LMU | LUDWIG-MAXIMILIANS-UNIVERSITÄT MÜNCHEN | FAKULTÄT FÜR PHYSIK METEOROLOGISCHES INSTITUT | MIM

The newly founded **Hans Ertel Zentrum for Data Assimilation** at the Ludwig-Maximilians Universität (LMU) München invites applications for

3 Post-Doc and 1 PhD Position in Ensemble Data Assimilation and Predictability.

We seek candidates with a background in meteorology, mathematics or physics. Experience in data assimilation or ensemble forecasting is desirable, but not a prerequisite.

The Hans Ertel Zentrum for Data Assimilation is focused on ensemble-based convective-scale data assimilation and the use of remote sensing observations. Its research is closely coordinated with the Deutscher Wetterdienst (DWD) and intends to extend the capabilities of the DWD data assimilation and ensemble prediction system.

The group is located in the Meteorological Institute of the LMU München, which has been ranked as Germany's number one in the Shanghai Ranking and as one of the country's elite universities by the German government's Excellence Initiative. The Meteorological Institute of LMU is closely tied to the nearby Institut für Physik der Atmosphäre of the Deutsches Zentrum für Luft- und Raumfahrt (DLR).

Remuneration: Post-doc salaries are according to the German salary scale TV-L, grade 13 (38,306-55,375 Euros per year before tax according to experience). The PhD salary is 50% of the Post-Doc salary.

Starting date: 1 April 2011 or as soon as possible thereafter.

Interested candidates should send a complete application package (CV; covering letter describing background, training and research interests; certificates; contact information of two references) as a single PDF to Dr. Martin Weissmann (martin.weissmann [at] dlr.de) and Dr. Christian Keil (christian.keil [at] lmu.de). Applications are being accepted immediately. The positions are open until filled.

Post-Doc 1: Assessment of observation impact in the DWD LETKF system (2 years plus possible for extension by 1.5 years)

Background: Modern data assimilation systems of numerical weather prediction (NWP) models are nowadays using millions of observations per day to construct the initial conditions (analysis field) for NWP forecasts. Thus, the assessment of the influence of individual observations or observation types on analyses and forecasts is crucial to monitor and improve the use of observations in data assimilation systems. Tools for the assessment of observation impact have been implemented at several leading NWP centres using 4D-Var data assimilation systems. Recent studies developed methods for such an assessment in idealized ensemble data assimilation (EnDA) systems that are similar to the system that will be used by DWD in the near future.

Goal: To develop and test tools to estimate and monitor the influence of observations on the analysis and the forecast error in the DWD modelling system. These tools shall be implemented in the DWD local ensemble transform Kalman filter (LETKF) data assimilation system KENDA (Km-Scale Ensemble-Based Data Assimilation). Furthermore, their results shall be compared to sensitivity experiments that exclude groups of observations to evaluate the accuracy of the approach and test refinements.

Essential skills:
- PhD in meteorology, mathematics, physics, or related field
- Good knowledge of spoken and written English
- Programming skills

Advantageous skills:
- Experience in data assimilation or ensemble prediction systems

Point of contact for further information:
Dr. Martin Weissmann (martin.weissmann [at] dlr.de)

Post-Doc 2: Assimilation of satellite radiance observations (2 years plus possible for extension by 1.5 years)

Background: Modern passive satellite instruments provide observations at increasingly high resolution. Infrared (IR) radiance observations from satellites are one of the most important sources of information for current NWP data assimilation systems. Visible (VIS) and near-infrared (NIR) channels however, are hardly used in data assimilation although those could provide considerably more information about cloud cover and liquid water content than the IR channels. One reason for not assimilating those channels directly in the past was the lack of a fast forward operator, because the required consideration of multiple scattering in the visible is considerably more difficult than the usual no-scattering-approximation in the IR.

Goal: To develop operators for the assimilation of high-resolution cloudy VIS and NIR satellite radiance observations in KENDA and to evaluate their benefit with sensitivity experiments. The development of the operator shall build upon preliminary work performed in the LMU group for experimental meteorology. In addition, the candidate shall collaborate with DWD on general issues with radiance assimilation in KENDA (e.g. localization).

Essential skills:
- PhD in meteorology, mathematics, physics, or related field
- Good knowledge of spoken and written English
- Programming skills

Advantageous skills:
- Knowledge of radiative transfer modelling
- Experience in data assimilation

Points of contact for further information:
Prof. Bernhard Mayer (bernhard.mayer [at] lmu.de)
Dr. Martin Weissmann (martin.weissmann [at] dlr.de)

Post-Doc 3: Ensemble initial condition perturbations and predictability (2 years plus possible for extension by 1.5 years)

Background: With NWP models approaching convective scales, a probabilistic approach for weather forecasting becomes more and more important. DWD and several weather centres around the world are planning to or have already introduced ensemble prediction systems (EPS) to estimate forecast uncertainty in addition to the deterministic forecast. While EPS are routinely used for global medium range weather forecasts, the design of short-range, high-resolution (convection-permitting) EPS remains difficult due to the poor knowledge of the mechanisms promoting rapid error growth and limited computing resources. Recently, a preliminary version of a convection-permitting EPS was developed at DWD, taking into account uncertainties in the lateral boundary conditions using different global models and some uncertainties in model physics. Using an ensemble based data assimilation system as KENDA allows for an examination of the propagation of initial condition errors in time and answering the question, how long what data should be assimilated during different weather regimes.

Goal: To investigate and improve the representation of forecast uncertainty in the DWD limited area ensemble through optimal ensemble perturbations. This shall be done by comparing convection-permitting EPS forecasts using different initial condition and physics perturbations and assessing the dependence of predictability to different assimilated observation types with particular emphasis on impact time and flow-dependence.

Essential skills:
- PhD in meteorology, mathematics, physics, or related field
- Good knowledge of spoken and written English
- Programming skills

Advantageous skills:
- Experience with ensemble prediction systems

Points of contact for further information:
Dr. Christian Keil (christian.keil [at] lmu.de)
Prof. George Craig (george.craig [at] lmu.de)
Dr. Martin Weissmann (martin.weissmann [at] dlr.de)

PhD Position: Treatment of non-linearities in ensemble-based data assimilation (3 years)

Background: Rapid error growth and the corresponding nonlinearity represent fundamental physical limitations to the predictability of weather. It is unlikely that deterministic models are able to accurately predict individual thunderstorms 24 hours in advance, and forecast models are increasingly using stochastic perturbations to represent the unobserved and often unresolved small-scale variability that triggers new storms. This can be incorporated in the data assimilation system as model error, but must be represented in a way that recognises that there it is a leading order influence, with a strongly non-Gaussian distribution due to intermittency in space and time. Conventional methods, such as weak constraint 4D-Var and ensemble Kalman filters may have difficulty in such situations, but other techniques exist that are more robust in the face of large model error (usually at the cost of sacrificing optimality in the linear Gaussian limit).

Goal: To develop and test novel methods to treat non-linearities encountered by convective-scale data assimilation. New methods as e.g. particle filters shall be implemented and tested in simplified data assimilation systems. The most promising method or methods shall be implemented in the KENDA system and compared to the operational system.

Essential skills:
- Master degree in meteorology, mathematics, physics, or related field
- Good knowledge of spoken and written English
- Programming skills

Advantageous skills:
- Experience in data assimilation

Points of contact for further information:
Prof. George Craig (george.craig [at] lmu.de)
Dr. Martin Weissmann (martin.weissmann [at] dlr.de)