

# Overview of HIRLAM surface activities

Patrick Samuelsson

... by Ekaterina Kourzeneva

Madrid  
1-4 Mar. 2019



# General HIRLAM surface comments

Release SURFEX	cy40h1.1.1 v7.3	cy43h2.1 (2019) v8.1	cy43h2.2 (2020?) v8.1
<b>ISBA</b>			
Patches	1 or 2 (no SBL model)	<b>2 (default)</b>	2 (-4)
Soil/veg	Force-restore	Force-restore	Diffusion (14 layers) + MEB
Snow	D95	D95	Explicit snow (12 layers)
Glacier	“Pile of snow”	“Pile of snow”	Explicit snow as glacier?
Assimilation	CANARI-OI	CANARI-OI	SEKF/EKF & TITAN/gridPP
<b>Sea</b>	SICE	SICE	SICE
Assim of ice	no	no	ice temperature EKF?
Waves	no	no	WW3?
<b>Lake</b>	FLake (optional)	<b>Flake (default)</b>	FLake
Assimilation	no	no	EKF?
<b>Town</b>	TEB	TEB	TEB (more options?)
Assimilation	yes	<b>no (?)</b>	??
<b>Physiog.</b>	ECOCLIMAP (modified)	<b>ECOCLIMAP-SG(?)</b>	Utilize high res. data

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# Surface options for potential activation in upcoming cy43h2.1 meteorological release

- ECOCLIMAP-SG, Second Generation
- ECUME6 scheme for the water fraction of the sea tile (see presentation by Karl-Ivar)
- Orography - turbulence (OROTUR)
- Modified values of minimum stomatal resistance  $R_{smin}$
- Assimilation of satellite product of snow extent
- SOILGRIDS - New clay and sand database

These options, and more, are described in detail on this HIRLAM wiki:  
[https://hirlam.org/trac/wiki/Surface\\_physics\\_assimilation/First\\_cy43h\\_setup](https://hirlam.org/trac/wiki/Surface_physics_assimilation/First_cy43h_setup)

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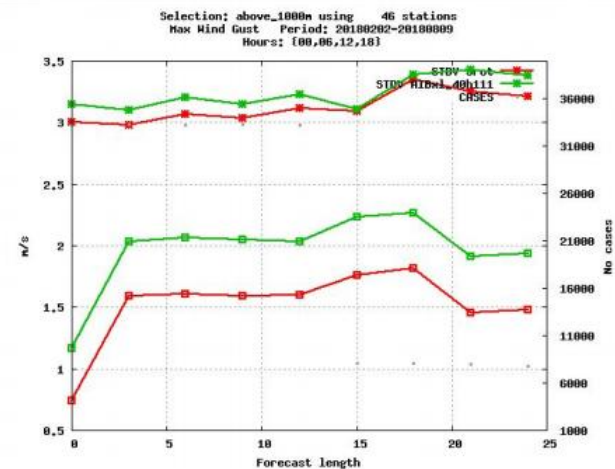
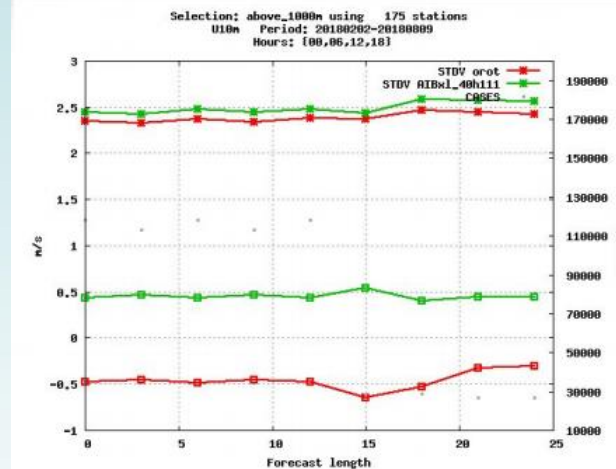


# OROTUR scheme

by L. Rontu, J. Calvo, S. Viana et. al

- verification of OROTUR, also in the frames of cy43 tests for different domains
- overall positive impact

OROTUR increases the momentum flux by adding a sub-grid orography dependent term



where  $C_{oo} = \alpha / \Delta x^2$  &  $V_{2oo}$  are tunable constants.

Default settings:  
 $\alpha = XCOROT = 500$   
 $XVOROT = 8$

$$\vec{\tau}_{tot} = \vec{\tau}_{os} + \vec{\tau}_{ts} = (1 + C_o \sigma_{SSO}^2) \vec{\tau}_{ts}$$

$$C_o = C_{oo} V_{oo}^2 / (V_{nlev}^2 + V_{oo}^2),$$

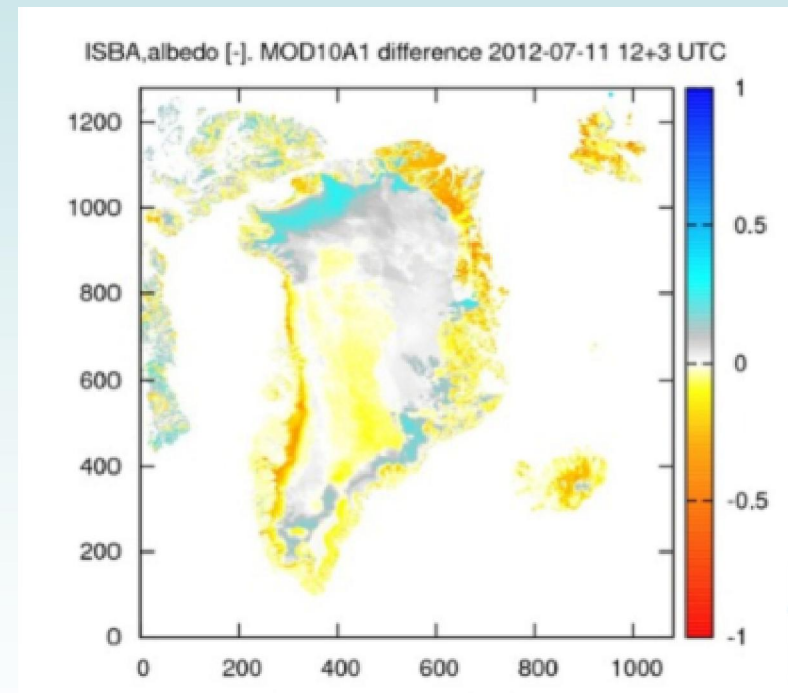
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# Using satellite albedo product over glaciers

by K.P. Nielsen, P. Samuelsson et. al

- gridded dataset GEUS MOD10A1 C6
- for CARRA project
- impact studies



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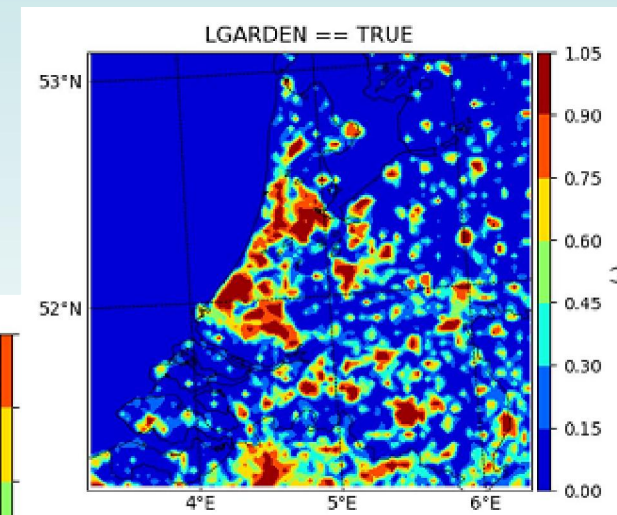
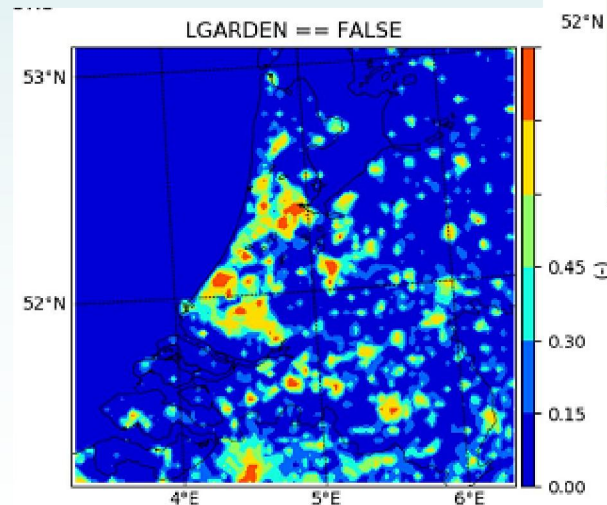


# Evaluation of ECOCLIMAP SG

by J. de Vries

- over the Netherlands, MetCoOp and Iberian domains
- no comparison with independent data
- fractions of sea, inland water, urban
- LAI and tree height
- larger urban fraction!
- LAI is more realistic, but ...

See presentation on  
ECOCLIMAP-SG by John de  
Vries (KNMI) for more details:  
[https://hirlam.org/trac/raw-attachment/wiki/Meetings/Surface/Surface201901/ECOCLIMAP\\_v2.2-SG.pptx](https://hirlam.org/trac/raw-attachment/wiki/Meetings/Surface/Surface201901/ECOCLIMAP_v2.2-SG.pptx)



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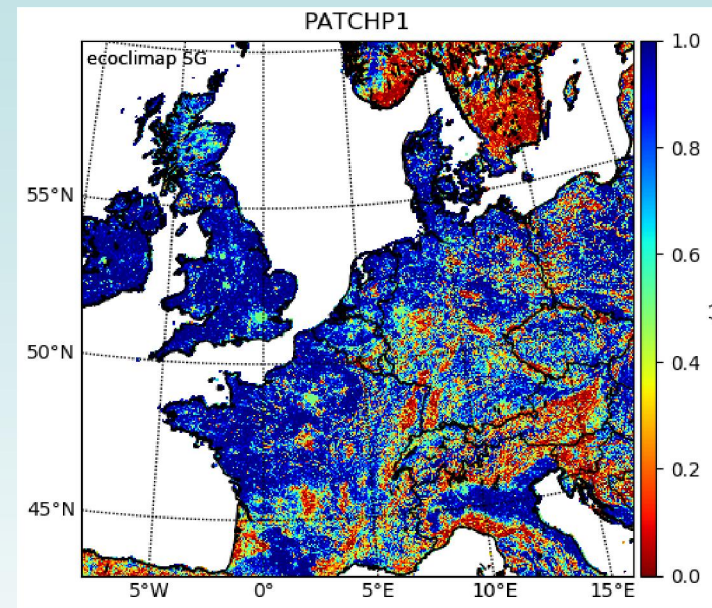
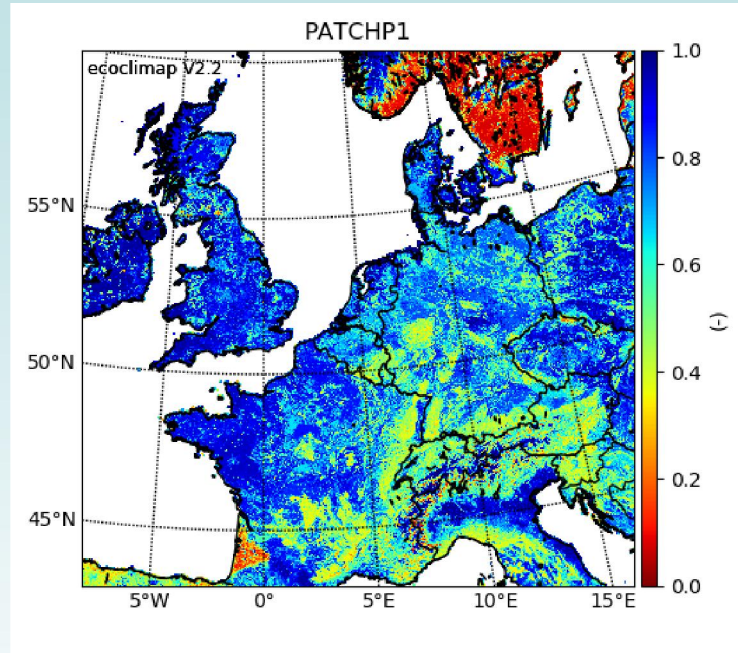


# Evaluation of ECOCLIMAP SG

## Fraction open land

v2.2

SG



Quite some 50-50% areas in v2.2 are  
near 100% forest in SG.

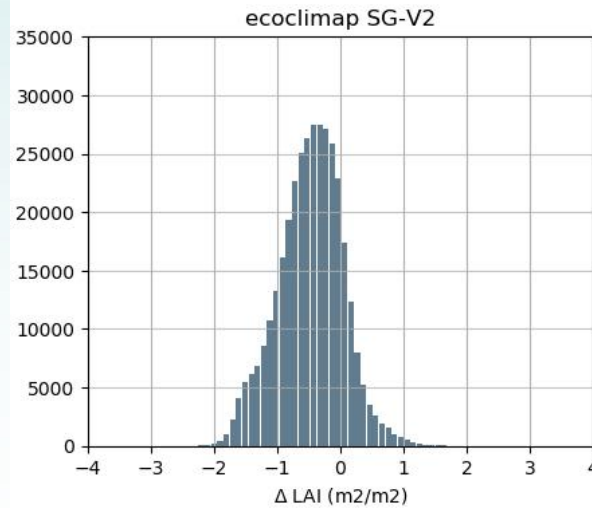
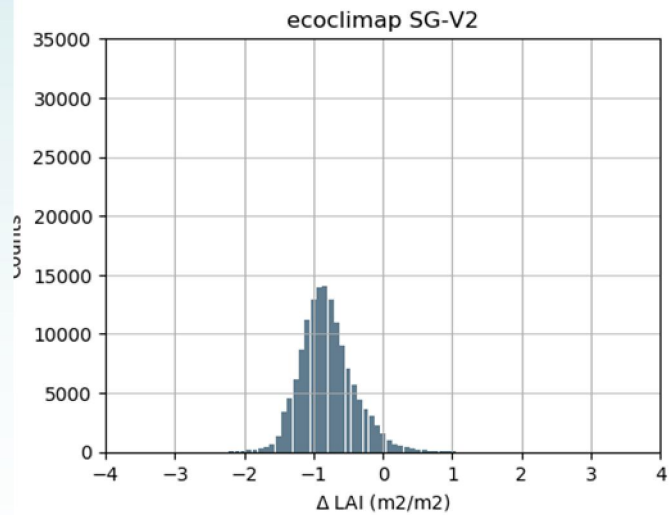
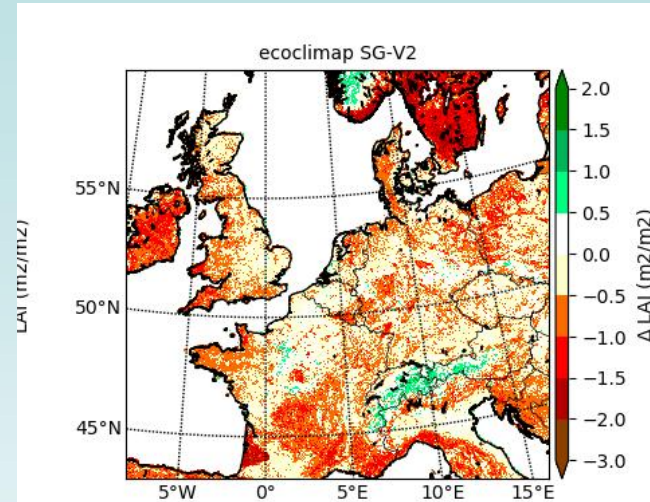
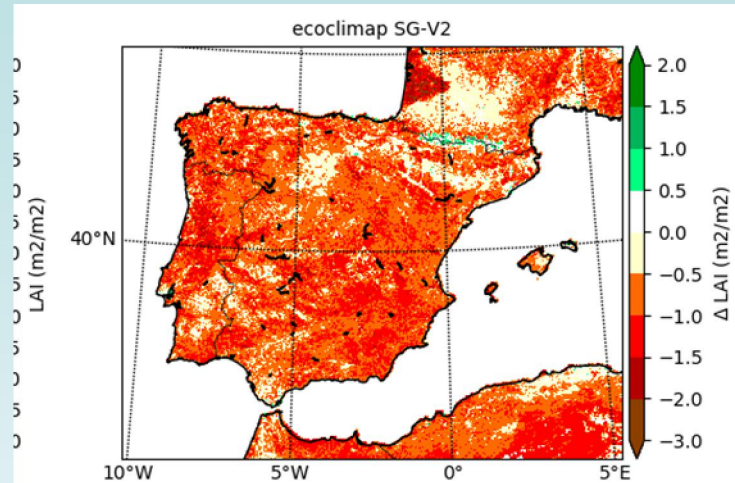
These changes are confirmed and supported by other land-use  
data sets.

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# Evaluation of ECOCLIMAP SG

LAI differences  
(SG - v2.2)  
at the beginning  
of April



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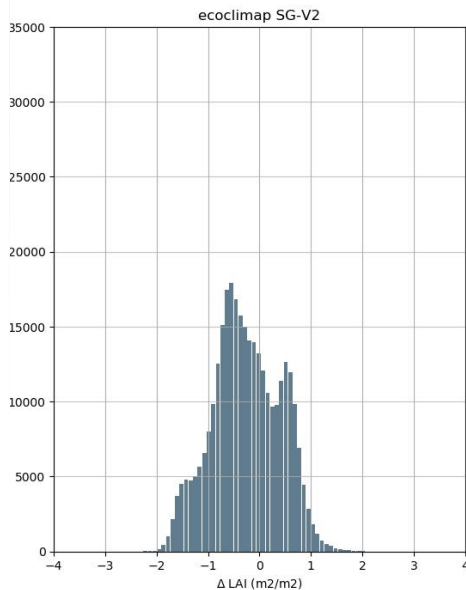
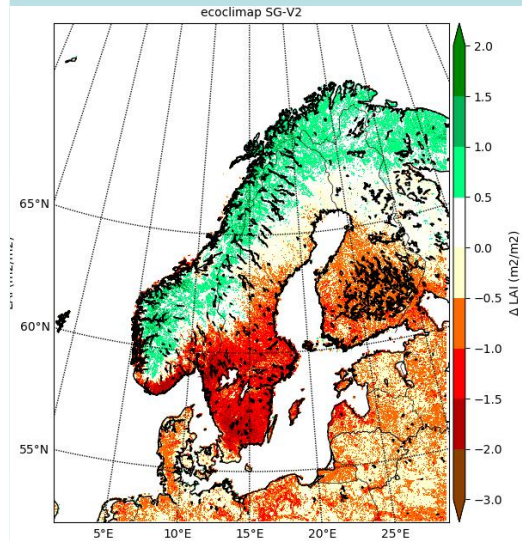


# Evaluation of ECOCLIMAP SG

Spring LAI is in general smaller in SG than in v2.2.

Also these changes are confirmed and supported by other land-use data sets.

HIRLAM experience is also that SG LAI looks more realistic since e.g. LAI in v2.2 show increasing LAI already in February-March, which is not realistic.

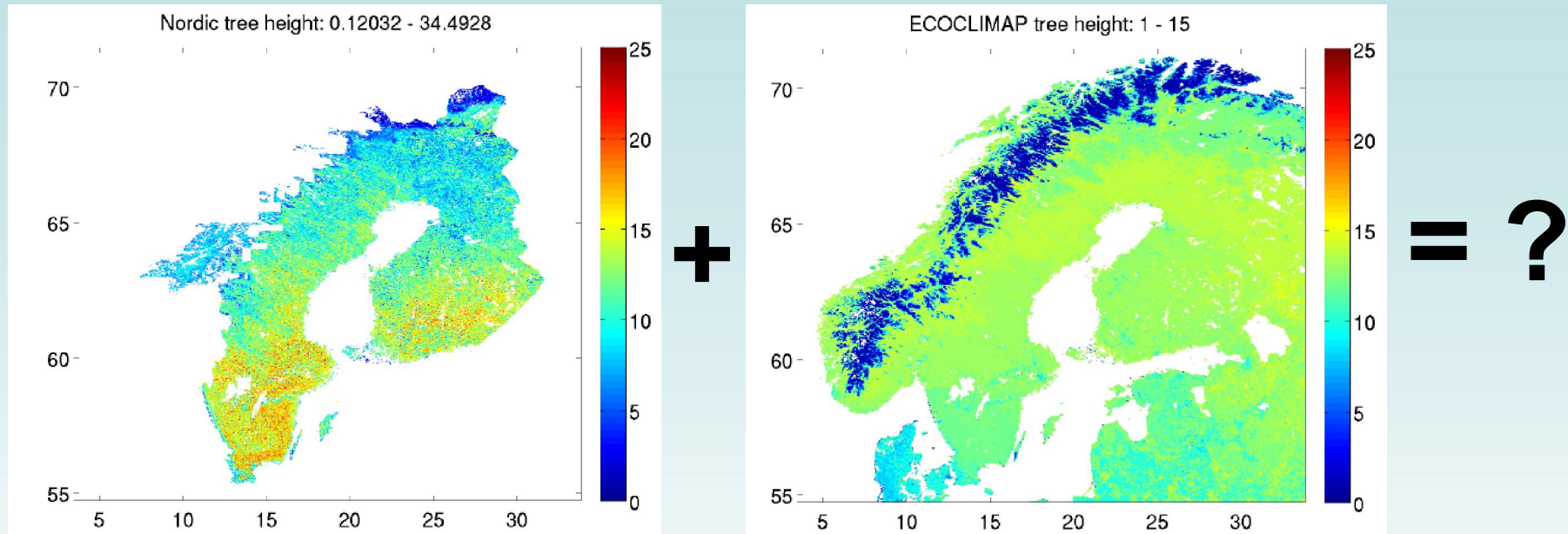


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# ECOCLIMAP SG - how to update?

Geographically limited data bases, e.g. laser scanned tree height



How to merge with global data avoiding artificial boundaries?

How to keep different contributions in a common update?

Currently such combinations is the responsibility of each partner.  
But ideas on how to proceed with physiography needs for NWP,  
even cross-consortia, are discussed...

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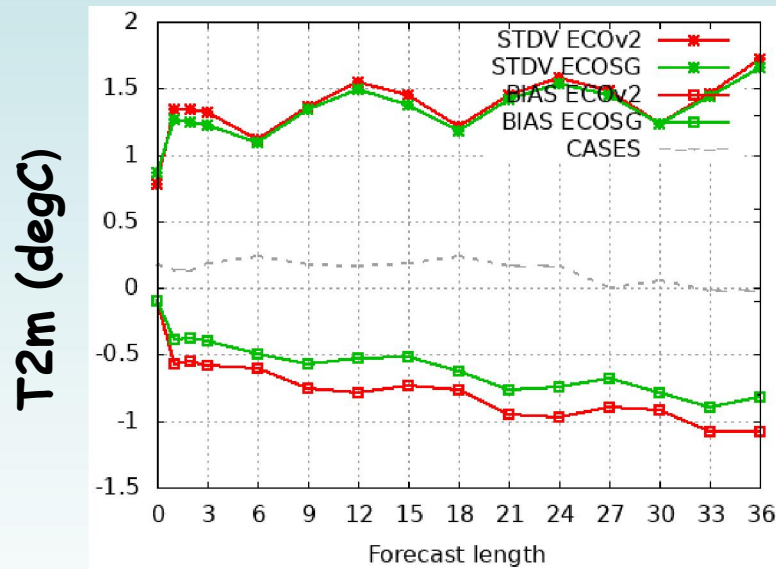


# First preliminary validation of ECOCLIMAP-SG

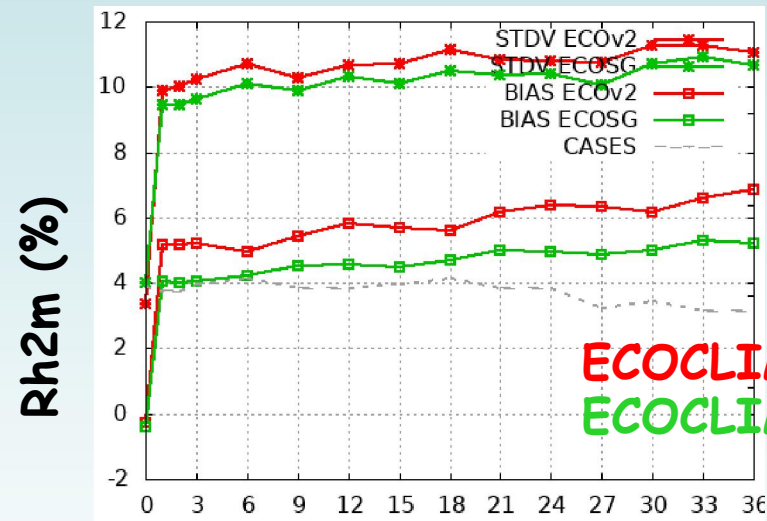
by P. Samuelsson

cy43h over the MetCoOp domain for April 1-14, 2018

Southern Sweden  
mostly no snow



Forecast length



Forecast length

ECOCLIMAPv2  
ECOCLIMAP-SG

ECO-SG gives improvement over  
Southern Sweden (decreased LAI)

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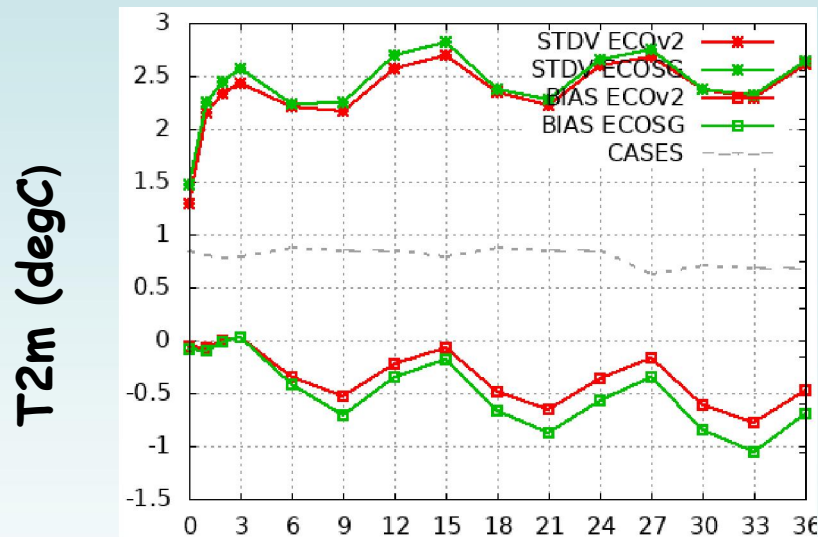


# First preliminary validation of ECOCLIMAP-SG

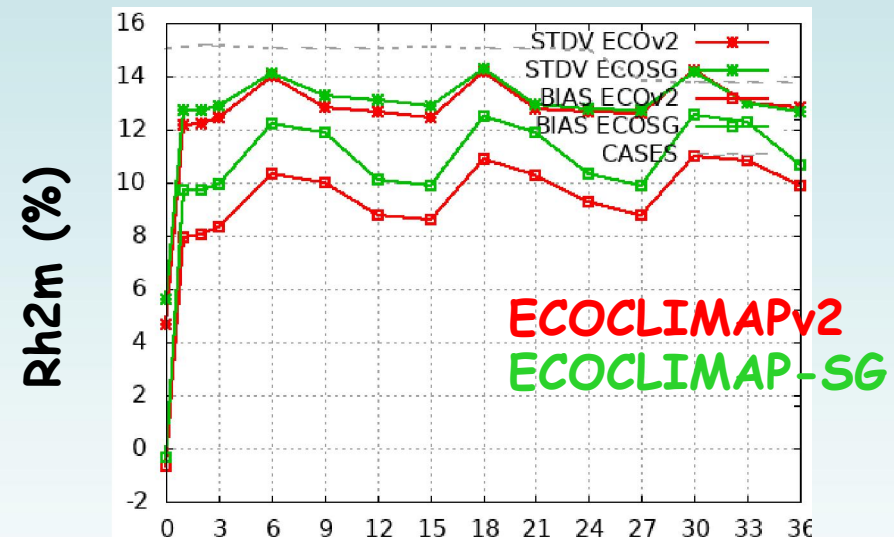
by P. Samuelsson

cy43h over the MetCoOp domain for April 1-14, 2018

Northern Sweden  
snow covered



Forecast length



Forecast length

ECOCLIMAPv2  
ECOCLIMAP-SG

... but worse results over Northern Sweden  
(decreased LAI in the South and  
increased LAI in the North)

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# Testing of different options in SURFEX (our wishlist) in climate mode

by S. Viana and E. Gleeson  
see presentation by S. Viana

- Iberian domain and Irish domain
- using various obs datasets for verification

```
&NAM_ISBA
CISBA = 'DIF' ! Activate diffusion soil heat transfer
YSOC_TOP = 'soc_top' ! Read top soil organic carbon field
YSOC_SUB = 'soc_sub' ! Read deep Soil organic carbon field
CPHOTO = 'NON' ! Jarvis formula is used for plant transpiration (nothing else is available for NPATCH<12)
LTR_ML = .FALSE. ! Radiative transfer in vegetation (but see LMEB option below).
NPATCH = 2-4 ! Number of patches. 2 means separate forest and open land. 3 would mean an additional patch
              with permanent snow (glaciers). 4 would mean yet an additional patch for bare soil)
LMEB = .TRUE. ! Use Multi-Energy Balance (explicit canopy). Automatically sets LTR_ML = .TRUE.
CPEDO_FUNCTION = 'CO84' ! should be used for DIF
XUNIF_RUNOFFB = 0.2 ! Used in combination only with CRUNOFF = 'DT92'. Tunable
/
&NAM_MEB_ISBA
LMEB_PATCH = .F., .T., ! Use MEB for forest but not for open land (with NPATCH=2)
LMEB_LITTER = .TRUE. ! Use litter on ground in forest.
/
&NAM_ISBAN
CSCOND = 'PL98' ! Type of soil thermal conductivity
CSNOWRES = 'RIL' ! Maximum Richardson number limit for stable conditions ISBA-SNOW3L turbulent exchange option.
CALBEDO = 'CM13' ! Albedo by cover and vegetation type processed from satellite data.
/
&NAM_SGH_ISBAN
CRUNOFF = 'DT92' ! DT92 means Dumenil and Todini (1992) subgrid runoff (should be used in combination with XUNIF_RUNOFFB=0.2).
              SGH means Decharme et al. (2006) Topmodel like subgrid runoff. This was developed for coarser resolution and requires
              subgrid slope information
CRAIN = 'SGH' ! Activate spatial distribution of rainfall.
CHORT = 'DEF' ! DEF=no Horton runoff. SGH activates the Horton surface runoff for intense rain on dry soil with limited infiltration capacity.
              This option was added in the climate model: it has to be evaluated carefully for NWP applications before taking the decision of its use.
LSOC = .TRUE. ! Activate soil organic carbon effect.
/
&NAM_PREP_ISBA_SNOW
CSNOW = '3-L' ! Explicit snow scheme (default 12 layers)
/
```

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# Modified minimum stomatal resistance $R_{smin}$ ...?

by P. Samuelsson

Hoshika et al. (2018):  $R_{smin}$  values should be 1.5-3 times larger:

Trees (4) =  $150 * 1.5$ , Coniferous (5) =  $150 * 2.75$ ,

C3 crops (7) =  $40 * 3.0$ , C4 crops (8) =  $120 * 1.5$ .

0: default

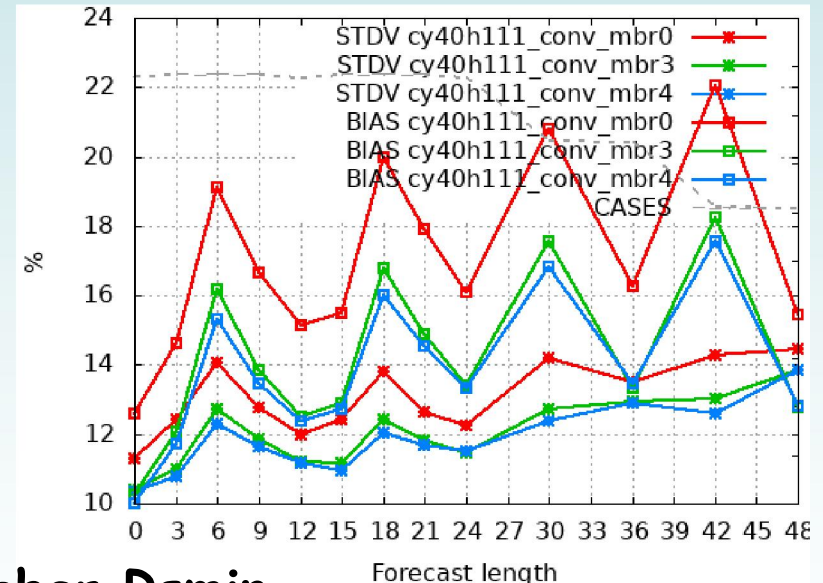
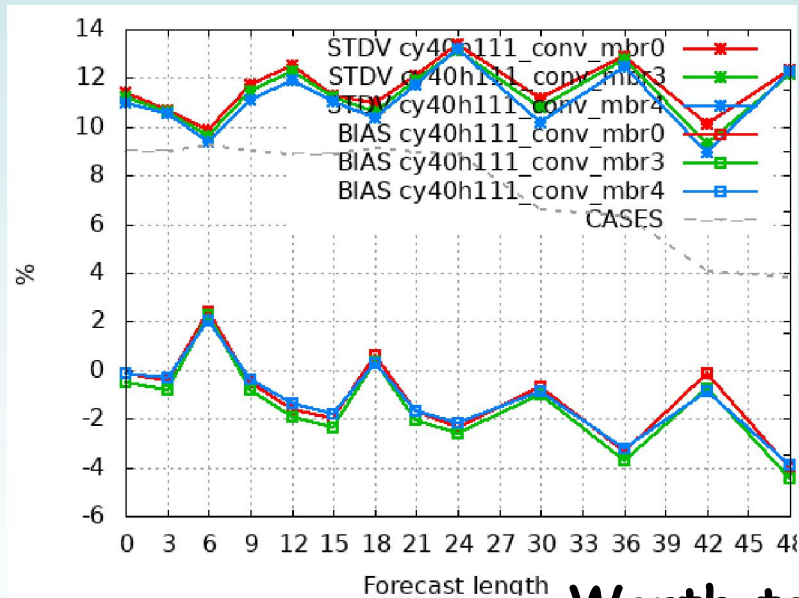
3: LAI/2

4:  $R_{smin} * (1.5-3)$

Rh2m for May 7-10, 2018

Southern Sweden, no snow

Northern Sweden, 2/3 still snow covered



Worth testing higher  $R_{smin}$   
 ECO-SG also suggests lower LAI...

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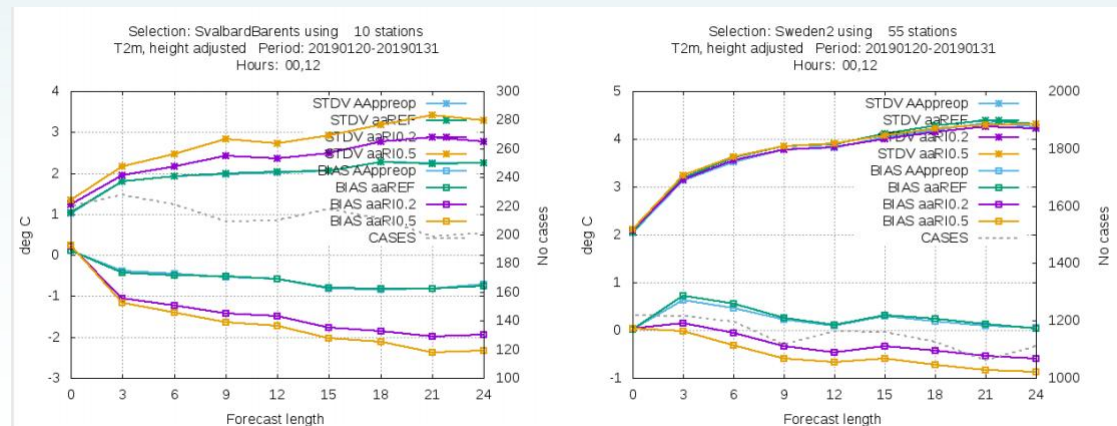
Hoshika, Y., Osada, Y., De Marco, A., Penuelas, J. and Paoletti, E., 2018. Global diurnal and nocturnal parameters of stomatal conductance in woody plants and major crops. Global Ecology and Biogeography, 27(2), pp.257-275.



# Testing:

by M. Homleid, L. Rontu et. al

- Harmonie Cy43h with many changes in surface
  - ISBA DIF (without DA), OROTUR, Snow ES, SoilGrids
  - Iberian and MetCoOp domains
- ISBA DIF is better in the stable boundary layer!
- the maximum Richardson number option for the stable boundary layer
  - sensitivity is very large! However both improvement and deterioration of scores



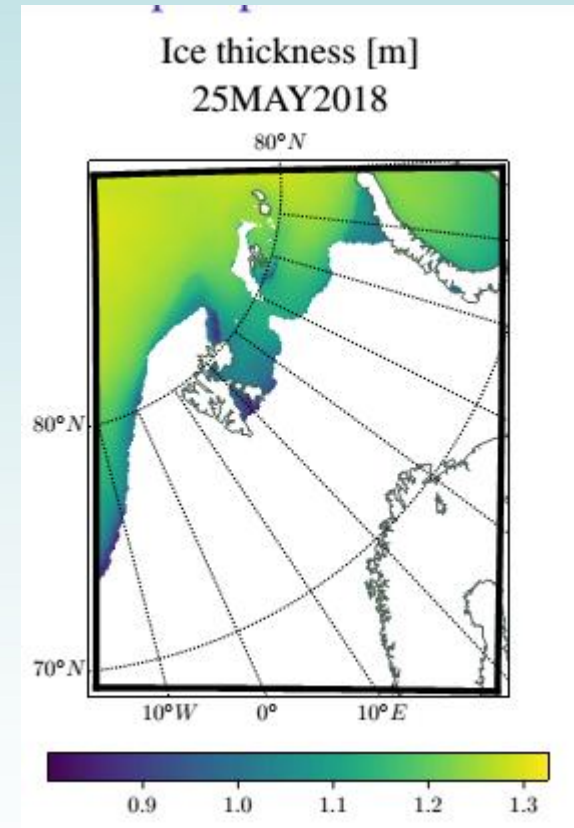
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# SICE scheme developments

see presentation by Y. Batrack

- evolving ice thickness ... runs pre-operationally for MetCoOp and in CARRA
- validations against various obs
- steps towards DA



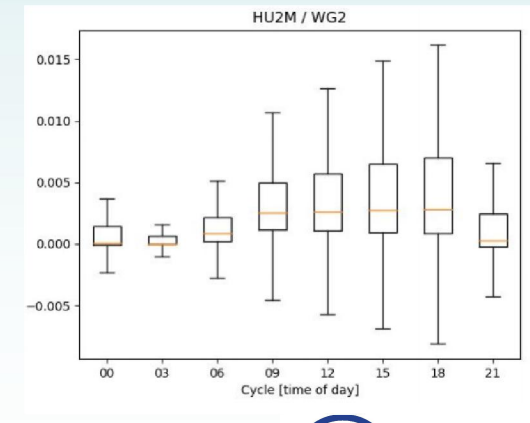
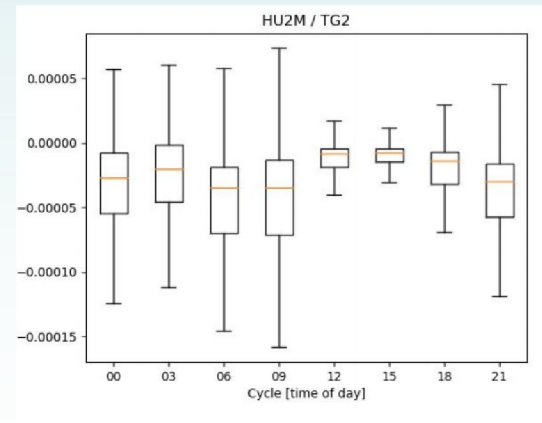
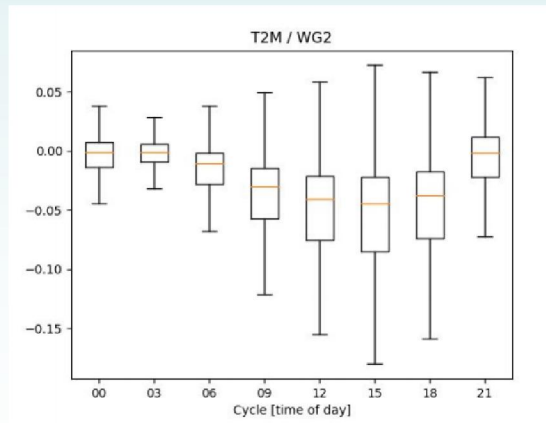
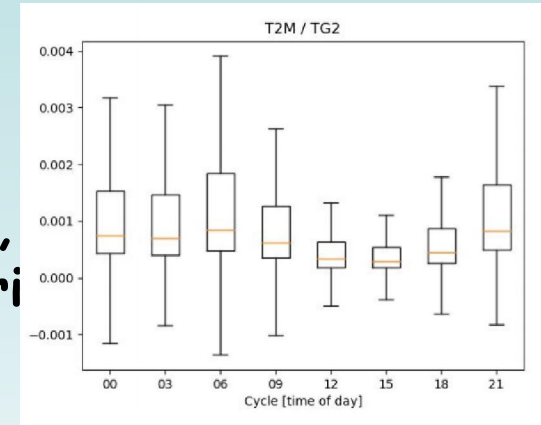
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# Testing of EKF/SODA for ISBA DIF

by Å. Bakketun et. al

- It was decided in the meeting in Trømse in spring 2018 to stop testing of EKF/SODA for ISBA FR, due to too large elements of Jacobian matrix
- Bugs corrected EKF/SODA for ISBA DIF



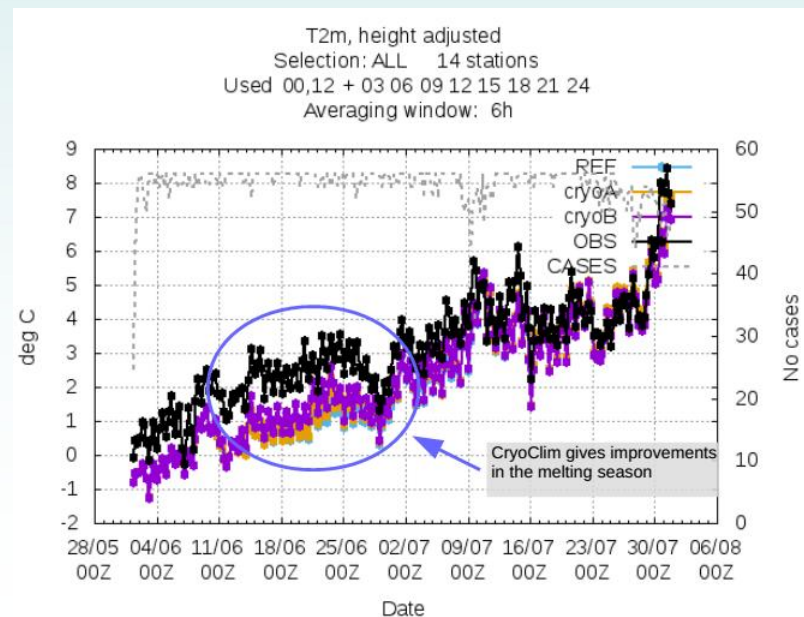
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# SE from satellite for snow analysis

by M. Homleid et. al

- CryoClim data on SE for CARRA
- Tests over Svalbard and Arctic domains: improvements over melting period
- HSAF data for operational use
- Thinning of HSAF data, experiment runs technically



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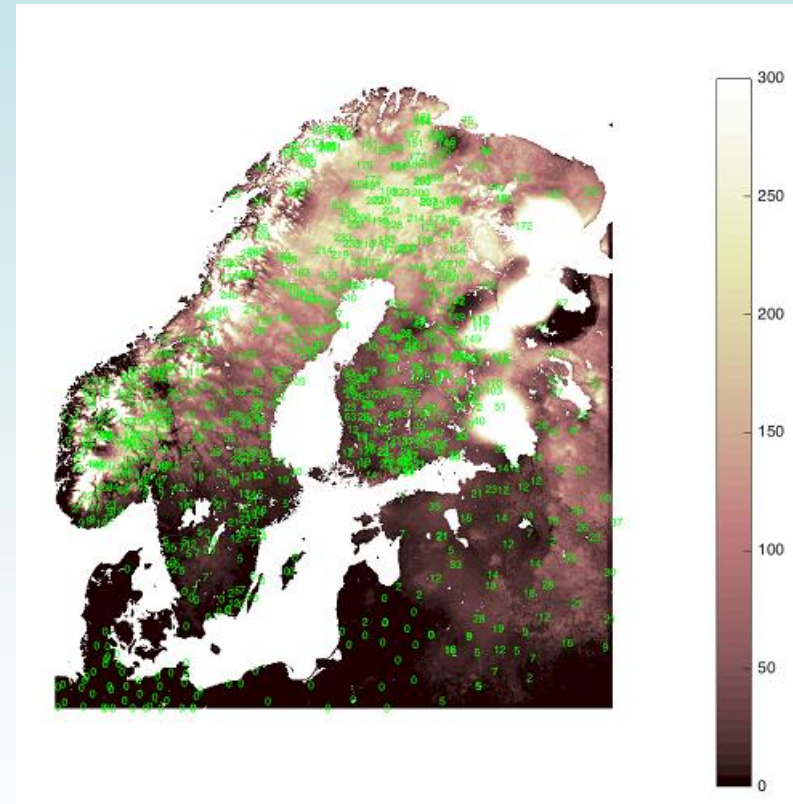




# CANARI work ...

see presentation by E. Kourzeneva

- Motivation: problems with snow analysis, etc.
- Harmonization between CANARI and SURFEX
- Improving of obs. operator
- How to proceed with tiling?



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# Alternative DA methods for the land surface ...

by T. Aspelien

## Gridpp software

- Came from post-analysis
- External, but connected with the system via file formats
- Intended for using of crowd-source observations

by T. Landelius

## Towards EnKF and coupled system

- 4D EnEKF system
- Use of satellite radiances
- Study of co-variances within the soil and between tiles

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Thank you!

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