



**Maynooth
University**
National University
of Ireland Maynooth



Trinity College Dublin
Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin



A4: Aigéin, Aeráid, agus athrú Atlantaigh

Newsletter | Nuachtlitir



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The Skellig Islands , Credit: Zoe Roseby

About

Ireland is a small island on the edge of a large ocean. Atlantic changes arguably impact Ireland more than any other country. For example, in 2015, when the record global surface temperatures were reached, Ireland had below average temperatures due to a cool Atlantic. Irish temperatures bucking the trend in 2015 brings sharp focus to the fact that understanding Ireland's place in a changing climate requires understanding the changing Atlantic.

The A4* project focuses on three areas of physical oceanography and climate research where impactful and strategically important progress can be made. These areas are: understanding Atlantic variability and its connection to the Irish shelf (WP1); advancing knowledge of Irish sea level change in an Atlantic context (WP2); and development of predictive capacity on decadal timescales for planning and management (WP3).

A4 is lead by Maynooth University, in partnership with Trinity College Dublin, and brings together international partners from Germany, the UK, and the USA.

*A4: Aigéin, Aeráid, agus athrú Atlantaigh = Oceans, Climate, and Atlantic Change

Fúinne Féin

Is oileán beag í Éire ar an imeall ag aigéan mór. D'fhéadfá an cás a dhéanamh go gcuireann athruithe Atlantacha isteach ar Éirinn níos mó ná thír ar bith eile. Sa bhliain 2015, mar shampla, nuair a baineadh na teoichtá dromchla domhanda is airde a bhí taifeadta amach ag an am, bhí teoichtá faoin meán ag Éirinn mar gheall ar an Atlantach fionnúar. Cuireann Éire ag teacht salach ar an gclaonadh a chonacthas sa bhliain 2015 aird faoi leith ar cé chomh tábhachtach is atá sé na athruithe san Atlantach a thuiscent chun gur féidir linn áit na hÉireann san athrú aeráide a thuiscent.

Dírionn an tionscadal A4* ar thrí réimse den aigéaneolaíocht fhisiciúil agus taighde aeráide gur féidir dul chun cinn a bhfuil tionchar aige agus tábhacht ó thaobh straitéisí ag baint leis a dhéanamh iontu. Is iad na réimsí sin ná: athraitheacht an Atlantaigh agus an nasc atá aige leis an scairbh Éireannach a thuiscent (WP1); elolas maidir le hathrú ar leibhéal na mara in Éirinn i gcomhthéacs an Atlantaigh a fheabhsú (WP2); agus inniúlacht réamhaithriseach ar amscálaí deichiúla don phleanáil agus don bhainistiocht a fhurbairt (WP3).

Tá A4 á stiúradh ag Ollscoil Mhá Nuad, i bpáirtneireacht le Coláiste na Tríonóide, agus tá sé tar éis páirtneiri idirnáisiúnta ón nGearmáin, ón Ríocht Aontaithe agus ó na Stáit Aontaithe a thabhairt le chéile.



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A4 in the field



March 2021 was a busy time in the field for A4 scientists. Having been cooped up and locked down for much of 2020, it was with smiling faces beneath our masks and under our rain hoods, we headed to the field to study Ireland's changing climate on the edge of the Atlantic.

Zoe and Fermin on Rossbeigh Strand. Credit: Zoe Roseby



Sediment core from Castlemaine Harbour. Credit: Zoe Roseby

County Kerry

Over the week of March 8th, Fermin Alvarez and Zoe Roseby, both based at Trinity College Dublin, visited Co. Kerry in the southwest corner of Ireland for a week of fieldwork. Their work will reconstruct past Irish sea level, critical for understanding ongoing and future changes. Together with PI Robin Edwards, the Trinity team use a 'geological tide gauge' approach, reconstructing past sea level changes using sediments and the microfossils within them (specifically marine organisms called foraminifera) recovered from saltmarshes around Ireland.

During their trip to Co. Kerry, Fermin and Zoe collected surface sediments along marsh transects to determine the relationship between elevation and foraminifera species abundance and recovered several sediment cores with the aim of producing a 'geological tide gauge' record for Co. Kerry. Overall, it was a highly successful trip, despite some wet and wild west coast weather!



A spell of sunny weather over Dingle peninsula.
Credit: Zoe Roseby

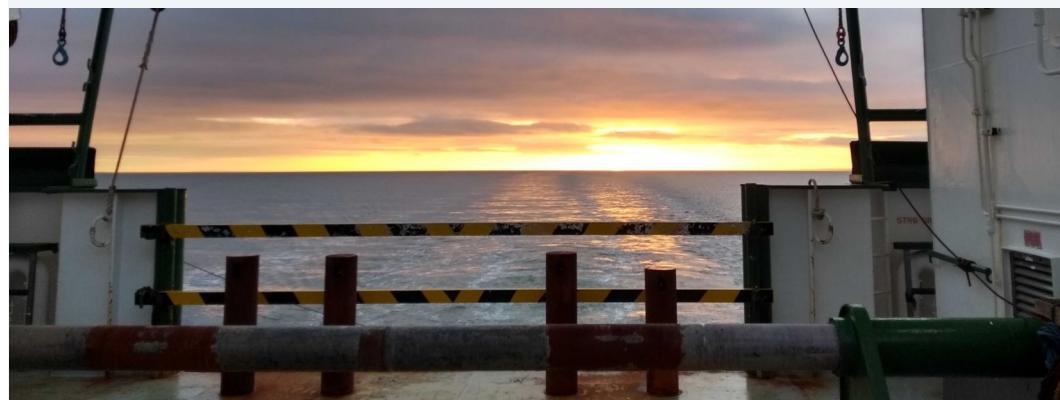


Gerard and Levke getting ready to board the Celtic Explorer. Credit: Gerard McCarthy

Celtic Explorer

At the same time, Levke Caesar and Gerard McCarthy, from Maynooth University, spent two weeks battling the waves west of Ireland as part of the Marine Institute's annual climate cruise on board the Celtic Explorer. The expedition was part of the annual ocean climate survey, run by the Marine Institute since 2006, that delivers long-term physical and biogeochemical observations, crucial to observing climate change.

With the Atlantic changing rapidly, this northern part of the Atlantic can be a bellweather for the health of the whole Atlantic system. In recent years, the coldest and freshest values for over 100 years were observed not far from here. Could these be indicative of a slowing or even collapsing Gulf Stream system? That is what A4 is investigating!



Sunset over the Atlantic Ocean from the Celtic Explorer. Credit: Gerard McCarthy

Outreach



The A4 project team have been involved with a number of outreach events, engaging with the general public, students and the scientific community. Below are some examples of these outreach events and links to watch, listen and learn more about our research.

Will Ireland Survive 2050? | RTÉ1, 11th November 2019

Gerard McCarthy (MU) talks with meteorologist Gerald Fleming about Atlantic Ocean circulation and its importance to Irish climate.

<https://www.rte.ie/player/movie/will-ireland-survive-2050%3F/116945447976>

Communicating climate change | Lindau Nobel Laureate Meeting 2020

Levke Caesar (MU) is involved with a panel discussing how climate change can be communicated most effectively.

<https://www.mediatheque.lindau-nobel.org/videos/38707/communicating-climate-change>

Irish Sea level Change in the Atlantic Context | Maynooth University, Love Data Week 2021, 8th February 2021

Maeve Upton presents a talk about examining historical sea level rise using statistical models and raw proxy data.

<https://www.youtube.com/watch?app=desktop&v=l4Ah0mRSsYA&feature=youtu.be&ucbcb=1>

Levke Caesar RTE Interview 25th February 2021

Levke is interviewed by Colman O'Sullivan for RTE news. They discuss the weakening Gulf Stream and its impact on Irish climate.

Weakening Atlantic Current Threats | Radio Ecosocial 4th April 2021

Levke Caesar (MU) and Alex Smith discuss a weakening Atlantic Meridional Overturning Circulation (AMOC).

<https://www.youtube.com/watch?v=4jd0emUultc>

In the Atlantic Ocean, Subtle Shifts Hint at Dramatic Dangers | New York Times, 2nd March 2021 by Moises Velasquez-Manoff and Jeremy White

This artful piece of science communication summarises the observed changes in the North Atlantic featuring work from Levke Caesar about the observed weakening of the AMOC and Samantha Hallam who has joined the team at Maynooth University in February 2021 about its connection to hurricanes.

<https://www.nytimes.com/interactive/2021/03/02/climate/atlantic-ocean-climate-change.html>



A4 celebrates International Day of Women and Girls in Science



You can see our #WhyIOceanScience tweets on our Twitter page @a_ceathair



Top-left to bottom-right: Zoe Roseby (TCD), Maeve Upton (MU), Samantha Hallam (MU - ROADMAP), Catherine O'Beirne (MU), Levke Caesar (MU), Niamh Cahill (MU) and Emma Worthington (NOC- SPITFIRE DTP)

Publications



2021

Diabaté, S. T., Swingedouw, D., Hirschi, J. J. M., Duche, A., Leadbitter, P. J., Haigh, I. D., & McCarthy, G. D. (2021). Western boundary circulation and coastal sea-level variability in northern hemisphere oceans. *Ocean Science Discussions*, 1-34.

Cesari, L., McCarthy, G. D., Thornalley, D. J. R., Cahill, N., & Rahmstorf, S. (2021). Current Atlantic Meridional Overturning Circulation weakest in last millennium. *Nature Geoscience*, 14(3), 118-120.

E. L. Worthington, B. I. Moat, D. A. Smeed, J. V. Mecking, R. MarshG. D. McCarthy (2021): A 30-year reconstruction of the Atlantic meridional overturning circulation shows no decline, *Ocean Science*, 17, 285-299

B. Mayer, A. Düsterhus & J. Baehr (2021): When does the Lorenz 1963 Model exhibit the Signal-to-Noise Paradox?, *Geophysical Research Letters*, e2020GL089283

2020

G. D. McCarthy, P. J. Brown, C. N. Flagg, G. Goni, L. Houpert, C. W. Hughes; R. Hummels, M. Inall, K. Jochumsen, K. M. H. Larsen (2020): Sustainable observations of the AMOC: Methodology and Technology, *Reviews of Geophysics*, 58 (1), e2019RG000654

H. Bryden, B. King, G. D. McCarthy, E. McDonagh; B. I. Moat, D. Smeed (2019): Reduction in ocean heat transport at 26°N since 2008 cools the eastern subpolar gyre of the North Atlantic Ocean, *Journal of Climate*, 33, 1677–1689

G. D. McCarthy, L. C. Jackson, S. A. Cunningham, N. P. Holliday, D. A. Smeed, D. P. Stevens (2020): Sustainable observations of the AMOC: Methodology and Technology, *MCCIP Science Review*, 190-207

A. Düsterhus (2020): Seasonal statistical-dynamical prediction of the North Atlantic Oscillation by probabilistic post-processing and its evaluation, *Nonlinear Processes in Geophysics*, 27, 121-131
P. Pieper, A. Düsterhus & J. Baehr (2020): A universal Standardized Precipitation Index candidate distribution function for observations and simulations, *Hydrology and Earth System Sciences*, 24(9), 4541-4565

J. O'Sullivan, C. Sweeney, A. C. Parnell (2020): Bayesian spatial extreme value analysis of maximum temperatures in County Dublin, Ireland, *Environmetrics*, 31, e2621

A. Hernández, C. Martín-Puertas, P. Moffa-Sánchez, E. Moreno-Chamarro, P. Ortega, S. Blockley, K. M. Cobb, L. Comas-Bru, S. Giralt, H. Goosse, J. Luterbacher, B. Martrat, R. Muscheler, A. C. Parnell, S. Pla-Rabes, J. Sjolte, A. A. Scaife, D. Swingedouw, E. Wise, G. Xu (2020): Modes of climate variability: Synthesis and review of proxy-based reconstructions through the Holocene, *Earth-Science Reviews*, 209, 103286

A. Hernández, G. Sánchez-López, S. Pla-Rabes, L. Comas-Bru, A. C. Parnell, N. Cahill, A. Geyer, R. M. Trigo, S. Giralt (2020): A 2,000-year Bayesian NAO reconstruction from the Iberian Peninsula, *Scientific Reports*, 10, 14961

Current Atlantic Meridional Overturning Circulation weakest in last millennium

In February, we published a study that showed that the Atlantic Overturning Circulation (also referred to as Gulf Stream System) has been weaker over the last decade than at any other point in the last 1,600 years. Together with colleagues from Maynooth University, the Imperial College in London and the Potsdam Institute of Climate Impact Research, we assembled a comparison of 11 different, previously published, proxy records of the Gulf Stream System, showing that they provide a consistent picture of its evolution.



The study about the evolution of the Gulf Stream System was published in *Nature Geoscience* in February 2021, credit: Levke Caesar

These proxy records of the Gulf Stream System are of various kinds: they include, for example, the grain size in ocean sediment cores (as a faster Gulf Stream System can transport larger grains), or the species compositions of corals (different types of corals prefer different water temperatures and the Gulf Stream System influences water temperatures in the North Atlantic). Together these proxies draw a picture of how the circulation has changed. For the majority of the investigated 1,600-year period, the Gulf Stream System has been relatively stable. However, from the end of the Little Ice Age (approximately 1850), the system began to decline, with a second, more drastic decline since the mid-20th century. This last decline is superimposed by what appears to be natural variability, with a recovery of the system in the 90s and a return to decline in the early 2000s.

As the Gulf Stream System has a large impact on European climate, there is a lot of public interest in new research. As the lead author of this publication, I have been involved in more than 20 interviews with journalists from all over the world. The nature of these interviews is manifold and as the media operates often on very short time scales, I sometimes had only minutes between interviews. But it is worth the stress. Talking to the media is one of the best ways to draw attention to your research – both from the public but also within the scientific community. I furthermore believe that as scientist, it is our job to provide the public with information about our research, especially when working in a field that calls for societal change, like climate science.

Levke Caesar



Live skype interview with Deutsche Welle International News, Credit: Deutsche Welle

The A4 team



Gerard McCarthy



Gerard McCarthy is an observational Physical Oceanographer, specialising in the Atlantic Meridional Overturning Circulation (AMOC) or Gulf Stream System, with particular interest in the role of the ocean in climate and sea level. Having completed his PhD in the University of Southampton, he joined the National Oceanography Centre, Southampton, UK, where he spent six years measuring the AMOC as part of the RAPID team. He joined ICARUS in the Department of Geography at Maynooth University in 2017 where he is currently an Associate Professor. He co-ordinates the A4 project, funded by the Marine Institute, and is a workpackage leader on Blue-Action, funded by the EC's Horizon 2020, and ROADMAP, funded by JPI Oceans and Climate.

Levke Caesar

Levke Caesar is a Climate Physicist working on large-scale ocean circulations in the North Atlantic, in particular the Atlantic Overturning Circulation (AMOC), and the effects of these circulations on other elements of the climate system. She completed her PhD in climate physics at the Potsdam Institute for Climate Impact Research in Germany, where she studied the evolution of the AMOC over the last century and showed that the circulation has slowed by about 15 percent since the mid-20th century. She joined ICAURS in October 2019 and is part of Work Package I of the A4 project where she studies the relationship between salinity and temperature changes in the North Atlantic.



Samuel Tiéfolo Diabaté



Sam Tiéfolo Diabaté completed a BSc in engineering science at Le Mans Université (France) in 2017, followed by a 2-year MSc program in physical oceanography at Université Toulouse-III (France) and Université d'Abomey-Calavry (Bénin). Since November 2019, he works as a PhD worker under the supervision of Gerard McCarthy and focuses on the linkages between sea surface elevation and oceanic currents, in particular at eastern and western boundary margins.

Jamie Mathews

Jamie Mathews is a research assistant at Maynooth University working in the Irish Climate Analysis and Research UnitS (ICARUS). His research includes observational analysis of the European Slope Current and is currently investigating its correlation with the Atlantic Meridional Overturning Circulation. He does this through the use of high resolution ocean models, as well as implementing observational data from the real world.



Niamh Cahill

Niamh Cahill is an applied statistician with interests in developing statistical models for the analysis of time dependent, compositional and/or spatial data. Niamh completed her PhD in University College Dublin in 2015. Following this she spent two years as a postdoctoral researcher in UMASS Amherst. Niamh joined the Mathematics and Statistics department at Maynooth University in 2018. One aspect of her research focuses on the development of statistical models to assess and interpret indicators of climate change, specifically sea-level change.

Andrew Parnell
Andrew Parnell is Hamilton Professor in the Hamilton Institute at Maynooth University. His research is in statistics and machine learning for large structured data sets in a variety of application areas. He is currently a principal investigator in the SFI I -Form Advanced Manufacturing Centre, and a funded investigator in the SFI Insight Centre or Data Analytics. He is an expert reviewer for the Intergovernmental Panel on Climate Change.



Maeve Upton

Maeve Upton graduated from Trinity College Dublin in 2018 with a BSc in Physics and Astrophysics. She started her PhD in Maynooth University in 2021 under the supervision of Prof Andrew Parnell and Dr Niamh Cahill. Her project aims to develop a series of statistical models to analyze historical sea level records using proxy data from salt marshes and Bayesian Hierarchical techniques. Her research will examine sea level changes along the East coast of North America and Ireland. In the future, Maeve will collaborate with Earth Scientists in Trinity College Dublin, to produce Ireland's first historic sea level record from Irish salt marshes and statistical models.

Robin Edwards

Robin Edwards is a geological oceanographer specialising in the reconstruction of sea level change with particular interest in the use of foraminifera as precise sea level indicators. Having completed his PhD at Durham University (UK) he moved to the Vrije Universiteit in Amsterdam where he worked on sea level projects in North America and Australia. He briefly returned to Durham as a lecturer before joining Trinity College Dublin where he is now Associate Professor in Earth Sciences. Robin is co-PI and leader of Work Package 2 in the A4 project.



Zoe Roseby

Zoe is a post-doctoral researcher at Trinity College Dublin. She works with the A4 project, reconstructing Irish sea level change using a range of sedimentological and micropalaeontological techniques. She carried out her PhD at the National Oceanography Centre, British Antarctic Survey and Durham University. Her project was focussed on reconstructing Antarctic ice stream retreat following the Last Glacial Maximum.



Fermin Alvarez

Fermin Alvarez graduated from the Basque Country University with a BSc in Geology (2014) and completed an M.Sc. in Marine Environments (2016). After a period working in the renewables energy industry, Fermin started his PhD in 2020 in the Geology Department at Trinity College Dublin, where he works as part of the work-package 2 in the A4 project. His PhD aims to reconstruct recent sea-level variations around Ireland through the study of saltmarsh sediments.



André Düsterhus

André Düsterhus is a climate statistician and physicist, focussing on long-term climate predictions in the North Atlantic system. After completing his PhD in Meteorology at the University of Bonn he spent time as a postdoc at the National Oceanography Centre in Liverpool and the Institute of Oceanography at the University of Hamburg. Beside his actual focus on decadal predictions he has worked on topics like data science, (paleo-)sea-level evolution and seasonal predictions. In 2019 he joined ICARUS at Maynooth University as a Research Fellow and leads the efforts of the A4 project on decadal predictions.



Stephen Ogungbenro

Stephen Ogungbenro completed his PhD in 2019 where his research established different impact of land use change (soil moisture) on deep convective cloud systems. Stephen is currently a Postdoctoral researcher working on the A4 project. He is a member of the WP3 team tasked with developing predictive capacity on decadal timescales for planning and management. Stephen plans to achieve this corporate goal by incorporating both observational and numerical resources within and outside the ocean to study their interaction and establish their impact on the climate of Ireland and her surrounding water.



Catherine O'Beirne

Catherine O'Beirne graduated from Trinity College Dublin in 2016 with a B.A. in Environmental Science and subsequently went on to complete an M.Sc. in Climate Change in 2018. Following graduating in 2018 she briefly worked in as an Environmental and Administrative Technician, the role included the preparation of environmental impact assessments, costing and quotes for domestic/industrial oil spill clean-up and restoration work. Catherine's work will focus on understanding Atlantic variability and its connection to the Irish shelf advancing knowledge of Irish sea-level change in an Atlantic context; development of predictive capacity on decadal timescales for the North Atlantic; and how these predictions be applied for stakeholder needs.



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