M2 SOAC : Fiche de stage de recherche en laboratoire

Laboratoire : LEGOS

Titre du stage : Water level dynamics in the Ganges-Brahmaputra deltaic continuum during extreme fluvial floodings

Nom et statut du (des) responsable (s) de stage : Fabien Durand (CR IRD HDR), Jamal Khan (Post-doctorant Université de La Rochelle), Florence Toublanc (IR CNRS)

Coordonnées (téléphone et email) du (des) responsable (s) de stage : Fabien Durand (fabien.durand@ird.fr)

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The Bengal delta, straddling Bangladesh and India, is characterized by a low-lying floodplain, with 50'000 km^2 situated less than 5 m above mean sea level. It is densely populated, with 60 million people. Situated at the junction between two mighty rivers draining most of the Himalayan watershed, the Ganges and the Brahmaputra, the Bengal delta is home to frequent and long-lasting floods during the summer monsoon season (June-September). For Bangladesh, populated by some 170 million people, it is estimated that 56 million people live nowadays under direct exposure to pluvial, fluvial or coastal flooding hazard.

Our group has developed a cross-scale hydrodynamical numerical model of the whole Bay of Bengal, extending inland up to the upstream limit of the tidal propagation in the Bengal delta across India and Bangladesh. The modelling platform is based on the SCHISM unstructured-grid ocean circulation model, coupled with WWM wave model (e.g. Krien et al., 2017). Its resolution, ranging from 15 km in the deep ocean to 250 m across the delta, is unprecedented. Our modelling platform has proven skillfull for the modeling of the coastal tide (Khan et al., 2020) as well as the surges and associated flooding generated by cyclonic storms (Khan et al., 2021). While both the pre-monsoon and post-monsoon seasons are characterized by a prominent cyclonic activity, the summer monsoon is also notorious for devastating flooding events. These floods result from the compounding effects of riverine monsoonal discharge, rainfall and oceanic intrusions driven by tides and waves. The objective of the proposed research is to use the modeling platform to ascertain the mechanisms of flooding occuring during the monsoon season. In particular, we will establish the respective roles of each of the three dominant factors driving the compound flooding, namely the fluvial discharge flowing from upstream, the oceanic tide propagating inside the delta, and the wave setup generated by the monsoonal depressions. We will focus on two of the most severe flood events of the recent years: September 1998 and July 2004. At the peak of both of these periods, about two thirds of the territory of Bangladesh were under water. The experimental strategy will essentially consist of building and assessing scenarios about the relative timings and magnitude of the various forcing factors, comparing the hindcast simulation with several sensitivity experiments where one or several forcing factors are switched off, and where the relative timings of the various forcing factors are altered. This will allow us to conclude about the fundamental conjunction of ingredients that conducted to the catastrophic events during these two seasons of summer 1998 and summer 2004.

The internship will be part of the project BANDSoS, funded by the Space Climate Observatory (2022-2024, www.spaceclimateobservatory.org/band-sos-bengal-delta). In this regard, the proposed work will help to better understand the flooding mechanisms at work in the current climatic conditions. It will also open up perspectives of interest for the definition of the future public policies to be developed and implemented over the Bengal delta for the adaptation/mitigation of the flooding hazard and its evolution in the course of the 21st century.

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