ALARO-1 with SURFEX - current status and plan

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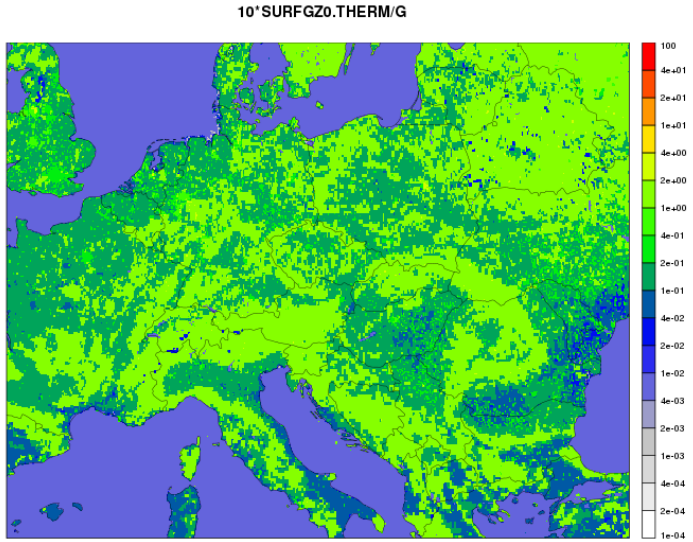
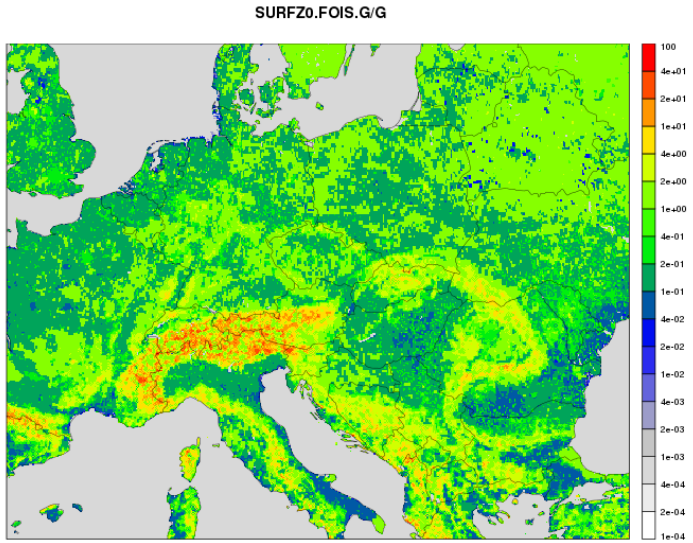
Motivation

- Main motivation is scientifically consistent transition from ISBA to SURFEX.
- Code checks on ISBA side were performed as well, revealing several bugs and inconsistencies to be corrected. (Jan presentation)
- The new roughness treatment in ISBA is:
- mechanical roughness (array SURFZ0.FOIS.G) contains effective value (with orography)
- thermal roughness (array SURFGZ0.THERM) is micrometeorological roughness (without orography)
- The new treatment should correspond to SURFEX, but it has to be checked.

Inspection of SURFEX fields comparing with ISBA

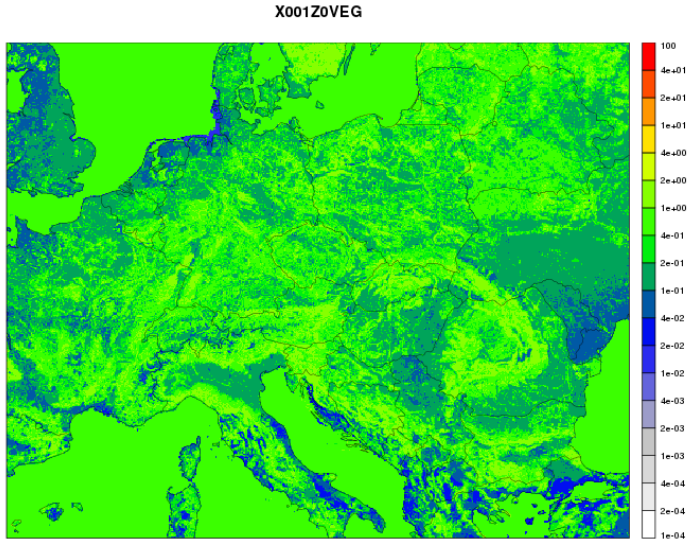
- ISBA roughness lengths
  LZ0THER = .F.(923 clim file)
- SURFGZ0.THERM
  (micrometeorological thermal roughness.)
  maximum $\sim 2\mathrm{m}$ typical value for forest
- SURFZ0.FOIS.G (effective mechanical roughness)
  maximum $\sim 100\mathrm{m}$ in hilly areas
- old GTOPO30 database

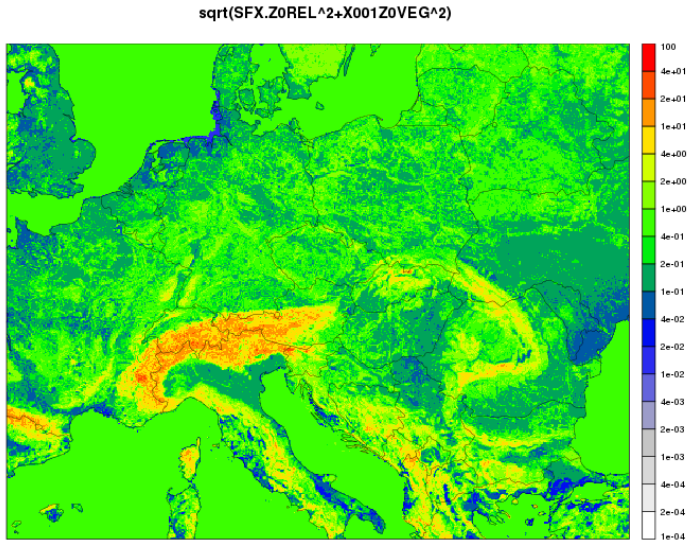




Inspection of SURFEX fields comparing with ISBA

- SURFEX roughness lengths (ICMSH sfx file)
- X001Z0VEG (micrometeorological thermal roughness)
- $\sqrt{X001Z0VEG^2 + SFX.Z0REL^2}$ (effective mechanical roughness)
- new GMTED2010 database
- more detailed physiography important for higher resolutions

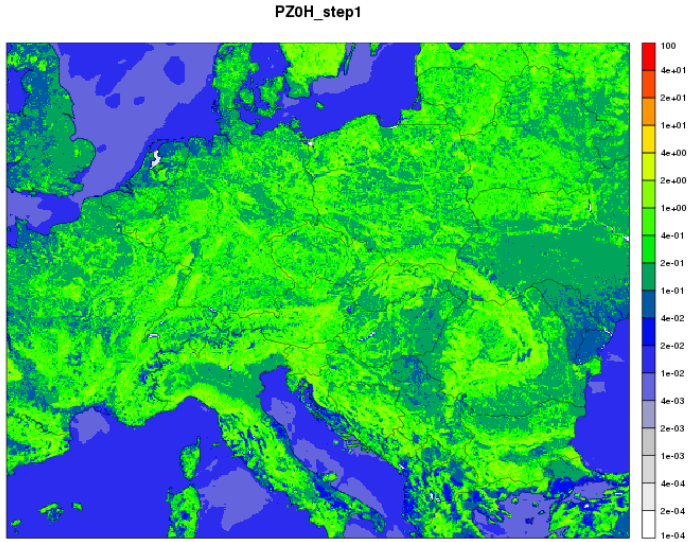


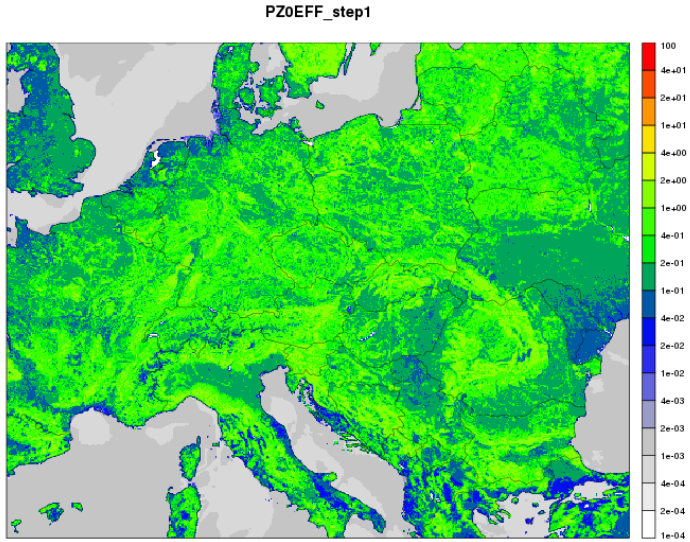


Transfering of roughnesses from surfex to atmospheric part

Surface roughnesses are transferred to atmosperic model:

- indirectly via exchange coefficients C_D and C_H
- directly as the gridbox averages z_{0D} and z_{0H}
- both of them are evaluated by SURFEX in SURFACE_CDCH_1DARP
- Roughnesses PZ0H and PZ0EFF entering subroutine SURFACE_CDCH_1DARP. PZ0EFF NOT EFFECTIVE! ↗





Gridbox averaged roughness EBA, Z01D

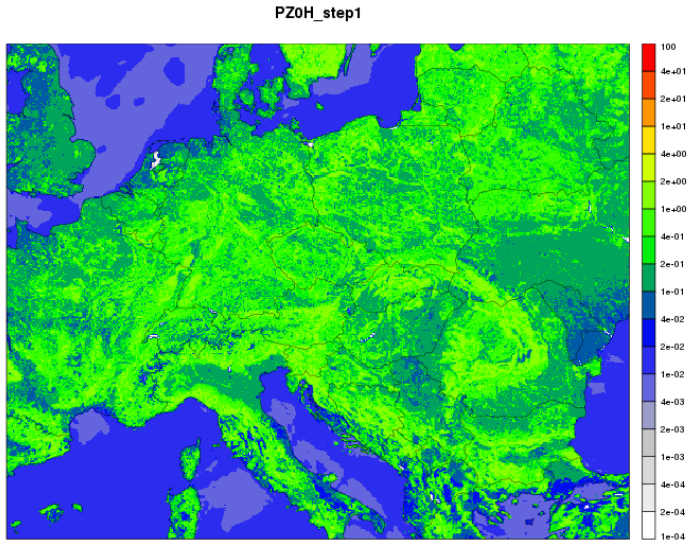
- default snow scheme in SURFEX is D95 and roughness isotropy HROUGH='NONE'
- for comparing with ISBA we need snow scheme EBA in (927):

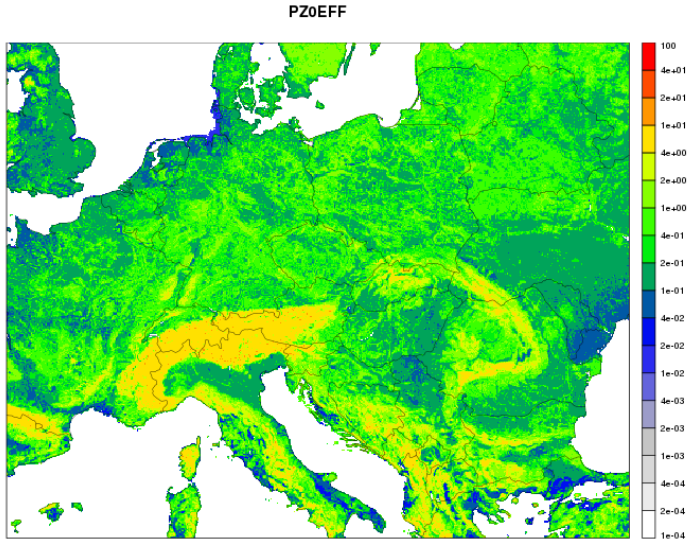
```
namelist PRE_REAL1.nam
&NAM_PREP_ISBA_SNOW
CSNOW='EBA',
/
```

- set HROUGH='Z01D' in (001):

```
namelist EXSEG1.nam
&NAM_ISBAn
CROUGH='Z01D',
/
&NAM_SSOn
CROUGH='NONE',
/
```

- Gridbox averaged PZ0H and PZ0EFF in aplpar ↗
- Cutted values over hilly areas





Gridbox averaged roughness

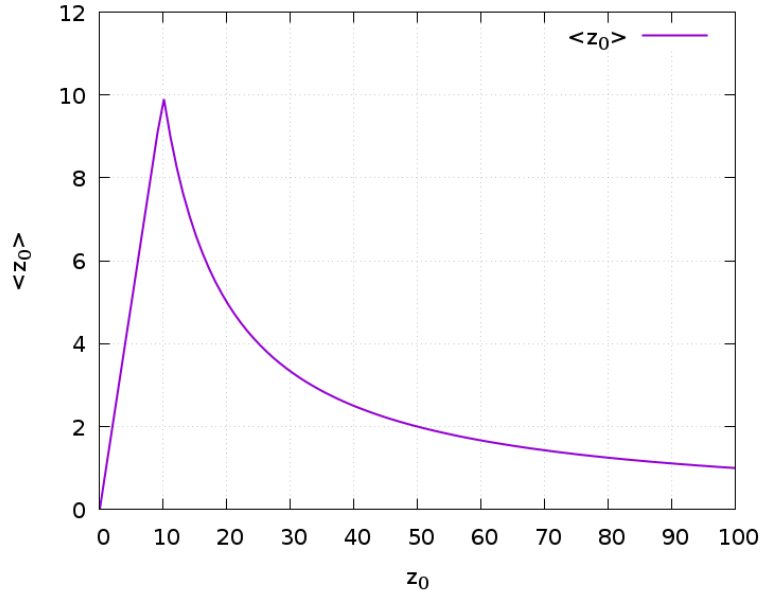
- Averaging formula in surfex:

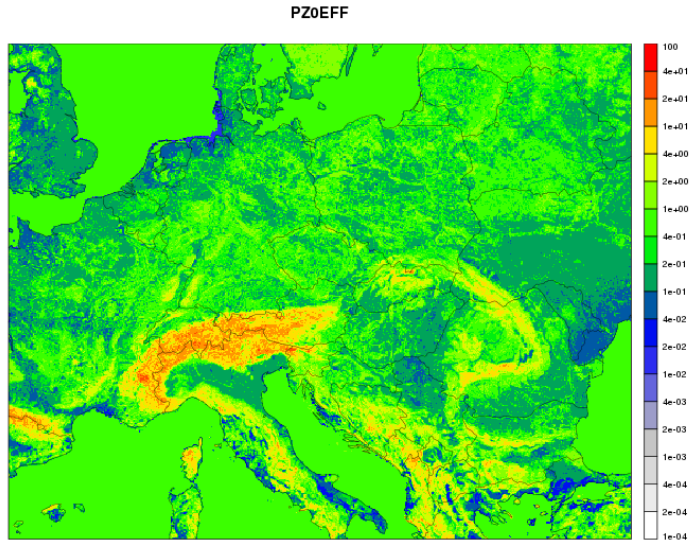
$$z_0 = H \exp\left\{ - \left[\sum_{i=1}^{N} \frac{w_i}{\ln^2[H/(z_0)_i]} \right]^{-\frac{1}{2}} \right\},$$

- only for $H \gg z_{0D}$
- Single patch or tile:

$$z_0 = \begin{cases} (z_0)_1 & (z_0)_1 < H, \\ \dfrac{H^2}{(z_0)_1} & (z_0)_1 > H. \end{cases}$$

- replacing approximation $\ln[H/(z_0)_i]$ by $\ln[1 + H/(z_0)_i]$ in all ~ 17 averaging sfx routines





Another problems with averaging roughnesses

- problem with snow-nosnow averaging
- linear formulas in Z0EFF routine (more snow fractions)

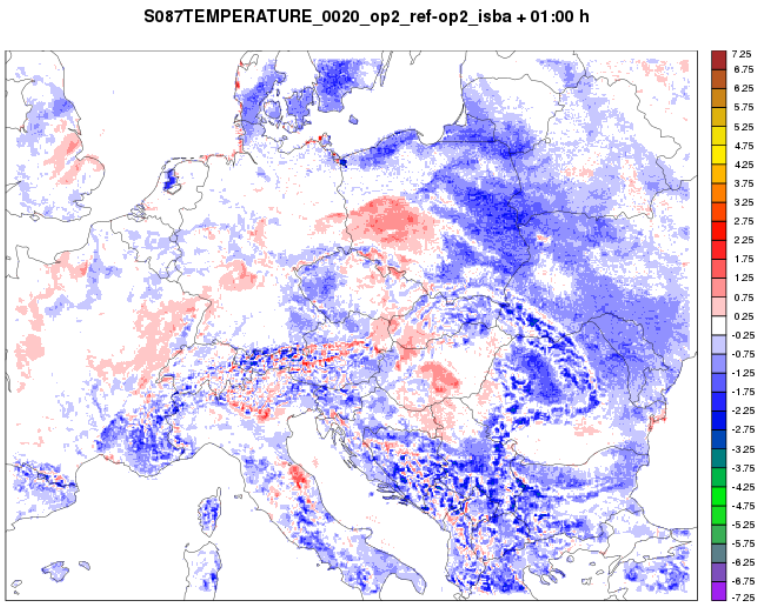
$$
\begin{aligned}
z_{0D} &= f_{D\mathrm{snow}}\, a_1 + (1 - f_{D\mathrm{snow}})(z_{0D}^{\mathrm{nosnow}}),\\
z_{0H} &= f_{H\mathrm{snow}}\, a_1 + (1 - f_{H\mathrm{snow}})(z_{0H}^{\mathrm{nosnow}}),\\
z_{0EFF} &= Z_{0D} + Z_{0REL}.
\end{aligned}
$$

- fixed quadratic formulas according ISBA (one snow fraction)

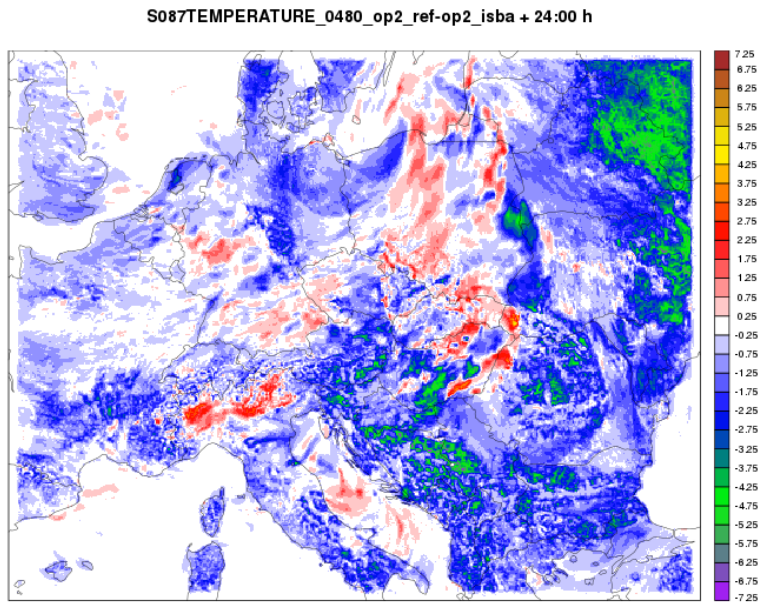
$$
\begin{aligned}
z_{0D} &= \sqrt{f_{\mathrm{snow}}(a_1)^2 + (1 - f_{\mathrm{snow}})(z_{0D}^{\mathrm{nosnow}})^2},\\
z_{0H} &= z_{0D}/10,\\
z_{0EFF} &= \sqrt{Z_{0D}^2 + Z_{0REL}^2}.
\end{aligned}
$$

Lowest model level temperature difference

- comparism between unmodified SURFEX and ISBA



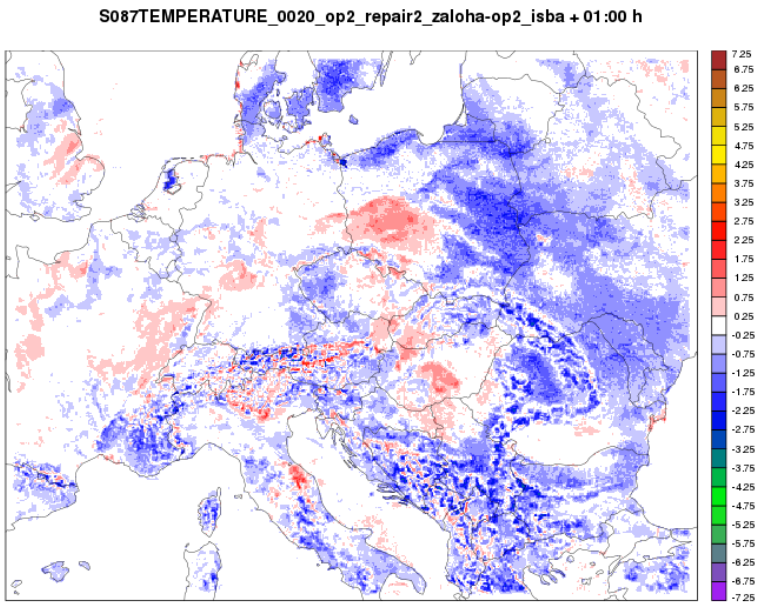
after one hour



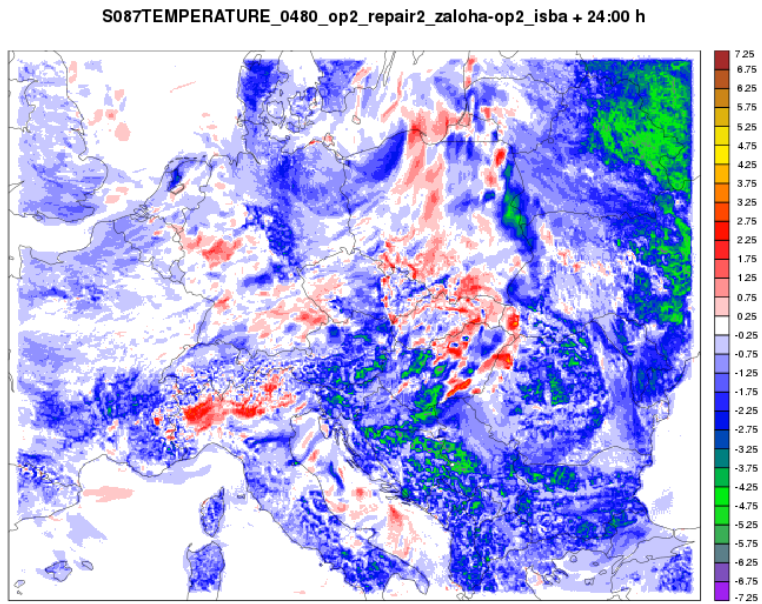
after 24 hours

Lowest model level temperature difference

- comparism between repaired SURFEX and ISBA



after one hour



after 24 hours

Conclusions

- Mechanical roughness without subgrid orography with default D95 snow scheme and Z01D isotropy.
- Serious problem with roughness averaging in SURFEX
- Experiments without radiation on ISBA an SURFEX was performed with negligible difference
- Different RCTVEG (vegetation thermal coefficient) was found in SURFEX and ISBA also with slightly difference
- Big differences in fields between ISBA and SURFEX are still unclear