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Enviro-HIRLAM online integrated ACT-NWP modeling system with two-way interactions: History and current status

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The Enviro-HIRLAM is an online coupled numerical weather prediction (NWP) and atmospheric chemical transport (ACT) model for research and forecasting of joint meteorological, chemical and biological weather. The integrated modeling system is developed by DMI and other collaborators (Chenevez et al., 2004; Baklanov et al., 2004, 2008a; Korsholm et al., 2008, Korsholm, 2009) and included by the European HIRLAM consortium as the baseline system in the HIRLAM Chemical Branch (https://hirlam.org/trac/wiki), it is used in several countries. The model development was initiated at DMI more than 10 years ago. It was the first meso-scale online coupled model in Europe considering two-way feedbacks between meteorology and chemistry/aerosols.

The first version of Enviro-HIRLAM was based on the DMI-HIRLAM NWP model with fully online integrated pollutant transport, dispersion and deposition (Chenevez et al., 2004), own chemical and aerosol (only for sulfur particles) dynamics models (Gross and Baklanov, 2004) and indirect effects of aerosols (Korsholm, 2009). To make the model suitable for CWF in urban areas, where most of population is concentrated, the meteorological part was improved by implementation of urban sublayer modules and parameterisations (Baklanov et al., 2008b). The current new version of Enviro-HIRLAM is based on the reference HIRLAM version 7.2 with new developed more sophisticated and effective chemical lumped scheme, multi-compound modal approach aerosol dynamics modules, aerosol feedbacks on radiation (direct and semi-direct effects) and on cloud microphysics (first and second indirect effects).

Validation and sensitivity tests of the on-line versus off-line integrated versions of Enviro-HIRLAM (Korsholm et al., 2008) showed that the online coupling improved the results. Different parts of Enviro-HIRLAM were evaluated versus the ETEX-1 experiment, Chernobyl accident and Paris study datasets and showed that the model performed satisfactorily (Korsholm, 2009).