Atmos. Chem. Phys. Discuss., 12, C12003–C12009, 2013
www.atmos-chem-phys-discuss.net/12/C12003/2013/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Observation of horizontal winds in the middle-atmosphere between 30 S and 55 N during the northern winter 2009–2010" *by* P. Baron et al.

Anonymous Referee #1

Received and published: 25 January 2013

General Comment

The paper "Observation of horizontal winds in the middle-atmosphere between 30S and 55N during the northern winter 2009-2010" by Baron et al. describes wind observations of the SMILES instrument in the approximate altitude range 20-80km.

Observations of this kind are an important contribution for a better understanding of the middle atmosphere. In particular, SMILES measurements cover the upper stratosphere and the mesosphere where direct wind observations are sparse and thus observational constraints for global models are missing. The potential of these observa-

Full Screen / Esc
Printer-friendly Version
Interactive Discussion
Discussion Paper

tions is demonstrated by comparison with ECMWF operational analyses for the time period October 2009 until December 2010: Good agreement is found at low altitudes. However, at high altitudes considerable differences are found.

The manuscript is very well written, contains significant new information, and is of interest for the whole atmospheric sciences community.
The manuscript is recommended for publication in ACP after consideration of the minor comments given below.

Main comments are:

- more information about the zero wind correction should be given
- more information about the used ECMWF model versions should be given

For details see below.

Minor Comments

1. p.32475, l.3: this statement is too general, wind observations from radiosondes cover altitudes up to about 30km
   suggest to add: "..., in particular at altitudes above 30km."
2. p.32476, l.19: It is not true that all equatorial waves are "non-geostrophic motions"!
   There are also Rossby-type equatorial wave modes, and even the wind field of

ACPD
12, C12003–C12009, 2013

mixed Rossby-gravity waves and Kelvin waves is partly geostrophic, in particular for the low zonal wavenumbers (see Matsuno, JMSJ, 1966).
It is however true that it is difficult to derive the larger scale wind fields using the geostrophic assumption in the tropics because the Coriolis parameter vanishes at the equator and the solutions become numerically unstable.
This has also an effect on wind estimates and wind climatologies that are using the geostrophic assumption. See, for example, Fleming et al., ASR, 1990 (CIRA-86).

3. p.32477, l.11: LOS winds from MLS are derived not only at altitudes 80-92km. Results are shown for the altitude range 70-92km (see Wu et al., 2008). However the precision at altitudes below 80km is much worse.

4. p.32478, l.7: What do you mean by $\pm 10^{\circ}$?
The explanation comes later in the manuscript, but here this causes confusion and could be mistaken as geographic latitude range.
Maybe just omit. Or briefly explain here.

5. p.32480, l.5: Again, what do you mean by $\pm 10^{\circ}$?
Please state more clearly that only orientations of the LOS are used that do not deviate by more than $\pm 10^{\circ}$ from the exact zonal and exact meridional direction, respectively. Because of the geometry of the instrument field of view in relation to the ISS orbit the LOS winds during the ascending (descending) portion of an orbit are almost in meridional (zonal) direction.

6. p.32480, ll.5–11: How large are the wind errors that result from not exactly meridionally or zonally oriented LOS?
Is this error contained in the error budget of Fig.3 (discussion on p.32481)?
Perhaps refer also to the discussion in Sect. 2.4.

7. p.32480, ll.9–11: Would it be possible to derive zonal and meridional winds for

ACPD
12, C12003–C12009, 2013

the whole latitude range by introducing corrections for the rotation of the LOS direction? This would be an important information for future instrument design.

8. p.32481: It should be mentioned that ECMWF operational analyses change from time to time, and that this has important consequences for the quality of ECMWF analysis winds. Please include the following information:
   There are two important changes in the ECMWF setup that are relevant for the SMILES data measured from October 2009 to April 2010:
   (a) on 8-Sep-2009 ECMWF cy35r3 was introduced:
   In particular, the mesospheric winds were significantly improved by using a nonorographic gravity wave scheme (Orr et al., J. Climate, 2010).
   Maybe this is the reason why ECMWF winds are already in gross agreement with SMILES, even in the mesosphere. Comparison with previous model versions probably would have been somewhat worse. This shows the importance of SMILES-like observations as a reference for model data.
   (b) on 26-Jan-2010 ECMWF cy36r1 was introduced:
   The main change is a general increase of the horizontal model resolution.
   In particular, the resolution of the deterministic forecast and analysis model was improved from T799 to T1279. Do you see any effects of this change when you compare to SMILES observations?

9. p.32482, l.15: Does the zero-wind correction derived from equatorial observations also hold at higher latitudes?
   Is this zero wind correction also valid for zonal winds?
   Please state more clearly!

10. p.32483, l.10ff: For the zero wind correction using ECMWF winds may currently be the best way to do, and ECMWF winds in the mesosphere may have improved since the inclusion of a nonorographic gravity wave scheme. However the meridional winds in the mesosphere will still not be fully realistic. As far as I know

ACPD
12, C12003–C12009, 2013

they are not even validated so far. Therefore I wonder whether it would be possible to use zero winds derived at lower altitudes also for higher altitudes to avoid ECMWF winds above 50km.
Please note that wind observations entering the ECMWF assimilation system are limited to altitudes of about 30km and below. Above this altitude winds are more or less the dynamics of a free-running model, in particular at low latitudes, as already stated in your introduction.

11. p.32483, l.25: ERA-40 is based on a rather outdated version of the ECMWF model (the IFS version cy23r4 used from June 2001 until January 2002 with some modifications). Therefore ECMWF winds may have improved meanwhile. Nevertheless, the main findings by Baldwin and Gray (2005) may still be valid.

12. p.32484, ll.7–9: What is the averaging time period for the wind altitude profiles shown in Fig.5?

13. p.32485/6: the zero wind profile is derived how often? daily?

14. p.32486: What about tides and other waves that might not be represented correctly in ECMWF data, in particular in the mesosphere? These waves could also contribute to the standard deviation of the SMILES-ECMWF differences.

15. p.32487: Does it make sense to calculate mean differences between ECMWF and SMILES averaged over November-April? There may be a seasonally dependent bias in ECMWF that should be larger when winds are stronger (DJF).
This may also be important for meridional winds.

16. p.32488, ll.4/5: improve ECMWF winds...
Please be more specific! How do you think SMILES could contribute?
Perhaps tune the model dynamics to match SMILES for the period of SMILES observations and then assume that this tuning also holds for other periods?

ACPD
12, C12003–C12009, 2013

Or are you thinking of SMILES-like measurements that might become operational in the future and their winds could be directly assimilated into ECMWF?

Further, I think that not only in the tropics, but also in the mesosphere in the extratropics SMILES might be useful to improve ECMWF winds. There are already applications for data assimilation in the mesosphere, for example, Polavarapu et al., QJRMS, 2005 or Eckermann et al., JASTP, 2009.

By comparing to SMILES observations one could also think of a further improvement of the gravity wave scheme used in ECMWF.

17. p.32491, l.16:
At the stratopause (1mbar) the zonal wind in November is only 20m/s in Fig.11, not 40m/s. Same in April: only 20...30m/s, and not 40m/s.
Please check!

18. p.32492, l.25: The statement in this line is not generally true! The SAO amplitude at 60km is about the same as in the NH stratosphere; "much smaller" is only valid for the SH stratosphere.
Please check!

19. p.32493, l.4ff: The diurnal tide is aliased with a period of two months... This means that the sub-structures seen in the SAO at the equator (Fig.12) might be due to diurnal tides. For example, the diurnal westward tide has notable amplitudes also in the stratosphere (Mukhtarov et al., JGR, 2009).

Technical Comments:

1. p.32502ff: please use larger fonts for all figures, where possible

2. p.32477: zonal-winds → zonal-wind

ACPD
12, C12003–C12009, 2013

Interactive Comment

3. p.32477, l.25: at at → at
4. p.32478, l.14: winds analysis → wind analysis
5. p.32479, l.7/8: capitalization in "superconductor-Insulator-superconductor" looks strange
6. p.32479, l.23: three winds profiles → three wind profiles
7. p.32480, l.13: semi → semidiurnal ??
8. p.32486, bottom: O3 lower and HCl upper panels ???
9. p.32487, l.5: ...as in the previous...
10. p.32488: in November and February → from November to February ??? the latitude range is extended southward in Fig.9 over the whole period, please check! (coverage is always 30S-60N, only in Oct. and Apr. reduced to 20S-60N)
11. p.32489, ll.10/11: sounds odd, please check!
12. p.32492, l.3, suggestion: Southern (left column) and northern tropics (right column) are shown
13. p.32492, l.13: this statement is somewhat confusing, suggestion: "the variation range within time intervals as short as about 1 week"
14. p.32493, l.10: winds products → wind products ?
15. p.32494, ll.3/4: What do you mean by "...using the O3 line signal enhanced during night time."?
16. p.32496, l.21: doppler → Doppler

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 32473, 2012.