WP7 Impact of External Drivers

IRMCo, Malta

PLEIADeS 3rd Plenary Meeting
10-13 March 2009, Izmir, Turkey

D6e Framework for Impact Assessment

Reference Library of Long Term Projections

Step 1: selection of 'best available' climate change projections

Step 2: future scenarios on available water resources

Step 3: evaluation of climate change impact indicators (agro-climatological hazards: crop water stress, droughts & floods)

Step 4: comparative analysis with observations obtained directly from stakeholders (farmers, irrigation scheme associations etc.)

Step 5: formulation of management scenarios that may represent adaptation to changing climate conditions

Short to Medium Term Impacts of Climate Variability & Possible Adaptation Strategies

D11 Impact of Climate Change

Impact scenarios in each pilot derived from combined interpretation of:

1) Construction of a **Reference Library of Long-term Climate Change Projections** for three time horizons: 2010-2039, 2040-2069 and 2070-2100

2) Historical Trend Analysis of monthly precipitation and temperature records:
- identification of possible trends on an annual and a seasonal basis
- identification of possible shift in aridity index
- obtain estimate of rainfall and temperature for the year 2025

3) Drought Analysis using several drought indices:
- Decile Indices (DI)
- Standardized Precipitation Index (SPI)
- Reconnaissance Drought Index (RDI)

=> **Summary of findings** presented in homogenized format for each pilot, including a qualitative statement on future evolution in dependency between the stakeholders at the river basin, irrigation scheme and farm level respectively

=> **Detailed results** for each pilot in D11 Annexes **1**, **2** and **3**

D12 Impact of Policies

Designed to include:

- a comparative analysis with observations obtained from stakeholders

Questionnaires addressed respectively to

(a) River Basin Authorities/Irrigation Advisory Services

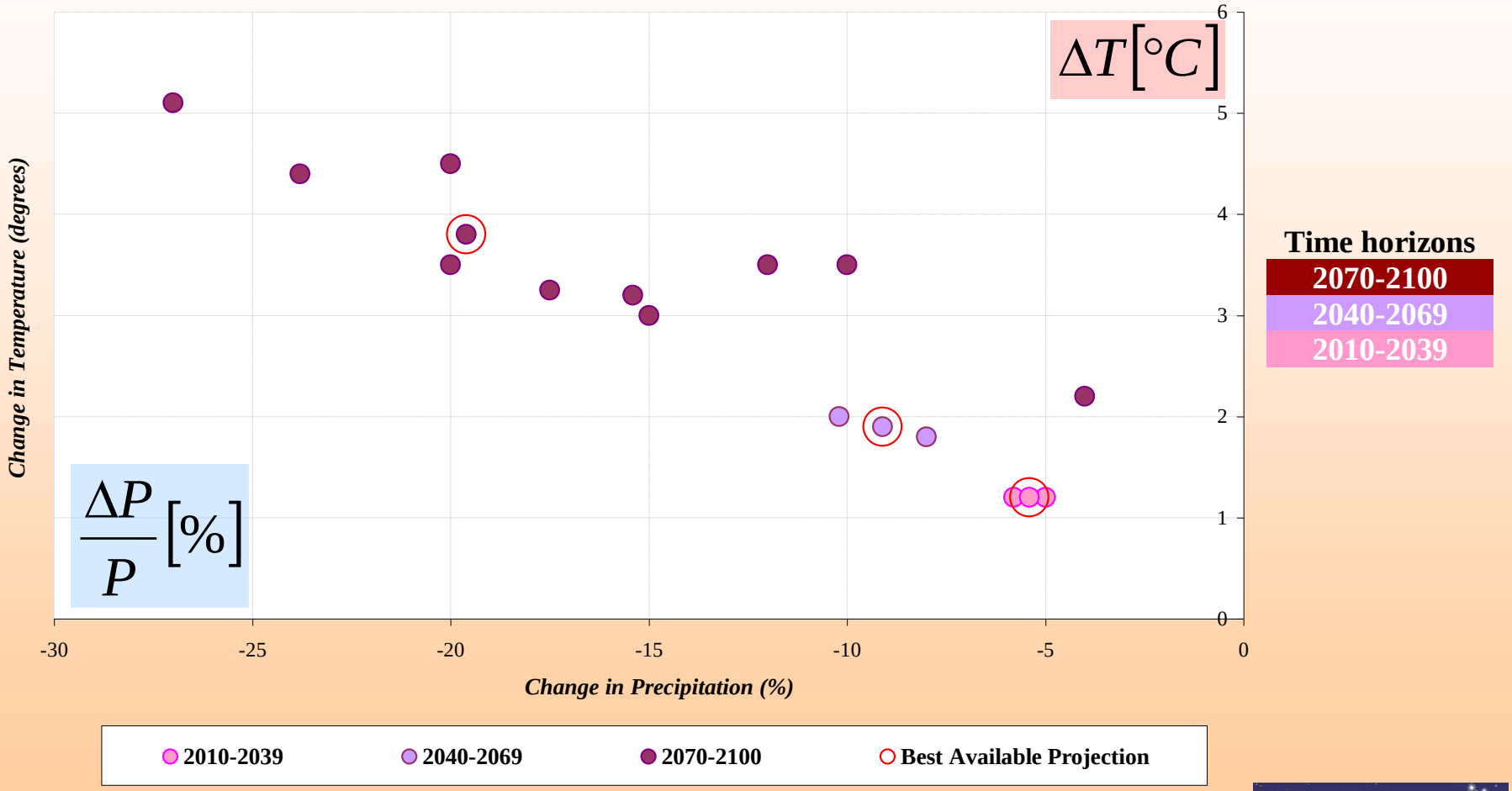
(b) Farmers

issued to all pilots to collect the 'knowledge' held by stakeholders

- formulation of management scenarios that may represent adaptation to changing climate conditions

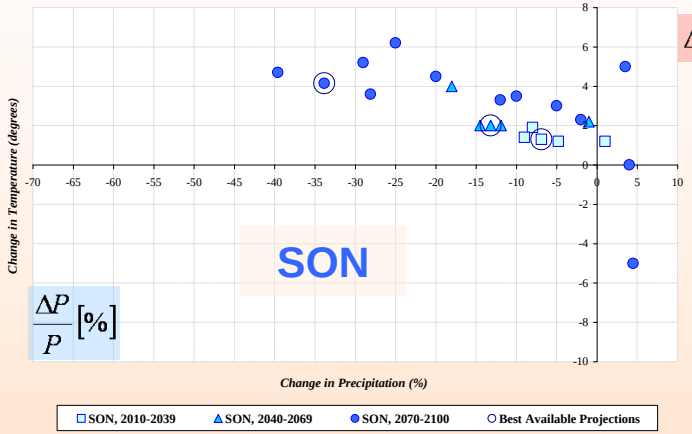
Results-1: Reference Library of Climate Change Projections

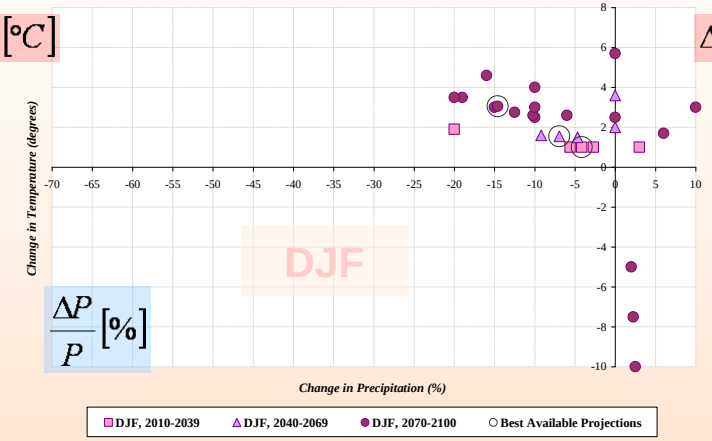
Range and 'Best Available' Annual Projections for Gediz Basin, Turkey



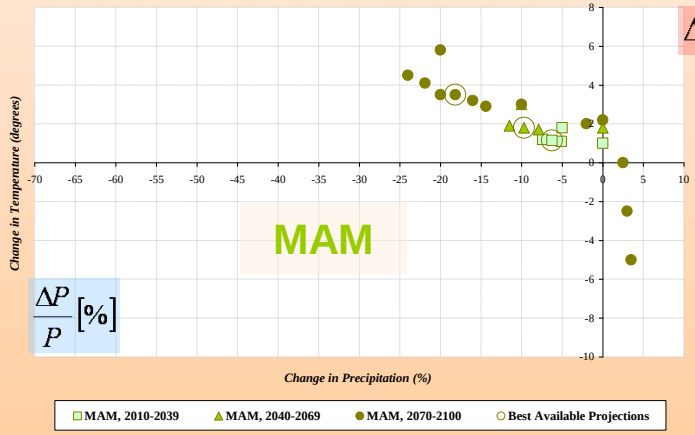
Results-1: Reference Library of Climate Change Projections

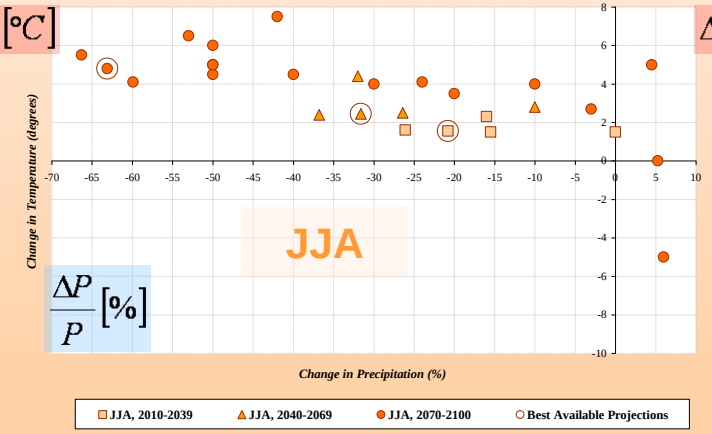
Range and 'Best Available' Seasonal Projections for Gediz Basin, Turkey





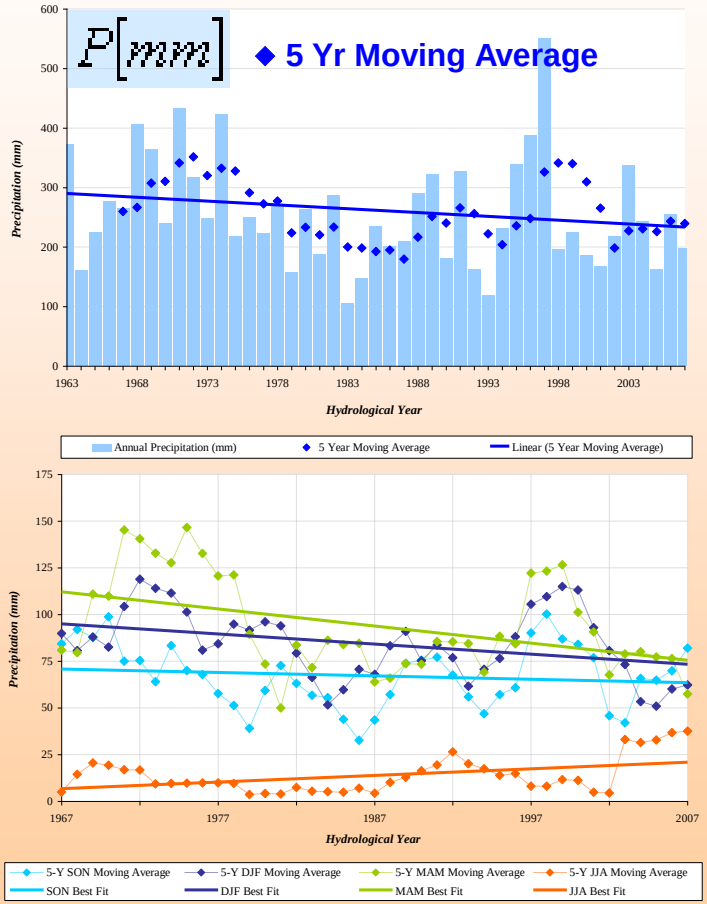
Time horizons
- □ 2070-2100
- △ 2040-2069
- ○ 2010-2039

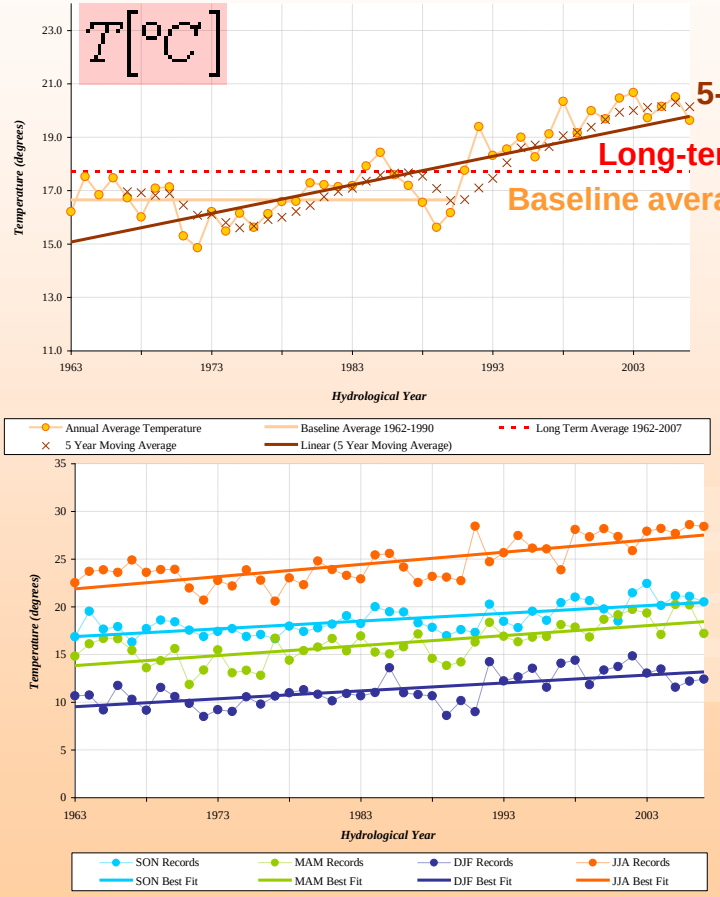




Results-2: Historical Trend Analysis

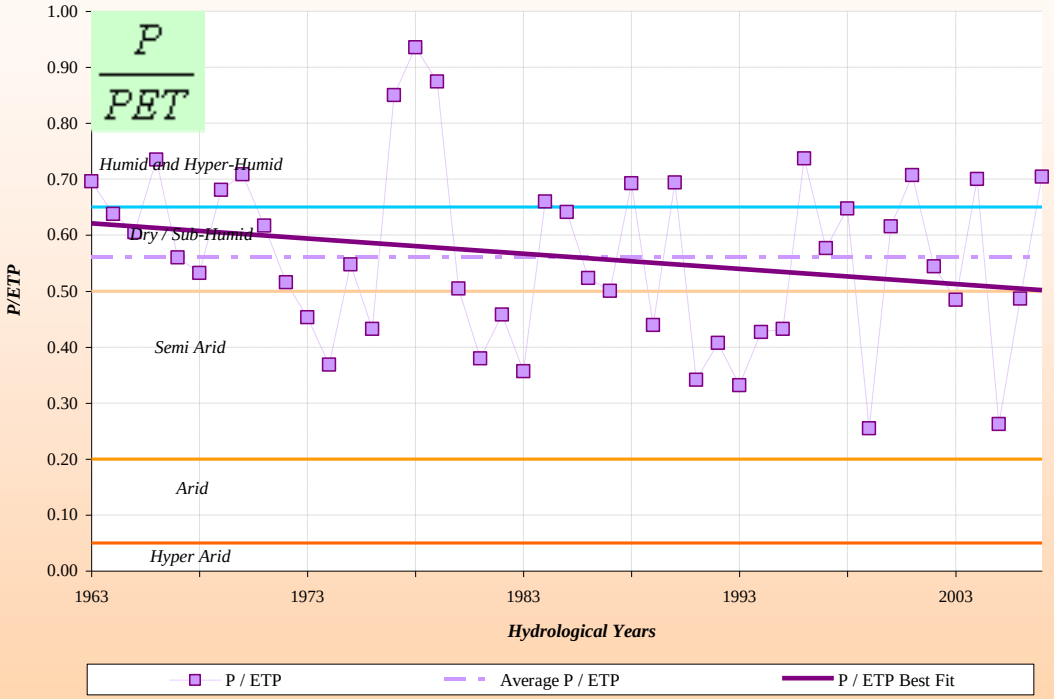
Annual and Seasonal Trend Analysis for Tensift Basin, Morocco





Results-2: Historical Trend Analysis

Aridity Index Analysis for Guadiana Basin, Spain

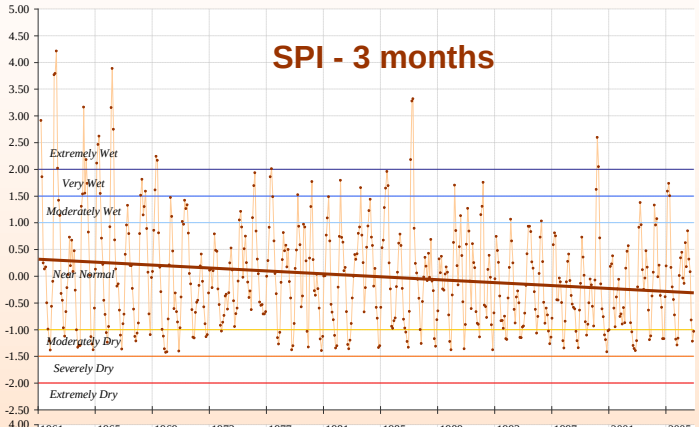


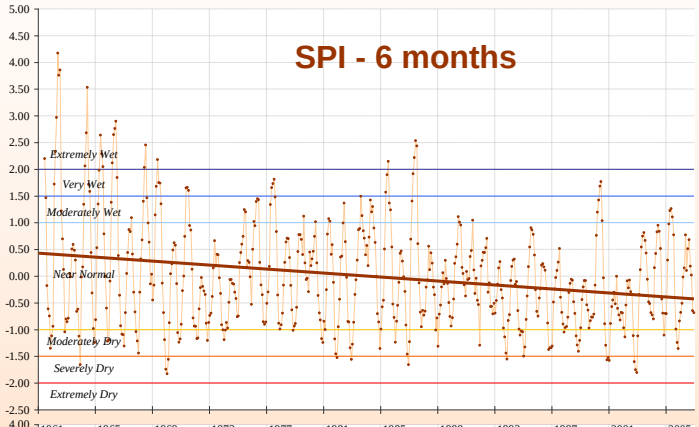
$$AI_i = \frac{P_i}{PET_i}$$

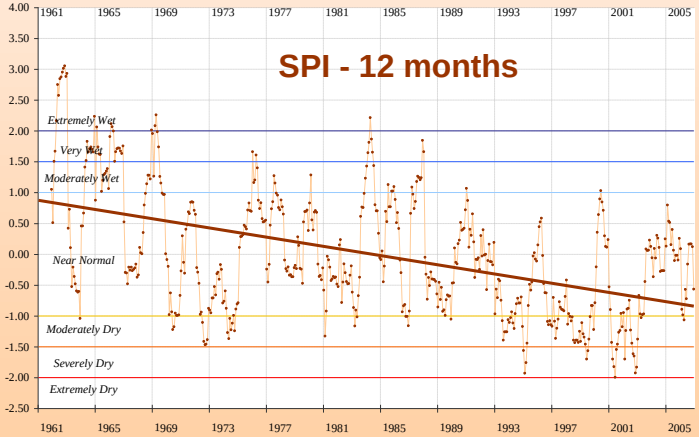
Classification	Aridity Index
Hyperarid	AI<0.05
Arid	0.05<AI<0.20
Semi-arid	0.20<AI<0.50
Dry sub-humid	0.50<AI<0.65

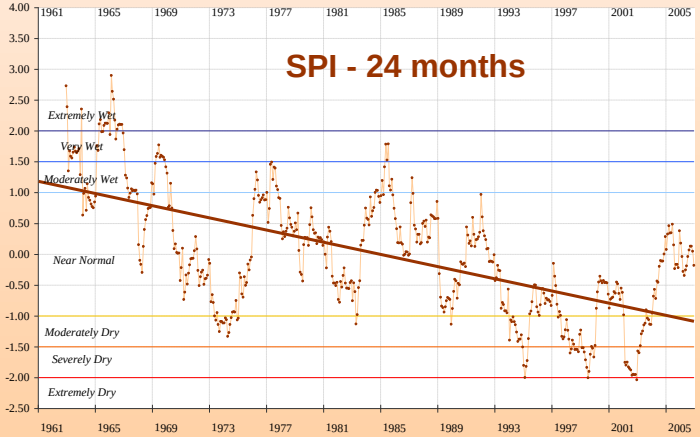
Results-3: Drought Analysis

Standardized Precipitation Index (SPI) analysis for Cuga Basin, Italy







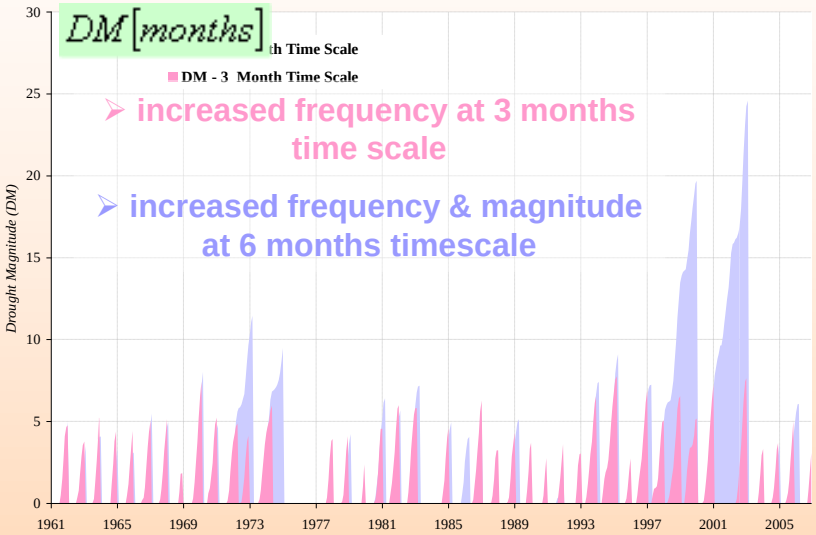


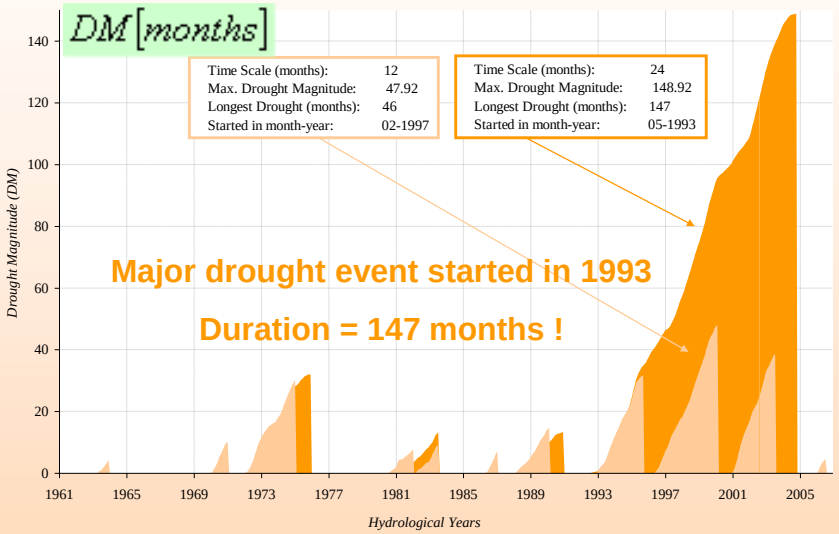
$$SPI = \frac{X_{ij} - X_{im}}{\sigma}$$

Drought Classes	SPI Values
Extremely Wet	>2.00
Very Wet	1.50 to 1.99
Moderately Wet	1.00 to 1.49
Near Normal	-0.99 to 0.99
Moderately Dry	-1.00 to -1.49
Severely Dry	-1.50 to -1.99
Extremely Dry	<-2.00

Results-3: Drought Analysis

Drought Magnitude (DM) analysis for Cuga Basin, Italy





3 and 6 months time scales are linked to short-term drought conditions and provision of early warning

12 and 24 month time scales are linked to long-term drought conditions affecting river flows and groundwater storage

$$DM = -\left(\sum_{j=1}^{j=x} SPI_{ij}\right)$$

Mc Kee (1993)

Conclusions-1: Comparison of projections

Pinios, GR

Time Step	Baseline Scenario (1960-1990)		2025 Projection based on Historical Trend Analysis		'Best Available' Climate Change Projection 2025	
	P (mm)	T (°C)	P (mm)	T (°C)	P (mm)	T (°C)
Y	421	15.7	385	15.2	379	17.7
DJF	124	6.3	112	6.1	99	8.2
MAM	107	14.4	115	14.1	102	16.2
JJA	59	26.0	59	24.7	49	28.3
SON	133	16.3	107	15.7	122	18.2

Gediz, TR

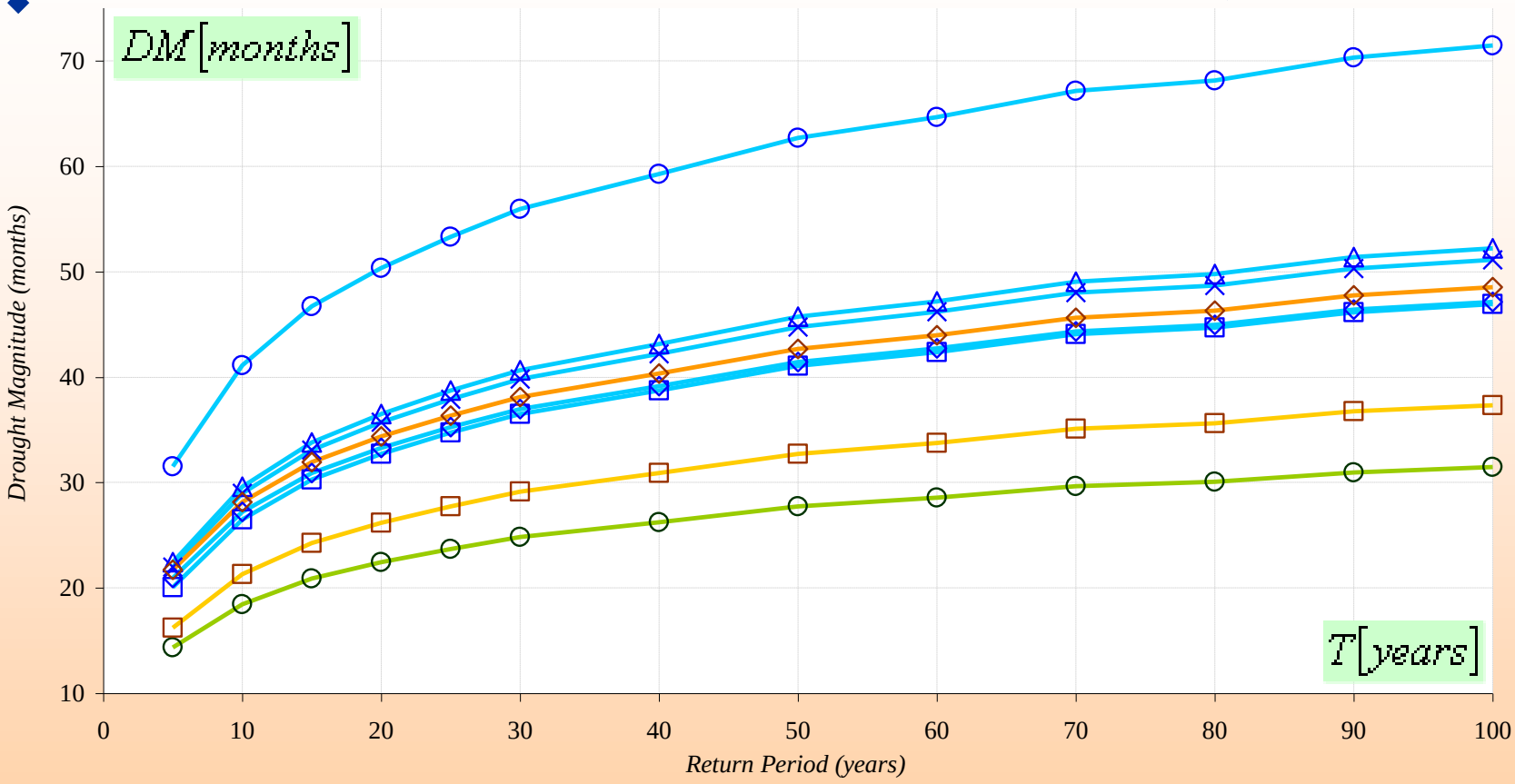
Time Step	Baseline Scenario (1960-1990)		2025 Projection based on Historical Trend Analysis		'Best Available' Climate Change Projection 2025	
	P (mm)	T (°C)	P (mm)	T (°C)	P (mm)	T (°C)
Y	551	16.6	383	17.4	521	17.8
DJF	289	8.6	159	8.4	277	9.6
MAM	131	15.1	101	15.9	123	16.3
JJA	14	25.4	0	27.3	11	26.9
SON	117	17.2	126	18.0	109	18.5

Both types of projection agree on decreased precipitation and increased temperature

Projected reduction in precipitation based on Historical Analysis is both stronger (TR) and weaker (GR) compared with

'Best Available' Climate Change Projections which 'consistently' foresee higher increases in temperature

Conclusions-2: Comparison of Drought Analysis findings



$$\widehat{DM}_T = \overline{DM} + K(T)s_{DM}$$

$$K(T) = -\frac{\sqrt{6}}{\pi}\left(0.5772 + \ln\left(-\ln\left[\frac{T(X)-1}{T(X)}\right]\right)\right)$$

Conclusions - 3: Feedback from stakeholders in pilots

River basin authorities ⟺ Irrigation Advisory Services ⟺ Farmer Associations

	Uplink to River Basin		↖ Irrigation Scheme Scenario		↘		Downlink to Farm Level
Pilot Zone	**Dependence on River Basin Level**	**Renewable Water Resources**	**Long-term drought conditions**	**Inter-Annual Variability**	**Seasonal changes in rainfall pattern**	**Short-term drought conditions**	**Dependence on Irrigation Scheme AS**
Pinios, Greece	Increased dependence very likely	Significant reduction expected	Increased frequency observed since 1984	Generally low. Possible minor shift to semi-arid conditions	Marked reduction of rainfall in most pluvial season (SON)	Very high increase in frequency observed	Increased dependence very likely
Gediz, Turkey	Increased dependence very likely	Significant reduction expected	Major long-term droughts observed only in last two decades	High. Marked shift to Semi-arid conditions	Very significant reduction in rainfall in DJF (most pluvial) and MAM season	Moderate increase in frequency. Extremely high increase in magnitude and duration	Increased dependence very likely