The Abdus Salam
International Centre for Theoretical Physics

United Nations
Educational, Scientific and
Cultural Organization

IAEA
International Atomic Energy Agency

2210-15

MedCLIVAR Workshop on: "Scenarios of Mediterranean Climate Change under Increased Radiative Active Gas Concentration and the Role of Aerosols

23 - 25 September 2010

Change of Mediterranean extreme events under increased greenhouse warming conditions

HERTIG Elke and Jacobeit J.

University of Augsburg Institute of Geography
Dept. of Physical Geography & Quantitative Methods
Universitaetsstrasse 10, 86135
Augsburg
GERMANY

Universität
Augsburg
University

Change of Mediterranean extreme events under increased greenhouse warming conditions

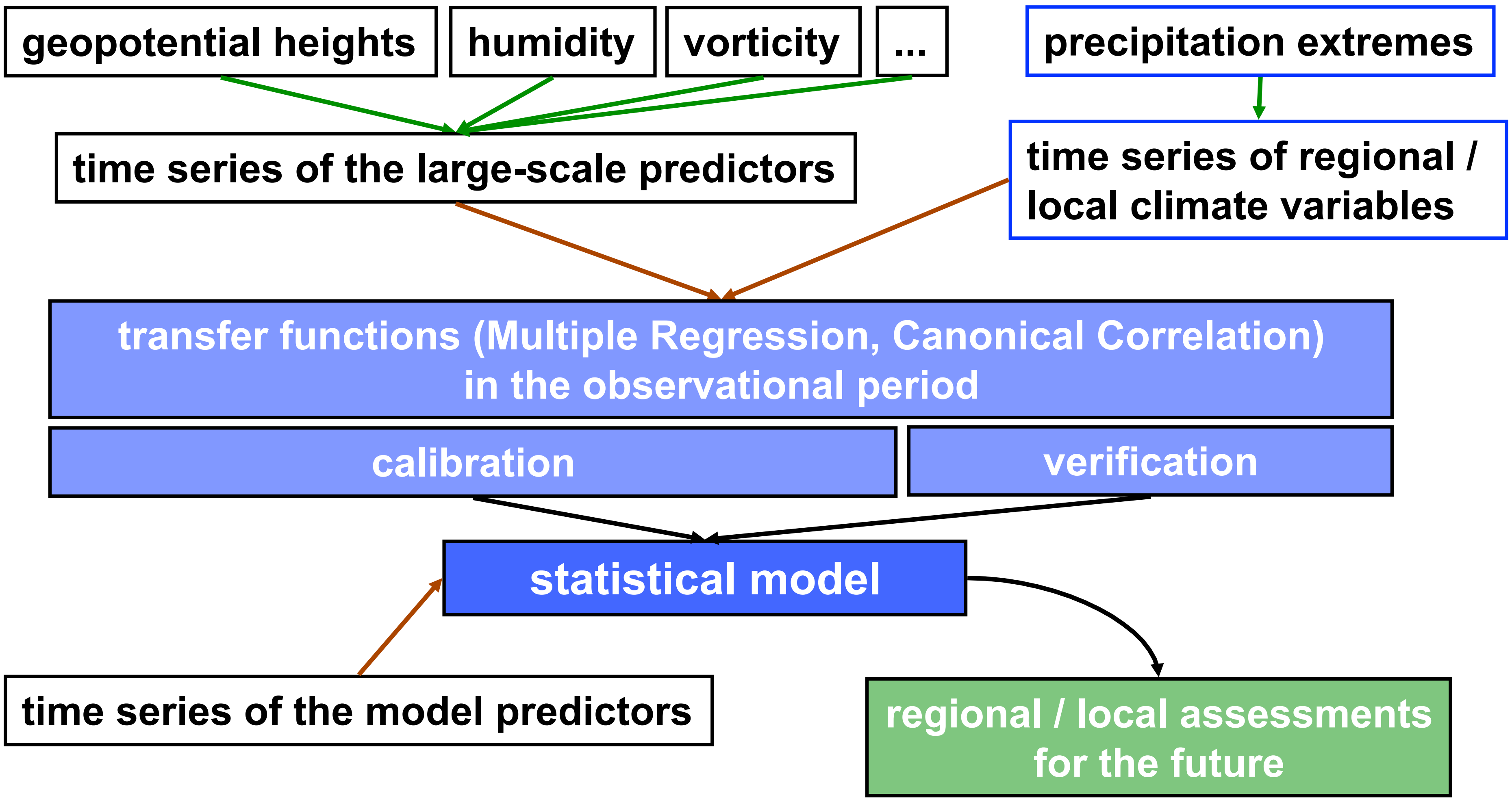
E. Hertig, J. Jacobeit
Institute of Geography
University of Augsburg
elke.hertig@geo.uni-augsburg.de

Outline

1. Introduction- Statistical Downscaling Scheme
2. Drought periods: Change in the Number of Consecutive Dry Days
3. Extreme precipitation: 95th percentile of precipitation

   -> Comparison between statistical and dynamical downscaling results
4. Non- stationarities and their consideration within statistical downscaling
5. Conclusions

Statistical Downscaling



Change in the Number of Consecutive Dry Days

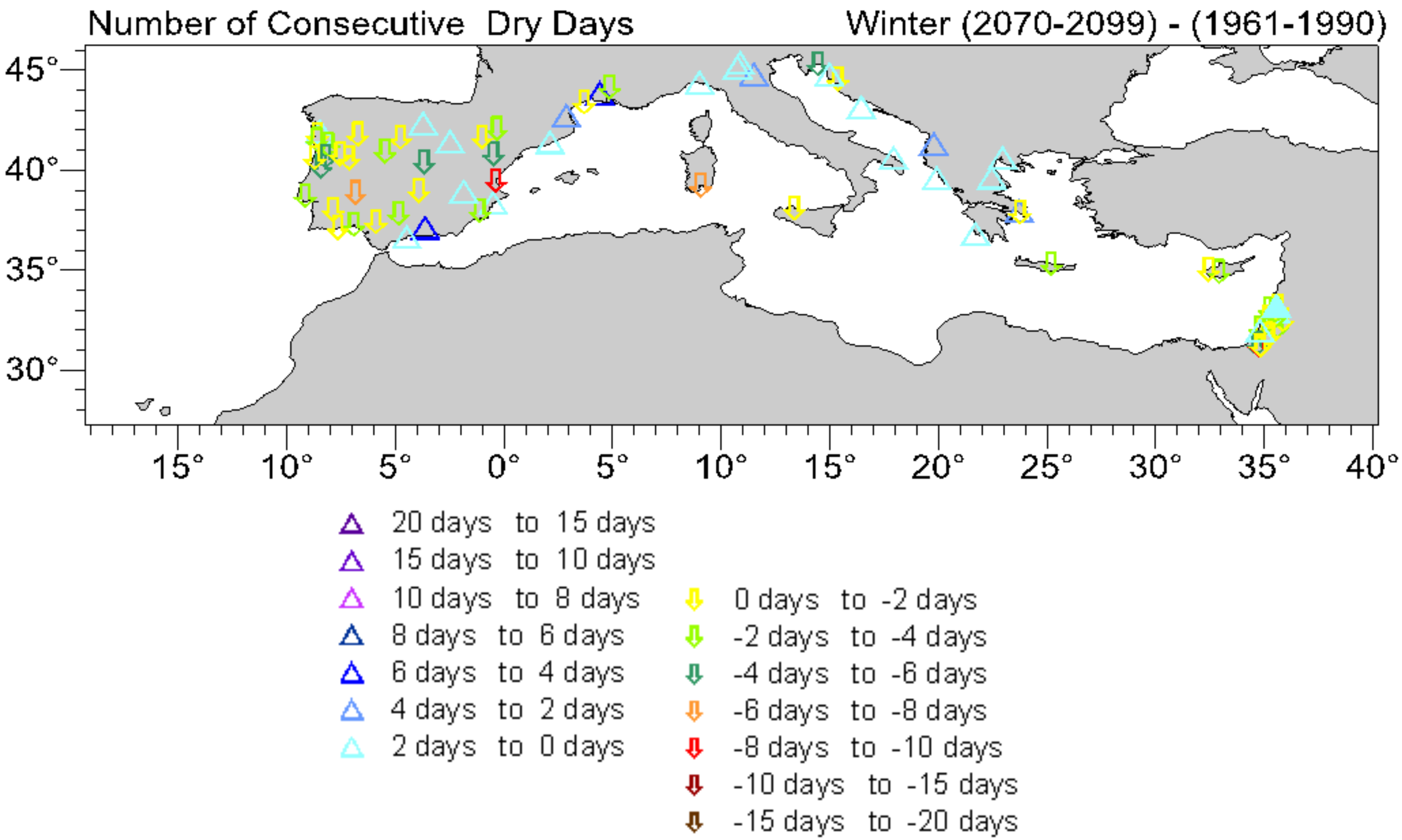
Statistical assessment

- based on station data
- downscaling technique: Multiple Regression Analysis
- predictor: 500hPa- geopotential heights
- scenario: SRES- A1B
- GCM: ECHAM5/MPI-OM
- comparison of the time periods 2070-2099 and 1961-1990

Number of Consecutive Dry Days, Winter
2070-2099 minus 1961-1990
SRES-A1B

Universität Augsburg University

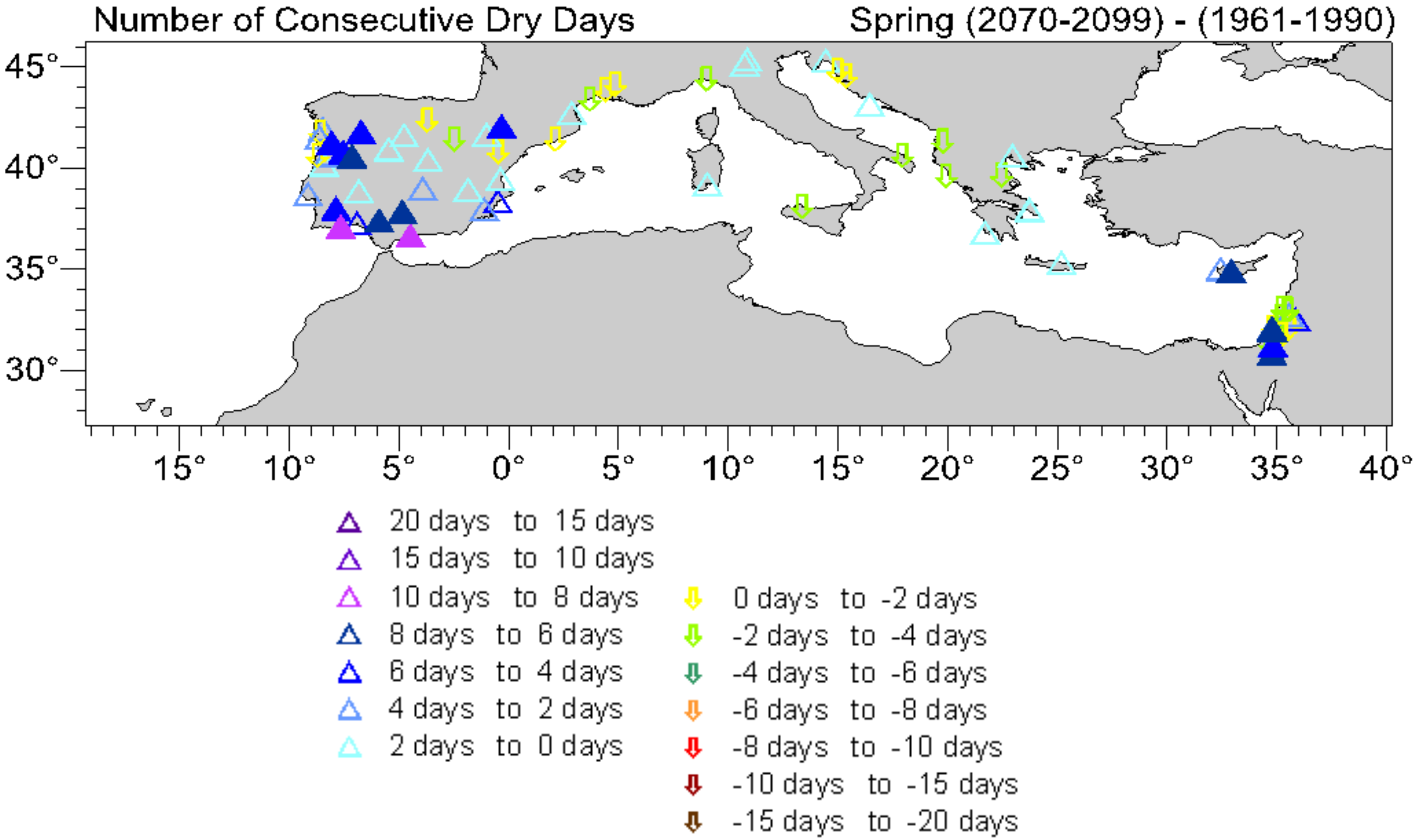
Predictor: 500hPa- geopotential heights



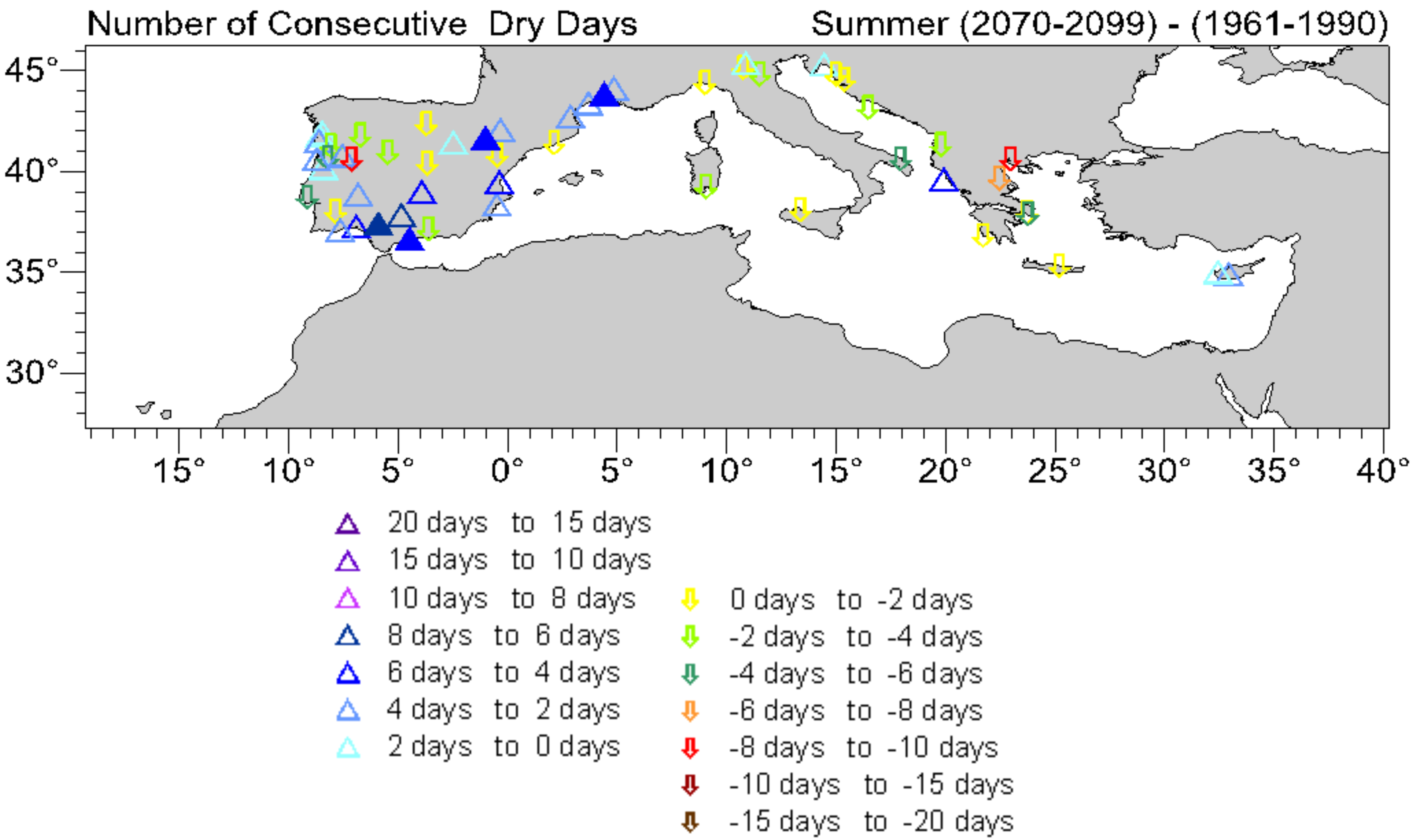
Number of Consecutive Dry Days, Spring
2070-2099 minus 1961-1990
SRES-A1B

Universität Augsburg University

Predictor: 500hPa- geopotential heights

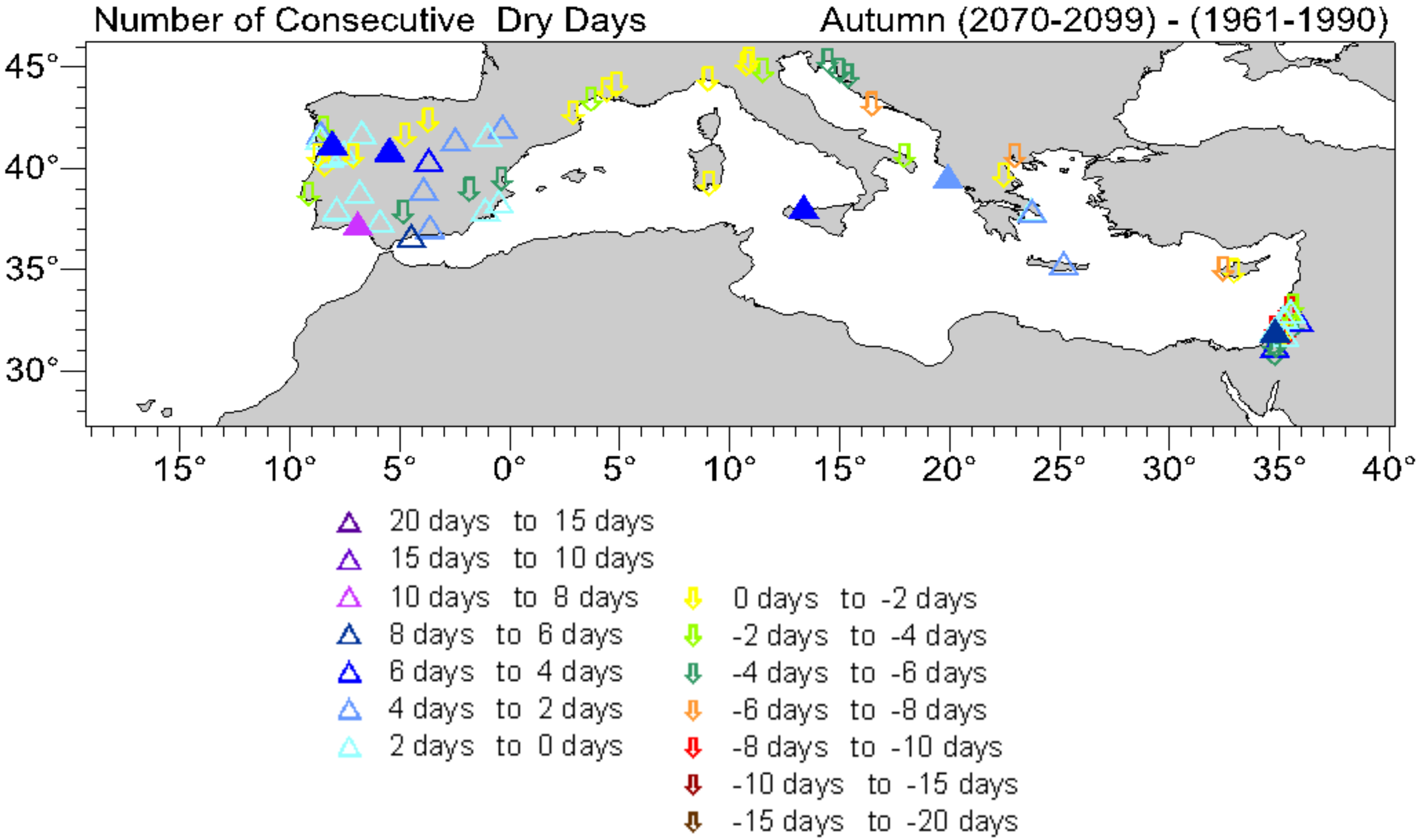


Predictor: 500hPa- geopotential heights



Universität Augsburg University

Predictor: 500hPa- geopotential heights



Change of the 95th percentile of precipitation

Statistical assessment

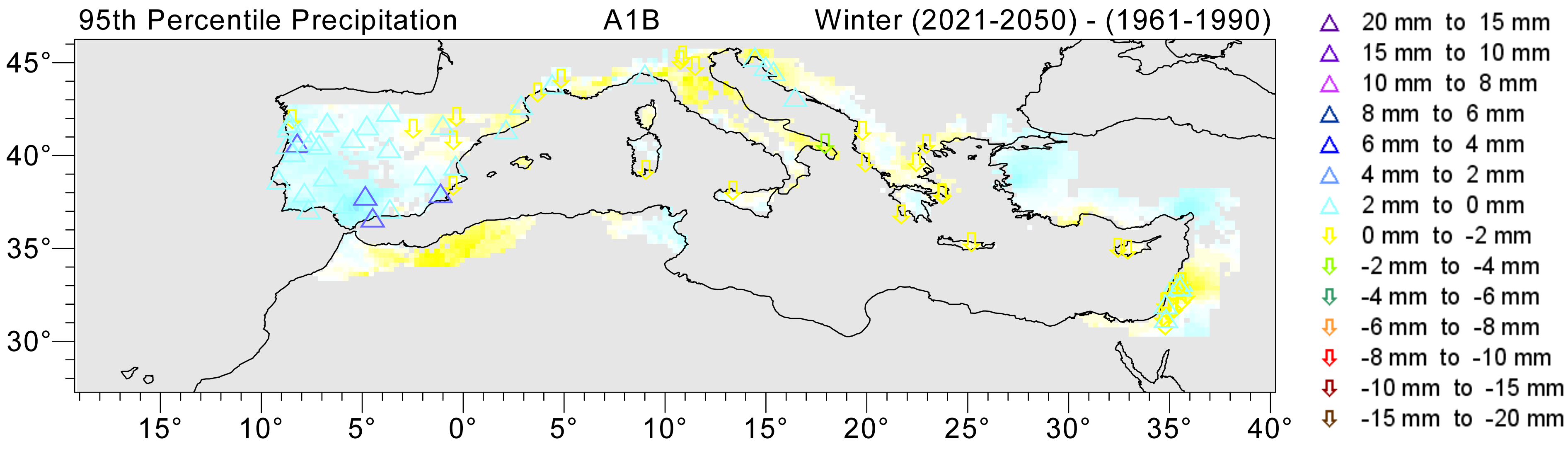
- based on station data and on gridded data (E-obs, 0.25 deg.)
- downscaling techniques: Multiple Regression Analysis / Canonical Correlation Analysis
- predictors: 500hPa- geopotential heights, 850hPa- specific humidity, 1000hPa- relative vorticity

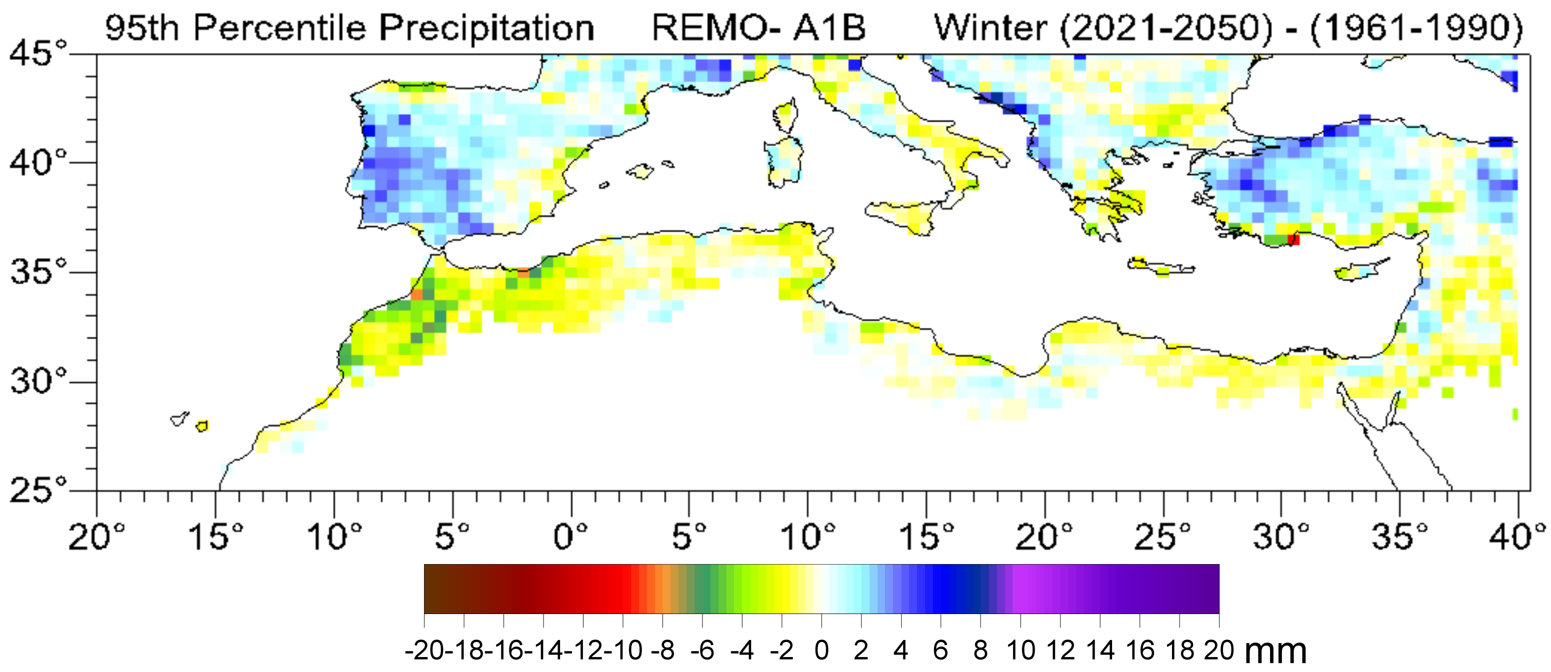
Comparison between statistical and dynamical downscaling results

- time slices: 2021-2050 minus 1961-1990
- dynamical downscaling with Regional Model REMO (MPI-M Hamburg)
- in both cases: SRES- A1B, ECHAM5/MPI-OM

95th percentile of precipitation, Winter
2021-2050 minus 1961-1990
SRES-A1B

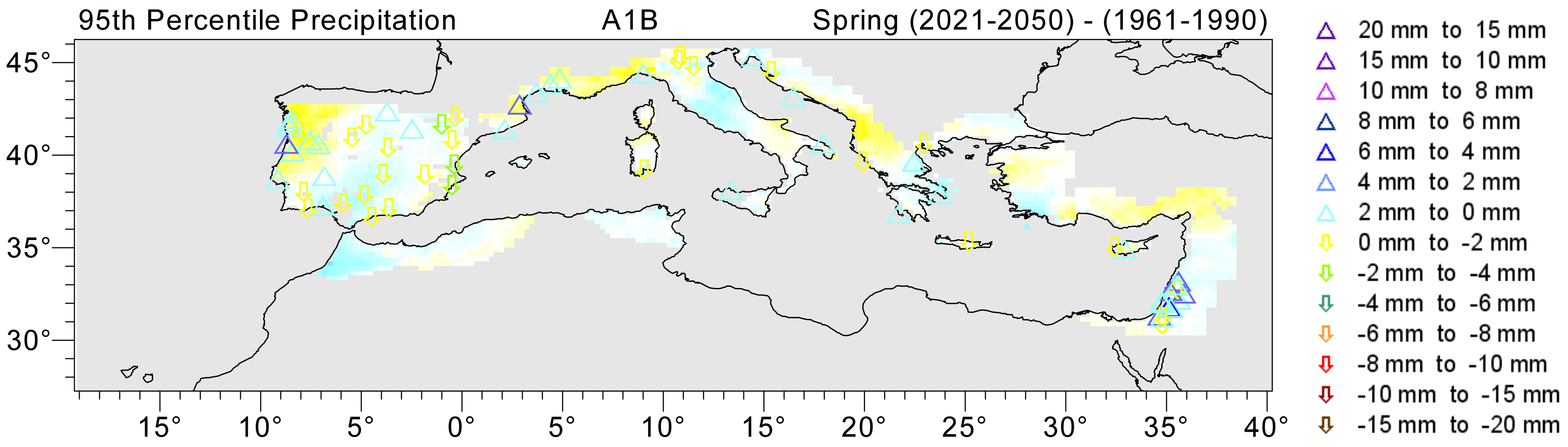
Universität Augsburg University

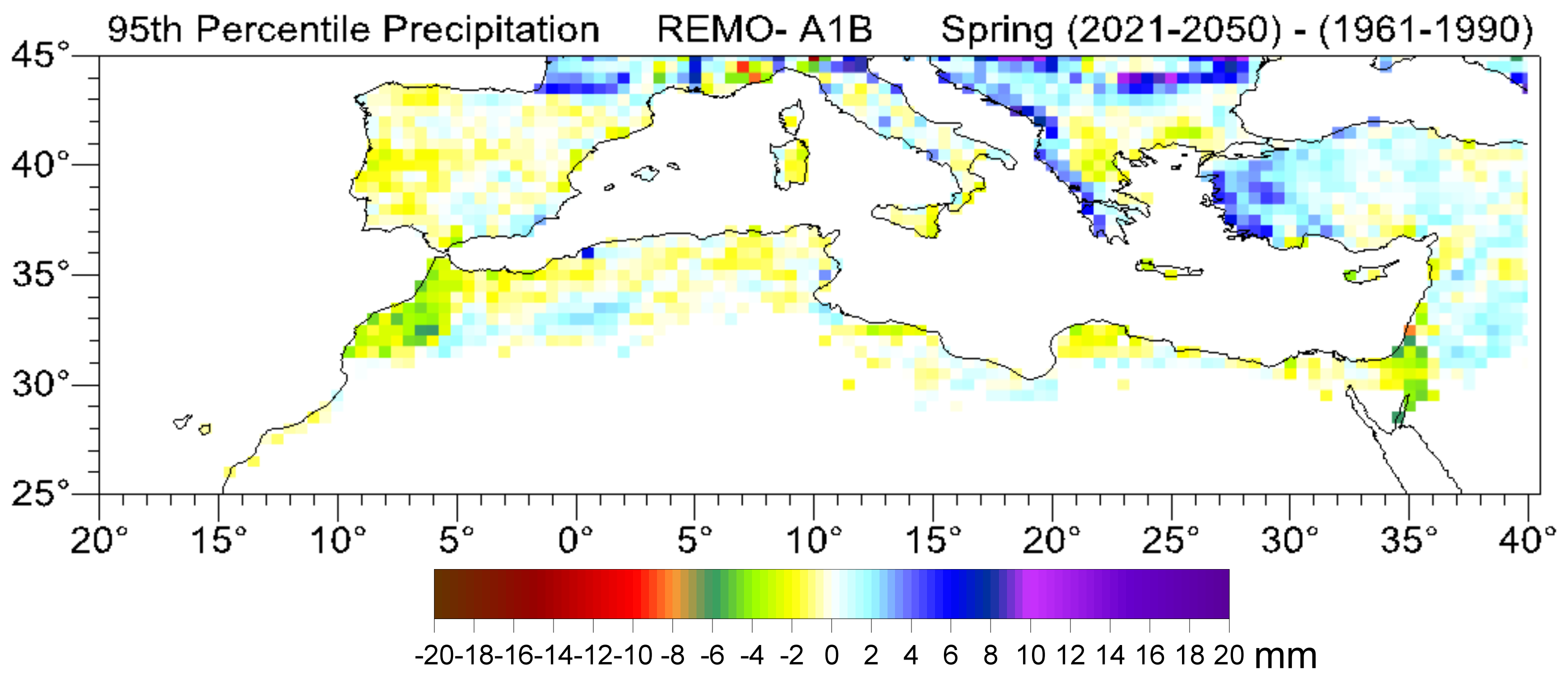




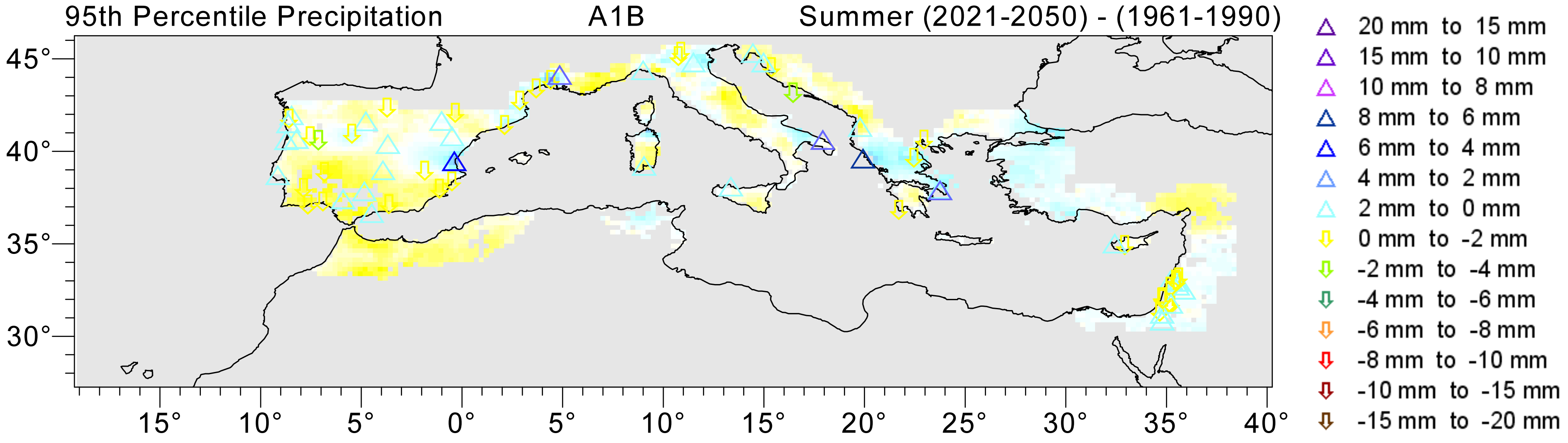
95th percentile of precipitation, Spring
2021-2050 minus 1961-1990
SRES-A1B

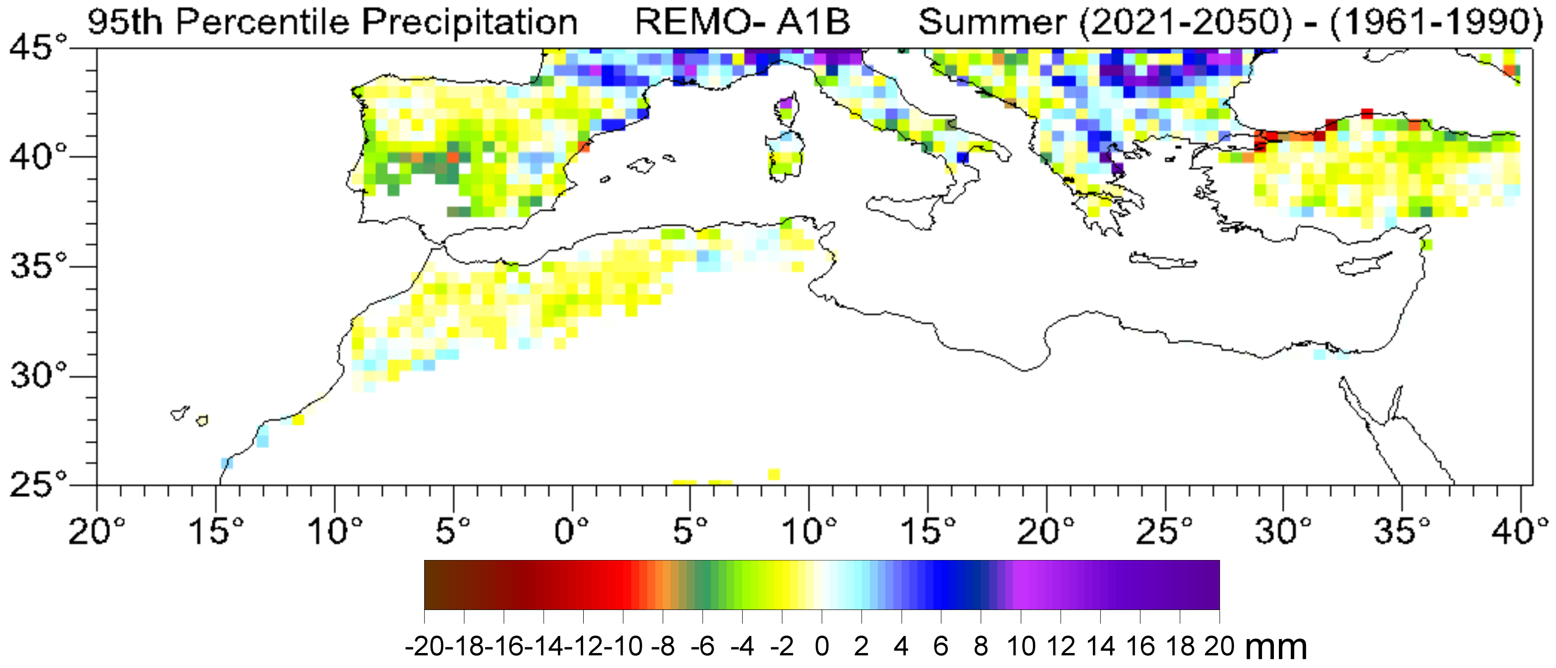
Universität Augsburg University





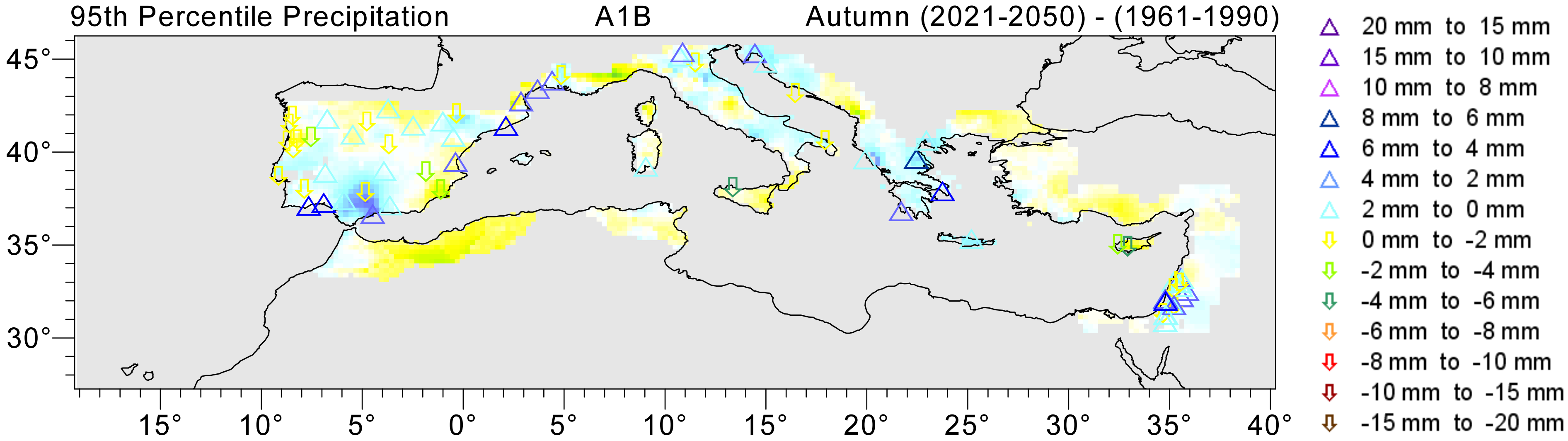
95th percentile of precipitation, Summer 2021-2050 minus 1961-1990 SRES-A1B

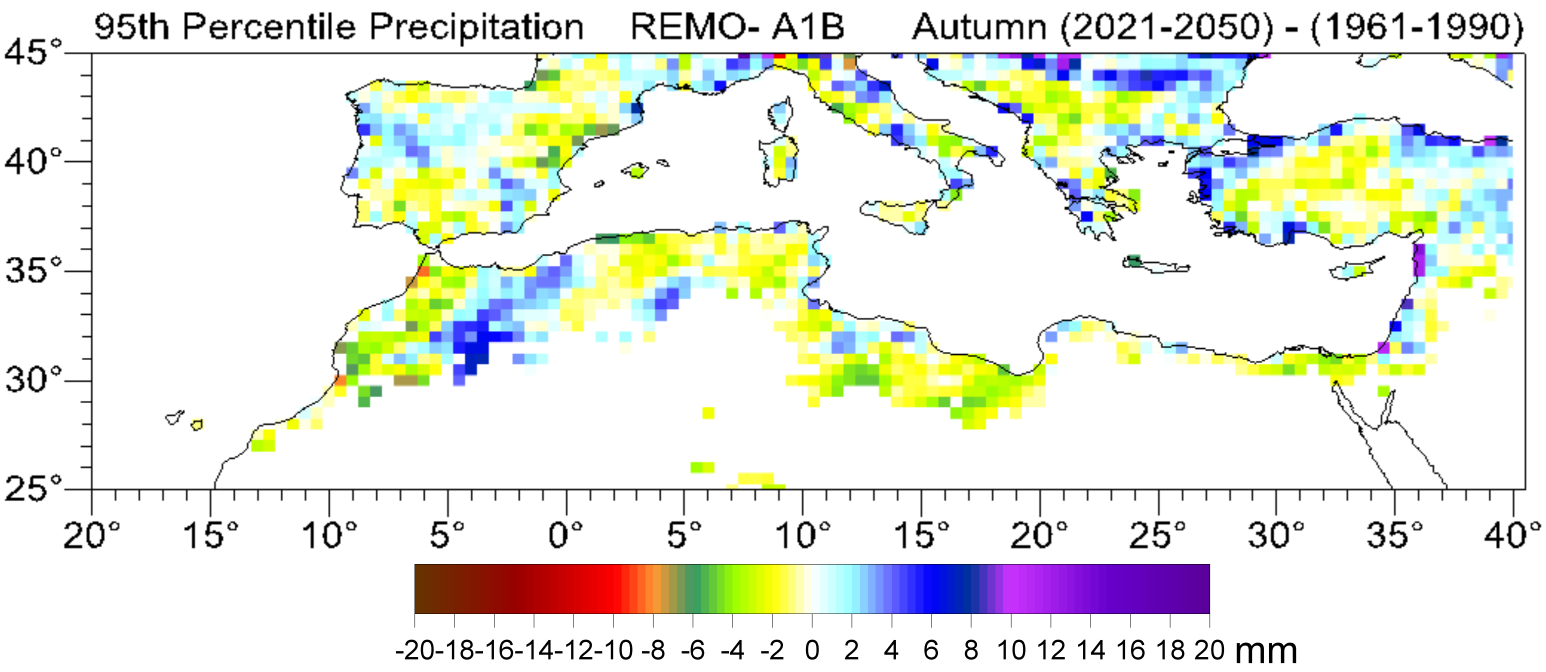




95th percentile of precipitation, Autumn
2021-2050 minus 1961-1990
SRES-A1B

Universität Augsburg University

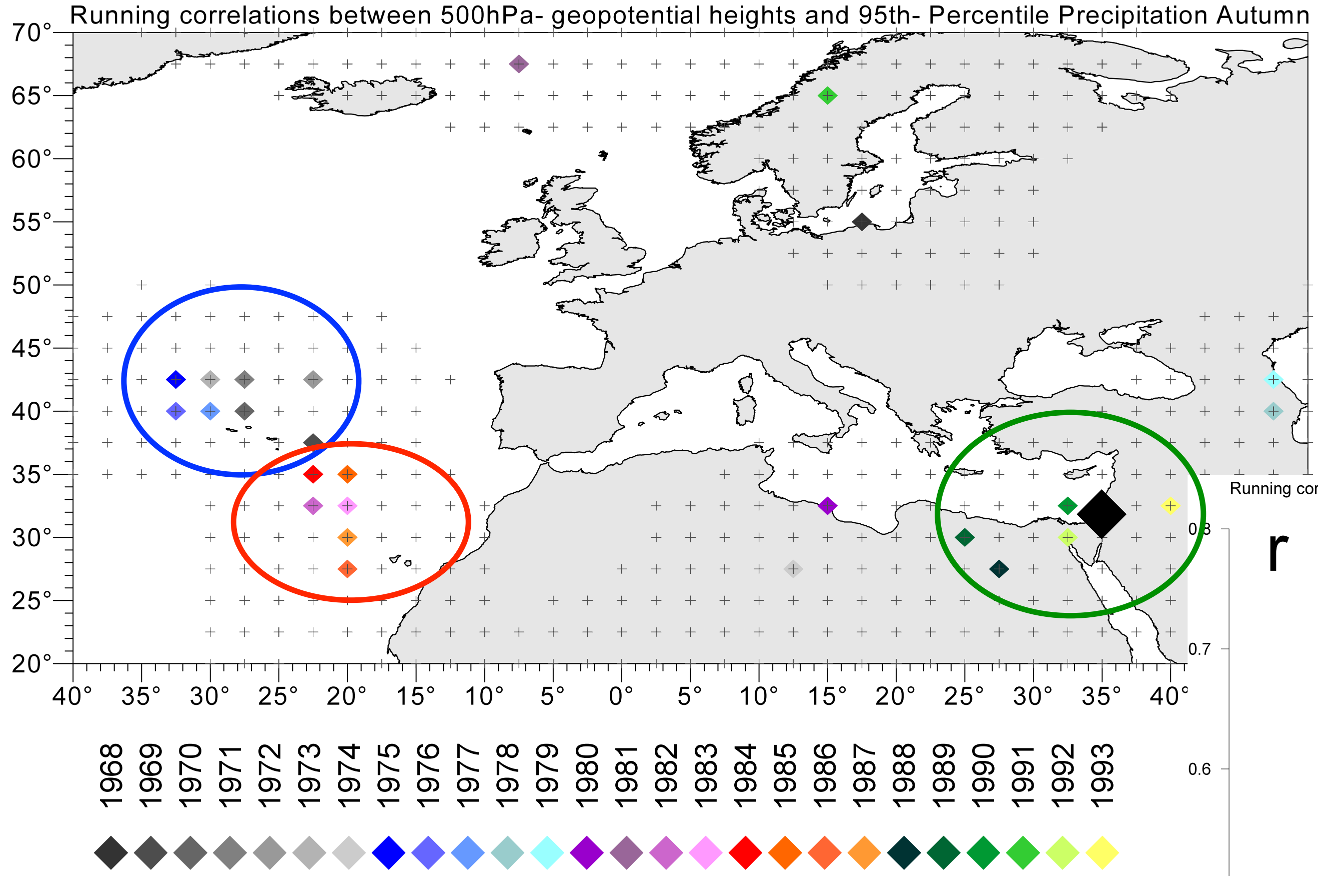




Non-stationarities and statistical downscaling

Running correlations

Universität Augsburg University

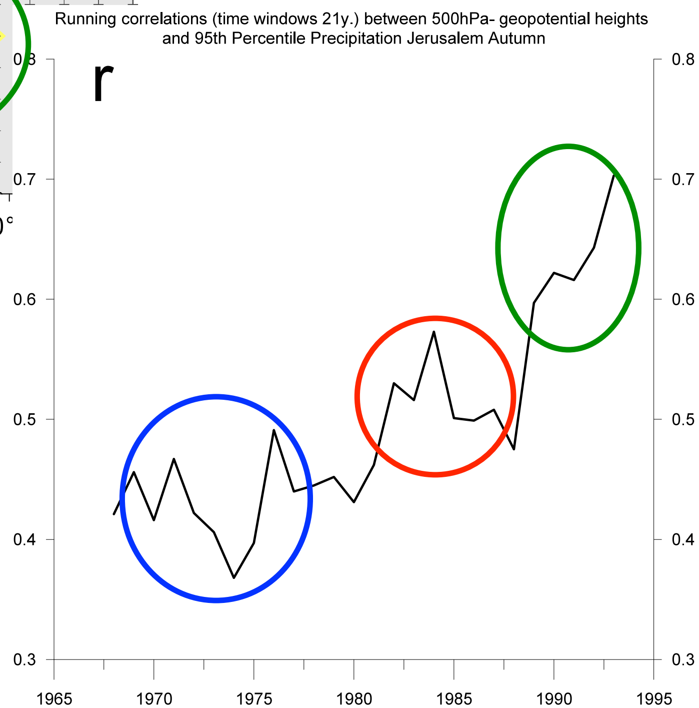


central year of 21-year time window

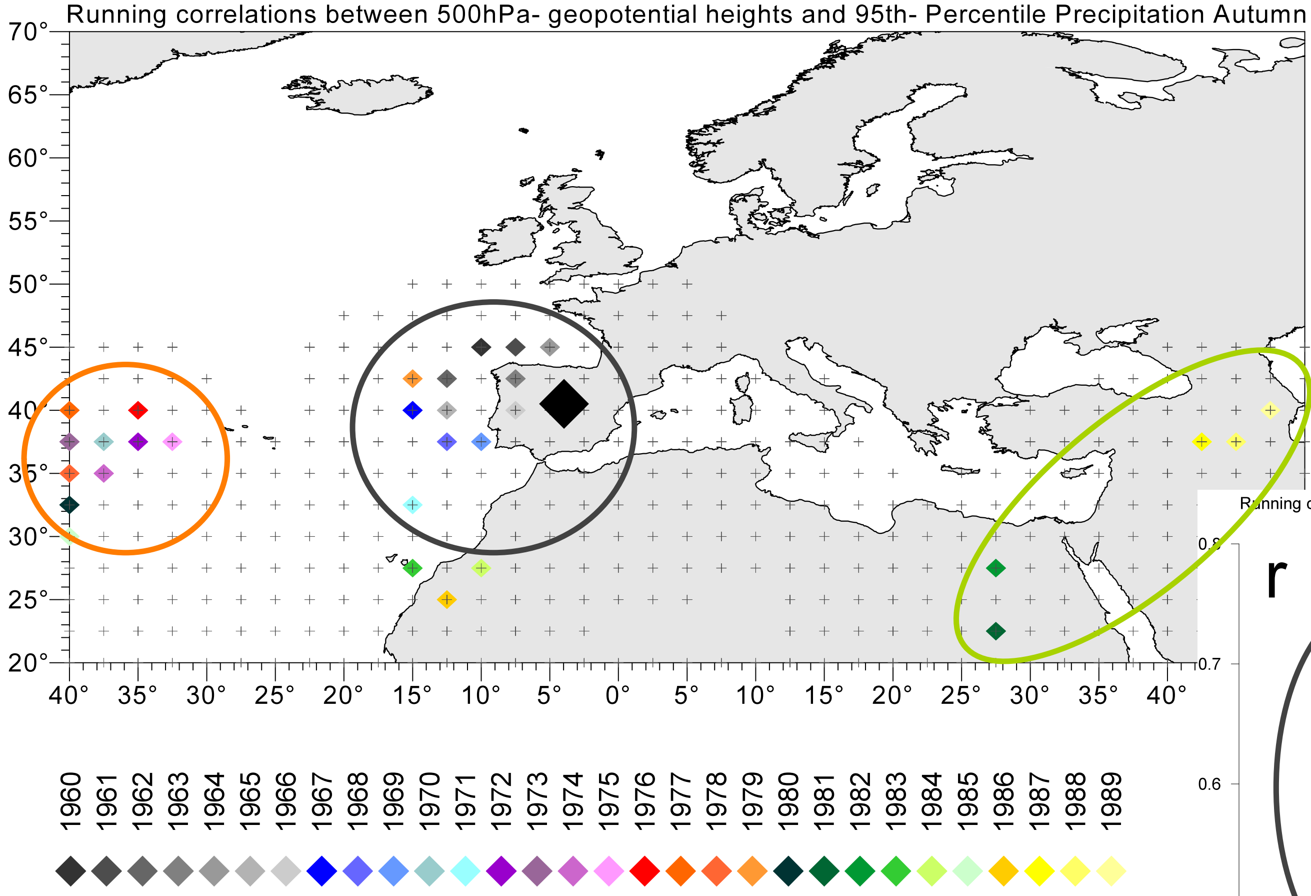
1958 - 2003

Jerusalem

95th Percentile
Precipitation Autumn –
500hPa- geopotential heights



Running correlations

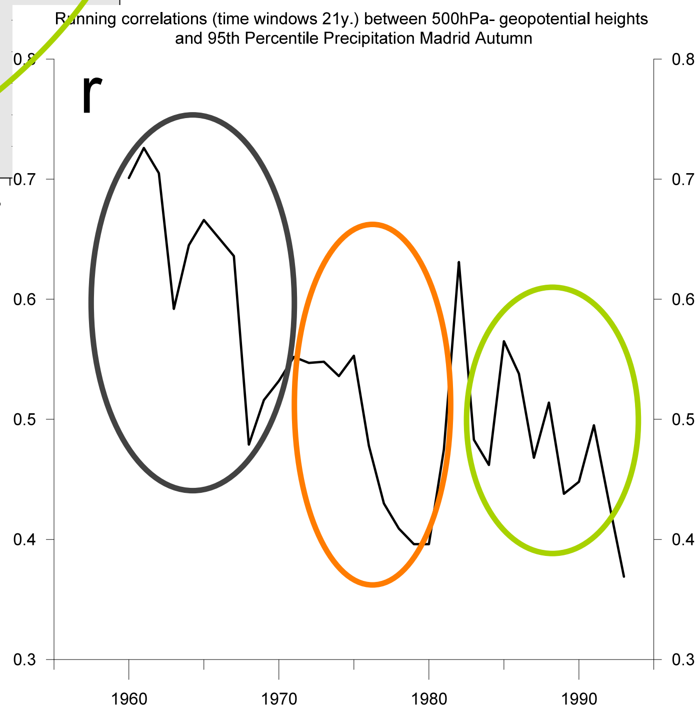


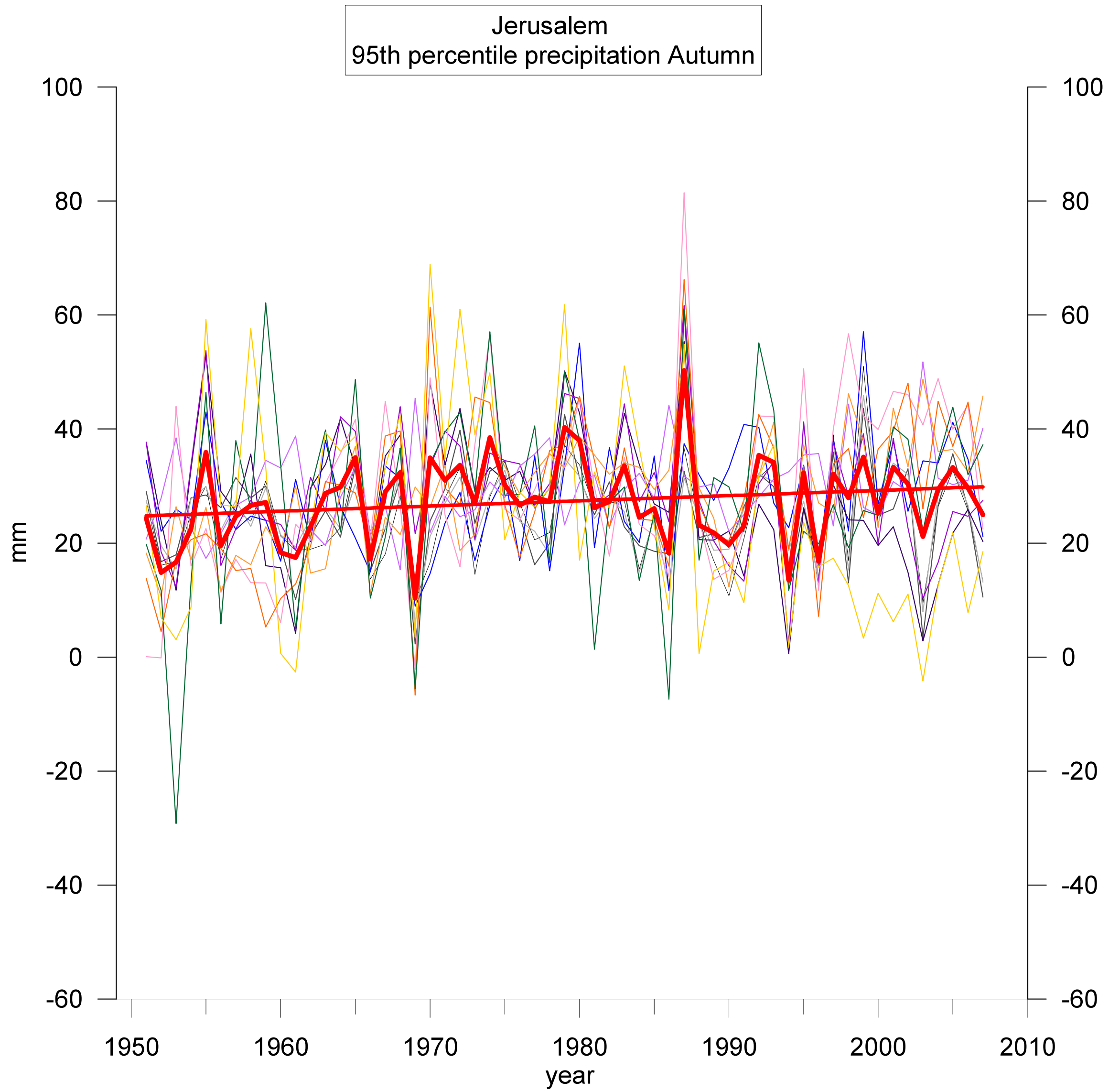
central year of 21-year time window

1950 - 1999

Madrid

95th Percentile Precipitation Autumn – 500hPa- geopotential heights

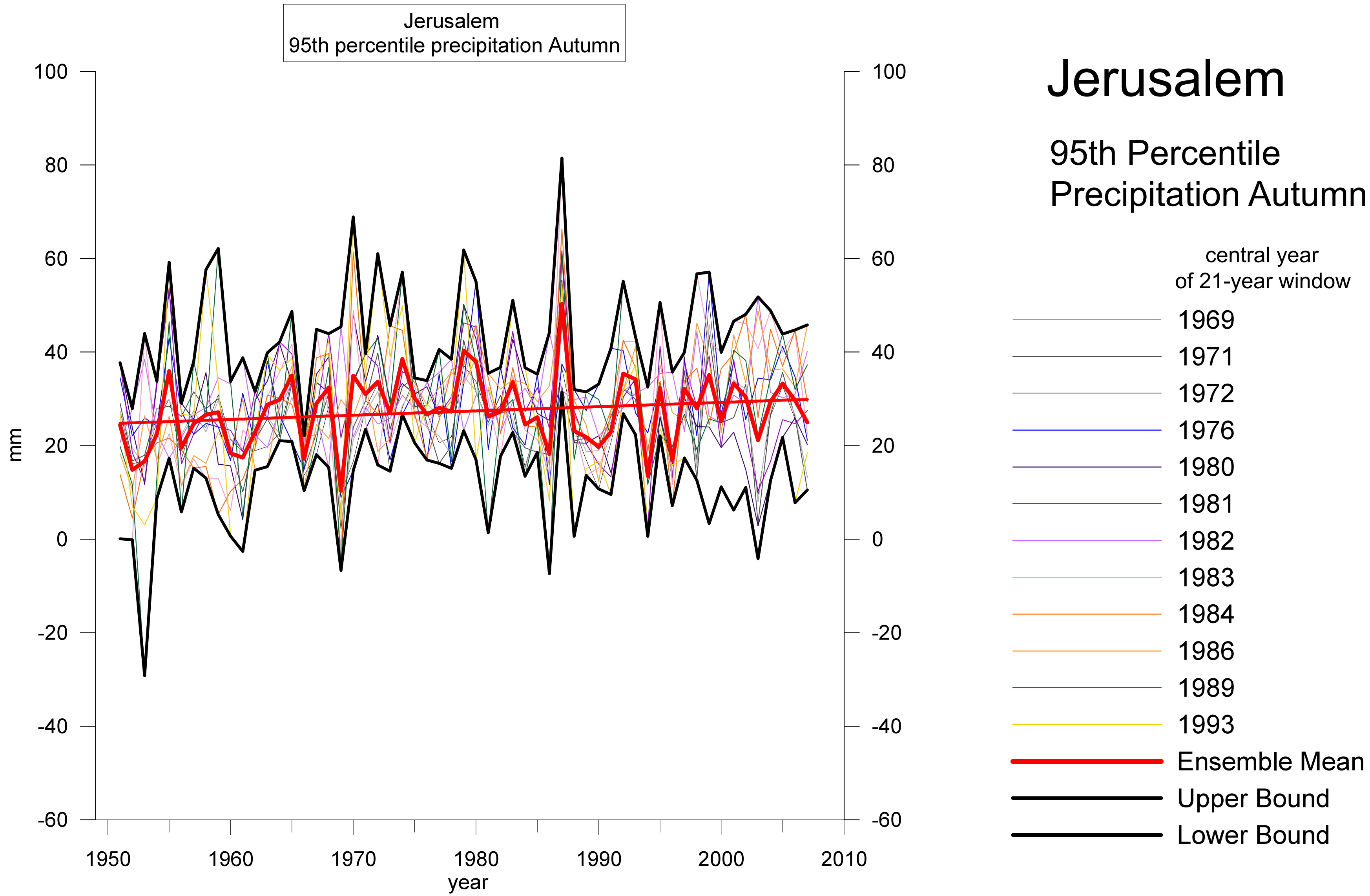


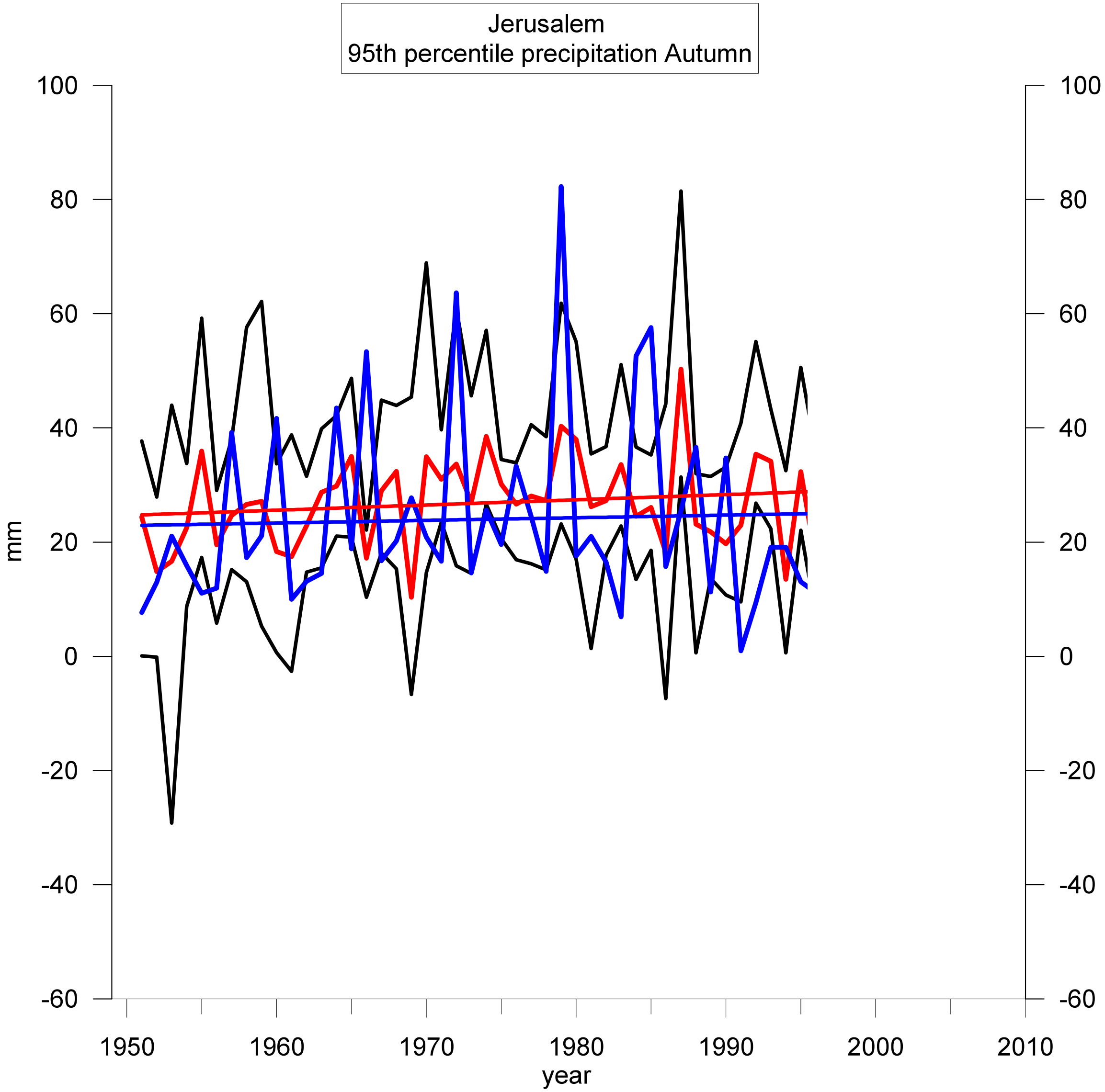


Jerusalem

95th Percentile Precipitation Autumn

Verification: Assessment mit Observations



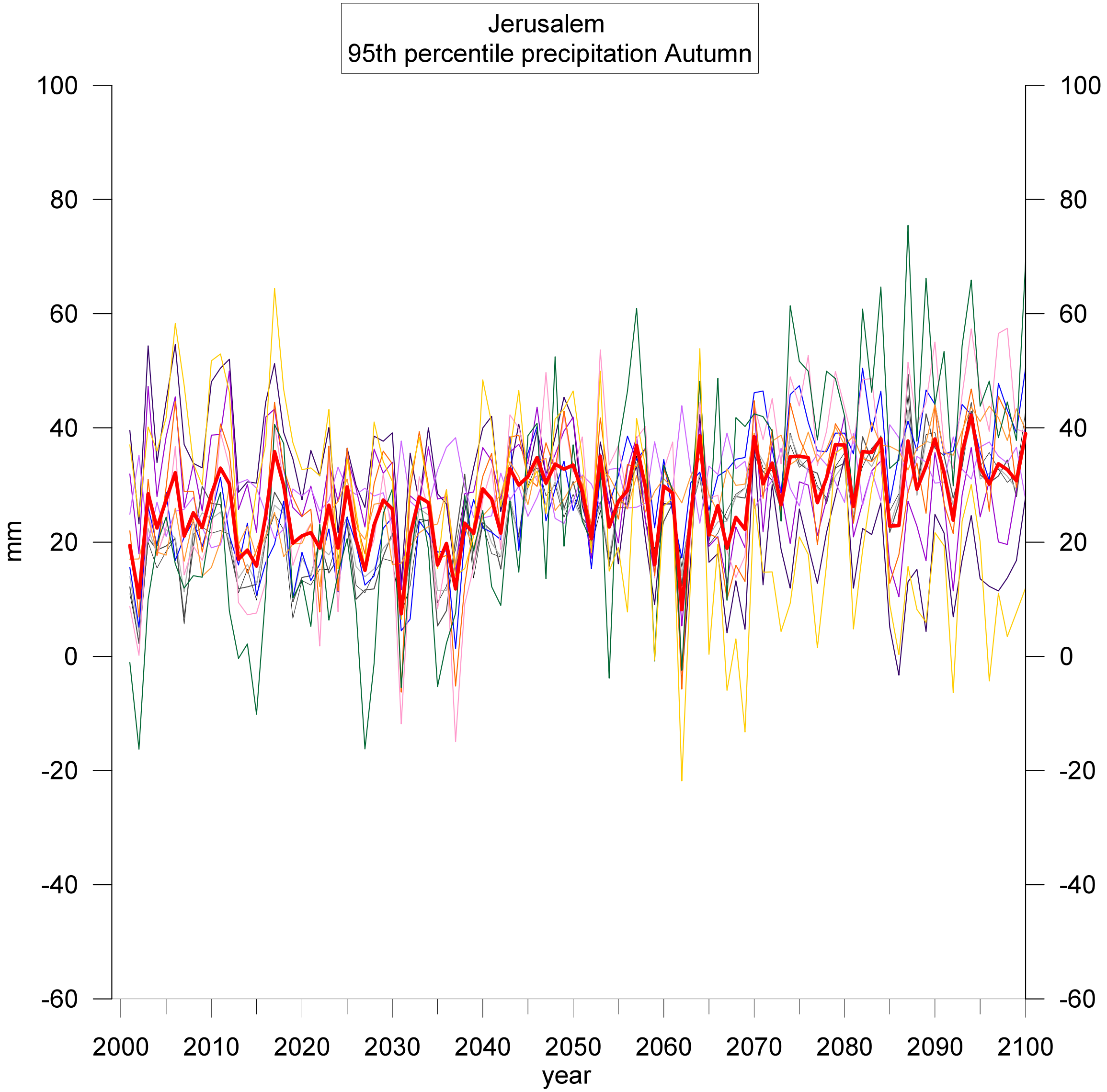


Jerusalem

95th Percentile Precipitation Autumn

Jerusalem
95th- Percentile Precipitation Autumn
Change 2000 to 2100, SRES-A1B

Universität Augsburg University



Jerusalem

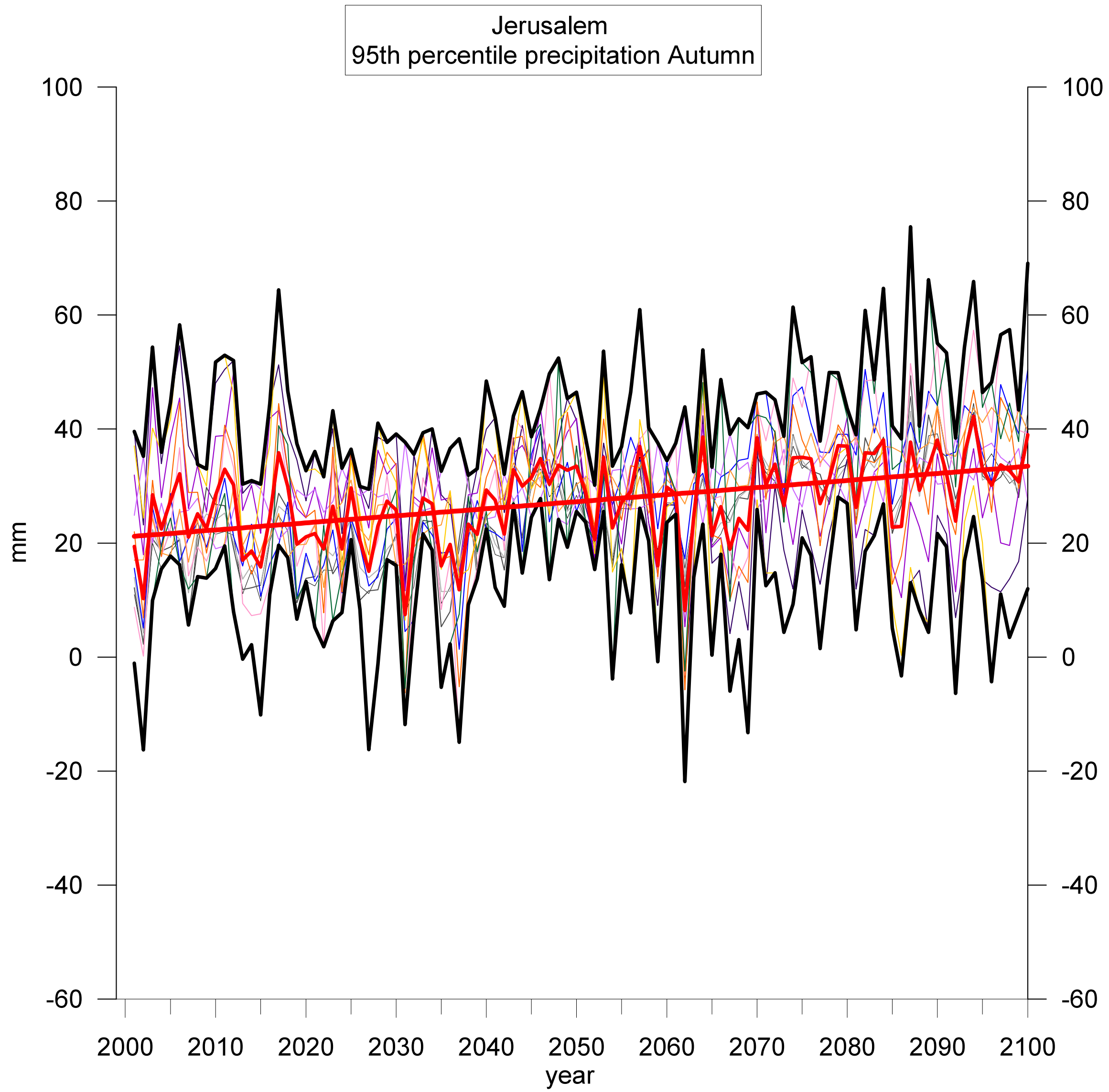
95th Percentile Precipitation Autumn

central year of 21-year window
- 1969
- 1971
- 1972
- 1976
- 1980
- 1981
- 1982
- 1983
- 1984
- 1986
- 1989
- 1993
- Ensemble Mean

Model: ECHAM5/MPI-OM, run1
Scenario: SRES-A1B

Jerusalem
95th- Percentile Precipitation Autumn Change 2000 to 2100, SRES-A1B

Universität Augsburg University



Jerusalem

95th Percentile Precipitation Autumn

central year of 21-year window

- 1969
- 1971
- 1972
- 1976
- 1980
- 1981
- 1982
- 1983
- 1984
- 1986
- 1989
- 1993
- Ensemble Mean
- Upper Bound
- Lower Bound

Model: ECHAM5/MPI-OM, run1
Scenario: SRES-A1B

Conclusions (1)

Results of the statistical downscaling for the Number of Consecutive Dry Days for the period 2070-2099 compared to 1961-1990:

- for the Iberian Peninsula (significant) increases of the number of consecutive dry days in spring, summer, and autumn.
- in the northern Mediterranean area mainly shorter dry periods in summer and autumn; longer dry periods in winter.
- significant increases of dry period length in the eastern Mediterranean region in spring, mixed picture in other seasons.

Conclusions (2)

Results of the comparison between statistical downscaling and dynamical downscaling for the periods 2021-2050 minus 1961-1990:

- good agreement for precipitation extremes in Winter
  - extremes governed by low-pressure systems, being part of the large-scale extra-tropical circulation
- lower correspondence in other seasons
  - predominance of convective precipitation

Conclusions (3)

Open issues concerning the new statistical downscaling scheme:

- Scheme to simple:
  - take other statistical techniques to select independent variables (e.g. PCA)
  - take other statistical techniques to relate circulation and climate (e.g. CCA)
- Time windows where no model can be established:
  - other predictors influence extremes (can be implemented)
  - sub-scale processes govern extreme behaviour
- Narrow upper and lower boundary:
  - identify „regime character“ for future time periods and select appropriate models

END