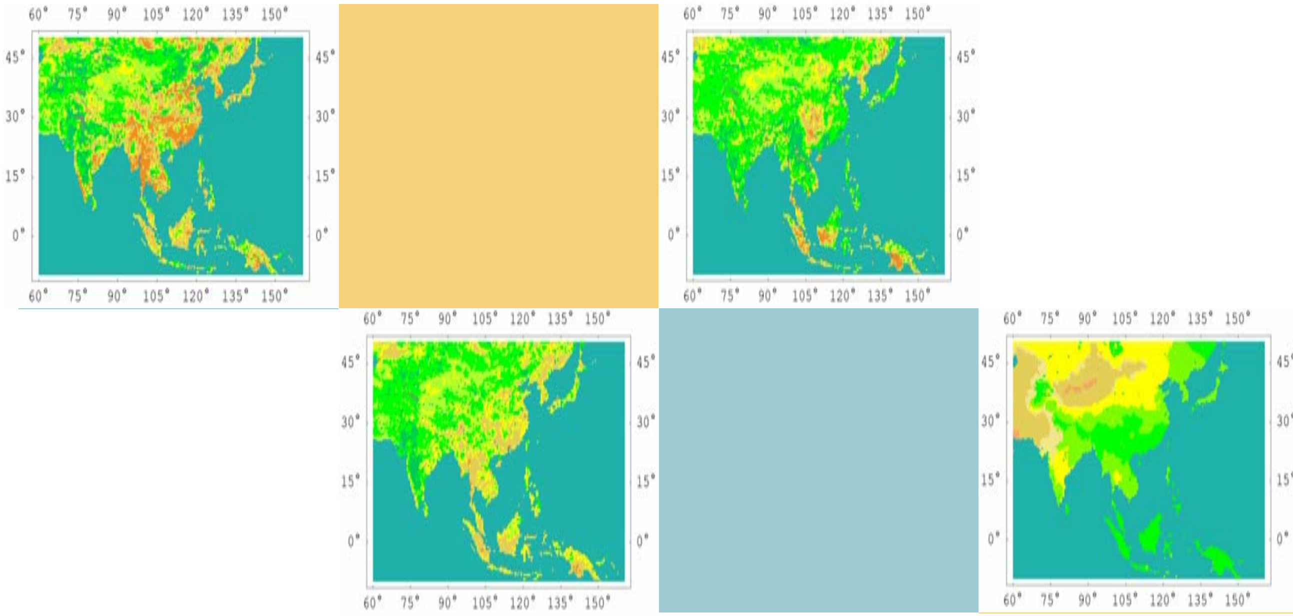
Apparent trends in photosynthetic capacity of Monsoon Asia from 1982 to 2002



By Georgii A. Alexandrov, Takehisa Oikawa and Yoshiki Yamagata

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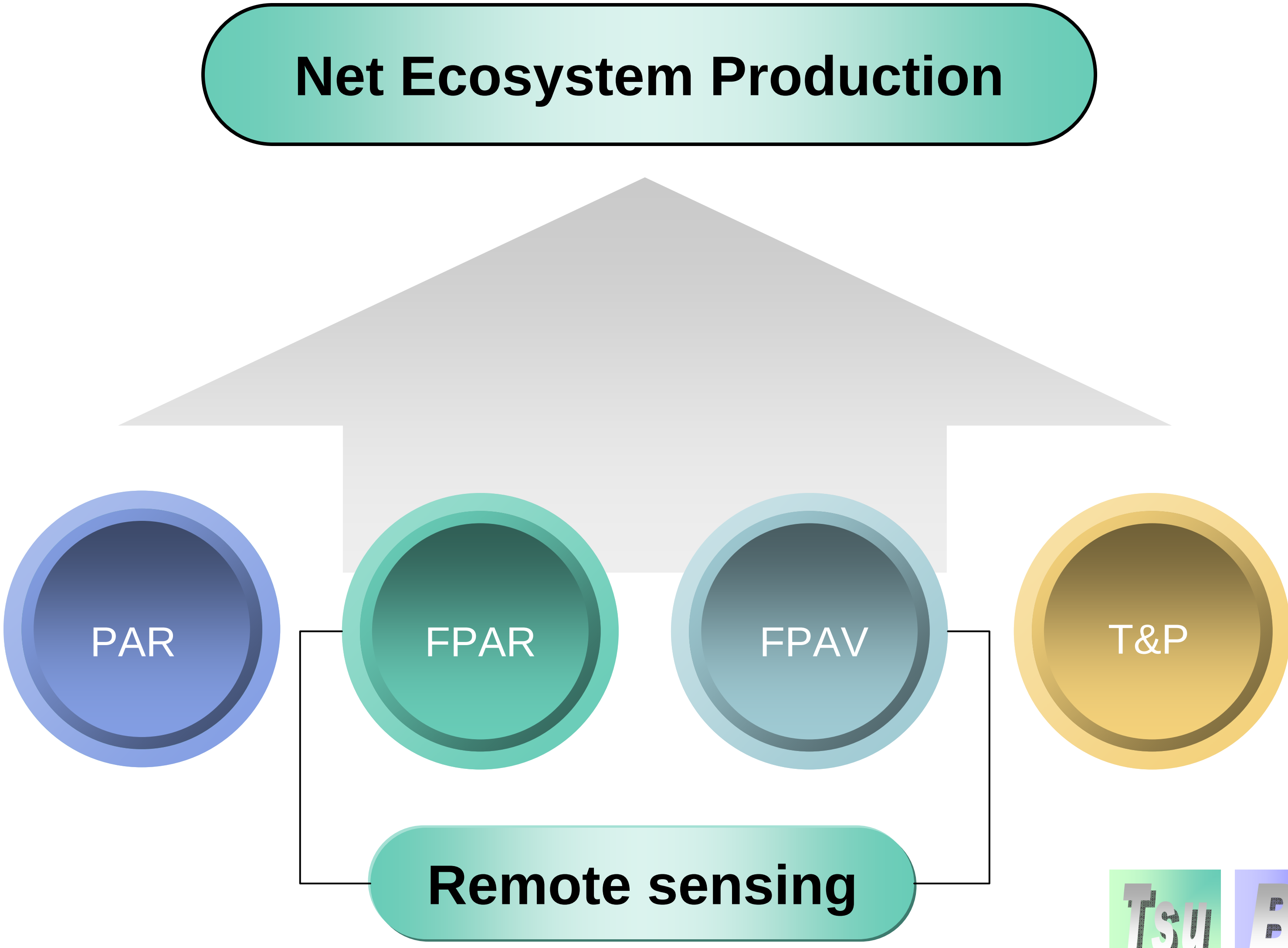
The natural controls of ecosystem gas exchange

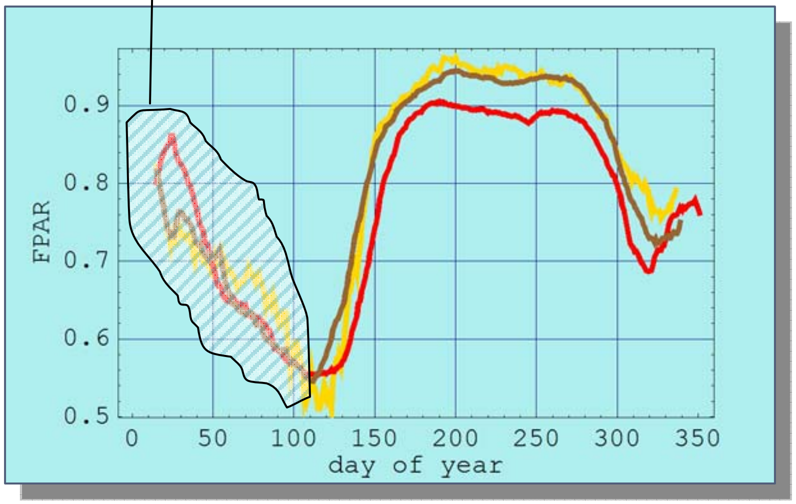


A corrected definition of FPAR

- FPAR is normally defined as the fraction of PAR absorbed by vegetation

- It is more reasonable to define it as the fraction of PAR absorbed by *photosynthetically active* vegetation (PAV)

The non-photosynthetic parts of trees also absorb PAR. However, this FPAR has no relation to photosynthesis.



FPAR measured at Tomakomai site of the AsiaFlux network (http://www-cger2.nies.go.jp/asiaflux). NB: It did not fall below 0.5 even when there were no leaves.

The concept of FPAV

FPAV stands for the Fraction of Photosynthetically Active Radiation and denotes the portion of land covered by a photosynthetically active canopy the Leaf Area Index of which is higher than 1.

$$GPP = FPAV \times P_g(PAR, FPAR, T, P)$$

Gross Primary Production of a region (e.g. of a grid cell)

Gross Primary Production per area of land covered with photosynthetically active canopy

The use of remote sensing

$$\iint_D FPAV(x,y) \times FPAR(x,y)\,dxdy =$$

$$= f(v_{NIR}, v_{Red}; v_{Blue}, v_{MIR})\big|_D$$

A function that transforms the reflectance into an index (e.g., NDVI, EVI, SAVI), characterizing the photosynthetic capacity of vegetation)

Earth surface reflectance measured at certain range of light wavelengths

Tsu Bi Mo

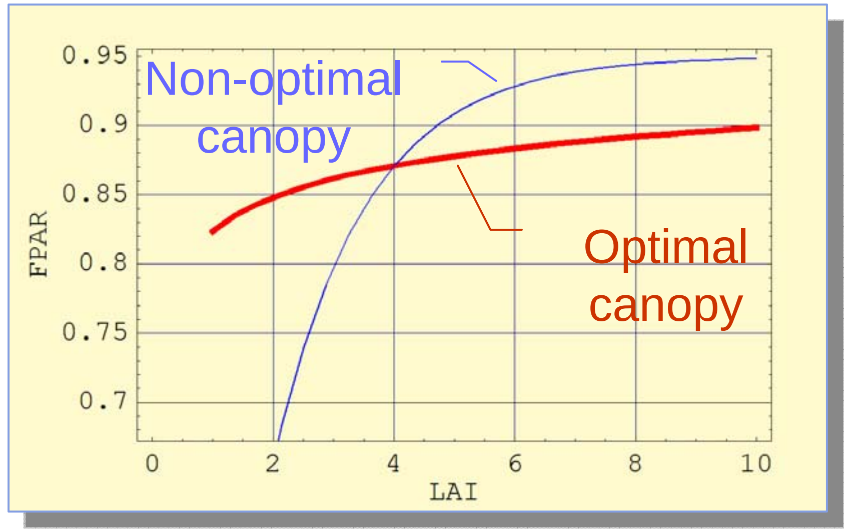
When the FPAR of PAV is constant …

Due to inverse relationship between Leaf Area Index and light attenuation coefficient, FPAR of dense canopies varies between 0.85-0.95.

Let us assume that FPAR is constant

$$FPAR = c$$

Then we may also assume that



Source: Alexandrov&Oikawa, Ecological Modelling, 95 (1997): 113-118

$$\frac{dFPAV}{dt} = \frac{1}{c}\frac{df(v_{NIR}, v_{Red}; v_{Blue}, v_{MIR})}{dt}$$

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Widely available satellite data

Product:
GIMMS-NDVI
Period:
1981-2002

NB: Slayback, Pinzon, Los and Tucker (2003: Global Change Biology 9:1-15)

Product:
NDVI, EVI
Period:
1998 -2002

NB: Boles, Xiao, Liu, Zhang, Munkhtuya, Chen and Ojima (2004: Rem. Sens. Env. 90:477-489)

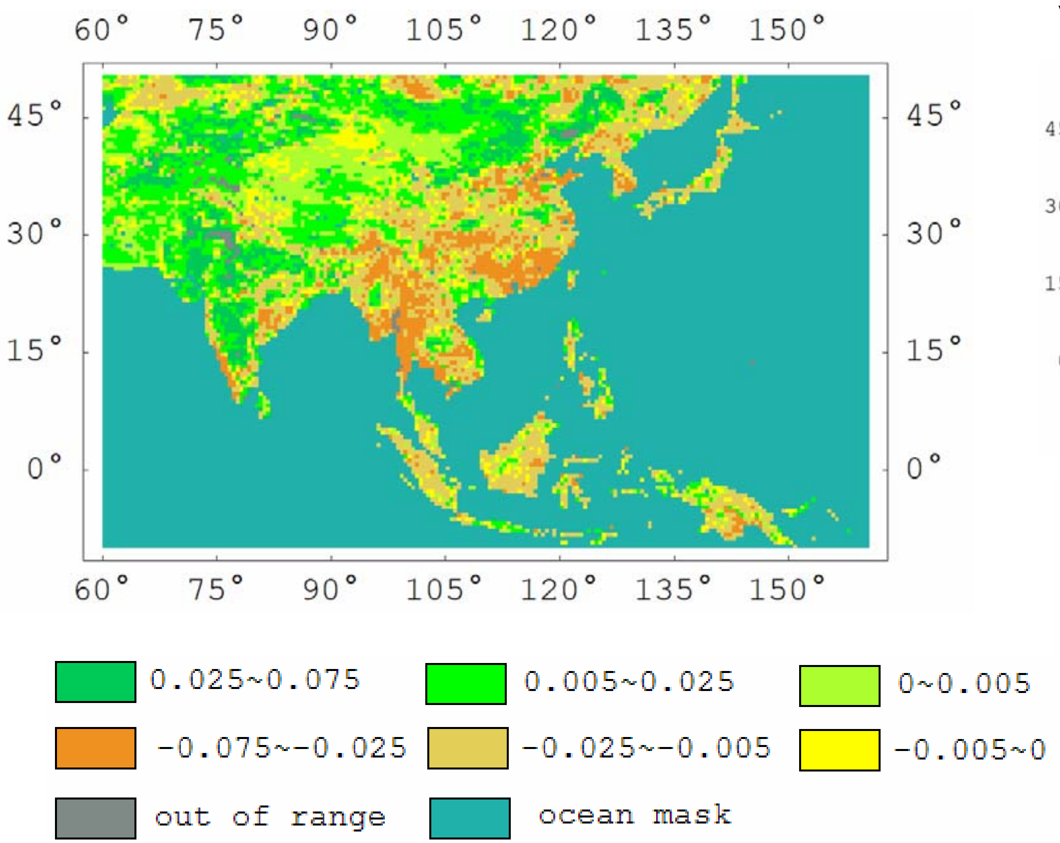
Product:
Surface reflec-tance, NDVI, EVI
Period:
2000

NB: Running (2002, The Earth Observer, 14(5)

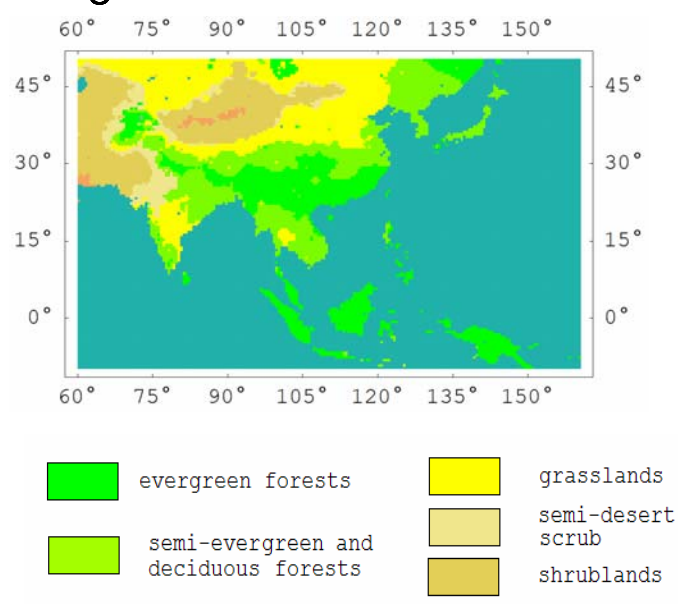
GIMMS-NDVI: inter-decadal variations in annual maximum of FPAV

The decrease in annual maximum of FPAV can be interpreted as land degradation.

The difference between annual maximum of monthly FPAV averaged over 1992-2002 and that averaged over 1982-1992



Vegetation zones



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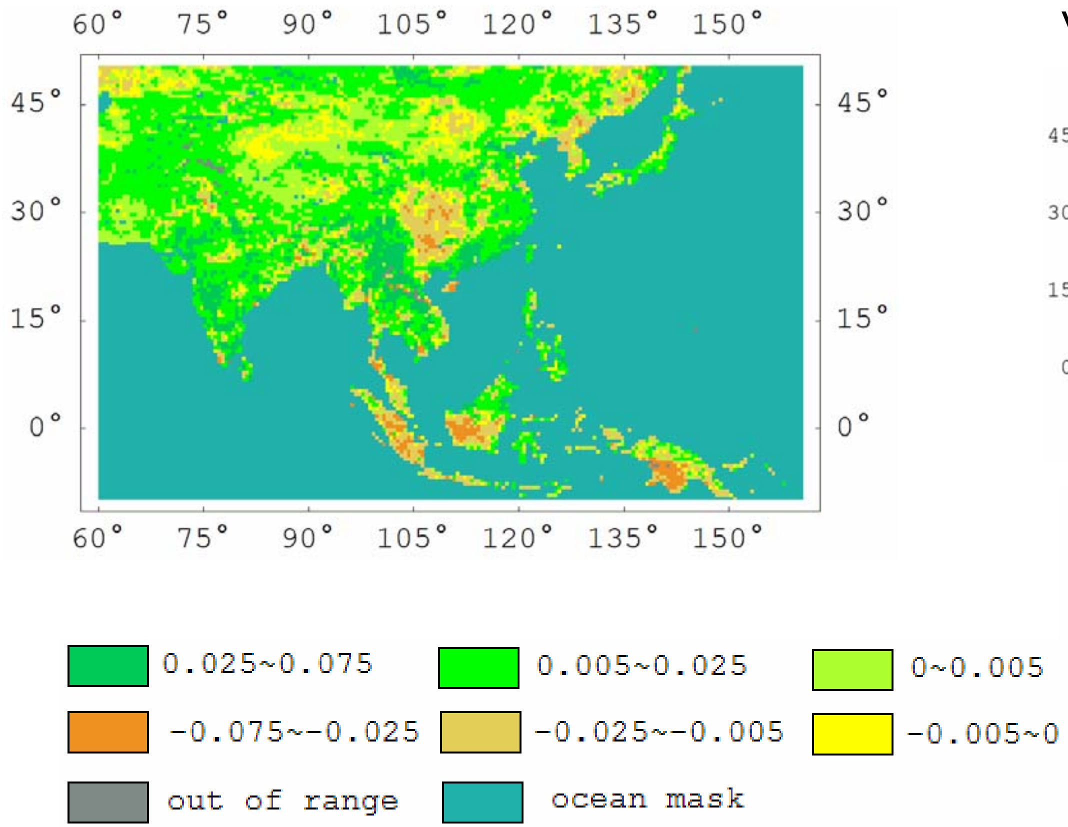
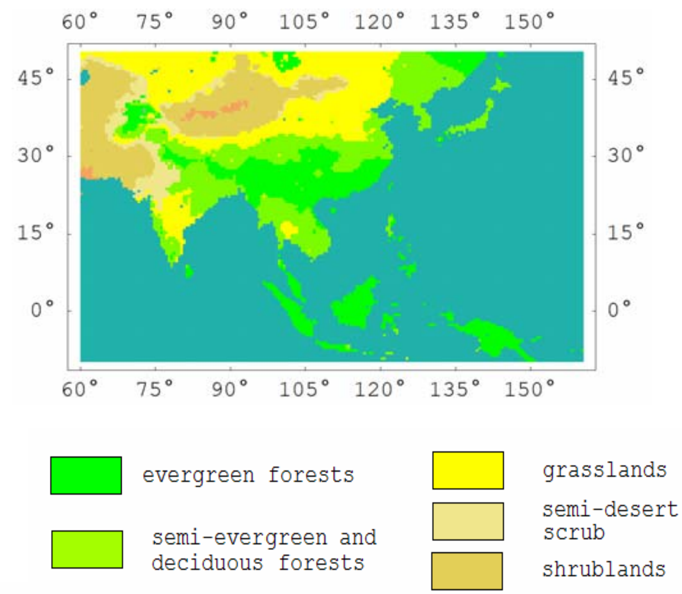
GIMMS-NDVI: inter-decadal variations in annual minimum of FPAV

The increase in annual minimum of FPAV can be interpreted as invasion of evergreen vegetation.

The difference between annual minimum of monthly FPAV averaged over 1992-2002 and that averaged over 1982-1992



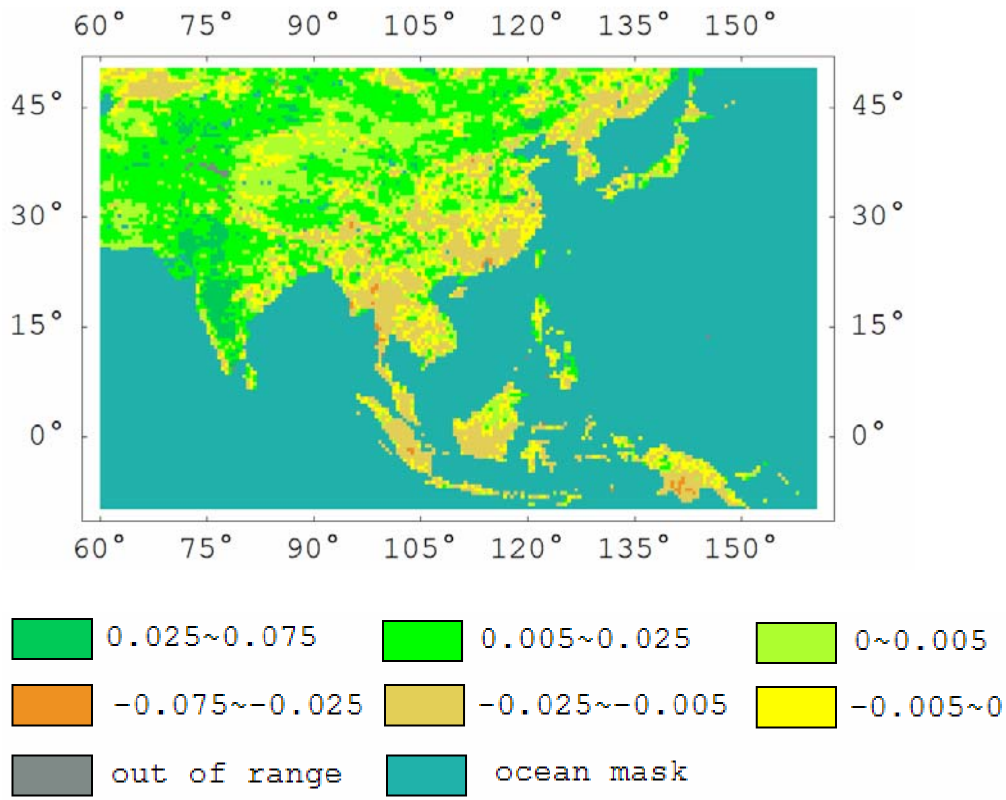
Vegetation zones (Box, 1995)



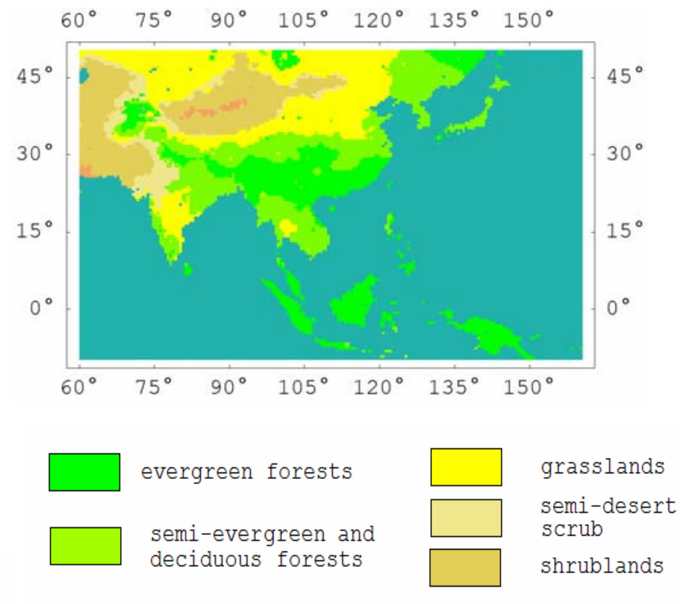
GIMMS-NDVI: inter-decadal variations in FPAV of warm season

The decrease in FPAV of warm season can be interpreted as decrease in photosynthetic capacity.

The difference between average monthly FPAV of warm season averaged over 1992-2002 and that averaged over 1982-1992



Vegetation zones



The percentage of land where shifts in FPAV are apparent

	Forest zone	Non-forest zone
dFPAVmax>0.005 (<-0.005)	21% (62%)	49% (18%)
dFPAVmin>0.005 (<-0.005)	53% (27%)	55% (6%)
dFPAVavr>0.005 (<-0.005)	24% (37%)	55% (7%)

Questions?

1. Are these shifts real? Or is it still illusion produced by orbital drift?

2. Are they related to climate variations? Or to land-use change?

3. Is it a trend? Or just a variation?

Announcement

I am going to give the presentation in front of the poster on Wednesday September 28 from 13:30 to 13:45

G.A.A.

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