Parameterization of mires in a numerical weather prediction model

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Mire (peatland): definition

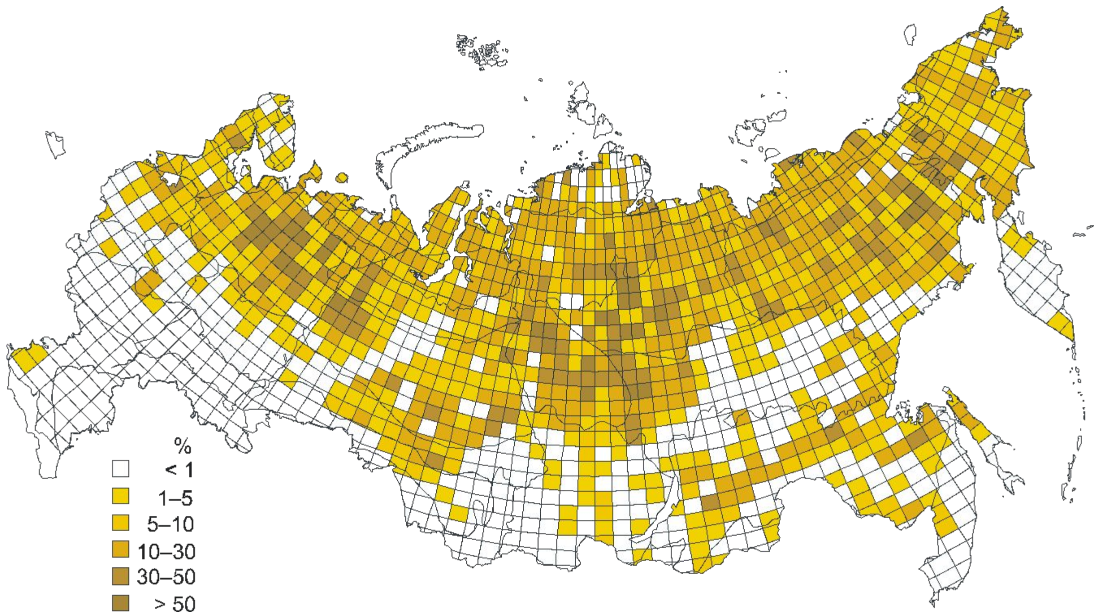
- Drainage of water is blocked. Precipitation is retained. Water table is close to the surface (max 70 cm)

- Specific vegetation-*Sphagnum* moss, sedges

- Decomposition of organic matter is slowed-peat is formed

Mires have a specific:

•Heat balance
•Moisture exchange



The spatial distribution of mires in Russia from the GIS "Peatlands of Russia" (Vompersky et al., 2005).

Global semi-Lagrangian NWP model SL-AV (Tolstykh, 2001)

- Operational NWP in Hydrometeorological Centre of Russia
- Resolution 0.72º lat и 0.9º lon, 50 vertical levels
- Dynamical core- semi-Lagrangian, semi-implicit, vorticity and divergence as prognostic variables, unstaggered horizontal grid
- Physical parameterizations- ALADIN/ALARO, including ISBA LSS
- In Siberia forecasts in summer are biased towards high air temperature and low relative humidity

Modifications done to the SL-AV model to simulate mire heat and water balance

- Multilayer soil heat transfer model with heat capacity and thermal conductivity from Wania et al. (2009)

- Water balance with MMWH

- Two schemes to simulate evapotranspiration(1-Lafleur et al., 2005;2-Weiss et al., 2006)

1

$$ET = 0.427 \cdot PET, \quad if \quad z_{wt} \geq 65$$
$$ET = 0.53 \cdot PET, \quad if \quad 25 \leq z_{wt} < 65$$
$$ET = 0.617 \cdot PET, \quad if \quad z_{wt} < 25$$

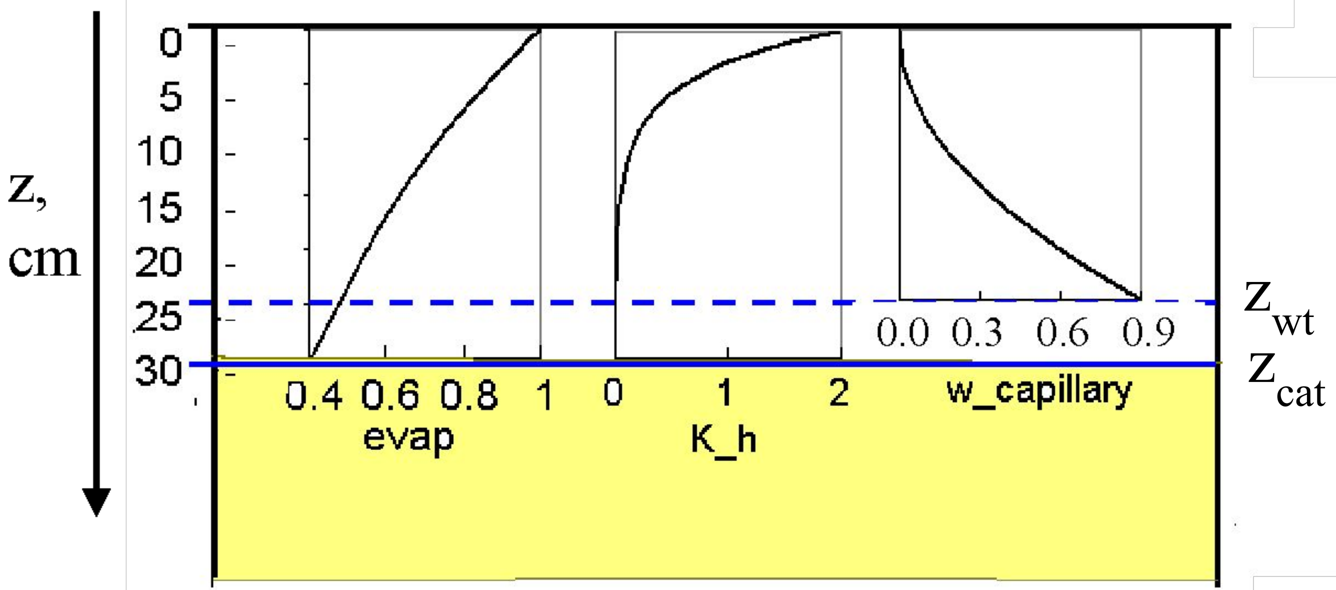
ET-evapotranspiration
PET-potential ET

2

$$ET = PET \cdot m, \qquad m = \begin{cases} s_0 + s_1(z_{wt} - z_L) + s_2(z_{wt} - z_L)^2 + s_3(z_{wt} - z_L)^3, if \ z_{wt} > z_L \\ 1, \quad if \quad z_{wt} \leq z_L, \end{cases}$$

- Prescribed roughness length and albedo

The Mixed Mire Water and Heat model MMWH (Granberg et al., 1999)

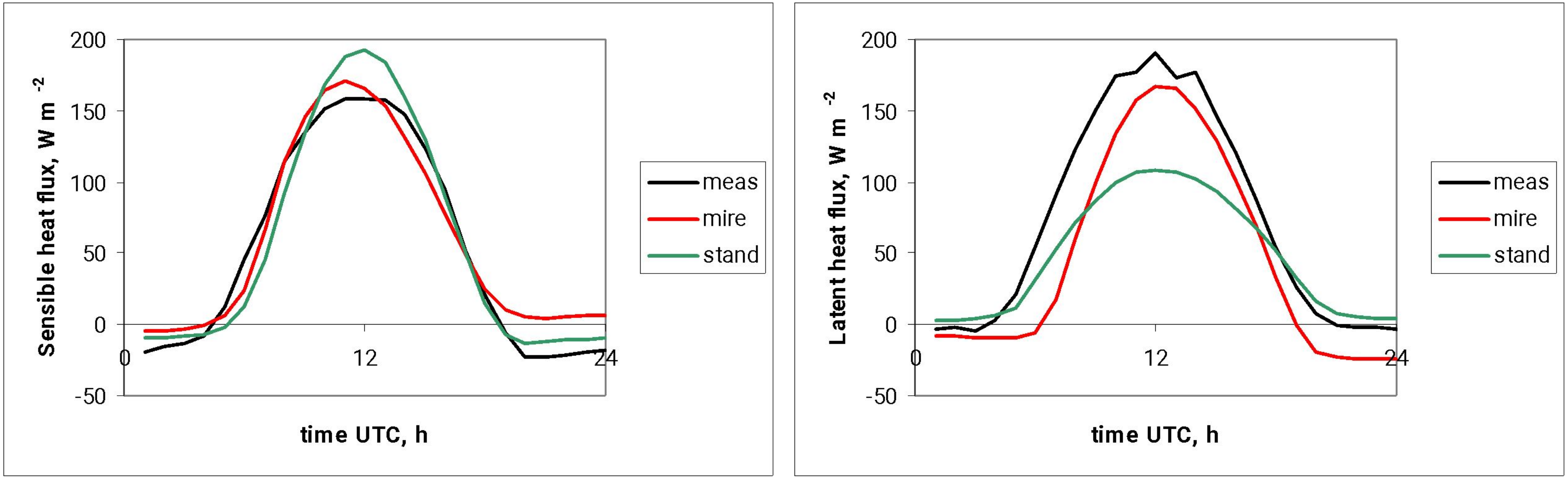


$$\Delta W = P - E - q,$$

$$q = l_q \cdot i \cdot K\_h(z_{cat} - z_{wt}),$$

W-water content, *P*-precipitation, *E*-evapotranspiration, *q*-runoff, *i*-slope of the water table, $\cdot$*K_h*-transmissivity coefficient, l_q-lumped parameter

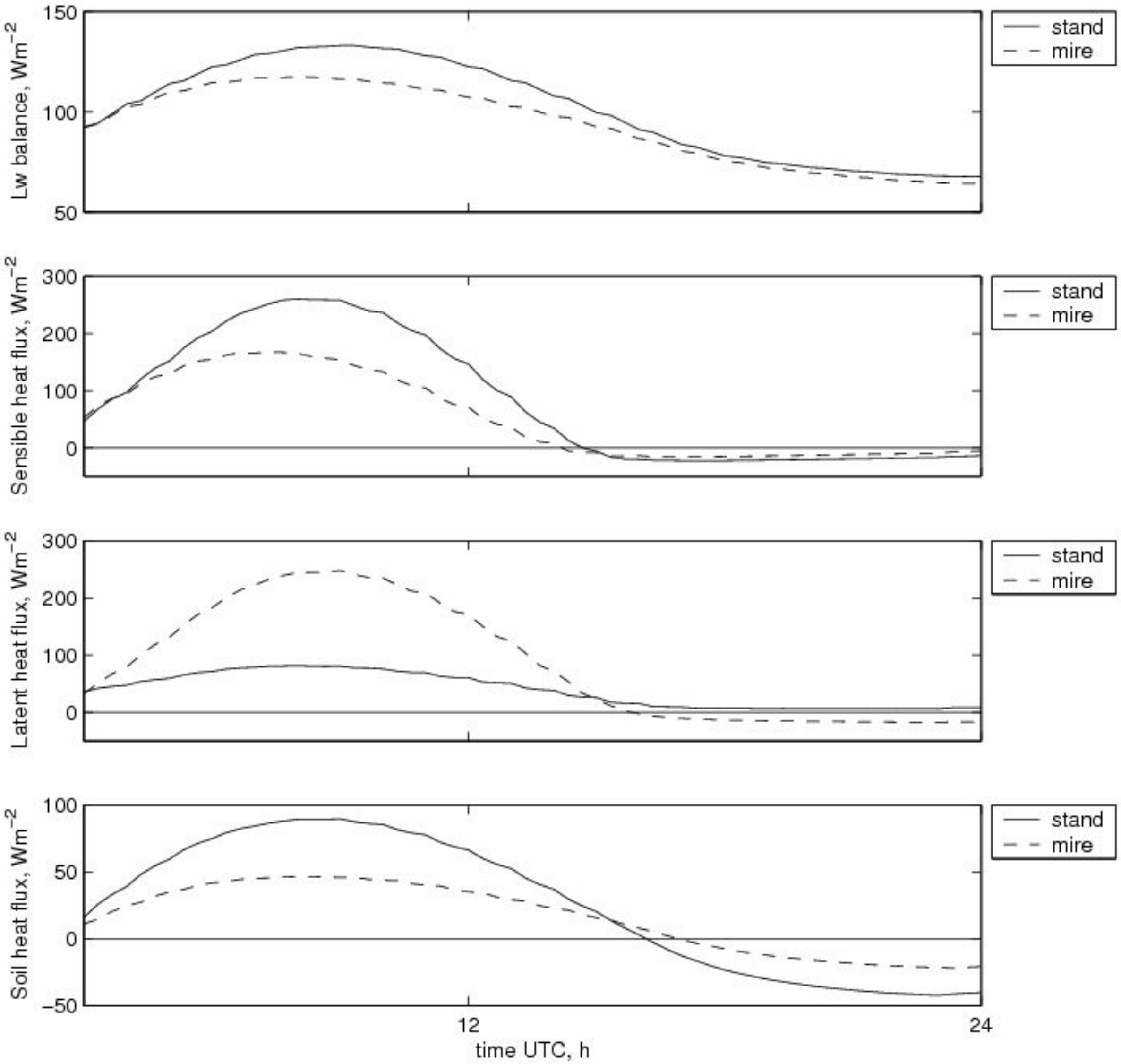
Components of the heat balance from the eddy-flux measurements, standard model simulation (stand), and simulation with a new model (mire). Degero Srormyr mire, Sweden



Sensible heat

Latent heat

Components of the radiation and heat balance from the standard model simulation (stand), and simulation with a new model (mire). July-August 2008, “mire” grid cells only, Western Siberia



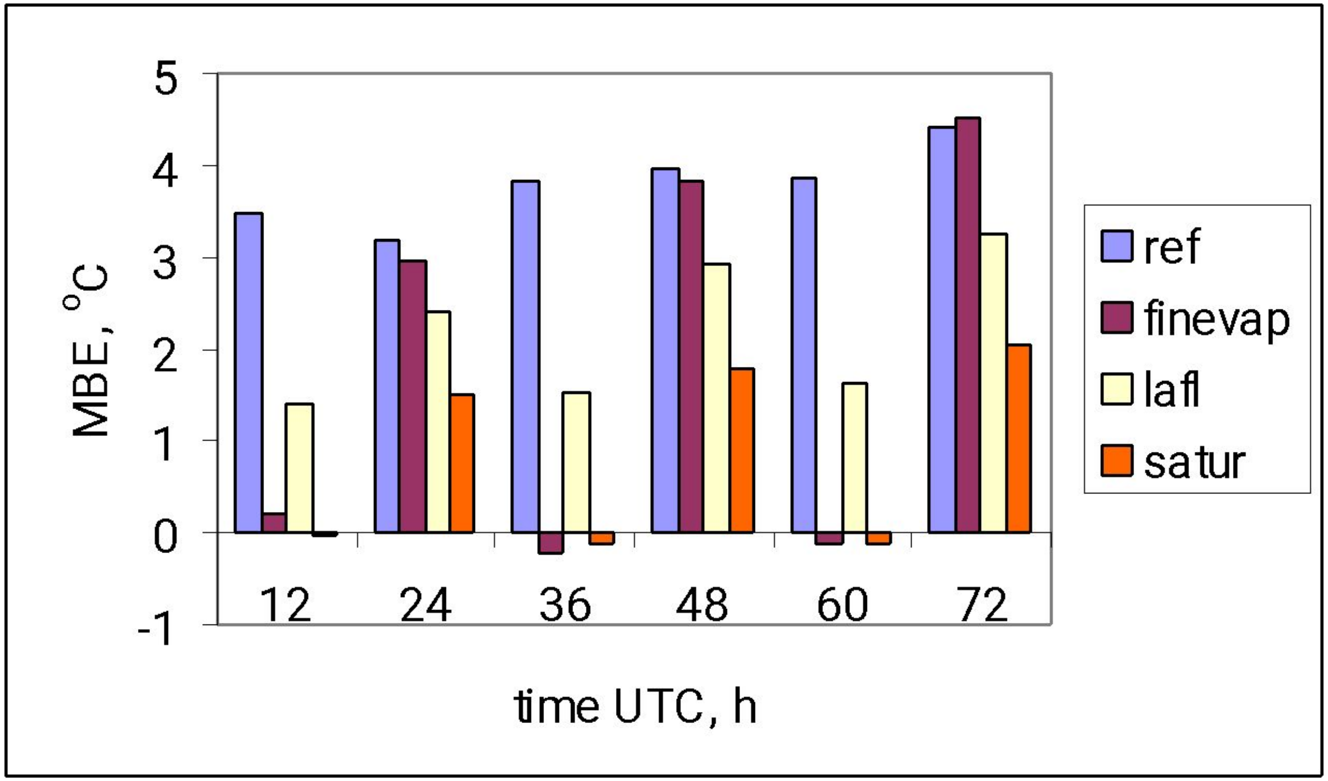
LW balance

Sensible heat

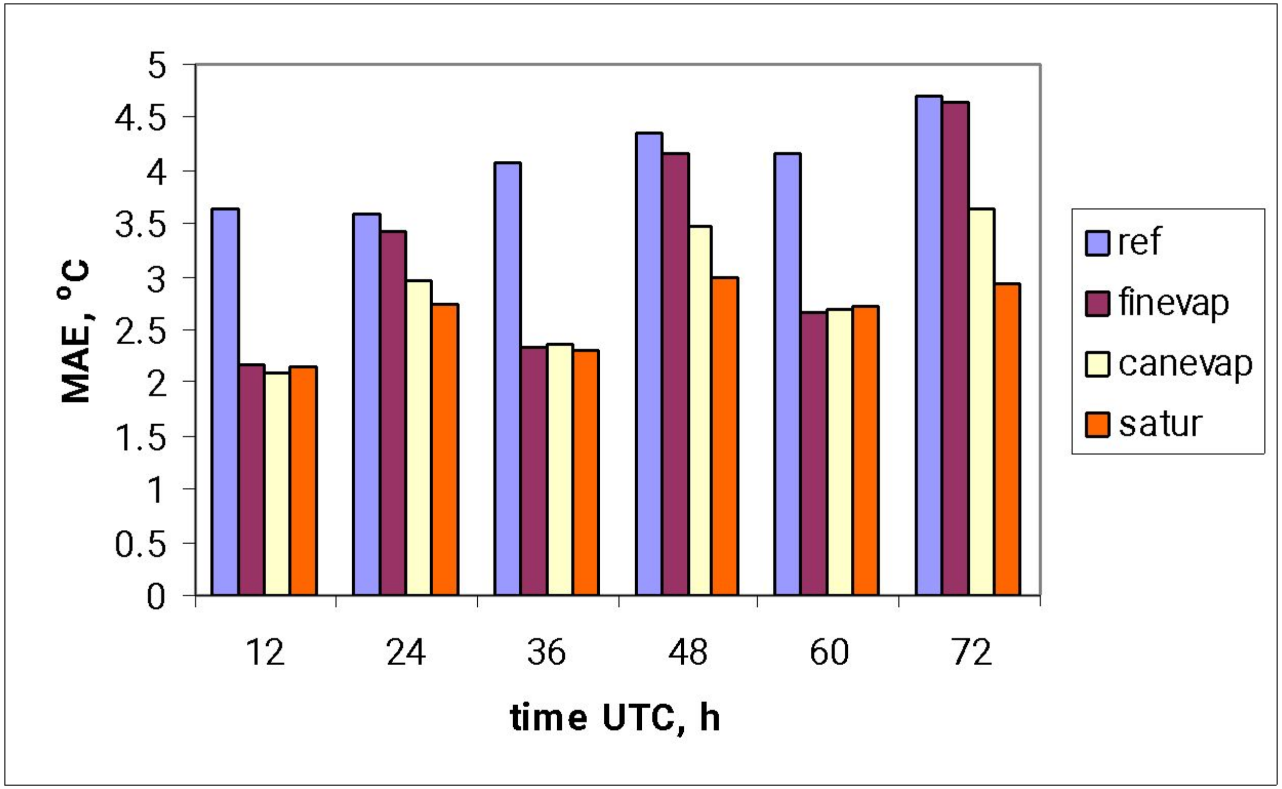
Latent heat

Soil heat flux

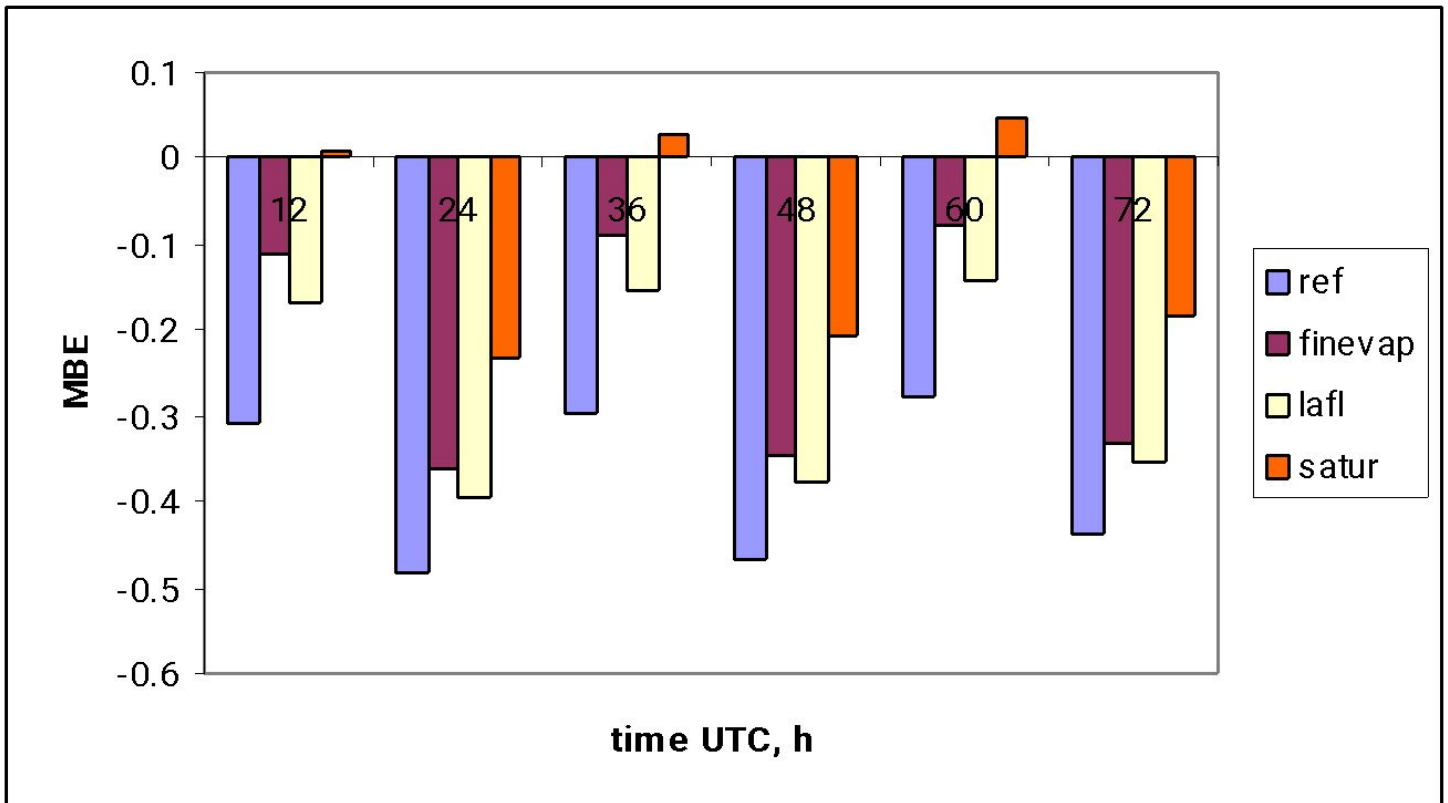
Mean bias error (MBE) for forecasted temperature °C, for the standard model (ref), for the saturated mire surface (satur) model, for the model with the Weiss et al. (2006) function for evapotranspiration (finevap), and for the model incorporating the Lafleur et al. (2005) function for evapotranspiration (canevap). July-August 2008, “mire” stations only, Western Siberia



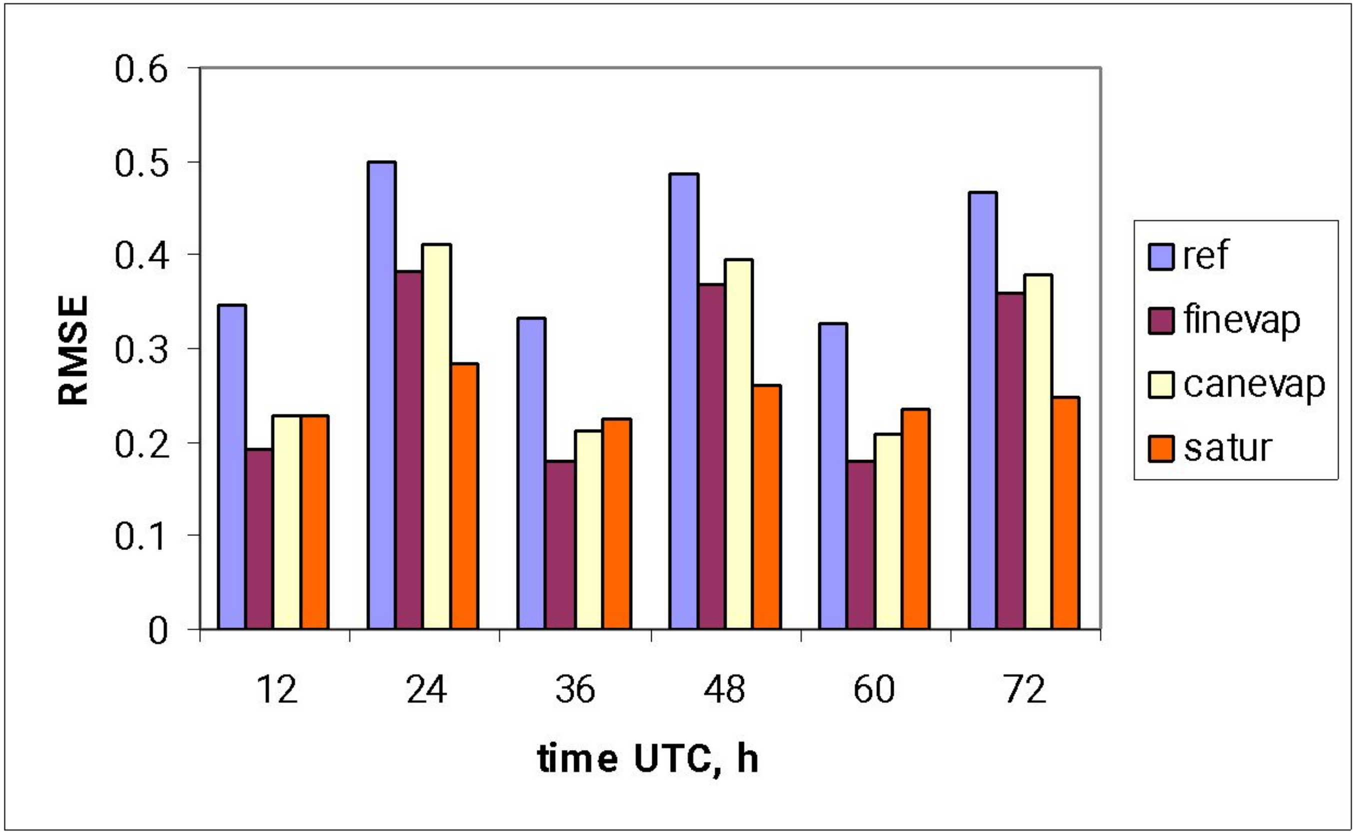
Mean absolute error (MAE) for forecasted temperature °C, for the standard model (ref), for the saturated mire surface (satur) model, for the model with the Weiss et al. (2006) function for evapotranspiration (finevap), and for the model incorporating the Lafleur et al. (2005) function for evapotranspiration (canevap). July-August 2008, "mire" stations only, Western Siberia



Mean bias error (MBE) for forecasted relative humidity, for the standard model (ref), for the saturated mire surface (satur) model, for the model with the Weiss et al. (2006) function for evapotranspiration (finevap), and for the model incorporating the Lafleur et al. (2005) function for evapotranspiration (canevap). July-August 2008, "mire" stations only, Western Siberia



RMSE for forecasted relative humidity, for the standard model (reef), for the saturated mire surface (satur) model, for the model with the Weiss et al. (2006) function for evapotranspiration (finevap), and for the model incorporating the Lafleur et al. (2005) function for evapotranspiration (canevap).
July-August 2008, “mire” stations only, Western Siberia



Conclusions:

It is important to incorporate mires when forcasting weather in Siberia

Heat balance partitioning has changed

The mire parameterization has helped to reduce a large warm temperature bias in Western Siberia for the forecast for lead times of 12, 36 and 60h, but did not eliminate forecast bias for lead times of 24, 48 and 72h.

Future plans:

- Testing the model for winter conditions (freezing and thawing)

- Investigating the effect of mire drainage on local and regional weather conditions

Thanks for your attention!

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