ARGOS

Decision Support System for Nuclear Emergencies

Introduction

The ARGOS decision support system is used for consequence assessment and decision support following an accidental or deliberate release of nuclear, radiological or chemical substances to the atmosphere. The ARGOS system is in operation or being commissioned in more than 10 European countries, as well as in Canada, Brazil and Australia. Since the initial version was released in 1995, the system has developed from a simple data presenta tion application to a sophisticated platform which integrates monitoring data, atmospheric dispersion models and calculation of doses in the food chain and the urban environment.

Cooperation in the ARGOS Consortium

For more than ten years the users of the ARGOS Decision Support System (DSS) has been organized in a consortium of users. The idea behind the consortium being to ensure a strong user engagement in the development and introduction of new functionalities into the ARGOS DSS. But even more important than that is to facilitate a close cooperation between the user organizations and to ensure a strong bond between end users of the ARGOS DSS and the academic world providing new research related to emergency management.

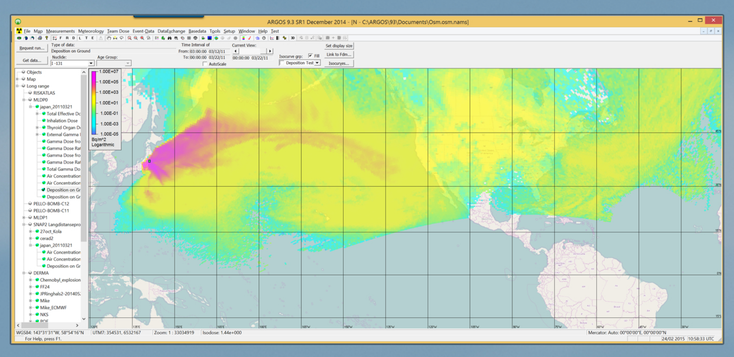

Figure 1 *SNAP prognosis of iodine deposition from Fukushima provided by NRPA*

Even though the nearest country using the ARGOS DSS is more than 5000 km away from Fukushima, all members of the ARGOS user group were immediately engaged in short term dose assessments as the Fukushima nuclear accident evolved. These dose assessments following either poorly known or hypothetical releases of radionuclides were both made long range, to see if the release would affect the user's homeland, and short to meso-scale range, in order to give advice to authorities and citizens either present in Japan or travelling to Japan. As an integrated part of this work the users of the ARGOS DSS were cooperating on improving dose assessment(s) made by the individual members of the consortium. ARGOS users were sharing data such as NWP model data and relevant orography data, estimations of source terms, results of meso- and long-range dispersion model calculations as well as the dose assessments themselves. The end result being a much stronger response to the situation as well as more consolidated advisory to the decision makers.

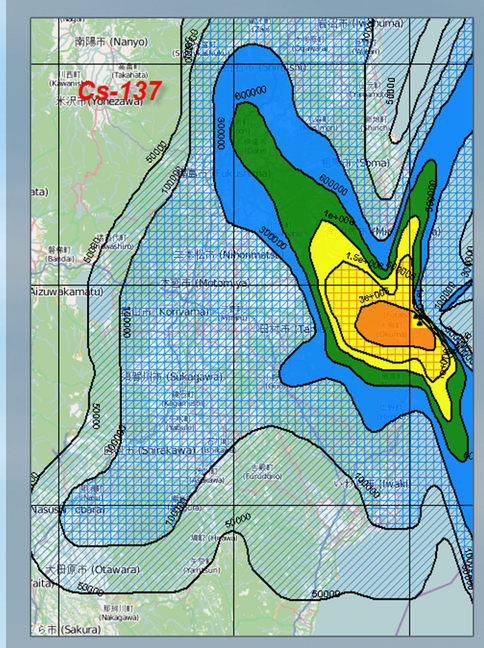

Figure 2 *RIMPUFF prognosis of cesium deposition from Fukushima provided by DEMA based on landuse and orography provided by DTU and NWP provided by ARPANSA*

Atmospheric Dispersion

Atmospheric dispersion in ARGOS is divided in three parts, an urban dispersion model URD – taking buildings into account, the short to meso scale model RIMPUFF and external long-range models: DERMA (Danish), MLDP0 (Canadian), SNAP (Norwegian) and MATCH (Swedish).

Uncertainties in Atmospheric Dispersion

Current development work within ARGOS DSS is on accommodating uncertainties in dispersion model calculations. A study has been performed by NKS (Nordic Nuclear Safety Research) on how to quantify uncertainties in the atmospheric dispersion model calculations and how to present such data in a comprehensible manner in the DSS, meeting the needs of both experts operating the system and those of the decision makers relying on practical decision support. The results of this study will be incorporated in upcoming versions of the ARGOS DSS.

In Figure 3 and Figure 4, two different approaches are taken to present modelling uncertainties, following the release of Cs-134 from Fukushima NPP on March 14, 2011. The uncertainties stem from limits in meteorological observations used to initialize the meteorological forecast series, and an ensemble of dispersion model runs is produced by perturbing the initial state of the NWP model. In Figure 3, quantile plots of the total deposition are shown based on the meteorological ensemble and in Figure 4, the probabilities for exceeding values of concentrations are presented. The two figures provide alternative means for presenting the uncertainties, which can readily be adapted to include other uncertainties, e.g. in the source term or release characteristics.

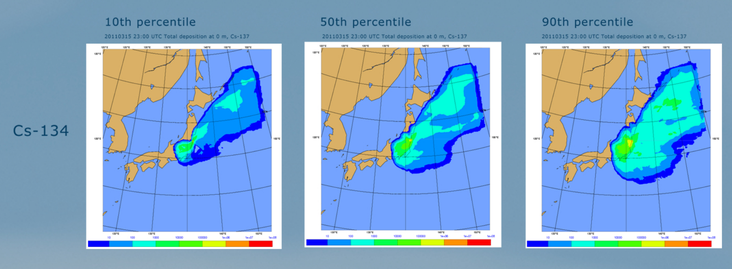

Figure 3 *Quantile plots of the total deposition*

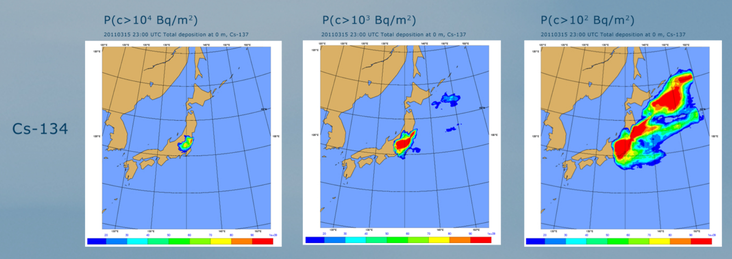

Figure 4 *Probability for exceeding specified value*

Monitoring

ARGOS is highly integrated with monitoring data. Especially data from the Airborne Gamma Monitoring (AGS) system are well integrated in ARGOS. The advanced software NUCSPEC for handling and analyzing spectrum data is part of the ARGOS consortium agreement. Supported monitoring types include:

- ɣ-dose rates and spectra from on-line monitoring stations
- ɣ-dose rates from European countries' monitoring systems (EURDEP-data)
- ɣ-dose rates from mobile units
- Airconcentrations from mobile units
- Isotopes in environmental samples

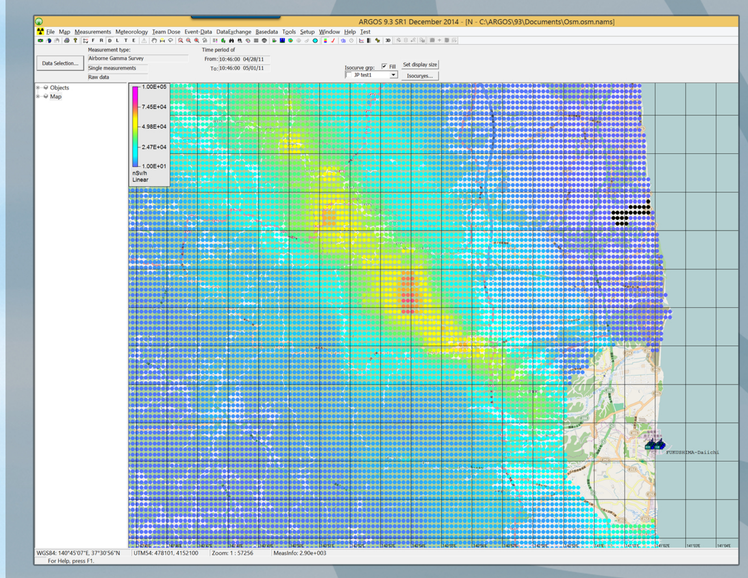

Figure 5 *AGS from NNSA showing ɣ-dose rate measured April 28th 2011 interpolated in ARGOS*

Food Dose Modelling

FDMT is originally based on the radio ecological model ECOSYS. The model also includes doses from deposited activity and resuspension and hence can be considered as a general dose-screening model.
AgriCP (Agricultural Countermeasure Program) is based on the food and dose model FDMT and is designed to estimate the effects of all kinds of agricultural countermeasures directly when simulating the transfer of radionuclides through the food chain. For this purpose, the model uses the same functions as FDMT but modifies the set of parameters used in these functions according to the simulated countermeasure. This approach allows for correct modelling of all reasonable single agricultural countermeasures and even combinations of countermeasures.

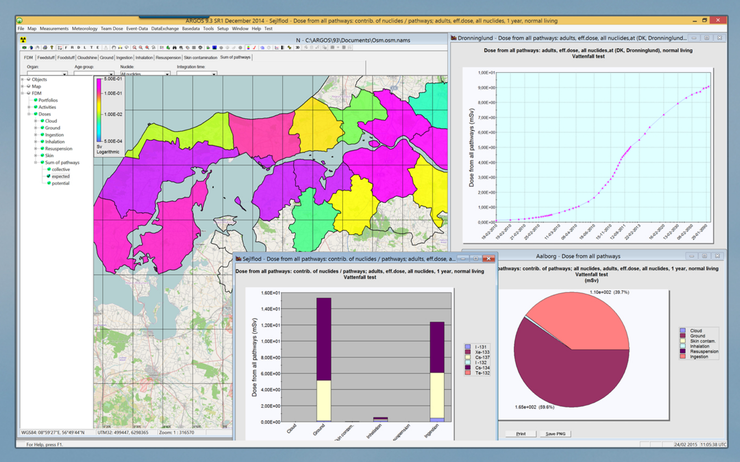

Figure 7 *Calculation of potential food doses after simulated release from NPP*

Dose Calculation in Urban areas ERMIN
(EuRopean Model for Inhabited areas)

After an accident, emergency management must continually evaluate which remediating actions are needed in specific areas, which countermeasures should be kept in place and which should be lifted.
For this purpose projected doses must be calculated. Consequences of implementing different countermeasures are then evaluated based on residual doses, waste and and worker dose as well as practical issues and costs. The doses cannot be derived from simple measurements at any time. The future behavior of the deposition and its interaction with material (surfaces etc.) must be modelled represented with a detailed model for inhabited areas. Input to the model comes from atmospheric dispersion or measurements.

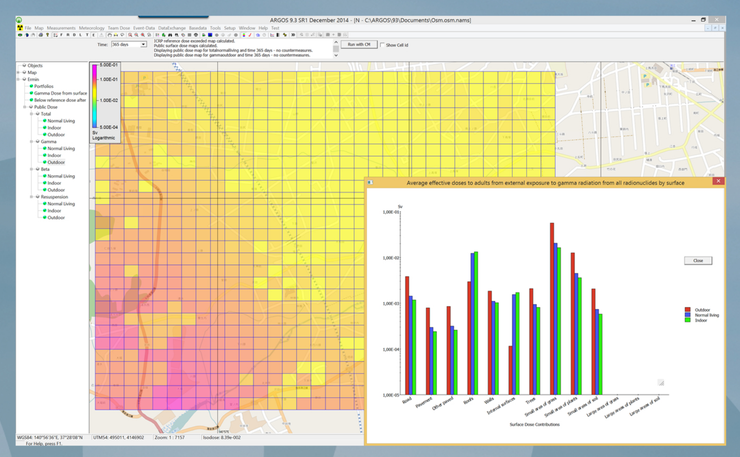

Figure 8 *ERMIN calculation of ɣ-dose after 1 one year in the Fukushima region*

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