Green or blue water? The importance of soils

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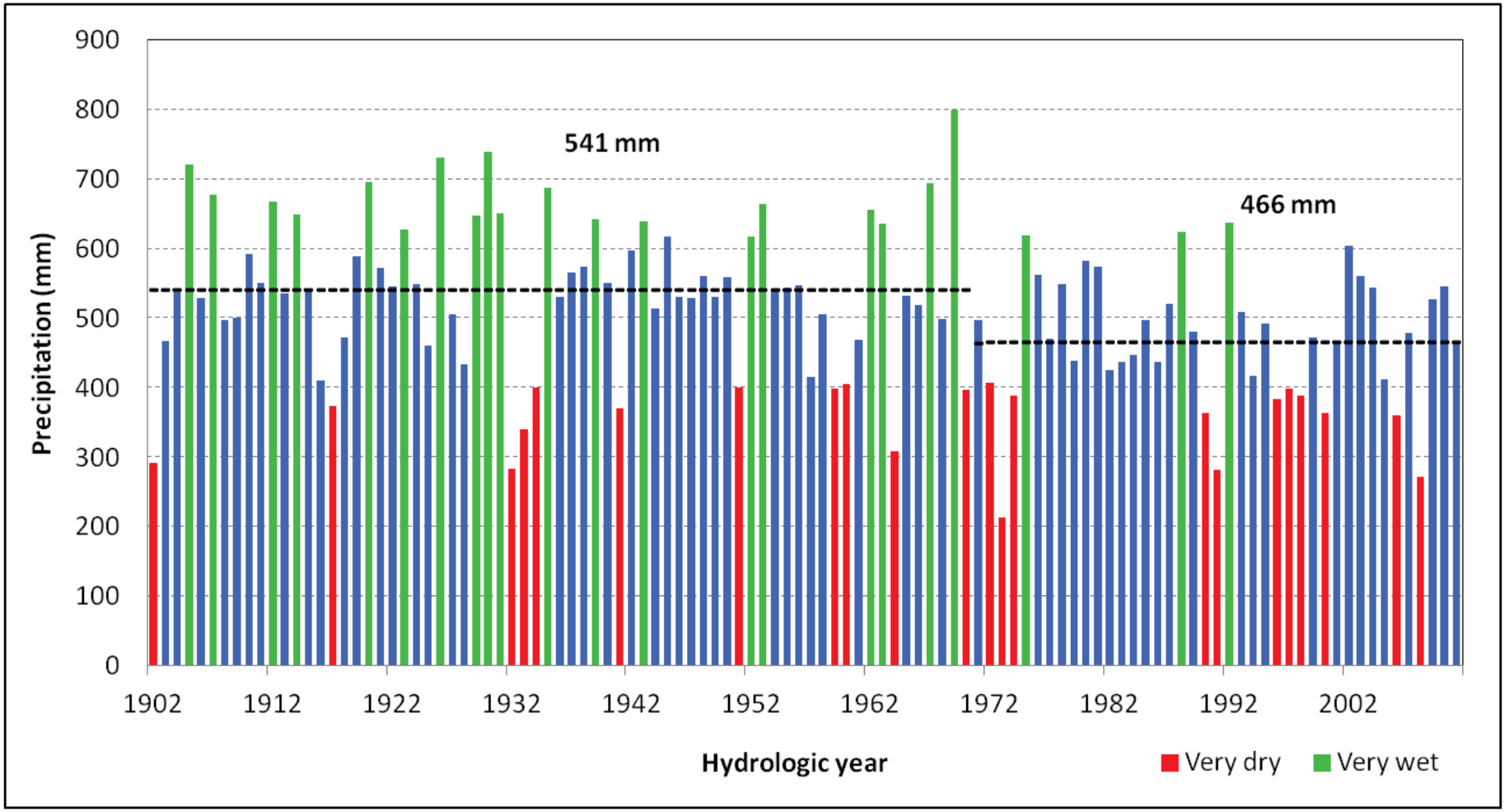
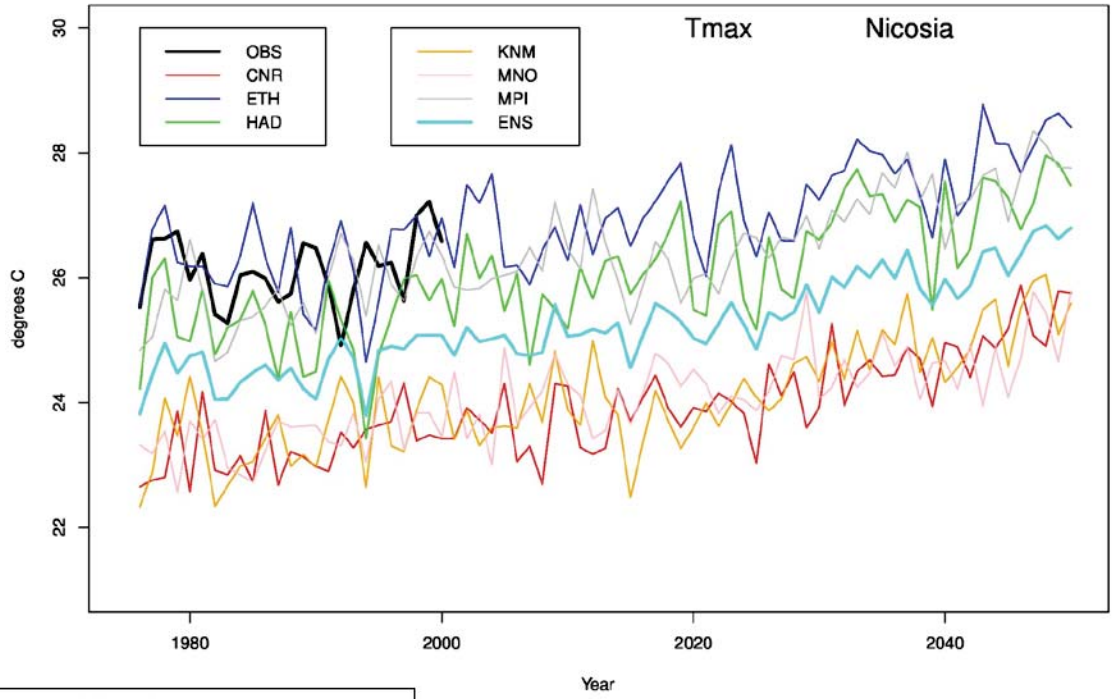
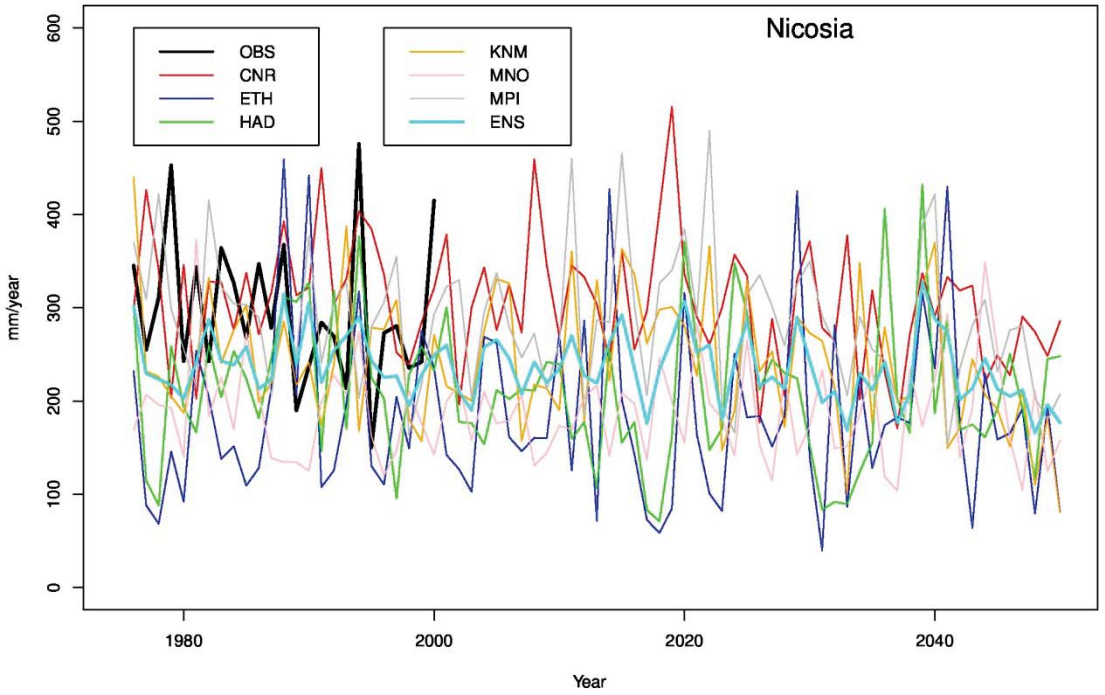
Highly variable precipitation



Source: CMS, 2012

Climate change

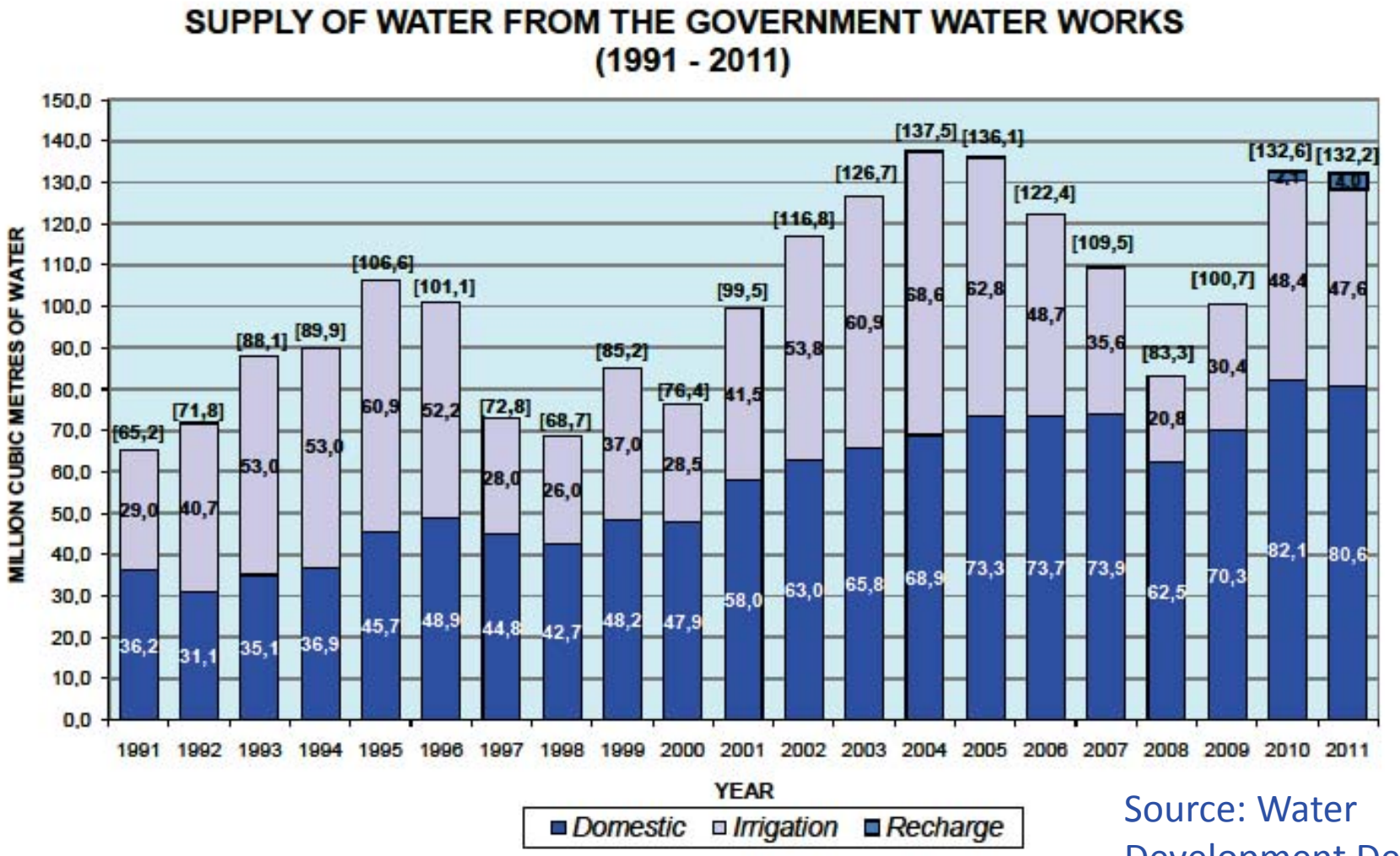




Source: ENSEMBLES
Hadjinicolaou et al., 2011

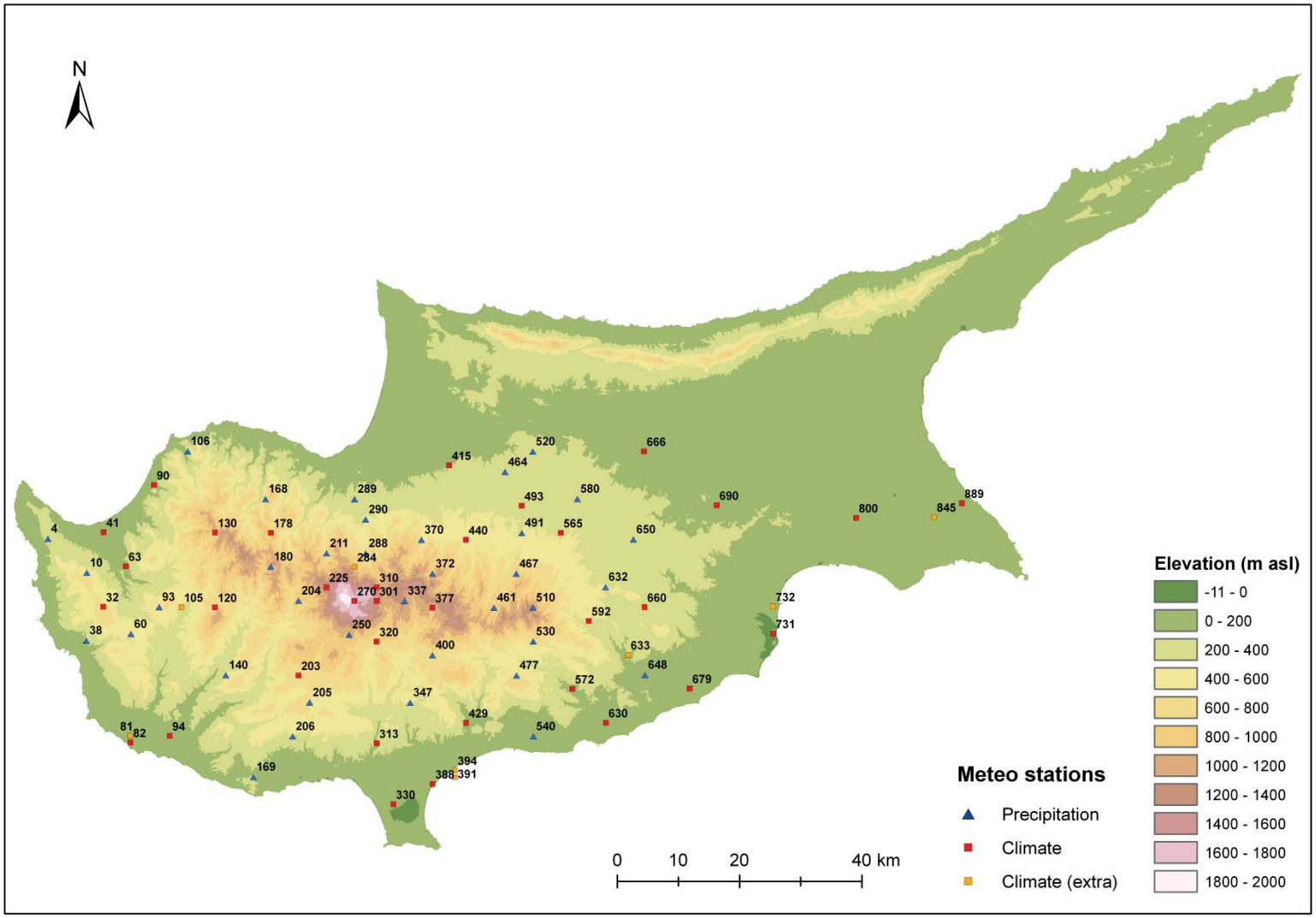
EEWRC

Irrigation water demand exceeds supply

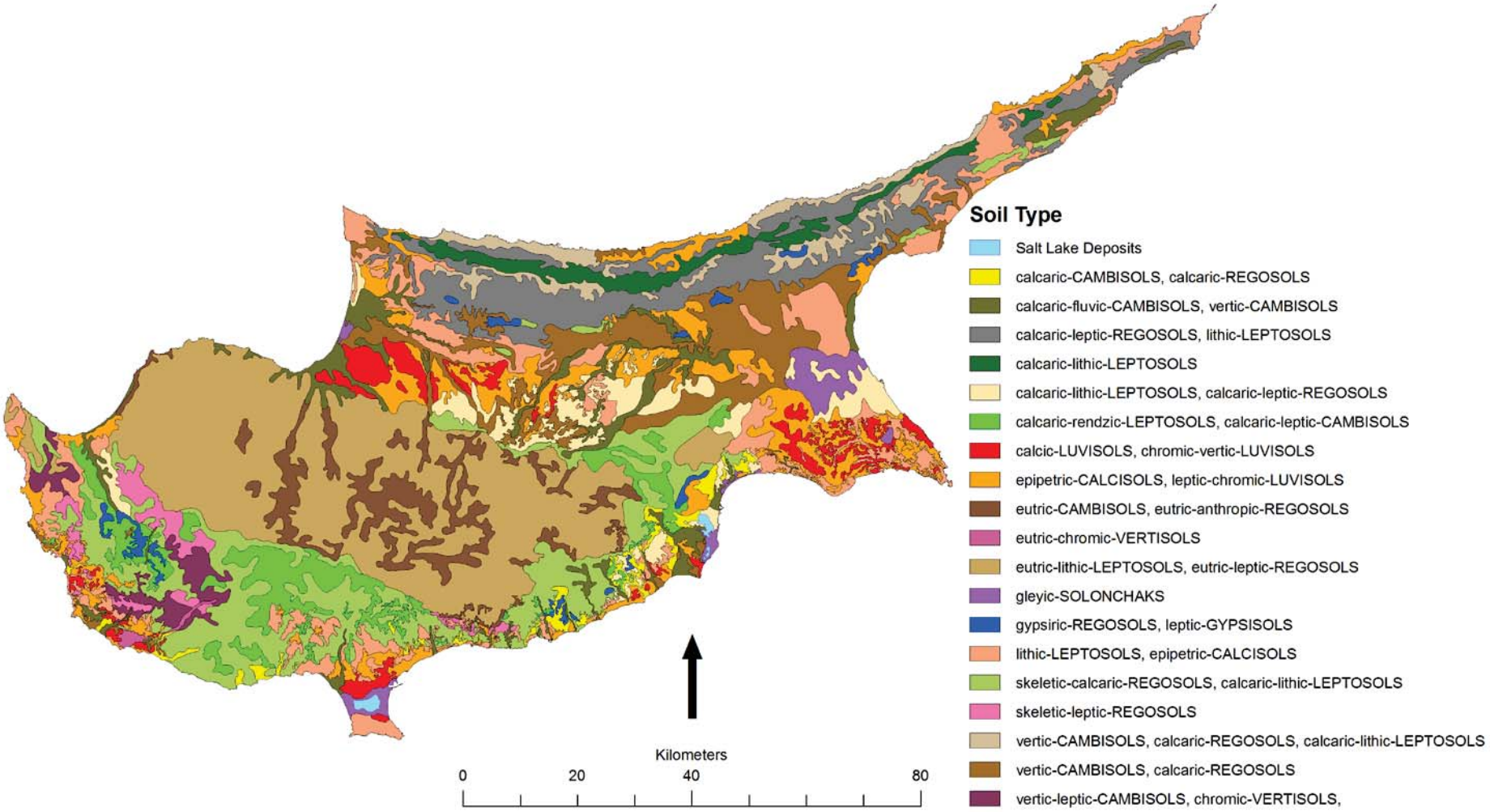


Source: Water Development Dept.

Steep slopes



Shallow and stony soils




Barley, Athienou


Almonds, Kambi

Grapes, Saranti

Objective

- To assess the effect of soil water holding capacities on green water (soil moisture provided by precipitation) use and blue water (irrigation) demand on the Mediterranean island of Cyprus, under varying precipitation patterns.

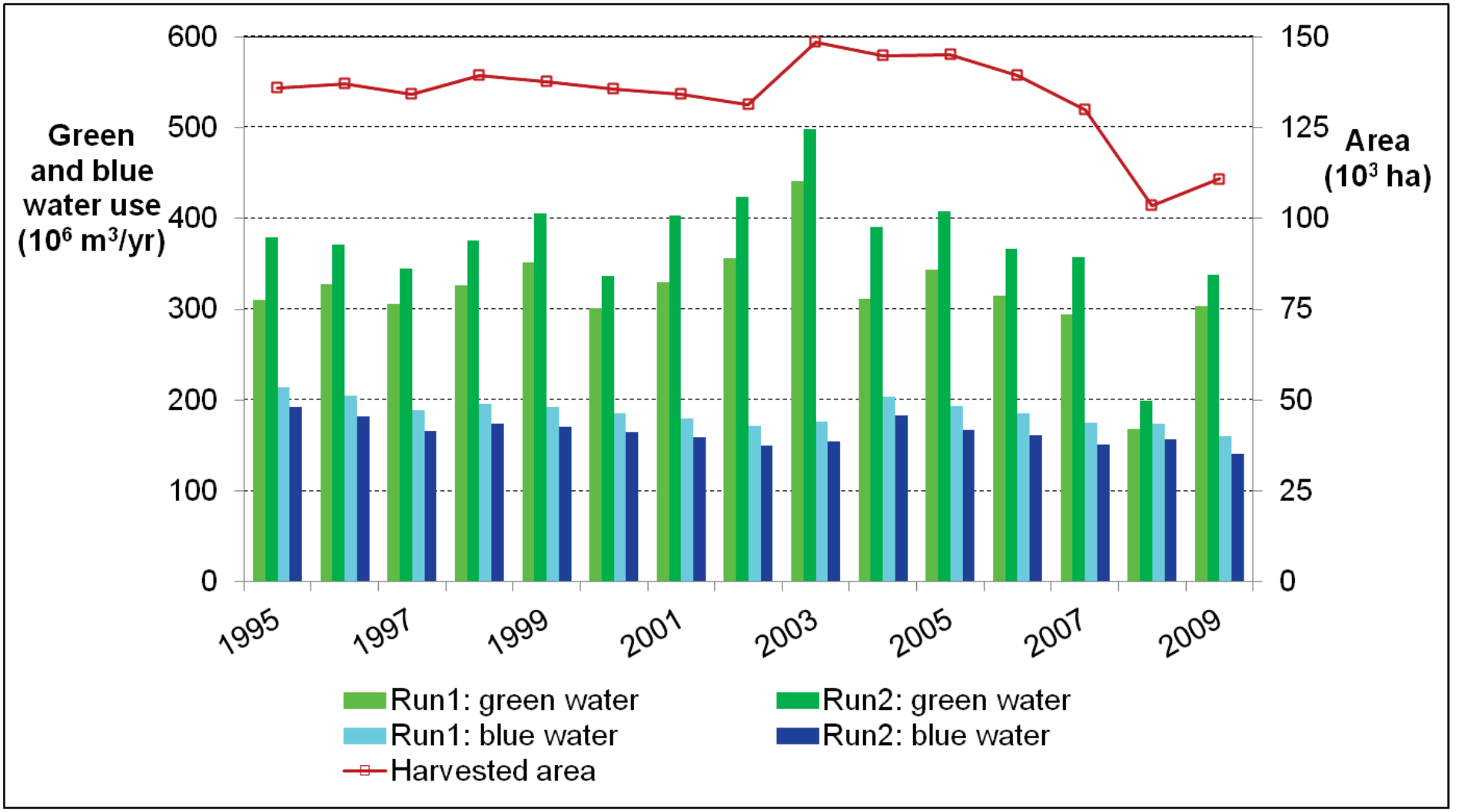
Methods and Data

- Soil water balance model, based on FAO-56 dual crop coefficient approach
- Input data:
  - Climate: daily values from 34 stations and 70 rain gauges
  - Crops: 83 crops, parameters based on local conditions
  - Crop areas: distributed over 431 communities based on agricultural census (2003), adjusted with annual statistics
  - Soil data: best estimates based on 1:250,000 soil map, Harmonized World Soil Database (FAO, 2009), European Soil Bureau Network (2005)

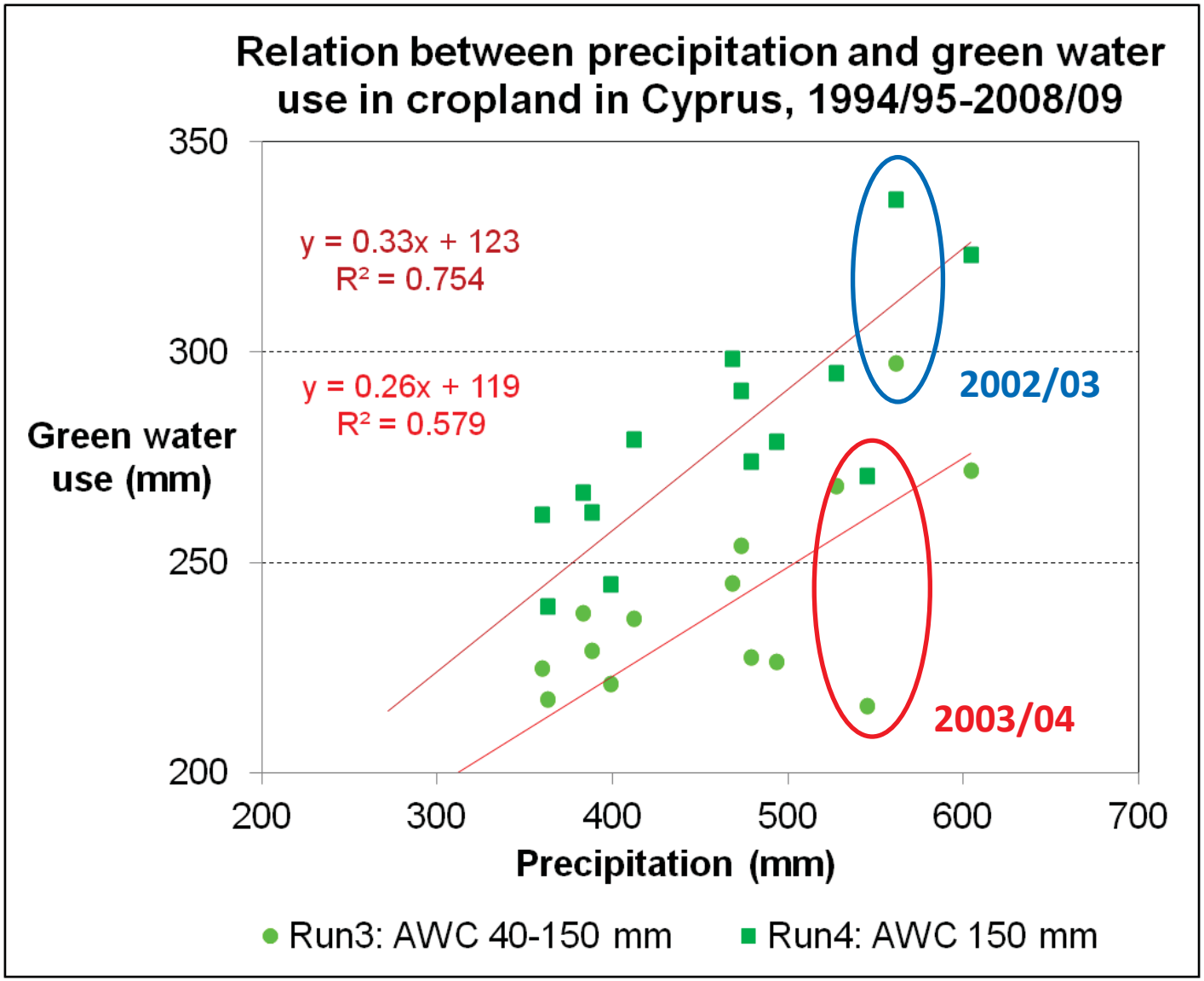
Four model simulations:

1. actual land use and best estimates of soil water holding capacities (40-150 mm);
2. actual land use and uniform soil water holding capacity (150 mm);
3. 2003 land use and best estimates of soil water holding capacities (40-150 mm);
4. 2003 land use and uniform soil water holding capacity (150 mm).

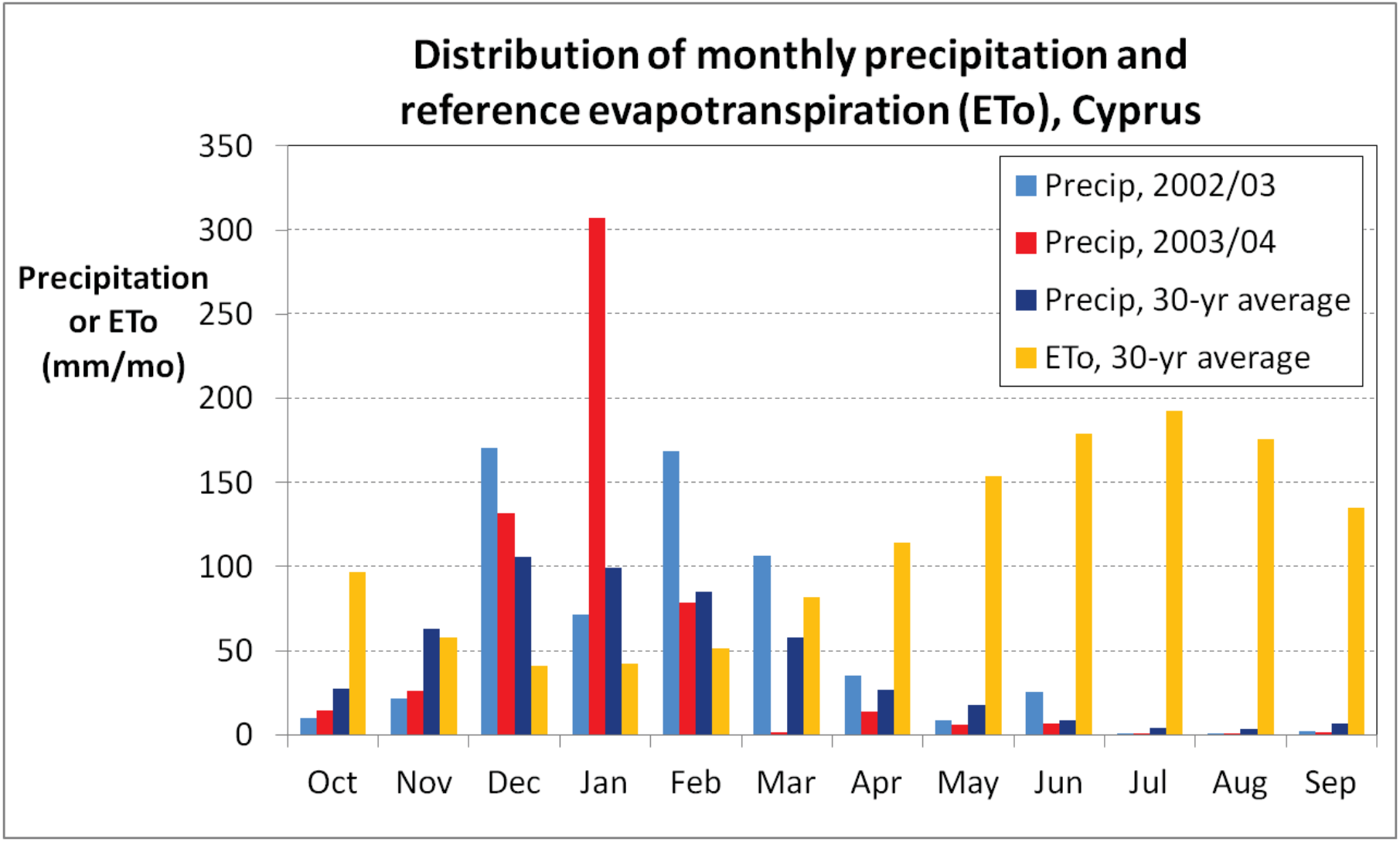
Results


Green and blue water use (10^6 m^3/yr)
600
500
400
300
200
100
0
150
125
100
75
50
25
0
Area (10^3 ha)
1995
1997
1999
2001
2003
2005
2007
2009
Run1: green water
Run2: green water
Run1: blue water
Run2: blue water
Harvested area

Results


Relation between precipitation and green water use in cropland in Cyprus, 1994/95-2008/09
y = 0.33x + 123
R² = 0.754
y = 0.26x + 119
R² = 0.579
2002/03
2003/04
Green water use (mm)
Precipitation (mm)
350
300
250
200
200
300
400
500
600
700
Run3: AWC 40-150 mm
Run4: AWC 150 mm

Results


Distribution of monthly precipitation and reference evapotranspiration (ETo), Cyprus
Precipitation or ETo (mm/mo)
350
300
250
200
150
100
50
0
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Precip, 2002/03
Precip, 2003/04
Precip, 30-yr average
ETo, 30-yr average

Conclusions

- Crop production systems on soils with high water holding capacities are more resilient to climate variability and climate change
- Soil maps tend to underestimate the area covered by Anthrosols such as terraces which may lead to over-estimation of blue water demand in global models
- Water price increases, resulting from the EU Water Framework Directive, may serve as an incentive to re-invest in abandoned terraces.

Thank you!

Acknowledgement
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