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Ensemble Deep Learning for Automated Dust Storm Detection Using Satellite Images

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***Abstract* - Dust storms are considered a severe meteorological disaster, especially in arid and semi-arid regions, which are characterized by dust aerosol-filled air and strong winds across an extensive area. Every year, a large number of aerosols are released from dust storms into the atmosphere, manipulating a deleterious impact both on the environment andhuman lives. Even if an increasing emphasis is being placed on dust storms due to the rapid change in global climate in the lastfifty years by utilizing the measurements from the moderate- resolution imaging spectroradiometer (MODIS), the possibilityof utilizing MODIS true-color composite images for the task hasnot been sufficiently discussed yet. Here, a supervised ensemblelearning approach comprising three state-of-the-art models is proposed to detect dust aerosols in the atmosphere of the Earthto test the above hypothesis. The proposed method incorporatesa linear combination of U-Net, DeepLabv3+ and Swin U-Net asthe deep learning architecture which quantifies a binary semantic segmentation problem of distinguishing dust- susceptible and non- susceptible regions in each unconstrained MODIS image. The framework is tested upon a custom- developed dataset from MODIS measurements which contains 1020 true-colour images, over land and ocean. The ground truthlabel for each image is manipulated through handcrafted binarysegmentation which results in a binary ground truth image for each true-colour MODIS image. The performance of the proposed framework is evaluated using mean intersection-over-union (mIoU) and average pixel accuracy (ACC) in terms of thesemantic detection of dust aerosols. In the final testing, the framework achieved its highest Acc of 87.3% with a mIoU of 75.2%. The obtained performance of the framework surpasses the single state-of-the-art modalities and thus, aggregates to a more accurate implementation in the domain of dust aerosol detection.**

Keywords - deep learning, dust storm, ensemble model, MODIS data