

Seasonal and interannual changes in vegetation activity of tropical forests in Southeast Asia

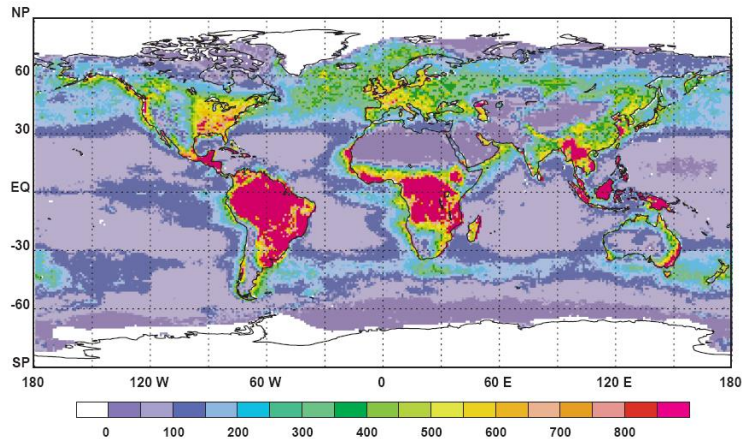
Yuan Zhang, Shilong Piao, Xiran Li, Zhenzhong Zeng,
Philippe Ciais, Mengtian Huang, Yongwen Liu



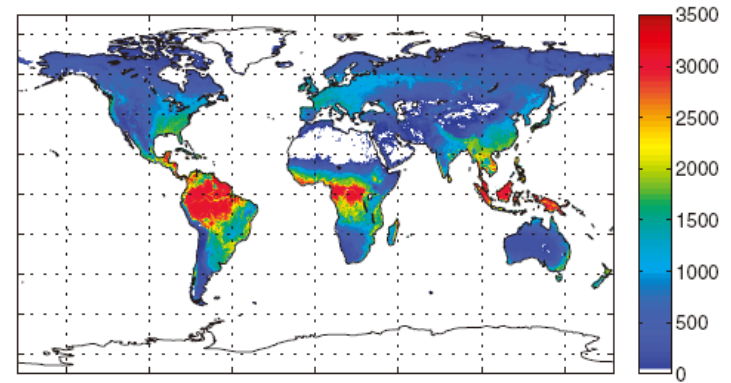
Outline

- Motivation
- Data
- Results and discussion
- Summary

Motivation



NPP (Field et al. 1998)



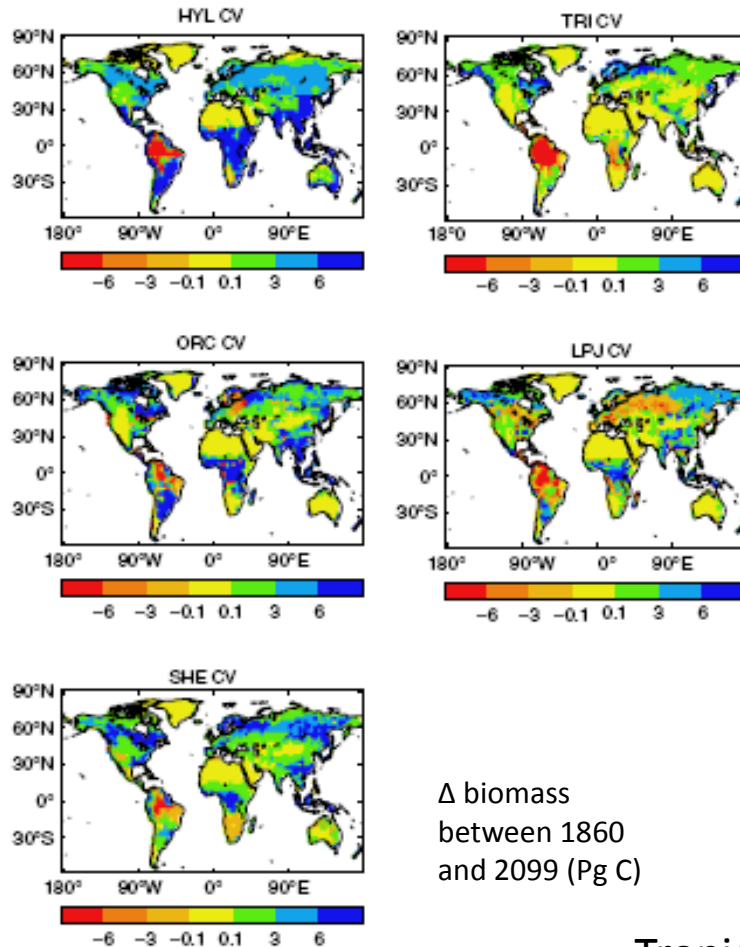
GPP (Beer et al. 2010)

	Area	Biomass
Humid tropical forests	13%	340 Pg C
Nonhumid tropical forests	12%	63 Pg C
Global terrestrial total	100%	652 Pg C

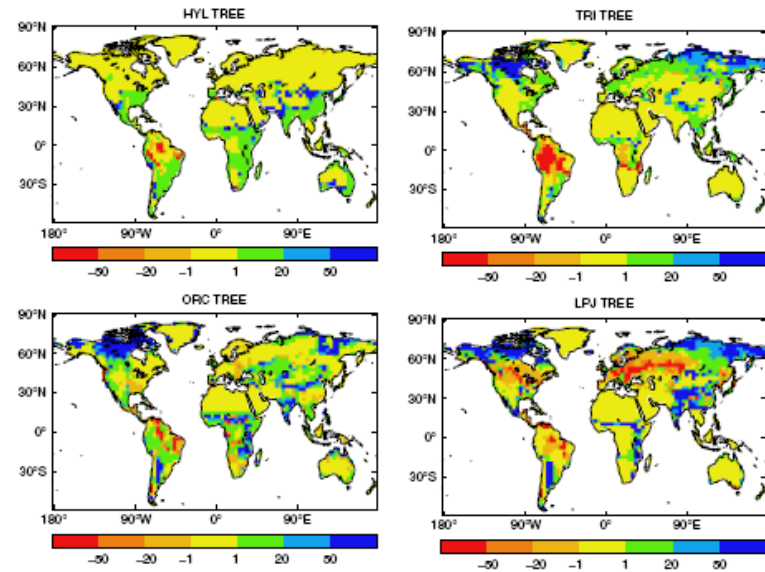
(Roy et al. 2001)

Tropical forests are critical for global C cycle.

Motivation



Δ biomass
between 1860
and 2099 (Pg C)

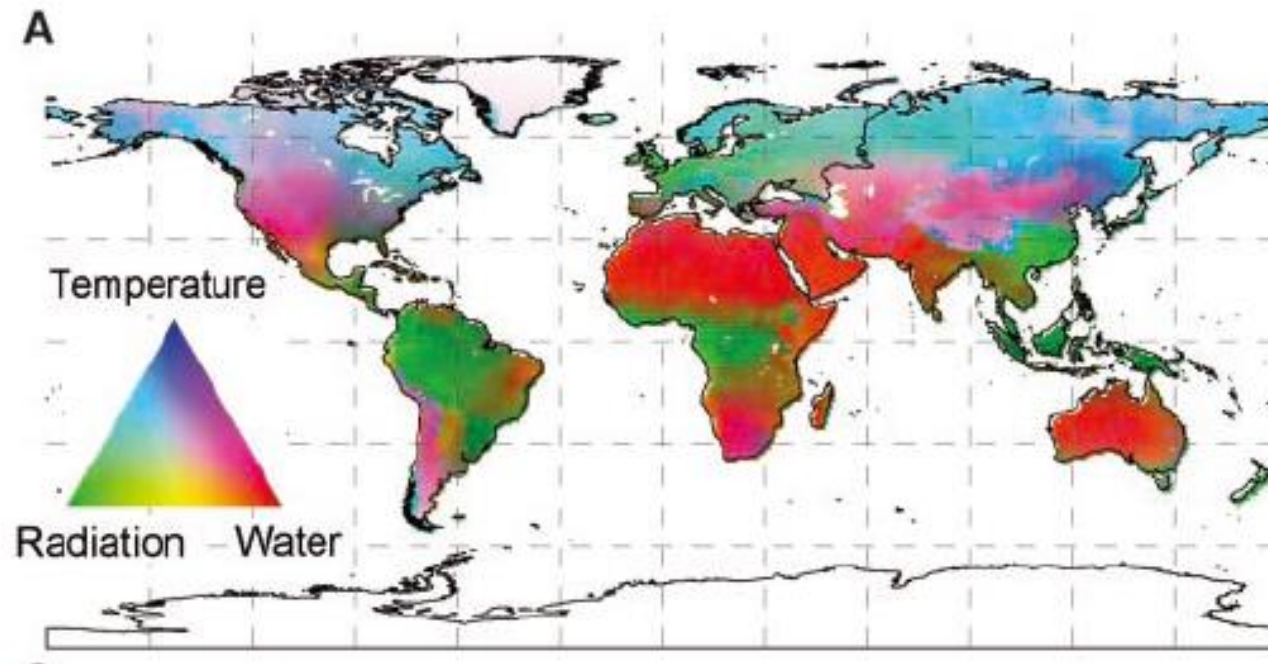


Δ Tree coverage between
1860 and 2099 (%)

(Sitch et al. 2008)

Tropical forests are sensitive to climate change,
but the mechanisms of how these forests
response to climate change are poorly understood.

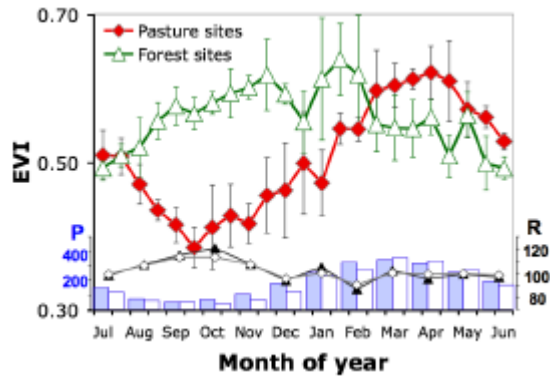
Motivation



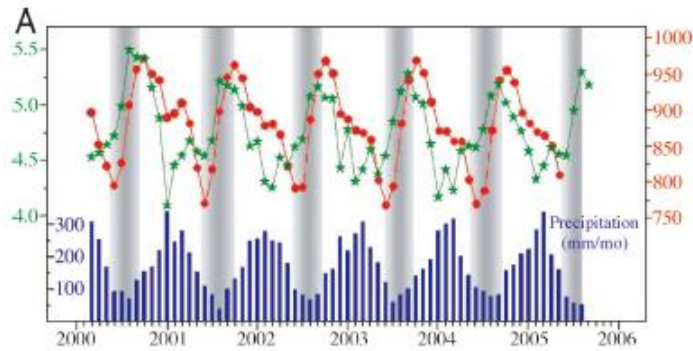
(Nemani et al. 2003)

Growth of vegetation in tropical regions
are radiation limited?

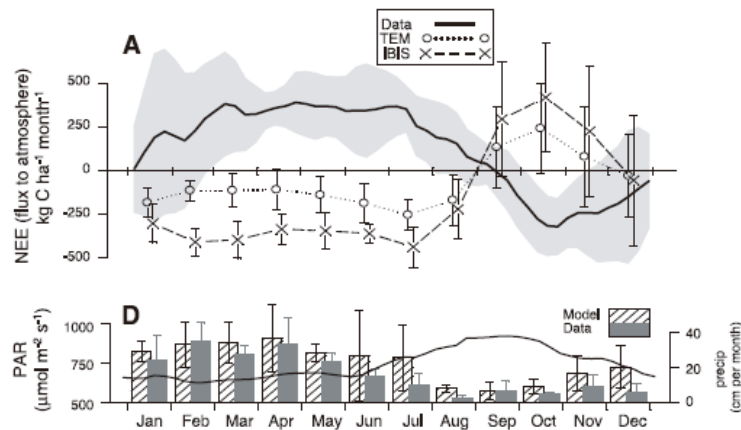
Motivation



(Huete et al. 2006)

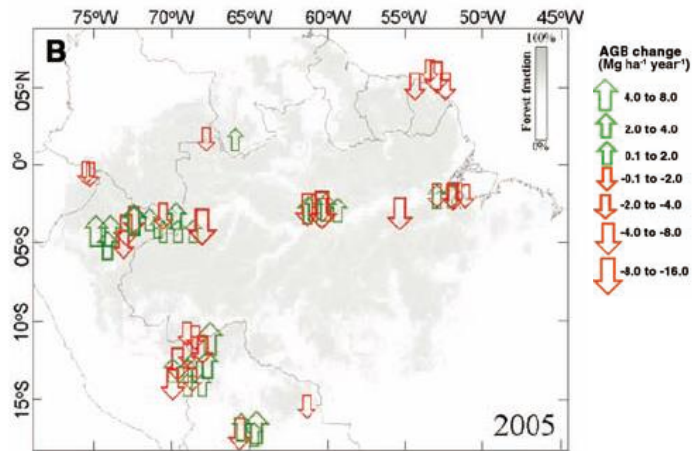


(Myneni et al. 2007)

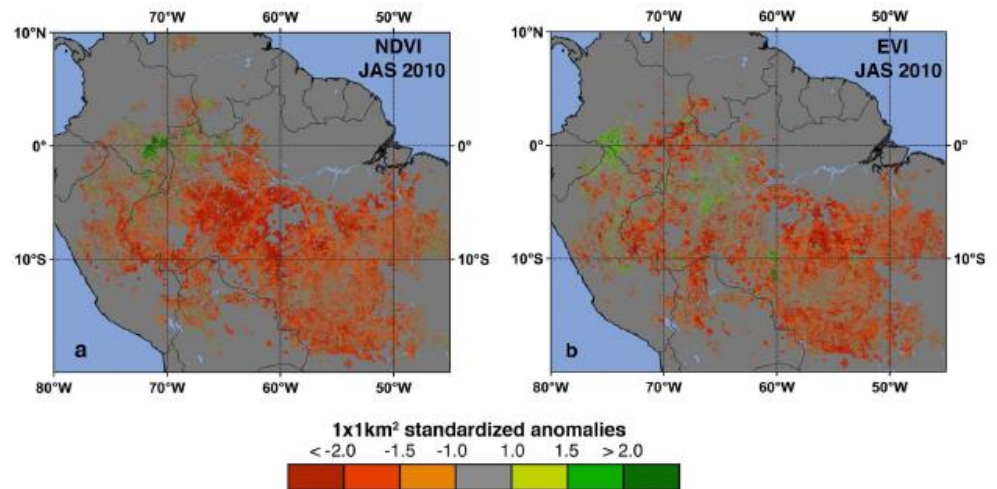


(Saleska et al. 2003)

Motivation

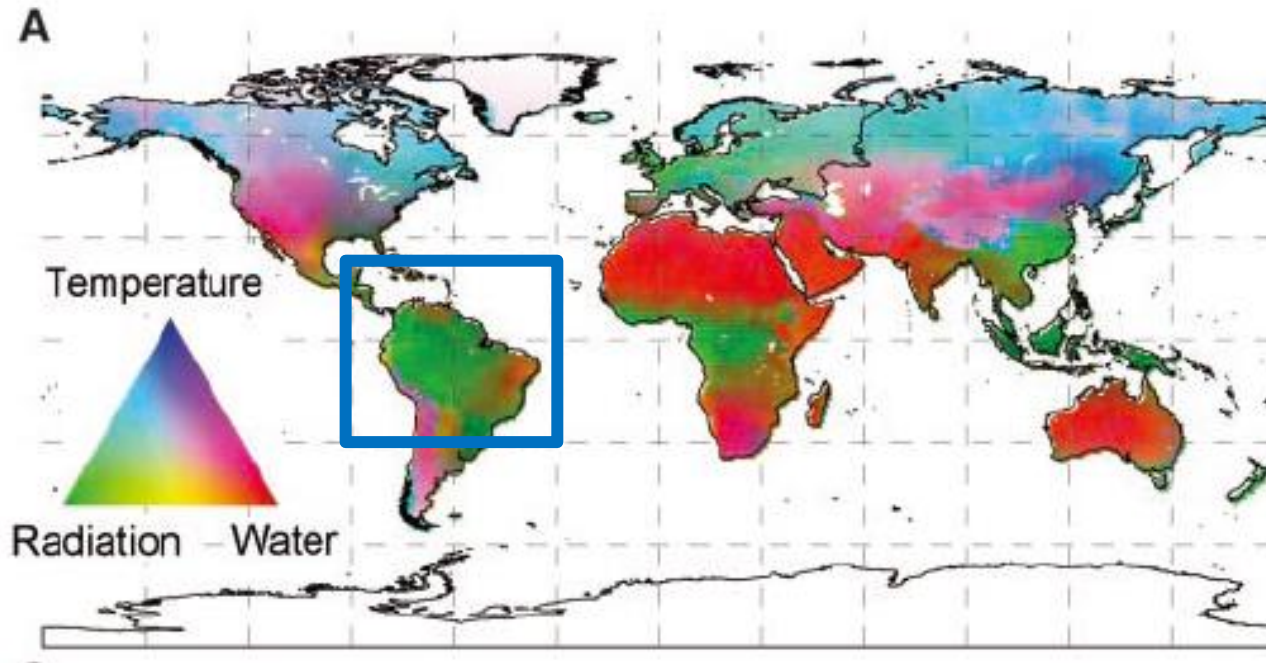


(Phillips et al. 2006)



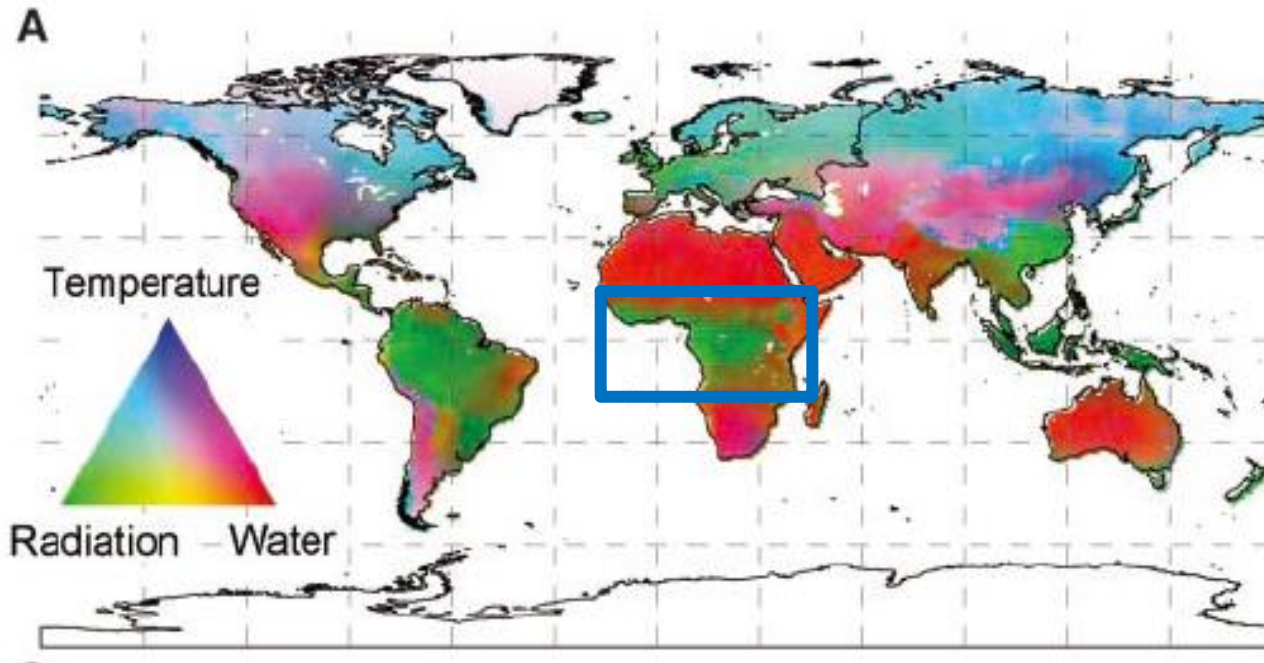
(Xu et al. 2011)

Motivation



(Nemani et al. 2003)

Motivation



(Meroni et al. 2003)

Response of African humid tropical forests

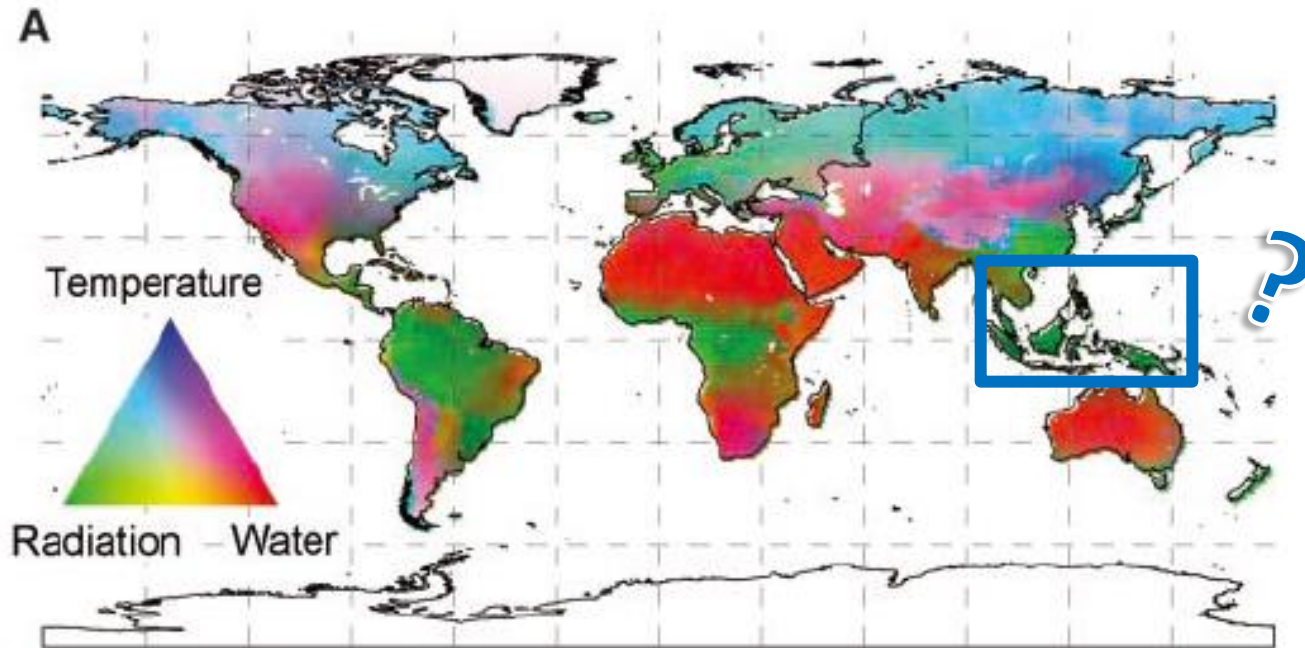
Widespread decline of Congo rainforest greenness in the past decade

Liming Zhou¹, Yuhong Tian², Ranga B. Myneni³, Philippe Ciais⁴, Sassan Saatchi⁵, Yi Y. Liu⁶, Shilong Piao⁷, Haishan Chen⁸, Eric F. Vermote⁹, Conghe Song^{10,11} & Taehee Hwang¹²

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Motivation



(Nemani et al. 2003)

A Large and Persistent Carbon Sink in the World's Forests

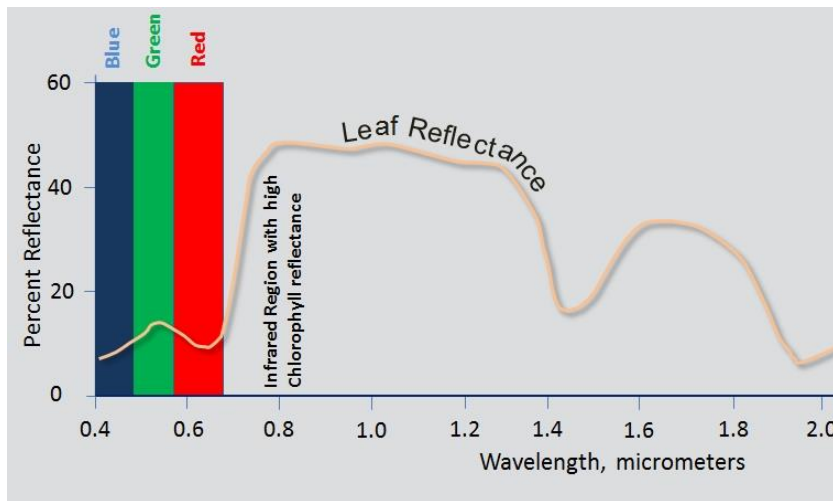
Yude Pan,^{1*} Richard A. Birdsey,¹ Jingyun Fang,^{2,3} Richard Houghton,⁴ Pekka E. Kauppi,⁵ Werner A. Kurz,⁶ Oliver L. Phillips,⁷ Anatoly Shvidenko,⁸ Simon L. Lewis,⁷ Josep G. Canadell,⁹ Philippe Ciais,¹⁰ Robert B. Jackson,¹¹ Stephen W. Pacala,¹² A. David McGuire,¹³ Shitong Piao,¹⁴ Aaron J. Doughty,¹⁵ Stephen C. C. 7, Daniel H. Hayes¹⁴

How vegetation activity varies in Southeast Asia?

What climate factors drive the variations?

Data

NDVI



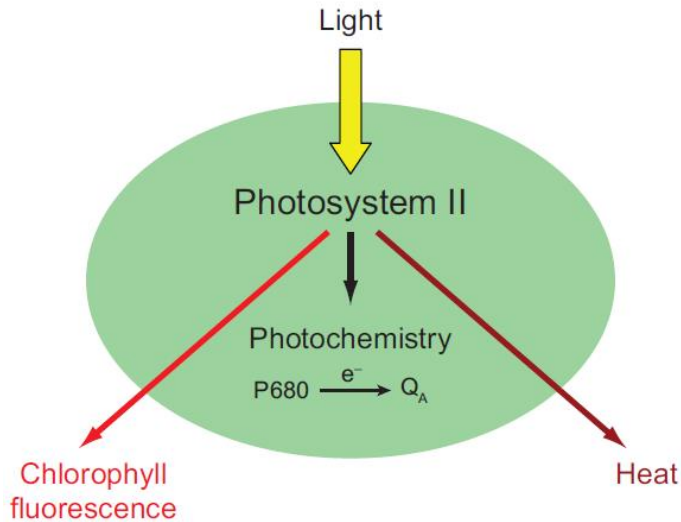
$$NDVI = \frac{(\rho_{NIR} - \rho_{Red})}{(\rho_{NIR} + \rho_{Red})}$$

GIMMS AVHRR NDVI3g: since 1981

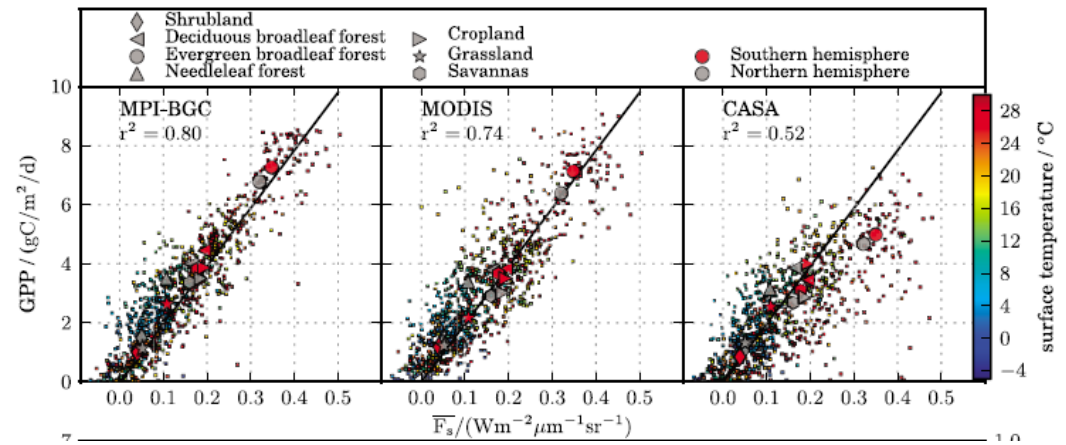
SPOT-VGT: since 1998

MODIS (MOD13A2, C5): since 2000

Sun-induced Chlorophyll Fluorescence (SIF)



(Baker et al. 2008)

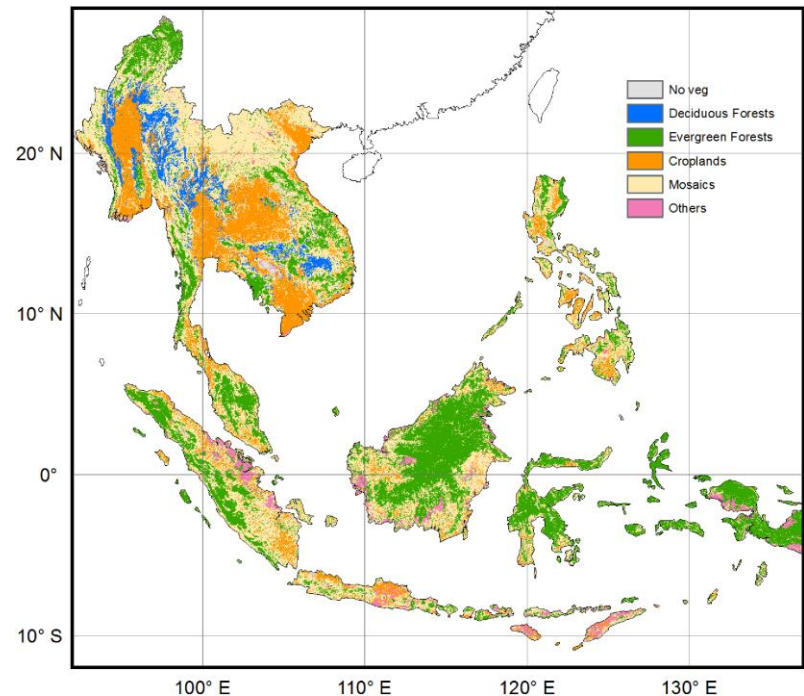


(Frankenberg et al. 2008)

GOSAT Sun-induced chlorophyll fluorescence (since 2009)

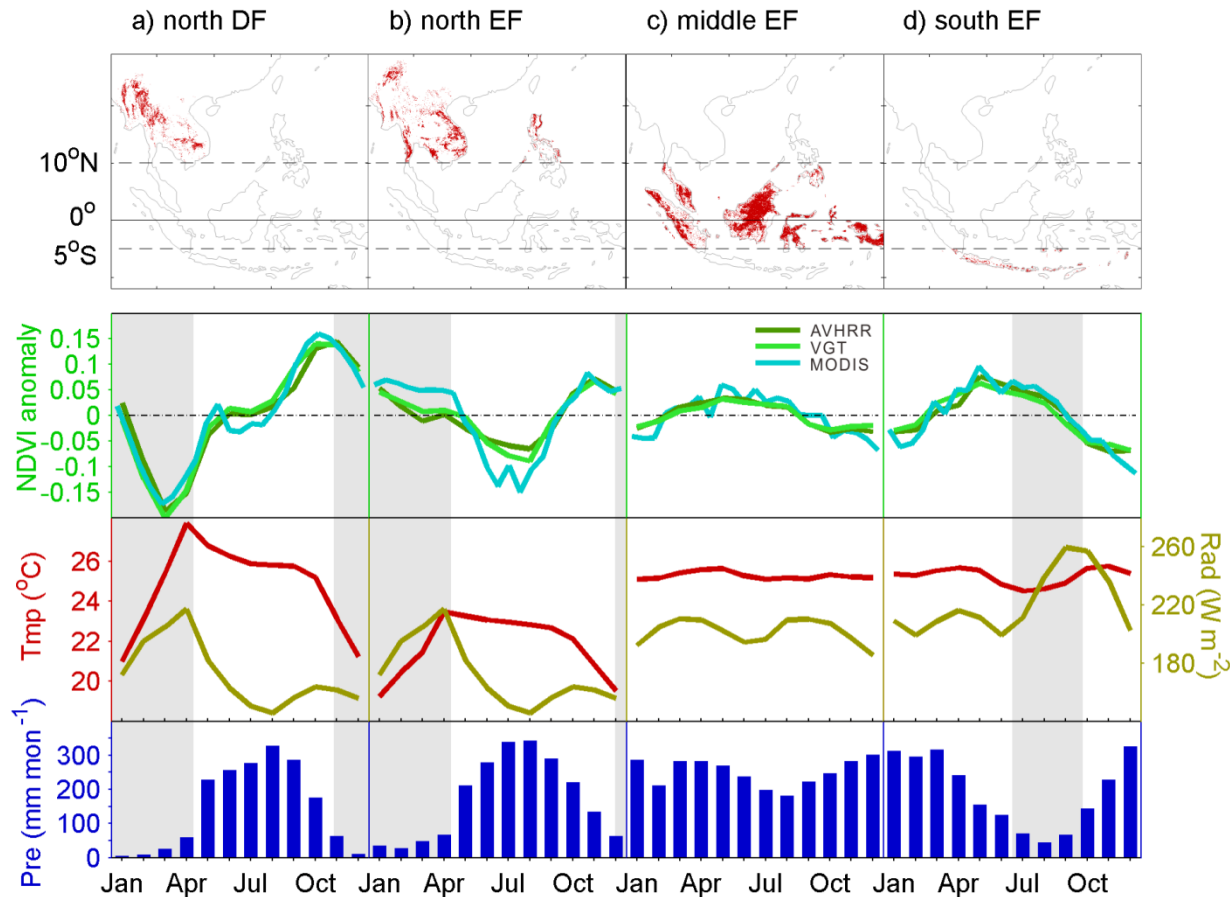
Other data

- CRU TS 3.21 Precipitation, Temperature
- SRB incoming shortwave radiation
- GLC 2000 land cover



Results and discussion

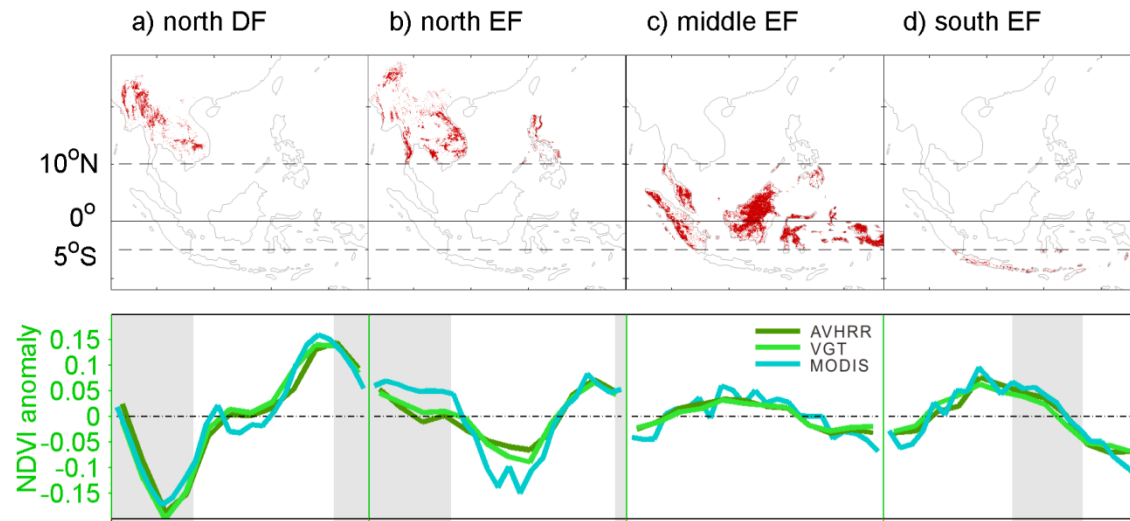
Seasonal variation



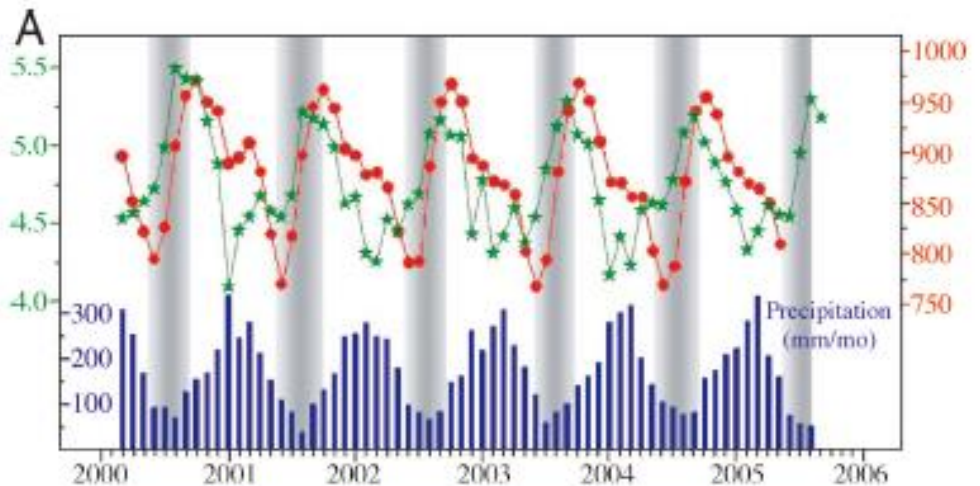
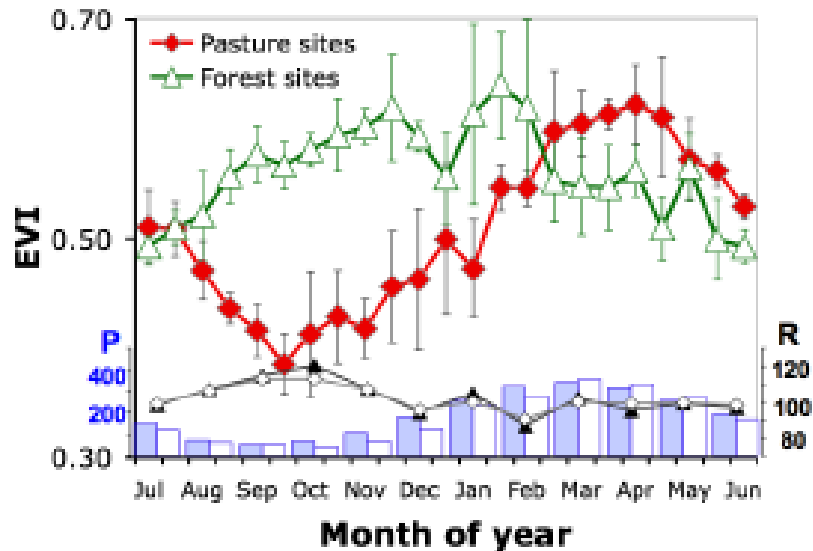
Distinct seasonal variation of climate factors from north to south Southeast Asia;

A remarkable decline in NDVI during dry season.

Seasonal variation



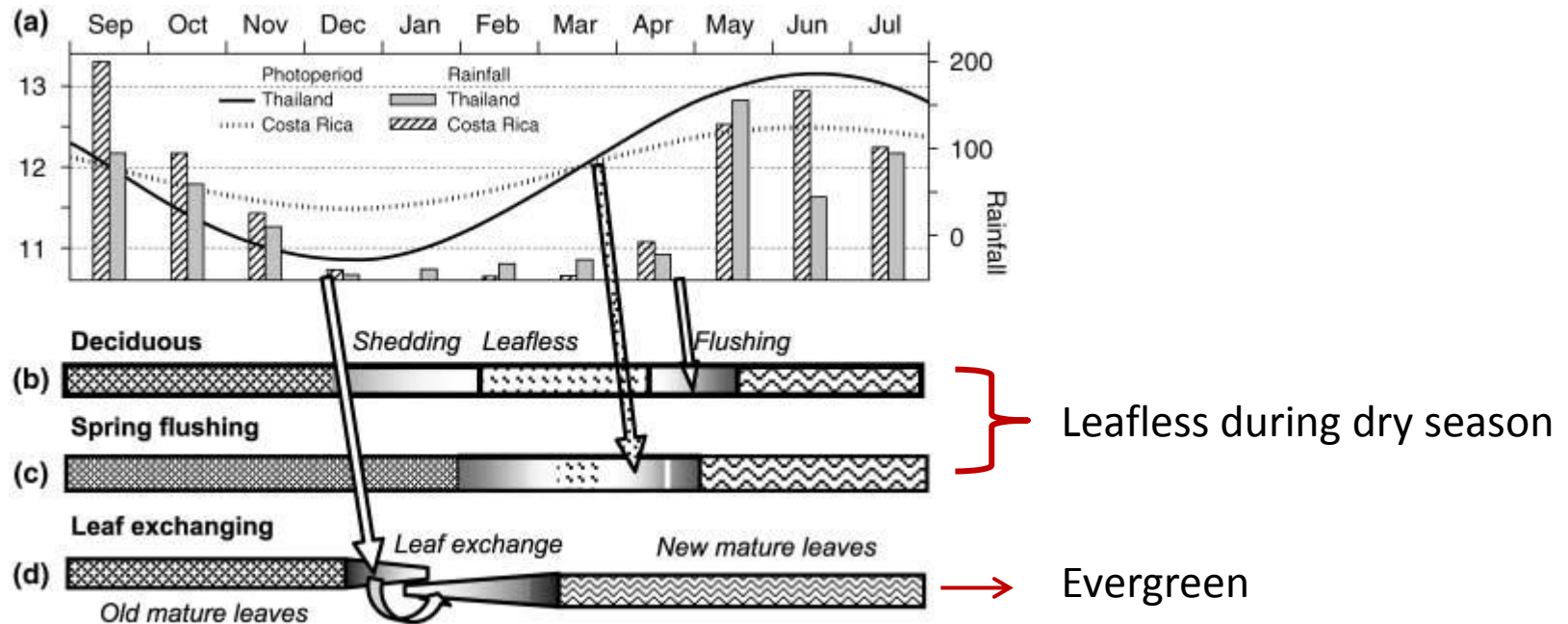
The seasonal variation of greenness in Southeast Asia forests differs from Amazon.



(Huete et al. 2006)

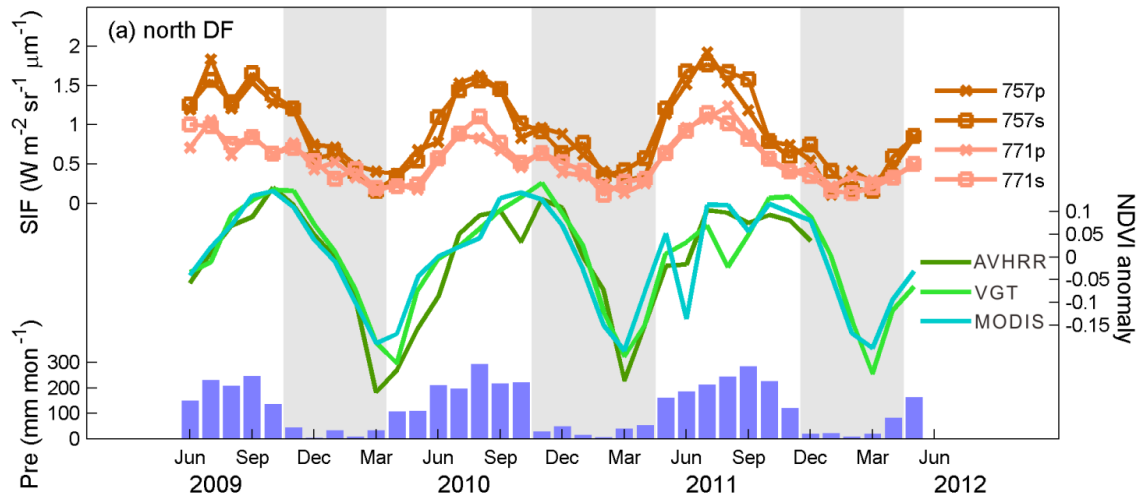
(Myneni et al. 2007)

Seasonal variation

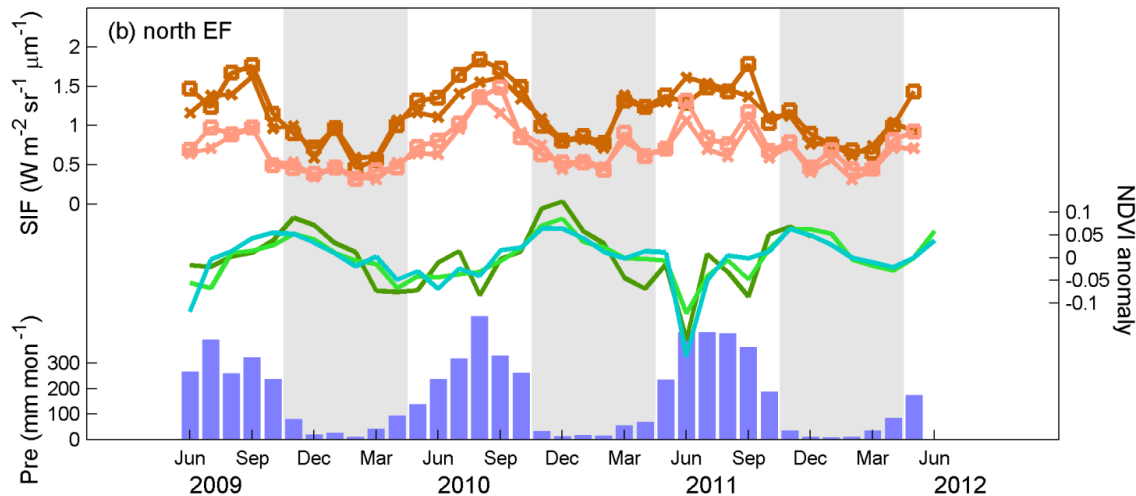


(Elliott et al. 2006)

Seasonal variation



NDVI represents greenness, chlorophyll content or potential photosynthesis ability

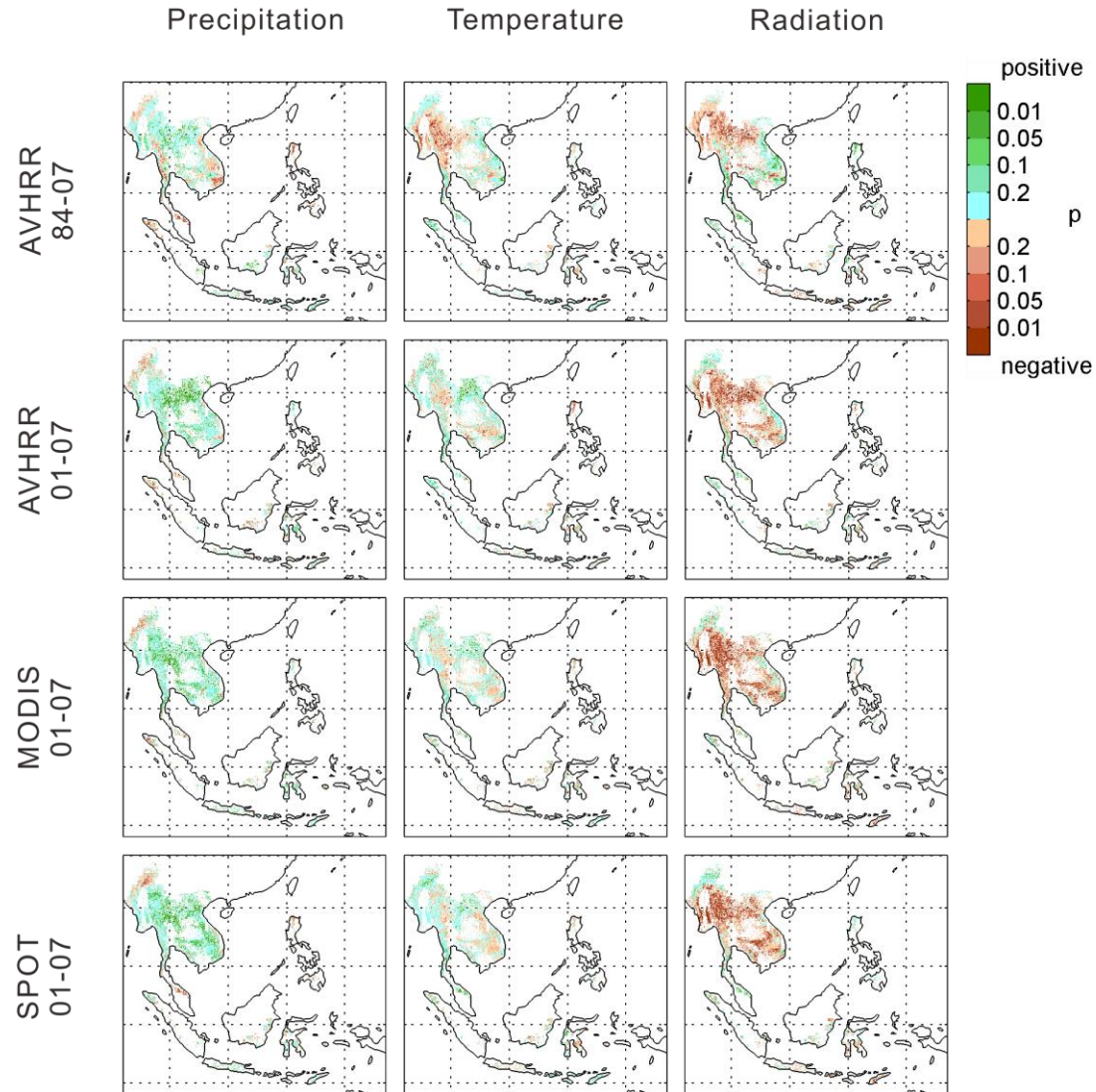


SIF is related to absorbed radiation and stress (e.g. heat, dry), reflects instantaneous photosynthesis activity

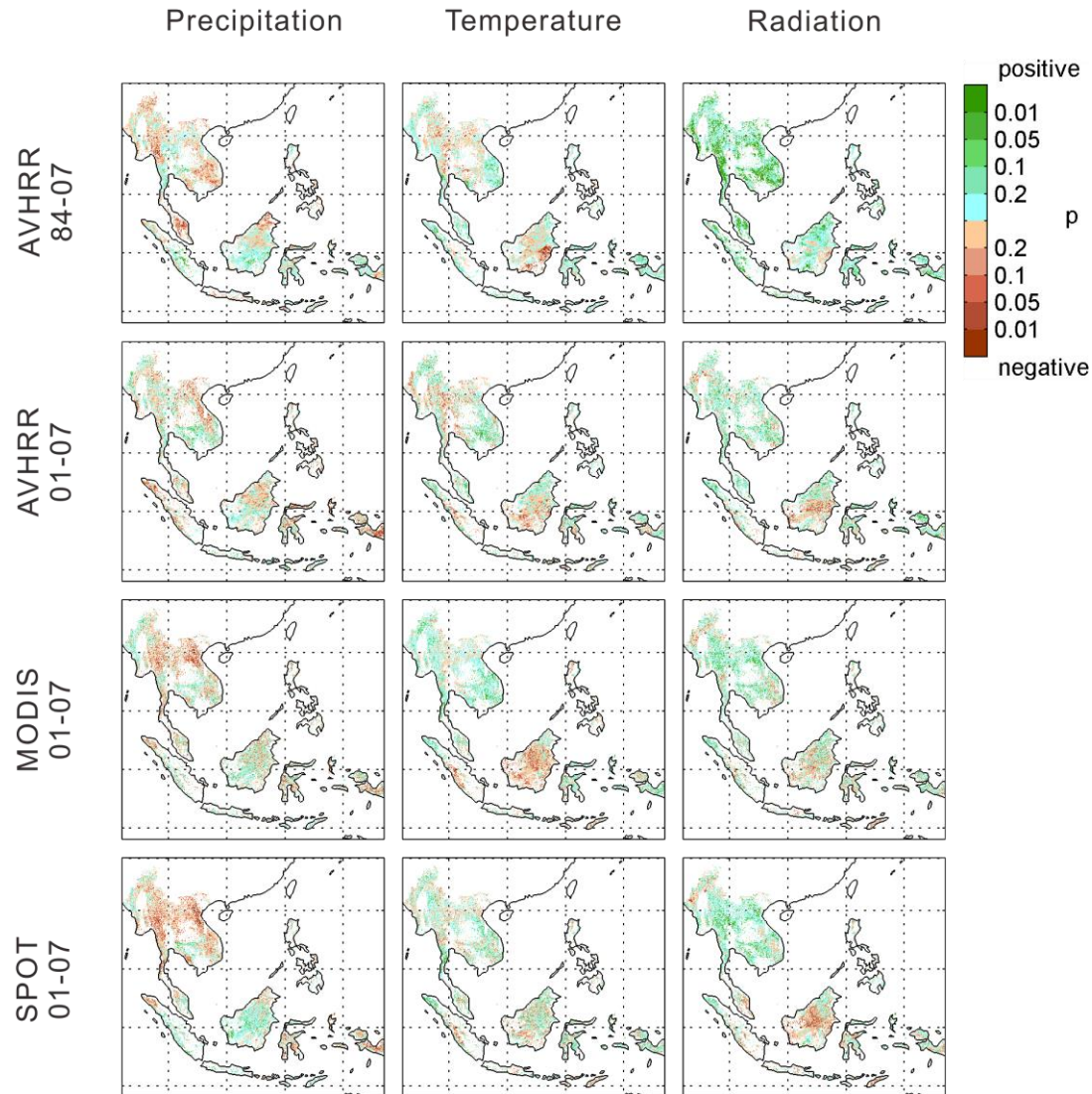
Seasonal variation

- At the season scale, in forests with pronounced wet-dry seasonal cycle, both NDVI and SIF decline during the dry season.
- During the wet season, SIF is generally consistent with NDVI in the DF but contrasts to NDVI in the EF.

Interannual-dry season



Interannual-wet season

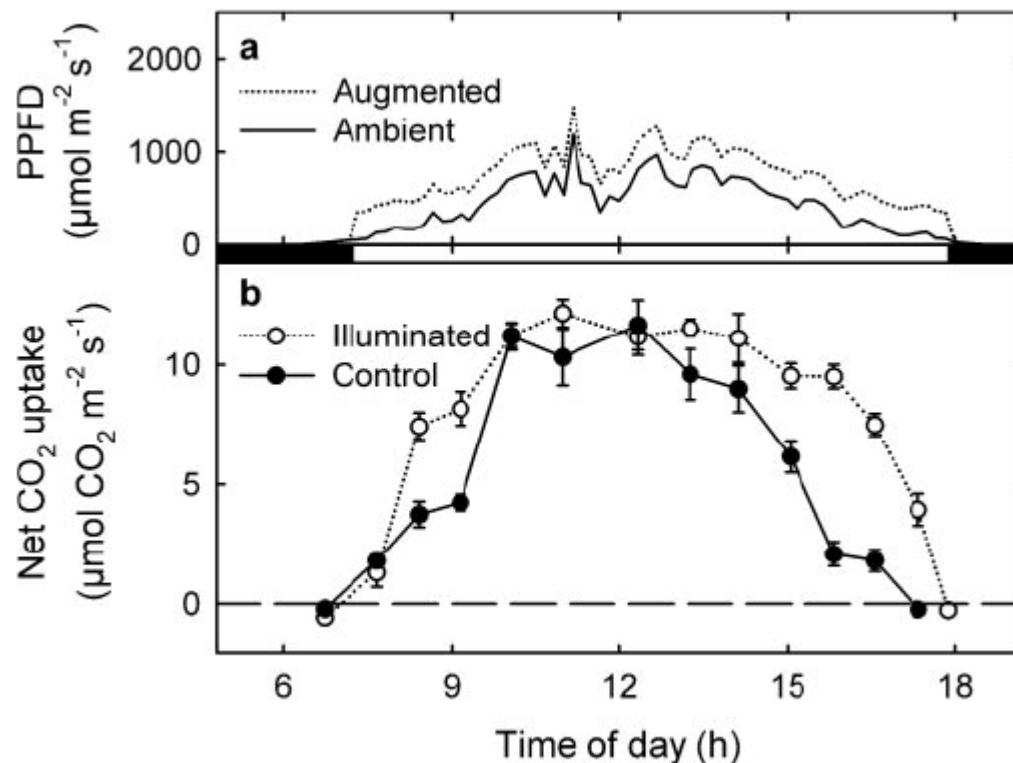


Interannual-wet season

Cloud cover limits net CO₂ uptake and growth of a rainforest tree during tropical rainy seasons

Eric A. Graham*, Stephen S. Mulkey*[†], Kaoru Kitajima*, Nathan G. Phillips[‡], and S. Joseph Wright[§]

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Summary

- At the season scale, in forests with pronounced wet-dry seasonal cycle, both NDVI and SIF decline during the dry season.
- During the wet season, SIF is generally consistent with NDVI in the DF but contrasts to NDVI in the EF.
- At the interannual scale, the dry season NDVI was positively correlated with precipitation, but was negatively correlated with radiation, while the wet season NDVI was positively correlated with radiation.
- Distinct driving factors of forests growth are found in Southeast Asia during different seasons.

Thanks for listening!