NERC
DOCTORAL TRAINING

UK Oil and Gas Collaborative Doctoral Training Centre (2017 start)

Project Title: Marine oil snow (MOS) formation and its role in the fate of crude oil in NE Atlantic waters

Host institution: Heriot-Watt University
Supervisor 1: Dr. Tony Gutierrez
Supervisor 2: Dr. Martin Jones (Newcastle University); Collaborators: Alejandro Gallego (MSS).

Project description:
Oil spills at sea are one of the most disastrous of anthropogenic pollution events. With oil exploration moving further into deeper waters (>1000m), this raises concern because of the unpredictability and current lack of experience and know-how in dealing with a deep-sea spill. A distinctive feature of the Deepwater Horizon (DWH) oil spill was the formation of unprecedented quantities of Marine Oil Snow (MOS). MOS of macroscopic cm-size dimensions can be described as a mucilaginous floating organic matter containing entrained crude oil within its amorphous matrix. The genesis and factors influencing its formation are not yet well resolved, but based on events from the DWH spill, MOS forms primarily in surface waters in the presence of crude oil and then rapidly sinks to the ocean floor. It has been suggested that increasing the residence time of MOS in the water column enhances the biodegradation of its entrained oil by the community of attached/associated microorganisms, thus reducing the amount of oil reaching the seabed and potentially also that would impact benthic ecosystems. This PhD project will focus on understanding MOS formation in coastal waters of the North-East Atlantic, particularly in regions where oil exploration is prevalent such as in the North Sea. The project objectives are to: 1) determine the conditions leading to MOS formation at different coastal sites; 2) investigate the diversity and abundance of oil-degrading microbial communities associated with MOS aggregates formed in different waters; and 3) measure crude oil biodegradation rates associated with MOS. This work will provide new information on whether, like during the DWH oil spill, MOS could be formed during a major spill in the NE Atlantic, the conditions influencing this, and what role MOS plays in the transport of crude oil hydrocarbons to the sea floor. The information gained could also feed into models that account for biological controls influencing the fate of oil in marine environments, and in-turn feed into optimising bioremediation/oil-spill response contingency plans. The supervisory team comprises members with extensive experience and expertise in ocean sampling and the microbiology of oils spills, and in the analysis of crude oil biodegradation rates. In summary, this project is designed with the ultimate aim of producing new information from lab and field experiments to predict the fate and impacts of crude oil to benthic ecosystems.

Research theme: Environmental Impact and Regulation. The project aims to fill a major knowledge gap on the formation of MOS in NE Atlantic waters where it remains to be sufficiently investigated, and its role in the fate of crude oil within the water column and sediment.

Research context: Gutierrez (1st super.) has to-date published 8 peer-reviewed publications related to the Deepwater Horizon oil spill. He currently heads an active research group comprised of 7 PhD students and 2 Postdoctoral researchers. He also has enduring collaborations with US groups in North Carolina and Georgia related to oil spills at sea.
Jones (2nd super.) is a geoscientist based at Newcastle University with many years of experience in the chemistry and behaviour of crude oils.