The role of LST characteristics in the data-driven simulation of fluxes of carbon, water and energy

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LST_cci User Workshop

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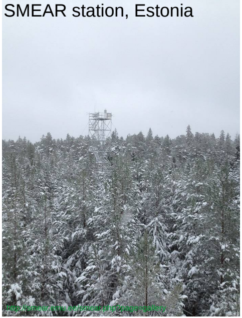
Max Planck Institute
for Biogeochemistry

FluxCom

land surface temperature cci

Eddy-covariance: the only way to directly measure land-atmosphere fluxes

Amazon Tall Tower Observatory, Brazil


SMEAR station, Estonia

Montana, USA

Barrow, Alaska

A complementary way to model natural fluxes over land

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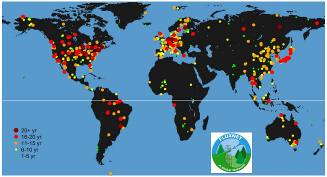
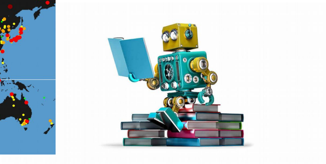
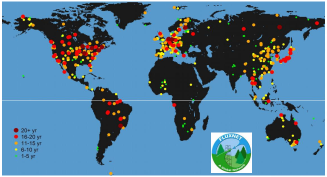
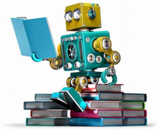


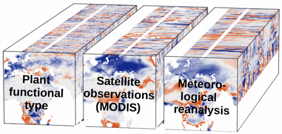


In-situ eddy-covariance fluxes & meteorology + machine learning

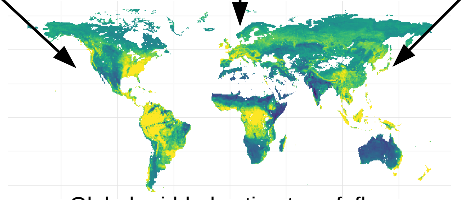
A complementary way to model natural fluxes over land







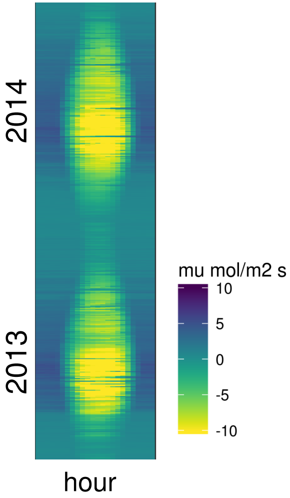
In-situ eddy-covariance fluxes & meteorology + machine learning + global gridded data sets of predictors



Global gridded estimates of fluxes

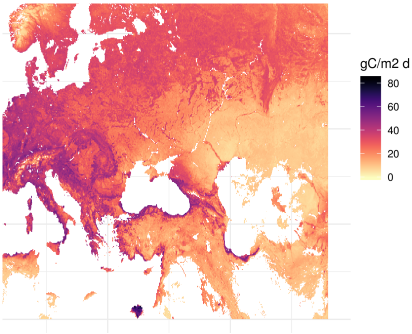
Annual net land CO_2 uptake [gC/m2d]

Simulated carbon fluxes



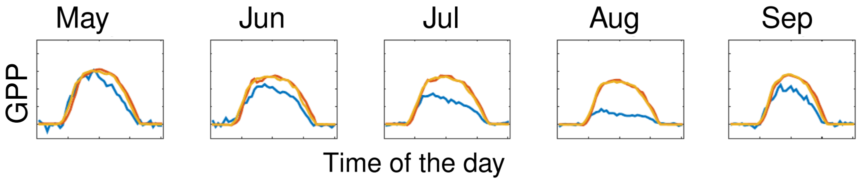
Net CO_2 uptake in the pixel of Jena/ Germany (hourly)

Annual gross CO_2 uptake through photosynthesis



Robust spatial and seasonal patterns

Drought effects not well represented



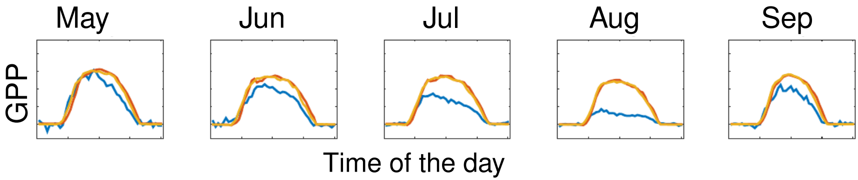
observation
modelled with daily predictors
modelled with daily & halfhourly predictors

Puechabon

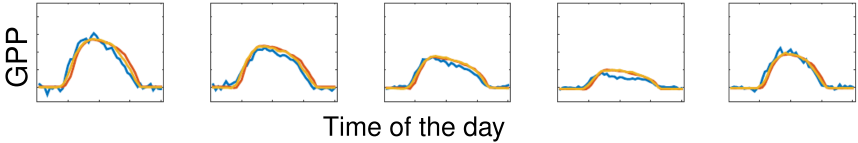
Bodesheim et al. 2018

GPP: gross photosynthetic CO_2 uptake

Drought effects not well represented



Daily GPP as additional daily predictor:



observation
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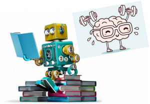
GPP: gross photosynthetic CO_2 uptake

FluxCom2.0

Eddy covariance & meteo:
- ► more sites & more site-years
- ► careful QC, gapfilling, ancillary
- ► harmonization of different sources
- ► additional eddy processing

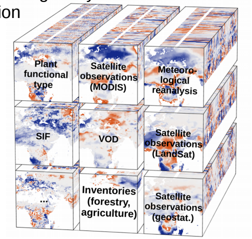


machine learning
- ► more and other techniques

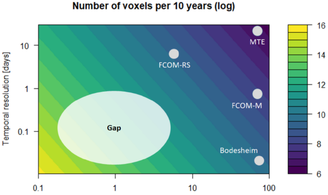
Features:
- ► extend suite of EO predictors
- ► both local (full resolution) and global scales
- ► dedicated QC+gapfilling
- ► develop methods to account for footprint mismatch & heterogeneity of EO data
- ► harmonization

UNDER CONSTRUCTION COMING SOON

FluxCom2.0



Set-up
- ► semi-operational
- ► flexible
- ► scalable

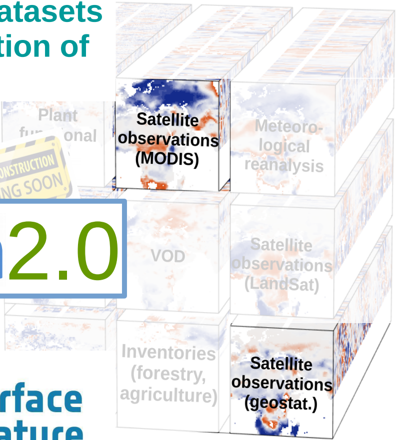


Resolution
- ► towards subdaily and ~km scale

Uncertainty characterization
- ► better characterization of different types and sources of uncertainty
- ► develop methods to estimate an overall uncertainty

Towards a better understanding of how characteristics of LST datasets affect the data-driven simulation of land-atmosphere fluxes:

► careful QC, gapfilling, ancillary techniques
► harmonization of different sources
► additional eddy processing



FluxCom2.0

&

land surface temperature cci

Set-up
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→**LST ranks among the most important predictor variables!**

Towards a better understanding of how characteristics of LST datasets affect the data-driven simulation of land-atmosphere fluxes:

which data?

- **MODIS daily:**
  - **CCI:**
    cutouts @0.01°/ 1km
  - **NASA:**
    cutouts @1km
    MxD11A1
- **Seviri hourly:**
  - **CCI:**
    0.05°, oblique,
    instant obs.
  - customized **LSAF**:
    0.05°, hourly avrg.,
    oblique & nadir

Towards a better understanding of how characteristics of LST datasets affect the data-driven simulation of land-atmosphere fluxes:

what do we want to know?

- representativeness of **temporal information**, ie hourly vs 4xdaily, hourly avrg. vs inst. hourly
- **directional effects**
- effects of **retrieval methods**

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→ Site-level cross-validation at ∼ 300 sites in Europe

Important processing steps

- **geometrical correction** to nadir (Ermida et al. 2018 RS) for Seviri and possibly CCI MODIS
- **QC** using flags, uncertainty information and beyond
- dedicated **gapfilling**
- **cutout** around towers for MODIS/ account for scale-mismatch of tower footprint–Seviri pixel explicitly (**downscaling**) or implicitly (in the machine-learning training)

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Discussion on any of these aspects very welcome!

Applications in the fields of...

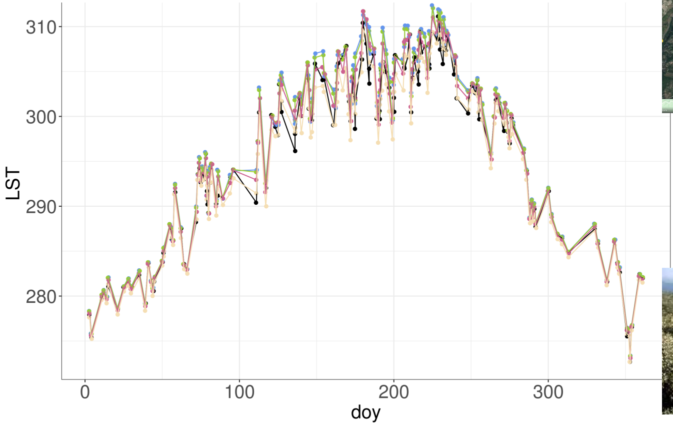
data-driven carbon, water and energy flux estimates

- the terrestrial carbon, water, energy cycles
- atmospheric sciences
- for the benchmarking of models of the land surface
- ecology
- land-atmosphere interactions
- ...

Spatially explicit flux estimates will be produced for the best performing set-up in the cross-validation

first tests on normalizing directionality

NASA Terra daytime swath products in the region of Puechabon/ France



normalized using the Kernel-hotspot model after Ermida et al. 2018

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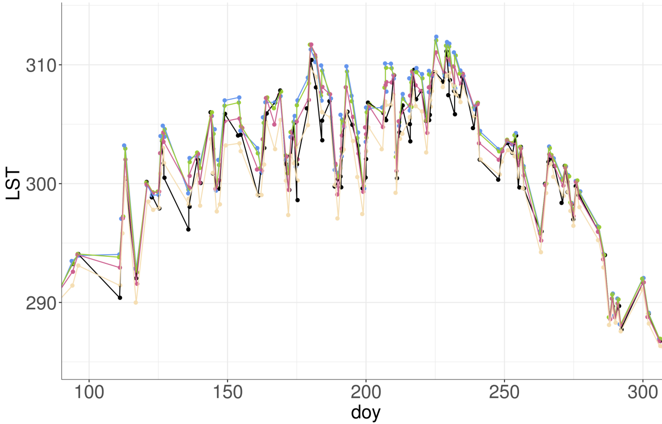

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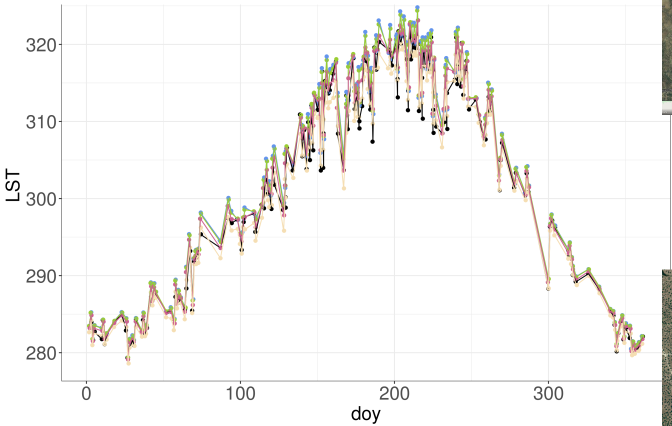
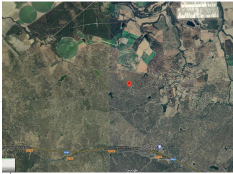
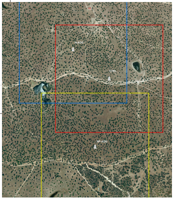




LST uncorr.
LST nadir
LST VZA=10
LST VZA=30
LST VZA=50



Pacheco-Labrador et al. 2017

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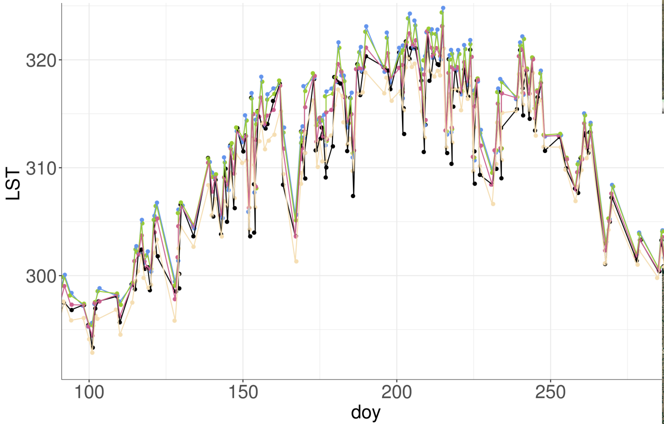

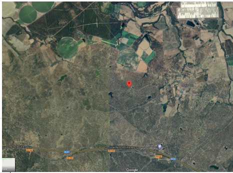

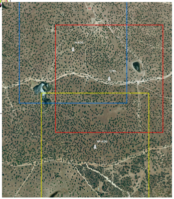

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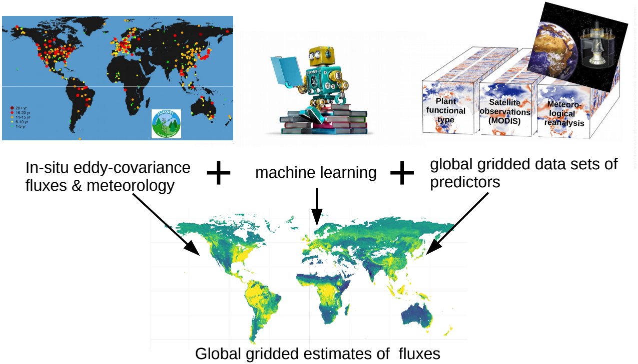
Thank you :)



questions, suggestions, criticism?

now, Padlet or swalth@bgc-jena.mpg.de