SMOS/SMAP update & VOD assimilation

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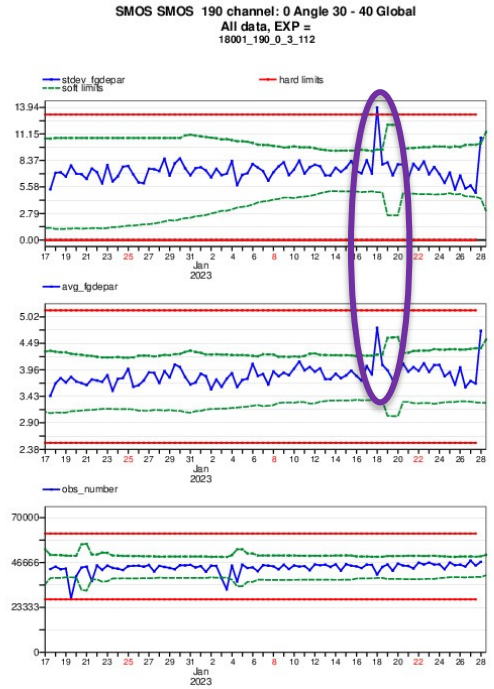
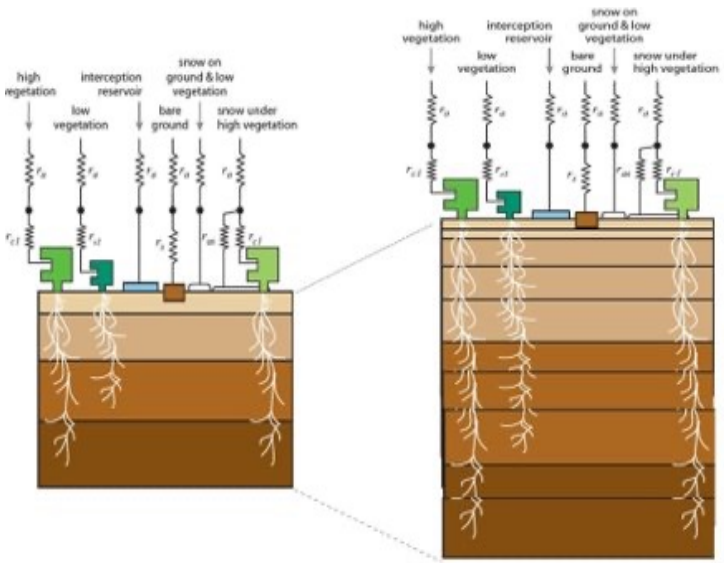
ECMWF

SMOS/SMAP update

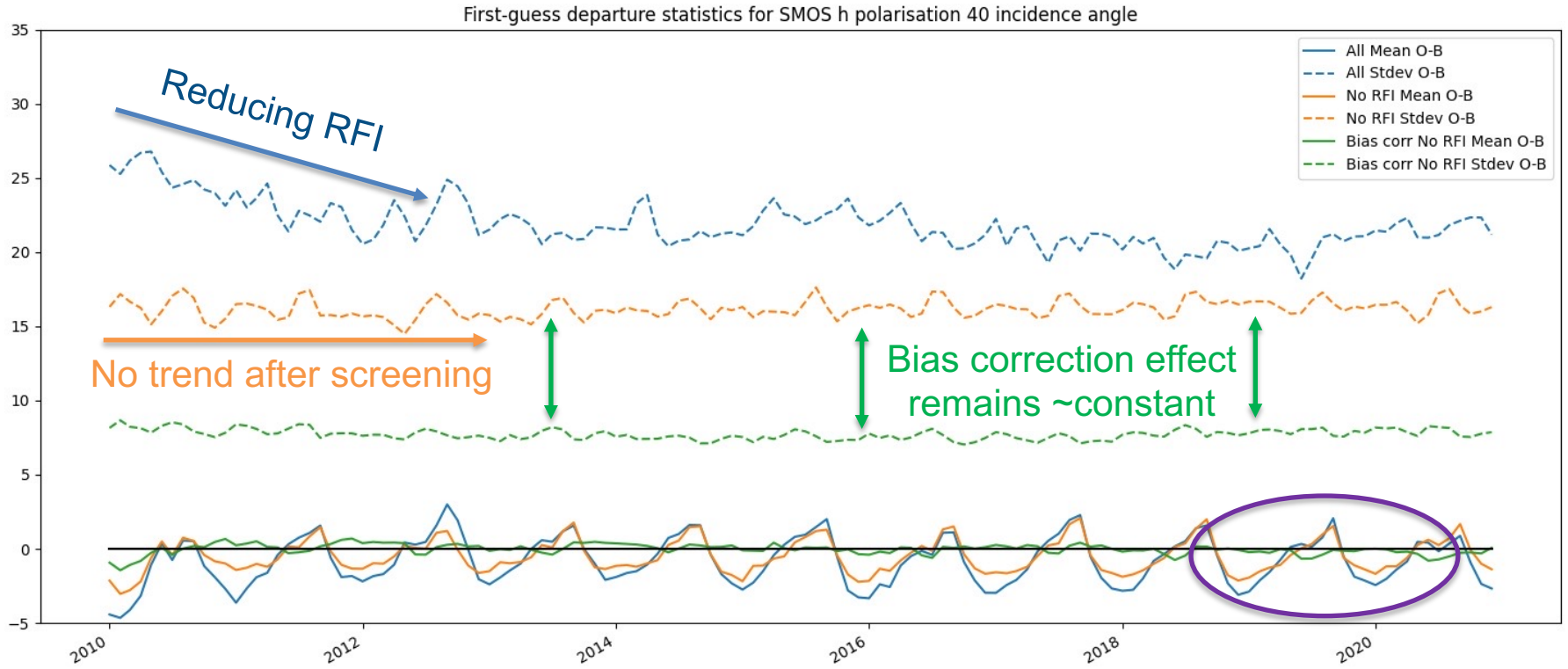
- SMOS and SMAP Tbs continue to be monitored against NWP background
  - Automatic alerts recently implemented
  - Useful for picking up new RFI sources/data anomalies
- SMOS NN product assimilated into SEKF
  - ~16% of observations are rejected (mainly from fg_depar check)
  - Reduced to ~12% with adaptive bias correction (planned for 50r1)
  - Retraining required for new 49r1 land surface climatology and re-processed SMOS (2024)
- Future plans
  - Develop improved observation operator within CERISE
  - Exploit finer discretization of soil model in 50r1/2
  - Revisit Tb assimilation using improved observation operator





SMOS multi-year monitoring

- Monitor latest re-processed v724 SMOS L1C Tbs against stable ERA5 reference from 2010 to 2021

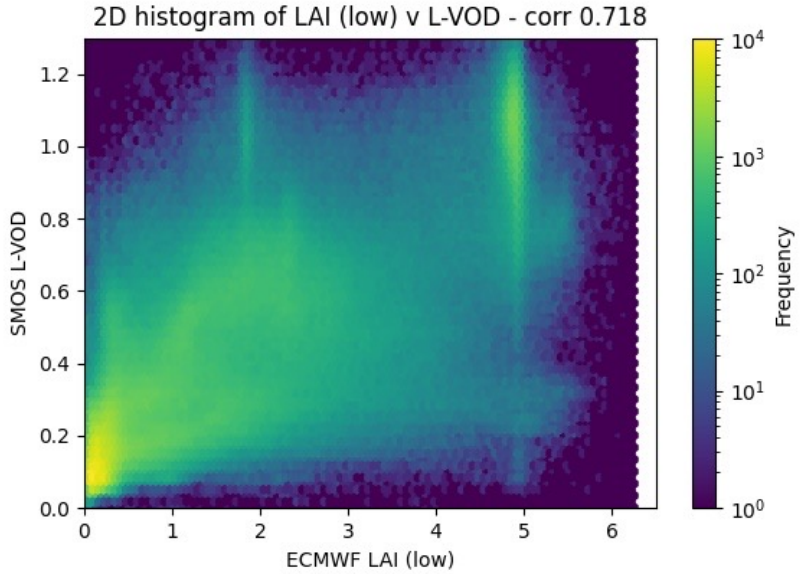


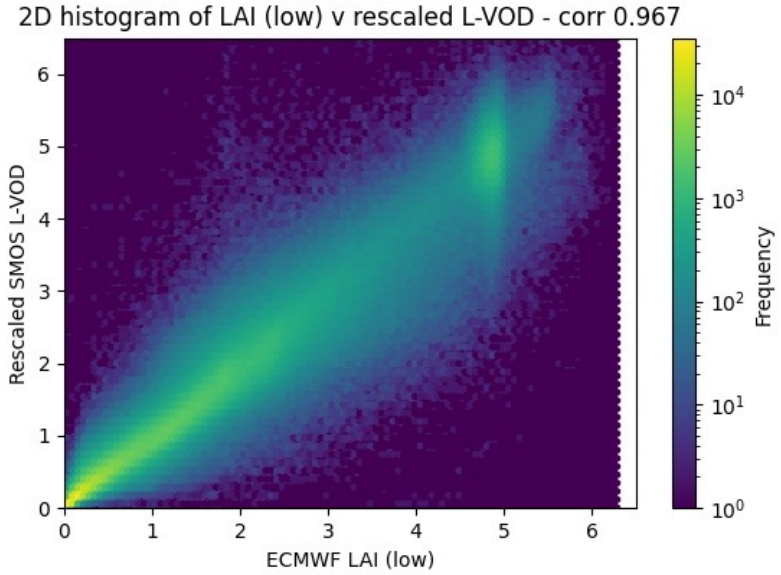
Seasonal biases successfully removed

- Key take aways for Tb assimilation:
  - Improved RFI screening (orange v blue)
  - Newly developed bias correction performs consistently (green v orange)
  - Data quality is consistent over entire lifetime (after RFI screening) – potential assimilation into future reanalyses

Rescaling observed VOD to model LAI

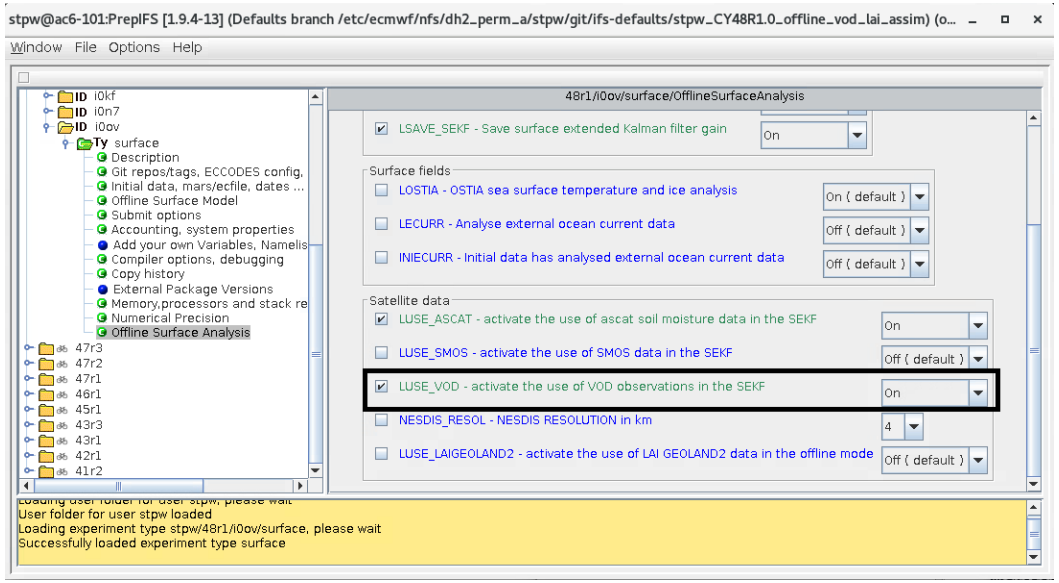
- Using satellite VOD observations due to their temporal frequency and insensitivity to clouds
- VOD observations from SMOS (L-band) and AMSR2 (C-, X-band)
  - Basic quality control applied (e.g. RFI, mountains, wetlands)
  - Reformatted into Tco1279 GRIB files for ingestion into offline LDAS
  - Using observations from 2016-2021
- Model LAI taken from monthly CONFESS files (based on CGLS dataset):
  - LAI for high and low vegetation considered separately
- Computed CDF-matching parameters to rescale VOD to LAI:
  - 2016-2017 data used for rescaling (validated on 2018-2019)
  - Produced monthly CDF-matching parameter files for all combinations of VOD band and low/high LAI = 72 sets of params





Assimilating VOD to analyse LAI

- Changes to offline LDAS to:
  - Ingest VOD observations (L, C and X-band separately)
  - Perform rescaling, using pre-computed CDF-matching params
  - Extend control vector to include LAI (high and low)
  - Assimilate rescaled obs to update LAI dynamically
  - Analysed LAI ingested into offline surface model
- Experiments run from 2018-2021



Observations vector

$$\mathbf{y}\ (\text{tobs}) = \begin{bmatrix} \mathrm{T}_{2m} \\ RH_{2m} \\ ASCAT_{sm} \\ VOD_{hi} \\ VOD_{lo} \end{bmatrix} \begin{matrix} [\mathrm{K}] \\ [\%] \\ [\mathrm{m^3/m^3}] \end{matrix}$$

Control vector

$$\mathbf{x}\mathrm{b}_{(\mathrm{t})} = \begin{bmatrix} SM_{l1(t)} \\ SM_{l2(t)} \\ SM_{l3(t)} \\ LAI_{hi} \\ LAI_{lo} \end{bmatrix}$$

Observations operator

$$\mathcal{H}\,[\mathrm{x_b^t}] = \begin{bmatrix} \mathrm{T}_{2m} \\ RH_{2m} \\ SM_{top} \\ LAI_{hi} \\ LAI_{lo} \end{bmatrix}$$

Assimilating VOD to analyse LAI

- Performing diagnostics and comparisons to current climatology
- Current/next steps:
  - Read in LAI analysis in place of climatology in full IFS and run forecast-only experiments
  - Run verification to measure NWP impact of dynamically updated LAI compared to monthly climatology