

Interactive comment on “Investigation of short-term effective radiative forcing of fire aerosols over North America using nudged hindcast ensembles” by Yawen Liu et al.

Anonymous Referee #2

Received and published: 8 July 2017

This paper studies the direct/indirect aerosol effect from fires using CAM5 with nudged horizontal wind speed and/or nudged temperature. Overall the approach is sound and the paper is well written. Yet it still needs some major clarifications before it is accepted for publication.

General comments:

Since fire emission inventories are critical to this study, please provide a table or a plot to show the BC/OC/SO₂ emissions from the 3 different inventories quantitatively. The colorbar in Fig. 2 is difficult to tell how bigger is the QF than the GF3/4. It seems QF emissions are at least 5 times larger than the other two. Please provide a table show-

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ing the different fire aerosol forcing components. In the introduction part, 3 different aerosol forcing are mentioned, but only direct forcing and short wave cloud forcing are presented in the result section. Please show long wave forcing and surface albedo forcing as well in the table. The initial condition for the 10-day ensemble runs is generated by S_NF with only u and v being nudged. Temperature is not nudged for the S_NF run. So my question is when you now include slow temperature nudging in the ensemble runs, will they go through some adjustment through the 10-day period? Or in other word, how well is the initial T compared to the T being nudged to on April 1st?

Specific comments: Abstract: why no forcing numbers are provided here. It is expected to see direct forcing and net indirect forcing rather than some changes in the short wave cloud forcing.

Line 62-76: Please show what these forcings are. Direct or indirect?

Line 103 : please provide relaxation time for the very weak temperature nudging.

Line 131-132: please show or elaborate how you convert monthly mean emissions to daily emissios.

Line 138-142: Does the CAM5 default/background emission already include fire emission? Or did you remove fire emissions from the CAM5's emission files if there is any?

Line 220-226: please define these forcings with a few sentences rather than refer readers to Ghan 2013.

Line 238 : please explain what "LEV 2.0 cloud-screened" is.

Line 268-272: How much does the fire emitted aerosols contribute to the total AOD? It would be helpful to show some estimate of the contributions from fire emitted aerosols and other background aerosols. I realized you presented background AOD and fire AOD later in Fig. 6. But it would be more helpful if you can present some data here when you quote the need to increase the fire emissions by a factor of 1-3. And please explain why increasing the fire emission by a factor 1-3 could then make the simulated

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AOD large enough to compare with the reanalysis. It seems it is still unlikely to me.

Line 357-358 : it is confusing here. Please consider revising.

Line 370-372 : In the simulations with nudged U and V, the circulation is constrained. So it seems the circulation change may be small enough. Then use this to explain to change of ice clouds. I suspect the coarse mode dust number may be smaller and this may contribute to the decrease of produced ice number since the ice nuclei number(dust) is smaller. Need further investigation here.

Line 385: make it clear it is SW cloud forcing.

Line 420: Why quote Fig. 3 here? I think Fig.3 shows results from Group A not from ensemble runs.

Line 430-432: How is the spread calculated for different N? Also how do you select the ensemble member for each different N? I suspect the number 9 required to converge may be different if the ensemble members for different N are constructed differently.

Fig 3 : Please give full name of TCC.

Fig 7 : what is is the KS test? Please give full name.

Fig 10: is a) total aerosol direct forcing?

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