Remote sensing of Vegetation Dynamics in Drylands: Evaluating Vegetation Optical Depth (VOD) using AVHRR NDVI and in situ data

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1. Background & Aims

- Derived from microwave radar observations, VOD (vegetation optical depth) is sensitive to the total water content in the entire vegetation layer (both the green and non-green components). Hence, it is expected to be a potential proxy for biomass and being complement to the optical-NIR based NDVI (sensitive to the vegetation greenness). Here, we are aiming to evaluate a recently developed long-term VOD dataset using in situ biomass measurements over the West African Sahel.

2. Data and Methods

- Table 1 gives an overall description of the data used.
- The spatial and seasonal patterns of VOD were compared to NDVI over the study area characterized by a clear north to south gradient of woody cover and biomass. The woody cover map and phenological behavior of herbaceous and dominant woody species were used to assist interpretation of the VOD seasonal variations.
- Different VOD/NDVI metrics were compared with the in situ data to assess their capability of reflecting biomass spatial and inter-annual dynamics.

3. Results

- Fig. 1: Location of in situ sites in Senegal with a background showing mean woody cover (Brandt et al., 2018). The study area is divided into three regions (North, Center and South) according to the long-term rainfall data, indicated by the isohyets. The areas in the dashed black boxes are further analyzed in Fig. 3A.
- Fig. 2: Spatial patterns of monthly mean VOD (A) and NDVI (B) during 1992–2017 from June to November.
- Fig. 3: (A) Seasonal patterns of mean VOD and NDVI in the sub-regions indicated in Fig. 1. (B) Phenology of typical Sahelian annual herbaceous vegetation and woody species. (C) Spatial relationships of woody cover and the annual maximum VOD/NDVI.
- Fig. 4: Scatter plots between in situ biomass data and seasonal metrics of October, annual max., and growing season small integral.

4. Conclusion

- VOD is an efficient proxy for green biomass of the entire vegetation stratum (both herbaceous and leaf of woody plants).
- VOD is more sensitive to the woody layer and less affected by saturation effect as compared to NDVI in the green parts of dryland areas.
- VOD appears to be robust against vegetation species composition for estimating biomass as compared to greenness measures derived from NDVI.
- The integration of the greenness seasonality (NDVI small integral) is most closely related to in situ measured biomass, while the VOD works equally well as a proxy for biomass when used as a “snapshot” in time (October, when the in situ biomass was measured).

References