(1) TOMCAT-GLOMAP - Toulouse Offline Model of Chemistry and Transport & GLObal Model of Aerosol Processes
CAM-Chem - Community Atmosphere Model with online tropospheric gas-phase and aerosol chemistry
JULES - Joint UK Land Environment Simulator
HadGEM2-ES - Hadley Centre Global Environment Model Version 2, including detailed extended atmospheric chemistry UKCA-ExtTC model

(2) ULeeds – University of Leeds, UK
Steve Arnold <s.arnold@leeds.ac.uk>
Dominick Spracklen <d.v.spracklen@leeds.ac.uk>
Sarah Monks <s.a.monks@leeds.ac.uk>

(3) Available modes for the model runs: Research

(4) Components & processes: Atmosphere, … & Physical, Chemical, …

(5) Brief model description
TOMCAT-GLOMAP - Toulouse Offline Model of Chemistry and Transport & GLObal Model of Aerosol Processes (Spracklen et al., 2005; Richards et al., 2013) is an off-line 3-dimensional global model of tropospheric chemistry-aerosol and transport, developed in Leeds. The model includes a detailed aerosol microphysics scheme, simulates size and composition resolved aerosol and treats SOA from monoterpenes and isoprene. The organic chemistry scheme in the model has recently been updated to include the ExTC scheme, a detailed organic chemistry scheme including oxidation of C2-C4 alkanes, lower alkenes, aromatics, isoprene and monoterpenes. We will run global simulations at ~2.8^{O} horizontal resolution, forced by ECMWF meteorology. See more details at: https://www.see.leeds.ac.uk/research/icas/research-themes/atmospheric-chemistry-and-aerosols/groups/aerosols-and-climate/the-glomap-model

CAM-Chem - Community Atmosphere Model with online tropospheric gas-phase and aerosol chemistry (Lamarque et al., 2012) is a version of Community Atmosphere Model (CAM) v4,, with online tropospheric gas-phase and aerosol chemistry. We use offline meteorology from GEOS-5 analyses from and the model is coupled interactively to land-surface processes simulated by the Community Land Model (CLM) version 3.0, which simulates BVOC emissions and deposition. Aerosol and O_3-NOx-CO-VOC chemistry are taken from the MOZART-4 chemical transport model (Emmmons et al.,). The atmosphere model has a horizontal grid resolution of 1.9^{o} x 2.5^{o}, with 56 vertical sigma-pressure levels between the surface and ~1 hPa.

JULES (Joint UK Land Environment Simulator) The JULES land surface model structure is designed to assess ecosystem response to surface climatology at the large scale, and can be forced with offline prescribed fields of surface temperature, radiation, precipitation, humidity. We will use the model to assess response of photosynthesis and carbon assimilation to 'offline' surface climate, ozone and aerosol fields. The model includes the parameterisation used by Sitch et al., (2007), which assumes a suppression of net leaf photosynthesis by ozone

that varies proportionally to the ozone flux through stomata above a specified critical ozone deposition flux. A land cover map will be used to define biogeography and ozone sensitivity parameters for a range of species representative of European and boreal vegetation will be applied, and the sensitivity of carbon uptake to the choice of these will be investigated.

HadGEM2-ES (Hadley Centre Global Environment Model Version 2) (Collins et al., 2011), includes a detailed representation of atmospheric chemistry applying the UK Chemistry and Aerosol (extended tropospheric chemistry in UKCA, UKCA-ExtTC) model (O'Connor et al, 2014), an interactive bVOC emission model and the ozone plant damage parameterisation of Sitch et al. (2007). UKCA-ExtTC includes a detailed description of 83 chemical species in the gas phase with ~300 photochemical reactions. Surface dry deposition follows the resistance-in-series appraoch with the important exception of stomatal uptake which applies online stomatal conductance through coupling UKCA directly to the land surface scheme in HadGEM2-ES (MOSES).

References

Collins, W. J., Bellouin, N., Doutriaux-Boucher, M., Gedney, N., Halloran, P., Hinton, T., Hughes, J., Jones, C. D., Joshi, M., Liddicoast, S., Martin, G., O'Connor, F., Rae, J., Senior, C., Sitch, S., Totterdell, I., Wiltshire, A., and Woodward, S., (2011), Development and evaluation of an Earth-system model – HadGEM2, Geosci. Model Dev. Discuss., 4, 997-1062, doi:10.5194/gmdd-4-997-2011.

Emmons, L. K., Walters, S., Hess, P. G., Lamarque, J.-F., Pfister, G. G., Fillmore, D., Granier, C., Guenther, A., Kinnison, D., Laepple, T., Orlando, J., Tie, X., Tyndall, G., Wiedinmyer, C., Baughcum, S. L., and Kloster, S., (2010), Description and evaluation of the Model for Ozone and Related chemical Tracers, version 4 (MOZART-4), Geosci. Model Dev., 3, 43-67, doi:10.5194/gmd-3-43-2010, 2010.

Lamarque, J.-F., Emmons, L. K., Hess, P. G., Kinnison, D. E., Tilmes, S., Vitt, F., Heald, C. L., Holland, E. A., Lauritzen, P. H., Neu, J., Orlando, J. J., Rasch, P. J., and Tyndall, G. K., (2012), CAM-chem: description and evaluation of interactive atmospheric chemistry in the Community Earth System Model, Geosci. Model Dev., 5, 369-411, doi:10.5194/gmd-5-369-2012.

O'Connor, F. M., Johnson, C. E., Morgenstern, O., Abraham, N. L., Braesicke, P., Dalvi, M., Folberth, G. A., Sanderson, M. G., Telford, P. J., Voulgarakis, A., Young, P. J., Zeng, G., Collins, W. J., and Pyle, J. A., (2014), Evaluation of the new UKCA climate-composition model – Part 2: The Troposphere, Geosci. Model Dev., 7, 41-91, doi:10.5194/gmd-7-41-2014.

*Sitch et al., (2007), Indirect radiative forcing of climate change through ozone effects on the land-carbon sink, Nature, **448**, 791-794, doi:10.1038/nature06059.*

Richards, N.A.D., Arnold, S.R., Chipperfield, M.P., Miles, G., Rap, A., Siddans, R., Monks, S.A., and Hollaway, M.J., (2013), The Mediterranean summertime ozone maximum: global emission sensitivities and radiative impacts, Atmos. Chem. Phys., 13, 2331-2345, doi:10.5194/acp-13-2331-2013.

Spracklen, D.V., Pringle, K.J., Carslaw, K.S., Chipperfield, M.P. and Mann, G.W., (2005), A global off-line model of size-resolved aerosol microphysics: I. Model development and prediction of aerosol properties, Atmospheric Chemistry and Physics, Vol. 5, 2227-2252.