NUMERICAL SIMULATION OF PHOTOCHEMICAL EPISODES IN ALPINE VALLEYS

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1. INTRODUCTION

Alpine valleys are sensitive to air pollution due to emission sources (traffic, industries, individual heating), morphology (narrow valley surrounded by high ridge), local meteorology (temperature inversions and slope winds). Such situations are rarely investigated with specific research programs taking into account detailed atmospheric chemistry coupling gas and aerosol phases. Following the accident under the Mont Blanc tunnel on March 24th, 1999, international traffic between France and Italy was stopped through the Chamonix Valley (France). The heavy-duty traffic (about 2130 trucks per day) has been diverted to the Maurienne Valley, with up to 4250 trucks per day. The program POVA (Pollution des Vallées Alpines) started in May 2000, with the objective to analyse air quality and develop atmospheric modelling in each of the two valleys, in order to study impact of traffic and local development scenarios.

2. MODELS

Atmospheric prediction model ARPS 4.5.2 (Advanced Regional Prediction System), developed at CAPS (Center for Analysis and Prediction of Storms) (Xue, 2000), enables to resolve atmosphere dynamics above complex terrain. A large (250 * 300 kms) field is driven by the ALADIN verticals of the French Meteorological Office and forces the field of interest (25 * 25 kms). This model is coupled off-line to the TAPOM 1.5.2 code of atmospheric chemistry (Transport and Air POllution Model) developed at the LPAS of the EPFLausanne (Clappier, 1998; Gong and Cho, 1993). TAPOM uses the Regional Atmospheric Chemistry Modeling (RACM) scheme (Stockwell et al.,1997). 300-meters grid cells to calculate dynamics and reactive chemistry make possible to represent accurately dynamics in the valley (slope winds) (Anquetin et al., 1999) and to process chemistry at fine scale.

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3. SIMULATION OF PHOTOCHEMICAL EPISODES IN CHAMONIX VALLEY

The emission inventory is based on the CORINAIR methodology and SNAPS's codes, uses a 100x100m grid and includes information (land use, population, traffic, industries,..) gathered from administrations and field investigations. The yearly inventory is turned into hourly emissions for a set of RACM data in specific cases (summer/winter, week day/week end/holidays, …) to be used in scenarios (Middleton et al., 1990). Then, different scenarios are tested in the valley of Chamonix with various sources: with and without road traffic, with and without heavy vehicles, for different meteorological cases. Sunny days, without synoptic wind, explain the contribution of local sources of pollution with mixing by slope winds. Days with a constant synoptic wind in the bottom of the valley gives an insight into the pollution background and boundary conditions species. Dispersion of a passive tracer enables to describe how primary pollutants are either mixed inside the valley or transported beyond the limits of the valley. Preliminary results, without comparison with campaign data, show that typical species of secondary pollutants (HNO_3, PAN) depend on road traffic and heavy –vehicles.
 Several sensitivity tests are being performed, based on real variation of the gases emissions and background. The first results are very encouraging, when compared to fields measurements.

4. CONCLUSION

The objective of the program is now to estimate the respective impacts of the various emissions sources present in the valleys and evaluate the variability in air concentrations according to changes in environmental conditions. Then the same study will begin for the other valley of POVA program (Maurienne valley) and the impact of road traffic will be evaluated.

5. ACKNOWLEDGEMENTS

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