

A new set of weather stations in Vallon de Nant, Alpes Vaudoises, Western Switzerland

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Introduction

The Vallon de Nant is an alpine valley located above the village of Les Plans-sur-Bex in the Vaud Alps. For more than twenty years, this valley has been of interest to the scientific groups of the Faculty of Geosciences and Environment (FGSE), who have carried out research in a variety of fields, including climatology, hydrology, geomorphology, geology, soil science and the study of flora and fauna. The site's rich landscape and ecological diversity have earned it the status of a nature reserve, with very little human intervention. All these factors make the Vallon de Nant an exceptional research site. Due to its high mountain character, the site already represents a unique experimental watershed in Switzerland and an observatory for the Alpine environment (Cherix & Vittoz 2009; Vittoz & Gmür 2009). The University of Lausanne has been strongly involved in scientific outreach activities on the Vallon de Nant (see <https://wp.unil.ch/vallondenant/>).

Among the research projects carried out or underway to date in the Vallon de Nant are the installation of weather stations in 2007, which were renewed in 2016, various hydrological (2016, 2018, 2020, 2021), dendrological (2016-2020), climatic (2007-2023), soil (2012, 2013, 2016, 2019, 2023), fauna (2016) and vegetation studies (2012, 2016). Master's and dissertation work has been carried out on a regular basis (Coquelin, 2008; Roth, 2011; Rubin, 2011; Antoniazza, 2023).

To guarantee and maintain the scientific interest of research in this exceptional site the FGSE recently invested in the renewal of the three weather stations. The following report provides details regarding

instrumentation, site location and data availability of these three new stations.

Previous installations

Following the decision by the first Dean of the Faculty to make the Vallon de Nant a priority research area (2005), the FGSE invested heavily in measurement networks for the Vallon de Nant. This included 4 meteorological stations and a flow gauging station. More recent related research works include Antoniazza et al. 2022, Michelon et al. 2023, Eeckmann et al. 2024 and others.

The aim of these four local meteorological stations was to provide additional, more detailed data than that supplied by MeteoSwiss. These stations are subject to harsh climatic conditions (low temperatures, heavy snowfalls, avalanches, little sunshine) and require regular maintenance. Despite the efforts made in recent years by the Vallon de Nant research community, some stations have been destroyed. Others, located in more accessible areas and less exposed to avalanches, have been maintained, but as the seasons have passed, most of the sensors have ceased to function.

Datasets from previous research projects, including previous weather data are available on Zenodo:

<https://zenodo.org/communities/vdn/>

Location and description of field sites

The Vallon de Nant

Stretching 6.5 km and oriented towards the northeast, the elevation of the Vallon de Nant varies from approximately 1200 to

over 3100 m. The southern part of the Vallon de Nant contains the Glacier des Martinets, which significantly influences the valley's hydrology through glacial meltwater, particularly during the summer (Michelon 2022).

Topographically, the eastern slopes are steep and rocky, characterized by debris cones and ephemeral streams active mainly during snowmelt. The western slopes, in contrast, are gentler and covered in grasslands with developed soils. Vegetation is diverse, ranging from alpine grasslands and spruce forests in the lower areas to subalpine meadows at higher elevations. This natural landscape is influenced by seasonal snowmelt, and regular avalanches shape the forest corridors on the northwest slopes (Lane et al. 2016).

The climate of the Vallon de Nant is typical of alpine regions, with cold winters and cool summers. Due to its orientation, some

parts of the valley are highly shadowed and experience virtually no solar irradiation during winter months. Precipitation is distributed throughout the year, with snow accumulating in the winter, feeding into the valley's streams and wetlands in warmer months (Vittoz & Gmür 2009).

Location of weather stations

The locations of the three new weather stations have been chosen to continue the measurements of previous stations, to cover a range of altitudes and aspects, with the *Auberge* station located lowest at the fairly flat valley bottom at the north-eastern entry of the valley, the *Chalet* station at intermediate altitude close to the valley side with a north-westerly aspect, and the *Chaux* station at the highest elevation on a valley shoulder close to the opposite valley side with a south-easterly aspect (see Figure 1). See Figures 2 - 4 and Table 1 for more details of the three stations.

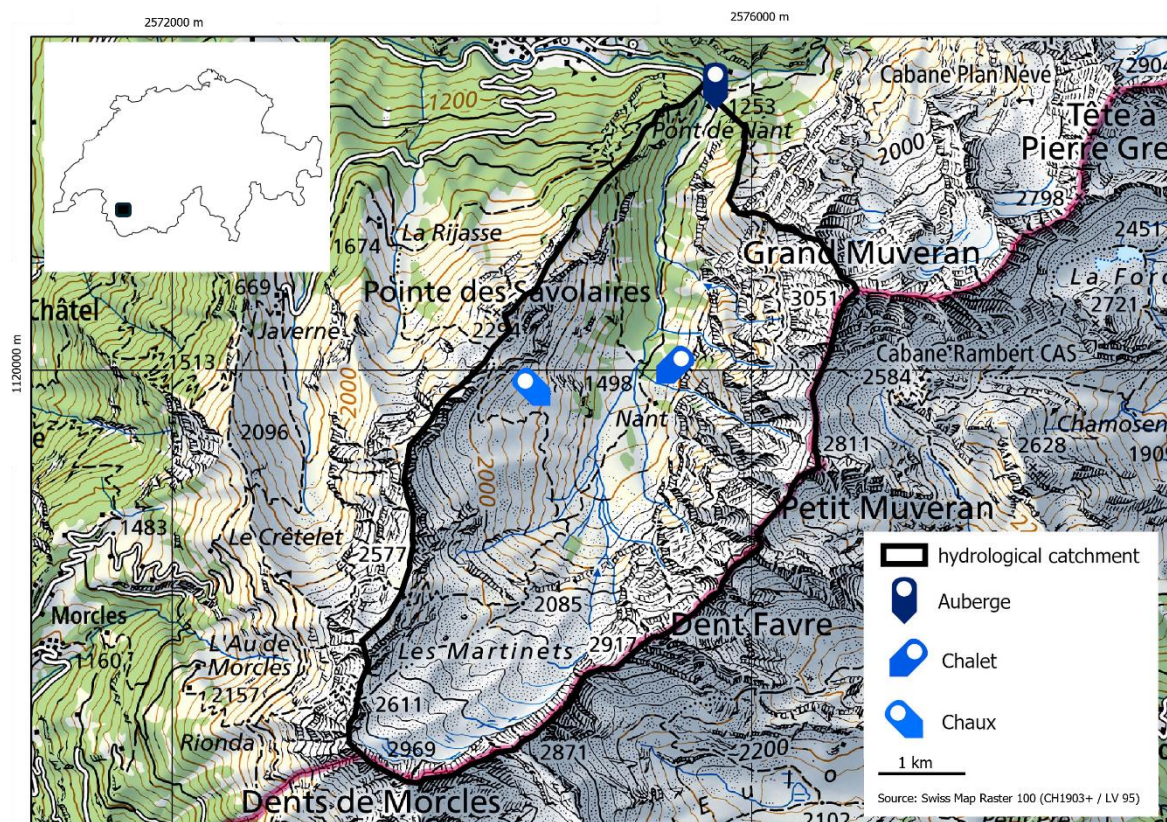


Figure 1. Map of the Vallon de Nant catchment with indication of the three weather stations at Auberge, Chalet and Chaux.



Figure 2. Auberge weather station with additional ultrasonic snow height sensor.



Figure 3. Chalet weather station.



Figure 4. Chaux weather station.

Table 1. Details of the site location of each station.

Station name	Coordinates (CH1903+)	Altitude	Short site description
Auberge	2'574'684.42, 1'122'239.78	1259 m	On flat field on valley bottom
Chalet	2'574'173.53, 1'119'881.10	1519 m	On large boulder close to valley side
Chaux	2'573'259.46, 1'119'690.02	1785 m	On large boulder on elevated valley shoulder / moraine

Table 2. Instrumentation details.

Instrument	Parameter	Logging type	Unit	Measurem. interval (Scan)	Logging interval	Logging acronym
Campbell Scientific EE181-L Air Temperature and Relative Humidity Sensor	Air temperature	Average	Degree celsius (°C)	1 min	10 min	<i>AirTC_Avg</i>
	Relative humidity	Sample	Per cent (%)	1 min	10 min	<i>RH</i>
CS100 Setra Barometric Pressure Sensor	Atmospheric pressure	Average	Millibar (mbar)	1 min	10 min	<i>BP_mbar_Avg</i>
Apogee Instruments CS301 Pyranometer	Solar radiation	Average	Watts per square meter (W/m ²)	1 min	10 min	<i>SlrW_Avg</i>
		Totalize	Megajoule per square meter (MJ/m ²)	1 min	10 min	<i>SlrMJ_Tot</i>
Young 52202-L Electrically Heated Rain and Snow Gage	Precipitation (liquid equivalent)	Totalize	Millimeters (mm)	1 min	10 min	<i>Rain_mm_Tot</i>
Young 05108-45-L Wind Monitor-HD, Alpine Version	Wind speed	Average	Meters/second	1 min	10 min	<i>WS_ms_Avg</i>
		Standard Deviation	Meters/second	1 min	10 min	<i>WS_ms_Std</i>
		Minimum	Meters/second	1 min	10 min	<i>WS_ms_Min</i>
		Maximum	Meters/second	1 min	10 min	<i>WS_ms_Max</i>
	Wind direction	Average	Degrees (°)	1 min	10 min	<i>WindDir_Avg</i>
SDI-12 Ultrasonic distance sensor	Snow height (Auberge only)	Sample	Millimeters (mm)	10 min	10 min	<i>snow_depth</i>

Technical details of sensors and measurement intervals

Instrumentation and Logging

Each station is equipped with a Campbell Scientific CR1000x logger and instruments monitoring air temperature, air pressure, relative humidity, solar radiation, wind speed, wind direction and precipitation. The *Auberge* station is additionally equipped with a snow height sensor. Data is recorded at a 10-minute interval and at UTC time. See Figure 2 for instrument details and logging parameters.

Electricity supply

The *Auberge* is connected to the 220V grid and supplies the weather station with 24V via a converter. Another converter in the station's box supplies 12V needed to power the logger and some sensors. The *Chalet* and *Chaux* stations are powered by 1 Unisun 80W/12V monocrystalline solar panel and an AGM 12V/60Ah battery and an additional Unisun 200W/24V monocrystalline solar panel and a 24V/100Ah battery to power the heated rain and snow gage. Each logging box is equipped with two Victron Bluesolar MPPT 75/15 15A 12V/24V regulators.

Data transmission

Telephone network coverage is very sparse in the Vallon de Nant, with close to no coverage at the *Auberge* station. The *Chalet* and *Chaux* stations are each equipped with a Campbell Scientific

CELL215 4G LTE CAT1 modem, a Swisscom SIM-card and an antenna to allow for remote access and data backup using the University of Lausanne's FTP server. The *Auberge* station is not connected to telephone network, but station access is generally easier, so data is manually backed up using a micro-USB cable and Campbell Scientific software.

Data curation and availability

Data will be checked for inconsistencies and erroneous data will be replaced by NaNs whenever the source of error is known, for example for false data generated by tall summer vegetation below the snow depth radar. Datasets are published annually, covering one full hydrological year (1 October – 30 September) on SWISSUbase. Datasets are published by year and station and will each have an assigned DOI.

<https://www.swissubase.ch/en/catalogue/studies/20934/20513/>

Datasets are available as tab delimited .txt files (see Figure 5). Timestamps are in UTC following the format `yyyy-mm-dd hh:mm:ss`.

Suggested citation:

Ballu, A., Miesen, F. (year): Weather data from Auberge station, Vallon de Nant, 01.10.20xx – 30.09.20xx. University of Lausanne. SWISSUbase. DOI: [url].

TIMESTAMP	BP_mbar	StrW_Avg	StrMJ_Tot	AirTC_Avg	Rain_mm	WS_ms_Avg	WS_ms_Std	WS_ms_Min	WS_ms_Max	WindDir_Avg	RH	BattV
TS	mbar	W/m ²	MJ/m ²	Deg C	mm	meters/second	meters/second	meters/second	meters/second	degrees	%	Volts
	Avg	Avg	Tot	Avg	Tot	Avg	Std	Min	Max	Avg	Smp	Smp

Figure 5. Dataset header at Auberge station.

Management and Maintenance

The three stations are regularly checked and maintained by the team of field technicians at the Institute of Earth Surface Dynamics, University of Lausanne. Each visit to the stations must be logged using a standardised online form, where changes,

adaptations, damages etc. are reported. Request to access the log file must be addressed to terrain-idyst@unil.ch.

Any request for additional sensors at the stations (including autonomous loggers, such as Hobo pendant loggers) must be directed to terrain-idyst@unil.ch.

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