ALARO-1 with SURFEX – some interfacing issues

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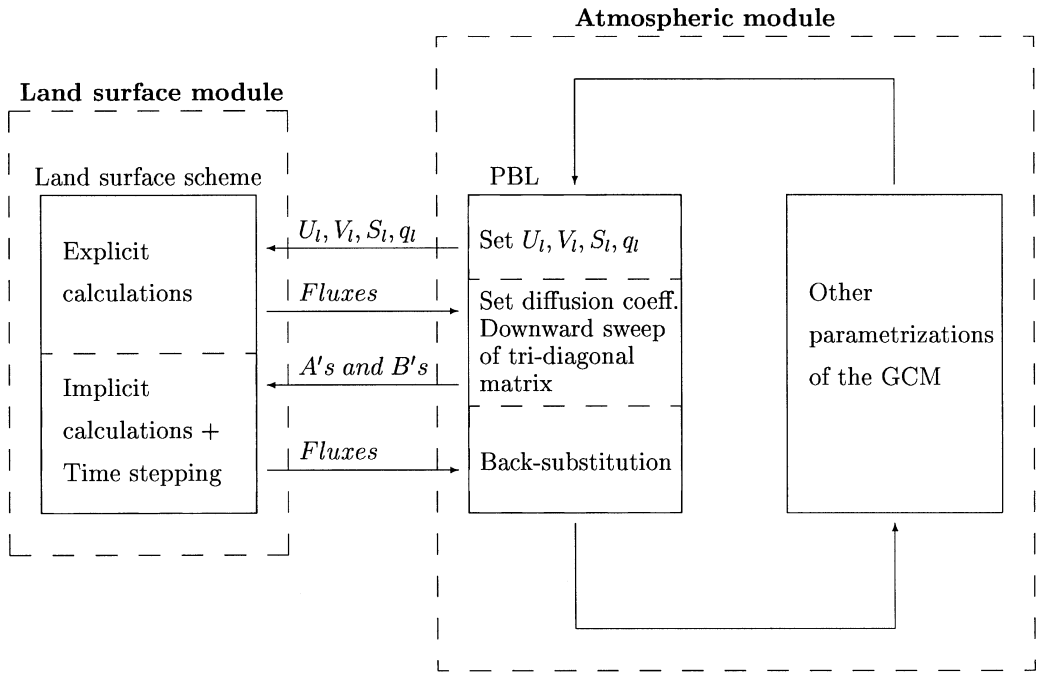
Introduction

- this presentation briefly summarizes results of two ALADIN flat rate stays of Rafiq Hamdi in Prague (1 + 1 week in 2017 and 2018)
- the goal was to make ALARO-1 running technically with SURFEX on cy43t2 at CHMI and to perform basic validations
- longer term goal is to use ALARO-1 with SURFEX, in order to benefit from better physiogeographic datasets not available in configuration e923 (GMTED2010 orography, ECOCLIMAP)
- SURFEX also offers some more advanced options attractive for NWP:
  - tiling
  - 3-level ISBA scheme
  - extended snow scheme (ISBA-ES)
  - town energy balance (TEB)
  - orographic-radiation interaction (ORORAD)
  - lake model (FLAKE)

Coupling SURFEX with atmospheric model

- interface proposed by Best et al. (2004) is followed:



- atmospheric model provides values X_l on the lowest model level (wind components U_l and V_l, dry static energy S_l, specific humidity q_l)
- in implicit timestepping it must deliver coefficients A_X and B_X, relating value X_l with corresponding surface flux τ_X:

$$X = A_X \tau_X + B_X \qquad (X = U_l, V_l, S_l, q_l)$$

- surface scheme sends back fluxes τ_X aggregated over tiles

Strategy of work

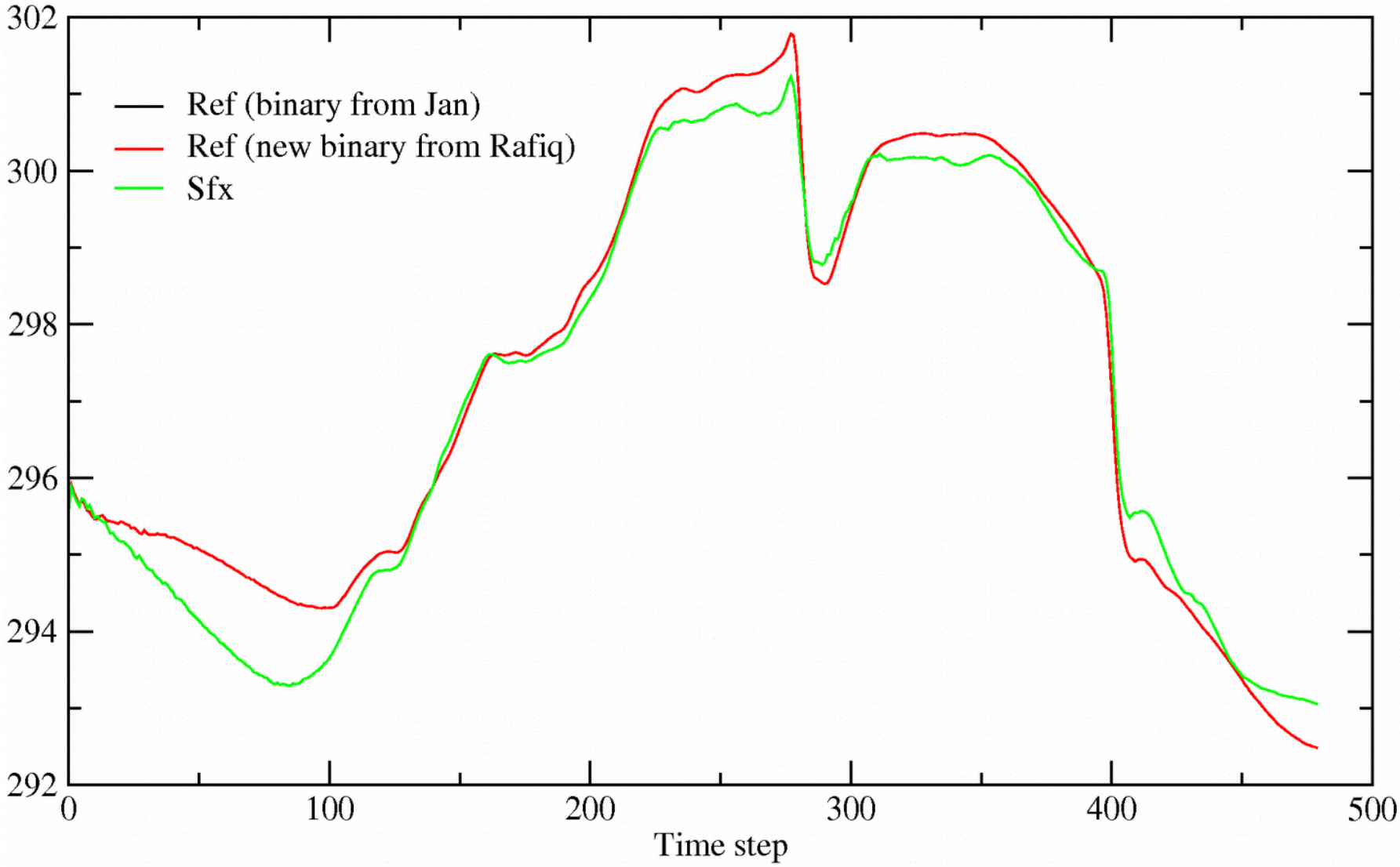
- reference ALARO-1 run used 2-level ISBA scheme in an old way, i.e. without calling SURFEX
- tested ALARO-1 run used 2-level ISBA scheme implemented under SURFEX $\Rightarrow$ different branch of code entered, careful validation needed
- tiling was off (available only on SURFEX side)
- snow issues were escaped by selecting summer case
- different screen level interpolation with/without SURFEX was avoided by comparing quantities at the lowest model level

Basic findings

- SURFEX run suffers from spurious oscillations of wind components, while the reference run is smooth
- no such oscillations are seen in temperature
- shortening the timestep at 4.7 km resolution from 180 s to 60 s reduces wind oscillations only slightly
- working hypothesis is that the problem is caused by fibrillations due to one timestep shift between SURFEX and TOUCANS turbulence
- antifibrillation treatment was coded but not yet tested because of compilation problems (CHMI dependency tool crashes on SURFEX project; awfully slow full build had to be used instead of incremental one)

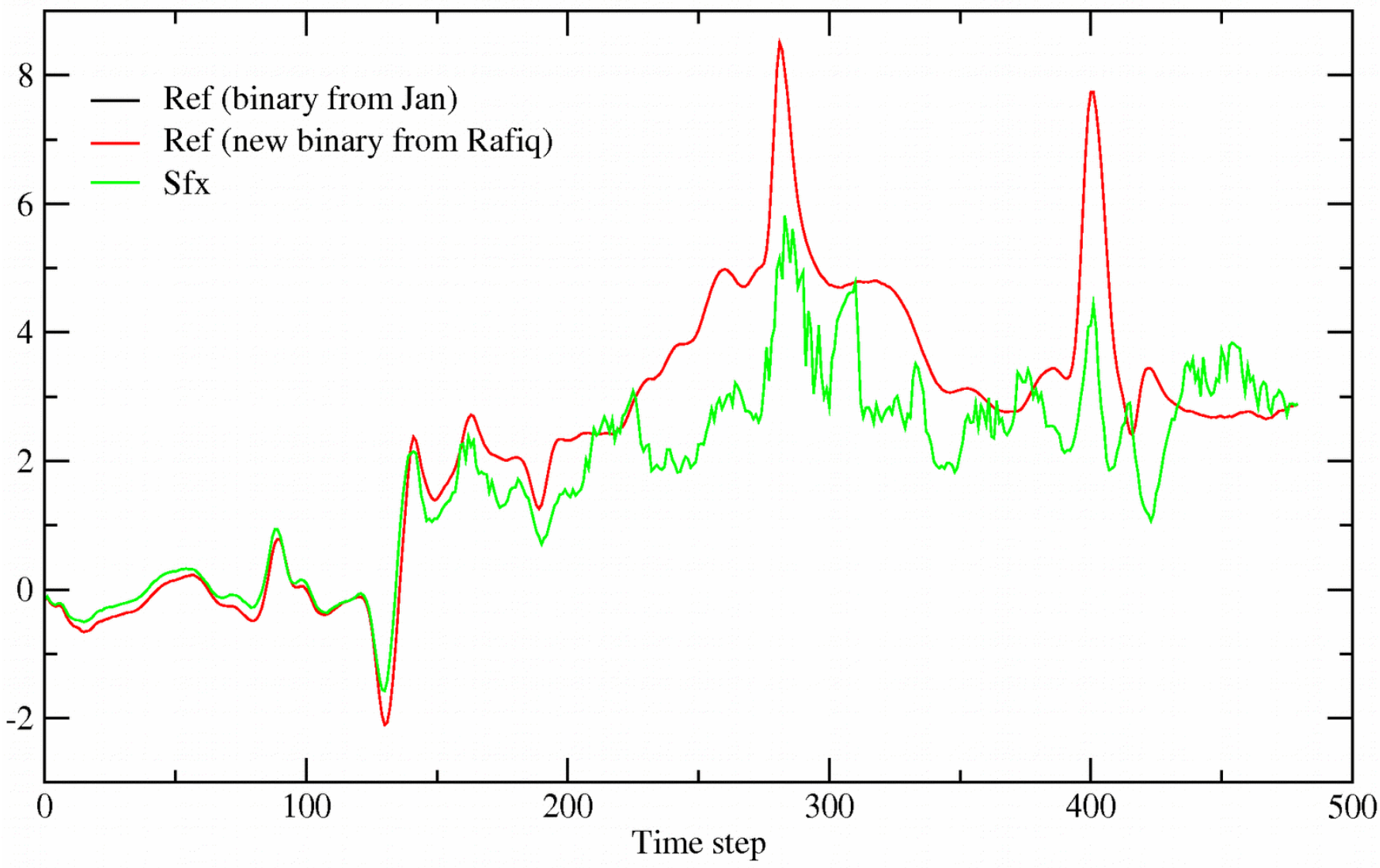
Evolution of temperature [K] on lowest model level

summer day, gridpoint near Prague, $\Delta x = 4.7\,\mathrm{km}$, $\Delta t = 180\,\mathrm{s}$



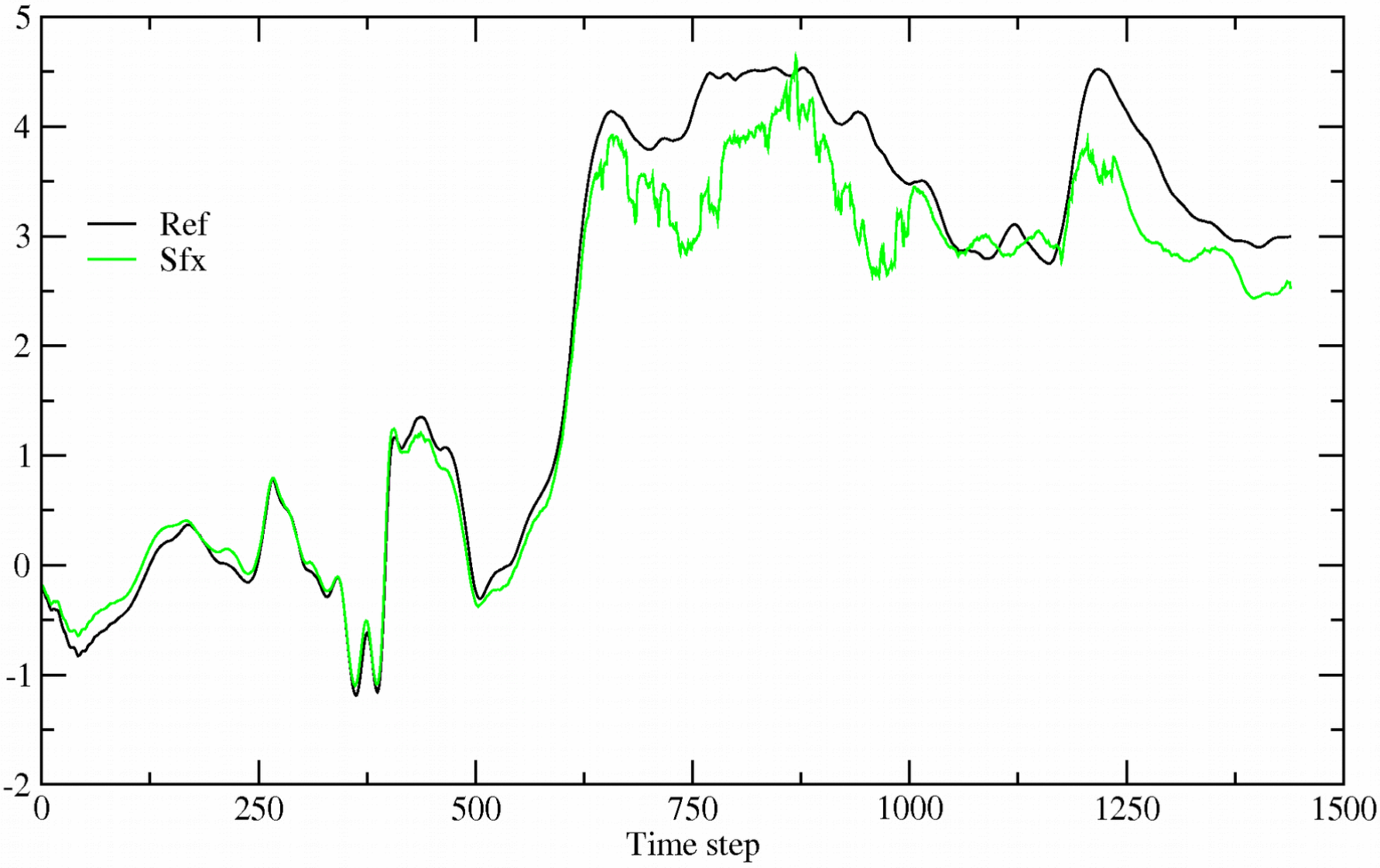
Evolution of U-wind [m/s] on lowest model level

summer day, gridpoint near Prague, $\Delta x = 4.7\,\mathrm{km}$, $\Delta t = 180\,\mathrm{s}$



Evolution of U-wind [m/s] on lowest model level

summer day, gridpoint near Prague, $\Delta x = 4.7\,\mathrm{km}$, $\Delta t = 60\,\mathrm{s}$



Conclusions

- ALARO-1 coupled with SURFEX suffers from spurious oscillations seen in wind components on the lowest model level
- it is not yet known whether recently coded antifibrillation treatment will help
- the interface of Best et al. (2004) cannot be followed strictly, since apart from surface fluxes (expressed via drag and heat coefficients) TOUCANS turbulence requires also surface roughness entering calculation of mixing length and TOMs solver
- if the interface was fully respected, application of effective dynamical roughness could be done outside SURFEX by adding drag coefficient due to subgrid-scale orography