Towards a coastal marine litter observatory with combination of drone imagery, artificial intelligence, and citizen science

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The presence of plastic litters in the coastal zone has been recognized as a significant problem. It can dramatically affect flora and fauna and lead to severe economic impacts on coastal communities, tourism and fishing industries. Traditional beach litter reports include individual transects on the beach, reporting on the litter's presence through a dedicated measuring protocol. In the new era of drone imagery, a new integrated coastal marine litter observatory is proposed. This observatory is based on aerial images acquired through citizen science using low cost self-owned drones and the automatic identification of litter accumulation zones through computer vision. The methodology consists of four steps: i) a dedicated protocol for acquiring drone imagery from non-experienced citizens using commercial drones, ii) image pre-processing (image tiling and geo-enrichment) and crowdsourced annotation, iii) data classification to litter and no litter though an artificial intelligence classification approach and iv) marine litter density maps creation and reporting. The resulted density maps currently are produced calculating the tiles containing litter at areas of hundred square meters on the beach and the entire process requires some minutes to run once the aerial data is uploaded online. The density maps automatically are reported to a spatial data infrastructure, ideal for time series analysis. Classification accuracy calculated against manual identification of 77.6%. The coastal marine litter observatory presents several benefits against traditional reporting methods, i.e. improved measurement of the policies against plastic pollution, validating marine litter transportation models, monitoring the SDG Indicator 14.1.1, and most important, guiding the cleaning efforts towards areas with a significant amount of litter.