

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)
```

```
2024-05-16 22:52:09.236656: I tensorflow/core/platform/cpu_feature_guard.cc:210] This TensorFlow
To enable the following instructions: AVX2 FMA, in other operations, rebuild TensorFlow with
2024-05-16 22:52:10.017968: W tensorflow/compiler/tf2tensorrt/utils/py_utils.cc:38] TF-TRT W
2024-05-16 22:52:12.809662: I external/local_xla/xla/stream_executor/cuda/cuda_executor.cc:9
2024-05-16 22:52:12.951404: 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 = 50
initial_repeats = 1

def champagne_stochastic(
    alpha_,
    beta_,
    gamma_L,
```

```

lambda_,
f,
r,
N=population,
I_L=initial_infecteds,
I_0=0,
S_L=0,
delta_=0,
end_time=epidemic_length,
num_events=number_of_events,
):
    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

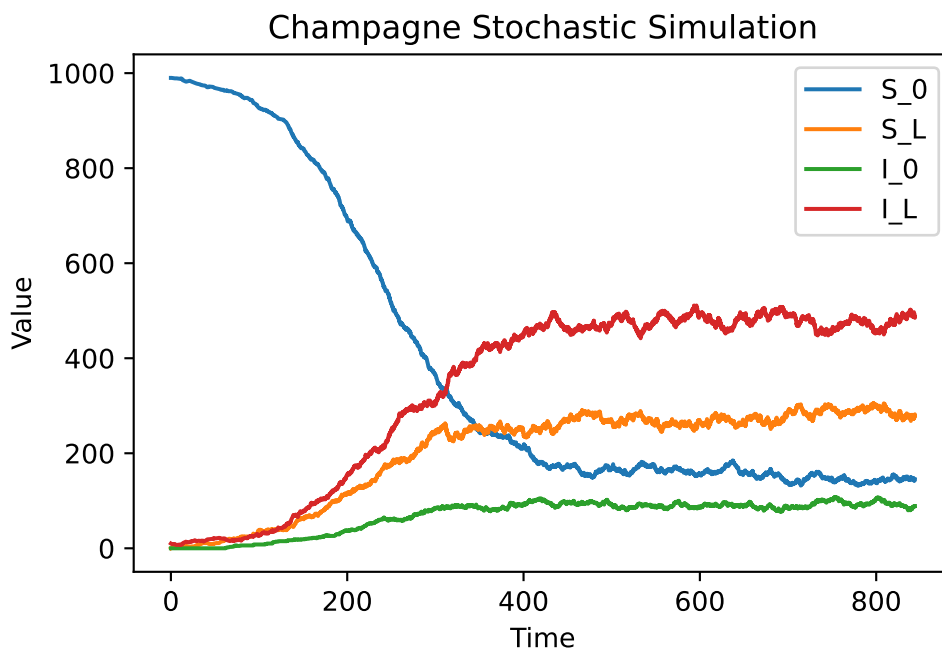
champ_samp = champagne_stochastic(
    pv_champ_alpha,
    pv_champ_beta,
    pv_champ_gamma_L,
    pv_champ_lambda,
    pv_champ_f,

```

```
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 = 30): # 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 | 0.100008 | 0.122349 | 0.009668 | 0.030752 | 0.024172 | 0.017094 |
| 1 | 0.659225 | 0.590955 | 0.001070 | 0.077894 | 0.010618 | 0.003555 |
| 2 | 0.503558 | 0.005003 | 0.031832 | 0.054106 | 0.002897 | 0.021146 |
| 3 | 0.011840 | 0.630562 | 0.023631 | 0.066976 | 0.050888 | 0.037636 |
| 4 | 0.271011 | 0.942434 | 0.014052 | 0.060275 | 0.044476 | 0.055432 |

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    -0.818993
1     0.456214
2    -0.792054
3     1.014436
4     0.479904
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()

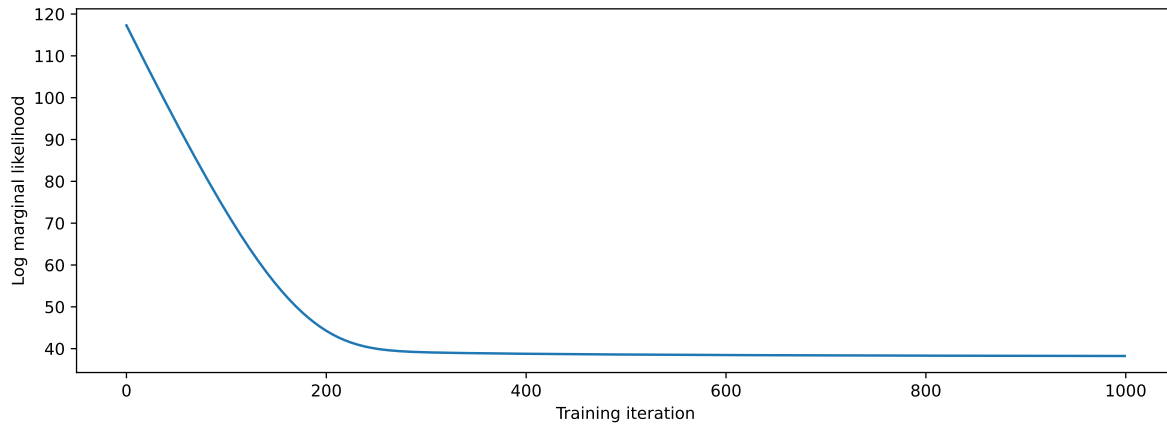
```

Trained parameters:

amplitude: 0.5182952271786987

length_scales: [0.24931591 0.24940271 0.00831412 0.01602661 0.01782116 0.01781205]

observation_noise_variance: 0.010855333821573481



```

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:

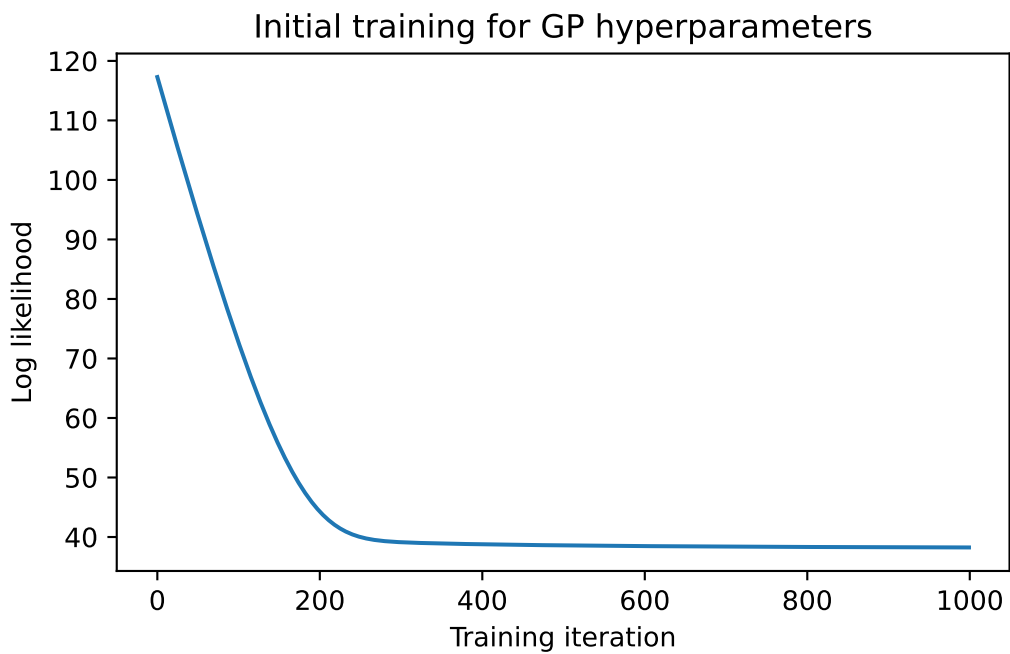
amplitude_champ:0 is 0.518

length_scales_champ:0 is [0.249 0.249 0.008 0.016 0.018 0.018]

observation_noise_variance_champ:0 is 0.011

bias_mean:0 is 0.183

```
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)

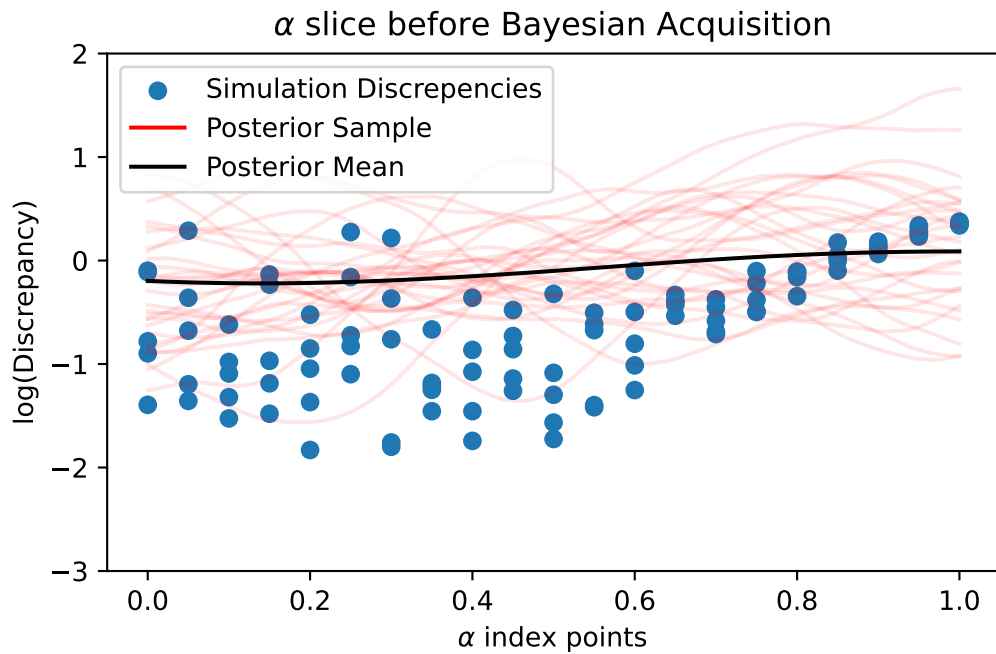
    plt.figure(figsize=(6, 3.5))
    plt.scatter(
        val_df[var].values,
        discreps,
        label = "Simulation Discrepancies",
    )
    for i in range(gp_samp_no):
        plt.plot(
            gp_samples_df[var].values,
            GP_samples[i, :],
            c="r",
            alpha=0.1,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

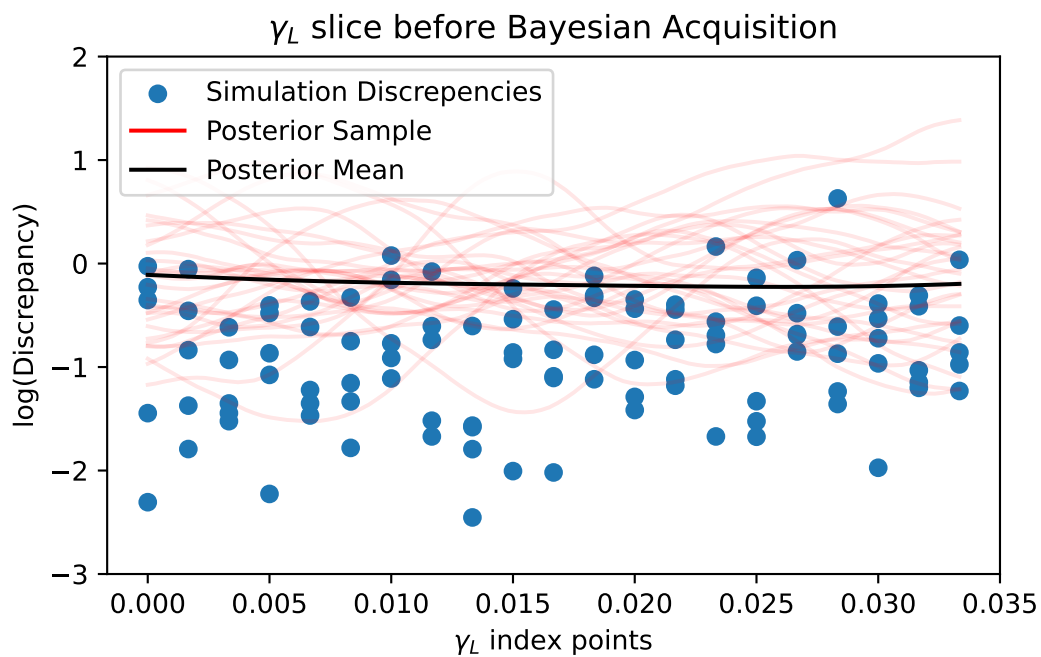
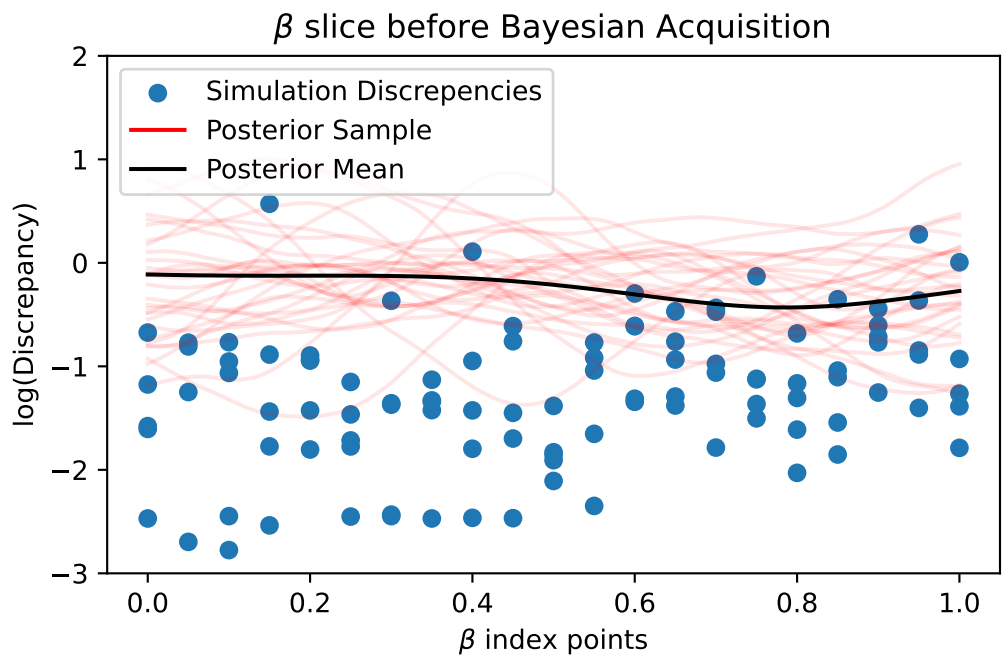
```

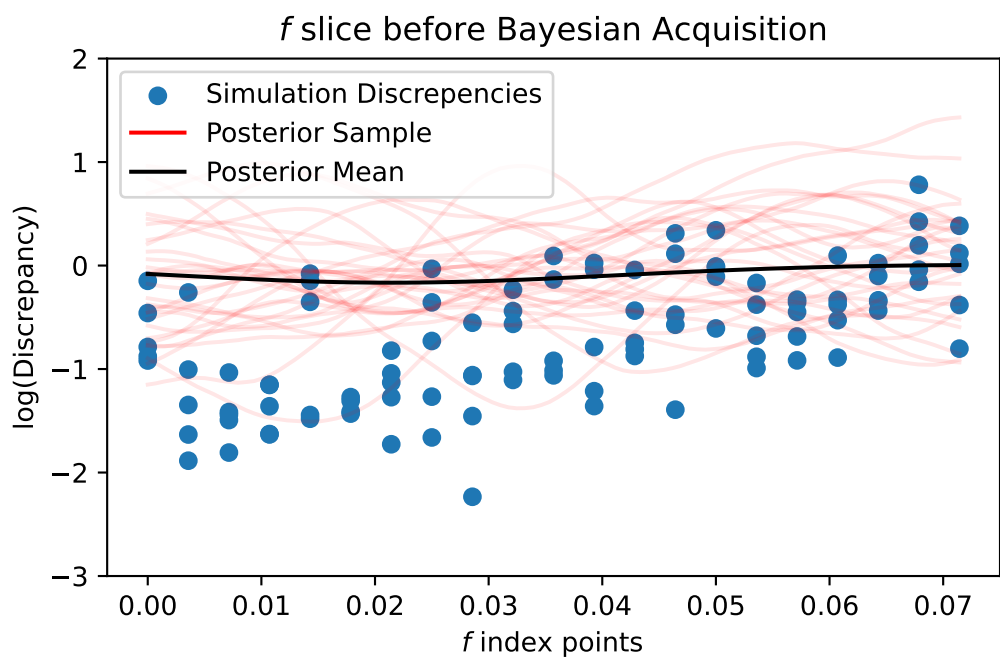
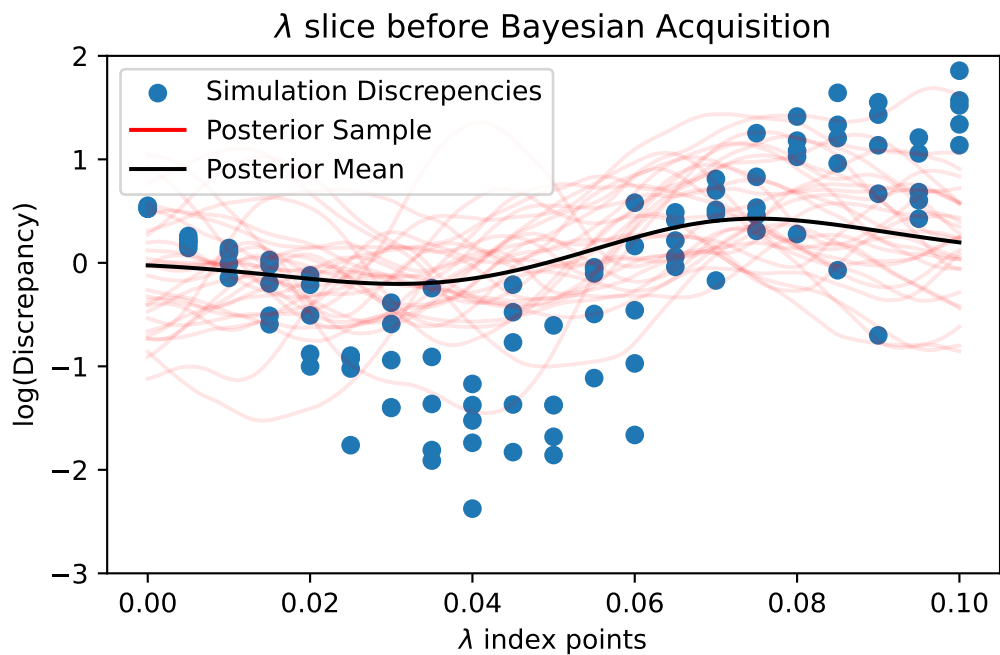
```

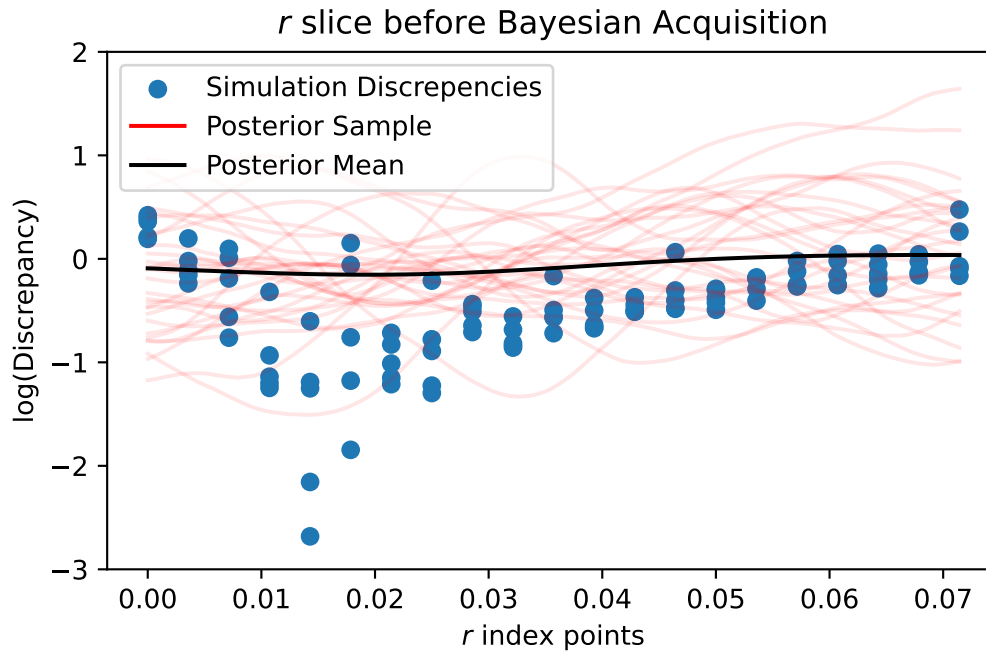
plt.title("$" + var + "$ slice before Bayesian Acquisition")
else:
    plt.xlabel("$\\" + var + "$ index points")
    plt.title("$\\" + var + "$ slice before Bayesian Acquisition")
# if var not in ["alpha", "beta"]:
#     plt.xscale("log", base=np.e)
plt.ylabel("log(Discrepancy)")
plt.ylim((-3, 2))
plt.savefig("champagne_GP_images/initial_" + var + "_slice_log_discrep.pdf")
plt.show()

```









Acquiring the next datapoint to test

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

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

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

kernel_self = kernel_champ.apply(new_guess, new_guess)
kernel_others = kernel_champ.apply(new_guess, index_vals)
K = kernel_champ.matrix(
    index_vals, index_vals
```



```

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

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

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

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

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

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

```

```
next_vars
```

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

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

```
def UCB_loss(champ_GP_reg):
    next_guess = tf.reshape(
        tf.stack([next_alpha, next_beta, next_gamma_L, next_lambda, next_f, next_r]),
        [1, 6],
    )
    mean_t = champ_GP_reg.mean_fn(next_guess)
    std_t = tf.math.sqrt(
        champ_GP_reg.variance(index_points=next_guess)
        - observation_noise_variance_champ
    )
    return tf.squeeze(mean_t - std_t)
```

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

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

```
num_iters = 10000
```

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

```
for i in range(num_iters):
```



```

loss = opt_var()
lls_[i] = loss

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

previous_loss = loss

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

```

Acquisition function convergence reached at iteration 88.

Trained parameters:

next_alpha is 0.544

next_beta is 0.68

next_gamma_L is 0.017

next_lambda is 0.051

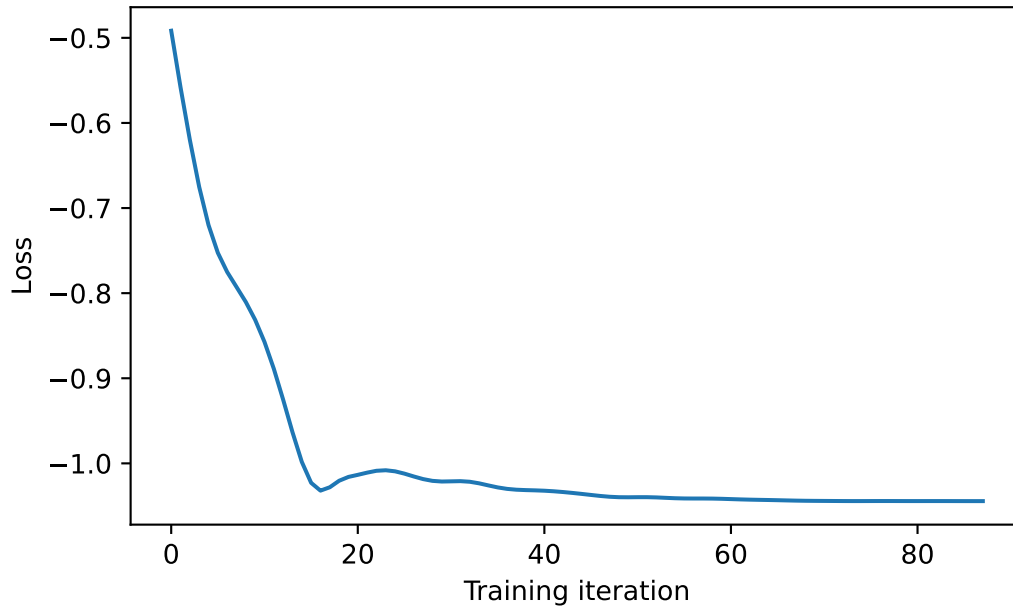
next_f is 0.036

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(champ_GP, index_vals, obs_vals, observation_noise_variance_champ):

    def L00_loss(champ_GP, index_vals, obs_vals, observation_noise_variance_champ):
        K = (
            champ_GP.kernel.matrix(index_vals, index_vals)
            + tf.eye(index_vals.shape[0], dtype=np.float64)
            * observation_noise_variance_champ
        )
        means = champ_GP.mean_fn(index_vals)
        K_inv = tf.linalg.inv(K)
        K_inv_y = K_inv @ tf.reshape(obs_vals - means, shape=[obs_vals.shape[0], 1])
        K_inv_diag = tf.linalg.diag_part(K_inv)
        log_var = tf.math.log(K_inv_diag)
        log_mu = tf.reshape(K_inv_y, shape=[-1]) ** 2
        return -tf.math.reduce_sum(log_var - log_mu)

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

```

num_iters = 10000

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

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

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

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

def update_GP_MLE(champ_GP):
    @tf.function(autograph=False, jit_compile=False)
    def train_model():
        with tf.GradientTape() as tape:
            loss = -champ_GP.log_prob(obs_vals)
            grads = tape.gradient(loss, champ_GP.trainable_variables)
            optimizer_slow.apply_gradients(zip(grads, champ_GP.trainable_variables))
        return loss

num_iters = 10000

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

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

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

```

```

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

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

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

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

    num_iters = 10000

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

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

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

    previous_loss = loss

```

```

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

def update_var_EI(GP_reg, alpha, beta, gamma_L, lambda_, f, r, min_obs):
    def EI_loss(alpha, beta, gamma_L, lambda_, f, r, min_obs):
        next_guess = tf.reshape(
            tf.stack([alpha, beta, gamma_L, lambda_, f, r]),
            [1, 6],
        )
        mean_t = GP_reg.mean_fn(next_guess)
        std_t = GP_reg.stddev(index_points=next_guess)
        delt = min_obs - mean_t
        return -tf.squeeze(
            delt * tfd.Normal(0, 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()

num_slice_updates = 11

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

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

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

#####

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

```

```

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

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

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

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

```



```

)

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

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

slice_var = [next_alpha, next_beta, next_gamma_L, next_lambda, next_f, next_r][t % 6]
for val in all_slices[t % 6]:
    if np.random.uniform() < 1/5 + np.exp(1 - t/4):
        slice_var.assign(val)

    new_params = np.array(
        [
            next_alpha.numpy(),
            next_beta.numpy(),
            next_gamma_L.numpy(),
            next_lambda.numpy(),
            next_f.numpy(),
            next_r.numpy(),
        ]
    ).reshape(1, -1)

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

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

#####

champ_GP_reg = tfd.GaussianProcessRegressionModel(
    kernel=kernel_champ,
    observation_index_points=index_vals,
    observations=obs_vals,
    observation_noise_variance=observation_noise_variance_champ,

```

```

        predictive_noise_variance=0.0,
        mean_fn=const_mean_fn(),
    )

    if t % update_GP_hp_freq == 0:
        champ_GP = tfd.GaussianProcess(
            kernel=kernel_champ,
            observation_noise_variance=observation_noise_variance_champ,
            index_points=index_vals,
            mean_fn=const_mean_fn(),
        )
        update_GP_LOO(champ_GP, index_vals, obs_vals, observation_noise_variance_champ)
        # update_GP_MLE(champ_GP)
        min_value = min(champ_GP_reg.mean_fn(index_vals))
        min_index = index_vals[champ_GP_reg.mean_fn(index_vals) == min_value][0,]
        print(
            "The minimum predicted mean of the observed indices is {}".format(
                min_value.numpy().round(3)
            )
            + " at the point \n{}".format(min_index.round(3))
        )

    if (t > 0) & (t % 50 == 0):
        print("Trained parameters:")
        for train_var in champ_GP.trainable_variables:
            if "bias" in train_var.name:
                print("{} is {}\n".format(train_var.name, train_var.numpy().round(3)))
            else:
                if "length" in train_var.name:
                    print(
                        "{} is {}\n".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, 2))
    plt.savefig(
        "champagne_GP_images/"
        + var
        + "_slice_"
        + str(t)
        + "_bolfi_updates_log_discrep.pdf"
    )
plt.show()

```

Iteration 0

Acquisition function convergence reached at iteration 4449.

The final EI loss was -0.033 with predicted mean of [0.012]

The next parameters to simulate from are [[0. 0. 0.033 0.1 0.071 0.]]

The mean of the samples was 2.426

Hyperparameter convergence reached at iteration 9882.

The minimum predicted mean of the observed indices is -0.992 at the point

[0.69 0.195 0.03 0.03 0.062 0.02]

Iteration 1

Acquisition function convergence reached at iteration 185.

The final EI loss was -0.371 with predicted mean of [-0.457]

The next parameters to simulate from are [[0.61 0.503 0.032 0.042 0.042 0.048]]
 The mean of the samples was -0.586
 Iteration 2
 Acquisition function convergence reached at iteration 176.
 The final EI loss was -0.288 with predicted mean of [-0.387]
 The next parameters to simulate from are [[0.832 0.486 0.02 0.029 0.008 0.006]]
 The mean of the samples was -0.69
 Iteration 3
 Acquisition function convergence reached at iteration 500.
 The final EI loss was -0.299 with predicted mean of [-0.53]
 The next parameters to simulate from are [[0.48 0.017 0.029 0.061 0.004 0.022]]
 The mean of the samples was -0.554
 Iteration 4
 Acquisition function convergence reached at iteration 180.
 The final EI loss was -0.399 with predicted mean of [-0.652]
 The next parameters to simulate from are [[0.836 0.487 0.023 0.029 0.009 0.006]]
 The mean of the samples was -0.592
 Iteration 5
 The final EI loss was -0.399 with predicted mean of [-0.655]
 The next parameters to simulate from are [[0.49 0.01 0.03 0.06 0.004 0.022]]
 The mean of the samples was -0.925
 Iteration 6
 Acquisition function convergence reached at iteration 167.
 The final EI loss was -0.399 with predicted mean of [-0.654]
 The next parameters to simulate from are [[0.814 0.486 0.02 0.028 0.01 0.006]]
 The mean of the samples was -0.598
 Iteration 7
 Acquisition function convergence reached at iteration 143.
 The final EI loss was -0.399 with predicted mean of [-0.653]
 The next parameters to simulate from are [[0.612 0.04 0.032 0.042 0.042 0.049]]
 The mean of the samples was -0.741
 Iteration 8
 Acquisition function convergence reached at iteration 283.
 The final EI loss was -0.399 with predicted mean of [-0.653]
 The next parameters to simulate from are [[0.48 0.017 0.029 0.032 0.004 0.022]]
 The mean of the samples was -0.746
 Iteration 9
 The final EI loss was -0.399 with predicted mean of [-0.646]
 The next parameters to simulate from are [[0.498 0.012 0.03 0.057 0.004 0.032]]
 The mean of the samples was -0.841
 Iteration 10
 The final EI loss was -0.397 with predicted mean of [-0.655]
 The next parameters to simulate from are [[0.492 0.012 0.03 0.056 0.004 0.038]]

The mean of the samples was -0.491
 Iteration 11
 Acquisition function convergence reached at iteration 171.
 The final EI loss was -0.399 with predicted mean of [-0.653]
 The next parameters to simulate from are [[0.828 0.492 0.025 0.029 0.009 0.005]]
 The mean of the samples was -0.516
 Iteration 12
 Acquisition function convergence reached at iteration 219.
 The final EI loss was -0.306 with predicted mean of [-0.679]
 The next parameters to simulate from are [[0.626 0.079 0.031 0.032 0.066 0.019]]
 The mean of the samples was -0.954
 Iteration 13
 The final EI loss was -0.399 with predicted mean of [-0.647]
 The next parameters to simulate from are [[0.493 0.02 0.028 0.062 0.004 0.025]]
 The mean of the samples was -0.241
 Iteration 14
 Acquisition function convergence reached at iteration 160.
 The final EI loss was -0.399 with predicted mean of [-0.645]
 The next parameters to simulate from are [[0.607 0.186 0.032 0.042 0.042 0.049]]
 The mean of the samples was -0.628
 Iteration 15
 Acquisition function convergence reached at iteration 1193.
 The final EI loss was -0.399 with predicted mean of [-0.645]
 The next parameters to simulate from are [[0.826 0.487 0.029 0.03 0.008 0.006]]
 The mean of the samples was -0.647
 Iteration 16
 The final EI loss was -0.399 with predicted mean of [-0.644]
 The next parameters to simulate from are [[0.478 0.011 0.031 0.029 0.004 0.023]]
 The mean of the samples was -0.566
 Iteration 17
 The final EI loss was -0.398 with predicted mean of [-0.64]
 The next parameters to simulate from are [[0.346 0.08 0.031 0.032 0.067 0.019]]
 The mean of the samples was -0.578
 Iteration 18
 Acquisition function convergence reached at iteration 197.
 The final EI loss was -0.355 with predicted mean of [-0.577]
 The next parameters to simulate from are [[0.531 0.863 0.028 0.059 0.005 0.023]]
 The mean of the samples was -0.483
 Iteration 19
 The final EI loss was -0.399 with predicted mean of [-0.645]
 The next parameters to simulate from are [[0.501 0.001 0.033 0.056 0.003 0.021]]
 The mean of the samples was -0.896
 Iteration 20

Acquisition function convergence reached at iteration 5386.
 The final EI loss was -0.399 with predicted mean of [-0.642]
 The next parameters to simulate from are [[0.817 0.494 0.016 0.03 0.009 0.006]]
 The mean of the samples was -0.564
 Hyperparameter convergence reached at iteration 6177.
 The minimum predicted mean of the observed indices is -1.138 at the point
 [0.48 0.017 0.029 0.05 0.004 0.022]
 Iteration 21
 Acquisition function convergence reached at iteration 5721.
 The final EI loss was -0.399 with predicted mean of [-0.569]
 The next parameters to simulate from are [[0.801 0.478 0.021 0.028 0.008 0.005]]
 The mean of the samples was -0.592
 Iteration 22
 Acquisition function convergence reached at iteration 193.
 The final EI loss was -0.381 with predicted mean of [-0.564]
 The next parameters to simulate from are [[0.224 0.611 0.016 0.017 0.035 0.035]]
 The mean of the samples was -0.659
 Iteration 23
 Acquisition function convergence reached at iteration 183.
 The final EI loss was -0.389 with predicted mean of [-0.569]
 The next parameters to simulate from are [[0.889 0.074 0.032 0.033 0.067 0.019]]
 The mean of the samples was -0.557
 Iteration 24
 Acquisition function convergence reached at iteration 135.
 The final EI loss was -0.027 with predicted mean of [-1.185]
 The next parameters to simulate from are [[0.481 0.022 0.029 0.047 0.005 0.024]]
 The mean of the samples was -1.187
 Iteration 25
 The final EI loss was -0.399 with predicted mean of [-0.594]
 The next parameters to simulate from are [[0.493 0.011 0.03 0.057 0.004 0.036]]
 The mean of the samples was -0.617
 Iteration 26
 Acquisition function convergence reached at iteration 2135.
 The final EI loss was -0.399 with predicted mean of [-0.592]
 The next parameters to simulate from are [[0.829 0.488 0.029 0.029 0.008 0.006]]
 The mean of the samples was -0.662
 Iteration 27
 Acquisition function convergence reached at iteration 2555.
 The final EI loss was -0.399 with predicted mean of [-0.592]
 The next parameters to simulate from are [[0.829 0.488 0.029 0.028 0.008 0.006]]
 The mean of the samples was -0.612
 Iteration 28
 Acquisition function convergence reached at iteration 4863.

The final EI loss was -0.399 with predicted mean of [-0.593]
 The next parameters to simulate from are [[0.83 0.488 0.03 0.028 0.008 0.006]]
 The mean of the samples was -0.626
 Iteration 29
 Acquisition function convergence reached at iteration 421.
 The final EI loss was -0.399 with predicted mean of [-0.592]
 The next parameters to simulate from are [[0.839 0.487 0.03 0.028 0.008 0.005]]
 The mean of the samples was -0.571
 Iteration 30
 The final EI loss was -0.399 with predicted mean of [-0.591]
 The next parameters to simulate from are [[0.491 0.011 0.03 0.057 0.005 0.037]]
 The mean of the samples was -0.618
 Iteration 31
 Acquisition function convergence reached at iteration 2368.
 The final EI loss was -0.309 with predicted mean of [-0.61]
 The next parameters to simulate from are [[0.841 0.616 0.021 0.025 0.071 0.001]]
 The mean of the samples was -0.049
 Iteration 32
 Acquisition function convergence reached at iteration 131.
 The final EI loss was -0.386 with predicted mean of [-0.601]
 The next parameters to simulate from are [[0.606 0.023 0.032 0.047 0.042 0.048]]
 The mean of the samples was -0.638
 Iteration 33
 Acquisition function convergence reached at iteration 169.
 The final EI loss was -0.349 with predicted mean of [-0.618]
 The next parameters to simulate from are [[0.06 0.12 0.008 0.033 0.024 0.016]]
 The mean of the samples was -0.761
 Iteration 34
 Acquisition function convergence reached at iteration 334.
 The final EI loss was -0.399 with predicted mean of [-0.592]
 The next parameters to simulate from are [[0.609 0.455 0.032 0.042 0.042 0.048]]
 The mean of the samples was -0.622
 Iteration 35
 Acquisition function convergence reached at iteration 1051.
 The final EI loss was -0.399 with predicted mean of [-0.593]
 The next parameters to simulate from are [[0.224 0.612 0.016 0.017 0.034 0.035]]
 The mean of the samples was -0.711
 Iteration 36
 Acquisition function convergence reached at iteration 225.
 The final EI loss was -0.359 with predicted mean of [-0.533]
 The next parameters to simulate from are [[0.508 0.82 0.029 0.057 0.005 0.025]]
 The mean of the samples was -0.474
 Iteration 37

Acquisition function convergence reached at iteration 437.
 The final EI loss was -0.399 with predicted mean of [-0.593]
 The next parameters to simulate from are [[0.609 0.469 0.032 0.042 0.043 0.048]]
 The mean of the samples was -0.556
 Iteration 38
 Acquisition function convergence reached at iteration 145.
 The final EI loss was -0.392 with predicted mean of [-0.594]
 The next parameters to simulate from are [[0.486 0.014 0.022 0.03 0.004 0.022]]
 The mean of the samples was -0.556
 Iteration 39
 Acquisition function convergence reached at iteration 152.
 The final EI loss was -0.384 with predicted mean of [-0.588]
 The next parameters to simulate from are [[0.701 0.022 0.029 0.047 0.005 0.024]]
 The mean of the samples was -0.498
 Iteration 40
 Acquisition function convergence reached at iteration 155.
 The final EI loss was -0.343 with predicted mean of [-0.519]
 The next parameters to simulate from are [[0.45 0.805 0.029 0.055 0.005 0.026]]
 The mean of the samples was -0.403
 Hyperparameter convergence reached at iteration 2268.
 The minimum predicted mean of the observed indices is -1.191 at the point
 [0.481 0.022 0.029 0.047 0.005 0.024]
 Iteration 41
 Acquisition function convergence reached at iteration 5467.
 The final EI loss was -0.399 with predicted mean of [-0.595]
 The next parameters to simulate from are [[0.482 0.014 0.03 0.029 0.005 0.022]]
 The mean of the samples was -0.574
 Iteration 42
 Acquisition function convergence reached at iteration 154.
 The final EI loss was -0.344 with predicted mean of [-0.522]
 The next parameters to simulate from are [[0.454 0.863 0.028 0.06 0. 0.027]]
 The mean of the samples was -0.375
 Iteration 43
 The final EI loss was -0.399 with predicted mean of [-0.597]
 The next parameters to simulate from are [[0.48 0.018 0.03 0.029 0.003 0.022]]
 The mean of the samples was -0.589
 Iteration 44
 The final EI loss was -0.399 with predicted mean of [-0.593]
 The next parameters to simulate from are [[0.489 0.016 0.03 0.06 0.002 0.022]]
 The mean of the samples was -0.691
 Iteration 45
 Acquisition function convergence reached at iteration 151.
 The final EI loss was -0.388 with predicted mean of [-0.589]

The next parameters to simulate from are `[[0.501 0.256 0.032 0.055 0.003 0.022]]`
 The mean of the samples was -0.831
 Iteration 46
 Acquisition function convergence reached at iteration 140.
 The final EI loss was -0.388 with predicted mean of `[-0.589]`
 The next parameters to simulate from are `[[0.483 0.74 0.03 0.03 0.003 0.022]]`
 The mean of the samples was -0.605
 Iteration 47
 Acquisition function convergence reached at iteration 157.
 The final EI loss was -0.279 with predicted mean of `[-0.448]`
 The next parameters to simulate from are `[[0.4 0.766 0.005 0.036 0.014 0.024]]`
 The mean of the samples was -0.695
 Iteration 48
 Acquisition function convergence reached at iteration 133.
 The final EI loss was -0.372 with predicted mean of `[-0.56]`
 The next parameters to simulate from are `[[0.477 0.804 0.029 0.05 0.005 0.024]]`
 The mean of the samples was -0.861
 Iteration 49
 Acquisition function convergence reached at iteration 136.
 The final EI loss was -0.013 with predicted mean of `[-1.216]`
 The next parameters to simulate from are `[[0.446 0.029 0.029 0.047 0.005 0.024]]`
 The mean of the samples was -0.86
 Iteration 50
 Acquisition function convergence reached at iteration 176.
 The final EI loss was -0.392 with predicted mean of `[-0.561]`
 The next parameters to simulate from are `[[0.063 0.12 0.008 0.019 0.024 0.016]]`
 The mean of the samples was -0.553
 Trained parameters:
 amplitude_champ:0 is 0.765

 length_scales_champ:0 is `[0.239 0.25 0.008 0.018 0.018 0.012]`

 observation_noise_variance_champ:0 is 0.11

 bias_mean:0 is 0.408

 Iteration 51
 Acquisition function convergence reached at iteration 137.
 The final EI loss was -0.399 with predicted mean of `[-0.563]`
 The next parameters to simulate from are `[[0.47 0.826 0.029 0.055 0.004 0.025]]`
 The mean of the samples was -0.475
 Iteration 52
 Acquisition function convergence reached at iteration 4982.

The final EI loss was -0.399 with predicted mean of [-0.563]
 The next parameters to simulate from are [[0.482 0.024 0.03 0.029 0.002 0.023]]
 The mean of the samples was -0.565
 Iteration 53
 Acquisition function convergence reached at iteration 172.
 The final EI loss was -0.396 with predicted mean of [-0.562]
 The next parameters to simulate from are [[0.699 0.023 0.029 0.047 0.005 0.024]]
 The mean of the samples was -0.681
 Iteration 54
 Acquisition function convergence reached at iteration 149.
 The final EI loss was -0.372 with predicted mean of [-0.545]
 The next parameters to simulate from are [[0.161 0.024 0.029 0.047 0.005 0.024]]
 The mean of the samples was -0.596
 Iteration 55
 Acquisition function convergence reached at iteration 88.
 The final EI loss was -0.001 with predicted mean of [-1.147]
 The next parameters to simulate from are [[0.451 0.027 0.029 0.047 0.005 0.024]]
 The mean of the samples was -1.245
 Iteration 56
 Acquisition function convergence reached at iteration 126.
 The final EI loss was -0.358 with predicted mean of [-0.547]
 The next parameters to simulate from are [[0.21 0.64 0.017 0.018 0.035 0.053]]
 The mean of the samples was -0.583
 Iteration 57
 Acquisition function convergence reached at iteration 143.
 The final EI loss was -0.398 with predicted mean of [-0.585]
 The next parameters to simulate from are [[0.064 0.12 0.008 0.02 0.024 0.016]]
 The mean of the samples was -0.647
 Iteration 58
 Acquisition function convergence reached at iteration 159.
 The final EI loss was -0.399 with predicted mean of [-0.585]
 The next parameters to simulate from are [[0.704 0.022 0.029 0.047 0.005 0.024]]
 The mean of the samples was -0.579
 Iteration 59
 Acquisition function convergence reached at iteration 137.
 The final EI loss was -0.012 with predicted mean of [-1.195]
 The next parameters to simulate from are [[0.453 0.073 0.029 0.046 0.007 0.024]]
 The mean of the samples was -1.159
 Iteration 60
 Acquisition function convergence reached at iteration 303.
 The final EI loss was -0.398 with predicted mean of [-0.591]
 The next parameters to simulate from are [[0.483 0.015 0.021 0.03 0.004 0.022]]
 The mean of the samples was -0.588

Hyperparameter convergence reached at iteration 6548.
The minimum predicted mean of the observed indices is -1.18 at the point
[0.453 0.073 0.029 0.046 0.007 0.024]

Iteration 61
Acquisition function convergence reached at iteration 159.
The final EI loss was -0.345 with predicted mean of [-0.59]
The next parameters to simulate from are [[0.98 0.743 0.019 0.034 0.011 0.001]]
The mean of the samples was -0.288

Iteration 62
Acquisition function convergence reached at iteration 3750.
The final EI loss was -0.399 with predicted mean of [-0.589]
The next parameters to simulate from are [[0.223 0.608 0.016 0.017 0.033 0.035]]
The mean of the samples was -0.641

Iteration 63
Acquisition function convergence reached at iteration 215.
The final EI loss was -0.399 with predicted mean of [-0.59]
The next parameters to simulate from are [[0.613 0.462 0.033 0.042 0.042 0.048]]
The mean of the samples was -0.602

Iteration 64
The final EI loss was -0.399 with predicted mean of [-0.588]
The next parameters to simulate from are [[0.5 0.011 0.03 0.057 0.005 0.038]]
The mean of the samples was -0.636

Iteration 65
Acquisition function convergence reached at iteration 5392.
The final EI loss was -0.399 with predicted mean of [-0.59]
The next parameters to simulate from are [[0.491 0.013 0.021 0.03 0.004 0.022]]
The mean of the samples was -0.563

Iteration 66
Acquisition function convergence reached at iteration 219.
The final EI loss was -0.399 with predicted mean of [-0.589]
The next parameters to simulate from are [[0.471 0.819 0.029 0.054 0.005 0.025]]
The mean of the samples was -0.655

Iteration 67
The final EI loss was -0.397 with predicted mean of [-0.59]
The next parameters to simulate from are [[0.816 0.506 0.015 0.03 0.008 0.006]]
The mean of the samples was -0.689

Iteration 68
The final EI loss was -0.398 with predicted mean of [-0.585]
The next parameters to simulate from are [[0.486 0.001 0.03 0.06 0.001 0.024]]
The mean of the samples was -0.601

Iteration 69
Acquisition function convergence reached at iteration 443.
The final EI loss was -0.358 with predicted mean of [-0.601]

The next parameters to simulate from are [[0.177 0.009 0.021 0.025 0.002 0.023]]
 The mean of the samples was -0.476
 Iteration 70
 Acquisition function convergence reached at iteration 133.
 The final EI loss was -0.002 with predicted mean of [-1.182]
 The next parameters to simulate from are [[0.447 0.067 0.029 0.046 0.007 0.024]]
 The mean of the samples was -1.273
 Iteration 71
 Acquisition function convergence reached at iteration 9818.
 The final EI loss was -0.385 with predicted mean of [-0.604]
 The next parameters to simulate from are [[0.45 0.069 0.028 0.046 0.007 0.051]]
 The mean of the samples was -0.6
 Iteration 72
 The final EI loss was -0.399 with predicted mean of [-0.599]
 The next parameters to simulate from are [[0.484 0. 0.021 0.03 0.003 0.022]]
 The mean of the samples was -0.496
 Iteration 73
 The final EI loss was -0.399 with predicted mean of [-0.601]
 The next parameters to simulate from are [[0.819 0.485 0.014 0.03 0.009 0.006]]
 The mean of the samples was -0.59
 Iteration 74
 The final EI loss was -0.398 with predicted mean of [-0.6]
 The next parameters to simulate from are [[0.207 0.608 0.016 0.018 0.032 0.035]]
 The mean of the samples was -0.682
 Iteration 75
 Acquisition function convergence reached at iteration 244.
 The final EI loss was -0.399 with predicted mean of [-0.6]
 The next parameters to simulate from are [[0.818 0.477 0.015 0.029 0.009 0.006]]
 The mean of the samples was -0.605
 Iteration 76
 The final EI loss was -0.399 with predicted mean of [-0.601]
 The next parameters to simulate from are [[0.826 0.48 0.012 0.03 0.008 0.006]]
 The mean of the samples was -0.528
 Iteration 77
 Acquisition function convergence reached at iteration 160.
 The final EI loss was -0.398 with predicted mean of [-0.6]
 The next parameters to simulate from are [[0.343 0.079 0.031 0.033 0.067 0.019]]
 The mean of the samples was -0.555
 Iteration 78
 Acquisition function convergence reached at iteration 3824.
 The final EI loss was -0.399 with predicted mean of [-0.6]
 The next parameters to simulate from are [[0.449 0.07 0.028 0.046 0.007 0.051]]
 The mean of the samples was -0.657

Iteration 79

Acquisition function convergence reached at iteration 3027.

The final EI loss was -0.399 with predicted mean of [-0.6]

The next parameters to simulate from are [[0.462 0.069 0.028 0.047 0.007 0.051]]

The mean of the samples was -0.654

Iteration 80

Acquisition function convergence reached at iteration 6121.

The final EI loss was -0.399 with predicted mean of [-0.601]

The next parameters to simulate from are [[0.458 0.824 0.028 0.054 0.004 0.024]]

The mean of the samples was -0.704

Hyperparameter convergence reached at iteration 1734.

The minimum predicted mean of the observed indices is -1.2 at the point

[0.447 0.067 0.029 0.046 0.007 0.024]

Iteration 81

Acquisition function convergence reached at iteration 6564.

The final EI loss was -0.399 with predicted mean of [-0.599]

The next parameters to simulate from are [[0.489 0.004 0.03 0.06 0.001 0.023]]

The mean of the samples was -0.477

Iteration 82

Acquisition function convergence reached at iteration 143.

The final EI loss was -0.001 with predicted mean of [-1.203]

The next parameters to simulate from are [[0.447 0.073 0.029 0.046 0.008 0.024]]

The mean of the samples was -1.156

Iteration 83

Acquisition function convergence reached at iteration 15.

The final EI loss was 0.0 with predicted mean of [0.499]

The next parameters to simulate from are [[0.527 0.04 0.028 0.086 0.004 0.023]]

The mean of the samples was 0.453

Iteration 84

Acquisition function convergence reached at iteration 268.

The final EI loss was -0.392 with predicted mean of [-0.588]

The next parameters to simulate from are [[0.436 0.07 0.03 0.041 0.068 0.023]]

The mean of the samples was -0.652

Iteration 85

Acquisition function convergence reached at iteration 185.

The final EI loss was -0.399 with predicted mean of [-0.59]

The next parameters to simulate from are [[0.615 0.472 0.033 0.041 0.042 0.048]]

The mean of the samples was -0.546

Iteration 86

The final EI loss was -0.398 with predicted mean of [-0.59]

The next parameters to simulate from are [[0.473 0.001 0.032 0.029 0.004 0.022]]

The mean of the samples was -0.787

Iteration 87

Acquisition function convergence reached at iteration 588.
 The final EI loss was -0.398 with predicted mean of [-0.59]
 The next parameters to simulate from are [[0.888 0.074 0.031 0.034 0.067 0.02]]
 The mean of the samples was -0.597
 Iteration 88
 The final EI loss was -0.399 with predicted mean of [-0.595]
 The next parameters to simulate from are [[0.485 0.001 0.03 0.059 0. 0.025]]
 The mean of the samples was -0.622
 Iteration 89
 Acquisition function convergence reached at iteration 9920.
 The final EI loss was -0.398 with predicted mean of [-0.589]
 The next parameters to simulate from are [[0.437 0.069 0.03 0.042 0.068 0.023]]
 The mean of the samples was -0.447
 Iteration 90
 Acquisition function convergence reached at iteration 141.
 The final EI loss was -0.398 with predicted mean of [-0.588]
 The next parameters to simulate from are [[0.404 0.768 0.004 0.036 0.014 0.025]]
 The mean of the samples was -0.683
 Iteration 91
 Acquisition function convergence reached at iteration 4149.
 The final EI loss was -0.399 with predicted mean of [-0.589]
 The next parameters to simulate from are [[0.461 0.069 0.028 0.047 0.007 0.052]]
 The mean of the samples was -0.554
 Iteration 92
 Acquisition function convergence reached at iteration 142.
 The final EI loss was -0.002 with predicted mean of [-1.183]
 The next parameters to simulate from are [[0.445 0.066 0.029 0.046 0.006 0.024]]
 The mean of the samples was -0.961
 Iteration 93
 Acquisition function convergence reached at iteration 499.
 The final EI loss was -0.399 with predicted mean of [-0.58]
 The next parameters to simulate from are [[0.492 0.015 0.03 0.057 0.004 0.039]]
 The mean of the samples was -0.6
 Iteration 94
 Acquisition function convergence reached at iteration 127.
 The final EI loss was -0.002 with predicted mean of [-1.165]
 The next parameters to simulate from are [[0.451 0.046 0.03 0.046 0.006 0.024]]
 The mean of the samples was -1.133
 Iteration 95
 The final EI loss was -0.399 with predicted mean of [-0.58]
 The next parameters to simulate from are [[0.484 0. 0.03 0.06 0. 0.025]]
 The mean of the samples was -0.634
 Iteration 96

The final EI loss was -0.399 with predicted mean of [-0.582]
 The next parameters to simulate from are [[0.453 0.066 0.028 0.047 0.007 0.054]]
 The mean of the samples was -0.521
 Iteration 97
 The final EI loss was -0.399 with predicted mean of [-0.581]
 The next parameters to simulate from are [[0.492 0.01 0.031 0.06 0. 0.025]]
 The mean of the samples was -0.817
 Iteration 98
 Acquisition function convergence reached at iteration 134.
 The final EI loss was -0.001 with predicted mean of [-1.162]
 The next parameters to simulate from are [[0.45 0.051 0.03 0.046 0.006 0.024]]
 The mean of the samples was -1.032
 Iteration 99
 Acquisition function convergence reached at iteration 936.
 The final EI loss was -0.396 with predicted mean of [-0.573]
 The next parameters to simulate from are [[0.484 0.021 0.012 0.058 0.003 0.023]]
 The mean of the samples was -0.472
 Iteration 100
 Acquisition function convergence reached at iteration 198.
 The final EI loss was -0.396 with predicted mean of [-0.574]
 The next parameters to simulate from are [[0.454 0.05 0.005 0.044 0.005 0.024]]
 The mean of the samples was -0.482
 Hyperparameter convergence reached at iteration 1517.
 The minimum predicted mean of the observed indices is -1.148 at the point
 [0.45 0.051 0.03 0.046 0.006 0.024]
 Trained parameters:
 amplitude_champ:0 is 0.749

 length_scales_champ:0 is [0.25 0.25 0.008 0.02 0.018 0.014]

 observation_noise_variance_champ:0 is 0.11

 bias_mean:0 is 0.484

 Iteration 101
 The final EI loss was -0.399 with predicted mean of [-0.574]
 The next parameters to simulate from are [[0.489 0.017 0.031 0.061 0. 0.025]]
 The mean of the samples was -0.428
 Iteration 102
 Acquisition function convergence reached at iteration 341.
 The final EI loss was -0.397 with predicted mean of [-0.575]
 The next parameters to simulate from are [[0.6 0.022 0.029 0.048 0.042 0.048]]
 The mean of the samples was -0.652

Iteration 103
The final EI loss was -0.397 with predicted mean of [-0.567]
The next parameters to simulate from are [[0.487 0.025 0.032 0.061 0. 0.025]]
The mean of the samples was -0.649

Iteration 104
Acquisition function convergence reached at iteration 149.
The final EI loss was -0.397 with predicted mean of [-0.573]
The next parameters to simulate from are [[0.454 0.048 0.029 0.048 0.051 0.024]]
The mean of the samples was -0.413

Iteration 105
Acquisition function convergence reached at iteration 146.
The final EI loss was -0.001 with predicted mean of [-1.149]
The next parameters to simulate from are [[0.45 0.041 0.03 0.046 0.006 0.024]]
The mean of the samples was -0.984

Iteration 106
Acquisition function convergence reached at iteration 111.
The final EI loss was -0.0 with predicted mean of [-1.134]
The next parameters to simulate from are [[0.45 0.045 0.03 0.046 0.006 0.024]]
The mean of the samples was -1.384

Iteration 107
The final EI loss was -0.398 with predicted mean of [-0.573]
The next parameters to simulate from are [[0.581 0.02 0.029 0.048 0.042 0.048]]
The mean of the samples was -0.548

Iteration 108
Acquisition function convergence reached at iteration 1098.
The final EI loss was -0.399 with predicted mean of [-0.576]
The next parameters to simulate from are [[0.608 0.538 0.033 0.041 0.043 0.048]]
The mean of the samples was -0.449

Iteration 109
Acquisition function convergence reached at iteration 192.
The final EI loss was -0.383 with predicted mean of [-0.569]
The next parameters to simulate from are [[0.825 0.489 0.029 0.066 0.008 0.006]]
The mean of the samples was -0.658

Iteration 110
Acquisition function convergence reached at iteration 9273.
The final EI loss was -0.399 with predicted mean of [-0.576]
The next parameters to simulate from are [[0.455 0.066 0.028 0.047 0.007 0.053]]
The mean of the samples was -0.628

Iteration 111
The final EI loss was -0.399 with predicted mean of [-0.576]
The next parameters to simulate from are [[0.828 0.479 0.012 0.029 0.009 0.006]]
The mean of the samples was -0.548

Iteration 112

Acquisition function convergence reached at iteration 519.
 The final EI loss was -0.399 with predicted mean of [-0.576]
 The next parameters to simulate from are [[0.44 0.068 0.03 0.041 0.068 0.023]]
 The mean of the samples was -0.526
 Iteration 113
 Acquisition function convergence reached at iteration 147.
 The final EI loss was -0.398 with predicted mean of [-0.576]
 The next parameters to simulate from are [[0.157 0.024 0.029 0.046 0.005 0.024]]
 The mean of the samples was -0.886
 Iteration 114
 Acquisition function convergence reached at iteration 250.
 The final EI loss was -0.399 with predicted mean of [-0.577]
 The next parameters to simulate from are [[0.454 0.05 0.005 0.044 0.006 0.024]]
 The mean of the samples was -0.673
 Iteration 115
 Acquisition function convergence reached at iteration 8401.
 The final EI loss was -0.399 with predicted mean of [-0.577]
 The next parameters to simulate from are [[0.709 0.021 0.029 0.047 0.005 0.024]]
 The mean of the samples was -0.657
 Iteration 116
 The final EI loss was -0.398 with predicted mean of [-0.581]
 The next parameters to simulate from are [[0.341 0.08 0.031 0.033 0.067 0.019]]
 The mean of the samples was -0.508
 Iteration 117
 The final EI loss was -0.398 with predicted mean of [-0.579]
 The next parameters to simulate from are [[0.495 0.036 0.032 0.06 0. 0.025]]
 The mean of the samples was -0.519
 Iteration 118
 Acquisition function convergence reached at iteration 9326.
 The final EI loss was -0.399 with predicted mean of [-0.576]
 The next parameters to simulate from are [[0.441 0.07 0.03 0.04 0.069 0.023]]
 The mean of the samples was -0.601
 Iteration 119
 Acquisition function convergence reached at iteration 421.
 The final EI loss was -0.399 with predicted mean of [-0.576]
 The next parameters to simulate from are [[0.452 0.051 0.004 0.044 0.006 0.024]]
 The mean of the samples was -0.657
 Iteration 120
 Acquisition function convergence reached at iteration 190.
 The final EI loss was 0.0 with predicted mean of [0.815]
 The next parameters to simulate from are [[0.195 0.012 0.024 0.081 0.003 0.023]]
 The mean of the samples was 0.997
 Hyperparameter convergence reached at iteration 1472.

The minimum predicted mean of the observed indices is -1.151 at the point
[0.451 0.046 0.03 0.046 0.006 0.024]

Iteration 121
Acquisition function convergence reached at iteration 1577.
The final EI loss was -0.399 with predicted mean of [-0.575]
The next parameters to simulate from are [[0.49 0.041 0.032 0.061 0.002 0.025]]
The mean of the samples was -0.518

Iteration 122
Acquisition function convergence reached at iteration 152.
The final EI loss was -0.394 with predicted mean of [-0.572]
The next parameters to simulate from are [[0.218 0.614 0.024 0.018 0.033 0.035]]
The mean of the samples was -0.754

Iteration 123
Acquisition function convergence reached at iteration 154.
The final EI loss was -0.392 with predicted mean of [-0.573]
The next parameters to simulate from are [[0.483 0.011 0.03 0.058 0.021 0.026]]
The mean of the samples was -0.614

Iteration 124
Acquisition function convergence reached at iteration 592.
The final EI loss was -0.399 with predicted mean of [-0.576]
The next parameters to simulate from are [[0.457 0.041 0.005 0.044 0.006 0.025]]
The mean of the samples was -0.648

Iteration 125
The final EI loss was -0.398 with predicted mean of [-0.577]
The next parameters to simulate from are [[0.816 0.507 0.028 0.03 0.008 0.004]]
The mean of the samples was -0.548

Iteration 126
Acquisition function convergence reached at iteration 139.
The final EI loss was -0.399 with predicted mean of [-0.576]
The next parameters to simulate from are [[0.457 0.851 0.029 0.056 0.003 0.025]]
The mean of the samples was -0.735

Iteration 127
The final EI loss was -0.394 with predicted mean of [-0.58]
The next parameters to simulate from are [[0.714 0.022 0.029 0.049 0.005 0.024]]
The mean of the samples was -0.712

Iteration 128
Acquisition function convergence reached at iteration 146.
The final EI loss was -0.399 with predicted mean of [-0.576]
The next parameters to simulate from are [[0.14 0.026 0.029 0.047 0.005 0.024]]
The mean of the samples was -0.725

Iteration 129
Acquisition function convergence reached at iteration 380.
The final EI loss was -0.399 with predicted mean of [-0.575]

The next parameters to simulate from are [[0.47 0.069 0.029 0.047 0.007 0.053]]
 The mean of the samples was -0.589
 Iteration 130
 Acquisition function convergence reached at iteration 142.
 The final EI loss was -0.399 with predicted mean of [-0.575]
 The next parameters to simulate from are [[0.623 0.479 0.033 0.04 0.042 0.048]]
 The mean of the samples was -0.662
 Iteration 131
 Acquisition function convergence reached at iteration 48.
 The final EI loss was 0.0 with predicted mean of [0.449]
 The next parameters to simulate from are [[0.438 0.02 0.029 0.003 0.003 0.028]]
 The mean of the samples was 0.288
 Iteration 132
 The final EI loss was -0.399 with predicted mean of [-0.573]
 The next parameters to simulate from are [[0.445 0.056 0.029 0.045 0.055 0.025]]
 The mean of the samples was -0.315
 Iteration 133
 Acquisition function convergence reached at iteration 2935.
 The final EI loss was -0.399 with predicted mean of [-0.575]
 The next parameters to simulate from are [[0.492 0.044 0.033 0.06 0.001 0.024]]
 The mean of the samples was -0.613
 Iteration 134
 Acquisition function convergence reached at iteration 345.
 The final EI loss was -0.399 with predicted mean of [-0.576]
 The next parameters to simulate from are [[0.456 0.03 0.004 0.044 0.006 0.024]]
 The mean of the samples was -0.587
 Iteration 135
 Acquisition function convergence reached at iteration 377.
 The final EI loss was -0.399 with predicted mean of [-0.576]
 The next parameters to simulate from are [[0.463 0.063 0.029 0.049 0.006 0.054]]
 The mean of the samples was -0.482
 Iteration 136
 The final EI loss was -0.399 with predicted mean of [-0.576]
 The next parameters to simulate from are [[0.124 0.024 0.029 0.046 0.005 0.024]]
 The mean of the samples was -0.812
 Iteration 137
 Acquisition function convergence reached at iteration 4510.
 The final EI loss was -0.399 with predicted mean of [-0.576]
 The next parameters to simulate from are [[0.49 0.204 0.032 0.061 0.001 0.024]]
 The mean of the samples was -0.61
 Iteration 138
 The final EI loss was -0.397 with predicted mean of [-0.58]
 The next parameters to simulate from are [[0.471 0.025 0.012 0.034 0.004 0.022]]

The mean of the samples was -0.527
 Iteration 139
 Acquisition function convergence reached at iteration 160.
 The final EI loss was -0.399 with predicted mean of [-0.576]
 The next parameters to simulate from are [[0.619 0.484 0.032 0.042 0.045 0.048]]
 The mean of the samples was -0.531
 Iteration 140
 Acquisition function convergence reached at iteration 146.
 The final EI loss was -0.399 with predicted mean of [-0.576]
 The next parameters to simulate from are [[0.464 0.078 0.028 0.049 0.008 0.052]]
 The mean of the samples was -0.521
 Hyperparameter convergence reached at iteration 1475.
 The minimum predicted mean of the observed indices is -1.152 at the point
 [0.451 0.046 0.03 0.046 0.006 0.024]
 Iteration 141
 Acquisition function convergence reached at iteration 138.
 The final EI loss was -0.385 with predicted mean of [-0.581]
 The next parameters to simulate from are [[0.189 0.069 0.028 0.05 0.007 0.053]]
 The mean of the samples was -0.683
 Iteration 142
 Acquisition function convergence reached at iteration 151.
 The final EI loss was -0.396 with predicted mean of [-0.577]
 The next parameters to simulate from are [[0.478 0.725 0.03 0.028 0.002 0.022]]
 The mean of the samples was -0.56
 Iteration 143
 The final EI loss was -0.399 with predicted mean of [-0.574]
 The next parameters to simulate from are [[0.596 0.013 0.029 0.048 0.042 0.048]]
 The mean of the samples was -0.59
 Iteration 144
 Acquisition function convergence reached at iteration 140.
 The final EI loss was -0.384 with predicted mean of [-0.577]
 The next parameters to simulate from are [[0.722 0.499 0.029 0.048 0.004 0.026]]
 The mean of the samples was -0.542
 Iteration 145
 Acquisition function convergence reached at iteration 130.
 The final EI loss was -0.001 with predicted mean of [-1.153]
 The next parameters to simulate from are [[0.448 0.048 0.03 0.046 0.007 0.024]]
 The mean of the samples was -1.124
 Iteration 146
 Acquisition function convergence reached at iteration 3536.
 The final EI loss was -0.396 with predicted mean of [-0.574]
 The next parameters to simulate from are [[0.72 0.5 0.029 0.048 0.004 0.026]]
 The mean of the samples was -0.593

Iteration 147
Acquisition function convergence reached at iteration 146.
The final EI loss was -0.398 with predicted mean of [-0.576]
The next parameters to simulate from are [[0.214 0.604 0.024 0.017 0.032 0.035]]
The mean of the samples was -0.505

Iteration 148
Acquisition function convergence reached at iteration 796.
The final EI loss was -0.399 with predicted mean of [-0.576]
The next parameters to simulate from are [[0.493 0.006 0.03 0.058 0.003 0.035]]
The mean of the samples was -0.463

Iteration 149
The final EI loss was -0.398 with predicted mean of [-0.579]
The next parameters to simulate from are [[0.474 0.002 0.022 0.03 0.002 0.02]]
The mean of the samples was -0.564

Iteration 150
Acquisition function convergence reached at iteration 164.
The final EI loss was -0.397 with predicted mean of [-0.575]
The next parameters to simulate from are [[0.839 0.478 0.022 0.027 0.07 0.004]]
The mean of the samples was -0.622

Trained parameters:
amplitude_champ:0 is 0.727

length_scales_champ:0 is [0.25 0.25 0.008 0.02 0.018 0.014]

observation_noise_variance_champ:0 is 0.116

bias_mean:0 is 0.498

Iteration 151
Acquisition function convergence reached at iteration 3137.
The final EI loss was -0.399 with predicted mean of [-0.576]
The next parameters to simulate from are [[0.345 0.079 0.031 0.033 0.068 0.019]]
The mean of the samples was -0.64

Iteration 152
Acquisition function convergence reached at iteration 166.
The final EI loss was -0.399 with predicted mean of [-0.575]
The next parameters to simulate from are [[0.063 0.12 0.008 0.019 0.024 0.016]]
The mean of the samples was -0.571

Iteration 153
Acquisition function convergence reached at iteration 145.
The final EI loss was -0.373 with predicted mean of [-0.583]
The next parameters to simulate from are [[0.321 0.073 0.02 0.035 0.069 0.018]]
The mean of the samples was -0.496

Iteration 154
Acquisition function convergence reached at iteration 159.
The final EI loss was -0.399 with predicted mean of [-0.575]
The next parameters to simulate from are [[0.606 0.517 0.033 0.041 0.043 0.047]]
The mean of the samples was -0.609

Iteration 155
Acquisition function convergence reached at iteration 134.
The final EI loss was -0.395 with predicted mean of [-0.569]
The next parameters to simulate from are [[0.463 0.768 0.028 0.046 0.007 0.05]]
The mean of the samples was -0.573

Iteration 156
Acquisition function convergence reached at iteration 156.
The final EI loss was -0.362 with predicted mean of [-0.587]
The next parameters to simulate from are [[0.294 0.911 0.032 0.036 0.067 0.017]]
The mean of the samples was -0.615

Iteration 157
Acquisition function convergence reached at iteration 3078.
The final EI loss was -0.399 with predicted mean of [-0.575]
The next parameters to simulate from are [[0.492 0.201 0.033 0.06 0.001 0.024]]
The mean of the samples was -0.302

Iteration 158
Acquisition function convergence reached at iteration 224.
The final EI loss was -0.399 with predicted mean of [-0.575]
The next parameters to simulate from are [[0.721 0.02 0.029 0.048 0.005 0.024]]
The mean of the samples was -0.657

Iteration 159
Acquisition function convergence reached at iteration 168.
The final EI loss was -0.399 with predicted mean of [-0.575]
The next parameters to simulate from are [[0.488 0.858 0.03 0.057 0.002 0.025]]
The mean of the samples was -0.415

Iteration 160
Acquisition function convergence reached at iteration 140.
The final EI loss was -0.0 with predicted mean of [-1.151]
The next parameters to simulate from are [[0.447 0.052 0.03 0.046 0.007 0.024]]
The mean of the samples was -1.154
Hyperparameter convergence reached at iteration 1607.
The minimum predicted mean of the observed indices is -1.149 at the point
[0.447 0.052 0.03 0.046 0.007 0.024]

Iteration 161
The final EI loss was -0.399 with predicted mean of [-0.578]
The next parameters to simulate from are [[0.597 0.004 0.029 0.048 0.042 0.048]]
The mean of the samples was -0.635

Iteration 162

Acquisition function convergence reached at iteration 126.
 The final EI loss was -0.399 with predicted mean of [-0.574]
 The next parameters to simulate from are [[0.463 0.768 0.028 0.046 0.007 0.049]]
 The mean of the samples was -0.593
 Iteration 163
 Acquisition function convergence reached at iteration 224.
 The final EI loss was -0.396 with predicted mean of [-0.575]
 The next parameters to simulate from are [[0.235 0.912 0.032 0.037 0.067 0.017]]
 The mean of the samples was -0.518
 Iteration 164
 Acquisition function convergence reached at iteration 242.
 The final EI loss was 0.0 with predicted mean of [1.438]
 The next parameters to simulate from are [[0.265 0.067 0.023 0.089 0.068 0.014]]
 The mean of the samples was 1.637
 Iteration 165
 Acquisition function convergence reached at iteration 3978.
 The final EI loss was -0.399 with predicted mean of [-0.574]
 The next parameters to simulate from are [[0.451 0.058 0.03 0.049 0.006 0.055]]
 The mean of the samples was -0.552
 Iteration 166
 Acquisition function convergence reached at iteration 1864.
 The final EI loss was -0.399 with predicted mean of [-0.574]
 The next parameters to simulate from are [[0.831 0.489 0.031 0.027 0.008 0.005]]
 The mean of the samples was -0.536
 Iteration 167
 Acquisition function convergence reached at iteration 1274.
 The final EI loss was -0.399 with predicted mean of [-0.575]
 The next parameters to simulate from are [[0.895 0.073 0.031 0.035 0.067 0.02]]
 The mean of the samples was -0.558
 Iteration 168
 The final EI loss was -0.399 with predicted mean of [-0.577]
 The next parameters to simulate from are [[0.497 0.892 0.031 0.056 0.002 0.024]]
 The mean of the samples was -0.665
 Iteration 169
 Acquisition function convergence reached at iteration 315.
 The final EI loss was -0.399 with predicted mean of [-0.574]
 The next parameters to simulate from are [[0.454 0.041 0.005 0.044 0.007 0.026]]
 The mean of the samples was -0.616
 Iteration 170
 Acquisition function convergence reached at iteration 2988.
 The final EI loss was -0.399 with predicted mean of [-0.574]
 The next parameters to simulate from are [[0.493 0.015 0.03 0.057 0.002 0.037]]
 The mean of the samples was -0.692

Iteration 171
Acquisition function convergence reached at iteration 2958.
The final EI loss was -0.399 with predicted mean of [-0.575]
The next parameters to simulate from are [[0.438 0.059 0.03 0.042 0.059 0.023]]
The mean of the samples was -0.426

Iteration 172
Acquisition function convergence reached at iteration 127.
The final EI loss was -0.399 with predicted mean of [-0.575]
The next parameters to simulate from are [[0.426 0.777 0.004 0.037 0.014 0.026]]
The mean of the samples was -0.558

Iteration 173
Acquisition function convergence reached at iteration 1280.
The final EI loss was -0.398 with predicted mean of [-0.575]
The next parameters to simulate from are [[0.189 0.07 0.028 0.051 0.007 0.052]]
The mean of the samples was -0.543

Iteration 174
Acquisition function convergence reached at iteration 137.
The final EI loss was -0.399 with predicted mean of [-0.574]
The next parameters to simulate from are [[0.485 0.033 0.031 0.061 0.005 0.025]]
The mean of the samples was -0.341

Iteration 175
The final EI loss was -0.399 with predicted mean of [-0.576]
The next parameters to simulate from are [[0.437 0.049 0.002 0.047 0.006 0.023]]
The mean of the samples was -0.618

Iteration 176
Acquisition function convergence reached at iteration 151.
The final EI loss was -0.399 with predicted mean of [-0.574]
The next parameters to simulate from are [[0.434 0.069 0.029 0.047 0.007 0.055]]
The mean of the samples was -0.571

Iteration 177
Acquisition function convergence reached at iteration 421.
The final EI loss was -0.399 with predicted mean of [-0.575]
The next parameters to simulate from are [[0.186 0.009 0.021 0.025 0.003 0.023]]
The mean of the samples was -0.507

Iteration 178
Acquisition function convergence reached at iteration 145.
The final EI loss was -0.382 with predicted mean of [-0.575]
The next parameters to simulate from are [[0.159 0.048 0.005 0.05 0.007 0.023]]
The mean of the samples was -0.511

Iteration 179
Acquisition function convergence reached at iteration 137.
The final EI loss was -0.001 with predicted mean of [-1.149]
The next parameters to simulate from are [[0.443 0.045 0.03 0.045 0.006 0.024]]

The mean of the samples was -1.221
 Iteration 180
 Acquisition function convergence reached at iteration 9.
 The final EI loss was 0.0 with predicted mean of [1.484]
 The next parameters to simulate from are [[0.317 0.074 0.028 0.091 0.071 0.016]]
 The mean of the samples was 1.413
 Hyperparameter convergence reached at iteration 1572.
 The minimum predicted mean of the observed indices is -1.151 at the point
 [0.443 0.045 0.03 0.045 0.006 0.024]
 Iteration 181
 The final EI loss was -0.399 with predicted mean of [-0.577]
 The next parameters to simulate from are [[0.447 0.065 0.03 0.039 0.071 0.023]]
 The mean of the samples was -0.675
 Iteration 182
 The final EI loss was -0.399 with predicted mean of [-0.575]
 The next parameters to simulate from are [[0.448 0.049 0.03 0.04 0.07 0.023]]
 The mean of the samples was -0.611
 Iteration 183
 The final EI loss was -0.397 with predicted mean of [-0.58]
 The next parameters to simulate from are [[0.471 0.001 0.032 0.029 0.002 0.021]]
 The mean of the samples was -0.607
 Iteration 184
 Acquisition function convergence reached at iteration 171.
 The final EI loss was -0.398 with predicted mean of [-0.575]
 The next parameters to simulate from are [[0.702 0.823 0.029 0.054 0.004 0.025]]
 The mean of the samples was -0.664
 Iteration 185
 Acquisition function convergence reached at iteration 5779.
 The final EI loss was -0.399 with predicted mean of [-0.575]
 The next parameters to simulate from are [[0.721 0.009 0.029 0.048 0.004 0.024]]
 The mean of the samples was -0.63
 Iteration 186
 Acquisition function convergence reached at iteration 685.
 The final EI loss was -0.399 with predicted mean of [-0.575]
 The next parameters to simulate from are [[0.432 0.062 0.002 0.046 0.006 0.023]]
 The mean of the samples was -0.434
 Iteration 187
 The final EI loss was -0.398 with predicted mean of [-0.574]
 The next parameters to simulate from are [[0.1 0. 0.029 0.045 0.005 0.024]]
 The mean of the samples was -0.602
 Iteration 188
 Acquisition function convergence reached at iteration 126.
 The final EI loss was -0.001 with predicted mean of [-1.152]

The next parameters to simulate from are [[0.448 0.049 0.03 0.045 0.006 0.023]]
 The mean of the samples was -1.151
 Iteration 189
 Acquisition function convergence reached at iteration 11.
 The final EI loss was 0.0 with predicted mean of [1.461]
 The next parameters to simulate from are [[0.262 0.063 0.021 0.087 0.065 0.013]]
 The mean of the samples was 1.483
 Iteration 190
 The final EI loss was -0.399 with predicted mean of [-0.576]
 The next parameters to simulate from are [[0.493 0.893 0.031 0.057 0.001 0.025]]
 The mean of the samples was -0.767
 Iteration 191
 The final EI loss was -0.399 with predicted mean of [-0.576]
 The next parameters to simulate from are [[0.6 0.001 0.029 0.048 0.042 0.048]]
 The mean of the samples was -0.613
 Iteration 192
 Acquisition function convergence reached at iteration 6059.
 The final EI loss was -0.399 with predicted mean of [-0.577]
 The next parameters to simulate from are [[0.6 0.002 0.029 0.047 0.042 0.015]]
 The mean of the samples was -0.664
 Iteration 193
 Acquisition function convergence reached at iteration 4460.
 The final EI loss was -0.399 with predicted mean of [-0.576]
 The next parameters to simulate from are [[0.433 0.059 0.03 0.041 0.059 0.023]]
 The mean of the samples was -0.788
 Iteration 194
 Acquisition function convergence reached at iteration 172.
 The final EI loss was -0.399 with predicted mean of [-0.576]
 The next parameters to simulate from are [[0.463 0.768 0.028 0.046 0.007 0.049]]
 The mean of the samples was -0.58
 Iteration 195
 Acquisition function convergence reached at iteration 7539.
 The final EI loss was -0.399 with predicted mean of [-0.576]
 The next parameters to simulate from are [[0.727 0.004 0.029 0.048 0.003 0.024]]
 The mean of the samples was -0.585
 Iteration 196
 Acquisition function convergence reached at iteration 1115.
 The final EI loss was -0.399 with predicted mean of [-0.576]
 The next parameters to simulate from are [[0.346 0.075 0.031 0.034 0.069 0.019]]
 The mean of the samples was -0.508
 Iteration 197
 Acquisition function convergence reached at iteration 164.
 The final EI loss was -0.354 with predicted mean of [-0.54]

The next parameters to simulate from are [[0.173 0.171 0.027 0.039 0.039 0.03]]
 The mean of the samples was -0.452
 Iteration 198
 The final EI loss was -0.399 with predicted mean of [-0.577]
 The next parameters to simulate from are [[0.612 0. 0.028 0.048 0.042 0.048]]
 The mean of the samples was -0.612
 Iteration 199
 The final EI loss was -0.399 with predicted mean of [-0.575]
 The next parameters to simulate from are [[0.415 0.778 0.004 0.039 0.011 0.025]]
 The mean of the samples was -0.625
 Iteration 200
 Acquisition function convergence reached at iteration 288.
 The final EI loss was -0.399 with predicted mean of [-0.576]
 The next parameters to simulate from are [[0.835 0.45 0.015 0.029 0.009 0.005]]
 The mean of the samples was -0.602
 Hyperparameter convergence reached at iteration 1532.
 The minimum predicted mean of the observed indices is -1.152 at the point
 [0.448 0.049 0.03 0.045 0.006 0.023]
 Trained parameters:
 amplitude_champ:0 is 0.721

 length_scales_champ:0 is [0.25 0.25 0.008 0.02 0.018 0.014]

 observation_noise_variance_champ:0 is 0.11

 bias_mean:0 is 0.543

 Iteration 201
 Acquisition function convergence reached at iteration 156.
 The final EI loss was -0.398 with predicted mean of [-0.576]
 The next parameters to simulate from are [[0.214 0.607 0.008 0.017 0.032 0.035]]
 The mean of the samples was -0.767
 Iteration 202
 The final EI loss was -0.399 with predicted mean of [-0.576]
 The next parameters to simulate from are [[0.475 0.001 0.032 0.029 0.001 0.022]]
 The mean of the samples was -0.591
 Iteration 203
 Acquisition function convergence reached at iteration 146.
 The final EI loss was -0.398 with predicted mean of [-0.576]
 The next parameters to simulate from are [[0.215 0.606 0.006 0.017 0.032 0.035]]
 The mean of the samples was -0.586
 Iteration 204
 Acquisition function convergence reached at iteration 157.

The final EI loss was -0.377 with predicted mean of [-0.586]
 The next parameters to simulate from are [[0.173 0.025 0.028 0.046 0.005 0.066]]
 The mean of the samples was -0.635
 Iteration 205
 Acquisition function convergence reached at iteration 4771.
 The final EI loss was -0.045 with predicted mean of [0.008]
 The next parameters to simulate from are [[1. 1. 0. 0.1 0. 0.071]]
 The mean of the samples was 0.384
 Iteration 206
 Acquisition function convergence reached at iteration 3966.
 The final EI loss was -0.399 with predicted mean of [-0.576]
 The next parameters to simulate from are [[0.244 0.908 0.032 0.037 0.067 0.017]]
 The mean of the samples was -0.538
 Iteration 207
 Acquisition function convergence reached at iteration 9127.
 The final EI loss was -0.399 with predicted mean of [-0.576]
 The next parameters to simulate from are [[0.606 0.552 0.032 0.04 0.042 0.047]]
 The mean of the samples was -0.636
 Iteration 208
 Acquisition function convergence reached at iteration 1618.
 The final EI loss was -0.399 with predicted mean of [-0.576]
 The next parameters to simulate from are [[0.48 0.73 0.03 0.028 0.002 0.022]]
 The mean of the samples was -0.615
 Iteration 209
 Acquisition function convergence reached at iteration 142.
 The final EI loss was -0.398 with predicted mean of [-0.628]
 The next parameters to simulate from are [[0.355 0.077 0.02 0.034 0.068 0.019]]
 The mean of the samples was -0.746
 Iteration 210
 Acquisition function convergence reached at iteration 229.
 The final EI loss was -0.327 with predicted mean of [-0.642]
 The next parameters to simulate from are [[0.204 0.593 0.014 0.011 0.064 0.038]]
 The mean of the samples was -0.577
 Iteration 211
 Acquisition function convergence reached at iteration 158.
 The final EI loss was -0.399 with predicted mean of [-0.629]
 The next parameters to simulate from are [[0.213 0.608 0.008 0.017 0.032 0.035]]
 The mean of the samples was -0.623
 Iteration 212
 Acquisition function convergence reached at iteration 839.
 The final EI loss was -0.399 with predicted mean of [-0.629]
 The next parameters to simulate from are [[0.209 0.605 0.009 0.017 0.032 0.035]]
 The mean of the samples was -0.65

Iteration 213
Acquisition function convergence reached at iteration 148.
The final EI loss was -0.372 with predicted mean of [-0.615]
The next parameters to simulate from are [[0.67 0.833 0.03 0.045 0.06 0.024]]
The mean of the samples was -0.473

Iteration 214
Acquisition function convergence reached at iteration 475.
The final EI loss was -0.399 with predicted mean of [-0.62]
The next parameters to simulate from are [[0.838 0.48 0.022 0.028 0.069 0.004]]
The mean of the samples was -0.643

Iteration 215
The final EI loss was -0.399 with predicted mean of [-0.619]
The next parameters to simulate from are [[0.496 0.923 0.031 0.056 0.002 0.024]]
The mean of the samples was -0.738

Iteration 216
Acquisition function convergence reached at iteration 209.
The final EI loss was -0.399 with predicted mean of [-0.62]
The next parameters to simulate from are [[0.211 0.606 0.008 0.019 0.032 0.034]]
The mean of the samples was -0.838

Iteration 217
Acquisition function convergence reached at iteration 142.
The final EI loss was -0.003 with predicted mean of [-1.246]
The next parameters to simulate from are [[0.483 0.715 0.03 0.028 0.063 0.022]]
The mean of the samples was -1.393

Iteration 218
Acquisition function convergence reached at iteration 151.
The final EI loss was -0.394 with predicted mean of [-0.656]
The next parameters to simulate from are [[0.654 0.832 0.03 0.021 0.06 0.024]]
The mean of the samples was -0.607

Iteration 219
The final EI loss was -0.399 with predicted mean of [-0.657]
The next parameters to simulate from are [[0.466 0. 0.033 0.03 0.003 0.022]]
The mean of the samples was -0.677

Iteration 220
Acquisition function convergence reached at iteration 97.
The final EI loss was 0.0 with predicted mean of [0.673]
The next parameters to simulate from are [[0.719 0.86 0.03 0.092 0.059 0.023]]
The mean of the samples was 0.902
Hyperparameter convergence reached at iteration 1502.
The minimum predicted mean of the observed indices is -1.313 at the point
[0.483 0.715 0.03 0.028 0.063 0.022]

Iteration 221
The final EI loss was -0.399 with predicted mean of [-0.654]

The next parameters to simulate from are [[0.227 0.617 0.023 0.019 0.032 0.035]]
 The mean of the samples was -0.584
 Iteration 222
 Acquisition function convergence reached at iteration 861.
 The final EI loss was -0.399 with predicted mean of [-0.656]
 The next parameters to simulate from are [[0.837 0.478 0.032 0.03 0.007 0.006]]
 The mean of the samples was -0.701
 Iteration 223
 Acquisition function convergence reached at iteration 169.
 The final EI loss was -0.395 with predicted mean of [-0.654]
 The next parameters to simulate from are [[0.651 0.836 0.03 0.043 0.06 0.023]]
 The mean of the samples was -0.691
 Iteration 224
 Acquisition function convergence reached at iteration 180.
 The final EI loss was -0.399 with predicted mean of [-0.656]
 The next parameters to simulate from are [[0.195 0.015 0.022 0.027 0.003 0.023]]
 The mean of the samples was -0.677
 Iteration 225
 Acquisition function convergence reached at iteration 99.
 The final EI loss was -0.399 with predicted mean of [-0.656]
 The next parameters to simulate from are [[0.214 0.621 0.009 0.018 0.033 0.036]]
 The mean of the samples was -0.688
 Iteration 226
 Acquisition function convergence reached at iteration 163.
 The final EI loss was -0.399 with predicted mean of [-0.656]
 The next parameters to simulate from are [[0.626 0.256 0.032 0.042 0.042 0.048]]
 The mean of the samples was -0.676
 Iteration 227
 Acquisition function convergence reached at iteration 525.
 The final EI loss was -0.399 with predicted mean of [-0.655]
 The next parameters to simulate from are [[0.483 0.736 0.03 0.031 0.002 0.023]]
 The mean of the samples was -0.759
 Iteration 228
 Acquisition function convergence reached at iteration 135.
 The final EI loss was -0.389 with predicted mean of [-0.656]
 The next parameters to simulate from are [[0.839 0.487 0.031 0.027 0.049 0.004]]
 The mean of the samples was -0.58
 Iteration 229
 Acquisition function convergence reached at iteration 146.
 The final EI loss was -0.399 with predicted mean of [-0.654]
 The next parameters to simulate from are [[0.606 0.181 0.033 0.042 0.043 0.05]]
 The mean of the samples was -0.722
 Iteration 230

Acquisition function convergence reached at iteration 141.
 The final EI loss was -0.399 with predicted mean of [-0.654]
 The next parameters to simulate from are [[0.621 0.238 0.032 0.042 0.041 0.05]]
 The mean of the samples was -0.618
 Iteration 231
 Acquisition function convergence reached at iteration 161.
 The final EI loss was -0.399 with predicted mean of [-0.654]
 The next parameters to simulate from are [[0.61 0.256 0.033 0.043 0.042 0.048]]
 The mean of the samples was -0.796
 Iteration 232
 Acquisition function convergence reached at iteration 167.
 The final EI loss was -0.395 with predicted mean of [-0.654]
 The next parameters to simulate from are [[0.425 0.276 0.03 0.041 0.06 0.023]]
 The mean of the samples was -0.624
 Iteration 233
 Acquisition function convergence reached at iteration 166.
 The final EI loss was -0.398 with predicted mean of [-0.653]
 The next parameters to simulate from are [[0.207 0.649 0.018 0.02 0.036 0.051]]
 The mean of the samples was -0.603
 Iteration 234
 Acquisition function convergence reached at iteration 4467.
 The final EI loss was -0.399 with predicted mean of [-0.654]
 The next parameters to simulate from are [[0.223 0.612 0.025 0.02 0.033 0.035]]
 The mean of the samples was -0.776
 Iteration 235
 Acquisition function convergence reached at iteration 2306.
 The final EI loss was -0.399 with predicted mean of [-0.654]
 The next parameters to simulate from are [[0.403 0.782 0.004 0.038 0.014 0.024]]
 The mean of the samples was -0.673
 Iteration 236
 The final EI loss was -0.399 with predicted mean of [-0.654]
 The next parameters to simulate from are [[0.503 0.935 0.031 0.055 0.002 0.024]]
 The mean of the samples was -0.75
 Iteration 237
 Acquisition function convergence reached at iteration 653.
 The final EI loss was -0.399 with predicted mean of [-0.654]
 The next parameters to simulate from are [[0.365 0.075 0.031 0.033 0.069 0.022]]
 The mean of the samples was -0.639
 Iteration 238
 Acquisition function convergence reached at iteration 4093.
 The final EI loss was -0.399 with predicted mean of [-0.654]
 The next parameters to simulate from are [[0.205 0.601 0.01 0.017 0.033 0.034]]
 The mean of the samples was -0.649

Iteration 239

Acquisition function convergence reached at iteration 270.

The final EI loss was -0.398 with predicted mean of [-0.655]

The next parameters to simulate from are [[0.186 0.593 0.014 0.011 0.064 0.038]]

The mean of the samples was -0.612

Iteration 240

Acquisition function convergence reached at iteration 143.

The final EI loss was -0.399 with predicted mean of [-0.655]

The next parameters to simulate from are [[0.614 0.217 0.033 0.042 0.046 0.049]]

The mean of the samples was -0.696

Hyperparameter convergence reached at iteration 1566.

The minimum predicted mean of the observed indices is -1.311 at the point

[0.483 0.715 0.03 0.028 0.063 0.022]

Iteration 241

Acquisition function convergence reached at iteration 754.

The final EI loss was -0.399 with predicted mean of [-0.655]

The next parameters to simulate from are [[0.871 0.478 0.032 0.03 0.007 0.007]]

The mean of the samples was -0.623

Iteration 242

The final EI loss was -0.399 with predicted mean of [-0.656]

The next parameters to simulate from are [[0.641 0.851 0.03 0.022 0.06 0.023]]

The mean of the samples was -0.553

Iteration 243

Acquisition function convergence reached at iteration 292.

The final EI loss was -0.398 with predicted mean of [-0.654]

The next parameters to simulate from are [[0.182 0.058 0.029 0.047 0.006 0.055]]

The mean of the samples was -0.75

Iteration 244

Acquisition function convergence reached at iteration 113.

The final EI loss was -0.001 with predicted mean of [-1.313]

The next parameters to simulate from are [[0.48 0.727 0.03 0.029 0.063 0.022]]

The mean of the samples was -1.303

Iteration 245

Acquisition function convergence reached at iteration 148.

The final EI loss was -0.399 with predicted mean of [-0.657]

The next parameters to simulate from are [[0.637 0.234 0.033 0.044 0.042 0.049]]

The mean of the samples was -0.639

Iteration 246

Acquisition function convergence reached at iteration 149.

The final EI loss was -0.399 with predicted mean of [-0.657]

The next parameters to simulate from are [[0.183 0.594 0.014 0.011 0.064 0.038]]

The mean of the samples was -0.657

Iteration 247

Acquisition function convergence reached at iteration 169.
 The final EI loss was -0.399 with predicted mean of [-0.657]
 The next parameters to simulate from are [[0.589 0.262 0.032 0.043 0.043 0.049]]
 The mean of the samples was -0.479
 Iteration 248
 Acquisition function convergence reached at iteration 2855.
 The final EI loss was -0.399 with predicted mean of [-0.657]
 The next parameters to simulate from are [[0.22 0.617 0.02 0.018 0.034 0.035]]
 The mean of the samples was -0.631
 Iteration 249
 The final EI loss was -0.399 with predicted mean of [-0.658]
 The next parameters to simulate from are [[0.201 0.649 0.018 0.02 0.036 0.05]]
 The mean of the samples was -0.766
 Iteration 250
 Acquisition function convergence reached at iteration 169.
 The final EI loss was -0.399 with predicted mean of [-0.657]
 The next parameters to simulate from are [[0.396 0.777 0.004 0.038 0.014 0.024]]
 The mean of the samples was -0.658
 Trained parameters:
 amplitude_champ:0 is 0.695

 length_scales_champ:0 is [0.25 0.25 0.008 0.018 0.018 0.013]

 observation_noise_variance_champ:0 is 0.106

 bias_mean:0 is 0.539

 Iteration 251
 The final EI loss was -0.399 with predicted mean of [-0.655]
 The next parameters to simulate from are [[0.284 0.915 0.031 0.035 0.067 0.018]]
 The mean of the samples was -0.645
 Iteration 252
 Acquisition function convergence reached at iteration 170.
 The final EI loss was -0.399 with predicted mean of [-0.657]
 The next parameters to simulate from are [[0.649 0.825 0.03 0.043 0.06 0.023]]
 The mean of the samples was -0.675
 Iteration 253
 Acquisition function convergence reached at iteration 40.
 The final EI loss was 0.0 with predicted mean of [0.653]
 The next parameters to simulate from are [[0.478 0.888 0.03 0.098 0.006 0.025]]
 The mean of the samples was 0.93
 Iteration 254
 Acquisition function convergence reached at iteration 956.

The final EI loss was -0.399 with predicted mean of [-0.654]
 The next parameters to simulate from are [[0.822 0.483 0.01 0.032 0.009 0.006]]
 The mean of the samples was -0.614
 Iteration 255
 Acquisition function convergence reached at iteration 169.
 The final EI loss was -0.399 with predicted mean of [-0.655]
 The next parameters to simulate from are [[0.361 0.045 0.031 0.032 0.066 0.02]]
 The mean of the samples was -0.607
 Iteration 256
 Acquisition function convergence reached at iteration 143.
 The final EI loss was -0.002 with predicted mean of [-1.313]
 The next parameters to simulate from are [[0.485 0.725 0.03 0.028 0.064 0.022]]
 The mean of the samples was -1.283
 Iteration 257
 Acquisition function convergence reached at iteration 104.
 The final EI loss was -0.399 with predicted mean of [-0.654]
 The next parameters to simulate from are [[0.302 0.909 0.032 0.035 0.068 0.017]]
 The mean of the samples was -0.665
 Iteration 258
 Acquisition function convergence reached at iteration 1250.
 The final EI loss was -0.399 with predicted mean of [-0.653]
 The next parameters to simulate from are [[0.219 0.618 0.019 0.019 0.032 0.035]]
 The mean of the samples was -0.734
 Iteration 259
 The final EI loss was -0.399 with predicted mean of [-0.654]
 The next parameters to simulate from are [[0.209 0.613 0.017 0.019 0.03 0.035]]
 The mean of the samples was -0.775
 Iteration 260
 Acquisition function convergence reached at iteration 486.
 The final EI loss was -0.399 with predicted mean of [-0.653]
 The next parameters to simulate from are [[0.169 0.594 0.014 0.011 0.065 0.037]]
 The mean of the samples was -0.617
 Hyperparameter convergence reached at iteration 1546.
 The minimum predicted mean of the observed indices is -1.307 at the point
 [0.485 0.725 0.03 0.028 0.064 0.022]
 Iteration 261
 Acquisition function convergence reached at iteration 134.
 The final EI loss was -0.371 with predicted mean of [-0.638]
 The next parameters to simulate from are [[0.528 0.642 0.026 0.025 0.033 0.031]]
 The mean of the samples was -0.691
 Iteration 262
 The final EI loss was -0.399 with predicted mean of [-0.651]
 The next parameters to simulate from are [[0.146 0.597 0.014 0.011 0.065 0.037]]

The mean of the samples was -0.73
 Iteration 263
 The final EI loss was -0.399 with predicted mean of [-0.653]
 The next parameters to simulate from are [[0.634 0.862 0.03 0.022 0.06 0.023]]
 The mean of the samples was -0.611
 Iteration 264
 The final EI loss was -0.399 with predicted mean of [-0.655]
 The next parameters to simulate from are [[0.26 0.905 0.031 0.035 0.068 0.019]]
 The mean of the samples was -0.7
 Iteration 265
 The final EI loss was -0.399 with predicted mean of [-0.654]
 The next parameters to simulate from are [[0.788 0.489 0.021 0.03 0.005 0.006]]
 The mean of the samples was -0.739
 Iteration 266
 Acquisition function convergence reached at iteration 2631.
 The final EI loss was -0.399 with predicted mean of [-0.654]
 The next parameters to simulate from are [[0.206 0.643 0.017 0.02 0.036 0.052]]
 The mean of the samples was -0.714
 Iteration 267
 Acquisition function convergence reached at iteration 195.
 The final EI loss was -0.396 with predicted mean of [-0.644]
 The next parameters to simulate from are [[0.469 0.77 0.031 0.046 0.009 0.047]]
 The mean of the samples was -0.71
 Iteration 268
 The final EI loss was -0.399 with predicted mean of [-0.656]
 The next parameters to simulate from are [[0.615 0. 0.029 0.046 0.042 0.015]]
 The mean of the samples was -0.711
 Iteration 269
 Acquisition function convergence reached at iteration 173.
 The final EI loss was -0.392 with predicted mean of [-0.648]
 The next parameters to simulate from are [[0.311 0.902 0.032 0.035 0.067 0.042]]
 The mean of the samples was -0.731
 Iteration 270
 Acquisition function convergence reached at iteration 590.
 The final EI loss was -0.399 with predicted mean of [-0.654]
 The next parameters to simulate from are [[0.487 0.02 0.03 0.055 0.007 0.039]]
 The mean of the samples was -0.643
 Iteration 271
 Acquisition function convergence reached at iteration 3502.
 The final EI loss was -0.399 with predicted mean of [-0.655]
 The next parameters to simulate from are [[0.146 0.596 0.013 0.01 0.063 0.037]]
 The mean of the samples was -0.544
 Iteration 272

Acquisition function convergence reached at iteration 170.
 The final EI loss was -0.398 with predicted mean of [-0.654]
 The next parameters to simulate from are [[0.401 0.839 0.03 0.042 0.063 0.023]]
 The mean of the samples was -0.778
 Iteration 273
 Acquisition function convergence reached at iteration 101.
 The final EI loss was -0.399 with predicted mean of [-0.655]
 The next parameters to simulate from are [[0.161 0.588 0.012 0.01 0.063 0.037]]
 The mean of the samples was -0.561
 Iteration 274
 Acquisition function convergence reached at iteration 311.
 The final EI loss was -0.399 with predicted mean of [-0.655]
 The next parameters to simulate from are [[0.178 0.607 0.014 0.011 0.063 0.035]]
 The mean of the samples was -0.561
 Iteration 275
 Acquisition function convergence reached at iteration 172.
 The final EI loss was -0.399 with predicted mean of [-0.655]
 The next parameters to simulate from are [[0.149 0.622 0.015 0.01 0.062 0.037]]
 The mean of the samples was -0.603
 Iteration 276
 Acquisition function convergence reached at iteration 8.
 The final EI loss was 0.0 with predicted mean of [0.754]
 The next parameters to simulate from are [[0.731 0.901 0.029 0.09 0.06 0.021]]
 The mean of the samples was 0.792
 Iteration 277
 Acquisition function convergence reached at iteration 143.
 The final EI loss was -0.399 with predicted mean of [-0.655]
 The next parameters to simulate from are [[0.631 0.237 0.033 0.044 0.042 0.048]]
 The mean of the samples was -0.609
 Iteration 278
 Acquisition function convergence reached at iteration 157.
 The final EI loss was -0.391 with predicted mean of [-0.648]
 The next parameters to simulate from are [[0.398 0.843 0.021 0.039 0.063 0.022]]
 The mean of the samples was -0.725
 Iteration 279
 Acquisition function convergence reached at iteration 165.
 The final EI loss was -0.398 with predicted mean of [-0.656]
 The next parameters to simulate from are [[0.299 0.912 0.032 0.036 0.068 0.043]]
 The mean of the samples was -0.64
 Iteration 280
 The final EI loss was -0.397 with predicted mean of [-0.652]
 The next parameters to simulate from are [[0.328 0.394 0.031 0.034 0.067 0.019]]
 The mean of the samples was -0.546

Hyperparameter convergence reached at iteration 1682.
The minimum predicted mean of the observed indices is -1.312 at the point
[0.48 0.727 0.03 0.029 0.063 0.022]

Iteration 281
Acquisition function convergence reached at iteration 49.
The final EI loss was 0.0 with predicted mean of [0.395]
The next parameters to simulate from are [[0.506 0.883 0.031 0.002 0.004 0.026]]
The mean of the samples was 0.318

Iteration 282
Acquisition function convergence reached at iteration 159.
The final EI loss was -0.391 with predicted mean of [-0.651]
The next parameters to simulate from are [[0.305 0.906 0.032 0.034 0.068 0.053]]
The mean of the samples was -0.641

Iteration 283
Acquisition function convergence reached at iteration 2832.
The final EI loss was -0.399 with predicted mean of [-0.655]
The next parameters to simulate from are [[0.479 0.728 0.03 0.027 0.007 0.022]]
The mean of the samples was -0.627

Iteration 284
Acquisition function convergence reached at iteration 147.
The final EI loss was -0.398 with predicted mean of [-0.656]
The next parameters to simulate from are [[0.801 0.726 0.021 0.029 0.005 0.006]]
The mean of the samples was -0.631

Iteration 285
The final EI loss was -0.399 with predicted mean of [-0.657]
The next parameters to simulate from are [[0.208 0.603 0.006 0.02 0.033 0.034]]
The mean of the samples was -0.801

Iteration 286
The final EI loss was -0.397 with predicted mean of [-0.667]
The next parameters to simulate from are [[0.658 0.842 0.03 0.024 0.061 0.023]]
The mean of the samples was -0.676

Iteration 287
Acquisition function convergence reached at iteration 137.
The final EI loss was -0.398 with predicted mean of [-0.655]
The next parameters to simulate from are [[0.396 0.844 0.021 0.04 0.063 0.022]]
The mean of the samples was -0.647

Iteration 288
The final EI loss was -0.399 with predicted mean of [-0.656]
The next parameters to simulate from are [[0.673 0.844 0.03 0.025 0.062 0.023]]
The mean of the samples was -0.63

Iteration 289
Acquisition function convergence reached at iteration 5508.
The final EI loss was -0.399 with predicted mean of [-0.656]

The next parameters to simulate from are [[0.137 0.634 0.013 0.01 0.063 0.039]]
 The mean of the samples was -0.587
 Iteration 290
 The final EI loss was -0.399 with predicted mean of [-0.656]
 The next parameters to simulate from are [[0.222 0.612 0.022 0.017 0.035 0.035]]
 The mean of the samples was -0.574
 Iteration 291
 Acquisition function convergence reached at iteration 227.
 The final EI loss was -0.399 with predicted mean of [-0.656]
 The next parameters to simulate from are [[0.399 0.788 0.003 0.038 0.014 0.024]]
 The mean of the samples was -0.671
 Iteration 292
 The final EI loss was -0.398 with predicted mean of [-0.657]
 The next parameters to simulate from are [[0.364 0.052 0.032 0.029 0.069 0.021]]
 The mean of the samples was -0.76
 Iteration 293
 Acquisition function convergence reached at iteration 197.
 The final EI loss was -0.399 with predicted mean of [-0.656]
 The next parameters to simulate from are [[0.379 0.783 0.004 0.039 0.012 0.024]]
 The mean of the samples was -0.609
 Iteration 294
 Acquisition function convergence reached at iteration 37.
 The final EI loss was 0.0 with predicted mean of [0.751]
 The next parameters to simulate from are [[0.722 0.863 0.03 0.091 0.056 0.028]]
 The mean of the samples was 0.805
 Iteration 295
 The final EI loss was -0.399 with predicted mean of [-0.656]
 The next parameters to simulate from are [[0.206 0.618 0.017 0.016 0.037 0.035]]
 The mean of the samples was -0.739
 Iteration 296
 The final EI loss was -0.399 with predicted mean of [-0.656]
 The next parameters to simulate from are [[0.677 0.826 0.031 0.042 0.06 0.023]]
 The mean of the samples was -0.735
 Iteration 297
 The final EI loss was -0.399 with predicted mean of [-0.654]
 The next parameters to simulate from are [[0.622 0.898 0.03 0.023 0.061 0.023]]
 The mean of the samples was -0.656
 Iteration 298
 Acquisition function convergence reached at iteration 717.
 The final EI loss was -0.399 with predicted mean of [-0.657]
 The next parameters to simulate from are [[0.293 0.912 0.032 0.037 0.068 0.043]]
 The mean of the samples was -0.638
 Iteration 299

The final EI loss was -0.399 with predicted mean of [-0.653]
 The next parameters to simulate from are [[0.52 0.952 0.031 0.055 0.002 0.024]]
 The mean of the samples was -0.785
 Iteration 300
 Acquisition function convergence reached at iteration 142.
 The final EI loss was -0.399 with predicted mean of [-0.657]
 The next parameters to simulate from are [[0.12 0.613 0.013 0.011 0.062 0.037]]
 The mean of the samples was -0.774
 Hyperparameter convergence reached at iteration 1608.
 The minimum predicted mean of the observed indices is -1.313 at the point
 [0.48 0.727 0.03 0.029 0.063 0.022]
 Trained parameters:
 amplitude_champ:0 is 0.694

 length_scales_champ:0 is [0.25 0.25 0.008 0.018 0.018 0.014]

 observation_noise_variance_champ:0 is 0.101

 bias_mean:0 is 0.563

 Iteration 301
 Acquisition function convergence reached at iteration 156.
 The final EI loss was -0.397 with predicted mean of [-0.655]
 The next parameters to simulate from are [[0.528 0.644 0.026 0.024 0.033 0.031]]
 The mean of the samples was -0.566
 Iteration 302
 Acquisition function convergence reached at iteration 150.
 The final EI loss was -0.369 with predicted mean of [-0.627]
 The next parameters to simulate from are [[0.353 0.091 0.031 0.032 0.066 0.058]]
 The mean of the samples was -0.853
 Iteration 303
 Acquisition function convergence reached at iteration 117.
 The final EI loss was -0.001 with predicted mean of [-1.315]
 The next parameters to simulate from are [[0.482 0.73 0.03 0.029 0.063 0.023]]
 The mean of the samples was -1.103
 Iteration 304
 The final EI loss was -0.399 with predicted mean of [-0.637]
 The next parameters to simulate from are [[0.772 0.495 0.021 0.029 0.004 0.006]]
 The mean of the samples was -0.587
 Iteration 305
 Acquisition function convergence reached at iteration 145.
 The final EI loss was -0.398 with predicted mean of [-0.634]
 The next parameters to simulate from are [[0.834 0.488 0.031 0.027 0.05 0.004]]

The mean of the samples was -0.714
 Iteration 306
 The final EI loss was -0.398 with predicted mean of [-0.631]
 The next parameters to simulate from are [[0.446 0. 0.033 0.029 0.003 0.021]]
 The mean of the samples was -0.624
 Iteration 307
 Acquisition function convergence reached at iteration 1177.
 The final EI loss was -0.399 with predicted mean of [-0.634]
 The next parameters to simulate from are [[0.601 0.461 0.033 0.04 0.042 0.047]]
 The mean of the samples was -0.698
 Iteration 308
 Acquisition function convergence reached at iteration 18.
 The final EI loss was 0.0 with predicted mean of [1.516]
 The next parameters to simulate from are [[0.375 0.105 0.031 0.098 0.06 0.014]]
 The mean of the samples was 1.675
 Iteration 309
 The final EI loss was -0.399 with predicted mean of [-0.634]
 The next parameters to simulate from are [[0.349 0.074 0.02 0.034 0.069 0.019]]
 The mean of the samples was -0.653
 Iteration 310
 Acquisition function convergence reached at iteration 11.
 The final EI loss was 0.0 with predicted mean of [1.44]
 The next parameters to simulate from are [[0.341 0.201 0.029 0.099 0.059 0.014]]
 The mean of the samples was 1.631
 Iteration 311
 The final EI loss was -0.397 with predicted mean of [-0.625]
 The next parameters to simulate from are [[0.507 0.974 0.031 0.056 0.001 0.025]]
 The mean of the samples was -0.72
 Iteration 312
 Acquisition function convergence reached at iteration 187.
 The final EI loss was -0.399 with predicted mean of [-0.634]
 The next parameters to simulate from are [[0.13 0.595 0.013 0.01 0.062 0.04]]
 The mean of the samples was -0.617
 Iteration 313
 Acquisition function convergence reached at iteration 287.
 The final EI loss was -0.399 with predicted mean of [-0.634]
 The next parameters to simulate from are [[0.273 0.931 0.032 0.036 0.068 0.018]]
 The mean of the samples was -0.715
 Iteration 314
 Acquisition function convergence reached at iteration 18.
 The final EI loss was 0.0 with predicted mean of [1.395]
 The next parameters to simulate from are [[0.181 0.892 0.029 0.088 0.054 0.021]]
 The mean of the samples was 1.387

Iteration 315
Acquisition function convergence reached at iteration 168.
The final EI loss was -0.399 with predicted mean of [-0.634]
The next parameters to simulate from are [[0.158 0.598 0.012 0.01 0.063 0.038]]
The mean of the samples was -0.595

Iteration 316
Acquisition function convergence reached at iteration 492.
The final EI loss was -0.399 with predicted mean of [-0.634]
The next parameters to simulate from are [[0.231 0.909 0.031 0.035 0.067 0.019]]
The mean of the samples was -0.712

Iteration 317
The final EI loss was -0.399 with predicted mean of [-0.635]
The next parameters to simulate from are [[0.08 0.609 0.013 0.009 0.063 0.039]]
The mean of the samples was -0.562

Iteration 318
Acquisition function convergence reached at iteration 45.
The final EI loss was 0.0 with predicted mean of [0.454]
The next parameters to simulate from are [[0.328 0.044 0.031 0. 0.067 0.017]]
The mean of the samples was 0.288

Iteration 319
Acquisition function convergence reached at iteration 132.
The final EI loss was 0.0 with predicted mean of [1.239]
The next parameters to simulate from are [[0.197 0.736 0.006 0.09 0.035 0.031]]
The mean of the samples was 1.327

Iteration 320
The final EI loss was -0.399 with predicted mean of [-0.632]
The next parameters to simulate from are [[0.512 0.639 0.027 0.024 0.033 0.031]]
The mean of the samples was -0.675

Hyperparameter convergence reached at iteration 1585.
The minimum predicted mean of the observed indices is -1.272 at the point
[0.482 0.73 0.03 0.029 0.063 0.023]

Iteration 321
Acquisition function convergence reached at iteration 192.
The final EI loss was -0.397 with predicted mean of [-0.636]
The next parameters to simulate from are [[0.351 0.083 0.031 0.033 0.067 0.062]]
The mean of the samples was -0.678

Iteration 322
Acquisition function convergence reached at iteration 287.
The final EI loss was -0.399 with predicted mean of [-0.636]
The next parameters to simulate from are [[0.404 0.071 0.031 0.033 0.067 0.018]]
The mean of the samples was -0.695

Iteration 323
Acquisition function convergence reached at iteration 9168.

The final EI loss was -0.399 with predicted mean of [-0.637]
 The next parameters to simulate from are [[0.703 0.827 0.031 0.042 0.06 0.024]]
 The mean of the samples was -0.765
 Iteration 324
 Acquisition function convergence reached at iteration 1529.
 The final EI loss was -0.397 with predicted mean of [-0.636]
 The next parameters to simulate from are [[0.821 0.675 0.013 0.029 0.007 0.006]]
 The mean of the samples was -0.709
 Iteration 325
 Acquisition function convergence reached at iteration 293.
 The final EI loss was -0.399 with predicted mean of [-0.636]
 The next parameters to simulate from are [[0.335 0.395 0.031 0.034 0.067 0.019]]
 The mean of the samples was -0.664
 Iteration 326
 Acquisition function convergence reached at iteration 10.
 The final EI loss was 0.0 with predicted mean of [1.474]
 The next parameters to simulate from are [[0.346 0.226 0.028 0.09 0.058 0.015]]
 The mean of the samples was 1.301
 Iteration 327
 Acquisition function convergence reached at iteration 97.
 The final EI loss was -0.399 with predicted mean of [-0.636]
 The next parameters to simulate from are [[0.459 0.771 0.031 0.047 0.006 0.048]]
 The mean of the samples was -0.616
 Iteration 328
 Acquisition function convergence reached at iteration 1528.
 The final EI loss was -0.399 with predicted mean of [-0.636]
 The next parameters to simulate from are [[0.43 0.042 0.03 0.038 0.071 0.022]]
 The mean of the samples was -0.665
 Iteration 329
 Acquisition function convergence reached at iteration 130.
 The final EI loss was -0.013 with predicted mean of [-1.295]
 The next parameters to simulate from are [[0.499 0.748 0.03 0.031 0.063 0.022]]
 The mean of the samples was -1.297
 Iteration 330
 Acquisition function convergence reached at iteration 9331.
 The final EI loss was -0.399 with predicted mean of [-0.648]
 The next parameters to simulate from are [[0.074 0.608 0.013 0.01 0.063 0.039]]
 The mean of the samples was -0.576
 Iteration 331
 Acquisition function convergence reached at iteration 169.
 The final EI loss was -0.399 with predicted mean of [-0.648]
 The next parameters to simulate from are [[0.175 0.646 0.015 0.011 0.063 0.037]]
 The mean of the samples was -0.638

Iteration 332
 Acquisition function convergence reached at iteration 5.
 The final EI loss was 0.0 with predicted mean of [0.947]
 The next parameters to simulate from are [[0.563 0.797 0.029 0.092 0.061 0.026]]
 The mean of the samples was 1.042

Iteration 333
 Acquisition function convergence reached at iteration 143.
 The final EI loss was -0.0 with predicted mean of [-1.296]
 The next parameters to simulate from are [[0.499 0.748 0.03 0.031 0.063 0.022]]
 The mean of the samples was -1.266

Iteration 334
 Acquisition function convergence reached at iteration 128.
 The final EI loss was -0.0 with predicted mean of [-1.291]
 The next parameters to simulate from are [[0.498 0.748 0.03 0.031 0.063 0.022]]
 The mean of the samples was -1.09

Iteration 335
 Acquisition function convergence reached at iteration 229.
 The final EI loss was -0.395 with predicted mean of [-0.633]
 The next parameters to simulate from are [[0.495 0.766 0.03 0.031 0.063 0.056]]
 The mean of the samples was -0.674

Iteration 336
 Acquisition function convergence reached at iteration 2026.
 The final EI loss was -0.399 with predicted mean of [-0.634]
 The next parameters to simulate from are [[0.797 0.491 0.022 0.028 0.022 0.004]]
 The mean of the samples was -0.463

Iteration 337
 Acquisition function convergence reached at iteration 8.
 The final EI loss was 0.0 with predicted mean of [1.009]
 The next parameters to simulate from are [[0.546 0.818 0.009 0.087 0.06 0.029]]
 The mean of the samples was 0.956

Iteration 338
 The final EI loss was -0.399 with predicted mean of [-0.636]
 The next parameters to simulate from are [[0.724 0.826 0.031 0.041 0.06 0.025]]
 The mean of the samples was -0.728

Iteration 339
 Acquisition function convergence reached at iteration 3079.
 The final EI loss was -0.399 with predicted mean of [-0.635]
 The next parameters to simulate from are [[0.504 0.949 0.033 0.056 0.001 0.025]]
 The mean of the samples was -0.574

Iteration 340
 The final EI loss was -0.394 with predicted mean of [-0.62]
 The next parameters to simulate from are [[0.504 0.632 0.026 0.023 0.033 0.031]]
 The mean of the samples was -0.589

Hyperparameter convergence reached at iteration 1652.
The minimum predicted mean of the observed indices is -1.268 at the point
[0.498 0.748 0.03 0.031 0.063 0.022]
Iteration 341
Acquisition function convergence reached at iteration 17.
The final EI loss was 0.0 with predicted mean of [0.951]
The next parameters to simulate from are [[0.528 0.903 0.028 0.095 0.055 0.022]]
The mean of the samples was 1.032
Iteration 342
Acquisition function convergence reached at iteration 169.
The final EI loss was -0.398 with predicted mean of [-0.634]
The next parameters to simulate from are [[0.5 0.764 0.03 0.031 0.063 0.056]]
The mean of the samples was -0.76
Iteration 343
The final EI loss was -0.398 with predicted mean of [-0.641]
The next parameters to simulate from are [[0.675 0.83 0.029 0.055 0.004 0.024]]
The mean of the samples was -0.702
Iteration 344
The final EI loss was -0.399 with predicted mean of [-0.64]
The next parameters to simulate from are [[0.23 0.907 0.031 0.034 0.07 0.02]]
The mean of the samples was -0.762
Iteration 345
Acquisition function convergence reached at iteration 9.
The final EI loss was 0.0 with predicted mean of [0.798]
The next parameters to simulate from are [[0.406 0.833 0.03 0.098 0.005 0.026]]
The mean of the samples was 1.073
Iteration 346
Acquisition function convergence reached at iteration 5.
The final EI loss was 0.0 with predicted mean of [0.898]
The next parameters to simulate from are [[0.567 0.799 0.029 0.086 0.061 0.027]]
The mean of the samples was 0.84
Iteration 347
Acquisition function convergence reached at iteration 225.
The final EI loss was -0.399 with predicted mean of [-0.634]
The next parameters to simulate from are [[0.305 0.909 0.032 0.035 0.068 0.055]]
The mean of the samples was -0.634
Iteration 348
Acquisition function convergence reached at iteration 291.
The final EI loss was -0.399 with predicted mean of [-0.634]
The next parameters to simulate from are [[0.584 0.506 0.032 0.04 0.042 0.047]]
The mean of the samples was -0.666
Iteration 349
Acquisition function convergence reached at iteration 67.

The final EI loss was 0.0 with predicted mean of [0.954]
 The next parameters to simulate from are [[0.212 0.052 0.02 0.082 0.007 0.028]]
 The mean of the samples was 0.835
 Iteration 350
 Acquisition function convergence reached at iteration 2.
 The final EI loss was 0.0 with predicted mean of [0.964]
 The next parameters to simulate from are [[0.498 0.748 0.03 0.089 0.063 0.022]]
 The mean of the samples was 1.043
 Trained parameters:
 amplitude_champ:0 is 0.682

 length_scales_champ:0 is [0.25 0.25 0.008 0.017 0.018 0.015]

 observation_noise_variance_champ:0 is 0.1

 bias_mean:0 is 0.576

 Iteration 351
 Acquisition function convergence reached at iteration 126.
 The final EI loss was -0.005 with predicted mean of [-1.277]
 The next parameters to simulate from are [[0.492 0.727 0.029 0.03 0.065 0.023]]
 The mean of the samples was -1.377
 Iteration 352
 The final EI loss was -0.399 with predicted mean of [-0.645]
 The next parameters to simulate from are [[0.82 0.49 0.022 0.029 0.069 0.003]]
 The mean of the samples was -0.428
 Iteration 353
 Acquisition function convergence reached at iteration 9721.
 The final EI loss was -0.399 with predicted mean of [-0.645]
 The next parameters to simulate from are [[0.419 0.277 0.03 0.041 0.059 0.022]]
 The mean of the samples was -0.63
 Iteration 354
 Acquisition function convergence reached at iteration 729.
 The final EI loss was -0.399 with predicted mean of [-0.646]
 The next parameters to simulate from are [[0.314 0.927 0.032 0.034 0.068 0.016]]
 The mean of the samples was -0.552
 Iteration 355
 Acquisition function convergence reached at iteration 66.
 The final EI loss was 0.0 with predicted mean of [1.107]
 The next parameters to simulate from are [[0.276 0.806 0.004 0.089 0.03 0.031]]
 The mean of the samples was 1.276
 Iteration 356
 Acquisition function convergence reached at iteration 126.

The final EI loss was -0.001 with predicted mean of [-1.294]
 The next parameters to simulate from are [[0.495 0.717 0.029 0.03 0.064 0.024]]
 The mean of the samples was -1.337
 Iteration 357
 Acquisition function convergence reached at iteration 193.
 The final EI loss was -0.399 with predicted mean of [-0.65]
 The next parameters to simulate from are [[0.505 0.763 0.03 0.031 0.063 0.057]]
 The mean of the samples was -0.665
 Iteration 358
 Acquisition function convergence reached at iteration 9.
 The final EI loss was 0.0 with predicted mean of [0.774]
 The next parameters to simulate from are [[0.514 0.807 0.03 0.079 0.059 0.021]]
 The mean of the samples was 0.82
 Iteration 359
 Acquisition function convergence reached at iteration 7788.
 The final EI loss was -0.399 with predicted mean of [-0.65]
 The next parameters to simulate from are [[0.441 0.026 0.03 0.038 0.071 0.023]]
 The mean of the samples was -0.649
 Iteration 360
 Acquisition function convergence reached at iteration 8.
 The final EI loss was 0.0 with predicted mean of [0.725]
 The next parameters to simulate from are [[0.523 0.799 0.03 0.08 0.052 0.018]]
 The mean of the samples was 0.7
 Hyperparameter convergence reached at iteration 1642.
 The minimum predicted mean of the observed indices is -1.3 at the point
 [0.495 0.717 0.029 0.03 0.064 0.024]
 Iteration 361
 Acquisition function convergence reached at iteration 144.
 The final EI loss was -0.0 with predicted mean of [-1.3]
 The next parameters to simulate from are [[0.496 0.712 0.029 0.031 0.064 0.024]]
 The mean of the samples was -1.413
 Iteration 362
 The final EI loss was -0.399 with predicted mean of [-0.658]
 The next parameters to simulate from are [[0.22 0.912 0.031 0.033 0.071 0.021]]
 The mean of the samples was -0.765
 Iteration 363
 Acquisition function convergence reached at iteration 300.
 The final EI loss was -0.399 with predicted mean of [-0.658]
 The next parameters to simulate from are [[0.327 0.086 0.031 0.03 0.067 0.021]]
 The mean of the samples was -0.625
 Iteration 364
 Acquisition function convergence reached at iteration 310.
 The final EI loss was -0.399 with predicted mean of [-0.658]

The next parameters to simulate from are [[0.496 0.763 0.03 0.031 0.063 0.057]]
 The mean of the samples was -0.618
 Iteration 365
 The final EI loss was -0.399 with predicted mean of [-0.661]
 The next parameters to simulate from are [[0.355 0.058 0.032 0.03 0.07 0.021]]
 The mean of the samples was -0.639
 Iteration 366
 Acquisition function convergence reached at iteration 215.
 The final EI loss was -0.399 with predicted mean of [-0.658]
 The next parameters to simulate from are [[0.485 0.035 0.03 0.054 0.006 0.04]]
 The mean of the samples was -0.639
 Iteration 367
 Acquisition function convergence reached at iteration 1717.
 The final EI loss was -0.399 with predicted mean of [-0.658]
 The next parameters to simulate from are [[0.151 0.6 0.011 0.01 0.063 0.038]]
 The mean of the samples was -0.651
 Iteration 368
 Acquisition function convergence reached at iteration 3579.
 The final EI loss was -0.399 with predicted mean of [-0.658]
 The next parameters to simulate from are [[0.584 0.917 0.029 0.057 0.003 0.025]]
 The mean of the samples was -0.568
 Iteration 369
 The final EI loss was -0.399 with predicted mean of [-0.666]
 The next parameters to simulate from are [[0.767 0.476 0.022 0.031 0.021 0.004]]
 The mean of the samples was -0.483
 Iteration 370
 Acquisition function convergence reached at iteration 461.
 The final EI loss was -0.399 with predicted mean of [-0.658]
 The next parameters to simulate from are [[0.891 0.073 0.031 0.034 0.067 0.006]]
 The mean of the samples was -0.902
 Iteration 371
 The final EI loss was -0.399 with predicted mean of [-0.657]
 The next parameters to simulate from are [[0.494 0.74 0.03 0.019 0.063 0.023]]
 The mean of the samples was -0.624
 Iteration 372
 Acquisition function convergence reached at iteration 460.
 The final EI loss was -0.399 with predicted mean of [-0.658]
 The next parameters to simulate from are [[0.353 0.075 0.02 0.034 0.068 0.019]]
 The mean of the samples was -0.725
 Iteration 373
 Acquisition function convergence reached at iteration 178.
 The final EI loss was -0.399 with predicted mean of [-0.658]
 The next parameters to simulate from are [[0.109 0.581 0.011 0.01 0.064 0.037]]

The mean of the samples was -0.698
 Iteration 374
 The final EI loss was -0.399 with predicted mean of [-0.658]
 The next parameters to simulate from are [[0.709 0.814 0.029 0.053 0.004 0.024]]
 The mean of the samples was -0.722
 Iteration 375
 Acquisition function convergence reached at iteration 539.
 The final EI loss was -0.399 with predicted mean of [-0.658]
 The next parameters to simulate from are [[0.467 0.771 0.031 0.046 0.009 0.047]]
 The mean of the samples was -0.764
 Iteration 376
 Acquisition function convergence reached at iteration 11.
 The final EI loss was 0.0 with predicted mean of [0.937]
 The next parameters to simulate from are [[0.318 0.717 0.003 0.089 0.016 0.025]]
 The mean of the samples was 1.11
 Iteration 377
 Acquisition function convergence reached at iteration 170.
 The final EI loss was -0.398 with predicted mean of [-0.658]
 The next parameters to simulate from are [[0.242 0.786 0.03 0.032 0.064 0.057]]
 The mean of the samples was -0.672
 Iteration 378
 The final EI loss was -0.399 with predicted mean of [-0.658]
 The next parameters to simulate from are [[0.522 0.768 0.03 0.019 0.063 0.023]]
 The mean of the samples was -0.545
 Iteration 379
 The final EI loss was -0.399 with predicted mean of [-0.662]
 The next parameters to simulate from are [[0.332 0.398 0.032 0.032 0.067 0.02]]
 The mean of the samples was -0.574
 Iteration 380
 Acquisition function convergence reached at iteration 1568.
 The final EI loss was -0.399 with predicted mean of [-0.659]
 The next parameters to simulate from are [[0.737 0.827 0.031 0.04 0.06 0.025]]
 The mean of the samples was -0.737
 Hyperparameter convergence reached at iteration 1737.
 The minimum predicted mean of the observed indices is -1.32 at the point
 [0.496 0.712 0.029 0.031 0.064 0.024]
 Iteration 381
 The final EI loss was -0.399 with predicted mean of [-0.658]
 The next parameters to simulate from are [[0.829 0.483 0.023 0.029 0.056 0.004]]
 The mean of the samples was -0.7
 Iteration 382
 Acquisition function convergence reached at iteration 592.
 The final EI loss was -0.399 with predicted mean of [-0.66]

The next parameters to simulate from are [[0.793 0.489 0.022 0.029 0.069 0.004]]
 The mean of the samples was -0.501
 Iteration 383
 Acquisition function convergence reached at iteration 203.
 The final EI loss was -0.394 with predicted mean of [-0.66]
 The next parameters to simulate from are [[0.91 0.061 0.031 0.035 0.031 0.006]]
 The mean of the samples was -0.685
 Iteration 384
 The final EI loss was -0.399 with predicted mean of [-0.662]
 The next parameters to simulate from are [[0.382 0.853 0.033 0.042 0.063 0.022]]
 The mean of the samples was -0.767
 Iteration 385
 Acquisition function convergence reached at iteration 5.
 The final EI loss was 0.0 with predicted mean of [1.252]
 The next parameters to simulate from are [[0.357 0.239 0.031 0.087 0.063 0.019]]
 The mean of the samples was 1.46
 Iteration 386
 Acquisition function convergence reached at iteration 624.
 The final EI loss was -0.399 with predicted mean of [-0.659]
 The next parameters to simulate from are [[0.228 0.788 0.03 0.032 0.065 0.057]]
 The mean of the samples was -0.602
 Iteration 387
 Acquisition function convergence reached at iteration 2.
 The final EI loss was 0.0 with predicted mean of [1.058]
 The next parameters to simulate from are [[0.496 0.723 0.027 0.093 0.064 0.024]]
 The mean of the samples was 1.163
 Iteration 388
 The final EI loss was -0.399 with predicted mean of [-0.664]
 The next parameters to simulate from are [[0.205 0.644 0.017 0.021 0.036 0.054]]
 The mean of the samples was -0.836
 Iteration 389
 Acquisition function convergence reached at iteration 148.
 The final EI loss was -0.399 with predicted mean of [-0.666]
 The next parameters to simulate from are [[0.491 0.638 0.027 0.023 0.033 0.03]]
 The mean of the samples was -0.815
 Iteration 390
 Acquisition function convergence reached at iteration 196.
 The final EI loss was -0.395 with predicted mean of [-0.664]
 The next parameters to simulate from are [[0.59 0.801 0.029 0.025 0.029 0.024]]
 The mean of the samples was -0.734
 Iteration 391
 Acquisition function convergence reached at iteration 125.
 The final EI loss was -0.005 with predicted mean of [-1.341]

The next parameters to simulate from are [[0.492 0.688 0.028 0.031 0.064 0.024]]
 The mean of the samples was -1.223
 Iteration 392
 Acquisition function convergence reached at iteration 366.
 The final EI loss was -0.399 with predicted mean of [-0.659]
 The next parameters to simulate from are [[0.252 0.806 0.031 0.032 0.065 0.057]]
 The mean of the samples was -0.673
 Iteration 393
 Acquisition function convergence reached at iteration 862.
 The final EI loss was -0.399 with predicted mean of [-0.659]
 The next parameters to simulate from are [[0.358 0.07 0.031 0.032 0.068 0.063]]
 The mean of the samples was -0.577
 Iteration 394
 Acquisition function convergence reached at iteration 2142.
 The final EI loss was -0.399 with predicted mean of [-0.659]
 The next parameters to simulate from are [[0.32 0.904 0.032 0.035 0.068 0.053]]
 The mean of the samples was -0.482
 Iteration 395
 Acquisition function convergence reached at iteration 35.
 The final EI loss was 0.0 with predicted mean of [0.856]
 The next parameters to simulate from are [[0.524 0.851 0.03 0.099 0.057 0.062]]
 The mean of the samples was 1.051
 Iteration 396
 Acquisition function convergence reached at iteration 11.
 The final EI loss was 0.0 with predicted mean of [1.16]
 The next parameters to simulate from are [[0.128 0.536 0.025 0.09 0.035 0.036]]
 The mean of the samples was 1.493
 Iteration 397
 Acquisition function convergence reached at iteration 5857.
 The final EI loss was -0.399 with predicted mean of [-0.659]
 The next parameters to simulate from are [[0.483 0.765 0.03 0.032 0.064 0.058]]
 The mean of the samples was -0.642
 Iteration 398
 Acquisition function convergence reached at iteration 132.
 The final EI loss was -0.399 with predicted mean of [-0.659]
 The next parameters to simulate from are [[0.469 0.767 0.031 0.047 0.007 0.047]]
 The mean of the samples was -0.607
 Iteration 399
 Acquisition function convergence reached at iteration 6749.
 The final EI loss was -0.399 with predicted mean of [-0.658]
 The next parameters to simulate from are [[0.838 0.477 0.033 0.03 0.008 0.005]]
 The mean of the samples was -0.652
 Iteration 400

Acquisition function convergence reached at iteration 127.
 The final EI loss was -0.399 with predicted mean of [-0.659]
 The next parameters to simulate from are [[0.357 0.387 0.031 0.033 0.067 0.019]]
 The mean of the samples was -0.74
 Hyperparameter convergence reached at iteration 1696.
 The minimum predicted mean of the observed indices is -1.317 at the point
 [0.492 0.688 0.028 0.031 0.064 0.024]
 Trained parameters:
 amplitude_champ:0 is 0.688

 length_scales_champ:0 is [0.25 0.25 0.008 0.017 0.018 0.014]

 observation_noise_variance_champ:0 is 0.097

 bias_mean:0 is 0.594

 Iteration 401
 Acquisition function convergence reached at iteration 13.
 The final EI loss was 0.0 with predicted mean of [1.453]
 The next parameters to simulate from are [[0.289 0.628 0.016 0.088 0.058 0.04]]
 The mean of the samples was 1.186
 Iteration 402
 The final EI loss was -0.399 with predicted mean of [-0.658]
 The next parameters to simulate from are [[0.897 0.055 0.031 0.035 0.067 0.017]]
 The mean of the samples was -0.637
 Iteration 403
 Acquisition function convergence reached at iteration 452.
 The final EI loss was -0.399 with predicted mean of [-0.659]
 The next parameters to simulate from are [[0.608 0.132 0.031 0.043 0.043 0.049]]
 The mean of the samples was -0.652
 Iteration 404
 Acquisition function convergence reached at iteration 3251.
 The final EI loss was -0.399 with predicted mean of [-0.658]
 The next parameters to simulate from are [[0.487 0.913 0.031 0.03 0.004 0.023]]
 The mean of the samples was -0.687
 Iteration 405
 The final EI loss was -0.399 with predicted mean of [-0.655]
 The next parameters to simulate from are [[0.19 0.908 0.031 0.033 0.071 0.021]]
 The mean of the samples was -0.658
 Iteration 406
 Acquisition function convergence reached at iteration 489.
 The final EI loss was -0.399 with predicted mean of [-0.658]
 The next parameters to simulate from are [[0.337 0.381 0.031 0.033 0.069 0.02]]

The mean of the samples was -0.806
 Iteration 407
 Acquisition function convergence reached at iteration 6211.
 The final EI loss was -0.399 with predicted mean of [-0.66]
 The next parameters to simulate from are [[0.468 0.003 0.033 0.029 0.008 0.021]]
 The mean of the samples was -0.701
 Iteration 408
 Acquisition function convergence reached at iteration 318.
 The final EI loss was -0.399 with predicted mean of [-0.659]
 The next parameters to simulate from are [[0.436 0.104 0.004 0.042 0.008 0.025]]
 The mean of the samples was -0.703
 Iteration 409
 Acquisition function convergence reached at iteration 2.
 The final EI loss was 0.0 with predicted mean of [0.829]
 The next parameters to simulate from are [[0.492 0.688 0.03 0.082 0.06 0.024]]
 The mean of the samples was 0.918
 Iteration 410
 The final EI loss was -0.399 with predicted mean of [-0.657]
 The next parameters to simulate from are [[0.485 0.746 0.03 0.03 0. 0.019]]
 The mean of the samples was -0.616
 Iteration 411
 Acquisition function convergence reached at iteration 162.
 The final EI loss was -0.399 with predicted mean of [-0.659]
 The next parameters to simulate from are [[0.372 0.789 0.003 0.038 0.015 0.026]]
 The mean of the samples was -0.647
 Iteration 412
 Acquisition function convergence reached at iteration 458.
 The final EI loss was -0.399 with predicted mean of [-0.659]
 The next parameters to simulate from are [[0.141 0.348 0.011 0.01 0.063 0.038]]
 The mean of the samples was -0.675
 Iteration 413
 Acquisition function convergence reached at iteration 7407.
 The final EI loss was -0.399 with predicted mean of [-0.658]
 The next parameters to simulate from are [[0.916 0.059 0.031 0.035 0.067 0.016]]
 The mean of the samples was -0.445
 Iteration 414
 Acquisition function convergence reached at iteration 192.
 The final EI loss was -0.399 with predicted mean of [-0.659]
 The next parameters to simulate from are [[0.334 0.904 0.032 0.033 0.068 0.053]]
 The mean of the samples was -0.753
 Iteration 415
 Acquisition function convergence reached at iteration 1144.
 The final EI loss was -0.399 with predicted mean of [-0.659]

The next parameters to simulate from are [[0.125 0.614 0.014 0.011 0.063 0.041]]
 The mean of the samples was -0.623
 Iteration 416
 Acquisition function convergence reached at iteration 2631.
 The final EI loss was -0.399 with predicted mean of [-0.659]
 The next parameters to simulate from are [[0.24 0.796 0.031 0.031 0.066 0.057]]
 The mean of the samples was -0.824
 Iteration 417
 Acquisition function convergence reached at iteration 363.
 The final EI loss was -0.399 with predicted mean of [-0.659]
 The next parameters to simulate from are [[0.123 0.576 0.01 0.009 0.064 0.038]]
 The mean of the samples was -0.635
 Iteration 418
 The final EI loss was -0.399 with predicted mean of [-0.656]
 The next parameters to simulate from are [[0.547 0.826 0.03 0.02 0.062 0.023]]
 The mean of the samples was -0.696
 Iteration 419
 Acquisition function convergence reached at iteration 148.
 The final EI loss was -0.399 with predicted mean of [-0.658]
 The next parameters to simulate from are [[0.572 0.447 0.032 0.04 0.043 0.047]]
 The mean of the samples was -0.648
 Iteration 420
 Acquisition function convergence reached at iteration 273.
 The final EI loss was -0.399 with predicted mean of [-0.659]
 The next parameters to simulate from are [[0.285 0.862 0.032 0.033 0.068 0.055]]
 The mean of the samples was -0.615
 Hyperparameter convergence reached at iteration 1699.
 The minimum predicted mean of the observed indices is -1.318 at the point
 [0.496 0.712 0.029 0.031 0.064 0.024]
 Iteration 421
 Acquisition function convergence reached at iteration 181.
 The final EI loss was -0.399 with predicted mean of [-0.659]
 The next parameters to simulate from are [[0.469 0.777 0.031 0.046 0.007 0.046]]
 The mean of the samples was -0.632
 Iteration 422
 Acquisition function convergence reached at iteration 159.
 The final EI loss was -0.399 with predicted mean of [-0.659]
 The next parameters to simulate from are [[0.21 0.785 0.031 0.032 0.063 0.056]]
 The mean of the samples was -0.637
 Iteration 423
 The final EI loss was -0.399 with predicted mean of [-0.654]
 The next parameters to simulate from are [[0.532 0.848 0.03 0.02 0.063 0.023]]
 The mean of the samples was -0.739

Iteration 424
Acquisition function convergence reached at iteration 130.
The final EI loss was -0.397 with predicted mean of [-0.659]
The next parameters to simulate from are [[0.477 0.971 0.03 0.032 0.065 0.058]]
The mean of the samples was -0.637

Iteration 425
The final EI loss was -0.399 with predicted mean of [-0.661]
The next parameters to simulate from are [[0.522 0.834 0.03 0.02 0.062 0.023]]
The mean of the samples was -0.622

Iteration 426
The final EI loss was -0.399 with predicted mean of [-0.659]
The next parameters to simulate from are [[0.186 0.915 0.031 0.032 0.071 0.021]]
The mean of the samples was -0.677

Iteration 427
Acquisition function convergence reached at iteration 140.
The final EI loss was -0.399 with predicted mean of [-0.659]
The next parameters to simulate from are [[0.226 0.784 0.031 0.031 0.065 0.059]]
The mean of the samples was -0.743

Iteration 428
Acquisition function convergence reached at iteration 7246.
The final EI loss was -0.399 with predicted mean of [-0.661]
The next parameters to simulate from are [[0.504 0.741 0.029 0.019 0.067 0.023]]
The mean of the samples was -0.656

Iteration 429
Acquisition function convergence reached at iteration 340.
The final EI loss was -0.399 with predicted mean of [-0.659]
The next parameters to simulate from are [[0.607 0.106 0.03 0.043 0.043 0.049]]
The mean of the samples was -0.586

Iteration 430
Acquisition function convergence reached at iteration 9.
The final EI loss was 0.0 with predicted mean of [0.621]
The next parameters to simulate from are [[0.507 0.806 0.03 0.075 0.061 0.059]]
The mean of the samples was 0.597

Iteration 431
Acquisition function convergence reached at iteration 137.
The final EI loss was -0.001 with predicted mean of [-1.319]
The next parameters to simulate from are [[0.492 0.705 0.029 0.031 0.064 0.024]]
The mean of the samples was -1.161

Iteration 432
The final EI loss was -0.398 with predicted mean of [-0.647]
The next parameters to simulate from are [[0.503 0.734 0.029 0.019 0.07 0.024]]
The mean of the samples was -0.694

Iteration 433

Acquisition function convergence reached at iteration 140.
 The final EI loss was -0.396 with predicted mean of [-0.65]
 The next parameters to simulate from are [[0.066 0.12 0.008 0.035 0.025 0.015]]
 The mean of the samples was -0.524
 Iteration 434
 Acquisition function convergence reached at iteration 5.
 The final EI loss was 0.0 with predicted mean of [1.393]
 The next parameters to simulate from are [[0.43 0.023 0.03 0.095 0.065 0.02]]
 The mean of the samples was 1.406
 Iteration 435
 Acquisition function convergence reached at iteration 4466.
 The final EI loss was -0.399 with predicted mean of [-0.65]
 The next parameters to simulate from are [[0.2 0.599 0.01 0.016 0.035 0.034]]
 The mean of the samples was -0.616
 Iteration 436
 Acquisition function convergence reached at iteration 150.
 The final EI loss was -0.391 with predicted mean of [-0.643]
 The next parameters to simulate from are [[0.083 0.789 0.008 0.034 0.024 0.017]]
 The mean of the samples was -0.807
 Iteration 437
 Acquisition function convergence reached at iteration 237.
 The final EI loss was -0.399 with predicted mean of [-0.649]
 The next parameters to simulate from are [[0.589 0.479 0.032 0.039 0.046 0.047]]
 The mean of the samples was -0.584
 Iteration 438
 Acquisition function convergence reached at iteration 2346.
 The final EI loss was -0.399 with predicted mean of [-0.65]
 The next parameters to simulate from are [[0.172 0.609 0.014 0.012 0.062 0.031]]
 The mean of the samples was -0.711
 Iteration 439
 Acquisition function convergence reached at iteration 2.
 The final EI loss was 0.0 with predicted mean of [1.111]
 The next parameters to simulate from are [[0.504 0.717 0.011 0.094 0.064 0.024]]
 The mean of the samples was 1.199
 Iteration 440
 Acquisition function convergence reached at iteration 200.
 The final EI loss was -0.399 with predicted mean of [-0.649]
 The next parameters to simulate from are [[0.509 0.757 0.031 0.02 0.065 0.022]]
 The mean of the samples was -0.685
 Hyperparameter convergence reached at iteration 1737.
 The minimum predicted mean of the observed indices is -1.298 at the point
 [0.495 0.717 0.029 0.03 0.064 0.024]
 Iteration 441

The final EI loss was -0.399 with predicted mean of [-0.652]
 The next parameters to simulate from are [[0.351 0.07 0.021 0.033 0.071 0.019]]
 The mean of the samples was -0.6
 Iteration 442
 Acquisition function convergence reached at iteration 368.
 The final EI loss was -0.399 with predicted mean of [-0.649]
 The next parameters to simulate from are [[0.3 0.905 0.033 0.034 0.067 0.054]]
 The mean of the samples was -0.543
 Iteration 443
 The final EI loss was -0.399 with predicted mean of [-0.648]
 The next parameters to simulate from are [[0.526 0.993 0.032 0.055 0.001 0.024]]
 The mean of the samples was -0.622
 Iteration 444
 The final EI loss was -0.398 with predicted mean of [-0.656]
 The next parameters to simulate from are [[0.359 0.037 0.033 0.031 0.07 0.022]]
 The mean of the samples was -0.688
 Iteration 445
 Acquisition function convergence reached at iteration 141.
 The final EI loss was -0.399 with predicted mean of [-0.649]
 The next parameters to simulate from are [[0.398 0.788 0.003 0.04 0.014 0.024]]
 The mean of the samples was -0.642
 Iteration 446
 Acquisition function convergence reached at iteration 161.
 The final EI loss was -0.399 with predicted mean of [-0.649]
 The next parameters to simulate from are [[0.843 0.491 0.023 0.027 0.069 0.004]]
 The mean of the samples was -0.779
 Iteration 447
 Acquisition function convergence reached at iteration 165.
 The final EI loss was -0.399 with predicted mean of [-0.649]
 The next parameters to simulate from are [[0.328 0.061 0.031 0.031 0.069 0.021]]
 The mean of the samples was -0.671
 Iteration 448
 Acquisition function convergence reached at iteration 12.
 The final EI loss was 0.0 with predicted mean of [1.367]
 The next parameters to simulate from are [[0.35 0.634 0.007 0.088 0.049 0.029]]
 The mean of the samples was 1.2
 Iteration 449
 Acquisition function convergence reached at iteration 1766.
 The final EI loss was -0.399 with predicted mean of [-0.649]
 The next parameters to simulate from are [[0.203 0.768 0.031 0.03 0.065 0.058]]
 The mean of the samples was -0.659
 Iteration 450
 Acquisition function convergence reached at iteration 118.

The final EI loss was -0.0 with predicted mean of [-1.298]
 The next parameters to simulate from are [[0.492 0.723 0.029 0.031 0.065 0.024]]
 The mean of the samples was -1.272
 Trained parameters:
 amplitude_champ:0 is 0.686

 length_scales_champ:0 is [0.25 0.25 0.008 0.016 0.018 0.014]

 observation_noise_variance_champ:0 is 0.095

 bias_mean:0 is 0.603

 Iteration 451
 Acquisition function convergence reached at iteration 1989.
 The final EI loss was -0.399 with predicted mean of [-0.648]
 The next parameters to simulate from are [[0.77 0.833 0.031 0.041 0.061 0.024]]
 The mean of the samples was -0.654
 Iteration 452
 Acquisition function convergence reached at iteration 16.
 The final EI loss was 0.0 with predicted mean of [1.214]
 The next parameters to simulate from are [[0.289 0.564 0.025 0.085 0.048 0.038]]
 The mean of the samples was 1.081
 Iteration 453
 Acquisition function convergence reached at iteration 15.
 The final EI loss was 0.0 with predicted mean of [1.19]
 The next parameters to simulate from are [[0.351 0.829 0.026 0.085 0.056 0.017]]
 The mean of the samples was 1.038
 Iteration 454
 Acquisition function convergence reached at iteration 151.
 The final EI loss was -0.399 with predicted mean of [-0.648]
 The next parameters to simulate from are [[0.362 0.783 0.003 0.039 0.013 0.025]]
 The mean of the samples was -0.697
 Iteration 455
 Acquisition function convergence reached at iteration 210.
 The final EI loss was -0.399 with predicted mean of [-0.648]
 The next parameters to simulate from are [[0.507 0.745 0.008 0.02 0.067 0.024]]
 The mean of the samples was -0.592
 Iteration 456
 Acquisition function convergence reached at iteration 8718.
 The final EI loss was -0.399 with predicted mean of [-0.648]
 The next parameters to simulate from are [[0.066 0.119 0.008 0.033 0.025 0.015]]
 The mean of the samples was -0.679
 Iteration 457

Acquisition function convergence reached at iteration 234.
 The final EI loss was -0.399 with predicted mean of [-0.648]
 The next parameters to simulate from are [[0.204 0.57 0.013 0.011 0.064 0.034]]
 The mean of the samples was -0.601
 Iteration 458
 The final EI loss was -0.398 with predicted mean of [-0.641]
 The next parameters to simulate from are [[0.485 0.746 0.03 0.03 0. 0.02]]
 The mean of the samples was -0.583
 Iteration 459
 Acquisition function convergence reached at iteration 98.
 The final EI loss was 0.0 with predicted mean of [1.219]
 The next parameters to simulate from are [[0.24 0.461 0.007 0.084 0.059 0.037]]
 The mean of the samples was 1.217
 Iteration 460
 The final EI loss was -0.399 with predicted mean of [-0.648]
 The next parameters to simulate from are [[0.448 0.012 0.03 0.041 0.056 0.023]]
 The mean of the samples was -0.666
 Hyperparameter convergence reached at iteration 5860.
 The minimum predicted mean of the observed indices is -1.297 at the point
 [0.492 0.723 0.029 0.031 0.065 0.024]
 Iteration 461
 Acquisition function convergence reached at iteration 160.
 The final EI loss was -0.399 with predicted mean of [-0.648]
 The next parameters to simulate from are [[0.84 0.718 0.031 0.03 0.007 0.007]]
 The mean of the samples was -0.74
 Iteration 462
 The final EI loss was -0.399 with predicted mean of [-0.649]
 The next parameters to simulate from are [[0.603 0.106 0.031 0.043 0.043 0.051]]
 The mean of the samples was -0.727
 Iteration 463
 Acquisition function convergence reached at iteration 143.
 The final EI loss was -0.396 with predicted mean of [-0.647]
 The next parameters to simulate from are [[0.312 0.902 0.033 0.034 0.016 0.054]]
 The mean of the samples was -0.683
 Iteration 464
 Acquisition function convergence reached at iteration 290.
 The final EI loss was -0.399 with predicted mean of [-0.648]
 The next parameters to simulate from are [[0.486 0.058 0.006 0.044 0.007 0.024]]
 The mean of the samples was -0.705
 Iteration 465
 Acquisition function convergence reached at iteration 381.
 The final EI loss was -0.399 with predicted mean of [-0.648]
 The next parameters to simulate from are [[0.799 0.726 0.021 0.029 0.005 0.006]]

The mean of the samples was -0.632
 Iteration 466
 Acquisition function convergence reached at iteration 1574.
 The final EI loss was -0.399 with predicted mean of [-0.648]
 The next parameters to simulate from are [[0.202 0.767 0.031 0.03 0.066 0.059]]
 The mean of the samples was -0.531
 Iteration 467
 Acquisition function convergence reached at iteration 65.
 The final EI loss was 0.0 with predicted mean of [1.27]
 The next parameters to simulate from are [[0.288 0.8 0.025 0.085 0.055 0.03]]
 The mean of the samples was 1.088
 Iteration 468
 Acquisition function convergence reached at iteration 372.
 The final EI loss was -0.399 with predicted mean of [-0.648]
 The next parameters to simulate from are [[0.495 0.77 0.029 0.031 0.064 0.059]]
 The mean of the samples was -0.621
 Iteration 469
 Acquisition function convergence reached at iteration 2925.
 The final EI loss was -0.399 with predicted mean of [-0.648]
 The next parameters to simulate from are [[0.434 0.005 0.03 0.038 0.069 0.022]]
 The mean of the samples was -0.642
 Iteration 470
 Acquisition function convergence reached at iteration 5896.
 The final EI loss was -0.399 with predicted mean of [-0.646]
 The next parameters to simulate from are [[0.208 0.717 0.017 0.017 0.035 0.036]]
 The mean of the samples was -0.613
 Iteration 471
 Acquisition function convergence reached at iteration 436.
 The final EI loss was -0.399 with predicted mean of [-0.646]
 The next parameters to simulate from are [[0.466 0.036 0.013 0.035 0.005 0.023]]
 The mean of the samples was -0.707
 Iteration 472
 Acquisition function convergence reached at iteration 4801.
 The final EI loss was -0.399 with predicted mean of [-0.647]
 The next parameters to simulate from are [[0.163 0.907 0.031 0.032 0.071 0.021]]
 The mean of the samples was -0.571
 Iteration 473
 The final EI loss was -0.399 with predicted mean of [-0.647]
 The next parameters to simulate from are [[0.355 0.03 0.033 0.029 0.07 0.021]]
 The mean of the samples was -0.651
 Iteration 474
 Acquisition function convergence reached at iteration 2942.
 The final EI loss was -0.399 with predicted mean of [-0.646]

The next parameters to simulate from are [[0.243 0.595 0.013 0.012 0.062 0.035]]
 The mean of the samples was -0.58
 Iteration 475
 Acquisition function convergence reached at iteration 8408.
 The final EI loss was -0.399 with predicted mean of [-0.647]
 The next parameters to simulate from are [[0.386 0.786 0.003 0.039 0.014 0.024]]
 The mean of the samples was -0.58
 Iteration 476
 Acquisition function convergence reached at iteration 1524.
 The final EI loss was -0.399 with predicted mean of [-0.647]
 The next parameters to simulate from are [[0.207 0.891 0.032 0.033 0.069 0.02]]
 The mean of the samples was -0.512
 Iteration 477
 Acquisition function convergence reached at iteration 2671.
 The final EI loss was -0.399 with predicted mean of [-0.647]
 The next parameters to simulate from are [[0.297 0.912 0.033 0.036 0.067 0.044]]
 The mean of the samples was -0.615
 Iteration 478
 Acquisition function convergence reached at iteration 511.
 The final EI loss was -0.399 with predicted mean of [-0.647]
 The next parameters to simulate from are [[0.288 0.842 0.032 0.035 0.068 0.018]]
 The mean of the samples was -0.619
 Iteration 479
 Acquisition function convergence reached at iteration 402.
 The final EI loss was -0.399 with predicted mean of [-0.647]
 The next parameters to simulate from are [[0.437 0.061 0.03 0.048 0.006 0.051]]
 The mean of the samples was -0.676
 Iteration 480
 Acquisition function convergence reached at iteration 150.
 The final EI loss was -0.399 with predicted mean of [-0.647]
 The next parameters to simulate from are [[0.2 0.639 0.015 0.019 0.036 0.053]]
 The mean of the samples was -0.64
 Hyperparameter convergence reached at iteration 1651.
 The minimum predicted mean of the observed indices is -1.293 at the point
 [0.492 0.727 0.029 0.03 0.065 0.023]
 Iteration 481
 Acquisition function convergence reached at iteration 138.
 The final EI loss was -0.001 with predicted mean of [-1.296]
 The next parameters to simulate from are [[0.492 0.743 0.029 0.03 0.064 0.023]]
 The mean of the samples was -1.187
 Iteration 482
 Acquisition function convergence reached at iteration 8384.
 The final EI loss was -0.399 with predicted mean of [-0.649]

The next parameters to simulate from are [[0.384 0.772 0.003 0.039 0.014 0.023]]
 The mean of the samples was -0.648
 Iteration 483
 Acquisition function convergence reached at iteration 1196.
 The final EI loss was -0.399 with predicted mean of [-0.649]
 The next parameters to simulate from are [[0.508 0.745 0.009 0.019 0.067 0.024]]
 The mean of the samples was -0.552
 Iteration 484
 Acquisition function convergence reached at iteration 272.
 The final EI loss was 0.0 with predicted mean of [1.131]
 The next parameters to simulate from are [[0.28 0.758 0.022 0.091 0.049 0.053]]
 The mean of the samples was 1.327
 Iteration 485
 Acquisition function convergence reached at iteration 4821.
 The final EI loss was -0.399 with predicted mean of [-0.649]
 The next parameters to simulate from are [[0.458 0.953 0.03 0.032 0.044 0.057]]
 The mean of the samples was -0.686
 Iteration 486
 Acquisition function convergence reached at iteration 142.
 The final EI loss was -0.399 with predicted mean of [-0.649]
 The next parameters to simulate from are [[0.194 0.775 0.03 0.029 0.064 0.058]]
 The mean of the samples was -0.849
 Iteration 487
 Acquisition function convergence reached at iteration 198.
 The final EI loss was -0.399 with predicted mean of [-0.649]
 The next parameters to simulate from are [[0.74 0.854 0.031 0.042 0.06 0.025]]
 The mean of the samples was -0.666
 Iteration 488
 Acquisition function convergence reached at iteration 211.
 The final EI loss was -0.399 with predicted mean of [-0.649]
 The next parameters to simulate from are [[0.756 0.858 0.031 0.041 0.06 0.024]]
 The mean of the samples was -0.638
 Iteration 489
 The final EI loss was -0.399 with predicted mean of [-0.65]
 The next parameters to simulate from are [[0.49 0.752 0.007 0.02 0.067 0.021]]
 The mean of the samples was -0.847
 Iteration 490
 Acquisition function convergence reached at iteration 9175.
 The final EI loss was -0.399 with predicted mean of [-0.649]
 The next parameters to simulate from are [[0.468 0.004 0.013 0.036 0.004 0.023]]
 The mean of the samples was -0.661
 Iteration 491
 The final EI loss was -0.399 with predicted mean of [-0.648]

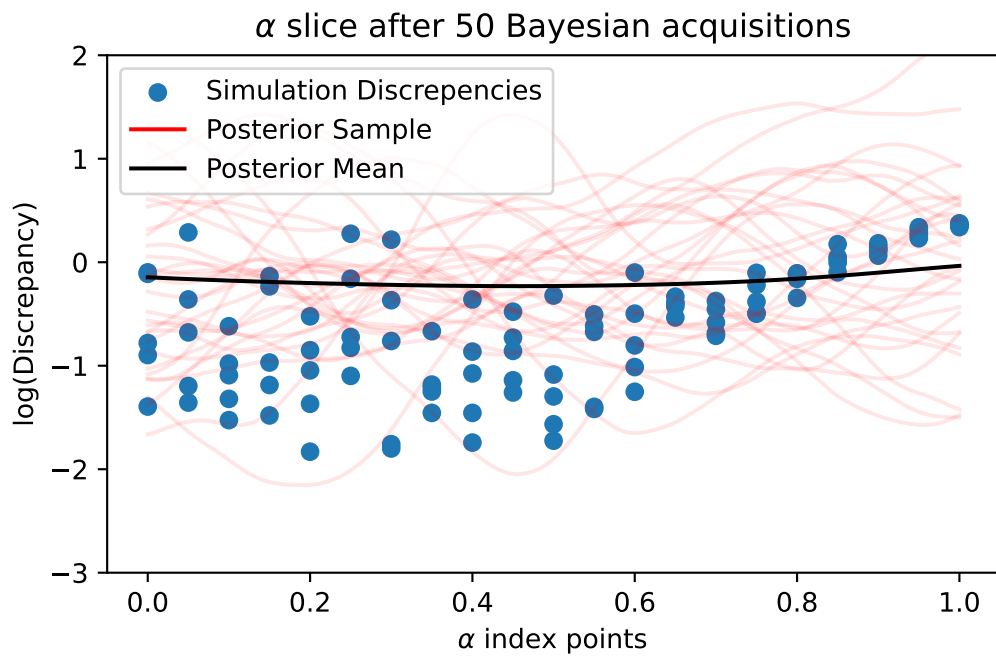
The next parameters to simulate from are [[0.823 0.487 0.023 0.03 0.069 0.004]]
 The mean of the samples was -0.589
 Iteration 492
 Acquisition function convergence reached at iteration 6276.
 The final EI loss was -0.399 with predicted mean of [-0.648]
 The next parameters to simulate from are [[0.494 0.75 0.006 0.021 0.066 0.021]]
 The mean of the samples was -0.749
 Iteration 493
 Acquisition function convergence reached at iteration 3189.
 The final EI loss was -0.399 with predicted mean of [-0.648]
 The next parameters to simulate from are [[0.436 0.015 0.03 0.042 0.044 0.023]]
 The mean of the samples was -0.702
 Iteration 494
 Acquisition function convergence reached at iteration 9794.
 The final EI loss was -0.399 with predicted mean of [-0.649]
 The next parameters to simulate from are [[0.489 0.946 0.031 0.03 0.004 0.023]]
 The mean of the samples was -0.683
 Iteration 495
 The final EI loss was -0.399 with predicted mean of [-0.649]
 The next parameters to simulate from are [[0.457 0.975 0.03 0.033 0.046 0.058]]
 The mean of the samples was -0.578
 Iteration 496
 Acquisition function convergence reached at iteration 162.
 The final EI loss was -0.394 with predicted mean of [-0.64]
 The next parameters to simulate from are [[0.511 0.951 0.031 0.052 0.003 0.043]]
 The mean of the samples was -0.605
 Iteration 497
 Acquisition function convergence reached at iteration 283.
 The final EI loss was -0.399 with predicted mean of [-0.649]
 The next parameters to simulate from are [[0.779 0.816 0.032 0.04 0.061 0.024]]
 The mean of the samples was -0.599
 Iteration 498
 Acquisition function convergence reached at iteration 164.
 The final EI loss was -0.399 with predicted mean of [-0.647]
 The next parameters to simulate from are [[0.84 0.486 0.022 0.027 0.057 0.004]]
 The mean of the samples was -0.597
 Iteration 499
 Acquisition function convergence reached at iteration 150.
 The final EI loss was -0.399 with predicted mean of [-0.647]
 The next parameters to simulate from are [[0.409 0.807 0.004 0.04 0.013 0.024]]
 The mean of the samples was -0.727
 Iteration 500
 Acquisition function convergence reached at iteration 2.

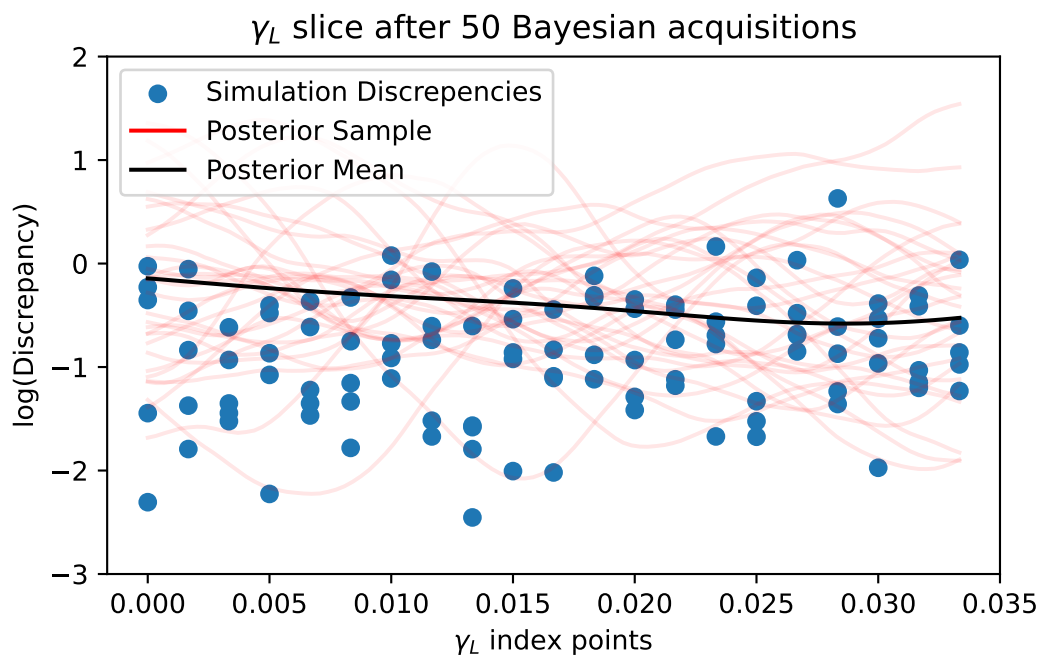
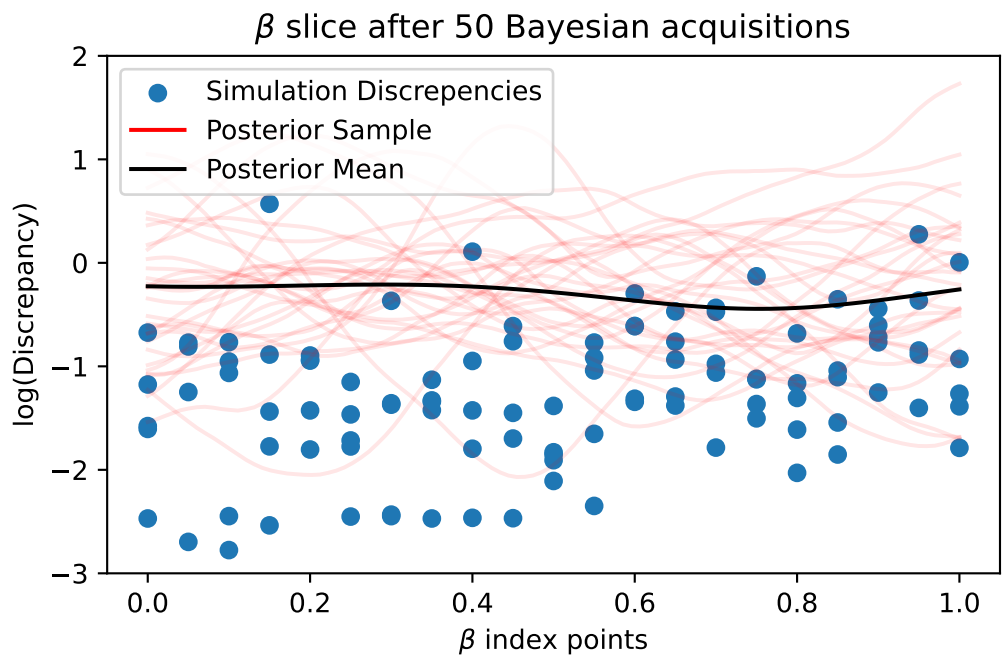
The final EI loss was 0.0 with predicted mean of [0.494]
The next parameters to simulate from are [[0.492 0.725 0.029 0.068 0.064 0.022]]
The mean of the samples was 0.37
Hyperparameter convergence reached at iteration 1625.
The minimum predicted mean of the observed indices is -1.296 at the point
[0.492 0.9 0.029 0.03 0.064 0.023]
Trained parameters:
amplitude_champ:0 is 0.677

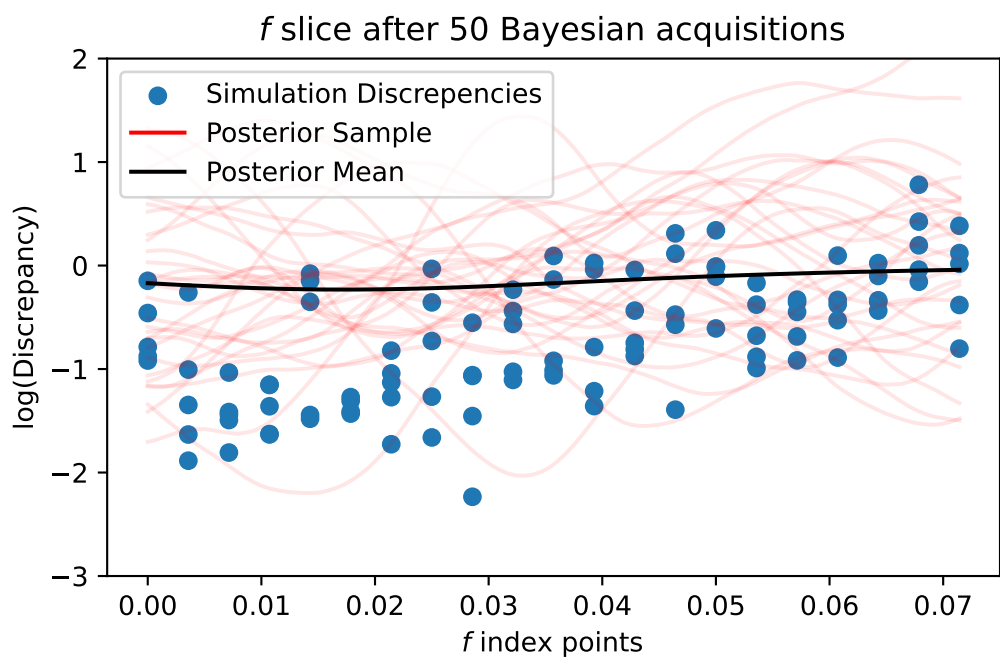
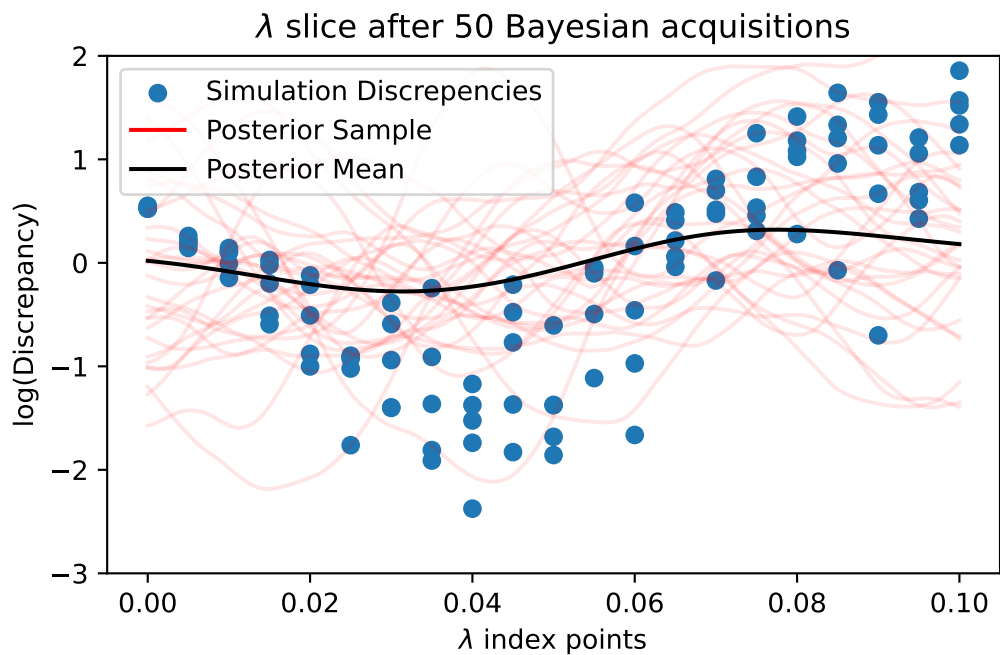
length_scales_champ:0 is [0.232 0.25 0.008 0.015 0.018 0.013]

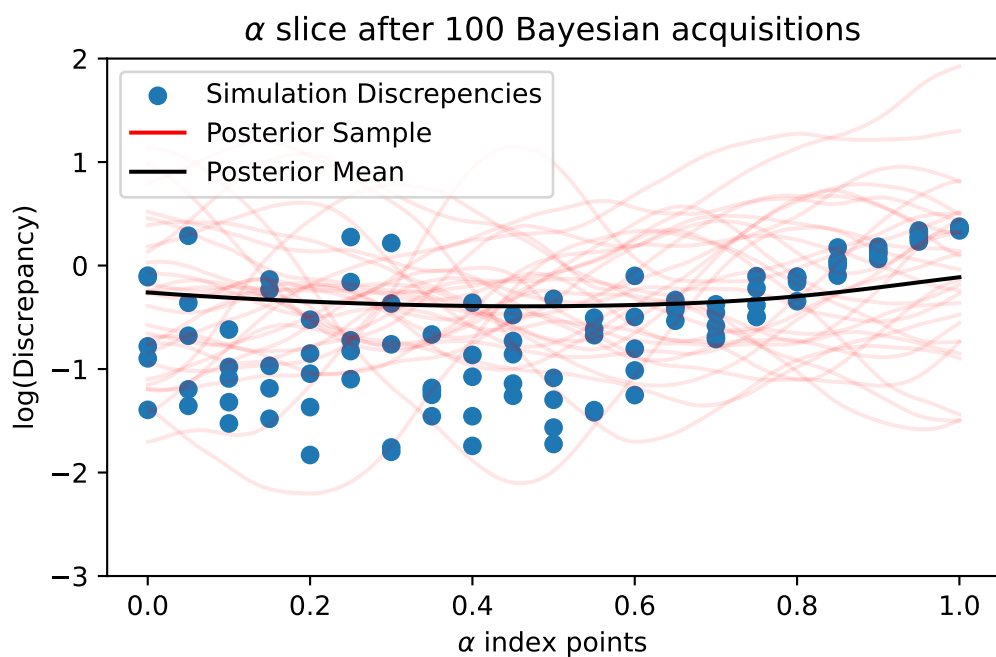
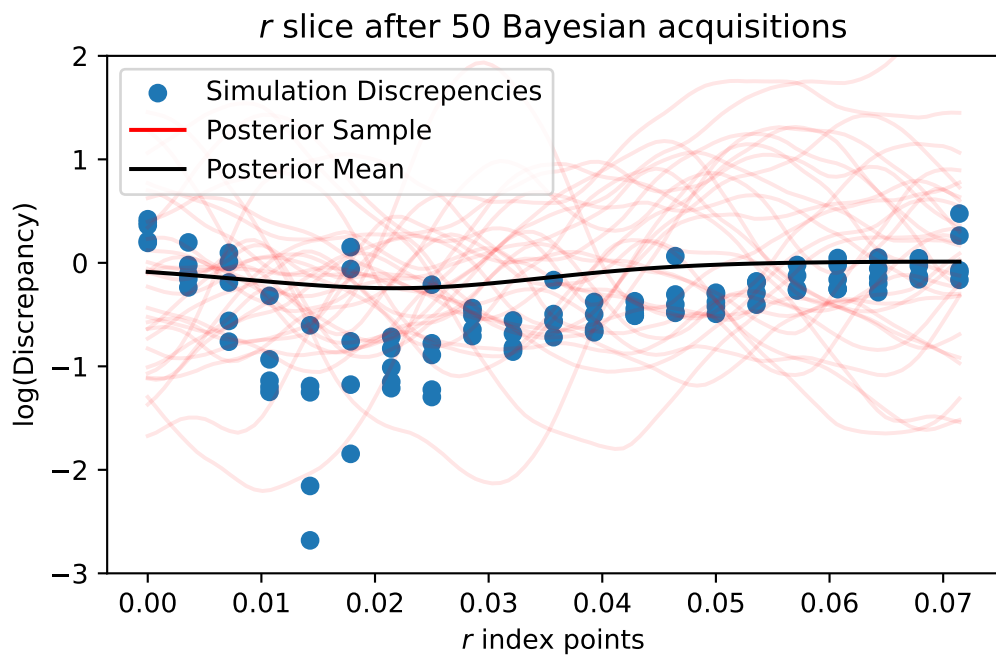
observation_noise_variance_champ:0 is 0.093

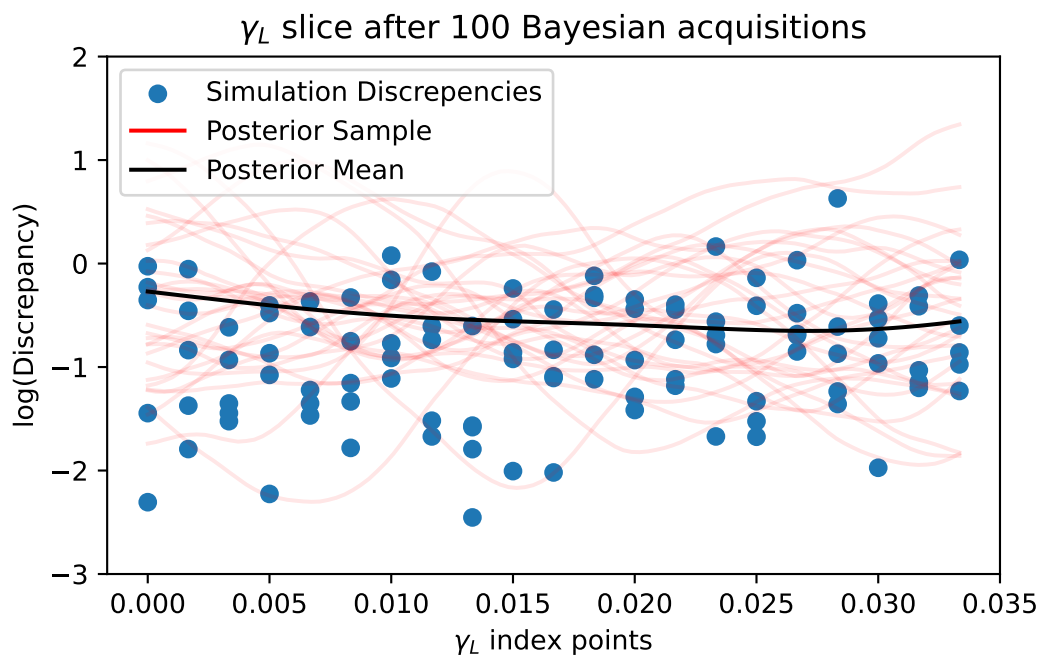
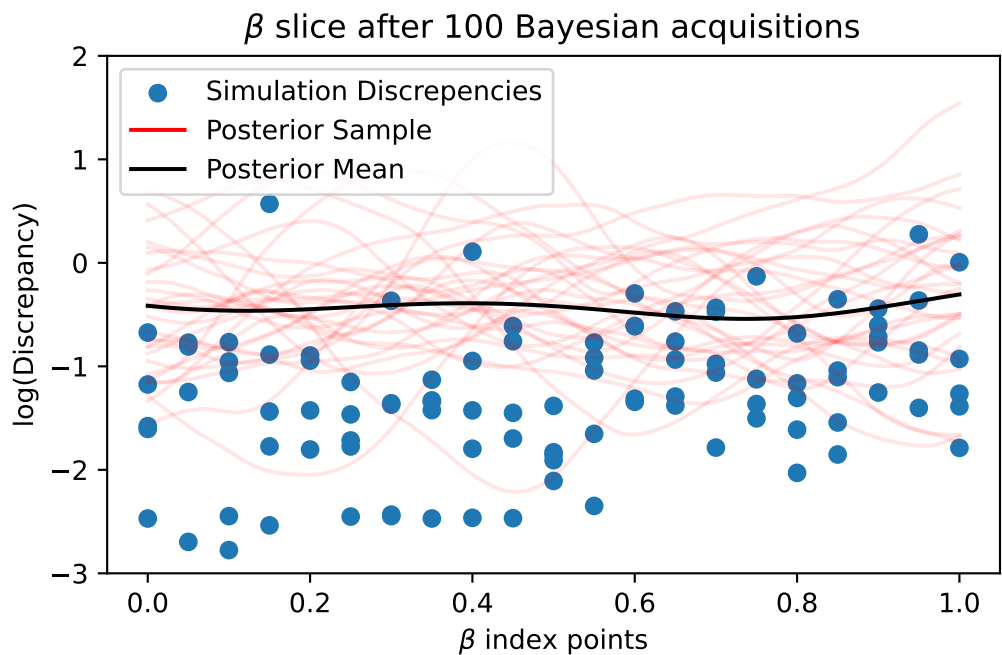
bias_mean:0 is 0.556

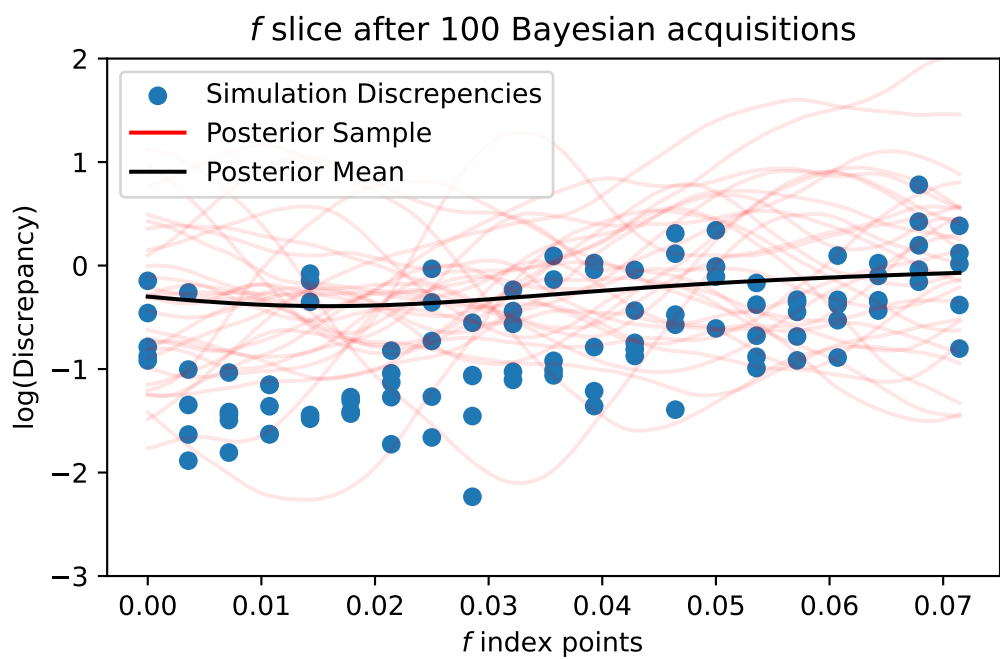
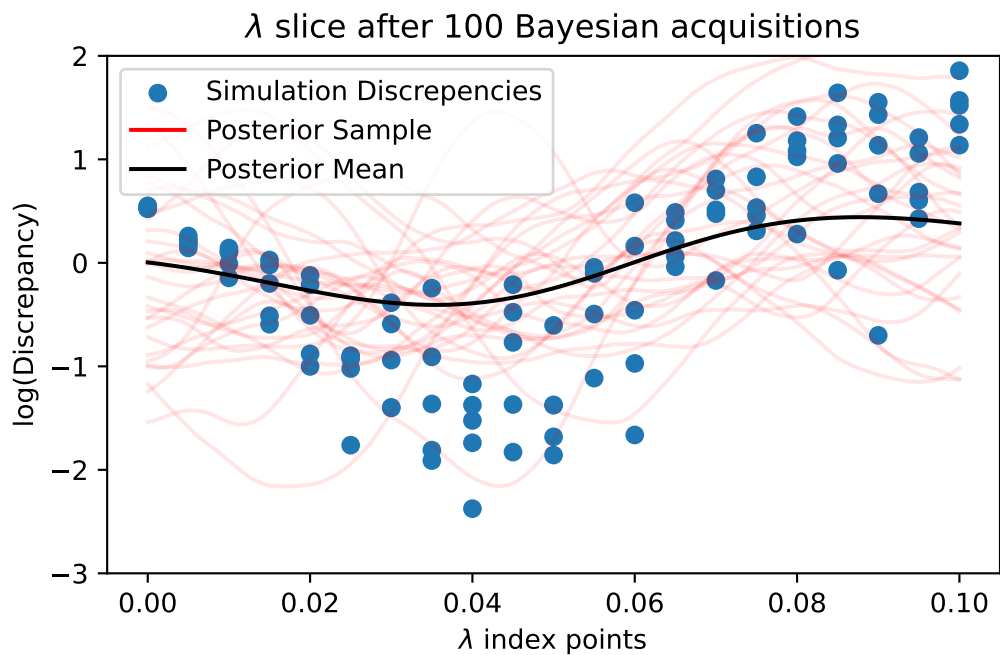


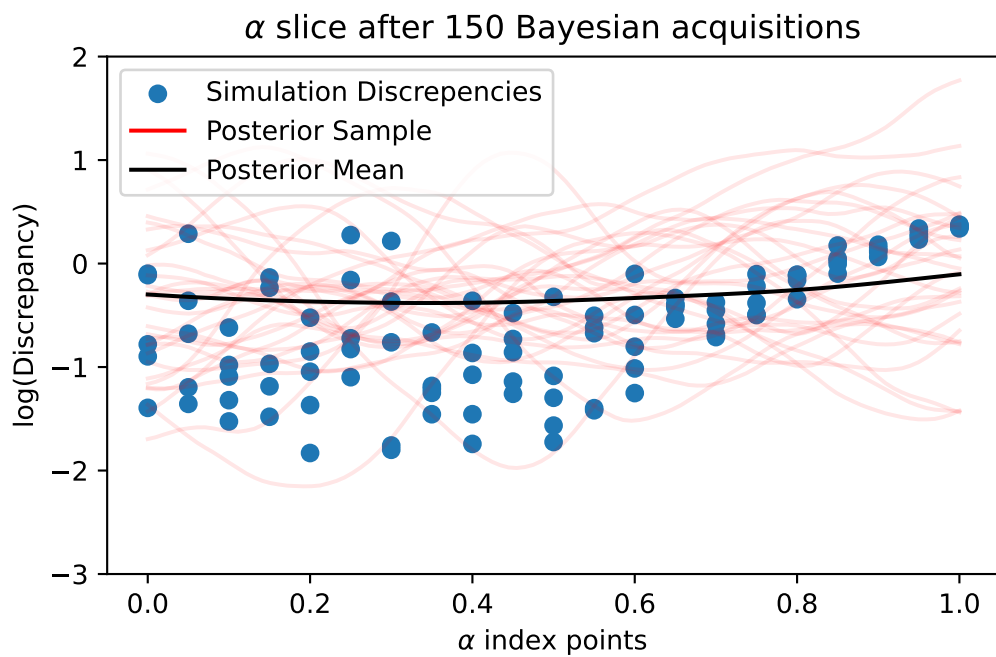
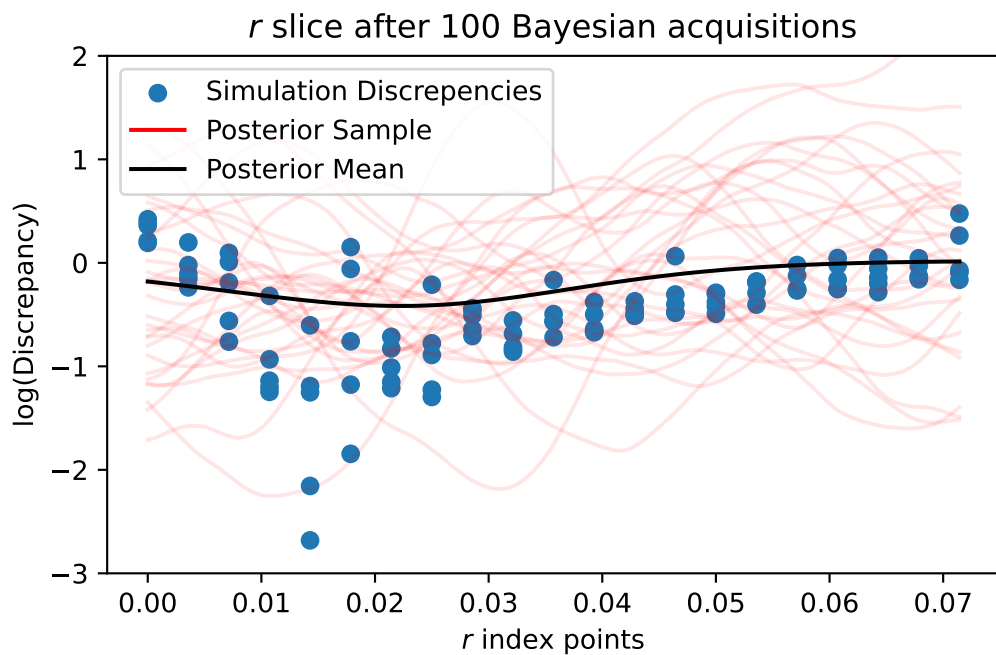


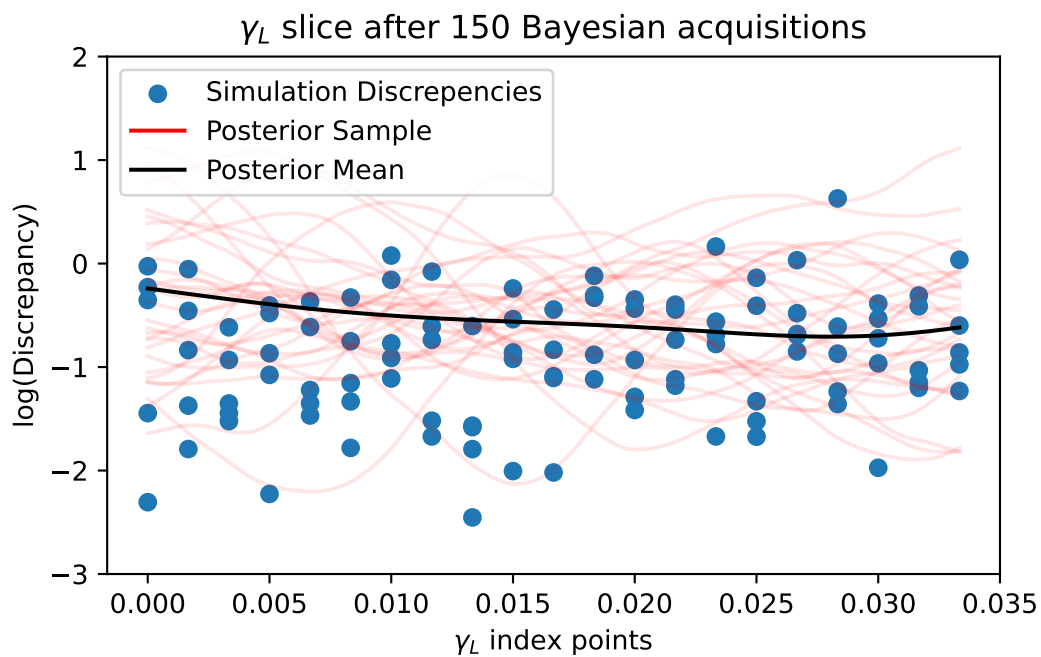
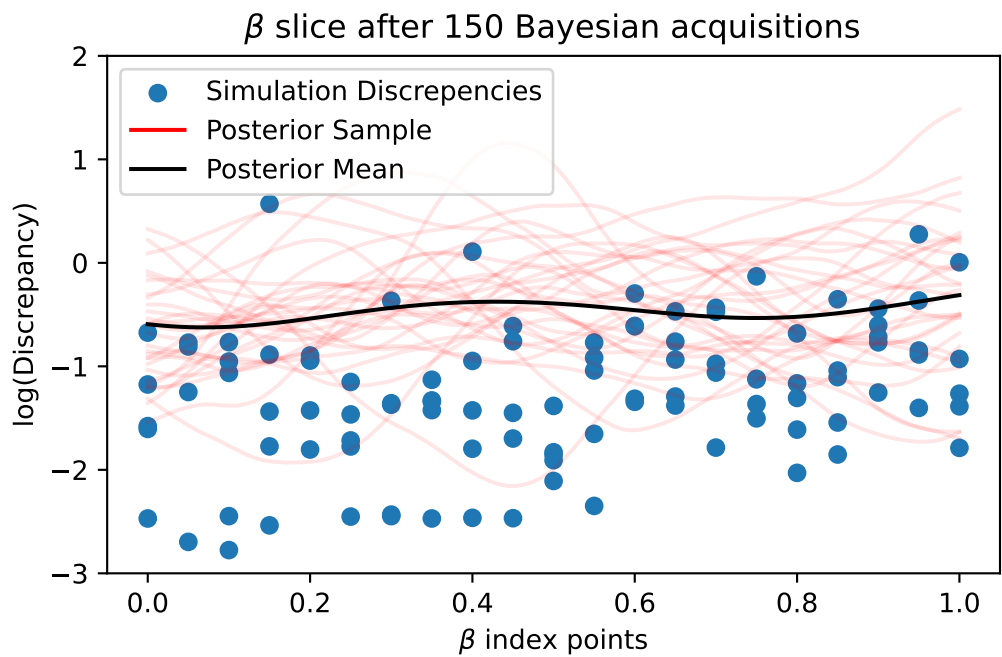


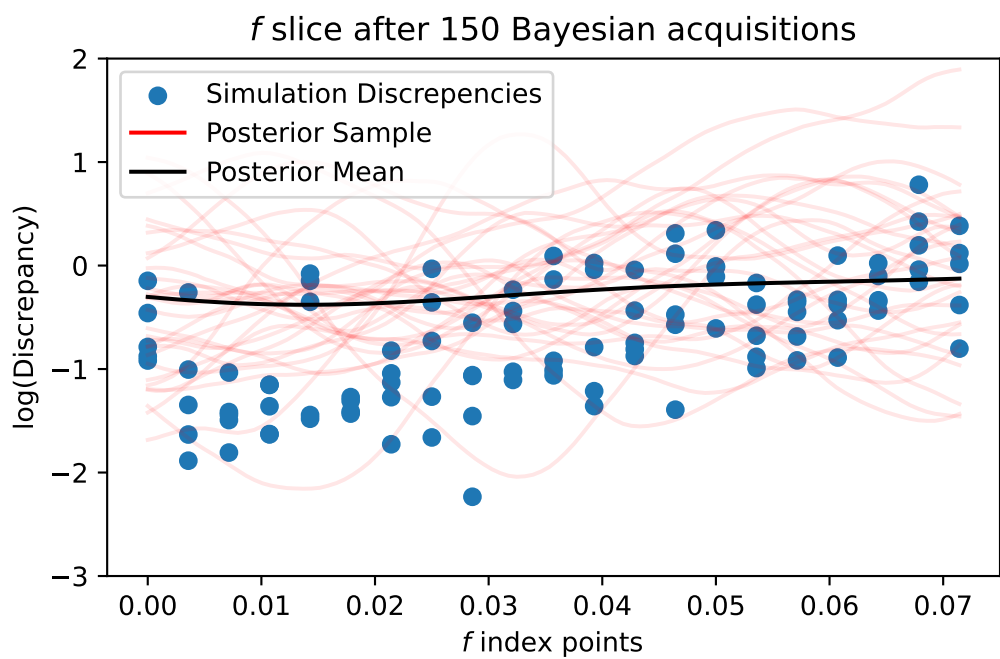
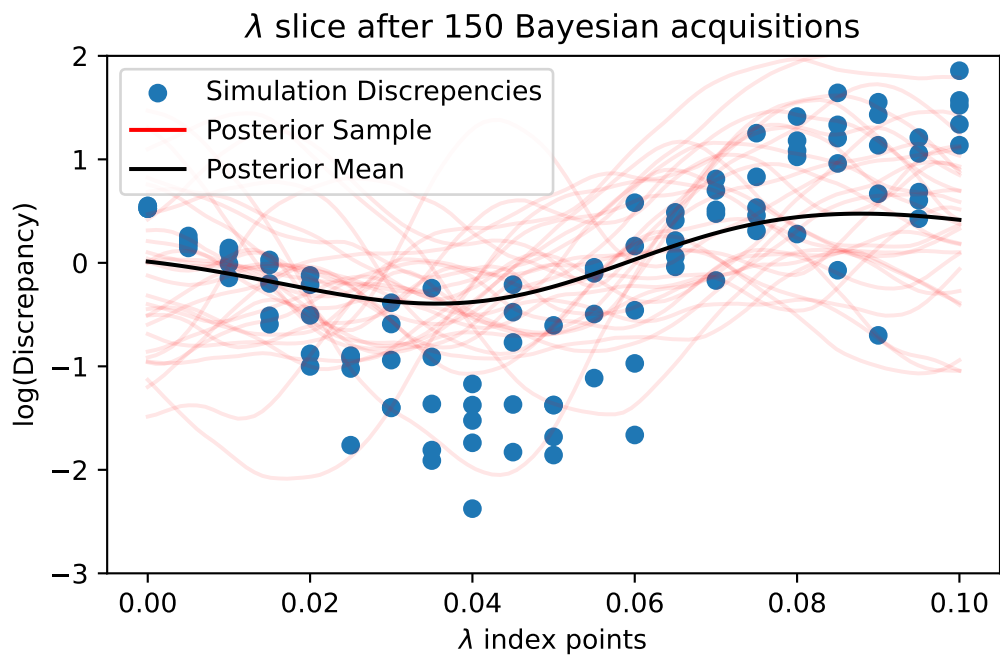


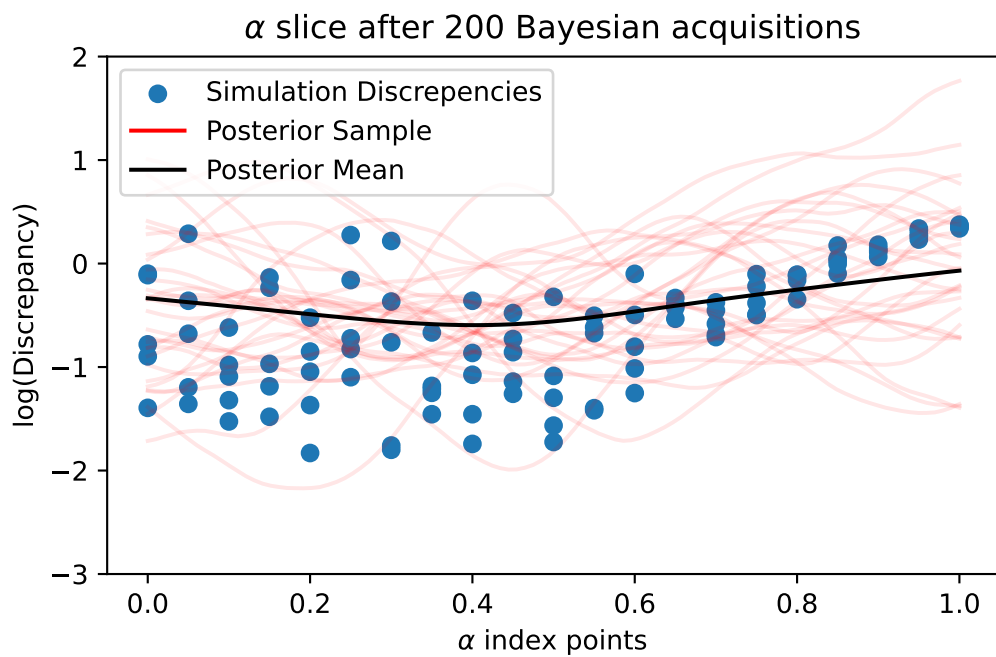
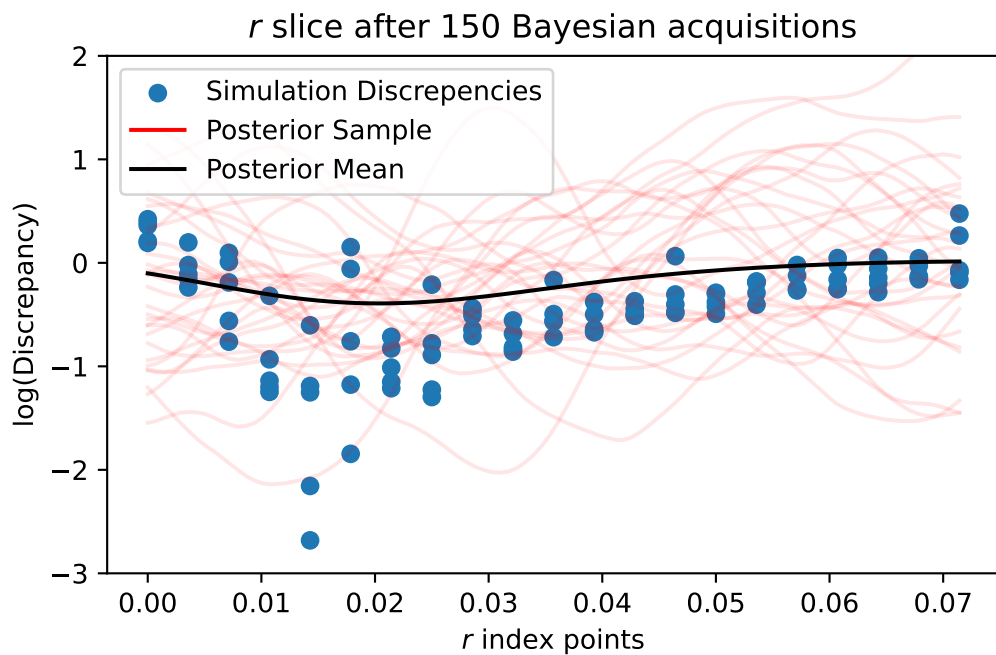


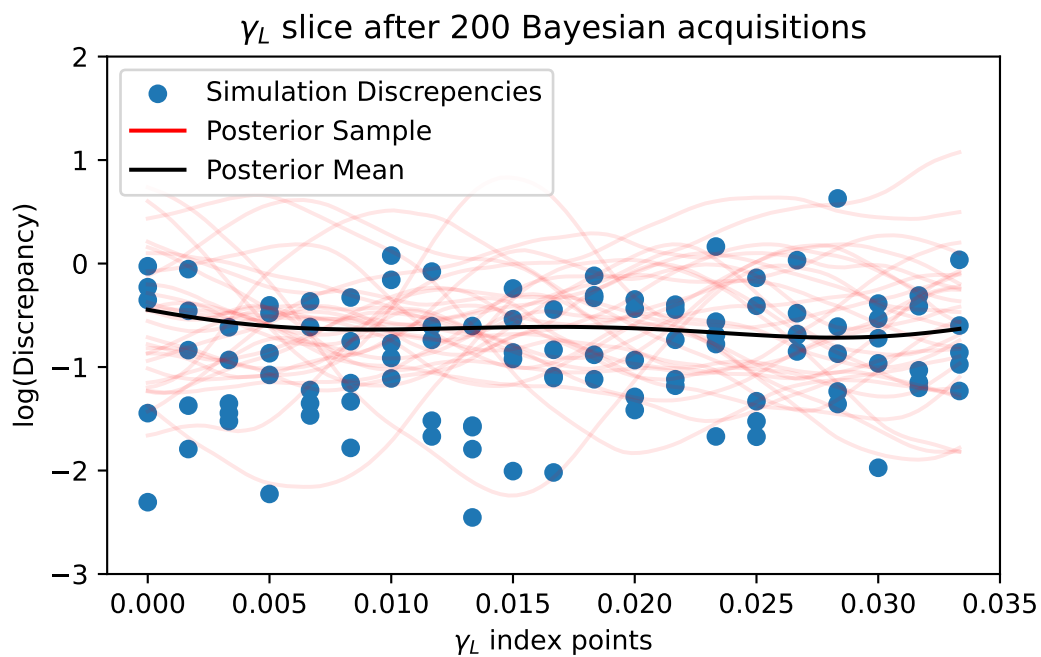
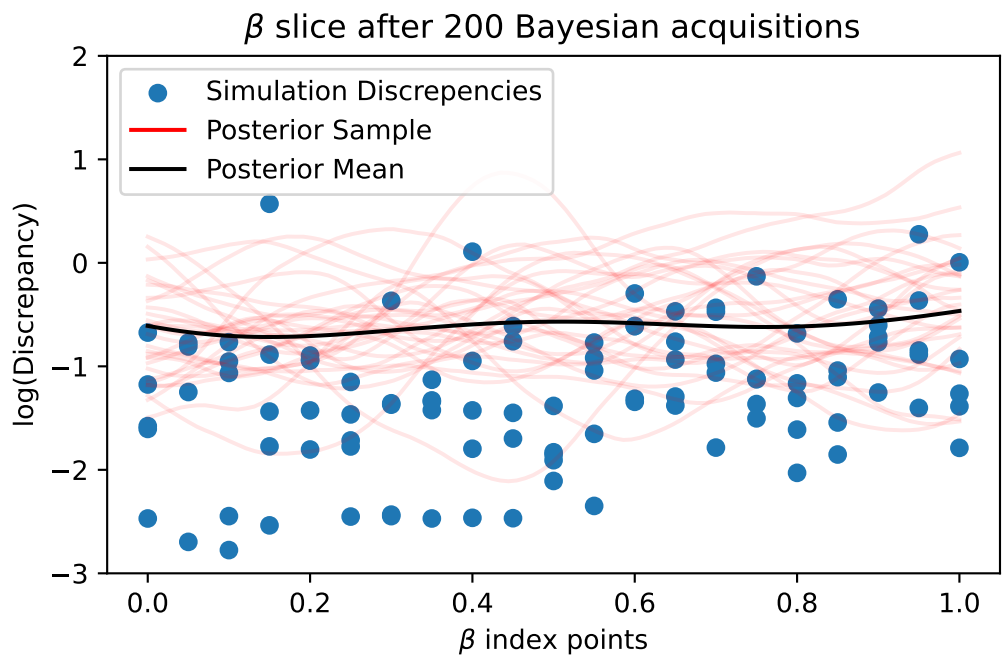


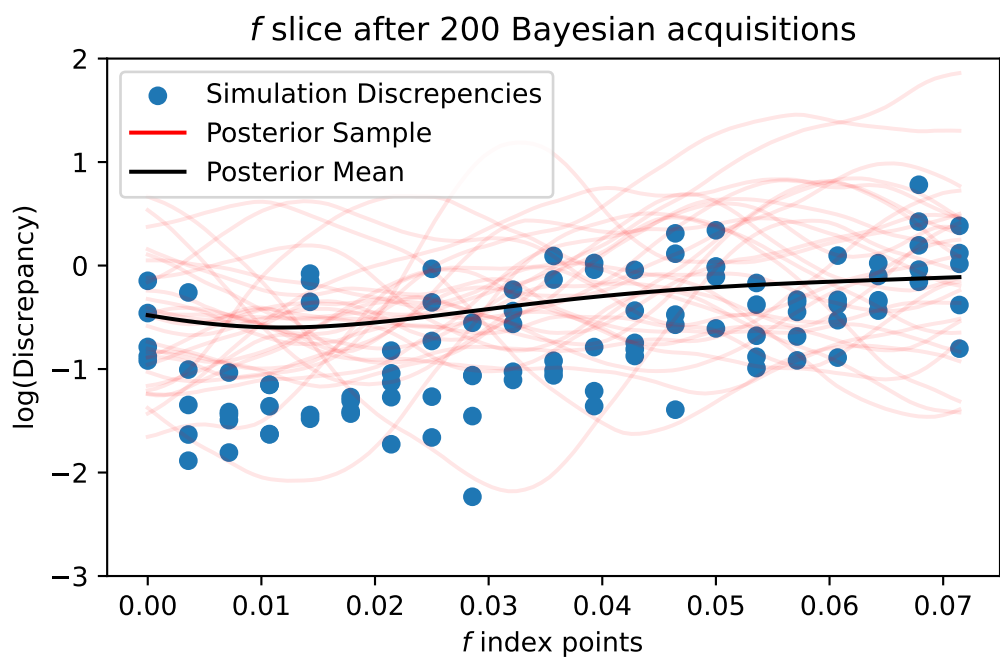
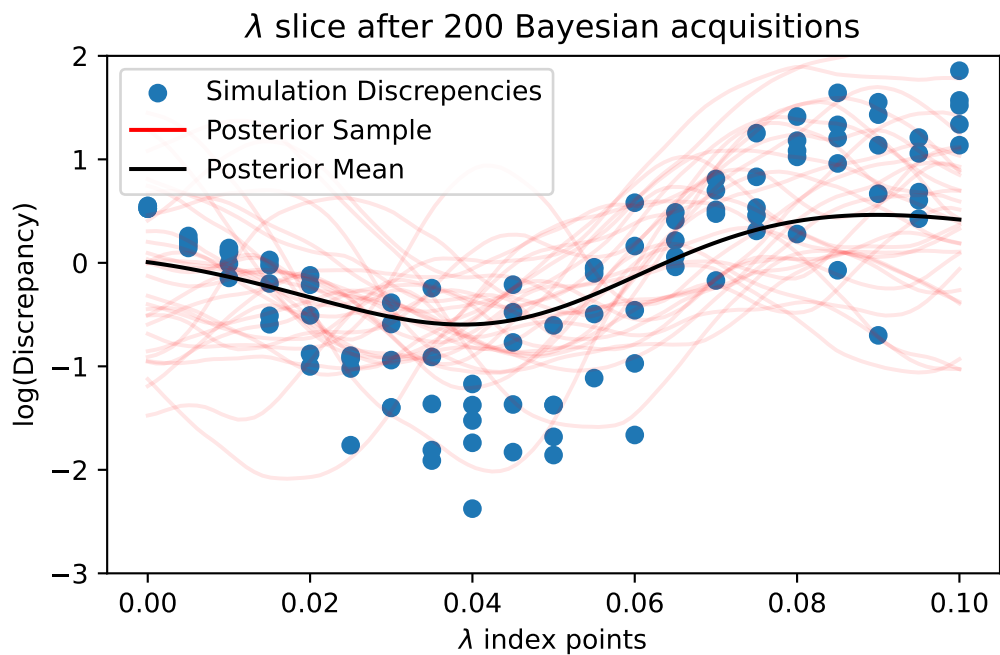


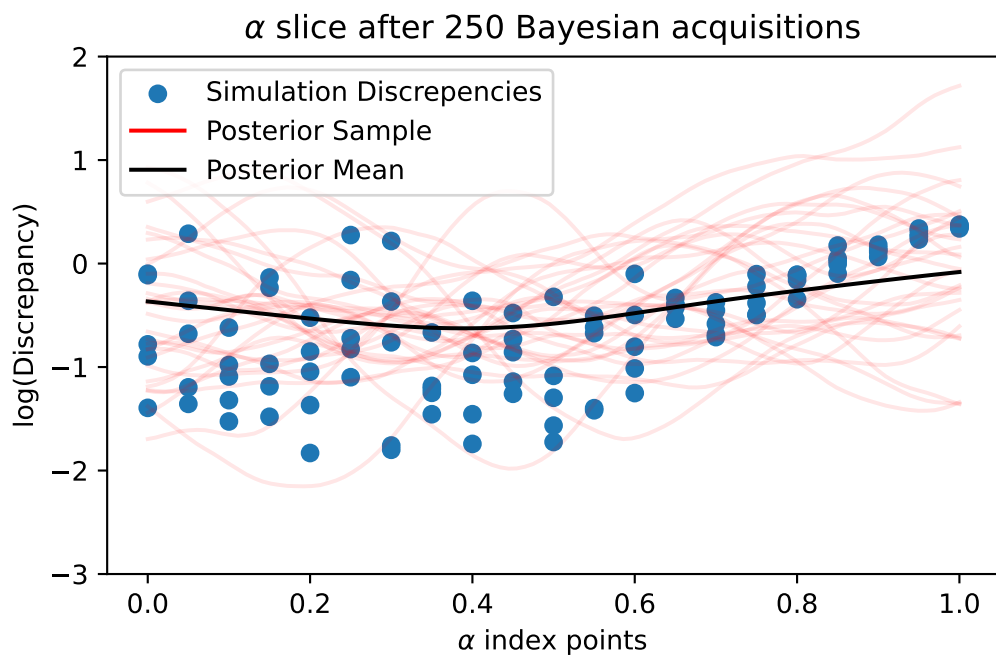
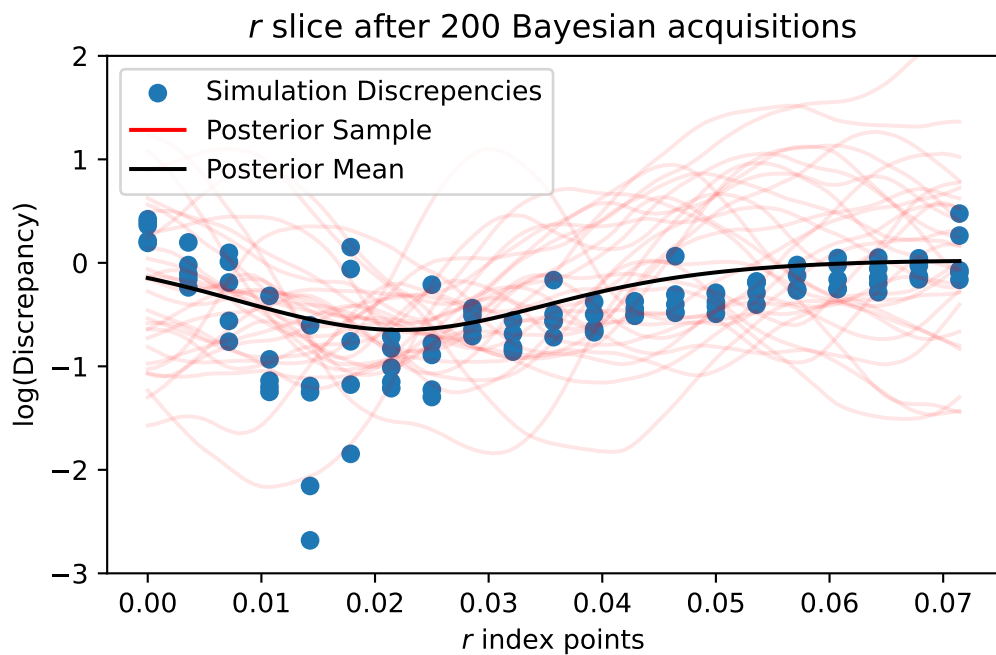


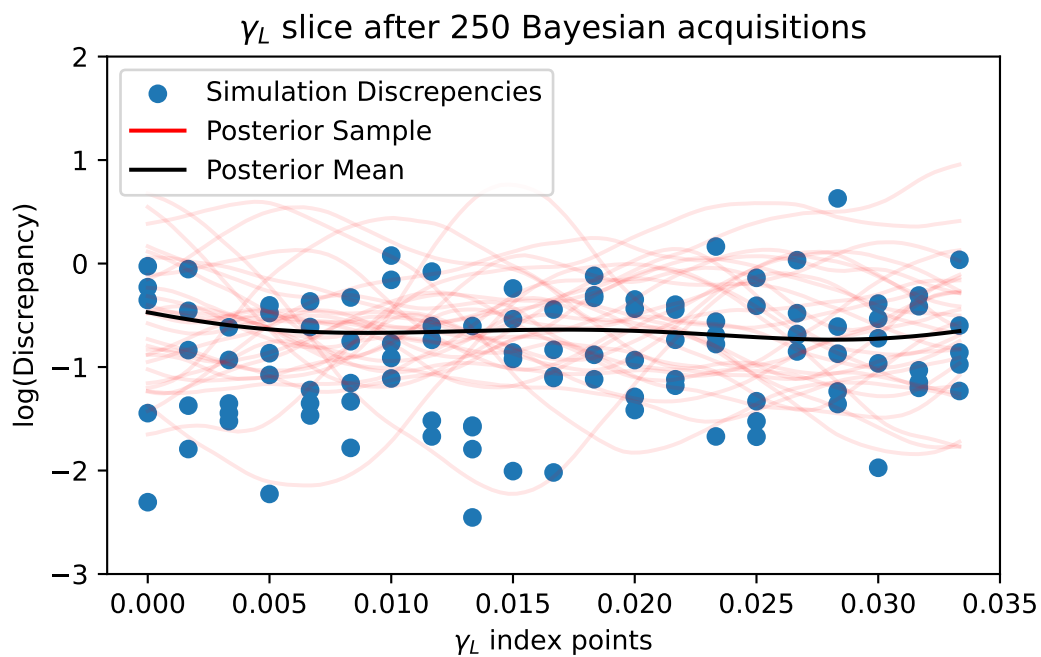
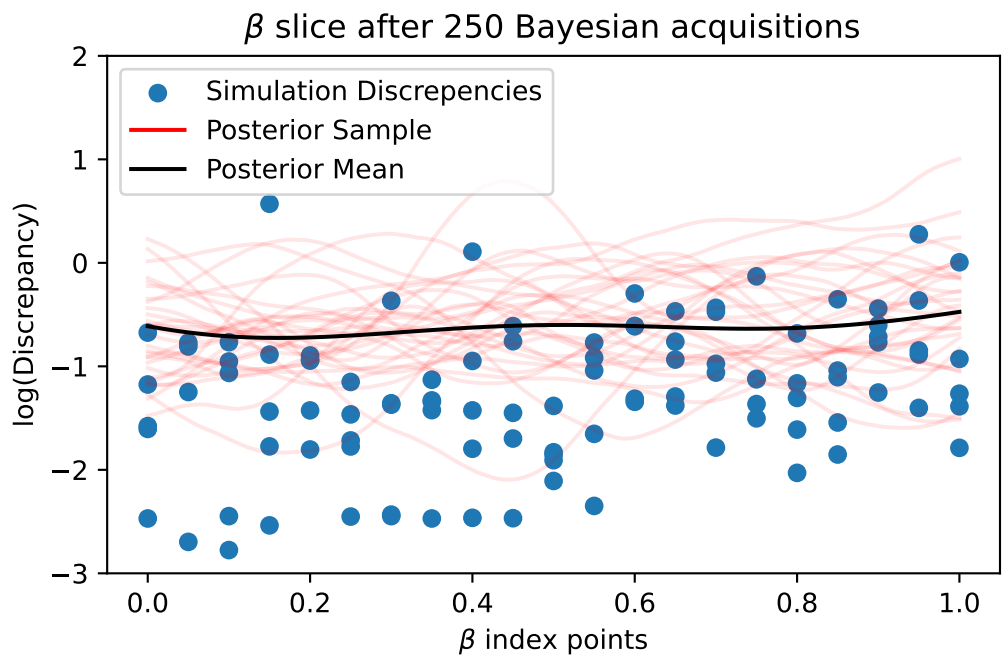


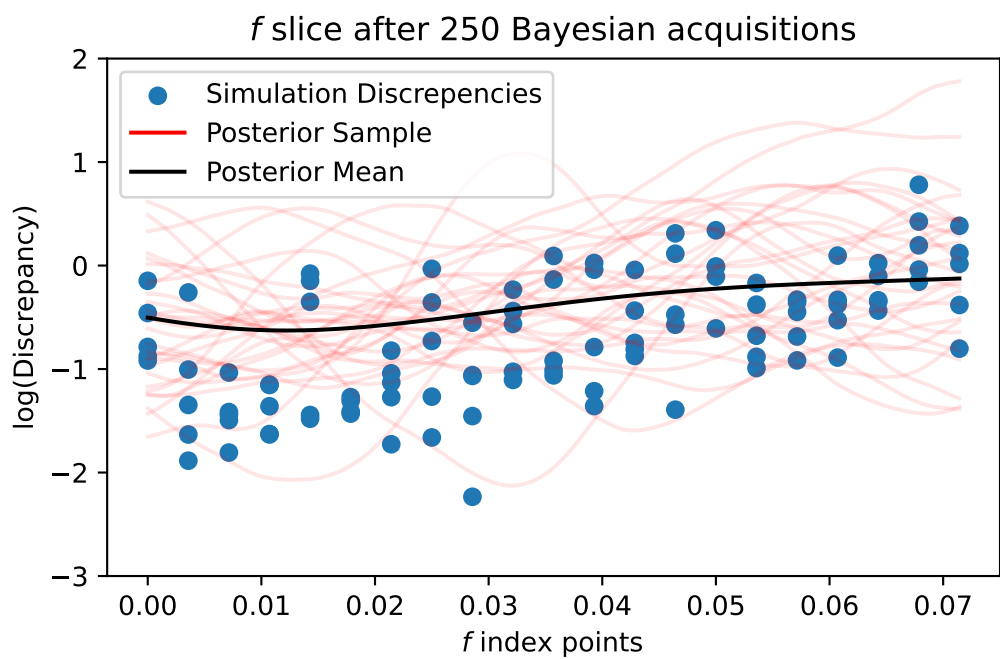
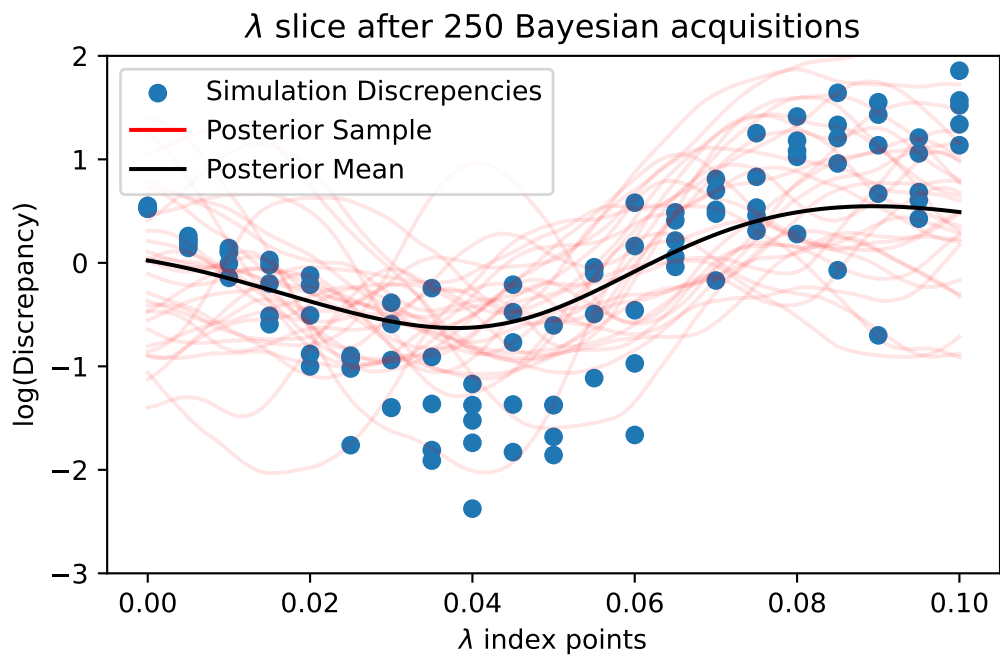


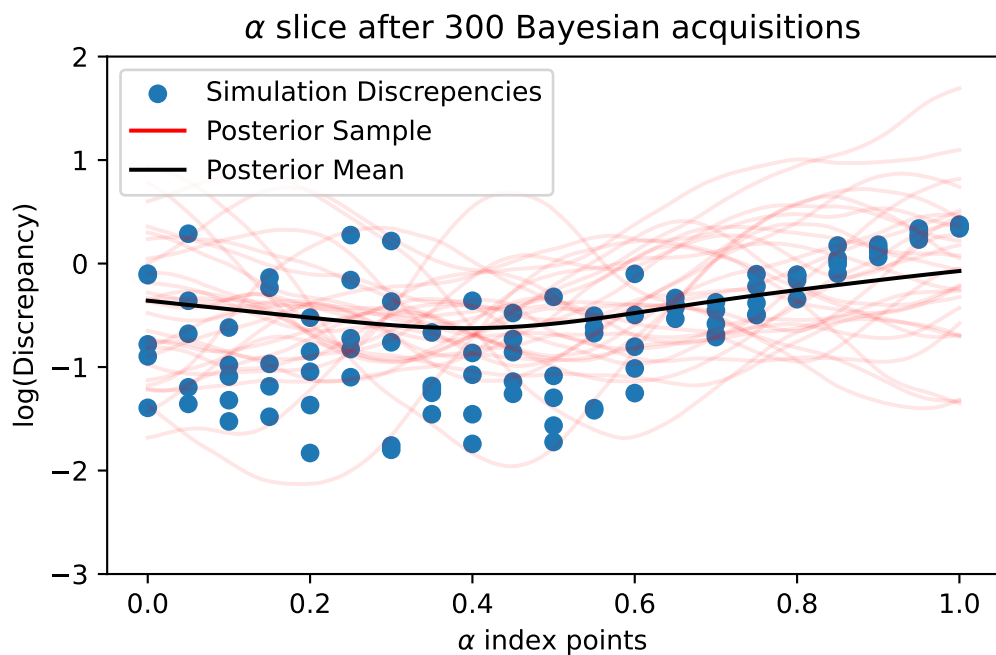
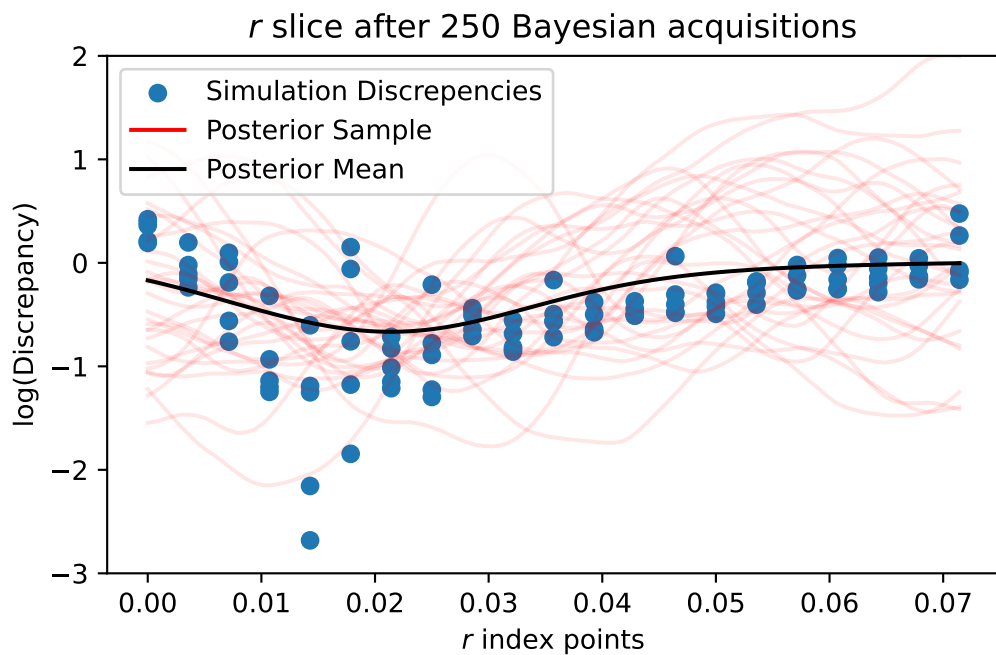


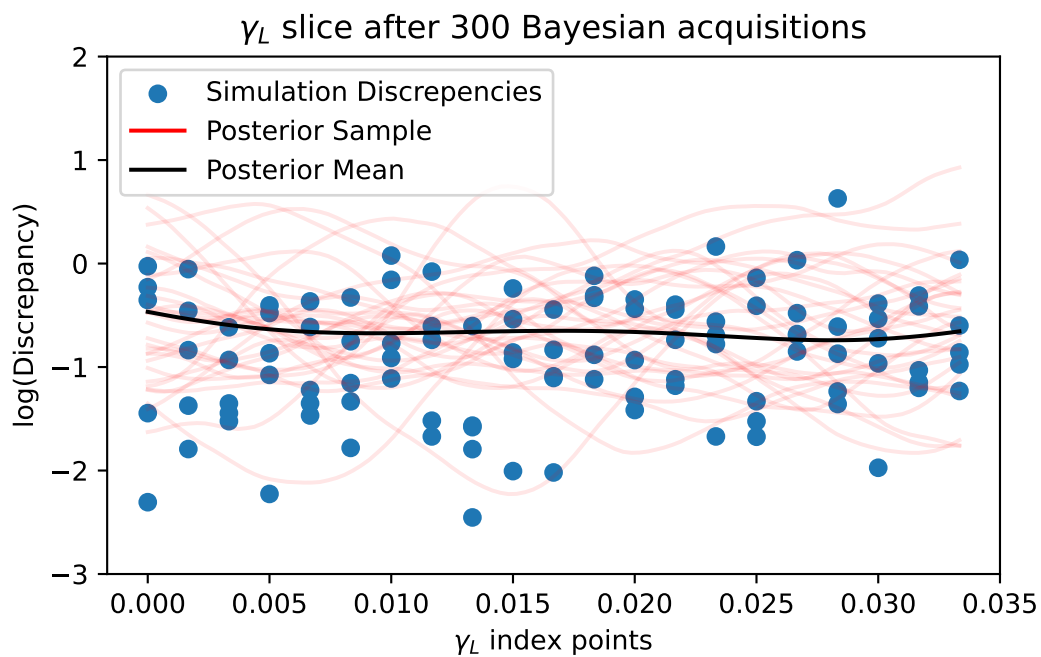
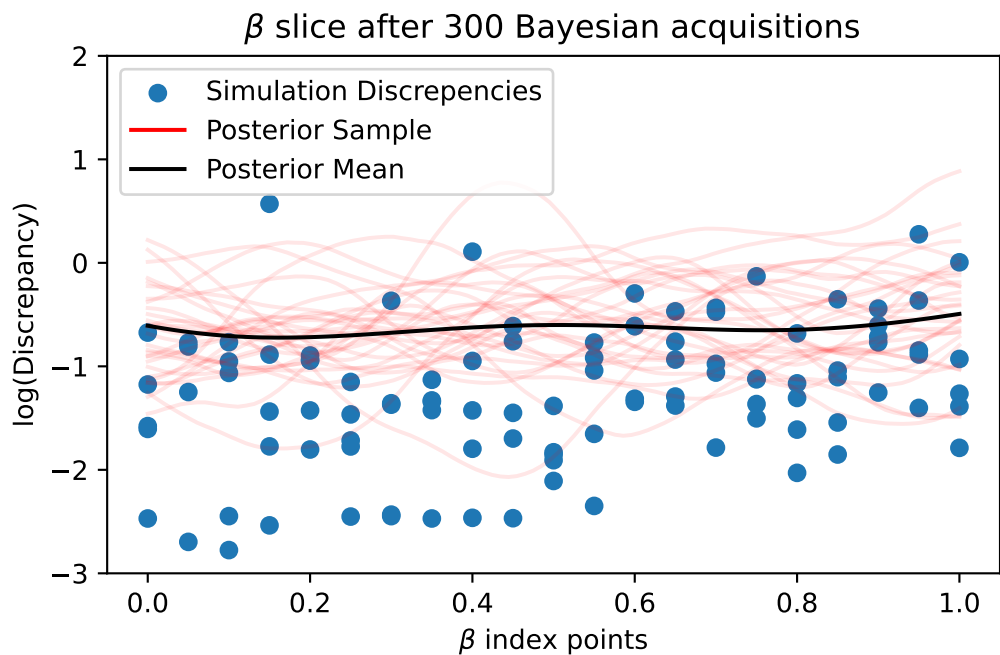


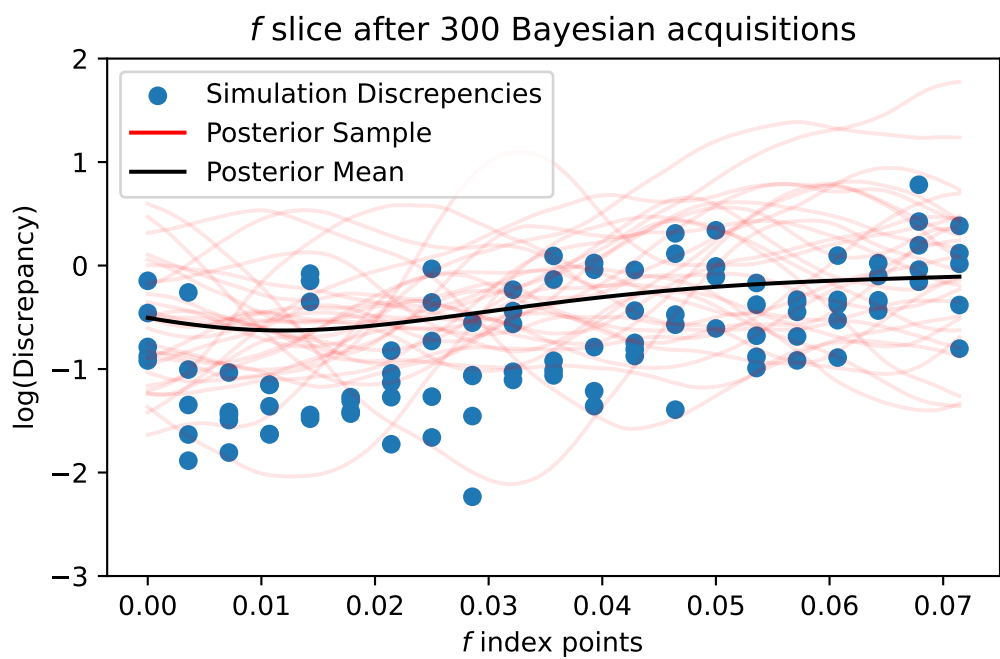
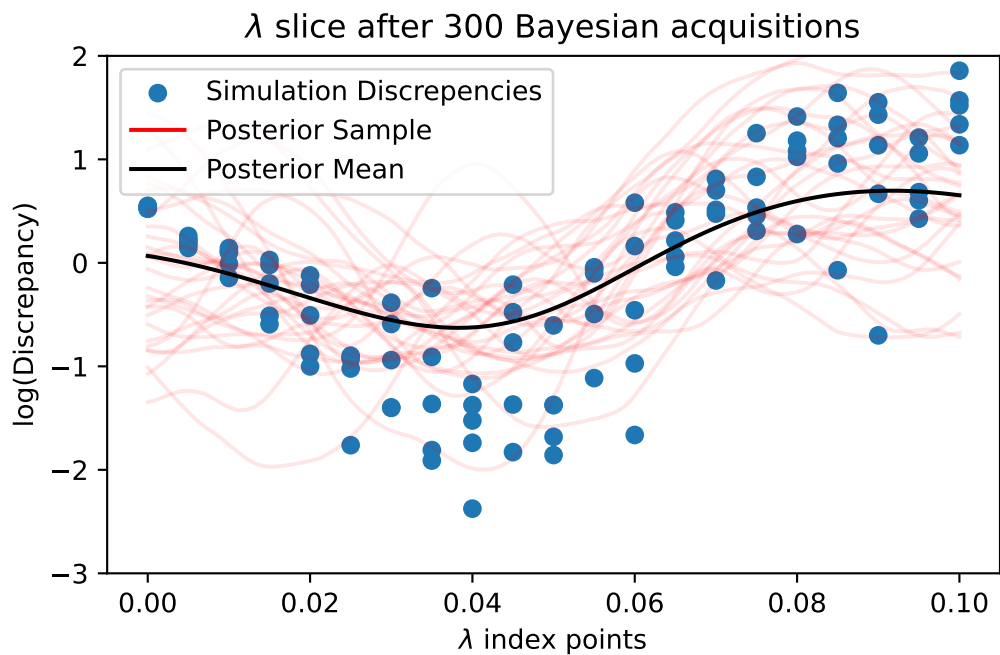


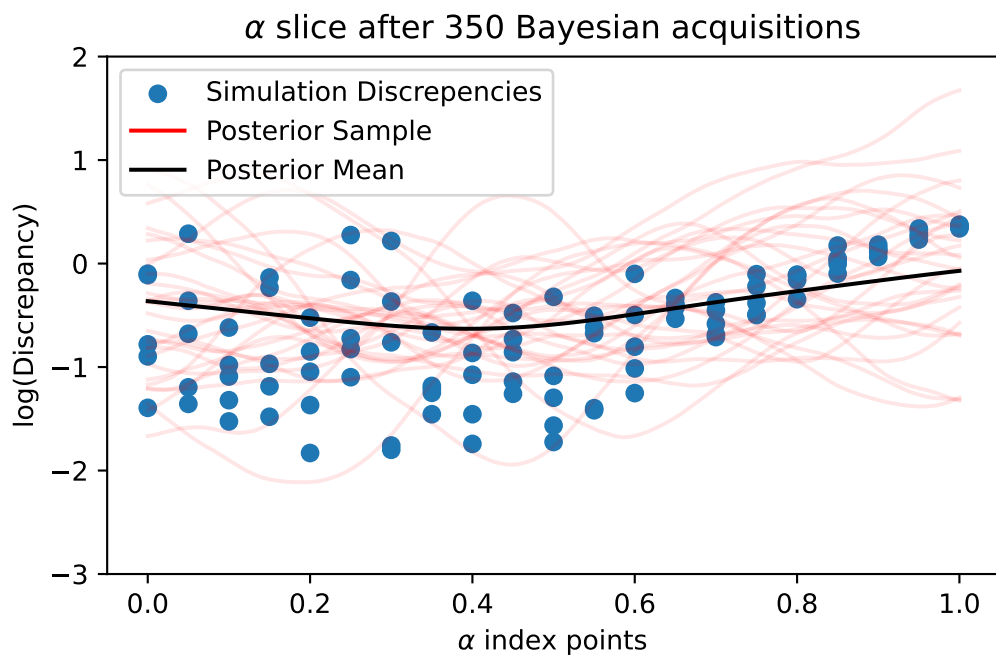
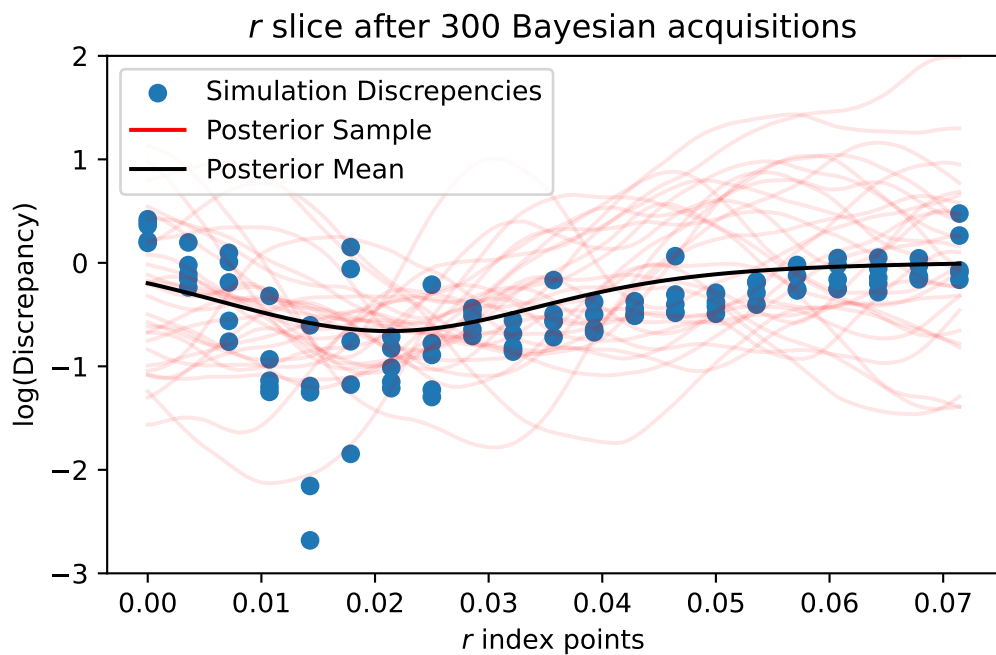


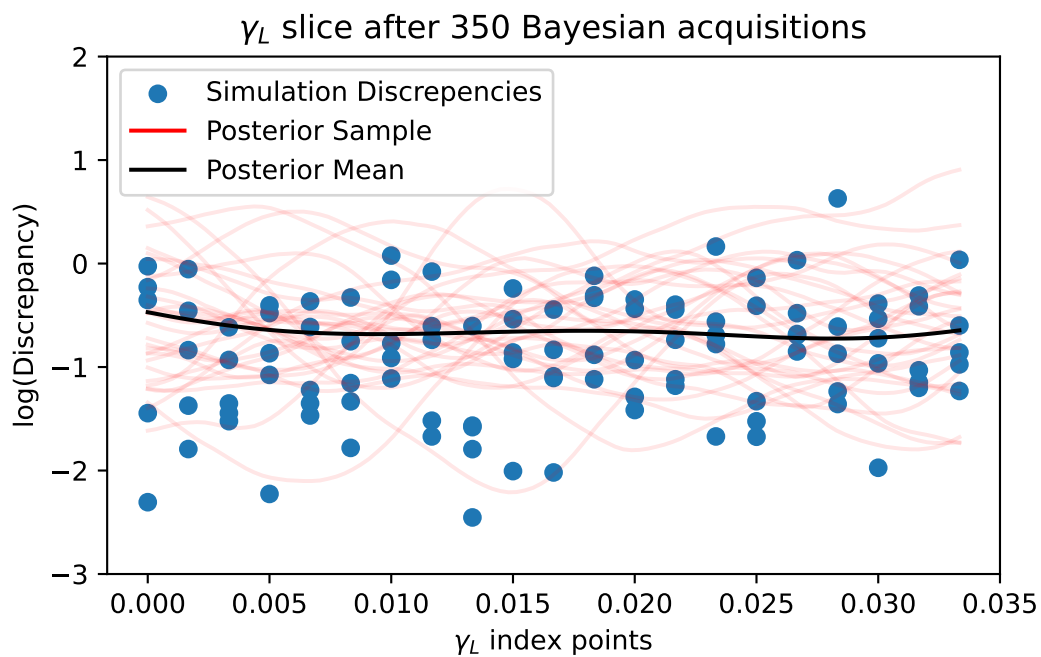
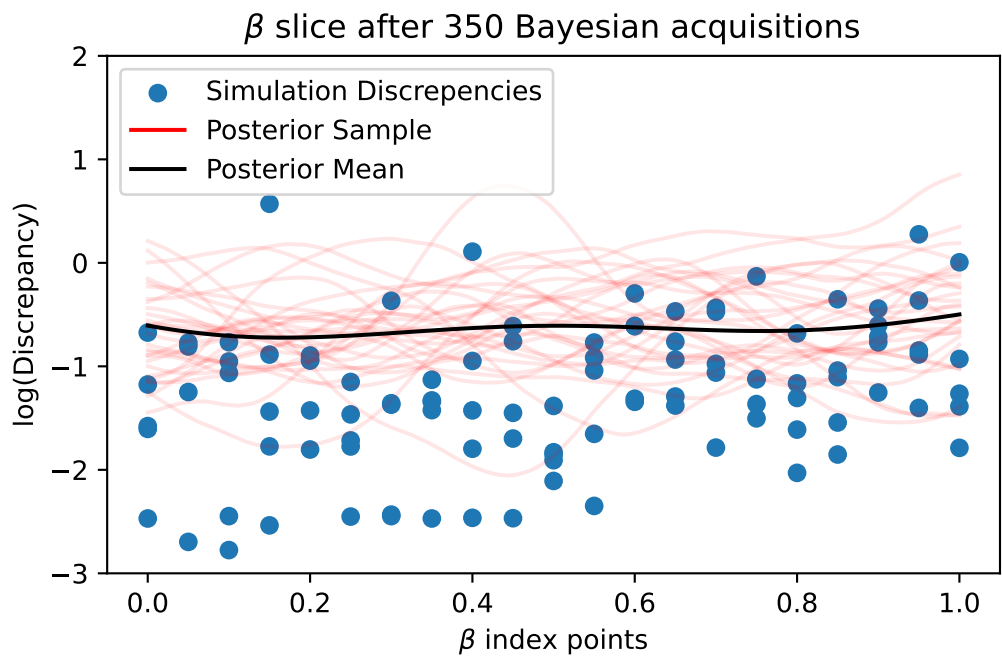


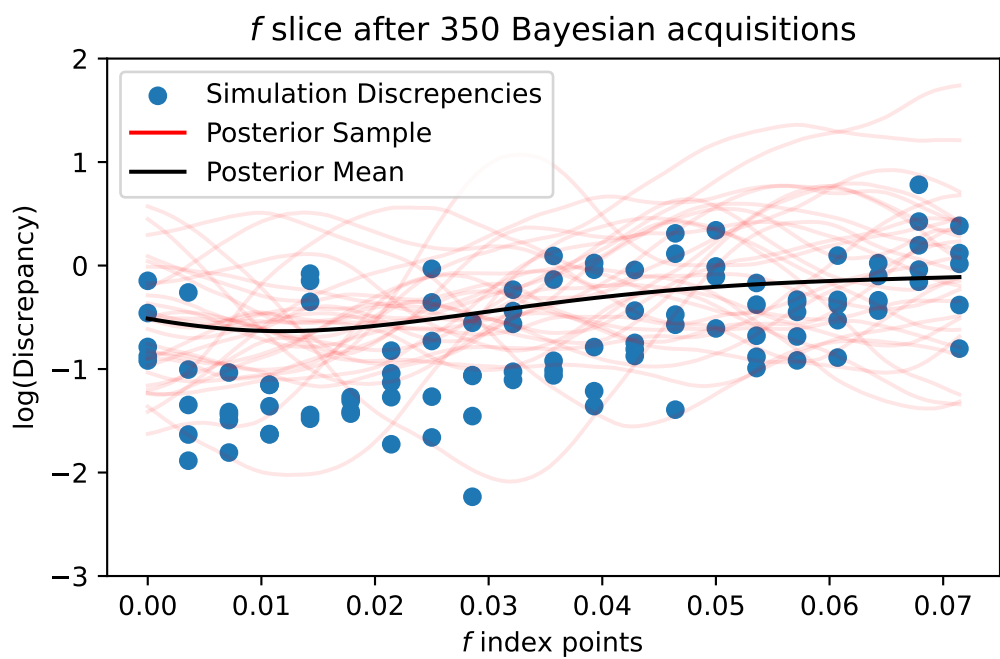
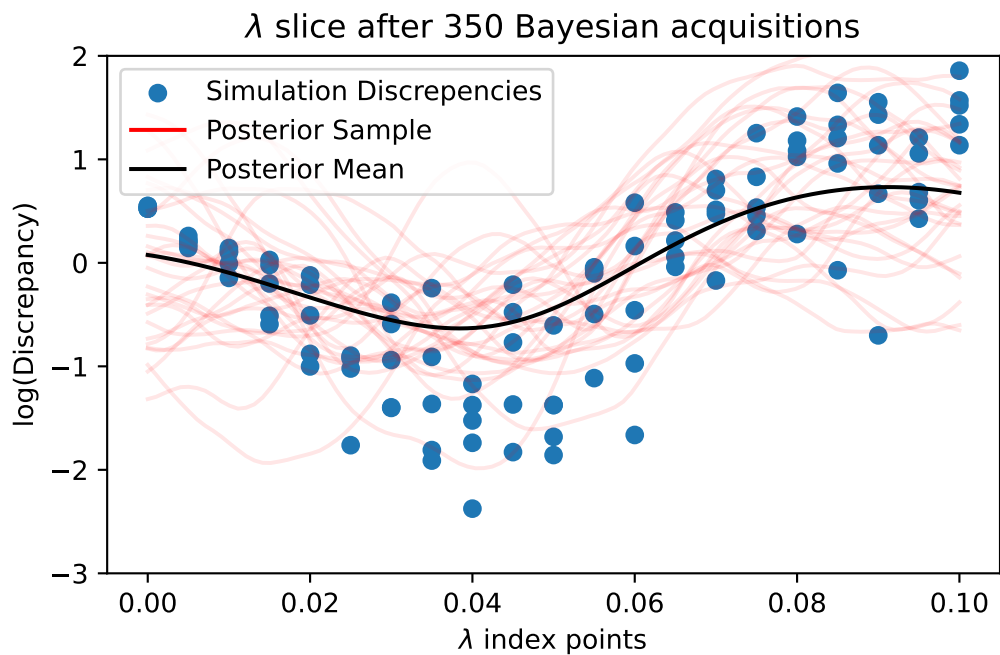


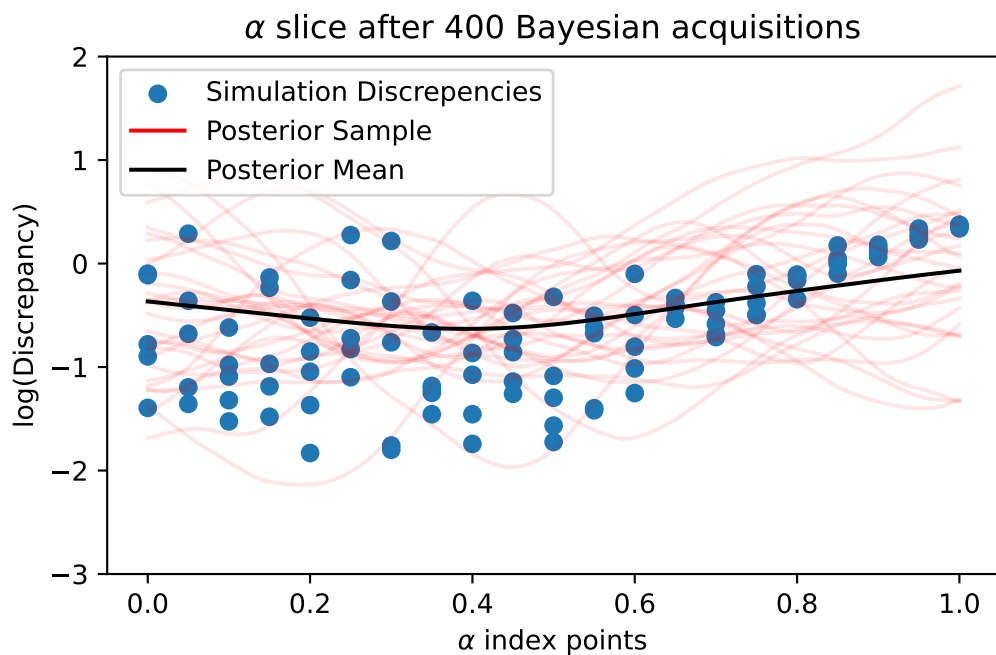
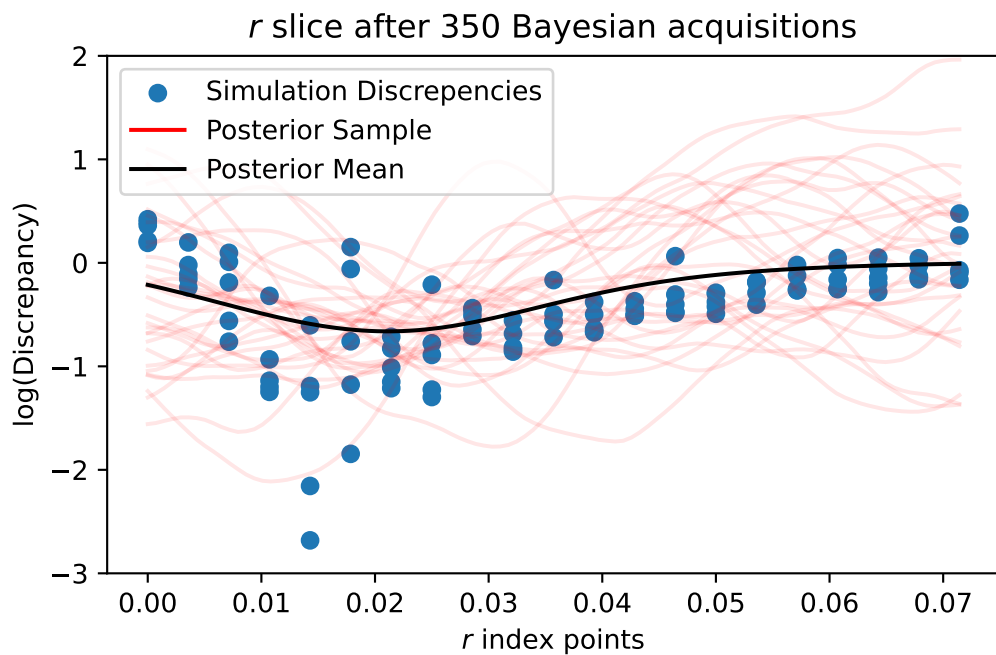


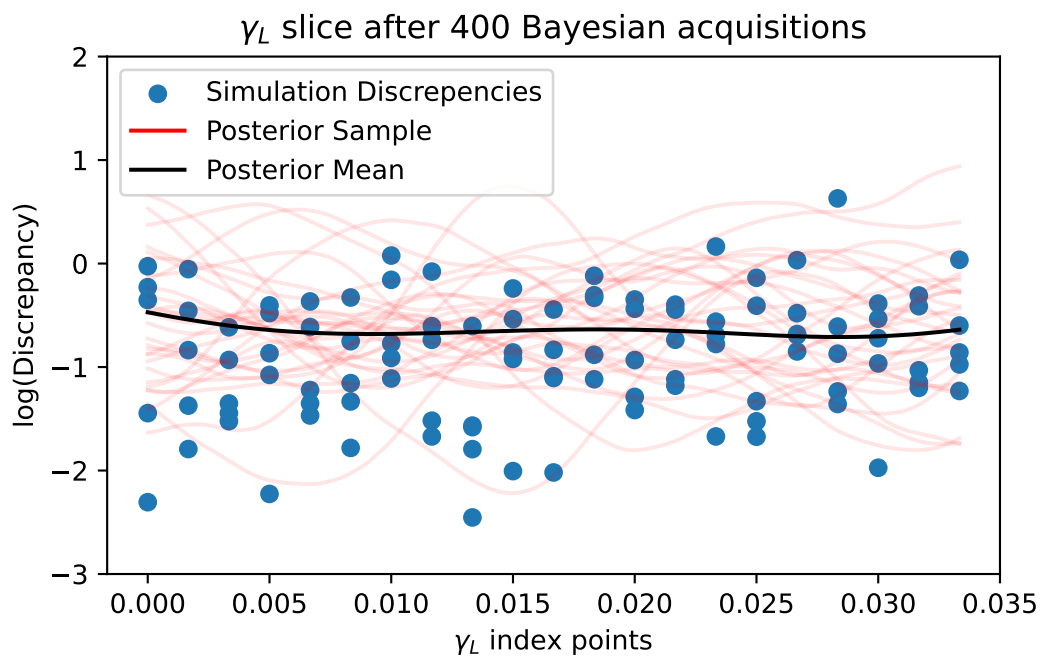
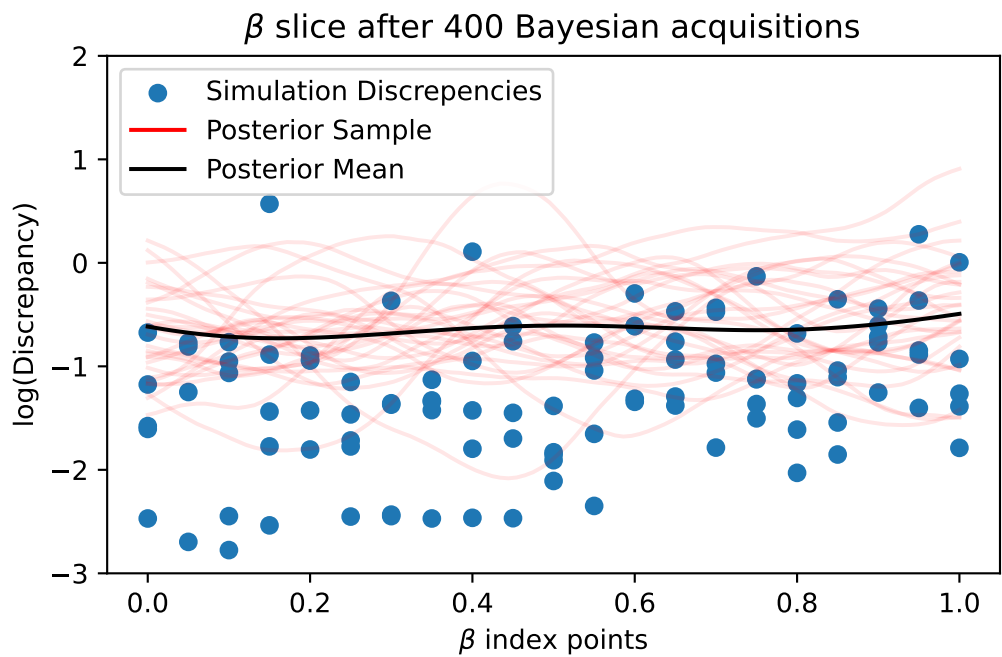


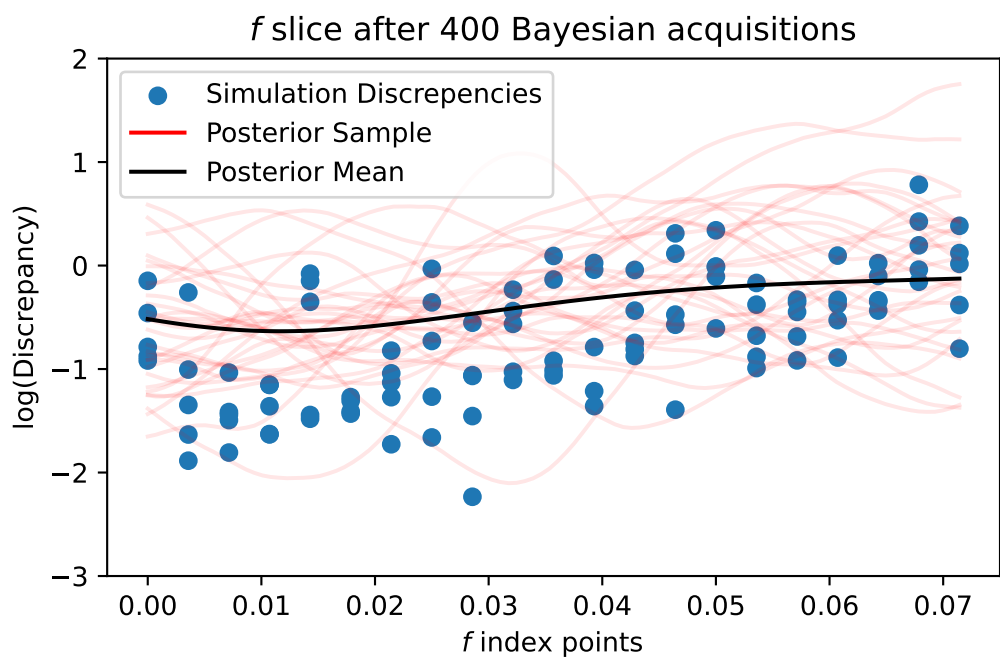
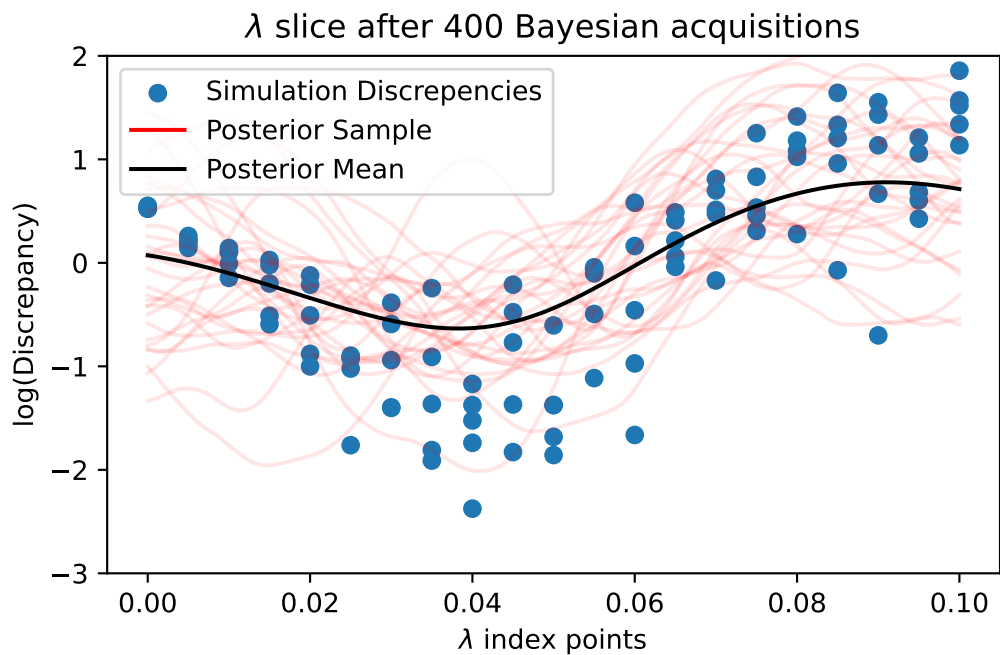


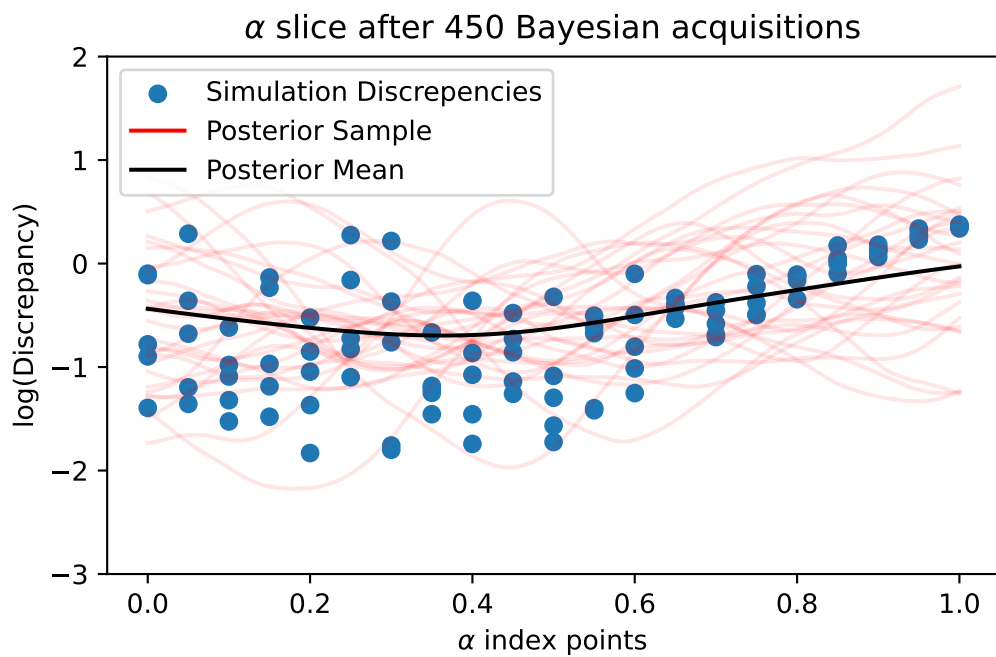
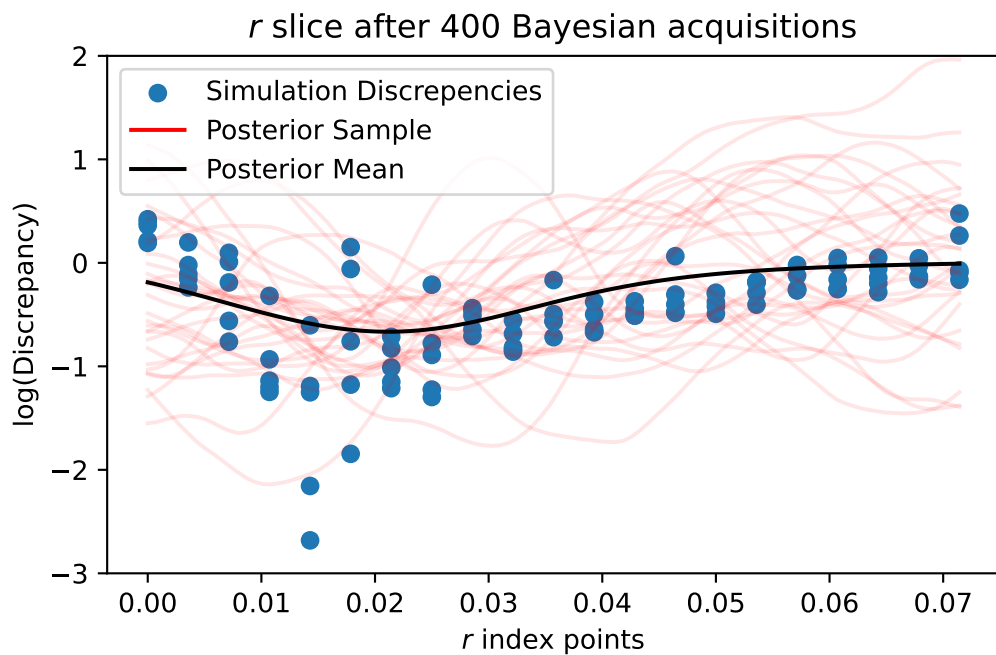


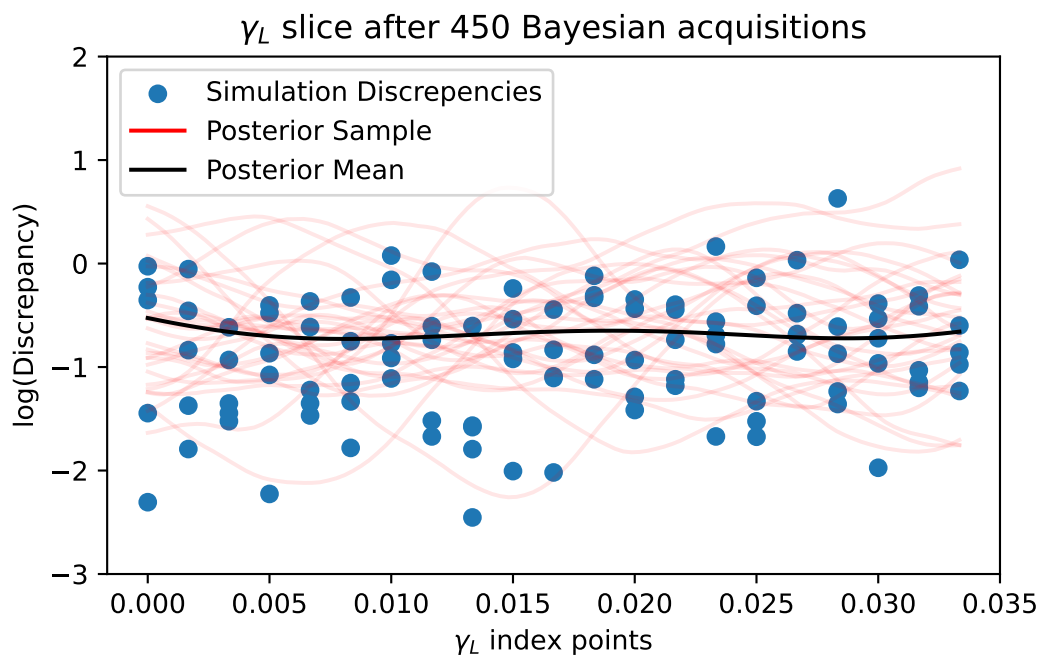
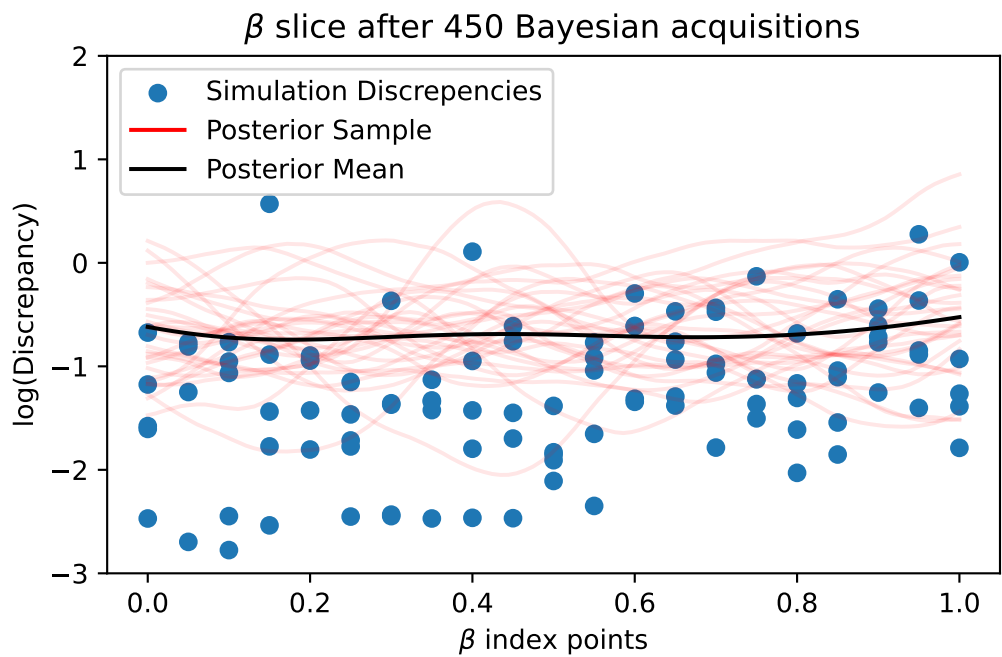


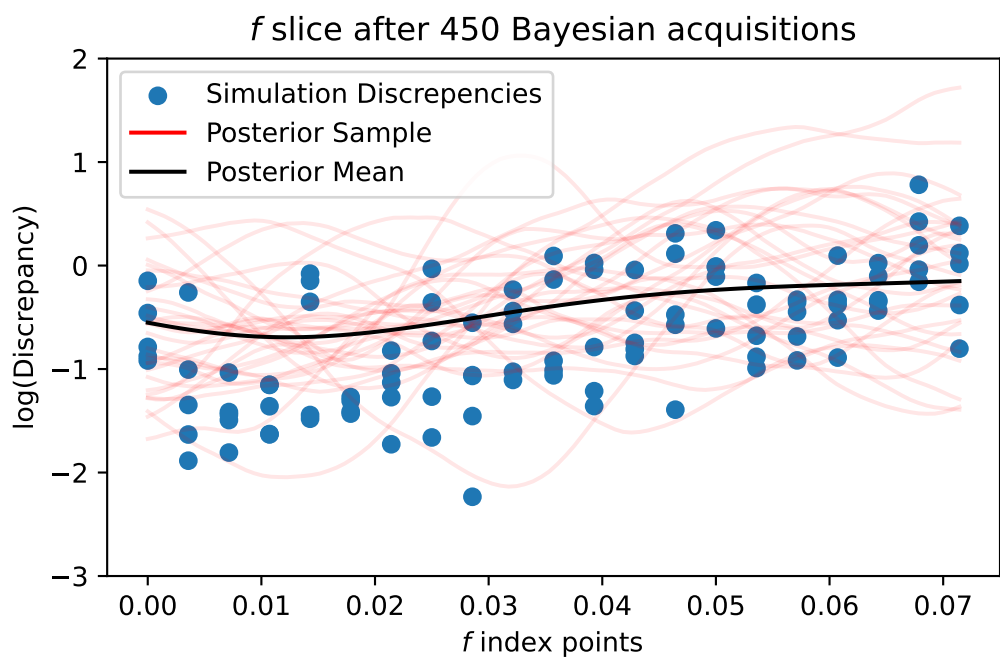
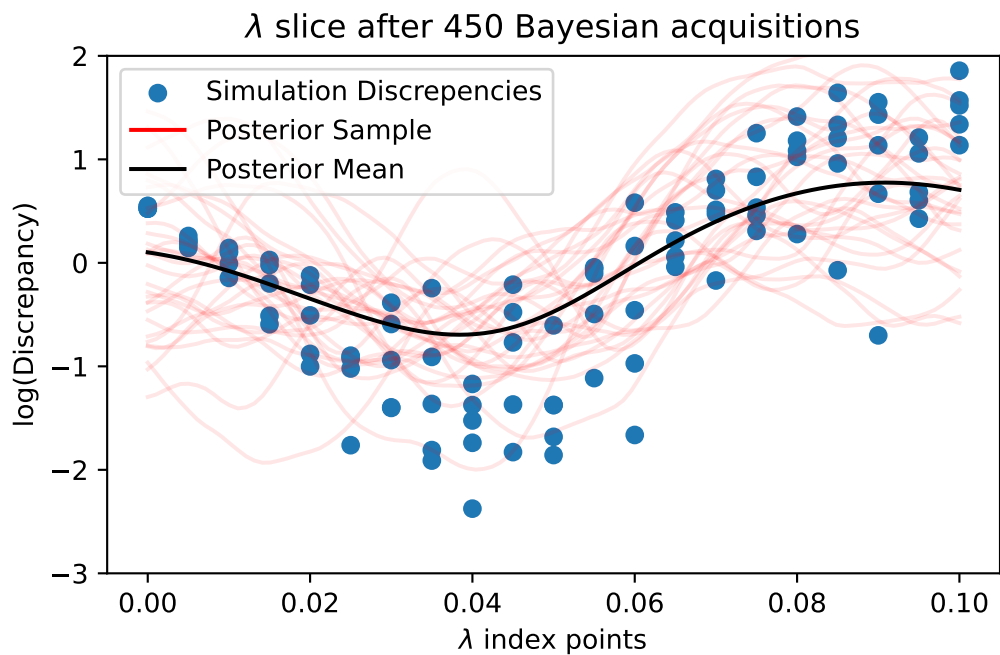


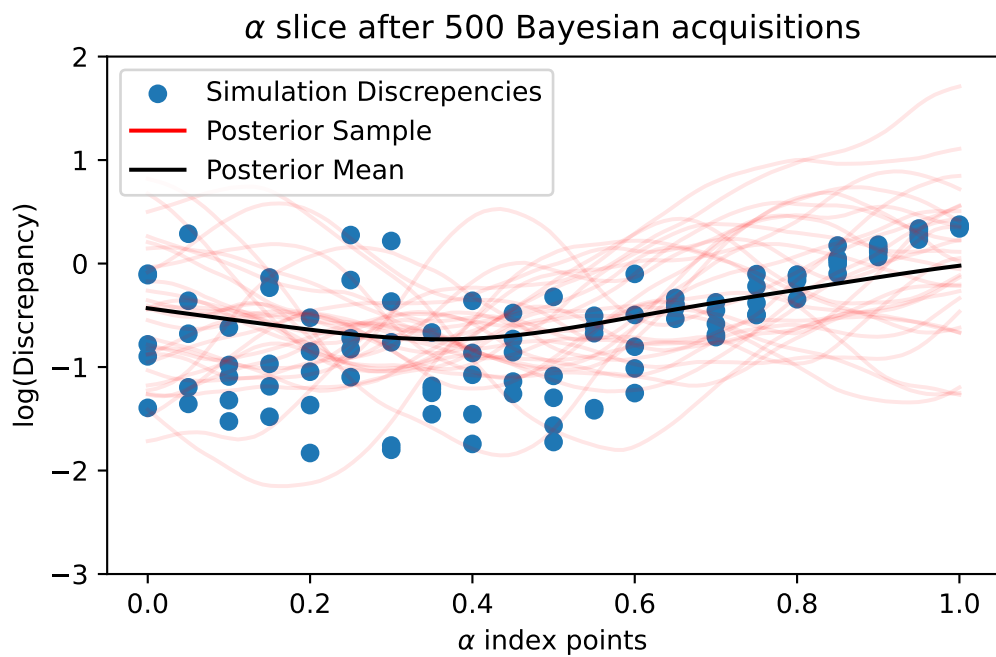
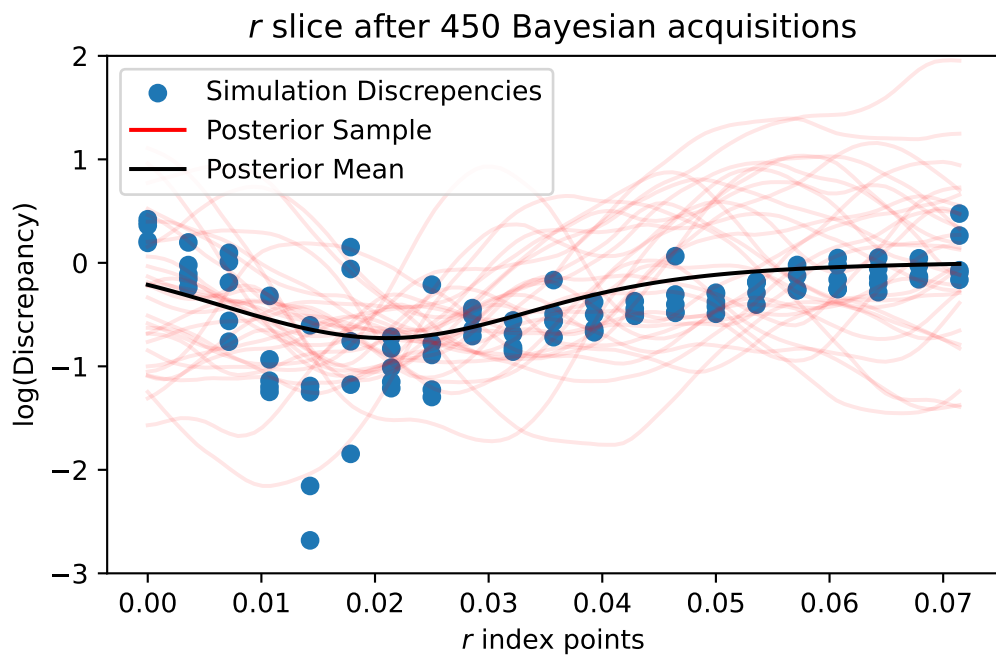


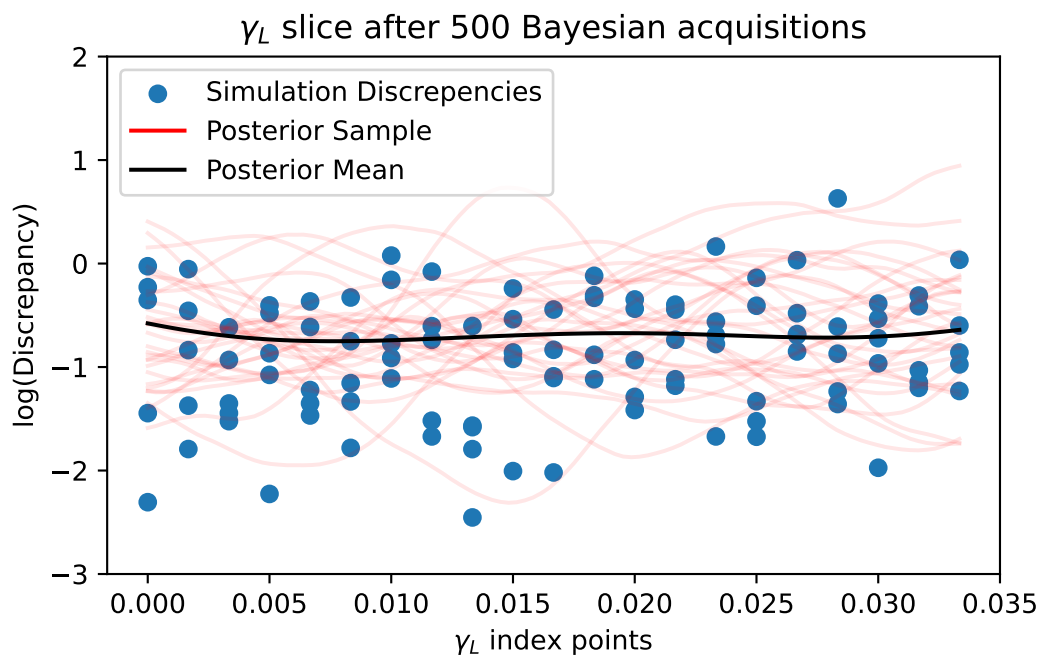
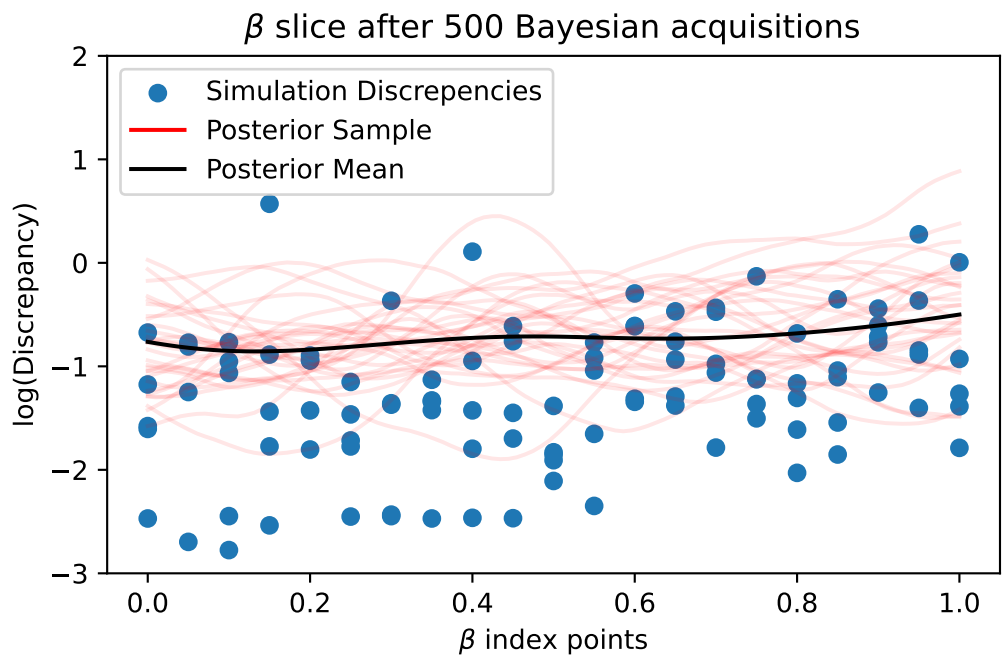


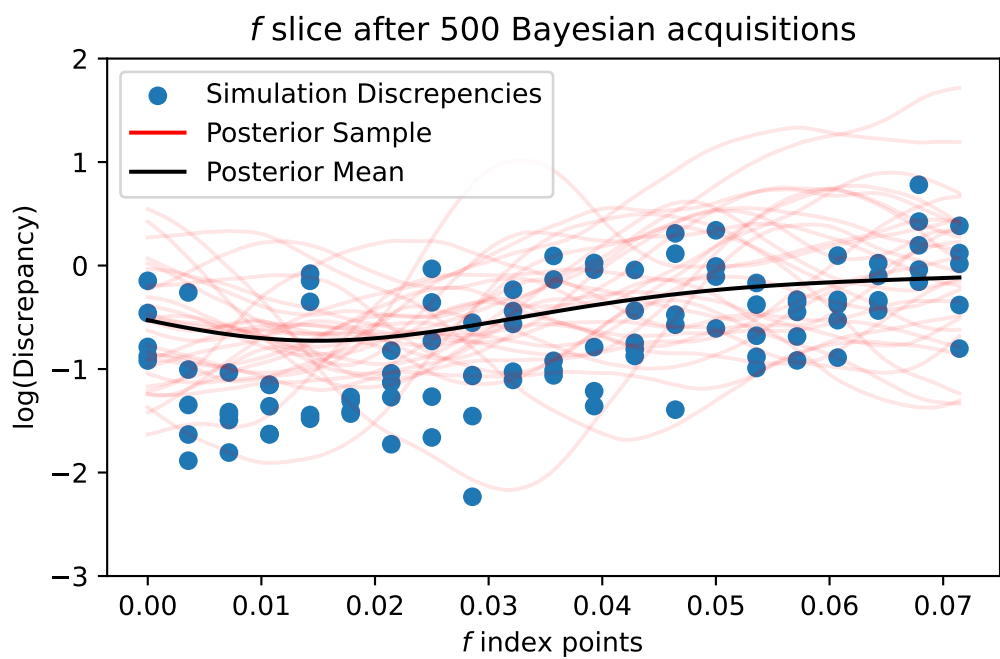
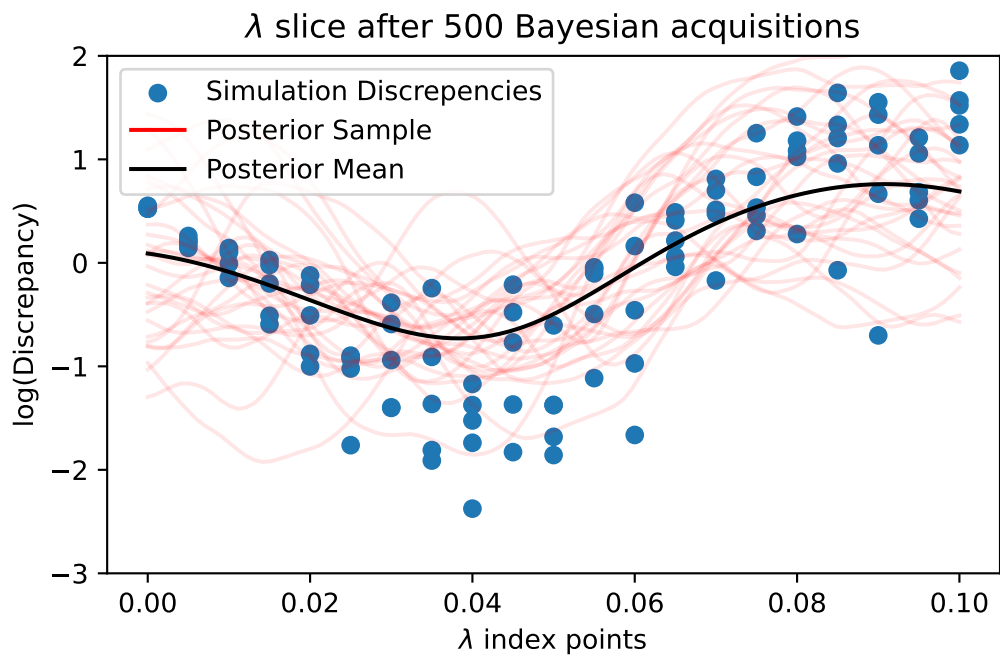


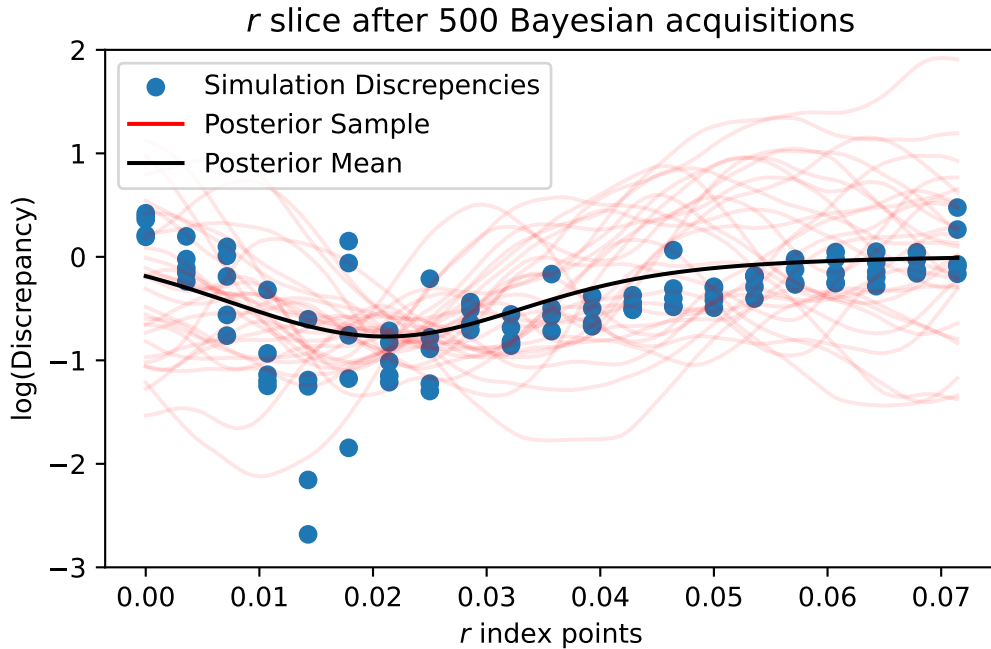












```

epsilon = -1.5
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)

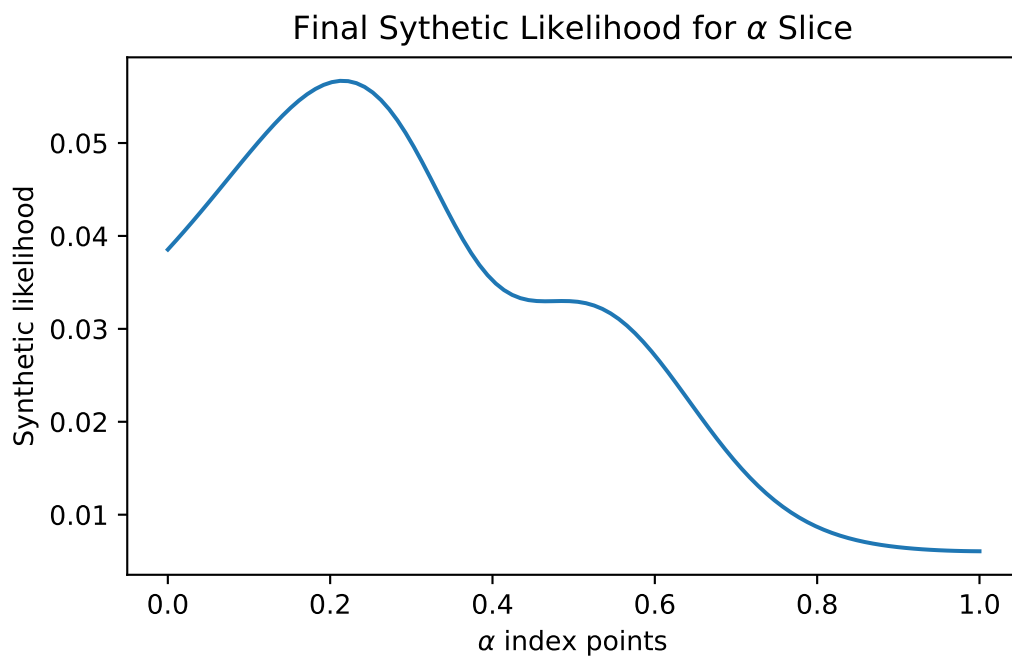
    plt.figure(figsize=(6, 3.5))
    plt.plot(
        slice_indices_dfs_dict[var + "_gp_indices_df"][var].values,
        np.exp(cdf_vals),

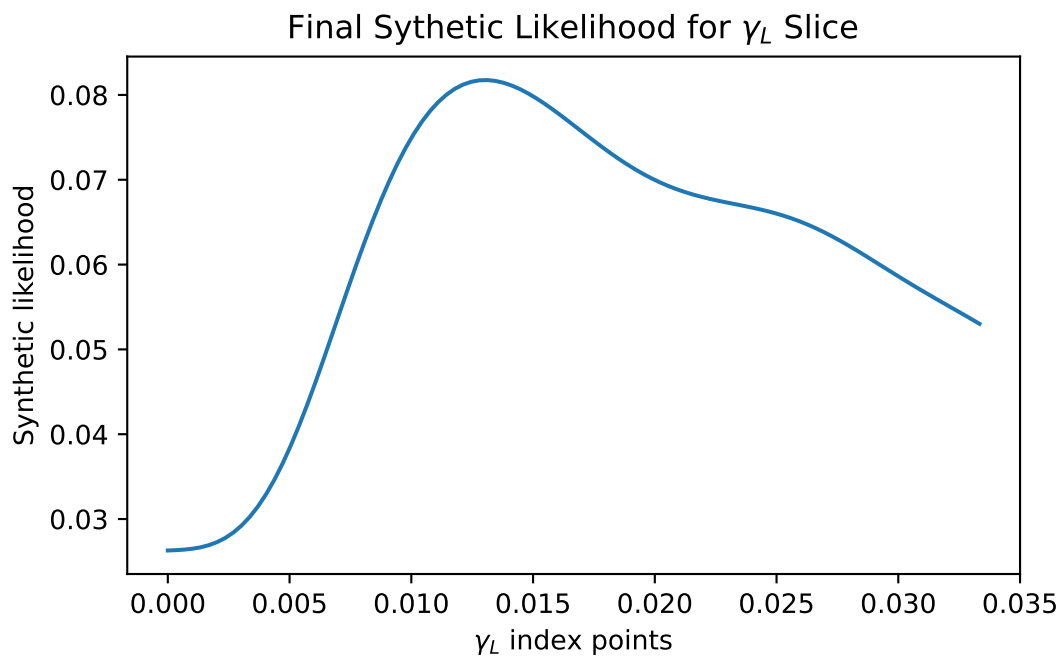
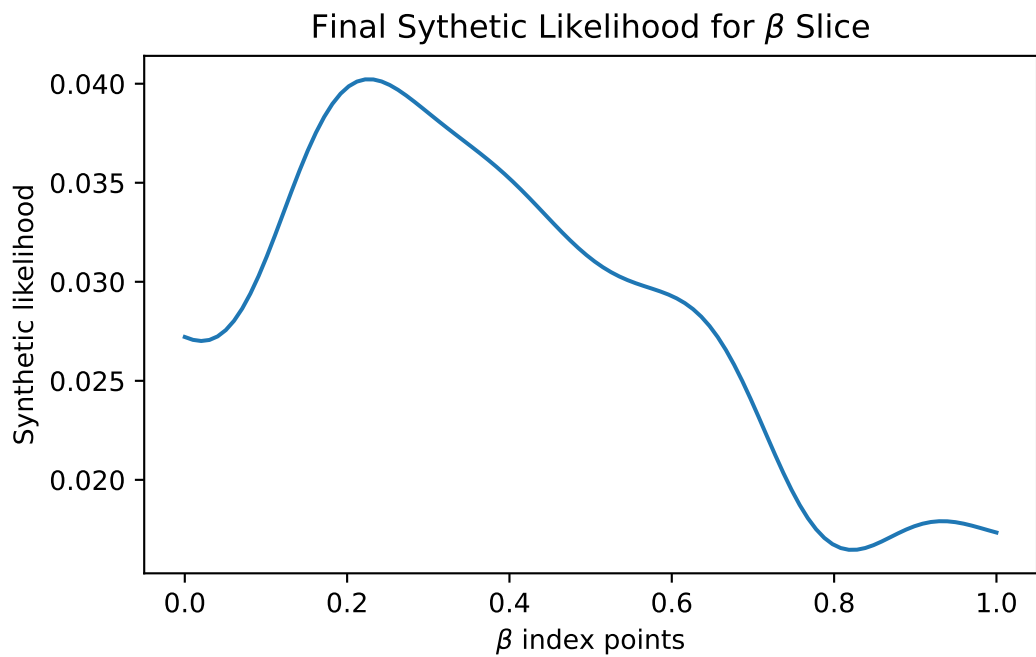
```

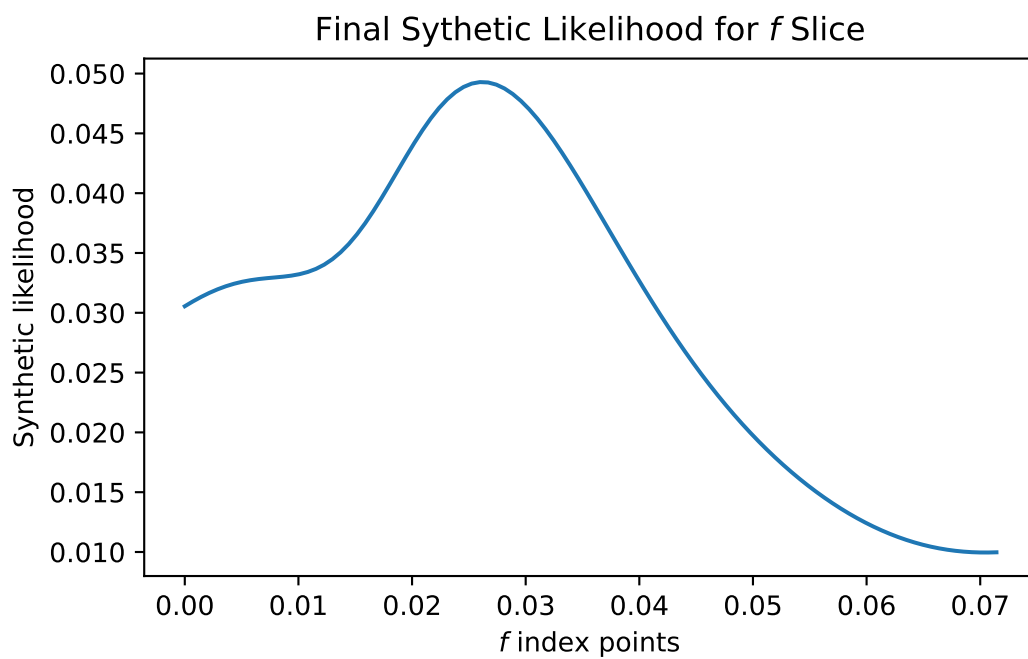
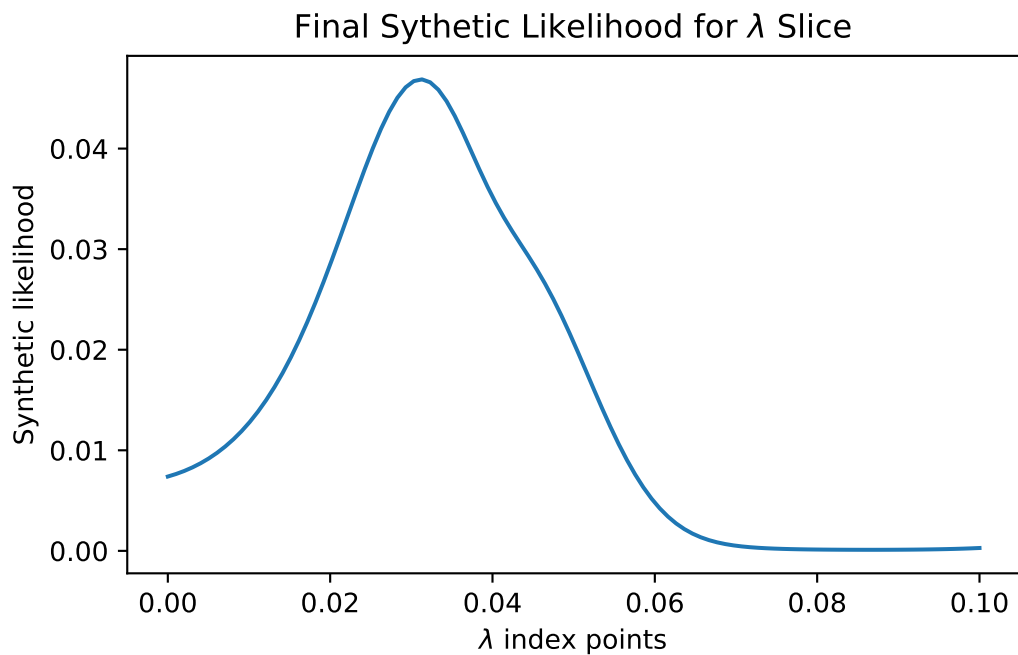
```

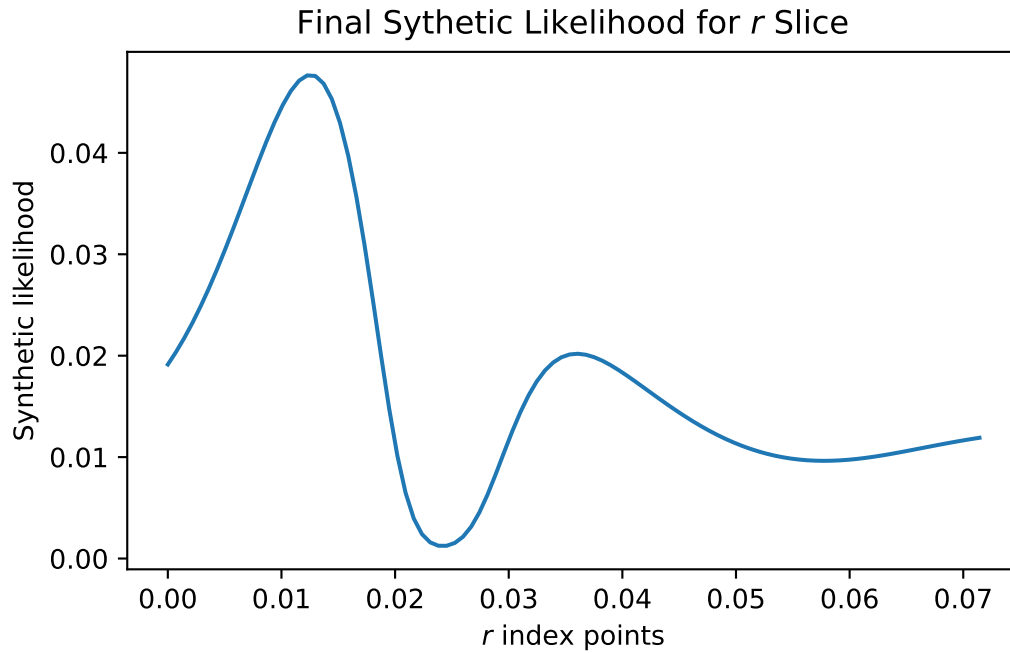
)
if var in ["f", "r"]:
    plt.xlabel("$" + var + "$ index points")
    plt.title("Final Sythetic Likelihood for $" + var + "$ Slice")
else:
    plt.xlabel("$\\" + var + "$ index points")
    plt.title("Final Sythetic Likelihood for $\\" + var + "$ Slice")
plt.ylabel("Synthetic likelihood")
plt.savefig(
    "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))
```

```
[0.242 0.786 0.03 0.032 0.064 0.071]
[0.351 0.07 0.021 0. 0.071 0.019]
[0.437 0.061 0.03 0.048 0.006 0.064]
[0.494 0.75 0.006 0.021 0.066 0.021]
[0.511 0.951 0.031 0.052 0.021 0.043]
[0.409 0.1 0.004 0.04 0.013 0.024]
[0.409 0.6 0.004 0.04 0.013 0.024]
[0.492 0.725 0. 0.068 0.064 0.022]
[0.492 0.725 0.027 0.068 0.064 0.022]
```