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CROP ACREAGE ESTIMATION FOR RICE IN INDIA USING SENTINEL-1 (SAR) IMAGERY AND RANDOM FOREST ALGORITHM

Abstract

Seasonal estimation of crop acreage and crop distribution is a crucial step to help formulate agriculture policies that affect the lives of farmers and those who depend on the produce. The crop acreage estimation needs to be timely and accurate to help farmers receive swift insurance payouts and aid insurance companies to detect fraudulent claims. A good crop acreage estimation tool will facilitate the development of a yield estimation model and an accurate price forecast model. Earth2Orbit Analytix (E2O), a Bengaluru based start-up, developed Crop Acreage Estimation Tool (CAET-Optical) using optical imagery from Sentinel-2 satellite for Rabi (winter cropping season) crops. This model was presented at the 2017 International Astronautical Congress (IAC) held in Adelaide, Australia. E2O is now developing a Crop Acreage Estimation Tool using Synthetic-aperture Radar (SAR) imagery (CAET-SAR) for the Kharif (monsoon) season crops. This tool is a semi-automatic workflow written in Python programming language that will enable swift downloading of the satellite image for the required Area of Interest (AOI), pre-process the downloaded imagery, correct ground data and finally use Machine Learning (ML) algorithms on the imagery and ground data to estimate acreage of the crop. To test the model accuracy E2O conducted a pilot study for estimating Rice crop acreage in Dhenkanal, a district in the Eastern Indian state of Odisha along the Bay of Bengal covering an area of 4,452 km. Rice is predominantly cultivated during the Kharif season (June - October). This season overlaps with the South-West monsoons and the cloud cover is high. Hence, SAR imagery from Sentinel-1 satellite was used to estimate the Rice acreage. E2O data science team used dual-polarization (VV+VH) Interferometric Wide swath mode (IW) data collected on the 18th August 2018 over Dhenkanal district. Pre-processing steps for the Sentinel-1 tile included orbit file application, radiometric calibration, speckle filtering, Range-Doppler Terrain Correction and dB conversion. Random Forest algorithm was implemented to obtain the crop acreage. An overall accuracy of 77% was achieved. The desired accuracy food grains is 95% or higher. The paper concludes with suggestions on how to improve accuracy using better quality and quantity of ground data, texture analysis, and polarization combinations.