WRF CHEM in the marine environment

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WRF-CHEM is the Weather Research and Forecasting (WRF) model coupled with Chemistry (Grell et al., 2005). The model simulates the emission, transport, mixing, and chemical transformation of trace gases and aerosols simultaneously with the meteorology. From a northern European perspective the contribution of sea salt to particular matter concentrations can be significant especially in coastal areas and the predictive ability of air quality models to forecast ambient sea salt levels is important for the effective management of air quality.

In this work we evaluate the performance of the WRF-CHEM model to forecast sea salt levels with particular emphasis on the Irish domain. Coarse and accumulation mode sea salt are determined using the parameterisation of Gong (2003) with fluxes calculated as a function of wind speed (based on the semi empirical paramaterisation of Monahan et al., 1986).
These fluxes are distributed in 4 size bins (1 sub-micron and 3 super micron). Simulations are performed for a winter and summer month in order to elucidate any seasonal bias in the parameterisation deployed.

For effective evaluation and validation a provisional assessment of the model performance with regard to meteorological indicators has been undertaken. These initial simulations have been centred over a European domain at a resolution of 50 x 50km and focus on November 2009.

Shown below in Figure 1 is the agreement between forecasts and observations for monthly averaged cumulative precipitation. Given the significant impact of wet deposition as a loss mechanism for ambient sea salt the ability to forecast accurately precipitation will have a significant bearing on the accuracy of the forecast.

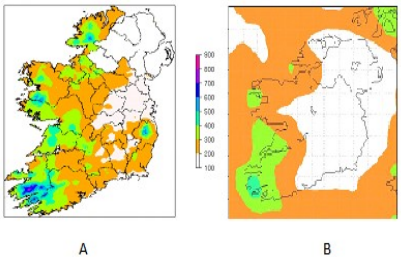

Figure 1. Observed monthly precipitation (A) 1km x 1km (Met Eireann) and modelled precipitation (B) 50 km x 50km (WRF) for November 2009.

Shown in Figure 2 is the agreement between modelled and measured wind direction over the same period from a measurement site in Iberian Peninsula (40.8000° N, 0.5167° E). There is also a high degree of correlation with wind speed (R>0.8).

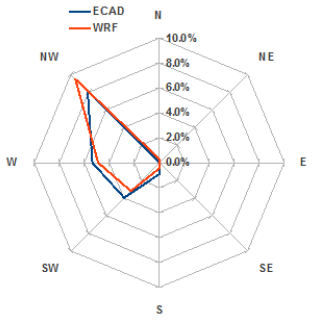

Figure 2. Observed monthly measured (ECAD) and modelled (WRF) wind direction for November 2009.

A more complete evaluation is currently being undertaken. Results for simulations will be evaluated against high resolution aerosol mass spectrometer speciated sub micron sea salt measurements as well as available speciated PM10 and PM2.5 filter measurements across a range of sites.

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