

Interactive comment on “IAP-AACM v1.0” Global to regional evaluation of the atmospheric chemistry model in CAS-ESM” by Ying Wei et al.

Anonymous Referee #3

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This paper presents the atmospheric chemistry component of CAS-ESM, IAP-AACM, and compares the offline model results (driven by WRF) with various observational data worldwide. This is an important step towards improving the Earth system simulations by CAS/IAP, a key participant of IPCC assessments. Below are a few suggestions to improve the paper.

The model evaluation focuses on comparisons with measurements of surface concentrations of pollutants, particularly aerosol pollutants. Because this model is developed primarily for climate studies, evaluation of the tropospheric chemistry (in addition to surface air quality) will be very important. Specifically, it would be very useful to include/expand the evaluation of vertical profiles and tropospheric burdens against observations. There are many satellite data for ozone, NO₂, SO₂ and HCHO, and many

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vertical profile data (e.g., ATOM) for gaseous/aerosol species. Other important measures of tropospheric chemistry that can be discussed include the mean OH concentration and budgets, ozone budgets, methane lifetime, and MCF lifetime.

Measurement data often contain missing values and outliers and have different temporal resolutions from model simulations. Please specify how the measurement data are processed and how model results are sampled (temporally and spatially) according to measurements. In particular, satellite data contain large amounts of missing values. Near-surface NO₂ measurements are contaminated by other nitrogen species, and what would be the implications for model evaluation (especially when discussing the model bias).

The resolution dependence discussed in Sect. 3.4 has also been studied in other recent works. It would be nice to refer to or compare against previous findings.

The spin-up time (one month) is too short for CO, ozone and other longer-lived species. This may explain part of the underestimate in CO. Please comment on the effect of spinup time.

There have been discussions in the literature on bug fixes in ISOROPIA II. Are these bugs and fixes relevant here?

Brief descriptions of WRFv3.3 would be very useful. The vertical resolution of WRF is different from that in IAP-AACM, so how is the conversion done?

Table 1 – do you extrapolate the emissions to 2014? If not, what would be implications for your model evaluation against measurements in 2014?

In the comparisons over China, only a few cities are selected, although there are CEMC measurements in other cities as well. Please explain the rationale for choosing these cities.

Specific comments:

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Abstract – please specify which part of the writing is for the evaluation of global model and which is for nested model. Also, please present the bias (in addition to R) of the model.

L48-67 – the references are relatively old. Please use newer ones. Also, aerosols affect the cardiovascular diseases very significantly.

L71 – change “prediction” to “projection”

L87-88 – there have been model evaluation studies over China in recent years. Please refer to these studies.

L97 – remove “precise”. Every model has its limitations.

L100 – change to “lateral (and upper) boundary conditions”

L147 – specify the resolution

L160 – do you mean “natural dust”?

L199 – do you mean the first layer center is 50 m?

Table 2 – please explain the meanings of these statistics and provide the units.

L279 – why not just use the WDCGG data in 2014?

CO model evaluation – could you comment on the effect of spinup time and coarse model resolution?

L416 – the ozone seasonality is not very well captured in many regions. Also, this paragraph is too long.

L452 – please specify the quantitative difference between GFED3 and GFED4.

L485-499 – please comment on the effect of difference in time (2006 for measurements and 2014 for model simulation).

L495 – BC depends on emissions and deposition processes.

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L500 – please clarify which components are included in PM2.5

L506 – please specify the version of MODIS AOD and how data are selected/sampled.

L512 – LAC or BC?

L522-531 – please consider to present the seasonality results in a line figure.

L526 – In the model, DJF is not the season with the highest AOD over East China.

L548-558 – please be more quantitative.

L567-568 – please provide model versions.

L572 – do you mean “other regional models”?

L575-576 – what are the differences in emissions?

Fig. 14 – please specify the components in PM2.5

Table 6 – please specify which one is global model and which one is regional model.
Also, please provide the mean values over these cities.

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