

Interactive comment on “Ancient versus modern mineral dust transported to high-altitude alpine glaciers evidences saharan sources and atmospheric circulation changes” by F. Thevenon et al.

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General comments

The study of paleoclimate, and aerosol in this, and mineral dust specifically, is most useful to the community as well as interesting to read about. Thevenon et al. have done a proper analysis of the dust in CG ice core CG03. Some of their main conclusions are that the major dust events reaching the western Alps have been of saharan origin during the last millennium. Furthermore, that the last century has had larger dust

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depositions, due to changes in circulations patterns.

I find that the laboratory work appear well performed, and that many conclusions are probable. However, the way that some of the text is written, and the way that the argumentation for some conclusions is done require more attention for a correct scientific text, as defined by ACP "Evaluation Criteria". Furthermore, as some conclusions are more solid than others, I would much appreciate if the authors detail the conclusions that are, based on their data, suggested wording: "further work will investigate...", "speculation", "an hypothesis can thus be formulated..." i.e. not-so-sure, as a help for the reader. Below follows the examples on these points in detail, and minor spelling corrections. I hope sincerely my comments will be a help to improve the quality of the article to even better.

Specific comments

The title: - "evidences". Is this the properly chosen word here? It implies a much stronger meaning than the analysis in the paper shows, in my opinion. Contrast with this alternative formulation "Ice-core data during the last millennium shows mineral dust deposition from mainly saharan sources, changes can be attributed to circulation variability".

- At least I would require the title to define the time-frame. The dictionary has several meanings on "ancient", so the reader is not well-served (one being for instance "the earliest known civilizations and extending to the fall of the western Roman Empire in a.d. 476").

Abstract: "...did not change significantly..." Could you please quantify that in some way? For instance by showing the percentile required to encompass the modern JFJ samples with the CG samples (and by choosing maybe the worst case of the most important parameter - or a combination of parameters (Nd and/or Sr, palygorskite, kaolinite/chlorite ratio etc ?)). Perhaps detail such an evaluation in the results section?

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"north-central to north-western" is this a standard formulation for Sahara? Otherwise an alternative could be north-western quarter or similar?

"began ca. 20 years" This is difficult to understand. Is the date important, 1870? in that case write 1870 and remove the part "after the industrial revolution. . .". Is it important that it is exactly 20 years after? Is the industrial revolution what matters and 1870 not so much? The conclusion that the circulation changes depend on the industrial revolution 1850 (where? how?) is not very convincing, at least not in the way it is currently formulated in the abstract now. Please rephrase lines 15-20, into shorter sentences. Or do you mean, for instance, that the mineral dust deposited in the Alps is not mostly of a direct anthropogenic source the last century - but that is to most readers quite obvious?

1. Intro

p 862 l 6: "documented Saharan dust sources" How? I suppose you mean by the XRD (table 2)? It would be beneficial to state here.

- It would be beneficial to explain specifically which samples from JFJ were deemed to be of Saharan origin and how they were evaluated in the results or methods section.

3.2 Should not the equations be numbered and improved in formatting?

This section should be expanded on, perhaps you can explain a bit more thorough the methodology, and include relevant references.

See comment on fig.4 below.

4. Results

p 865 l 17: Higher EFs for Pb and Cs U are indications of anthropogenic influence according to that section. This must be detailed, and shown specifically for what time-frames, and be compared with also atmospheric as well as the crust concentrations (EF).

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p 866 l 20-24: The text states the similarity between Saharan dust in literature and the analysis shown from the paleodust, for "dusty" layers with $D_p > 1.5 \mu\text{m}$, concerning the Sr and Nd.

- The authors need to show the dusty layers more easily to the reader (as well as the "light-colored" the authors mention later). When I draw a line through $1.5 \mu\text{m}$, in figure 2 panel "mean mineral size", and read the corresponding time periods for events larger than this, would that be ALL dusty layers?

In lines 24 and the next paragraph you try to explain this. But it becomes slightly confusing: perhaps "saharan dust samples analyzed in literature" should be inserted in line 18-19?

Then, on p 867, l 1-5 you write that the conclusion for the reason to lower Sr last century is "intercontinental dust background properties . . . and/or anthropogenic". Here the conclusive wording is not warranted, I would advice to formulate a hypothesis and to work to verify that with more data onwards.

Then on p 867 l 5-13 the authors write that the aerosol surface area correlate positively with Sr, as well as with the "dusty layers" (fig 6). - Please mark and define the "dusty layers" for a reader to identify. - Moreover, it is not always the case that the surface area correlates with larger particles (for instance from fig 2 year 1690 and 1660 they anticorrelate), and it is possible that the surface area is generated by smaller numerous particles. Has this been considered?

Furthermore I have difficulty in finding how the surface area for the ice core samples are measured, and it would be proper for the reader to see that, as that connects the linear x-axis of the top panel (JFJ) with the bottom log-scale (ice core) for panel "PM10 / total aerosols" in fig 2!

The above mentioned section is: hard to read and to understand much due to the structure. Many figures are referenced all at once. Perhaps readability, and the arguments,

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and following conclusions would be easier, if each figure was introduced with proper explanation sequentially? fig 2 - fact; fig 3 - fact - literature; fig 4 - fact - conclusion etc.

p 868 l 12-24: This is a very interesting part of the paper, and could with advantage be expanded on with a few sentences explaining to a less specialist reader. . . this is the part of the paper where the shown results actually connect with the circulation. My comment is simply; it is based on the assumption from one paper Kang et al 2003. How sure where they, and on what timescales, as you compare periods of a hundred years or less?

Technical corrections

Table 2 and 3 - a reader would appreciate to have also the sample names (64, 66, 68 ,70 . . . E, F, G . . .) in these tables.

Fig 3. I cant separate the sample 1200-1300 AD from the yellow box named N and W African sources in the print-out. Where is what? They are BOTH circles with a cross in?

Fig 4. From that data (top panel) it appears as if P is present at JFJ (although the peak is not labelled)?

And a question on method: is it even remotely possible that in the lower panel, that the peak labelled Micas 003 could be actually Quartz 101?

— A side-note: there is, to my best knowledge, still high-volume samples, 24h, in the freezer at PSI, from a spring campaign during 2004. That might be interesting for you to analyze in a similar way. Dates of interest 15-20th March 04 (Sjogren et al., 2008), events identified with the method described in Collaud Coen et al., 2004. That could, for instance give a JFJ sample point half-way through the last solar cycle, roughly at max, although the European climate was quite similar 2004 and 2008-2009. Do not hesitate to contact me if this interests you, or contact directly the LAC at PSI.ch.

References

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