# BEeS

## The LifeWatch ERIC Biodiversity & Ecosystem eScience Conference

LifeWatch ERIC

Heraklion, 30 June - 3 July 2025

2 July 2025 | 15:00

BEeS
Heraklion
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LifeWatch ERIC

hcmr ΕΛΚΕΘΕ

iMBBC ΙΘΑΒΒΥΚ

# Session: Tracking the Wild: Unlocking Insights into Animal Movement, Behaviour, and Biologging

2 July 2025 | 14:30-16:30

# Animal Sentinels: near real-time environmental monitoring via automated bird tracking analysis

*Presenter: Eldar Rakhimberdiev (Theoretical and Computational Ecology, University of Amsterdam)*

*Coauthors: Judy Shamoun-Baranes (Theoretical and Computational Ecology, University of Amsterdam) & Wouter Vansteelant (BirdEyes, University of Groningen)*

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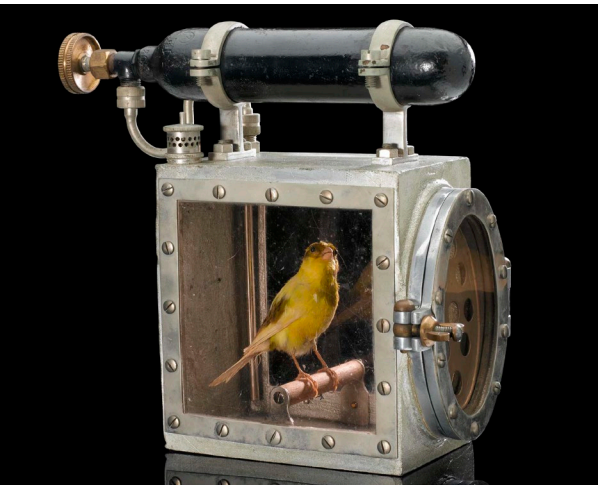
# Animal sentinels in the XIX and early XX century

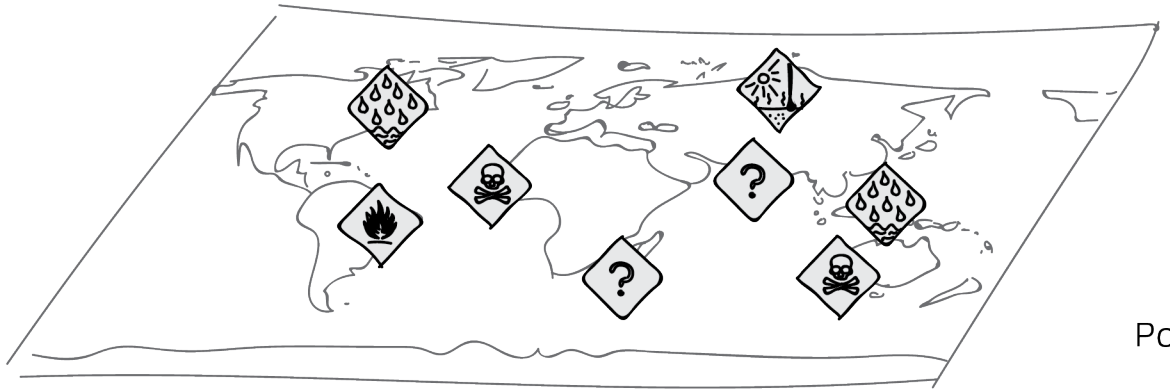
# Animal sentinels in the late XX century


source: https://www.bbe-moldaenke.de/



XXI century – borderless design:
let animal sentinels go explore the environment!

# the principle



latent environmental problems

Poisoning

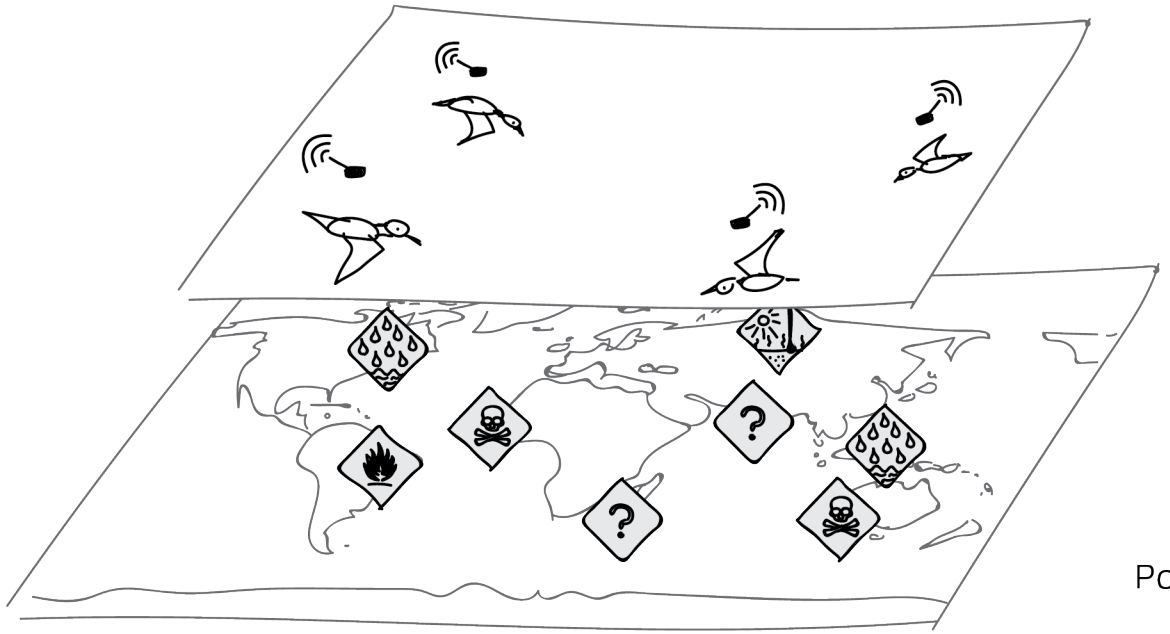
Floods

Wildfires

Droughts

Other problems

# the principle



transmitters

animal sentinels

latent environmental problems

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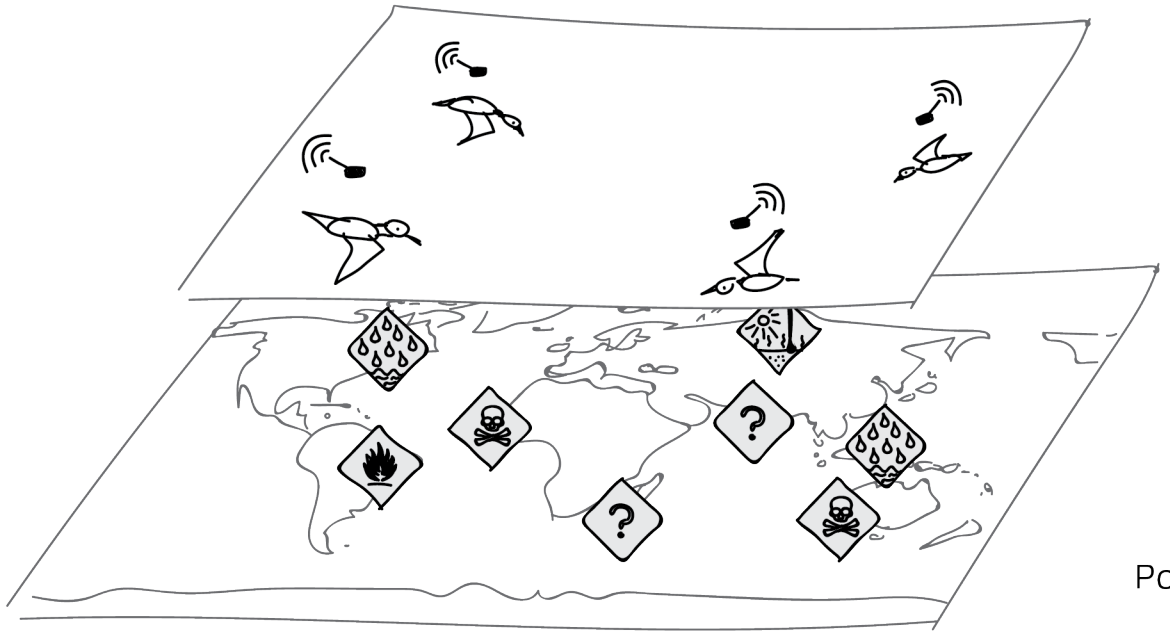
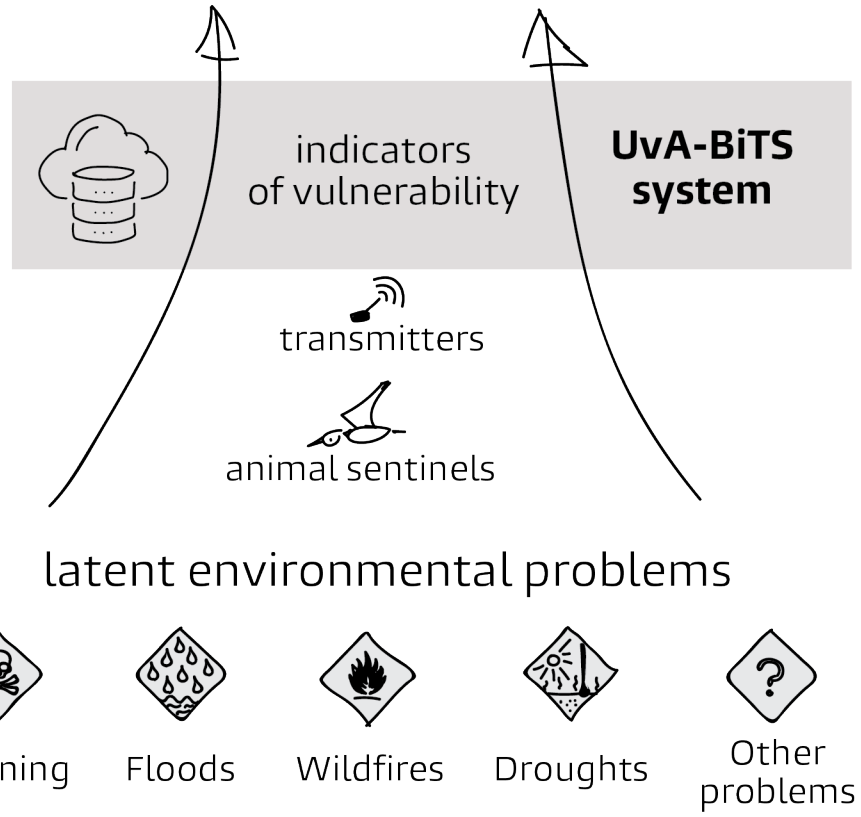
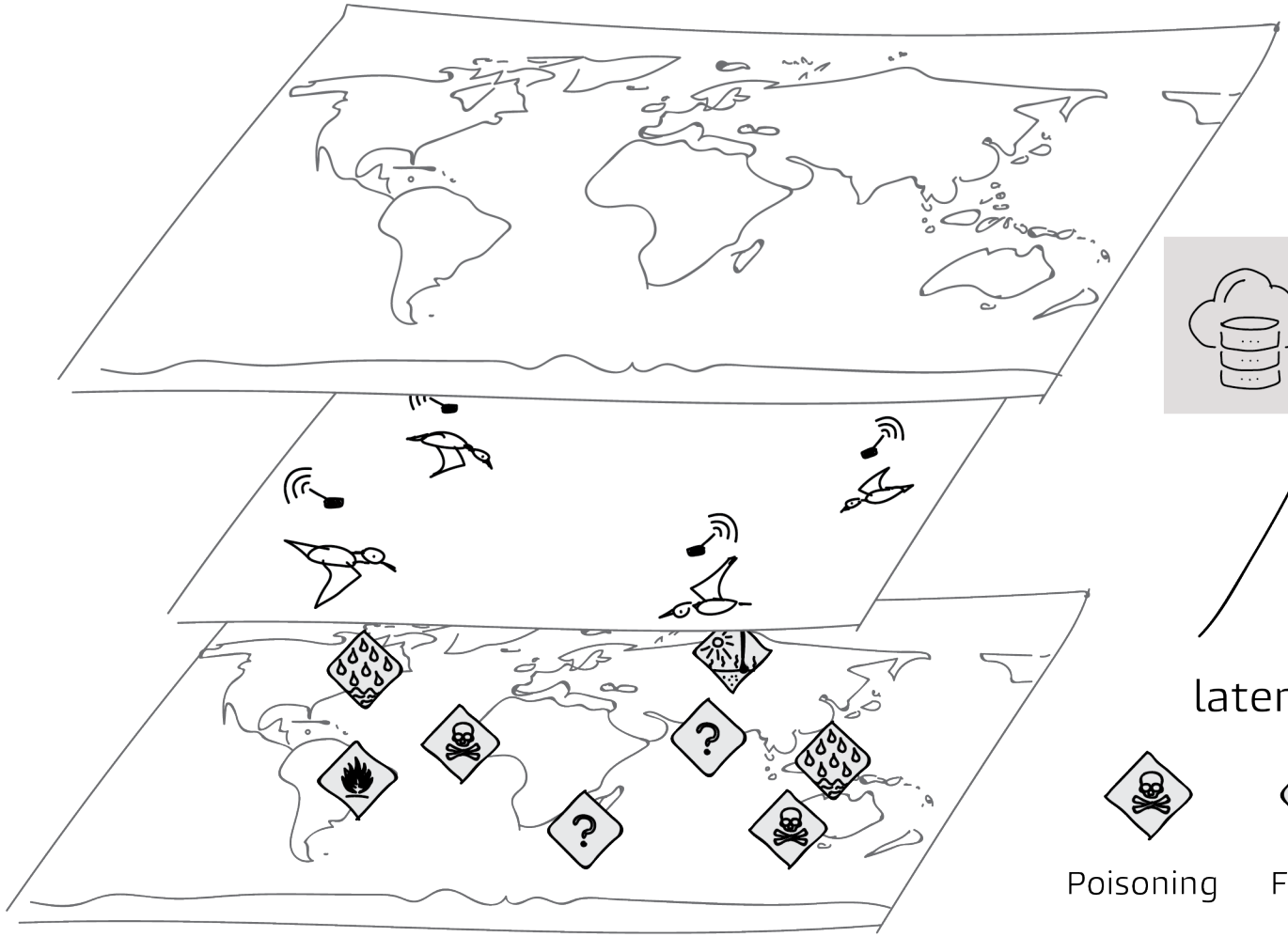
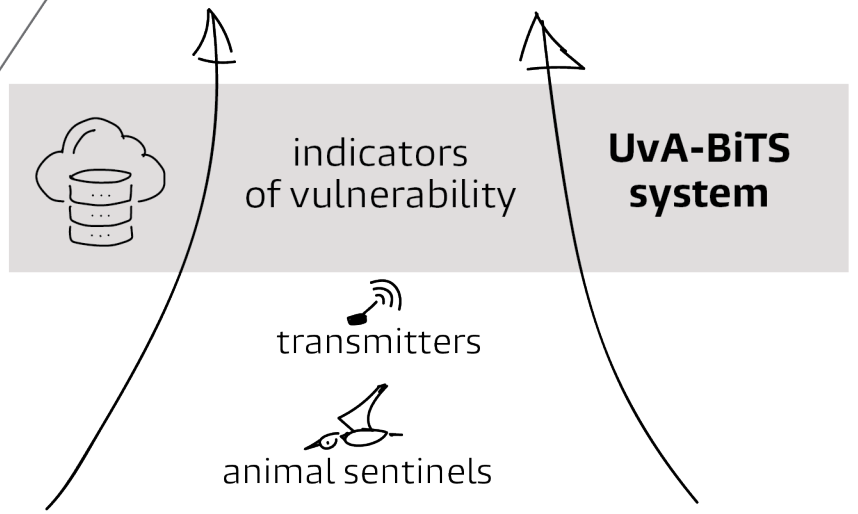
# the principle





# the principle

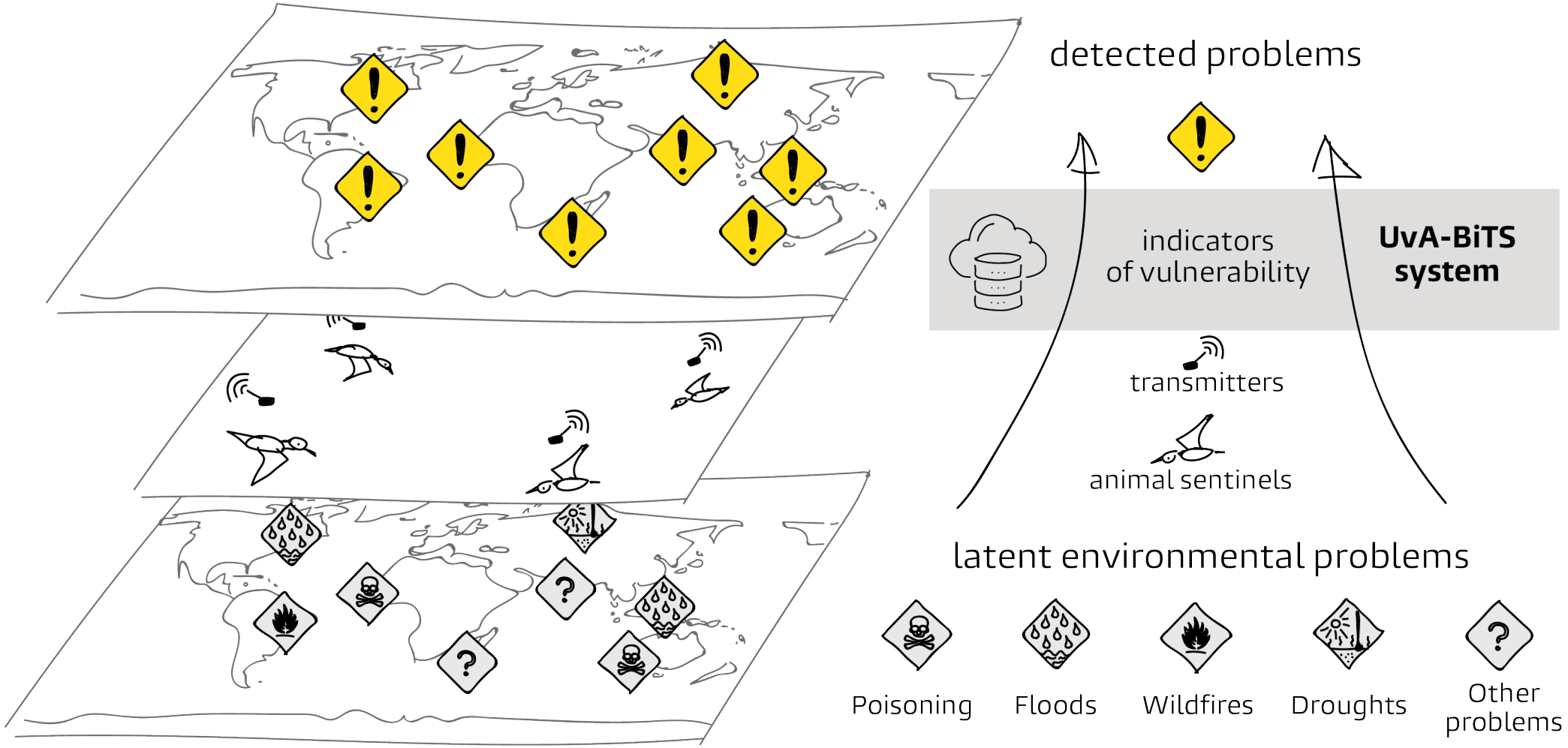





latent environmental problems

Poisoning Floods Wildfires Droughts Other problems

# the principle



# Main approaches to animal sentinels

## Specific signals of interest

## Generic signature of anomalies

# Main approaches to animal sentinels

**Specific signals of interest**

- Illegal/unreported/unregulated fishing
- Spread of diseases
- Illegal garbage dumping
- Wildfires

**Generic signature of anomalies**

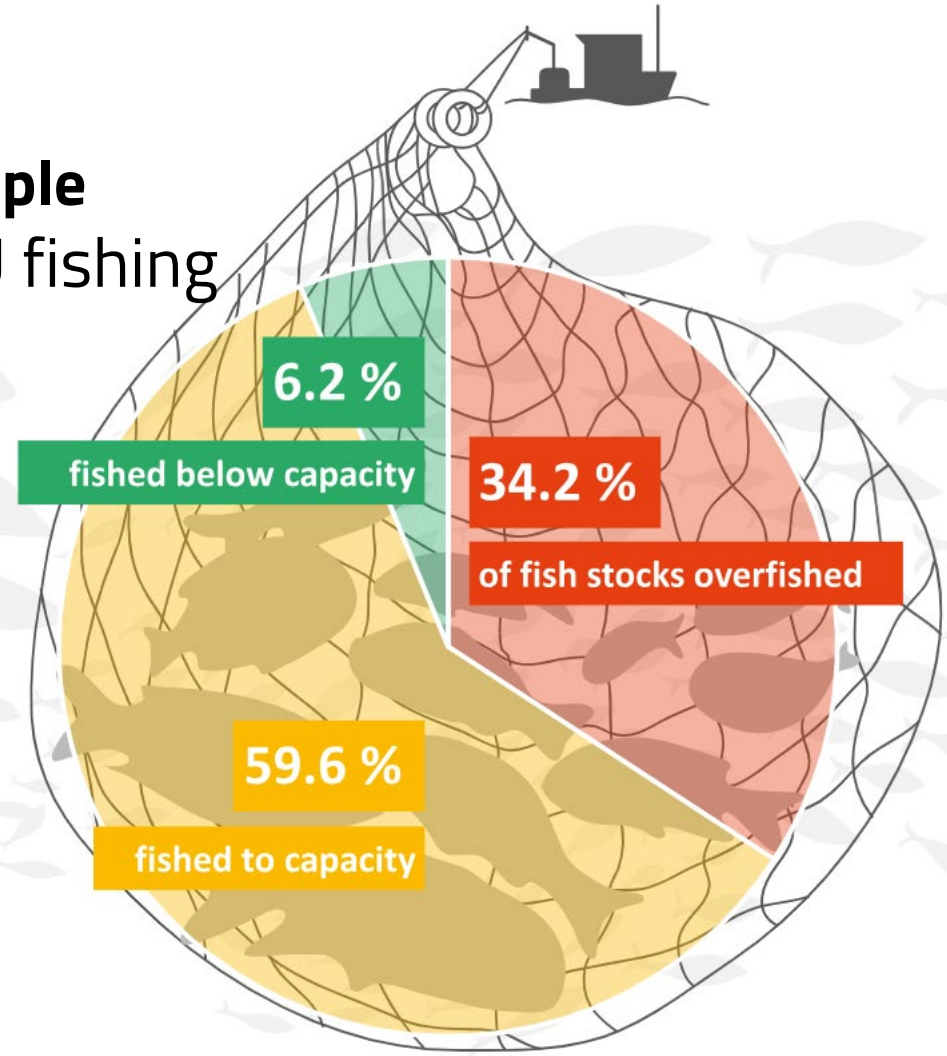
# Specific signals of interest – approaching the task

**Steps to take**

- Define the problem

**example**

- IUU fishing




Source: https://op.europa.eu/, FAO

# Specific signals of interest – approaching the task

**Steps to take**

- Define the problem
- Select the sentinel species

**example**

- IUU fishing

© Christoph Moning

# Specific signals of interest – approaching the task

**Steps to take**

- Define the problem
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# Specific signals of interest – approaching the task

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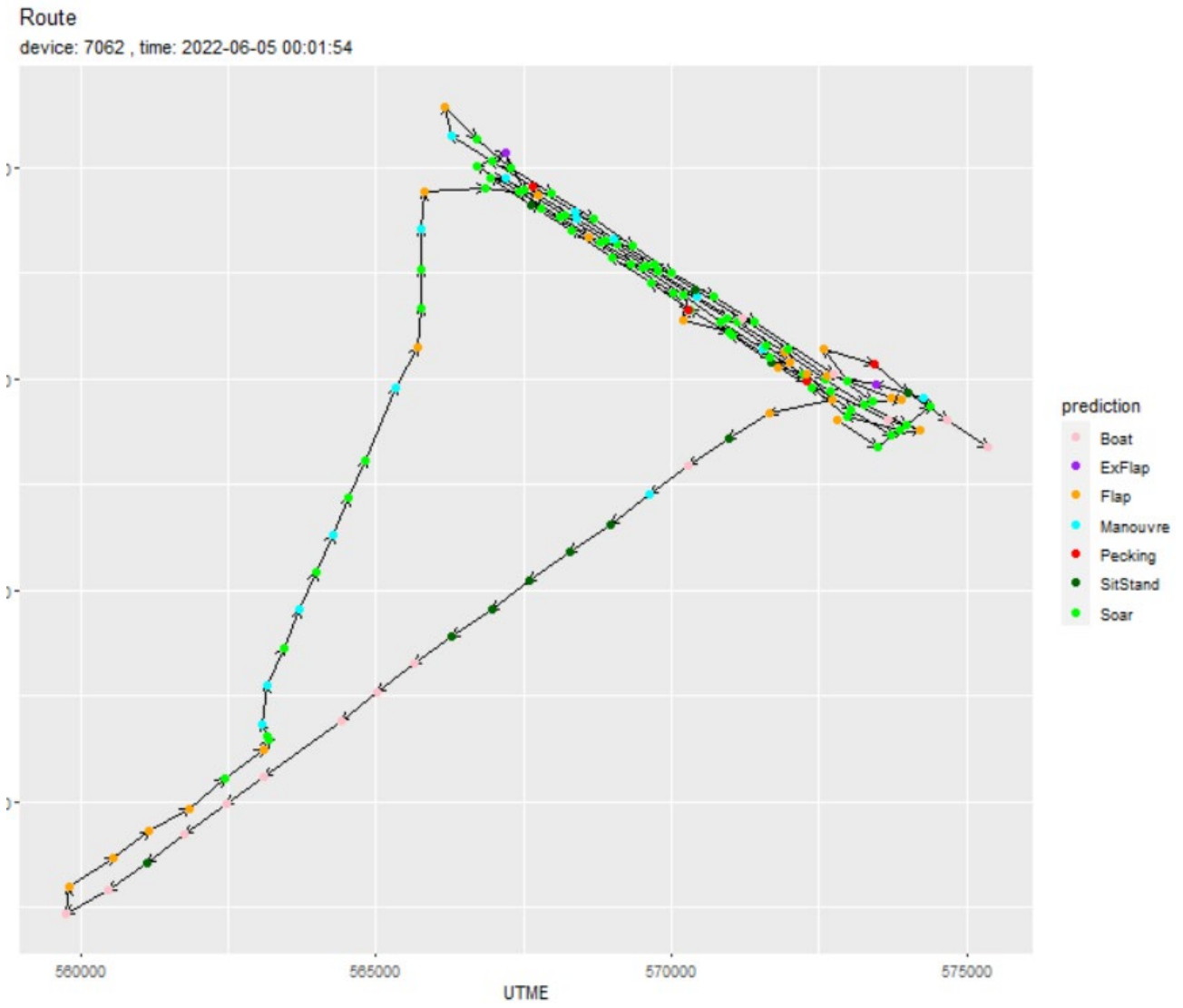


# Specific signals of interest – approaching the task

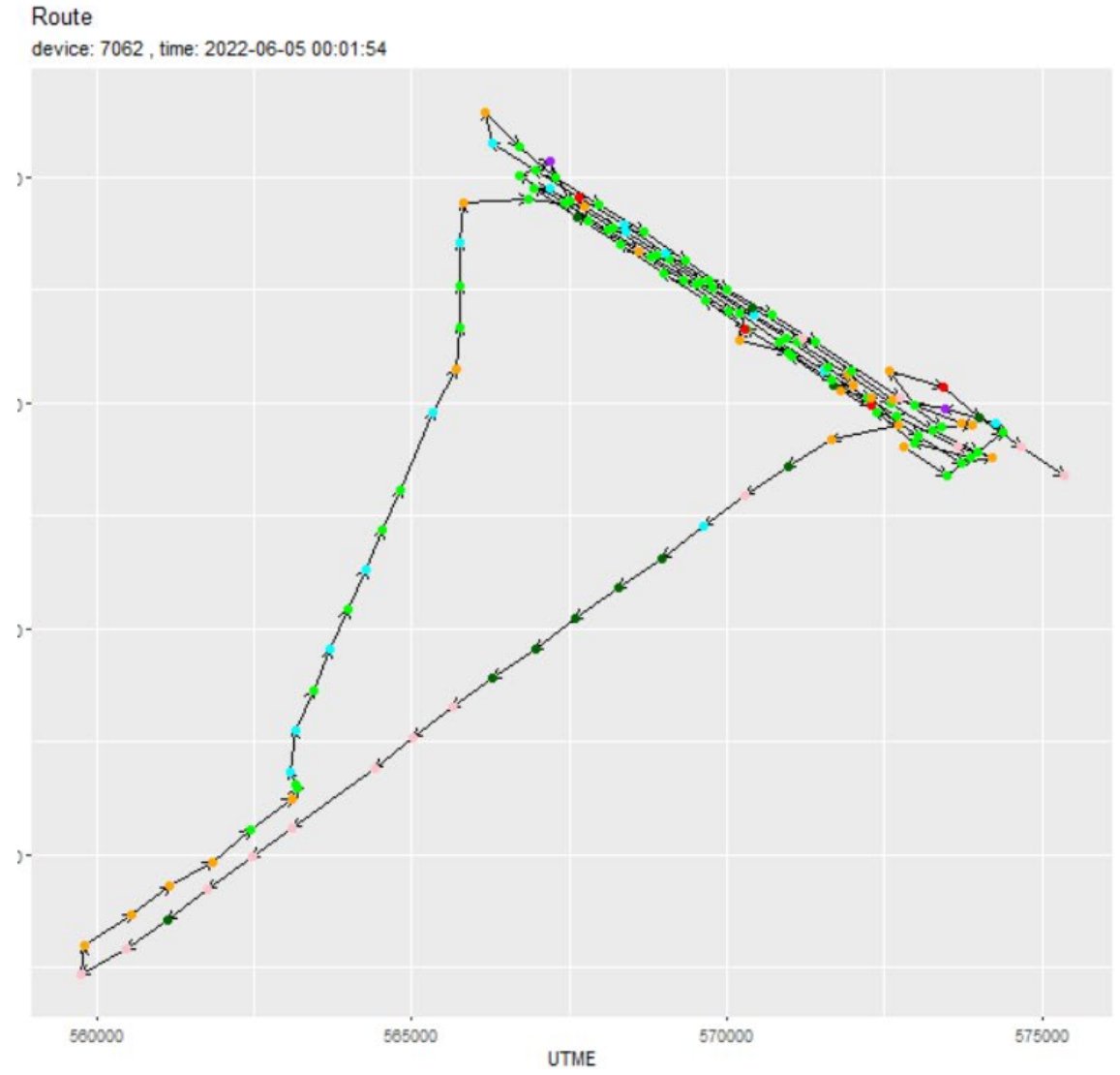
**Steps to take**

- Define the problem
- Select the sentinel species
- Find the signature
- Develop detection pipeline

**example**

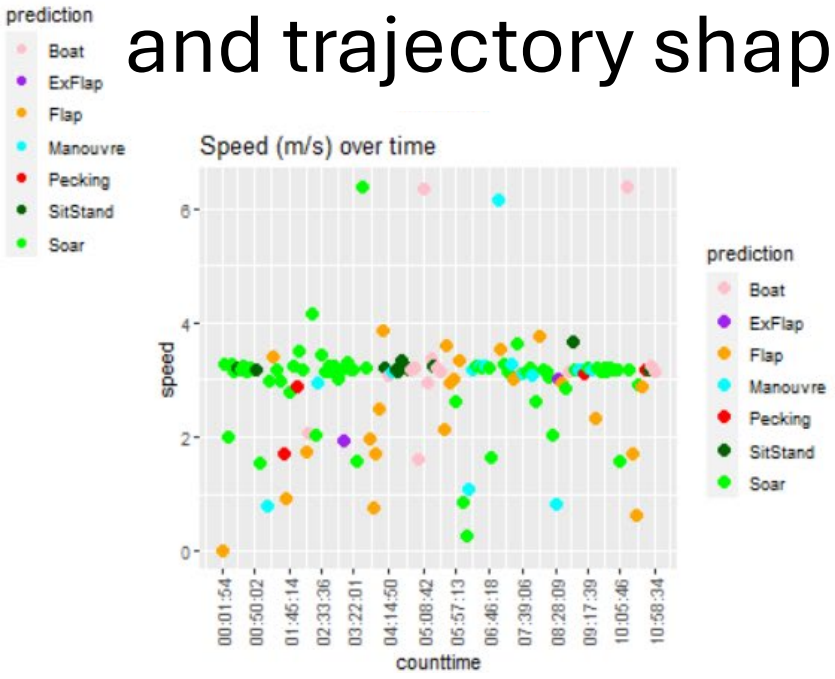
- IUU fishing
- Lesser Black-backed Gull
- Boat following trajectory

# Specific signals of interest –




Detection of fishing boat activity with tracked gulls

- track segmentation with HMMs;
- event classification by speed and trajectory shape.



# Specific signals of interest – approaching the task

**Steps to take**

- Define the problem
- Select the sentinel species
- Find the signature
- Develop detection pipeline
- Evaluate performance

**example**

- IUU fishing
- Lesser Black-backed Gull
- Boat following trajectory
- HMM over the movement track

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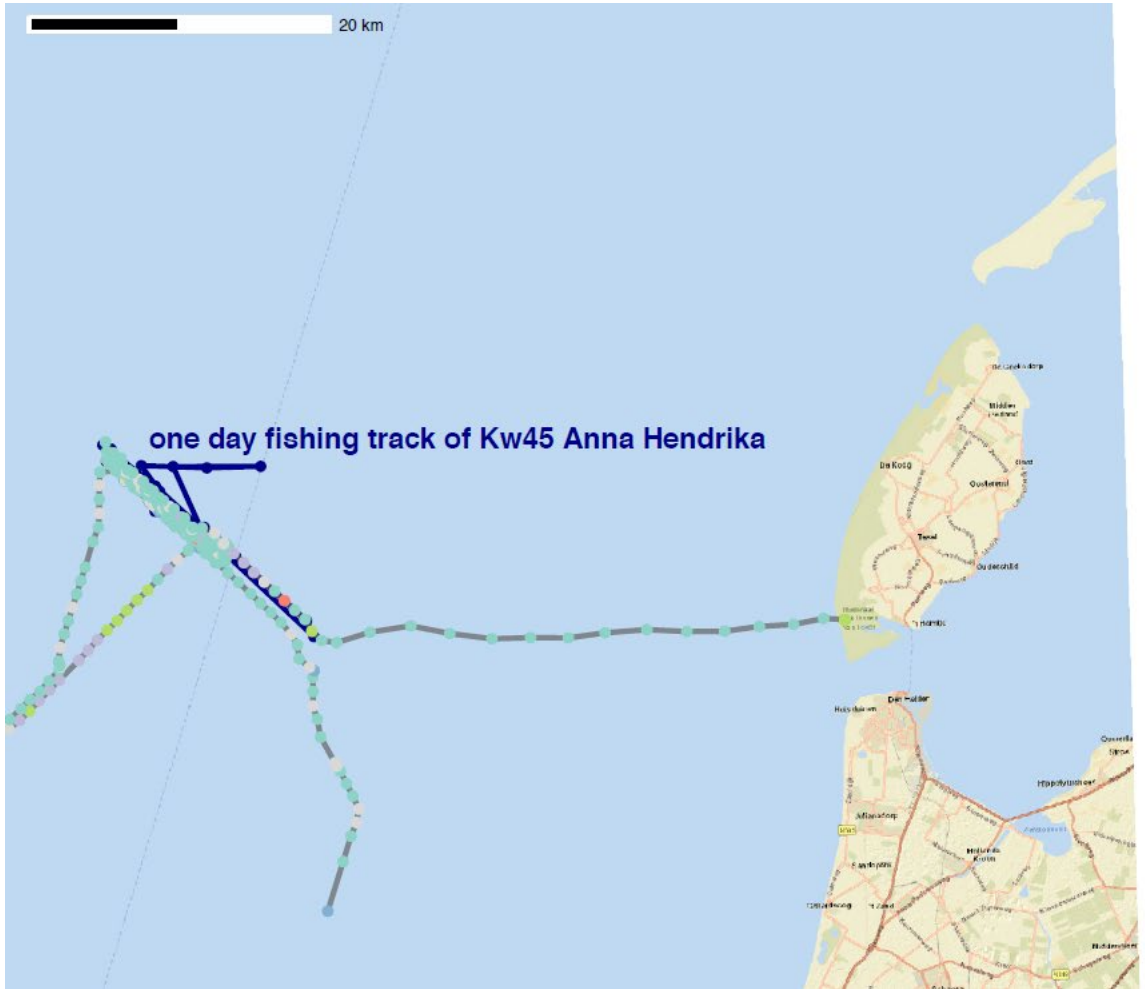
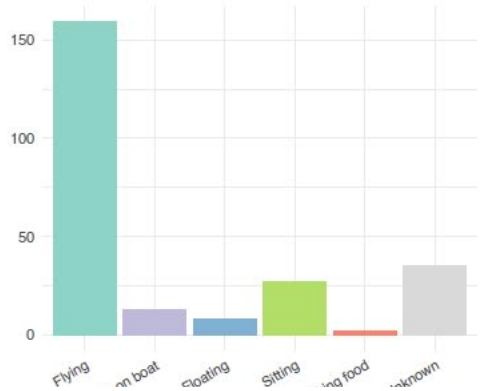
**example**

- IUU fishing
- Lesser Black-backed Gull
- Boat following trajectory
- HMM over the movement track
- Compare with AIS data

# Specific signals of interest – approaching the task




Compare bird detected fishing activity with AIS data

~70% of detected events are unreported!

# Main approaches to animal sentinels

**Specific signals of interest**

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**Generic signature of anomalies**

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**Specific signals of interest**

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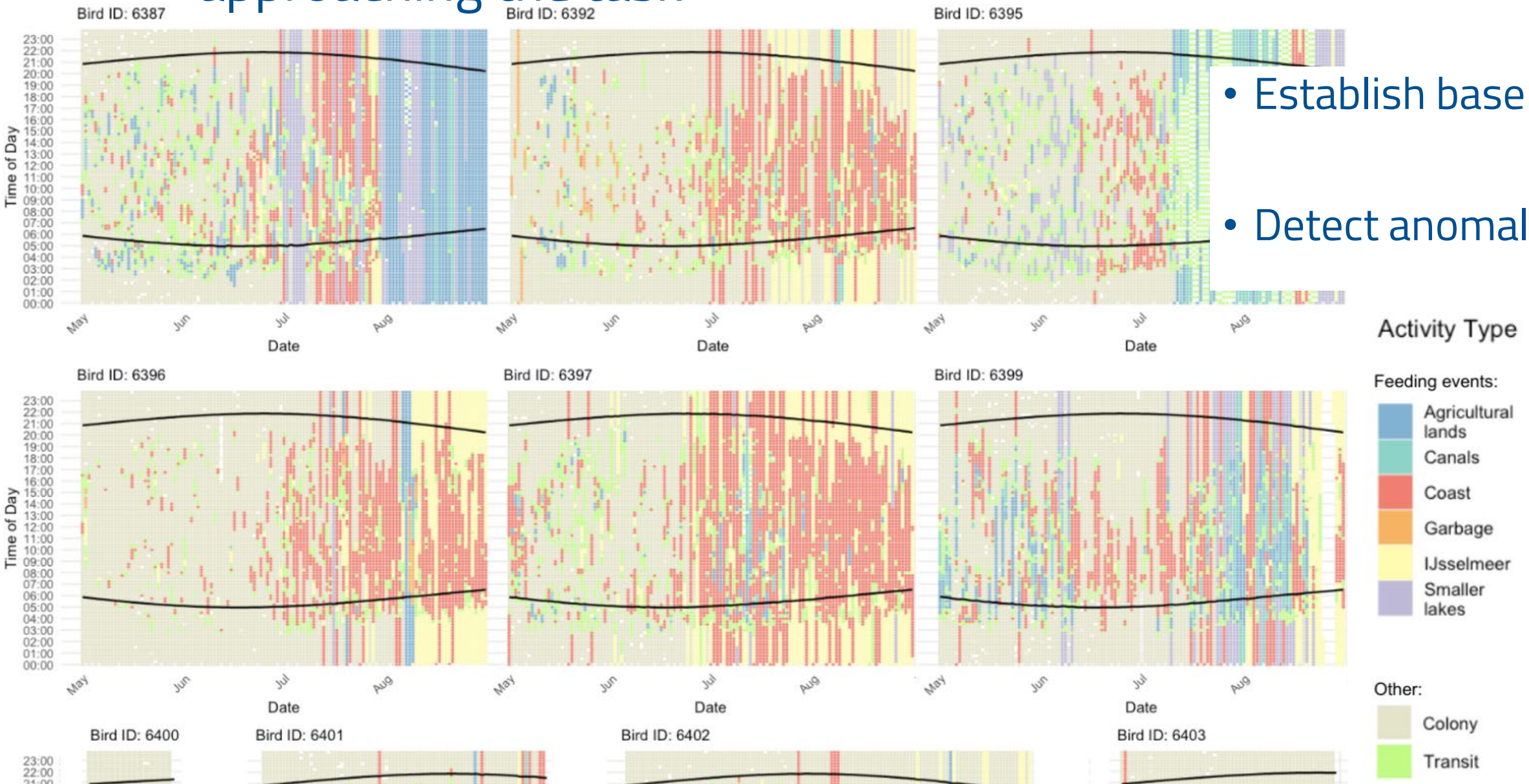
**Generic signature of anomalies**

- Establish baselines
- Detect anomalies

# Generic signature of disturbances – approaching the task




- Establish baselines
- Detect anomalies

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# Where do we get the data?

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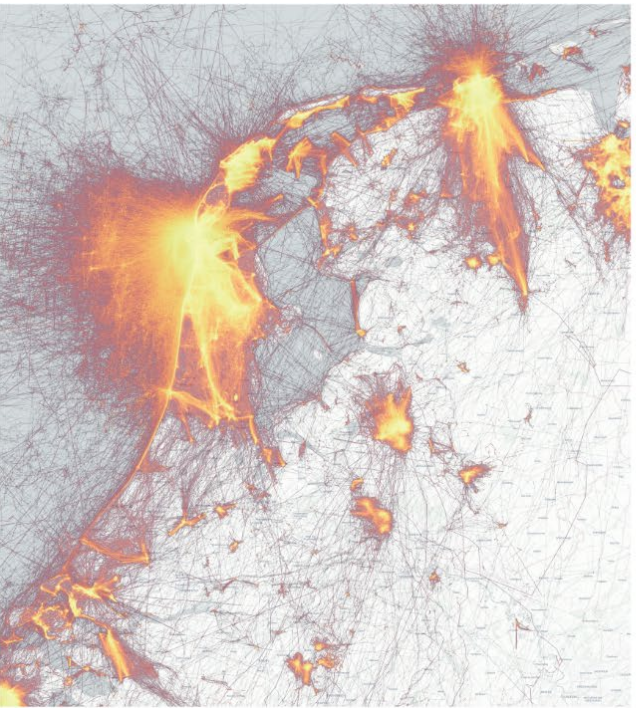

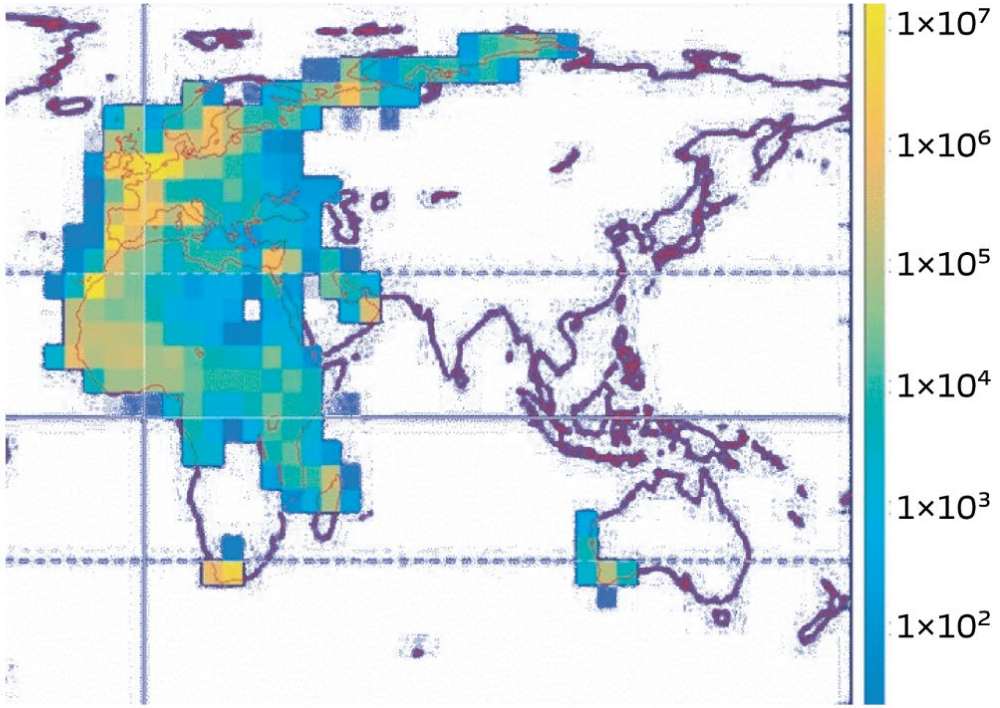

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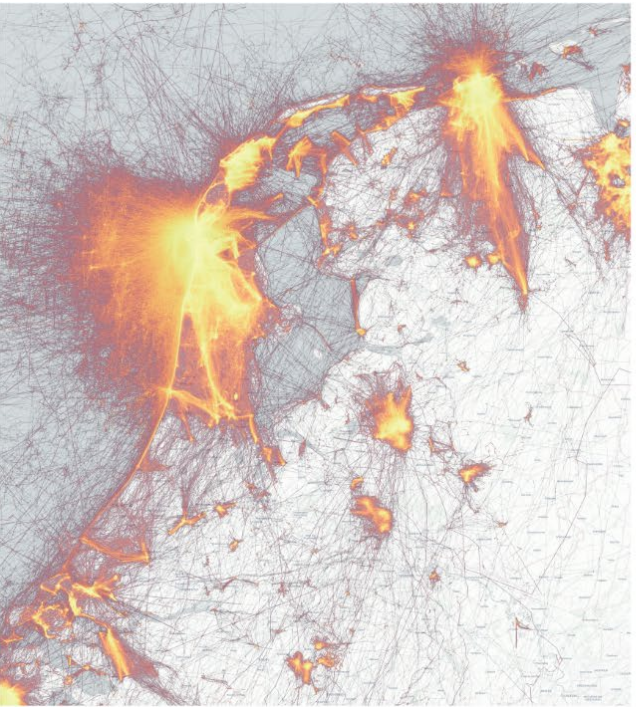
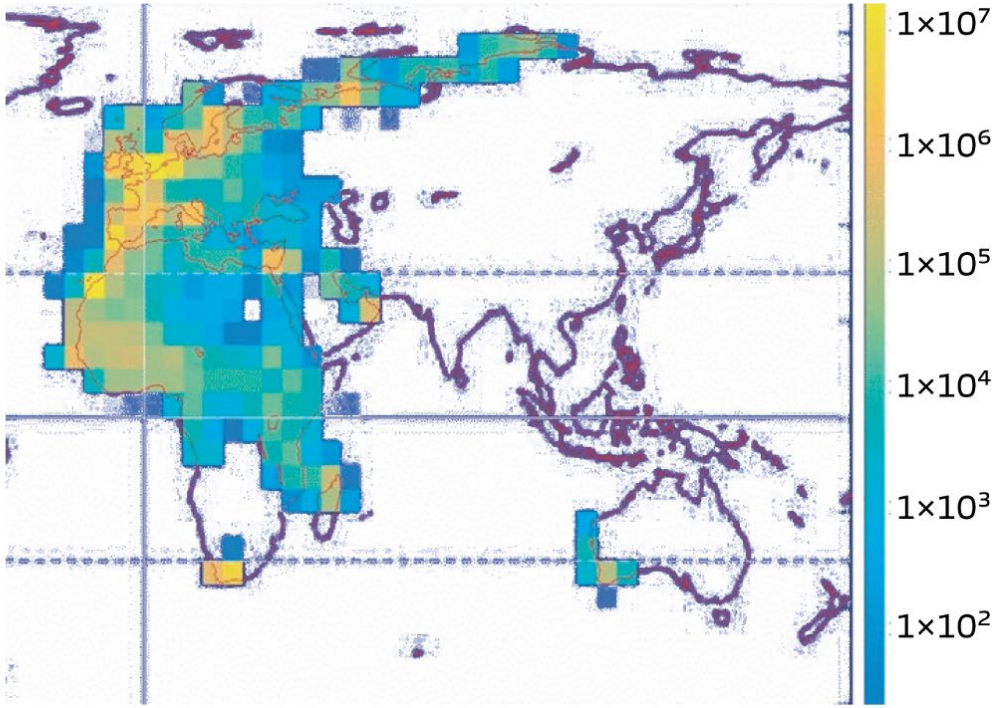
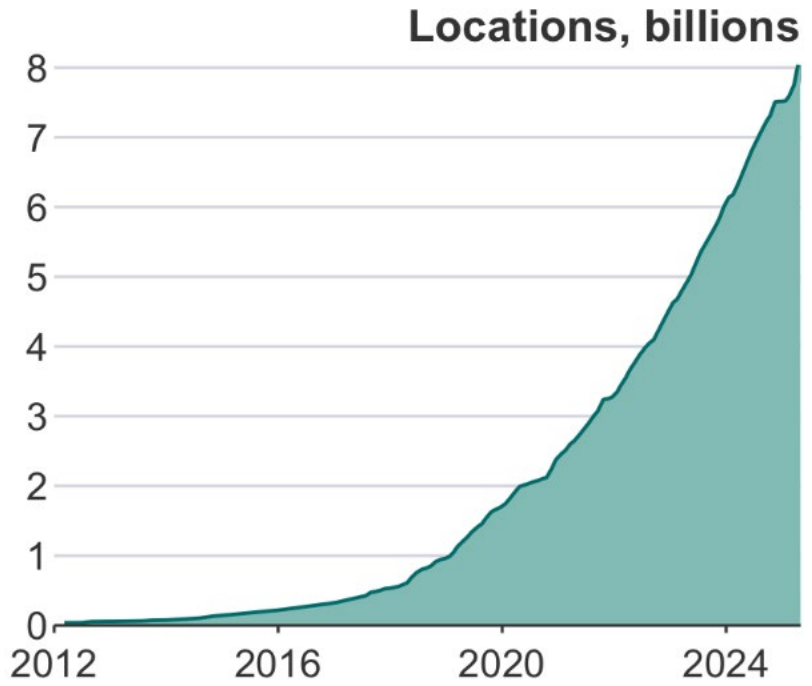
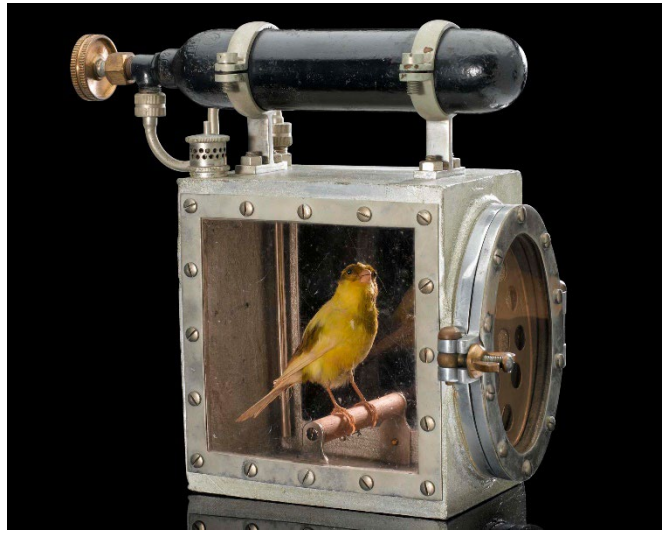
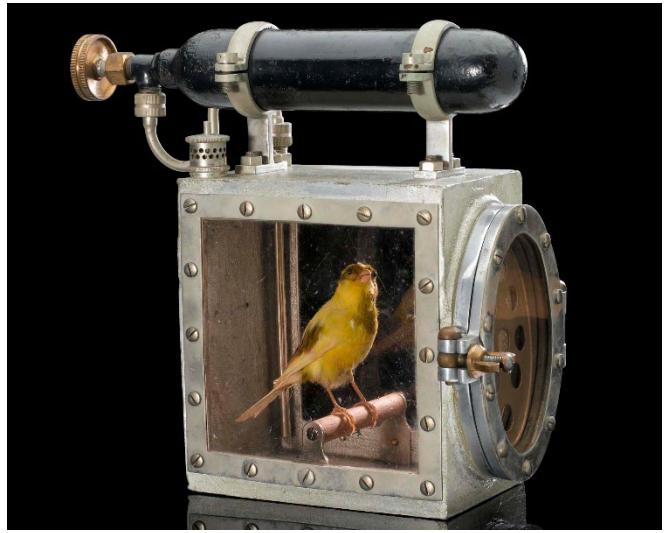






monitoring of
**local** environment
with animal sentinels



monitoring of
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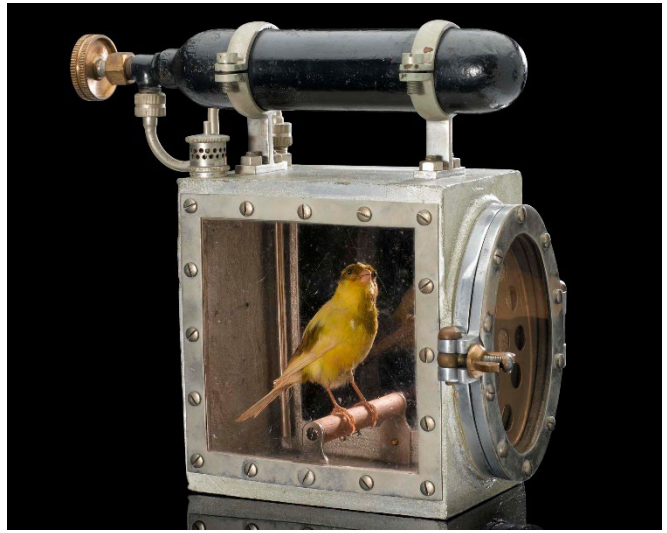
**automated** monitoring of
**local** environment
with animal sentinels

# Animal Sentinels: near real-time environmental monitoring via automated bird tracking analysis



monitoring of
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**automated** monitoring of
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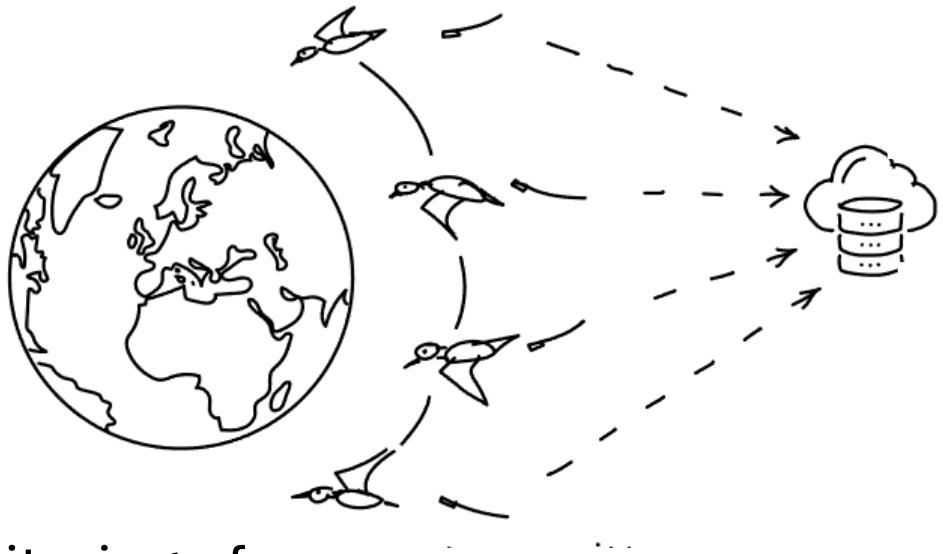

**automated** monitoring of
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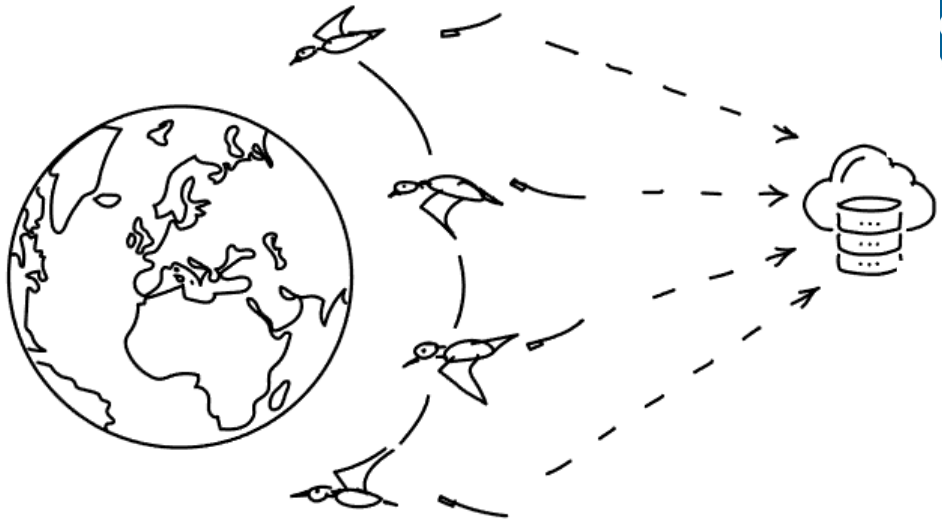
# Animal Sentinels: near real-time environmental monitoring via automated bird tracking analysis



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*Questions?*
*Eldar.Rakhimberdiev@uva.nl*

Thank you!