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Gaseous chemistry and aerosol mechanism developments for version 3.5.1 of the online regional model, WRF-Chem

S. Archer-Nicholls et al. ▾

Received: 07 Jan 2014 – Discussion started: 22 Jan 2014 – Revised: 18 Sep 2014 – Accepted: 25 Sep 2014 – Published: 08 Nov 2014

Abstract. We have made a number of developments to the Weather, Research and Forecasting model coupled with Chemistry (WRF-Chem), with the aim of improving model prediction of trace atmospheric gas-phase chemical and aerosol composition, and of interactions between air quality and weather. A reduced form of the Common Reactive Intermediates gas-phase chemical mechanism (CRIV2-R5) has been added, using the Kinetic Pre-Processor (KPP) interface, to enable more explicit simulation of VOC degradation. N₂O₅ heterogeneous chemistry has been added to the existing sectional MOSAIC aerosol module, and coupled to both the CRIV2-R5 and existing CBM-Z gas-phase schemes. Modifications have also been made to the sea-spray aerosol emission representation, allowing the inclusion of primary organic material in sea-spray aerosol. We have worked on the European domain, with a particular focus on making the model suitable for the study of nighttime chemistry and oxidation by the nitrate radical in the UK atmosphere. Driven by appropriate emissions, wind fields and chemical boundary conditions, implementation of the different developments are illustrated, using a modified version of WRF-Chem 3.4.1, in order to demonstrate the impact that these changes have in the Northwest European domain. These developments are publicly available in WRF-Chem from version 3.5.1 onwards.

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How to cite: Archer-Nicholls, S., Lowe, D., Utembe, S., Allan, J., Zaveri, R. A., Fast, J. D., Hodnebrog, Ø., Denier van der Gon, H., and McFiggans, G.: Gaseous chemistry and aerosol mechanism developments for version 3.5.1 of the online regional model, WRF-Chem, *Geosci. Model Dev.*, 7, 2557–2579, <https://doi.org/10.5194/gmd-7-2557-2014>, 2014.