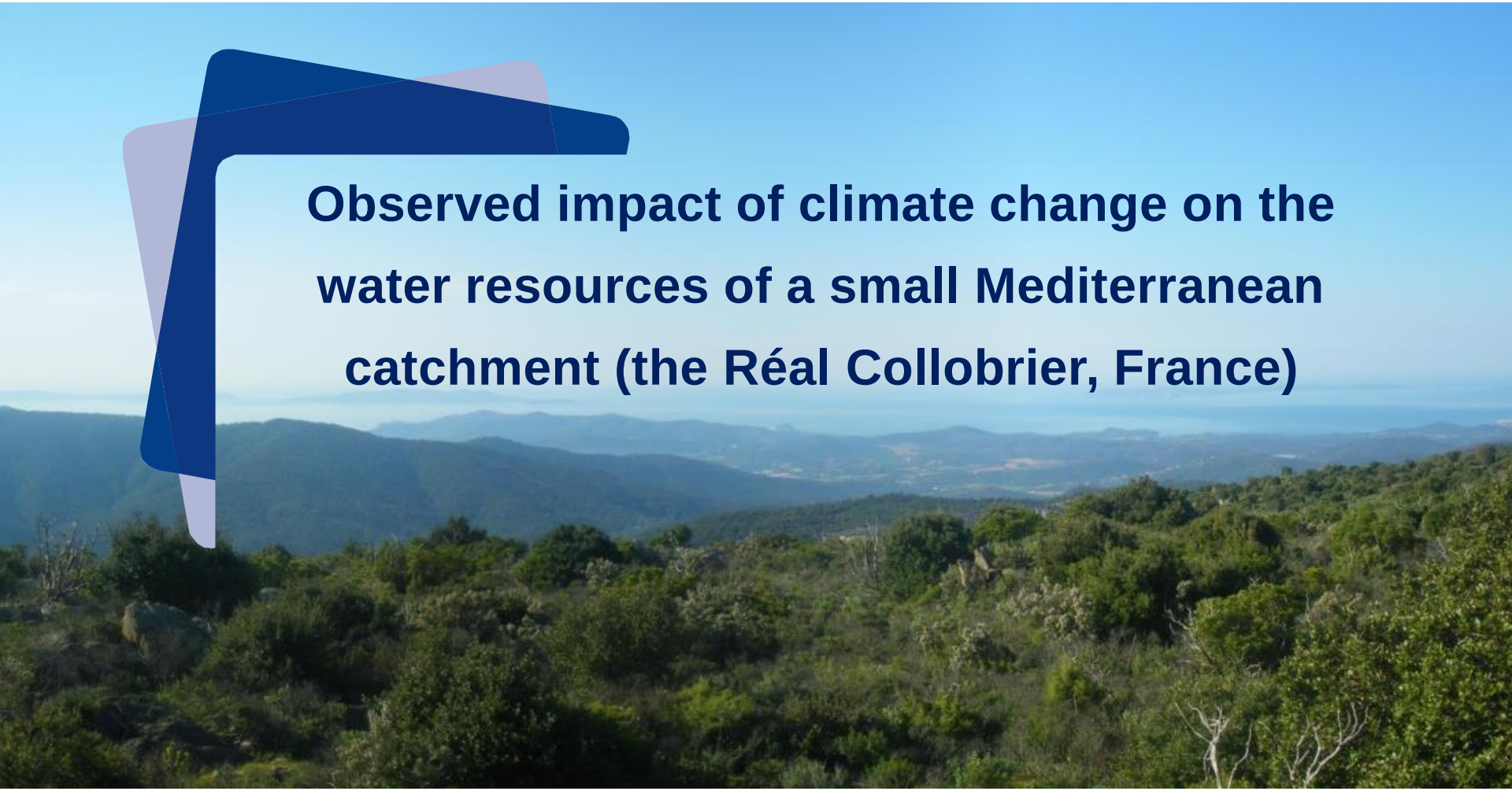

Observed impact of climate change on the water resources of a small Mediterranean catchment (the Réal Collobrier, France)

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Generality about the basin

Hydrological observatory managed since 1966.
Benchmark site for regional hydro-climatology.
Evaluation long-term hydrological Mediterranean trends.

Saint-Tropez

Plaine des Maures

Collobrières

Localization

- VAR department, in the Massif des Maures
- Area of 70 km²
- Altitude ranging from 80 m to 770 m from the west to the east

Hydrography

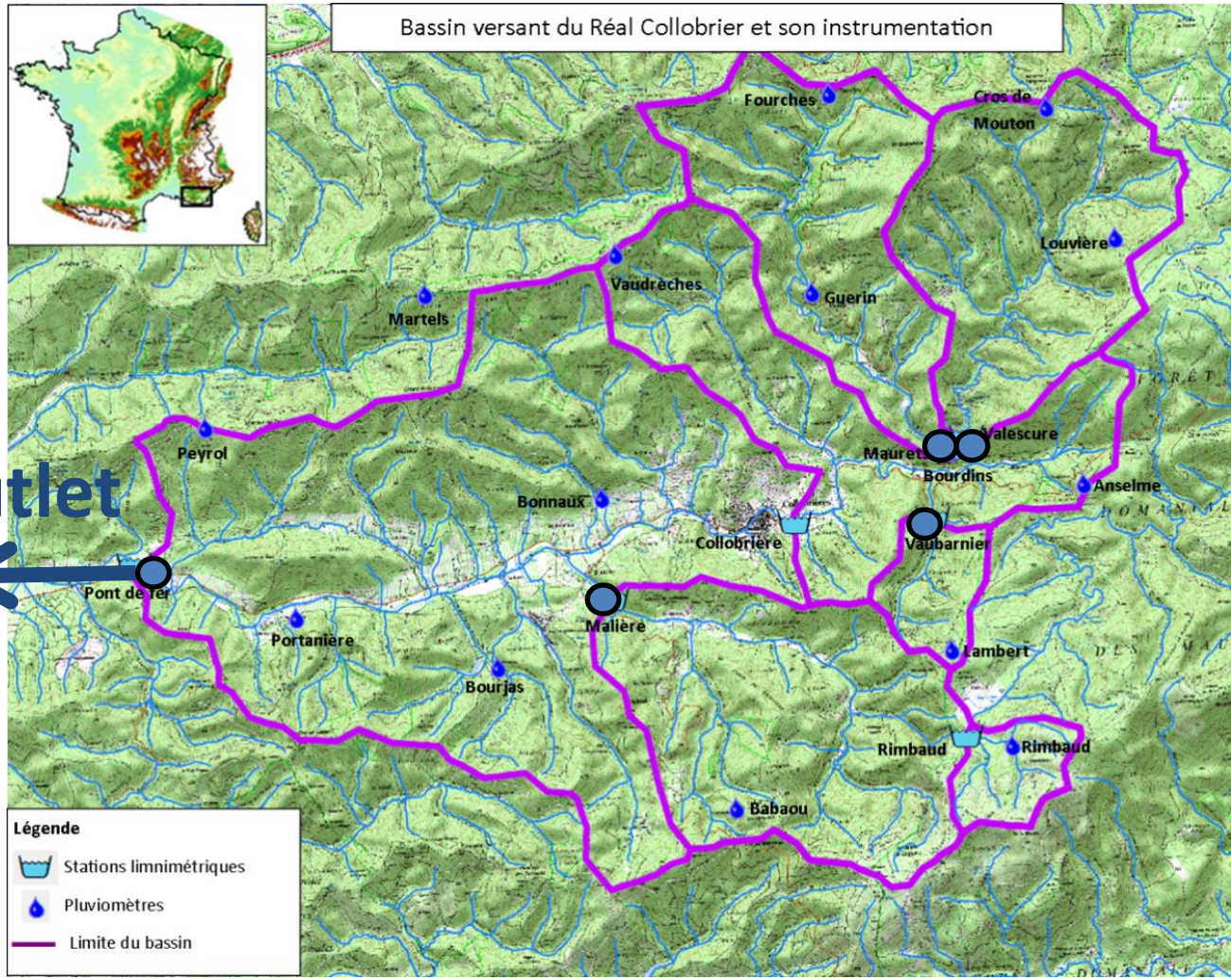
- Tributary of Réal Martin, itself a tributary of the Gapeau

Land use

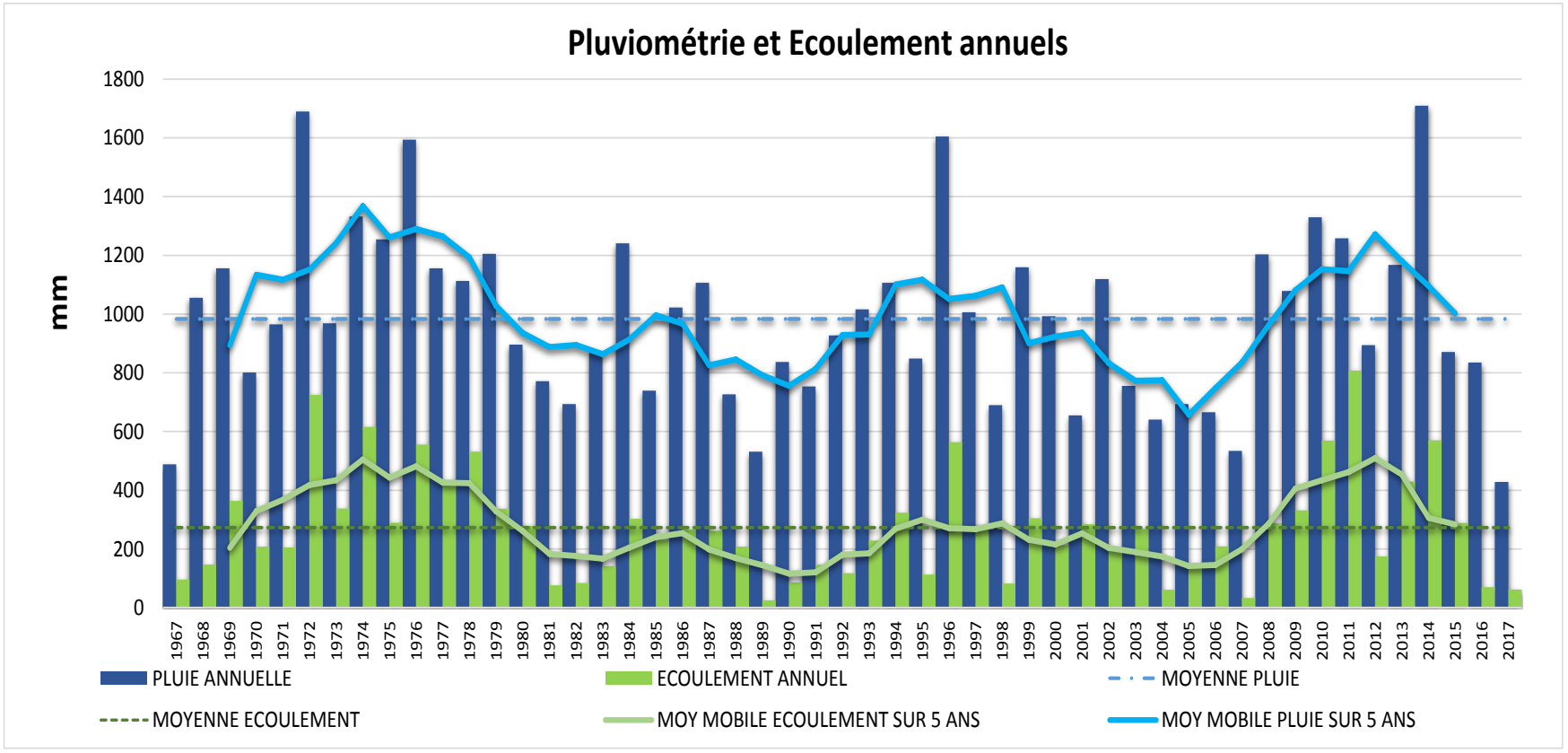
- Forest cover on relief
- Vineyards downstream
- Town of Collobrières

Measurement

Outlet



51 year statistics	Avg.	Min.	Max.
Rainfall (mm/y)	984	428	1709
Discharge (mm/y)	273	25	807
Average rainfall for rainfall events > 20 mm/d.	41	29	56
Number of days with discharge lower than 4. l/s (Q20%) (d)	73	0	173



Climate trends : Variables and methods

Name		Description
Wet days - CWD*		Number of days with Rainfall > Threshold
Dryer days CDD*		Number of days with rainfall < Threshold
Longer dry period - Max CDD*		Number of days of the longer period with rainfall < Threshold
Intensity of daily Rain > Threshold - INT		Mean of the daily rainfall > threshold
DrySL*		Mean lenght of periods with rainfall < threshold
Max Sum1D, Max Sum3D, Max Sum5D		Annual maximum of 1D, 3D or 5D rainfall
SPI		Standardized precipitation index
SFI		Standardized flow index

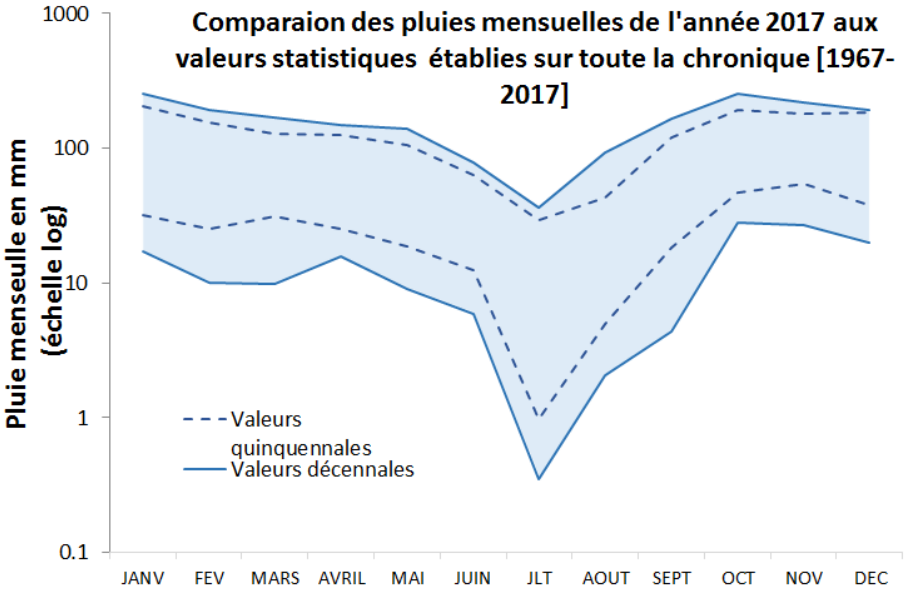
- Thresholds : 2, 5, 10, 20 mm/d
- Tendencies are calculated usinfg the Sen's slope.
- The significativity is assessed using the Man-Kendall test.
- Period 1967-2017 (51 year period)

Trends : annual variables

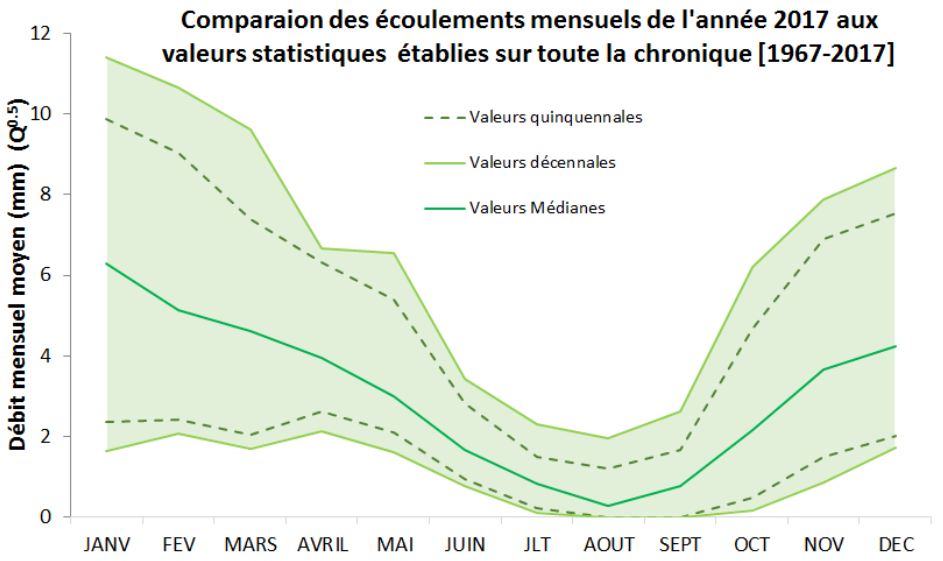
Variable	Tendency	Significativity
Mean Rainfall	-1.3 to -5.2 mm/y	No
Discharge at the Outlet	-1.1 mm/y	No
Discharge at the upper sub-basins	-3.2 to -4.0 mm/y	Yes for 3 basins (10%)

	2mm threshold	5 mm threshold	10 mm threshold	20 mm threshold
CWD	↓↓	↓↓ (5%)	↓(10%)	
CDD	↑↑	↑↑	↑	
MaxCDD				
Intensity				↑
DrySL	↑↑	↑		↑
MaxSum1D				
MaxSum3D				
MaxSum5D				

Annual cycle of precipitation and streamflow



Rainfall

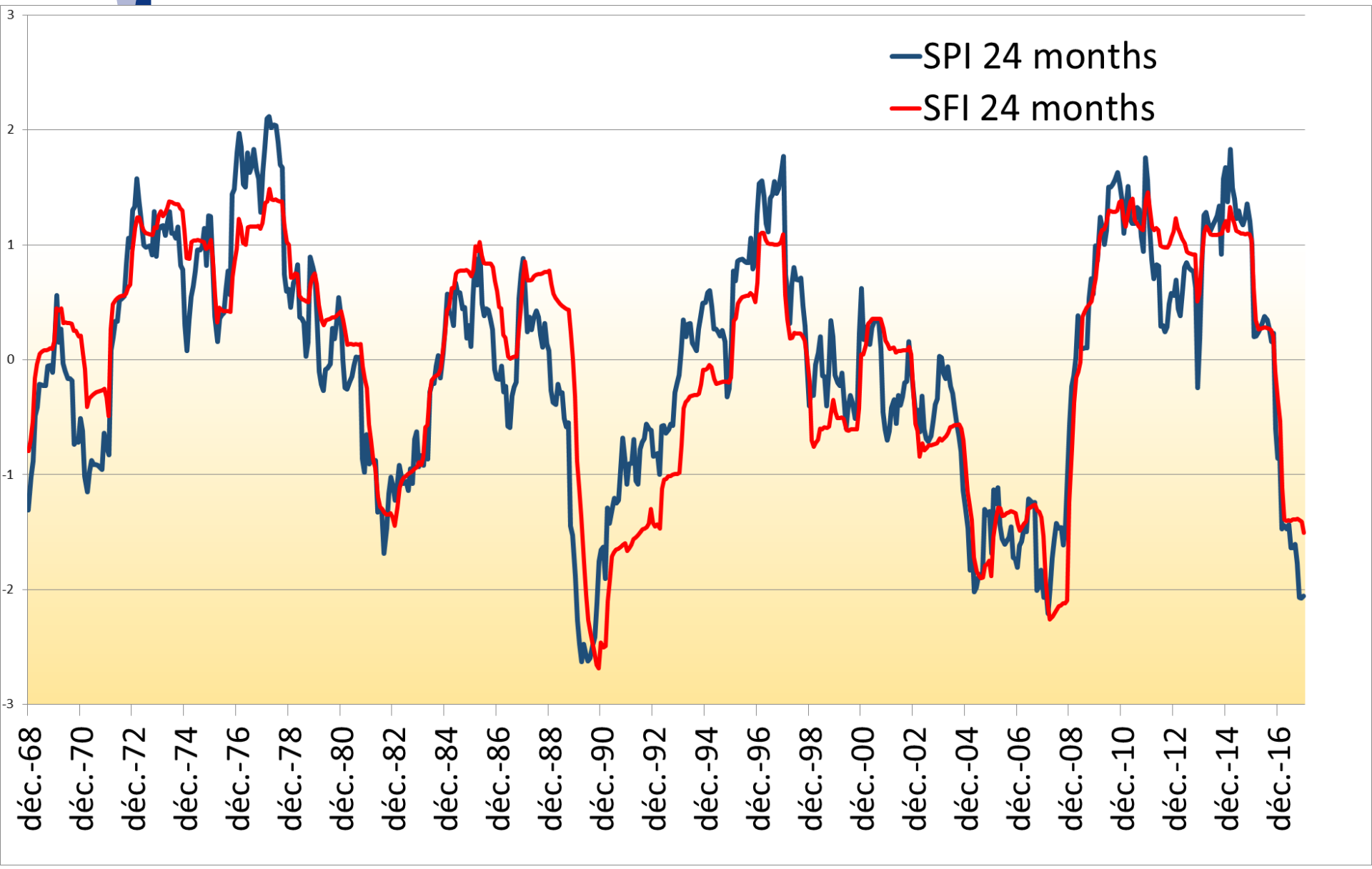


Streamflow

Monthly trends

Monthly rain	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Tend. (mm/m)		-1.2	-0.7 to -1.1					-0.2 to -0.3				

Monthly discharge	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Outlet			↓	↓↓								
Malière			↓↓	↓↓								
Valescure		↓	↓↓	↓↓								
Maurets			↓↓	↓↓	↓↓	↓						
Vaubarnier				↓↓		↓			↓↓			


SPI 24 months
SFI 24 months
3
2
1
0
-1
-2
-3
déc.-68
déc.-70
déc.-72
déc.-74
déc.-76
déc.-78
déc.-80
déc.-82
déc.-84
déc.-86
déc.-88
déc.-90
déc.-92
déc.-94
déc.-96
déc.-98
déc.-00
déc.-02
déc.-04
déc.-06
déc.-08
déc.-10
déc.-12
déc.-14
déc.-16

Trends on drought indexes

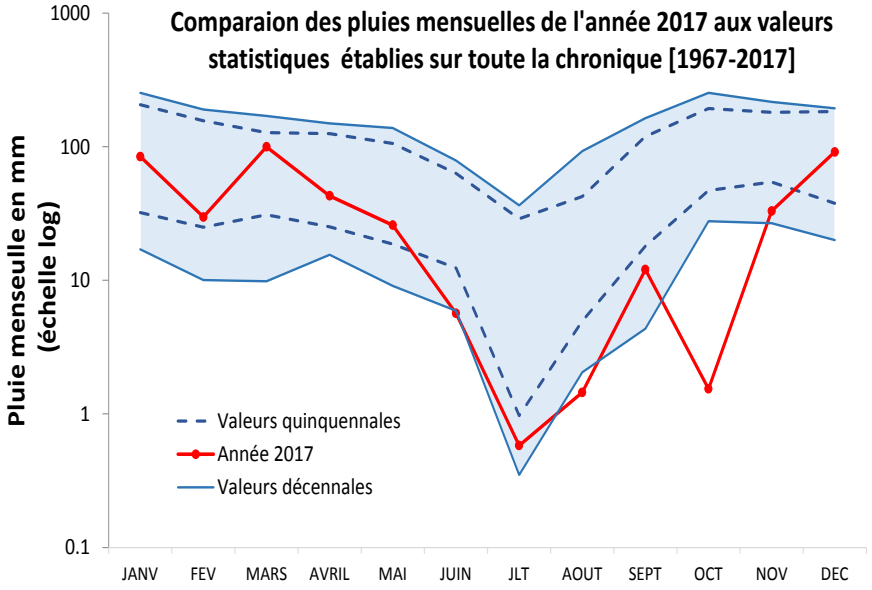
SPI	1 month	3 months	6 month	9 months	12 months	24 months
Signf. Tendency (15 rain gauges)	8/15	11/15	13/15	13/15	13/15	14/15

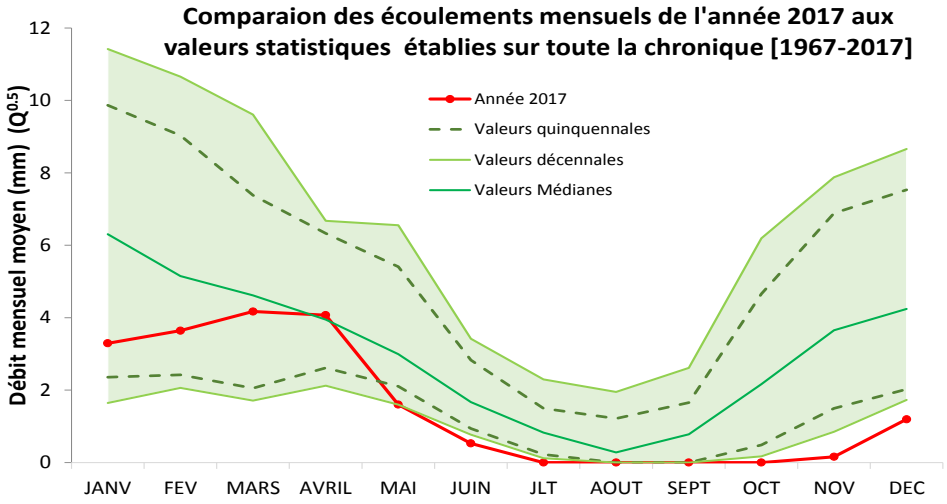
SFI	1 month	3 months	6 month	9 months	12 months	24 months
Outlet	↓				↓↓	↓↓
Malière	↓↓	↓↓	↓↓	↓↓	↓↓	↓↓
Valescure	↓	↓	↓↓	↓↓	↓↓	↓↓
Maurets	↓↓	↓↓	↓↓	↓↓	↓↓	↓↓
Vaubarnier	↓↓	↓↓	↓↓	↓↓	↓↓	↓↓

2017 an exceptionally dry year without high precipitation event

51 year statistics	Avg.	Min.	Max.	2017	
				Value	Comment
Rainfall (mm/y)	984	428	1709	428	Lower value
Discharge (mm/y)	273	25	807	62	Fourth lower value
Average rainfall for rainfall events > 20 mm/d. (mm/d)	41	29	56	29	Lower value
Number of days with discharge lower than 4. l/s (Q20%) (d)	73	0	173	173	Lower value

2017 monthly precipitation and streamflows





Conclusions

The 51-year dataset shows several significant trends :

- Slight tendency to increase in the intensity of the precipitation above 20 mm

- Increase of dry days and dry periods
- Precipitation decrease in March and April
- Decrease in annual, March and April streamflow
- The drought indexes evolution shows that the basin slightly moves toward a dryer state

Due to the temperature increase, the decrease in spring and annual discharge might be due both precipitation and evapotranspiration changes.

2017 is exceptional :

- lowest precipitation record, fourth lowest annual discharge, almost 6 month with no discharge. No high precipitation event

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