

Floods caused by Irma in Gulf of Mexico

Sentinel-1 CSAR IW acquired on 12 July 2017 from 10:54:49 to 10:55:14 UTC

Sentinel-1 CSAR IW acquired on 29 August 2017 from 23:26:34 to 23:28:14 UTC

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Sentinel-1 CSAR IW acquired on 10 September 2017 from 23:26:36 to 23:28:16 UTC

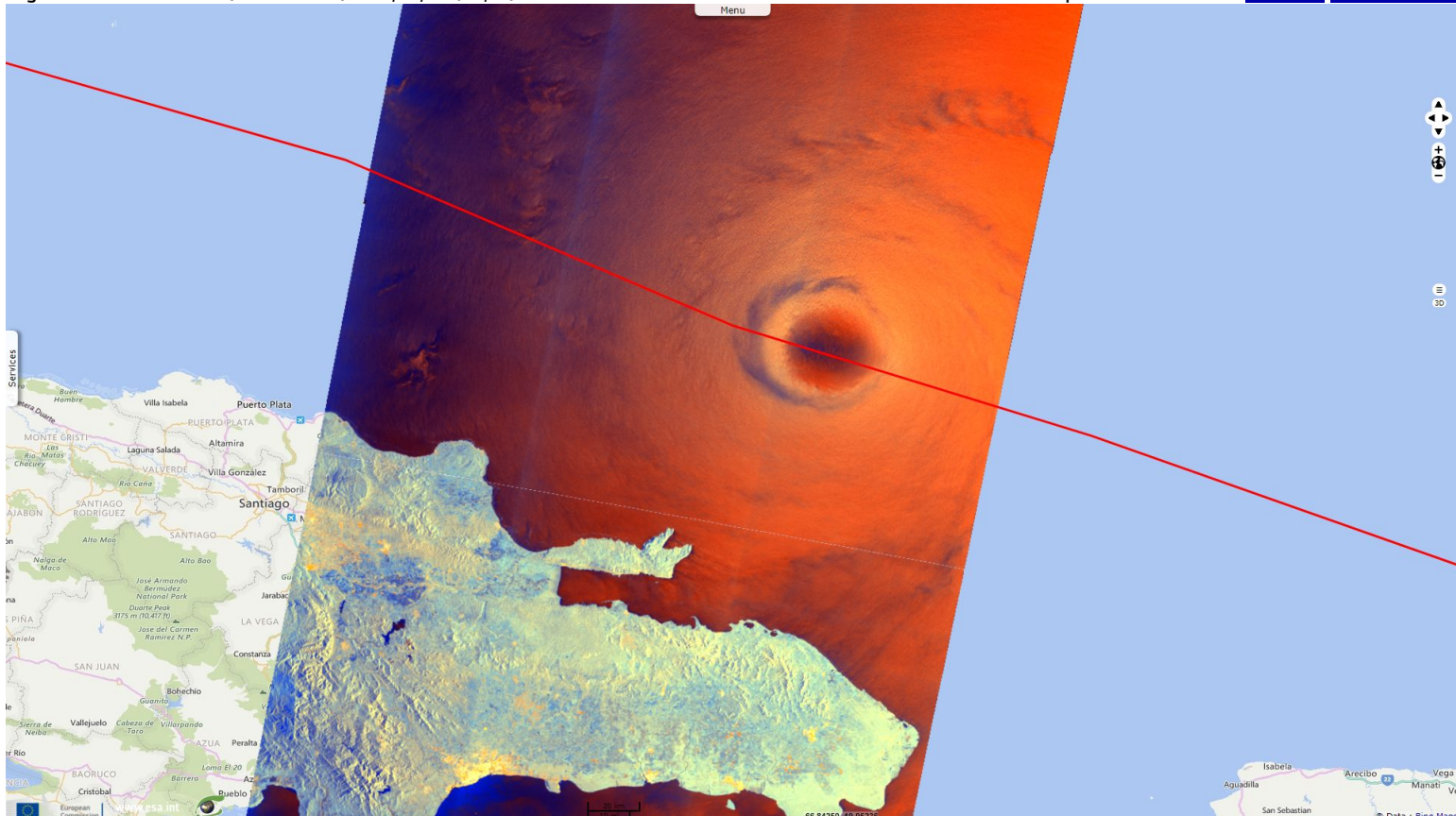
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Fig. 1 - S1A CSAR IW (07.09.2017) - vv,vh,ndi(vh,vv) - Hurricane Irma off the northern coast of Dominican Republic.

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

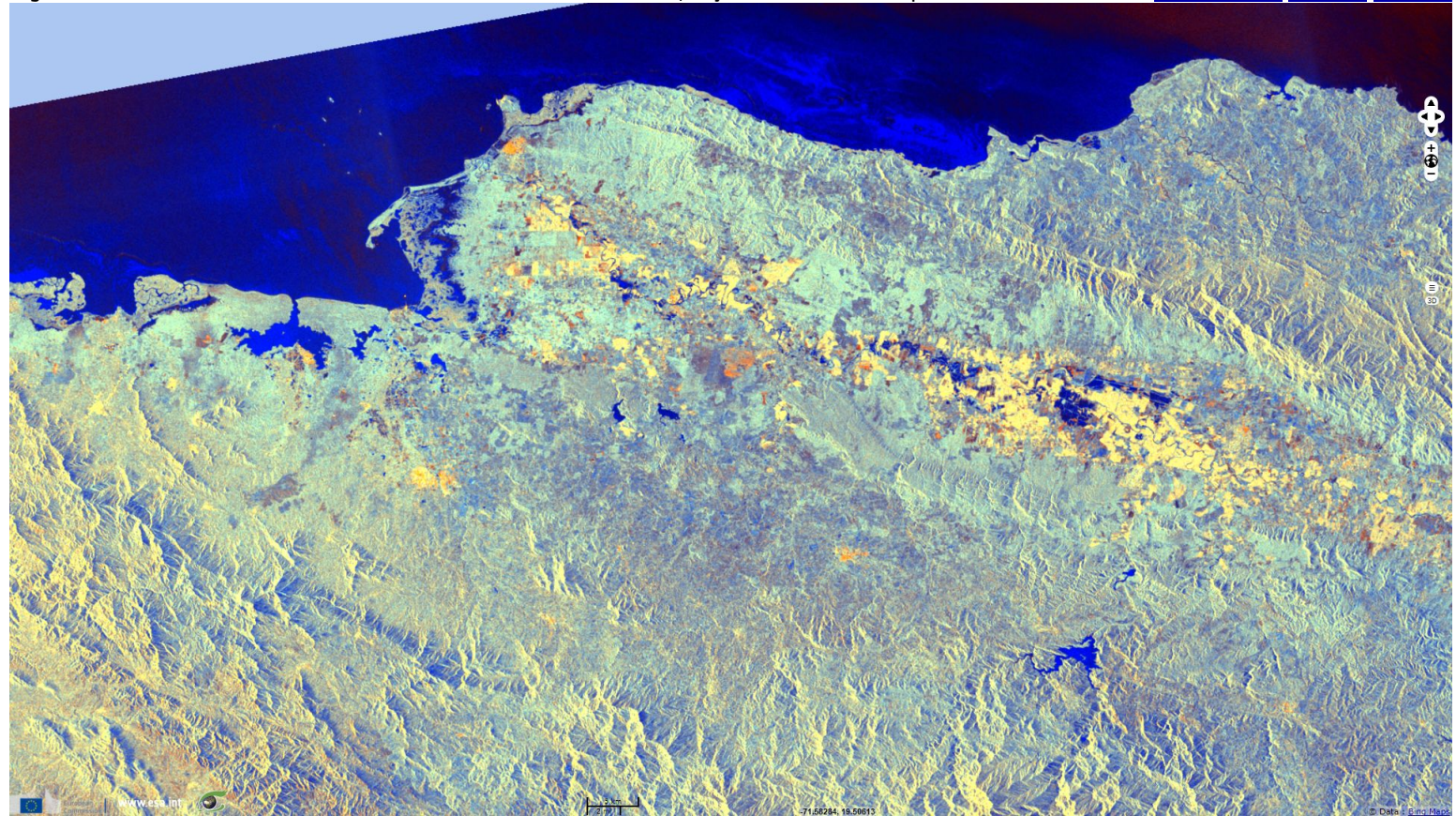


With sustained winds exceeding 300kph at its apex and remaining hundreds of kilometers wide for several days, Irma is one of the strongest hurricane ever recorded in the Atlantic ocean. Though its eye made landfall over several of the smaller Caribbean islands, causing them castrastrophic damage, extensive flooding can be more readily assessed on bigger land areas.

Bright red to orange waters show higher backscattering caused by waves that can be attributed to high wind speed. The co-polarised component (red) is more sensitive to this than the cross-polarised (green) which is why the colour leans more toward the red where the waves are high.

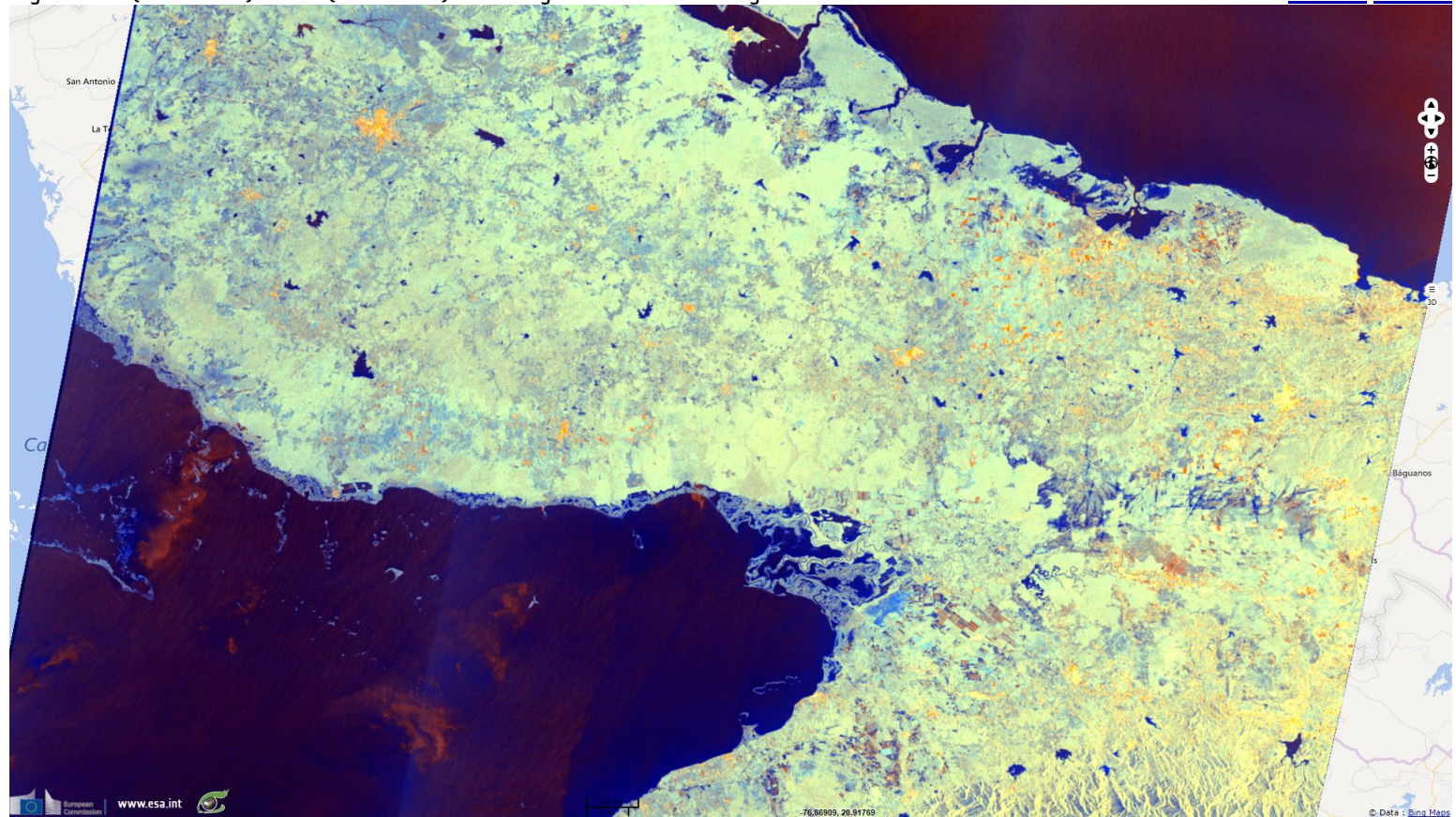
The blue channel corresponds to the normalized difference between cross-polarised and co-polarised bands. When there are no waves to backscatter the signal toward the satellite, such as here in the eye wall, values are about as low in both bands in which case the normalized difference is comparatively higher, hence a blue hue. This happens over areas where the wind is low (such as wind sheltered areas) or where intense rainfalls are taking place.

Fig. 2 - S1A (02.09.2017) & S1B (08.09.2017) - Floods in Monte Cristi, Dajabon (Dominican Rep.) & Nord-Est (Haiti). [2D animation](#) [2D view](#) [2D view](#)



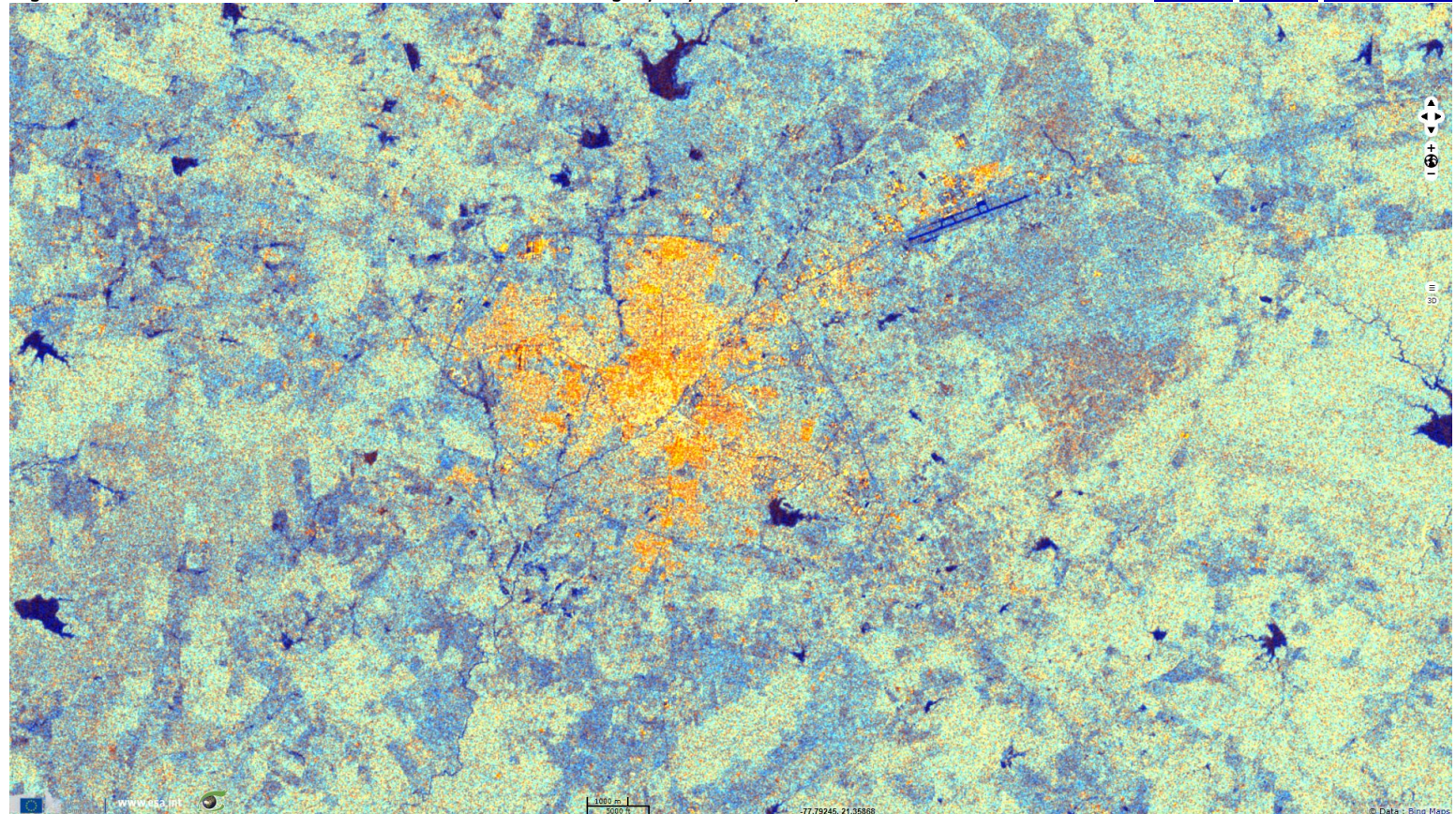
Hispaniola island was not crossed by Irma's eye but in Dominican Republic beach resorts and thousands of locals were evacuated to safety. The provinces of Monte Cristi (mostly flood plains near Yaque del Norte river) and Dajabon in Dominican Republic and Nord-Est (cities of Ferrier, Bossus and Fort Liberté) in Haiti were flooded by the precipitation as it is highlighted by comparing these images taken days before and hours after Irma's passage.

Fig. 3 - S1A (03.09.2017) & S1B (09.09.2017) - Flooding in the south-east regions of Cuba. [2D view](#) [2D view](#)



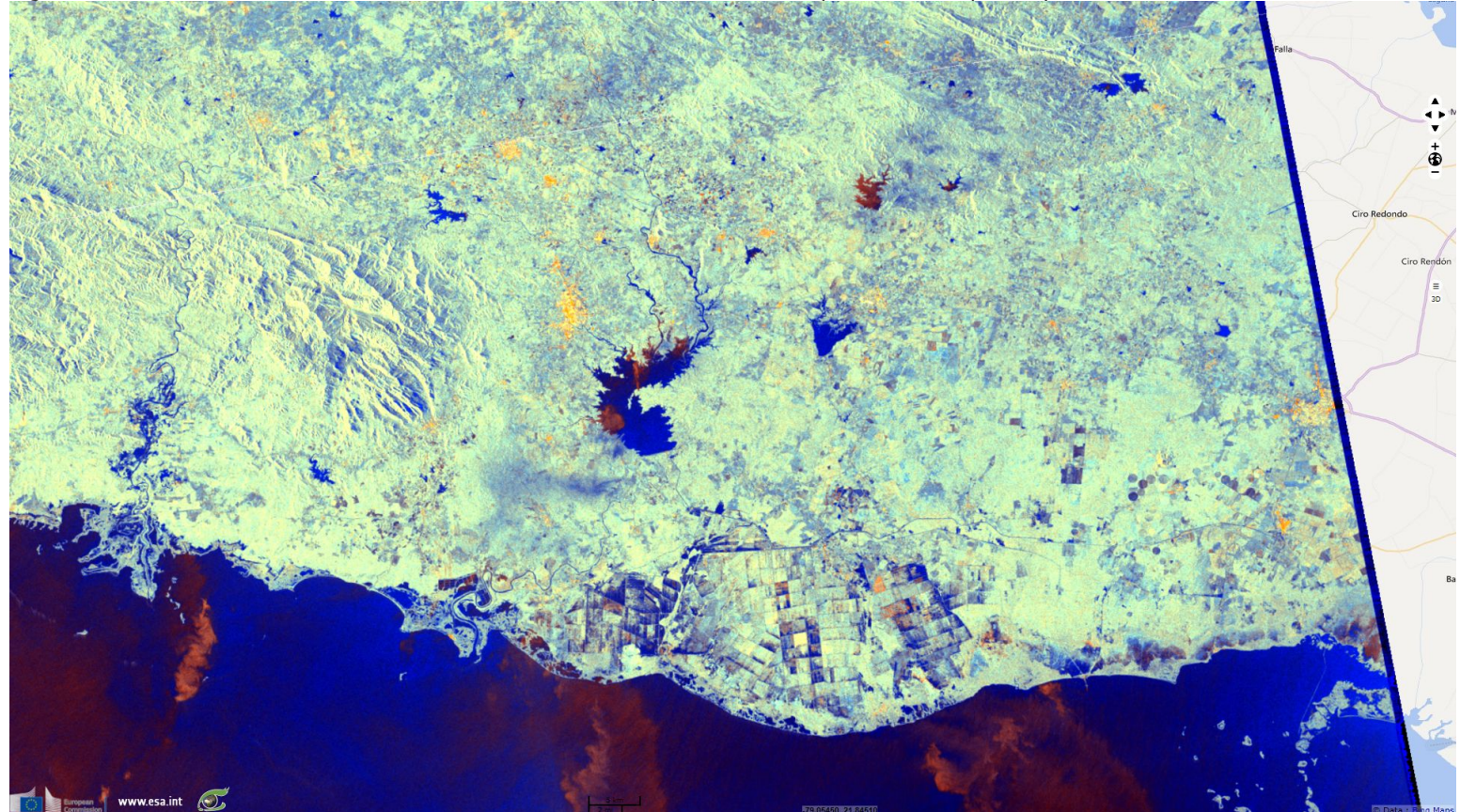
Irma then directed toward Cuba "where more than a million people have evacuated their homes as a precaution." according to [France24](#). The New-York Times [reminds](#): "it was the first Category 5 hurricane to make landfall in Cuba since 1924".

Fig. 4 - S1A (03.09.2017) & S1B (09.09.2017) - Zoom on Camagüey city flooded by rainfed rio Hatibonico & rio Tinima. [2D view](#) [2D view](#) [2D animation](#)



Camagüey is the third largest city in Cuba, its city centre is a UNESCO World heritage site. Located in a plain between rio Hatibonico and rio Tinima, it was vulnerable and was damaged as these rivers flooded.

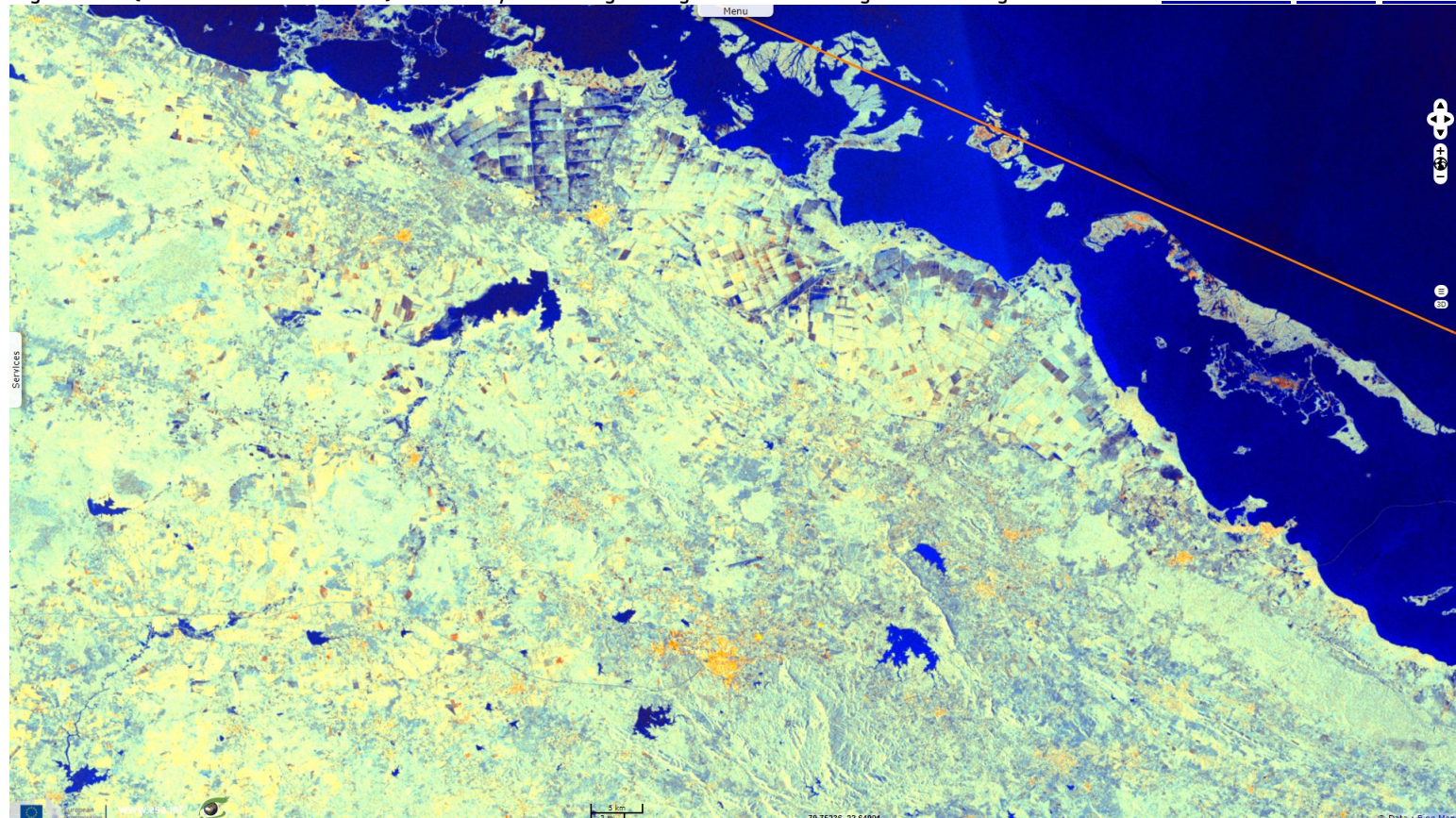
Fig. 5 - S1A (29.08.2017 & 10.09.2017) - While further from the eye, south Sancti Spiritus wasn't spared by rainfalls. [2D view](#) [2D view](#) [2D animation](#)



At west, Rio Agabama flooded near its outlet. In the center, Embalse Zaza and la Felicidad lakes gathered a lot of waters. Croplands located near the southern coast were drenched by excessive water.

Fig. 6 - S1A (29.08.2017 & 10.09.2017) - Irma's eye ran along the lagoon area bordering Villa Clara region

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



According to Cuba meteorologic services, the country was hit by 260 kph sustained winds and its northern coast was hit waves up to 7m high.

Fig. 7 - S1A (29.08.2017 & 10.09.2017) - Lakes and rivers overflowing south of Cienfuegos and Matanzas regions.

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

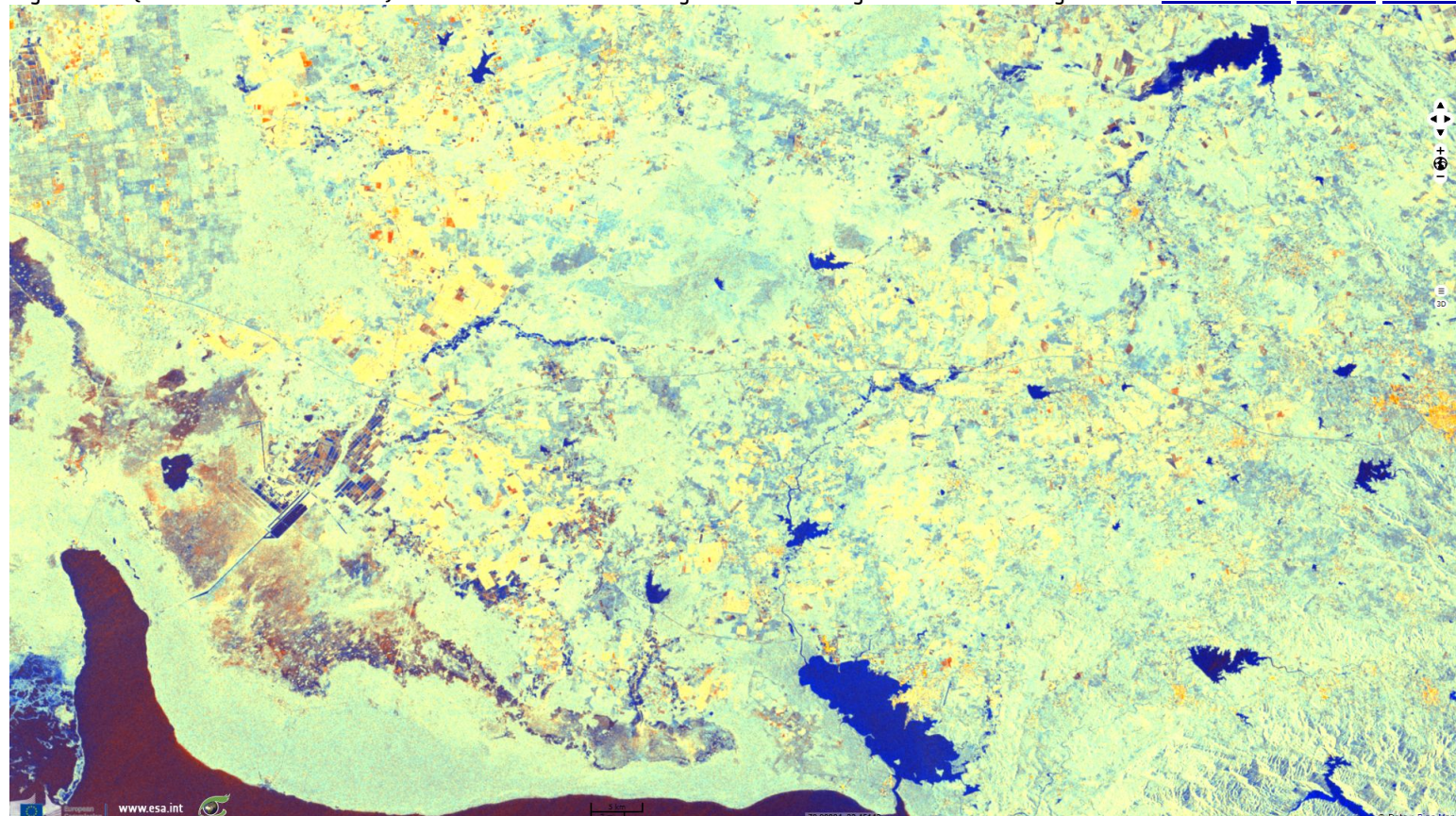


Fig. 8 - S1A (29.08.2017 & 10.09.2017) - Soaked cropland north-east of Matanzas region.

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

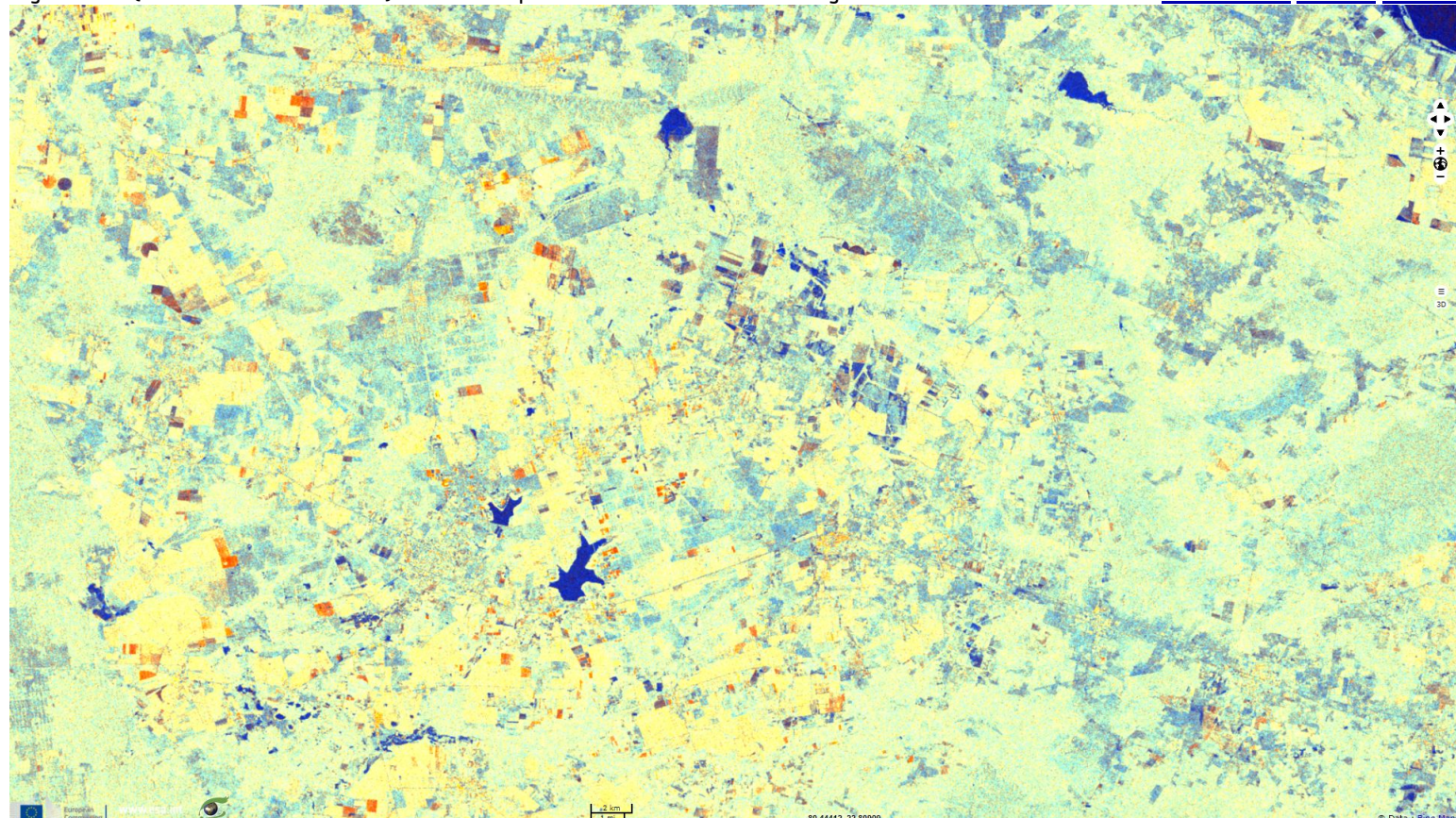
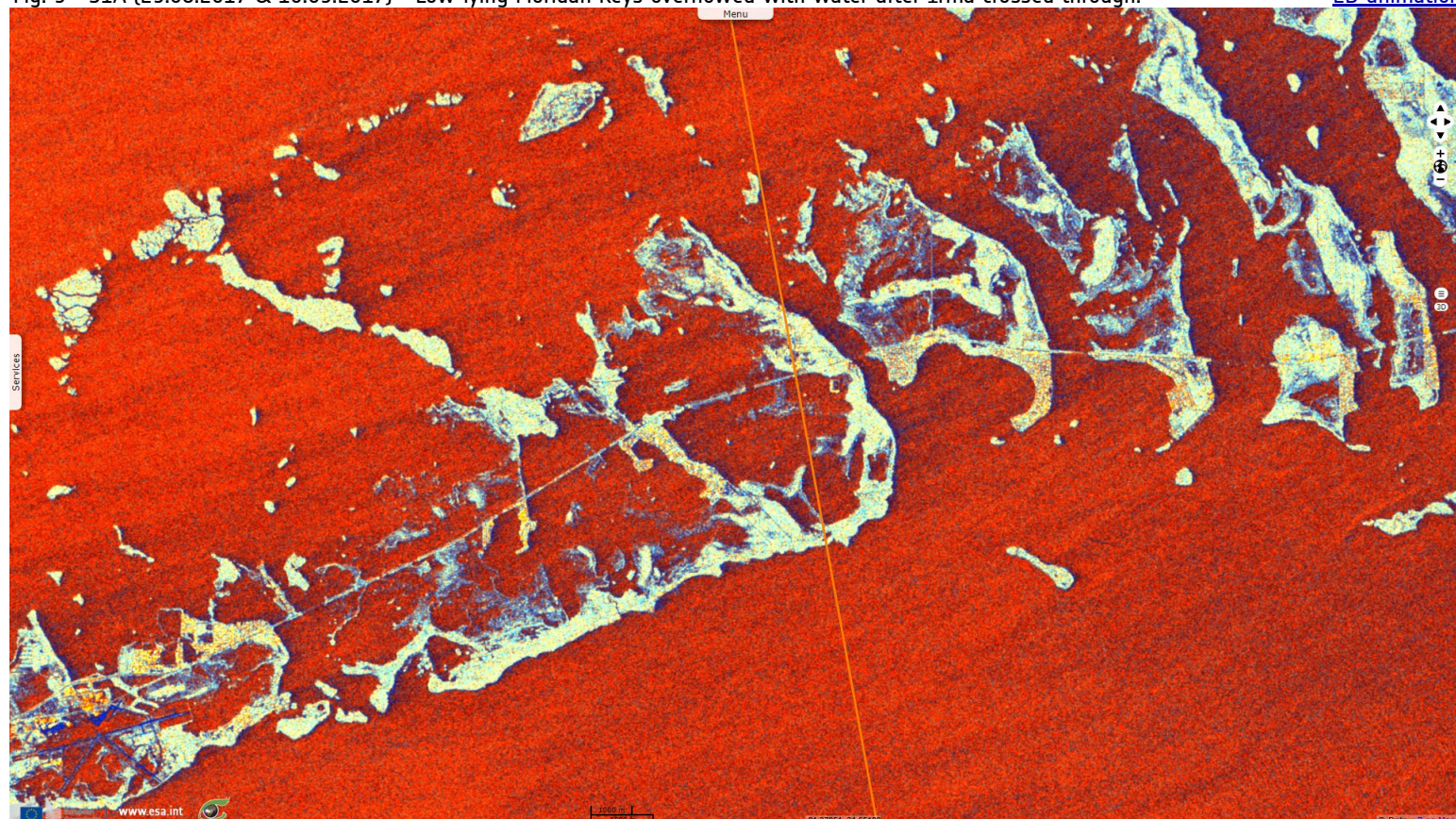


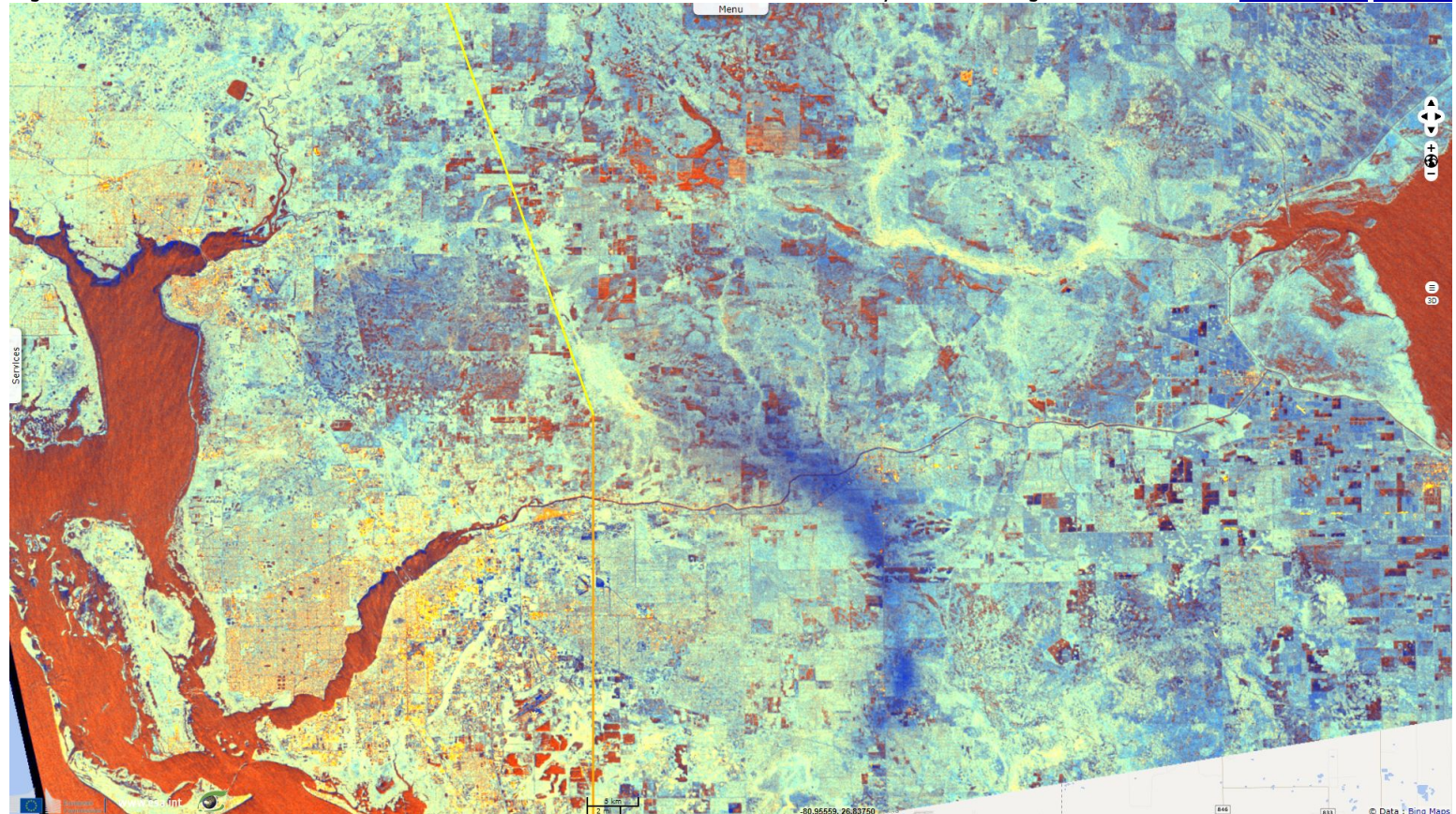
Fig. 9 - S1A (29.08.2017 & 10.09.2017) - Low-lying Floridan Keys overflowed with water after Irma crossed through.

[2D animation](#)















Being low lying islands located on Irma's path, the Keys in Florida were at risk from even a weakened Irma. According to the Federal Emergency Management Agency (FEMA), *"At least a quarter of houses in the Keys were destroyed, [...] while 65 per cent of buildings suffered damage."* Flooding can be easily identified in Key West military base, at the south west of the image, and in most of the bigger islands.

Fig. 10 - S1A (29.08.2017 & 10.09.2017) - Western coast of Florida while it was roamed by the weakening hurricane Irma. [2D animation](#) [2D view](#)



The New-York Times [reminds](#): "Florida officials directed 6.5 million residents to leave their homes in one of the largest emergency evacuations in American history. On Saturday evening, Gov. Rick Scott of Florida warned that the state could get as much as 18 inches of rain, with the Keys getting up to 25 inches. Southwest Florida could see a storm surge of 15 feet above ground level, and entire neighborhoods stretching northward from Naples to Tampa Bay could be submerged.". Irma is estimated to have caused over 100 casualties with over fifty people killed in mainland US and 15 million suffered outages during the storm.

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