ONE Planet
Doctoral Training Partnership

Natural Environment Research Council

Project title: Nonlinear wave description of transient jökulhlaup flows

(Ref: OP2128) Keywords: glacier hydrology, jökulhlaup, nonlinear wave, extreme event

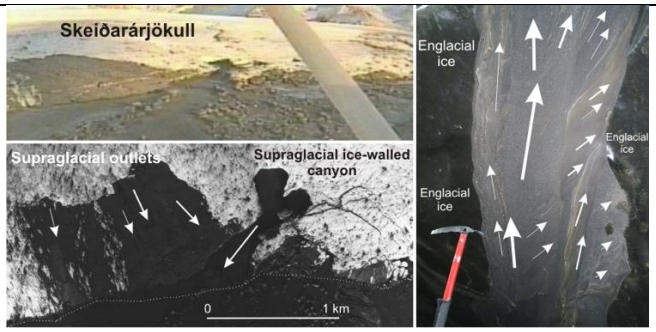
One Planet Research Theme:

Climate & Climate Change ☒ | Earth System Processes ☒ | Anthropocene ☐ | Environmental Informatics ☐

Lead Supervisor: Dr Thibault Congy

Key Research Gaps and Questions:

(1) How does jökulhlaup flow behave within a glacial drainage network?
(2) How does jökulhlaup rheology influence sub- and englacial flow dynamics?
(3) What is the impact of climate change on jökulhlaup dynamics?



Top and bottom left *show aerial views of the margin of Skeiðarárjökull during the 1996 jökulhlaup.* ***Right*** *an englacial hydrofracture filled by deposition from a vertically ascending flow.*

Project Description:

Glacial outburst floods (jökulhlaups) are a major hazard in many actively glaciated regions. They can be generated by a wide range of mechanisms such as ice-dammed (ice-marginal, sub- and supraglacial) lake drainage, glacier surges and subglacial volcanic activity. Relatively little is known about jökulhlaup flow within sub and englacial systems. The 1996 jökulhlaup at Skeiðarárjökull, Iceland (picture above) was a catalyst for greater understanding of transient sub and englacial hydraulics. **The project aims** to provide a better mathematical description of flows through rapidly changing jökulhlaup drainage networks. Better understanding of jökulhlaup dynamics is an essential pre-requisite for hazard management within glaciated regions subject to rapid and ongoing climate change.

Dynamics of the drainage system will be investigated within the highly topical and inter-disciplinary framework of dispersive hydrodynamics, dedicated to fluid-like dynamics of nonlinear waves with applications ranging from the atmosphere to quantum fluids. Dispersive hydrodynamics has proven efficient in the description of extreme events in geophysical applications, such as tsunami waves and rogue waves in the ocean. The project will utilise field knowledge of sub and englacial jökulhlaup pathways and flow rheology to constrain mathematical models. The student will learn nonlinear analytical techniques for partial differential equations such as the wave modulation theory as well as advanced numerical methods for dispersive hydrodynamics. They will also have the opportunity to test mathematical predictions using primary and secondary datasets of Icelandic jökulhlaup systems with Andy Russell (Newcastle University).

Prerequisites:

Candidates who have achieved/are expecting a degree in mathematics or physics. They should be able to demonstrate excellent communication skills and the ability to work independently (with appropriate guidance provided) in order to successfully complete the outlined project. For more information, please contact Dr Thibault Congy (thibault.congy@northumbria.ac.uk).

Newcastle University

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