Accident in the Japanese NPP Fukushima: Large emissions of Cesium-137 and Iodine-131/Spread of Radioactivity/ weather currently favourable/low level radioactivity observed in Iceland (Update: 24 March 2011 16:00)

Weather in the crisis region

Currently, weak winds dominate in the crisis region. During the day, they turn from westerly into northerly directions. Air from the Fukushima plant is predominately transported to the Pacific.

Tomorrow, the weather situation will change. A disturbance crosses the region with heavy rain. The wind turns for a short period to northerly and easterly directions. Air from the reactors can thus be blown inland.

The day after tomorrow, north-westerly winds predominate. Air from Fukushima will thus be transported to the Pacific.

Emission estimates based on CTBTO data

Due to the numerous highly accurate radionuclide data (24-hour air samples) available to us from the world-wide network of the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) in Vienna, we can now estimate the source strengths of Iodine-131 and Cesium-137 for the first few days of the accident. The measurement accuracy of the network amounts to about 10 μBqm^{-3} for both isotopes.

During the first two days, March 12 and 13, the Fukushima emissions were mostly transported to the Pacific, eventually hitting the CTBTO station in Sacramento/California on March 17 (see Figure below). The maximum measurement there was 14000 μBqm^{-3} of Iodine-131 on March 18. Based on our plume dispersion model simulations, we estimated the source strengths of Caesium and Iodine needed to explain these readings. They amounted to 1.3 10^{17} Bq and 5 10^{15} Bq per day, respectively.

On March 14, the wind changed its direction. Consequently, emissions were transported inland, hitting the CTBTO station in Takasaki, Japan (see Figure below). The measurements on March 15 at this station showed Iodine-131 activity concentrations of 1.5 10^{7} μBqm^{-3} (24 hours), exceeding the readings from California by a factor of 1000. Based on our plume model simulations, we now estimated the source strengths of Caesium and Iodine needed to explain the readings at Takasaki. They amounted to 1.2 10^{17} Bq and 4 10^{16} Bq per day, respectively. So, while the emission estimates for Iodine are very consistent, those for Cesium-137 showed some day-to-day variability.

On March 15 and 16, most of the material from Fukushima was transported to the Pacific, where it faded away before causing major detections at CTBTO stations. Therefore, we cannot make reliable source estimates for those two days without in-depth analysis.

During the reactor accident in Chernobyl in 1986, the total releases of Iodine-131 and Cesium-137 (whole accident scenario) were 1.76 10^{18} Bq and 8.5 10^{16} Bq, respectively. The three day emissions from Fukushima of Iodine-131 would be about 20% of the total Chernobyl emissions, while those of Cesium-137 would be between 20 and 60% of the total Chernobyl emissions, depending whether one believes in the different Iodine to Caesium ratio measured in Japan.

ZAMG also estimated the effective dose rates that would follow from its emission estimates. In the highest contaminated grid cell of the model, namely the grid cell where the power plant is situated, the dose rates would be between 1 and 5 Micro Sievert per hour. This is well in line with data made available by the International Atomic Energy Agency (IAEA) in Vienna.

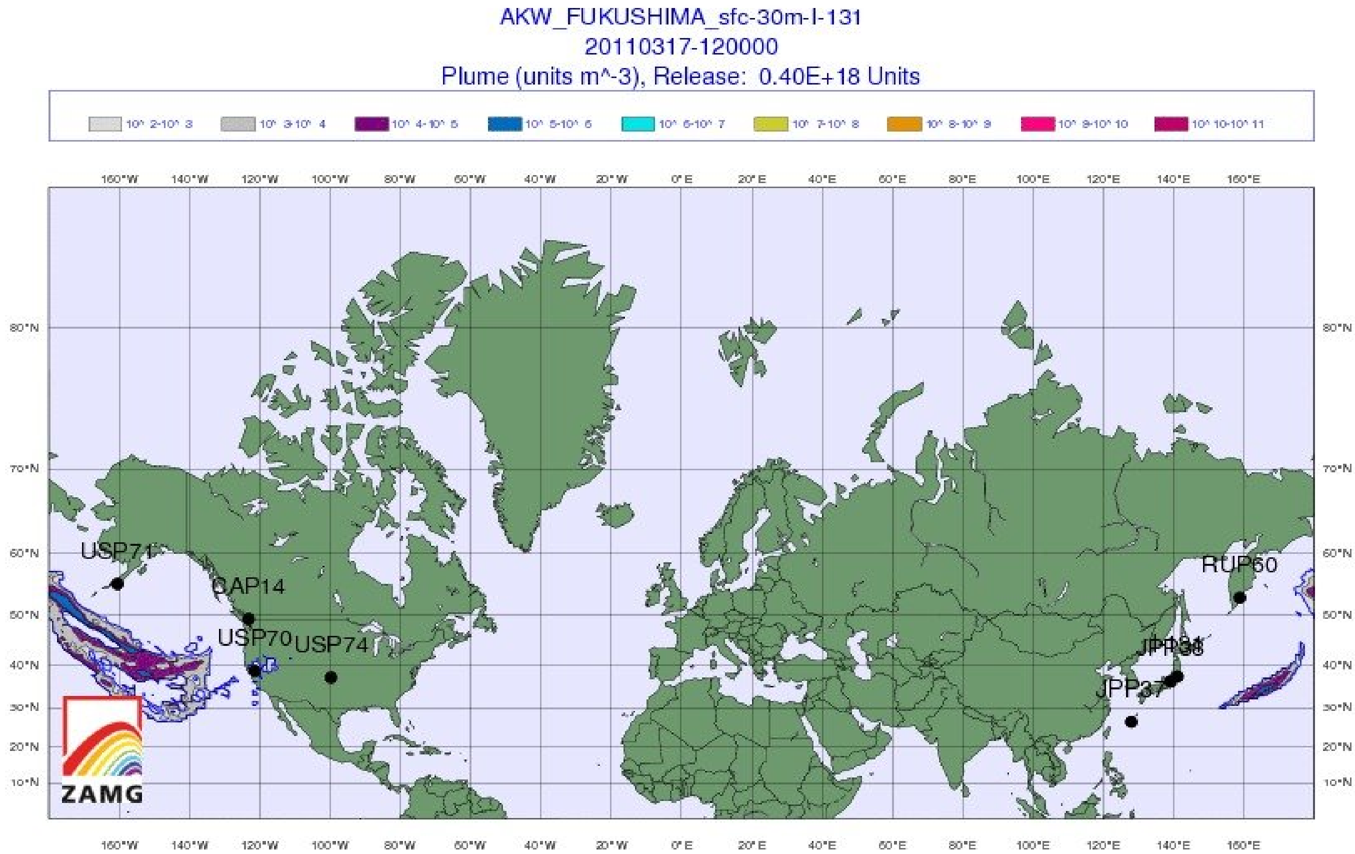

Figure: Iodine-131 from the Reactor in Fukushima reached the U.S. West Coast on March 17.

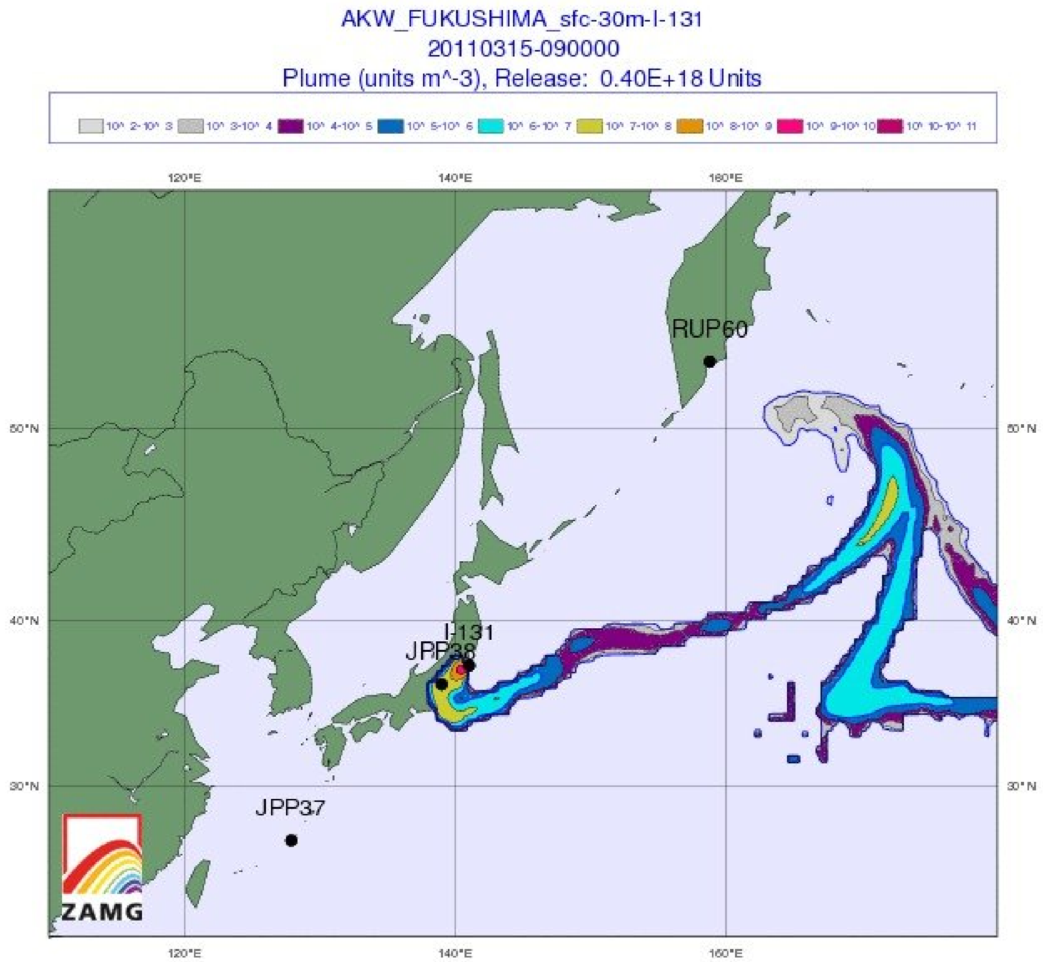

Figure: On March 15, the radioactive cloud from Fukushima reactor was transported inland, hitting the CTBTO station in Takasaki.

Dispersion Modeling

The results of the dispersion model show that radioactivity is transported mostly to the Pacific today. Tomorrow, the cloud would be transported more inland. The day after tomorrow, the cloud is transported to the Pacific Ocean.

The colour scale shows a total of 5 colours. The area marked „E“shows an area with estimated current equivalent dose rate of 10 mSv/h (in a 25x25 km^2 square). The violet colour on the outer edge of contaminated areas (Area A) represents 0,3 µSv/h, which corresponds to the amount of the natural background radiation dose.

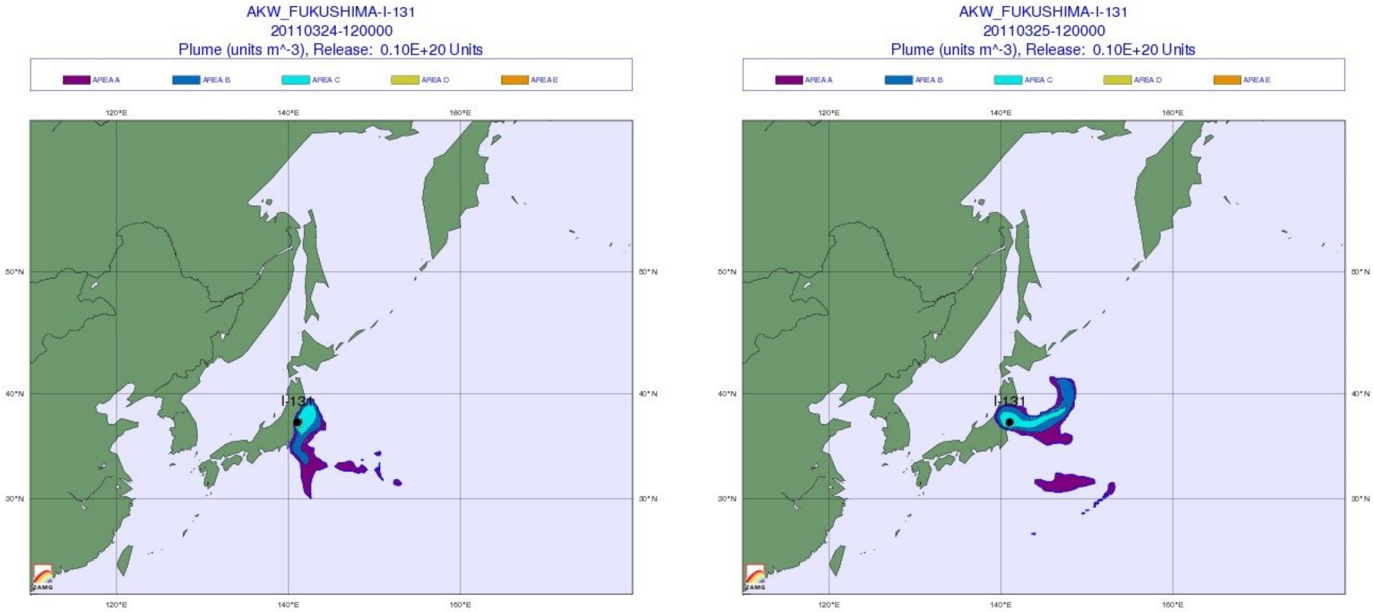

Figure: Spread of Radioactivity over Eastern Asia today and tomorrow 12:00 UTC

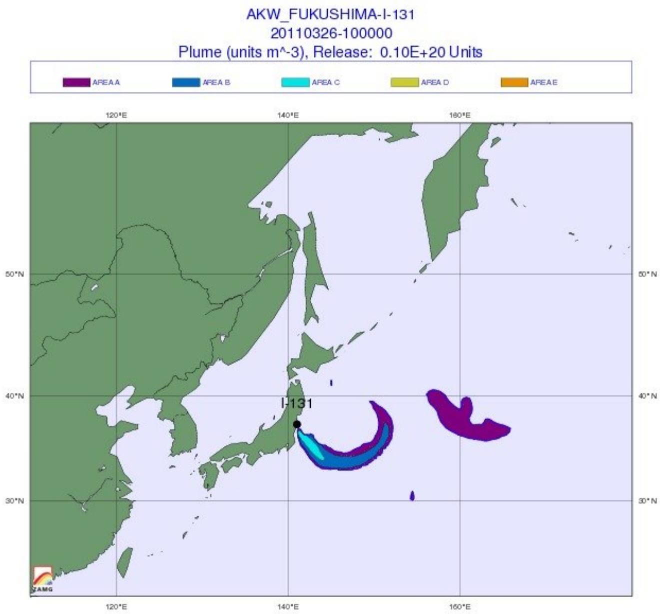

Figure: Spread of Radioactivity over Eastern Asia the day after tomorrow 12:00 UTC

Radiation data/CTBTO: What can we measure with modern technology?

The current CTBTO radioactivity data (status today, data from March 21) sow extremely low concentrations of Iodine-131 over Iceland. Other isotopes were not measured there. The Iodine-131 activity concentrations were about 10 µBqm-3, which translates into an effective dose rate of about 10^{-6} (one in a million) Nano-Sievert per hour. This is hundred million times less the natural radioactivity exposure in Austria. In other words, one needs to be exposed about 10000 years to this radioactivity level to get the same dose as the natural exposition of one single hour.

There are currently no CTBTO data showing Iodine and/or Caesium in Central Europe. The measurement of these tiny traces of radioactivity with the usually applied means, for example the total dose measurement devices, is impossible.

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ZAMG will not answer any questions related to travel in Japan or in other parts of the world, since this is the responsibility of national radiation protection authorities. Travel advisories and warnings are available from your foreign ministry. In Austria, such advisories are available on www.bmeia.gv.at.

This information is updated daily, and whenever the development of the situation requires it.

Videos:

Plume spread from Fukushima/Permanent Release/Iodine-131