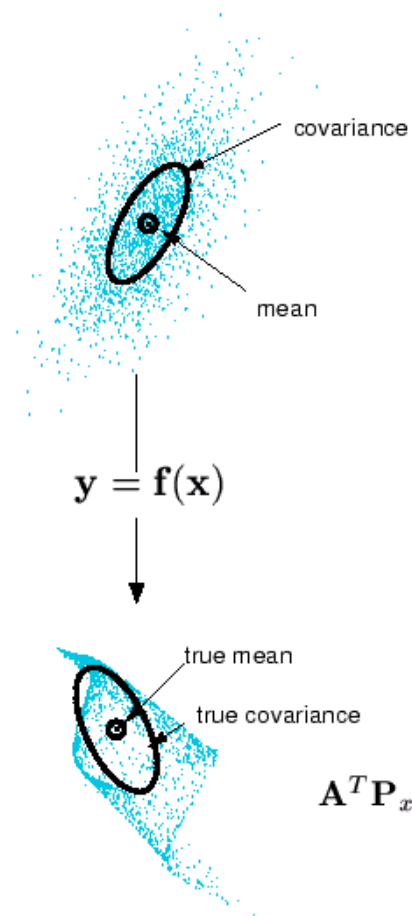


Application of the Unscented Kalman Filter (UKF) and adaptive filtering to soil moisture assimilation

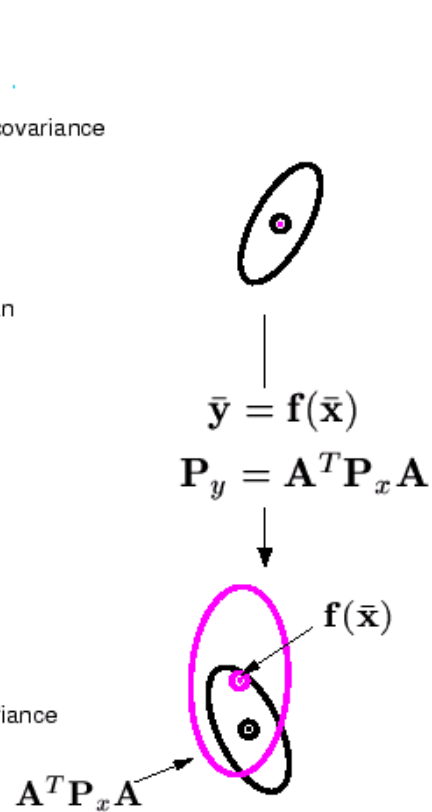
Han The, KNMI

Estimator for **B** in UKF

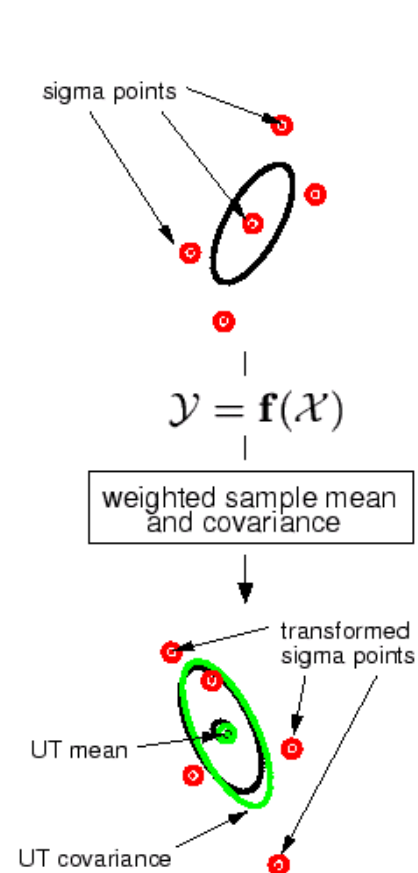
Actual (sampling)



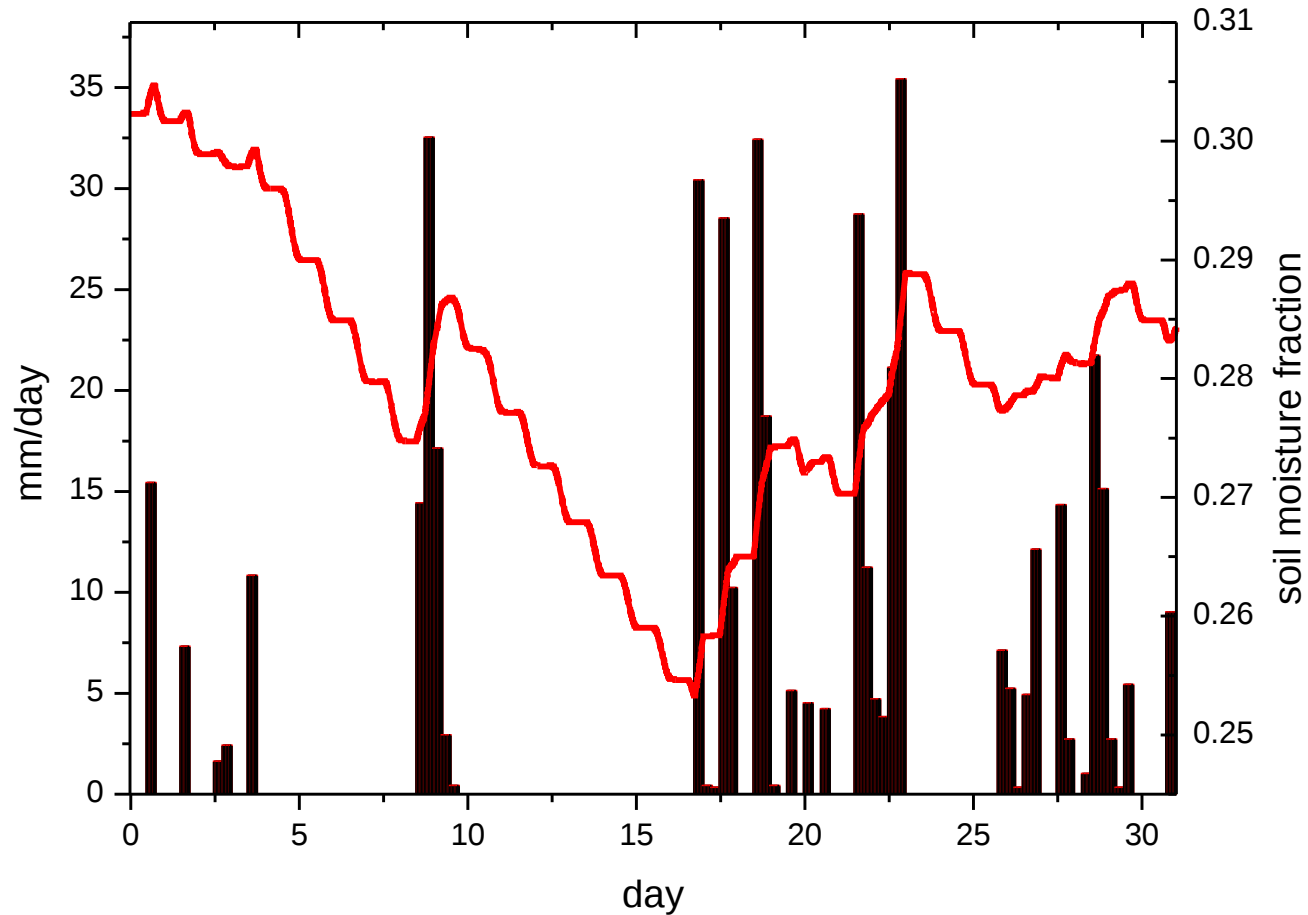
Linearized (EKF)



UT



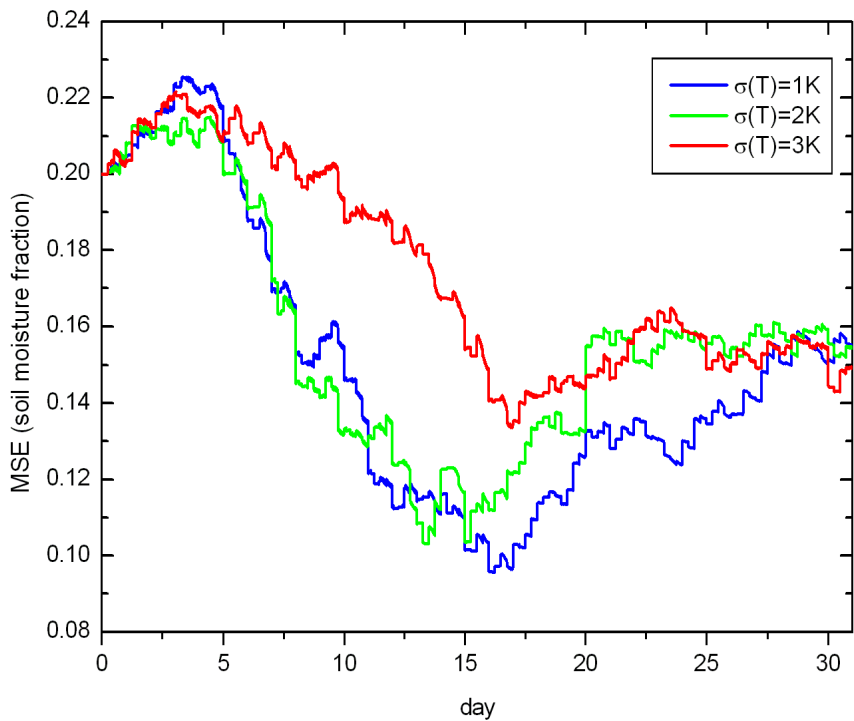
Simulation run with ERA40 data



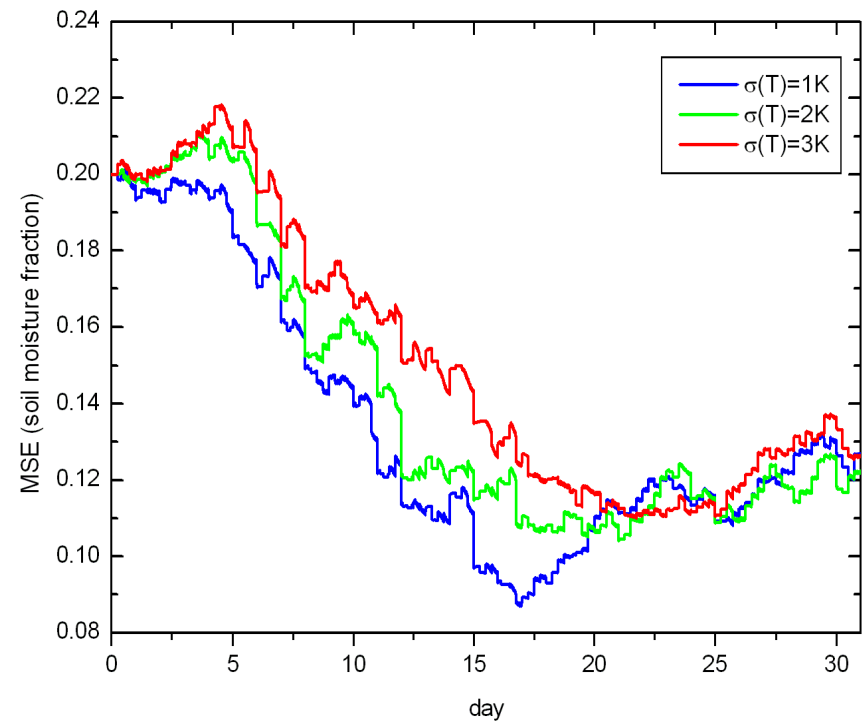
Comparison between EKF vs UKF

MSE over 100 runs

EKF



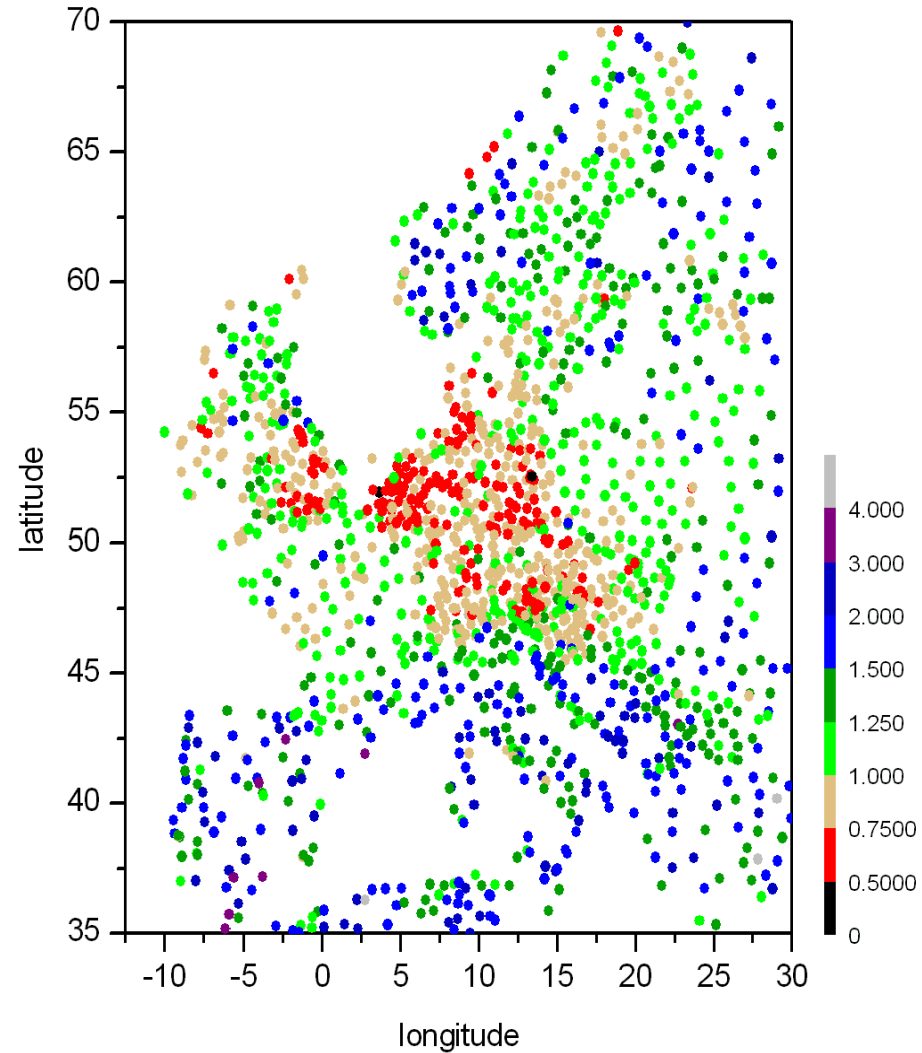
UKF



Errors that must be taken into account

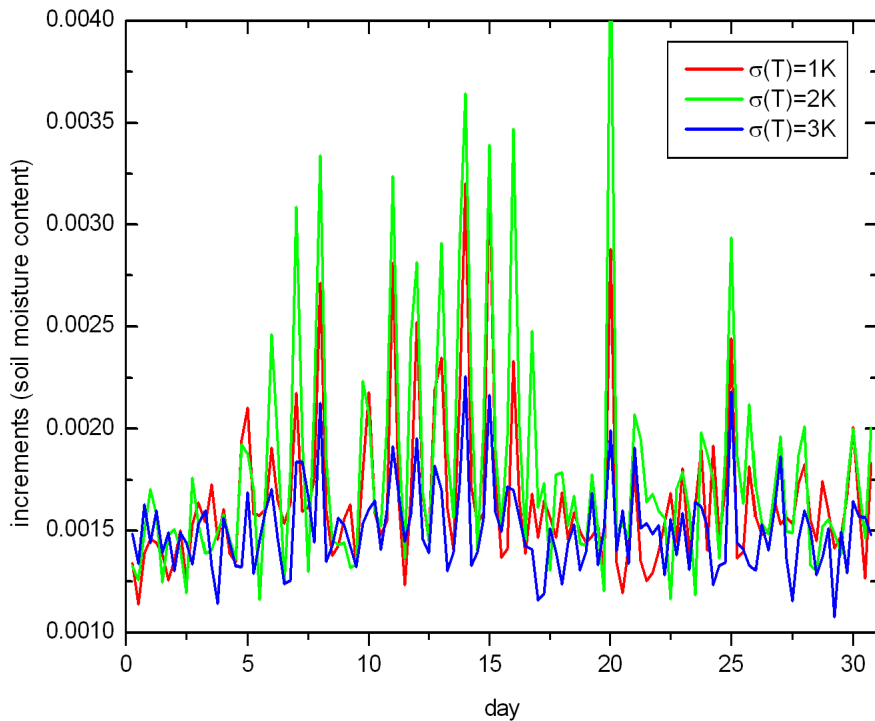
- numerical errors and limitations
- errors in the initial conditions of the system
- **ill-defined filter parameters**
- ill-defined model parameters

Estimated interpolation error of T2m

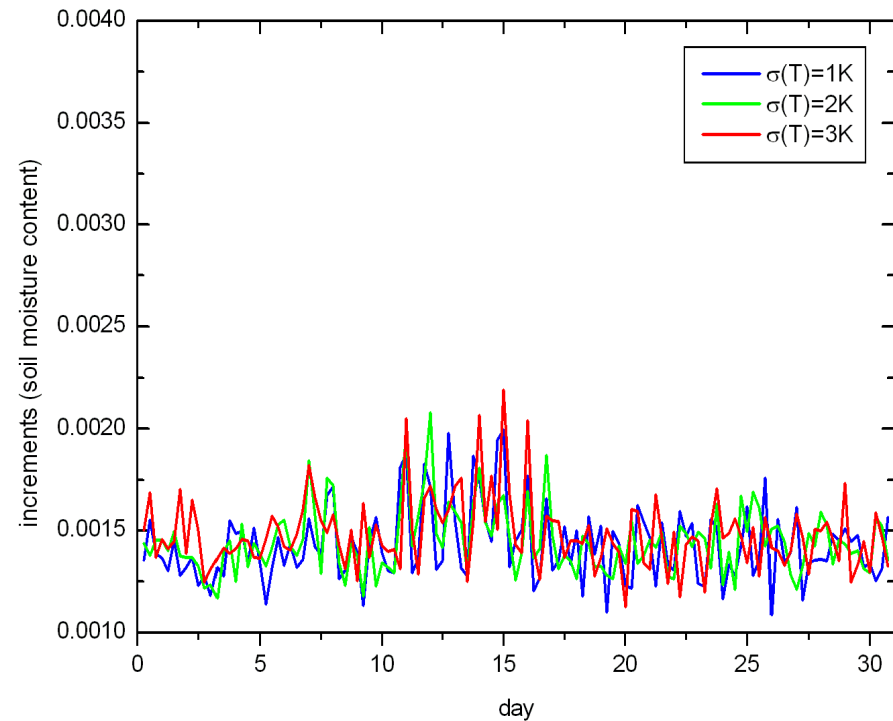


Comparison of the increments EKF and UKF with matching \mathbf{R} and $\sigma(T_{2m})$

EKF



UKF

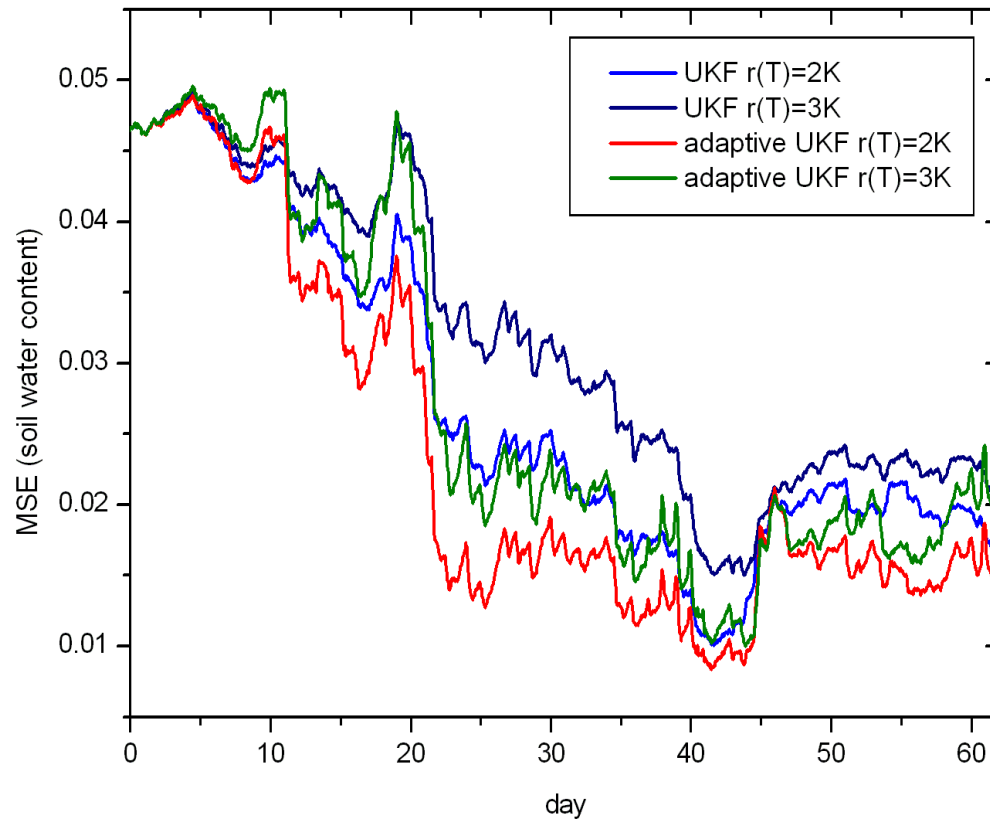


Adaptive filtering

Define cost function V_k based on the difference between P_{yy} and the variance of $H(X_n)$ based on the innovation $Y_n - H(X_n)$

Song and Han (2008)

Comparison test UKF-Adaptive UKF for measurement error $\sigma(T) = 2K$



Conclusions

- UKF seems to be more “robust” than EKF and offers the possibility to use an 1-hourly assimilation cycle
- UKF is relatively cheap (for small dimensional systems)
- Adaptive UKF is an efficient tool to solve ill-defined filter parameters **Q** and **R**