Memorandum of Understanding

for the implementation of a European Concerted Research Action designated as

COST Action 715

Meteorology applied to Urban Air Pollution Problems

The Signatories to this Memorandum of Understanding declaring their common intention to participate in the concerted Action referred to above and described in the Technical Annex to the Memorandum, have reached the following understanding:

1. The Action will be carried out in accordance with the provisions of the document COST 400/94, Rules and Procedures for Implementing COST Actions, the contents of which are fully known to the Signatories.

2. The main objective of the Action is to increase knowledge of, and the accessibility to, the main meteorological parameters which determine urban pollution levels, by comparing and contrasting methods in use for determining these parameters in European countries, leading to recommendations of approaches of the best way of using routinely available meteorological information in air pollution assessments of urban areas.

3. The overall cost of the activities carried out under the Action has been estimated on the basis of information available during the planning of the Action, at ECU 6,000,000 in 1998 prices, for the period 1998 to 2003 inclusive.

4. The Memorandum of Understanding will take effect on being signed by at least five Signatories.

5. The Memorandum of Understanding will remain in force for a period of five years.

Technical Annex

Action 715

Meteorology applied to Urban Air Pollution Problems

A Background

One of the key aims of European environmental policy is to improve air quality in European cities and urban areas. The framework Directive on air quality assessment and management was adopted by the Council of Ministers of the European Union in September 1996. It will lead to daughter Directives on up to 13 air pollutants, for which assessments of air quality in certain areas (mainly large urban areas with high populations) will be required. Remedial plans may need to be drawn up in areas of poor air quality. To undertake these tasks, reliable air pollution models are necessary to supplement, and sometimes replace, measurements and also to investigate future emission scenarios. These models will need accurate meteorological input variables consistently applied within EU member states.

These requirements introduce real practical problems for the meteorological community. For example some of the meteorological variables are quantities that are not routinely measured, such as the mixing layer depth. In normal circumstances the number of meteorological stations in urban areas is limited to a few sites, often just at airports.

COST 710 on the Harmonization of the pre-processing of meteorological data for atmospheric dispersion models, has addressed some of these issues. It has identified schemes in current use for obtaining the key meteorological variables associated with pollution. However, COST 710 did not place emphasis on urban meteorological situations. The purpose of the new Action is to specifically focus on the key topic of urban meteorology, and on the aspects of meteorology which determine urban pollution levels.

A number of major European cities: Amsterdam, Athens, Brussels, London, Paris etc contain detailed air pollution monitoring networks, and have an interest in predicting air pollution episodes one day or more in advance. The intention of city administrators is to issue warnings about forthcoming episodes and thereby encourage a change in the urban population's behaviour. This could be of use for a number of reasons, such as (1) to encourage a decrease in car use, (2) provide free public transport (to promote its use) or (3) to persuade sensitive individuals to take precautionary action. Any such measures require accurate predictions of the meteorological variables which determine air quality. The testing of the prediction models starts by testing the ability of meteorological schemes to routinely calculate these meteorological variables.

Another related requirement of pollution protection agencies in European countries is to be able to explain and interpret why high pollution levels have occurred on a specific day. High pollution levels may be recorded by a monitoring network, or could coincide with an increase in hospital attendances. In such situations the meteorological description of the episode is crucial to the interpretation. The meteorological description of pollution episodes requires

emphasis on parameters which are not normally directly measured at meteorological stations, and therefore significant processing of routinely measured data has to be undertaken.

The processed meteorological data will be of a similar form, regardless of the dispersion model, or urban pollution model, that each country or city may use. Therefore the testing of schemes for predicting urban meteorological variables which influence pollution levels will be of benefit to all European countries, regardless of local circumstances.

Considerable interest has been generated and progress made on the question of harmonization of dispersion models for regulatory purposes. COST Action 710 and COST Action 615 (on databases, monitoring and modelling of urban air quality) were sponsors of the 4th Workshop on Harmonisation within Atmospheric Dispersion Modelling for Regulatory Purposes, held in Ostend (May 1996). Modelling of urban pollution was one of the key aims. However, the determination of the best description of urban meteorology for pollution estimates was not addressed specifically, and remains a neglected area. COST 710 finished in February 1997 and COST 615 completes its work in June 1998 after an extension of one year.

Easy access to reliable meteorological variables describing urban pollution meteorology is still of paramount importance to model users. A great benefit of the proposed COST Action will be the opportunity to share experiences of how this is done in different European countries.

B Objectives and Benefits

The objective of this Action is to increase knowledge of, and the accessibility to, the main meteorological parameters which determine urban pollution levels, by comparing and contrasting methods in use in European countries, leading to recommendations of the best way of using routine meteorological information in air pollution assessments.

Urban pollution meteorology is characterised by a number of fundamental parameters (wind speed, mixing layer depth etc) and their evolution in time. To achieve its objective this Action will:

(1) review methods of deriving the most accurate description of urban meteorology, with emphasis on the factors which have the greatest effect on urban pollution, and to review methods of obtaining urban meteorological variables, in use in European countries, their application and potential application, and to compare their accuracy. The derivation of meteorological variables for different European cities, according to size, latitude, distance to coast and surrounding topography will be considered,

(2) identify observational datasets that may be available to test methods identified in (1), and to exchange these datasets so that they can be more widely applied,

(3) review treatments of situations which have the potential for producing pollution episodes e.g. stagnant situations, including how existing models (particularly fine-mesh meso-scale models) and measurements in participating countries may be used or modified to describe the micrometeorological pollution climate of urban areas, leading to recommendations of ways of obtaining appropriate meteorological data for use in urban pollution models.

The Action will address the best ways of providing data to the community of model users. This could include amongst other items: boundary conditions for urban scale models, land-use maps with sufficient resolution, representative wind statistics and synoptic classifications taking into account urban modifications. The beneficiaries of this COST Action will be the air pollution model users. They will benefit from better knowledge of, and greater access to, descriptions of urban pollution meteorology. The holders of meteorological information will be able to consider improved ways of processing meteorological information in order that it may be used effectively in air quality assessments of urban areas. Good methods for undertaking urban air quality assessments are required if the Directive on air quality assessment and management is to be implemented effectively.

C Scientific Programme

The Action will review the most important parameters of the urban climate which determine pollution levels. These are mixing layer depth, wind speed, wind profile, atmospheric stability etc and the fundamental parameters which determine these, namely surface heat flux, friction velocity, roughness length etc. The deliverables from COST 710 on Harmonization of the pre-processing of atmospheric data for atmospheric dispersion models, included recommendations of how these parameters may best be derived at general rural locations, and this will be the starting point for work under the new Action.

The way in which air flow over rural locations is modified as it crosses urban areas will be considered, leading to modifications in the main variables describing urban meteorology. Methods for tackling this problem in European countries will be reviewed from the viewpoint of modifying rural measurements and the use of numerical weather forecasting models. Detailed monitoring datasets collected for pollution modelling purposes, or for related purposes, will be identified and, if appropriate, used for testing the schemes. Special attention will be paid to recent and on-going work in this area.

In order to focus the programme into well-defined tasks, it is proposed that a number of Working Groups are set up to tackle different aspects of the problem. The topic areas of these Working Groups are listed below:

(1) wind fields in urban areas, the use and validity of various parametrization schemes. This Working Group will include in its work consideration of the effects of increased roughness in urban areas.

(2) mixing depths in urban areas and their determination and diurnal variation, the use and validity of various parametrization schemes. This Working Group will consider surface heat fluxes in urban areas. Consideration of turbulence profiles will be shared between Working Groups 1 and 2.

(3) the treatment required in situations leading to pollution episodes, particularly low wind speeds, their prediction and interpretation. This Working Group will pay particular attention to conditions of persistent light winds leading to air pollution episodes. Certain parameter values may be poorly defined during episodes and require extra attention. Attention would need to be paid as to how low wind speeds are to be determined. Consideration of the

forecasting of episodes will be included. The forecast methods may be based on solving the fundamental conservation equations or on statistical methods.

(4) the role of numerical models in the description of urban pollution meteorology; the use and validity of various parametrization schemes. This Working Group will link with the other areas and recommend how far numerical methods can be used to tackle the problems left over from the other Working Groups. It would not be just a review of numerical prediction methods. It would include work on how such methods can be tested.

The work of all four Working Groups will include consideration of the influence of complex terrain. Special cases of complex terrain e.g. a coastal site, a valley site and a hilly site will be considered to simplify the range of possibilities under discussion. How rural measurements may be applied to urban areas is another part of the programme of Working Groups (1), (2) and (3).

A detailed specification of the subject matter of each Working Group will be agreed by the Management Committee when the Working Groups are set up. The intention would be consider all scales of interest to policy decisions and hence to include the need to consider scales, normally considered to be subgrid scale phenomena, such as street canyons.

D Organisation and Timetable

The organisation of this Action is centred around the activities of the Working Groups. However, until the Working Groups have made detailed assessments of the information available in each European country, it is not apparent whether the balance of their work is equitable. For example, the number of observational datasets may be inadequate for the successful completion of tasks in one or other of the Working Groups. For this reason a phased approach to this Action is proposed.

In the first phase the Working Groups will be set up under a Management Committee. After the first year the Management Committee will review and compare the progress of the Working Groups at a small Workshop, at which preliminary results and plans will be discussed. After this first year the Management Committee will decide on a detailed plan for the dissemination of results: in what form, how, to whom and when they will be presented and distributed. Priorities in the work programme of each Group will be set. Subject to the approval of the Management Committee, the Working Groups will continue their work leading to a major Workshop or Conference after three or four years. The results of the Working Groups will be presented to a wider audience at this time. During the final year the Management Committee will draw together the conclusions of the Working Groups leading to the publication of results and recommendations.

In summary there will be three phases: (1) setting up and preliminary assessment (1 year); (2) main working programme (3 years); (3) response to peer review, completion of work programme, and publication (1 year). The overall duration of the Action is 5 years. The Working Groups are expected to work as autonomous bodies. The one year preliminary phase allows the Management Committee time to sort out problems over overlaps and duplication, and define the exact intentions and likely progress of each Working Group.

E Economic Dimension of the Project

The following COST countries have actively participated in the preparation of the Action or otherwise indicated their interest: Belgium, Denmark, Finland, France, Germany, Italy, United Kingdom, Switzerland.

A preliminary estimate assumed that each of the four Working Groups devoted at least 0.75 man years of effort each year, for five years. This would involve a total of 15 man years of effort equating to a total of ECU 1,350,000. This estimate was based on work undertaken by national meteorological services. If the efforts of other research institutes, universities, city authorities, regulators and environmental consultants are also included, an additional 18 projects, valued at 250,000 ECU on average including capital and staffing, should be added to this. It can therefore be concluded that taking into account the co-ordination costs of 150,000 ECU to be covered by the COST budget of the European Commission, the overall cost of the activities to be carried out under the Action, at 1998 prices, would be roughly ECU 6.0 million. This should be regarded as a conservative figure.