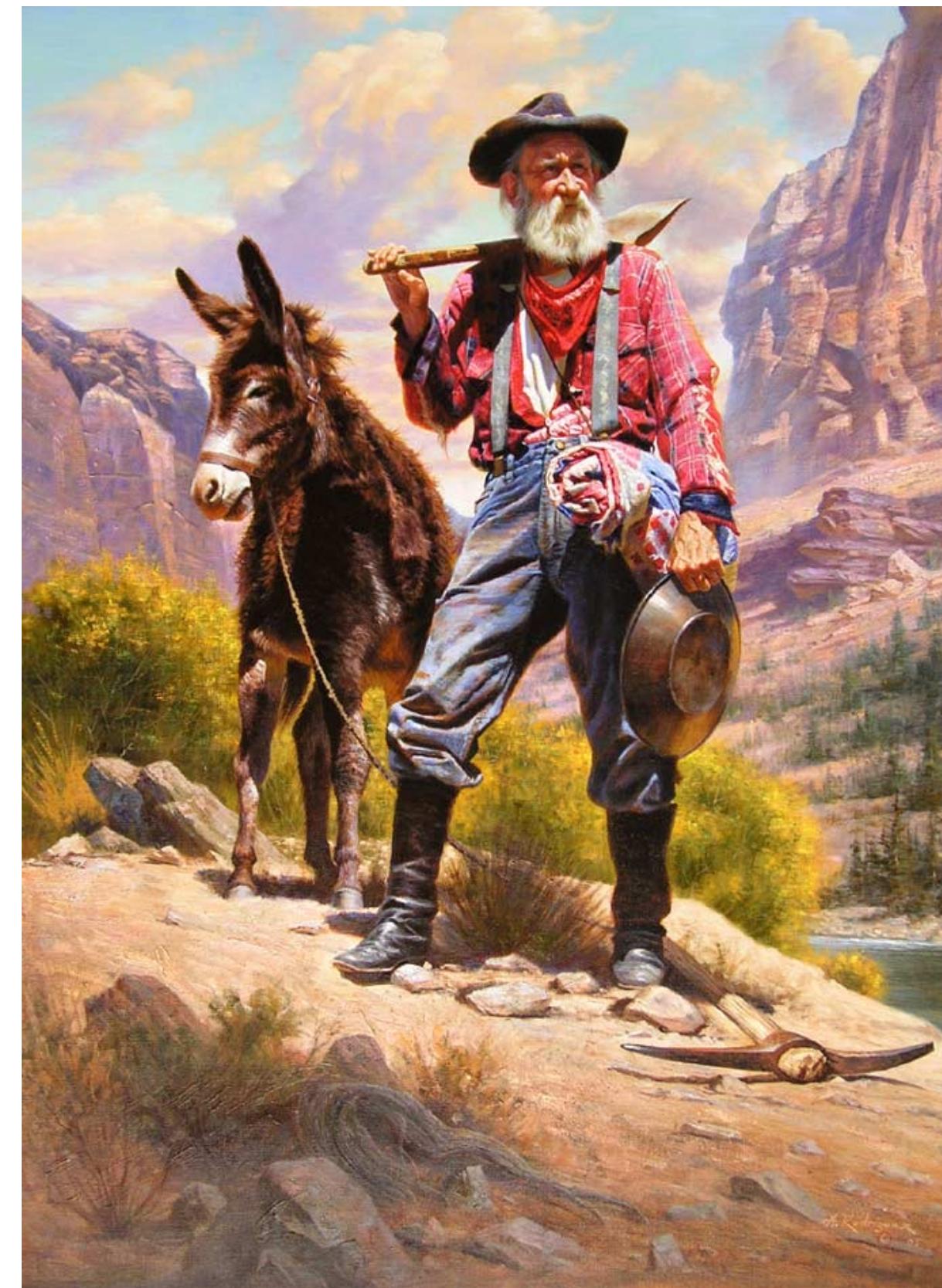


# Mining Gold with Bayesian Optimization

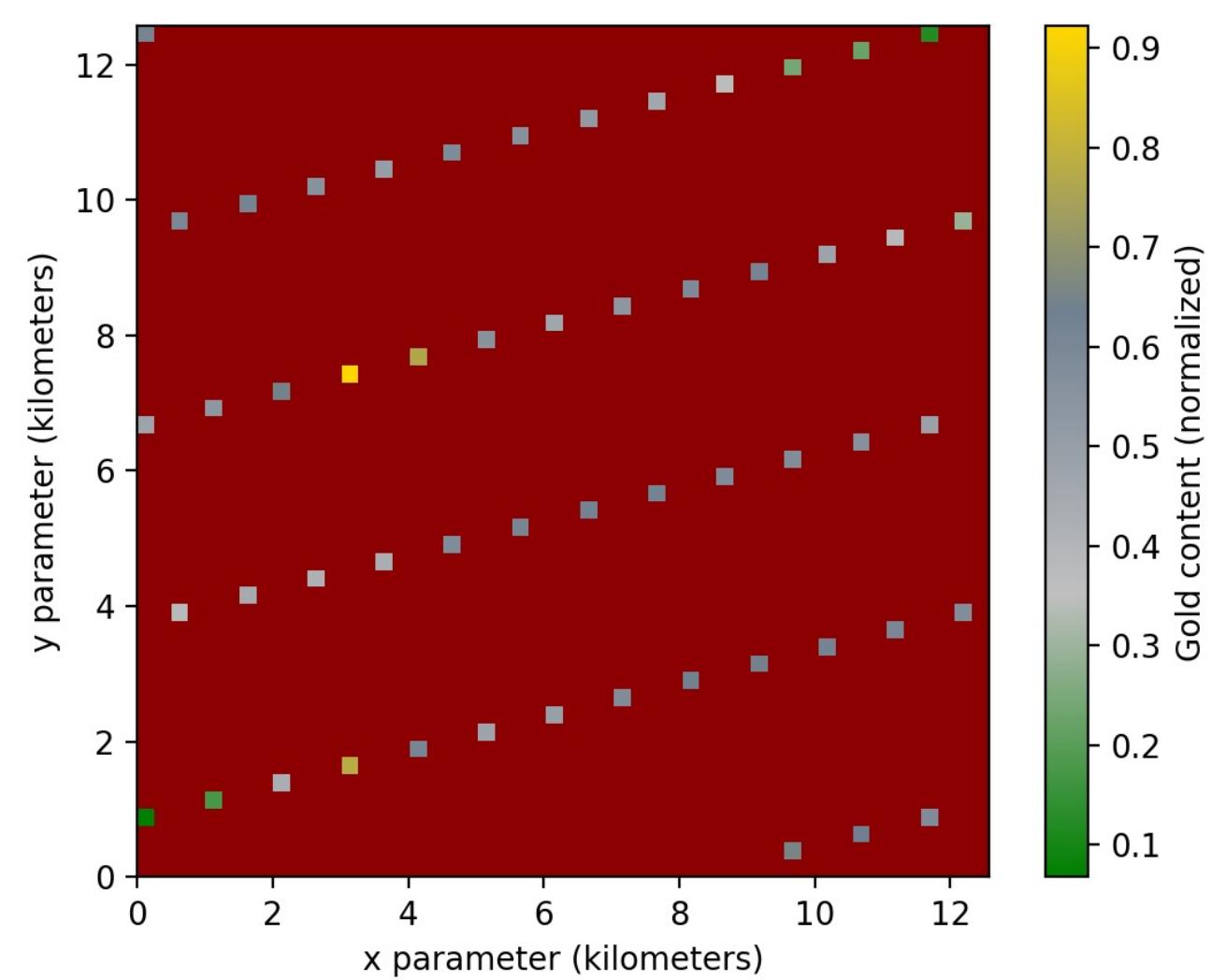
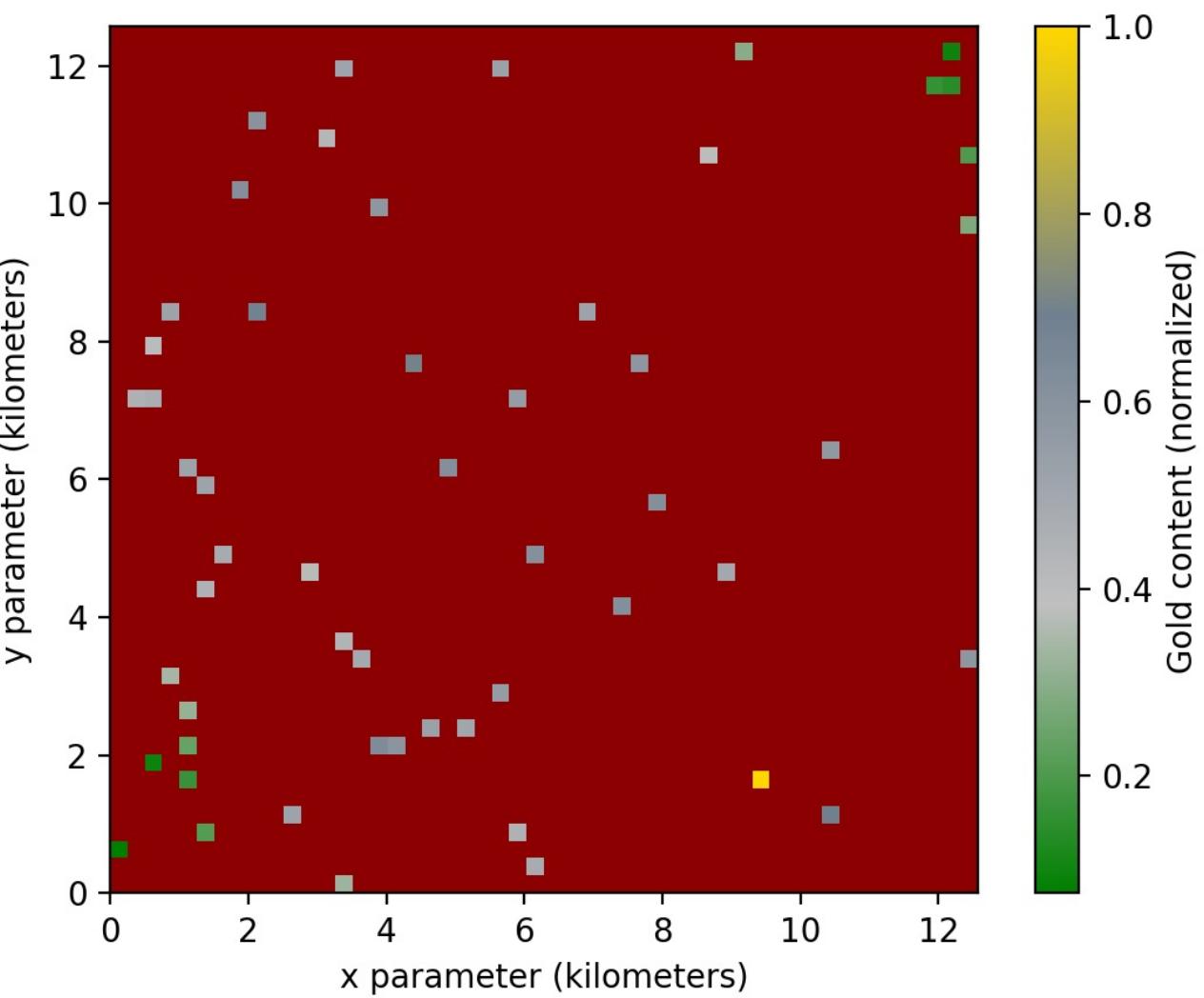
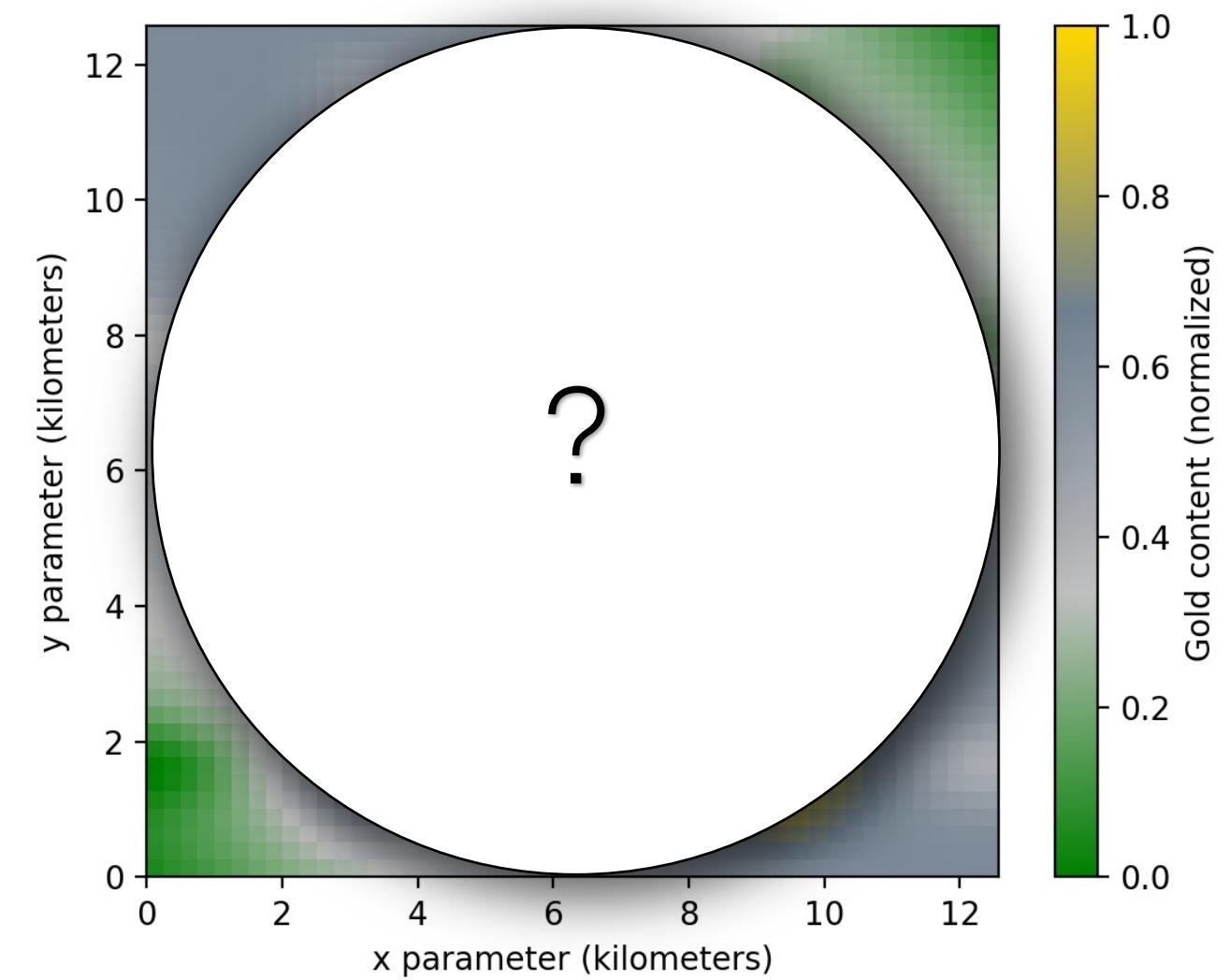
Floris-Jan Willemse  
Amsterdam, 29/03/2021



# Let's mine for gold!



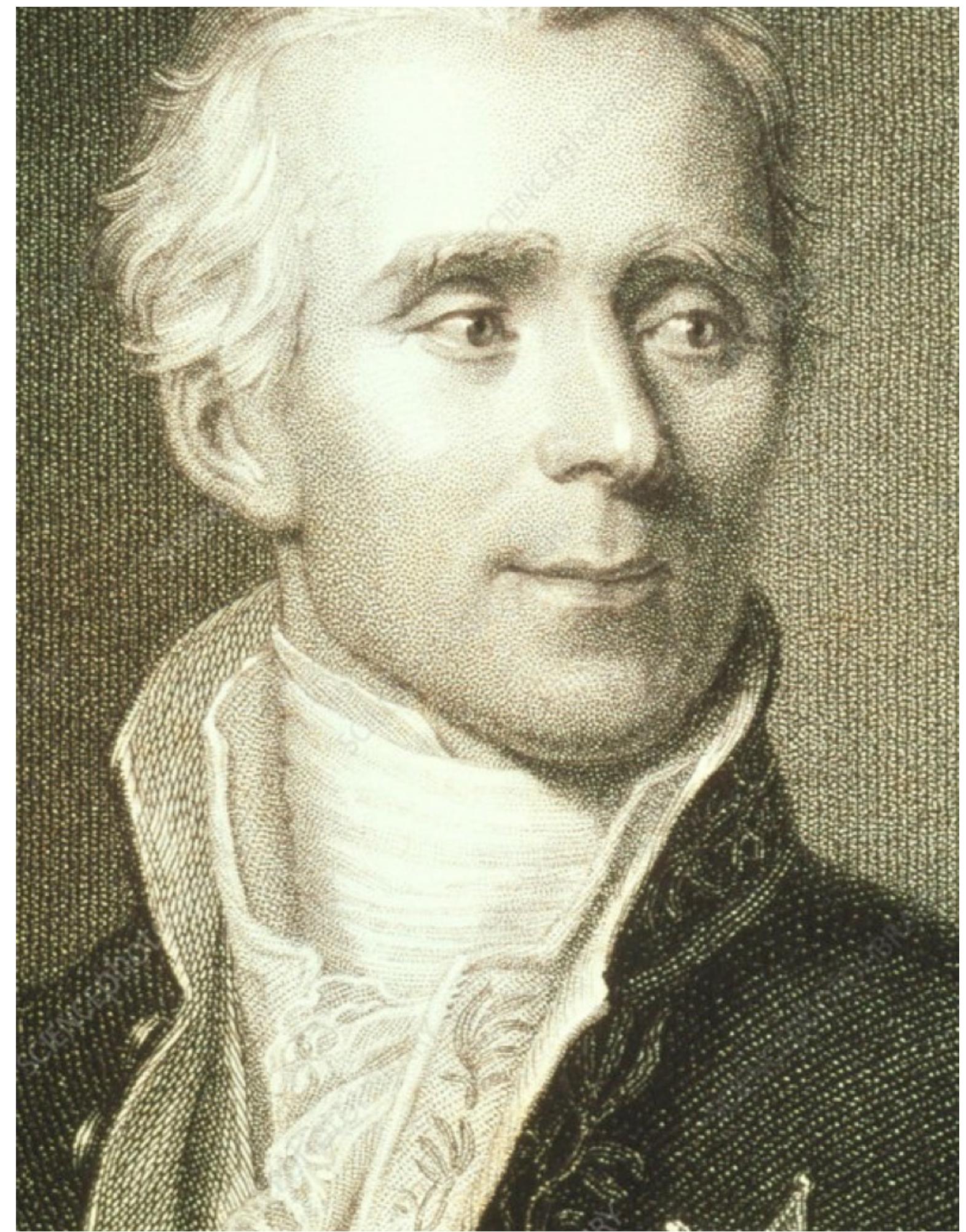
# ...but where?



**“How long will the Berlin wall stand?”**

---





Pierre-Simon Laplace

$$P(A|B) = \frac{P(B|A)P(A)}{P(B)}.$$



Thomas Bayes

**“How long will the Berlin wall stand?”**

---



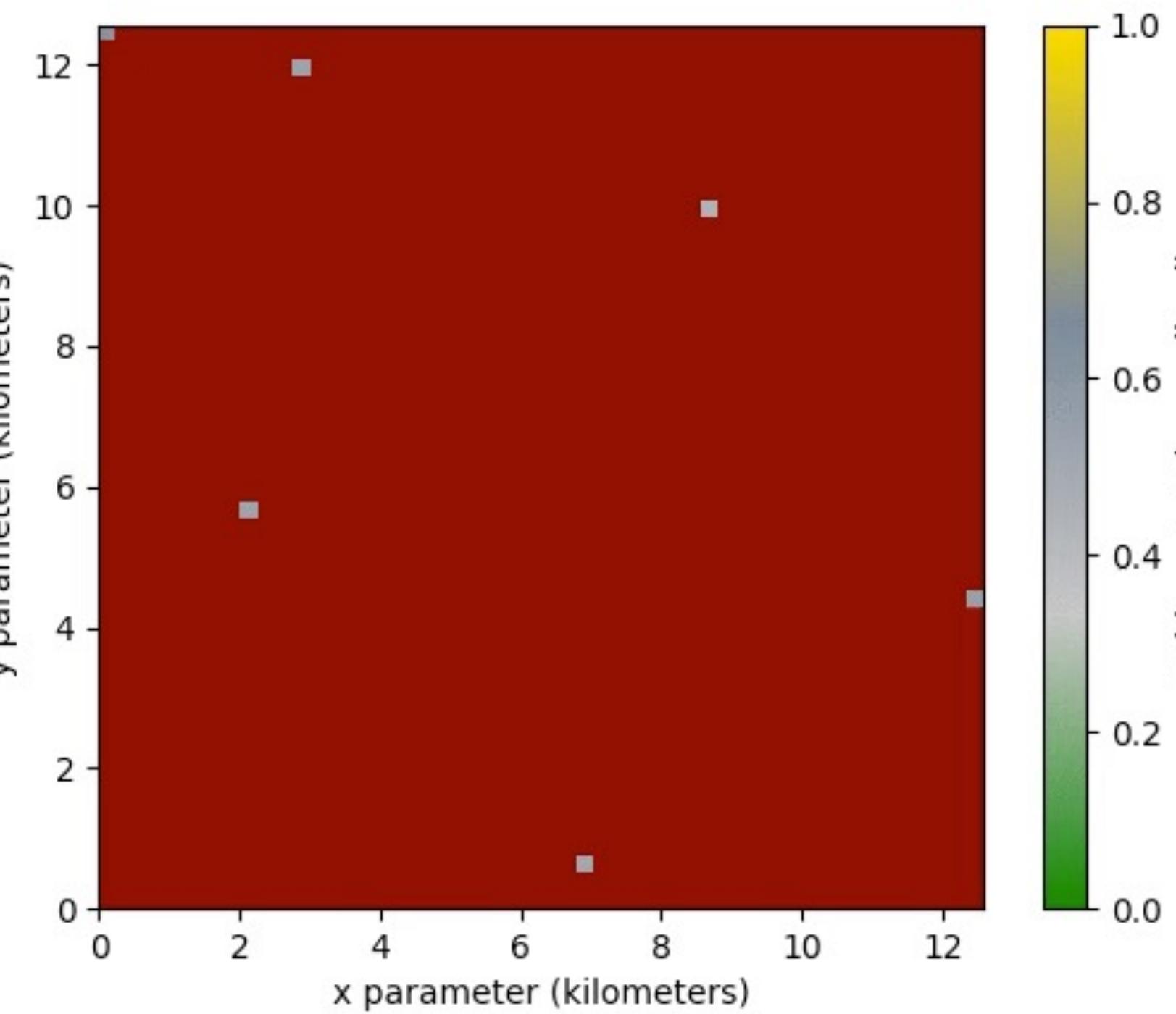
$$f(x, y) = ?$$

$$g(x, y) \approx f(x, y)$$

1. Take initial sample of objective function
2. Initialize surrogate function with initial sample
3. While time < max\_time:
  - a. Determine next sample point with acquisition function
  - b. Sample point with objective function to get observation
  - c. Update surrogate function with observation
4. Output optimal observation

# Bayesian Optimization

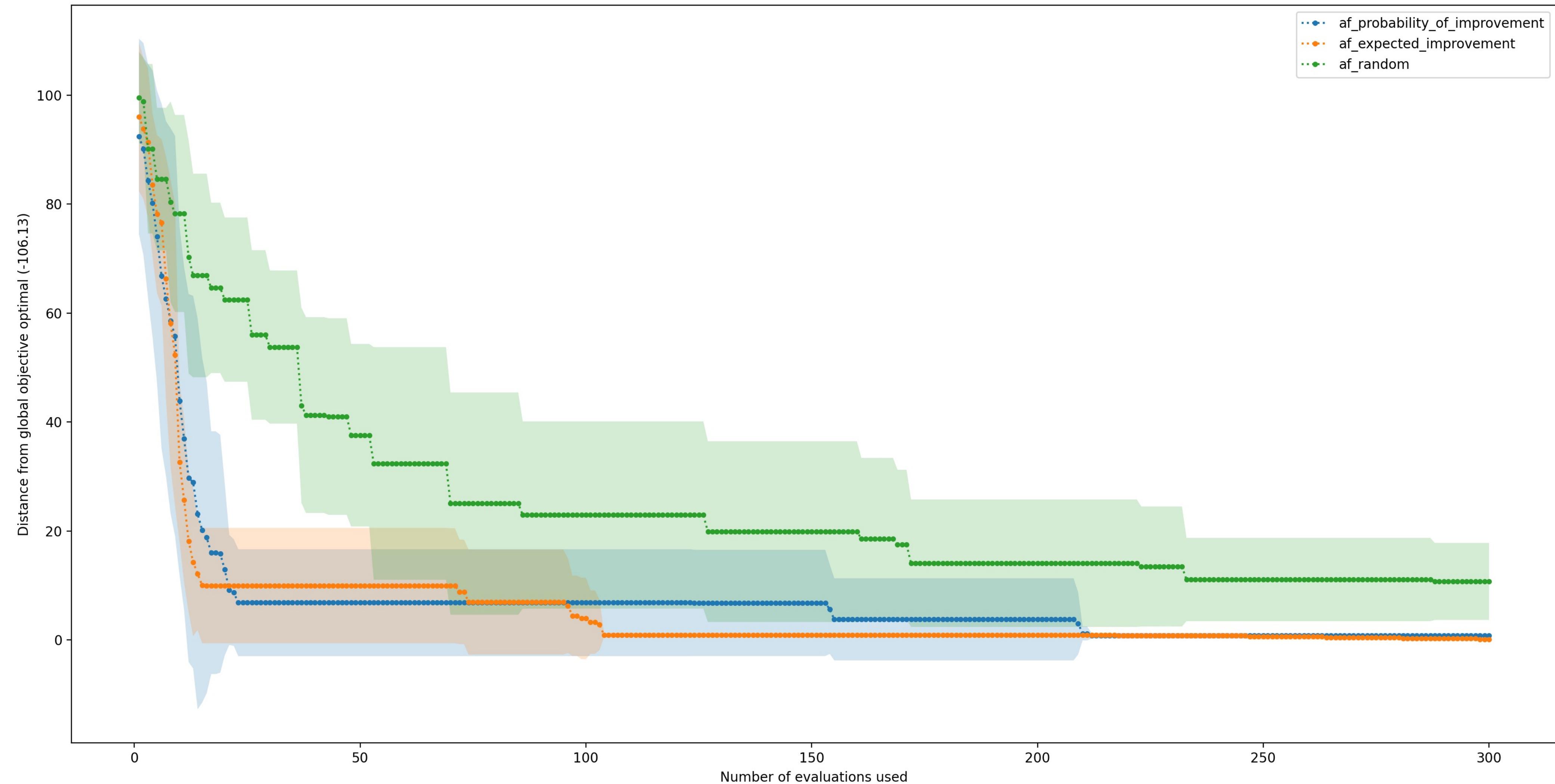
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  - c. Update surrogate function with observation
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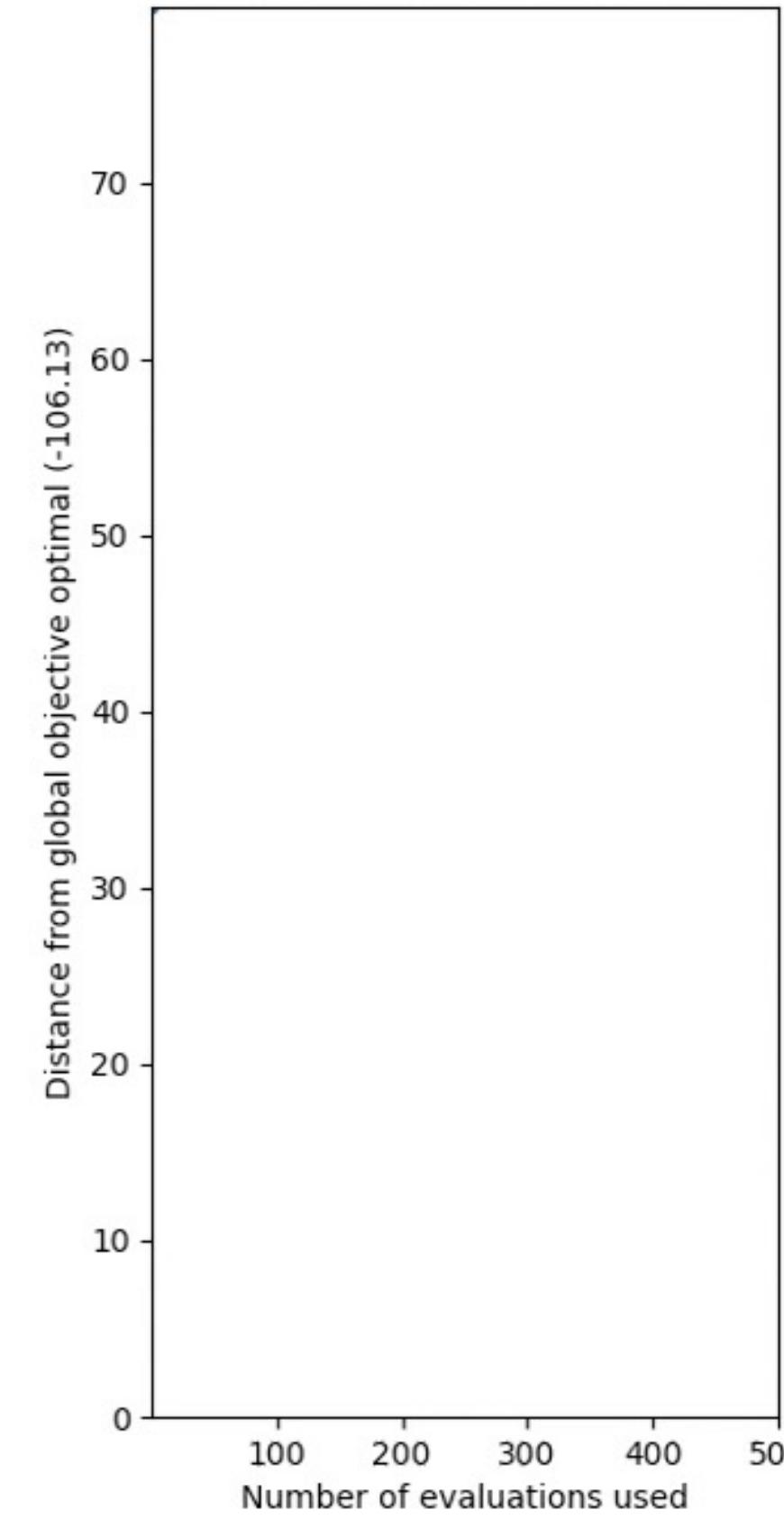
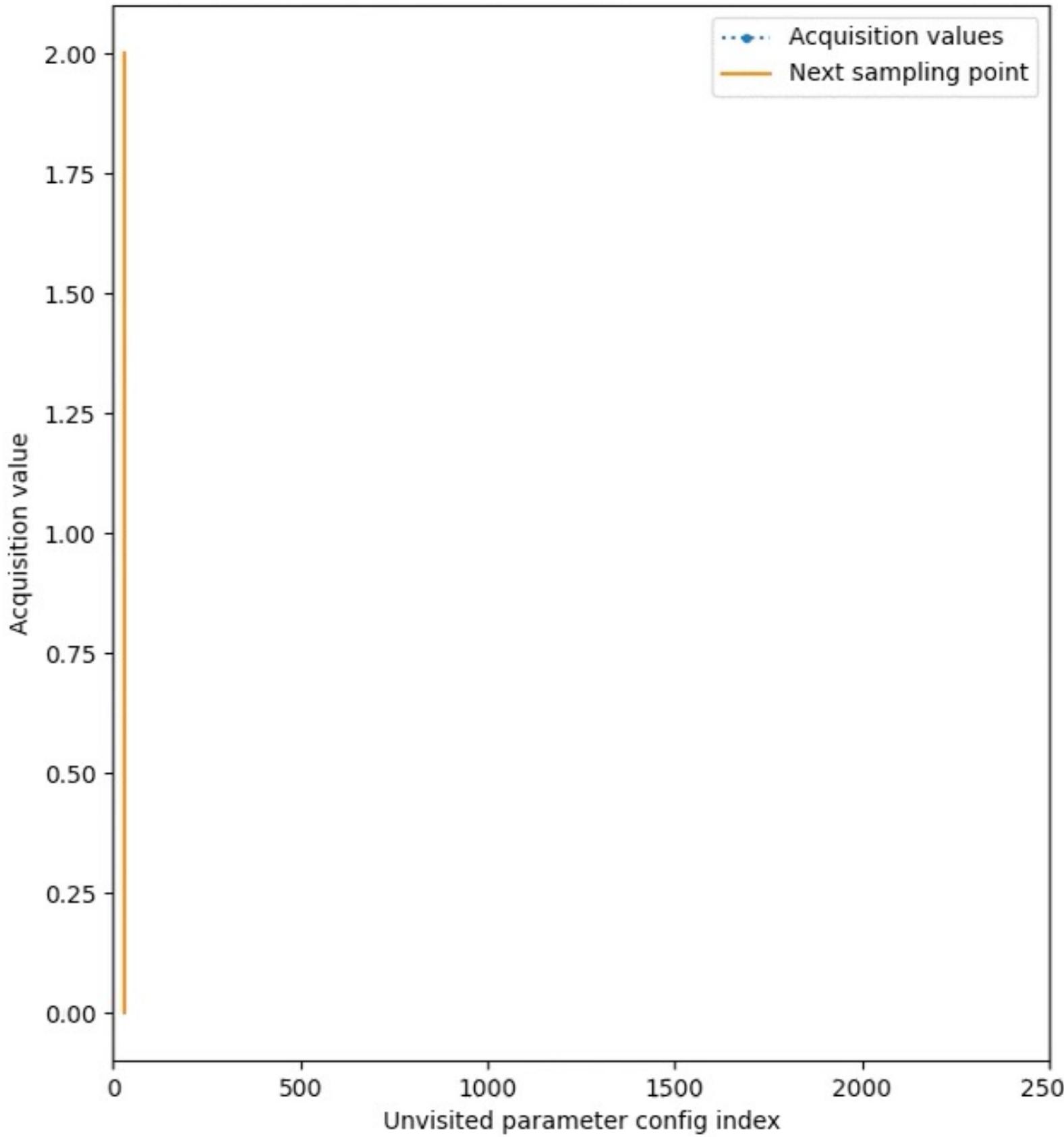
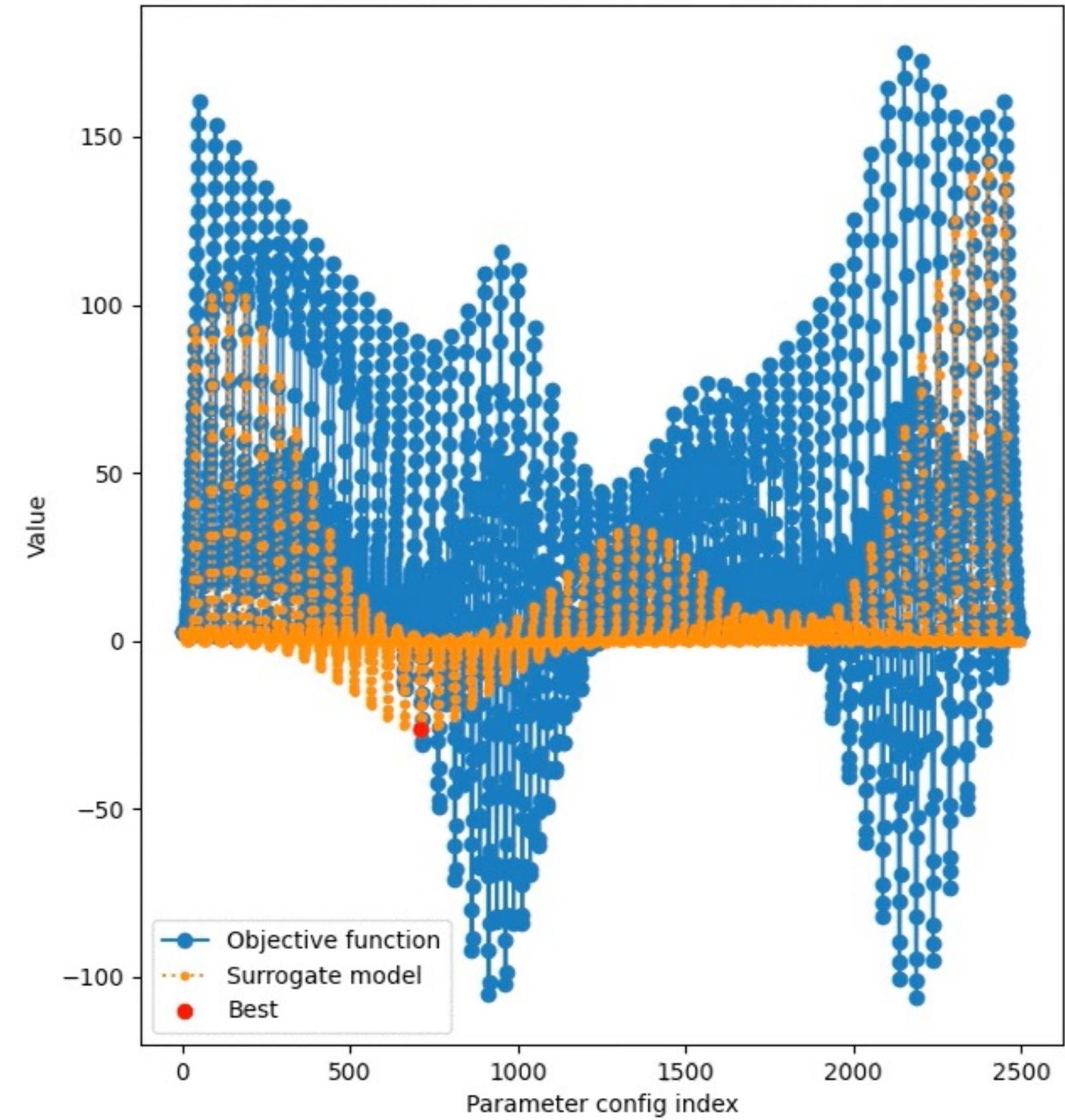
# Bayesian Optimization: performance

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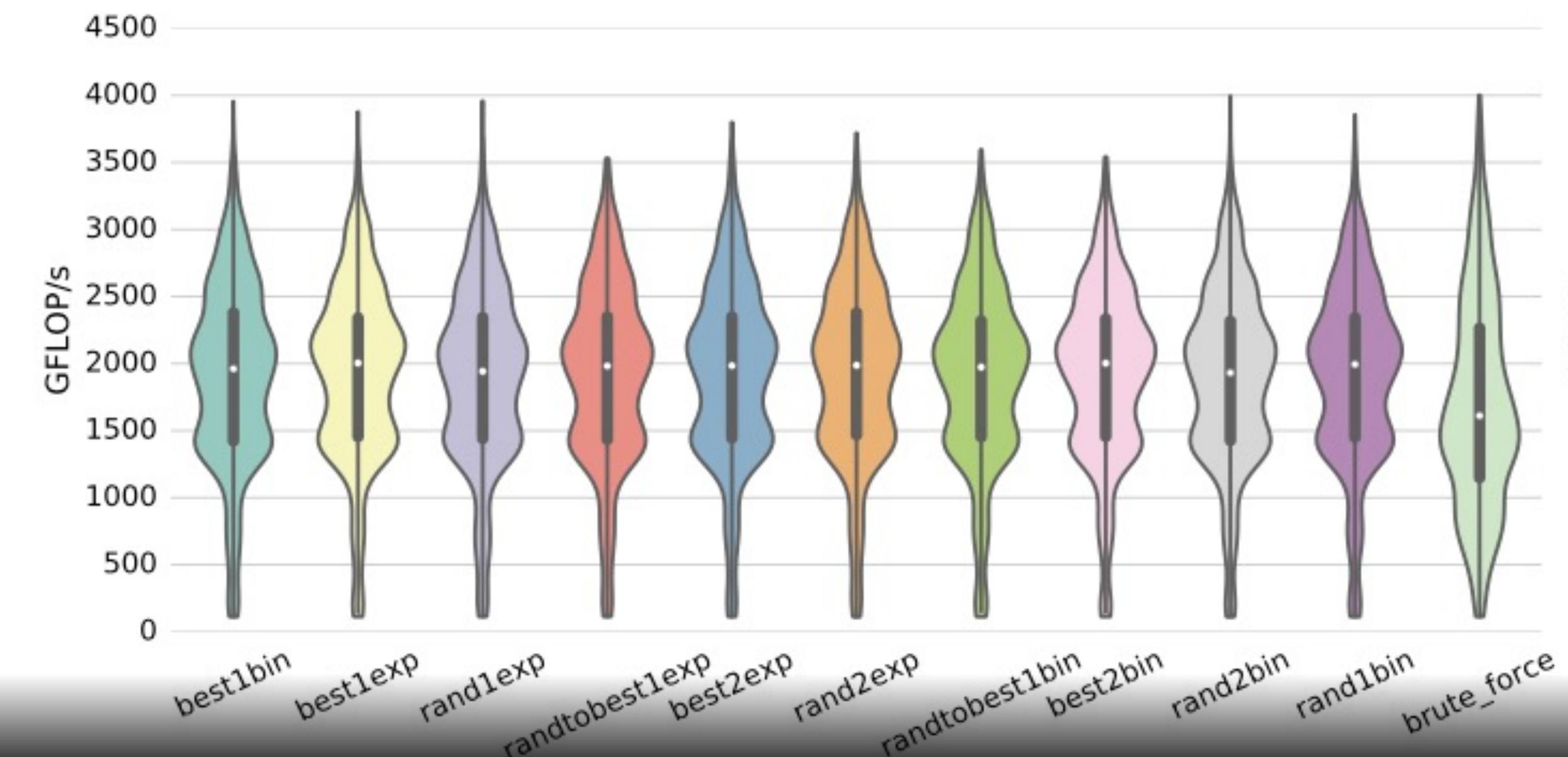
# Bayesian Optimization: under the hood

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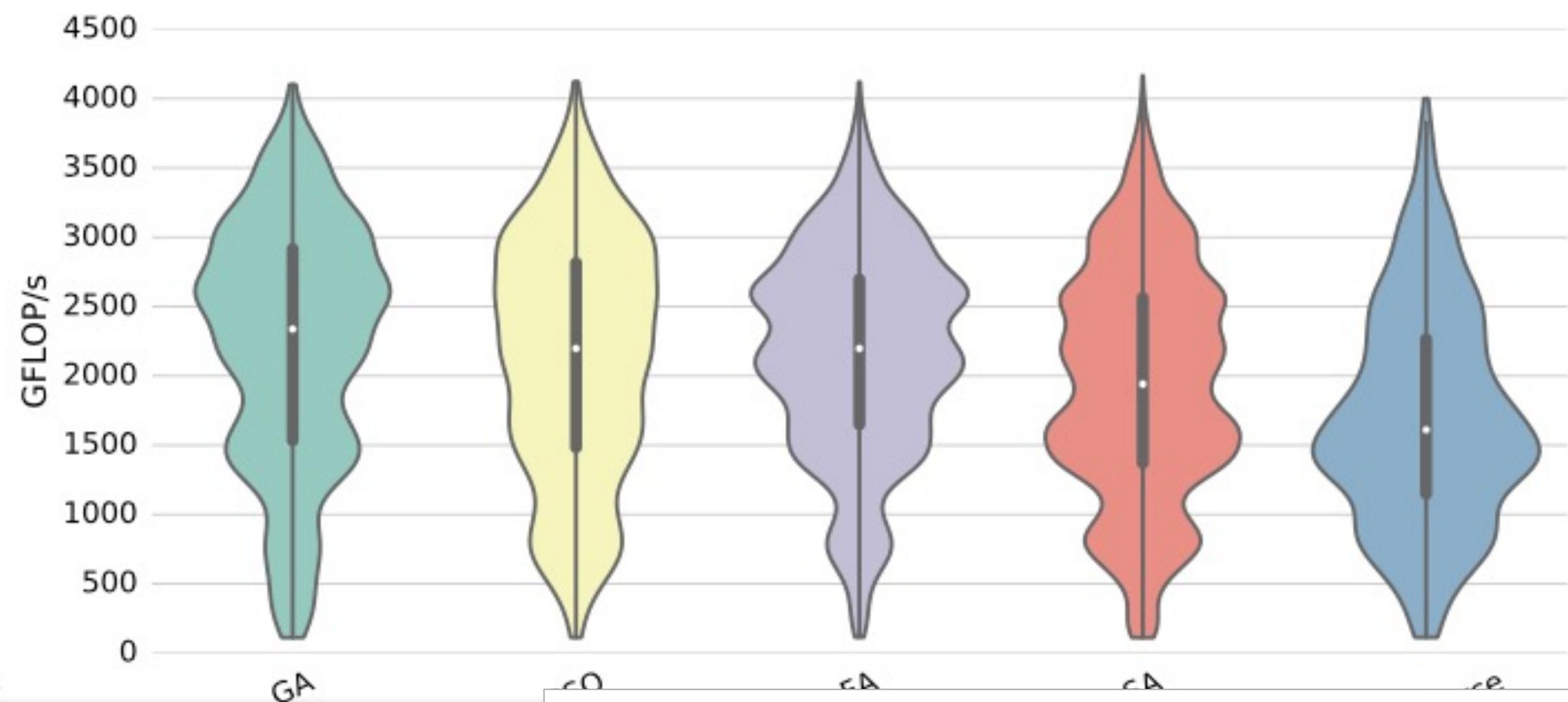
(a)

Auto-tuning 2D Convolution with Differential Evolution on GTX Titan X (Maxwell)



(b)

Auto-tuning 2D Convolution with Global Optimization methods on GTX Titan X (Maxwell)



## Kernel Tuner

Bayesian Optimization for Auto-Tuning GPU Kernels



# In summary, Bayesian Optimization...

- ... is useful for optimizing an expensive, non-convex objective function.
- ... can be stopped at any time to obtain the current optimum.
- ... works best with  $\# \text{parameters} < 20$ .
- ... can be computationally expensive in updating the model.

# Let's stay in touch

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