

# 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 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)
```

```
2024-05-14 10:00:28.051186: I tensorflow/core/platform/cpu_feature_guard.cc:210] This TensorFlow
To enable the following instructions: AVX2 FMA, in other operations, rebuild TensorFlow with
2024-05-14 10:00:28.809891: W tensorflow/compiler/tf2tensorrt/utils/py_utils.cc:38] TF-TRT W
2024-05-14 10:00:31.464122: I external/local_xla/xla/stream_executor/cuda/cuda_executor.cc:9
2024-05-14 10:00:31.609714: W tensorflow/core/common_runtime/gpu/gpu_device.cc:2251] Cannot c
Skipping registering GPU devices...
```

## Model itself

```
np.random.seed(590154)

population = 1000
initial_infecteds = 10
epidemic_length = 1000
number_of_events = 15000

pv_champ_alpha = 0.4 # prop of effective cure
pv_champ_beta = 0.4 # prop of radical cure
pv_champ_gamma_L = 1 / 223 # liver stage clearance rate
pv_champ_delta = 0.05 # prop of imported cases
pv_champ_lambda = 0.04 # transmission rate
pv_champ_f = 1 / 72 # relapse frequency
pv_champ_r = 1 / 60 # blood stage clearance rate

gamma_L_max = 1/30
lambda_max = 0.1
f_max = 1/14
r_max = 1/14

num_lhc_samples = 36
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,
):
    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
)

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

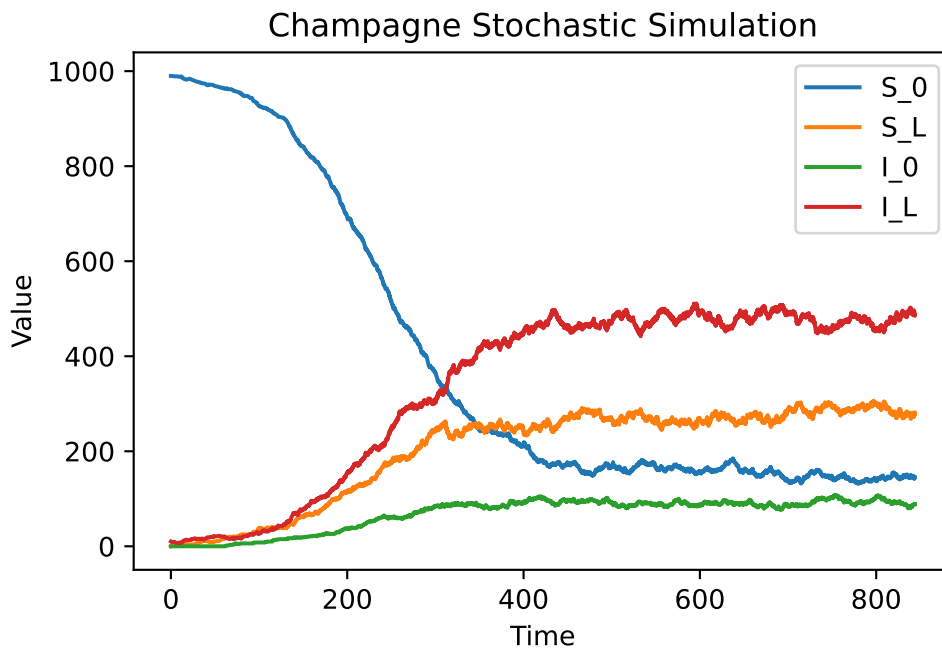
champ_samp = champagne_stochastic(
    pv_champ_alpha,
    pv_champ_beta,
    pv_champ_gamma_L,
    pv_champ_lambda,
    pv_champ_f,

```

```
pv_champ_r,
) # .melt(id_vars='t')
```

## 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):
    champ_df_ = champagne_stochastic(alpha_, beta_, gamma_L, lambda_, f, r)
    fin_t = champ_df_.iloc[-1]["t"]
    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)
    fin_prev = champ_df_.iloc[-1]["I_0"] + champ_df_.iloc[-1]["I_L"]

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

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,
)

def discrepancy_fn(alpha_, beta_, gamma_L, lambda_, f, r, mean_of = 20): # best is L1 norm
    mean_obs = 0
    for i in range(mean_of):
        x = champ_sum_stats(alpha_, beta_, gamma_L, lambda_, f, r)
        mean_obs += (
            1
            / mean_of
            * np.log(np.linalg.norm((x - observed_sum_stats) / observed_sum_stats))
        )
    # return np.sum(np.abs((x - observed_sum_stats) / observed_sum_stats))
    # return np.linalg.norm((x - observed_sum_stats) / observed_sum_stats)
    return mean_obs

```



## 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[:, 2] = 1/50* LHC_samples[:, 2]
# LHC_samples[:, 3] = 0.2 * LHC_samples[:, 3]
# LHC_samples[:, 4] = 1/10 * LHC_samples[:, 4]
# LHC_samples[:, 5] = 1/10 * LHC_samples[:, 5]
# LHC_samples[:, 2] = -pv_champ_gamma_L * np.log(LHC_samples[:, 2])
# LHC_samples[:, 3] = -pv_champ_lambda * np.log(LHC_samples[:, 3])
# LHC_samples[:, 4] = -pv_champ_f * np.log(LHC_samples[:, 4])
# LHC_samples[:, 5] = -pv_champ_r * np.log(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	0.638900	0.614374	0.021761	0.039933	0.003810	0.007869
1	0.276701	0.070771	0.031115	0.085963	0.050461	0.070414
2	0.727164	0.756949	0.001619	0.064036	0.011960	0.001591
3	0.155333	0.292447	0.004117	0.048578	0.027027	0.020526
4	0.181960	0.003381	0.018591	0.042049	0.039947	0.015481

## 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    -0.658582
1     1.109420
2     0.081519
3     0.079612
4    -0.229133
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 / 4, 1.0 / 4, gamma_L_max / 4, lambda_max / 4, f_max / 4, r_max / 4],
    ),
    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.Var

```

## 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

```

## Maximum Likelihood Estimation

```

# Now we optimize the model parameters.
num_iters = 1000

# Use `tf.function` to trace the loss for more efficient evaluation.
@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)

```

```

Adam_optim.apply_gradients(zip(grads, champ_GP.trainable_variables))
return loss

# Store the likelihood values during training, so we can plot the progress
lls_ = np.zeros(num_iters, np.float64)
for i in range(num_iters):
    loss = train_model()
    lls_[i] = loss

print("Trained parameters:")
print("amplitude: {}".format(amplitude_champ._value().numpy()))
print("length_scales: {}".format(length_scales_champ._value().numpy()))
print(
    "observation_noise_variance: {}".format(
        observation_noise_variance_champ._value().numpy()
    )
)

# Plot the loss evolution
plt.figure(figsize=(12, 4))
plt.plot(lls_)
plt.xlabel("Training iteration")
plt.ylabel("Log marginal likelihood")
plt.show()

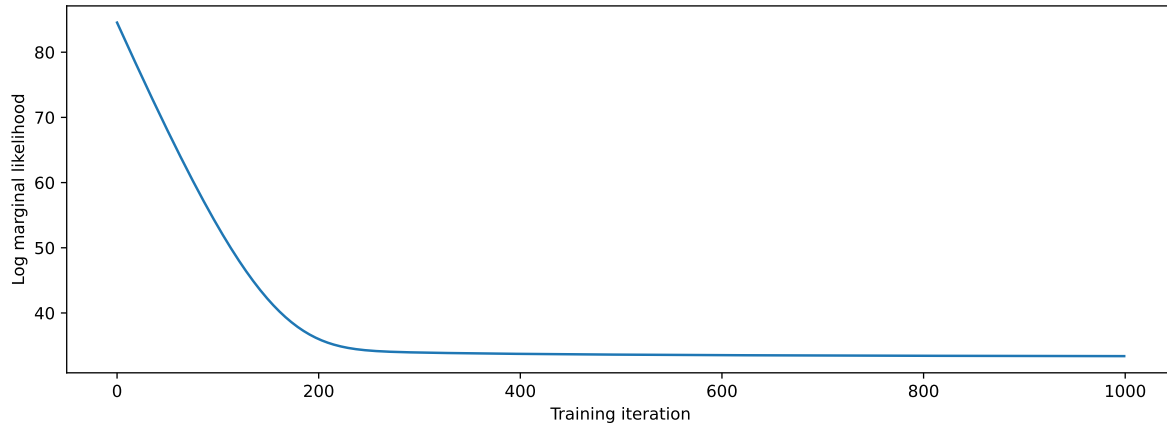
```

Trained parameters:

amplitude: 0.6111800185223677

length\_scales: [0.24925655 0.24944336 0.00831369 0.01736666 0.01780976 0.0178098 ]

observation\_noise\_variance: 0.01342538536368222



```

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 / 4,
                            1.0 / 4,
                            gamma_L_max / 4,
                            lambda_max / 4,
                            f_max / 4,
                            r_max / 4,
                        ],
                    )
                    .forward(var)
                    .numpy()
                    .round(3),
                )
            )
        else:
            print(
                "{} is {}\n".format(
                    var.name, constrain_positive.forward(var).numpy().round(3)
                )
            )

```

```
)  
)
```

Trained parameters:

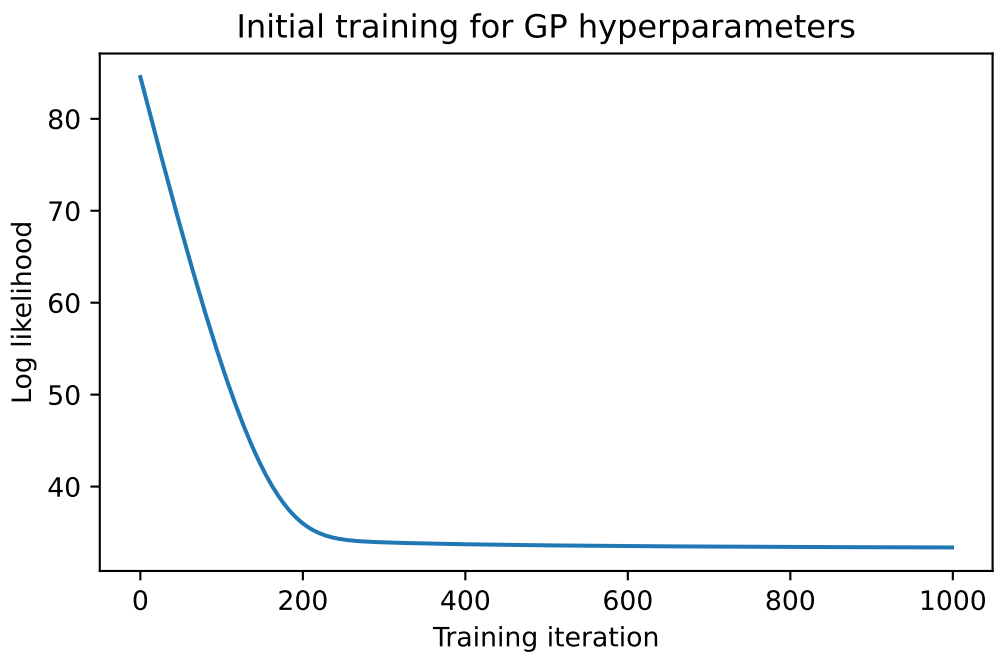
amplitude\_champ:0 is 0.611

length\_scales\_champ:0 is [0.249 0.249 0.008 0.017 0.018 0.018]

observation\_noise\_variance\_champ:0 is 0.013

bias\_mean:0 is 0.131

```
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_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,
    ), 5, 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,
    ), 5, 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), # 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,
), 5, 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), # 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,
),
"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), # 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,

```

```

), 5, 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), # 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,
),
"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,
), 5, 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,
), 5, 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 = {}

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

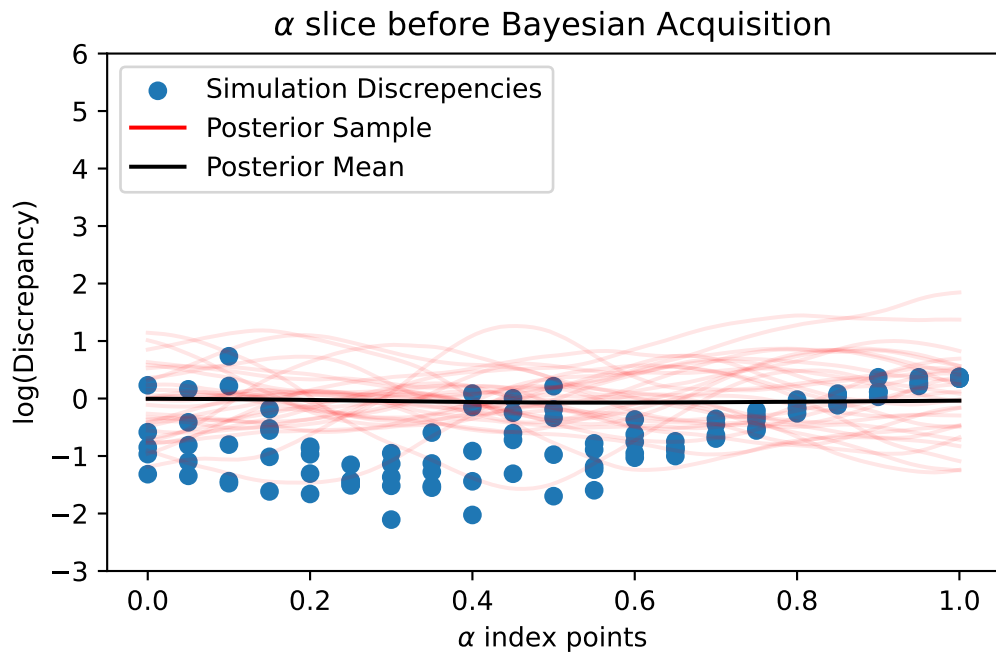
    plt.figure(figsize=(6, 3.5))
    plt.scatter(
        val_df[var].values,
        discreps,
        label = "Simulation Discrepancies",
    )
    for i in range(gp_samp_no):
        plt.plot(
            gp_samples_df[var].values,
            GP_samples[i, :],
            c="r",
            alpha=0.1,
            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")

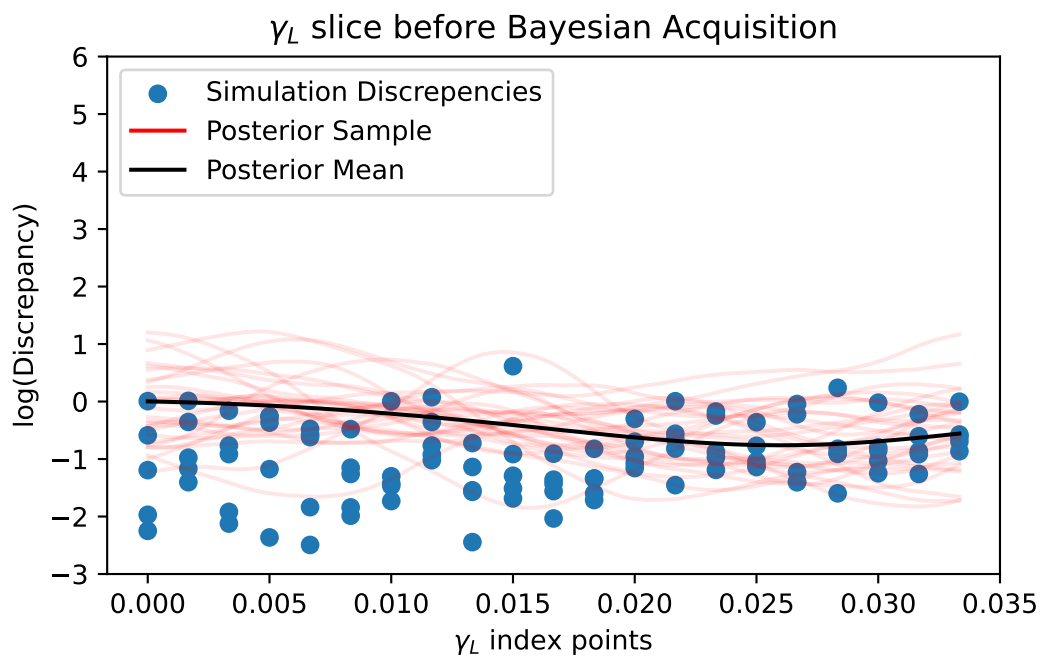
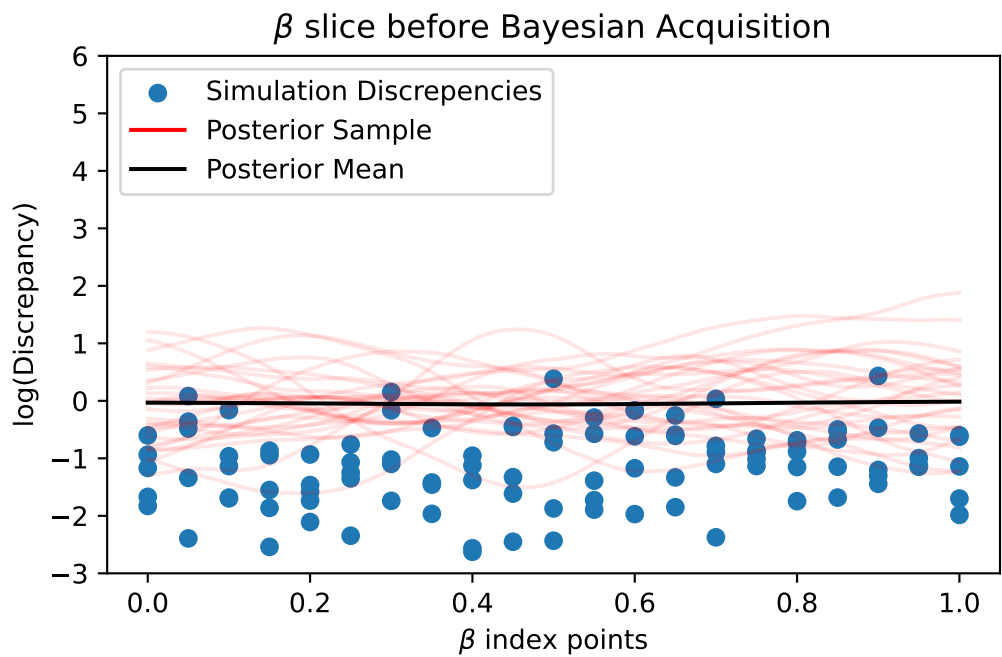
```

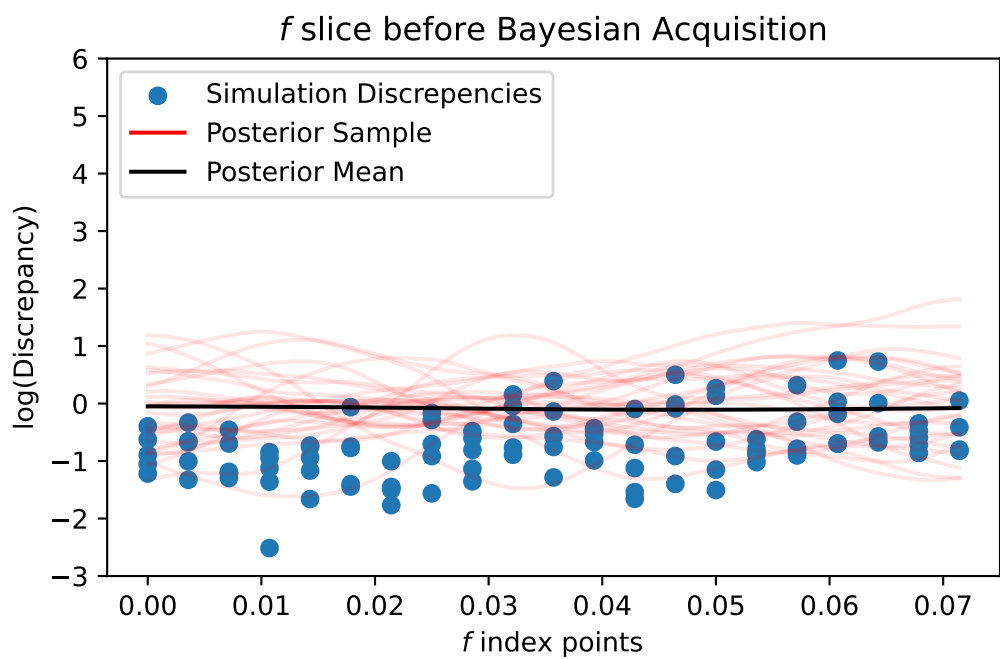
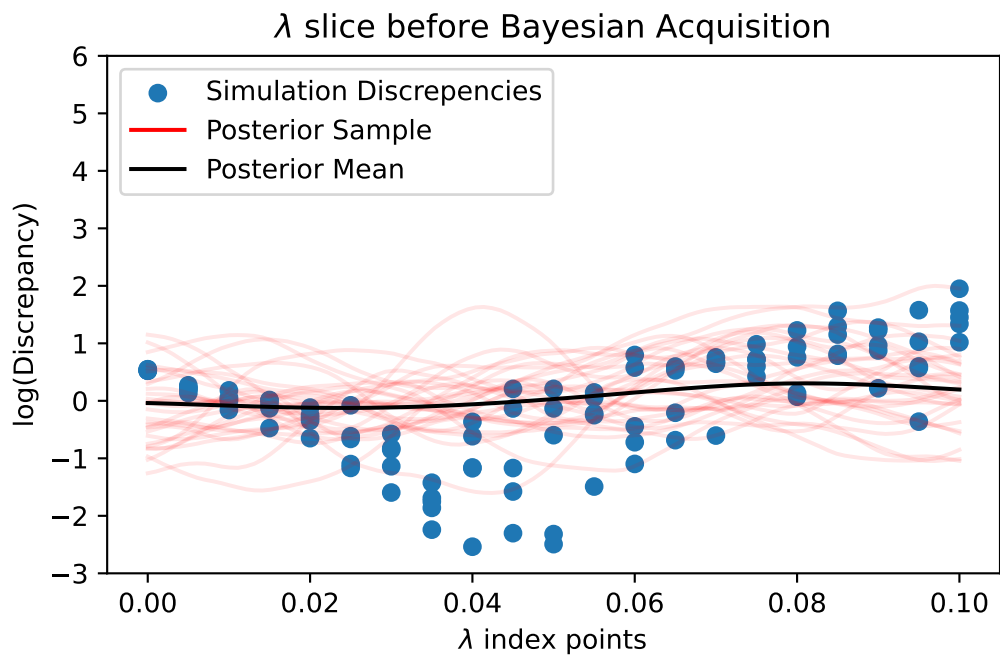
```

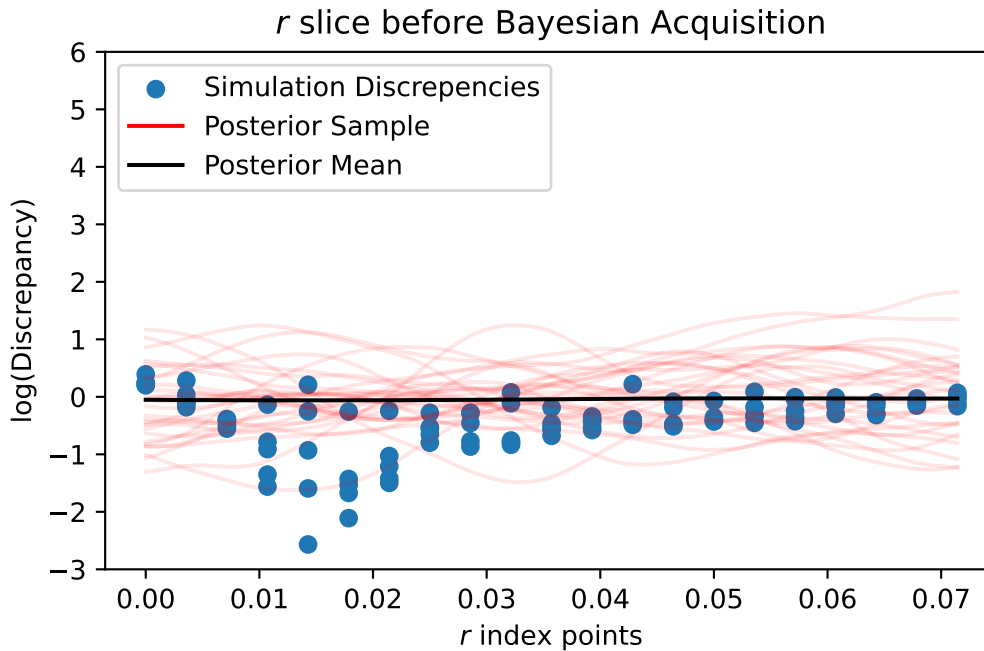
plt.title("$" + var + "$ slice before Bayesian Acquisition")
else:
    plt.xlabel("$\\\" + var + "$ index points")
    plt.title("$\\\" + var + "$ slice before Bayesian Acquisition")
# if var not in ["alpha", "beta"]:
#     plt.xscale("log", base=np.e)
plt.ylabel("log(Discrepancy)")
plt.ylim((-3, 6))
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
```



```

    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 94.

Trained parameters:

next\_alpha is 0.617

next\_beta is 0.563

next\_gamma\_L is 0.017

next\_lambda is 0.051

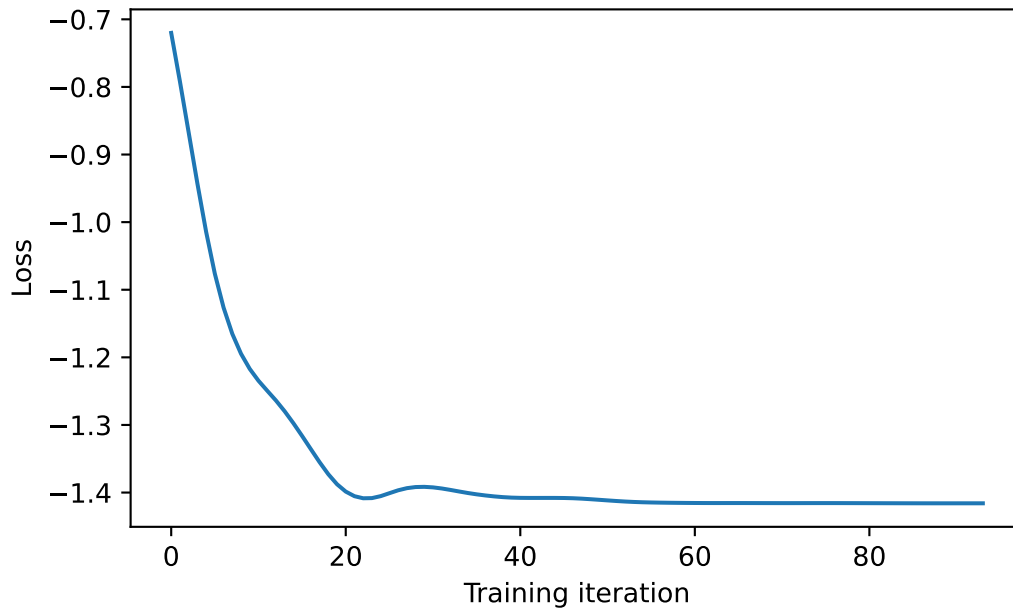
next\_f is 0.036

next\_r is 0.036

```

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():
    @tf.function(autograph=False, jit_compile=False)
    def opt_GP():
        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)
            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, std_t).cdf(delt)
            + std_t * GP_reg.prob(delt, index_points=next_guess)
        )

    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-9 # 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)
        )
    )

# update_var_EI(
#     champ_GP_reg, next_alpha, next_beta, next_gamma_L, next_lambda, next_f, next_r
# )
# EI = tfp_acq.GaussianProcessExpectedImprovement(champ_GP_reg, obs_vals)

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()

```

```

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() > 0.2:
        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)))
#####

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()
        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 / 4,
                                    1.0 / 4,
                                    gamma_L_max / 4,
                                    lambda_max / 4,
                                    f_max / 4,
                                    r_max / 4,
                                ]
                            )
                        )
                    )

```

```

        ],
    )
    .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)

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, 6))
    plt.savefig(
        "champagne_GP_images/"
        + var
        + "_slice_"
        + str(t)
        + "_bolfi_updates_log_discrep.pdf"
    )
plt.show()

```

Iteration 0

Acquisition function convergence reached at iteration 127.

The final EI loss was -0.008 with predicted mean of [-1.092]

The next parameters to simulate from are [[0.331 0.248 0.027 0.037 0.002 0.024]]

The mean of the samples was -0.957

Hyperparameter convergence reached at iteration 3862.

The minimum predicted mean of the observed indices is -1.052 at the point

[0.317 0.247 0.027 0.037 0. 0.025]

Iteration 1

Acquisition function convergence reached at iteration 195.

The final EI loss was -0.381 with predicted mean of [-0.538]  
 The next parameters to simulate from are [[0.656 0.688 0.021 0.04 0.002 0.006]]  
 The mean of the samples was -0.541  
 Iteration 2  
 Acquisition function convergence reached at iteration 185.  
 The final EI loss was -0.39 with predicted mean of [-0.532]  
 The next parameters to simulate from are [[0.074 0.157 0.023 0.027 0.011 0.016]]  
 The mean of the samples was -0.504  
 Iteration 3  
 Acquisition function convergence reached at iteration 1169.  
 The final EI loss was -0.008 with predicted mean of [-1.066]  
 The next parameters to simulate from are [[0.293 0.242 0.027 0.036 0. 0.026]]  
 The mean of the samples was -1.148  
 Iteration 4  
 The final EI loss was -0.399 with predicted mean of [-0.56]  
 The next parameters to simulate from are [[0.063 0.172 0.023 0.028 0.009 0.018]]  
 The mean of the samples was -0.655  
 Iteration 5  
 Acquisition function convergence reached at iteration 149.  
 The final EI loss was -0.351 with predicted mean of [-0.548]  
 The next parameters to simulate from are [[0.63 0.317 0.027 0.058 0.022 0.028]]  
 The mean of the samples was -0.191  
 Iteration 6  
 Acquisition function convergence reached at iteration 2449.  
 The final EI loss was -0.399 with predicted mean of [-0.562]  
 The next parameters to simulate from are [[0.018 0.166 0.023 0.027 0.01 0.018]]  
 The mean of the samples was -0.52  
 Iteration 7  
 Acquisition function convergence reached at iteration 3203.  
 The final EI loss was -0.399 with predicted mean of [-0.561]  
 The next parameters to simulate from are [[0.646 0.678 0.021 0.039 0.001 0.007]]  
 The mean of the samples was -0.544  
 Iteration 8  
 Acquisition function convergence reached at iteration 131.  
 The final EI loss was -0.399 with predicted mean of [-0.561]  
 The next parameters to simulate from are [[0.668 0.656 0.021 0.039 0. 0.007]]  
 The mean of the samples was -0.712  
 Iteration 9  
 Acquisition function convergence reached at iteration 5808.  
 The final EI loss was -0.398 with predicted mean of [-0.561]  
 The next parameters to simulate from are [[0.684 0.691 0.021 0.04 0. 0.004]]  
 The mean of the samples was -0.304  
 Iteration 10

The final EI loss was -0.399 with predicted mean of [-0.561]  
 The next parameters to simulate from are [[0.655 0.272 0.028 0.055 0.021 0.023]]  
 The mean of the samples was -0.652  
 Iteration 11  
 Acquisition function convergence reached at iteration 4121.  
 The final EI loss was -0.033 with predicted mean of [0.012]  
 The next parameters to simulate from are [[0. 1. 0. 0.1 0. 0. ]]  
 The mean of the samples was 2.332  
 Iteration 12  
 The final EI loss was -0.394 with predicted mean of [-0.581]  
 The next parameters to simulate from are [[0.658 0.258 0.028 0.055 0.021 0.026]]  
 The mean of the samples was -0.559  
 Iteration 13  
 Acquisition function convergence reached at iteration 104.  
 The final EI loss was -0.01 with predicted mean of [-1.14]  
 The next parameters to simulate from are [[0.264 0.24 0.027 0.036 0. 0.028]]  
 The mean of the samples was -1.212  
 Iteration 14  
 Acquisition function convergence reached at iteration 153.  
 The final EI loss was -0.399 with predicted mean of [-0.594]  
 The next parameters to simulate from are [[0.081 0.179 0.023 0.029 0.012 0.018]]  
 The mean of the samples was -0.544  
 Iteration 15  
 Acquisition function convergence reached at iteration 362.  
 The final EI loss was -0.351 with predicted mean of [-0.599]  
 The next parameters to simulate from are [[0.809 0.611 0.018 0.042 0.067 0.007]]  
 The mean of the samples was -0.884  
 Iteration 16  
 Acquisition function convergence reached at iteration 211.  
 The final EI loss was -0.399 with predicted mean of [-0.594]  
 The next parameters to simulate from are [[0.657 0.643 0.021 0.038 0. 0.005]]  
 The mean of the samples was -0.417  
 Iteration 17  
 Acquisition function convergence reached at iteration 133.  
 The final EI loss was -0.005 with predicted mean of [-1.198]  
 The next parameters to simulate from are [[0.243 0.238 0.027 0.035 0. 0.028]]  
 The mean of the samples was -0.86  
 Iteration 18  
 Acquisition function convergence reached at iteration 254.  
 The final EI loss was -0.399 with predicted mean of [-0.554]  
 The next parameters to simulate from are [[0.033 0.175 0.023 0.029 0.011 0.02 ]]  
 The mean of the samples was -0.8  
 Iteration 19

Acquisition function convergence reached at iteration 2729.  
 The final EI loss was -0.399 with predicted mean of [-0.554]  
 The next parameters to simulate from are [[0.654 0.628 0.021 0.039 0.005 0.006]]  
 The mean of the samples was -0.609  
 Iteration 20  
 Acquisition function convergence reached at iteration 119.  
 The final EI loss was -0.006 with predicted mean of [-1.119]  
 The next parameters to simulate from are [[0.303 0.24 0.027 0.037 0. 0.027]]  
 The mean of the samples was -1.13  
 Hyperparameter convergence reached at iteration 3904.  
 The minimum predicted mean of the observed indices is -1.123 at the point  
 [0.303 0.24 0.027 0.037 0. 0.027]  
 Iteration 21  
 The final EI loss was -0.399 with predicted mean of [-0.567]  
 The next parameters to simulate from are [[0.122 0.173 0.024 0.028 0.007 0.016]]  
 The mean of the samples was -0.467  
 Iteration 22  
 Acquisition function convergence reached at iteration 103.  
 The final EI loss was -0.001 with predicted mean of [-1.129]  
 The next parameters to simulate from are [[0.31 0.24 0.026 0.037 0. 0.028]]  
 The mean of the samples was -1.011  
 Iteration 23  
 Acquisition function convergence reached at iteration 156.  
 The final EI loss was -0.399 with predicted mean of [-0.55]  
 The next parameters to simulate from are [[0.661 0.637 0.023 0.037 0. 0.007]]  
 The mean of the samples was -0.656  
 Iteration 24  
 Acquisition function convergence reached at iteration 247.  
 The final EI loss was -0.399 with predicted mean of [-0.55]  
 The next parameters to simulate from are [[0.13 0.177 0.025 0.029 0.005 0.017]]  
 The mean of the samples was -0.588  
 Iteration 25  
 Acquisition function convergence reached at iteration 139.  
 The final EI loss was -0.002 with predicted mean of [-1.103]  
 The next parameters to simulate from are [[0.295 0.244 0.027 0.037 0. 0.026]]  
 The mean of the samples was -0.984  
 Iteration 26  
 Acquisition function convergence reached at iteration 186.  
 The final EI loss was -0.395 with predicted mean of [-0.541]  
 The next parameters to simulate from are [[0.454 0.521 0.01 0.02 0.035 0.032]]  
 The mean of the samples was -0.456  
 Iteration 27  
 The final EI loss was -0.399 with predicted mean of [-0.539]

The next parameters to simulate from are [[0.136 0.178 0.025 0.029 0.002 0.015]]  
 The mean of the samples was -0.467  
 Iteration 28  
 Acquisition function convergence reached at iteration 138.  
 The final EI loss was -0.002 with predicted mean of [-1.083]  
 The next parameters to simulate from are [[0.303 0.242 0.027 0.036 0. 0.027]]  
 The mean of the samples was -0.86  
 Iteration 29  
 Acquisition function convergence reached at iteration 150.  
 The final EI loss was -0.03 with predicted mean of [-1.11]  
 The next parameters to simulate from are [[0.286 0.237 0.027 0.041 0. 0.026]]  
 The mean of the samples was -1.061  
 Iteration 30  
 Acquisition function convergence reached at iteration 132.  
 The final EI loss was -0.002 with predicted mean of [-1.077]  
 The next parameters to simulate from are [[0.288 0.239 0.027 0.04 0. 0.026]]  
 The mean of the samples was -0.964  
 Iteration 31  
 The final EI loss was -0.399 with predicted mean of [-0.521]  
 The next parameters to simulate from are [[0.128 0.181 0.025 0.029 0. 0.016]]  
 The mean of the samples was -0.478  
 Iteration 32  
 Acquisition function convergence reached at iteration 241.  
 The final EI loss was -0.399 with predicted mean of [-0.522]  
 The next parameters to simulate from are [[0.649 0.623 0.022 0.039 0.004 0.004]]  
 The mean of the samples was -0.37  
 Iteration 33  
 Acquisition function convergence reached at iteration 136.  
 The final EI loss was -0.003 with predicted mean of [-1.049]  
 The next parameters to simulate from are [[0.293 0.242 0.027 0.038 0. 0.026]]  
 The mean of the samples was -0.897  
 Iteration 34  
 Acquisition function convergence reached at iteration 112.  
 The final EI loss was -0.013 with predicted mean of [-1.061]  
 The next parameters to simulate from are [[0.692 0.2 0.029 0.051 0.019 0.015]]  
 The mean of the samples was -1.254  
 Iteration 35  
 Acquisition function convergence reached at iteration 141.  
 The final EI loss was -0.337 with predicted mean of [-0.566]  
 The next parameters to simulate from are [[0.823 0.119 0.021 0.049 0.009 0.011]]  
 The mean of the samples was -0.707  
 Iteration 36  
 Acquisition function convergence reached at iteration 205.

The final EI loss was -0.361 with predicted mean of [-0.613]  
 The next parameters to simulate from are [[0.78 0.438 0.017 0.022 0.066 0.003]]  
 The mean of the samples was -0.23  
 Iteration 37  
 Acquisition function convergence reached at iteration 147.  
 The final EI loss was -0.046 with predicted mean of [-1.273]  
 The next parameters to simulate from are [[0.695 0.197 0.029 0.047 0.016 0.014]]  
 The mean of the samples was -1.162  
 Iteration 38  
 The final EI loss was -0.397 with predicted mean of [-0.587]  
 The next parameters to simulate from are [[0.419 0.493 0.01 0.023 0.035 0.034]]  
 The mean of the samples was -0.672  
 Iteration 39  
 Acquisition function convergence reached at iteration 125.  
 The final EI loss was -0.008 with predicted mean of [-1.196]  
 The next parameters to simulate from are [[0.696 0.195 0.029 0.049 0.017 0.015]]  
 The mean of the samples was -1.238  
 Iteration 40  
 Acquisition function convergence reached at iteration 169.  
 The final EI loss was -0.392 with predicted mean of [-0.607]  
 The next parameters to simulate from are [[0.821 0.668 0.018 0.048 0.068 0.009]]  
 The mean of the samples was -0.417  
 Hyperparameter convergence reached at iteration 2217.  
 The minimum predicted mean of the observed indices is -1.209 at the point  
 [0.696 0.195 0.029 0.049 0.017 0.015]  
 Iteration 41  
 Acquisition function convergence reached at iteration 9512.  
 The final EI loss was -0.399 with predicted mean of [-0.605]  
 The next parameters to simulate from are [[0.664 0.235 0.028 0.053 0.019 0.028]]  
 The mean of the samples was -0.762  
 Iteration 42  
 Acquisition function convergence reached at iteration 440.  
 The final EI loss was -0.399 with predicted mean of [-0.605]  
 The next parameters to simulate from are [[0.838 0.104 0.02 0.049 0.008 0.009]]  
 The mean of the samples was -0.754  
 Iteration 43  
 Acquisition function convergence reached at iteration 118.  
 The final EI loss was -0.006 with predicted mean of [-1.221]  
 The next parameters to simulate from are [[0.693 0.184 0.029 0.048 0.017 0.016]]  
 The mean of the samples was -0.876  
 Iteration 44  
 Acquisition function convergence reached at iteration 190.  
 The final EI loss was -0.399 with predicted mean of [-0.574]



The next parameters to simulate from are [[0.166 0.166 0.025 0.027 0.004 0.017]]  
 The mean of the samples was -0.444  
 Iteration 45  
 Acquisition function convergence reached at iteration 124.  
 The final EI loss was -0.088 with predicted mean of [-1.264]  
 The next parameters to simulate from are [[0.704 0.227 0.028 0.05 0.017 0.012]]  
 The mean of the samples was -1.03  
 Iteration 46  
 The final EI loss was -0.398 with predicted mean of [-0.562]  
 The next parameters to simulate from are [[0.667 0.236 0.028 0.053 0.019 0.032]]  
 The mean of the samples was -0.728  
 Iteration 47  
 The final EI loss was -0.398 with predicted mean of [-0.56]  
 The next parameters to simulate from are [[0.659 0.308 0.027 0.058 0.022 0.019]]  
 The mean of the samples was -0.672  
 Iteration 48  
 Acquisition function convergence reached at iteration 122.  
 The final EI loss was -0.009 with predicted mean of [-1.14]  
 The next parameters to simulate from are [[0.695 0.208 0.029 0.05 0.018 0.014]]  
 The mean of the samples was -1.08  
 Iteration 49  
 The final EI loss was -0.399 with predicted mean of [-0.561]  
 The next parameters to simulate from are [[0.66 0.242 0.029 0.056 0.021 0.034]]  
 The mean of the samples was -0.576  
 Iteration 50  
 Acquisition function convergence reached at iteration 150.  
 The final EI loss was -0.399 with predicted mean of [-0.563]  
 The next parameters to simulate from are [[0.881 0.074 0.018 0.05 0.007 0.009]]  
 The mean of the samples was -0.595  
 Trained parameters:  
 amplitude\_champ:0 is 0.62  
  
 length\_scales\_champ:0 is [0.25 0.25 0.008 0.024 0.018 0.018]  
  
 observation\_noise\_variance\_champ:0 is 0.009  
  
 bias\_mean:0 is 0.245  
  
 Iteration 51  
 Acquisition function convergence reached at iteration 137.  
 The final EI loss was -0.0 with predicted mean of [-1.127]  
 The next parameters to simulate from are [[0.696 0.208 0.029 0.05 0.018 0.014]]  
 The mean of the samples was -1.131

Iteration 52  
 Acquisition function convergence reached at iteration 117.  
 The final EI loss was -0.0 with predicted mean of [-1.128]  
 The next parameters to simulate from are [[0.696 0.209 0.029 0.05 0.018 0.014]]  
 The mean of the samples was -1.057

Iteration 53  
 Acquisition function convergence reached at iteration 138.  
 The final EI loss was -0.0 with predicted mean of [-1.117]  
 The next parameters to simulate from are [[0.695 0.206 0.029 0.05 0.018 0.014]]  
 The mean of the samples was -1.015

Iteration 54  
 Acquisition function convergence reached at iteration 124.  
 The final EI loss was -0.0 with predicted mean of [-1.105]  
 The next parameters to simulate from are [[0.697 0.208 0.029 0.05 0.018 0.014]]  
 The mean of the samples was -1.108

Iteration 55  
 Acquisition function convergence reached at iteration 868.  
 The final EI loss was -0.399 with predicted mean of [-0.553]  
 The next parameters to simulate from are [[0.679 0.621 0.021 0.04 0.006 0.006]]  
 The mean of the samples was -0.644

Iteration 56  
 The final EI loss was -0.399 with predicted mean of [-0.552]  
 The next parameters to simulate from are [[0.661 0.225 0.03 0.058 0.021 0.035]]  
 The mean of the samples was -0.379

Iteration 57  
 Acquisition function convergence reached at iteration 3983.  
 The final EI loss was -0.343 with predicted mean of [-0.56]  
 The next parameters to simulate from are [[0.696 0.055 0.033 0.041 0.015 0.018]]  
 The mean of the samples was -0.903

Iteration 58  
 Acquisition function convergence reached at iteration 108.  
 The final EI loss was -0.001 with predicted mean of [-1.107]  
 The next parameters to simulate from are [[0.701 0.201 0.029 0.049 0.018 0.014]]  
 The mean of the samples was -0.98

Iteration 59  
 The final EI loss was -0.399 with predicted mean of [-0.549]  
 The next parameters to simulate from are [[0.669 0.21 0.031 0.055 0.02 0.034]]  
 The mean of the samples was -0.685

Iteration 60  
 The final EI loss was -0.399 with predicted mean of [-0.548]  
 The next parameters to simulate from are [[0.043 0.177 0.022 0.03 0.013 0.017]]  
 The mean of the samples was -0.675  
 Hyperparameter convergence reached at iteration 1233.

The minimum predicted mean of the observed indices is -1.093 at the point  
[0.695 0.206 0.029 0.05 0.018 0.014]

Iteration 61  
Acquisition function convergence reached at iteration 131.  
The final EI loss was -0.008 with predicted mean of [-1.106]  
The next parameters to simulate from are [[0.684 0.206 0.029 0.05 0.016 0.015]]  
The mean of the samples was -0.968

Iteration 62  
Acquisition function convergence reached at iteration 133.  
The final EI loss was -0.004 with predicted mean of [-1.1]  
The next parameters to simulate from are [[0.705 0.203 0.029 0.048 0.02 0.015]]  
The mean of the samples was -1.173

Iteration 63  
The final EI loss was -0.399 with predicted mean of [-0.562]  
The next parameters to simulate from are [[0.657 0.328 0.027 0.061 0.021 0.016]]  
The mean of the samples was -0.258

Iteration 64  
Acquisition function convergence reached at iteration 136.  
The final EI loss was -0.014 with predicted mean of [-1.164]  
The next parameters to simulate from are [[0.711 0.211 0.028 0.046 0.021 0.016]]  
The mean of the samples was -1.261

Iteration 65  
Acquisition function convergence reached at iteration 133.  
The final EI loss was -0.008 with predicted mean of [-1.243]  
The next parameters to simulate from are [[0.716 0.218 0.028 0.043 0.022 0.016]]  
The mean of the samples was -1.238

Iteration 66  
The final EI loss was -0.399 with predicted mean of [-0.621]  
The next parameters to simulate from are [[0.816 0.676 0.018 0.043 0.067 0.007]]  
The mean of the samples was -1.04

Iteration 67  
Acquisition function convergence reached at iteration 117.  
The final EI loss was -0.0 with predicted mean of [-1.24]  
The next parameters to simulate from are [[0.716 0.218 0.028 0.044 0.022 0.016]]  
The mean of the samples was -1.218

Iteration 68  
Acquisition function convergence reached at iteration 1583.  
The final EI loss was -0.399 with predicted mean of [-0.616]  
The next parameters to simulate from are [[0.699 0.652 0.02 0.04 0.007 0.006]]  
The mean of the samples was -0.656

Iteration 69  
The final EI loss was -0.399 with predicted mean of [-0.616]  
The next parameters to simulate from are [[0.002 0.183 0.023 0.032 0.013 0.016]]

The mean of the samples was -0.499  
 Iteration 70  
 The final EI loss was -0.396 with predicted mean of [-0.624]  
 The next parameters to simulate from are [[0.669 0.227 0.029 0.06 0.014 0.014]]  
 The mean of the samples was -0.443  
 Iteration 71  
 The final EI loss was -0.396 with predicted mean of [-0.601]  
 The next parameters to simulate from are [[0.697 0.183 0.033 0.057 0.017 0.035]]  
 The mean of the samples was -0.488  
 Iteration 72  
 Acquisition function convergence reached at iteration 444.  
 The final EI loss was -0.373 with predicted mean of [-0.619]  
 The next parameters to simulate from are [[0.344 0.247 0.028 0.053 0.003 0.02 ]]  
 The mean of the samples was -0.375  
 Iteration 73  
 Acquisition function convergence reached at iteration 9238.  
 The final EI loss was -0.399 with predicted mean of [-0.617]  
 The next parameters to simulate from are [[0.868 0.041 0.019 0.05 0.007 0.009]]  
 The mean of the samples was -0.555  
 Iteration 74  
 The final EI loss was -0.399 with predicted mean of [-0.617]  
 The next parameters to simulate from are [[0.668 0.212 0.029 0.054 0.01 0.014]]  
 The mean of the samples was -0.762  
 Iteration 75  
 Acquisition function convergence reached at iteration 128.  
 The final EI loss was -0.001 with predicted mean of [-1.236]  
 The next parameters to simulate from are [[0.714 0.226 0.028 0.044 0.021 0.016]]  
 The mean of the samples was -0.863  
 Iteration 76  
 Acquisition function convergence reached at iteration 501.  
 The final EI loss was -0.399 with predicted mean of [-0.583]  
 The next parameters to simulate from are [[0.067 0.186 0.023 0.026 0.013 0.018]]  
 The mean of the samples was -0.644  
 Iteration 77  
 Acquisition function convergence reached at iteration 107.  
 The final EI loss was -0.02 with predicted mean of [-1.198]  
 The next parameters to simulate from are [[0.707 0.173 0.028 0.045 0.021 0.015]]  
 The mean of the samples was -1.266  
 Iteration 78  
 Acquisition function convergence reached at iteration 135.  
 The final EI loss was -0.006 with predicted mean of [-1.25]  
 The next parameters to simulate from are [[0.703 0.152 0.027 0.045 0.021 0.015]]  
 The mean of the samples was -1.164

Iteration 79

Acquisition function convergence reached at iteration 3859.

The final EI loss was -0.399 with predicted mean of [-0.605]

The next parameters to simulate from are [[0.66 0.211 0.029 0.055 0.007 0.014]]

The mean of the samples was -1.255

Iteration 80

Acquisition function convergence reached at iteration 774.

The final EI loss was -0.399 with predicted mean of [-0.604]

The next parameters to simulate from are [[0.7 0.697 0.02 0.039 0.006 0.006]]

The mean of the samples was -0.658

Hyperparameter convergence reached at iteration 1812.

The minimum predicted mean of the observed indices is -1.204 at the point

[0.707 0.173 0.028 0.045 0.021 0.015]

Iteration 81

Acquisition function convergence reached at iteration 177.

The final EI loss was -0.399 with predicted mean of [-0.602]

The next parameters to simulate from are [[0.151 0.17 0.023 0.026 0.011 0.019]]

The mean of the samples was -0.584

Iteration 82

Acquisition function convergence reached at iteration 194.

The final EI loss was -0.399 with predicted mean of [-0.602]

The next parameters to simulate from are [[0.87 0.094 0.018 0.048 0.008 0.007]]

The mean of the samples was -0.753

Iteration 83

Acquisition function convergence reached at iteration 175.

The final EI loss was -0.399 with predicted mean of [-0.602]

The next parameters to simulate from are [[0.703 0.727 0.02 0.041 0.006 0.006]]

The mean of the samples was -0.816

Iteration 84

Acquisition function convergence reached at iteration 1514.

The final EI loss was -0.399 with predicted mean of [-0.602]

The next parameters to simulate from are [[0.902 0.049 0.019 0.048 0.007 0.007]]

The mean of the samples was -0.463

Iteration 85

Acquisition function convergence reached at iteration 4277.

The final EI loss was -0.399 with predicted mean of [-0.602]

The next parameters to simulate from are [[0.11 0.183 0.025 0.029 0.001 0.02 ]]

The mean of the samples was -0.531

Iteration 86

Acquisition function convergence reached at iteration 108.

The final EI loss was -0.003 with predicted mean of [-1.209]

The next parameters to simulate from are [[0.708 0.173 0.028 0.046 0.022 0.015]]

The mean of the samples was -1.318

Iteration 87  
The final EI loss was -0.398 with predicted mean of [-0.622]  
The next parameters to simulate from are [[0.685 0.179 0.033 0.053 0.017 0.036]]  
The mean of the samples was -0.512

Iteration 88  
Acquisition function convergence reached at iteration 500.  
The final EI loss was -0.399 with predicted mean of [-0.622]  
The next parameters to simulate from are [[0.787 0.464 0.017 0.03 0.066 0.005]]  
The mean of the samples was -0.837

Iteration 89  
Acquisition function convergence reached at iteration 136.  
The final EI loss was -0.004 with predicted mean of [-1.25]  
The next parameters to simulate from are [[0.711 0.166 0.028 0.047 0.023 0.015]]  
The mean of the samples was -1.0

Iteration 90  
The final EI loss was -0.399 with predicted mean of [-0.601]  
The next parameters to simulate from are [[0.783 0.414 0.017 0.029 0.066 0.005]]  
The mean of the samples was -0.725

Iteration 91  
Acquisition function convergence reached at iteration 5590.  
The final EI loss was -0.399 with predicted mean of [-0.599]  
The next parameters to simulate from are [[0.698 0.733 0.021 0.038 0.002 0.006]]  
The mean of the samples was -0.733

Iteration 92  
Acquisition function convergence reached at iteration 136.  
The final EI loss was -0.004 with predicted mean of [-1.206]  
The next parameters to simulate from are [[0.703 0.178 0.027 0.045 0.02 0.015]]  
The mean of the samples was -1.494

Iteration 93  
Acquisition function convergence reached at iteration 136.  
The final EI loss was -0.027 with predicted mean of [-1.332]  
The next parameters to simulate from are [[0.691 0.168 0.026 0.043 0.018 0.015]]  
The mean of the samples was -1.116

Iteration 94  
Acquisition function convergence reached at iteration 127.  
The final EI loss was -0.0 with predicted mean of [-1.244]  
The next parameters to simulate from are [[0.707 0.175 0.027 0.045 0.02 0.015]]  
The mean of the samples was -1.302

Iteration 95  
The final EI loss was -0.399 with predicted mean of [-0.626]  
The next parameters to simulate from are [[0.682 0.181 0.033 0.05 0.017 0.035]]  
The mean of the samples was -0.719

Iteration 96

The final EI loss was -0.398 with predicted mean of [-0.629]  
 The next parameters to simulate from are [[0.81 0.6 0.017 0.045 0.067 0.01 ]]  
 The mean of the samples was -0.615  
 Iteration 97  
 The final EI loss was -0.394 with predicted mean of [-0.611]  
 The next parameters to simulate from are [[0.33 0.248 0.027 0.047 0.004 0.019]]  
 The mean of the samples was -0.739  
 Iteration 98  
 Acquisition function convergence reached at iteration 296.  
 The final EI loss was -0.399 with predicted mean of [-0.626]  
 The next parameters to simulate from are [[0.873 0.097 0.02 0.05 0.009 0.012]]  
 The mean of the samples was -0.535  
 Iteration 99  
 Acquisition function convergence reached at iteration 215.  
 The final EI loss was -0.399 with predicted mean of [-0.626]  
 The next parameters to simulate from are [[0.706 0.244 0.029 0.058 0.014 0.014]]  
 The mean of the samples was -0.848  
 Iteration 100  
 Acquisition function convergence reached at iteration 127.  
 The final EI loss was -0.003 with predicted mean of [-1.258]  
 The next parameters to simulate from are [[0.723 0.172 0.027 0.045 0.019 0.015]]  
 The mean of the samples was -1.015  
 Hyperparameter convergence reached at iteration 534.  
 The minimum predicted mean of the observed indices is -1.219 at the point  
 [0.703 0.178 0.027 0.045 0.02 0.015]  
 Trained parameters:  
 amplitude\_champ:0 is 0.581  
  
 length\_scales\_champ:0 is [0.25 0.25 0.008 0.02 0.018 0.018]  
  
 observation\_noise\_variance\_champ:0 is 0.013  
  
 bias\_mean:0 is 0.204  
  
 Iteration 101  
 Acquisition function convergence reached at iteration 126.  
 The final EI loss was -0.008 with predicted mean of [-1.233]  
 The next parameters to simulate from are [[0.681 0.179 0.027 0.044 0.02 0.015]]  
 The mean of the samples was -1.208  
 Iteration 102  
 Acquisition function convergence reached at iteration 3232.  
 The final EI loss was -0.37 with predicted mean of [-0.621]  
 The next parameters to simulate from are [[0.801 0. 0.033 0.035 0.015 0.018]]

The mean of the samples was -0.568  
 Iteration 103  
 The final EI loss was -0.399 with predicted mean of [-0.607]  
 The next parameters to simulate from are [[0.069 0.194 0.024 0.031 0.001 0.021]]  
 The mean of the samples was -0.757  
 Iteration 104  
 The final EI loss was -0.399 with predicted mean of [-0.615]  
 The next parameters to simulate from are [[0.816 0.579 0.017 0.044 0.067 0.013]]  
 The mean of the samples was -0.608  
 Iteration 105  
 Acquisition function convergence reached at iteration 2299.  
 The final EI loss was -0.399 with predicted mean of [-0.613]  
 The next parameters to simulate from are [[0.089 0.182 0.024 0.027 0.001 0.023]]  
 The mean of the samples was -0.592  
 Iteration 106  
 Acquisition function convergence reached at iteration 120.  
 The final EI loss was -0.0 with predicted mean of [-1.226]  
 The next parameters to simulate from are [[0.684 0.179 0.027 0.044 0.02 0.015]]  
 The mean of the samples was -1.195  
 Iteration 107  
 The final EI loss was -0.399 with predicted mean of [-0.614]  
 The next parameters to simulate from are [[0.727 0.235 0.03 0.061 0.016 0.015]]  
 The mean of the samples was -0.785  
 Iteration 108  
 The final EI loss was -0.397 with predicted mean of [-0.618]  
 The next parameters to simulate from are [[0.727 0.238 0.031 0.064 0.016 0.015]]  
 The mean of the samples was -0.649  
 Iteration 109  
 The final EI loss was -0.399 with predicted mean of [-0.609]  
 The next parameters to simulate from are [[0.743 0.241 0.032 0.067 0.017 0.015]]  
 The mean of the samples was -0.434  
 Iteration 110  
 The final EI loss was -0.399 with predicted mean of [-0.609]  
 The next parameters to simulate from are [[0.329 0.242 0.028 0.051 0. 0.023]]  
 The mean of the samples was -1.21  
 Iteration 111  
 Acquisition function convergence reached at iteration 5082.  
 The final EI loss was -0.399 with predicted mean of [-0.607]  
 The next parameters to simulate from are [[0.757 0.234 0.033 0.064 0.016 0.015]]  
 The mean of the samples was -0.438  
 Iteration 112  
 Acquisition function convergence reached at iteration 133.  
 The final EI loss was -0.001 with predicted mean of [-1.217]



The next parameters to simulate from are [[0.697 0.178 0.028 0.045 0.02 0.015]]  
 The mean of the samples was -1.208  
 Iteration 113  
 Acquisition function convergence reached at iteration 127.  
 The final EI loss was -0.0 with predicted mean of [-1.216]  
 The next parameters to simulate from are [[0.697 0.178 0.028 0.045 0.02 0.015]]  
 The mean of the samples was -1.143  
 Iteration 114  
 Acquisition function convergence reached at iteration 889.  
 The final EI loss was -0.399 with predicted mean of [-0.605]  
 The next parameters to simulate from are [[0.69 0.594 0.022 0.038 0.002 0.006]]  
 The mean of the samples was -0.739  
 Iteration 115  
 The final EI loss was -0.399 with predicted mean of [-0.608]  
 The next parameters to simulate from are [[0.808 0.001 0.033 0.038 0.016 0.017]]  
 The mean of the samples was -0.685  
 Iteration 116  
 The final EI loss was -0.398 with predicted mean of [-0.609]  
 The next parameters to simulate from are [[0.083 0.194 0.024 0.025 0. 0.025]]  
 The mean of the samples was -0.485  
 Iteration 117  
 The final EI loss was -0.399 with predicted mean of [-0.603]  
 The next parameters to simulate from are [[0.758 0.221 0.033 0.061 0.017 0.016]]  
 The mean of the samples was -0.842  
 Iteration 118  
 The final EI loss was -0.399 with predicted mean of [-0.605]  
 The next parameters to simulate from are [[0.814 0.565 0.017 0.042 0.067 0.015]]  
 The mean of the samples was -0.608  
 Iteration 119  
 The final EI loss was -0.396 with predicted mean of [-0.599]  
 The next parameters to simulate from are [[0.296 0.23 0.026 0.042 0.006 0.016]]  
 The mean of the samples was -0.722  
 Iteration 120  
 Acquisition function convergence reached at iteration 6558.  
 The final EI loss was -0.388 with predicted mean of [-0.579]  
 The next parameters to simulate from are [[0.337 0.805 0.009 0.025 0.045 0.047]]  
 The mean of the samples was -0.576  
 Hyperparameter convergence reached at iteration 554.  
 The minimum predicted mean of the observed indices is -1.207 at the point  
 [0.697 0.178 0.028 0.045 0.02 0.015]  
 Iteration 121  
 Acquisition function convergence reached at iteration 187.  
 The final EI loss was -0.399 with predicted mean of [-0.604]

The next parameters to simulate from are [[0.842 0.021 0.033 0.036 0.016 0.018]]  
 The mean of the samples was -0.441  
 Iteration 122  
 Acquisition function convergence reached at iteration 1616.  
 The final EI loss was -0.399 with predicted mean of [-0.604]  
 The next parameters to simulate from are [[0.844 0.043 0.032 0.039 0.016 0.017]]  
 The mean of the samples was -0.562  
 Iteration 123  
 Acquisition function convergence reached at iteration 130.  
 The final EI loss was -0.0 with predicted mean of [-1.209]  
 The next parameters to simulate from are [[0.699 0.18 0.027 0.045 0.02 0.015]]  
 The mean of the samples was -1.208  
 Iteration 124  
 Acquisition function convergence reached at iteration 138.  
 The final EI loss was -0.0 with predicted mean of [-1.209]  
 The next parameters to simulate from are [[0.699 0.18 0.027 0.045 0.02 0.015]]  
 The mean of the samples was -1.367  
 Iteration 125  
 The final EI loss was -0.398 with predicted mean of [-0.616]  
 The next parameters to simulate from are [[0.764 0.198 0.033 0.064 0.015 0.017]]  
 The mean of the samples was -0.432  
 Iteration 126  
 The final EI loss was -0.399 with predicted mean of [-0.609]  
 The next parameters to simulate from are [[0.702 0.197 0.033 0.057 0.018 0.031]]  
 The mean of the samples was -0.622  
 Iteration 127  
 The final EI loss was -0.398 with predicted mean of [-0.613]  
 The next parameters to simulate from are [[0.736 0.238 0.033 0.062 0.011 0.014]]  
 The mean of the samples was -0.479  
 Iteration 128  
 Acquisition function convergence reached at iteration 5836.  
 The final EI loss was -0.399 with predicted mean of [-0.61]  
 The next parameters to simulate from are [[0.784 0.422 0.017 0.028 0.066 0.002]]  
 The mean of the samples was -0.072  
 Iteration 129  
 Acquisition function convergence reached at iteration 150.  
 The final EI loss was -0.399 with predicted mean of [-0.61]  
 The next parameters to simulate from are [[0.879 0.102 0.02 0.052 0.01 0.009]]  
 The mean of the samples was -0.677  
 Iteration 130  
 The final EI loss was -0.399 with predicted mean of [-0.608]  
 The next parameters to simulate from are [[0.74 0.631 0.021 0.038 0.006 0.004]]  
 The mean of the samples was -0.425

Iteration 131  
Acquisition function convergence reached at iteration 1784.  
The final EI loss was -0.399 with predicted mean of [-0.61]  
The next parameters to simulate from are [[0.887 0.08 0.018 0.048 0.004 0.006]]  
The mean of the samples was -0.587

Iteration 132  
Acquisition function convergence reached at iteration 157.  
The final EI loss was -0.399 with predicted mean of [-0.61]  
The next parameters to simulate from are [[0.178 0.165 0.024 0.03 0.01 0.019]]  
The mean of the samples was -0.536

Iteration 133  
Acquisition function convergence reached at iteration 108.  
The final EI loss was -0.001 with predicted mean of [-1.221]  
The next parameters to simulate from are [[0.696 0.178 0.027 0.044 0.02 0.014]]  
The mean of the samples was -1.235

Iteration 134  
Acquisition function convergence reached at iteration 257.  
The final EI loss was -0.399 with predicted mean of [-0.611]  
The next parameters to simulate from are [[0.088 0.196 0.024 0.033 0.007 0.016]]  
The mean of the samples was -0.5

Iteration 135  
Acquisition function convergence reached at iteration 1118.  
The final EI loss was -0.399 with predicted mean of [-0.611]  
The next parameters to simulate from are [[0.675 0.188 0.032 0.05 0.018 0.038]]  
The mean of the samples was -0.641

Iteration 136  
Acquisition function convergence reached at iteration 140.  
The final EI loss was -0.0 with predicted mean of [-1.222]  
The next parameters to simulate from are [[0.695 0.178 0.027 0.044 0.02 0.014]]  
The mean of the samples was -1.032

Iteration 137  
Acquisition function convergence reached at iteration 159.  
The final EI loss was -0.399 with predicted mean of [-0.604]  
The next parameters to simulate from are [[0.688 0.608 0.02 0.04 0.008 0.006]]  
The mean of the samples was -0.69

Iteration 138  
The final EI loss was -0.395 with predicted mean of [-0.591]  
The next parameters to simulate from are [[0.735 0.235 0.033 0.06 0.01 0.011]]  
The mean of the samples was -0.839

Iteration 139  
Acquisition function convergence reached at iteration 1013.  
The final EI loss was -0.399 with predicted mean of [-0.603]  
The next parameters to simulate from are [[0.859 0.052 0.032 0.042 0.016 0.016]]

The mean of the samples was -0.531  
 Iteration 140  
 Acquisition function convergence reached at iteration 143.  
 The final EI loss was -0.001 with predicted mean of [-1.209]  
 The next parameters to simulate from are [[0.7 0.179 0.027 0.045 0.021 0.015]]  
 The mean of the samples was -1.245  
 Hyperparameter convergence reached at iteration 1177.  
 The minimum predicted mean of the observed indices is -1.211 at the point  
 [0.7 0.179 0.027 0.045 0.021 0.015]  
 Iteration 141  
 Acquisition function convergence reached at iteration 140.  
 The final EI loss was -0.0 with predicted mean of [-1.211]  
 The next parameters to simulate from are [[0.701 0.179 0.028 0.045 0.02 0.015]]  
 The mean of the samples was -1.133  
 Iteration 142  
 The final EI loss was -0.399 with predicted mean of [-0.608]  
 The next parameters to simulate from are [[0.707 0.194 0.033 0.058 0.013 0.028]]  
 The mean of the samples was -0.7  
 Iteration 143  
 Acquisition function convergence reached at iteration 129.  
 The final EI loss was -0.0 with predicted mean of [-1.206]  
 The next parameters to simulate from are [[0.702 0.18 0.028 0.045 0.02 0.015]]  
 The mean of the samples was -1.358  
 Iteration 144  
 Acquisition function convergence reached at iteration 593.  
 The final EI loss was -0.399 with predicted mean of [-0.607]  
 The next parameters to simulate from are [[0.33 0.23 0.026 0.042 0.008 0.016]]  
 The mean of the samples was -0.824  
 Iteration 145  
 The final EI loss was -0.399 with predicted mean of [-0.606]  
 The next parameters to simulate from are [[0.672 0.183 0.033 0.047 0.017 0.038]]  
 The mean of the samples was -0.575  
 Iteration 146  
 Acquisition function convergence reached at iteration 126.  
 The final EI loss was -0.0 with predicted mean of [-1.214]  
 The next parameters to simulate from are [[0.698 0.18 0.027 0.045 0.02 0.015]]  
 The mean of the samples was -1.296  
 Iteration 147  
 Acquisition function convergence reached at iteration 169.  
 The final EI loss was -0.399 with predicted mean of [-0.609]  
 The next parameters to simulate from are [[0.074 0.193 0.023 0.023 0.014 0.019]]  
 The mean of the samples was -0.475  
 Iteration 148

Acquisition function convergence reached at iteration 178.  
 The final EI loss was -0.399 with predicted mean of [-0.609]  
 The next parameters to simulate from are [[0.748 0.614 0.021 0.038 0.009 0.005]]  
 The mean of the samples was -0.801  
 Iteration 149  
 Acquisition function convergence reached at iteration 4596.  
 The final EI loss was -0.399 with predicted mean of [-0.609]  
 The next parameters to simulate from are [[0.846 0.072 0.033 0.042 0.016 0.016]]  
 The mean of the samples was -0.547  
 Iteration 150  
 The final EI loss was -0.399 with predicted mean of [-0.608]  
 The next parameters to simulate from are [[0.056 0.179 0.023 0.023 0.012 0.023]]  
 The mean of the samples was -0.633  
 Trained parameters:  
 amplitude\_champ:0 is 0.589  
  
 length\_scales\_champ:0 is [0.25 0.25 0.008 0.022 0.018 0.018]  
  
 observation\_noise\_variance\_champ:0 is 0.012  
  
 bias\_mean:0 is 0.217  
  
 Iteration 151  
 Acquisition function convergence reached at iteration 179.  
 The final EI loss was -0.399 with predicted mean of [-0.609]  
 The next parameters to simulate from are [[0.693 0.686 0.019 0.038 0.004 0.005]]  
 The mean of the samples was -0.522  
 Iteration 152  
 The final EI loss was -0.399 with predicted mean of [-0.613]  
 The next parameters to simulate from are [[0.69 0.18 0.033 0.06 0.01 0.025]]  
 The mean of the samples was -0.652  
 Iteration 153  
 Acquisition function convergence reached at iteration 129.  
 The final EI loss was -0.0 with predicted mean of [-1.218]  
 The next parameters to simulate from are [[0.697 0.18 0.027 0.045 0.021 0.015]]  
 The mean of the samples was -1.194  
 Iteration 154  
 Acquisition function convergence reached at iteration 177.  
 The final EI loss was -0.399 with predicted mean of [-0.608]  
 The next parameters to simulate from are [[0.724 0.762 0.02 0.04 0.004 0.004]]  
 The mean of the samples was -0.482  
 Iteration 155  
 Acquisition function convergence reached at iteration 1818.

The final EI loss was -0.399 with predicted mean of [-0.608]  
 The next parameters to simulate from are [[0.664 0.191 0.032 0.045 0.017 0.04 ]]  
 The mean of the samples was -0.558  
 Iteration 156  
 Acquisition function convergence reached at iteration 115.  
 The final EI loss was -0.0 with predicted mean of [-1.217]  
 The next parameters to simulate from are [[0.698 0.18 0.027 0.045 0.02 0.015]]  
 The mean of the samples was -1.491  
 Iteration 157  
 Acquisition function convergence reached at iteration 126.  
 The final EI loss was -0.001 with predicted mean of [-1.232]  
 The next parameters to simulate from are [[0.693 0.179 0.027 0.045 0.021 0.015]]  
 The mean of the samples was -1.006  
 Iteration 158  
 Acquisition function convergence reached at iteration 2728.  
 The final EI loss was -0.399 with predicted mean of [-0.61]  
 The next parameters to simulate from are [[0.717 0.73 0.02 0.04 0.009 0.004]]  
 The mean of the samples was -0.544  
 Iteration 159  
 Acquisition function convergence reached at iteration 142.  
 The final EI loss was -0.0 with predicted mean of [-1.22]  
 The next parameters to simulate from are [[0.702 0.18 0.028 0.045 0.02 0.015]]  
 The mean of the samples was -1.125  
 Iteration 160  
 The final EI loss was -0.399 with predicted mean of [-0.606]  
 The next parameters to simulate from are [[0.819 0.675 0.018 0.049 0.068 0.005]]  
 The mean of the samples was -0.813  
 Hyperparameter convergence reached at iteration 687.  
 The minimum predicted mean of the observed indices is -1.215 at the point  
 [0.702 0.18 0.028 0.045 0.02 0.015]  
 Iteration 161  
 The final EI loss was -0.399 with predicted mean of [-0.609]  
 The next parameters to simulate from are [[0.788 0.486 0.017 0.022 0.066 0.006]]  
 The mean of the samples was -0.679  
 Iteration 162  
 Acquisition function convergence reached at iteration 2488.  
 The final EI loss was -0.399 with predicted mean of [-0.607]  
 The next parameters to simulate from are [[0.142 0.201 0.025 0.026 0.002 0.025]]  
 The mean of the samples was -0.549  
 Iteration 163  
 Acquisition function convergence reached at iteration 121.  
 The final EI loss was -0.0 with predicted mean of [-1.215]  
 The next parameters to simulate from are [[0.701 0.179 0.028 0.045 0.02 0.015]]

The mean of the samples was -0.979  
 Iteration 164  
 Acquisition function convergence reached at iteration 141.  
 The final EI loss was -0.0 with predicted mean of [-1.206]  
 The next parameters to simulate from are [[0.701 0.181 0.028 0.045 0.02 0.015]]  
 The mean of the samples was -1.075  
 Iteration 165  
 The final EI loss was -0.399 with predicted mean of [-0.603]  
 The next parameters to simulate from are [[0.707 0.145 0.033 0.061 0.013 0.022]]  
 The mean of the samples was -0.587  
 Iteration 166  
 Acquisition function convergence reached at iteration 134.  
 The final EI loss was -0.0 with predicted mean of [-1.201]  
 The next parameters to simulate from are [[0.701 0.181 0.028 0.045 0.02 0.015]]  
 The mean of the samples was -1.386  
 Iteration 167  
 Acquisition function convergence reached at iteration 1004.  
 The final EI loss was -0.399 with predicted mean of [-0.604]  
 The next parameters to simulate from are [[0.835 0.027 0.032 0.042 0.016 0.014]]  
 The mean of the samples was -0.762  
 Iteration 168  
 The final EI loss was -0.399 with predicted mean of [-0.596]  
 The next parameters to simulate from are [[0.699 0.083 0.033 0.06 0.013 0.021]]  
 The mean of the samples was -0.574  
 Iteration 169  
 Acquisition function convergence reached at iteration 401.  
 The final EI loss was -0.399 with predicted mean of [-0.604]  
 The next parameters to simulate from are [[0.287 0.223 0.026 0.042 0.01 0.014]]  
 The mean of the samples was -0.506  
 Iteration 170  
 Acquisition function convergence reached at iteration 127.  
 The final EI loss was -0.051 with predicted mean of [-1.29]  
 The next parameters to simulate from are [[0.659 0.211 0.029 0.049 0. 0.015]]  
 The mean of the samples was -0.966  
 Iteration 171  
 Acquisition function convergence reached at iteration 6855.  
 The final EI loss was -0.399 with predicted mean of [-0.604]  
 The next parameters to simulate from are [[0.884 0.051 0.02 0.048 0.009 0.006]]  
 The mean of the samples was -0.881  
 Iteration 172  
 Acquisition function convergence reached at iteration 144.  
 The final EI loss was -0.399 with predicted mean of [-0.604]  
 The next parameters to simulate from are [[0.65 0.186 0.031 0.044 0.016 0.04 ]]

The mean of the samples was -0.614  
 Iteration 173  
 Acquisition function convergence reached at iteration 156.  
 The final EI loss was -0.399 with predicted mean of [-0.604]  
 The next parameters to simulate from are [[0.718 0.762 0.021 0.043 0.009 0.005]]  
 The mean of the samples was -0.626  
 Iteration 174  
 The final EI loss was -0.399 with predicted mean of [-0.604]  
 The next parameters to simulate from are [[0.751 0.235 0.032 0.064 0.013 0.01 ]]  
 The mean of the samples was -0.698  
 Iteration 175  
 Acquisition function convergence reached at iteration 119.  
 The final EI loss was -0.0 with predicted mean of [-1.21]  
 The next parameters to simulate from are [[0.702 0.176 0.028 0.045 0.02 0.014]]  
 The mean of the samples was -1.155  
 Iteration 176  
 Acquisition function convergence reached at iteration 509.  
 The final EI loss was -0.399 with predicted mean of [-0.603]  
 The next parameters to simulate from are [[0.262 0.187 0.026 0.036 0.008 0.015]]  
 The mean of the samples was -0.548  
 Iteration 177  
 Acquisition function convergence reached at iteration 8880.  
 The final EI loss was -0.399 with predicted mean of [-0.603]  
 The next parameters to simulate from are [[0.944 0.056 0.02 0.049 0.009 0.006]]  
 The mean of the samples was -0.228  
 Iteration 178  
 Acquisition function convergence reached at iteration 3671.  
 The final EI loss was -0.02 with predicted mean of [0.008]  
 The next parameters to simulate from are [[1. 0. 0. 0.1 0. 0. ]]  
 The mean of the samples was 0.505  
 Iteration 179  
 Acquisition function convergence reached at iteration 95.  
 The final EI loss was -0.0 with predicted mean of [-1.207]  
 The next parameters to simulate from are [[0.701 0.176 0.028 0.045 0.02 0.015]]  
 The mean of the samples was -1.064  
 Iteration 180  
 Acquisition function convergence reached at iteration 115.  
 The final EI loss was -0.0 with predicted mean of [-1.201]  
 The next parameters to simulate from are [[0.7 0.178 0.028 0.045 0.02 0.015]]  
 The mean of the samples was -0.967  
 Hyperparameter convergence reached at iteration 1893.  
 The minimum predicted mean of the observed indices is -1.194 at the point  
 [0.701 0.179 0.028 0.045 0.02 0.015]



Iteration 181  
Acquisition function convergence reached at iteration 4527.  
The final EI loss was -0.399 with predicted mean of [-0.597]  
The next parameters to simulate from are [[0.762 0.237 0.03 0.066 0.015 0.01 ]]  
The mean of the samples was -0.348

Iteration 182  
Acquisition function convergence reached at iteration 323.  
The final EI loss was -0.399 with predicted mean of [-0.597]  
The next parameters to simulate from are [[0.661 0.745 0.02 0.043 0.009 0.005]]  
The mean of the samples was -0.471

Iteration 183  
The final EI loss was -0.399 with predicted mean of [-0.598]  
The next parameters to simulate from are [[0.785 0.501 0.017 0.018 0.066 0.007]]  
The mean of the samples was -0.402

Iteration 184  
Acquisition function convergence reached at iteration 2300.  
The final EI loss was -0.399 with predicted mean of [-0.597]  
The next parameters to simulate from are [[0.836 0.106 0.019 0.05 0.005 0.013]]  
The mean of the samples was -0.476

Iteration 185  
Acquisition function convergence reached at iteration 138.  
The final EI loss was -0.0 with predicted mean of [-1.194]  
The next parameters to simulate from are [[0.699 0.179 0.028 0.044 0.02 0.015]]  
The mean of the samples was -0.988

Iteration 186  
The final EI loss was -0.399 with predicted mean of [-0.596]  
The next parameters to simulate from are [[0.746 0.233 0.033 0.065 0.012 0.007]]  
The mean of the samples was -0.323

Iteration 187  
Acquisition function convergence reached at iteration 132.  
The final EI loss was -0.0 with predicted mean of [-1.188]  
The next parameters to simulate from are [[0.703 0.18 0.028 0.045 0.02 0.015]]  
The mean of the samples was -1.19

Iteration 188  
Acquisition function convergence reached at iteration 134.  
The final EI loss was -0.0 with predicted mean of [-1.188]  
The next parameters to simulate from are [[0.703 0.18 0.028 0.045 0.02 0.015]]  
The mean of the samples was -1.293

Iteration 189  
Acquisition function convergence reached at iteration 134.  
The final EI loss was -0.0 with predicted mean of [-1.192]  
The next parameters to simulate from are [[0.705 0.18 0.027 0.045 0.02 0.016]]  
The mean of the samples was -1.052

Iteration 190  
Acquisition function convergence reached at iteration 122.  
The final EI loss was -0.0 with predicted mean of [-1.187]  
The next parameters to simulate from are [[0.702 0.181 0.028 0.045 0.02 0.015]]  
The mean of the samples was -1.129

Iteration 191  
Acquisition function convergence reached at iteration 3909.  
The final EI loss was -0.399 with predicted mean of [-0.592]  
The next parameters to simulate from are [[0.777 0.003 0.033 0.031 0.015 0.018]]  
The mean of the samples was -0.52

Iteration 192  
Acquisition function convergence reached at iteration 3482.  
The final EI loss was -0.016 with predicted mean of [0.024]  
The next parameters to simulate from are [[0. 0. 0. 0.1 0. 0. ]]  
The mean of the samples was 2.432

Iteration 193  
Acquisition function convergence reached at iteration 172.  
The final EI loss was -0.399 with predicted mean of [-0.593]  
The next parameters to simulate from are [[0.705 0.291 0.029 0.062 0.016 0.018]]  
The mean of the samples was -0.411

Iteration 194  
The final EI loss was -0.399 with predicted mean of [-0.594]  
The next parameters to simulate from are [[0.693 0.353 0.027 0.056 0.021 0.016]]  
The mean of the samples was -0.855

Iteration 195  
Acquisition function convergence reached at iteration 137.  
The final EI loss was -0.001 with predicted mean of [-1.186]  
The next parameters to simulate from are [[0.702 0.188 0.027 0.045 0.021 0.015]]  
The mean of the samples was -1.25

Iteration 196  
The final EI loss was -0.399 with predicted mean of [-0.594]  
The next parameters to simulate from are [[0.906 0.092 0.02 0.046 0.005 0.003]]  
The mean of the samples was -0.793

Iteration 197  
The final EI loss was -0.399 with predicted mean of [-0.594]  
The next parameters to simulate from are [[0.643 0.2 0.03 0.043 0.016 0.041]]  
The mean of the samples was -0.534

Iteration 198  
Acquisition function convergence reached at iteration 128.  
The final EI loss was -0.0 with predicted mean of [-1.189]  
The next parameters to simulate from are [[0.703 0.192 0.027 0.045 0.021 0.015]]  
The mean of the samples was -1.3

Iteration 199

Acquisition function convergence reached at iteration 121.  
 The final EI loss was -0.001 with predicted mean of [-1.199]  
 The next parameters to simulate from are [[0.706 0.199 0.027 0.045 0.021 0.015]]  
 The mean of the samples was -1.14  
 Iteration 200  
 Acquisition function convergence reached at iteration 134.  
 The final EI loss was -0.0 with predicted mean of [-1.192]  
 The next parameters to simulate from are [[0.703 0.193 0.027 0.045 0.021 0.015]]  
 The mean of the samples was -1.287  
 Hyperparameter convergence reached at iteration 1718.  
 The minimum predicted mean of the observed indices is -1.203 at the point  
 [0.706 0.199 0.027 0.045 0.021 0.015]  
 Trained parameters:  
 amplitude\_champ:0 is 0.596  
  
 length\_scales\_champ:0 is [0.25 0.25 0.008 0.023 0.018 0.018]  
  
 observation\_noise\_variance\_champ:0 is 0.013  
  
 bias\_mean:0 is 0.318  
  
 Iteration 201  
 The final EI loss was -0.399 with predicted mean of [-0.602]  
 The next parameters to simulate from are [[0.728 0.033 0.031 0.015 0.017]]  
 The mean of the samples was -0.621  
 Iteration 202  
 Acquisition function convergence reached at iteration 3398.  
 The final EI loss was -0.399 with predicted mean of [-0.602]  
 The next parameters to simulate from are [[0.675 0.105 0.031 0.061 0.014 0.021]]  
 The mean of the samples was -0.252  
 Iteration 203  
 Acquisition function convergence reached at iteration 1233.  
 The final EI loss was -0.399 with predicted mean of [-0.602]  
 The next parameters to simulate from are [[0.745 0.736 0.019 0.04 0.008 0.005]]  
 The mean of the samples was -0.776  
 Iteration 204  
 Acquisition function convergence reached at iteration 102.  
 The final EI loss was -0.0 with predicted mean of [-1.206]  
 The next parameters to simulate from are [[0.703 0.202 0.027 0.045 0.021 0.015]]  
 The mean of the samples was -1.459  
 Iteration 205  
 Acquisition function convergence reached at iteration 716.  
 The final EI loss was -0.399 with predicted mean of [-0.622]

The next parameters to simulate from are [[0.235 0.205 0.025 0.035 0.011 0.019]]  
 The mean of the samples was -0.813  
 Iteration 206  
 Acquisition function convergence reached at iteration 148.  
 The final EI loss was -0.399 with predicted mean of [-0.622]  
 The next parameters to simulate from are [[0.448 0.479 0.011 0.023 0.035 0.032]]  
 The mean of the samples was -0.708  
 Iteration 207  
 Acquisition function convergence reached at iteration 118.  
 The final EI loss was -0.012 with predicted mean of [-1.264]  
 The next parameters to simulate from are [[0.706 0.219 0.026 0.045 0.022 0.014]]  
 The mean of the samples was -1.508  
 Iteration 208  
 Acquisition function convergence reached at iteration 1363.  
 The final EI loss was -0.399 with predicted mean of [-0.684]  
 The next parameters to simulate from are [[0.727 0.717 0.017 0.04 0.01 0.005]]  
 The mean of the samples was -0.817  
 Iteration 209  
 Acquisition function convergence reached at iteration 2589.  
 The final EI loss was -0.399 with predicted mean of [-0.684]  
 The next parameters to simulate from are [[0.405 0.466 0.011 0.021 0.036 0.035]]  
 The mean of the samples was -0.538  
 Iteration 210  
 Acquisition function convergence reached at iteration 3935.  
 The final EI loss was -0.399 with predicted mean of [-0.684]  
 The next parameters to simulate from are [[0.62 0.212 0.029 0.045 0.016 0.038]]  
 The mean of the samples was -0.601  
 Iteration 211  
 Acquisition function convergence reached at iteration 207.  
 The final EI loss was -0.399 with predicted mean of [-0.684]  
 The next parameters to simulate from are [[0.768 0.644 0.02 0.035 0.005 0.005]]  
 The mean of the samples was -0.763  
 Iteration 212  
 The final EI loss was -0.399 with predicted mean of [-0.685]  
 The next parameters to simulate from are [[0.107 0.22 0.023 0.034 0.014 0.019]]  
 The mean of the samples was -0.628  
 Iteration 213  
 Acquisition function convergence reached at iteration 125.  
 The final EI loss was -0.029 with predicted mean of [-1.415]  
 The next parameters to simulate from are [[0.71 0.239 0.025 0.045 0.022 0.014]]  
 The mean of the samples was -1.517  
 Iteration 214  
 Acquisition function convergence reached at iteration 124.

The final EI loss was -0.005 with predicted mean of [-1.49]  
 The next parameters to simulate from are [[0.711 0.248 0.024 0.044 0.023 0.013]]  
 The mean of the samples was -1.403  
 Iteration 215  
 Acquisition function convergence reached at iteration 18.  
 The final EI loss was 0.0 with predicted mean of [0.399]  
 The next parameters to simulate from are [[0.556 0.353 0.029 0.071 0.016 0.021]]  
 The mean of the samples was 0.188  
 Iteration 216  
 Acquisition function convergence reached at iteration 1834.  
 The final EI loss was -0.399 with predicted mean of [-0.723]  
 The next parameters to simulate from are [[0.628 0.118 0.03 0.051 0.016 0.02 ]]  
 The mean of the samples was -1.208  
 Iteration 217  
 Acquisition function convergence reached at iteration 222.  
 The final EI loss was -0.399 with predicted mean of [-0.723]  
 The next parameters to simulate from are [[0.713 0.792 0.018 0.039 0.01 0.006]]  
 The mean of the samples was -0.665  
 Iteration 218  
 Acquisition function convergence reached at iteration 2121.  
 The final EI loss was -0.399 with predicted mean of [-0.723]  
 The next parameters to simulate from are [[0.831 0.097 0.031 0.048 0.017 0.016]]  
 The mean of the samples was -0.726  
 Iteration 219  
 Acquisition function convergence reached at iteration 114.  
 The final EI loss was -0.001 with predicted mean of [-1.448]  
 The next parameters to simulate from are [[0.712 0.246 0.024 0.045 0.023 0.013]]  
 The mean of the samples was -1.035  
 Iteration 220  
 Acquisition function convergence reached at iteration 846.  
 The final EI loss was -0.399 with predicted mean of [-0.67]  
 The next parameters to simulate from are [[0.862 0.113 0.03 0.048 0.017 0.015]]  
 The mean of the samples was -0.66  
 Hyperparameter convergence reached at iteration 1211.  
 The minimum predicted mean of the observed indices is -1.34 at the point  
 [0.71 0.239 0.025 0.045 0.022 0.014]  
 Iteration 221  
 Acquisition function convergence reached at iteration 121.  
 The final EI loss was -0.006 with predicted mean of [-1.35]  
 The next parameters to simulate from are [[0.702 0.228 0.025 0.045 0.022 0.014]]  
 The mean of the samples was -1.238  
 Iteration 222  
 Acquisition function convergence reached at iteration 132.

The final EI loss was -0.399 with predicted mean of [-0.664]  
 The next parameters to simulate from are [[0.405 0.516 0.011 0.025 0.035 0.033]]  
 The mean of the samples was -0.803  
 Iteration 223  
 Acquisition function convergence reached at iteration 122.  
 The final EI loss was -0.0 with predicted mean of [-1.329]  
 The next parameters to simulate from are [[0.705 0.23 0.025 0.045 0.022 0.014]]  
 The mean of the samples was -1.129  
 Iteration 224  
 Acquisition function convergence reached at iteration 171.  
 The final EI loss was -0.399 with predicted mean of [-0.65]  
 The next parameters to simulate from are [[0.166 0.198 0.023 0.026 0.008 0.024]]  
 The mean of the samples was -0.656  
 Iteration 225  
 Acquisition function convergence reached at iteration 126.  
 The final EI loss was -0.0 with predicted mean of [-1.299]  
 The next parameters to simulate from are [[0.707 0.229 0.025 0.045 0.022 0.014]]  
 The mean of the samples was -1.401  
 Iteration 226  
 Acquisition function convergence reached at iteration 1211.  
 The final EI loss was -0.399 with predicted mean of [-0.656]  
 The next parameters to simulate from are [[0.821 0.082 0.03 0.04 0.017 0.015]]  
 The mean of the samples was -0.78  
 Iteration 227  
 Acquisition function convergence reached at iteration 106.  
 The final EI loss was -0.0 with predicted mean of [-1.312]  
 The next parameters to simulate from are [[0.711 0.231 0.025 0.045 0.022 0.014]]  
 The mean of the samples was -1.321  
 Iteration 228  
 Acquisition function convergence reached at iteration 141.  
 The final EI loss was -0.0 with predicted mean of [-1.313]  
 The next parameters to simulate from are [[0.711 0.231 0.025 0.045 0.022 0.014]]  
 The mean of the samples was -1.194  
 Iteration 229  
 Acquisition function convergence reached at iteration 519.  
 The final EI loss was -0.399 with predicted mean of [-0.65]  
 The next parameters to simulate from are [[0.873 0.122 0.03 0.052 0.017 0.014]]  
 The mean of the samples was -0.581  
 Iteration 230  
 Acquisition function convergence reached at iteration 134.  
 The final EI loss was -0.0 with predicted mean of [-1.3]  
 The next parameters to simulate from are [[0.706 0.23 0.025 0.045 0.022 0.014]]  
 The mean of the samples was -1.348

Iteration 231  
Acquisition function convergence reached at iteration 2275.  
The final EI loss was -0.399 with predicted mean of [-0.652]  
The next parameters to simulate from are [[0.802 0.126 0.02 0.047 0.004 0.012]]  
The mean of the samples was -0.695

Iteration 232  
Acquisition function convergence reached at iteration 138.  
The final EI loss was -0.0 with predicted mean of [-1.305]  
The next parameters to simulate from are [[0.705 0.23 0.025 0.045 0.022 0.014]]  
The mean of the samples was -1.183

Iteration 233  
Acquisition function convergence reached at iteration 100.  
The final EI loss was -0.0 with predicted mean of [-1.294]  
The next parameters to simulate from are [[0.707 0.23 0.025 0.045 0.022 0.014]]  
The mean of the samples was -1.389

Iteration 234  
Acquisition function convergence reached at iteration 115.  
The final EI loss was -0.0 with predicted mean of [-1.302]  
The next parameters to simulate from are [[0.707 0.23 0.025 0.045 0.022 0.014]]  
The mean of the samples was -1.192

Iteration 235  
The final EI loss was -0.399 with predicted mean of [-0.649]  
The next parameters to simulate from are [[0.8 0.529 0.018 0.019 0.066 0.011]]  
The mean of the samples was -0.526

Iteration 236  
Acquisition function convergence reached at iteration 3719.  
The final EI loss was -0.399 with predicted mean of [-0.647]  
The next parameters to simulate from are [[0.274 0.216 0.026 0.04 0.003 0.014]]  
The mean of the samples was -0.468

Iteration 237  
Acquisition function convergence reached at iteration 123.  
The final EI loss was -0.0 with predicted mean of [-1.294]  
The next parameters to simulate from are [[0.706 0.229 0.025 0.045 0.022 0.014]]  
The mean of the samples was -0.968

Iteration 238  
Acquisition function convergence reached at iteration 1252.  
The final EI loss was -0.399 with predicted mean of [-0.636]  
The next parameters to simulate from are [[0.752 0.736 0.017 0.039 0.006 0.003]]  
The mean of the samples was -0.373

Iteration 239  
Acquisition function convergence reached at iteration 135.  
The final EI loss was -0.399 with predicted mean of [-0.636]  
The next parameters to simulate from are [[0.165 0.221 0.024 0.025 0.009 0.026]]

The mean of the samples was -0.585  
 Iteration 240  
 Acquisition function convergence reached at iteration 11.  
 The final EI loss was 0.0 with predicted mean of [0.368]  
 The next parameters to simulate from are [[0.541 0.367 0.027 0.076 0.019 0.022]]  
 The mean of the samples was 0.342  
 Hyperparameter convergence reached at iteration 833.  
 The minimum predicted mean of the observed indices is -1.272 at the point  
 [0.711 0.231 0.025 0.045 0.022 0.014]  
 Iteration 241  
 Acquisition function convergence reached at iteration 97.  
 The final EI loss was -0.0 with predicted mean of [-1.272]  
 The next parameters to simulate from are [[0.71 0.23 0.025 0.045 0.022 0.014]]  
 The mean of the samples was -0.954  
 Iteration 242  
 Acquisition function convergence reached at iteration 225.  
 The final EI loss was -0.001 with predicted mean of [-1.253]  
 The next parameters to simulate from are [[0.701 0.221 0.026 0.045 0.022 0.014]]  
 The mean of the samples was -1.207  
 Iteration 243  
 Acquisition function convergence reached at iteration 122.  
 The final EI loss was -0.0 with predicted mean of [-1.25]  
 The next parameters to simulate from are [[0.703 0.224 0.026 0.045 0.022 0.014]]  
 The mean of the samples was -1.128  
 Iteration 244  
 Acquisition function convergence reached at iteration 138.  
 The final EI loss was -0.0 with predicted mean of [-1.244]  
 The next parameters to simulate from are [[0.712 0.243 0.025 0.044 0.022 0.013]]  
 The mean of the samples was -1.161  
 Iteration 245  
 Acquisition function convergence reached at iteration 8405.  
 The final EI loss was -0.399 with predicted mean of [-0.62]  
 The next parameters to simulate from are [[0.94 0.101 0.02 0.046 0.006 0.002]]  
 The mean of the samples was -0.672  
 Iteration 246  
 Acquisition function convergence reached at iteration 246.  
 The final EI loss was -0.399 with predicted mean of [-0.62]  
 The next parameters to simulate from are [[0.876 0.106 0.031 0.046 0.019 0.013]]  
 The mean of the samples was -0.68  
 Iteration 247  
 Acquisition function convergence reached at iteration 166.  
 The final EI loss was -0.399 with predicted mean of [-0.62]  
 The next parameters to simulate from are [[0.73 0.753 0.019 0.035 0.007 0.005]]



The mean of the samples was -0.446  
 Iteration 248  
 Acquisition function convergence reached at iteration 5154.  
 The final EI loss was -0.399 with predicted mean of [-0.62]  
 The next parameters to simulate from are [[0.911 0.088 0.019 0.046 0.001 0.004]]  
 The mean of the samples was -0.66  
 Iteration 249  
 Acquisition function convergence reached at iteration 106.  
 The final EI loss was -0.0 with predicted mean of [-1.241]  
 The next parameters to simulate from are [[0.703 0.217 0.026 0.045 0.022 0.014]]  
 The mean of the samples was -1.034  
 Iteration 250  
 Acquisition function convergence reached at iteration 137.  
 The final EI loss was -0.001 with predicted mean of [-1.235]  
 The next parameters to simulate from are [[0.717 0.254 0.024 0.044 0.022 0.013]]  
 The mean of the samples was -1.173  
 Trained parameters:  
 amplitude\_champ:0 is 0.57  
  
 length\_scales\_champ:0 is [0.25 0.25 0.008 0.022 0.018 0.018]  
  
 observation\_noise\_variance\_champ:0 is 0.015  
  
 bias\_mean:0 is 0.311  
  
 Iteration 251  
 Acquisition function convergence reached at iteration 78.  
 The final EI loss was -0.0 with predicted mean of [-1.229]  
 The next parameters to simulate from are [[0.704 0.218 0.026 0.045 0.022 0.014]]  
 The mean of the samples was -1.141  
 Iteration 252  
 Acquisition function convergence reached at iteration 441.  
 The final EI loss was -0.399 with predicted mean of [-0.612]  
 The next parameters to simulate from are [[0.852 0.095 0.03 0.044 0.017 0.019]]  
 The mean of the samples was -0.482  
 Iteration 253  
 Acquisition function convergence reached at iteration 116.  
 The final EI loss was -0.0 with predicted mean of [-1.225]  
 The next parameters to simulate from are [[0.708 0.236 0.025 0.044 0.022 0.013]]  
 The mean of the samples was -1.196  
 Iteration 254  
 The final EI loss was -0.399 with predicted mean of [-0.613]  
 The next parameters to simulate from are [[0.742 0.231 0.033 0.06 0.012 0.005]]

The mean of the samples was -0.107  
 Iteration 255  
 Acquisition function convergence reached at iteration 118.  
 The final EI loss was -0.0 with predicted mean of [-1.225]  
 The next parameters to simulate from are [[0.701 0.216 0.026 0.045 0.021 0.015]]  
 The mean of the samples was -1.117  
 Iteration 256  
 Acquisition function convergence reached at iteration 4607.  
 The final EI loss was -0.399 with predicted mean of [-0.612]  
 The next parameters to simulate from are [[0.775 0.752 0.02 0.042 0.005 0.004]]  
 The mean of the samples was -0.699  
 Iteration 257  
 Acquisition function convergence reached at iteration 2959.  
 The final EI loss was -0.399 with predicted mean of [-0.611]  
 The next parameters to simulate from are [[0.074 0.153 0.023 0.025 0.005 0.025]]  
 The mean of the samples was -0.662  
 Iteration 258  
 Acquisition function convergence reached at iteration 119.  
 The final EI loss was -0.0 with predicted mean of [-1.222]  
 The next parameters to simulate from are [[0.714 0.249 0.024 0.044 0.022 0.013]]  
 The mean of the samples was -1.416  
 Iteration 259  
 Acquisition function convergence reached at iteration 131.  
 The final EI loss was -0.004 with predicted mean of [-1.258]  
 The next parameters to simulate from are [[0.723 0.273 0.023 0.043 0.022 0.013]]  
 The mean of the samples was -1.358  
 Iteration 260  
 Acquisition function convergence reached at iteration 1821.  
 The final EI loss was -0.399 with predicted mean of [-0.649]  
 The next parameters to simulate from are [[0.733 0.218 0.031 0.054 0.013 0.007]]  
 The mean of the samples was -0.524  
 Hyperparameter convergence reached at iteration 856.  
 The minimum predicted mean of the observed indices is -1.298 at the point  
 [0.723 0.273 0.023 0.043 0.022 0.013]  
 Iteration 261  
 Acquisition function convergence reached at iteration 1201.  
 The final EI loss was -0.399 with predicted mean of [-0.649]  
 The next parameters to simulate from are [[0.867 0.112 0.029 0.05 0.016 0.011]]  
 The mean of the samples was -0.857  
 Iteration 262  
 Acquisition function convergence reached at iteration 337.  
 The final EI loss was -0.399 with predicted mean of [-0.648]  
 The next parameters to simulate from are [[0.738 0.225 0.032 0.051 0.013 0.008]]

The mean of the samples was -0.599  
 Iteration 263  
 Acquisition function convergence reached at iteration 878.  
 The final EI loss was -0.399 with predicted mean of [-0.648]  
 The next parameters to simulate from are [[0.214 0.203 0.024 0.027 0.013 0.023]]  
 The mean of the samples was -0.867  
 Iteration 264  
 Acquisition function convergence reached at iteration 123.  
 The final EI loss was -0.007 with predicted mean of [-1.309]  
 The next parameters to simulate from are [[0.731 0.298 0.023 0.042 0.021 0.013]]  
 The mean of the samples was -1.463  
 Iteration 265  
 Acquisition function convergence reached at iteration 124.  
 The final EI loss was -0.013 with predicted mean of [-1.413]  
 The next parameters to simulate from are [[0.739 0.329 0.022 0.041 0.02 0.013]]  
 The mean of the samples was -1.156  
 Iteration 266  
 The final EI loss was -0.399 with predicted mean of [-0.657]  
 The next parameters to simulate from are [[0.392 0.513 0.009 0.026 0.035 0.033]]  
 The mean of the samples was -0.731  
 Iteration 267  
 The final EI loss was -0.399 with predicted mean of [-0.656]  
 The next parameters to simulate from are [[0.926 0.063 0.021 0.042 0.002 0.002]]  
 The mean of the samples was -0.56  
 Iteration 268  
 Acquisition function convergence reached at iteration 293.  
 The final EI loss was -0.003 with predicted mean of [-1.316]  
 The next parameters to simulate from are [[0.731 0.281 0.023 0.043 0.021 0.012]]  
 The mean of the samples was -1.223  
 Iteration 269  
 Acquisition function convergence reached at iteration 60.  
 The final EI loss was 0.0 with predicted mean of [0.407]  
 The next parameters to simulate from are [[0.445 0.342 0.027 0.078 0.021 0.025]]  
 The mean of the samples was 0.632  
 Iteration 270  
 The final EI loss was -0.399 with predicted mean of [-0.649]  
 The next parameters to simulate from are [[0.323 0.231 0.027 0.04 0. 0.015]]  
 The mean of the samples was -0.632  
 Iteration 271  
 Acquisition function convergence reached at iteration 115.  
 The final EI loss was -0.001 with predicted mean of [-1.297]  
 The next parameters to simulate from are [[0.727 0.284 0.023 0.043 0.021 0.013]]  
 The mean of the samples was -1.178

Iteration 272  
Acquisition function convergence reached at iteration 112.  
The final EI loss was -0.0 with predicted mean of [-1.28]  
The next parameters to simulate from are [[0.726 0.28 0.023 0.043 0.022 0.013]]  
The mean of the samples was -1.275

Iteration 273  
Acquisition function convergence reached at iteration 126.  
The final EI loss was -0.0 with predicted mean of [-1.279]  
The next parameters to simulate from are [[0.726 0.28 0.023 0.043 0.022 0.013]]  
The mean of the samples was -1.098

Iteration 274  
Acquisition function convergence reached at iteration 547.  
The final EI loss was -0.399 with predicted mean of [-0.629]  
The next parameters to simulate from are [[0.811 0.15 0.02 0.047 0.001 0.013]]  
The mean of the samples was -0.574

Iteration 275  
Acquisition function convergence reached at iteration 139.  
The final EI loss was -0.0 with predicted mean of [-1.259]  
The next parameters to simulate from are [[0.724 0.275 0.023 0.043 0.022 0.013]]  
The mean of the samples was -1.293

Iteration 276  
Acquisition function convergence reached at iteration 119.  
The final EI loss was -0.0 with predicted mean of [-1.262]  
The next parameters to simulate from are [[0.724 0.276 0.023 0.043 0.022 0.013]]  
The mean of the samples was -1.082

Iteration 277  
Acquisition function convergence reached at iteration 2715.  
The final EI loss was -0.399 with predicted mean of [-0.623]  
The next parameters to simulate from are [[0.627 0.217 0.028 0.044 0.016 0.037]]  
The mean of the samples was -0.649

Iteration 278  
Acquisition function convergence reached at iteration 701.  
The final EI loss was -0.399 with predicted mean of [-0.624]  
The next parameters to simulate from are [[0.759 0.219 0.032 0.048 0.013 0.009]]  
The mean of the samples was -0.783

Iteration 279  
Acquisition function convergence reached at iteration 193.  
The final EI loss was -0.399 with predicted mean of [-0.624]  
The next parameters to simulate from are [[0.116 0.241 0.023 0.03 0.016 0.019]]  
The mean of the samples was -0.711

Iteration 280  
The final EI loss was -0.399 with predicted mean of [-0.625]  
The next parameters to simulate from are [[0.363 0.242 0.027 0.037 0. 0.014]]

The mean of the samples was -0.494  
 Hyperparameter convergence reached at iteration 864.  
 The minimum predicted mean of the observed indices is -1.247 at the point  
 [0.723 0.273 0.023 0.043 0.022 0.013]  
 Iteration 281  
 Acquisition function convergence reached at iteration 1446.  
 The final EI loss was -0.399 with predicted mean of [-0.623]  
 The next parameters to simulate from are [[0.684 0.562 0.02 0.04 0.009 0.004]]  
 The mean of the samples was -0.435  
 Iteration 282  
 Acquisition function convergence reached at iteration 139.  
 The final EI loss was -0.001 with predicted mean of [-1.249]  
 The next parameters to simulate from are [[0.728 0.27 0.024 0.043 0.022 0.013]]  
 The mean of the samples was -1.192  
 Iteration 283  
 Acquisition function convergence reached at iteration 183.  
 The final EI loss was -0.399 with predicted mean of [-0.622]  
 The next parameters to simulate from are [[0.653 0.246 0.028 0.044 0.018 0.037]]  
 The mean of the samples was -0.567  
 Iteration 284  
 Acquisition function convergence reached at iteration 788.  
 The final EI loss was -0.399 with predicted mean of [-0.622]  
 The next parameters to simulate from are [[0.15 0.213 0.023 0.026 0.004 0.025]]  
 The mean of the samples was -0.67  
 Iteration 285  
 Acquisition function convergence reached at iteration 229.  
 The final EI loss was -0.399 with predicted mean of [-0.622]  
 The next parameters to simulate from are [[0.794 0.771 0.02 0.044 0.007 0.003]]  
 The mean of the samples was -0.536  
 Iteration 286  
 Acquisition function convergence reached at iteration 7732.  
 The final EI loss was -0.399 with predicted mean of [-0.622]  
 The next parameters to simulate from are [[0.393 0.516 0.008 0.025 0.035 0.033]]  
 The mean of the samples was -0.823  
 Iteration 287  
 Acquisition function convergence reached at iteration 3909.  
 The final EI loss was -0.399 with predicted mean of [-0.622]  
 The next parameters to simulate from are [[0.772 0.692 0.018 0.044 0.007 0.003]]  
 The mean of the samples was -0.464  
 Iteration 288  
 Acquisition function convergence reached at iteration 132.  
 The final EI loss was -0.0 with predicted mean of [-1.244]  
 The next parameters to simulate from are [[0.724 0.269 0.024 0.043 0.022 0.013]]

The mean of the samples was -1.394  
 Iteration 289  
 Acquisition function convergence reached at iteration 3894.  
 The final EI loss was -0.399 with predicted mean of [-0.627]  
 The next parameters to simulate from are [[0.385 0.522 0.011 0.02 0.036 0.033]]  
 The mean of the samples was -0.632  
 Iteration 290  
 Acquisition function convergence reached at iteration 136.  
 The final EI loss was -0.0 with predicted mean of [-1.255]  
 The next parameters to simulate from are [[0.726 0.269 0.023 0.043 0.022 0.013]]  
 The mean of the samples was -1.198  
 Iteration 291  
 Acquisition function convergence reached at iteration 3698.  
 The final EI loss was -0.399 with predicted mean of [-0.625]  
 The next parameters to simulate from are [[0.841 0.163 0.03 0.057 0.015 0.008]]  
 The mean of the samples was -0.978  
 Iteration 292  
 Acquisition function convergence reached at iteration 8375.  
 The final EI loss was -0.399 with predicted mean of [-0.625]  
 The next parameters to simulate from are [[0.018 0.183 0.024 0.028 0. 0.023]]  
 The mean of the samples was -0.644  
 Iteration 293  
 Acquisition function convergence reached at iteration 84.  
 The final EI loss was -0.0 with predicted mean of [-1.251]  
 The next parameters to simulate from are [[0.724 0.271 0.023 0.043 0.022 0.013]]  
 The mean of the samples was -1.586  
 Iteration 294  
 Acquisition function convergence reached at iteration 72.  
 The final EI loss was 0.0 with predicted mean of [1.269]  
 The next parameters to simulate from are [[0.223 0.57 0.023 0.093 0.044 0.032]]  
 The mean of the samples was 1.52  
 Iteration 295  
 Acquisition function convergence reached at iteration 695.  
 The final EI loss was -0.399 with predicted mean of [-0.635]  
 The next parameters to simulate from are [[0.468 0.486 0.012 0.022 0.035 0.03 ]]  
 The mean of the samples was -0.666  
 Iteration 296  
 Acquisition function convergence reached at iteration 103.  
 The final EI loss was -0.0 with predicted mean of [-1.272]  
 The next parameters to simulate from are [[0.727 0.278 0.024 0.043 0.022 0.013]]  
 The mean of the samples was -1.148  
 Iteration 297  
 Acquisition function convergence reached at iteration 134.

The final EI loss was -0.0 with predicted mean of [-1.264]  
 The next parameters to simulate from are [[0.723 0.268 0.023 0.043 0.022 0.013]]  
 The mean of the samples was -1.167  
 Iteration 298  
 Acquisition function convergence reached at iteration 138.  
 The final EI loss was -0.0 with predicted mean of [-1.259]  
 The next parameters to simulate from are [[0.724 0.271 0.023 0.043 0.022 0.013]]  
 The mean of the samples was -1.282  
 Iteration 299  
 Acquisition function convergence reached at iteration 4333.  
 The final EI loss was -0.399 with predicted mean of [-0.63]  
 The next parameters to simulate from are [[0.807 0.67 0.021 0.038 0.004 0.004]]  
 The mean of the samples was -0.833  
 Iteration 300  
 Acquisition function convergence reached at iteration 11.  
 The final EI loss was 0.0 with predicted mean of [0.518]  
 The next parameters to simulate from are [[0.565 0.353 0.026 0.079 0.026 0.022]]  
 The mean of the samples was 0.454  
 Hyperparameter convergence reached at iteration 885.  
 The minimum predicted mean of the observed indices is -1.26 at the point  
 [0.724 0.271 0.023 0.043 0.022 0.013]  
 Trained parameters:  
 amplitude\_champ:0 is 0.555  
  
 length\_scales\_champ:0 is [0.25 0.25 0.008 0.023 0.018 0.018]  
  
 observation\_noise\_variance\_champ:0 is 0.015  
  
 bias\_mean:0 is 0.318  
  
 Iteration 301  
 Acquisition function convergence reached at iteration 7188.  
 The final EI loss was -0.399 with predicted mean of [-0.63]  
 The next parameters to simulate from are [[0.711 0.207 0.031 0.047 0.018 0.037]]  
 The mean of the samples was -0.589  
 Iteration 302  
 Acquisition function convergence reached at iteration 4210.  
 The final EI loss was -0.399 with predicted mean of [-0.63]  
 The next parameters to simulate from are [[0.093 0.205 0.023 0.036 0.016 0.019]]  
 The mean of the samples was -0.731  
 Iteration 303  
 Acquisition function convergence reached at iteration 1125.  
 The final EI loss was -0.399 with predicted mean of [-0.63]

The next parameters to simulate from are [[0.788 0.047 0.031 0.032 0.016 0.015]]  
 The mean of the samples was -0.731  
 Iteration 304  
 Acquisition function convergence reached at iteration 130.  
 The final EI loss was -0.0 with predicted mean of [-1.26]  
 The next parameters to simulate from are [[0.724 0.271 0.023 0.043 0.022 0.013]]  
 The mean of the samples was -1.571  
 Iteration 305  
 Acquisition function convergence reached at iteration 1289.  
 The final EI loss was -0.399 with predicted mean of [-0.638]  
 The next parameters to simulate from are [[0.138 0.197 0.023 0.033 0.018 0.017]]  
 The mean of the samples was -0.566  
 Iteration 306  
 Acquisition function convergence reached at iteration 573.  
 The final EI loss was -0.399 with predicted mean of [-0.637]  
 The next parameters to simulate from are [[0.399 0.23 0.027 0.039 0.005 0.014]]  
 The mean of the samples was -0.595  
 Iteration 307  
 Acquisition function convergence reached at iteration 138.  
 The final EI loss was -0.0 with predicted mean of [-1.276]  
 The next parameters to simulate from are [[0.729 0.274 0.024 0.043 0.022 0.013]]  
 The mean of the samples was -1.247  
 Iteration 308  
 Acquisition function convergence reached at iteration 1429.  
 The final EI loss was -0.399 with predicted mean of [-0.637]  
 The next parameters to simulate from are [[0.695 0.274 0.032 0.052 0.013 0.01 ]]  
 The mean of the samples was -0.73  
 Iteration 309  
 Acquisition function convergence reached at iteration 112.  
 The final EI loss was -0.0 with predicted mean of [-1.274]  
 The next parameters to simulate from are [[0.727 0.273 0.024 0.043 0.022 0.013]]  
 The mean of the samples was -1.153  
 Iteration 310  
 Acquisition function convergence reached at iteration 1716.  
 The final EI loss was -0.399 with predicted mean of [-0.634]  
 The next parameters to simulate from are [[0.664 0.288 0.032 0.05 0.013 0.009]]  
 The mean of the samples was -0.653  
 Iteration 311  
 Acquisition function convergence reached at iteration 127.  
 The final EI loss was -0.0 with predicted mean of [-1.268]  
 The next parameters to simulate from are [[0.723 0.271 0.023 0.043 0.022 0.013]]  
 The mean of the samples was -1.204  
 Iteration 312



Acquisition function convergence reached at iteration 624.  
 The final EI loss was -0.399 with predicted mean of [-0.633]  
 The next parameters to simulate from are [[0.835 0.695 0.019 0.038 0.004 0.003]]  
 The mean of the samples was -0.739  
 Iteration 313  
 Acquisition function convergence reached at iteration 146.  
 The final EI loss was -0.0 with predicted mean of [-1.266]  
 The next parameters to simulate from are [[0.724 0.271 0.023 0.043 0.022 0.013]]  
 The mean of the samples was -1.129  
 Iteration 314  
 Acquisition function convergence reached at iteration 147.  
 The final EI loss was -0.0 with predicted mean of [-1.26]  
 The next parameters to simulate from are [[0.724 0.27 0.023 0.043 0.022 0.013]]  
 The mean of the samples was -1.18  
 Iteration 315  
 Acquisition function convergence reached at iteration 621.  
 The final EI loss was -0.399 with predicted mean of [-0.628]  
 The next parameters to simulate from are [[0.738 0.759 0.017 0.041 0.013 0.004]]  
 The mean of the samples was -0.716  
 Iteration 316  
 Acquisition function convergence reached at iteration 141.  
 The final EI loss was -0.0 with predicted mean of [-1.257]  
 The next parameters to simulate from are [[0.724 0.27 0.024 0.043 0.022 0.013]]  
 The mean of the samples was -1.415  
 Iteration 317  
 Acquisition function convergence reached at iteration 128.  
 The final EI loss was -0.0 with predicted mean of [-1.263]  
 The next parameters to simulate from are [[0.724 0.271 0.023 0.043 0.022 0.013]]  
 The mean of the samples was -1.393  
 Iteration 318  
 Acquisition function convergence reached at iteration 203.  
 The final EI loss was -0.399 with predicted mean of [-0.634]  
 The next parameters to simulate from are [[0.823 0.106 0.03 0.038 0.014 0.018]]  
 The mean of the samples was -0.536  
 Iteration 319  
 Acquisition function convergence reached at iteration 3092.  
 The final EI loss was -0.399 with predicted mean of [-0.634]  
 The next parameters to simulate from are [[0.831 0.199 0.031 0.064 0.017 0.011]]  
 The mean of the samples was -0.66  
 Iteration 320  
 Acquisition function convergence reached at iteration 138.  
 The final EI loss was -0.0 with predicted mean of [-1.268]  
 The next parameters to simulate from are [[0.724 0.272 0.023 0.043 0.022 0.013]]

The mean of the samples was -1.019  
 Hyperparameter convergence reached at iteration 864.  
 The minimum predicted mean of the observed indices is -1.259 at the point  
 [0.724 0.269 0.024 0.043 0.022 0.013]  
 Iteration 321  
 Acquisition function convergence reached at iteration 112.  
 The final EI loss was -0.0 with predicted mean of [-1.259]  
 The next parameters to simulate from are [[0.723 0.269 0.024 0.043 0.021 0.013]]  
 The mean of the samples was -1.276  
 Iteration 322  
 Acquisition function convergence reached at iteration 153.  
 The final EI loss was -0.0 with predicted mean of [-1.26]  
 The next parameters to simulate from are [[0.723 0.269 0.024 0.043 0.021 0.013]]  
 The mean of the samples was -1.276  
 Iteration 323  
 Acquisition function convergence reached at iteration 115.  
 The final EI loss was -0.0 with predicted mean of [-1.26]  
 The next parameters to simulate from are [[0.723 0.268 0.024 0.043 0.021 0.013]]  
 The mean of the samples was -0.995  
 Iteration 324  
 Acquisition function convergence reached at iteration 1283.  
 The final EI loss was -0.399 with predicted mean of [-0.626]  
 The next parameters to simulate from are [[0.783 0.195 0.031 0.05 0.012 0.004]]  
 The mean of the samples was -0.343  
 Iteration 325  
 Acquisition function convergence reached at iteration 132.  
 The final EI loss was -0.001 with predicted mean of [-1.253]  
 The next parameters to simulate from are [[0.723 0.271 0.023 0.043 0.022 0.013]]  
 The mean of the samples was -1.157  
 Iteration 326  
 Acquisition function convergence reached at iteration 378.  
 The final EI loss was -0.399 with predicted mean of [-0.624]  
 The next parameters to simulate from are [[0.797 0.142 0.03 0.036 0.016 0.019]]  
 The mean of the samples was -0.609  
 Iteration 327  
 Acquisition function convergence reached at iteration 906.  
 The final EI loss was -0.393 with predicted mean of [-0.614]  
 The next parameters to simulate from are [[0.331 0.713 0.01 0.027 0.043 0.042]]  
 The mean of the samples was -0.594  
 Iteration 328  
 Acquisition function convergence reached at iteration 4421.  
 The final EI loss was -0.399 with predicted mean of [-0.624]  
 The next parameters to simulate from are [[0.332 0.678 0.01 0.027 0.041 0.041]]

The mean of the samples was -0.653  
 Iteration 329  
 The final EI loss was -0.399 with predicted mean of [-0.627]  
 The next parameters to simulate from are [[0.671 0.259 0.027 0.044 0.018 0.035]]  
 The mean of the samples was -0.543  
 Iteration 330  
 Acquisition function convergence reached at iteration 5364.  
 The final EI loss was -0.399 with predicted mean of [-0.624]  
 The next parameters to simulate from are [[0.813 0.14 0.022 0.047 0.004 0.014]]  
 The mean of the samples was -0.531  
 Iteration 331  
 Acquisition function convergence reached at iteration 133.  
 The final EI loss was -0.0 with predicted mean of [-1.249]  
 The next parameters to simulate from are [[0.723 0.267 0.023 0.043 0.022 0.013]]  
 The mean of the samples was -1.327  
 Iteration 332  
 Acquisition function convergence reached at iteration 95.  
 The final EI loss was -0.0 with predicted mean of [-1.252]  
 The next parameters to simulate from are [[0.724 0.265 0.023 0.043 0.022 0.013]]  
 The mean of the samples was -1.323  
 Iteration 333  
 Acquisition function convergence reached at iteration 2054.  
 The final EI loss was -0.399 with predicted mean of [-0.628]  
 The next parameters to simulate from are [[0.787 0.559 0.017 0.02 0.065 0.01 ]]  
 The mean of the samples was -0.514  
 Iteration 334  
 Acquisition function convergence reached at iteration 56.  
 The final EI loss was 0.0 with predicted mean of [0.733]  
 The next parameters to simulate from are [[0.451 0.267 0.017 0.089 0.037 0.016]]  
 The mean of the samples was 1.117  
 Iteration 335  
 Acquisition function convergence reached at iteration 125.  
 The final EI loss was -0.001 with predicted mean of [-1.257]  
 The next parameters to simulate from are [[0.726 0.262 0.023 0.043 0.022 0.012]]  
 The mean of the samples was -1.011  
 Iteration 336  
 Acquisition function convergence reached at iteration 2418.  
 The final EI loss was -0.399 with predicted mean of [-0.624]  
 The next parameters to simulate from are [[0.35 0.678 0.01 0.025 0.042 0.039]]  
 The mean of the samples was -0.794  
 Iteration 337  
 Acquisition function convergence reached at iteration 404.  
 The final EI loss was -0.399 with predicted mean of [-0.624]

The next parameters to simulate from are [[0.66 0.237 0.032 0.058 0.016 0.011]]  
 The mean of the samples was -0.572  
 Iteration 338  
 Acquisition function convergence reached at iteration 804.  
 The final EI loss was -0.399 with predicted mean of [-0.624]  
 The next parameters to simulate from are [[0.759 0.828 0.019 0.041 0.011 0.005]]  
 The mean of the samples was -0.897  
 Iteration 339  
 Acquisition function convergence reached at iteration 950.  
 The final EI loss was -0.399 with predicted mean of [-0.624]  
 The next parameters to simulate from are [[0.916 0.143 0.02 0.048 0.003 0.006]]  
 The mean of the samples was -0.44  
 Iteration 340  
 Acquisition function convergence reached at iteration 152.  
 The final EI loss was -0.003 with predicted mean of [-1.254]  
 The next parameters to simulate from are [[0.715 0.282 0.024 0.043 0.021 0.014]]  
 The mean of the samples was -1.11  
 Hyperparameter convergence reached at iteration 5285.  
 The minimum predicted mean of the observed indices is -1.243 at the point  
 [0.724 0.269 0.024 0.043 0.022 0.013]  
 Iteration 341  
 The final EI loss was -0.399 with predicted mean of [-0.621]  
 The next parameters to simulate from are [[0.813 0.57 0.017 0.048 0.067 0.008]]  
 The mean of the samples was -0.707  
 Iteration 342  
 Acquisition function convergence reached at iteration 191.  
 The final EI loss was -0.399 with predicted mean of [-0.622]  
 The next parameters to simulate from are [[0.648 0.183 0.03 0.045 0.013 0.039]]  
 The mean of the samples was -0.602  
 Iteration 343  
 Acquisition function convergence reached at iteration 132.  
 The final EI loss was -0.0 with predicted mean of [-1.244]  
 The next parameters to simulate from are [[0.723 0.265 0.024 0.043 0.022 0.013]]  
 The mean of the samples was -1.191  
 Iteration 344  
 Acquisition function convergence reached at iteration 5844.  
 The final EI loss was -0.399 with predicted mean of [-0.621]  
 The next parameters to simulate from are [[0.784 0.178 0.022 0.047 0.001 0.013]]  
 The mean of the samples was -0.734  
 Iteration 345  
 The final EI loss was -0.399 with predicted mean of [-0.623]  
 The next parameters to simulate from are [[0.861 0.682 0.021 0.037 0.005 0.001]]  
 The mean of the samples was -0.346

Iteration 346  
 Acquisition function convergence reached at iteration 6700.  
 The final EI loss was -0.399 with predicted mean of [-0.621]  
 The next parameters to simulate from are [[0.81 0.084 0.033 0.047 0.016 0.021]]  
 The mean of the samples was -0.705  
 Iteration 347  
 Acquisition function convergence reached at iteration 3134.  
 The final EI loss was -0.399 with predicted mean of [-0.621]  
 The next parameters to simulate from are [[0.592 0.172 0.031 0.044 0.015 0.04 ]]  
 The mean of the samples was -0.819  
 Iteration 348  
 The final EI loss was -0.399 with predicted mean of [-0.618]  
 The next parameters to simulate from are [[0.001 0.196 0.024 0.033 0.004 0.018]]  
 The mean of the samples was -0.63  
 Iteration 349  
 The final EI loss was -0.399 with predicted mean of [-0.621]  
 The next parameters to simulate from are [[0.398 0.209 0.026 0.037 0.007 0.013]]  
 The mean of the samples was -0.549  
 Iteration 350  
 The final EI loss was -0.399 with predicted mean of [-0.619]  
 The next parameters to simulate from are [[0.814 0.508 0.017 0.021 0.07 0.01 ]]  
 The mean of the samples was -0.578  
 Trained parameters:  
 amplitude\_champ:0 is 0.534  
  
 length\_scales\_champ:0 is [0.25 0.25 0.008 0.023 0.018 0.015]  
  
 observation\_noise\_variance\_champ:0 is 0.015  
  
 bias\_mean:0 is 0.301  
  
 Iteration 351  
 Acquisition function convergence reached at iteration 144.  
 The final EI loss was -0.0 with predicted mean of [-1.242]  
 The next parameters to simulate from are [[0.724 0.266 0.024 0.043 0.022 0.013]]  
 The mean of the samples was -1.155  
 Iteration 352  
 Acquisition function convergence reached at iteration 105.  
 The final EI loss was -0.0 with predicted mean of [-1.24]  
 The next parameters to simulate from are [[0.723 0.267 0.024 0.043 0.022 0.013]]  
 The mean of the samples was -1.162  
 Iteration 353  
 The final EI loss was -0.399 with predicted mean of [-0.618]

The next parameters to simulate from are [[0.589 0.161 0.031 0.043 0.015 0.043]]  
 The mean of the samples was -0.714  
 Iteration 354  
 Acquisition function convergence reached at iteration 5229.  
 The final EI loss was -0.399 with predicted mean of [-0.619]  
 The next parameters to simulate from are [[0.874 0.687 0.022 0.038 0.003 0.003]]  
 The mean of the samples was -1.024  
 Iteration 355  
 Acquisition function convergence reached at iteration 112.  
 The final EI loss was -0.0 with predicted mean of [-1.238]  
 The next parameters to simulate from are [[0.723 0.268 0.024 0.043 0.022 0.013]]  
 The mean of the samples was -1.044  
 Iteration 356  
 The final EI loss was -0.399 with predicted mean of [-0.613]  
 The next parameters to simulate from are [[0.756 0.203 0.031 0.046 0.019 0.033]]  
 The mean of the samples was -0.487  
 Iteration 357  
 Acquisition function convergence reached at iteration 208.  
 The final EI loss was -0.399 with predicted mean of [-0.617]  
 The next parameters to simulate from are [[0.443 0.482 0.013 0.02 0.035 0.03 ]]  
 The mean of the samples was -0.538  
 Iteration 358  
 Acquisition function convergence reached at iteration 136.  
 The final EI loss was -0.0 with predicted mean of [-1.233]  
 The next parameters to simulate from are [[0.721 0.267 0.024 0.043 0.022 0.013]]  
 The mean of the samples was -1.684  
 Iteration 359  
 Acquisition function convergence reached at iteration 117.  
 The final EI loss was -0.001 with predicted mean of [-1.246]  
 The next parameters to simulate from are [[0.715 0.263 0.023 0.043 0.022 0.013]]  
 The mean of the samples was -1.179  
 Iteration 360  
 Acquisition function convergence reached at iteration 9687.  
 The final EI loss was -0.399 with predicted mean of [-0.622]  
 The next parameters to simulate from are [[0.737 0.247 0.028 0.046 0.019 0.03 ]]  
 The mean of the samples was -0.55  
 Hyperparameter convergence reached at iteration 816.  
 The minimum predicted mean of the observed indices is -1.243 at the point  
 [0.721 0.267 0.024 0.043 0.022 0.013]  
 Iteration 361  
 Acquisition function convergence reached at iteration 153.  
 The final EI loss was -0.0 with predicted mean of [-1.243]  
 The next parameters to simulate from are [[0.72 0.266 0.024 0.043 0.022 0.013]]

The mean of the samples was -1.139  
 Iteration 362  
 Acquisition function convergence reached at iteration 1194.  
 The final EI loss was -0.399 with predicted mean of [-0.62]  
 The next parameters to simulate from are [[0.765 0.202 0.029 0.052 0.01 0.006]]  
 The mean of the samples was -0.593  
 Iteration 363  
 Acquisition function convergence reached at iteration 133.  
 The final EI loss was -0.0 with predicted mean of [-1.24]  
 The next parameters to simulate from are [[0.723 0.268 0.024 0.043 0.022 0.013]]  
 The mean of the samples was -1.038  
 Iteration 364  
 Acquisition function convergence reached at iteration 129.  
 The final EI loss was -0.0 with predicted mean of [-1.236]  
 The next parameters to simulate from are [[0.722 0.267 0.024 0.043 0.022 0.013]]  
 The mean of the samples was -1.408  
 Iteration 365  
 Acquisition function convergence reached at iteration 143.  
 The final EI loss was -0.0 with predicted mean of [-1.239]  
 The next parameters to simulate from are [[0.722 0.267 0.024 0.043 0.022 0.013]]  
 The mean of the samples was -0.97  
 Iteration 366  
 The final EI loss was -0.399 with predicted mean of [-0.616]  
 The next parameters to simulate from are [[0.394 0.215 0.026 0.036 0.011 0.013]]  
 The mean of the samples was -0.525  
 Iteration 367  
 Acquisition function convergence reached at iteration 1723.  
 The final EI loss was -0.399 with predicted mean of [-0.617]  
 The next parameters to simulate from are [[0.857 0.091 0.032 0.049 0.021 0.016]]  
 The mean of the samples was -0.597  
 Iteration 368  
 Acquisition function convergence reached at iteration 6064.  
 The final EI loss was -0.399 with predicted mean of [-0.617]  
 The next parameters to simulate from are [[0.028 0.192 0.026 0.032 0.001 0.02 ]]  
 The mean of the samples was -0.743  
 Iteration 369  
 Acquisition function convergence reached at iteration 116.  
 The final EI loss was -0.0 with predicted mean of [-1.234]  
 The next parameters to simulate from are [[0.726 0.269 0.024 0.043 0.022 0.013]]  
 The mean of the samples was -1.271  
 Iteration 370  
 Acquisition function convergence reached at iteration 133.  
 The final EI loss was -0.0 with predicted mean of [-1.235]

The next parameters to simulate from are [[0.728 0.27 0.024 0.044 0.022 0.013]]  
 The mean of the samples was -1.106  
 Iteration 371  
 Acquisition function convergence reached at iteration 122.  
 The final EI loss was -0.0 with predicted mean of [-1.232]  
 The next parameters to simulate from are [[0.721 0.266 0.024 0.043 0.022 0.013]]  
 The mean of the samples was -1.022  
 Iteration 372  
 Acquisition function convergence reached at iteration 4443.  
 The final EI loss was -0.399 with predicted mean of [-0.614]  
 The next parameters to simulate from are [[0.805 0.807 0.018 0.041 0.012 0.002]]  
 The mean of the samples was -0.427  
 Iteration 373  
 Acquisition function convergence reached at iteration 129.  
 The final EI loss was -0.0 with predicted mean of [-1.228]  
 The next parameters to simulate from are [[0.725 0.27 0.024 0.043 0.022 0.013]]  
 The mean of the samples was -1.41  
 Iteration 374  
 Acquisition function convergence reached at iteration 500.  
 The final EI loss was -0.399 with predicted mean of [-0.616]  
 The next parameters to simulate from are [[0.755 0.867 0.019 0.042 0.011 0.004]]  
 The mean of the samples was -0.65  
 Iteration 375  
 Acquisition function convergence reached at iteration 7855.  
 The final EI loss was -0.399 with predicted mean of [-0.616]  
 The next parameters to simulate from are [[0.815 0.125 0.033 0.048 0.016 0.023]]  
 The mean of the samples was -0.596  
 Iteration 376  
 Acquisition function convergence reached at iteration 3189.  
 The final EI loss was -0.399 with predicted mean of [-0.616]  
 The next parameters to simulate from are [[0.361 0.718 0.01 0.025 0.044 0.044]]  
 The mean of the samples was -0.631  
 Iteration 377  
 Acquisition function convergence reached at iteration 1876.  
 The final EI loss was -0.399 with predicted mean of [-0.616]  
 The next parameters to simulate from are [[0.728 0.57 0.02 0.039 0.013 0.004]]  
 The mean of the samples was -0.423  
 Iteration 378  
 Acquisition function convergence reached at iteration 7186.  
 The final EI loss was -0.399 with predicted mean of [-0.616]  
 The next parameters to simulate from are [[0.781 0.27 0.033 0.063 0.01 0.013]]  
 The mean of the samples was -0.826  
 Iteration 379



Acquisition function convergence reached at iteration 133.  
 The final EI loss was -0.0 with predicted mean of [-1.233]  
 The next parameters to simulate from are [[0.729 0.271 0.024 0.044 0.022 0.013]]  
 The mean of the samples was -1.168  
 Iteration 380  
 Acquisition function convergence reached at iteration 346.  
 The final EI loss was -0.399 with predicted mean of [-0.615]  
 The next parameters to simulate from are [[0.768 0.898 0.018 0.041 0.011 0.004]]  
 The mean of the samples was -0.544  
 Hyperparameter convergence reached at iteration 838.  
 The minimum predicted mean of the observed indices is -1.23 at the point  
 [0.723 0.268 0.024 0.043 0.022 0.013]  
 Iteration 381  
 Acquisition function convergence reached at iteration 112.  
 The final EI loss was -0.0 with predicted mean of [-1.23]  
 The next parameters to simulate from are [[0.724 0.268 0.024 0.043 0.022 0.013]]  
 The mean of the samples was -1.311  
 Iteration 382  
 Acquisition function convergence reached at iteration 121.  
 The final EI loss was -0.0 with predicted mean of [-1.232]  
 The next parameters to simulate from are [[0.726 0.269 0.024 0.044 0.022 0.013]]  
 The mean of the samples was -1.339  
 Iteration 383  
 Acquisition function convergence reached at iteration 155.  
 The final EI loss was -0.399 with predicted mean of [-0.618]  
 The next parameters to simulate from are [[0.823 0.115 0.031 0.048 0.022 0.02 ]]  
 The mean of the samples was -0.646  
 Iteration 384  
 Acquisition function convergence reached at iteration 127.  
 The final EI loss was -0.0 with predicted mean of [-1.236]  
 The next parameters to simulate from are [[0.729 0.271 0.024 0.044 0.022 0.013]]  
 The mean of the samples was -1.182  
 Iteration 385  
 Acquisition function convergence reached at iteration 7398.  
 The final EI loss was -0.399 with predicted mean of [-0.617]  
 The next parameters to simulate from are [[0.584 0.154 0.031 0.043 0.015 0.045]]  
 The mean of the samples was -0.625  
 Iteration 386  
 Acquisition function convergence reached at iteration 236.  
 The final EI loss was -0.399 with predicted mean of [-0.617]  
 The next parameters to simulate from are [[0.418 0.484 0.014 0.022 0.036 0.031]]  
 The mean of the samples was -0.548  
 Iteration 387

Acquisition function convergence reached at iteration 135.  
 The final EI loss was -0.0 with predicted mean of [-1.233]  
 The next parameters to simulate from are [[0.726 0.268 0.024 0.044 0.022 0.013]]  
 The mean of the samples was -0.999  
 Iteration 388  
 Acquisition function convergence reached at iteration 1038.  
 The final EI loss was -0.399 with predicted mean of [-0.615]  
 The next parameters to simulate from are [[0.011 0.178 0.024 0.023 0.011 0.024]]  
 The mean of the samples was -0.441  
 Iteration 389  
 Acquisition function convergence reached at iteration 1410.  
 The final EI loss was -0.399 with predicted mean of [-0.615]  
 The next parameters to simulate from are [[0.573 0.165 0.029 0.043 0.016 0.044]]  
 The mean of the samples was -0.717  
 Iteration 390  
 Acquisition function convergence reached at iteration 119.  
 The final EI loss was -0.0 with predicted mean of [-1.229]  
 The next parameters to simulate from are [[0.719 0.265 0.023 0.043 0.022 0.013]]  
 The mean of the samples was -1.258  
 Iteration 391  
 Acquisition function convergence reached at iteration 129.  
 The final EI loss was -0.0 with predicted mean of [-1.23]  
 The next parameters to simulate from are [[0.718 0.265 0.023 0.043 0.022 0.013]]  
 The mean of the samples was -1.323  
 Iteration 392  
 Acquisition function convergence reached at iteration 358.  
 The final EI loss was -0.399 with predicted mean of [-0.617]  
 The next parameters to simulate from are [[0.825 0.114 0.032 0.049 0.025 0.02 ]]  
 The mean of the samples was -0.691  
 Iteration 393  
 Acquisition function convergence reached at iteration 136.  
 The final EI loss was -0.0 with predicted mean of [-1.234]  
 The next parameters to simulate from are [[0.714 0.262 0.023 0.043 0.022 0.013]]  
 The mean of the samples was -1.027  
 Iteration 394  
 Acquisition function convergence reached at iteration 126.  
 The final EI loss was -0.0 with predicted mean of [-1.23]  
 The next parameters to simulate from are [[0.73 0.273 0.024 0.044 0.022 0.013]]  
 The mean of the samples was -0.894  
 Iteration 395  
 Acquisition function convergence reached at iteration 122.  
 The final EI loss was -0.0 with predicted mean of [-1.229]  
 The next parameters to simulate from are [[0.711 0.259 0.023 0.042 0.022 0.013]]

The mean of the samples was -1.285  
 Iteration 396  
 Acquisition function convergence reached at iteration 1566.  
 The final EI loss was -0.399 with predicted mean of [-0.618]  
 The next parameters to simulate from are [[0.901 0.083 0.029 0.046 0.014 0.012]]  
 The mean of the samples was -0.436  
 Iteration 397  
 Acquisition function convergence reached at iteration 119.  
 The final EI loss was -0.001 with predicted mean of [-1.236]  
 The next parameters to simulate from are [[0.708 0.256 0.023 0.042 0.022 0.013]]  
 The mean of the samples was -1.412  
 Iteration 398  
 Acquisition function convergence reached at iteration 116.  
 The final EI loss was -0.008 with predicted mean of [-1.282]  
 The next parameters to simulate from are [[0.695 0.246 0.022 0.041 0.021 0.013]]  
 The mean of the samples was -1.074  
 Iteration 399  
 Acquisition function convergence reached at iteration 1111.  
 The final EI loss was -0.399 with predicted mean of [-0.615]  
 The next parameters to simulate from are [[0.723 0.218 0.031 0.049 0.007 0.007]]  
 The mean of the samples was -0.586  
 Iteration 400  
 Acquisition function convergence reached at iteration 149.  
 The final EI loss was -0.399 with predicted mean of [-0.615]  
 The next parameters to simulate from are [[0.063 0.211 0.024 0.025 0.015 0.025]]  
 The mean of the samples was -0.74  
 Hyperparameter convergence reached at iteration 849.  
 The minimum predicted mean of the observed indices is -1.23 at the point  
 [0.714 0.262 0.023 0.043 0.022 0.013]  
 Trained parameters:  
 amplitude\_champ:0 is 0.519  
  
 length\_scales\_champ:0 is [0.25 0.25 0.008 0.023 0.018 0.015]  
  
 observation\_noise\_variance\_champ:0 is 0.016  
  
 bias\_mean:0 is 0.295  
  
 Iteration 401  
 Acquisition function convergence reached at iteration 6.  
 The final EI loss was 0.0 with predicted mean of [0.106]  
 The next parameters to simulate from are [[0.63 0.336 0.026 0.069 0.024 0.017]]  
 The mean of the samples was 0.378

Iteration 402  
Acquisition function convergence reached at iteration 141.  
The final EI loss was -0.0 with predicted mean of [-1.23]  
The next parameters to simulate from are [[0.71 0.259 0.023 0.043 0.022 0.013]]  
The mean of the samples was -1.327

Iteration 403  
Acquisition function convergence reached at iteration 9232.  
The final EI loss was -0.399 with predicted mean of [-0.618]  
The next parameters to simulate from are [[0.558 0.149 0.03 0.043 0.016 0.047]]  
The mean of the samples was -0.7

Iteration 404  
Acquisition function convergence reached at iteration 129.  
The final EI loss was -0.0 with predicted mean of [-1.236]  
The next parameters to simulate from are [[0.706 0.257 0.023 0.042 0.021 0.013]]  
The mean of the samples was -1.257

Iteration 405  
Acquisition function convergence reached at iteration 749.  
The final EI loss was -0.399 with predicted mean of [-0.619]  
The next parameters to simulate from are [[0.753 0.254 0.029 0.054 0.009 0.007]]  
The mean of the samples was -0.522

Iteration 406  
Acquisition function convergence reached at iteration 147.  
The final EI loss was 0.0 with predicted mean of [-1.187]  
The next parameters to simulate from are [[0.704 0.18 0.028 0.045 0.02 0.015]]  
The mean of the samples was -1.093

Iteration 407  
Acquisition function convergence reached at iteration 144.  
The final EI loss was -0.0 with predicted mean of [-1.238]  
The next parameters to simulate from are [[0.704 0.257 0.023 0.042 0.021 0.013]]  
The mean of the samples was -1.308

Iteration 408  
Acquisition function convergence reached at iteration 650.  
The final EI loss was -0.399 with predicted mean of [-0.622]  
The next parameters to simulate from are [[0.817 0.156 0.029 0.035 0.017 0.017]]  
The mean of the samples was -0.617

Iteration 409  
Acquisition function convergence reached at iteration 800.  
The final EI loss was -0.399 with predicted mean of [-0.622]  
The next parameters to simulate from are [[0.918 0.142 0.028 0.053 0.016 0.011]]  
The mean of the samples was -0.385

Iteration 410  
Acquisition function convergence reached at iteration 217.  
The final EI loss was -0.0 with predicted mean of [-1.246]

The next parameters to simulate from are [[0.698 0.258 0.023 0.042 0.021 0.013]]  
 The mean of the samples was -1.085  
 Iteration 411  
 Acquisition function convergence reached at iteration 8348.  
 The final EI loss was -0.399 with predicted mean of [-0.616]  
 The next parameters to simulate from are [[0.928 0.03 0.02 0.044 0.005 0.001]]  
 The mean of the samples was -0.624  
 Iteration 412  
 Acquisition function convergence reached at iteration 128.  
 The final EI loss was -0.0 with predicted mean of [-1.233]  
 The next parameters to simulate from are [[0.712 0.255 0.023 0.043 0.022 0.013]]  
 The mean of the samples was -1.263  
 Iteration 413  
 Acquisition function convergence reached at iteration 144.  
 The final EI loss was -0.399 with predicted mean of [-0.617]  
 The next parameters to simulate from are [[0.582 0.18 0.028 0.043 0.016 0.046]]  
 The mean of the samples was -0.521  
 Iteration 414  
 Acquisition function convergence reached at iteration 1226.  
 The final EI loss was -0.399 with predicted mean of [-0.617]  
 The next parameters to simulate from are [[0.899 0.189 0.029 0.053 0.018 0.013]]  
 The mean of the samples was -0.527  
 Iteration 415  
 Acquisition function convergence reached at iteration 198.  
 The final EI loss was -0.399 with predicted mean of [-0.617]  
 The next parameters to simulate from are [[0.422 0.486 0.013 0.022 0.033 0.029]]  
 The mean of the samples was -0.826  
 Iteration 416  
 Acquisition function convergence reached at iteration 517.  
 The final EI loss was -0.399 with predicted mean of [-0.617]  
 The next parameters to simulate from are [[0.369 0.699 0.01 0.022 0.044 0.044]]  
 The mean of the samples was -0.528  
 Iteration 417  
 Acquisition function convergence reached at iteration 1361.  
 The final EI loss was -0.399 with predicted mean of [-0.617]  
 The next parameters to simulate from are [[0.411 0.491 0.013 0.017 0.032 0.028]]  
 The mean of the samples was -0.461  
 Iteration 418  
 Acquisition function convergence reached at iteration 145.  
 The final EI loss was -0.0 with predicted mean of [-1.235]  
 The next parameters to simulate from are [[0.709 0.255 0.023 0.043 0.022 0.013]]  
 The mean of the samples was -1.282  
 Iteration 419

Acquisition function convergence reached at iteration 140.  
 The final EI loss was -0.0 with predicted mean of [-1.237]  
 The next parameters to simulate from are [[0.708 0.254 0.023 0.043 0.022 0.013]]  
 The mean of the samples was -1.411  
 Iteration 420  
 Acquisition function convergence reached at iteration 6265.  
 The final EI loss was -0.399 with predicted mean of [-0.623]  
 The next parameters to simulate from are [[0.798 0.521 0.017 0.022 0.071 0.01 ]]  
 The mean of the samples was -0.808  
 Hyperparameter convergence reached at iteration 812.  
 The minimum predicted mean of the observed indices is -1.245 at the point  
 [0.708 0.254 0.023 0.043 0.022 0.013]  
 Iteration 421  
 Acquisition function convergence reached at iteration 2747.  
 The final EI loss was -0.399 with predicted mean of [-0.623]  
 The next parameters to simulate from are [[0.004 0.129 0.024 0.027 0.004 0.022]]  
 The mean of the samples was -0.71  
 Iteration 422  
 Acquisition function convergence reached at iteration 116.  
 The final EI loss was 0.002 with predicted mean of [-1.222]  
 The next parameters to simulate from are [[0.725 0.27 0.024 0.043 0.022 0.013]]  
 The mean of the samples was -1.105  
 Iteration 423  
 Acquisition function convergence reached at iteration 108.  
 The final EI loss was -0.001 with predicted mean of [-1.247]  
 The next parameters to simulate from are [[0.703 0.247 0.023 0.043 0.022 0.013]]  
 The mean of the samples was -1.184  
 Iteration 424  
 Acquisition function convergence reached at iteration 364.  
 The final EI loss was -0.399 with predicted mean of [-0.621]  
 The next parameters to simulate from are [[0.434 0.478 0.012 0.02 0.032 0.026]]  
 The mean of the samples was -0.621  
 Iteration 425  
 The final EI loss was -0.397 with predicted mean of [-0.612]  
 The next parameters to simulate from are [[0.762 0.044 0.032 0.028 0.015 0.014]]  
 The mean of the samples was -0.727  
 Iteration 426  
 Acquisition function convergence reached at iteration 137.  
 The final EI loss was -0.0 with predicted mean of [-1.242]  
 The next parameters to simulate from are [[0.705 0.251 0.023 0.043 0.022 0.013]]  
 The mean of the samples was -1.208  
 Iteration 427  
 Acquisition function convergence reached at iteration 143.

The final EI loss was -0.399 with predicted mean of [-0.62]  
 The next parameters to simulate from are [[0.27 0.21 0.025 0.031 0.013 0.016]]  
 The mean of the samples was -0.61  
 Iteration 428  
 Acquisition function convergence reached at iteration 97.  
 The final EI loss was -0.0 with predicted mean of [-1.24]  
 The next parameters to simulate from are [[0.705 0.252 0.023 0.043 0.022 0.013]]  
 The mean of the samples was -1.403  
 Iteration 429  
 Acquisition function convergence reached at iteration 4544.  
 The final EI loss was -0.399 with predicted mean of [-0.625]  
 The next parameters to simulate from are [[0.868 0.158 0.028 0.05 0.01 0.008]]  
 The mean of the samples was -0.738  
 Iteration 430  
 The final EI loss was -0.399 with predicted mean of [-0.625]  
 The next parameters to simulate from are [[0.754 0.538 0.02 0.04 0.014 0.006]]  
 The mean of the samples was -0.908  
 Iteration 431  
 Acquisition function convergence reached at iteration 140.  
 The final EI loss was -0.0 with predicted mean of [-1.248]  
 The next parameters to simulate from are [[0.701 0.247 0.023 0.043 0.022 0.013]]  
 The mean of the samples was -1.12  
 Iteration 432  
 Acquisition function convergence reached at iteration 2508.  
 The final EI loss was -0.399 with predicted mean of [-0.62]  
 The next parameters to simulate from are [[0.41 0.466 0.013 0.02 0.03 0.025]]  
 The mean of the samples was -0.655  
 Iteration 433  
 Acquisition function convergence reached at iteration 3405.  
 The final EI loss was -0.399 with predicted mean of [-0.62]  
 The next parameters to simulate from are [[0.78 0.493 0.017 0.021 0.065 0.012]]  
 The mean of the samples was -0.552  
 Iteration 434  
 Acquisition function convergence reached at iteration 2583.  
 The final EI loss was -0.399 with predicted mean of [-0.62]  
 The next parameters to simulate from are [[0.419 0.458 0.014 0.019 0.029 0.025]]  
 The mean of the samples was -0.55  
 Iteration 435  
 Acquisition function convergence reached at iteration 2549.  
 The final EI loss was -0.399 with predicted mean of [-0.62]  
 The next parameters to simulate from are [[0.053 0.2 0.023 0.022 0.017 0.024]]  
 The mean of the samples was -0.466  
 Iteration 436

The final EI loss was -0.399 with predicted mean of [-0.621]  
 The next parameters to simulate from are [[0.731 0.022 0.033 0.026 0.015 0.013]]  
 The mean of the samples was -0.438  
 Iteration 437  
 Acquisition function convergence reached at iteration 144.  
 The final EI loss was -0.0 with predicted mean of [-1.24]  
 The next parameters to simulate from are [[0.705 0.253 0.023 0.043 0.022 0.013]]  
 The mean of the samples was -1.336  
 Iteration 438  
 Acquisition function convergence reached at iteration 481.  
 The final EI loss was -0.399 with predicted mean of [-0.622]  
 The next parameters to simulate from are [[0.766 0.929 0.019 0.041 0.011 0.006]]  
 The mean of the samples was -1.153  
 Iteration 439  
 Acquisition function convergence reached at iteration 1161.  
 The final EI loss was -0.399 with predicted mean of [-0.622]  
 The next parameters to simulate from are [[0.855 0.197 0.027 0.051 0.009 0.006]]  
 The mean of the samples was -0.995  
 Iteration 440  
 Acquisition function convergence reached at iteration 138.  
 The final EI loss was -0.0 with predicted mean of [-1.244]  
 The next parameters to simulate from are [[0.703 0.25 0.023 0.043 0.021 0.013]]  
 The mean of the samples was -1.197  
 Hyperparameter convergence reached at iteration 781.  
 The minimum predicted mean of the observed indices is -1.242 at the point  
 [0.705 0.253 0.023 0.043 0.022 0.013]  
 Iteration 441  
 Acquisition function convergence reached at iteration 4366.  
 The final EI loss was -0.399 with predicted mean of [-0.621]  
 The next parameters to simulate from are [[0.807 0.691 0.019 0.041 0.012 0.003]]  
 The mean of the samples was -0.728  
 Iteration 442  
 Acquisition function convergence reached at iteration 213.  
 The final EI loss was -0.399 with predicted mean of [-0.621]  
 The next parameters to simulate from are [[0.406 0.216 0.026 0.033 0.013 0.014]]  
 The mean of the samples was -0.668  
 Iteration 443  
 Acquisition function convergence reached at iteration 5312.  
 The final EI loss was -0.399 with predicted mean of [-0.621]  
 The next parameters to simulate from are [[0.383 0.213 0.026 0.035 0.016 0.014]]  
 The mean of the samples was -0.67  
 Iteration 444  
 Acquisition function convergence reached at iteration 5.



The final EI loss was 0.0 with predicted mean of [0.216]  
 The next parameters to simulate from are [[0.643 0.266 0.025 0.068 0.025 0.016]]  
 The mean of the samples was 0.09  
 Iteration 445  
 Acquisition function convergence reached at iteration 107.  
 The final EI loss was -0.0 with predicted mean of [-1.242]  
 The next parameters to simulate from are [[0.703 0.252 0.023 0.043 0.022 0.013]]  
 The mean of the samples was -1.117  
 Iteration 446  
 Acquisition function convergence reached at iteration 141.  
 The final EI loss was -0.0 with predicted mean of [-1.237]  
 The next parameters to simulate from are [[0.707 0.255 0.023 0.043 0.022 0.013]]  
 The mean of the samples was -1.249  
 Iteration 447  
 Acquisition function convergence reached at iteration 6909.  
 The final EI loss was -0.399 with predicted mean of [-0.619]  
 The next parameters to simulate from are [[0.845 0.501 0.018 0.021 0.071 0.01 ]]  
 The mean of the samples was -0.48  
 Iteration 448  
 Acquisition function convergence reached at iteration 142.  
 The final EI loss was -0.0 with predicted mean of [-1.237]  
 The next parameters to simulate from are [[0.706 0.254 0.023 0.043 0.022 0.013]]  
 The mean of the samples was -1.527  
 Iteration 449  
 Acquisition function convergence reached at iteration 258.  
 The final EI loss was -0.399 with predicted mean of [-0.624]  
 The next parameters to simulate from are [[0.694 0.507 0.021 0.04 0.012 0.005]]  
 The mean of the samples was -0.541  
 Iteration 450  
 Acquisition function convergence reached at iteration 129.  
 The final EI loss was -0.0 with predicted mean of [-1.248]  
 The next parameters to simulate from are [[0.702 0.249 0.023 0.043 0.022 0.013]]  
 The mean of the samples was -1.38  
 Trained parameters:  
 amplitude\_champ:0 is 0.52  
  
 length\_scales\_champ:0 is [0.25 0.25 0.008 0.023 0.018 0.014]  
  
 observation\_noise\_variance\_champ:0 is 0.015  
  
 bias\_mean:0 is 0.28  
  
 Iteration 451

Acquisition function convergence reached at iteration 143.  
 The final EI loss was -0.0 with predicted mean of [-1.255]  
 The next parameters to simulate from are [[0.699 0.245 0.023 0.043 0.022 0.013]]  
 The mean of the samples was -1.244  
 Iteration 452  
 Acquisition function convergence reached at iteration 145.  
 The final EI loss was -0.0 with predicted mean of [-1.254]  
 The next parameters to simulate from are [[0.699 0.245 0.023 0.043 0.022 0.013]]  
 The mean of the samples was -1.435  
 Iteration 453  
 The final EI loss was -0.399 with predicted mean of [-0.633]  
 The next parameters to simulate from are [[0.787 0.469 0.017 0.037 0.066 0.002]]  
 The mean of the samples was -0.259  
 Iteration 454  
 Acquisition function convergence reached at iteration 8962.  
 The final EI loss was -0.399 with predicted mean of [-0.633]  
 The next parameters to simulate from are [[0.863 0.169 0.031 0.054 0.013 0.005]]  
 The mean of the samples was -1.01  
 Iteration 455  
 The final EI loss was -0.399 with predicted mean of [-0.634]  
 The next parameters to simulate from are [[0.862 0.004 0.033 0.044 0.017 0.013]]  
 The mean of the samples was -0.724  
 Iteration 456  
 Acquisition function convergence reached at iteration 1845.  
 The final EI loss was -0.399 with predicted mean of [-0.633]  
 The next parameters to simulate from are [[0.785 0.718 0.016 0.041 0.013 0.003]]  
 The mean of the samples was -0.695  
 Iteration 457  
 Acquisition function convergence reached at iteration 137.  
 The final EI loss was -0.001 with predicted mean of [-1.267]  
 The next parameters to simulate from are [[0.694 0.24 0.023 0.043 0.022 0.013]]  
 The mean of the samples was -1.251  
 Iteration 458  
 Acquisition function convergence reached at iteration 5.  
 The final EI loss was 0.0 with predicted mean of [0.298]  
 The next parameters to simulate from are [[0.673 0.249 0.024 0.075 0.023 0.014]]  
 The mean of the samples was 0.236  
 Iteration 459  
 Acquisition function convergence reached at iteration 626.  
 The final EI loss was -0.399 with predicted mean of [-0.633]  
 The next parameters to simulate from are [[0.732 0.284 0.028 0.049 0.012 0.007]]  
 The mean of the samples was -0.66  
 Iteration 460

The final EI loss was -0.395 with predicted mean of [-0.617]  
 The next parameters to simulate from are [[0.84 0.165 0.033 0.051 0.013 0.02 ]]  
 The mean of the samples was -0.566  
 Hyperparameter convergence reached at iteration 769.  
 The minimum predicted mean of the observed indices is -1.265 at the point  
 [0.694 0.24 0.023 0.043 0.022 0.013]  
 Iteration 461  
 Acquisition function convergence reached at iteration 5852.  
 The final EI loss was -0.399 with predicted mean of [-0.633]  
 The next parameters to simulate from are [[0.553 0.186 0.027 0.043 0.016 0.042]]  
 The mean of the samples was -0.642  
 Iteration 462  
 Acquisition function convergence reached at iteration 218.  
 The final EI loss was -0.399 with predicted mean of [-0.633]  
 The next parameters to simulate from are [[0.57 0.141 0.031 0.044 0.012 0.047]]  
 The mean of the samples was -0.549  
 Iteration 463  
 The final EI loss was -0.399 with predicted mean of [-0.635]  
 The next parameters to simulate from are [[0.901 0.003 0.033 0.047 0.017 0.011]]  
 The mean of the samples was -0.596  
 Iteration 464  
 Acquisition function convergence reached at iteration 129.  
 The final EI loss was -0.0 with predicted mean of [-1.265]  
 The next parameters to simulate from are [[0.695 0.24 0.023 0.043 0.022 0.013]]  
 The mean of the samples was -1.366  
 Iteration 465  
 Acquisition function convergence reached at iteration 149.  
 The final EI loss was -0.399 with predicted mean of [-0.636]  
 The next parameters to simulate from are [[0.689 0.525 0.022 0.04 0.015 0.006]]  
 The mean of the samples was -0.587  
 Iteration 466  
 Acquisition function convergence reached at iteration 147.  
 The final EI loss was -0.0 with predicted mean of [-1.273]  
 The next parameters to simulate from are [[0.693 0.236 0.023 0.043 0.022 0.013]]  
 The mean of the samples was -1.413  
 Iteration 467  
 Acquisition function convergence reached at iteration 122.  
 The final EI loss was -0.001 with predicted mean of [-1.288]  
 The next parameters to simulate from are [[0.689 0.228 0.023 0.043 0.022 0.014]]  
 The mean of the samples was -0.92  
 Iteration 468  
 Acquisition function convergence reached at iteration 11.  
 The final EI loss was 0.0 with predicted mean of [0.804]

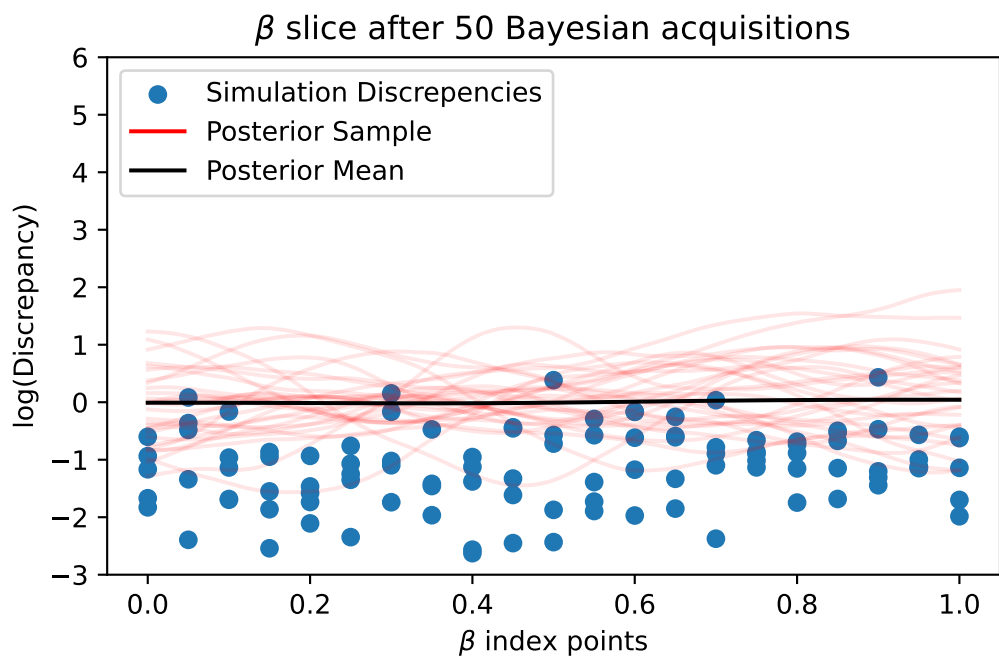
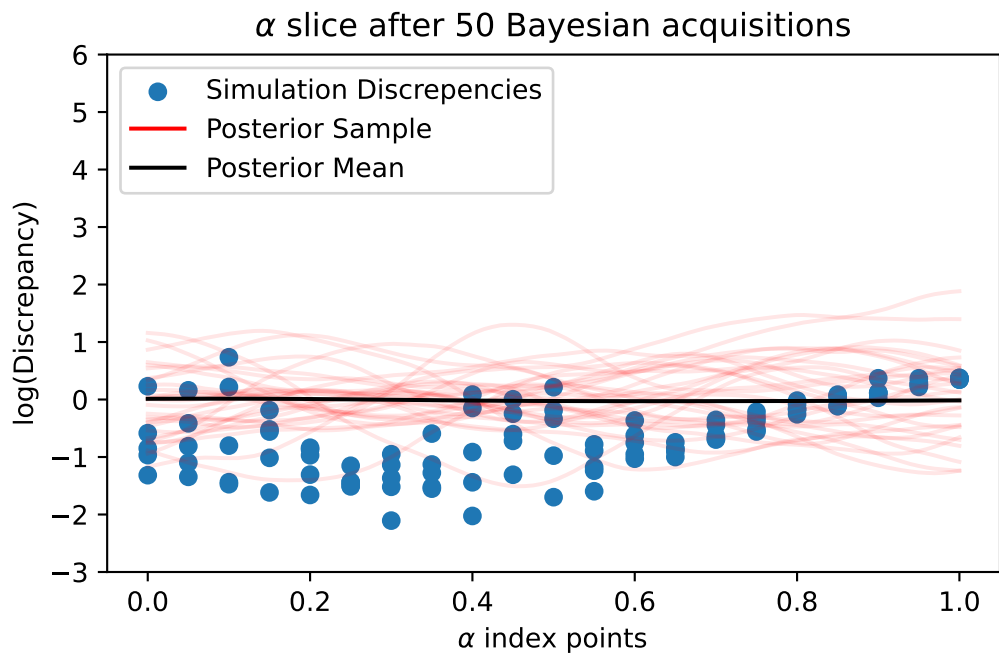
The next parameters to simulate from are [[0.561 0.334 0.019 0.092 0.031 0.02 ]]  
 The mean of the samples was 0.841  
 Iteration 469  
 Acquisition function convergence reached at iteration 505.  
 The final EI loss was -0.399 with predicted mean of [-0.629]  
 The next parameters to simulate from are [[0.782 0.8 0.018 0.033 0.009 0.004]]  
 The mean of the samples was -0.913  
 Iteration 470  
 Acquisition function convergence reached at iteration 2074.  
 The final EI loss was -0.399 with predicted mean of [-0.629]  
 The next parameters to simulate from are [[0.887 0.007 0.03 0.046 0.015 0.01 ]]  
 The mean of the samples was -0.612  
 Iteration 471  
 Acquisition function convergence reached at iteration 5273.  
 The final EI loss was -0.399 with predicted mean of [-0.629]  
 The next parameters to simulate from are [[0.888 0.688 0.019 0.038 0.008 0.002]]  
 The mean of the samples was -0.931  
 Iteration 472  
 The final EI loss was -0.399 with predicted mean of [-0.627]  
 The next parameters to simulate from are [[0.912 0.003 0.033 0.049 0.017 0.008]]  
 The mean of the samples was -0.587  
 Iteration 473  
 Acquisition function convergence reached at iteration 117.  
 The final EI loss was -0.001 with predicted mean of [-1.26]  
 The next parameters to simulate from are [[0.698 0.252 0.023 0.042 0.021 0.013]]  
 The mean of the samples was -1.487  
 Iteration 474  
 Acquisition function convergence reached at iteration 7818.  
 The final EI loss was -0.399 with predicted mean of [-0.637]  
 The next parameters to simulate from are [[0.848 0.162 0.031 0.053 0.013 0.001]]  
 The mean of the samples was -0.163  
 Iteration 475  
 Acquisition function convergence reached at iteration 136.  
 The final EI loss was -0.002 with predicted mean of [-1.278]  
 The next parameters to simulate from are [[0.692 0.254 0.023 0.042 0.02 0.013]]  
 The mean of the samples was -1.406  
 Iteration 476  
 Acquisition function convergence reached at iteration 8064.  
 The final EI loss was -0.399 with predicted mean of [-0.649]  
 The next parameters to simulate from are [[0.788 0.587 0.022 0.04 0.004 0.004]]  
 The mean of the samples was -0.646  
 Iteration 477  
 Acquisition function convergence reached at iteration 1040.

The final EI loss was -0.399 with predicted mean of [-0.648]  
 The next parameters to simulate from are [[0.847 0.136 0.029 0.046 0.025 0.016]]  
 The mean of the samples was -0.734  
 Iteration 478  
 Acquisition function convergence reached at iteration 146.  
 The final EI loss was -0.002 with predicted mean of [-1.3]  
 The next parameters to simulate from are [[0.688 0.256 0.023 0.041 0.019 0.013]]  
 The mean of the samples was -0.953  
 Iteration 479  
 Acquisition function convergence reached at iteration 136.  
 The final EI loss was -0.001 with predicted mean of [-1.262]  
 The next parameters to simulate from are [[0.7 0.249 0.023 0.042 0.022 0.013]]  
 The mean of the samples was -1.491  
 Iteration 480  
 Acquisition function convergence reached at iteration 103.  
 The final EI loss was 0.0 with predicted mean of [-1.215]  
 The next parameters to simulate from are [[0.727 0.271 0.024 0.043 0.022 0.013]]  
 The mean of the samples was -0.979  
 Hyperparameter convergence reached at iteration 766.  
 The minimum predicted mean of the observed indices is -1.273 at the point  
 [0.7 0.249 0.023 0.042 0.022 0.013]  
 Iteration 481  
 Acquisition function convergence reached at iteration 109.  
 The final EI loss was 0.0 with predicted mean of [-1.209]  
 The next parameters to simulate from are [[0.727 0.271 0.024 0.043 0.022 0.013]]  
 The mean of the samples was -1.167  
 Iteration 482  
 Acquisition function convergence reached at iteration 142.  
 The final EI loss was -0.002 with predicted mean of [-1.278]  
 The next parameters to simulate from are [[0.695 0.249 0.023 0.042 0.023 0.013]]  
 The mean of the samples was -1.453  
 Iteration 483  
 Acquisition function convergence reached at iteration 1941.  
 The final EI loss was -0.399 with predicted mean of [-0.649]  
 The next parameters to simulate from are [[0.839 0.152 0.021 0.054 0.005 0.01 ]]  
 The mean of the samples was -0.671  
 Iteration 484  
 Acquisition function convergence reached at iteration 132.  
 The final EI loss was -0.399 with predicted mean of [-0.65]  
 The next parameters to simulate from are [[0.367 0.217 0.026 0.034 0.019 0.014]]  
 The mean of the samples was -0.625  
 Iteration 485  
 Acquisition function convergence reached at iteration 4134.

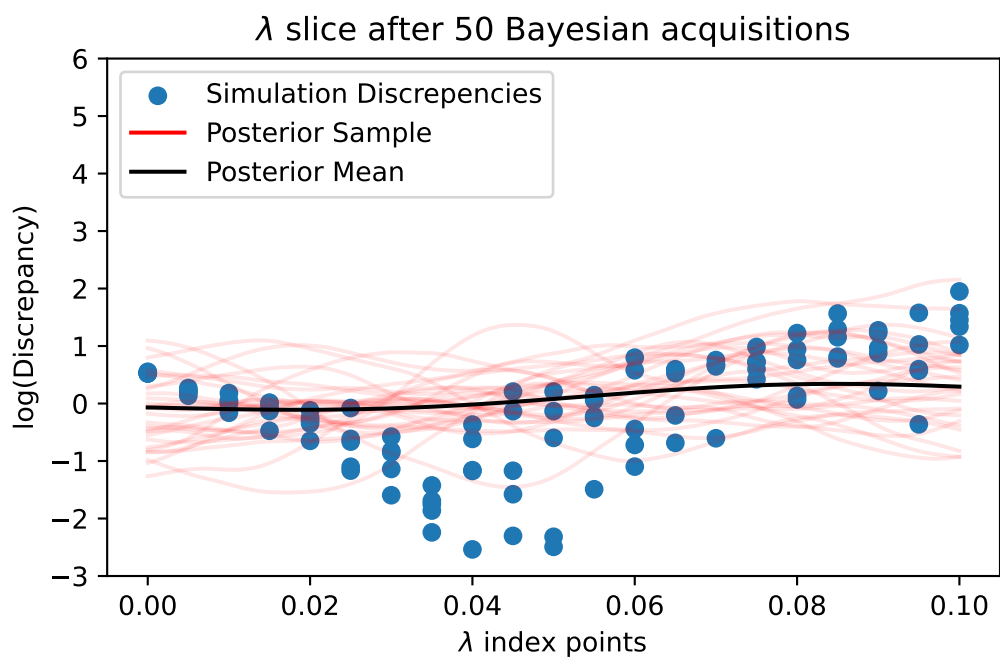
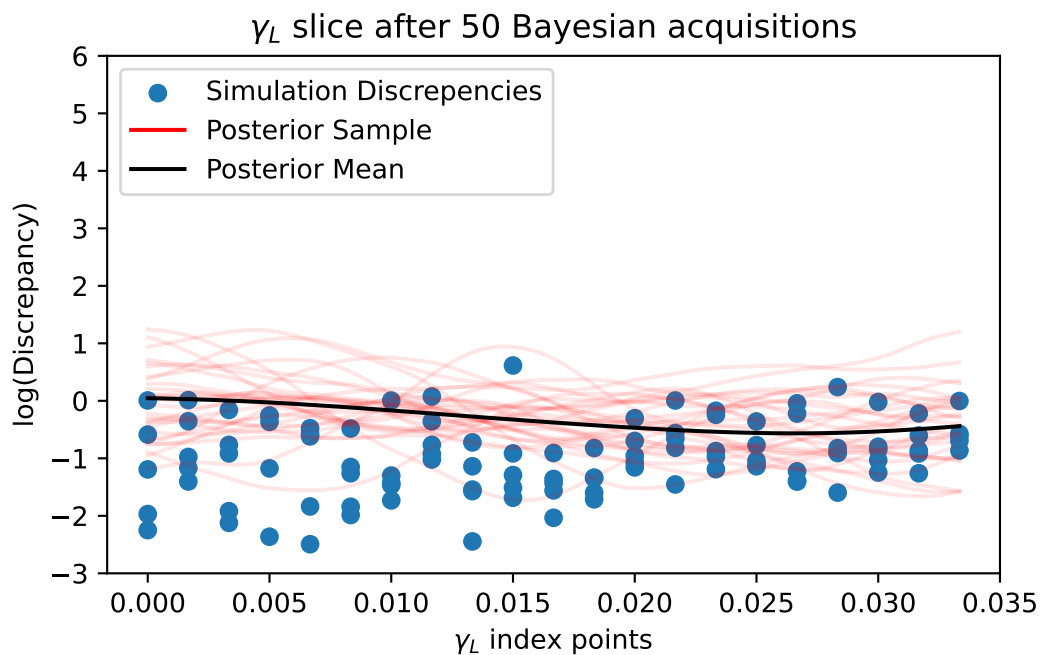
The final EI loss was -0.399 with predicted mean of [-0.65]  
 The next parameters to simulate from are [[0.912 0.131 0.021 0.052 0.004 0.004]]  
 The mean of the samples was -0.693  
 Iteration 486  
 Acquisition function convergence reached at iteration 1666.  
 The final EI loss was -0.399 with predicted mean of [-0.65]  
 The next parameters to simulate from are [[0.893 0.151 0.029 0.047 0.022 0.011]]  
 The mean of the samples was -0.637  
 Iteration 487  
 Acquisition function convergence reached at iteration 8.  
 The final EI loss was 0.0 with predicted mean of [0.439]  
 The next parameters to simulate from are [[0.589 0.334 0.026 0.086 0.019 0.019]]  
 The mean of the samples was 0.437  
 Iteration 488  
 Acquisition function convergence reached at iteration 142.  
 The final EI loss was -0.005 with predicted mean of [-1.309]  
 The next parameters to simulate from are [[0.689 0.253 0.023 0.04 0.024 0.014]]  
 The mean of the samples was -1.011  
 Iteration 489  
 Acquisition function convergence reached at iteration 2.  
 The final EI loss was 0.0 with predicted mean of [0.326]  
 The next parameters to simulate from are [[0.699 0.245 0.024 0.083 0.022 0.012]]  
 The mean of the samples was 0.575  
 Iteration 490  
 The final EI loss was -0.399 with predicted mean of [-0.632]  
 The next parameters to simulate from are [[0.426 0.461 0.014 0.023 0.03 0.022]]  
 The mean of the samples was -0.829  
 Iteration 491  
 The final EI loss was -0.399 with predicted mean of [-0.637]  
 The next parameters to simulate from are [[0.799 0.202 0.033 0.05 0.012 0.024]]  
 The mean of the samples was -0.631  
 Iteration 492  
 Acquisition function convergence reached at iteration 110.  
 The final EI loss was -0.001 with predicted mean of [-1.27]  
 The next parameters to simulate from are [[0.701 0.242 0.023 0.043 0.021 0.013]]  
 The mean of the samples was -1.019  
 Iteration 493  
 Acquisition function convergence reached at iteration 141.  
 The final EI loss was -0.0 with predicted mean of [-1.259]  
 The next parameters to simulate from are [[0.699 0.248 0.023 0.042 0.022 0.013]]  
 The mean of the samples was -1.387  
 Iteration 494  
 Acquisition function convergence reached at iteration 123.

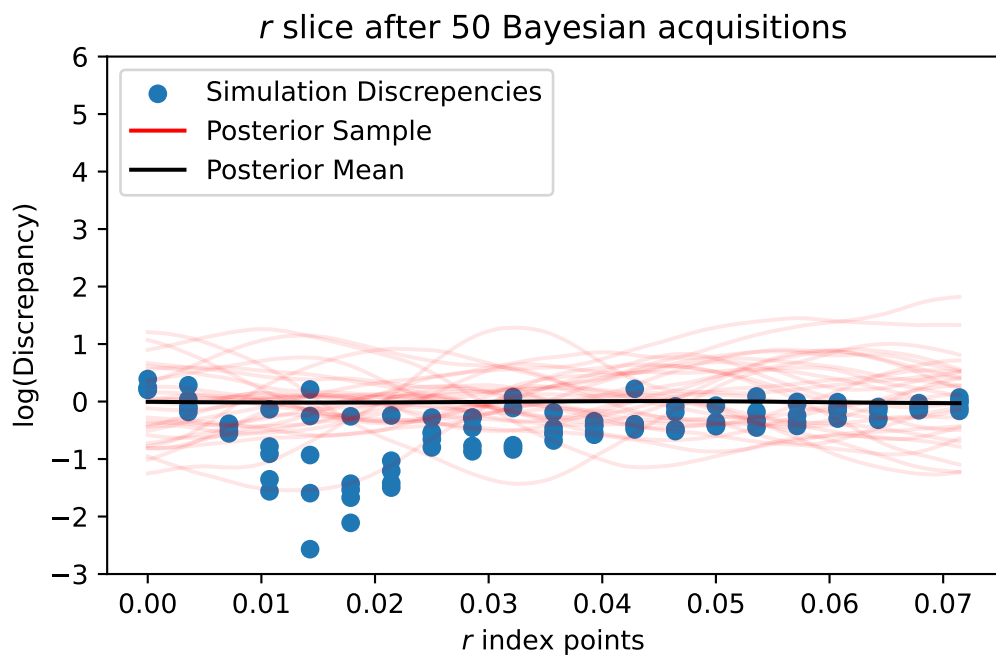
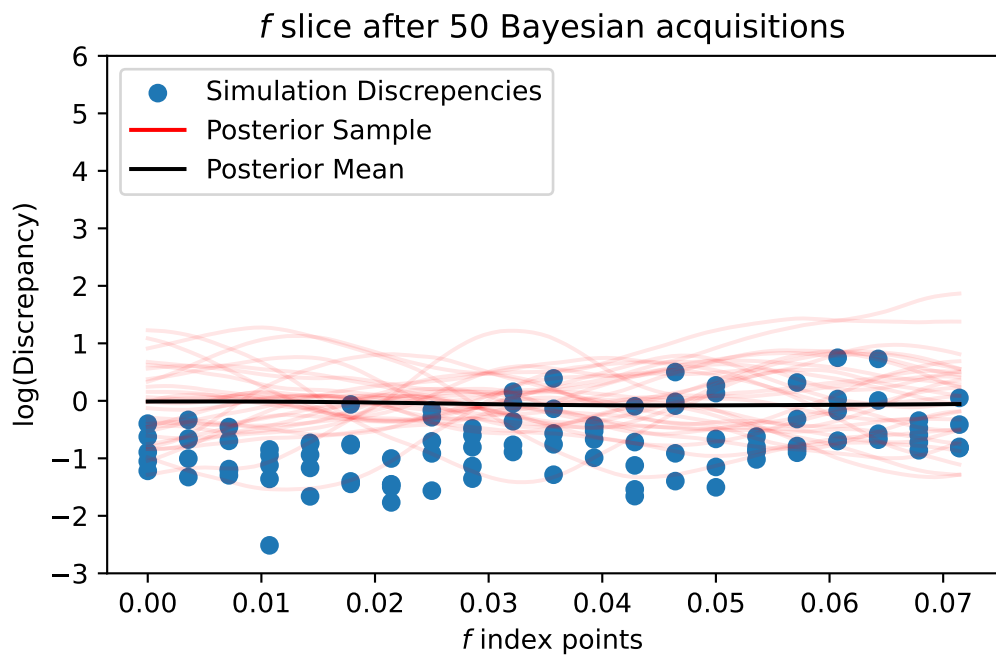
The final EI loss was 0.0 with predicted mean of [-1.204]  
 The next parameters to simulate from are [[0.729 0.273 0.024 0.044 0.022 0.013]]  
 The mean of the samples was -1.462  
 Iteration 495  
 Acquisition function convergence reached at iteration 145.  
 The final EI loss was 0.0 with predicted mean of [-1.21]  
 The next parameters to simulate from are [[0.73 0.273 0.024 0.044 0.022 0.013]]  
 The mean of the samples was -1.081  
 Iteration 496  
 Acquisition function convergence reached at iteration 584.  
 The final EI loss was -0.399 with predicted mean of [-0.631]  
 The next parameters to simulate from are [[0.917 0.153 0.028 0.05 0.02 0.007]]  
 The mean of the samples was -0.722  
 Iteration 497  
 Acquisition function convergence reached at iteration 137.  
 The final EI loss was -0.0 with predicted mean of [-1.262]  
 The next parameters to simulate from are [[0.698 0.247 0.023 0.042 0.022 0.013]]  
 The mean of the samples was -1.678  
 Iteration 498  
 Acquisition function convergence reached at iteration 118.  
 The final EI loss was 0.0 with predicted mean of [-1.208]  
 The next parameters to simulate from are [[0.729 0.273 0.024 0.044 0.022 0.013]]  
 The mean of the samples was -1.051  
 Iteration 499  
 Acquisition function convergence reached at iteration 99.  
 The final EI loss was 0.0 with predicted mean of [-1.204]  
 The next parameters to simulate from are [[0.729 0.273 0.024 0.044 0.022 0.013]]  
 The mean of the samples was -1.198  
 Iteration 500  
 Acquisition function convergence reached at iteration 6384.  
 The final EI loss was -0.399 with predicted mean of [-0.638]  
 The next parameters to simulate from are [[0.815 0.596 0.022 0.04 0. 0.003]]  
 The mean of the samples was -0.573  
 Hyperparameter convergence reached at iteration 772.  
 The minimum predicted mean of the observed indices is -1.275 at the point  
 [0.698 0.247 0.023 0.042 0.022 0.013]  
 Trained parameters:  
 amplitude\_champ:0 is 0.506  
  
 length\_scales\_champ:0 is [0.25 0.25 0.008 0.024 0.018 0.014]  
  
 observation\_noise\_variance\_champ:0 is 0.017

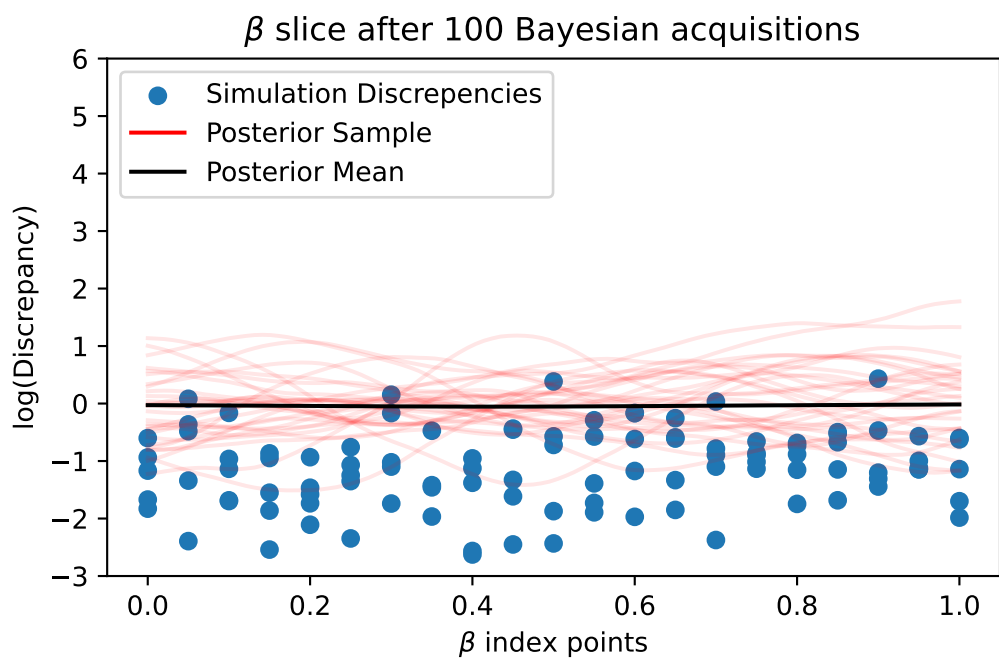
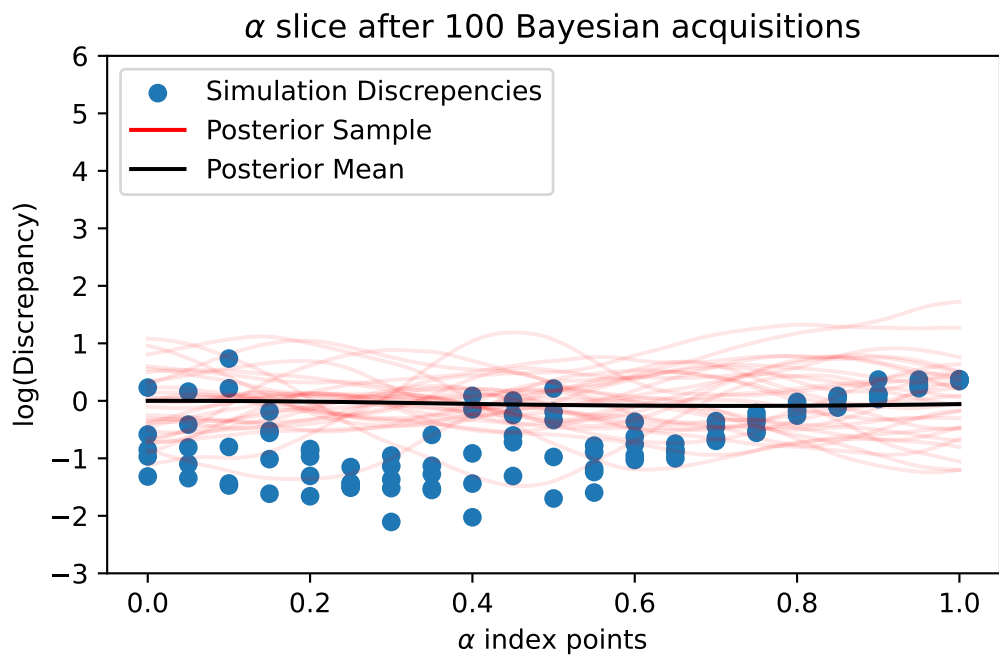
bias\_mean:0 is 0.281

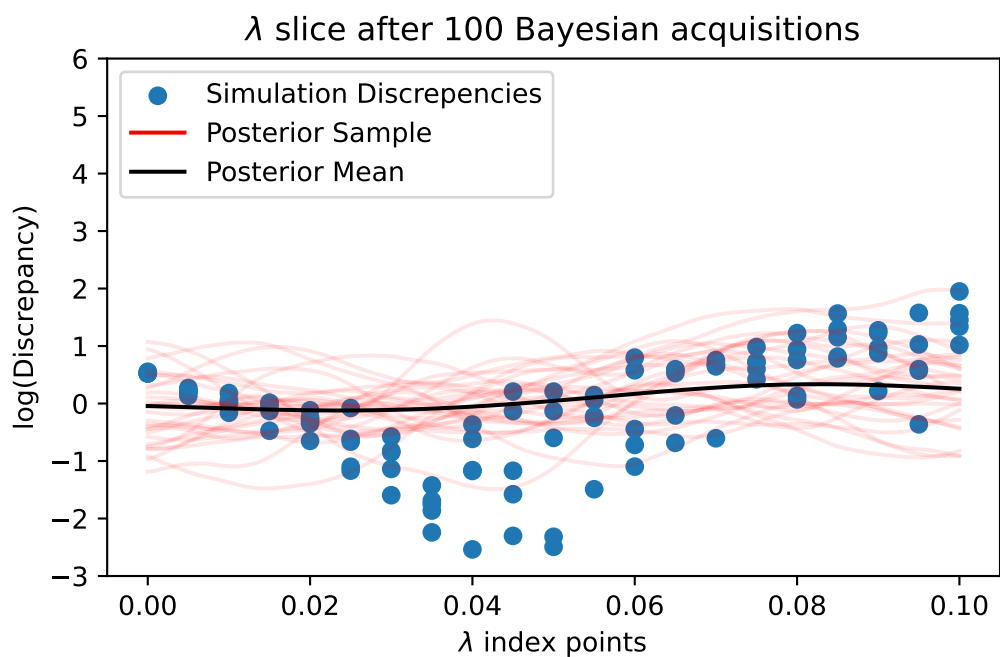
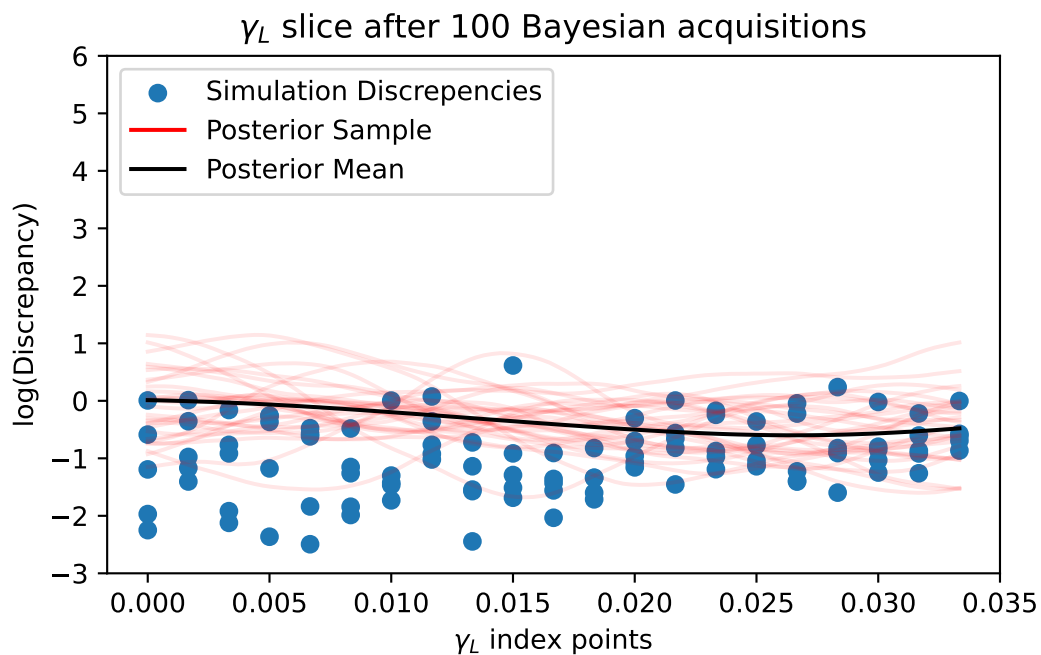


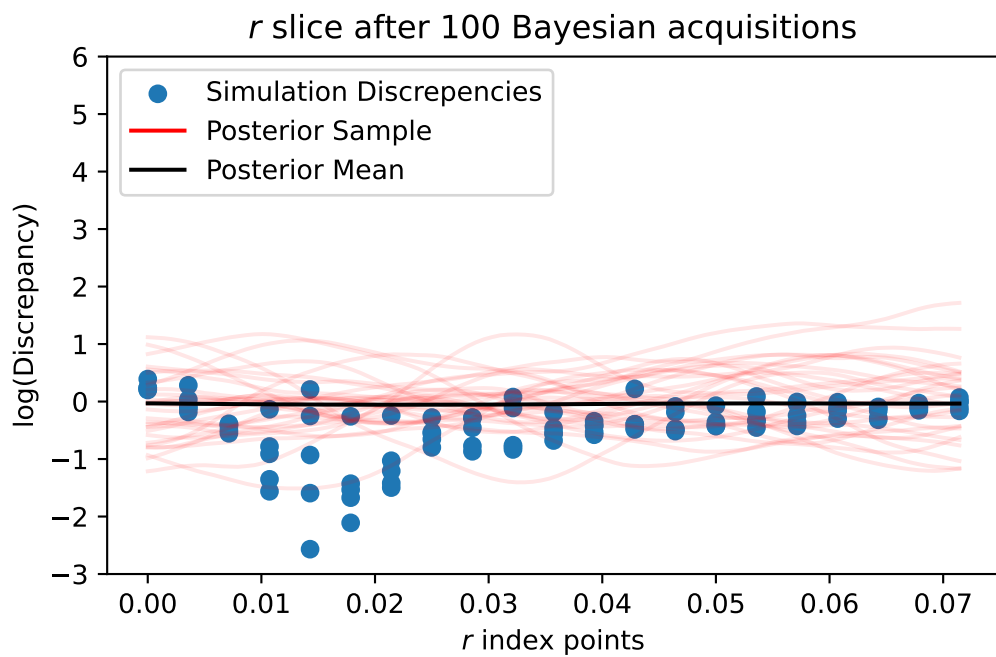
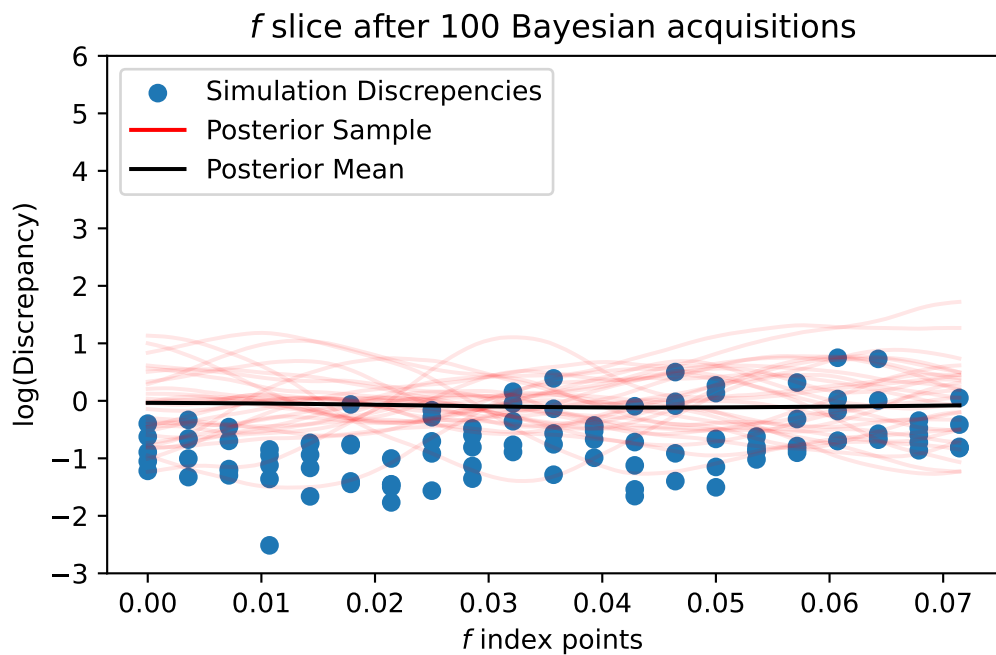


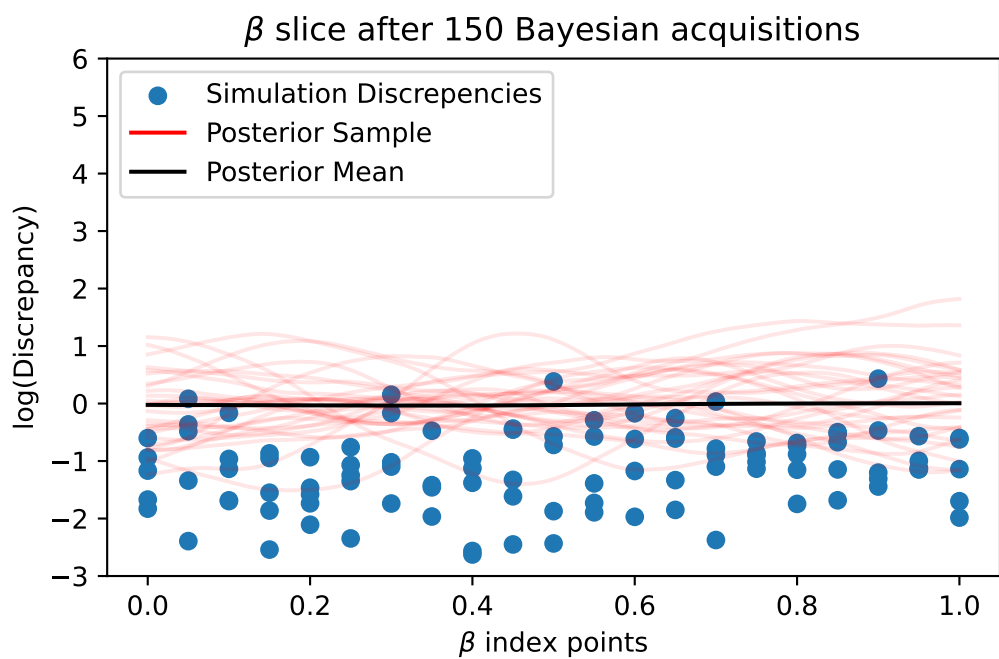
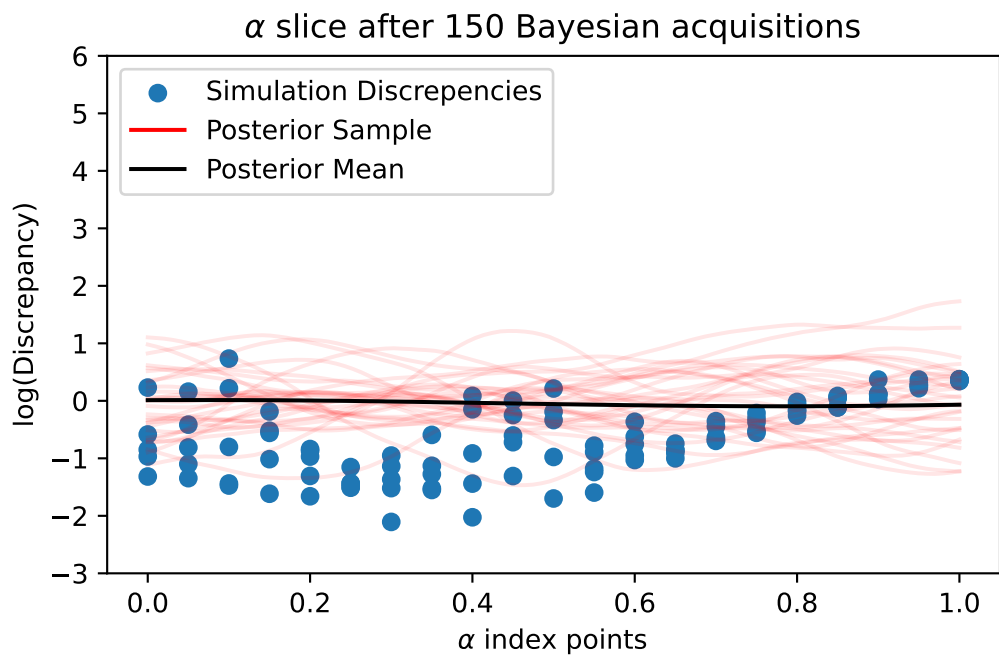


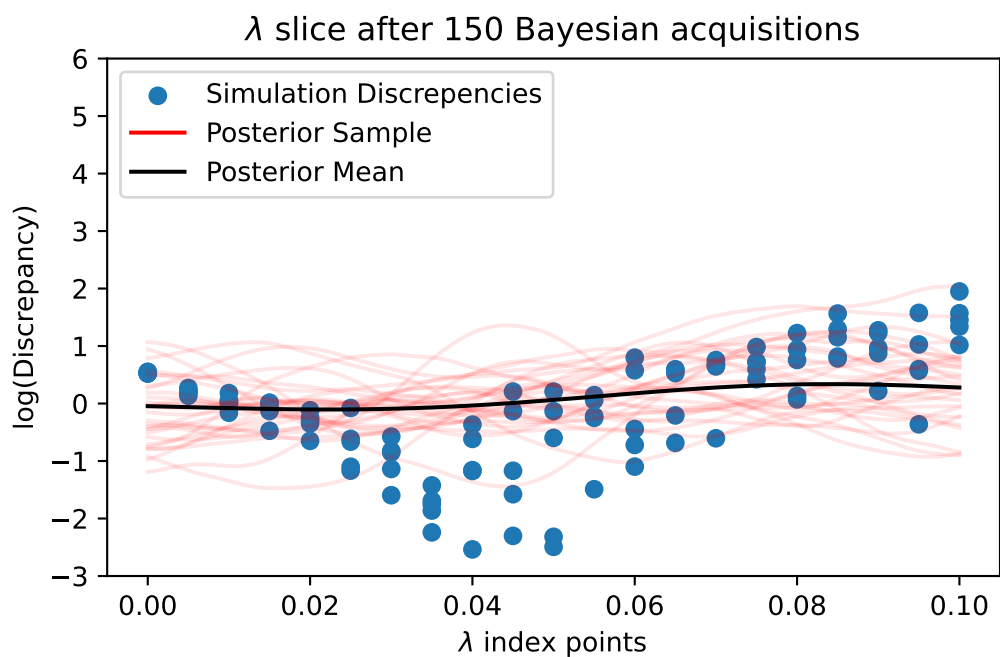
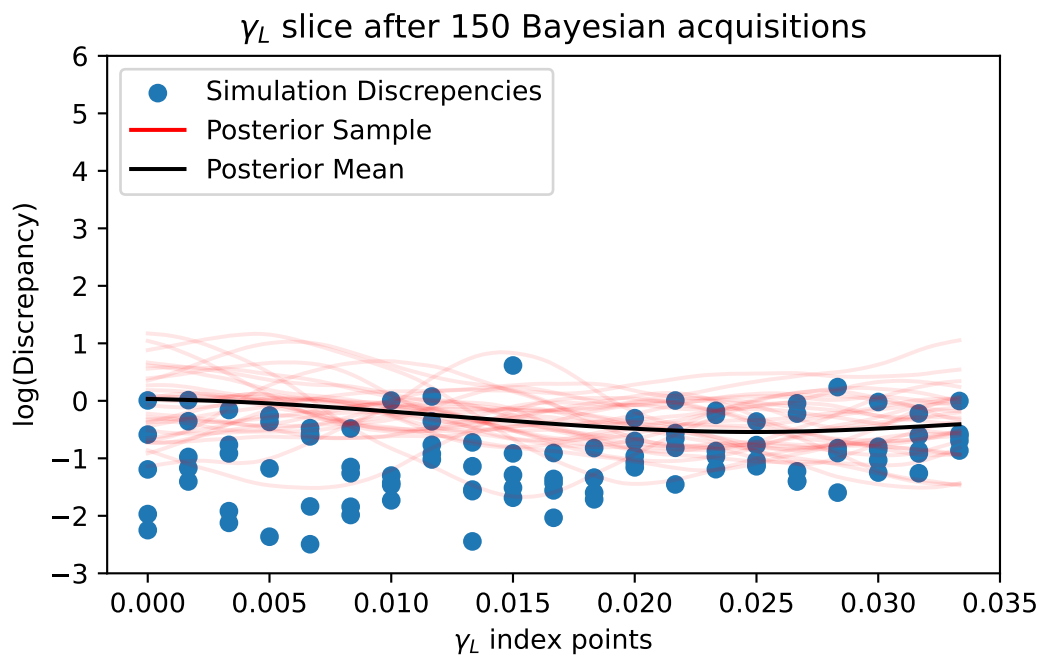


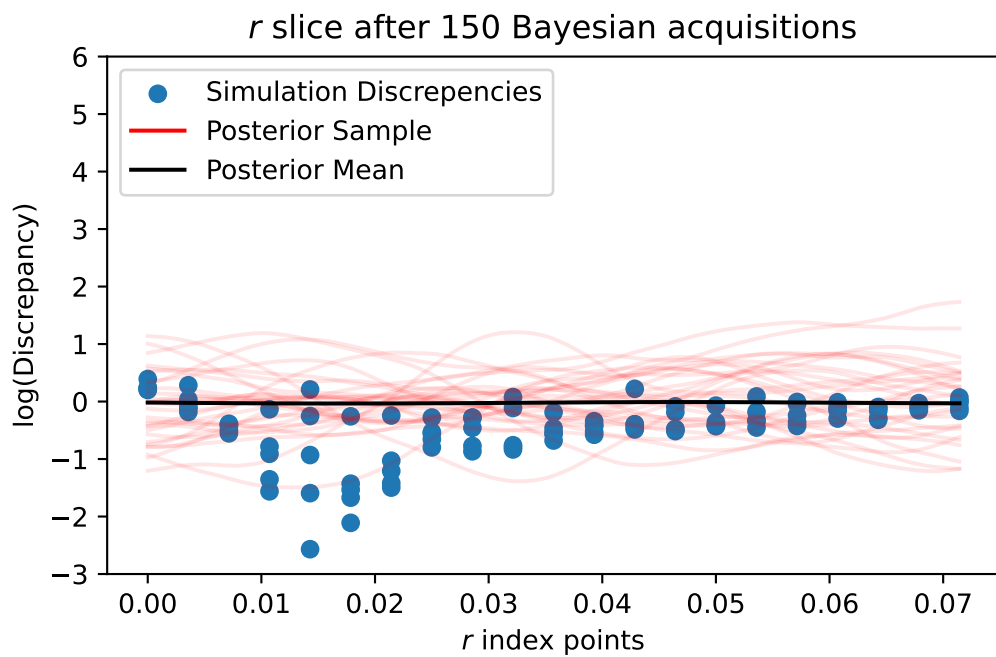
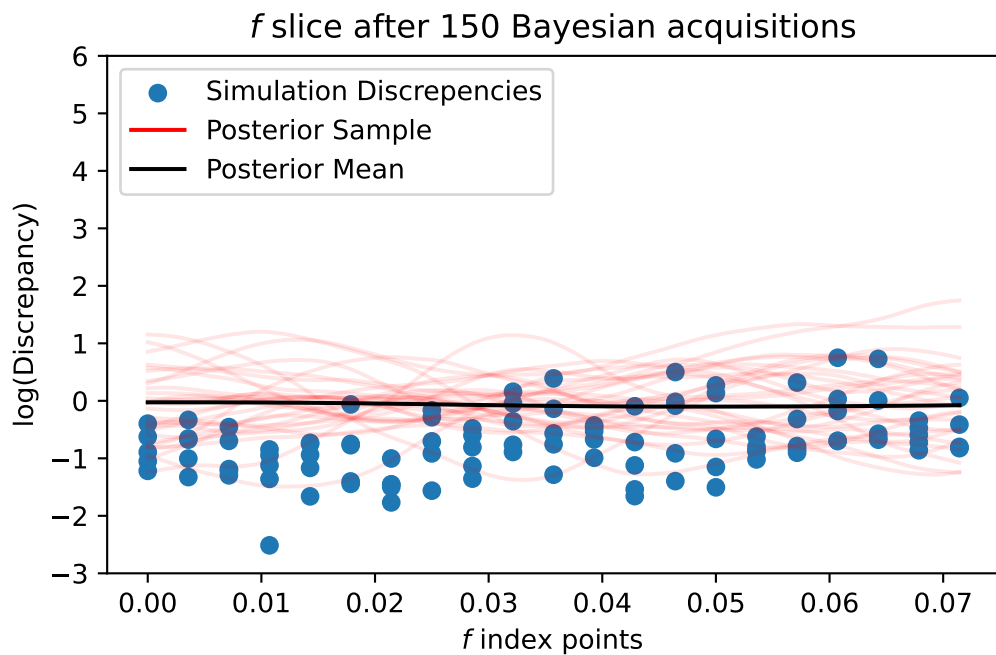




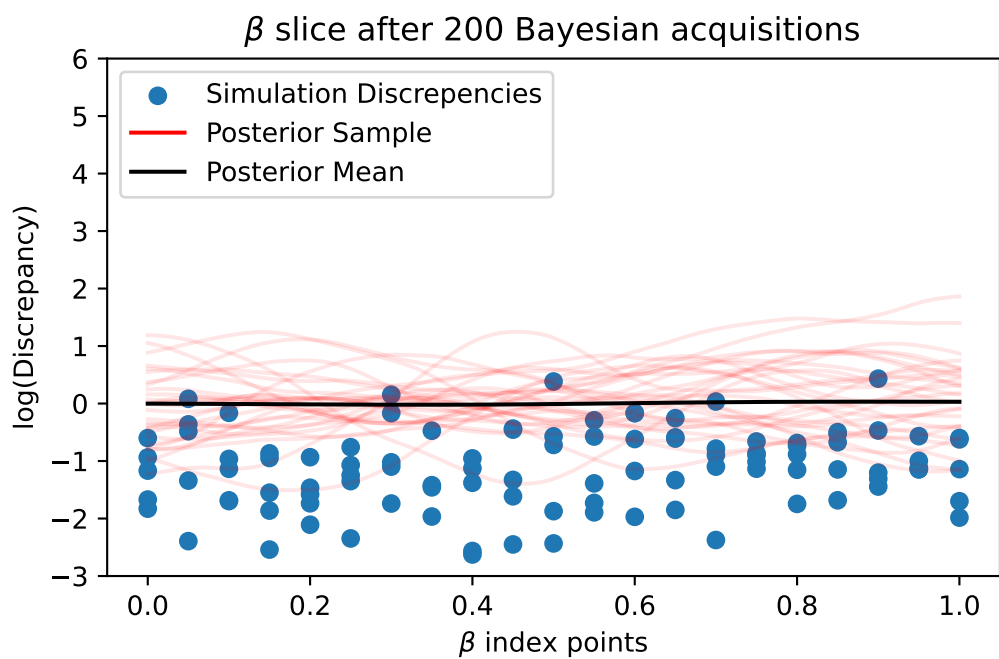
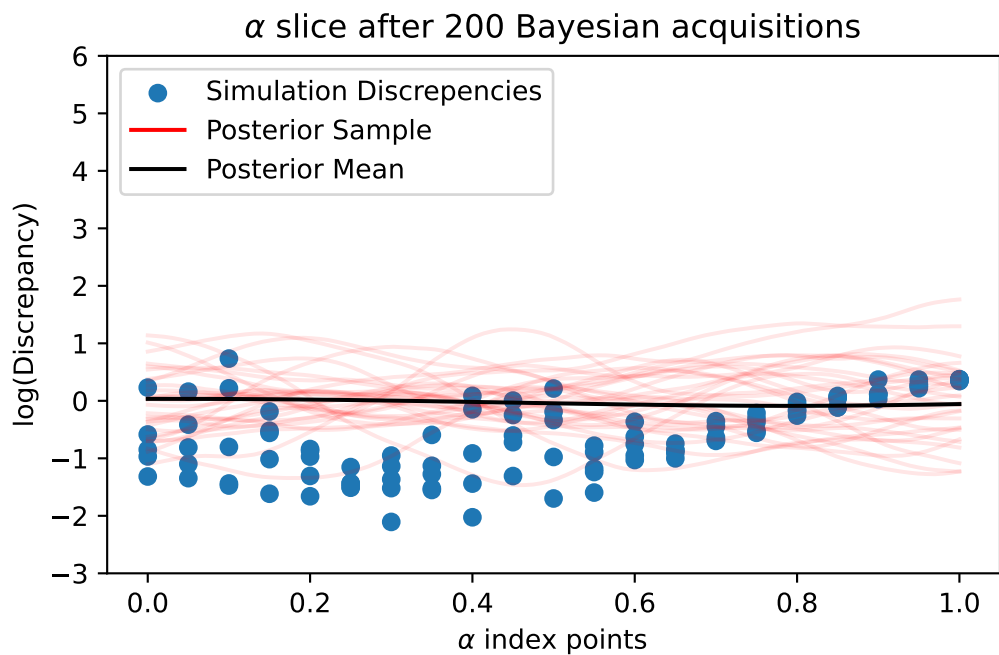


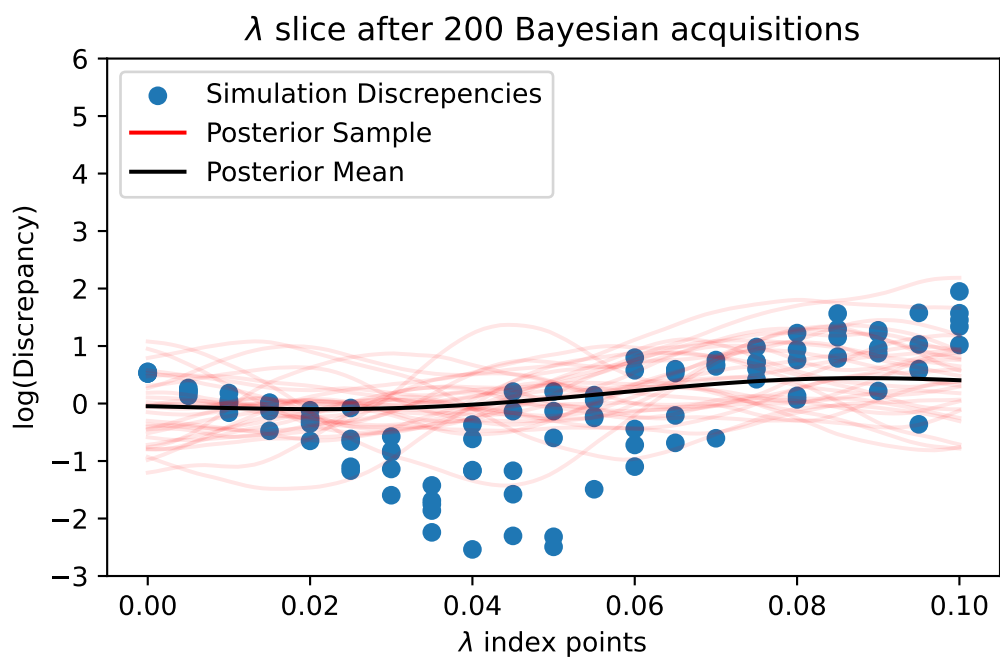
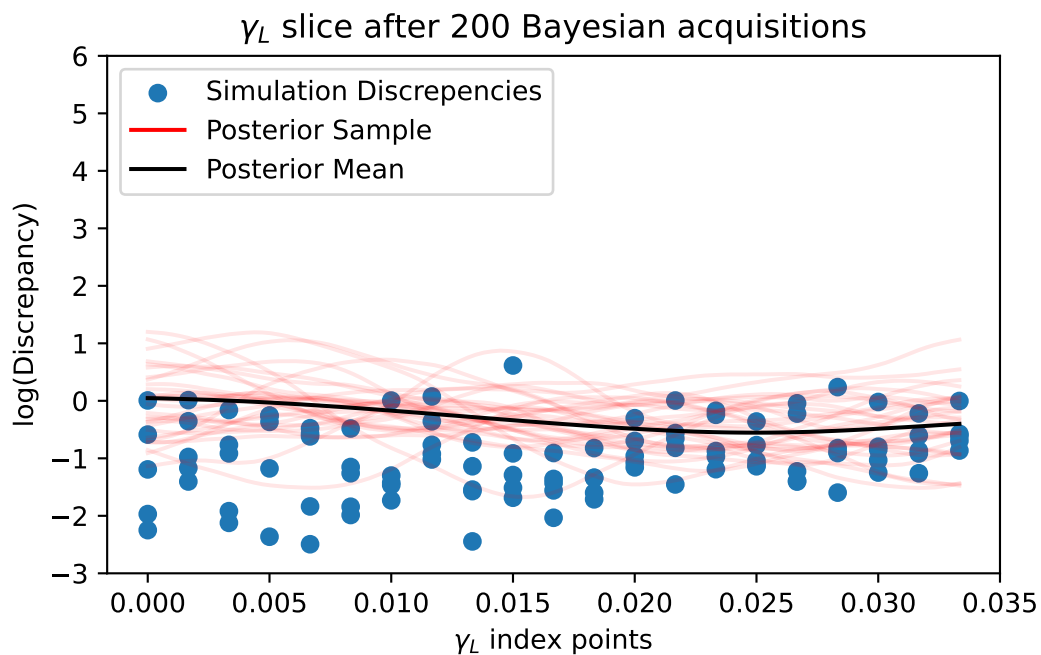


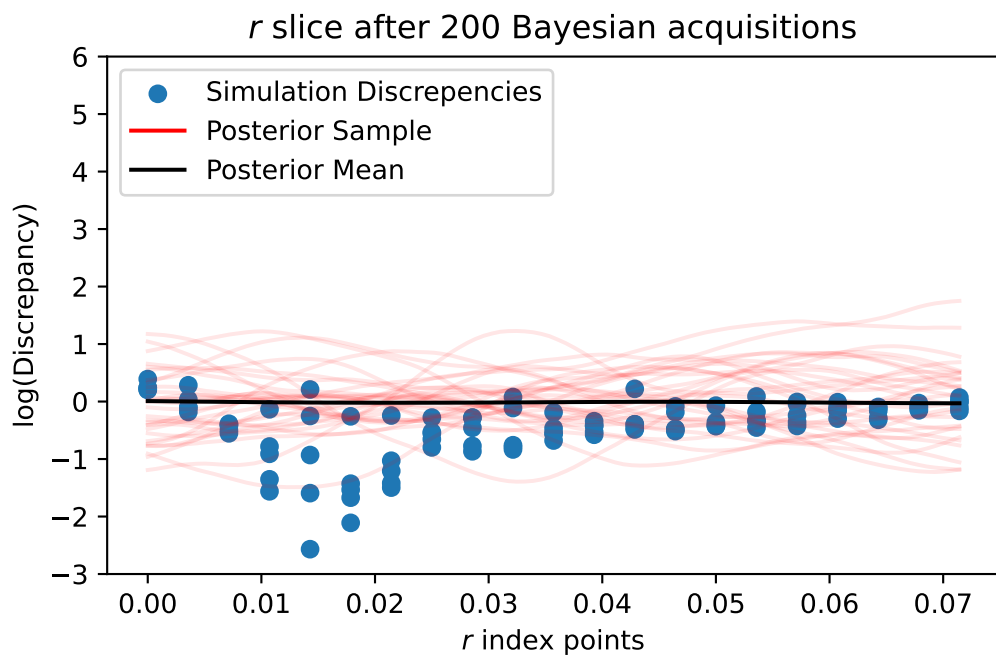
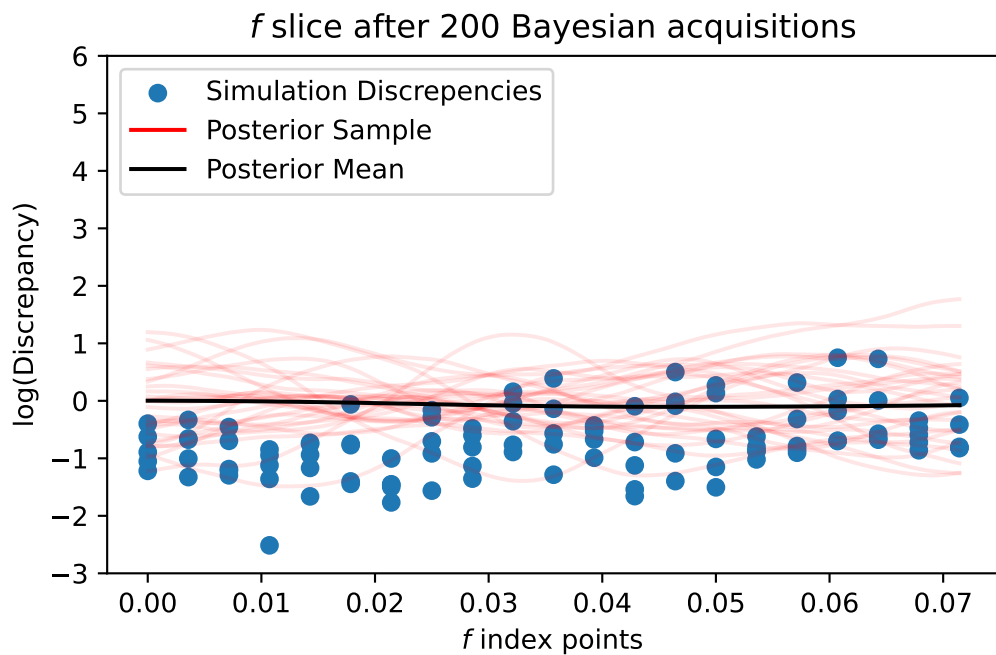


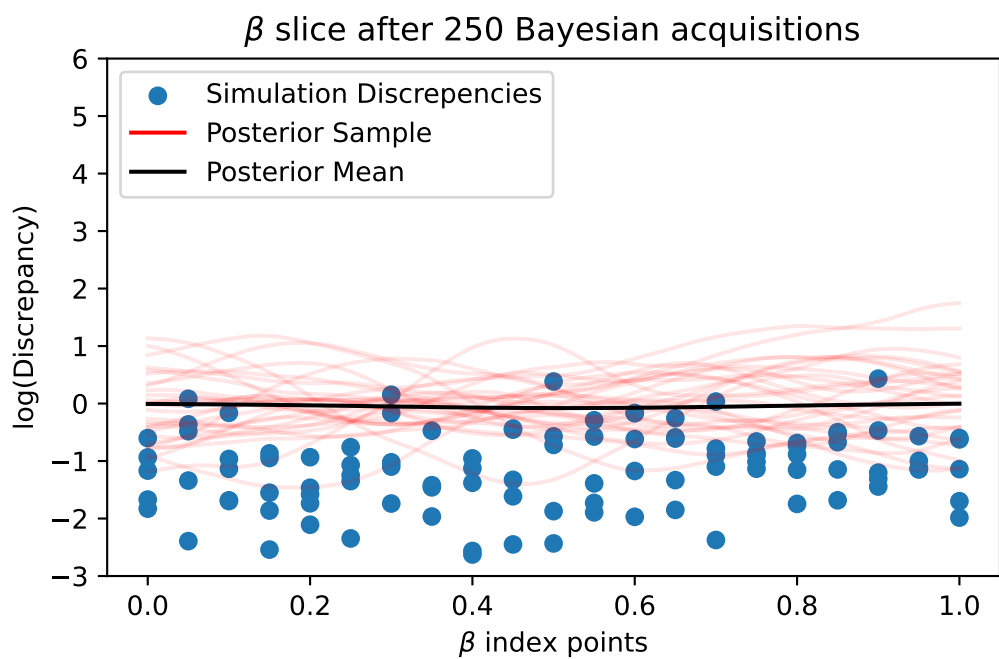
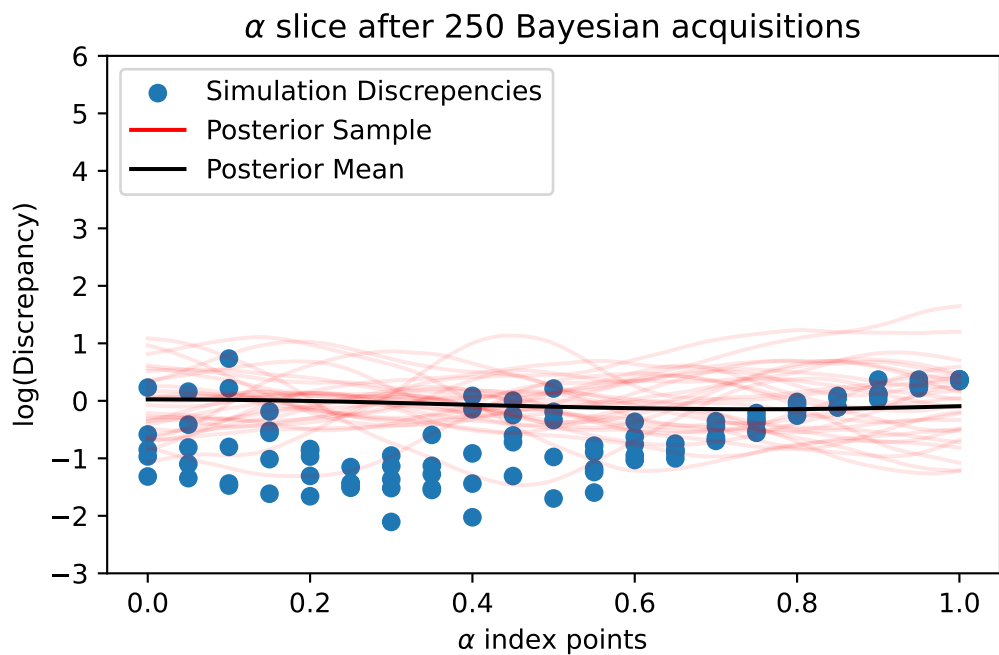


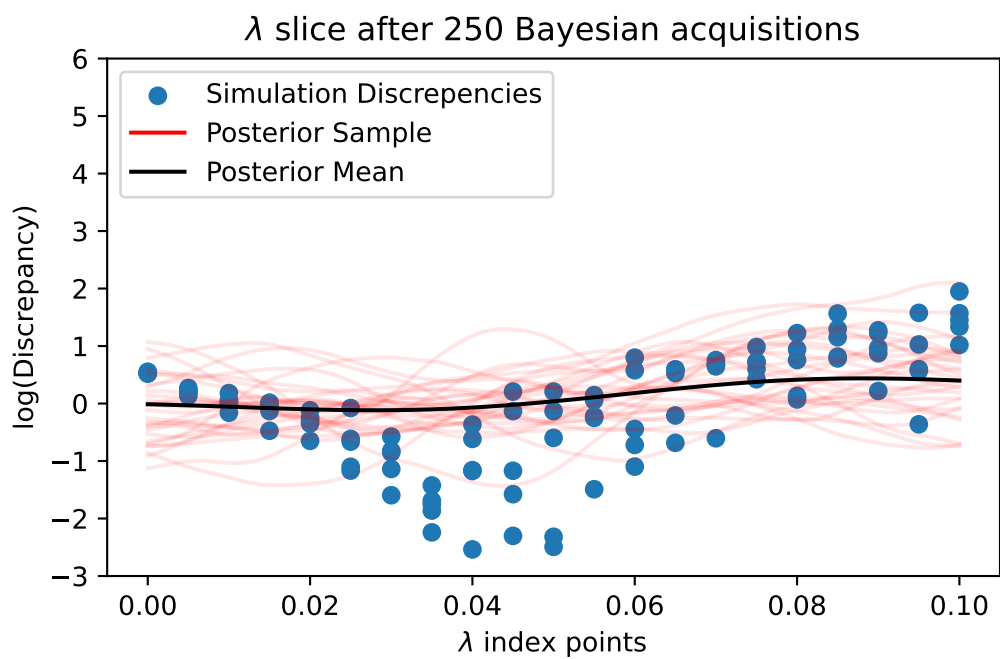
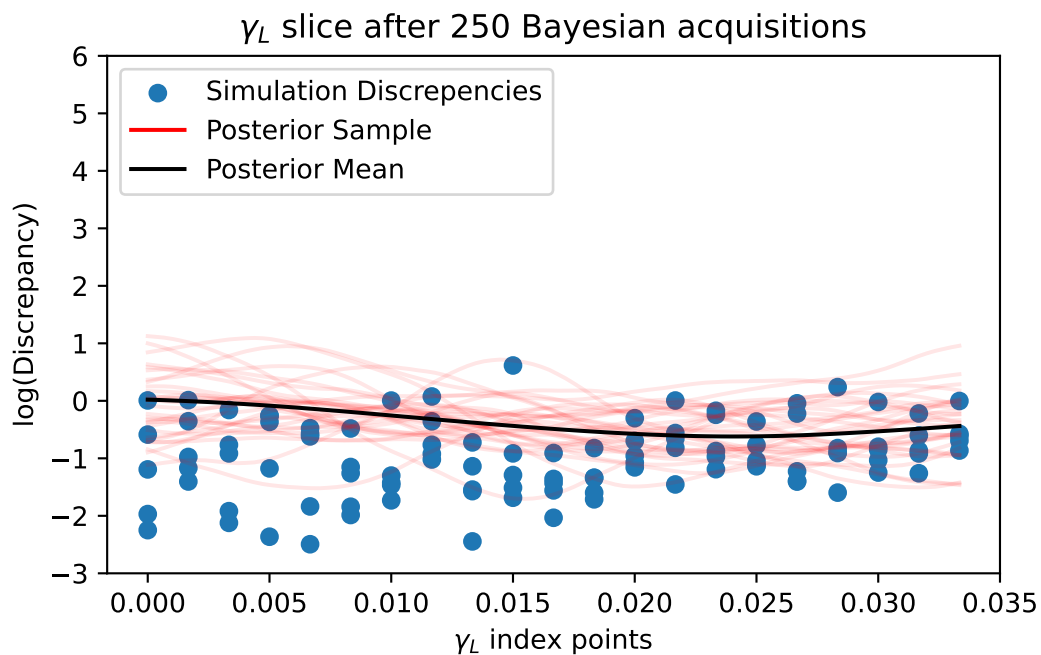


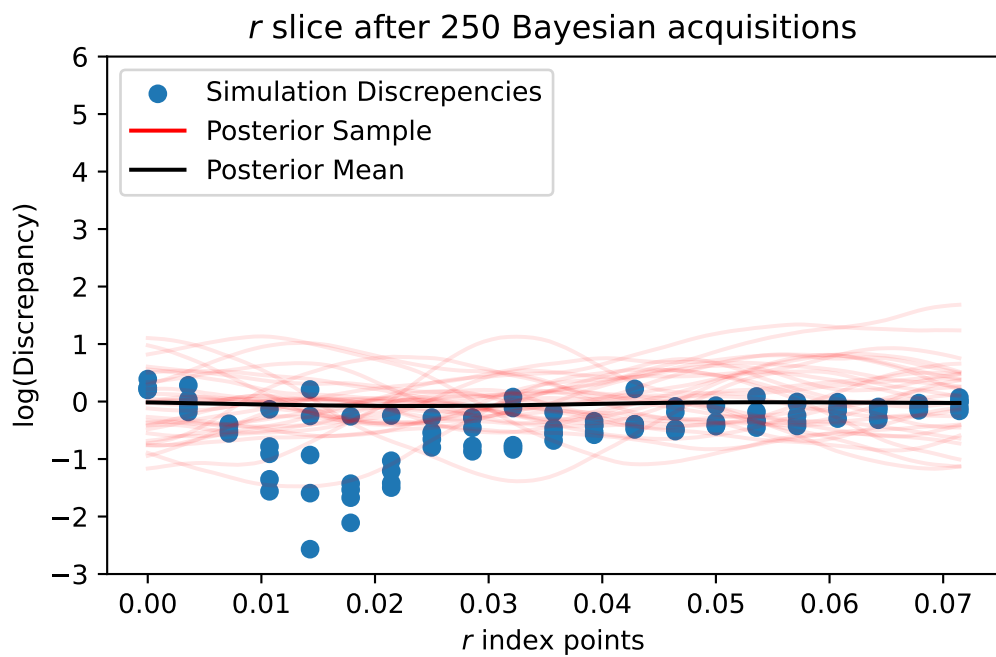
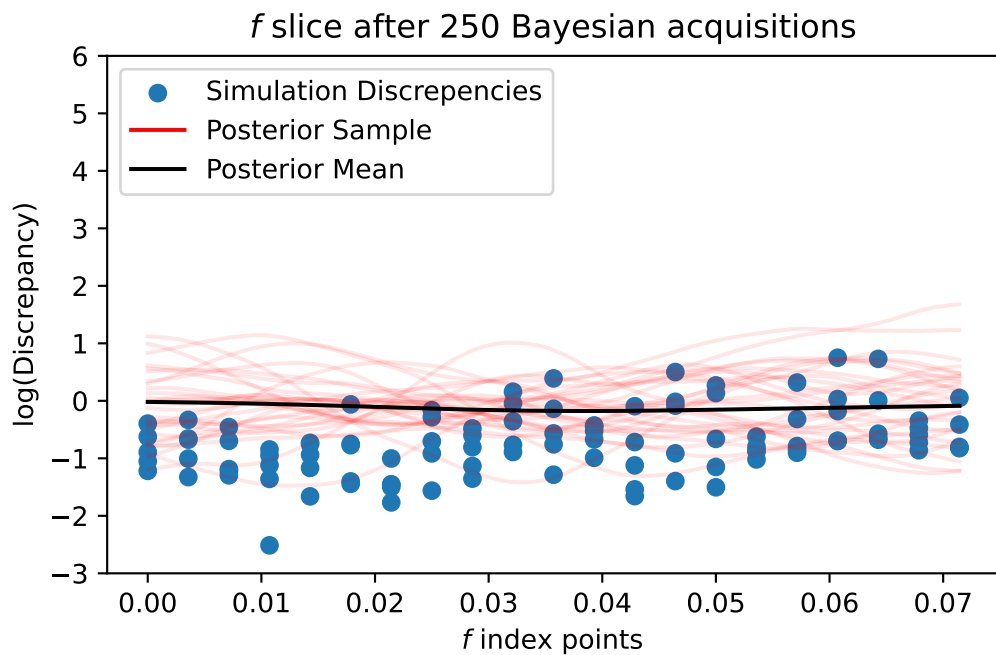


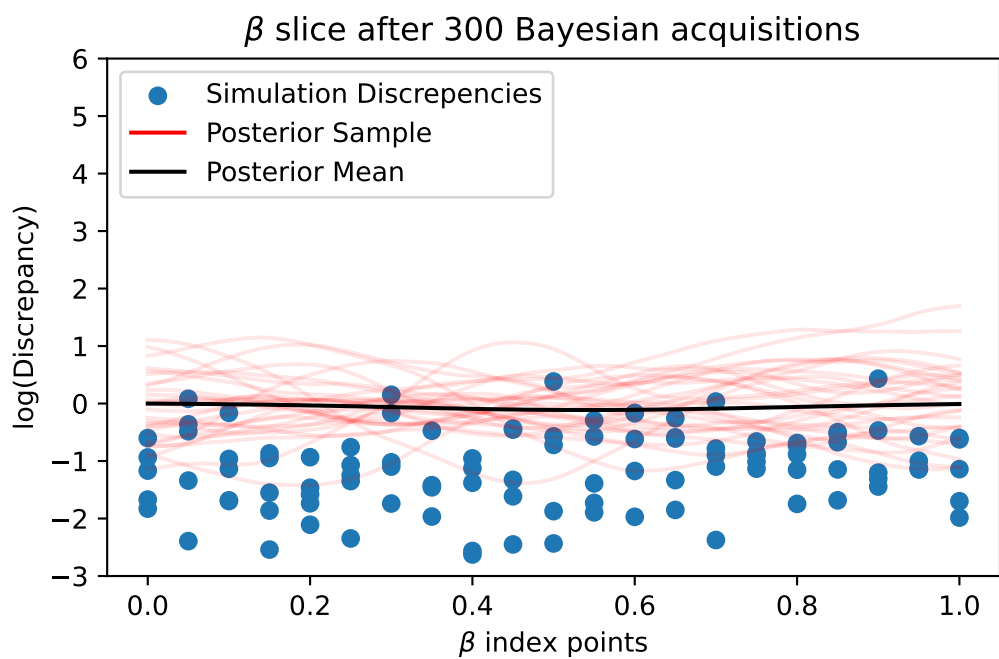
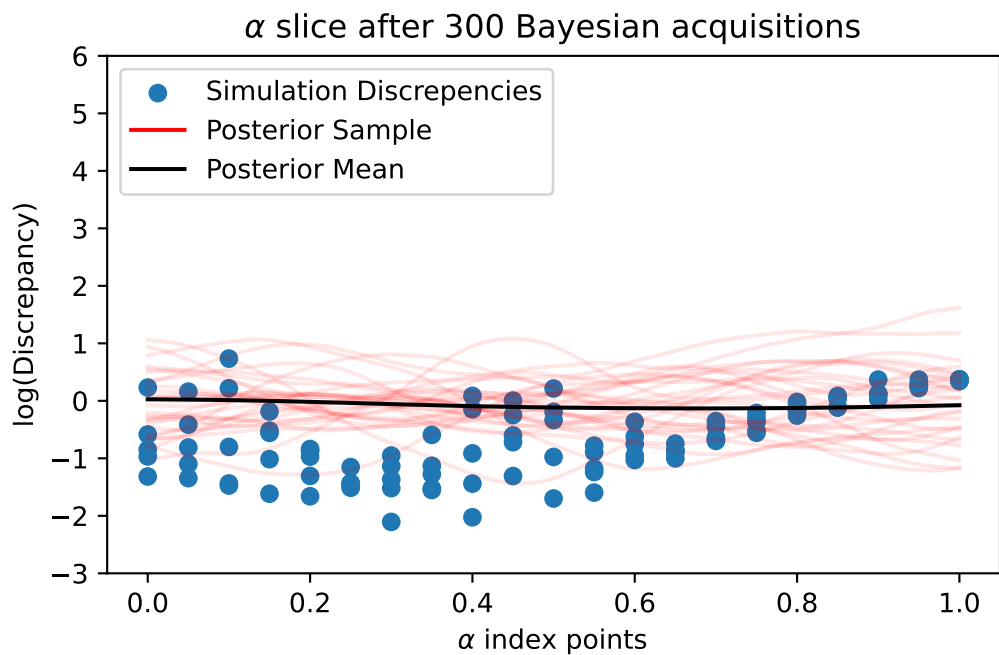


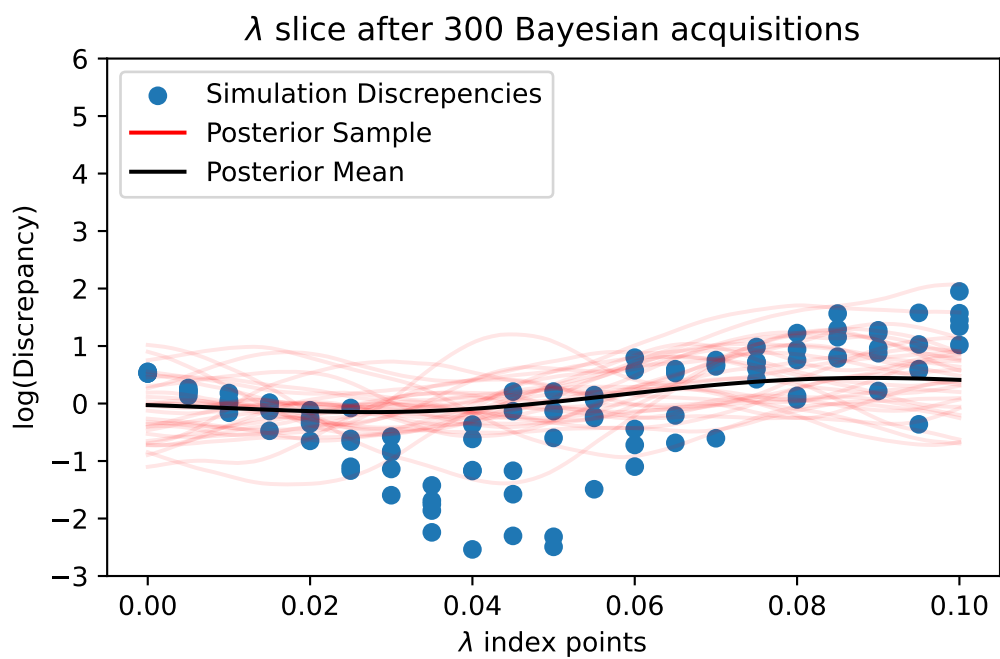
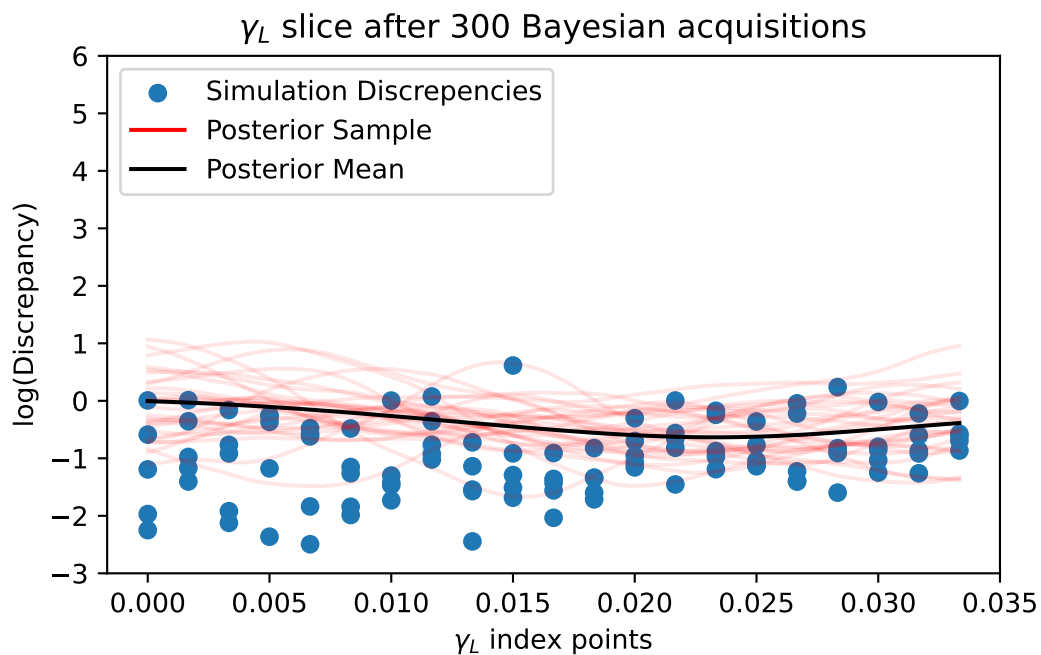




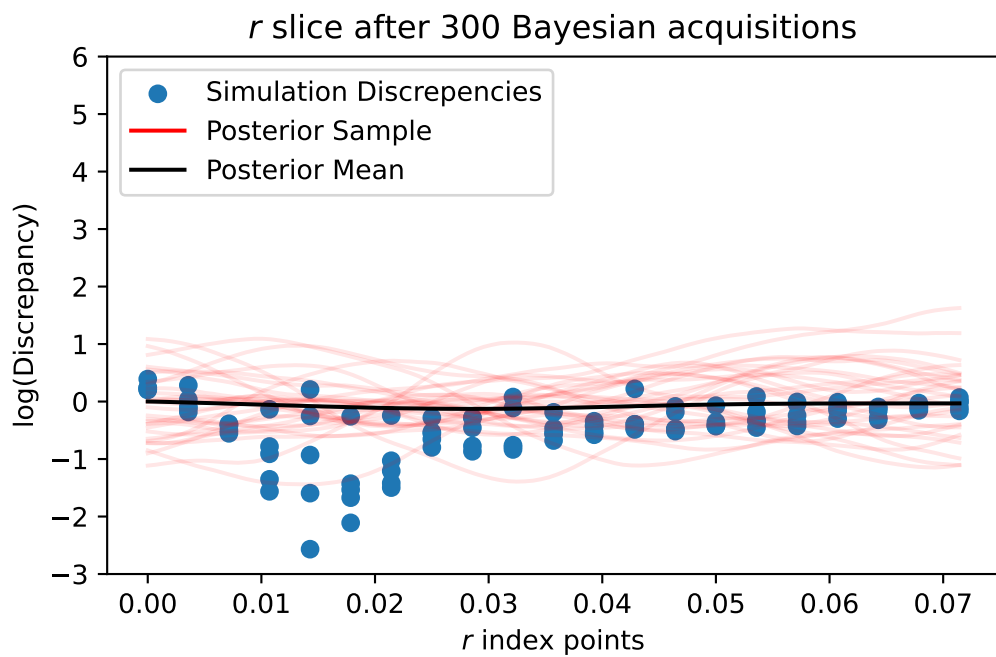
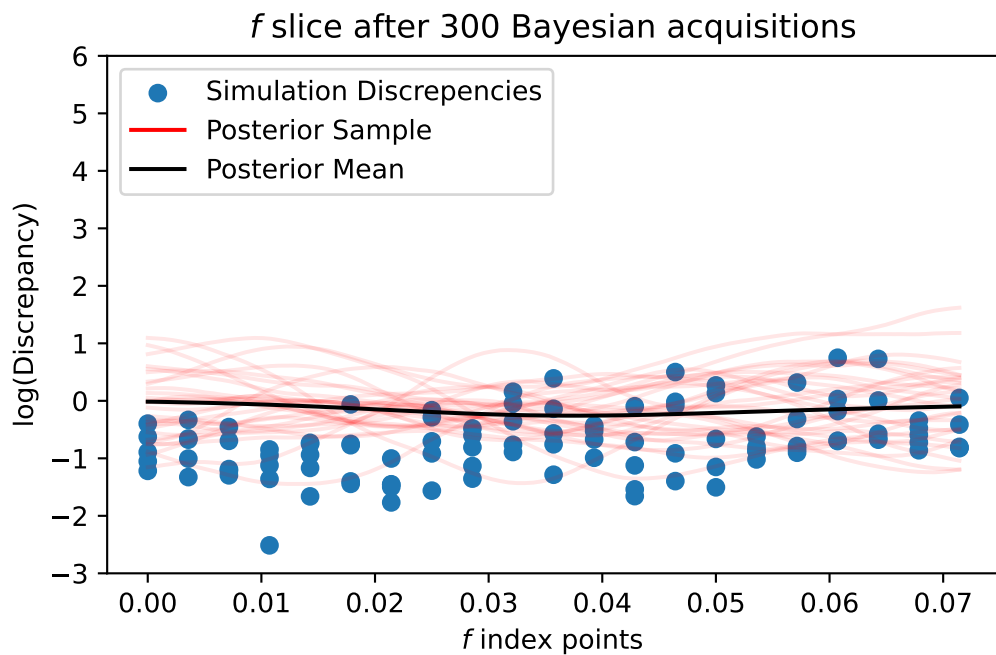


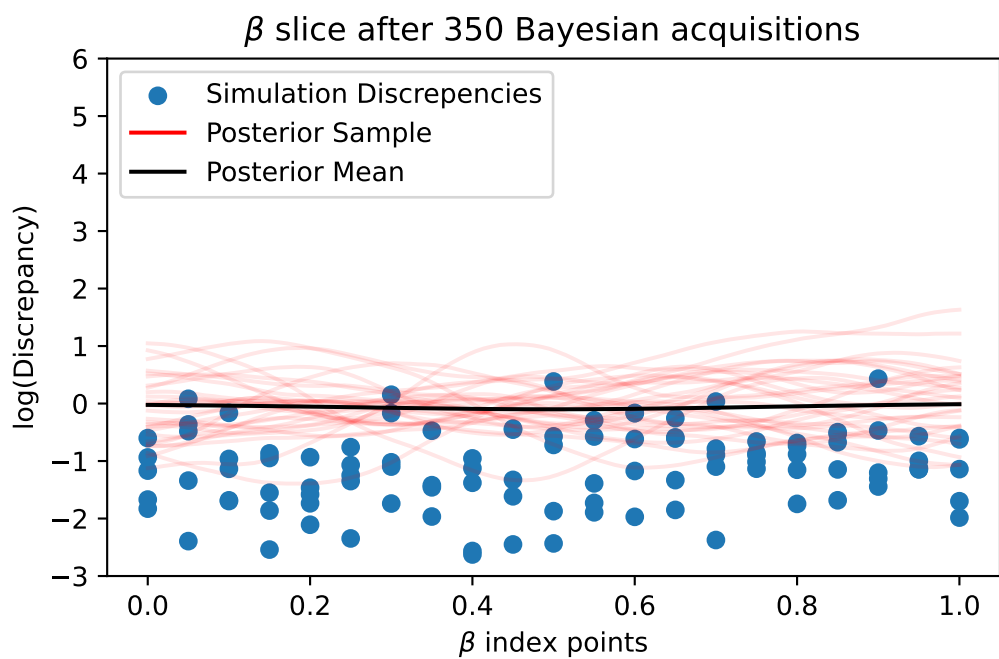
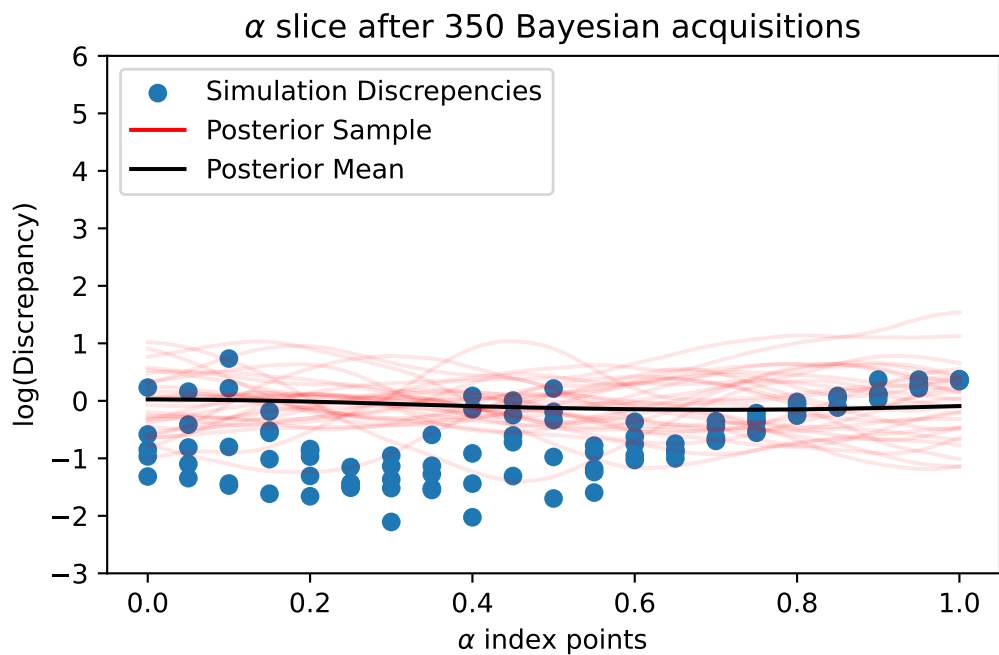


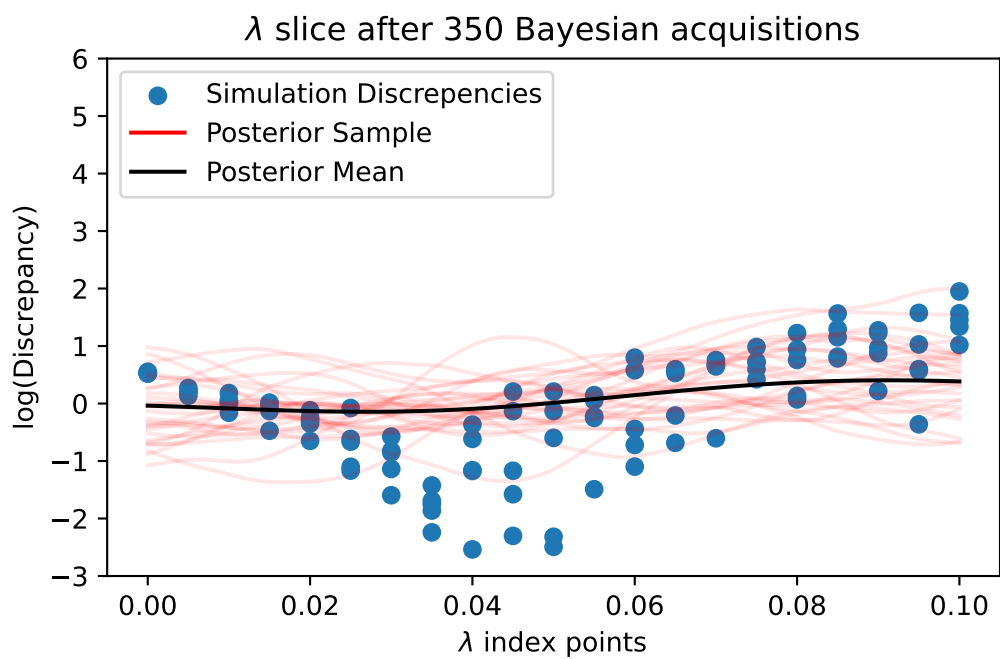
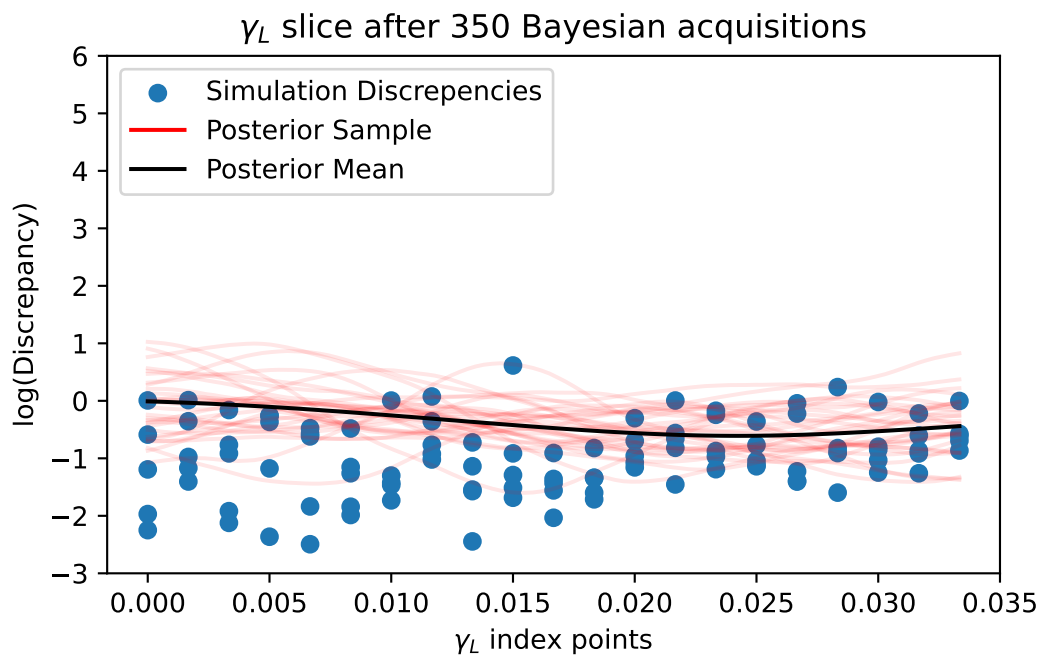


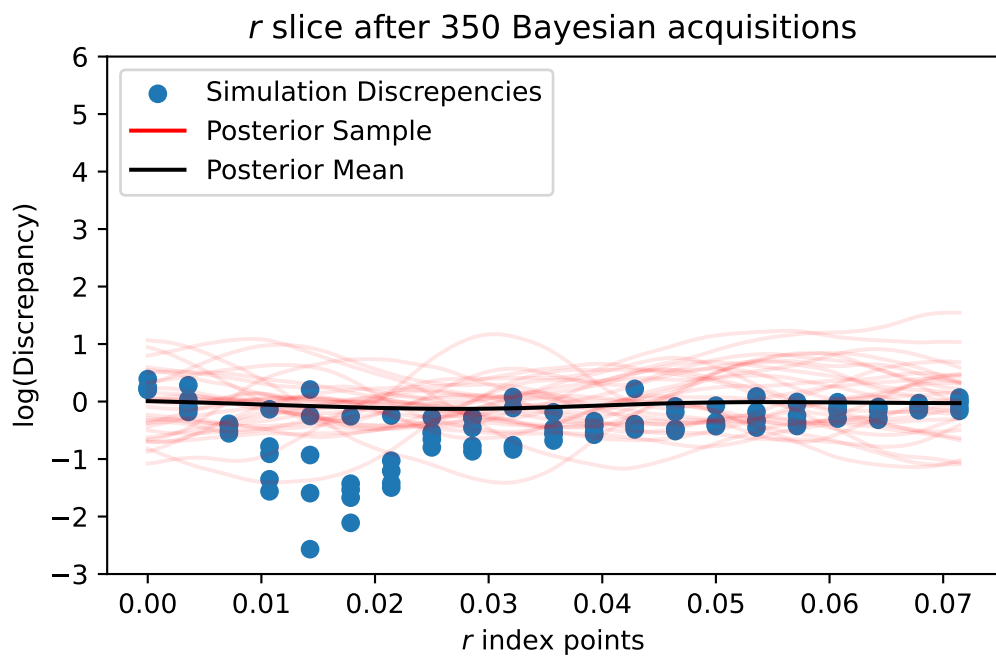
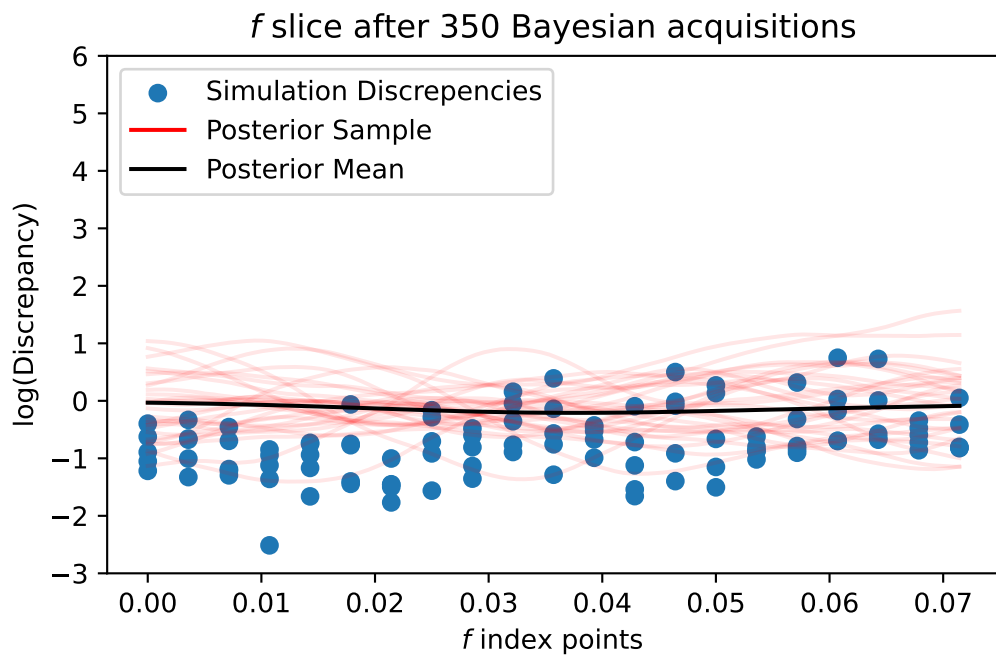


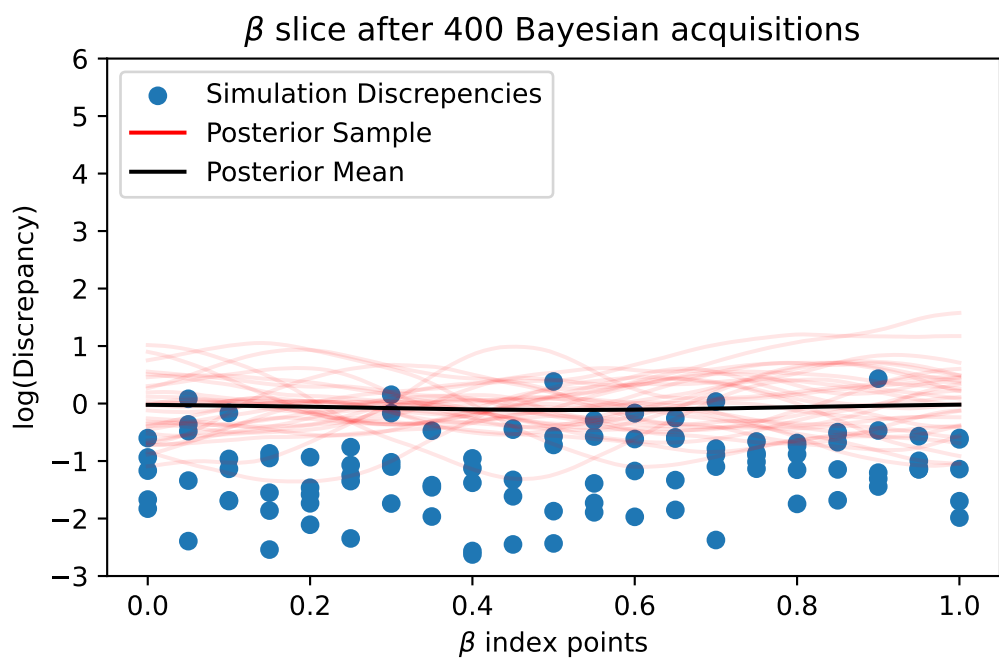
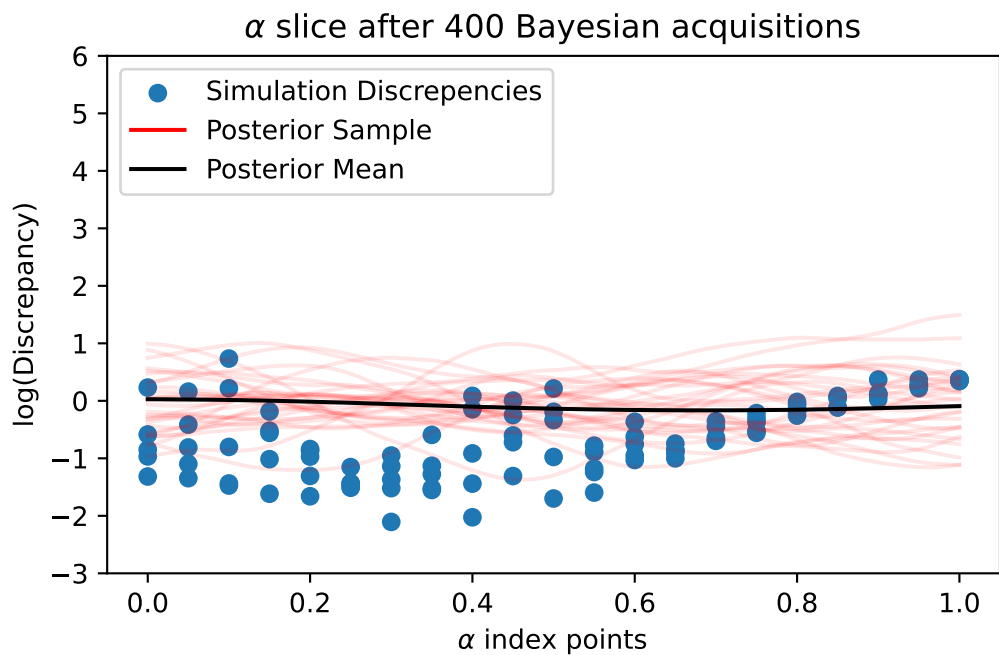


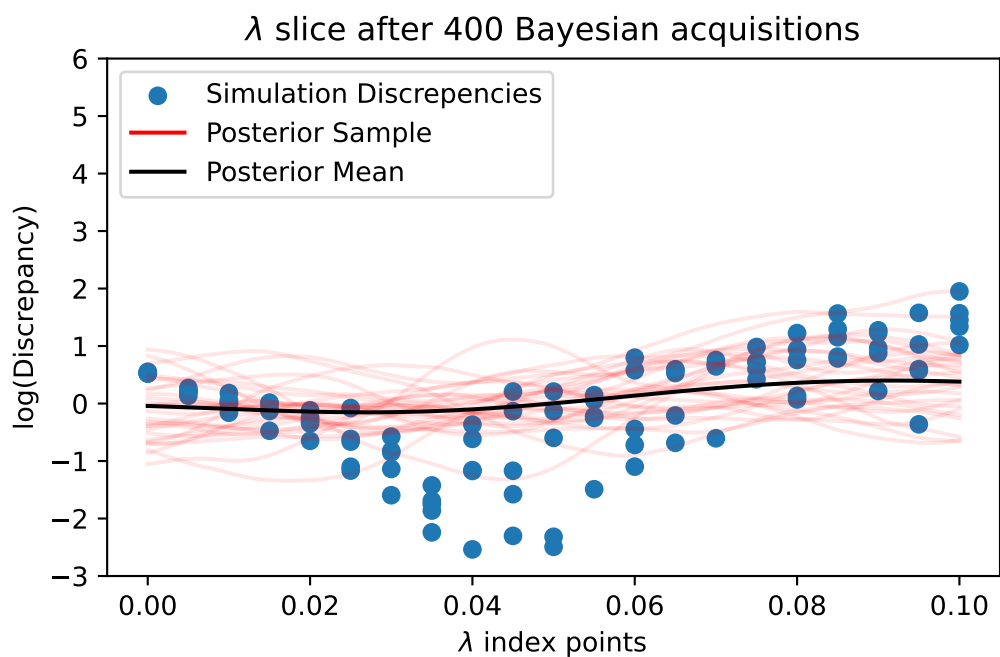
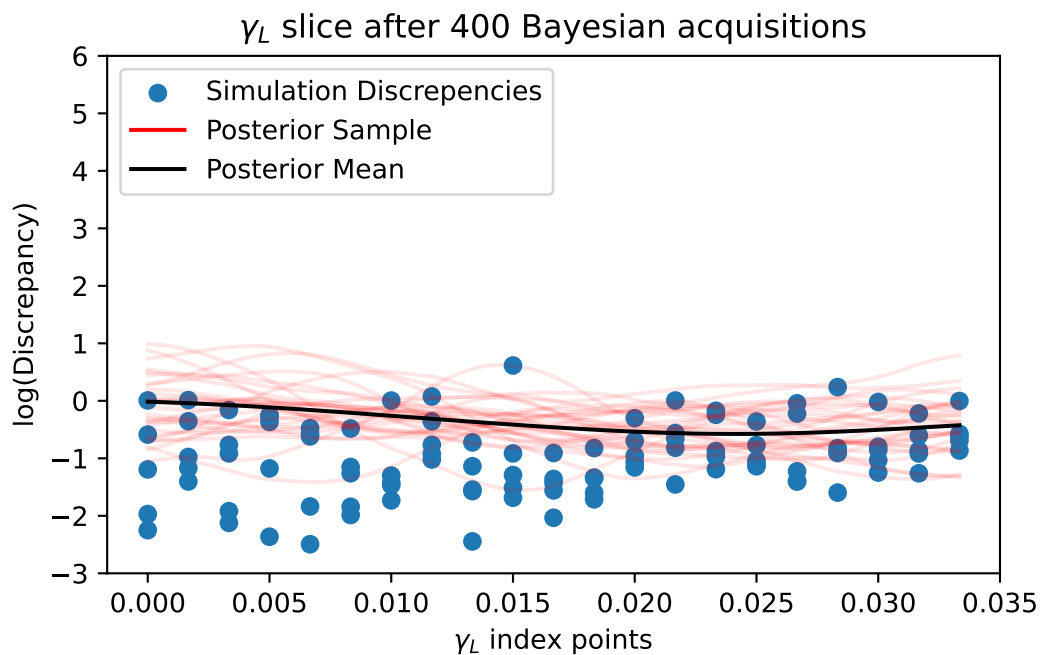


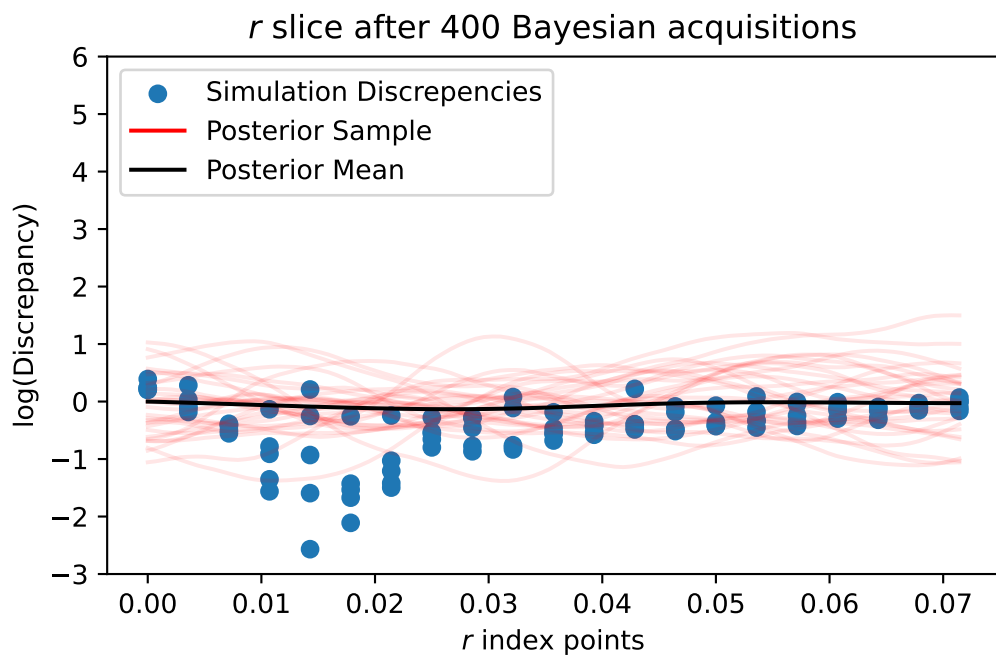
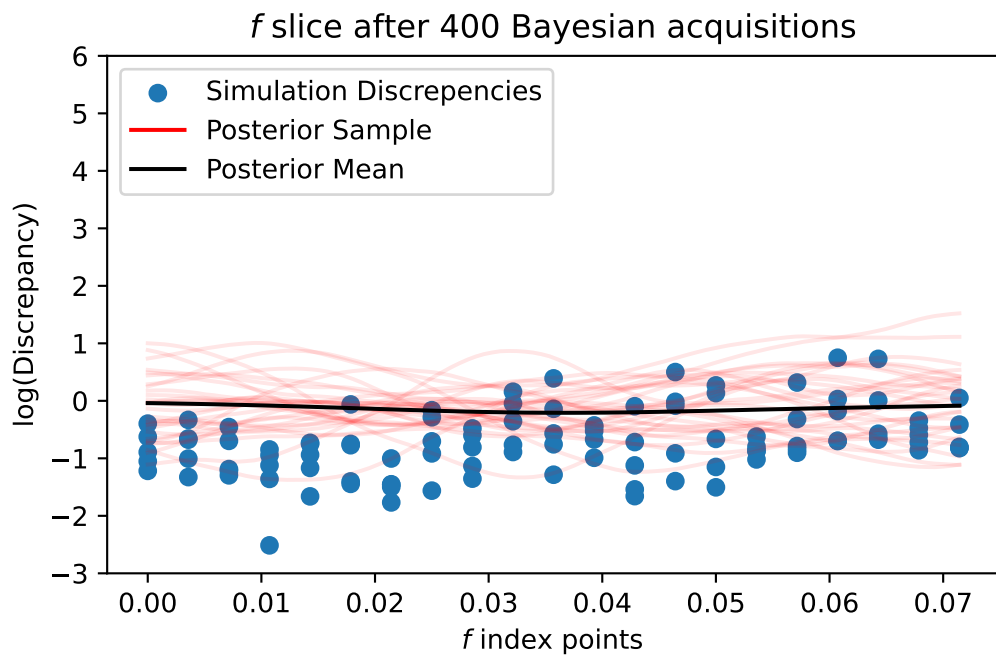


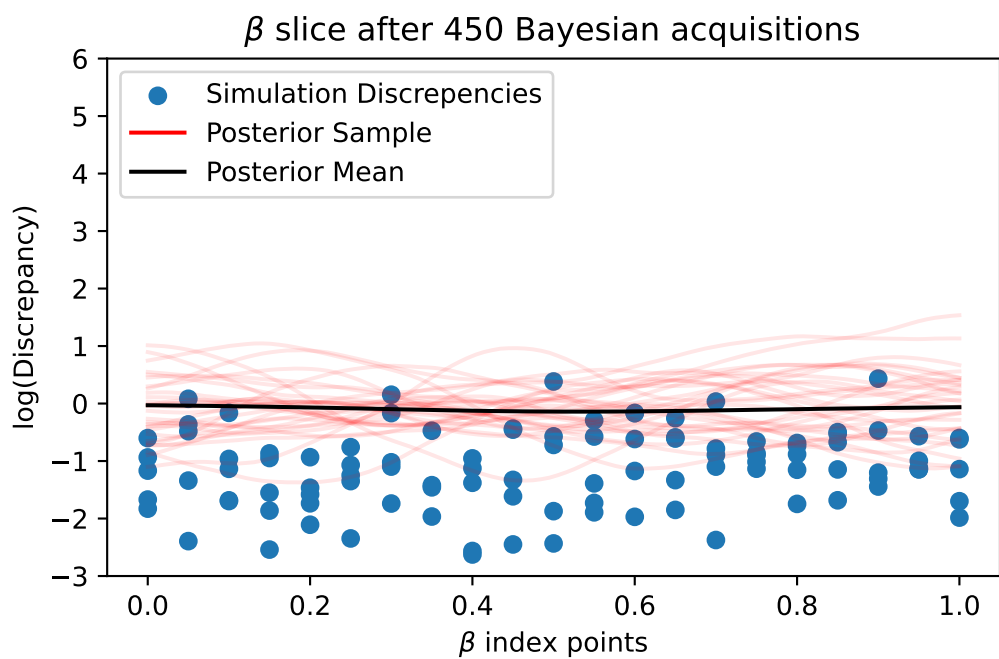
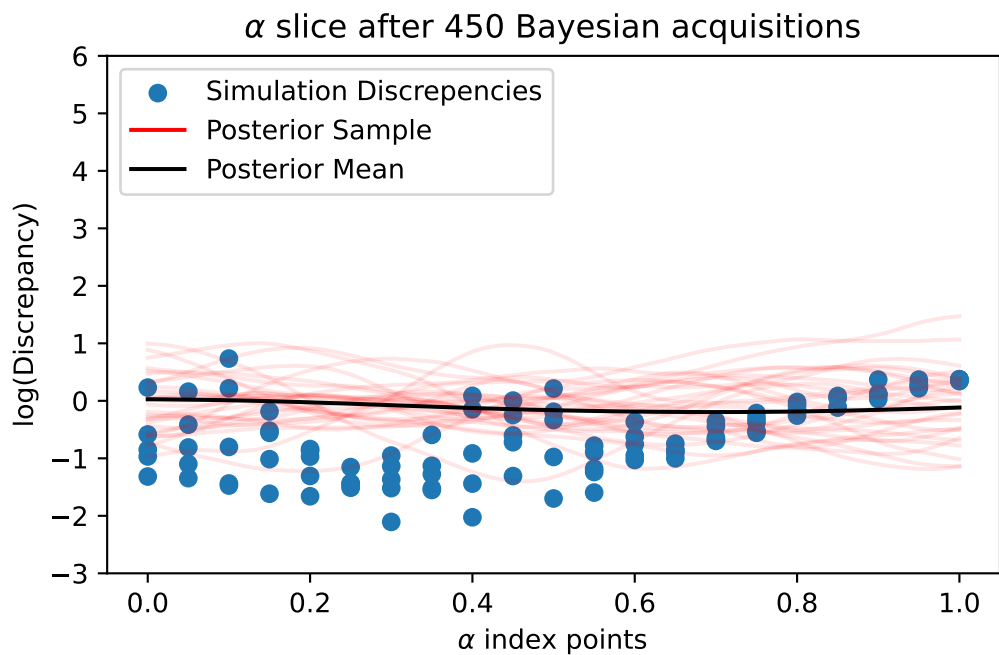




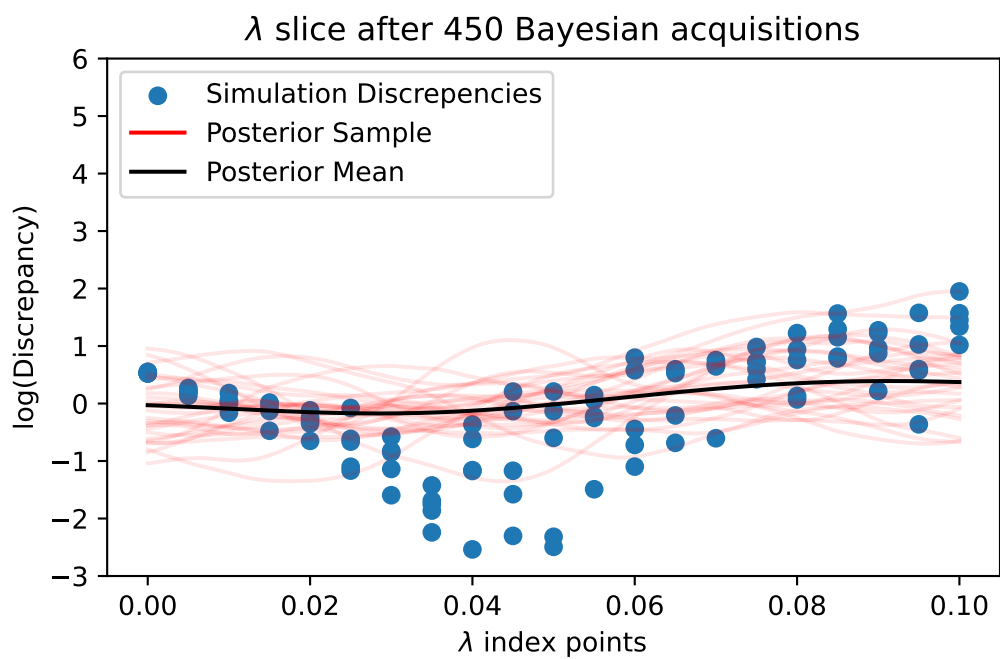
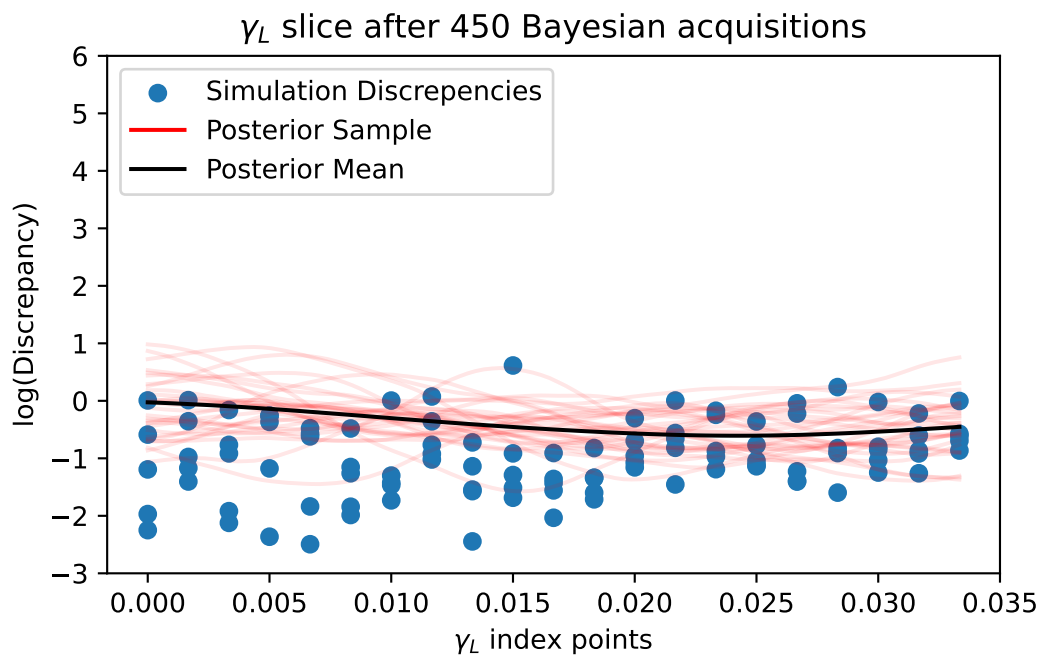


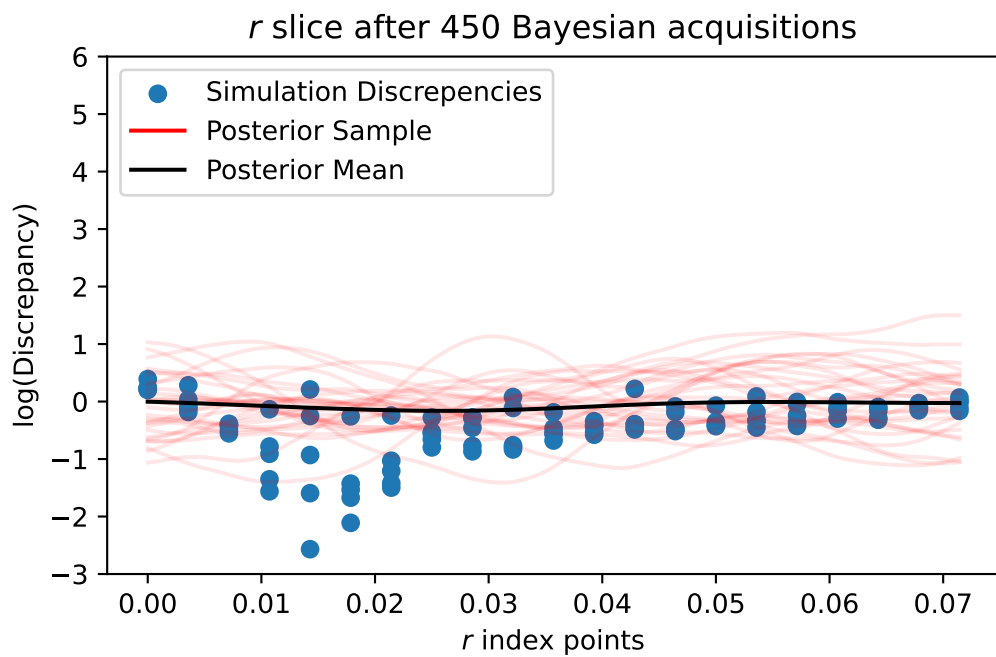
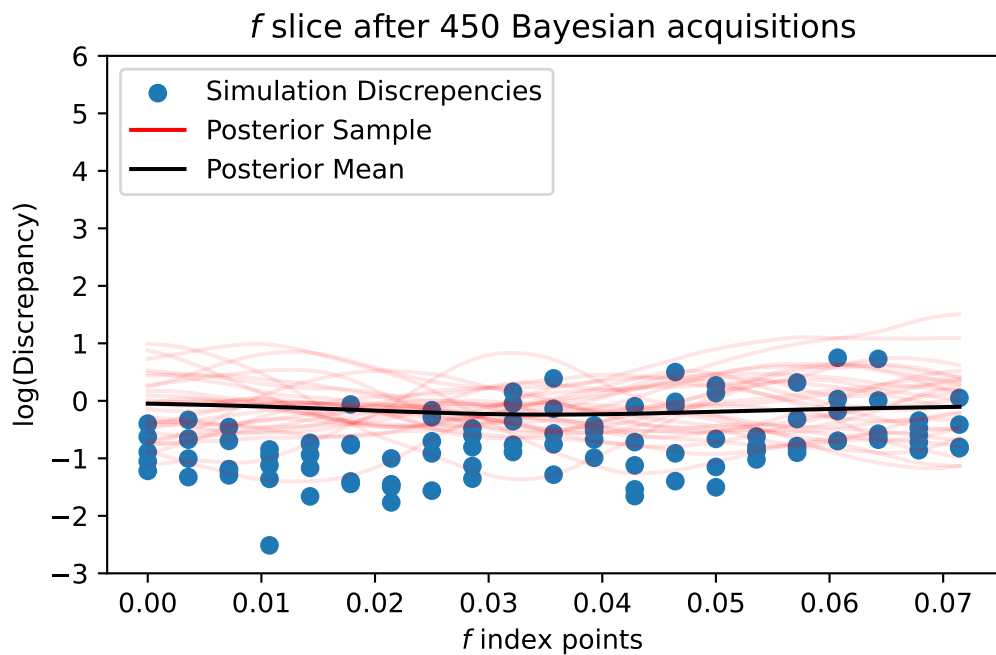


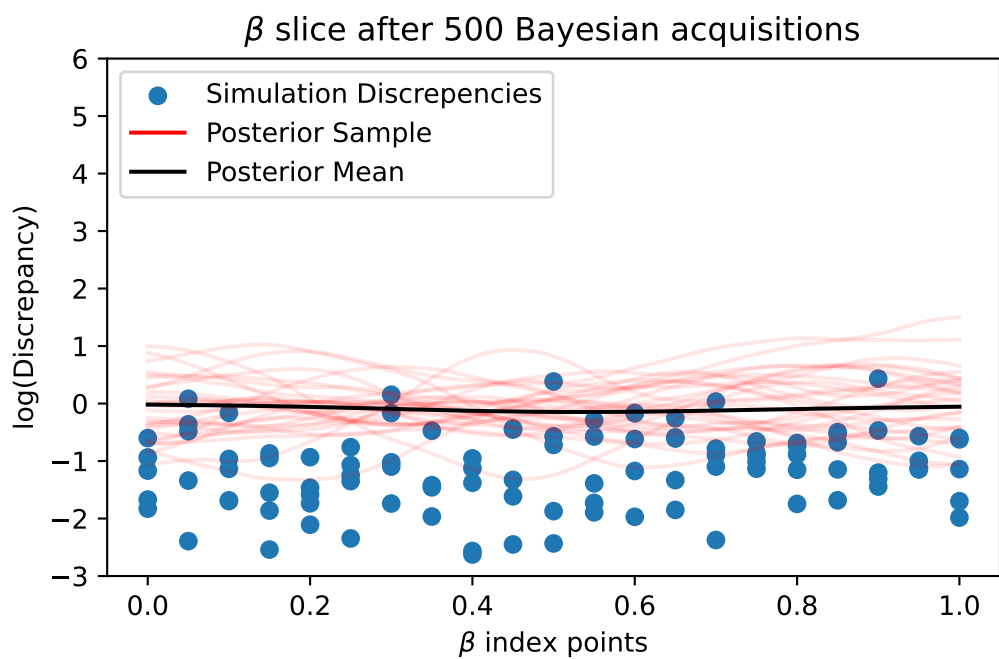
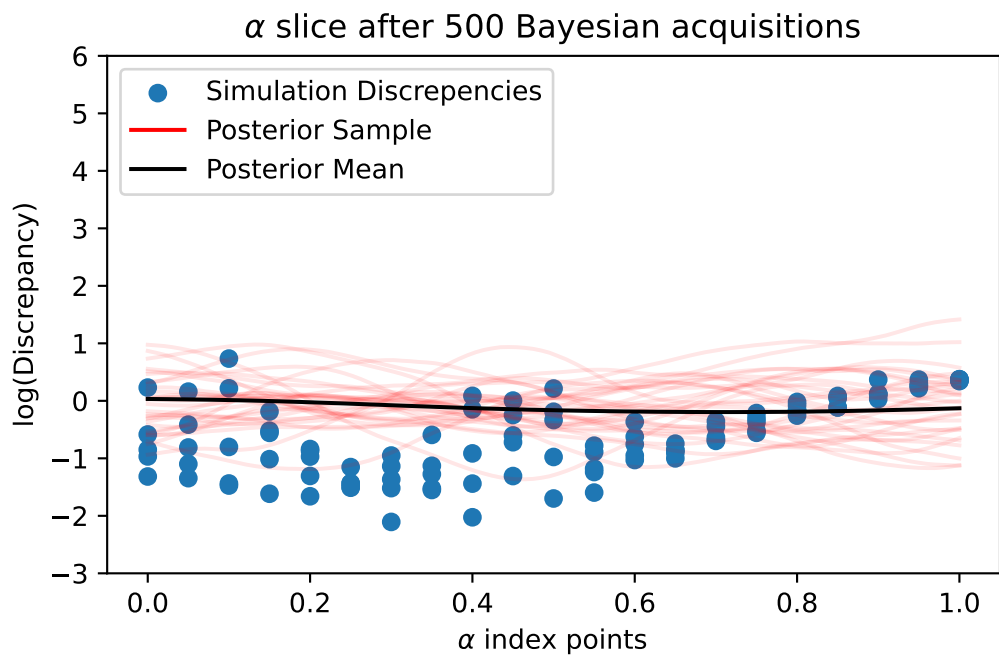


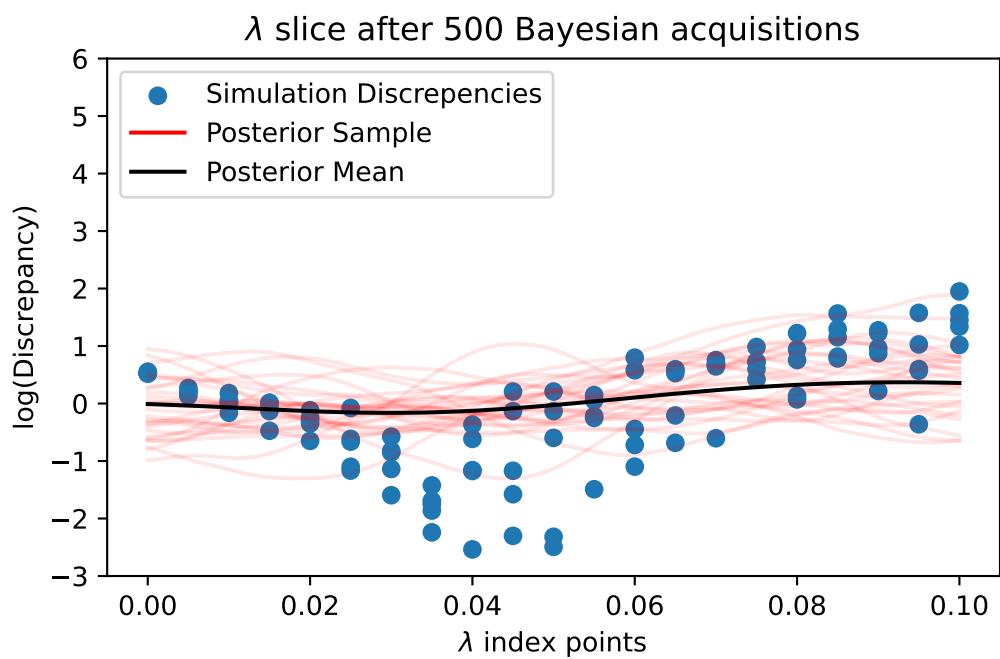
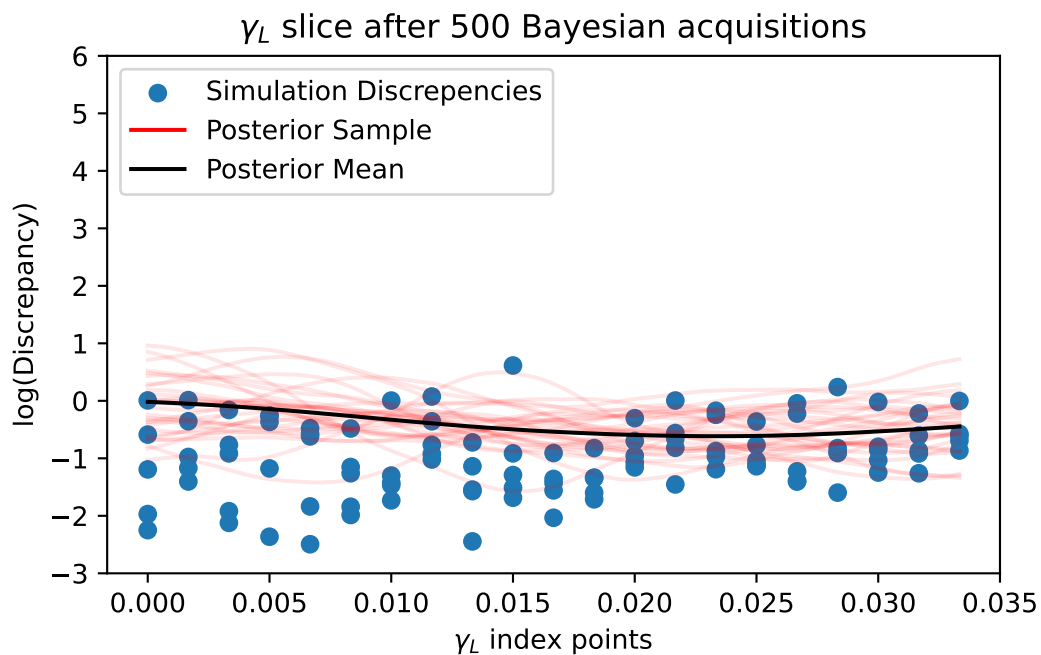


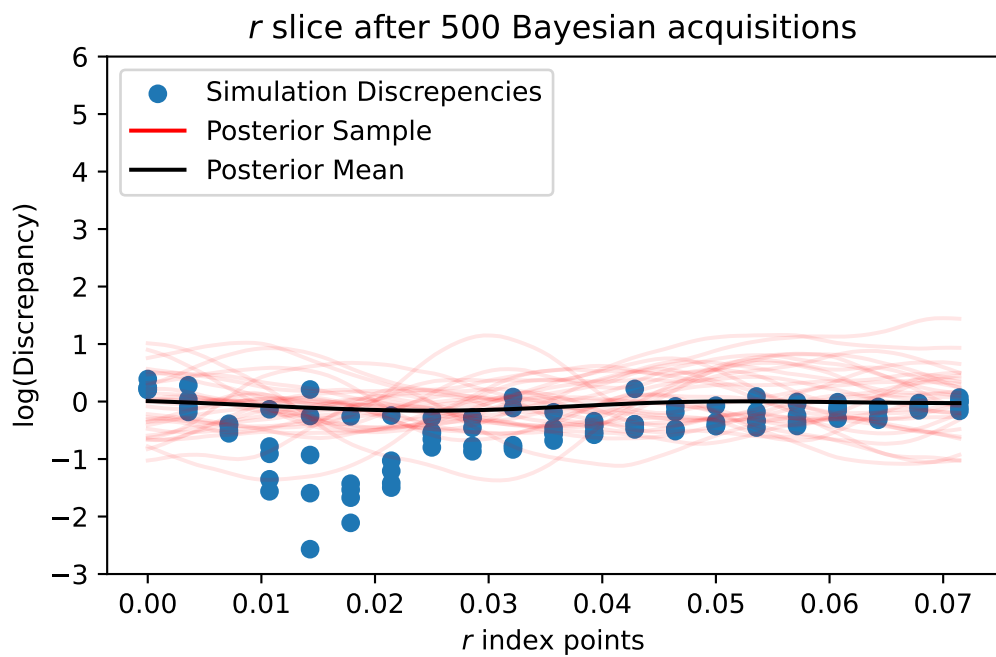
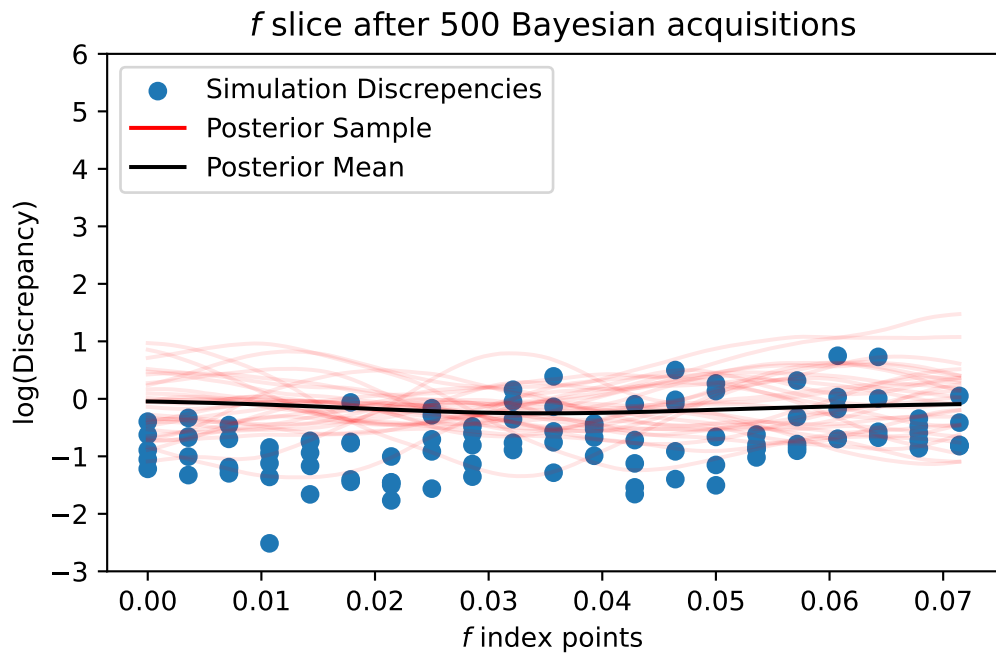












```
epsilon = -2.
for var in vars:
    champ_GP_reg = tfd.GaussianProcessRegressionModel(
```

```

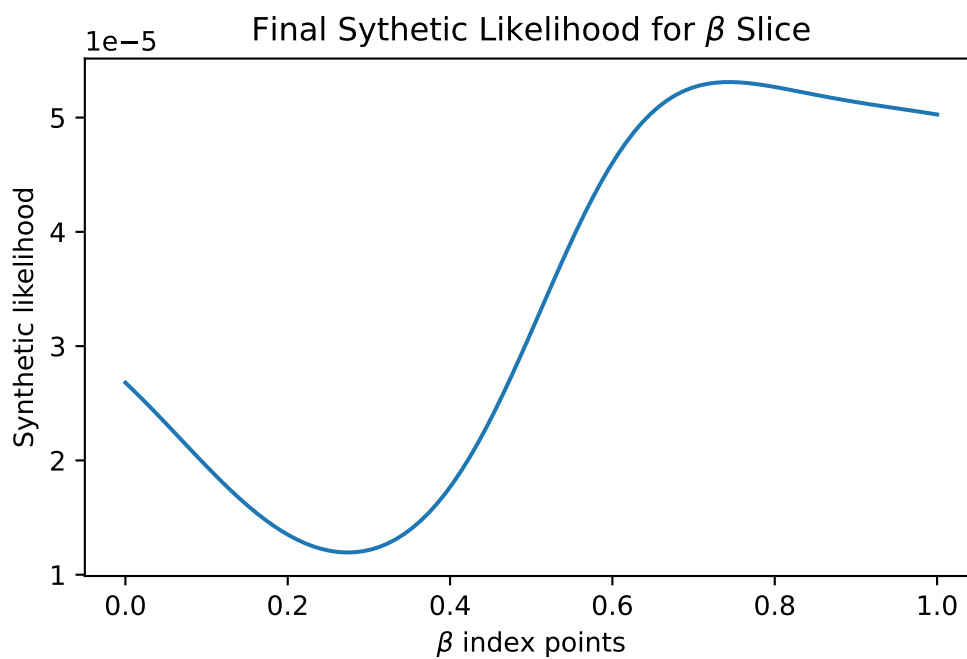
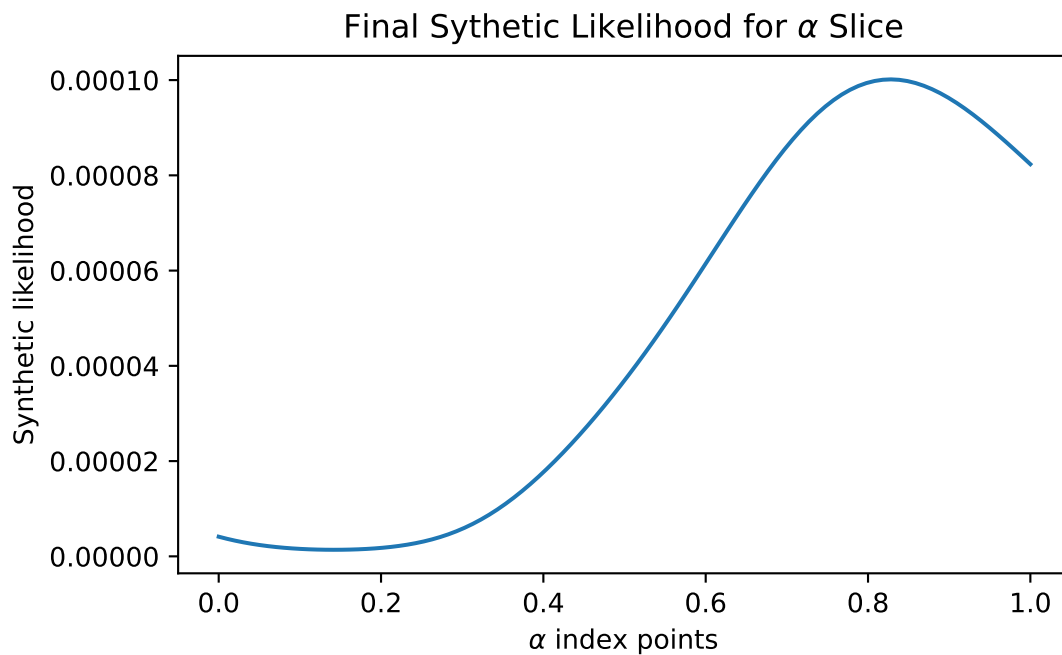
        kernel=kernel_champ,
        index_points=slice_indices_dfs_dict[var + "_gp_indices_df"].values,
        observation_index_points=index_vals,
        observations=obs_vals,
        observation_noise_variance=observation_noise_variance_champ,
        predictive_noise_variance=0.0,
        mean_fn=const_mean_fn(),
    )

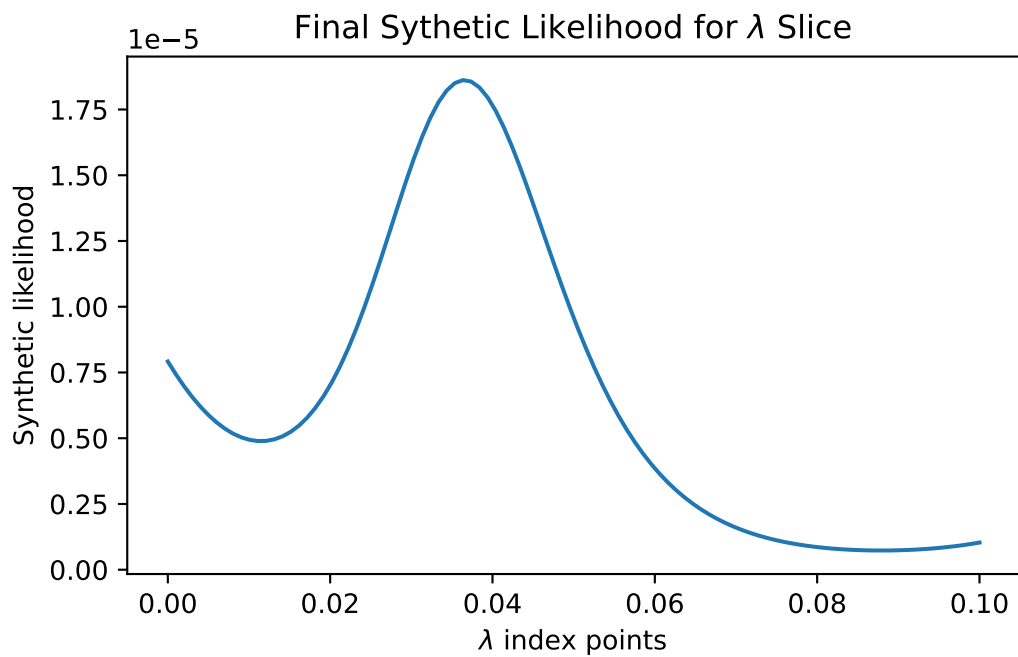
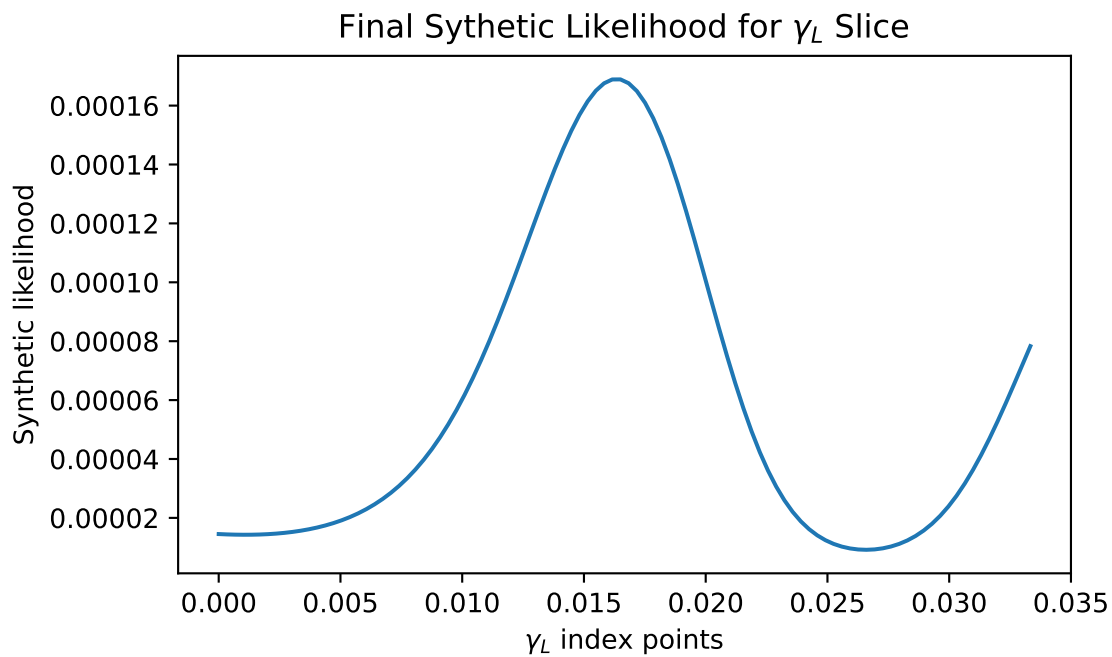
    indices_for_lik = slice_indices_dfs_dict[var + "_gp_indices_df"].values

    mean = champ_GP_reg.mean_fn(indices_for_lik)
    variance = champ_GP_reg.variance(index_points=indices_for_lik)
    post_std = np.sqrt(variance)
    cdf_vals = tfd.Normal(mean, post_std).log_cdf(epsilon)

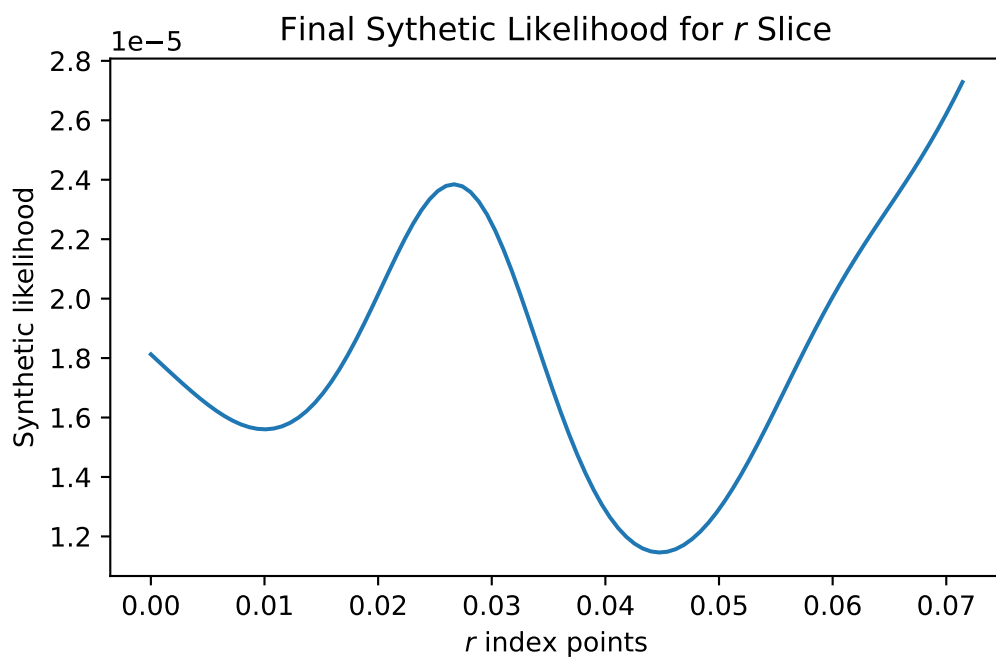
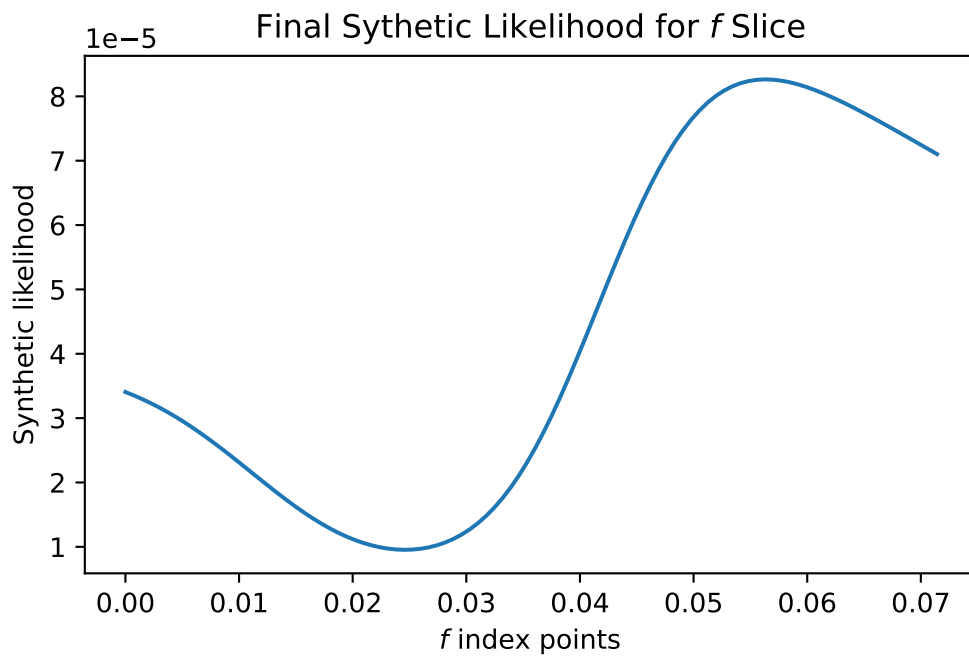
    plt.figure(figsize=(6, 3.5))
    plt.plot(
        slice_indices_dfs_dict[var + "_gp_indices_df"][var].values,
        np.exp(cdf_vals),
    )
    if var in ["f", "r"]:
        plt.xlabel("$" + var + "$ index points")
        plt.title("Final Sythetic Likelihood for $" + var + "$ Slice")
    else:
        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))
```

```
[0.681 0.179 0.027 0.044 0.02  0.015]
[0.711 0.207 0.031 0.047 0.018 0.037]
[0.004 0.129 0.024 0.027 0.004 0.022]
[0.553 0.186 0.027 0.043 0.016 0.042]
[0.727 0.271 0.024 0.043 0.022 0.013]
[0.699 0.248 0.023 0.042 0.022 0.013]
[0.698 0.247 0.023 0.042 0.022 0.013]
[0.729 0.273 0.024 0.044 0.022 0.013]
[0.815 0.596 0.022 0.04  0.    0.003]
```