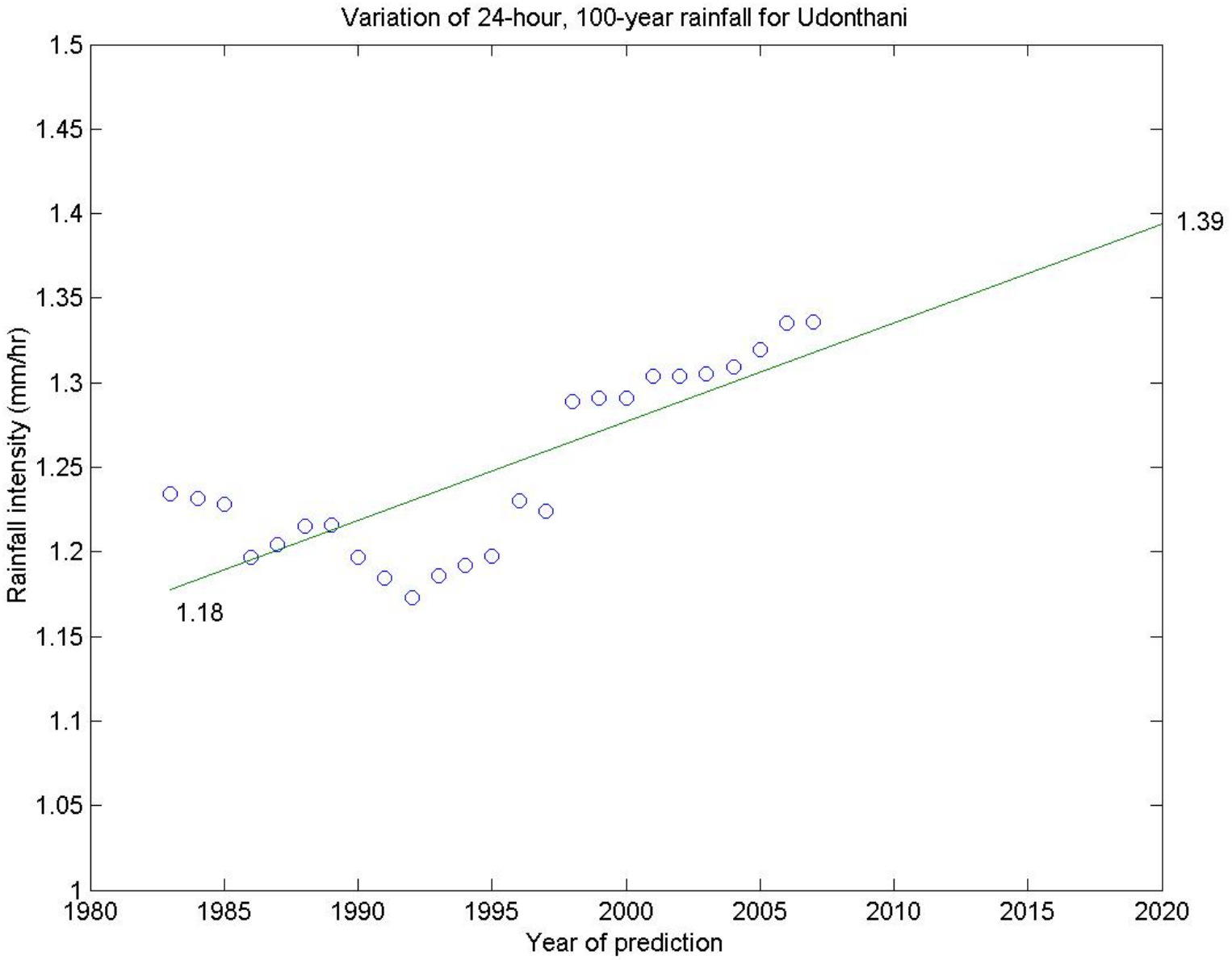
-Each set of consecutive 15 years was treated as one equally likely drawn sample set.

- from 40 years of data, 1968-2007.
- 1st set is 1968-1982 to predict from 1983 on ward.
- 2nd set is 1969-1983 to for 1984 on ward.
- We got 26 predictions from 1983 to 2007.

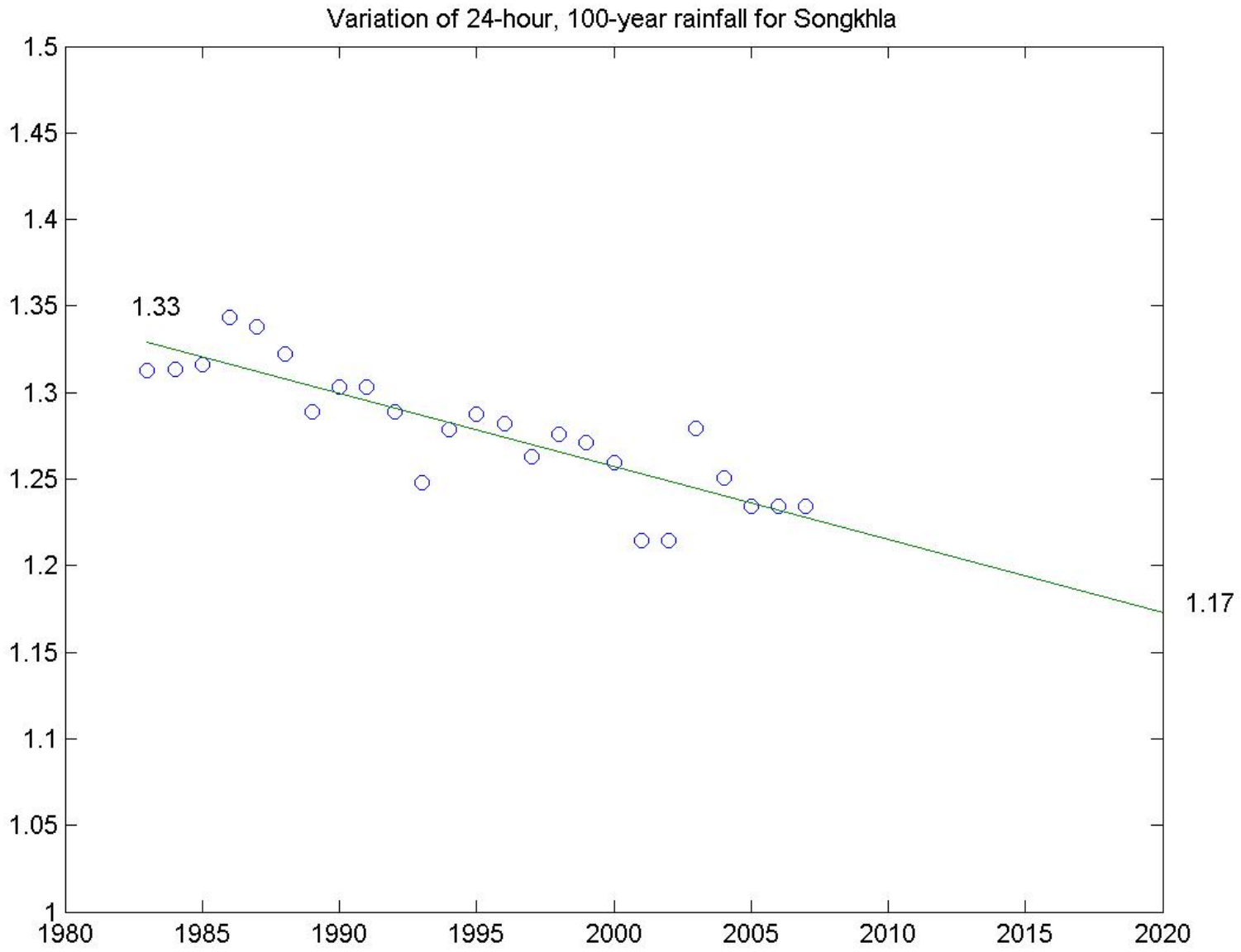
- **Result :** Suphanburi



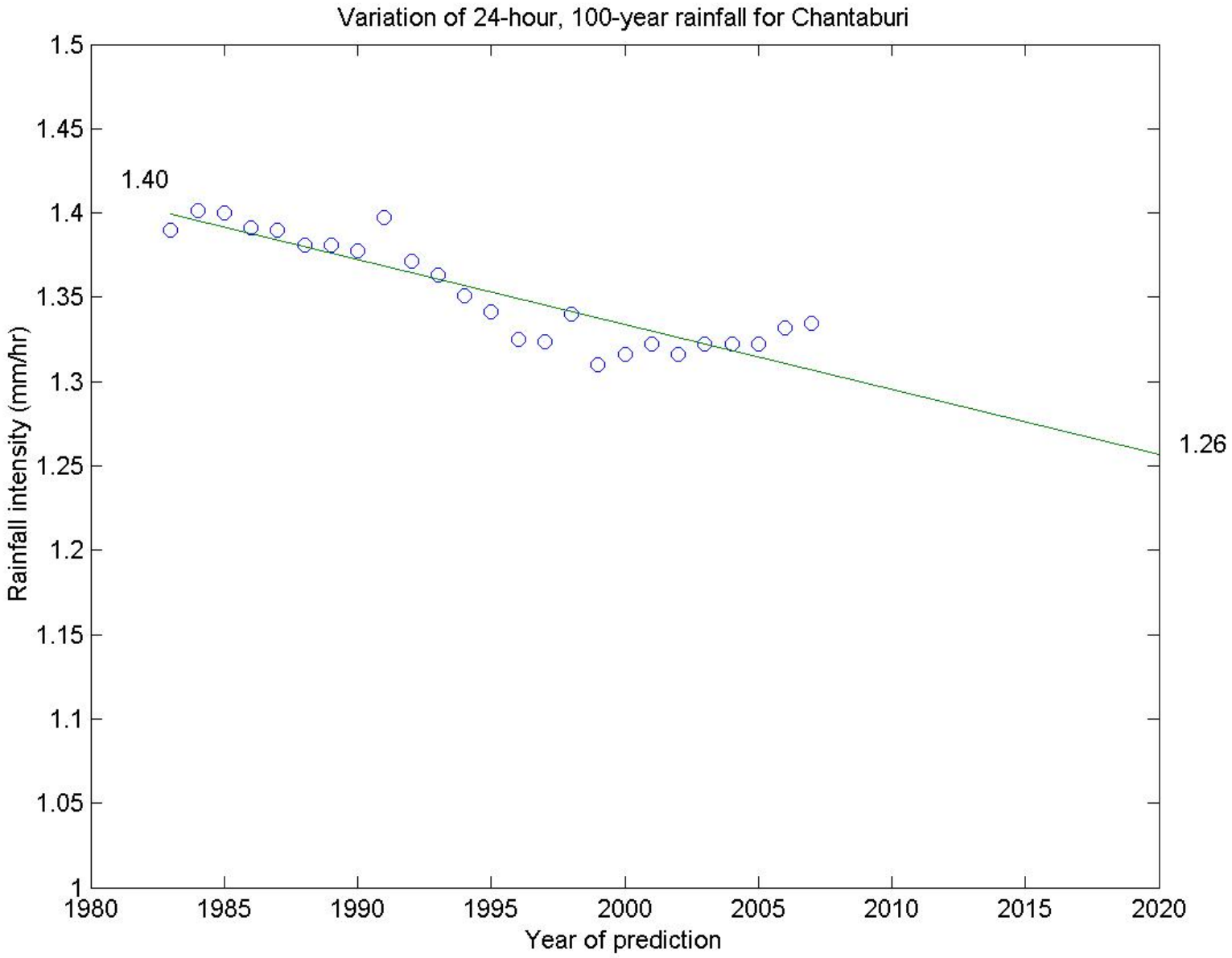
- **Result :** Udonthani



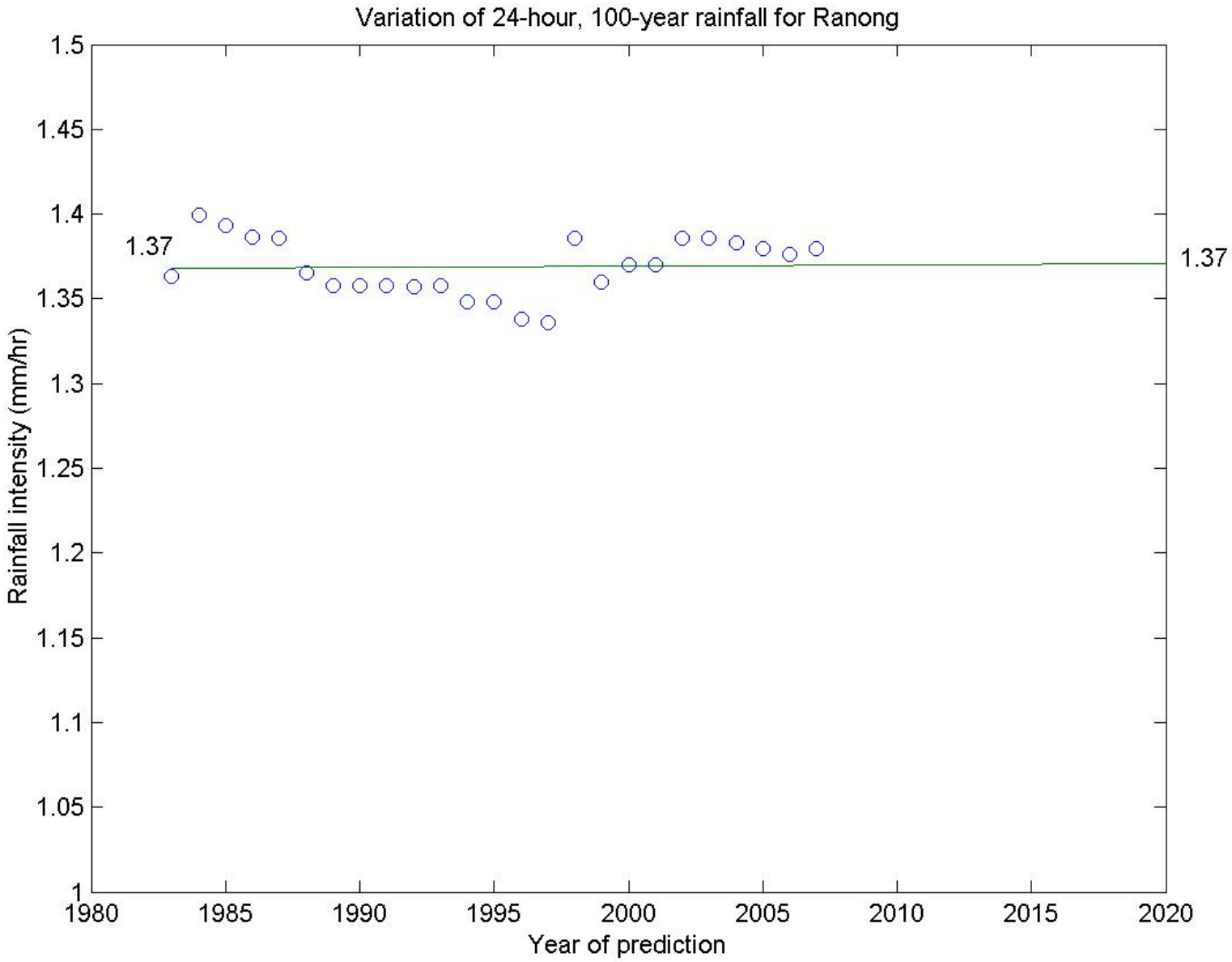
- **Result :** Songkhla



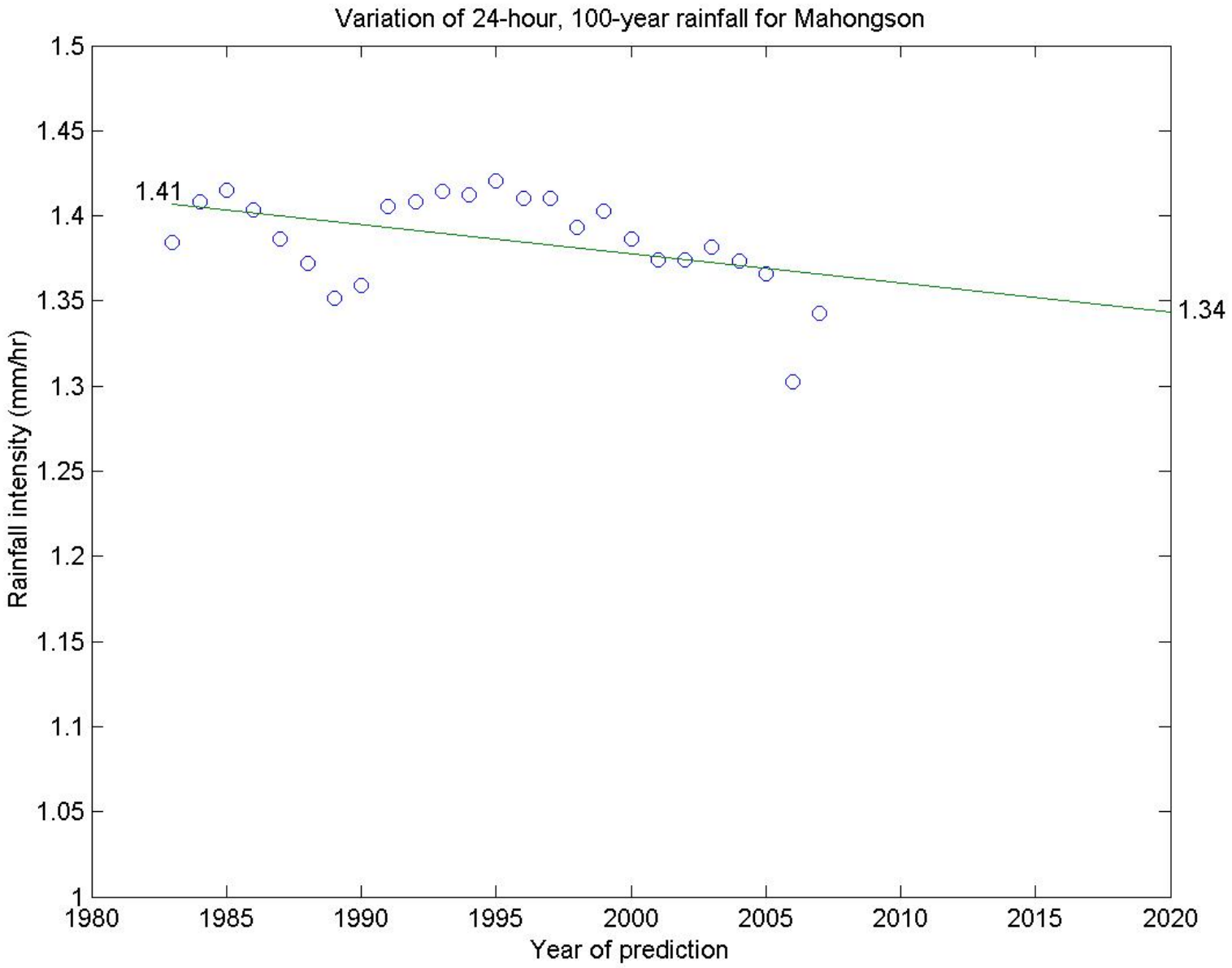
- **Result :** Chanthaburi



- **Result :** Ranong



- **Result :** Maehongson



- Analysis results

Stations	Average annual rainfall (mm)	Rainfall Intensity from 40 year of data (mm/hr)	Return period from 40 year of data (years)	Actual return period on 2020 (years)
Supanbury	1121	1.18	100	17
Udonthani	1457	1.24	100	19
Songkha	2060	1.28	100	429
Chanthbary	2970	1.34	100	562
Ranong	4189	1.37	100	100
Mae Hongson	1289	1.38	100	214

- **Conclusion**
    - When ignore effect of climate change
        - average maximum rainfall intensity varies with average annual rainfall
        - except Maehongson station, the highest intensity but the next to smallest annual rainfall
    - Case of low annual rainfall and low maximum intensity
        - become smaller actual return period
        - dangerous cases

- **Conclusion**

    - Case of high annual rainfall and high maximum intensity and case of low annual rainfall but high maximum intensity.

        - become higher actual return period

        - safer cases

    - Case of extremely high annual rainfall.

        - no climate change effect on maximum intensity

Acknowledgments

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- *Department of Agricultural Engineering, Faculty of Engineering, Khon Kaen University, Thailand*