SWAT 2015
PULA / SARDINIA / ITALY

Climate Change Impact Assessment on Mediterranean Natural Pastures

Luca Doro
Laura Mula
Martina Buffa
Luigi Ledda

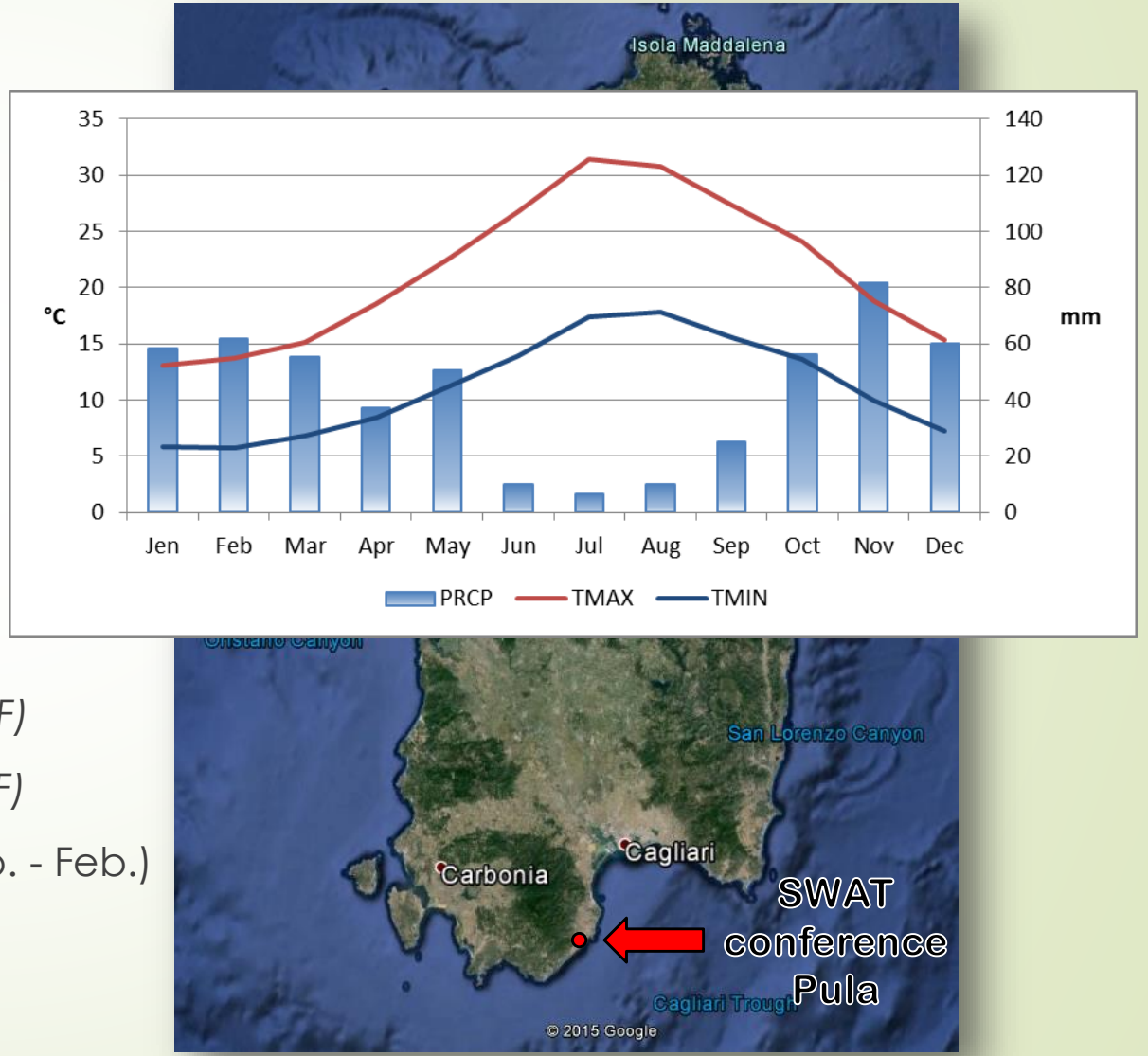
uniss
UNIVERSITÀ DEGLI STUDI DI SASSARI

Introduction

- In Italy permanent grassland represent 26.7% of the agricultural area (3.4 millions of hectares).
- Sardinia is the region with the largest area covered by grassland and pasture (693,000 ha), covering areas where the ground morphology, weather, and soil make them unsuitable for intensive agricultural use.

Introduction: studied area

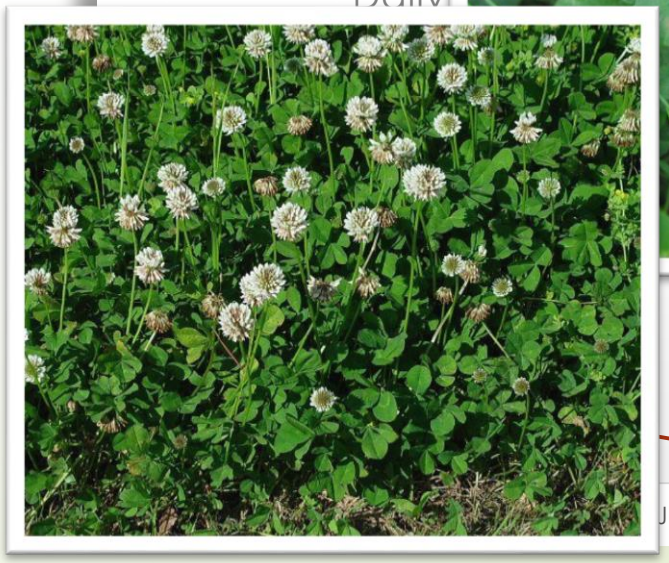
- North-West Sardinia
  - Flat area
  - Soil texture: Clay-Loam
  - Average soil depth: 35-40 cm
- Mediterranean climate
  - Weather data: 1951 – 2010
  - Average annual max temp.: 20.6 °C *(69 °F)*
  - Average annual min temp.: 11.4 °C *(52 °F)*
  - Average precipitation: 569 mm (70% Sep. - Feb.)



Introduction: studied area

pasture characteristics

- Spring (60-70%) and autumn (30-40%) growth
- Annual species
  - Grasses (Avena sp. pl., Lagurus sp. pl.)
  - Legumes (Trifolium sp. pl., Medicago sp. pl.)



Objective

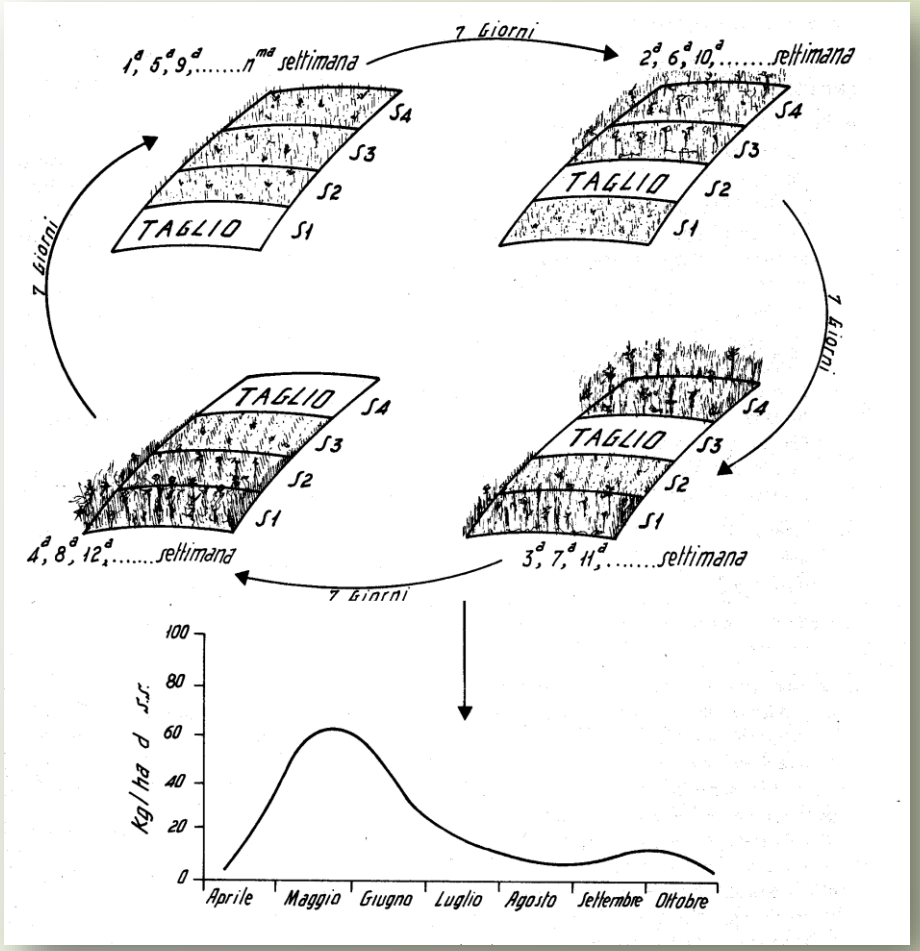
Productivity assessment as affected by climate change and climate variability

- Tool used: EPIC simulation model

Methods:

Data collected for the model calibration

- Period of observation: 1983 - 1988
- Corrall and Fenlon methodology
- Samples collected in each plot (4)
- Above ground biomass harvested



Methods:

Model calibration

- **Calibration**: 1984 – 1986 **Validation**: 1987 – 1988
- General “winter pasture” was used
- Management based on the experimental protocol

Methods:
Weather scenario 1: 2031-2090 present conditions

- Generated weather data (MarkSim™)
  - Present climate
  - Weather data: 2031-2090

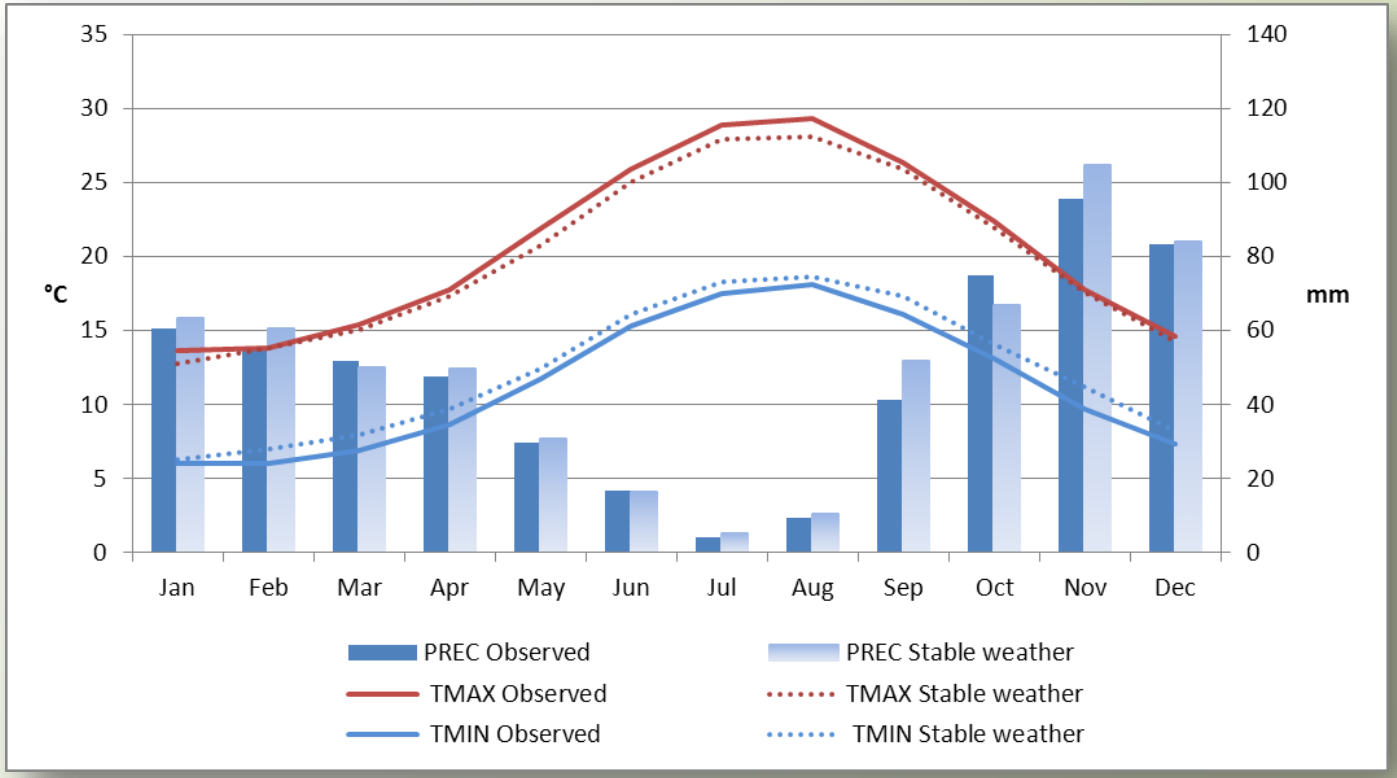
    Generated 60-year weather data

    Yearly average max temp.: 20.0 °C (*-0.6*)

    Yearly average min temp.: 12.5 °C (*+1.1*)

    Yearly precipitation: 593 mm (*+4%*)

    CO_2 concentration: 390 ppm



Methods:

Weather scenario 2: 2031-2090 **B1**

- Generated weather data (MarkSim™)
  - Ensemble mean of CNRM-CM3; CSIRO-Mk3_5; ECHam5; MIROC 3.2
  - Emission scenario: B1
  - Weather data: 2031 - 2090

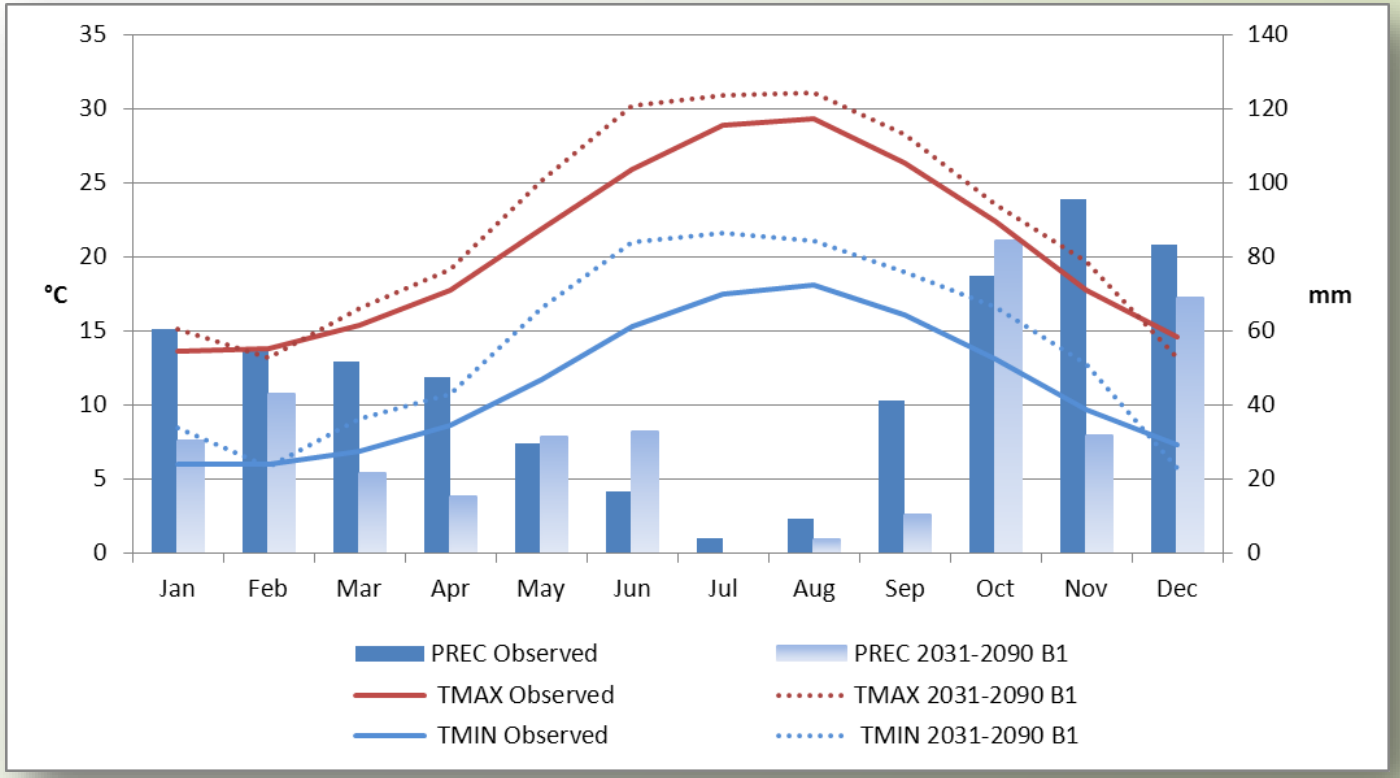
    Generated 60-year weather data

    Yearly average max temp.: 22.1 °C (*+1.5*)

    Yearly average min temp.: 14.0 °C (*+2.7*)

    Yearly precipitation: 372 mm (*-35%*)

    CO_2 concentration: 434 – 541 ppm



Methods:

Weather scenario 3: 2031-2090 **A1b**

- Generated weather data (MarkSim™)
  - Ensemble mean of CNRM-CM3; CSIRO-Mk3_5; ECHam5; MIROC 3.2
  - Emission scenario: A1b
  - Weather data: 2031 - 2090

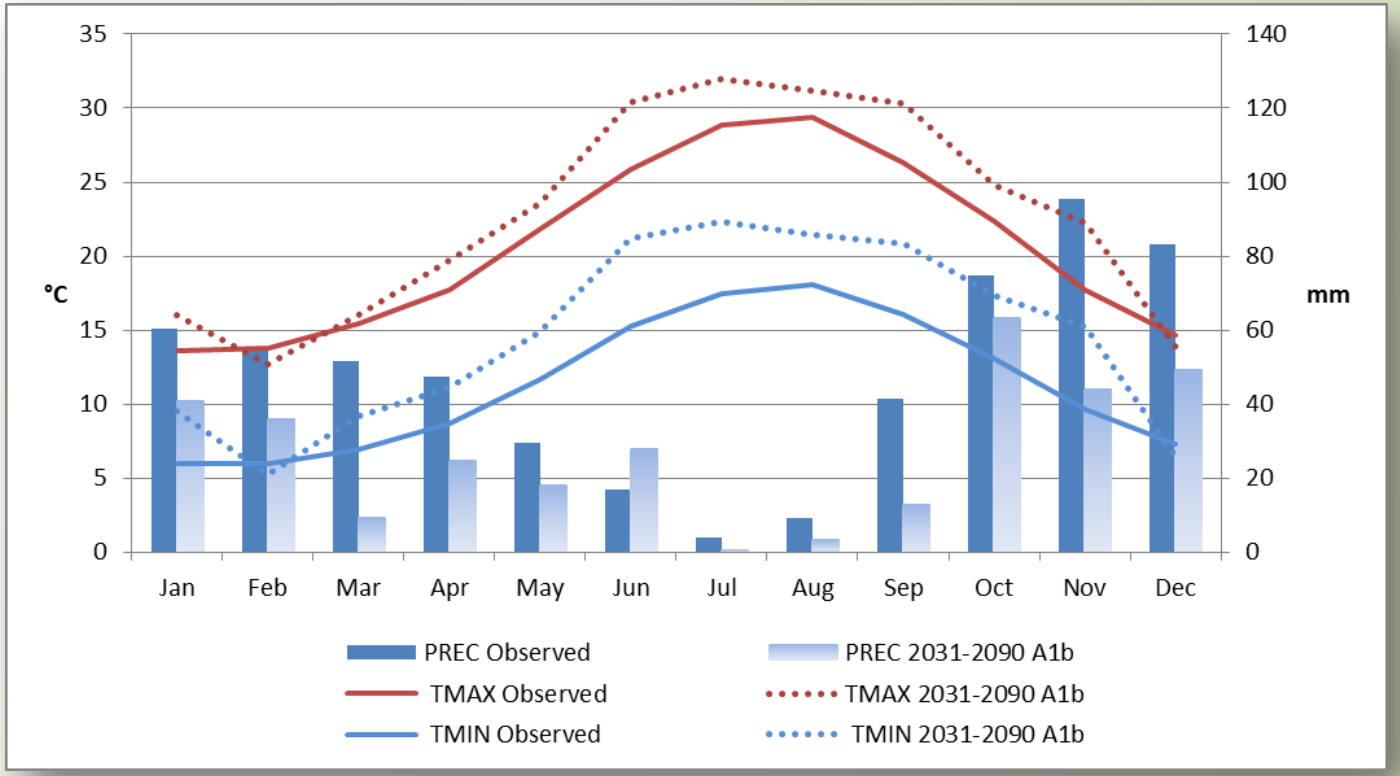
    Generated 60-year weather data

    Yearly average max temp.: 22.7 °C (+2.1)

    Yearly average min temp.: 14.6 °C (+3.2)

    Yearly precipitation: 329 mm (-42%)

    CO_2 concentration: 450 – 679 ppm



Methods:
Weather scenarios

	TMAX (°C)	TMIN (°C)	PREC (mm)	CO2 (ppm)
Observed	**20.6**	**11.4**	**569**	**316 - 390**
2031-2090 **present conditions**	-0.6	**+1.1**	+24.0	390
2031-2090 **B1**	**+1.5**	**+2.7**	-197.0	434 - 541
2031-2090 **A1b**	**+2.1**	**+3.2**	-240.0	450 - 679

Results:

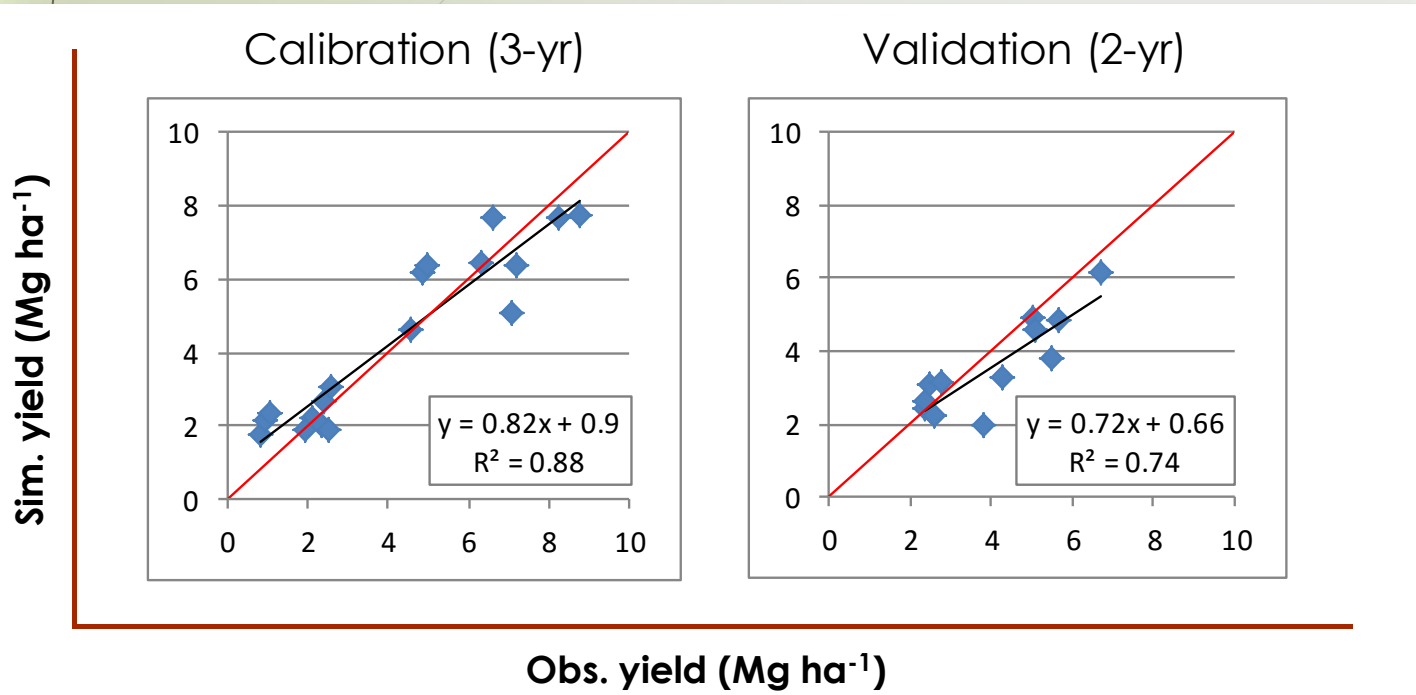
Model calibration

Crop Parameters	Default	Calibrated
TOP	15.0	18.0
TBS	0.0	5.0
DLAI	0.7	0.8
DLAP1	15.05	3.01
DLAP2	50.95	60.95
HMX	1.0	0.45
RDMX	2.0	0.3
IDC	6	5

Global Parematers	Default	Calibrated
Root growth-soil strength	1.5	1.0
Soil water lower limit	0.5	1.0
Moisture required for seed germination	(0.3 – 0.9)	0.5
Fraction of maturity at spring growth initiation	0.0	0.38
Weighting factor for estimating soil evaporation	1.0	0.0
Heat unit adjustment at harvest	0.0	0.4

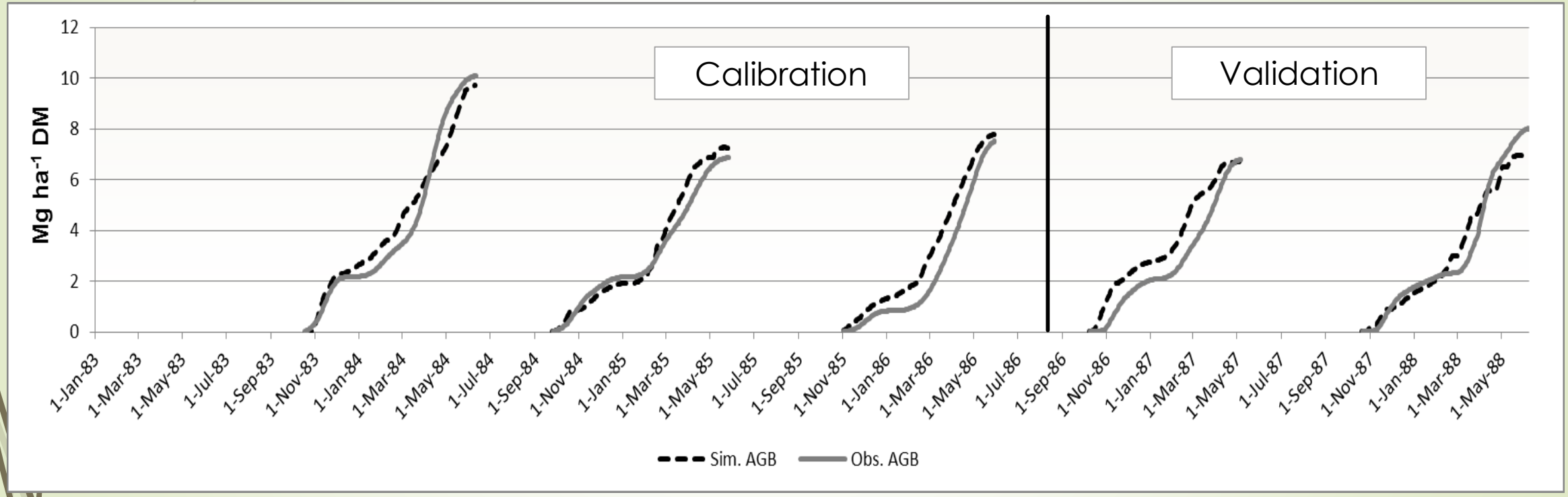
Results:

Calibration and Validation



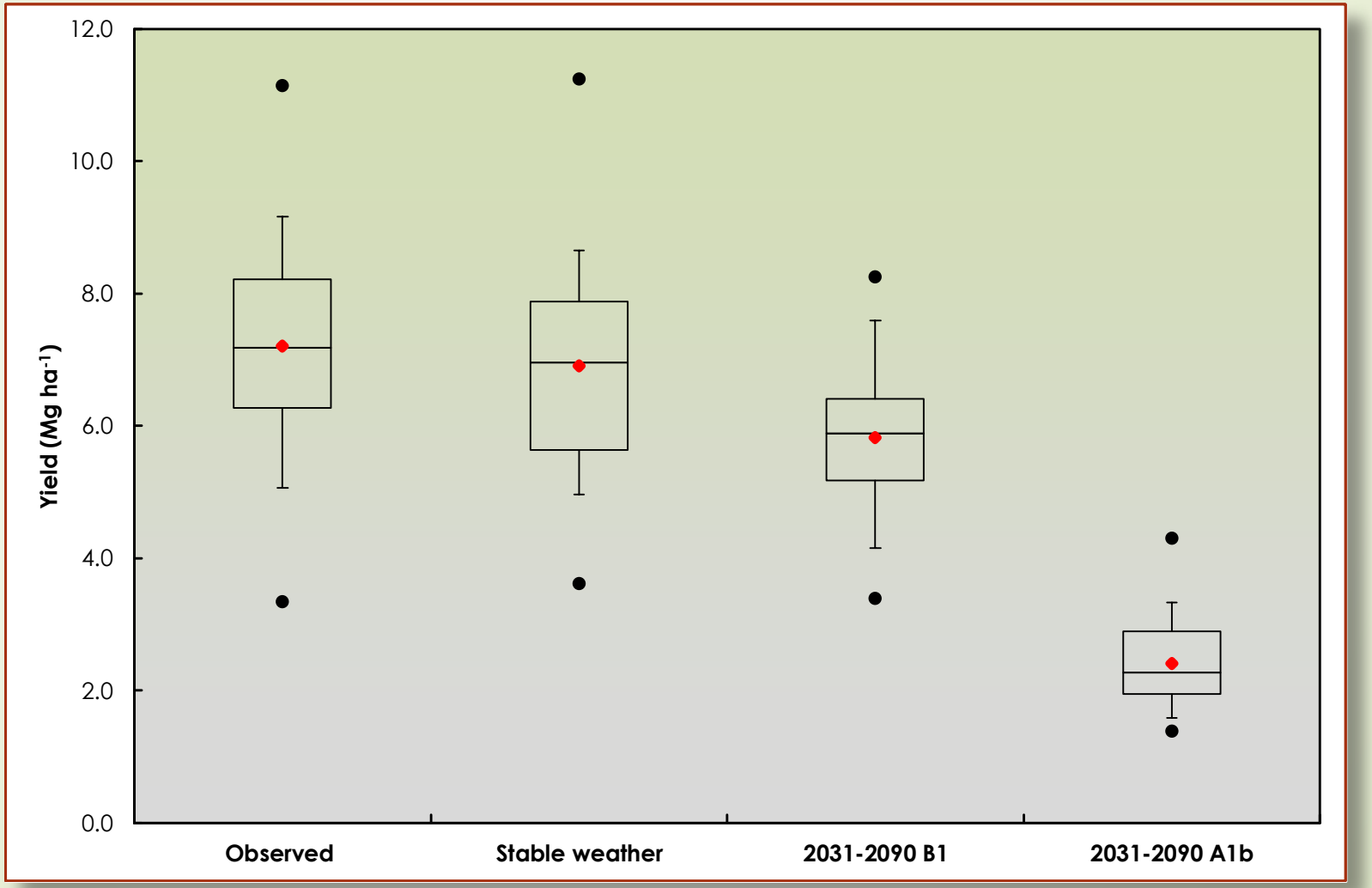
	MAE	RRMSE	EF	d	CD
Min	0.00	0.00	-inf.	0.00	0.00
Max	+inf.	+inf.	1.00	1.00	+inf.
Best	0.00	0.00	1.00	1.00	1.00
Calibration	0.76	22.42	0.87	0.96	1.28
Validation	0.69	21.74	0.64	0.89	1.24

Results:
Calibration and validation



Results:

Impacts of weather scenarios



Conclusions

- The EPIC model is suitable to simulate Mediterranean natural pastures
- The model is sensitive to different weather scenarios
  - Slight yield reduction with the stable future weather (no statistical difference)
  - Slight yield reduction with B1 scenario (no statistical difference)
  - Severe yield reduction with A1b scenario

- Possible future development
  - Simulation based on functional groups/plants community approach
  - Improve simulation of crop growth after cutting/grazing

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- **Luca Doro**

  ldoro@uniss.it
  Università degli Studi di Sassari
  http://www.uniss.it

  ldoro@brc.tamus.edu
  Blackland Research & Extension Center
  http://www.blackland.tamu.edu

- **Laura Mula:** lmula@uniss.it
- **Martina Buffa**
- **Luigi Ledda:** lledda@uniss.it

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