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Atmospheric Measurement Techniques Discussions

Interactive comment on "Ground-based remote sensing profiling and numerical weather prediction model to manage nuclear power plants meteorological surveillance in Switzerland" *by* B. Calpini et al.

Anonymous Referee #2

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General comments

The paper addresses an important problem of the development of numerical models to be used for data assimilation and for prediction of atmospheric dispersion of nuclear debris released from unlikely accidents of nuclear plants. The biggest contribution of the work described in the paper is the creation of a unique methodology which was anticipated but never implemented in practice. The authors show convincingly how to make the transition from Gaussian dispersion models driven by selected in situ

observations to more realistic transport models coupled to a modern data analysis system driven by a non-hydrostatic meteorological model. This change is of crucial importance considering the extreme spatial and temporal variability of the atmospheric flow in the region with complex terrain. It is quite evident that many effects associated with the rapid changes of wind speed and direction could be correctly captured by the proposed data assimilation/modelling system. The presented work presents therefore a clear path which could be followed by all interested in creation of the radionuclide monitoring systems for nuclear plants. Despite all these positive opinions about the proposed technique I still believe that the local measurements in the vicinity of plant for both meteorological element and radioactivity are very much needed. Even our current, local scale meteorological models do not capture all scales of motions with sufficient accuracy in order to support a reliable calculation of atmospheric dispersion of radioactive materials. The optimum solution in my view is to retain the observation around the plant and include them in the proposed data assimilation cycle. Considering the complexity and cost of the entire infrastructure associated with the nuclear plant these few additional measurements are quite acceptable from the point of view of the cost effectiveness.

Specific comments

My specific comments are designed mainly to ask for some clarifications and to further underline both the virtues and the limitations of the proposed approach.

The former safety tool: It will be useful to mention that the old technology was not adequate because the Gaussian models have inherent limiting assumptions concerning the time and space dependence of the wind field. Consequently these models were failing when addressing the situation with rapid changes in wind direction, also the effects associated with wind shear were not correctly captured by the Gaussian models.

Description of the model

After reading the description of the model driving the proposed data assimilation cycle I still see many uncertainties and unsolved issues. In particular the problem of horizontal diffusion in the terrain following coordinate system raises my doubts as to whether the proposed model is accurate enough to provide reliable wind data at very small scales.

Availability of data and the role of the backup technology

How will the situation of the sudden lack of data from ECMWF during the unlikely nuclear emergency be handled? Are there any mechanisms to assure continuation of the monitoring in such a situation? Life shows that the data flow is interrupted most often when the data is most needed.

Convection and the model resolution

I wonder if the mesh size of 2.2 km is sufficient to claim that the model can simulate convection, particularly in the case of convection over complex topography.

Some references to ADPIC (what are the limitations?)

The ADPIC model is not described correctly; some additional references are needed. I would welcome also the discussion of the limitations of the proposed dispersion model.

The discussion of the Lagrangian outputs

The discussion of the Lagrangian outputs at the end of section 4 is not clear, it will be useful to state clearly what models are being compared.

Limitations of the non-hydrostatic model: The meteorological model used in the data assimilation cycle is based on the Reynolds averaged equations. In some situations, particularly in the vicinity of the plant, this approximation could be not adequate. Some comments on the potential role of the Large Eddy Simulation methodology will be interesting.

Theoretical basis for dispersion modelling Dispersion of radioactive particles is governed by all scales of motions and the complex effects of interaction between turbulence, chaotic advection and inertia of particles are still not handled correctly even in the most advanced dispersion modelling systems. The limitations of the current theory of dispersion should be briefly discussed.

Interactive comment on Atmos. Meas. Tech. Discuss., 4, 789, 2011.