Which place for neural network approach in Coastal Research?

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Abstract:

More than one-third (2.75 billion) of the world's population lives both within 100 km distance of the coast and <100 m above sea level. Over the past decades, predicting shoreline change has thus been a key issue worldwide. Coastal dynamic is inherently complex and understanding the processes that drive it has been a goal for many decades for researches all around the world and is still challenging them. Thus, coastal scientists are often torn between providing easy to use parametric/simplified models and capturing the complexity of the processes. Many approaches have been developed from models based on conservation equations to equilibrium-based models, from data decompositions techniques to machine learning algorithms. This is a challenging topic that plays an important role in translating our fundamental research into something more pragmatic but also accurate. In this keynote, we will present the contributions of neural network in coastal research and presenting applications.

Considering shoreline dynamics, predictors, process-based or data-driven, tend to be developed and tested on high-frequency and high-quality data sets. Thus data is key, especially real-time high frequency and high-quality in-situ coastal monitoring programs. To meet this demand, the design of low-coast community beach program which empowers local communities to collect quantitative measurements of coastline change using their smartphones, improves data coverage but it almost inevitably produces a sparse dataset. Combining hydrodynamic and morphological variables extracted from these community programs and artificial neural network allows us to evaluate if sparse data could still provide physically-sound shoreline change predictions.

Use of neural network also provided significant contribution in the study of wave induced runup. Wave induced runup is defined as the time-varying position of the water's edge on the foreshore of the beach, resulting from a (quasi) steady component above the still water level (the wave setup) and a time-varying fluctuating component (the "swash"). Wave-induced runup is an important process driving nearshore hydrodynamics and sediment transport. In particular runup is required to estimate extreme water levels and associated effects of coastal flooding hazards by overwash. In addition, runup also plays a critical role in coastal changes,

as the transition area between the surfzone and the subaerial beach, the swash zone is an important part of the littoral sediment budget.

Biography

Nadia obtained her first MEngSc (Coastal Engineering and offshore Engineering) at the University of Toulon-Var, France in 1999, and then a second Msc (oceanography and Paleo-Oceanography) in 2000 and her PhD in 2003 at Bordeaux University, France. In 2004 she got a position as Associate Professor at Bordeaux University and has been promoted full-time Professor in 2018. Since January 2020 she is the head of the School of Earth Sciences and Environment at Bordeaux University. In 2016 she joined the Committee of Women in Coastal Geoscience & Engineering.

She carries out her research within the METHYS team in Bordeaux (EPOC laboratory). The adopted scientific approach is largely based on experimental approaches (field measurements and observations) and can employ innovative techniques in remote sensing and neural networks. In 2008 she was in charge of the Truc Vert -ECORS field experiment what was at this time the largest field experiment ever ran in Europe. This field experiment was designed to measure beach morphodynamics under highly energetic conditions and involved 19 partners and up to 120 persons. Her current scientific activity strongly focuses on open beaches, their response to energetic events and the inter-connections between the human and natural dimensions of coasts.