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Atmospheric chemistry modeling capabilities in the IFS: current status and future perspectives

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The Copernicus Atmospheric Monitoring Service (CAMS) provides global forecasts and analyses of trace gases using the Integrated Forecast System (IFS) as operated by ECMWF. The operational chemistry module of the IFS relies on a tropospheric chemistry scheme using a modified version of the CB05 reaction mechanism, complemented with a linear ozone parameterization for the stratosphere.
In recent years various updates to this module have been developed. In particular, a stratospheric chemistry module based on the BASCOE chemistry has been coupled to this module. Also two alternative modules have been implemented, based on MOCAGE and MOZART chemistry. Any of the modules have been reviewed thoroughly, resulting in updates in parameterizations for reaction rates, heterogeneous chemistry, photolysis and numerical solver. Also the option to use an online parameterization for dry deposition is currently supported.

As a result, these three, largely independent, modules for atmospheric chemistry are currently available for sensitivity testing, and may as such provide a mini-ensemble of global atmospheric trace gases. Also, with mature chemistry modules within the IFS, the modeling of secondary organic and inorganic aerosol formation is receiving more attention. An example is the development of a secondary organic aerosol module depending on precursor trace gases originating from aromatics emissions.

In this contribution we provide an overview of the current status of the atmospheric chemistry modeling capabilities in the operational, pre-operational, as well as experimental versions of the IFS. We focus on the range of available chemistry modules, their recent revisions, and their relevance within the scope of ECMWF's integrated chemistry-aerosol-meteorology modeling.