Test: Issues of SWAT2012 runs with *.sol and *.sub parameters

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R packages

```r
library(tibble)
library(dplyr)
library(SWATplusR)
```

Define parameters

The following parameter set resulted in an undesired behavior when it was implemented in a SWAT201 simulation using `SWATplusR` and empty output files were returned. Some testing showed that the alteration of parameters in the *.sub and *.sol input files resulted in the described issue. To analyze the problem, subsets of *.sub and *.sol were selected for the simulation with SWAT2012.

```r
par_issue <- tibble("GW_DELAY.gw|change = absval" = c(30, 450),
                    "OV_N.hru|change = absval" = c(0.01, 30),
                    "CN2.mgt|change = relchg" = c(-0.2, 0.2),
                    "REVAPMN.gw|change = absval" = c(0, 500),
                    "SOL_AWC.sol|change = absval" = c(0.01, 0.5),
                    "SURLAG.bsn|change = absval" = c(0, 24),
                    "ESCO.hru|change = absval" = c(0, 1),
                    "SHALLST.gw|change = absval" = c(0, 1000),
                    "GWQMN.gw|change = absval" = c(0, 5000),
                    "ALPHA_BF.gw|change = absval" = c(0, 1),
                    "LAT_TIME.hru|change = absval" = c(0, 180),
                    "SLSOIL.hru|change = absval" = c(0, 150),
                    "HRU_SLP.hru|change = absval" = c(0, 0.6),
                    "CH_K2.rte|change = absval" = c(0, 500),
                    "SOL_Z.sol|change = absval" = c(0, 1000),
                    "CH_K1.sub|change = absval" = c(0, 300),
                    "SLSUBBSN.hru|change = absval" = c(10, 150),
                    "CANMX.hru|change = absval" = c(0, 100),
                    "CH_N2.rte|change = absval" = c(0, 0.3),
                    "CH_N1.sub|change = absval" = c(0.01, 30),
                    "EVRCH.bsn|change = absval" = c(0.5, 1),
                    "GW_REVAP.gw|change = absval" = c(0, 0.3),
                    "RCHRG_DP.gw|change = absval" = c(0, 1),
                    "EPCO.hru|change = absval" = c(0, 1),
                    "PLAPS.sub|change = absval" = c(0, 100))
```

Selected test runs

Debug with *.sub parameters

For debugging only the *.sub parameters were selected from the defined parameter set.

```r
par_sub <- select(par_issue, contains(".sub"))
```

```r
path_2012 <- "C:/swat2012_demo"
```

```r
q_sub <- run_swat2012(project_path = path_2012,
                      output = define_output(file = "rch",
                                             variable = "FLOW_OUT",
                                             unit = 3),
                      parameter = par_sub,
                      start_date = "2000-01-01",
                      end_date = "2007-12-31",
                      years_skip = 3,
                      n_thread = 2)
```

```
## Building 2 threads in 'C:/swat2012_demo/.model_run':
##
 Thread 1 of 2   Time elapsed: 0S   Time remaining: 0S
 Thread 2 of 2   Time elapsed: 1S   Time remaining: 0S

 Completed 2 threads in 1S
## Performing 2 simulations on 2 cores:
##
 Simulation 1 of 2   Time elapsed: 2S   Time remaining: 2S
 Simulation 2 of 2   Time elapsed: 2S   Time remaining: 0S

 Completed 2 simulations in 2S
```

An issue with different file lengths of *.sub files was encountered. Problem was fixed in `write_par_list()` L46. Test was sucessful.

```r
q_sub$simulation$FLOW_OUT
```

```
## # A tibble: 1,826 x 3
##    date        run_1 run_2
##    <date>      <dbl> <dbl>
##  1 2003-01-01 0.409 0.695
##  2 2003-01-02 0.377 0.562
##  3 2003-01-03 0.369 0.507
##  4 2003-01-04 0.363 0.477
##  5 2003-01-05 0.359 0.460
##  6 2003-01-06 0.357 0.449
##  7 2003-01-07 0.355 0.443
##  8 2003-01-08 0.354 0.438
##  9 2003-01-09 0.353 0.435
## 10 2003-01-10 0.352 0.432
## # ... with 1,816 more rows
```

Debug with *.sol parameters

For debugging only the *.sol parameters were selected from the defined parameter set.

```r
par_sol <- select(par_issue, contains(".sol"))
```

```r
q_sol <- run_swat2012(project_path = path_2012,
                      output = define_output(file = "rch",
```

```
                                        variable = "FLOW_OUT",
                                        unit = 3),
                      parameter = par_sol,
                      start_date = "2000-01-01",
                      end_date = "2007-12-31",
                      years_skip = 3,
                      n_thread = 2)
```

The issue for soil parameters resulted from different numbers of soil layers. In the code the number of soil layers that are modified were defined by the first *.sol file. If any further *.sol file has fewer layers, NA values are written in the updated files that cause an error. In any case, defining the number of layers by the first soil is highly problematic and was thus fixed. Now the number of layers is kept flexible for every HRU.

Additionally, using `'change = absval'` for `'SOL_Z.sol'` is problematic. In that case the same soil depth is assigned to all soil layers of an HRU and the consequence is an error in the simulation. Thus, soil layers should be either changed with `'change = abschg'` or `'change = pctchg'`. Alternatively, soil layers can be modified layer-wise by adding `'| layer = 1'` or similar constraints to the parameter name.

Both parameter definition examples below work for instance with the demo SWAT2012 setup:

```
par_sol <- tibble("SOL_AWC.sol|change = absval" = c(0.01, 0.5),
                  "SOL_Z.sol|change = abschg" = c(0, 1000))


q_sol <- run_swat2012(project_path = path_2012,
                      output = define_output(file = "rch",
                                             variable = "FLOW_OUT",
                                             unit = 3),
                      parameter = par_sol,
                      start_date = "2000-01-01",
                      end_date = "2007-12-31",
                      years_skip = 3,
                      n_thread = 2)
```

```
## Building 2 threads in 'C:/swat2012_demo/.model_run':
##
 Thread 1 of 2   Time elapsed: 0S   Time remaining: 0S
 Thread 2 of 2   Time elapsed: 1S   Time remaining: 0S


 Completed 2 threads in 1S
## Performing 2 simulations on 2 cores:
##
 Simulation 1 of 2   Time elapsed: 2S   Time remaining: 2S
 Simulation 2 of 2   Time elapsed: 3S   Time remaining: 0S


 Completed 2 simulations in 3S
```

```
par_sol <- tibble("SOL_AWC.sol|change = absval" = c(0.01, 0.5),
                  "sol_z1::SOL_Z.sol|change = absval| layer = 1" = c(50, 500),
                  "sol_z2::SOL_Z.sol|change = absval| layer = 2" = c(600, 1000),
                  "sol_z3::SOL_Z.sol|change = absval| layer = 3" = c(750, 1500))


q_sol <- run_swat2012(project_path = path_2012,
                      output = define_output(file = "rch",
                                             variable = "FLOW_OUT",
                                             unit = 3),
                      parameter = par_sol,
```

```
                        start_date = "2000-01-01",
                        end_date = "2007-12-31",
                        years_skip = 3,
                        n_thread = 2)
```

```
## Building 2 threads in 'C:/swat2012_demo/.model_run':
##
 Thread 1 of 2   Time elapsed: 0S   Time remaining: 0S
 Thread 2 of 2   Time elapsed: 1S   Time remaining: 0S

 Completed 2 threads in 1S
## Performing 2 simulations on 2 cores:
##
 Simulation 1 of 2   Time elapsed: 2S   Time remaining: 2S
 Simulation 2 of 2   Time elapsed: 2S   Time remaining: 0S

 Completed 2 simulations in 2S
```

```
q_sol$simulation$FLOW_OUT
```

```
## # A tibble: 1,826 x 3
##    date          run_1 run_2
##    <date>        <dbl> <dbl>
##  1 2003-01-01 0.641 0.395
##  2 2003-01-02 0.607 0.340
##  3 2003-01-03 0.598 0.316
##  4 2003-01-04 0.591 0.300
##  5 2003-01-05 0.586 0.289
##  6 2003-01-06 0.581 0.282
##  7 2003-01-07 0.578 0.277
##  8 2003-01-08 0.573 0.274
##  9 2003-01-09 0.569 0.272
## 10 2003-01-10 0.565 0.270
## # ... with 1,816 more rows
```

Test run with the initial parameter set

Finally the entire initial parameter set is tested here considering however the necessary corrections for the parameter 'SOL_Z.sol':

```
par_issue <- par_issue %>%
  rename(., `SOL_Z.sol|change = abschg` = `SOL_Z.sol|change = absval`)

q_test <- run_swat2012(project_path = path_2012,
                       output = define_output(file = "rch",
                                              variable = "FLOW_OUT",
                                              unit = 3),
                       parameter = par_issue,
                       start_date = "2000-01-01",
                       end_date = "2007-12-31",
                       years_skip = 3,
                       n_thread = 2)
```

```
## Building 2 threads in 'C:/swat2012_demo/.model_run':
```

```
##
 Thread 1 of 2    Time elapsed: 0S    Time remaining: 0S
 Thread 2 of 2    Time elapsed: 1S    Time remaining: 0S

 Completed 2 threads in 1S
## Performing 2 simulations on 2 cores:
##
 Simulation 1 of 2    Time elapsed: 3S    Time remaining: 3S
 Simulation 2 of 2    Time elapsed: 3S    Time remaining: 0S

 Completed 2 simulations in 3S
```

q_test

```
## $parameter
## $parameter$values
## # A tibble: 2 x 25
##   GW_DELAY  OV_N   CN2 REVAPMN SOL_AWC SURLAG  ESCO SHALLST GWQMN ALPHA_BF
##      <dbl> <dbl> <dbl>   <dbl>   <dbl>  <dbl> <dbl>   <dbl> <dbl>    <dbl>
## 1       30  0.01  -0.2       0    0.01      0     0       0     0        0
## 2      450 30      0.2     500     0.5     24     1    1000  5000        1
## # ... with 15 more variables: LAT_TIME <dbl>, SLSOIL <dbl>, HRU_SLP <dbl>,
## #   CH_K2 <dbl>, SOL_Z <dbl>, CH_K1 <dbl>, SLSUBBSN <dbl>, CANMX <dbl>,
## #   CH_N2 <dbl>, CH_N1 <dbl>, EVRCH <dbl>, GW_REVAP <dbl>, RCHRG_DP <dbl>,
## #   EPCO <dbl>, PLAPS <dbl>
##
## $parameter$definition
## # A tibble: 25 x 6
##    par_name parameter file_name change file_expression    spec_expression
##    <chr>    <chr>     <chr>     <chr>  <chr>              <chr>
## 1 GW_DELAY GW_DELAY  gw        absval filter(., file_name~ ""
## 2 OV_N     OV_N      hru       absval filter(., file_name~ ""
## 3 CN2      CN2       mgt       relchg filter(., file_name~ ""
## 4 REVAPMN  REVAPMN   gw        absval filter(., file_name~ ""
## 5 SOL_AWC  SOL_AWC   sol       absval filter(., file_name~ ""
## 6 SURLAG   SURLAG    bsn       absval filter(., file_name~ ""
## 7 ESCO     ESCO      hru       absval filter(., file_name~ ""
## 8 SHALLST  SHALLST   gw        absval filter(., file_name~ ""
## 9 GWQMN    GWQMN     gw        absval filter(., file_name~ ""
## 10 ALPHA_BF ALPHA_BF gw        absval filter(., file_name~ ""
## # ... with 15 more rows
##
##
## $simulation
## $simulation$FLOW_OUT
## # A tibble: 1,826 x 3
##    date        run_1     run_2
##    <date>      <dbl>     <dbl>
## 1 2003-01-01 0.000351  0.786
## 2 2003-01-02 0.000184  0.623
## 3 2003-01-03 0.0000513 0.468
## 4 2003-01-04 0.0000619 0.358
## 5 2003-01-05 0         0.283
## 6 2003-01-06 0         0.231
## 7 2003-01-07 0         0.193
```

```
##  8 2003-01-08 0          0.165
##  9 2003-01-09 0          0.142
## 10 2003-01-10 0          0.125
## # ... with 1,816 more rows
```