



## **Report on a research visit to the National Oceanography Centre, Liverpool, UK**

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**Host institution:** National Oceanography Centre, Liverpool, UK

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### **Motivation for research**

Sea level extremes are consequences of a variety of processes spanning over different temporal and spatial scales. Due to the global rise of mean sea level, extremes are expected to become more frequent with their impact being presumably multiplied in the future climate. Therefore, their understanding and assessment of their future occurrences is of the utmost importance to the humankind. The visit to the National Oceanography Centre (NOC) provided by the British Scholarship Trust (BST) has given me an insight on one of the world's leading institutions in the field of oceanography and allowed me to work with great scientists whose ideas and research have been an inspiration for my PhD research from the very beginning. The time spent in the NOC enabled me to introduce a whole new topic to my PhD research, which has further allowed me to shape the draft of my own doctoral thesis.

### **Doctoral research**

My doctoral research is focused on the meteorological tsunamis and other nonseismic sea-level oscillations at tsunami timescales (NSLOTTs) which have recently taken an emerging role in sea-level research. These phenomena have been documented to generate destructive floods across the world's coastlines, to threaten the safety of navigation and to affect coastal structures and people at beaches. However, limitations of the systematic research of NSLOTTs exist, mostly because of lack of global long-term sea-level data of research quality with a small sampling interval. To override such a deficiency, raw sea-level data measured with 1- minute temporal resolution at numerous global tide gauges were obtained from several sources, quality-checked, filtered to extract the high-frequency oscillations and gathered into the publicly-available dataset named MISELA (Minute Sea-Level Analysis). Once created, the MISELA dataset was analysed in order to create a global climatology of NSLOTTs. The variances of the NSLOTT series and their ranges were calculated to estimate moderate and extreme manifestations of NSLOTTs, as well as to quantify their contribution to the total sea-level height in the different world's regions. Moreover, strong events were extracted and examined at each station, while the synchronicity between occurrences of extreme episodes at neighbouring stations was quantified.



## **Collaboration in the UK**

My visit to the NOC was a valuable experience, through which I established a collaboration with scientists from this institution. My host supervisor Dr Joanne Williams, who I met in 2019 at the General Assembly of the International Union of Geodesy and Geophysics in Montreal, Canada, was excited to host me and to dedicate her time to get familiarized with my PhD research. Back in Montreal, she kindly offered her help and provided software tools which I used for data quality check during construction of the MISELA dataset. This was a cornerstone for our collaboration, which has been again renewed during my stay in the NOC.

## **Research at the NOC**

After completing the MISELA dataset and performing its analyses it was a time to introduce an atmospheric component to this study, as the NSLOTTs have meteorological origin and are generated by atmospheric disturbances. The idea and the work plan were established in its final form upon my arrival in the UK and included (i) obtaining synoptic variables from the atmospheric reanalysis, (ii) determining an atmospheric setup during extreme episodes of NSLOTTs, and (iii) constructing the index which quantifies the connection between NSLOTTs and atmospheric processes. Global correlations between relevant synoptic variables (like wind, temperature, mean sea-level pressure, geopotential and others on the vertical profiles above the affected area) and NSLOTTs were determined to depict patterns of the atmospheric setup during extreme events. For each location, an optimal combination of these variables was established and used for constructing the index. Therefore, the aim of this study is to understand the complex combination of atmospheric processes which generate NSLOTTs in the different world's regions. This should allow for a global reanalysis of NSLOTTs and short-term forecasts, the latter being the ultimate goal of such analyses. The analyses were conducted during my stay in the UK, while the paper based on the results is currently in preparation and soon to be submitted in a high-ranked journal.

## **Additional engagement**

During my visit, I participated in the weekly meetings of the sea-level group in the NOC in which around 15 experts from this field discuss their ideas, current progresses and plans for future research. Upon my arrival, I was invited by Dr Williams to present my research at this meeting, too. I gave a talk about my PhD research which was then followed by a long discussion. There I gain new ideas for the future work and proposals for collaborations, as some of those scientist has already been familiar with my work and made use of the MISELA dataset. Therefore, I consider this presentation to be a valuable part of the overall experience and a great practice for the upcoming oral defence of my doctoral dissertation.



## Achievements

All the analyses that were done during my stay in the NOC are found to be successful and provided valuable results which will be included in the upcoming publication, as well as in my doctoral dissertation. The analyses are planned to be deepened in the future through the collaboration with Dr Williams and possibly some other scientists from the NOC sea-level group. All of this has given me a fresh motivation for research and enriched my career path.

I was also happy to be involved in everyday interaction with the NOC staff and social events that were organized on a weekly basis. People were welcoming and warm which made my stay very pleasant. In addition, all the administrative obligations with BST and human resources of the NOC went very smoothly and contributed to this amazing experience. I consider this scholarship to be a great opportunity to spend some time working in an international institution, establish new collaborations and extend knowledge on the topics of interest.

18 February 2022

Petra Zemunik

A handwritten signature in blue ink that reads "P. Zemunik".