Arctic salinity from space: Monitoring the freshwater system.

Justino Martínez[1], Carolina Gabarró[2], Veronica Gonzalez-Gambau[2], Cristina González-Haro[1], Estrella Olmedo[2], Joaquim Ballabrera-Poy[1], Antonio Turiel[1], Rafael Catany[3], Manuel Arias[3], Rhiannon Davies[3], Laurent Bertino[4], Jiping Xie[4], Roshin P. Raj[4], Roberto Sabia[5], Wenqing Tang[6], and Simon Yueh[6]

[1]Institute of Marine Sciences, CSIC
[2]Barcelona Expert Center, Institute of Marine Sciences, CSIC
[3]Argans Ltd.
[4]Nansen Environmental and Remote Sensing Center
[5]Telespazio-Vega for European Space Agency
[6]Jet Propulsion Laboratory

November 24, 2022

Posted on 24 Nov 2022 — CC-BY 4.0 — https://doi.org/10.1002/essoar.10501363.1 — This a preprint and has not been peer reviewed. Data may be preliminary.

Abstract

The Arctic Ocean contains only a 1% of the world's ocean water, but the rivers that flow out into it account for the 10% of the volume world's rivers freshwater. The upper layer of fresher water facilitates the creation of sea ice and plays an important role in the position of the jet stream and storms over the northern hemisphere [ISBN, 978-82-7971-097-4]. Remote sensing measurements are of special importance in the Arctic since in situ data is very scarce there. SMOS and SMAP are currently providing sea surface salinity (SSS) measures, but only the product provided by Barcelona Expert Center (BEC) is a dedicated product for the Arctic region. The product that we present in this work is an improvement of the BEC Arctic v2.0. The new version 3.0 has as the primary objective the describing better the river discharges. The spatial grid used is WGS84/NSIDC EASE-Grid 2.0 North for the all stages of the processing chain. This procedure avoids spatial interpolation, favoring the definition of river mouths. The salinity retrieval is based on the Debiased non-bayesian method [doi:10.1016/j.rse.2017.02.023] and similarly to what is done in the processing of altimetric data, SMOS salinity is corrected using a reference calculated from the own SMOS data for each latitude, longitude, pass orientation and antenna measuring position. Arctic v3.0 differs from current method [doi:10.3390/rs10111772] in two important points: the reference is computed for brightness temperature instead of SSS and the antenna has been divided in a more homogeneous grid. Other improvements concern to data filtering and propagation of the radiometric errors to SSS. All these improvements provide level 3 maps less noisy, increasing the effective resolution of salinity gradients. Freshwater gradients are much better resolved than in previous version (Fig. 1). Comparison with JPL SMAP product is also planned as a first step to generate a combined product. This work is funded by ESA Arctic + project and also includes the assimilation of the resulting SSS product in the ocean-sea ice data assimilation system TOPAZ as the next version TOPAZ5. A preliminary study [doi:10.5194/os-2018-163] has been performed concluding that BEC product could be a good candidate to be assimilated by TOPAZ. Moreover, some preliminary tests with a pre-release v3.0 version will start shortly.

Arctic salinity from space: Monitoring the freshwater system

Justino Martínez[1], Carolina Gabarró[1], Verónica González-Gambau[1], Cristina González-Haro[1], Estrella Olmedo[1], Joaquim Ballabrera-Poy[1], Antonio Turiel[1], Rafael Catany[2], Manuel Arias[2], Rhiannon Davies[2], Laurent Bertino[3], Jiping Xie[3], Roshin P. Raj[3], Roberto Sabia[4], Wenqing Tang[5], Simon H. Yueh[5]

[1]Barcelona Expert Center, Institute of Marine Sciences, CSIC, Physical and Technological Oceanography, Barcelona, Spain
[2]Argans Ltd., Plymouth, United Kingdom — [3]Nansen Environmental and Remote Sensing Center, Bergen, Norway
[4]Telespazio-Vega for European Space Agency, Frascati, Italy — [5]Jet Propulsion Laboratory, Pasadena, CA, United States

Arctic+ Salinity

ESA ITT: AO/1-9158/18/I-BG

arcticsalinity.argans.co.uk

Arctic+ salinity is an ESA's Invitation To Tender devoted to provide a better description of salinity gradients, freshwater fluxes and currents than the obtained until now from SMOS derived products. The result is a product capable of characterize the Arctic salinity and monitor some aspects of the climate change.

Arctic+ salinity ITT started in December 2018 and it will finish in June 2020. Now we are presenting the resulting salinity product that will be freely distributed in January. The next step is to provide specific studies about the Arctic.

Stay tuned to our oral contribution in Ocean Sciences Meeting 2020!

ARGANS

CSIC Consejo Superior de Investigaciones Científicas — ICM Institut de Ciències del Mar — NERSC

Data distribution

BEC Barcelona Expert Center

Arctic+ salinity product will be publicly available in January. Our distribution list is open to inform about news concerning this and oher products.

Our products are distributed by ftp. You can freely register to this service.

Arctic+ salinity daily 9-day maps will be distributed in WGS 84 / NSIDC EASE-Grid 2.0 North EPSG:6931 (25 km) for years 2011-2019.

DOI 10.20350/digitalCSIC/9065

This is the SMOS satellite

Questions? Contact with Justino at justino@icm.csic.es

2D ANIMATION

Kangerdlugssuaq Fjord

500 m

200 m

Internal waves

Norwegian current

Freshwater current

Pechora

Discharges

Dvina

Elbe

Rhine

Discharges

Arctic rivers Pacific inflow

Olenkov

Mackenzie

Lena

Yukon

Extreme 2015 run off of Ob river seems to be originated by continental melting. Probably linked to abnormally high temperatures in summer.

Ob'

Lena

Olenkov

Yenisei

2015 Ob' run off

2D ANIMATION

Sea Surface Salinity 28 30 32 34 36

09/2019

3D ANIMATION

Sea Surface Salinity 28 30 32 34 36

10/2014

2D maps and the corresponding animations have been made using Panoply (https://www.giss.nasa.gov/tools/panoply/). 3D animation has been made using ParaView (https://www.paraview.org/)

TAKE A COPY

AGU100 Advancing Earth and Space Science

AGU FALL MEETING — Thursday, 12 December 2019

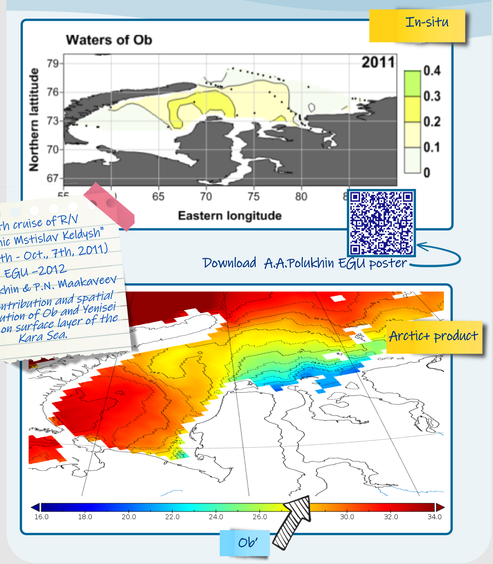
SMOS MISSION

providing L-band data since 2010

Soil Moisture and Ocean Salinity (SMOS) mission is measuring those variables from space since 2010.

SMOS, launched on 2 November 2009, is one of the ESA's Earth Explorer missions. Its single payload, the Microwave Imaging Radiometer by Aperture Synthesis radiometer (MIRAS), is the first 2D synthetic aperture interferometric radiometer in space. It operates in L-band at 1.413 GHz.

SMOS provides brightness temperature 2D images about 1400 km wide every 1.2 seconds.

esa

Rivers freshwater signatures are well characterized