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Earth Observation Strategies for degradation monitoring in South Africa with Sentinels – Results from the SPACES 2 SALDi-project

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The project 'South African Land Degradation Monitor (SALDi)' contributes to the German-South African Science Program SPACES by addressing the dynamics and functioning of multi-use landscapes with respect to land use, land cover change, water fluxes, and implications for habitats and ecosystem services. Particularly, SALDi aims: i) to develop an automated system for high temporal (bi-weekly) and spatial resolution (10 to 30 m) change detection monitoring of ecosystem service dynamics, ii) to develop, adapt and apply a Regional Earth System Model (RESM) to South Africa and investigate the feedbacks between land surface properties and the regional climate, iii) to advance current soil degradation process assessment tools as a limiting factor for ecosystem services. Protected areas (SANParks and other) within our six study regions represent benchmark sites, providing a foundation for baseline trend scenarios, against which climate-driven ecosystem service dynamics of multi-used landscape (cropland, rangeland, forests) are evaluated. Our study regions follow a climatic SW-NE transect: 1-Overberg, 2-Kai !Garib/Augrabies Falls, 3-Sol Plaatje/Kimberley, 4-Mantsopa/Ladybrand, 5-Bojanala Platinum/Pilanesberg, 6-Ehlanzeni /Mpumalanga.

We are utilizing Sentinel-1A/B C-Band VV/VH-SAR time series with a 10 m resolution. The revisit time is 12 days on average for South Africa. Pre-processing is done using pyroSAR, a Python framework for large-scale SAR-processing providing processing utilities in ESA's Sentinel Application Platform (SNAP) as well as GAMMA Remote Sensing software. The first two analytical approaches for the evaluation of the Sentinel-1 time series to detect surface changes, are based on the recognition of irregularities in the radar backscatter or coherence dynamics. Sentinel-2A/B data were pre-processed to L2A and used to calculate a wide range of vegetation indices (e.g. NDVI, EVI, SAVI, REIP) using DLR's Sen2Cor-processor. The time frame starts with the first Sentinel-1 and -2 acquisitions and continues. The analysis-ready data, that is, harmonized, standardized, interoperable, radiometrically and geometrically consistent data, is being ingested in the SALDi Data Cube. Algorithms and models for developing products such as land degradation indicators are being developed using Jypiter notebooks. SANSA in collaboration with SARAO (South African Radio Astronomy Observatory), is developing the open data cube Digital Earth South Africa (DESA) based on SPOT data. Other datasets from different sensors will be ingested at a later stage. SALDi's Data Cube will be open access to make it available to the wider scientific community, and

also for teaching and training purposes. The application/use of the individual development stages should be possible on the fly for the partners in South Africa. The SASSCAL platform shall be used for distribution of the finalised SALDi Data Cube.

This presentation demonstrates results from hyper-temporal Sentinel-1 and -2 timeseries concerning woody cover mapping and breakpoint analyses of the complex savanna systems, invasive slangbos (Seriphium plumosum) bush encroachment in grassland areas and regional soil moisture retrievals. Validation has been performed by cross-comparisons with VHR airborne DMC surface products, field trips and permanently installed soil moisture networks and interaction with local South African stakeholders.