ROSSIHNI

Remote Sensing and Social Interest for Humanitarian Insights

Programm / Ausschreibung	ASAP, ASAP, ASAP 18. Ausschreibung (2021)	**Status**	abgeschlossen
Projektstart	01.07.2022	**Projektende**	30.09.2024
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Keywords	Dürremonitoring; soziale Medien; Dürrefolgen; Ostafrika; Sentinel-1		

Projektbeschreibung

ROSSIHNI unterstützt Hilfsorganisationen wie das Rote Kreuz und das Welternährungsprogramm der Vereinten Nationen (UN WFP) bei der proaktiven Bekämpfung von Dürrekatastrophen in Ostafrika durch neuartige Informationsprodukte. Bodenfeuchte ist vor allem für die Systeme des UN WFP eine kritische Lücke. Deshalb steht im Zentrum des Projektes die Entwicklung eines neuartigen Dürreindex, der durch die Kombination von Radarmessungen (METOP und Sentinel-1) gleichzeitig eine höhere räumliche Auflösung und verbesserte Genauigkeit liefert. Das Rote Kreuz benötigt zusätzlich Informationen, die es ermöglichen das Fundraising für oft wenig bekannte humanitäre Krisen zu optimieren. Zu diesem Zweck werden die Bodenfeuchtigkeitsdaten mit Informationen über die lokalen Auswirkungen der Dürre auf Ernährungssicherheit und globalen Auswertungen von Nachrichten und sozialen Medien kombiniert. So wird es erstmals möglich sein zu verstehen, wie sich Dürre-Schocks auf Ernährungssicherheit auswirken, aber auch wie, wann und wo Klimaanomalien und Dürreschäden in wohlhabenden Geberländern wahrgenommen werden. Somit unterstützt ROSSIHNI mehrere UN-Nachhaltigkeitsziele, insbesondere die Ziele ‘Zero hunger’, ‘Climate action’ und ‘No poverty’. Das Projekt ist eine Kooperation der TU Wien mit drei KMUs und dem Roten Kreuz Österreich. Außerdem wird ROSSIHNI vom UN WFP unterstützt. So deckt das Projekt die Wertschöpfungskette von der Grundlagen- und angewandten Forschung bis hin zu kommerziellen Services von hoher gesellschaftlicher Relevanz ab. Zwei der KMUs, PERIGEE aus Österreich und SPACE4GOOD aus den Niederlanden, nehmen zum ersten Mal an einem ASAP Projekt teil.

Abstract

ROSSIHNI is the first research-driven attempt to link a new drought index product based on radar backscatter observations from ASCAT and Sentinel-1 to a suite of algorithms that predict drought impacts and measure social interest. Our study region is East Africa, a humanitarian hot spot region frequently hit by droughts and other natural extremes. The resulting prototype dashboard will use the radar-based drought index as visual evidence for socioeconomic and agricultural impacts, related fundraising needs, and to support the operational activities of two of the world’s largest aid organizations, namely the Red Cross and Red Crescent Movement and the UN World Food Programme. Thereby, the project will support a number of UN Sustainable Development Goals, most notably the goals ‘Zero hunger’, ‘Climate action’ and ‘No poverty’. ROSSIHNI is a cooperation of TU Wien with three SMEs and the Austrian Red Cross supported by the UN World Food Programme, thereby spanning a bridge from fundamental and applied research to commercial applications of high importance to social and

environmental policies. Two SMEs, PERIGEE from Austria and SPACE4GOOD from The Netherlands, are new to the ASAP programme.

Endberichtkurzfassung

ROSSIHNI Project can best be summed up by explaining th e six main objectives in detail:
The first objective was to evaluate the readiness of the new ASCAT Surface Soil Moisture (SSM) dataset at a 6.25 km sampling for agricultural drought monitoring in East Africa. This evaluation specifically addressed challenges such as subsurface scattering and long-term land cover changes affecting ASCAT SSM retrievals. We identified subsurface scattering issues in arid regions through correlations with ERA5-Land data, which led to the development of a global subsurface scattering mask, as referenced in Wagner et al. (2024). To counter unrealistic wetting and drying trends caused by changes in land cover, we introduced an enhanced calibration method within the TU-Wien Soil Moisture Retrieval (TUW-SMR) algorithm. This method involves a moving window approach to estimate dry and wet backscatter references, effectively reducing spurious soil moisture trends linked to long-term land cover changes. After implementing these improvements, we conducted a comprehensive quality assessment of the enhanced ASCAT SSM 6.25 km product. This assessment involved comparisons with ERA5-Land and ESA CCI (passive) soil moisture datasets. We also evaluated the ability of the enhanced ASCAT SSM product to detect agricultural droughts in Eastern Africa by analyzing historical drought events in the Horn of Africa and Mozambique—regions that frequently experience severe drought conditions. Our findings demonstrated that anomalies in ASCAT SSM effectively capture drought situations, particularly when compared to anomalies in other hydro-meteorological variables. Additionally, we reviewed and summarized all currently available soil moisture-based drought indicators as published by Vreugdenhil et al. (2022). From this review, we computed two anomaly-based drought indicators: the Soil Moisture Anomaly Percentage Index (SMAPI) and the Soil Moisture Anomaly Z-score. The SMAPI and Z-scores derived from the enhanced ASCAT product exhibited spatial patterns consistent with the Standardized Precipitation-Evapotranspiration Index (SPEI) during past drought events. These results underscore the potential of the enhanced ASCAT SSM product for effective monitoring of agricultural drought, with detailed findings summarized in deliverable 4.1.

The second objective is to demonstrate the potential of S-1 CR data for assessing the impact of drought on vegetation. S-1 constellation, equipped with SAR sensors, provides all-weather, day-and-night imaging capabilities regardless of cloud cover as well as information on vegetation structure, biomass and moisture content. Here, the Soil Water Deficit Index (SWDI), derived from ASCAT SSM data at 6.5 km sampling, was utilized to quantify agricultural drought across forests, croplands, and grasslands at the district level in Mozambique. The SWDI, combined with meteorological and drought impact data, provided the foundation of the analysis. Subsequently, S-1 CR and MODIS NDVI were examined to monitor vegetation dynamics and evaluate drought impacts on their seasonal cycles. This objective was successfully completed and the results are summarized in Deliverable 5.2.

The third objective focuses on combining the drought and VI time-series with drought impact information in a machine learning approach for identifying high impact drought hazards. The project makes use of regional information from existing databases (e.g. Integrated Food Security Phase Classification / IPC), reports on drought impact (e.g. www.reliefweb.int), and information from expert groups as e.g. FAO on agricultural prices, food access and availability, and trading. Furthermore, the project consortium will make use of its connections to local partners for accessing additional information on drought impact. Other datasets such as drought events, may be added along the way to reinforce the findings. Due to the delay of the SSM and drought indicator data achieving this objective may be delayed and further work is needed.

The fourth objective is to analyze drought hazard and impact data in the context of global awareness regarding drought and related socioeconomic impacts, such as food crises. Perigee identified patterns and insights that can be used to raise awareness for drought-related crises earlier and more efficiently. A dedicated dashboard was developed to centralize emergency information about drought risk, including satellite-derived soil moisture anomalies, along with emergency reports, global media reporting, and a sentiment component, which classifies news articles as negative, positive, or neutral. This objective also emphasizes the transformative potential of integrating advanced data analytics with public engagement to enhance global awareness and accelerate humanitarian interventions. A dedicated report summarizes the main findings.

The fifth objective deals with the testing of the interdisciplinary workflow (pre-operational EO data-based drought monitoring, using ML model for identifying drought impact, quantifying social awareness) on historical data for the East African study region to identify, from which moment donor organisations could have retrieved reliable, EO based information on an uprising crisis. This objective was achieved by automating and orchestrating the processing pipeline using Apache Airflow. The tasks involved in collecting EO data, calculating drought indices, estimating food insecurity levels, and performing post-processing were managed within a structured workflow (DAG). Dockerisation ensured that each task could be executed consistently, and Airflow’s UI and logging capabilities provided real-time monitoring and management of the process. The historical data analysis provided insights into when EO-based information on the drought crisis could be reliably available.

The sixth objective is to collaborate with the Austrian Red Cross, African Red Cross National Societies in the target region, and the UN WFP to identify current drought-specific data and information requirements to strengthen their programming. In addition, this objective concentrates on evaluating how novel insights into the relationship between drought shocks, reported impacts, and social awareness can reduce uncertainties in decision-making.

Three user requirement workshops were carried out with Red Cross partners. In addition, discussions with the UN WFP concentrated on the optimal integration of satellite data into the internal PRISM (Platform for Real-time Impact and Situation Monitoring) system. The results of the user requirement workshops and the meetings with UN WFP are summarized in the user requirement report.

Projektkoordinator

- Technische Universität Wien

Projektpartner

- PERIGEE GmbH
- Space4Good
- EODC Earth Observation Data Centre for Water Resources Monitoring GmbH