

INTERCOMPARISON BETWEEN OBSERVATIONS AND 3D HIGH RESOLUTION MODELS FOR POLLUTANTS DISPERSION IN THE HARBORS OF MARSEILLE AND TOULON IN 2021

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1 AtmoSud is the Air Quality Observatory in South Region (France) agreed by the Ministry of Environment. AtmoSud's missions : **Monitoring network / Inventory of Emissions / Modelling / Forecasting**

3 Measurement campaigns was conducted in 2021 in Marseille and Toulon in the frame of the SCIPPER and AER NOSTRUM projects. It was a combination of **fixed stations, micro-sensors and remote measurements** allowing to capture a maximum of plumes (Figure 1).

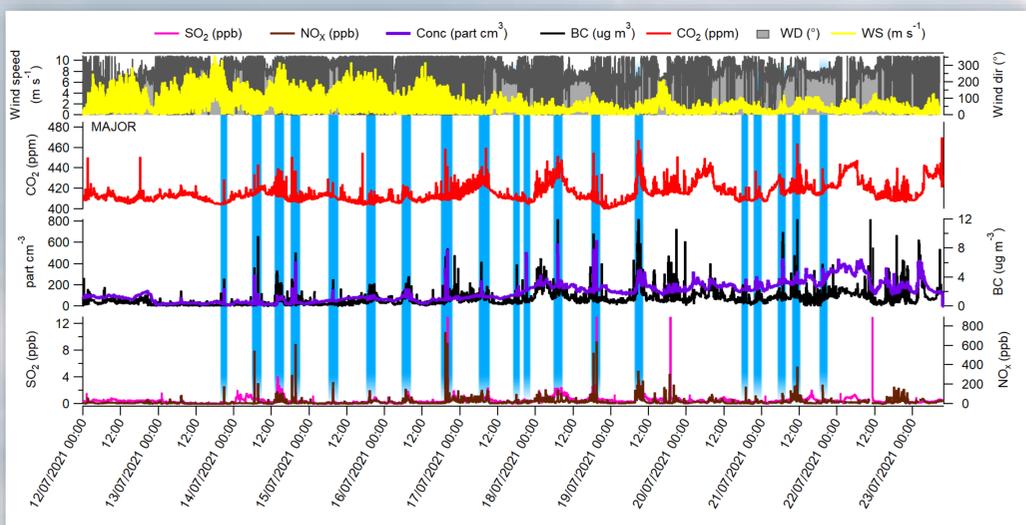


Figure 1: Temporal variations of the major pollutants and weather data observed in the « La Major » site (Marseille) between 12/07/2021 and 23/07/2021; highlights in blue represent suspected ship pollution events



Figure 3: Time-series of SO₂ simulated concentrations with the CFD model at La Major measurement observation site

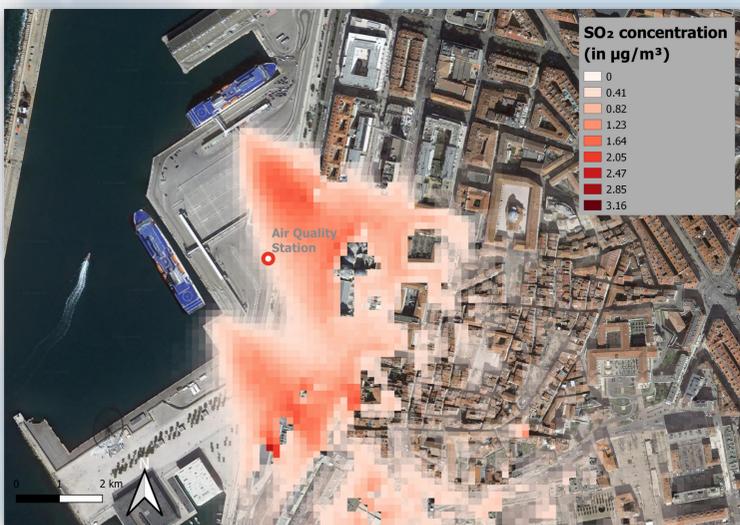


Figure 4: Example of plume modelling with PMSS in Marseille, simulated concentrations of SO₂

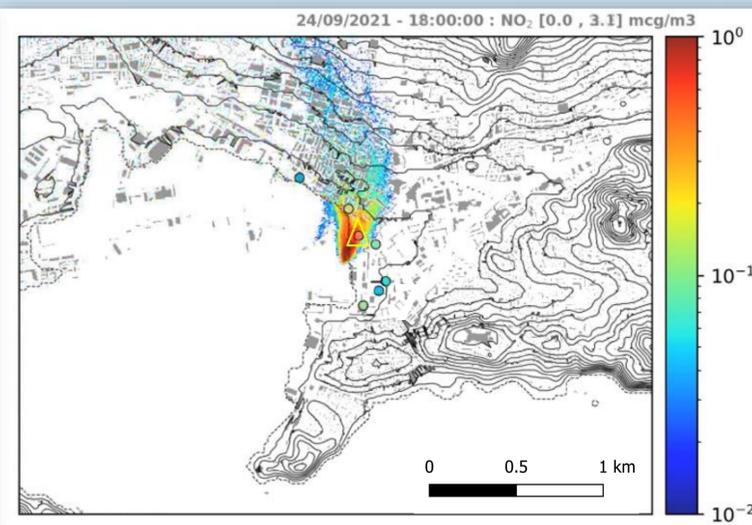


Figure 5: Example of plume modelling with PMSS in Toulon, simulated concentrations of NO₂, in Toulon. Mobile lab (yellow triangle and red and white circle). Micro-sensors concentrations (color dots).

2 Shipping activities in the Region Sud

Coastal areas, densely populated in France, are particularly impacted by shipping. In 2020, regulations for emissions in the Mediterranean Sea came into effect with the **limitation of fuel sulphur content** (0.5%). In this context, AtmoSud is involved in different projects to improve its understanding of atmospheric pollution.

4 Air quality modelling work resides in reproducing concentrations measured with **2 models (PMSS and ANSYS Fluent)**. A work of identification of individual plumes has been implemented (Figure 1). The ship emissions of selected pollutants have been estimated thanks to the technical characteristics of each individual vessel, the load of the engine and the fuel consumption.

5 Model assessment consists in running each models to evaluate if **the simulated plume intersects the mobile lab** and if estimated concentrations were close to the measurements. Every event is investigated and gives the performance score of each models' configuration (Figure 2).

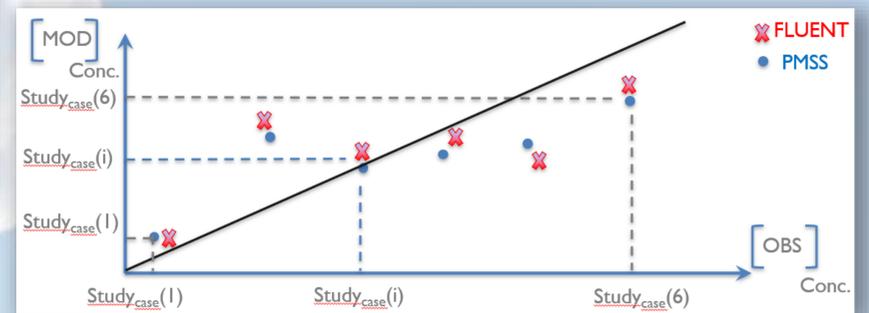


Figure 2: Model intercomparison between models. Each cross (FLUENT) or dot (PMSS) corresponds to a different simulation with different emissions (different IMO ship) and different weather conditions

6 ANSYS FLUENT is a fluid simulation software that provides modelling capabilities for a wide range of fluid flow studies. In this specific work **the RANS-CFD approach** was implemented to resolve fluid flow equations in a very high-resolution computational domain (0.5-2 meters), simulating 3D gas-transport (Figure 3).

7 PMSS (Parallel-Micro-SWIFT-SPRAY) is a parallelized **3D particle Lagrangian dispersion model** that simulates the advection and diffusion of gaseous species in the atmosphere (Figure 4 and Figure 5). Developed and distributed by ARIA Technologies, it is dedicated to small scale and complex terrain, such as urban or industrial environments.

8 References

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