

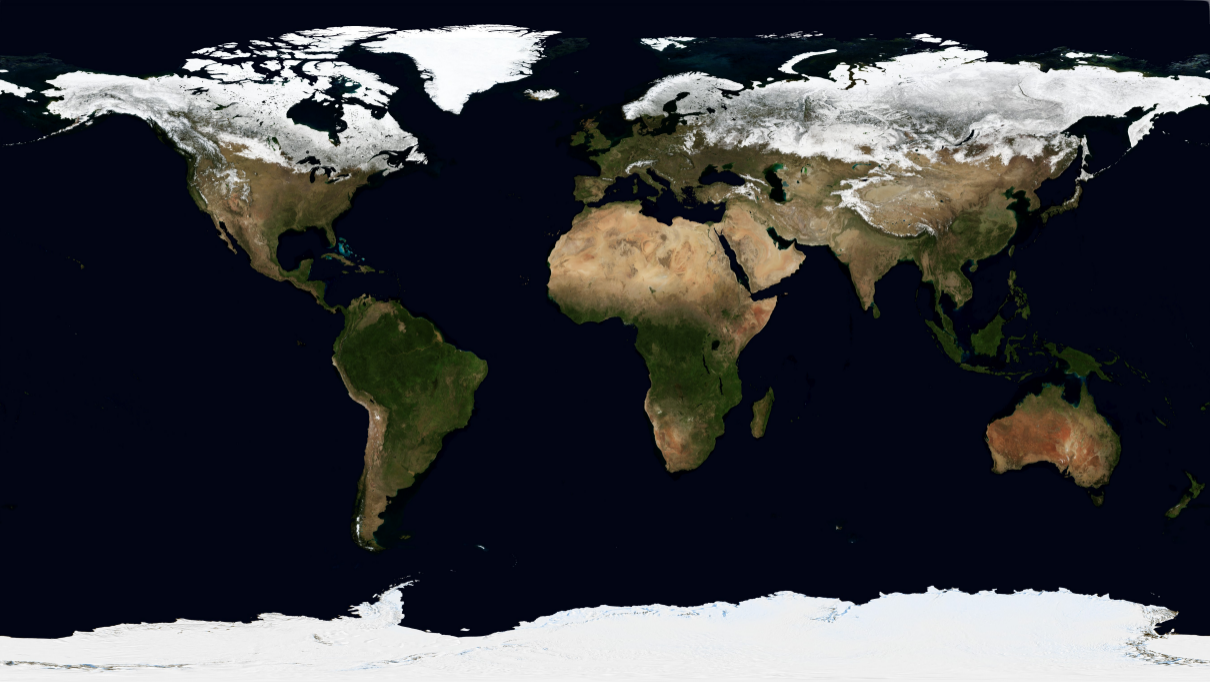
Our Earth's Land Surface Monitored by Satellites and Models

prof. dr. ir. Gabriëlle De Lannoy

KU Leuven - EES

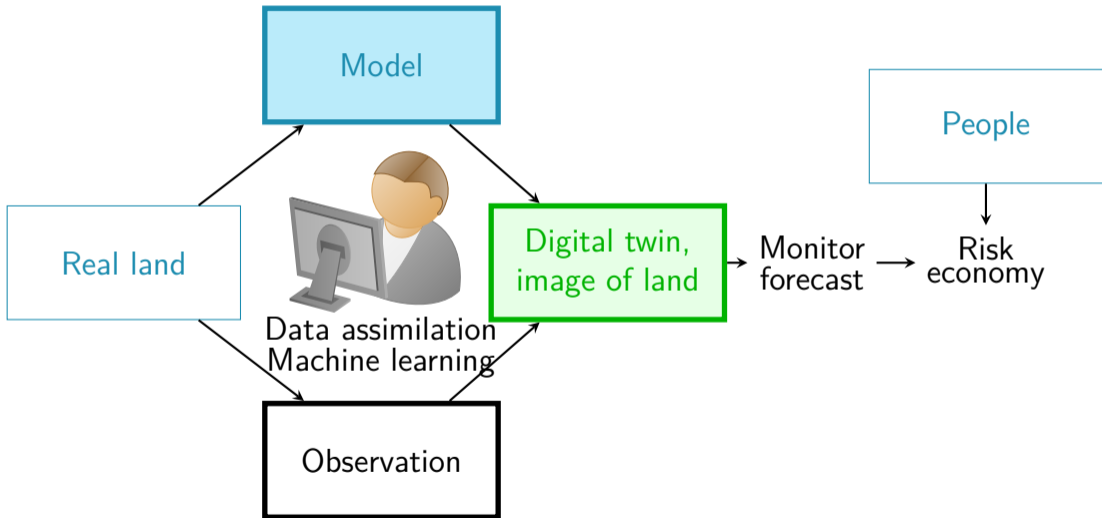
26 March 2026



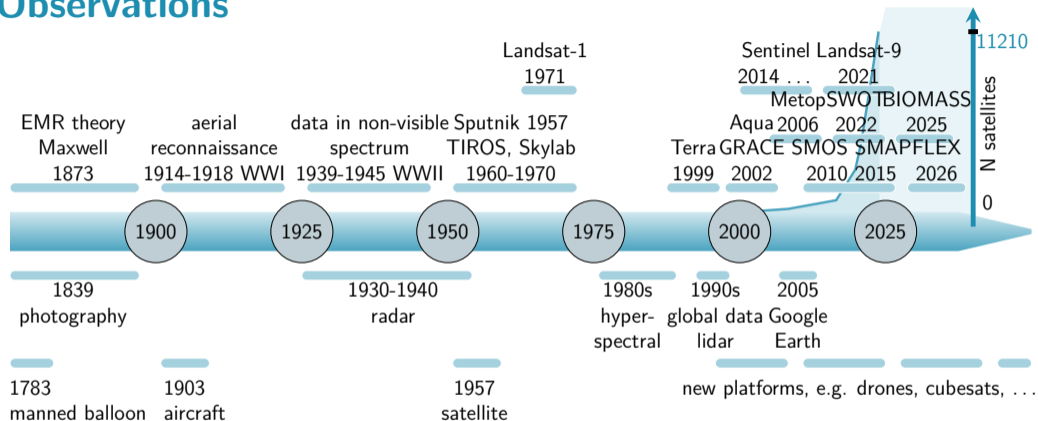




Research Approach



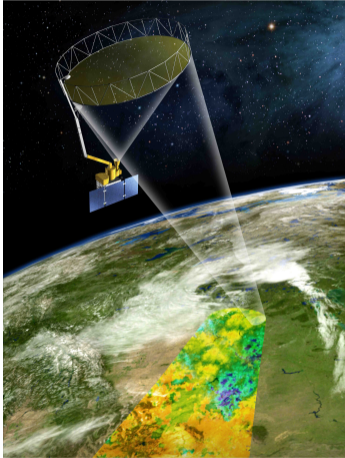
Observations



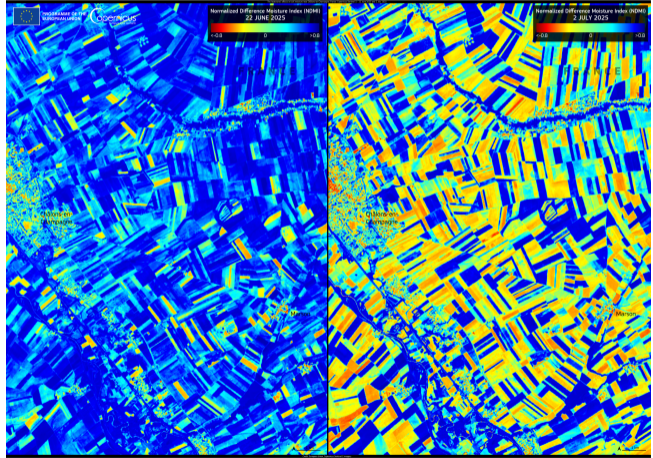
Increasingly higher resolution observations
 ▶ more detail in time, space, spectral bands

Observations

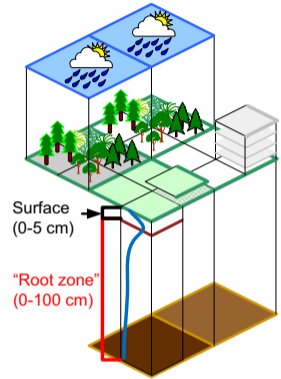
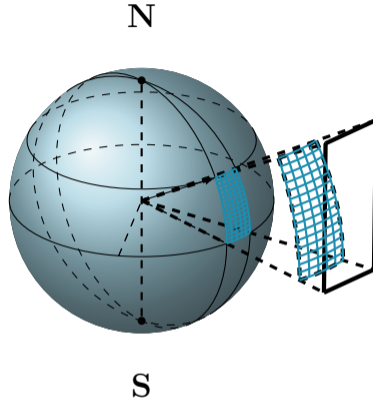
SMAP



Sentinel-2



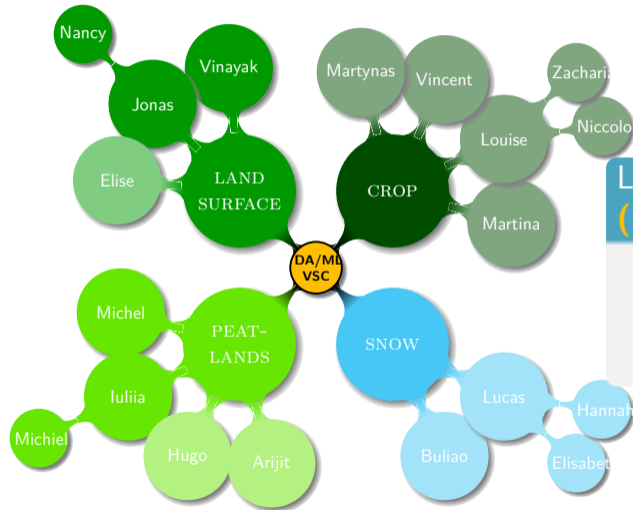
Models



Increasingly higher resolution modeling

- ▶ numerical, physically-based or '*machine learning*'
- ▶ all locations, depths, time steps (De Lannoy et al., 2022)

Research Team



Land surface data assimilation (DA/ML)

- ▶ satellite remote sensing
- ▶ land surface/crop model
- ▶ Kalman filter, XGBoost, ...

My HPC Path

Workstation
2002–2006

NASA NCCS
2006–2016

VSC HPC
2016–now

In the office @ UGent-NASA



Discover @ NASA GSFC



then 3.3 Tflops, now 5 Pflops
Land Information System (LIS),
Goddard Earth Observing System (GEOS)
land data assimilation system (Idas),
from research to operations

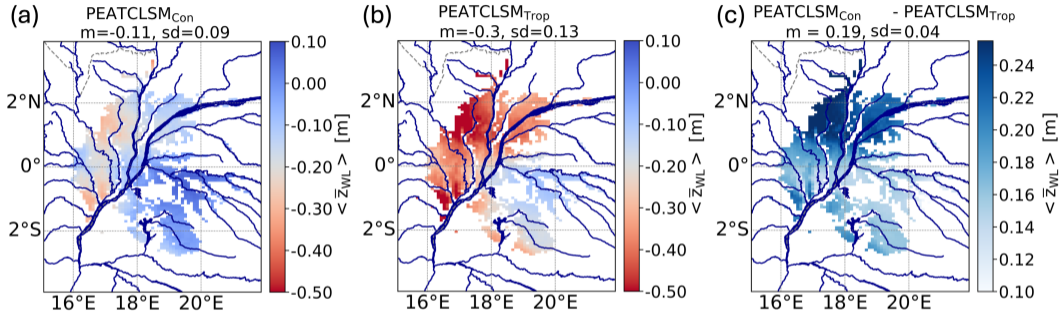
Genius wICE @ KU Leuven



LIS, GEOSIdas



Water Levels in Congo Peatlands

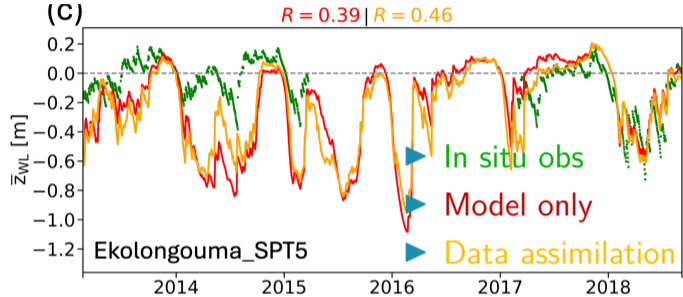


(Apers et al., 2026)

Model development & satellite DA (GEOSIdas)

- ▶ more realistic groundwater depth (2010-2022)
- ▶ wetter peatland

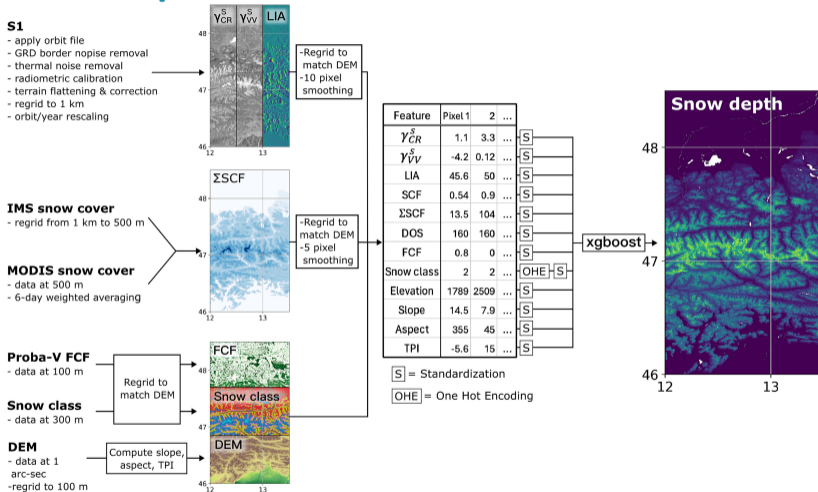
Water Levels in Congo Peatlands



Model development & satellite DA (GEOSIdas)

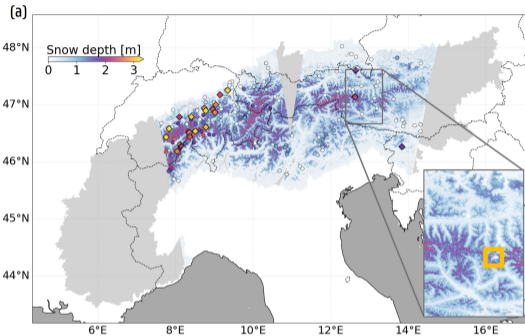
- ▶ microwave satellite DA further simulation
- ▶ satellite DA reveals missing (river) process

Snow in the Alps



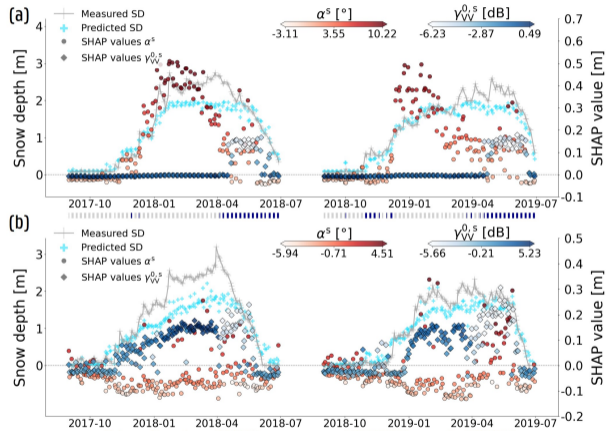
(Dunmire et al., 2024; Boeykens et al., 2025)

Snow in the Alps

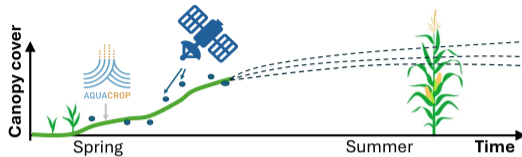







Satellite radar → snow depth

- ▶ which signal \sim snow when, where?
- ▶ train on points, apply for Alps



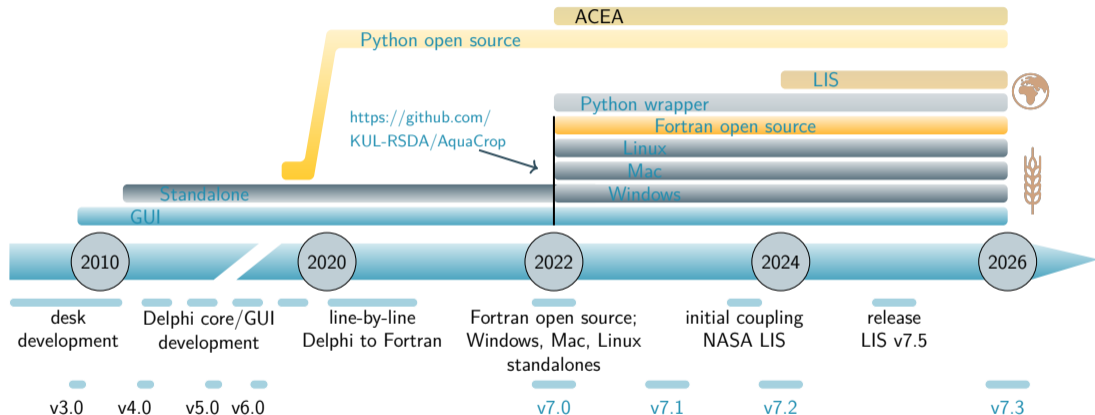
AquaCrop Model



 <p>https://github.com/KUL-RSDA/AquaCrop/releases</p> <p>Graphical User Interface (FAO)</p>	 <p>Stand-alone executables</p>	 <p>https://github.com/KUL-RSDA/AquaCrop</p> <p>Version-controlled Fortran code</p>
 <p>https://github.com/KUL-RSDA/RegionalAC_Py</p> <p>Python wrapper</p>	 <p>https://github.com/NASA-LIS/LISF</p> <p>NASA's Land Information System</p>	

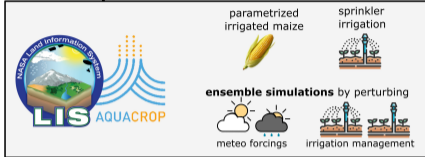
(De Lannoy et al., 2026)

AquaCrop Model

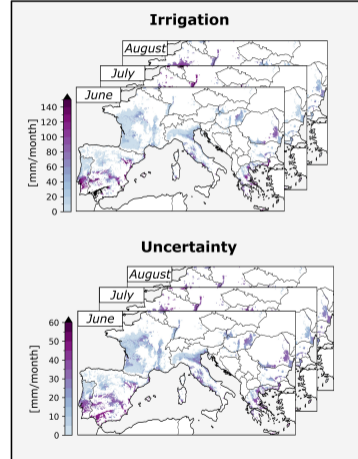


Irrigation over European Croplands

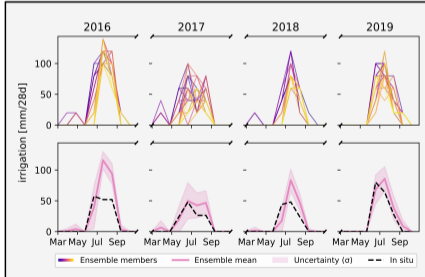
Model setup



Dataset

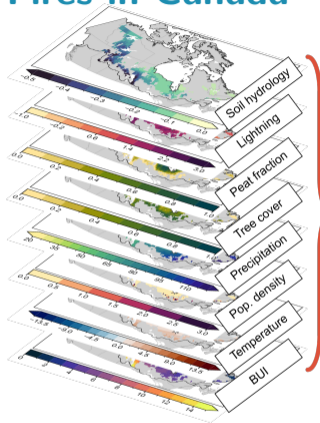


Evaluation

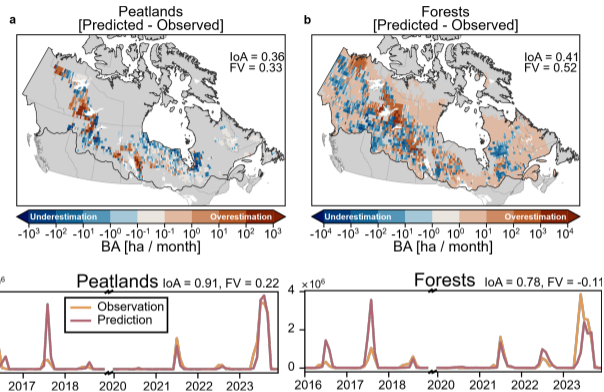


(Busschaert et al., 2026)

Fires in Canada



(Mortelmans et al., 2026)



Predict burned area (BA) using land surface data

- ▶ train LightGBM on satellite-based fires (BA)
- ▶ main drivers different for peatlands and forests

Conclusions

Our Earth's land surface

- ▶ advancing process-based **models**
- ▶ developing new machine learning **models**
- ▶ **models** with more detail (more processes, higher spatial resolution)
- ▶ satellite **data** with higher spatial, temporal and spectral resolution
- ▶ storage and compute ↑

Some references

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