

Consequences of the destruction of Kakhovka dam, Ukraine

Sentinel-3 OLCI FR acquired on **01 June 2023** at 07:58:33 UTC
Sentinel-3 SRAL LAND acquired on **08 June 2023** at 08:06:26 & 18:57:57 UTC
Sentinel-2 MSI acquired on **08 June 2023** at 08:46:01 UTC

...

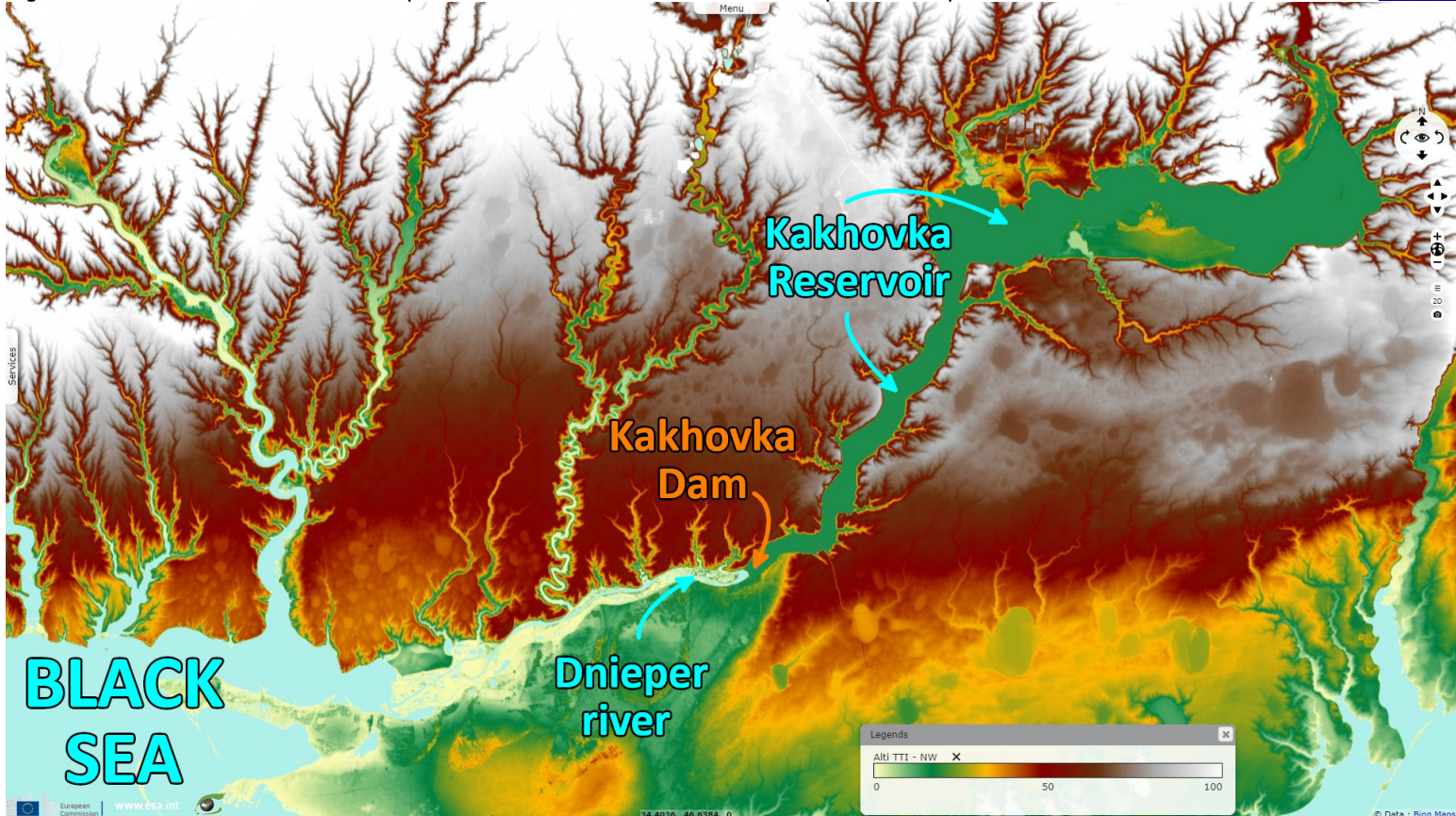
Sentinel-1 CSAR IW acquired on **09 June 2023** at 15:36:57 UTC

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

Keyword(s): Emergency, flooding, infrastructure, lake reservoir, hydropower, food security, energy security, agriculture, fishing, biodiversity, pollution, Ukraine

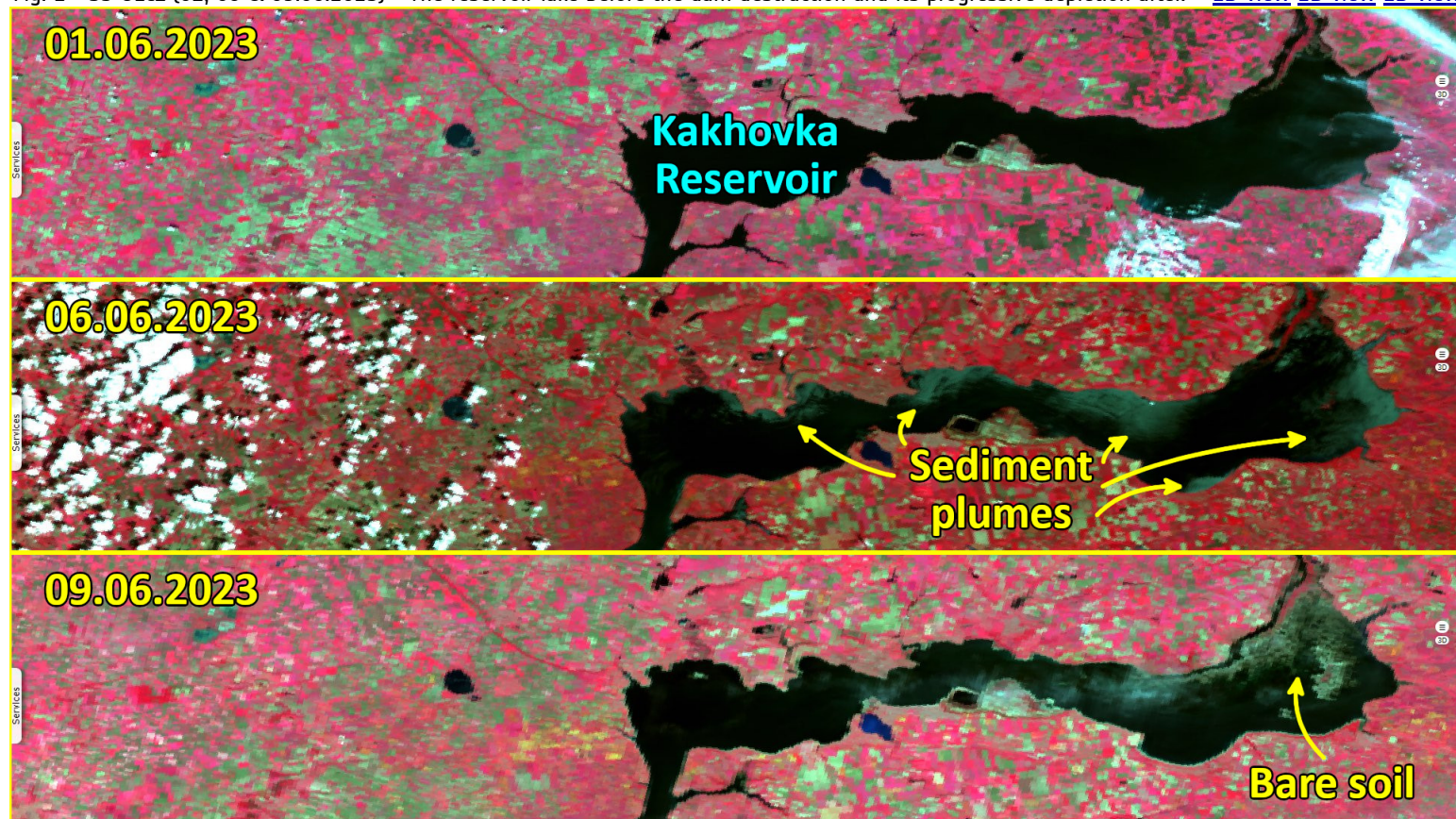
Fig. 1 - COP-DEM - The Kakhovka Dam separates a 18 km³ lake from from the estuary of the Dnieper river.

[3D view](#)



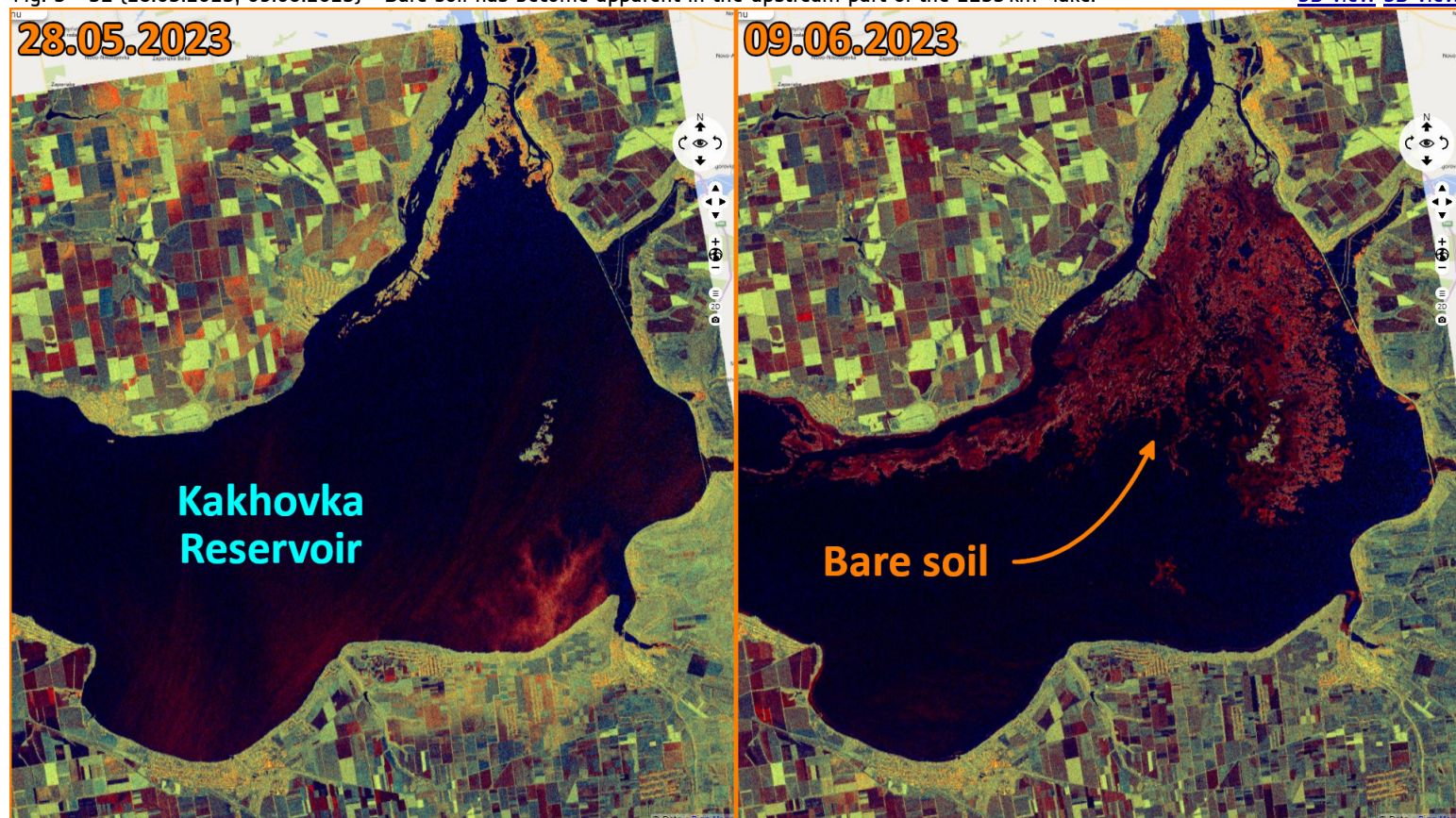
The Kakhovka Dam in Ukraine was destroyed in the early hours of 6 June 2023, causing extensive flooding along the lower Dnieper river in Kherson Oblast. The dam was under the control of the Russian military, which had seized it in the early days of the Russian invasion of Ukraine.

Fig. 2 - S3 OLCI [01, 06 & 09.06.2023] - The reservoir lake before the dam destruction and its progressive depletion after. [2D view](#) [2D view](#) [2D view](#)



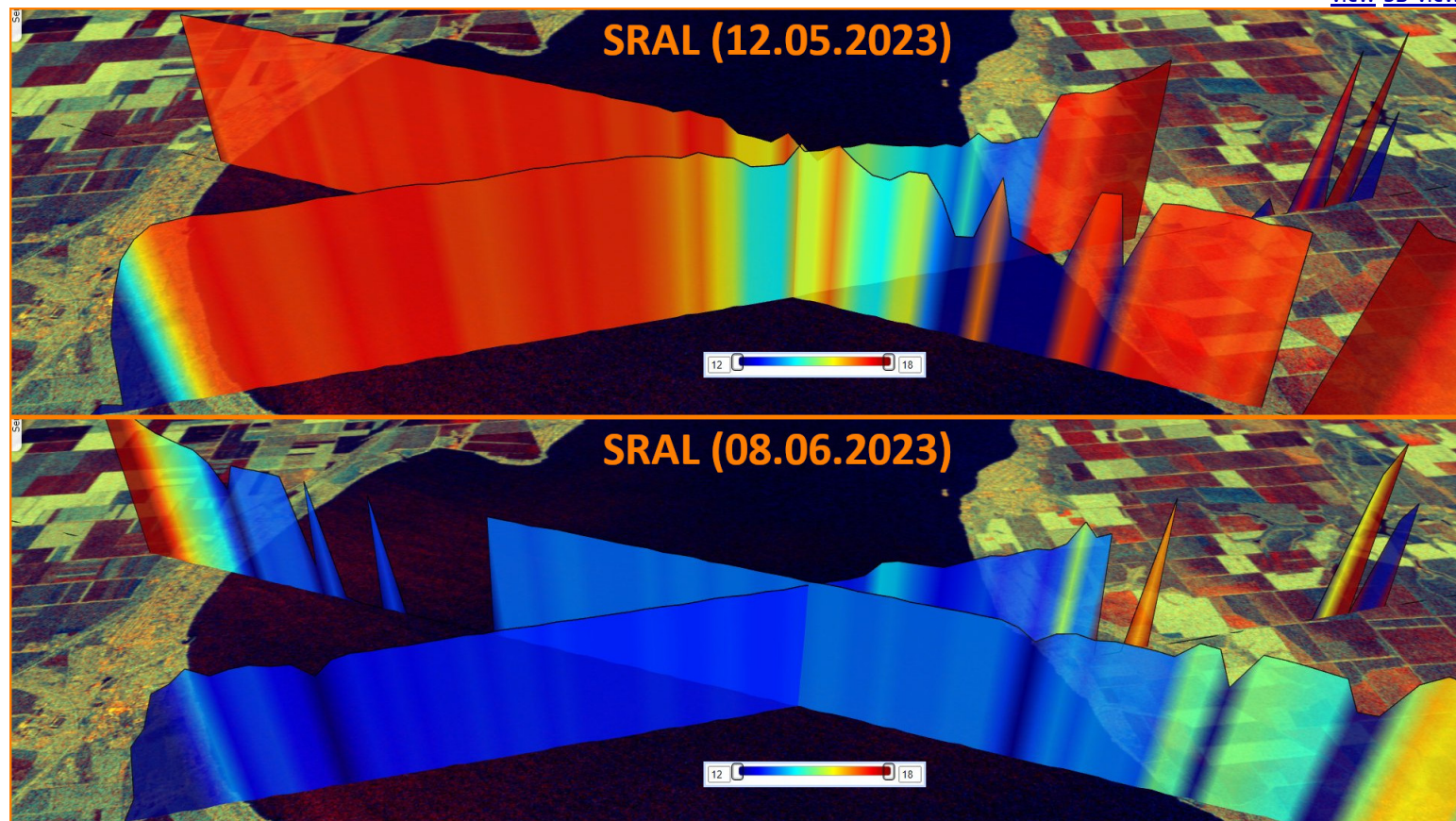
Dinara Khalilova gave a provisional human and material toll on [The Kyiv Independent](#): "According to the Interior Ministry, 2743 residents of Kherson Oblast have been evacuated, including 205 children and 76 people with reduced mobility. In Mykolaiv Oblast, 31 settlements have been flooded, from which 982 people, including 167 children, have been rescued, the ministry wrote on Telegram. "Ten people died, and 42 are considered missing, including seven children, Interior Minister Ihor Klymenko reported on June 12."

Fig. 3 - S1 (28.05.2023; 09.06.2023) - Bare soil has become apparent in the upstream part of the 2155 km² lake. [3D view](#) [3D view](#)



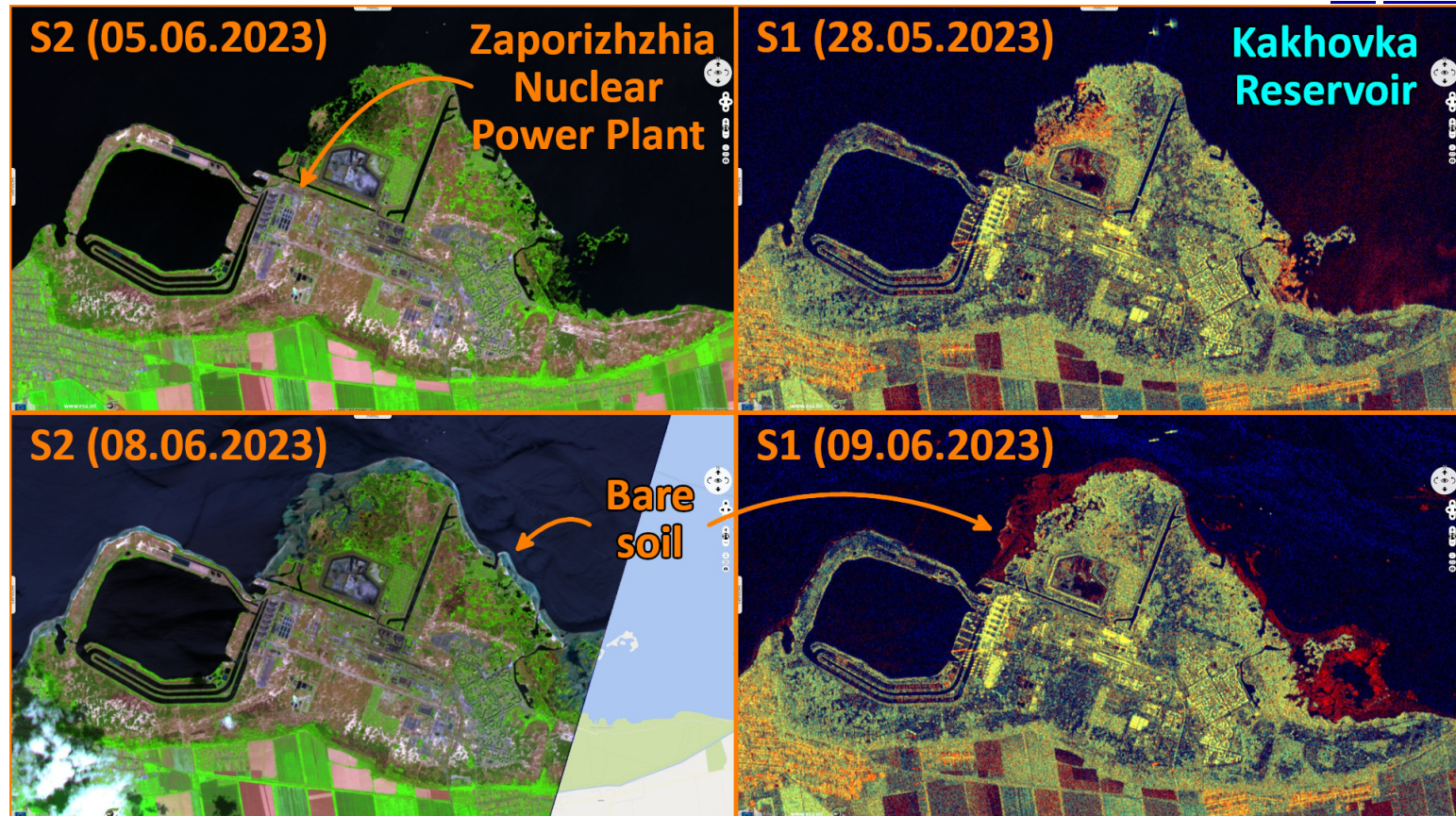
"At the very least, it has forced the evacuation of thousands of people, flooded national parks and jeopardised water supplies to millions of people. In the worst-case scenario, it may pose a long-term danger to Europe's biggest nuclear plant, Zaporizhzhia, and could also spread agrotoxins and petrochemicals into the Black Sea.", wrote Jonathan Watts for [the Guardian](#) "Ukrainian scientists are waiting for the water to subside before fully assessing the environmental impact of the Kakhovka dam breach, but one former minister warned it could prove the country's worst ecological disaster since the Chernobyl nuclear meltdown."

Fig. 4 - S3 SRAL (12.05.2023, 08.06.2023) - Height 20Hz Ku - The level of the lake has dropped several meters between the 6 and 8 June 2023. [3D view](#) [3D view](#)



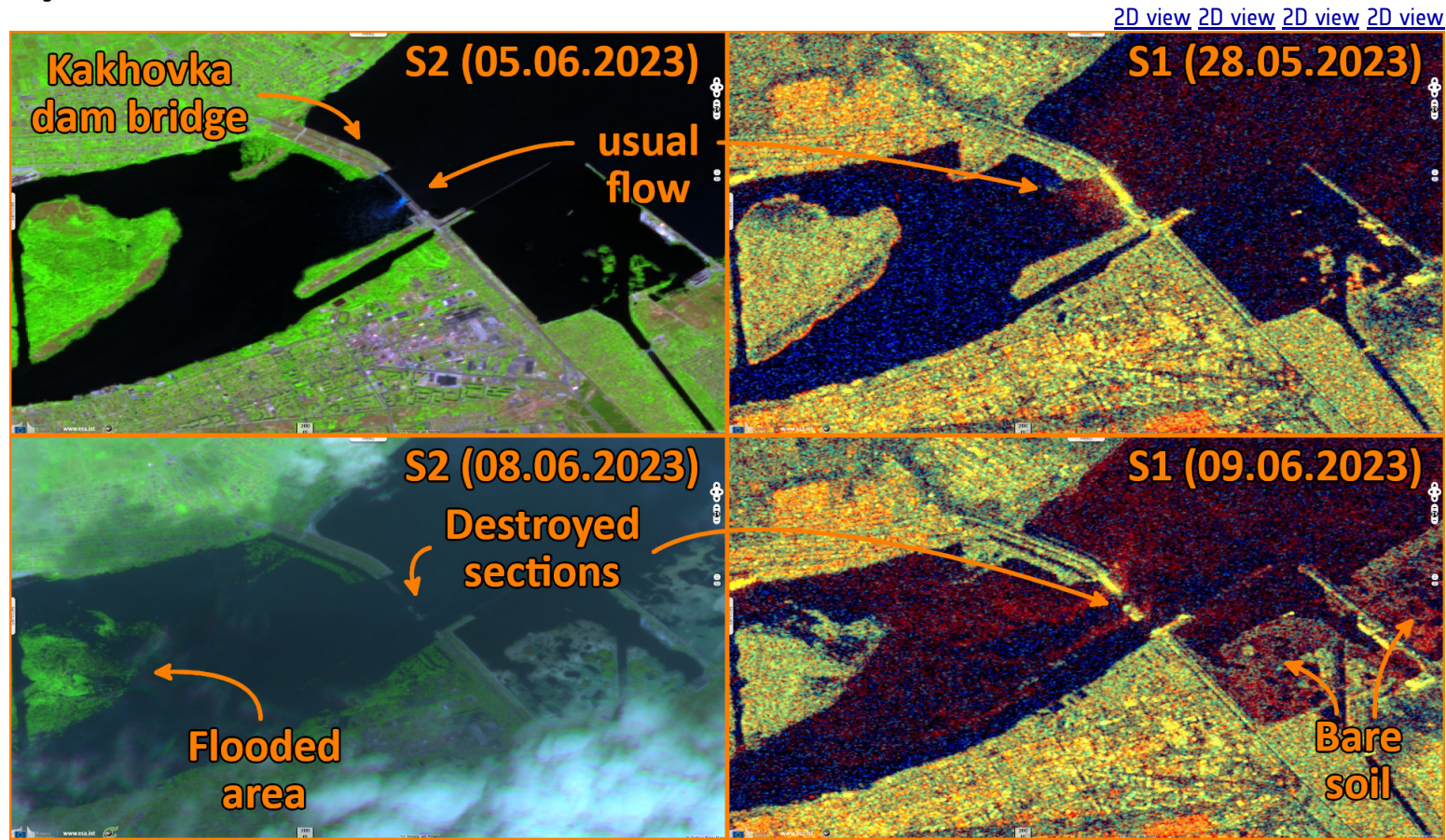
"The destruction of the Kakhovka dam will flood tens of thousands of hectares of agricultural land in southern Ukraine and could turn at least 500 000 hectares of land left without irrigation into 'deserts', the agriculture ministry said." according to [Reuters](#). Globally, the effect will be felt far from the war as grain price have inflated as a response to the destruction.

Fig. 5 - S2 (05.06.2023, 08.06.2023), S1 (28.05.2023, 09.06.2023) - Bare soil appeared around Zaporizhzhia nuclear power plant. [3D view](#) [3D view](#) [3D view](#) [3D view](#)



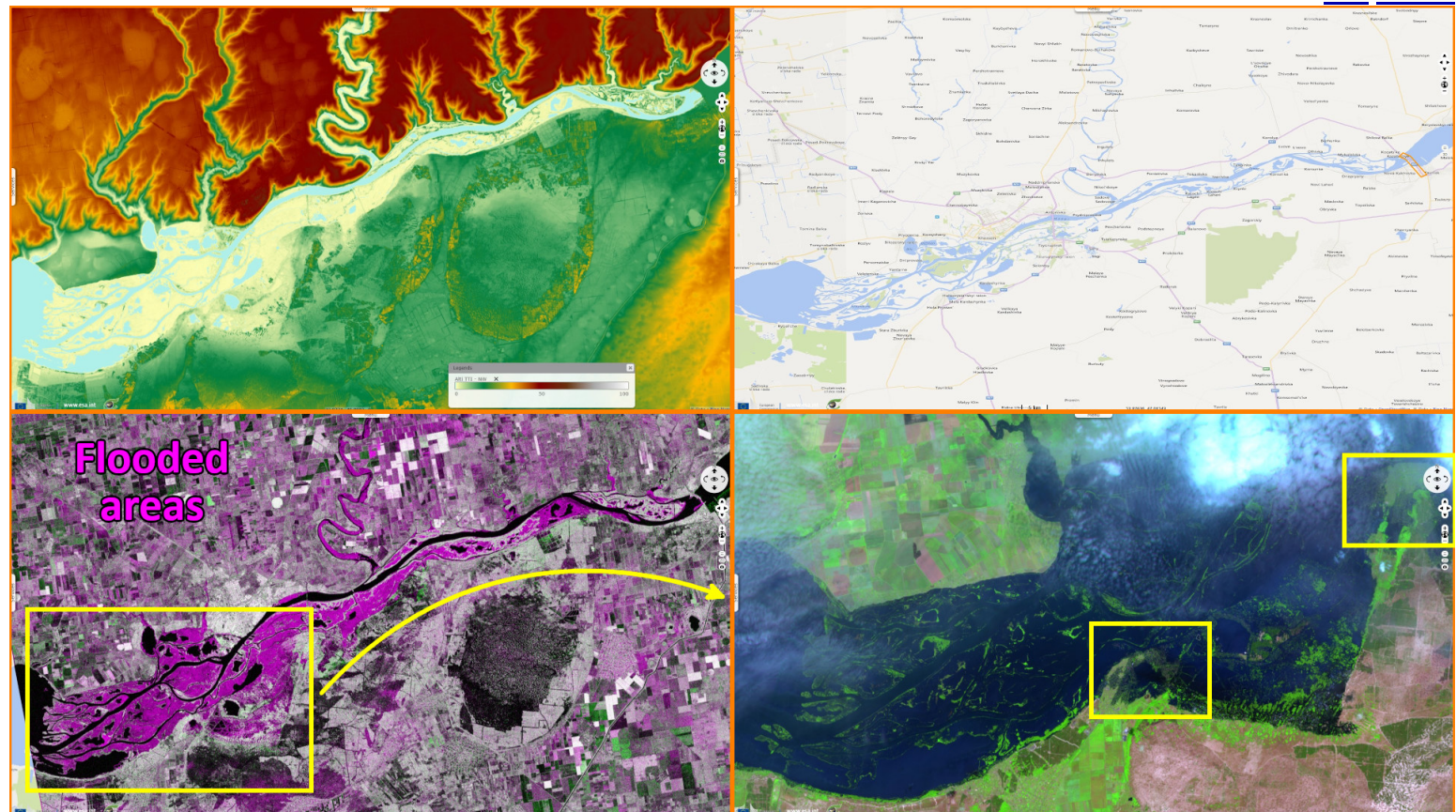
"Floodwater has inundated tens of thousands of hectares of farms and arable lands, washing away their topsoil layers, according to Ukraine's environment ministry. 'We will not be able to cultivate agricultural plants on this soil for many years ahead,' said Krasnolutskyi. The floods could wash fertilizers used on agricultural land into the river, where they could disrupt aquatic ecosystems."

Fig. 6 - S2 (05.06.2023, 08.06.2023), S1 (28.05.2023, 09.06.2023) - The dam was 30 m tall & 3.2 km long. The destroyed part of the dam is ~200 m long.



The Ukrainian Ministry of Agriculture estimated a loss of \$285M USD to the fishing industry, as a result of fish being stranded in shallows as the water level goes down or carried to flooded land where they will die after the flood recedes, as well as freshwater fish being exposed to saltwater and vice versa.

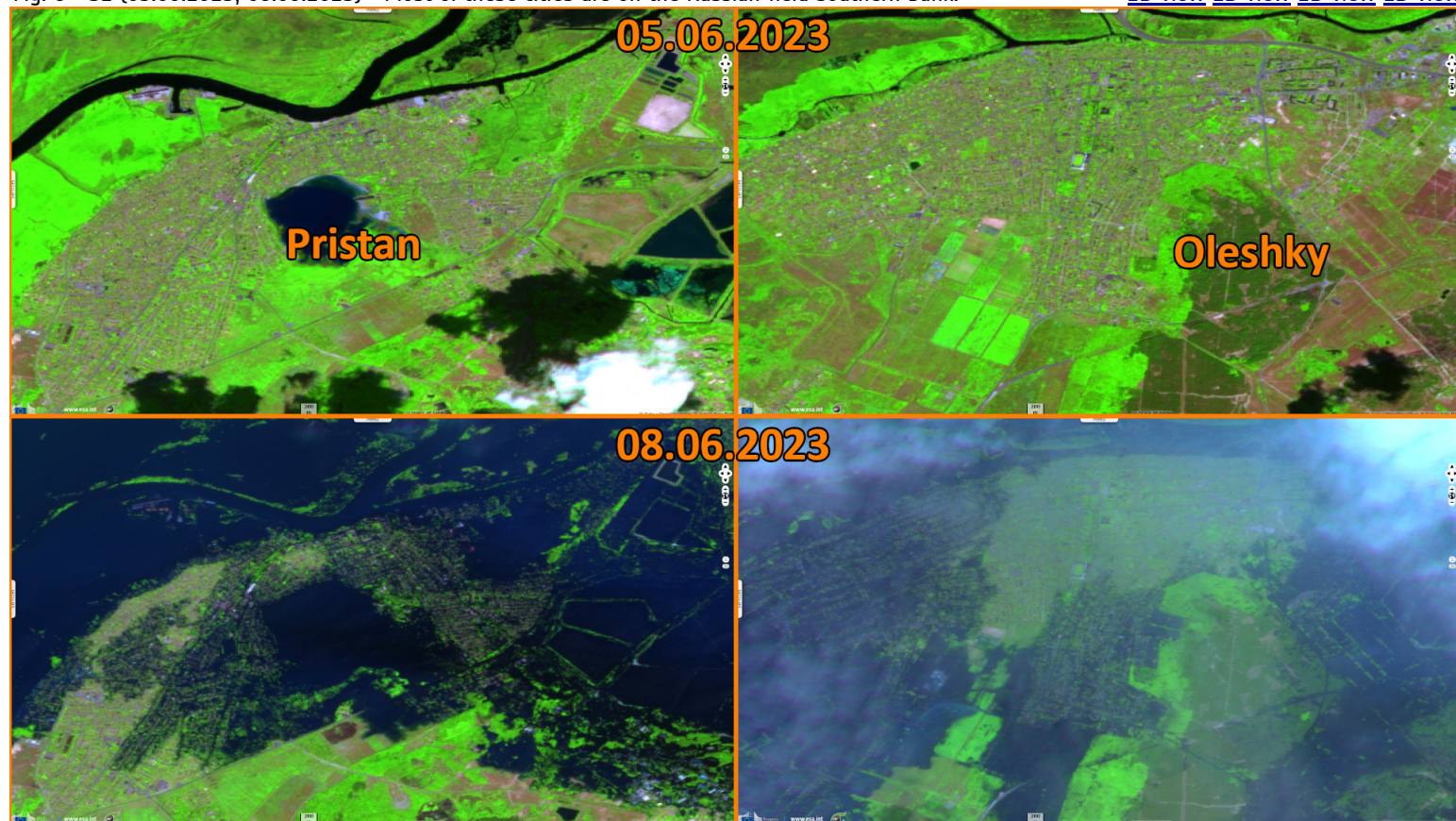
Fig. 7 - COP-DEM, S1 (28.05.2023, 09.06.2023), S2 (08.06.2023) - Many cities on the banks of the river are drown underwater. [2D view](#) [3D view](#) [3D view](#) [view](#) [3D view](#)



The reservoir has a total capacity of 18 km³. Its level was quickly increasing before the dam destruction, water levels in the reservoir had reached a 30-year high by late May. The dam used to generate 1.4 TWh yearly which is enough to power 350 000 typical European homes. In addition, it provided large quantity of water to cool Zaporizhzhia nuclear power plant which may not be restarted until its water input is secured, further hampering energy production of Ukraine.

Fig. 8 - S2 (05.06.2023, 08.06.2023) - Most of these cities are on the Russian-held southern bank.

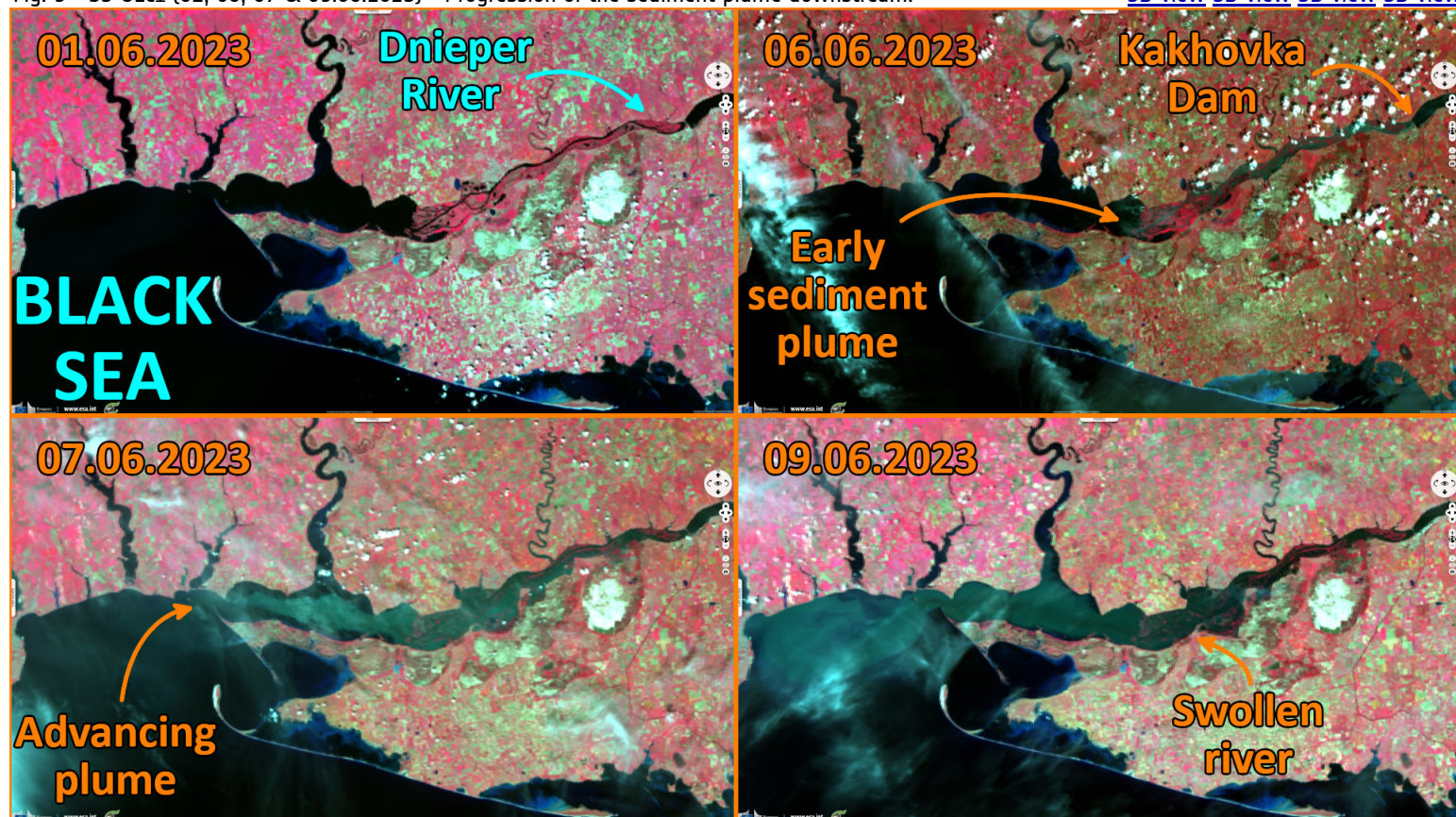
[2D view](#) [2D view](#) [2D view](#) [2D view](#)















The structure was too robust to be destroyed by a missile or a conventional bomb according to experts, it is thought tons of explosives could have been detonated from within the dam structure.

Fig. 9 - S3 OLCI (01, 06, 07 & 09.06.2023) - Progression of the sediment plume downstream.

[3D view](#) [3D view](#) [3D view](#) [3D view](#)



Isabel Van Brugen provides additional hint on the US magazine [Newsweek](#): "On May 30, a week before the dam's collapse, the Russian government approved a law aimed at 'ensuring the safety of hydraulic structures' in the Ukrainian regions it proclaimed to have annexed in September 2022—the Donetsk and Luhansk regions, in Kherson, and Zaporizhzhia. The legislation states that until January 1, 2028, investigations into accidents at hydro-technical structures that occurred as a result of military operations, sabotage and terrorist activities are prohibited. The decree was signed by Russian Prime Minister Mikhail Mishustin and came into effect on the day it was published."

More on European Commission space:							
More on ESA:				S-1 website	S-2 website	S-3 website	
More on Copernicus program:				Scihub_portal	Cophub_portal	Inthub_portal	Colhub_portal
More on VisioTerra:				Sentinel Vision Portal	Envisat+ERS_portal	Swarm+GOCE_portal	CryoSat_portal