



Low latency and high resolution GHG emission estimates to support monitoring and modelling activities in Spain

Oliver Legarreta, Paula Castesana, Ivan Lombardich, Carles Tena, Carmen Piñero-Megías, Artur Viñas, Johanna Gehlen, Luca Rizza, Carlos Pérez García-Pando, and Marc Guevara Vilardel
Barcelona Supercomputing Center, Earth Science, Barcelona, Spain (oliver.legarreta@bsc.es)

Reliable and timely information on greenhouse gas (GHG) emissions is essential for evaluating mitigation policies and supporting data assimilation and verification modelling frameworks. In this contribution, we present the sPanish EmissioN mOnitoring systeM for grEeNhouse gAses (PHENOMENA), a low-latency GHG modelling framework developed within the RESPIRE-CLIMATE Spanish national project, which received formal endorsement from the WMO-IG3IS initiative.

PHENOMENA provides harmonised daily and high spatial resolution (up to 1 km × 1 km) CO₂ and CH₄ emissions for the main combustion-related sectors, including electricity generation, manufacturing industry (cement and iron and steel), residential and commercial combustion, road transport, shipping and aviation. The system estimates CO₂ and CH₄ emissions by combining low latency activity data and fuel- and process-dependent emission factors through bottom-up and downscaling approaches. The data collected and pre-processed includes hourly near-real-time traffic counts from the national road network, hourly electricity production data reported by individual power plants, daily Copernicus ERA5-Land surface temperature, monthly industrial production statistics and AIS (Automatic Identification System) data, among others.

PHENOMENA produces multiple GHG emission products, including high resolution maps of daily emissions per sector, as well as daily summaries of emissions aggregated at different regional levels and for the main Spanish metropolitan regions. The emissions computed with PHENOMENA allows representing the intra-weekly and seasonal variability of GHG emissions as well as changes in their spatial patterns, which can be linked to specific policy, socioeconomic, and weather impacts.

The results produced with PHENOMENA are compared to official GHG emission inventories as well as to other state-of-the-art low latency GHG emission datasets, such as the ones produced by the CAMS Carbon Monitor initiative. Overall, these developments demonstrate the capability of PHENOMENA to deliver consistent, multisector and near-real-time GHG emission estimates, supporting national monitoring, policy evaluation and future verification and data-assimilation efforts.