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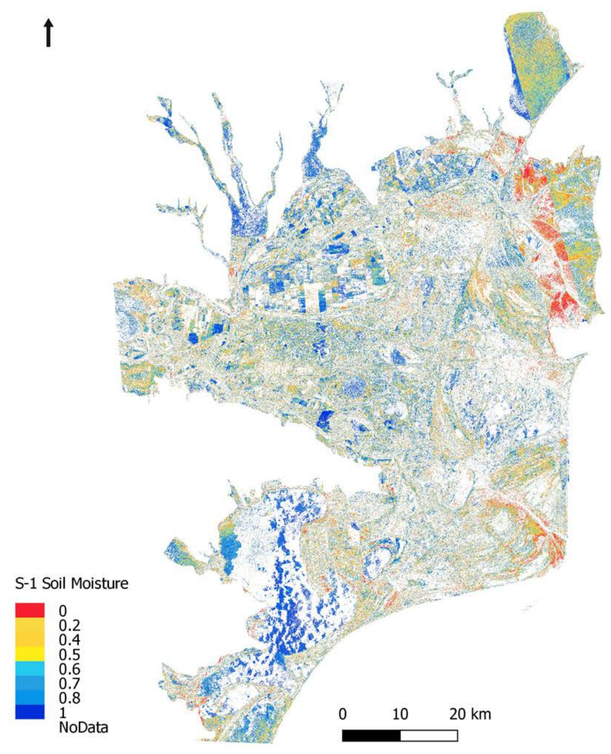
The Danube Delta Estimation of Relative Soil Moisture Content Using Sentinel-1 & Sentinel-2 Satellite Data

Introduction

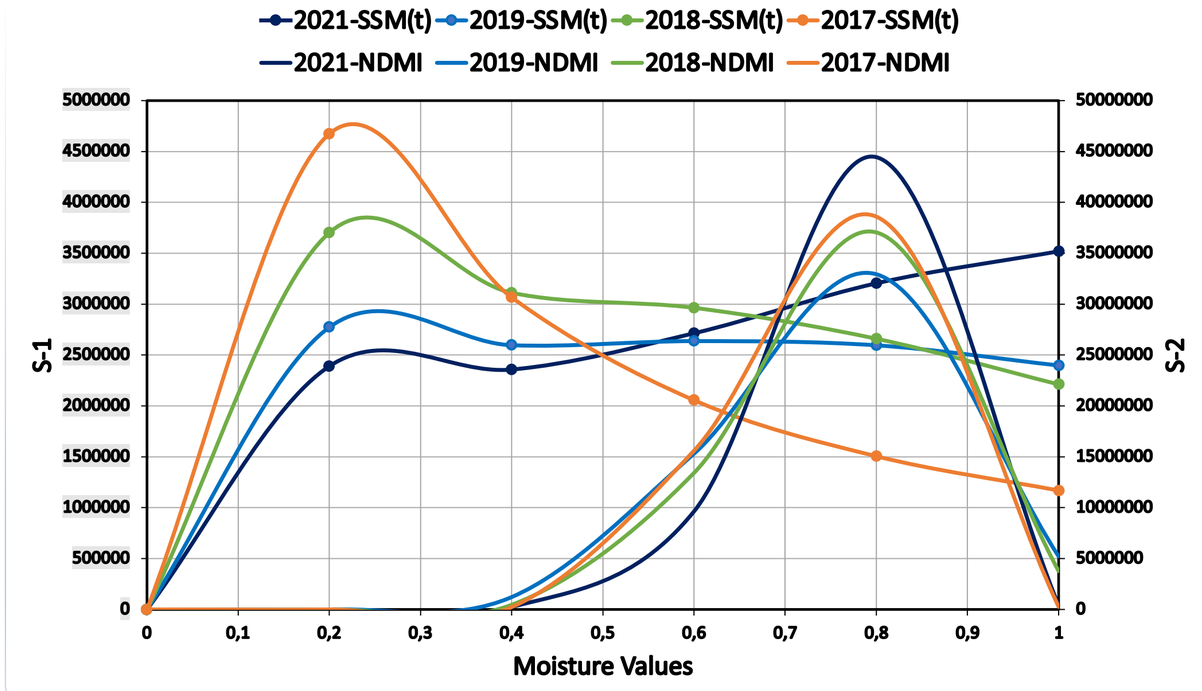
The soil moisture content (SMC) relates water quantity in a portion to the number of solids in the soil sample, expressed as a proportion. Soil moisture is critical in regulating water and energy exchange at the land surface. It has an essential role in assessing agricultural conditions, irrigation management, and hydrologic concerns. Optical and thermal infrared methods are more suitable for soil moisture monitoring in bare soil and sparse vegetation areas. As for the moderate to leafy vegetation coverage areas, the microwave retrieval method has become one of the most effective soil moisture retrievals due to its advantages, such as long-wavelength, penetration ability, and no influence from clouds.

Objective

While wet soil and moisture content decrease dramatically in the Danube Delta over the summer, this paper calculates the SMC using the July images series from Sentinel-2 (S-2) optical satellites and Sentinel-1 (S-1) radar satellites from 2015 to 2021. Furthermore, S-1 moisture estimation is associated with Danube River water levels. The results' efficacy was explored by comparing S-1 and S-2 outcomes in different land cover types and linking them to meteorological conditions.



2021-July Moisture Estimation based on Sentinel-1



Time-series S-1 and S-2 Based on pixel moisture value and intensity

Implementation

The S-1 moisture estimation equation was compared to the S-2 Moisture Index equation. Extraction of moisture content in the river Delta was challenging due to the large area, wet surface, weather, and delta water level variations.

Based on their estimations, the first comparison was with the in-situ surface samples (2021–July).

According to the findings, the weather has a greater impact on S-2 images. According to the comparison, S-1 has a more robust reverse correlation coefficient with Woodland and Wetland coverage than S-2. In the Grassland cover, S-2 has a greater correlation coefficient. The change detection comparison highlighted that the S-1 time series is better than S-2 with change detection. While S-2 change detection is affected by weather and provided inaccurate estimates for multiple years, S-1 results were more closely tied to river water level.

The last comparison employed random samples across time series land cover types to demonstrate S-1 capacity to discern between places with the lowest moisture content.

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