

Interactive
Comment

Interactive comment on “An episode of extremely high PM concentrations over Central Europe caused by dust emitted over the southern Ukraine” by W. Birmili et al.

Anonymous Referee #2

Received and published: 29 August 2007

review:

Title: An Episode of Extremely High PM Concentrations over Central Europe Caused by Dust Emitted over the Southern Ukraine Author(s): W. Birmili, and The High PM Concentrations Team

General Comment:

The Team has provided a thorough documentation of an extreme aerosol event that occurred in early spring 2007 in the Ukraine, which subsequently impacted air quality over a broad region of Europe. The paper reads well for the most part and includes a

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wealth of reference material. The event is of unprecedented magnitude and should be brought to the attention of the community. Equally impressive is the network of observatories that were operational during this episode, providing a comprehensive data set on which analyses are based. The effort to assimilate and analyze this data is laudable. While there are no new scientific findings of note, the Team utilizes methodologies that are well established and demonstrates how such a network can be exploited to monitor air quality now and in the future, important due to expected changes in climate.

The analysis is somewhat redundant in parts and the paper could be shortened without sacrificing scientific content. On the other hand, some elaboration of topics referenced but not discussed in specific terms would make for a more balanced paper having broader appeal. Clarification of a few points is required and some fundamental definitions should be given for the benefit of readers not familiar with the language or terms pertaining to aerosol research.

Specific Comments, in order of paper sections:

The Title should spell out the meaning of “PM.” PM then needs to be defined in simple terms at the earliest, appropriate point in the text (introduction), including how the various subscripts denote different particle size cuts. While widely used within the community, these abbreviations may be new to some readers.

In the Abstract state more definitively the cause of the dust storm. It is stated near the end that the source is known “with confidence” so why at the beginning use the phrase “most likely caused by” ? Again, spell out PM at this point. Values of PM, extinction and optical depth are quantified. These should be related to typical clean background conditions to place the event into context. The narrative beginning on line 20, “On 23 March” might be best placed at the beginning of the abstract, followed by “On 24 March” The concluding remarks may need elaboration depending on what additional discussion is included in the main body of the paper.

Introduction

1.1 should be expanded to include other sources of dust that impact the global climate. Saharan dust may account for most of the dust but what about Asian dust sources? There is growing interest in the ‘Asian Brown cloud’ and its downwind impact on North America for instance. Some specific reference to this topic is warranted. What specific health issues are related to various dust sources and what impacts do these aerosols have on climate. What is the magnitude of radiative forcing, degree of uncertainty and prediction of climate impact in a warming world? Dust also interacts with clouds with indirect radiative consequences that should be mentioned. While these points may be made in the reference material, giving an overview provides further motivation for monitoring PM and promotes the importance of this study.

1.3 PM should be defined here if not above, including denotation of size cuts.

Measurements section;

2.1 What is the resolution of MSG satellite imagery over the study area? It is a bit confusing that the MODIS website became available as of 11 June 2007. Does this mean activated or when images become available, in which case the March imagery is not included; perhaps simply drop the date.

2.2 sun photometer is generally one word. The AERONET data is in fact not “continuous” but sampled at specific air mass increments I believe with temporal gaps and no measurements are made at night; clarify.

“as of 11 June” could be deleted because it is confusing as to when the data are available as opposed to when the website became active.

2.3 point of curiosity related to Table 1 in the appendix; why are so few observations available from Österreichisches and Bayerisches?

2.4 In this section, as in the entire manuscript, strive to use similar units; e.g., use either microns or nanometers for wavelength denotation and particle size descriptions. A mix of μm and nm often appear in the same sentence and used in comparative analyses.

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For example, ‘3 nm to 10 μm ’ is used to describe the size range of particles analyzed.

This section contains too much detail perhaps and could be shortened. Might a table of methodologies, size ranges measured with references be used to summarize and then provide a more general overview? The “interested reader” as referred to with regard to the Grover et al 2006 paper could then delve into the details. This section could also be combined with 2.5 that gives further details of the particle sampling and analysis strategies, which are no doubt very thorough.

NOTE on grammar: “since” and “as” are too frequently used instead of “because” to describe cause and effect. Because is preferred because it is definitive and there is no ambiguity in terms of time or equality as indicated by since and as, respectively.

I do not know the ACPD convention of using English versus Americanized spellings of such words as parameterize, characterize, utilize etc. but should verify usage.

‘Government’ rather than ‘governmental’ may be a better descriptor of the network observatories.

2.5 References or links to “official guideline VDI and DIN EN ISO 11885 should be given

2.6 could be cut and pasted into section 3.2, eliminating any redundant information.

Meteorological overview

This section needs some work. Rewrite to make it succinct and to the point. Figure 1 is not very legible and I feel should be eliminated. Many readers are not familiar with such charts. This one requires further elaboration for the general reader to understand which I think is unwarranted. The pattern that drives this particular circulation is well illustrated in Figure 2. Simply stated, the high-low dipole pattern sets up a strong pressure gradient, creates a low-level jet from the Ukraine into central Europe. With Fig. 2, corresponding trajectory analyses and satellite imagery there is no need to dwell on the synoptic chart for the earlier period. The paper is long and this is one

section that can be shortened and one figure that can be eliminated without loss of information. On Fig. 2, indicate the source region and the key observatories as is done in Fig. 7

3.2 bring down the relevant material from 2.6 and fashion a coherent description of the analysis. I was not able to make much sense of Figure 3 owing to its small size and resolution. I am sure it contains a wealth of information so try to improve on the quality and explain it in simplest of terms.

3.3 Is there a color scale that should go with Figure 4, relating to index values? Highlight the boxed area blown up in Figure 5 in Fig. 4 rather than using an arrow.

Can you speculate on why the filaments form along what appears to be the mean wind direction? This is a curiosity more than anything but one that others will share.

Hot spots are indicated in the imagery, possibly due to fires or emission plumes. What, if any, effect might the mixing of this air with dust have on the chemical analyses, particle size analysis etc. Is there a source of BC here, smaller particles?

Two reasons are given why Saharan dust was not mixed in the plume. A 3rd and 4th may be worth investigating or mentioning. 3. Is there no chemical “fingerprint” that distinguishes desert dust from the Chernozem (soil); it seems there should be. 4. The size spectra of Saharan dust is distinctive from that derived for this event. This is evident in the AOD measurements and derived Angstrom Exponent as well (e.g., Figure 10).

Aerosol measurements in Central Europe

The section should be carefully edited to keep the discussion as clear as possible. Rewording of some phrases will make it more readable.

Make units consistent throughout and with above sections

4.1.1 What is a “roadside station?”

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4.1.2 define voivodeships

4.1.3 Figure 7; denotation of frontal lines are not readable on my copy, make clearer or enlarge.

4.2 under p 12249, lines 10 and 11 should be deleted or tied in with discussion.

4.3 sunphotometer is generally one word. Aerosol optical depth (AOD) is generally used where particle optical depth is in this paper. What is the accuracy of AERONET AOD and can you verify the instrument was calibrated routinely over the six years of service represented in Figure 10? Error bars on spectral AOD would be useful. The y-axis should read aerosol optical depth to distinguish it from total, assuming that attenuation by ozone and other gases was accounted for. Were they?

In discussion related to AERONET data some elaboration and reference is required. The definition of Angstrom exponent A should be given with some reference and mention of its use as an indicator of relative particle size. It is misleading to say A is derived from the “interval 440-870 nm” suggesting a fit to all wavelengths within the interval was made. I believe the fit is to the 440 and 870 pair of wavelengths. Reference is made to particles $> 1.2 \mu\text{m}$ as related to A . How is this threshold determined from a number that gives only relative information?

4.2.2 Can you speculate more specifically about the source of carbon? Is it possible to determine the location of the hot spots in the satellite images and whether these may contribute, being in the transport pathway? Is the CO_2 concentration high relative to climatological values? Carbon content will affect radiative properties significantly so this point might be worth investigating further.

4.4.3 The point being made is not very clear. Try to reword and combine with above Section 4.4.2 that refers to similar analyses (Fig. 12). In fact, Figure 13 could be eliminated and the results simply stated. The salient information is in Fig. 12 and Fig. 13 serves only to show spatial homogeneity during the dust event.

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4.4.4 try to get to the main point (dust PM10 accounts for 80%) with a more direct explanation, i.e., shorten the last few paragraphs.

Discussion

Consider making this section a more general narrative instead of cutting it into short sections, avoiding too much redundancy. It can be a recap of the important points but should also include new ideas if relevant to this or future investigations. I suggest the material in 5.4 precede 5.3 as introductory to the question posed.

5.3 serves well to put the study into context.

5.5 should be elaborated to include more recent concerns and speculations. Are there scenarios (model predictions) in IPCC perhaps that predict deforestation/desertification in various regions that will enhance dust emissions? Concerns are global because Asian dust, for instance, can be transported to Europe as well as to North America, with its associated toxic, industrial emissions. It is clear from the climatology that dust from the Ukraine has not had a major impact on Central Europe but dust from the Sahara may have. Is there any evidence of increased frequency or intensity of dust from that region? The network described is a huge asset to the European community. It will serve to monitor such events in the future and should be promoted on this basis. If deficient in some way, this too should be mentioned so improvements can be made.

Conclusions

Fine. Include perhaps the normal background levels where quantities are given to characterize the dust to place in context. If discussion is elaborated as suggested above include salient points.

Nice paper!

Interactive comment on Atmos. Chem. Phys. Discuss., 7, 12231, 2007.

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