A Soil Moisture Analysis System for the ELDAS-Project

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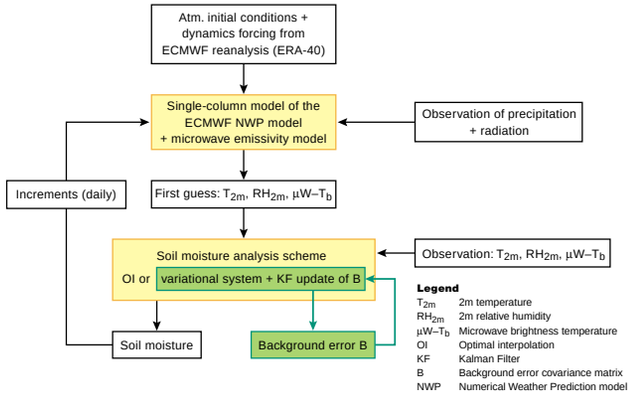
MOTIVATION

The European Land Data Assimilation System-Project (ELDAS) aims at designing, testing and implementing a soil moisture data assimilation system into NWP models, capable of producing realistic soil moisture fields. (More information about ELDAS is on the poster by B. van den Hurk in this session). Two analysis schemes, the operational optimal interpolation and a variational system with a Kalman Filter update of the background error covariance matrix (KF-system) are compared. The systems are tested and validated with measurements from the field experiments MUREX and SGP97.

EXPERIMENT DESIGN



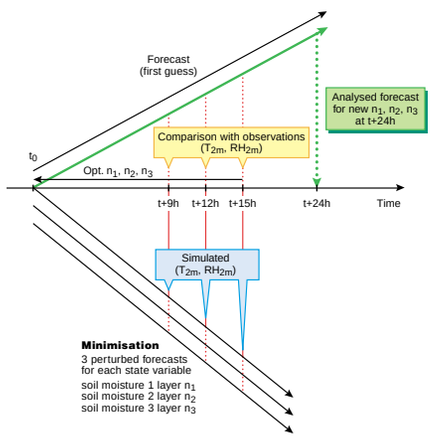
SOIL MOISTURE ANALYSIS SYSTEMS

Optimal Interpolation (OI)

- Used in the operational ECMWF – forecast since 1999.
- Fixed statistically derived forecast errors
- Criteria for the applicability of the method:
  – atmospheric and soil conditions (e.g. daytime, no rainfall, no frozen soil)
  – corrections when T and RH error are negatively correlated
- Based on *Douville et al.*, 2000

Kalman Filter (KF)

- Updated forecast error depending on synoptic situation
- No atmospheric criteria for the applicability of the method necessary
- Based on *Hess*, 2001



Schematic of the KF-system

Results of the data assimilation experiments

RESULTS OF THE MUREX EXPERIMENT

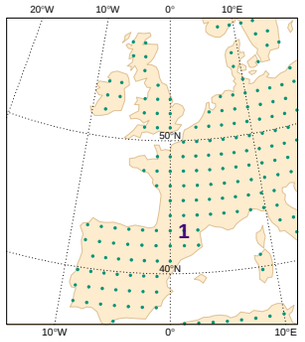


Fig. 3 Location of the MUREX field experiment (France).

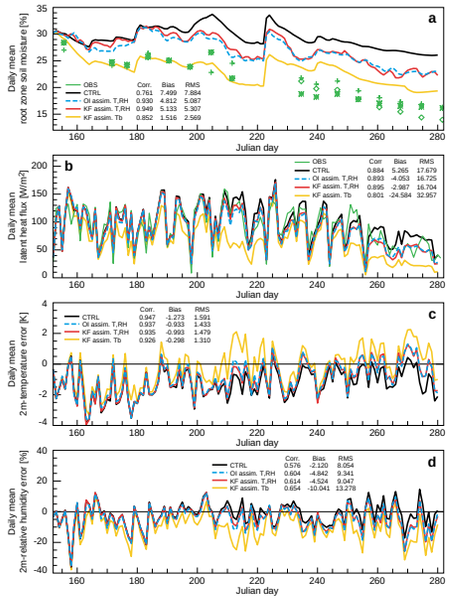


Fig. 4 Evolution of the daily mean a) soil moisture, b) latent heat flux, c) 2m-temperature and d) 2m relative humidity for the control-run and different assimilation runs from 1st of June till 9th of October 1997.

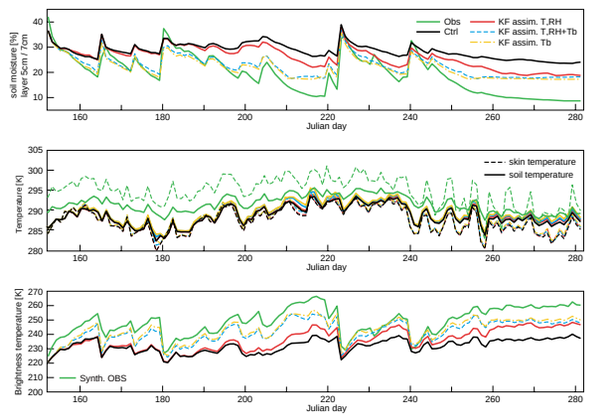


Fig. 5 Evolution of soil moisture in 5/7cm depth (top), of skin and soil temperature in 5/7 cm depth (middle) and of microwave brightness temperatures (bottom) at 6 LST. 'Observed' brightness temperatures were produced synthetically.

RESULTS OF THE SGP97 EXPERIMENT FOR LITTLE WASHITA

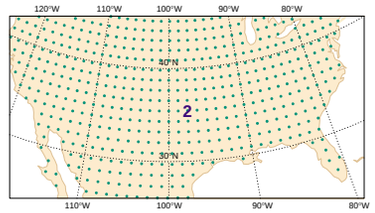


Fig. 6 Location of the SGP97 field experiment.

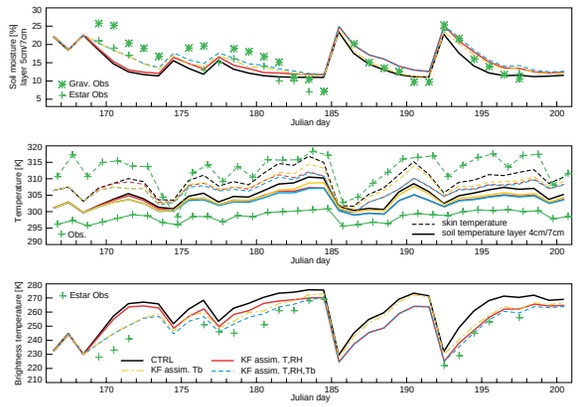


Fig. 7 Evolution of the soil moisture value in 4/7cm depth (top), of the skin and soil temperature in 5/7 cm depth (middle) and of the microwave brightness temperatures (bottom) from 15th June till 19th July 1997 at 11 LST.

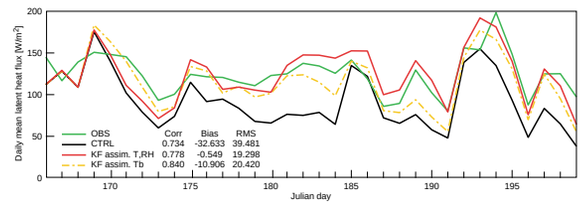


Fig. 8 Evolution of the daily mean latent heat flux for the control-run and different assimilation runs from 15th of June till 19th of July 1997.

CONCLUSIONS

The KF- and the OI-system give nearly similar results. The advantage of the KF-system is the dependence of the forecast errors on the synoptic situation rather than being fixed to statistical derived values as in OI. This makes atmospheric criteria for the applicability of the method no longer necessary and allows for an easier implementation of new observation types. The assimilation of microwave brightness temperatures MW-T_b improves the soil moisture simulation considerably.

Future work will focus on assimilating T_{2m}, RH_{2m} and MW-T_b to minimize the combined errors in the predictions of soil moisture, evaporation and screen-level observations.

REFERENCES

Douville H., **Viterbo P.**, **Mahfouf J.-F.** and **Beljaars A.C.M.**, 2000: Evaluation of the Optimum Interpolation and Nudging Techniques for Soil Moisture Analysis Using FIFE Data, *Monthly Weather Review*, **128**, pp. 1733–1756.

Hess R., 2001: Assimilation of screen-level observations by variational soil moisture analysis, *Meteorology and Atmospheric Physics*, **77**, pp. 145–154.

ELDAS webpage: http://www.knmi.nl/samenw/eldas