Recent developments of decision support system Rodos. Application for Fukushima Accident.

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Introduction

Following the earthquake and tsunami in Japan the Karlsruhe Institute of Technology has set up six working groups to follow the impact of this natural disaster on the nuclear power plants of Japan, in particular Fukushima. One of the six working groups was dealing with the radiological consequences of potential releases of radioactive materials into the environment.

The first step was to set up the RODOS (Real-time On-line Decision Support) system for off site nuclear and radiological emergencies, that is installed operationally in Germany and used in many European countries for the site of Fukushima.

Meteorological Fields

Based on meteorological information provided by the National Center for Environmental Prediction of USA (NCEP) and conservative estimates of the source terms, we were able to perform dispersion calculations with prognostic weather data produced by Numerical Weather Forecasting (NWP) models WRF was customised for Japan at IMMSP

The NWP Models output has been calibrated versus the observation WMO data and model parameters has been tuned respectively

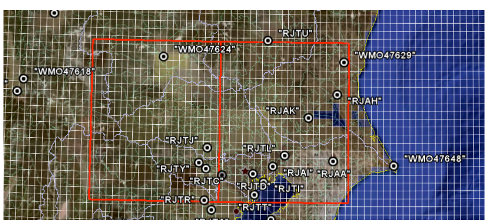


Fig.1 Two investigated cells FNL (red color), grid WRF (white color) and land meteorological stations (points and names of stations).

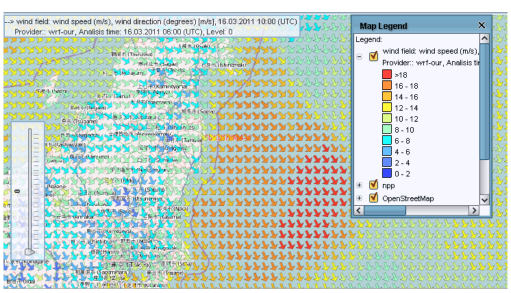


Fig.2 Visualization of numerical weather prediction data from WRF: wind field at 10m near Fukushima in JRODOS window

Atmospheric Dispersion and Fallout

As we didn't know exact values of emission, so we used for calculation of the distributions pollution characteristic which are known on 16 March. Namely the conservative estimates of the Fukushima source term was 20% of Chernobyl source term with respect to I-131 and 20 to 60%

with atmospheric dispersion module which consist of meteorological pre-processing and 3 alternative atmospheric dispersion modules: ATSTEP, DIPCOT and RIMPUFF.

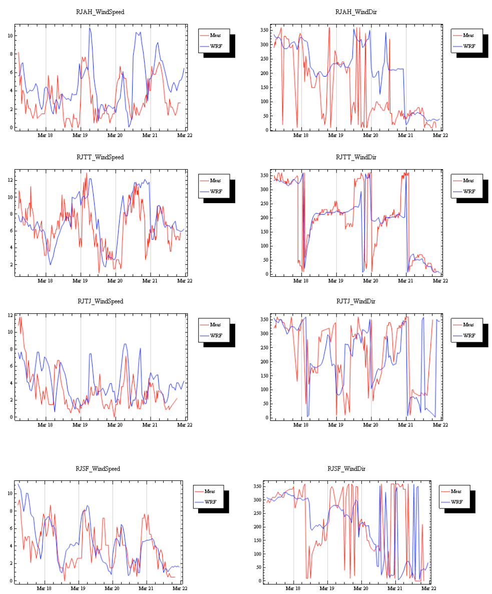


Fig.3 Comparisons of wind speed and wind directions with station data at RJAH – Hyakuri Airoport, RJTT – Tokyo Int Airoport, RJTJ – Iruma Airoport, RJSF – Fukushima Airoport

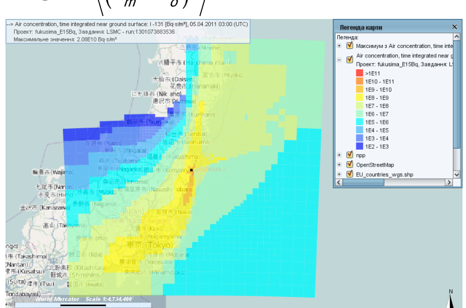
Table. Statistical comparisons of the wind fields

	Final analysis	WRF,
VWD, point-by-point	2.90	3.27
VWD, cell-averaged	2.46	2.17
RMST, point-by-point	2.83	1.99
RMST, cell averaged	1.71	1.66

Vector wind difference accounts for both errors in wind direction and in wind speed:

$$VWD = \left\langle \left((u_m - u_o)^2 + (v_m - v_o)^2 \right)^{1/2} \right\rangle$$

$$RMST = \left\langle (T_m - T_o)^2 \right\rangle^{1/2}$$



scenario and meteorological scenario of 1-3 April 2011

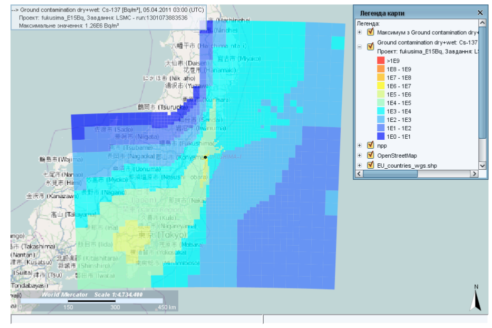


Fig.5 Ground contamination by Cs-137. Duration of emission - 3 days, release rate - 1□16 Bq/day that approximately corresponds to 30 % of Chernobyl emission.

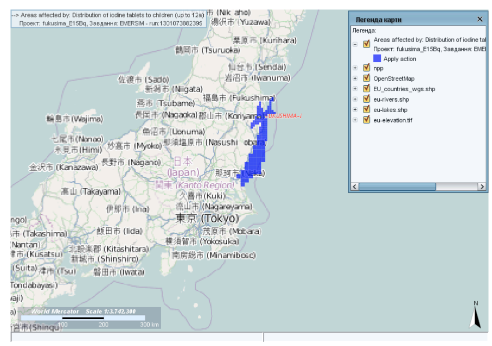


Fig.6 Region of iodine tablets application for children following hypothetical release scenario and meteorological scenario of 1-3 April 2011

Figures 4 and 5 shows the consequences of such hypothetical scenario of release of 3*1016 Bq of Cs-137 and 3*1017 of I-131 during 1-3 April 2011. The wind transported a radioactive cloud to the south in direction of Tokyo (Figure 4). However the predicted countermeasure involved mainly iodine tablets for children (Figure 6) and those countermeasures didn't reach Tokyo. The region of iodine tablets for adults was much less (not shown) and spread up to 50 km from reactor to the south

Conclusions

Modelling Fukushima nuclear release proved flexibility of the JRodos architecture and implementation, allowing fast customization to a new geographical location and creation of additional system components to support integration of Weather Research and Forecasting (WRF) model in JRODOS. The new features are highly appreciated by the JRodos Users community (e.g. CIEMAT, Spain; RIVM, the Netherlands; Umwelbundesamt, Austria).