High–resolution raw satellite data for sea surface salinity and temperature in coastal areas globally



Dr Encarni Medina-Lopez

Chancellor's Fellow in Data Driven Innovation, Space & Satellite



EGU2020: Sharing Geoscience Online 《 그 》 《 문 》 《 문 》 《 문 》 《 문 》 종 문 》 영 역 ()

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About me



More in my webpage, Google Scholar, and LinkedIn.

COASTAL AND ENVIRONMENTAL REMOTE SENSING GROUP (CERES)



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PROJECTS AT CERES

Research projects:

- SCORE: Satellite Climate Observation for Offshore Renewable Energy Cost Reduction (Supergen ORE Flex Fund funded) – Dr Simone Zen (Simone.Zen@ed.ac.uk)
- Remote sensing of the spatial and temporal dynamics of the Omo river and delta.
- PhD projects:
 - High-resolution satellite remote sensing of the coastal morphology: erosion, flooding and climate change scenarios – Ms Emma McAllister (Emma.McAllister@ed.ac.uk)
 - Remote sensing of water chemistry parameters to aid decision-makers, effectively monitor water bodies and enhance sustainability of treatment plants with water service providers - Mr James Harding (James.Harding@ed.ac.uk)
 - ▶ High-resolution sea surface salinity and temperature in coastal areas

THE RELEVANCE OF SATELLITE DATA

- Ocean Energy Europe and Copernicus Satellite Network in partnership (23rd April 2018): generate data on seas and oceans *available* to industry [*].
- Satellite data: fair use of information. Development cooperation.
- Free data. ESA Climate Change Initiative (United Nations).





- Human interactions in environment worldwide.
- New and existing **coastal popula-tions**.
- Marine energy applications: observing waves and wind from space.

[*] Press release: https://www.oceanenergy-europe.eu/press-release-oee-and-copernicus-marine-service-to-help-the-european

-ocean-energy-industry-to-go-global

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High–resolution raw satellite data for sea surface salinity (SSS) and temperature (SST) in coastal areas globally

- Motivation: Ocean Salinity and Temperature relevant for climate change, hydrological cycle, human activities, etc.
- Existing info:
 - Discrete local info: Buoys? Vessels?
 - Numerical models: need boundary conditions and validation data.
 - Current SSS and SST derived from satellite, very poor resolution (~ 35 km SMOS (SSS), ~ 4 km MODIS (SST)), more needed near the coast.
- Using Sentinel-2 data level 1C (10 60m resolution multi–spectral), revisit time ~ 5 days. Data since 2015 covering all oceans.
 - 13 spectral bands (RGB, water vapour, NIR, SWIR, ...) + Cloud mask band (clear sky vs. cirrus / opaque clouds).
 - We use Top of Atmosphere Reflectance. Atmospheric corrections normally applied to convert to BOA (Slow! Loss of information). We avoid this step ("raw"data).
- Copernicus in situ data: more than 14,000 valid SSS and SST platforms around the world (4,600 since 2015).



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Matching process + Deep Neural Network (NN):

- ► In situ data flag system (Copernicus) only very good data.
- Sentinel–2 band data around platform location (100m).
- Temperature and Salinity are trained independently. Salinity is trained with NO information on temperature!
- NN is trained for Interpolation (NN knows how platform behaves) and Extrapolation (NN has never seen any data from platform).

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TEMPERATURE extrapolation: |Predicted - Measured|. Most common error ~ 0,4° C. Correlation 86%



Source: Medina–Lopez et al: High–resolution sea surface temperature and salinity in coastal areas worldwide from raw satellite data. Remote Sensing, 11(19), 2019, https://doi.org/10.3390/rs11192191.

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SALINITY extrapolation: |Predicted - Measured|. Most common error ~ 0,4PSU. Correlation 82%



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Evaluation in all pixels on tile region over Guadalquivir River mouth and Bay of Cádiz

- ▶ NN evaluated in all pixels. 100m resolution. Patterns, eddies, fronts?
- Yearly analysis for 2016.



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THANK YOU

emedina@ed.ac.uk



