Effects of climate variability on vegetation phenology in spring: application to a wine growing area in Burgundy (France)

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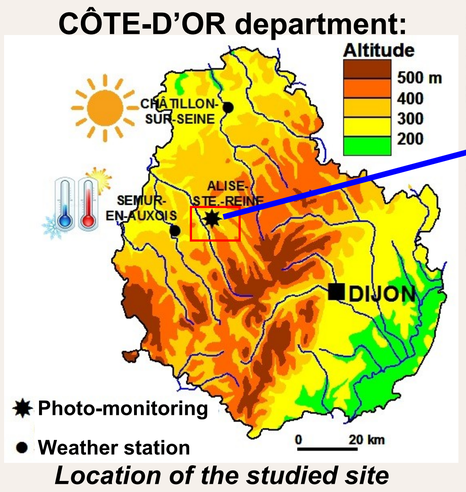
INTRODUCTION

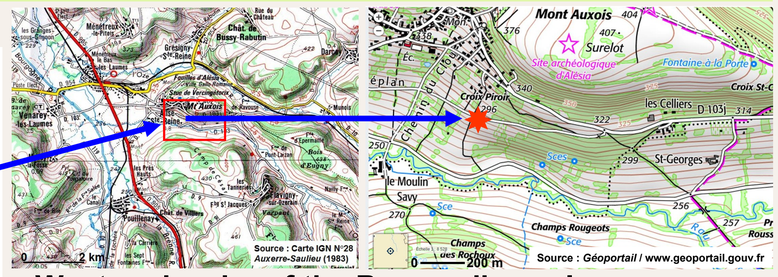
Many studies already showed the interest of vegetation phenology data to support research on climate variability and change. A photo-monitoring (*PHOTOPHENO-21*) is carried out since 2011 on the wine growing area of Alise-Sainte-Reine in Burgundy (Eastern France, Côte-d'Or department), in order to explain the interannual variability of vegetation phenology by the analysis of the climate variability and the frequency, sequence and duration of atmospheric circulation patterns and weather types.

STUDIED AREA & SITE

CÔTE-D'OR department:



Location of the studied site and weather stations



- **Western border of the Burgundian calcareous plateau, with the narrow valleys of the Brenne river and its tributaries (Oze, Ozerain).**
- **Southern slope of Mont-Auxois: tabular hill with a maximum altitude of 407 m.**
- **Vegetation cover and land use: plots of land for vine cultivation, orchards (apple trees, pear trees, quince trees, etc…), meadows and woods.**

DATA & METHODS

- **Selected photographic shots: vine plots and other surrounding plants (fruit trees and deciduous forest on the opposite slope).**
  - Shot « A » : view facing southwest ; altitude: 296 m.
  - Shot « B » : view facing southeast ; altitude: 296 m.
- **Selection of photos taken in early May 2011, 2016, 2017 and 2018: timing of budburst and leaf appearance.**
- **Climatic Interpretation performed on the months of January to April, using Météo-France data (1981-2010 period):**
  - Monthly mean minimum and maximum temperature at SEMUR-EN-AUXOIS ;
  - Monthly sunshine duration (hours) at CHÂTILLON-SUR-SEINE.
- **Analysis of the occurrence frequency in synoptic-scale atmospheric circulation patterns over Europe, using the *Hess-Brezowsky* classification (Deutscher Wetterdienst).**

➔ 5 *Großwettertypen* : West (W), South (S), Northwest & North (NW & N), Northeast & East (NE & E), Main high/low pressure area over Central Europe (CE).

PHOTO-MONITORING: SPRING 2011 & 2018 ; 2016 & 2017

A

B

- **Earlier leaf appearance (vine and trees) in 2011 and 2018 than in 2016 and 2017 at the same time of the year: between 8 and 12 spread leaves on each vine stock.**
- **Spring vegetation onset in 2011 was the earliest of the four selected years.**

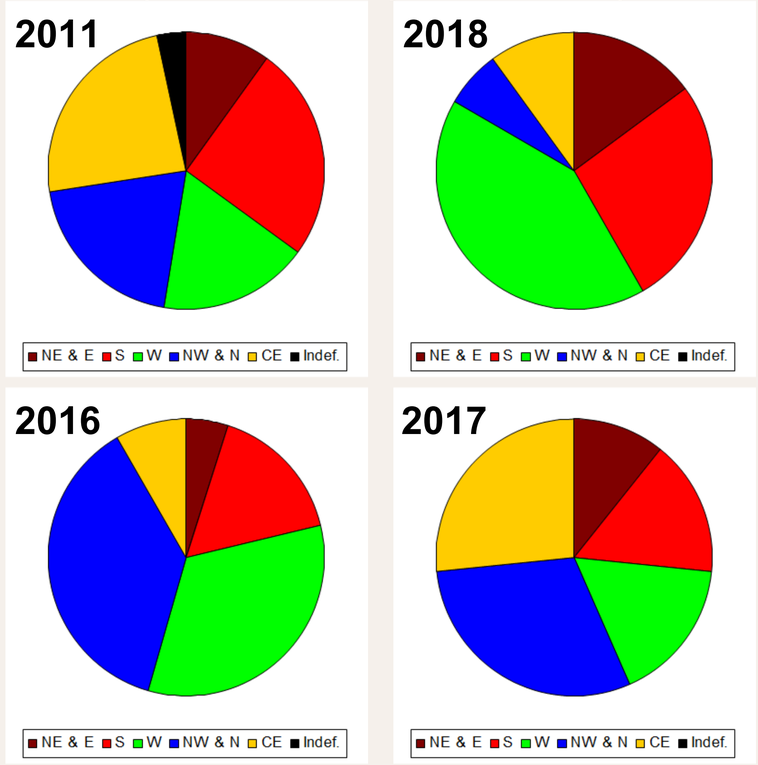
- **Delayed vegetation phenology in 2016 and 2017 compared with 2011 and 2018.**

➔ Only a few vine shoots ; many trees still without leaves.

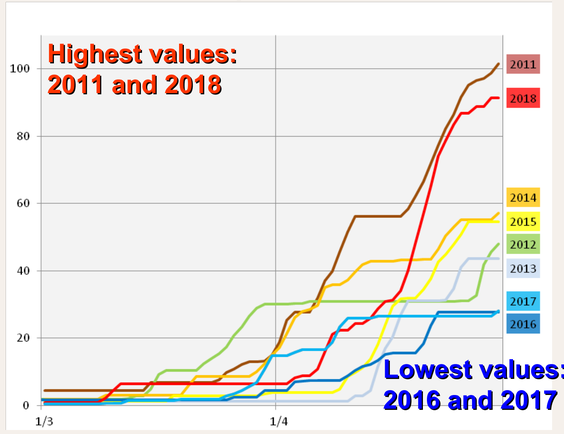
- **Observable differences between 2016 and 2017: contradictory conclusions according to the type of plants.**

CLIMATIC INTERPRETATION

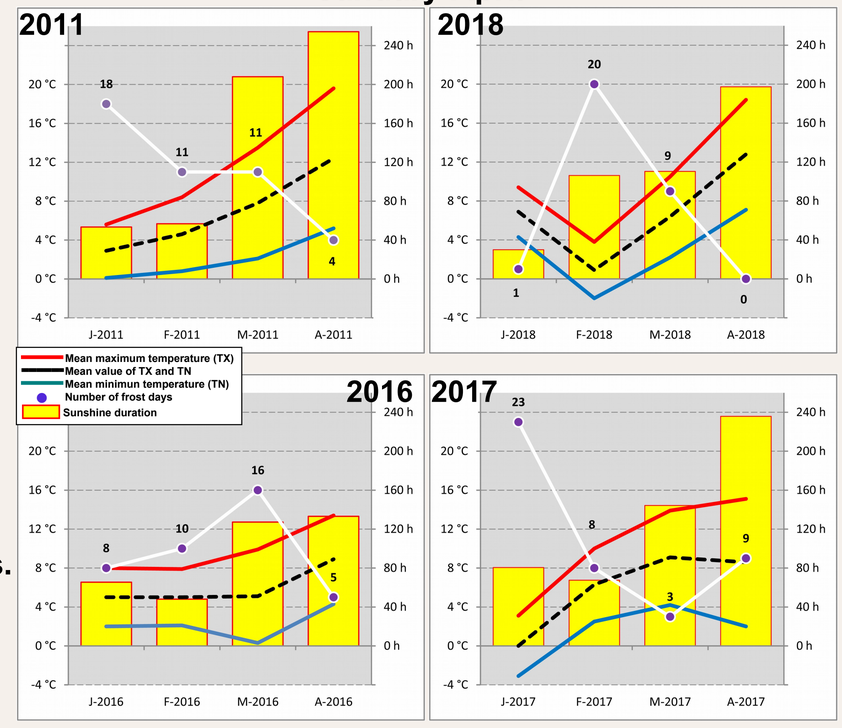
Frequency of atmospheric circulation patterns (Hess-Brezowsky classification)



Sum of daily mean temperatures ≥ 10°C: March & April 2011 to 2018



Temperature (°C) & sunshine duration (h): January-April



- **Higher frequency of S. circulations in 2011 and 2018 than in 2016 and 2017 ; lower frequency of NW & N circulations.**
- **Higher frequency of « CE » type in 2011 than in 2018: anticyclonic configurations favourable to sunny weather types.**

➔ TX positive anomaly of +4,9°C in April 2011.

- **Higher frequency of « CE » type in 2017 than in 2016**

➔ Positive anomaly of sunshine duration in March and April 2017 (+3.5 and +36.6%) ; negative anomaly in March and April 2016 (-8.8 and -22.8%). However, these favourable climatic features in 2017 are not visible on the vegetation. The higher occurrence of frost days in April 2017 (9 days) than in April 2016 (5 days) may have a strong impact on vine and (fruit) trees.

CONCLUSION

The photo-monitoring carried out on the wine growing area of Alise-Sainte-Reine in May 2011, 2016, 2017 and 2018 clearly showed two groups of years. The leaf appearance was clearly earlier In 2011 and 2018 than in 2016 and 2017. The spring vegetation onset in 2011 was the earliest of the four selected years. The analysis of weather data between January and April allowed to explain the differences in phenological stages between early May 2011 and 2018, but not the slight differences between 2016 and 2017. The more favourable climatic features in 2017 than in 2016 are not visible on the vegetation. The high occurrence of frost days in April 2017 could be a possible explanation. The differences in phenological stages will be studied taking into account each type of plant and grape variety.

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