Spatial and temporal characteristics of the yearly rainfall frequency distribution in Cyprus

F.S. Tymvios and S.C. Michaelides
Department of Meteorology, Cyprus

Adapt to Climate: Thursday, 27 March 2014

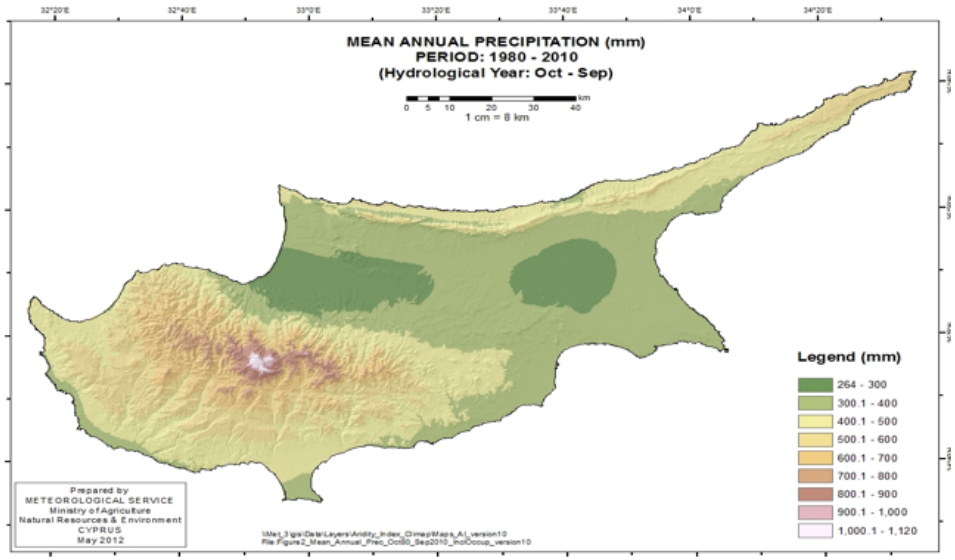
What triggered this work?

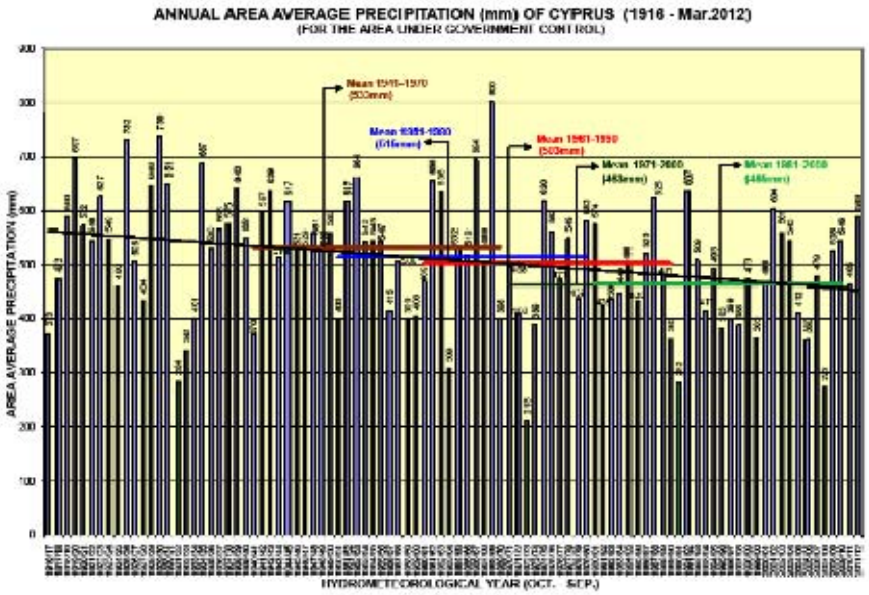
- Climate change:
  - Myth or reality?
  - Fact or exaggeration?
  - Can we provide evidences?
- We need concrete proof USiNG REAL DATA..
  - The kind of proof that the "science of the averages" is not able to offer

Let's talk "Math" : Model an indicator

- Parameters used as indicators of the Climate change:
  - Temperature and Rainfall
  - Long time series of accurate Temperature Records with high spatial coverage are not available for Cyprus.
  - On the other hand, continuous precipitation records are available from the beginning of the previous century, at more than 30 stations spread around the island.
- Inevitably we modeled precipitation..

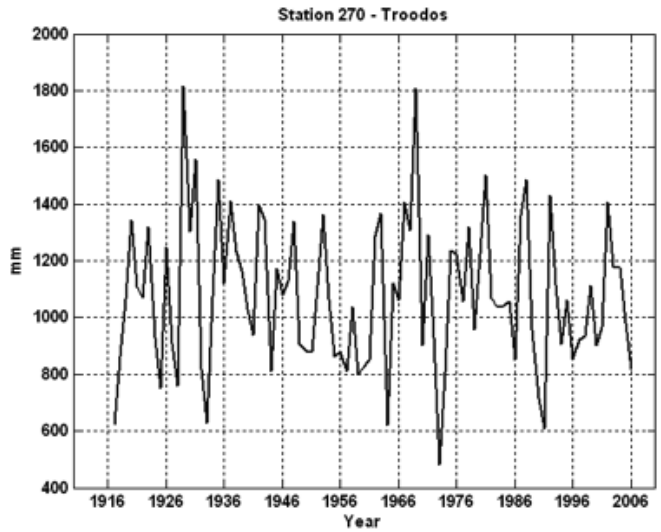
Precipitation in Cyprus





Modeling the yearly average precipitation

- This is the yearly average value. HUGE variability



Modeling the yearly average precipitation

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- We have the climatological periods (30 years).

- 1920-1949
- 1921-1950
- 1922-1951
- …
- 1976-2007
- …

Modeling the yearly average precipitation

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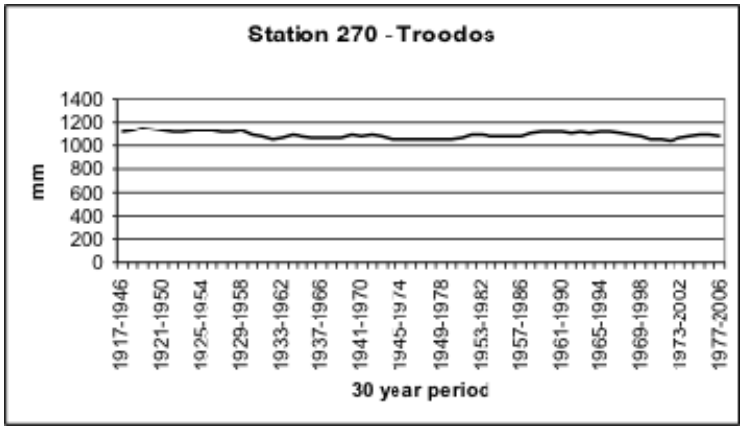

Modeling the yearly average precipitation

- This is the yearly average value. HUGE variability
- We have the climatological periods (30 years). Smoooooooooth!!
- How can we combine the two and make our climate change assumptions solid?

Modeling the yearly average precipitation: The Gamma Distribution (probability density function,pdf)

$$f(x,\alpha,\beta) = \frac{\beta^{\alpha}}{\Gamma(\alpha)} x^{\alpha-1} e^{-\beta\ x}$$

- X – precipitation
- a – shape parameter
- 1/β – size parameter

Modeling the yearly average precipitation: The Gamma Distribution

Shape parameter a

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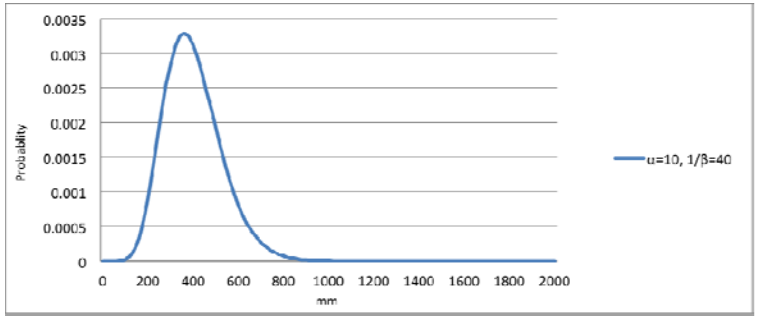

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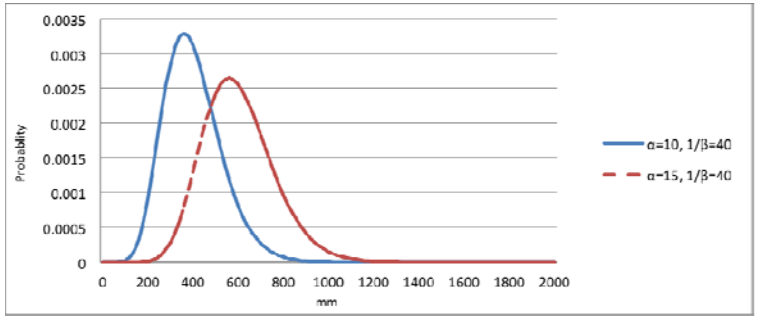

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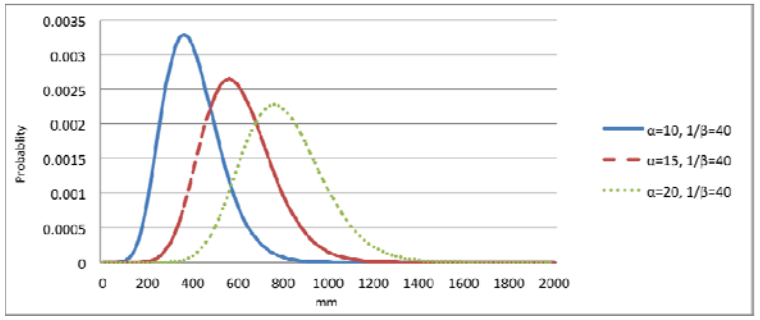

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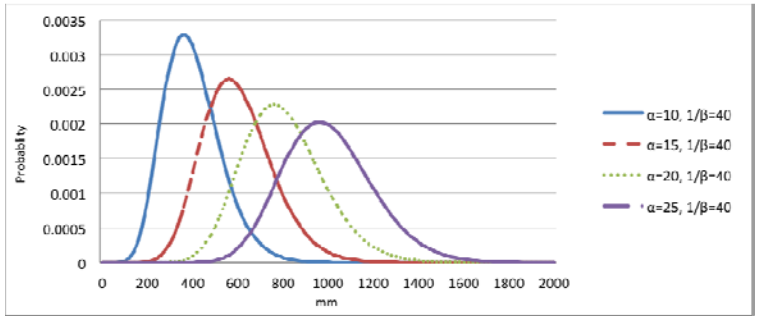

Modeling the yearly average precipitation: The Gamma Distribution

Size parameter 1/β

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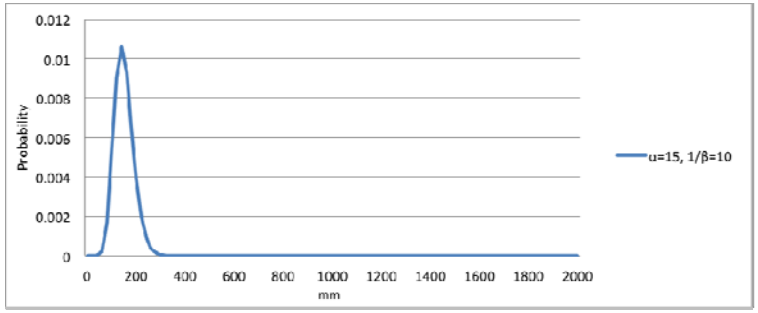

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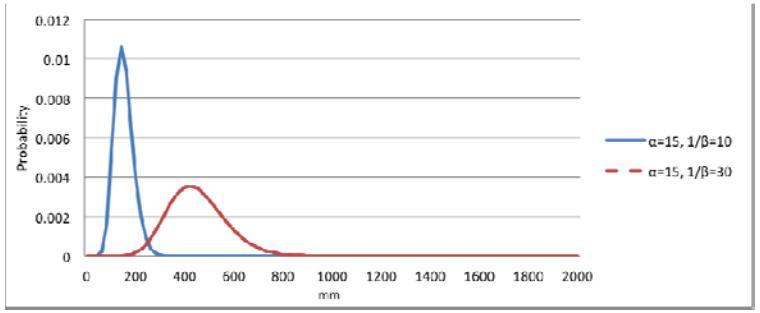

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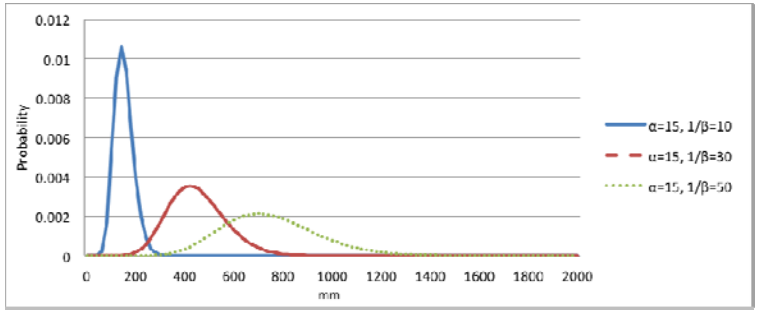

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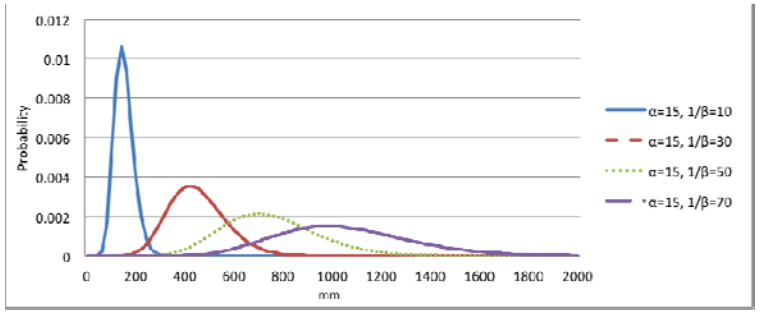
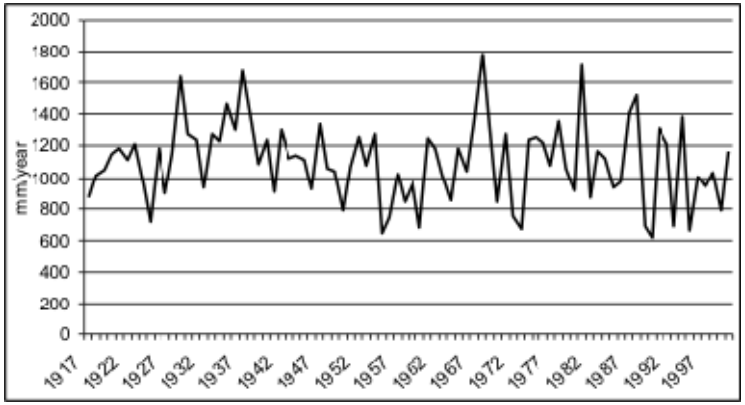
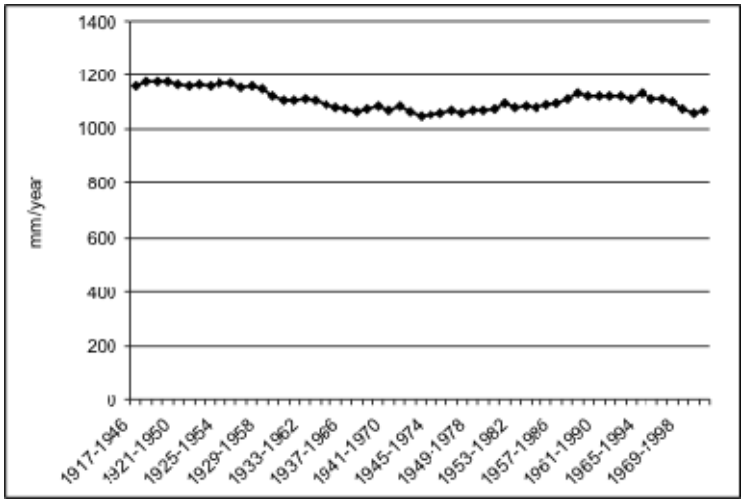


Results: Troodos

Repeating previous slides:
Average yearly precipitation

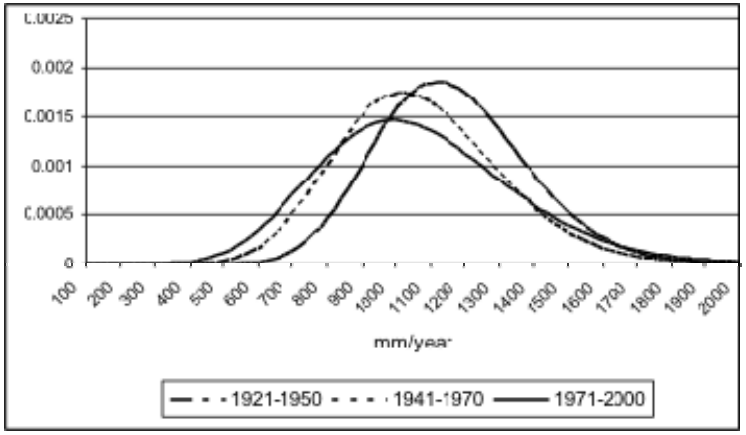


Repeating previous slides:
Consecutive climate periods

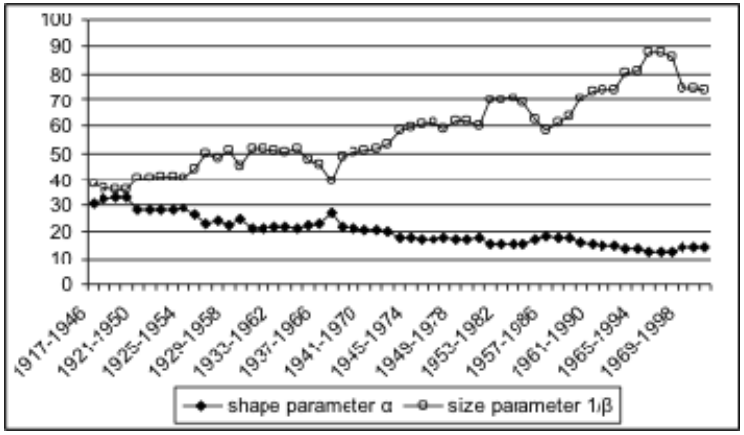


Results: Troodos

Gamma distribution at the beginning, middle and end of the time series

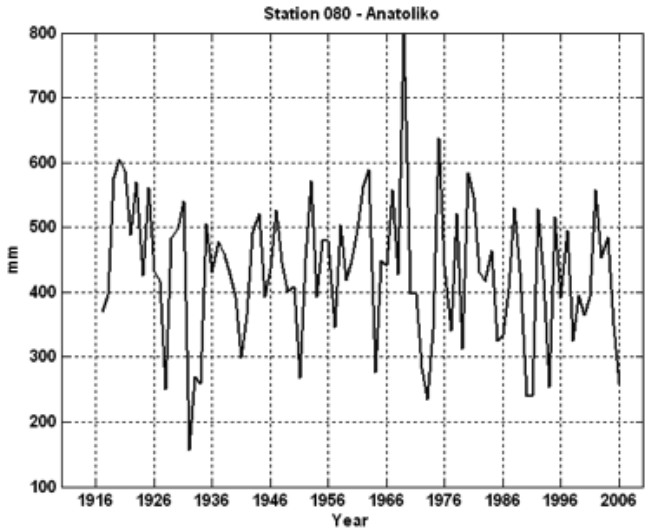


Alpha and beta: Consecutive climate periods

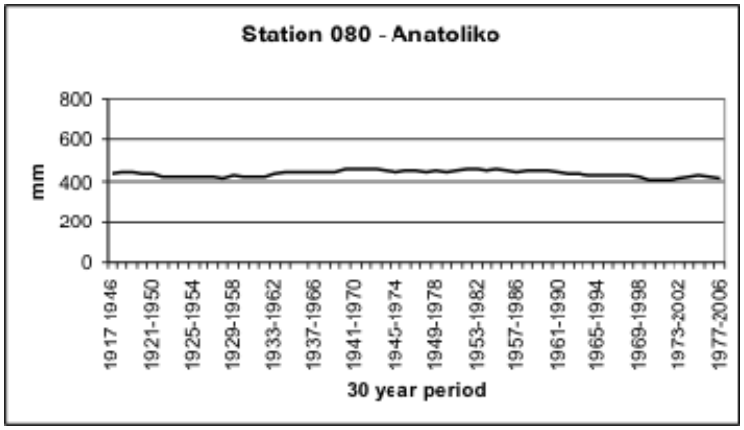


Results: anatoliko

Average yearly value



Rolling climatological periods



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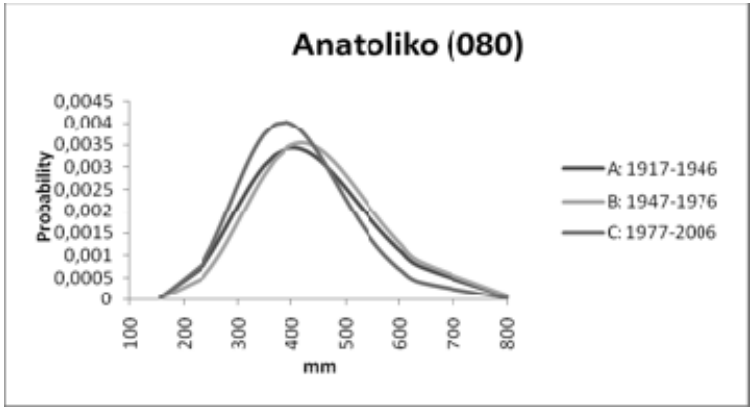

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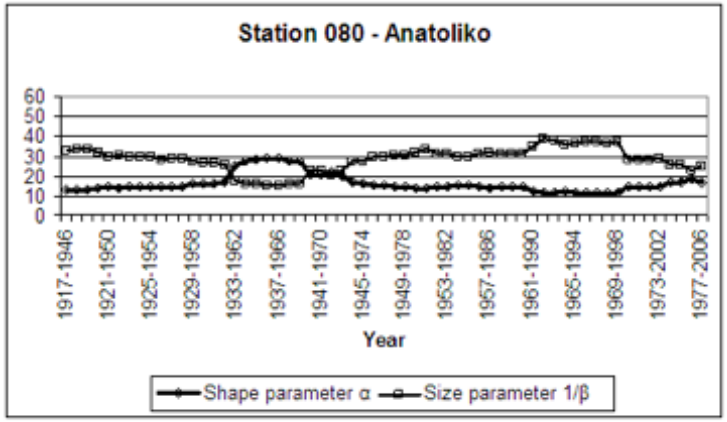
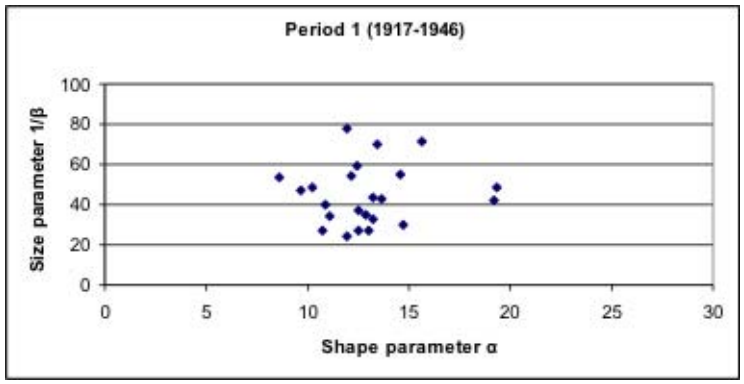
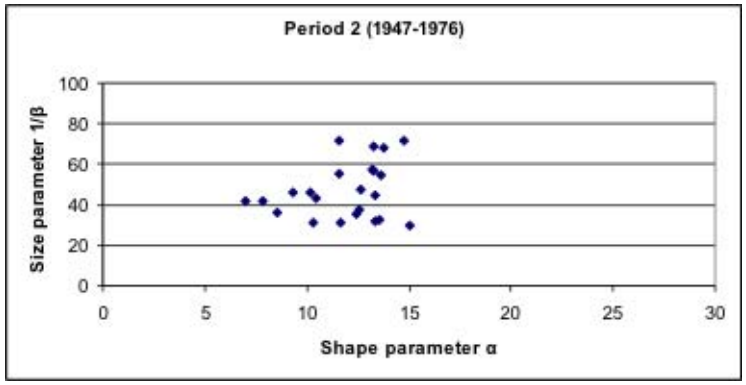
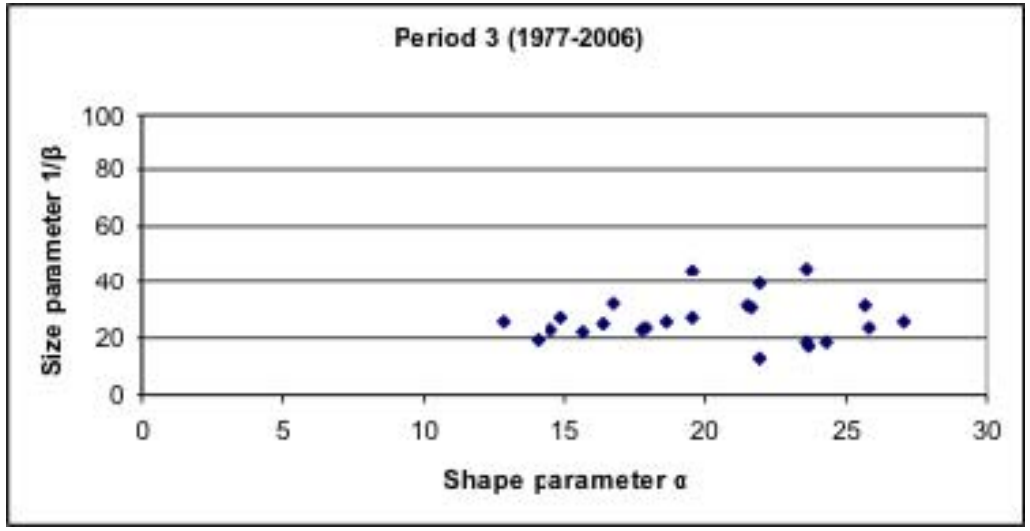


Temporal analysis of the results







Spatial analysis of the results

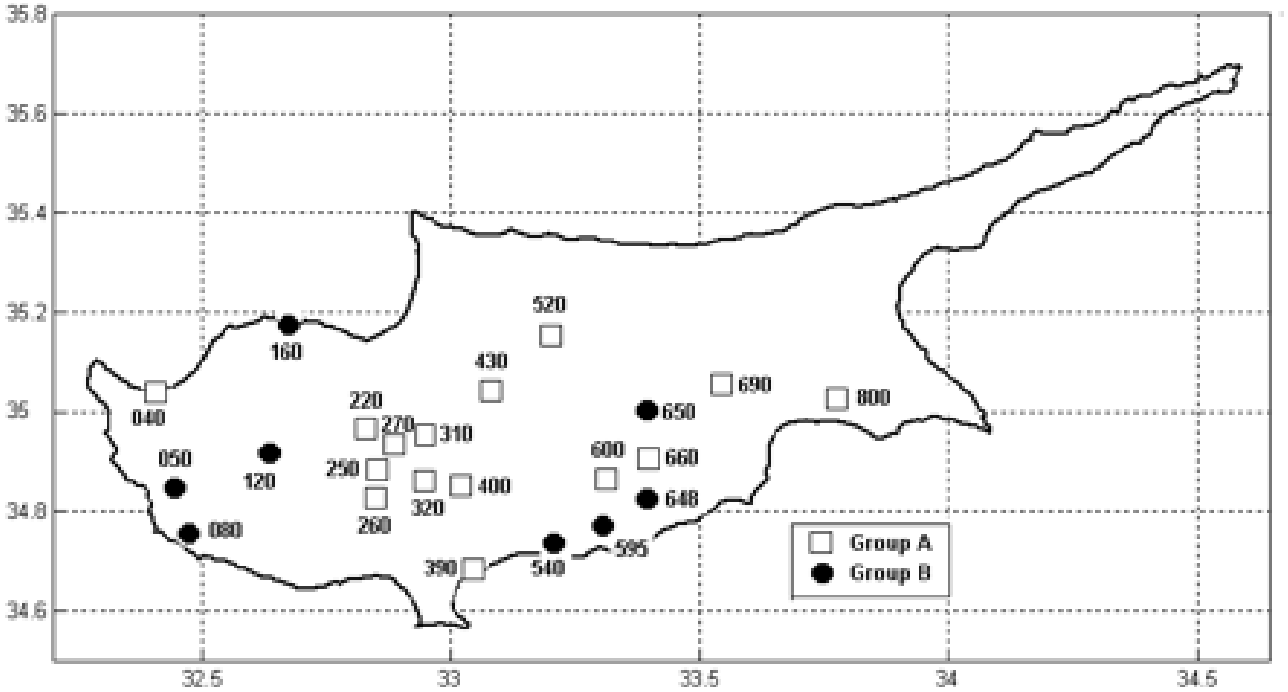
Group A (b3>b1>b2)

- 15 stations
- Semi-mountainous and mountainous stations
- Forests
- High average rainfall >800mm

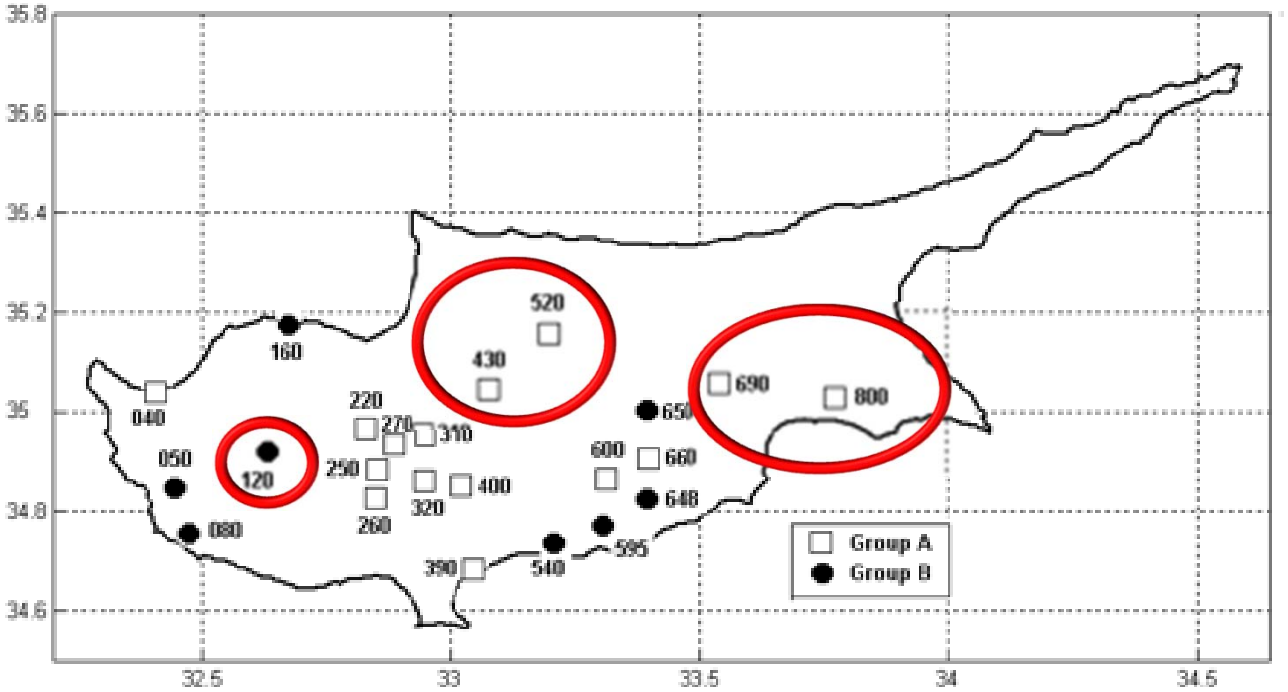
Group B (b3>b2>b1)

- 8 stations
- Mainly on the eastern flank of Troodos mountains
- Low bushy vegetation
- Mediocre rainfall

Spatial analysis of the results:



Spatial analysis of the results: Surprises!!



Concluding ..

- the shape parameter a shows a clear tendency to decrease while the size parameter 1/β increases.
- The increase of 1/βcan be interpreted as a tendency for reduced probability of large annual rainfall amounts in the most recent years
- The reduction ofa shows increase of asymmetry of the P.D.F. of annual rainfall
- The combination of 2 increases the probability of appearance of extreme amounts of annual rainfall: excessive rainfall and extended drought.
- Clear distinction between the temporal behavior of low and high rainfall stations

Future plans

- Expand the database with more stations (46)
- Introduce homogenization techniques for the problematic stations
- Include latest data
- Future projections from climate models ??

THANK YOU :-)

- Contact info:

  - silas@ucy.ac.cy
  - f.tymvios@cyi.ac.cy