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Low-cost, high accuracy Global Navigation Satellite System positioning for understanding floods

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Detailed elevation is a prerequisite for many hydrological applications. To name a few, understanding of urban and rural flood hazard and risk; understanding floodplain geometries and conveyance; and monitoring morphological changes. The accuracy of traditional Global Navigation Satellite System (GNSS) chipsets in smart phones is typically in the order of several meters, too low to be useful for such applications. Structure from Motion photogrammetry methods or Light Detection and Ranging (LIDAR), may be used to establish 3D point clouds from drone photos or lidar instrumentation, but even these require very accurate Ground Control Point (GCP) observations for a satisfactory result. These can be acquired through specialised GNSS rover equipment, combined with a multi-frequency GNSS base station or base station network, providing a Real-Time (RTK) or Post-Processing Kinematics (PPK) solution. These techniques are too expensive and too difficult to maintain for use within low resource settings and are usually deployed by experts or specialised firms.

Here we investigate if accurate positioning (horizontal and vertical) can be acquired using a very recently released low-cost multi-constellation dual-frequency receiver (ublox ZED-F9P), connected with a simple antenna and a smart phone. The setup is remarkably small and easy to carry into the field. Using a geodetic (high-grade) GNSS antenna and receiver as base station, initial results over baselines in the order of a few km with the low-cost receiver revealed a positioning performance in the centimeter domain. Currently, we are testing the solution using a smart phone setup as base station within Dar es Salaam, to improve elevation mapping within the community mapping project “Ramani Huria”. We will also test the equipment for use in GCP observations within the ZAMSECUR project in Zambia and TWIGA project in Ghana. This new technology opens doors to affordable and robust observations of positions and elevation in low resource settings.