Sentinel Vision
EVT-395
07 February 2019

2D Layerstack

Level fluctuations in Lake Poyang

Sentinel-1 CSAR IW acquired on **01 July 2018** at 10:18:04 UTC
Sentinel-3 SLSTR RBT acquired on **02 July 2018** from 01:54:50 to 01:57:50 UTC
...
Sentinel-3 OLCI FR acquired on **04 September 2018** from 02:35:53 to 02:38:53 UTC
Sentinel-1 CSAR IW acquired on **23 September 2018** at 10:18:08 UTC

Author(s): Sentinel Vision team, VisioTerra, France - svp@visioterra.fr

Keyword(s): hydrology, natural ressources, biodiversity, ramsar wetland, river, sand mining, alluvium, sediment, erosion, China

Fig. 1 - S1 (01.07.2018) - vv,vh,ndi(vh,vv) colour composite - Lake Poyang, already shrunk at the start of summer 2018. 2D view

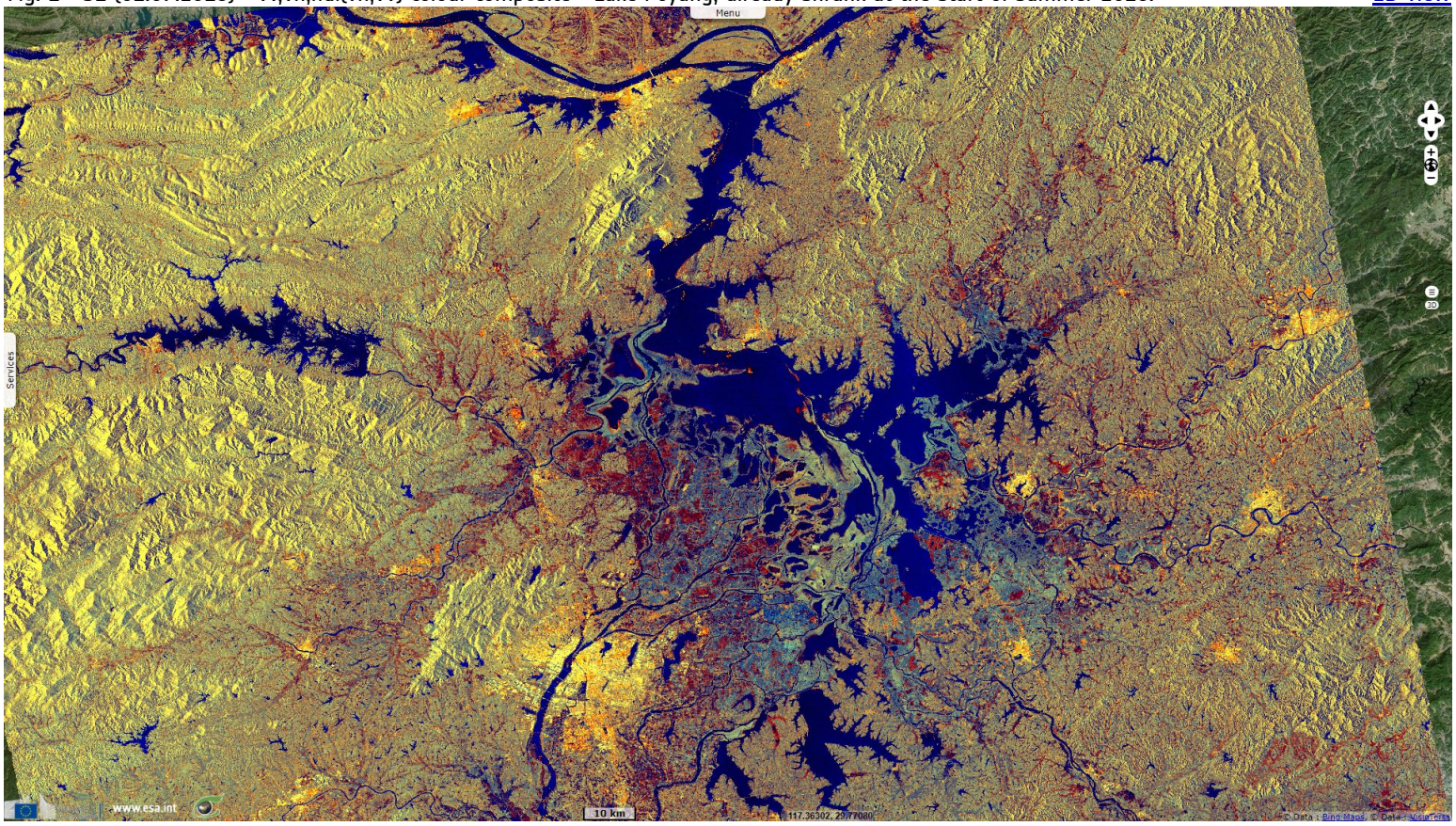
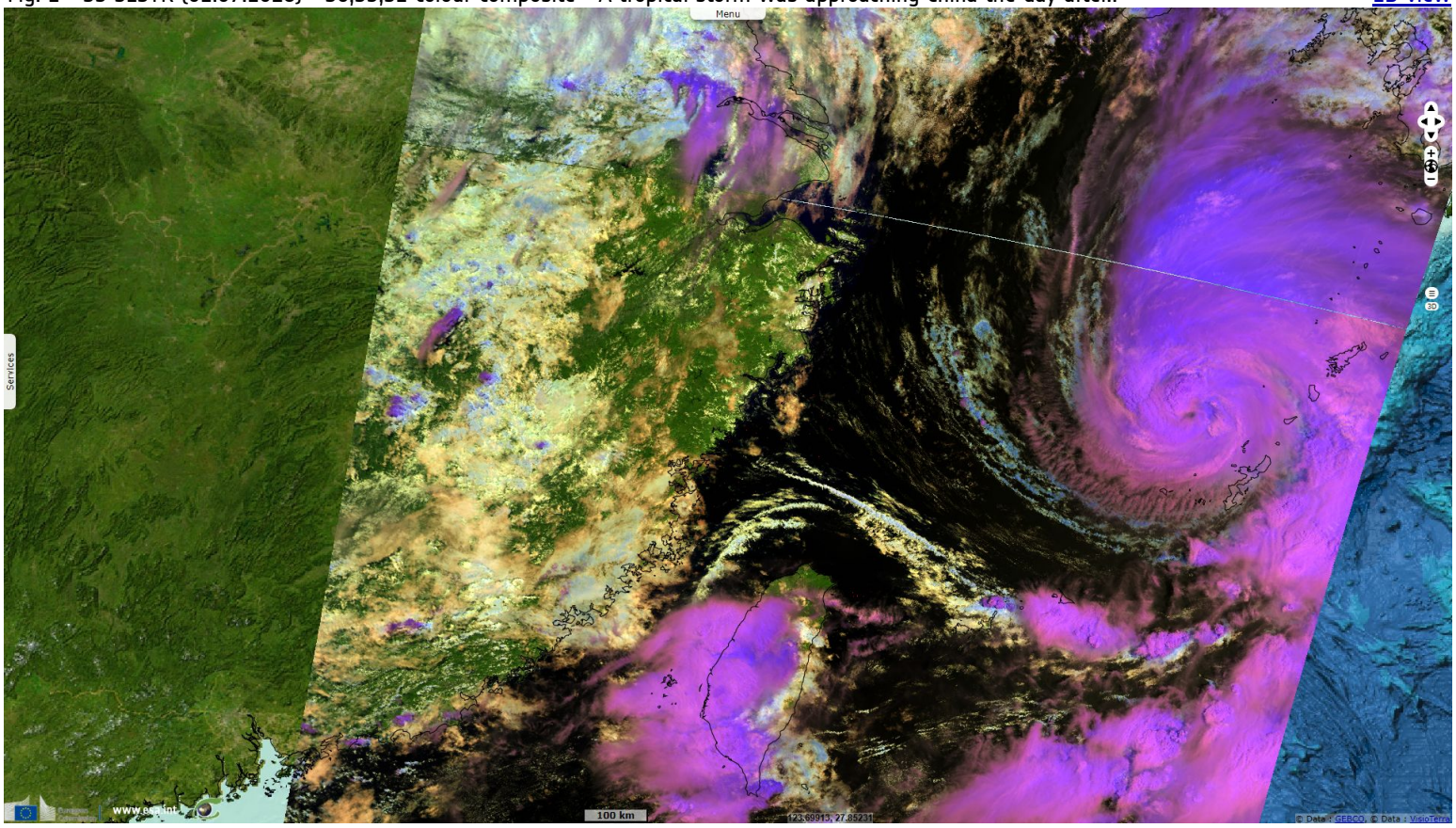


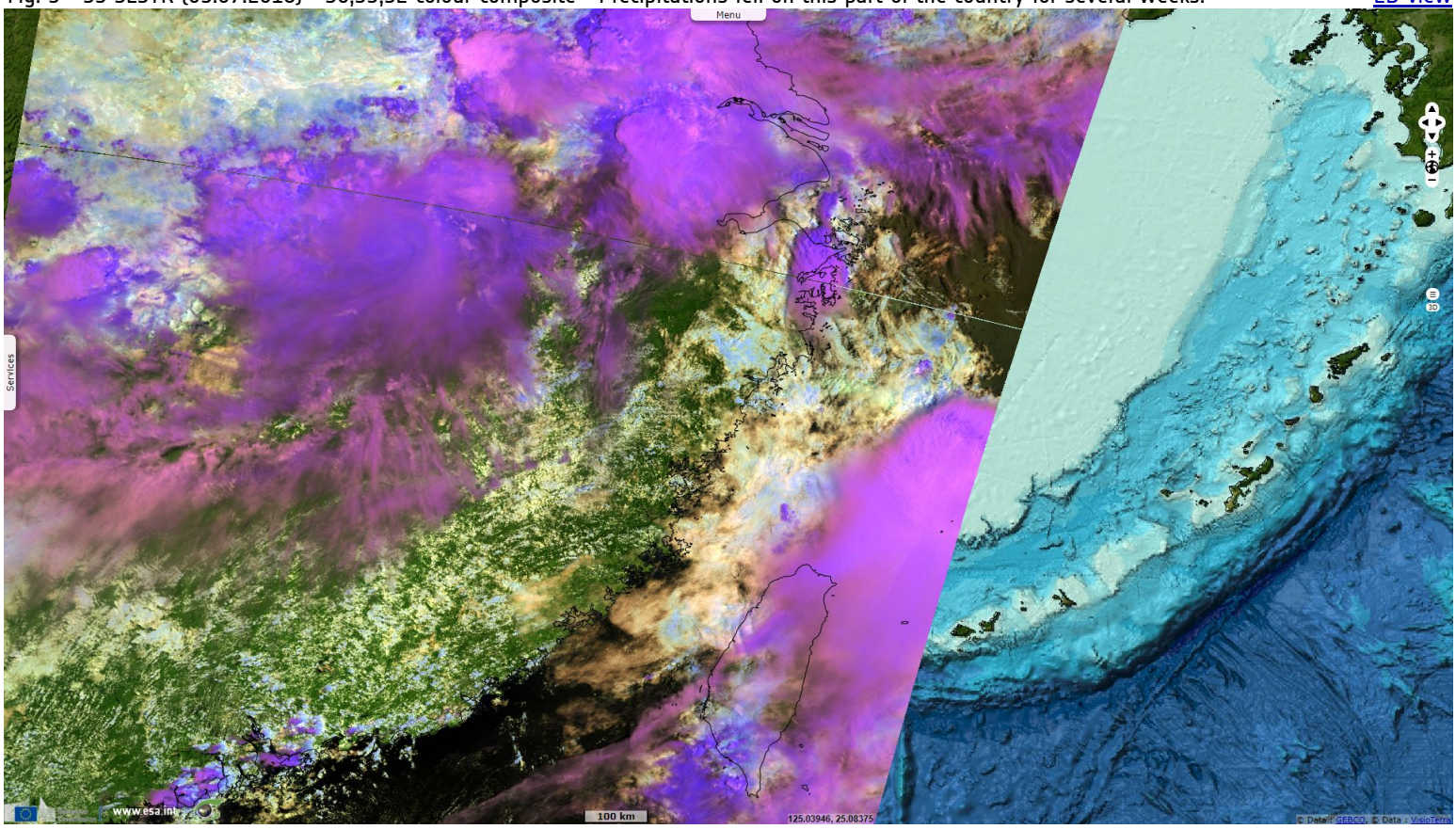
Fig. 2 - S3 SLSTR (02.07.2018) - S6,S5,S2 colour composite - A tropical storm was approaching China the day after.. 2D view



Poyang Lake is a large freshwater lake in China. Its catchment area reaches 160 000 km² while its size is subject to seasonal fluctuations usually variing between 4400 km² in the rainy season and 1000 km² in the dry season but it can sometimes almost completely dry up. According to its Ramsar sheet, it lies "*within a region of subtropical, deciduous broad-leaved and evergreen forest surrounded by marshes and wet grassland fed by five major rivers.*"

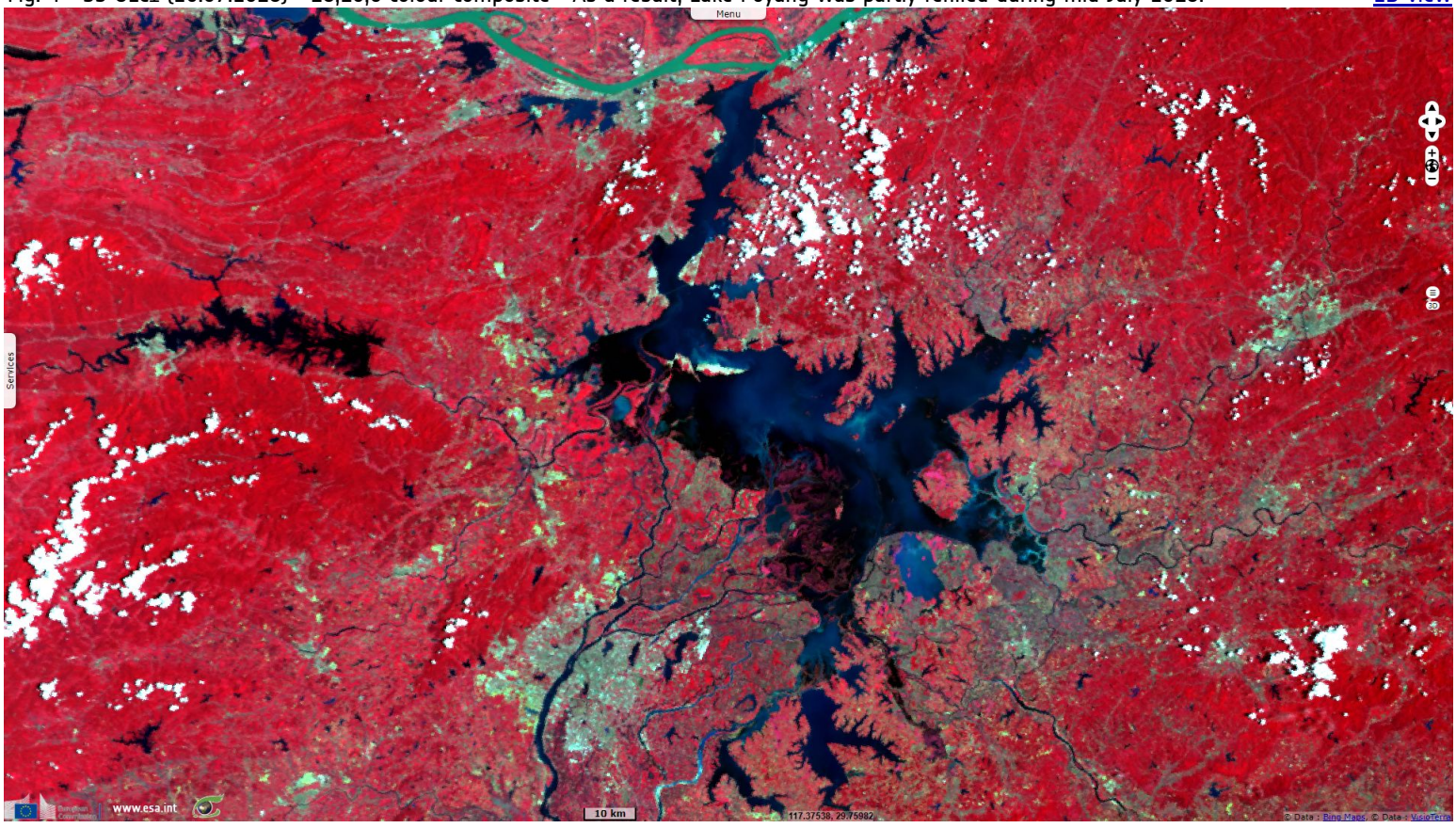
It is an important site for biodiversity: The lake supports numerous species of plankton, mollusc, 332 bird species (which of 54 red-list species, in particular White Cranes and Siberian Cranes), 124 waterfowls species (max. 500 000 individuals), 122 species of fish, 81 species of amphibians & reptiles and 45 species of mammals (among which the finless porpoise) and 600 species of plants, reports globalnature.org.

Fig. 3 - S3 SLSTR (05.07.2018) - S6,S5,S2 colour composite - Precipitations fell on this part of the country for several weeks. 2D view



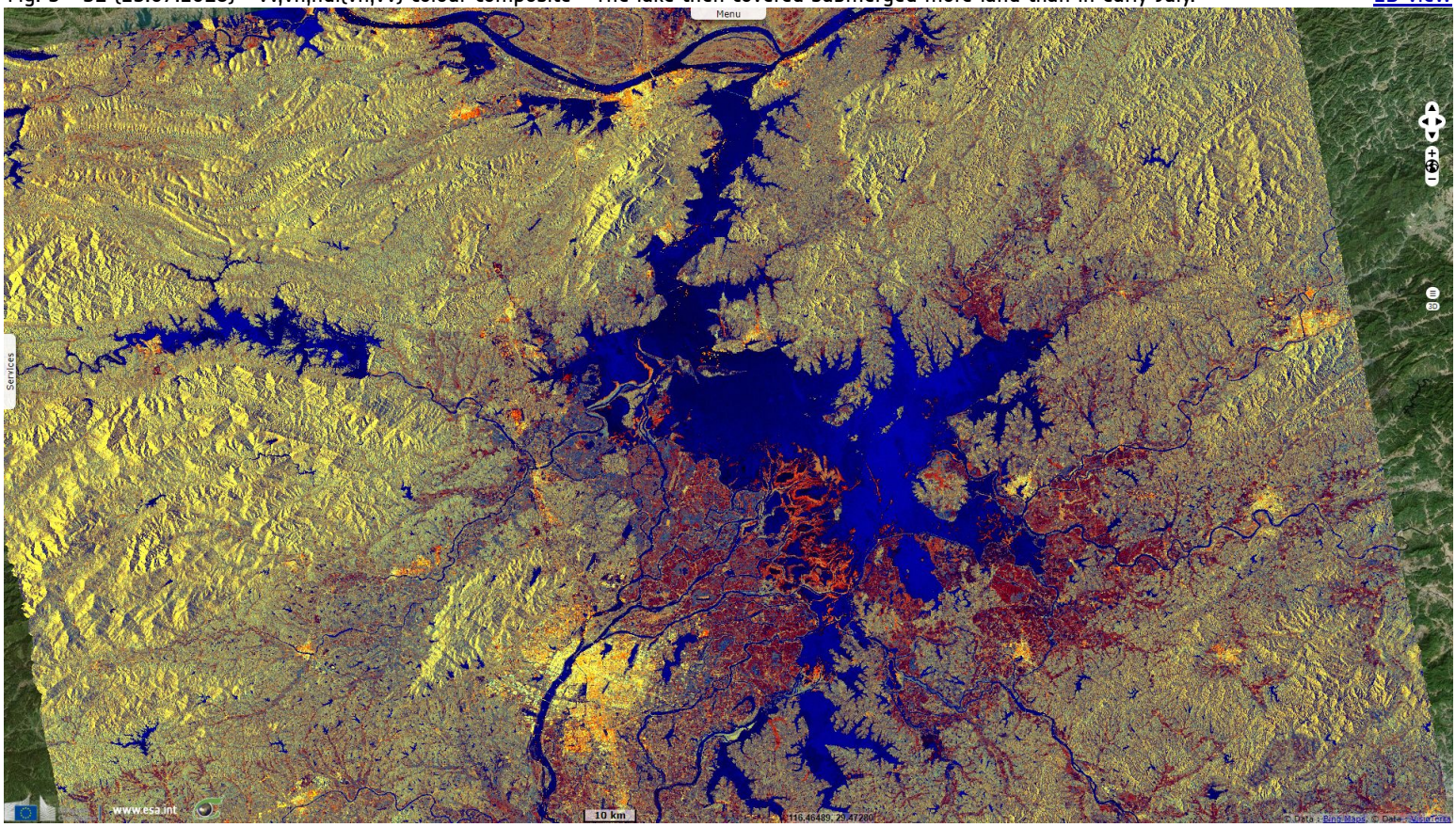
Poyang lake is used as the World's most important sand mine with 360 million tons dredged each year. Copernicus-funded site floodlist.com warns against the effects the coastal effects of sand mining: "*Combined with losses of soil-holding mangroves and accelerating groundwater extraction, which can lead to land sinking, the mining is increasing climate-related threats for those living in low-lying coastal areas.*"

Fig. 4 - S3 OLCI (20.07.2018) - 18,10,6 colour composite - As a result, Lake Poyang was partly refilled during mid July 2018. 2D view



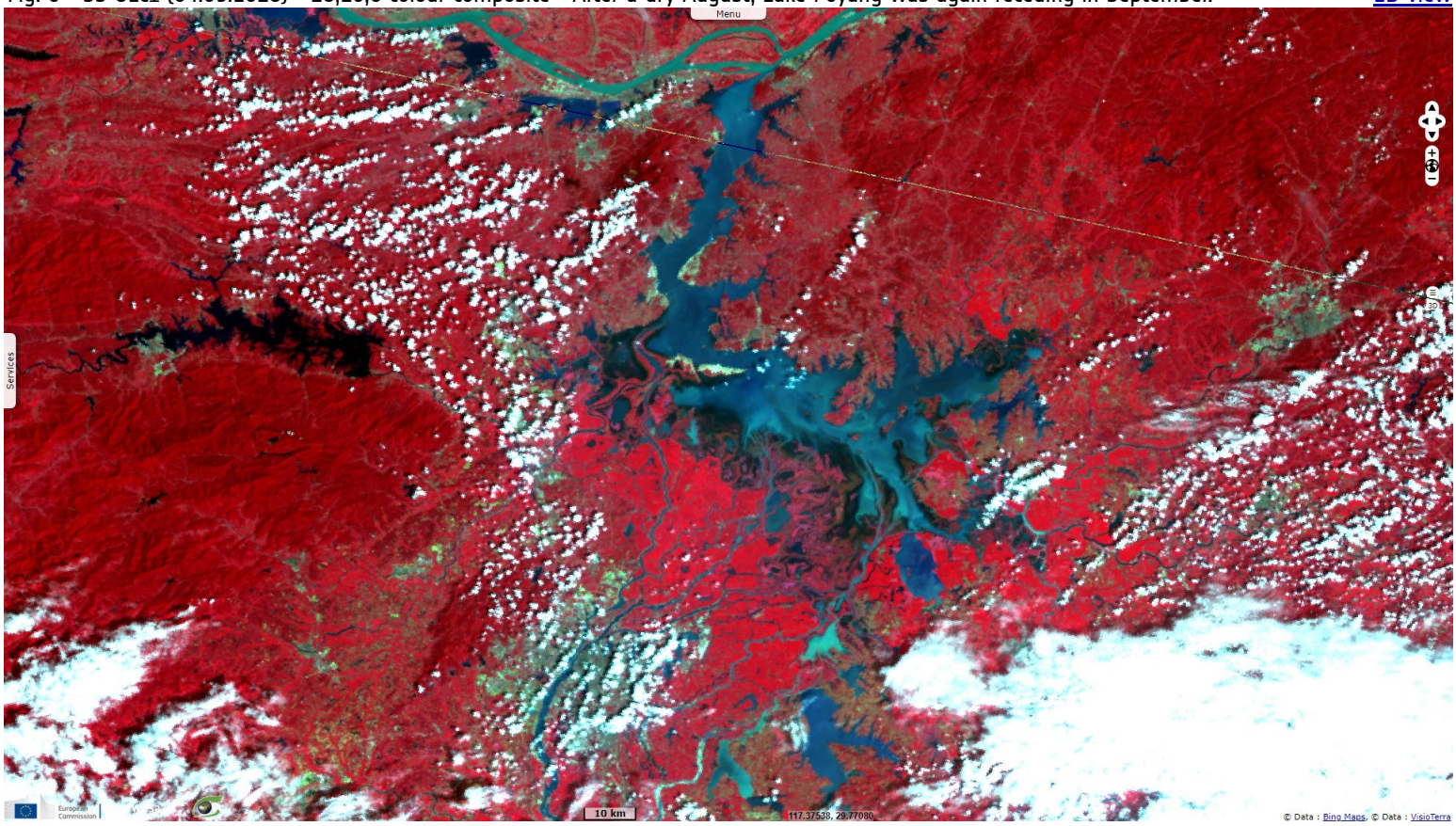
"*In some major rivers in Asia, such as the Mekong, Yangtze and Ganges-Brahmaputra-Meghna, as much as 90 percent of the sediment that once traveled down the system is now collecting in reservoirs or being mined, WWF's research showed. That means much less material is arriving in delta areas to replace soil lost to coastal erosion and other natural processes. For those living in the deltas, it can mean growing risk of floods, inundation from coastal storm surges and worsening salt contamination in drinking water.*"

Fig. 5 - S1 (25.07.2018) - vv,vh,ndi(vh,vv) colour composite - The lake then covered submerged more land than in early July. 2D view



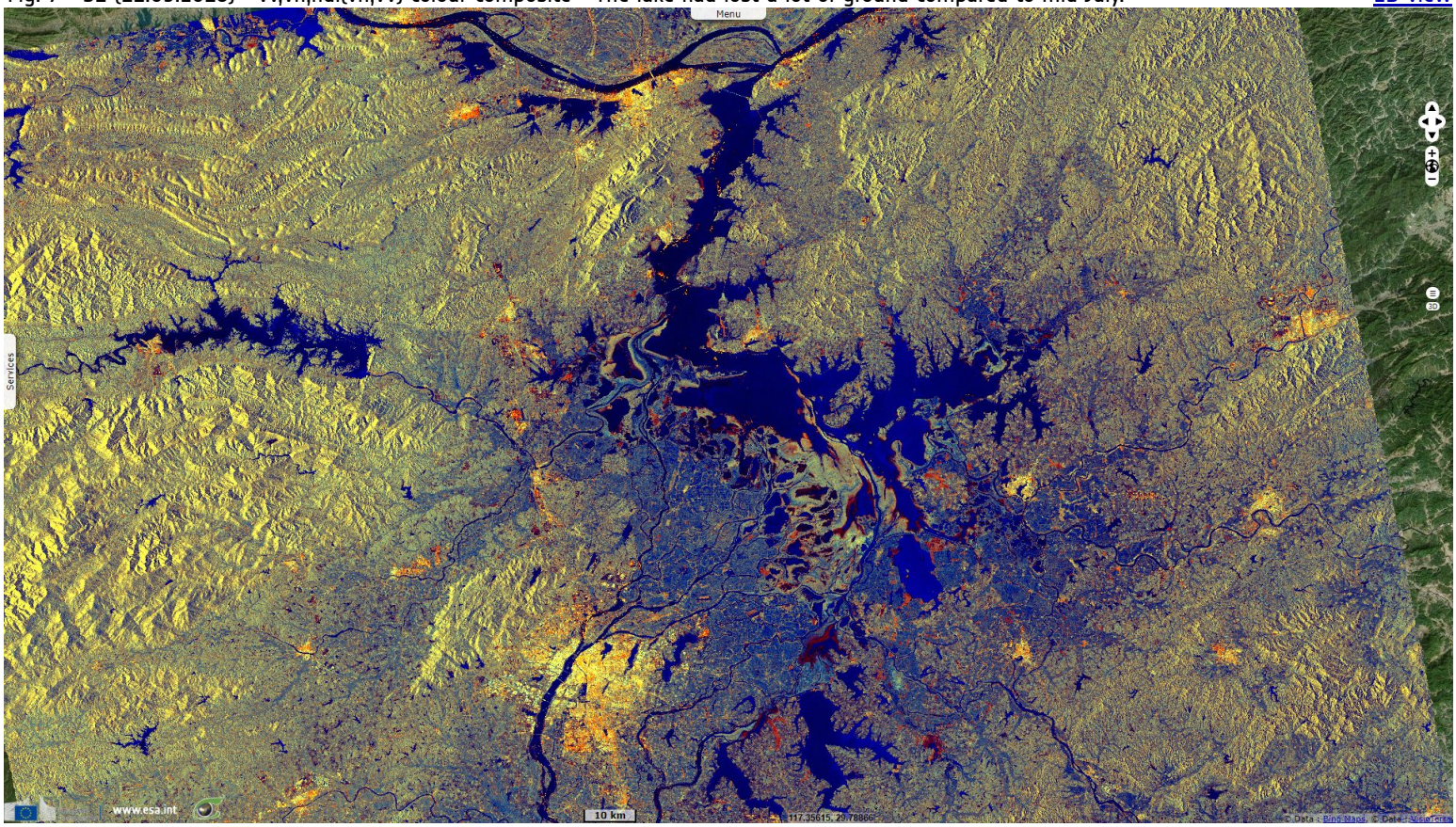
"*According to the U.N. Environment Programme, though record keeping is poor, global consumption of sand and gravel likely exceeded 40 billion tonnes in 2012, up from 9 billion tonnes in the 1970s, making it one of the world's most extracted resources by volume. 'To give a sense of its use, for every bucket of cement, five to seven buckets of sand are used in concrete. For every kilometre of road built, 30 000 tonnes of sand is used as its base,' Goichot said.*
But sand is just as important in the river systems it is harvested from, he said. 'Keeping sand in the rivers is the best adaptation to climate change. If a river delta receives enough sediment, it builds itself above sea level in a natural reaction,' Goichot, told the Thomson Reuters Foundation in an interview in Stockholm."

Fig. 6 - S3 OLCI (04.09.2018) - 18,10,6 colour composite - After a dry August, Lake Poyang was again receding in September. 2D view



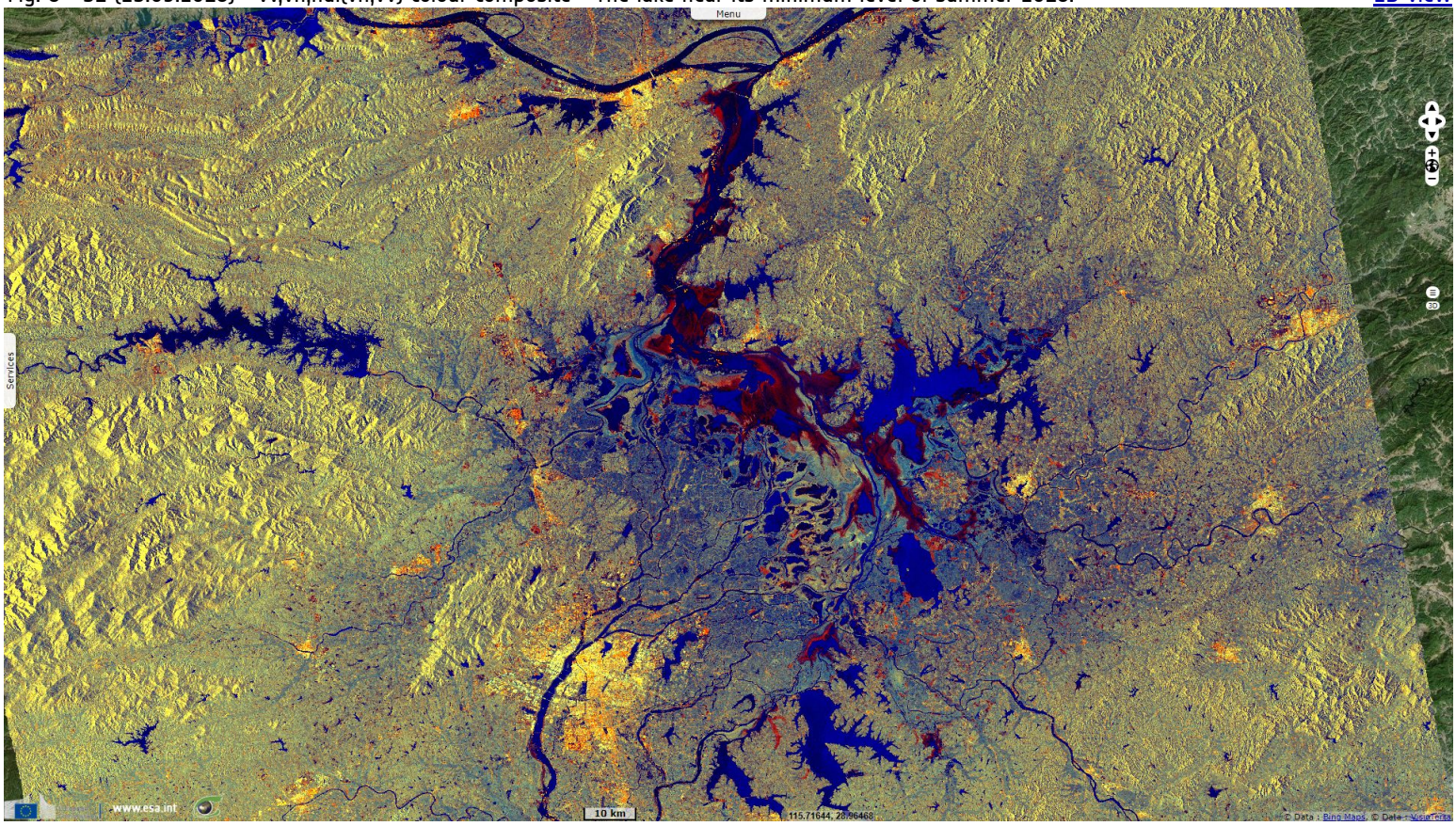
"*But sand mining also feeds Asia's rapidly growing cities. New buildings and roads require it and urban land is often expanded by pouring sand into wetlands or rice paddies.*" "*Sand mining remains unregulated in many areas, however, and illegal sand mining operations operate in as many as 70 countries worldwide, Goichot said.*"
"*River sand is preferred for construction in many cases because desert sand is too rounded to bind concrete well, while seabed sand contains salt that can corrode metal and dredging it can be costly. But too much harvesting of river sand is now taking a toll on those living downstream, Goichot said, with the Mekong delta, for instance, losing 12 metres of land along its coast each year, the equivalent of a football field and a half of land every day.*"

Fig. 7 - S1 (11.09.2018) - vv,vh,ndi(vh,vv) colour composite - The lake had lost a lot of ground compared to mid-July. 2D view



Zhang Kejia, senior reporter and editor with China Youth Daily also points out the danger of sand dredging on local biodiversity: "*On Poyang Lake, I witnessed the shocking effects of large-scale sand dredging, which is threatening the survival of the finless porpoise.*" "*Sand dredging has become a mainstay of local economic development in the last few years, and is an important source of fiscal revenue in the region that borders Poyang Lake. But at the same time, high-density dredging projects have been the principal cause of the death of the local wildlife population.*"

Fig. 8 - S1 (23.09.2018) - vv,vh,ndi(vh,vv) colour composite - The lake near its minimum level of summer 2018. 2D view

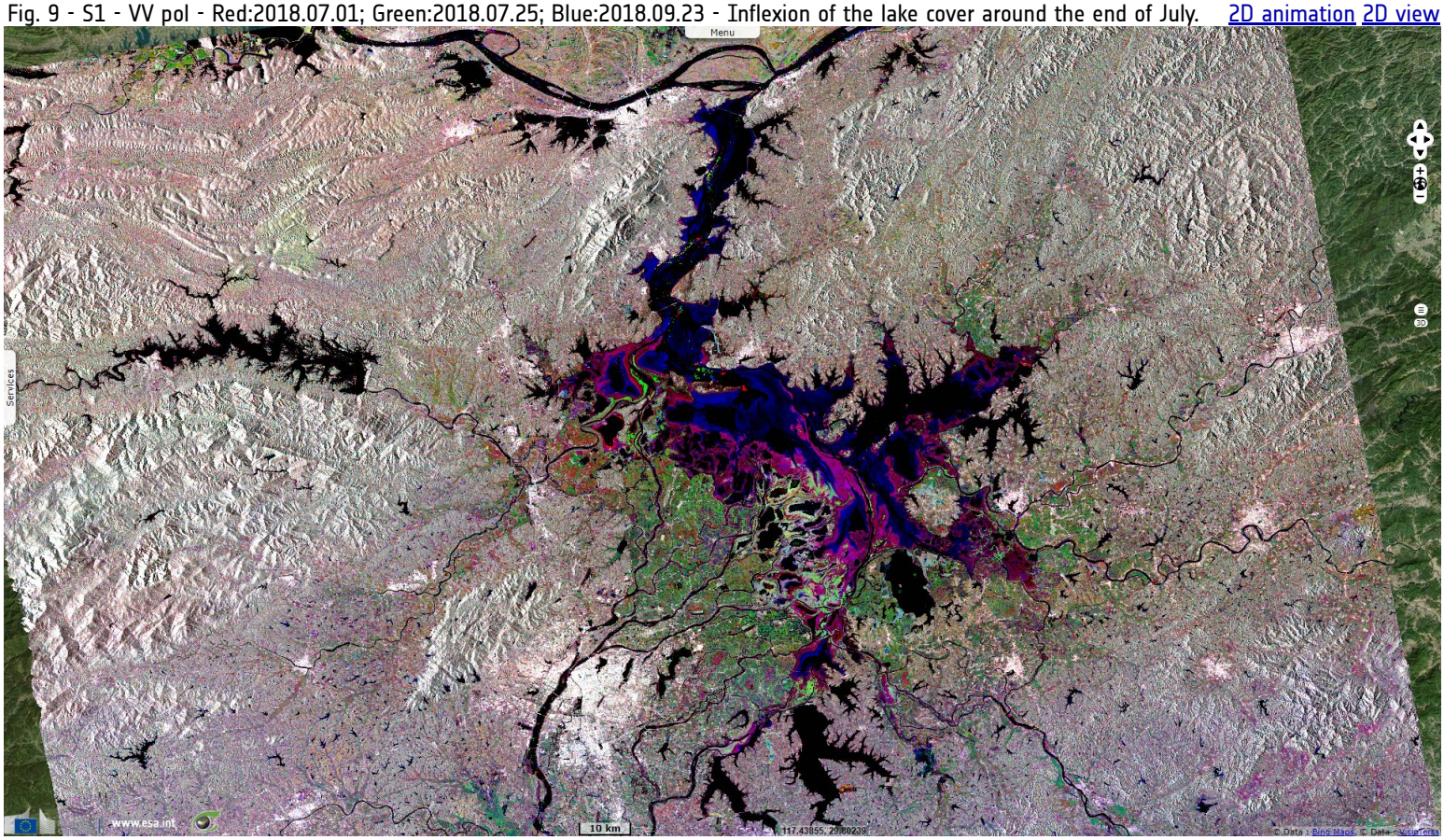


On May 28, 2011, fishing boats on the exposed bed of Poyang Lake - Source.

Zhang Kejia goes further: "*Dr Wang Kexiong, head of the survey team, told me that on a normal day there are countless thousand-tonne dredgers and transport ships on the lake. The dredgers are arranged in a line in the centre of the lake. With the tall cranes and other machinery on the ships towering over each other, the scene resembles a bustling urban construction site.*

In the lake's muddy waters, the porpoises cannot see as far as they once could, and have to rely on their highly-developed sonar systems to avoid obstacles and look for food. 'One large ship passes through the mouth of Poyang Lake every 30 seconds,' said Wang Kexiong. 'With such a high density of shipping, the porpoises cannot swim freely from one bank to another. They don't even have a chance to come up for air or hunt for food.' Moreover, with the massive amount of noise from ships transporting sand interfering with their sonar systems, it is even harder for the porpoises to locate fish to eat."

Fig. 9 - S1 - VV pol - Red:2018.07.01; Green:2018.07.25; Blue:2018.09.23 - Inflexion of the lake cover around the end of July. 2D animation 2D view



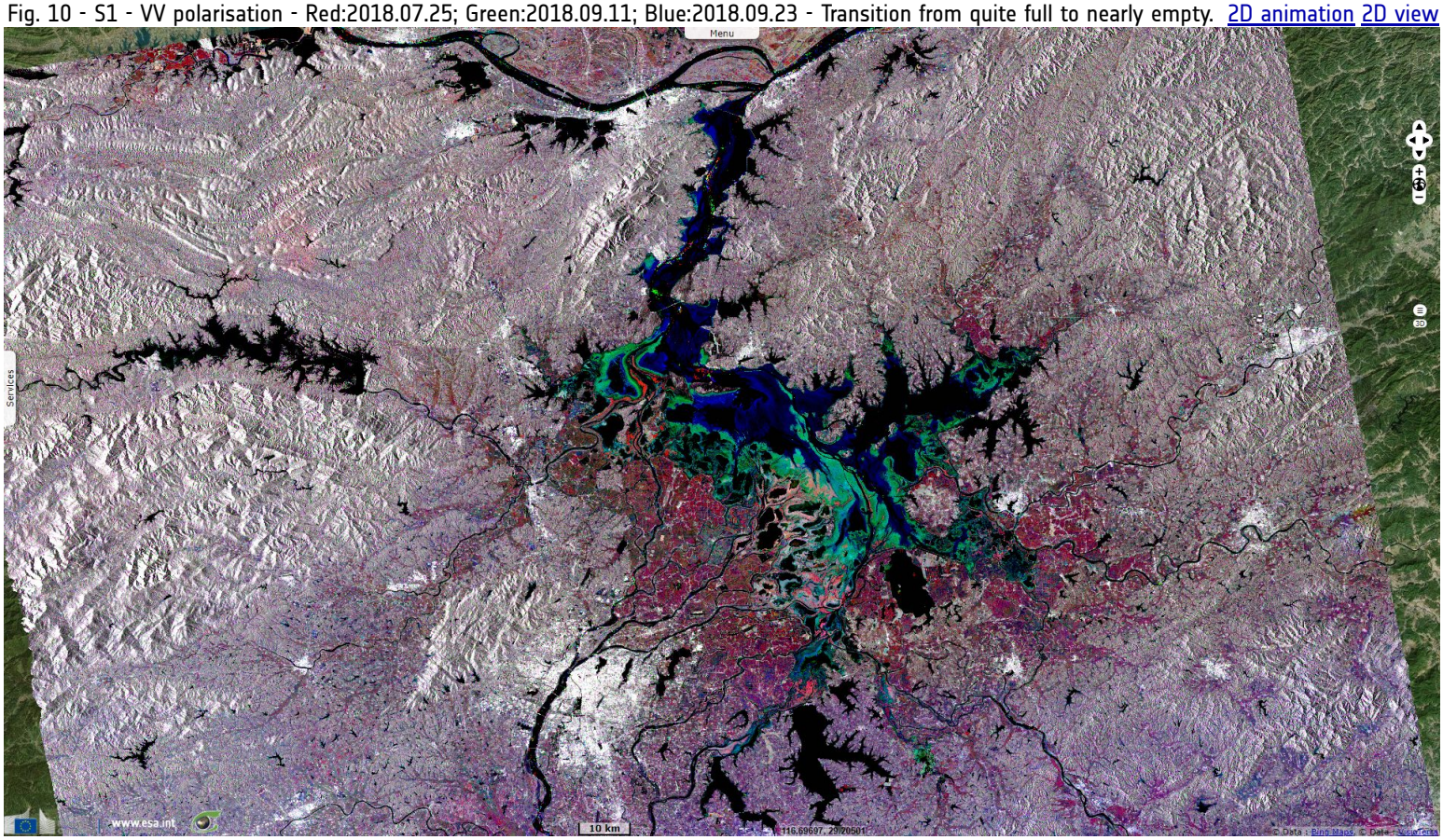
This multidate composite highlights the inflexion in the lake cover from a low surface, to a higher value after rainfalls and then to a very low cover. The lake was already quite low on July 1st (red channel) so that a large amount of land (bright) was visible around the lake (dark). By the end of July (green channel), the lake cover had largely increased, hence the larger dark area in the green channel. At the end of September (blue channel), the lake surface was minimal so there were more bright areas than in the other channels.

The black areas on the RGB composite was submerged during the three dates. The areas in blue were submerged during on both July images but were dry on the September image. The areas showing in magenta were underwater on the image acquired the 25.07.2018 but dry at the date before and after, thus they show the maximum reached by the lake at this date.

Zhang Kejia continues: "*On January 26, the porpoise survey team braved the cold and boarded a giant dredging ship – known as the Dredging King by locals – that was anchored on Poyang Lake. A foreman told us that the Dredging King could dredge up hundreds of thousands of tonnes of sand every day. In summer and autumn's high-water season, they can sell sand with a value of over 100 000 yuan (US$12,900) in one night.*

Zhou Junqi, director of fisheries for the area around the lake's mouth, in Jiangxi province, said that the sand dredging first began in Poyang Lake after large-scale flooding in 1998. In the first few years, there was no obvious effect on the fishing industry or the environment. The dredging brought in a lot of money very quickly, and allowing it to continue was much easier than trying to think of other ways of attracting investment to the area."

Fig. 10 - S1 - VV polarisation - Red:2018.07.25; Green:2018.09.11; Blue:2018.09.23 - Transition from quite full to nearly empty. 2D animation 2D view



This multidate composite shows the transition from a quite filled lake after rainfalls to its nearly empty state at the end of September.
As the lake level was high the 25th July 2018 (red channel), a large water-covered area is dark while less surface is covered by land (bright). At the end of September (blue channel), the lake surface (dark) had shrunk, revealing more land so this channel shows more bright pixels than the others corresponding to other dates. The image of the 11.09.2018 (green channel) shows an intermediate situation between the two other acquisitions.
Black pixels on this composite show pixels that were underwater at all three dates. Blue pixels show areas submerged on the first two acquisitions but dry during the last. Finally, cyan pixels correspond to land that was dry on the last two acquisitions but still flooded during the first.

Zhang Kejia adds: "*The last few years have seen an increasing number of ships weighing over 1 000 tonnes, said Zhou. Aquatic plants and animals that used to swim in the lake have disappeared. The migration routes of semi-migratory fish have been disrupted by ships dredging and transporting sand. The breeding grounds for fish that once laid their eggs in sand and among rocks and plants have been destroyed. As a result, fish and shrimp populations have been falling every year, cutting off the food supply to porpoises, which now have trouble growing to their full size.*

Sand dredging brings in tens of millions of yuan to the Poyang Lake region every year, a considerable sum for counties that are lagging behind in economic development. But academics are now asking: who is going to pick up the bill for the damage done to the local environment and resources ?" "*The increase in GDP around Poyang Lake, brought about by sand dredging, comes at the cost of sacrificing the natural environment and its biodiversity. Most local officials, in their push for GDP, have neglected environmental protection and forgotten the baiji and the finless porpoise.*",
Zhou Junqi concludes.