F. Parrenin (Referee)

The original text of the comment is black, the answers are blue.

This manuscript studies the regimes of precipitations and their stable isotopic composition at Dome Fuji (East Antarctica) based on 1-year observations and on modeling (AMPS, ECHAM5-wiso and MCIM).

It is found that 60% of the precipitations were caused by synoptically-induced events, while the remaining 40% are due to diamond dust (although these numbers depend on the definition used for synoptic precipitation and diamond dust).

The synoptic situations were analyzed and classified in 5 categories, with the most common being an upper-level ridge that extends onto the Antarctic plateau and causes strong northerly advection from the ocean.

A mean source of precipitation centered at ∼55◦S was determined.

MCIM was able to reproduce the seasonal cycle of deuterium, O-18 and deuterium excess, but the isotopic fractionation was on average underestimated, even after tuning the model. ECHAM5-wiso was on average closer to the observations, but it could not reproduce the seasonal cycle of excess. This is problematic for using this kind of GCMs equipped with isotopes to interpret the deuterium excess records.

This study has consequences for ice core interpretation. It is indeed found that the relationship between d18O and surface temperature is higher for precipitations events that for diamond dust. This is an important conclusion regarding the use of the isotopic paleo-thermometer.

It is also found that deuterium excess does not have any clear link, neither with relative humidity, nor with sea surface temperature at the moisture source. This challenges the use of excess to reconstruct source conditions.

Before giving my comments, I should state that I am not an expert of atmospheric processes. So I am not well aware of the recent bibliography regarding atmospheric processes in Antarctica, although the current study gives a good overview of previous works in its section 2. That being said, I found this manuscript particularly easy to access for a non-specialist. Everything is very clear and accessible.

As an ice core scientist, I found that this study has important implications regarding the use of isotopic composition of ice to reconstruct past temperature and snow accumulation conditions at the site of deposition. For example, the correlation between snow isotopic composition and surface temperature is weak for diamond dust, which represent almost half of the precipitations at Dome Fuji. Also, the corrections based on deuterium excess applied to reconstruct past temperature variations seem to be not appropriate. Overall, I found that this study is almost ready for publication.

We thank the referee for his positive review. We address each comment below.

Minor comments :

- p. 2, l. 11-12: "In the light of .. fluctuations (Masson-Delmotte et al., 2006)" I would place this sentence right at the beginning of the introduction.

We changed this in the revised manuscript.

- p. 2, l. 27-28: "Noone et al. (1999)" -> "(Noone et al., 1999)"

We corrected this in the revised manuscript.

- p. 5: Please better explain what is "Rayleigh-type model", "trajectory model", "simple isotopic models".

Rayleigh-type models belong to the simple isotopic models. The explanation was improved in the text (p.5,l15):

To reconstruct information about the temperature both at the deposition site and at the source region, simple Rayleigh–type models are used. These models consider the fractionation in an isolated air parcel using only moisture source and condensation conditions as input. They do not include dynamic processes or turbulent mixing. In a pure Rayleigh model it is assumed that the condensate in the cloud is immediately removed by precipitation after formation (e.g. Merlivat and Jouzel, 1979). In other simple models (e.g. Ciais and Jouzel, 1994), the fraction of the condensate that is precipitated can be chosen.

p.8,l.10 was shortened to:
Generally, two types of isotopic models are distinguished: Rayleigh-type models (see above) and isotopic GCMs (e.g. ECHAM5-wiso, Werner et al., 2011), which include an explicit representation of stable water isotopes into a three dimensional atmospheric model.

- p. 6, l. 28: dot after "2009)".
We corrected this in the revised manuscript.
- p. 8, l. 1-3: what is the chosen value for n?
For simplicity's sake, RIP does not define a threshold for convergence, but simply does two iterations for each time step, which turned out to be exact enough in the praxis for our purposes. The time step we used was 600s.
- p. 12, l. 21-23: I did not understand why the arrival level of precipitations is not determined by the model.
AMPS archive data were used to determine the best approximation of the mean arrival level. In order to determine the exact arrival level for each case the lifting condensation level has to be determined, for which the model data are not accurate enough because of the low humidity of the atmosphere above the Antarctic plateau.
- p. 13, l. 21: "rout" -> "root"
We corrected this in the revised manuscript.
- p. 14, l. 28: "cantered" -> "centered"
We corrected this in the revised manuscript.
- p. 15, l. 27-28: "contrary to the assumption used for decades in ice core studies..." I am not sure this was really the assumption made in ice core studies. Ice core scientists simply said that the isotopic composition of precipitation is linked to the site minus source temperature difference, and not to the site temperature alone.
The isotopic composition of precipitation is mainly linked to the temperature difference between source area and deposition site. However, quite a few studies consider not only this difference, but also the geographical location of the moisture source. For the site temperature, the warm air advection described in our study is usually not taken into account in those studies.
We changed our formulation as follows and gave an additional reference:
Contrary to the assumptions used for many years in ice core studies (see Jouzel, 2014 and references therein)….