German Remote Sensing Data Center

Detection of Grassland Degradation in Azerbaijan by Combining Multi-Decadal NDVI Time Series and Fractional Cover Estimates Based on DESIS Data

Sarah Asam, Frederic Schwarzenbacher, David Marshall, Martin Bachmann

MOTIVATION

- **Grasslands** used for **pasturing** are especially prone to degradation.
- Livestock farming is important for Azerbaijan's agriculture, degradation can significantly **impact livelihoods**
- Grasslands are under anthropogenic pressure, specially on community pastures → **erosion**

Fig. 1: Examples of degraded pastures in Azerbaijan

- Degradation is generally assessed in remote sensing by quantifying changes in VI **time series**.
- **Long** time series needed to detect trends; **frequent** observations needed to distinguish degradation from phenology.
- **Fractions** of soil, vital and degraded vegetation **cover** add information.

→ Aim: assess grassland **condition** and **potential degradation hotpots** through combining **multispectral** time series with **hyperspectral** data.

In situ data

- Campaigns in August & October 2018.
- 296 samples of land cover, cover fractions and erosion intensity in grassland, cropland and shrubland.

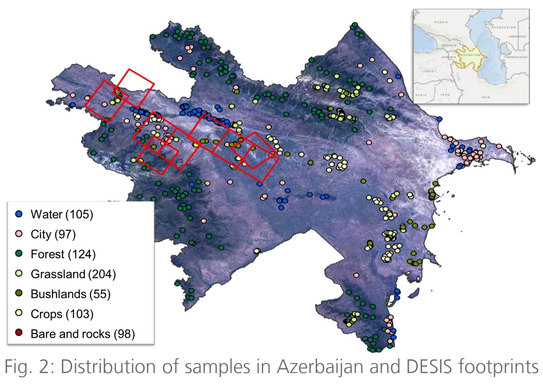

Fig. 2: Distribution of samples in Azerbaijan and DESIS footprints

APPROACH

Grassland Mask

- **Random Forest LULC** classification
- 70 spectral-temporal metrics of 2018 Sentinel-2 data as input.
- On-screen sampling of urban areas, soil, water and forests.
- Overall **accuracy of 83 %**.

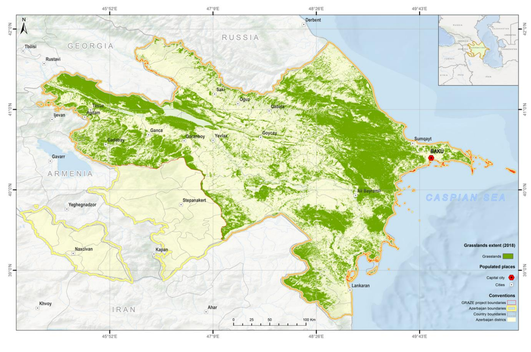

Fig. 3: Grassland mask for 2018 at 10 m spatial resolution.

NDVI Time Series

- Yearly Landsat & Sentinel-2 **median NDVI** for the years 1984 – 2021
- Clouds and cloud shadow masks out using fmask and Sen2Cor
- Mann-Kendall **trend test** and Sen's slope test

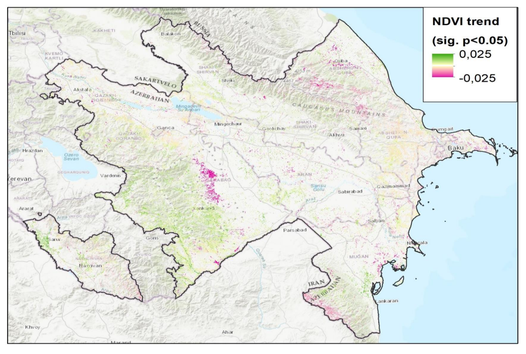

Fig. 4: NDVI trend 1984 – 2021

Fractional Cover

- 9 **DESIS** acquisitions 2019 – 2021
- 30 m spatial res., 30 km footprint
- Cloud coverage<25%; sun angle<40°
- Overlap with 42 in situ sample points
- **EnMap *fCover*** processor (Rogge et al. 2012; Bachmann et al. 2009; Marshall et al. 2021)

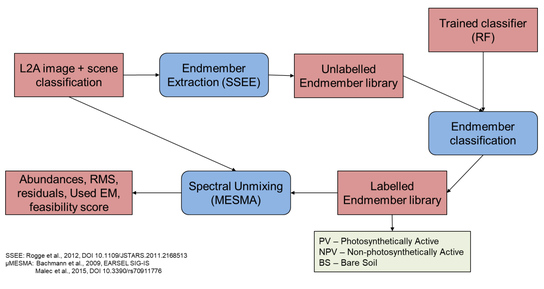

Fig. 6: EnMAP fCover processor

RESULTS

- 5.4% of grasslands show significant ($p<0.05$) **negative** NDVI trend
- **PV** fCover could be derived from DESIS with a mean absolute error of 8.3 %
- Pixels with **high PV fCover** are **less degraded** (positive NDVI trend).

➢ A multi-decadal assessment of vegetation condition was enhanced by adding canopy structure information from DESIS data

➢ To do: Comparison to in situ estimates of erosion intensity

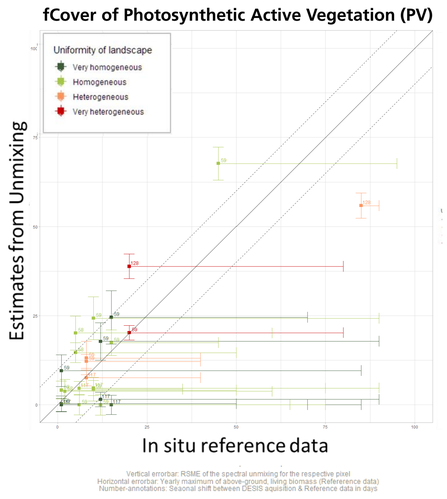

Fig. 7: Estimates of PV fCover vs. in situ reference data

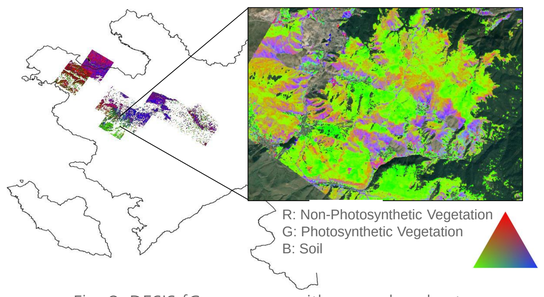

Fig. 8: DESIS fCover maps with example subset

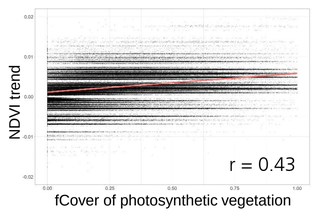

Fig. 9: Correlation analysis between PV fCover and NDVI trend

Institut für Ökologie

Deutsches Zentrum für Luft- und Raumfahrt