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Evaluation of EO Based vegetation trends in drylands

Comparing GIMMS and VIP global NDVI time series

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Abstract

A preliminary assessment of the new VIP dataset (V2) as potential dataset for global vegetation trend analysis is presented here. We compared per-pixel trends in yearly NDVI sum derived from VIP to similar trends derived from GIMMS 3g (Tucker et al. 2005) over the period 1982-2010. The first results showed that for approx. 44 % of the globe, trends derived from VIP and GIMMS are in agreement (Fig. 2). Consistent significant (p=0.05) positive trends were observed for 14 % of the land surface, such as in Europe, Eastern USA and in the Sudano-Sahelian region. Consistent significant (p=0.05) negative trends were found for approx. 3 % of the land surface, mainly in arid and hyper arid regions. Clear disagreement between VIP/GIMMS trends were observed for only 2.7 % of the land surface, such as in Argentina, Central Africa, South Mongolia, US Great Lakes region.

Data

VIP (Vegetation Index and Phenology)

Product: monthly continuity top-down data (VIP30P4) Version 2
Period: from Jan. 1982 to Dec. 2010
Resolution: originally 0.05 deg., resampled to 0.833 deg. (i.e. GIMMS resolution)

GIMMS (Global Inventory Modeling and Mapping Studies)

Product: bi-monthly GIMMS 3g
Period: from Jan. 1982 to Dec. 2010
Resolution: 0.833 deg.

Methods

NDVI metrics Yearly sums of VIP/GIMMS NDVI were used in this research. For the VIP yearly NDVI sum we considered solely pixels with at least eight months of good to marginal quality (i.e. with a per pixel reliability < 3). Regarding the GIMMS dataset, no data pixels and pixels marked as water were masked out.

Trend We evaluated the existence of trends by using the Mann-Kendall operator. This is a rank-based non-parametric trend indicator that measures the degree to which a trend is consistently increasing or decreasing. Images expressed as z-scores were calculated in order to assess the significance of the Mann-Kendall trends.

Consensus map The z-score images were combined to extract areas with consistent or differing trends across the two datasets. A consensus map was produced that shows the agreement of positive or negative trends for every pixel.

Trends in drylands Spatial means of z-scores were calculated for semi-arid areas in each continent. The FAO Global map of aridity was used to delimited these areas (www.fao.org/geonetwork/)

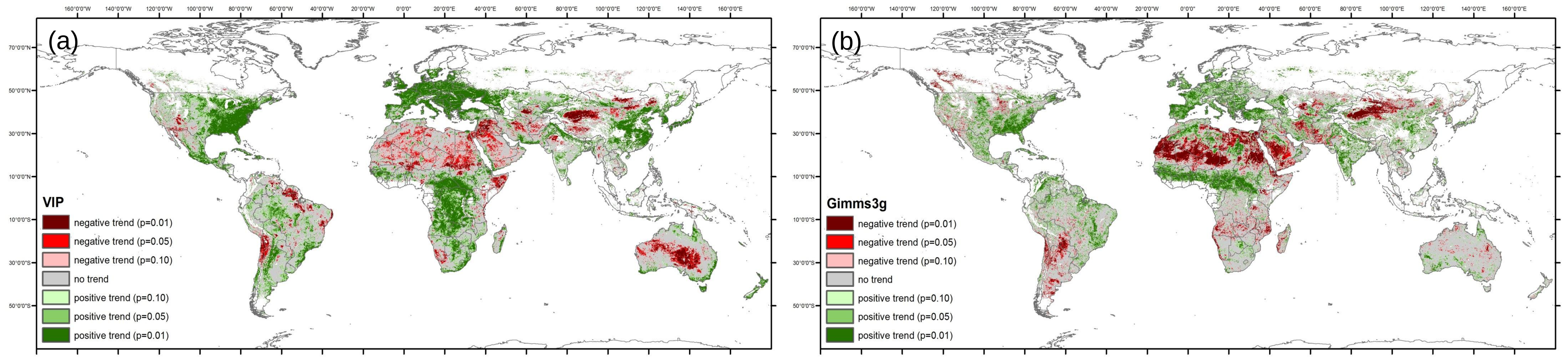


Fig. 1: Significance map of global NDVI trends expressed as z-scores based on the VIP (a) and GIMMS (b) dataset

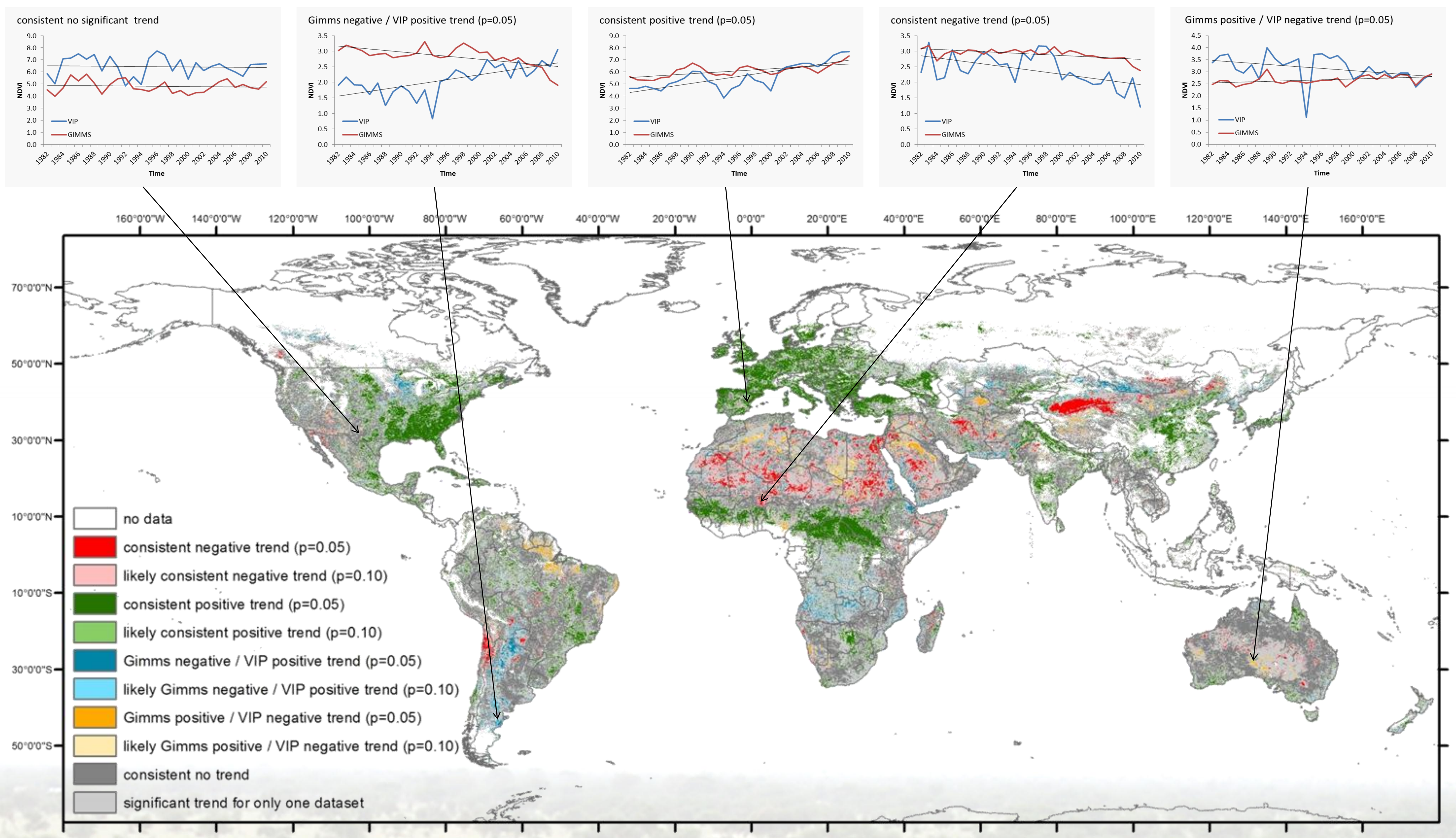
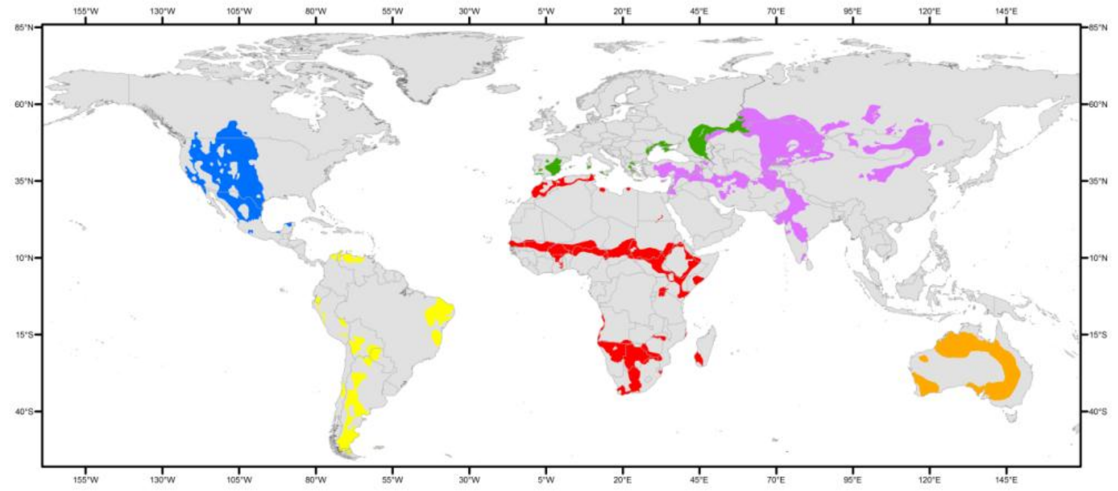


Fig. 2: Map showing the agreement between NDVI trends calculated on the VIP and GIMMS3g datasets. Pixels that did not meet the quality standards are indicated as no data. Profiles of selected areas representing individual consensus classes are shown on top of the map. These profiles indicate the annual NDVI sum for the period 1982-2010.



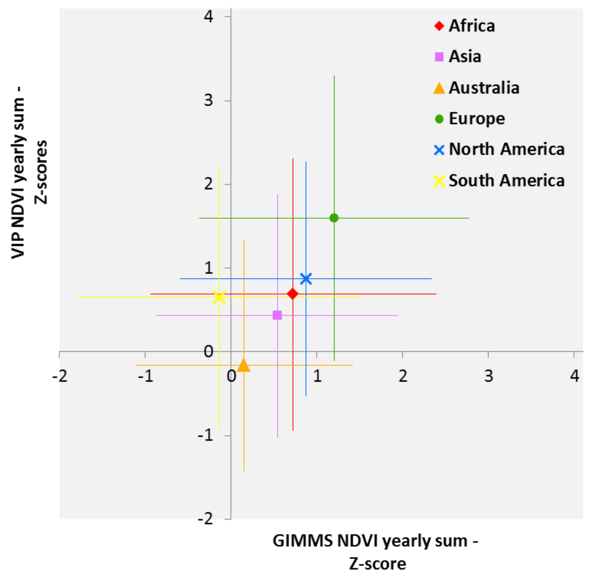


Fig. 3: (Left) Spatial means of z-scores and error bars that correspond to standard deviation were calculated for semi-arid areas in each continent. (Above) Semi-arid areas per continent were delimited using the FAO Global map of aridity (www.fao.org/geonetwork/).

Tab. 1: Contingency table showing the consensus across the two datasets in percentage of pixel that have positive or negative trends or no trend (absent)

		VIP						
Trend		negative p=0.01	negative p=0.05	negative p=0.10	absent	positive p=0.10	positive p=0.05	positive p=0.01
GIMMS negative	p=0.01	0.69	1.12	1.07	3.49	0.18	0.33	0.48
GIMMS negative	p=0.05	0.32	0.51	0.47	2.54	0.19	0.36	0.52
GIMMS negative	p=0.10	0.19	0.28	0.23	1.52	0.12	0.23	0.35
GIMMS absent		2.24	3.11	2.20	26.49	2.94	5.72	11.45
GIMMS positive	p=0.10	0.12	0.21	0.15	2.14	0.29	0.60	1.68
GIMMS positive	p=0.05	0.18	0.36	0.28	3.69	0.53	1.12	3.55
GIMMS positive	p=0.01	0.15	0.34	0.33	4.79	0.77	1.77	7.56

Results

Areas of agreement are shown spatially (Fig. 2) and as percentage of pixel that exhibit significant NDVI trends or non-significant trends (Tab. 1). The first results showed that for approx. 44 % of the globe, trends derived from VIP and GIMMS are in agreement (Tab. 1) and approx. 2.7 % are inconsistent. In general, trend analysis on the VIP dataset produced more significant results (45.7 %) than analysis on the GIMMS dataset (37.7 %). Profiles for selected areas illustrate the agreement or disagreement of trends of the annual NDVI sum. The very sudden drop of annual NDVI derived from the VIP dataset in the year 1994 for a test region in Australia can be explained by missing data values in that respective year. In addition, the profiles based on VIP data show a higher inter-annual variation than those based on GIMMS data.

The analysis of semi-arid areas per continent (Fig. 3) showed that VIP and GIMMS yearly NDVI trends are the closest to the 1:1 line in Asia, Africa and North America, whereas in Europe and in South America trends derived from the GIMMS dataset tend to be lower than those derived from VIP. The standard deviations for both datasets are approx. the same.

Conclusion and perspective

This analysis showed that yearly NDVI trends derived from VIP version 2 and GIMMS 3g have a relatively good level of agreement at global scale (i.e. consistent trends results for 44% of land pixels). However further analysis are needed to comfort these preliminary results. Indeed consistency in trends of other NDVI metrics (e.g. start/end/length of season, cyclic fraction, etc.) will need to be investigated as well as the impact of data quality and completeness on trend analysis.

Acknowledgement

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References

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