

Inference on the Champagne Model using a Gaussian Process

TODO

- Change outputs

Setting up the Champagne Model

Imports

```
import pandas as pd
import numpy as np
from typing import Any
import matplotlib.pyplot as plt
import multiprocessing as mp
import pickle
import random

from scipy.stats import qmc
from scipy.stats import norm

import tensorflow as tf
import tensorflow_probability as tfp
from tensorflow_probability.python.distributions import normal

tfb = tfp.bijectors
tfd = tfp.distributions
tfk = tfp.math.psd_kernels
tfp_acq = tfp.experimental.bayesopt.acquisition
```

```

gpu_devices = tf.config.experimental.list_physical_devices("GPU")
for device in gpu_devices:
    tf.config.experimental.set_memory_growth(device, True)

```

```

2024-06-05 21:58:46.639464: I tensorflow/core/util/port.cc:113] oneDNN custom operations are
2024-06-05 21:58:47.230796: I tensorflow/core/platform/cpu_feature_guard.cc:210] This Tensor
To enable the following instructions: AVX2 AVX512F AVX512_VNNI FMA, in other operations, reb
2024-06-05 21:58:49.310269: W tensorflow/compiler/tf2tensorrt/utils/py_utils.cc:38] TF-TRT W
2024-06-05 21:58:53.098649: W tensorflow/core/common_runtime/gpu/gpu_device.cc:2251] Cannot c
Skipping registering GPU devices...

```

Model itself

```

np.random.seed(590154)

population = 10000
initial_infecteds = 100
epidemic_length = 1000 # not used
number_of_events = 200000

pv_champ_alpha = 0.95 * 0.13 # prop of effective care
pv_champ_beta = 0.429 # prop of radical cure
pv_champ_gamma_L = 1 / 383 # liver stage clearance rate
pv_champ_delta = 0.05 # prop of imported cases
pv_champ_lambda = 0.01 # transmission rate
pv_champ_f = 1 / 69 # relapse frequency
pv_champ_r = 1 / 60 # blood stage clearance rate

gamma_L_max = 1 / 30
lambda_max = 0.05
f_max = 1 / 20
r_max = 1 / 15

upper_bounds = np.array([1, 1, gamma_L_max, lambda_max, f_max, r_max])

num_lhc_samples = 50
initial_repeats = 1

```

```

def champagne_stochastic(
    alpha_,
    beta_,
    gamma_L,
    lambda_,
    f,
    r,
    N=population,
    I_L=initial_infecteds,
    I_0=0,
    S_L=0,
    delta_=0,
    # end_time=epidemic_length,
    num_events=number_of_events,
    seed=12,
):
    np.random.seed(seed)
    if (0 > (alpha_ or beta_)) or (1 < (alpha_ or beta_)):
        return "Alpha or Beta out of bounds"
    if 0 > (gamma_L or lambda_ or f or r):
        return "Gamma, lambda, f or r out of bounds"

    t = 0
    S_0 = N - I_L - I_0 - S_L
    inc_counter = 0

    list_of_outcomes = [
        {"t": 0, "S_0": S_0, "S_L": S_L, "I_0": I_0, "I_L": I_L, "inc_counter": 0}
    ]

    prop_new = alpha_ * beta_ * f / (alpha_ * beta_ * f + gamma_L)
    i = 0

    while (i < num_events) or (t < 30):
        i += 1
        if S_0 == N:
            while t < 31:
                t += 1
                new_stages = {
                    "t": t,
                    "S_0": N,

```

```

        "S_L": 0,
        "I_0": 0,
        "I_L": 0,
        "inc_counter": inc_counter,
    }
    list_of_outcomes.append(new_stages)
    break

S_0_to_I_L = (1 - alpha_) * lambda_ * (I_L + I_0) / N * S_0
S_0_to_S_L = alpha_ * (1 - beta_) * lambda_ * (I_0 + I_L) / N * S_0
I_0_to_S_0 = r * I_0 / N
I_0_to_I_L = lambda_ * (I_L + I_0) / N * I_0
I_L_to_I_0 = gamma_L * I_L
I_L_to_S_L = r * I_L
S_L_to_S_0 = (gamma_L + (f + lambda_ * (I_0 + I_L) / N) * alpha_ * beta_) * S_L
S_L_to_I_L = (f + lambda_ * (I_0 + I_L) / N) * (1 - alpha_) * S_L

total_rate = (
    S_0_to_I_L
    + S_0_to_S_L
    + I_0_to_S_0
    + I_0_to_I_L
    + I_L_to_I_0
    + I_L_to_S_L
    + S_L_to_S_0
    + S_L_to_I_L
)

delta_t = np.random.exponential(1 / total_rate)
new_stages_prob = [
    S_0_to_I_L / total_rate,
    S_0_to_S_L / total_rate,
    I_0_to_S_0 / total_rate,
    I_0_to_I_L / total_rate,
    I_L_to_I_0 / total_rate,
    I_L_to_S_L / total_rate,
    S_L_to_S_0 / total_rate,
    S_L_to_I_L / total_rate,
]
t += delta_t
silent_incidences = np.random.poisson(

```

```

        delta_t * alpha_ * beta_ * lambda_ * (I_L + I_0) * S_0 / N
        + delta_t * alpha_ * (1 - beta_) * (f + lambda_ * (I_L + I_0) / N) * S_L
    )

```

```

new_stages = np.random.choice(
    [
        {
            "t": t,
            "S_0": S_0 - 1,
            "S_L": S_L,
            "I_0": I_0,
            "I_L": I_L + 1,
            "inc_counter": inc_counter + silent_incidences + 1,
        },
        {
            "t": t,
            "S_0": S_0 - 1,
            "S_L": S_L + 1,
            "I_0": I_0,
            "I_L": I_L,
            "inc_counter": inc_counter + silent_incidences + 1,
        },
        {
            "t": t,
            "S_0": S_0 + 1,
            "S_L": S_L,
            "I_0": I_0 - 1,
            "I_L": I_L,
            "inc_counter": inc_counter + silent_incidences,
        },
        {
            "t": t,
            "S_0": S_0,
            "S_L": S_L,
            "I_0": I_0 - 1,
            "I_L": I_L + 1,
            "inc_counter": inc_counter + silent_incidences,
        },
        {
            "t": t,
            "S_0": S_0,

```

```

        "S_L": S_L,
        "I_0": I_0 + 1,
        "I_L": I_L - 1,
        "inc_counter": inc_counter + silent_incidences,
    },
    {
        "t": t,
        "S_0": S_0,
        "S_L": S_L + 1,
        "I_0": I_0,
        "I_L": I_L - 1,
        "inc_counter": inc_counter + silent_incidences,
    },
    {
        "t": t,
        "S_0": S_0 + 1,
        "S_L": S_L - 1,
        "I_0": I_0,
        "I_L": I_L,
        "inc_counter": inc_counter
        + silent_incidences
        + np.random.binomial(1, prop_new),
    },
    {
        "t": t,
        "S_0": S_0,
        "S_L": S_L - 1,
        "I_0": I_0,
        "I_L": I_L + 1,
        "inc_counter": inc_counter + silent_incidences + 1,
    },
],
p=new_stages_prob,
)

list_of_outcomes.append(new_stages)

S_0 = new_stages["S_0"]
I_0 = new_stages["I_0"]
I_L = new_stages["I_L"]
S_L = new_stages["S_L"]

```

```

        inc_counter = new_stages["inc_counter"]

outcome_df = pd.DataFrame(list_of_outcomes)
return outcome_df

champ_samp = champagne_stochastic(
    pv_champ_alpha,
    pv_champ_beta,
    pv_champ_gamma_L,
    pv_champ_lambda,
    pv_champ_f,
    pv_champ_r,
)

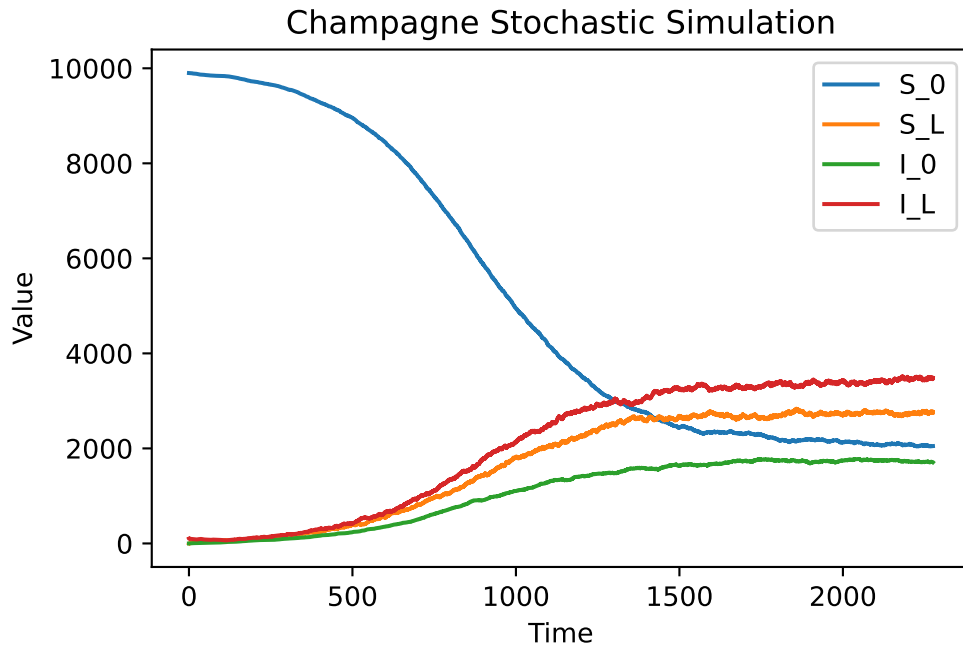
```

Plotting outcome

```

champ_samp.drop("inc_counter", axis=1).plot(x="t", legend=True)
plt.xlabel("Time")
plt.ylabel("Value")
plt.title("Champagne Stochastic Simulation")
plt.savefig("champagne_GP_images/champagne_simulation.pdf")
plt.show()

```



Function that Outputs Final Prevalence

```
def incidence(df, start, days):
    start_ind = df[df["t"].le(start)].index[-1]
    end_ind = df[df["t"].le(start + days)].index[-1]
    incidence_week = df.iloc[end_ind]["inc_counter"] - df.iloc[start_ind]["inc_counter"]
    return incidence_week

def champ_sum_stats(alpha_, beta_, gamma_L, lambda_, f, r, seed=12301923):
    champ_df_ = champagne_stochastic(alpha_, beta_, gamma_L, lambda_, f, r, seed=seed)
    first_month_inc = incidence(champ_df_, 0, 30)
    fin_t = champ_df_.iloc[-1]["t"]
    fin_week_inc = incidence(champ_df_, fin_t - 7, 7)

    first_month_ind = champ_df_[champ_df_["t"].le(30)].index[-1]
    first_month_prev = (
        champ_df_.iloc[first_month_ind]["I_0"]
        + champ_df_.iloc[first_month_ind]["I_L"]
    )
    fin_prev = champ_df_.iloc[-1]["I_0"] + champ_df_.iloc[-1]["I_L"]
```



```

        return np.array([fin_week_inc, fin_prev, first_month_inc, first_month_prev])

observed_sum_stats = champ_sum_stats(
    pv_champ_alpha,
    pv_champ_beta,
    pv_champ_gamma_L,
    pv_champ_lambda,
    pv_champ_f,
    pv_champ_r,
)

print(observed_sum_stats)

def single_discrepancy(alpha_, beta_, gamma_L, lambda_, f, r, seed=12301923):
    x = champ_sum_stats(alpha_, beta_, gamma_L, lambda_, f, r, seed=seed)
    return np.log(np.linalg.norm((x - observed_sum_stats) / observed_sum_stats))

def discrepancy_fn(alpha_, beta_, gamma_L, lambda_, f, r, mean_of=30):
    seed = int(np.random.uniform() * 1000000)
    with mp.Pool(processes=mp.cpu_count()) as pool:
        args = [
            (alpha_, beta_, gamma_L, lambda_, f, r, seed * i) for i in range(mean_of)
        ]
        results = pool.starmap(single_discrepancy, args)
    mean_obs = np.mean(results)
    return mean_obs

```

```
[ 461.  5205.   42.   87.]
```

Gaussian Process Regression on Final Prevalence Discrepancy

```

my_seed = np.random.default_rng(seed=1795) # For replicability

variables_names = ["alpha", "beta", "gamma_L", "lambda", "f", "r"]

```

```

LHC_sampler = qmc.LatinHypercube(d=6, seed=my_seed)
LHC_samples = LHC_sampler.random(n=num_lhc_samples)

# Using Champagne Initialisation table 2
LHC_samples[:, 2] = gamma_L_max * LHC_samples[:, 2]
LHC_samples[:, 3] = lambda_max * LHC_samples[:, 3]
LHC_samples[:, 4] = f_max * LHC_samples[:, 4]
LHC_samples[:, 5] = r_max * LHC_samples[:, 5]

LHC_samples = np.repeat(LHC_samples, initial_repeats, axis = 0)

LHC_indices_df = pd.DataFrame(LHC_samples, columns=variables_names)

print(LHC_indices_df.head())

```

	alpha	beta	gamma_L	lambda	f	r
0	0.100008	0.122349	0.009668	0.015376	0.016920	0.015954
1	0.659225	0.590955	0.001070	0.038947	0.007433	0.003318
2	0.503558	0.005003	0.031832	0.027053	0.002028	0.019736
3	0.011840	0.630562	0.023631	0.033488	0.035622	0.035127
4	0.271011	0.942434	0.014052	0.030138	0.031133	0.051736

Generate Discrepancies

```

random_discrepancies = LHC_indices_df.apply(
    lambda x: discrepancy_fn(
        x["alpha"], x["beta"], x["gamma_L"], x["lambda"], x["f"], x["r"]
    ),
    axis=1,
)

print(random_discrepancies.head())

```

```

0    -0.653335
1     0.898650
2    -0.157476
3     1.011083
4     0.571400
dtype: float64

```

Differing Methods to Iterate Function

```
# import timeit

# def function1():
#     np.vectorize(champ_sum_stats)(random_indices_df['alpha'],
#     random_indices_df['beta'], random_indices_df['gamma_L'],
#     random_indices_df['lambda'], random_indices_df['f'], random_indices_df['r'])
#     pass

# def function2():
#     random_indices_df.apply(
#         lambda x: champ_sum_stats(
#             x['alpha'], x['beta'], x['gamma_L'], x['lambda'], x['f'], x['r']),
#         axis = 1)
#     pass

# # Time function1
# time_taken_function1 = timeit.timeit(
#     "function1()", globals=globals(), number=100)

# # Time function2
# time_taken_function2 = timeit.timeit(
#     "function2()", globals=globals(), number=100)

# print("Time taken for function1:", time_taken_function1)
# print("Time taken for function2:", time_taken_function2)
```

Time taken for function1: 187.48960775700016 Time taken for function2: 204.06618941299985

Constrain Variables to be Positive

```
constrain_positive = tfb.Shift(np.finfo(np.float64).tiny)(tfb.Exp())
```

Custom Quadratic Mean Function

```
class quad_mean_fn(tf.Module):
    def __init__(self):
        super(quad_mean_fn, self).__init__()
        # self.amp_alpha_mean = tfp.util.TransformedVariable(
        #     bijector=constrain_positive,
        #     initial_value=1.0,
        #     dtype=np.float64,
        #     name="amp_alpha_mean",
        # )
        # self.alpha_tp = tf.Variable(pv_champ_alpha, dtype=np.float64, name="alpha_tp")
        # self.amp_beta_mean = tfp.util.TransformedVariable(
        #     bijector=constrain_positive,
        #     initial_value=0.5,
        #     dtype=np.float64,
        #     name="amp_beta_mean",
        # )
        # self.beta_tp = tf.Variable(pv_champ_beta, dtype=np.float64, name="beta_tp")
        self.amp_gamma_L_mean = tfp.util.TransformedVariable(
            bijector=constrain_positive,
            initial_value=1.0,
            dtype=np.float64,
            name="amp_gamma_L_mean",
        )
        # self.gamma_L_tp = tfp.util.TransformedVariable(
        #     bijector=constrain_positive,
        #     initial_value=1.0,
        #     dtype=np.float64,
        #     name="gamma_L_tp",
        # )
        self.amp_lambda_mean = tfp.util.TransformedVariable(
            bijector=constrain_positive,
            initial_value=1.0,
            dtype=np.float64,
            name="amp_lambda_mean",
        )
        # self.lambda_tp = tfp.util.TransformedVariable(
        #     bijector=constrain_positive,
        #     initial_value=1.0,
        #     dtype=np.float64,
```

```

#     name="lambda_tp",
# )
self.amp_f_mean = tfp.util.TransformedVariable(
    bijector=constrain_positive,
    initial_value=1.0,
    dtype=np.float64,
    name="amp_f_mean",
)
# self.f_tp = tfp.util.TransformedVariable(
#     bijector=constrain_positive,
#     initial_value=1.0,
#     dtype=np.float64,
#     name="f_tp",
# )
self.amp_r_mean = tfp.util.TransformedVariable(
    bijector=constrain_positive,
    initial_value=1.0,
    dtype=np.float64,
    name="amp_r_mean",
)
# self.r_tp = tfp.util.TransformedVariable(
#     bijector=constrain_positive,
#     initial_value=1.0,
#     dtype=np.float64,
#     name="r_tp",
# )
# self.bias_mean = tfp.util.TransformedVariable(
#     bijector=constrain_positive,
#     initial_value=1.0,
#     dtype=np.float64,
#     name="bias_mean",
# )
self.bias_mean = tf.Variable(-1.5, dtype=np.float64, name="bias_mean")

def __call__(self, x):
    return (
        self.bias_mean
        # + self.amp_alpha_mean * (x[..., 0] - self.alpha_tp) ** 2
        # + self.amp_beta_mean * (x[..., 1] - self.beta_tp) ** 2
        # + self.amp_gamma_L_mean * (x[..., 2] - self.gamma_L_tp) ** 2
        # + self.amp_lambda_mean * (x[..., 3] - self.lambda_tp) ** 2
    )

```

```

        # + self.amp_f_mean * (x[..., 4] - self.f_tp) ** 2
        # + self.amp_r_mean * (x[..., 5] - self.r_tp) ** 2
        + self.amp_gamma_L_mean * (x[..., 2]) ** 2
        + self.amp_lambda_mean * (x[..., 3]) ** 2
        + self.amp_f_mean * (x[..., 4]) ** 2
        + self.amp_r_mean * (x[..., 5]) ** 2
    )

quad_mean_fn().__call__(x=np.array([[1.0, 1.0, 1.0, 1.0, 1.0, 1.0]])) # should return 1

```

```
<tf.Tensor: shape=(1,), dtype=float64, numpy=array([2.5])>
```

Custom Linear Mean Function

```

class lin_mean_fn(tf.Module):
    def __init__(self):
        super(lin_mean_fn, self).__init__()
        # self.amp_alpha_lin = tfp.util.TransformedVariable(
        #     bijector=constrain_positive,
        #     initial_value=1.0,
        #     dtype=np.float64,
        #     name="amp_alpha_lin",
        # )
        # self.amp_beta_lin = tfp.util.TransformedVariable(
        #     bijector=constrain_positive,
        #     initial_value=0.5,
        #     dtype=np.float64,
        #     name="amp_beta_lin",
        # )
        self.amp_gamma_L_lin = tfp.util.TransformedVariable(
            bijector=constrain_positive,
            initial_value=1.0,
            dtype=np.float64,
            name="amp_gamma_L_lin",
        )
        self.amp_lambda_lin = tfp.util.TransformedVariable(
            bijector=constrain_positive,
            initial_value=1.0,
            dtype=np.float64,

```

```

        name="amp_lambda_lin",
    )
    self.amp_f_lin = tfp.util.TransformedVariable(
        bijector=constrain_positive,
        initial_value=1.0,
        dtype=np.float64,
        name="amp_f_lin",
    )
    self.amp_r_lin = tfp.util.TransformedVariable(
        bijector=constrain_positive,
        initial_value=1.0,
        dtype=np.float64,
        name="amp_r_lin",
    )
    # self.bias_lin = tfp.util.TransformedVariable(
    #     bijector=constrain_positive,
    #     initial_value=1.0,
    #     dtype=np.float64,
    #     name="bias_lin",
    # )
    self.bias_lin = tf.Variable(0.0, dtype=np.float64, name="bias_mean")

def __call__(self, x):
    return (
        self.bias_lin
        # + self.amp_alpha_lin * (x[..., 0])
        # + self.amp_beta_lin * (x[..., 1])
        + self.amp_gamma_L_lin * (x[..., 2])
        + self.amp_lambda_lin * (x[..., 3])
        + self.amp_f_lin * (x[..., 4])
        + self.amp_r_lin * (x[..., 5])
    )

class const_mean_fn(tf.Module):
    def __init__(self):
        super(const_mean_fn, self).__init__()
        self.bias_lin = tf.Variable(0.0, dtype=np.float64, name="bias_mean")

    def __call__(self, x):
        return self.bias_lin

```

Making the ARD Kernel

```
index_vals = LHC_indices_df.values
obs_vals = random_discrepancies.values

amplitude_champ = tfp.util.TransformedVariable(
    bijector=constrain_positive,
    initial_value=4.0,
    dtype=np.float64,
    name="amplitude_champ",
)

observation_noise_variance_champ = tfp.util.TransformedVariable(
    bijector=constrain_positive,
    initial_value=1.,
    dtype=np.float64,
    name="observation_noise_variance_champ",
)

length_scales_champ = tfp.util.TransformedVariable(
    bijector=tfb.Sigmoid(
        np.float64(0.0),
        [1.0 / 2, 1.0 / 2, gamma_L_max / 2, lambda_max / 2, f_max / 2, r_max / 2],
    ),
    initial_value=[1 / 8, 1 / 8, gamma_L_max / 8, lambda_max / 8, f_max / 8, r_max / 8],
    dtype=np.float64,
    name="length_scales_champ",
)

kernel_champ = tfk.FeatureScaled(
    tfk.MaternFiveHalves(amplitude=amplitude_champ),
    scale_diag=length_scales_champ,
)
```


Define the Gaussian Process with Quadratic Mean Function and ARD Kernel

```
# Define Gaussian Process with the custom kernel
champ_GP = tfd.GaussianProcess(
    kernel=kernel_champ,
    observation_noise_variance=observation_noise_variance_champ,
    index_points=index_vals,
    mean_fn=const_mean_fn(),
)

print(champ_GP.trainable_variables)

Adam_optim = tf.keras.optimizers.Adam(learning_rate=0.01)

(<tf.Variable 'amplitude_champ:0' shape=() dtype=float64, numpy=1.3862943611198906>, <tf.Variable 'observation_noise_variance_champ:0' shape=() dtype=float64, numpy=1.0>,
array([-1.09861229, -1.09861229, -1.09861229, -1.09861229, -1.09861229,
       -1.09861229]))>, <tf.Variable 'observation_noise_variance_champ:0' shape=() dtype=float64, numpy=1.0>)
```

Train the Hyperparameters

Leave One Out Predictive Log-likelihood

```
# predictive log stuff
@tf.function(autograph=False, jit_compile=False)
def optimize():
    with tf.GradientTape() as tape:
        K = (
            champ_GP.kernel.matrix(index_vals, index_vals)
            + tf.eye(index_vals.shape[0], dtype=np.float64)
            * observation_noise_variance_champ
        )
        means = champ_GP.mean_fn(index_vals)
        K_inv = tf.linalg.inv(K)
        K_inv_y = K_inv @ tf.reshape(obs_vals - means, shape=[obs_vals.shape[0], 1])
        K_inv_diag = tf.linalg.diag_part(K_inv)
        log_var = tf.math.log(K_inv_diag)
        log_mu = tf.reshape(K_inv_y, shape=[-1]) ** 2
        loss = -tf.math.reduce_sum(log_var - log_mu)
    grads = tape.gradient(loss, champ_GP.trainable_variables)
    Adam_optim.apply_gradients(zip(grads, champ_GP.trainable_variables))
```

```

        return loss

num_iters = 10000

lls_ = np.zeros(num_iters, np.float64)
tolerance = 1e-6 # Set your desired tolerance level
previous_loss = float("inf")

for i in range(num_iters):
    loss = optimize()
    lls_[i] = loss

    # Check if change in loss is less than tolerance
    if abs(loss - previous_loss) < tolerance:
        print(f"Hyperparameter convergence reached at iteration {i+1}.")
        lls_ = lls_[range(i + 1)]
        break

previous_loss = loss

```

Hyperparameter convergence reached at iteration 4529.

```

print("Trained parameters:")
for var in champ_GP.trainable_variables:
    if "bias" in var.name:
        print("{} is {}\n".format(var.name, var.numpy().round(3)))
    else:
        if "length" in var.name:
            print(
                "{} is {}\n".format(
                    var.name,
                    tfb.Sigmoid(
                        np.float64(0.0),
                        [
                            1.0 / 2,
                            1.0 / 2,
                            gamma_L_max / 2,
                            lambda_max / 2,
                            f_max / 2,

```

```

        r_max / 2,
    ],
)
    .forward(var)
    .numpy()
    .round(3),
)
)
else:
    print(
        "{} is {}".format(
            var.name, constrain_positive.forward(var).numpy().round(3)
        )
    )

initial_losses_LOOCV = lls_

```

Trained parameters:

amplitude_champ:0 is 0.74

length_scales_champ:0 is [0.499 0.5 0.017 0.007 0.025 0.033]

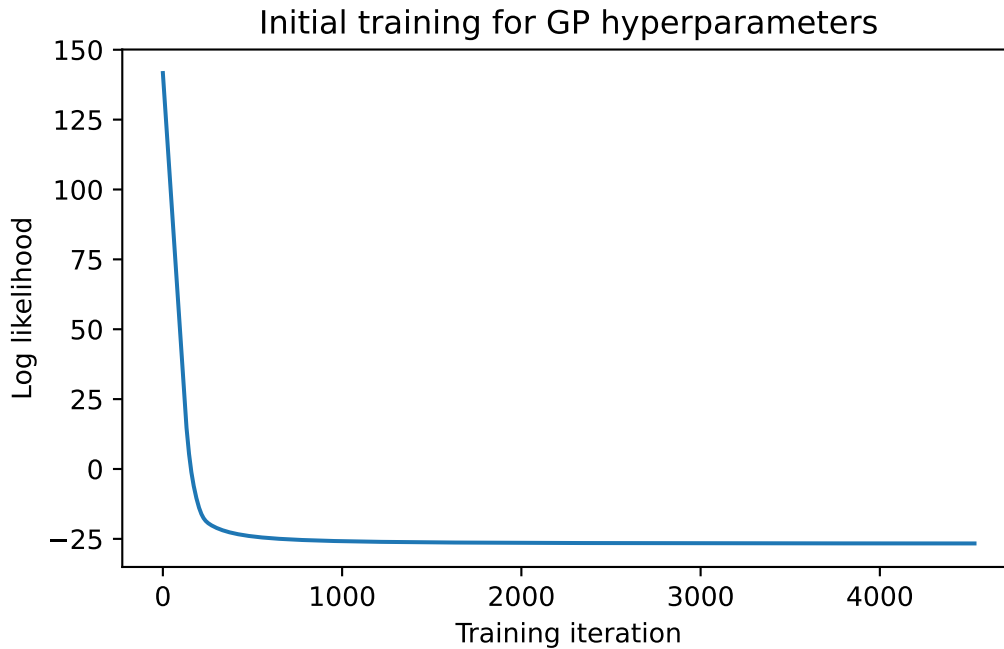
observation_noise_variance_champ:0 is 0.0

bias_mean:0 is 0.562

```

plt.figure(figsize=(6, 3.5))
plt.plot(lls_)
plt.title("Initial training for GP hyperparameters")
plt.xlabel("Training iteration")
plt.ylabel("Log likelihood")
plt.savefig("champagne_GP_images/hyperparam_loss_log_discrep.pdf")
plt.show()

```



Creating slices across one variable dimension

```
plot_samp_no = 21
plot_samp_times = 10
plot_gp_no = 100
gp_samp_no = 30

slice_samples_dict = {
    "alpha_slice_samples": np.repeat(np.concatenate(
        (
            np.linspace(0, 1, plot_samp_no, dtype=np.float64).reshape(-1, 1), # alpha
            np.repeat(pv_champ_beta, plot_samp_no).reshape(-1, 1), # beta
            np.repeat(pv_champ_gamma_L, plot_samp_no).reshape(-1, 1), # gamma_L
            np.repeat(pv_champ_lambda, plot_samp_no).reshape(-1, 1), # lambda
            np.repeat(pv_champ_f, plot_samp_no).reshape(-1, 1), # f
            np.repeat(pv_champ_r, plot_samp_no).reshape(-1, 1), # r
        ),
        axis=1,
    ), plot_samp_times, axis = 0),
    "alpha_gp_samples": np.concatenate(
```

```

(
    np.linspace(0, 1, plot_gp_no, dtype=np.float64).reshape(-1, 1), # alpha
    np.repeat(pv_champ_beta, plot_gp_no).reshape(-1, 1), # beta
    np.repeat(pv_champ_gamma_L, plot_gp_no).reshape(-1, 1), # gamma_L
    np.repeat(pv_champ_lambda, plot_gp_no).reshape(-1, 1), # lambda
    np.repeat(pv_champ_f, plot_gp_no).reshape(-1, 1), # f
    np.repeat(pv_champ_r, plot_gp_no).reshape(-1, 1), # r
),
axis=1,
),
"beta_slice_samples": np.repeat(np.concatenate(
(
    np.repeat(pv_champ_alpha, plot_samp_no).reshape(-1, 1), # alpha
    np.linspace(0, 1, plot_samp_no, dtype=np.float64).reshape(-1, 1), # beta
    np.repeat(pv_champ_gamma_L, plot_samp_no).reshape(-1, 1), # gamma_L
    np.repeat(pv_champ_lambda, plot_samp_no).reshape(-1, 1), # lambda
    np.repeat(pv_champ_f, plot_samp_no).reshape(-1, 1), # f
    np.repeat(pv_champ_r, plot_samp_no).reshape(-1, 1), # r
),
axis=1,
), plot_samp_times, axis = 0),
"beta_gp_samples": np.concatenate(
(
    np.repeat(pv_champ_alpha, plot_gp_no).reshape(-1, 1), # alpha
    np.linspace(0, 1, plot_gp_no, dtype=np.float64).reshape(-1, 1), # beta
    np.repeat(pv_champ_gamma_L, plot_gp_no).reshape(-1, 1), # gamma_L
    np.repeat(pv_champ_lambda, plot_gp_no).reshape(-1, 1), # lambda
    np.repeat(pv_champ_f, plot_gp_no).reshape(-1, 1), # f
    np.repeat(pv_champ_r, plot_gp_no).reshape(-1, 1), # r
),
axis=1,
),
"gamma_L_slice_samples": np.repeat(np.concatenate(
(
    np.repeat(pv_champ_alpha, plot_samp_no).reshape(-1, 1), # alpha
    np.repeat(pv_champ_beta, plot_samp_no).reshape(-1, 1), # beta
    np.linspace(0, gamma_L_max, plot_samp_no, dtype=np.float64).reshape(-1, 1), #
    np.repeat(pv_champ_lambda, plot_samp_no).reshape(-1, 1), # lambda
    np.repeat(pv_champ_f, plot_samp_no).reshape(-1, 1), # f
    np.repeat(pv_champ_r, plot_samp_no).reshape(-1, 1), # r
),
),

```

```

        axis=1,
    ), plot_samp_times, axis = 0),
    "gamma_L_gp_samples": np.concatenate(
        (
            np.repeat(pv_champ_alpha, plot_gp_no).reshape(-1, 1), # alpha
            np.repeat(pv_champ_beta, plot_gp_no).reshape(-1, 1), # beta
            np.linspace(0, gamma_L_max, plot_gp_no, dtype=np.float64).reshape(-1, 1), # g
            np.repeat(pv_champ_lambda, plot_gp_no).reshape(-1, 1), # lambda
            np.repeat(pv_champ_f, plot_gp_no).reshape(-1, 1), # f
            np.repeat(pv_champ_r, plot_gp_no).reshape(-1, 1), # r
        ),
        axis=1,
    ),
    "lambda_slice_samples": np.repeat(np.concatenate(
        (
            np.repeat(pv_champ_alpha, plot_samp_no).reshape(-1, 1), # alpha
            np.repeat(pv_champ_beta, plot_samp_no).reshape(-1, 1), # beta
            np.repeat(pv_champ_gamma_L, plot_samp_no).reshape(-1, 1), # gamma_L
            np.linspace(0, lambda_max, plot_samp_no, dtype=np.float64).reshape(-1, 1), # l
            np.repeat(pv_champ_f, plot_samp_no).reshape(-1, 1), # f
            np.repeat(pv_champ_r, plot_samp_no).reshape(-1, 1), # r
        ),
        axis=1,
    ), plot_samp_times, axis = 0),
    "lambda_gp_samples": np.concatenate(
        (
            np.repeat(pv_champ_alpha, plot_gp_no).reshape(-1, 1), # alpha
            np.repeat(pv_champ_beta, plot_gp_no).reshape(-1, 1), # beta
            np.repeat(pv_champ_gamma_L, plot_gp_no).reshape(-1, 1), # gamma_L
            np.linspace(0, lambda_max, plot_gp_no, dtype=np.float64).reshape(-1, 1), # lam
            np.repeat(pv_champ_f, plot_gp_no).reshape(-1, 1), # f
            np.repeat(pv_champ_r, plot_gp_no).reshape(-1, 1), # r
        ),
        axis=1,
    ),
    "f_slice_samples": np.repeat(np.concatenate(
        (
            np.repeat(pv_champ_alpha, plot_samp_no).reshape(-1, 1), # alpha
            np.repeat(pv_champ_beta, plot_samp_no).reshape(-1, 1), # beta
            np.repeat(pv_champ_gamma_L, plot_samp_no).reshape(-1, 1), # gamma_L
            np.repeat(pv_champ_lambda, plot_samp_no).reshape(-1, 1), # lambda

```

```

        np.linspace(0, f_max, plot_samp_no, dtype=np.float64).reshape(-1, 1), # f
        np.repeat(pv_champ_r, plot_samp_no).reshape(-1, 1), # r
    ),
    axis=1,
), plot_samp_times, axis = 0),
"f_gp_samples": np.concatenate(
    (
        np.repeat(pv_champ_alpha, plot_gp_no).reshape(-1, 1), # alpha
        np.repeat(pv_champ_beta, plot_gp_no).reshape(-1, 1), # beta
        np.repeat(pv_champ_gamma_L, plot_gp_no).reshape(-1, 1), # gamma_L
        np.repeat(pv_champ_lambda, plot_gp_no).reshape(-1, 1), # lambda
        np.linspace(0, f_max, plot_gp_no, dtype=np.float64).reshape(-1, 1), # f
        np.repeat(pv_champ_r, plot_gp_no).reshape(-1, 1), # r
    ),
    axis=1,
),
"r_slice_samples": np.repeat(np.concatenate(
    (
        np.repeat(pv_champ_alpha, plot_samp_no).reshape(-1, 1), # alpha
        np.repeat(pv_champ_beta, plot_samp_no).reshape(-1, 1), # beta
        np.repeat(pv_champ_gamma_L, plot_samp_no).reshape(-1, 1), # gamma_L
        np.repeat(pv_champ_lambda, plot_samp_no).reshape(-1, 1), # lambda
        np.repeat(pv_champ_f, plot_samp_no).reshape(-1, 1), # f
        np.linspace(0, r_max, plot_samp_no, dtype=np.float64).reshape(-1, 1), # r
    ),
    axis=1,
), plot_samp_times, axis = 0),
"r_gp_samples": np.concatenate(
    (
        np.repeat(pv_champ_alpha, plot_gp_no).reshape(-1, 1), # alpha
        np.repeat(pv_champ_beta, plot_gp_no).reshape(-1, 1), # beta
        np.repeat(pv_champ_gamma_L, plot_gp_no).reshape(-1, 1), # gamma_L
        np.repeat(pv_champ_lambda, plot_gp_no).reshape(-1, 1), # lambda
        np.repeat(pv_champ_f, plot_gp_no).reshape(-1, 1), # f
        np.linspace(0, r_max, plot_gp_no, dtype=np.float64).reshape(-1, 1), # r
    ),
    axis=1,
),
}

```

Plotting the GPs across different slices

```
GP_seed = tfp.random.sanitize_seed(4362)
vars = ["alpha", "beta", "gamma_L", "lambda", "f", "r"]
slice_indices_dfs_dict = {}
slice_index_vals_dict = {}
slice_discrepancies_dict = {}
gp_samples_dict = {}

for var in vars:
    val_df = pd.DataFrame(
        slice_samples_dict[var + "_slice_samples"], columns=variables_names
    )
    slice_indices_dfs_dict[var + "_slice_indices_df"] = val_df
    slice_index_vals_dict[var + "_slice_index_vals"] = val_df.values

    df_temp = val_df.assign(seed=range(val_df.shape[0]))
    seed = int(np.random.uniform() * 1000000)
    with mp.Pool(processes=mp.cpu_count()) as pool:
        args = list(df_temp.itertuples(index=False, name=None))
        results = pool.starmap(single_discrepancy, args)

    discreps = results
    slice_discrepancies_dict[var + "_slice_discrepancies"] = discreps

    gp_samples_df = pd.DataFrame(
        slice_samples_dict[var + "_gp_samples"], columns=variables_names
    )
    slice_indices_dfs_dict[var + "_gp_indices_df"] = gp_samples_df
    slice_index_vals_dict[var + "_gp_index_vals"] = gp_samples_df.values

    champ_GP_reg_plot = tfd.GaussianProcessRegressionModel(
        kernel=kernel_champ,
        index_points=gp_samples_df.values,
        observation_index_points=index_vals,
        observations=obs_vals,
        observation_noise_variance=observation_noise_variance_champ,
        predictive_noise_variance=0.0,
        mean_fn=const_mean_fn(),
    )
    GP_samples = champ_GP_reg_plot.sample(gp_samp_no, seed=GP_seed)
```

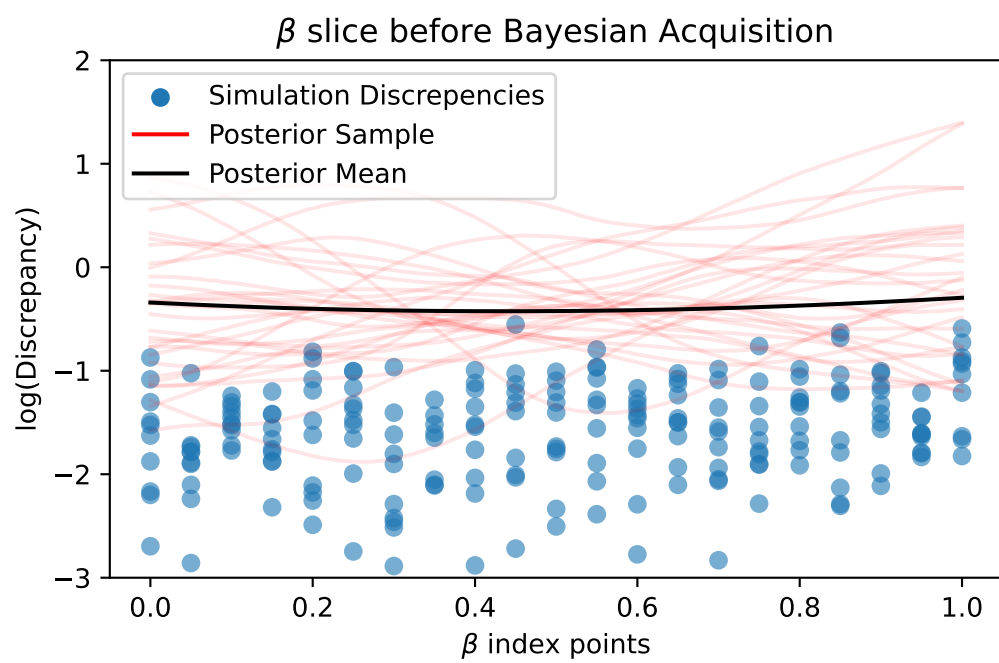
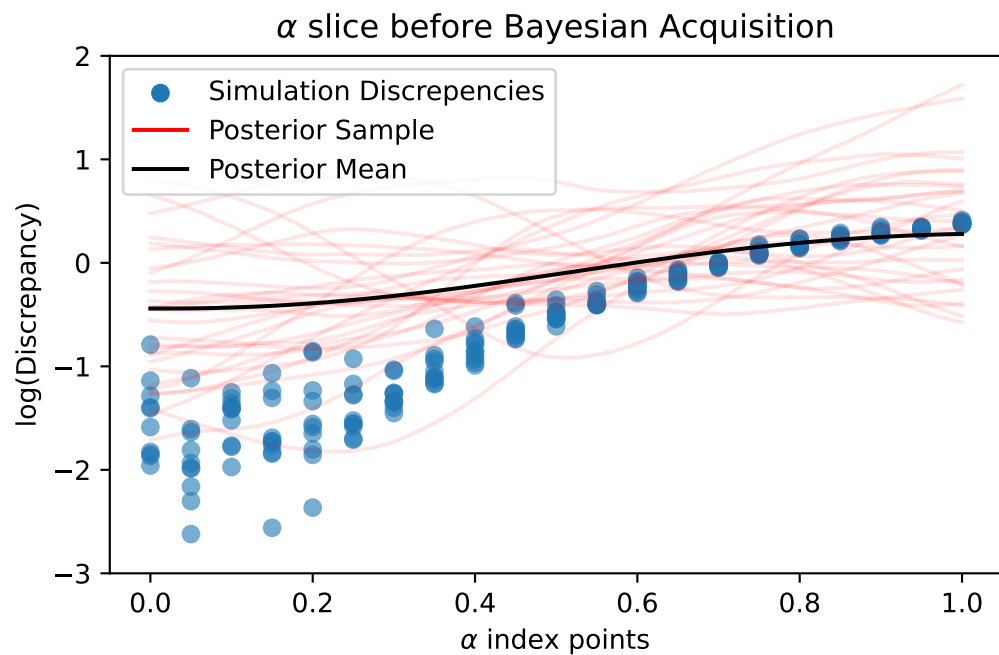


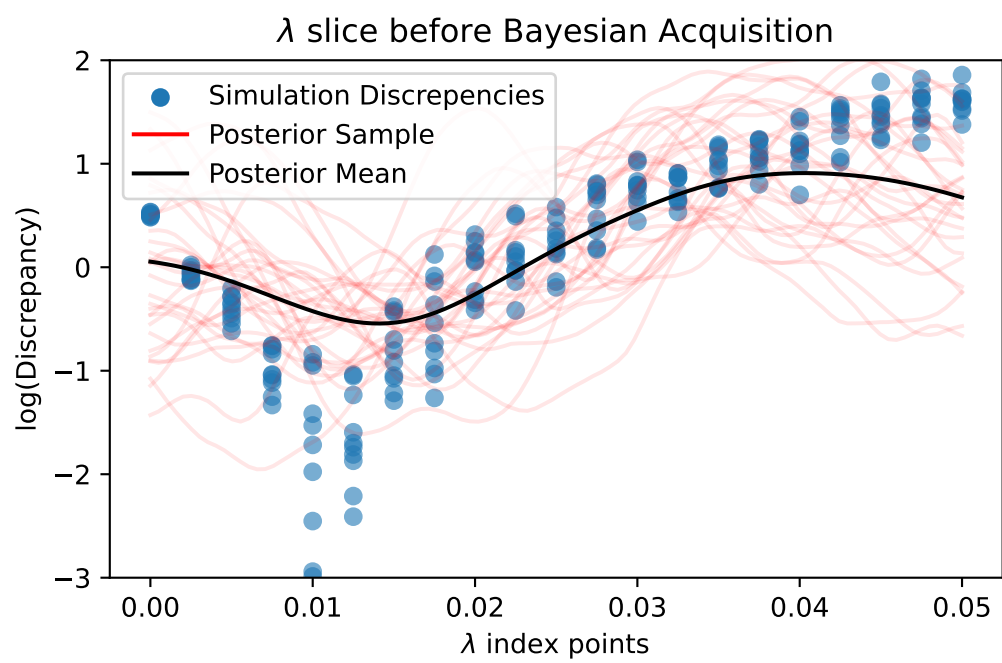
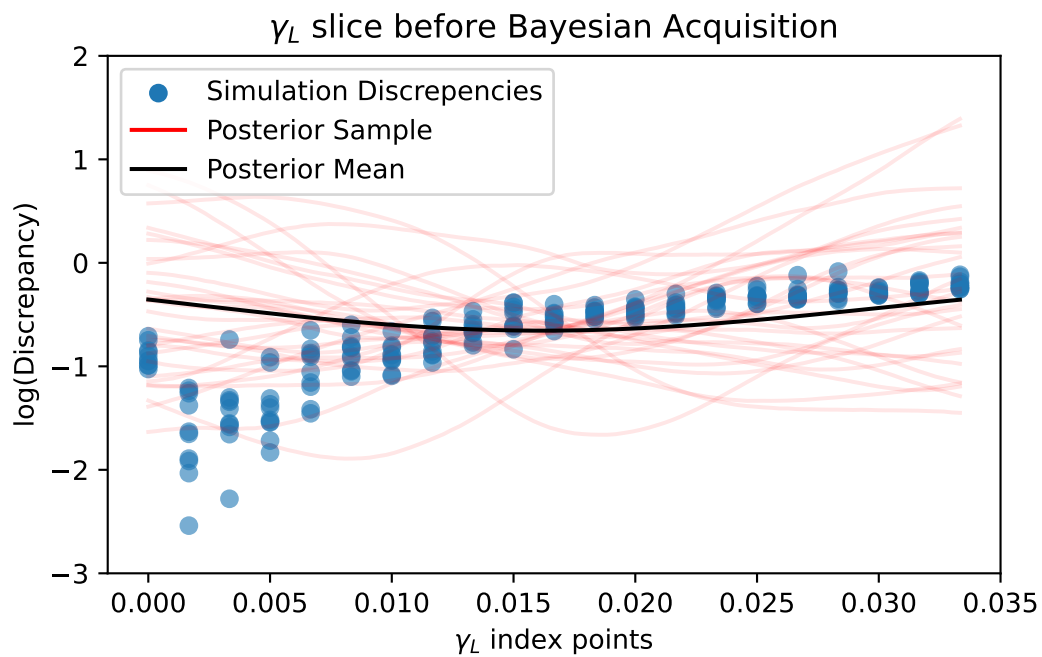
```

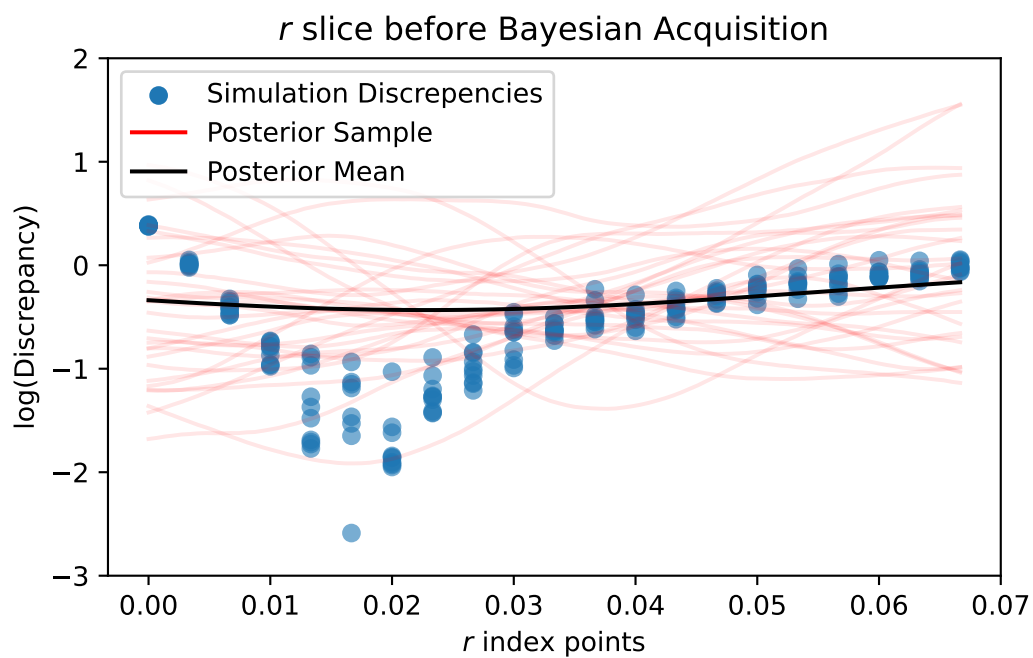
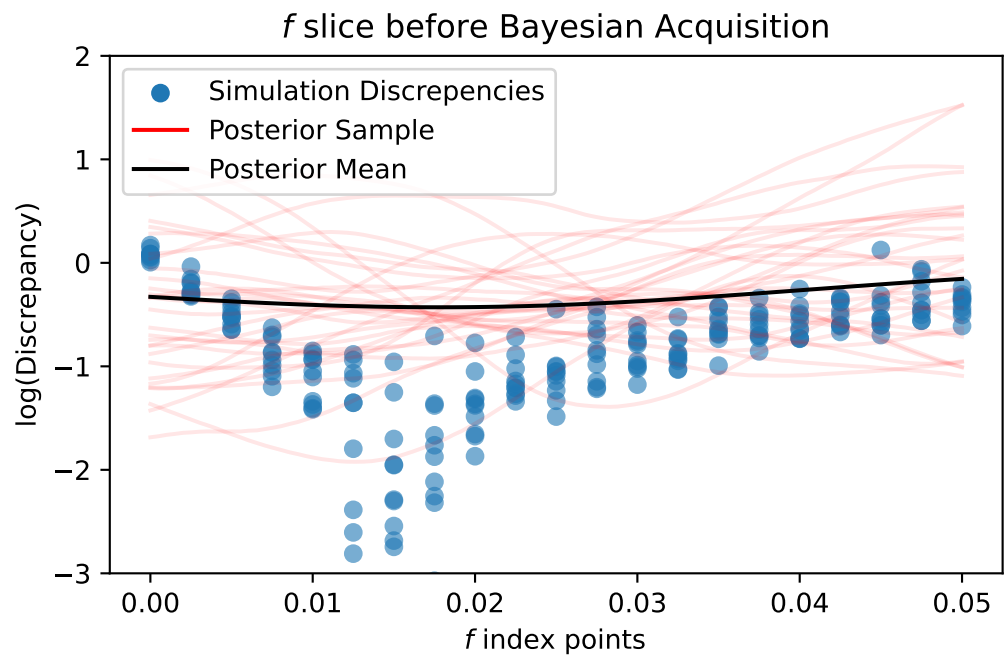
gp_samples_dict[var + "initial_gp_samps"] = GP_samples

plt.figure(figsize=(6, 3.5))
plt.scatter(
    val_df[var].values,
    discreps,
    label="Simulation Discrepancies",
    alpha=0.6,
)
for i in range(gp_samp_no):
    plt.plot(
        gp_samples_df[var].values,
        GP_samples[i, :],
        c="r",
        alpha=0.1,
        label="Posterior Sample" if i == 0 else None,
    )
plt.plot(
    slice_indices_dfs_dict[var + "_gp_indices_df"][var].values,
    champ_GP_reg_plot.mean_fn(
        slice_indices_dfs_dict[var + "_gp_indices_df"].values
    ),
    c="black",
    alpha=1,
    label="Posterior Mean",
)
leg = plt.legend(loc="upper left")
for lh in leg.legend_handles:
    lh.set_alpha(1)
if var in ["f", "r"]:
    plt.xlabel("$" + var + "$ index points")
    plt.title("$" + var + "$ slice before Bayesian Acquisition")
else:
    plt.xlabel("$\\\" + var + "$ index points")
    plt.title("$\\\" + var + "$ slice before Bayesian Acquisition")
# if var not in ["alpha", "beta"]:
#     plt.xscale("log", base=np.e)
plt.ylabel("log(Discrepancy)")
plt.ylim((-3, 2))
plt.savefig("champagne_GP_images/initial_" + var + "_slice_log_discrep.pdf")
plt.show()

```







Acquiring the next datapoint to test

Proof that `.variance` returns what we need in acquisition function

```
champ_GP_reg = tfd.GaussianProcessRegressionModel(
    kernel=kernel_champ,
    observation_index_points=index_vals,
    observations=obs_vals,
    observation_noise_variance=observation_noise_variance_champ,
    mean_fn=const_mean_fn(),
)

new_guess = np.array([0.4, 0.4, 0.004, 0.04, 0.01, 0.17])
mean_t = champ_GP_reg.mean_fn(new_guess)
variance_t = champ_GP_reg.variance(index_points=[new_guess])

kernel_self = kernel_champ.apply(new_guess, new_guess)
kernel_others = kernel_champ.apply(new_guess, index_vals)
K = kernel_champ.matrix(
    index_vals, index_vals
) + observation_noise_variance_champ * np.identity(index_vals.shape[0])
inv_K = np.linalg.inv(K)
print("Self Kernel is {}".format(kernel_self.numpy().round(3)))
print("Others Kernel is {}".format(kernel_others.numpy().round(3)))
print(inv_K)
my_var_t = kernel_self - kernel_others.numpy() @ inv_K @ kernel_others.numpy()

print("Variance function is {}".format(variance_t.numpy().round(3)))
print("Variance function is {}".format(my_var_t.numpy().round(3)))
```

Self Kernel is 0.548

```
Others Kernel is [0.    0.    0.    0.001 0.002 0.005 0.    0.001 0.    0.    0.002 0.
 0.    0.001 0.004 0.004 0.    0.007 0.    0.001 0.001 0.001 0.006 0.001
 0.    0.001 0.003 0.    0.    0.    0.    0.    0.    0.    0.    0.
 0.    0.    0.    0.006 0.006 0.    0.    0.    0.    0.003 0.    0.001
 0.    0.    ]
[[ 2.33380624e+00  4.96553983e-03 -1.27813573e-02 ... -6.23666743e-02
  4.06492589e-04 -5.11513670e-01]
 [ 4.96553983e-03  2.35381789e+00  1.78783954e-02 ...  3.81195623e-03
 -4.97121878e-01  9.57940430e-04]
 [-1.27813573e-02  1.78783954e-02  2.15731364e+00 ... -3.79254994e-01
```

```

9.13202433e-03 -3.71753537e-01]
...
[-6.23666743e-02  3.81195623e-03 -3.79254994e-01 ...  2.23151986e+00
 1.30410003e-03  3.85189894e-03]
[ 4.06492589e-04 -4.97121878e-01  9.13202433e-03 ...  1.30410003e-03
 2.06686174e+00  3.78201721e-03]
[-5.11513670e-01  9.57940430e-04 -3.71753537e-01 ...  3.85189894e-03
 3.78201721e-03  2.53092314e+00]]
Variance function is [0.548]
Variance function is 0.548

```

Loss function

```

next_alpha = tfp.util.TransformedVariable(
    initial_value=0.5,
    bijector=tfb.Sigmoid(),
    dtype=np.float64,
    name="next_alpha",
)

next_beta = tfp.util.TransformedVariable(
    initial_value=0.5,
    bijector=tfb.Sigmoid(),
    dtype=np.float64,
    name="next_beta",
)

next_gamma_L = tfp.util.TransformedVariable(
    initial_value=gamma_L_max/2,
    bijector=tfb.Sigmoid(np.float64(0.), gamma_L_max),
    dtype=np.float64,
    name="next_gamma_L",
)

next_lambda = tfp.util.TransformedVariable(
    initial_value=lambda_max/2,
    bijector=tfb.Sigmoid(np.float64(0.), lambda_max),
    dtype=np.float64,
    name="next_lambda",
)

```

```

next_f = tfp.util.TransformedVariable(
    initial_value=f_max/2,
    bijector=tfb.Sigmoid(np.float64(0.), f_max),
    dtype=np.float64,
    name="next_f",
)

```

```

)

```

```

next_r = tfp.util.TransformedVariable(
    initial_value=r_max/2,
    bijector=tfb.Sigmoid(np.float64(0.), r_max),
    dtype=np.float64,
    name="next_r",
)

```

```

)

```

```

next_vars = (
    (next_alpha.trainable_variables[0],
    next_beta.trainable_variables[0],
    next_gamma_L.trainable_variables[0],
    next_lambda.trainable_variables[0],
    next_f.trainable_variables[0],
    next_r.trainable_variables[0],)
)

```

```

)

```

```

next_vars

```

```

(<tf.Variable 'next_alpha:0' shape=() dtype=float64, numpy=0.0>,
<tf.Variable 'next_beta:0' shape=() dtype=float64, numpy=0.0>,
<tf.Variable 'next_gamma_L:0' shape=() dtype=float64, numpy=0.0>,
<tf.Variable 'next_lambda:0' shape=() dtype=float64, numpy=0.0>,
<tf.Variable 'next_f:0' shape=() dtype=float64, numpy=0.0>,
<tf.Variable 'next_r:0' shape=() dtype=float64, numpy=0.0>)

```

```

eta_t = tf.constant(1.0, dtype=np.float64)

```

```

def UCB_loss(champ_GP_reg):
    next_guess = tf.reshape(
        tf.stack([next_alpha, next_beta, next_gamma_L, next_lambda, next_f, next_r]),
        [1, 6],
    )
    mean_t = champ_GP_reg.mean_fn(next_guess)

```

```

std_t = tf.math.sqrt(
    champ_GP_reg.variance(index_points=next_guess)
    - observation_noise_variance_champ
)
return tf.squeeze(mean_t - std_t)

optimizer_fast = tf.keras.optimizers.Adam(learning_rate=0.1)

@tf.function(autograph=False, jit_compile=False)
def opt_var():
    with tf.GradientTape() as tape:
        loss = UCB_loss(champ_GP_reg)
    grads = tape.gradient(loss, next_vars)
    optimizer_fast.apply_gradients(zip(grads, next_vars))
    return loss

num_iters = 10000

lls_ = np.zeros(num_iters, np.float64)
tolerance = 1e-6 # Set your desired tolerance level
previous_loss = float("inf")

for i in range(num_iters):
    loss = opt_var()
    lls_[i] = loss

    # Check if change in loss is less than tolerance
    if abs(loss - previous_loss) < tolerance:
        print(f"Acquisition function convergence reached at iteration {i+1}.")
        lls_ = lls_[range(i + 1)]
        break

    previous_loss = loss

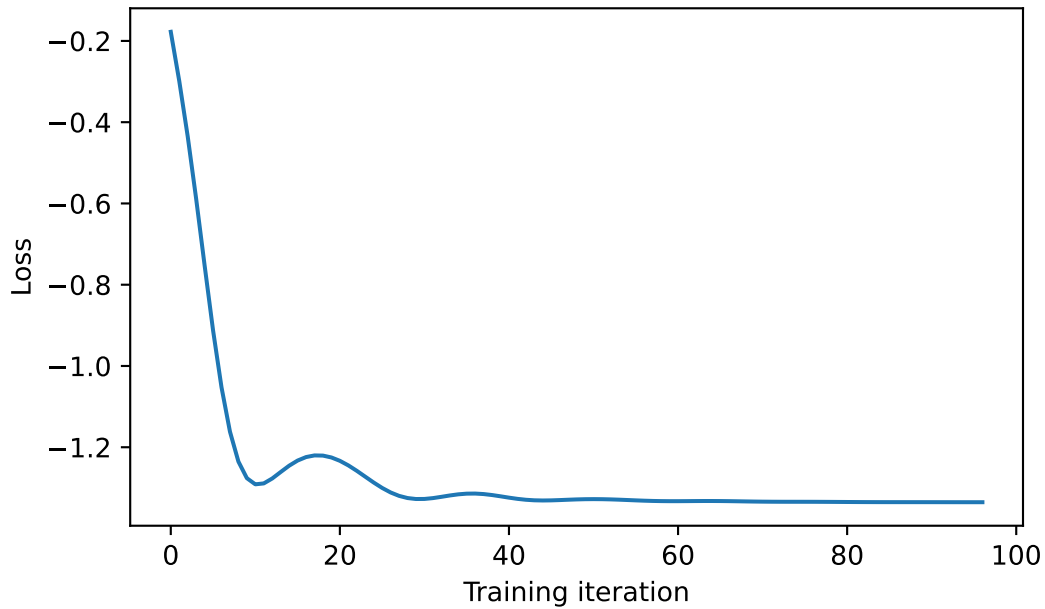
print("Trained parameters:")
for var in [next_alpha, next_beta, next_gamma_L, next_lambda, next_f, next_r]:
    print("{} is {}".format(var.name, (var.bijector.forward(var).numpy().round(3))))

```

Acquisition function convergence reached at iteration 97.
Trained parameters:


```
next_alpha is 0.545
next_beta is 0.644
next_gamma_L is 0.017
next_lambda is 0.025
next_f is 0.025
next_r is 0.034
```

```
plt.figure(figsize=(6, 3.5))
plt.plot(lls_)
plt.xlabel("Training iteration")
plt.ylabel("Loss")
plt.savefig("champagne_GP_images/bolfi_optim_loss_log_discrep.pdf")
plt.show()
```



```
def update_GP_L00(champ_GP, index_vals, obs_vals, observation_noise_variance_champ):

    def L00_loss(champ_GP, index_vals, obs_vals, observation_noise_variance_champ):
        K = (
            champ_GP.kernel.matrix(index_vals, index_vals)
            + tf.eye(index_vals.shape[0], dtype=np.float64)
            * observation_noise_variance_champ
        )
```

```

means = champ_GP.mean_fn(index_vals)
K_inv = tf.linalg.inv(K)
K_inv_y = K_inv @ tf.reshape(obs_vals - means, shape=[obs_vals.shape[0], 1])
K_inv_diag = tf.linalg.diag_part(K_inv)
log_var = tf.math.log(K_inv_diag)
log_mu = tf.reshape(K_inv_y, shape=[-1]) ** 2
return -tf.math.reduce_sum(log_var - log_mu)

@tf.function(autograph=False, jit_compile=False)
def opt_GP():
    with tf.GradientTape() as tape:
        loss = L00_loss(
            champ_GP, index_vals, obs_vals, observation_noise_variance_champ
        )
    grads = tape.gradient(loss, champ_GP.trainable_variables)
    optimizer_slow.apply_gradients(zip(grads, champ_GP.trainable_variables))
    return loss

num_iters = 10000

lls_ = np.zeros(num_iters, np.float64)
tolerance = 1e-6 # Set your desired tolerance level
previous_loss = float("inf")

for i in range(num_iters):
    loss = opt_GP()

    # Check if change in loss is less than tolerance
    if abs(loss - previous_loss) < tolerance:
        print(f"Hyperparameter convergence reached at iteration {i+1}.")
        break

    previous_loss = loss
for var in optimizer_slow.variables:
    var.assign(tf.zeros_like(var))

def update_GP_MLE(champ_GP):
    @tf.function(autograph=False, jit_compile=False)
    def train_model():
        with tf.GradientTape() as tape:

```

```

        loss = -champ_GP.log_prob(obs_vals)
        grads = tape.gradient(loss, champ_GP.trainable_variables)
        optimizer_slow.apply_gradients(zip(grads, champ_GP.trainable_variables))
        return loss

num_iters = 10000

lls_ = np.zeros(num_iters, np.float64)
tolerance = 1e-6 # Set your desired tolerance level
previous_loss = float("inf")

for i in range(num_iters):
    loss = train_model()

    # Check if change in loss is less than tolerance
    if abs(loss - previous_loss) < tolerance:
        print(f"Hyperparameter convergence reached at iteration {i+1}.")
        break

    previous_loss = loss
    for var in optimizer_slow.variables:
        var.assign(tf.zeros_like(var))

# def UCB_loss(eta_t, champ_GP_reg):
#     next_guess = tf.reshape(
#         tf.stack([next_alpha, next_beta, next_gamma_L, next_lambda, next_f, next_r]),
#         [1, 6],
#     )
#     mean_t = champ_GP_reg.mean_fn(next_guess)
#     std_t = champ_GP_reg.stddev(index_points=next_guess)
#     return tf.squeeze(mean_t - eta_t * std_t)

def update_var_UCB(eta_t, champ_GP_reg, next_vars):
    optimizer_fast = tf.keras.optimizers.Adam(learning_rate=0.1)

    @tf.function(autograph=False, jit_compile=False)
    def opt_var():
        with tf.GradientTape() as tape:
            loss = UCB_loss(eta_t, champ_GP_reg)

```

```

        grads = tape.gradient(loss, next_vars)
        optimizer_fast.apply_gradients(zip(grads, next_vars))
        return loss

num_iters = 10000

lls_ = np.zeros(num_iters, np.float64)
tolerance = 1e-3 # Set your desired tolerance level
previous_loss = float("inf")

for i in range(num_iters):
    loss = opt_var()
    lls_[i] = loss

    # Check if change in loss is less than tolerance
    if abs(loss - previous_loss) < tolerance:
        print(f"Acquisition function convergence reached at iteration {i+1}.")
        break

    previous_loss = loss

next_guess = tf.reshape(
    tf.stack([next_alpha, next_beta, next_gamma_L, next_lambda, next_f, next_r]),
    [1, 6],
)
print(
    "The final UCB loss was {}".format(loss.numpy().round(3))
    + " with predicted mean of {}".format(
        champ_GP_reg.mean_fn(next_guess).numpy().round(3)
    )
)
for var in optimizer_fast.variables:
    var.assign(tf.zeros_like(var))

def update_var_EI(GP_reg, alpha, beta, gamma_L, lambda_, f, r, min_obs):
    def EI_loss(alpha, beta, gamma_L, lambda_, f, r, min_obs):
        next_guess = tf.reshape(
            tf.stack([alpha, beta, gamma_L, lambda_, f, r]),
            [1, 6],
        )

```

```

mean_t = GP_reg.mean_fn(next_guess)
std_t = GP_reg.stddev(index_points=next_guess)
delt = min_obs - mean_t
return -tf.squeeze(
    delt * tfd.Normal(0, np.float64(1)).cdf(delt / std_t)
    + std_t * tfd.Normal(0, np.float64(1)).prob(delt / std_t)
)

optimizer_fast = tf.keras.optimizers.Adam(learning_rate=0.1)

@tf.function(autograph=False, jit_compile=False)
def opt_var():
    with tf.GradientTape() as tape:
        loss = EI_loss(alpha, beta, gamma_L, lambda_, f, r, min_obs)
    grads = tape.gradient(loss, next_vars)
    optimizer_fast.apply_gradients(zip(grads, next_vars))
    return loss

num_iters = 10000

lls_ = np.zeros(num_iters, np.float64)
tolerance = 1e-6 # Set your desired tolerance level
previous_loss = np.float64("inf")

for i in range(num_iters):
    loss = opt_var()
    lls_[i] = loss

    # Check if change in loss is less than tolerance
    if abs(loss - previous_loss) < tolerance:
        print(f"Acquisition function convergence reached at iteration {i+1}.")
        lls_ = lls_[range(i + 1)]
        break

    previous_loss = loss

next_guess = tf.reshape(
    tf.stack([next_alpha, next_beta, next_gamma_L, next_lambda, next_f, next_r]),
    [1, 6],
)
print(

```

```

        "The final EI loss was {}".format(loss.numpy().round(3))
        + " with predicted mean of {}".format(
            champ_GP_reg.mean_fn(next_guess).numpy().round(3)
        )
    )

def new_eta_t(t, d, exploration_rate):
    # return np.log((t + 1) ** (d * 2 + 2) * np.pi**2 / (3 * exploration_rate))
    return np.sqrt(np.log((t + 1) ** (d * 2 + 2) * np.pi**2 / (3 * exploration_rate)))

# optimizer_fast = tf.keras.optimizers.Adam(learning_rate=1.)
# update_var_EI()
# plt.figure(figsize=(6, 3.5))
# plt.plot(lls_)
# plt.xlabel("Training iteration")
# plt.ylabel("Loss")
# plt.show()

num_slice_updates = 10

all_slices = [
    np.linspace(0, 1, num_slice_updates, dtype=np.float64), # alpha
    np.linspace(0, 1, num_slice_updates, dtype=np.float64), # beta
    np.linspace(0, gamma_L_max, num_slice_updates, dtype=np.float64), # gamma_L
    np.linspace(0, lambda_max, num_slice_updates, dtype=np.float64), # lambda
    np.linspace(0, f_max, num_slice_updates, dtype=np.float64), # f
    np.linspace(0, r_max, num_slice_updates, dtype=np.float64), # r
]

exploration_rate = 1
d = 6
update_GP_hp_freq = 20 # how many iterations before updating GP hyperparams
eta_t = tf.Variable(0, dtype=np.float64, name="eta_t")
min_obs = tf.Variable(100, dtype=np.float64, name="min_obs", shape=())
min_index = index_vals[
    champ_GP_reg.mean_fn(index_vals) == min(champ_GP_reg.mean_fn(index_vals))
][0]
simulation_reps = 20

```

```

for t in range(501):
    min_index = index_vals[
        champ_GP_reg.mean_fn(index_vals) == min(champ_GP_reg.mean_fn(index_vals))
    ][
        0,
    ]
    optimizer_slow = tf.keras.optimizers.Adam()
    eta_t.assign(new_eta_t(t, d, exploration_rate))
    min_obs.assign(min(champ_GP_reg.mean_fn(index_vals)))
    print("Iteration " + str(t))
    # print(eta_t)

#####

# for var in [next_alpha, next_beta, next_gamma_L, next_lambda, next_f, next_r]:
#     var.assign(
#         var.bijector.forward(np.float64(100000000.0))
#         * np.float64(np.random.uniform())
#     )

index_update = 0
for var in [next_alpha, next_beta, next_gamma_L, next_lambda, next_f, next_r]:
    if np.random.uniform() > 0.5:
        var.assign(min_index[index_update])
    else:
        var.assign(
            var.bijector.forward(np.float64(100000000.0))
            * np.float64(np.random.uniform())
        )
    index_update += 1

# update_var_UCB(eta_t, champ_GP_reg)
update_var_EI(
    champ_GP_reg,
    next_alpha,
    next_beta,
    next_gamma_L,
    next_lambda,
    next_f,
    next_r,
    min_obs,

```

```

)

new_params = np.array(
    [
        next_alpha.numpy(),
        next_beta.numpy(),
        next_gamma_L.numpy(),
        next_lambda.numpy(),
        next_f.numpy(),
        next_r.numpy(),
    ]
).reshape(1, -1)
print("The next parameters to simulate from are {}".format(new_params.round(3)))

new_discrepancy = discrepancy_fn(
    next_alpha.numpy(),
    next_beta.numpy(),
    next_gamma_L.numpy(),
    next_lambda.numpy(),
    next_f.numpy(),
    next_r.numpy(),
)

index_vals = np.append(index_vals, new_params, axis=0)
obs_vals = np.append(obs_vals, new_discrepancy)

print("The mean of the samples was {}".format(new_discrepancy.round(3)))

slice_var = [next_alpha, next_beta, next_gamma_L, next_lambda, next_f, next_r][
    t % 6
]
if np.random.uniform() < 1 / 20 + np.exp(1 - t / 4):
    for val in all_slices[t % 6]:

        slice_var.assign(val)

        new_params = np.array(
            [
                next_alpha.numpy(),
                next_beta.numpy(),
                next_gamma_L.numpy(),

```



```

        next_lambda.numpy(),
        next_f.numpy(),
        next_r.numpy(),
    ]
).reshape(1, -1)

new_discrepancy = discrepancy_fn(
    next_alpha.numpy(),
    next_beta.numpy(),
    next_gamma_L.numpy(),
    next_lambda.numpy(),
    next_f.numpy(),
    next_r.numpy(),
)

index_vals = np.append(index_vals, new_params, axis=0)
obs_vals = np.append(obs_vals, new_discrepancy)

#####

champ_GP_reg = tfd.GaussianProcessRegressionModel(
    kernel=kernel_champ,
    observation_index_points=index_vals,
    observations=obs_vals,
    observation_noise_variance=observation_noise_variance_champ,
    predictive_noise_variance=0.0,
    mean_fn=const_mean_fn(),
)

if t % update_GP_hp_freq == 0:
    champ_GP = tfd.GaussianProcess(
        kernel=kernel_champ,
        observation_noise_variance=observation_noise_variance_champ,
        index_points=index_vals,
        mean_fn=const_mean_fn(),
    )
    update_GP_LOO(champ_GP, index_vals, obs_vals, observation_noise_variance_champ)
    # update_GP_MLE(champ_GP)
    min_value = min(champ_GP_reg.mean_fn(index_vals))
    min_index = index_vals[champ_GP_reg.mean_fn(index_vals) == min_value][0,]
    print(

```

```

        "The minimum predicted mean of the observed indices is {}".format(
            min_value.numpy().round(3)
        )
        + " at the point \n{}".format(min_index.round(3))
    )

if (t > 0) & (t % 50 == 0):
    print("Trained parameters:")
    for train_var in champ_GP.trainable_variables:
        if "bias" in train_var.name:
            print("{} is {}".format(train_var.name, train_var.numpy().round(3)))
        else:
            if "length" in train_var.name:
                print(
                    "{} is {}".format(
                        train_var.name,
                        tfb.Sigmoid(
                            np.float64(0.0),
                            [
                                1.0 / 2,
                                1.0 / 2,
                                gamma_L_max / 2,
                                lambda_max / 2,
                                f_max / 2,
                                r_max / 2,
                            ],
                        ),
                    )
                    .forward(train_var)
                    .numpy()
                    .round(3),
                )
            else:
                print(
                    "{} is {}".format(
                        train_var.name,
                        constrain_positive.forward(train_var).numpy().round(3),
                    )
                )

for var in vars:

```

```

champ_GP_reg_plot = tfd.GaussianProcessRegressionModel(
    kernel=kernel_champ,
    index_points=slice_indices_dfs_dict[var + "_gp_indices_df"].values,
    observation_index_points=index_vals,
    observations=obs_vals,
    observation_noise_variance=observation_noise_variance_champ,
    predictive_noise_variance=0.0,
    mean_fn=const_mean_fn(),
)
GP_samples = champ_GP_reg_plot.sample(gp_samp_no, seed=GP_seed)
gp_samples_dict[var + "_gp_samps" + str(t) + "iters"] = GP_samples

plt.figure(figsize=(6, 3.5))
plt.scatter(
    slice_indices_dfs_dict[var + "_slice_indices_df"][var].values,
    slice_discrepancies_dict[var + "_slice_discrepancies"],
    label="Simulation Discrepancies",
)
for i in range(gp_samp_no):
    plt.plot(
        slice_indices_dfs_dict[var + "_gp_indices_df"][var].values,
        GP_samples[i, :],
        c="r",
        alpha=0.1,
        label="Posterior Sample" if i == 0 else None,
    )
plt.plot(
    slice_indices_dfs_dict[var + "_gp_indices_df"][var].values,
    champ_GP_reg_plot.mean_fn(
        slice_indices_dfs_dict[var + "_gp_indices_df"].values
    ),
    c="black",
    alpha=1,
    label="Posterior Mean",
)
leg = plt.legend(loc="upper left")
for lh in leg.legend_handles:
    lh.set_alpha(1)
if var in ["f", "r"]:
    plt.xlabel("$" + var + "$ index points")
    plt.title(

```

```

        "$" + var + "$ slice after " + str(t) + " Bayesian acquisitions"
    )
else:
    plt.xlabel("$\\" + var + "$ index points")
    plt.title(
        "$\\" + var + "$ slice after " + str(t) + " Bayesian acquisitions"
    )
plt.ylabel("log(Discrepancy)")
plt.ylim((-3, 2))
plt.savefig(
    "champagne_GP_images/"
    + var
    + "_slice_"
    + str(t)
    + "_bolfi_updates_log_discrep.pdf"
)
plt.show()

```

Iteration 0

Acquisition function convergence reached at iteration 63.

The final EI loss was -0.134 with predicted mean of [-0.916]

The next parameters to simulate from are [[0.157 0.59 0.02 0.013 0.019 0.027]]

The mean of the samples was -1.138

The minimum predicted mean of the observed indices is -1.134 at the point

[0.157 0.59 0.02 0.013 0.019 0.027]

Iteration 1

Acquisition function convergence reached at iteration 109.

The final EI loss was -0.13 with predicted mean of [-0.983]

The next parameters to simulate from are [[0.126 0.637 0.015 0.013 0.009 0.038]]

The mean of the samples was -0.635

Iteration 2

Acquisition function convergence reached at iteration 87.

The final EI loss was -0.128 with predicted mean of [-1.033]

The next parameters to simulate from are [[0.154 0.803 0.025 0.013 0.025 0.022]]

The mean of the samples was -0.71

Iteration 3

Acquisition function convergence reached at iteration 74.

The final EI loss was -0.094 with predicted mean of [-1.404]

The next parameters to simulate from are [[0.136 0.66 0.009 0.014 0.027 0.025]]

The mean of the samples was -1.038

Iteration 4

Acquisition function convergence reached at iteration 87.
 The final EI loss was -0.004 with predicted mean of [0.032]
 The next parameters to simulate from are [[0.998 0.996 0.033 0.008 0.05 0.]]
 The mean of the samples was 0.247
 Iteration 5
 Acquisition function convergence reached at iteration 75.
 The final EI loss was -0.004 with predicted mean of [0.072]
 The next parameters to simulate from are [[0.999 0.995 0.033 0.029 0.05 0.001]]
 The mean of the samples was 0.49
 Iteration 6
 Acquisition function convergence reached at iteration 49.
 The final EI loss was -0.019 with predicted mean of [-0.683]
 The next parameters to simulate from are [[0.346 0.344 0.023 0.013 0.008 0.005]]
 The mean of the samples was 0.037
 Iteration 7
 Acquisition function convergence reached at iteration 101.
 The final EI loss was -0.082 with predicted mean of [-1.746]
 The next parameters to simulate from are [[0.127 0.722 0.009 0.01 0.025 0.024]]
 The mean of the samples was -1.53
 Iteration 8
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.641]
 The next parameters to simulate from are [[0.134 0.664 0.009 0.031 0.028 0.004]]
 The mean of the samples was 1.065
 Iteration 9
 Acquisition function convergence reached at iteration 85.
 The final EI loss was -0.091 with predicted mean of [-1.724]
 The next parameters to simulate from are [[0.165 0.675 0.009 0.011 0.029 0.024]]
 The mean of the samples was -1.495
 Iteration 10
 Acquisition function convergence reached at iteration 119.
 The final EI loss was -0.005 with predicted mean of [0.072]
 The next parameters to simulate from are [[0.999 0.005 0. 0. 0.05 0.]]
 The mean of the samples was 0.277
 Iteration 11
 Acquisition function convergence reached at iteration 68.
 The final EI loss was -0.079 with predicted mean of [-1.597]
 The next parameters to simulate from are [[0.106 0.526 0.012 0.01 0.029 0.029]]
 The mean of the samples was -1.408
 Iteration 12
 Acquisition function convergence reached at iteration 49.
 The final EI loss was -0.004 with predicted mean of [-0.073]
 The next parameters to simulate from are [[0.005 0.996 0.009 0.013 0.001 0.002]]

The mean of the samples was 0.288
 Iteration 13
 Acquisition function convergence reached at iteration 92.
 The final EI loss was -0.004 with predicted mean of [0.183]
 The next parameters to simulate from are [[0.001 0. 0.033 0.05 0. 0.]]
 The mean of the samples was 2.079
 Iteration 14
 Acquisition function convergence reached at iteration 58.
 The final EI loss was -0.021 with predicted mean of [-0.768]
 The next parameters to simulate from are [[0.352 0.968 0.021 0.015 0.012 0.037]]
 The mean of the samples was -0.604
 Iteration 15
 Acquisition function convergence reached at iteration 110.
 The final EI loss was -0.043 with predicted mean of [-1.632]
 The next parameters to simulate from are [[0.142 0.652 0.01 0.011 0.025 0.028]]
 The mean of the samples was -1.617
 Iteration 16
 Acquisition function convergence reached at iteration 94.
 The final EI loss was -0.004 with predicted mean of [0.13]
 The next parameters to simulate from are [[0.999 0.006 0.033 0.039 0. 0.066]]
 The mean of the samples was 0.483
 Iteration 17
 Acquisition function convergence reached at iteration 75.
 The final EI loss was -0.017 with predicted mean of [-0.689]
 The next parameters to simulate from are [[0.325 0.407 0.027 0.015 0.02 0.049]]
 The mean of the samples was -0.679
 Iteration 18
 Acquisition function convergence reached at iteration 72.
 The final EI loss was -0.002 with predicted mean of [0.326]
 The next parameters to simulate from are [[0.458 0.005 0. 0.05 0. 0.]]
 The mean of the samples was 1.615
 Iteration 19
 Acquisition function convergence reached at iteration 39.
 The final EI loss was -0.009 with predicted mean of [-0.477]
 The next parameters to simulate from are [[0.414 0.709 0.033 0.012 0.033 0.034]]
 The mean of the samples was -0.857
 Iteration 20
 Acquisition function convergence reached at iteration 75.
 The final EI loss was -0.011 with predicted mean of [-0.561]
 The next parameters to simulate from are [[0.213 0.003 0.015 0.012 0.031 0.035]]
 The mean of the samples was -0.893
 The minimum predicted mean of the observed indices is -1.682 at the point
 [0.136 0.66 0.009 0.011 0.027 0.025]

Iteration 21

Acquisition function convergence reached at iteration 82.

The final EI loss was -0.099 with predicted mean of [-1.573]

The next parameters to simulate from are [[0.11 0.754 0.009 0.011 0.032 0.029]]

The mean of the samples was -1.165

Iteration 22

Acquisition function convergence reached at iteration 122.

The final EI loss was -0.009 with predicted mean of [0.015]

The next parameters to simulate from are [[0.94 0.987 0. 0.034 0.049 0.065]]

The mean of the samples was 0.74

Iteration 23

Acquisition function convergence reached at iteration 89.

The final EI loss was -0.007 with predicted mean of [0.088]

The next parameters to simulate from are [[0.005 0.002 0.033 0.039 0.05 0.066]]

The mean of the samples was 1.319

Iteration 24

Acquisition function convergence reached at iteration 2.

The final EI loss was -0.0 with predicted mean of [0.873]

The next parameters to simulate from are [[0.135 0.661 0.009 0.035 0.028 0.014]]

The mean of the samples was 1.107

Iteration 25

Acquisition function convergence reached at iteration 59.

The final EI loss was -0.14 with predicted mean of [-1.667]

The next parameters to simulate from are [[0.155 0.578 0.009 0.011 0.022 0.021]]

The mean of the samples was -1.418

Iteration 26

Acquisition function convergence reached at iteration 87.

The final EI loss was -0.084 with predicted mean of [-1.493]

The next parameters to simulate from are [[0.202 0.753 0.009 0.011 0.023 0.027]]

The mean of the samples was -1.325

Iteration 27

Acquisition function convergence reached at iteration 147.

The final EI loss was -0.058 with predicted mean of [-1.02]

The next parameters to simulate from are [[0.289 0.417 0.024 0.013 0.036 0.034]]

The mean of the samples was -0.921

Iteration 28

Acquisition function convergence reached at iteration 60.

The final EI loss was -0.034 with predicted mean of [-0.821]

The next parameters to simulate from are [[0.446 0.662 0.028 0.014 0.033 0.033]]

The mean of the samples was -0.93

Iteration 29

Acquisition function convergence reached at iteration 61.

The final EI loss was -0.066 with predicted mean of [-1.533]

The next parameters to simulate from are [[0.127 0.626 0.012 0.011 0.028 0.021]]
 The mean of the samples was -1.207
 Iteration 30
 Acquisition function convergence reached at iteration 85.
 The final EI loss was -0.099 with predicted mean of [-1.491]
 The next parameters to simulate from are [[0.127 0.524 0.007 0.01 0.025 0.028]]
 The mean of the samples was -1.553
 Iteration 31
 Acquisition function convergence reached at iteration 110.
 The final EI loss was -0.074 with predicted mean of [-1.584]
 The next parameters to simulate from are [[0.124 0.65 0.008 0.011 0.022 0.026]]
 The mean of the samples was -1.731
 Iteration 32
 Acquisition function convergence reached at iteration 83.
 The final EI loss was -0.056 with predicted mean of [-1.553]
 The next parameters to simulate from are [[0.105 0.639 0.008 0.011 0.019 0.029]]
 The mean of the samples was -1.29
 Iteration 33
 Acquisition function convergence reached at iteration 56.
 The final EI loss was -0.035 with predicted mean of [-0.94]
 The next parameters to simulate from are [[0.352 0.556 0.027 0.013 0.017 0.037]]
 The mean of the samples was -0.717
 Iteration 34
 Acquisition function convergence reached at iteration 74.
 The final EI loss was -0.042 with predicted mean of [-0.933]
 The next parameters to simulate from are [[0.124 0.423 0.02 0.015 0.033 0.035]]
 The mean of the samples was -0.652
 Iteration 35
 Acquisition function convergence reached at iteration 101.
 The final EI loss was -0.084 with predicted mean of [-1.647]
 The next parameters to simulate from are [[0.139 0.622 0.007 0.011 0.027 0.024]]
 The mean of the samples was -1.501
 Iteration 36
 Acquisition function convergence reached at iteration 125.
 The final EI loss was -0.063 with predicted mean of [-1.488]
 The next parameters to simulate from are [[0.157 0.523 0.009 0.01 0.023 0.027]]
 The mean of the samples was -1.255
 Iteration 37
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.276]
 The next parameters to simulate from are [[0.136 0.66 0.008 0.011 0.027 0.007]]
 The mean of the samples was -0.208
 Iteration 38

Acquisition function convergence reached at iteration 56.
 The final EI loss was -0.011 with predicted mean of [0.016]
 The next parameters to simulate from are [[0.968 0.962 0.033 0. 0. 0.004]]
 The mean of the samples was 0.543
 Iteration 39
 Acquisition function convergence reached at iteration 27.
 The final EI loss was -0.041 with predicted mean of [-1.061]
 The next parameters to simulate from are [[0.036 0.356 0.008 0.01 0.028 0.029]]
 The mean of the samples was -1.455
 Iteration 40
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [1.003]
 The next parameters to simulate from are [[0.136 0.66 0.006 0.039 0.023 0.022]]
 The mean of the samples was 1.196
 Hyperparameter convergence reached at iteration 7217.
 The minimum predicted mean of the observed indices is -1.544 at the point
 [0.124 0.65 0.008 0.011 0.022 0.026]
 Iteration 41
 Acquisition function convergence reached at iteration 119.
 The final EI loss was -0.085 with predicted mean of [-1.564]
 The next parameters to simulate from are [[0.086 0.623 0.009 0.011 0.024 0.025]]
 The mean of the samples was -1.442
 Iteration 42
 Acquisition function convergence reached at iteration 168.
 The final EI loss was -0.057 with predicted mean of [-1.378]
 The next parameters to simulate from are [[0.068 0.357 0.011 0.011 0.024 0.029]]
 The mean of the samples was -1.643
 Iteration 43
 Acquisition function convergence reached at iteration 72.
 The final EI loss was -0.011 with predicted mean of [-0.177]
 The next parameters to simulate from are [[0.732 0.97 0.03 0.019 0.004 0.001]]
 The mean of the samples was 0.2
 Iteration 44
 Acquisition function convergence reached at iteration 82.
 The final EI loss was -0.08 with predicted mean of [-1.548]
 The next parameters to simulate from are [[0.076 0.405 0.01 0.011 0.024 0.028]]
 The mean of the samples was -1.502
 Iteration 45
 Acquisition function convergence reached at iteration 66.
 The final EI loss was -0.028 with predicted mean of [-0.753]
 The next parameters to simulate from are [[0.436 0.111 0.024 0.014 0.029 0.03]]
 The mean of the samples was -1.021
 Iteration 46

Acquisition function convergence reached at iteration 193.
 The final EI loss was -0.012 with predicted mean of [-0.308]
 The next parameters to simulate from are [[0.749 0.002 0.022 0.014 0.03 0.004]]
 The mean of the samples was -0.291
 Iteration 47
 Acquisition function convergence reached at iteration 105.
 The final EI loss was -0.006 with predicted mean of [0.107]
 The next parameters to simulate from are [[0.002 0.992 0.033 0.05 0. 0.067]]
 The mean of the samples was 0.99
 Iteration 48
 Acquisition function convergence reached at iteration 54.
 The final EI loss was -0.064 with predicted mean of [-1.368]
 The next parameters to simulate from are [[0.018 0.302 0.012 0.011 0.024 0.031]]
 The mean of the samples was -1.358
 Iteration 49
 Acquisition function convergence reached at iteration 98.
 The final EI loss was -0.056 with predicted mean of [-1.394]
 The next parameters to simulate from are [[0.072 0.246 0.008 0.011 0.023 0.029]]
 The mean of the samples was -1.545
 Iteration 50
 Acquisition function convergence reached at iteration 119.
 The final EI loss was -0.055 with predicted mean of [-1.549]
 The next parameters to simulate from are [[0.082 0.406 0.009 0.011 0.024 0.028]]
 The mean of the samples was -1.483
 Trained parameters:
 amplitude_champ:0 is 0.796

 length_scales_champ:0 is [0.195 0.5 0.01 0.007 0.02 0.018]

 observation_noise_variance_champ:0 is 0.067

 bias_mean:0 is 0.669

 Iteration 51
 Acquisition function convergence reached at iteration 50.
 The final EI loss was -0.054 with predicted mean of [-1.415]
 The next parameters to simulate from are [[0.083 0.205 0.01 0.011 0.028 0.028]]
 The mean of the samples was -1.208
 Iteration 52
 Acquisition function convergence reached at iteration 103.
 The final EI loss was -0.059 with predicted mean of [-1.468]
 The next parameters to simulate from are [[0.041 0.378 0.009 0.01 0.02 0.029]]
 The mean of the samples was -1.628

Iteration 53
 Acquisition function convergence reached at iteration 74.
 The final EI loss was -0.063 with predicted mean of [-1.559]
 The next parameters to simulate from are [[0.055 0.412 0.009 0.01 0.022 0.029]]
 The mean of the samples was -1.59

Iteration 54
 Acquisition function convergence reached at iteration 41.
 The final EI loss was -0.02 with predicted mean of [-0.7]
 The next parameters to simulate from are [[0.454 0.224 0.031 0.012 0.041 0.028]]
 The mean of the samples was -0.923

Iteration 55
 Acquisition function convergence reached at iteration 67.
 The final EI loss was -0.055 with predicted mean of [-1.437]
 The next parameters to simulate from are [[0.009 0.361 0.008 0.011 0.02 0.031]]
 The mean of the samples was -1.406

Iteration 56
 Acquisition function convergence reached at iteration 84.
 The final EI loss was -0.051 with predicted mean of [-1.47]
 The next parameters to simulate from are [[0.055 0.308 0.009 0.01 0.019 0.029]]
 The mean of the samples was -1.306

Iteration 57
 Acquisition function convergence reached at iteration 116.
 The final EI loss was -0.055 with predicted mean of [-1.552]
 The next parameters to simulate from are [[0.056 0.464 0.01 0.011 0.023 0.029]]
 The mean of the samples was -1.667

Iteration 58
 Acquisition function convergence reached at iteration 45.
 The final EI loss was -0.047 with predicted mean of [-1.562]
 The next parameters to simulate from are [[0.051 0.477 0.011 0.011 0.023 0.029]]
 The mean of the samples was -1.6

Iteration 59
 Acquisition function convergence reached at iteration 85.
 The final EI loss was -0.042 with predicted mean of [-1.577]
 The next parameters to simulate from are [[0.05 0.473 0.01 0.011 0.023 0.029]]
 The mean of the samples was -1.514

Iteration 60
 Acquisition function convergence reached at iteration 100.
 The final EI loss was -0.006 with predicted mean of [0.049]
 The next parameters to simulate from are [[0.988 0.002 0. 0.05 0.049 0.066]]
 The mean of the samples was 1.623

Hyperparameter convergence reached at iteration 1993.
 The minimum predicted mean of the observed indices is -1.569 at the point
 [0.056 0.464 0.01 0.011 0.023 0.029]

Iteration 61
Acquisition function convergence reached at iteration 55.
The final EI loss was -0.042 with predicted mean of [-1.562]
The next parameters to simulate from are [[0.091 0.489 0.01 0.011 0.023 0.028]]
The mean of the samples was -1.732

Iteration 62
Acquisition function convergence reached at iteration 133.
The final EI loss was -0.042 with predicted mean of [-1.579]
The next parameters to simulate from are [[0.093 0.486 0.01 0.011 0.022 0.028]]
The mean of the samples was -1.55

Iteration 63
Acquisition function convergence reached at iteration 54.
The final EI loss was -0.023 with predicted mean of [-1.023]
The next parameters to simulate from are [[0.01 0.146 0.006 0.011 0.024 0.039]]
The mean of the samples was -0.867

Iteration 64
Acquisition function convergence reached at iteration 37.
The final EI loss was -0.017 with predicted mean of [-0.953]
The next parameters to simulate from are [[0.281 0.108 0.02 0.013 0.02 0.027]]
The mean of the samples was -1.157

Iteration 65
Acquisition function convergence reached at iteration 75.
The final EI loss was -0.039 with predicted mean of [-1.59]
The next parameters to simulate from are [[0.083 0.487 0.01 0.011 0.023 0.028]]
The mean of the samples was -1.637

Iteration 66
Acquisition function convergence reached at iteration 96.
The final EI loss was -0.007 with predicted mean of [-0.206]
The next parameters to simulate from are [[0.797 0.021 0.024 0.02 0.002 0.]]
The mean of the samples was 0.267

Iteration 67
Acquisition function convergence reached at iteration 121.
The final EI loss was -0.035 with predicted mean of [-1.588]
The next parameters to simulate from are [[0.083 0.484 0.011 0.011 0.022 0.028]]
The mean of the samples was -1.521

Iteration 68
Acquisition function convergence reached at iteration 2.
The final EI loss was -0.0 with predicted mean of [0.289]
The next parameters to simulate from are [[0.895 0.498 0.01 0.012 0.023 0.027]]
The mean of the samples was 0.256

Iteration 69
Acquisition function convergence reached at iteration 66.
The final EI loss was -0.031 with predicted mean of [-1.461]

The next parameters to simulate from are [[0.005 0.508 0.011 0.011 0.023 0.029]]
 The mean of the samples was -1.429
 Iteration 70
 Acquisition function convergence reached at iteration 68.
 The final EI loss was -0.017 with predicted mean of [-0.74]
 The next parameters to simulate from are [[0.272 0.039 0.028 0.011 0.024 0.032]]
 The mean of the samples was -0.984
 Iteration 71
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.868]
 The next parameters to simulate from are [[0.08 0.9 0.014 0.035 0.022 0.028]]
 The mean of the samples was 0.932
 Iteration 72
 Acquisition function convergence reached at iteration 70.
 The final EI loss was -0.034 with predicted mean of [-1.578]
 The next parameters to simulate from are [[0.069 0.443 0.009 0.011 0.023 0.028]]
 The mean of the samples was -1.475
 Iteration 73
 Acquisition function convergence reached at iteration 102.
 The final EI loss was -0.034 with predicted mean of [-1.566]
 The next parameters to simulate from are [[0.108 0.559 0.011 0.011 0.023 0.027]]
 The mean of the samples was -1.419
 Iteration 74
 Acquisition function convergence reached at iteration 74.
 The final EI loss was -0.035 with predicted mean of [-1.568]
 The next parameters to simulate from are [[0.077 0.466 0.009 0.011 0.024 0.028]]
 The mean of the samples was -1.59
 Iteration 75
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.499]
 The next parameters to simulate from are [[0.082 0.604 0.011 0.012 0.022 0.058]]
 The mean of the samples was -0.555
 Iteration 76
 Acquisition function convergence reached at iteration 46.
 The final EI loss was -0.034 with predicted mean of [-1.576]
 The next parameters to simulate from are [[0.066 0.443 0.01 0.011 0.024 0.029]]
 The mean of the samples was -1.46
 Iteration 77
 Acquisition function convergence reached at iteration 64.
 The final EI loss was -0.034 with predicted mean of [-1.525]
 The next parameters to simulate from are [[0.058 0.392 0.011 0.012 0.021 0.028]]
 The mean of the samples was -1.528
 Iteration 78

Acquisition function convergence reached at iteration 71.
 The final EI loss was -0.031 with predicted mean of [-1.564]
 The next parameters to simulate from are [[0.066 0.456 0.01 0.011 0.023 0.028]]
 The mean of the samples was -1.585
 Iteration 79
 Acquisition function convergence reached at iteration 37.
 The final EI loss was -0.03 with predicted mean of [-1.552]
 The next parameters to simulate from are [[0.088 0.455 0.009 0.011 0.023 0.027]]
 The mean of the samples was -1.678
 Iteration 80
 Acquisition function convergence reached at iteration 44.
 The final EI loss was -0.016 with predicted mean of [-0.801]
 The next parameters to simulate from are [[0.379 0.083 0.018 0.016 0.017 0.035]]
 The mean of the samples was -0.783
 Hyperparameter convergence reached at iteration 2087.
 The minimum predicted mean of the observed indices is -1.575 at the point
 [0.083 0.487 0.01 0.011 0.023 0.028]
 Iteration 81
 Acquisition function convergence reached at iteration 63.
 The final EI loss was -0.031 with predicted mean of [-1.571]
 The next parameters to simulate from are [[0.088 0.468 0.009 0.011 0.023 0.027]]
 The mean of the samples was -1.643
 Iteration 82
 Acquisition function convergence reached at iteration 142.
 The final EI loss was -0.031 with predicted mean of [-1.571]
 The next parameters to simulate from are [[0.095 0.466 0.009 0.011 0.023 0.027]]
 The mean of the samples was -1.663
 Iteration 83
 Acquisition function convergence reached at iteration 221.
 The final EI loss was -0.031 with predicted mean of [-1.577]
 The next parameters to simulate from are [[0.09 0.453 0.009 0.011 0.023 0.027]]
 The mean of the samples was -1.645
 Iteration 84
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.609]
 The next parameters to simulate from are [[0.222 0.797 0.01 0.028 0.038 0.029]]
 The mean of the samples was 0.765
 Iteration 85
 Acquisition function convergence reached at iteration 80.
 The final EI loss was -0.002 with predicted mean of [0.194]
 The next parameters to simulate from are [[0.001 0.002 0. 0.05 0.05 0.]]
 The mean of the samples was 2.103
 Iteration 86

Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [1.353]
 The next parameters to simulate from are [[0.083 0.486 0.01 0.046 0.039 0.028]]
 The mean of the samples was 1.605
 Iteration 87
 Acquisition function convergence reached at iteration 75.
 The final EI loss was -0.029 with predicted mean of [-1.583]
 The next parameters to simulate from are [[0.082 0.496 0.009 0.011 0.024 0.027]]
 The mean of the samples was -1.61
 Iteration 88
 Acquisition function convergence reached at iteration 61.
 The final EI loss was -0.027 with predicted mean of [-1.581]
 The next parameters to simulate from are [[0.081 0.497 0.009 0.011 0.024 0.027]]
 The mean of the samples was -1.542
 Iteration 89
 Acquisition function convergence reached at iteration 84.
 The final EI loss was -0.003 with predicted mean of [0.103]
 The next parameters to simulate from are [[0.998 0.994 0. 0.05 0.05 0.001]]
 The mean of the samples was 0.846
 Iteration 90
 Acquisition function convergence reached at iteration 163.
 The final EI loss was -0.026 with predicted mean of [-1.572]
 The next parameters to simulate from are [[0.106 0.525 0.01 0.011 0.023 0.027]]
 The mean of the samples was -1.415
 Iteration 91
 Acquisition function convergence reached at iteration 74.
 The final EI loss was -0.027 with predicted mean of [-1.557]
 The next parameters to simulate from are [[0.058 0.46 0.009 0.011 0.024 0.027]]
 The mean of the samples was -1.444
 Iteration 92
 Acquisition function convergence reached at iteration 37.
 The final EI loss was -0.028 with predicted mean of [-1.556]
 The next parameters to simulate from are [[0.08 0.422 0.011 0.011 0.022 0.028]]
 The mean of the samples was -1.386
 Iteration 93
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.812]
 The next parameters to simulate from are [[0.082 0.493 0.009 0.011 0.024 0.015]]
 The mean of the samples was -0.657
 Iteration 94
 Acquisition function convergence reached at iteration 98.
 The final EI loss was -0.026 with predicted mean of [-1.565]
 The next parameters to simulate from are [[0.079 0.494 0.009 0.011 0.024 0.028]]

The mean of the samples was -1.553
 Iteration 95
 Acquisition function convergence reached at iteration 69.
 The final EI loss was -0.014 with predicted mean of [-0.96]
 The next parameters to simulate from are [[0.363 0.29 0.023 0.01 0.03 0.025]]
 The mean of the samples was -0.987
 Iteration 96
 Acquisition function convergence reached at iteration 83.
 The final EI loss was -0.025 with predicted mean of [-1.548]
 The next parameters to simulate from are [[0.082 0.466 0.008 0.011 0.022 0.027]]
 The mean of the samples was -1.575
 Iteration 97
 Acquisition function convergence reached at iteration 110.
 The final EI loss was -0.027 with predicted mean of [-1.543]
 The next parameters to simulate from are [[0.122 0.634 0.01 0.011 0.023 0.026]]
 The mean of the samples was -1.613
 Iteration 98
 Acquisition function convergence reached at iteration 83.
 The final EI loss was -0.009 with predicted mean of [-0.43]
 The next parameters to simulate from are [[0.186 0.988 0.031 0.013 0.031 0.047]]
 The mean of the samples was -0.907
 Iteration 99
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [1.221]
 The next parameters to simulate from are [[0.081 0.806 0.016 0.047 0.024 0.014]]
 The mean of the samples was 1.616
 Iteration 100
 Acquisition function convergence reached at iteration 52.
 The final EI loss was -0.013 with predicted mean of [-0.624]
 The next parameters to simulate from are [[0.004 0.991 0.021 0.01 0.032 0.04]]
 The mean of the samples was -1.047
 Hyperparameter convergence reached at iteration 5546.
 The minimum predicted mean of the observed indices is -1.567 at the point
 [0.082 0.496 0.009 0.011 0.024 0.027]
 Trained parameters:
 amplitude_champ:0 is 0.762

 length_scales_champ:0 is [0.241 0.5 0.012 0.007 0.024 0.02]

 observation_noise_variance_champ:0 is 0.087

 bias_mean:0 is 0.866

Iteration 101
Acquisition function convergence reached at iteration 44.
The final EI loss was -0.026 with predicted mean of [-1.512]
The next parameters to simulate from are [[0.107 0.432 0.009 0.011 0.02 0.027]]
The mean of the samples was -1.529

Iteration 102
Acquisition function convergence reached at iteration 49.
The final EI loss was -0.025 with predicted mean of [-1.543]
The next parameters to simulate from are [[0.116 0.611 0.009 0.011 0.022 0.026]]
The mean of the samples was -1.484

Iteration 103
Acquisition function convergence reached at iteration 41.
The final EI loss was -0.011 with predicted mean of [-0.578]
The next parameters to simulate from are [[0.412 0.001 0.021 0.012 0.049 0.026]]
The mean of the samples was -0.496

Iteration 104
Acquisition function convergence reached at iteration 32.
The final EI loss was -0.014 with predicted mean of [-0.666]
The next parameters to simulate from are [[0.502 0.094 0.033 0.013 0.017 0.029]]
The mean of the samples was -0.913

Iteration 105
Acquisition function convergence reached at iteration 72.
The final EI loss was -0.001 with predicted mean of [0.322]
The next parameters to simulate from are [[0.001 0.003 0.033 0.05 0. 0.066]]
The mean of the samples was 1.06

Iteration 106
Acquisition function convergence reached at iteration 44.
The final EI loss was -0.014 with predicted mean of [-0.545]
The next parameters to simulate from are [[0.027 0.966 0.029 0.009 0.05 0.043]]
The mean of the samples was -0.714

Iteration 107
Acquisition function convergence reached at iteration 50.
The final EI loss was -0.025 with predicted mean of [-1.56]
The next parameters to simulate from are [[0.077 0.476 0.009 0.011 0.025 0.028]]
The mean of the samples was -1.503

Iteration 108
Acquisition function convergence reached at iteration 2.
The final EI loss was -0.0 with predicted mean of [0.409]
The next parameters to simulate from are [[0.08 0.483 0.009 0.025 0.024 0.028]]
The mean of the samples was 0.469

Iteration 109
Acquisition function convergence reached at iteration 49.
The final EI loss was -0.017 with predicted mean of [-0.723]

The next parameters to simulate from are [[0.002 0.665 0.028 0.01 0.025 0.045]]
 The mean of the samples was -0.819
 Iteration 110
 Acquisition function convergence reached at iteration 106.
 The final EI loss was -0.025 with predicted mean of [-1.55]
 The next parameters to simulate from are [[0.072 0.486 0.009 0.011 0.022 0.027]]
 The mean of the samples was -1.665
 Iteration 111
 Acquisition function convergence reached at iteration 108.
 The final EI loss was -0.025 with predicted mean of [-1.547]
 The next parameters to simulate from are [[0.069 0.487 0.008 0.011 0.021 0.027]]
 The mean of the samples was -1.607
 Iteration 112
 Acquisition function convergence reached at iteration 89.
 The final EI loss was -0.004 with predicted mean of [0.053]
 The next parameters to simulate from are [[0.999 0.992 0. 0. 0.049 0.066]]
 The mean of the samples was 0.491
 Iteration 113
 Acquisition function convergence reached at iteration 97.
 The final EI loss was -0.006 with predicted mean of [-0.204]
 The next parameters to simulate from are [[0.001 0.995 0.001 0.008 0. 0.034]]
 The mean of the samples was 0.421
 Iteration 114
 Acquisition function convergence reached at iteration 115.
 The final EI loss was -0.024 with predicted mean of [-1.557]
 The next parameters to simulate from are [[0.087 0.46 0.008 0.011 0.022 0.027]]
 The mean of the samples was -1.521
 Iteration 115
 Acquisition function convergence reached at iteration 72.
 The final EI loss was -0.024 with predicted mean of [-1.563]
 The next parameters to simulate from are [[0.074 0.505 0.01 0.011 0.023 0.028]]
 The mean of the samples was -1.474
 Iteration 116
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [1.38]
 The next parameters to simulate from are [[0.281 0.524 0.009 0.049 0.023 0.031]]
 The mean of the samples was 1.437
 Iteration 117
 Acquisition function convergence reached at iteration 76.
 The final EI loss was -0.024 with predicted mean of [-1.54]
 The next parameters to simulate from are [[0.068 0.419 0.009 0.012 0.022 0.028]]
 The mean of the samples was -1.445
 Iteration 118

Acquisition function convergence reached at iteration 53.
 The final EI loss was -0.021 with predicted mean of [-1.44]
 The next parameters to simulate from are [[0.011 0.502 0.009 0.011 0.027 0.029]]
 The mean of the samples was -1.322
 Iteration 119
 Acquisition function convergence reached at iteration 70.
 The final EI loss was -0.004 with predicted mean of [0.057]
 The next parameters to simulate from are [[0.998 0.998 0. 0.018 0.05 0.001]]
 The mean of the samples was 0.321
 Iteration 120
 Acquisition function convergence reached at iteration 83.
 The final EI loss was -0.025 with predicted mean of [-1.551]
 The next parameters to simulate from are [[0.121 0.537 0.009 0.011 0.023 0.026]]
 The mean of the samples was -1.612
 Hyperparameter convergence reached at iteration 7128.
 The minimum predicted mean of the observed indices is -1.564 at the point
 [0.088 0.468 0.009 0.011 0.023 0.027]
 Iteration 121
 Acquisition function convergence reached at iteration 21.
 The final EI loss was -0.025 with predicted mean of [-1.559]
 The next parameters to simulate from are [[0.108 0.48 0.01 0.011 0.023 0.027]]
 The mean of the samples was -1.516
 Iteration 122
 Acquisition function convergence reached at iteration 100.
 The final EI loss was -0.009 with predicted mean of [-0.528]
 The next parameters to simulate from are [[0.572 0.022 0.033 0.008 0.029 0.022]]
 The mean of the samples was -0.605
 Iteration 123
 Acquisition function convergence reached at iteration 68.
 The final EI loss was -0.045 with predicted mean of [-1.499]
 The next parameters to simulate from are [[0.134 0.225 0.009 0.011 0.018 0.026]]
 The mean of the samples was -1.594
 Iteration 124
 Acquisition function convergence reached at iteration 52.
 The final EI loss was -0.011 with predicted mean of [-0.609]
 The next parameters to simulate from are [[0. 0.993 0.024 0.013 0.036 0.057]]
 The mean of the samples was -0.584
 Iteration 125
 Acquisition function convergence reached at iteration 98.
 The final EI loss was -0.043 with predicted mean of [-1.563]
 The next parameters to simulate from are [[0.12 0.274 0.009 0.011 0.02 0.027]]
 The mean of the samples was -1.519
 Iteration 126

Acquisition function convergence reached at iteration 37.
 The final EI loss was -0.037 with predicted mean of [-1.458]
 The next parameters to simulate from are [[0.153 0.173 0.007 0.011 0.019 0.026]]
 The mean of the samples was -1.68
 Iteration 127
 Acquisition function convergence reached at iteration 106.
 The final EI loss was -0.022 with predicted mean of [-1.227]
 The next parameters to simulate from are [[0.047 0.996 0.012 0.011 0.029 0.028]]
 The mean of the samples was -1.308
 Iteration 128
 Acquisition function convergence reached at iteration 90.
 The final EI loss was -0.01 with predicted mean of [-0.627]
 The next parameters to simulate from are [[0.418 0.039 0.033 0.014 0.037 0.044]]
 The mean of the samples was -0.689
 Iteration 129
 Acquisition function convergence reached at iteration 60.
 The final EI loss was -0.046 with predicted mean of [-1.558]
 The next parameters to simulate from are [[0.143 0.225 0.008 0.011 0.02 0.027]]
 The mean of the samples was -1.609
 Iteration 130
 Acquisition function convergence reached at iteration 96.
 The final EI loss was -0.01 with predicted mean of [-0.656]
 The next parameters to simulate from are [[0.225 0.581 0.033 0.013 0.046 0.044]]
 The mean of the samples was -0.716
 Iteration 131
 Acquisition function convergence reached at iteration 130.
 The final EI loss was -0.044 with predicted mean of [-1.512]
 The next parameters to simulate from are [[0.161 0.129 0.009 0.01 0.018 0.026]]
 The mean of the samples was -1.492
 Iteration 132
 Acquisition function convergence reached at iteration 83.
 The final EI loss was -0.042 with predicted mean of [-1.581]
 The next parameters to simulate from are [[0.125 0.269 0.008 0.011 0.021 0.027]]
 The mean of the samples was -1.698
 Iteration 133
 Acquisition function convergence reached at iteration 78.
 The final EI loss was -0.006 with predicted mean of [-0.298]
 The next parameters to simulate from are [[0.012 0.024 0.03 0.01 0.047 0.04]]
 The mean of the samples was -0.76
 Iteration 134
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [1.072]
 The next parameters to simulate from are [[0.125 0.269 0.01 0.044 0.021 0.062]]

The mean of the samples was 1.132
 Iteration 135
 Acquisition function convergence reached at iteration 141.
 The final EI loss was -0.022 with predicted mean of [-1.494]
 The next parameters to simulate from are [[0.08 0.751 0.011 0.011 0.023 0.027]]
 The mean of the samples was -1.42
 Iteration 136
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [1.051]
 The next parameters to simulate from are [[0.125 0.911 0.008 0.041 0.021 0.027]]
 The mean of the samples was 1.208
 Iteration 137
 Acquisition function convergence reached at iteration 57.
 The final EI loss was -0.041 with predicted mean of [-1.592]
 The next parameters to simulate from are [[0.127 0.269 0.008 0.011 0.021 0.027]]
 The mean of the samples was -1.543
 Iteration 138
 Acquisition function convergence reached at iteration 64.
 The final EI loss was -0.02 with predicted mean of [-1.257]
 The next parameters to simulate from are [[0.185 0.995 0.011 0.011 0.028 0.026]]
 The mean of the samples was -1.303
 Iteration 139
 Acquisition function convergence reached at iteration 40.
 The final EI loss was -0.008 with predicted mean of [-0.492]
 The next parameters to simulate from are [[0.007 0.065 0.014 0.008 0.05 0.033]]
 The mean of the samples was -0.893
 Iteration 140
 Acquisition function convergence reached at iteration 59.
 The final EI loss was -0.039 with predicted mean of [-1.593]
 The next parameters to simulate from are [[0.124 0.288 0.008 0.011 0.021 0.027]]
 The mean of the samples was -1.619
 Hyperparameter convergence reached at iteration 3363.
 The minimum predicted mean of the observed indices is -1.594 at the point
 [0.124 0.288 0.008 0.011 0.021 0.027]
 Iteration 141
 Acquisition function convergence reached at iteration 58.
 The final EI loss was -0.007 with predicted mean of [-0.477]
 The next parameters to simulate from are [[0.286 0.007 0.033 0.014 0.002 0.034]]
 The mean of the samples was -0.683
 Iteration 142
 Acquisition function convergence reached at iteration 77.
 The final EI loss was -0.035 with predicted mean of [-1.589]
 The next parameters to simulate from are [[0.134 0.287 0.009 0.011 0.021 0.027]]

The mean of the samples was -1.675
 Iteration 143
 Acquisition function convergence reached at iteration 80.
 The final EI loss was -0.004 with predicted mean of [-0.079]
 The next parameters to simulate from are [[0.458 0.007 0. 0.01 0. 0.001]]
 The mean of the samples was 0.086
 Iteration 144
 Acquisition function convergence reached at iteration 70.
 The final EI loss was -0.034 with predicted mean of [-1.597]
 The next parameters to simulate from are [[0.134 0.291 0.009 0.011 0.021 0.027]]
 The mean of the samples was -1.724
 Iteration 145
 Acquisition function convergence reached at iteration 40.
 The final EI loss was -0.034 with predicted mean of [-1.595]
 The next parameters to simulate from are [[0.141 0.278 0.009 0.011 0.021 0.027]]
 The mean of the samples was -1.485
 Iteration 146
 Acquisition function convergence reached at iteration 88.
 The final EI loss was -0.005 with predicted mean of [-0.324]
 The next parameters to simulate from are [[0.716 0.006 0.033 0.011 0.049 0.039]]
 The mean of the samples was -0.384
 Iteration 147
 Acquisition function convergence reached at iteration 113.
 The final EI loss was -0.033 with predicted mean of [-1.543]
 The next parameters to simulate from are [[0.124 0.222 0.007 0.01 0.022 0.026]]
 The mean of the samples was -1.834
 Iteration 148
 Acquisition function convergence reached at iteration 64.
 The final EI loss was -0.003 with predicted mean of [-0.035]
 The next parameters to simulate from are [[0.004 0.014 0. 0.018 0.001 0.067]]
 The mean of the samples was 0.405
 Iteration 149
 Acquisition function convergence reached at iteration 43.
 The final EI loss was -0.042 with predicted mean of [-1.56]
 The next parameters to simulate from are [[0.13 0.202 0.007 0.01 0.023 0.026]]
 The mean of the samples was -1.784
 Iteration 150
 Acquisition function convergence reached at iteration 100.
 The final EI loss was -0.049 with predicted mean of [-1.606]
 The next parameters to simulate from are [[0.131 0.203 0.006 0.01 0.023 0.026]]
 The mean of the samples was -1.674
 Trained parameters:
 amplitude_champ:0 is 0.736

length_scales_champ:0 is [0.26 0.5 0.013 0.007 0.023 0.02]

observation_noise_variance_champ:0 is 0.095

bias_mean:0 is 0.836

Iteration 151

Acquisition function convergence reached at iteration 59.

The final EI loss was -0.044 with predicted mean of [-1.618]

The next parameters to simulate from are [[0.13 0.187 0.006 0.01 0.023 0.026]]

The mean of the samples was -1.654

Iteration 152

Acquisition function convergence reached at iteration 167.

The final EI loss was -0.04 with predicted mean of [-1.635]

The next parameters to simulate from are [[0.129 0.207 0.007 0.01 0.023 0.026]]

The mean of the samples was -1.481

Iteration 153

Acquisition function convergence reached at iteration 56.

The final EI loss was -0.01 with predicted mean of [-1.254]

The next parameters to simulate from are [[0.002 0.747 0.014 0.01 0.026 0.031]]

The mean of the samples was -1.235

Iteration 154

Acquisition function convergence reached at iteration 2.

The final EI loss was -0.0 with predicted mean of [0.992]

The next parameters to simulate from are [[0.123 0.218 0.007 0.038 0.022 0.027]]

The mean of the samples was 1.126

Iteration 155

Acquisition function convergence reached at iteration 73.

The final EI loss was -0.037 with predicted mean of [-1.604]

The next parameters to simulate from are [[0.112 0.198 0.006 0.01 0.021 0.026]]

The mean of the samples was -1.617

Iteration 156

Acquisition function convergence reached at iteration 2.

The final EI loss was -0.0 with predicted mean of [0.986]

The next parameters to simulate from are [[0.124 0.222 0.007 0.047 0.024 0.064]]

The mean of the samples was 1.359

Iteration 157

Acquisition function convergence reached at iteration 141.

The final EI loss was -0.036 with predicted mean of [-1.626]

The next parameters to simulate from are [[0.122 0.228 0.008 0.01 0.022 0.026]]

The mean of the samples was -1.662

Iteration 158

Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.319]
 The next parameters to simulate from are [[0.124 0.526 0.007 0.01 0.022 0.062]]
 The mean of the samples was -0.329
 Iteration 159
 Acquisition function convergence reached at iteration 100.
 The final EI loss was -0.035 with predicted mean of [-1.612]
 The next parameters to simulate from are [[0.149 0.222 0.007 0.01 0.024 0.026]]
 The mean of the samples was -1.615
 Iteration 160
 Acquisition function convergence reached at iteration 88.
 The final EI loss was -0.04 with predicted mean of [-1.629]
 The next parameters to simulate from are [[0.102 0.223 0.008 0.01 0.02 0.026]]
 The mean of the samples was -1.741
 Hyperparameter convergence reached at iteration 2211.
 The minimum predicted mean of the observed indices is -1.637 at the point
 [0.102 0.223 0.008 0.01 0.02 0.026]
 Iteration 161
 Acquisition function convergence reached at iteration 150.
 The final EI loss was -0.038 with predicted mean of [-1.636]
 The next parameters to simulate from are [[0.101 0.227 0.008 0.01 0.02 0.026]]
 The mean of the samples was -1.602
 Iteration 162
 Acquisition function convergence reached at iteration 102.
 The final EI loss was -0.037 with predicted mean of [-1.638]
 The next parameters to simulate from are [[0.103 0.231 0.008 0.01 0.02 0.026]]
 The mean of the samples was -1.621
 Iteration 163
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.742]
 The next parameters to simulate from are [[0.299 0.108 0.008 0.032 0.028 0.026]]
 The mean of the samples was 0.88
 Iteration 164
 Acquisition function convergence reached at iteration 65.
 The final EI loss was -0.008 with predicted mean of [-0.696]
 The next parameters to simulate from are [[0.114 0.989 0.016 0.011 0.049 0.032]]
 The mean of the samples was -0.926
 Iteration 165
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.718]
 The next parameters to simulate from are [[0.103 0.923 0.008 0.029 0.039 0.022]]
 The mean of the samples was 0.884
 Iteration 166

Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [1.24]
 The next parameters to simulate from are [[0.103 0.348 0.001 0.044 0.02 0.026]]
 The mean of the samples was 1.426
 Iteration 167
 Acquisition function convergence reached at iteration 89.
 The final EI loss was -0.005 with predicted mean of [-0.521]
 The next parameters to simulate from are [[0.2 0.006 0.033 0.01 0.05 0.025]]
 The mean of the samples was -0.476
 Iteration 168
 Acquisition function convergence reached at iteration 51.
 The final EI loss was -0.033 with predicted mean of [-1.63]
 The next parameters to simulate from are [[0.102 0.226 0.008 0.01 0.02 0.026]]
 The mean of the samples was -1.586
 Iteration 169
 Acquisition function convergence reached at iteration 165.
 The final EI loss was -0.033 with predicted mean of [-1.64]
 The next parameters to simulate from are [[0.113 0.261 0.008 0.01 0.021 0.026]]
 The mean of the samples was -1.549
 Iteration 170
 Acquisition function convergence reached at iteration 63.
 The final EI loss was -0.009 with predicted mean of [-0.847]
 The next parameters to simulate from are [[0.004 0.525 0.02 0.009 0.044 0.038]]
 The mean of the samples was -0.967
 Iteration 171
 Acquisition function convergence reached at iteration 61.
 The final EI loss was -0.001 with predicted mean of [0.191]
 The next parameters to simulate from are [[0.995 0.002 0.033 0.05 0. 0.067]]
 The mean of the samples was 0.574
 Iteration 172
 Acquisition function convergence reached at iteration 165.
 The final EI loss was -0.029 with predicted mean of [-1.56]
 The next parameters to simulate from are [[0.095 0.15 0.007 0.01 0.019 0.026]]
 The mean of the samples was -1.702
 Iteration 173
 Acquisition function convergence reached at iteration 101.
 The final EI loss was -0.032 with predicted mean of [-1.609]
 The next parameters to simulate from are [[0.095 0.18 0.007 0.01 0.019 0.026]]
 The mean of the samples was -1.68
 Iteration 174
 Acquisition function convergence reached at iteration 32.
 The final EI loss was -0.005 with predicted mean of [-0.638]
 The next parameters to simulate from are [[0.449 0.016 0.025 0.012 0.002 0.032]]

The mean of the samples was -0.232
 Iteration 175
 Acquisition function convergence reached at iteration 81.
 The final EI loss was -0.032 with predicted mean of [-1.614]
 The next parameters to simulate from are [[0.092 0.166 0.007 0.01 0.019 0.026]]
 The mean of the samples was -1.794
 Iteration 176
 Acquisition function convergence reached at iteration 66.
 The final EI loss was -0.034 with predicted mean of [-1.606]
 The next parameters to simulate from are [[0.085 0.14 0.007 0.01 0.019 0.025]]
 The mean of the samples was -1.735
 Iteration 177
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.956]
 The next parameters to simulate from are [[0.102 0.548 0.008 0.034 0.02 0.026]]
 The mean of the samples was 0.943
 Iteration 178
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [1.491]
 The next parameters to simulate from are [[0.142 0.223 0.008 0.046 0.02 0.008]]
 The mean of the samples was 1.677
 Iteration 179
 Acquisition function convergence reached at iteration 63.
 The final EI loss was -0.035 with predicted mean of [-1.615]
 The next parameters to simulate from are [[0.09 0.125 0.007 0.01 0.018 0.025]]
 The mean of the samples was -1.621
 Iteration 180
 Acquisition function convergence reached at iteration 47.
 The final EI loss was -0.032 with predicted mean of [-1.64]
 The next parameters to simulate from are [[0.087 0.151 0.008 0.01 0.02 0.025]]
 The mean of the samples was -1.818
 Hyperparameter convergence reached at iteration 2209.
 The minimum predicted mean of the observed indices is -1.662 at the point
 [0.102 0.223 0.008 0.01 0.02 0.026]
 Iteration 181
 Acquisition function convergence reached at iteration 63.
 The final EI loss was -0.001 with predicted mean of [0.07]
 The next parameters to simulate from are [[0.989 0.011 0. 0.017 0. 0.001]]
 The mean of the samples was 0.326
 Iteration 182
 Acquisition function convergence reached at iteration 67.
 The final EI loss was -0.034 with predicted mean of [-1.645]
 The next parameters to simulate from are [[0.081 0.147 0.008 0.01 0.02 0.025]]

The mean of the samples was -1.722
 Iteration 183
 Acquisition function convergence reached at iteration 90.
 The final EI loss was -0.004 with predicted mean of [-0.762]
 The next parameters to simulate from are [[0.357 0.002 0.033 0.016 0.028 0.027]]
 The mean of the samples was -0.578
 Iteration 184
 Acquisition function convergence reached at iteration 124.
 The final EI loss was -0.034 with predicted mean of [-1.647]
 The next parameters to simulate from are [[0.079 0.138 0.008 0.01 0.02 0.025]]
 The mean of the samples was -1.63
 Iteration 185
 Acquisition function convergence reached at iteration 89.
 The final EI loss was -0.032 with predicted mean of [-1.656]
 The next parameters to simulate from are [[0.086 0.177 0.007 0.01 0.019 0.026]]
 The mean of the samples was -1.544
 Iteration 186
 Acquisition function convergence reached at iteration 53.
 The final EI loss was -0.029 with predicted mean of [-1.586]
 The next parameters to simulate from are [[0.1 0.064 0.007 0.01 0.019 0.025]]
 The mean of the samples was -1.781
 Iteration 187
 Acquisition function convergence reached at iteration 50.
 The final EI loss was -0.033 with predicted mean of [-1.604]
 The next parameters to simulate from are [[0.107 0.051 0.006 0.01 0.02 0.024]]
 The mean of the samples was -1.836
 Iteration 188
 Acquisition function convergence reached at iteration 11.
 The final EI loss was -0.004 with predicted mean of [-0.477]
 The next parameters to simulate from are [[0.036 0.069 0.031 0.012 0.031 0.056]]
 The mean of the samples was -0.903
 Iteration 189
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.959]
 The next parameters to simulate from are [[0.271 0.166 0.007 0.035 0.019 0.026]]
 The mean of the samples was 0.982
 Iteration 190
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [1.339]
 The next parameters to simulate from are [[0.092 0.686 0.007 0.043 0.019 0.022]]
 The mean of the samples was 1.349
 Iteration 191
 Acquisition function convergence reached at iteration 40.

The final EI loss was -0.006 with predicted mean of [-0.527]
 The next parameters to simulate from are [[0. 0.005 0.018 0.01 0.046 0.057]]
 The mean of the samples was -0.494
 Iteration 192
 Acquisition function convergence reached at iteration 74.
 The final EI loss was -0.006 with predicted mean of [-0.646]
 The next parameters to simulate from are [[0.001 0.011 0.033 0.01 0.02 0.038]]
 The mean of the samples was -0.657
 Iteration 193
 Acquisition function convergence reached at iteration 38.
 The final EI loss was -0.01 with predicted mean of [-1.424]
 The next parameters to simulate from are [[0.172 0.833 0.009 0.01 0.018 0.024]]
 The mean of the samples was -1.17
 Iteration 194
 Acquisition function convergence reached at iteration 63.
 The final EI loss was -0.001 with predicted mean of [0.14]
 The next parameters to simulate from are [[0.001 0.006 0.033 0.022 0. 0.]]
 The mean of the samples was 0.802
 Iteration 195
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.794]
 The next parameters to simulate from are [[0.397 0.166 0.007 0.033 0.019 0.026]]
 The mean of the samples was 0.803
 Iteration 196
 Acquisition function convergence reached at iteration 73.
 The final EI loss was -0.037 with predicted mean of [-1.631]
 The next parameters to simulate from are [[0.104 0.066 0.005 0.01 0.018 0.025]]
 The mean of the samples was -1.354
 Iteration 197
 Acquisition function convergence reached at iteration 50.
 The final EI loss was -0.011 with predicted mean of [-1.22]
 The next parameters to simulate from are [[0.03 0.991 0.007 0.009 0.03 0.025]]
 The mean of the samples was -1.429
 Iteration 198
 Acquisition function convergence reached at iteration 84.
 The final EI loss was -0.009 with predicted mean of [-1.281]
 The next parameters to simulate from are [[0.01 0.997 0.008 0.012 0.025 0.026]]
 The mean of the samples was -1.286
 Iteration 199
 Acquisition function convergence reached at iteration 69.
 The final EI loss was -0.002 with predicted mean of [-0.173]
 The next parameters to simulate from are [[0.691 0.004 0.033 0.007 0.05 0.004]]
 The mean of the samples was 0.063

Iteration 200

Acquisition function convergence reached at iteration 72.

The final EI loss was -0.037 with predicted mean of [-1.645]

The next parameters to simulate from are [[0.097 0.102 0.009 0.01 0.021 0.024]]

The mean of the samples was -1.484

Hyperparameter convergence reached at iteration 2804.

The minimum predicted mean of the observed indices is -1.669 at the point

[0.092 0.166 0.007 0.01 0.019 0.026]

Trained parameters:

amplitude_champ:0 is 0.699

length_scales_champ:0 is [0.292 0.5 0.012 0.007 0.024 0.021]

observation_noise_variance_champ:0 is 0.108

bias_mean:0 is 0.819

Iteration 201

Acquisition function convergence reached at iteration 69.

The final EI loss was -0.008 with predicted mean of [-1.34]

The next parameters to simulate from are [[0.13 0.99 0.007 0.01 0.03 0.025]]

The mean of the samples was -1.545

Iteration 202

Acquisition function convergence reached at iteration 55.

The final EI loss was -0.026 with predicted mean of [-1.514]

The next parameters to simulate from are [[0.046 0.032 0.007 0.01 0.024 0.024]]

The mean of the samples was -1.606

Iteration 203

Acquisition function convergence reached at iteration 108.

The final EI loss was -0.029 with predicted mean of [-1.665]

The next parameters to simulate from are [[0.08 0.142 0.007 0.01 0.021 0.025]]

The mean of the samples was -1.62

Iteration 204

Acquisition function convergence reached at iteration 2.

The final EI loss was -0.0 with predicted mean of [1.516]

The next parameters to simulate from are [[0.258 0.166 0.003 0.046 0.019 0.011]]

The mean of the samples was 1.557

Iteration 205

Acquisition function convergence reached at iteration 68.

The final EI loss was -0.028 with predicted mean of [-1.661]

The next parameters to simulate from are [[0.099 0.12 0.008 0.01 0.02 0.026]]

The mean of the samples was -1.653

Iteration 206

Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [1.07]
 The next parameters to simulate from are [[0.585 0.164 0.007 0.046 0.019 0.026]]
 The mean of the samples was 1.24
 Iteration 207
 Acquisition function convergence reached at iteration 62.
 The final EI loss was -0.001 with predicted mean of [0.133]
 The next parameters to simulate from are [[1. 0.004 0. 0.028 0.05 0.001]]
 The mean of the samples was 0.933
 Iteration 208
 Acquisition function convergence reached at iteration 57.
 The final EI loss was -0.027 with predicted mean of [-1.652]
 The next parameters to simulate from are [[0.072 0.165 0.007 0.01 0.021 0.025]]
 The mean of the samples was -1.653
 Iteration 209
 Acquisition function convergence reached at iteration 87.
 The final EI loss was -0.027 with predicted mean of [-1.657]
 The next parameters to simulate from are [[0.1 0.121 0.008 0.01 0.019 0.026]]
 The mean of the samples was -1.734
 Iteration 210
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.516]
 The next parameters to simulate from are [[0.091 0.165 0.007 0.025 0.033 0.019]]
 The mean of the samples was 0.564
 Iteration 211
 Acquisition function convergence reached at iteration 87.
 The final EI loss was -0.027 with predicted mean of [-1.659]
 The next parameters to simulate from are [[0.099 0.12 0.008 0.01 0.019 0.027]]
 The mean of the samples was -1.382
 Iteration 212
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [1.323]
 The next parameters to simulate from are [[0.2 0.396 0.007 0.049 0.019 0.043]]
 The mean of the samples was 1.402
 Iteration 213
 Acquisition function convergence reached at iteration 128.
 The final EI loss was -0.029 with predicted mean of [-1.648]
 The next parameters to simulate from are [[0.093 0.139 0.007 0.01 0.022 0.024]]
 The mean of the samples was -1.668
 Iteration 214
 Acquisition function convergence reached at iteration 88.
 The final EI loss was -0.004 with predicted mean of [-0.317]
 The next parameters to simulate from are [[0.066 0.004 0.033 0.009 0.005 0.062]]

The mean of the samples was -0.043
 Iteration 215
 Acquisition function convergence reached at iteration 76.
 The final EI loss was -0.028 with predicted mean of [-1.656]
 The next parameters to simulate from are [[0.084 0.166 0.007 0.01 0.022 0.025]]
 The mean of the samples was -1.655
 Iteration 216
 Acquisition function convergence reached at iteration 73.
 The final EI loss was -0.025 with predicted mean of [-1.666]
 The next parameters to simulate from are [[0.088 0.16 0.007 0.01 0.021 0.026]]
 The mean of the samples was -1.84
 Iteration 217
 Acquisition function convergence reached at iteration 85.
 The final EI loss was -0.003 with predicted mean of [-0.374]
 The next parameters to simulate from are [[0.072 0.008 0.033 0.015 0.049 0.066]]
 The mean of the samples was -0.116
 Iteration 218
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [1.104]
 The next parameters to simulate from are [[0.088 0.16 0.007 0.039 0.021 0.026]]
 The mean of the samples was 1.197
 Iteration 219
 Acquisition function convergence reached at iteration 63.
 The final EI loss was -0.002 with predicted mean of [-0.234]
 The next parameters to simulate from are [[0.492 0.007 0.033 0.02 0.001 0.05]]
 The mean of the samples was -0.369
 Iteration 220
 Acquisition function convergence reached at iteration 63.
 The final EI loss was -0.024 with predicted mean of [-1.665]
 The next parameters to simulate from are [[0.081 0.166 0.007 0.01 0.021 0.026]]
 The mean of the samples was -1.787
 Hyperparameter convergence reached at iteration 3795.
 The minimum predicted mean of the observed indices is -1.676 at the point
 [0.088 0.16 0.007 0.01 0.021 0.026]
 Iteration 221
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.001]
 The next parameters to simulate from are [[0.088 0.157 0.007 0.015 0.015 0.005]]
 The mean of the samples was 0.059
 Iteration 222
 Acquisition function convergence reached at iteration 85.
 The final EI loss was -0.024 with predicted mean of [-1.656]
 The next parameters to simulate from are [[0.069 0.162 0.006 0.01 0.021 0.026]]

The mean of the samples was -1.628
 Iteration 223
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.347]
 The next parameters to simulate from are [[0.088 0.195 0.007 0.01 0.021 0.009]]
 The mean of the samples was -0.322
 Iteration 224
 Acquisition function convergence reached at iteration 51.
 The final EI loss was -0.023 with predicted mean of [-1.662]
 The next parameters to simulate from are [[0.069 0.18 0.007 0.01 0.021 0.026]]
 The mean of the samples was -1.821
 Iteration 225
 Acquisition function convergence reached at iteration 45.
 The final EI loss was -0.004 with predicted mean of [-0.833]
 The next parameters to simulate from are [[0.196 0.378 0.033 0.01 0.03 0.039]]
 The mean of the samples was -0.727
 Iteration 226
 Acquisition function convergence reached at iteration 56.
 The final EI loss was -0.024 with predicted mean of [-1.661]
 The next parameters to simulate from are [[0.065 0.178 0.007 0.01 0.021 0.026]]
 The mean of the samples was -1.723
 Iteration 227
 Acquisition function convergence reached at iteration 84.
 The final EI loss was -0.023 with predicted mean of [-1.665]
 The next parameters to simulate from are [[0.066 0.172 0.007 0.01 0.021 0.026]]
 The mean of the samples was -1.73
 Iteration 228
 Acquisition function convergence reached at iteration 64.
 The final EI loss was -0.023 with predicted mean of [-1.665]
 The next parameters to simulate from are [[0.061 0.176 0.007 0.01 0.021 0.026]]
 The mean of the samples was -1.643
 Iteration 229
 Acquisition function convergence reached at iteration 129.
 The final EI loss was -0.022 with predicted mean of [-1.672]
 The next parameters to simulate from are [[0.07 0.173 0.007 0.01 0.021 0.026]]
 The mean of the samples was -1.775
 Iteration 230
 Acquisition function convergence reached at iteration 39.
 The final EI loss was -0.001 with predicted mean of [-0.027]
 The next parameters to simulate from are [[0.992 0.006 0.033 0.015 0.049 0.058]]
 The mean of the samples was 0.568
 Iteration 231
 Acquisition function convergence reached at iteration 82.

The final EI loss was -0.025 with predicted mean of [-1.6]
 The next parameters to simulate from are [[0.049 0.809 0.007 0.01 0.025 0.026]]
 The mean of the samples was -1.509
 Iteration 232
 Acquisition function convergence reached at iteration 67.
 The final EI loss was -0.023 with predicted mean of [-1.658]
 The next parameters to simulate from are [[0.063 0.204 0.006 0.01 0.02 0.026]]
 The mean of the samples was -1.681
 Iteration 233
 Acquisition function convergence reached at iteration 127.
 The final EI loss was -0.017 with predicted mean of [-1.592]
 The next parameters to simulate from are [[0.053 0.815 0.007 0.01 0.025 0.026]]
 The mean of the samples was -1.693
 Iteration 234
 Acquisition function convergence reached at iteration 29.
 The final EI loss was -0.022 with predicted mean of [-1.645]
 The next parameters to simulate from are [[0.076 0.213 0.005 0.01 0.02 0.026]]
 The mean of the samples was -1.723
 Iteration 235
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [1.211]
 The next parameters to simulate from are [[0.088 0.16 0.01 0.041 0.021 0.026]]
 The mean of the samples was 1.27
 Iteration 236
 Acquisition function convergence reached at iteration 99.
 The final EI loss was -0.022 with predicted mean of [-1.669]
 The next parameters to simulate from are [[0.066 0.207 0.006 0.01 0.02 0.026]]
 The mean of the samples was -1.715
 Iteration 237
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [1.03]
 The next parameters to simulate from are [[0.088 0.185 0.007 0.042 0.003 0.026]]
 The mean of the samples was 1.095
 Iteration 238
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.925]
 The next parameters to simulate from are [[0.083 0.151 0.033 0.042 0.022 0.027]]
 The mean of the samples was 1.303
 Iteration 239
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.866]
 The next parameters to simulate from are [[0.376 0.921 0.032 0.045 0.021 0.028]]
 The mean of the samples was 1.146

Iteration 240

WARNING:tensorflow:5 out of the last 106 calls to <function update_var_EI.<locals>.opt_var at

Acquisition function convergence reached at iteration 102.

The final EI loss was -0.022 with predicted mean of [-1.669]

The next parameters to simulate from are [[0.065 0.193 0.006 0.01 0.02 0.026]]

The mean of the samples was -1.733

Hyperparameter convergence reached at iteration 2401.

The minimum predicted mean of the observed indices is -1.689 at the point

[0.088 0.16 0.007 0.01 0.021 0.026]

Iteration 241

Acquisition function convergence reached at iteration 2.

The final EI loss was -0.0 with predicted mean of [1.149]

The next parameters to simulate from are [[0.088 0.16 0.007 0.041 0.04 0.026]]

The mean of the samples was 1.472

Iteration 242

Acquisition function convergence reached at iteration 110.

The final EI loss was -0.023 with predicted mean of [-1.667]

The next parameters to simulate from are [[0.067 0.179 0.006 0.01 0.022 0.026]]

The mean of the samples was -1.66

Iteration 243

Acquisition function convergence reached at iteration 103.

The final EI loss was -0.022 with predicted mean of [-1.68]

The next parameters to simulate from are [[0.071 0.195 0.006 0.01 0.021 0.026]]

The mean of the samples was -1.715

Iteration 244

Acquisition function convergence reached at iteration 61.

The final EI loss was -0.018 with predicted mean of [-1.608]

The next parameters to simulate from are [[0.059 0.805 0.007 0.01 0.024 0.026]]

The mean of the samples was -1.718

Iteration 245

Acquisition function convergence reached at iteration 2.

The final EI loss was -0.0 with predicted mean of [0.7]

The next parameters to simulate from are [[0.315 0.504 0.007 0.036 0.003 0.026]]

The mean of the samples was 0.481

Iteration 246

Acquisition function convergence reached at iteration 21.

The final EI loss was -0.001 with predicted mean of [-0.491]

The next parameters to simulate from are [[0.27 0.024 0.025 0.01 0.04 0.058]]

The mean of the samples was -0.552

Iteration 247

Acquisition function convergence reached at iteration 65.

The final EI loss was -0.022 with predicted mean of [-1.671]

The next parameters to simulate from are [[0.074 0.171 0.006 0.01 0.022 0.026]]

The mean of the samples was -1.506
 Iteration 248
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.097]
 The next parameters to simulate from are [[0.816 0.146 0.007 0.01 0.02 0.024]]
 The mean of the samples was -0.046
 Iteration 249
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [1.513]
 The next parameters to simulate from are [[0.147 0.347 0.007 0.045 0.042 0.026]]
 The mean of the samples was 1.605
 Iteration 250
 Acquisition function convergence reached at iteration 21.
 The final EI loss was -0.002 with predicted mean of [-0.471]
 The next parameters to simulate from are [[0.74 0.081 0.033 0.016 0.021 0.026]]
 The mean of the samples was -0.62
 Trained parameters:
 amplitude_champ:0 is 0.678

 length_scales_champ:0 is [0.299 0.5 0.012 0.007 0.022 0.02]

 observation_noise_variance_champ:0 is 0.111

 bias_mean:0 is 0.819

 Iteration 251
 Acquisition function convergence reached at iteration 79.
 The final EI loss was -0.022 with predicted mean of [-1.669]
 The next parameters to simulate from are [[0.062 0.18 0.007 0.01 0.019 0.026]]
 The mean of the samples was -1.764
 Iteration 252
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.691]
 The next parameters to simulate from are [[0.088 0.16 0.002 0.033 0.015 0.026]]
 The mean of the samples was 0.834
 Iteration 253
 Acquisition function convergence reached at iteration 36.
 The final EI loss was -0.021 with predicted mean of [-1.628]
 The next parameters to simulate from are [[0.033 0.122 0.007 0.01 0.02 0.026]]
 The mean of the samples was -1.666
 Iteration 254
 Acquisition function convergence reached at iteration 36.
 The final EI loss was -0.019 with predicted mean of [-1.621]

The next parameters to simulate from are [[0.056 0.822 0.007 0.01 0.024 0.026]]
 The mean of the samples was -1.749
 Iteration 255
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [1.088]
 The next parameters to simulate from are [[0.088 0.16 0.007 0.046 0.021 0.066]]
 The mean of the samples was 1.266
 Iteration 256
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.916]
 The next parameters to simulate from are [[0.732 0.159 0.008 0.044 0.037 0.026]]
 The mean of the samples was 1.357
 Iteration 257
 Acquisition function convergence reached at iteration 63.
 The final EI loss was -0.022 with predicted mean of [-1.677]
 The next parameters to simulate from are [[0.07 0.186 0.008 0.01 0.019 0.026]]
 The mean of the samples was -1.68
 Iteration 258
 Acquisition function convergence reached at iteration 31.
 The final EI loss was -0.021 with predicted mean of [-1.682]
 The next parameters to simulate from are [[0.071 0.207 0.008 0.01 0.02 0.026]]
 The mean of the samples was -1.652
 Iteration 259
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [1.44]
 The next parameters to simulate from are [[0.088 0.082 0.007 0.049 0.021 0.026]]
 The mean of the samples was 1.548
 Iteration 260
 Acquisition function convergence reached at iteration 110.
 The final EI loss was -0.021 with predicted mean of [-1.669]
 The next parameters to simulate from are [[0.063 0.182 0.007 0.01 0.019 0.026]]
 The mean of the samples was -1.685
 The minimum predicted mean of the observed indices is -1.693 at the point
 [0.092 0.166 0.007 0.01 0.019 0.026]
 Iteration 261
 Acquisition function convergence reached at iteration 91.
 The final EI loss was -0.024 with predicted mean of [-1.654]
 The next parameters to simulate from are [[0.074 0.192 0.007 0.01 0.016 0.026]]
 The mean of the samples was -1.591
 Iteration 262
 Acquisition function convergence reached at iteration 94.
 The final EI loss was -0.021 with predicted mean of [-1.668]
 The next parameters to simulate from are [[0.076 0.155 0.007 0.01 0.017 0.026]]

The mean of the samples was -1.525
 Iteration 263
 Acquisition function convergence reached at iteration 93.
 The final EI loss was -0.017 with predicted mean of [-1.488]
 The next parameters to simulate from are [[0.008 0.009 0.008 0.01 0.018 0.026]]
 The mean of the samples was -1.374
 Iteration 264
 Acquisition function convergence reached at iteration 87.
 The final EI loss was -0.003 with predicted mean of [-0.301]
 The next parameters to simulate from are [[0.052 0.994 0.033 0.013 0.002 0.051]]
 The mean of the samples was -0.306
 Iteration 265
 Acquisition function convergence reached at iteration 37.
 The final EI loss was -0.007 with predicted mean of [-0.846]
 The next parameters to simulate from are [[0.001 0.023 0.02 0.009 0.027 0.03]]
 The mean of the samples was -0.827
 Iteration 266
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [1.234]
 The next parameters to simulate from are [[0.088 0.625 0.009 0.04 0.021 0.026]]
 The mean of the samples was 1.27
 Iteration 267
 Acquisition function convergence reached at iteration 64.
 The final EI loss was -0.001 with predicted mean of [-0.047]
 The next parameters to simulate from are [[0.003 0.996 0.033 0.001 0. 0.058]]
 The mean of the samples was 0.416
 Iteration 268
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.886]
 The next parameters to simulate from are [[0.273 0.492 0.007 0.032 0.03 0.026]]
 The mean of the samples was 0.893
 Iteration 269
 Acquisition function convergence reached at iteration 49.
 The final EI loss was -0.004 with predicted mean of [-0.873]
 The next parameters to simulate from are [[0.021 0.195 0.025 0.012 0.028 0.043]]
 The mean of the samples was -1.151
 Iteration 270
 Acquisition function convergence reached at iteration 40.
 The final EI loss was -0.02 with predicted mean of [-1.674]
 The next parameters to simulate from are [[0.081 0.144 0.007 0.01 0.023 0.026]]
 The mean of the samples was -1.683
 Iteration 271
 Acquisition function convergence reached at iteration 71.

The final EI loss was -0.019 with predicted mean of [-1.683]
 The next parameters to simulate from are [[0.085 0.167 0.007 0.01 0.022 0.026]]
 The mean of the samples was -1.708
 Iteration 272
 Acquisition function convergence reached at iteration 138.
 The final EI loss was -0.019 with predicted mean of [-1.638]
 The next parameters to simulate from are [[0.088 0.85 0.008 0.011 0.024 0.025]]
 The mean of the samples was -1.788
 Iteration 273
 Acquisition function convergence reached at iteration 120.
 The final EI loss was -0.019 with predicted mean of [-1.676]
 The next parameters to simulate from are [[0.088 0.139 0.007 0.01 0.023 0.026]]
 The mean of the samples was -1.714
 Iteration 274
 Acquisition function convergence reached at iteration 47.
 The final EI loss was -0.001 with predicted mean of [0.112]
 The next parameters to simulate from are [[0.998 0.001 0.033 0.032 0.001 0.]]
 The mean of the samples was 0.615
 Iteration 275
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.022]
 The next parameters to simulate from are [[0.088 0.159 0.007 0.002 0.021 0.026]]
 The mean of the samples was -0.013
 Iteration 276
 Acquisition function convergence reached at iteration 48.
 The final EI loss was -0.001 with predicted mean of [-0.172]
 The next parameters to simulate from are [[0.617 0.004 0.033 0.011 0.002 0.053]]
 The mean of the samples was 0.15
 Iteration 277
 Acquisition function convergence reached at iteration 89.
 The final EI loss was -0.019 with predicted mean of [-1.685]
 The next parameters to simulate from are [[0.076 0.193 0.007 0.01 0.022 0.026]]
 The mean of the samples was -1.716
 Iteration 278
 Acquisition function convergence reached at iteration 90.
 The final EI loss was -0.019 with predicted mean of [-1.672]
 The next parameters to simulate from are [[0.097 0.119 0.007 0.01 0.023 0.026]]
 The mean of the samples was -1.578
 Iteration 279
 Acquisition function convergence reached at iteration 76.
 The final EI loss was -0.019 with predicted mean of [-1.685]
 The next parameters to simulate from are [[0.075 0.223 0.007 0.01 0.021 0.026]]
 The mean of the samples was -1.783

Iteration 280

Acquisition function convergence reached at iteration 2.

The final EI loss was -0.0 with predicted mean of [-1.116]

The next parameters to simulate from are [[0.09 0.152 0.007 0.009 0.02 0.016]]

The mean of the samples was -1.012

Hyperparameter convergence reached at iteration 3125.

The minimum predicted mean of the observed indices is -1.694 at the point

[0.088 0.16 0.007 0.01 0.021 0.026]

Iteration 281

Acquisition function convergence reached at iteration 2.

The final EI loss was -0.0 with predicted mean of [0.545]

The next parameters to simulate from are [[0.035 0.719 0.007 0.027 0.021 0.026]]

The mean of the samples was 0.609

Iteration 282

Acquisition function convergence reached at iteration 2.

The final EI loss was -0.0 with predicted mean of [-0.742]

The next parameters to simulate from are [[0.09 0.708 0.023 0.01 0.023 0.027]]

The mean of the samples was -0.67

Iteration 283

WARNING:tensorflow:5 out of the last 83 calls to <function update_var_EI.<locals>.opt_var at

Acquisition function convergence reached at iteration 61.

The final EI loss was -0.004 with predicted mean of [-0.712]

The next parameters to simulate from are [[0.004 0.517 0.032 0.015 0.03 0.045]]

The mean of the samples was -0.761

Iteration 284

Acquisition function convergence reached at iteration 2.

The final EI loss was -0.0 with predicted mean of [0.979]

The next parameters to simulate from are [[0.752 0.16 0.026 0.047 0.021 0.026]]

The mean of the samples was 1.088

Iteration 285

Acquisition function convergence reached at iteration 69.

The final EI loss was -0.003 with predicted mean of [-0.672]

The next parameters to simulate from are [[0.003 0.002 0.026 0.015 0.017 0.048]]

The mean of the samples was -1.029

Iteration 286

Acquisition function convergence reached at iteration 50.

The final EI loss was -0.001 with predicted mean of [0.101]

The next parameters to simulate from are [[0.99 0.001 0. 0.014 0. 0.066]]

The mean of the samples was 0.55

Iteration 287

Acquisition function convergence reached at iteration 78.

The final EI loss was -0.022 with predicted mean of [-1.662]

The next parameters to simulate from are [[0.093 0.846 0.008 0.011 0.024 0.025]]

The mean of the samples was -1.832
 Iteration 288
 Acquisition function convergence reached at iteration 53.
 The final EI loss was -0.001 with predicted mean of [0.149]
 The next parameters to simulate from are [[0.995 0.988 0.014 0.05 0.001 0.066]]
 The mean of the samples was 0.529
 Iteration 289
 Acquisition function convergence reached at iteration 108.
 The final EI loss was -0.025 with predicted mean of [-1.674]
 The next parameters to simulate from are [[0.092 0.852 0.008 0.011 0.024 0.025]]
 The mean of the samples was -1.853
 Iteration 290
 Acquisition function convergence reached at iteration 39.
 The final EI loss was -0.001 with predicted mean of [-0.129]
 The next parameters to simulate from are [[0.199 0.019 0.017 0.018 0.046 0.066]]
 The mean of the samples was 0.447
 Iteration 291
 Acquisition function convergence reached at iteration 26.
 The final EI loss was -0.002 with predicted mean of [-0.788]
 The next parameters to simulate from are [[0.557 0.476 0.032 0.013 0.024 0.024]]
 The mean of the samples was -0.977
 Iteration 292
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.668]
 The next parameters to simulate from are [[0.088 0.505 0.007 0.028 0.021 0.026]]
 The mean of the samples was 0.622
 Iteration 293
 Acquisition function convergence reached at iteration 72.
 The final EI loss was -0.019 with predicted mean of [-1.689]
 The next parameters to simulate from are [[0.077 0.226 0.007 0.01 0.021 0.026]]
 The mean of the samples was -1.804
 Iteration 294
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [1.334]
 The next parameters to simulate from are [[0.088 0.16 0.007 0.044 0.018 0.032]]
 The mean of the samples was 1.354
 Iteration 295
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [1.564]
 The next parameters to simulate from are [[0.088 0.16 0.007 0.045 0.038 0.026]]
 The mean of the samples was 1.6
 Iteration 296
 Acquisition function convergence reached at iteration 102.

The final EI loss was -0.029 with predicted mean of [-1.685]
 The next parameters to simulate from are [[0.093 0.851 0.008 0.011 0.024 0.025]]
 The mean of the samples was -1.862
 Iteration 297
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [1.319]
 The next parameters to simulate from are [[0.092 0.852 0.008 0.045 0.024 0.024]]
 The mean of the samples was 1.456
 Iteration 298
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.966]
 The next parameters to simulate from are [[0.339 0.852 0.008 0.039 0.024 0.025]]
 The mean of the samples was 0.957
 Iteration 299
 Acquisition function convergence reached at iteration 44.
 The final EI loss was -0.003 with predicted mean of [-0.825]
 The next parameters to simulate from are [[0.018 0.311 0.027 0.014 0.011 0.038]]
 The mean of the samples was -0.966
 Iteration 300
 Acquisition function convergence reached at iteration 171.
 The final EI loss was -0.032 with predicted mean of [-1.696]
 The next parameters to simulate from are [[0.093 0.855 0.008 0.011 0.024 0.025]]
 The mean of the samples was -1.693
 Hyperparameter convergence reached at iteration 2107.
 The minimum predicted mean of the observed indices is -1.699 at the point
 [0.092 0.852 0.008 0.011 0.024 0.025]
 Trained parameters:
 amplitude_champ:0 is 0.671

 length_scales_champ:0 is [0.304 0.5 0.009 0.007 0.023 0.02]

 observation_noise_variance_champ:0 is 0.103

 bias_mean:0 is 0.793

 Iteration 301
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [1.003]
 The next parameters to simulate from are [[0.541 0.768 0.008 0.048 0.024 0.025]]
 The mean of the samples was 1.233
 Iteration 302
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.256]

The next parameters to simulate from are [[0.905 0.867 0.008 0.01 0.025 0.023]]
 The mean of the samples was 0.306
 Iteration 303
 Acquisition function convergence reached at iteration 47.
 The final EI loss was -0.018 with predicted mean of [-1.693]
 The next parameters to simulate from are [[0.073 0.224 0.007 0.01 0.021 0.026]]
 The mean of the samples was -1.659
 Iteration 304
 Acquisition function convergence reached at iteration 23.
 The final EI loss was -0.004 with predicted mean of [-0.751]
 The next parameters to simulate from are [[0.254 0.974 0.024 0.013 0.044 0.035]]
 The mean of the samples was -0.746
 Iteration 305
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [1.38]
 The next parameters to simulate from are [[0.305 0.246 0.018 0.046 0.024 0.025]]
 The mean of the samples was 1.349
 Iteration 306
 Acquisition function convergence reached at iteration 34.
 The final EI loss was -0.029 with predicted mean of [-1.696]
 The next parameters to simulate from are [[0.079 0.849 0.008 0.011 0.024 0.025]]
 The mean of the samples was -1.501
 Iteration 307
 Acquisition function convergence reached at iteration 60.
 The final EI loss was -0.019 with predicted mean of [-1.692]
 The next parameters to simulate from are [[0.075 0.224 0.007 0.01 0.021 0.026]]
 The mean of the samples was -1.588
 Iteration 308
 Acquisition function convergence reached at iteration 109.
 The final EI loss was -0.018 with predicted mean of [-1.693]
 The next parameters to simulate from are [[0.078 0.213 0.007 0.01 0.021 0.026]]
 The mean of the samples was -1.671
 Iteration 309
 Acquisition function convergence reached at iteration 57.
 The final EI loss was -0.001 with predicted mean of [-0.021]
 The next parameters to simulate from are [[0.726 0.013 0.023 0.003 0.003 0.]]
 The mean of the samples was 0.393
 Iteration 310
 Acquisition function convergence reached at iteration 74.
 The final EI loss was -0.019 with predicted mean of [-1.687]
 The next parameters to simulate from are [[0.107 0.123 0.007 0.01 0.021 0.026]]
 The mean of the samples was -1.909
 Iteration 311

Acquisition function convergence reached at iteration 30.
 The final EI loss was -0.002 with predicted mean of [-0.908]
 The next parameters to simulate from are [[0.547 0.262 0.028 0.012 0.029 0.035]]
 The mean of the samples was -0.762
 Iteration 312
 Acquisition function convergence reached at iteration 129.
 The final EI loss was -0.025 with predicted mean of [-1.687]
 The next parameters to simulate from are [[0.104 0.857 0.007 0.011 0.024 0.025]]
 The mean of the samples was -1.748
 Iteration 313
 Acquisition function convergence reached at iteration 98.
 The final EI loss was -0.02 with predicted mean of [-1.692]
 The next parameters to simulate from are [[0.104 0.114 0.007 0.01 0.021 0.026]]
 The mean of the samples was -1.707
 Iteration 314
 Acquisition function convergence reached at iteration 198.
 The final EI loss was -0.025 with predicted mean of [-1.692]
 The next parameters to simulate from are [[0.101 0.854 0.007 0.011 0.024 0.025]]
 The mean of the samples was -1.618
 Iteration 315
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.042]
 The next parameters to simulate from are [[0.829 0.16 0.007 0.01 0.018 0.026]]
 The mean of the samples was 0.056
 Iteration 316
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.646]
 The next parameters to simulate from are [[0.139 0.158 0.007 0.01 0.021 0.047]]
 The mean of the samples was -0.607
 Iteration 317
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.943]
 The next parameters to simulate from are [[0.633 0.16 0.007 0.039 0.021 0.026]]
 The mean of the samples was 0.96
 Iteration 318
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.849]
 The next parameters to simulate from are [[0.828 0.625 0.022 0.046 0.021 0.012]]
 The mean of the samples was 0.952
 Iteration 319
 Acquisition function convergence reached at iteration 36.
 The final EI loss was -0.003 with predicted mean of [-0.724]
 The next parameters to simulate from are [[0.167 0.749 0.022 0.009 0.046 0.048]]

The mean of the samples was -0.678
 Iteration 320
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [1.402]
 The next parameters to simulate from are [[0.253 0.235 0.007 0.047 0.045 0.032]]
 The mean of the samples was 1.633
 Hyperparameter convergence reached at iteration 4078.
 The minimum predicted mean of the observed indices is -1.701 at the point
 [0.088 0.16 0.007 0.01 0.021 0.026]
 Iteration 321
 Acquisition function convergence reached at iteration 40.
 The final EI loss was -0.019 with predicted mean of [-1.695]
 The next parameters to simulate from are [[0.107 0.129 0.007 0.01 0.021 0.026]]
 The mean of the samples was -1.624
 Iteration 322
 Acquisition function convergence reached at iteration 106.
 The final EI loss was -0.019 with predicted mean of [-1.687]
 The next parameters to simulate from are [[0.11 0.112 0.007 0.01 0.021 0.026]]
 The mean of the samples was -1.671
 Iteration 323
 Acquisition function convergence reached at iteration 58.
 The final EI loss was -0.016 with predicted mean of [-1.591]
 The next parameters to simulate from are [[0.125 0.004 0.007 0.01 0.022 0.026]]
 The mean of the samples was -1.605
 Iteration 324
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [1.266]
 The next parameters to simulate from are [[0.188 0.16 0.026 0.046 0.021 0.013]]
 The mean of the samples was 1.555
 Iteration 325
 Acquisition function convergence reached at iteration 41.
 The final EI loss was -0.004 with predicted mean of [-1.]
 The next parameters to simulate from are [[0.148 0.011 0.027 0.014 0.031 0.041]]
 The mean of the samples was -0.825
 Iteration 326
 Acquisition function convergence reached at iteration 151.
 The final EI loss was -0.018 with predicted mean of [-1.698]
 The next parameters to simulate from are [[0.102 0.142 0.007 0.01 0.02 0.026]]
 The mean of the samples was -1.74
 Iteration 327
 Acquisition function convergence reached at iteration 71.
 The final EI loss was -0.018 with predicted mean of [-1.699]
 The next parameters to simulate from are [[0.101 0.144 0.007 0.01 0.021 0.026]]

The mean of the samples was -1.555
 Iteration 328
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [1.345]
 The next parameters to simulate from are [[0.144 0.16 0.016 0.046 0.028 0.026]]
 The mean of the samples was 1.516
 Iteration 329
 Acquisition function convergence reached at iteration 80.
 The final EI loss was -0.001 with predicted mean of [-0.113]
 The next parameters to simulate from are [[0.015 0.005 0.011 0.001 0.05 0.066]]
 The mean of the samples was -0.075
 Iteration 330
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.863]
 The next parameters to simulate from are [[0.128 0.157 0.025 0.034 0.021 0.026]]
 The mean of the samples was 0.919
 Iteration 331
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [1.048]
 The next parameters to simulate from are [[0.534 0.16 0.029 0.046 0.021 0.055]]
 The mean of the samples was 1.013
 Iteration 332
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [1.325]
 The next parameters to simulate from are [[0.088 0.416 0.012 0.04 0.042 0.028]]
 The mean of the samples was 1.384
 Iteration 333
 Acquisition function convergence reached at iteration 26.
 The final EI loss was -0.002 with predicted mean of [-0.529]
 The next parameters to simulate from are [[0.319 1. 0.033 0.017 0.021 0.038]]
 The mean of the samples was -1.051
 Iteration 334
 Acquisition function convergence reached at iteration 84.
 The final EI loss was -0.025 with predicted mean of [-1.688]
 The next parameters to simulate from are [[0.102 0.853 0.007 0.011 0.024 0.026]]
 The mean of the samples was -1.749
 Iteration 335
 Acquisition function convergence reached at iteration 104.
 The final EI loss was -0.017 with predicted mean of [-1.695]
 The next parameters to simulate from are [[0.099 0.139 0.007 0.01 0.02 0.026]]
 The mean of the samples was -1.668
 Iteration 336
 Acquisition function convergence reached at iteration 32.

The final EI loss was -0.013 with predicted mean of [-1.585]
 The next parameters to simulate from are [[0.089 0.025 0.007 0.01 0.025 0.026]]
 The mean of the samples was -1.549
 Iteration 337
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [1.171]
 The next parameters to simulate from are [[0.088 0.27 0.007 0.039 0.021 0.026]]
 The mean of the samples was 1.176
 Iteration 338
 Acquisition function convergence reached at iteration 45.
 The final EI loss was -0.001 with predicted mean of [-0.051]
 The next parameters to simulate from are [[0.228 0.006 0.033 0.003 0.001 0.031]]
 The mean of the samples was 0.214
 Iteration 339
 Acquisition function convergence reached at iteration 37.
 The final EI loss was -0.012 with predicted mean of [-1.516]
 The next parameters to simulate from are [[0.124 0.028 0.007 0.01 0.015 0.025]]
 The mean of the samples was -1.336
 Iteration 340
 Acquisition function convergence reached at iteration 46.
 The final EI loss was -0.018 with predicted mean of [-1.696]
 The next parameters to simulate from are [[0.083 0.183 0.007 0.01 0.022 0.025]]
 The mean of the samples was -1.627
 Hyperparameter convergence reached at iteration 2069.
 The minimum predicted mean of the observed indices is -1.699 at the point
 [0.088 0.16 0.007 0.01 0.021 0.026]
 Iteration 341
 Acquisition function convergence reached at iteration 50.
 The final EI loss was -0.004 with predicted mean of [-0.792]
 The next parameters to simulate from are [[0.003 0.287 0.021 0.009 0.024 0.051]]
 The mean of the samples was -0.824
 Iteration 342
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.213]
 The next parameters to simulate from are [[0.855 0.873 0.015 0.009 0.02 0.025]]
 The mean of the samples was 0.221
 Iteration 343
 Acquisition function convergence reached at iteration 44.
 The final EI loss was -0.003 with predicted mean of [-0.687]
 The next parameters to simulate from are [[0.005 0.031 0.022 0.007 0.046 0.038]]
 The mean of the samples was -0.702
 Iteration 344
 Acquisition function convergence reached at iteration 41.

The final EI loss was -0.026 with predicted mean of [-1.693]
 The next parameters to simulate from are [[0.098 0.846 0.007 0.011 0.024 0.026]]
 The mean of the samples was -1.776
 Iteration 345
 Acquisition function convergence reached at iteration 41.
 The final EI loss was -0.001 with predicted mean of [-0.006]
 The next parameters to simulate from are [[0.919 0.009 0.033 0. 0.047 0.036]]
 The mean of the samples was 0.399
 Iteration 346
 Acquisition function convergence reached at iteration 85.
 The final EI loss was -0.027 with predicted mean of [-1.697]
 The next parameters to simulate from are [[0.102 0.849 0.007 0.011 0.024 0.026]]
 The mean of the samples was -1.683
 Iteration 347
 Acquisition function convergence reached at iteration 156.
 The final EI loss was -0.026 with predicted mean of [-1.695]
 The next parameters to simulate from are [[0.102 0.855 0.007 0.011 0.024 0.026]]
 The mean of the samples was -1.725
 Iteration 348
 Acquisition function convergence reached at iteration 103.
 The final EI loss was -0.018 with predicted mean of [-1.697]
 The next parameters to simulate from are [[0.086 0.164 0.007 0.01 0.022 0.025]]
 The mean of the samples was -1.66
 Iteration 349
 Acquisition function convergence reached at iteration 41.
 The final EI loss was -0.002 with predicted mean of [-0.38]
 The next parameters to simulate from are [[0.016 0.003 0.022 0.013 0.004 0.063]]
 The mean of the samples was -0.234
 Iteration 350
 Acquisition function convergence reached at iteration 51.
 The final EI loss was -0.026 with predicted mean of [-1.698]
 The next parameters to simulate from are [[0.098 0.845 0.007 0.011 0.024 0.025]]
 The mean of the samples was -1.678
 Trained parameters:
 amplitude_champ:0 is 0.665

 length_scales_champ:0 is [0.332 0.5 0.008 0.007 0.022 0.02]

 observation_noise_variance_champ:0 is 0.105

 bias_mean:0 is 0.788

 Iteration 351

Acquisition function convergence reached at iteration 30.
 The final EI loss was -0.001 with predicted mean of [0.084]
 The next parameters to simulate from are [[0.986 0.95 0.017 0.02 0.047 0.002]]
 The mean of the samples was 0.118
 Iteration 352
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.711]
 The next parameters to simulate from are [[0.098 0.066 0.007 0.032 0.009 0.015]]
 The mean of the samples was 0.887
 Iteration 353
 Acquisition function convergence reached at iteration 101.
 The final EI loss was -0.015 with predicted mean of [-1.691]
 The next parameters to simulate from are [[0.082 0.167 0.007 0.011 0.021 0.025]]
 The mean of the samples was -1.614
 Iteration 354
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.634]
 The next parameters to simulate from are [[0.274 0.845 0.007 0.03 0.024 0.025]]
 The mean of the samples was 0.589
 Iteration 355
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.885]
 The next parameters to simulate from are [[0.054 0.846 0.007 0.036 0.024 0.044]]
 The mean of the samples was 1.018
 Iteration 356
 Acquisition function convergence reached at iteration 72.
 The final EI loss was -0.015 with predicted mean of [-1.694]
 The next parameters to simulate from are [[0.079 0.185 0.007 0.01 0.022 0.025]]
 The mean of the samples was -1.673
 Iteration 357
 Acquisition function convergence reached at iteration 66.
 The final EI loss was -0.002 with predicted mean of [-0.438]
 The next parameters to simulate from are [[0.484 0.982 0.033 0.017 0.002 0.04]]
 The mean of the samples was -0.466
 Iteration 358
 Acquisition function convergence reached at iteration 98.
 The final EI loss was -0.001 with predicted mean of [-0.147]
 The next parameters to simulate from are [[0.256 0.992 0.033 0.021 0.001 0.066]]
 The mean of the samples was -0.415
 Iteration 359
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.647]
 The next parameters to simulate from are [[0.098 0.845 0.026 0.011 0.024 0.025]]

The mean of the samples was -0.639
 Iteration 360
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [1.113]
 The next parameters to simulate from are [[0.098 0.845 0.019 0.039 0.031 0.025]]
 The mean of the samples was 1.207
 Hyperparameter convergence reached at iteration 2073.
 The minimum predicted mean of the observed indices is -1.703 at the point
 [0.098 0.845 0.007 0.011 0.024 0.025]
 Iteration 361
 Acquisition function convergence reached at iteration 28.
 The final EI loss was -0.001 with predicted mean of [-0.617]
 The next parameters to simulate from are [[0.119 0.012 0.023 0.017 0.007 0.035]]
 The mean of the samples was -1.075
 Iteration 362
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.589]
 The next parameters to simulate from are [[0.098 0.846 0.007 0.026 0.047 0.025]]
 The mean of the samples was 0.764
 Iteration 363
 Acquisition function convergence reached at iteration 65.
 The final EI loss was -0.025 with predicted mean of [-1.703]
 The next parameters to simulate from are [[0.093 0.843 0.007 0.011 0.023 0.025]]
 The mean of the samples was -1.527
 Iteration 364
 Acquisition function convergence reached at iteration 187.
 The final EI loss was -0.017 with predicted mean of [-1.697]
 The next parameters to simulate from are [[0.089 0.175 0.007 0.01 0.021 0.025]]
 The mean of the samples was -1.809
 Iteration 365
 Acquisition function convergence reached at iteration 38.
 The final EI loss was -0.002 with predicted mean of [-0.606]
 The next parameters to simulate from are [[0.282 0.012 0.008 0.011 0.001 0.023]]
 The mean of the samples was -0.076
 Iteration 366
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.627]
 The next parameters to simulate from are [[0.089 0.174 0.027 0.01 0.021 0.025]]
 The mean of the samples was -0.574
 Iteration 367
 Acquisition function convergence reached at iteration 103.
 The final EI loss was -0.017 with predicted mean of [-1.698]
 The next parameters to simulate from are [[0.086 0.158 0.007 0.01 0.022 0.025]]

The mean of the samples was -1.615
 Iteration 368
 Acquisition function convergence reached at iteration 53.
 The final EI loss was -0.017 with predicted mean of [-1.697]
 The next parameters to simulate from are [[0.086 0.173 0.007 0.01 0.022 0.025]]
 The mean of the samples was -1.902
 Iteration 369
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.918]
 The next parameters to simulate from are [[0.089 0.072 0.027 0.037 0.021 0.036]]
 The mean of the samples was 0.998
 Iteration 370
 Acquisition function convergence reached at iteration 25.
 The final EI loss was -0.002 with predicted mean of [-0.74]
 The next parameters to simulate from are [[0.185 0.525 0.014 0.01 0.05 0.03]]
 The mean of the samples was -0.929
 Iteration 371
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.978]
 The next parameters to simulate from are [[0.323 0.175 0.007 0.034 0.023 0.02]]
 The mean of the samples was 0.905
 Iteration 372
 Acquisition function convergence reached at iteration 101.
 The final EI loss was -0.021 with predicted mean of [-1.689]
 The next parameters to simulate from are [[0.109 0.869 0.007 0.01 0.025 0.025]]
 The mean of the samples was -1.665
 Iteration 373
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.325]
 The next parameters to simulate from are [[0.089 0.631 0.007 0.023 0.021 0.025]]
 The mean of the samples was 0.255
 Iteration 374
 Acquisition function convergence reached at iteration 179.
 The final EI loss was -0.017 with predicted mean of [-1.7]
 The next parameters to simulate from are [[0.085 0.166 0.007 0.01 0.022 0.025]]
 The mean of the samples was -1.768
 Iteration 375
 Acquisition function convergence reached at iteration 52.
 The final EI loss was -0.001 with predicted mean of [-0.967]
 The next parameters to simulate from are [[0.202 0.003 0.027 0.015 0.013 0.04]]
 The mean of the samples was -1.055
 Iteration 376
 Acquisition function convergence reached at iteration 28.

The final EI loss was -0.001 with predicted mean of [-0.006]
 The next parameters to simulate from are [[0.538 0.016 0.024 0.025 0.003 0.061]]
 The mean of the samples was -0.084
 Iteration 377
 Acquisition function convergence reached at iteration 53.
 The final EI loss was -0.002 with predicted mean of [-0.481]
 The next parameters to simulate from are [[0.232 0.992 0.033 0.017 0.049 0.034]]
 The mean of the samples was -0.339
 Iteration 378
 Acquisition function convergence reached at iteration 51.
 The final EI loss was -0.002 with predicted mean of [-0.697]
 The next parameters to simulate from are [[0.2 0.508 0.025 0.009 0.049 0.03]]
 The mean of the samples was -0.839
 Iteration 379
 Acquisition function convergence reached at iteration 88.
 The final EI loss was -0.021 with predicted mean of [-1.679]
 The next parameters to simulate from are [[0.076 0.819 0.007 0.011 0.022 0.026]]
 The mean of the samples was -1.744
 Iteration 380
 Acquisition function convergence reached at iteration 64.
 The final EI loss was -0.002 with predicted mean of [-0.973]
 The next parameters to simulate from are [[0.268 0.386 0.016 0.013 0.032 0.023]]
 The mean of the samples was -1.007
 Hyperparameter convergence reached at iteration 2159.
 The minimum predicted mean of the observed indices is -1.705 at the point
 [0.089 0.175 0.007 0.01 0.021 0.025]
 Iteration 381
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.747]
 The next parameters to simulate from are [[0.089 0.197 0.007 0.037 0. 0.026]]
 The mean of the samples was 0.758
 Iteration 382
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.1]
 The next parameters to simulate from are [[0.855 0.175 0.007 0.012 0.021 0.028]]
 The mean of the samples was 0.091
 Iteration 383
 Acquisition function convergence reached at iteration 107.
 The final EI loss was -0.016 with predicted mean of [-1.702]
 The next parameters to simulate from are [[0.083 0.162 0.007 0.01 0.022 0.025]]
 The mean of the samples was -1.744
 Iteration 384
 Acquisition function convergence reached at iteration 2.

The final EI loss was -0.0 with predicted mean of [0.38]
 The next parameters to simulate from are [[0.088 0.215 0.022 0.027 0.016 0.026]]
 The mean of the samples was 0.391
 Iteration 385
 Acquisition function convergence reached at iteration 14.
 The final EI loss was -0.0 with predicted mean of [0.201]
 The next parameters to simulate from are [[0.007 0.212 0.003 0.03 0.003 0.064]]
 The mean of the samples was 0.075
 Iteration 386
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [1.29]
 The next parameters to simulate from are [[0.094 0.175 0.007 0.043 0.015 0.025]]
 The mean of the samples was 1.265
 Iteration 387
 Acquisition function convergence reached at iteration 21.
 The final EI loss was -0.001 with predicted mean of [-0.76]
 The next parameters to simulate from are [[0.571 0.033 0.027 0.013 0.025 0.02]]
 The mean of the samples was -1.121
 Iteration 388
 Acquisition function convergence reached at iteration 60.
 The final EI loss was -0.016 with predicted mean of [-1.703]
 The next parameters to simulate from are [[0.08 0.175 0.007 0.01 0.022 0.025]]
 The mean of the samples was -1.594
 Iteration 389
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.118]
 The next parameters to simulate from are [[0.089 0.175 0.007 0.021 0.021 0.025]]
 The mean of the samples was 0.118
 Iteration 390
 Acquisition function convergence reached at iteration 9.
 The final EI loss was -0.0 with predicted mean of [0.045]
 The next parameters to simulate from are [[0.945 0.926 0.026 0.017 0.044 0.021]]
 The mean of the samples was 0.247
 Iteration 391
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.771]
 The next parameters to simulate from are [[0.096 0.175 0.007 0.027 0.034 0.013]]
 The mean of the samples was 0.786
 Iteration 392
 Acquisition function convergence reached at iteration 61.
 The final EI loss was -0.016 with predicted mean of [-1.702]
 The next parameters to simulate from are [[0.083 0.167 0.007 0.01 0.022 0.025]]
 The mean of the samples was -1.888

Iteration 393
Acquisition function convergence reached at iteration 86.
The final EI loss was -0.016 with predicted mean of [-1.704]
The next parameters to simulate from are [[0.082 0.164 0.007 0.01 0.022 0.025]]
The mean of the samples was -1.656

Iteration 394
Acquisition function convergence reached at iteration 52.
The final EI loss was -0.02 with predicted mean of [-1.678]
The next parameters to simulate from are [[0.086 0.804 0.007 0.011 0.022 0.026]]
The mean of the samples was -1.715

Iteration 395
Acquisition function convergence reached at iteration 149.
The final EI loss was -0.016 with predicted mean of [-1.703]
The next parameters to simulate from are [[0.083 0.168 0.007 0.01 0.022 0.025]]
The mean of the samples was -1.608

Iteration 396
Acquisition function convergence reached at iteration 2.
The final EI loss was -0.0 with predicted mean of [0.76]
The next parameters to simulate from are [[0.184 0.174 0.024 0.03 0.036 0.025]]
The mean of the samples was 0.807

Iteration 397
Acquisition function convergence reached at iteration 73.
The final EI loss was -0.021 with predicted mean of [-1.687]
The next parameters to simulate from are [[0.073 0.814 0.007 0.011 0.023 0.026]]
The mean of the samples was -1.672

Iteration 398
Acquisition function convergence reached at iteration 119.
The final EI loss was -0.02 with predicted mean of [-1.688]
The next parameters to simulate from are [[0.106 0.868 0.007 0.01 0.024 0.026]]
The mean of the samples was -1.67

Iteration 399
Acquisition function convergence reached at iteration 55.
The final EI loss was -0.001 with predicted mean of [-0.101]
The next parameters to simulate from are [[0.684 0.992 0.033 0.014 0.001 0.066]]
The mean of the samples was 0.221

Iteration 400
Acquisition function convergence reached at iteration 87.
The final EI loss was -0.016 with predicted mean of [-1.702]
The next parameters to simulate from are [[0.083 0.171 0.007 0.01 0.022 0.025]]
The mean of the samples was -1.755

Hyperparameter convergence reached at iteration 2151.
The minimum predicted mean of the observed indices is -1.705 at the point
[0.089 0.175 0.007 0.01 0.021 0.025]

Trained parameters:

amplitude_champ:0 is 0.656

length_scales_champ:0 is [0.336 0.5 0.008 0.007 0.022 0.02]

observation_noise_variance_champ:0 is 0.102

bias_mean:0 is 0.801

Iteration 401

Acquisition function convergence reached at iteration 36.

The final EI loss was -0.001 with predicted mean of [-0.715]

The next parameters to simulate from are [[0.297 0.009 0.027 0.008 0.042 0.038]]

The mean of the samples was -0.807

Iteration 402

Acquisition function convergence reached at iteration 113.

The final EI loss was -0.02 with predicted mean of [-1.681]

The next parameters to simulate from are [[0.069 0.811 0.007 0.011 0.022 0.026]]

The mean of the samples was -1.629

Iteration 403

Acquisition function convergence reached at iteration 2.

The final EI loss was -0.0 with predicted mean of [0.166]

The next parameters to simulate from are [[0.748 0.29 0.012 0.004 0.022 0.025]]

The mean of the samples was 0.132

Iteration 404

Acquisition function convergence reached at iteration 2.

The final EI loss was -0.0 with predicted mean of [1.032]

The next parameters to simulate from are [[0.089 0.77 0.007 0.049 0.01 0.006]]

The mean of the samples was 1.857

Iteration 405

Acquisition function convergence reached at iteration 22.

The final EI loss was -0.001 with predicted mean of [-0.192]

The next parameters to simulate from are [[0.462 0.958 0.013 0.016 0.008 0.009]]

The mean of the samples was -0.668

Iteration 406

Acquisition function convergence reached at iteration 85.

The final EI loss was -0.019 with predicted mean of [-1.682]

The next parameters to simulate from are [[0.116 0.875 0.007 0.01 0.024 0.025]]

The mean of the samples was -1.562

Iteration 407

Acquisition function convergence reached at iteration 7.

The final EI loss was -0.0 with predicted mean of [0.041]

The next parameters to simulate from are [[0.853 0.274 0.012 0.019 0.023 0.001]]

The mean of the samples was 0.146
 Iteration 408
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.705]
 The next parameters to simulate from are [[0.736 0.998 0.028 0.044 0.02 0.035]]
 The mean of the samples was 0.648
 Iteration 409
 Acquisition function convergence reached at iteration 117.
 The final EI loss was -0.018 with predicted mean of [-1.668]
 The next parameters to simulate from are [[0.061 0.79 0.007 0.011 0.022 0.026]]
 The mean of the samples was -1.81
 Iteration 410
 Acquisition function convergence reached at iteration 32.
 The final EI loss was -0.001 with predicted mean of [-0.352]
 The next parameters to simulate from are [[0.006 0.051 0.033 0.016 0.049 0.036]]
 The mean of the samples was -0.165
 Iteration 411
 Acquisition function convergence reached at iteration 43.
 The final EI loss was -0.002 with predicted mean of [-0.773]
 The next parameters to simulate from are [[0.471 0.006 0.026 0.018 0.018 0.028]]
 The mean of the samples was -0.752
 Iteration 412
 Acquisition function convergence reached at iteration 73.
 The final EI loss was -0.002 with predicted mean of [-0.656]
 The next parameters to simulate from are [[0.002 0.876 0.02 0.009 0.05 0.023]]
 The mean of the samples was -0.442
 Iteration 413
 Acquisition function convergence reached at iteration 51.
 The final EI loss was -0.015 with predicted mean of [-1.698]
 The next parameters to simulate from are [[0.079 0.149 0.007 0.01 0.022 0.025]]
 The mean of the samples was -1.735
 Iteration 414
 Acquisition function convergence reached at iteration 75.
 The final EI loss was -0.015 with predicted mean of [-1.703]
 The next parameters to simulate from are [[0.079 0.179 0.007 0.01 0.022 0.025]]
 The mean of the samples was -1.71
 Iteration 415
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [1.21]
 The next parameters to simulate from are [[0.089 0.175 0.001 0.042 0.021 0.025]]
 The mean of the samples was 1.306
 Iteration 416
 Acquisition function convergence reached at iteration 2.

The final EI loss was -0.0 with predicted mean of [-0.376]
 The next parameters to simulate from are [[0.09 0.171 0. 0.01 0.014 0.025]]
 The mean of the samples was -0.532
 Iteration 417
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [1.332]
 The next parameters to simulate from are [[0.089 0.021 0.012 0.045 0.021 0.025]]
 The mean of the samples was 1.455
 Iteration 418
 Acquisition function convergence reached at iteration 45.
 The final EI loss was -0.002 with predicted mean of [-1.]
 The next parameters to simulate from are [[0.157 0.006 0.022 0.012 0.022 0.041]]
 The mean of the samples was -1.051
 Iteration 419
 Acquisition function convergence reached at iteration 40.
 The final EI loss was -0.002 with predicted mean of [-0.378]
 The next parameters to simulate from are [[0.036 0.949 0.033 0.017 0.028 0.065]]
 The mean of the samples was -0.623
 Iteration 420
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.951]
 The next parameters to simulate from are [[0.089 0.048 0.007 0.039 0.007 0.025]]
 The mean of the samples was 0.949
 Hyperparameter convergence reached at iteration 2249.
 The minimum predicted mean of the observed indices is -1.704 at the point
 [0.089 0.175 0.007 0.01 0.021 0.025]
 Iteration 421
 Acquisition function convergence reached at iteration 54.
 The final EI loss was -0.0 with predicted mean of [0.101]
 The next parameters to simulate from are [[0.002 0.009 0. 0. 0.049 0.001]]
 The mean of the samples was 0.465
 Iteration 422
 Acquisition function convergence reached at iteration 58.
 The final EI loss was -0.001 with predicted mean of [-0.78]
 The next parameters to simulate from are [[0.004 0.004 0.026 0.008 0.028 0.048]]
 The mean of the samples was -0.616
 Iteration 423
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [1.324]
 The next parameters to simulate from are [[0.089 0.048 0.016 0.046 0.016 0.015]]
 The mean of the samples was 1.669
 Iteration 424
 Acquisition function convergence reached at iteration 53.

The final EI loss was -0.016 with predicted mean of [-1.701]
 The next parameters to simulate from are [[0.075 0.171 0.008 0.01 0.022 0.025]]
 The mean of the samples was -1.507
 Iteration 425
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [1.101]
 The next parameters to simulate from are [[0.089 0.175 0.017 0.04 0.048 0.025]]
 The mean of the samples was 1.442
 Iteration 426
 Acquisition function convergence reached at iteration 55.
 The final EI loss was -0.001 with predicted mean of [-0.038]
 The next parameters to simulate from are [[0.004 0.013 0.011 0.001 0.004 0.064]]
 The mean of the samples was 0.441
 Iteration 427
 Acquisition function convergence reached at iteration 45.
 The final EI loss was -0.001 with predicted mean of [0.102]
 The next parameters to simulate from are [[0.996 0.008 0.001 0. 0.049 0.065]]
 The mean of the samples was 0.601
 Iteration 428
 Acquisition function convergence reached at iteration 76.
 The final EI loss was -0.015 with predicted mean of [-1.698]
 The next parameters to simulate from are [[0.079 0.166 0.007 0.01 0.021 0.025]]
 The mean of the samples was -1.625
 Iteration 429
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.159]
 The next parameters to simulate from are [[0.086 0.258 0.007 0.004 0.021 0.014]]
 The mean of the samples was -0.217
 Iteration 430
 Acquisition function convergence reached at iteration 47.
 The final EI loss was -0.002 with predicted mean of [-0.522]
 The next parameters to simulate from are [[0.023 0.391 0.033 0.018 0.005 0.047]]
 The mean of the samples was -1.138
 Iteration 431
 Acquisition function convergence reached at iteration 53.
 The final EI loss was -0.015 with predicted mean of [-1.699]
 The next parameters to simulate from are [[0.084 0.166 0.007 0.01 0.021 0.026]]
 The mean of the samples was -1.753
 Iteration 432
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.131]
 The next parameters to simulate from are [[0.089 0.033 0.007 0.02 0.021 0.052]]
 The mean of the samples was 0.138

Iteration 433
Acquisition function convergence reached at iteration 88.
The final EI loss was -0.015 with predicted mean of [-1.698]
The next parameters to simulate from are [[0.086 0.157 0.007 0.01 0.022 0.026]]
The mean of the samples was -1.627

Iteration 434
Acquisition function convergence reached at iteration 86.
The final EI loss was -0.015 with predicted mean of [-1.695]
The next parameters to simulate from are [[0.088 0.166 0.008 0.01 0.022 0.026]]
The mean of the samples was -1.704

Iteration 435
Acquisition function convergence reached at iteration 51.
The final EI loss was -0.015 with predicted mean of [-1.694]
The next parameters to simulate from are [[0.089 0.139 0.007 0.01 0.022 0.026]]
The mean of the samples was -1.763

Iteration 436
Acquisition function convergence reached at iteration 66.
The final EI loss was -0.018 with predicted mean of [-1.66]
The next parameters to simulate from are [[0.047 0.79 0.008 0.011 0.022 0.026]]
The mean of the samples was -1.682

Iteration 437
Acquisition function convergence reached at iteration 2.
The final EI loss was -0.0 with predicted mean of [1.476]
The next parameters to simulate from are [[0.089 0.175 0.024 0.047 0.021 0.008]]
The mean of the samples was 1.773

Iteration 438
Acquisition function convergence reached at iteration 41.
The final EI loss was -0.015 with predicted mean of [-1.689]
The next parameters to simulate from are [[0.094 0.118 0.007 0.01 0.023 0.026]]
The mean of the samples was -1.654

Iteration 439
Acquisition function convergence reached at iteration 74.
The final EI loss was -0.014 with predicted mean of [-1.688]
The next parameters to simulate from are [[0.059 0.21 0.007 0.01 0.021 0.026]]
The mean of the samples was -1.739

Iteration 440
Acquisition function convergence reached at iteration 38.
The final EI loss was -0.002 with predicted mean of [-0.813]
The next parameters to simulate from are [[0.003 0.008 0.018 0.015 0.02 0.031]]
The mean of the samples was -0.962
Hyperparameter convergence reached at iteration 2192.
The minimum predicted mean of the observed indices is -1.704 at the point
[0.089 0.175 0.007 0.01 0.021 0.025]

Iteration 441
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.262]
 The next parameters to simulate from are [[0.089 0.22 0.02 0.025 0.021 0.03]]
 The mean of the samples was 0.308

Iteration 442
 Acquisition function convergence reached at iteration 92.
 The final EI loss was -0.017 with predicted mean of [-1.646]
 The next parameters to simulate from are [[0.034 0.785 0.008 0.011 0.022 0.026]]
 The mean of the samples was -1.658

Iteration 443
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.915]
 The next parameters to simulate from are [[0.092 0.17 0.018 0.011 0.022 0.025]]
 The mean of the samples was -0.853

Iteration 444
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [1.216]
 The next parameters to simulate from are [[0.248 0.175 0.023 0.039 0.038 0.025]]
 The mean of the samples was 1.223

Iteration 445
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [1.441]
 The next parameters to simulate from are [[0.089 0.853 0.007 0.047 0.021 0.025]]
 The mean of the samples was 1.563

Iteration 446
 Acquisition function convergence reached at iteration 54.
 The final EI loss was -0.015 with predicted mean of [-1.696]
 The next parameters to simulate from are [[0.068 0.17 0.008 0.01 0.022 0.026]]
 The mean of the samples was -1.639

Iteration 447
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.266]
 The next parameters to simulate from are [[0.089 0.205 0.007 0.01 0.021 0.002]]
 The mean of the samples was 0.255

Iteration 448
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.125]
 The next parameters to simulate from are [[0.879 0.175 0.005 0.01 0.022 0.025]]
 The mean of the samples was 0.152

Iteration 449
 Acquisition function convergence reached at iteration 75.
 The final EI loss was -0.014 with predicted mean of [-1.697]

The next parameters to simulate from are [[0.07 0.172 0.008 0.01 0.022 0.026]]
 The mean of the samples was -1.743
 Iteration 450
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.543]
 The next parameters to simulate from are [[0.089 0.381 0.011 0.025 0.031 0.025]]
 The mean of the samples was 0.501
 Trained parameters:
 amplitude_champ:0 is 0.652

 length_scales_champ:0 is [0.368 0.5 0.008 0.007 0.021 0.02]

 observation_noise_variance_champ:0 is 0.104

 bias_mean:0 is 0.822

 Iteration 451
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [1.372]
 The next parameters to simulate from are [[0.364 0.504 0.03 0.045 0.02 0.025]]
 The mean of the samples was 1.251
 Iteration 452
 Acquisition function convergence reached at iteration 106.
 The final EI loss was -0.014 with predicted mean of [-1.695]
 The next parameters to simulate from are [[0.101 0.124 0.007 0.01 0.022 0.026]]
 The mean of the samples was -1.506
 Iteration 453
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [1.349]
 The next parameters to simulate from are [[0.473 0.175 0.007 0.047 0.021 0.029]]
 The mean of the samples was 1.314
 Iteration 454
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.854]
 The next parameters to simulate from are [[0.089 0.175 0.018 0.01 0.021 0.025]]
 The mean of the samples was -0.821
 Iteration 455
 Acquisition function convergence reached at iteration 74.
 The final EI loss was -0.018 with predicted mean of [-1.681]
 The next parameters to simulate from are [[0.062 0.796 0.008 0.011 0.023 0.026]]
 The mean of the samples was -1.556
 Iteration 456
 Acquisition function convergence reached at iteration 35.

The final EI loss was -0.001 with predicted mean of [-0.058]
 The next parameters to simulate from are [[0.37 0.996 0.02 0.023 0.002 0.064]]
 The mean of the samples was -0.076
 Iteration 457
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [-0.821]
 The next parameters to simulate from are [[0.089 0.234 0.007 0.01 0.021 0.043]]
 The mean of the samples was -0.831
 Iteration 458
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.822]
 The next parameters to simulate from are [[0.568 0.175 0.014 0.045 0.001 0.025]]
 The mean of the samples was 0.786
 Iteration 459
 Acquisition function convergence reached at iteration 18.
 The final EI loss was -0.014 with predicted mean of [-1.683]
 The next parameters to simulate from are [[0.064 0.217 0.007 0.01 0.021 0.026]]
 The mean of the samples was -1.625
 Iteration 460
 Acquisition function convergence reached at iteration 98.
 The final EI loss was -0.014 with predicted mean of [-1.683]
 The next parameters to simulate from are [[0.069 0.259 0.008 0.01 0.021 0.026]]
 The mean of the samples was -1.637
 Hyperparameter convergence reached at iteration 2194.
 The minimum predicted mean of the observed indices is -1.699 at the point
 [0.089 0.175 0.007 0.01 0.021 0.025]
 Iteration 461
 Acquisition function convergence reached at iteration 51.
 The final EI loss was -0.0 with predicted mean of [0.109]
 The next parameters to simulate from are [[0.992 0.993 0.021 0.03 0.001 0.]]
 The mean of the samples was 0.132
 Iteration 462
 Acquisition function convergence reached at iteration 43.
 The final EI loss was -0.016 with predicted mean of [-1.684]
 The next parameters to simulate from are [[0.071 0.805 0.008 0.011 0.023 0.025]]
 The mean of the samples was -1.666
 Iteration 463
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.952]
 The next parameters to simulate from are [[0.064 0.175 0.007 0.03 0.043 0.025]]
 The mean of the samples was 1.015
 Iteration 464
 Acquisition function convergence reached at iteration 2.

The final EI loss was -0.0 with predicted mean of [0.685]
 The next parameters to simulate from are [[0.102 0.175 0.026 0.028 0.034 0.025]]
 The mean of the samples was 0.673
 Iteration 465
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [1.513]
 The next parameters to simulate from are [[0.089 0.175 0.007 0.047 0.033 0.036]]
 The mean of the samples was 1.595
 Iteration 466
 Acquisition function convergence reached at iteration 44.
 The final EI loss was -0.001 with predicted mean of [-0.271]
 The next parameters to simulate from are [[0.005 0.986 0.023 0.006 0.041 0.065]]
 The mean of the samples was -0.506
 Iteration 467
 Acquisition function convergence reached at iteration 141.
 The final EI loss was -0.017 with predicted mean of [-1.684]
 The next parameters to simulate from are [[0.07 0.828 0.008 0.011 0.024 0.025]]
 The mean of the samples was -1.638
 Iteration 468
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.86]
 The next parameters to simulate from are [[0.013 0.175 0.007 0.035 0.009 0.025]]
 The mean of the samples was 0.881
 Iteration 469
 Acquisition function convergence reached at iteration 36.
 The final EI loss was -0.014 with predicted mean of [-1.7]
 The next parameters to simulate from are [[0.087 0.17 0.007 0.01 0.021 0.026]]
 The mean of the samples was -1.815
 Iteration 470
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.261]
 The next parameters to simulate from are [[0.961 0.166 0.007 0.017 0.02 0.025]]
 The mean of the samples was 0.332
 Iteration 471
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [1.212]
 The next parameters to simulate from are [[0.087 0.726 0.007 0.045 0.047 0.026]]
 The mean of the samples was 1.628
 Iteration 472
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [1.022]
 The next parameters to simulate from are [[0.335 0.428 0.021 0.044 0.003 0.026]]
 The mean of the samples was 1.018

Iteration 473
Acquisition function convergence reached at iteration 48.
The final EI loss was -0.0 with predicted mean of [0.175]
The next parameters to simulate from are [[0.934 0.004 0. 0.032 0.001 0.066]]
The mean of the samples was 0.499

Iteration 474
Acquisition function convergence reached at iteration 41.
The final EI loss was -0.004 with predicted mean of [-0.91]
The next parameters to simulate from are [[0.207 0.618 0.033 0.018 0.013 0.04]]
The mean of the samples was -0.957

Iteration 475
Acquisition function convergence reached at iteration 98.
The final EI loss was -0.003 with predicted mean of [-0.744]
The next parameters to simulate from are [[0.008 0.017 0.03 0.019 0. 0.044]]
The mean of the samples was -0.924

Iteration 476
Acquisition function convergence reached at iteration 34.
The final EI loss was -0.001 with predicted mean of [-0.63]
The next parameters to simulate from are [[0.547 0.996 0.033 0.014 0.024 0.032]]
The mean of the samples was -0.65

Iteration 477
Acquisition function convergence reached at iteration 40.
The final EI loss was -0.001 with predicted mean of [-0.421]
The next parameters to simulate from are [[0.269 0.011 0.007 0.009 0.05 0.028]]
The mean of the samples was -0.268

Iteration 478
Acquisition function convergence reached at iteration 2.
The final EI loss was -0.0 with predicted mean of [0.705]
The next parameters to simulate from are [[0.403 0.17 0.007 0.031 0.022 0.026]]
The mean of the samples was 0.755

Iteration 479
Acquisition function convergence reached at iteration 46.
The final EI loss was -0.003 with predicted mean of [-0.823]
The next parameters to simulate from are [[0.011 0.141 0.033 0.018 0.015 0.053]]
The mean of the samples was -1.04

Iteration 480
Acquisition function convergence reached at iteration 76.
The final EI loss was -0.014 with predicted mean of [-1.69]
The next parameters to simulate from are [[0.079 0.132 0.007 0.01 0.021 0.025]]
The mean of the samples was -1.829

Hyperparameter convergence reached at iteration 2224.
The minimum predicted mean of the observed indices is -1.703 at the point
[0.087 0.17 0.007 0.01 0.021 0.026]

Iteration 481
Acquisition function convergence reached at iteration 2.
The final EI loss was -0.0 with predicted mean of [0.249]
The next parameters to simulate from are [[0.087 0.17 0.027 0.025 0.021 0.026]]
The mean of the samples was 0.155

Iteration 482
Acquisition function convergence reached at iteration 64.
The final EI loss was -0.002 with predicted mean of [-0.806]
The next parameters to simulate from are [[0.185 0.375 0.028 0.019 0. 0.042]]
The mean of the samples was -0.812

Iteration 483
Acquisition function convergence reached at iteration 2.
The final EI loss was -0.0 with predicted mean of [0.526]
The next parameters to simulate from are [[0.861 0.158 0.008 0.028 0.031 0.025]]
The mean of the samples was 0.587

Iteration 484
Acquisition function convergence reached at iteration 71.
The final EI loss was -0.002 with predicted mean of [-0.815]
The next parameters to simulate from are [[0.008 0.289 0.033 0.015 0.001 0.039]]
The mean of the samples was -0.736

Iteration 485
Acquisition function convergence reached at iteration 26.
The final EI loss was -0.003 with predicted mean of [-0.968]
The next parameters to simulate from are [[0.001 0.504 0.012 0.009 0.04 0.038]]
The mean of the samples was -0.863

Iteration 486
Acquisition function convergence reached at iteration 2.
The final EI loss was -0.0 with predicted mean of [0.79]
The next parameters to simulate from are [[0.827 0.297 0.007 0.036 0.032 0.01]]
The mean of the samples was 1.004

Iteration 487
Acquisition function convergence reached at iteration 2.
The final EI loss was -0.0 with predicted mean of [0.988]
The next parameters to simulate from are [[0.709 0.17 0.002 0.05 0.034 0.053]]
The mean of the samples was 1.366

Iteration 488
Acquisition function convergence reached at iteration 2.
The final EI loss was -0.0 with predicted mean of [1.249]
The next parameters to simulate from are [[0.526 0.17 0.016 0.045 0.021 0.019]]
The mean of the samples was 1.21

Iteration 489
Acquisition function convergence reached at iteration 40.
The final EI loss was -0.0 with predicted mean of [0.051]

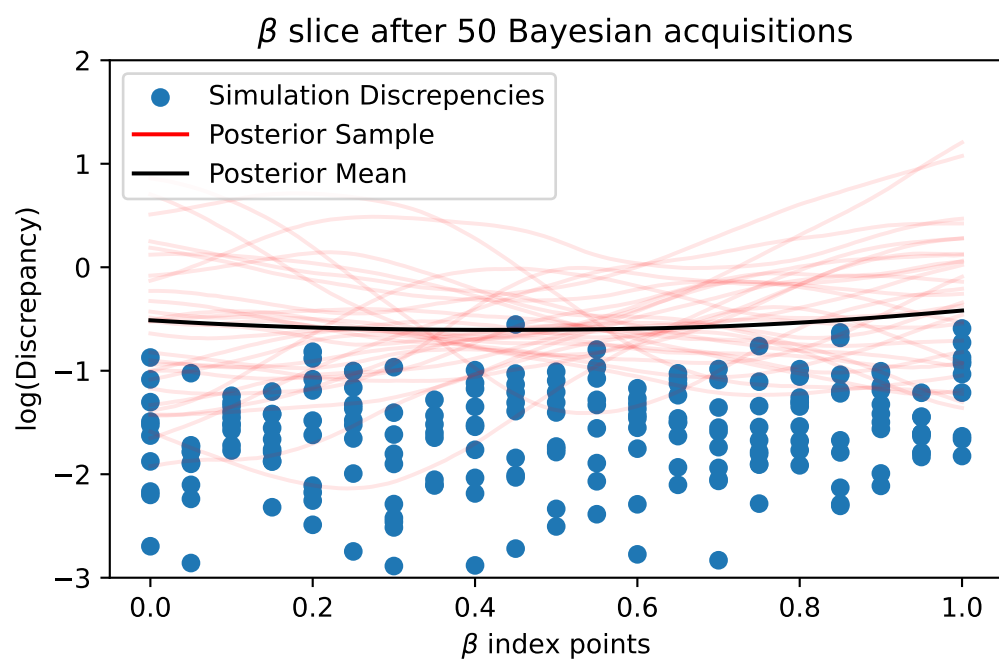
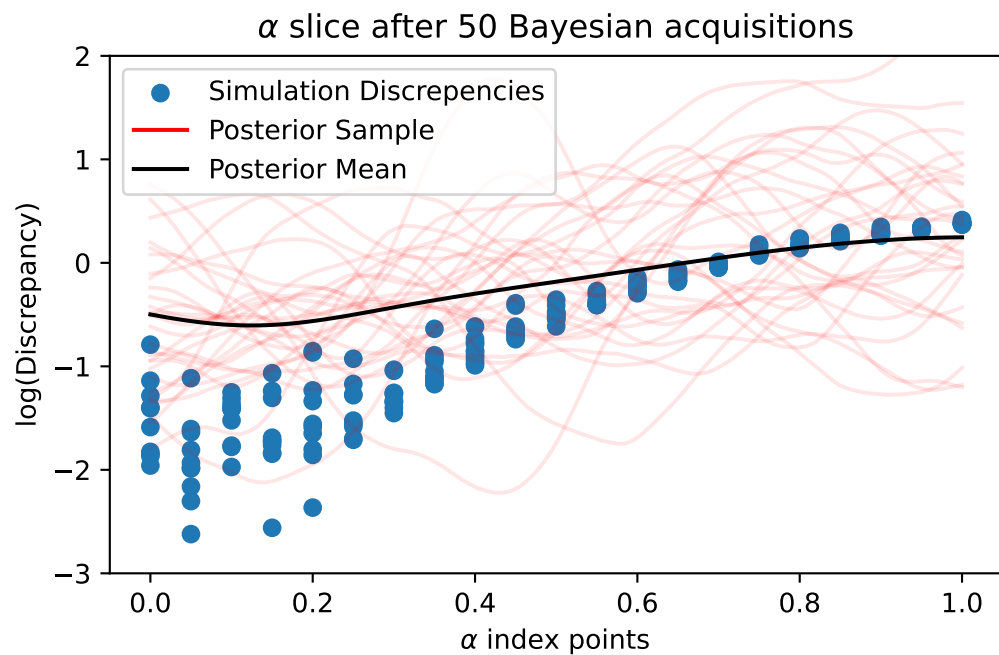
The next parameters to simulate from are [[0.996 0.007 0.032 0.018 0.048 0.]]
 The mean of the samples was 0.2
 Iteration 490
 Acquisition function convergence reached at iteration 83.
 The final EI loss was -0.002 with predicted mean of [-0.614]
 The next parameters to simulate from are [[0.012 0.967 0.033 0.02 0.014 0.045]]
 The mean of the samples was -0.683
 Iteration 491
 Acquisition function convergence reached at iteration 58.
 The final EI loss was -0.001 with predicted mean of [-0.329]
 The next parameters to simulate from are [[0.306 0.993 0.033 0.012 0.049 0.063]]
 The mean of the samples was -0.461
 Iteration 492
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [1.707]
 The next parameters to simulate from are [[0.087 0.17 0.032 0.046 0.014 0.004]]
 The mean of the samples was 1.74
 Iteration 493
 Acquisition function convergence reached at iteration 51.
 The final EI loss was -0.001 with predicted mean of [-0.371]
 The next parameters to simulate from are [[0.267 0.008 0.02 0.004 0.049 0.024]]
 The mean of the samples was -0.401
 Iteration 494
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [1.05]
 The next parameters to simulate from are [[0.79 0.17 0.007 0.042 0.021 0.026]]
 The mean of the samples was 1.006
 Iteration 495
 Acquisition function convergence reached at iteration 95.
 The final EI loss was -0.014 with predicted mean of [-1.692]
 The next parameters to simulate from are [[0.083 0.134 0.007 0.011 0.021 0.026]]
 The mean of the samples was -1.651
 Iteration 496
 Acquisition function convergence reached at iteration 27.
 The final EI loss was -0.0 with predicted mean of [-0.308]
 The next parameters to simulate from are [[0.211 0.027 0.024 0.014 0.045 0.014]]
 The mean of the samples was -0.151
 Iteration 497
 Acquisition function convergence reached at iteration 2.
 The final EI loss was -0.0 with predicted mean of [0.659]
 The next parameters to simulate from are [[0.084 0.164 0.033 0.034 0.047 0.025]]
 The mean of the samples was 1.08
 Iteration 498

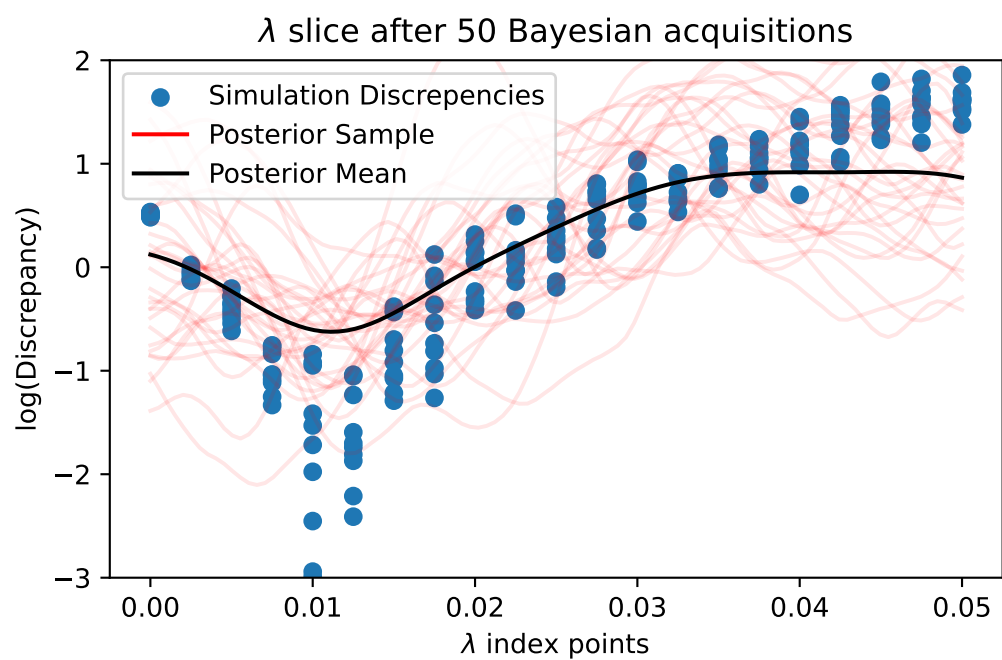
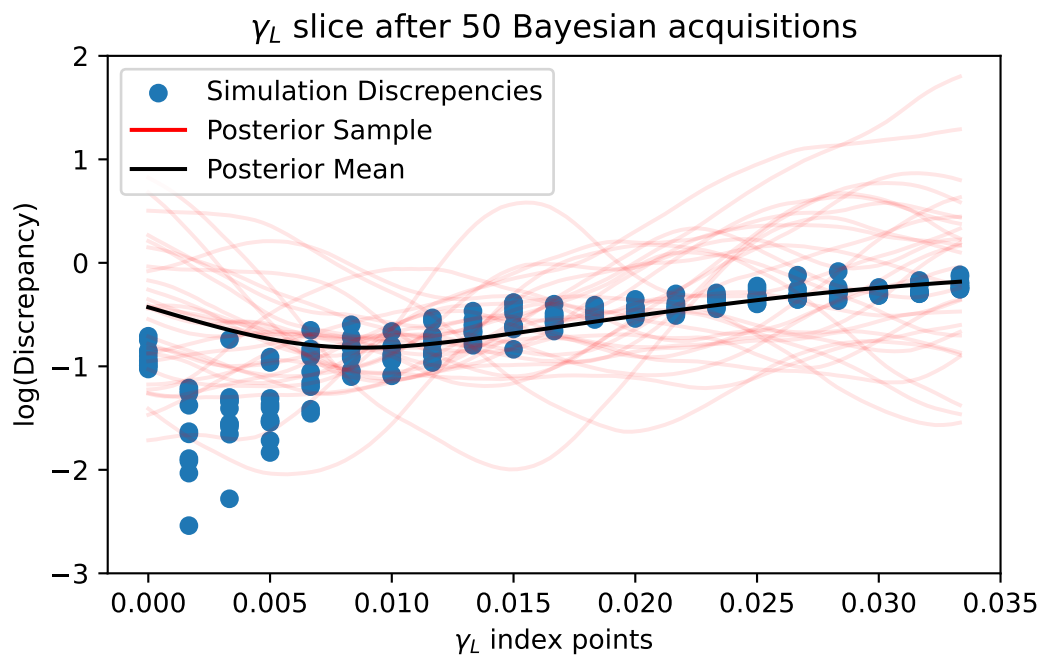
Acquisition function convergence reached at iteration 10.
The final EI loss was -0.0 with predicted mean of [0.095]
The next parameters to simulate from are [[0.601 0.079 0.014 0.013 0.012 0.066]]
The mean of the samples was 0.136
Iteration 499
Acquisition function convergence reached at iteration 115.
The final EI loss was -0.014 with predicted mean of [-1.694]
The next parameters to simulate from are [[0.083 0.138 0.007 0.01 0.021 0.025]]
The mean of the samples was -1.747
Iteration 500
Acquisition function convergence reached at iteration 59.
The final EI loss was -0.014 with predicted mean of [-1.676]
The next parameters to simulate from are [[0.085 0.868 0.008 0.011 0.024 0.024]]
The mean of the samples was -1.564
Hyperparameter convergence reached at iteration 2145.
The minimum predicted mean of the observed indices is -1.703 at the point
[0.087 0.17 0.007 0.01 0.021 0.026]
Trained parameters:
amplitude_champ:0 is 0.635

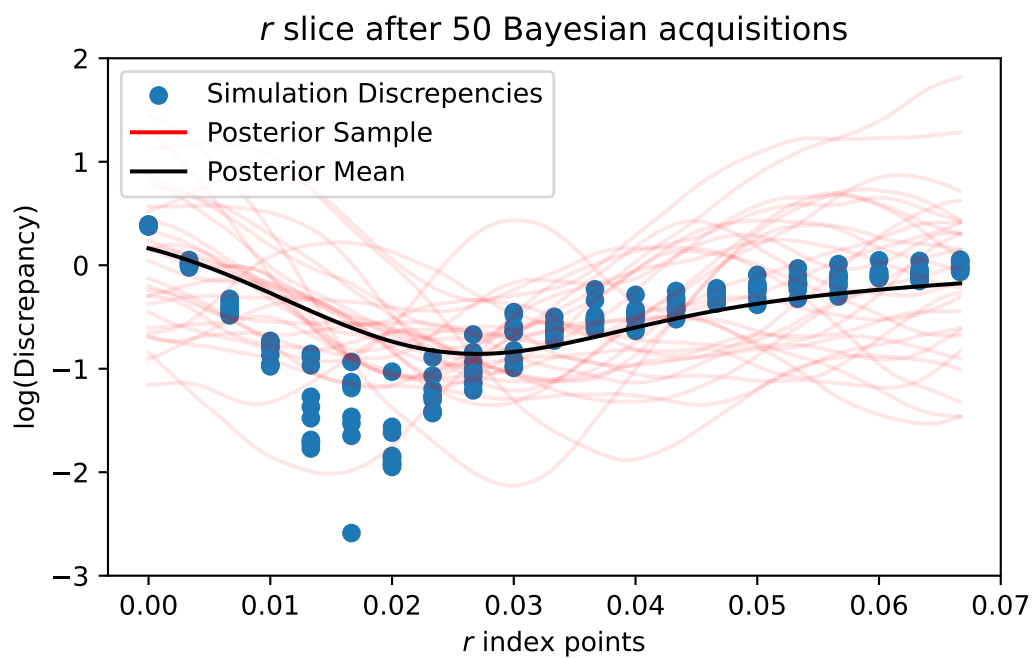
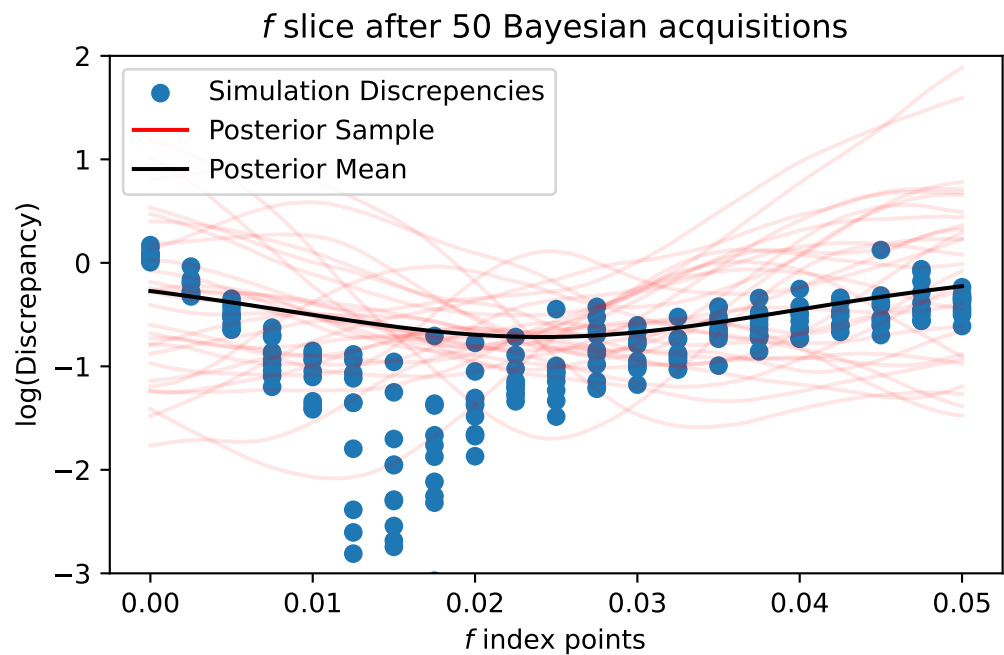
length_scales_champ:0 is [0.335 0.5 0.009 0.007 0.022 0.02]

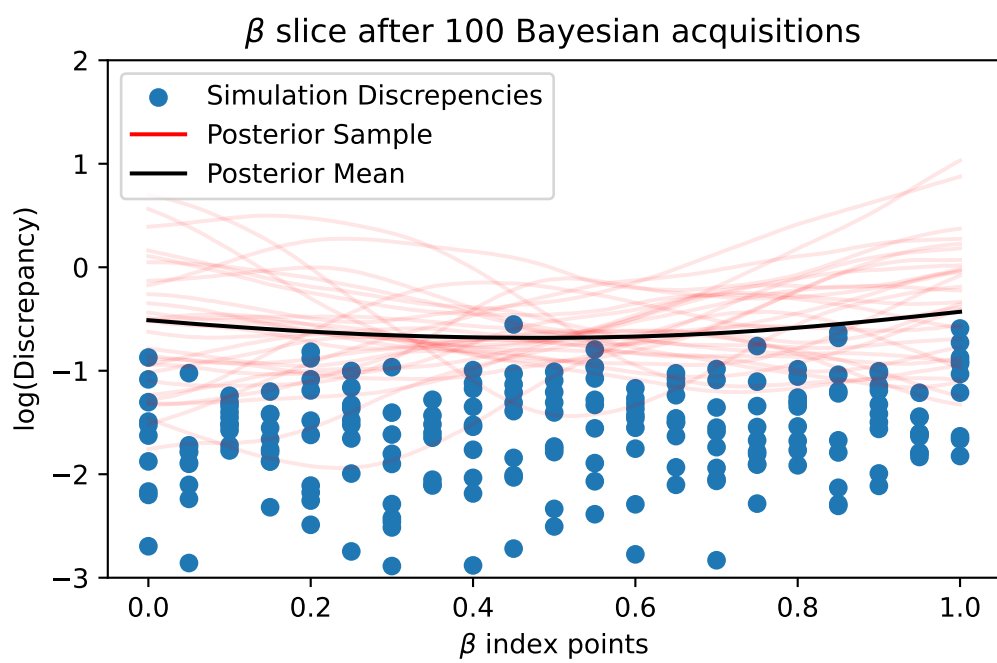
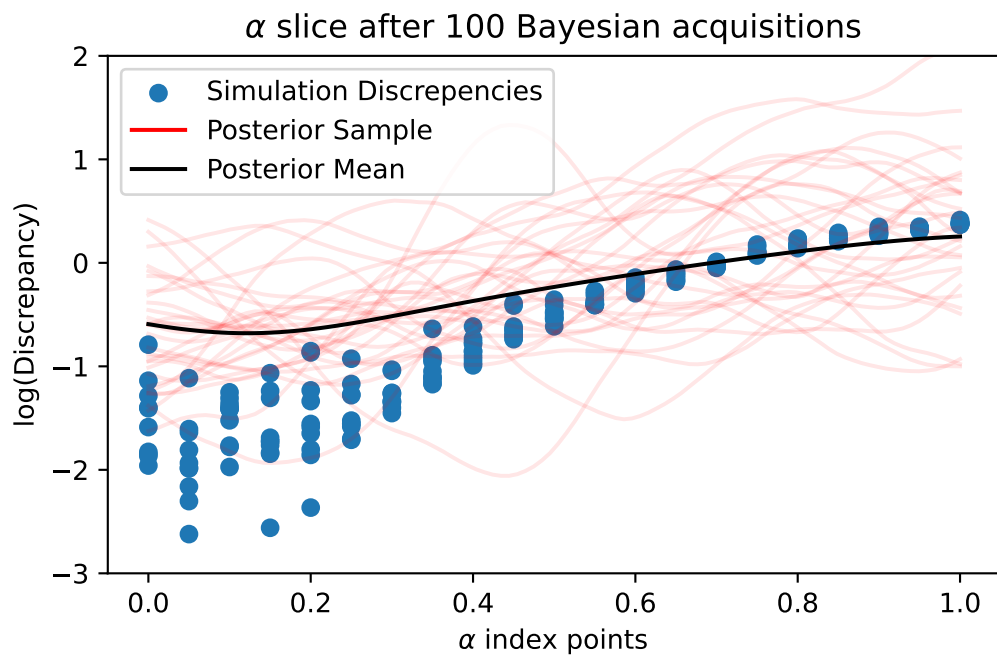
observation_noise_variance_champ:0 is 0.102

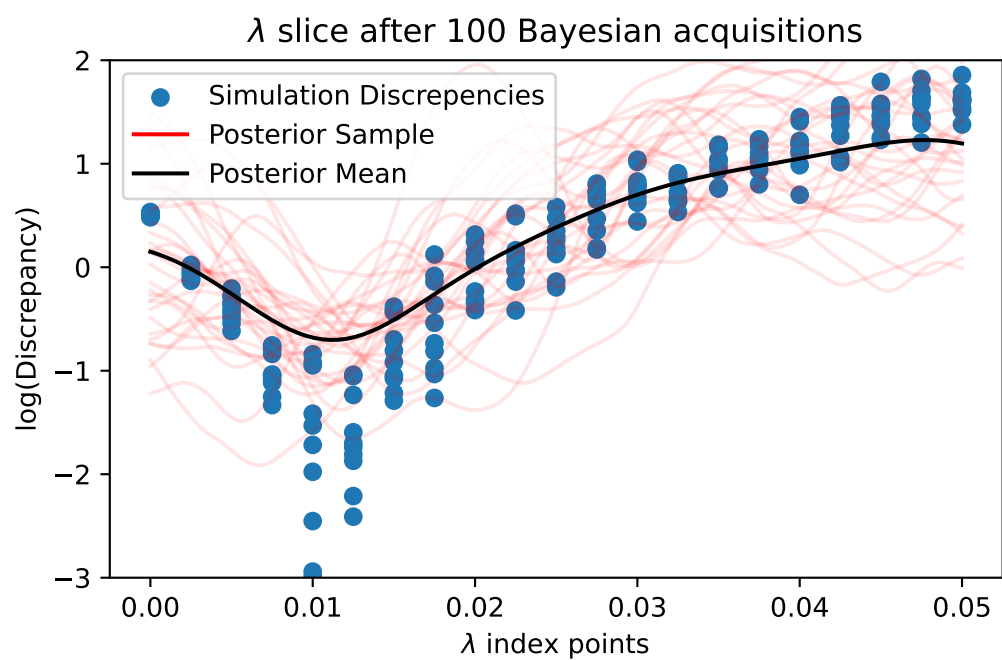
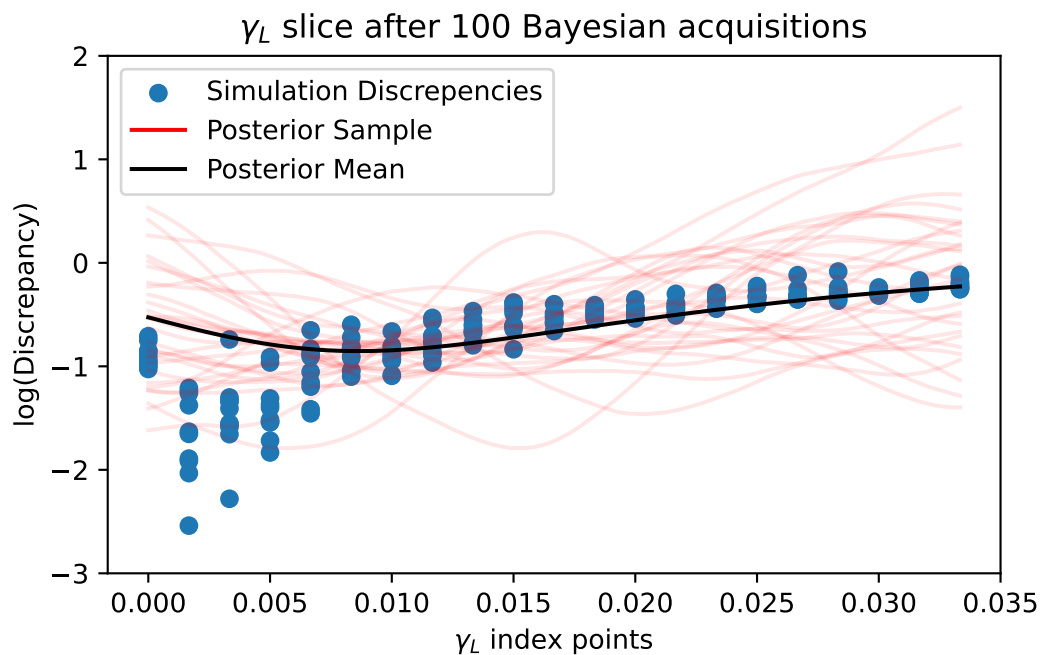
bias_mean:0 is 0.804

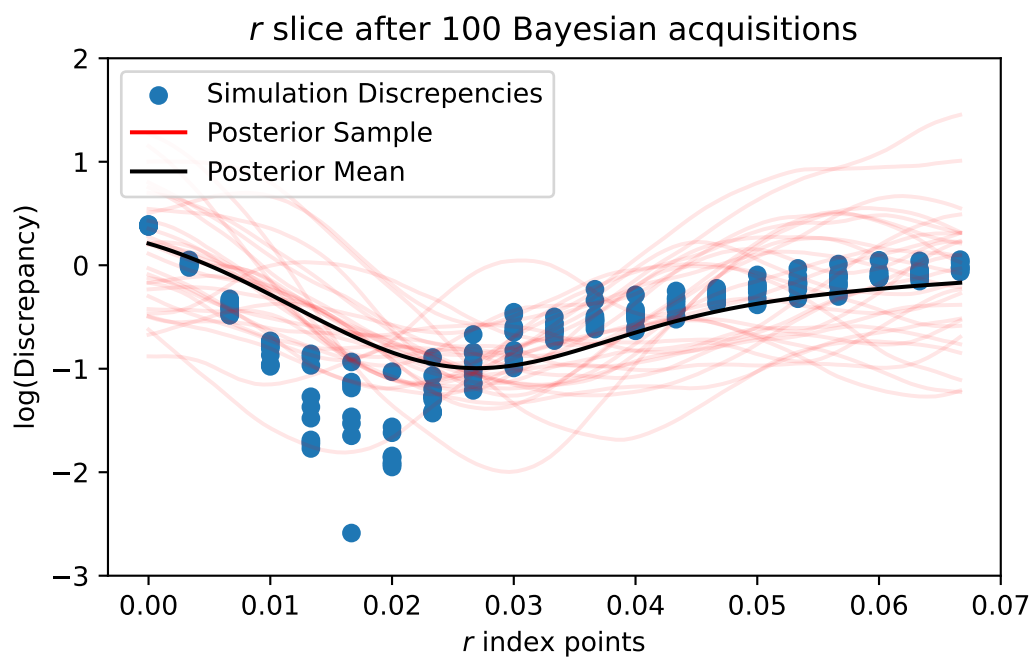
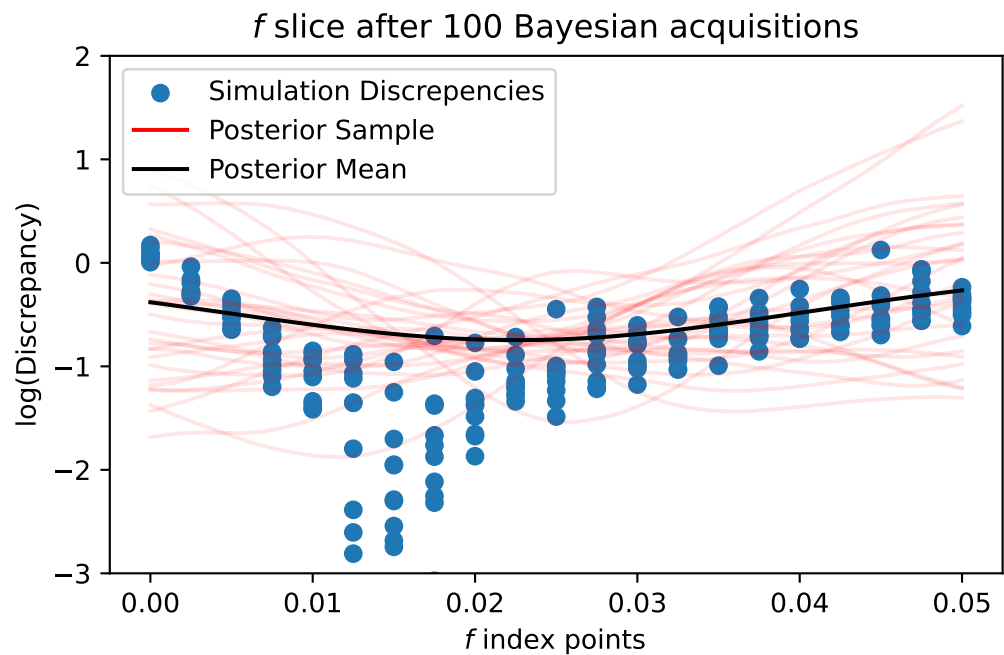


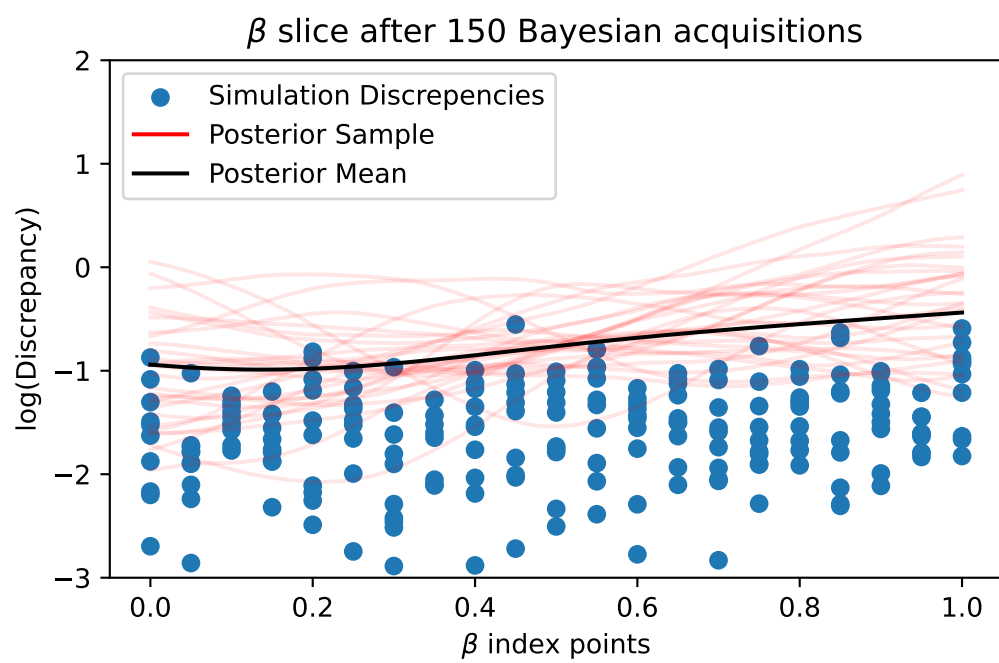
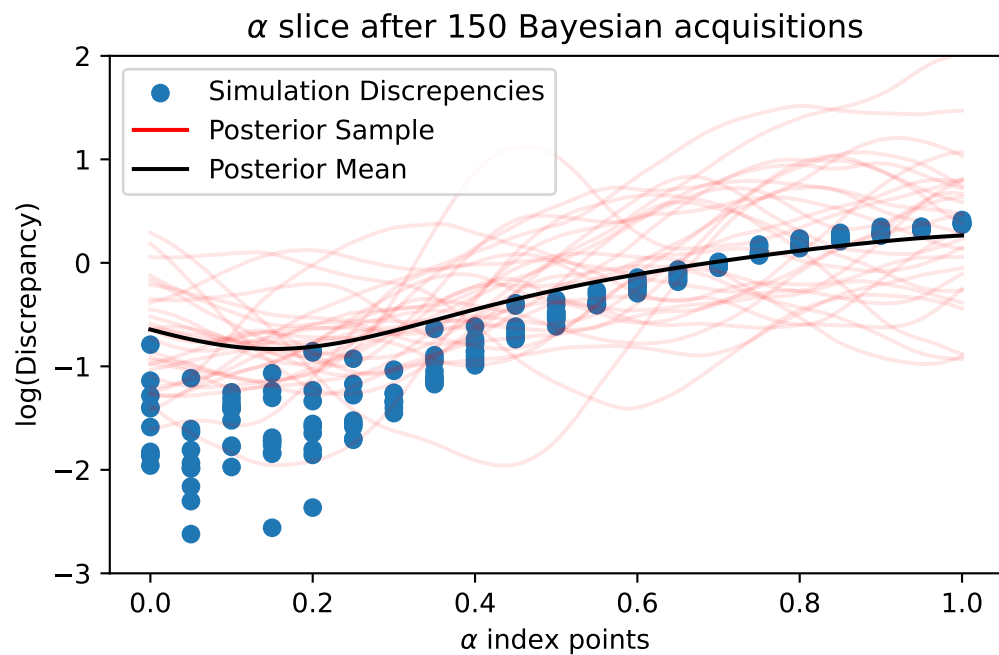


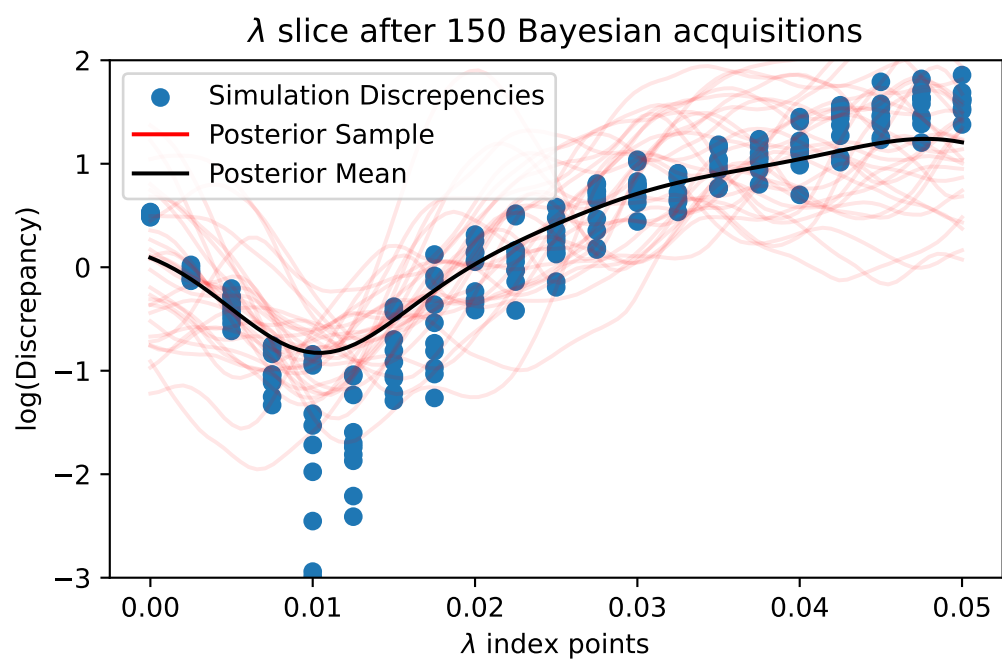
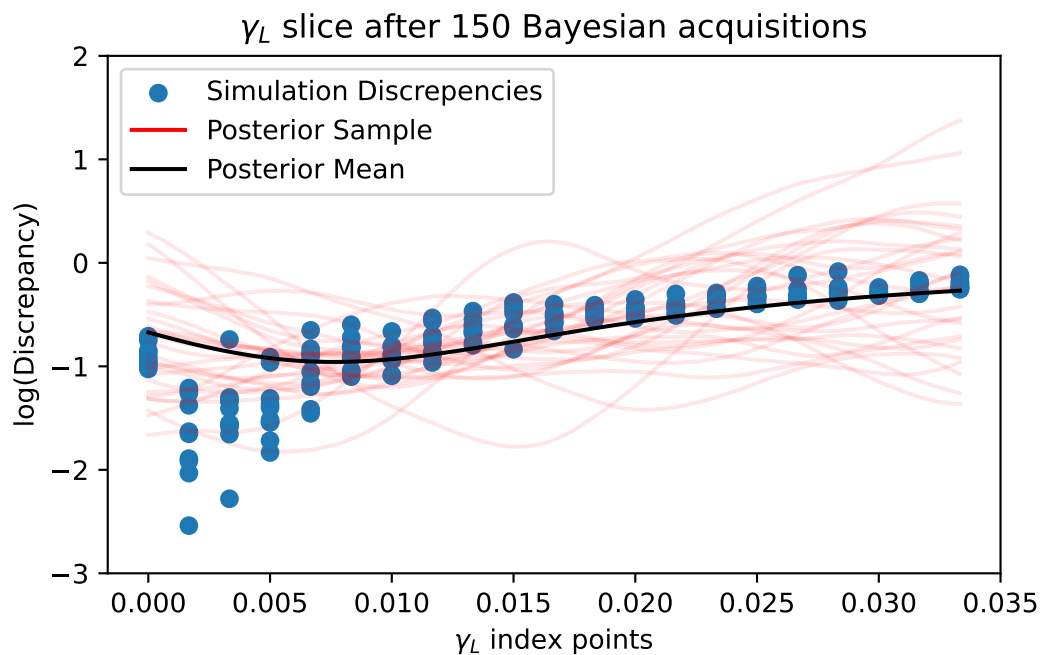


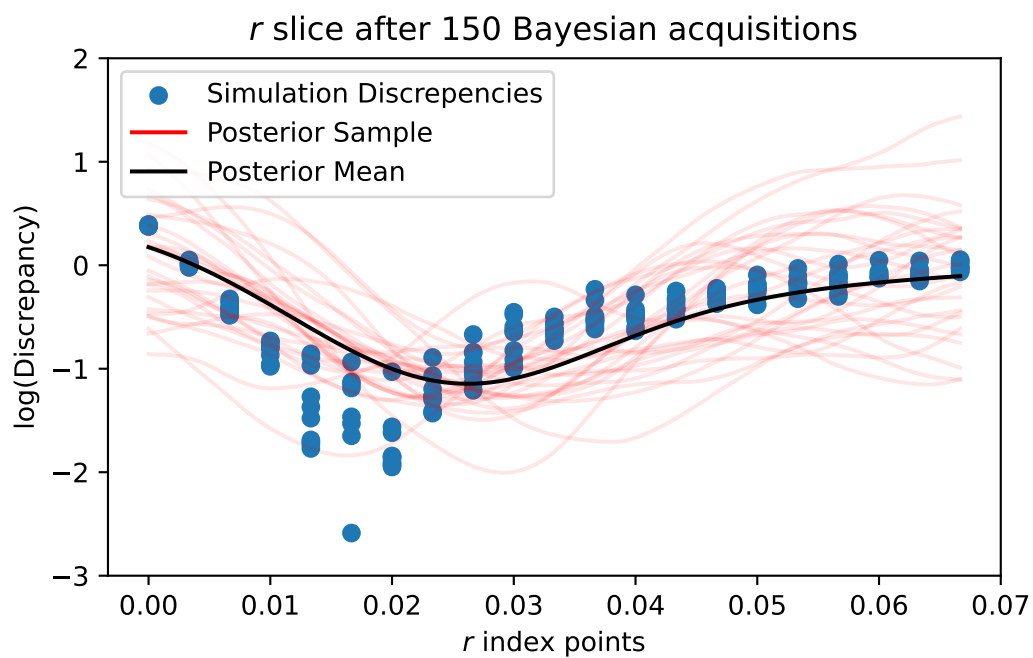
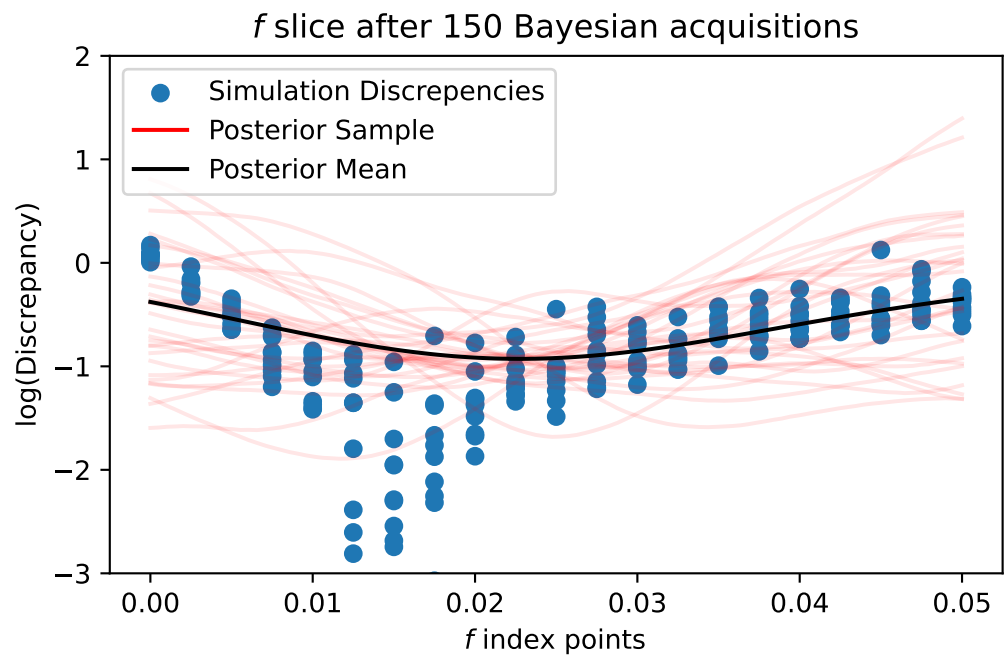


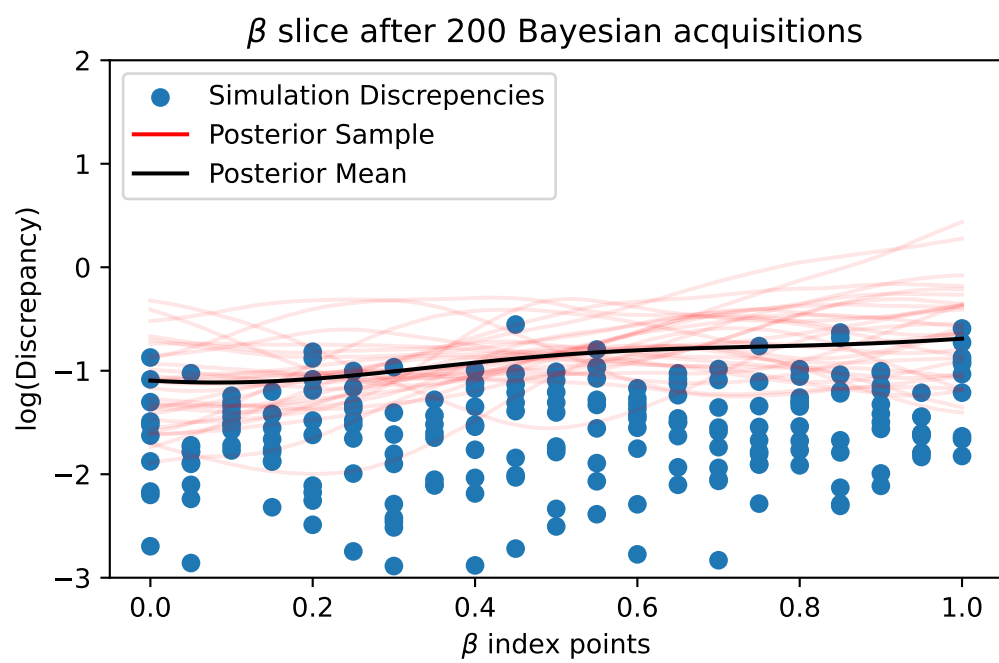
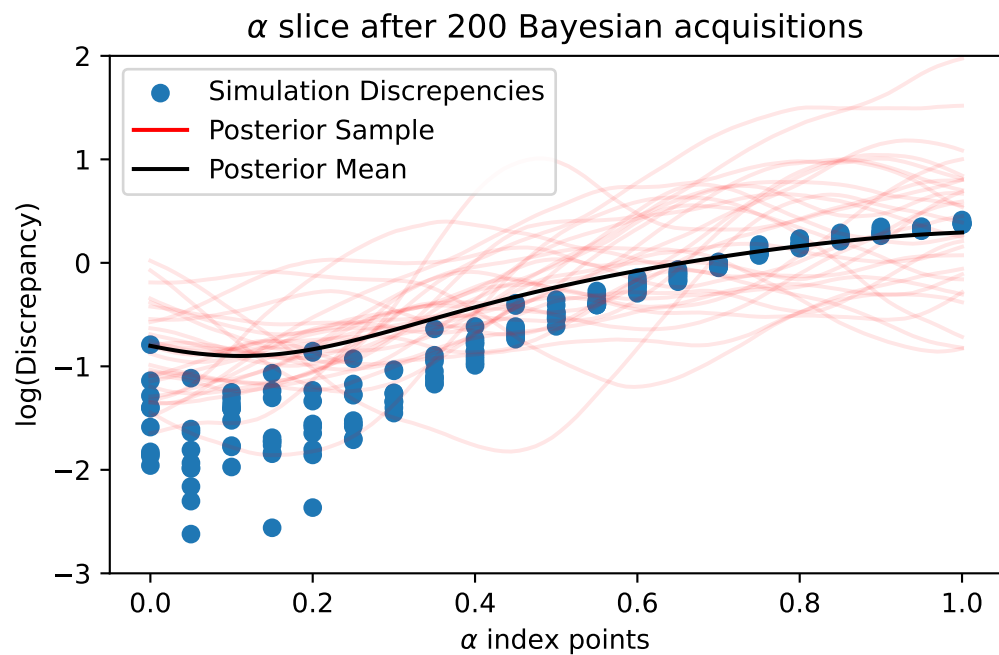


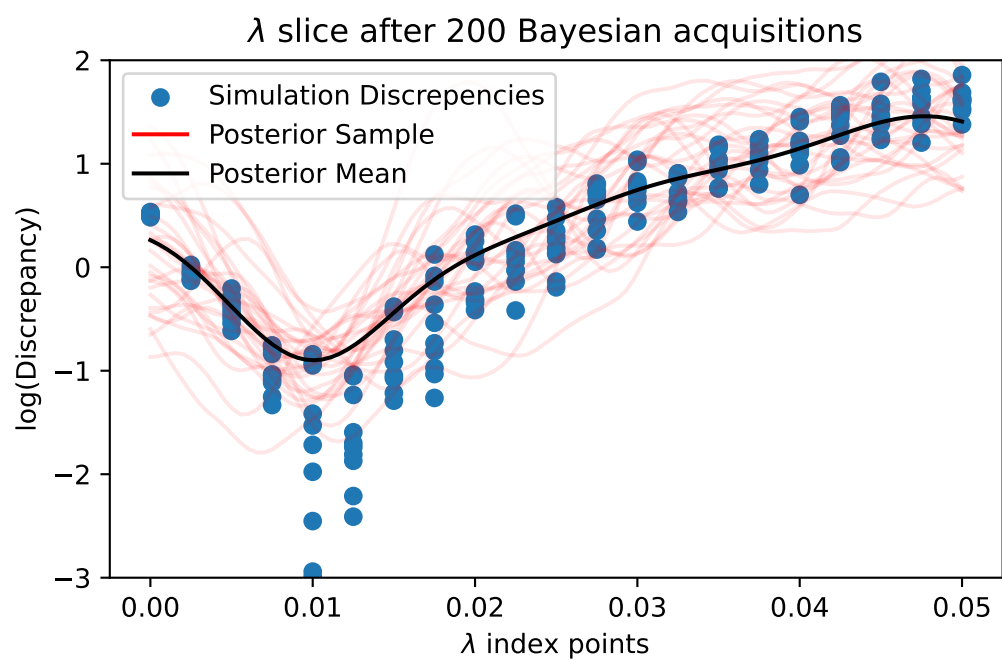
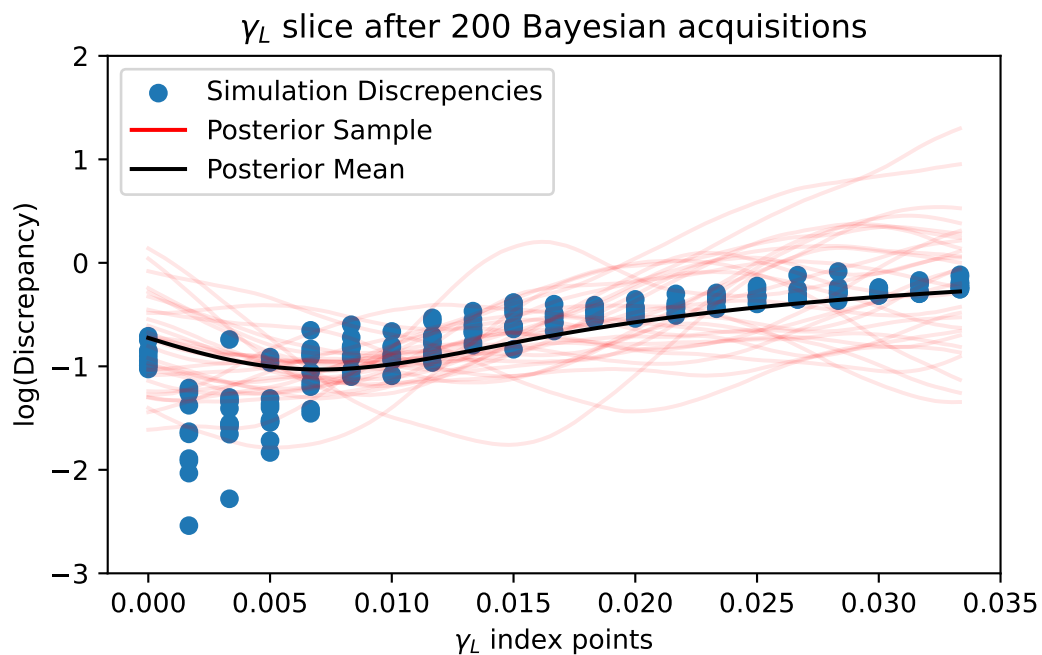


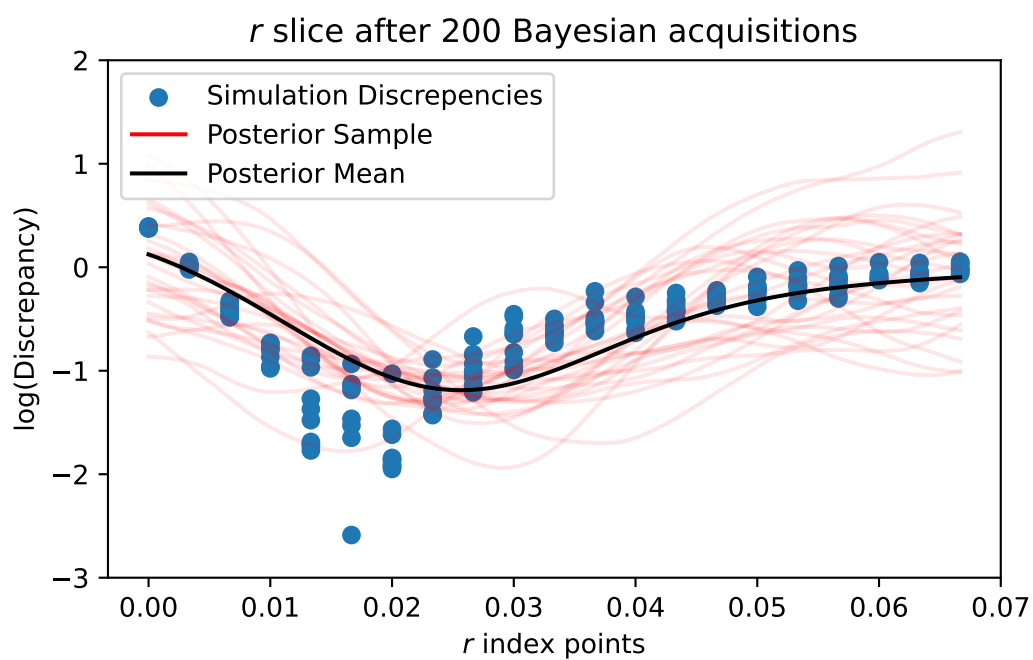
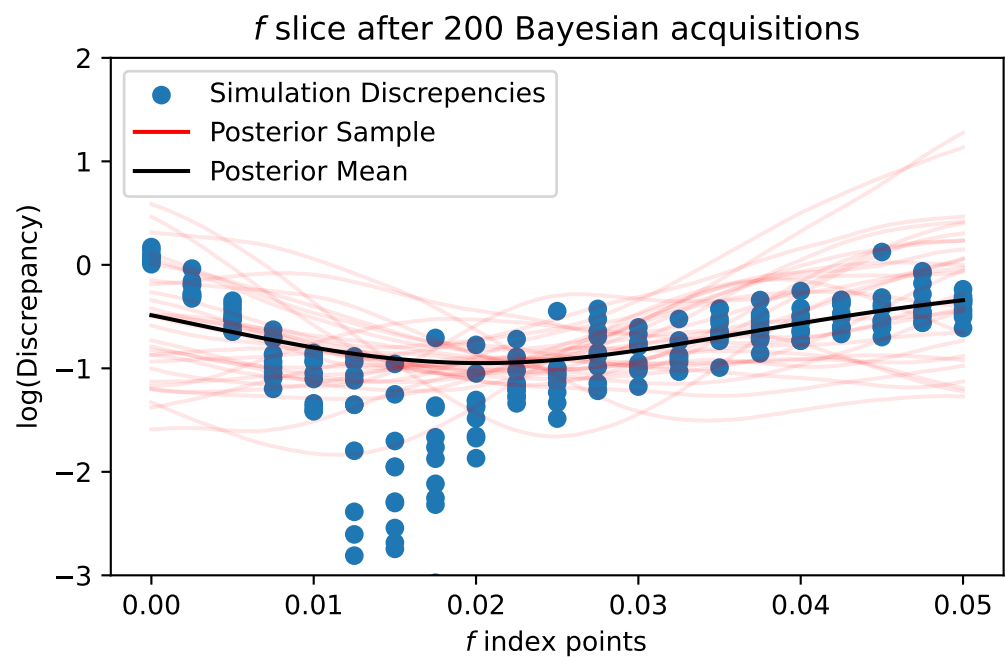


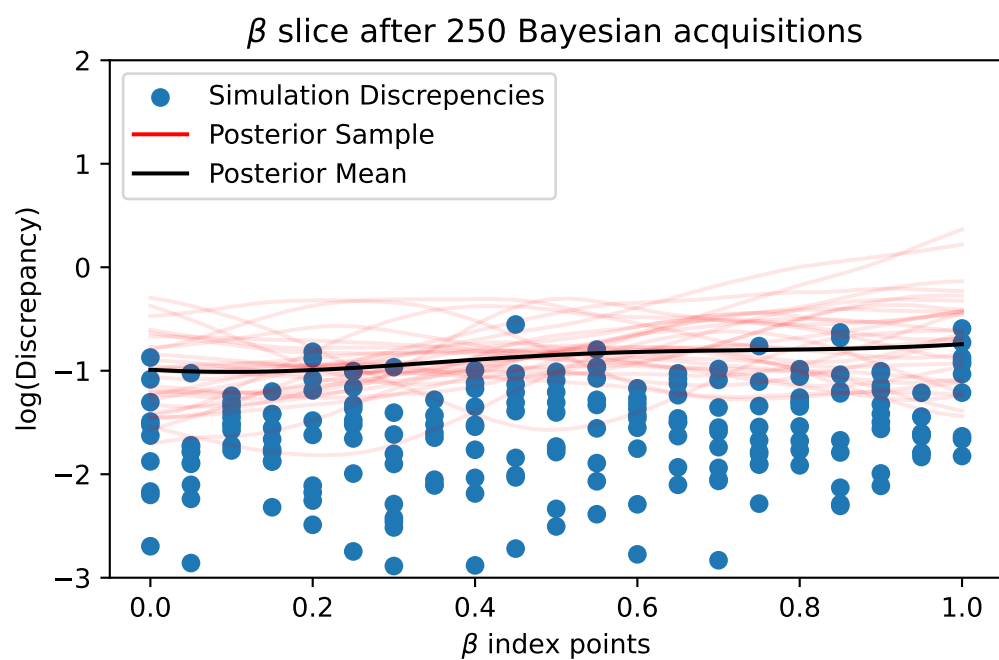
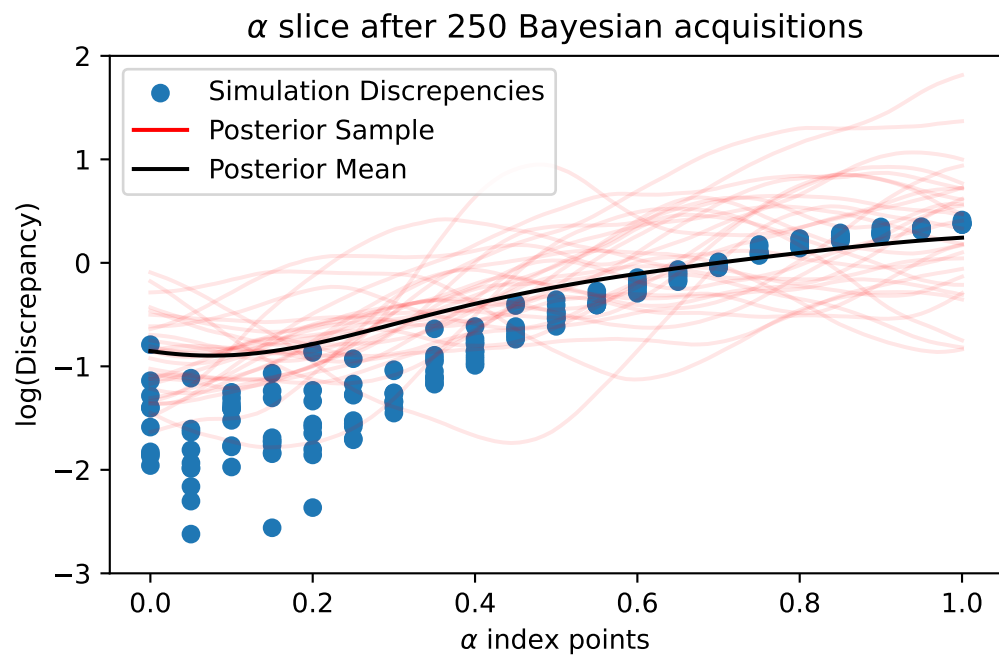


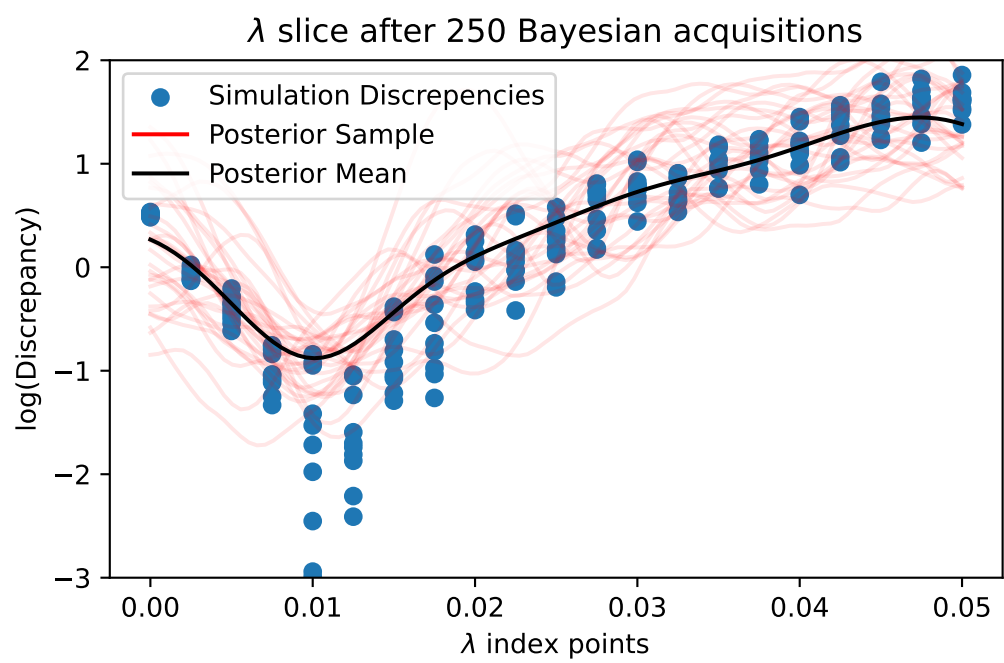
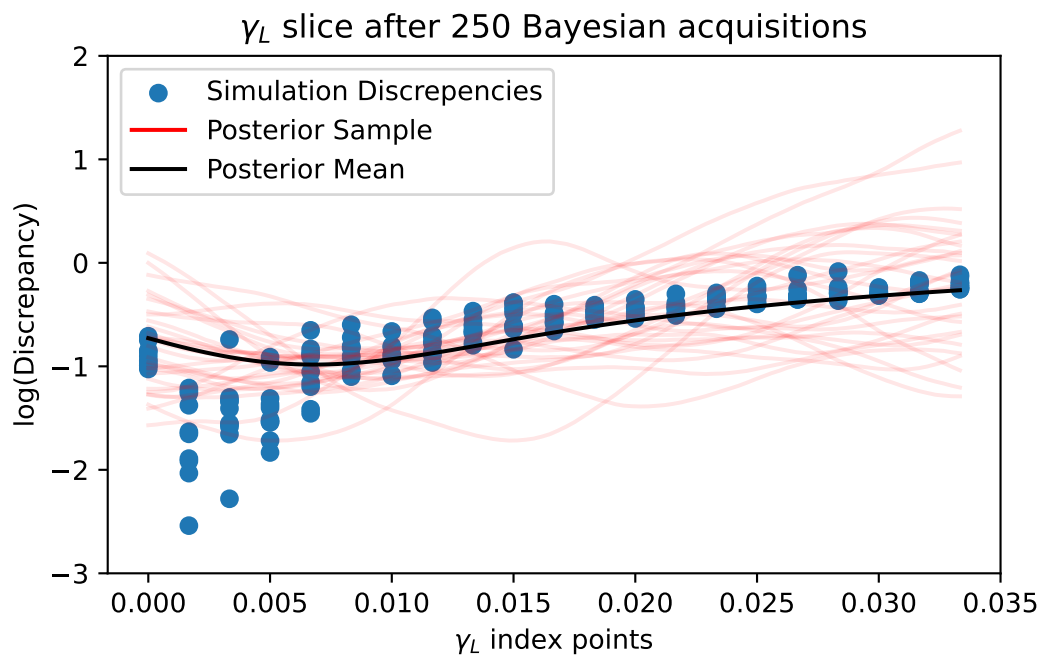


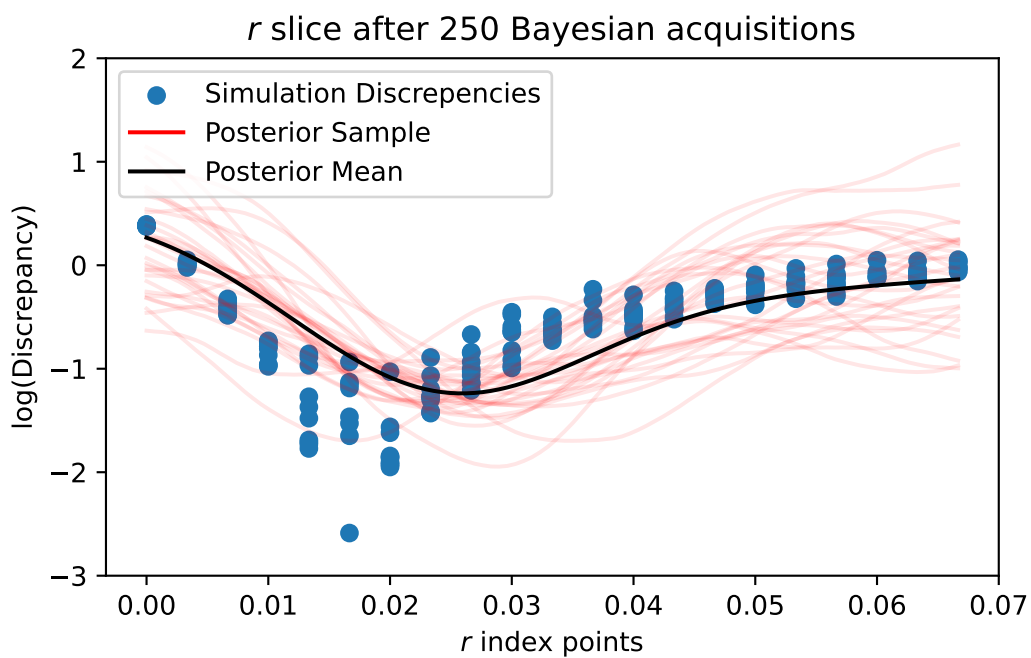
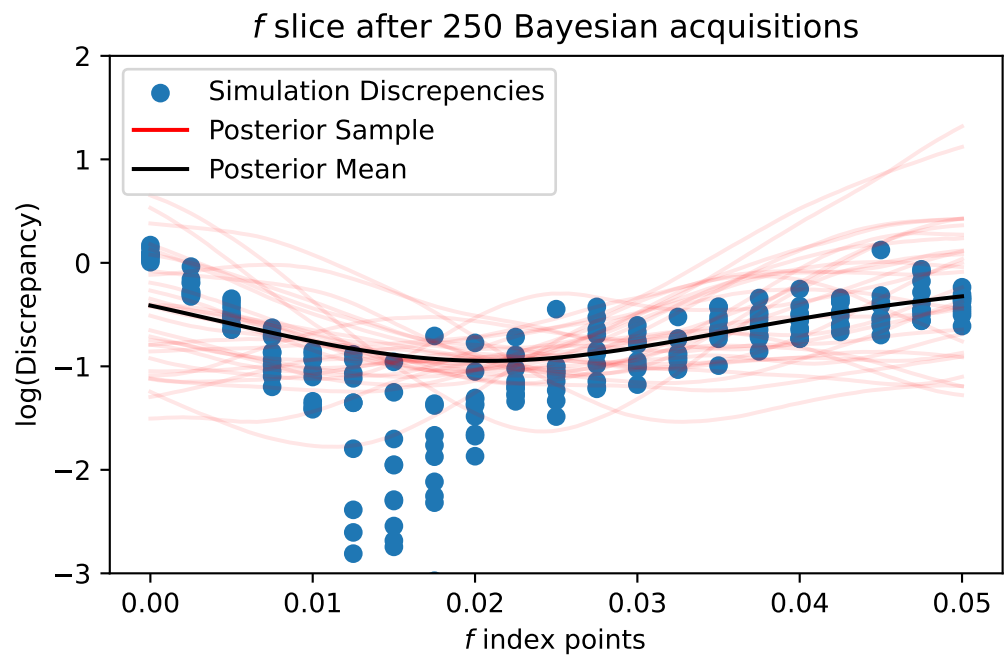


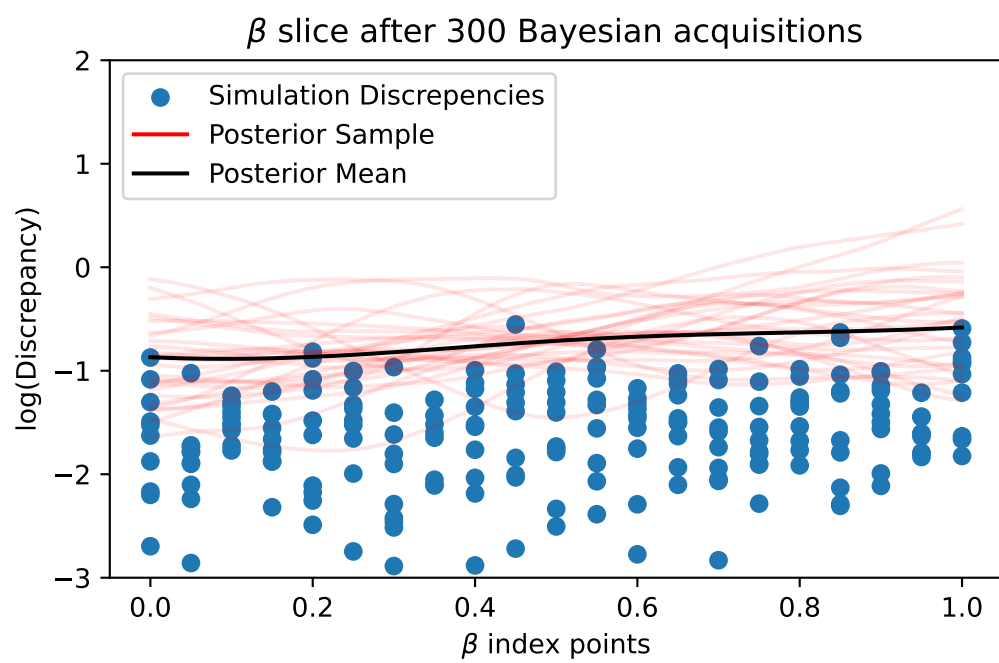
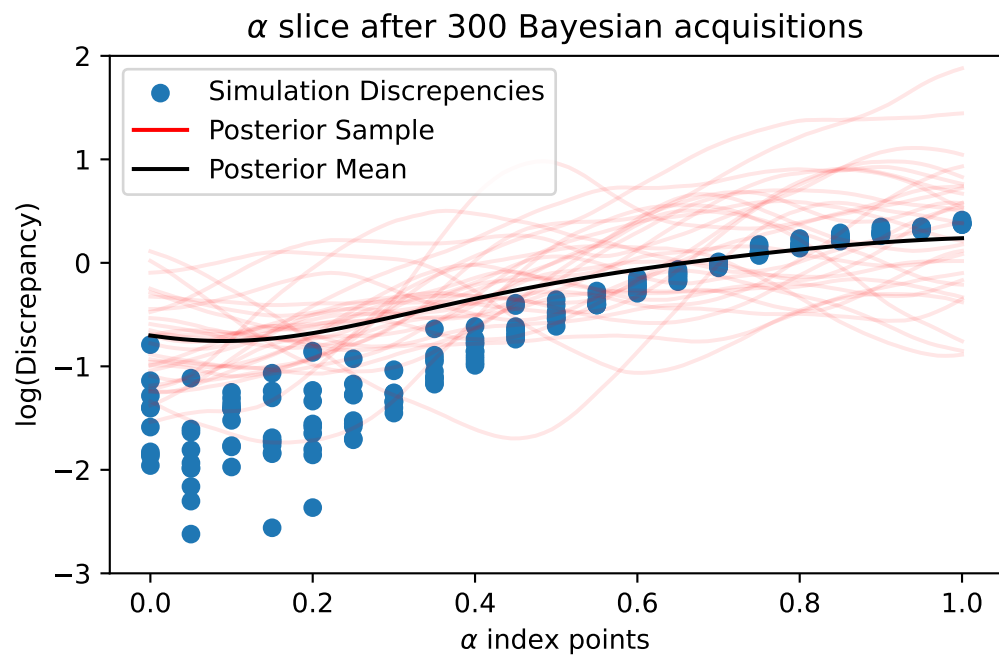


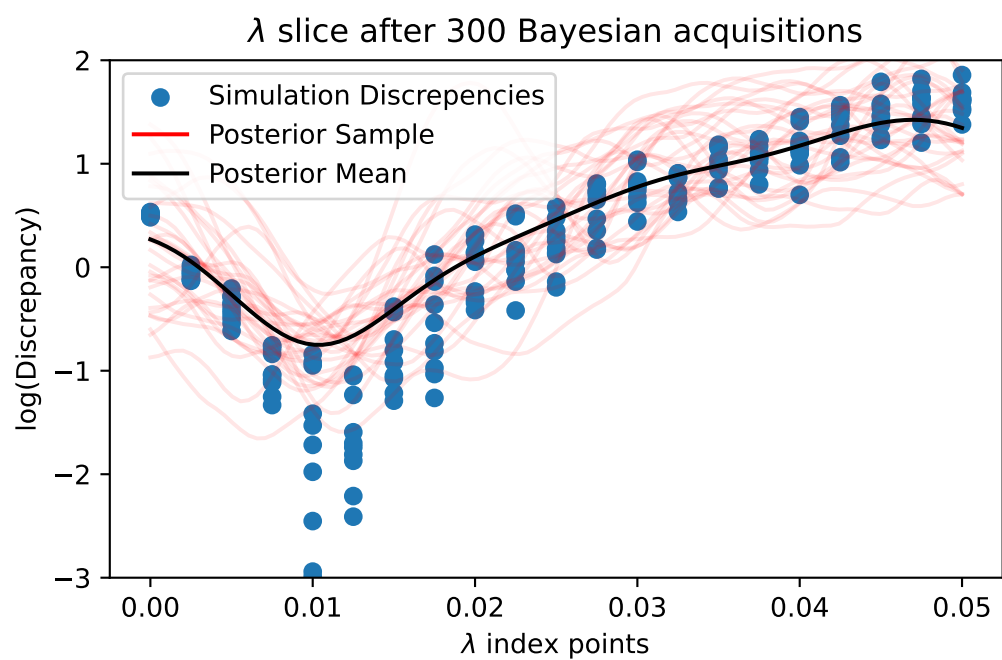
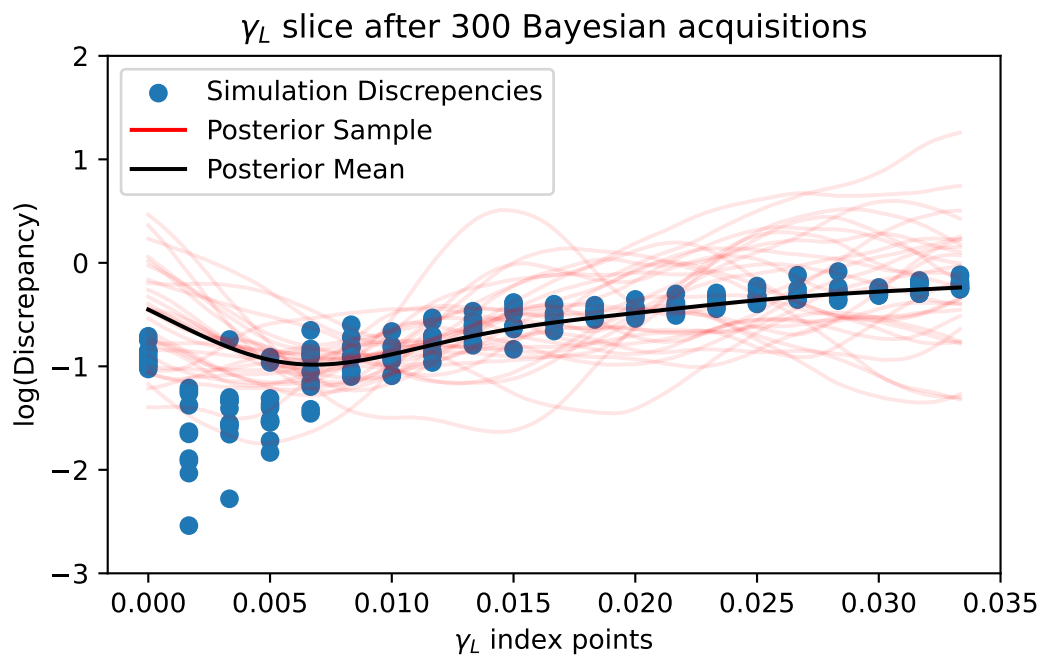


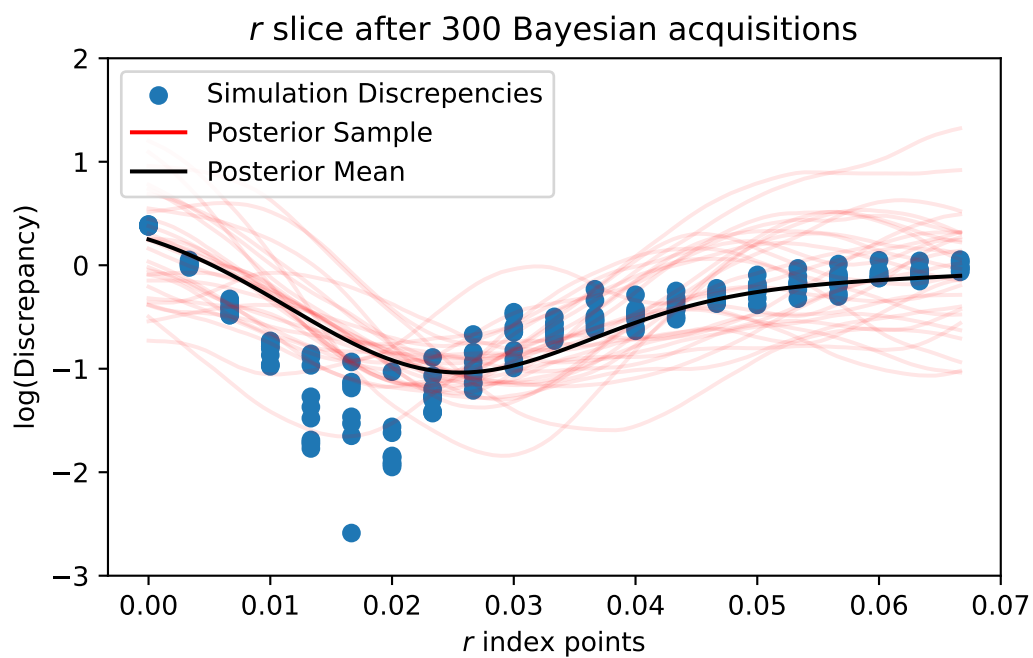
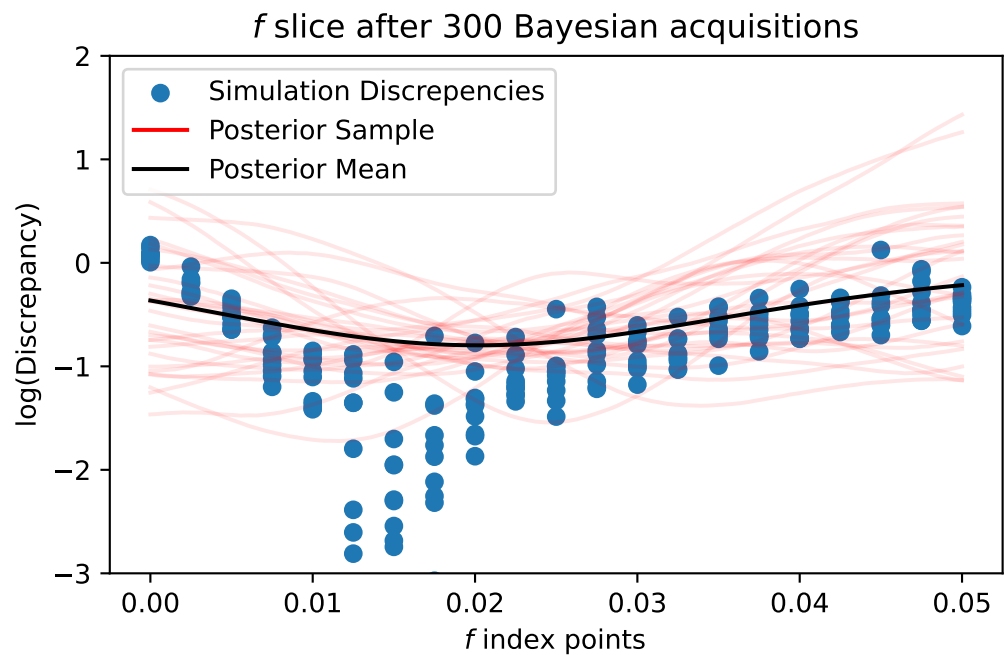


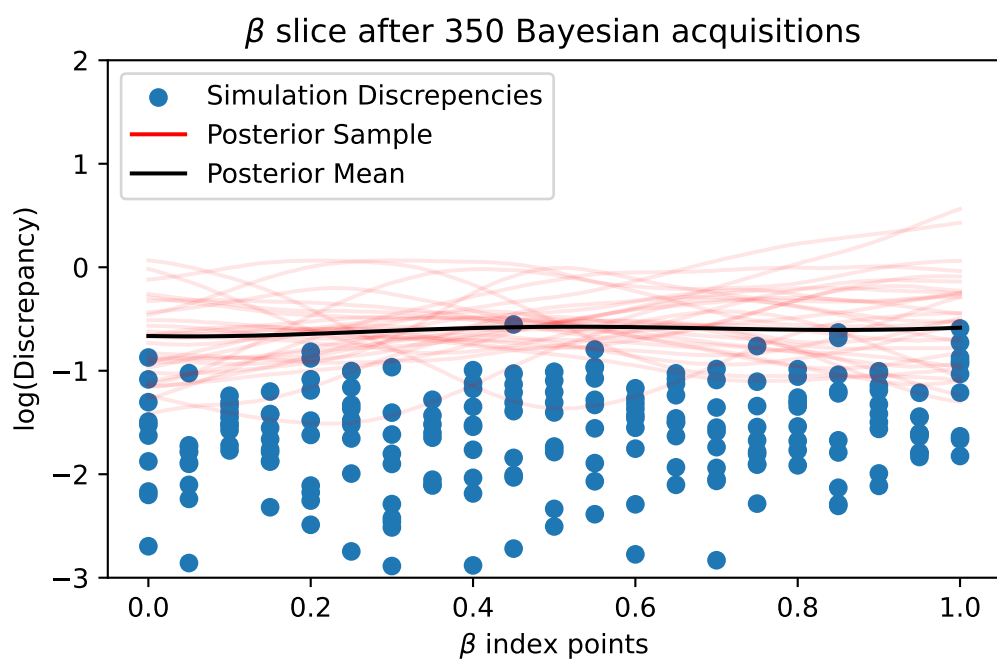
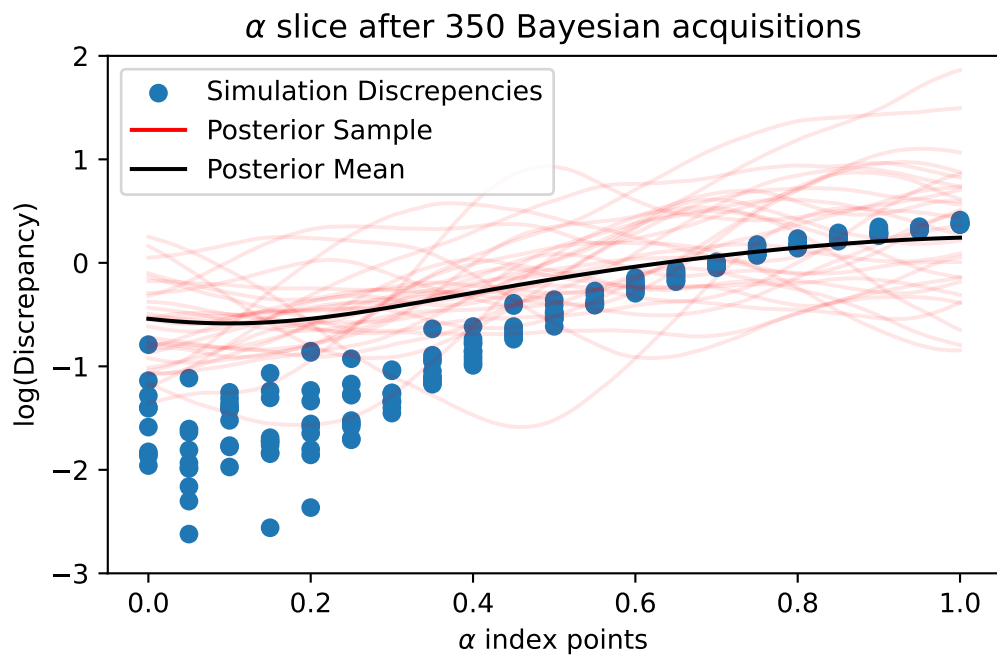


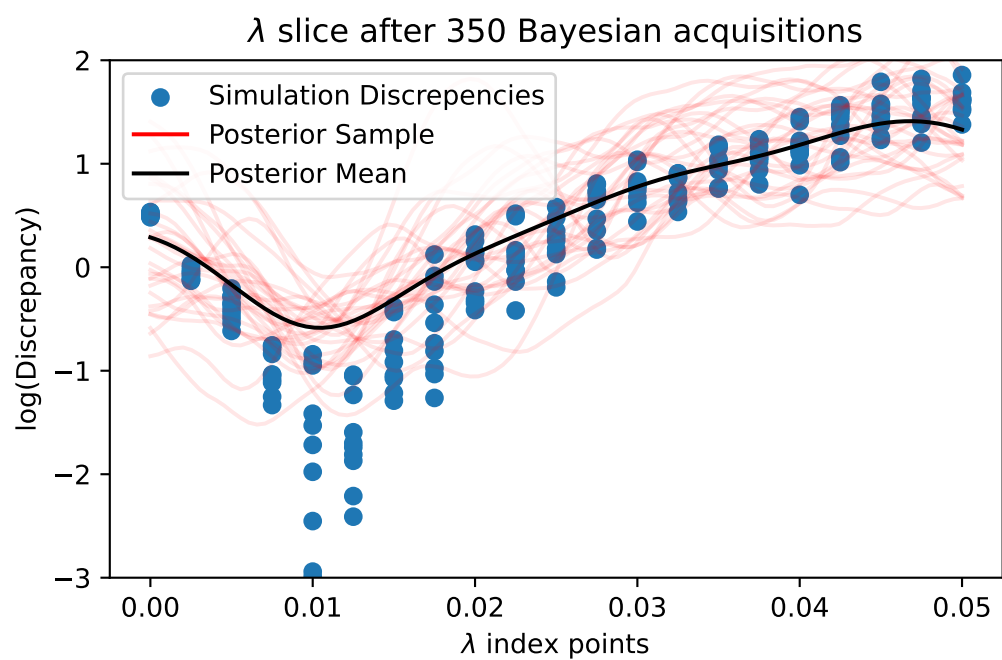
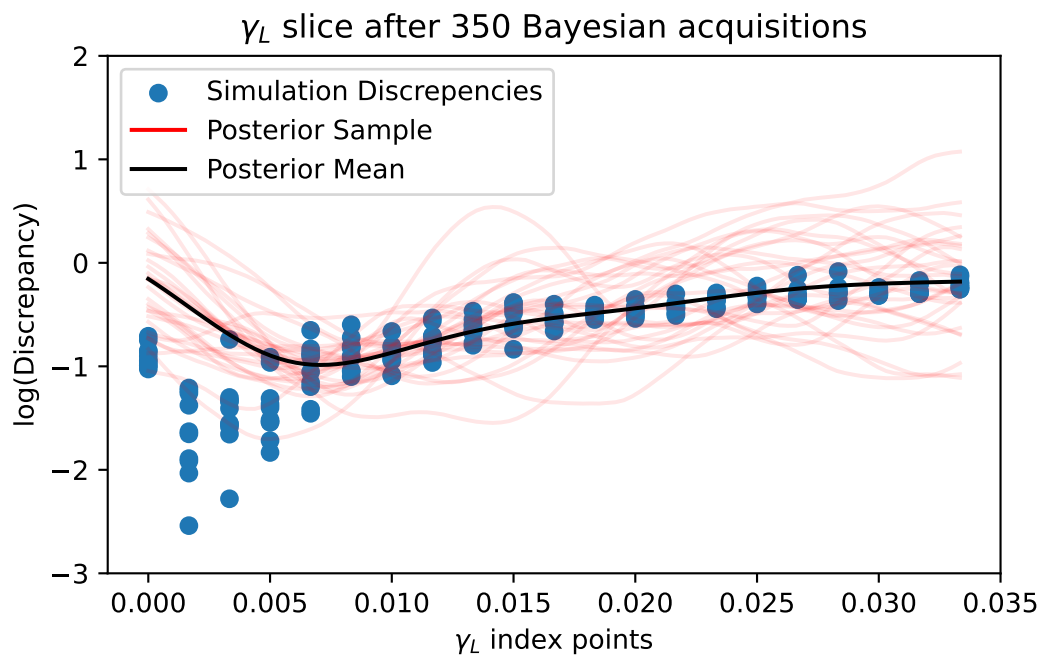


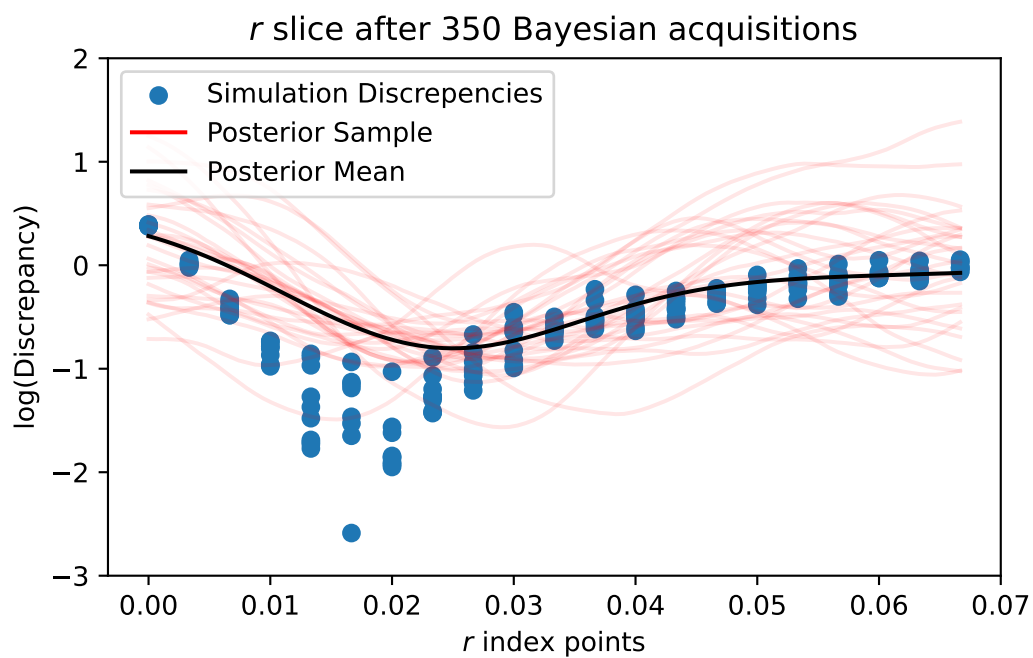
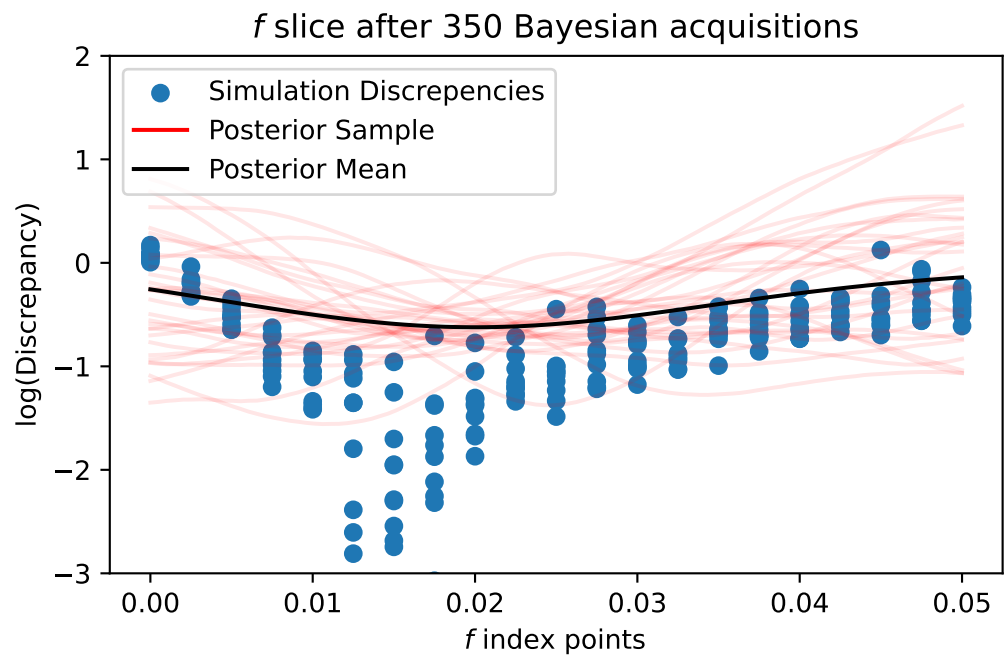


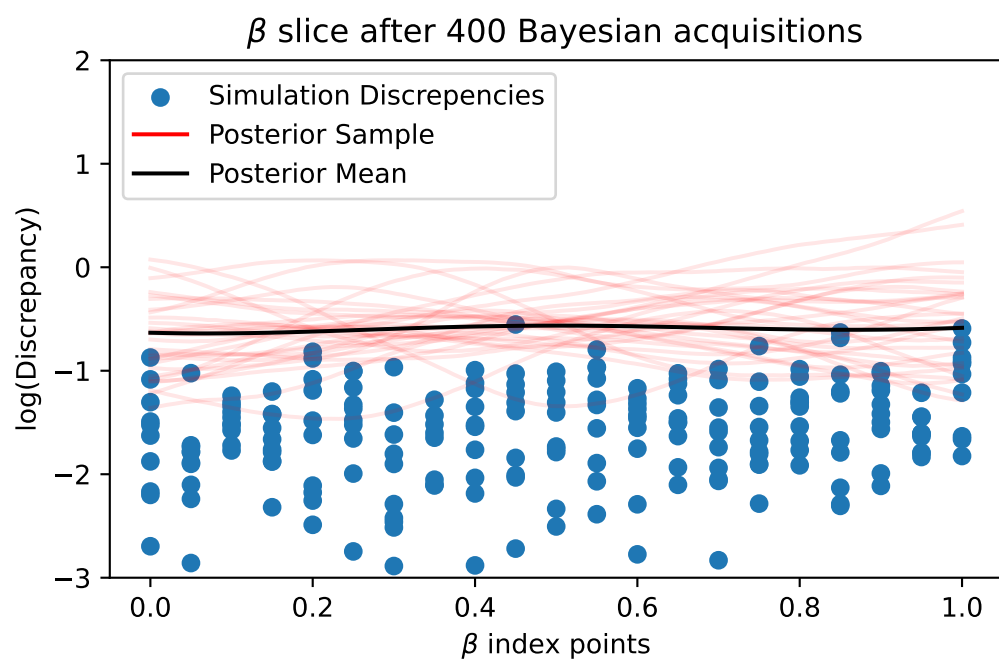
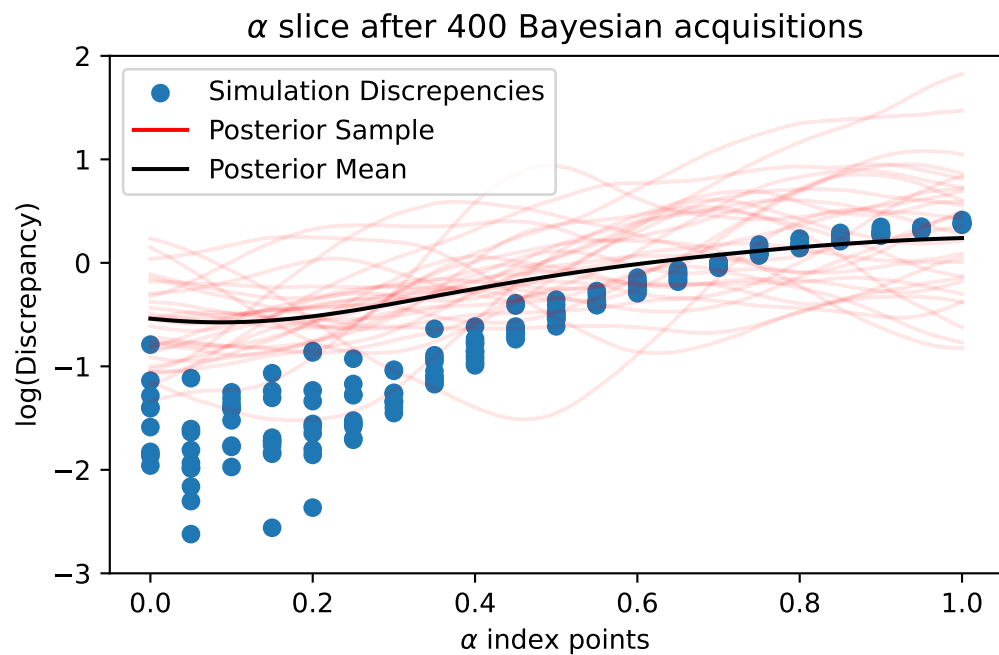


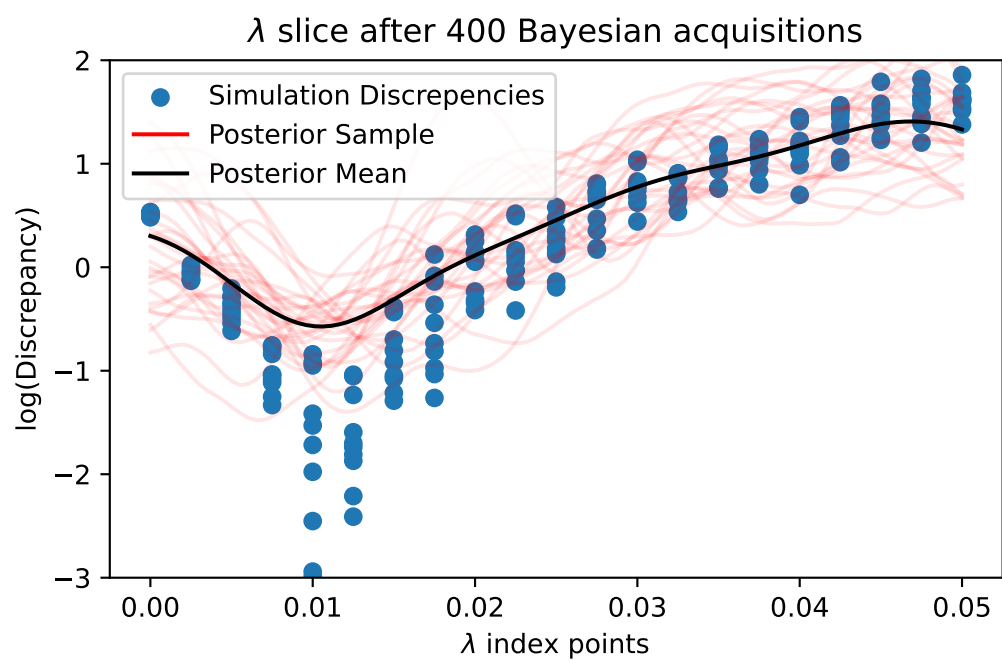
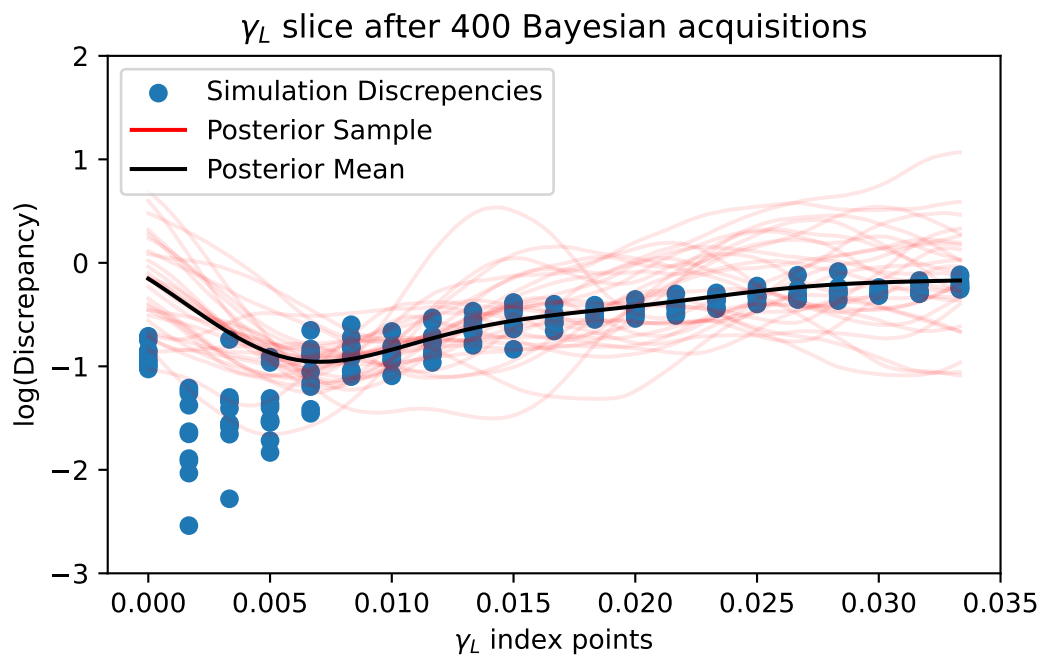


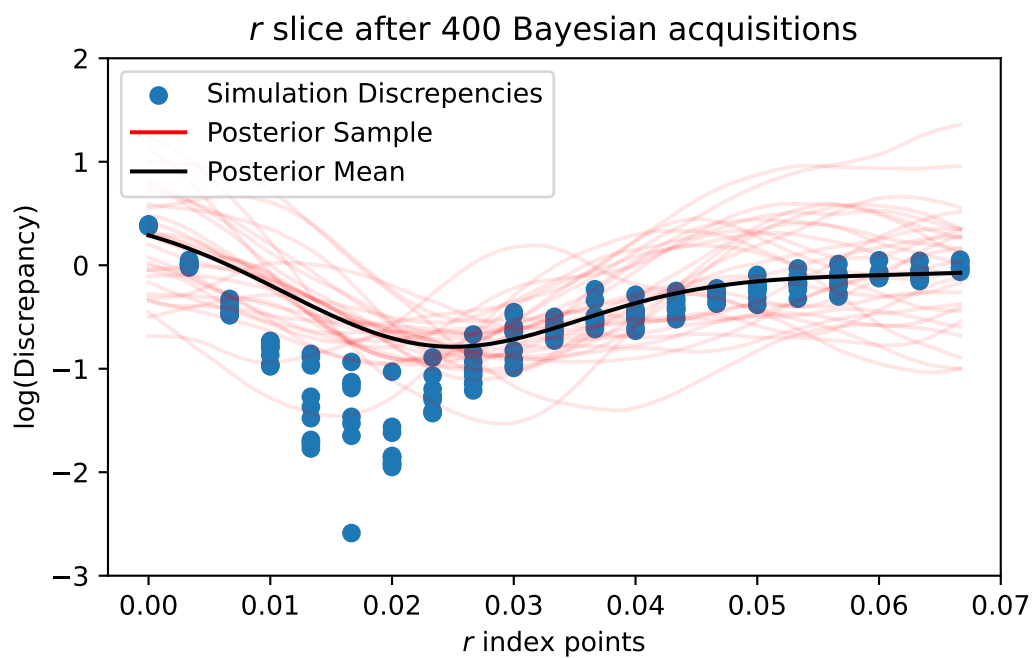
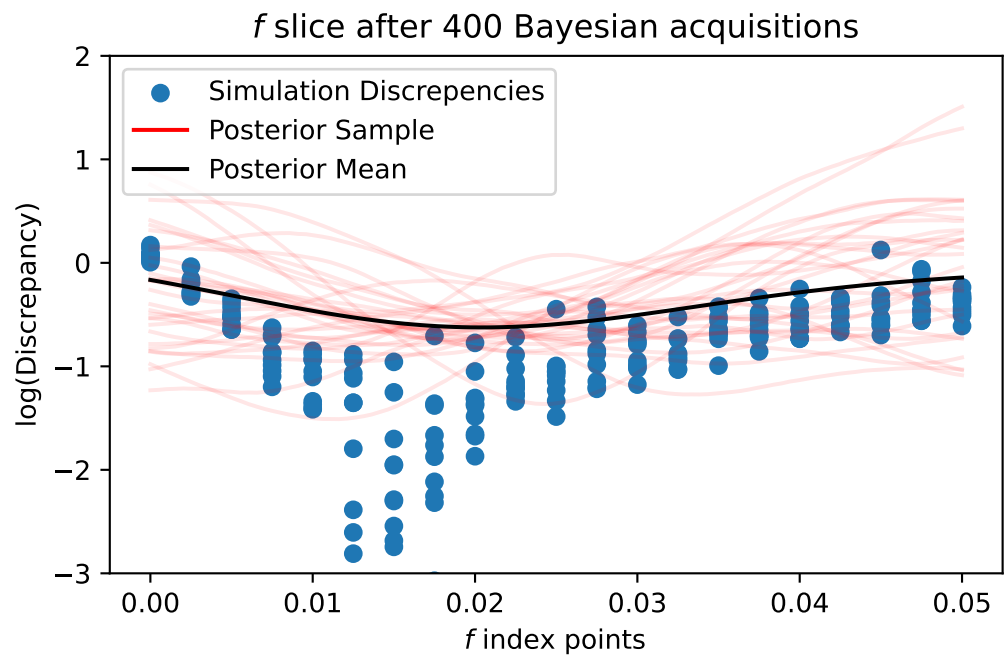


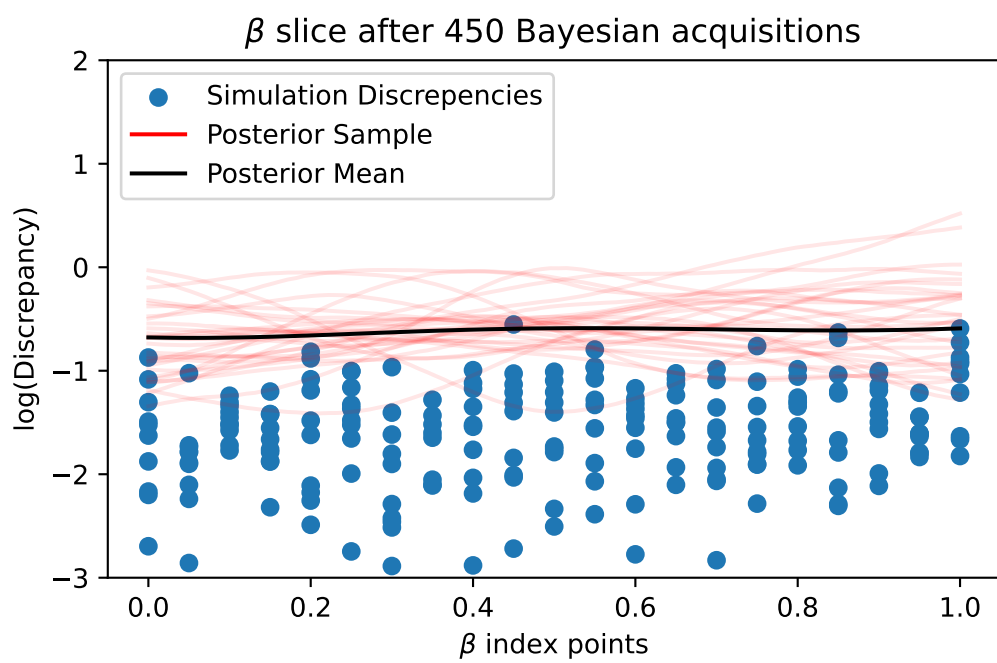
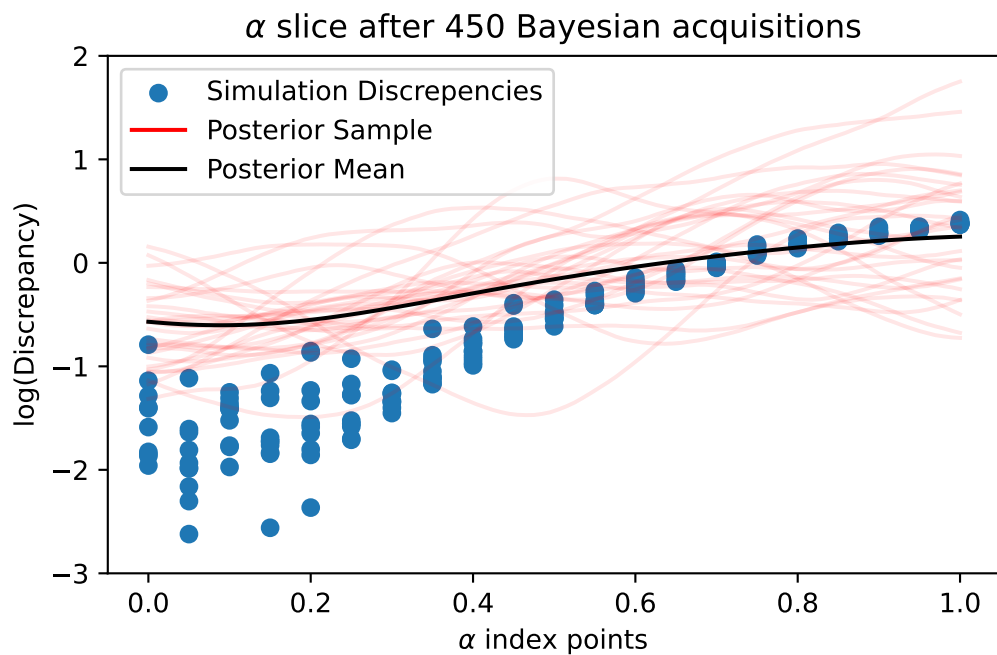


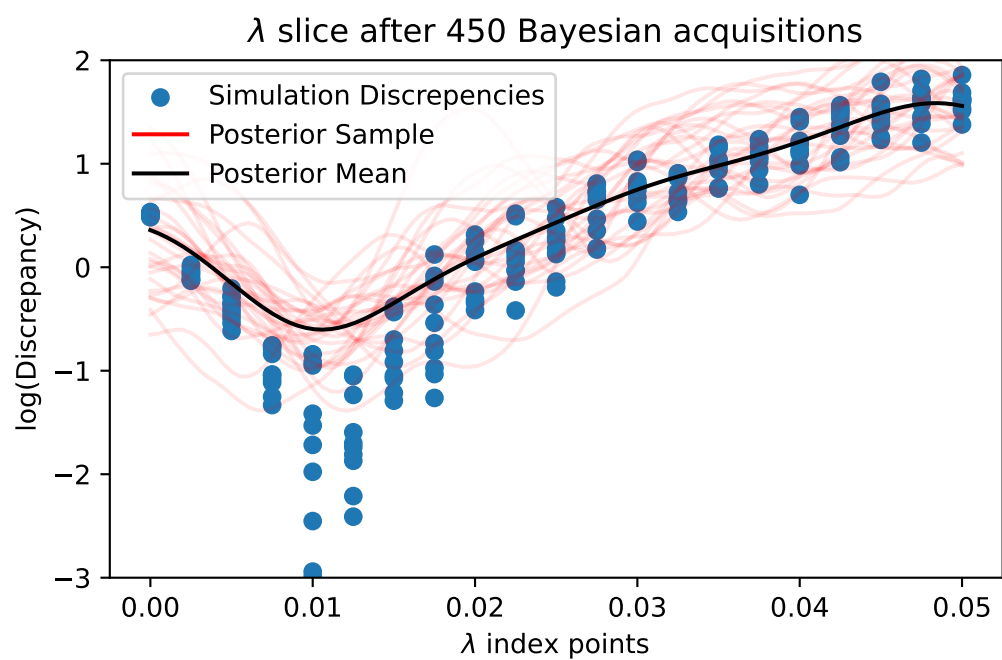
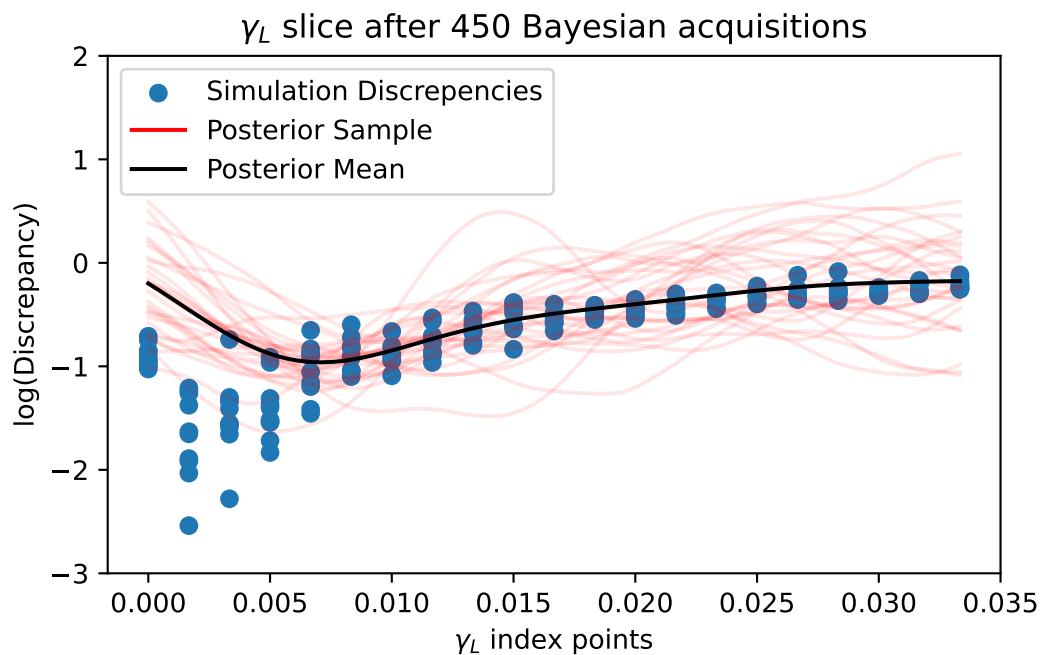


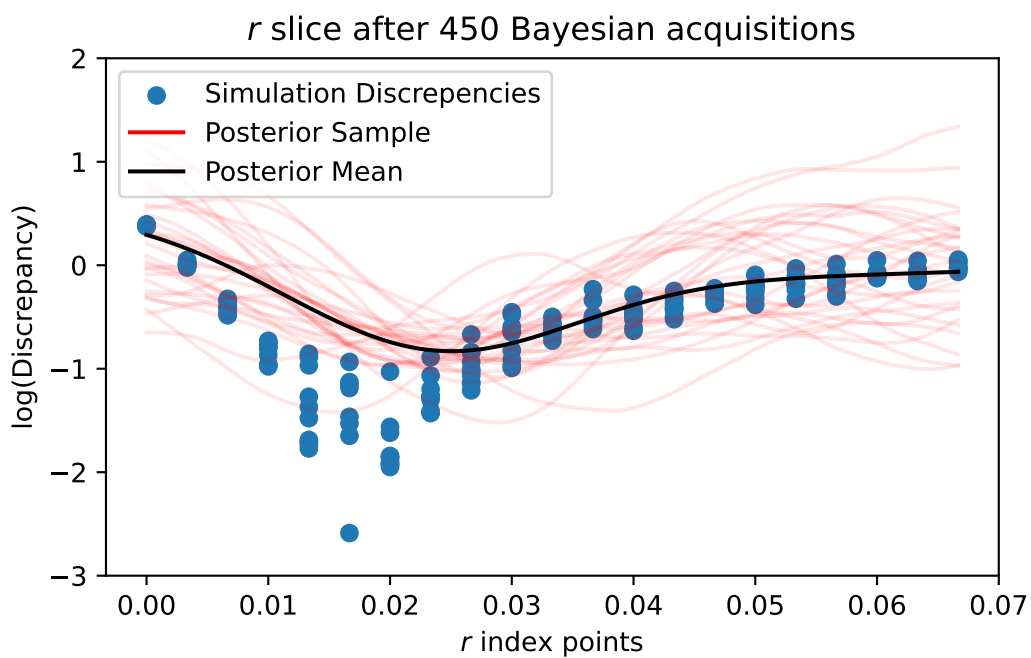
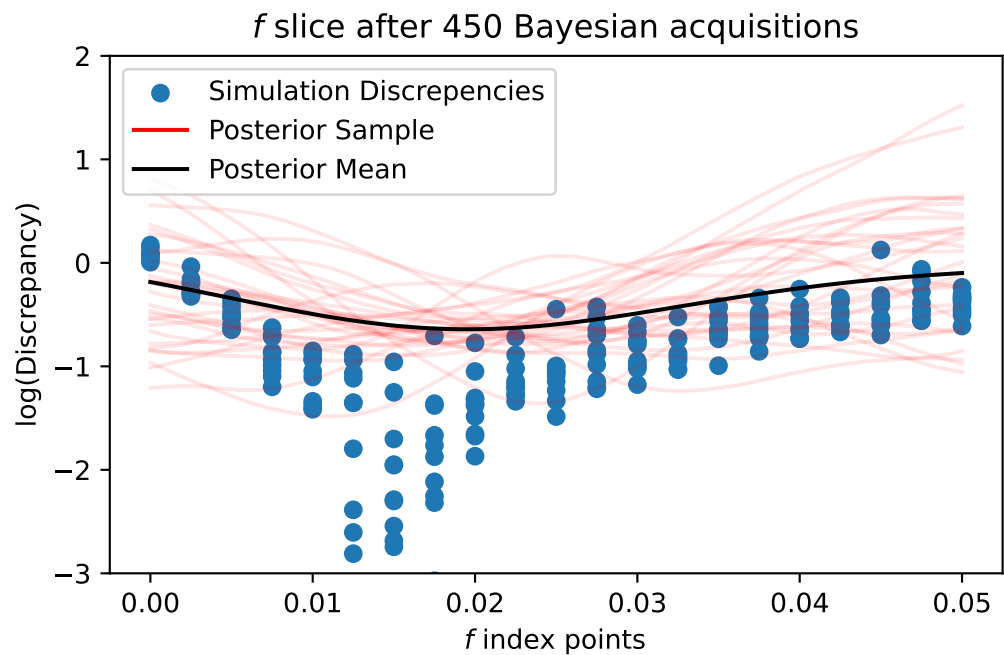


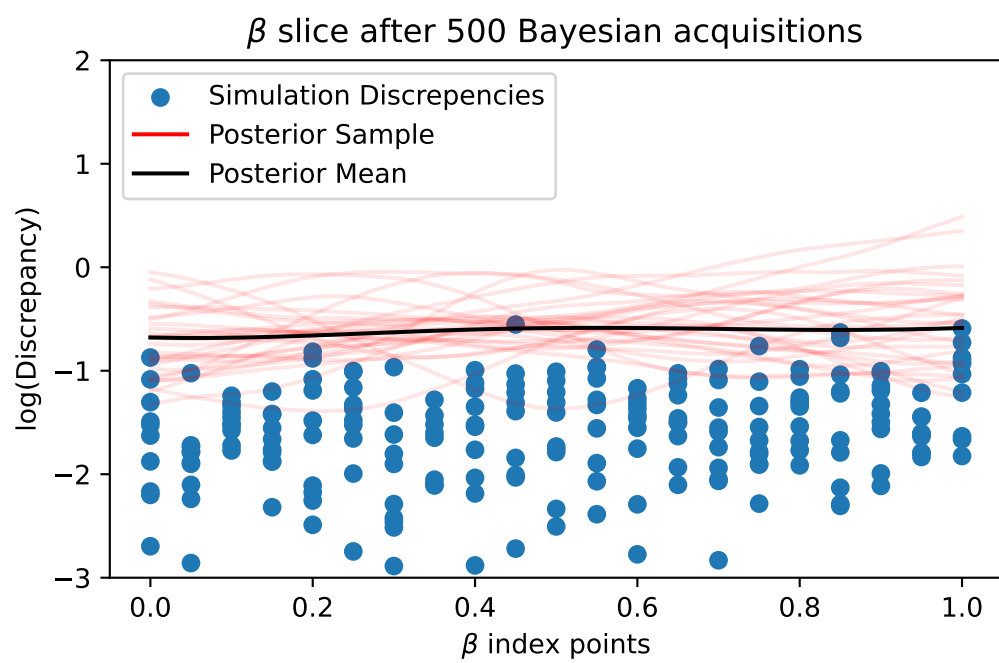
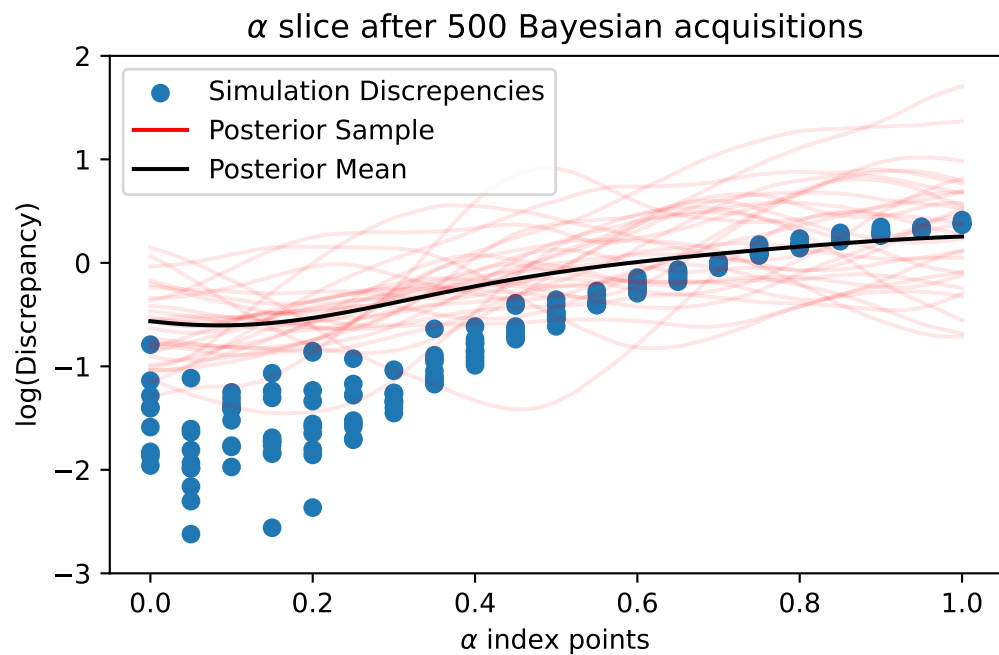


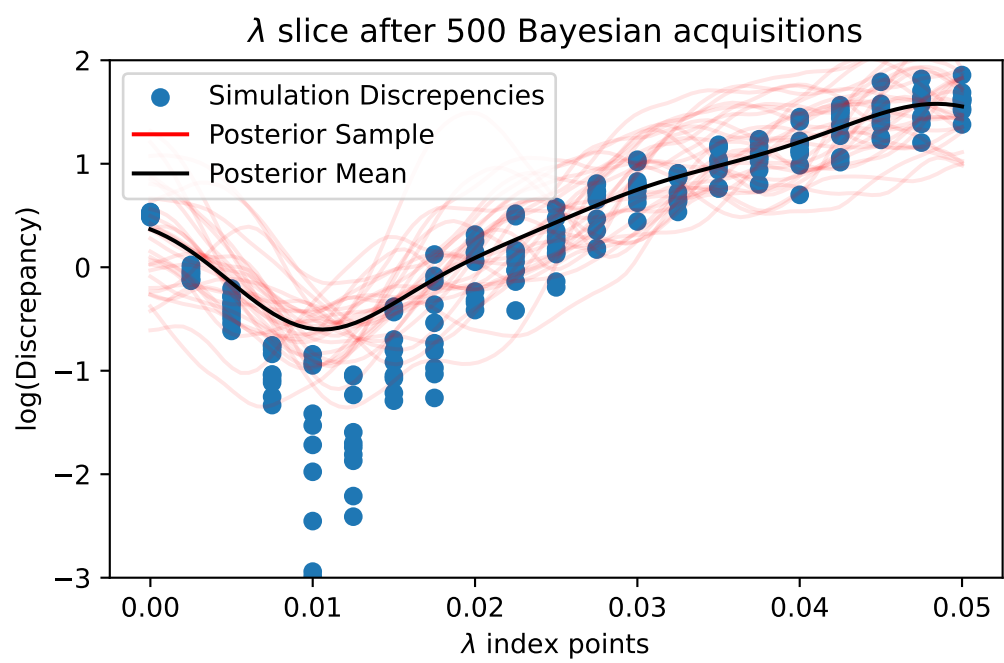
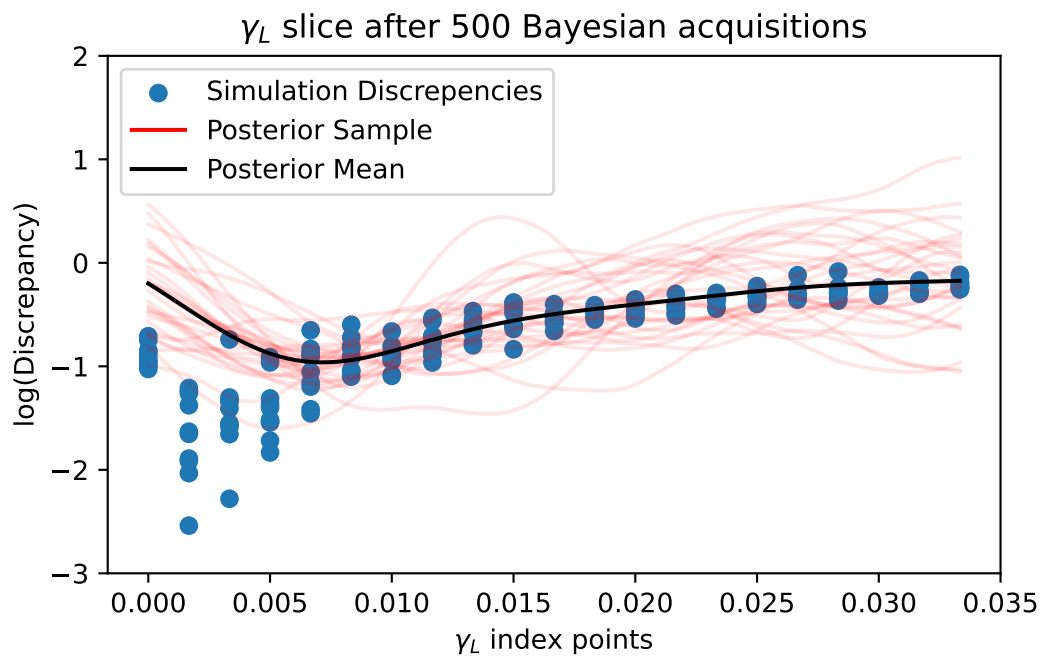


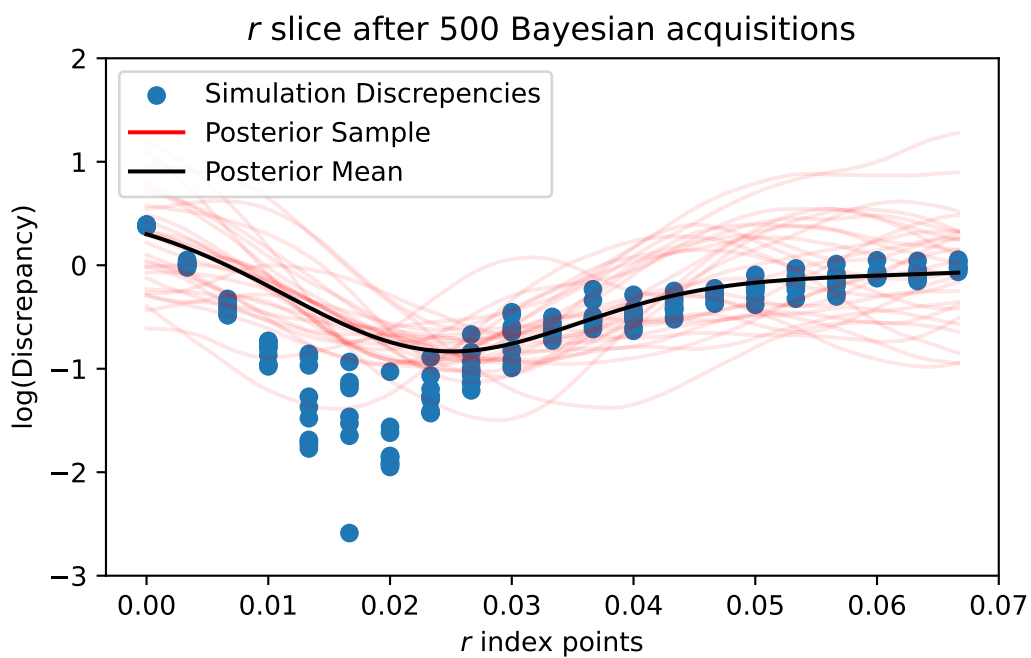
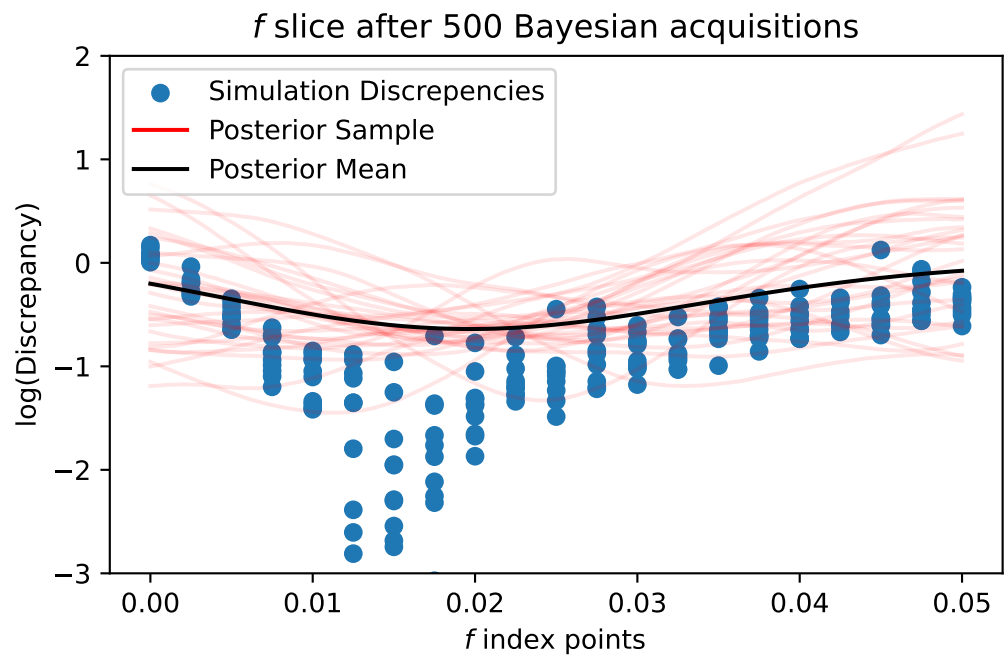













```

epsilon = -5

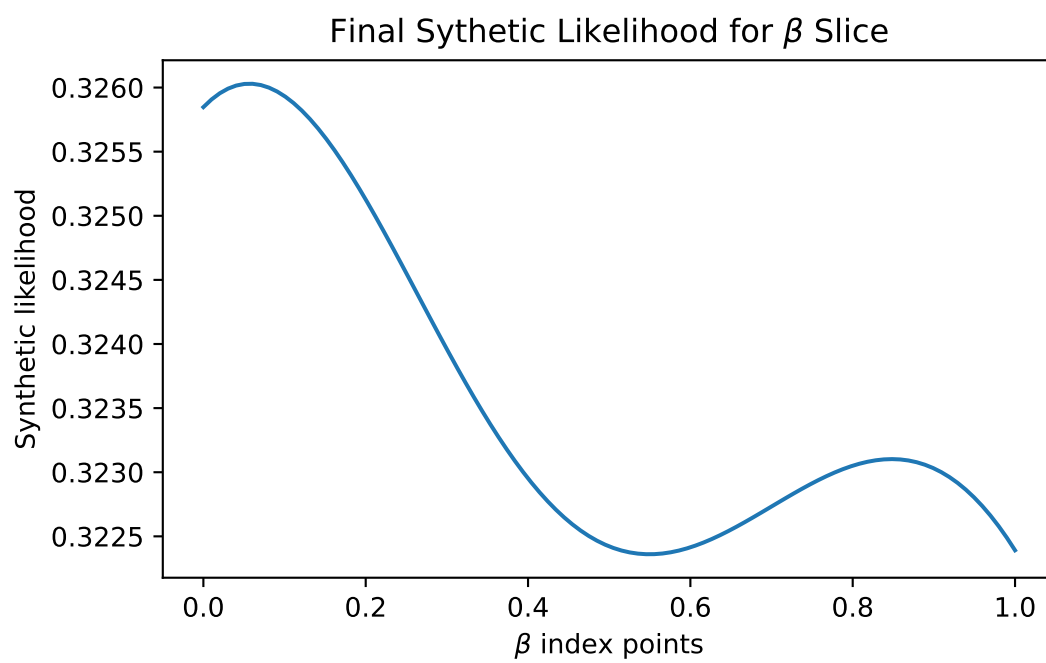
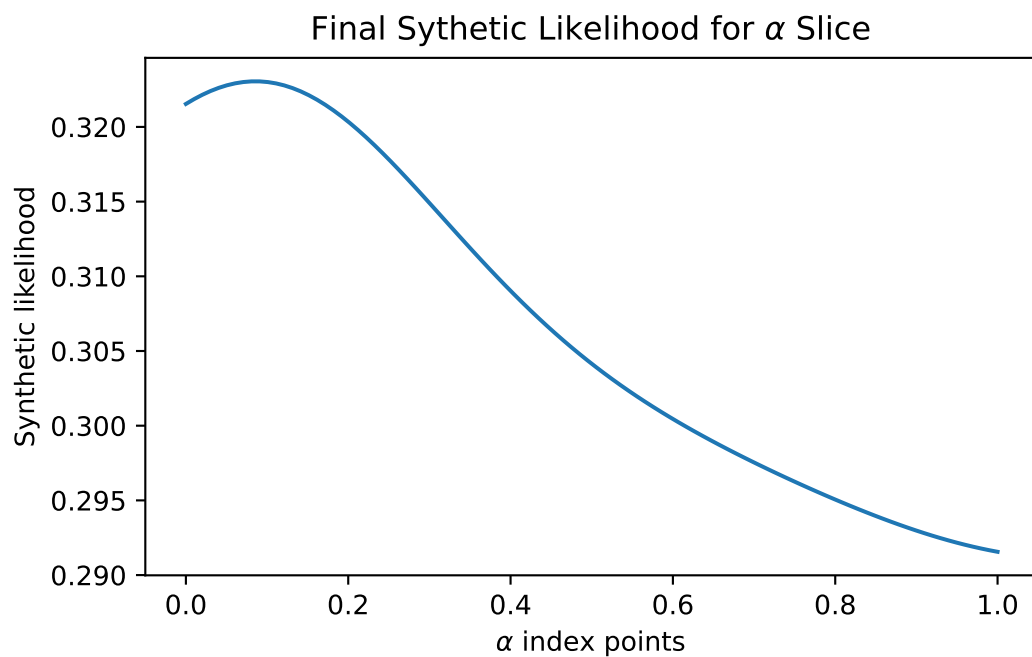
likelihood_dict = {}
for var in vars:
    champ_GP_reg = tfd.GaussianProcessRegressionModel(
        kernel=kernel_champ,
        index_points=slice_indices_dfs_dict[var + "_gp_indices_df"].values,
        observation_index_points=index_vals,
        observations=obs_vals,
        observation_noise_variance=observation_noise_variance_champ,
        predictive_noise_variance=0.0,
        mean_fn=const_mean_fn(),
    )

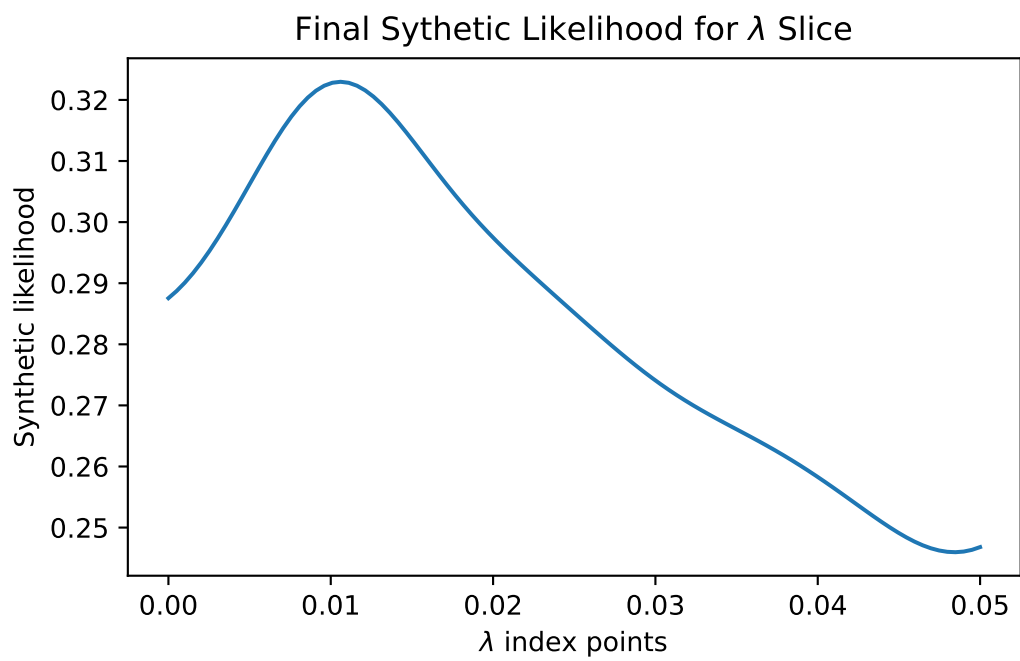
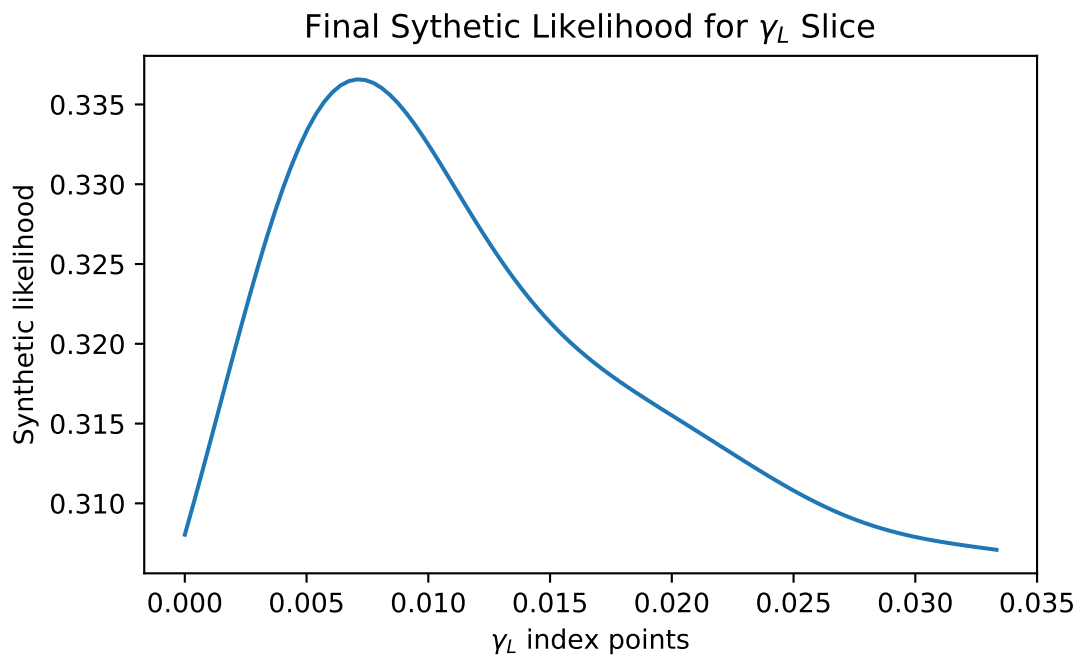
    indices_for_lik = slice_indices_dfs_dict[var + "_gp_indices_df"].values

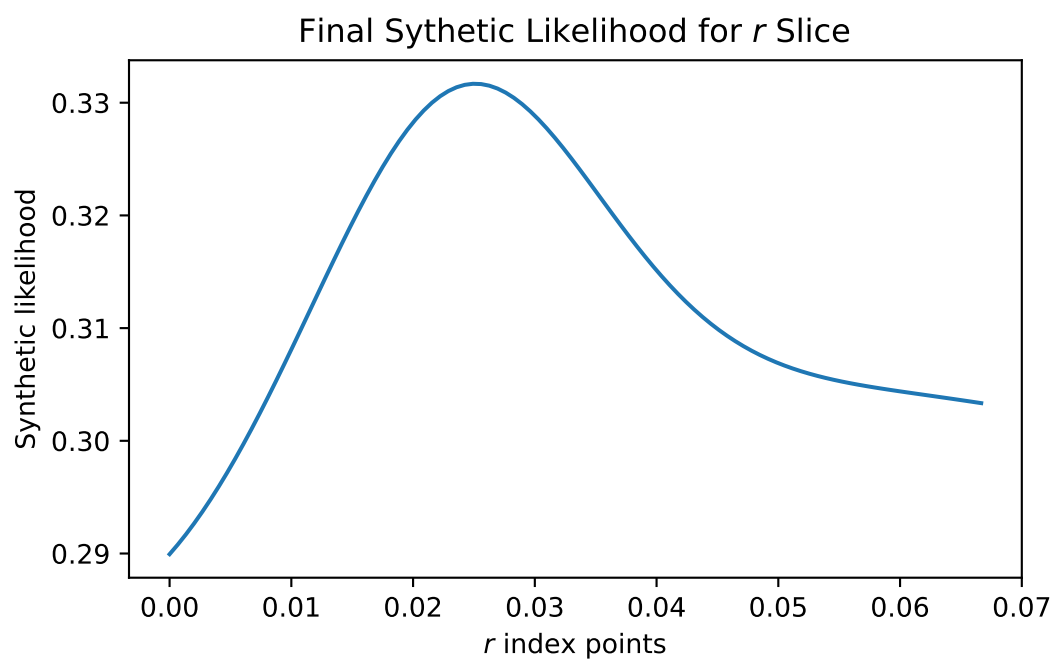
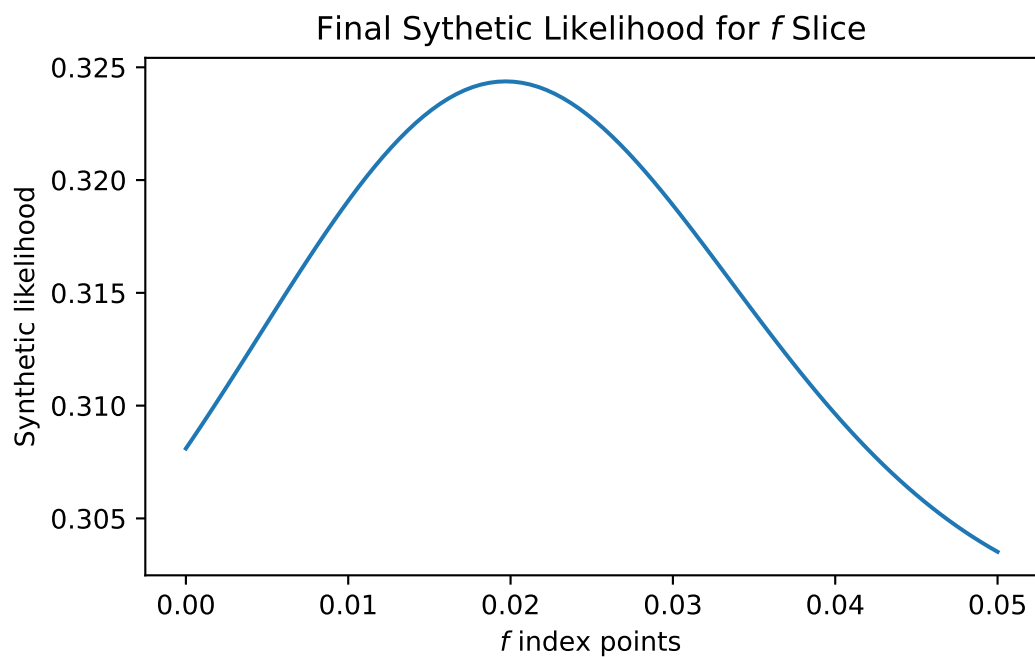
    mean = champ_GP_reg.mean_fn(indices_for_lik)
    variance = 30**2 * observation_noise_variance_champ.numpy()
    post_std = np.sqrt(variance)
    cdf_vals = tfd.Normal(mean, post_std).log_cdf(epsilon)
    likelihood_dict[var + "_synth_lik"] = cdf_vals

plt.figure(figsize=(6, 3.5))
plt.plot(
    slice_indices_dfs_dict[var + "_gp_indices_df"][var].values,
    np.exp(cdf_vals),
)
if var in ["f", "r"]:
    plt.xlabel("$" + var + "$ index points")
    plt.title("Final Sythetic Likelihood for $" + var + "$ Slice")
else:
    plt.xlabel("$\\" + var + "$ index points")
    plt.title("Final Sythetic Likelihood for $\\" + var + "$ Slice")
plt.ylabel("Synthetic likelihood")
plt.savefig(
    "champagne_GP_images/" + var + "_slice_" + str(t) + "_synth_likelihood.pdf"
)
plt.show()

```







```

# print(index_vals[-600,].round(3))
# print(index_vals[-400,].round(3))
print(index_vals[-200,].round(3))
print(index_vals[-80,].round(3))
print(index_vals[-40,].round(3))
print(index_vals[-20,].round(3))
print(index_vals[-8,].round(3))
print(index_vals[-4,].round(3))
print(index_vals[-2,].round(3))
print(index_vals[-1,].round(3))

```

```

[0.323 0.175 0.007 0.034 0.023 0.02 ]
[0.07  0.172 0.008 0.01  0.022 0.007]
[0.087 0.726 0.007 0.045 0.047 0.026]
[0.008 0.289 0.033 0.015 0.033 0.039]
[0.267 0.008 0.02  0.004 0.049 0.024]
[0.084 0.164 0.033 0.034 0.047 0.025]
[0.083 0.138 0.007 0.01  0.021 0.025]
[0.085 0.868 0.008 0.011 0.024 0.024]

```

```

objects_to_preserve = [
    index_vals,
    discreps,
    champ_samp,
    initial_losses_LOOCV,
    slice_samples_dict,
    slice_discrepancies_dict,
    LHC_indices_df,
    gp_samples_dict,
    likelihood_dict,
]

with open("gp_objs.pkl", "wb") as fp:
    pickle.dump(objects_to_preserve, fp)
    print("dictionary saved successfully to file")

```

dictionary saved successfully to file