Temperature measurements - Vallon de Nant
Synthesis report

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1 Loggers locations

A field campaign was set up from July 2021 to September 2023 in order to have in-situ temperature measurements, which represent an additional data source for estimating the performance of the temperature products and better describe the local site effects in the valley. A series of 28 mini-temperature sensors (ibutton loggers) distributed in the basin is installed, in particular at the bottom of the valley. 28 loggers (12 masts + 18 single loggers) were installed in August 2021. The data were recorded in August 2022 and the loggers were finally uninstalled in September 2023. The sensors are installed on a mast, under a plastic shelter at 2 m from the ground. The measurement time step is 2 hours. The sensors worked well, except 1 mast (logger 9 at Larze) which was broken, certainly by the snow and 1 other mast (logger 25) which disappeared. After the data collection in August 2022, the remaining 28 sensors remained in place and the measurements were restarted with the same time step, for collection of new data (and recovery of the sensors) until summer of 2023. Figure 1 show the situation and photos of 9 of the 12 stakes initially installed. Stakes 4,10, 18 and 19 form an altitudinal transect perpendicular to the axis of the valley.

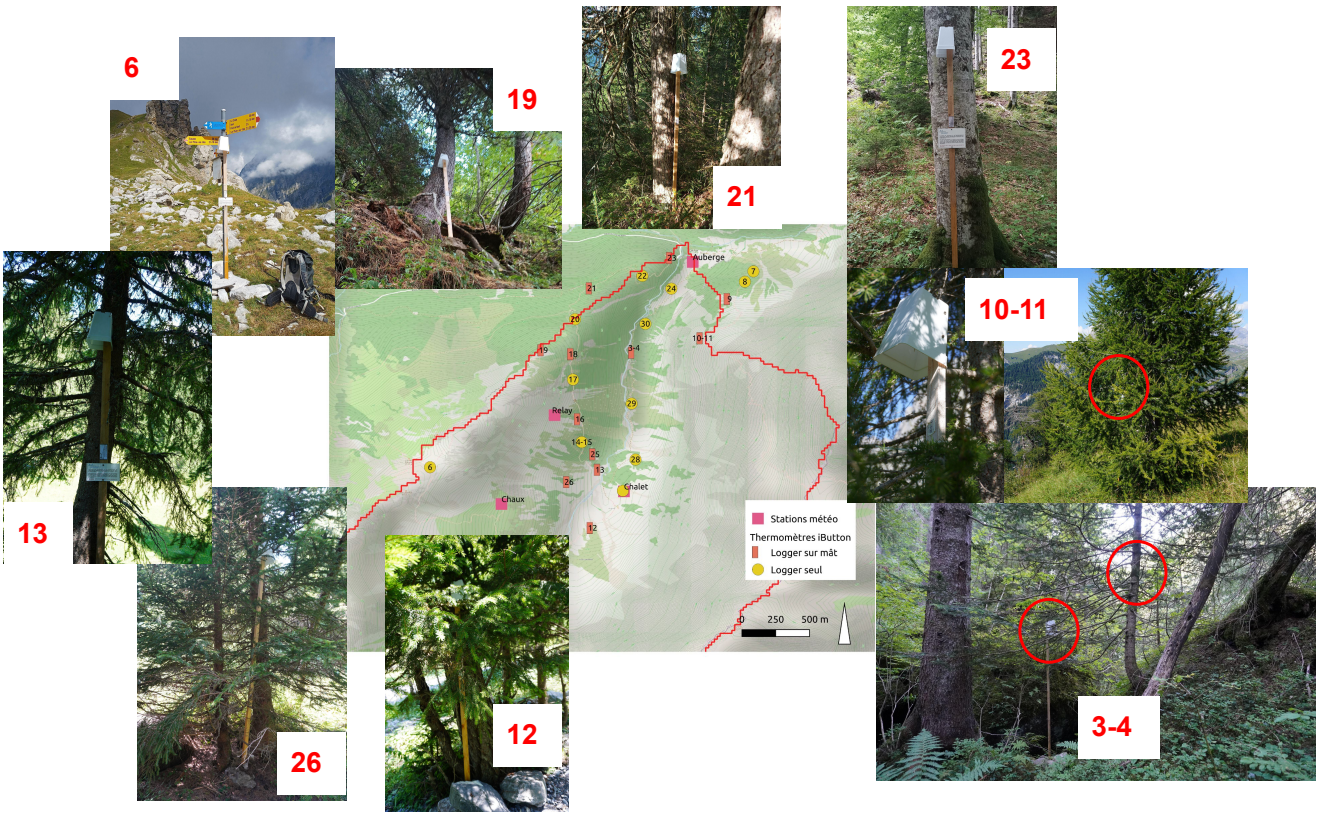

FIGURE 1 – Location and photos of 9 of the 12 mast initially installed.

2 Impact of the mast for the 3 duplicated sensors

Figure 2 presents the 2-hour temperatures measured by the 30 loggers from 2021-08-06 to 2023-09-10. Sensor 4 stopped on 2021-12-31 at 22 :30 :01. The measurements from sensor 9 (broken mast) are not reliable after winter. The rest of the measurements are of good quality. Loggers 3-4, 10-11 and 14-15 are duplicated : for each of these sites, there is a sensor installed in a stake and just nearby a sensor fixed in a tree branch. The objective is to estimate the impact of installing the stake compared to a fixed installation in a tree. These 3 sites are located in a relatively dense forest (3-4 and 14-15) or on an isolated tree (10-11).

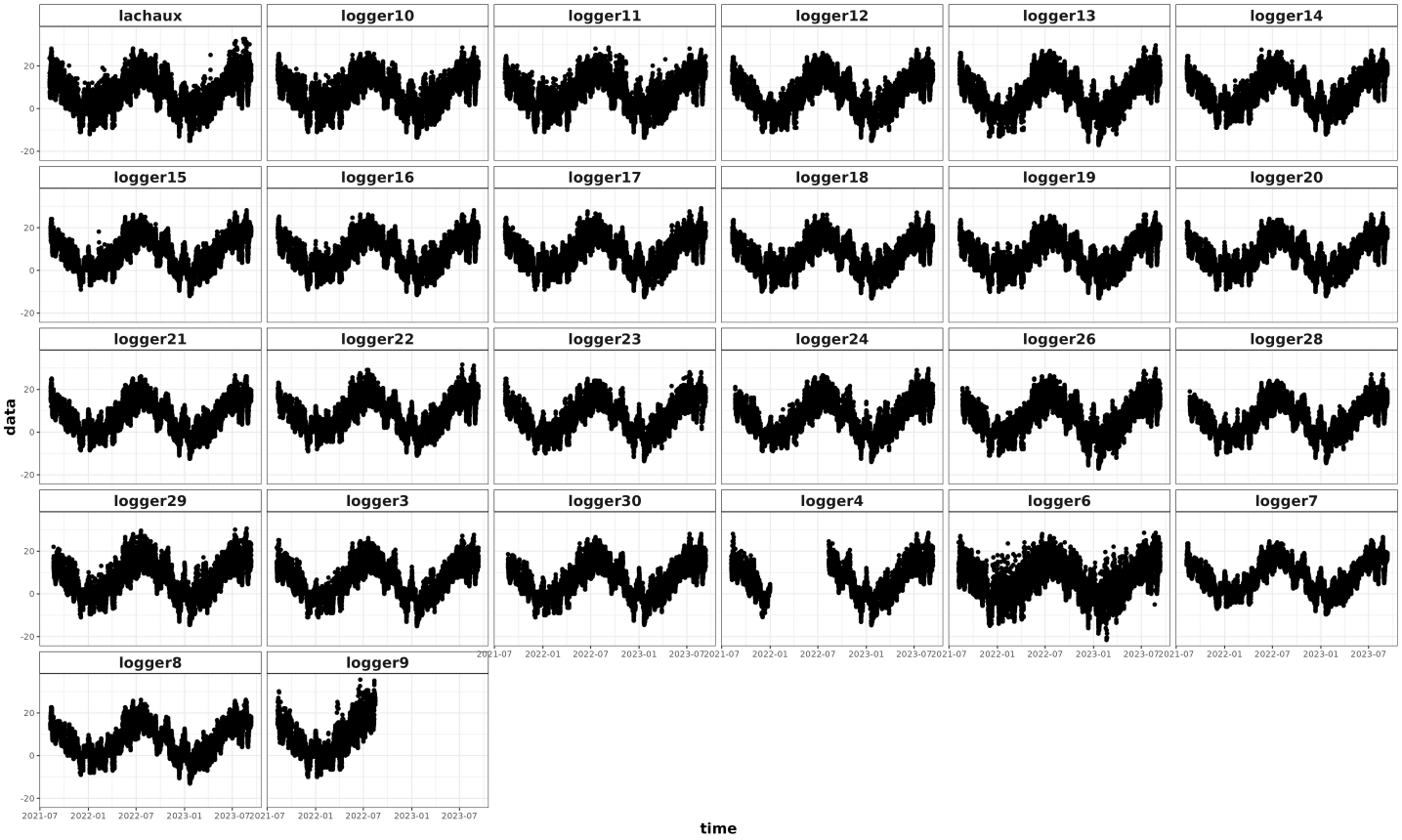

FIGURE 2 – 2h temperatures measured at the 26 sensors from 2021-08-06 to 2023-09-10.

Loggers 3-4, 10-11 and 14-15 are duplicated : for each of these sites, a sensor is installed under a plastic shelter along a mast and just nearby a sensor fixed in a tree branch. The objective is to estimate the impact of the mast compared to a fixed installation in a tree. These 3 sites are located in the forest relatively dense (3-4 and 14-15) or on an isolated tree (10-11). Figure 3 presents the average monthly temperatures obtained at the 6 duplicated loggers. We observe that the difference between the temperatures measured by loggers on a mast or by simple loggers in the trees is small on a monthly average. We can therefore deduce that the temperatures measured by the 2 devices can be used indifferently, at least at monthly time intervals.

3 Results

Annual dynamics

The figure 4 presents the average monthly temperatures for the available 26 sensors, from 2021-08-06 to 2023-09-10.

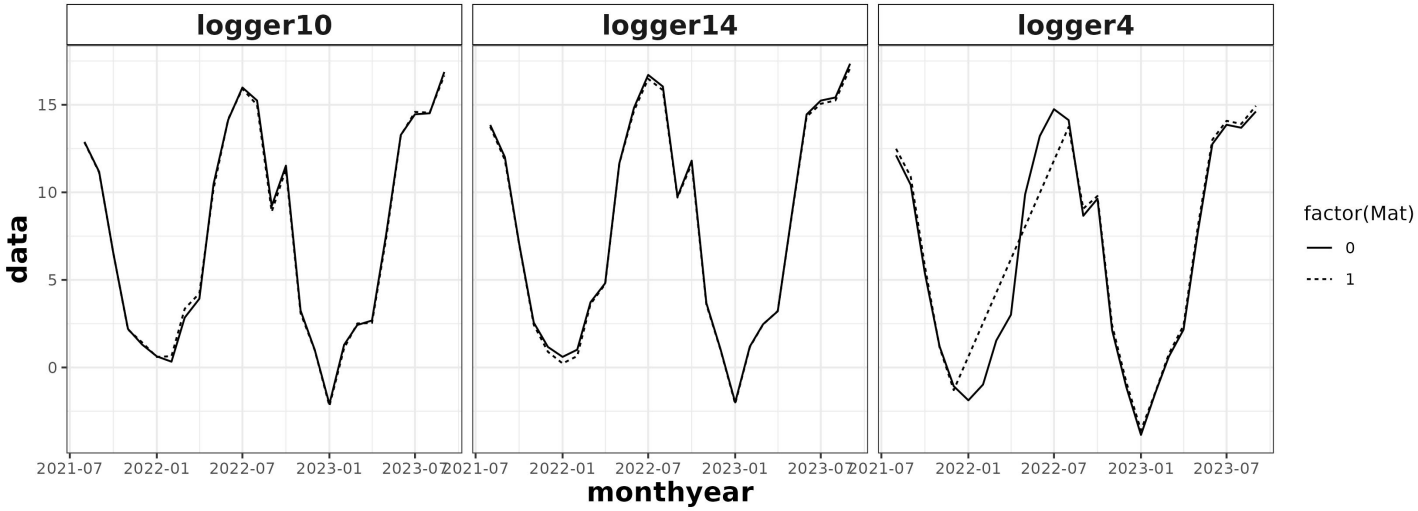

FIGURE 3 – Average monthly temperature at the double measurement points (logger 3-4, 10-11 and 14-15). Dash = Mast, solid line = logger alone.

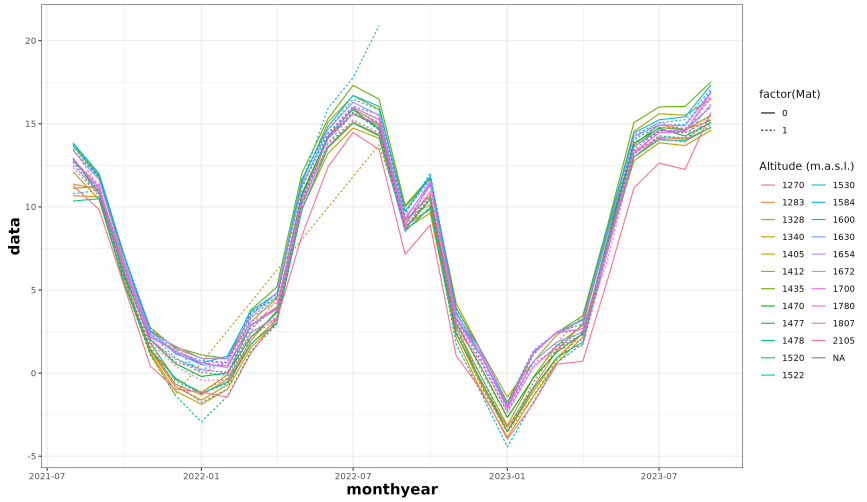

FIGURE 4 – Monthly averaged temperatures for the available 26 sensors, from 2021-08-06 to 2023-09-10

Altitudinal lapse rate

The figure 5 presents the average temperatures over the entire measurement period at the 26 sensors as a function of their altitude. Two 12-months periods are distinguished : August 2021-August 2022 (2022) and August 2022-August 2023 (2023). For both years,a very weak correlation between these average temperatures and altitude is observed, even for the loggers who form an altitudinal transect (loggers 4,10, 18 and 19). Site effects (or biases in measurements) therefore seem to be predominant here compared to the impact of altitude on temperatures. In addition, the behavior for the two years are very different (with opposite sign of lapse rates).

Spatial distribution

The figure 6 presents a map of the average temperatures over the entire measurement period at the 26 sensors. The temperatures on the Auberge-¿Alpage section (in dense forest, little exposed to the sun) are generally lower than the temperatures on the path to *Trou à l'Ours* and than the path to *La Larze* (in sparse forest, exposed to the sun). However, this observation varies greatly on a monthly scale (see Table 1). In addition, the cold air accumulation at the bottom of the valley is sharper for the August 2021-August 2022 (2022) year.

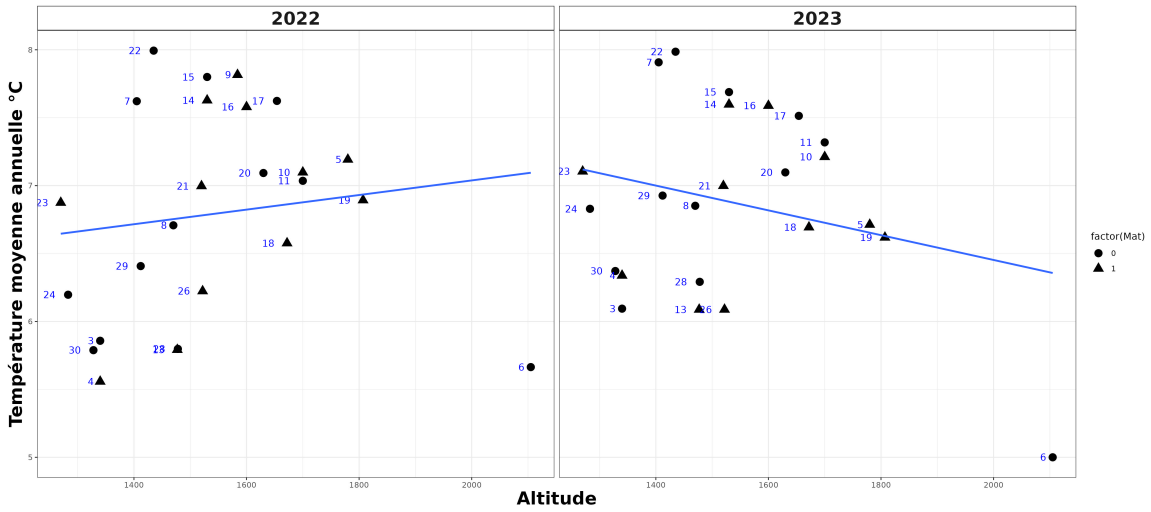

FIGURE 5 – Average annual temperatures over the entire measurement period at the 26 sensors versus their altitude, for the August 2021-August 2022 (2022) and August 2022-August 2023 (2023) years.

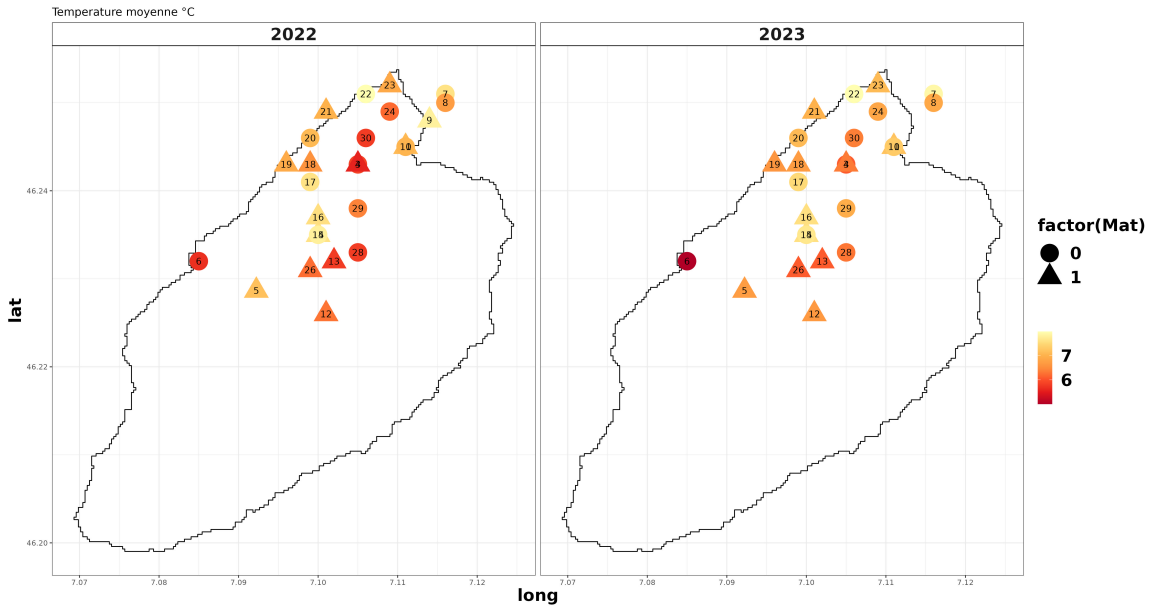

FIGURE 6 – Average temperatures at the 26 sensors, averaged over for the August 2021-August 2022 (2022) and August 2022-August 2023 (2023) years.

Impact of sun exposure

The figure 7 presents the average daily cycle, for each month, of temperatures at logger 24 (near Auberge), 13 (Alpage) and 19 (Savolaire crest), which have different altitudes and different exposure to sun. For the months of April to September, we observe a regular shift in daily dynamics for these 3 loggers, which may correspond to the arrival of sunshine. The measurements vary greatly for the months of March and October (melting snow, presence of water on the sensors... ?). These results are interesting and can be further explored in order to explain breeze or trapping phenomena.

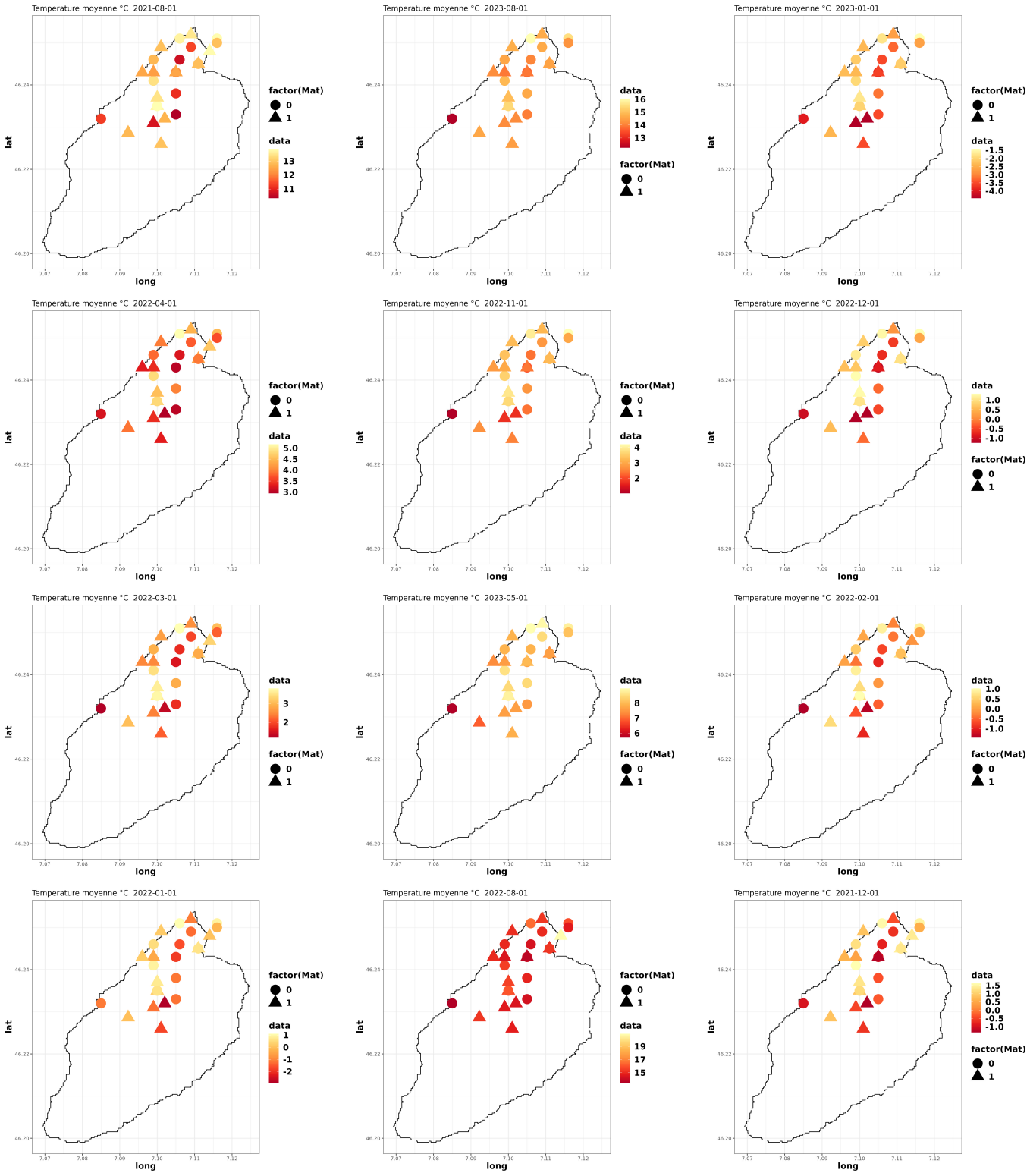

TABLE 1 – Monthly average temperatures at the 26 sensors

4 Conclusion

- The loggers generally worked well and provided usable data.
- The measurements can now be compared to other products studied for temperatures : temperatures interpolated by inverse distance from measurements at stations, CHCLIM25 and outputs from the AWE2D models.
- Hourly dynamics can be used to describe breeze or trapping phenomena.

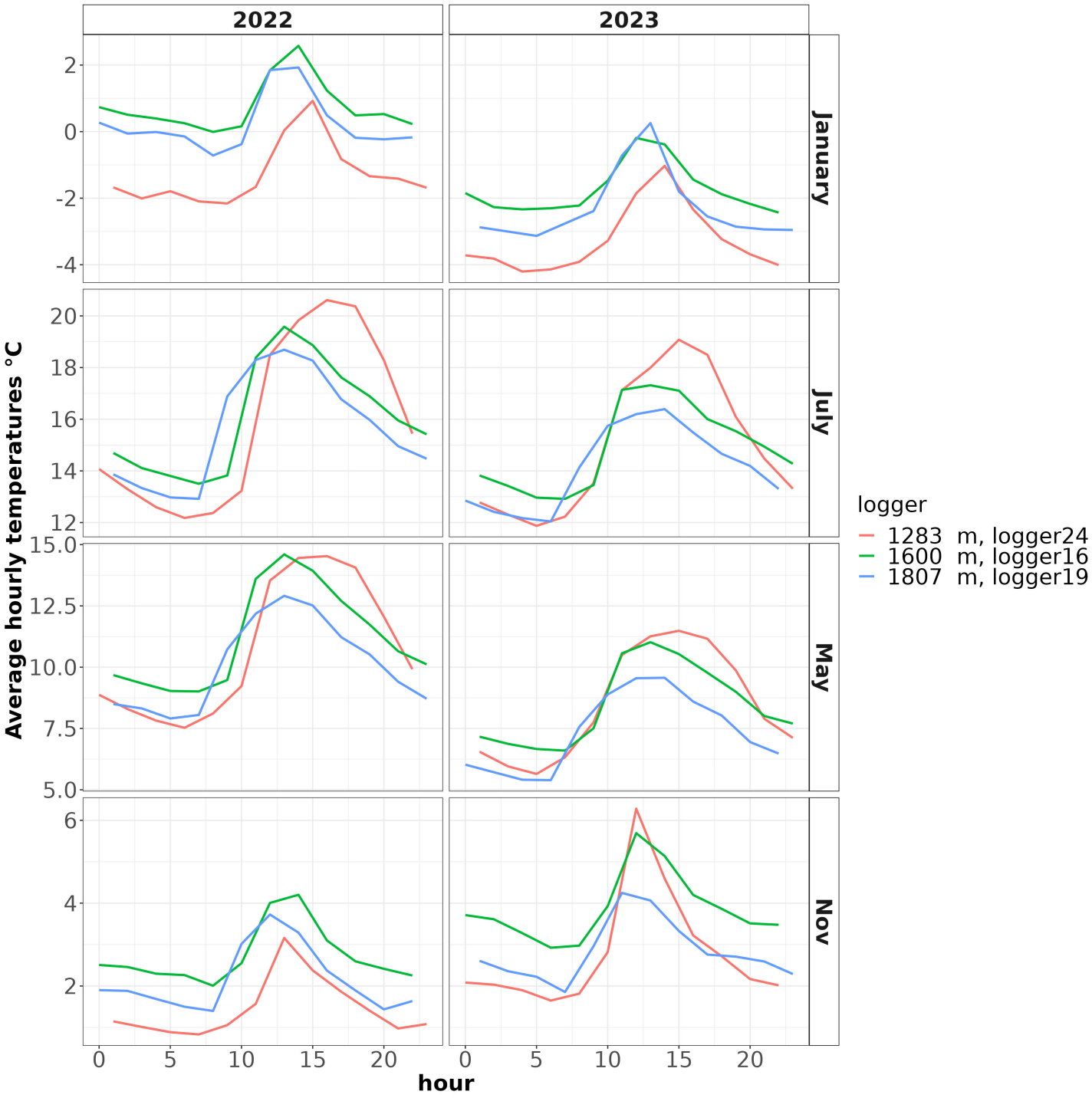

FIGURE 7 – Average daily cycle, for January, July, May and November, of temperatures at logger 24 (near Auberge), 13 (Alpage) and 19 (Savolaire crest).

id	Mat	ALT	LAT	LON	Commentaire
3	0	1340	46.243	7.105	Forêt – double de 4
4	1	1340	46.243	7.105	Forêt
5	1	1780	46.22866	7.09223	station La Chaux
6	0	2105	46.232	7.085	Col des Pauvres
montée à La Larze					
7	0	1405	46.251	7.116	Forêt
8	0	1470	46.25	7.116	Forêt
9	1	1584	46.248	7.114	Arbre isolé Mât cassé en octobre 2021
10	1	1700	46.245	7.111	Arbre isolé
11	0	1700	46.245	7.111	Arbre isolé -double de 10
montée au trou à l'Ours					
12	1		46.226	7.101	Forêt basse dans moraine
13	1	1477	46.232	7.102	Forêt peu dense
14	1	1530	46.235	7.1	Forêt
15	0	1530	46.235	7.1	Forêt – double de 14
16	1	1600	46.237	7.1	Forêt
17	0	1654	46.241	7.099	Forêt
18	1	1672	46.243	7.099	Forêt
19	1	1807	46.243	7.096	Forêt
20	0	1630	46.246	7.099	Forêt
Sous Cinglo					
21	1	1520	46.249	7.101	Forêt
22	0	1435	46.251	7.106	Forêt
23	1	1270	46.252	7.109	Forêt
Fond de vallée -Alpage					
24	0	1283	46.249	7.109	Arbre isolé vers auberge
25	1	1478	46.233	7.101	Piquet disparu
26	1	1522	46.231	7.099	Forêt
27	0	1531	46.23	7.104	Forêt
28	0	1478	46.233	7.105	Forêt
29	0	1412	46.238	7.105	Forêt
30	0	1328	46.246	7.106	Forêt