Air pollution modelling over complex topography
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The present study deals with air pollution modelling over complex topography, both from the phenomenological and numerical point of view. The theme of air pollution modelling has been faced at first from a phenomenological point of view. Then a numerical approach for the resolution of the diffusion-advection equation has been followed. Two different methods have been explored: puff-models and lagrangian particle models.

The eulero-lagrangian puff-model CALPUFF (released by Earth Tech) has been used as a reference: closures and parametrizations adopted by this software have been tested over complex terrain and some minor changes have been introduced into the original code. A further step was the development of a lagrangian particle-tracking program, suitable for not homogenous not stationary flows, and also adapted to complex terrain cases, accounting for vertical skewed turrbulence in any atmospheric stability class. Langevin equation were solved following Thomson's (1987) approach. Special attention was put on near field dispersion processes. In fact, lagrangian models turn out to be the most advanced numerical schemes for pollutant transport simulations but at now only suitable for short term simulations, at least in complex terrain where high spatial resolution is needed.

An extension for the lagrangian model has been then developed, using the so called "kernel method"; this feature improves considerably the calculation performance, dramatically reducing computation tiime, so that simulations also become praticable for longer temporal scales; nevertheless it seems the kernel method seems to lead to unreliable results for narrow valleys or very steep slopes, so results cannot be generalized. Moreover, the problem of the determination of vertical profiles of turbulent diffusivity on complex orography has been faced. Both a local approach and a global one (suitable for compact valleys) for the estimate of eddy diffusivity in valley have been investigated. The first one has been adopted in the lagrangian problem previously developed. Since atmospheric turbulence is mostly generated by solar thermal flux, a procedure for the calculation of the effective solar radiation was developed. The method, which can be introduced into meteorological models which use complex orography as input, takes into account for shadowed areas, soil coverage and the possible precense of clouds which filter and reduce the incoming solar radiation. Tests have been carried out using a modified version of model CALMET (EarthTech Inc.).

Results are in agreement with turbulence data acquired by means of a sonic anemometer during a field campain performed by the Department of Civile and Environmental Engineering of the University of Trento. Finally, the analysis of near field dispersion over complex terrain has been extended to the urban context, adopting, basically, the same conceptual tools on a smaller scale. A finite volume three-dimensional numerical model has been developed and tested in simulating dispersion of traffic derived pollutants in the town of Trento. For ground level sources geometry of the domain and emission condition turn out to be very important with respect to meteorological conditions (especially atmospheric stability). The roughness, i.e. the buildings of the study area has been therefore explicitely considered, using a high resolution deigital elevation map of the urban area. This approach has turned out to be necessary for near field dispersion, when the emission source is located inside the roughness and the impact area entirely fall inside the near field. Here a comparison has been made between the predicted numerical solution and data measured by air quality stations which are present in the urban area, showing a good agreement.

A further refinement of the study has lead to the development of a two-dimensional x-z lagrangian model at the "street scale", for the study of canyon effects which tends to trap pollutant inside an urban canyon with behaviours which typically depends on geometric features, atmospheric turbulence and wind speed.