



IV international workshop on hydrological extremes
From prediction to prevention of hydrological risk
in Mediterranean countries



*University of Calabria, Soil Protection Dept.,
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**REGIONALIZATION OF DROUGHT IN
NORTHERN ALGERIA USING THE
STANDARDIZED PRECIPITATION INDEX (SPI)
(1936-2010)**

Sabrina TALBI

*National High School of Hydraulic (ENSH)
Blida, Algeria*

CONTEXT

Drought: naturel phenomenon that occurs when precipitation is significantly lower than normal.

Low precipitation can lead to severe hydrological deficit

**SERIOUS PROBLEMS FOR AGRICULTURE,
INDUSTRY, DRINKING WATER SUPPLY...**

CONTEXT

Annual water surface potential in Northern Algeria:

- *Late 70's: 13,5 Billion m³*
- *1980-1990: 12,4 Billion m³*
- *Currently : 10 Billion m³*

CONTEXT

Decrease of rainfall since the mid-70's

Algeria has experienced a significant drought period of about 25 years old

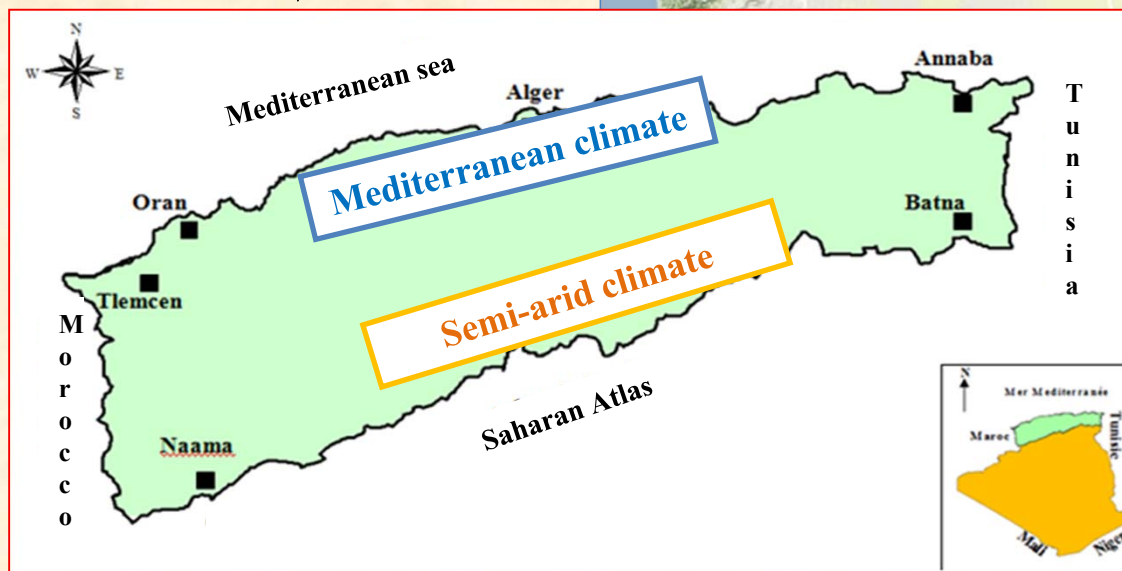
Rainfall Deficit : 20-30% (ANRH)

ISSUE/OBJECTIVE

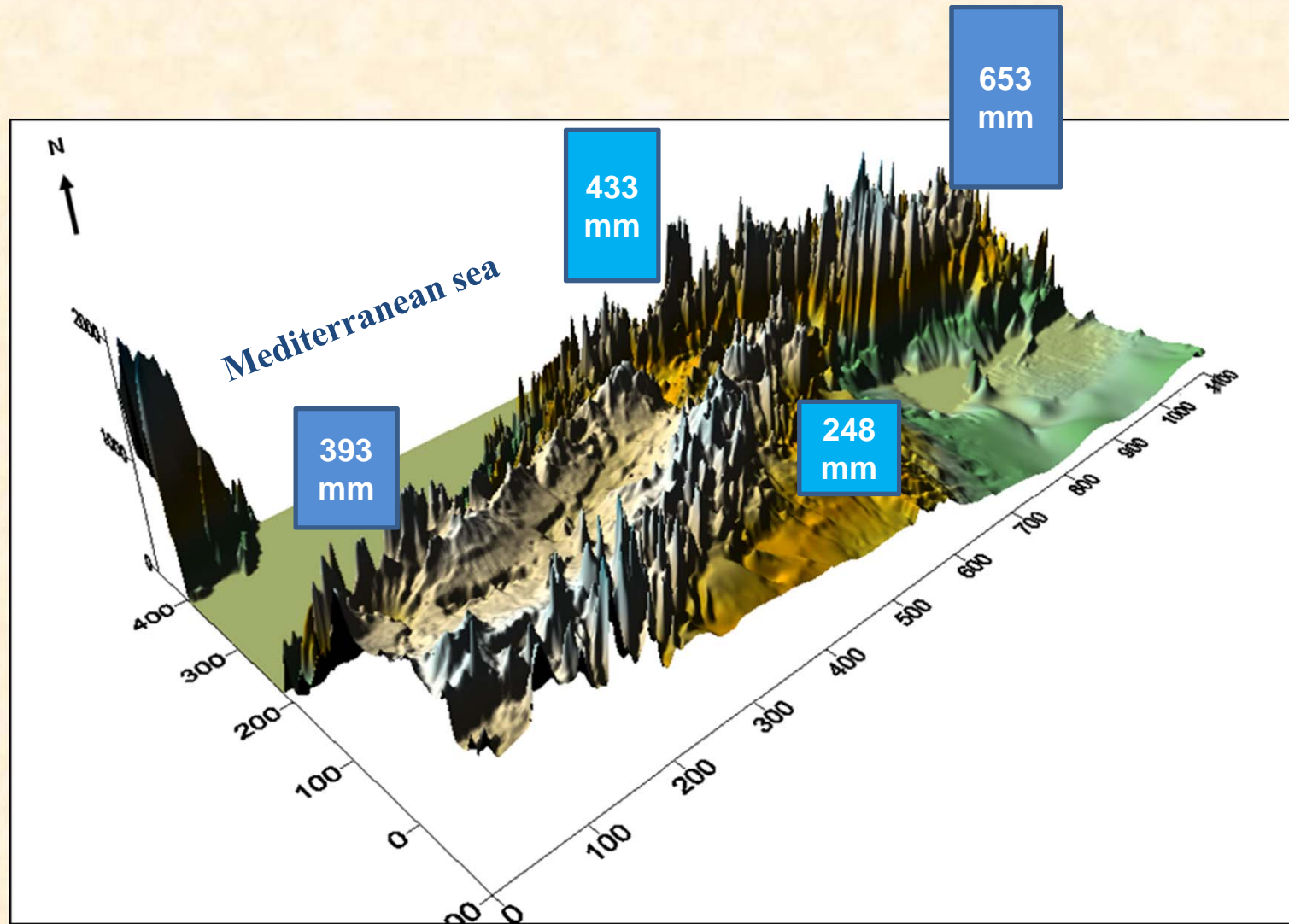
**Spatial and temporal evolution of drought in
Northern Algeria during the period
1936/1937-2009/2010 ???**

Characteristics of Study area

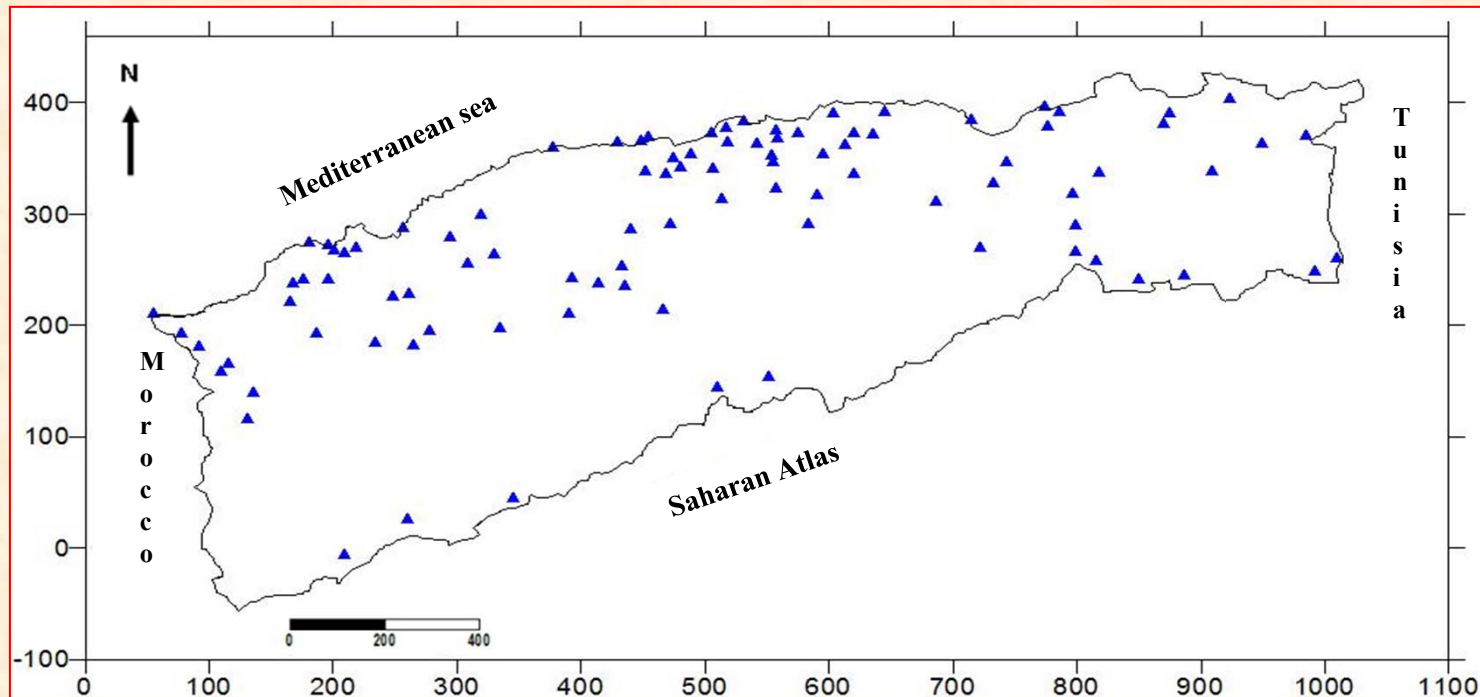
Study area



Rainfall variability in Northern Algeria



Rainfall Network



102 rainfall gauging stations

METHODS

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graph TD; A[METHODS] --> B[MONITORING DROUGHT]; A --> C[REGIONALIZATION OF DROUGHT (SPI)]; B --> D[Standardized precipitation index (SPI)]; C --> E[Rotated Principal Component Analysis (RPCA)];
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The diagram is a flowchart titled 'METHODS' in a light green box. It branches into two orange boxes: 'MONITORING DROUGHT' and 'REGIONALIZATION OF DROUGHT (SPI)'. Below 'MONITORING DROUGHT' is a blue arrow pointing to a yellow box 'Standardized precipitation index (SPI)'. Below 'REGIONALIZATION OF DROUGHT (SPI)' is a blue arrow pointing to a yellow box 'Rotated Principal Component Analysis (RPCA)'.

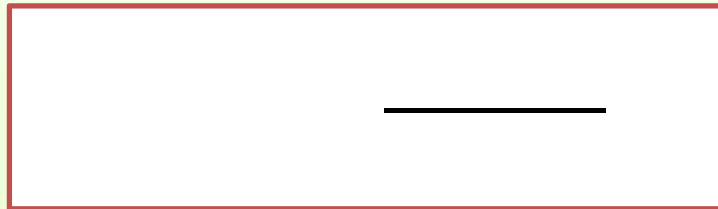
MONITORING DROUGHT

**Standardized
precipitation index
(SPI)**

REGIONALIZATION OF DROUGHT (SPI)

**Rotated Principal
Component Analysis
(RPCA)**

Standardized Precipitation Index (SPI)



SPI_i : Standardized precipitation index of the year (i)

x_i : Rainfall precipitated during the year (i)

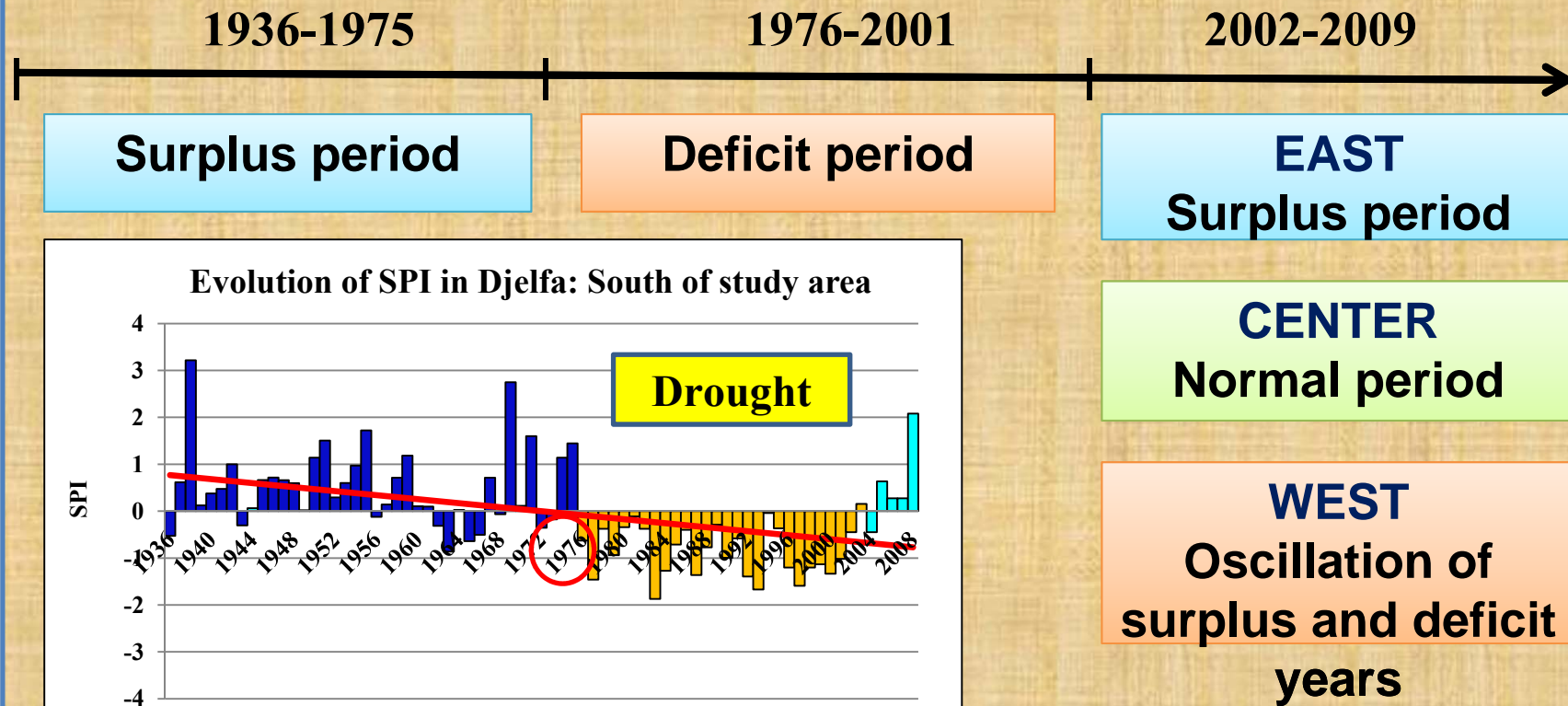
\bar{X}_i : Average inter-annual rainfall during the period of study (1936-2010)

σ_i : Standard-deviation of average Inter-annual rainfall

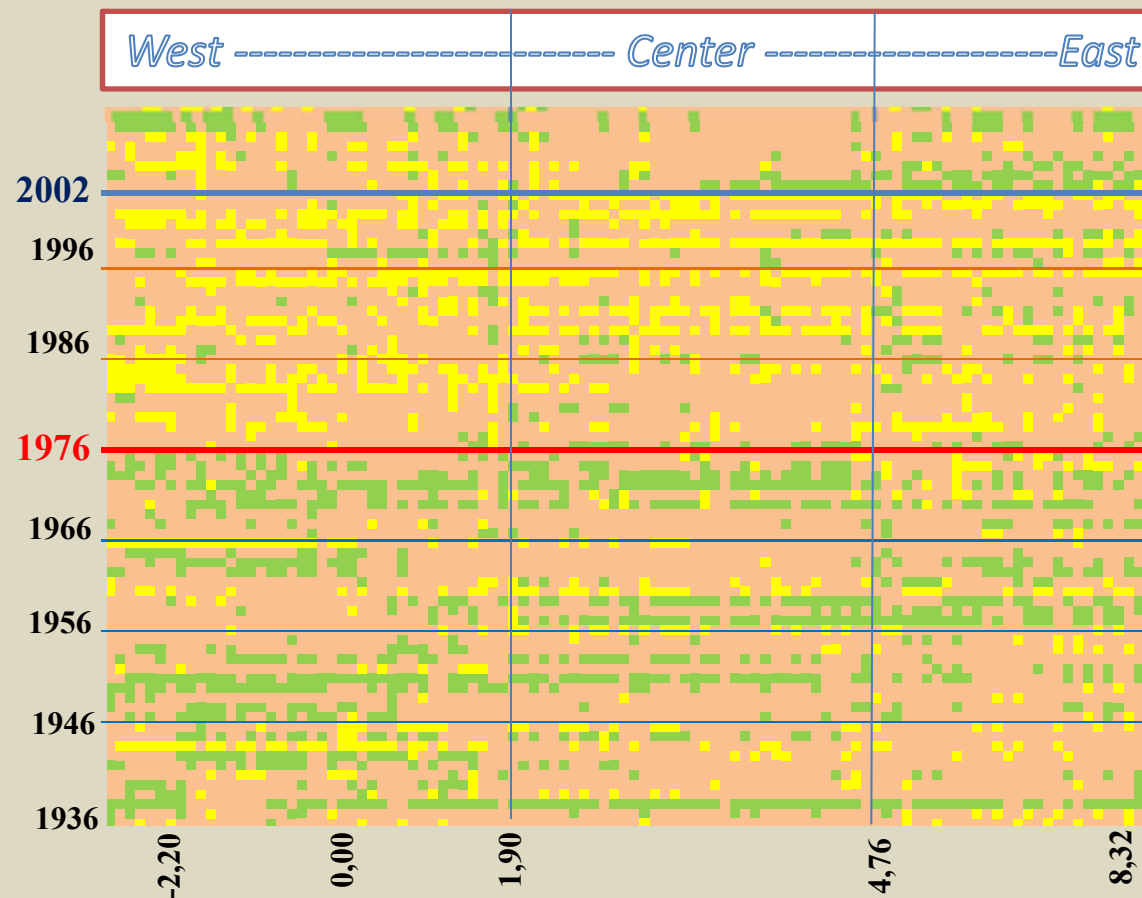
SPI values	Category
≥ 2	Extremely wet
$1,5 \leq SPI < 2$	Very wet
$1 \leq SPI < 1,5$	Moderatly wet
$(-) 1 < SPI < 1$	Near normal
$(-) 1,5 < SPI \leq (-) 1$	dry
$(-) 2 < SPI \leq (-) 1,5$	severly dry
$SPI \leq (-) 2$	Extremely dry

Results : SPI (annual scale)

❖ Three periods



Results : SPI (annual)



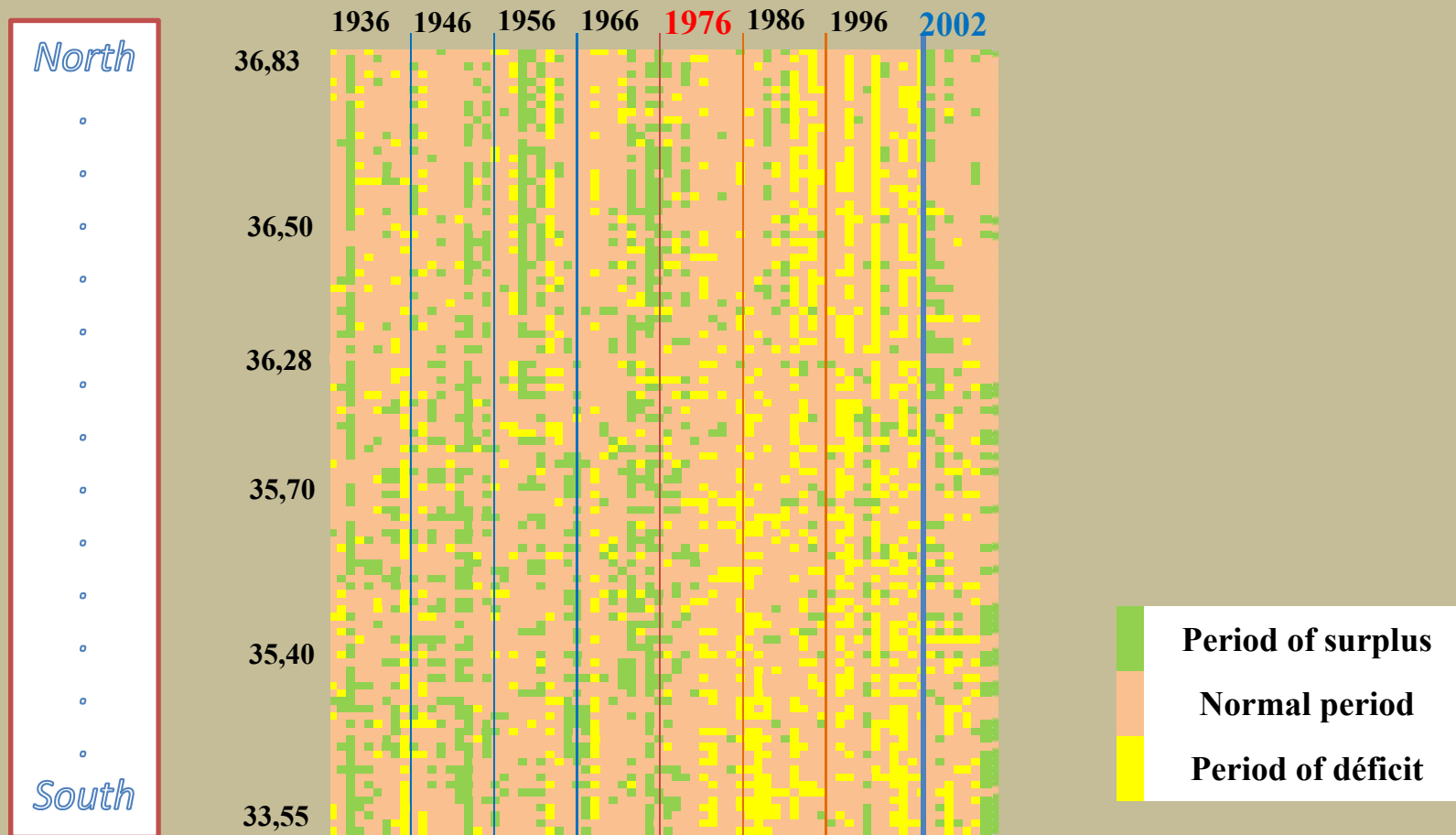
Deficit years:
1987,1988,1992,1993

**Very dry years in
West:**
1998,1999

**Very dry years in
Center and East:**
2000,2001

*Representing of surplus and deficit periods according to
the longitude of rainfall gauging stations*

Results : SPI (annual)



Representing of surplus and deficit periods according to the latitude of rainfall gauging stations

REGIONALIZATION OF SPI

	<i>PC I</i>	<i>PC II</i>	<i>PC III</i>	<i>PC IV</i>
% Variance	17,65	13,38	7,52	16,07
% cumulative	17,65	31,04	38,57	54,64

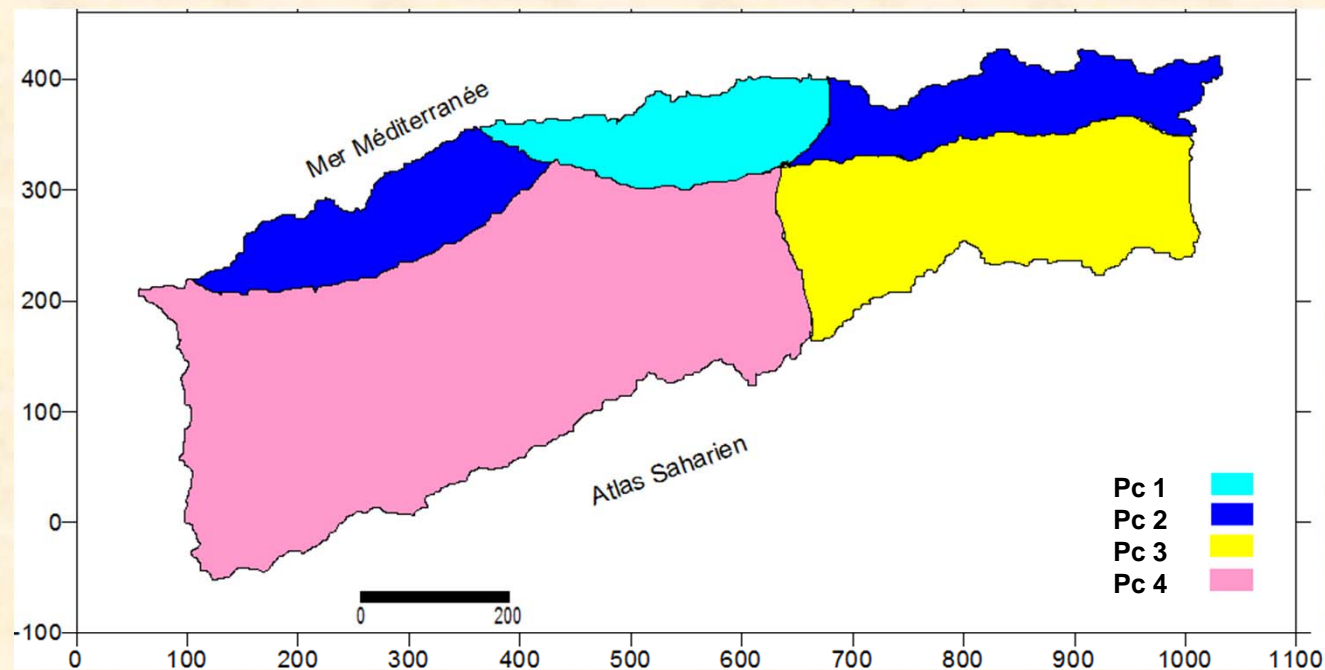
**Principal Component Analysis
after Varimax Rotation**

Regionalization of SPI (1936-2010)

West Coast

Central Coast

East Coast



**West+Central
highlands**

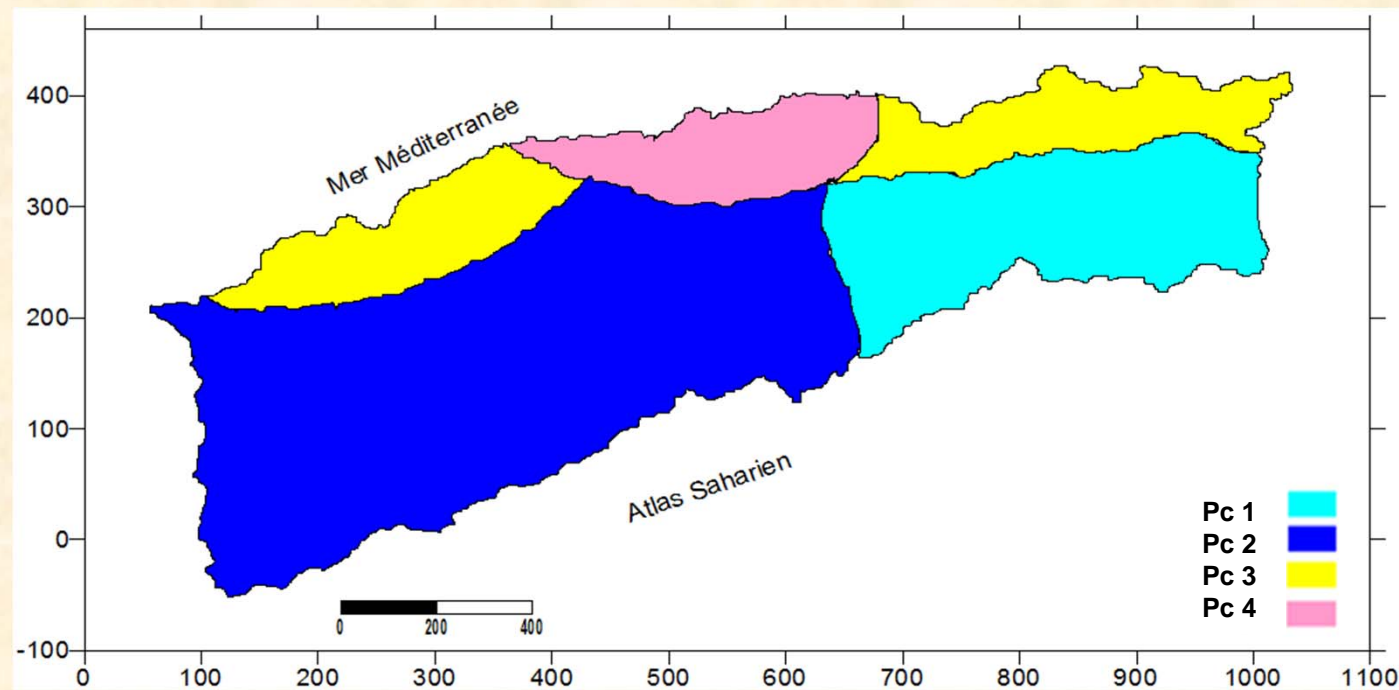
East highlands

Regionalization of SPI (1936-1975)

West Coast

Central Coast

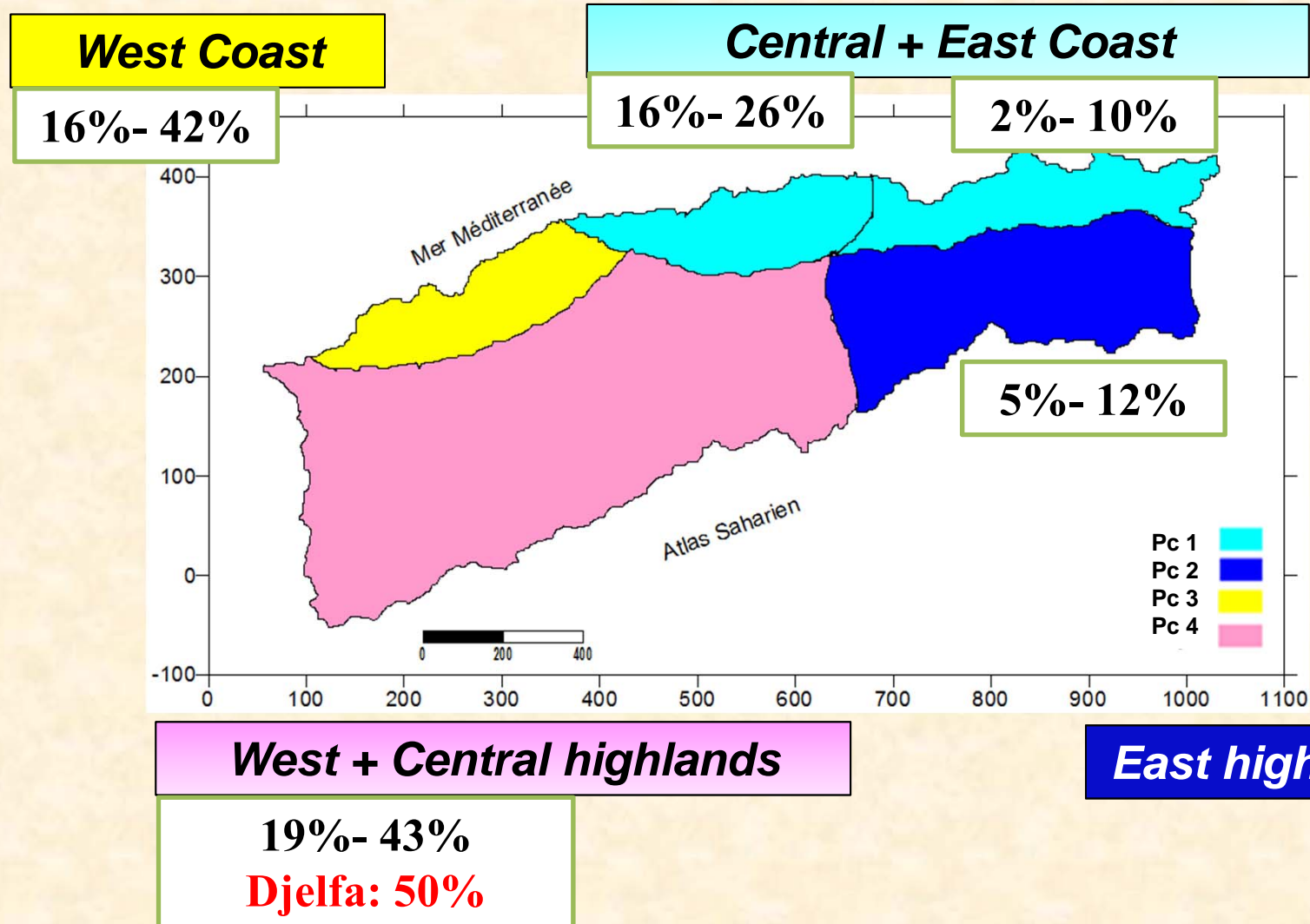
East Coast



**West + Central
highlands**

East highlands

Regionalization of SPI (1976-2001)

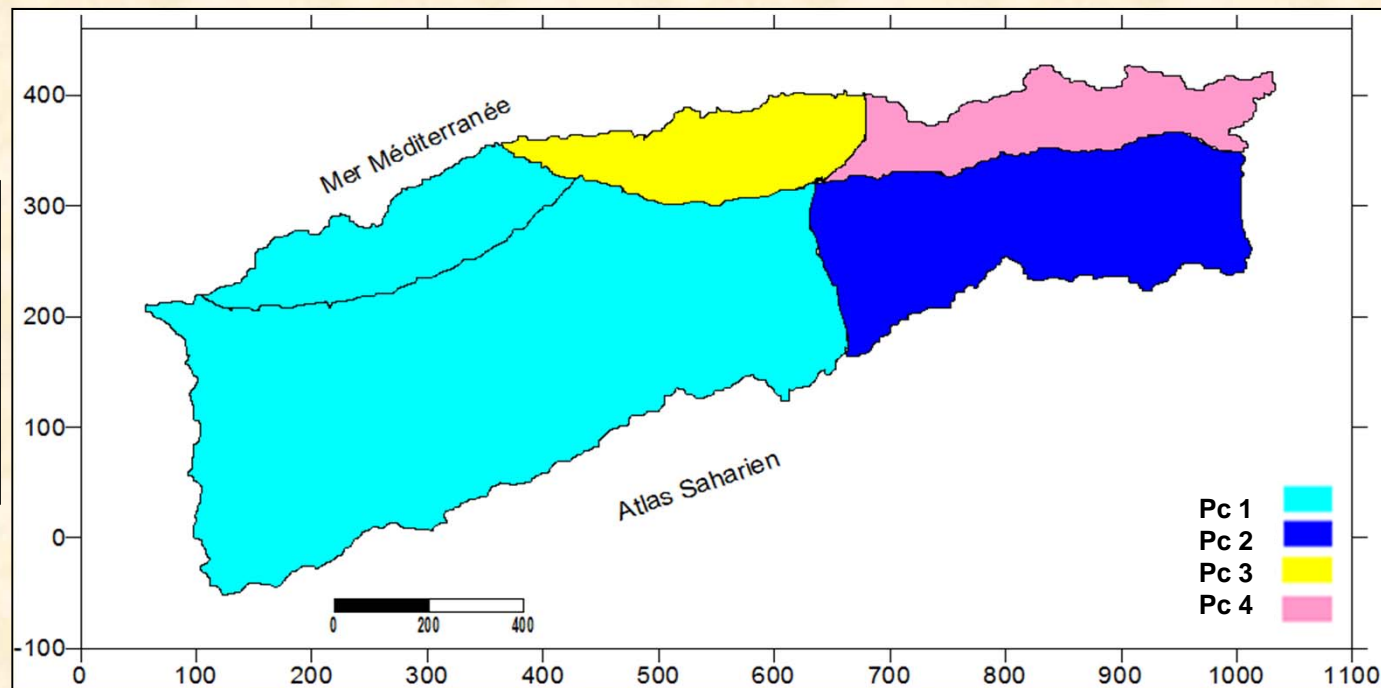


Regionalization of SPI (2002-2010)

Center Coast

East Coast

**North
Western
Coastal
+
Highlands**



East highlands

Conclusion

Study période: 1936-2010

**Monitoring drought
(SPI)**

3 periods :
Surplus: 1936-1975
Deficit: 1976-2001
2002-2010:
surplus in East
Normal in Center
oscillation of surplus and
deficit years in West

**Regionalization of
drought
(RPCA)**

5 regions:
**West-Central Highlands: most
important and severe drought**
West coast: important drought
**Center coast: less severity of
drought**
East Highlands: slight drought
East coast : slight drought

Conclusion

Northern Algeria is vulnerable to drought

Different degree of severity from a region to another

Water resources management

Mobilize more water resources in the West than the East



Thank you for your attention