18th ETH-Conference on Combustion Generated Nanoparticles
June 22nd – 25th 2014

Paper/Poster-Abstract Form

Author…Ulrich Uhrner
Co-Authors… B.C. Lackner, R. Reifeltshammer, R. Forkel and P.J. Sturm
Affiliation …Institute for Internal Combustion Engines and Thermodynamics, Graz University of Technology
Mailing address …Inffeldgasse 21a, 8010 Graz, Austria…….
Phone …+43 664 8592329… E-mail…Uhrner@ivt.tugraz.at ……

Title: Inter-regional Air Quality Assessment – bridging the gap between regional and kerbside PM

Many areas located in southern alpine valleys and basins face in particular during winter time unusual high PM concentrations. Due to the complex terrain and related complicated atmospheric processes, air quality and exposure assessment is a difficult task. Although municipalities like Leibnitz (SE-Austria, pop. 9000), Maribor (NE-Slovenia pop. 95000) and Klagenfurt (S-Austria, pop. 90000) have quite low population and no big industries, the national and EU air quality standards have been exceeded frequently and significantly within the last years. Source-receptor modelling identified PM from traffic and residential heating as main sources. However, the impact of transport and the impact of secondary aerosols remained still unclear and form one of the major objectives of the study presented here.

A new multi-scale model approach was developed simulating air chemistry and aerosols from European level at coarse resolution (25 km) down to resolutions allowing for a representation of valley and basins located sources and subsequent air chemistry and transport processes (1 km). In a further step, the pronounced gradients from strong localized sources, such as road traffic or residential heating, were resolved by micro-scale modelling within the local core domains Leibnitz, Maribor and Klagenfurt. In order to make the best use of both model systems, emissions were processed on 1 km resolution for S-Austria/Slovenia and for the micro-scale simulations (order of 10 m accuracy).

A good agreement with various measurements located in the core domains was obtained for simulated total PM10 (see Fig. 1). Comparisons with filter analysis and aethalometer measurements, sampled at 6 characteristic sites, indicate that the modelled PM10 composition is realistic. The inorganic secondary PM10 turned out to be the major PM component on the regional level. PM attributable to residential heating revealed to be the second most abundant PM component, which is strongly influenced by local emissions using wood. Even at the kerbside Völkermarkter Straße (VM) in Klagenfurt, PM traffic exhaust (carbonaceous and predominantly UFP) components are significantly smaller than domestic heating contributions. Traffic exhaust and non-exhaust related PM is only at main arterial roads a major component.

Traffic and agriculture are major precursor sources for ammonium nitrate formation. As secondary formed aerosols contribute strongly to the PM10/PM2.5 burden in the concerned regions, the interaction of NOx from traffic and NH3 from agriculture is highlighted. The analysis of the regional emission reduction scenarios shows that region-wide NH3 measures are more effective in total PM reductions than measures on NOx (e.g. speed limits on major roads and highways).

The holistic air quality assessment, which comprised the creation of the PMinter emission data base and the combination of two model systems, enables the replacement of the “unspecified PM background” usually applied in dispersion simulations for environmental assessment and a better chemical or source related specification of PM components. The approach can be used for holistic environmental assessment and more specified health assessment studies. The chosen approach demonstrated that the combined use of the WRF-Chem and the GRAL model can represent realistically concentration patterns ranging from urban background to kerbside locations.

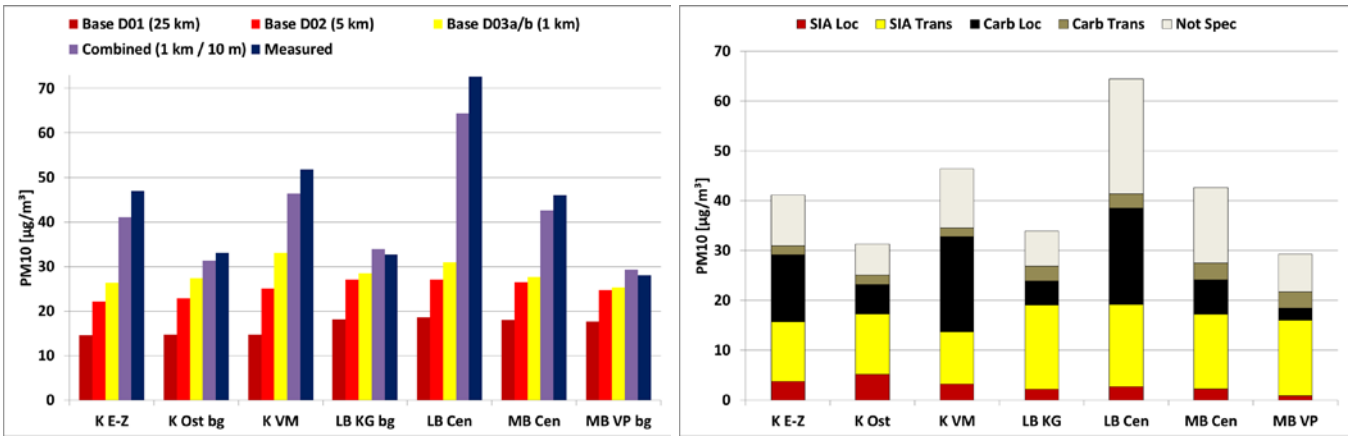

Fig. 1: January mean PM10 computed with WRF-Chem and measured at characteristic PMinter monitoring stations using different horizontal resolutions and the combined WRF-Chem/GRAL (left), simulated regional & local contributions for secondary inorganic (SIA) and carbonaceous (Carb) PM10 components WRF-chem/GRAL simulations (right). “Trans” refers to emission/formation outside the 3 core areas and transport to the core areas; “Loc” to emission/formation inside the 3 core areas. Carbonaceous PM10 is health relevant PM originating mainly from traffic & domestic heating.

Short CV:
From 2006 Senior Project Scientist at the Institute for Internal Combustion Engines and Thermodynamics, Graz University of Technology; project management, environmental assessment and air quality model development
2004-2006 Post-doc at IfT Leipzig; Aerosol dynamics, chemistry and CFD modelling
1999-2003 Scientist and PhD student at IfT Leipzig; Aerosol dynamics & atmospheric modelling
1997-1999 ECMWF (UK) Research in Numerical Weather Prediction
1997 Diploma in Meteorology University of Karlsruhe (TH)

Return by e-mail latest 11th of April 2014 to ttm.a.mayer@bluewin.ch