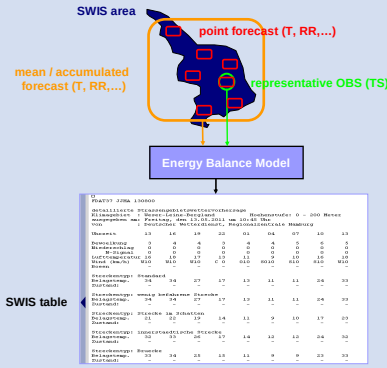
A road map towards implementing a probabilistic road weather information system

Motivation

The German National Weather Service (DWD) runs a dedicated forecast system for providing detailed information on the road conditions in Germany. This road condition and weather information system, called SWIS (Straßenzustands- und Wetter-Informations-System), was set up about 20 years ago with the objective to support the efficient management of the German road network, especially during winter time. It aims to enable decision-makers to optimize their planning and distribute their resources in the most cost-effective way. Considering the inevitable uncertainties of weather forecasts, and recognizing the potential benefits of incorporating reliable predictions of these uncertainties in the decision-making process, we are in the process of extending our forecast system to incorporate such probabilistic information.

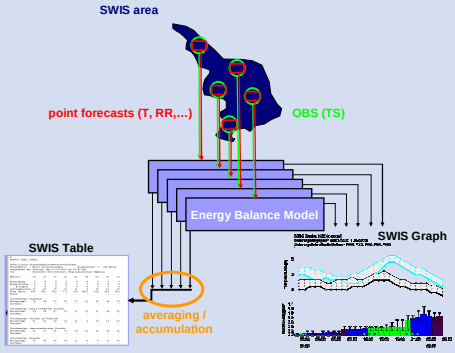
SWIS today…



An important forecast product provided by the current system are so-called **SWIS area forecasts**. They are produced by

- dividing Germany into 237 areas (on different height levels)
- averaging the 27h point forecasts of temperature, precipitation, etc. from the DWD model system at all stations inside this area to a mean area forecast (MET_{avg})
- running an energy balance model (EBM),
  - ➢ initialized with the road surface temperature (TS) from a representative road observation inside the SWIS area
  - ➢ forced by the average meteorological forecast (MET_{avg})
- distributing the predicted (area average) road temperatures and conditions as well as the meteorological forecast (MET_{avg}) as a so-called **SWIS table**

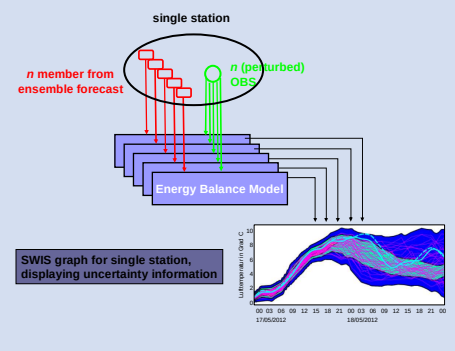
…tomorrow…



As a first step towards introducing some uncertainty aspects into SWIS, the method to calculate and present the SWIS area forecasts will be changed to:

- Running the EBM for every station inside the SWIS area,
  - ➢ initialized with TS from a road observation station, and
  - ➢ forced by the corresponding meteorological point forecast
- Distributing the SWIS forecasts as
  - ➢ (traditional, i.e. averaged) SWIS table,
  - ➢ SWIS graph, containing the time series of (individually) selected stations of interest, displaying information on the **spatial variability** of the forecasts, or individual point forecasts at a single station and for a chosen time range

…and thereafter



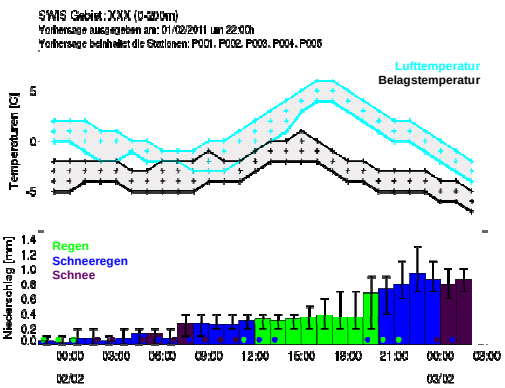
In order to introduce real probabilistic or uncertainty aspects into SWIS, the method to calculate and present the SWIS point forecasts will be changed to:

- Running the energy balance model for every station inside the SWIS area *n* times,
  - ➢ initialized with *n* perturbed TS from a road obs station, and
  - ➢ forced by *n* member of the corresponding meteorological ensemble forecast
- Distributing the SWIS forecasts as
  - ➢ SWIS graph, displaying the **uncertainty** at single stations
  - ➢ SWIS graph, containing the time series of (individually) selected stations of interest, summarizing the information on the **uncertainty and spatial variability** of the forecasts

What the users think…

The plans for optimizing the current system and extending it for providing probabilistic forecasts has been presented to the authorities responsible for road maintenance in Germany. The main feedback from these discussions include the following points:

- The new generation of road agents entering the service is happy to work with new technologies including new (probabilistic) forecast products
- Established products should not be withdrawn, or only if they are replaced by other products giving comparable information
- Information overload has to be avoided
- The forecast product range should facilitate both a quick overview of the situation and the possibility for a more detailed assessment
- The focus of the decision-making lies on the forecast range of 1-2 days. Longer forecast ranges of up to seasonal timescales can be of interest and may be tested at a later stage
- The development of new system components and forecast products should incorporate feedback from (test) user groups



Example of possible new visualization of SWIS forecast:

The graph is created interactively by users choosing their stations, time range, and variables of interest. The spatial variability over the area of interest (or some standard areas) becomes obvious by displaying the range of forecasts.

…and our next steps

- Technical implementation of the first step, i.e. running the EBM at individual stations with consistent initialization and atmospheric forcing
- Verification and sensitivity studies using different forecast datasets for the forcing
- Collecting and implementing user feedback on the utility of the new features and products

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