Operationalizing the hyper-temporal benefits of CubeSats through artificial intelligence to provide new opportunities for measuring and monitoring geomorphic change in rivers.

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- **This abstract is for an Oral presentation**
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ABSTRACT

Remote sensing methods are continuously producing new opportunities to measure large-scale river geomorphology, overcoming spatial and often financial constraints of traditional in-situ monitoring. However, the majority of these methods lack the temporal resolution to capture the dynamism inherent in river systems. The PlanetScope CubeSat constellation uses ~200 low-cost optical satellites to provide hyper-temporal daily imagery of the Earth, without significantly sacrificing spatial resolution. However, combining this information, captured at different altitudes, times of day, and atmospheric conditions comes at the cost of reductions in radiometric quality. Therefore, segmenting images into land and water, the foundation of all other research, has proven difficult to automate.

We applied a novel Artificial Intelligence method termed Convolutional Neural Network (CNN) Supervised Classification (CSC), first developed for aerial imagery (Carbonneau et al., 2020), to automate the extraction of river water masks from PlanetScope imagery. Our method, which combines a pretrained CNNs able to learn image characteristics beyond simple spectral thresholds with a localized neural network, which uses the CNN outputs to train a classifier specific to a given image, was tested on 36 rivers from 12 global biomes and found to have a produce highly accurate water masks (median F1 accuracy score of 0.93).

We subsequently developed a simple method to fine-tune our model, further improving performance on rivers outside of the training set. This enabled us to test PlanetScope's ability to measure hyper temporal change in channel shape and form in the Amazon during recent droughts. 35 river islands were chosen in the Amazon basin and their size and shape were monitored to measure how droughts changed the wetted area of a large river system. We also quantify how changes in these islands impacts the sinuosity of the channel centerline at a finer temporal resolution than has ever previously been carried out at this scale. Our approach sheds new light on how the Amazon and its islands have shifted in recent years in response to changing hydroclimatic conditions, and gives an indication of how, through the operationalizing of the PlanetScope constellation, geomorphic variables can be measured or monitored in exciting new ways.

REFERENCES

Carbonneau, P. E., Dugdale, S. J., Breckon, T. P., Dietrich, J. T., Fonstad, M. A., Miyamoto, H. & Woodget, A. S. 2020. Adopting deep learning methods for airborne RGB fluvial scene classification. Remote Sensing of Environment, 251, 112107.