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Image-velocimetry techniques under particle aggregation for streamflow monitoring: a numerical approach

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Monitoring extreme events with high accuracy and consistency is still a challenge, even by using up-to-date approaches. On the one side, field campaigns are in general expensive and time-consuming, requiring the presence of high-qualified personnel and forward planning. On the other side, non-contact approaches (such as image velocimetry, radars, and microwave systems) have had promising signs of progress in recent years, making now possible real-time flow monitoring. This work focuses on the estimation of surface flow velocities for streamflow monitoring under particle aggregation, in which tracers are not necessarily uniformly distributed across the entire field of view. This issue is extremely relevant for the computing stream flows since velocity errors are transmitted to river discharge estimations. Ad-hoc numerical simulations were performed to consider different levels of particle aggregation, particle colour and shapes, seeding density, and background noise. Particle Tracking Velocimetry (PTV) and Large-Scale Particle Image Velocimetry (LSPIV) were used for image velocimetry estimations due to their widely used worldwide. Comparisons between the theoretical and computed velocities were carried out to determine the associated uncertainty and optimal experimental setup that minimises those errors.