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Modelling of the sea breeze and atmospheric pollution transport in the French coastal region of the North Sea

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Our study adresses the problem of the forecast of the atmospheric pollution. More particularly we simulated the transport of passive scalars in the atmosphere of the Dunkerque area. Dunkerque (51°N, 2°20'E) is situated on the northern coast of France at the eastern limit of the English Channel in Flanders. The typical weather is windy and cloudy. Western wind is dominating in the region, blowing from Atlantic to the North Sea. The Flanders coastline is flat and the hills usually appear at the distance of 30 km from the coast and are up to 200 meters high. On sunny days in summer, sea breezes develop frequently. This area is strongly industrialized and polluted by many metallurgic factories and refineries bordering the coast. Thus the influence of sea breeze dispersion of the pollutants in this area is an important aspect of the pollution transport in the coastal zone.

Modelling the sea breeze which is developped in the atmospheric boundary layer requires non hydrostatic approximation. For simulation of sea breeze we applied the atmospherical 3D non hydrostatic model Meso-NH. We present here the results of our numerical simulations for a sunny summer day in September when sea breeze developped on the Dunkerque area, with an opposing synoptical wind. The results of simulations are validated by avalaible in-situ data. We studied the vertical structure of the lower tropospheric layers under sea breeze conditions and observed how the sea breeze head propagates towards inland. We followed this event round the day. We observed that the sea breeze strongly influences the character of the dispersion of locally emitted pollutants in the lower troposheric layers of the industrialized coastal zone. Simulations reveal that passive tracers emitted inside the breeze stay trapped in it and that passive tracers emitted outside the breeze tend to concentrate above the sea breeze current, in the breeze's recirculation zone.