# Abstract for 8th Annual Irish Sea Level Meeting

**reslr: An R package for relative sea level modelling**

The 2021 Intergovernmental Panel on Climate Change report highlighted how rates of sea level rise are the fastest in at least the last 3,000 years. Understanding historical sea level trends, both globally, regionally and locally, is critical for comprehending the dynamics and impacts of sea level change. The influence of different sea level drivers, for example thermal expansion, ocean dynamics and glacial – isostatic adjustment (GIA), has changed throughout time and space. Therefore, a useful statistical model requires both flexibility in time and space and have the capability to examine these separate drivers, whilst taking account of uncertainty.

To address this need, we developed ***reslr***, an open-source R package that provides a suite of statistical tools for modelling relative sea level (RSL) change. The package allow for the incorporation of both sea-level proxy data and instrumental records, such as tide gauge data, and support the use of external prior information to inform model structure and evolution over space and time. By combining data sources, robust statistical methods, and a user-friendly software implementation, reslr provides researchers with a flexible platform to explore, model, and better understand the processes driving relative sea level change.

In this talk, I will outline the statistical framework underpinning reslr, demonstrate its application to sea level records from the Atlantic coasts of North America and Ireland, and highlight key findings.

The 2021 Intergovernmental Panel on Climate Change report highlighted how rates of sea level rise are the fastest in at least the last 3,000 years. As a result, it is important to understand historical sea level trends at a global and local level in order to comprehend the drivers of sea level change and the potential impacts. The influence of different sea level drivers, for example thermal expansion, ocean dynamics and glacial – isostatic adjustment (GIA), has changed throughout time and space. Therefore, a useful statistical model requires both flexibility in time and space and have the capability to examine these separate drivers, whilst taking account of uncertainty.

The aim of our project is to develop statistical models to examine historic sea level changes for North America's and Ireland's Atlantic Coast. For our models, we utilise sea-level proxy data and tide gauge data which provide relative sea level estimates with uncertainty. The statistical approach employed is that of extensions of Generalised Additive Models (GAMs), which allow separate components of sea level to be modelled individually and efficiently and for smooth rates of change and accelerations to be calculated.

The model is built in a Bayesian framework which allows for external prior information to constrain the evolution of sea level change over space and time. The proxy data is collected from salt-marsh sediment cores and dated using biological and geochemical sea level indicators. Additional tide gauge data is taken from the Permanent Service for Mean Sea Level online. Uncertainty in dating is extremely important when using proxy records and is accounted for using the Noisy Input uncertainty method (McHutchon and Rasmussen 2011).

By combining statistical models, proxy and tidal gauge data, our results have shown that current sea level along North America’s east coast is the highest it has been in at least the last 15 centuries. The GAMs have the capability of examining the different drivers of relative sea level change such as GIA, local factors and eustatic influences. Our models have demonstrated that GIA was the main driver of relative sea level change along North America’s Atlantic coast, until the 20$^{th}$ century when a sharp rise in rates of sea level change can be seen.