

DISSERTATION TOPICS



Year 2: EGM303.350.351

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Dr Joerg Arnscheidt



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Joerg researches issues of water quality and aquatic ecology. Currently active research and conservation projects he is involved in investigate antibiotics and antimicrobial resistance, interactions between bacteria, algae and aquatic invertebrates, filter feeders, monitoring and ecological consequences of siltation, nutrient management and crayfish conservation. Other recurring topics are water quality of natural bathing waters, ecological impact of channelisation and ecology of subterranean and hyporheic environments.

Project 1: How can stream sediments identify pollution from point sources?

Point sources of aquatic pollution like combined sewage overflows often discharge only episodically into streams. Monitoring strategies which rely on water spot samples therefore often fail to identify these sources. However, streambed sediments may conserve markers of this pollution for much longer than flowing water. Student projects will investigate potential pollution markers in stream sediments that can be identified through toxicological, microbiological, chemical or microscopic analysis. These projects will involve work in the field and laboratory.

Project 2: Investigation of a rapid assessment method for siltation in streams

Transfer of eroded fine particles from soils and stream banks cause clog streambed sediments, obstruct water exchange between stream and sediment and thus cause oxygen poor sediments and death of invertebrate and salmonid fish eggs. This project will investigate whether the shuffle index (white tile method) correlates sufficiently well to streambed sediment parameters to qualify as a reliable monitoring tool in environmental assessment. It involves work in the field and in the laboratory.

Project 3: Can marl lake sediments provide a chemical buffer against groundwater induced eutrophication in marl lakes?

There are not many marl lakes in the UK and they can be stunning water features because of their exceptional water clarity and assemblages of rare aquatic species. Unfortunately, a group of such cross-border lakes in counties Fermanagh and Monaghan has experienced a decline in water quality and the occurrence of protected species. One hypothesis for their decline is that groundwater influx may cause nutrient accumulation. This project will test how well marl lake sediment adsorbs soluble Phosphorus in groundwater. Dissertations can involve fieldwork and laboratory work.

Project 4: Ecology of springs in Northern Ireland

Springs of stream and rivers have received much less scientific attention than other habitats in running waters and thus their fauna and its special adaptations have remained much less known by comparison. Projects will try to characterise and compare hydrological and chemical features of springs as well as their diversity in regard to benthic macroinvertebrates. Student projects will involve work in the field and laboratory.

Dr Suzanne Beech



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Suzanne's research lies at the intersections between social and cultural geography focusing on young people, migration and mobility, and international higher education. At present, she is researching the role of migration industries in international higher education transitions, namely the importance of higher education agents in facilitating global geographies of international student mobility.

Project 1: Writing landscapes: an analysis of the role of literature in developing iconographic landscapes

Project 2: Being outdoors: experiencing the landscape through the rhythms and geographies of walking

Project 3: Evolving identities: an analysis of the changing, and multiple, belongings of first and second generation migrants

Project 4: Remembering industrial heritage: commemorating and celebrating a clanging Ulster

Project 5: Forest schools and outdoor classrooms: the importance of place and student learning environments

Project 6: Creating Shared Identities: An analysis of how Belfast's City Hall attempts to bring together a divided city

Dr Saad Bhatti



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Saad's research interests include multi- and interdisciplinary applications of geospatial methods focusing primarily on human geography, urbanisation, population studies, demography, space-time dynamics of spatial development, socioeconomic and infrastructure inequalities. He is also interested in developing robust methods for processing and analysing the sensor (passive and active) data obtained through satellites and air-borne platforms for a variety of purposes including land use / land cover mapping, environment, forestry, water resources, and others.

Project 1: Open topic on a study involving multi-criteria spatial analysis (some examples below)

Multi-criteria GIS-based modelling technique for identifying potential solar farm sites: A case study in Mauritius. <https://www.sciencedirect.com/science/article/pii/S0960148118310553>

Assessing the fuel poverty vulnerability of urban neighbourhoods using a spatial multi-criteria decision analysis for the German city of Oberhausen.
<https://www.sciencedirect.com/science/article/pii/S1364032117310651>

Application of the GIS based multi-criteria decision analysis and analytical hierarchy process (AHP) in the flood susceptibility mapping (Tunisia). <https://link.springer.com/article/10.1007/s12517-019-4754-9>

Multi-hazard assessment modeling via multi-criteria analysis and GIS: a case study.
<https://link.springer.com/article/10.1007/s12665-018-8003-4>

Land suitability evaluation for organic agriculture of wheat using GIS and multicriteria analysis.
<https://www.tandfonline.com/doi/full/10.1080/23754931.2018.1448715>

Combining multicriteria decision analysis and GIS to assess vulnerability within a protected area: An objective methodology for managing complex and fragile systems.
<https://www.sciencedirect.com/science/article/pii/S1470160X19307319>

Validation of spatial multicriteria decision analysis results using public participation GIS.
<https://www.sciencedirect.com/science/article/pii/S0143622818310695>

Project 2: Assessment and analysis of patterns of spatial inequalities

Research question: How does the inequalities in terms of socio-economic conditions, health, environment, green spaces, etc. vary spatially (and temporally if data is available) in the study area?

Summary: This project aims at combining the use of demographic data (census, etc.) and geographic information systems (GIS) to understand the spatial patterns of various inequalities in the study area. The potential of using remote sensing data (satellite remote sensing in particular) would also be explored in this study. The outputs would be helpful: (1) in terms of developing spatial methods to examine spatial inequalities; and (2) in identifying areas (within the study area) that need to be focused to address the inequality / disparity issues.

Benedek, J. and Ivan, K., 2018. Remote sensing based assessment of variation of spatial disparities. *Geographia technica*, 13(1), pp.1-9.

Martínez, J., 2009. The use of GIS and indicators to monitor intra-urban inequalities. A case study in Rosario, Argentina. *Habitat International*, 33(4), pp.387-396.

Pan, J.H., Zhang, J.L. and Zhang, Y., 2006. Analysis of regional economic disparities in Gansu Province based on ESDA and GIS [J]. *Journal of Northwest Normal University (Natural Science)*, 6.

Project 3: Aging population – Spatial distribution analysis of demographics using census and other data

Research question: What are the spatial patterns of various demographic groups in the study area, and how is the older population distributed?

Summary: A significantly higher elderly population presents some real societal challenges and pressures on public services such as healthcare, etc. This study would explore the spatial distribution and patterns of various demographic groups with a particular focus on the older population to understand their distribution in the study area. Time-series analysis could also be carried out in this regard to develop a spatio-temporal demographic profile of the study area. Geographical locations of healthcare centres could also be analysed to understand the need for improving the provision of services. The outputs would reveal the spatial patterns of demographics eventually helping in better decision making for improved provision of various services.

Atkins, M.T. and Tonts, M., 2016. Exploring cities through a population ageing matrix: A spatial and temporal analysis of older adult population trends in Perth, Australia. *Australian Geographer*, 47(1), pp.65-87.

Davies, A. and James, A., 2011. *Geographies of ageing: Social processes and the spatial unevenness of population ageing*. Ashgate Publishing, Ltd..

Lin, C.H.A., Lahiri, S. and Hsu, C.P., 2015. Population aging and regional income inequality in Taiwan: A spatial dimension. *Social Indicators Research*, 122(3), pp.757-777.

Love, D. and Lindquist, P., 1995. The geographical accessibility of hospitals to the aged: a geographic information systems analysis within Illinois. *Health services research*, 29(6), p.629.

Project 4: Public transport users' satisfaction – Spatial distribution and analysis

Research question: Is there any spatial pattern or demographic links in terms of satisfaction with public transport?

Summary: Encouraging the use of public transport requires improvement in provision of services that caters the needs of individual travellers. It is a key challenge for public transport authorities and operators to attain and maintain the service level that fulfils the travellers' requirements. This study aims at exploring and characterising the travel satisfaction with public transport services. This would involve developing and conducting questionnaire surveys of travellers within the identified study area, and then to map and analyse the spatial distribution of responses in terms of users' satisfaction (cost, travel duration, cleanliness, etc.) using various categories such as time of travel (morning, afternoon, evening, night, etc.), age group, etc. The outcomes would help understanding the spatial patterns and / or demographic links in terms of public satisfaction with the transport facilities.

Abenzoza, R.F., Cats, O. and Susilo, Y.O., 2017. Travel satisfaction with public transport: Determinants, user classes, regional disparities and their evolution. *Transportation Research Part A: Policy and Practice*, 95, pp.64-84.

Eboli, L., Forciniti, C. and Mazzulla, G., 2018. Spatial variation of the perceived transit service quality at rail stations. *Transportation Research Part A: Policy and Practice*, 114, pp.67-83.

Ye, R. and Titheridge, H., 2017. Satisfaction with the commute: The role of travel mode choice, built environment and attitudes. *Transportation Research Part D: Transport and Environment*, 52, pp.535-547.

Dr Colin Breen



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Colin's research focusses on historic landscape and societal change, environment and conflict, and the historical archaeologies of past maritime societies. He is currently engaged in research across the Middle East and Africa, as well as across the Atlantic maritime zone of NW Europe.

Project 1: Remembering conflict in Northern Ireland's museums

This project will take one or more of Northern Ireland's museums and examine how conflict in both interpreted and remembered. The student will undertake a mixed methods approach towards this dissertation, including qualitative and observational surveys with both relevant experts, researchers and other interested parties.

Crooke, E., 2001. Confronting a Troubled History: which past in Northern Ireland? S museums?. *International Journal of Heritage Studies*, 7(2), pp.119-136.

Crooke, E., 2005. Dealing with the past: museums and heritage in Northern Ireland and Cape Town, South Africa. *International journal of heritage studies*, 11(2), pp.131-142.

Project 2: Historical Geographies of Place

Landscapes on the Island of Ireland have been subject to human impact for millennia. This dissertation topic will take an urban or rural landscape familiar to the student, and will map spatial and demographic change. Using a range of primary sources, including maps, census and economic data, the student will investigate socio-political developments within their study area, and identify the primary drivers of change. This type of subject will be useful to students who are interested in careers in planning, landscape management or historical research.

Ashworth, G.J. and Graham, B., 2017. *Senses of place: Senses of time*. Routledge.

Morrissey, J., Nally, D., Strohmayer, U. and Whelan, Y., 2014. *Key concepts in historical geography*. Sage.

Project 3: Environment (or heritage) and its role in peace-building in Northern Ireland

This project will examine the potential role environment or heritage plays in building peace across Northern Irish society. It will first look at the broader international role environment plays before examining potential initiatives across Northern Ireland. This project will involve detailed research coupled with qualitative analysis.

Bakut, B., 2006. *The Environment, Peace and Conflict in Africa*. Best, SG Introduction to Peace and Conflict Studies in West Africa. Ibadan: Spectrum Books Limited.

Brock, L., 1991. Peace through parks: the environment on the peace research agenda. *Journal of Peace Research*, 28(4), pp.407-423.

Project 4: Ulster Scots identity in Ulster

This project will critically analyse the emergence of the Ulster Scots identity across Ulster and position in within the context of the contemporary arena. The project will involve undertaking historical analysis, coupled with qualitative survey of key individuals and organisations.

McCall, C., 2002. Political transformation and the reinvention of the Ulster-Scots identity and culture. *Identities: Global Studies in Culture and Power*, 9(2), pp.197-218.

Craith, M., 2001. Politicised linguistic consciousness: the case of Ulster-Scots. *Nations and Nationalism*, 7(1), pp.21-37.

Project 5: Environmental change and migration

In the lead up to the recent COP21 a number of high profile politicians made a direct link between environment and climate change and the recent refugee crisis. This project will critically examine this direct linkage. The student will engage with a range of experts and NGOs to examine their experience and perceptions of this paradigm.

Hugo, G., 2008. *Migration, development and environment*. Geneva: International Organization for Migration.

Laczko, F. and Aghazarm, C. eds., 2009. *Migration, environment and climate change: Assessing the evidence* (pp. 7-40). Geneva: International Organization for Migration

Project 6: Alternative Space

This project will examine the emergence and development of *Alternative Space* from a histo-political or cultural geography perspective. These types of spaces can include political, religious or sexual spaces associated with communal, radical or discordant aspirations.

Smith, M., 2001. *An ethics of place: Radical ecology, postmodernity, and social theory*. Suny Press.

Springer, S., 2011. Public space as emancipation: meditations on anarchism, radical democracy, neoliberalism and violence. *Antipode*, 43(2), pp.525-562.

Dr Janina Büscher



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Janina is a marine biogeochemist with an interest in ocean change impacts on benthic ecosystems: (i) impacts of ocean acidification and warming on cold-water ecosystems, (ii) natural variability of environmental conditions in benthic ecosystems and physiological adaptations of cold-water corals to different ranges of physical and chemical water properties, and (iii) biogeochemistry of water masses in the Northeast Atlantic at present and future trends in the light of ongoing ocean acidification.

Project 1: Short-term metabolic responses of the cold-water coral *Lophelia pertusa* (also known as *Desmophyllum pertusum*) to acute temperature elevation.

Skills required: This project would suit a student interested in future ocean change impacts on marine deep-sea organisms. This will be a desk-based analysis using extant data from a short-term experiment carried out onboard a research vessel.

Summary: Cold-water corals are benthic ecosystem engineers that build complex three-dimensional deep-sea habitats supporting high local biodiversity. Over the last decades, more and more studies have looked into the sensitivity of corals in the deep to climate change impacts such as ocean acidification and global warming. In a short-term experiment onboard a research vessel, the metabolic performance of live, freshly collected specimens of the most abundant cold-water coral species *Lophelia pertusa* (recently renamed to *Desmophyllum pertusum*) was measured under ambient (~7.5°C) and elevated (12°C) temperature conditions. Oxygen consumption rates were logged in closed respiration chambers at 1-minute intervals over 12 hours each. The aim of this study is to analyse the data and compare respiration rates under ambient and acute temperature stress conditions. Specimens were further kept in the respiration chambers until 0% oxygen was left to test the respiration regulation ability under hypoxia. In addition, the polyp behaviour (polyp expansion and retraction state) was monitored hourly by taking photographs of the 10 replicates of this study.

Gori, A., Orejas, C., Mienis, F., Ferrier-Pagès, C., Bilan, M., Flöter, S., Rexnaud, S., Sweetman, A.K., Roberts, J.M., Wienberg, C., Hebbeln, D. (2023) Natural hypoxic conditions do not affect the respiration rates of the cold-water coral *Desmophyllum pertusum* (*Lophelia pertusa*) living in the Angola margin (Southeastern Atlantic Ocean). *Deep Sea Research Part I: Oceanographic Research Papers* 197: 104052. doi: 10.1016/j.dsr.2023.104052

Dorey, N., Gjelsvik, Ø., Kutti, T., Büscher, J.V. (2020) Broad thermal tolerance in the cold-water coral *Lophelia pertusa* from Arctic and boreal reefs. *Frontiers in Physiology - Physiological Responses in Aquatic Organisms Adapted to Extreme or Changing Environments* 10: 1636. doi: 10.3389/fphys.2019.01636.

Dodds, L.A., Roberts, J.M., Taylor, A.C., Marubini, F. (2007) Metabolic tolerance of the cold-water coral *Lophelia pertusa* (Scleractinia) to temperature and dissolved oxygen change. *Journal of Experimental Marine Biology and Ecology* 349: 205 – 214. doi: 10.1016/j.jembe.2007.05.013

Project 2: The fate of Arctic Water Masses in the Rockall Trough – trends of ocean acidification in Nordic waters.

Skills required: This project would suit a student interested in water masses and future ocean change of their biogeochemical characteristics. This will be a desk-based analysis using extant data from a research cruise with RV *Celtic Explorer* to the Nordic Seas. Good skills in ODV are preferential.

Summary: In 2020, a research cruise under the motto “Constraining the Impact of Arctic Amplification in the Nordic Sea: A biogeochemical approach” (CIAAN) was carried out in the Nordic Sea. Several CTD casts were performed north of Iceland from west to east, along the Norwegian continental shelf edge at the eastern side and along the Greenlandic shelf edge at the western side. In addition to physical parameters logged throughout the water column at those 14 stations, discrete water samples were collected for analysis of dissolved oxygen, total alkalinity, dissolved inorganic carbon and dissolved inorganic nutrients (nitrate, nitrite, phosphate, silicate). The aim of this study is to determine the seawater chemistry of water masses moving southward, contributing to the signatures seen in the Rockall Trough in the coming years. The data set may provide a prospect of the conditions and the acidification status of newly formed deep waters, which will be entering the Rockall Trough over the coming decade and impact benthic ecosystems like cold-water corals.

Fransner F., Fröb, F., Tjiputra, J., Goris, N., Lauvset, S. K., Skjelvan, I., Jeansson, E., Omar, A., Chierici, M., Jones, E., Fransson, A., Ólafsdóttir, S. R., Johannessen, T., and Olsen, A. (2022) Acidification of the Nordic Seas. *Biogeosciences* 19: 979 – 1012. doi: 10.5194/bg-19-979-2022

Skjelvan, I., Lauvset, S.K., Johannessen, T., Gundersen, K., Skagseth, Ø. (2022) Decadal trends in Ocean Acidification from the Ocean Weather Station M in the Norwegian Sea. *Journal of Marine Systems* 234: 103775. doi: 10.1016/j.jmarsys.2022.103775

Project 3: Short-term metabolic responses of Arctic *Lithothamnion glaciale* rhodoliths to ocean acidification and warming

Skills required: This project would suit a student interested in future ocean change impacts on calcifying marine organisms. This will be a desk-based analysis using extant data from a short-term experiment carried out onboard a research vessel.

Summary: As a result of the rising CO₂ emission into the atmosphere, the ocean’s carbonate chemistry is currently altered towards lower carbonate ion concentrations and lower seawater pH – a process known as ‘ocean acidification’. At the same time, global temperature is rising, especially affecting Arctic waters. Crustose coralline red algae (Corallinales, Rhodophyta) are important components of the benthic marine ecosystem of the photic zone and contribute significantly to coastal carbonate depositions. These organisms are considered to be among the first organisms to respond to ocean acidification due to their high-Mg calcite skeleton, which is the most soluble form of CaCO₃. In an onboard short-term experiment, metabolic responses of the free-living coralline red alga *Lithothamnion glaciale* from Svalbard to different future acidification and temperature scenarios were measured. The aim of this study is to analyse the gathered data and compare oxygen consumption (respiration) and oxygen production (photosynthetic) rates under ambient conditions vs. warming and/or acidification. In addition, metabolic activity was tested under different light intensities.

P.T. Muñoz, C.A. Sáez, M.B. Martínez-Callejas, M.R. Flores-Molina, E. Bastos, A. Fonseca, C.F.D. Gurgel, J.B. Barufi, L. Rörlig, J.M. Hall-Spencer, P.A. Horta (2018) Short-term interactive effects of increased temperatures and acidification on the calcifying macroalgae *Lithothamnion crispatum* and *Sonderophycus capensis*. *Aquatic Botany* 148: 46 – 52. doi: 10.1016/j.aquabot.2018.04.008

Martin, S., and Hall-Spencer, J.M. (2016) Effects of Ocean Warming and Acidification on Rhodolith/Maërl Beds. In: Riosmena-Rodríguez, R., Nelson, W., Aguirre, J. (eds) *Rhodolith/Maërl*

Beds: A Global Perspective. Coastal Research Library, vol 15. Springer, Cham. doi: 10.1007/978-3-319-29315-8_3

Büdenbender, J., Riebesell, U., Form, A. (2011) Calcification of the Arctic coralline red algae *Lithothamnion glaciale* in response to elevated CO₂. *Marine Ecology Progress Series* 441:79 – 87. doi: 10.3354/meps09405

Project 4: Cold-water coral polyp behaviour characterisation in the natural environment

Skills required: This project would suit a student interested in marine benthic organisms' behaviour and has high perseverance skills to watch video footage of the same object and analyse large data sets. Good technical skills with regard to video/image editing software would be advantageous. This will be a desk-based analysis using extant data.

Summary: Polyp behaviour, i.e. the expansion and retraction of coral polyps, is controlled by the physiological needs of the coral coupled with external factors such as food availability, current speed, and changes in physicochemical parameters of the surrounding seawater as well as physical disturbance. Changes in polyp behaviour could therefore be an indicator of external factors impacting the corals' health. In tropical scleractinian corals polyp behaviour has been well documented by a number of studies and has been attributed to diel cycles of food availability, tidal currents and solar irradiance. Due to the challenges of accessing them, less is known of cold-water coral polyp behaviour. To investigate the expansion/ retraction behaviour of the most abundant cold-water coral species *Lophelia pertusa* (recently renamed to *Desmophyllum pertusum*) in their natural habitat, an autonomous video setup (GoPro Hero 3 in a watertight housing) was deployed in front of a living coral colony for 24 hours to record behaviour patterns in a daily cycle. The aim of this study is to analyse and interpret the natural polyp behaviour monitoring footage.

Chapron, L., Peru, E., Engler, A., Ghiglione, J.F., Meistertzheim, A.L., Pruski, A.M., Purser, A., Vétion, G., Galand, P.E., Lartaud, F. (2018) Macro- and microplastics affect cold-water corals growth, feeding and behaviour. *Scientific Reports* 8(1):15299. doi: 10.1038/s41598-018-33683-6

Pacherres, C.O., Schmidt, G.M., Richter, C. (2013) Autotrophic and heterotrophic responses of the coral *Porites lutea* to large amplitude internal waves. *Journal of Experimental Biology* 216(23): 4365 – 4374. doi: 10.1242/jeb.085548

Project 5: Water column characterisation at inshore vs. offshore cold-water coral reefs along the Norwegian continental shelf during summer

Skills required: This project would suit a student interested in water masses and future ocean change of their biogeochemical characteristics. This will be a desk-based analysis using extant data from a research cruise with RV POSEIDON to Norwegian cold-water coral reef sites. Good skills in ODV are preferential.

Summary: In 2018, a research cruise with RV POSEIDON (POS525) was carried out to investigate cold-water coral reef sites along the Norwegian continental margin. Cold-water coral ecosystems are important biodiversity hotspots, contributing to the global carbonate budget as they build large three-dimensional reef structures. These habitats are threatened by human activities such as fishing and climate change. The environmental conditions surrounding cold-water coral reefs are important driving forces affecting ecosystem dynamics and functioning. The aim of this study is to compare biogeochemical properties at four different reef sites, in- and offshore mid- and northern Norway, to describe the physicochemical conditions of the spatially distinct cold-water coral occurrences and characterise water masses the reefs are bathed in. For this, temperature, salinity, dissolved oxygen, and carbonate chemistry data were collected by means of CTD casts at various locations of the reefs (top and the flanks) during the cruise and shall be analysed and interpreted for the dissertation.

- Puerta, P., Johnson, C., Carreiro-Silva, M., Henry, L.-A., Kenchington, E., Morato, T., Kazanidis, G., Rueda, J.L., Urra, J., Ross, S., Wei, C.-L., González-Irusta, J.M., Arnaud-Haond, S. and Orejas, C. (2020) Influence of Water Masses on the Biodiversity and Biogeography of Deep-Sea Benthic Ecosystems in the North Atlantic. *Frontiers in Marine Science* 7: 239. doi: 10.3389/fmars.2020.00239
- Sundahl, H., Buhl-Mortensen, P. and Buhl-Mortensen, L. (2020) Distribution and Suitable Habitat of the Cold-Water Corals *Lophelia pertusa*, *Paragorgia arborea*, and *Primnoa resedaeformis* on the Norwegian Continental Shelf. *Frontiers in Marine Science* 7:213. doi: 10.3389/fmars.2020.00213
- Rüggeberg, A., Flögel, S., Dullo, W.-C., Hissmann, K., Freiwald, A. (2011) Water mass characteristics and sill dynamics in a subpolar cold-water coral reef setting at Stjernsund, northern Norway. *Marine Geology* 282(1 - 2): 5 - 12. doi: 10.1016/j.margeo.2010.05.009

Prof Andrew Cooper



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Andrew's research interests are in the areas of coastal geomorphology, coastal processes and coastal zone management.

Project 1: Shoreline change in the Outer Hebrides

Skills required: This project would suit a student interested in geology and coastal geomorphology

Summary: The beaches and dunes of the Outer Hebrides contain the largest area of machair in the British Isles. They rest on a rocky platform and seem to respond mainly to extreme storms. This project is concerned with mapping shoreline change from historical maps and air photos and interpreting the changes in the context of sea-level change and patterns of storminess.

Project 2: Nature and distribution of sea defences

Skills required: This project would suit a student interested in coastal geomorphology and with GIS and remote sensing capabilities.

Summary: The Irish coast has a profusion of sea defences of different types and installed for different purposes. The aim in the project is to classify and map sea defences with a view to assessing their impact on the ability of coastal environments to respond to future changes in sea level. The project will involve a mix of remote sensing (air photography) interpretation and ground truthing using fieldwork

Project 3: Tidal inlet geomorphology and temporal changes

Skills required: This project would suit a student interested in coastal geomorphology and with GIS and remote sensing capabilities.

Summary: Tidal inlets are dynamic environments that change in response to tidal and wave forcing. This project would assess the variations in morphology of tidal inlets and historical change at selected tidal inlets around the Irish Coast and interpret the changes. Data would be obtained from Google Earth, Earth Engine and other sources. The tidal prisms of estuaries and the volume of associated ebb tide deltas would be compared with established relationships.

Byrne, R.J., Gammisch, R.A. and Thomas, G.R. 1980. Tidal prism-inlet area relations for small tidal inlets. Ch.

151. <http://journals.tdl.org/icce/index.php/icce/article/viewFile/3578/3260>

Cooper, J.A.G., 2013. Geomorphic behaviour of fetch-limited barrier islands, Chesapeake Bay, USA. *Geomorphology*, doi:10.1016/j.geomorph.2012.06.019

Walton, T.L and Adams, W.D. 1976. Capacity of inlet outer bars to store sand. *Coastal Engineering*

Project 4: Sand composition and origin on the rocky coast of the Giant's Causeway

Skills required: This project would suit a student interested in coastal geomorphology and lab work.

Summary: Among the rocky outcrops along the Giant's Causeway coast are many areas of shelly sand. The distribution, composition and texture of that sediment will provide clues as to its origin. This project involves mapping and sampling these sands and analysing their texture and composition in the lab.

Project 5: Dunefield migration at decadal timescales

Skills required: This project would suit a student interested in geomorphology and with basic ability in GIS/remote sensing

Summary: the availability of multi-decadal datasets of the earth's surface in Earth Engine and Google earth enable the measurement and interpretation of dune behaviour in various parts of the world. This project will use these sources to quantify rates and patterns of dune migration in large coastal dunefields. The results will then be interpreted in relation to information on potential driving forces (e.g. wind velocity, and other climatic variables) and associated coastal changes (erosion, inlet migration, etc).

Prof Paul Dunlop



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Paul is a Quaternary glaciologist who investigates glacial landscapes in both terrestrial and marine environments to reconstruct past ice sheet behaviour. Understanding how ice sheets operate over long-time scales provides critical information on the global climate system and the processes of climate change. This research area requires a multidisciplinary approach and Paul uses a variety of cutting edge techniques to investigate glacial landscapes that includes satellite remote sensing, GIS, marine geophysics and cosmogenic nuclide and radiocarbon dating to work out what was happening during the last Ice Age and to help age constrain glacial events.

Project 1: Investigating glacier recession in the Austrian Alps

Skills required: This project would suit a student interested in satellite remote sensing/GIS and glaciology.

Summary: There is a lot of concern about how glaciers are receding in Alpine regions due to climatic warming and the associated impacts this will have on tourism, hydro-power schemes and future water supplies. The Austrian Alps are currently showing signs of rapid change since the mountains are lower lying than in other Alpine regions. This project will map the recessional pattern of a glacial catchment in the Dachstine region of Austria using Landsat data from the early 1970s to present day to assess the decadal changes that are occurring in the glacial catchment.

Frank Paul, Andreas Käab, Max Maisch, Tobias Kellenberger, Wilfried Haerberli (2004) Rapid disintegration of Alpine glaciers observed with satellite data. *Geophysical Research Letters* 31, issue 21. Available online from: <http://onlinelibrary.wiley.com/doi/10.1029/2004GL020816/full>

Project 2: Investigating recessional patterns of clean versus debris covered glaciers in the Himalaya.

Skills required This project would suit a student interested in satellite remote sensing/GIS and glaciology.

Summary: The UN's climate science body admitted that a claim made in its 2007 IPCC report – that Himalayan glaciers could melt away by 2035 - was unfounded. This has led a lot of speculation as to what is the state of play of Himalayan glaciers in terms of how they are responding to climate change. Recent studies monitoring glacier change in this region have also found that debris covered glaciers are often static in comparison to clean glaciers which are not blanketed by rock debris so the response is not a simple pattern of retreat. This project will use satellite imagery to investigate both debris covered and clean glaciers in the Baltoro Region of the Karakorum from 1970s to assess whether it is the case that both glacial systems are responding differently to climate warming.

Dirk Scherler, Bodo Bookhagen & Manfred R. Strecker (2011) Spatially variable response of Himalayan glaciers to climate change affected by debris cover. *Nature Geoscience* 4, 156–159

Dr Wes Forsythe



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Wes is a maritime archaeologist, with interests in the activities and economies of coastal communities in the medieval and post-medieval eras. His research examines strategies for exploiting and utilising marine resources and their resulting effect on the coastal landscape. In addition to research carried out at home, Wes has been active in north and east Africa working in regions affected by conflict, under-resourcing and neglect.

Project 1: Assessing the effectiveness of the new National Trust centre at the Giants Causeway

Summary: The new National Trust Centre at the Giants Causeway has aroused much controversy in terms of its architectural design and content. This project seeks to assess how successful it has been in aesthetic, functional and commercial terms. Is it successful in minimizing landscape impact; does it provide adequate space and a satisfactory balance between facilities, educational, and entertainment content? Has it successfully stimulated visitor numbers, increased sales of merchandise and improved the visitor experience? Is it appropriate to the World Heritage Site designation?

Methods: This topic would suit quantitative / qualitative questionnaires aimed primarily at visitors to the centre; but also members of staff within National Trust. Semi-structured interviews with staff may also be appropriate. National Trust statistics will be needed to provide context and back the findings of the study; and content analysis on the centre will support findings. National Trust permission to carry out the project will be required.

Boyd, Stephen. "Heritage tourism route development as part of 'big build projects': cases from Northern Ireland." (2013).

Crawford, Kevin R., and Róisín Black. "Visitor understanding of the geodiversity and the geoconservation value of the Giant's Causeway world heritage site, Northern Ireland." *Geoheritage* 4.1-2 (2012): 115-126.

McLaughlin, J. "A Simple and Quiet Monumentality-The new visitor centre at the Giant's Causeway, Northern Ireland." *Topos: European landscape magazine* 86 (2014): 24.

Project 2: 'Right to Repair' – an environmental or economic imperative?

Description: The 'Right to Repair' movement seeks to overhaul our relationship to consumer goods that no longer last beyond their warranty and have huge implications for resource use and the environment. Lax rules on manufacturers have facilitated the production of consumer goods that cannot be repaired, or can only be serviced by manufacturers themselves at inflated costs. Both consumer groups and the environmental lobby have petitioned western governments to address this waste. Manufacturers have defended their position as producing up to date goods that often have improved energy usage. This project seeks to identify whether an economic or environmental imperative is the key motivator for the movement.

Methods: This topic would suit quantitative / qualitative questionnaires aiming to compare and contrast two or more groups. A particularly interesting means of doing this might be by age – the older generation typically having more familiarity with repairing goods, and the younger more environmentally conscious. In addition, the researcher might seek groups from different geographical locations, with many immigrant

communities to NI having a greater repair ethic and even establishing businesses based on this. Semi-structured interviews with movement activists may also be appropriate.

References

To date there has been little academic studies of this phenomenon due to its recent emergence, however there are plenty of online articles and discussions.

Anon. (2017) A "right to repair" movement tools up. The Economist <https://www.economist.com/business/2017/09/30/a-right-to-repair-movement-tools-up>
<https://www.bbc.co.uk/news/science-environment-46797396>

Wiens, K. (2015) The Right to Repair. *IEEE Consumer Electronics Magazine*. 124-135

Project 3: Cultures of Consumption – commercial Vs craft food and drink

Summary Many messages bombard consumers about the relative purity, health benefits, dangers and manipulation of food and drink in the modern world. This has led to international variations in food standards and legal frameworks (e.g. laws on the genetic manipulation of crops). A range of products are affected by scientific findings, legal restrictions and the perceptions and preferences of consumers. This project seeks to examine the varied attitudes of consumers to such products and includes factors such as geographical location, health impacts, cost, availability and taste. A range of products may be suitable for study from organic and artisan foods to craft beer.

Methods: This topic would suit quantitative / qualitative questionnaires aimed at consumers, and should aim to compare and contrast attitudes using geographical and social variations (i.e. within rural and urban settings and across income levels). Semi-structured interviews with producers may also be appropriate.

Aquilani, Barbara, et al. "Beer choice and consumption determinants when craft beers are tasted: An exploratory study of consumer preferences." *Food Quality and Preference* 41 (2015): 214-224.

D'Aveni, Richard. "The Empire strikes back. Counterrevolutionary strategies for industry leaders." *Harvard Business Review* 80.11 (2002): 66-74.

Jackson, P., Ward, N. and Russell, P. (2009). Moral economies of food and geographies of responsibility. *Transactions of the Institute of British Geographers*, 34(1), 908-924.

Pietrykowski, Bruce. "You are what you eat: the social economy of the slow food movement." *Review of social economy* 62.3 (2004): 307-321.

Project 4: Segregation in Northern Ireland – beyond a 'benign apartheid'

Summary: Northern Ireland's then First Minister, Peter Robinson, once called our education system a benign form of apartheid. For many young people in Northern Ireland their first experience of mixed education is university. However it is not always the case that separation in the school system leads to complete segregation between Northern Ireland's communities. This project attempts to identify and explore areas where young people meet and mix outside of school and the church – this could be through family, sports, youth clubs etc.

Methods: This topic would suit quantitative / qualitative questionnaires aimed primarily at university students. It should strive to achieve equal community and gender representation. A geographical spread

across the six counties should also be attempted.

Hewstone, Miles, et al. (2005) "Intergroup contact in a divided society: Challenging segregation in Northern Ireland." *The social psychology of inclusion and exclusion*: 265-292.

Murtagh, B. J. (2010) "The politics of territory: Policy and segregation in Northern Ireland."

Paolini, Stefania, et al. (2004) "Effects of direct and indirect cross-group friendships on judgments of Catholics and Protestants in Northern Ireland: The mediating role of an anxiety-reduction mechanism." *Personality and Social Psychology Bulletin* 30.6: 770-786.

Smith, Alan. (2001) "Religious segregation and the emergence of integrated schools in Northern Ireland." *Oxford Review of Education* 27.4: 559-575.

Project 5: The Irish Language in Northern Ireland – an attitudinal study

Summary: The Irish language continues to be a point of controversy and debate in Northern Ireland, typically articulated via political grand-standing. The language has variously been co-opted as a key component of cultural (and political) identity or shunned as an expensive and tokenistic gesture to an Irish-speaking minority. This project seeks an up to date examination of attitudes toward the language that transcends the usual political and media soapboxes. In it a range of opinions on the authenticity, use, significance and future of the language will be sought.

Methods: This topic would suit quantitative / qualitative questionnaires aiming to compare and contrast two age groups – 18-30 and 40+. It should attempt to gauge the knowledge (fluency and context) levels, importance to heritage and identity, and attitudes to proposed future developments. Semi-structured interviews with language activists may also be appropriate.

Craith, M. Nic. (1999) "Irish speakers in Northern Ireland, and the Good Friday agreement." *Journal of Multilingual and Multicultural Development* 20.6: 494-507.

Crowley, Tony. (2005) *Wars of words: the politics of language in Ireland 1537-2004*. Oxford University Press.

DCAL Irish Language Bill Consultation (2015) <https://www.dcalni.gov.uk/publications/irish-language-billconsultation-2015-report-and-responses>

Northover, Mehroo, and Stephen Donnelly. (1996) "A future for English/Irish bilingualism in Northern Ireland?" *Journal of Multilingual and Multicultural Development* 17.1: 33-48.

Pritchard, Rosalind MO. (2004) "Protestants and the Irish language: Historical heritage and current attitudes in Northern Ireland." *Journal of Multilingual and Multicultural Development* 25.1: 62-82.

Project 6: Recreational and social use of cultural heritage sites

Description: A range of cultural heritage sites are distributed across Northern Ireland, ranging of prehistoric tombs, to Medieval castles and industrial structures. Managed by the Dept for Communities, the cultural heritage sector often struggles to be heard above concerns for the natural environment. Professionals in the sector have often called for greater articulation of the case for preserving and caring for sites of cultural heritage. This is an on-going challenge in an era when heritage is often reduced to cost benefits. This project seeks to identify the key motivations for the recreational and social use of heritage sites in State Care. It will identify the characteristics of current users of heritage sites, their reasons for visiting such sites and attitudes to built heritage in an attempt to develop such an argument.

Methods: This topic would suit quantitative / qualitative questionnaires aiming to compare and contrast attitudes from a range of users in a range of geographical locations. It will attempt to profile the typical user, activities carried out at the site and how perceptions of sites vary according to a range of factors. Semi-structured interviews with sector professionals may also be appropriate.

References

Hamlin, A., 2003. Archaeological heritage management in Northern Ireland: Challenges and solutions. In *Cultural Resource Management in Contemporary Society* (pp. 82-91). Routledge.

McManus, R., 1997. Heritage and Tourism in Ireland-an unholy alliance?. *Irish Geography*, 30(2), pp.90-98.

Waterton, E. and Watson, S. eds., 2013. *Heritage and community engagement: collaboration or contestation?*. Routledge.

Dr Edoardo Grotoli



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Edoardo is a geomorphologist with interests in many aspects of physical processes, hazards, and management of coastal zones. His research methods range from field measurements to remote sensing and GIS analyses. Primary research foci are sediment transport, storm impact and monitoring of sandy and gravelly beaches in different wave and tidal environments. Recently, he worked on shoreline analyses over the last two centuries to better understand long-term drivers of coastal change.

Project 1 – Quantifying multidecadal coastal dune changes with different remote sensed data

A combination of two or more remotely sensed data sets (historical maps, aerial photos, LiDAR, GNSS and/or drone-derived) will be analysed through GIS software to quantify the geomorphic evolution of a coastal sand dune over several decades of time or over a more limited time span. Newly generated remotely sensed datasets will be validated against recent (coeval when possible) and accurate datasets. Links between sediment displacements and natural forcing will be also be attempted.

Skills required: This project would suit a student interested in remote sensing/GIS and coastal geomorphology.

Carvalho, R.C., Allan, B., Kennedy, D.M., Leach, C., O'Brien, S. and Ierodiaconou, D., 2021. Quantifying decadal volumetric changes along sandy beaches using improved historical aerial photographic models and contemporary data. *Earth Surface Processes and Landforms*, 46(10), pp.1882-1897.

Duo, E., Fabbri, S., Grotoli, E. and Ciavola, P., 2021. Uncertainty of drone-derived dems and significance of detected morphodynamics in artificially scraped dunes. *Remote Sensing*, 13(9), p.1823.

Fabbri, S., Grotoli, E., Armaroli, C. and Ciavola, P., 2021. Using high-spatial resolution UAV-derived data to evaluate vegetation and geomorphological changes on a dune field involved in a restoration endeavour. *remote sensing*, 13(10), p.1987.

Grotoli, E., Biauxque, M., Rogers, D., Jackson, D.W.T. and Cooper, J.A.G., 2021. Structure-from-motion-derived digital surface models from historical aerial photographs: a new 3D application for coastal dune monitoring. *Remote Sensing*, 13(1), 95.

Guisado-Pintado, E., Jackson, D.W. and Rogers, D., 2019. 3D mapping efficacy of a drone and terrestrial laser scanner over a temperate beach-dune zone. *Geomorphology*, 328, pp.157-172.

James, M.R., Chandler, J.H., Eltner, A., Fraser, C., Miller, P.E., Mills, J.P., Noble, T., Robson, S. and Lane, S.N., 2019. Guidelines on the use of structure-from-motion photogrammetry in geomorphic research. *Earth Surface Processes and Landforms*, 44(10), pp.2081-2084.

Project 2 – Coastal erosion along the Northern Ireland coastline: who is already suffering from it?

This project aims to identify all the population together with public and private land uses that are already suffering from consequences of coastal erosion along sectors of the Northern Ireland coast. GIS analyses on primary and secondary data will inform on which population and what properties, land uses, or public infrastructures are already vulnerable to coastal flooding and storms. Interpretation of aerial photographs and LiDAR-derived data combined with historical shoreline trends and information available from

stakeholders on the major erosion spots will build up a geographic database of human and natural resources that are already fighting against sea level rise.

Skills required: This project would suit a student interested in GIS and coastal hazard/coastal management.

Courteille, M., Jeanson, M., Collin, A., James, D., Claverie, T., Charpentier, M., Gairin, E., Trouillefou, M., Giraud-Renard, E., Dolique, F. and Lecchini, D., 2022. Characterisation of long-term evolution (1950–2016) and vulnerability of Mayotte's shoreline using aerial photographs and a multidisciplinary vulnerability index. *Regional Studies in Marine Science*, 55, p.102537.

Parthasarathy, K.S.S. & Paresh Chandra Deka, 2021. Remote sensing and GIS application in assessment of coastal vulnerability and shoreline changes: a review, *ISH Journal of Hydraulic Engineering*, 27:sup1, 588-600.

Stevens, A.J., Clarke, D., Nicholls, R.J. and Wadey, M.P., 2015. Estimating the long-term historic evolution of exposure to flooding of coastal populations. *Natural Hazards and Earth System Sciences*, 15(6), pp.1215-1229.

Prof Derek Jackson



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Professor Jackson's research efforts have a general focus on coastal environmental change (morphodynamics and geomorphology) at a number of time and space scales. These efforts link into themes such as climate change impacts, its associated sea level rise and increased storminess on coastlines. Ultimately much of the work he carries out helps in the development of responses to climate change and pressures on natural beach and dune systems globally. Specifically, the main focus of his work examines wind-blown processes and modelling of airflow in a variety of planetary environments in temperate through to arid zones. Recent developments on the airflow modelling theme have involved research of dune movement at a number of locations on Mars, examining specific wind flow and dune landforms.

Project 1: Nearshore wave modelling under modal to storm wave scenarios along the Donegal coastline: wave model results and associated beach state

Skills required: Would suit a student interested in modelling natural processes, geospatial data and fieldwork

Summary: Using multi-beam data on the nearshore detailed bathymetry is now available for inclusion in computer modelling of wave refraction processes. Results from these models can be used to examine the forcing by waves that result in beach morphological changes. This project will focus on the creation of a detailed bathymetry, the running of multiple wave scenarios of incident wave heights and directions and examination of actual beach state. This will be under a series of scenarios ranging from modal up to storm conditions. Wave data will be derived from hindcast data offshore using the UK virtual buoy network of points. Results will also be used to compare against actual beach changes that have occurred over a particular period of time.

Jackson, Derek, Cooper, Andrew and del Rio, L (2005) Geological control of beach morphodynamic state. *MARINE GEOLOGY*, 216 (4). pp. 297-314.

Jackson, Derek and Cooper, Andrew (2009) Application of the equilibrium planform concept to natural beaches in Northern Ireland. *Coastal Engineering*, 57. pp. 112-123.

Short, A.D. and Jackson, D.W.T. (2013) Beach Morphodynamics. In: *Treatise on Geomorphology*. (Eds: Shroder, John F.), Elsevier, Academic Press, Amsterdam, San Diego, pp. 106-129. ISBN 9780123747396

Project 2 Nearshore wave modelling under modal to storm wave scenarios along the Antrim coastline and associated beach state

Skills required: Would suit a student interested in modelling natural processes, geospatial data and fieldwork

Summary: Using multi-beam data on the nearshore detailed bathymetry is now available for inclusion in computer modelling of wave refraction processes. Results from these models can be used to examine the forcing by waves that result in beach morphological changes. This project will focus on the creation of a detailed bathymetry, the running of multiple wave scenarios of incident wave heights and directions and examination of actual beach state. This will be under a series of scenarios ranging from modal up to storm

conditions. Wave data will be derived from hindcast data offshore using the UK virtual buoy network of points. Results will also be used to compare against actual beach changes that have occurred over a particular period of time.

Jackson, Derek, Cooper, Andrew and del Rio, L (2005) Geological control of beach morphodynamic state. *MARINE GEOLOGY*, 216 (4). pp. 297-314.

Jackson, Derek and Cooper, Andrew (2009) Application of the equilibrium planform concept to natural beaches in Northern Ireland. *Coastal Engineering*, 57. pp. 112-123.

Short, A.D. and Jackson, D.W.T. (2013) Beach Morphodynamics. In: *Treatise on Geomorphology*. (Eds: Shroder, John F.), Elsevier, Academic Press, Amsterdam, San Diego, pp. 106-129. ISBN 9780123747396

Project 3 Sand dune activity in Ireland during historical times

Skills required: Would suit a student interested in GIS mapping of natural processes, geospatial data and fieldwork

Summary: Sand dunes represent unique geomorphological landforms that closely mirror climatic patterns. Wind, precipitation levels, vegetation and sediment availability all combine to form dune systems at stages of activity. In recent decades we have seen dramatic re-sealing of sand dune systems across Ireland. This project would seek to examine this through aerial photography and GIS techniques as well as time series of climate data.

Jackson, Derek and Cooper, Andrew (2011) Coastal dune fields in Ireland: rapid regional response to climatic change. *Journal of Coastal Research*, SI 64. pp. 293-297.

Provoost, S., Jones, M.L.M. & Edmondson, S.E. (2009). Changes in landscape and vegetation of coastal dunes in northwest Europe: a review. *Journal of Coastal Conservation*. DOI 10.1007/s11852-009-0068-5.

Prof Phil Jordan



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Phil's research follows several themes within a catchment science framework: nutrient and sediment dynamics and fate in river and lake catchments, high-resolution monitoring of pollution dynamics in rivers, biogeochemical interactions within freshwater ecosystems, risk assessment of critical source areas/times of pollution at multiple scales, and agri-environmental policy development and review.

Project 1: Using rainfall and runoff intensity indices to investigate flood potential in a changing climate

Higher frequencies and magnitudes of extreme storm events are expected features of a changing climate across North-West Europe. This has implications for planning to enable all parts of society to adapt to flooding events.

Analysing historical datasets is a critical part of this planning and Northern Ireland has a rich record of both rainfall and river discharge (runoff) records, sometimes stretching back into the 19th Century.

This project will provide an assessment of changes to extreme rainfall and/or runoff conditions in Northern Ireland through an analysis of historical records that are publicly available.

The project will use programming methods in MS Excel to organise and analyse the data, and recently published methods to investigate changes to extreme events (Murphy et al., 2023).

Key reference:

Murphy et al. (2023). The emergence of a climate change signal in long-term Irish meteorological observations. <https://doi.org/10.1016/j.wace.2023.100608>

Project 2: Above and below ground carbon storage in woodlands

Achieving net-zero carbon emissions by 2050 is an important part of the Paris Agreement 2015 for countries around the world to tackle the effects of climate change (UNCC, 2015). Methods to achieve this will be regionally different but all will require an audit of current and changing conditions. Above and below ground biomass (AGB/BGB) are example conditions that can be considered as long-term carbon stores and that also increase carbon storage through growth. Trees and hedgerows are clearly important in this regard and estimating the AGB/BGB and hence carbon storage is a significant pathway to auditing for net-zero carbon emissions. These audits can be used in green financing schemes such as off-setting carbon emissions to companies that need to reduce their own emissions (such as transport), or in-setting carbon emissions for individual landowners (such as farmers).

A non-destructive way of estimating AGB/ABG in trees is to use allometric equations that relate an easily measured feature of the tree, such as trunk diameter at breast height (DBH), to AGB/BGB. These relationships have been established for most tree species and a common estimate of carbon storage is to multiply AGB and/or BGB by 0.5 (Randle et al., 2014).

However, a challenge is to make these measurements over large areas of woodland using suitable, statistically correct sampling methods.

Two projects are possible here.

1. Use field survey methods to determine the AGB/BGB of trees and hence a baseline of stored carbon.
2. Develop a remote sensing way of relating tree height and canopy footprint to AGB/BGB

Key references:

Randle, T., Matthews, R., Jenkins T. (2014). *Technical Specifications for the Biomass Equations Developed for the 2011 Forecast*; Forest Research Internal Publication; Forestry Commission: Edinburgh, Scotland. URL: <https://cdn.forestresearch.gov.uk/2022/02/revise-biomass-equations-27jan2014.pdf>

United Nations Climate Change (2015) URL: <https://unfccc.int/process-and-meetings/the-paris-agreement>

Project 3: Stream flume validation using salt dilution gauging

River water level and discharge records are extremely important for flood and drought planning and resilience, water quality assessments, land drainage, discharge consents, irrigation, and drinking water supply. There are over one hundred river discharge monitoring stations operated by the Department for Infrastructure in Northern Ireland used for these purposes (DfI, 2023).

Water level in rivers is relatively easy to measure using automatic measuring and logging equipment. However, relating level (m) to discharge (m^3/s) requires a 'rating curve' where river discharge is measured at different water levels using current meters and a calibration equation developed.

However, in headwaters or other small streams, discharge measurements using current meters is difficult due to stream depth and width. An alternative method is to use salt dilution gauging techniques that measure the passage of a slug of salt-water in a stream using a conductivity meter. This is a rapid way of establishing rating curves in small rivers, and/or validating the discharge measurements of pre-calibrated flumes or weirs (Chappell, n.d., Richardson et al., 2017).

This project will use salt-dilution gauging techniques to validate the discharges predicted by three pre-calibrated flumes in the Glens of Antrim uplands. The flumes are installed in small head water streams and the data are being used to determine the most effective way of restoring degraded peatlands.

This is a field-work intensive project and will require a number of field visits to use salt-dilution gauging methods over a range of stream water levels.

Key references:

Chappell, N. (no date). Discharge in White Scar Cave using the integration (Gulp) method. URL: <http://www.es.lancs.ac.uk/people/nickc/104/case16a.htm>

Department for Infrastructure (2023).

URL: https://www.hydrometcloud.de/Rivers_Agency/index.jsp?menu=index

Richardson et al. (2017). Quantifying the relation between electrical conductivity and salt concentration for dilution gauging via dry salt injection. Confluence: Journal of Watershed Science and Management, 2/1. URL: <https://www.confluence-jwsm.ca/index.php/jwsm/article/download/1/2>

Project 4: Altitude-weighted rainfall measurements in the uplands

Rainfall measurements are important for weather forecasting, flood and drought planning and water quality assessments. This is especially so in a period of changing climate conditions and weather extremes.

Measurements are generally made at synoptic meteorological stations that combine other parameters (wind speed and direction, humidity, temperature, radiation, etc.) (CEH, 2023). However, in upland environments, the data from such weather stations may not be reflective of conditions that change rapidly with altitude. This is an important consideration as, in the uplands, rainfall may exceed that measured at the nearest weather station that might, for convenience, be situated at a much lower altitude (Fowler et al, 1988).

This project will test this assumption by comparing rainfall measured at an altitude of 274m by the Centre for Ecology and Hydrology at the Glenwherry Hill Farm in the Glens of Antrim (<https://cosmos.ceh.ac.uk/sites/GLENW>), with a series of rain gauges that will be situated at much lower and higher altitudes. Rainfall totals over pre-determined periods and rainfall intensity will be compared for an altitude-weighted assessment of the CEH rain gauge.

This is a field-work intensive project in the uplands and requires regular field visits with University researchers.

Key references:

Centre for Ecology and Hydrology (2023). Cosmic-ray soil moisture monitoring network. URL: <https://cosmos.ceh.ac.uk/>

Fowler et al. (1988) The influence of altitude on rainfall composition at great dun fell. URL: [https://doi.org/10.1016/0004-6981\(88\)90160-6](https://doi.org/10.1016/0004-6981(88)90160-6)

Project 5: Optimising soil testing sub-sample resolution to estimate field-scale mean chemical concentration

Determining the average chemical concentration of agricultural fields is important for both agronomic potential and environmental risk. This is particularly so with nutrients that are necessary for crop/grass growth but also cause water quality issues when rainfall causes runoff and leaching to rivers and lakes. Composite soil sampling is a standard method for estimating mean field chemical concentration but the number of sub-samples required for a representative composite is uncertain. In this project, the number of sub-samples will be optimized statistically to a point where mean chemical concentrations do not change significantly from repeated, random sampling.

The project will be in three parts. 1) Soil sub-sampling in a 2ha grassland field at the nodes of a virtual grid. 2) Analysing the soil sub-samples in the laboratory for the nutrient phosphorus. 3) Using a random number approach to repeat sample the soil results at fixed resolutions (n = 5, n=10, n=15 etc.).

The variability of the repeat results sampling will be assessed and an optimum soil sampling resolution determined.

Key reference:

Nanni et al. 2011.
http://www.scielo.br/scielo.php?pid=S0103-90162011000300017&script=sci_arttext

Note. The soil sampling will have to be conducted between November and January only and so will suit a student with access to farmland and/or a placement year student. Establishing a virtual grid over the field will require access to and knowledge of Year 2 GIS.

Project 6: Optimising slurry nutrient content and spreading rate

Cattle slurry is a by-product of intensive dairy farming and an important nutrient replacement source on grasslands. The nutrient content (nitrogen, phosphorus, potassium) and spreading rate of slurry is important information to ensure that nutrient replacements are optimized. This optimization is crucial to balance agronomic need against the potential for nutrient loss to water (during runoff events) where eutrophication can occur.

Although estimates of slurry nutrient concentrations and area spreading rates are published in advisory guidelines, there remains uncertainty. This is often due to slurry quality and also established behaviour.

This project will compare farmer knowledge of nutrient replacement (concentration and spreading rate) with a technical method based on published relationships between nutrients and slurry dry matter. The project will be based on two concurrent surveys. 1) Farmers will be interviewed on the field nutrient replacement value based on their normal practice. 2) Slurry used in this normal practice will be tested for dry matter content based on the hydrometer method and results taken from published tables. Correct, under or over application rate and nutrient replacement value will be recorded and implications discussed.

Key references:

Piccinini and Bortone, 1991
<http://tinyurl.com/yycne6c>

Murphy, 2018
https://www.youtube.com/watch?v=dPi_KxpjSv8

Note: This project is suited for students with a farming background, interested in the agri-environment and with access to the dairy farming community, and needs to be conducted between February and September.

Project 7: Organic farming and soil functional benefits – biodiversity

Organic farming is a multi-million pound industry and driven by the need to supply healthier food, with low or no chemical residues. Chemical fertilizers and pesticides are generally prohibited on agricultural soils used for organic production. Soils are also considered in a functional framework where primary production is one such function. Other main functions include nutrient cycling, carbon sequestration, water purification/regulation, and biodiversity provision. Soil biodiversity can be quantified on a genetic level and also via microbial composition and macro-invertebrate communities. A rich soil invertebrate biodiversity supports a wider food web in the countryside but the benefits from organic farming in this regard are largely unquantified.

This project will investigate the soil functional benefits of organic farming with regard to invertebrate biodiversity using a series of paired comparisons – organic versus non-organic farming on similar land uses. Invertebrates will be collected using soil samples collected from the fields and a Berlese funnel extraction method or pit-traps. Invertebrates will be counted and biodiversity determined using the Shannon Index. Statistical comparisons will be made using a suitable non-parametric test.

Key references:

<https://tiee.esa.org/vol/v3/experiments/soil/description.html>

Hole et al. 2004

<https://www.sciencedirect.com/science/article/abs/pii/S0006320704003246>

Note: This project is suited for students with a farming background, interested in the agri-environment and with access to the organic farming community, and needs to be conducted during the summer semester.
Projects from two students can be considered using different invertebrate collection techniques.

Project 8: Longitudinal pollution surveying to assess the influence of rural point sources in river catchments

Pollution can enter river systems from discrete sources such as septic tank systems, waste-water treatment discharges or consented industrial discharges. The effect of these inputs can be a stepped increase in pollutant concentration depending on the magnitude of the input and the dilution capacity of the receiving river system and which may eventually become diluted. If the pollution source is persistent then the effect of these inputs is more noticeable during low summer flows and when impacts may also be greatest and particularly when downstream dilution is constrained by further inputs. Phosphorus, ammonia, dissolved organic matter and turbidity may singularly or in combination be evident as stepped increases in pollution concentration downstream of rural waste-water discharge points and which may either be persistent or released in batches. Longitudinal, or downstream to upstream, surveying of rivers by repeated grab sampling is one way to determine the discrete and cumulative impact of these discharge points.

This project will use a spatial dataset of known rural waste-water discharge points in a river system chosen by the student and assess the discrete and cumulative impacts of the discharges using a longitudinal surveying approach. Samples will be collected (at points determined after study of the spatial data) during a low flow summer period and repeated on another occasion. Pollution chemistry will be determined in the laboratory. A statistical analysis of water pollution will be undertaken using paired datasets upstream and downstream of each suspected pollution source. A final assessment will be made on the discrete and cumulative impact of rural point sources in the river catchment.

Key references:

Arnscheidt et al., 2007

<https://www.sciencedirect.com/science/article/pii/S004896970700397X>

Melland et al., 2012

<https://www.sciencedirect.com/science/article/pii/S146290111200086X>

Note: This project can only be undertaken between the months of May and September for both field and laboratory work. Students will require car transport and be prepared for laboratory work immediately (24hours later) following fieldwork.

Projects from two students can be considered using different river catchments, pollution parameters and laboratory techniques.

Dr Sara McDowell



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Sara's interdisciplinary research focuses on the spatial dynamics of conflict and peacebuilding in divided or transitional societies and has two key strands. The first strand explores the ways in which the past is negotiated in contested spaces within societies engaged in peace processes. The second strand of Sara's research focuses on the relationship between social media and border politics in divided societies.

Project 1: Migration and Spaces of Exception: Asylum spaces and Immigration policy in the UK

This project seeks to understand whether the concept of 'spaces of exception' can be applied to holding/asylum centres in the UK. Spaces of exception are largely defined as places where regulations and laws can be suspended in the event of a political emergency. The project will involve mapping asylum spaces, examining immigration policy, analysing the outsourcing of centres to external actors and unpacking representations of the centres. Qualitative methods will be employed.

Recommended reading

Canning, V. (2019). Degradation by design: women and asylum in northern Europe. *Race & Class*, 61(1): 46-63. <https://doi.org/10.1177/0306396819850986>

Silverman, S. J., & Hajela, R. (2020). Immigration Detention in the UK. Migration Observatory.

Project 2: A study of NGO search and rescue activity in the Mediterranean

This project will map NGO activity in the Mediterranean across a six-month period and assess the difficulties in operating in a space where (maritime) boundaries are blurred. Search and Rescue vessels often encounter difficulty in docking at many European ports as some governments are reluctant to have those intercepted at sea disembark on their respective territories. Using a case study approach, this project would examine policies that determine the scope of search and rescue activity, analyse the work of Open Arms (a Spanish NGO operating in the Mediterranean) and document how its work is represented in the media. Methods would include some social media data analysis and a content analysis of reportage.

Recommended reading

McDowell, S. (2022). Geopoliticizing geographies of care: scales of responsibility towards sea-borne migrants and refugees in the Mediterranean. *Geopolitics*, 27(2): 444-461.

Project 3: A study of Climate Activism

The visibility and scope of climate activism has grown considerably in recent years. This project will trace the development of activism in this sphere and assess how it is shaping public discourse around climate change. It will also examine how protests are represented by the media. The project will involve documenting the trajectory of environmental protest movements, analysing the activities of key grassroots organisations in this space and assessing the ways in which the media represents protests and strikes.

Recommended reading

Martiskainen, M., Axon, S., Sovacool, B. K., Sareen, S., Del Rio, D. F., & Axon, K. (2020). Contextualizing climate justice activism: Knowledge, emotions, motivations, and actions among climate strikers in six cities. *Global Environmental Change*, 65, 102180.

Project 4: Demilitarisation and Regeneration: Examining the political economy of peacebuilding in Northern Ireland

This project will examine the political economy of peacebuilding in Northern Ireland through a case study of flagship regeneration developments that were designed to underpin the peace process through boosting the economy and deterritorialising deeply contested sites. The project will focus on the redevelopment of former military sites (including the Maze Prison) that were transferred to the public under the Chancellor's Reinvestment and Reform Initiative and use a mixed-methods approach.

Recommended reading

Oloke, I., & Byrne, S. (2021). The Political Economy of Sustainable Peacebuilding in Northern Ireland. *International Journal of Peace Studies*, 26(2): 31-40.

Project 5: Examining Greenwashing: Public Perceptions and Governmental Regulation

As consumers become more environmentally conscious, greenwashing (the practice of making a product or a company appear more sustainable or eco-friendly) has gained more traction. It is often however unregulated. This project seeks to examine the practice of greenwashing and think about how it permeates companies and institutions. As well as interrogating pro-environmental behaviours, the research will also think about how governments regulate greenwashing (if at all).

Recommended reading:

Urbański M, ul Haque A. (2020). Are You Environmentally Conscious Enough to Differentiate between Greenwashed and Sustainable Items? A Global Consumers Perspective. *Sustainability* 12(5):1786. <https://doi.org/10.3390/su120517>

Dr Chris McGonigle



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Chris's interdisciplinary research interests are focused on understanding what is driving patterns of biodiversity in marine environments, and how we can use acoustic techniques to develop our ability to monitor and conserve these resources most effectively. Specific projects he is currently involved in include: mid-water and ocean floor mapping for fisheries stock assessment, species distribution and hydrodynamic modelling for benthic habitat mapping. This work is at the interface of marine ecology, acoustics, spatial analysis and numerical modelling. Chris's research has societal relevance and impact with implications for sustainable development of marine resources, and the conservation of marine biodiversity.

Project 1. Characterising mobile scavenger assemblages using non-invasive monitoring: Baited Remote Underwater Video (BRUV) as a tool for Marine Protected Areas.

Skills required: This project would suit a student interested in benthic habitat mapping, acoustic remote sensing, marine and landscape ecology and GIS. This will be a desk-based analysis using extant data.

Summary: Baited Remote Underwater Video (BRUV) has emerged in recent years as a monitoring method that provide an opportunity to collect valuable information about species of conservation value, mobile scavenging communities and other information of biological interest (Langlois et al., 2006; Fox et al., 2018; Taylor et al., 2013). This information can inform the management of Marine Protected Areas (MPAs) by providing detailed information about site occupancy and behaviour of key groups of organisms. Using a series of data sets from existing research projects, this project will characterise mobile communities and allow for those to be related to wider habitat level information from geomorphological datasets.

Fox, C. J., Benjamins, S., Masden, E. A., & Miller, R. (2018). Challenges and opportunities in monitoring the impacts of tidal-stream energy devices on marine vertebrates. *Renewable and Sustainable Energy Reviews*, 81, 1926-1938.

Langlois, T., Chabanet, P., Pelletier, D., & Harvey, E. (2006). Baited underwater video for assessing reef fish populations in marine reserves. *Fisheries Newsletter-South Pacific Commission*, 118, 53.

Taylor, M. D., Baker, J., & Suthers, I. M. (2013). Tidal currents, sampling effort and baited remote underwater video (BRUV) surveys: are we drawing the right conclusions?. *Fisheries Research*, 140, 96-104.

Project 2. Diversity of intertidal rockpools – size, morphology and geology as controls on assemblage structure underwater.

Skills required: This project would suit a numerate student interested in experimental design, statistics and marine ecology. There would be a substantial field component to this work.

Summary: Rockpools are unique and interesting habitats within which to study ecological processes. At the boundary between terrestrial and marine systems, they are afforded exchange with open system with the rise and fall of the tide which creates a series of microhabitats that are persistently covered in topographic low points on the shore platform. Existing literature shows that geomorphology and the material properties of the underlying geology can shape the biological community response (Duckson &

Duckson, 1995; Legrand et al., 2018). This project will explore some of these concepts in underwater habitats in terms of flora and fauna assemblages across a range of geological conditions, energetic exposures or other physicochemical parameters.

Duckson Jr, D. W., & Duckson, L. J. (1995). Morphology of bedrock step pool systems 1. *JAWRA Journal of the American Water Resources Association*, 31(1), 43-51.

Griffiths, S. P., Davis, A. R., & West, R. J. (2006). Role of habitat complexity in structuring temperate rockpool ichthyofaunas. *Marine Ecology Progress Series*, 313, 227-239.

Huggett, J., & Griffiths, C. L. (1986). Some relationships between elevation, physico-chemical variables and biota of intertidal rock pools. *Marine Ecology Progress Series*, 29(2), 189-197.

Legrand, E., Riera, P., Pouliquen, L., Bohner, O., Cariou, T., & Martin, S. (2018). Ecological characterization of intertidal rockpools: Seasonal and diurnal monitoring of physico-chemical parameters. *Regional Studies in Marine Science*, 17, 1-10.

Morris, S., & Taylor, A. C. (1983). Diurnal and seasonal variation in physico-chemical conditions within intertidal rock pools. *Estuarine, Coastal and Shelf Science*, 17(3), 339-355.

White, G. E., Hose, G. C., & Brown, C. (2015). Influence of rock-pool characteristics on the distribution and abundance of inter-tidal fishes. *Marine Ecology*, 36(4), 1332-1344.

Project 3. Intertidal community ecology: measuring changes in community structure across an environmental gradient (point-source pollution)

Skills required: This project would suit a numerate student interested in marine ecology and water quality. There would be a substantial field component to this work.

Summary: Environmental gradients play an important structural role in marine systems. Gradients in contaminants are commonly found moving away from point-source pollution, and interact with existing natural and ecological gradients (Bishop et al., 2002). Benthic community structures are often used as environmental indicators for measuring the impacts of pollutants (López Gappa et al., 1990). Changes observed in community structure in these environments can inform about benthic organisms tolerance of pollution stresses. This project will measure intertidal assemblage structures across a pollution gradient using univariate and multivariate techniques, and statistically determine the significance of any variations. Bishop, M.J., Underwood, A.J. Archambault, P. 2002. Sewage and environmental impacts on rocky shores: necessity of identifying relevant spatial scales, *Marine Ecology Progress Series*, 236, 121-128

López Gappa, J.J. Tablado, A. and Magalidi, N.H. 1990. Influence of sewage pollution on a rocky intertidal community dominated by the mytilid *Brachidontes rodriguezii*, *Marine Ecology Progress Series*, 63, 163-175

Dr Paul McKenzie



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Paul is interested in the use of GIS and Remote Sensing to answer a wide range of geographical issues. His research focuses on the development of risk models for poverty mapping across large spatial scales. Other interests include the use of remotely sensed data to map and monitor the environment and the fusion of remotely sensed datasets to extract features in the urban and agricultural landscapes. Paul has also a keen interest in developing the use of GIS in Schools.

Project 1 – Rural Residential Development

Rural Residential Development (RRD) leads to biodiversity loss and has a negative impact on ecosystem services (McKenzie et al., 2011) while also turning carbon sinks into carbon sources (Churkina et al., 2020). Longitudinal aerial imagery from Ordnance Survey Northern Ireland (OSNI) will be used to identify the rate and morphology of rural development. The impact of RRD on natural ecosystems will be considered using classified satellite imagery from Land Cover Map. The project will suit a student with a strong interest in spatial data and physical geography / environmental science.

Cillis, G., Statuto, D., and Picuno, P. (2021). Integrating remote-sensed and historical geodata to assess interactions between rural buildings and agroforestry land. *Journal of Environmental Engineering and Landscape Management*, 29(3), 229-243. <https://doi.org/10.3846/jeelm.2021.15080>

Gude, P.H., Hansen, A.J., Rasker, R. And Maxwell, B. (2006). Rates and drivers of rural residential development in the Greater Yellowstone. *Landscape and Urban Planning*, 77(1), pp. 131-151.

Ledda, Serra and De Montis, 2019. The Effect of Rural Buildings on Landscape Fragmentation in Natura 2000 Sites: A Case Study in Sardinia. *Sustainability*, 11(17), p.4695. <https://doi.org/10.3390/su11174695>.

McKenzie, P., Cooper, A., McCann, T., and Rogers, D. (2011). The ecological impact of rural building on habitats in an agricultural landscape. *Landscape and Urban Planning*, 101, 262-268. <https://doi.org/10.1016/j.landurbplan.2011.02.031>

Project 2 – Riparian zone change

Riparian zones have experienced significant change over the last 50 years due to anthropogenic activities which alter the biological condition of rivers (Maass, et al., 2021). Climate change is also impacting significantly on freshwater species (Griffith and Gobler, 2020) as increased water temperature modifies basal metabolic functioning (Pörtner and Farrell, 2008), timing of pivotal biological events (Asch, 2015), and species occurrence (Harley et al., 2006). Freshwater habitats have become the most damaged in the world, with almost a third of fish populations threatened with extinction (Lovgren, 2021).

Riparian zones represent a critical interface between terrestrial and aquatic ecosystems which provide significant ecological services (ES) such as eliminating pollutants from run-off, reducing flood damage, increasing fish biodiversity and abundance and delivering animal and plant resources which support recreation and improve human quality of life. Riparian zones are regarded as critical to the preservation of the biological conditions of rivers (Naiman and Décamps, 1997) and landscape change in these areas has a significant impact on the ability of species to function (Stoffers et al., 2022).

This project will use archived aerial imagery and current orthophotography to map changes to riparian zones over time. The project will suit a student with a strong interest in spatial data and physical geography / environmental science. The project will have supervision from both Dr Joerg Arnscheidt and Dr Paul McKenzie.

Atkinson, S.F., Hunter, B.A. and English, A.R. (2010). Prioritizing Riparian Corridors for Water Quality Protection in Urbanizing Watersheds. *Journal of Water Resource and Protection*, 02(07), pp.675–682.

Etter, A., Andrade, A., Nelson, C.R., Cortés, J. and Saavedra, K. (2020). Assessing restoration priorities for high-risk ecosystems: An application of the IUCN Red List of Ecosystems. *Land Use Policy*, 99, p.104874.

Fernandes, M.R., Aguiar, F.C. and Ferreira, M.T. (2011). Assessing riparian vegetation structure and the influence of land use using landscape metrics and geostatistical tools. *Landscape and Urban Planning*, 99(2), pp.166–177.

Stoffers, T., Buijse, A.D., Geerling, G.W., Jans, L.H., Schoor, M.M., Poos, J.J., Verreth, J.A.J. and Nagelkerke, L.A.J. (2022). Freshwater fish biodiversity restoration in floodplain rivers requires connectivity and habitat heterogeneity at multiple spatial scales. *Science of The Total Environment*, 838, p.156509. doi: <https://doi.org/10.1016/j.scitotenv.2022.156509>

Project 3 - Solar acceptability in rural communities

The decentralization of energy is an important step in meeting government net-zero targets by 2050. Energy communities, particularly in rural communities that are off the main grid network, can avail of low carbon technologies (LCTs) such as wind or solar PV ([Brummer, 2018](#)).

Energy Communities face challenges such as reduced Feed-in-Tariffs and government support (Nolden et al., 2020). Martens (2022) finds that in Germany the success of renewable energy communities is associated with acceptance and support from sub-national level government, and the pre-existence of other communities.

This project will use GIS and spatial data to identify groups of buildings that could avail of solar PV systems for local energy production. The project will use both GIS and questionnaires to identify possible communities and their attitudes to solar PV adoption.

Liu, D., Qi, S. and Xu, T., 2023. Visual observation or oral communication? The effect of social learning on solar photovoltaic adoption intention in rural China. *Energy Research & Social Science*, [e-journal] 97, pp.102950. 10.1016/j.erss.2023.102950.
<<https://www.sciencedirect.com/science/article/pii/S2214629623000105>>.

Scheller, F., Doser, I., Schulte, E., Johanning, S., McKenna, R. and Bruckner, T., 2021. Stakeholder dynamics in residential solar energy adoption: findings from focus group discussions in Germany. *Energy Research & Social Science*, [e-journal] 76, pp.102065. 10.1016/j.erss.2021.102065.
<<https://www.sciencedirect.com/science/article/pii/S2214629621001584>>.

Schulte, E., Scheller, F., Sloot, D. and Bruckner, T., 2022. A meta-analysis of residential PV adoption: the important role of perceived benefits, intentions and antecedents in solar energy acceptance. *Energy Research & Social Science*, 84, pp.102339. 10.1016/j.erss.2021.102339.
<<https://www.sciencedirect.com/science/article/pii/S2214629621004308>>.

Dr Bob McNabb



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Bob is interested in how remote sensing data can help us understand changes in glacial landscapes over a variety of temporal and spatial scales.

Project 1: Mapping glacier changes over time

On a global scale, glacier melt and recession is currently accelerating. Unfortunately, many studies of glacier changes are constrained to the "satellite era" (ca. 1970-present), and observations of extent or length for many glaciers around the world are only available at a single point in time. In this project, you will work to help fill in some of these gaps by mapping glaciers using a combination of satellite imagery, declassified reconnaissance imagery, aerial photographs, or even geomorphological imprints left by retreating glaciers. The focus is mostly open-ended, and could vary from mapping glacier changes on a regional scale over several decades or even centuries, to mapping higher-resolution changes at a single glacier. There is also the potential to analyze/compare glacier changes with external factors such as air and ocean temperatures.

Potential study areas include Greenland, Arctic Canada, Alaska, the Russian Arctic, South America, or High Mountain Asia. This project is suitable for a student with interest in satellite remote sensing/GIS, glaciology, geomorphology, or even some computer programming (Python/Matlab or similar).

Example references:

Carr, J. R., Bell, H., Killick, R., & Holt, T. (2017). Exceptional retreat of Novaya Zemlya's marine-terminating outlet glaciers between 2000 and 2013. *The Cryosphere*, 11(5), 2149–2174. <https://doi.org/10.5194/tc-11-2149-2017>

Glasser, N. F., Harrison, S., Jansson, K. N., Anderson, K., & Cowley, A. (2011). Global sea-level contribution from the Patagonian Icefields since the Little Ice Age maximum. *Nature Geoscience*, 4(5), 303–307. <https://doi.org/10.1038/ngeo1122>

Leclercq, P. W., Oerlemans, J., Basagic, H. J., Bushueva, I., Cook, A. J., & Le Bris, R. (2014). A data set of worldwide glacier length fluctuations. *The Cryosphere*, 8(2), 659–672. <https://doi.org/10.5194/tc-8-659-2014>

McNabb, R. W., & Hock, R. (2014). Alaska tidewater glacier terminus positions, 1948–2012. *Journal of Geophysical Research*, 119(2), 153–167. <https://doi.org/10.1002/2013JF002915>

Winsvold, S. H., Andreassen, L. M., & Kienholz, C. (2014). Glacier area and length changes in Norway from repeat inventories. *The Cryosphere*, 8(5), 1885–1903. <https://doi.org/10.5194/tc-8-1885-2014>

Project 2: Detection of supraglacial lakes and timing of drainage

Supraglacial lakes are a significant source of water that has the potential to reach the glacier bed, dramatically increasing glacier velocities, which in turn can impact glacier stability, local ecosystems, and global sea levels. For this project, you will use optical and radar satellite imagery to detect supraglacial lakes in an area to be discussed. The goal is to determine if and when they drain, and given the

availability of digital elevation models in the selected study area, estimate lake volumes through time. Suitable for a student with interest in satellite remote sensing/GIS, glaciology, or even some computer programming (Python/Matlab or similar).

Example references:

Hoffman, M. J., G. A. Catania, T. A. Neumann, L. C. Andrews, and J. A. Rumrill (2011), Links between acceleration, melting, and supraglacial lake drainage of the western Greenland Ice Sheet. *Journal of Geophysical Research*, 116, F04035. <https://doi.org/10.1029/2010JF001934>

Wendleder, A., Friedl, P., & Mayer, C. (2018). Impacts of climate and supraglacial lakes on the surface velocity of Baltoro Glacier from 1992 to 2017. *Remote Sensing*, 10(11), 1681. <https://doi.org/10.3390/rs10111681>

Project 3: Mapping harmful algal blooms using satellite remote sensing

Harmful algal blooms affect public health and ecosystem integrity, and are increasing in frequency and intensity due to effects associated with pollution and climate change. The growth of available satellite data in recent years provides an effective tool for detecting and monitoring these events. Methods used to detect harmful algal blooms from satellite imagery range from relatively simple indices to more complex machine learning approaches. For this project, you will investigate the use of optical satellite imagery to detect harmful algal blooms, with the potential for investigating both inland water bodies or coastal areas. Suitable for a student with interest in satellite remote sensing and water quality monitoring.

Example references:

Hu, C., 2009. A novel ocean color index to detect floating algae in the global oceans. *Remote Sensing of Environment* 113, 2118–2129. <https://doi.org/10.1016/j.rse.2009.05.012>

Rolim, S.B.A., Veetil, B.K., Vieiro, A.P., Kessler, A.B., Gonzatti, C., 2023. Remote sensing for mapping algal blooms in freshwater lakes: a review. *Environmental Science and Pollution Research* 30, 19602–19616. <https://doi.org/10.1007/s11356-023-25230-2>

Project 4: Flood detection and monitoring using remote sensing

Floods can inundate large areas, causing damage to agricultural lands, property, transportation links, and leading to loss of life. Satellite remote sensing, especially Synthetic Aperture Radar (SAR), is a key tool for identifying and mapping flood-prone areas, helping to improve flood management and mitigate these damaging effects. In this project, you will investigate the use of GIS and remote sensing to identify flood-prone areas in a study region to be determined. Suitable for a student with an interest in remote sensing/GIS, land use management, or hazard and risk management.

Example references:

Brivio, P.A., Colombo, R., Maggi, M., Tomasoni, R., 2002. Integration of remote sensing data and GIS for accurate mapping of flooded areas. *International Journal of Remote Sensing* 23, 429–441. <https://doi.org/10.1080/01431160010014729>

Clement, M. A., Kilsby, C. G., Moore, P., 2018. Multi-temporal synthetic aperture radar flood mapping using change detection. *Journal of Flood Risk Management* 11, 152–168. <https://doi.org/10.1111/jfr3.12303>

Pulvirenti, L., Pierdicca, N., Chini, M., Guerriero, L., 2011. An algorithm for operational flood mapping from Synthetic Aperture Radar (SAR) data using fuzzy logic. *Natural Hazards and Earth System Sciences* 11, 529–540. <https://doi.org/10.5194/nhess-11-529-2011>

Project 5: Detection and mapping of wildfires

Wildfire occurrence is increasing in different regions around the world, due in part to human-induced climate change. Several techniques exist to identify and monitor both active and past fire extents using satellite remote sensing, including the use of both thermal remote sensing and Synthetic Aperture Radar (SAR). In this project, you will use a variety of remote sensing and GIS techniques to investigate wildfires in a study region to be determined. Suitable for a student with an interest in remote sensing/GIS, land use management, or hazard and risk management.

Example references:

Bourgeau-Chavez, L.L., Kasischke, E.S., Brunzell, S., Mudd, J.P., Tukman, M., 2002. Mapping fire scars in global boreal forests using imaging radar data. *International Journal of Remote Sensing* 23, 4211–4234. <https://doi.org/10.1080/01431160110109589>

Tran, B.N., Tanase, M.A., Bennett, L.T., Aponte, C., 2018. Evaluation of Spectral Indices for Assessing Fire Severity in Australian Temperate Forests. *Remote Sensing* 10, 1680. <https://doi.org/10.3390/rs10111680>

Project 6: Urban heat islands

Urban or built environments tend to be hotter than surrounding natural or rural areas, though even within urban areas there can be considerable variation in temperature. This effect, known as the “urban heat island” effect, is due to the physical properties of the built environment, which tends to absorb solar energy and trap heat. Urban heat islands can have a direct impact on the health and welfare of residents, and the effects are often worse in poorer areas of a city. In this project, you will use a combination of satellite remote sensing and GIS to investigate aspects of urban heat islands in a study area to be determined. Suitable for a student with an interest in remote sensing/GIS, social policy, or sustainable development.

Example references:

Benz, S.A., Burney, J.A., 2021. Widespread Race and Class Disparities in Surface Urban Heat Extremes Across the United States. *Earth’s Future* 9. <https://doi.org/10.1029/2021EF002016>

Halder, B., Bandyopadhyay, J., Banik, P., 2021. Monitoring the effect of urban development on urban heat island based on remote sensing and geo-spatial approach in Kolkata and adjacent areas, India. *Sustainable Cities and Society* 74, 103186. <https://doi.org/10.1016/j.scs.2021.103186>

Yin, Y., He, L., Wennberg, P.O., Frankenberg, C., 2023. Unequal exposure to heatwaves in Los Angeles: Impact of uneven green spaces. *Science Advances* 9, eade8501. <https://doi.org/10.1126/sciadv.ade8501>

Zhou, D., Xiao, J., Bonafoni, S., Berger, C., Deilami, K., Zhou, Y., Frohling, S., Yao, R., Qiao, Z., Sobrino, J., 2018. Satellite Remote Sensing of Surface Urban Heat Islands: Progress, Challenges, and Perspectives. *Remote Sensing* 11, 48. <https://doi.org/10.3390/rs11010048>

Additional research topics are possible based on student interest, please contact Bob directly to discuss.

Prof Adrian Moore



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Adrian has research interests in the application of GIS technologies to examine the relationships between the physical and social environments, human health and health care delivery. He is particularly interested in the mapping and spatial analysis of environmental risk factors related to aging.

Project 1: The Geography of Deprivation and Dental Health in Northern Ireland

Skills required: This project would suit a student with good skills in GIS and an interest in geography related health research and analysis

Summary: Poor oral health is closely associated with socio-economic deprivation and social exclusion. Over the years there has been a real and sustained improvement in oral health assisted by better diets, fluoride toothpastes and the fluoridation of water but inequalities still exist. The shift in dentists from the NHS to the private sector is one of many factors that make it difficult for some people to find an NHS dentist when they need one and this is especially true for those living in more deprived and remote areas. Using GIS-based spatial analytical techniques, this project will investigate geographical variations in dental health across Northern Ireland at the small area level. Dental health will be measured using health service data on extractions, fillings, crowns and x-rays from 2013 to 2017. Particular emphasis will be given to examining the relationships between dental health and area level deprivation, rurality/urbanisation, and access to dental health services.

André Kramer A, -C, Pivodic A, Hakeberg M, Östberg A, 2019 *Multilevel Analysis of Dental Caries in Swedish Children and Adolescents in Relation to Socioeconomic Status*. Caries Research

K. W. McKenzie, M. Goodwin, I. Pretty 2017 *NHS dental service utilisation and social deprivation in older adults in North West England* British Dental Journal volume 223, pages 102–107

Project 2: Patterns and Trends in Cancer Incidence in Northern Ireland

Skills required: This project would suit a student with good skills in GIS and an interest in geography related health research and analysis

Summary: The seven year incidence (number) of all type cancers in Northern Ireland has risen by almost 50% between 1993/99 to 2011/17. Using SOA level health service data this project will map and examine the change and the geographic distribution of cancer incidence in Northern Ireland over that period in relation to a variety of socio-economic factors. Access to primary and secondary health care services will also be examined to determine if geographic availability to services may be influencing distribution patterns and trends.

Turner M , Fielding S , Ong Y , Dibben C , Feng Z , Brewster D , Black C , Lee A, Murchie P 2017 *A cancer geography paradox? Poorer cancer outcomes with longer travelling times to healthcare facilities despite prompt diagnosis and treatment: a data-linkage study* British Journal of Cancer 117, 439–449

Gilbert S, Pow-Sang J, Xiao, H 2016 *Geographical Factors Associated with Health Disparities in*

Project 3: Ageing, Cognitive Health (Dementia) and Deprivation in Ireland

Skills required: This project would suit a student with good skills in GIS and an interest in geography related health research and analysis

Summary: As populations get older in Western developed countries like the UK and Ireland, the nature and causes of ill-health (morbidity) are changing. There has been a significant increase in the incidence of chronic conditions relating to mental health and cognitive dysfunction in our ageing populations that put considerable additional burdens on families and health care providers. Additionally, there is also a significantly higher prevalence of cognitive impairment in elderly individuals living in socio-economically deprived areas.

This project will examine the relationship between area based deprivation and cognitive dysfunction in Ireland (North and South) using data from a Trinity College Dublin, Ulster University and Department of Agriculture (TUDA) study of 5,186 community dwelling, non-institutionalised adults aged ≥ 60 years recruited between 2008 and 2012, from Northern Ireland and Republic of Ireland. Different measures of cognitive dysfunction and indices of deprivation will be used to examine the relationship between area based deprivation and risk of cognitive dysfunction.

Adrian McCann, Helene McNulty, Jan Rigby, Catherine F Hughes, Leane Hoey, Anne M Molloy, Conal J Cunningham, Miriam C Casey, Fergal Tracey, Maurice O'Kane, Kevin McCarroll, Mary Ward, Katie Moore, JJ Strain, Adrian Moore, (2017) *Impact of area-level socioeconomic deprivation on the risk of cognitive dysfunction in older adults* Journal of the American Geriatrics Society 66.

Basta N, Matthews F, Chatfield M, Carol Brayne C, 2008 *Community-level socio-economic status and cognitive and functional impairment in the older population* European Journal of Public Health, Volume 18, Issue 1, February 2008, P. 48–54.

Dr Rory Quinn



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Rory is a marine geoscientist, interested in applications of ocean mapping methods. His research focuses on detecting, quantifying and understanding change in geomorphological, anthropogenic, archaeological and bio-physical environments.

Project 1: Identifying optimal locations for offshore renewable development

Skills required: Would suit a student interested in renewables, geomorphology, ocean engineering and GIS

Wind and tidal energy are widely accepted as key renewable energy sources worldwide. Although the development of offshore arrays is emerging to utilize energy on a large scale, they face complicated operational conditions and increasingly high costs. Geographical Information Systems (GIS) are therefore commonly used in renewable energy resource analysis to establish optimal locations for offshore development (Cradden et al., 2016). This project will use the modelling capabilities in ArcGIS to determine sites for renewables on the shelf seas around Ireland. Geospatial and remotely sensed data will be sourced from online data portals to aid site selection: EMODnet (<http://www.emodnet.eu>) and INFOMAR (<https://www.infomar.ie/data>). The 'Weighted Overlay' tool in ArcGIS will be used to solve the multicriteria problem of optimal site location (Nobre et al., 2009) for a range of renewable installations.

Cradden, L., Kalogeri, C., Martinez Barrios, I., Galanis, G., Ingram, D., Kallos, G., 2016, Multi-criteria site selection for offshore renewable energy platforms, *Renewable Energy*, 87 (1): 791-806.
<https://doi.org/10.1016/j.renene.2015.10.035>

Nobre, A., Pacheco, M., Jorge, R, Lopes, M.F.P., Gato, L.M.C., 2009, Geo-spatial multi-criteria analysis for wave energy conversion system deployment, *Renewable Energy*, 34(1): 97-111.
<https://doi.org/10.1016/j.renene.2008.03.002>

Project 2: A geo-database of marine munitions dumps and potentially polluting shipwrecks off Ireland and the UK

Skills required: Would suit a student interested in environmental pollution, shipwrecks and GIS

The issues of potentially polluting wrecks and munitions dumps at sea are under-researched despite the threats presented to society (OSPAR Commission, 2005). 75% of sunken wrecks date back to WWII, and their metal structures are ageing, threatening to release their contents into the ocean due to the effects of corrosion (EU Parliamentary Assembly, 2012). By example, the North Atlantic Ocean contains 25% of the potentially polluting wrecks in the world, containing nearly 38% of the total volume of oil trapped in sunken vessels. Additionally, warships and munitions dumps related to WW1 and WW2 carried and contain munitions which, over the years, have become corroded to the point where they are liable to start leaking significant quantities of toxic substances (Callaway et al., 2011). Some of these toxic substances, such as mercury, are not biodegradable and can cause chemical contamination of the food chain. This study will investigate the spatial distribution of these sites and investigate them in relation to key

environmental and anthropogenic variables, including depth, substrate, energy, salinity, and proximity to fishing grounds and planned ocean engineering sites.

Callaway, A., Quinn, R., Brown, C.J., Service, M. and Benetti, S., 2011, Heavy metal contamination of Beaufort's Dyke, North Channel, Irish Sea: a legacy of ordnance disposal. *Marine Pollution Bulletin*. 62(11): 2345-2355.

EU Parliamentary Assembly, 2012, The environmental impact of sunken shipwrecks, <https://assembly.coe.int/nw/xml/XRef/Xref-XML2HTML-en.asp?fileid=18077&lang=en> (21 November 2021)

OSPAR Commission, 2005, Overview of Past Dumping at Sea of Chemical Weapons and Munitions in the OSPAR Maritime Area, <https://www.ospar.org/documents?v=7021> (21 November 2021)

Project 3: 'Ocean sprawl' - habitat loss associated with human impacts on the seabed

Skills required: Would suit a student interested in the Anthropocene, geomorphology, habitat-loss, human-environment interactions and GIS

Physical loss of habitat is an extreme pressure on marine ecosystems (Heery et al., 2017). Habitat is lost if its substrate, morphology or topography is permanently altered. The main activities causing such damage are offshore installations, port anchorage, dredging and dumping, windfarms, sand or gravel extractions and all kinds of construction on the seabed. In 2000, the term 'Anthropocene' was proposed for the current geological epoch to emphasize the central role of mankind in geology and ecology (Crutzen and Stoermer, 2000). The informal term was soon adopted by many earth and environmental scientists to signal the impact of human activity on chemical, biological and physical processes operating on Earth (e.g. Corlett 2015). In this project you will assess the role of humans in modifying the seabed (Budillon et al., 2022) and assess the potential impact on habitat loss. The project will involve analysis and interpretation of multibeam echosounder data to characterise and quantify the impact of human activities on the seafloor in estuaries and and/or shelf seas.

Budillon, F.; Firetto Carlino, M.; Innangi, S.; Passaro, S.; Tonielli, R.; Trincardi, F.; Sprovieri, M., 2022, The Anthropogenic Footprint of Physical Harm on the Seabed of Augusta Bay (Western Ionian Sea); A Geophysical Investigation. *J. Mar. Sci. Eng.*, 10,1737. <https://doi.org/10.3390/jmse10111737>

Corlett, R.T., 2015, The Anthropocene concept in ecology and conservation, *Trends in Ecology and Evolution* 30, 36-41.

Crutzen, P.J. and Stoermer, E.F., 2000, The 'Anthropocene'. *Global Change Newsletter*, 41, 17.

Heery, E.C., Bishop, M.J., Critchley, L.P. et al., 2017, Identifying the consequences of ocean sprawl for sedimentary habitats, *Journal of Experimental Marine Biology and Ecology*, 492,31-48. <https://doi.org/10.1016/j.jembe.2017.01.020>

Project 4: Does commercial fishing impact underwater cultural heritage?

Skills required: Would suit a student interested in GIS, underwater cultural heritage and remote sensing

Maximizing social and economic benefits from fisheries and protecting underwater cultural heritage are management goals often viewed to be at odds with each other (Krumholz and Brennan, 2015). Some researchers argue that wrecks are heavily impacted by commercial fishing practices (e.g. Brennan et al., 2016), while others are less convinced (e.g. Parham, 2017). Shipwrecks are not only important from a

cultural standpoint, but have important implications for engineering, ecology, recreation and as potential pollution sources. Therefore the true impact of commercial fishing practices on these sites is important from many perspectives. This project will explore the impacts of commercial fishing practices on shipwrecks using data from the EMODnet Human Activities portal (<https://www.emodnet-humanactivities.eu/view-data.php>) and multibeam echosounder surveys.

Brennan, M.L., Davis, D, Ballard, R.D., Trembanis, A.C., Vaughn, J.I., Krumholz, J.S., Delgado, J.P., Roman, C.N., Smart, C., Bell, K.L.C., Duman, M. and DuVal, C., 2016, Quantification of bottom trawl fishing damage to ancient shipwreck sites, *Marine Geology*, 371, 82-88.

Krumholz, J. S. and Brennan, M. L., 2015. Fishing for common ground: Investigations of the impact of trawling on ancient shipwreck sites uncovers a potential for management synergy. *Marine Policy*, 61(C): 127-133.

Parham, D. (2017). Response of David Parham to Sean Kingsley's comments on his review of Sean Kingsley's 'Fishing and Shipwreck Heritage: Marine Archaeology's Greatest Threat'. *The Antiquaries Journal*, 97, 301-302.

Project 5: Sediment wave morphology and migration in the Malin Sea

Skills required: Would suit a student interested in geomorphology, hydrodynamics, ocean engineering and GIS

Multibeam echosounder bathymetry and backscatter data from the Malin Sea were collected as part of the Joint Irish Bathymetric Survey (JIBS) in 2009. Spectacular sediment wave fields, oriented transverse to tidal flow, dominate the southern section of the south Malin Sea. This project will map, classify and examine the relationships between sediment wave morphology, sediment type, bathymetry, tidal currents, and migration using established bedform classification schemes (Van Landeghem et al., 2009; Stow et al, 2009). The project has direct relevance to offshore renewables, as in areas of mobile sediment, scour around seabed installations increases the cost and complexity of engineering solutions.

Van Landeghem, K.J.J., Wheeler, A.J., Mitchell, N.C., and Sutton, G., 2009, Variations in sediment wave dimensions across the tidally dominated Irish Sea, NW Europe: *Marine Geology*, 263: 108-119. <http://dx.doi.org/10.1016/j.margeo.2009.04.003>

Stow, D, Hernandez-Molina, FJ, Llave, E, Sayago-Gil, M, Rio, VDD and Branson, A, 2009, Bedform-velocity matrix: the estimation of bottom current velocity from bedform observations, *Geology*, 37(4): 327-330. <http://dx.doi.org/10.1130/G25259A.1>

Project 6: Investigating scour at fully submerged WWI shipwreck sites

Skills required: Would suit a student interested in geomorphology, underwater cultural heritage, hydrodynamics, ocean engineering and GIS

20th century shipwrecks act as a hidden pollution risk, as they may release toxic components (e.g. oil, fuel, antifouling paints) into the ecosystem (Masetti and Calder, 2012). Shipwrecks are also important from historical, biological and offshore engineering perspectives. Wreck sites act as open systems, with the exchange of material (sediment, water, toxic fluids and solids) and energy (wave, tidal, storm) across system boundaries. Formation processes at these sites are therefore driven by a combination of chemical, biological and physical processes, with physical processes dominant in initial phases (Quinn, 2006). This project will investigate complex erosional and depositional patterns around two WWI shipwrecks in Belfast Lough that have formed in response to hydrodynamic forcing. Using multibeam echosounder data,

sediment samples and the output from a computational fluid dynamic model (Quinn and Smyth, 2018), you will map and interpret the geomorphology of the wreck sites. The project has direct relevance to offshore renewables, as in areas of mobile sediment, scour around seabed installations increases the cost and complexity of engineering solutions.

Quinn, R., 2006, The role of scour in shipwreck site formation processes and the preservation of wreck-associated scour signatures in the sedimentary record, *Journal of Archaeological Science*, 33: 1419-1432. <https://doi.org/10.1016/j.jas.2006.01.011>

Quinn, R. and Smyth, T.A.G., 2018, Processes and patterns of flow, erosion, and deposition at shipwreck sites: a computational fluid dynamic simulation, *Archaeological and Anthropological Sciences*, 10: 1429-1442. <https://doi.org/10.1007/s12520-017-0468-7>

Project 7: Where should we find the best-preserved prehistoric human remains on the seabed in NW Europe?

Skills required: Would suit a student interested in oceanography, underwater cultural heritage and GIS

Since the last glacial maximum, large vertical changes in sea level relative to the land surface have led to significant horizontal shifts in the position of coastlines around Northwest Europe (Brooks et al, 2012). Therefore, for much of the last 20,000 years, extensive tracts of the present-day shelf seafloor were sub-aerially exposed, primarily due to the glacial eustatic lowering of sea level. These now-submerged areas were important landscapes for prehistoric humans as they offered a range of coastal, marine, and terrestrial resources and access to transportation and migration routes along coastlines and into estuaries and rivers (Westley et al., 2011). This project will use the modelling capabilities in ArcGIS to determine where we stand the best chance of finding the preserved remains of prehistoric humans below the seabed in NW Europe using a series of global datasets available through two online portals: EMODnet (<http://www.emodnet.eu>) and Bio-ORACLE (<http://www.bio-oracle.org>). The 'Weighted Overlay' tool in ArcMap will then be used to solve the multicriteria problems of site preservation and prediction.

Brooks, A.J., Bradley, S.L., Edwards, R.J. and Goodwyn, N. (2012) The palaeogeography of Northwest Europe during the last 20,000 years. *Journal of Maps*, 7: 573-587.

Sturt, F., Garrow, D. and Bradley, S., 2013, New models of North West European Holocene palaeogeography and inundation, *Journal of Archaeological Science* 40 (11): 3963-3976

Project 8: Where should we find the best-preserved shipwrecks in NW Europe?

Skills required: Would suit a student interested in oceanography, underwater cultural heritage and GIS

Site formation processes at wreck sites are driven by a combination of chemical, biological and physical processes, with physical processes dominant in initial phases (Quinn, 2006; Ward et al., 1999). This project will use the modelling capabilities in ArcGIS to determine where we stand the best chance of finding well-preserved shipwrecks on the European continental shelf using a series of global datasets available through two online portals: EMODnet (<http://www.emodnet.eu>) and Bio-ORACLE (<http://www.bio-oracle.org>). The 'Weighted Overlay' tool in ArcMap will then be used to solve the multicriteria problem of site preservation potential.

Quinn, R., 2006, The role of scour in shipwreck site formation processes and the preservation of wreck-associated scour signatures in the sedimentary record, *Journal of Archaeological Science*, 33: 1419-1432. doi:10.1016/j.jas.2006.01.011

Ward, I.A.K., Larcombe, P., Veth, P., 1999, A new process-based model for wreck site formation, *Journal of Archaeological Science*, 26(5): 561-570.