Reply to Reviewer 1(in green font)

Anonymous Referee #1, 20 Oct 2025
Summary: The manuscript presents an analysis of a newly discovered series of historical meteorological data comprising subdaily air temperature, wind and pressure taken by Charles Lewis Giesecke in Nuuk, Eastern Greenland, covering the period 1809-1813. The authors compare these observations with recent observations from the same location, analyse long-term changes in temperature and its connection to wind direction.

The main findings are that air temperature was almost always colder than in recent times, and that advection from the North-East played a more significant role than it does today. The colder temperatures agree with other indirect information derived from ice-core records.

Recommendation:

The study is interesting, as meteorological observations this old are very rare. The manuscript is, in my opinion, well and clearly written, although a few figures could be more clearly designed. There are some aspects that the study does not cover, and that could also be interesting for the reader, as I explained in more detail below. My recommendation is that the manuscript can gain from some moderate revisions, which are certainly feasible

Reply: Thank you very much for your suggestions. All were taken into account.

Main points:

1) Clarity of some figures. Figure 5, perhaps one of the most relevant in the study, is not optimally designed, making it difficult for the reader to skim the relevant information. My suggestion is to display the 1D and 2D spreads of the modern temperatures as coloured surfaces in the background, against which the mean of the modern and of the historical temperatures is plotted as dark lines
   Reply: Done

2) Similarly, Figure 9 could include the temperature levels as circles, instead of a linear scale on the y-axis as it is now.
   Reply: Done

3) Perhaps more importantly, the study is strongly focused on the mean annual cycle, and essentially all figures display in some way or another the mean annual cycle derived from the 5 years of observations. No figures actually show a time series over the period of observations, such as monthly or annual means. The period is admittedly short, but this type of information would be useful when discussing the purported impact of volcanic eruptions. For instance, this period includes the 1809 Tambora (?) eruption, less known than its 1815 counterpart, but nevertheless intense. The time series of annual means or monthly anomalies might provide insights into the impact of this eruption on temperature in Nuuk and its recovery in the following years. Also, the lack of any clear signal would be relevant. A time series of wind direction frequency could also be interesting, as eruptions have been suggested to impact the state of the NAO towards a more zonal state. Would this impact be visible in the wind direction data? Again, a positive or negative answer would be, in my view, interesting.

Reply: Thank you for this suggestion. Two new figures have been added (Figs. 5 and 6). The following text was added to the Result part:

Figure 5 shows the course of monthly average air temperatures in the study period to determine whether the strong eruption (the third largest since 1500) of an unidentified volcano at the end of 1808, and most likely at the beginning of 1809 (Vinther et al. 2006; Timmreck et al., 2021), influenced the air temperature in SW Greenland. A significant cooling in Nuuk occurred from the second winter after the eruption. This cooling occurred mainly in wintertime and persisted until the end of the series, but the greatest was in the expedition year 1810/11. Following the eruption, there was a notable increase in the frequency of calms and winds from the north-east sector, accompanied by a decrease in the number of winds from other directions, particularly those from the south-east and south-west sectors (Fig. 6).

And to the Discussion and conclusions part:

Our results presented in Fig. 5 confirm the existing finding of Vinther et al. (2006), i.e. the very cold weather in the first years of the 1810s. According to our data, an observed cooling occurred after 1809, initially small in winter 1809/10 and then significantly greater in the following three winters, 1810/11-1812/13. This cooling is also observed in data from paleoreanalysis (ModE-RA), but not in the data from the 20th Century Reanalysis (20CRv3). In summer, some cooling is evident only in 1811. As a result, the coldest expedition year after a volcanic eruption in 1809 occurred in 1810/11. Data series presented in Fig. 5 (except 20CRv3) also confirm Schneider et al.'s (2017) finding that after the 1809 event, temperatures remain low until the Mt. Tambora eruption in 1815. Changes in atmospheric circulation that occurred after this eruption, from a negative to a positive NAO indices in wintertime (see Luterbacher et al., 2002a, b), caused a change in wind directions in SW Greenland, i.e. (domination of winds from the northern sector, see Fig. 6). Positive phase of the NAO cause a significant decrease (3-6°C) of winter air temperature in the western part of Greenland in contemporary series of data, particularly in its SW part (see Fig. 12 in Przybylak 2000). A similar finding was recently presented by Faust et al. (2025, submitted; see their Fig. 4) for southwest Greenland, based on temperature reconstruction using a high-resolution sedimentary record, for the late Holocene.

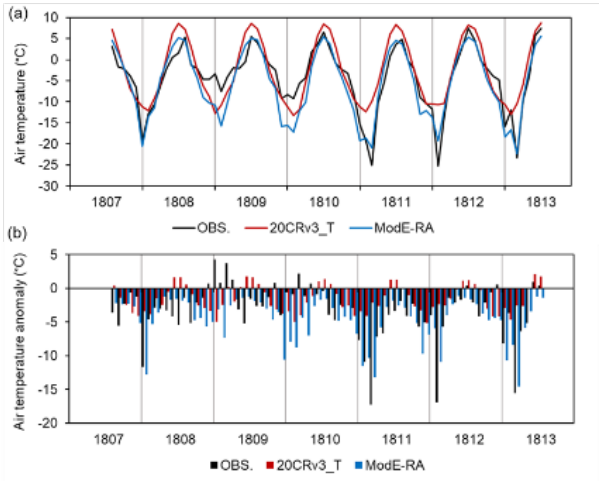

Fig. 5 (a) Time series of mean monthly air temperatures in Nuuk in the period 1807–13 according to different datasets, and **(b)** their anomalies in reference to the period 1991-2020. A large, unknown, volcanic eruption most likely occurred in early 1809.

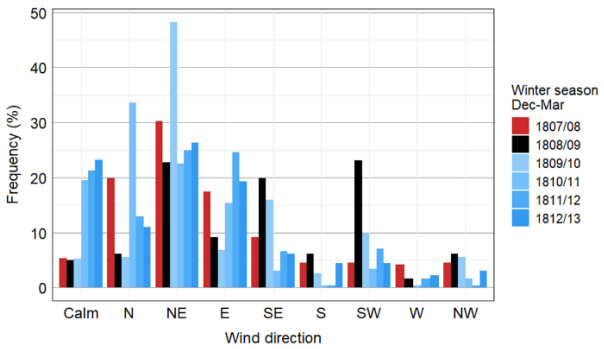

Fig. 6. Frequency of winds in Nuuk in the winter season (Dec – Mar) in particular years of the period 1807–13. In black, the year of the eruption of an unknown volcano

4) Following this time-series approach, another suggestion is to compare the monthly anomalies or annual means with those from the neighbouring cell in the 20CR reanalysis. The agreement probably cannot be expected to be good, but it would also be an interesting test for the 20CR reanalysis using independent historical observations.
Reply: Done, see new Fig. 5.

Particular points:

4) 'A cooling of this severity has previously been found for the study region, the whole of Greenland and the whole Arctic.'

The meaning of this sentence in the abstract is not clear to me, unless it refers to previous studies (?). If yes, please state it so.

Reply: Done

A cooling of this severity in the first decades of the 19th century for the study region, the whole of Greenland and the whole Arctic has also been earlier reconstructed by other scientists using different proxy data and models.

5) 'Intense volcanic activity and, to a lesser degree, the low solar activity connected with the Dalton minimum are most often given as reasons for the cooling of the early 19th century.'

I would be reluctant to include this sentence in the abstract, as it is actually not a conclusion of the present study. It can mislead the reader into thinking that this study also attributed the cooling to those climate forcings.

Reply: Thank you for this suggestion. You are right, this is based on the literature review. The sentence was deleted from the Abstract.

6) 'about the existence of long-term continuous meteorological observations'

What does 'continuous' mean here ? I guess daily temporal scales, but it is unclear.

Reply: Done. The sentence was changed to: 'about the existence of a long-term continuous series of daily and sub-daily meteorological observations'. We hope that the sentence is clearer now.

7) 'We calculated MDATs according to eight different formulas:'

I would have a suggestion that the authors may want to follow, although it is not critical. Instead of testing different links between subdaily measurements and daily means, a linear regression would yield the proper weights for the three subdaily data to reconstruct the daily mean

Reply: We can't really use linear regression because we don't know the exact times of measurement in the historical series. Therefore, we tested various possible variants of measurement times, including the morning, noon, and evening parts of the day to estimate the biases in comparison to the so-called real daily mean temperature (calculated from 24 measurements a day). If we knew the times of observation, we could perform a linear regression between the 24-hour average and the average of the known three measurement hours based on contemporary data and apply the regression formula to the historical series.

8) 'temperature between 5 and 25 February never rose above -20 °C, and between 19 and 25

February it was even above -30 °C'

I guess the authors mean that the temperature remains above -30 °C. The formulation is ambiguous

Reply: Yes. You are right. For clarity, we propose the following change to the sentence:

'temperature between 5 and 25 February never rose above -20 °C, and between 19 and 25 February it was constantly below -30 °C'

9) 'The question arises: What could be the reason for such great heating from one day to

the next? '

The authors suggest that föhn was responsible for this sudden warming. It seems plausible, but perhaps

One analogous situation can be found in 20th-century observations to support this hypothesis, possibly dating back to before the retreat of the ice sheet.

Thank you for this suggestion. We have conducted a search for such cases and concluded that.

although the entire series of temperatures from Nuuk (1873–2023) reveals that the maximum MDAT change from one day to the next was of 20.7 °C (from 7 to 8 March 1939), we cannot assume that the historical value of 35.6 °C is incorrect.

10) line 410 , consider opening subsections for wind, daily temperature variability, etc. It would later help the reader skimming the article.

Reply: Done, see the text

11) 'In historical times, the irregularity of thermal roses is..'

Perhaps not irregularity, but the deviation from circular symmetry

Reply: Thank you for the suggestion. We have changed 'irregularity' to your proposition, i.e., *deviation from circular symmetry*.

- **Citation**: https://doi.org/10.5194/egusphere-2025-4313-RC1

- **RC2**: 'Small correction on my previous comment', Anonymous Referee #1, 20 Oct 2025 reply

I meant, of course, 'Nuuk, Western Greenland'

Reply: Thank you.