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# Improving the decision support system JRodos according to customer requirements

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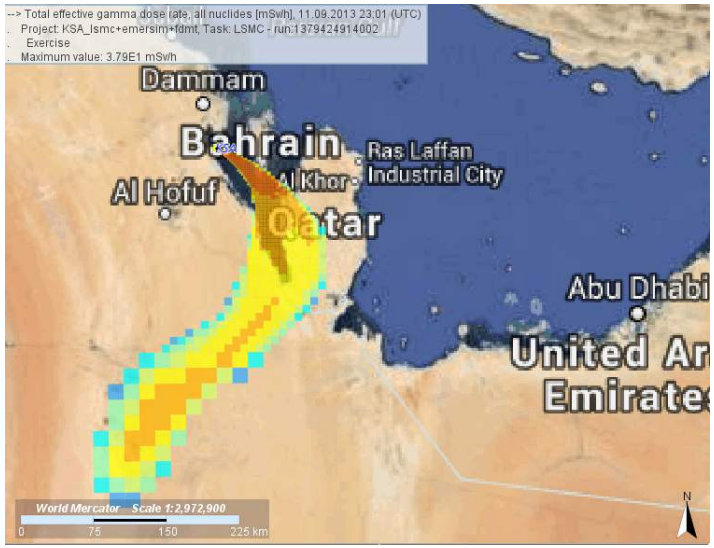


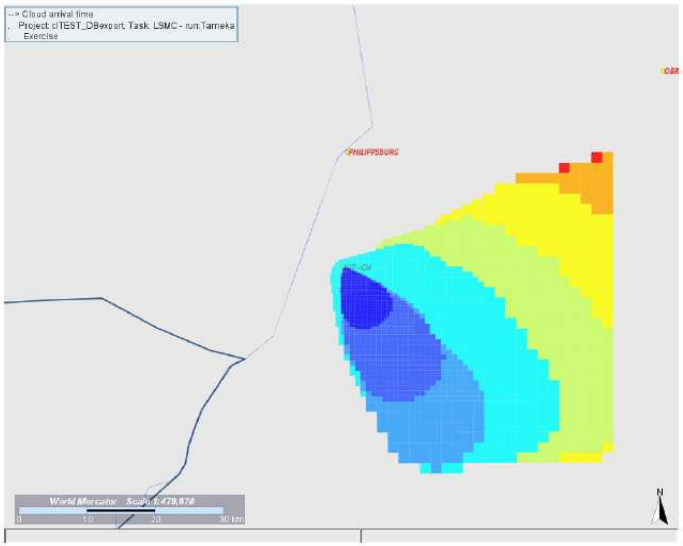


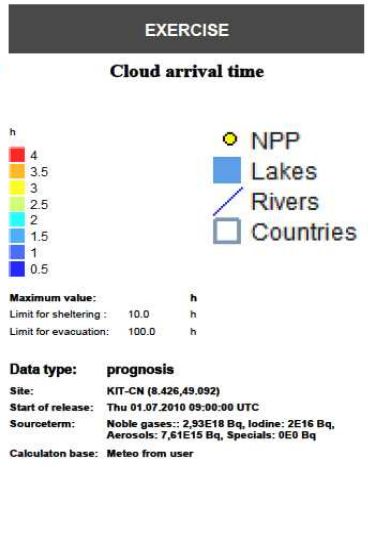

# Typical phases in the evolution of DS systems

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1. Beginning: Development of an operationally applicable system as such
2. Expansion I: Introduction of new models and system features, mainly on behalf of visions of the developers
3. Expansion II: Introduction of new models and system features, mainly on behalf of users (operational and non-operational), assisted or made possible by advances in information technology and tools
4. Maturation: Consolidation and quality assurance, further developments ... ideally, on behalf of developers, users, and visionaries together

# Example 1: JRodos world wide applicability

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- Triggered by the needs of the JRodos community during the Fukushima accident in 2011
- Atmospheric dispersion and deposition and other DSS model calculations require knowledge about:

1. Characteristics of the nuclear facility causing the release event (for example, the coordinates)
2. Geographical characteristics around the release location (elevation, land use, soil type, population density, and agricultural production)
3. The atmospheric conditions determining the dispersion and deposition of the released radioactive material

# JRodos world wide - Meteorological data

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- For releases anywhere on the globe, it cannot not be taken for granted that appropriate meteorological data would be available for running JRodos
- JRodos offers a read support of the freely available and globally applicable numerical weather forecast and reanalysis data from the NOMADS service in the USA*)
- The system has a tool allowing to download such data for a user-specified time period and applying them in JRodos

*) Reference: National Centres for Environmental Prediction. NCEP www.ncep.noaa.gov)

# JRodos world wide - Meteorological data (2)

- Data from the NOMADS service in the USA
  - GRIB1 format (1 degree pixel)
  - GRIB2 format (0.5 degree pixel)
  - Since January 2015: 0.25 degree GRIB2 data is available (but be aware, files are heavy ~ 200 M Byte each, making a set of about 2-4 GB)
  - 10 days forecast

# JRodos world wide - Meteorological data (3)

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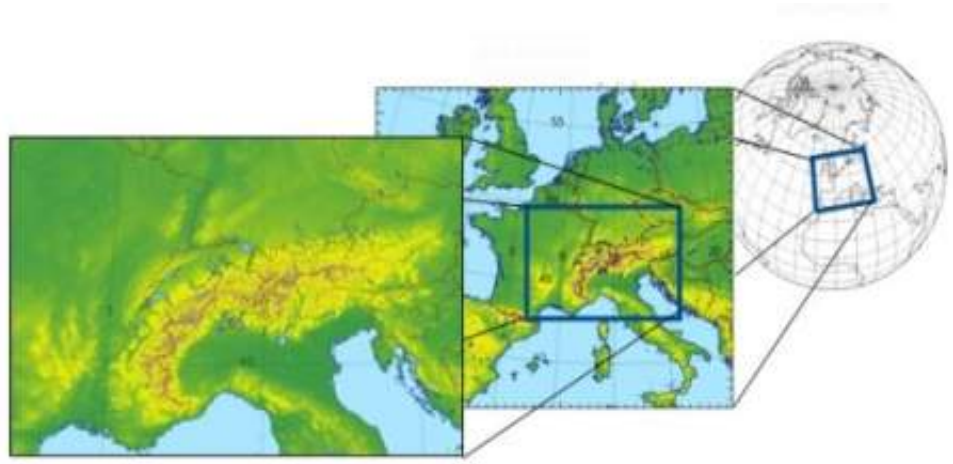
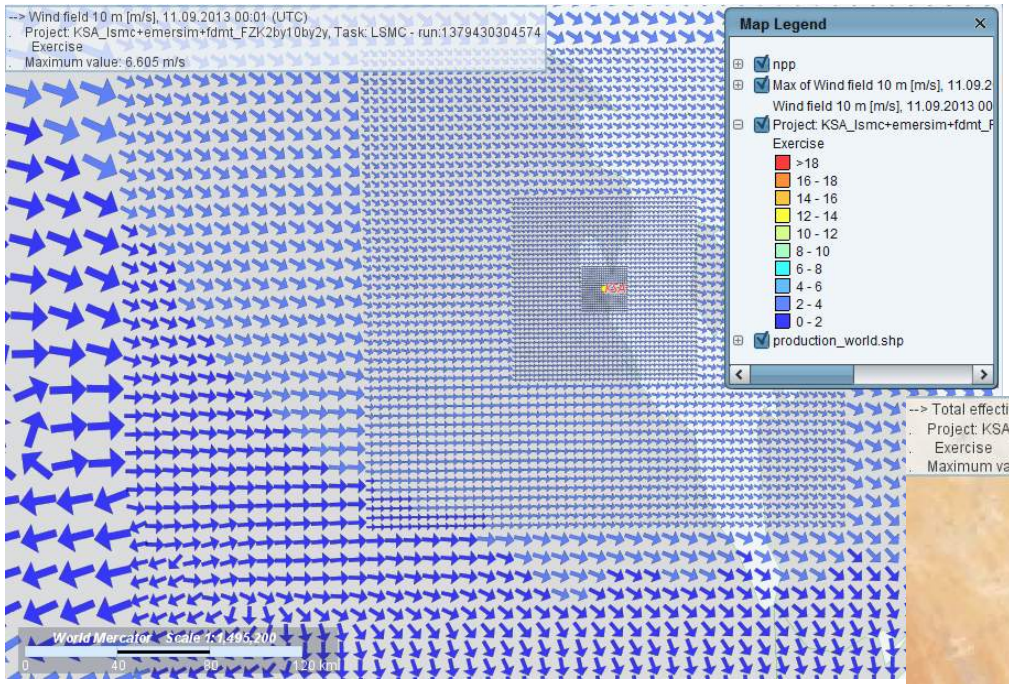
- If no other data is available in a country – we still argue that data from national weather services should be used, JRodos can work with the NOMADS data
- If more detailed wind fields are needed due to complex elevation - local weather forecast data is required
- If data from a national weather provider is not available, one can use the NOMADS data as input to the meteo calculation model - Weather Research Forecast model (WRF)

# JRodos world wide - Meteorological data (4)

- The WRF model is supplied to JRodos users as a prepared package with a default set of geographical data and model settings
- Requires no compilation, runs “out of the box" after minimal changes in several properties files
- The output is automatically transferred to JRodos Server where it is parsed and saved for availability in calculations

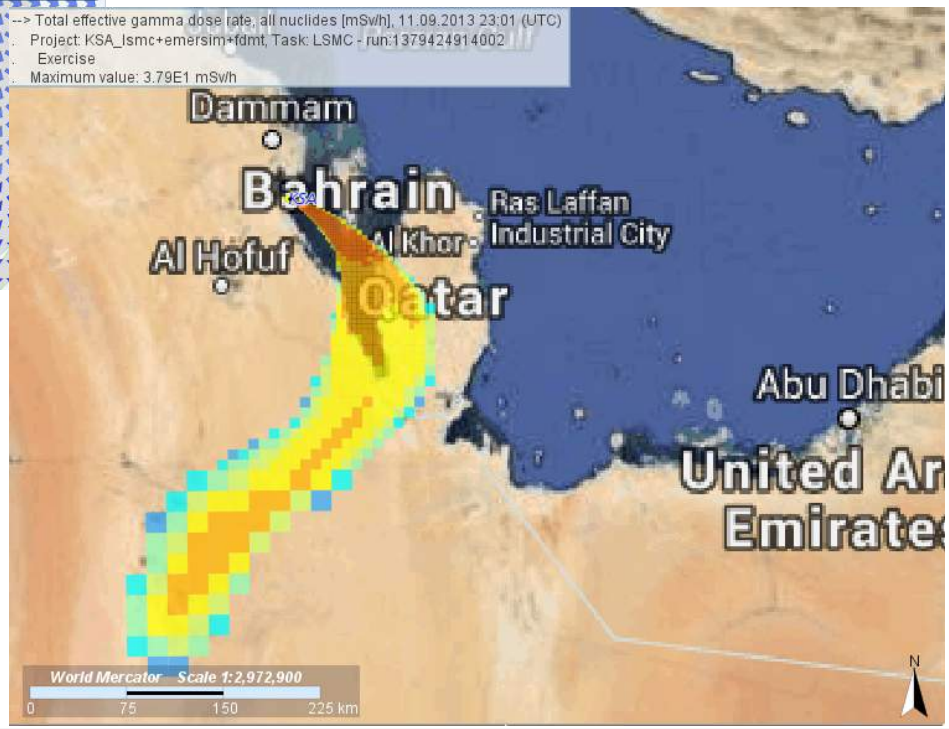


# JRodos world-wide - application example with NOMADS re-analysis data for September 2013




*Left: Wind field in 10 m height; NOMADS re-analysis data for 11.9.2013, for Saudi-Arabia (JRodos screenshot)*

*Right: Total effective gamma dose rate, using the NOMADS weather data for a fictive release from a fictive reactor in Saudi-Arabia (JRodos screenshot)*



# Example 2: LASAT - Lagrangian Simulation of Aerosol Transport

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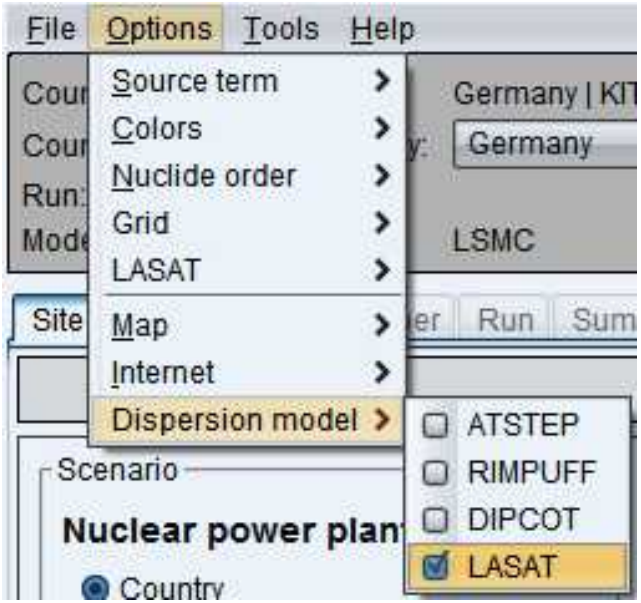
- On request of several operation users; only possible thanks to the progress in IT




- Three-dimensional Lagrangian particle model
- Dispersion of substances in the atmosphere with "random walk" model
- Certified cloud gamma dose calculation with module LOPGAM (VDI)
- Can handle multiple sources
- Can handle different particle sizes, e.g. considers sedimentation of heavy aerosols
- Requires high-end hardware (ENSI grid with ~ 150.000 points
- LASAT is a closed source, no source code available to KIT

# Parallelization of LASAT-JRodos

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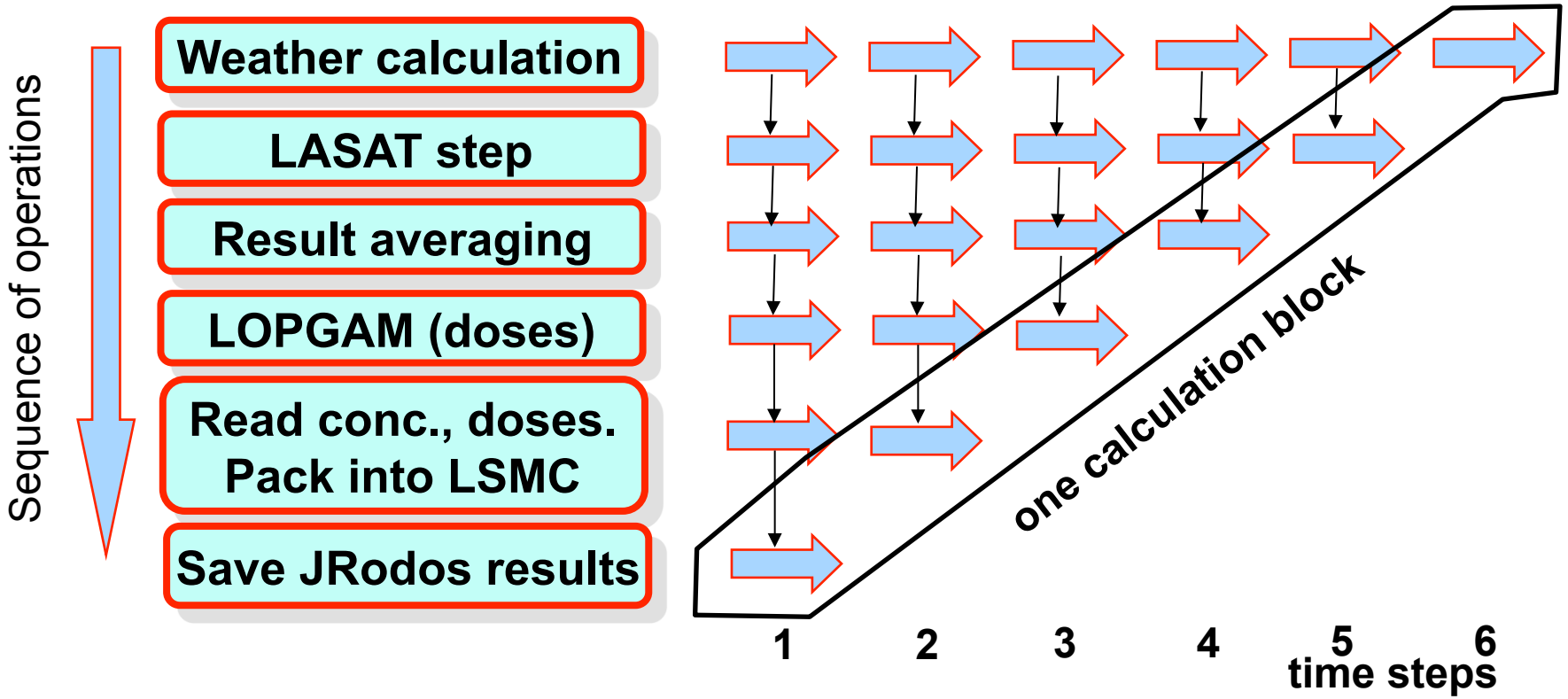
- Some tasks must be done as sequential steps 1, 2, 3 etc – cannot be performed within one parallel loop
  - E.g. weather reading/processing
- There's a list of tasks which should be strictly followed – cannot be parallelized
  - Weather preparation,
  - then LASAT step,
  - then LOPGAM (doses) step,
  - then reading concentrations/doses files,
  - then pack them into LSMC containers,
  - then store JRodos step results

# LASAT implementation parallelization

- Operations in one calculation block are performed **in parallel** !
- Sequence of operations is correct !



# LASAT implementation parallelization (2)

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- Solution – the computational blocks are performed in parallel but with *shifted time*!
  - for the step “now + 4” … weather preparation
  - for the step “now + 3” … lasat step with parallel result dumping (thus it happens on now + 1)
  - for the step “now + 2” … averaging (when needed)
  - for the step “now + 1” … lopgam
  - for the step “now” … reading concentrations and gamma dose rates and repacking into JRodos
  - for the step “now – 1” … saving JRodos step results

# Example 3: JRodos Statistic Output Tool

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- Development was initiated in 2012 by one group of users who wanted to carry out a specific task for their organization; tool has since then been appreciated and used by others which had already initiated several improvements
- As pre-requisite, numerical weather prediction (NWP) data must be available for some prolonged period of time
- Allows to use one fixed release scenario defined with JRodos and saved as an xml-file for runs with different weather scenarios
- The scenario settings are fixed for all runs within one batch; the only changing part is the date and the time of the release - this generates the statistics that comes purely from the variation of the weather conditions

# JRodos Statistic Output Tool (continuation)

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- The user specifies the start and end date for the meteorological sampling, and which results to be stored
- Once kicked, the tool will automatically select for each day in the defined time interval a random starting time, carry out the calculations, and deliver the results to a user-specified output folder
- Each run will generate one text file “Cell  Value” for each of the selected results, with unique identifiers for the filenames
- The generated results can then be used as input for a separate statistical analysis; this step and the tools that will be used (e.g. "Matlab") is in the responsibility of the user

# Example 4: Advanced system features

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- Requests from different users and ideas from the system developers together produced a significant extension and upgrade of previously existing system features
- The root that enabled the developments: Store heavy model results as file in a dedicated folder
  - JRodos now supports storing calculation results in a pre-configured folder on the file system (JRodos Install guide)
  - Good for
    - reducing the data base load for heavy results
    - providing access to the calculation results with 3rd party software

# Advanced system features (continuation)

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- **Accessing model results from a 3rd party GIS software**
  - Map-type result fields can be accessed by installing a JRodos WPS extension (Web Processing Service) of the Geoserver web software; No running JRodos Server or Client required for accessing the results
  - The export / publish process can be automated by using the cUrl script approach and RESTful Geoserver functionality for automated processing/publishing/deleting layers
  - The JRodosWPS request can be saved as an XML file for later use as a template

# Consolidation and quality assurance

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- Increasing system complexity usually makes it more demanding and difficult to control and guarantee the stability of the product
- Consequently, the aspect of quality assurance becomes increasingly more important and required growing investment to assure business continuity and customer trust

# JRodos consolidation and quality assurance

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- The effort towards a better quality assurance that started in earnest in March 2014 was continued and intensified
  - One person dedicated to co-ordinate and control QA and testing
  - Test cases were developed for system and model components and for bugs reported in the Bugzilla system
  - Customers have started to provide "use cases" for their special requirements
  - **New**: JRodos Internet Websites for Testing

# JRodos testing via Internet Websites

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- The web pages give JRodos users the opportunity to check tests performed by the JRodos team
  - The pages contain detailed test descriptions (test cases), RODOS-Lite pages as screen dumps (jpg, png) and selected results (jpg, png, txt); where possible, the associated xml-file and meteorology are made available for downloading to reconstruct the test on the user's own JRodos installation
- Test presentations are divided into test sections.
  - Each section can be treated on its own while ensuring that higher-level functions are already being successfully tested
  - The basic test sections are User Interface, Customization, Models/ Model chain, RODOS-Lite, Bugzilla reports. Additional tests are made available on the basis of user requests.

# JRodos testing via Internet Websites (cont.)

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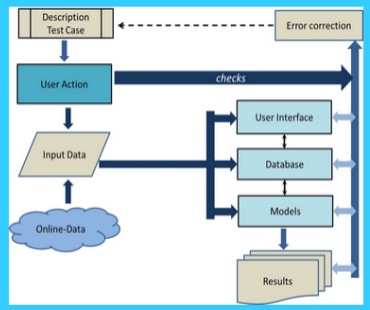
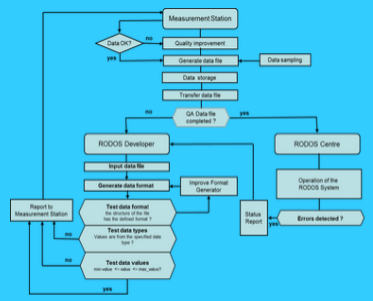
## Welcome to the JRodos Test Site!

- Introduction
- Installation
- Userinterface & Tools
- Customisation
- Models
- RodosLite
- User Specific
- Bugzilla
- Manuals
- Help



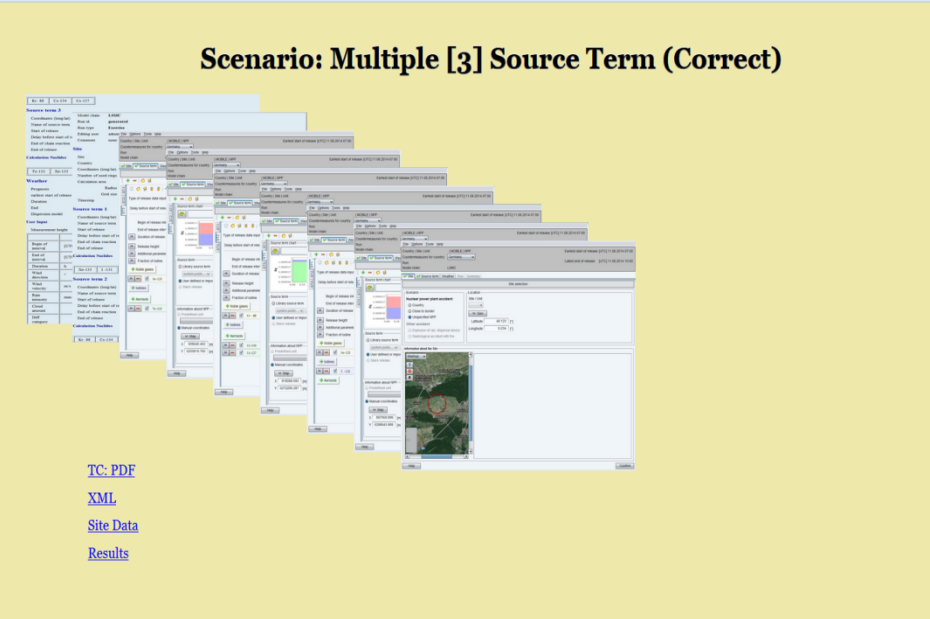

Test Cycle

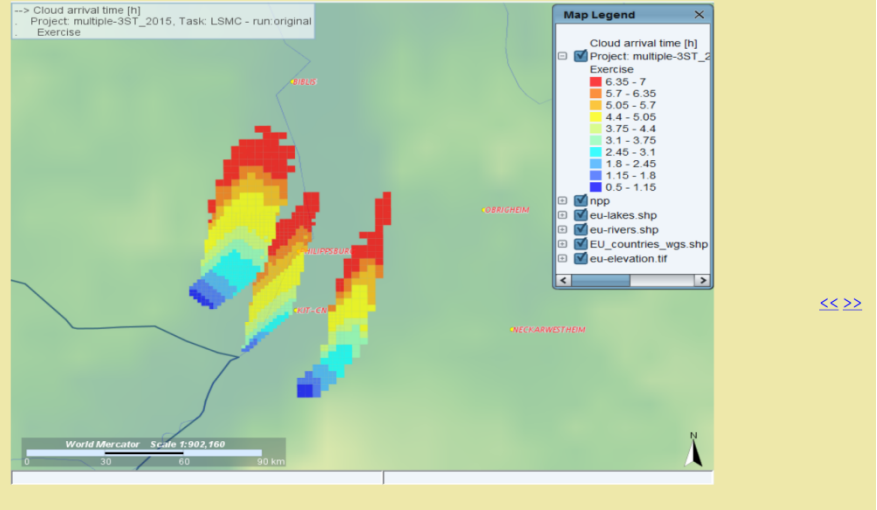



Test Online Data

*Testvorlage: Erstellt am 15.Dez 2014*

# JRodos testing via Internet Websites (cont.)




## Test Case + RodosLite + XML + Results

# Ideas for future development issued during user group meeting April 21 to 22, 2015

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- All users: Consolidation of system, models, input interface (RODOS-Lite)
- Several users from various organizations: LASAT - additional concentration field for higher vertical level(s)
- Make time-reversed mode to identify source regions possible with LSMC/MATCH models - one user did that on own initiative, giving idea that this would be a "nice-to-have" for all
- Comparison of all dispersion models, in particular LASAT with DIPCOT

# Ideas for future developments issued during user group meeting April 21 to 22, 2015

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- Further model development:
  - Extension of nuclide data base and upgrade to a modern dose factor data base (currently under way)
  - Extend current ICRP screening model to taking into account national intervention levels; different criteria to determine end of actions
  - Improved RDD (dirty bomb) and transport accident models; also, they should be able to run with Lasat and Dipcot
- Data assimilation
- JRodos Web Client, JRodos Server Web service to supply system input data in an automated manner
- Enhance the current training package for external users by including E-Learning techniques

# Summary

- Within the JRodos user community, all developments become available for the whole user community, even if initiated (and paid for) by the interest of special groups

- The system is applied by the various end users as an operational support tool and as a training tool in the field of emergency management and rehabilitation preparedness, thus contributing to the improvement of radiation protection in general