International Earth Surface Working Group - IESWG

Co-chair: Gianpaolo Balsamo (ECMWF)
Co-chair: Benjamin Ruston (NRL-Monterey)

This current group has convened 3 meetings; edited a special issue‡; is finalizing a seminar series; and preparations are underway for the 4th meeting

‡Advancing Earth Surface Representation via Enhanced Use of Earth Observations in Monitoring and Forecasting Applications https://www.mdpi.com/journal/remotesensing/special_issues/earthsurface_RS

Events	Partner*	Location	Date
1st	SMAP Weather Focus Session	Monterey, CA, USA	19-20Jul2017
2nd	EUMETSAT Land-SAF	Lisboa, Portugal	26-28Jun2018
3rd	Global Cryosphere Watch (WMO/ESA)	Montréal, Canada	15-17Jul2019
--	Invited Seminar Series and Discussions	Virtual	TBD Jun2021; Jul2021;Sep2021
4th	TBD	Helsinki, Finland	TBD May2022

*to broaden exposure and understand breadth of issues; ILSWG has partnered in each of the 3 previous in-person meetings

International Earth Surface Working Group - IESWG

There are a number of other existing Land/Surface Working Groups:

- **Existing WGs** currently focus on either a given **observable** or **specific processes**
- The **IESWG** will bridge the gap engaging **Earth surface-interface multi-disciplinary**
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International Bodies	
Modelling	***Observations***
WMO Polar Prediction Project	WMO Global Cryosphere Watch
WCRP CMIP and SnowMIP	IEEE GNSS+R
WCRP GEWEX panels / LHAs	Water/Energy cycle
WWRP WGNE	NWP/Atmosphere
HEPEX	Hydrology

The uptake of Earth observations in IR/MW over land and snow remains very low with roadblocks not just in observation simulation; but, in the alignment of the numerical models with that of the forward models and products.

The current IESWG co-chairs are split specialties between modelling and observations.
The intention is to preserve this representation moving forward.

ECMWF

International Earth Surface Working Group - IESWG

Goal: Gather requirements specific to surface observations to enhance both our understanding and ability to monitor the components of the Earth system.

Foster uptake of Earth Observations for land, vegetation, and snow

Objectives of the IESWG include (*for full details see draft IESWG ToR*):

- Use of Earth Observation (EO)-data for Cryosphere and Biosphere modelling relevant to study processes at the land-atmosphere interactions;
- Use of EO-data for parameter optimization including those for the land surface, vegetation and snow and the resulting surface emissivity/reflectance spectra;
- Land Data Assimilation Systems (LDASs) both current state and recent developments; sensitivity studies of surface model parameters to remotely sensed data;
- Radiative transfer and emissivity/reflectivity model development: VIS/IR/MW, review of current parameterization for forward modelling surface boundary;
- Retrievals of land surface parameters: product characteristics and performances;

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Activities:

Special Issue: Advancing Earth Surface Representation via Enhanced Use of Earth Observations in Monitoring and Forecasting Applications (2019)
https://www.mdpi.com/journal/remotesensing/special_issues/earthsurface_RS

Overview Article: Balsamo, G.; et. al. Satellite and In Situ Observations for Advancing Global Earth Surface Modelling: A Review. *Remote Sens.* **2018**, *10*, 2038.
https://doi.org/10.3390/rs10122038

New Special Issue: Remote Sensing of Land Surface and Earth System Modelling (closing date: 31May2021)
https://www.mdpi.com/journal/remotesensing/special_issues/Land_Surface_Earth_System_Modeling

IESWG has:

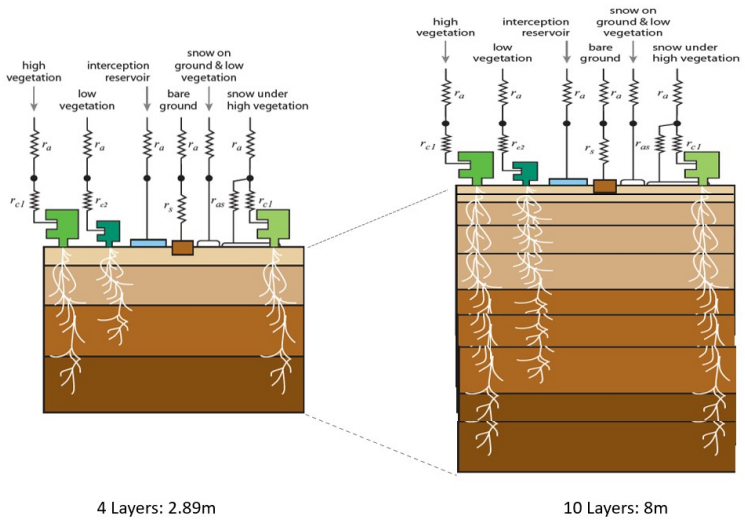
- *coordinated a roadmap to highlight largest deficiencies and experiments designed to understand and prioritize research and development*
- *documented the current state of the land surface models and data assimilation systems*
- *an effort underway working towards coordinating a climatology of surface sensitive L-band radiances*
- *worked towards creating a community-wide adopted set of validation metrics, particularly scoring coupled interactions and energy budget closures.*

ECMWF

Key issues of relevance to CGMS:

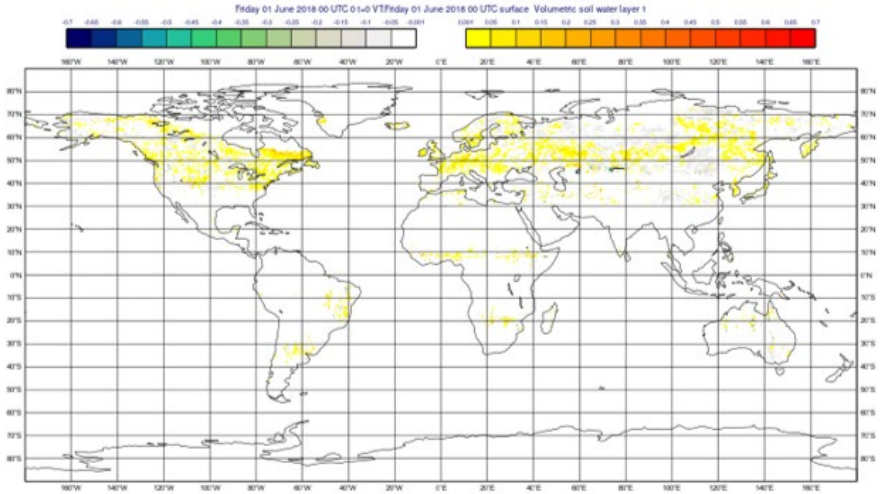
- The International Earth Surface Working Group (IESWG) has targeted a gap:
  - Arctic (snow covered surface), Land and Vegetated surfaces continue to lack coordinated effort throughout the process from observation uptake by data assimilation into numerical prediction models
  - Compensating errors make model development difficult: having confidence that our model developments bring the model closer to observations (not necessarily model analysis) for the right reason is crucial;
- The IESWG is engaging Earth surface-interface multi-disciplinary experts facilitating both modellers & data assimilation experts:
  - Improving the coupled models which in turn allows us to improve the use of Earth surface sensitive satellite observations
- For the remainder of 2021 convene a virtual 3 part invited seminar series and discussion covering:
  - Snow ice and cryosphere-atmosphere interaction
  - Vegetation and land-atmosphere fluxes
  - Soil moisture, river-discharge and water cycle
- Apr2022 the IESWG will convene a 4th workshop in Helsinki, Finland.

Improving surface hydrology using EO IR / MW data enhance Earth system models

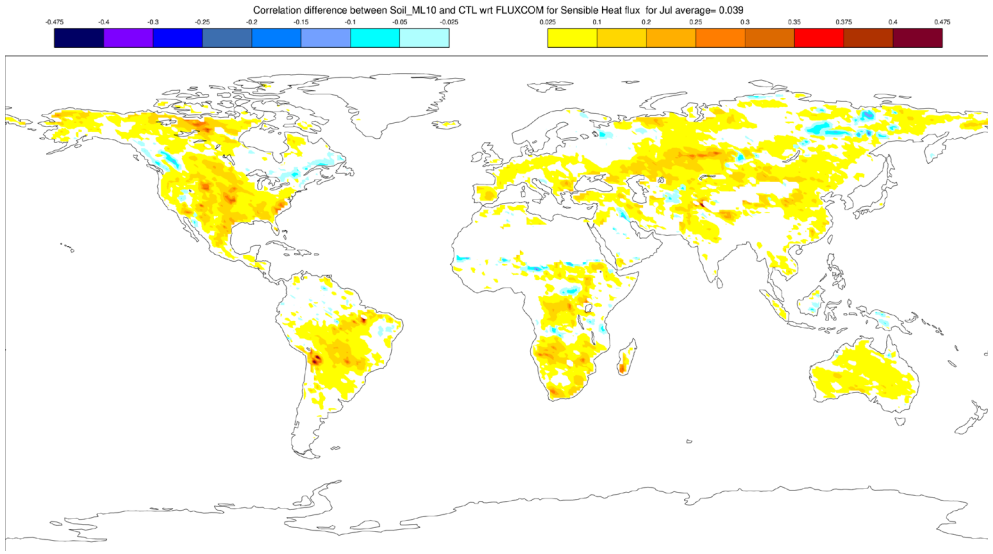


4 Layers: 2.89m

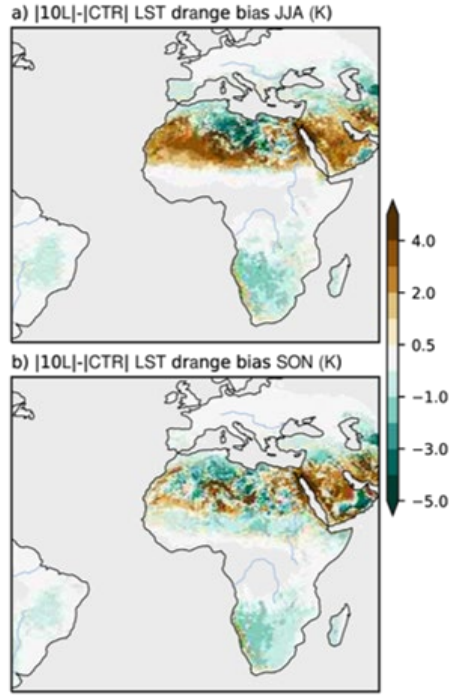
10 Layers: 8m



Layer1 SM correlate better with **ESA-CCI** SM (plot for JJA 2018: Corr_10L –Corr_CTL)



Better match (correlation) to **FLUXCOM** Sensible heat flux **Machine Learning** product.



better match with **EUMETSAT** Land-SAF LST

==> better interaction with the atmosphere, brought by special care to hydrology, enhance the possibility to assimilate IR / MW observations

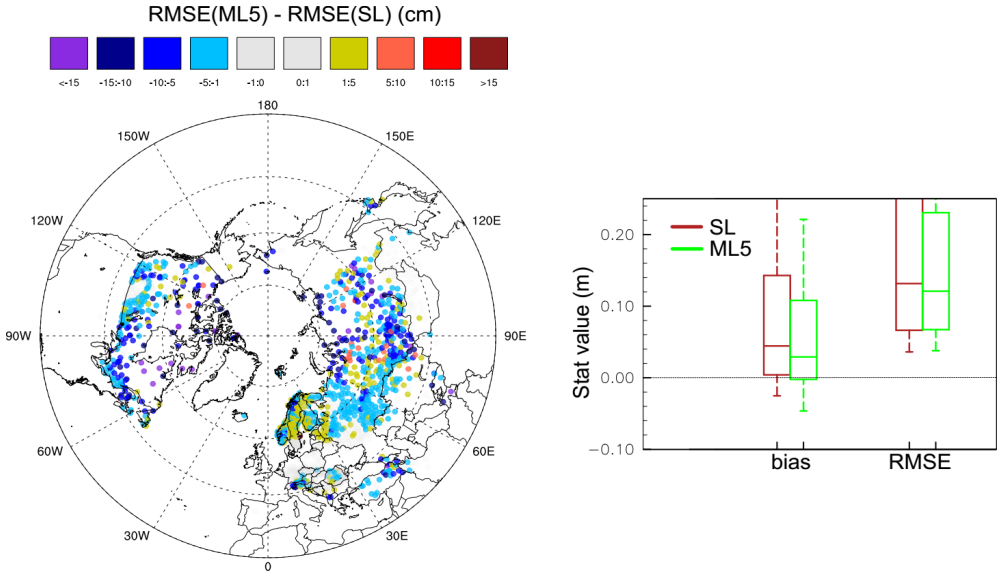
Boussetta et al (2021) MDPI-Special issue on Land Surface Modelling
https://www.mdpi.com/journal/atmosphere/special_issues/representation_land_surface_model

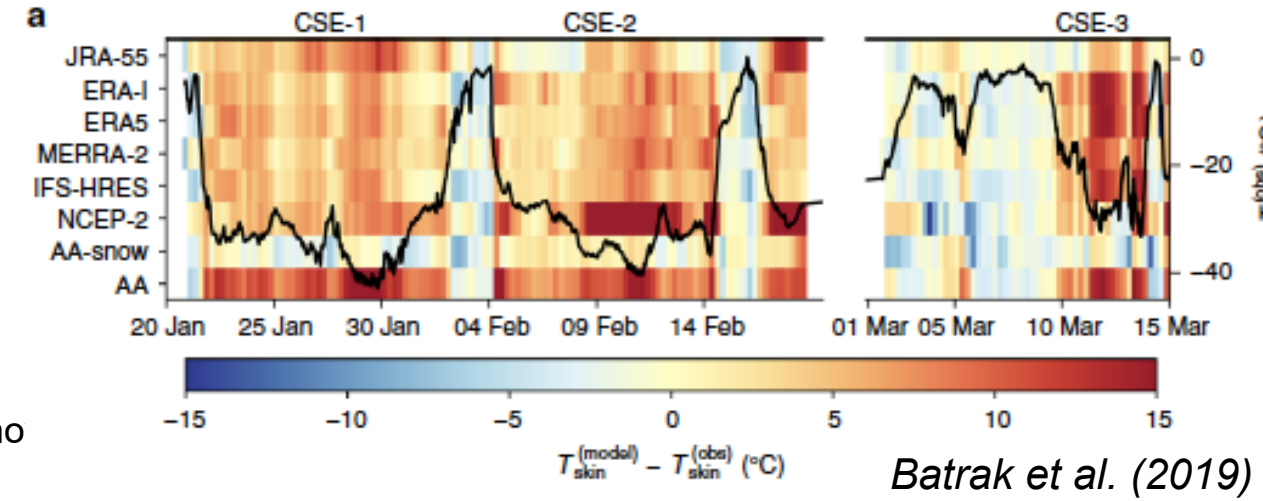
A key focus of the IESWG is on Polar regions

- Forecast skills in the medium-range can be improved by
  - Improving the initial conditions (DA)
  - Improving the model

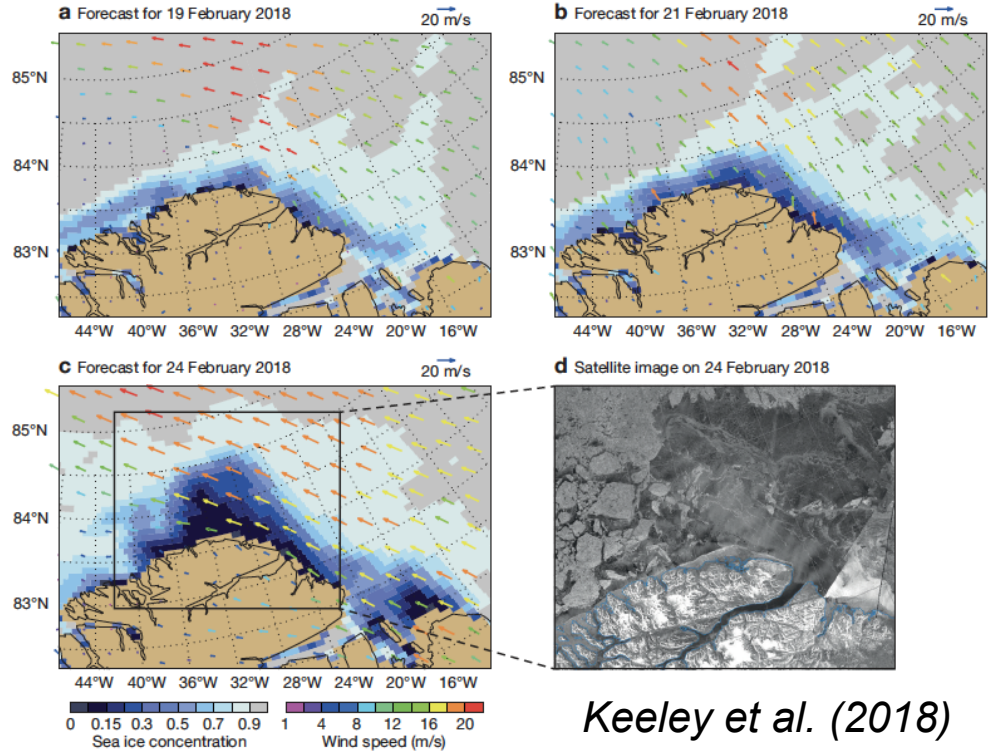
Can feedback on

- Large errors still exists in current NWP systems
  - (Near-) Surface temperature over land/sea-ice, in particular over sno covered surfaces
- Modelling improvements are driven by in-situ + EO data
  - Snow coupling improvements are relevant on continent & sea-ice





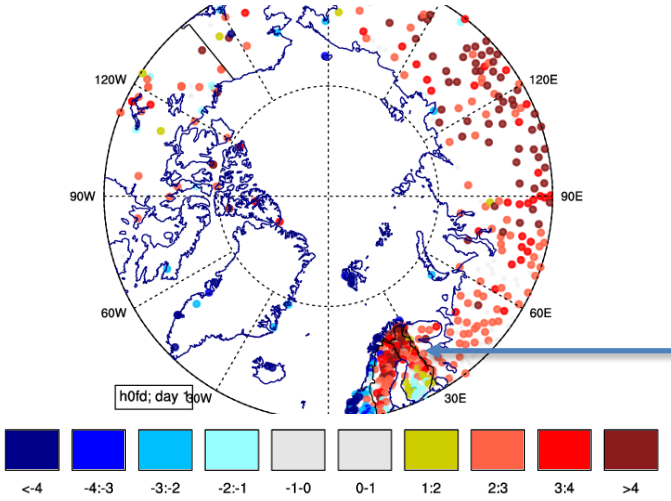
Batrak et al. (2019)



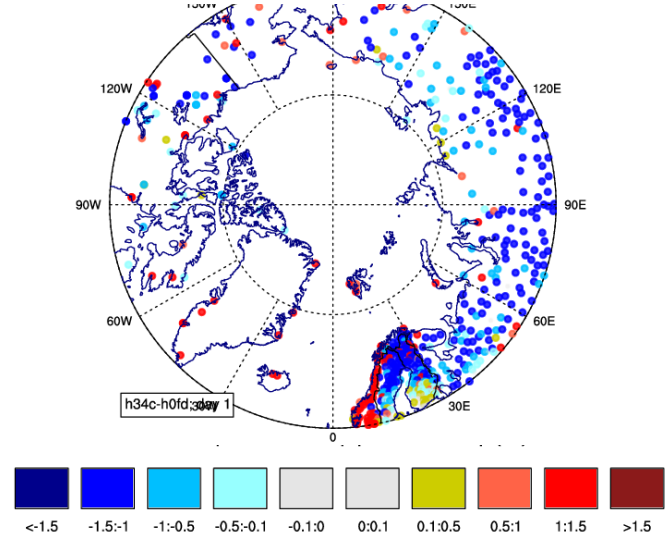
Keeley et al. (2018)

Evaluating the impact of multi-layer snow modelling over land

Bias minimum 2-metre temperature (T2m) single-layer snow (CTL) against obs



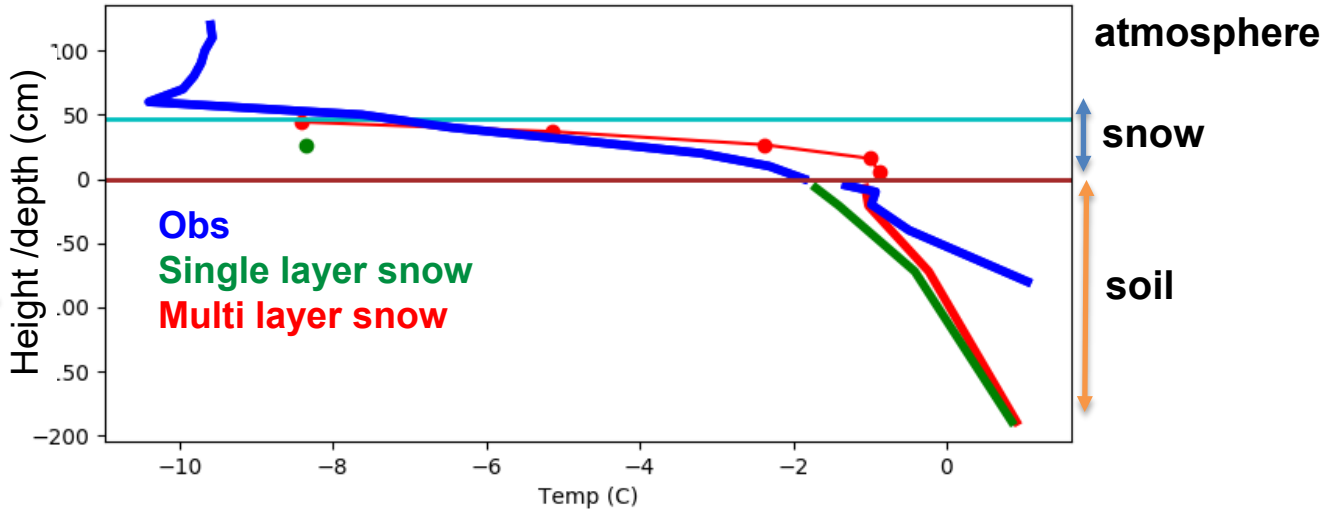
Absolute bias difference T2m (multi-layer snow) – (single-layer snow)



Temperature profile for Jan-Feb 2017 at Sodankyla, Finland

J. Day & G. Arduini

Arduini et al, JAMES, 2019



- Forecasts with current single-layer snow scheme show widespread positive bias in minimum T2m
- Multi-layer snow scheme improves near-surface temperature extremes
- Multi-layer snow scheme improves simulation of snow internal properties

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Advanced prediction in polar regions and beyond

Multi-layer snow emission

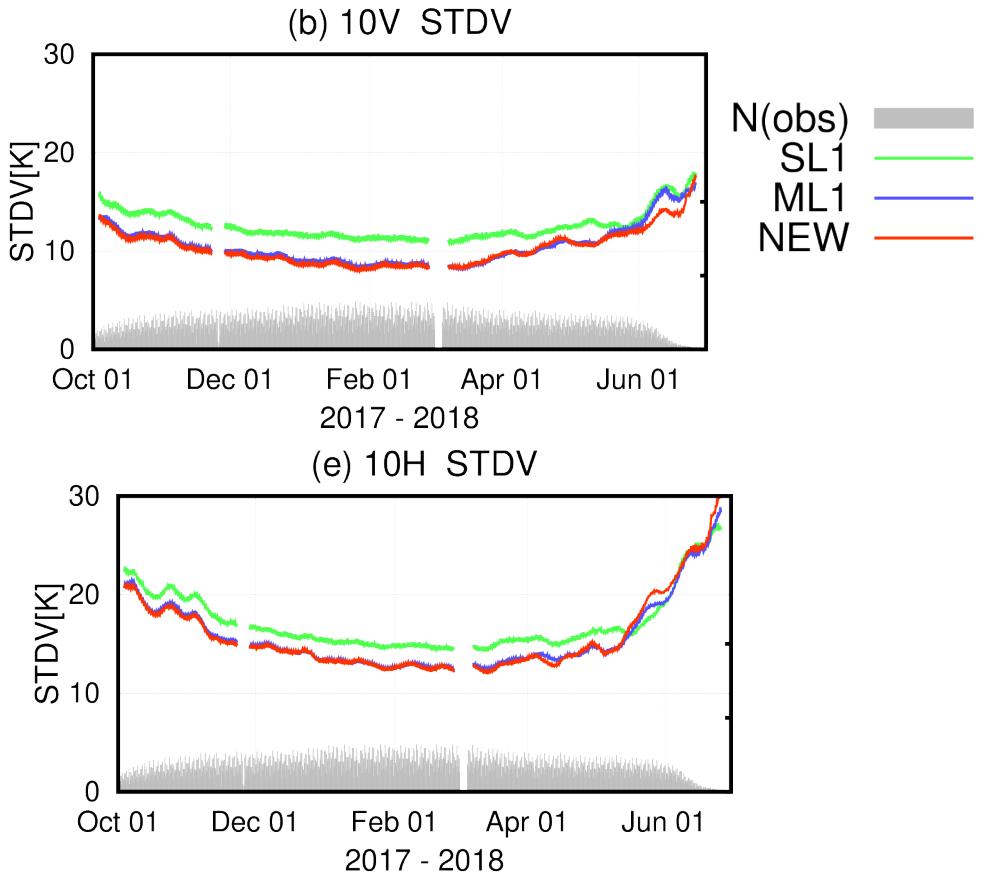
Multi-layer snowpack model (Arduini et al 2019)

→ Impact on snow emissions?

→ Multi- vs single-layer snow emission model compared to AMSR2 10GHz data

Multi-layer snowpack scheme (ML1 and NEW) leads to reduce STDV and higher correlation.

NH snow-covered area
(w/o glacier and high vegetation)



remote sensing

MDPI

Article

Evaluation of a Microwave Emissivity Module for Snow Covered Area with CMEM in the ECMWF Integrated Forecasting System

Yoichi Hirahara [1,2,*], Patricia de Rosnay [1] and Gabriele Arduini [1]

Remote Sens. **2020**, *12*(18), 2946; https://doi.org/10.3390/rs12182946

To be re-considered by CGMS-50:

- General action, to review and provide feedback to draft of Terms of Reference (ToR) for the International Earth Surface Working Group (IESWG)
- Action to the CGMS agencies, if it hasn't previously sent representation, consider joining IESWG-4 to provide their insights and priorities
- Incorporate responses from CGMS-49 plenary, and report outcome of IESWG-4 back to the CGMS-50 plenary for endorsement of IESWG