SURFEX in Helsinki, NumLab 2009

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NUMLAB

In the year 2009, the topic of the NumLab course of the University of Helsinki was SURFEX. The first NumLab in 1976 was devoted to the omega equation. In the year 1999, the topic of the NumLab was HIRLAM. HIRLAM Newsletter reported[1]:

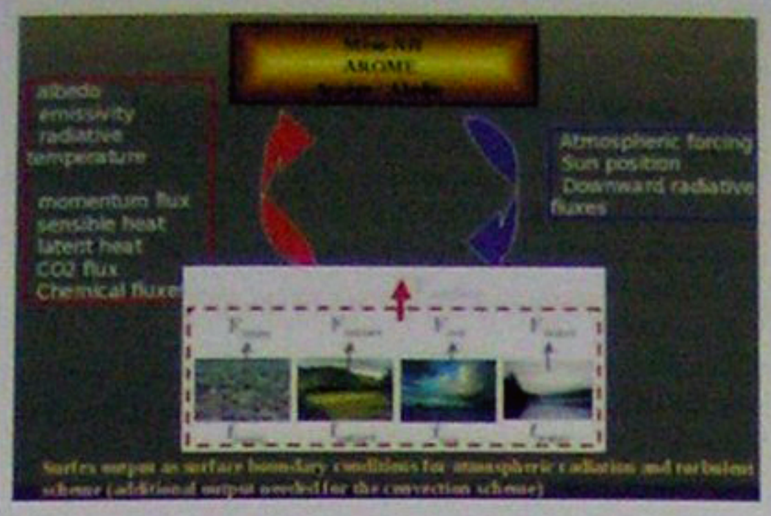
"There have been about 15 Numlab courses since 1976. The idea of such an interactive course comes from Juhani Rinne, a member of the HIRLAM advisory committee, who organised the course until year 1993. ... The theme of the course varies from year to year, so that the students would always have an opportunity to become acquainted with a model new for them. Many students therefore participate in two Numlab courses during their studies. Models studied in various Numlab courses thus far include a barotropic model, the ECMWF model, a model of stratospheric chemistry, the Lorenz chaos model, an Australian limited area model used as an operational NWP model at FMI before HIRLAM etc."

During 2001-2007, the ECHAM climate model and three other models were studied during these semester-long laboratory courses.

[1] Rontu, L. and K. Ruosteenoja, 2000. HIRLAM in the Numlab course at the University of Helsinki. HIRLAM Newsletter (35).

Highlights of the results reported by the NumLab 2009 groups are presented below: thanks to all participants for the contributions!

SURFEX



SURFEX, SURFace EXternalisée, is an externalized surface scheme from Meteo France. It is used operationally in AROME and also available in other models (HARMONIE, ALADIN, ALARO). For research and education, SURFEX has been coupled to MesoNH and is available as a stand-alone version. Presently, SURFEX v.5.0 has been released by Meteo France. Scientific and technical documentation is being prepared for publication. Links to recent overview presentations given by Patrick Le Moigne can be found at http://hirlam.fmi.fi/numlab/doc/

STUDIES

20 MSc and post-graduate students and some FMI staff participated the 2009 Numlab. After short introductory excercises and lectures, participants divided to five groups, each of which chose their own topic for further studies:

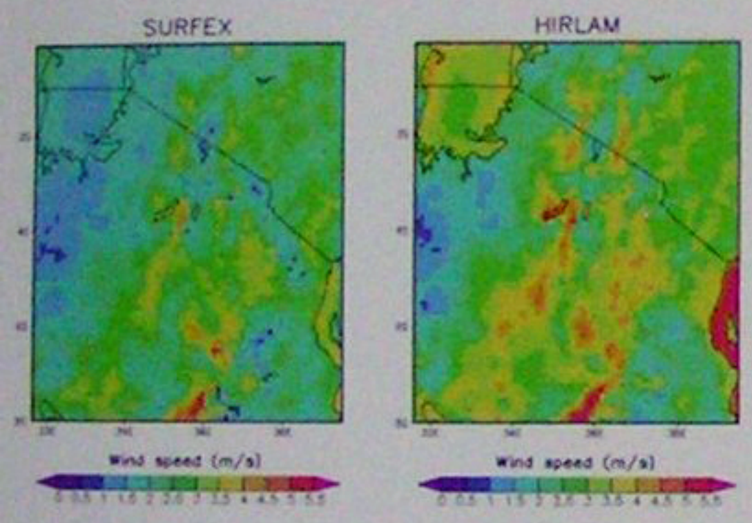
- SURFEX simulations for Tanzania
- SURFEX and surface layer fluxes in boreal forest, Norunda
- SURFEX and soil moisture at Ylistaro
- Simulations with FLAKE for a small boreal lake, Valkea-Kotinen
- SURFEX simulation of snowmelt in Sodankylä

In the experiments, we used SURFEX v.3.0 in stand-alone mode. Atmospheric forcing for one- and two-dimensional experiments was prepared by the groups or extracted from earlier HIRLAM experiments. (Ask the authors for the technical details if interested!). Tools for the analysis and presentation of the results with GrADS were developed and applied. Seminar presentations and a printed report concluded Numlab 2009. The report, along with other course material, is available at http://www.atm.helsinki.fi/ jaraisan/numlab2009/NumLab09.html

NUMLAB PARTICIPANTS 2009:

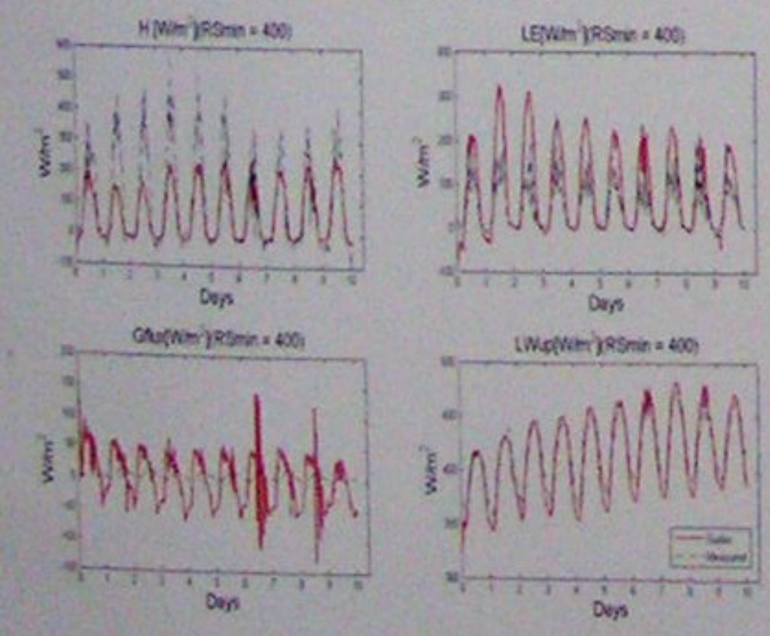
TARU BALK CARL FORTELIUS ARI HEIKKINEN MIIKKA HILKE PAULI JOKINEN MIRJA KEMPPI SAMULI LAUNIANEN TUOMO LAURI KAROLIINA LJUNGBERG TUOMAS NAAKKA KATJA NEVALAINEN ANNIKA NORDBO ANNU OIKKONEN OLLI PELTOLA PEKKA RANTALA LAURA RONTU JOUNI RÄISÄNEN (COURSE LEADER) SANNA SALMI ANU-MAIJA SUNDSTRÖM IRENE SUOMI JUHA TONTTILA JENNA TUOMINEN JUSSI YLIHÄISI WITH CONTRIBUTIONS BY EVGENY ATLASKIN KALLE EEROLA PATRICK LE MOIGNE ROBERTA PIRAZZINI TIMO VIHMA. THANKS TO LASSE JALAVA, FMI AND RISTO MAKKONEN, UH WHO PROVIDED US WITH THE COMPUTERS NUMLAB AND SUMU.

Tanzanian 10-metre wind, 2006



Time averaged 10 meter wind speed difference between SURFEX and HIRLAM in Tanzania (1-9 April 2006, rainy period). HIRLAM produces higher wind speeds than SURFEX, especially over water surfaces, plateaus and mountainous areas. HIRLAM lowest model level (ca. 32 m) wind has been used as forcing for SURFEX. Over lakes, the reference waterflux parametrizations were applied, not the lake model FLake.

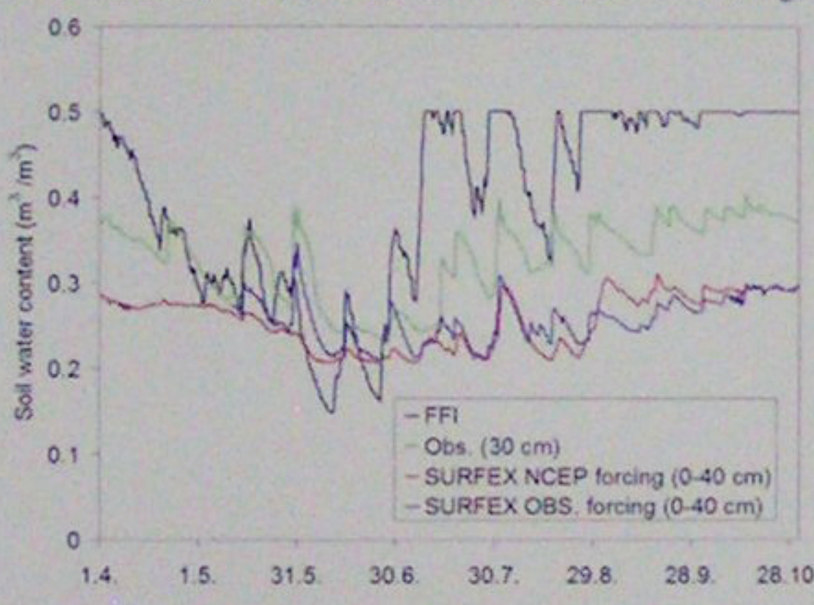
Surface fluxes in boreal forest, 2005



Comparison of SURFEX (ISBA) fluxes and eddy-covariance fluxes at a boreal coniferous forest in Norunda, Sweden, during dry period 1-15 July, 2005. SURFEX was run with parameter values Rsmin = 400 s/mm, LAI = 4. Meteorological observations at Norunda were used as forcing.

In ten days, the measured soil water content decreases from 0.35 (35 per cent) to 0.30 (deep soil) and from 0.35 to 0.25 (surface), in SURFEX from 0.29 to 0.24 and from 0.29 to 0.16, respectively. The quite large diurnal amplitude of the surface soil moisture variation in SURFEX was not confirmed by the measurements.

Soil moisture with NCEP and observation forcing, comparison with measurements and a forest fire model



Soil water content obtained from SURFEX with NCEP forcing (red) and forcing based on SYNOP-observations (blue) as well as FMI forest fire model (FFI) soil water content calculated with NCEP forcing (black). The soil moisture measurements (green) are from 30 cm depth; whereas, SURFEX represents the soil moisture of 0–40 cm layer, and FFI 6 cm depth.

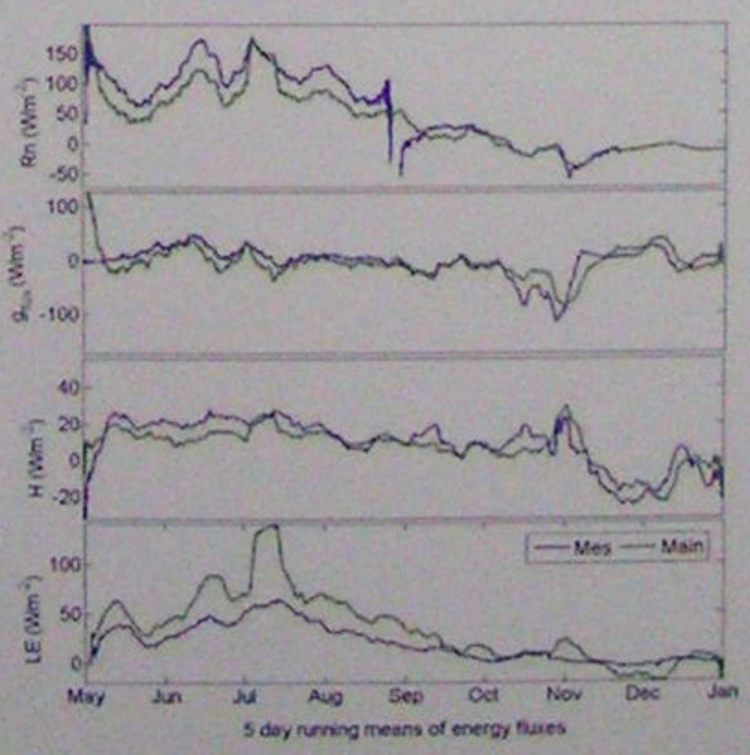
Main results of the study:

- The quality of rain data in atmospheric forcing is important. In the end of May-beginning of June, when there is rain, SURFEX with observation forcing agrees better with the measured soil water content than SURFEX with NCEP. In fact, since the NCEP grid is coarse (2.5 deg), it can not represent the local rain events well.

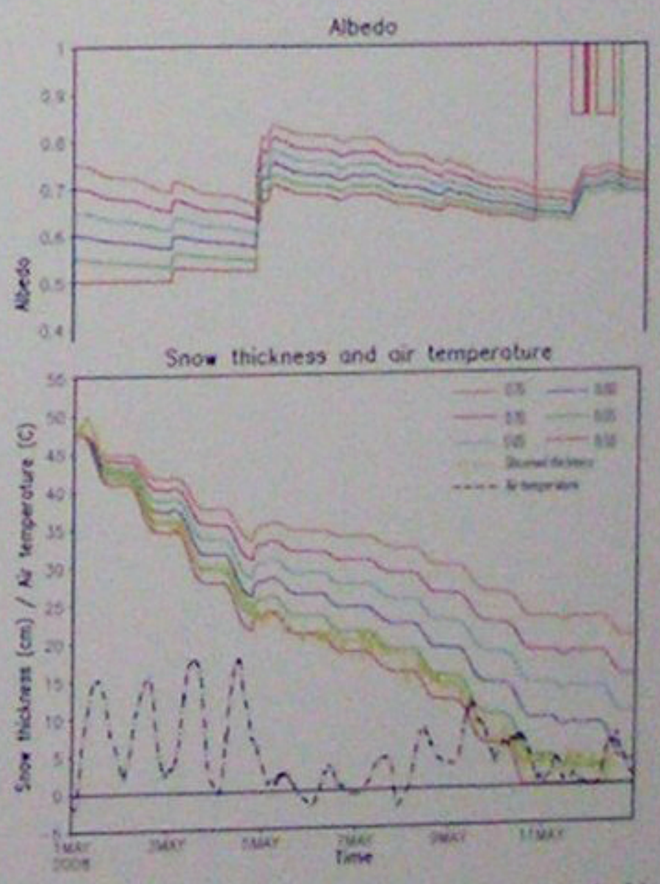
- Evaporation seems to be too strong in SURFEX. At the end of the period, SURFEX is much drier than according to the observations or the FFI model.

FLake on Lake Valkea-Kotinen, 2006

Single-point SURFEX with FLake was run for 3 May - 31 December, 2006. Atmospheric forcing and all verification data were provided by obsevations over this small and shallow (ca. 6 m deep) lake. One simulation was configured as realistically as possible, in addition ten experiments for sensitivity analysis were run. Freezing of the lake was simulated with an accuracy of a few days. The figure shows simulated (Main) and observed (Mes) energy fluxes over the lake. Surface temperature was slightly overestimated and the lake albedo too high (0.135 instead of 0.07), also the latent heat flux is overestimated by FLake.



Snowmelt in Sodankylä, 2008



According to observations, about 50 cm deep snow layer melted in Sodankylä in May 2008 within two weeks. SURFEX was able to simulate the snowmelt realistically when initial snow albedo was set to a value of 0.55. In the upper figure, evolution of the snow albedo of different initial values is shown. Lower figure depicts the decrease of the snow depth (observed: yellow line) and observed air temperature. Atmospheric forcing was given by the Sodankylä observations.

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