

# Bioaerosol sensing using deep learning

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## 1 Motivation

**Air**

Every year in the UK, exposure to polluting particles causes:

- 16,500 strokes.
- 4,200 lung cancers.
- Alzheimer's disease.



**40,000 deaths per year<sup>1</sup>**  
**£20 billion per year**

Monitoring of pollution is vital to understand its origins and reduce it. Current sensors can lack accuracy and be expensive.

**Water**

Impact on marine life due to plastic particles absorbing toxins & entering food chain.



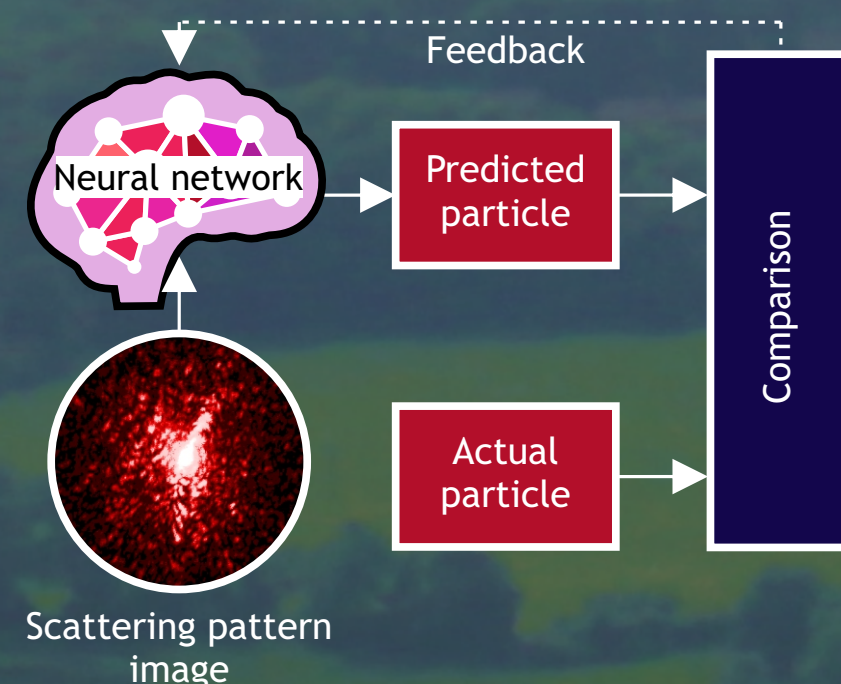
**Trillions of microbeads enter the sea per year**

## 3 Experimental setup

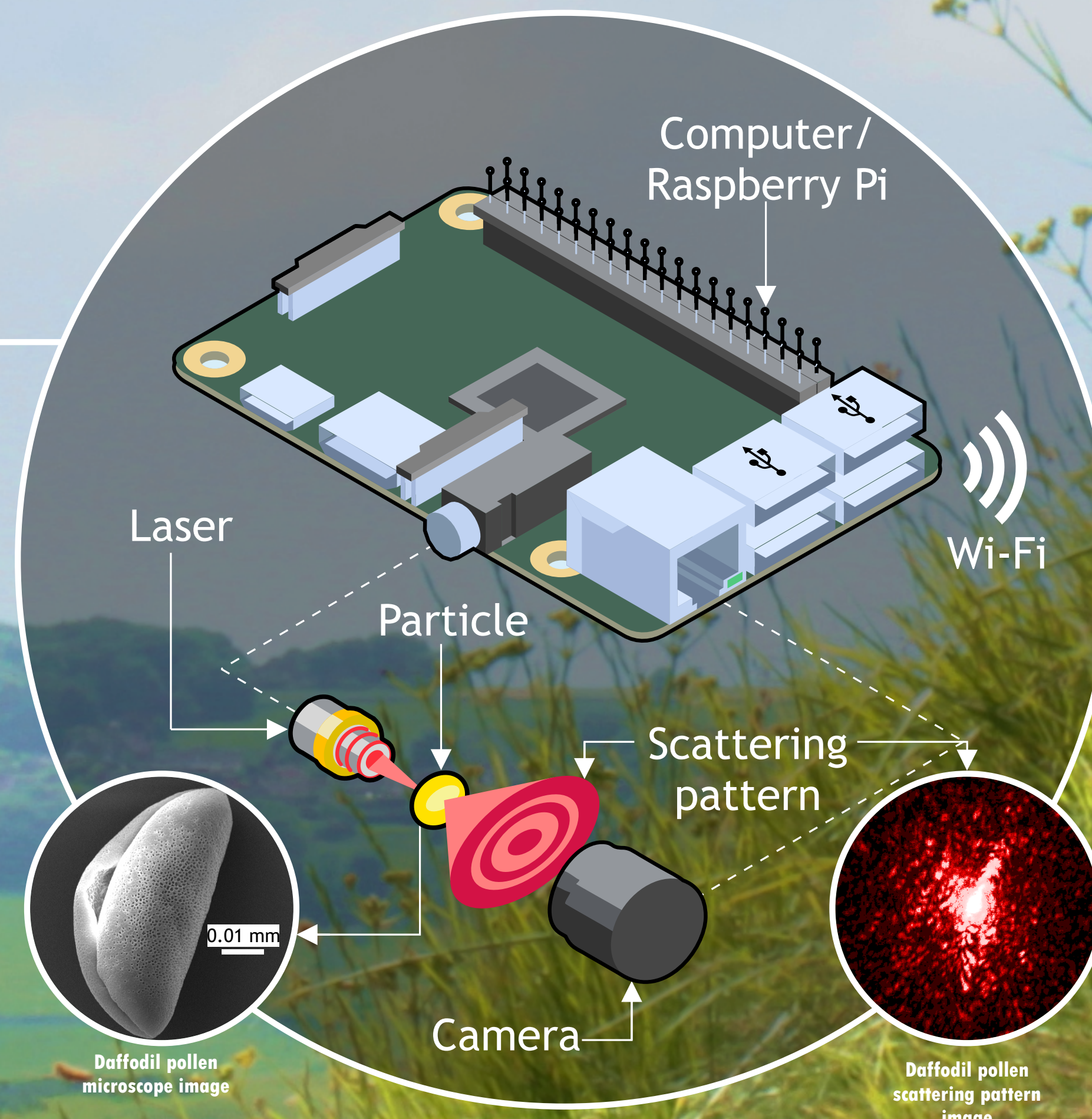
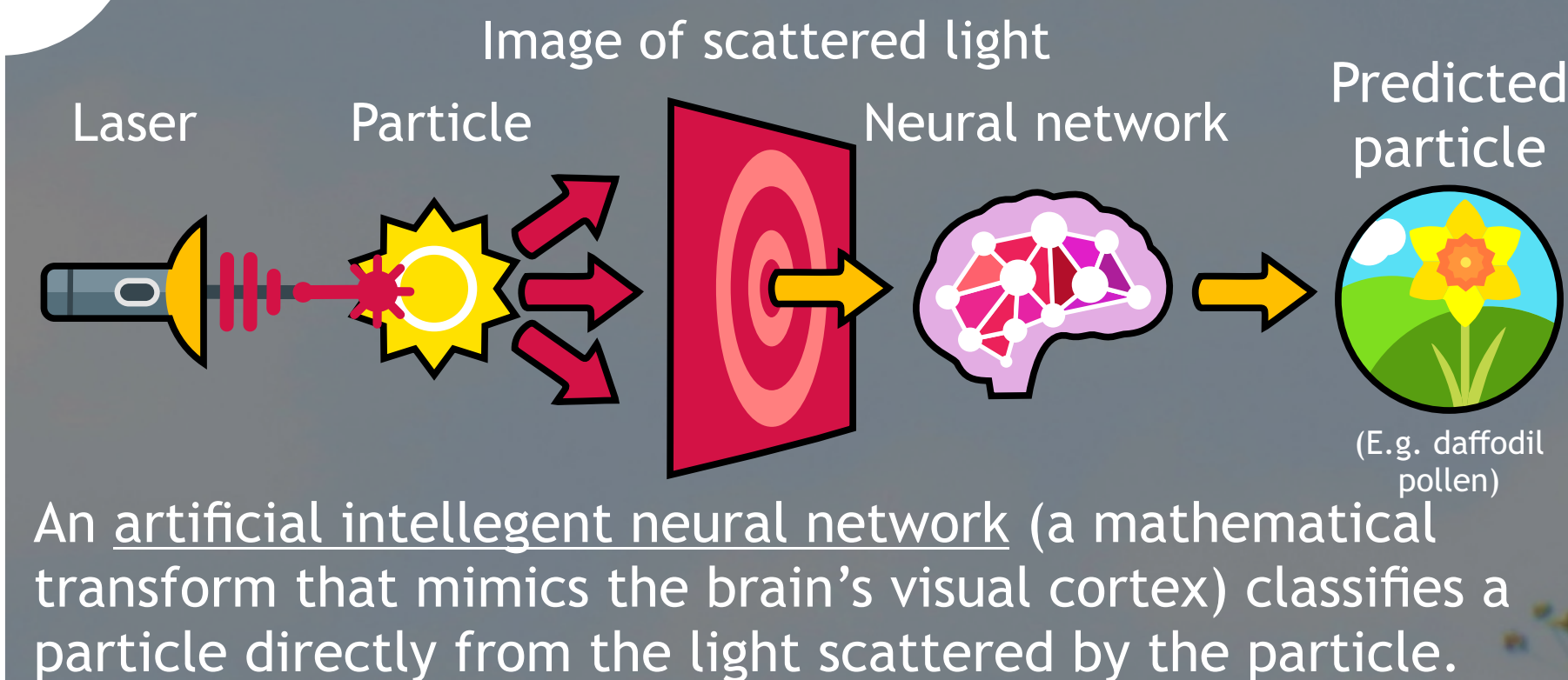
- A red laser beam was directed onto diesel, wood ash, pollen particles in air, and plastic particles in water, and the scattered light was imaged by a camera.
- The images were used for training the neural network.

## 4 Training neural network

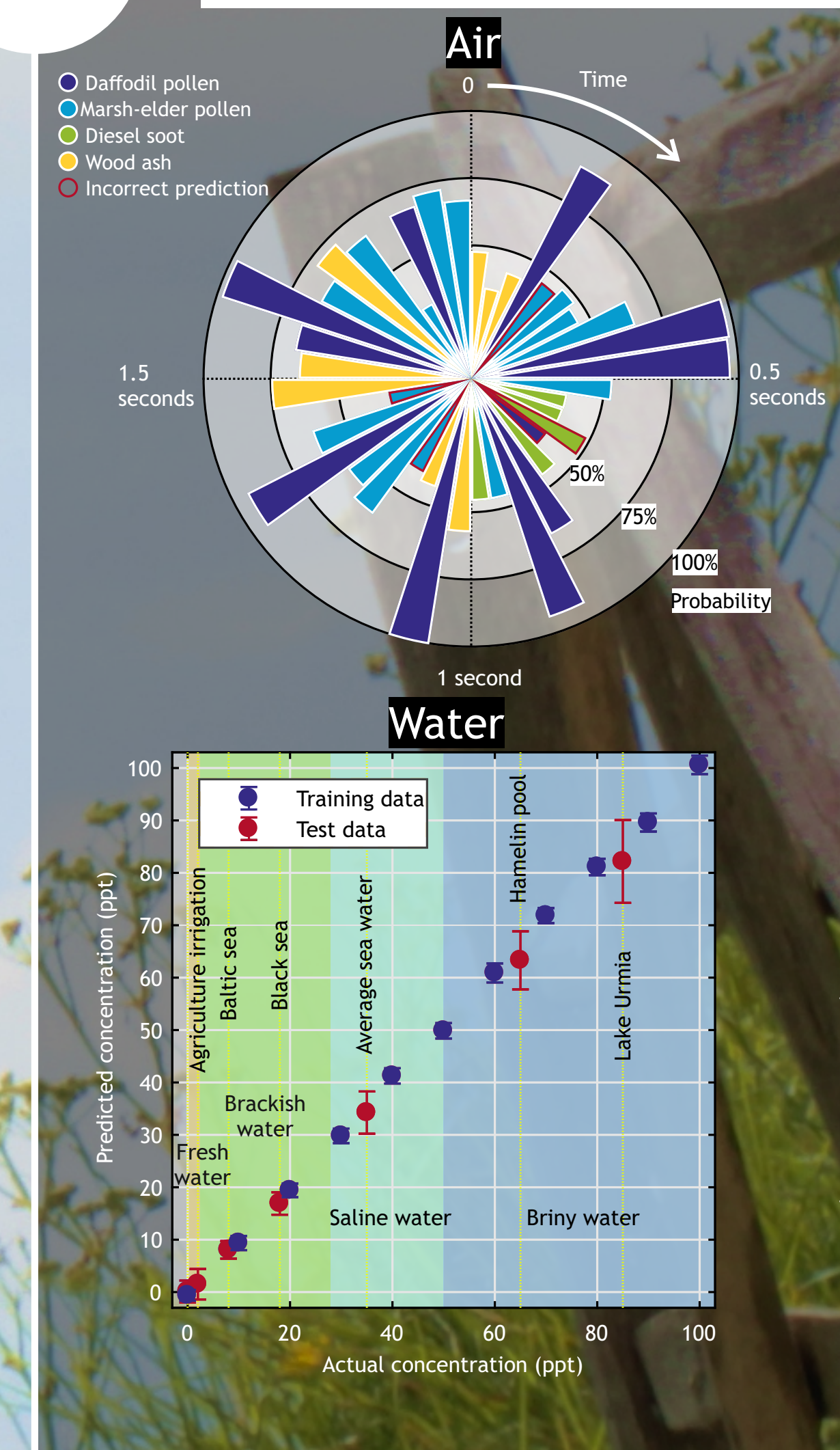
- Scattering patterns were used as an input for the neural network, which was trained to predict the material and number of particles.
- Once trained, the neural network was used in real-time for particle pollution classification.



## 2 Concept



## 5 Real-time detection



Real-time sensing of pollen, diesel and wood ash particles. Most likely particle type with its probability of prediction as a function of time<sup>2</sup>.

Detecting 0.008 mm plastic particles in water, with the average prediction accuracy of water salinity presented.

## 6 Future work

Nationwide sensors:

Developing a network of sensors over the country, such as on lampposts and in marine areas, which send data to the cloud and allow a live map of particle pollution to be viewed online.

Wearable technology:

- Rings, watches, headphones.
- Air pollution monitor with alerts.
- Hay fever alerts.
- Personalised.

