LUDWIG-MAXIMILIANS-UNIVERSITÄT MÜNCHEN
FAKULTÄT FÜR PHYSIK
METEOROLOGIE

Deutsches Zentrum für Luft- und Raumfahrt e.V. in der Helmholtz-Gemeinschaft

Hans-Ertel-Zentrum für Wetterforschung
Deutscher Wetterdienst

Hans-Ertel-Center for data assimilation

Ensemble-based convective-scale data assimilation and the use of remote sensing observations

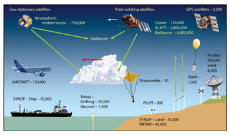
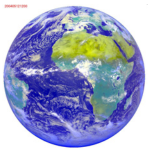
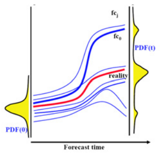
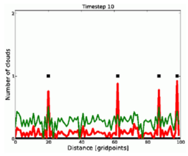
M. Weissmann, R. Buras, G. Craig, K. Folger, M. Haslehner, C. Keil, P. Kostka, C. Kühnlein, B. Mayer, M. Sommer, M. Würsch
Meteorologisches Institut, Ludwig-Maximilians-Universität München

O. Reitebuch
Institut für Physik der Atmosphäre, Deutsches Zentrum für Luft- und Raumfahrt, Oberpfaffenhofen

Goals

- Fundamental research in the areas of data assimilation (DA) and ensemble forecasting
- Training of young researchers and students
- Methods to assess the analysis and forecast impact of observations in the KENDA-COSMO system
- Methods to use additional satellite observations for NWP
- Methods to improve the representation of forecast uncertainty in the KENDA-COSMO system
- Robust data assimilation methods for strongly non-linear system with non-Gaussian error statistics

Research areas

Observation impact	Satellite observations	Ensemble forecasts	DA methods
Tools to quantify the analysis and forecast impact of observations in EnDA	Direct assimilation of MSG SEVIRI VIS+NIR radiances in KENDA	Improved representation of forecast uncertainty	Methods for convective-scale DA
Monitoring of observations	AMV height correction with lidar observations	KENDA initial perturbations	Idealized tests with non-Gaussian error statistics (toy models)
Optimized use of observations	(Lightning) (ADM-Aeolus)	Flow-dependence and impact time of perturbations	Robust methods for highly non-linear systems

General

- Research group at LMU Munich, collaboration with DLR
- Strong interaction with DWD research department
- Funding from DWD: 2011-2014 (possible extension until 2022)

Project funding:
- University project leader
- 3 Post-Docs
- 2 PhD students
- DWD project leader

Current additional group members from LMU/DLR
- 1 PhD student
- 2 Master students
- Supervisors and technical support

Individual sub-projects:
- Assimilation of SEVIRI VIS and NIR radiances (Philipp Kostka, Post-Doc, starting date: May 2011)
- Assessment of observation impact (Matthias Sommer, Post-Doc, starting date: Nov 2011)
- Ensemble perturbations and forecast uncertainty (Christian Kühnlein, Post-Doc, starting date: Sep 2011)
- AMV height correction with airborne lidar (Kathrin Folger, master student, starting date: May 2011)
- AMV height correction with spaceborne lidar (tbd, PhD student, starting date: Jan 2012)
- Robust methods for convective scale DA (Mylene Haslehner, PhD student, starting date: Jun 2011)
- Testing DA-algorithms in simple, but non-linear models (Michael Würsch, PhD student, starting date: Mar 2010)

First results

"Slow" forward operator for VIS+NIR MSG-SEVIRI radiances

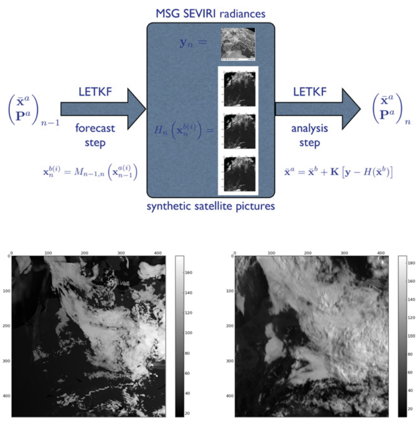


Figure 1. Synthetic satellite image from COSMO output and corresponding MSG image of the SEVIRI VIS 0.6 channel at 6:00 UTC on 01 August 2011.

Future Plans
1. Wavelength dependent surface albedo
2. Accounting for sub-gridscale clouds
3. Assessment of operator accuracy with MYSTIC
4. Implementation in KENDA/COSMO
5. Forecast impact of cloud information
6. Accelerating operator

Height comparison of AMVs and airborne lidar cloud top heights during T-PARC

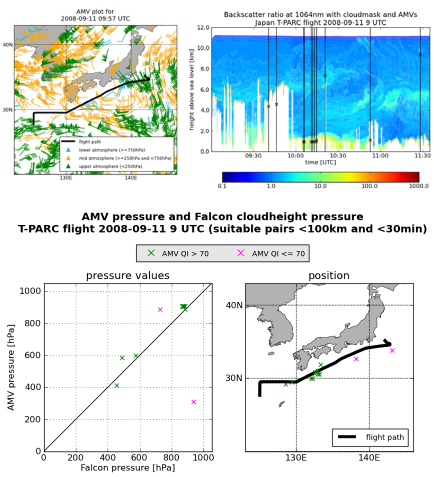


Figure 2. Comparison of AMV heights and cloud top heights derived from lidar observations from the DLR Falcon aircraft on 11 Sept 2008 during T-PARC.

Future Plans
1. Correction of AMV heights with airborne lidar
2. Evaluation of wind accuracy after AMV height correction with dropsondes and Doppler wind lidar (DWL)
3. Intercomparison of dropsonde, DWL and AMV winds
4. AMV height correction with CALIPSO
5. Improvement of AMV assimilation in DWD system, e.g. assigned error, super-obbing, first-guess height correction
6. Investigation of the benefit of rapid scan AMVs for LAM

The impact of localization and observation averaging in a simple stochastic model

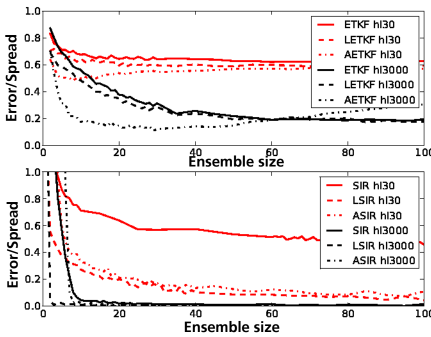


Figure 3. Ensemble size vs. final error for all methods and half-lives.

- Both standard methods fail at the dynamical situation
- Localization works very well for the particle filter (SIR)
- Averaging seems more useful for the ETKF

Future Plans
1. Use a modified shallow-water model to test the methods on a more complex problem where interactions with gravity waves occur
2. Idealised experiments with the systems of COSMO/KENDA