vito
vision on technology

04/05/2015

The effect of climate fluctuations on vegetation across East and Central Africa

Lunch seminar series (spring 2014)

Division of Forest, Nature and Landscape

KU LEUVEN

t another climate change story?

- Scientific consensus is converging

> *The contrast in precipitation between wet and dry regions and between wet and dry seasons will increase, although there may be regional exceptions.*

> *xtreme precipitation events over most of the mid-latitude land asses and over wet tropical regions will very likely become ore intense and more frequent by the end of this century, as obal mean surface temperature increases . (…)*

> *(…) Due to the increase in moisture availability, ENSO-related precipitation variability on regional scales will likely intensify.*

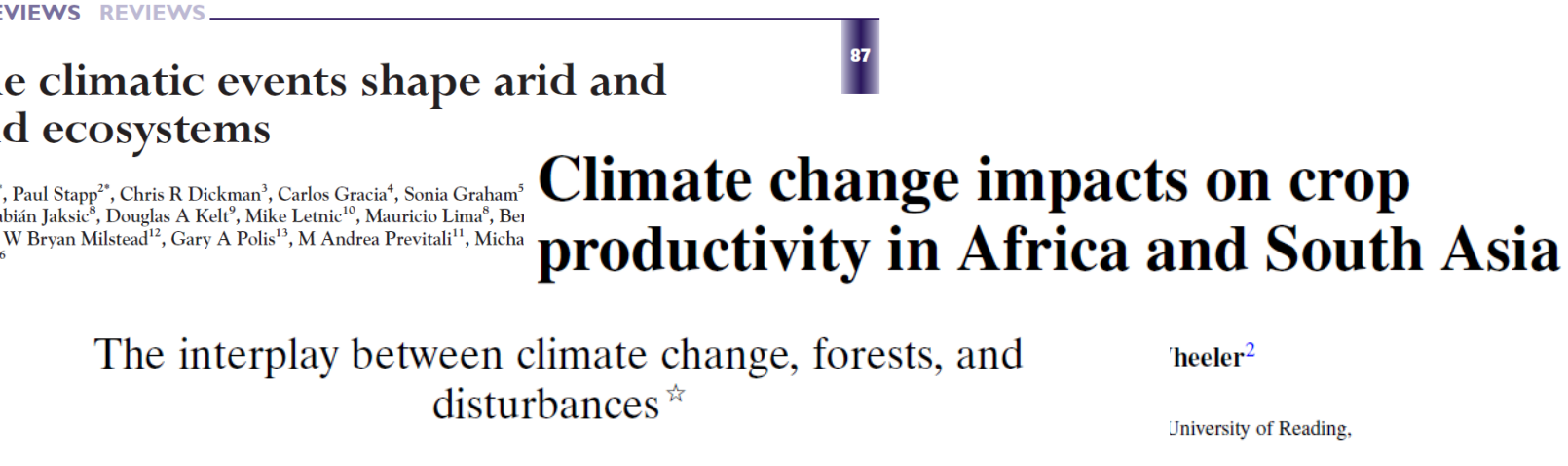
- IPCC, Climate change 2013: The physical science basis

e point of this research

Patterns of climate variability are shifting in time

Magnitude and direction differ strongly across regions

» ***How does this affect regional vegetation patterns?***



EVIEWS REVIEWS 87

e climatic events shape arid and
d ecosystems

, Paul Stapp[2*], Chris R Dickman[3], Carlos Gracia[4], Sonia Graham[5]
bián Jaksic[8], Douglas A Kelt[9], Mike Letnic[10], Mauricio Lima[8], Be
W Bryan Milstead[12], Gary A Polis[13], M Andrea Previtali[11], Micha

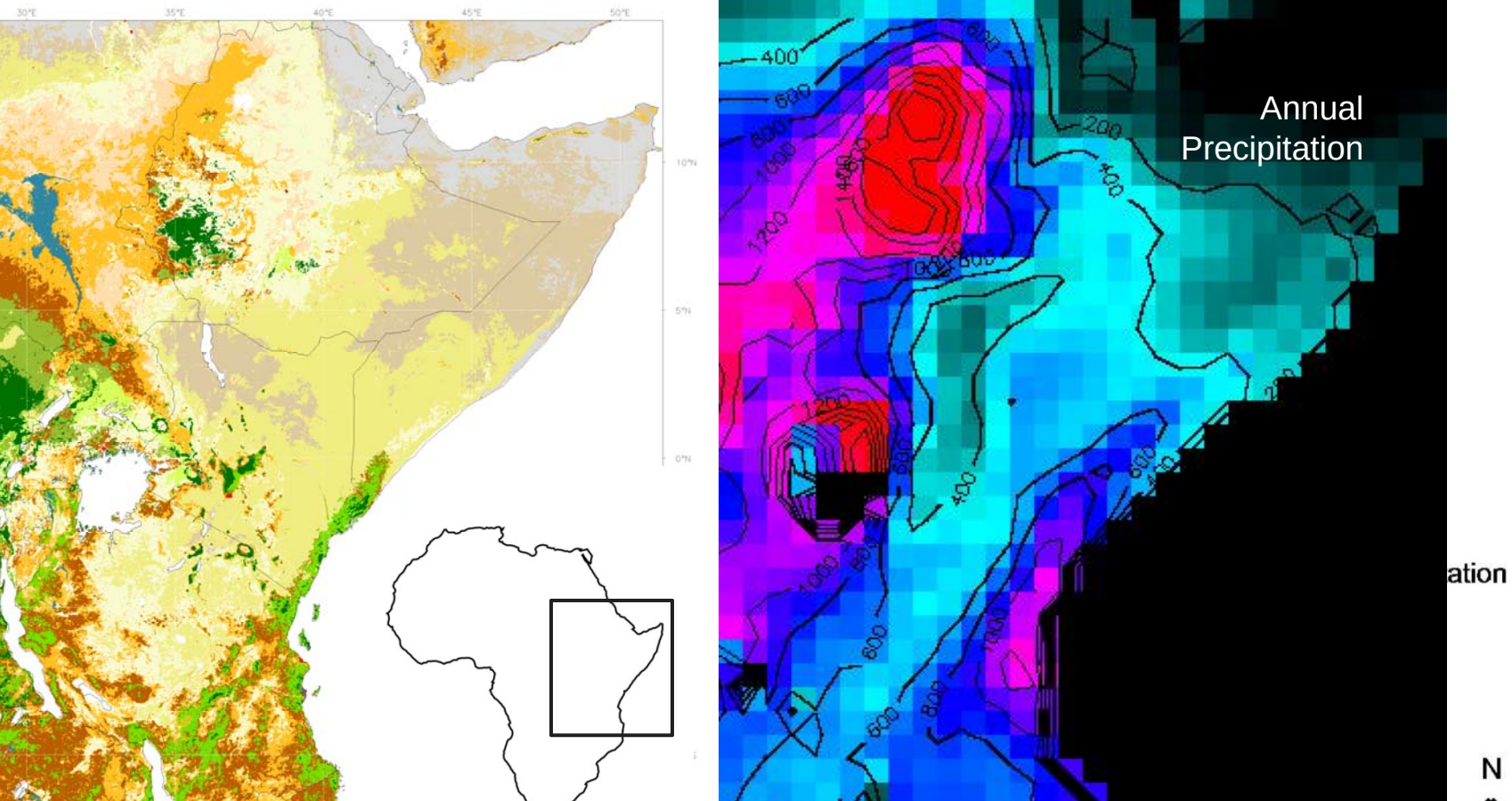
Climate change impacts on crop productivity in Africa and South Asia

The interplay between climate change, forests, and disturbances ☆

heeler[2]

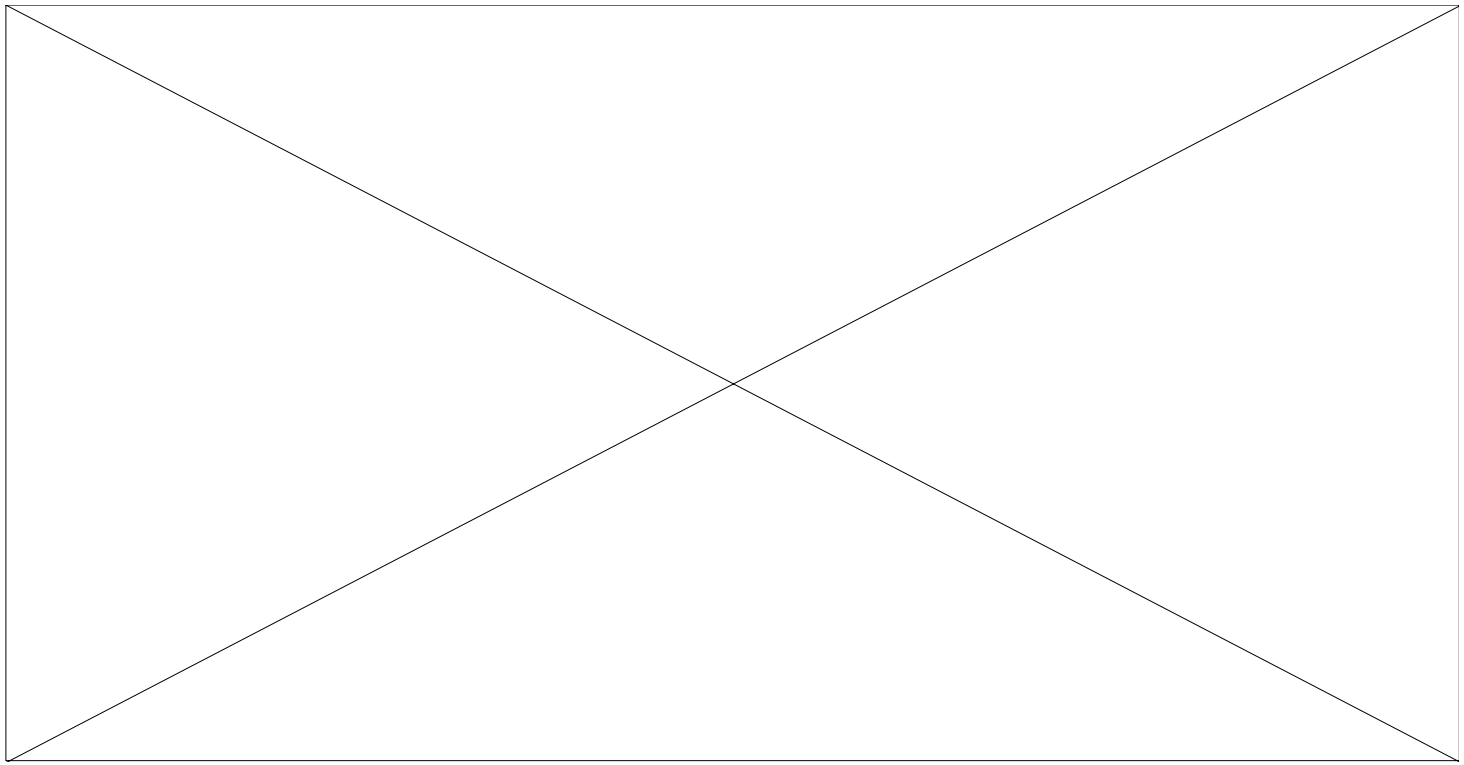
University of Reading,

udy area


Water/Background
Tree Cover; broadleaved; evergreen
Tree Cover; broadleaved; deciduous; closed
Annual
Precipitation
ation
N

nage data

Global land surface monitoring (nearly daily coverage!)



nage data

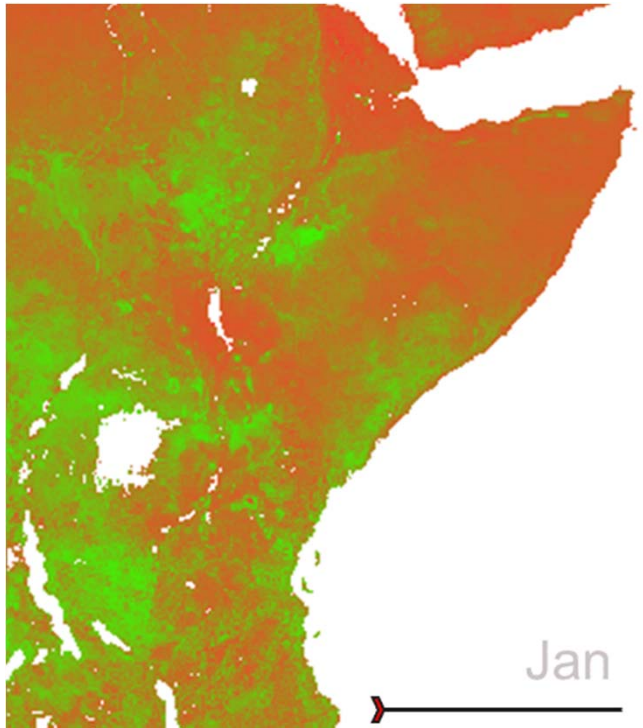
Temporal changes in vegetation cover

NDVI index

- NOAA-AVHRR (1981-1999)
- SPOT-VGT (1998-2014)
- Proba-V (2013- present)

4km/1km/300m spatial resolution

10-daily synthesis



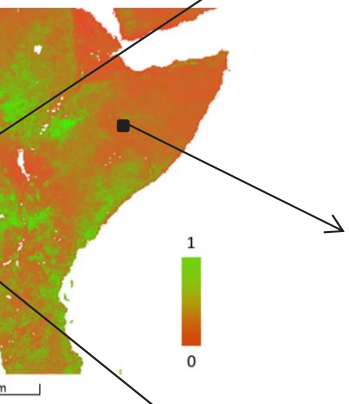
1

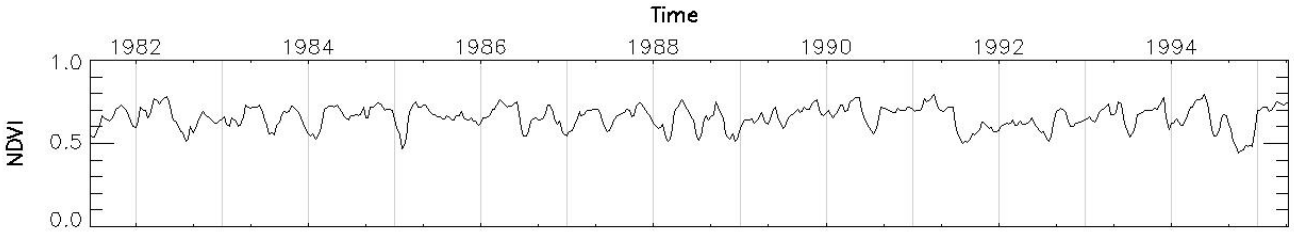
0

$$NDVI = \frac{Refl_{NIR} - Refl_R}{Refl_{NIR} + Refl_R}$$

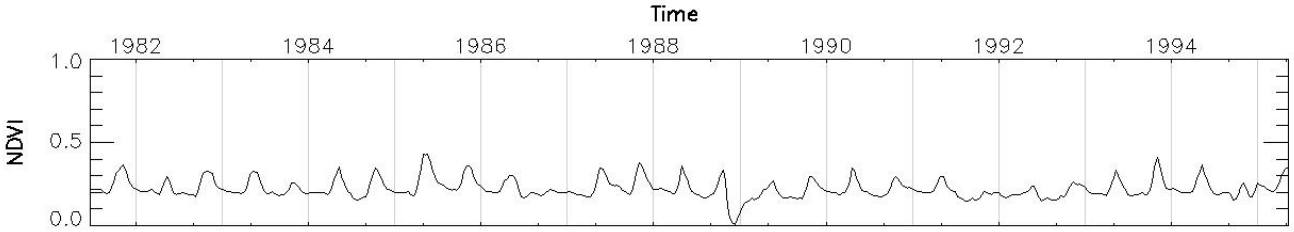
nage data

Temporal changes in vegetation cover

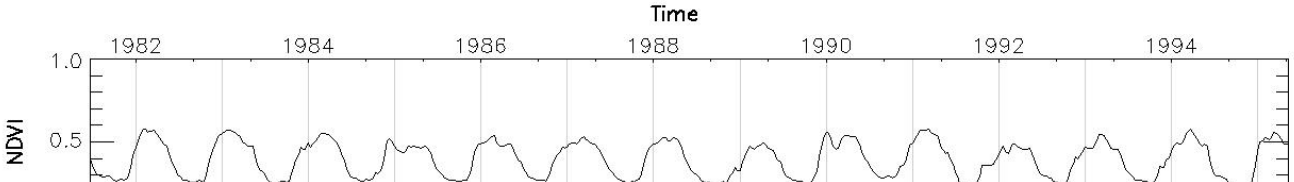




NW DR Congo (humid conditions, tropical evergreen forest vegetation)



E Ethopia (arid conditions, steppe vegetation)



ecific questions

Which time scales (other than the annual season) are present in long-term vegetation index time series ?

» Time series decomposition, analysis of periodicities

How do inter-annual climatic components behave over time ?

» Trend analysis of long-periodic components

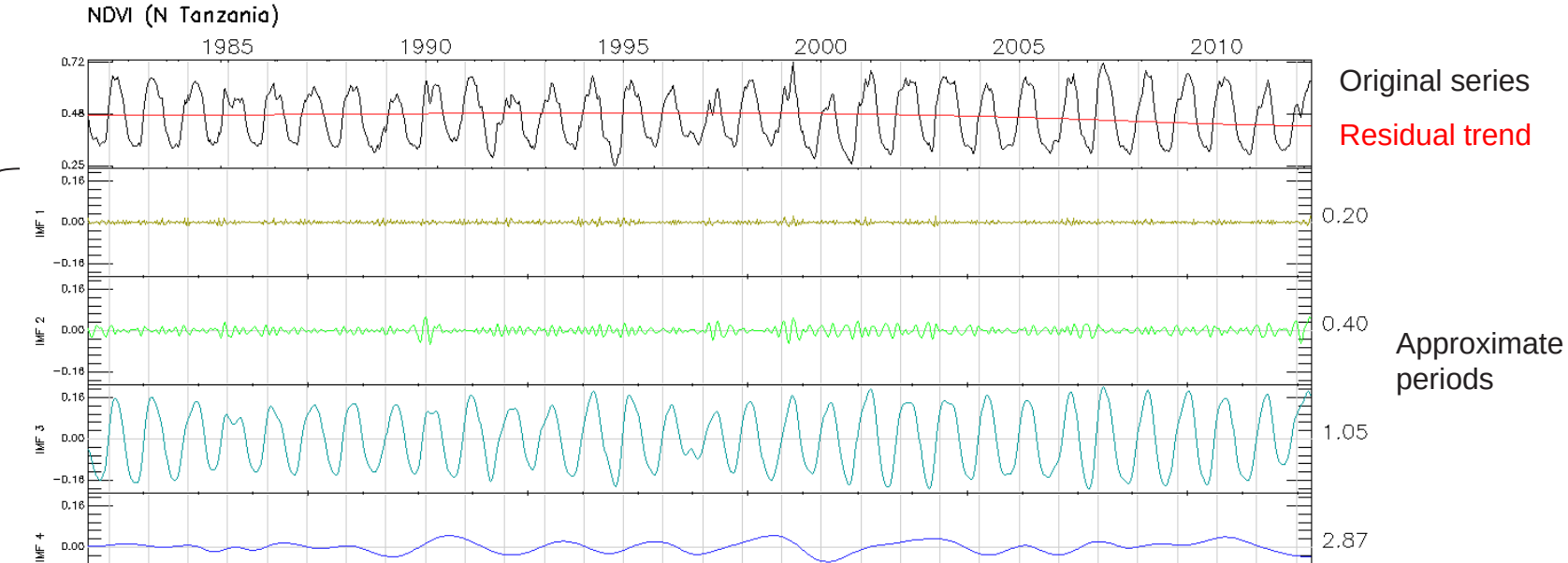
Are detected patterns related to other factors than climate variability ?

» Co-analysis with concurrent meteorological series

1. Detecting time scales: EMD method

Time series decomposition

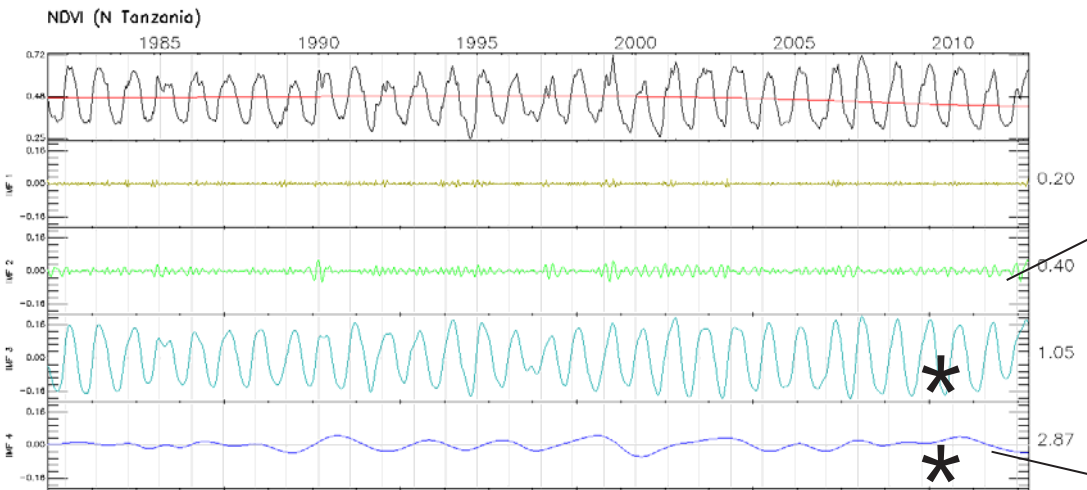
- Empirical Mode Decomposition (EMD)
- Identify intrinsic time scales of series, while keeping time dimension



1. Detecting time scales: EMD method

Significance test for components

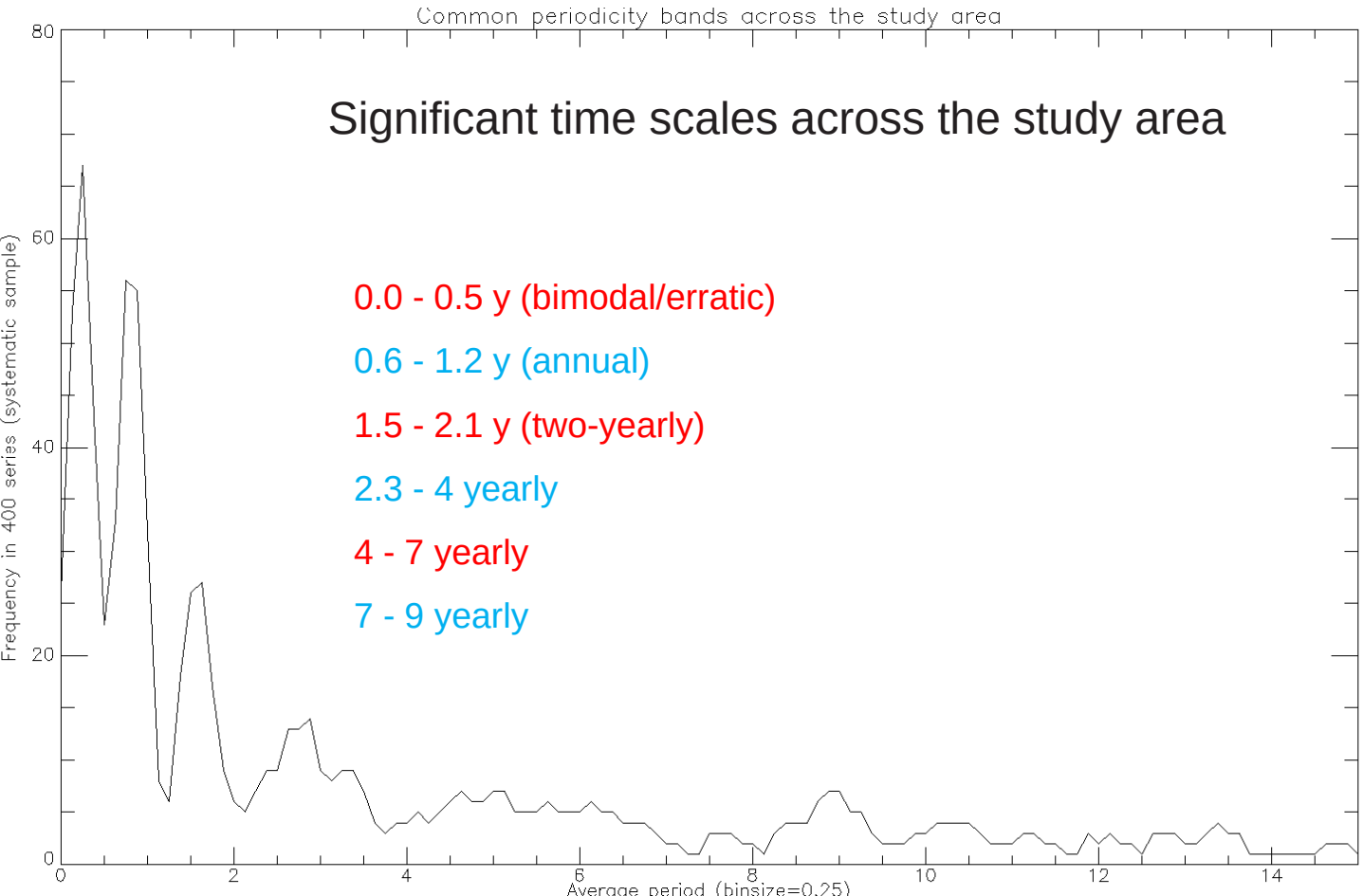
- Components have two properties: time-scale(T), amplitude/energy(E)
- Calibrate with decomposition of normalized white noise
- Theoretical relationship: $\ln(E) = -\ln(T) \pm$ confidence limit
  (if beyond confidence limit -> component originates from real process)



high frequent, but low amplitude ~noise

larger time scale, rel.

1. Detecting time scales: results



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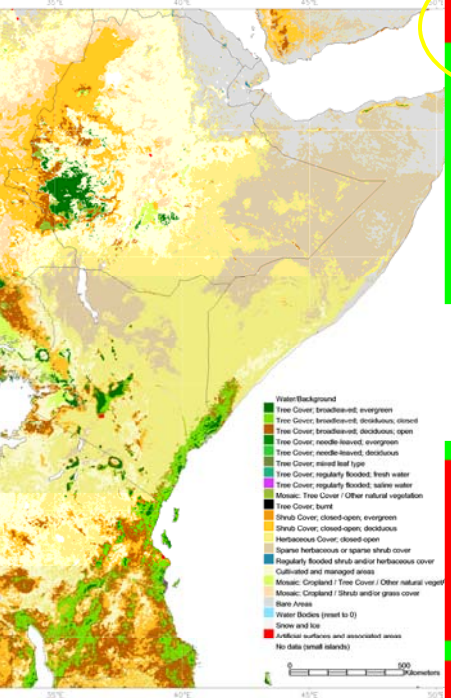
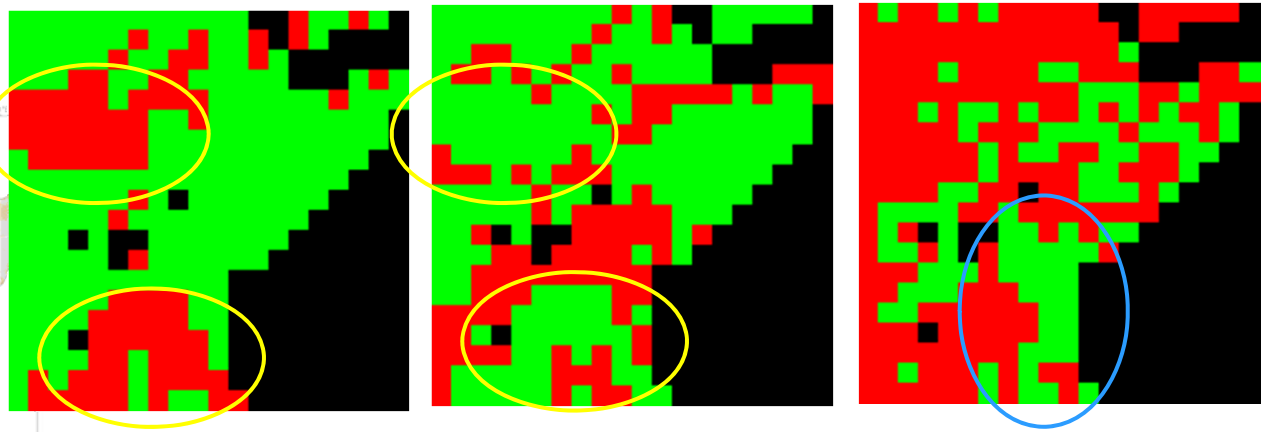


significant

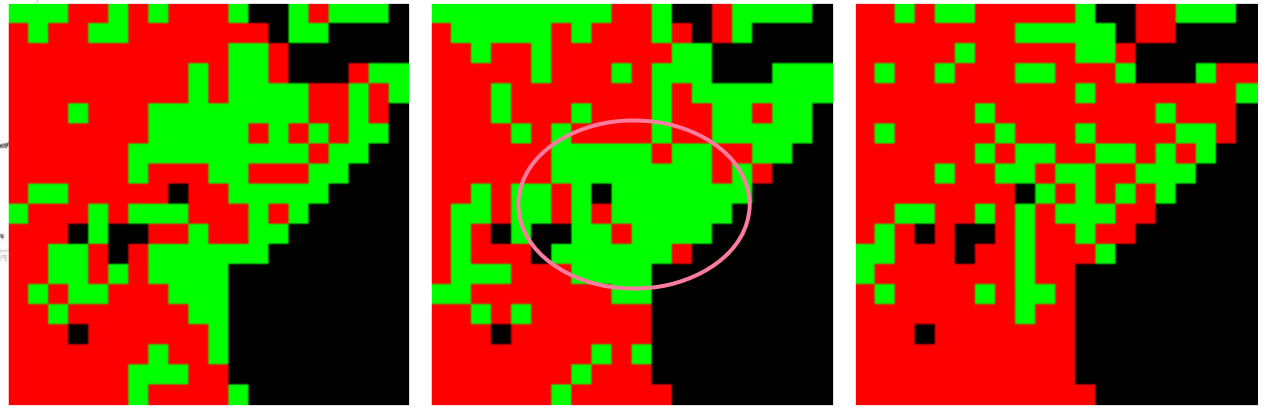
not significant



bi-modal/erratic

annual

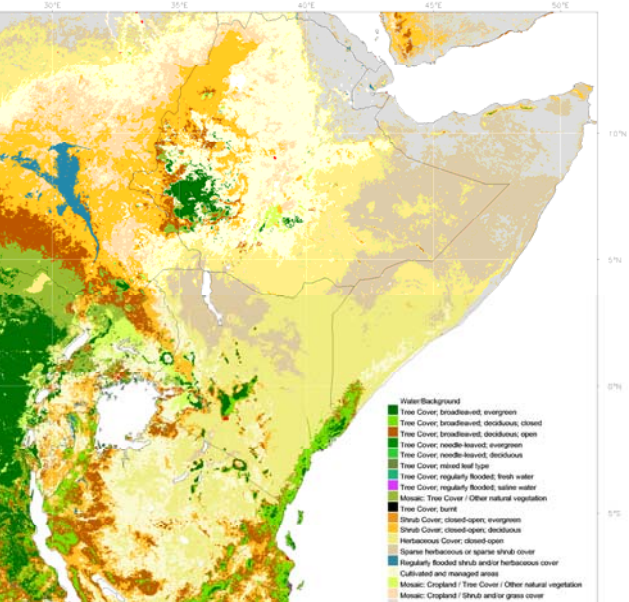
two-yearly



2. Intensity of inter-annual patterns over time

Trend estimation of component amplitude

Mann-Kendall test, Theil-Sen estimator



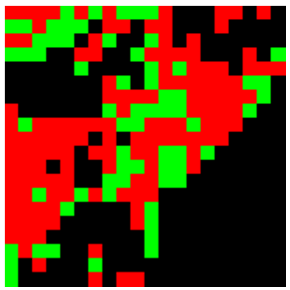
increasing Amp

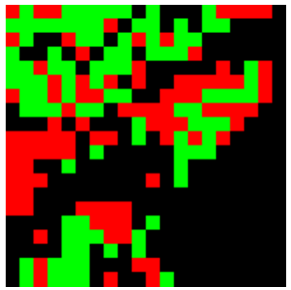
decreasing Amp

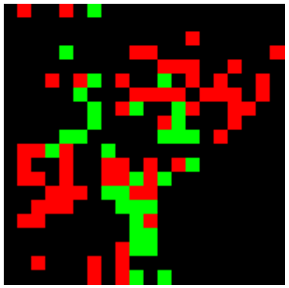
bi-modal/erratic

annual

two-yearly



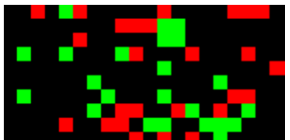




2-4 yearly

4-7 yearly

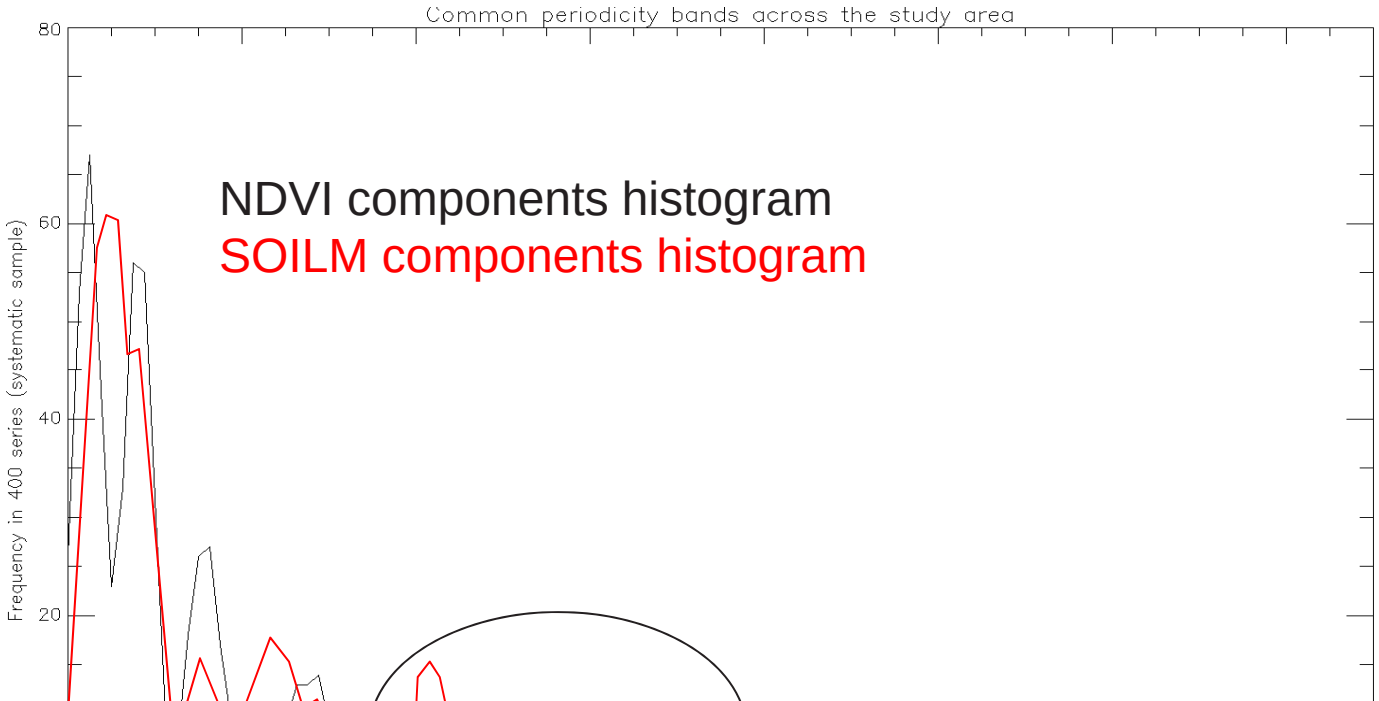
7-10 yearly



3. Attribute patterns to climate variability?

Soil moisture as explanatory variable

GLDAS dataset: data-assimilation (in-situ input data+model interpolations)



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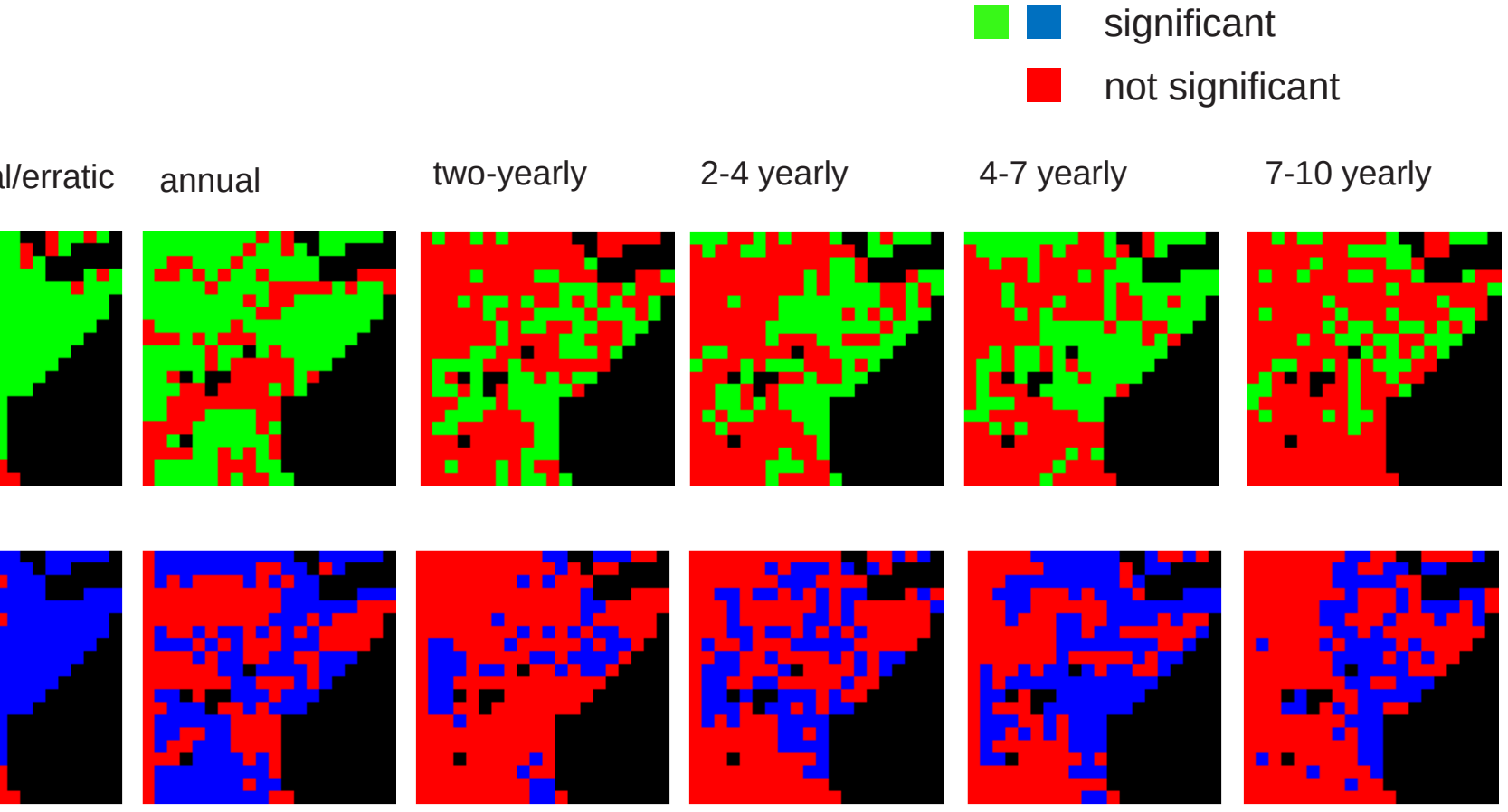

scussion

nterannual variability in vegetation greennes is most strongly detected in grassland ecosystems and deciduous woodlands with oceanic influence

Most evidence for increasing inter-annual variability is found for the 4 to 7 yearly cycle

This time scale in vegetation greenness tends to be most strongly coupled to climatic variability, approximated by soil moisture content

The contrast in precipitation between wet and dry regions and between wet and dry seasons will increase, although there may be regional exceptions.

(…) Due to the increase in moisture availability, ENSO-related precipitation variability on regional scales will likely intensify.

rther scope

- More detailed spatial analysis along principal gradients
- Coupling of trends in NDVI and Soil Moisture Content
- Detection of abrupt changes (hydrological approach with sequential Mann-Kendall test, calibration needed)

uestions and comments