Baseline climate scenarios for the LIFE ACT project

Ancona, ACT Conference 2010

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Fabiana Baffo[1], Franco Desiato[2], Guido Fioravanti[2], Piero Fraschetti[2], Walter Perconti[2], Andrea Toreti[2,3]

[1]Fondazione ENI Enrico Mattei (FEEM), Venice, Italy, [2]Istituto Superiore per la Protezione e la Ricerca Ambientale (ISPRA), Rome, Italy, [3]Oeschger Centre for Climate Change Research (OCCR) and Institute of Geography, Climatology and Meteorology, University of Bern, Bern, Switzerland

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OUTLINE:

- ✓ Review of climate model projections (GCMs and RCMs) for Ancona, Bullas and Patras*

- ✓ Review of instrumental time series analysis for Ancona, Bullas and Patras*

- ✓ Downscaling: preliminary results

*Results already illustrated in the document: "*Baseline climate scenario – Climate trends and Projections*"

Ancona, Bullas and Patras: temperature/precipitation climate model projections

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3 Regional Climate Models (RCMs)[1]: **Scenario A1B** (intermediate emission scenario)

Model	Ownership	Resolution
CNRM-RM5.1	Meteo France (CNRM)	25 km
SMHIRCA	Swedish Meteorological and Hydrological Institute (SMHI)	25 km
KNMI-RACMO2	The Royal Netherlands Meteorological Institute (KNMI)	50 km

2 General Circulation Models (GCMs)[2]: **Scenario A1B**, **A2** (pessimistic) and **B1** (optimistic)

Model	Ownership	Resolution
CNRM	Meteo France (CNRM)	(2° x 1.5°) about 300 km
INGV	Istituto Nazionale di Geofisica e Vulcanologia (INGV)	(2° x 1.5°) about 300 km

[1]ENSEMBLES project (http://ensemblesrt3.dmi.dk/), Research line: production of regional climate scenarios for impact assessments

[2]PCMDI (http://www-pcmdi.llnl.gov/), Program for Climate Models Diagnosis and Intercomparison

Temperature projections: general results for Ancona, Bullas and Patras

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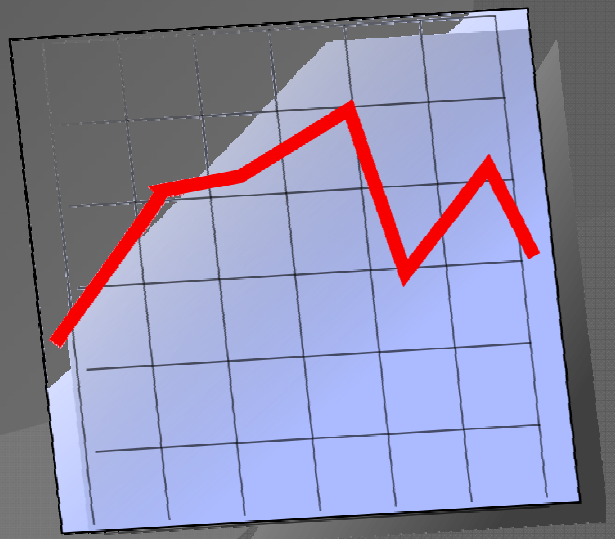
RCMs results:

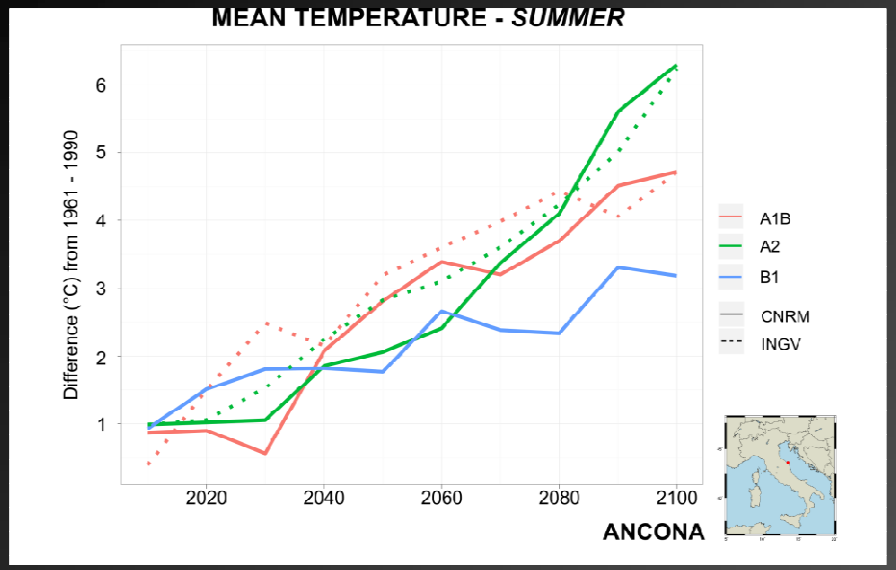
✓Then mean temperature exhibits an increasing trend which is almost linear throughout the whole century.

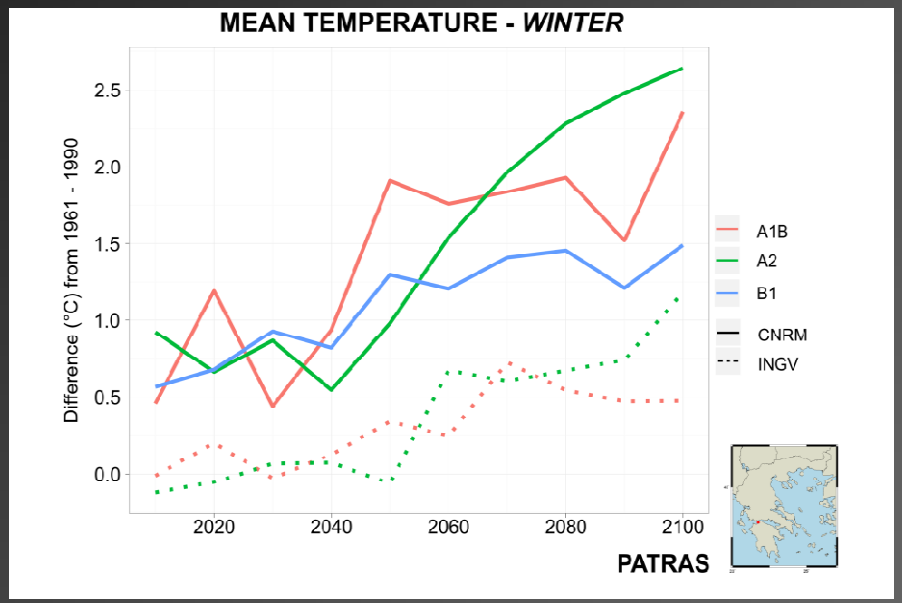
✓For minimum and maximum temperatures, the trend does not show significant differences with respect to the increase of mean temperature.

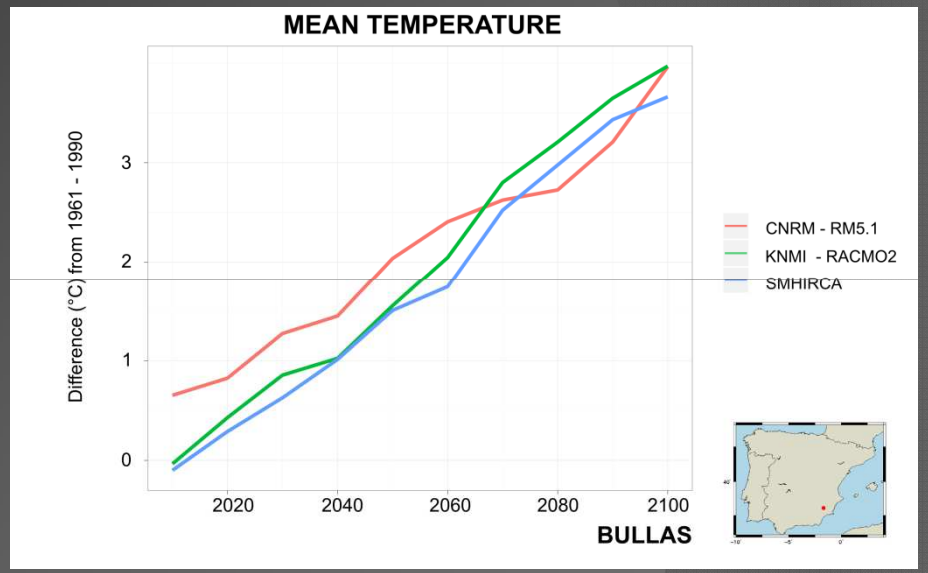
GCMs results:

✓A warming stronger in summer and weaker in winter is predicted for all the emission scenarios.









RCMs & GCMs

Model projections are presented as temperature anomalies with respect to 1961-1990

Temperature projections: RCMs results

Ancona

✓ An increase of the mean temperature at the end of the century between 3.4 ℃ (SMHIRCA) and 3.7 ℃ (RM5.1).

✓ A warming more pronounced in summer (between 3.9 ℃ a nd 5.7 ℃) and less in spring (between 2.4 ℃ and 2.9 ℃).

Bullas

- ✓ A rise of the mean temperature at the end of the century between 3.7 ℃ (SMHIRCA) and 4.0 ℃ (RM5.1 and RACMO2).
- ✓ A warming more pronounced in summer (between 4.9 ℃ a nd 5.6 ℃) and less in spring (between 2.0 ℃ and 3.3 ℃).

Patras

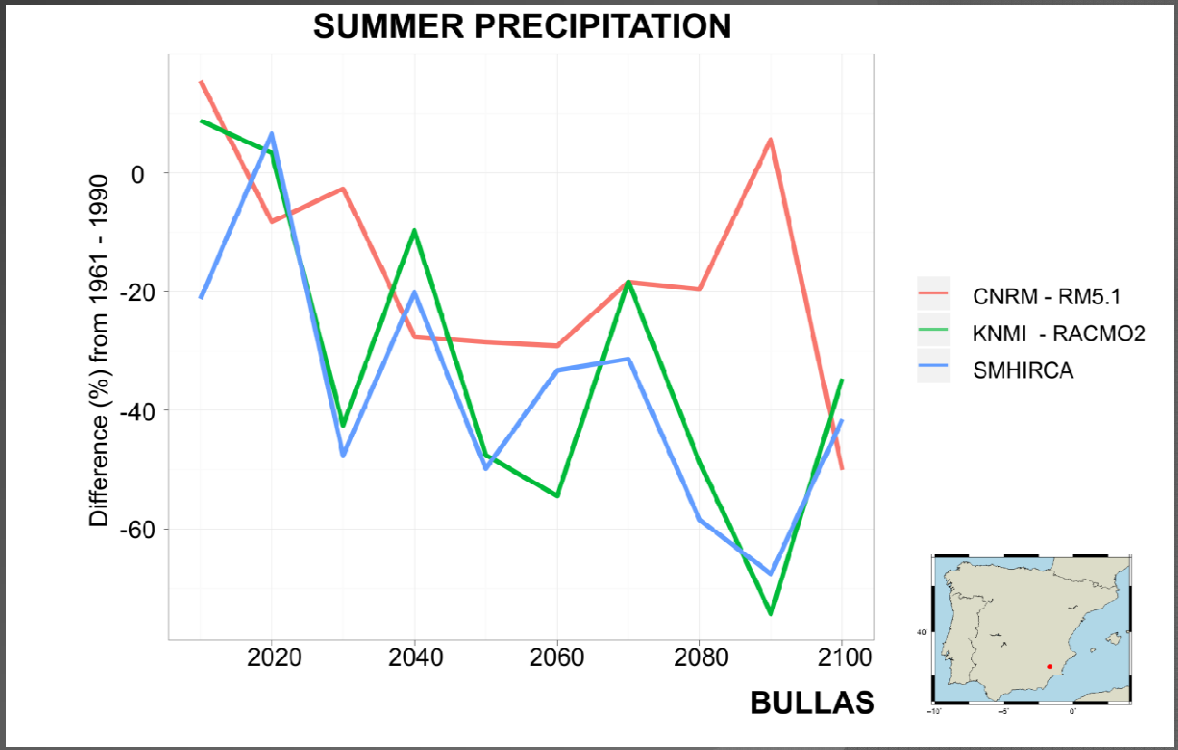
✓A rise of the mean temperature at the end of the century between 3.5 ℃ (RM5.1) and 4.0 ℃ (RACMO2).

✓A warming more pronounced in summer (between 4.5 ℃ and 5.1 ℃) and less in spring (between 2.4 ℃ and 3.0 ℃).

Precipitation projections: general results for Ancona, Bullas and Patras

RCMs and GCMs results:

Larger uncertainty and irregular behaviour of precipitation projections than temperature.



Model projections are presented as percentage variation of annual cumulated precipitation with respect to 1961-1990.

Instrumental time series

Instrumental climate time series represent an essential source of information for the assessment of the past and current climate change

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Homogeneisation/Trend estimation of climate time series and statistical downscaling require:

- Long term series (at least 40 years) for the candidate station

- At least three reference stations with long term series (at least 40 years).

- Reference stations must be representative of the regional climate of the candidate station.

Ancona: temperature and precipitation time series

The new data available to us (2007 – 2009) do not alter the general risults already illustrated in July 2010 (Rome)

Trend assessment	
Temperature	**Precipitation**
A break point was identified in 1978 (Standard Normal Homogeneity Test & Caussinus - Mestre test)	No breakpoint was detected
Time series from 1973 to 2009	Time series from 1978/1979 to 2009
No significant trend in Winter (Mann – Kendal test)	No significant trend in Spring, Summer and Autumn. A **weak** but **significant** decrease characterises both the winter and annual series but longer time periods are needed to support this result

Ancona: temperature time series (1973 -2009)

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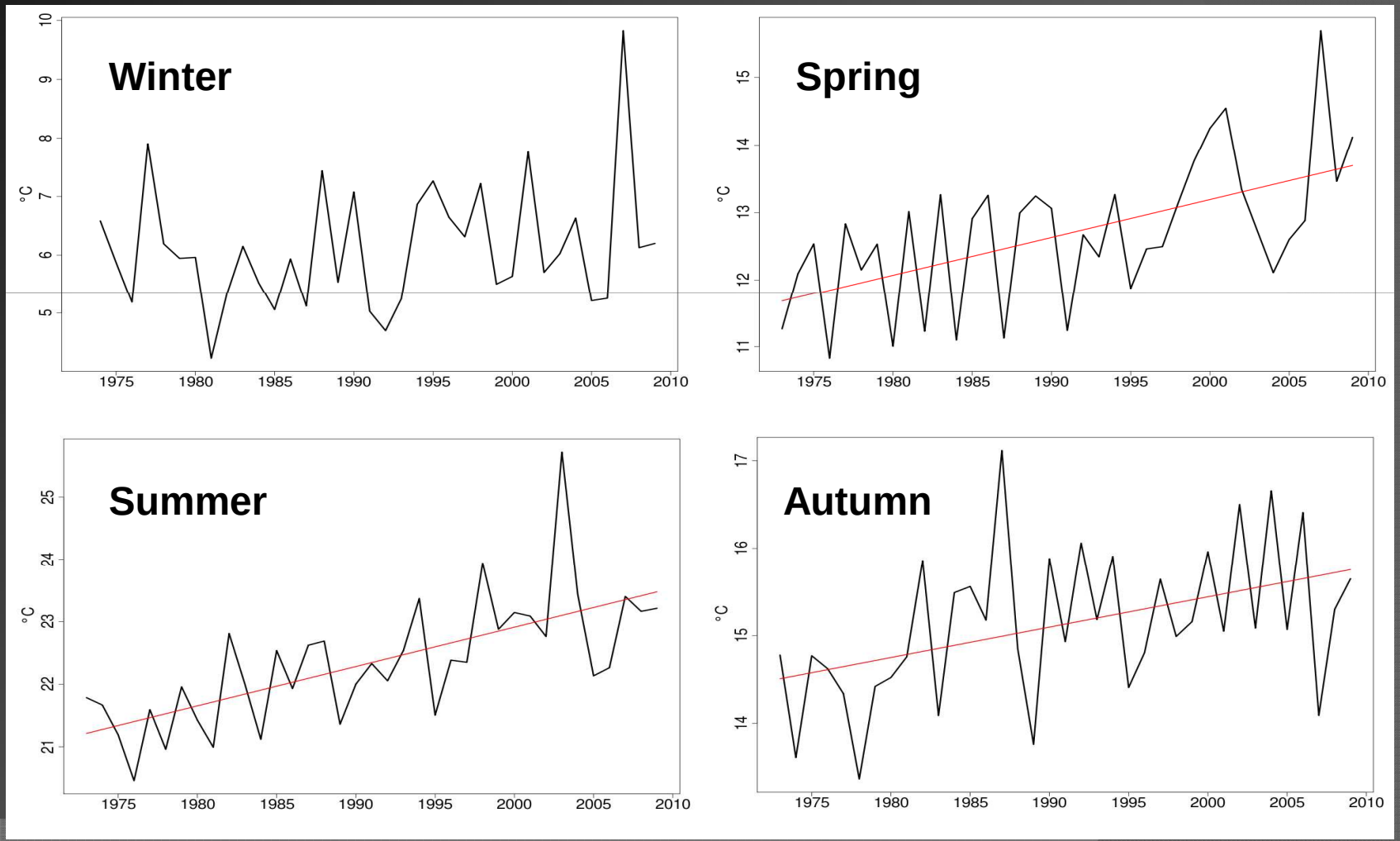

Ancona: precipitation time series (1973 -2009)

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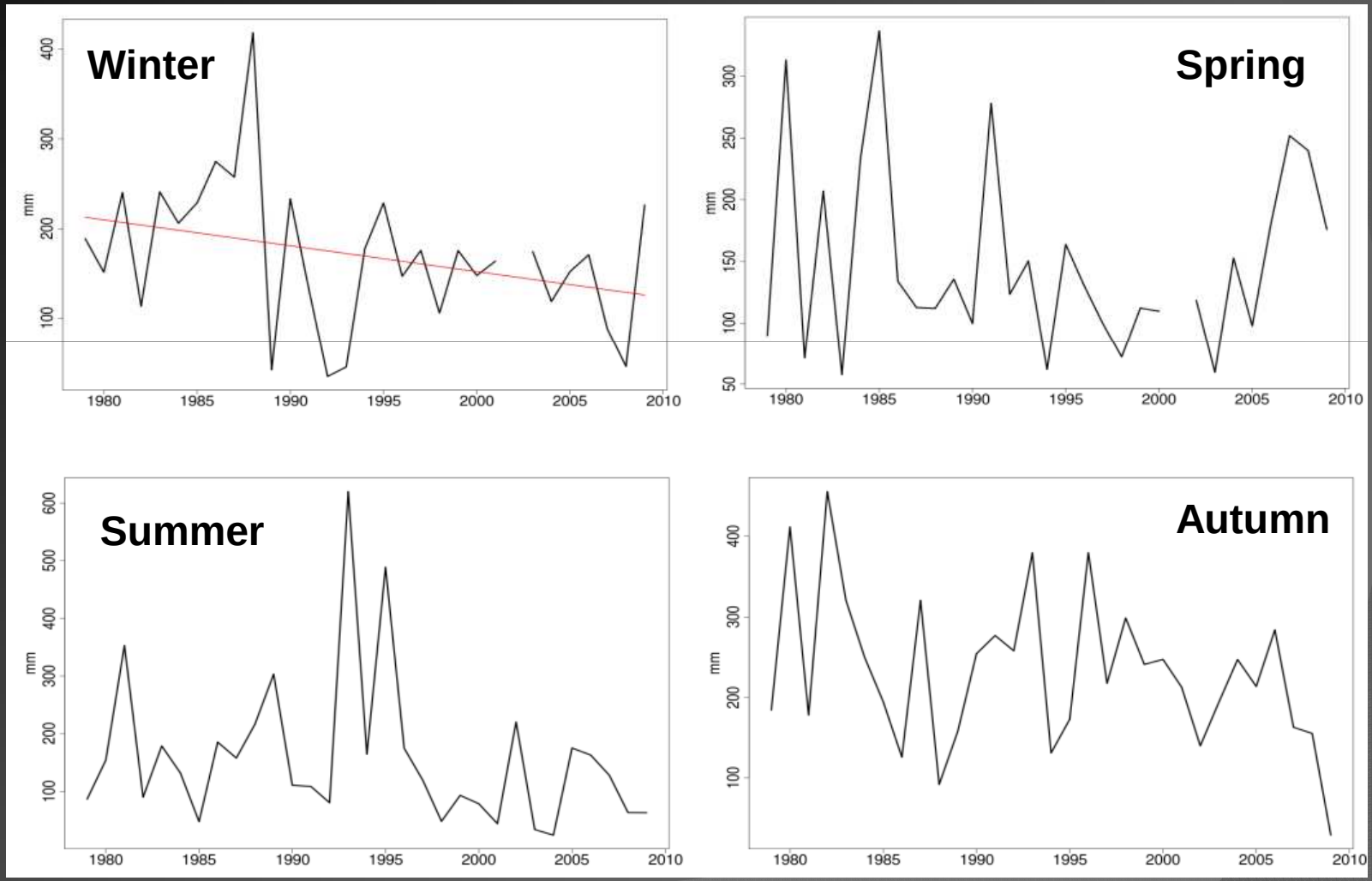

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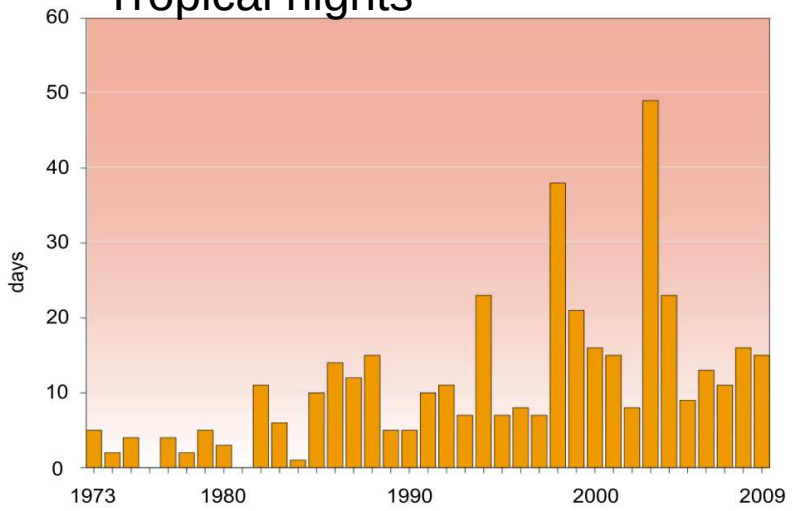
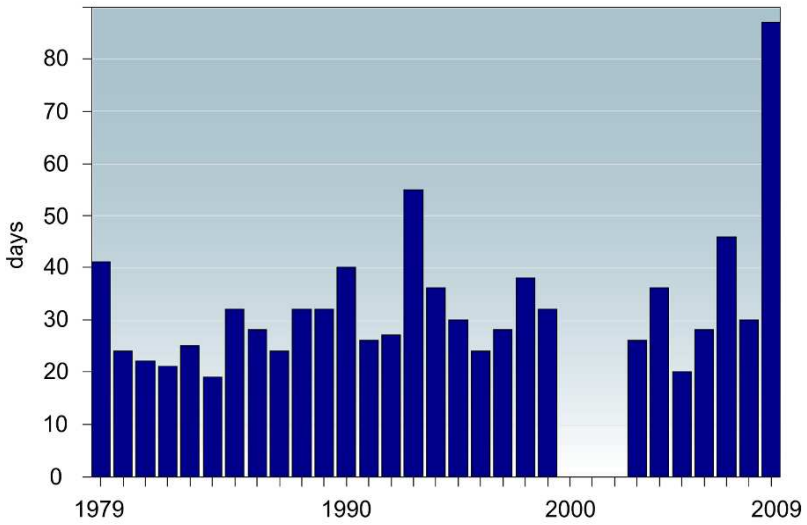
Ancona: indicators for extreme events (1973 -2009)

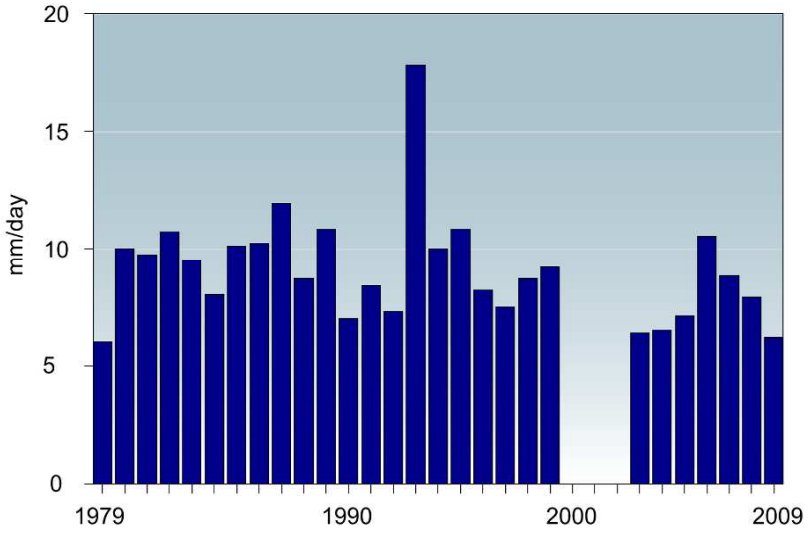
Tropical nights



Consecutive Dry Days



Simple Daily Intensity Index



Bullas/Patras: time series quality control

Each time series underwent a quality control analysis in order to evaluate its reliability for trend assessment and downscaling

Requirements for time series analysis concern with:
Length of time series
Quality control of data values

Two types of quality control:

1) Gross error checking: to detect and flag obviously erroneous values (e. g. shift in commas, negative precipitation).

2) Internal consistency check: to inspect coherency between associated elements within each record
(e.g. max temperature < min temperature)

Bullas: temperature time series

Bullas and Bullas (Depuradora): longer observation periods are needed for trend assessment and downscaling

Station Name	First Year	Last Year	Years with >=1 Missing Months
Moratalla (Segura)	1973	2002	1973, 1976, 1994, 2002
Moratalla (P. Bomberos)	2000	2009	2000, 2007, 2009
Caravaca	1985	2009	1985, 1998, 2009
Cehegin	1971	2009	1971, 1986
Calasparra	1933	2009	1938, 1939, 1966, 1967, 1968, 1969, 1994, 2009
Bullas (Depuradora)	**1997**	**2009**	**1997, 2009**
Bullas	**1933**	**1976**	**1938, 1939, 1963, 1976**
Mula (Emb. De la Cierva)	1933	2009	1938, 1939, 2006, 2008, 2009

Bullas temperature time series: truncation of data values

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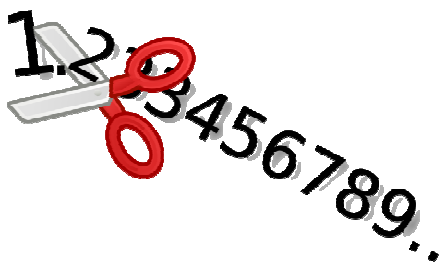
```
Day;Month;Year;Tmin;Tmax
1;4;1997;6;18
2;4;1997;6;19
3;4;1997;8;20
4;4;1997;11;23
5;4;1997;9;20;
6;4;1997;8;18
7;4;1997;10;18
8;4;1997;9;12
9;4;1997;9;10
10;4;1997;8;10
11;4;1997;6;15
12;4;1997;8;20
13;4;1997;8;18
14;4;1997;7;19
15;4;1997;8;22
16;4;1997;12;25
17;4;1997;13;18
18;4;1997;9;15
19;4;1997;9;16
20;4;1997;10;15
21;4;1997;8;13
22;4;1997;9;19
23;4;1997;9;20
24;4;1997;8;20
25;4;1997;10;18
26;4;1997;10;22
```

The global quality of all time series is seriously altered by truncation to integers of most data values.



Patras: temperature time series

Station Name	First Year	Last Year	Years with >=1 Missing Months
Patras	1960	2003	None

- ✓ The series meets the quality control requirements
- ✓ The observation period is long enough for trend assessment and downscaling activities.

However:

- ✓ **No time series of neighbour stations** available for break point detection and time series homogeneization
- ✓ No data available for trend assessment **in** the period 2004 – 2009. Furthermore, most recent years significantly contribute to the calibration of statistical models for downscaling

Bullas/Patras: temperature time series for downscaling

E-OBS DATASET			
Description	**Period covered**	**Spatial resolution**	**Download from:**
Daily gridded observational dataset for precipitation and temperature in Europe	1959 –to present	Data available on a 0.25 and 0.5 degree regular lat-lon grid	http://eca.knmi.nl/dailydata/index.php ()
USAGE: **1) temperature time series for Bullas and Patras from 1973 to 2008 for the calibration and validation of statistical downscaling models 2) 1961 – 1990 mean temperature for Ancona, Bullas and Patras**			

Downscaling: general overview

General Circulation Models (GCM) provide a consistent picture of possible climate change based on a set of various assumptions scenarios

However: their output is too coarse for the assessment of climate change impacts

Downscaling attempts to resolve such a discrepancy: uses information at large scale to make predictions at local scale

Statistical downscaling

1) The definition of a statistical relationship between local climate variables Y (e.g. temperature) and large scale predictors X (e.g. geopotential height at 500 hPa)

2) The application of this relationship to the output of GCM experiments to simulate local climate characteristics in the future

Long-term observed data are required to derive and validate the statistical relationship (model calibration and validation)

Downscaling: data description

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Local climate variable Y:

Ancona temperature time series from 1973 to 2008 / E-OBS gridded datasets for Bullas and Patras

Large scale predictors X:

Geopotential height at 500 hPa (Z500) and air temperature at 850 hPa (T850).

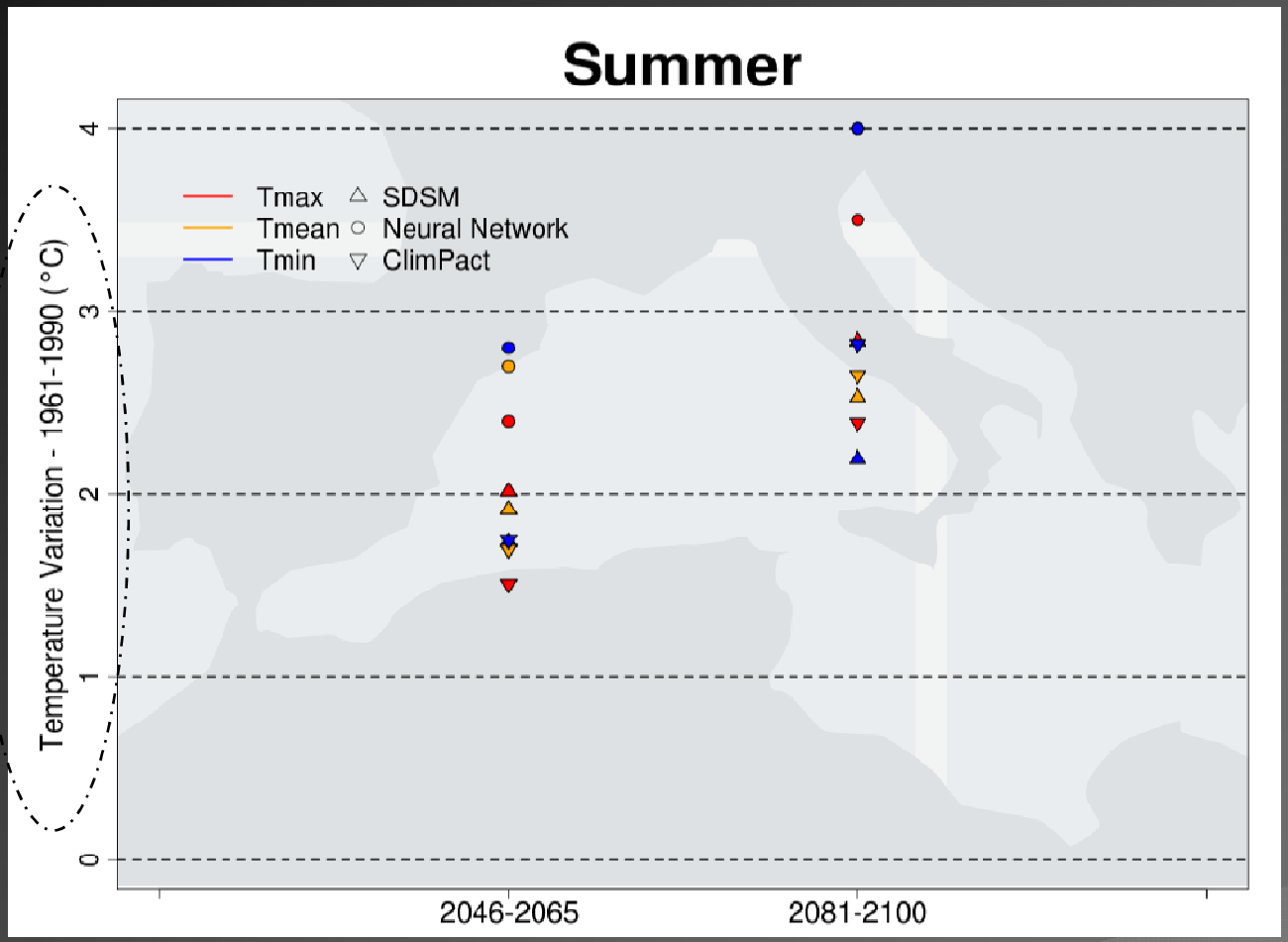
Data source: NCEP/NCAR reanalysis (1973 - 2008) for model calibration/validation; GCMs experiments (e.g. BCCR-BCM2.0)

Downscaling tools:

Approach	Software	Predictors	Study Area
Linear regression with EOF analysis	**Clim.pact** (R data analysis environment)	Common EOFs of the gridded fields	35°W – 35°E/30°S - 60°N
Stochastic weather generator and linear regression	**SDSM**	Single cell for the target area	
Neural Network (Multi-Layer Perceptron without any hidden layer)	**AMORE** (R data analysis environment)	EOFs of the gridded fields	35°W – 35°E/30°S - 60°N

SDSM is the only tool which provides users a GUI (Graphical User Interface), which facilitates data manipulation by any user

Downscaling: preliminary results for Ancona



Validation period:

1973 - 1998

Calibration period:

1989 - 2008

Scenario A1B

BCCR-BCM2.0 GCM: Bjerknes Centre for Climate Research (BCCR), Univ. of Bergen, Norway

Downscaling: preliminary results for Ancona

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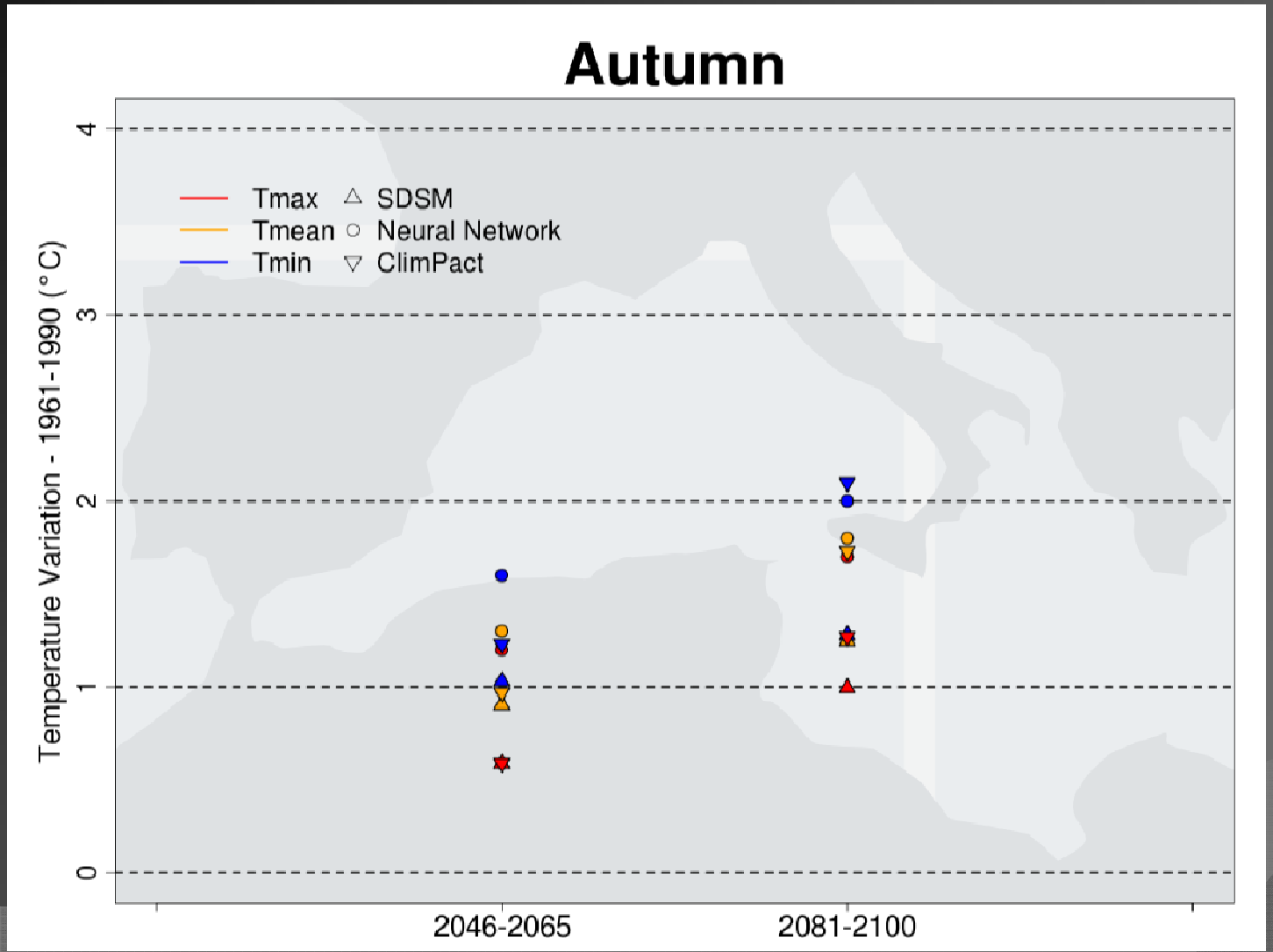

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THANK YOU

guido.fioravanti@isprambiente.it