

Figure 1: Month in a minute video.

December 2024

Another big red-letter day for the Baileys.

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The theme for this month is extremes. 2023 was the warmest year we've measured on Earth. A big red-letter day for the climate. The last time the global average temperature was this high was 125 000 years ago (at least). It's likely modern humans have never seen a climate like the one we are in now. The more important point though is that 2023 will be one of the coolest we see by the end of the century. All years for the foreseeable future are likely to be warmer. Let that sink in.

At UVic December, 2023 was the warmest we've recorded since 2002. Table 1 lists the ten warmest Decembers (see also, Fig, 2). 2023 stands out! Even the average minimum temperature was warmer than the bottom sixteen values (not all shown in the table, see the figure).

What's the reason for this? Mainly, the global signal. It's been overwhelming this year. Fig. 3 shows the global picture. The orange

December at UVic			
Year	Minimum	Mean (SD)	Maximum
	°C	°C	°C
2023	6.0	8.07 (1.1)	10.0
2004	4.9	6.72 (0.9)	8.7
2002	4.6	6.49 (0.9)	8.2
2014	4.2	6.38 (1.1)	8.5
2019	4.7	6.29 (0.8)	7.6
2018	4.1	6.28 (1.1)	8.2
2020	4.4	6.22 (1.0)	8.1
2005	4.1	5.99 (1.0)	7.9
2010	4.0	5.86 (1.0)	7.7
2015	3.8	5.86 (1.0)	7.7

Table 1: Ten warmest Decembers.



Figure 2: December temperatures at UVic.

line is 2023. The three dashed lines are the previous climate normals, each warmer than the next. What's exceptional is the increase in the second half of the year. September, 2023 was $1.8 \,^{\circ}\text{C}$ warmer than the pre-industrial period. We've got months now that exceed the threshold agreed internationally. It won't be long before a year is recorded warmer than the 1.5 $^{\circ}\text{C}$ 'limit'. One year isn't enough to declare the limit exceeded but we know that what we observe in the present will be the cooler temperatures of the future.



Figure 4 shows the daily average temperature at UVic this past month, as well as the *average extremes*. The dashed lines show the averages over the entire record, since 2002. There were some brief periods of normal or colder than normal temperature but much of the month was warmer than expected.

The next figure, 5, gives the historical monthly temperature range, with the average for month marked with a diamond. These are the actual extremes of each month. That is, the warmest and coldest minute.

Figure 3: Daily Global Surface Air Temperature.

We see that it's not that unusual to have at least one warm observation in December. The temperature reached 14.85 °C on 2024-12-05, but the warmest observation in these records as 15.31 °C on 2014-12-09.



Figure 4: Daily average temperature at UVic.





Rainfall

Rain has been lower than expected in Greater Victoria for more than a year. In December this year we observed 99 mm at UVic. The rain fell over 20 days. This is above the average (since 2002). Both quantities are shown in Fig. 6. While many of us don't really enjoy the usual long periods of dark rainy days at the end of fall and the beginning of winter, we do value, and rely on, the rain to fill our drinking water reservoir in the wet season. Reservoir levels are shown in Fig. 7. The data show that we are still catching up, the level is still at the five year minimum level.







Figure 7: Sooke reservoir levels, cropped.

Just over half of the rain fell on three days, 2, 4, and 11 December. These correspond to atmospheric river events that swept along the coast of Vancouver Island. The December 4 event was documented on the NASA Earth Observatory site (Ref 1). The image they shared, of total precipitable water vapour is shown as Fig. 8. Atmospheric river is a good term for this phenomenon, and does have a good definition and a scale but I still like the old colloquial term, *Pineapple Express*. Information about the atmospheric river scale can be found in Ralph *et al*, 2019 (Ref: 2). A forecast of this phenomenon for our region is at Ref: 3.

- 1. https://earthobservatory.nasa.gov/images/152164/atmospheric-river-flows-into-the-pacific-northwest
- 2. https://doi.org/10.1175/BAMS-D-18-0023.1
- 3. https://cw3e.ucsd.edu/arscale/



Total Precipitable Water Vapor (kg/m²) 0 20 ≥40

Figure 8: This map shows the total precipitable water vapour in the atmosphere at 13:30 PST on December 4.