

MetPrep: A Model-Agnostic Meteorological Pre-Processor for Emergency Applications of Local Pollutant Dispersal

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Abstract

Pollutant transport modelling is widely used to simulate specific pollution events, to study emission transport in future scenarios, and to guide mitigation strategies. When focusing on the local impacts of single-source atmospheric circulations influenced by the topography around the source become vital in capturing the correct dispersal pathways. However, given the urgent nature of such events, employing dynamical downscaling models (e.g. the Weather Research and Forecasting model; WRF) in high-enough resolution is often impossible within the time constraints of the emergency. As a trade-off between accuracy and computational time, diagnostic wind models are often employed to adjust the wind fields of global datasets by applying first-order topographic corrections. Even though numerous diagnostic wind models exist, they are either based on legacy code, or be tied to particular transport models. To counteract this, as part of the EU Center of Excellence for Exascale in Solid Earth project (ChEESE-2P), we have developed a model-agnostic meteorological preprocessor (MetPrep). MetPrep can ingest meteorological data from a number of sources, apply topographic corrections based on the Shuttle Radar Topography Mission (SRTM) 1 Arc-Second Global Digital Elevation Map (DEM) and create output mimicking the format of the WRF model, thus allowing for the use of any model that has been developed to use WRF data as input (e.g. FALL3D, FLEXPART, HYSPLIT, and CMAQ among others). As a pilot study we couple MetPrep with the FALL3D model and focus on the long-lasting Tajogaite eruption at Cumbre Vieja, La Palma (September-December 2021); an eruption that highlighted the severe impacts of volcanic gas emissions on human activities and the environment, along with the difficulties in accurately forecasting gas emission dispersal over complex topography. This study is part of the grant PCI2022-134973-2 funded by MICIU/AEI/10.13039/501100011033 and by the European Union “NextGenerationEU”/PRTR, and grant EXC 2077 (Germany’s Excellence Strategy).

Early Career Scientist

NO, I am not an early career scientist.

IGAC Activities

MAP-AQ: Monitoring, Analysis and Prediction of Air Quality