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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Sources and distribution of trace species in Alpine precipitation inferred from two 60-year ice core paleorecords" *by* A. Eichler et al.

Anonymous Referee #3

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This manuscript aims to compare the deposition records of two ice cores drilled in northern and southern parts of Switzerland Alps in view to extract relevant atmospheric information on (1) the geographical and temporal changes of deposits of chemical species; (2) the source regions influencing such Alpine sites. This highly complex topic has already been addressed before in several studies dealing with Alpine ice cores. To my point of view the present study adds no new relevant information and in fact on many aspects does not offer the guaranty on the reliability of such records for atmospheric chemistry (in contrast to what was done in a serie of recent papers having appeared in the JGR-Atmosphere).

This is mainly due to the following aspects:

1) There is no convicting assessment made concerning the reliability of the ice core records in term of their atmospheric relevance and therefore a major part of the conclusions are highly speculative. Indeed, several studies have shown that the interpretation of Alpine ice core records need carefully investigations of the accumulation characteristics at and upstream to the drillsite. Only if it is demonstrated that the ice record is largely free of local deposition artefacts the data can be used in terms of atmospheric information. In this manuscript this part is clearly missed. A comparison of the Grenzgletscher (GG) core with existing ice core data from the 1 km distant Colle Gnifetti site (not discussed in the paper) show very different and temporal trends. That represents a big problem when using such records to reconstruct atmospheric changes. As an example: data of SO4+, NO3-, and NH4+ (covering recent times back to the preindustrial period) published from the same group (Schwikowski et al., 1999; Doescher et al., 1995a; Doescher et al., 1995b) obtained on an ice core drilled at Colle Gnifetti, at a distance to the GG drillsite are not compared with this new ice core record, even this could be very interesting: e.g. Doescher et al, 1995 reports an increase of NH4+ from preindustrial to 1950 and rather unchanged levels from 1950 -1980, the here presented GG trend shows a very slight increase from 1940 to 1965, a sharp increase between 1965 and 1970, and a decrease from 1970 to 1980. So which record represents the atmosphere change?

2) Methods deployed for data processing are partly applied without precaution. For example: seasonal cycles of the chemical snow deposits are presented for the GG core on the base of the seasonal cycle of stable water isotope, which represents the temperature of the precipitation and not (as stated by the authors) the air temperature. The seasonal pattern of the stables isotopes shows roughly same shape than the seasonal cycle of air temperature (as shown for Gr. St. Bernhard in the manuscript and as observed for Jungfraujoch). However if a rough conversion from permille to °C is made for the GG ice core (not made in the manuscript!!) this would result in a seasonal air temperature variation of 6°C at the drill site. This is very different compared to what is observed at Gr. St. Bernhard (12°C) and at this thigh Alpine site (ca. 20°C). This

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discrepancy may indicate that (a) there is no year round accumulation with a lack of winter snow, (b) that the isotope signal has diffused. Whatever, obtained winter levels are about 4 times higher than what was observed until now at such high Alpine sites, including again the adjacent site Colle Gnifetti (e.g. Preunkert et al., 2000; Doescher et al., 1995; Legrand et al., 2002). And in spite of these discrepancy of deposition data, authors use this seasonal signals and winter values to derive atmospheric relevant conclusions. 3) In addition conclusions presented in this paper are partly made without taking into account the complexity of source and precipitation in continantal regions (origin of cations). An example: In this manuscript Ca2+ , and Na+ are assumed to be tracers for dust and for sea salt inputs, respectively. Based on this statement, it is concluded that the increase of Na+ observed in the 1960s for summer and winter depositions in the Fiescherhorn (FG) is due to a climatic change (increased sea salt transport via westerly winds due to increase of frequency of zonal weather patterns). On the other hand, Legrand et al., 2002 observed no such increase for Na+ within their ice core study at Col du Dome (4250 m asl, Mont Blanc massif), a site located at the extreme western part of the Alps, which should also record such kind of climatic change if it exists (not discussed in the manuscript). Further, in contrary to what is stated here, Legrand et al., 2002, showed that high Alpine Na+ deposition are not exclusively derived from sea spray but have various origins including soil emission which make up 50% of the Na+ depositions in summer. Thus it is absolutely not to exclude that the observed increase for Na+ in the FG core is linked with an increase of soil derived Na+ at the drill site FG induced by changes of local emissions around the drillsite (not discussed in the manuscript).

4) Also recent atmospheric circulation data (EMEP -study of long range transmission of air pollutants in Europe) are not adressed, and detailed historical emission inventories for NH3; and NOx (Van Ardenne et al., 2001) exisit in contrary to what the authors claimed.

5) A good part of interpretation made for the FG core and for the Monte Rose summit

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area (which includes the GG site) are already published by Schwikowski, et al., 1999a, and b; Doescher et al., 1995a; and b.

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