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Flood flow modelling coupled with ML-based land cover detection from UAV and satellite river imagery

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This research examined a new method for coupling flood flow modelling with the machine learning (ML)-based land cover detection from the Unmanned Aerial Vehicle (UAV) and satellite river imagery. We examined a 2 km river channel section with a gravel bed in the Kurobe River, Japan. The method used Random Forests (RF) for riverine land cover detection with the satellite images' RGBs and Near InfraRed (NIRs). In the process, the UAV images were used effectively to train the RF in several small portions of the river channel where the types of riverine land cover were precise. Using these UAV images with the corresponding feature values (i.e., RGBs and NIRs) of the satellite images made it possible to create the training data with high accuracy for land cover detection. The results indicated that combining the high- and low-resolution images in the RF could effectively detect waters, gravel/sand, trees, and grasses from the satellite images with a certain degree of accuracy. Its F-measure, consisting of precision and recall rates, had high enough with 0.8. Then, the ML-based land covers were coupled with a flood flow model. In the coupling, the results of the detected riverine land covers were converted into the roughness coefficients of the two-dimensional flood flow analysis. The flood flow simulation could reproduce the velocity field and water surface profile of flood flows with high accuracy. These results strongly suggest the effectiveness of coupling the current flood flow modelling with the ML-based land cover detection for grasping the most vulnerable portions in river flood management.