RIGC, Yokohama, Japan

November 18, 2009

Dear Anonymous Referee 1,

Thank you for your comments on the paper *"Sensitivity of ensemble Lagrangian reconstructions to assimilated wind time step resolution"*.

We have addressed your concern of the lack of statistical representativeness of a single profile. We have used a series of suitable profiles from the SHADOZ database. The stations of Ascension, Fidji, Irene, Reunion and Samoa where chosen due to their distance to the equator comparable to Bauru. They are distributed in the subtropics and tropics in both hemispheres and different longitudes. As for the suggestion of performing the same analysis at different times of the year, it has to be taken into account that this analysis, originally conducted for the Hibiscus campaign (Brazil, 2004), required a special archiving of hourly winds with a branch of the ECMWF model. Such experimental winds exist only for the January and February 2004 and this period could not be extended within the scope of this work. Hence the analysis has been focused on the period for which the winds are available.

The single profile presented as motivation for the geometrical analysis was not intended to derive robust statistics from it, but is given as a case study in which the meteorological situation shows a clear extratropical intrusion that produced a thin lamina at about 17 km. This allows to assess the effect of different advecting wind fields on the diffusive reconstructions associated with synoptic scales based on a well documented case study (Pisso and Legras, 2008).

Also, the original motivation of the work was not only the calculation of diffusive reconstructions or the description of the method (which is referenced in the paper) but the application of the reconstructions to set out a tool adapted to assess the representation of atmospheric flows by time series of 3D meteorological wind fields. The geometric information contained in such time series can be exploited with the help of Lagrangian trajectories.

The selected profiles from the SHADOZ database have been reconstructed using 1, 3, and 6 hourly winds in addition to the newer ERA Interim reanalysis for further comparison. Instead of a case by case description of particular features such as intrusions (absent in the majority of the cases) the integrated O_3 along the profile was statistically compared with the observations as in Pisso et al. (2009) [1].

The results obtained with one hourly winds yield sligthly more accurate reconstruction than the 3 hourly winds, although the gain in performance is smaller than the passage from 6 to 3 hourly winds. There are even days in which the

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[1] Pisso, I., E. Real, K. S. Law, B. Legras, N. Bousserez, J. L. Attié, and H. Schlager (2009), Estimation of mixing in the troposphere from Lagrangian trace gas reconstructions during long-range pollution plume transport, J. Geophys. Res., 114, D19301, doi:10.1029/2008JD011289.

3 hourly winds outperform the 1 hourly winds. The improvement from 3 to 1 hourly winds is similar to that obtained from 3 hourly operational to 3 hourly ERA-Interim winds.

The new results are consistent with our original conclusion. Increased temporal resolution provides better results thanks to the better description of the mesoscale motions but when synoptic scale motions are mainly at the origin of the formation of the structures such increased time resolution has a less noticeable effect. On the other hand, the same range of improvement can be obtained with changes in the model alone.

Specific comments:

Page 8620 The paragraph was changed and references to the literature related to trajectories in the troposphere have been added.

Section 2.2

Information about the length of the trajectory calculations has been added for the HIBISCUS and SHADOZ profiles at the end of section 2.2 and the reference to Pisso and Legras was corrected (in that paper only standard 3 hourly winds were used).

During the early stage of this work in was found somewhat unexpectedly that such an increase of time resolution yielded a small change in the description of the large scale structure described before. This leads to the concern that a CFL-type condition could be being violated and it was found that the increase in spatial resolution would ensure that both temporal and spatial increases were balanced. Even increasing time resolution the change is unnoticeable in the peak corresponding to the intrusion although in layers immediately above the quality seems to worsen. The small change suggests that in this case the increase of both temporal and spatial resolution does not yield a significant amount of information discarding the errors associated with the noise and the information overhead due to oversampling. For this reasons we believe that this tool has potential applications in the context of data assimilation.

For the SHADOZ profiles all the wind fields have been used with a consistent horizontal resolution of $1° \times 1°$ in order to assess the changes due to the time resolution and to the assimilation scheme.

Fig. 2 : The suggested change has been done and figure 2 has been corrected.

Page 8624: The change has been introduced.

Page 8625: The word 'support' was used in its mathematical sense i.e. the set of points in which a function or distribution is nonzero. The paragraph was rewritten to ease its reading, the word support has been replaced by 'space

occupied by'.

Yours sincerely,

The authors