

# The Center for Cyber Defenders

Expanding computer security knowledge



## PROM

Securing Industrial Control Systems through Modeling Physical Systems

Sheridan Harding, Brigham Young University

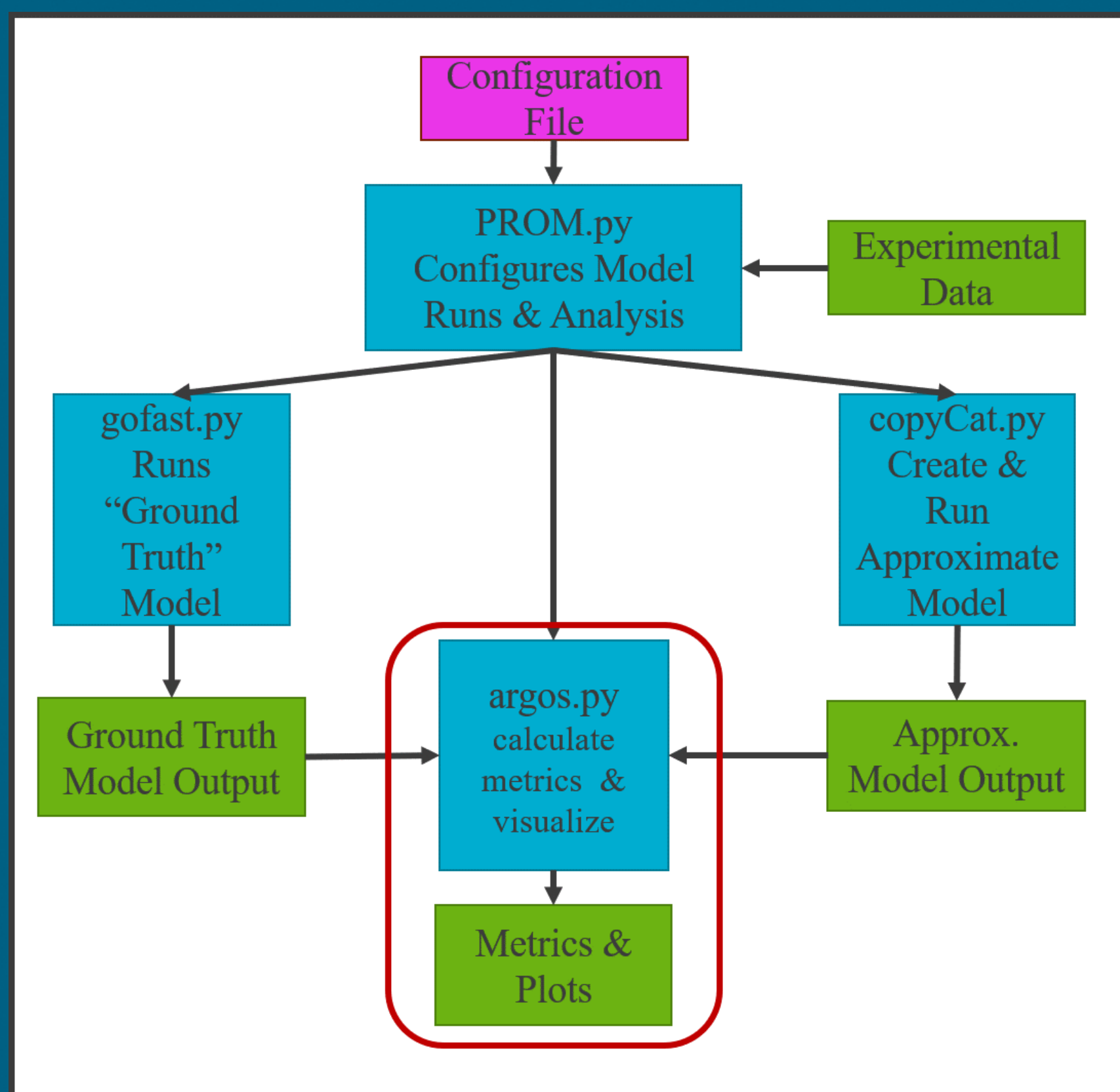
Project Mentors: Ray Fasano, Org. 5621 , Eric Vugrin, Org. 5600

### Problem Statement:

- PROM project builds math models of physical processes in industrial control systems
- System Identification (SID) algorithms build the models by processing data from SCADA servers.
- Research Question:** Is the SID model “good enough” to be useful?

### Objectives and Approach:

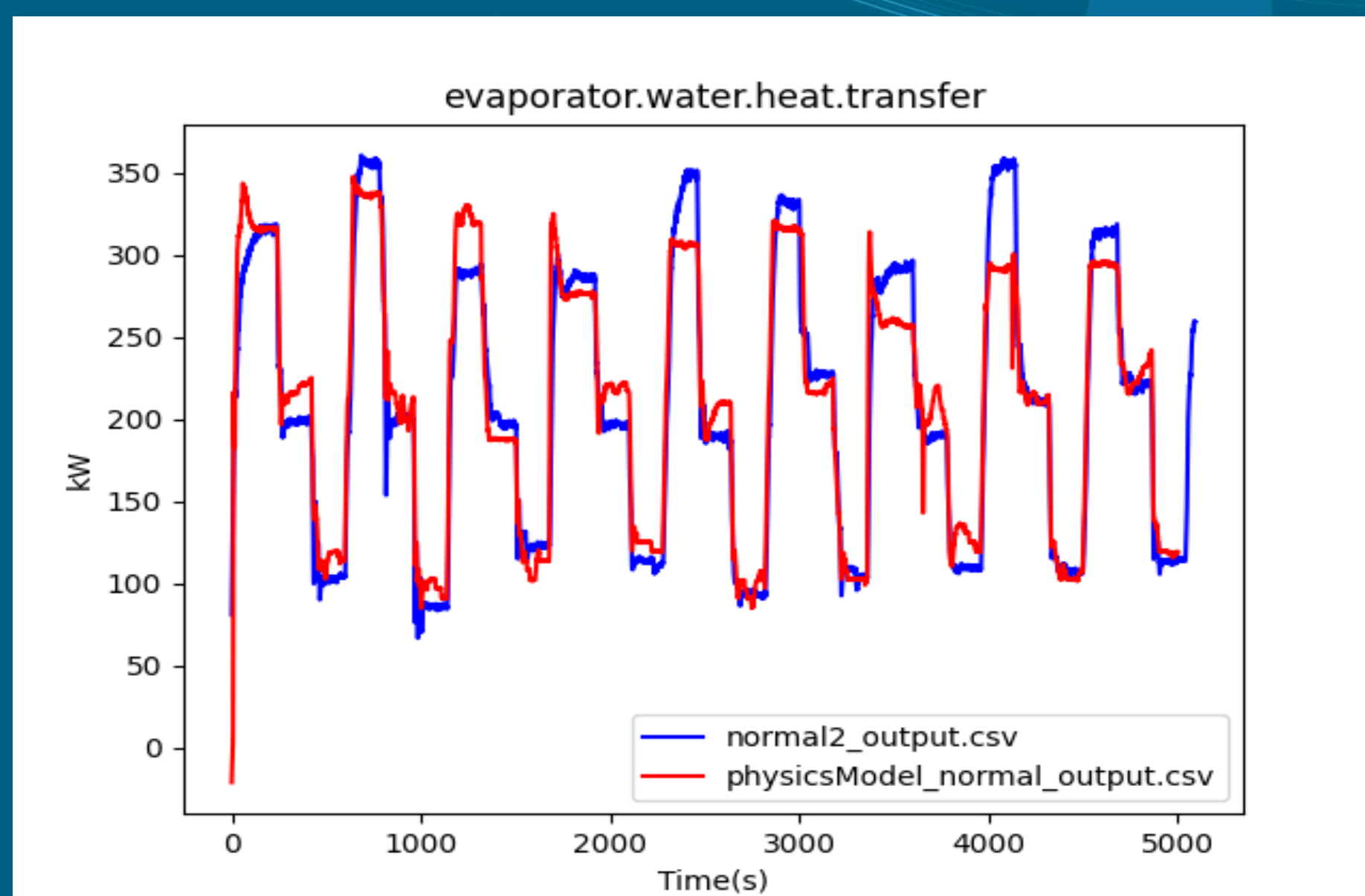
- Example system: industrial chiller
- Goal: evaluate the suitability of the SID model for cybersecurity investigations



Evaluation Pipeline

- Requirement:** select, develop, and code metrics to compare collections of time series data

### Results:



Visual comparison for one variable

$$R^2 = 0.92, RMS = 23.54$$

- Implemented 9 metrics in Python
- Most promising metrics included
  - $R^2$  metric: fraction of “difference variance” attributed to linear model

$$R^2 = 1 - \frac{\sum_{i=1}^n (x_i - y_i)^2}{\sum_{i=1}^n (y_i - \bar{y})^2}$$

Potential challenges applying  $R^2$  to highly nonlinear systems

- Root-Mean Squared Error (RMS): spread of differences between datasets

$$RMS = \sqrt{\frac{\sum_{i=1}^n (x_i - y_i)^2}{n}}$$

- Future work: investigate acceptance criteria

### Impact and Benefits:

- Automated visual and statistical comparison of models
- Enhanced confidence in resulting models and analyses