AOD trends during 2001-2010 from observations and model simulations.



MPI for Chemistry

26/11/2015







Motivation

Numerical model Model evaluation Observational data

Results and discussion

Conclusion

Motivation

De Meij et al.(2012)





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All work performed with the EMAC model ECHAM5/MESSy for Atmospheric Chemistry

www.messy-interface.org



Main characteristics:

- Basemodel: General circulation model ECHAM5 (developed at the MPI for Meteorology in Hamburg).
- Chemistry submodels : MESSy, Modular Earth Submodel System





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Hence:

- Global scale studies.
- Flexible for different studies on atmospheric chemistry.

Model set-up:

- T63 horizontal resolution ($\sim 1.1^\circ \times 1.1^\circ$ degree).
- 31 vertical levels (up to 10 *hPa*), with 25 layers in the troposphere.
- 245 reactions including hydrocarbons up to 4 carbon atoms.
- Aerosol based on 7 interacting lognormal modes.
- Gas/aerosol partitioning using ISORROPIA-II.
- One year of spin-up time.
- 10 year of simulation (2001-2010).
- weakly nudge towards ECMWF ERA-Interim data.



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Simulations

- RCP00 : constant emissions (2000)
- RCP85 : varying anthropogenic emissions
- Same dynamics





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Evaluation

Evaluated on different publications (e.g. Yoon et al. (2015))

Comparison of EMAC calculated and AERONET observed daily AOD with all available measurement (2001-2010).





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Observational data:

- The Multi-angle Imaging SpectroRadiometer (MISR) instrument onboard of the TERRA satellite (level 3 collection F15).
- The MODerate resolution Imaging Spectroradiometer (MODIS) onboard of the TERRA satellite (Level 3 collection 051).



Results and discussion

Global trends Regional trend

Conclusion





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Linear trend between 2001-2010 in $[10^{-2}/year]$ for the simulations RCP00 and RCP85 at the correct overpass time of the TERRA satellite.





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Results and discussion

Global trends Regional trends Trend cause

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Conclusion





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Modelled AOD changes between 2001-2010 for different regions and species.





Results and discussion

Conclusion

The model EMAC has been used to identify causes of AOD trends in the decade 2001-2010:

- AOD increases over Middle East and North Africa are caused mostly due to meteorological effects
- Over Eastern US and Western Europe, significant decreasing trends are calculated only with decreasing emissions in the decade 2001-2010 are included
- For South Asia and East China, the AOD is increasing due to a combination of changes in the emissions and meteorology.



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Please check: AS3.12 Atmospheric composition variability and trends PICO session, Tuesday, 10:30-12:00

"Trend estimates of AERONET-observed and model-simulated AOT percentiles between 1993 and 2013" EGU2016-5038

"Aerosol optical depth trend over the Middle East" EGU2016-12142



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Pozzer, A., de Meij, A., Yoon, J., Tost, H., Georgoulias, A. K., and Astitha, M.:
"AOD trends during 2001-2010 from observations and model simulations", Atmos. Chem. Phys., 15, 5521-5535, doi:10.5194/acp-15-5521-2015, 2015.

Thank you for your attention!