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Assessing SfM-Photogrammetry potential at micro-scale on a rapidly evolving mud-bank: case study on a mesocosm study within pioneer mangroves in French Guiana (South America)

Jules Fleury (1), Guillaume Brunier (1), Emma Michaud (2), Edward Anthony (1), Philippe Dussouillez (1), and Sylvain Morvan (3)

(1) Aix-Marseille Université, CEREGE UMR7330, Aix en Provence, France (fleury@cerege.fr), (2) LEMAR, UMR 6539 (CNRS-UBO-IRD-IFREMER), (3) CNRS Guyane, USR 3456

Mud banks are the loci of rich bio-geo-chemical processes occuring rapidly at infra-tide frequency. Their surface topography is commonly affected by many of these processes, including bioturbation, water drainage or dessication.
Quantifying surface morphology and changes on a mud bank at the micro-scale is a challenging task due to a number of issues. First, the water-saturated nature of the soil makes it difficult to measure High Resolution Topography (HRT) with classical methods. Second, setting up an instrumented experiment without disrupting the signal being studied is hardly achieved at micro-scale. Finally, the highly mobile nature of this environment enhancing strong spatio-temporal heterogeneity is hard to capture.
Terrestrial Laser Scanning (TLS) and SfM (Surface from Motion)-Photogrammetry are two techniques that enable mapping of micro-scale features, but the first technique is not suitable because of the poor quality of the backscattered laser signal on wet surfaces and the need to set up several measuring stations on a complex, unstable substrate. Thus, we set up an experiment to assess the feasibility and the accuracy of SfM in such a context. We took the opportunity of the installation of a pontoon dedicated to the study of bio-geochemical processes within benthic mesocosms installed on a mud bank inhabited by pioneer mangroves trees to develop an adapted photogrammetry protocol based on a full-frame remotely triggered camera sensor mounted on a pole. The incident light on the surface was also controlled with a light-diffusing device. We obtained sub-millimetric resolution 3D-topography and visible imagery. Surveys were carried out every 2 hours at low tide to detect surface changes due to water content variation as well as bioturbation mainly caused by crabs digging galleries and feeding on sediment surface.
Both the qualitative and quantitative results seem very promising and lead us to expect new insights into heterogeneous surface processes on a highly dynamic mud bank. Remaining issues are finding appropriate validation data at such a high level of resolution in order to assess accuracy, and developing an acquisition method at a frequency high enough to enable us to decipher bulk soil movement from local changing features.