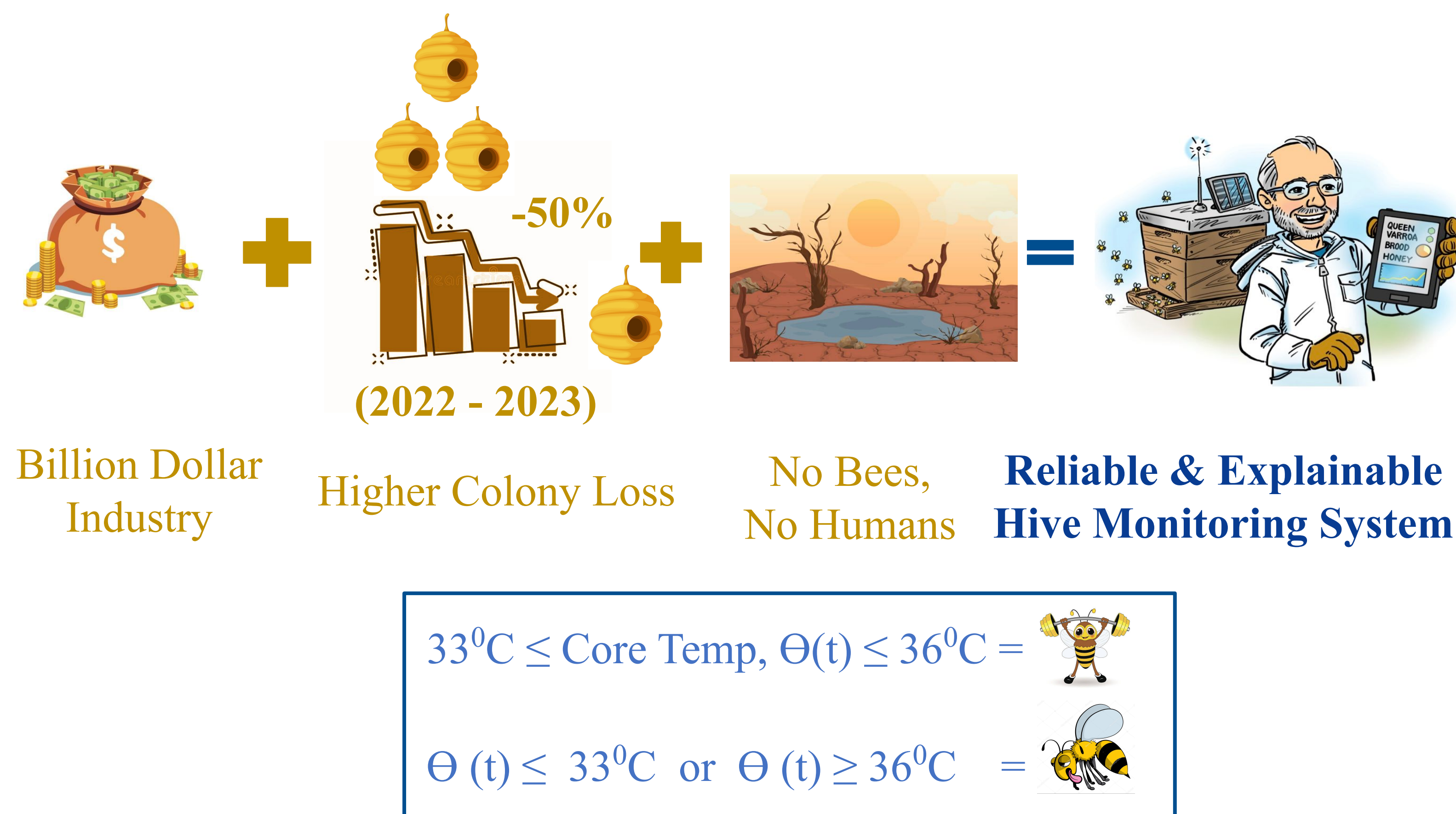


# EBV: Electronic Bee-Veterinarian for Principled Mining and Forecasting of Honeybee Time Series

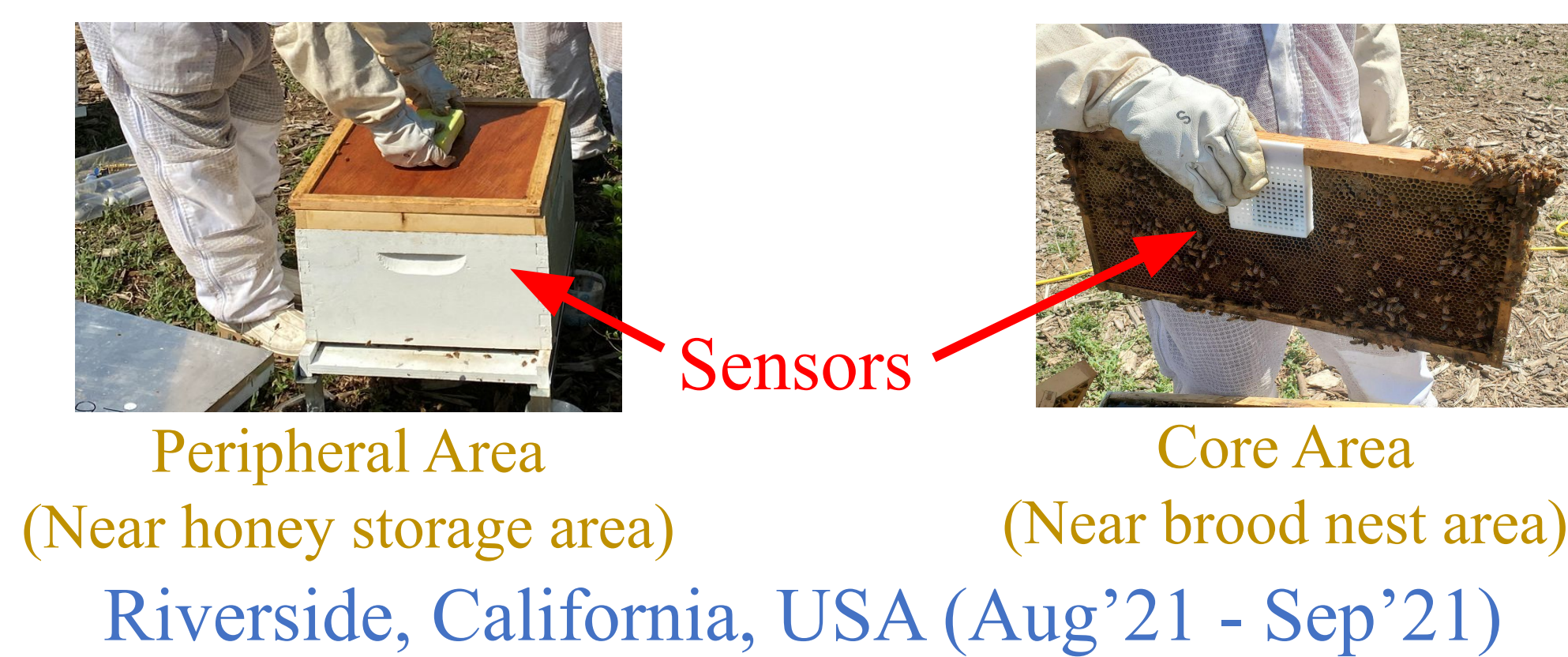
Mst Shamima Hossain<sup>1</sup>, Christos Faloutsos<sup>2</sup>, Boris Baer<sup>1</sup>, Hyoseung Kim<sup>1</sup>, Vassilis J. Tsotras<sup>1</sup>  
<sup>1</sup>University of California, Riverside, CA, USA; <sup>2</sup>Carnegie Mellon University, Pittsburgh, PA, USA

## 1. Motivation

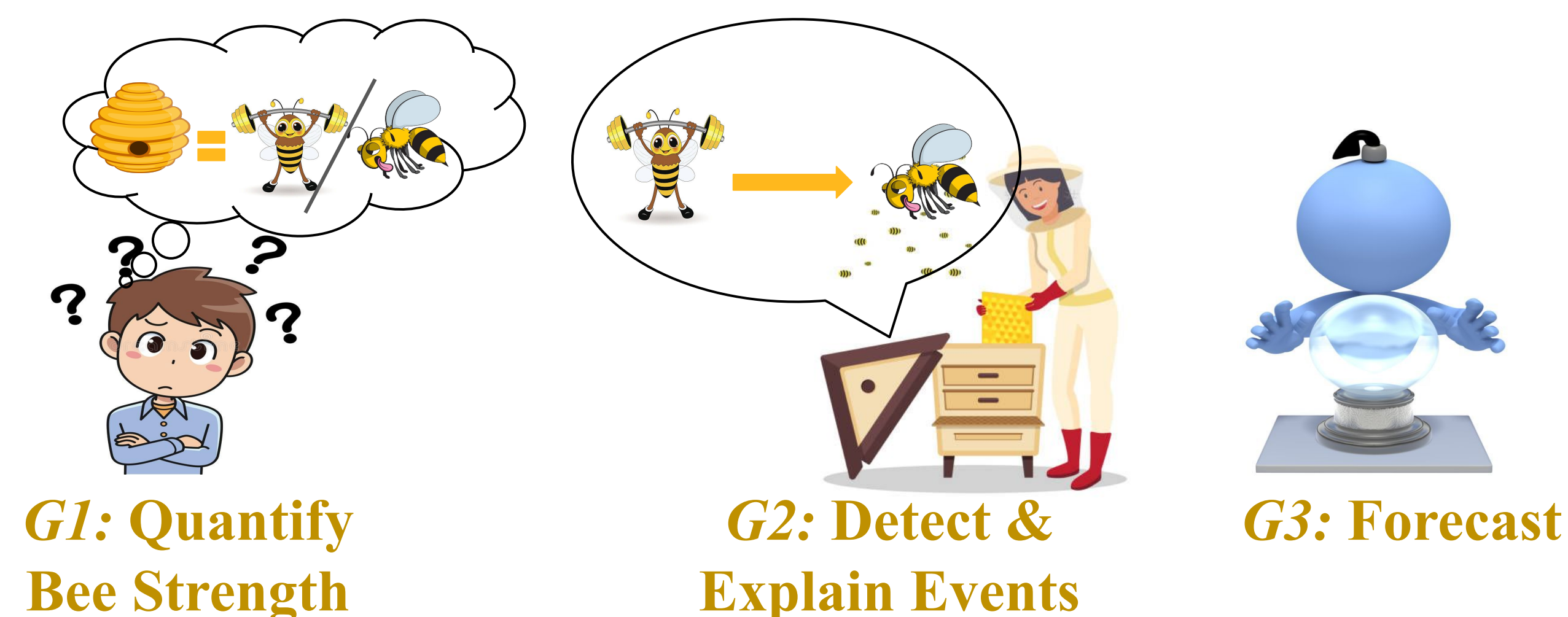


## 2. Problem Statement

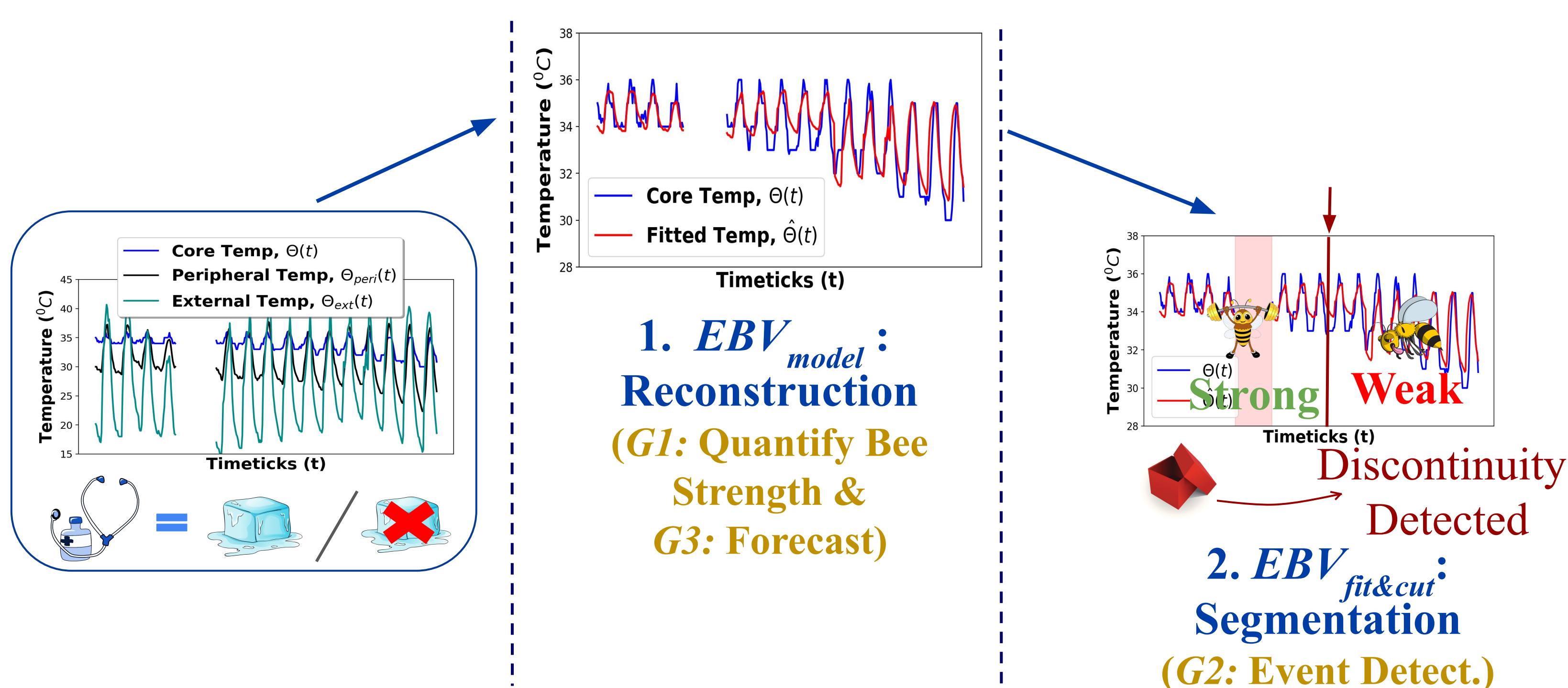
GIVEN:



DO:



## 3. Proposed Method: EBV

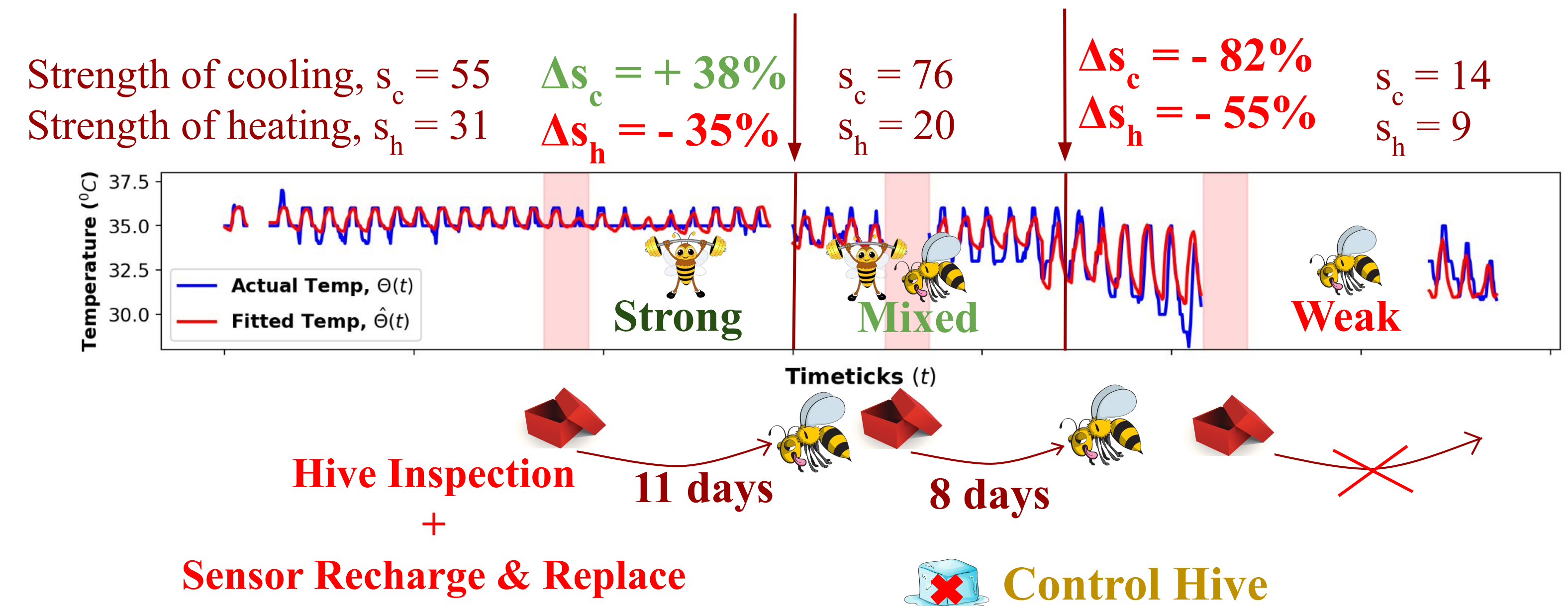


EBV<sub>model</sub>:

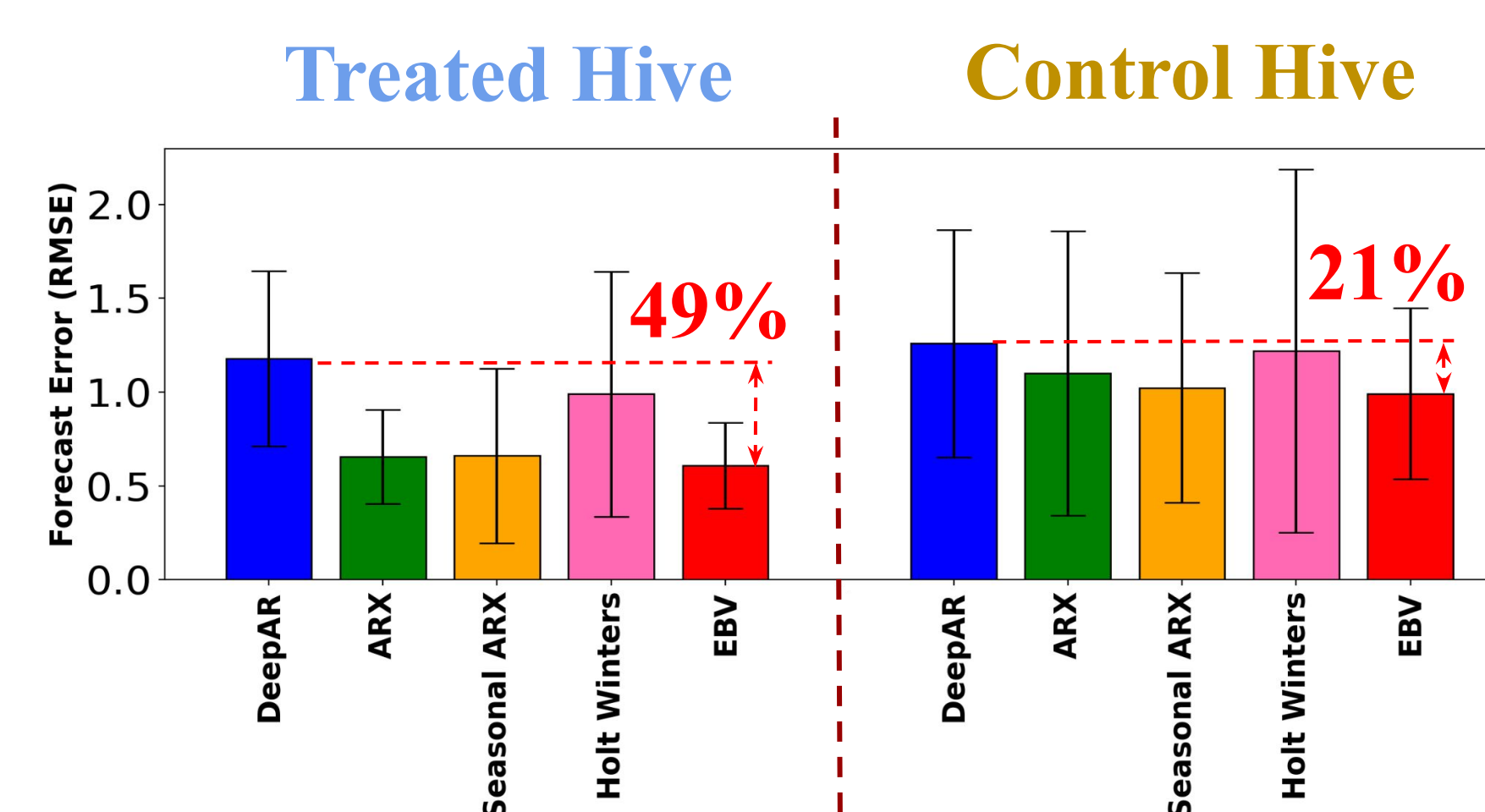
$$\frac{\partial \theta(t)}{\partial t} = \begin{cases} \theta_{ext}(t) + \theta_{adj}(t) - 2\theta(t) - s_c \theta(t) & \text{if } \theta_{ext}(t) \geq 0 \\ \theta_{ext}(t) + \theta_{adj}(t) - 2\theta(t) + s_h \theta(t) & \text{otherwise} \end{cases}$$

## 4. Experimental Results

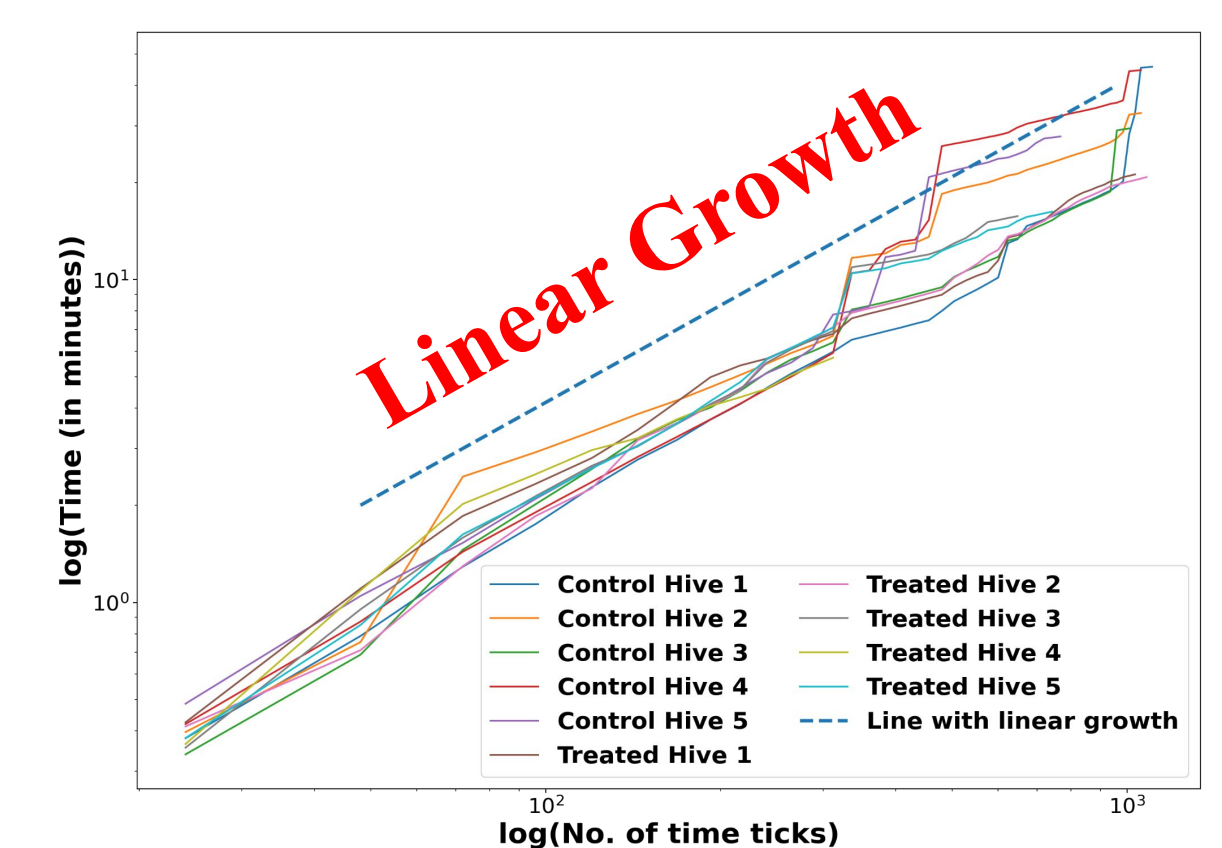
### Q1 Explainable: Event Detection (G2)



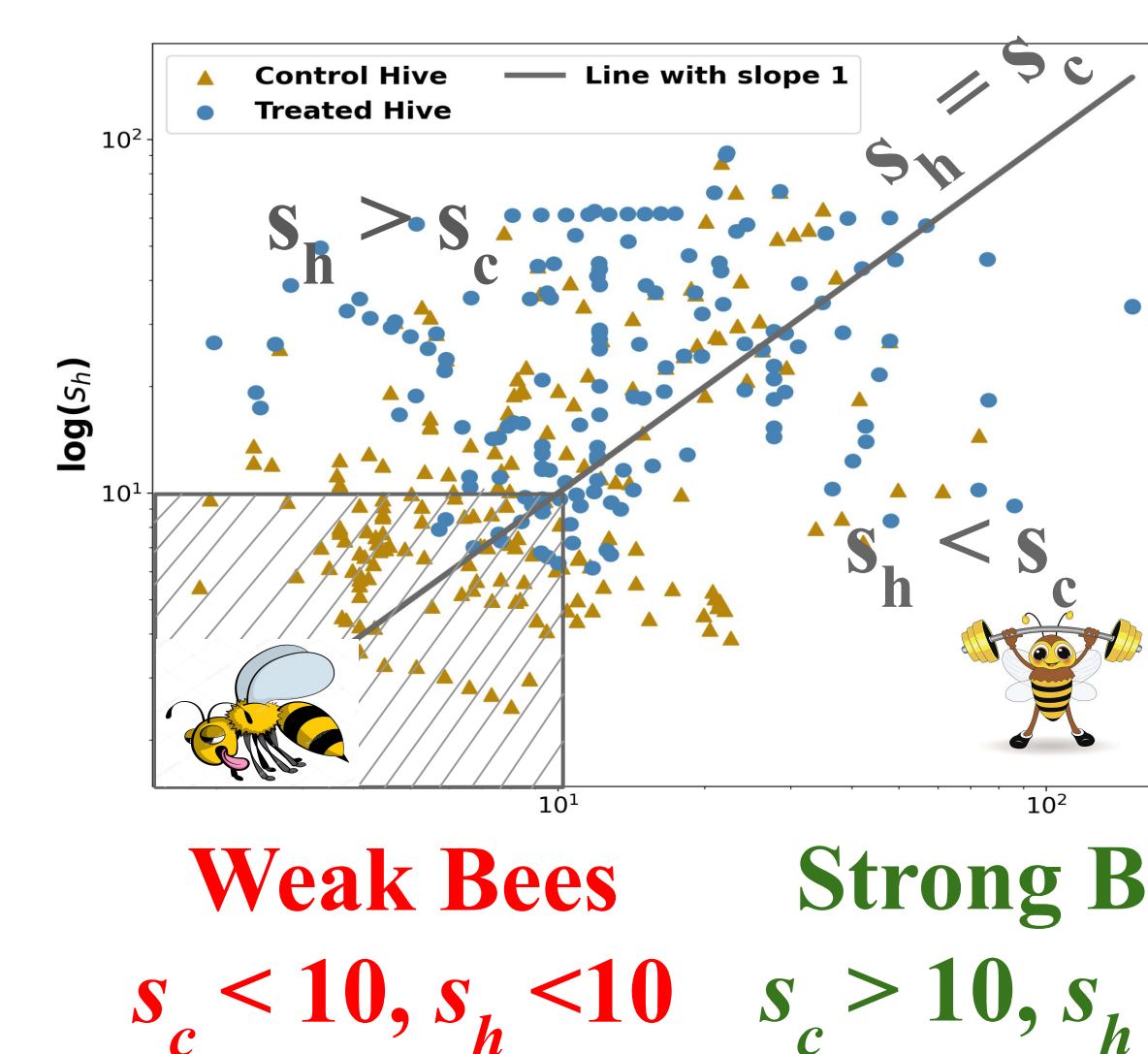
### Q2 Effective: Forecasting (G3)



### Q3 Scalable



### Q4 Informative (G2)



### Observation (1):

Heating is easier than cooling ( $s_h > s_c$ )

### Observation (2):

Bees in treated hives are stronger, i.e. better thermoregulation

### Observation (3):

Control (= un-treated) hives suffer more from hive-openings.

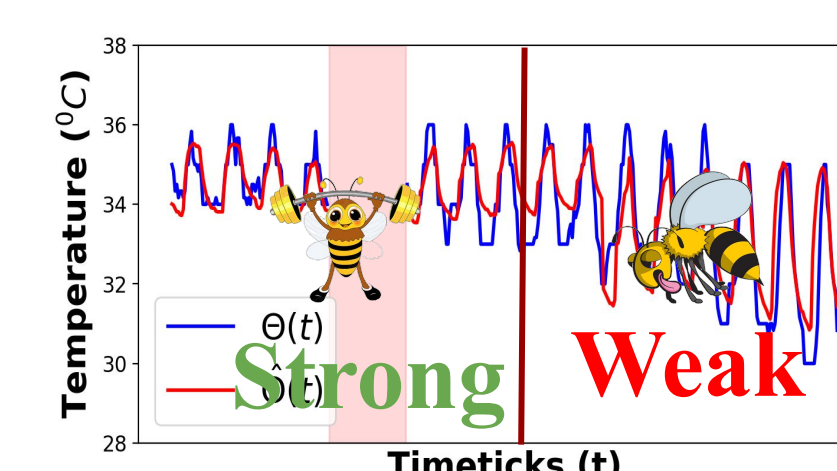
## 5. Conclusion

✓ C1: Principled

$$\nabla^2 \theta \propto \partial \theta / \partial t$$

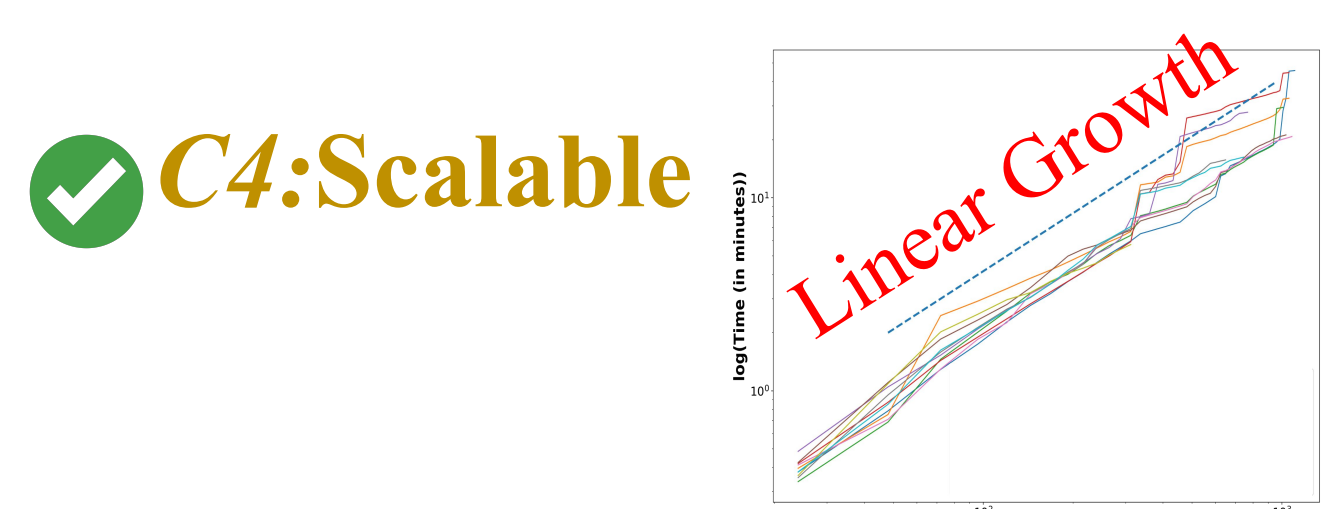
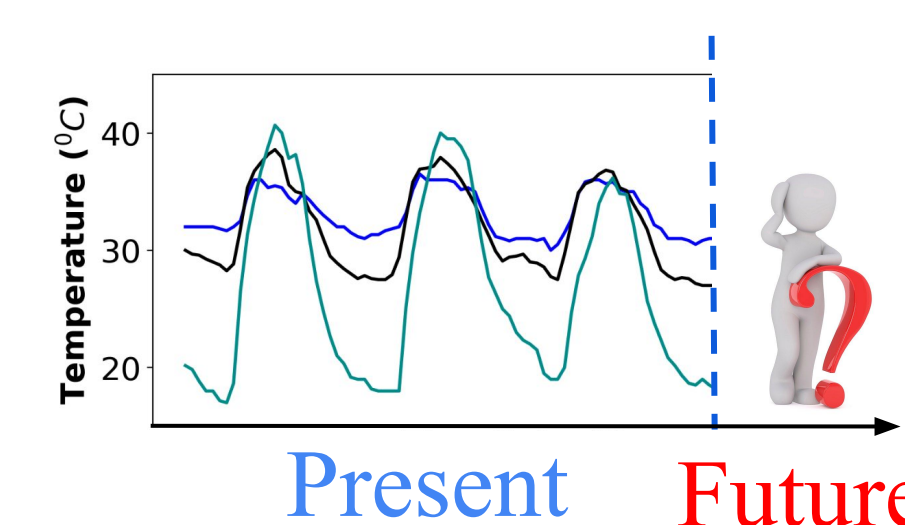
✓ C4: Scalable

✓ C2: Explainable



✓ C5: Informative

✓ C3: Effective



Ongoing Work: Real-time notification of honey bee health

Source Code:  
[github.com/rtenlab/EBeeVet](https://github.com/rtenlab/EBeeVet)

Contact:  
[mhoss037@ucr.edu](mailto:mhoss037@ucr.edu) [ciber.ucr.edu](mailto:ciber.ucr.edu)