

Extreme air pollution in the Ganges valley

Sentinel-3 OLCI FR acquired on **31 October 2019** at 04:40:15 and from 05:16:50 to 05:19:50 UTC
Sentinel-2 MSI acquired on **31 October 2019** at 05:09:41 UTC
Sentinel-5P TROPOMI AER_AI and CO acquired on **31 October 2019** from 07:59:39 to 08:04:38 UTC

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Sentinel-5P TROPOMI CO acquired on **04 November 2019** at 06:47:01 & 08:27:00 UTC

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

Keyword(s): Atmosphere, pollution, air quality, weather, transport, agriculture, crop burning, India, Pakistan.



[2D Layerstack](#)

Fig. 1 - S3 OLCI (31.10.2019) - 10,6,3 natural colour - After Diwali, a thick brownish haze became apparent as clouds moved away eastward. [2D view](#)

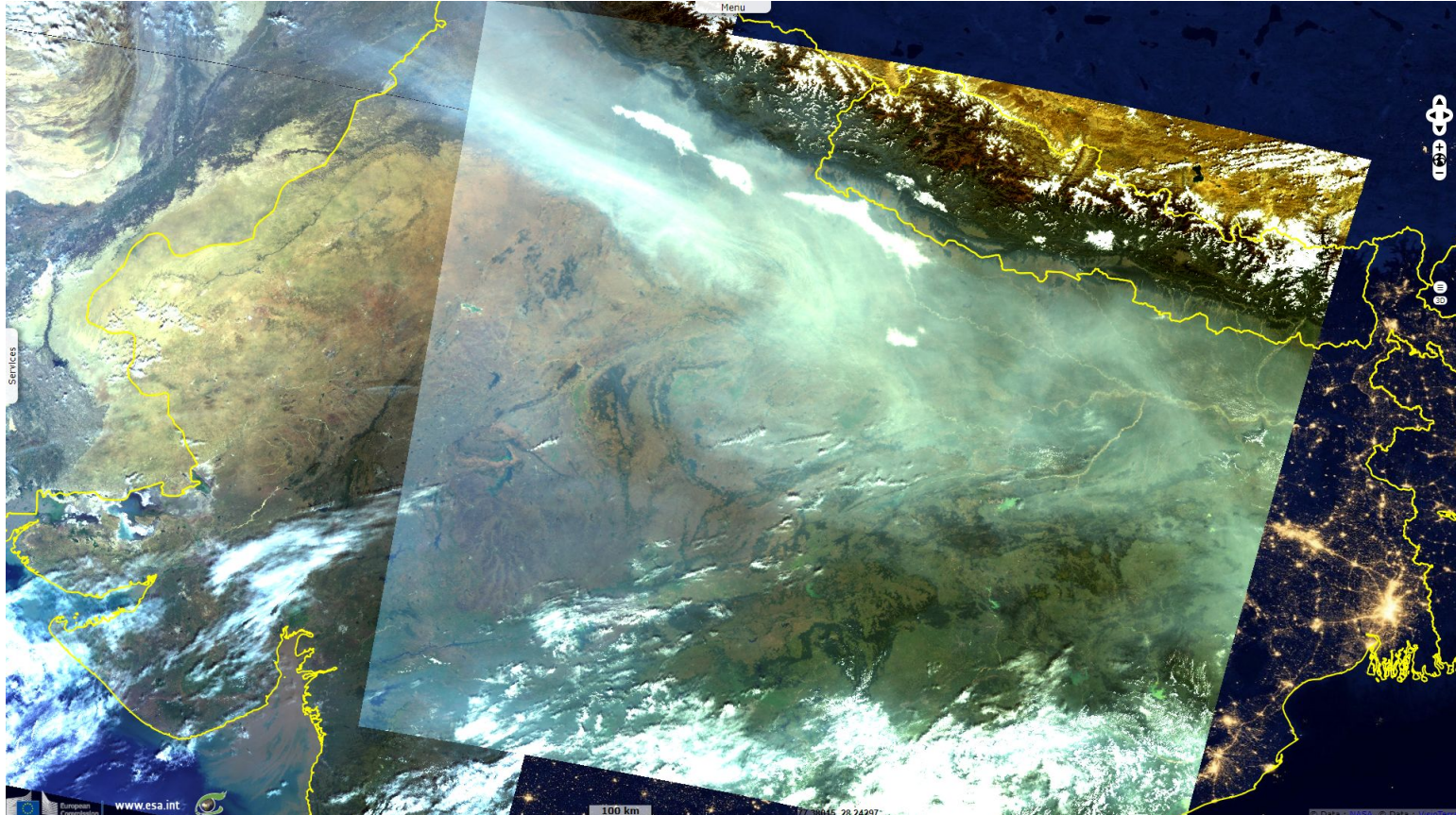


Fig. 2 - S5P TROPOMI (31.10.2019) - CO total column - This plume over Delhi originates from fertile plains between India & Pakistan. [2D view](#)

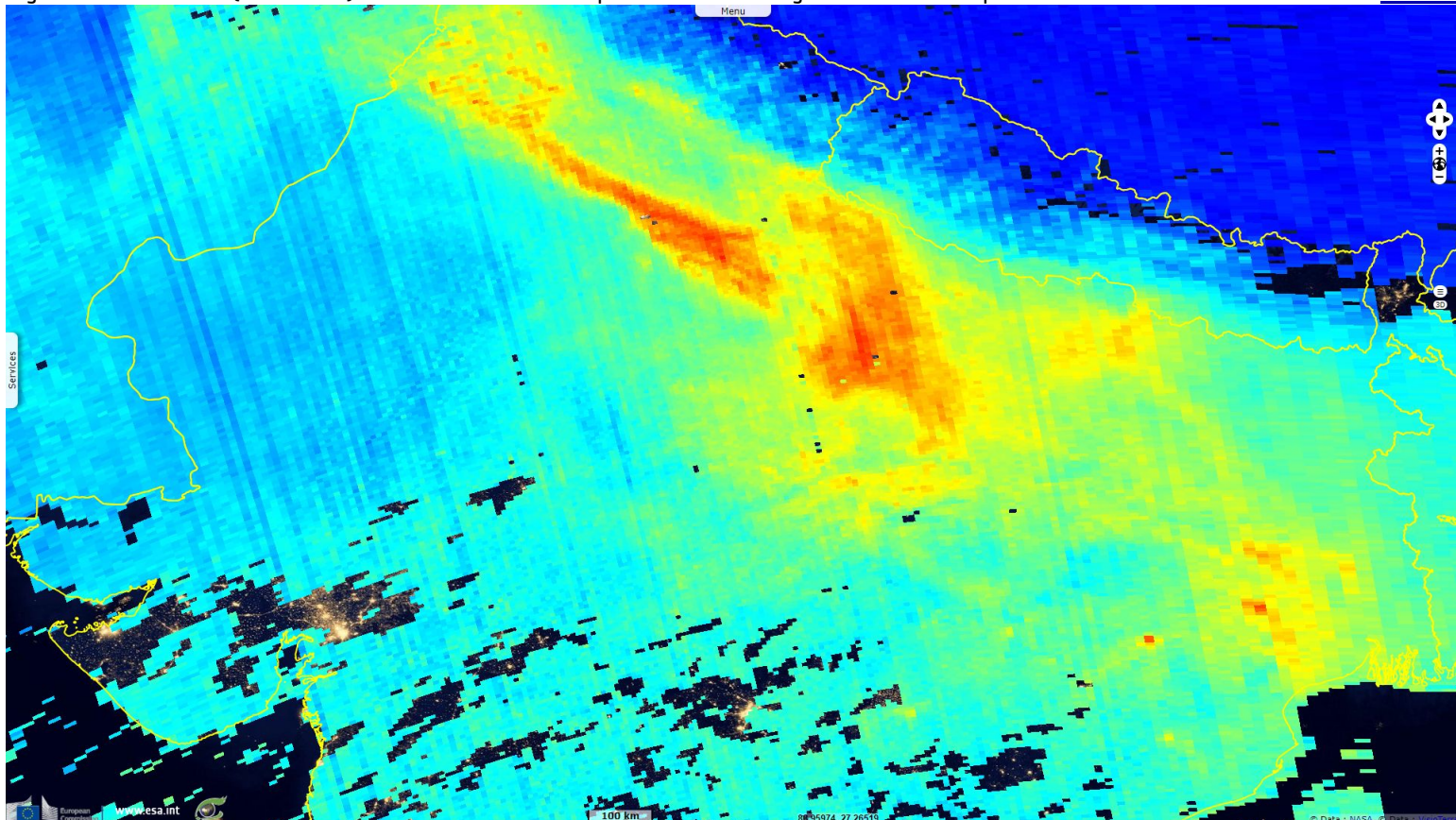
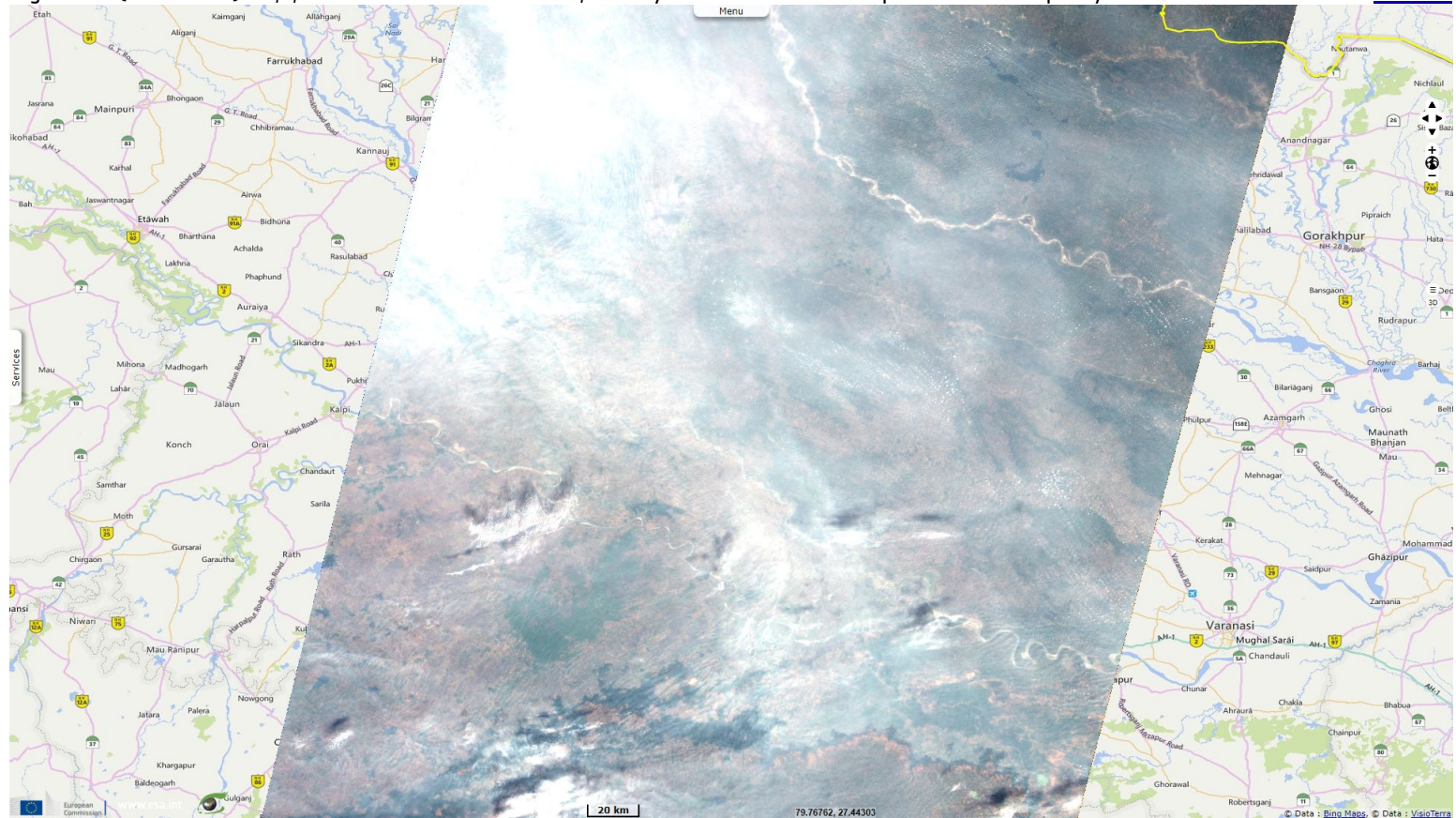


Fig. 3 - S2 (31.10.2019) - 4,3,2 natural colour - Visible here, the city of Lucknow took the spot of worst air quality index of Diwali 2018.

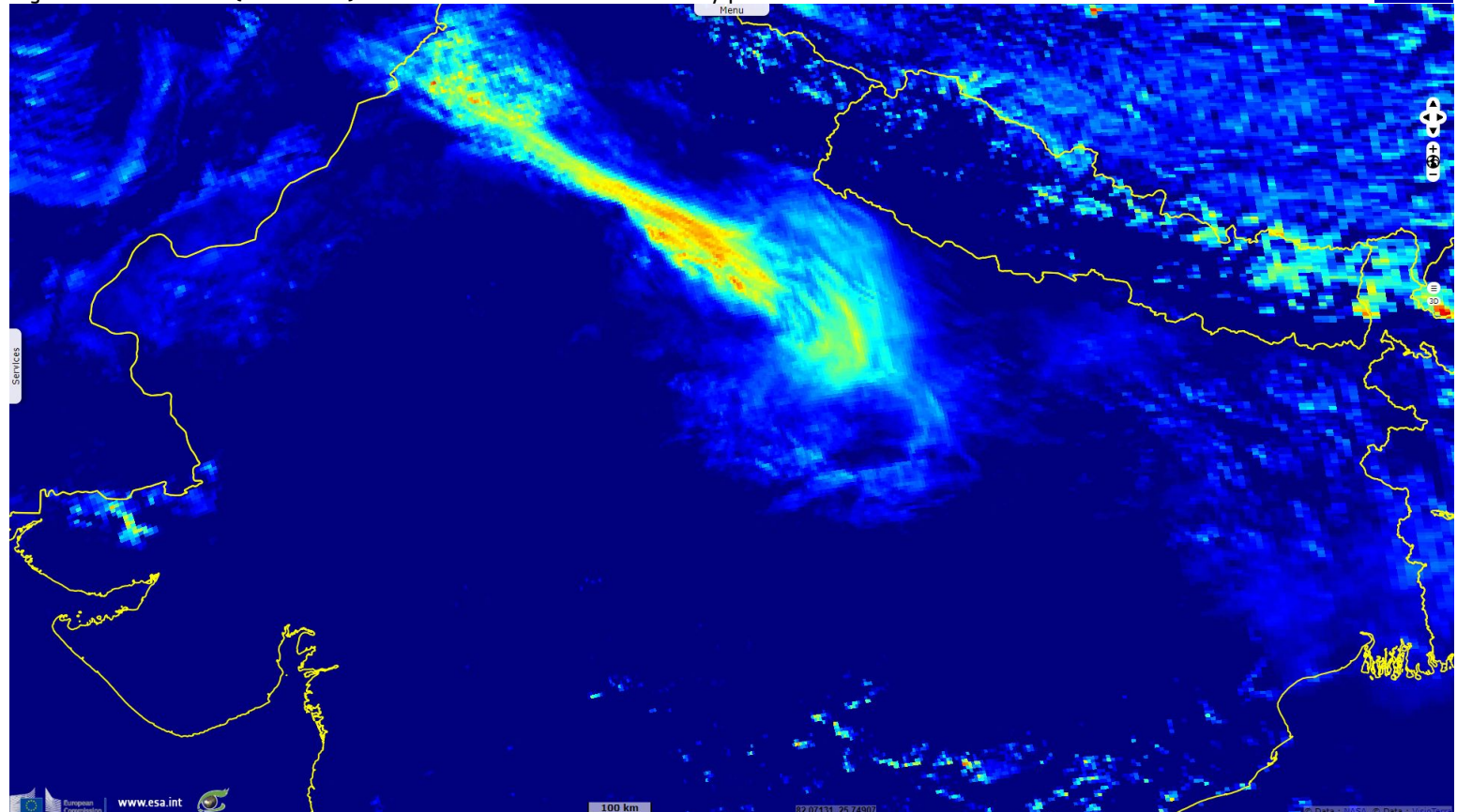
[2D view](#)



In an [article](#) published in *Aerosol and Air Quality Research* in December 2017, Hiren Jethva wrote: "The mass concentration of PM_{2.5} escalates from ~50 $\mu\text{g m}^{-3}$ measured prior to the onset of residue burning in early October to as high as 300 $\mu\text{g m}^{-3}$ (24-hour averaged, 7-day running mean) during the peak burning period in early November. A linear regression analysis reveals that the variations in PM_{2.5} over New Delhi can be attributed to the concurrent changes in the satellite retrievals of fire counts and aerosols over the crop burning area. The back-trajectory analysis shows that most clusters (>80%) of the northwesterly flow near the ground intercepted the crop burning region before arriving at the receptor location in New Delhi; this further corroborates the transport patterns inferred from the satellite data."

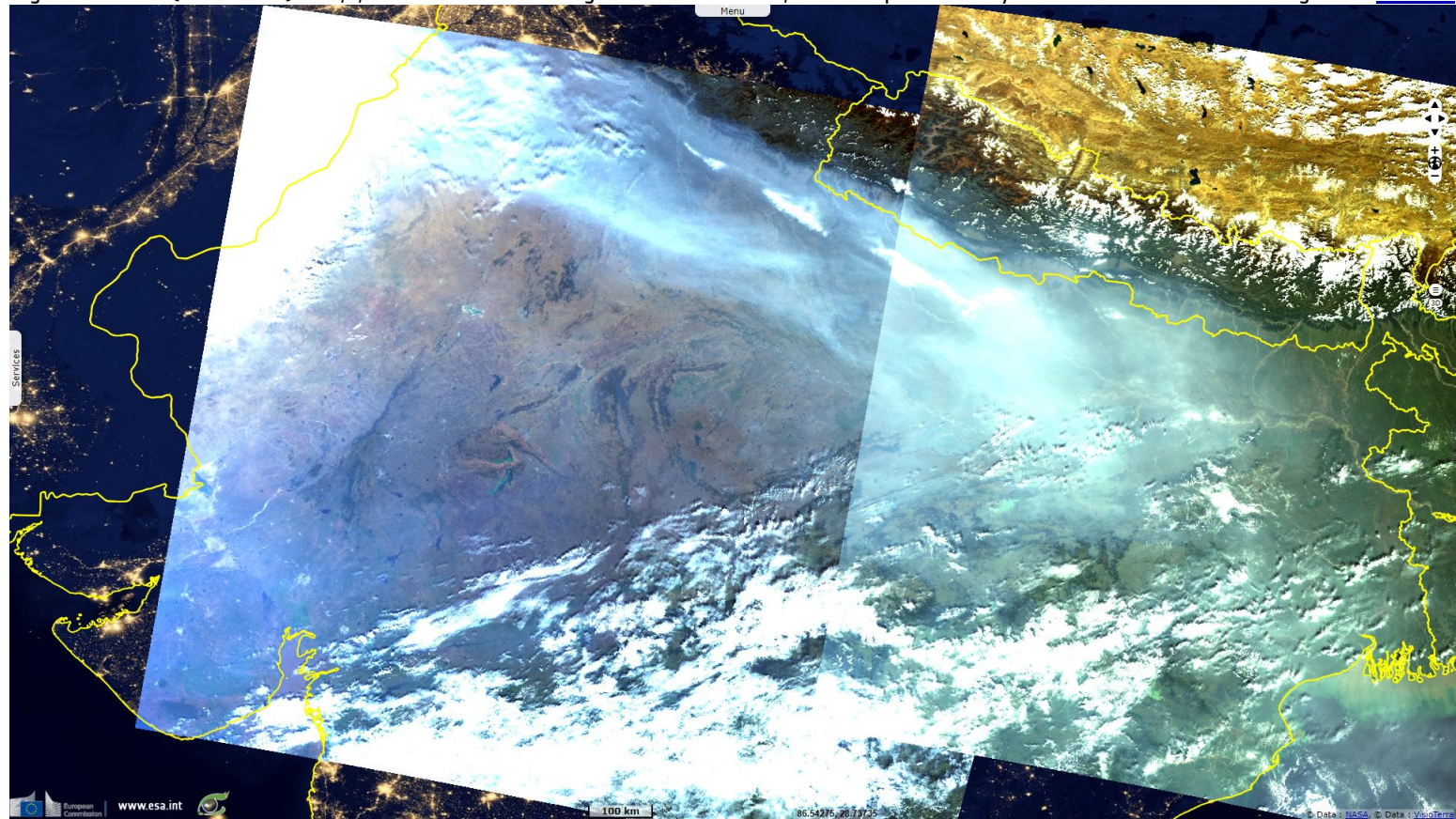
Fig. 4 - S5P TROPOMI (31.10.2019) - Aerosol Index - The aerosol density peaks from Delhi onwards.

[2D view](#)



"The seasonal crop residue burning over the northwestern states of Punjab and Haryana in India is a major source of pollution over the greater Indo-Gangetic Plain region. The burning of waste material resulted from the harvest of rice crop produces aerosols and trace gases in large quantities, which affects the air quality locally and across the region downwind of the sources. The correlation analysis suggests a strong influence of crop residue fires and associated smoke aerosols observed by MODIS and OMI sensors over Punjab on the concentration of PM_{2.5} measured on the ground in New Delhi."

Fig. 5 - S3 OLCI (01.11.2019) - 10,6,3 natural colour - Owing to moderate winds, the toxic plume slowly moved S-E instead of hovering. [2D view](#)

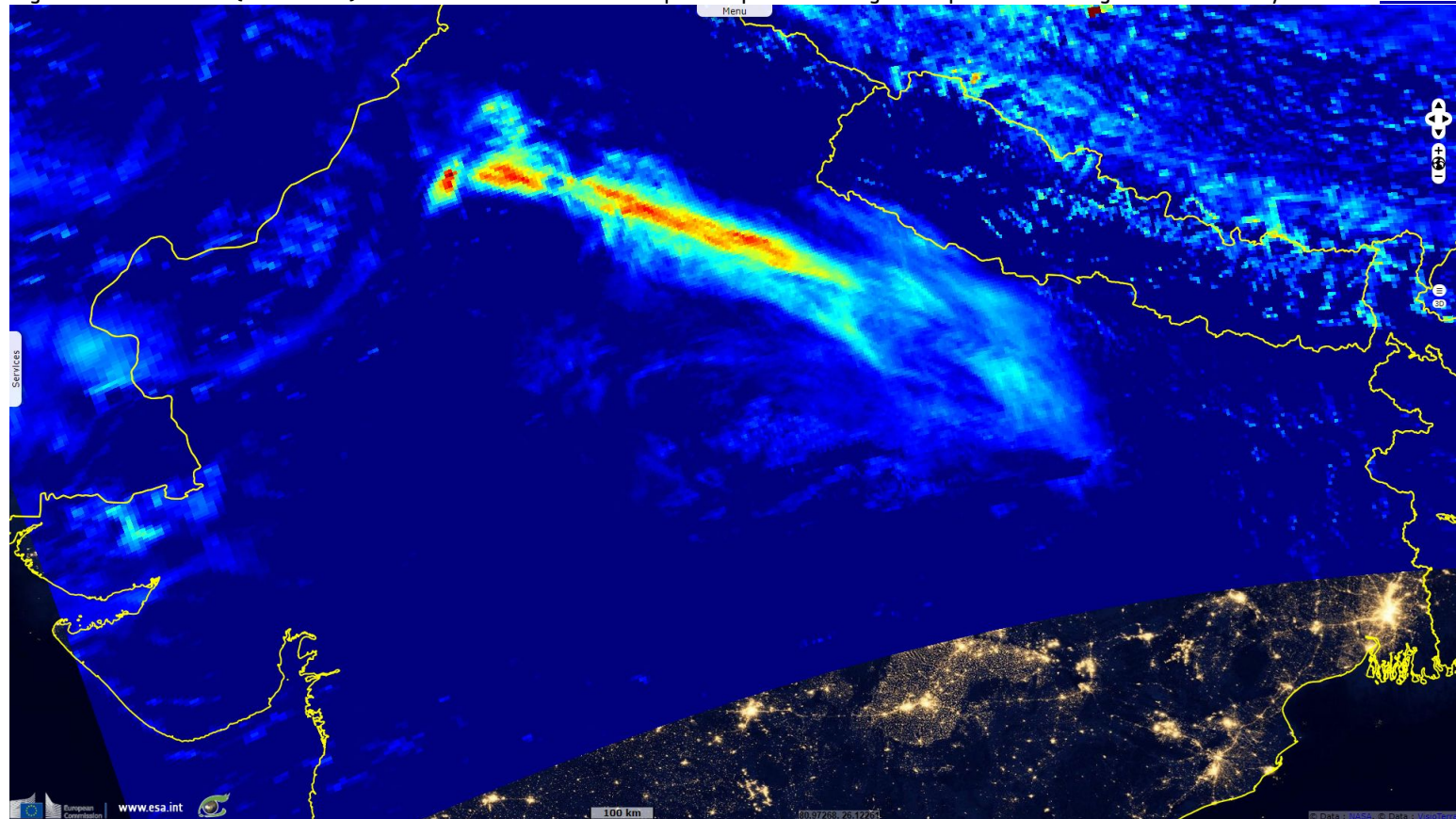


This massive source of pollution comes on top of everyday (factories, daily motorised traffic), seasonal (low wind, cold temperatures, higher air moisture and fossil fuel based heating) and occasional pollution. [Die Deutsche Welle](#) specifies the effects of one of these particular occasion, Diwali: "Air pollution in New Delhi has spiked after India's biggest fireworks party of the year. Residents woke up to a pall of grey left behind by acrid smoke from fireworks that remained trapped in the city's cool air."



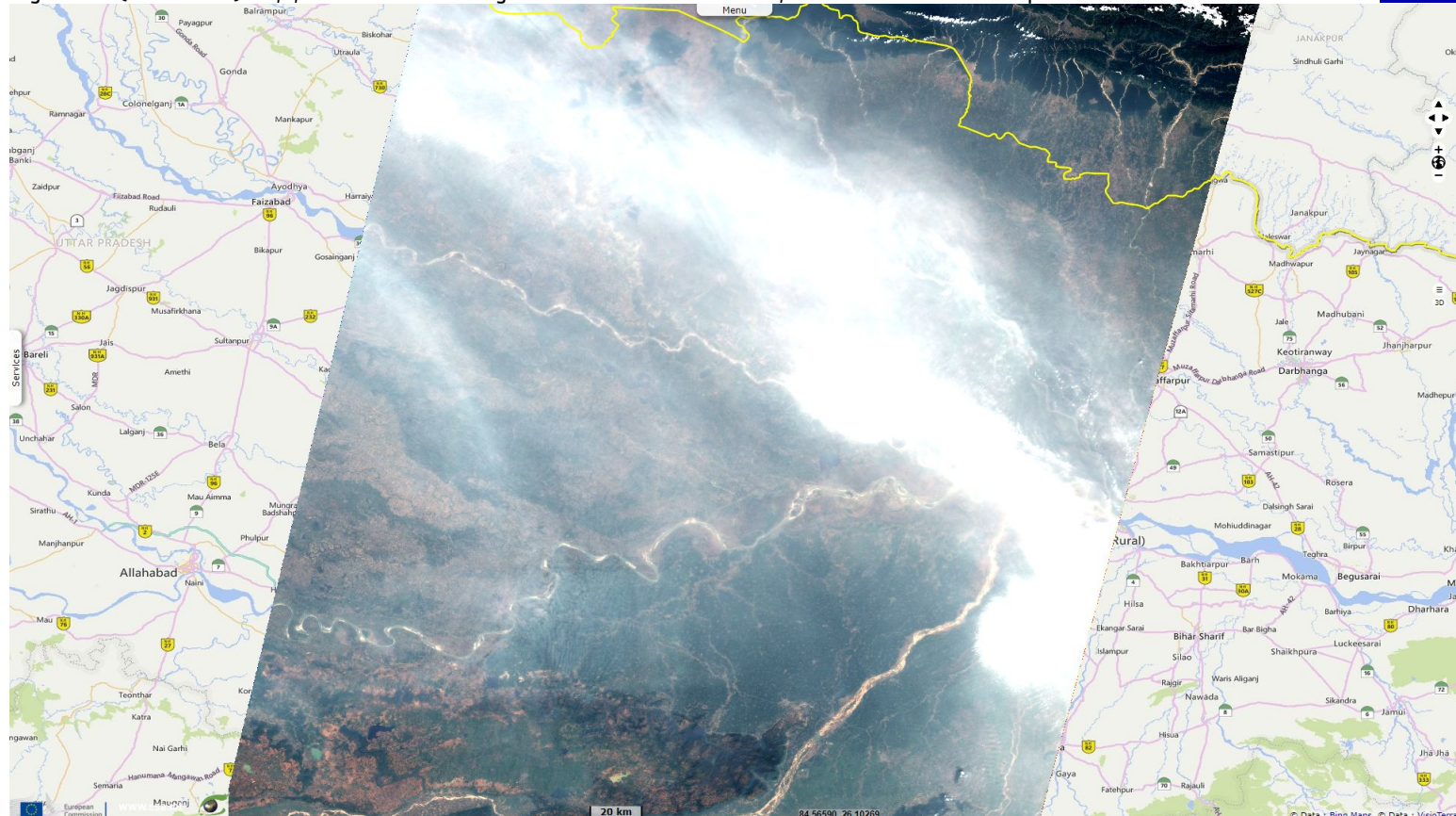
Left: A man burning firecrackers - source: PA
Right: A photograph in Delhi's Mayur Vihar, on October 24 2019 — three days before Diwali.

Fig. 6 - S5P TROPOMI (01.11.2019) - Aerosol Index with colour map - The particles smog both spread east and got denser the day after. [2D view](#)



"Air pollution in New Delhi and several other Indian cities deteriorated on Monday to the worst recorded level, a day after revelers set off firecrackers and rockets to celebrate the Hindu festival of lights, Diwali. The smoke from fireworks added to emissions from cars and trucks as well as stubble fires by farmers around Delhi that have made it the world's most polluted capital."

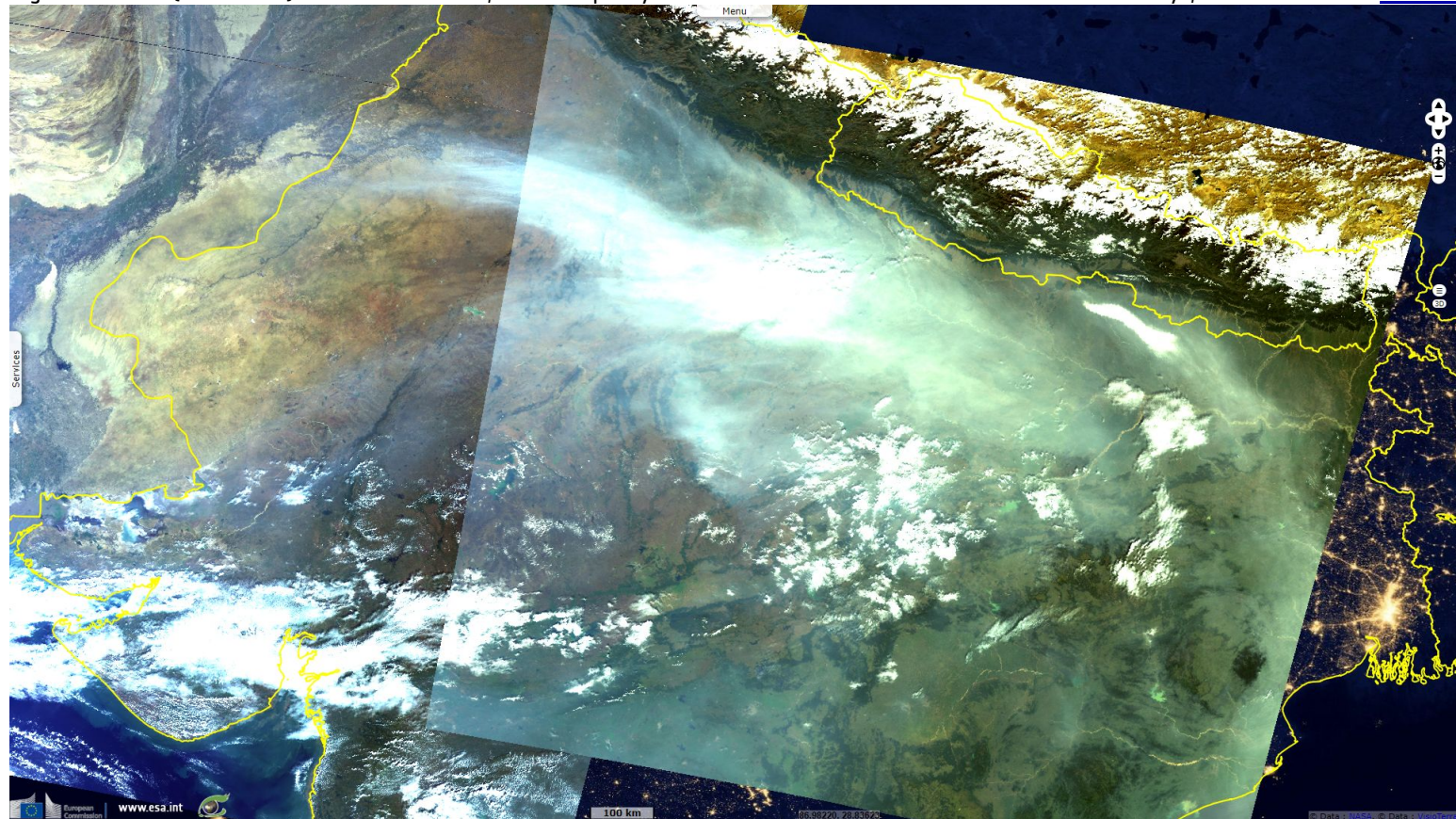
Fig. 7 - S2 (02.11.2019) - 4,3,2 natural colour - Aligned with Delhi and Lucknow, Patna had taken second place for worst air of Diwali 2018. [2D view](#)



"The air quality index, which measures the concentration of poisonous particulate matter, touched 500 in several parts of Delhi, including the international airport, in the early hours of Monday, the maximum recorded by the government's Central Pollution Control Board. Anything above 401 is classified as "severe." Air pollution at that level can seriously affect those with existing respiratory illnesses, and even those who are healthy. The levels have remained above 300 since early Monday morning, or "very poor," which can cause respiratory illness after prolonged exposure."

Fig. 8 - S3 OLCI (04.11.2019) - From Diwali 2019, Delhi air quality has been hazardous or worse for nine consecutive days, a record.

[2D view](#)

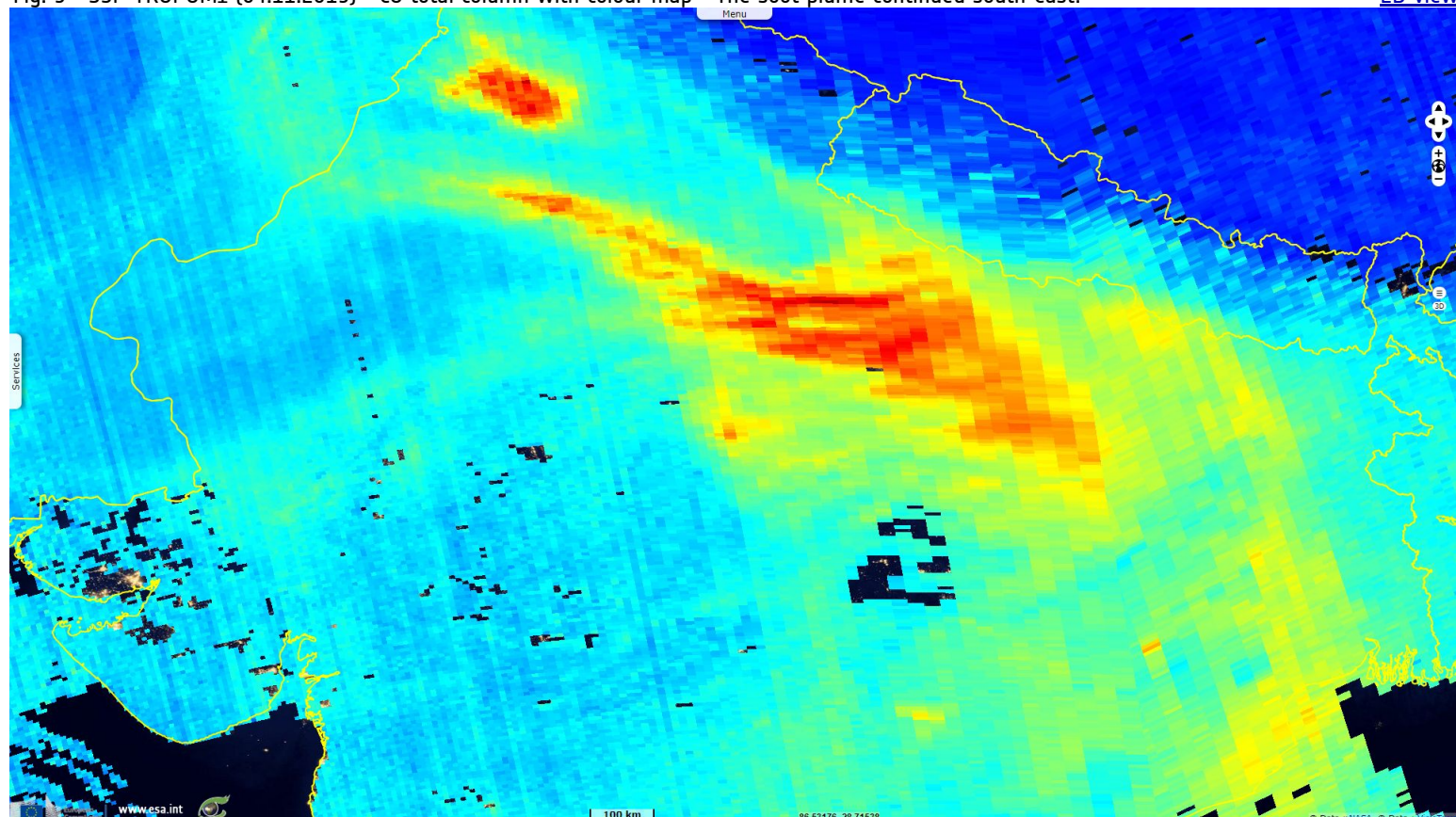


"The overall air quality index across the city, however, was at its lowest in three years due to favorable wind speeds and some reduction in the use of fireworks during Diwali, according to SAFAR, a government-run monitor. In an effort to limit pollution over the festival period, India's Supreme Court had ordered residents to only use safe and environmentally-friendly fireworks that emit less smoke and soot. It also stipulated that the fireworks could only be set off for a maximum of two hours, and only in designation areas such as parks – a ruling that appeared to go largely ignored."

In metro.co.uk, Jimmy Nsubuga [reports](#) another attempt to change behaviours: "The New Delhi government held a four-day laser show starting Saturday to encourage residents to skip firecrackers altogether."

Fig. 9 - S5P TROPOMI (04.11.2019) - CO total column with colour map - The soot plume continued south-east.

[2D view](#)















Die Deutsche Welle continues: "The government has taken a slew of measures, including shutting down thermal power plants and banning construction during the pollution season. In November, a bid to reduce road traffic will be introduced with odd and even registration plates allowed on Delhi roads on alternate days. Several other Indian cities have initiated some pollution control action in recent years, but there has been little or no political will to enforce anti-pollution laws."

Fig. 10 - S2 (04.11.2019) - 4,3,2 natural colour - While spread larger on its eastern end, the haze was still quite thick. [2D view](#)



The views expressed herein can in no way be taken to reflect the official opinion of the European Space Agency or the European Union.
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