PROJECT TITLE: Sea level rise: Solving the puzzle of the 20th Century record

DTP Research Theme(s): Changing Planet

Lead Institution: University of Bristol

Main Supervisor: Prof Jonathan Bamber, School of Geographical Sciences, Bristol

Co-Supervisors: Dr Rory Bingham and Dr Sam Royston, School of Geographical Sciences, Bristol

Co-Supervisors: Dr Svetlana Jevrejeva and Dr Francisco Calafat, National Oceanography Centre, Liverpool

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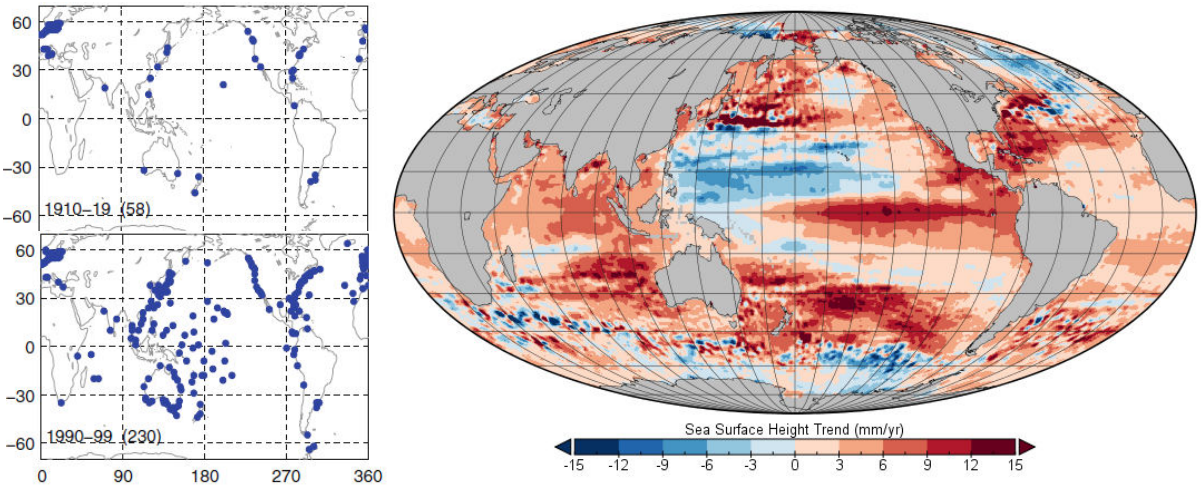

Difference in available tide gauge data between 1910-1919 (left top) and 1990-1999 (left bottom). Spatial variability in sea level trends observed by satellites (right; 2005 – 2015).

Project Background

Sea level rise (SLR) is a key indicator of climate change (an Essential Climate Variable) and is one of its most serious consequences for society. Different reconstructions for 20th Century sea level rise rates have been produced from tide gauge data but with conflicting estimates. Since 1992 we have also had observations from satellite altimetry, but these measurements also have uncertainty in the early part of the record and increasing errors near the coast. Obtaining a robust and reliable estimate of SLR is a critical step to improving projections and our understanding of how the oceans are responding to a changing climate. It is the aim of this project and allied to a European Research Council project called GlobalMass, based in Bristol (www.globalmass.eu).

Project Aims and Methods

The aim of this project is to produce a consistent, rigorous sea level record from the "measurement era" (late 19th, 20th and first two decades of the 21st Century) from a combination of tide gauge data, satellite altimetry, ocean model output and statistical inference techniques that can combine the different data sets and account for their different accuracies and spatial and temporal properties. To achieve this we will use a statistical inference approach, which will allow us to combine prior knowledge about how the oceans behave with observations to produce an estimate for SLR and, equally importantly, reliable uncertainties for those estimates. The student will take advantage of new coastal altimetry data sets and recently

recovered historical tide gauge records, which can be difficult to incorporate into traditional sea level reconstruction techniques.

The tide gauge data do not just measure SLR, however and may be affected by local vertical land motion due to tectonics or human-induced effects such as water extraction or impoundment. They require careful handling and good understanding of their reliability and quality. Similarly satellite altimetry has systematic errors that need to be considered in our statistical approach. The project is joint with the National Oceanography Centre Liverpool, who maintain the tide gauge archive and are the world leading experts on them. The project also involves experts in satellite altimetry and statistical inference. The student will be working with world class scientists in all these aspects of the problem.

Candidate

You will have a degree in a numerate discipline such as physics, maths, statistics, electrical engineering or geophysics. You will be someone that wants to apply their skills to geoscience problems of global significance and be happy working in a multidisciplinary environment. Some computer programming experience would be beneficial.

Collaboration

The student will be co-supervised Sveta Jeverejeva and Francisco Calafat at National Oceanography Centre, Liverpool (see for example http://www.psmsl.org/about_us/). NOC have a background in sea level reconstruction and projection and will advise on all aspects of the analysis of the tide gauge records, as well as collaborating on the methods for interpolating the data to produce an unbiased estimate of SLR.

Training

The student will receive in-house training in all aspects of the problem covering climate change, oceanography, satellite remote sensing, statistical inference and computer programming. In addition to university run courses there will be opportunities to attend relevant external events such as the Delft Summer School on Sea level Change. In addition, extensive day to day support would be provided by members of the GlobalMass project (www.globalmass.eu)

References / Background reading list

Church & White (2011), Sea-Level Rise from the Late 19th to the Early 21st Century, Surveys in Geophysics, 32:585-602, doi:10.1007/s10712-011-9119-1

Dieng, H. B., A. Cazenave, B. Meyssignac, and M. Ablain (2017), New estimate of the current rate of sea level rise from a sea level budget approach, Geophysical Research Letters, 2017GL073308, doi:10.1002/2017GL073308.

Hamlington, B. D., and P. R. Thompson (2015), Considerations for Estimating the 20th Century Trend in Global Mean Sea Level, Geophys. Res. Lett., n/a-n/a, doi:10.1002/2015GL064177.

Hay, C. C., E. Morrow, R. E. Kopp, and J. X. Mitrovica (2015), Probabilistic reanalysis of twentieth century sea-level rise, Nature, doi:10.1038/nature14093.

Watson, C. S., N. J. White, J. A. Church, M. A. King, R. J. Burgette, and B. Legresy (2015), Unabated global mean sea-level rise over the satellite altimeter era, Nature Clim. Change, 5(6), 565-568, doi:10.1038/nclimate2635

Links

School webpage - http://www.bristol.ac.uk/geography/courses/postgraduate/
Bristol Doctoral Training Prospectus: http://www.bristol.ac.uk/study/postgraduate/about/research-programmes/