Saturnalia

Barolo 2019

Harvest report

January 2023

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Introduction

Saturnalia collects, processes and analyses data – mainly from satellites – to deliver insights for the fine wines industry.

Our main advantage is **scalability**: thanks to satellite data, we can monitor several areas of the world at once and retrieve valuable insights.

We believe that accessing **punctual** and **detailed** analyses of vintages is acquiring more and more value in the industry. Our reports represent an introduction to our world: the reader may enjoy even deeper information by accessing our platform, including details on single wines.

The report provides a general overview on the entire Barolo area.

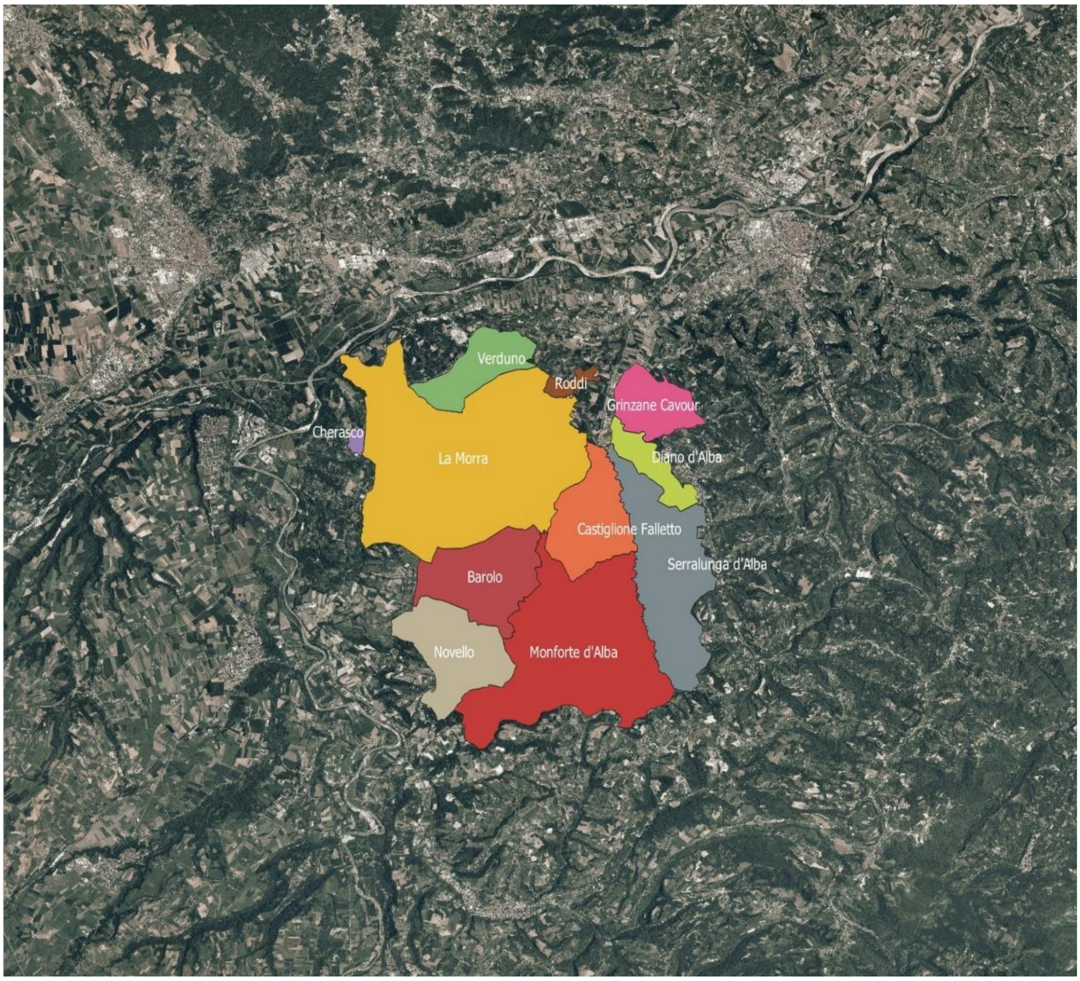


Figure 1. Area of interest

General overview

2019 in a few words:

- A warm – but not exceptionally – vintage overall, mainly in June and July
- Dry beginning of the year, followed by average precipitation from April onwards
- Diurnal variation above average only in September
- The SVI distribution is similar to vintage 2016
- General: more classical vintage, less gradual heat accumulation than 2016
- Our expectations: higher alcohol and less acidity than 2016

Rainfall comparison

Drought started in winter, with rain missing in December and January. Precipitation we more regular from April onwards, in line with a classical vintage (Figure 2).

Further investigation on **daily precipitation** (Figure 3) showed how rain was quite regular, with some thunderstorms in July.

Figure 4 is useful to compare 3 recent vintages: 2016, 2017 and 2019. 2016 works as an example of a vintage considered of very high quality; 2017 as a very hot vintage. Looking at precipitation, 2016 and 2019 were very similar from May onwards.

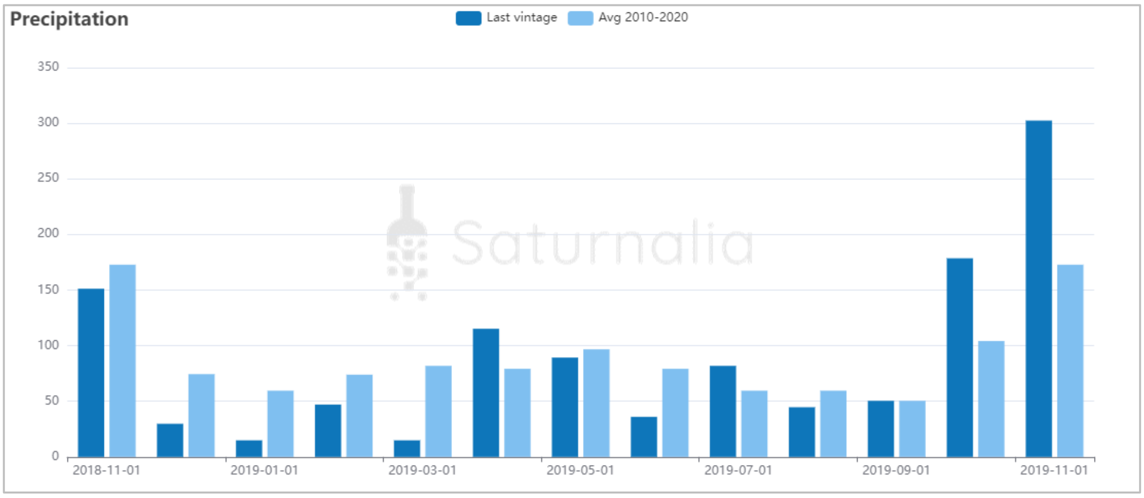


Figure 2. Comparison of monthly precipitation between vintage 2019 and the average of the last 10 seasons.

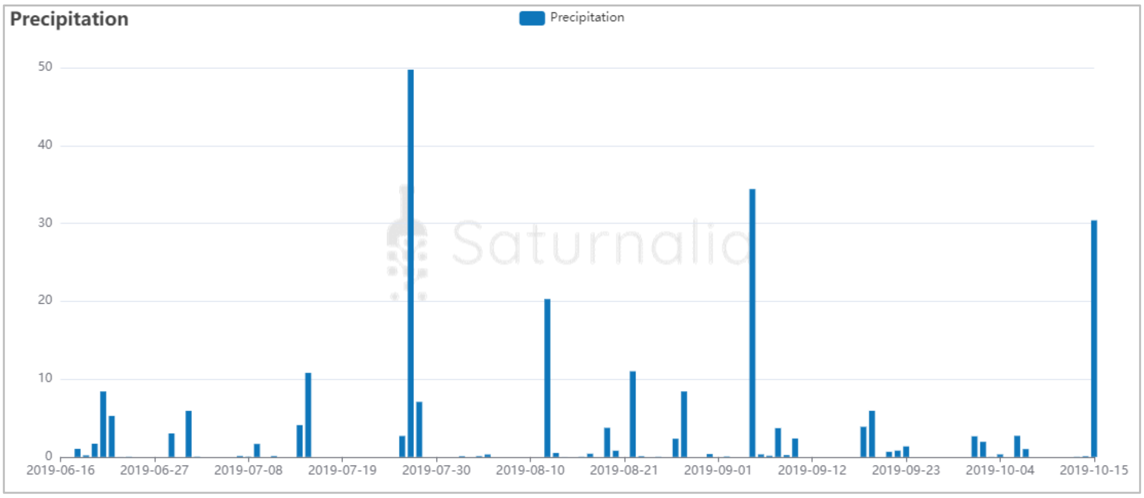


Figure 3. Daily precipitation from May 1 to August 31 2019.

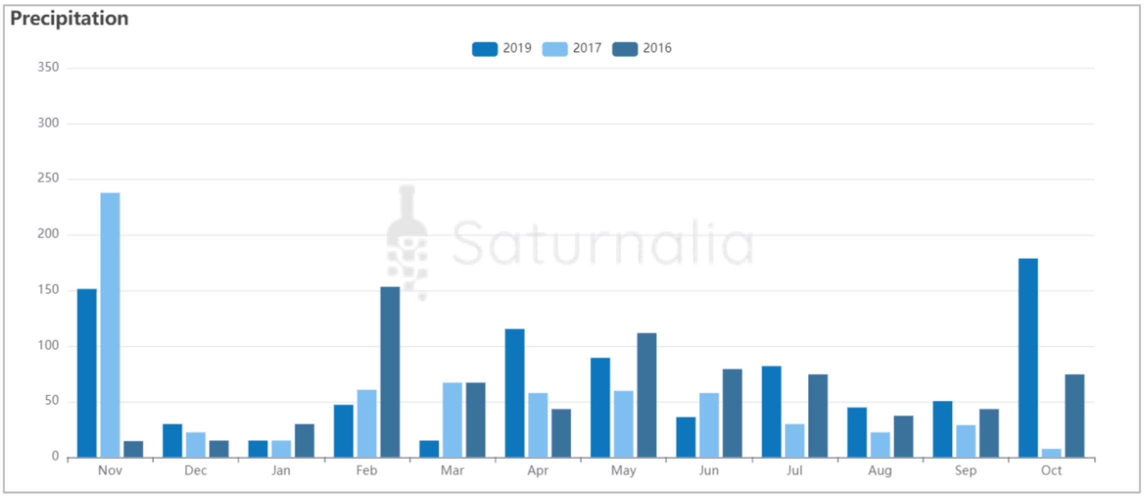


Figure 4. Comparison of monthly rainfall between 2016, 2017 and 2019.

Municipality	Rest (1/11 - 31/03) [mm]	Budburst to flowering (01/04 - 15/06) [mm]	Flowering to veraison (16/06 - 15/08) [mm]	Veraison to harvest (16/08 - 15/10) [mm]	TOTAL [mm]
Barolo	235.07 (-48.37%)	213.3 (0.65%)	128.32 (5.56%)	93.68 (-29.16%)	670.37 (-27.21%)
Castiglione Falletto	221.01 (-51.46%)	212.24 (0.15%)	121.8 (-2.78%)	121.96 (-7.77%)	677.01 (-26.78%)
Cherasco	228.47 (-49.82%)	219.29 (-1.65%)	123.12 (-4.47%)	120.01 (-9.25%)	690.89 (-26.45%)

Diano d'Alba	235.07 (-48.37%)	213.3 (0.65%)	128.32 (5.56%)	93.68 (-29.16%)	670.37 (-27.21%)
Grinzane Cavour	243.38 (-47.37%)	214.76 (-0.35%)	118.76 (-7.85%)	116.27 (-12.07%)	693.17 (-26.19%)
La Morra	243.38 (-47.37%)	214.76 (-0.35%)	118.76 (-7.85%)	116.27 (-12.07%)	693.17 (-26.19%)
Monforte d'Alba	243.38 (-47.37%)	214.76 (-0.35%)	118.76 (-7.85%)	116.27 (-12.07%)	693.17 (-26.19%)
Novello	245.89 (-46.83%)	211.17 (-2.02%)	125.39 (0.18%)	106.83 (-19.21%)	689.28 (-26.31%)
Roddi	245.89 (-46.83%)	211.17 (-2.02%)	125.39 (0.18%)	106.83 (-19.21%)	689.28 (-26.31%)
Serralunga d'Alba	243.38 (-47.37%)	214.76 (-0.35%)	118.76 (-7.85%)	116.27 (-12.07%)	693.17 (-26.19%)
Verduno	243.38 (-47.37%)	214.76 (-0.35%)	118.76 (-7.85%)	116.27 (-12.07%)	693.17 (-26.19%)

Table 1. Barolo 2019 precipitation across municipalities

Temperatures comparison

In terms of temperature, **2019** was more normal. The **growing degree days (GDD)** chart (see Figure 7) shows exceptional warm days in March, June and July, while the other months were less so. The GDD curve shows a sudden increase in temperatures from June instead of a gradual accumulation.

Furthermore, Figure 8 shows a comparison of a benchmark vintage (2016) and another very hot vintage, 2017. While 2016 was more gradual and presenting warm temperatures until September, 2017 and 2019 had more extreme increases in March and June. 2017 was very early – causing major exposure to frost.

Figure 6 shows the diurnal variation recorded during the season: summer values were below average, recovered only in September.

The warmest municipality, according to our data, was **Cherasco**, followed by **Grinzane Cavour** and **Diano d'Alba**. Considering the average of the last 10 years, **Diano d'Alba** and **Barolo** were the one with the greatest difference, 16.57%.

These numbers contribute to defining a picture of the trend for the season: high daily temperatures mainly in June and July, with an early start of the season in March. Sub-optimal diurnal variation. Therefore, we expect higher alcohol.

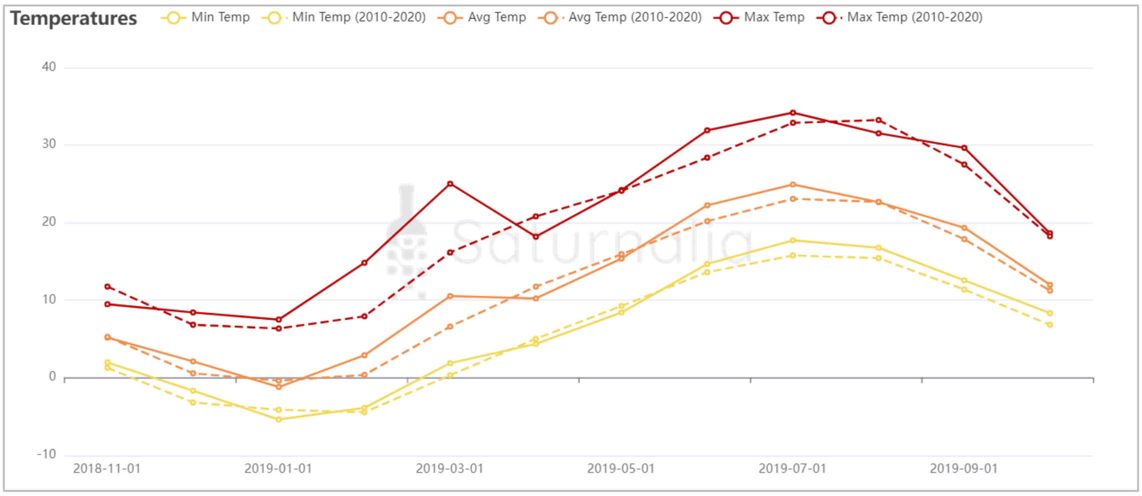


Figure 5. Comparison of monthly temperatures between vintage 2019 and the average of the last 10 seasons.

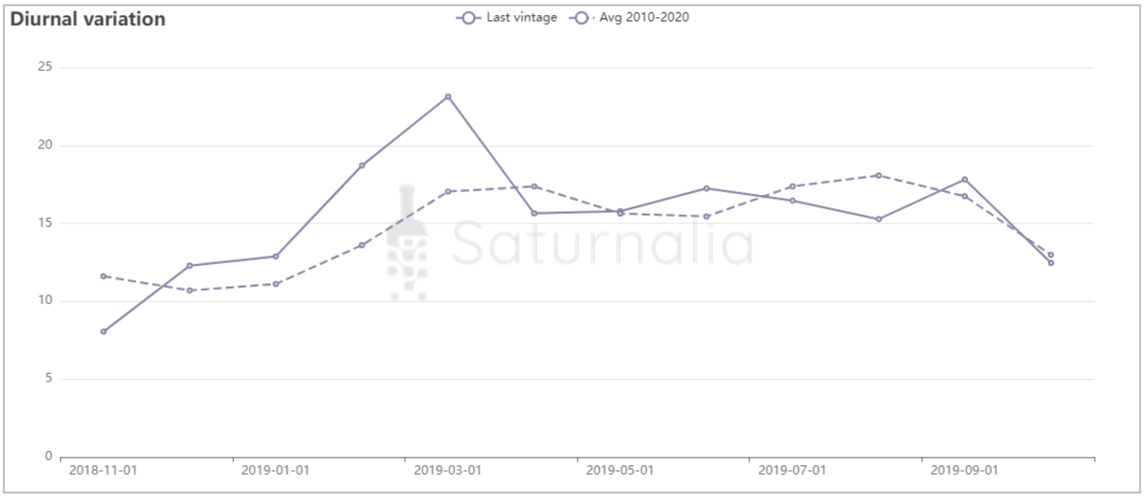


Figure 6. Comparison of monthly diurnal variation between vintage 2019 and the average of the last 10 seasons.

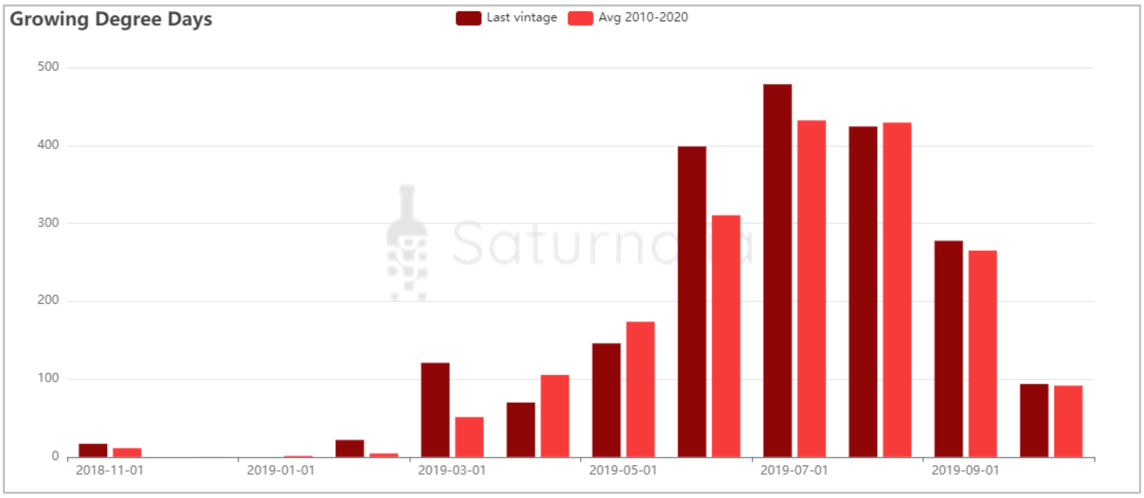


Figure 7. Comparison of monthly GDD between vintage 2019 and the average of the last 10 seasons.

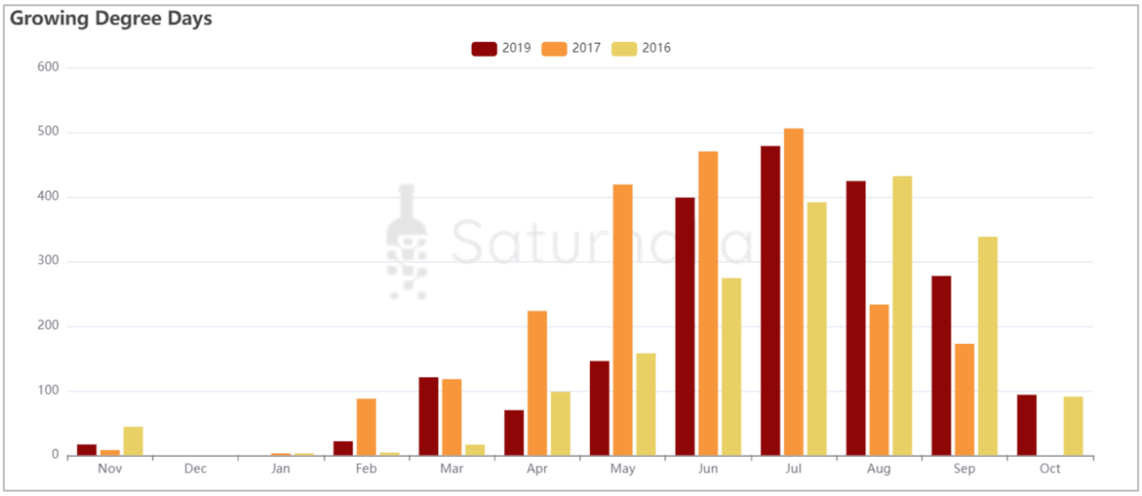
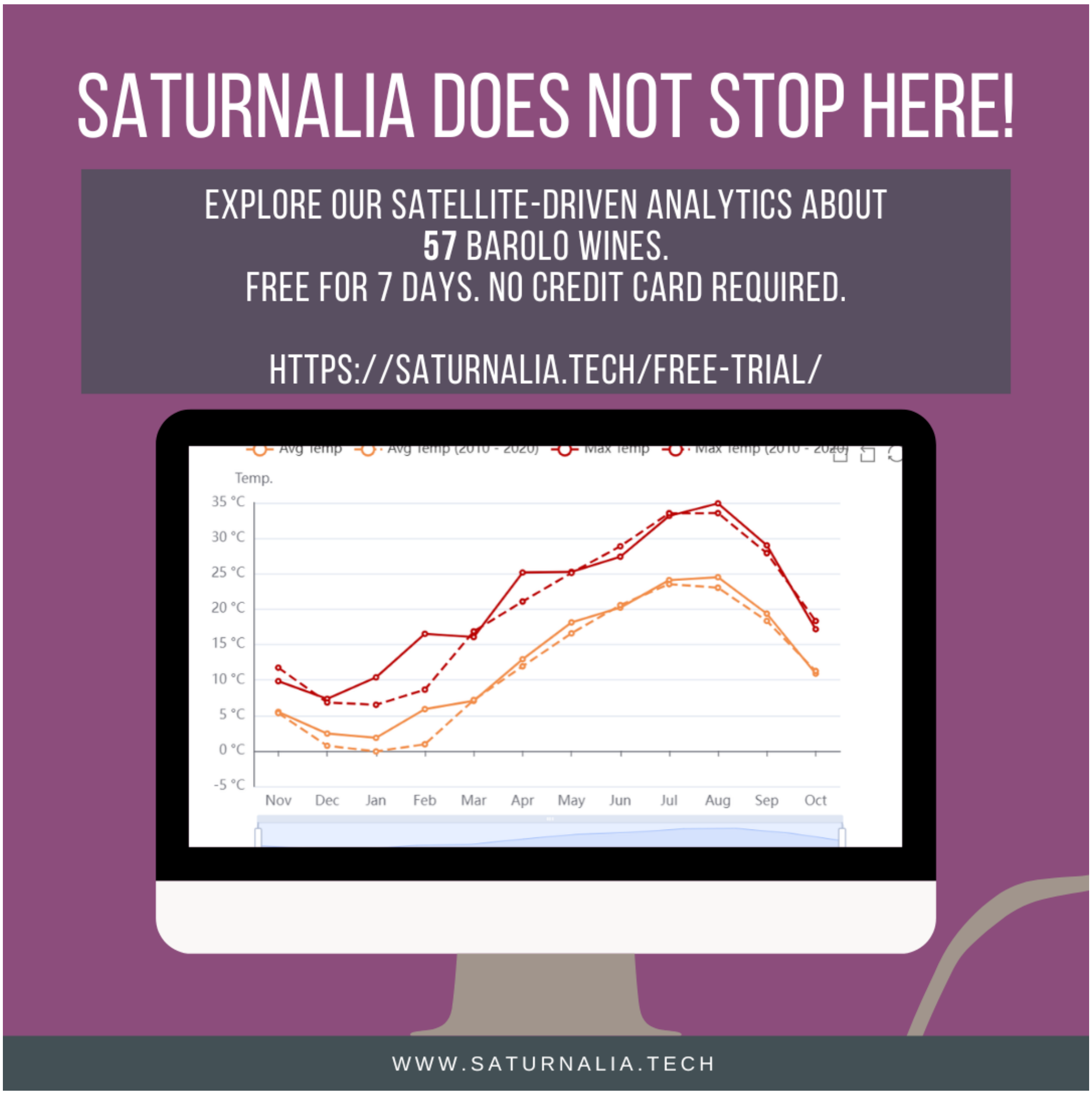


Figure 8. Comparison of monthly GDD between vintages 2019, 2017 and 2016.

Municipality	Rest (1/11 - 31/03) [°C]	Budburst to flowering (01/04 - 15/06) [°C]	Flowering to veraison (16/06 - 15/08) [°C]	Veraison to harvest (16/08 - 15/10) [°C]	TOTAL [°C]
Barolo	157.79 (134.00%)	359.19 (-11.10%)	954.62 (-24.47%)	554.15 (10.97%)	2025.75 (16.57%)
Castiglione Falletto	165.39 (121.64%)	370.98 (-19.22%)	987.22 (19.97%)	577.89 (8.25%)	2101.48 (11.15%)
Cherasco	138.09 (84.88%)	402.6 (-15.91%)	1010.13 (18.78%)	588.75 (5.37%)	2139.57 (9.01%)

Diano d'Alba	157.79 (134.00%)	359.19 (-11.10%)	954.62 (-24.47%)	554.15 (10.97%)	2025.75 (16.57%)
Grinzane Cavour	159.58 (115.18%)	387.13 (-20.61%)	983.13 (13.65%)	581.46 (2.62%)	2111.3 (5.91%)
La Morra	156.35 (137.87%)	349.41 (-10.62%)	934.37 (24.56%)	520.48 (6.23%)	1960.61 (15.55%)
Monforte d'Alba	153.53 (115.39%)	404.44 (-13.77%)	954.41 (14.93%)	571.7 (5.02%)	2084.08 (8.82%)
Novello	159.18 (133.81%)	371.37 (-14.43%)	944.95 (17.81%)	541.62 (3.08%)	2017.12 (10.25%)
Roddi	159.18 (133.81%)	371.37 (-14.43%)	944.95 (17.81%)	541.62 (3.08%)	2017.12 (10.25%)
Serralunga d'Alba	153.53 (115.39%)	404.44 (-13.77%)	954.41 (14.93%)	571.7 (5.02%)	2084.08 (8.82%)
Verduno	158.72 (127.75%)	398.61 (-10.66%)	967.54 (19.75%)	564.06 (7.53%)	2088.93 (13.01%)

Table 2. Barolo 2019 GDD across municipalities.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Appendix 1

Vegetation monitoring

Earth Observation satellites are mainly of two types:

- optical (multispectral, hyperspectral)
- radar (synthetic aperture)

Optical sensors are most frequently used for vegetation monitoring applications (chlorophyll content and water absorption). They collect the sun light reflected by the target in several spectral bands. Differently from standard photography, multispectral satellites can record the response in one or more infrared bands.

Why using infrared? The reflectance of vegetation is higher in infrared bands (increased portion of light reflected to the sensor in respect of the visible light) and this enables the collection of more information. Figure 9 shows a typical reflectance curve for vegetation: we can notice that a higher reflectance (higher curve) is within the interval between 0.8 μm and 1.4 μm (near infrared). Our eyes can only see the light between 0.4 μm and 0.6 μm (from blue to red). Other precious insights can be derived from bands in the medium infrared. For example, it is possible to determine the presence of water from the absorption peaks at 1.4 μm, 1.9 μm and 2.5 μm.

One of the main limitations of optical remote sensing are clouds as they block the light reflected by the target.

For vineyard monitoring we have developed a new vegetation index, the Saturnalia Evolution Index (SEI). A vegetation index is a mathematical combination of several spectral bands designed to highlight some key features. The SEI index takes advantage of several bands in the visible and infrared spectrum to have measures correlated with the quantity of chlorophyll, mesophyll, and the amount of water available. This index is computed every time a satellite scans the area. Continuous revisit allows to monitor vineyards during the growing season by creating SEI curves in time.

Starting from SEI values collected during the growing season, we have developed a summary measure called Saturnalia Variation Index (SVI). Distributions are calculated by considering the raw count of pixels within the region of interest.

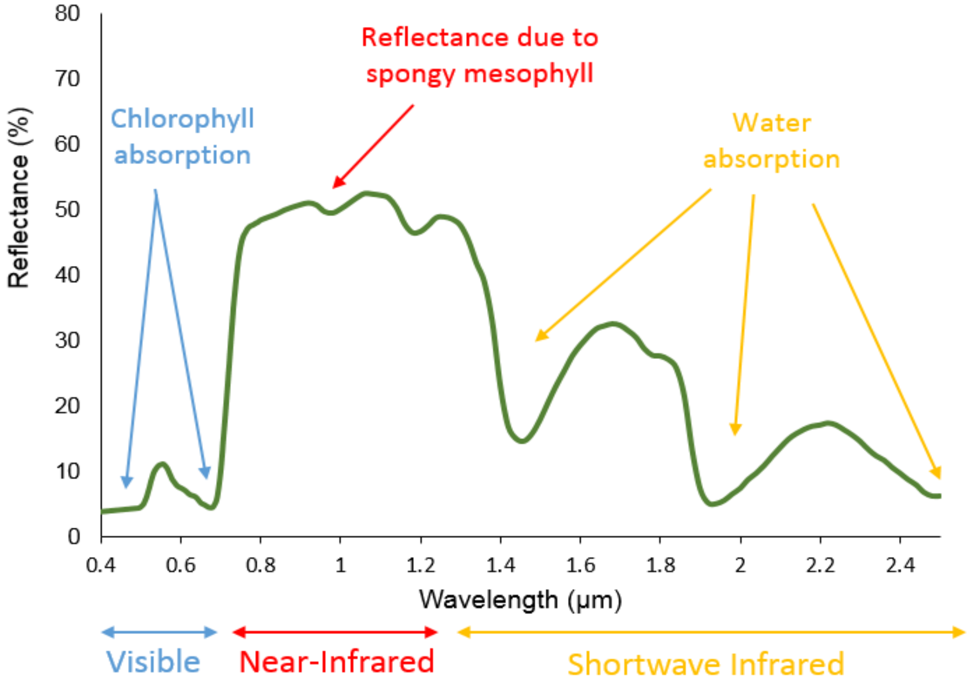

Figure 9. Example of reflectance curve for vegetation. (https://pages.cms.hu-berlin.de/EOL/gcg_eo/fig/s03_vegetation_spectrum.png)

Precipitation and temperatures

Precipitation data comes from the Global Precipitation Measurement (GPM) mission. It is a collaboration between NASA and JAXA (Japanese Space Agency) born with the aim to provide next-generation observations of rain and snow worldwide from satellite. [1]

The Land Surface Temperature (LST) is the radiative skin temperature of the land surface. It represents a mixture of bare soil and vegetation temperature. To further clarify, it is different from the air temperature, commonly measured by weather stations on the ground. Again, this measure is retrieved by several satellites constantly monitoring the globe. [2, 3]

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[1] G. Huffman, D. Bolvin, D. Braithwaite, K. Hsu, R. Joyce, P. Xie, 2014: Integrated Multi-satellitE Retrievals for GPM (IMERG), version 4.4. NASA's Precipitation Processing Center, accessed 31 March, 2015, ftp://arthurhou.pps.eosdis.nasa.gov/gpmdata/

[2] Freitas, S. C. ; Trigo, I. ; Macedo, J. ; Barroso, C. ; Silva, R. ; Perdigao, R. Land Surface Temperature from multiple geostationary satellites. International Journal of Remote Sensing 2013, Vol 34, 3051-3068.

[3] Kogan, F. Operational Space Technology for Global Vegetation Assessment. Bulletin American Meteorological Society 2001, 1949-1964.

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