COMPARISON OF FLEXPART-WRF AND SINAC-AROME LAGRANGIAN DISPERSION MODELS: A CASE STUDY FOR A NUCLEAR INCIDENT

Zita Ferenczi[1], Emese Homolya[2], Tamás Pázmándi[2], Péter Szántó[2]

[1]Hungarian Meteorological Service, Division for Analysis of Atmospheric Environment, Hungary

[2]Hungarian Academy of Sciences Centre for Energy Research, Budapest, Hungary

ferenczi.z@met.hu, emese.homolya@energia.mta.hu

Introduction

The accuracy of the analyses concerning the environmental effects of radioactive emissions from nuclear facilities is essential for risk management and decision making strategies. In this study we used two Lagrangian type models to investigate the environmental effects of specific radioactive emissions. Dispersion of the released radioactive material was estimated using the **SINAC-AROME** model and the well-known **FLEXPART-WRF** particle dispersion model. Results on activity concentrations were compared and analyzed. The comparison of the two models provided information about the uncertainty of the predictions and pointed out the most important directions for further development of the SINAC dispersion model.

Model descriptions

SINAC (Simulator Software for Interactive Modelling of Environmental Consequences of Nuclear Accidents) is a programme system developed in the Hungarian Academy of Sciences KFKI Atomic Energy Research Institute that is used for predicting the environmental consequences of accidental short term atmospheric releases of radioactive pollutants. The programme is based on a puff model and uses input meteorological files calculated by the AROME weather prediction model. SINAC has been used as a training and potential decision support system by the Hungarian Atomic Energy Authority Centre for Emergency Response, Training and Analysis over the last decade.

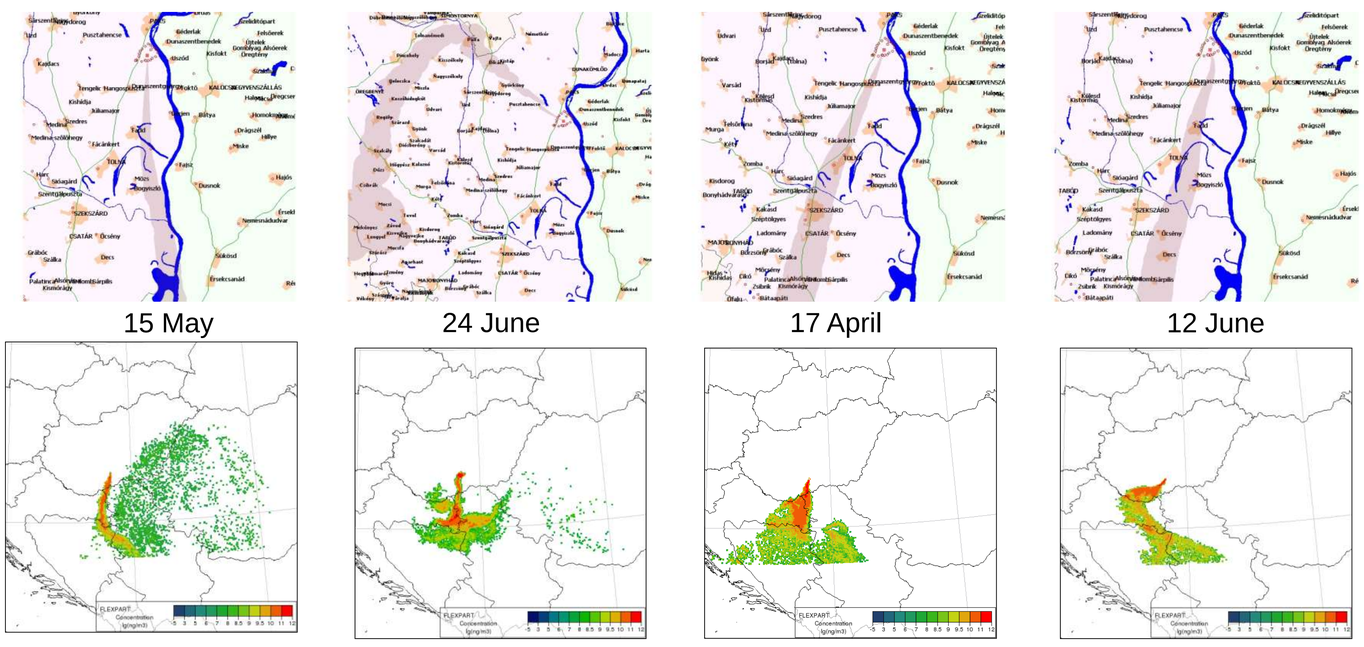
The Lagrangian particle dispersion model **FLEXPART** computes the trajectories of the emitted polluted particles and their concentration changes along the trajectories caused by the effects of diffusion, dry and wet deposition and radioactive decay. FLEXPART has been used as a transport model from meso to long-range scales by the Hungarian Meteorological Service to support the work of the decision makers in Hungary in an accidental case. The model uses input meteorological files calculated by the WRF (in meso-scale) and ECMWF (in long-range) numerical weather prediction models, depending on the aim of the simulation.

Detailed specification of the model runs

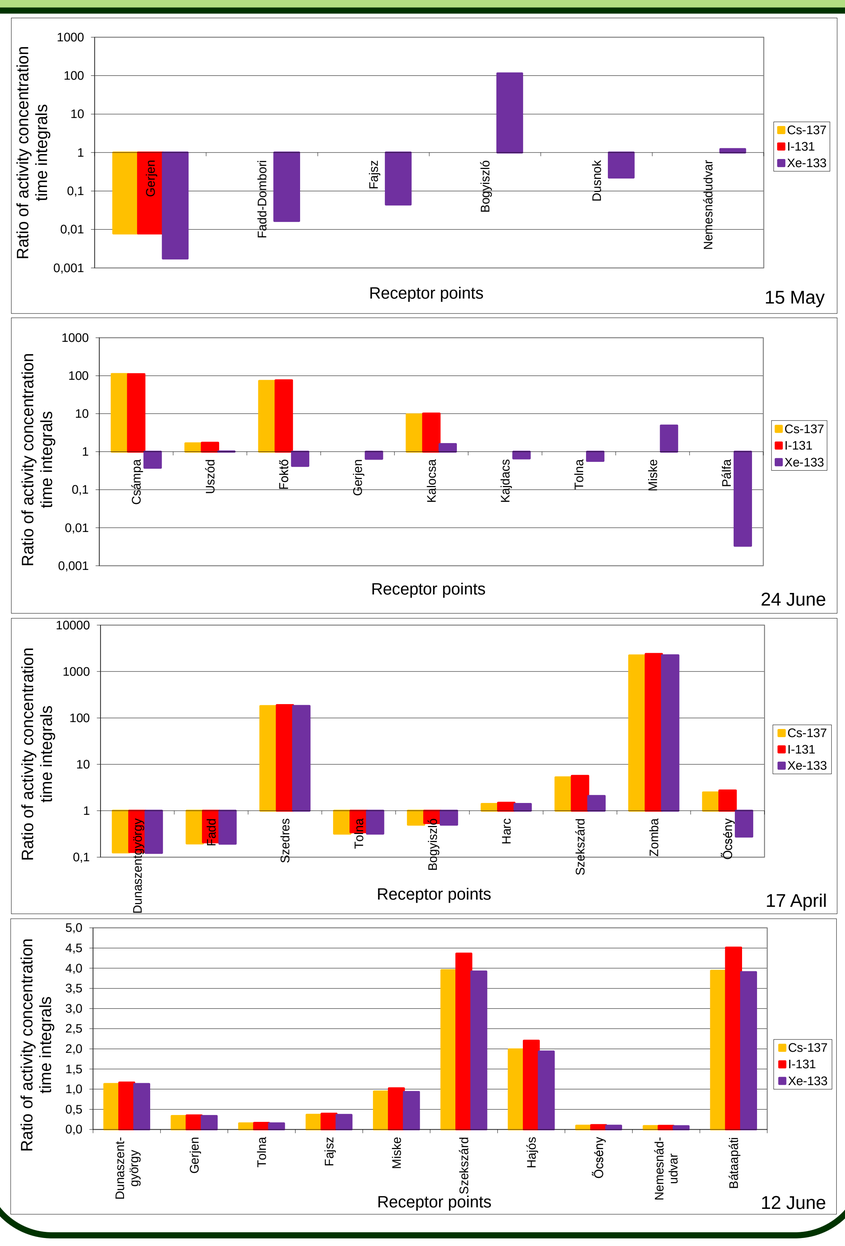
Total emitted activity for every emitted nuclides	^{133}Xe ^{131}I ^{137}Cs	9.0E+12 Bq 1.3E+08 Bq 6.4E+07 Bq
Beginning and period of the release		06 UTC, 24 hours
Total time interval of the simulation		24 hours
Meteorology		Precipitation with strong wind: 06 UTC, 15 May 2014
		Precipitation with weak wind: 06 UTC, 24 June 2014
		Dry weather with strong wind: 06 UTC, 17 April 2014
		Dry weather with weak wind: 06 UTC, 12 June 2014

Meteorological parameters at the station of Paks

Clouds of SINAC and FLEXPART



Rates of the activity concentration time integrals



Conclusions

- Comparing the calculations of the two NWP models we found that the values of the meteorological parameters predicted by the AROME and WRF were significantly different. The differences in the weather predictions are reflected in the results of the dispersion models.
- Comparing the output data of the weather prediction models with the measurements it was found that both models overestimated wind speed in all cases, and the forecast of precipitation was also inaccurate.
- The analysis shows that the most essential meteorological parameter that leads to differences in results is precipitation.
- The models are in a good agreement in determining the direction of the movement of the polluted material and the location of the affected areas by the plume despite the fact that two different high resolution numerical weather prediction models provided the meteorological input for the dispersion models. The uncertainty in concentration values might occur due to the different treatments of the dispersion and deposition processes.