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CONTENTS

Front cover: A view from the Rožman hill toward the Klek Mountain, Croatia, (photo by B. Rožman)

EDITORIAL

Dear EURASAP members,

In the present issue you will find an article of a group of authors from UK, Italy and Bulgaria. Article focuses on the modelling system applicable for simulation of dispersion of airborne pollutants over complex topography.

In the Newsletter you will also find information on several events which will be held during 2011. Please note that these information are updated on regular basis at the EURASAP website http://www.eurasap.org/.

Also, at the last page you can find the EURASAP membership form for 2011. (Please, do not forget to use it.)

I wish you all a Happy and Successful New Year!

The Newsletter Editor

Scientists' Contributions

ABOUT THE BEHAVIOUR OF THE SAFE_AIR II ATMOSPHERIC DISPERSION NUMERICAL MODEL DURING LOW WIND CONDITIONS

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Abstract: The SAFE_AIR II modelling system (Simulation of Air pollution From Emissions _ Above Inhomogeneous Regions, Version II) has been implemented at the Department of Physics of the University of Genova (Italy) to simulate dispersion of air pollutants over complex terrain. A test case has been performed in order to point out the importance of meteorological input on model results. Three different configurations have been chosen in order to initialize the model: i) surface and upper air data; ii) surface data only; iii) upper air data only. The behaviour of SAFE_AIR II, driven

by different meteorological data pre-processing, has been investigated by means of the simulation of a hypothetical emission above a real complex orography (Florence outskirts, Italy) under low wind real meteorological conditions. The influence of the meteorological input was very relevant to the model outputs, more relevant than the dispersion scheme used.

Key words: *atmospheric dispersion, numerical modelling, meteorological pre-processors, low wind conditions*

1. INTRODUCTION

The performance of atmospheric dispersion numerical models depends crucially on the meteorological input, especially when short-term simulations are performed using new generation models which overcome the limitations of the 'classical' Gaussian ones. On the one hand new generation models simulate atmospheric dispersion processes more realistically and are able to take into account specific local conditions. On the other hand they require specific meteorological input (e.g., 3D wind velocity fields and turbulent parameters) additional to the usual input data. Therefore, they have to be driven by sophisticated meteorological pre-processors which require in their turn more extended and more reliable meteorological input data. In fact, these pre-processors need numerous input data, with a deciding role not only for the quality of the data, but also for the spatial and temporal resolution. In Europe no standards exist about which particular meteorological dataset should be used; furthermore there are many situations when the modellers should face unperfected measurements data making the

modelling less effective, unreliable or even impossible. Because of the importance of meteorology to atmospheric dispersion modelling, is important to investigate the influence of the meteorological pre-processor in order to identify the effect of the variation of one or more model inputs and/or parameters on the model outputs, and consequently on the dispersion simulation results. In particular, studies of dispersion during low wind conditions, though very few, are very significant for air pollution problems. They assume relevant importance due to the frequent occurrence of low-wind conditions associated with high pollution levels.

In the present paper the above topic is addressed: the behaviour of the SAFE_AIR II dispersion numerical model, driven by different meteorological data pre-processing, has been investigated by means of the simulation of a hypothetical emission above a real complex orography (Florence outskirts, Italy) under low wind real meteorological conditions.

2. DESCRIPTION OF THE SAFE_AIR II MODEL

The SAFE_AIR II modelling system (Simulation of Air pollution From Emissions _ Above Inhomogeneous Regions, Version II) has been implemented at the Department of Physics of the University of Genova (Italy) to simulate dispersion of air pollutants over complex terrain. SAFE_AIR II is included in the Model Database of the European Topic Centre on Air Quality of the European Environment Agency (http://pandora.meng.auth.gr/mds/strquery.php?wholedb) and in the APAT (Agency for Environmental Protection and for

Technical Support) list of air pollution models (http://www.smr.arpa.emr.it/ctn/scen2.htm).

SAFE_AIR II consists of three parts: two linked meteorological pre-processors - WINDS (Wind-field Interpolation by Non Divergent Schemes, Release 4.2, Georgieva et al., 2003a) and ABLE (Acquisition of Boundary Layer parameters, Release 1.3, Georgieva et al., 2006) - and a model which simulates the airborne pollutant transport and diffusion (P6, Program Plotting Paths of Pollutant Puffs and Plumes, Release 2.3, Canepa and Ratto, 2007).

As already said, this work concerns a study of the SAFE_AIR II model behaviour during low wind conditions. In fact, statistical evaluation exercises concerning the whole model and/or some of its modules have been already carried out, against both wind tunnel and full scale data with emissions from different sources: Acordon et al. 2003, Canepa et al. 2000a, Canepa and Builtjes 2001, Canepa and Ratto 2003, Cavallaro et al. 2007, Georgieva et al. 2001, Georgieva et al. 2003b, and Georgieva et al. 2005. Furthermore, the model performance using different atmospheric dispersion schemes has been analysed by: Busillo et al. 2004, Canepa et al. 2000b, Canepa et al. 2007, and Corti et al. 2001.

2.1 Wind-field construction: the WINDS model

WINDS is a mass-consistent flow model (Ratto et al., 1994) developed at the Department of Physics of the University of Genova (Italy). It builds a three-dimensional wind field by the following two steps: first, an initial wind field is constructed, through an

interpolation procedure, starting from available wind data at given points; then, an adjustment step, based on the variational approach (Sasaki, 1970), is performed in order to assure mass consistency.

At the first step WINDS can use different initialisation schemes: ground station data and/or geostrophic wind, observed vertical profiles (SODAR, etc), profiles coming from larger scale meteorological models (e.g. Limited Area Models), etc.

WINDS is written in conformal terrain-following coordinates. The advantage with respect to Cartesian coordinates is that the terrain surface is more accurately represented, the surface boundary conditions are easily treated and thus a higher vertical grid resolution near the terrain surface can be used.

As typical for diagnostic flow models, WINDS reproduces mainly the dynamical effects of the topography on the wind field – speed-up, channelling, blocking. However, in WINDS, other relevant phenomena are taken into account by means of parameterisations. Thus, the effect of the atmospheric stability and the surface roughness on the wind profile are parameterized using Zilitinkevich (1989) formulae. Also the development of an Internal Boundary Layer due to an abrupt change in the surface roughness (as sea-land transition) has been parameterised.

WINDS Release 4.2 included in SAFE_AIR II incorporates also a new numerical method for the adjustment step. In fact, besides the SOR (Successive Over-Relaxation) iterative method, the ADI (Alternating Direction Implicit) iterative method has been implemented in order to achieve a non-divergent flow field (Roache, 1982). Although more complex as a procedure, the ADI method results more effective than the SOR method in terms of computational time. Numerical test have shown that the computational time decreases by a factor of 30 and this is especially notable for simulations in stable atmospheric conditions.

WINDS is also widely used as a stand-alone model for many geophysical and engineering applications like forest fire propagation studies, wind potential assessments, detection of critical wind conditions for aircraft operations, and evaluation of wind-induced actions on structures (Burlando et al., 2007; Castino et al., 2003).

2.2 Micrometeorological parameters calculation: the ABLE model

The ABLE model, which was not present in the previous version of SAFE_AIR, calculates the horizontal distribution of dispersion relevant boundary layer parameters - like mixing height, Hmix, Monin-Obukhov length, LMO, friction velocity, u*, convective velocity scale, w* - starting from routinely measured meteorological variables. These parameters are not measured routinely, however they are required as input for dispersion modelling. Thus, a good parameterization of these parameters is essential for the accurate simulation of pollutant's dispersion in the low atmosphere.

For the definition of the mixing height, the one used by COST Action 710 (1998) has been adopted: "The mixing height is the height of the layer adjacent to the ground over which pollutants or any constituents emitted within this layer or entrained into it

become vertically dispersed by convection or mechanical turbulence within a time scale of about one hour".

The growth and the structure of the mixing height is driven by the fluxes of heat and momentum which depend not only on meteorological variables, but also on surface characteristics, such as roughness of the underlying terrain, albedo, moisture content. Therefore, the estimation of the sensible heat flux, H, is fundamental for the calculation of the mixing height.

ABLE is based on the energy balance method to determine the sensible heat flux. In diurnal conditions, the scheme by Holtslag and van Ulden (1983) and van Ulden and Holtslag (1985) is used. To take into account the topographic effects on the amount of the incoming solar radiation a slope correction factor is included in the algorithm. In nocturnal conditions, a semi-empirical approach is adopted as in the recent versions of both the CALMET (Scire et al., 2000) and AERMOD (Cimorelli et al., 2002) models.

The mixing height is computed as a 2D field using different formulae for stable (night-time) and convective (day-time) conditions over land, while a different procedure is adopted over see. Day-time is defined by an upward (positive) sensible heat flux, night-time by a downward (negative) one.

The pre-processor uses a slab model for the growth of the mixing height during day-time conditions as proposed by Batchvarova and Gryning (1991). According to this model, the mixing layer growth is initially proportional to the friction velocity, with mechanical production of turbulent kinetic energy being the controlling mechanism; the importance of mechanical production diminishes gradually as the production of convective turbulence becomes important.

For the parameterization in night-time conditions the Nieuwstadt (1981) formula is implemented, which is based on friction velocity and Monin-Obukhov stability parameters.

It is to mention that the surface wind velocity field produced by the model WINDS acts as an input for ABLE while the horizontal distribution of other required meteorological input data (cloud cover, temperature, pressure, etc.) is estimated on the basis of available observations.

2.3 The P6 dispersion module

P6 is a multi-source model mainly designed to simulate the air quality dispersion at local and regional scales from point sources; however this model can also be used for line, area, and volume sources.

P6 is a Lagrangian model based on the basic Gaussian formula. The emitted pollutant is divided into a sequence of 'elements', either plume segments or puffs, which are connected together, but whose dynamics is a function of local meteorological conditions. Therefore, while maintaining the simplicity of the Gaussian formula, P6 allows to perform numerical simulation of both non-stationary and inhomogeneous situations (e.g. dispersion above complex terrain).

Plume segments provide a numerically fast simulation of the dispersion of air pollutants near the source, during transport conditions. Puffs allow a proper simulation of diffusion, both far from the source and during calm or low-wind situations. Note that the type of element (plume segment or puff) does not affect its dynamics, but only the computation of the concentration field. Thus, the basic dynamical features will be discussed independently of its type, plume or puff.

The dynamics of the elements, which are described in a Cartesian reference frame, consists of the following processes.

1) Generation at the source: a new element is added at the beginning of the element 'chain' originated from each source.
2) Plume rise: a) the final plume rise can be calculated directly by the code according to one of the following options: i) Turner method (Turner, 1985), ii) Briggs formulae (Briggs, 1969, 1972, 1975), iii) Moore model (Moore, 1974); b) otherwise, the user can provide the code with a plume rise value (positive or vanishing), for every source. Furthermore, the user can decide to take into account: the stack tip downwash phenomenon; the building downwash phenomenon; the interaction of the rise of the plume with the top of the mixed layer.

3) Advection: each existing element is transported from an old to a new position, according to the current wind vector averaged over the volume covered by the element size.

4) Diffusion by atmospheric turbulence: the element σ-functions are increased, based on the "virtual distance/age" concept (Ludwig et al., 1977; Zannetti, 1981), whose semi-empirical justification is

presented in Zannetti (1986). The dynamics of the element σ-functions depend on the type of the σ-functions and the current atmospheric turbulence status at the element location.

5) Possible chemical transformation: a first-order chemical reaction scheme is adopted, in which the chemical transformation term reduces the mass of primary pollutant and increases the mass of secondary pollutant in each element. The model is able to deal with linear chemical reactions only.

6) Possible deposition: both dry and wet depositions are simulated by first-order reaction schemes and are computed by an exponential reduction of the pollutant mass.

7) Possible gravitational settling of coarse particles: the particulate plume is viewed as similar to a gaseous plume tilted downward through an angle determined by wind speed and settling velocity. The user can simulate, through subsequent simulations, the dispersion of particulate matter having different settling velocity.

As far as the choice of the σ-functions is concerned (see also item 4), the model includes both well known semi-empirical dispersion σ-functions (Pasquill-Gifford-Turner, Brookhaven, Briggs open country, and Briggs urban) and three sets of σ-functions which have a lesser degree of turbulence parameterization than the semi-empirical σ-functions cited above. The latter are: 1) Mazzino (1997) σ-functions, which has never been implemented until now in any dispersion model; 2) Draxler (1976) σ-functions, already implemented in the CALPUFF model approved by U.S. EPA; 3) a modified version of Hanna and

Strimaitis (1990) σ-functions for neutral and stable cases (for more details see Canepa and Ratto 2007). In fact, these last three sets of σ-functions do not make use of the stability class, but they are function of standard deviations of velocity fluctuations (σ_u, σ_v, σ_w) and Lagrangian time scales (T_{Lu}, T_{Lv}, T_{Lw}) in order to take into account turbulence characteristics. Using P6 Release 2.3, the standard deviations of velocity fluctuations (σ_u, σ_v, σ_w) can be read directly as an input for each grid point of the domain. If they are not available, they can be provided, together with Lagrangian time scales (T_{Lu}, $T_{L}v$, T_{Lw}), by means of an internal subroutine starting from the ABLE output (for more details see Canepa and Ratto 2007).

3. THE PERFORMED SIMULATIONS

In this study we simulated the dispersion from two hypothetical point sources located in the Florence outskirts in real meteorological situations. The hypothetical sources represent two industrial stacks (closely located) emitting an inert pollutant at a total rate of 2 g/s and temperature of the initial plume of 140 °C; the stacks are 60 m high with an internal diameter of 1.6 m.

The area in consideration is an industrial settling located in a relatively flat terrain with the exception of the northeast corner, where there are several hills (maximum elevation about 750 m a.s.l., see Figure 1). The domain size is 20 x 20 km^2 and it includes also several urban settlings, in particular a part of the Florence metropolitan area (south-east domain corner) and a part of the Prato metropolitan area (north-west domain corner).

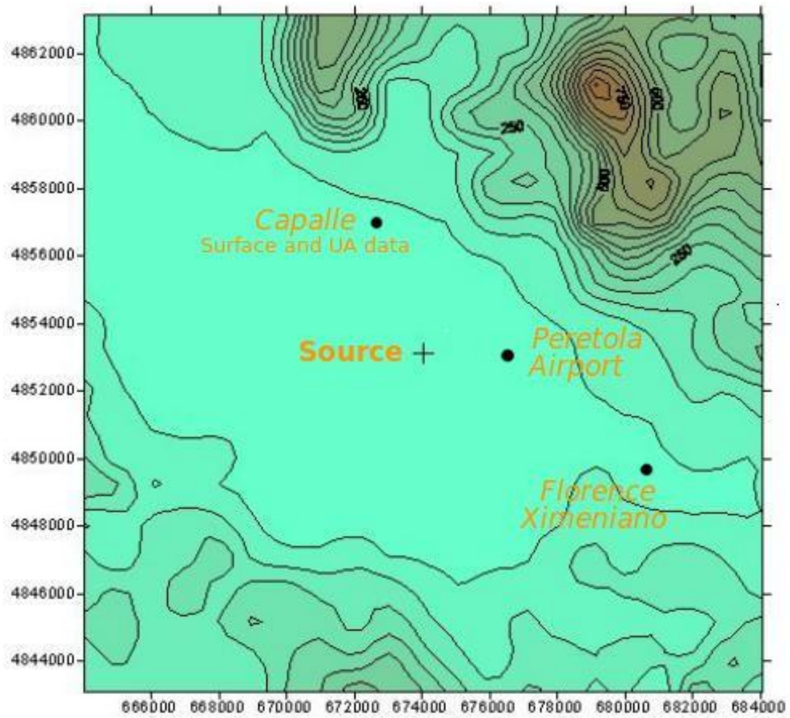

Figure 1. The studied area. Isolines depict the topography; points represent the available meteorological stations.

The meteorological fields in the studied area are reconstructed on the basis of observations provided by three meteorological stations located inside the studied area itself. The main meteorological station (tagged "Capalle" in Figure 1), operated by LAMMA (Meteorology and Environmental Modelling Laboratory), is located

less than 4 km far from the position of the hypothetical sources. It provides both surface (S) data (temperature, relative humidity, as well as wind speed and direction measured at 10 m a.g.l.) and upper air (UA) data. The latter (temperature, wind speed and direction) are derived from RASS and SODAR measurements from about 60 m a.g.l. up to an elevation of 400-500 m a.g.l..

The two other meteorological stations are used for radiation data (Osservatorio Ximeniano in the city of Florence, 8.2 km far from the sources) and for pressure and cloud cover measured at the Florence airport meteorological station (2.4 km far from the sources).

A three-day measurement period from 00.00 LST of May 16 to 00.00 LST of May 19 2002 has been chosen, it was particularly critical as far as pollutant dispersion is concerned. In fact this period was characterized either by calm wind (wind speed < 0.4 m/s) or by time intervals with wind speeds in the range of 1 – 4 m/s. The average surface air temperature was + 20.8 °C (min = + 12.4 °C, max = + 29.9 °C).

Three different configurations have been chosen in order to study the sensitivity of the SAFE_AIR II results to the meteorological input - the model has been initialized using the Capalle station measurements with:

i) surface and upper air data (S&UA configuration);
ii) surface data only (S configuration);
iii) upper air data only (UA configuration).

The SAFE_AIR II simulations have been performed using both the Brookhaven and Draxler dispersion σ-functions in order to test the different behaviour of the code using semi-empirical σ-functions or more advanced formulations. The Brookhaven σ-functions have been chosen among the semi-empirical ones because generally speaking they gave the best results with respect to the other available semi-empirical σ-functions in P6 (e.g., Canepa et al., 2000a). The Draxler σ-functions have been chosen among the advanced ones because they are the most commonly used in the dispersion model applications with respect to the other available advanced σ-functions in P6.

The SAFE_AIR II simulation outputs consist of hourly averaged values of two-dimensional (2D) and three-dimensional (3D) fields of meteorological variables and pollutant concentrations. In particular, the simulation results of the present study were: 3D wind fields with a horizontal discretization of 500 x 500 m^2 and on 20 levels along the vertical direction (conformal terrain-following coordinates); 2D fields of mixing height (H_{mix}), Monin-Obukhov length (L_{MO}), friction velocity (u^*), convective velocity scale (w^*), and ground level pollutant concentration (*c*) with a horizontal discretization of 500 x 500 m^2.

In the case ii) - surface data only - the daytime mixing height has been calculated using the default value for the potential temperature gradient (0.005 K/m); in the other two cases the potential temperature gradient has been calculated from vertical temperature profiles.

4. RESULTS AND DISCUSSION

The simulation results for the selected period have been analysed on the basis of:
1) graphical comparison among the meteorological pre-processor outputs for the three input configurations;
2) graphical comparison among the dispersion module outputs for the six (three meteorological x two σ-functions) input configurations;
3) statistical analysis of the ground level concentration values for the six input configurations.

4.1 Graphical comparison among the meteorological pre-processor outputs

The time evolution of wind speed at 10 m a.g.l. (WS), mixing height (H_{mix}), Monin-Obukhov length (L_{MO}), friction velocity (u^*), and convective velocity scale (w^*) are shown in Figures 2-6. These values are presented averaged over the whole domain; in any case they were quite uniform across the domain itself.

As shown in the figures, when a surface meteorological station is present, providing additional upper air introduces small modifications on the time series of WS, L_{MO}, and u^*. On the contrary, results from the UA configuration (only upper air data, without surface measurements), are totally different. No such behaviour can be found for H_{mix}, and w^*. As far as the simulation of the 10 m wind speed is concerned (Figure 2), it can be noticed that if surface data are used the model output shows a well defined daily variation, with maximum velocity values at about 5 p.m.. This is the same behaviour of the temporal series of the surface measurements at Capalle station (Figure 7) that is representative for the flow conditions in the model domain. Therefore we believe that feeding the model with surface data improves the model output accuracy, that is to say the model is able to simulate the low level wind systems which develops with clear sky under no external synoptic forcing like during the simulated period.

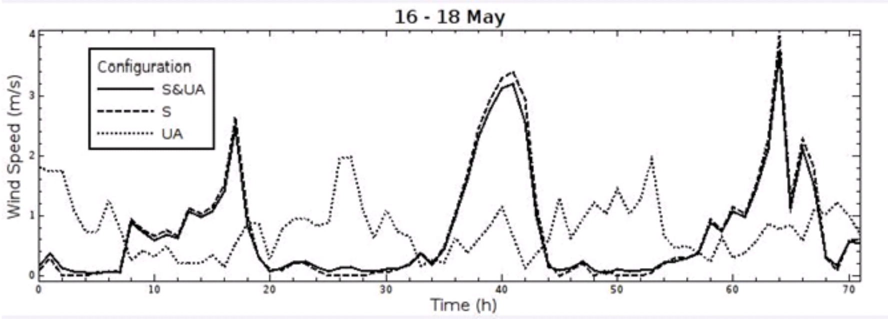

Figure 2. Simulated wind speed at 10 m a.g.l. for the simulated period averaged over the whole domain.

The mixing height, H_{mix}, is a critical factor because it is one of the most influential meteorological parameters for dispersion models especially when its value is low and the plume during its rising strongly interacts with the top of the mixed layer. This phenomenon can determine high ground level pollutant concentrations. Unfortunately, the estimation of the H_{mix} values from the Capalle station SODAR vertical profiles for the simulated period was not possible because the upper measurement level of the vertical profiles was below the mixing height elevation.

From the L_{MO} outputs it can be seen that the atmosphere was stable at night-time and unstable at day-time, instability lasted for about 10 hours a day.

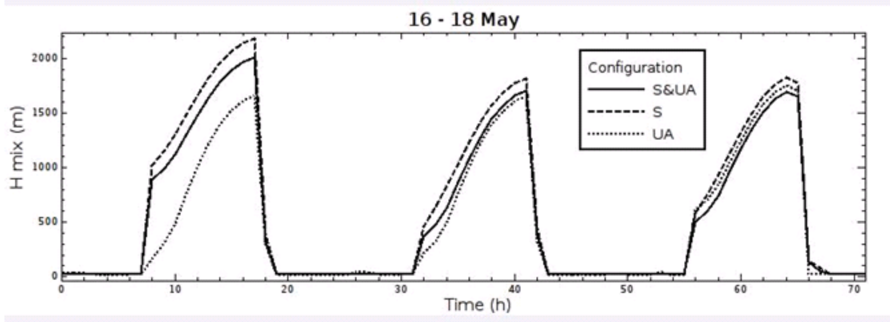

Figure 3. Simulated mixing height for the simulated period averaged over the whole domain.

4.2 Graphical comparison among the dispersion module outputs

The average (72 h) ground level concentration maps for the study period, the three test configurations, and the two considered σ-functions (Section 3) are reported in Figure 8.

An evident difference in the concentration maximum values and in the shape of the contour maps can be seen between maps obtained using both different model configurations and σ-functions. This fact confirms that a proper simulation of low wind meteorological conditions is particularly critical. Unfortunately, we had no clear indication from available data about the best performing model input configuration, even if we could argue that S&UA configuration should give in principle the most reliable results, because more information in taken into account.

4.3 Statistical analysis of the ground level concentration values

Some simple statistics concerning the time averaged (72 h) ground level concentrations have been calculated in order to quantitatively analyse the behaviour of the models. In particular we calculated: the maximum, the mean concentration averaged over the whole domain, its standard deviation, and the mean of the 100 highest concentrations. Results are reported in Table 1. Statistical analysis clearly confirms, as already qualitatively noticed from Figure 8, that a proper simulation of low wind meteorological conditions is particularly critical.

5. CONCLUSIONS

The SAFE_AIR II modelling system simulates dispersion of air pollutants over complex terrain. It consists of three parts: two linked meteorological pre-processors - WINDS to simulate a three dimensional wind field starting from available measurements and ABLE to calculate the horizontal distribution of dispersion relevant boundary layer parameters - and a model, P6, which simulates the airborne pollutant transport and diffusion. A test case study has been performed in order to point out the importance of meteorological input on the SAFE_AIR_II dispersion model results.

The model behaviour has been investigated by means of the simulation of a hypothetical emission above a real complex orography (Florence outskirts, Italy) under low wind real meteorological conditions.

Both the dispersion scheme used and the influence of the meteorological input, together with its processing by the model, do show large differences in the model outputs. Differences in modelled meteorological variables affected dramatically modelled concentrations. Therefore, before routinely applying the SAFE_AIR II dispersion model on a specific complex study area, especially under local critical meteorological conditions, a calibration study is recommended. That is to say we recommend performing a procedure to make estimates of the parameters of model routines, which best fit the general model structure to specific local observed data sets.

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REFERENCES

Acordon, V., Canepa, E., Georgieva, E., Ratto, C.F., 2003. The SAFE_AIR II code: a validation exercise. Conference proceedings of 7° Convegno Nazionale di Ingegneria del Vento, IN-VENTO-2002, 16-18 September 2002, Milano, Italy, 153-160.

Batchvarova, E, Gryning, S.E., 1991. Applied model for the growth of the daytime mixed layer. Boundary-Layer Meteorology, (56) 261-274.

Briggs, G.A., 1969. Plume rise. AEC Crit. Rev. Ser., TID-25075. U.S. At. Energy Comm., Div. Tech. Inform. Ext., Oak Ridge, Tennessee, USA.

Briggs, G.A., 1972. Chimney plumes in neutral and stable surroundings. Atmospheric Environment (6) 507-510.

Briggs, G.A., 1975. Plume rise prediction. In: D. Haugen (editor). Lectures on air pollution and environmental impact analyses. American Meteorological Society, Boston, USA.

Burlando, M., Carassale, L., Georgieva, E., Ratto, C.F., Solari, G., 2007. A simple and efficient procedure for the numerical simulation of wind in complex terrain. Boundary-Layer Meteorology (125) 417-439.

Busillo, C., Calastrini, F., Carpentieri, M., Corti, A., Gualtieri, G., Canepa, E., 2004. Meteorological input for atmospheric dispersion models: an inter-comparison between new generation models. 9th International Conference on Harmonisation within Atmospheric Dispersion Modelling for Regulatory Purposes, 1-4 June 2004, Garmisch-Partenkirchen, Germany. Conference proceedings, Vol. 1, 23-27.

Canepa, E., Modesti, F., Ratto C.F., 2000a. Evaluation of the SAFE_AIR code against air pollution field and laboratory experiments. Atmospheric Environment 34 (28) 4805-4818.

Canepa, E., Dallorto, L., Ratto, C.F., 2000b. About the plume rise description in the dispersion code SAFE_AIR. International Journal of Environment and Pollution 14 (1-6) 235-245.

Canepa, E., Builtjes, P.J.H., 2001. Methodology of model testing and application to dispersion simulation above complex terrain. International Journal of Environment and Pollution 16 (1-6) 101-115.

Canepa, E., Ratto, C.F., 2003. SAFE_AIR algorithms to simulate the transport of pollutant elements: a model validation exercise and sensitivity analysis. Environmental Modelling & Software 18 (4) 365-372.

Canepa, E., Ratto, C.F., 2007. P6 Release 2.3 User's Guide. Department of Physics - University of Genova, Genova, Italy.
http://www.fisica.unige.it/atmosfera/_file/safe_air_II/p6-23-1.pdf
http://www.fisica.unige.it/atmosfera/_file/safe_air_II/p6-23-2.pdf

Canepa, E., D'Alberti, F., D'Amati, F., Triacchini, G., 2007. The GIS-based SafeAirView software for the concentration assessment of radioactive pollutants after an accidental releases. Science of the Total Environment (373/1) 32-42.

Castino, F., Rusca, L., Solari, G., 2003. Wind climate micro-zoning: a pilot application to Liguria Region (North-Western Italy). Journal of Wind Engineering and Industrial Aerodynamics (91) 1353-1375.

Cavallaro, M., Canepa, E., Georgieva, E., 2007. The SAFE_AIR II dispersion model: description and statistical evaluation of its dispersion module against wind tunnel data from area sources. Ecological Modelling (202/3-4) 547-558.
http://dx.doi.org/10.1016/j.ecolmodel.2006.11.018

Cimorelli, A.J., Perry, S.G., Venkatram, A., Weil, J.C., Paine, R.J., Wilson, R.B., Lee, R.F., Peters, W.D., Brode, R.W., Pauimer, J.O., 2002. AERMOD: Description of Model Formulation. U.S. EPA 454/R-02-002d.

Corti, A., Zanobini, M., Canepa, E., 2001. Use of Wind Tunnel measurements for mathematical model comparison and validation. 2nd International Conference on Air Pollution Modelling and Simulation APMS'2001, 9-13 April, 2001, Paris, France. Conference proceedings, 341-354.

COST Action 710, 1998. Harmonization of the pre-processing of meteorological data for atmospheric dispersion models. Final Report, Fisher, B., Erbrink, J., Finardi, S., et al., (Eds.), EC Belgium.

Draxler, R.R., 1976. Determination of atmospheric diffusion parameters. Atmospheric Environment (10) 99-105.

Georgieva, E., Canepa, E., Ratto, C.F., 2001. The determination of the mixing height: an extended version of the SAFE_AIR dispersion model. Millenium NATO/CCMS International Technical Meeting on Air Pollution Modelling and its Application, 15-19 May 2000, Boulder, Colorado, USA, Air pollution modeling and its application XIV, Gryning and Schiermeir, (Eds.), Kluwer Academic/ Plenum Publisher, New York, USA, 719-720.

Georgieva, E., Canepa, E., Mazzino, A. Ratto, C.F., 2003a. WINDS Release 4.2 User's Guide. Department of Physics - University of Genova, Genova, Italy.
http://www.fisica.unige.it/atmosfera/_file/safe_air_II/winds4_2.pdf

Georgieva, E., Canepa, E., Bonafè, G., Minguzzi E., 2003b. Evaluation of ABLE mixing height algorithms against observed and modelled data for the Po Valley, Italy. 26th NATO/CCMS International Technical Meeting on Air Pollution Modelling and its Application. 26 – 30 May 2003, Istanbul, Turkey. Preprints, p. 396-403.

Georgieva, E., Canepa, E., Ratto, C.F., 2005. Modification of the SAFE_AIR II dispersion code for urban application. 8° Convegno Nazionale di Ingegneria del Vento, IN-VENTO-2004, 21-23 June 2004, Reggio Calabria, Italy. Conference proceedigs, 339-348.

Georgieva, E., Canepa, E., Ratto, C.F., 2006. ABLE Release 1.3 User's Guide. Department of Physics - University of Genova, Genova, Italy.
http://www.fisica.unige.it/atmosfera/_file/safe_air_II/ABLE_13.pdf

Hanna, S.R., Strimaitis, D.G., 1990. Rugged terrain effects in diffusion. In Atmospheric processes over complex terrain. Blumen, W., (Ed.), AMS, 109-143.

Holtslag, A.A.M., van Ulden, A.P., 1983. A Simple Scheme for Daytime Estimates of the Surface Fluxes from routine Weather Data. Journal of Climate and Applied Meteorology (22) 517-529.

Ludwig, F.L., Gasiorek, L.S., Ruff, R.E., 1977. Simplification of a Gaussian puff model for real-time minicomputer use. Atmospheric Environment. (11) 431-436.

Mazzino, A., 1997. Effective correlation times in turbulent scalar transport. Physical Review E (56) 5500-5510.

Moore, D.J., 1974. A comparison of the trajectories of rising buoyant plumes with theoretical/empirical models. Atmospheric Environment (8) 441-457.

Nieuwstadt, F.T.M., 1981. The steady state height and resistance laws of the nocturnal boundary layer: Theory compared with Cabauw observations. Boundary-Layer Meteorology (20) 3-17.

Ratto, C.F., Festa, R., Romeo, C., Frumento, O.A., Galluzzi, M., 1994. Mass-consistent models for wind fields over complex terrain: the state of the art. Environmental Software, (9) 247-268.

Roache, P.J., 1982. Computational Fluid Dynamics. Albuquerque: Hermosa Publishers, ISBN 0-913478-05-9.

Sasaki, Y., 1970. Some basic formalism in numerical variational analysis. Monthly Weather Review (98) 875-883.

Scire, J.S., Robe, F.R., Fernau, M.E., Yamartino, R.J., 2000. A User's guide for the CALMET Meteorological Model (Version 5), Earth Tech, Inc., Concord, MA.

Turner, D.B., 1985. Proposed pragmatic methods for estimating plume rise and plume penetration through atmospheric layers. Atmospheric Environment (7) 1215-1218.

van Ulden, A.P., Holtslag, A.A.M., 1985. Estimation of atmospheric boundary layer parameters for diffusion applications. Journal of Climate and Applied Meteorology (24) 1196-1207.

Zannetti, P., 1981. An improved puff algorithm for plumes dispersion simulation. Journal of Applied Meteorology (20) 1203-1211.

Zannetti, P., 1986. A new mixed segment-puff approach for dispersion modeling. Atmospheric Environment (20) 1121-1130.

Zilitinkevich, S.S., 1989. Velocity profiles, the resistance law and the dissipation rate of mean flow kinetic energy in a neutrally and stably stratified planetary boundary layer. Boundary-Layer Meteorology (46) 367-387.

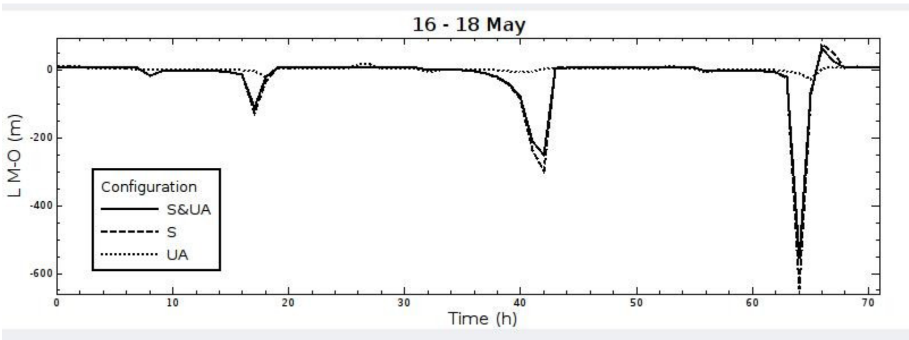

Figure 4. Simulated Monin-Obukhov length for the simulated period averaged over the whole domain.

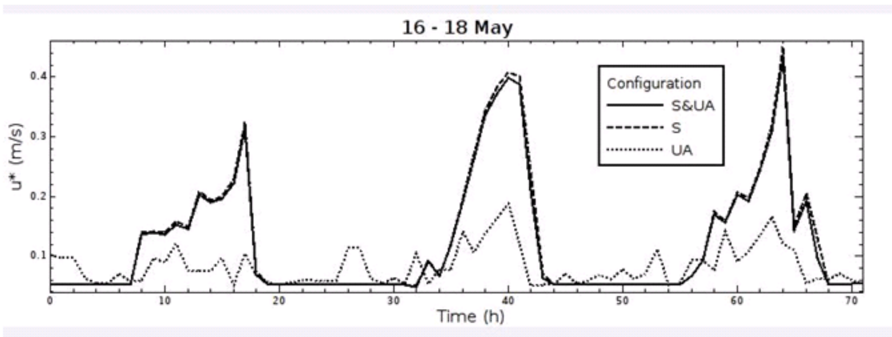

Figure 5. Simulated friction velocity for the simulated period averaged over the whole domain.

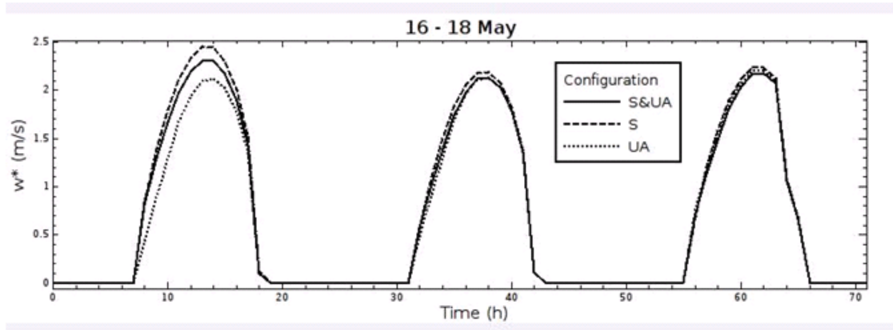

Figure 6. Simulated convective velocity scale for the simulated period averaged over the whole domain.

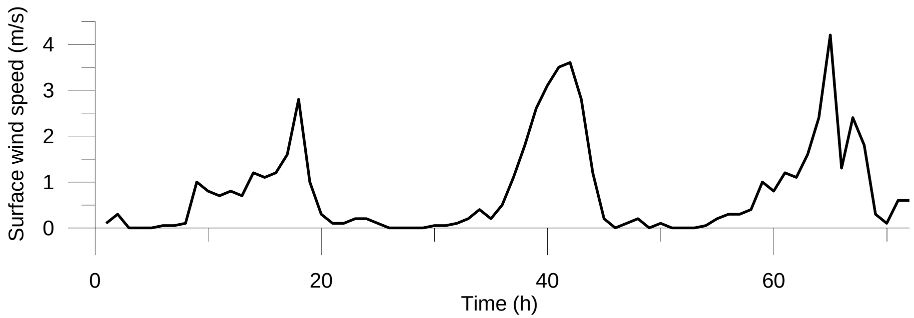

Figure 7. Wind speed at 10 m a.g.l. measured at the Capalle station: for the simulated period.

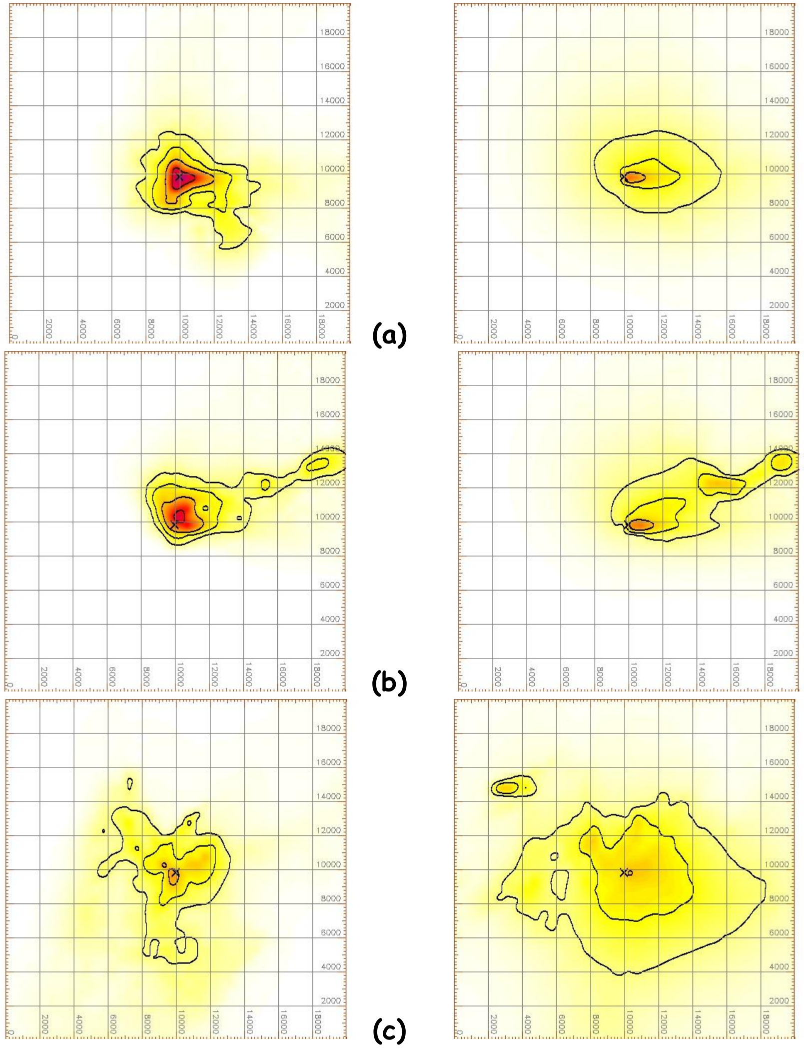

Table 1
Statistics for the time average (72 h) simulated ground level concentrations. All values are in [μg/m^3].

Configuration		Max	Mean	St. Dev.	Mean 100
S&UA	Brook	21.94	0.23	0.98	2.50
	Drax	3.22	0.17	0.24	0.87
S	Brook	35.83	0.22	1.34	2.58
	Drax	3.13	0.15	0.27	0.98
UA	Brook	4.39	0.28	0.45	1.62
	Drax	2.71	0.47	0.42	1.60

Figure 8. Average (72 h) simulated ground level concentrations; contour levels are set to 0.5, 1, 2, 5, 10, and 20 μg/m^3; Brookhaven (left), and Draxler (right) σ-functions; (a) S&UA configuration, (b) S configuration, (c) UA configuration.

Jobs and PhD positions

PHD STUDENTSHIP IN THE AREA OF 'SOURCE APPORTIONMENT OF PARTICULATE MATTER AND RELATED CHEMICAL SPECIES'

A PhD studentship is available in the area of 'source apportionment of particulate matter and related chemical species' at Centre for Atmospheric and Instrumentation Research (CAIR), University of Hertfordshire. For more details, please see the web-link:
http://www.jobs.ac.uk/job/ABX232/phd-studentship/

Future events

NATO ADVANCED RESEARCH WORKSHOP - CLIMATE CHANGE, HUMAN HEALTH AND NATIONAL SECURITY
Dubrovnik, Croatia, 28 - 30 April 2011

Participants of this workshop will explore the intricate relationships between climate change, human health and the security of nations, and how these relationships are mediated by conflicts arising from scarcity of water resources, impacts on food production, rising energy demands, and deteriorating human health and behavioral changes. The intended outcome is the publication of a document outlining the state-of-the-art of understanding of these issues and their interrelationships as well as identification of future research and policy and management needs.

Participation in this workshop is by invitation only with each attendee presenting an overview of the current understanding of their field followed by a discussion on how their work is related to the theme of the workshop.

Currently the available spaces are full, but if cancellations occur then there is a possibility of accommodating other interested participants.

For more information, please visit the website:
http://www.nd.edu/~dynamics/NATOWorkshop.htm

1st WORLD SCIENTIFIC CONFERENCE PETRA 2011 (POLLUTION AND ENVIRONMENT-TREATMENT OF AIR)
Prague, Czech Republic, 17 - 20 May, 2011

The Conference is held under the auspices of the Czech Ministry of the Environment and the Czech Ministry of Industry and Trade and it is devoted to the protection of global climate. The main objective of the Conference is to concentrate experts from all over the world to introduce the latest scientific and practical knowledge in the branch and to exchange their experience in an effort to find common ways to cooperate. The conference is intended for researchers and wider public concerned about the given issue.

More information at:
http://odour.webnode.cz/en/konference/konference-petra-2011/

11th INTERNATIONAL MULTIDISCIPLINARY SCIENTIFIC GEO-CONFERENCE & EXPO SGEM2011 - MODERN MANAGEMENT OF MINE PRODUCING, GEOLOGY AND ENVIRONMENTAL PROTECTION
Albena, Bulgaria, 19 - 25 JUNE, 2011

The SGEM GeoConference focuses on the latest findings and technologies in surveying geology and mining, ecology, and management, in order to contribute to the sustainable use of natural resources. In this regards all theoretical, methodological and conceptual reports presenting contemporary geoscience development and problems solving ideas are expecting with a great interest. Special attention will be given to reports, proposing science based ideas for decision-making and adaptation to the new reality of global changes. All accepted papers will be published in a conference proceedings indexed by ISI Web of Knowledge, Web of Science.

The conference is the best platform for knowledge and experience shearing in the field of geosciences. Special workshops will be held as a parallel to the SGEM2011 conference sessions. This is an additional opportunity for SGEM participants to exchange views and to learn about best practice in environmental and geo researches application and management.

T O P I C S:
1. Section „Geology"
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4. Section „Mineral Processing"
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8. Section „Photogrammetry and Remote Sensing"
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10. Section „Informatics"
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12. Section „Micro and Nano Technologies"
13. Section „Hydrology and Water Resources"
14. Section „Marine and Ocean Ecosystems"
15. Section „Forest Ecosystems"
16. Section „Soils"
17. Section „Air Pollution and Climate Change"
18. Section „Renewable Energy Sources and Clean Technologies"
19. Section „Nuclear Technologies"
20. Section „Ecology and Environmental Protection"
21. Section „Recycling"
22. Section „Environmental Economics"
23. Section „Education and Accreditation"
24. Section „Environmental Legislation, Multilateral Relations and

For more information, please visit the website: www.sgem.org

GLOREAM-EURASAP 2011 WORKSHOP ON GLOBAL AND REGIONAL ATMOSPHERIC MODELLING, Copenhagen, Denmark, 26 – 28 JANUARY 2011

The aim of the workshop is to investigate the processes and phenomena which determine the chemical composition of the troposphere by means of advanced and integrated modelling, both on regional (over Europe) and global scale. The idea of the workshop is to present newest results and problems and debate ongoing developments in the atmospheric modelling community. Presentations are informal and time slots typically around 20 minutes. Poster presentations are also welcome.

The venue of the workshop will be the famous honour residence of Niels Bohr which is conveniently located at Carlsberg.

A website with more information concerning the workshop venue, deadlines, accomodation and contact information is available - see http://gloream2011.dmu.dk. An abstract form as well as a registration form is available at the - please fill out and submit by email to lmf@dmu.dk

Deadline for abstract submission and registration is Friday December 17 2011.

14TH CONFERENCE ON HARMONISATION WITHIN ATMOSPHERIC DISPERSION MODELLING FOR REGULATORY PURPOSES, KOS, GREECE, 2 – 6 OCTOBER, 2011

The 14th conference on Harmonisation will take place on the island of Kos in Greece, October 2-6, 2011. For more information, please see http://www.harmo14.gr/.

THE ACCENT-PLUS SYMPOSIUM "AIR QUALITY AND CLIMATE CHANGE: INTERACTIONS AND FEEDBACKS", URBINO, ITALY, 13 - 16 SEPTEMBER, 2011

The web-site of the third Urbino Symposium, organised by ACCENT-Plus is now available at http://www.uniurb.it/sa/accentplus2011/leaflet2011.html.

The symposium, entitled "Air Quality and Climate Change: interactions and feedbacks" will take place from 13 to 16 September 2011. Under the heading "important dates" (http://www.uniurb.it/sa/accentplus2011/information2011-date.html), you will see the main deadlines for submissions etc. For any further information, please contact the accent project office (project.office@accent-network.org).

EUROPEAN ASSOCIATION FOR THE SCIENCE OF AIR POLLUTION
MEMBERSHIP FORM 2011

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