Interannual Land Surface Variability

Stephen D. Prince
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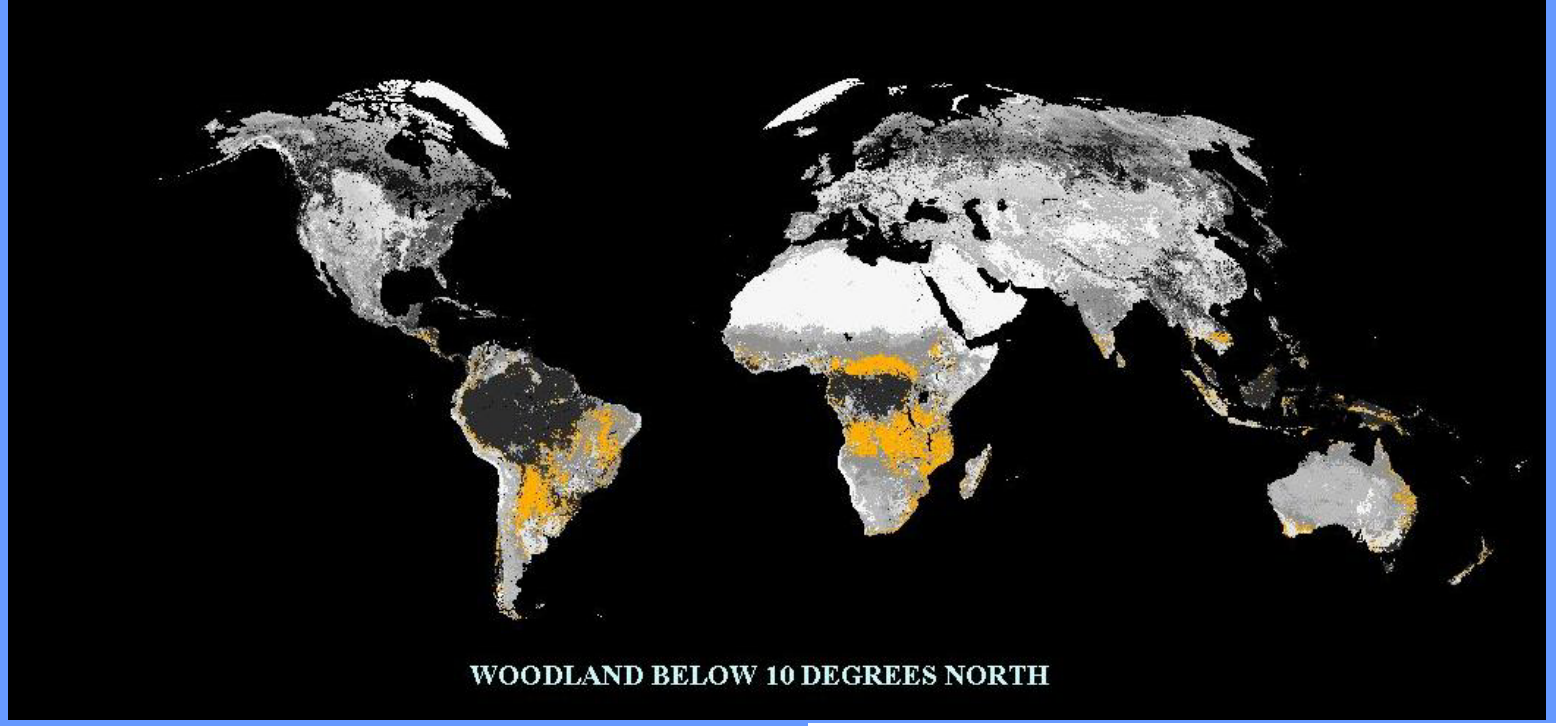
Jennifer Small
Daolan Zheng
Lisa Ojanen
Inbal Reshef

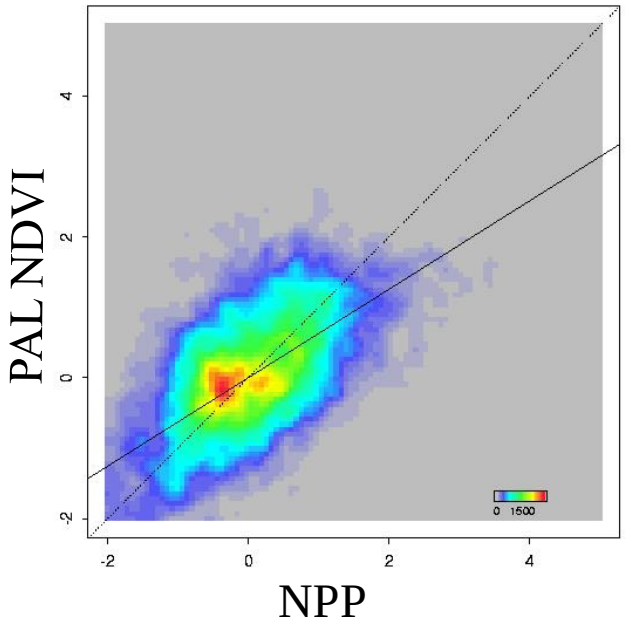


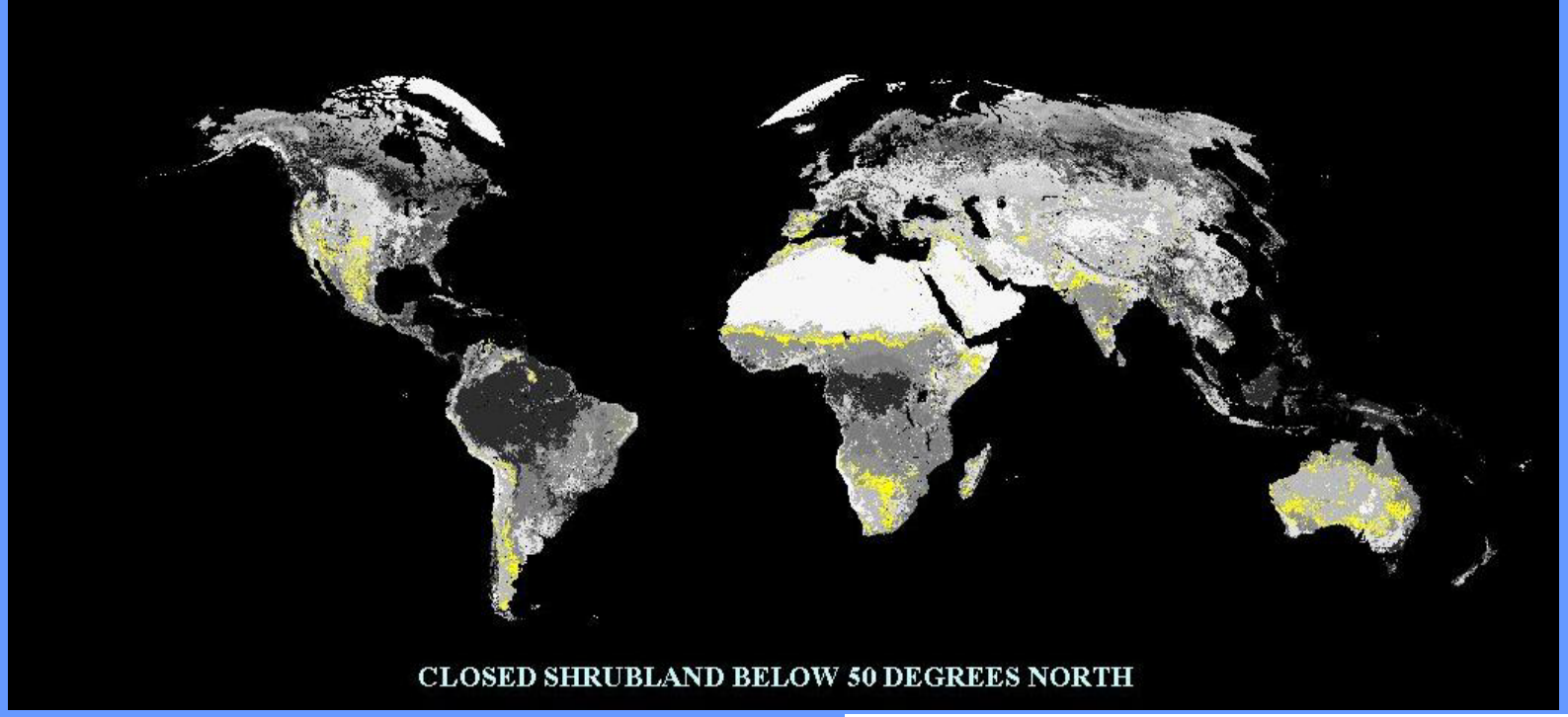
WOODLAND ≤10 N

Centered and standardized (N-mean/std dev)

Dotted line = 1:1 line,

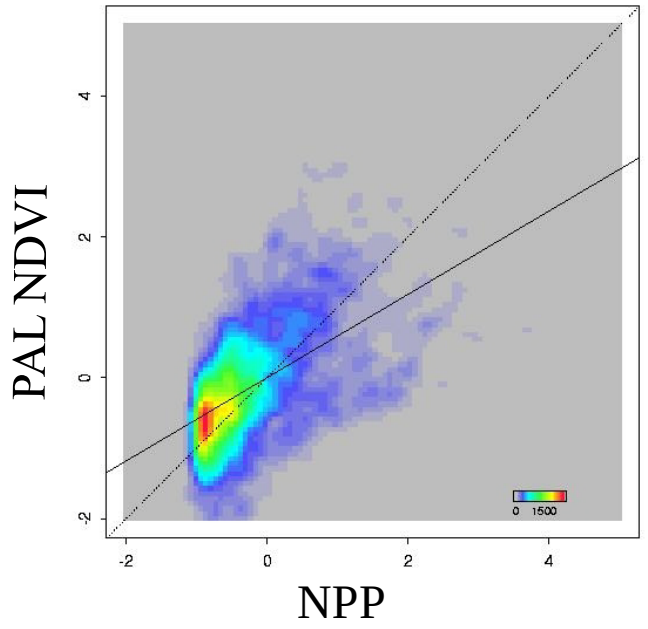
Solid line = linear regression line

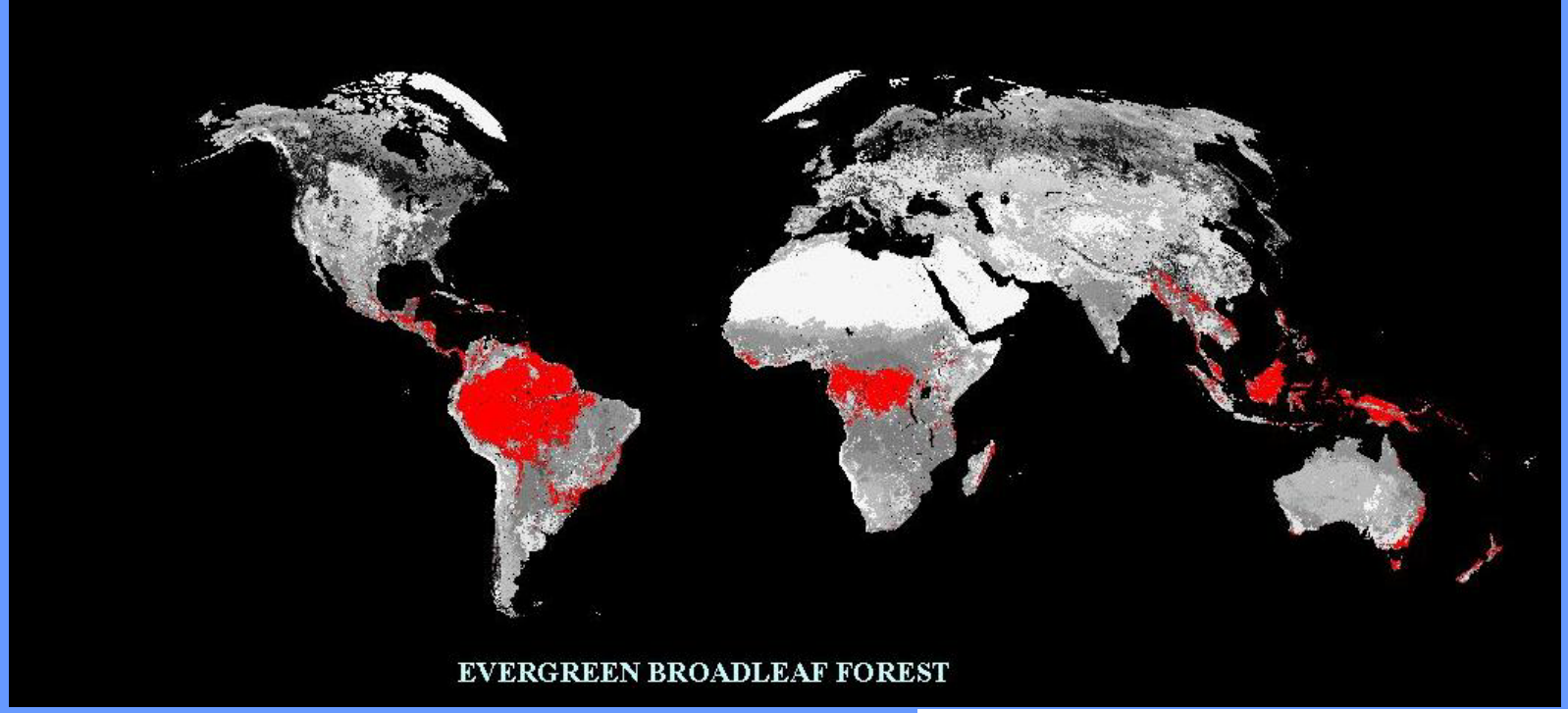




CLOSED SHRUBLAND < 50°N

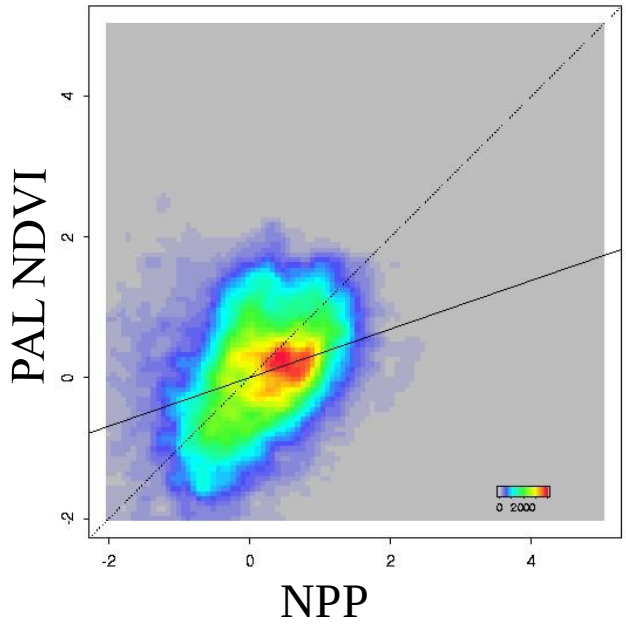
Centered and standardized
(N-mean/std dev)
Dotted line = 1:1 line,
Solid line = linear regression line

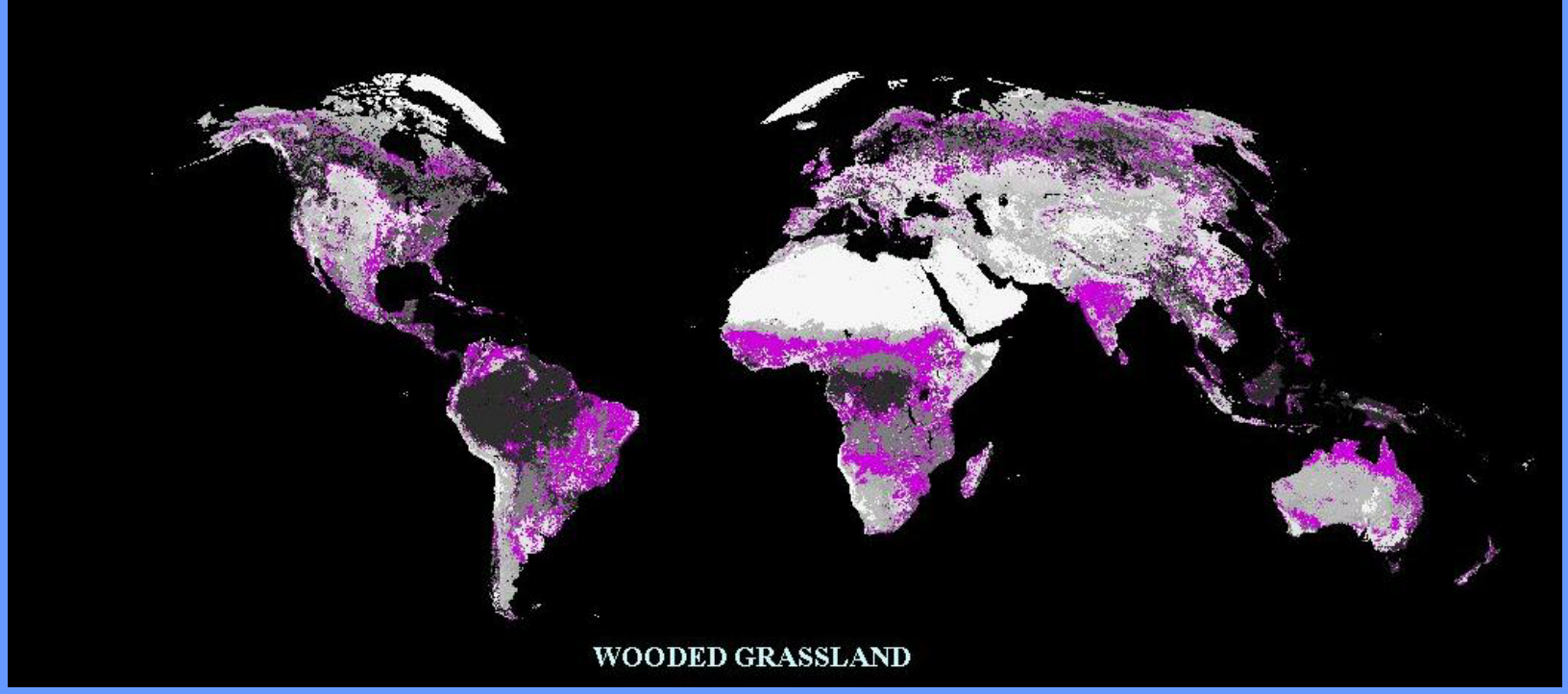




EVERGREEN BROADLEAF FOREST

Centered and standardized
(N-mean/std dev)
Dotted line = 1:1 line,
Solid line = linear regression line



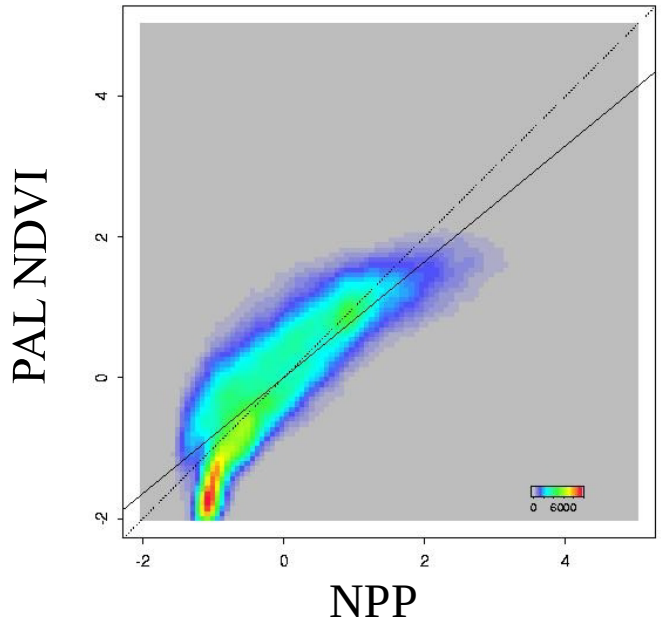


WOODED GRASSLAND

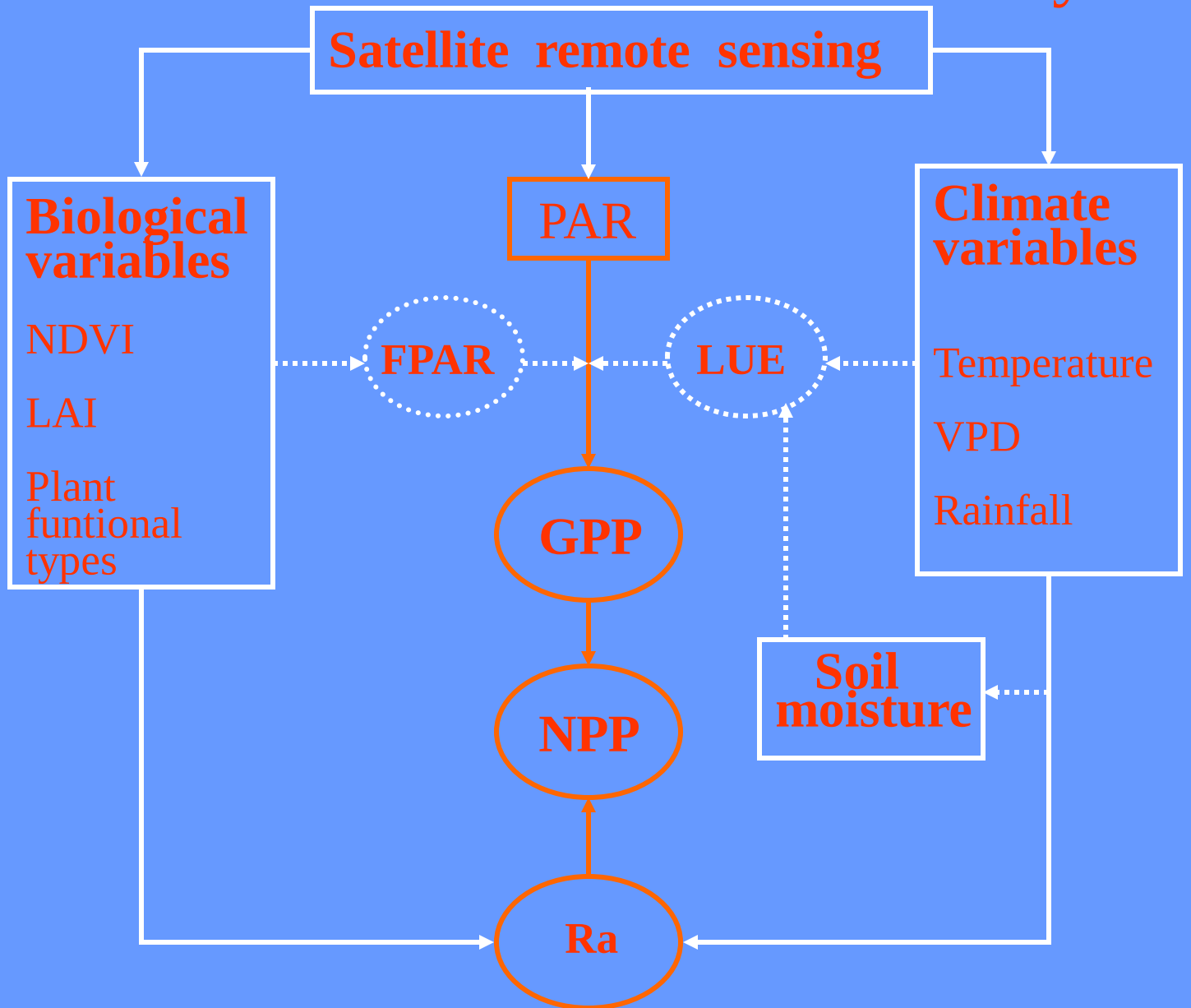
Centered and standardized (N-mean/std dev)

Dotted line = 1:1 line,

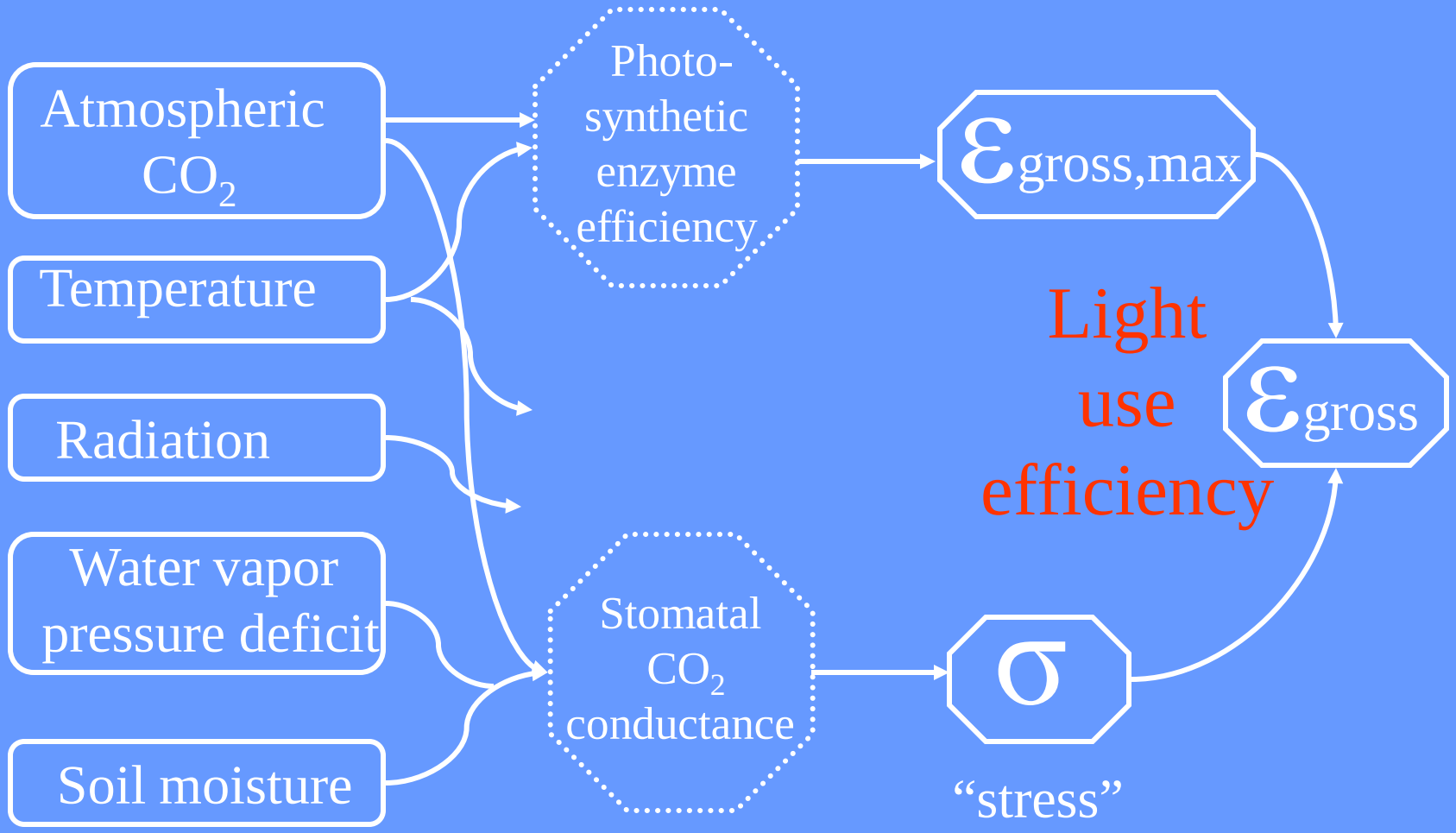
Solid line = linear regression line



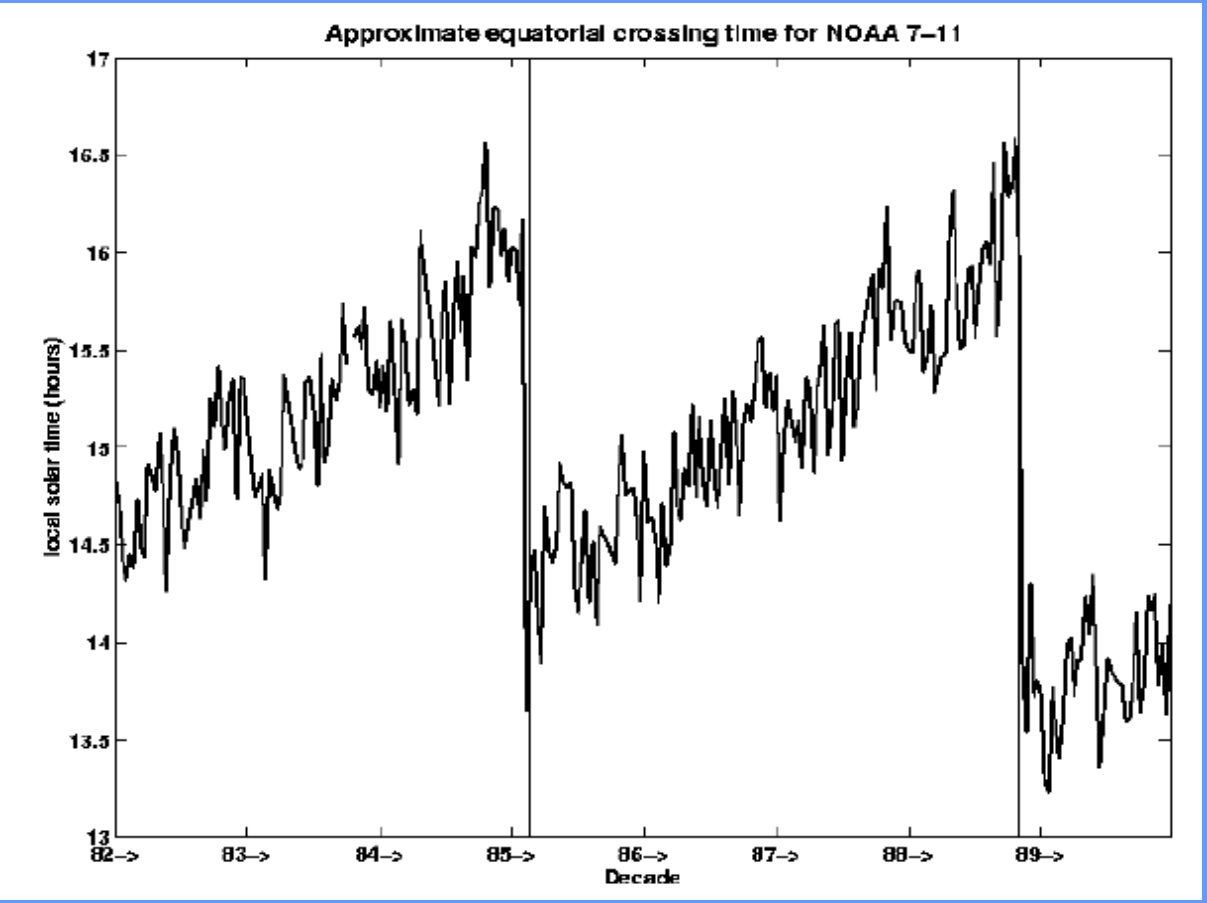
GLO-PEM:
A Satellite-Driven Production Efficiency Model



Determination of Light Use Efficiency in GLO-PEM

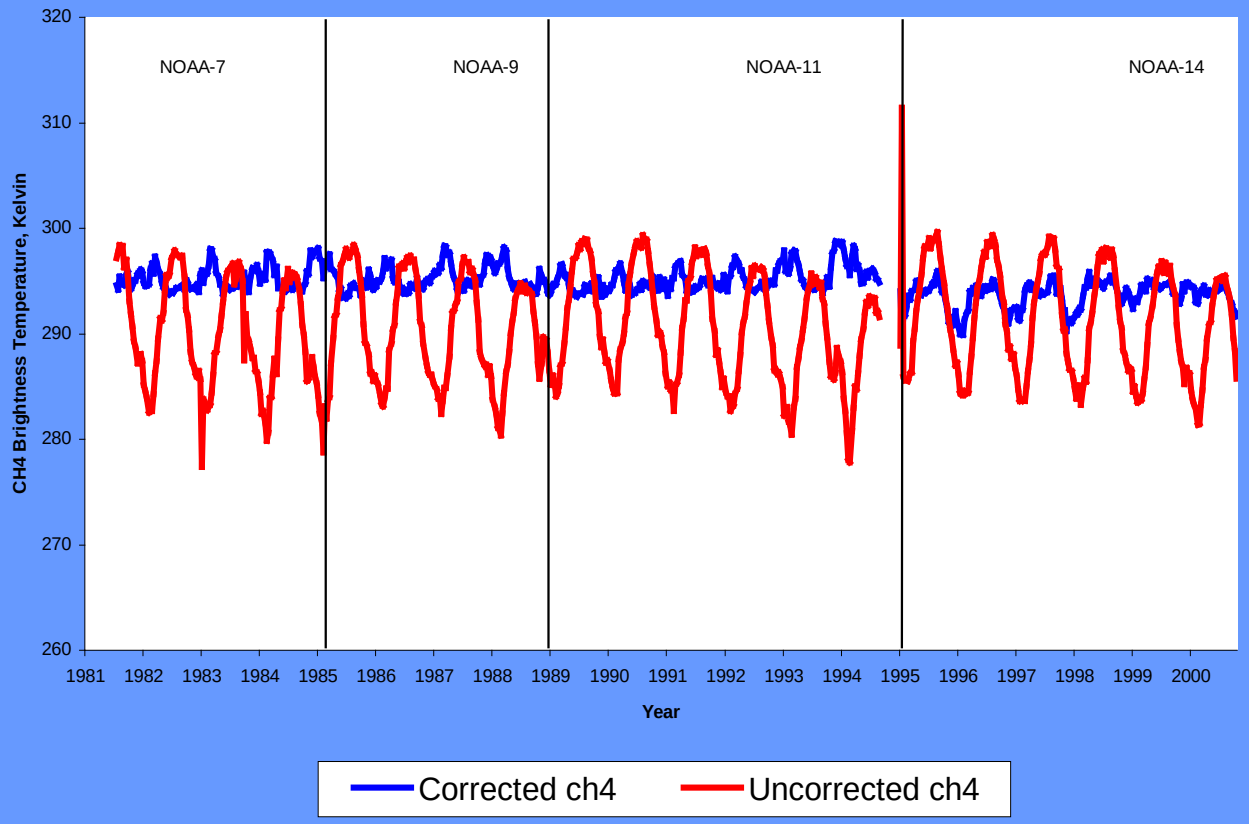


Orbital drift within and among satellite platforms



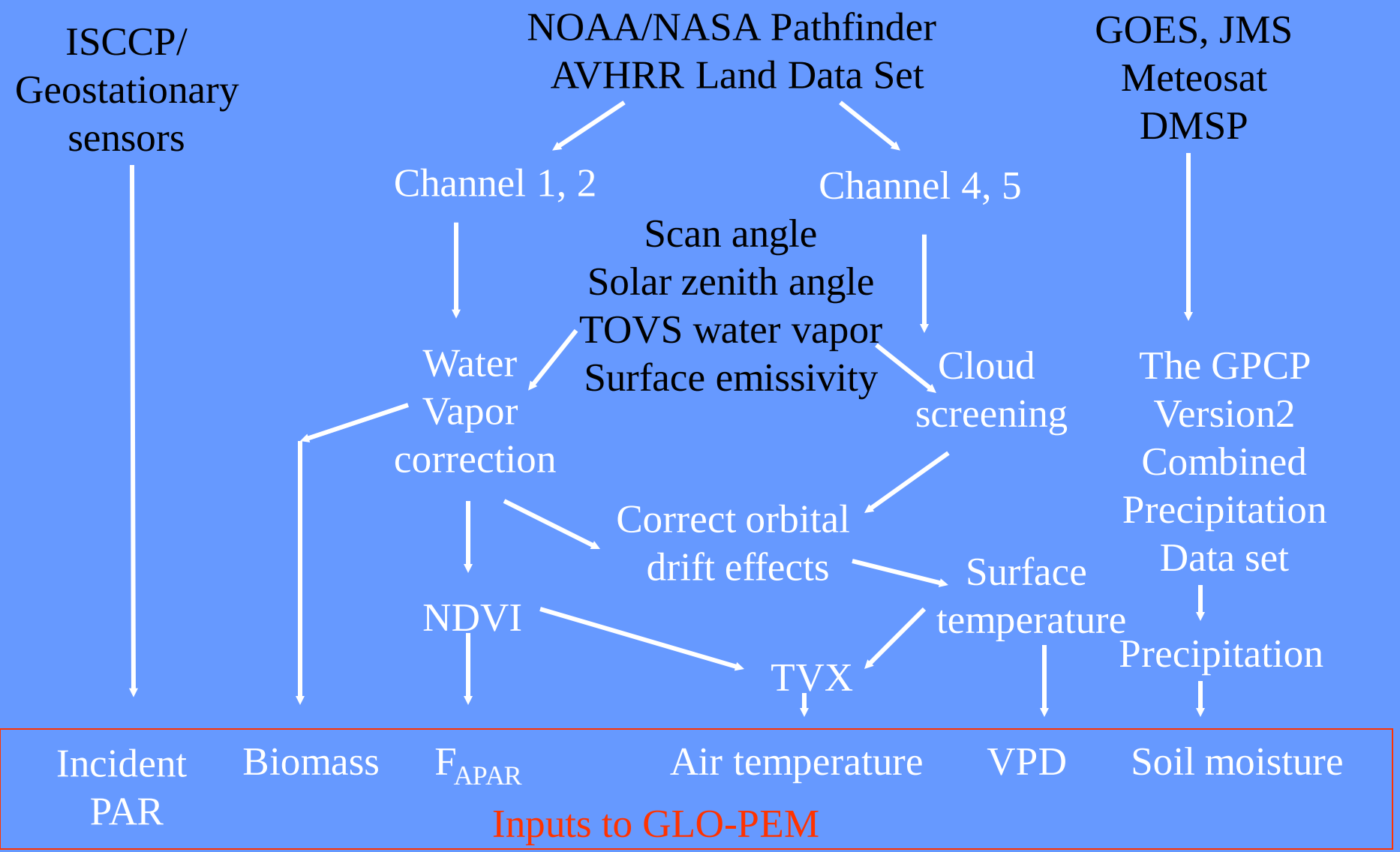
The changes in the equatorial acquisition time of the NOAA satellite platforms

Correction for satellite orbital drift effects

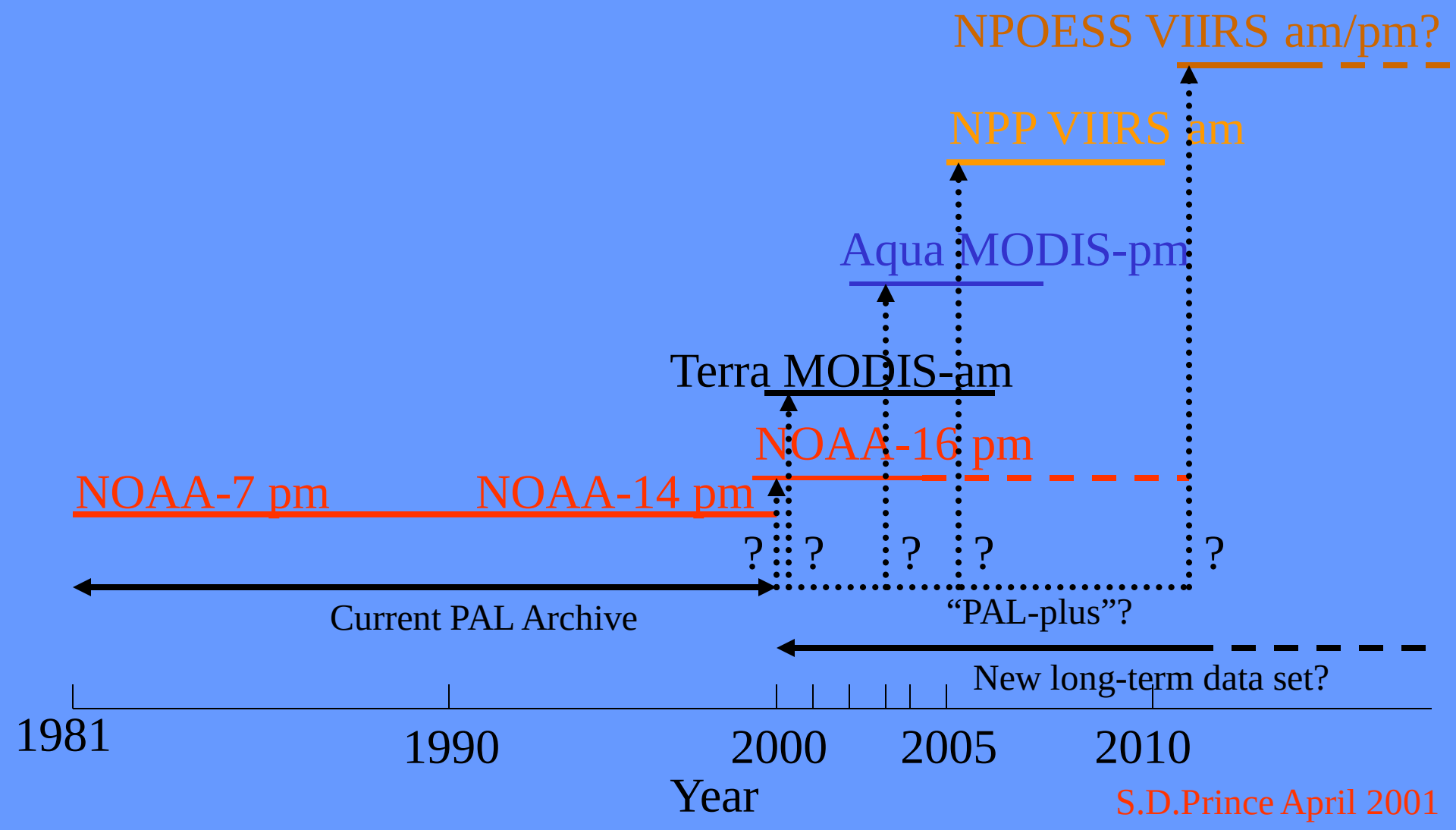


GLO-PEM has a thermal correction algorithm, and therefore can produce temporally consistent estimates using multiyear AVHRR data

Satellite data inputs for GLO-PEM

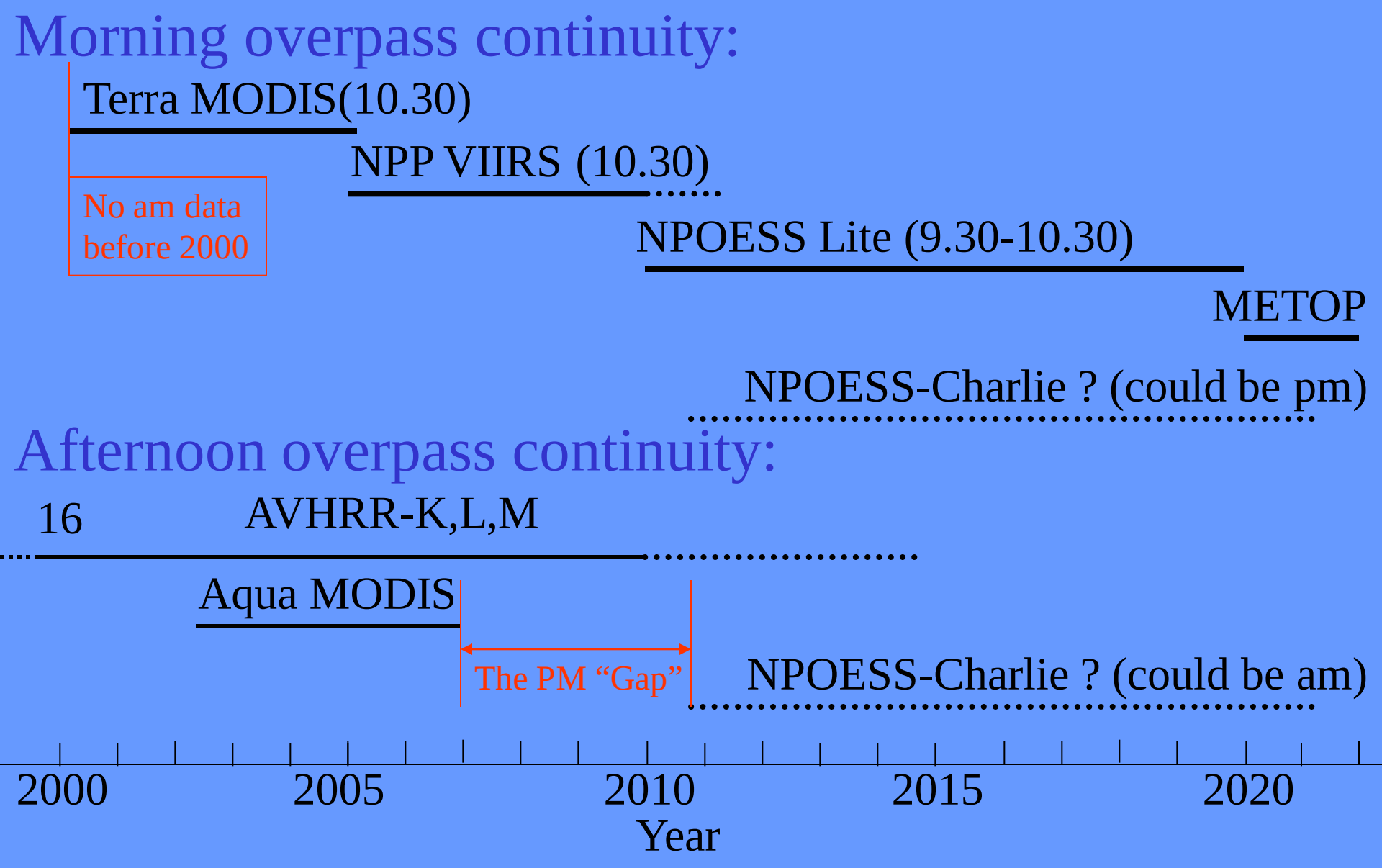


Continuity of the long-term global terrestrial satellite data set

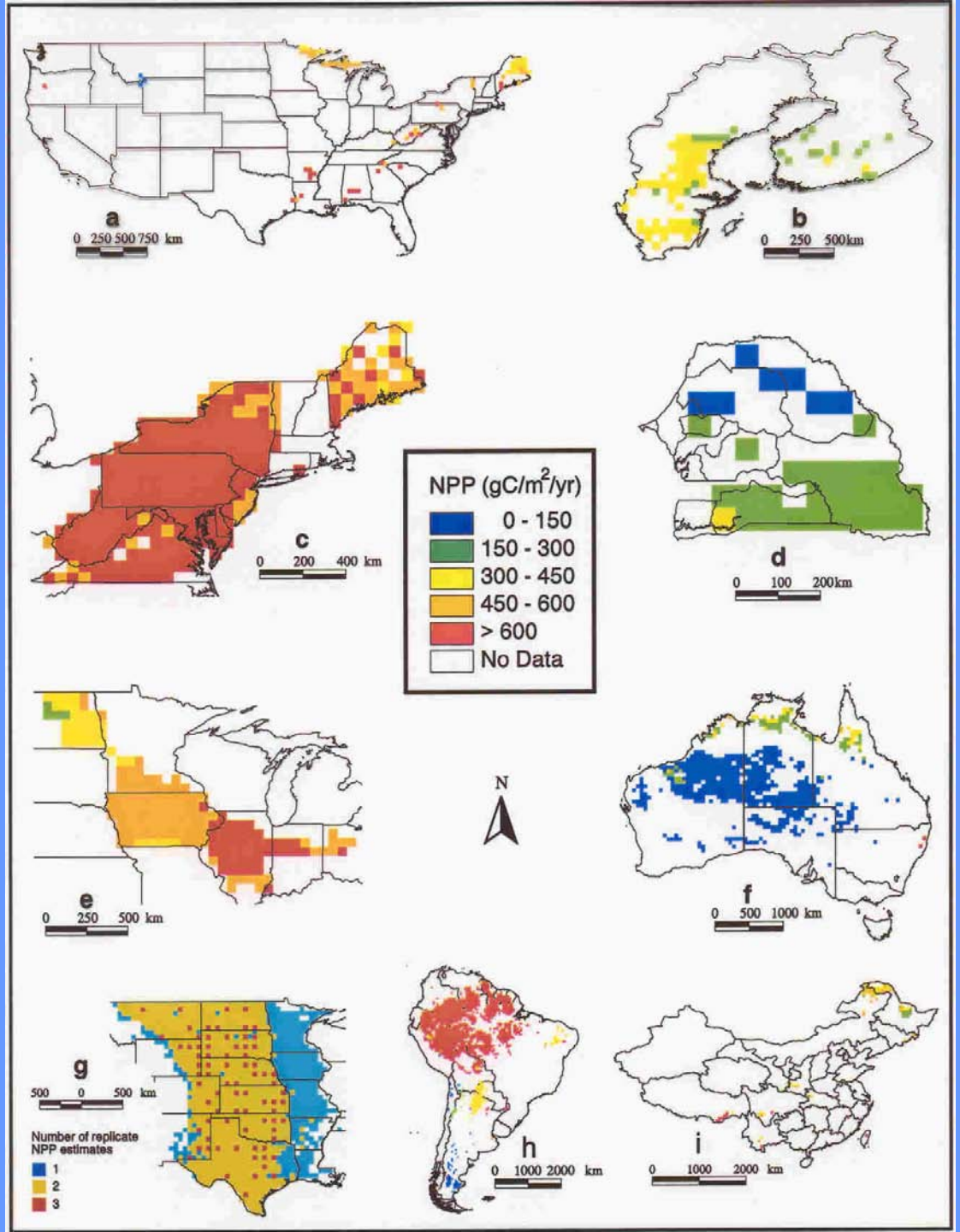


S.D.Prince April 2001

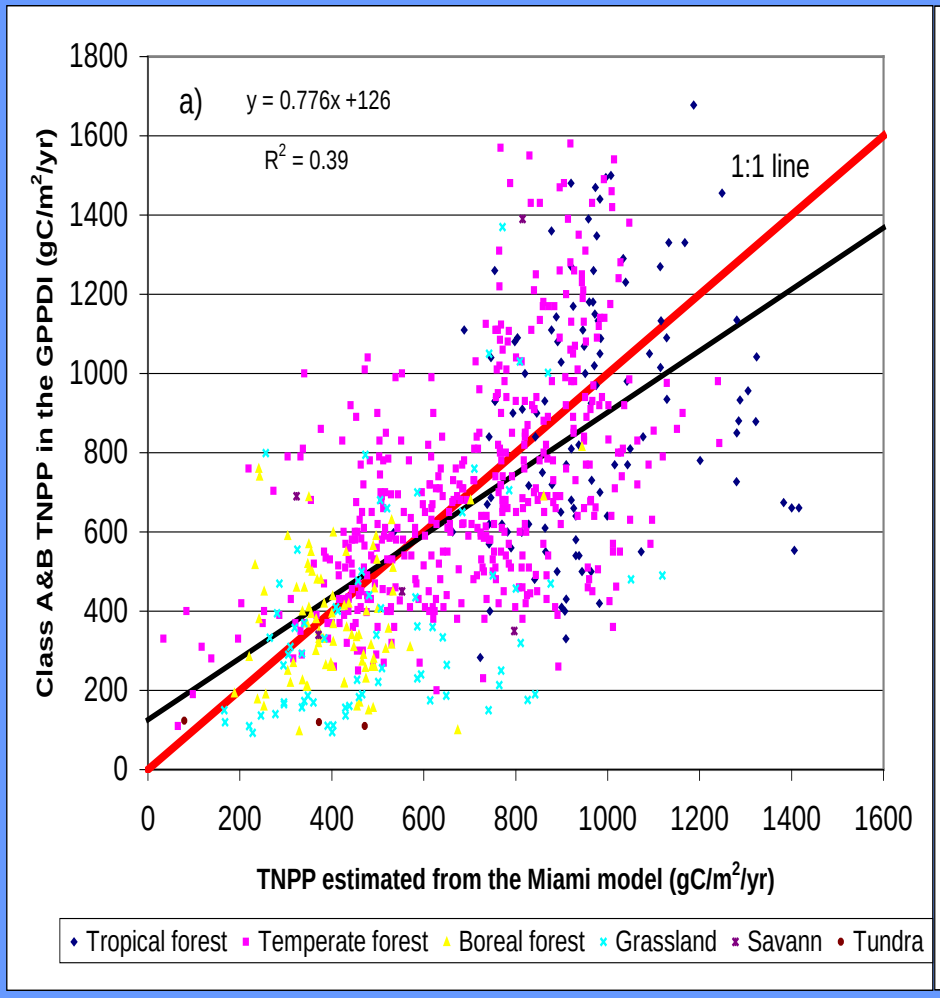
Continuity of the long-term global terrestrial satellite data set

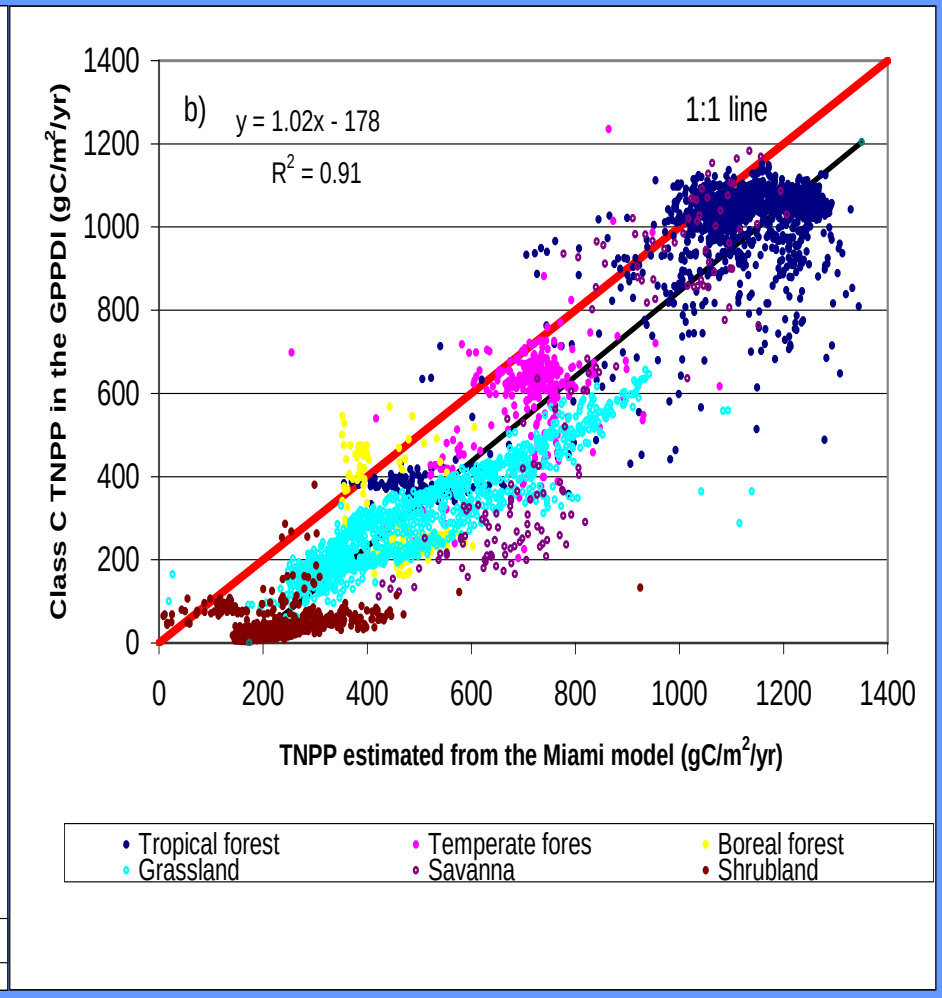


IGBP-DIS Global Primary Production Data Initiative (GPPDI) 0.5 x 0.5 grid cell locations

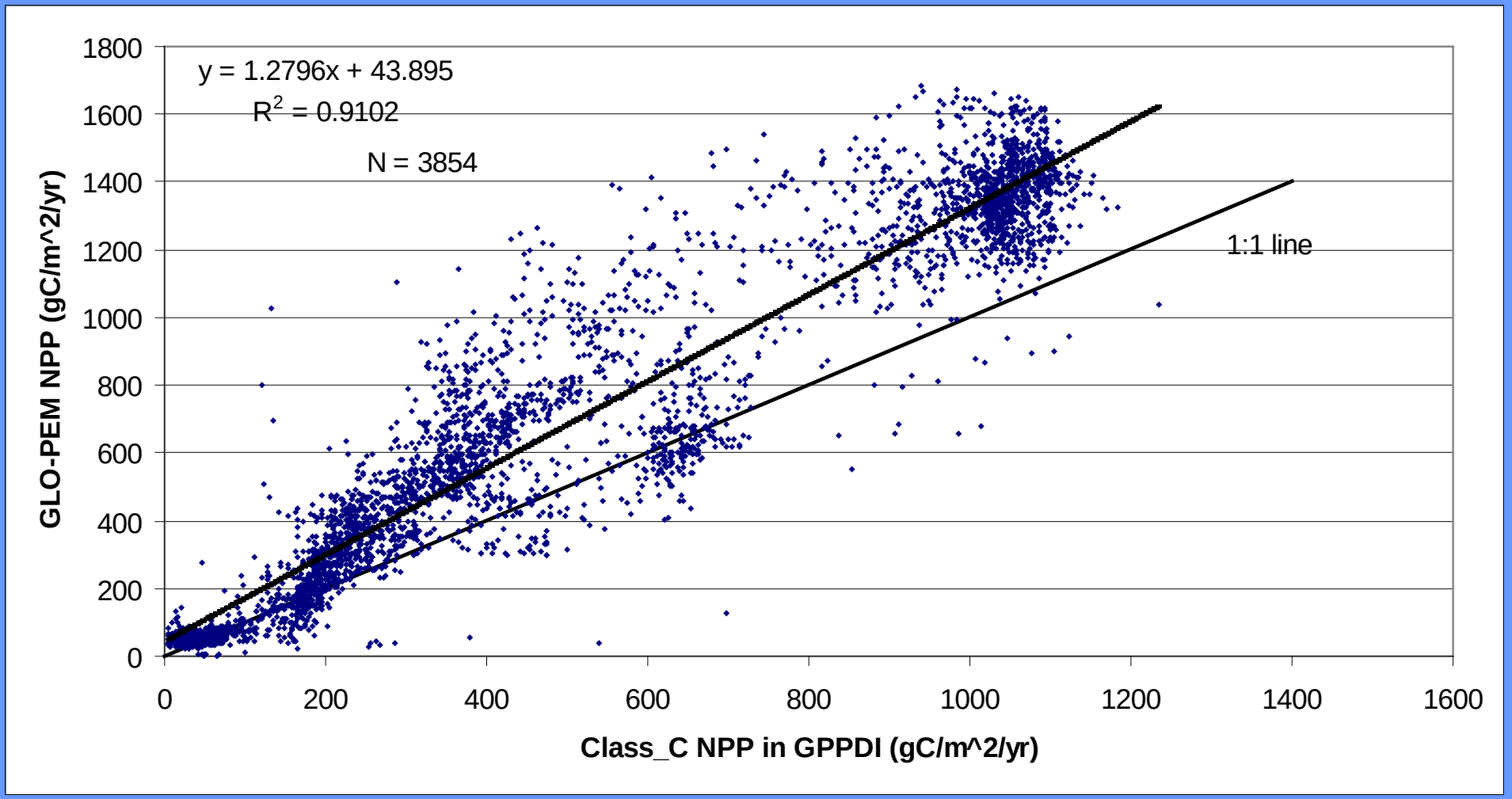


Comparison between field point and 0.5 grid-cell NPP data (GPPDI) and Miami Model NPP estimates

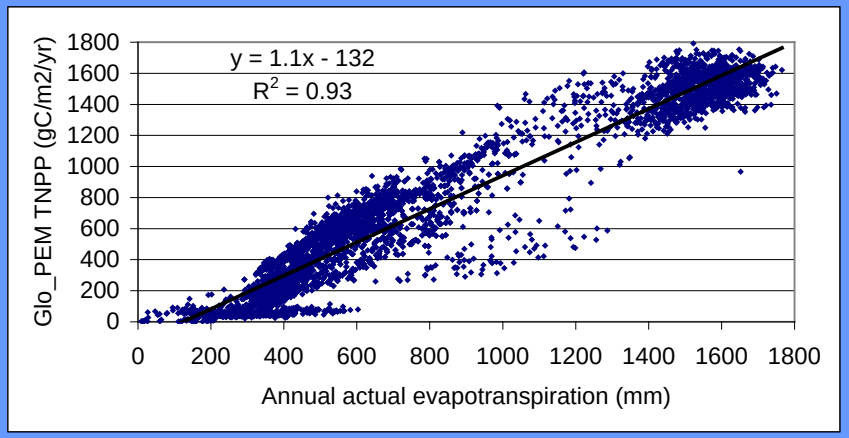




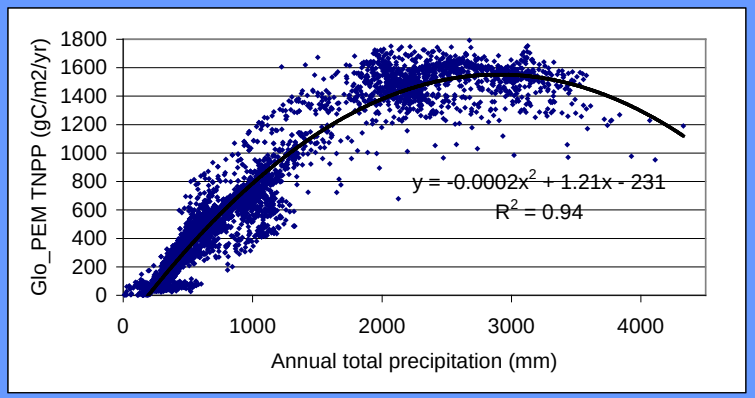
Validation of GLO-PEM NPP simulations using 0.5 degree field estimates



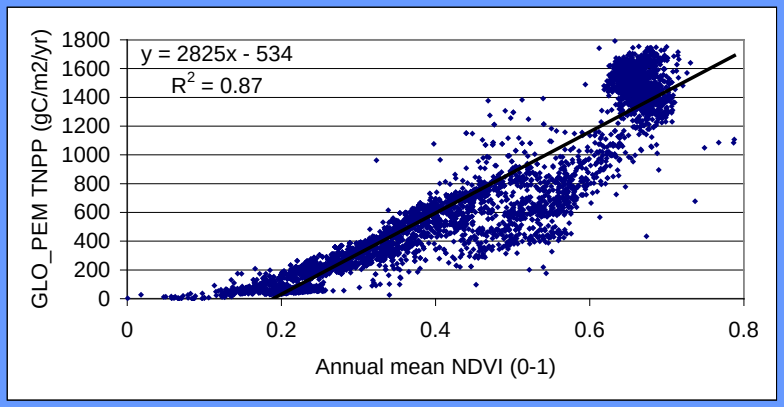
http://www.geog.umd.edu/glopem/



GLO-PEM & AET



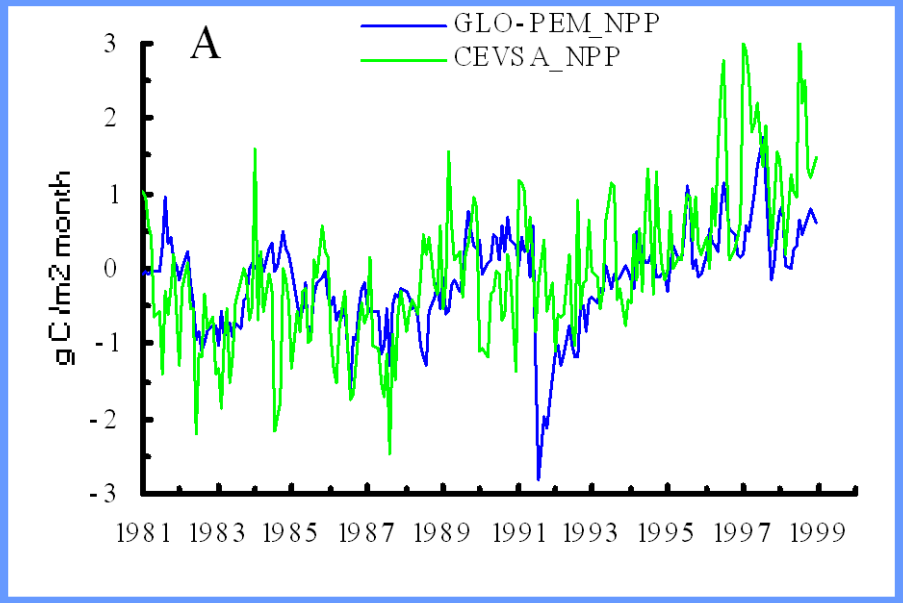
GLO-PEM & PPT



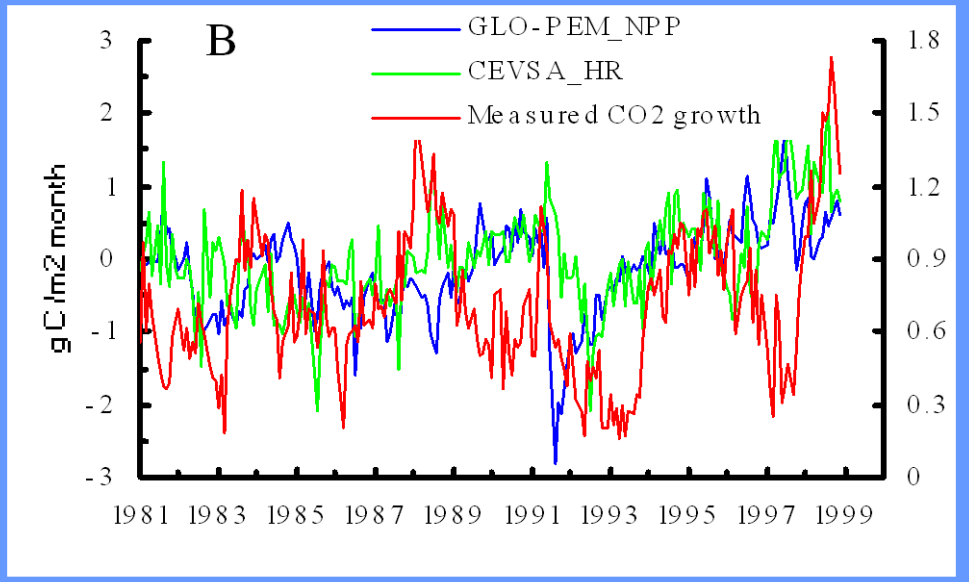
GLO-PEM & NDVI

Comparison with other models

Anomalies in global mean NPP estimated with GLO-PEM and CEVSA



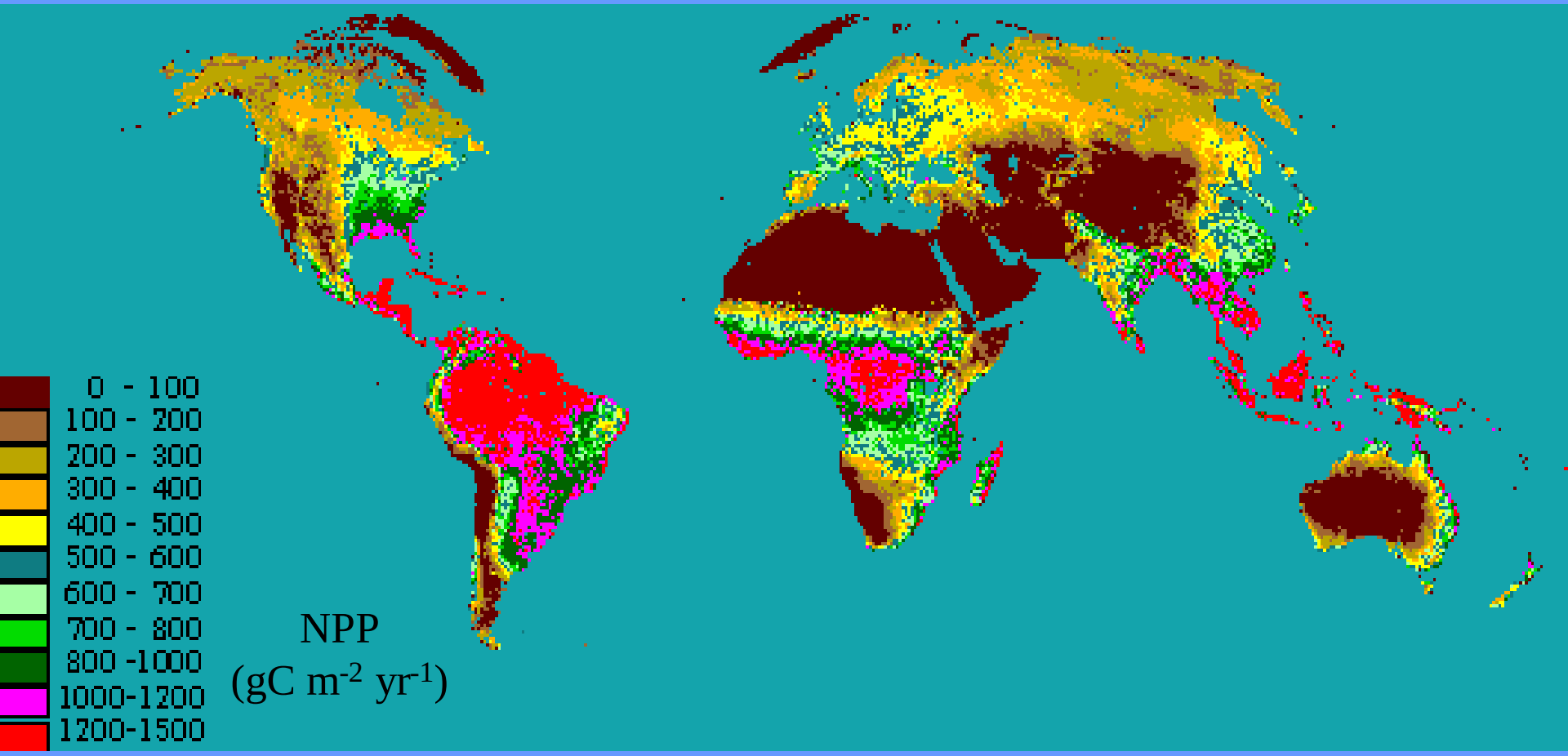
Anomalies in global mean NPP with GLO-PEM,
Measured growth rates of atmospheric CO_2 ,
Heterotrophic respiration (HR) from CEVSA.



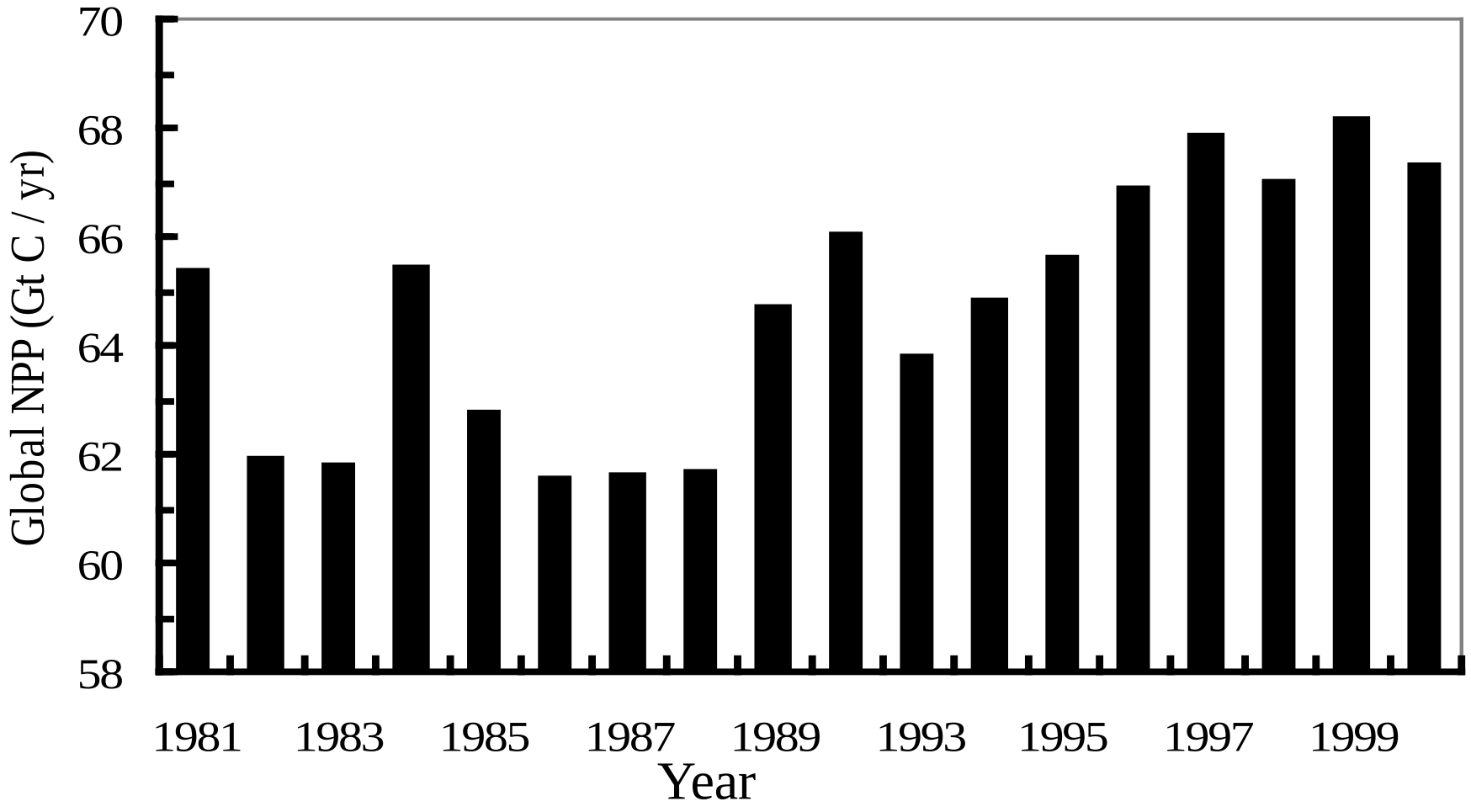
Interannual variability and trend in global terrestrial net primaryproductivity: satellite analysis 1980-2000

M. Cao, S.D. Prince, J. Small, S.J. Goetz. Department of Geography, University of Maryland

Mean annual NPP (1981-2000) estimated with GLO-PEM at 8km resolution



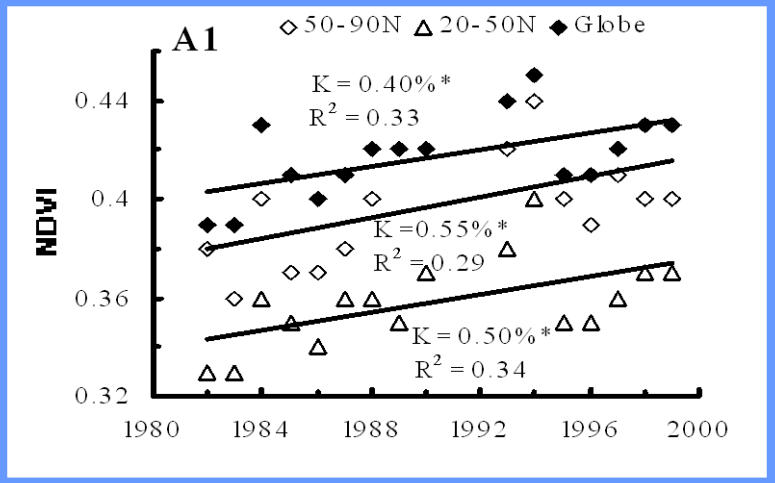
Inter-annual variation in global total NPP Gt C/ yr

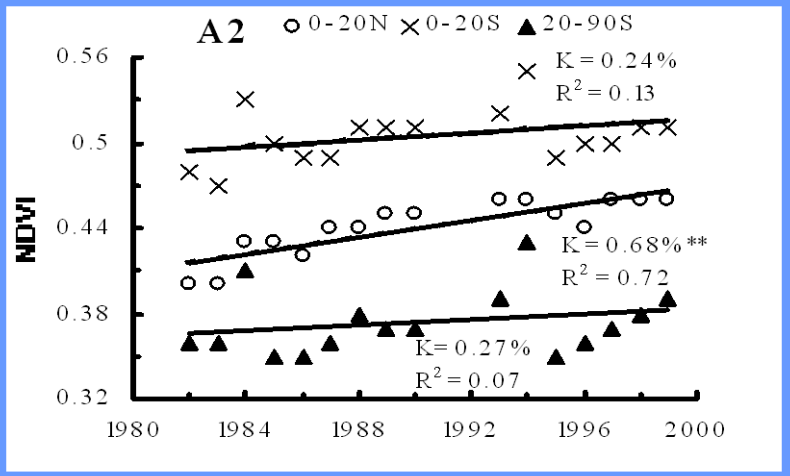


Interannual trends in mean land NDVI and in total land NPP

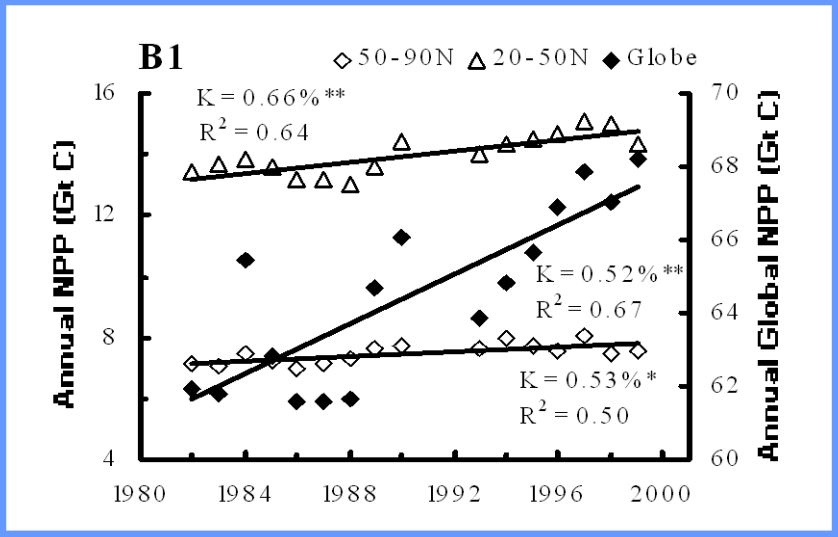
Annual growth rate K, significance * 95%,** 99%. 1991-92 omitted because of the Mount Pinatubo eruption.

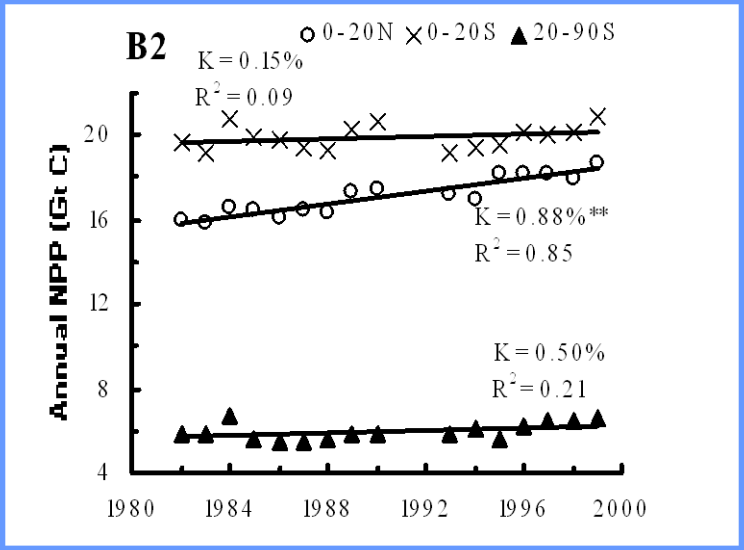
Trends in mean land NDVI





Trends in total land NPP

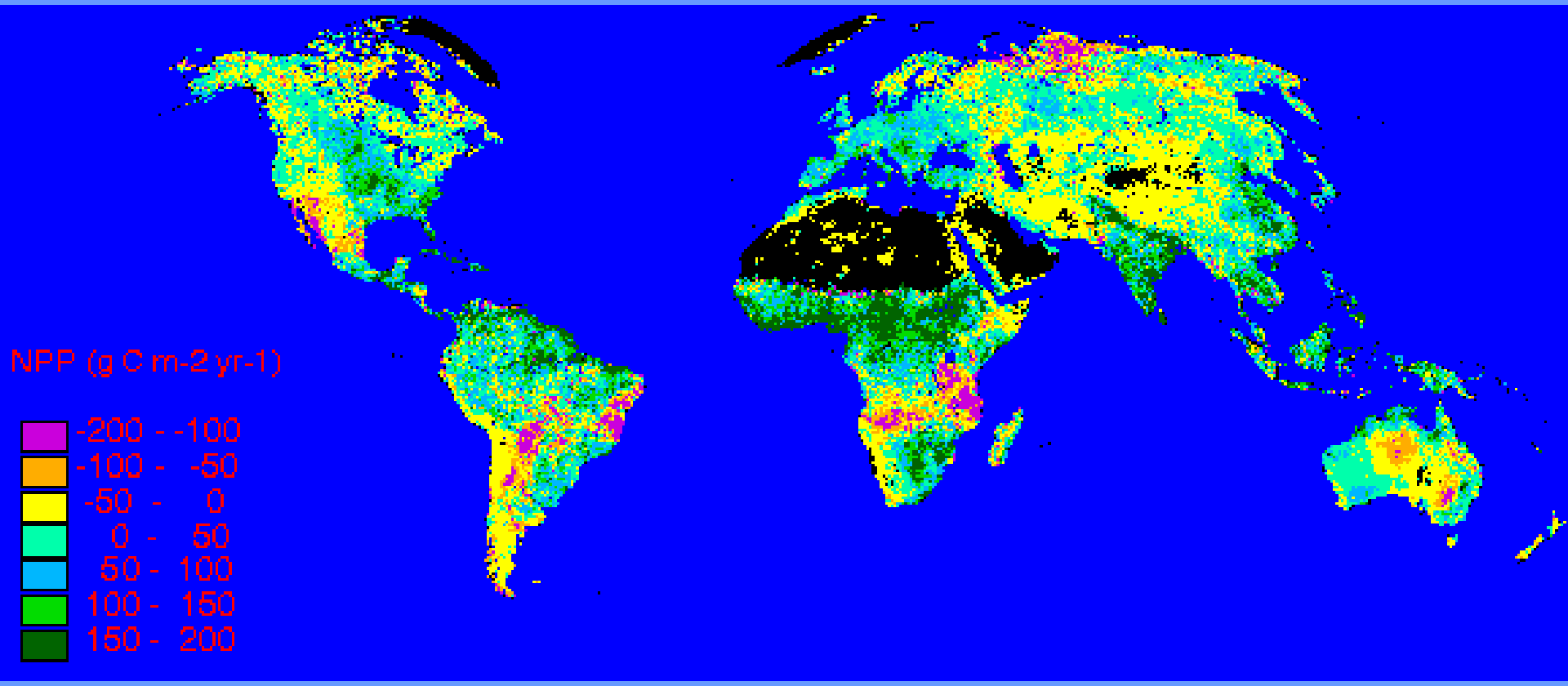




Interannual variability and trend in global terrestrial net primaryproductivity: satellite analysis 1980-2000

M. Cao, S.D. Prince, J. Small, S.J. Goetz. Department of Geography, University of Maryland

GLO-PEM estimate of changes in annual NPP 1982-2000



Temporal changes in NPP for the globe and each hemisphere 1981-2000.

MEI is an indicator of the intensity of El Niño (+ve) and La Niña (-ve).
The 10-day anomaly is the deseasonalized change in NPP.
NPP anomalies in g C m^{-2} per 10 days.

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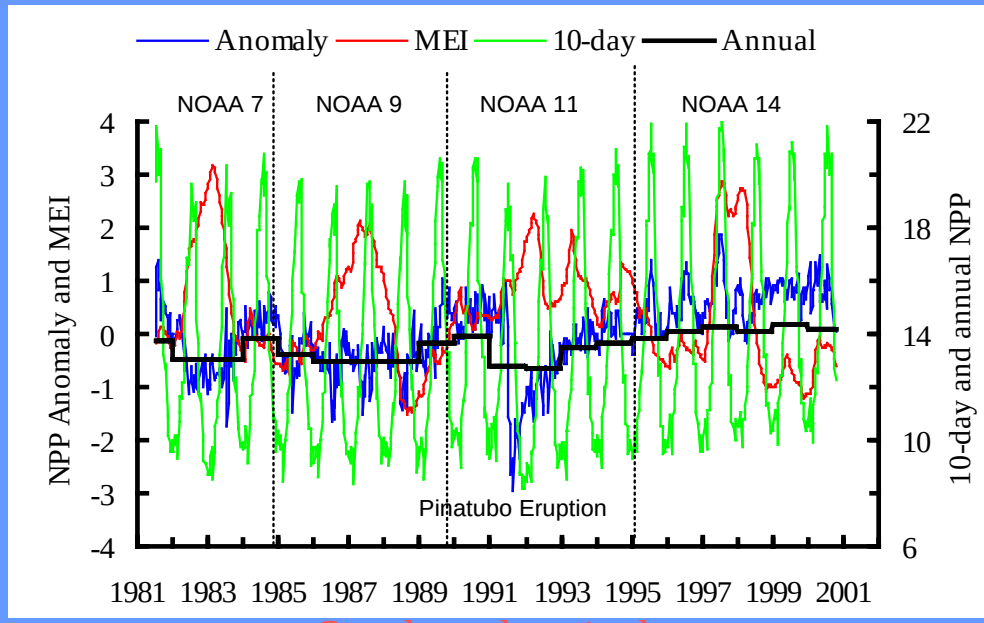
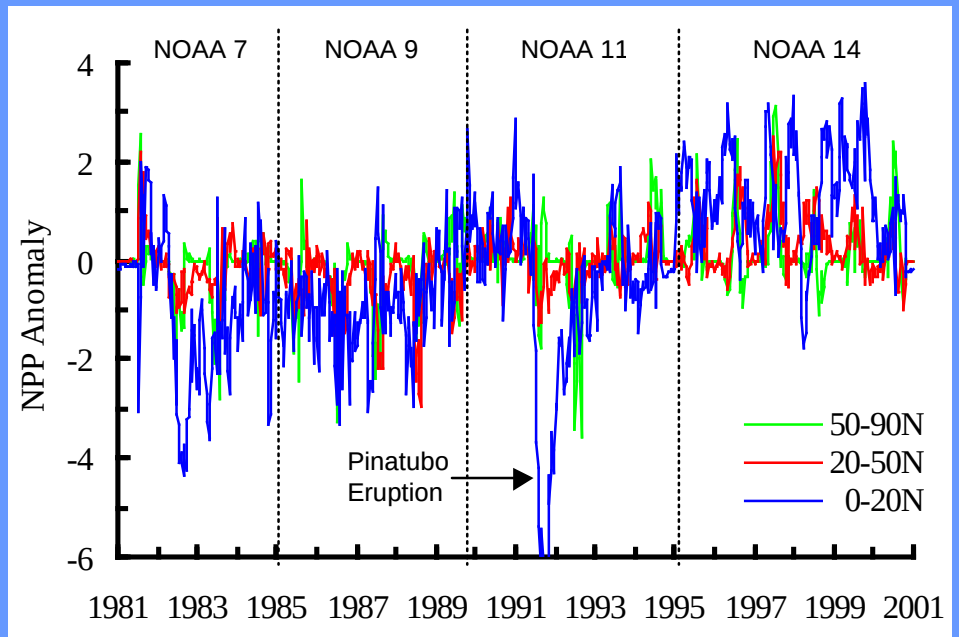
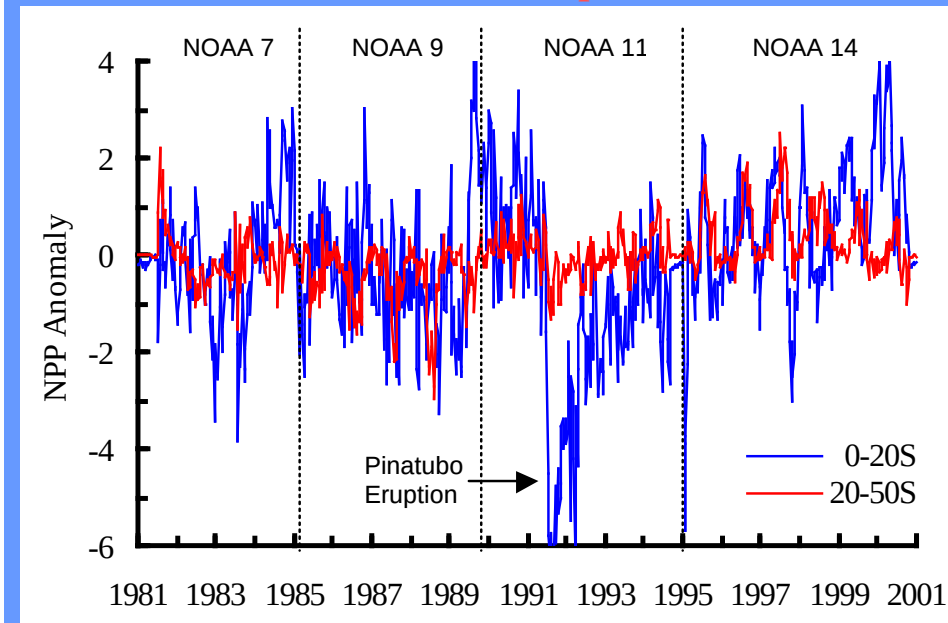
Global



Northern hemisphere



Southern hemisphere

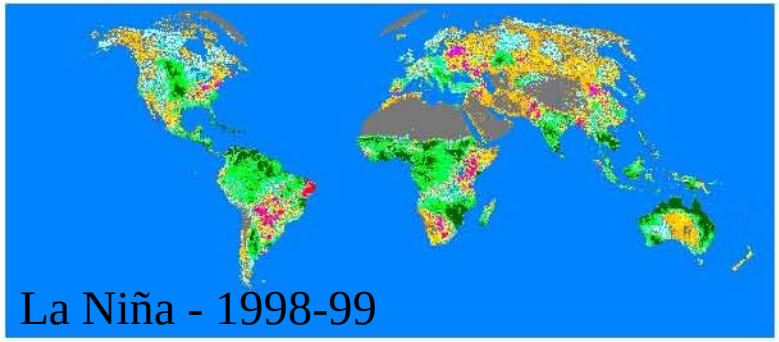


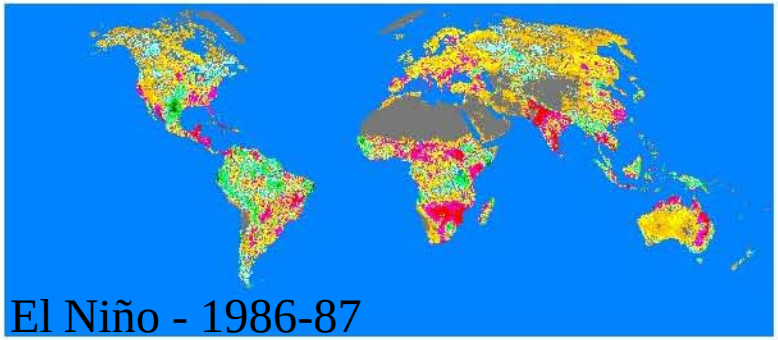
The responses of NPP to ENSO

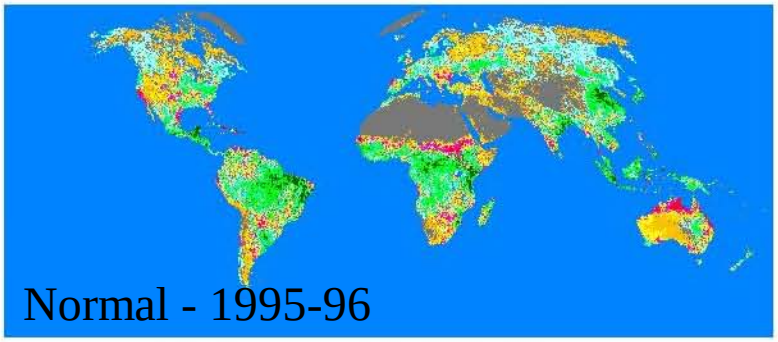
Difference between NPP for the stated year and mean value for whole period 1981-2000.

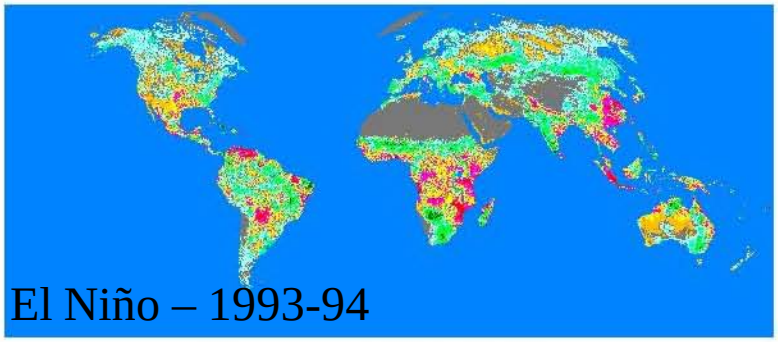
Anomalies.
Yr. x-(mean of 1981-2000)
gCm^{-2} per 10 d

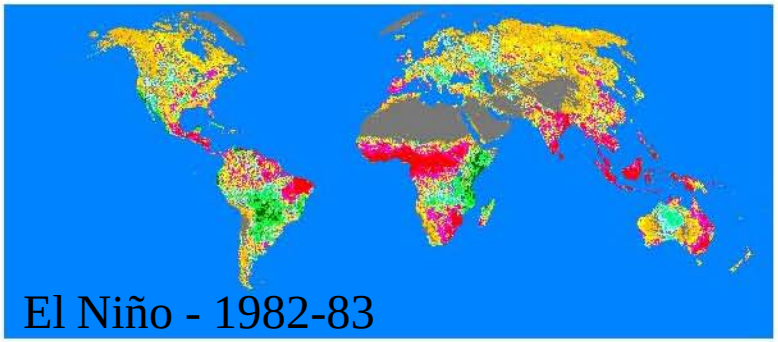
- -8 - -4
- -4 - -2
- -2 - -1
- -1 - -0.2
- -0.2 - 0.2
- 0.2 - 1
- 1 - 2
- 2 - 4
- 4 - 8

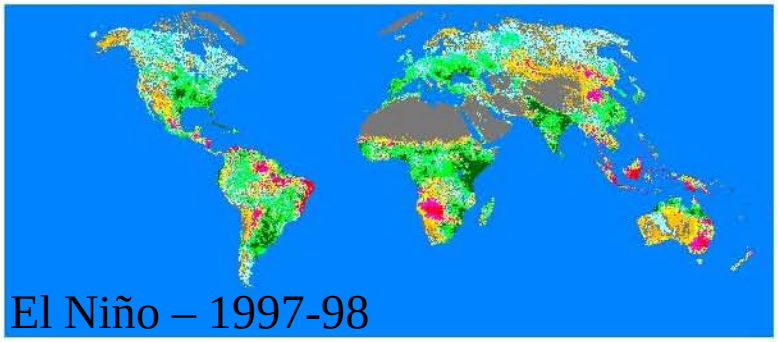












Interannual variability and trend in global terrestrial net primaryproductivity: satellite analysis 1980-2000

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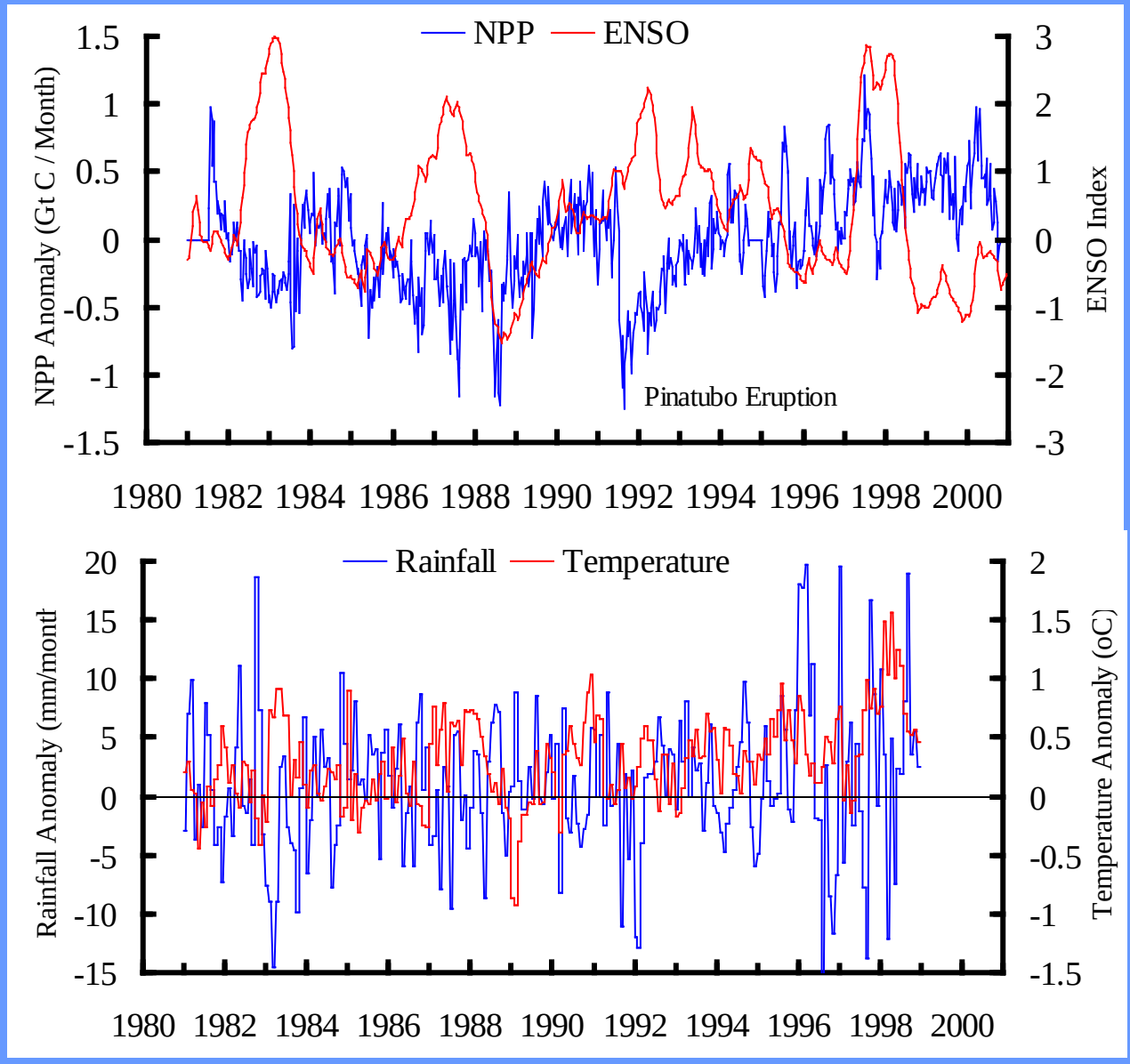
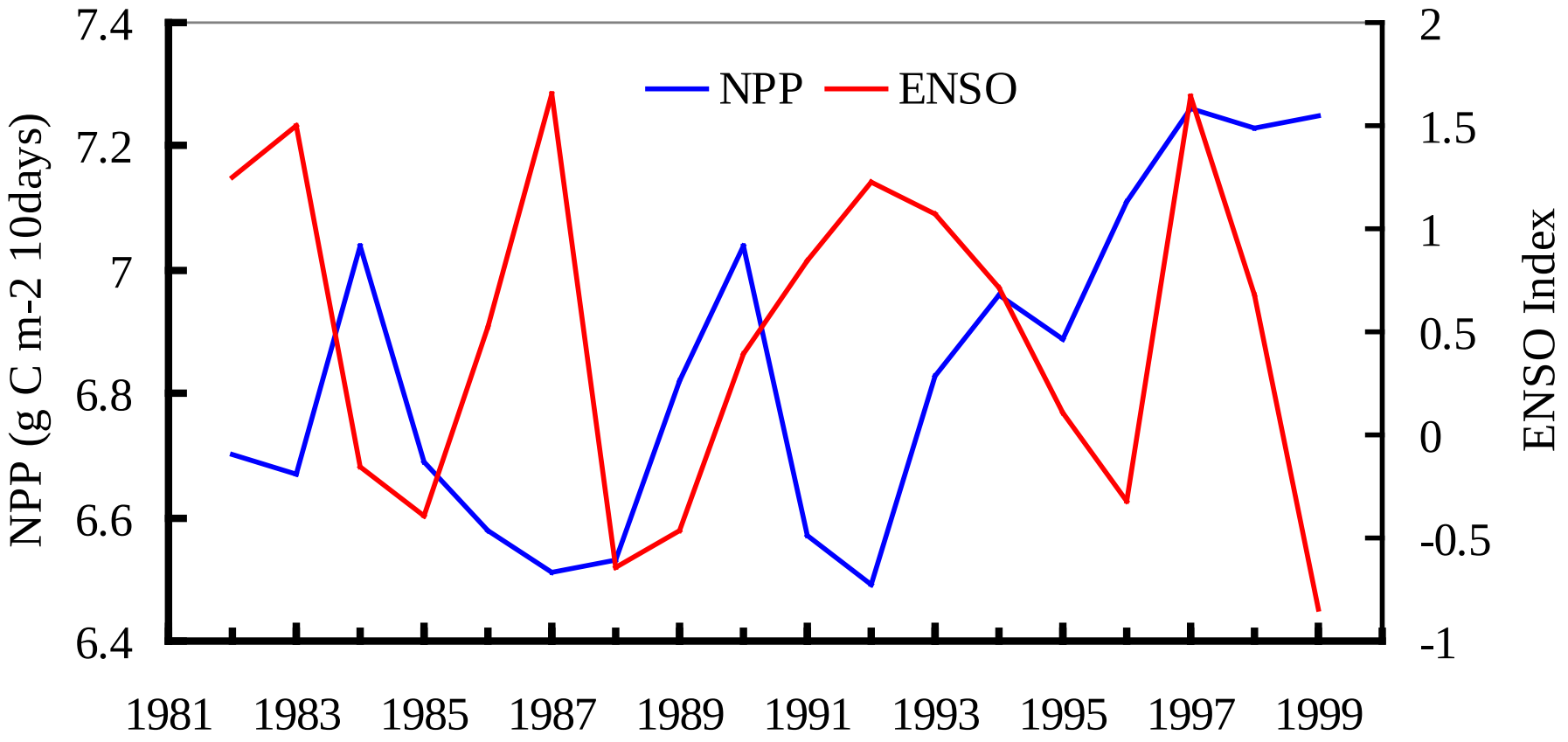
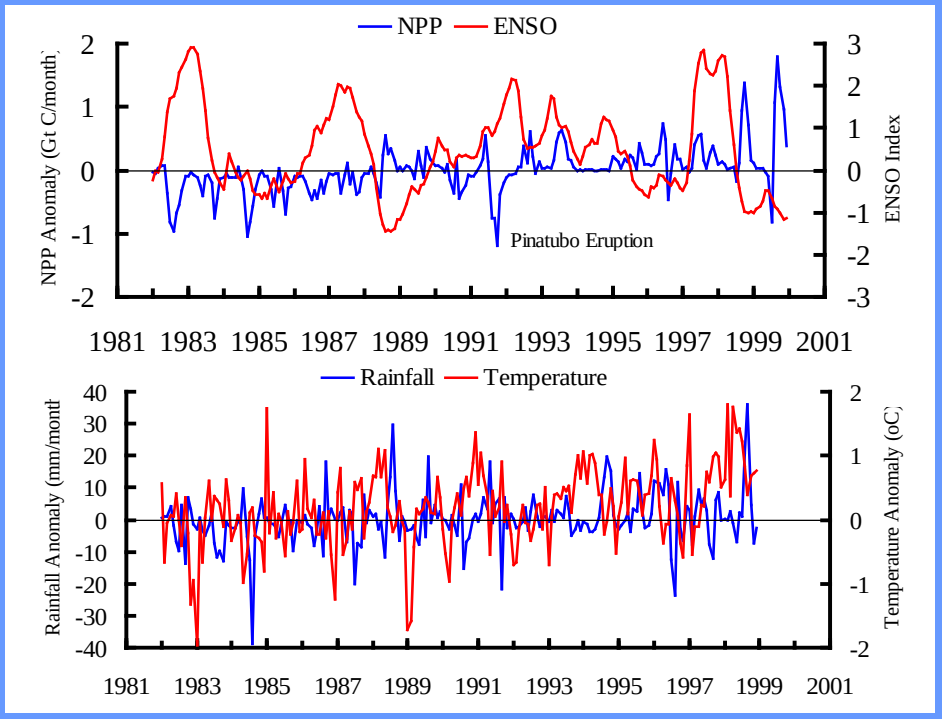
AFRICA

Whole continent

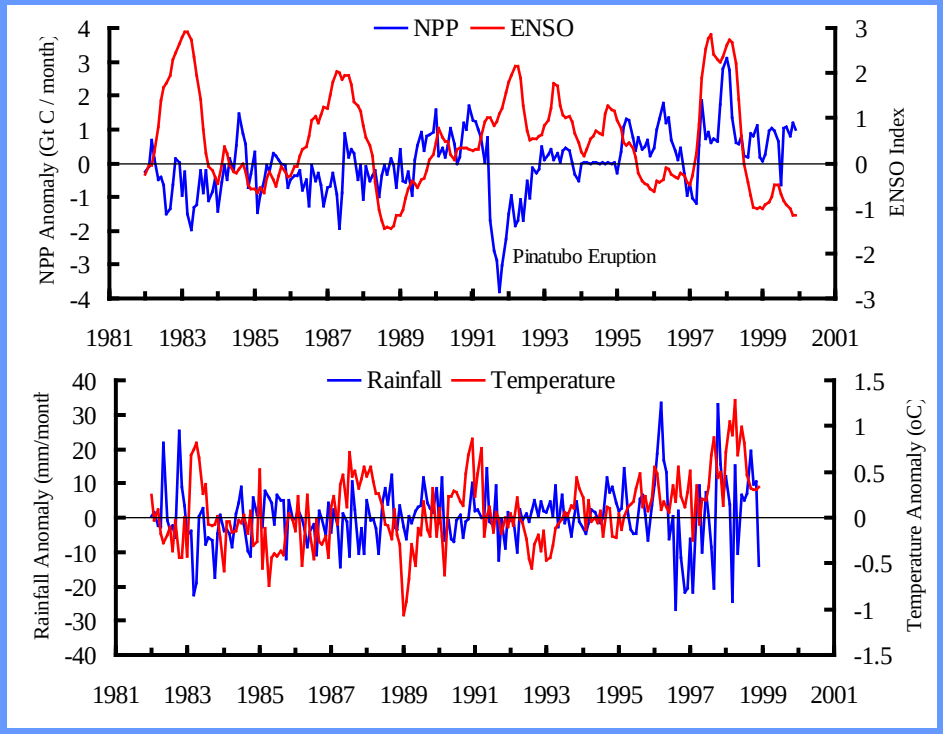


Interannual Variation in NPP and ENSO Cycles for the Whole African Continent

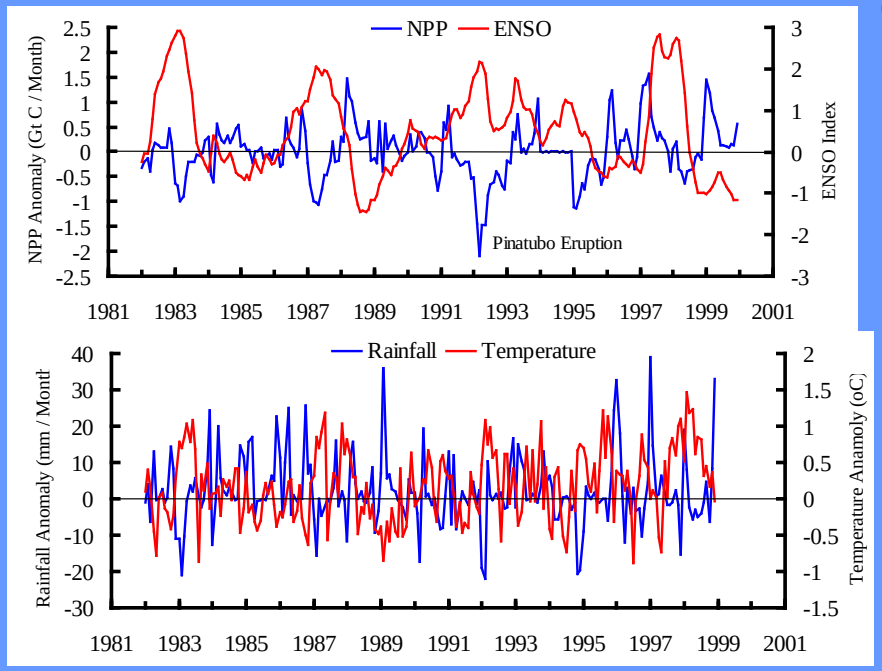




Northern Africa (>10°N)

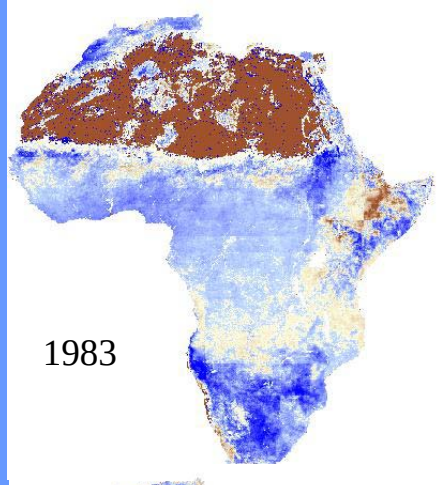


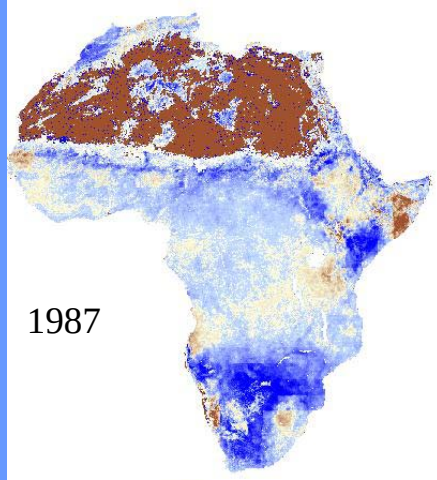
Central Africa (10°N-10°S)

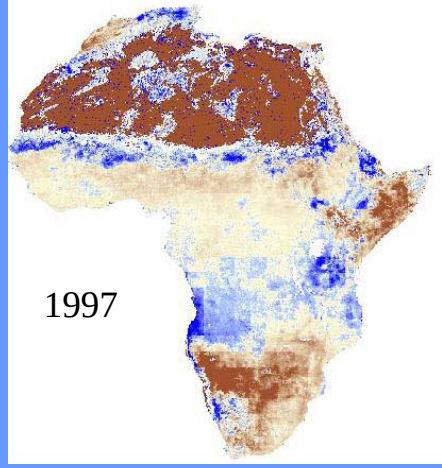


Southern Africa (<30°S)

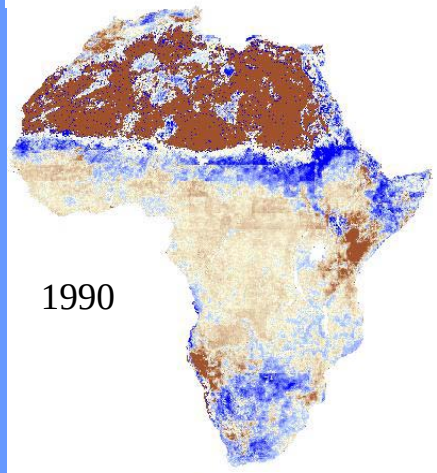
El Niño

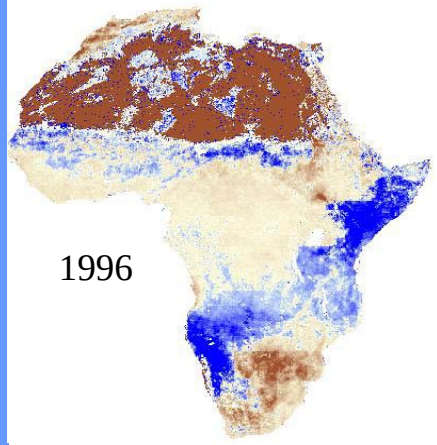




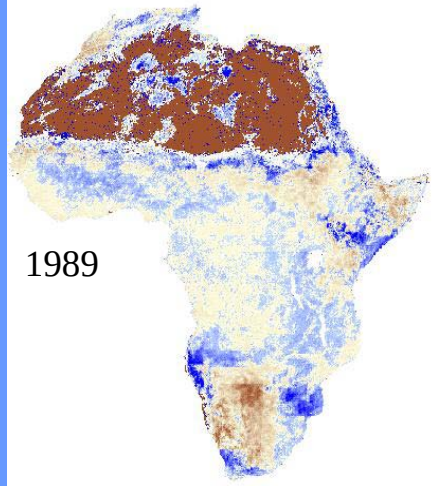


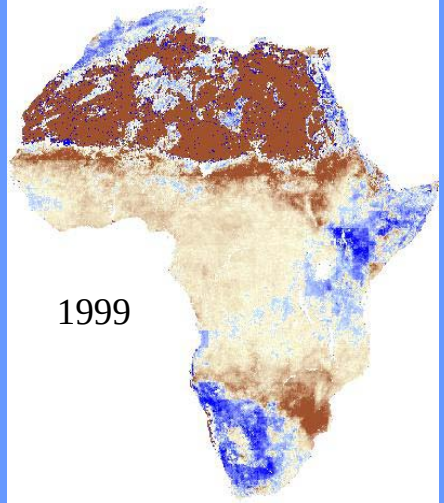
Normal

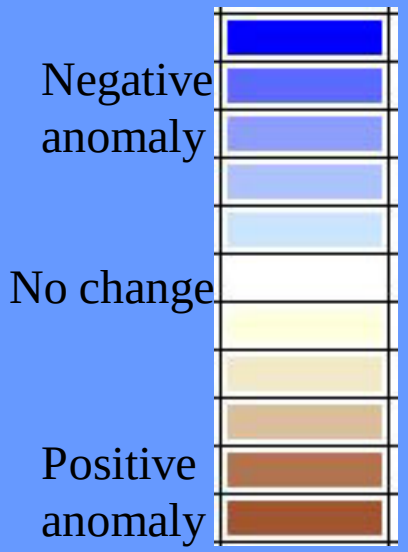




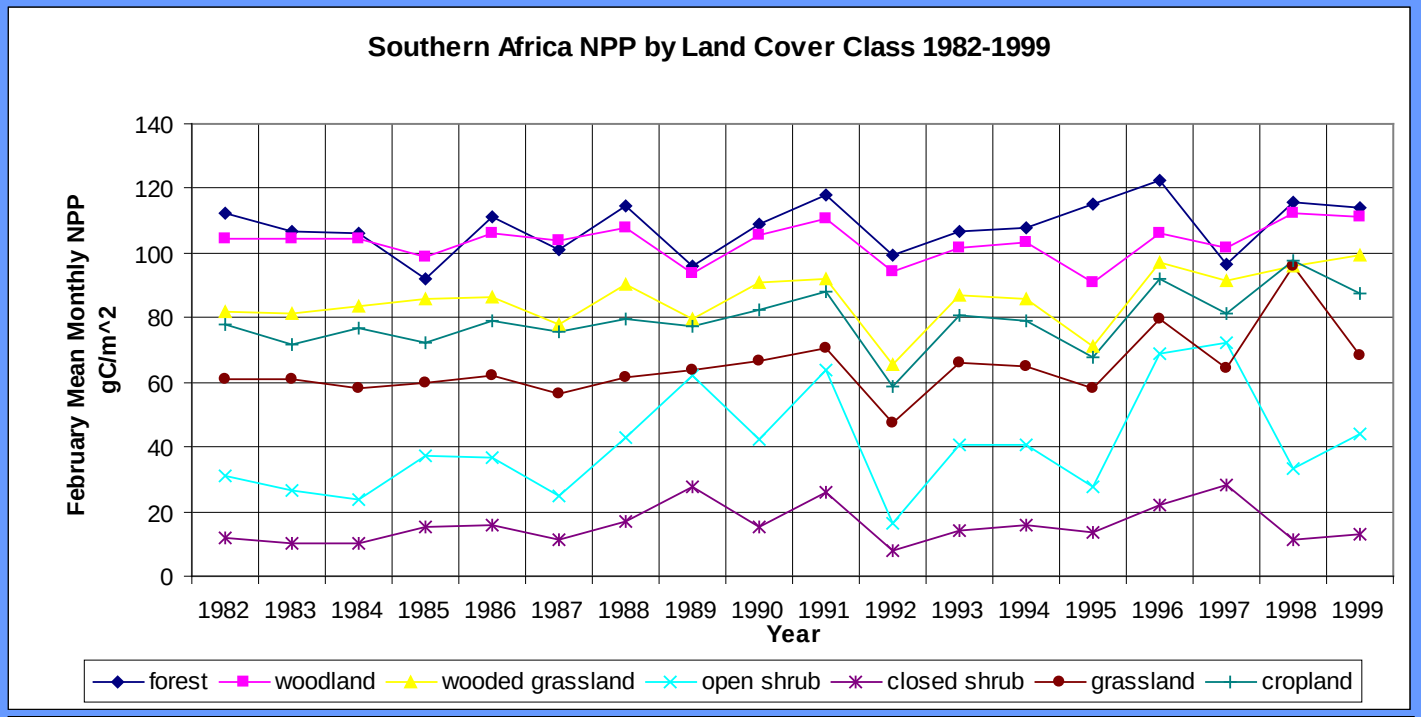
La Niña

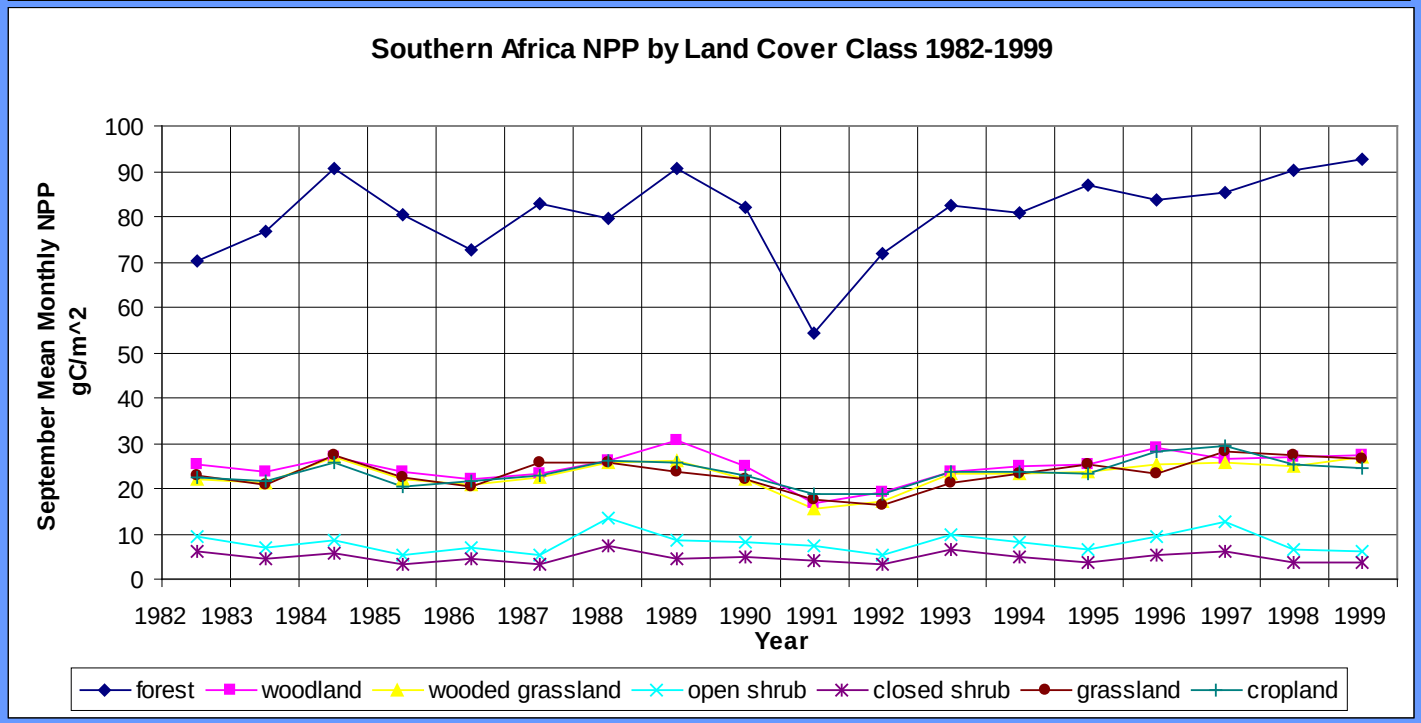




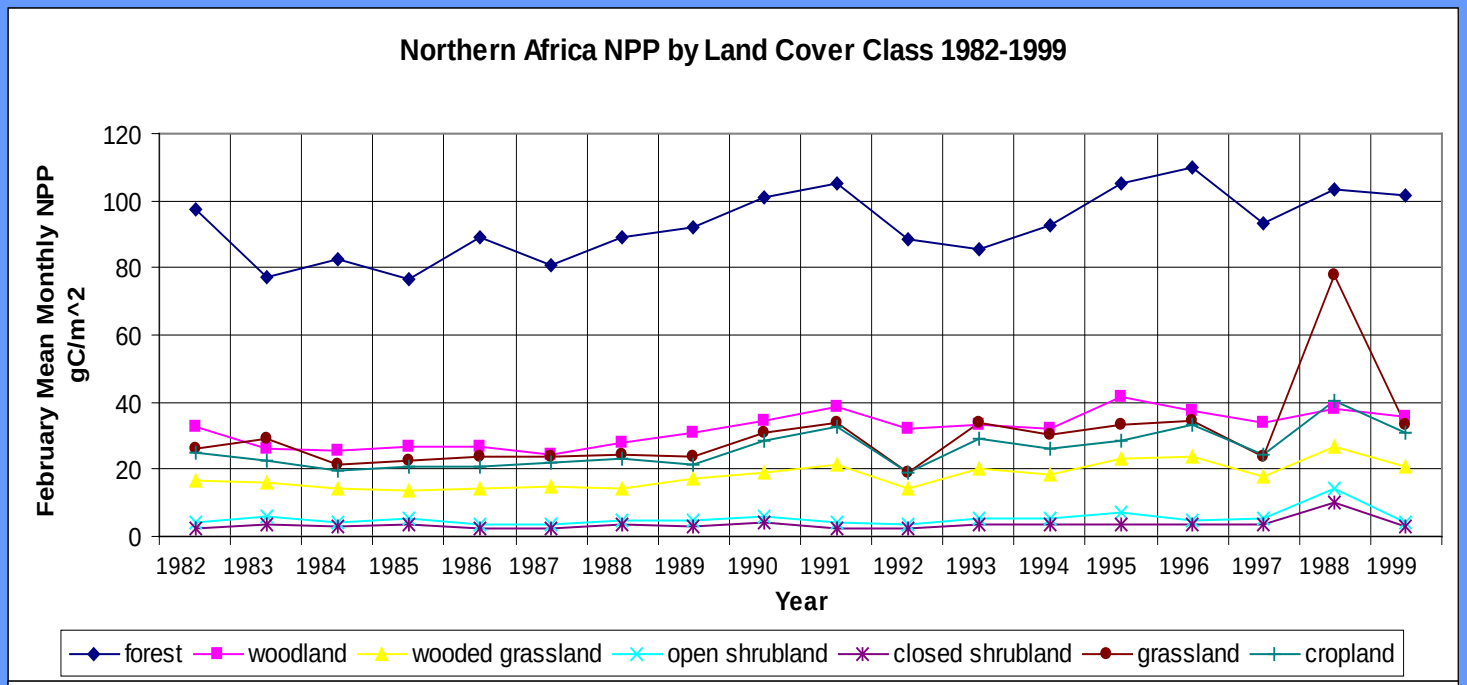


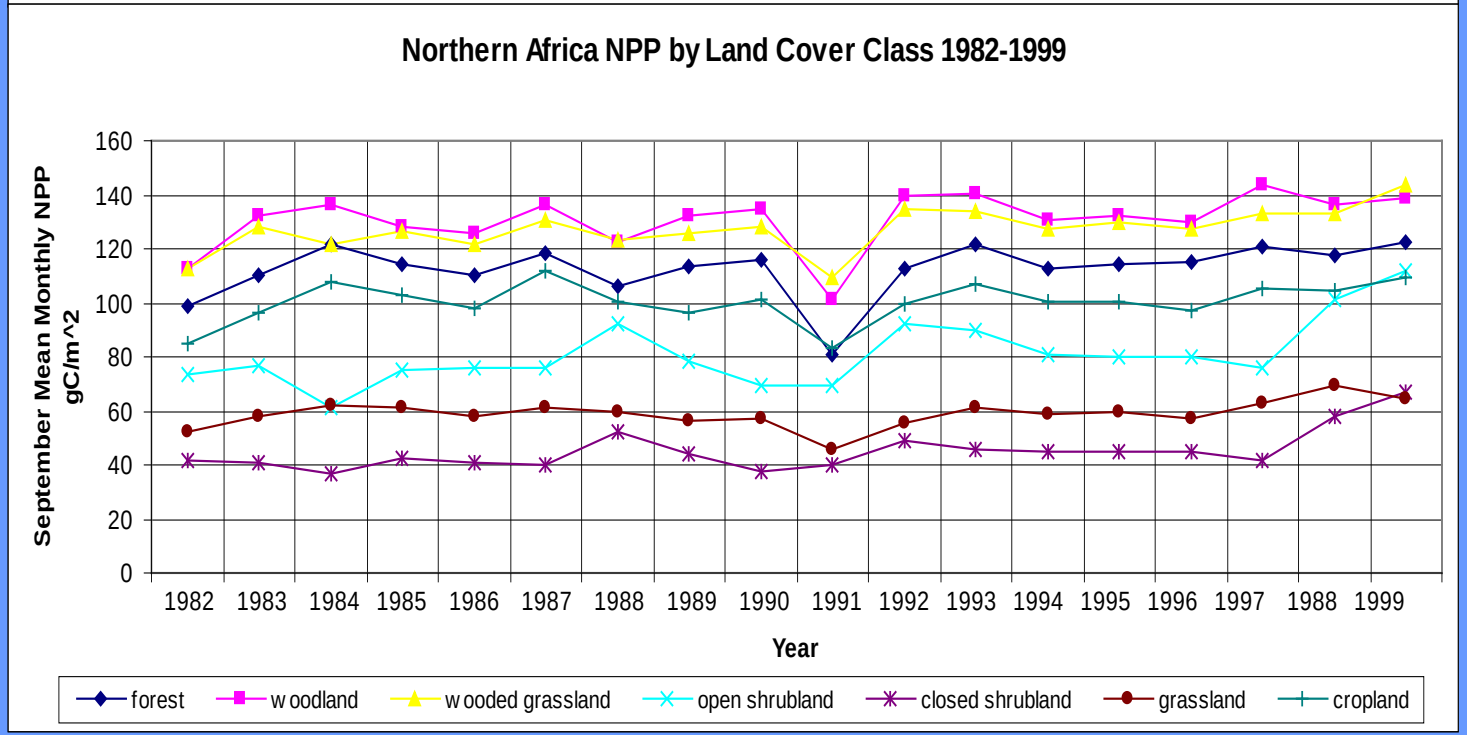
Annual NPP by cover class for Southern Africa in wet and dry seasons



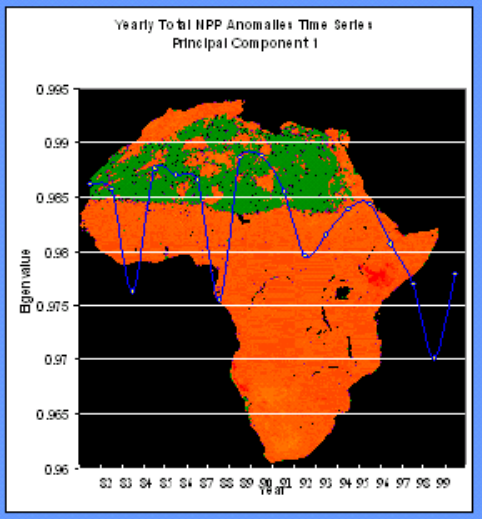


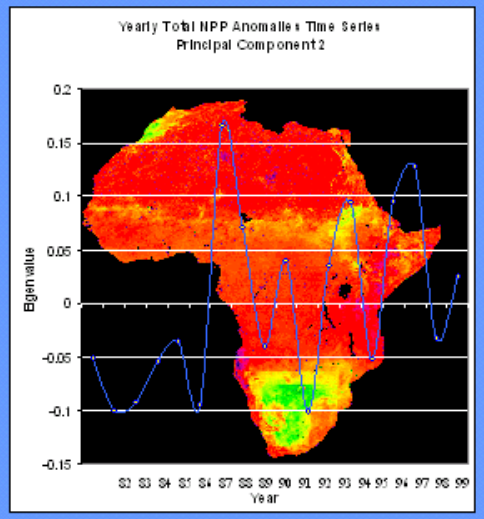
Annual NPP by cover class for Northern Africa in wet and dry seasons

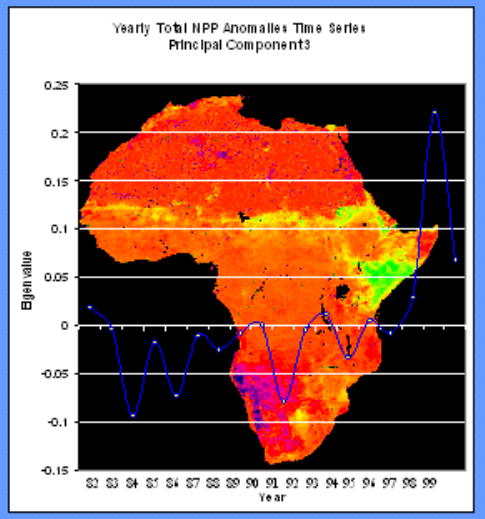


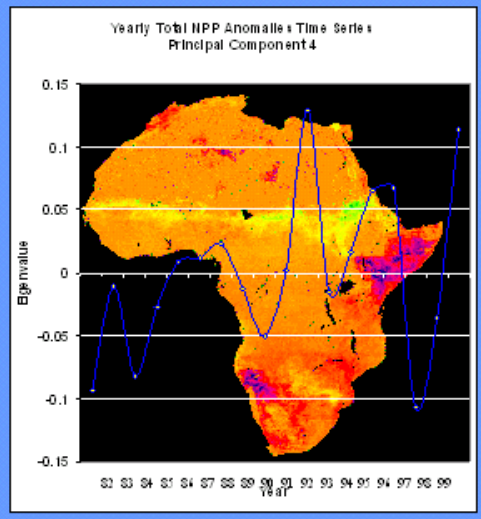


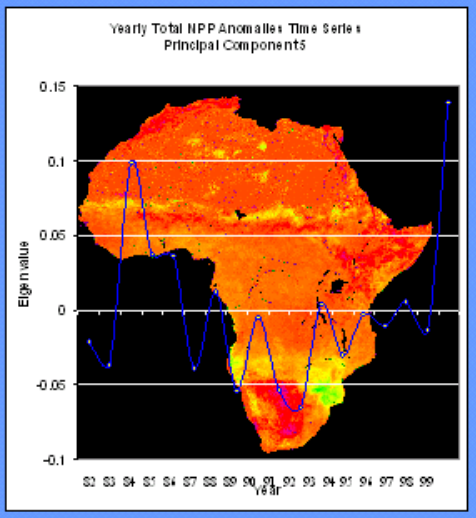
Standardized Principal Components Analysis of Annual Anomalies

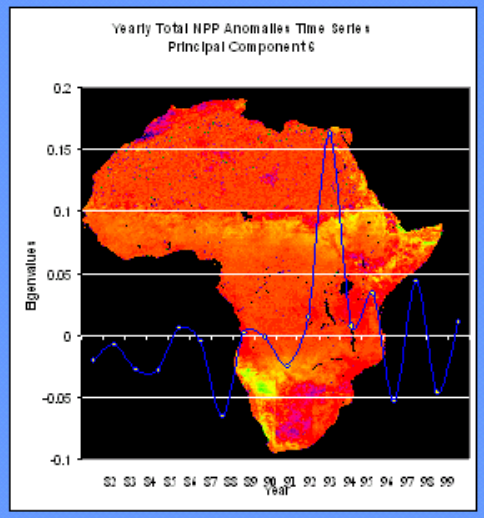


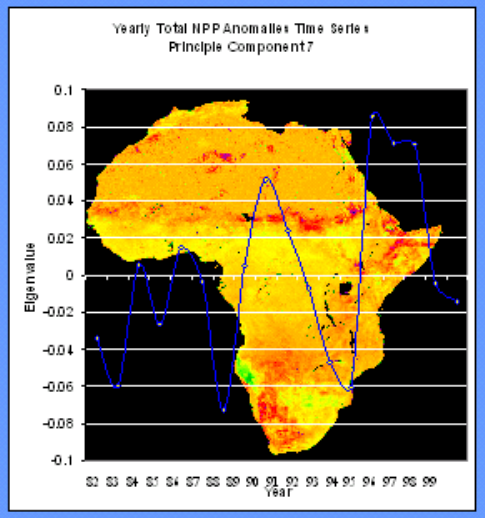


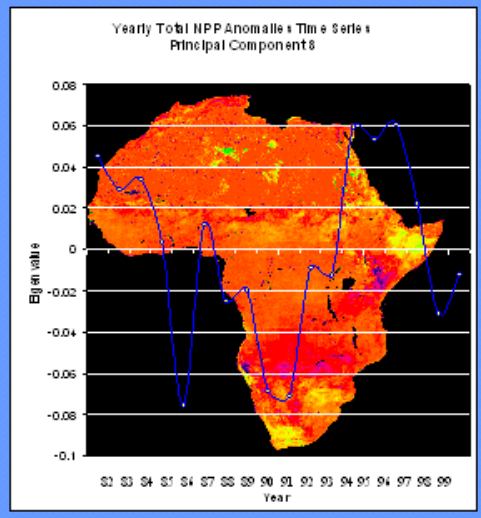


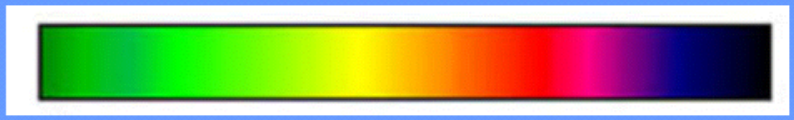








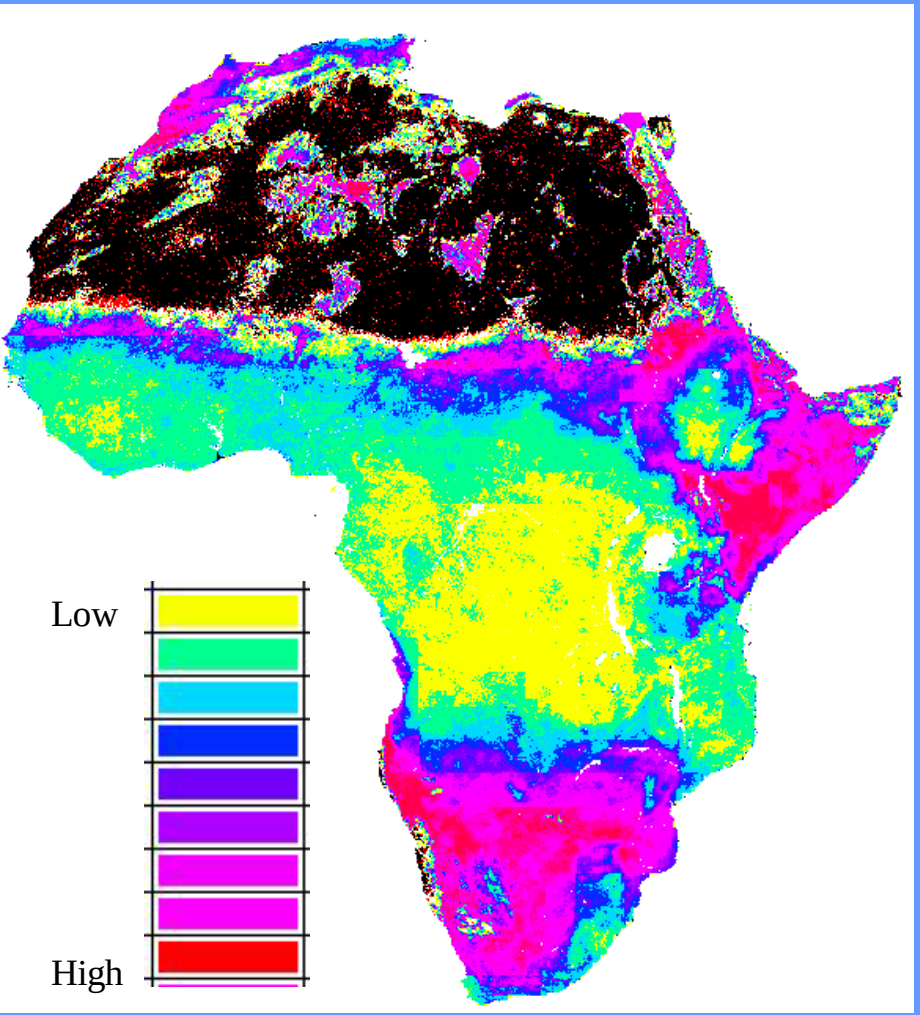




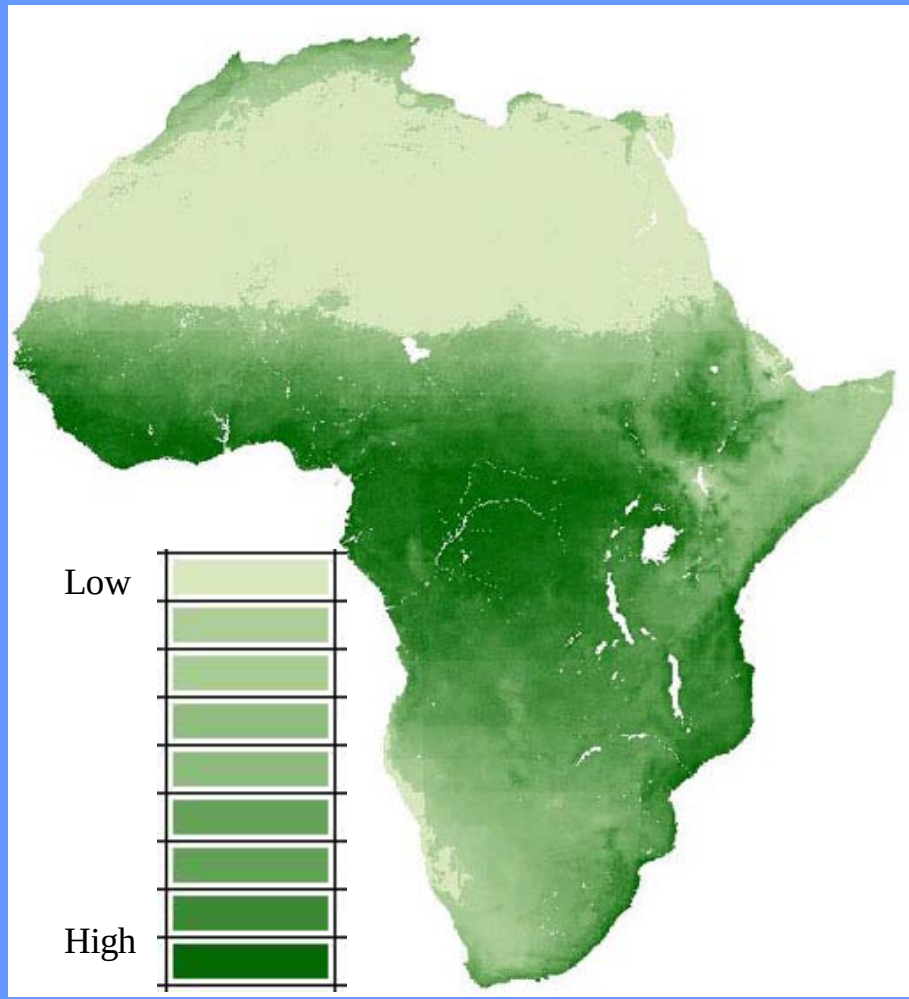
Strong positive

Strong negative

Coefficient of Variation and Mean Annual NPP 1982 - 1999



Coefficient of variation

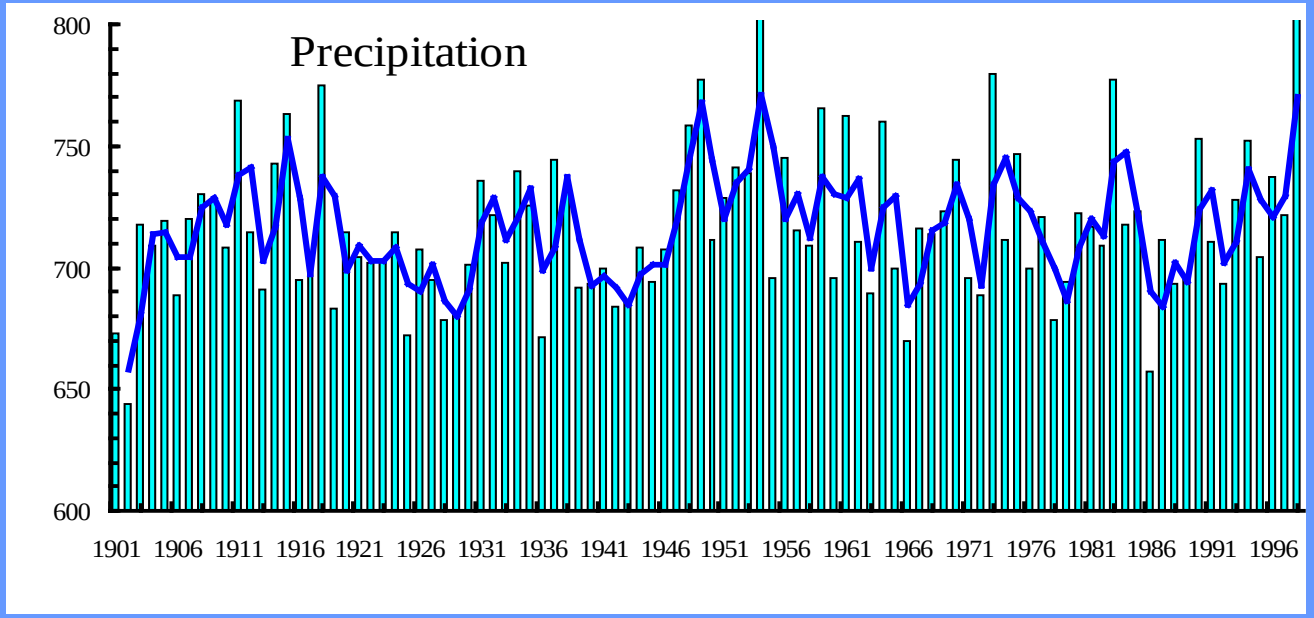


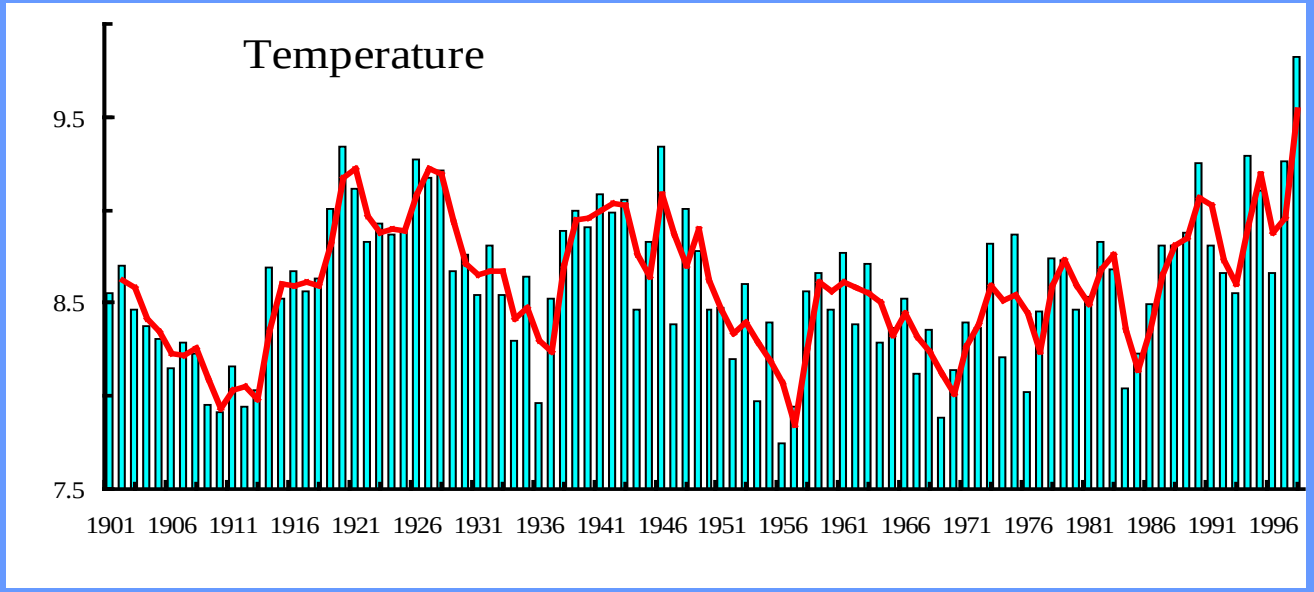
Mean Annual NPP

Interannual variations in ecosystem carbon fluxes in China from 1981 through 2000

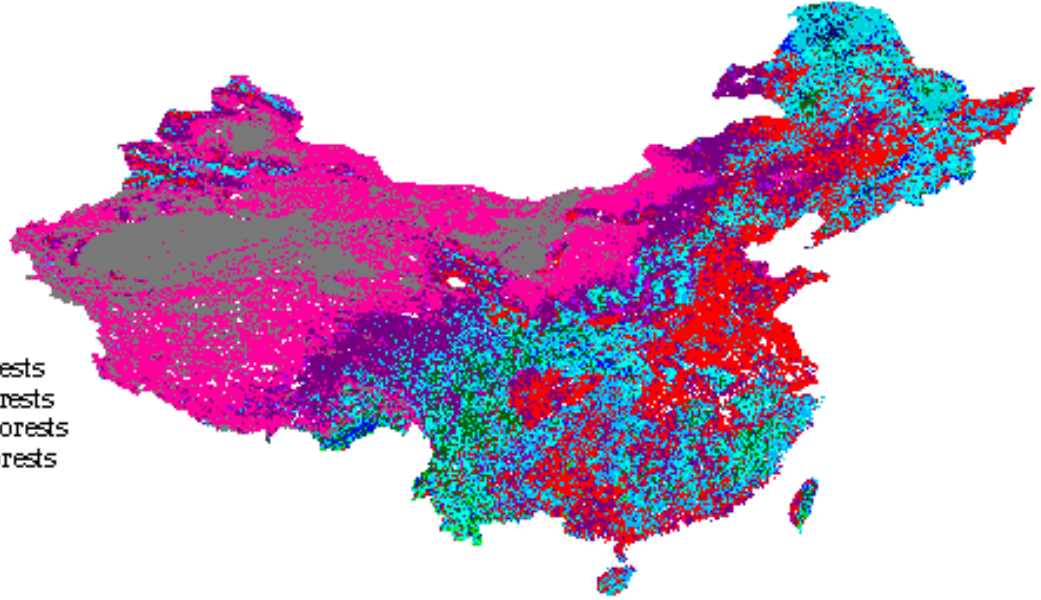
1981-2000 was an unusual period with strongest warming and El Niño events that forms a ‘natural experiment’ that display the responses of ecosystems to climate variability.

Climate Variability in China in the 20th Century





Data Source:
CRU-UEA,
UK, 2000



1. Needlelef evergreenforests
2. Broadleaf evergreen forests
3. Needleleaf deciduous forests
4. Broadleaf deciduous forests
5. Mixed forests
6. Woodlands
7. Wooded gresslands
8. Closed shrublands
9. Open shrublands
10. Grasslands
11. Croplands
12. Bared lands

1
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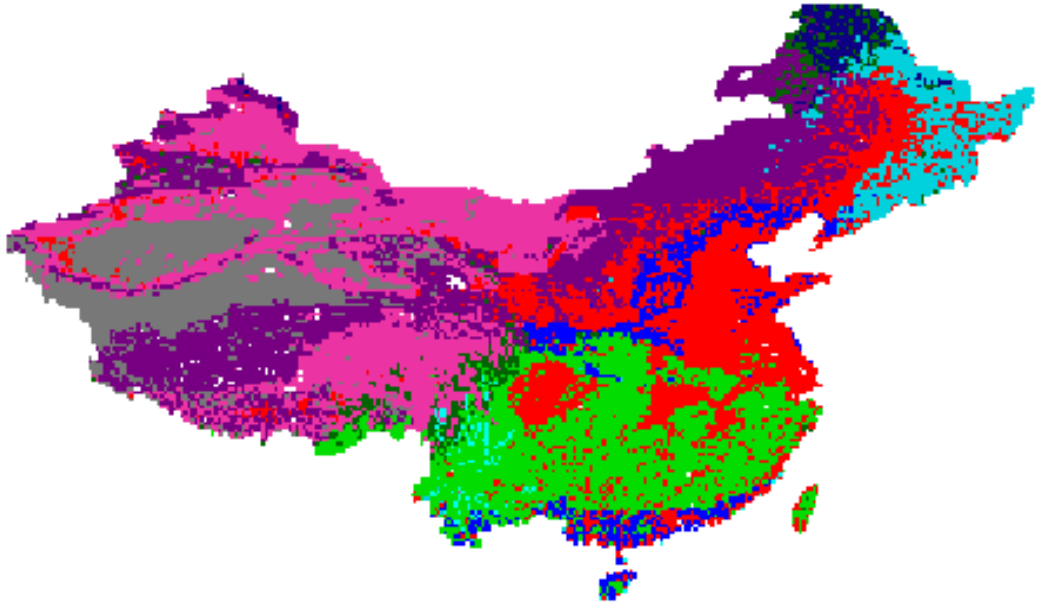
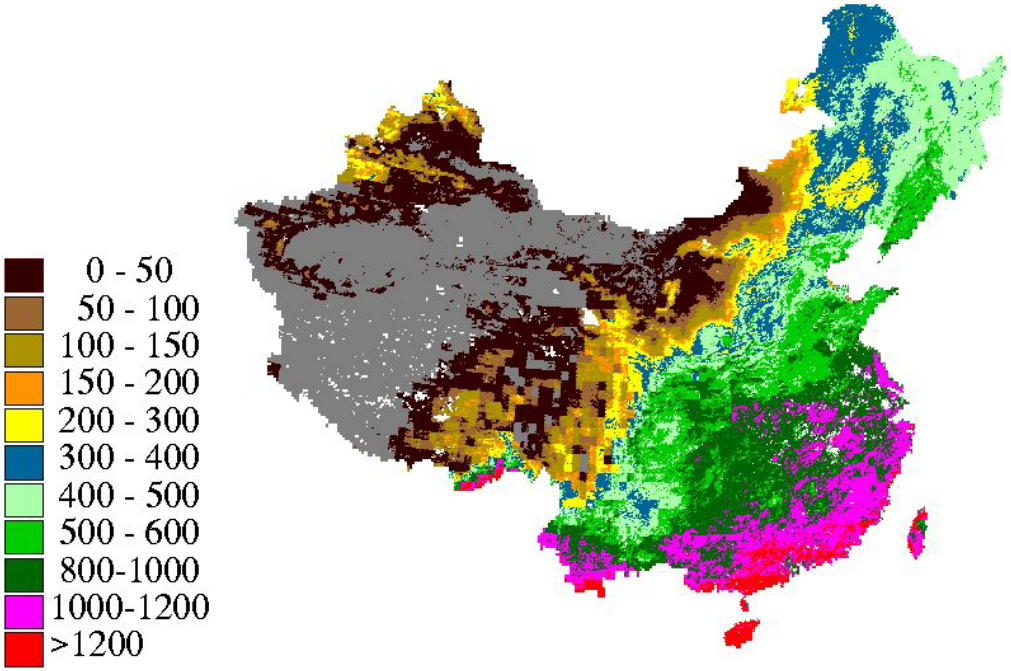
12

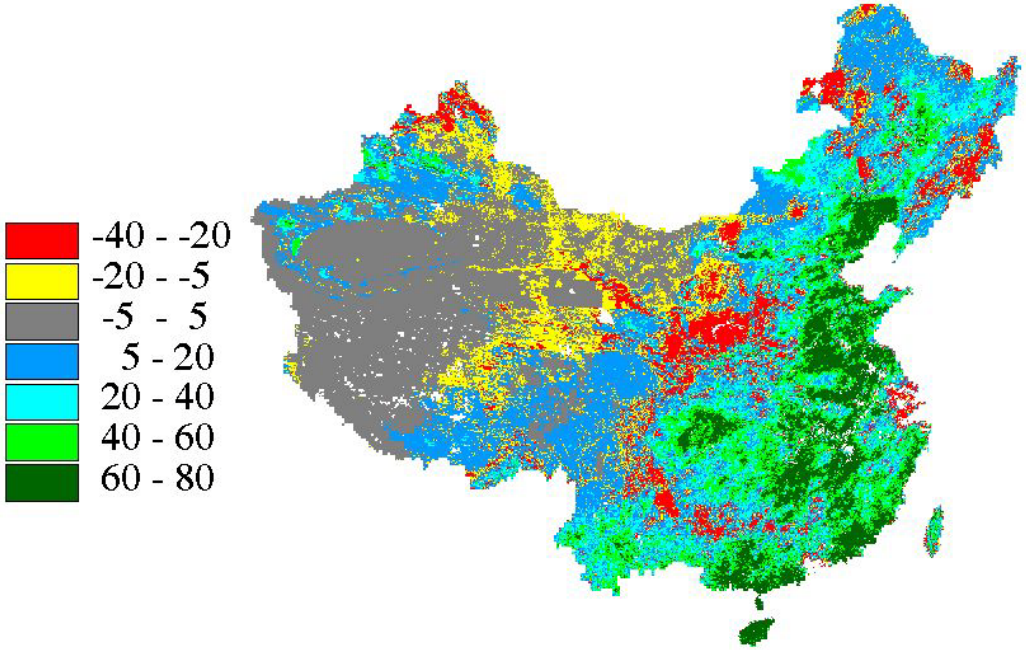
AVHRR-based Landcover Classification



Conventional Vegetation Classification

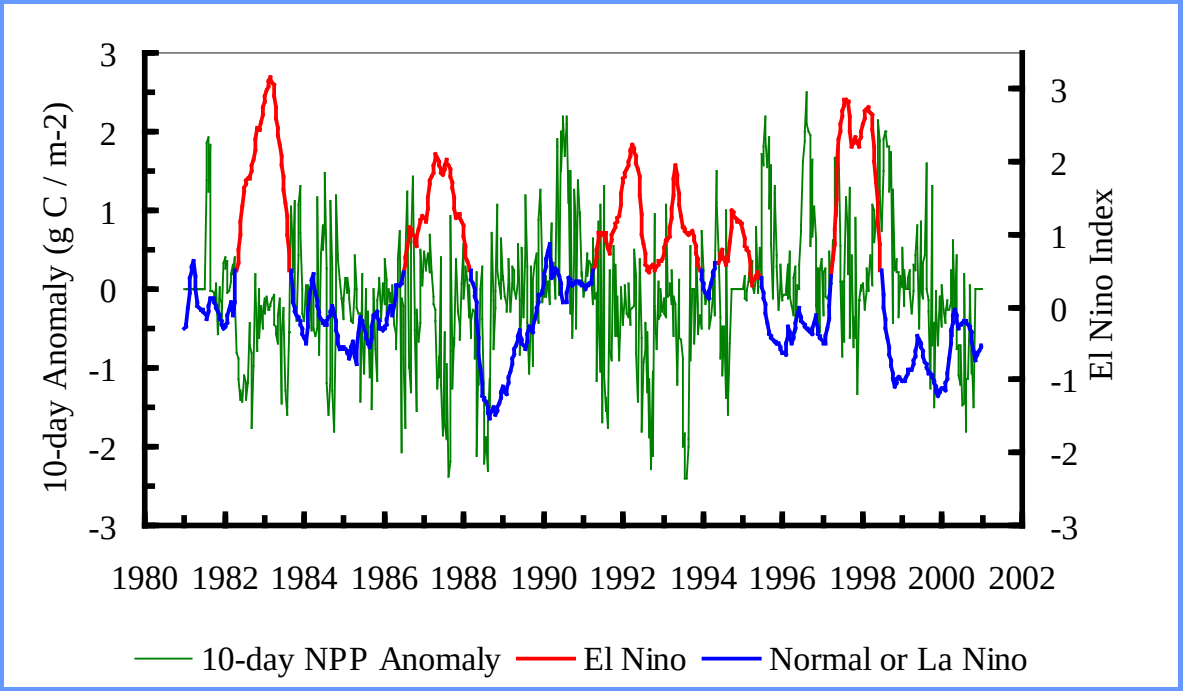


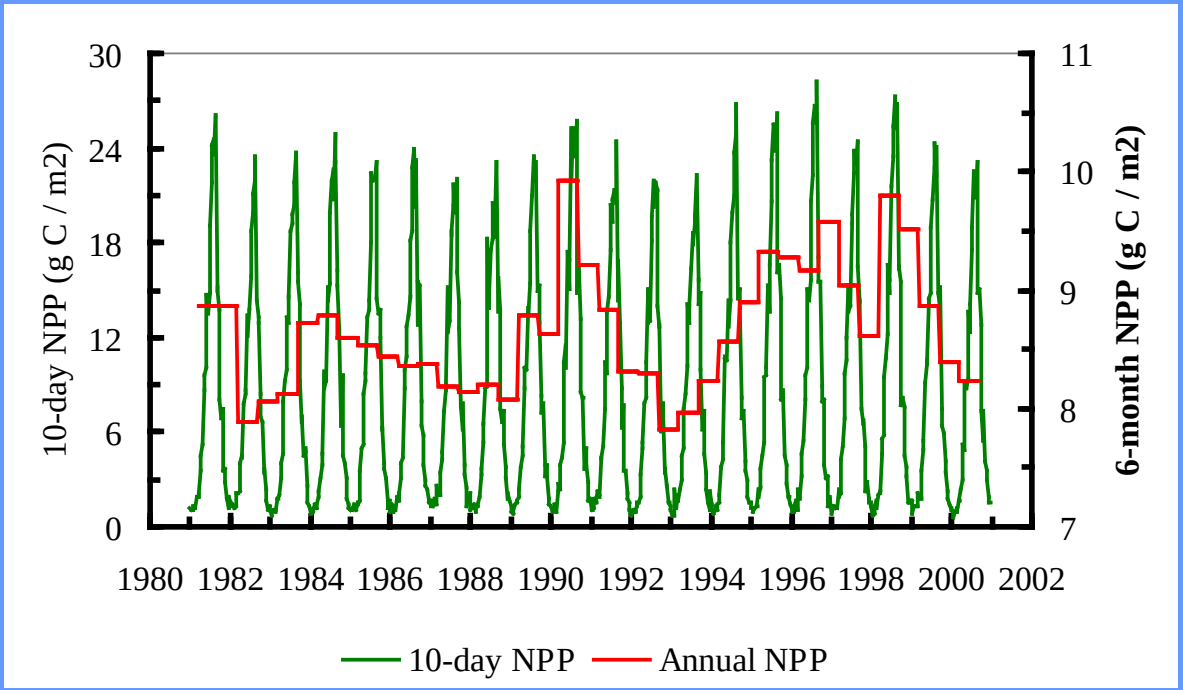
Annual net primary productivity in 1981-2000 (g C m-2)



Changes in net primary productivity between 1981 and 2000 (g C m-2)

Inter-annual NPP variability in China





Program Summary

1. Significant results:

- Established the utility of the 20 yr AVHRR GAC archive for global interannual studies
- Demonstrated temporal and geographic correlations of NPP with ENSO
- Demonstrated factors other than ENSO are equally important
- Identified key regions where variability is repeated/unique

2. Relevance:

- Developed a means to derive a key functional variable (NPP) at high time and space resolution (8km/10d) for medium term (20yrs)
- Derivation of empirical patterns of vegetation dynamics

3. Social Science Proportion

- -100% (according to reviewers), but adopted by South Africa as their means of monitoring desertification and national carbon sequestration

Program Summary….. continued

4. Carbon relevance (high), GOFC relevance (high)

5. New Findings:
- Large interannual global fluctuations in NPP (~6GtC/yr)
- Highly spatially heterogenous
- Importance of low N latitudes in carbon sequestration (NPP)

6. New potential:
- Medium term monitoring of NPP at landscape scale

7. New Products
- Created a global 8km/10d/20yr NPP data set – release to researchers