Atmos. Chem. Phys. Discuss., 10, C1842–C1846, 2010
www.atmos-chem-phys-discuss.net/10/C1842/2010/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Ozone over the Western Mediterranean Sea – results from two years of shipborne measurements" *by* K. Velchev et al.

Anonymous Referee #1

Received and published: 20 April 2010

The objective of this paper is to discuss ozone data measured onboard a ship during 27 and 30 one week cruises around the western Mediterranean sea, respectively, in spring/summer 2006 and 2007. Black carbon and aerosol size spectrum are also measured. The overall data set is valuable and complementary of other studies using aircraft (Millan 2000), ground based stations (Nolle 2002). Therefore the analysis of the data set deserves publication. Regarding the objectives, the authors mention the question of the relative impact of long range transport and regional/local ozone production and also how these new results modify our view of the ozone budget proposed by former studies. They are indeed important questions and it is well explained in the introduction. These objectives are somewhat forgotten when discussing the data: section 3 does not provide always the best spatial and temporal variability, section 4 is based on a crude methodology considering the complexity of the transport processes, namely:

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

3D-trajectories using 1dg x 1dg ECMWF and GDAS wind data, and vertical wind cross section from NCEP re-analysis. A comparison of mesoscale model approaches with these results are missing, also I think that the aerosol/ozone joint analysis could be more complete: scatter plot O3/BC, use of the GRIMM data to distinguish the fine and coarse aerosol fraction to discuss dust outbreaks, long range transport of aerosol (see for example the aircraft analysis of Stohl 2007 in ACP).

So I would recommend a change of the discussion section 3 and 4 to be better suited to the initial objectives. For example in section 3, a better selection of plots can be made and section 4, which is very lengthy, should concentrate on the vertical cross section of the wind field and a set of trajectories plot more convincing about the true origin of high or low ozone. Only high ozone cases are actually considered. If possible a Lagrangian dispersion model with emission tracers should be used.

Section 2 Method

The analysis of shipborne measurements is very tricky to avoid local contamination from the ship emissions. Nothing is said about the measurement sampling strategy. Does it correspond to a standard procedure defined for example by EMEP. Is there any aerosol filtering at the ozone inlet? The author mentioned comparisons between different locations on board the ship and filtering techniques to check how reliable the data are. Some plots and more quantitative results of this analysis would be welcomed (comparison between Deck 4 and 14, plot with different wind speed conditions). The issue of data filtering according to the daytime is not clearly addressed while it may change the data interpretation. A plot showing the ship positions during nighttime and daytime could be useful (especially for the cruise section along the coastlines where the inland ozone deposition and land breeze are likely to influence the ozone sink) . Did the authors consider also the BC data along with the wind to remove strong contribution from the ship emissions ?

Since the main originality of the paper is to provide a new data set, I think this section

ACPD

10, C1842–C1846, 2010

must be as complete as possible.

Section 3

There are unnecessary discussions about the effects of harbour data which could be removed right away and also the discussion of Fig. 6 is not very helpful. The ozone sink is well known near large cities and it is not necessary to discuss this. In fact the whole section 3.2 is lengthy and very speculative and not very new about the impact of a sea breeze effect near a large city (see results from the ESCOMPTE project results in 2005 Atmos. Res. Special issue or in Zhang et al. JAM 1998 paper). I would only keep the part discussing the effect of the O3 diurnal variation but showing results of the ship measurements themselves not only the plot of the island station O3 diurnal variation. For example, the nighttime versus daytime ozone and BC data (except for the open sea section between Tunis and Palma) can be more convincing than Fig.6 to discuss the actual effect of sea breeze on the ozone budget at the regional scale of the basin (i.e. not considering the the harbor locations).

I am not sure how useful is Fig. 3 and I do not see a lot of information in this plot, where ozone level appears rather constant with the same variability everywhere. A table with similar information including also more complete statistical information would be more convincing for a quantitative assessment of the ozone variability as a function of the 7 major sections of the ship cruise. Another idea is to plot, on one hand, the scatter plot BC/O3 (useful to discuss long range versus regional because BC is unlikely to remain high for long range transport) and, on the other hand, the mean, 10 and 90 percentile and outlier of the ozone in the 7 major sections of the ship cruise, i.e. between the harbour locations (see for example the kind of O3 plots used in Reeves et al. ACPD 2010 paper discussing the AMMA campaign aircraft data). Discussion of the occurrence of extreme values in some specific regions would provide information about the local influences.

The seasonal and yearly variations are on the contrary very interesting to discuss the

ACPD

10, C1842–C1846, 2010

potential influence of long range transport. The plots in Fig. 4 are however not very readable

So my main recommendations would be to produce more relevant plots and to focus already the data discussion to answer key questions:

-regional/long range transport (BC/O3 scatter plot, O3 statistical analysis for the different areas) ?

-diurnal effect along the coast (sea breeze even away from the source points) ?

-seasonal and yearly variations for the 7 regions around the western Mediterranean sea ?

-any extreme values and where ?

Section 4

This section is very lengthy for results which have been already discussed in Millan 2000. A critical analysis of the met data used for describing the regional scale circulations in the Mediterranean basin should be added using at least comparisons with results from mesoscale modeling works already published in the literature. Orography being very important for the vertical circulation discussed in this paper a critical assessment of the ability of the large scale analysis to reproduce this is needed.

I would reduce the section 4.1 to the discussion of the vertical structure of the wind field fig 9 and 10 for the low and high ozone episode. The effect of downward motion related to anticyclonic conditions can equally bring high or low ozone from continental regions. This is not really considered. For example the upward branch from Africa could reduce the ozone level. Line 25 p. 6141 the reference to downward transport from the upper troposphere is not supported by a cross-section limited to the altitude range 1000-500 hPa.

Simulations with tracers for example using a Lagrangian model like FLEXPART are

ACPD

10, C1842–C1846, 2010

better tools to show the effectiveness of the transport pathways than mean vertical wind field patterns. Can the authors provide such simulations. Anyway this should be discussed in the text.

The trajectory sections are rather weak because it is difficult to derive hard conclusions from a set of trajectories for high ozone episode showing almost all the possible transport pathways. Calculations of 3D trajectories at very low altitude as done in this paper (50 m, 500 m) are not very reliable using large scale meteorological wind field and this must be discussed using different ending points and the two set of wind fields. It would be also more convincing to make comparisons of trajectories for low and high ozone case studies. Also the timing of the trajectory position with the known emission sources should be documented to discuss the actual link with the ozone production.

Technical details

Fig. 4 Season and date are not very readable. A focus on the western med would be better.

Fig. 11 and 12 Timing of the trajectory positions are not very clear (1 point every 6 hours ??)

Scales are very difficult to read.

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 6129, 2010.