MAPPING COASTAL TYPOLOGY USING PUBLICLY AVAILABLE EARTH OBSERVATION DATA AND DEEP NEURAL NETWORKS

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ABSTRACT
Given the urgent need for a high-resolution geomorphological characterization of the coast, we developed an innovative method to classify large amounts of thumbnail images, extracted from publicly available Earth Observation data, into an erosion-dedicated coastal typology. The dataset is an valuable asset for coastal managers who aim for sustainable use of the coastal zone.

INTRODUCTION

The coastal zone is extremely valuable as it is a habitat for diverse biota, offers critical ecosystem services, acts as a natural defense system to coastal flooding and is also of high economic importance for human beings. Despite its importance, the coastal zone is increasingly under pressure by anthropogenic influences and accelerated climate change. Current estimates of flood damage and adaptation costs for the 21st century emphasize the need of long-term coastal adaptation strategies (Vousdoukas et al. 2020). However, one of the present technical barriers for implementing effective coastal planning of mitigation and adaptation strategies is the lack of accurate probabilistic models for predicting coastal change (Ranasinghe 2020). Given that such models require accurate information on what the coast consists of, at both high resolution and broad spatial scales, there is an urgent need for a high-resolution geomorphological characterization of the coast at regional scale.

EMERGING TECHNOLOGIES

In recent years many satellite-derived data products have been introduced as computing power increased and space operators opened their catalogues to the public. Nowadays, cloud providers offer flexible Automated Programming Interfaces (APIs) to access data as well as run computations in parallel across several thousand instances. Innovation in computer hardware and a flourishing open source community triggered extensive use of deep Neural Networks (NNs), which have established themselves in natural language processing and computer vision tasks. Applying these kinds of algorithms to satellite-derived data products to produce a continental scale classification of coastal environments at high resolution (1km alongshore) is self-evident.

METHODS

At several thousand coastline sites across the world, each covering approximately 500 x 500 meter, experts labelled the prominent geomorphological feature (Salman et al. 2004). These samples compose the training data for a supervised classifier algorithm while their locations are used to extract publicly available Earth Observation data from a cloud provider using a recently introduced API. The data consists of multispectral satellite imagery (Sentinel-2) as well as other geospatial data, including elevation (SRTM) and the tidal horizontal and vertical dynamic range. The neural network (UNET architecture), trained and optimized over the training and validation set respectively, is tasked to classify the extracted images.

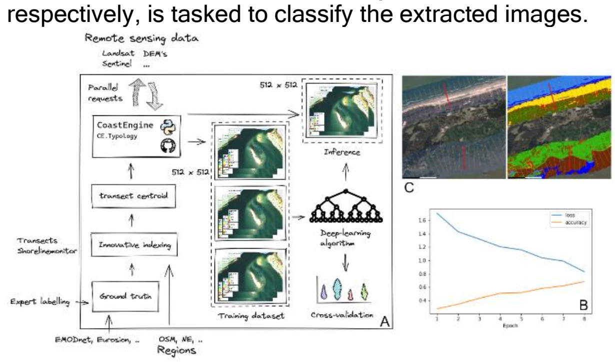

Figure 1 – A): Automated coastal type detection from satellite-derived data products using a deep learning architecture; B): loss and accuracy rates per epoch for a small scale experiment; C): coastal type detection at transect level.

RESULTS

Preliminary results on the test partition indicate that the model will have good generalization capabilities, hence, can confidently be applied in inference modus on out-of-the-sample data. The geomorphological characterization of the coast includes sediment types, cliff types and land use, complemented by several attributes, such as coastal elevation and statistics of its dynamics. Results become available in static cloud format at the Deltares data server, following STAC catalogue specifications.

REFERENCES

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