Updating WaSiM applications to Version 9.07.00 and later

When updating a WaSiM application to version 9.07.00 or later (from any version previous to 9.07.00 resp. 9.06.01), two things need to be done:

1. adding some new parameters to the control file, especially if using the glacier model (otherwise it's not required, but you should do it anyway since other future extensions may require the changes for 9.07.01 as a pre-requisite, even if no glaciers are used in your setup)
2. add some new grids required by the snow model and the glacier model to the StateIni directory

Extending the control file

Note: there is a sample control file available on the web site containing all the following changes (e.g. here http://www.wasim.ch/downloads/prog/wasim_9-07-01/sample_control_file.ctl)

Version 9.06.03 introduced some new snow model approaches. In Version 9.07.00, the snow model approaches were extended by separate handling of snow on glaciers and off glaciers. To have a compatible control file it is recommended to extend the control file to the latest changes in any case, even if no glaciers and none of the new snow model approaches are used. ***Note: When not using glaciers and not using the new snow model approaches, your model might run with the old control file, but future extensions to either the snow model or the glacier model will count on a control file format that is compatible to the latest WaSiM version, so it is highly recommended to add the control file changes anyway.***

The control file needs the following changes. ***Please note: long lines with comments (printed in green color) are shown as multiple comment lines here. You can leave them as they are, but you can also delete the line breaks between comment lines to have the comments after a valid entry only. In any case, a line that starts with a # is a comment line, but the # must be found on the first position of the line (no spaces or tabs allowed), otherwise WaSiM may read wrong parameters.***

1. Define variables for snow model entities that must be split up into those valid on glaciers and those valid off glaciers:

```
$set $SSNOOnGlacgrid           = ssno_onGlac_//$grid//.//$suffix
$set $SLIQOnGlacgrid           = sliq_onGlac_//$grid//.//$suffix
$set $SSTOOnGlacgrid           = ssto_onGlac_//$grid//.//$suffix
$set $snowtemperaturgridGL     = snowtempgl//$grid//.//$suffix
$set $snowsurftemperaturgridGL = ssrftempgl//$grid//.//$suffix
$set $ETRSgridGl               = etrsgl//$grid//.//$suffix
$set $QSNOWOnGlacgrid          = qsmegl//$grid//.//$suffix
```

2. Define variables for new grids for snow slides and new snow melt methods since version 9.06.03

```
$set $inputmassgrid            = inpmass//$grid//.//$suffix
$set $mobilemassgrid           = mobmass//$grid//.//$suffix
$set $depositiongrid           = deposit//$grid//.//$suffix
$set $snowtemperaturgrid       = snowtemp//$grid//.//$suffix
$set $snowsurftemperaturgrid   = ssrftemp//$grid//.//$suffix
$set $slidefraction1           =  $grid//.sd1
$set $slidefraction2           =  $grid//.sd2
```

```
$set $slidefraction3          =  $grid//.sd3
$set $slidefraction4          =  $grid//.sd4
$set $depositionindex         =  $grid//.svfdir_2_halb
```

3. When using snow model methods that include slides or wind driven snow redistribution: Add new entries to the section standardgrids (and change the number of grids to read):

```
$inpath_grid//$slidefraction1  slidefraction1   fillcode = 0 # new snow
# model extensions: fraction of the area flowing to the North (slides)
$inpath_grid//$slidefraction2  slidefraction2   fillcode = 0 # new snow
# model extensions: fraction of the area flowing to the West (slides)
$inpath_grid//$slidefraction3  slidefraction3   fillcode = 0 # new snow
# model extensions: fraction of the area flowing to the East (slides)
$inpath_grid//$slidefraction4  slidefraction4   fillcode = 0 # new snow
#model extensions: fraction of the area flowing to the South (slides)
$inpath_grid//$depositionindex deposition_index fillcode = 1 # new snow
# model extensions: correction factor for wind impact on snow fall
```

Note: The slidefraction grids are required by all snow model methods that uses slides. They must be generated with tanalys. You need to download an actual version of tanalys as well.
The depositionindex grid is required by all snow model methods that include wind driven snow redistribution. It can be generated with tanalys as well.

4. Add an additional line as last parameter for the [evapotranspiration] model:

```
3.3  4.4  6.1  7.9  9.4  10.0  9.9  9.0  7.8  6.0  4.2  3.2  # …
0.62  0.1 # part of the temperature amplitude ...
$outpath//cloud//$grid//.//$code//$year $once_per_interval # statistic
                                                    modelled cloudiness
```

5. Add some comments before the snow model that describe the possible snow model methods:

```
# snow model methods:
# conventional:
# 1 = T-index
# 2 = T-u-Index
# 3 = energy balance approach after Anderson
# 4 = extended energy bal. approach after Braun (observed vapor pressure)
# extended methods (introduced by Michael Warscher in 2013, implemented
# into WaSiMs main distribution by J. Schulla, 2014):
# 5 = Enhanced energy balance approach (enhEnbal)
# 6 = enhEnbal + gravitational slides
# 7 = enhEnbal + gravitational slides + wind redistribution
# 8 = T-Index + gravitational slides
# 9 = T-Index + gravitational slides + wind redistribution
# 10 = T-Index + wind redistribution
# 11 = enhEnbal + wind redistribution
# 12 = T-u-Index + gravitational slides
# 13 = T-u-Index + wind redistribution
# 14 = T-u-Index + gravitational slides + wind redistribution
```

6. Add the following lines to the end of the [snow_model] section:

```
# now some new parameters and file names follow for the snow model
# extensions implemented in 2014 (originally implemented by M. Warscher
# and adopted to the publicly available release and extended them a little
# bit by J. Schulla in 2014 )
$outpath//$snowtemperaturgrid # result grid with snow pack temperature
$Writegrid
$outpath//snowtemp//$grid//.//$code//$year $once_per_interval # statistics
$outpath//$snowsurftemperaturgrid # result grid snow surface temperature
$Writegrid
$outpath//ssrftemp//$grid//.//$code//$year $once_per_interval # statistics
```

```
$outpath//$inputmassgrid # result grid with input masses for slides
$Writegrid
$outpath//inpmass//$grid//.//$code//$year $once_per_interval # statistics
$outpath//$mobilemassgrid # result grid with mobiel mass for slides
$Writegrid
$outpath//mobmass//$grid//.//$code//$year $once_per_interval # statistics
$outpath//$depositiongrid # result grid with deposition amount for slides
$Writegrid
$outpath//deposit//$grid//.//$code//$year $once_per_interval # statistics
55    # maximum deposition slope (0...90)
3     # scaling for maximum deposition (0..inf)
30    # minimum slope for creating slides (0...90) (scale dependent! The
# coarser the resolution, the smaller this value must be since the average
# slope decreases).
0.007 # fraction of snow pack that forms the slide (0...1]
1.00  # LWINcorr: correction factor for incoming long wave radiation for
# fine tuning the energy balance (accouting together with LWOUTcorr for
# errors in cloudiness and albedo); recommended Values: 0.6...1.4
1.0 # LWOUTcorr: correction factor for outgoing long wave radiation for
# fine tuning the energy balance (accouting together with LWINcorr for
# errors in cloudiness and albedo): recommended Values: 0.6...1.4
```

7. Add the following rows to the end of the section [ice_firn]

```
$outpath//ssto_OffGlac_//$grid//.//$code//$year $once_per_interval # total
# snow storage, in mm, (liquid and solid fraction) for the unglacierized
# part of a cell (usefull for annual balances of all
# inputs/outputs/storages, since snow on glaciers is handled in the
# glacier mass balance already)
$outpath//$SSNOOnGlacgrid  # name of the grids with the snow storage solid
# in mm valid for the glacierized part of a cell
$Writegrid
$outpath//$SLIQOnGlacgrid  # name of the grids with the snow storage
# liquid in mm valid for the glacierized part of a cell
$Writegrid
$outpath//$SSTOOnGlacgrid  # name of the grids with the total snow storage
# solid AND liquid in mm valid for the glacierized part of a cell
$Writegrid
$outpath//$QSNOWOnGlacgrid # name of the grids with the total snow outflow
# in mm valid for the glacierized part of a cell
$Writegrid
$outpath//$snowsurftemperaturgridGL  # name of the grids with snow surface
# temperature, valid for the glacierized part of a cell
$Writegrid
$outpath//$snowtemperaturgridGL # name of the grids with snow pack
# temperature, valid for the glacierized part of a cell
$Writegrid
$outpath//$ETRSgridGl # name of the grids with snow evaporation in mm,
# valid for the glacierized part of a cell
$Writegrid
```

Creating additional grids for initialization

When the control file has been updated to the latest version, you can run the model either with readgrids=0 to create the additionally required initialization or you can create these grids as described below. When using the first method, you need to copy the following grids to the StateIni directory for the next coupled run (names used here refer to the variables used above):

- sliq_onGlac_<your basin code>.grd
- ssno_onGlac_<your basin code>.grd

- ssto_onGlac_<your basin code>.grd
- ssrftemp<your basin code>.grd
- ssrftempgl<your basin code>.grd
- snowtemp<your basin code>.grd
- snowtempgl<your basin code>.grd

To create these grids manually from an existing model result set, follow these steps:

1. sliq_onGlac_<your basin code>.grd:
   create this grid by masking the existing grid sliq<your basin code>.grid with the glacier IDs using gridmask, e.g.:
   `gridmask sliq_onGlac_a500.grd glida500.grd sliq_onGlac_a500.grd`
2. ssno_onGlac_<your basin code>.grd:
   create this grid by masking the existing grid ssno<your basin code>.grid with the glacier IDs using gridmask, e.g.:
   `gridmask ssno_onGlac_a500.grd glida500.grd ssno_onGlac_a500.grd`
3. ssto_onGlac_<your basin code>.grd:
   create this grid by masking the existing grid ssto<your basin code>.grid with the glacier IDs using gridmask, e.g.:
   `gridmask ssto_onGlac_a500.grd glida500.grd ssto_onGlac_a500.grd`
4. ssrftemp<your basin code>.grd (snow surface temperature off glaciers)
   create a grid with constant values of 273.15 (=0°C in Kelvin), e.g. by using remap:
   `remap a500.ezg 273.rmp ssrftempa500.grd`
   The remap file looks like this:
   -9000 10000 : 273.15
5. ssrftempgl<your basin code>.grd (snow surface temperature on glaciers)
   create a grid with constant values of 273.15 (=0°C in Kelvin), e.g. by using remap:
   `remap a500.ezg 273.rmp ssrftempgla500.grd`
6. snowtemp<your basin code>.grd (snow pack temperature off glaciers)
   create a grid with constant values of -9999 (nodata), e.g. by using remap:
   `remap a500.ezg 9999.rmp snowtempa500.grd`
7. snowtempgl<your basin code>.grd (snow pack temperature on glaciers)
   create a grid with constant values of -9999 (nodata), e.g. by using remap:
   `remap a500.ezg 9999.rmp snowtempgla500.grd`
8. place these grids in the StateIni directory and run WaSiM 9.07.01 to see if everything works.