

Method for source localization proposed and applied to the October 2017 case of atmospheric dispersion of Ru-106

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Measurements of Ru-106

During 3–6 October 2017, low concentrations of Ru-106 were detected in Europe. No other radionuclides detected (e.g. fission products such as Cs-137).

Asked by DEMA to assist in locating the release.

387 measurement data, some of which below detection limit.

Selection of measurements for the localization study:

Measurement time less than 36 hours.

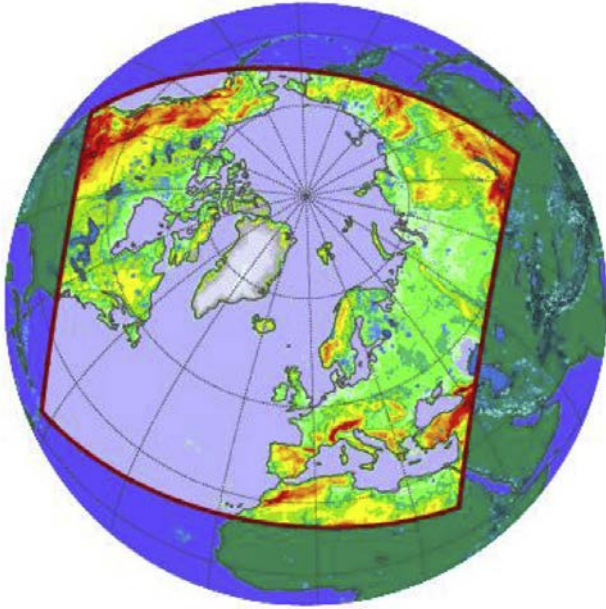
Lower threshold concentration 1 Bq/m³.

Thereby, the data set is reduced to 81 measurements.

The discarded data can and should, however, be used for verification purposes.

Assume Ru-106 originates from same geographically fixed ground-level release location allowing for the release to have taken place during a finite time period.

Numerical weather prediction model



T15 version of HIRLAM

Atmospheric dispersion model

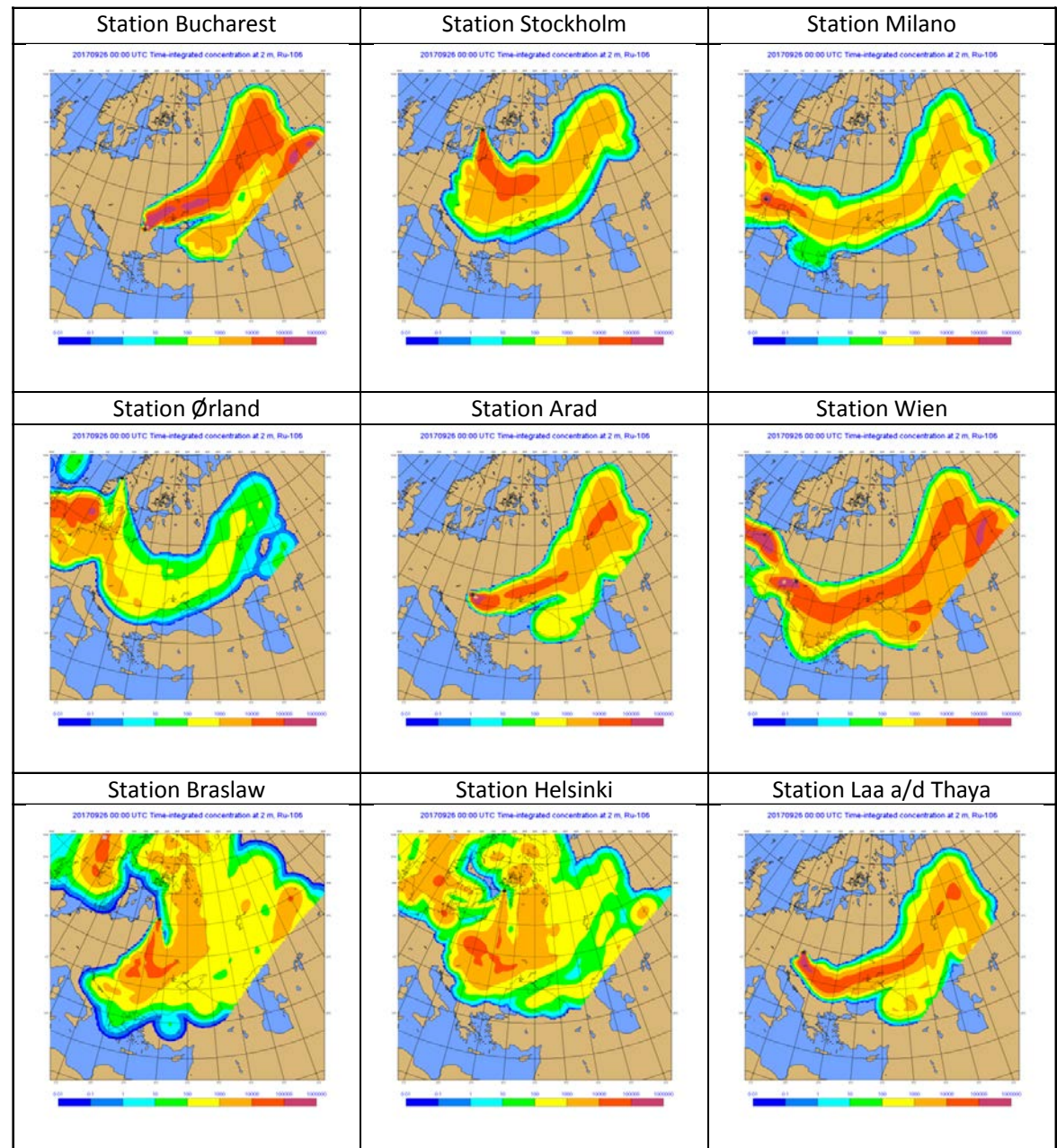
Danish Emergency Response Model of the Atmosphere (DERMA)

Inverse modelling

Influence functions
(time-integrated concentration)

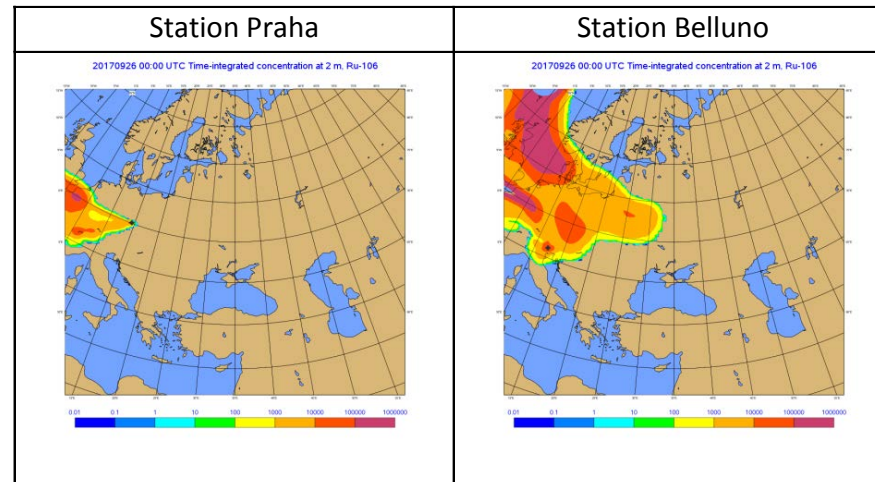
Release point to be found in the overlap, i.e. the intersection

Period covered:
9 days



For a few of the measurements, the corresponding inverse plumes do not comply well with the others.

Inverse time-integrated 2-m concentration in units of $\text{Bq}\cdot\text{h}/\text{m}^3$ valid at 00 UTC on 2017-09-26.

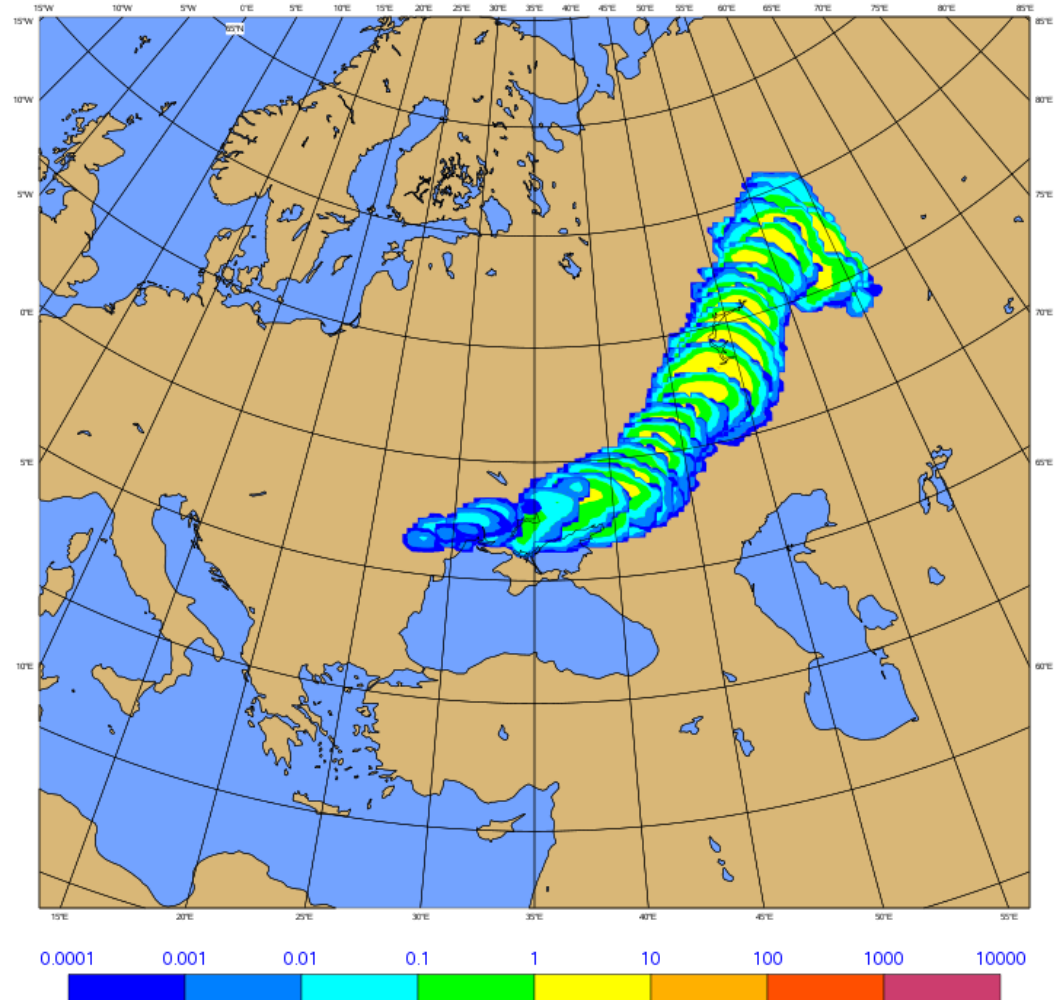


Instantaneous concentration at 2 m, Ru-106

Potential location of the release of Ru-106.

Time series of three-hourly 20th percentile inverse 2-m concentration maps from 2017-09-26 06 UTC to 2017-09-29 15 UTC.

Allows for disagreement between measurements and models.

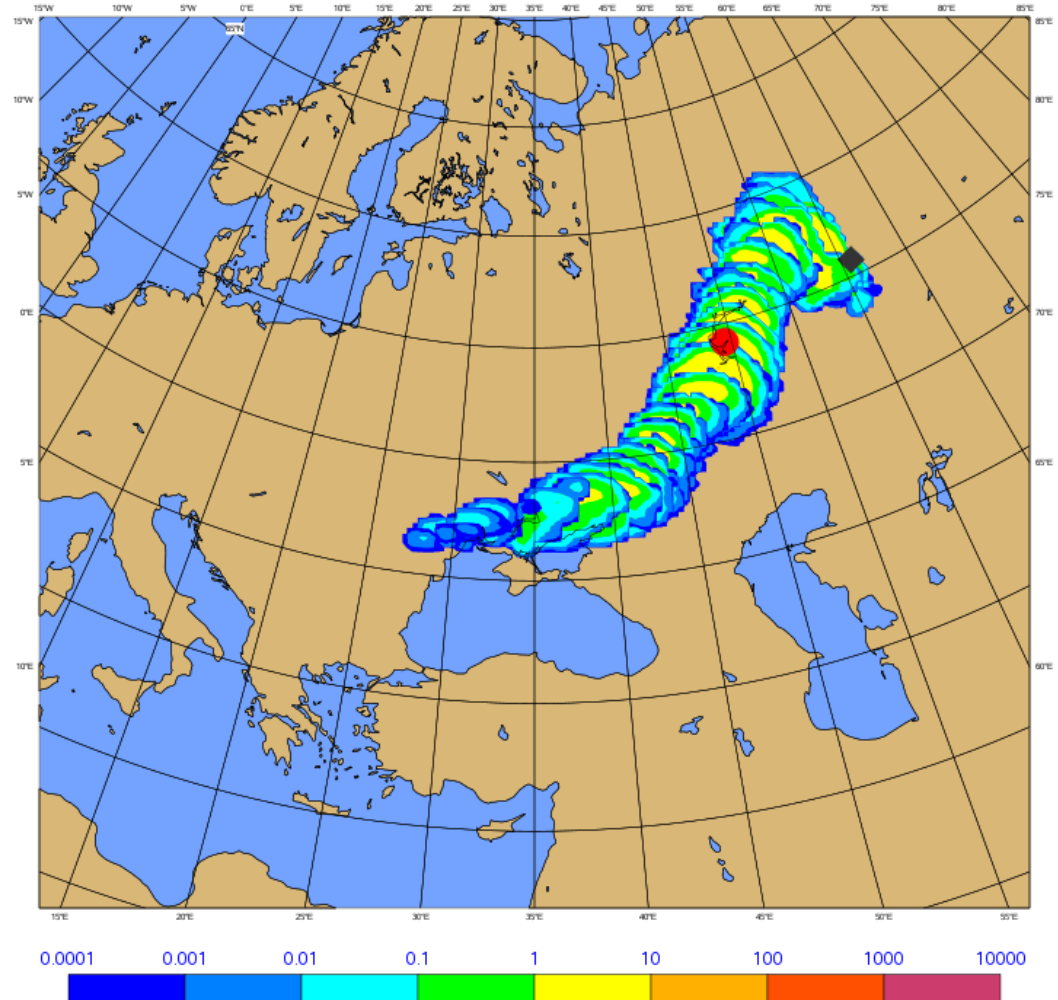


Instantaneous concentration at 2 m, Ru-106

Potential location of the release of Ru-106.

Time series of three-hourly 20th percentile inverse 2-m concentration maps from 2017-09-26 06 UTC to 2017-09-29 15 UTC.

With a red dot and a black diamond, the NIIAR and the Mayak nuclear facilities are indicated, respectively.

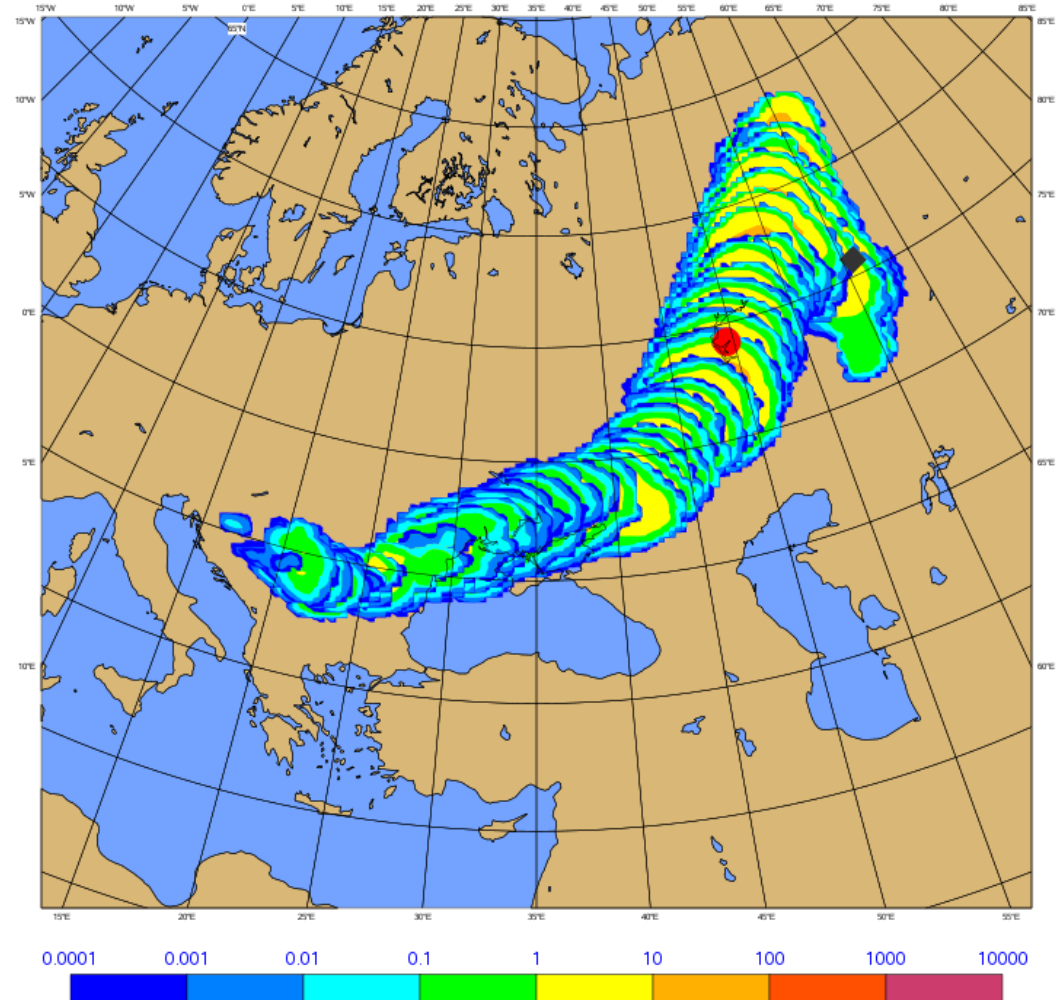


Instantaneous concentration at 2 m, Ru-106

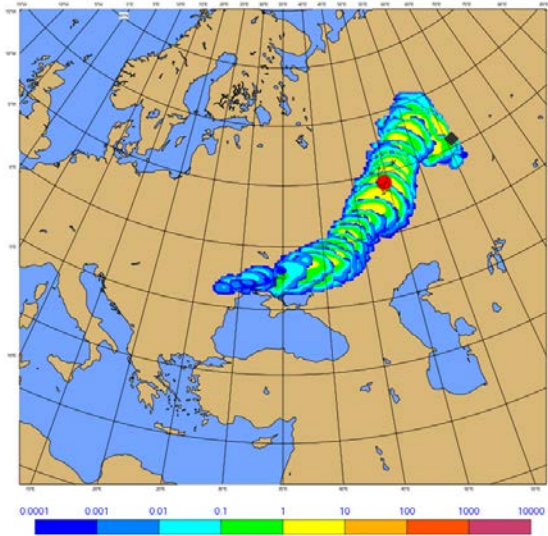
Potential location of the release of Ru-106.

Time series of three-hourly **30th** percentile inverse 2-m concentration maps from 2017-09-26 06 UTC to 2017-09-29 15 UTC.

With a red dot and a black diamond, the NIIAR and the Mayak nuclear facilities are indicated, respectively.

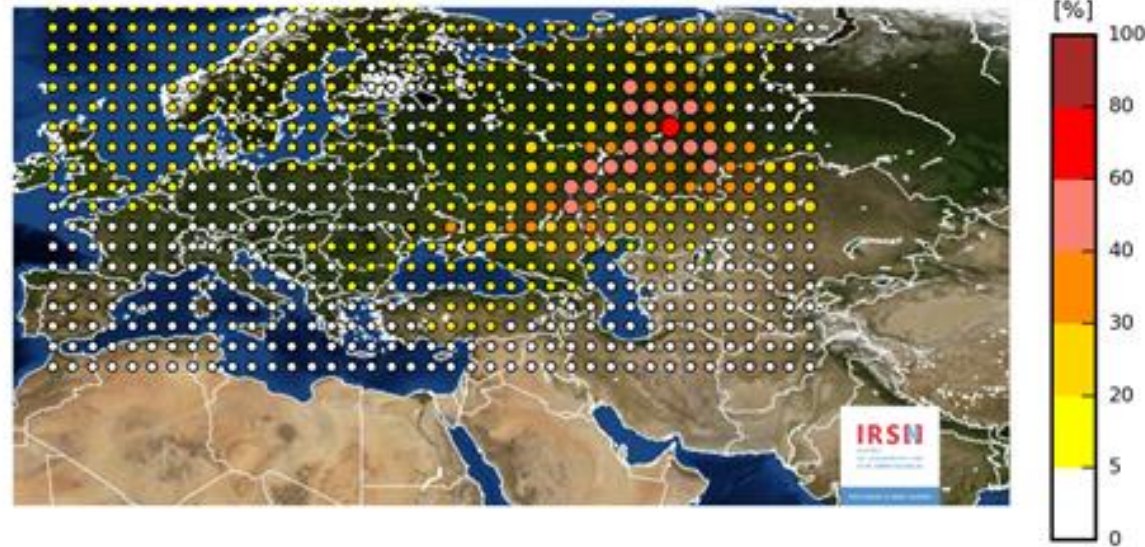


Instantaneous concentration at 2 m, Ru-106



DEMA – DMI results

Concentrations simulées et observées dans un facteur 2 en fonction du point de rejet (%)

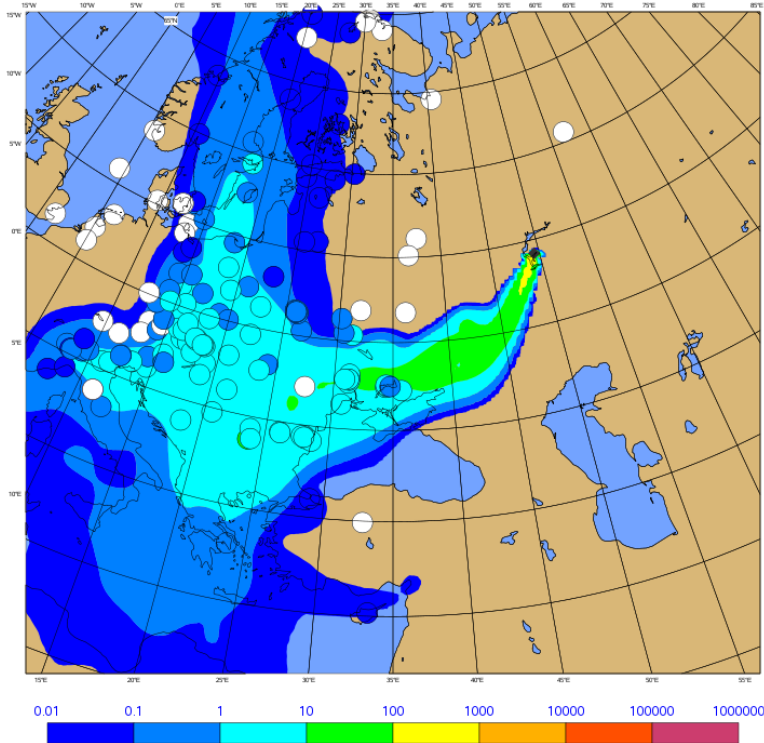


IRSN – Meteo France results

Forward modelling

Niiar

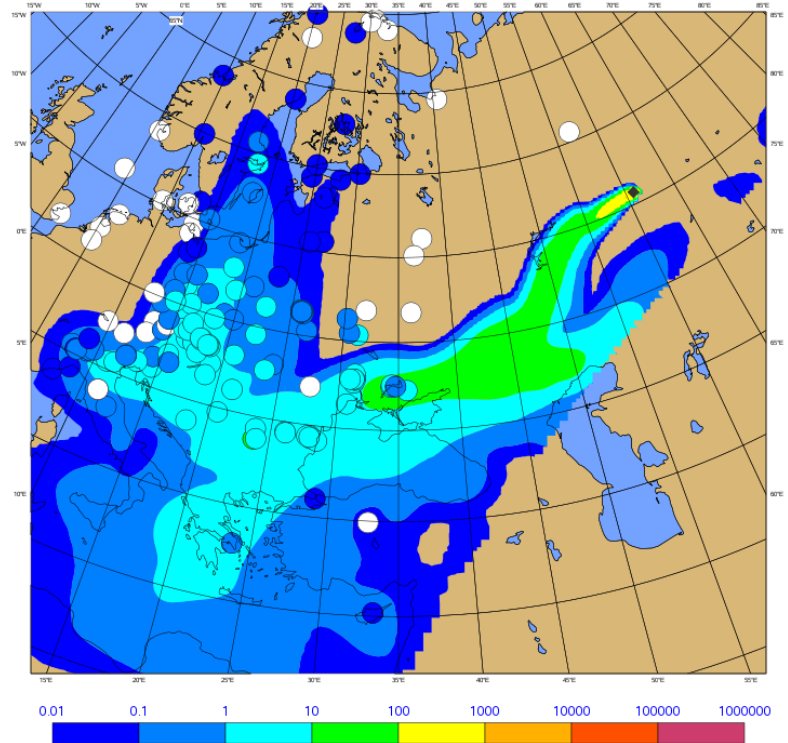
20171006 00:00 UTC Time-integrated concentration at 2 m, Ru-106



460 TBq

Mayak

20171006 00:00 UTC Time-integrated concentration at 2 m, Ru-106



1100 TBq

All measurements inserted. White indicates measurement below detection limit.

Reference

J. H. Sørensen.

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Journ. Envir. Radioactivity **189C** (2018) 221–226

<https://doi.org/10.1016/j.jenvrad.2018.03.010>