WG2 Integrated systems of MetM and CTM: strategy, interfaces and module unification

Historically, air pollution forecasting and numerical weather predictions (NWP) were developed separately. This was plausible in the previous decades when the resolution of NWP models was too poor for meso-scale air pollution forecasting. Due to modern NWP models approaching meso- and city-scale resolution and using land-use databases with finer resolution, this situation is changing. As a result the conventional concepts of meso- and urban-scale air pollution forecasting need revision along the lines of integration of MetM and CTM. For example, a new Environment Canada conception suggests to switch from the weather forecast to the environment forecast. Some European projects (e.g. FUMAPEX) already work in this direction and will feed into this Action. Within FUMAPEX, for example, Urban Air Quality Information and Forecasting Systems (UAQIFS) will include integration of NWP models to urban air pollution and population exposure models (Baklanov et al., 2002).

The eventual integration strategy will not be focused around any particular model – instead it would possibly be to consider an open integrated system with fixed architecture (module interface structure) and with a possibility of incorporating different MetMs/NWP models and CTMs. Such a strategy would only be realised through jointly agreed specifications of module structure for easy-to-use interfacing and integration. An example of such an integrated approach is that of the PRISM specification for integrated Earth System Models: http://prism.enes.org/.
As pointed out earlier urban/rural transition processes (e.g. recirculations and feedbacks) are important as are interaction of these locally forced features with synoptic scale processes (e.g. fronts and convection). Furthermore, at regional scales the interaction of meteorology (e.g. cloud formation) and pollution transport (e.g. cloud nuclei, precipitation) becomes significant. In this case off-line coupling does not allow the study of feedbacks of atmospheric pollutants on meteorological processes and the access to meteorological fields are limited by the model outputs and a large amount of data exchange.

Online coupling, on the other hand, would allow the implementation of 'integrated' physical and chemical parametrization schemes. Additionally, NWP models are not primarily developed for air pollution modelling and their results need to be designed as input to meso-scale air quality models or they have to be integrated into joint modelling systems for air quality forecasting and assessments. For this reason both off-line and on-line coupling of MetMs and CTMs will be considered in WG2. Thus, a timely and innovative field of activity will be to assess the interfaces between MeTMs and CTMs and the MetM-for-CTM models, and to establish the basis for their harmonization and benchmarking. WG2 will also review practical aspects of running meso-scale models, e.g., gaining access to meteorological and environmental/geographical datasets, running models, accessibility of model codes and data sets. It will consider methods for the aggregation of episodic results, model down-scaling as well as nesting. The activity will also address the formulation of requirements of mesoscale meteorological models suitable as input to air pollution models. Examination of data assimilation techniques will also form part of WG2 activities as it has been shown that powerful assimilation techniques may be just as critical for achieving accurate forecasts as the comprehensiveness of the model, at least on the short-range (1-2 days). In this respect, the Action will inspect the requirements for assimilation techniques with a view to development of future monitoring networks. Meteorological networks are under a transition phase with many manual stations changing to less numerous automatic stations. The use of remote sensing data is increasing and will be assessed (e.g. through GMES). Pollutant monitoring networks are still very coarse and their resolution cannot generally cope with high-frequency meteorological processes. Both CTM and NWP meso-scale models require and are dependent on specific input data that may also influence the final outputs: land-use and topographical data, parameters coupled with land-use (e.g., albedo) and emission data. The Action will assess existing datasets and methods in order to propose recommendations for the basic characteristics of datasets required for these models with respect to factors such as spatial and temporal resolution and classes split.

The overall aim of WG2, therefore, will be to identify the requirements for the unification of MetM and CTM modules and to propose recommendations for a European strategy for integrated mesoscale modelling capability. In order to achieve this aim the following activities are planned:
a) Overview of existing integrated (off-line and on-line) systems in Europe and outside Europe.
b) Identification of the advantages and disadvantages of strategies for integrating of MetMs and CTMs.
c) Development of guidance and strategy for on-line coupling of MetMs and CTMs and for their off-line interfacing.
d) Overview of existing module structures of MetMs and CTMs, along with recommendations and
requirements for module unification.
e) Formulation of requirements of mesoscale MetMs suitable as input to air pollution models and improved meteorological pre-processors and model interfaces, including deposition processes, capable of connecting mesoscale MetM results to CTM models.
f) Recommended methods for the model down-scaling and nesting, as well as assimilation techniques.
g) Identifying requirements (including observation data needs) for an integrated mesoscale modelling capability/strategy for Europe.

Inputs to the Activity:
Inputs to the activity will include data and information on CTM and Met models, used and developed in different countries, their experience of model integration, as well as existing module interface structures. As to data requirements, it would include meteorological data, chemical pollutant data as well as emission inventories for selected pollutants (such as NOx, VOCs and PM10).

Deliverables*:*
1. Overview of existing integrated (off-line and on-line) mesoscale systems.
2. Overview of existing module structures of MetMs and CTMs, recommendations and requirements for module unification.
3. Requirements of meso-scale MetMs suitable as input to CTMs, assessment of meteorological pre-processors and model interfaces between MetMs and CTMs.
4. Recommended methods for the model down-scaling and nesting, as well as assimilation techniques.
5. Requirements for an integrated mesoscale modelling capability/strategy for Europe, including data needs.