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Comment

## ***Interactive comment on* “Transport analysis of ozone enhancement in Southern Ontario during BAQS-Met” by H. He et al.**

**Anonymous Referee #2**

Received and published: 2 September 2010

### OVERALL REVIEW

This draft paper analyses some case studies of stratosphere-troposphere exchanges during the BAQS-Met campaign in Ontario (U.S.A) in the summer of 2007. The dataset includes ozone profiles from balloon soundings, tropopause height from a windprofiler radar, surface ozone measurements, and NASA satellite products for ozone from TES and AIRS spectrometer and sounder, respectively. Data interpretation is further drawn by using a Lagrangian dispersion model and geostatistical interpolation results of satellite ozone data.

The dataset gathered during this campaign is very valuable. Unfortunately, the draft paper suffers from a lack of specific scientific objectives and from several weaknesses in the methodologies of interpretation. For these reasons, I cannot recommend its

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publication to ACP.

## MAJOR COMMENTS:

**Objectives and results:** The introduction gathers some platitudes on stratosphere-troposphere exchanges (STE). It does not provide a status of what is well known and of what is needed to be further investigated to better know on this topic. A synthesis of recent summer mid-latitude STE studies is needed (e.g., Colette and Ancellet, *Atmos. Env.*, 2005 ; Brioude et al., *ACP*, 2006 ; Thompson et al., *JGR*, 2007). Authors should define their objectives in showing how the STE case studies they are proposing would bring new information, or a better quantification of irreversible transport, to improve our assessment of impact of summer STE in the tropospheric ozone budget. Results that are summarized in the conclusions section suggest that several STE events can be studied with the BAQS-Met dataset, but do not offer anything conceptually new on the mechanism, and do not bring new insight into the impact of these STE events on the tropospheric ozone budget.

**Methodologies for data interpretation:** - Kriging interpolation of satellite ozone data: Before to interpolate the data, please, give the rationality to use TES and AIRS ozone profiles in the lower troposphere and in the boundary layer. How many degrees of freedom are there in this part of the troposphere for these sensors ? What are the validation studies, e.g. for use in the lower troposphere and in boundary layer ? Then, the confidence to use this interpolated dataset in the transport analysis must be established by direct comparison with independent datasets; i.e. with ozone sounding and surface station data. - GEM-FLEXPART model study: Because the outputs of the GEM-FLEXPART runs are used to investigate the penetration of stratospheric intrusions down into the boundary layer, the relevance for this special use of FLEXPART based on its parameterization of turbulence and its associated downward transport of the stratospheric tracer across the top of the boundary layer should be first demonstrated. - Radar tropopause dataset: This is a nice and complementary dataset for detection of stratospheric intrusions (Hocking et al., 2007). However, its interpretation

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is biased on an unproven direct link between rapid changes in radar tropopause height and the occurrence of a stratospheric intrusion. It leads to misleading and useless questionings when ozone soundings show stratospheric intrusions that are not associated with tropopause breaks (e.g., page 15569 lines 7-9, page 15571 lines 8-10, pages 15571 (line 29) – 15572 (line 1), and page 15574 lines 10-11 and 16-17). Simply, depending on how weather systems move across the radar site, tropopause breaks associated with stratospheric intrusions may or may not be observed by the radar.

#### MINOR COMMENTS:

Page 15561 (Abstract, lines 8-12): This sentence is misleading. For instance, I do not see how surface ozone data have shown to support the occurrence of stratospheric ozone intrusion events.

Pages 15561 (line 26) – 15562 (line 1): Add references for the other mentioned processes leading to stratosphere-troposphere exchanges.

Page 15562 (lines 2-4): Although the sentence is correct, the use of the reference Hocking et al. (2007) in it is not appropriate. Indeed, abrupt variations of tropopause may be associated with stratospheric ozone intrusions. However, the observation of this tropopause feature by an instrument, a windprofiler radar in the case of Hocking et al. (2007), only depends on the relative position of the instrument in the weather system, not on the weather system itself.

Page 15562 (line 22): what means “long-term” for satellite measurements ?

Page 15563 (line 4): year for Parrington et al.: 2008 or 2009 ?

Page 15565 (section 2.2.1 TES data): Please specify what is the vertical resolution (or degree of freedom) of TES data in the troposphere.

Page 15565 (section 2.2.2 AIRS data, line 23): What means 45 km pixels ? 45 km by 45 km ?

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Page 15565 (section 2.2.2 AIRS data): What is the vertical resolution (or degree of freedom) of AIRS data in the troposphere ?

Page 15566 (section 2.2.2 AIRS data, lines 9-10): It is not obvious to understand why AIRS ozone profiles have a finer latitude-longitude resolution than TES ones, given the confusion on AIRS pixels (see question above).

Page 15567 (line 15): replace “a” by “the”

Page 15568 (section 4, Fig.1): Incomplete description of Fig. 1: only one case of STE is suggested at the beginning of the time series (21 - 23 June), the rest of the figure is even not commented.

Page 15569 (section 4, Fig. 2): Uncoordinated description of Fig. 2. Why should there be an association between ozone intrusions and radar tropopause excursion rates ? What is the usefulness of this stratospheric ozone intrusion indicator ? The ozone enhancement observed in ozonesonde measurements on 7 July was not analysed when presenting Fig. 1.

Page 15569 (lines 19-20): “The TES profile also appears to show high ozone in the boundary layer, consistent with the surface observations in Fig. 1.” I do not see why it is consistent with surface observations. The peak value of the daily cycle of surface ozone shown in Fig. 1 on July 1 does not show an enhancement, it is on the contrary a relative minimum compared to the end of June, or compared to days after July 3. Please, explain.

Page 15569 (lines 20-22): Please explain what do you mean with “large stratospheric intrusion in the upper troposphere”. It seems to be here no more than a low tropopause associated with an upper-level trough, which does not mean there is an intrusion.

Page 15570 (lines 11-13): Again, it is not evident at all that Fig. 1 shows high ozone concentrations (approximately 80–100 ppb) down to the ground on July 1.

Pages 15571-15572 (line 29 and Lines 1-2): Why ? Explain, please.

## FIGURES:

Figure 1 (Page 15584): It seems that UTC is used here. Please indicate the difference with the local time.

Figure 3 (Page 15586): There seems to be partial inconsistency between top and bottom parts of the figure. For instance, the ozone mixing ratio lower than 50 ppbv at 68N-70W seen on the bottom part of the figure is not present at 6 km a.s.l on the top of the figure.

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