

Evaluating the relationship between SIF and GPP under climate extremes

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In-situ data from 56 FLUXNET sites:

- 8 forest PFTs (EBF separated for Tr. and ExTr.)
- Sites covering the period 2007-2018
- Variables:
 - GPP & PAR
 - Climate variables gap-filled with ERA5:
T, SWin, VPD
 - Measured Soil Water Content (when available)



Masked out winter days

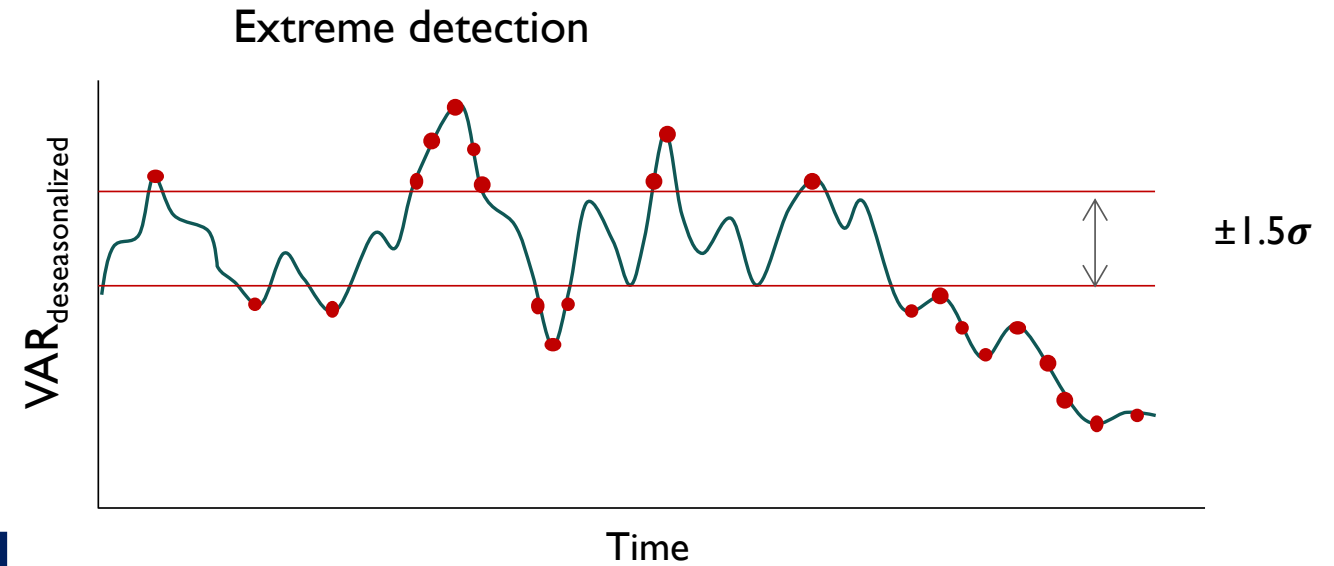
fPAR from MODIS (1km)

SIF from two RS-based products, extracted for each EC-site location

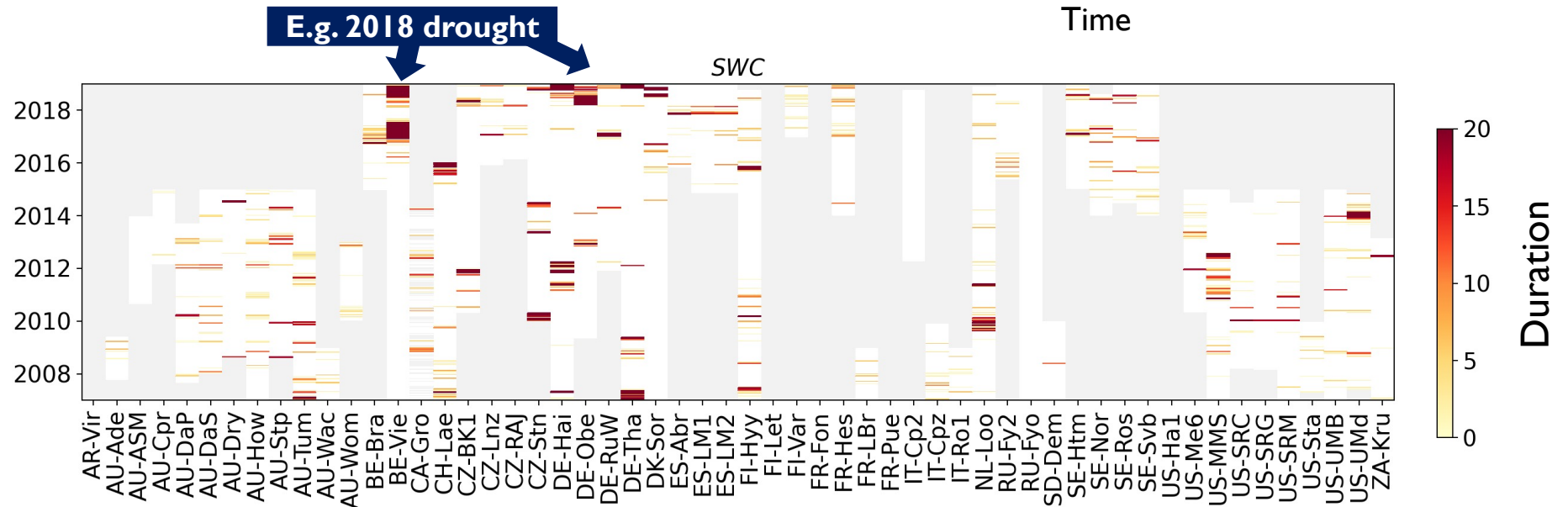
- GOME-2 downscale at 0.05degree (8D time-steps from 16D moving window) from Duveiller et al. (2019) **2007-2018**
- GOME-2 at 0.5 degree and daily time-steps from Köhler et al. (2015): smoothed by 16D moving average **2007-2016**
- TROPOMI at up to 7×3.5-km and daily time-steps: smoothed by 16D moving average **2018 only**

Climate extreme detection

1. Deseasonalise data
2. Calculate 16D moving average
3. Standardize anomalies
4. Binary classification of days:
 - Extreme T/VPD $\geq 2\sigma$
 - Extreme SWC $\leq -1.5\sigma$
5. Calculate duration of extreme conditions
6. Filter out extremes < 3 days



Example for Soil Water Content



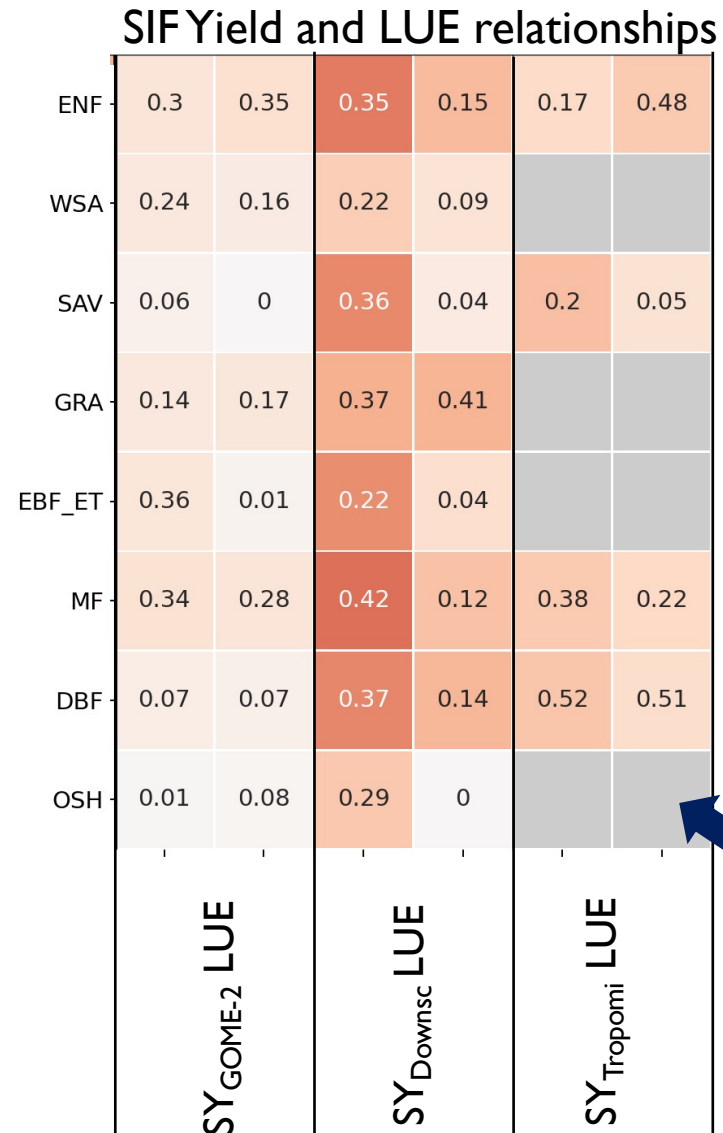
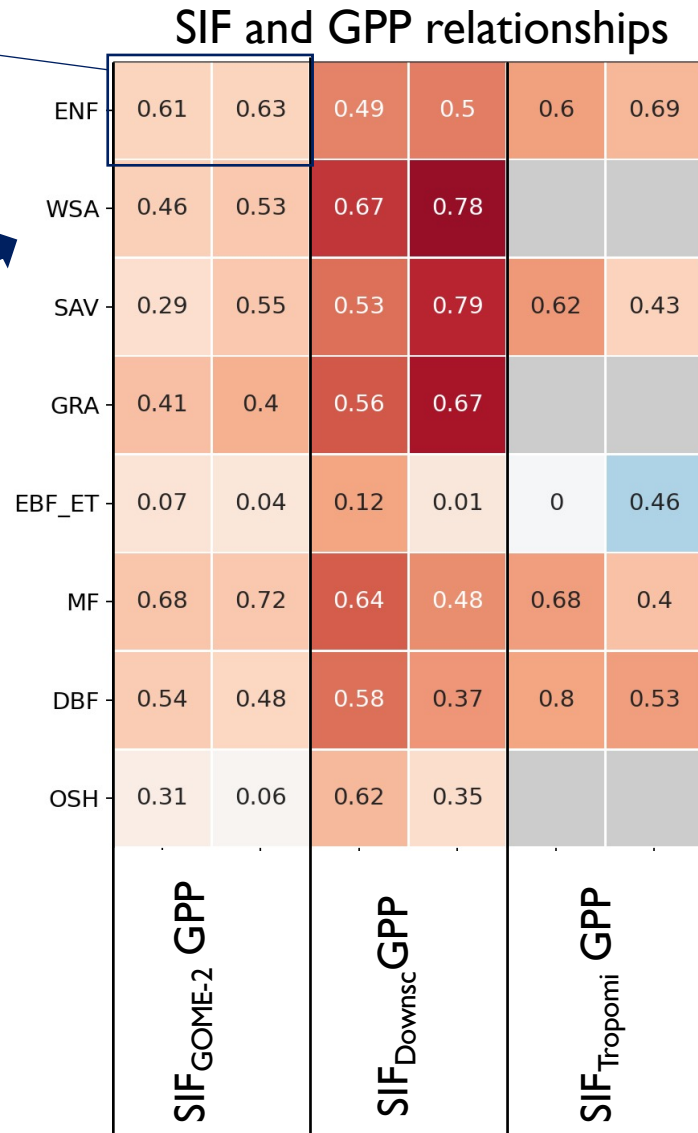
SIF vs GPP relationships under climate extremes

Other days
Extreme days

SAV: stronger relationships between SIF and GPP during extreme days

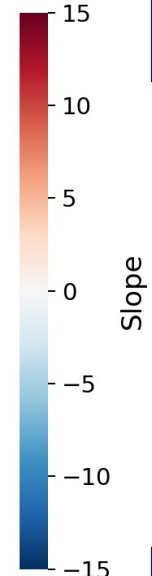
The opposite is found in DBF

The values in the cells show the R^2 of the relationship between each variable pair



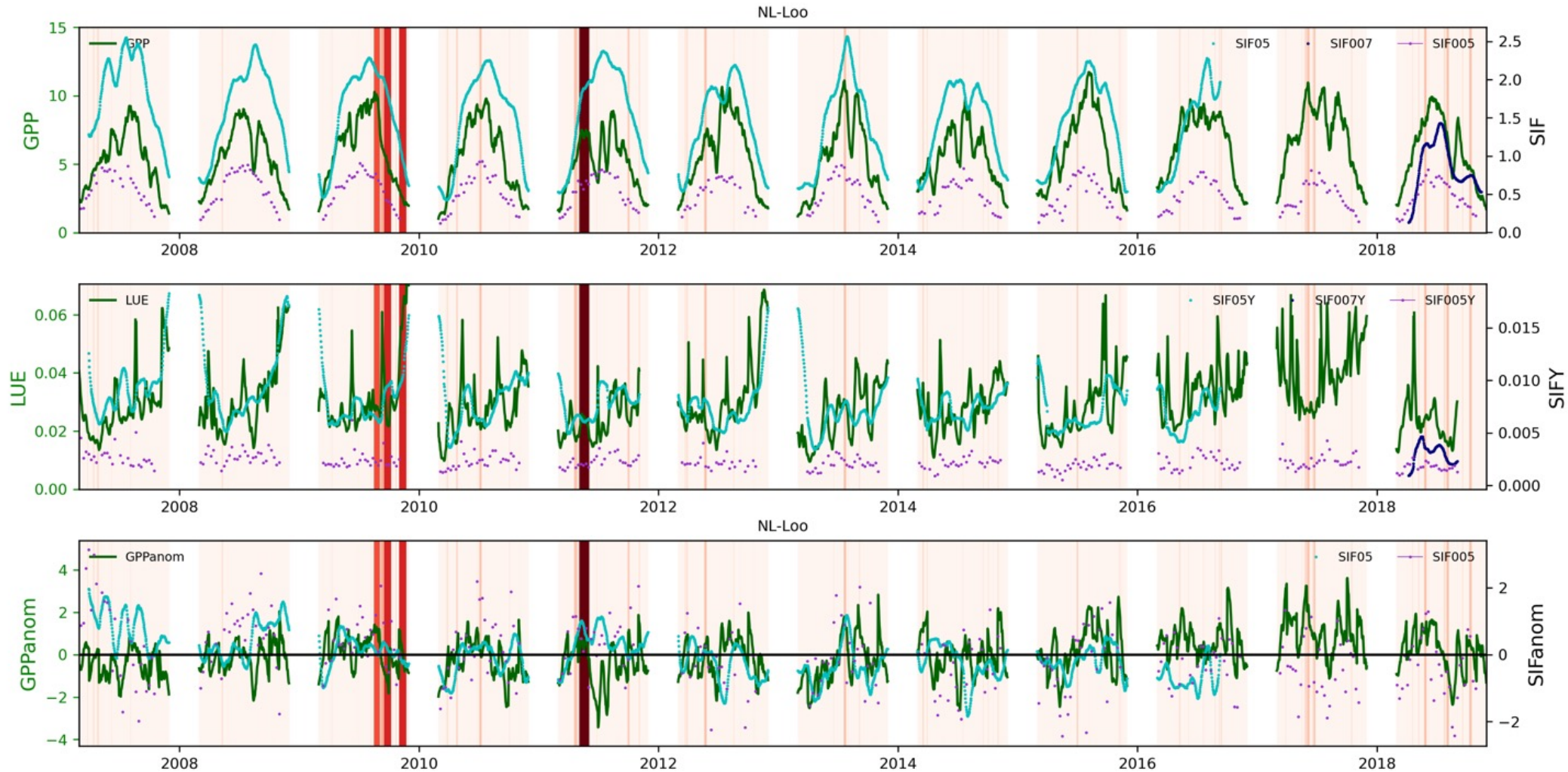
Yield relationships generally weaker

But stronger for the downscale product & TROPOMI: spatial scale?



Example: GPP, LUE and GPPanom in NL-Loo (ENF)

Time-series of SIF and GPP (top), their yields (center) and anomalies (bottom)



GOME-2

**GOME-2
downscale**

TROPOMI

GPP / LUE



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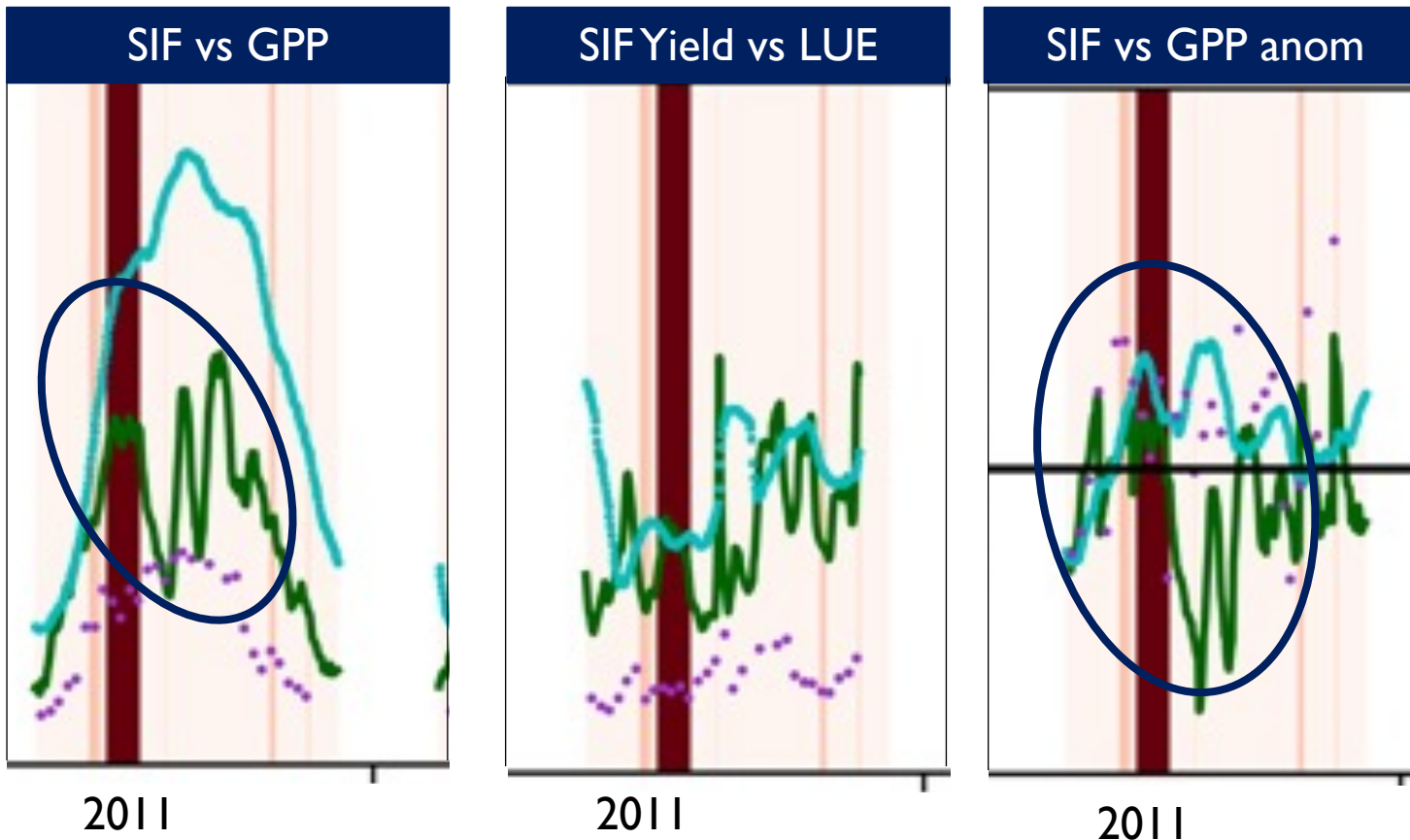
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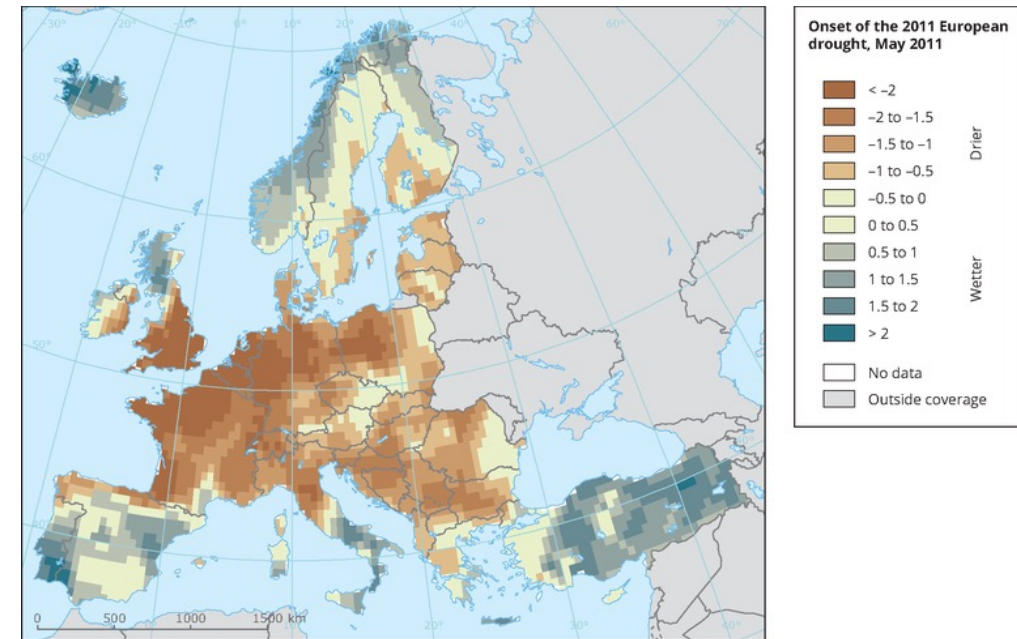
* No anomalies calculated for TROPOMI because of short time-series

Example: GPP, LUE and GPPanom in NL-Loo (ENF)

Time-series of SIF and GPP (top), their yields (center) and anomalies (bottom) – **drought spring 2011**



GOME-2 GOME-2 downscale GPP / LUE



SIF and GPP and their anomalies show opposite dynamics after the peak of drought

Coming up...

- Extended time-series up to 2019/2020 would allow covering two more years of TROPOMI and two extreme summers at least in Europe
- Refine “stress” definitions
- Evaluate seasonal-dependence of these relationships



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