

Comments from LEGRAND Michel on the manuscript from OSMONT Dimitri and co-workers

The paper presents the first long-term continuous and high-resolution refractory black carbon (rBC) record extracted from ice cores drilled in Svalbard and covering the last 800 years. The record is discussed in terms of anthropogenic (fossil fuel) emissions as well as past biomass burning (boreal fires) occurrence. The contribution of biomass burning to the rBC variations is addressed with complementary information from other potential proxies of biomass burning including ammonium, formate, vanillic and p-hydroxybenzoic acids.

Data on black carbon in ice deposits in the Arctic basin are definitely of major interest when considering our future climate. Past frequency of boreal fires also are of importance since boreal forest is an important carbon reservoir and experiences natural fires of which the severity is expected to change with the on-going global warming. At the opposite to Canadian fires, Siberian fires are far less documented except for the very last decades (satellite data). The Svalbard experiencing air masses from Siberia and to a lesser extent from Europe and North America, this paper provides new information together with those recently extracted from the Akademii Nauk on Siberian fires over the past. The paper is therefore of great interest for scientific communities working on forest fire records in ice cores and lake sediments as well as for the general topic of climate/fire conditions/vegetation interactions.

Overall the manuscript is well organized and clearly written. The discussion of data is very well conducted, and I enjoyed reading it. I therefore recommend publication of the manuscript, after authors consider the following (minor) points rise below.

**Evaluation:**

Among others, I identify two very positive aspects in this paper:

Inherent to this region, present climatic conditions may, in some extent, disturb the ice record. This difficulty is well addressed in the manuscript.

I would like to congratulate the authors for reporting and discussing together several potential biomass-burning proxies (too many previous studies only focusing on one or two proxies).

**Minor points:**

Section 3.2.1:

Line 4: "Inflection point": please reword.

Line 9: You can also cite here the work from McConnell.

Line 26: remove "aerosol" since nitrate is partly in the form of gaseous nitric acid.

Equation 2: why this use of molar ratio: why not mass ratio (0.25) ??? (all your data are in mass concentrations)

### Section 3.4

Lines 35-39: I think the reference is here is not adequate: the year 1994 is not exceptional because documented by Dibb et al. in terms of back-trajectories. May certainly be more useful here to say that “the year 1994 was marked by a high fire activity in Canada (6.08 MHa burnt, see Legrand et al. 2016 for the complete references of data that I copied below). By the way, that permits to compare with your following discussions on 1980 and 1981.

Data on area burned in Canada are available since 1920 (Van Wagner, 1988) and became more accurate after 1959 with the Canadian National Fire Database (Canadian Forest Service, 2015, National Fire Database – Agency Fire Data, Northern Forestry Centre, Edmonton, Alberta; <http://cwfis.cfs.nrcan.gc.ca/ha/nfdb>) providing precise fire location, start date, and final size (Stocks et al., 2003).

Lines 15-26, second page: I like this discussion.

Line 24, second page of this section: “secondary production of formate (from formaldehyde) is possible : Please add « formaldehyde and numerous volatile organic compounds including alkenes for instance (see Figure 1 in the review from Legrand et al. (2016)” is possible.

### **End of the review**