

Dispersion model based dose rate measurement simulation for exercises

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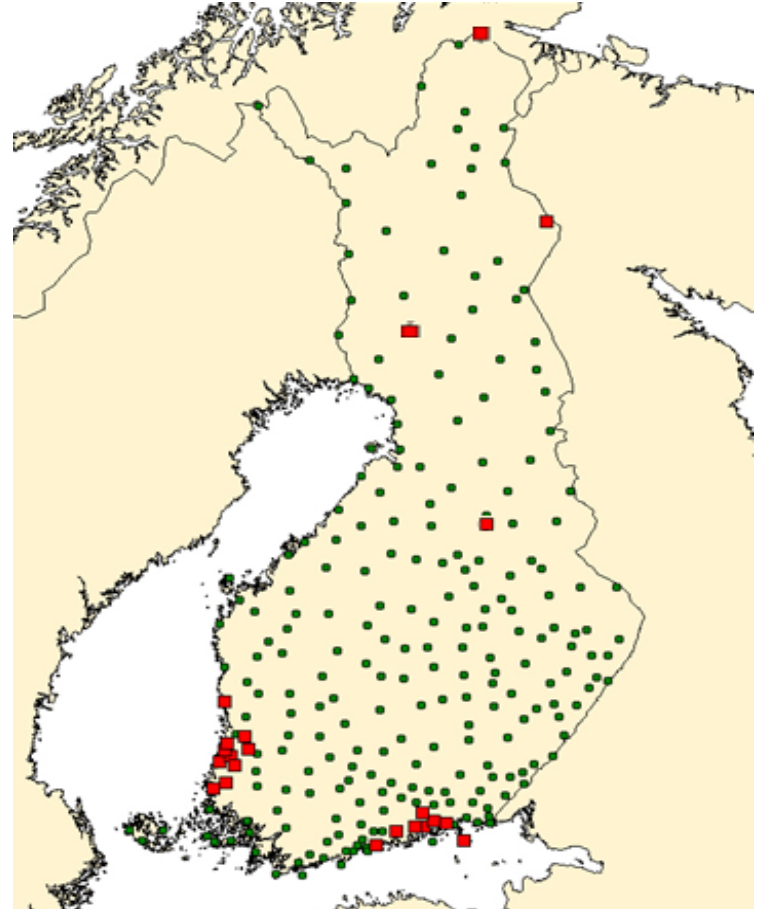
STUK - Radiation and Nuclear Safety Authority

NSFS Conference 2015, Roskilde, Denmark

25.8.2015

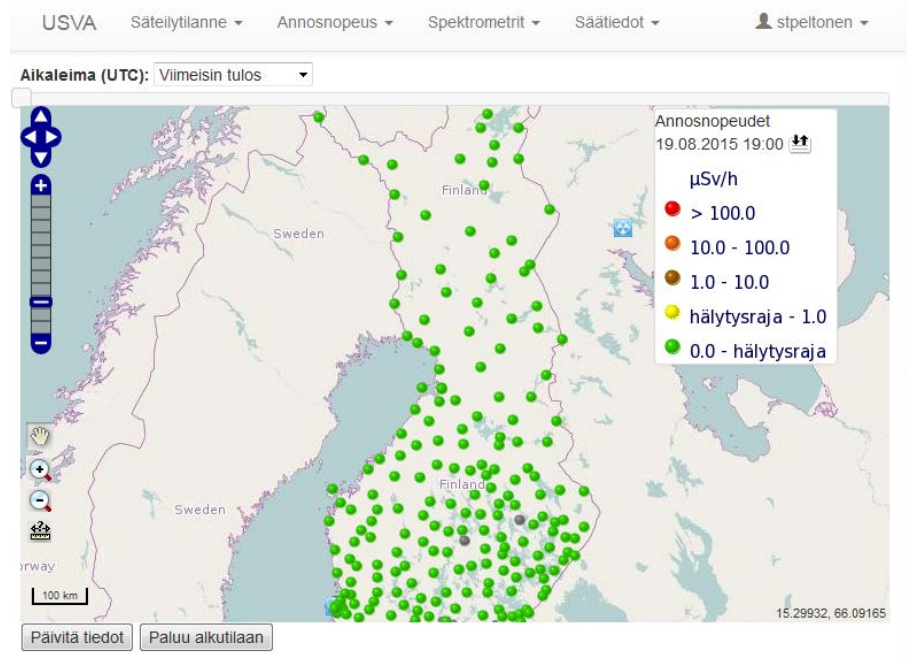
Dose rate monitoring network in Finland

- The external dose rate monitoring network ULJAS covers over 250 monitoring stations geographically evenly distributed over Finland
- The dose rate results are collected and presented by the USVA system.
- Communication every 10 minute
- The USVA system also alerts STUK's expert on duty when dose rate exceeds station specific alarm limit.

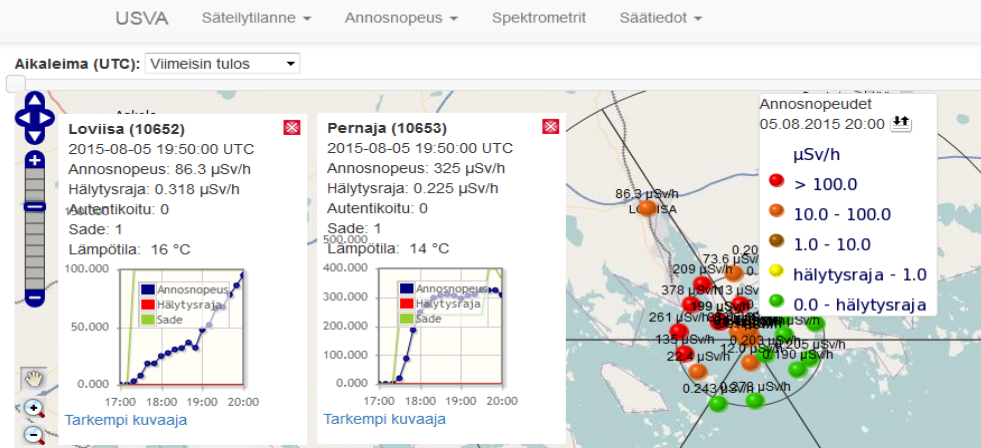


USVA and Exercise USVA

- STUK has developed tools to simulate dose rate measurements for these ULJAS stations
- The USVA system has a separate Web site for exercise usage. The system is called "Exercise USVA"
- Web interface has a similar layout compared to normal dose rate monitoring network view except for the large "exercise" text appearing on the site



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Usage of dose rate simulator

- The simulation is created and carried out using Web-based emergency management system TIUKU
 - TIUKU is also used for running and displaying dispersion model results, dose calculations, analyses and reporting etc.
 - System is very easy to use and even non-experts can be trained to run simulations
 - By integrating the simulation to TIUKU system it is verified that all the development made for normal dispersion model usage is also available for simulation purposes.
- Simulator starts the dispersion calculation using predefined source term and numerical weather prediction (NWP) data
- The model output doses and dose rates which are interpolated to the coordinate points of the dose-rate monitoring stations

Dispersion models: SILAM

- Long-range dispersion model
SILAM provided by Finnish meteorological institute
- Euler/Lagrangian dispersion
- NWP models: HIRLAM, ECMWF, HARMONIE
- Dispersion calculations via TIUKU system (see Web form)
- Two calculations: more detailed spatial resolution near NPP site
- SILAM runs on FMI's supercomputers and there is a dedicated Web Service for STUK

Options

Particle number

10000

NWP Source*

HIRLAM RCR

Time resolution (min)*

10


Forecast length (h)

12

Calculation options in preferred order*

Boundary box: (LLX,URX,LLY,URY)*

19,60,24,63




Resolution (km)*

5

Boundary box: (LLX,URX,LLY,URY)*

11.0,32.0,56.0,67.0

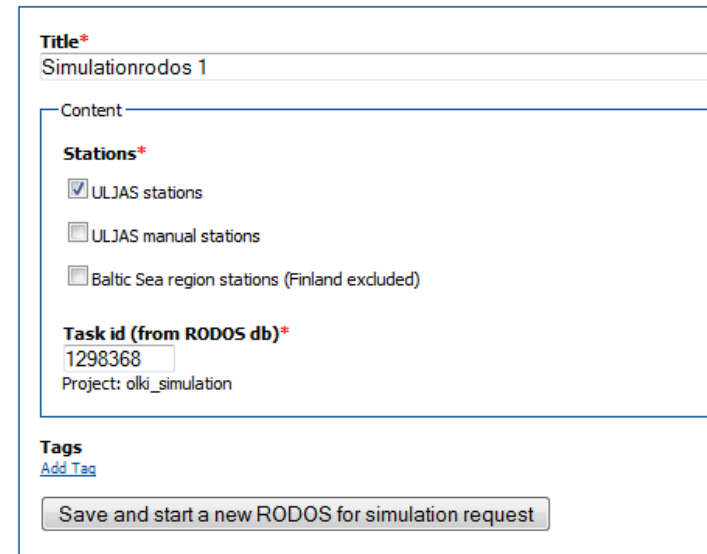


Resolution (km)*

10

Dispersion models: JRODOS

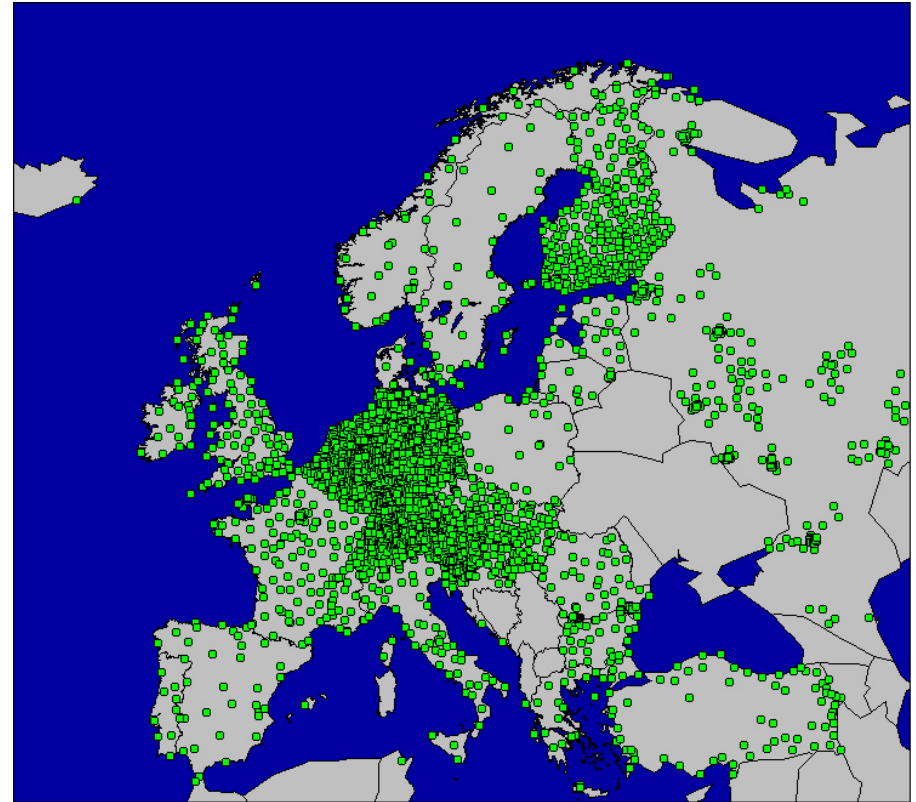
- JRODOS Decision Support System contains four different short/medium range dispersion models: ATSTEP, RIMPUFF, DIPCOT, and LASAT.
- User can select if the dispersion is based on NWP data or weather input by hand.
- In JRODOS there is a nested calculation grid and thus multiple calculations are not necessary.
- JRODOS can export the calculation results to GIS database from where the simulator reads the values.



The screenshot shows a web form for creating a simulation request. It includes a 'Title*' field with the value 'Simulationrodos 1'. A 'Content' section contains 'Stations*' with three checkboxes: 'ULJAS stations' (checked), 'ULJAS manual stations' (unchecked), and 'Baltic Sea region stations (Finland excluded)' (unchecked). Below this is a 'Task id (from RODOS db)*' field with the value '1298368' and a 'Project: olki_simulation' label. A 'Tags' section has a link 'Add Tag'. At the bottom is a button labeled 'Save and start a new RODOS for simulation request'.

Simulator software: Station locations

- The simulator software can simulate dose rate results to all known monitoring stations in Europe. However any location can be used for simulation in addition to existing dose rate monitoring stations.



Simulator software: Features

- Before the simulation begins, the exercise database is cleared and three weeks of real measurement data is copied into exercise database.
 - If the simulation time is in the past the real measurement results are overwritten by simulated results.
- The simulator software uses real measurements as background and the reported value is calculated by adding the value read from dispersion model output to background.
 - If the measured result does not exist for given point, dose rate value 0.1 $\mu\text{Sv/h}$ is used as background
- As the exercise progresses the simulated measurements incremented by background values are inserted into database with 10 minutes interval.

Simulator status

- As the exercise progresses the simulated measurements incremented by background values are inserted into database with 10 minutes interval.
- The simulator user can follow the status of simulation in the Web page.

Status: Running

Current simulation

Simulation start time: 2015-04-15 10:11 UTC

User: Tuomas Peltonen

Simulation end time: 2015-04-16 06:00 UTC

```
2015-04-15 10:11:34,439 INFO 1199 minutes remaining in the simulation process.
2015-04-15 10:11:34,434 WARNING avg_4h or stdev_4h are None on station '3957', use change value 1
2015-04-15 10:11:34,405 WARNING avg_4h or stdev_4h are None on station '0R501', use change value 1
2015-04-15 10:11:34,391 WARNING avg_4h or stdev_4h are None on station '4444', use change value 1
2015-04-15 10:11:34,274 WARNING avg_4h or stdev_4h are None on station '0R110', use change value 1
2015-04-15 10:11:33,440 WARNING avg_4h or stdev_4h are None on station '10054', use change value 1
2015-04-15 10:11:32,093 INFO update uljas tables
2015-04-15 10:11:32,091 INFO processed file /tmp/usvasim_2015_04_15T10_11_6313/20150415_100000/uljas/dose1091520150415_100000.xml
2015-04-15 10:11:32,082 WARNING avg_4h or stdev_4h are None on station '10915', use change value 1
2015-04-15 10:11:32,080 INFO processed file /tmp/usvasim_2015_04_15T10_11_6313/20150415_100000/uljas/dose1091620150415_100000.xml
2015-04-15 10:11:32,071 WARNING avg_4h or stdev_4h are None on station '10916', use change value 1
2015-04-15 10:11:32,069 INFO processed file /tmp/usvasim_2015_04_15T10_11_6313/20150415_100000/uljas/dose1091120150415_100000.xml
2015-04-15 10:11:32,060 WARNING avg_4h or stdev_4h are None on station '10911', use change value 1
2015-04-15 10:11:32,057 INFO processed file /tmp/usvasim_2015_04_15T10_11_6313/20150415_100000/uljas/dose1092220150415_100000.xml
2015-04-15 10:11:32,045 INFO processed file /tmp/usvasim_2015_04_15T10_11_6313/20150415_100000/uljas/dose3385520150415_100000.xml
2015-04-15 10:11:32,032 INFO processed file /tmp/usvasim_2015_04_15T10_11_6313/20150415_100000/uljas/dose1091720150415_100000.xml
2015-04-15 10:11:32,024 WARNING avg_4h or stdev_4h are None on station '10917', use change value 1
2015-04-15 10:11:32,021 INFO processed file /tmp/usvasim_2015_04_15T10_11_6313/20150415_100000/uljas/dose1091320150415_100000.xml
2015-04-15 10:11:32,012 WARNING avg_4h or stdev_4h are None on station '10913', use change value 1
2015-04-15 10:11:32,010 INFO processed file /tmp/usvasim_2015_04_15T10_11_6313/20150415_100000/uljas/dose1091220150415_100000.xml
2015-04-15 10:11:32,001 WARNING avg_4h or stdev_4h are None on station '10912', use change value 1
2015-04-15 10:11:31,999 INFO processed file /tmp/usvasim_2015_04_15T10_11_6313/20150415_100000/uljas/dose1385520150415_100000.xml
```

Exercise USVA

- The end users can follow the simulation via Exercise USVA Web Page.
- Like the operational USVA Web page it is available on the Internet but it is password protected.
- The results are accessible for all the players in the exercise including the rescue officers. In national exercises the URL of the page is written in exercise instructions and participants are encouraged to follow this site during the exercise.
- The results are also available in the TIUKU system.
 - This makes it possible to display model results together with simulated results on the map.
- Also WMS/WFS service for the results is available and can be used with various GIS applications.

Exercise USVA: Front page

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USVA

Säteilytilanne ▾

Annosnopeus ▾

Spektrometrit

Säätiedot ▾

 stpeltonen ▾

Verkon tila

22.08.2015 klo 20.15 UTC

Toimivia asemia

252

Asemia yhteensä

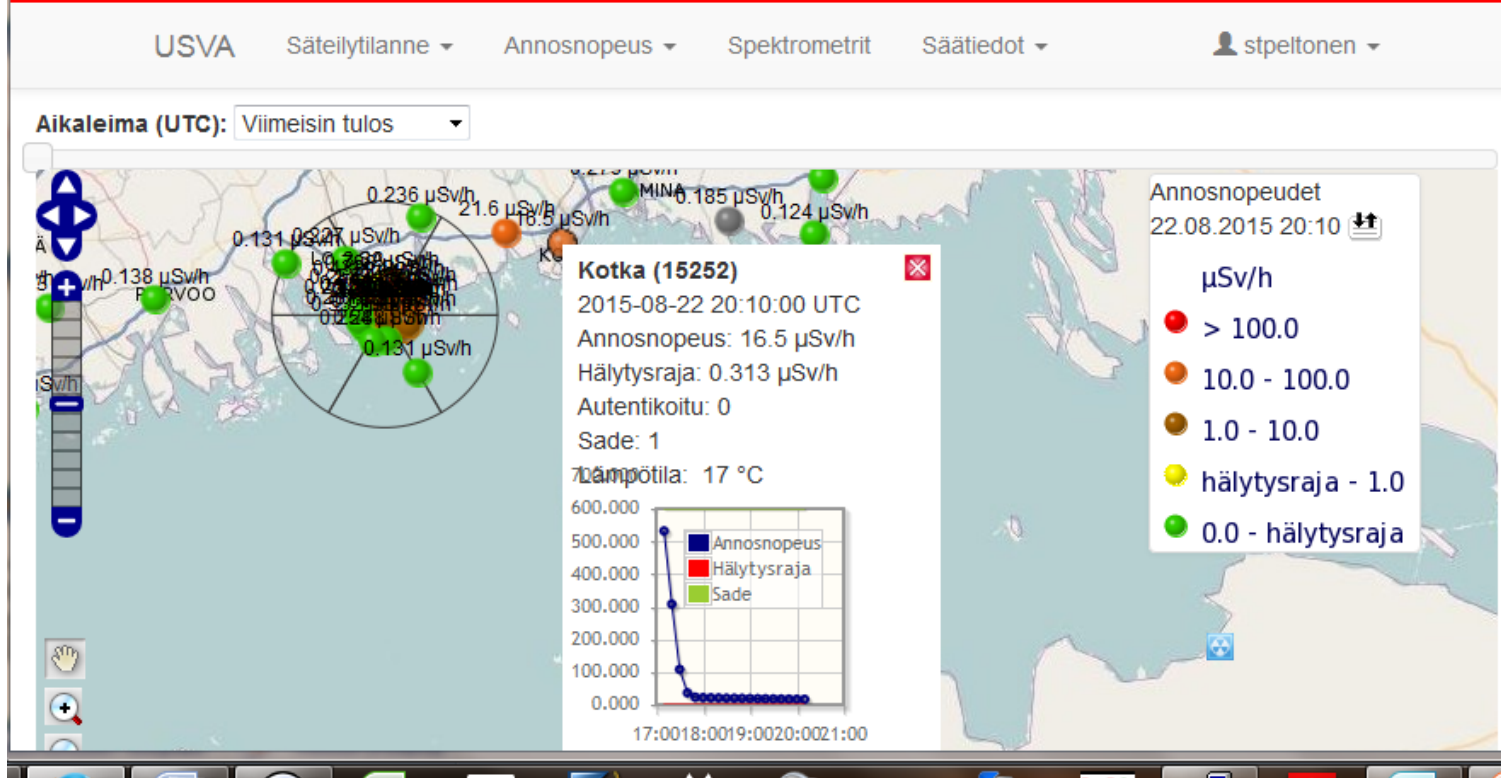
255

Suurin annosnopeus 25.296 $\mu\text{Sv/h}$ asemalla LOVIISA506.

[Asemien viimeisimmät tulokset](#)

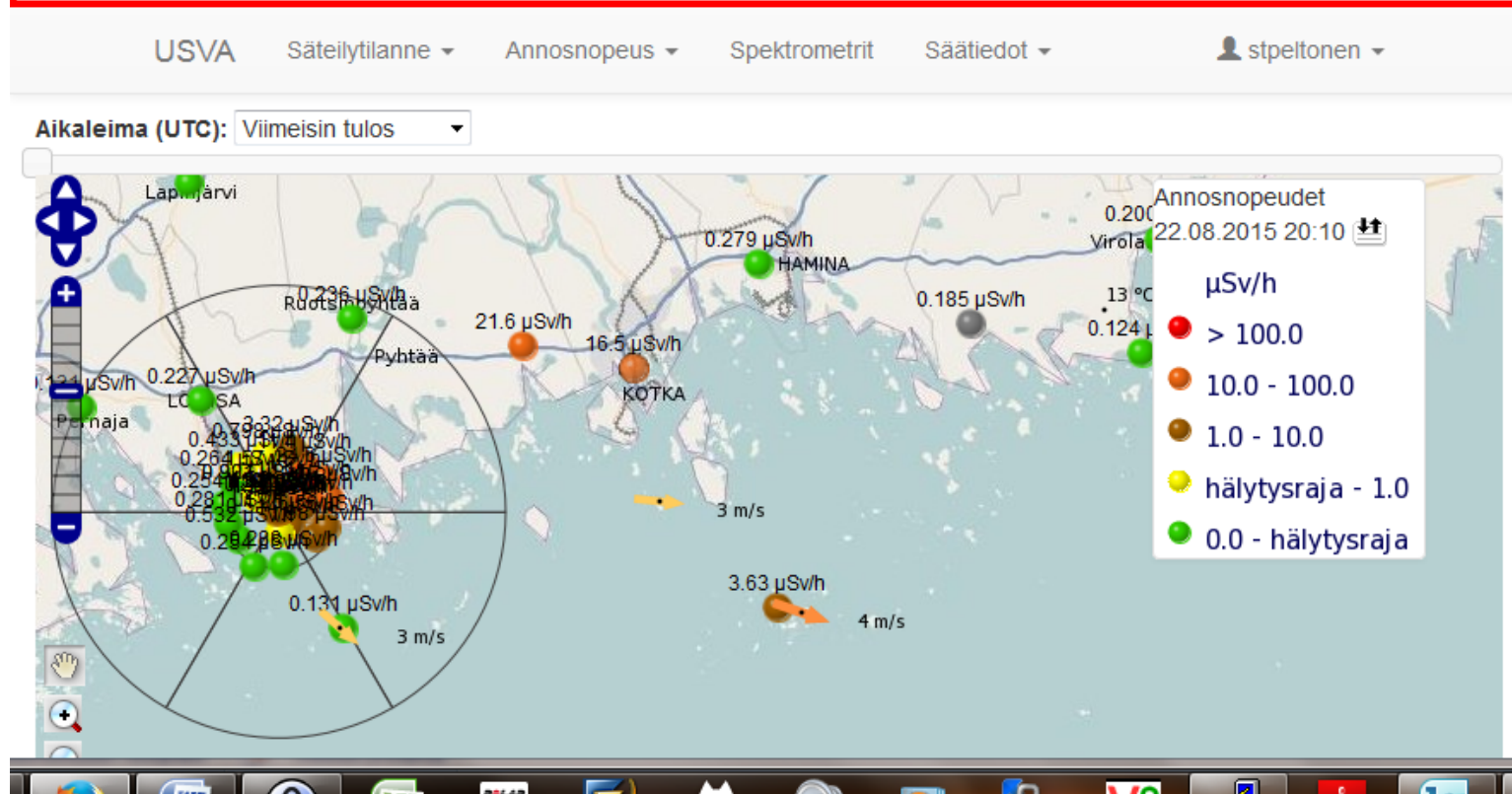
Exercise USVA: Map view

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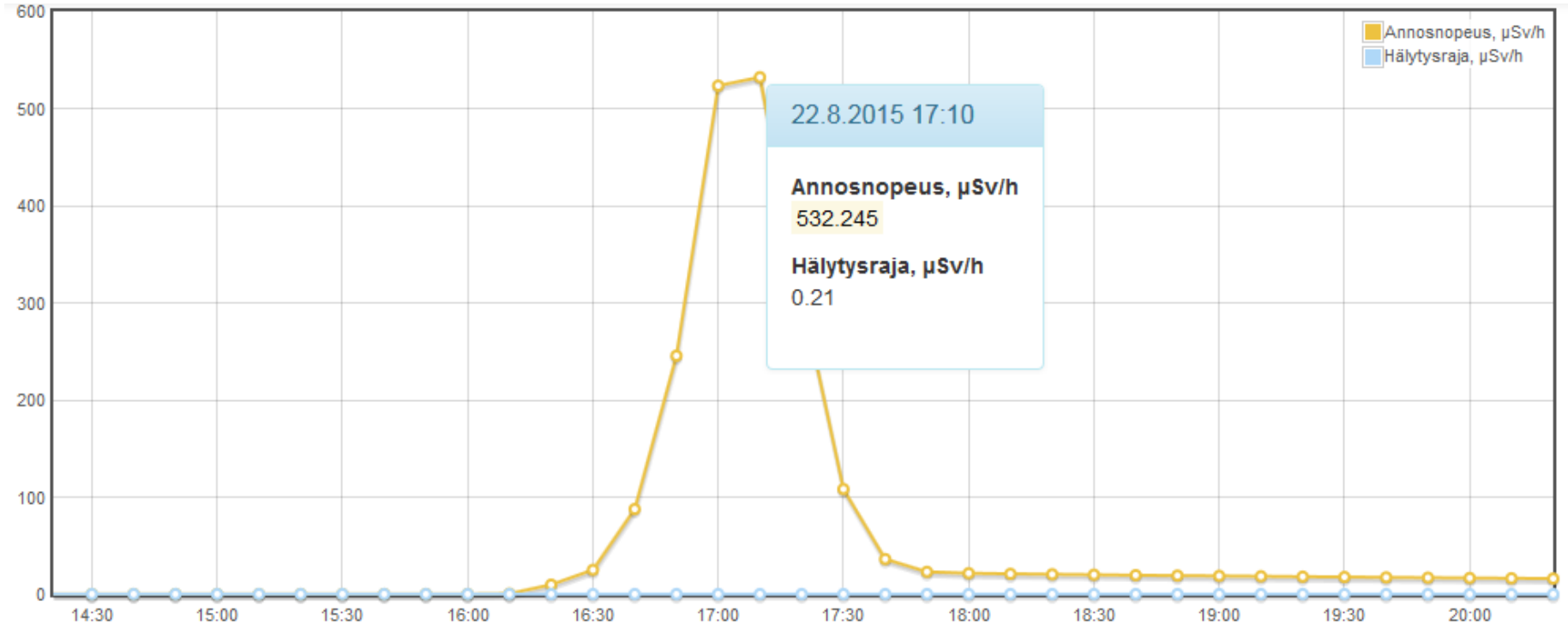


Exercise USVA: Weather observations

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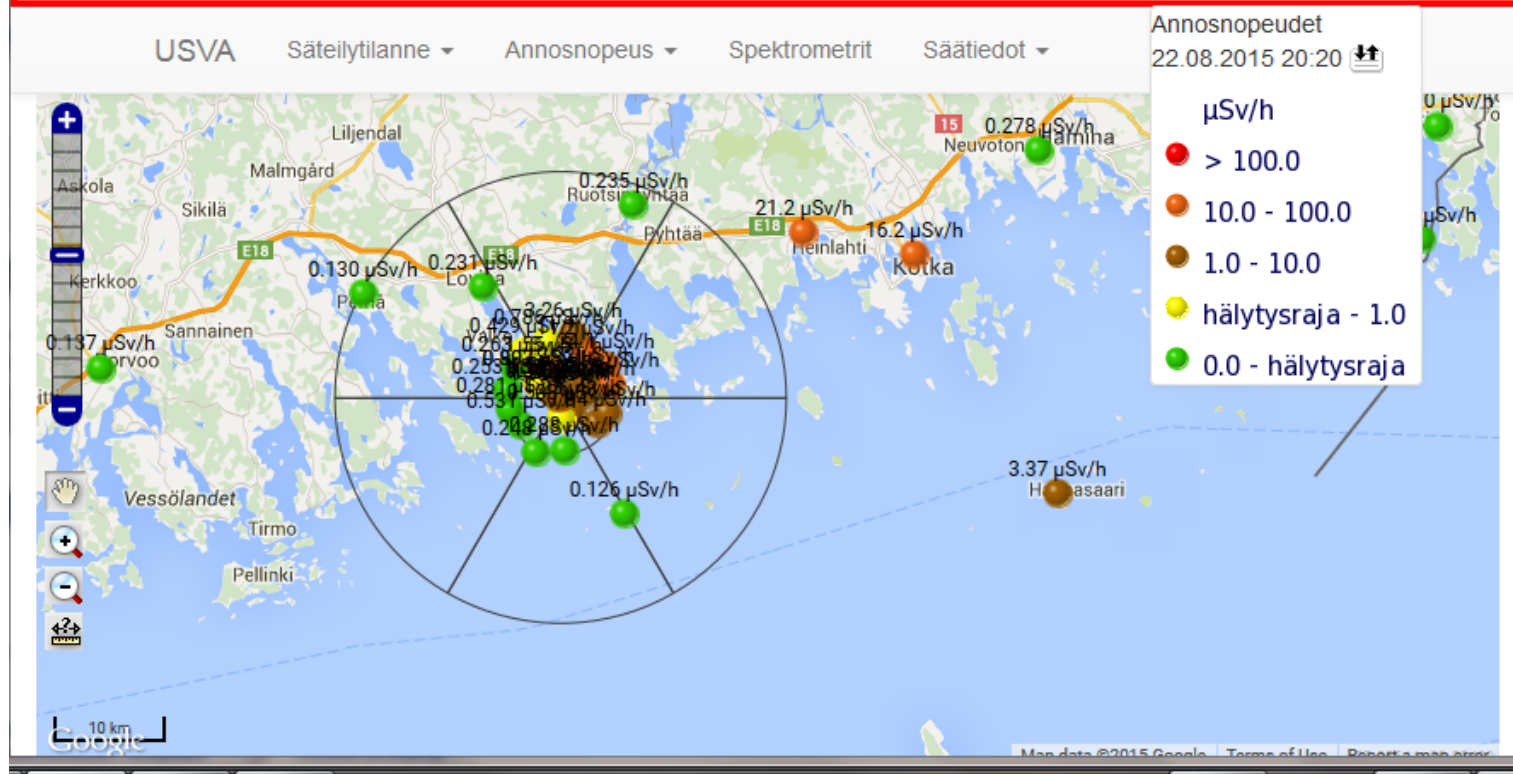


Exercise USVA: Detailed view of single station



Exercise USVA: Background maps (Google)

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Conclusions

- Compared to traditional simulation methods for exercises STUK's system has many advanced features.
- It can use the most sophisticated dispersion models available and it is not limited to one dispersion model or one weather prediction model.
- NWP based real weather conditions including historical data are supported but also weather input by hand can also be used.
- **The real-time availability of results online for large number of players is unique feature and following of results via Web makes it possible to have more realistic feeling of an exercise.**