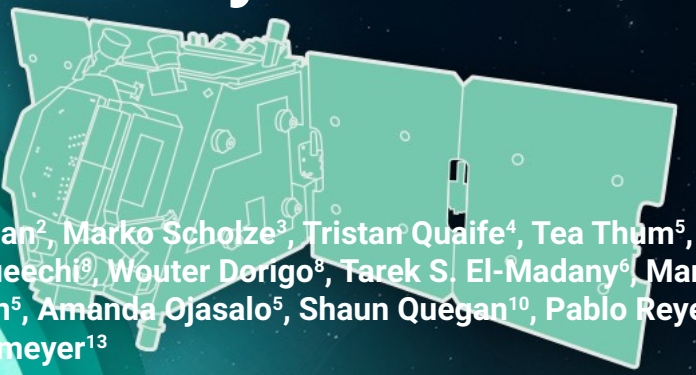
Terrestrial Carbon Community Assimilation System and BIOMASS



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EOBIOMASS Webinar
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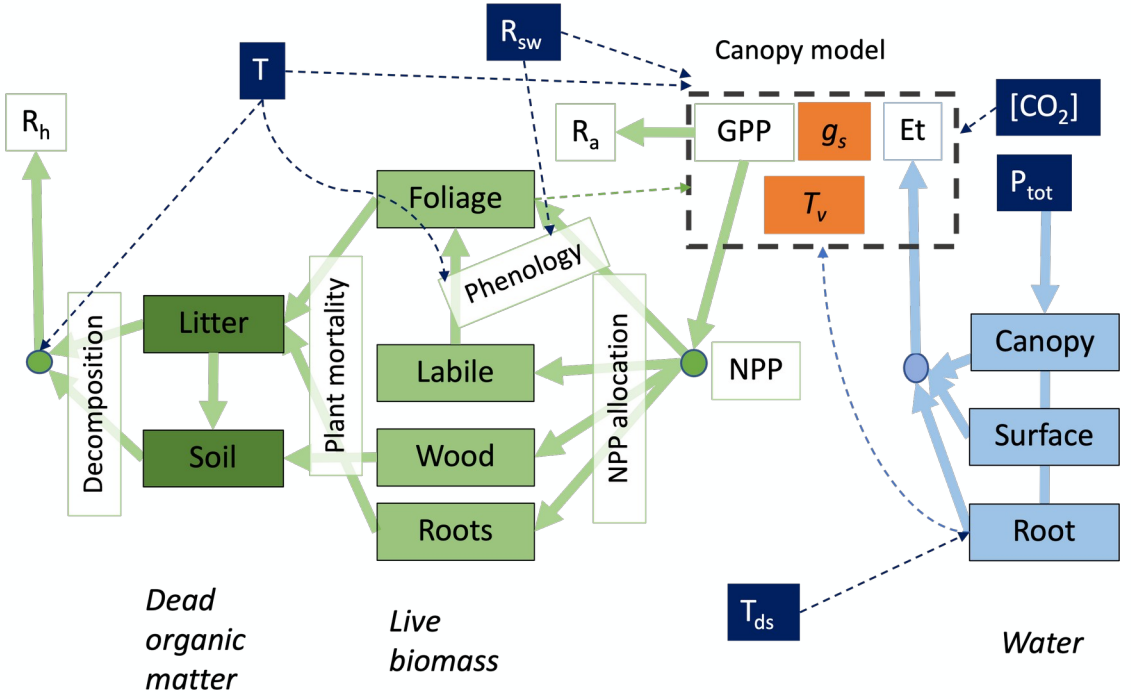
What is TCCAS?

- The **Terrestrial Carbon Community Assimilation System** (TCCAS) is built around the newly developed **D&B terrestrial biosphere** model.
- The focus of TCCAS is the **combination** of a **diverse array of observational data streams** with the **D&B model** to yield a **consistent picture of the terrestrial carbon, water and energy cycles**.
- The development of TCCAS is being **funded** through the **carbon cluster of the European Space Agency** and under Contract No 101082194 by the European Union.
- TCCAS is an open source activity set up by six institution partners:

Terrestrial Biosphere Model

- D&B
- Simulation of Carbon, Water, and Energy Cycles



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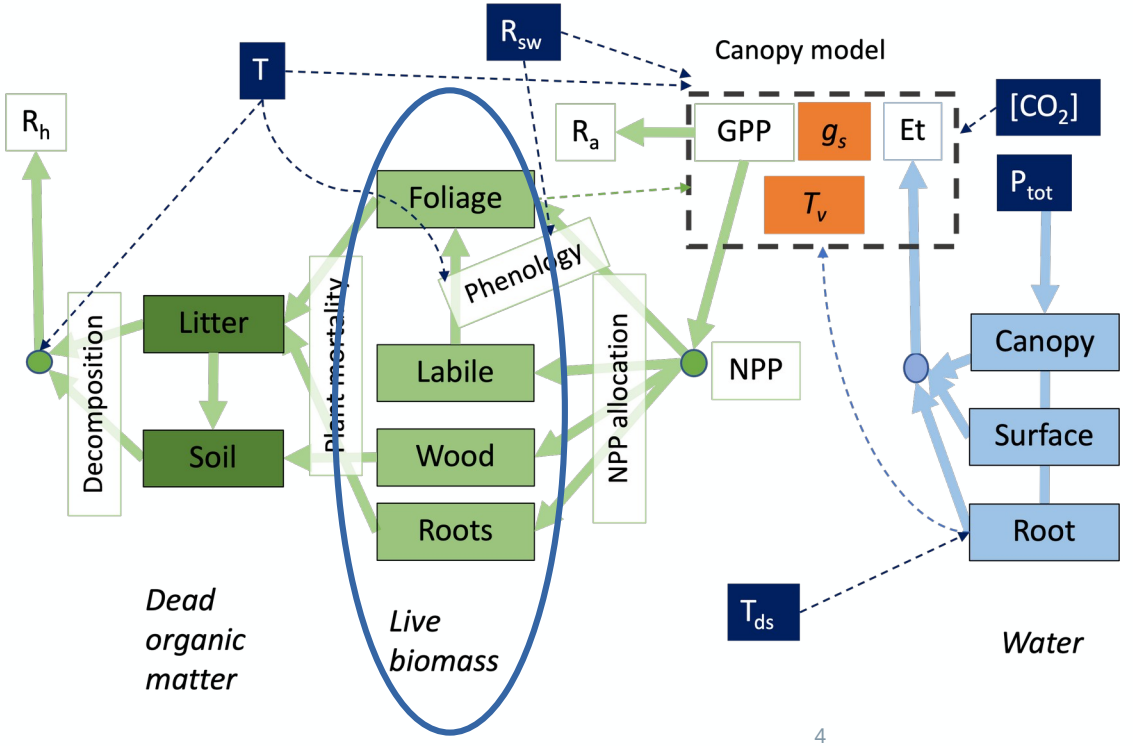
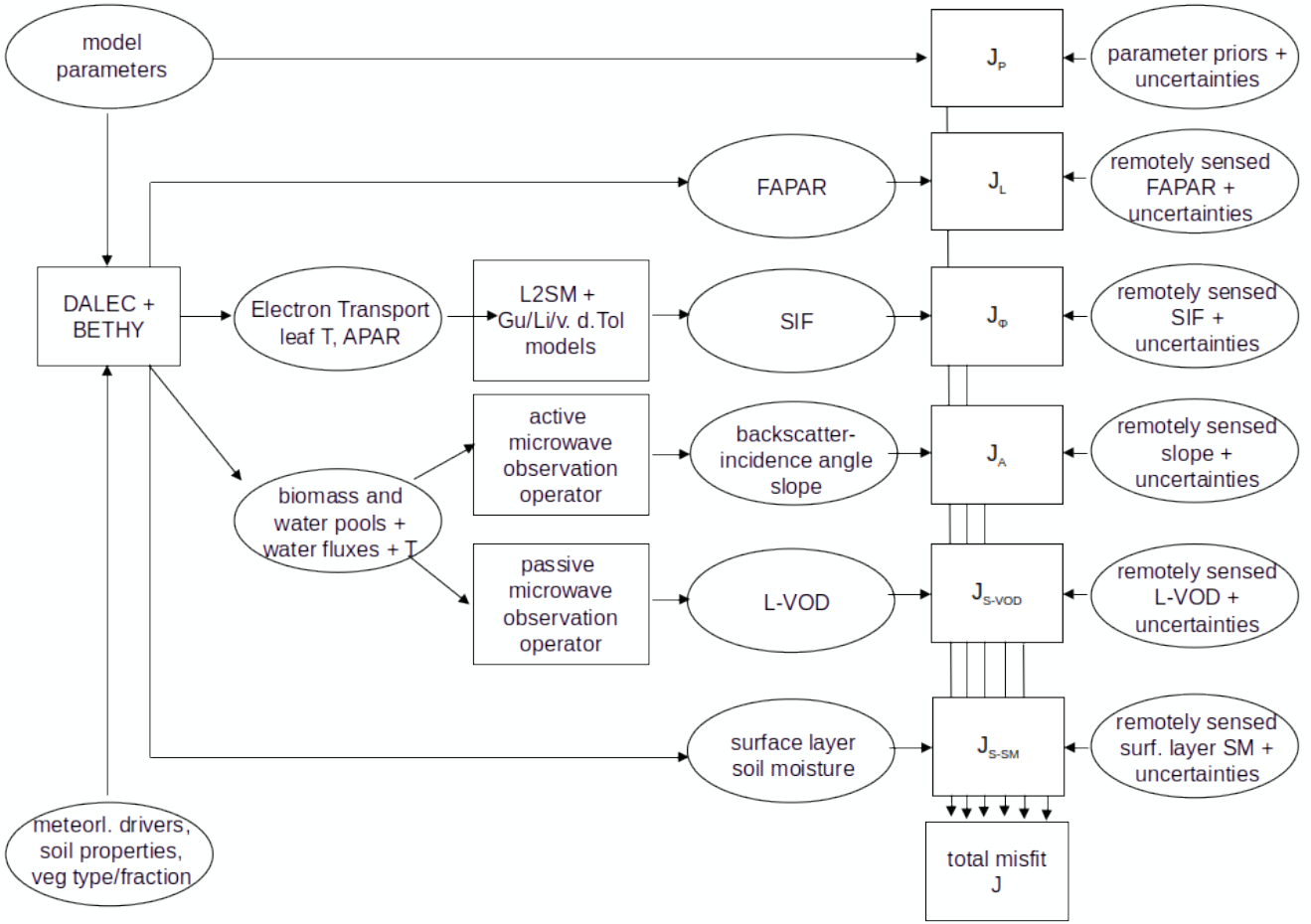


What does TCCAS offer?

- Open source community system
- Observation operators for optical as well as active and passive microwave observations
- Assimilation on the footprint
- Tangent and adjoint codes
- Modular setup
- Computational efficiency
- Tested on point to regional scales
- Experienced developer team
- Documentation
- User support and training



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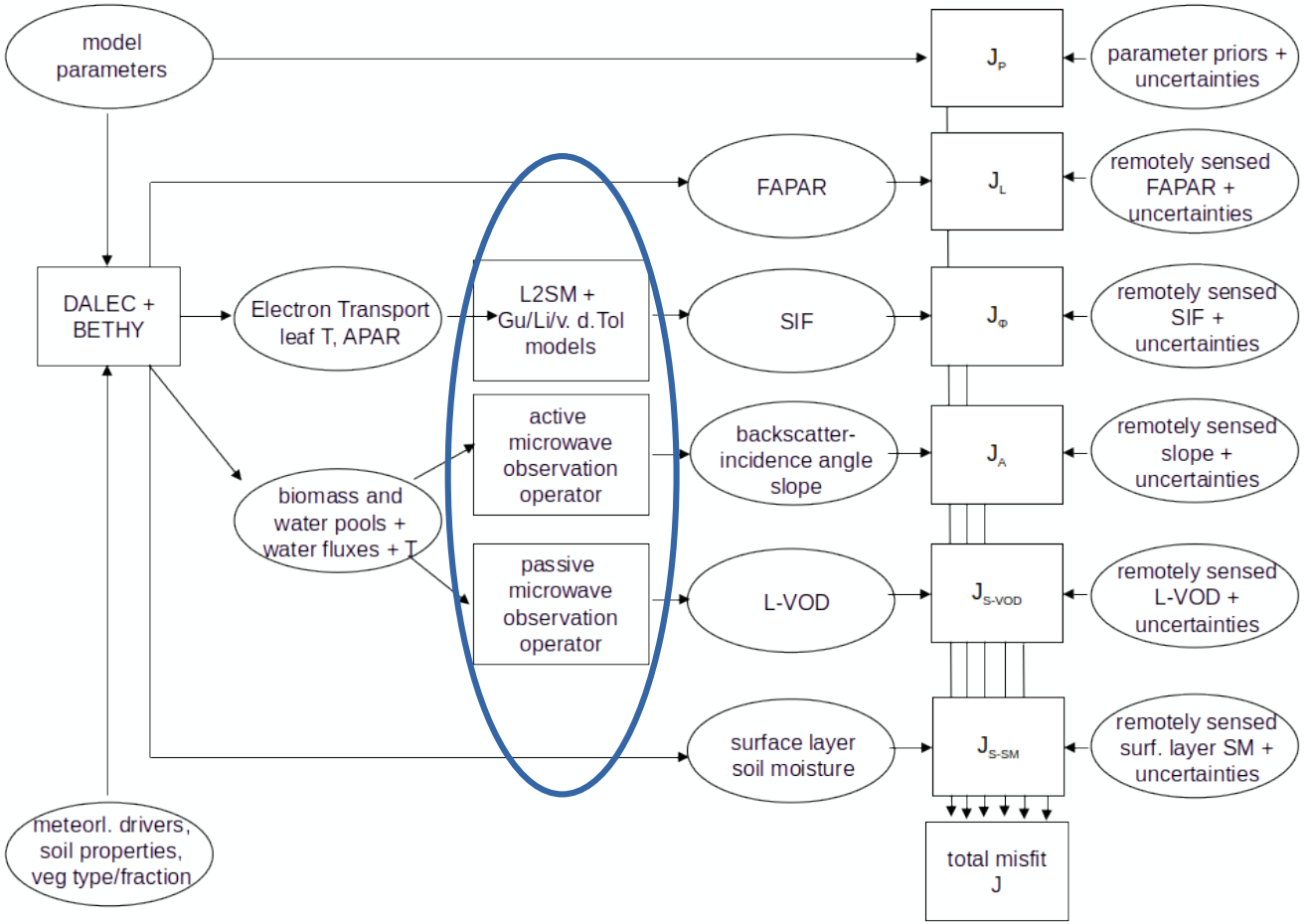

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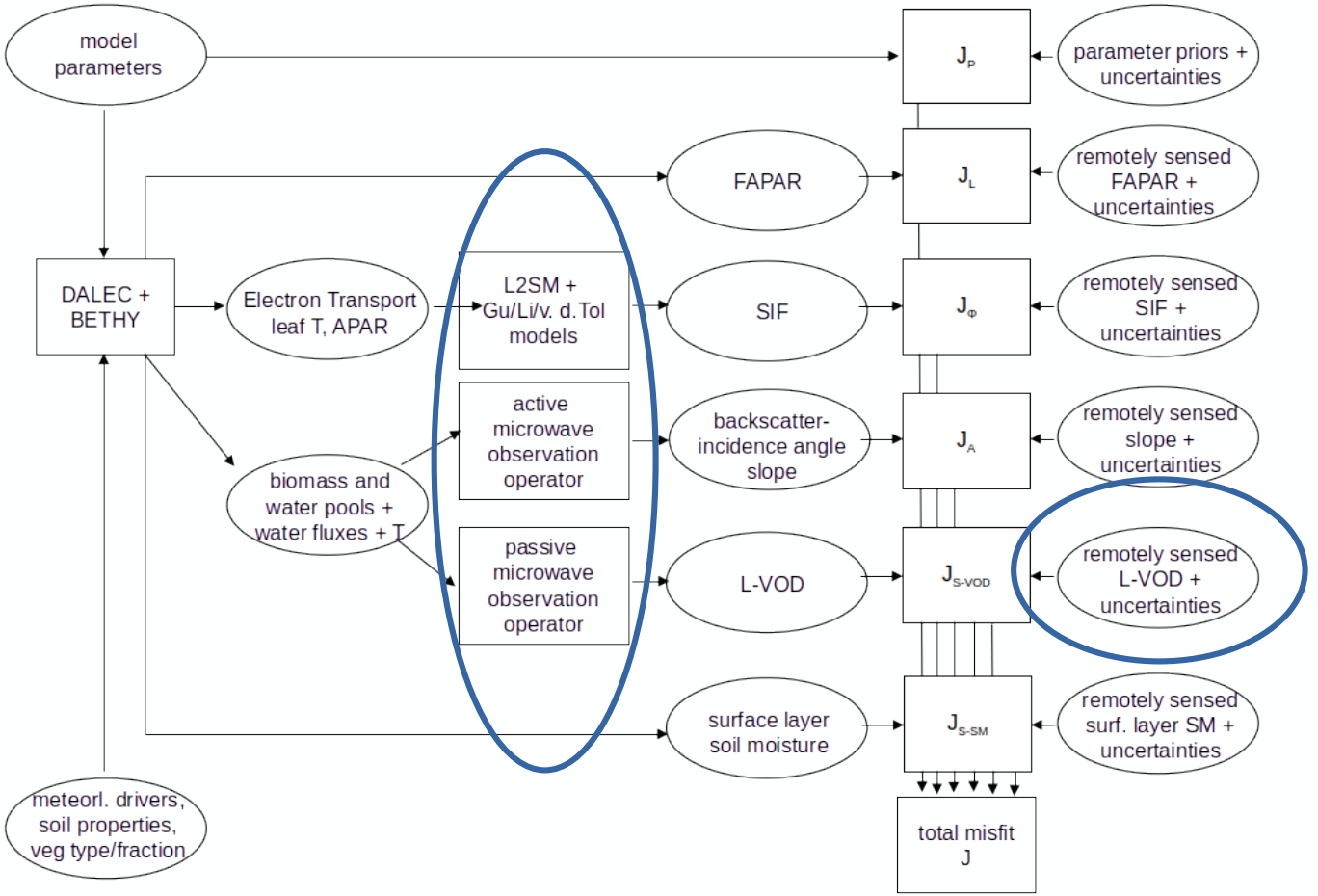
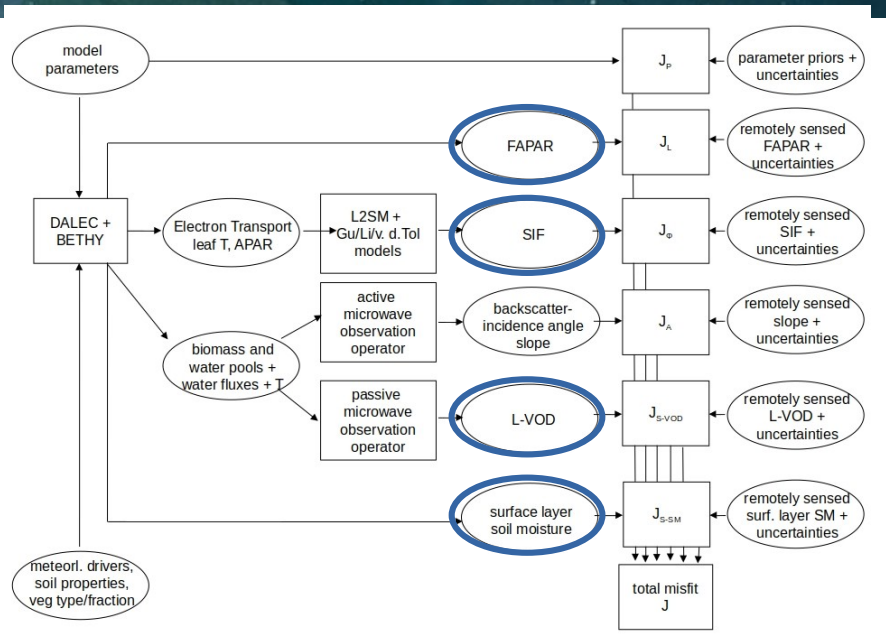


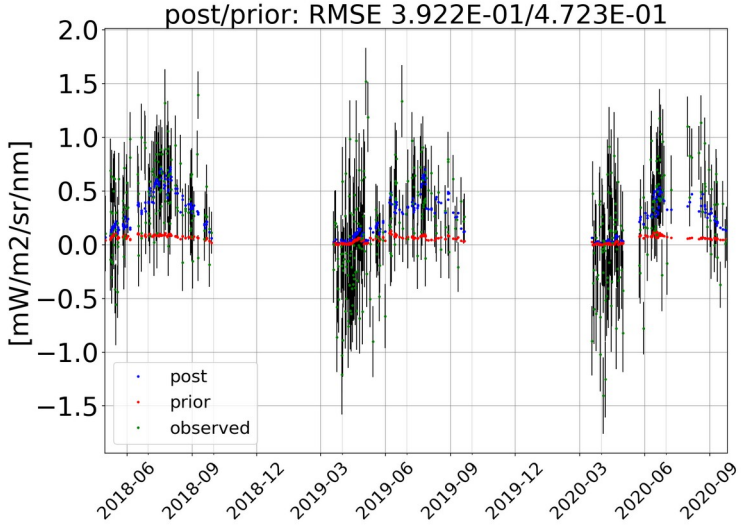
Joint Data Assimilation at Sodankyla

- Boreal site in Lapland
- Evergreen Conifers and understorey
- Spin up 2015+2016
- Assimilation window 2017-2021
- Prior Uncertainty: 20% for all process parameters and 80% for all initial pool sizes
- Joint assimilation of:
  - FAPAR: JRC-TIP, twostream RT
  - SIF: TROPOSIF, Gu model
  - L-VOD: SMOS, empirical
  - surface layer soil moisture: SMOS

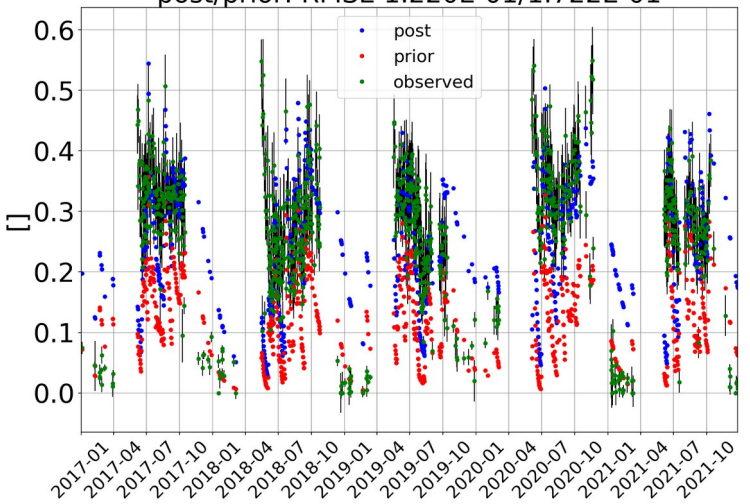


Assimilation (left/middle) and validation (right) variables

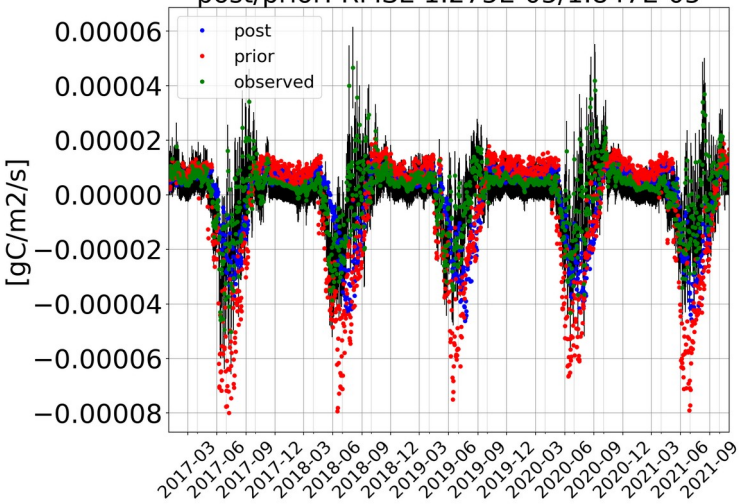
Solar induced fluorescence at 743nm
post/prior: RMSE 3.922E-01/4.723E-01



fractional water content in surface layer
post/prior: RMSE 1.220E-01/1.722E-01

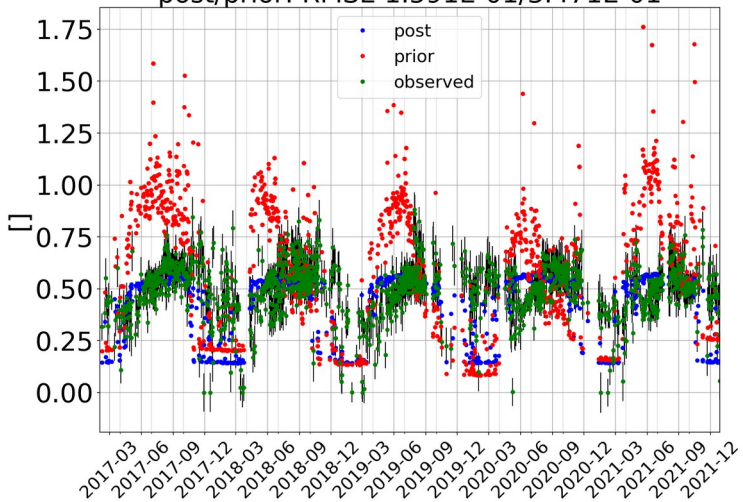


net ecosystem exchange flux
post/prior: RMSE 1.275E-05/1.847E-05

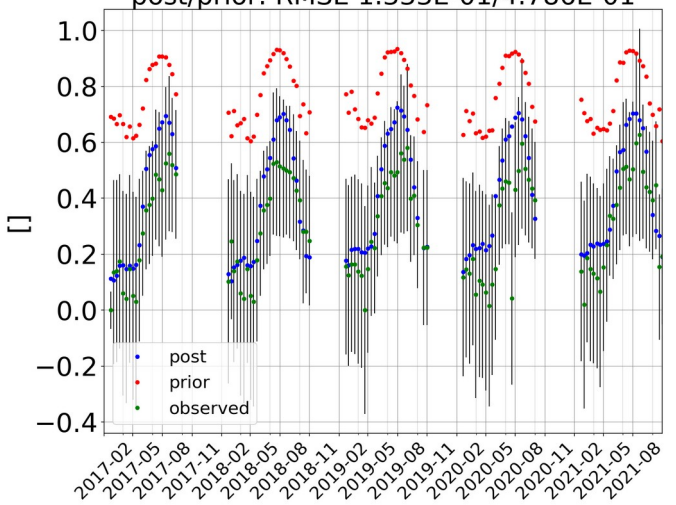


Obs (green), prior (red), posterior (blue)

vod
post/prior: RMSE 1.591E-01/3.471E-01

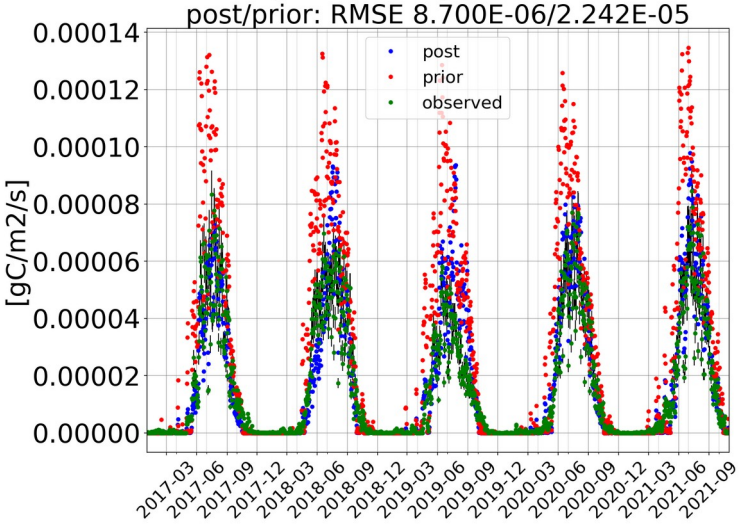


Fraction of Absorbed Photosynthetically Active Radiation
post/prior: RMSE 1.333E-01/4.786E-01



GPP

gross primary production
post/prior: RMSE 8.700E-06/2.242E-05



Analysis of Information Content

A: posterior parameter uncertainty:

$$A = (M^T R^{-1} M + B^{-1})^{-1}$$

B: prior parameter uncertainty

R: data uncertainty $R = C_{obs} + C_{mod}$

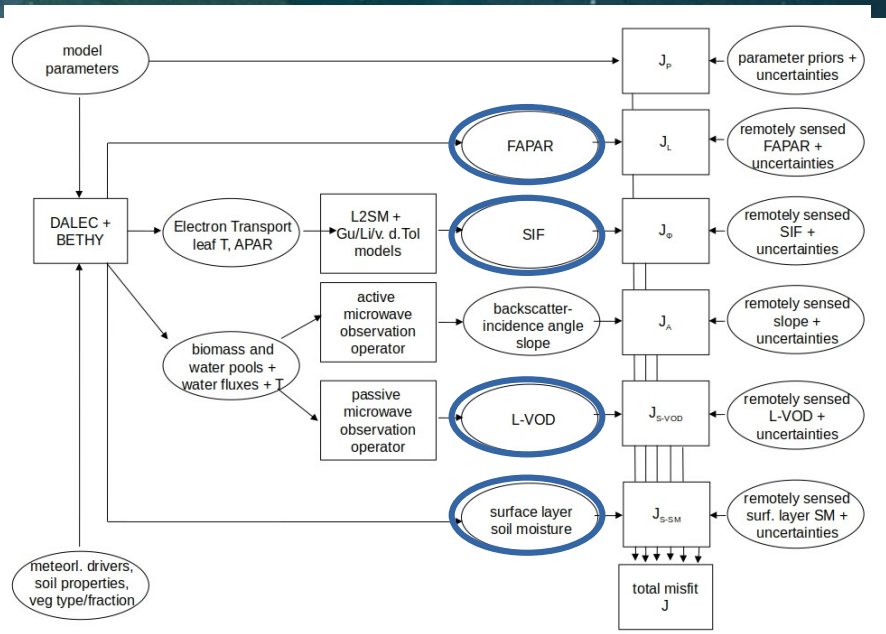
M: linearised model

Plots show unc. reduction:

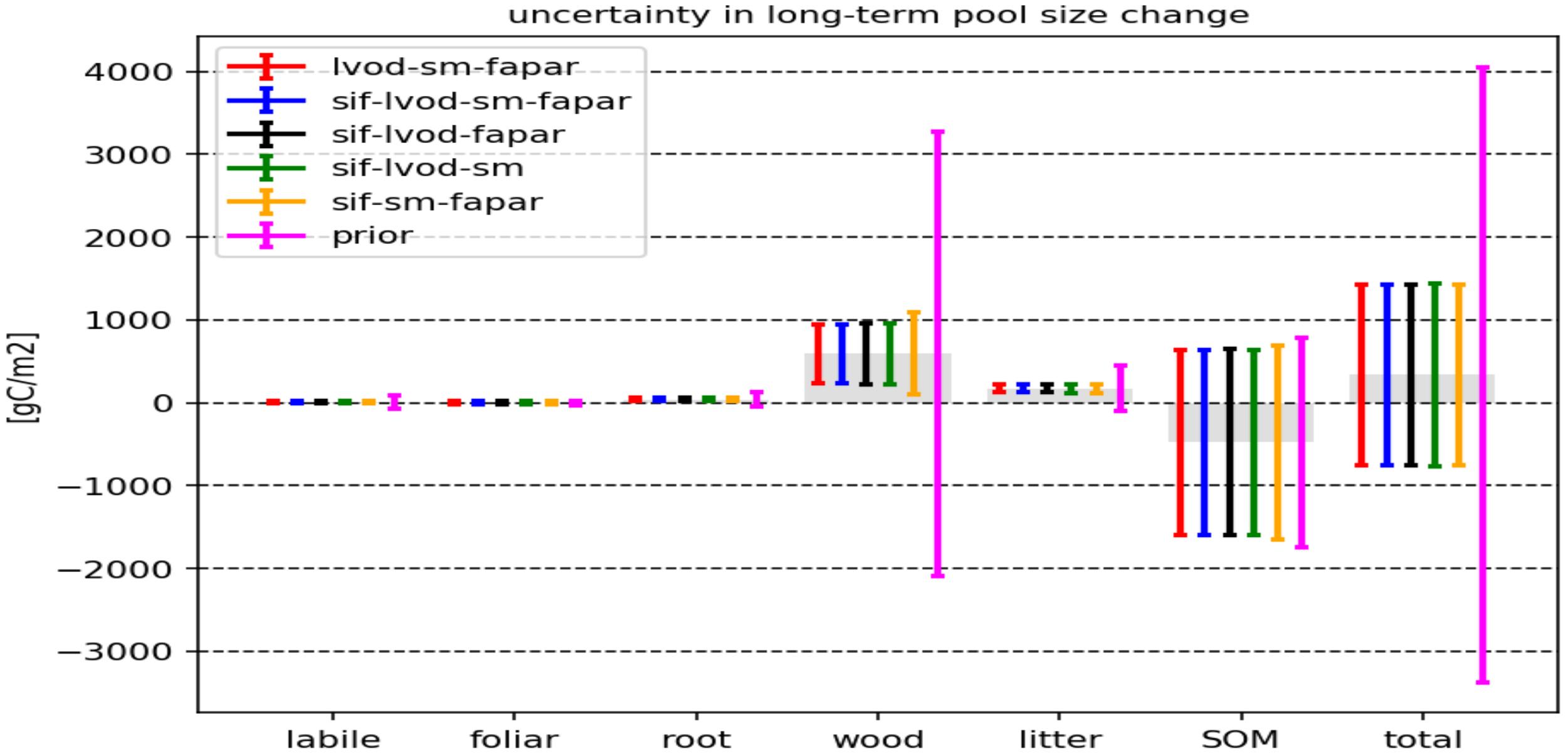
$$(\sigma_{prior} - \sigma_{posterior}) / \sigma_{prior}$$

5 Experiments at Sodankylä (Everg. Conifer and understorey):

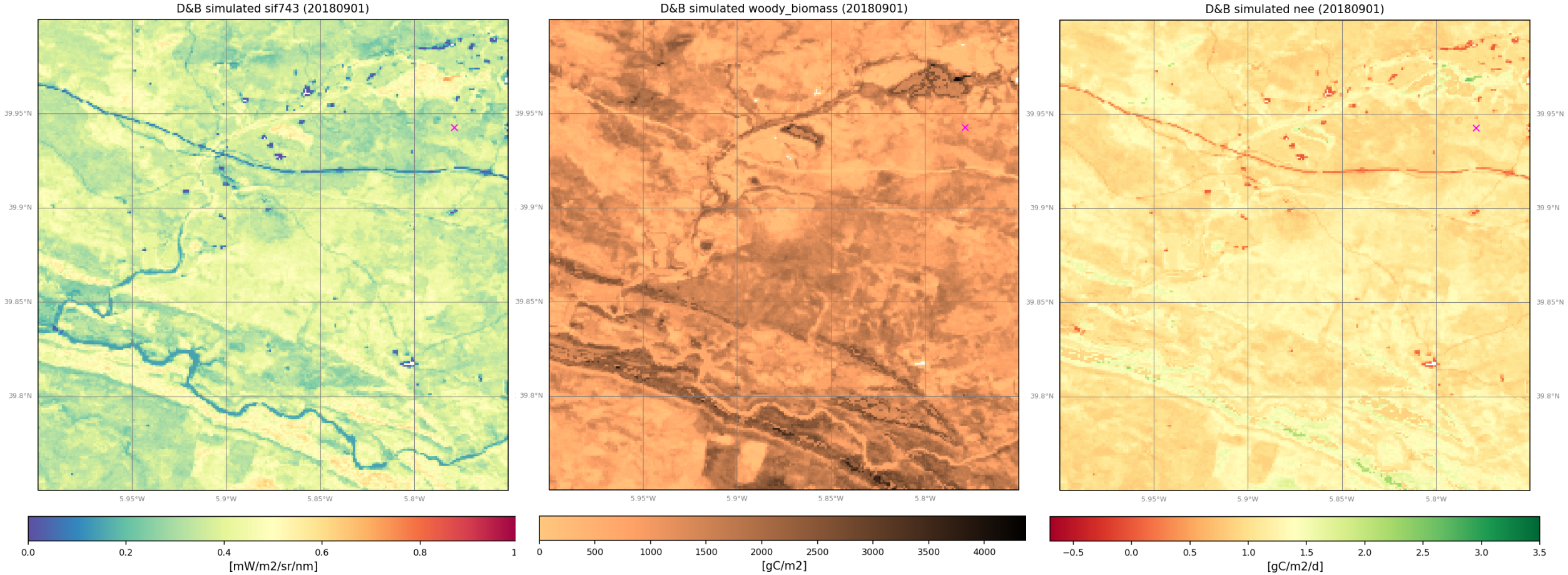
- First, using all 4 data streams
- Then, leaving one data stream out (in turn)



Reduction in uncertainty relative to prior of increase in carbon pools over integration period



Posterior simulation over a region in Spain
SIF (left), Woody biomass (middle), NEE (right)



Use of BIOMASS

- Data Assimilation
  - Integrated perspective on carbon, water and energy cycles
  - Includes D&B process understanding
  - Information from multiple missions
- Typical applications include
  - Monitoring relevant variables in space and time
  - Assessment of net carbon flux
  - Quantification of the impact of an intervention in the landscape on carbon uptake (Carbon Credits)
- Requirements
  - Need BIOMASS product with uncertainty ranges, ideally also correlation in space and time
  - Need information to construct observation operator

Further Information

- Contact
  - https://tccas.inversion-lab.com
  - TCCAS@Inversion-Lab.com
  - Thomas.Kaminski@Inversion-Lab.com
- Next training events:
  - Living Planet Symposion, Vienna, June 23-27
  - Nanjing, August 24-29