March, 2022, back to field experiment.

In the frame of the US-NSF project FRES (EAR 19-25974, Exploring the Linkages between Sea-Level Change, Sediment Transport and Geomorphology on Coastal Freshwater Water Sequestration), I eventually go back for ~4-weeks of fieldwork in Bangladesh. The FRES project has been funded in 2020, when I was still at LDEO in the USA and I was involved as a co-PI on the Lamont part of the project. This project aims to better understand the distribution in depth of the fresh and salty water in the Ganges Delta. Researchers from New Mexico Tech, the LDEO of Columbia University, the University of Dhaka and the LIENSs in La Rochelle are involved. This experiment is now 2-years delay and being able to make it feasible was far from being simple. Yet, this extra time gave me the opportunity to implement new topics and after several back and forth on the schedule, I am eventually flying to Dacca, the capital of Bangladesh.

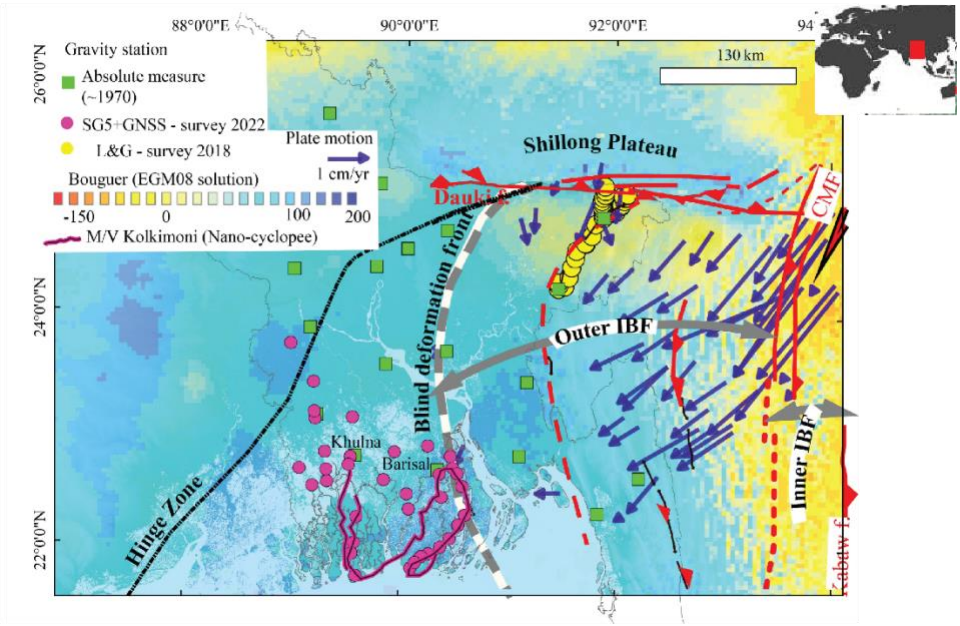
I am going in Southeast Bangladesh with a Scintrex-5 relative gravimeter and the Nano-cyclopee, both from the instrumental park of INSU (the French National Institute of Sciences of the Universe of the CNRS), as carry on and hold luggage respectively. This should give us an inedited opportunity to acquire data for constraining the local Geoid: the real shape of the earth's surface. Constraining the Geoid has many scientific applications. The Geoid is used to determine the absolute elevation derived from any GPS deployment, constraining satellite gravimetric data (for example, GRACE data), constraining flood models and can help on understanding the solid earth's structure. In turn, the Geoid is critical for any tentative to understand the Relative Sea Level, i.e. the balance of the moving sea and land.

Pictures of the Nano-Cyclopee deployment. On the left, the instruments autonomously recording during the sunset, while we are leaving the Sundarbans National Forest. On the right, Sanju Singha (from Dhaka University) and myself, happy after having setting up the instruments the morning after we boarded. The first time I met Sanju was in 2018 in Sreemengal, when Sanju was finishing his Master Degree.

The fieldwork is amphibious, and is on-board of the M/V Kokilmoni. We are using a boat to reach isolated areas in the Sundarbans National Forest as well as over the Tetulia channel, South to Barisal. We also planned to deploy instrument on board for acquiring data along the tide channels. This is the case of the Nano-Cyclopee that we have installed in front of the boat, on a solid wood stick. The Nano-Cyclopee is a kinematic tide gage that has been designed for recording in the same time the absolute position of the instrument and the water elevation. For having a better chance to acquire good data, we are monitoring the water elevation with 2 different instruments: a radar and an acoustic altimeter. In the same time, a GPS antenna is recording our position at a frequency of 1 Hz (every seconds).

Pictures: Gravity combined with GNSS survey in Bangladesh. Left: Myself measuring at the GNSS antenna in Khulna University. Middle: Masud Rana (who has just finished his Master at Dhaka University) doing measurement at a Geodetic monument. Right: Measurement in a partial open space in the Sundarbans forest. On the back of the picture, you can see Mike Steckler, taking a picture of the deployment. The hand in front is Sanju's one. The two other persons are part of the Kolkimoni's crew that helps us a lot to deploy the station over all the survey.

While instruments record continuously on-board, I am going on land for deploying a GPS antenna combined with the relative gravimeter. Stations are either at the same places that we are acquiring the magneto-telluric (MT) data or at the Geodetic monument (that we have occupied in 2020). Kerry Key from Lamont is leading the MT data. These measurements will help on determining the Geoid continuity at the land-water continuum. Gravity data will also help on analyzing the Magneto-Telluric data, in particular the low frequency ones that provide images of the deep structure of the earth, and in particular the debate sediment-crust transition in the Bengal Delta. Earth's structure is often determined by combining active and passive seismic data acquisition as well as satellite observations. Yet, observation in the Bengal delta remains scarce and hard to reconciliate in the Bengal delta. One of the best guess about the structure there is that the sediments are more than 15 km thick and are over-loading a crust that seems to subduct below the Indo-Burman ranges. This may be an ended member case of over-sediment subduction zone. We have a very limited knowledge of how a subduction that involves so much sediment can work, which means that we don't know exactly how this plate boundary and its seismicity may work. I am testing lots of earth's model in the Bengal Delta which aims to understand better how the earth is moving compare to the Ocean but also what is the earth's structure and the hazard implication there.



After many unexpected situations, I eventually come back in La Rochelle safe and sounds mid-April, as well as the instrument that I took with me. We have acquired many inedited and new data (see the map of the survey) that I am processing in order to better understand the solid earth's structure and displacement over the Bengal Delta.