

# Global analysis of canopy-scale chlorophyll fluorescence retrievals from MetOp-A/GOME-2 data

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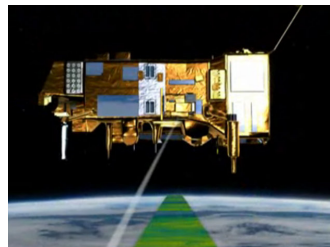
<sup>2</sup>Max Planck Institute for Biogeochemistry, Germany

# Outline

- 1 SIF and GPP on global scale
- 2 Crop study
- 3 SIF modeling

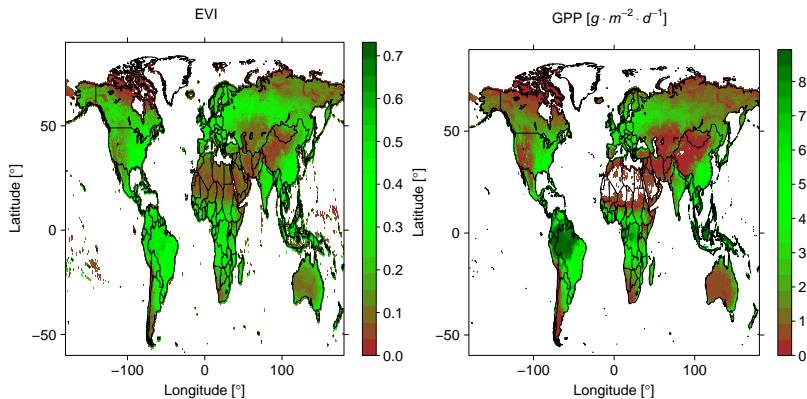
# Data

- Global data driven GPP estimates (M. Jung, MPI-BGC Jena)
- Remotely sensed SIF from GOME-2 (J. Joiner et al)
- Both on a  $0.5^\circ$  grid
- Monthly resolution
- Comparison with EVI (derived from MODIS)



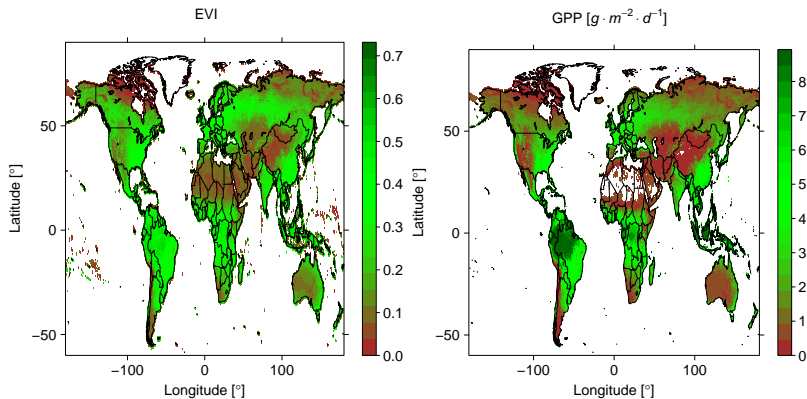
<http://www.esa.int>

## EVI vs. GPP



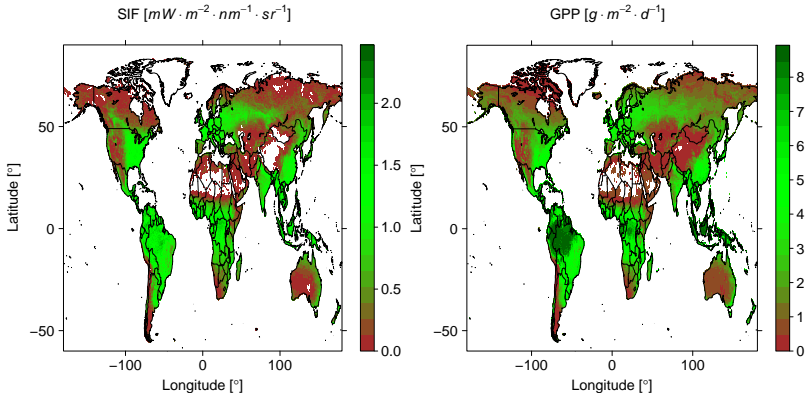
- General agreement in multi-year-average patterns

# EVI vs. GPP



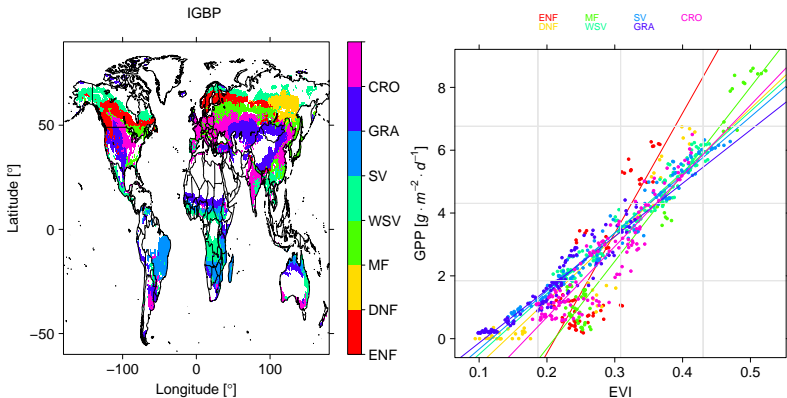
- General agreement in multi-year-average patterns
- Low agreement in ratios of high and less productive regions

# SIF vs GPP



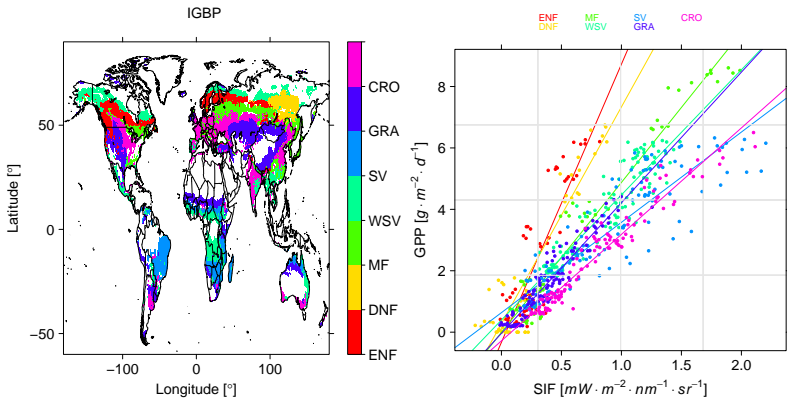
- Good agreement even for low productive regions

# EV1 per biome view



- Small spread in slopes between different biomes
- Linear relationship is questionable

# SIF per biome view



- Larger spread in slopes
- Good linear relationship

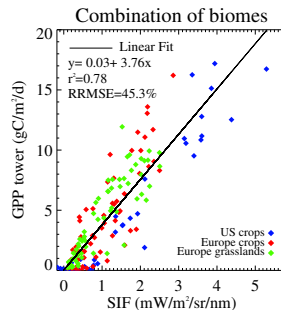
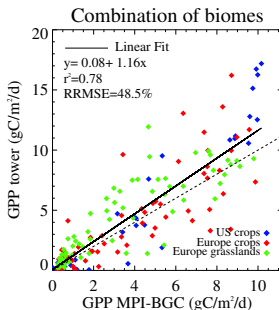


# Scaling of SIF to GPP

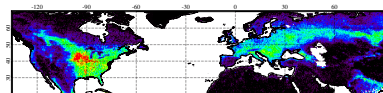
- Linear relation per biome can be used to scale SIF to GPP (i. e. crops and grasslands)

# Scaling of SIF to GPP

- Linear relation per biome can be used to scale SIF to GPP (i. e. crops and grasslands)
- Flux towers on homogeneous areas as basis for fitting

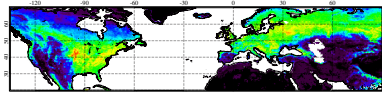


# Why crops?



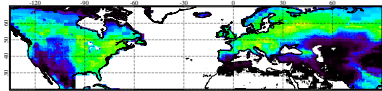
SIF (mW/m²/sr/nm)

0.0 0.9 1.8 2.7 3.6 4.5



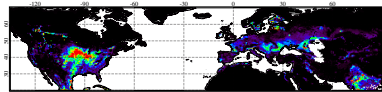
GPP Data-driven (gC/m²/d)

0 2 5 7 10 13



GPP Proc.-based (gC/m²/d)

0 2 5 7 10 13

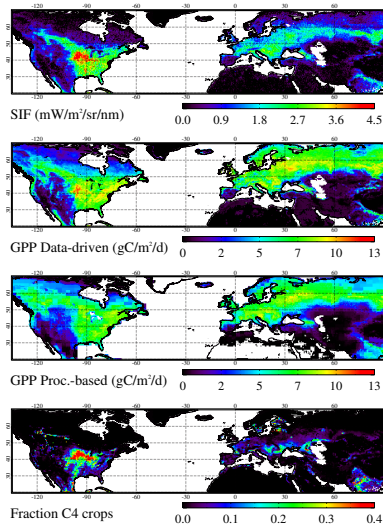


Fraction C4 crops

0.0 0.1 0.2 0.3 0.4

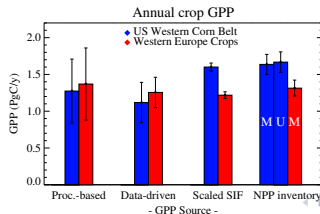
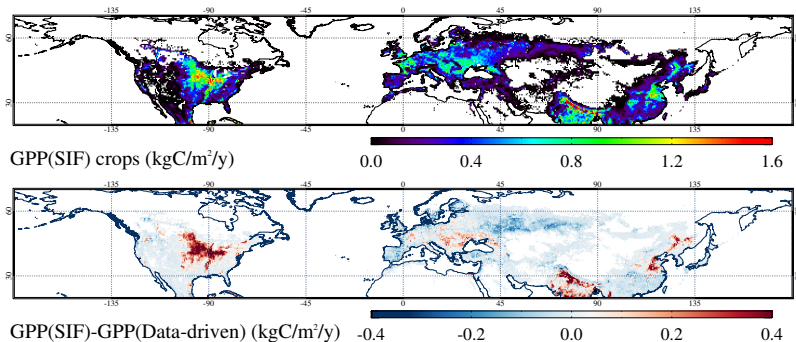
- Pattern of high productivity at US WCB

# Why crops?



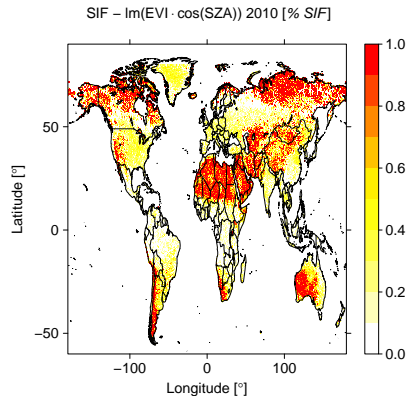
- Pattern of high productivity at US WCB
- Not apparent in process-based and data-driven models (Paio et al, Beer et al)

# Crop Study



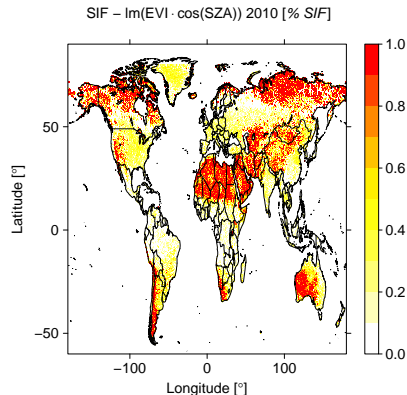
# Understanding the signal

- $SIF = a + b[EV I \cdot \cos(SZA)]$



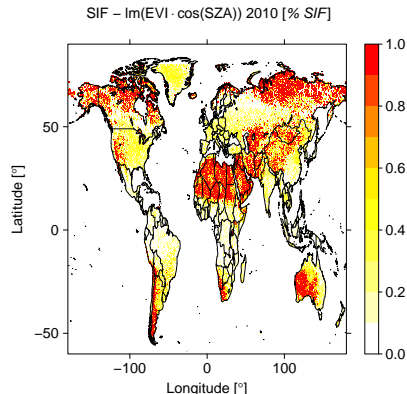
# Understanding the signal

- $SIF = a + b[EV I \cdot \cos(SZA)]$
- Large differences in high latitudes
- Simple linear scaling seems to be inappropriate



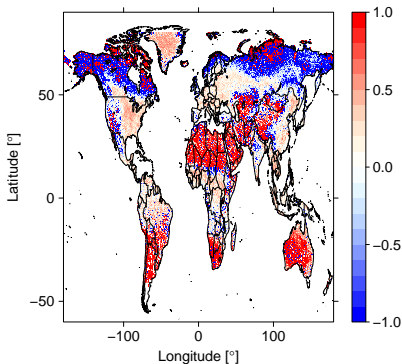
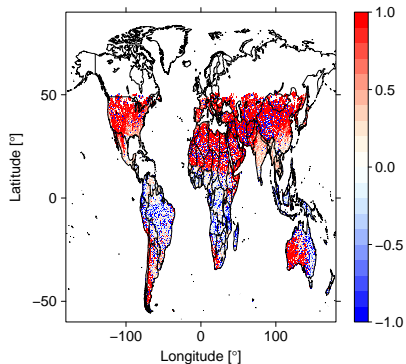
# Understanding the signal

- $SIF = a + b[EV I \cdot \cos(SZA)]$
- Large differences in high latitudes
- Simple linear scaling seems to be inappropriate
- Which additional factors do influence the signal?



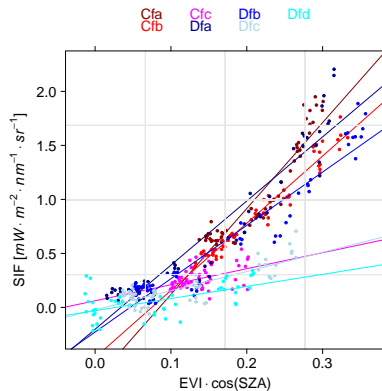
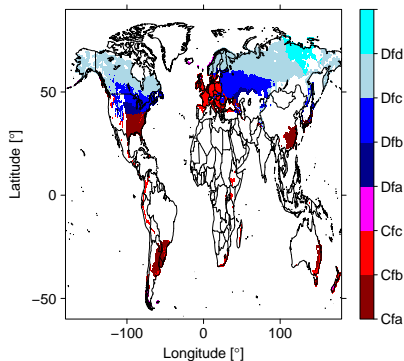


# Seasonal view

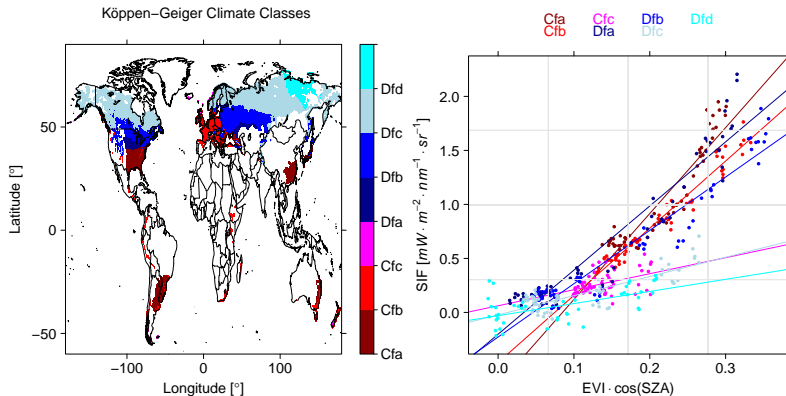
SIF –  $\ln(\text{EVI} \cdot \cos(\text{SZA}))$  July 2010 [% SIF]SIF –  $\ln(\text{EVI} \cdot \cos(\text{SZA}))$  December 2010 [% SIF]

# Additional influences

Köppen–Geiger Climate Classes

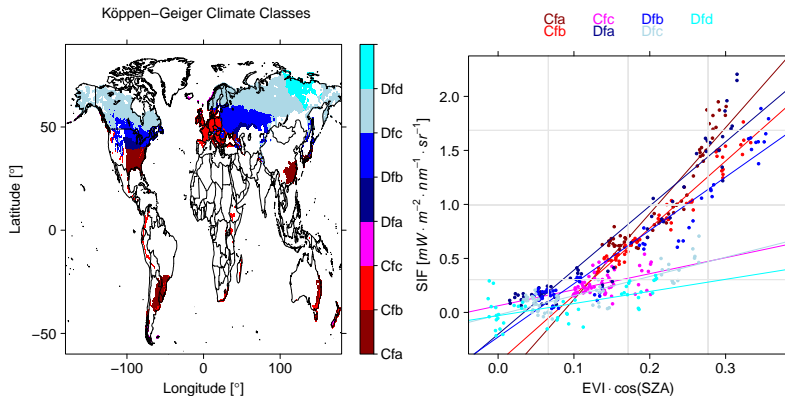


# Additional influences



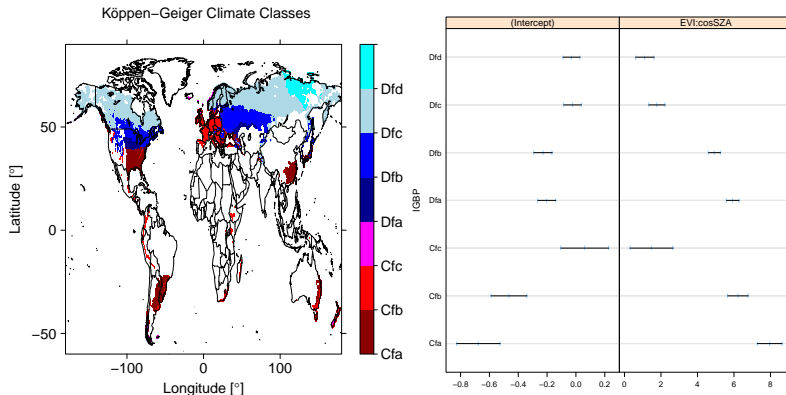
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- SIF dependency on temperature and precipitation patterns

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# SIF modeling



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# Summary

- Global patterns of vegetation productivity and GOME-2 SIF retrievals show really good agreement
- Closer investigation reveals different slopes per biome (IGBP)
- Linear relationship between SIF and GPP on tower scale leads to a new estimation of crop productivity (GPP)
- Main drivers of SIF are leaf greenness (EVI) and illumination ( $\cos(\text{SZA})$ )
- Local meteorological conditions regulate the magnitude of scaling

# Thank you for your attention!

