Air quality modelling of fugitive dust emissions caused by agricultural activities using two different chemical transport models

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1. INTRODUCTION

Fugitive dust emissions caused by agricultural activities (i.e. land preparation and harvesting) contribute to the ambient particulate matter mass (i.e. coarse fraction), especially in Mediterranean countries like Spain, characterised by large agricultural and some semiarid regions. This work describes the integration and modelling of fugitive dust emissions caused by agricultural operations within the CALIOPE air quality forecast system and over Spain (http://www.bsc.es/cailiope/es). An estimation methodology based on Schaap et al. (2009) was implemented inside the system in order to analyse the contribution of this source to PM10 concentrations.

2. METHODOLOGY

Methodology adapted from Schaap et al. (2009) and implemented in the HERMES v2.0 model (Guevara et al., 2013), the emission core of the CALIOPE air quality forecast system.

3. EMISSIONS

The CALIOPE air quality system was applied on a 4km horizontal resolution grid covering the whole Iberian Peninsula, with a temporal resolution of 1 hour and using two different chemistry transport models (i.e. CMAQv5.0.1 and CHIMEREv2013b) so the impact of different dry deposition schemes on the modelled PM10 concentrations was also analysed. The concentration results obtained running the two simulations (one for each chemical transport model) were evaluated against observational data from AirBase stations (EEA, 2013).

4. AIR QUALITY CONCENTRATIONS

4.1. Emission factors

Methodology adapted from Schaap et al. (2009) and implemented in the HERMESv2.0 model (Guevara et al., 2013), the emission core of the CALIOPE air quality forecast system.

5. CONCLUSIONS

5.1. Total amount of PM10 emissions by agricultural activities (215,593 t·year-1) is 40% higher than the rest of HERMESv2.0 emissions (137,427 t·year-1) and contributes by 57% to the total Spanish PM10 emitted. Emissions are spatially distributed across the arable land areas, with contributions up to 40 t·year-1·cell-1. In terms of temporal allocation most of them occur during the land preparation period (i.e. June, August to November). In terms of air quality, PM10 modelled concentrations are only affected in or in the vicinity of arable land areas (up to 6 µg·m-3 in August). The inclusion of emissions from agricultural activities allows for the average MB of ~3 µg·m-3 (CMAQ) and ~2 µg·m-3 (CHIMERE) at those stations located near arable land areas. On the other hand, correlation factors are increased up to 0.13 (CMAQ) and 0.17 (CHIMERE).

All these positive effects are, however, limited by the dry deposition mechanisms of both models, which are found to be a significant sink for the agricultural fugitive dust emissions (up to ~69% of total extra emitted PM10 emissions in the case of CMAQ).

6. REFERENCES


6.1. Emissions


