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Notes on discussion in Stable Boundary Layer Workshop, Helsinki 2 November 2005

In the discussion, based on presentations (available at <http://netfam.fmi.fi>) a list of topics for further studies and a wish- list for Sodankylä observations was formulated from different points of view.

Interesting topics for HIRLAM

The stability dependency of the momentum roughness, discussed in the presentation of Ivan Mammarella and Sergei Zilitinkevich deserves further study and sensitivity experiments with HIRLAM. Corresponding formulations for heat roughness would be useful. In HIRLAM, the different roughness definitions should be systematically checked by a person well familiar with the HIRLAM code.

Formulation of surface fluxes within the shallow stable boundary layer, based on resistance laws instead of bulk formulations was discussed earlier in the January meeting based on presentation of Sergei Zilitinkevich. First version of these has been tried in HIRLAM by Veniamin Perov and reported a few years ago in HIRLAM Newsletter. A recent paper by Zilitinkevich and Esau (QJRMS, 131,1863- 1892) presents further development of these ideas. Implementation into a up- to date HIRLAM version would be useful, and Sodankylä mast and sounding data could be used for validation.

The spectral stability functions presented by Veniamin Perov could applied for the turbulence closure within the TKE-based K-1 turbulence scheme of HIRLAM. Sensitivity studies with one- dimensional HIRLAM, studying also the effects of vertical resolution should be performed. Validation with Sodankylä data is possible and necessary. Detailed diagnostics of the full three- dimensional model experiments are needed in addition to the standard verification.

New tools have been developed for comparison of HIRLAM results with Sodankylä mast and sounding data. These were discussed in the presentation of Jevgeni Atlaskin and first comparisons analysed in the presentation of Timo Vihma. Tools and data should be made available for modellers. Inclusion of monthly/weekly summaries of the comparisons with the operational HIRLAM to the mast verification page is desirable. Use of the new tools for validation of the developing snow- forest- surface scheme of HIRLAM is of high priority.

Problems of two- metre temperature diagnostic calculation in HIRLAM should be addressed, also to ensure that the optimal output parameters are used and compared with observations.

From the point of view of Sodankylä observation usage

The highest priority task is collection of the existing data with descriptions and tools into a single site available for researchers.

The present data sources in Sodankylä include:

- soundings, also data with up to 2s time interval could be made available
- mast data: temperature, humidity, wind, heat and momentum fluxes, part of radiation fluxes
- additional radiation measurements
- ground and snow temperature measurements
- cloud data from ceilometers

First task would be to compose an inventory of the available data. Next, the data streams should be arranged to ensure automatic data collection in a single agreed storage. Special data base structures may not be necessary, but collection of files, descriptions and tools to handle them would be preferable. Realization of these needs is a responsibility of FMI, and finding a full-time person to do the job would be highly desirable.

Based on the data, at least the following tasks are ongoing

- operational comparison with HIRLAM results
- collection of data sets for CEOP and some other international data bases
- several different model comparison and boundary layer studies by different people

Specific data requests/possibilities were mentioned:

- need of Special Observation Periods for stable boundary layer studies, including also tethered balloon measurements
- Luosto radar data(+ icing measurements at Luosto) are in principle available
- Long-wave radiation measurements, both upwelling and downwelling should be made available, and ensured that the measurements are working properly (seems not to be case for upwelling LW at the moment)

Data requirements from the point of view of research problems

To detect the capping inversions and low level jets, data above the mast height should be available: high-resolution sounding data, tethered balloon, profilers (used in Helsinki testbed) could provide them.

To study the surface radiation balance in clear and cloudy cases, upwelling and downwelling long- and shortwave radiation fluxes are needed. Data from ceilometers and high resolution AWS observations should be combined with the radiation fluxes, as well as with the observations of the surface state (surface temperature, snow – to determine albedo and surface emissivity). A comparison of measured and HIRLAM radiation balance in Sodankylä has been planned to be started next year. Discussion about the improvement of the radiation measurement instruments is ongoing at FMI.

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