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Supplementary Information for

Radioactive Ruthenium from an Undeclared Major Nuclear Release in Fall 2017, Part 2: Atmospheric modeling and source reconstruction

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www.pnas.org/cgi/doi/10.1073/pnas.1907823116

Supplementary Information Text

Grid refinement

To confirm the location of the source of ^{106}Ru, a sub-domain restricted to the release area identified as the most relevant in southern of the Urals, was considered. This sub-domain of dimension [52E, 63E], [53N, 59N] is divided into a set of 322 meshes where each center of mesh is a potential source location. The spatial resolution between two potential source locations is $0.5° \times 0.5°$, identical to that of the meteorological data. The inverse method was then applied to estimate the source term for each of the 322 potential source locations. The results confirm the conclusions drawn for a resolution of $2° \times 2°$, since the regions in southern of the Urals are the ones that best reproduce the air concentration measurements (Fig. S2). Slight differences can nevertheless be observed in terms of location of the most pertinent area. The area where the fac2 values were above 40% is slightly further south and does not extend as far northwest.

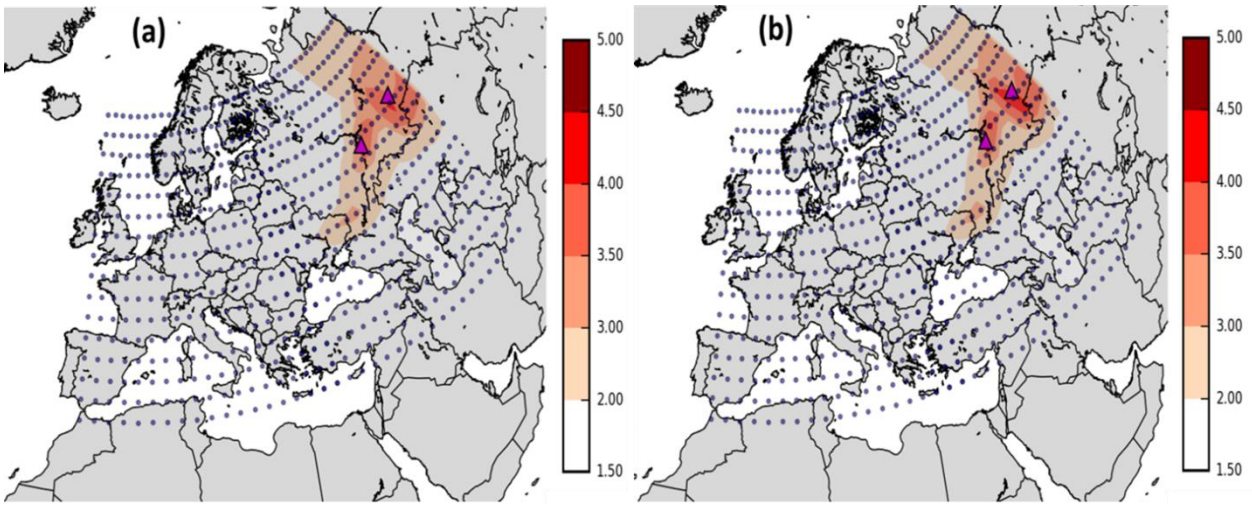

Fig. S1. Reduction factor of the cost function (RFJ) obtained for a) $\boldsymbol{\theta = 0.001}$ b) $\boldsymbol{\theta = 0.01}$. Purple triangles represent the location of Mayak and Dimitrovgrad sites. Blue dots are the 720 potential source locations.

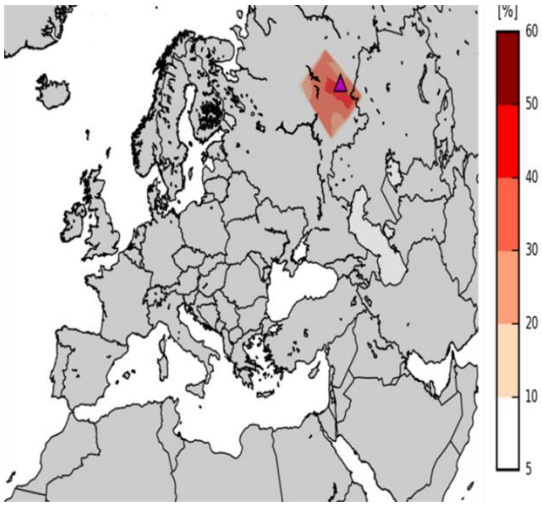

Fig. S2. Percentage of the simulated air concentrations that are within a factor of 2 of the observed values with 0.5° spatial resolution. Purple triangle represents the location of Mayak site.

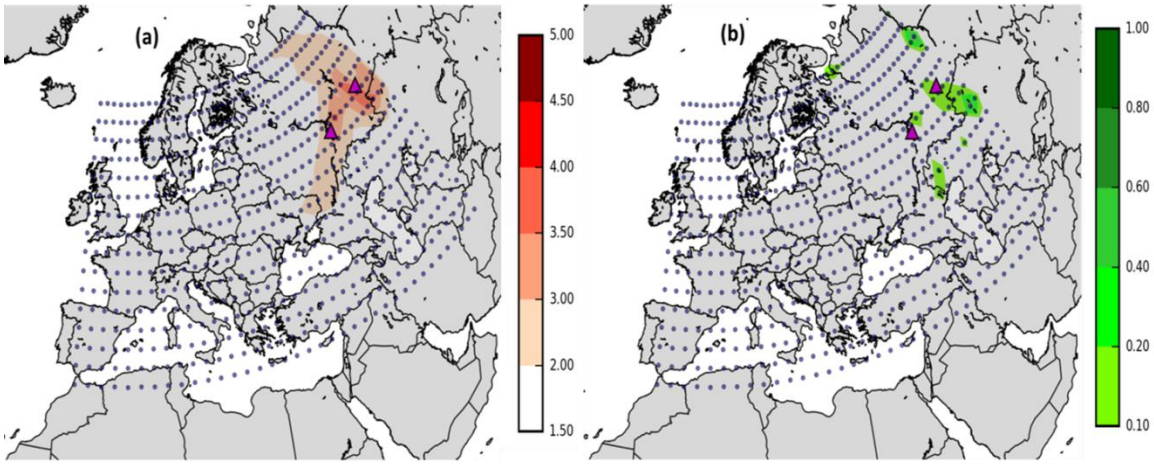

Fig. S3. (a) Average and (b) Standard deviation on the RFJ computed using Monte Carlo analysis (n=1000 samples). Purple triangles represent the location of Mayak and Dimitrovgrad sites. Blue dots are the 720 potential source locations.

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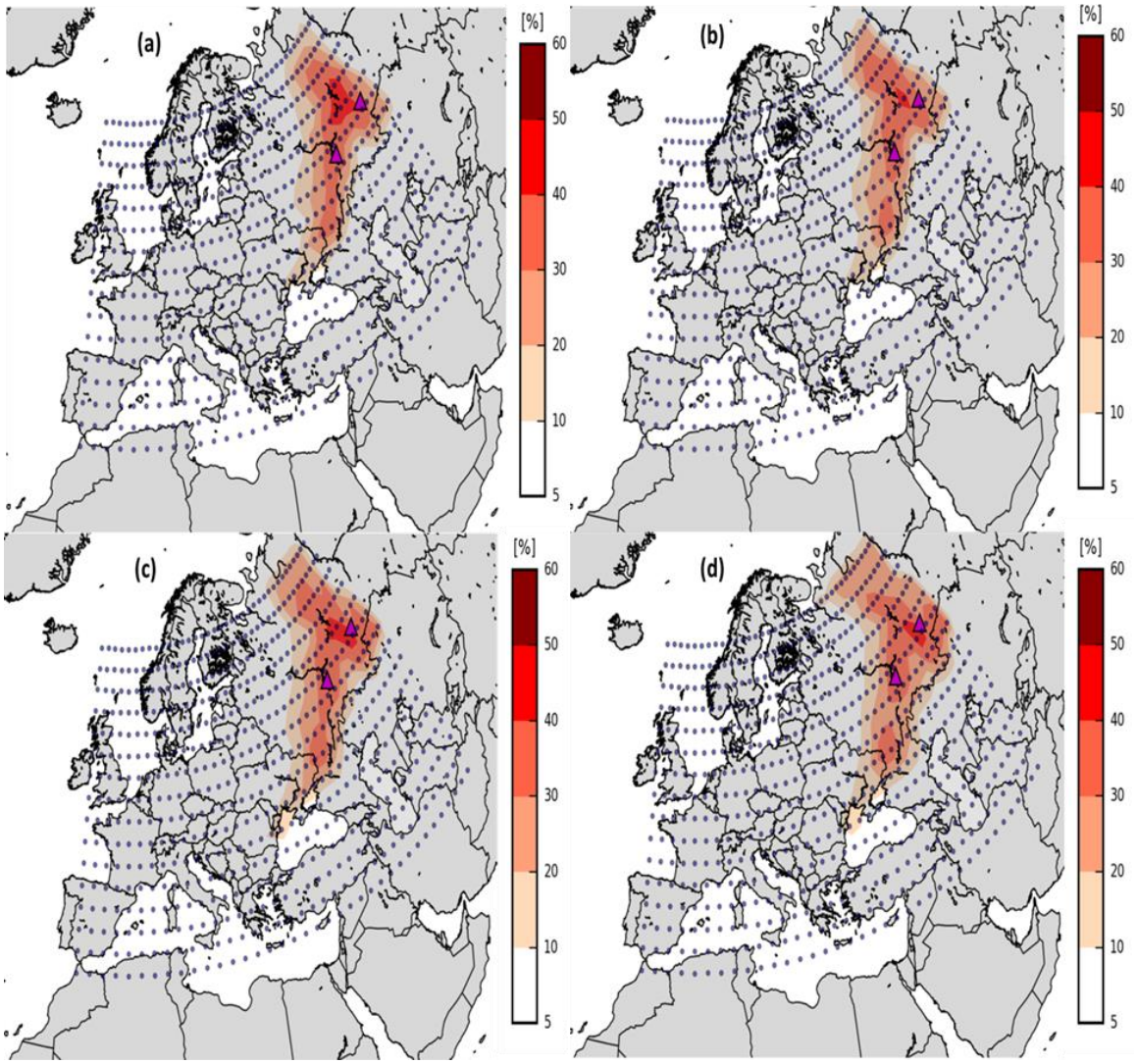

Fig. S4. Average percentage of the simulated air concentrations that are within a factor of 2 of the observed values computed from *n* = 1000 random subsets of: (a) 10 stations; (b) 20 stations; (c) 50 stations; (d) 100 stations.

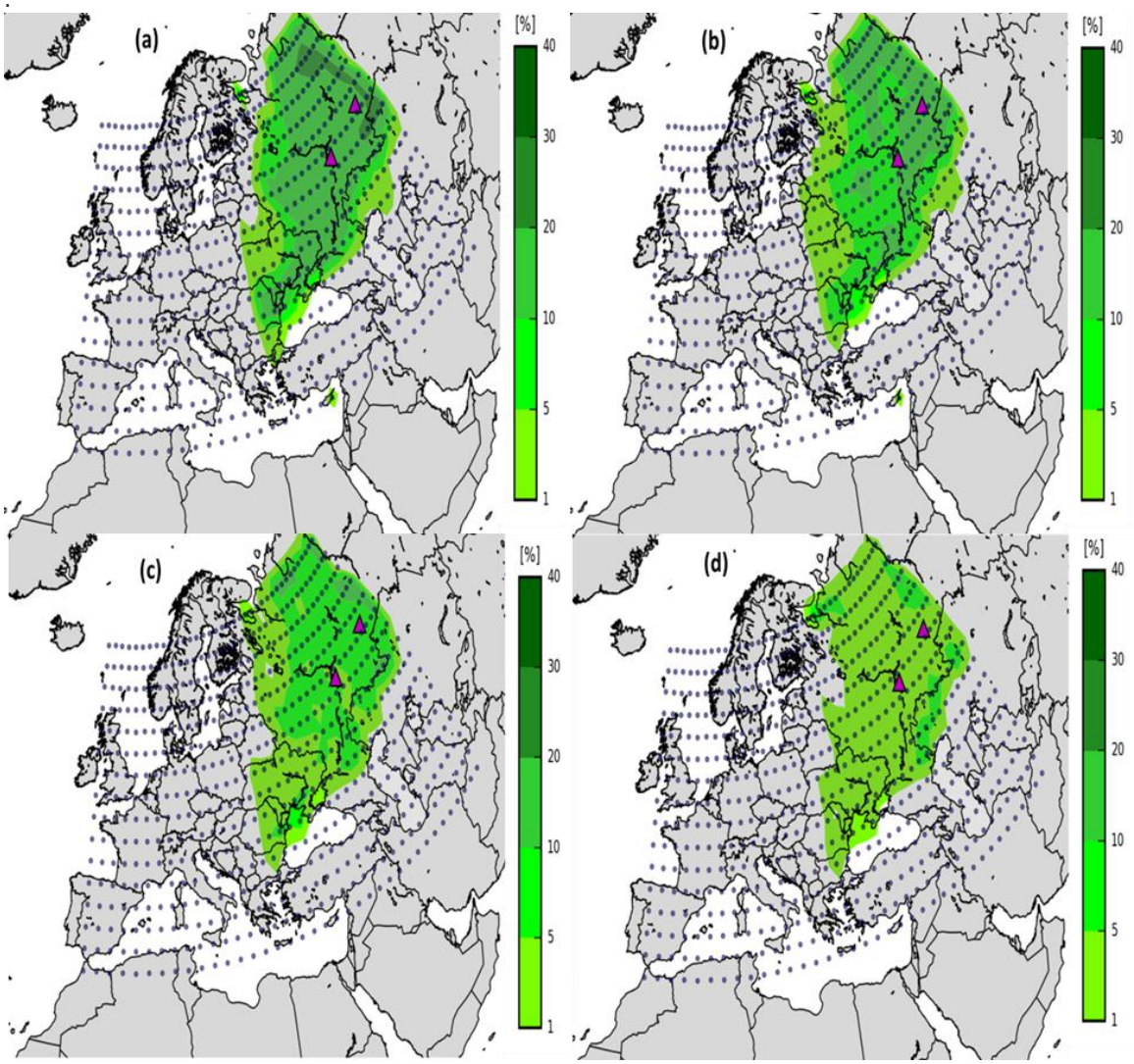

Fig. S5. Standard deviation of the percentage of the simulated air concentrations that are within a factor of 2 of the observed values computed from *n* = 1000 random subsets of: (a) 10 stations; (b) 20 stations; (c) 50 stations; (d) 100 stations.

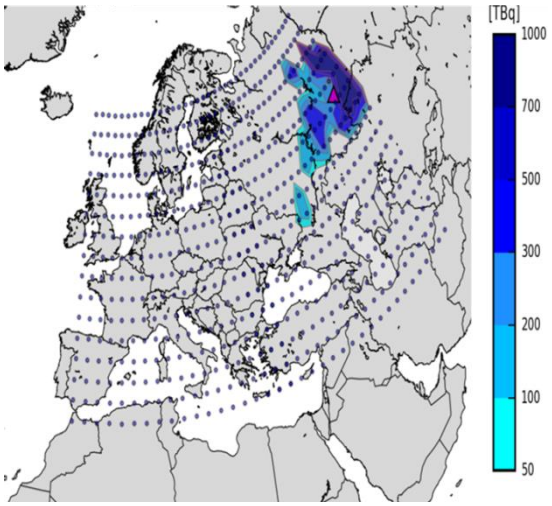

Fig. S6. Quantity of ^{106}Ru (TBq) assessed in the geographical area where the values of fac2 are higher than 30%. Purple triangle represents the location of Mayak site. Blue dots are the 720 potential source locations

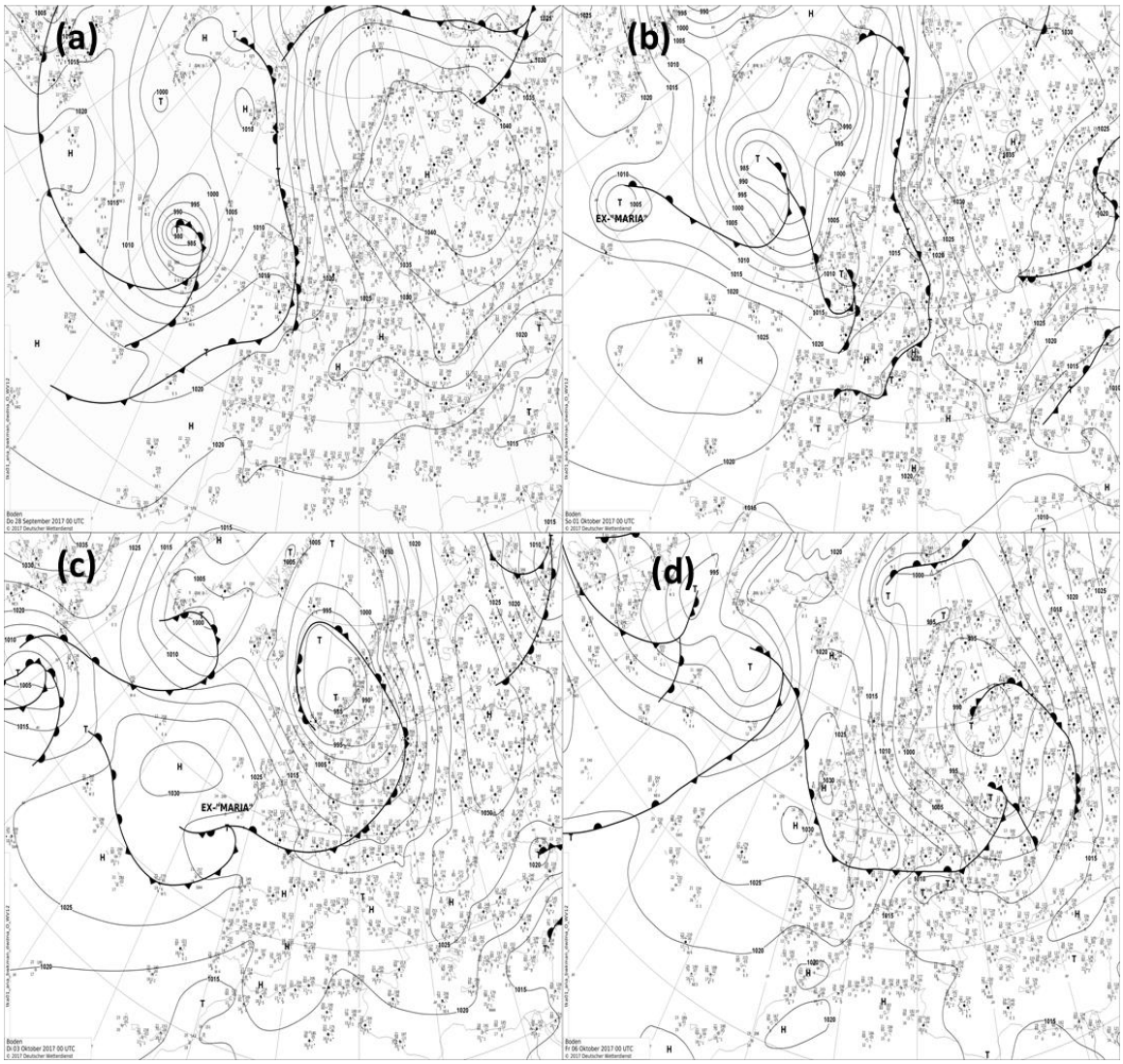

Fig. S7. Weather charts reanalysis from Deutscher Wetterdienst (DWD) Institute: (a) 09/28 00:00, (b) 10/01 00:00, (c) 10/03 00:00, (d) 10/06 00:00 (https://www.wetterzentrale.de/reanalysis.php?map=1&model=dwd&var=45&jaar=2017&maand=10&dag=06&uur=0000&h=0&tr=1440&nmaps=24#mapref)