Reply to Referee#2

We thank Anonymous Referee #2 for providing useful remarks on the manuscript.

The English syntax has been re-checked by native English-speaking co-authors.

Title/Abstract: Since this article is submitted to the NDACC 25th anniversary Special Issue, it would be suitable to explicitly cite NDACC either in the title, or in the abstract (when presenting the OHP lidars).

The first sentence of the abstract was modified: "…obtained by two independent regularly-maintained lidar systems operating within the Network for Detection of Atmospheric Composition Change (NDACC)."

Section 2.3: Are all extinction coefficient conversions factors (ke) using the same reference of Jäger and Deshler (2002; 2003)? Please specify if so.

The value of wavelength exponent depends on the wavelength pair. For the 355 nm - 532 nm pair *ke* value was adapted from Jager and Deshler (2002). The same value (*ke*=-1.6) was used for SAGE II (525 nm) and GOMOS (550 nm), for which the wavelength conversion means multiplying the extinction by a factor of 0.979 and 1.055 respectively. For OSIRIS (750 nm) and OMPS (675 nm) the wavelength exponents were suggested by the instrument PIs.
Following a suggestion of Referee#1, a new table (Tab. 1) containing information on the wavelength exponents κe used for conversion of all data set was added to Sect. 2.3.

Line 200 and Fig. 1: The number of CALIOP samples is much larger than the number of samples from the other instruments. Why not restricting the CALIOP coincidence window within the OHP region instead of the full zonal-mean? This would (maybe) improve the agreement with the lidars, for example during the periods 2007-2008 and 2010-2011.

Measurements of stratospheric aerosol by CALIOP, particularly during background conditions have a low signal to noise ratio and require substantial averaging to be useful. On a monthly-mean scale the aerosol loading in the stratosphere, even under active volcanic conditions is rather uniform thanks to a strong zonal flow. This is confirmed by a strong correlation and high degree of agreement between all the sAOD series.

Please note also that the OHP lidar data have been reprocessed over the course of paper revision (see Author comment in ACPD, AC1 "Reprocessing of the OHP lidar data and related changes to the manuscript"). This has improved the qualitative results of intercomparison between $sAOD_{1730}$ from OHP lidars and CALIOP (see updated Tab. 2, former Tab.1). For example correlation between LiO3S and CALIOP has increased from 0.85 to 0.91. The mean difference between LTA and CALIOP is -0.4 ± 1.7% with correlation of 0.96. Such figures leave very limited room for further improvement of the agreement.

Fig. 1: Can the aspect ratio of this figure be less elongated (more square) in order to distinguish the various measurements from each other?

The aspect ratio of Fig. 1 has been reduced.

Lines 285-287: Fig. 3 does not really show a difference in the e-folding rate for Sarychev and Nabro, it looks more like the background level after Nabro (late 2012) is simply higher than that after Sarychev (early 2010). The authors refer to time-series from CALIOP and OSIRIS . Can they refer to specific publications?

While it may occur from Fig. 3 that the decay time of volcanic aerosol after Sarychev and Nabro eruptions is about the same, sAOD after Nabro decreases to 1/*e* of the peak sAOD value only after 19 months according to the zonally-averaged satellite series. Over the course of the year 2012, the remnants of Nabro aerosol are still residing in the stratosphere and this period is classified as volcanically-perturbed. The "true" background level is achieved only in early 2013. The duration of the volcanic period associated with Nabro eruption is determined using the criteria described in Sect. 4.4 (former Sect. 4.1). We could not find in the literature any concrete statements regarding the full lifetime of Nabro aerosol at mid-latitudes, however the observations provided here serve well to address this question.

Lines 329-330 and fig.3: How do the monthly-mean sAOD uncertainties compare with the 1-sigma threshold level set to determine what is quiescent and what is not? Although there is a risk to overload Fig. 3, it would be interesting to overplot vertical bars to denote +/- 1 standard uncertainty for each monthly mean sAOD sample plotted. In any case, some text should be added to discuss the relative magnitude of this uncertainty and the 1-sigma threshold value. This will determine whether the observed increase can be considered statistically significant or not.

The average standard uncertainty for the monthly-mean values of $sAOD_{1730}$ from OHP lidars amounts to 4.8% (LiO3S) and 3.5% (LTA). The 1-sigma threshold level for the "reference" quiescent periods computed on the base of monthly mean values is 12.6%.

The sentence in the first paragraph of Sect. 3 was modified to explicitly mention the standard errors of monthly-mean values from OHP lidars: "The average error for monthly averages of OHP lidars' $sAOD_{1730}$ amounts to 4.8% (LiO3S) and 3.5% (LTA)."

Following a similar remark from Referee #3, the sentence in the end of the second paragraph in Sect. 4.1 (former Sect. 4) was modified as follows: "According to the mean of OHP lidars, the average background $sAOD_{1730}$ for the "reference" quiescent period of $2.37 \cdot 10^{-3} \pm 12.6\%$ (1σ), which is marked in Fig. 3 by dashed line and grey shading, indicating ±1-σ range of values. SAGE II reports $sAOD_{1730}$ for the same period of $2.4 \cdot 10^{-3} \pm 10.2\%$."

Lines 440-441: See above comment on line 200: For CALIOP, it would make more sense to use an average over a longitude band centered over OHP (e.g., +/-20 deg) rather than a full zonal mean.

After reprocessing of OHP lidar data (please see AC1 for details) it was possible to extend the lower boundary of all the plots showing aerosol vertical distribution below 15 km. The updated Fig. 7 shows better the signatures of ATAL, both in OHP and CALIOP panels, rendering the interpretation less ambiguous. Restricting CALIOP data to a limited longitude band would not necessarily enhance the ATAL signal. As stated in Sect. 3 (Intercomparison of OHP lidars and satellites sounders), the coherence between lidar and satellite series suggests that the stratospheric aerosol burden is zonally-uniform at least on a monthly-mean scale. This is explained by the presence of strong zonal winds in the stratosphere, which rapidly homogenize the aerosol and tracers in the zonal direction. OHP is under influence of Asian monsoon circulation during July-September season. In October, the mean zonal flow intensifies at the level of ATAL as can be seen in Fig. AR2.1, and stratospheric aerosol becomes zonally-uniform at OHP latitude.

Last Paragraph (Lines 558-563): The authors should also emphasize on the critical need for ground-based lidar observations in the next decade, as there will possibly be a gap in aerosol profilers from space after CALIOP has ceased operation.

The last paragraph has been updated with the following sentence:
"The need for continuous ground-based observations becomes critical as there may be a lack in space-borne aerosol measurements after CALIOP has ceased operation."

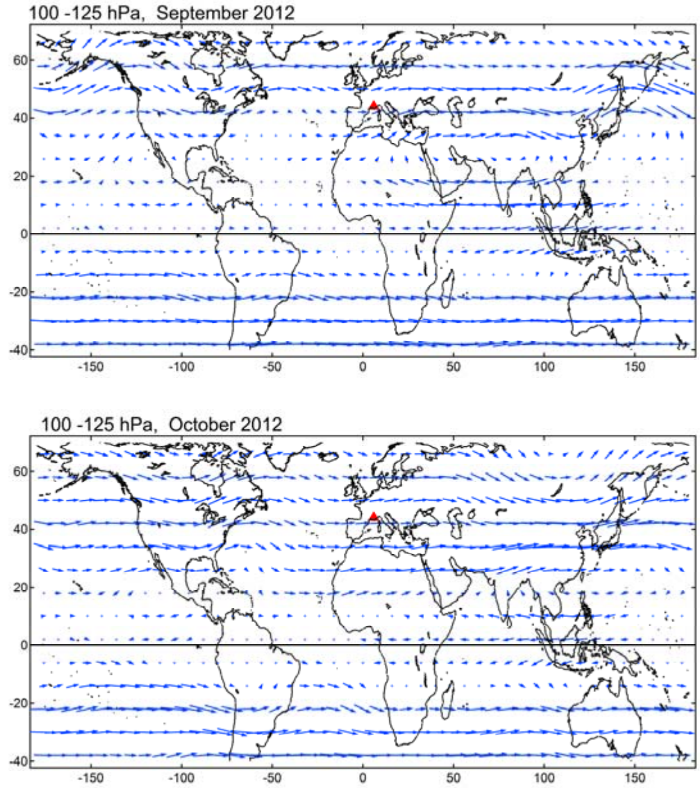

Figure AR2.1 Wind field at 100-125 mBar level from ERA-Interim reanalysis during September (top) and October (bottom) 2012.