SONYC: Monitoring, Analysis and Mitigation of Urban Noise Pollution

Juan Pablo Bello, Claudio Silva, Oded Nov, Luke DuBois (New York University)
and Anish Arora (Ohio State University), w/ Charlie Mydlarz

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The New York Times | https://nyti.ms/2vBlsjh

N.Y. / REGION

New York Becomes the City That Never Shuts Up

By WINNIE HU JULY 19, 2017

Richard T. McIntosh has never heard such a racket outside his window.

Traffic roars through his neighborhood on the Upper East Side of Manhattan at all hours. The whine of refrigerated grocery trucks by the curb makes things worse. And construction of a new apartment tower across the street forces him to flee his own home. There is the deafening rat-a-tat of jack hammers and the incessant banging and high-pitched wail of construction equipment that echoes in his head.

"I've had two years of absolute violation of my right to peace and quiet," said Mr. McIntosh, a television producer who has lived on the Upper East Side for more than five decades. "I think it's against the Geneva Conventions to have this much noise."

New York City has never been kind to human ears, from its screeching subways and honking taxis to wailing police sirens. But even at its loudest, there were always relatively tranquil pockets like the Upper East Side that offered some relief from the day-to-day cacophony of the big city. Those pockets are vanishing. As the city grows more crowded, with a record 8.5 million residents and a forest of new buildings, finding respite from loud cellphone chatter, rooftop parties, backhoes digging foundations, or any other aural assault has become harder and harder.

In other words, New York is really living up to its reputation as the city that never sleeps.

Noise impact

Estimated 9 of 10 adults in NYC exposed to harmful levels of noise

Noise pollution can result in:

SLEEP LOSS

STRESS

HEARING LOSS

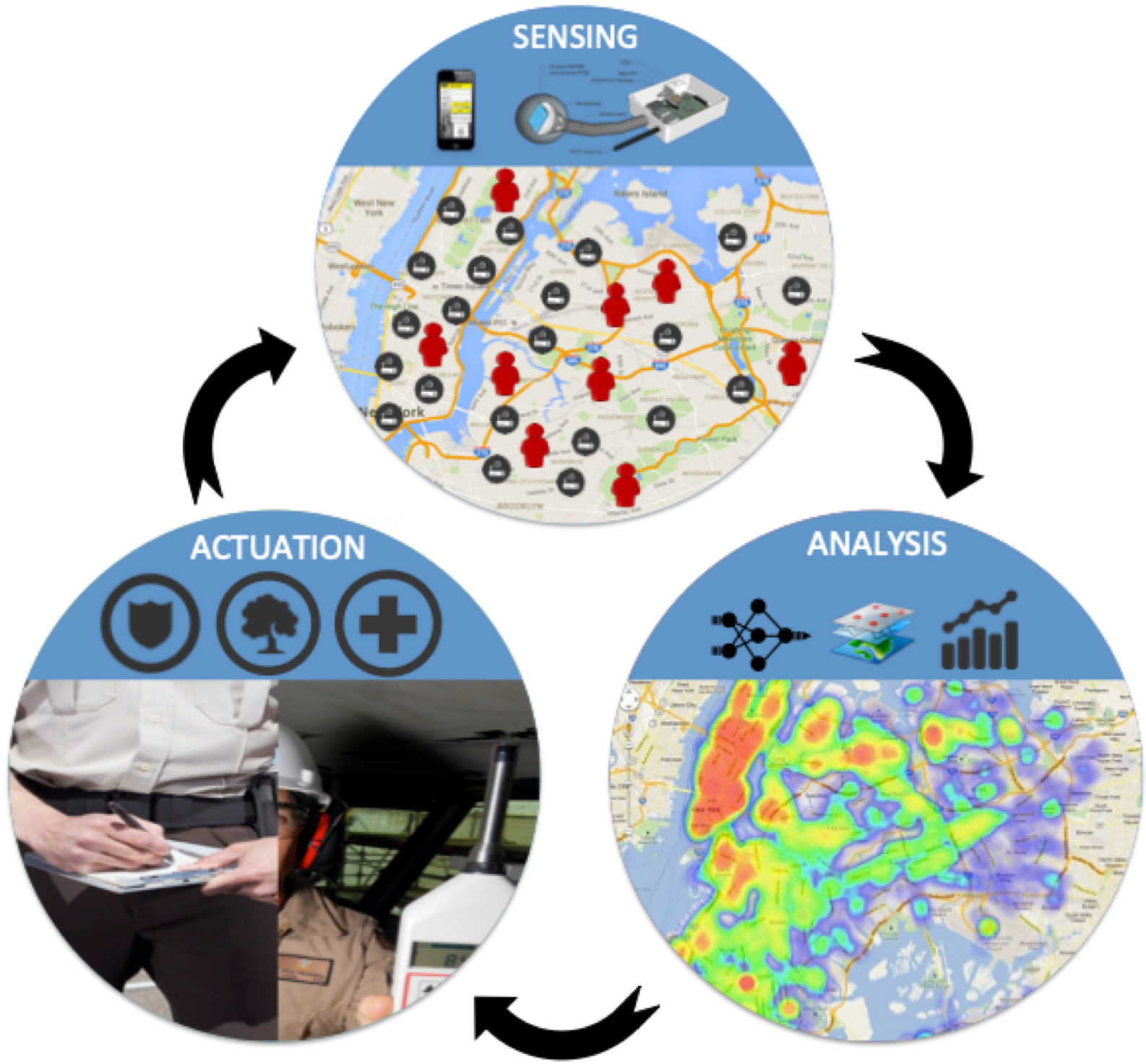
REDUCED PRODUCTIVITY

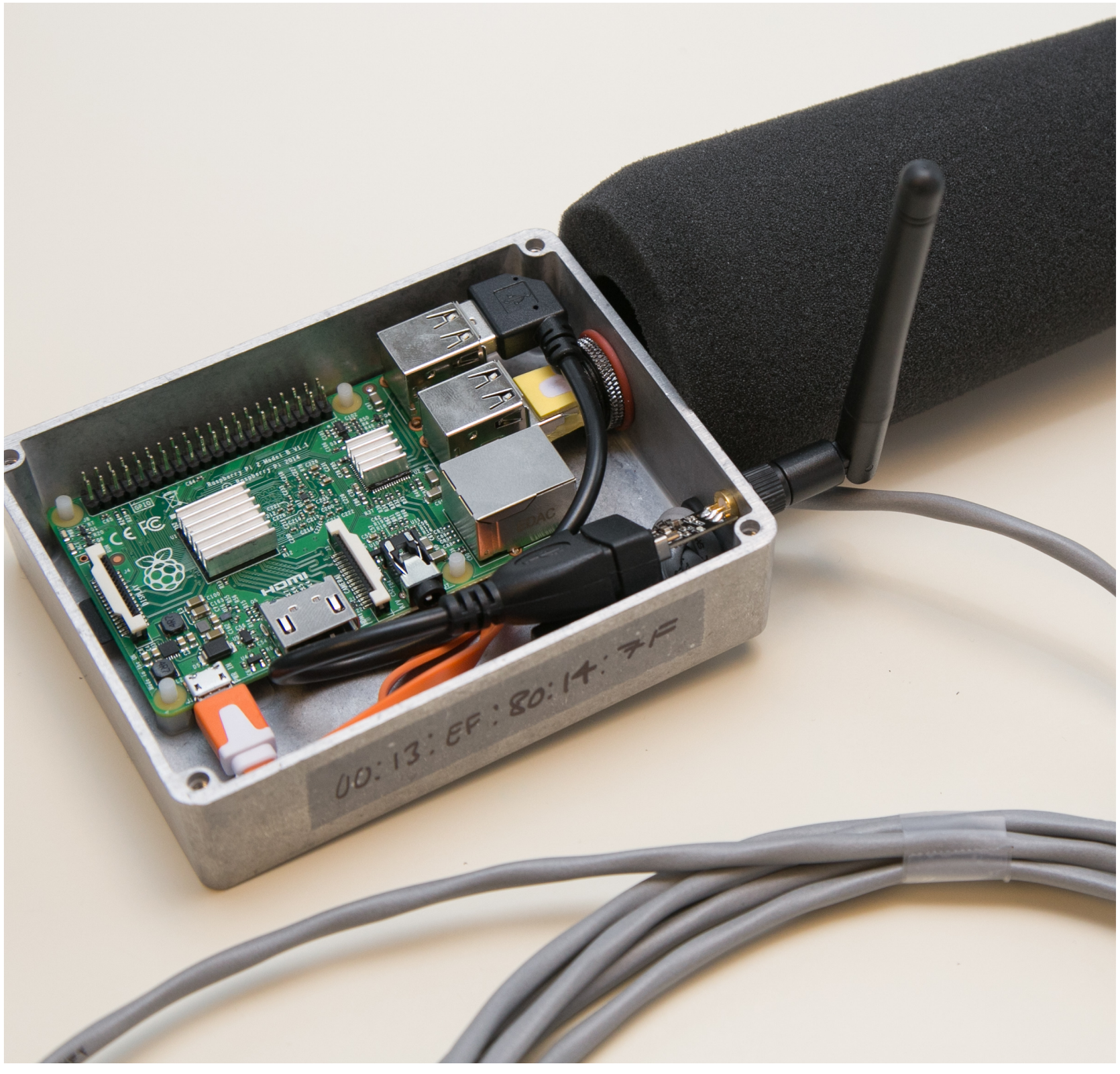
LEARNING IMPAIRMENT

SONYC

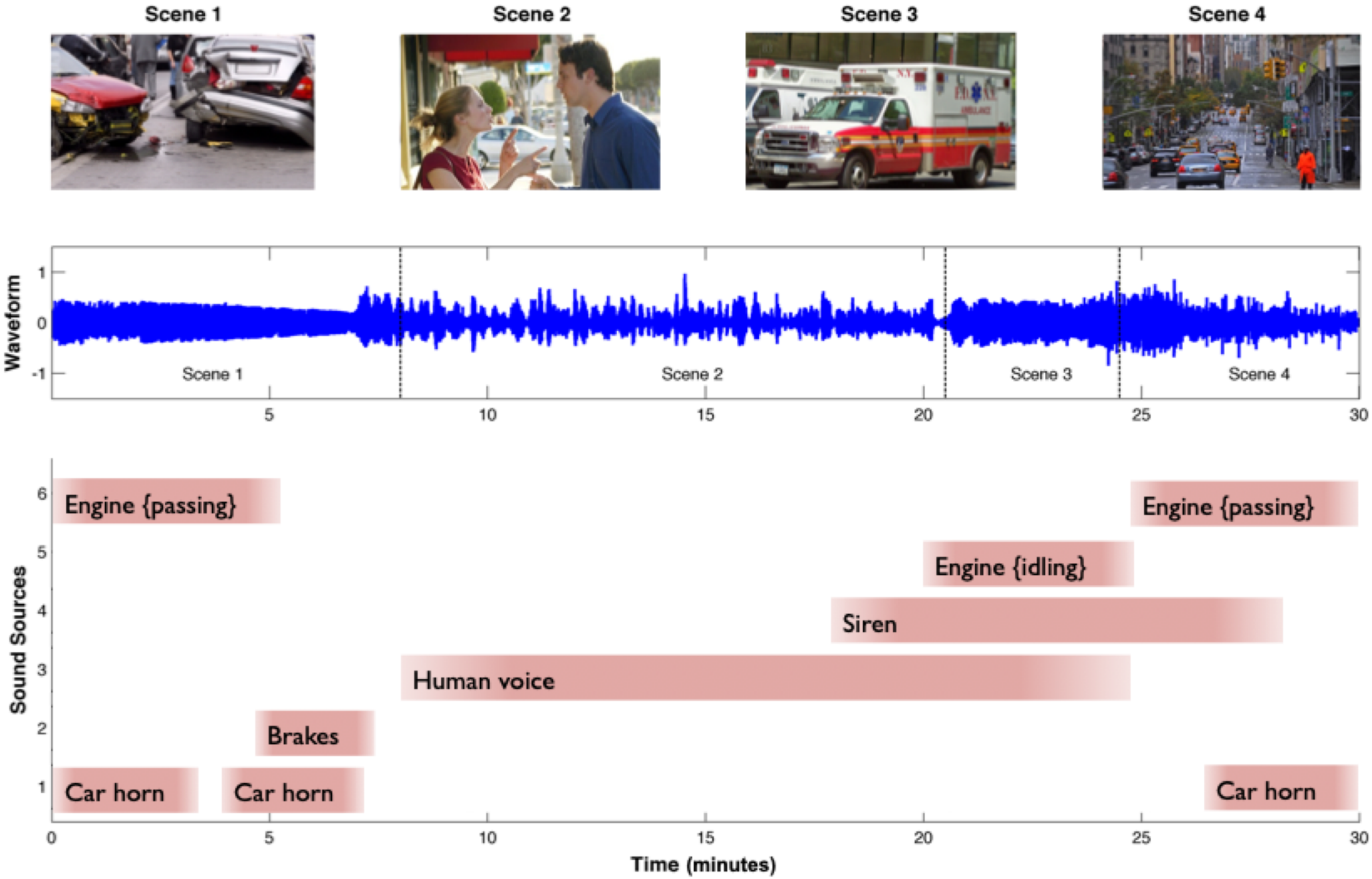
CPS solution aimed at reducing urban noise pollution

SONYC



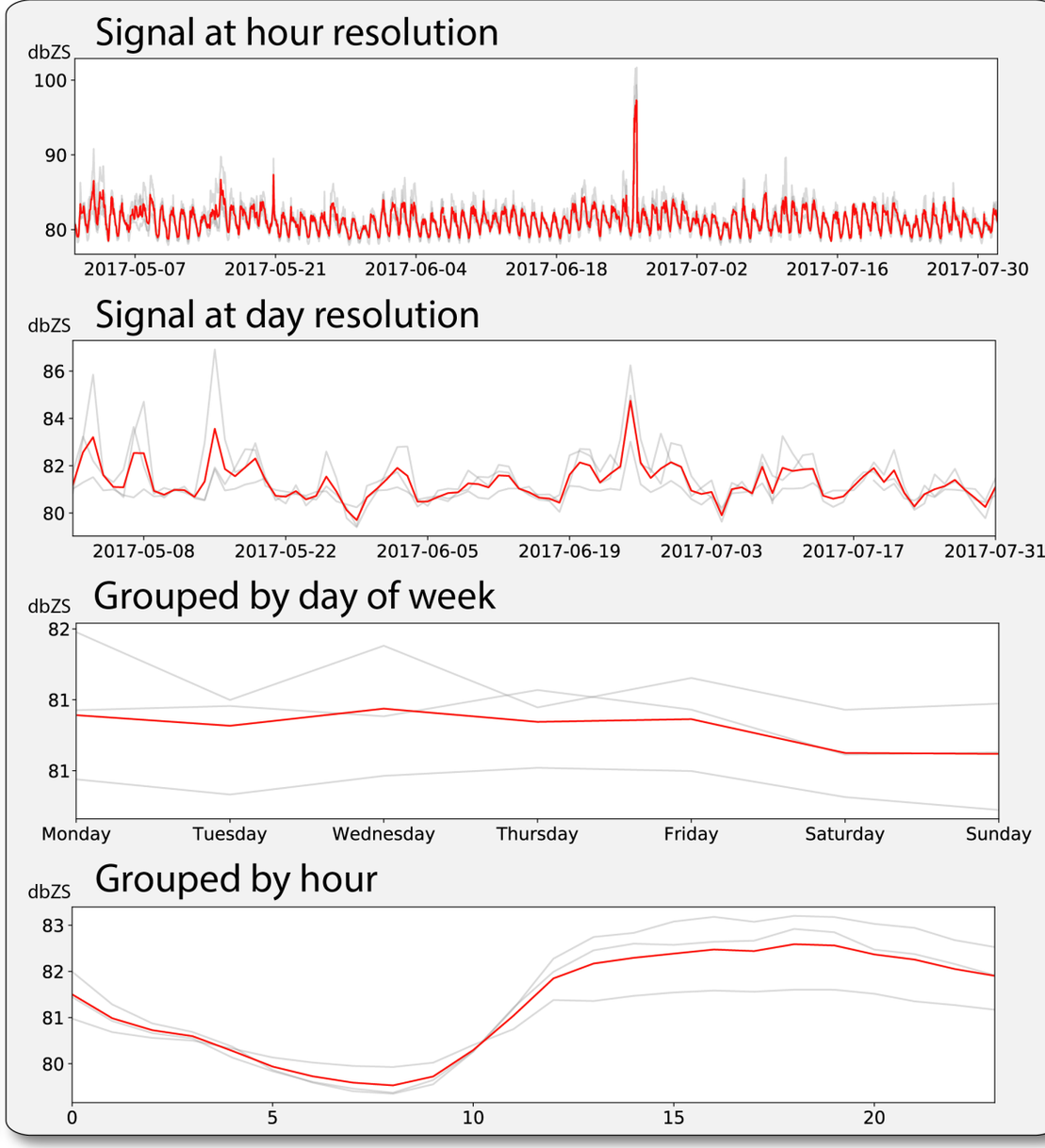


54 sensors, 3 NYC boroughs: 60 years of noise data



Deep Machine Listening

Automatic noise source ID

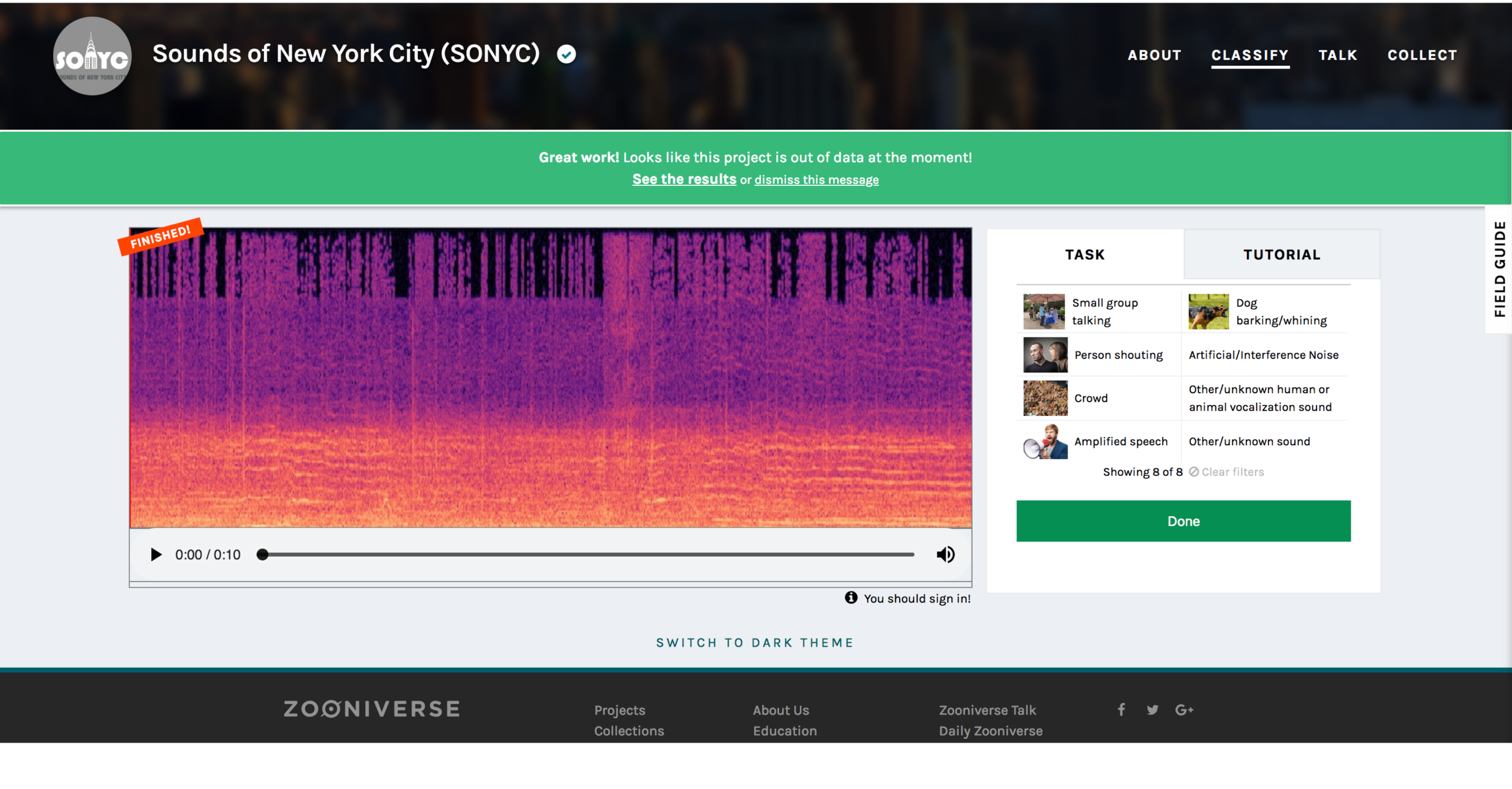


Large-scale noise analysis and visualization

Demo

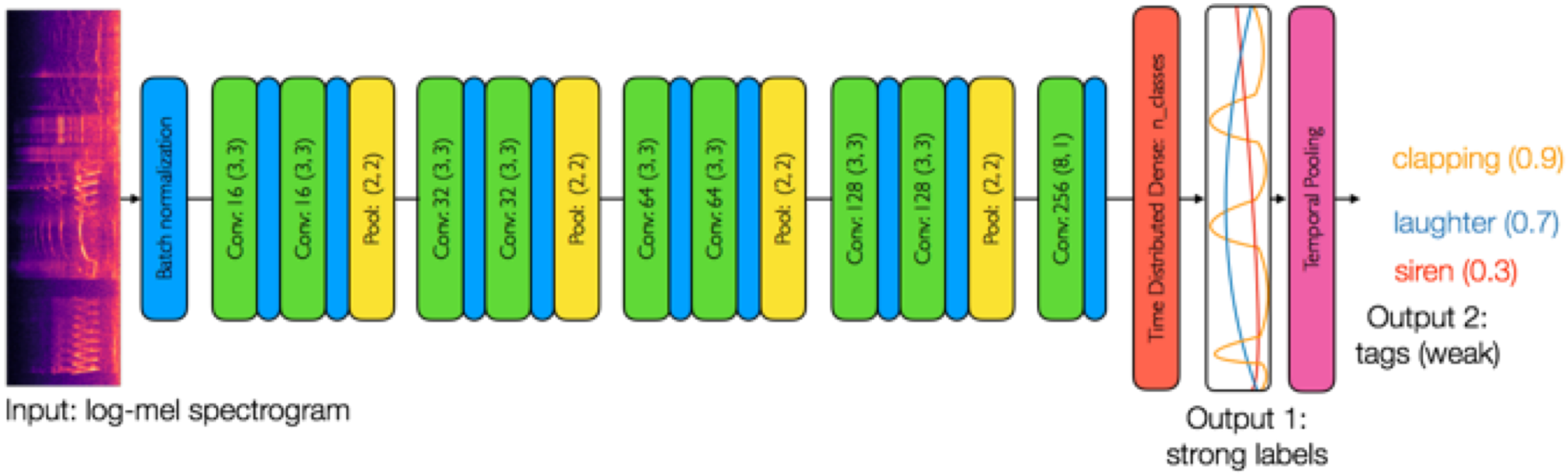
Lots of sensor network data: so what?

- Crowd-sourced annotations



Lots of sensor network data: so what?

- Multiple-instance learning using auto-pooling



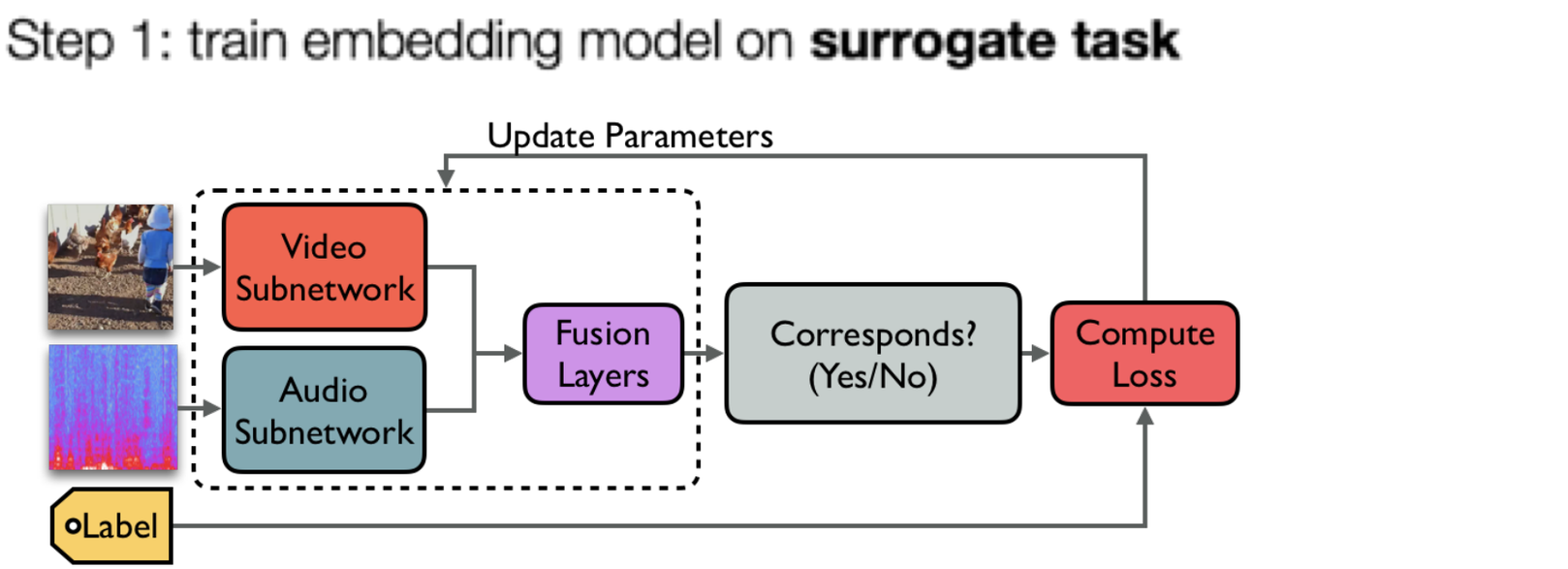
- $\alpha = 0$ ⇒ mean pooling
- $\alpha = 1$ ⇒ softmax pooling
- $\alpha \to \infty$ ⇒ max pooling
- $\alpha \to -\infty$ ⇒ min pooling

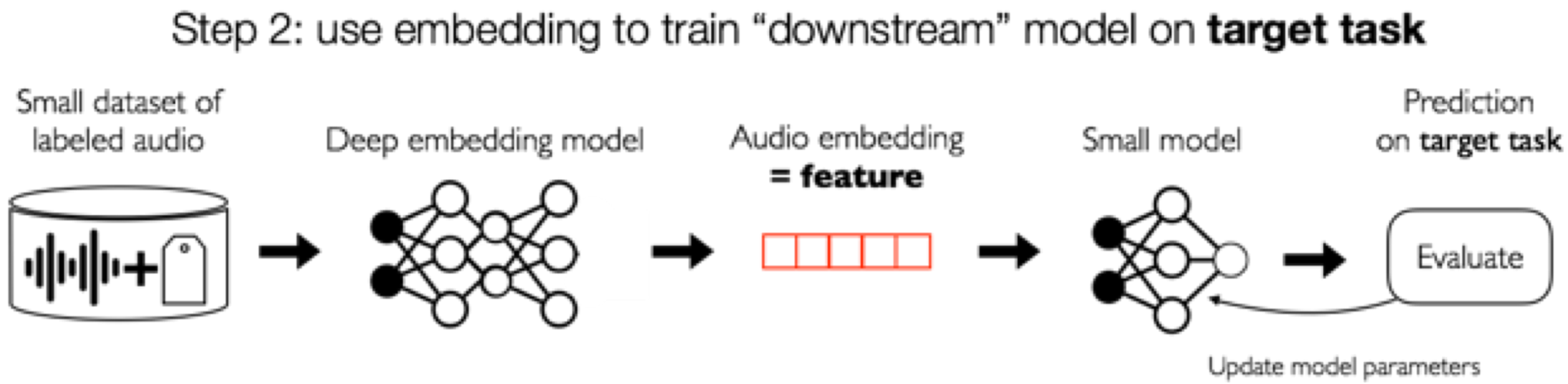
$$\hat{P}_\alpha(Y \mid X) = \sum_{x \in X} \hat{p}(Y \mid x) \left(\frac{\exp\left(\alpha \cdot \hat{p}(Y \mid x)\right)}{\sum_{z \in X} \exp\left(\alpha \cdot \hat{p}(Y \mid z)\right)} \right)$$

- Multi-label? each class gets its own α

Lots of sensor network data: so what?

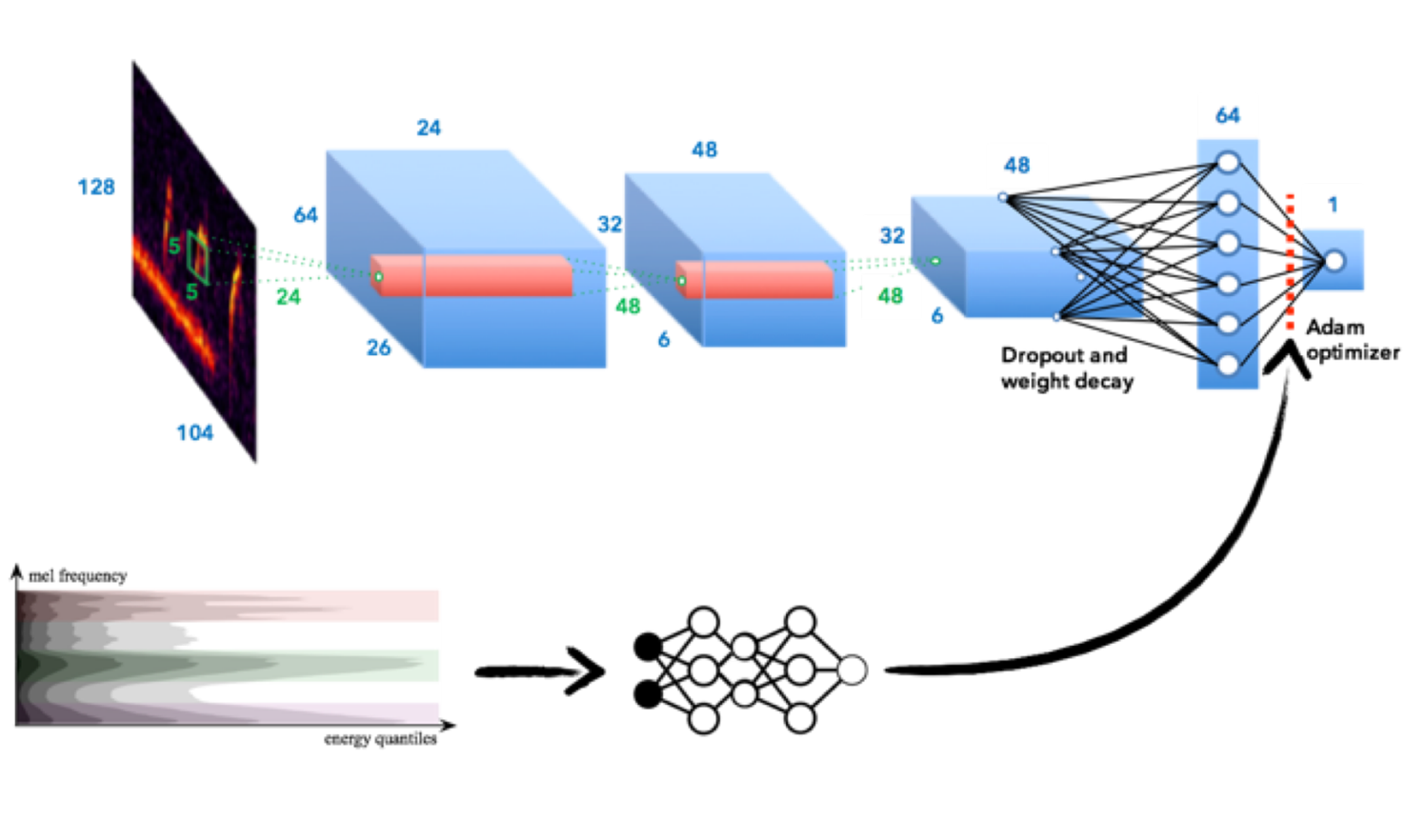
- Self-supervised embedding learning

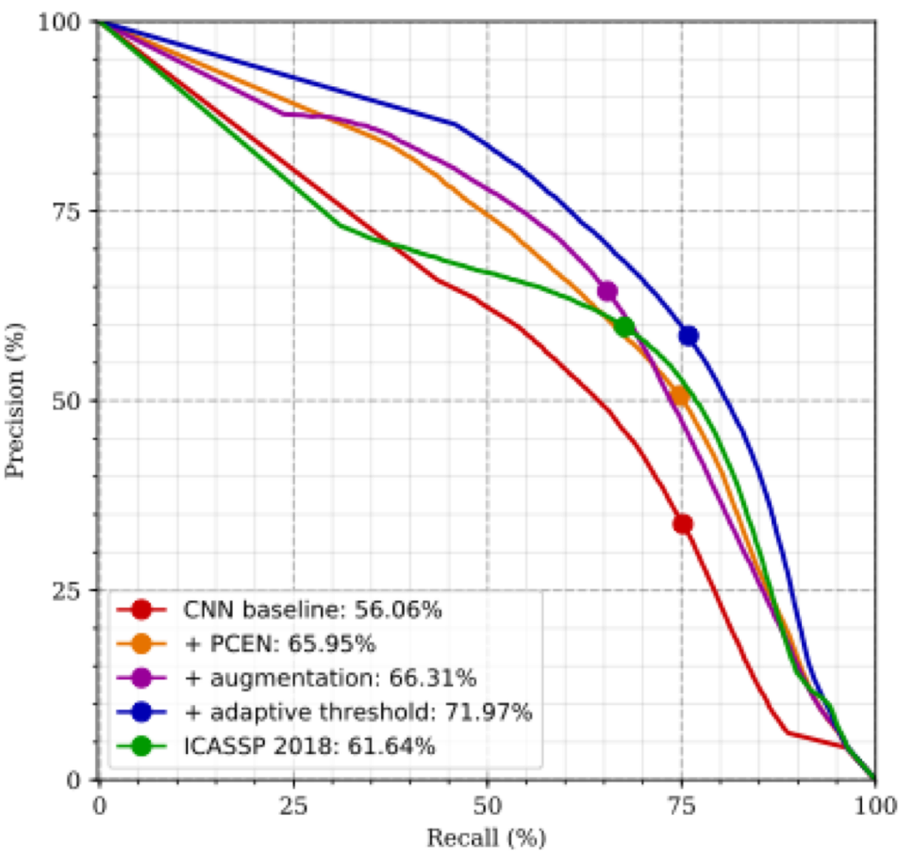




Lots of sensor network data: so what?

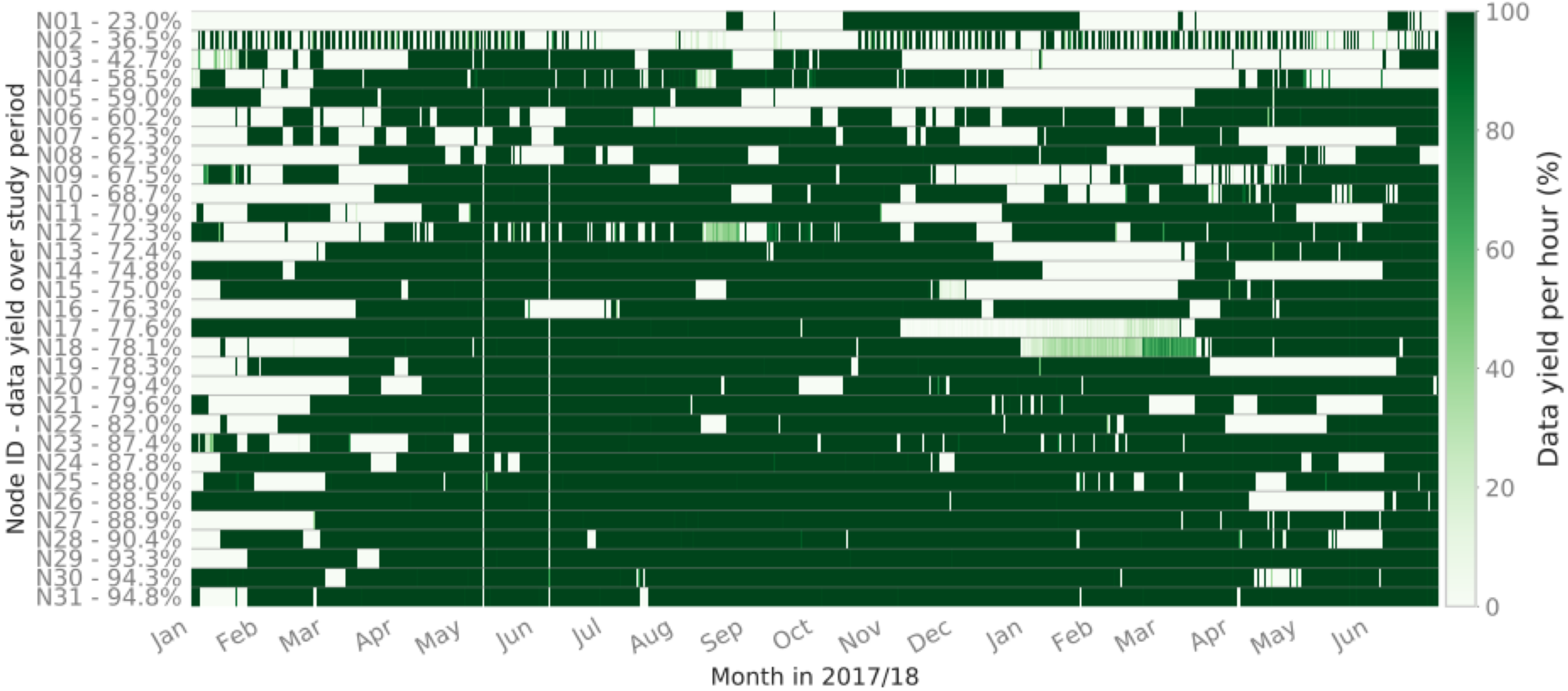
- Context-adaptive neural networks





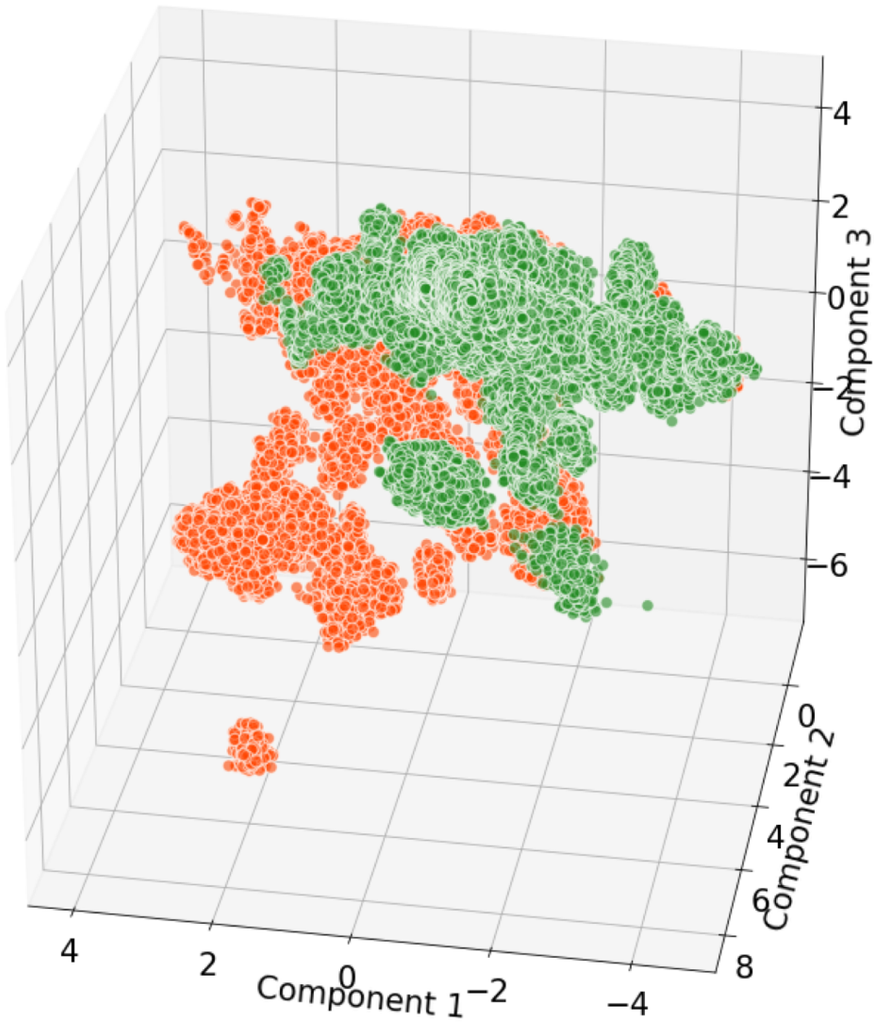
Lots of sensor network data: so what?

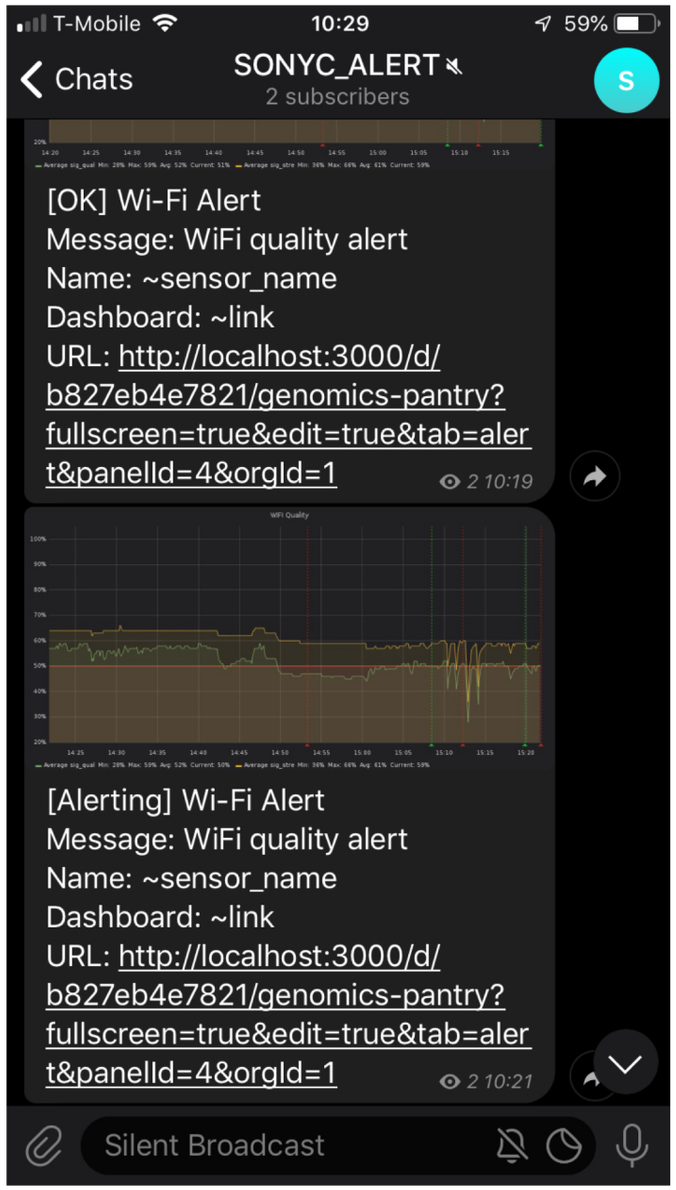
- The reality of running a sensor network

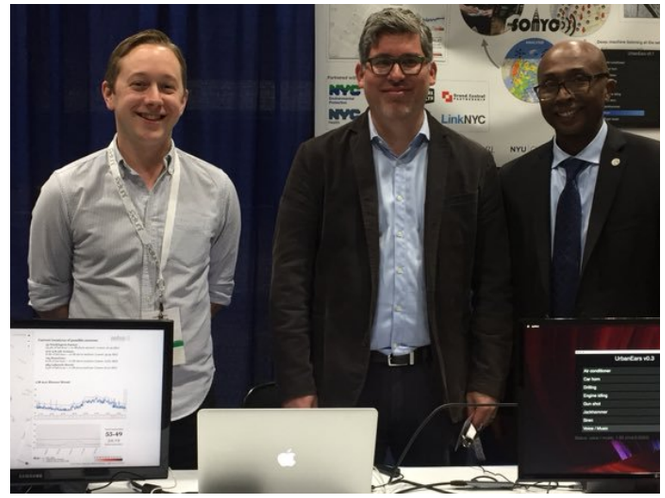


Lots of sensor network data: so what?

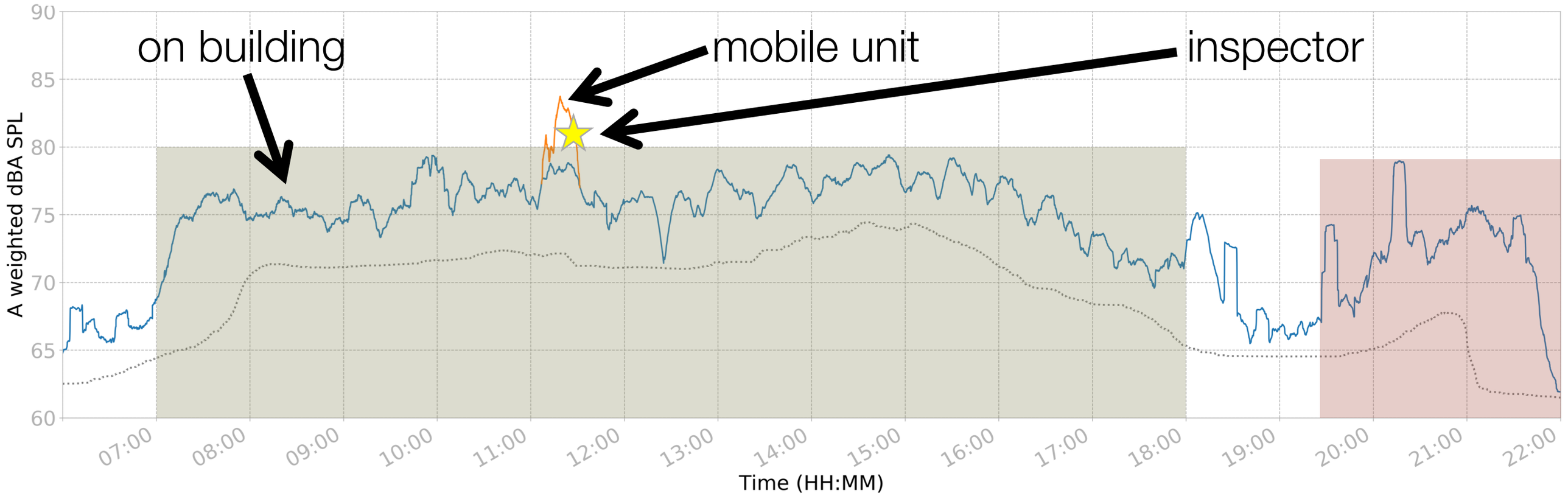
- Status data: normal vs pre-failure
- Classifier trained on 18 mo. of network data







DEP partnership: building deployments, mobile sensor, focused studies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Thanks!

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