USE OF A MODELLING SYSTEM TO PREDICT POLLEN CONCENTRATIONS OVER VENETO REGION (NORTHERN ITALY): INFLUENCE OF VEGETATION MAPS SPATIAL RESOLUTION

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Introduction: in a worldwide increasing trend of allergic diseases [1], accurate forecasting models will be useful to inform susceptible populations (e.g. patients with asthma or allergies) about pollen concentrations [2]. Pollen forecasts could be conveyed using an e-Health platform accessible via a smartphone App that provides personalized alert messages. As long-range transport has an important role in pollen distribution [3], implementing high-resolution models could make up for the lack of a dense monitoring network and improve pollen estimations [2].

Aims: to implement and validate a novel pollen prediction model for the main allergenic families/genera (alder, birch, grass, olive, ragweed) in the Veneto Region, using high-resolution vegetation coverage maps (spatial resolution 3 km).

Methods: ENEA has developed the MINNI operational forecast system that is included in the Copernicus Atmospheric Monitoring Service (CAMS2_40) [4,5]. This system implements the Finnish Meteorological Institute algorithms [3] to estimate pollen emissions. Such algorithms were used to estimate the pollen emissions over a modelling domain including the Veneto region using two vegetation coverage datasets: a) the European dataset available at an horizontal resolution of 0.15°x0.10° and spatially interpolated on the target domain (CAMS); b) high-resolution datasets from the following sources: CORINAIR (for olive and grass) [6]; European Forest Institute (alder and birch) [7]; data from Bonini et al., 2018 (ragweed) [8] (VENETO). The Flexible Air quality Regional Model (FARM, ARIANET) [9] was applied to the year 2019 using: 1) the pollen emissions calculated using the two vegetation datasets (a, b); 2) the meteorological fields predicted by the WRF (Weather Research and Forecasting) prognostic model [10]; 3) pollen boundary conditions provided by the FORAIR-IT operational forecast system developed by ENEA [11]. Further ancillary information (e.g. horizontal and vertical diffusivities as well as pollen deposition velocities) was derived from the SURFPro micro-meteorological processor developed by ARIANET [12].

Hourly pollen concentrations calculated by FARM were compared with the observations collected at 15 stations, participating in the POLLNET monitoring network [13], available in the modelling domain. Observed vs predicted daily averaged concentrations (from simulations fed by CAMS -a- and VENETO -b- vegetation maps) were compared using a performance indicator, the Root Mean Square Error (RMSE), and a derived parameter, the difference in Seasonal Pollen Integrals (ΔSPIn, pollen/cubic meter or p/m^3).

Results: a better agreement between observed and predicted pollen concentrations was obtained using the high-resolution vegetation maps (VENETO). As an example, the following RMSE VENETO vs. CAMS were obtained for alder (21.01 vs 372.63) and birch (19.15 vs. 61.65) pollen concentrations (p/m^3). Similar RMSE

values were obtained for olive (4.00 vs 4.43) and ragweed (5.28 vs 5.25) pollen concentrations (p/m^3) while for grass a worse performance was obtained using VENETO vegetation dataset (29.96 vs 22.24) (p/m^3). Results from the ΔSPIn were consistent with the RMSE patterns.

Conclusions: a novel pollen prediction model incorporating high-resolution vegetation coverage data for Veneto Region was implemented and validated for the first time. The model performance resulted better for tree pollens (alder, birch, olive) than herbaceous ones (grass, ragweed). The lack of more detailed vegetation coverage maps influenced the performance of the models for some families/genera.

Fig. 1 – Distribution of ΔSPIN for CAMS and VENETO simulations (vs observed values, dashed line) at the 15 monitoring stations.

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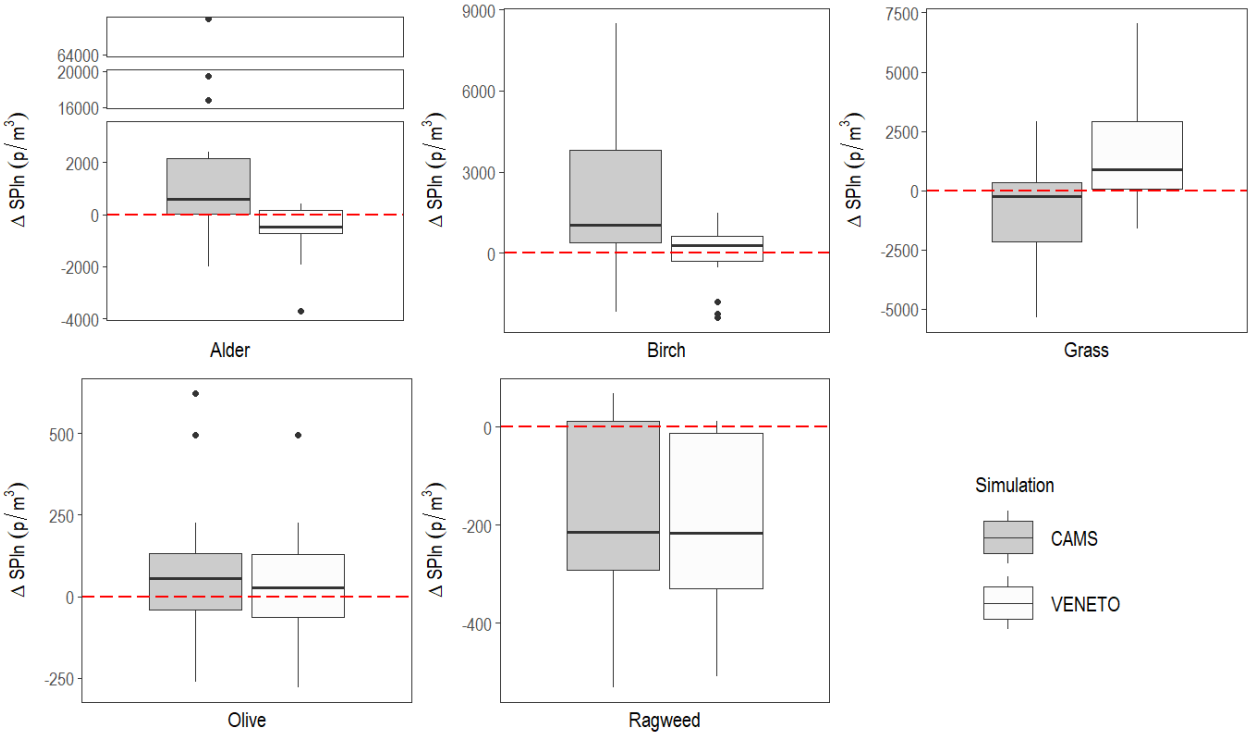
Δ SPln (p/m3)
64000
20000
16000
2000
0
-2000
-4000
Alder
9000
6000
3000
0
Birch
7500
5000
2500
0
-2500
-5000
Grass
500
250
0
-250
Olive
0
-200
-400
Ragweed
Simulation
CAMS
VENETO