

# 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 choose 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, as denoted in the table. The task 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). Note
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 ( <a href="#">basin-</a> , <a href="#">time-</a> or <a href="#">map-</a> 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 comments. It is ignored by the program. Second to 21st row are used to define tasks and calibration settings. Parameters to be calibrated are defined from row 22 and onward.

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

Code	Argument	Description
task	<i>two letter word</i>	define what kind of optimisation to do (see methods above), and if all results are to be written afterwards for the MC methods
scan_numx	<i>integer</i>	number of steps taken for the first parameter (SC method)
scan_numy	<i>integer</i>	number of steps taken for the second parameter (SC method)

Code	Argument	Description
num_mc	<i>integer</i>	number of Monte Carlo simulations (per centre point and stage for progressive MC)
num_ens	<i>integer</i>	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_bpmmc	<i>integer</i>	number of simulations per reduced parameter space which the best simulations shall be selected from (MC-method)
num_bpmax	<i>integer</i>	number of reductions of the parameter space for MC simulation (MC-method)
num_stages	<i>integer</i>	number of stages for progressive Monte Carlo
num_zoom	<i>real</i>	reduction of parameter space (0-1) for each stage of progressive MC
DEMC_ngen	<i>integer</i>	number of generations for DE method
DEMC_npop	<i>integer</i>	number of populations for DE method
DEMC_gammascale	<i>real</i>	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	<i>real</i>	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	<i>real</i>	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 below).
DEMC_accprob	<i>integer</i>	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 likelihood 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)
BR_latOffs	<i>real</i>	lateral offset from original value for line search delimitation (BN method) (not in use)
num_maxItr	<i>integer</i>	max amount of iterations (interrupt non-MonteCarlo methods)
num_maxTim	<i>integer</i>	max calibration time (hours) (interrupt non-MonteCarlo methods)
num_parItr	<i>integer</i>	number of iterations taken into account for parameter change tolerance (interrupt non-MonteCarlo methods)
num_criItr	<i>integer</i>	number of iterations taken into account for criterium change tolerance (interrupt non-MonteCarlo methods)

Code	Argument	Description
num_criTol	<i>real</i>	tolerance for criteria relative change over last iterations (interrupt non-MonteCarlo methods)
lnS_maxItr	<i>integer</i>	max amount of line search iterations (per line)
lnS_tol	<i>real</i>	general relative tolerance for line search
lnS_log	<i>Y/N</i>	line search write progression in calibration.log (alternative is own file)
QN_nrmTol	<i>real</i>	tolerance for gradient norm to be considered zero (QN methods)
QN_pctDerv	<i>real</i>	factor to offset current parameter value for numerical derivative (QN methods)
QN_stencil	<i>integer</i>	numerical derivative stencil type (QN methods)
QN_lambMax	<i>real</i>	factor to contain lambda prior to line search (QN methods)
QN_lambAcc	<i>real</i>	factor increasing the step length (QN methods)

From row 22 and onward, parameters to calibrate are defined (no quotation marks). For class- or land use-dependent parameters, values for all soil-types/land-uses/subbasin/parameterregion/lakeregions or one value for general parameter 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 additional 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 class- or region-dependent parameters.

Example of parameter rows:

```

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    2.0    0.0
ttmp    0.0    2.0
ttmp    0.01   0.01

```

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 temperatures for 2 land-uses.