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Prognostic Ozone for ICON: Enabling UV Forecasts

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Stratospheric Ozone (O_3) absorbs biologically harmful solar ultraviolet radiation (most of the UV□B radiation) and keeps it from reaching the surface. Such UV radiation is destructive of genetic cellular material in plants and animals, as well as human beings. Without the ozone layer, life on the surface of the Earth would not be possible as we know it.

As part of its work the German Weather Service (DWD) provides UV index maps to warn the population in Germany of excessive UV exposure [[1]]. For this purpose, global ICON data, external ozone data and an external UV model is used.

This study aims to create a self-consistent framework to generate UV index maps entirely from the non-hydrostatic global modelling system ICON [[2]]. For this purpose, a linearized ozone scheme (LINOZ) [[3]] will be optimized and the forecast functionality of ICON-ART [[4]][[5]] (ICOsahedral Non-hydrostatic – Aerosols and Reactive Trace gases) will be extended. For the derivation of UV radiation fluxes and indices a radiative transfer model for solar radiation (Cloud-J) [[6]] shall be implemented and extended. Since the entire framework is to be used at the DWD during ongoing operations, a functionality with very low computational effort is required.

Here we present the first results of the UV radiation flux through the atmosphere and its diurnal variation. Furthermore, the influence of clouds on the UV radiation flux is considered.

[[1]] https://kunden.dwd.de/uvi/index.jsp

[[2]] Zängl, G., et al. (2014), The ICON (ICOsahedral Non-hydrostatic) modelling framework of DWD MPI-M: Description of the non-hydrostatic dynamical core. Q.J.R. Meteorol. Soc., doi:10.1002/qj.2378

[[3]] McLinden, C. A., et al. (2000), Stratospheric ozone in 3-D models: A simple chemistry and the cross-tropopause flux, Journal of Geophysical Research: Atmospheres, doi:10.1029/2000JD900124

[[4]] Rieger, D., et al. (2015), ICON-ART - A new online-coupled model system from the global to regional scale, Geosci. Model Dev., doi:10.5194/gmd-8-1659-2015

[[5]] Schröter, et al. (2018), ICON-ART 2.1: a flexible tracer framework and its application for composition studies in numerical weather forecasting and climate simulations. Geosci. Model Dev., doi:10.5194/gmd-11-4043-2018

[[6]] Prather, M.J. (2015), Photolysis rates in correlated overlapping cloud fields: Cloud-J 7.3c. Geosci. Model Dev., doi:10.5194/gmd-8-2587-2015