



TerraSAR-X image of the month – Lively winter view

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Ice and snow can be colourful – at least when seen through the 'eyes' of the German Aerospace Center's (Deutsches Zentrum für Luft- und Raumfahrt - DLR) TerraSAR-X radar satellite. The radar signals are able to penetrate the snow cover to a depth of one metre – and the subsurface reflects the pulse in different ways. This makes the frozen delta of the Mackenzie River in Canada appear multi-coloured in an image revealing the various structures in the landscape underneath the snow.

From the Great Slave Lake to the Arctic Ocean, the Mackenzie River snakes its way for 1900 kilometres through the Northwest Territories of Canada. During the few ice-free months of the year, the river flows gently through the flat landscape. But when the Arctic winter arrives, everything comes to a standstill – on the surface at least. The polar night would make it impossible for an optical satellite to image the ice world of the Mackenzie River; even when the scant daylight permits a view of it, the entire landscape appears uniformly white in optical images. But the TerraSAR-X satellite image from 31 January 2012 depicts the landscape in violet, blue and green. "The radar signals penetrate the dry snow and are then reflected back in very different ways," explains Thomas Busche from the DLR Microwaves and Radar Institute.

Appearing as a grey-green surface in the image, the structure of the vegetation in the barren tundra, which consists of grass and dwarf shrubs, contrasts clearly with the frozen river. River islands, which are only sparsely vegetated, also show signs of sand and gravel bars or dunes – the bright violet colouring in the radar image makes this subsurface clear. From its orbit 514 kilometres above the Earth, TerraSAR-X can even observe variations in the roughness of the ice – surfaces that are actually white display numerous shades of colour in the radar image. Deep-frozen lakes and pools to the left and right of the river look like shimmering violet mirrors, because ice on standing water is especially flat and reflects the majority of the radar signals back to the satellite's receiver. In contrast, the frozen Mackenzie River, with its irregular ice layer, reflects radiation back quite differently and appears blue in the radar image. This landscape contains what is referred to as hummock ice and smallish ice floes that have been pushed onto and against one another. The numerous corners and edges reflect the radar signals back to the satellite particularly well. Ice surfaces that were particularly heavily distorted during their formation are visible in shades of yellow. The depth of the lakes and thickness of the ice layer also play a part in this colourful winter landscape – shallow lakes that are frozen to the bottom are coloured differently to lakes that still have liquid water under their ice.

Even the few traces of humanity in this almost inaccessible region do not escape the 'eyes' of the radar; the bright, occasionally straight line on the bluish ice surface of the Mackenzie River could be the Tuktoyaktuk Winter Road. When the river freezes over in winter, its ice surface becomes a 'natural' access road. Large trucks drive along the winter road, connecting the Inuvik settlements along the south of the river with Tuktoyaktuk at the northern end of the Mackenzie River. This cross-country route is the only way to reach the Eskimo settlement during the winter months.

The colourful winter landscape serves a particular purpose for researchers, as they can use various images of the same region to track movement – when the river landscape freezes, when the ice sheet begins to break up again and when the thaw begins. The duration and intensity of this icy period are important indicators for climate research. "With TerraSAR-X, we can look underneath the snowy surface even during the polar night or through thick cloud cover – we have an instrument for environmental observation in these remote regions of the Arctic tundra," says Busche.

The TerraSAR-X mission

TerraSAR-X is the first German satellite manufactured under what is known as a Public-Private Partnership between the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt; DLR) and Astrium GmbH in Friedrichshafen. The satellite travels around the Earth in a polar orbit and records unique, high-quality X-band radar data about the entire planet using its active antenna. TerraSAR-X works regardless of weather conditions, cloud cover or the absence of daylight and is able to provide radar data with a resolution down to one metre.

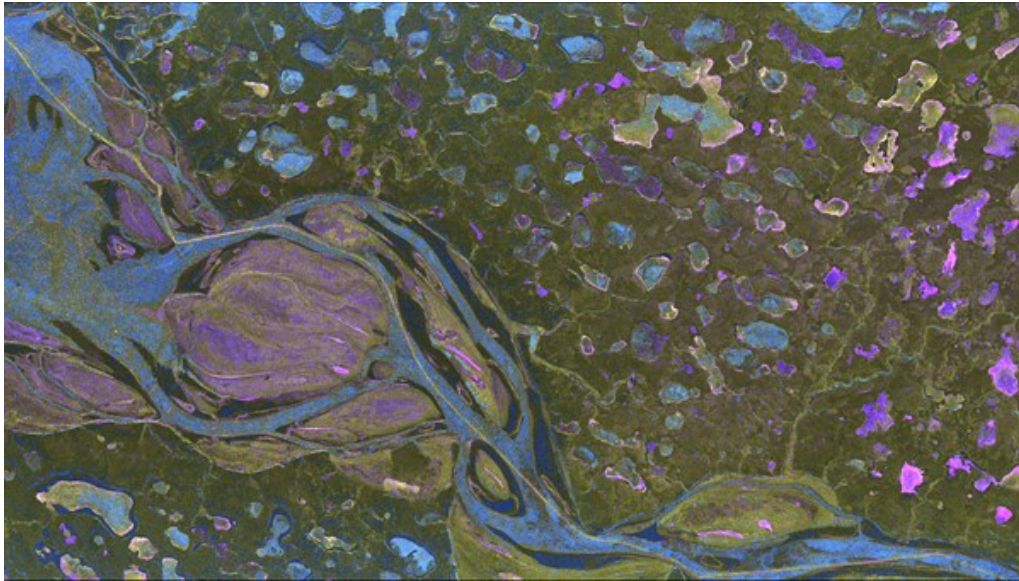
DLR is responsible for using TerraSAR-X data for scientific purposes. It is also responsible for planning and implementing the mission as well as controlling the satellite. Astrium built the satellite and shares the costs of developing and using it. Infoterra GmbH, a subsidiary company founded specifically for this purpose by Astrium, is responsible for marketing the data commercially.

Contacts

Manuela Braun
German Aerospace Center (DLR)
Media Relations, Space Research
Tel.: +49 2203 601-3882
Fax: +49 2203 601-3249
Manuela.Braun@dlr.de

Thomas Busche
German Aerospace Center (DLR)
DLR Microwaves and Radar Institute
Tel.: +49 8153 28-2193
Thomas.Busche@DLR.de

Radar view of the Mackenzie River



Radar signals from the TerraSAR-X satellite can penetrate the upper layers of snow and ice that cover the Mackenzie River in Canada. The shades of colour enable DLR researchers to draw conclusions about the ice formations and various subsurfaces.

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