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The suitability of unmanned aerial vehicles and Structure-from-Motion analysis to assess tidal creek morphogenesis in a recently inundated saltmarsh restoration schemes

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Tidal creek networks play an important role in saltmarsh and mudflat environments as they are the major pathway for water, sediment and nutrients between the intertidal and subtidal zones. However, apart from results from morphodynamic models, little is known of the initial morphogenesis of tidal creek network, and there is a lack of quantitative analysis of field datasets and measurements. This is probably due to most creek networks found in intertidal environments already being in a state of quasi-equilibrium.

One environment that does allow for empirical studies of embryonic creek morphogenesis is saltmarsh restoration and creation schemes, such as managed realignment (MR) sites, through the transition from a non-channelled to channelled landscape. MR describes the processes of relocating the land / sea border by de-embanking, breaching or removing flood defences, creating new defences inland, allowing tidal inundation of the previously defended coastal hinterland to improve the level and sustainability of flood defences and to compensate for habitat loss elsewhere. Creek evolution in MR schemes is important to ensure a supply of sediment to the newly inundated intertidal zone, and for site and sediment drainage. However, MR schemes have been recognised to have lower biodiversity than natural saltmarshes, which has been associated with poor sediment drainage resulting from physical disturbances caused by the former land use.

Whilst previously studies have assessed creek morphogenesis in restored and constructed saltmarshes, these studies tend to rely on traditional surveying techniques such as LiDAR, aerial photography or differential global positioning system (dGPS) measurements. These approaches lack the surveying resolution and frequency required to identify subtle, but important, changes in morphology, and therefore may result in initial creek formation and development processes being missed. Unmanned aerial vehicles (UAVs) are being increasingly used across a number of scientific disciplines to provide high resolution imagery which, through the low-cost photogrammetric method Structure-from-Motion (SfM), can be used for high resolution topographic reconstruction.

This study assesses the suitability of this approach for measuring creek morphogenesis in a recently inundated MR site; the Medmerry Managed Realignment Site, West Sussex, United Kingdom (breached September 2013). Specifically, two UAV surveys from July 2016 and September 2017, taken from a near-breach site where two creeks had formed following site inundation, are compared to more traditional surveying techniques. Results indicate strong agreement between digital surface model produced the dGPS measurements (XYZ Root-mean-square-error < 0.033 m). The two surveys are then compared through volumetric analysis to assess the potential for using SfM analysis of UAV images to evaluate morphological development in newly inundated intertidal settings. The implications of these findings for both pre- and post-site inundation monitoring programmes discussed, as is the potential for developing the use of this technique into wider coastal monitoring programmes and surveys.