IUP-AWI Blockseminar

Advancing Earth Observation Sciences

July 4, 2017, 09:30 – 15:00

Alfred Wegener Institute, Building F, Bussestrasse 24, 27568 Bremerhaven, Room "Glaskasten"

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Theme

This seminar will provide an overview of two upcoming major initiatives, the Uni Bremen Excellence Cluster Advancing Earth Observation Sciences (AEOS) and Year of Polar Prediction (YOPP). It will present examples of research in various areas of Earth Observation Sciences, including satellite, airborne, and in-situ measurements, and studies involving observations and modeling.

Program

09:30 – 10:00	Coffee
10:00 – 10:20	Claus Lämmerzahl (Uni-HB/Zarm): AEOS – an overview of the proposed Bremen Excellence Cluster
10:20 – 10:40	Helge Gößling (AWI): YOPP – the Year of Polar Prediction
10:40 – 11:00	Ben Rabe & Mario Hoppmann (AWI): Observations of the FRAM and MIDO observatories
11:00 – 11:20	Axel Behrendt (AWI): UDASH - Unified Database for Arctic and Subarctic Hydrography
11:20 – 11:40	Larysa Istomina (Uni-HB/IUP): Characterization of the summer sea ice from optical sensors
11:40 – 12:00	Lorenzo Zampieri (AWI): Verification of sea ice forecasts for the sub-seasonal and seasonal timescale (see abstract)
12:00 – 13:00	Lunch (provided)
13:00 – 13:45	**Christoph Gerbig (MPI-BGC Jena – Special Guest): On the potential of regular airborne observations for constraining greenhouse gas fluxes (see abstract)**
13:50 – 14:00	Break
14:00 – 14:15	Michael Buchwitz (Uni-HB/IUP): Satellite observations of carbon dioxide and methane
14:15 – 14:30	Stefan Hendricks (AWI): Remote Sensing of sea ice thickness
14:30 – 14:45	Christian Haas (AWI): Remote sensing of snow on sea ice – what are we missing?
14:45 – 15:00	Frank Kauker (AWI): Earth observation impact assessments

Abstracts

On the potential of regular airborne observations for constraining greenhouse gas fluxes

Christoph Gerbig, MPI-BGC Jena

Within the European research infrastructure IAGOS, the In-service Aircraft for a Global Observing System, globally distributed measurements of greenhouse gases (GHG) like CO2 and CH4, as well as CO will start in 2017. The cavity ring-down spectroscopy (CRDS) based measurement system for autonomous measurement has been designed, tested, and qualified for deployment on commercial airliners. A supplemental type certificate for installation in the avionics bay of Airbus A340 and A330 has been issued by EASA in late 2016. Near-real time data transmission is foreseen for utilization of observations by the Copernicus Atmosphere Monitoring Service (CAMS) and by other users. Within the next years, about five aircrafts from various airlines operating out of different parts of the world will be equipped, providing about 5000 vertical profiles per year with near-global distribution. Different applications of regular vertical GHG profile observations within inverse modeling of CO2 and CH4 will be presented.

In global inverse modeling of CO2, we find that posterior fluxes retrieved using aircraft profiles are less susceptible to errors in mixing heights as compared to the ground-based network. We further use synthetic vertical profiles of CO2 in an inversion to estimate the potential of these measurements in constraining the regional carbon budget. Our results show that regions such as tropical Africa and temperate Eurasia, that are under-constrained by the existing surface based network, will benefit the most from these measurements.

For regional inverse modeling, the gradient in GHG abundance between mixed-layer air and free tropospheric air is used for constraining surface-atmosphere exchange fluxes. We use a regional modeling framework consisting of the Lagrangian particle dispersion model STILT (Stochastic Time-Inverted Lagrangian Transport), combined with high resolution (10 km x 10 km) EDGARv4.3 (Emission Database for Global Atmospheric Research) emission inventory, differentiated by emission sector and fuel type for CO2, CO, and CH4, and combined with the VPRM (Vegetation Photosynthesis and Respiration Model) for biospheric fluxes of CO2. Different species such as CO2 and CO have partially overlapping emission patterns for given fuel-combustion related sectors, and thus share part of the uncertainties, both related to the a priori knowledge of emissions, and to model-data mismatch error. Applying the modeling framework to synthetic IAGOS profile observations, we evaluate the benefits of using correlations between different species' uncertainties on the performance of the atmospheric inversion.

Verification of sea ice forecasts for the sub-seasonal and seasonal timescale

Lorenzo Zampieri, AWI

Sea ice forecasts are becoming a demanding need since human activities in the Arctic are constantly increasing and this trend is expected to continue. Forecast system development needs to be guided by verification metrics that quantify skill in an appropriate way. Here we apply different verification metrics to real sea ice forecasts to study the behavior of the metrics and to quantify potential predictability, focusing on the sea ice edge position and on sub-seasonal to seasonal time scales. The employed metrics are the pan-Arctic sea ice extent (SIE) and area (SIA), the Integrated Ice Edge Error (IIEE), the Spatial Probability Score (SPS), and the Modified Hausdorff Distance (MHD). While the first two metrics evaluate a single integrated quantity, the latter three assess the spatial distribution of the ice cover. Forecasts are verified against the high resolution AMSR-E and AMSR2 89 GHz sea ice concentration products provided by the University of Bremen. Sea ice forecast products from various research institutes and operational centers are analyzed, in particular those collected within the Sub-Seasonal to Seasonal Prediction Project. The forecast systems are characterized by quite different features with regard to the spatial resolution and the complexity of the forecast model, the number of ensemble members and the forecast length. The broad pool of models allows a comprehensive analysis of the metrics' behavior in different situations, highlighting strengths and weaknesses of the models and of the metrics themselves.