

Resum de Tesi Doctoral



UNIVERSITAT POLITÈCNICA DE CATALUNYA
BARCELONATECH

Escola de Doctorat

DNI/NIE/Passaport	46411516T		
Nom i cognoms	Marc Guevara Vilardell		
Títol de la tesi	Development of a high-resolution emission model for air quality modelling in Spain		
Unitat estructural	Departament de Projectes d'Enginyeria		
Programa	Enginyeria Ambiental		
Codis UNESCO	330800	330801	330804

(Mínim 1 i màxim 4, podeu veure els codis a <http://doctorat.upc.edu/gestio-academica/impresos/tesi-matricula-i-diposit/codis-unesco>)

Resum de la tesi de 4000 caràcters màxim (si supera els 4000 es tallarà automàticament)

Air pollution is an important issue for public health, the economy and the environment. In order to evaluate, preserve and improve the status of the atmosphere, air quality modelling is presented as a necessary tool that offers a complete description of the air quality problem, including an analysis of factors and causes (emission sources, meteorological processes and atmospheric processes), thus complementing the information obtained from air pollution monitoring networks. In this framework, a proper knowledge of emission sources and their distribution in time and space is crucial in the development of a high-resolution air quality modelling system. The present Ph.D. thesis introduces the High-Selective Resolution Modelling Emission System (HERMESv2.0), a high spatial (up to 1 km x 1 km) and temporal (1 hour) resolution emission model for Europe and Spain that provides anthropogenic and biogenic emission information both for air quality modelling and environmental management, taking the year 2009 as the reference period. The model has been developed under the framework of the CALIOPE-AQFS air quality forecast system, a state-of-the-art modelling framework developed by the Earth Science department of the Barcelona Supercomputing Center-Centro Nacional de Supercomputación (BSC-CNS) and implemented in the MareNostrum3 supercomputer. HERMESv2.0 estimates atmospheric emissions for nitrogen oxides (NO_x), sulphur oxides (SO_x), carbon monoxide (CO), non-methane volatile organic compounds (NMVOCs), ammonia (NH₃), primary particulate matter (PM), particles with diameter less than or equal to 10 µm (PM₁₀) and particles with diameter less than or equal to 2.5 µm (PM_{2.5}), and considers different pollutant activities including: (1) combustion in energy industries, (2) residential/commercial combustion plants, (3) combustion in manufacturing industries, (4) industrial processes, (5) extraction and distribution of fossil fuels, (6) solvent uses, (7) road transport, (8) other mobile sources, (9) waste treatment, (10) agriculture and (11) biogenic sources. For Europe the model applies an emission processing system to the EMEP inventory, while for Spain it mainly uses bottom-up approaches, combining activity factors from official sources with emission factors and state-of-the-art methodologies reported by official guidelines or in-situ measurements. The annual emissions estimated by HERMESv2.0 for Spain in 2009 are: NO_x, 939 kt; NMVOCs, 2,332 kt; SO_x, 284 kt; CO, 2,183 kt; NH₃, 342 kt; TSP, 184 kt; PM₁₀, 141 kt and PM_{2.5}, 106 kt. Road transport is the most significant pollutant source for NO_x (38%), CO (31%) and TSP, PM₁₀ and PM_{2.5} (31%), while point sources account for almost 90% of total SO_x. On the other hand, more than half of NMVOCs come from biogenic sources (67%), while agriculture contributes to the major part of NH₃ (97%). Emission results were compared with the ones reported by the Spanish National Emission Inventory (INESP) and HERMES04, the previous version of the emission model. Moreover, an inter-comparison between HERMESv2.0 and the European TNO-MACC-II emission inventory using the CALIOPE system was also performed in order to contrast the two emission datasets on modelling NO₂, SO₂, O₃ and PM₁₀ concentrations for Spain in February and June 2009. All these aforementioned works helped to validate the emission estimates, confirm distribution patterns and identify gaps in HERMESv2.0. Regarding the last point, two different works were developed in order to improve the model in terms of: vertical distribution of point source emissions and characterization of fugitive dust emission sources. This Ph.D. thesis has demonstrated that the HERMESv2.0 model can be used as the emission core of the CALIOPE-AQFS system for assessing diagnostic studies and forecasting the air quality in Spain, studying future scenarios and for regulatory modelling applications.

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