General comments:

*This is manuscript represents a good and important overview of the surface scheme
SURFEX and should be useful for those working with surface development in various
type of modelling systems. SURFEX is a fast developing modelling system and an
overview paper like this is very helpful, especially since it lists many references to
developments and studies related to individual components of SURFEX.*

We thank Patrick Samuelsson for the positive comments. The answer to the Detailed
comments are provided below.

Detailed comments:

*Page 3774, Line 5: The Viterbo and Beljars (1995) reference for TESSEL is old. Please
include more recent reference.*

Will be replaced by Balsamo et al., 2009.

Page 3774, Line 14: Please also include reference to ALARO.

ALARO will added in the list of models, with reference to Gérard et al. 2009 and Hamdi et
al., 2012.

*Page 3775, Section 2: I think this section should be extended to make it more clear
what more or less tiles/patches means from a physical process point of view in SUR-
FEX. E.g. that one separate snow storage is present in each tile/patch, that each
tile/patch soil column is treated independently from energy/hydrology perspective (see
comment below on subgrid hydrology options), that turbulent exchanges of fluxes de-
pend on tile/patch characteristics like roughness length, surface temperature.*

The description of the tiling approach in Section 2 will be improved in order to explain that it
deeply modifies the way of calculation of the variables and fluxes.

*Page 3777, line 14: It is not required (or possible) to define optical properties in input
fields for FLake in current SURFEX.*

It is true that there is no global database available for this parameter (extinction coefficient).
However the possibility is already coded in Surfex. For clarity reasons the reference to
optical properties will be deleted here, but the possibility to use values prescribed by users
or maps will be mentioned in the Flake description (Sect 4.4).

*Page 3791, Lines 20-26: Here I get the impression that the tile approach is simply
one among five optional hydrology parameterisations but I think that gives the wrong
impression. The tile approach is fundamentally different from the mixing approach and
that hydrological processes are treated by tile in the tile approach is just a consequence*

of that. See comment on Section 2 above.

Yes, we agree that the tile approach is not simply another option for the subgrid hydrology. Actually, the tile approach has great consequences on the surface energy and water budget, but also on hydrology within the soil. This lines will be re-writtten to ensure the correct link with the tile approach description in section 2.

Page 3792, Line 11: Please replace "used in other" with "used in some".

OK, will be done

Page 3793, Line 2: Is the one-layer snow scheme in TEB a unique one or is it the same as one of the bulk schemes in ISBA?

Yes, the snow model of TEB is unique, but actually it is derived from the bulk snow model of ISBA (Douville 1995). The corresponding text will be modified.

Page 3794, Line 8: How do surface properties change when sea ice appears?

Sea-ice properties are prescribed at the beginning of the run, and they are constant all over the run. It is a limitation of SURFEX. The sentence will be modified to be less ambiguous on this point, and the lack of a sea-ice model will be indicated in the conclusion/perspective sections.

Page 3796, Lines 16-17: Here I get the impression that lakes are disregarded if not explicitly resolved. That is true in non-tiled schemes but not in tiled schemes as SUR-FEX provides. Thus, the overall area coverage of lakes will remain the same in a tiled scheme independent on horizontal resolution.

We agree, but for large grid mesh, the lake influence on the grid-averaged diagnostics is low. It must be recognized that this sentence is confusing. Actually we want here to stress that high resolution numerical weather prediction models will have to explicitely take into account such lakes. The sentence will be corrected.

Page 3797, Line 1: Again, only lake depth is required by FLake at the moment.

Yes, we will modify the text to be more precise when considering the extinction coefficient (see answer to comment Page 3777, line 14)

Page 3800, Line 18: Please specify the spectral bands SURFEX can deal with.

Surfex can be forced with data in any spectral discretization for the solar spectrum. For the calculation of the albedo, the bands are regrouped into the model in 3 bands : UV, visible and near infrared. This precision will be entered in the text.

Page 3801, Lines 11-13: I would assume that some TEB prognostic variables may have the same short time scale as some ISBA variables. Thus, if implicit coupling is required to keep these ISBA variables stable it would be the same for TEB, right? So, is this statement really true (e.g. for long time steps in order of 30 min)?

The coupling between TEB and the atmosphere is explicit in SURFEX v7.2. However some internal processes of TEB are solved implicitely to ensure the stability of the scheme. An implicit coupling between TEB and the atmosphere is possible, but not yet done. This precision will be entered in the text.

Page 3802, Line 11: Maybe I'm confused, correct me if I'm wrong, but I thought that

the SBL scheme is not implicitly coupled?! I have heard arguments like it works well for short time steps but since it is not implicitly coupled it will probably not work well for long time steps.

The SBL scheme is implicitly coupled with the surface, but <u>not</u> with the atmosphere in SURFEXV7.2. It is true that this may cause instabilities and this option is not used for climate runs. An implicit coupling is possible, but not yet coded. This precision will be entered in the text.