ACCORD
A Consortium for COnvection-scale modelling Research and Development

ACCORD overview of Land Surface Data Assimilation

E. Kurzeneva,

basing on contributions of many colleagues …

Canonical System Configurationss

- AROME
- HARMONIE-AROME
- ALARO

National Weather Services

United Weather Centers

- MetCoOp/UWC-East
- UWC-West
- …

Horizontal part of Land Surface DA

- OI CANARI: tuning of length scales

- OI gridPP

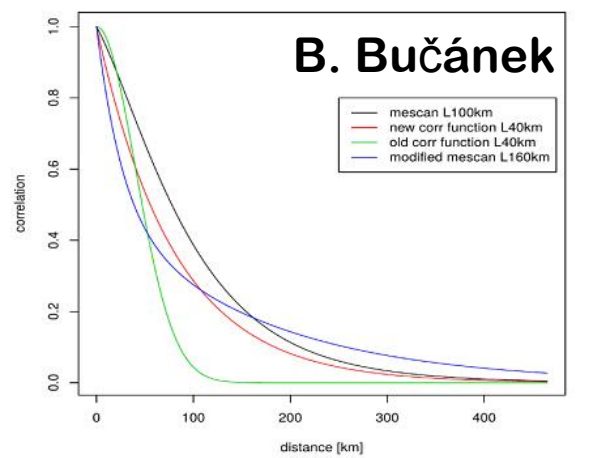
+ QC Titan

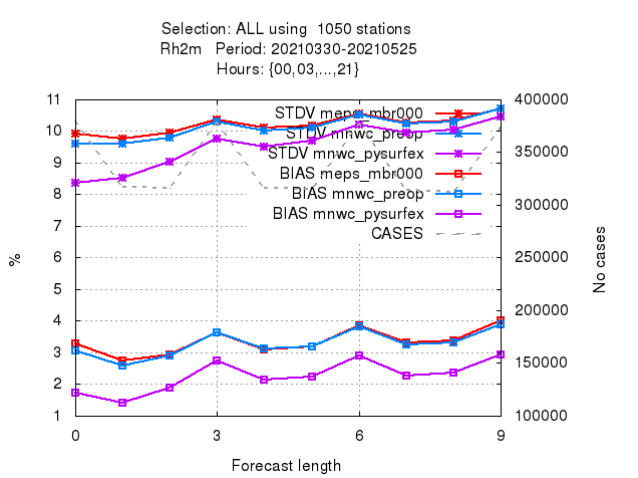
+ scripting system pysurfex

Suggests modular approach for easy tuning of QC, useful for crowd-source data

Maximization of probability, alternatively to minimizaton of errors => different parameter notations

For MetCoOp in nowcasting mode (without cycling), with NetAtmo observations improved RH2m scores

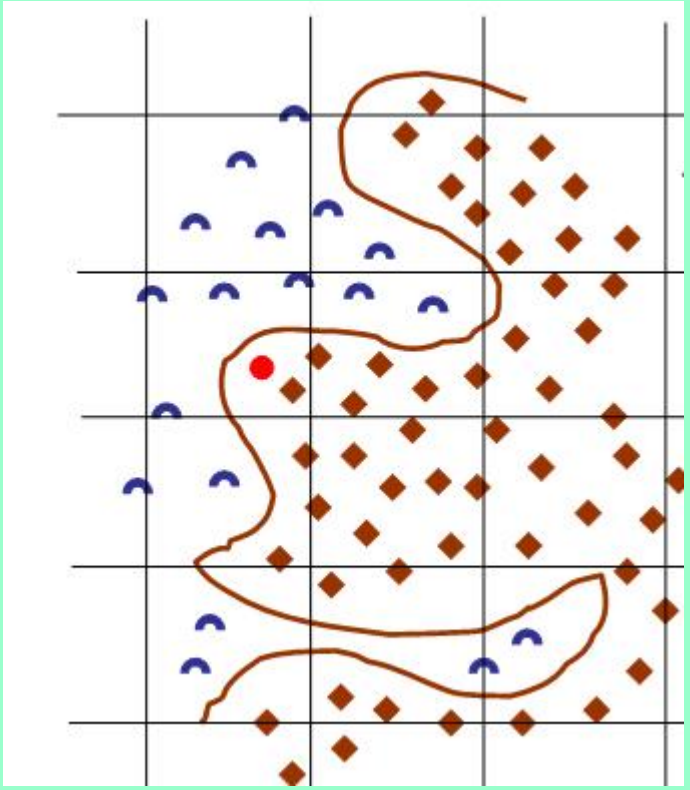




T. Aspelien, E. Gregow, P. Samuelsson

Physiography in DA

- **DA physiography**: 150 sec res, water and land, 50% masking
- **Model physiography**: 30(10) sec res, 4 tiles, up to 20 patches, 0 (100) % masking
- Inconsistencies reveal differently, depending on a scripting system of CSC
- The most sensitive parameter is snow
- Work on harmonization: corrections needed everywhere
- On track



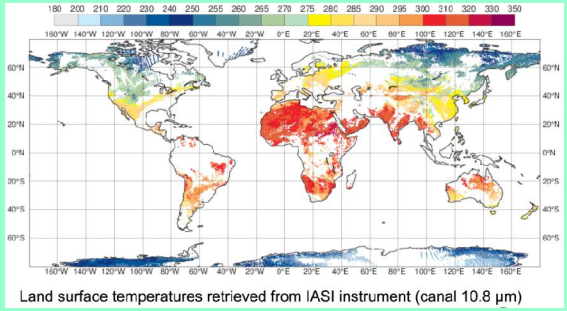
E. Kurzeneva

Vertical: assimilation of Land Surface Temperature from SEVIRI in ISBA-FR

- LST retrieved from SEVIRI, 5 km resolution after thinning. Affected by cloudiness.
- Assimilated together with SYNOP T2m and RH2m in AROME ISBA-FR with vertical OI
- New OI coefficients, developed for the new variable. Obs. and bgr. errors and correlations are estimated by Desroziers method
- Resulting LST is transferred to UA analysis for obs. operators
- First experiments over France show improvement of T2m and RH2m and upper air forecast scores
- Application of this methodology to LST from IASI is planned.

- Evaluation of land surface temperature assimilation on AROME forecasts against Synops

Forecast ranges	0h	6h	12h	18h	24h	30h	36h	42h	48h
T2m (K)	-0.01	0	0	0	0.01	0.01	0	0.01	0.01
Hu2m (%)	-0.02	0.01	0.04	0.08	0.06	0.06	-0.02	0.01	0.07

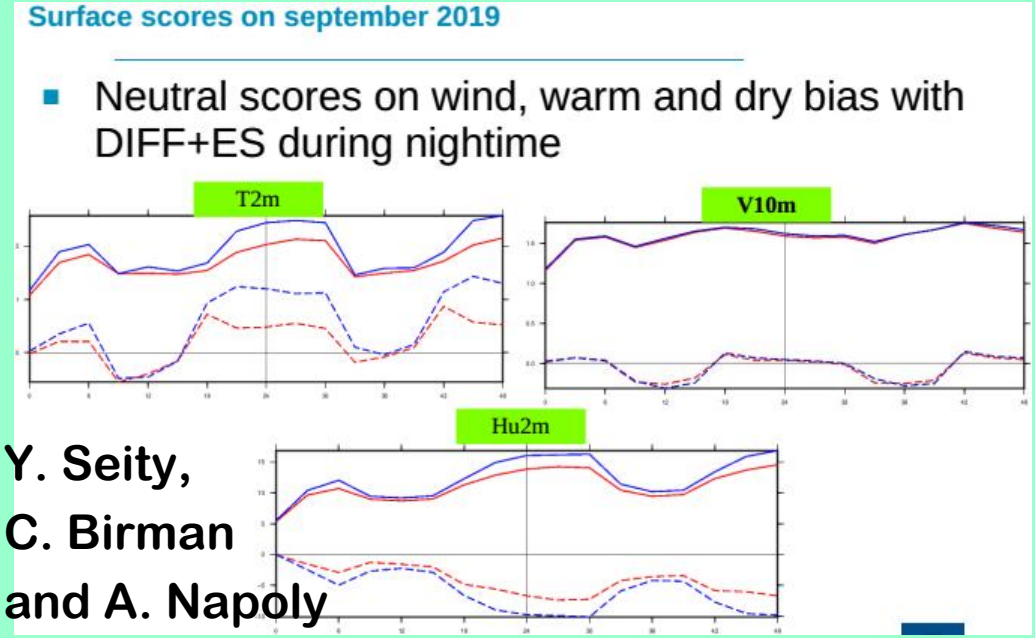


Land surface temperatures retrieved from IASI instrument (canal 10.8 µm)

Z. Sassi, C. Birman and MF colleagues

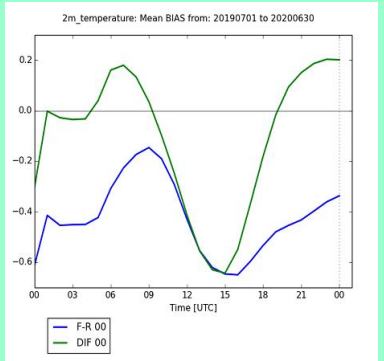
Vertical: OI for ISBA-DIF

- **ISBA-DIF: 14 layers in soil, down to 12 m, up to 12 layers in snow**
- **Simplified OI, mainly for validation of ISBA-DIF: t and w increments decreasing within the soil**
- **Assimilation of T2m and RH2m**
- **Promising results over small domain in France: neutral scores in winter, warm dry bias during night in autumn**



Y. Seity, C. Birman and A. Napoly

- **Similar experiments over Austria: ISBA-DIF is warmer and dryer**



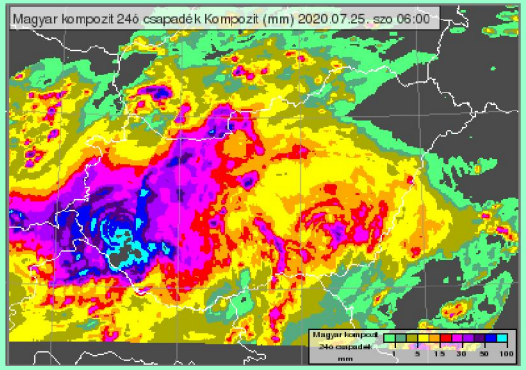
S. Schneider and S. Oswald

Vertical: SEKF for ISBA-FR

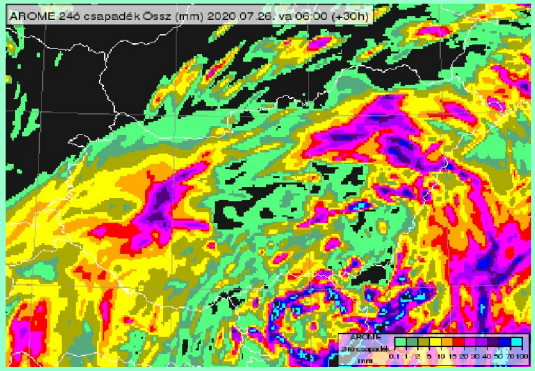
- Assimilation of T2m and RH2m into 3-layer ISBA-FR with SEKF
- Linearity check with positive-negative Jacobians, restricting of Jacobians and of innovations
- Tuning of assimilation parameters
- Experiments over Central Europe. Positive impact on T2m, Td2m and precipitation scores

Case study 24-accum. prec, 00.24.07.2020.+30h

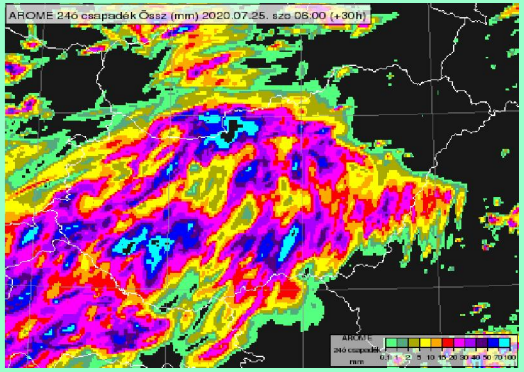
Radar



OI



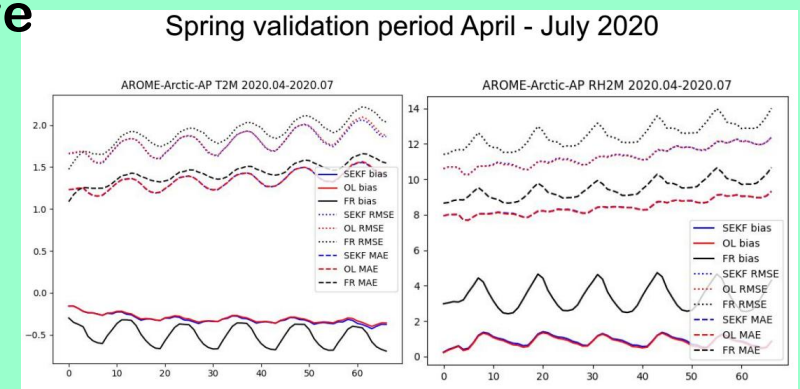
EKF



H. Toth

Vertical: SEKF for ISBA-DIF

- Assimilation with SEKF of T2m and RH2m into ISBA-DIF with 14 layers in the soil, down to 12 m, up to 12 layers in snow. Includes also Multi-Energy-Balance scheme: thermal balance for vegetation. 2 patches
- Linearity check with positive-negative Jacobians, restricting of Jacobians
- Long experiment over AROME-ARCTIC domain
- Results are promising: better T2m and RH2m scores comparing with ISBA-FR/OI. But difficult to access the impact of SEKF



Å. Bakettun, T. Aspelien, P. Samuelsson

Vertical: EnKF for ISBA-DIF

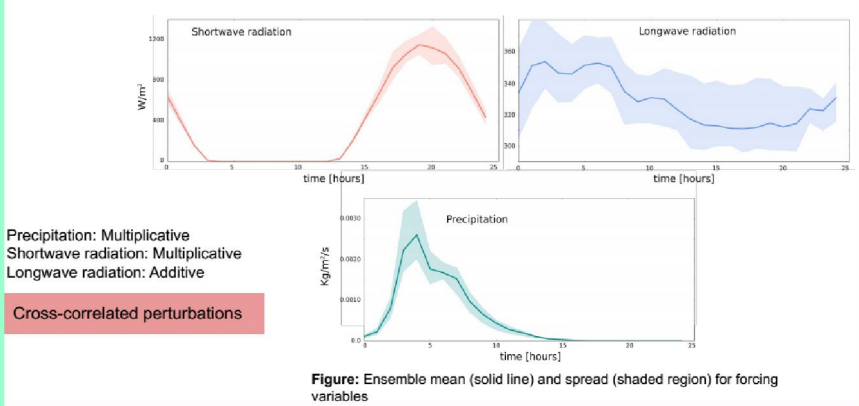


Figure: Ensemble mean (solid line) and spread (shaded region) for forcing variables

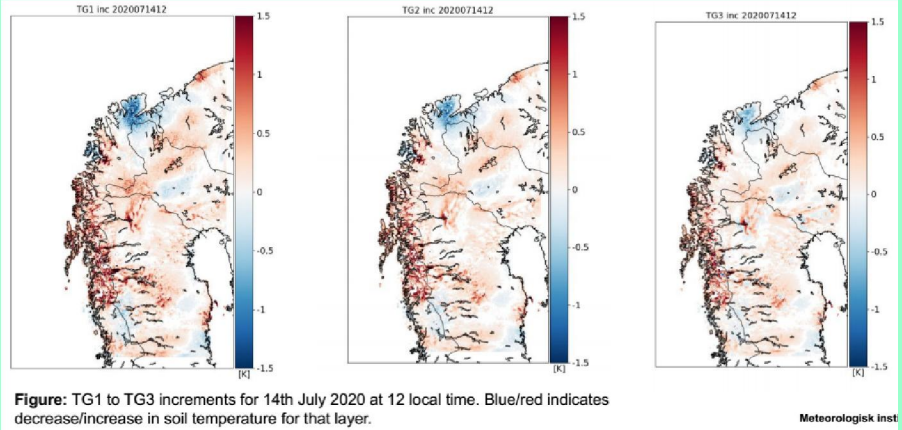


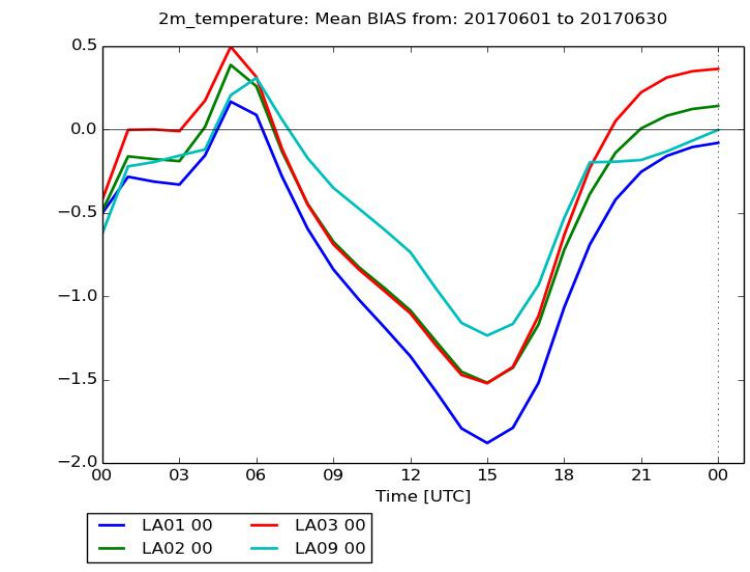
Figure: TG1 to TG3 increments for 14th July 2020 at 12 local time. Blue/red indicates decrease/increase in soil temperature for that layer.

- Assimilation with EnKF of T2m and RH2m into ISBA-DIF with 14 layers in the soil, down to 12 m, up to 12 layers in snow.
- Research activities, over AROME-ARCTIC domain
- EnKF is based on the perturbed off-line forcing
- Works technically and provides reasonable results.
- In future, to use for assimilation of satellite radiances

J. Blyverket

Experimental assimilation of LAI

- LAI data of Sentinel 2, res. down to 10m
- ISBA-DIF with prognostic LAI, 12 patches, full run with AROMEcy43 over Austria for June, physiography improved locally
- SEKF to assimilate only LAI
- Effect on T2m scores: assimilation is beneficial.



No DA, 1 patch, clim. LAI
No DA, 12 patches, prognostic LAI
No DA, 12 patches, prognostic LAI and high-resolution land cover data
SERF assimilation of LAI, 12 patches, prognostic LAI

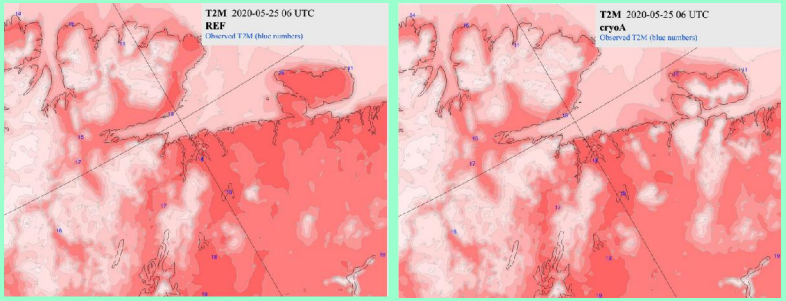
S. Schneider

Assimilation of satellite SE

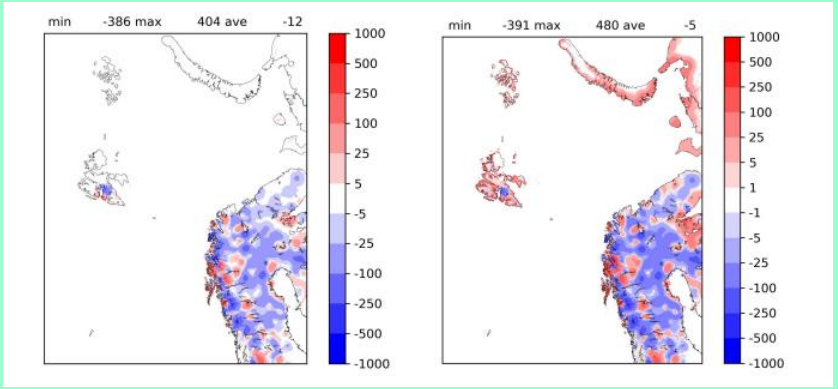
- 2 products of SE:
  - CryoLike (Met.no). Composite.
  - EUMETSAT H SAF (FMI). Metop.
- Both products are NWP-oriented.
  - CryoLike: swaths =>
    2.5 km model grid =>
    thinning to 10 km
  - H SAF: swaths =>
    snow barrels, irregular locations
    representing 10x10 pixel boxes
- Simple algorithm a la ECMWF
- For MetCoOp.
- Not easy to demonstrate an effect on standard scores, however sensitivity is well seen.

T2m, 25.05.2020, 15 UTC

Only SYNOP | SYNOP+CryoLike



Snow barrels, SWE, kg/m**2, 12.04.2017



OL-SYNOP | OL-(SYNOP+SE)

M. Homleid, L. Rontu, E. Kurzeneva

EKF for Simple Ice Scheme

- **SICE: temperature profile in the ice and ice depth. Snow with ISBA-ES. Governed by Sea Ice Concentration observations.**
- **L2 NRT VIIRS Sea Ice Surface Temperature from OSI SAF. Resolution 750m, only over satellite overpass, gaps due to cloudiness**
- **Bias-aware 1D EKF.**
- **SIST is fast variable, model is biased**

Y. Batrack

classic extended Kalman filter

$$B = MAM^T + Q$$

$$K = BH^T \left[HBH^T + R\right]^{-1}$$

$$X_a = X_b + K\left[Y - \mathcal{H}(X_b)\right]$$

$$A = [I - KH]B$$

bias-aware extended Kalman filter

$$B = MAM^T + Q$$

$$K = BH^T \left[HBH^T + R\right]^{-1}$$

$$K^b = B^b H^T \left[HB^b H^T + HBH^T + R\right]^{-1}$$

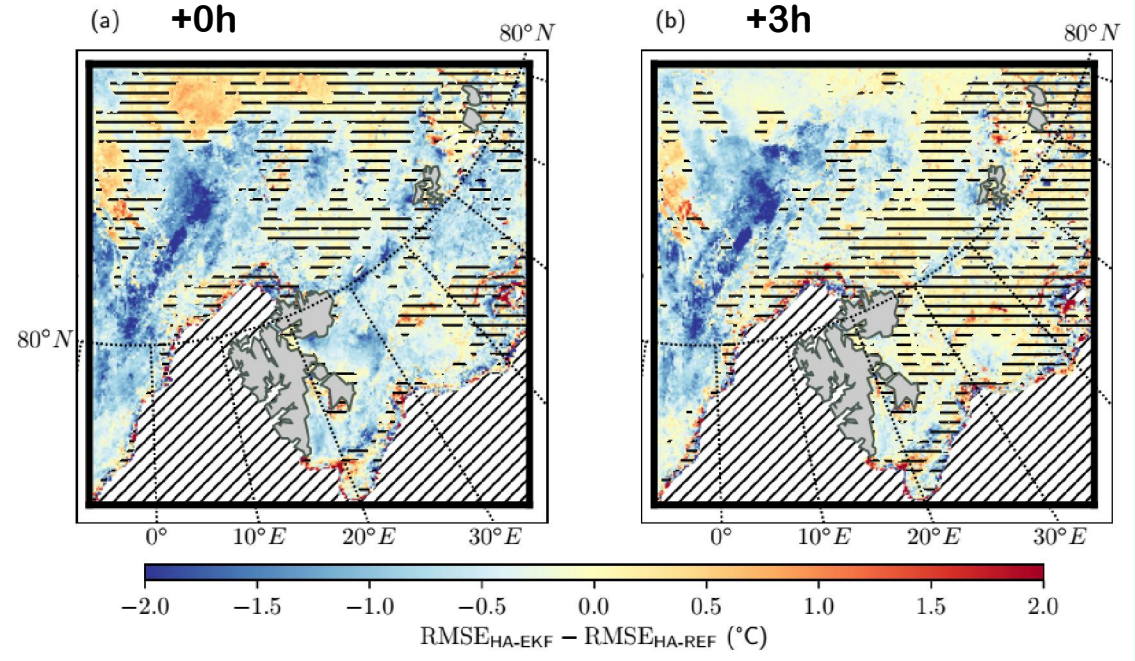
$$b_a = b_b - K^b\left[Y - \mathcal{H}(X_b - b_b)\right]$$

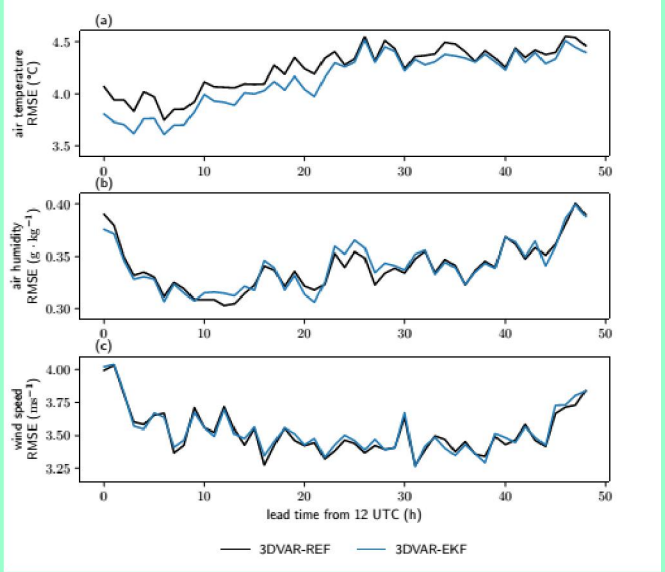
$$X_a = (X_b - b_a) + K\left[Y - \mathcal{H}(X_b - b_a)\right]$$

$$A = [I - KH]B[I - KH]^T + KRK^T$$

EKF for Simple Ice Scheme

- Verification vs MODIS SIST and Swalbard coastal stations T2m
- Small Nordic domain, 1.09.2019-01.02.2020
- Promising results, reduction of RMSE
- Effect decreases with lead time





Y. Batrack

Towards coupled DA

- Internally funded project H2O at Met.no
  R. Stappers
- Application of project CAISA at SMHI
  J. Bojarova
- Ts from the surface analysis is used in UA analysis

Thank you for your attention!