Geophysical Research Abstracts
Vol. 13, EGU2011-13531, 2011
EGU General Assembly 2011

Source Apportionment with Receptor Models: needs, trends and prospects

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Receptor models use multivariate analysis to estimate source of pollutants on the basis of the mixture of chemicals measured at the receptor. They require low computational intensity and are independent from emission inventories and meteorological data. However, since they resolve a mass balance equation are not appropriate for reactive species and perform better in areas relatively close to the sources. For that reason are suitable for urban and regional scales. The type of receptor model to be used depends on the available knowledge about the source profiles. When the sources are well known a chemical mass balance approach is preferred while pure factor analysis is the choice when no information about the sources is available. Hybrid models combine both types of approaches.
During the past decade the number of peer-reviewed scientific papers including receptor modelling tripled and more than fifty per cent of source apportionment studies used this kind of models. Moreover they have been extensively used in the identification of pollution sources in support to the implementation of the European Air Quality Legislation (e.g. drawing up remediation plans).
The reliability of receptor model outputs depends on appropriate data collection, in terms of data capture and kind of chemical species, and proper expression of uncertainty in the input data. An aspect particularly relevant in PMF, which scales data on the basis of their uncertainty. In addition, determining the number of relevant sources and establishing the correspondence between factors and sources still appear as critical steps.
According to a number of surveys (Viana et al., 2008; Fragkou et al., 2010) the most common used receptor models in Europe have been PCA (and modifications), Chemical Mass Balance (CMB) and Positive Matrix Factorization (PMF). However ,little is known about the comparability between the output of different models or between different implementations of a model.
Improving comparability and reliability of receptor models could be achieved by performing intercomparison exercises and compiling quality assurance protocols to reduce the influence of expert subjectivity to a minimum. Some effort has been made to compare the results of different source apportionment methods on the same dataset (Viana et al., 2006; Larsen et al., 2008; Laupsa et al., 2009; Favez et al., 2010). A community-wide intercomparison organized and evaluated by the JRC on the basis of international standards is currently in progress.
Further improvements in the performance of Receptor Models are expected from the application of advanced tools which make it possible to combine chemical data with other kind of information (meteorological data, trajectory analysis, etc.). More effort should be done to extend the range of the chemical species used as explanatory variables (e.g. VOCs, inorganic gases, organic markers, etc.). Receptor models have also good prospects in the study of the impact of pollutants on health. Combining source identification with toxicological data is a promising approach to identify cost efficient mitigation measures.