Workshop on Land Productivity Indicators for Drylands

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Diversity II Presentation II

About:

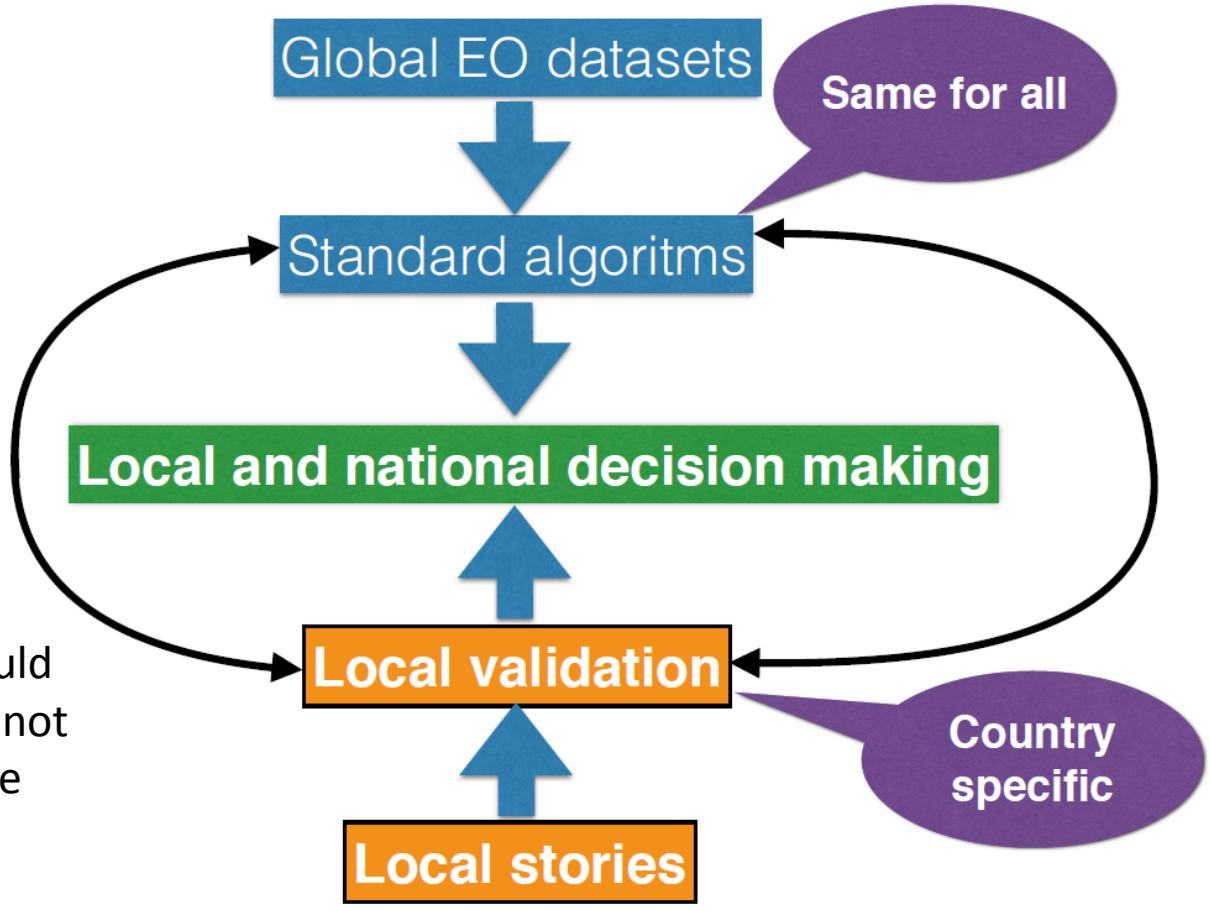
Proposed “second order” indicators of Diversity II

Generating second order indicators means to turn descriptive information or characterisations into ***assessments and evaluations***

… of the status and trends of degradation or land improvement.

Starting with Patrik Klintenberg's conclusion and modifying it with a remark of Lúcio:

How do we make best use of our remote sensing resources to support the monitoring and evaluation of land degradation?



Lúcio Pires do Rosário : Indicators should be ***evaluated***, not validated in the field

What may this mean in practice ?

- Should we leave the descriptive indicators („first order“ in DiversityII) as they are or similar ?
- Or should we do assessments („second order“ indicators) but refrain from labelling them strictly in terms of biodiversity, degradation, stability, and improvements ?
- Our suggestions: deliver both levels of information to the users and along with them
    - Interpretation keys (alternatives)
    - Some background knowledge
    - Where appropriate, tools to work with them

What can DiversityII contribute?

- Elaborated „first order“ indicators (both maps and underlying data)
- A set of „second order“ indicators containing diagnoses of ***potential*** status and trends
- (Short) narratives to link some of the outcomes to developments on the ground, or providing overviews what may have happened according to the EO results
    - Examplary interpretation keys (generic)
    - Some background knowledge
    - Tools to work with them

Biodiversity	Cibio: Linking vegetation productivity to faunal abundance and faunal diversity and temporal changes thereof Literature review about the relation between vegetation productivity and plant species richness Address "functional biodiversity" Study the DiversityII productivity indicators in relation to known hotspots and concentrations of biodiversity
Degradation in the form of persisting and/or progressing trends of vegetation (productivity) loss	First order NPP and RUE indicators (status, changes, trends) <u>Second order indicators:</u> 1. Derive maps showing the direct NPP proxy – rainfall relation • For the 20 years preceding the MERIS epoch • For the MERIS epoch • As epochal change between these periods (using GIMMS NDVI) 2. Working towards Local Productivity Scaling (on a demonstration basis)
Degradation through bush encroachment	First order NPP and RUE indicators (status, changes, trends) <u>Second order indicators:</u> 3. Using ratios of seasonal NPP proxies, e.g. the percentage of the dry season mean of the overall vegetation year mean and its trend
Land use / cover change	Demonstrate selected cases where relations between productivity changes and land use/cover changes can be found (i.e. no systematic "mapping" of land use/cover changes)
Salinisation	Not addressed
Other manifestations of or potential hints to land status changes?	Derive status, change and trend information for meteorological and soil moisture data What else may be observed /retrieved with EO data exploitation?

Proposed structure of biodiversity/ degradation related indicators and

Contributions of DiversityII to biodiversity and land condition mapping based on NPP proxies

via

- Maps
- Continuous data
- Booklets

Biodiversity – Vegetation productivity
Discussion of Kenneth Clarke (2008)

- While the relation depends on spatial scale and on the number of functional vegetation types considered, on climate, topography, etc. (e.g. in humid areas it can be observed that e.g. unmanured meadows have much higher plant diversity than overly fertilized meadows),

- **Overall (on a larger scale) „the greater the amount and duration of primary productivity the greater the capacity to generate and support high biodiversity** (O'Brien 1993; Whittaker *et al.* 2003)“

- This productivity theory has been challenged by researchers who „have questioned why greater productivity should not simply lead to larger populations without increasing species richness (Willig *et al.* 2003)“.

- “Some theoretical explanations were advanced by Abrams (1995)“

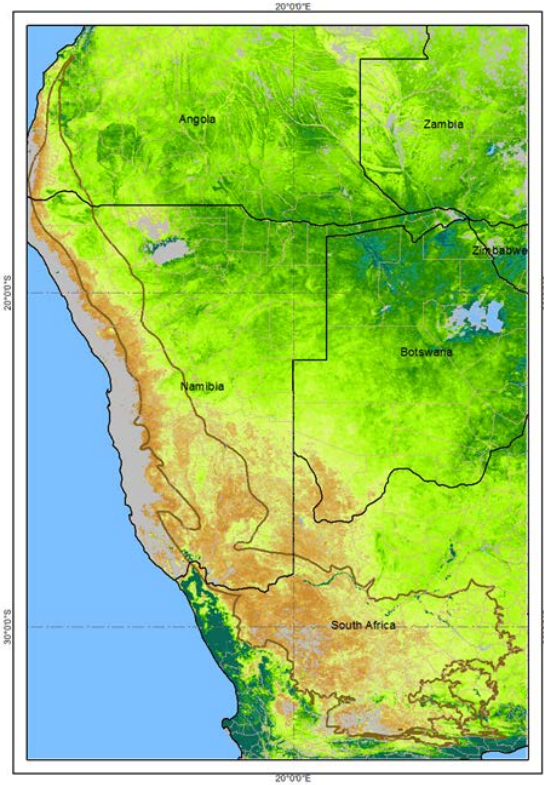
Biodiversity – Vegetation productivity
Discussion of Kenneth Clarke (2008)

1. Increased productivity increases the abundance of rare species, reducing their extinction rates;
2. Increased productivity increases the abundance of rare resources or combinations of resources and conditions that are required by specialists;
3. Increased productivity increases intraspecific density dependence, allowing coexistence of species, some of which would be excluded at lower productivity;
4. Over large geographical areas, cells of generally high productivity will contain scattered low productivity sites, and their species will contribute to the diversity measured across high productivity regions (Whittaker et al. 2003)

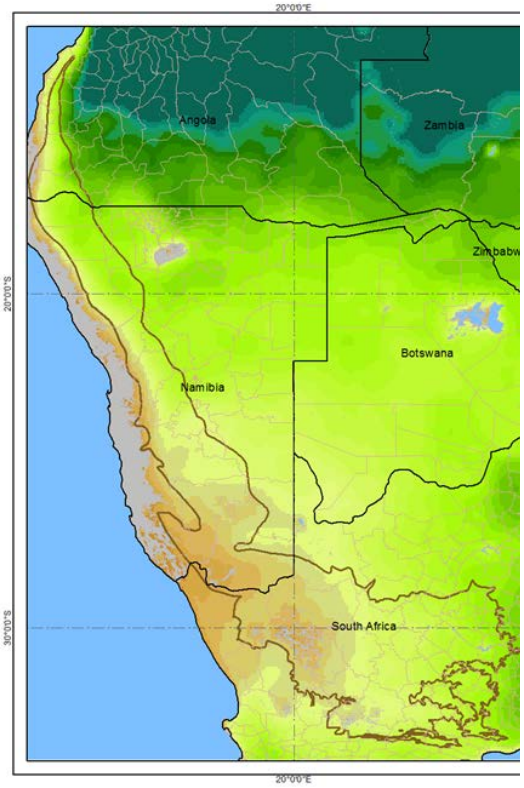
Overall conclusion (Clarke 2008):

"Thus, at broad scales the relationship between water-energy dynamics and species richness has been demonstrated by significant macro-scale studies, and is relatively consistent across the globe".

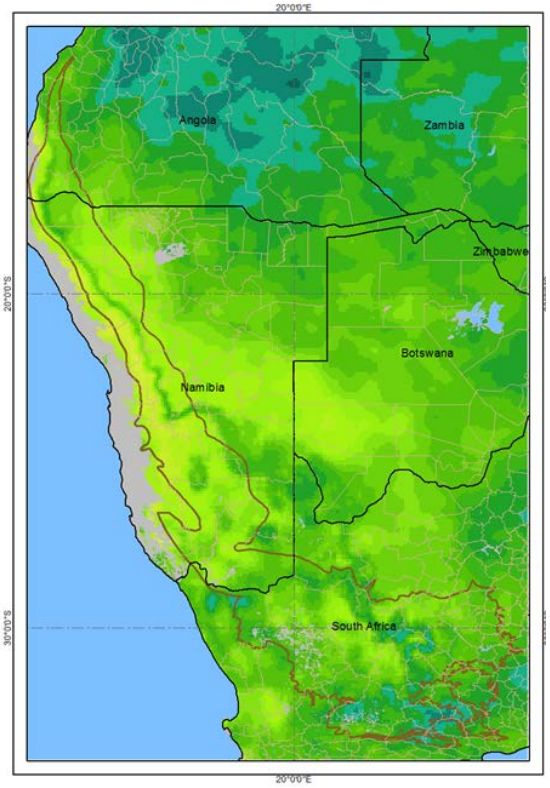
Potential Biodiversity Hotspot areas and areas with possibly higher biodiversity



Mean vegyear RUE

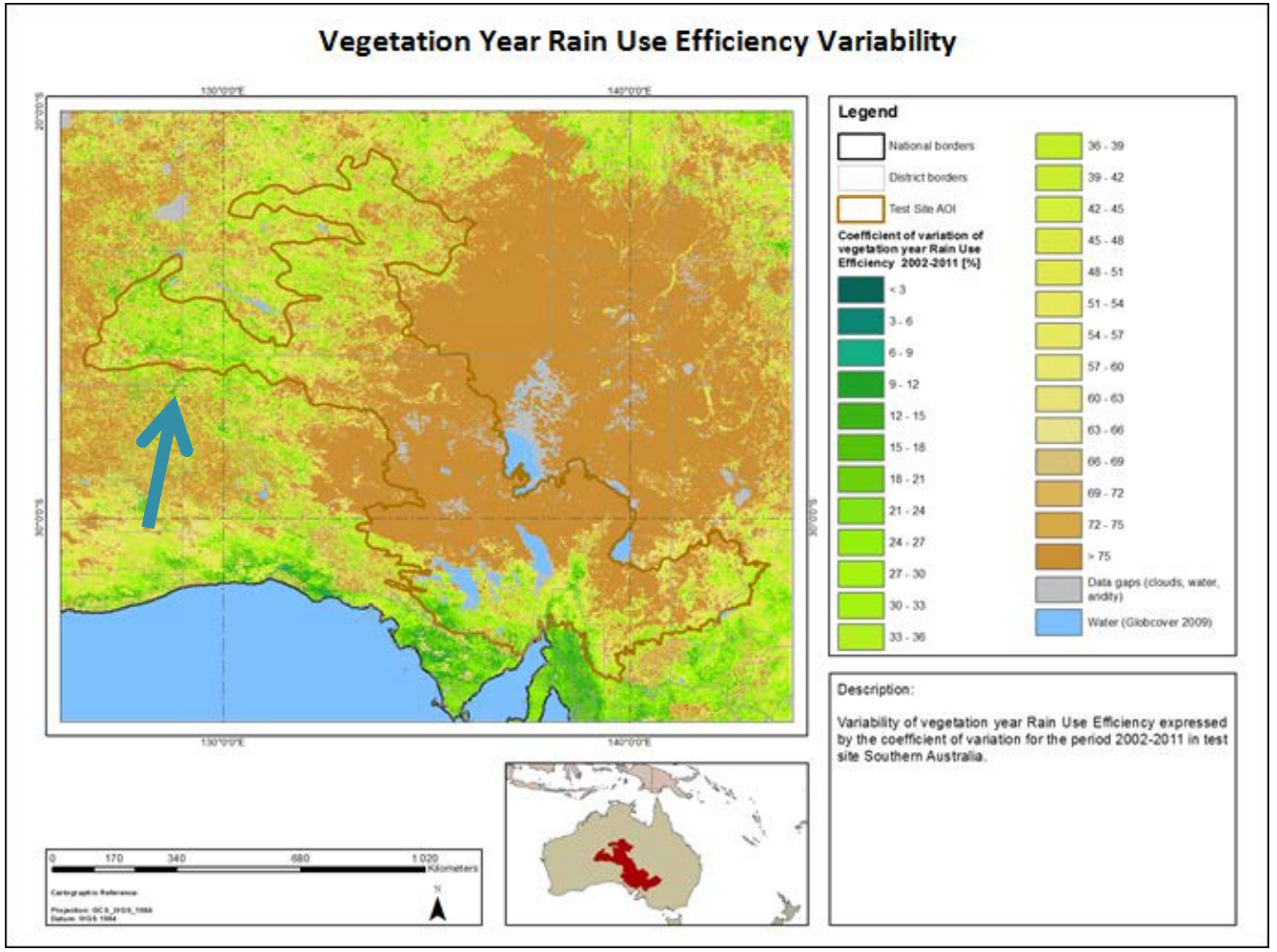


Mean vegyear rainfall 2003 - 2010



Rainfall variability

NPP indicators and biodiversity hotspots



The **Great Sandy-Tanami Deserts** are the richest deserts in Australia that exhibit high levels of local endemism (http://wwf.panda.org/about_our_earth/ecoregions/great_sandy_tanami_deserts.cfm)

Functional Biodiversity

……as a property of agroecosystems

Agriculture, Ecosystems and Environment 127 (2008) 7–21

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journal homepage: www.elsevier.com/locate/agee

Review

Functional biodiversity: An agroecosystem approach

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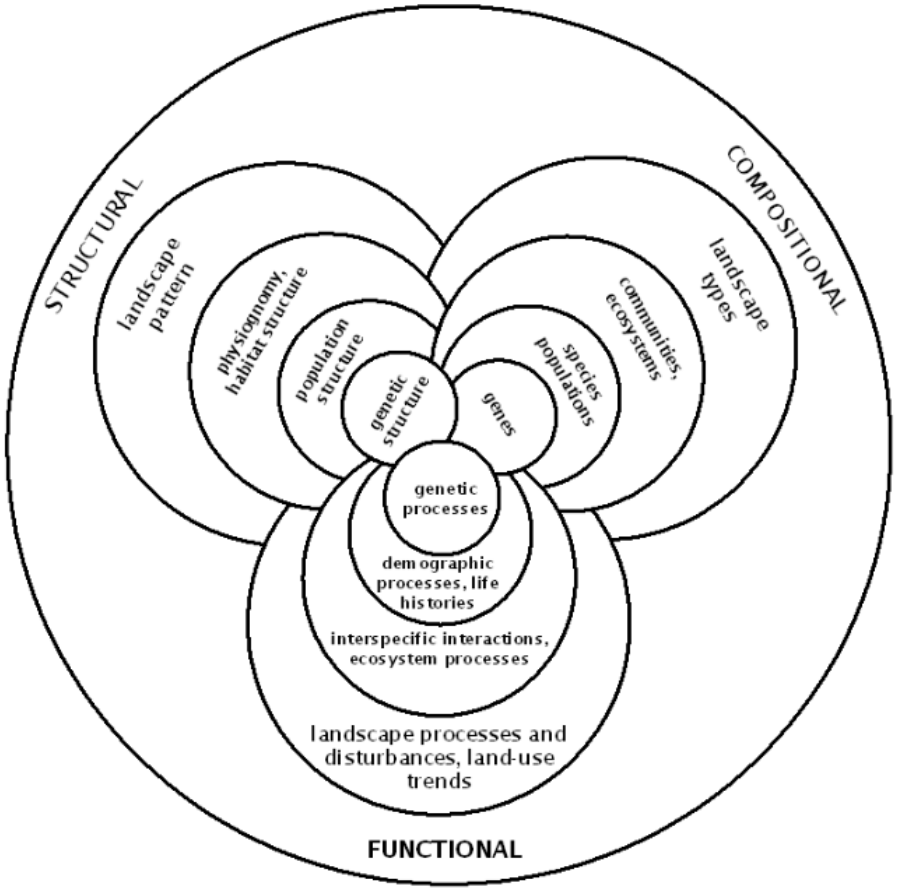
Functional Biodiversity



….. as adopted as science background for conservation by the Kruger National Park

http://www.sanparks.org/parks/kruger/conservation/scientific/

Compositional, structural, and functional biodiversity, shown as interconnected spheres, each encompassing multiple levels of organization. Noss, RF. 1990. Indicators for Monitoring Biodiversity: A Hierarchical Approach. Conservation Biology. Vol 4; Issue 4; Page 355-364.

Local Net Production Scaling (Prince at al. 2009)

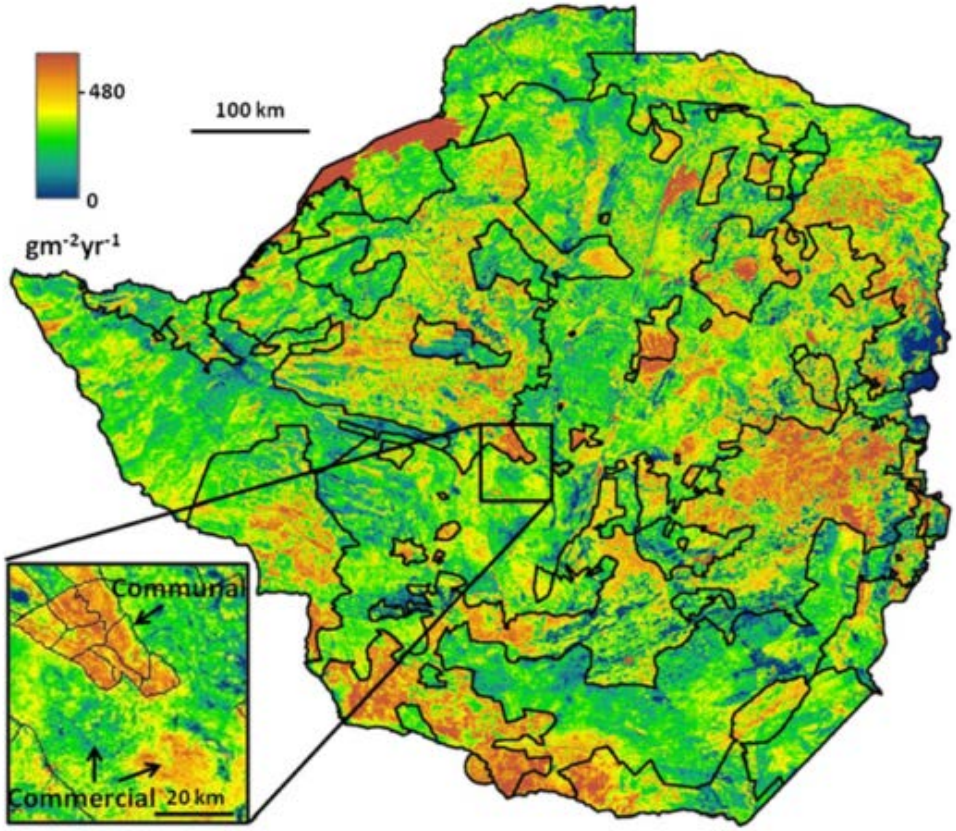
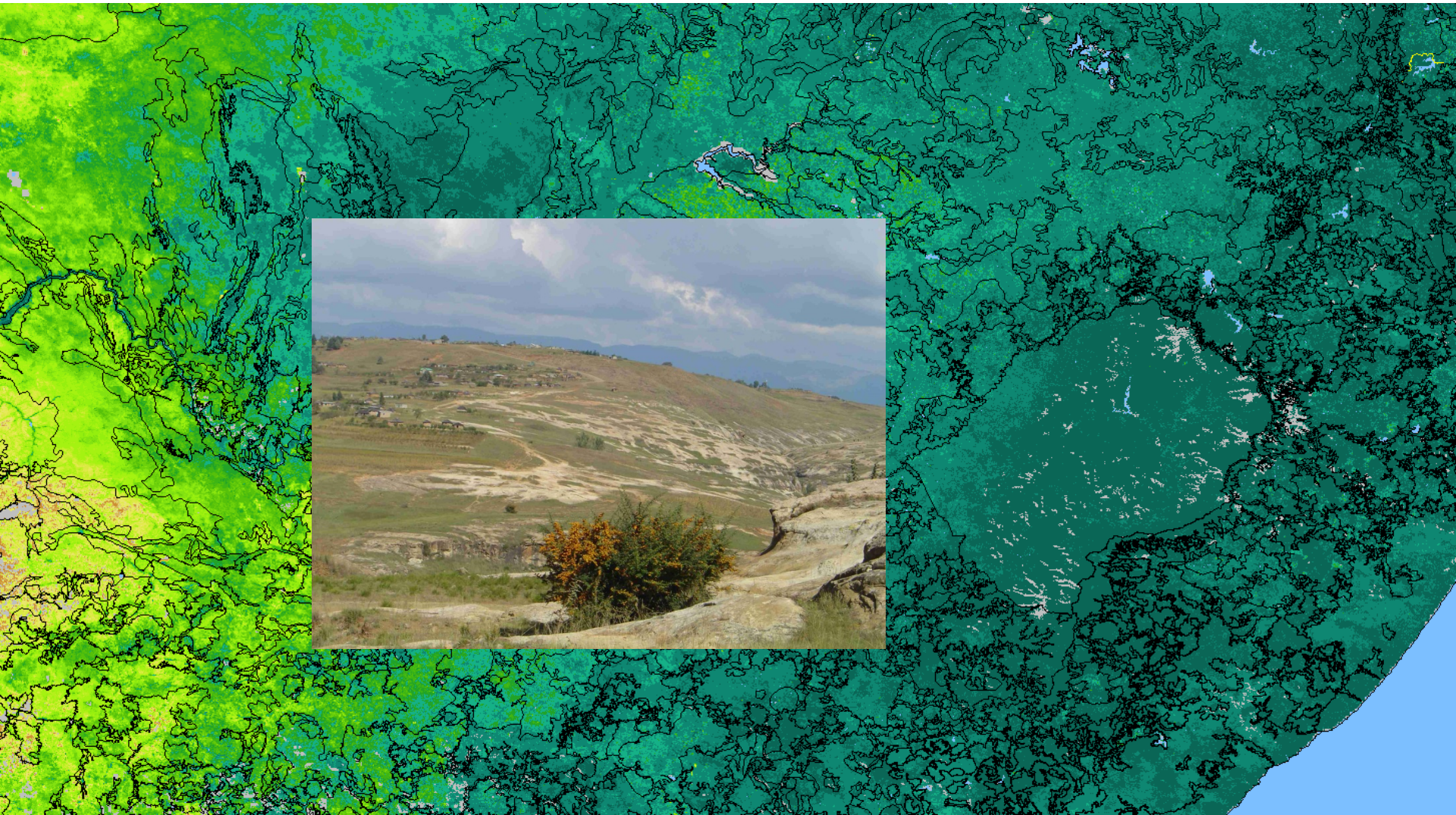


Fig. 6. Local NPP Scaling (LNS) of Zimbabwe using the ZSOL soils map and precipitation (ZSOL–PPT) land capability classification. Communal and Commercial area boundaries shown in black. Inset, higher resolution segment SW of Gweru showing communal area degradation (top left) and commercial area degradation (lower right).

"The local net production scaling (LNS) method, tested here in Zimbabwe, estimates potential production in homogeneous land capability classes and models the actual productivity using remotely-sensed observations. The difference between the potential and actual productivities provides a map of the location and severity of degradation".

Vegetation Year Coefficient of Variation with SOTER boundaries (http://www.isric.org/projects/soil-and-terrain-database-soter-programme)



Direct NPP Proxy – rainfall relation

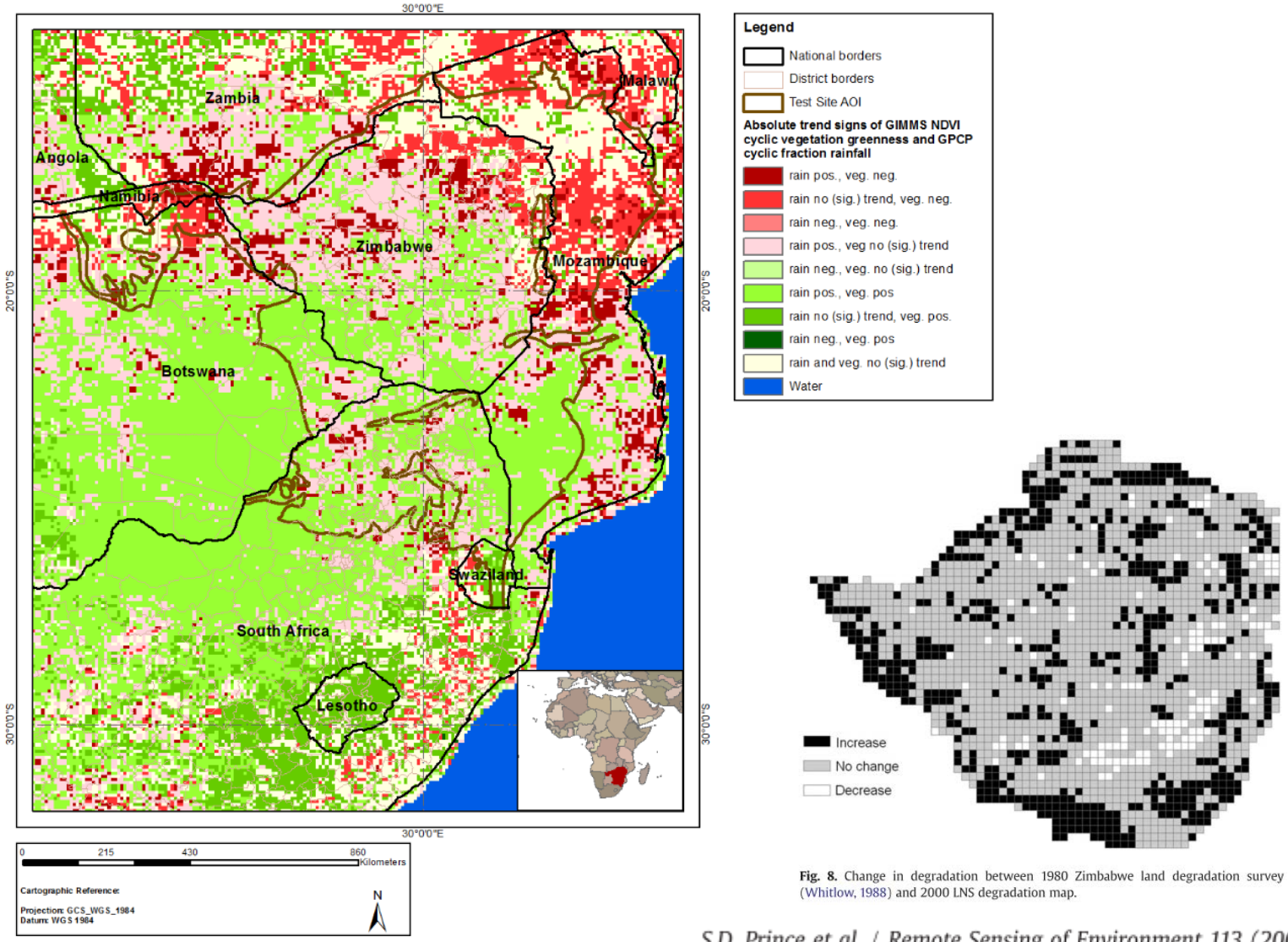
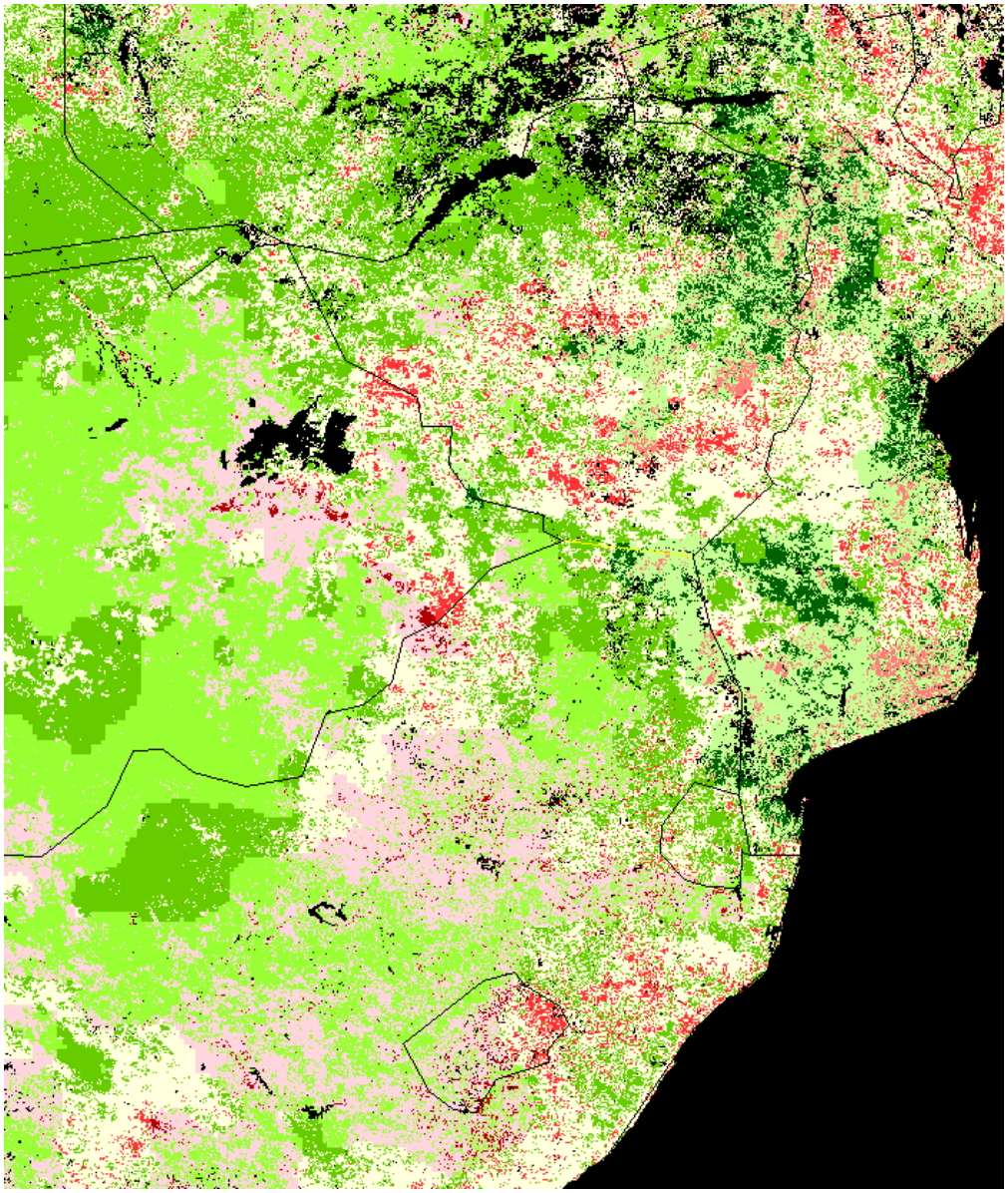


Fig. 8. Change in degradation between 1980 Zimbabwe land degradation survey (Whitlow, 1988) and 2000 LNS degradation map.

S.D. Prince et al. / Remote Sensing of Environment 113 (2009) 1046–1057

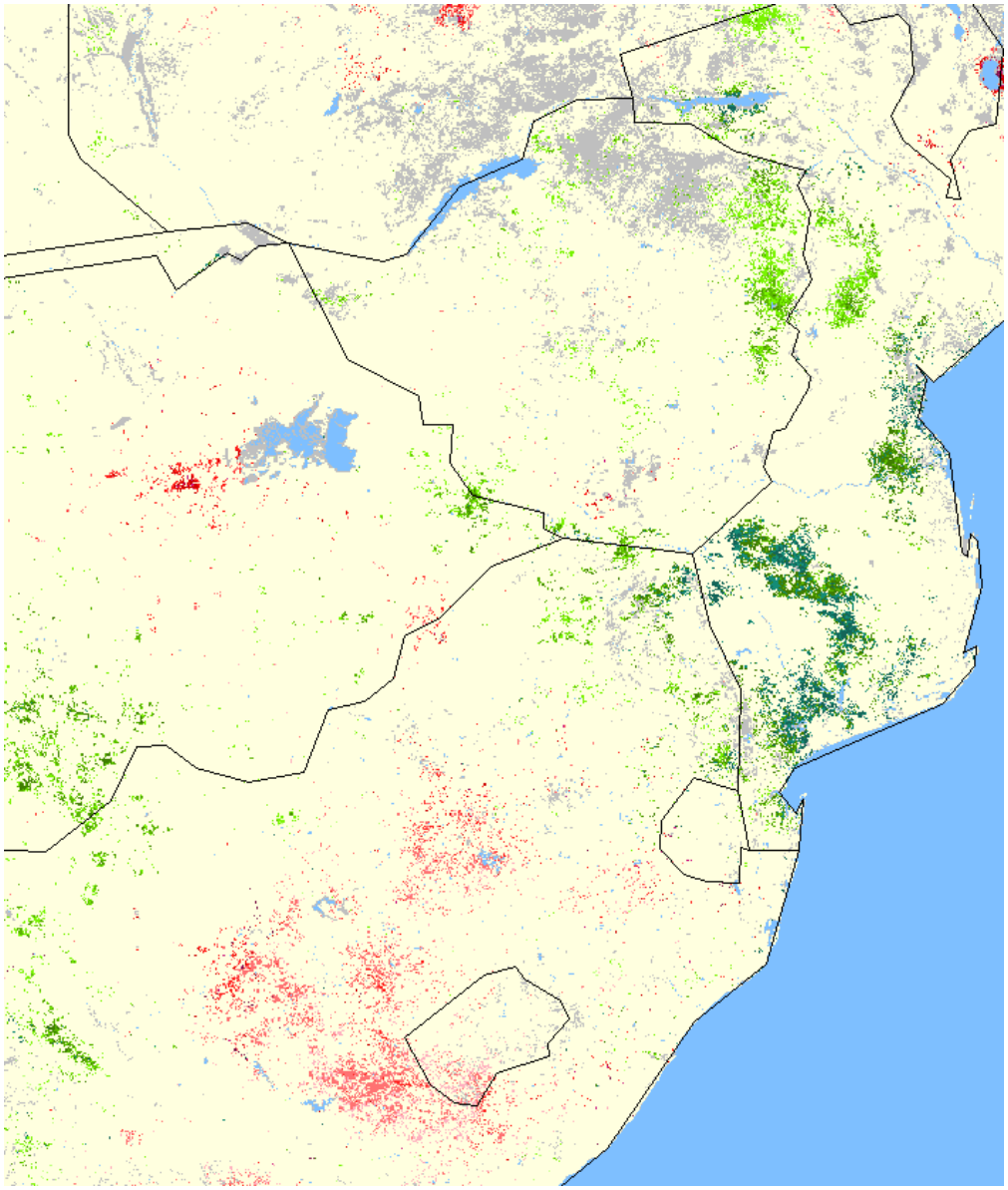
Direct NPP Proxy – rainfall relation 2003-2010



This approach is based on simply combining NPP proxy trends and rainfall trends (using smoothed yearly sums) without applying a model to their relationsship and thereby assuming proportionality (RUE) or linearity (restrend)

rain pos., veg. neg.
rain no (sig.) trend, veg. neg.
rain neg. veg. neg.
rain pos., veg. no (sig.) trend
rain neg., veg. no (sig.) trend
rain pos., veg. pos.
rain no (sig.) trend, veg. pos.
rain neg., veg. pos.
rain and veg. no (sig.) trend
water, ice, no data

RUE trends of vegetation years 2003-2010



Thank You !