

Surface Water and Ocean Topography

INTRODUCTION

The SWOT (Surface Water and Ocean Topography) mission is a joint initiative launched on December 16th 2022 by NASA (National Aeronautics and Space Administration) and CNES (Centre National d'Études Spatiales), in partnership with the CSA (Canadian Space Agency) and the UKSA (United Kingdom Space Agency) [1]. The primary goal of this mission is to study both ocean and terrestrial surface waters, with a specific focus on how water levels change over time. [1] [2]

APPLICATION

Because the satellite was launched not too long ago (16th December 2023), new applications are still being tested. Based on the accuracy increase of one order in magnitude, projects use SWOT data for mainly two purposes:

The satellite enables highly accurate mapping of water bodies on land, combined with more precise measurements of water levels and depths. The 2-radar sensor model shows high coherence and the measured phase difference can be trusted to retrieve the elevation of the scene. This improves the prediction and estimation of water volumes, advancing hydrologic models.

Based on the finer resolution of ocean topography and water levels, sub-mesoscale currents can be observed and modelled, providing insight into local nutrient and heat flow of the ocean. Since the ocean is the biggest heat sink of the earth, the SWOT data will lead to major improvements in climate modelling. [3,4]

What makes the sensor fit the application ?

Thanks to being equipped with two radar sensors, both acquisitions can be compared. When both signals show high coherence the measured phase difference can be trusted to retrieve the elevation of the scene. Thanks to the sensors pointing at nadir, water bodies and all flat areas in general yield a strong backscattering signal, allowing to reach high coherence on water surfaces. SWOT's ability to revisit every 21 days also allows for frequent observations across the globe, which is crucial for long-term studies and modelling of water bodies and oceanic processes.

DESCRIPTION

SWOT is set to map the entire globe over a period of three years. The satellite points at nadir, and after operating in a fast-sampling phase, it covers Earth's surface every 21 days. [2] Picture around 120km x 150km

The satellite is equipped with two radar sensors. The key instrument on SWOT is the Ka-band Radar Interferometer (KaRIn), which operates in the microwave **Ka-band** frequency range around 27-40 GHz Microwave bands It has a resolution around 10-20m and an accuracy of 0.5m. [2]

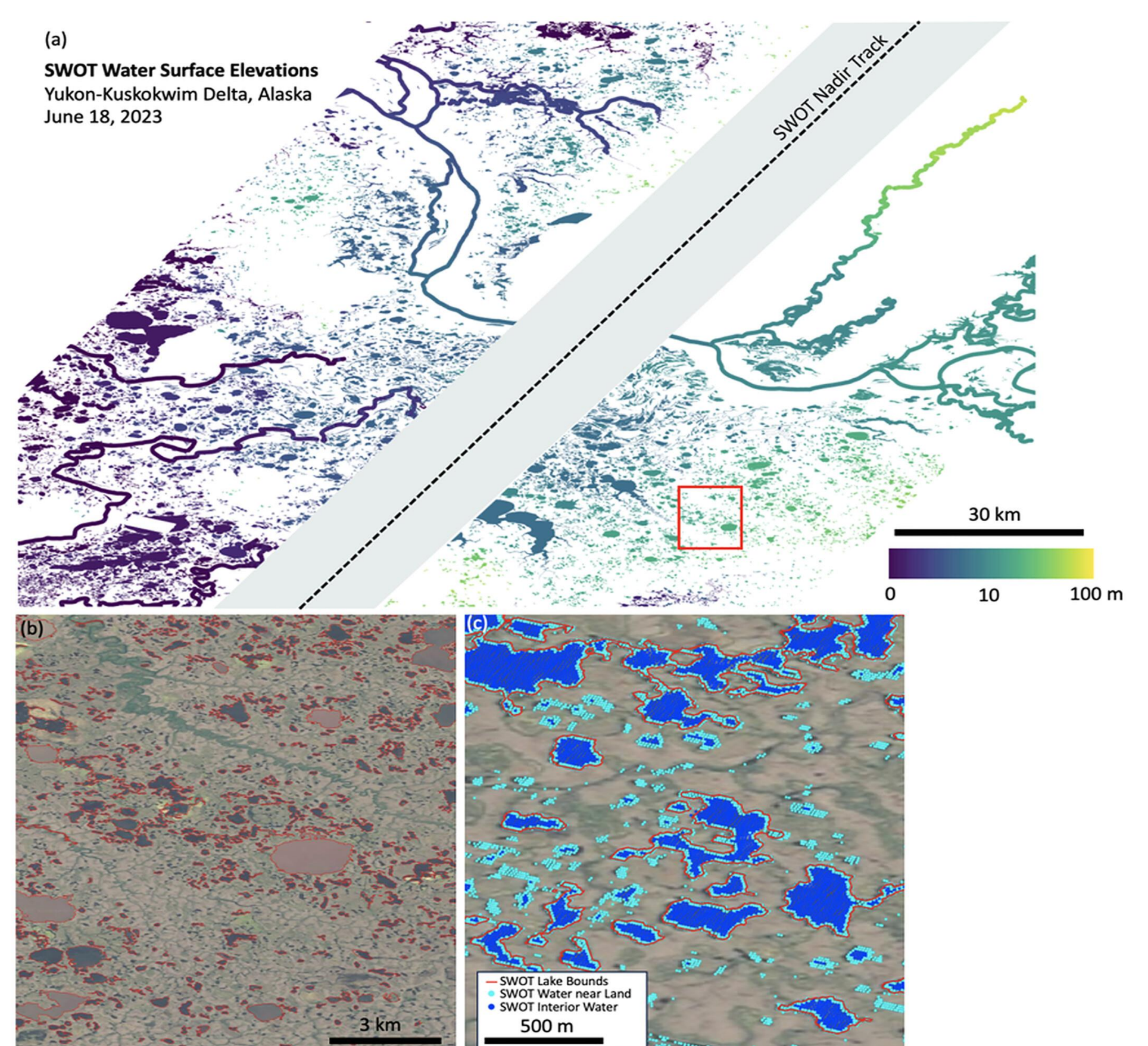
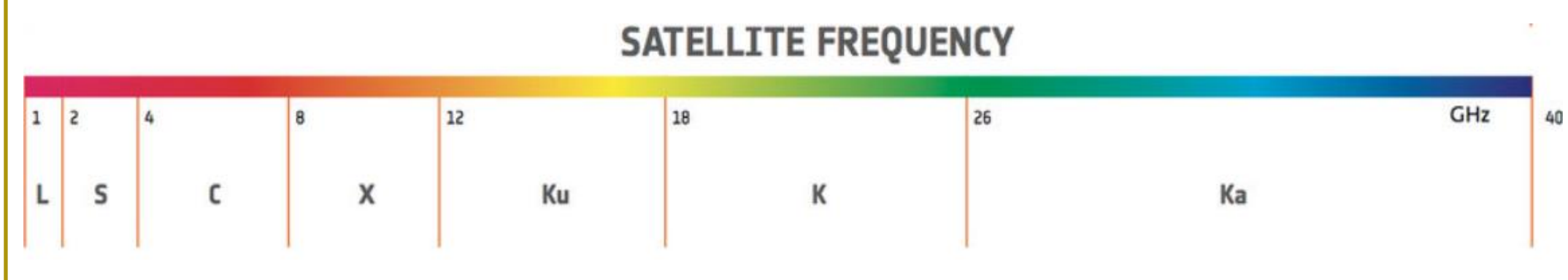


Fig 1: Mapping of continental water bodies

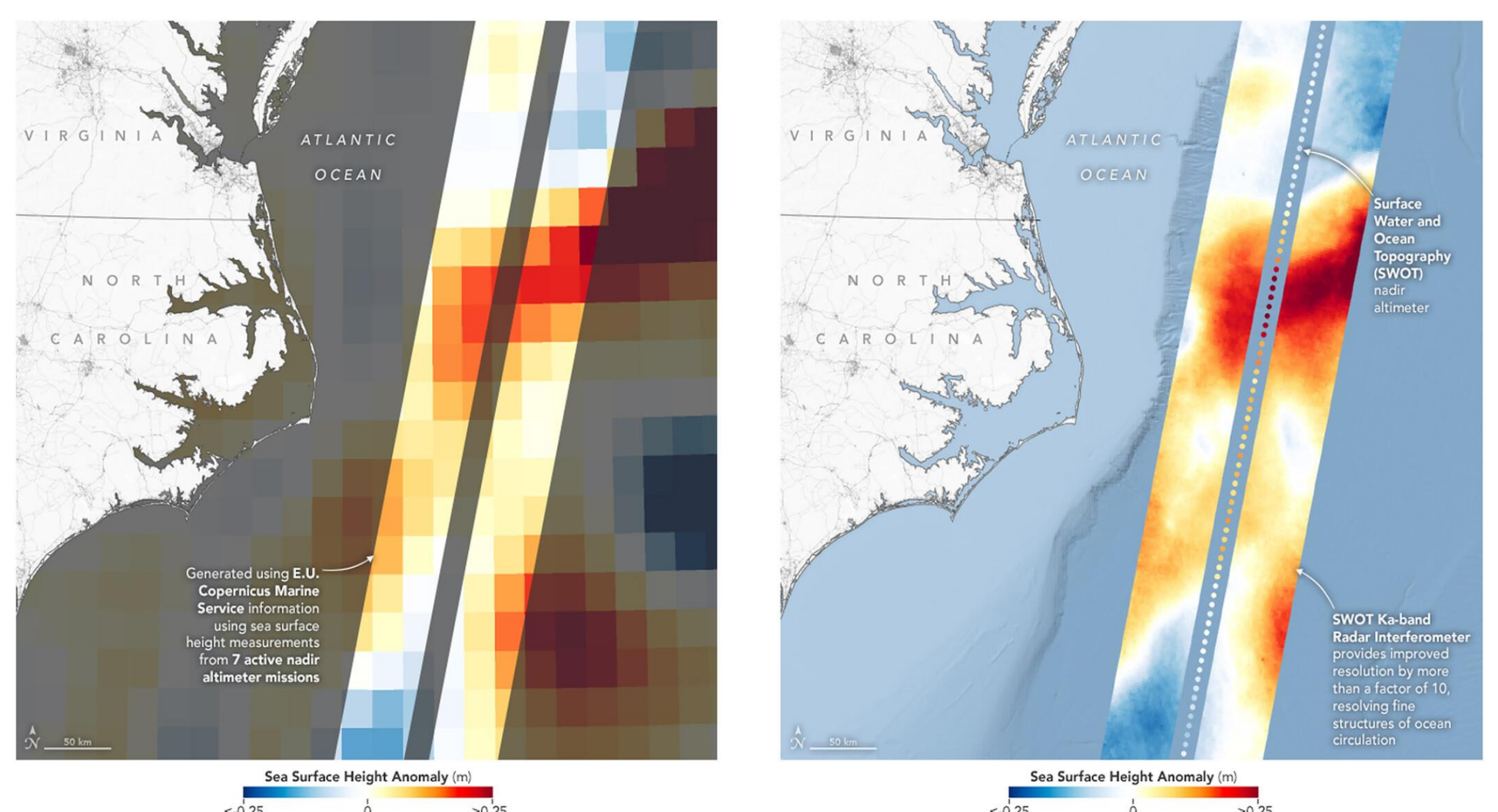


Fig 2: Ocean topography mapping before and after SWOT

Sources: [1] <https://swot.jpl.nasa.gov/> [2] <https://www.eoportal.org/satellite-missions/swot#performance-specifications> [3] <https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2023GL107652>

[4] <https://journals.plos.org/water/article?id=10.1371/journal.pwat.0000226>

<https://eosps.nasa.gov/missions/surface-water-ocean-topography>

https://en.wikipedia.org/wiki/Surface_Water_and_Ocean_Topography