optpar.txt

The file holds additional model options to info.txt and is therefore located in the same folder as info.txt. The file is used to define what kind of optimisation to be done if `calibration` is set in info.txt. There are several different methods to chose from, each with their settings. Which model parameters to calibrate and within which boundaries are information also given in *optpar.txt*.

Maximum 100 model parameters may be optimised simultaneously. To optimise more parameters, the code needs to be changed (set *maxoptpar* to a higher value). All parameters are described in the section on par.txt, but not all of them can be calibrated. The objective function of the optimization is defined in info.txt as the combination of criteria chosen, see Performance criteria options.

There are eight methods of optimisation implemented in HYPE as detailed in the table below. Additionally, there are two other tasks for output generation, `WA` and `WS`, which produce detailed performance and simulation results for all runs performed during optimisation. Tasks `WA` and `WS` are compatible with selected optimisation methods only, a denoted in the table. The tast of organized scanning `SC` is a parameter investigation method.

Task	Description
`MC`	Monte Carlo (MC) simulation with parameter values randomly distributed over the intervals (basic MC-method)
`BP`	progressive Monte Carlo simulation with parameter space limited by best found so far (alternative MC-method)
`SM`	progressive Monte Carlo simulation with parameter space reduced in stages (alternative MC-method)
`DE`	differential evolution Markov Chain method (alternative MC-method)
`BN`	optimisation with Brent method
`Q1`	optimisation with QuasiNewton DFP gradient-based method
`Q2`	optimisation with QuasiNewton BFGS gradient-based method
`SD`	optimisation with steepest descent method
`WA`	write performance result for all simulations (`MC`, `SM` or `DE`)
`WS`	write simulation results (basin-, time- or map-files) for all ensembles in Monte Carlo simulation (`MC`, `BP`, or `DE`) (maximum 9999999 ensembles total)
`SC`	organised scanning of two parameters

File content

The first row is for general comments. It is ignored by the program when reading the file. Next comes a section with calibration settings. It reaches from second to 21st row, and are used to define tasks and other settings. Last comes a section defining the parameters to be calibrated. These occupy row 22 and onward.

In the calibration setting section a row starts with a code indicating a task or other settings. Argument of the code is listed from character 12 and forward on each row. The following options are available for the calibration setting section:

Code	Argument	Description
`task`	*two letter word*	define what kind of optimisation to do (see methods above), and if additional results are to be written for the MC-methods
`cal_log`	*Y/N*	flag for writing calibration.log file, default is Y
`scan_numx`	*integer*	number of steps taken for the first parameter (SC method)
`scan_numy`	*integer*	number of steps taken for the second parameter (SC method)
`num_mc`	*integer*	number of Monte Carlo simulations (per centre point and stage for progressive MC)
`num_ens`	*integer*	number of best Monte Carlo simulations to keep and print results from (and use as centre points for next stage of progressive MC) (maximum 999)
`num_bpmc`	*integer*	number of simulations per reduced parameter space which the best simulations shall be selected from (BP MC-method)
`num_bpmax`	*integer*	number of reductions of the parameter space for MC simulation (BP MC-method)
`num_stages`	*integer*	number of stages for progressive Monte Carlo (SM MC-method)
`num_zoom`	*real*	reduction of parameter space (0-1) for each stage of progressive MC (BP MC-method)
`DEMC_ngen`	*integer*	number of generations for DE method
`DEMC_npop`	*integer*	number of populations for DE method
`DEMC_gammascale`	*real*	scaling of the mutation strength for DE method. A new (next generation) parameter candidate is proposed as a mutation of the parent parameter value based on the difference between two random members of the parent population. `DEMC_gammascale` is a scaling factor for the resulting parameter jump width. Small values will cause smaller mutations, which potentially stabilises the search through large parameter spaces at the cost of convergence speed. A value of 1 will result in no scaling.
`DEMC_crossover`	*real*	crossover probability for DE method. Probability that the proposed candidate is chosen instead of the parent parameter. Large `DEMC_crossover` values mean larger probability that the proposal is chosen. Set to 1, all proposals are accepted. This makes it harder to find an acceptable overall proposal because all parameters are changed in every generation. Set to 0.5, each parameter candidate has only a 50% chance to be accepted into the next proposal.
`DEMC_sigma`	*real*	sample error standard deviation for DE method. Base for the standard deviation of the random perturbation, which adds random noise to the proposed parameter in addition to the gamma-mutation. This value is multiplied with 3rd-row value for each parameter (see description of parameter rows below).
`DEMC_accprob`	*integer*	scaling factor for probabilistic acceptance for DE method (0 = off (default); >0 = on). If set to off, parameter proposals will only (and always) be accepted if the likelyhood score decreases (= better performance). Values close to 0 will increase the probability of acceptance within the probabilistic framework, a value of 1 means no scaling.
`BR_diagStp`	*Y/N*	flag for taking a diagonal step at the end of each iteration (BN method)
`num_maxItr`	*integer*	max amount of iterations (interrupt non-MonteCarlo methods)
`num_maxTim`	*integer*	max calibration time (hours) (interrupt non-MonteCarlo methods)

Code	Argument	Description
`num_parItr`	*integer*	number of iterations taken into account for parameter change tolerance (interrupt non-MonteCarlo methods)
`num_criItr`	*integer*	number of iterations taken into account for criterium change tolerance (interrupt non-MonteCarlo methods)
`num_criTol`	*real*	tolerance for criteria relative change over last iterations (interrupt non-MonteCarlo methods)
`lnS_maxItr`	*integer*	max amount of line search iterations (per line) (non-Monte Carlo methods)
`lnS_tol`	*real*	general relative tolerance for line search (non-Monte Carlo methods)
`QN_nrmTol`	*real*	tolerance for gradient norm to be considered zero (QN methods)
`QN_pctDerv`	*real*	factor to offset current parameter value for numerical derivative (QN methods)
`QN_stencil`	*integer*	numerical derivative stencil type (2, 4, 6 and 8 allowed) (QN methods)
`QN_lambMax`	*real*	factor to contain lambda (within given parameter intervals) prior to line search (QN methods)
`QN_lambAcc`	*real*	factor increasing the step length (QN methods)

From row 22 and onward, model parameters to be calibrated are listed. The parameter is given as it is or with single quotation marks (e.g. 'cevp') followed by its values. For non-general parameters, values for all soil types/land uses/subbasins/parameterregions/etc have to be provided.

Each parameter is defined on three rows:

- **Row 1** specifies lower boundaries of the parameter range
- **Row 2** specifies upper boundaries of the parameter range (the model actually accepts lower and upper boundaries in any order)
- **Row 3** specifies either a minimum step width for parameter change *or*, in case of the DE method, a parameter specific factor to scale the random noise added to the proposed next-generation parameter, see description of DEMC settings code `DEMC_sigma` in table above.

NOTE: If lower and upper boundaries are identical, the parameter is omitted. This allows to calibrate a selection of the values for dependent parameters.

Example of parameter rows in *optpar.txt*:

```
wcfc    0.100 0.020 0.120 0.050 0.250 0.250 0.150 0.050 0.500 0.500 0.050
wcfc    0.100 0.120 0.120 0.050 0.250 0.250 0.150 0.050 0.500 0.500 0.050
wcfc    0.001 0.001 0.001 0.001 0.001 0.001 0.001 0.001 0.001 0.001 0.001
ttmp  0.0   0.0
ttmp  2.0   2.0
ttmp  0.01  0.01
```

Explaination of example: The rows starting with wcfc are representing field capacity for 11 soil types, where the second soil type's wcfc is calibrated. Parameter ttmp is threshold temperature for 2 land uses, which are both calibrated.