The global chemistry climate model ECHAM6-HAMMOZ

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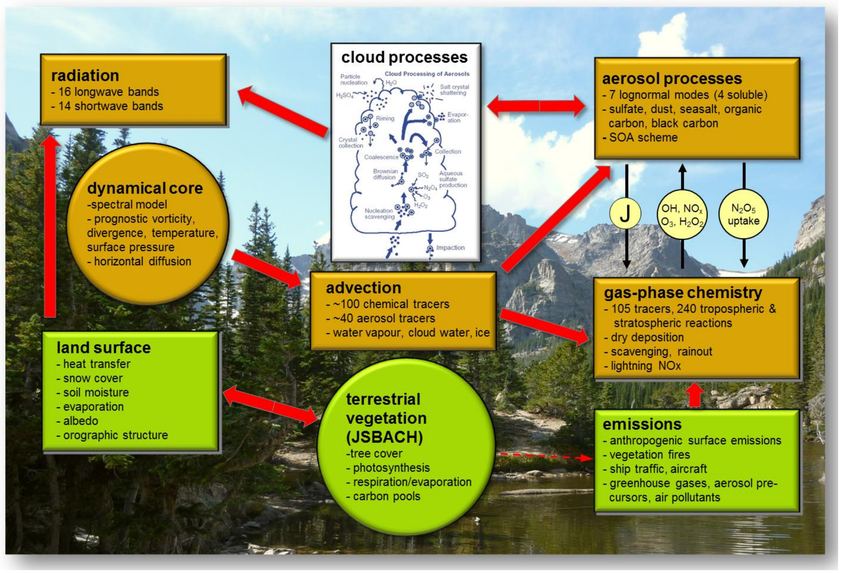
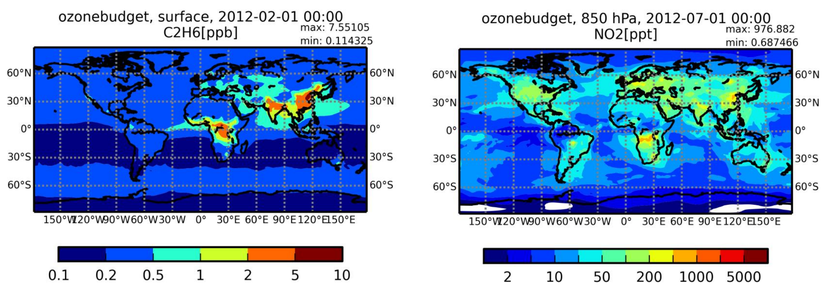
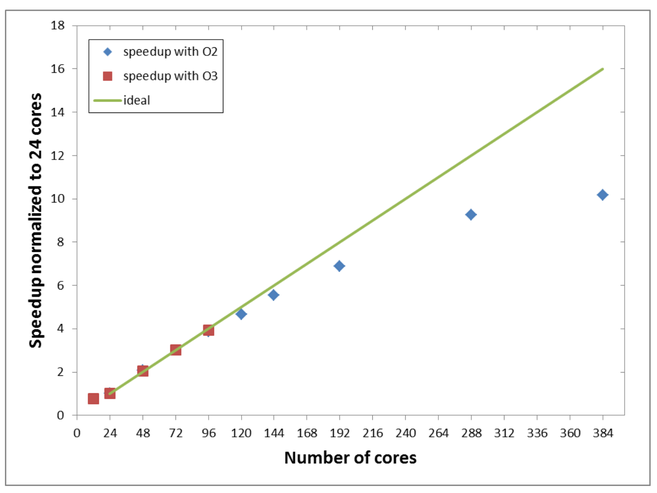
Abstract: Atmospheric composition of short-lived gases and aerosols is an important component of the global climate system. Complex processes from emissions, transport, and chemical reactions to heterogeneous loss processes and radiation interactions need to be implemented in climate models to reach an adequate understanding of the role of short-lived climate forcers on the climate system and to allow the assessment of climate impacts on the regional scale. With ECHAM6-HAMMOZ we have developed a comprehensive model of tropospheric and stratospheric aerosols and gas-phase chemistry which is now running successfully on the Jülich supercomputer JURECA.



ECHAM6-HAMMOZ is a global chemistry climate model with a spectral dynamical core, a comprehensive package of physical parameterisations, and detailed schemes for gas-phase chemistry and aerosol physics. It contains many biogeochemical feedback cycles and can optionally be coupled to an ocean model.
The gas-phase chemistry module has been developed in Jülich. The reaction mechanism comprises more than 600 reactions of ~200 species.

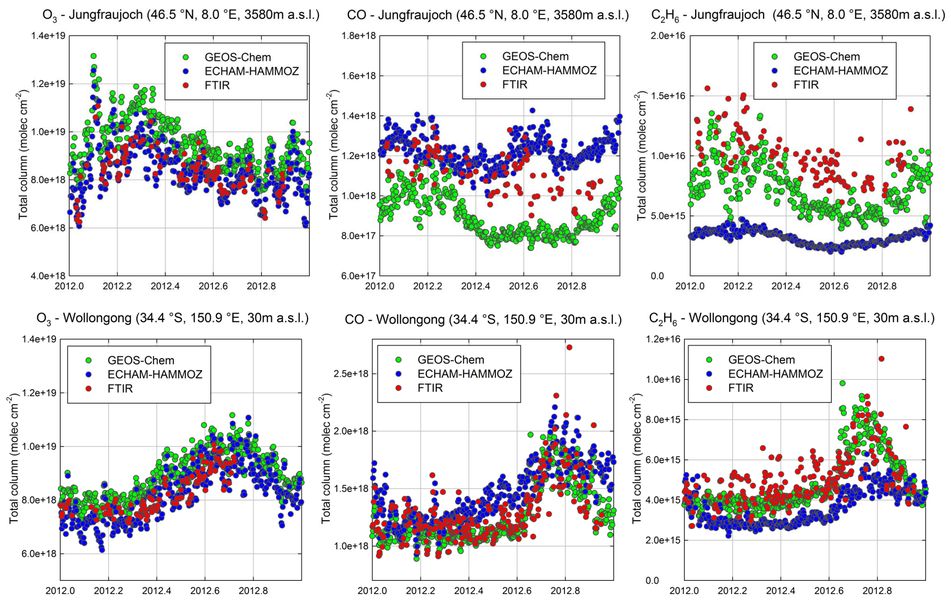


Monthly mean mixing ratios of ethane in January (left) and NO_2 in July (right)

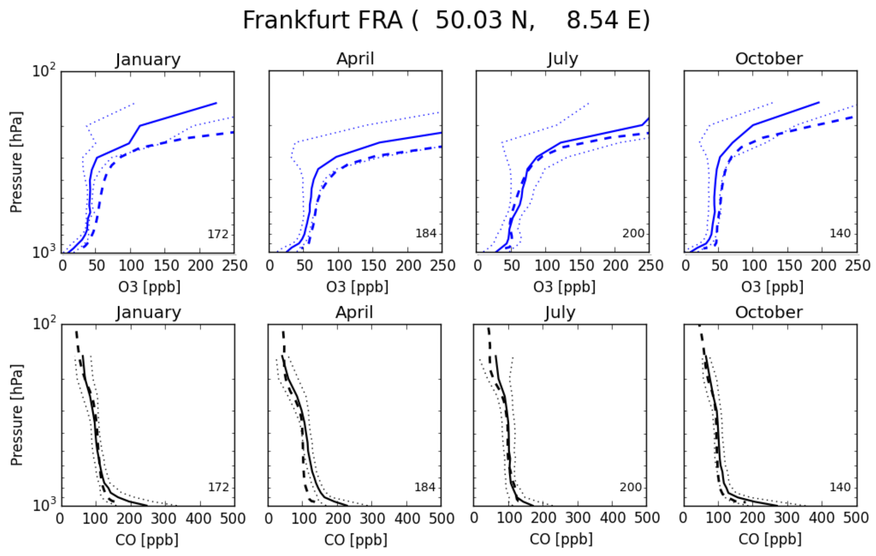


The model runs on JURECA and scales well up to ~190 cores if we run in resolution T63L47 (96 latitude bands). In this resolution a 1-year simulation on 144 cores takes about 48 hours. Standard output of a 1-year run amounts to ~0.5 TByte.

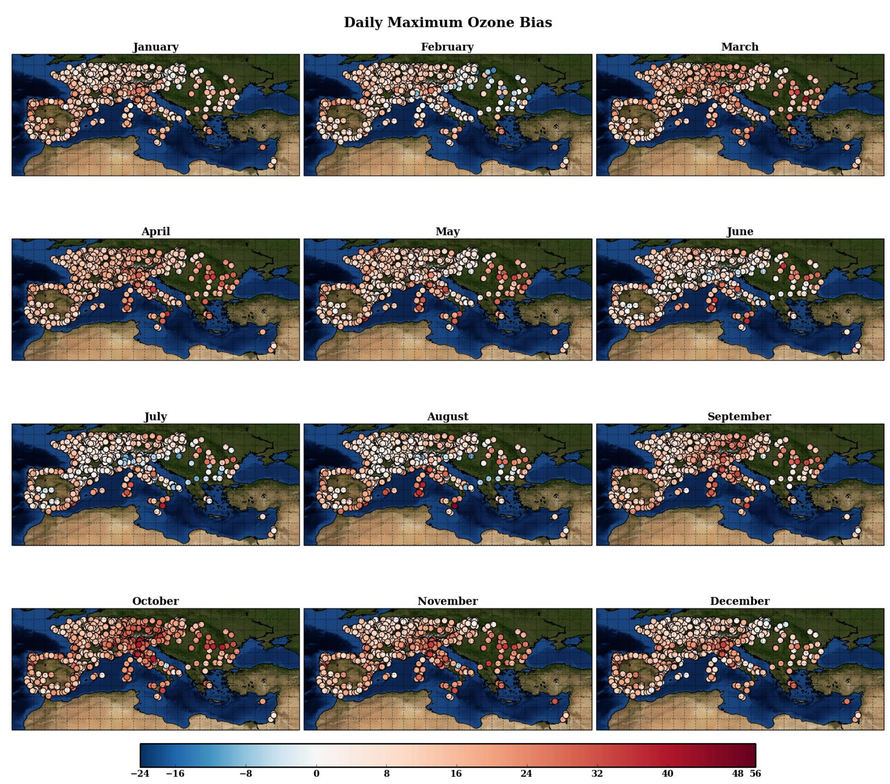
Model evaluation: ECHAM6-HAMMOZ was run for 2.5 years in „nudging mode“ and the output has been compared to a variety of atmospheric composition datasets.



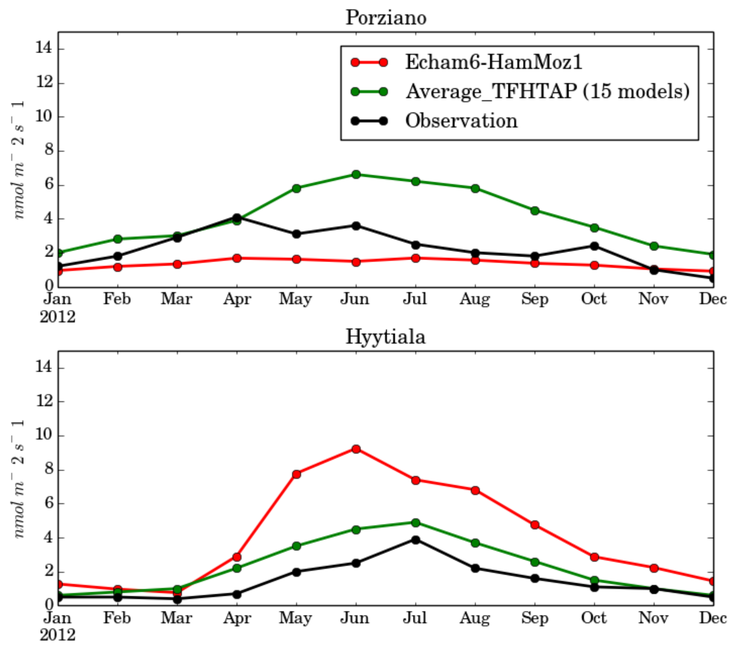
FTIR column amounts of ozone, CO, and ethane over Jungfraujoch (top) and Wollongong (bottom)



Vertical profiles of ozone (top) and CO (bottom) from passenger aircraft measurements (IAGOS) over Frankfurt. Solid line: obs., dashed line: model.



Bias of maximum daily 8-hour average ozone mixing ratio at ~1000 measurement sites across Europe (TOAR database)



Ozone dry deposition flux at two selected stations in Europe