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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Global chemical weather forecasts for field campaign planning: predictions and observations of large-scale features during MINOS, CONTRACE, and INDOEX" *by* M. G. Lawrence et al.

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Review of "Global chemical weather forecasts for field campaign planning: Predictions and observations of large-scale features during MINOS, CONTRACT, and INDOEX" by M.G. Lawrence et al.

This paper describes the use of chemical weather forecasts from the MATCH-MPIC model (and three other models) in three recent field campaigns. The paper describes how chemical weather forecasts were used in flight planning in these missions, and evaluates the performance of these models versus observations (and versus near-real-

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time analysis model runs). The authors introduce useful metrics for evaluating model performance, and provide good examples of the strengths and weaknesses of global chemical weather forecast models. The paper is well-written and well-organized.

Specific comments:

Abstract

Are the statistics for model-obs agreement that are given for CO concentrations, or for CO deviations from the mean?

1. Introduction

p. 1547, lines 1-3 Meteorological variability is not the only cause of variations in trace species concentrations. For instance, there is also variation in emissions (which may not be properly represented in models).

It would be useful to explain what you mean by a "chemical weather forecast." You mention (p.1548) that the MATCH aerosol forecasts assimilate observations of chemical species. The forecasts you are discussing in this paper are quite different from the familiar weather forecasts in that they only use climatological chemical boundary conditions (emissions) and only get their "real-time" skill through the meteorology assimilation/forecast. (You do make this point somewhat in the Conclusions.)

p.1548 Over what spatial scales are the regional models you refer to being run? Could you give some idea about whether you are referring to continental-scale, or something much smaller (as may be in the case in a cloud-resolving model).

2. Forecast model system setup

p. 1549 Do the regional CO tracers, include all emissions from a given region, or only certain source types (e.g., fossil fuel combustion, biomass burning, natural emissions)? I assume they also include only direct emissions, not secondary production from VOC oxidation.

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Indicate that you are using the NCEP Aviation model analysis/forecasts. (I believe it may have recently been renamed to something like NCEP Global Forecast System.)

p.1550 Describe in more detail exactly which AVN products you are using. I believe you are using the analysis and 3-hour forecasts from 0Z and 6Z, together with the analysis and 72-hour (?) forecast from 12Z.

Does it make sense to talk the products that are ready at 6 UTC as being available in time for the daily flight briefings? The campaigns have taken place in many different time zones, and (I'm sure) have had many different schedules for when meetings/briefings take place during the day.

3.2 Overview of the forecast applications during the three field campaigns

p. 1552 You describe the flights for which MATCH-MPIC forecasts played a primary role. Could you give a brief explanation of what some of the other types of flights were? Were they just exploratory, or were they going after features that could not be predicted by global models?

p. 1553, l. 4 How much of the correlation you find is due to, e.g., the background vertical gradient in CO (vs. "plumes")? It might be useful to try to come up with a separate measure concerning how well the model predicted the location, timing, and composition of plumes specifically.

p. 1554, l. 6 Typo: varaible –> variable

p. 1554, l.22 Unclear. Did the met. forecast or the chemical forecast indicate the presence of the ITCT at 6S?

p. 1555, l. 20 You should mention (somewhere) how convection is handled in MATCH. Specifically, that you are rediagnosing convection, not using convection predicted by NCEP/AVN. Thus, this diagnosis is being done at T42 resolution (vs. the AVN T170 resolution). What implications does this have?

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p. 1555, l.24 While convective venting of the East Asian boundary layer is certainly important for ITCT 2K2, the long-range transport across the Pacific that was being studied in this campaign suggests that it might not be a good campaign to look at the strengths of regional models. Perhaps this would make more sense in the context of TRACE-P or ITCT 2K4 (over the northeastern US and N. Atlantic in Summer 2004).

3.3 The Asian monsoon plume during MINOS

p. 1558, l. 21-25 (and Fig. 9) Provide specific altitude ranges for the "plumes" in each flight. It is not at all clear from Fig. 9 what you mean about MATCH-MPIC underestimating the plumes during the first two flights, and ECHAM matching the obs well. In panels (a) and (b), there is little difference between the two models, and neither shows an obvious "plume." For panel (c), are you refering to the slight enhancement at 12 km in ECHAM? (For the third flight, it is of course obvious that ECHAM is overestimating CO above 10 km.) Perhaps ovals could be used to indicate the plumes, as in Fig. 15.

pp. 1558-1559 You mention that both models overestimate CO near the surface (due to elevated emissions from eastern Europe). In panels (b) and (c), both models are indeed too high near the surface. However, in panel (a), ECHAM appears to be too low in the lower troposphere, also in a region of large influence of eastern European emissions. Why?

p. 1561, l. 10-13 It is difficult to tell from Fig. 13 how well the two model forecasts agree, since you show total CO from MATCH-MPIC and NA CO from FLEXPART. Considering Fig. 12 as well, it looks like MATCH-MPIC has much more N. Amer. CO (at least at 600 hPa) than FLEXPART, with a somewhat different distribution.

4. Conclusions

p. 1564, l. 4-5 You state that the 25-30% discrepancies in mean CO levels are within the range of uncertainty in current emissions inventories. This is a bit vague. What specifically do you mean? I don't think the global CO source is uncertain at that level,

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although for a given region or source type, there could certainly be this much uncertainty. You could cite a reference here for to show the range of current emission inventories.

p. 1564-1566 The discussion of the difference between chemical forecasts and meteorological forecasts is good. You make the important point that chemical forecasts are much more "stable" than meteorological forecasts. They do not typically diverge within several days. One piece of information that might be useful to assimilate, besides concentrations, is emissions. You should mention that models typically use climatological emissions. While most emission sources do not vary greatly from climatology, there may sometimes be significant variations, e.g., in biomass burning emissions. The use of satellite fire counts in specifying biomass burning emissions is quite promising. In addition, assimilation of trace species concentrations may also help reduce the effect of errors in model physics or emissions. Global satellite coverage, even if only providing a couple of vertical layers in the troposphere, could be quite valuable (although getting the data in a timely manner might be difficult).

Appendix: Model descriptions

p.1567 How different is the rediagnosed water vapor distribution from that provided by NCEP? Are there significant biases between the two?

p. 1568 Add a bit more description about how the O3 STE flux was decreased from earlier versions of MATCH-MPIC. This is a significant improvement, worth an extra sentence or two in the paper, esp. given that the only reference now is a Ph.D. thesis, which is hard for most readers to access. (You could also mention that von KuhlmannŠs thesis is available on the web.) Does the photolysis calculation include effects of clouds? Mention that the NOx/HNO3 ratio is, I assume, typically biased low in the model, and where this bias is most pronounced.

p. 1569 (FLEXPART) Mention explicitly that FLEXPART does not include other emission sources of CO, or production of CO from VOC oxidation. What is the spatial

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resolution associated with FLEXPART (in their emission inventories and in their model output)?

Table 3 Indicate exactly what quantity is computed as the "RMS." Is it the RMS difference between CO deviations divided by the mean observed concentration?

Figure 4 Could you indicate in this figure the boundaries of the source regions for Southern Asian CO and Northern Asian CO?

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