# Optimizing Japanese dam reservoir inflow forecasts for efficient operation

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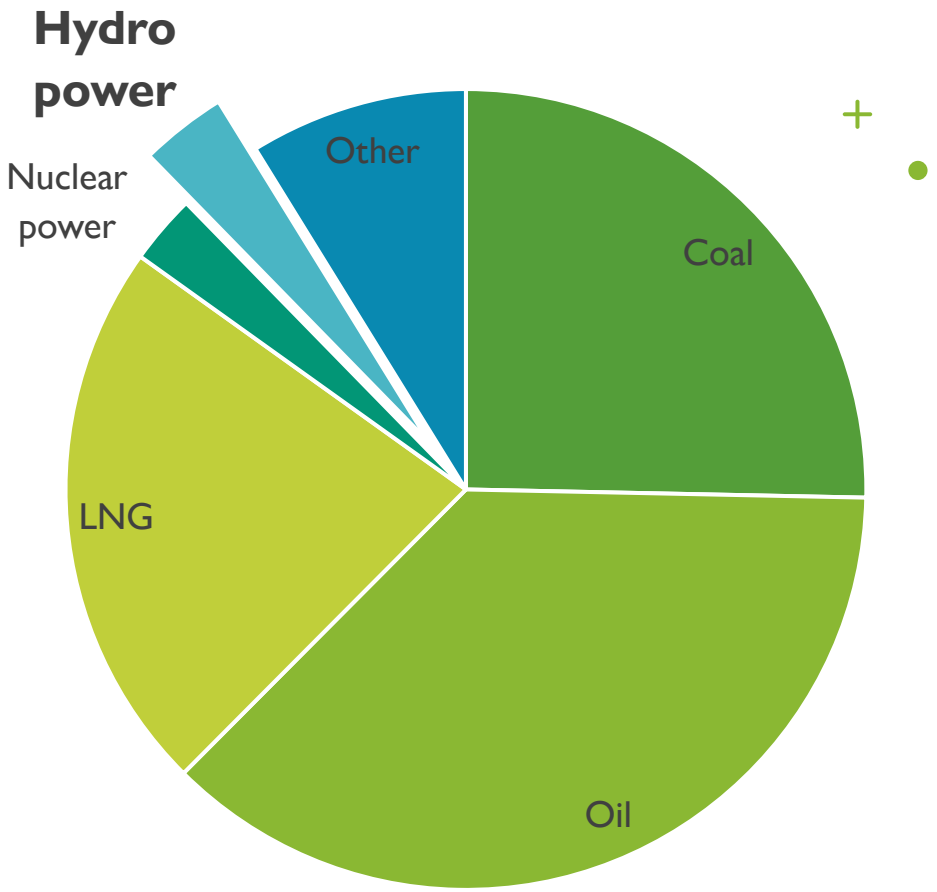
# Background

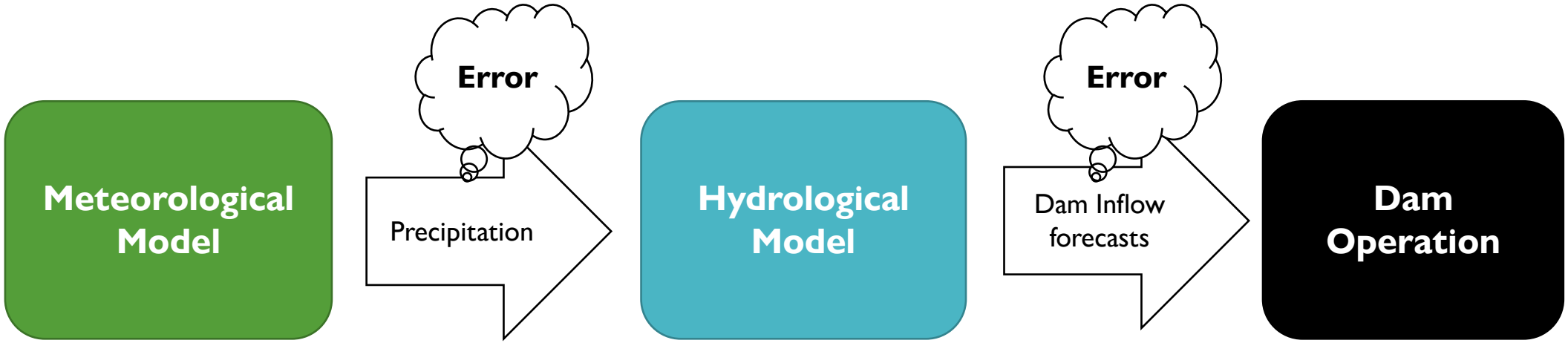
- Japan's climate and topography are suitable for Hydropower generation.
- Hydropower accounts for only 4% of Japan's energy consumption.
- Dam operations are not optimized for hydropower.




**Primary Energy Supply Composition in Japan**

https://www.enecho.meti.go.jp/about/pamphlet/energy2021/001/

# Why is hydropower not optimized?




- Uncertainty in **precipitation forecasts** and uncertainty in **Hydrological modeling** make dam operation difficult.

# In this work

- We focus on improving the accuracy of dam inflow forecast.

- To do so:
  - **Assembled a Dataset covering 127 public dams across Japan.**
  - **Proposed different ML discharge forecasting systems.**

# Dataset

| Data Source | Variable | Type | Unit |
|---|---|---|---|
| MLIT | Discharge | In-Situ | $m^3/s$ |
| JMA | Precipitation | Forecast | mm |
| MLIT | Precipitation | In-Situ | mm |
| GSMap | Precipitation | Remote Sensing | mm |
| JMA | Precipitation | Assimilated Model | mm |
| JMA | Temperature | Assimilated Model | degrees |
| JMA | Wind | Assimilated Model | m/s |
| TE [9] | Snow melt | Model | $m^3/s$ |

Table 1: Summary of the variables in our dataset

# Experiments

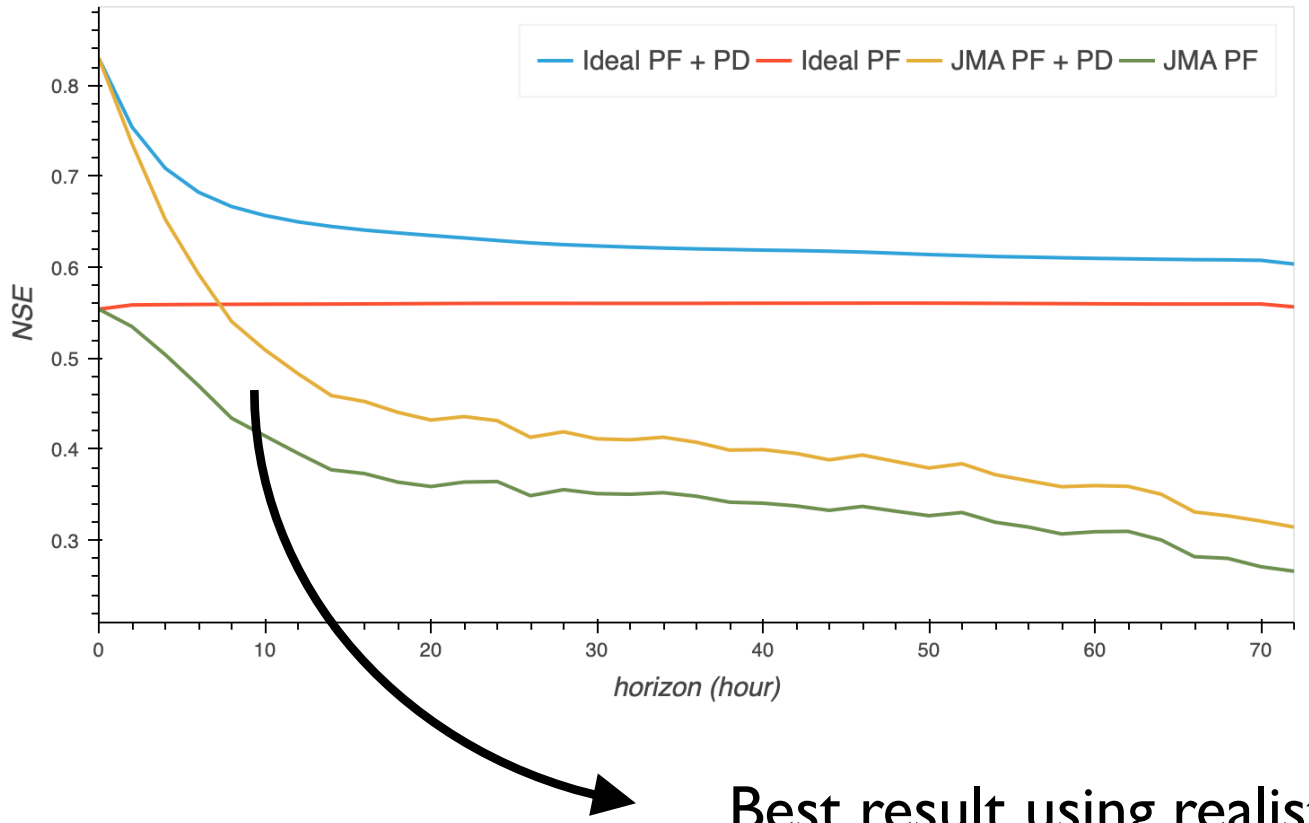
**Characterize forecast error by quantitatively answering the following questions.**

1. How does forecast horizon impact river discharge accuracy?
2. Are discharge forecast errors most impacted by precipitation forecast errors or hydrological errors?
3. What variables are most predictive of river discharge?
4. What hydrological models are most accurate for river Japanese dams discharge modeling?

**Model**

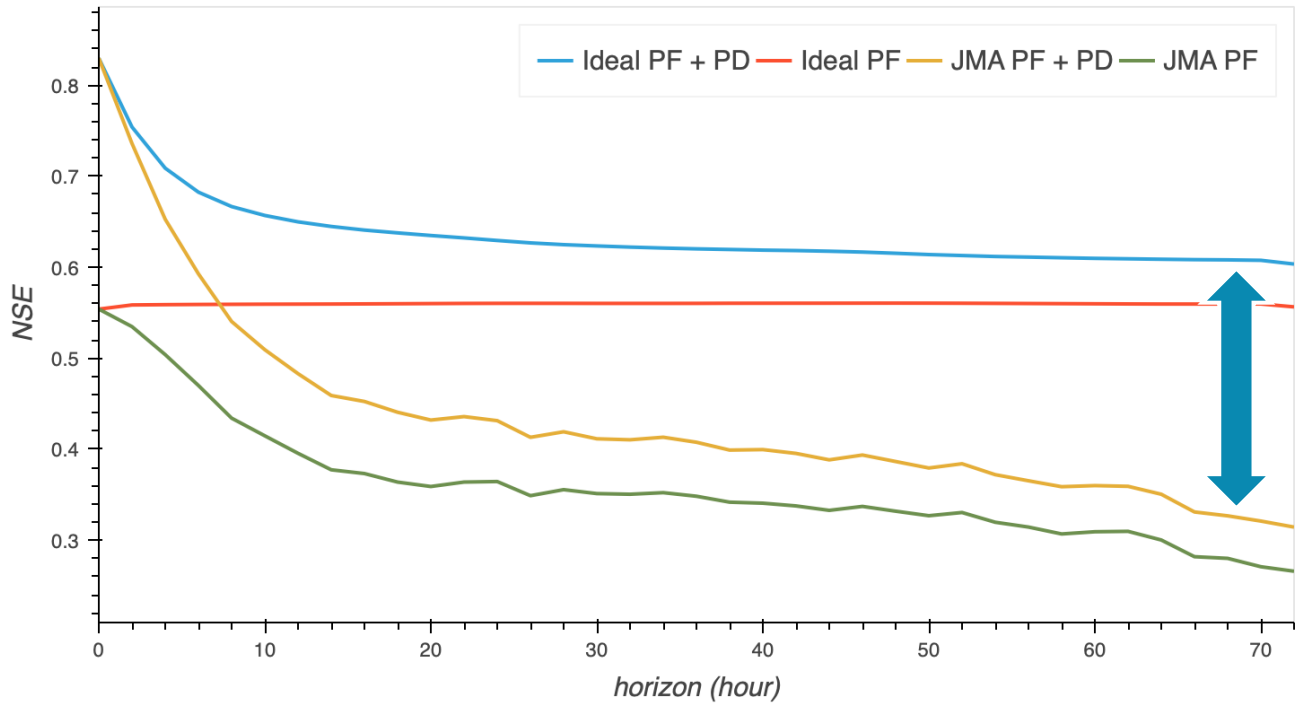
- Unless unspecified, the model used is a linear baseline regressor.
- Train one model per dam, and we report the average accuracy.

# 1. How does forecast horizon impact river discharge accuracy?



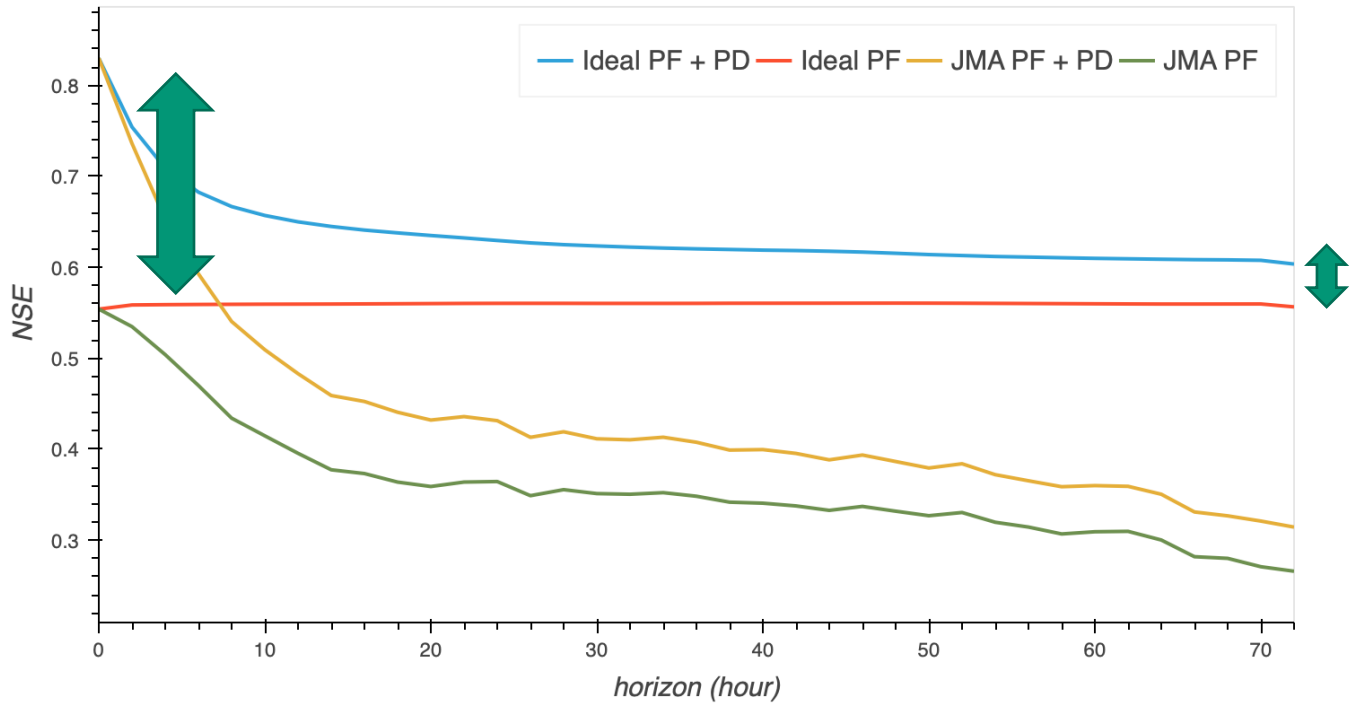

Best result using realistic data

# 2. Are discharge forecast errors most impacted by precipitation forecast errors or hydrological errors?



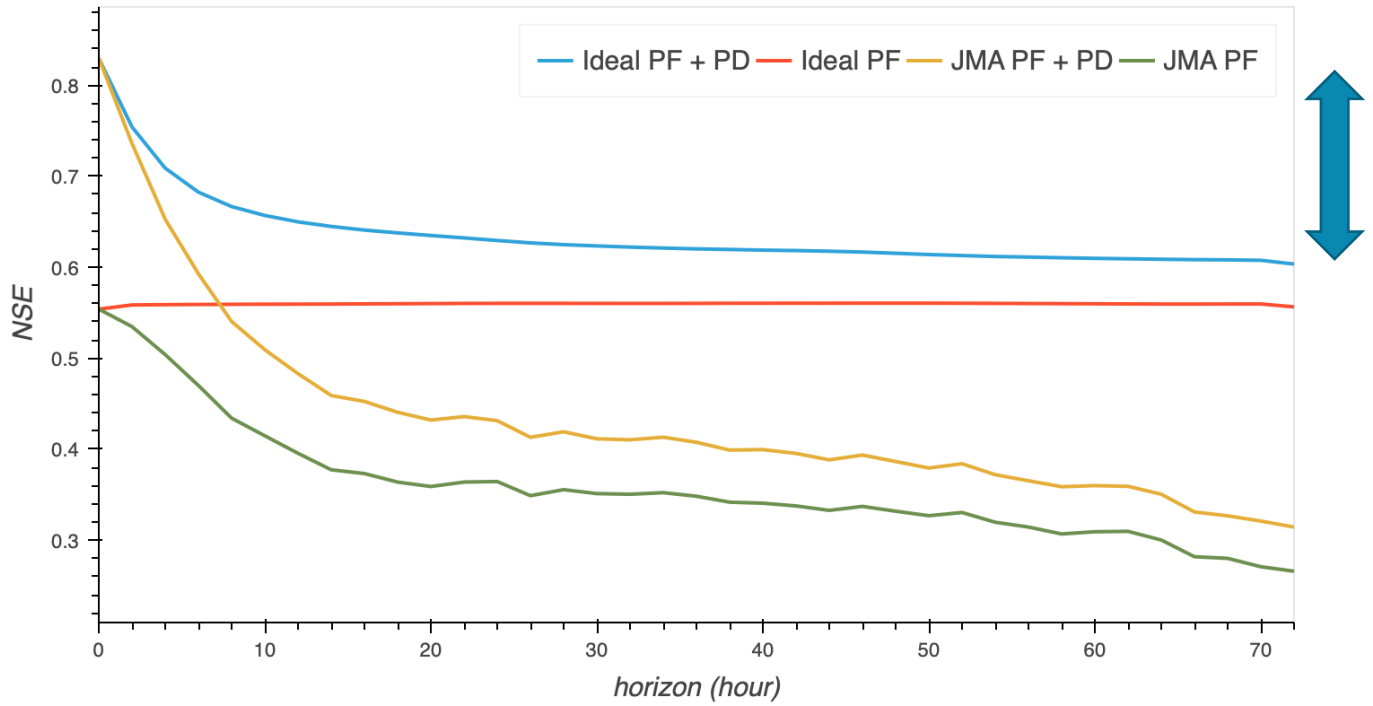

- Most long-horizon errors are dominated by uncertainty in the precipitation forecast

# 2. Are discharge forecast errors most impacted by precipitation forecast errors or hydrological errors?



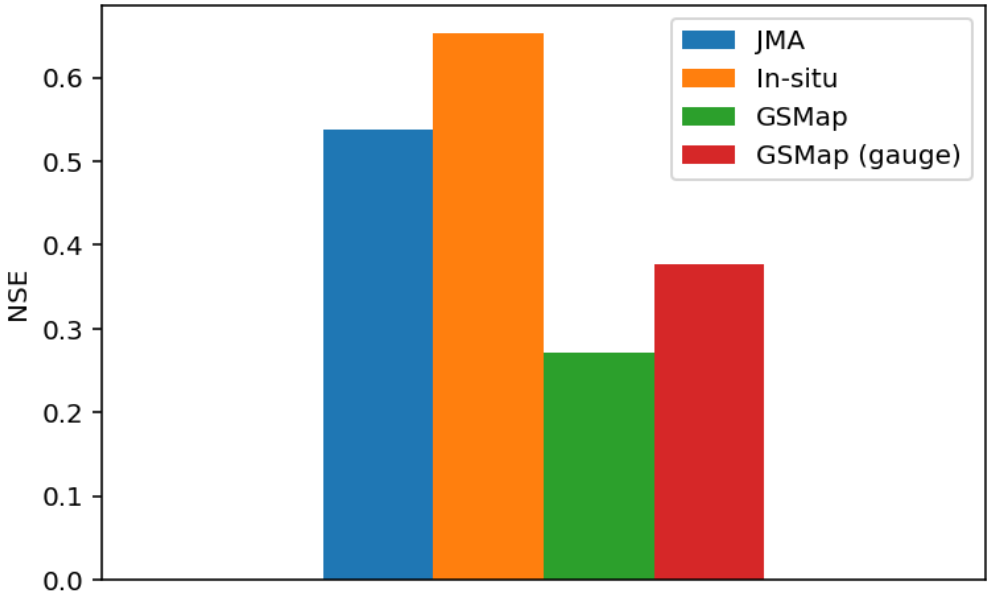

- Past discharge(PD) can greatly improve forecast accuracy in the short term, but the effect is limited over longer time horizons.

# 2. Are discharge forecast errors most impacted by precipitation forecast errors or hydrological errors?

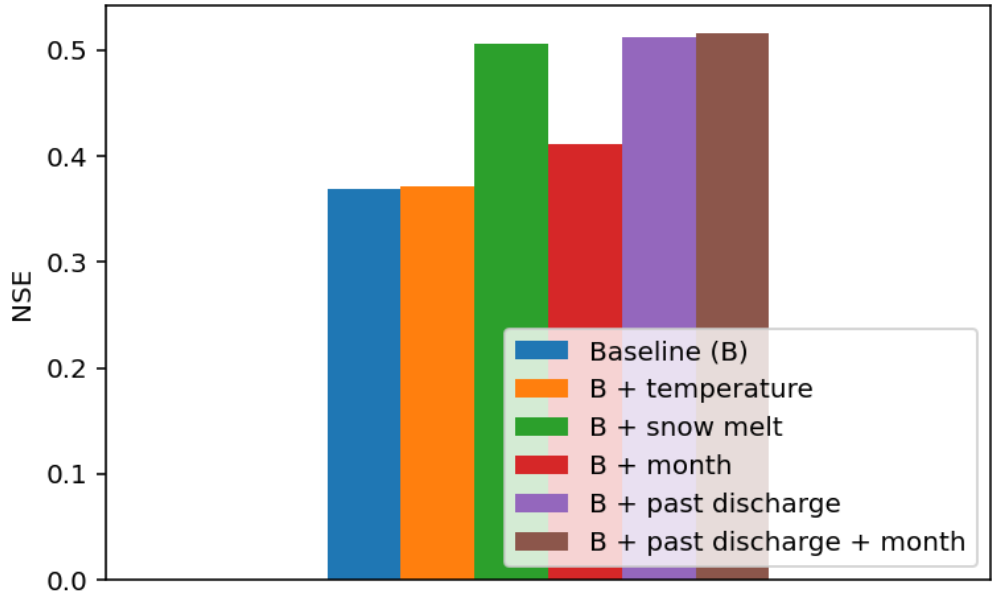



- The decrease in accuracy observed in the blue curve is attributed to hydrological errors.

# 3. What variables are most predictive of river discharge?

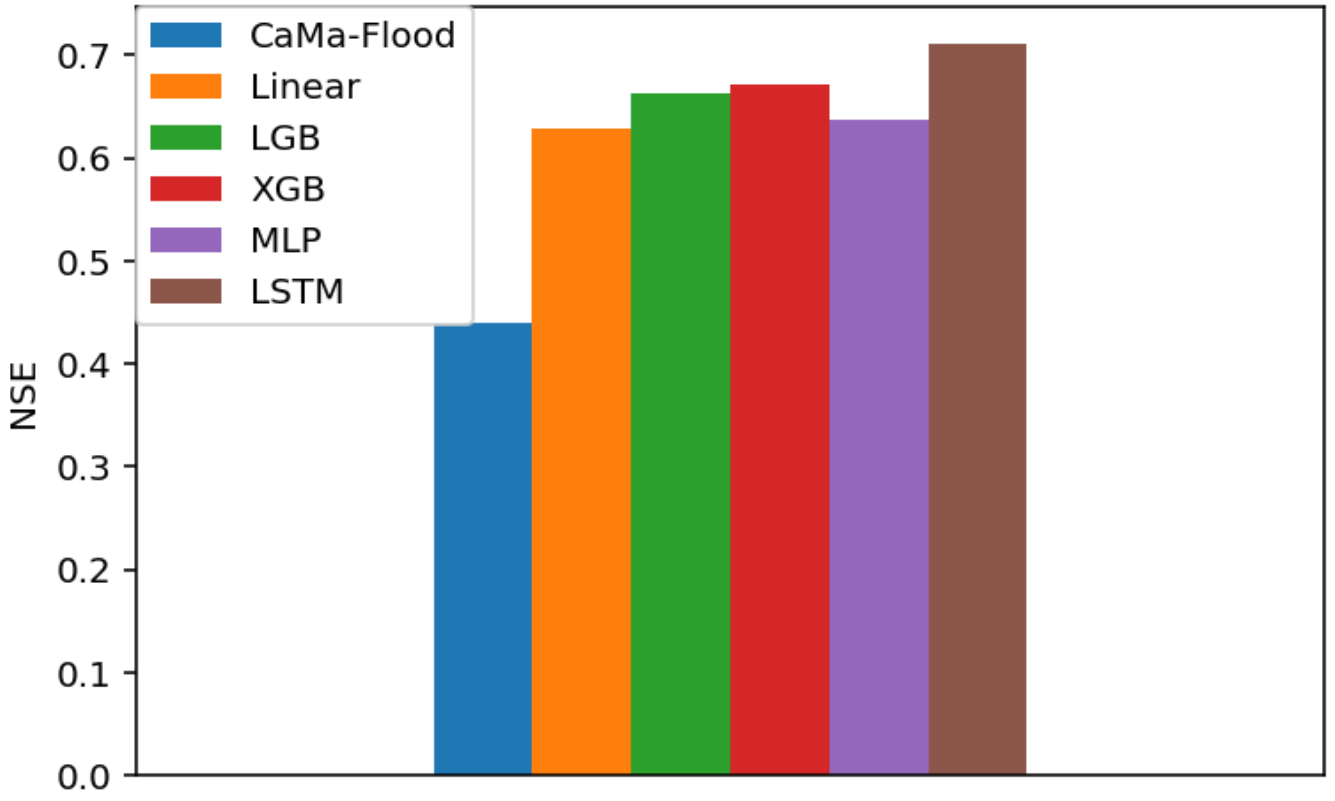



**Impact of precipitation data**




**Impact of additional data**

# 4. What hydrological models are most accurate for river Japanese dams discharge modeling?




- ML models outperform the hydrology model (CaMa-Flood)