mcmc_analysis_cats_BPH_baysian

November 24, 2025

1 # 1. Density coner plot

A sample is 1 parameter set scanned. For the corner plot below, the quantiles (represented by the solid lines) are 0.16,0.5,0.84 of the samples. Dots represent individual samples (outside the line surrounding 0.84 of the samples) The parameter search is performed in the transformed space of x_c/η, β/η, x_c^2/ϵ, x_c but we also show the regular parameters

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(25,)
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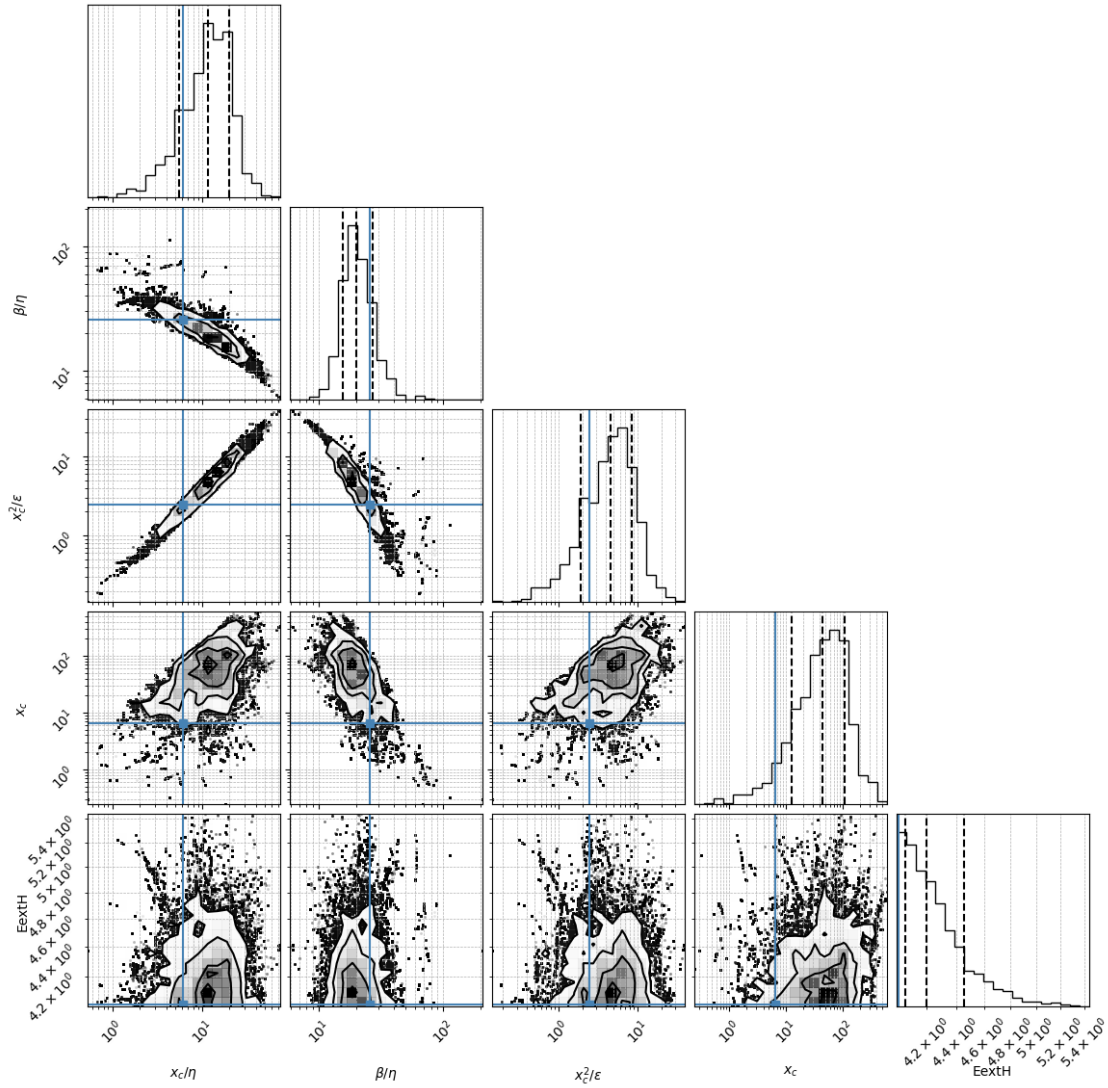
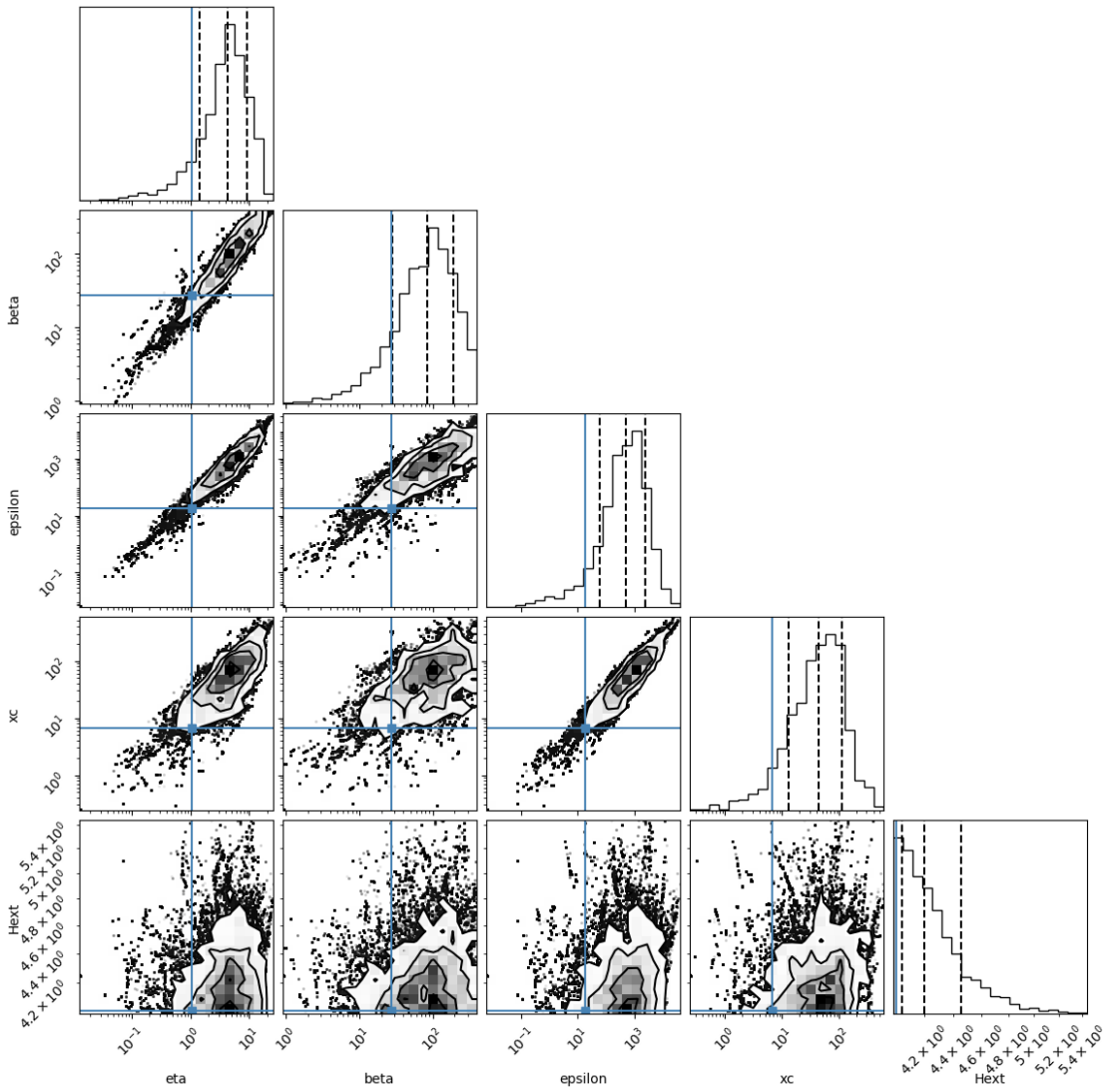
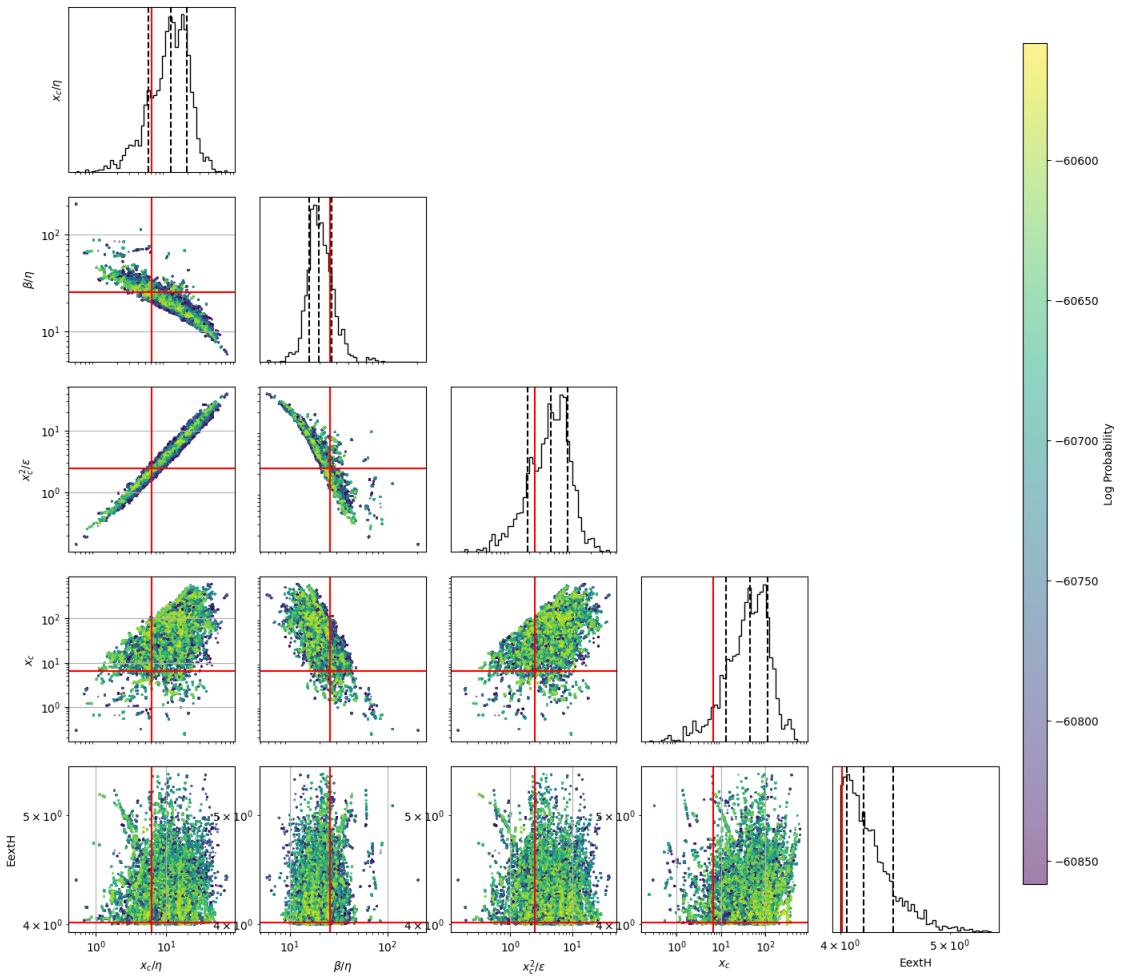

β/η
x_c^2/ε
x_c
EextH
x_c/η
β/η
x_c^2/ε
x_c
EextH



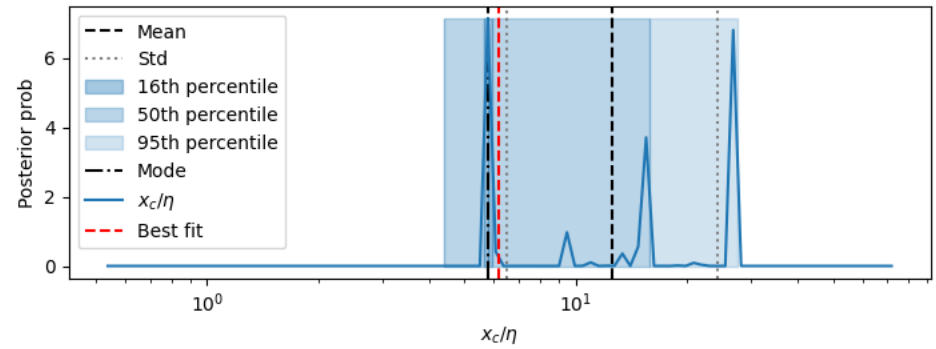
2 2. Heat map corner plot of raw samples

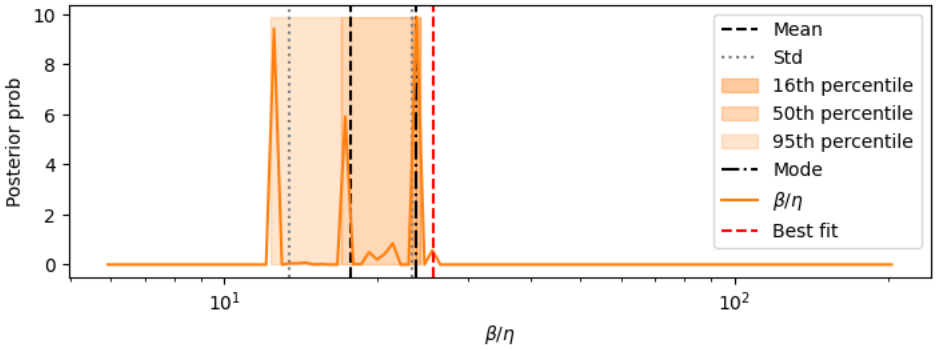
This plot shows all the raw sample points and their lnprobability

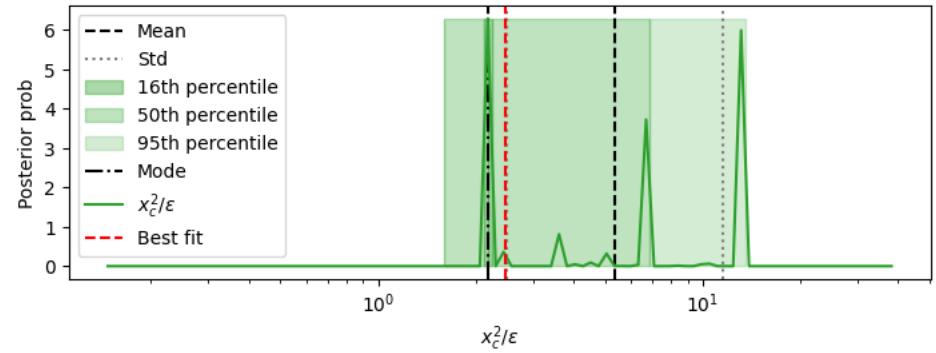


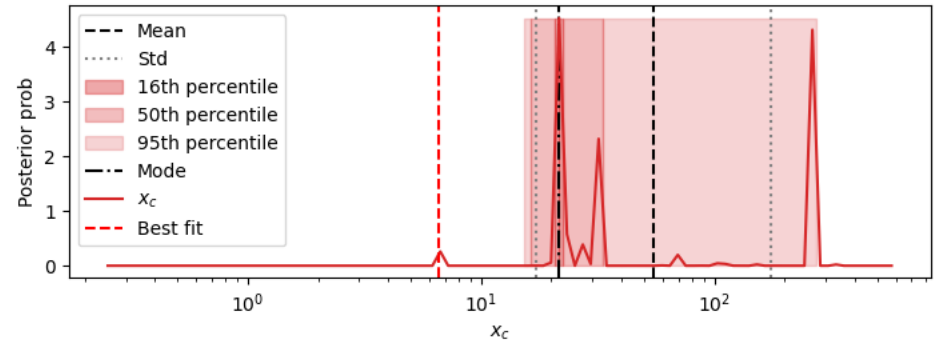
3 3. Posterior distributions of parameters

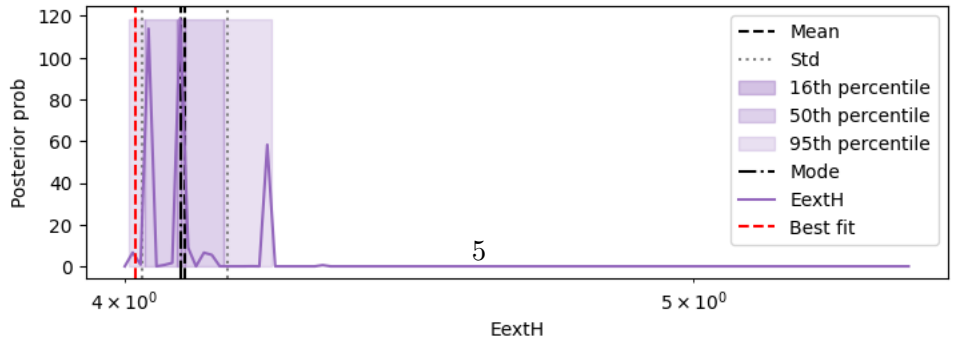
1d marginalizations of posterior distributions. we use a grid of size nbins=100-150


Mean
Std
16th percentile
50th percentile
95th percentile
Mode
x_c/η
Best fit
Posterior prob
x_c/η


Mean
Std
16th percentile
50th percentile
95th percentile
Mode
β/η
Best fit
Posterior prob
β/η

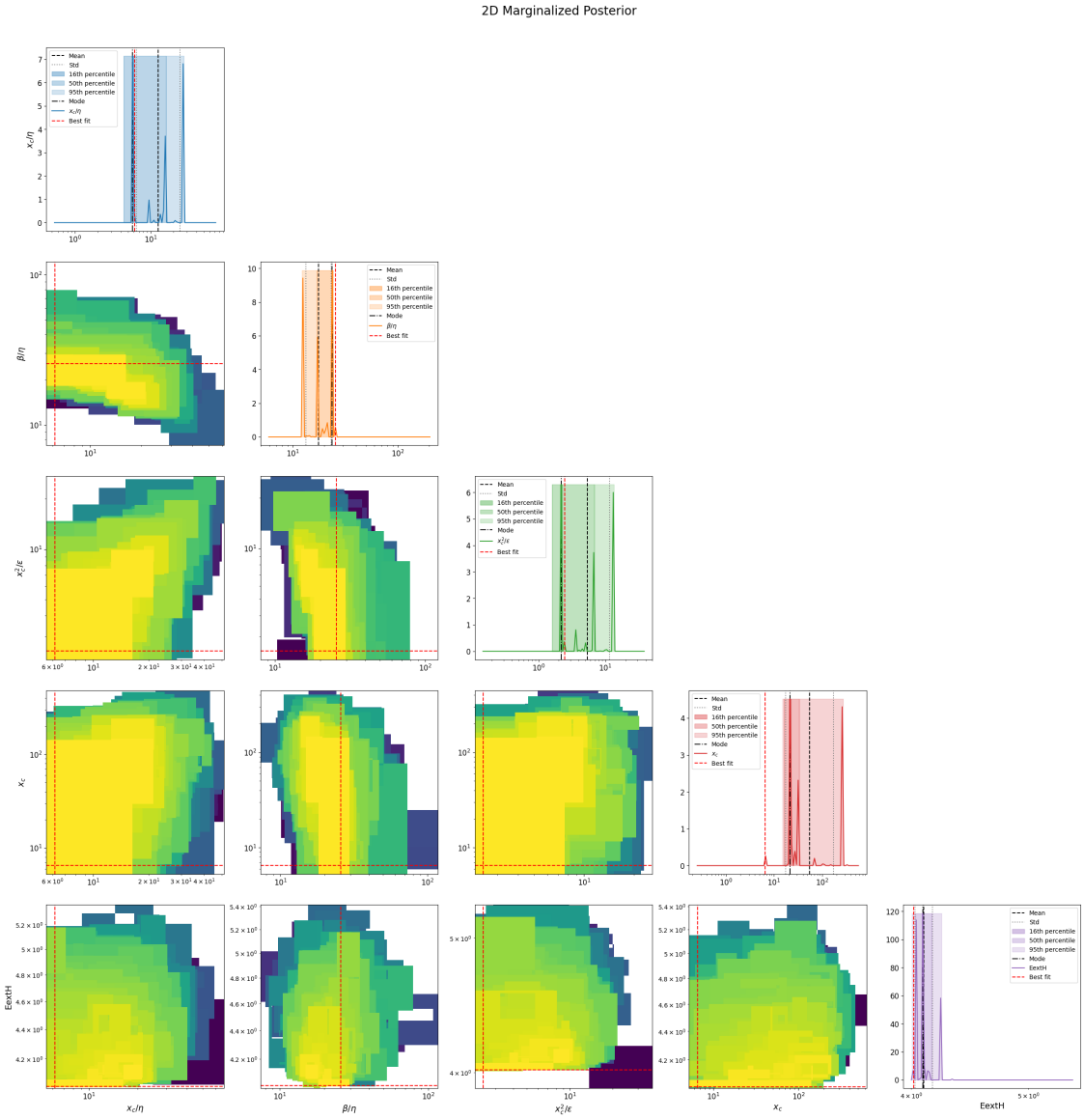

Mean
Std
16th percentile
50th percentile
95th percentile
Mode
x_c^2/ε
Best fit
Posterior prob
x_c^2/ε


Mean
Std
16th percentile
50th percentile
95th percentile
Mode
x_c
Best fit
Posterior prob
x_c


Mean
Std
16th percentile
50th percentile
95th percentile
Mode
EextH
Best fit
Posterior prob
EextH

2D marginalizations of posterior distributions

```
/Volumes/alon/navehr/SRtools/SRtools/samples_utils.py:474: UserWarning: The
input coordinates to pcolormesh are interpreted as cell centers, but are not
monotonically increasing or decreasing. This may lead to incorrectly calculated
cell edges, in which case, please supply explicit cell edges to pcolormesh.
  ax.pcolormesh(X, Y, Z, **kwargs)
```




```
Rescaling the samples TIME by 365
```

4 4. Table of results

mode is the marginalized mode, max_likwlihood is the sample with highest likelihood mode_overall is the 4D posterior mode

	mean	\
xc/eta	12.562	
beta/eta	17.702	
xc^2/epsilon	5.349	
xc	55.077	
ExtH	4.096	
eta	4.261	
beta	78.571	
epsilon	544.525	
sqrt(xc/eta)	3.475	
s= eta^0.5*xc^1.5/epsilon	1.468	
beta*xc/epsilon	7.704	
eta*xc/epsilon	0.398	
Fx=beta^2/eta*xc	112.557	
Dx =beta*epsilon/eta*xc^2	10.63	
Pk=beta*k/epsilon	0.0631	
Fk=beta^2/eta*k	2804.514	
Dk =beta*epsilon/eta*k^2	43650.477	
Fk^2/Dk=beta^3/eta*epsilon	173.367	
epsilon/beta^2	0.0922	
k/beta	0.00624	
k^2/epsilon	0.000429	
eta/xc	0.0796	
beta/xc	1.385	
epsilon/xc^2	0.187	
k/xc	0.0092	
best fit no ext hazard_MedianLifetime	13.05	
best fit no ext hazard_MaxLifetime	24.81	
best fit_MedianLifetime	11.72	
best fit_MaxLifetime	25.0	
data_MedianLifetime	12.0	
data_MaxLifetime	17.0	
ML_lnprob	-60558.091429	

		std	\
xc/eta		[6.049, 11.668]	
beta/eta		[4.277, 5.639]	
xc^2/epsilon		[2.868, 6.182]	
xc		[37.796, 120.462]	
ExtH		[0.068, 0.0691]	
eta		[1.953, 3.606]	

beta	[30.576, 50.055]
epsilon	[431.614, 2081.502]
sqrt(xc/eta)	[0.933, 1.275]
s= eta^0.5*xc^1.5/epsilon	[0.506, 0.771]
beta*xc/epsilon	[1.12, 1.31]
eta*xc/epsilon	[0.000349, 0.000349]
Fx=beta^2/eta*xc	[1.304, 1.319]
Dx =beta*epsilon/eta*xc^2	[0.0997, 0.101]
Pk=beta*k/epsilon	[0.0454, 0.162]
Fk=beta^2/eta*k	[1129.765, 1891.891]
Dk =beta*epsilon/eta*k^2	[33121.922, 137320.608]
Fk^2/Dk=beta^3/eta*epsilon	[128.026, 489.525]
epsilon/beta^2	[0.0625, 0.194]
k/beta	[0.00258, 0.0044]
k^2/epsilon	[0.000351, 0.00192]
eta/xc	[0.0383, 0.0739]
beta/xc	[0.849, 2.192]
epsilon/xc^2	[0.1, 0.216]
k/xc	[0.00633, 0.0203]
best fit no ext hazard_MedianLifetime	0.51
best fit no ext hazard_MaxLifetime	0
best fit_MedianLifetime	0.51
best fit_MaxLifetime	0
data_MedianLifetime	0.51
data_MaxLifetime	0
ML_lnprob	[-60558.09142866669, -60558.09142866669]

	mode \
xc/eta	5.781
beta/eta	23.834
xc^2/epsilon	2.179
xc	21.579
ExtH	4.089
eta	3.683
beta	90.199
epsilon	205.842
sqrt(xc/eta)	2.404
s= eta^0.5*xc^1.5/epsilon	0.911
beta*xc/epsilon	9.188
eta*xc/epsilon	0.398
Fx=beta^2/eta*xc	112.564
Dx =beta*epsilon/eta*xc^2	10.63
Pk=beta*k/epsilon	0.203
Fk=beta^2/eta*k	4257.222
Dk =beta*epsilon/eta*k^2	21309.367
Fk^2/Dk=beta^3/eta*epsilon	833.0
epsilon/beta^2	0.0254

k/beta	0.00554
k^2/epsilon	0.00121
eta/xc	0.173
beta/xc	4.142
epsilon/xc^2	0.459
k/xc	0.0232
best fit no ext hazard_MedianLifetime	13.05
best fit no ext hazard_MaxLifetime	24.81
best fit_MedianLifetime	11.72
best fit_MaxLifetime	25.0
data_MedianLifetime	12.0
data_MaxLifetime	17.0
ML_lnprob	-60558.091429

	percentile_16 \
xc/eta	[5.64, 5.926]
beta/eta	[23.411, 24.263]
xc^2/epsilon	[2.118, 2.241]
xc	[20.752, 22.439]
ExtH	[4.082, 4.095]
eta	[3.547, 3.825]
beta	[87.488, 92.993]
epsilon	[190.313, 222.638]
sqrt(xc/eta)	[2.375, 2.434]
s= eta^0.5*xc^1.5/epsilon	[0.896, 0.925]
beta*xc/epsilon	[9.056, 9.323]
eta*xc/epsilon	[0.396, 0.401]
Fx=beta^2/eta*xc	[105.963, 119.576]
Dx =beta*epsilon/eta*xc^2	[10.153, 11.13]
Pk=beta*k/epsilon	[0.193, 0.213]
Fk=beta^2/eta*k	[4105.79, 4414.238]
Dk =beta*epsilon/eta*k^2	[19846.786, 22879.73]
Fk^2/Dk=beta^3/eta*epsilon	[772.844, 897.837]
epsilon/beta^2	[0.024, 0.0269]
k/beta	[0.00537, 0.00571]
k^2/epsilon	[0.00112, 0.00131]
eta/xc	[0.169, 0.177]
beta/xc	[3.97, 4.322]
epsilon/xc^2	[0.446, 0.472]
k/xc	[0.0223, 0.0241]
best fit no ext hazard_MedianLifetime	[12.56, 13.56]
best fit no ext hazard_MaxLifetime	[24.81, 24.81]
best fit_MedianLifetime	[11.23, 12.23]
best fit_MaxLifetime	[25.0, 25.0]
data_MedianLifetime	[11.51, 12.51]
data_MaxLifetime	[17.0, 17.0]

```
ML_lnprob                                [-60558.09142866669, -60558.09142866669]

                                                                      percentile_50
\
xc/eta                                                                 [4.404, 15.936]
beta/eta                                                              [16.972, 24.263]
xc^2/epsilon                                                              [1.6, 6.886]
xc                                                                    [16.415, 33.169]
ExtH                                                                    [4.032, 4.159]
eta                                                                   [3.547, 10.231]
beta                                                                [82.309, 134.112]
epsilon                                                           [190.313, 2001.803]
sqrt(xc/eta)                                                           [2.099, 3.117]
s= eta^0.5*xc^1.5/epsilon                                              [0.766, 1.308]
beta*xc/epsilon                                                        [7.389, 9.598]
eta*xc/epsilon                                                         [0.396, 0.401]
Fx=beta^2/eta*xc                                                    [105.963, 119.576]
Dx =beta*epsilon/eta*xc^2                                              [10.153, 11.13]
Pk=beta*k/epsilon                                                      [0.116, 0.236]
Fk=beta^2/eta*k                                                   [3072.988, 6817.256]
Dk =beta*epsilon/eta*k^2                                        [14933.745, 295899.263]
Fk^2/Dk=beta^3/eta*epsilon                                         [127.886, 1635.388]
epsilon/beta^2                                                         [0.0191, 0.133]
k/beta                                                              [0.00373, 0.00607]
k^2/epsilon                                                          [5.69e-05, 0.0018]
eta/xc                                                                 [0.0628, 0.227]
beta/xc                                                                [1.016, 5.125]
epsilon/xc^2                                                           [0.145, 0.625]
k/xc                                                                [0.0163, 0.0304]
best fit no ext hazard_MedianLifetime                                  [12.56, 13.56]
best fit no ext hazard_MaxLifetime                                     [24.81, 24.81]
best fit_MedianLifetime                                                [11.23, 12.23]
best fit_MaxLifetime                                                     [25.0, 25.0]
data_MedianLifetime                                                    [11.51, 12.51]
data_MaxLifetime                                                         [17.0, 17.0]
ML_lnprob                                [-60558.09142866669, -60558.09142866669]

                                                                      percentile_95
\
xc/eta                                                                 [4.404, 27.459]
beta/eta                                                              [12.304, 24.263]
xc^2/epsilon                                                             [1.6, 13.505]
xc                                                                  [15.181, 273.661]
ExtH                                                                    [4.007, 4.237]
eta                                                                     [1.936, 16.11]
beta                                                                [32.954, 246.884]
epsilon                                                             [86.86, 6002.507]
```

sqrt(xc/eta)	[2.099, 5.24]
s= eta^0.5*xc^1.5/epsilon	[0.766, 2.616]
beta*xc/epsilon	[6.207, 9.598]
eta*xc/epsilon	[0.396, 0.401]
Fx=beta^2/eta*xc	[105.963, 119.576]
Dx =beta*epsilon/eta*xc^2	[10.153, 11.13]
Pk=beta*k/epsilon	[0.0111, 0.289]
Fk=beta^2/eta*k	[1114.642, 10528.425]
Dk =beta*epsilon/eta*k^2	[8455.238, 295899.263]
Fk^2/Dk=beta^3/eta*epsilon	[33.18, 1635.388]
epsilon/beta^2	[0.0191, 0.372]
k/beta	[0.00202, 0.0152]
k^2/epsilon	[4.16e-05, 0.0046]
eta/xc	[0.0364, 0.227]
beta/xc	[0.434, 6.617]
epsilon/xc^2	[0.074, 0.625]
k/xc	[0.00183, 0.0329]
best fit no ext hazard_MedianLifetime	[12.56, 13.56]
best fit no ext hazard_MaxLifetime	[24.81, 24.81]
best fit_MedianLifetime	[11.23, 12.23]
best fit_MaxLifetime	[25.0, 25.0]
data_MedianLifetime	[11.51, 12.51]
data_MaxLifetime	[17.0, 17.0]
ML_lnprob	[-60558.09142866669, -60558.09142866669]

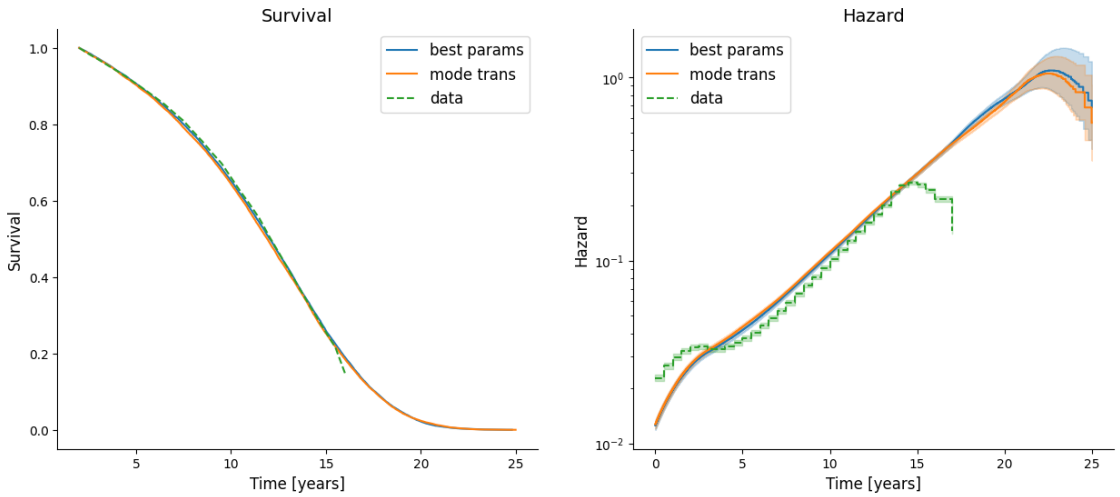
	max_likelihood	mode_overall
xc/eta	6.174	5.786
beta/eta	25.701	23.913
xc^2/epsilon	2.468	2.192
xc	6.545	21.575
ExtH	4.017	4.04
eta	1.06	3.729
beta	27.243	89.164
epsilon	17.357	212.337
sqrt(xc/eta)	2.485	2.405
s= eta^0.5*xc^1.5/epsilon	0.993	0.911
beta*xc/epsilon	10.273	9.059
eta*xc/epsilon	0.4	0.4
Fx=beta^2/eta*xc	106.98	106.98
Dx =beta*epsilon/eta*xc^2	10.414	10.414
Pk=beta*k/epsilon	0.785	0.21
Fk=beta^2/eta*k	1400.341	4264.37
Dk =beta*epsilon/eta*k^2	1784.363	20310.663
Fk^2/Dk=beta^3/eta*epsilon	1098.966	895.335
epsilon/beta^2	0.0234	0.0267
k/beta	0.0184	0.00561
k^2/epsilon	0.0144	0.00118

eta/xc	0.162	0.173
beta/xc	4.162	4.133
epsilon/xc^2	0.405	0.456
k/xc	0.0764	0.0232
best fit no ext hazard_MedianLifetime	13.05	NaN
best fit no ext hazard_MaxLifetime	24.81	NaN
best fit_MedianLifetime	11.72	NaN
best fit_MaxLifetime	25.0	NaN
data_MedianLifetime	12.0	NaN
data_MaxLifetime	17.0	NaN
ML_lnprob	-60558.091429	-60558.091429

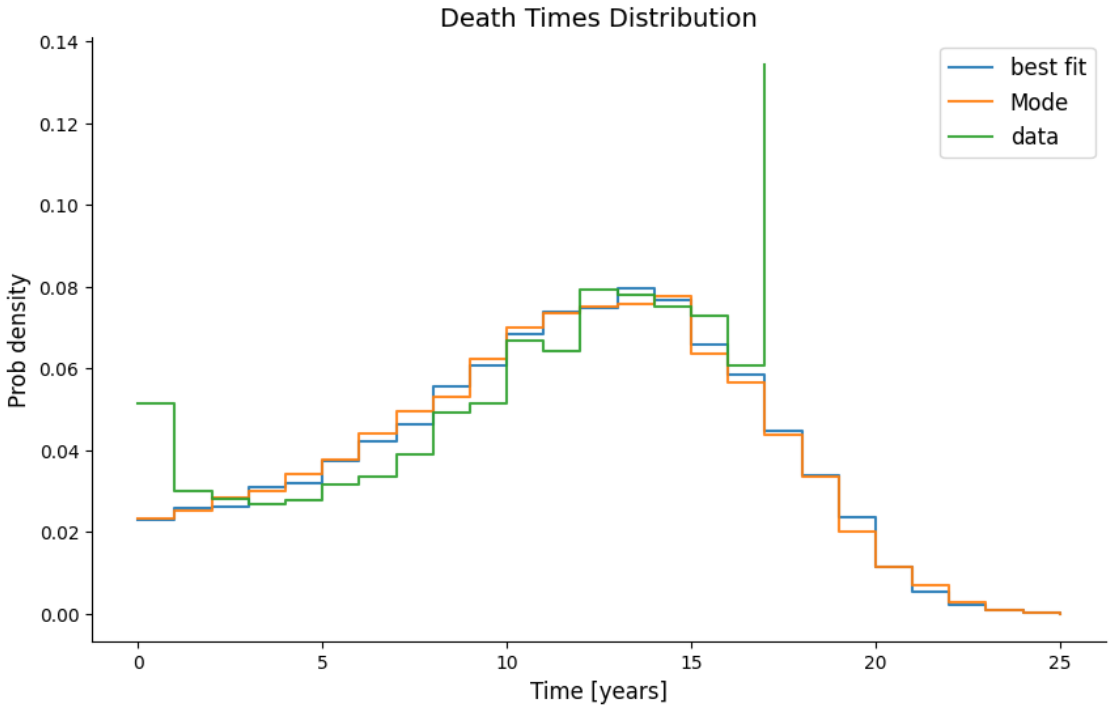
5 5. Fits of simulations to data

best params is the sample with highest likelihood. mode trans is the 4D posterior mode in the transformed space of x_c/η, β/η, x_c^2/ϵ, x_c

```
Text(0, 0.5, 'Hazard')
```




```
Text(0, 0.5, 'Prob density')
```


Death Times Distribution
best fit
Mode
data
Prob density
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
0
5
10
15
20
25
Time [years]