RSMC OBNINSK
USER'S INTERPRETATION GUIDELINES
ATMOSPHERIC TRANSPORT MODEL OUTPUTS

January 2020

1. Introduction

In the context of current agreements between the Russian Federal Service for Hydrometeorology and Environmental Monitoring (Roshydromet) and WMO, Roshydromet is prepared to provide diagnostic and forecast transport, dispersion, and deposition estimates for atmospheric releases of hazardous pollutants that may cross international political boundaries. The Federal Environmental Emergency Response Center (FEERC) of Roshydromet is designated for the activity mentioned above. The primary region (WMO RA-II) of coverage includes the territory of Asia. This document provides a description of the RSMC Obninsk products.

2. The Federal Environmental Emergency Response Centre (FFERC) of Roshydromet

The Federal Service of Russia for Hydrometeorology and Environmental Monitoring (Roshydromet) is actively involved in response actions at the national level in case of environmental emergencies including those related to nuclear accidents. In this connection, Roshydromet has established FEERC deployed at Research and Production Association (RPA) "Typhoon" (Obninsk) to provide on-line and prognostic information on the radiation situation in the territory of Russia. The Centre is designed to provide information support to activities related to mitigation of consequences of nuclear accidents within and outside the country.

To fulfill its tasks the Centre has direct on-line access to the information incoming through various channels including GTS of WMO, Roshydromet's meteorological telecommunication system (MTS). Hence, the current archives of global meteorological information and national radiological data can be managed in real-time automatically.

Russian National Meteorological Centre as a partner of the FEERC provides the baseline data derived from meteorological objective analysis and numerical forecasts.

A suite of mathematical models has been developed and is used successfully at the FEERC. These models simulate atmospheric dispersion of pollutants in a wide spatial and temporal range including local, regional and global scales. The models are handled by highly qualified personnel; competent experts are invited to analyze and study the situation in detail. All this suggests that the Centre is capable of making real-time diagnosis and prediction of pollutants dispersion on a global, regional and local level.
The emergency response system is usually initiated by a telephone call and facsimile message to the Duty Operator at the FEERC.

3. Emergency Response Models

At present, the following models of regional and global atmospheric transport are used:

- The trajectory model generates a map with a set of 3-D trajectories of air masses starting at specified heights above ground level.

- The STADIUM (STochastic Atmospheric DIffUsion Model) is used for modeling atmospheric transport and dispersion of pollutants (radioactive or chemical) over medium and long ranges of distances. The STADIUM is based on Lagrangian approach with turbulent dispersion simulated by random walk technique (Monte-Carlo method). Such an approach allows applying modern parameterizations for turbulent dispersion and deposition processes. Deposition including both wet and dry deposition is computed using a deposition velocity for the dry component of the removal process and in-cloud and below-cloud removal rates for the wet deposition. The model allows considering the essential features associated with instability and non-uniformity of the atmospheric boundary layer, spatial heterogeneity of the underlying surface.

The STADIUM provides a set of spatial-temporal fields of air concentration and deposition (dry and wet) of pollutants as well as information on the arrival time of the radioactive cloud.

4. Description of the STADIUM output maps for the default scenario

An initial response of an RSMC will be to provide a set of forecast products based on a "default scenario" unless details about the emergency are known at the time of the model run. The default products consist of a 3-level trajectory forecast, three average exposure forecasts from the analysis time to +24h, +24h to +48h and +48h to +72h, three total deposition maps for the period from the start of release to +24h, +48h and +72h, as well a map with the arrival time of the radioactive plume. Figures 1-8 present a typical product suite from STADIUM using the default scenario. For these maps the following items are identical:

(1): The hypothetical release started on 15 September 2019, 12:00 UTC

(2): The source is located at latitude 60.40° N and at longitude 18.17° E (FORSMARK-1, Sweden).

Figure 1 shows forecast air parcel trajectories starting at 500 (red triangles), 1500 (blue squares), and 3000 meters (green circles) above model ground level on a map. Trajectories are labeled every 6 hours by a filled symbol. The vertical projection of the trajectories with time is shown in the panel below the map.

Figure 2 shows the arrival time of the radioactive plume for +6h, +12h, +18h and +24h.

Figure 3-5 show the total (wet and dry) deposition for the period from the start of release at 12:00 UTC 15 September 2019 to +24h, +48h, and +72h.

Figures 6-8 show 24-hour average surface to 500 meter time integrated concentration (exposure) from the start of the release to the nearest even 12 hour synoptic period, which results in a time integration of greater than 12 hours. Figure 8 has been marked with red coded letters in this document only to explain the meaning of each section. Here is a description of what it contains:

1: Identification of RSMC Obninsk, Russia as an author of this calculation.

2: Indicates that the air concentration or exposure output units are averaged from the ground to 500 meters above the model ground level and the units are Becquerel-seconds per cubic meter (default units). Unless the source release rate is known at the time of the model run, the default emission rate is one Becquerel over six hours. Output units can easily be scaled to any multiple of the default emission rate. Ground-level deposition maps are identified on this line with units of Becquerel per square meter.

3: The integration period over which the time-integrated air concentrations are computed. All times are in UTC (Universal Time Coordinated) and are indicated by the start and end of the integration period.

4: The symbol indicating source location.

5: The latitude of the grid line.

6: The longitude of the grid line.

7: Shading and colors used for plotting the four concentration contour intervals and their corresponding values.

8: The maximum of calculated exposure (or deposition) value.

9: Starting date and time of the hypothetical release, the latitude and longitude of the release location in decimal degrees, the total release and its duration.

The distribution of the release is uniform between the surface and 500 meters above the ground level.

10: Additional notes indicate that the contour intervals may change from map to map as the interval depends upon the concentration range on each map.

11: The results for this simulation are based upon the default scenario, since no additional information was available at the time of the model run.

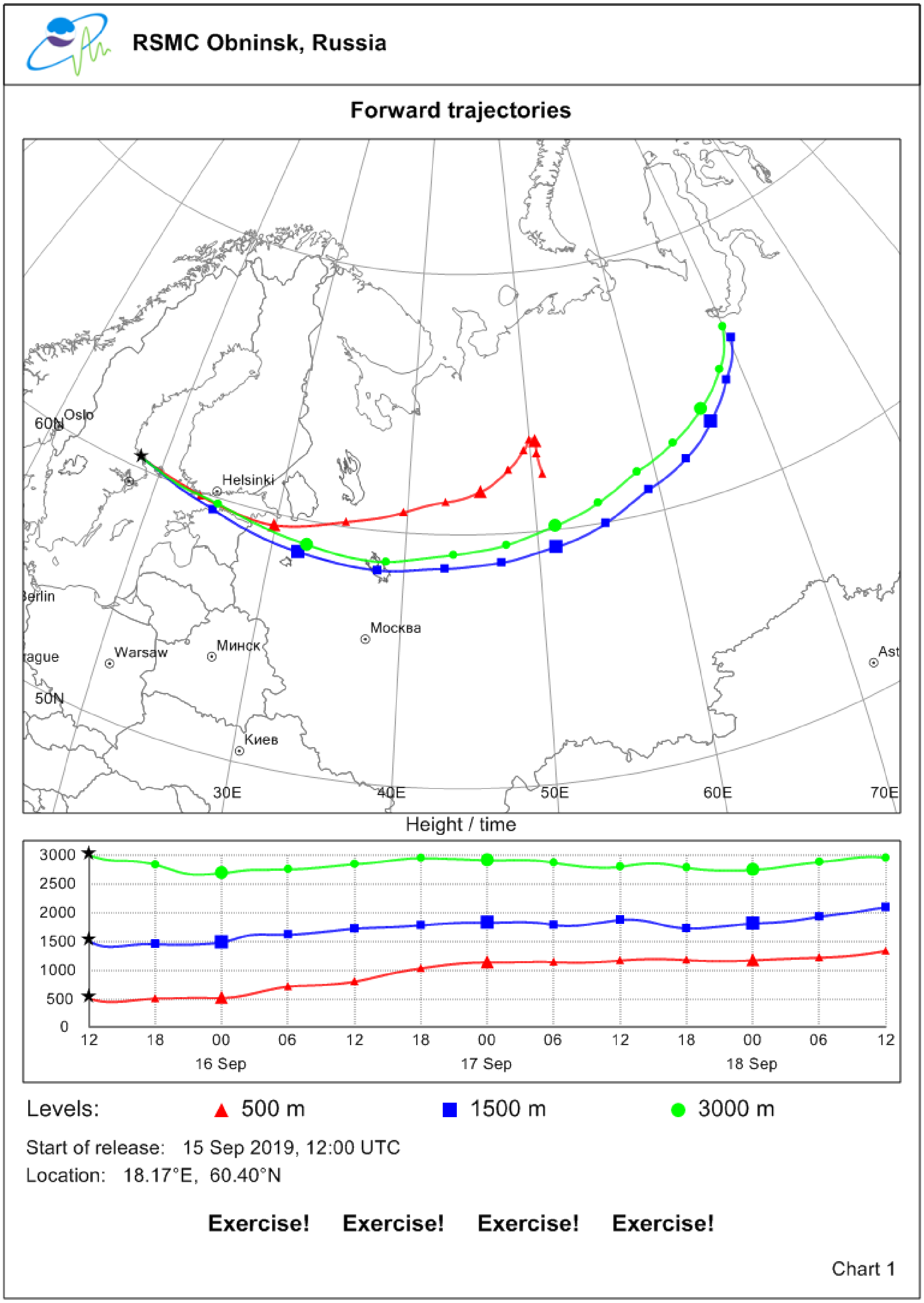


Figure 1. Horizontal and vertical projection of the 500, 1500, and 3000 meter above ground level forecast air parcel trajectories.

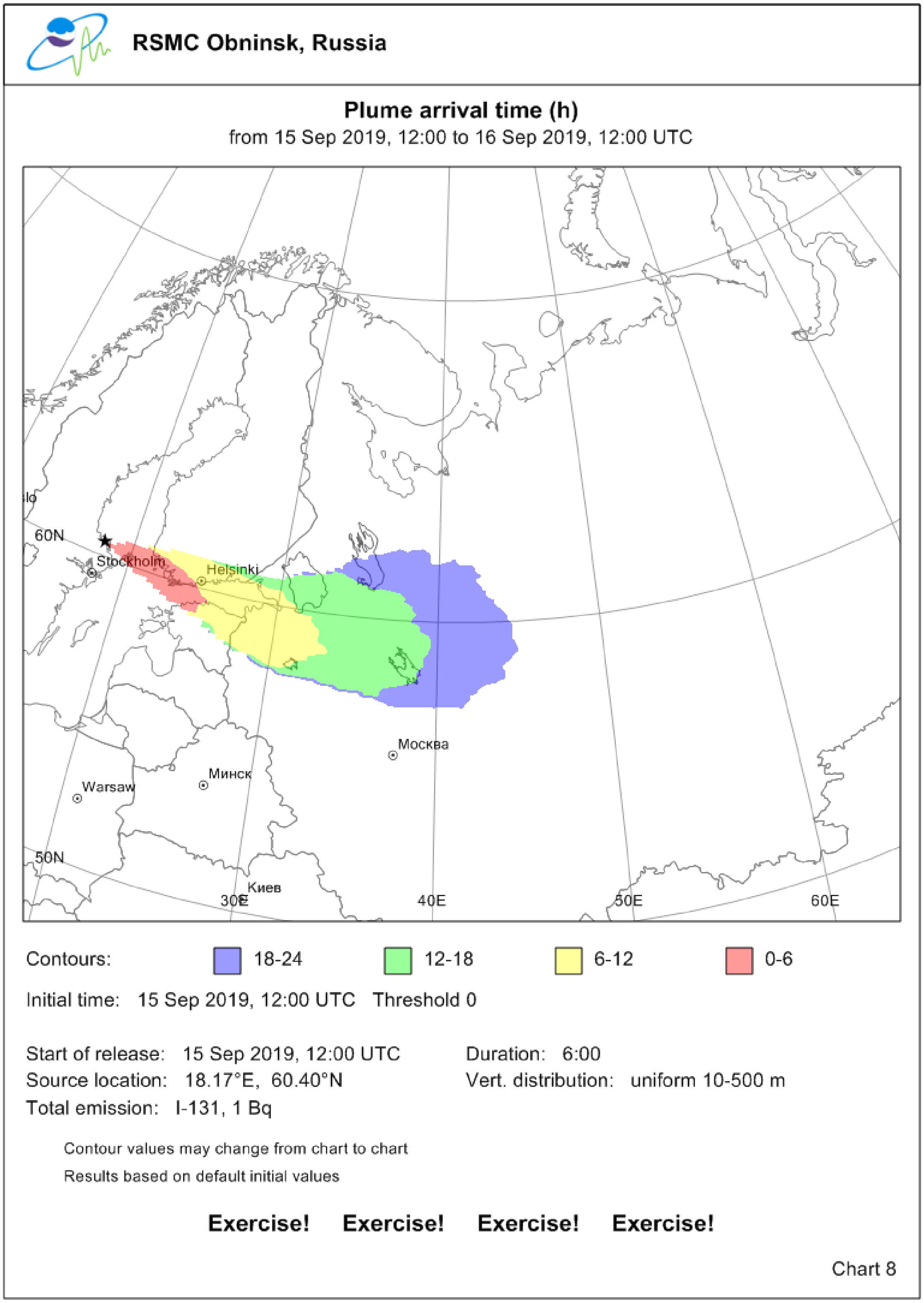


Figure 2. Plume arrival time for a hypothetical accident

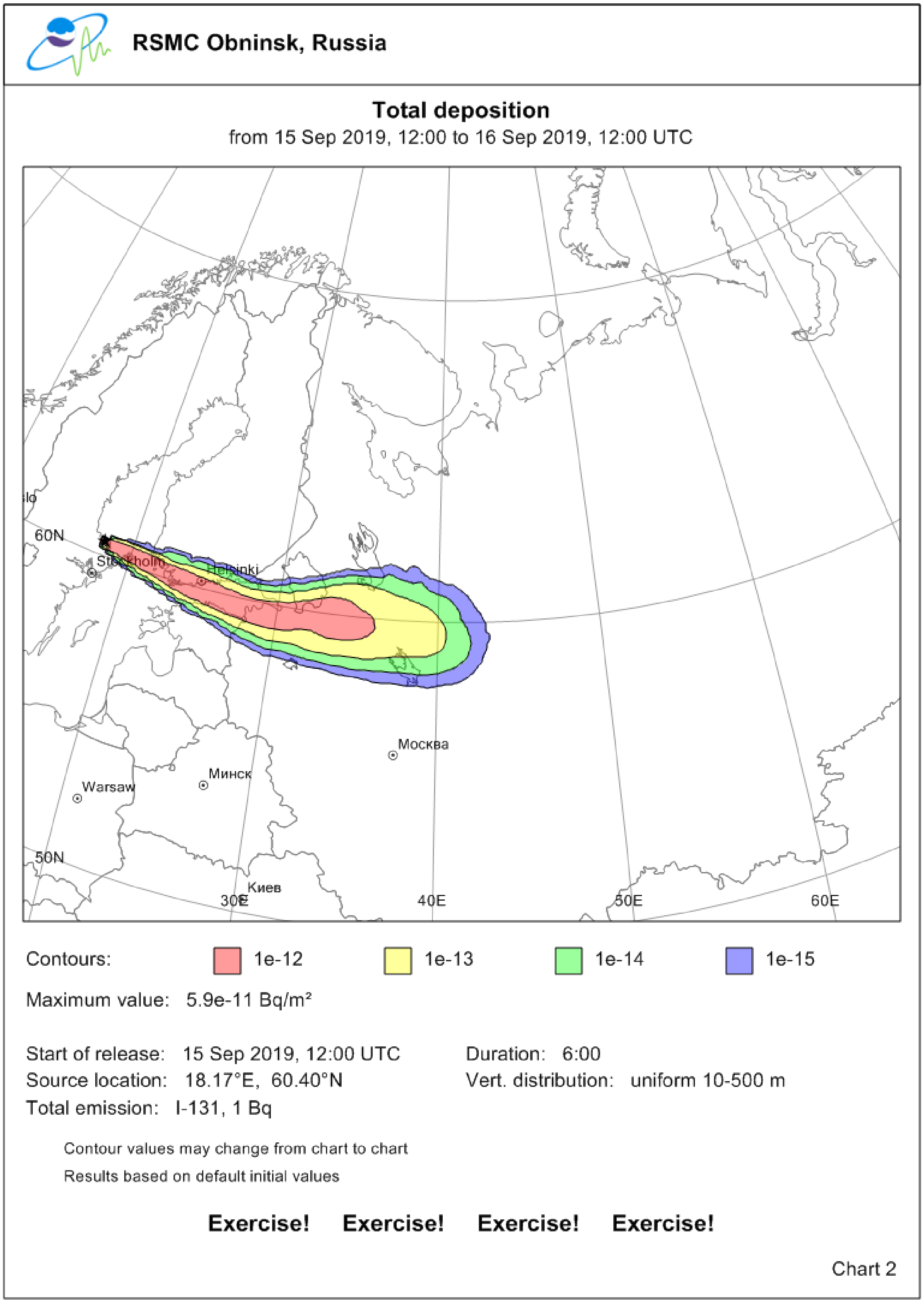


Figure 3. **24-hour total deposition forecast for a hypothetical accident**

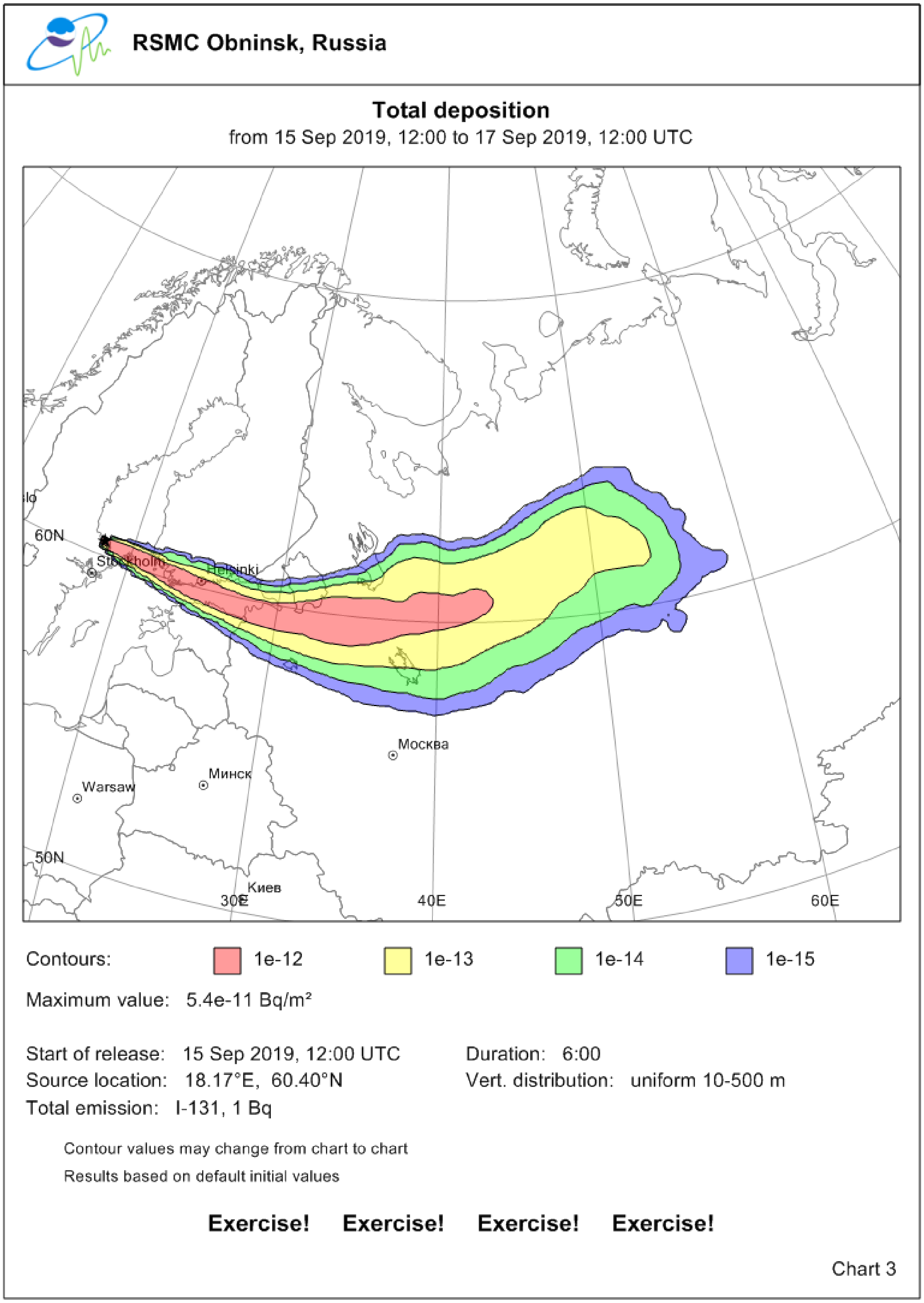


Figure 4. 48-hour total deposition forecast for a hypothetical accident

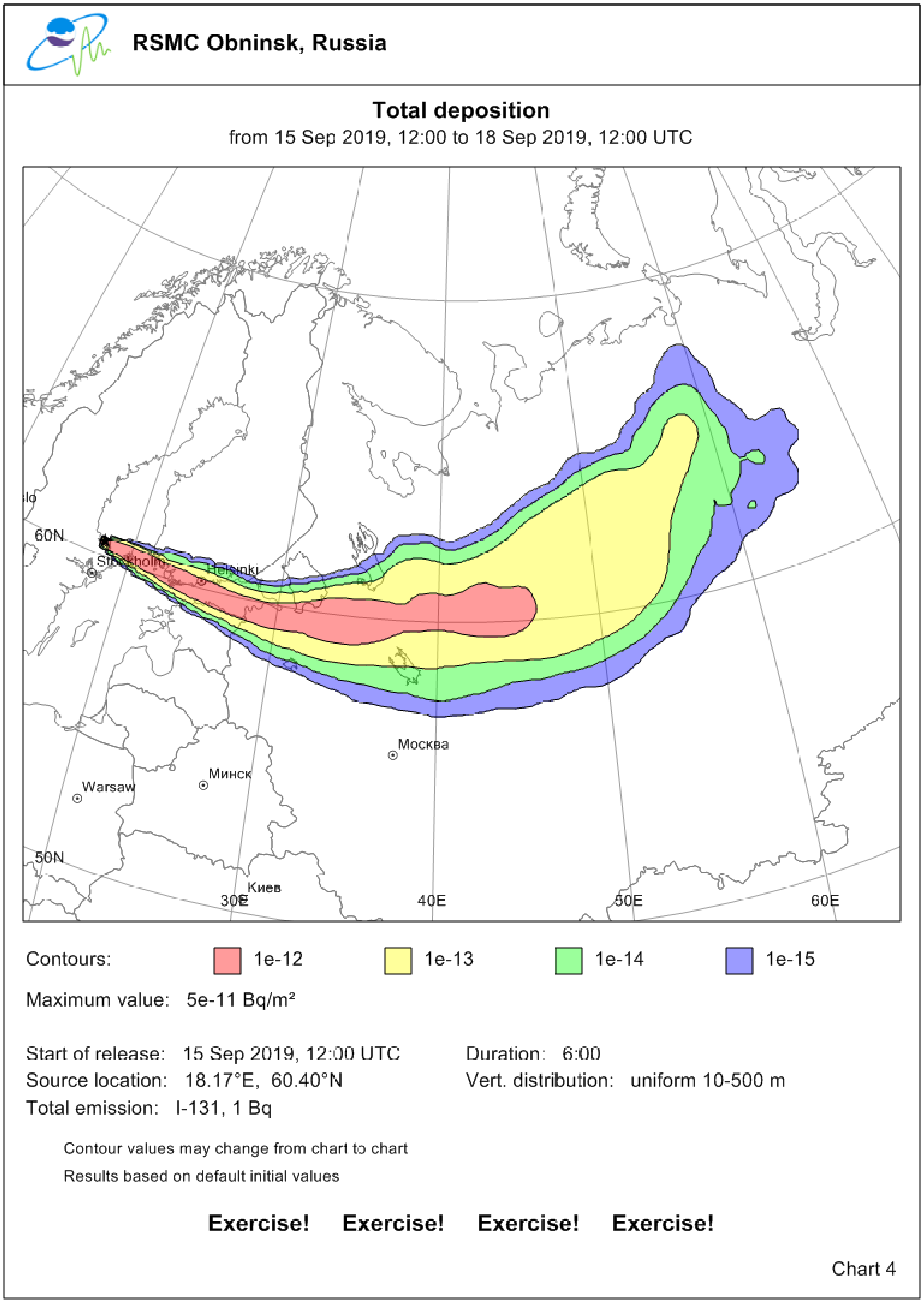
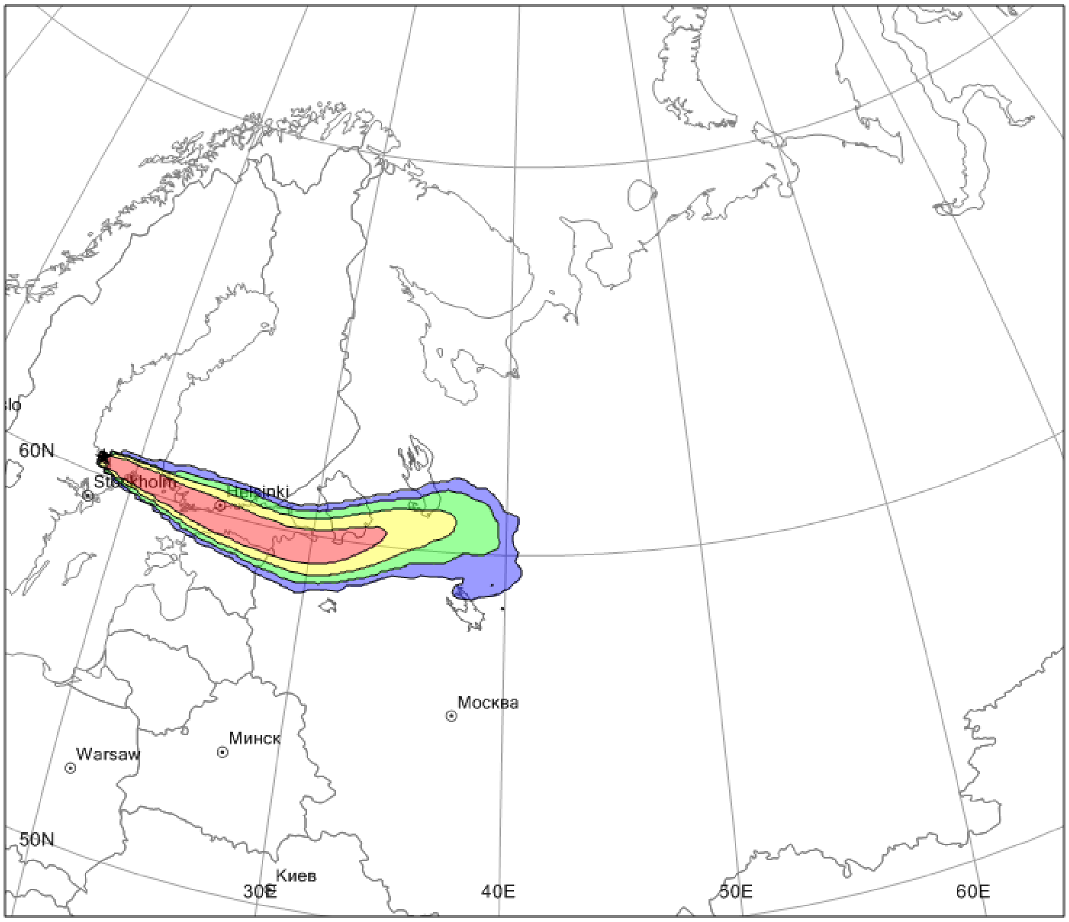


Figure 5. 72-hour total deposition forecast for a hypothetical accident

RSMC Obninsk, Russia

Time integrated surface to 500 m layer concentration

from 15 Sep 2019, 12:00 to 16 Sep 2019, 12:00 UTC



Contours: 1e-10 1e-11 1e-12 1e-13

Maximum value: 7e-09 Bq*s/m³

Start of release: 15 Sep 2019, 12:00 UTC
Duration: 6:00
Source location: 18.17°E, 60.40°N
Vert. distribution: uniform 10-500 m
Total emission: I-131, 1 Bq

Contour values may change from chart to chart
Results based on default initial values

Exercise! Exercise! Exercise! Exercise!

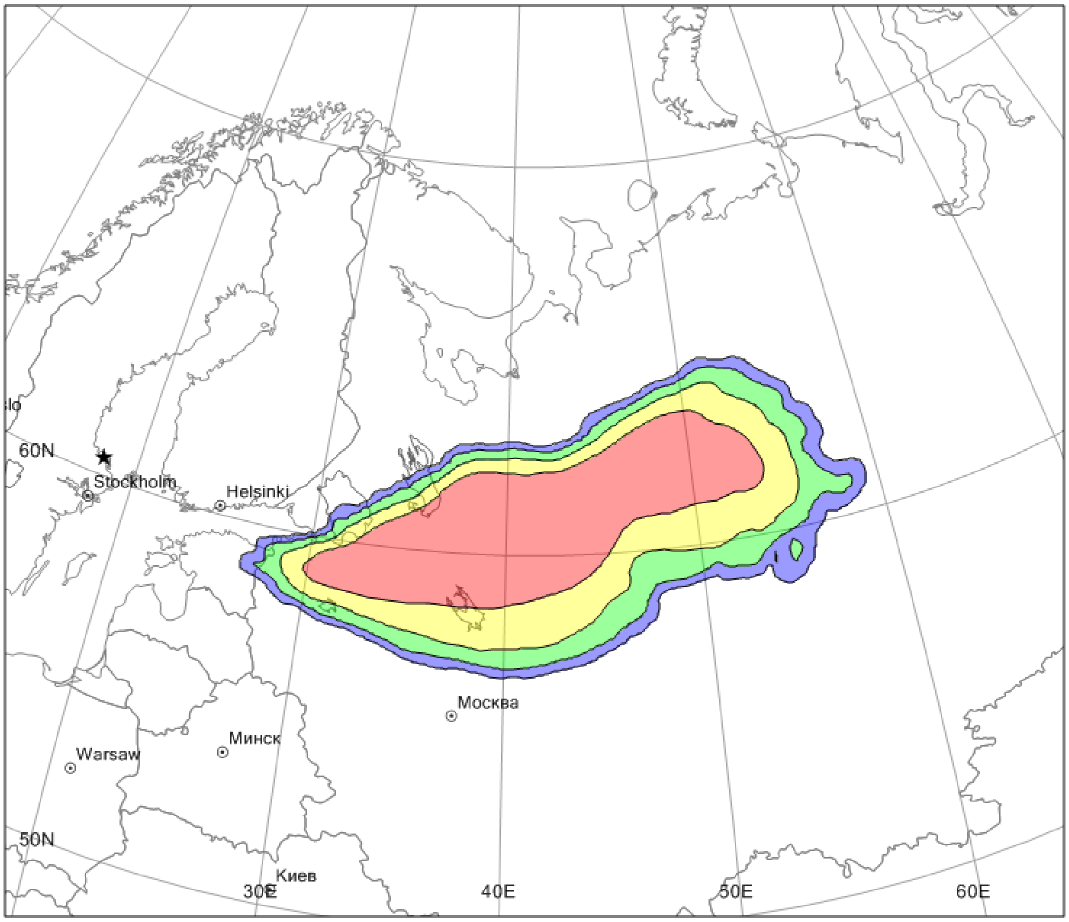
Chart 5

Figure 6. First 24-hour average exposure forecast for a hypothetical accident

RSMC Obninsk, Russia

Time integrated surface to 500 m layer concentration

from 16 Sep 2019, 12:00 to 17 Sep 2019, 12:00 UTC



Contours: 1e-11 1e-12 1e-13 1e-14

Maximum value: 2e-10 Bq*s/m³

Start of release: 15 Sep 2019, 12:00 UTC

Duration: 6:00

Source location: 18.17°E, 60.40°N

Vert. distribution: uniform 10-500 m

Total emission: I-131, 1 Bq

Contour values may change from chart to chart

Results based on default initial values

Exercise! Exercise! Exercise! Exercise!

Chart 6

Figure 7. Second 24-hour average exposure forecast for a hypothetical accident

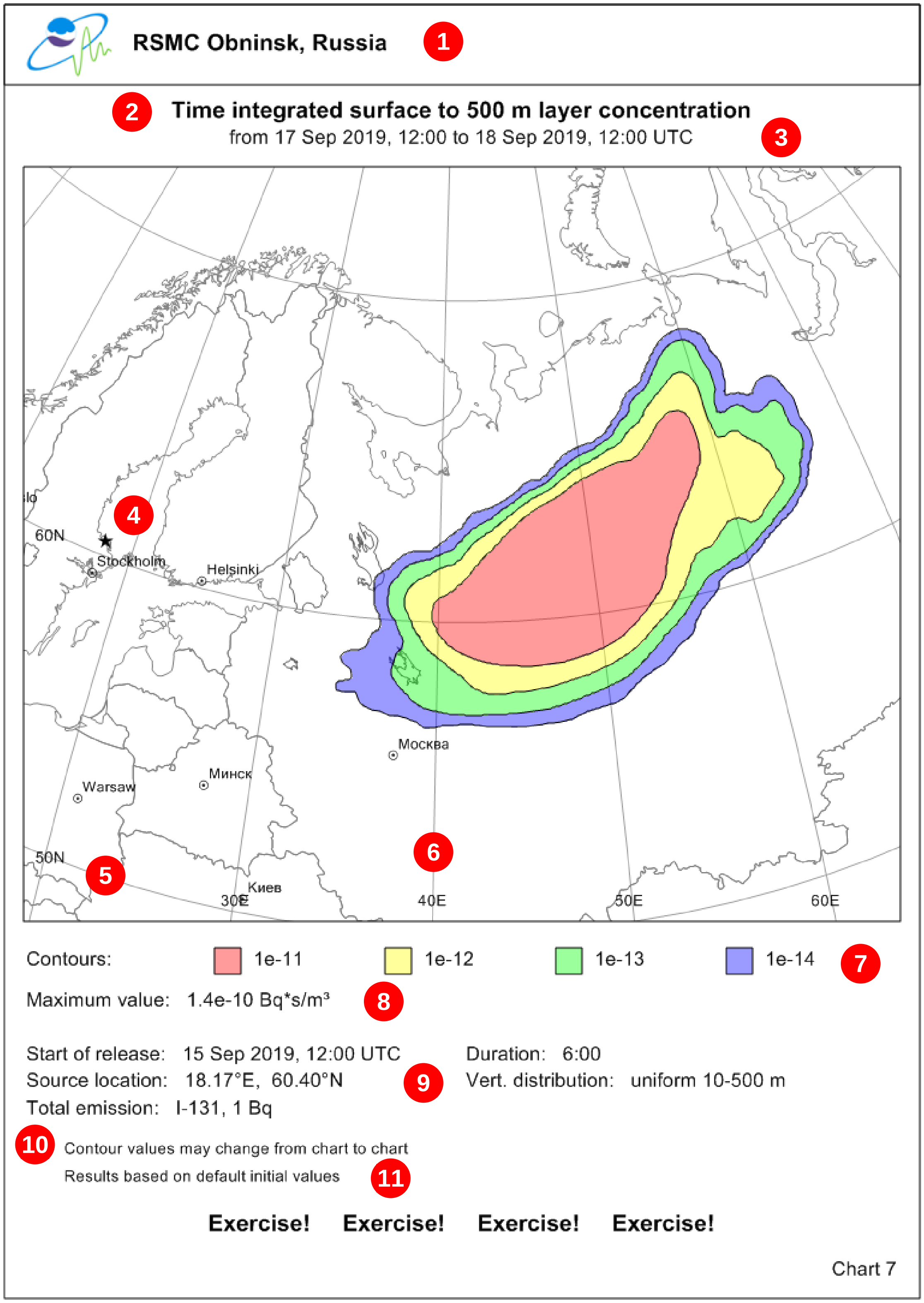


Figure 8. Third 24-hour average exposure forecast for a hypothetical accident. The red circled numbers are for reference in this document only and do not appear on the forecast products.