

Validation source perturbation (Source uncertainties)

The second version of this page is available here: [Validation source perturbation \(Source uncertainties\) V2](#)

To maintain compatibility with current workflows while adding additional functionality to the workflow, we intend to change the way perturbed source parameters are passed to the components of the slurm ground motion workflow.

Proposed workflow change

It has been proposed that srf generation will be split into two steps: perturbation and srf generation.

This will split the current two workflow steps (gcmt2srf, nhm2srf) to generate srf into three (gcmt2srfparams, nhm2srfparams, srfparams2srf).

There will be an intermediary file containing all the parameters to generate the srf, allowing users to manually modify these files if they choose to do so.

This will be able to be integrated into the automated workflow by making each step work on a single realisation, with a multi process wrapper to allow it to also be used as a stand alone step. The automated workflow step would not allow time for the user to modify the intermediary file.

User input

All parameters to be perturbed are to be included in the source_uncertainty.yaml file. Any additional parameters must also have nominal values provided.

The nominal values and perturbation settings for each of these parameters will have to be given in the source uncertainties yaml (as passed to gcmt2srf).

Each parameter that is given in the CMT solutions csv file will be at the top level, while each additional parameter will be nested inside the relevant process.

Each parameter will have at least two associated pieces of information, being the nominal value (mean) of the parameter, and the distribution. If the distribution requires any random variables, these must also be given.

An example is available below:

source_uncertainty.yaml

```
mw:
  distribution: uniform
  half_range: 0.05
hf:
  sdrops:
    mean: 50
    half_range: 5
    distribution: uniform
  rvfac:
    mean: 0.8
    std_dev: 0.01
    distribution: normal
  rvfac_shallow:
    mean: 0.7
    distribution: none
bb:
  fmin:
    mean: 0.2
    distribution: uniform_relative
    scale_factor: 0.05
emod3d:
  fmin:
    mean: 0.01
    std_dev: 0.001
    distribution: normal
```

Currently available distributions

Distribution name	Distribution variable	Notes
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none	N/A	Uses the value as given.
uniform	half_range	mean is the median (middle) value, and half_range half the difference between the highest and lowest value.
normal	std_dev	Regular normal distribution.
uniform_relative	scale_factor	A normal distribution where the highest and lowest possible value are mean* (1+scale_factor) and mean* (1-scale_factor) respectively. Scale factor to be given as a decimal.
log_normal	std_dev	Regular log_nromal distribution.
weibull	k, scale_factor	Does not take a mean value. Equivalent to $\text{scale_factor} * (-\ln(U))^{1/a}$ where U is the uniform distribution over [0, 1).
truncated_normal	std_dev, std_dev_limit	Similar to normal distribution, except all values fall within [std_dev_limit] standard deviations of the mean. std_dev_limit has a default value of 2.
truncated_log_normal	std_dev, std_dev_limit	Similar to log normal distribution, except all values of the underlying normal distribution fall within [std_dev_limit] standard deviations of the mean. std_dev_limit has a default value of 2. Mean must be given as a string of the form "log(x)" where x is the unmodified value of the mean.
duplicate	targets (must be a list of strings, even if only 1 target)	Copies the given target perturbed variable. The perturbate_parameters function must include functionality to handle cases where the target is perturbed after the current variable.

A note on emod3d

Any variable found in the e3d.par file may be placed in the emod3d section of source_uncertainty.yaml, and will be carried over. Any non numeric entries must have the distribution 'none'.

Internal changes

In order to simplify the implementation of this, we have chosen to have every parameter added to the slurm script and passed as an argument to the simulation script, which will then discard any parameters it does not recognize.

Parameters for srf generation

These parameters have a mean specified via other methods and do not need one in the source uncertainty file. If a mean is provided in the source uncertainty file it will take precedence

Parameter	Type 1	Type 2	Type 3	Type 4
depth				
mw (magnitude)				(mag0)
mom				(mom0)
strike				(stk)
rake				(rak)
dip				
vs				
rho				
rise_time				
rvfac		Optional	Optional	Optional
rough		Optional	Optional	Optional
slip_cov		Optional	Optional	Optional
flen		Calculated, but can be given/perturbed		
dlen		Calculated, but can be given/perturbed		
fwid		Calculated, but can be given/perturbed		
dwid		Calculated, but can be given/perturbed		
dtop		Calculated, but can be given/perturbed		
shypo		Calculated, but can be given/perturbed		
dhypo		Calculated, but can be given/perturbed		

rvfac vs rvfrac

Genslip takes the parameter rvfrac while HF takes the parameter rvfac, however scientifically these are the same value.

This different spelling allows the two to be perturbed independently. With the current perturbation implementation a challenge arises when it is to be perturbed and used for both.

The currently proposed solution is that:

1. If neither are given via command line or in the source uncertainties file, the defaults will be used.
2. If rvfrac is given in the source uncertainties file (and rvfac is not provided any where), it is perturbed and then copied to rvfac.
3. If rvfac is given via command line to gcmt2srf or in the source uncertainties file (and rvfrac is not given), it is perturbed and then copied to rvfrac.
4. If both are given, either via command line or the source uncertainties file, they are perturbed and used separately.

Parameters for each component

The parameters for each component are as follows:

	hf	bb
flo		
fmin		
fmidbot		
lfvsref		
sim_bin		
t-sec		
sdrop		
rayset		
seed		
duration		
dt		
fmax		
kappa		
qfexp		
rvfac		
rvfac_shallow		
rvfac_deep		
czero		
calpha		
mom		
rupv		
velocity-model		
site-vm-dir		
vs-moho		
fa_sig1		
fa_sig2		
rv_sig1		
hf_path_dur		