

IOW press release, July 31, 2019

How stressed are coastal seas by humans and climate? Expedition with research vessel SONNE to the South China Sea

On August 2, 2019, the German research vessel SONNE sets off from Singapore for the SO269-SOCLIS cruise to the South China Sea under the lead of IOW scientist Joanna Waniek. At more than 70 sampling stations, 24 German and 16 Chinese scientists will investigate, how natural materials and anthropogenic harmful substances are distributed in the shelf area and deeper oceanic regions, which physical processes are responsible for observed pattern, how far the pollution halo of industrial centres and large conurbations reaches into the sea, and how different climate conditions affect the relevant processes. The expedition ends on September 3 in Hong Kong.

Over the past three decades, China, one of the world's most densely populated countries, has experienced a massive increase of industrial and agricultural activity in the catchment areas of large river systems, which wash considerable amounts of nutrients, pollutants and other critical substances such as microplastics and pharmaceutical residues into the sea. In particular, rapidly growing megacities, which can have up to 100 million inhabitants, and industrial centres on coasts and river mouths are responsible for this development. How do the immense population numbers and the continuing rapid industrialisation of these conurbations affect the pollution levels in the respective coastal seas? Can changes caused by this already be detected and is climate change likely to intensify the environmental impact? These are the central questions of the German-Chinese joint project MEGAPOL (short for "Megacity's fingerprint in Chinese marginal seas: Investigation of pollutant fingerprints and dispersal"), coordinated by the Leibniz Institute for Baltic Sea Research Warnemünde (IOW), that provides the framework for the ship expedition SO269-SOCLIS (short for "South China Sea – natural laboratory under climatic and anthropogenic stress").

"Our research area – the Pearl River-South China Sea continuum – is indeed like a natural laboratory, in which we can explore not only issues relevant to China, but also, in the face of growing megacities worldwide, take a glimpse into the future of coastal seas with immense civilization pressure," says Joanna Waniek from the IOW, who heads the project and the expedition. "In addition to the extreme conurbations that already exist in the region, there is an intensive exchange between land and ocean due to the large rivers, as well as shifts in the physical forces behind this exchange, such as the monsoon and ocean currents, which themselves are influenced by climate change – in other words, we have all the 'ingredients' we need for a model system and our studies," Waniek continues.

The interdisciplinary expedition team on board the RV SONNE includes, besides researchers from the IOW, scientists from the universities of Hamburg and Cologne, the Helmholtz Zentrum Geesthacht Centre for Materials and Coastal Research (HZG), the Shanghai Jiao Tong University and the Guangzhou Marine Geological Survey. Based on the findings and method development of two previous expeditions to the South China Sea on Chinese research vessels (2015 and 2018), an extensive work programme has

been planned, which includes air, water and marine sediment sampling, hydrographical and hydroacoustic measurements as well as the detection of sedimentation patterns by means of moorings.

“Our previous work suggests that two substance groups in particular – organic and inorganic pollutants as well as reactive nitrogen from rivers with characteristic isotopic composition – are suitable markers for identifying and quantifying the transport paths of anthropogenic pollution from source to sea,” explains Joanna Waniek. The focus will be on “well-known” pollutants such as PCB, DDT and PAH, as well as on “emerging” pollutants such as microplastics, hormones, antibiotics and UV filters, which are found in sun screen products, the marine researcher states. Together with the results of the previous research cruises and the data from the Chinese partner institutions, this year’s expedition to the South China Sea will allow to trace the development of the acute pollution in the region over a period of 5 years. Furthermore, the researchers hope that the analysis of sediment cores from selected sampling sites will shed light on how exchange and transport processes have changed over the past millennia. “The sediments are like an archive that enables us to reconstruct earlier environmental conditions and sedimentation processes and also provides clues as to how the recent history of human-induced pollution in the respective sea area proceeded,” Waniek says.

“The cooperation with our Chinese partners has proved to be extremely fruitful for everyone. We are therefore very much looking forward to the scientific and cultural exchange, which is particularly intensive during such an expedition and especially exciting for the younger expedition participants,” Joanna Waniek concludes.

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