



THE DEVELOPMENT OF A MULTI-SCALE MODELLING SYSTEM FOR EVALUATION OF URBAN NO_x LEVELS IN MODENA (ITALY)



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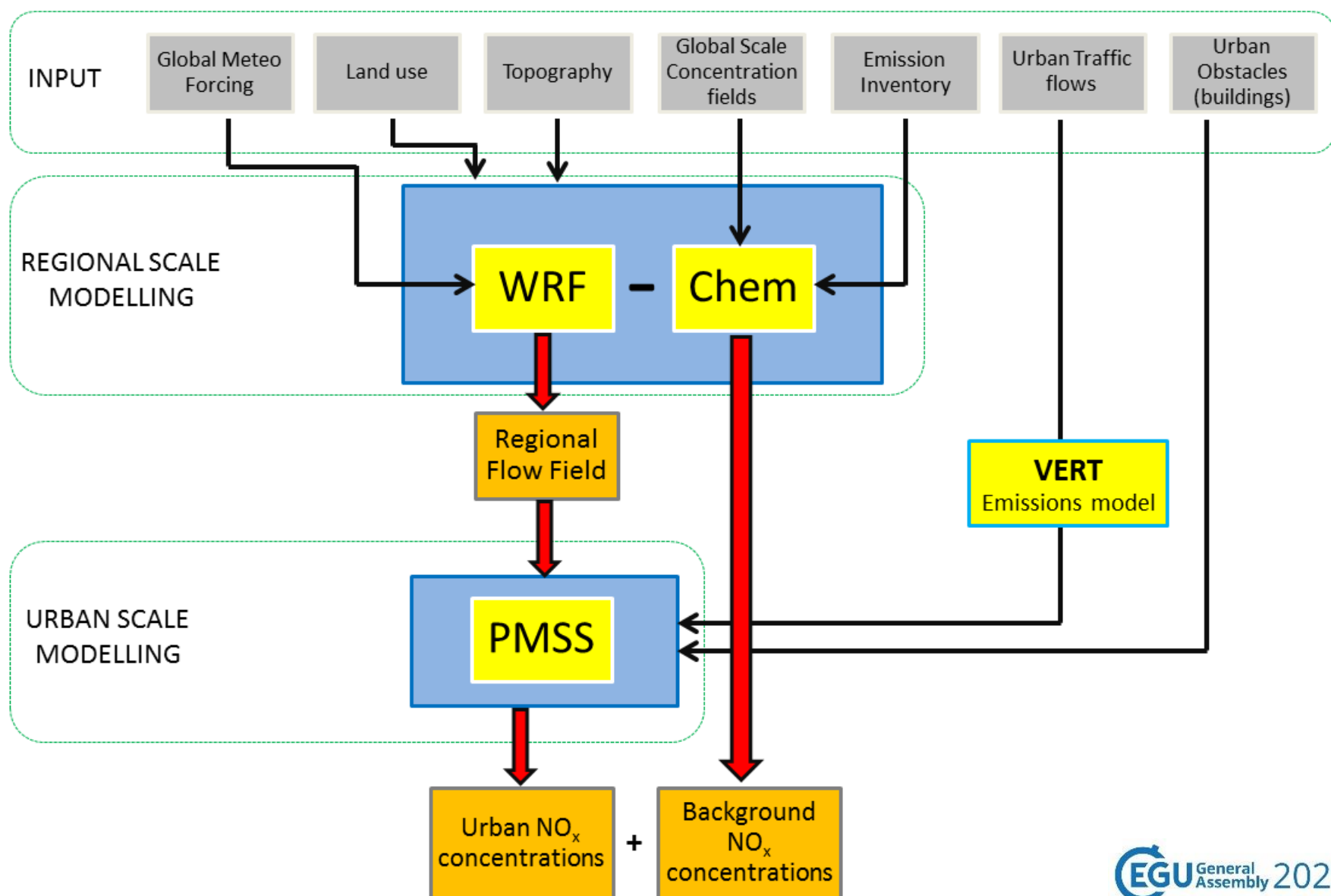
Goal of the project

- Develop a multi-scale modelling system able to provide hourly NO_x ($\text{NO} + \text{NO}_2$) atmospheric concentration fields at a building-resolving scale in the urban area of Modena (Italy)

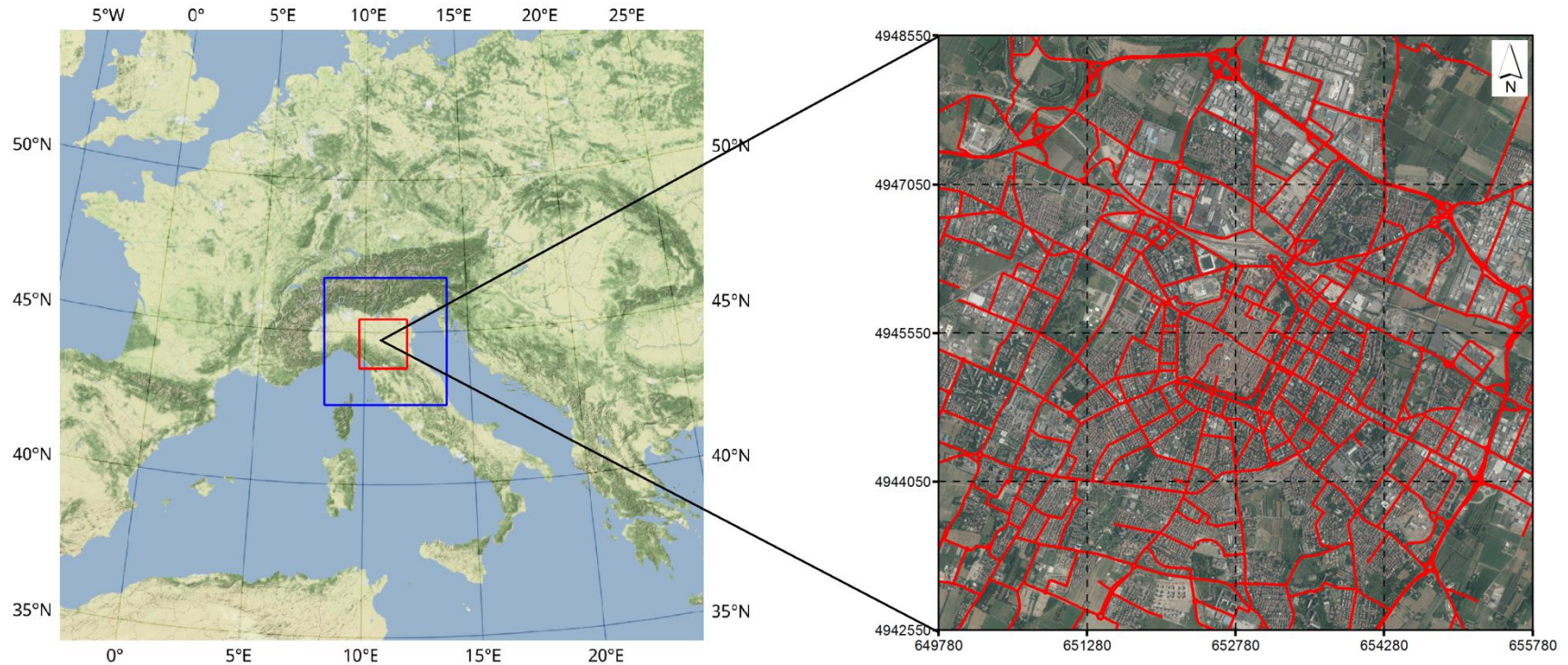
Why?

- Support local policymakers and inform citizenship about the air quality and the impact of urban emission sources, particularly traffic
- Identify a tool able to support urban mobility planning and estimate the effects of different fleet composition scenarios
- Endorse human exposure studies, health impact assessments, as well as the effects of local traffic policies on urban air quality

Multi-scale model flow chart



Case Study



WRF-Chem

Three one-way nested domains

Resolution: **15 km, 3 km and 1 km**

Parallel Micro SWIFT SPRAY

Modena urban domain: **6 km x 6 km**

Resolution: **4 m**

Simulation period: 28 October – 8 November 2016

The same period whereby a traffic measurement campaign was carried out by four Doppler radar traffic counters in the proximity of one busy intersection within Modena urban domain

PMSS emissions estimation

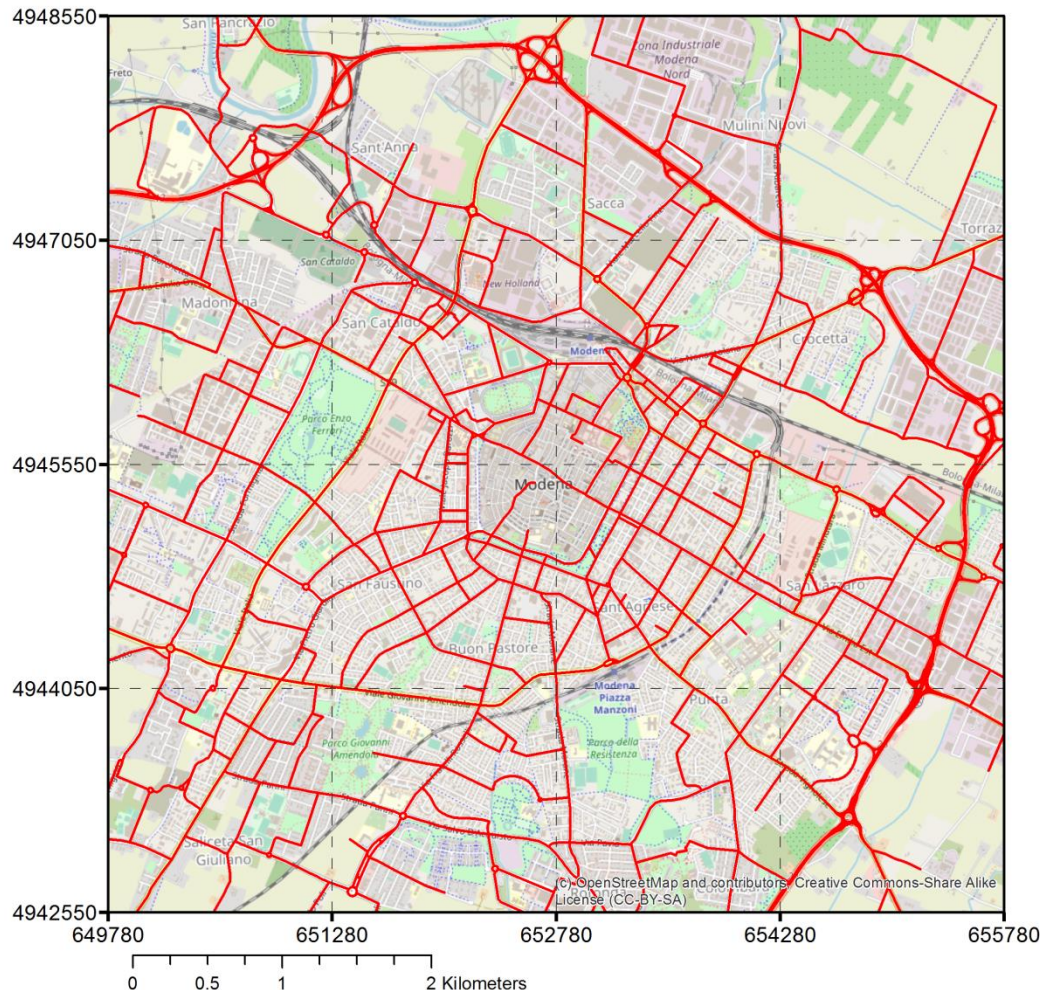
Only traffic emissions were simulated with the PMSS modelling suite

Bottom-up approach

Traffic flows data on the main urban roads were assessed by the means of the PTV VISUM traffic model



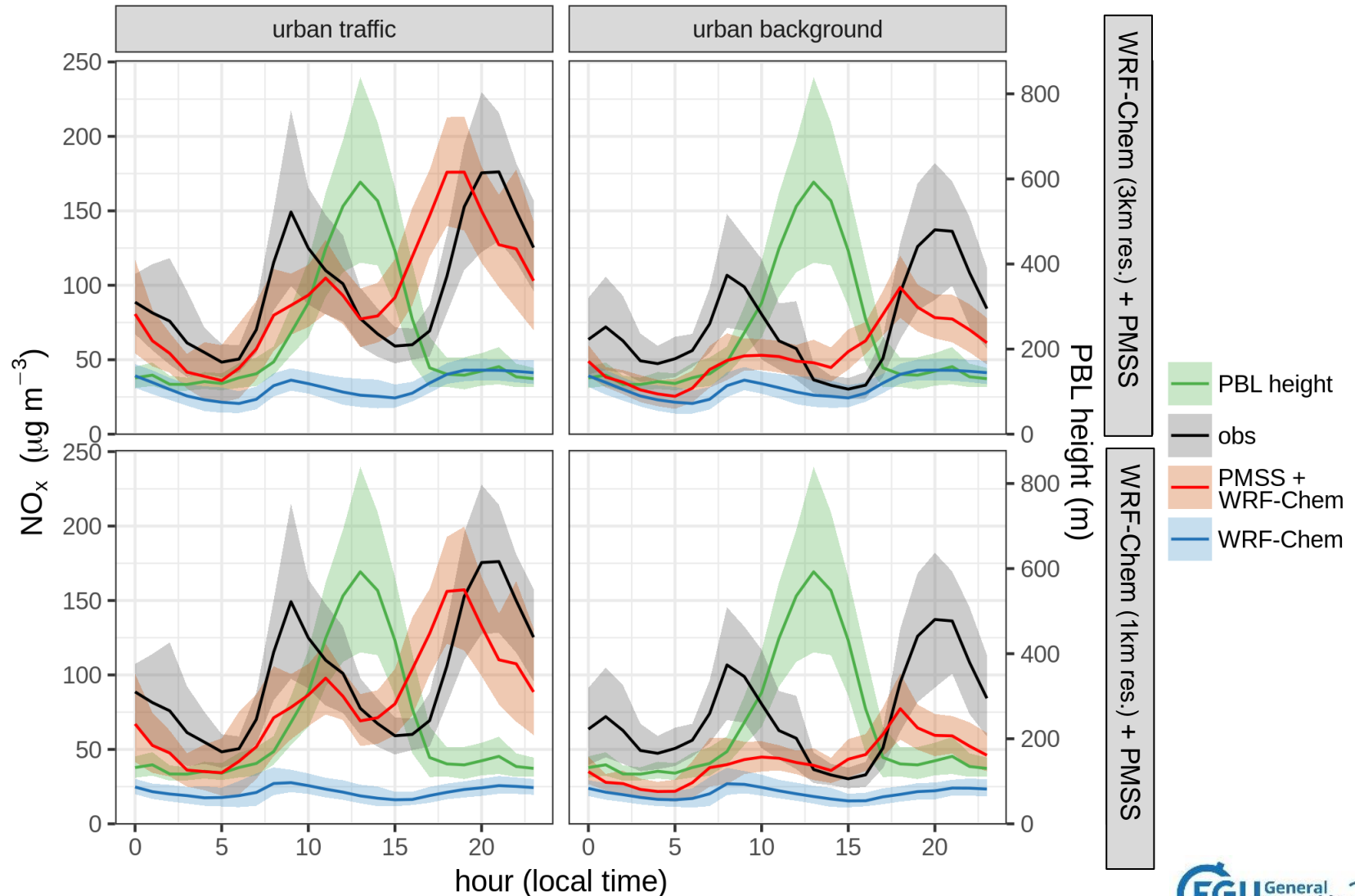
NO_x emissions were estimated using PTV VISUM traffic data and EMEP/EEA Cold & Hot Emissions Factors



MODELS EVALUATION RESULTS

WRF-Chem (3 km and 1 km resolution) combined with PMSS:

Variation of NO_x concentration by hour of the day at two urban air quality stations



MODELS EVALUATION RESULTS

WRF-Chem (3 km and 1 km resolution) combined with PMSS:

Statistics of hourly NO_x concentrations at the two urban air quality stations

Configuration	Station	NMB	FB	NMSE	FAC2	R
WRF-Chem (3km res.) + PMSS	Urban traffic	-0.04	0.04	0.48	0.72	0.47
	Urban back ground	-0.25	0.29	0.75	0.62	0.44
WRF-Chem (1km res.) + PMSS	Urban traffic	-0.15	0.16	0.54	0.68	0.48
	Urban back ground	-0.41	0.52	1.15	0.59	0.43

Reference acceptance criteria defined by Hanna and Chang* for urban environment:

FB	NMSE	FAC2
< 0.67	< 6	> 0.30

*Hanna, S.R., Chang, J.C., 2012. Acceptance criteria for urban dispersion model evaluation. *Meteorological Atmospheric Physics* 116, 133–146

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