



On the assimilation of land surface temperature in the coupled land-atmosphere system

C. Sgoff, A. Schomburg, J. Schmidli

ISDA 2018 - 07. March 2018





Motivation

- Near-surface weather and climate variability strongly influenced by interactions between land surface and atmospheric boundary layer via the turbulent exchange fluxes
- Turbulent fluxes difficult to measure over large scales: assimilation of directly related variables
- Land Surface Temperature (LST) is a crucial component of this tightly coupled system
- OSSE (within the COSMO-KENDA system) is designed to assimilate LST
- Main goal: access impact on fully coupled system





Satellite Data

- LST retrieval is derived from SEVIRI/MSG and provided by Land Surface Analysis SAF
- Derived by a split-window algorithm (MSG IR10.8 and MSG IR12.0)
- LST product is available every 15 minutes
- Resolution over chosen domain ~ 5 km





Nature Run - "Truth"

- Atmospheric model: **COSMO-DE** Version 5.04c
- Multi-layer soil model: TERRA_ML with new skin temperature scheme
- To reduce identical twin effect a highly resolved horizontal grid is used:
 - resolution ~ 0.7km (480 x 480 grid points)
- Small area around Lindenberg
- 4 day period: 25.03.2017 00:00 UTC -29.03.2017 00:00 UTC







Synthetic Observations



Interpolate model equivalent **in observational space**: average 7x7 grid box around nearest neighbor

+ Perturb with observation errors



Cloud Mask



- Data is limited by total cloud cover
- SATELLITE: includes only cloud-free pixels with cloud mask provided by NoWCasting SAF
- MODEL: includes all areas where the model simulates a total cloud cover < 10%
- Clear sky pixels: cloud free in both cases







Assimilation System

- **COSMO KENDA:** operational System at DWD since March 2017 (Kilometer-scale ensemble data assimilation, Schraff et al. 2016)
- **LETKF** (Local Ensemble Transform Kalman Filter, Hunt et al. 2007)
- 40 Member and 1 deterministic in 2.8km resolution
- Start from KENDA-analysis
- One hour assimilation cycle
- Up to now only atmospheric variables in state vector, soil variables under preparation (still bug in code), thus currently no effect on soil temperature and moisture





Solid lines: time series of RMSE, Spread and observation error in observation space

Dashed lines: mean over two day periods

Bars: amount of active observations at each assimilation step



ans-Ertel-Zentrum Comparison with ,truth



whole domain (including cloudy, i.e. notassimilated pixel)

Wetterforschung

GOETHE



Difference and RMSE are averaged over whole domain (including cloudy, i.e. notassimilated pixel)

27/03/1





GOETHI



ISDA 2018, Munich - Christine Sgoff



ISDA 2018, Munich - Christine Sgoff



ISDA 2018, Munich - Christine Sgoff





Summary/Outlook

Summary:

- Observations are limited by cloud cover
- Data assimilation system works, promising results on atmosphere temperature
- coupling between surface and atmosphere shows interesting correlations

Outlook:

- Anti-correlation currently under further investigation
- Soil variables will become included in state vector
- Evaluation of impact on fully coupled system











Thank you for your attention

ISDA - 07. March 2018 contact: <u>sgoff@iau.uni-frankfurt.de</u>