Student Research Projects

NIOZ Marine Masters Summer Course 'Exploring the Wadden Sea'
NIOZ – Royal Netherlands Institute for Sea Research, Texel, 10 July - 22 July 2022

Project 1: Tidal dynamics and their influence on plankton dynamics – part 1: physical oceanography

The Wadden Sea is a complex tidal ecosystem, changing continuously in terms of currents, waves, sea level, temperature, salinity, sediment concentration and hence light conditions and availability of nutrients. This dynamic environment has an effect on the biodiversity and productivity of the lower parts of the food chain (phytoplankton and zooplankton). To obtain an impression of the physical oceanography underlying these interactions, a variety of physicochemical parameters will be studied during one tidal cycle.

Project 2: Tidal dynamics and their influence on plankton dynamics – part 2: phytoplankton

The Wadden Sea is a complex tidal ecosystem, changing continuously in terms of currents, waves, sea level, temperature, salinity, sediment concentration and hence light conditions and availability of nutrients. This dynamic environment has its effect on the biodiversity and productivity of the lower parts of the food chain. To obtain an impression of what this means for phytoplankton, a variety of physicochemical and biological parameters will be studied along a salinity gradient in the Dutch Wadden Sea and during one tidal cycle.

Project 3: Tidal dynamics and their effect on sediment transport

Every day, tidal currents move tons of suspended sediment from the North Sea into the Wadden Sea and back again, through the tidal inlets that breach the Wadden Sea island chain. In the Wadden Sea, sheltered by the barrier islands against the force of incoming waves from the North Sea, sediment particles suspended in the seawater settle out on the seabed. With time, sediments accumulate into vast tidal flats emerging during low tide, which are the typical landscape element of the Wadden Sea and an important habitat for marine life. Whether this landscape will remain during future sea level rise and local seabed subsidence depends on the balance of sediment import and export through the tidal inlets. In this project, we will quantify suspended sediment transport in the Texelstroom in relation to the dynamics of the tide.

Project 4: Spatio-temporal analysis of benthic species at De Schorren, Texel from 2018-2021

The Wadden Sea is an internationally recognized ecological treasure along the Dutch, German and Danish coast. It is a shallow region with large tidal flats that serves as a nursery area for fish and a staging area for migrating birds. Primary production and availability of macrozoobenthos are crucial for their food security. The status of these lower levels of the food web is considered indicative of ecosystem functioning. Currently, the most extensive ecological survey is the SIBES-project: an annual campaign sampling all macrozoobenthos and sediment characteristics on a 500m grid. A large part of monitoring depends on the changes that happen over space and time. We would like to understand the spatial and temporal patterns over a region in the northern part of Texel for

sediment or macrozoobenthic properties over the years 2015-2021. Students will study physical oceanographic parameters, macrobenthos and sediment.

Project 5: The role of chemical structure and UV exposure on the degradation of plastic in the marine environment

Large quantities of plastics comprising a diverse set of hydrocarbon or hydrocarbon-like polymers are constantly released into the oceans. The impacts of plastics in marine environments are poorly understood, though we know they can be persistent in the environment and harmful to marine life. The severity of this problem is gaining momentum because the untamed demand for plastics has led to an ever-increasing release of plastic to the sea. However, despite its seemingly persistent properties, plastic litter does not accumulate as expected, indicating a substantial sink for plastics in the ocean. Several potential sinks for floating plastic litter ranging from enhanced sinking as a result of biofouling, microbial degradation and photo degradation are currently discussed in the scientific community. It seems likely that the chemical structure of the polymer plays an important role in its degradability. In this project, we will identify the chemical structure of marine plastic debris using Raman spectroscopy. Furthermore, we will measure polymer degradation products by chromatographic assays to determine plastic degradation as a function of the polymer structure and UV exposure.

Project 6: How shelf seas help reduce climate change

Continental shelf seas play an important part in the carbon cycle. Growth of phytoplankton in highly productive shelf sea waters drives CO_2 uptake from the atmosphere, slowing the effect of our greenhouse gas emissions on Earth's climate. In the North Sea, CO_2 uptake is boosted by alkalinity supplied from chemical reactions in the sediments, particularly in shallow areas like the Wadden Sea, and river waters. Elevated alkalinity also mitigates ocean acidification. In this project, we will measure dissolved CO_2, alkalinity and pH in seawater samples that we will collect on a transect from Texel (where the Wadden and North Seas connect) to the IJsselmeer (freshwater endmember for the Wadden Sea) plus water samples from the IJsselmeer itself. From the data, we will determine the balance of alkalinity supply: how much comes from the IJsselmeer and how much from the sediments? This balance is important to determine for future climate projections, as each supply may respond differently to human pressures and management decisions. We will also calculate how much extra CO_2 is stored as a result and find the effect on seawater pH and carbonate mineral solubility.

Project 7: Predation of the worm *Nephtys* on the worm *Scoloplos*

The strength and direction of biological interactions depend on the environmental conditions in which they happen. We want to understand the relative importance of interspecific interactions and environmental variables on the distribution of benthic communities of the Wadden Sea mudflats. *Nephtys hombergii* is a carnivorous polychaete known for structuring the macroinvertebrate community in the intertidal mudflats of the Wadden Sea. Lab and field experiments have shown how it can directly affect the abundance of other polychaetes, having a particularly large effect on *Scoloplos armiger*. *N. hombergii* is found in sediment with a median grain size of <50 - 400 um, but occurring much more frequently at fine sediment sites. *S. armiger* occurs more frequently in areas with a median grain size of 200-350 um. We hypothesize that this difference in preferred sediment conditions could be the result of a difference in the effectiveness that *N. hombergii* has to prey on *S. armiger* in sediment of larger size in a way that these areas result in a refuge for *S. armiger*. To test for this, we will measure the mortality of *S. armiger* exposed to *N. hombergii* under two sediment conditions.