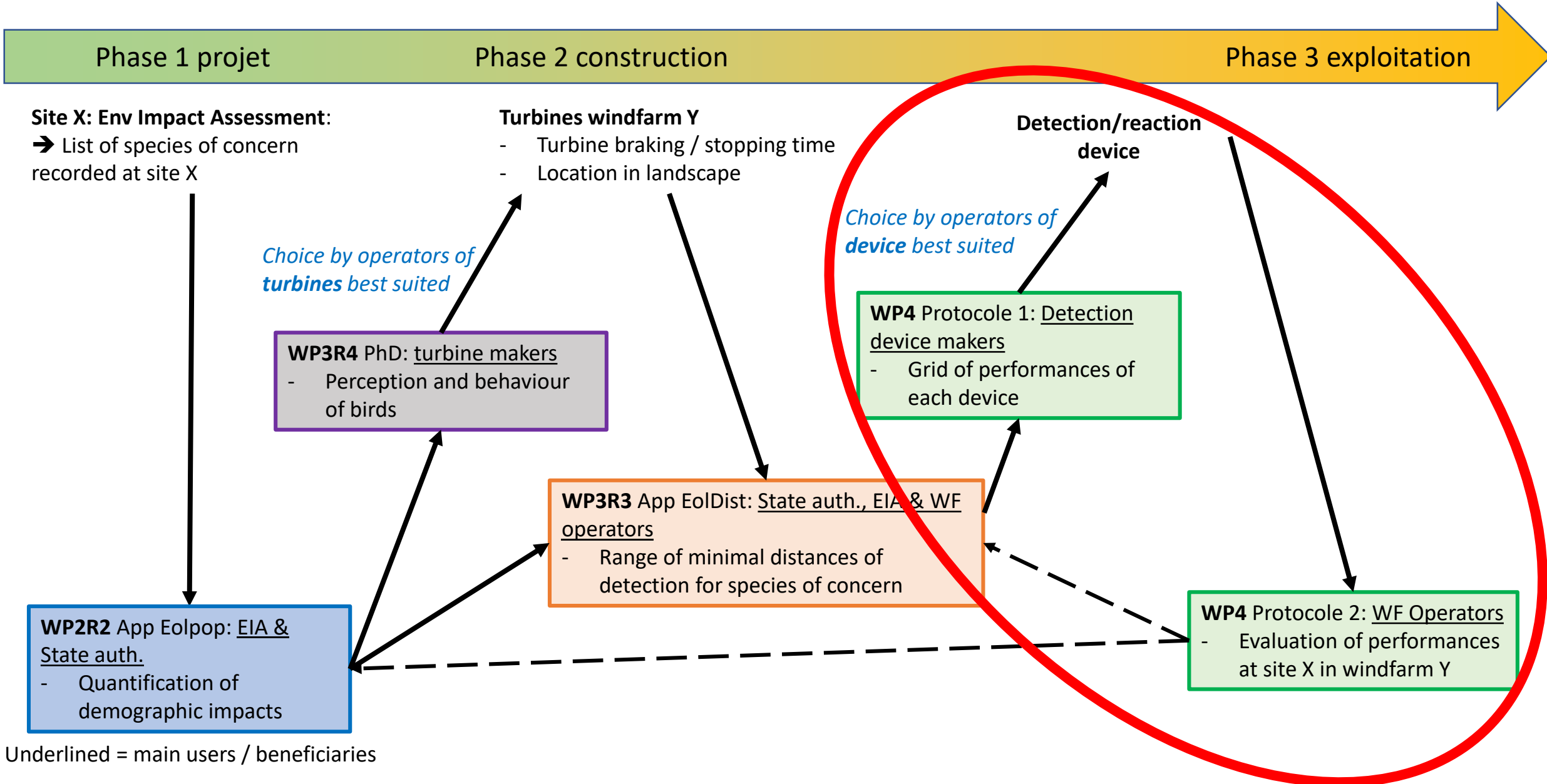


« MAPE – WP4, Collaborative and concerted redaction of a robust and reliable protocol testing the detection/classification systems' performance »

November 18th, 2021

Sophie DUPONT, Alexandre CORBEAU, Olivier DURIEZ & Aurélien BESNARD

Integration of research results into the process of windfarm development



Legislation issues



REDUCING the avian mortality

Prefectoral decree

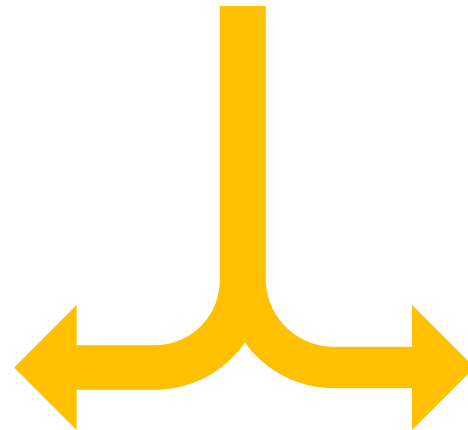


Legislation regulation

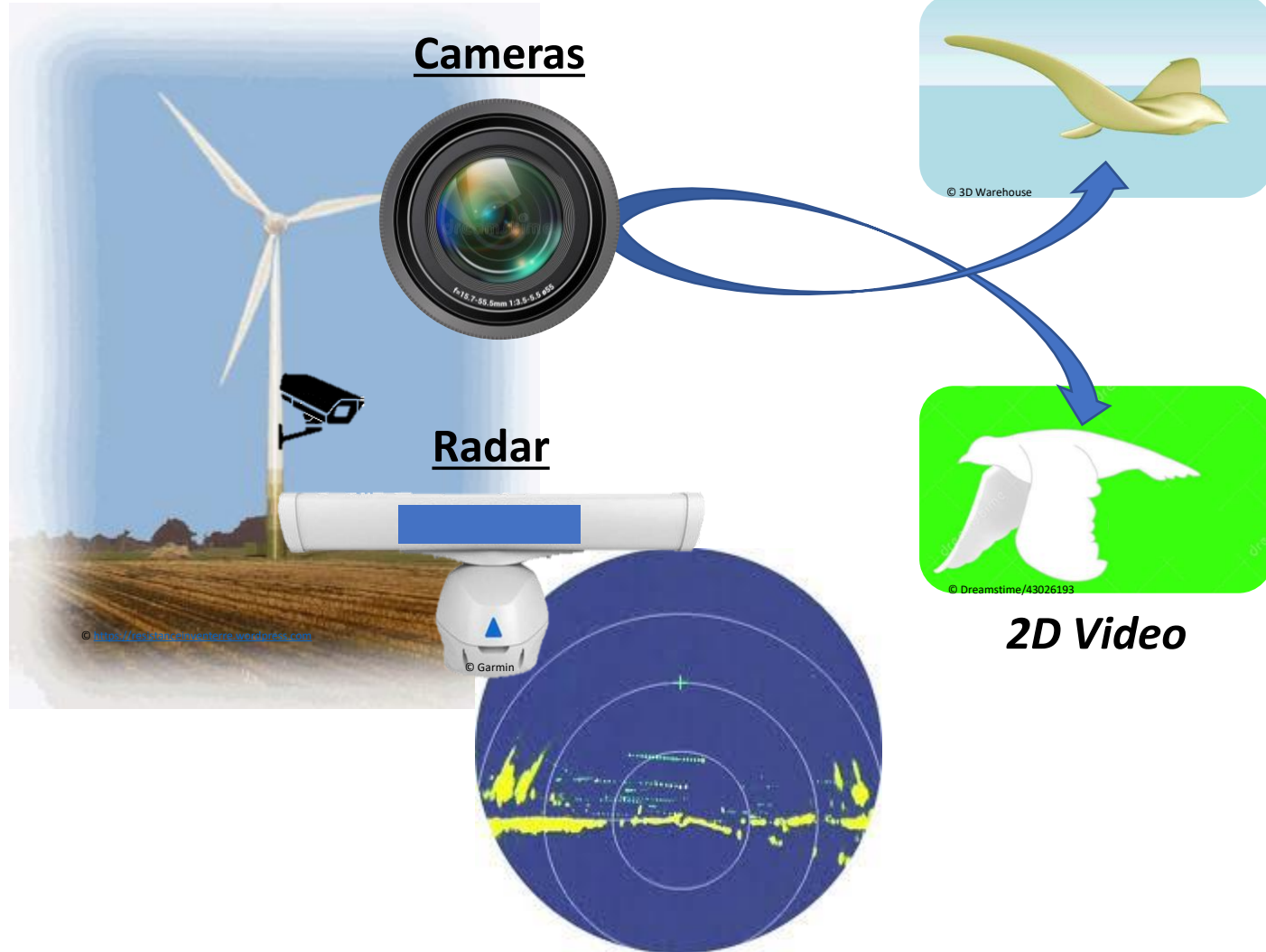
Curtailment during risk periods



Installation of detection/reaction systems

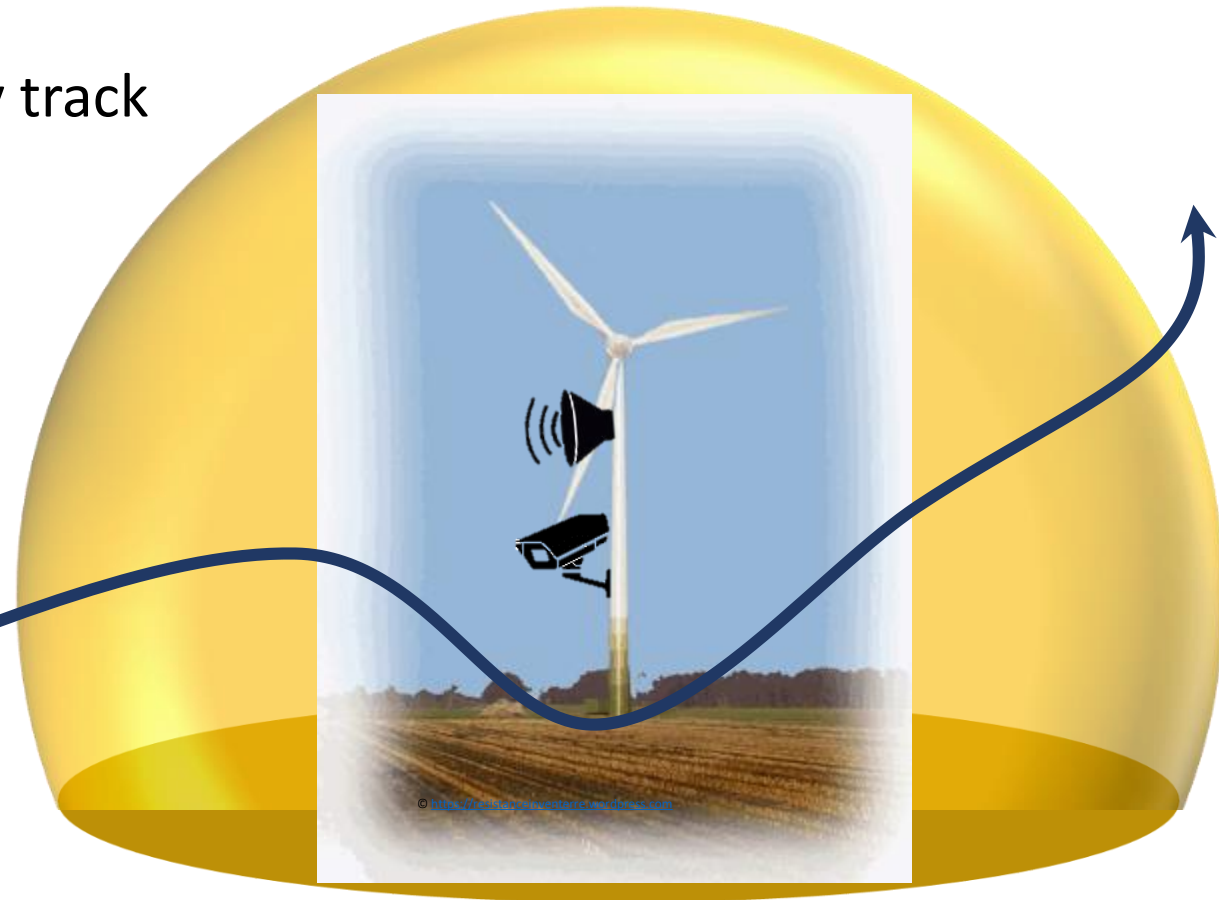


Detection/reaction systems

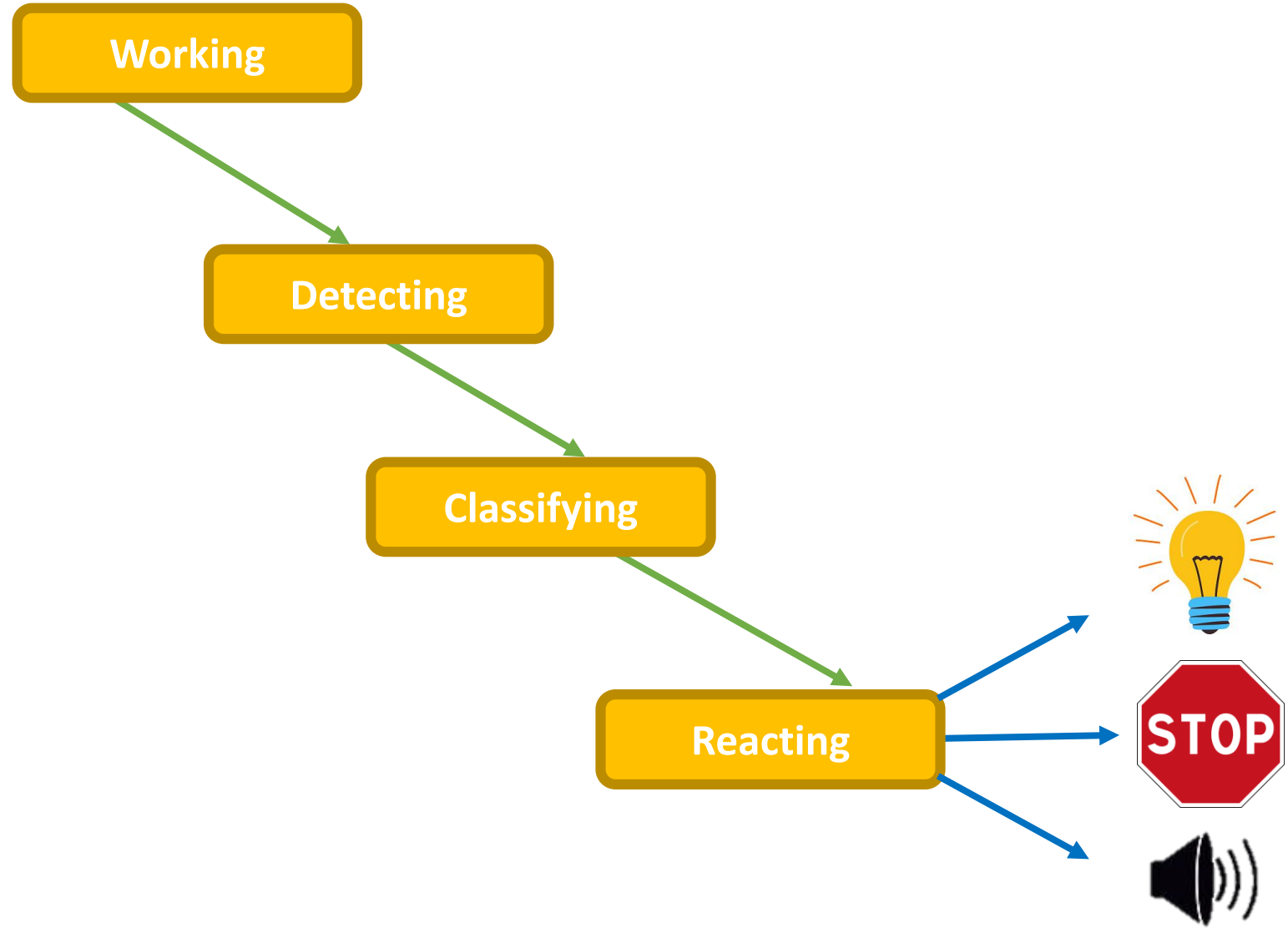


Detection/reaction systems

- Based on 4 principles:
 - One or several target species
 - Defined risk area
 - Detection of endangered birds with risky track
 - Warning signals and/or curtailments if intrusion in the risk area

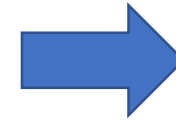


Detection/reaction systems



- Mortalities still observed in equipped wind turbines

- The MAPE project: drafting an evaluation protocol



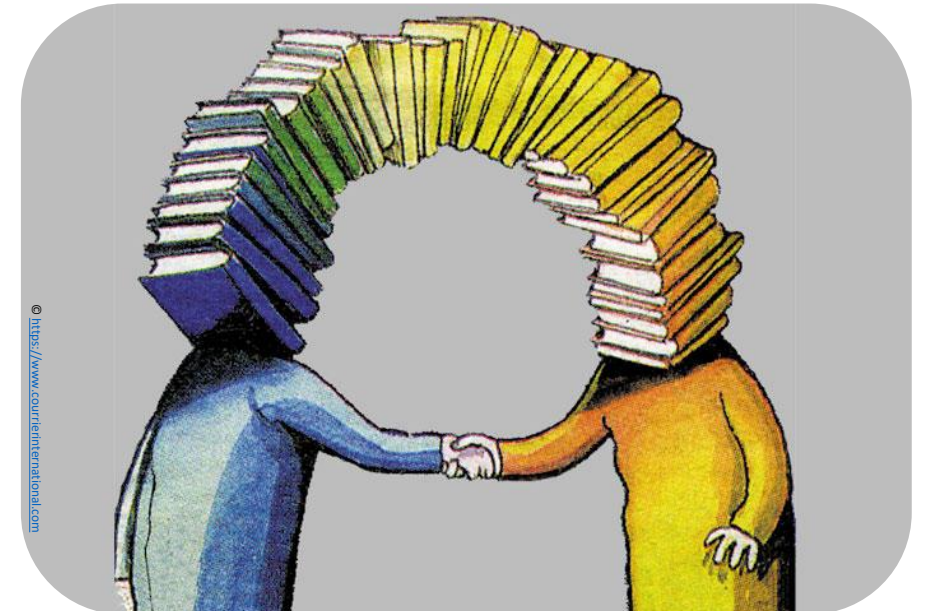
WP4

- Complete
- Comparable
- Collaborative
- Neutral

Preliminary work

- Available literature = State of the art
 - International scientific production
 - Field experiments reports and feedbacks

- Consultation
 - Environmental Impact Assessment companies
 - KNE members
 - Active members of the wind farm sector
 - Detection system suppliers
 - Turbine manufacturers
 - International workshops/conferences



A current imperfect evaluation

- Only a limited number of experiments available
- An evaluation carried out by suppliers and a few operators
- Methodological biases

 **No-independency of the evaluation**

 **Bias measurements**

mape^Y A current imperfect evaluation – *bias measurements*

- **Only based on detection/classification probability and not on operation/reaction**
- **Detection/classification bias...**
 - ...which represent a risk for the operators investing in these systems
 - Assessment only under optimal detection conditions
 - ➔ **Optimistic evaluation**
 - Compared to human observers
 - ➔ **Overestimated evaluation**

A current imperfect evaluation

- Statistical reliability
 - No standardization or repeatability from one test to another

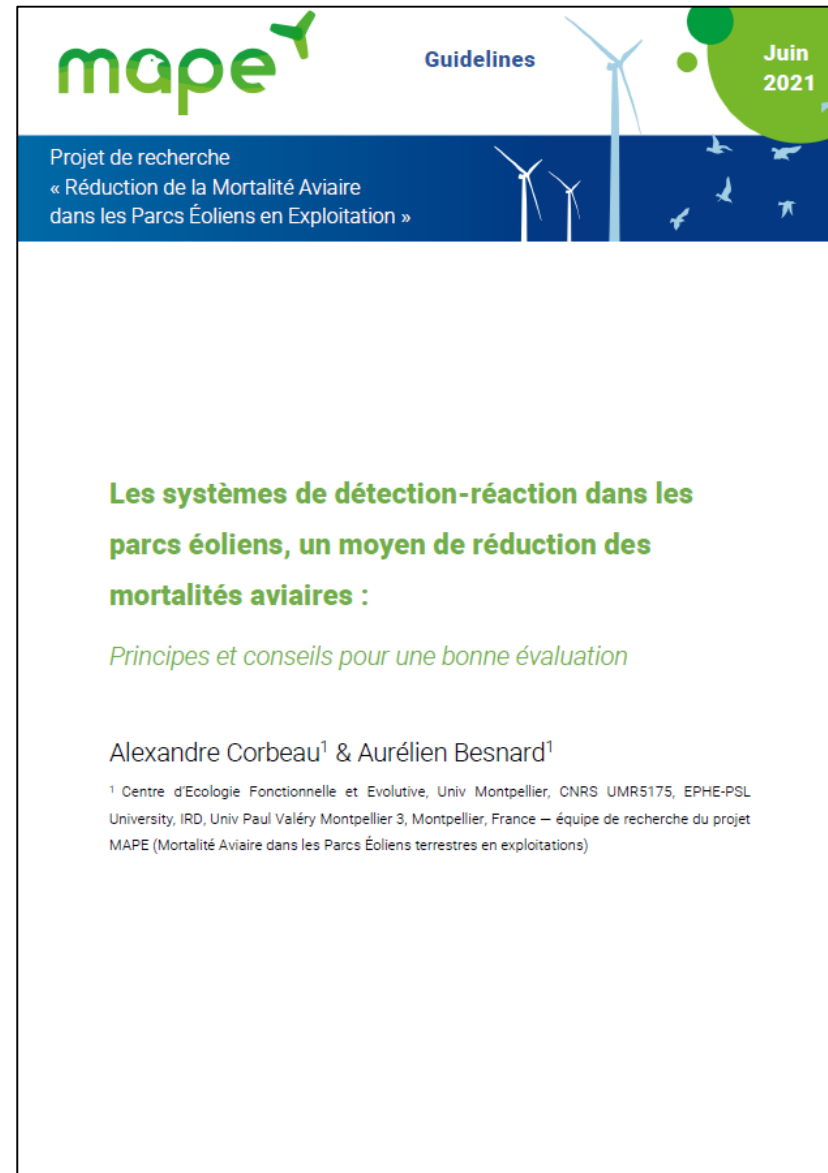
➔ **No comparison possible**

- Parameters to estimate and variables of interest rarely explicitly defined
- Few statistical analyses presented (confidence intervals, statistical power...)
- Small sample size



A current imperfect evaluation

- Publication of a guideline note « Wind farm detection/reaction systems as means of reducing bird mortality: Principles and guidance for the achievement of a robust and reliable evaluation of these systems' performance » (available in french version in our website, <https://mape.cnrs.fr/>)



WP4 - Two protocols

- Significant heterogeneity of systems and wind farms
- Systems-specific parameters/settings
- Wind farm-specific configurations

*To be implemented by (i) **suppliers** / (ii) **operators***

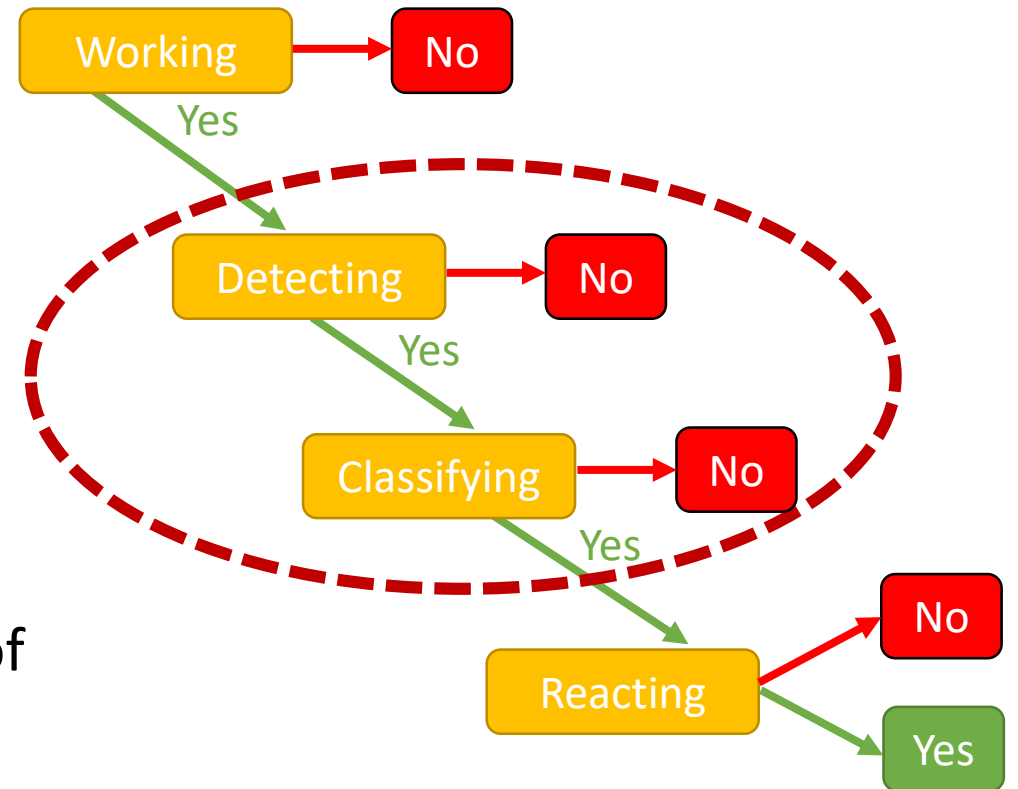
A large blue L-shaped arrow pointing from the top-left towards the bottom-right, indicating a flow or relationship between the text blocks.

A standard protocol for comparing systems and setting/describing their performances

A protocol for verifying that the performance of a system is in agreement with prefectoral decree in force on a given wind farm

Protocol (i): A standard protocol for comparing systems and setting/describing their performances

- A protocol applicable to all types of current and future detection/classification systems
- Evaluation of generic performances
- Focus on detection and classification
 - Independent steps from the infrastructure of the wind farm (connection, network...)



Protocol (i): A standard protocol for comparing systems and setting/describing their performances

Parameters to estimate

Probability of detection/classification

- Comparison to a Reference entity (*should be exhaustive and representative*)
 - Falconry birds
 - Drones/Kites
 - Wild birds equipped with GPS tag

Known journey



- Logistic and technological constraints
- Close enough to reality?
- Long-term feasibility

Protocol (i): A standard protocol for comparing systems and setting/describing their performances

Parameters to estimate

Probability of detection/classification

- Comparison to a Reference entity (*should be exhaustive and representative*)
 - Falconry birds
 - Drones/Kites
 - Wild birds equipped with GPS tag
 - Human observer } **Non-exhaustive detection**

Need to estimate detection bias to use this method as a reference

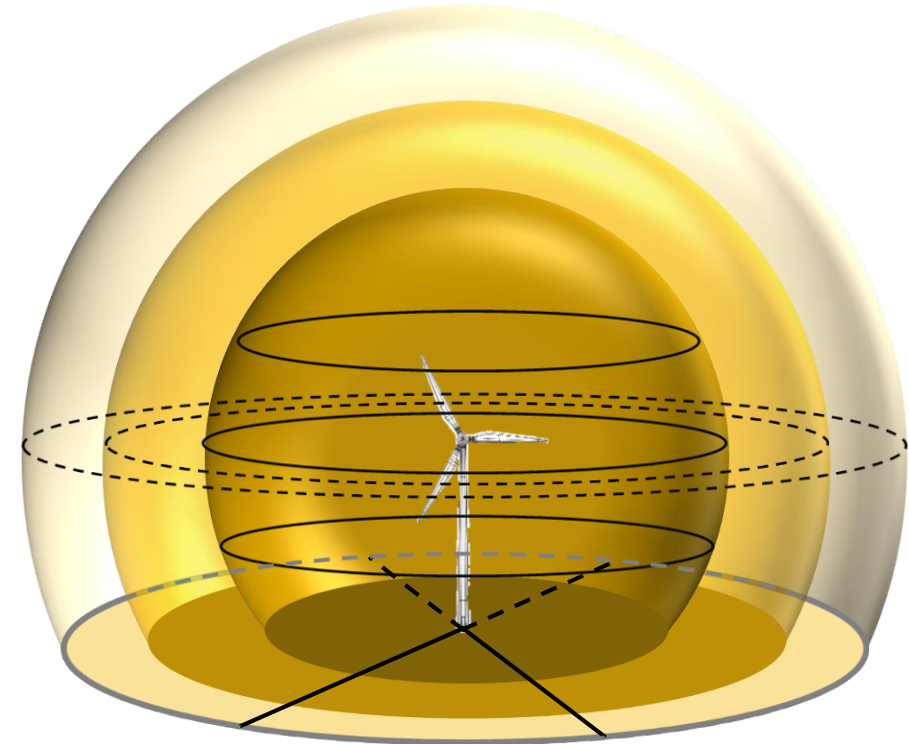
Protocol (i): A standard protocol for comparing systems and setting/describing their performances

Measurement of a probability of detection/classification for each influencing variables:

- Species
- Distance



In interaction through the size of the target bird



Protocol (i): A standard protocol for comparing systems and setting/describing their performances

Measurement of a probability of detection/classification for each influencing variables:

- Species
- Distance



In interaction through the size of the target bird

- Background



Protocol (i): A standard protocol for comparing systems and setting/describing their performances

Measurement of a probability of detection/classification for each influencing variables:

- Species
- Distance



In interaction through the size of the target bird

- Background
- Meteorological conditions (rainfall)



Protocol (i): A standard protocol for comparing systems and setting/describing their performances

Measurement of a probability of detection/classification for each influencing variables:

- Species
- Distance
- Background
- Meteorological conditions (rainfall)
- Time of the day and seasons (visibility)



In interaction through the size of the target bird



Protocol (i): A standard protocol for comparing systems and setting/describing their performances

Measurement of a probability of detection/classification for each influencing variables:

- Species
- Distance



In interaction through the size of the target bird

- Background
- Meteorological conditions (rainfall)
- Time of the day and seasons (visibility)
- Altitude//Height



Protocol (i): A standard protocol for comparing systems and setting/describing their performances

Measurement of a probability of detection/classification for each influencing variables:

- Species
- Distance



In interaction through the size of the target bird

- Background
- Meteorological conditions (rainfall)
- Time of the day and seasons (visibility)
- Altitude//Height
- Azimuth
- Simultaneous targets





Protocol (i): A standard protocol for comparing systems and setting/describing their performances

Objective: Fill a performance table

The figures presented in these tables are fictitious

For the system A

Background	100m	300m	500m	Drones?
Clear sky	0,90 [IC95% 0.87 ; 0.94]	0,90 [IC95% 0.87 ; 0.94]	NA	0,90 [IC95% 0.87 ; 0.94]
Cloudy sky	0,80 [IC95% 0.66 ; 0.98]	0,80 [IC95% 0.66 ; 0.98]	NA	0,80 [IC95% 0.66 ; 0.98]
Ground with movement	0,80 [IC95% 0.66 ; 0.98]	0,80 [IC95% 0.66 ; 0.98]	NA	0,80 [IC95% 0.66 ; 0.98]
Ground without movement	0,70 [IC95% 0.63 ; 0.87]	0,70 [IC95% 0.63 ; 0.87]	NA	0,70 [IC95% 0.63 ; 0.87]

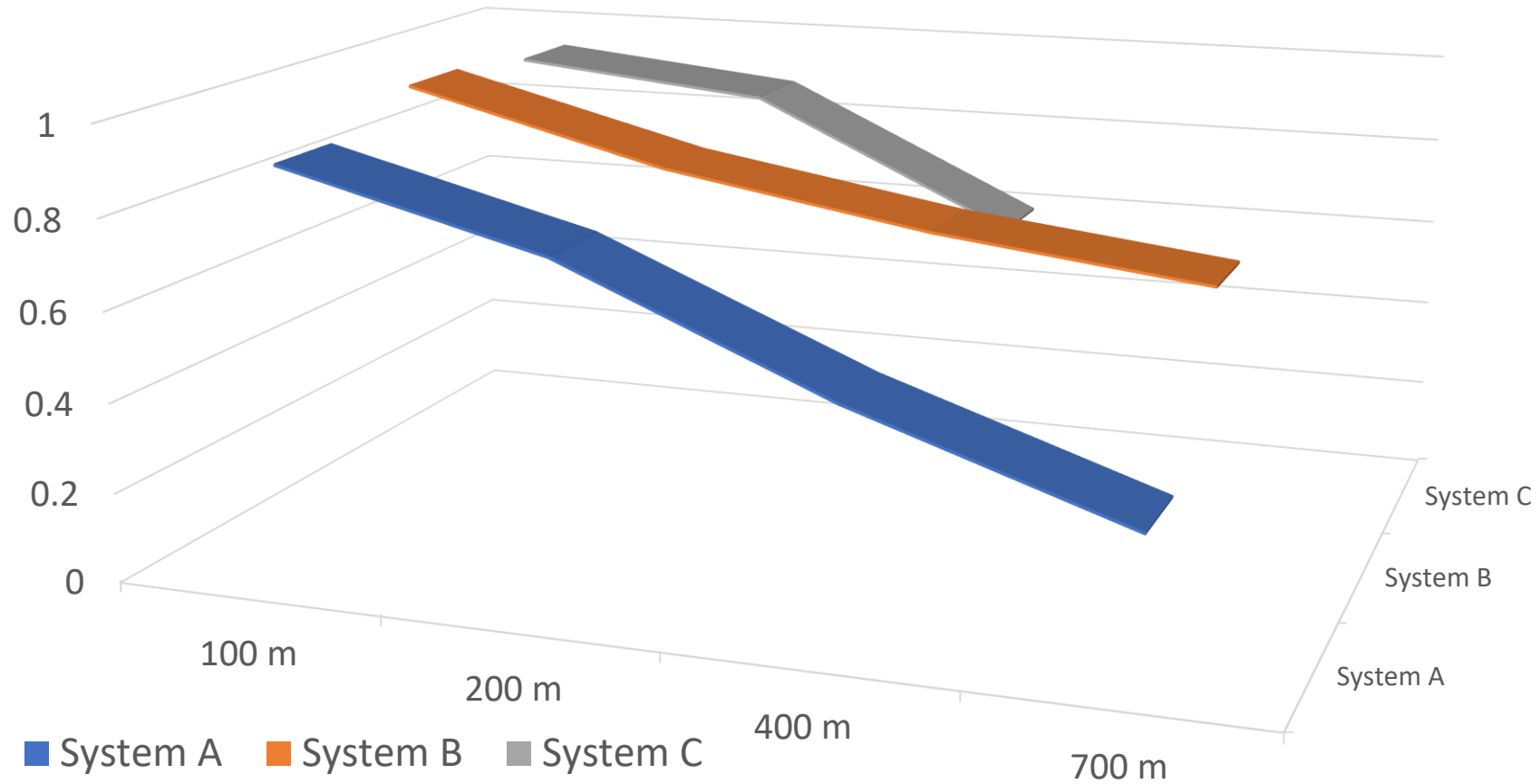
For the system B

Background	100m	300m	500m	Drones?
Clear sky	0,86 [IC95% 0.70 ; 0.99]	0,82 [IC95% 0.70 ; 0.96]	0,73 [IC95% 0.67 ; 0.80]	0,86 [IC95% 0.70 ; 0.99]
Cloudy sky	0,84 [IC95% 0.73 ; 0.97]	0,78 [IC95% 0.67 ; 0.88]	0,63 [IC95% 0.41 ; 0.89]	0,83 [IC95% 0.73 ; 0.90]
Ground with movement	0,82 [IC95% 0.74 ; 0.91]	0,79 [IC95% 0.66 ; 0.97]	0,62 [IC95% 0.37 ; 0.95]	0,74 [IC95% 0.58 ; 0.93]
Ground without movement	0,75 [IC95% 0.65 ; 0.86]	0,67 [IC95% 0.51 ; 0.89]	0,60 [IC95% 0.41 ; 0.88]	0,71 [IC95% 0.52 ; 9.98]

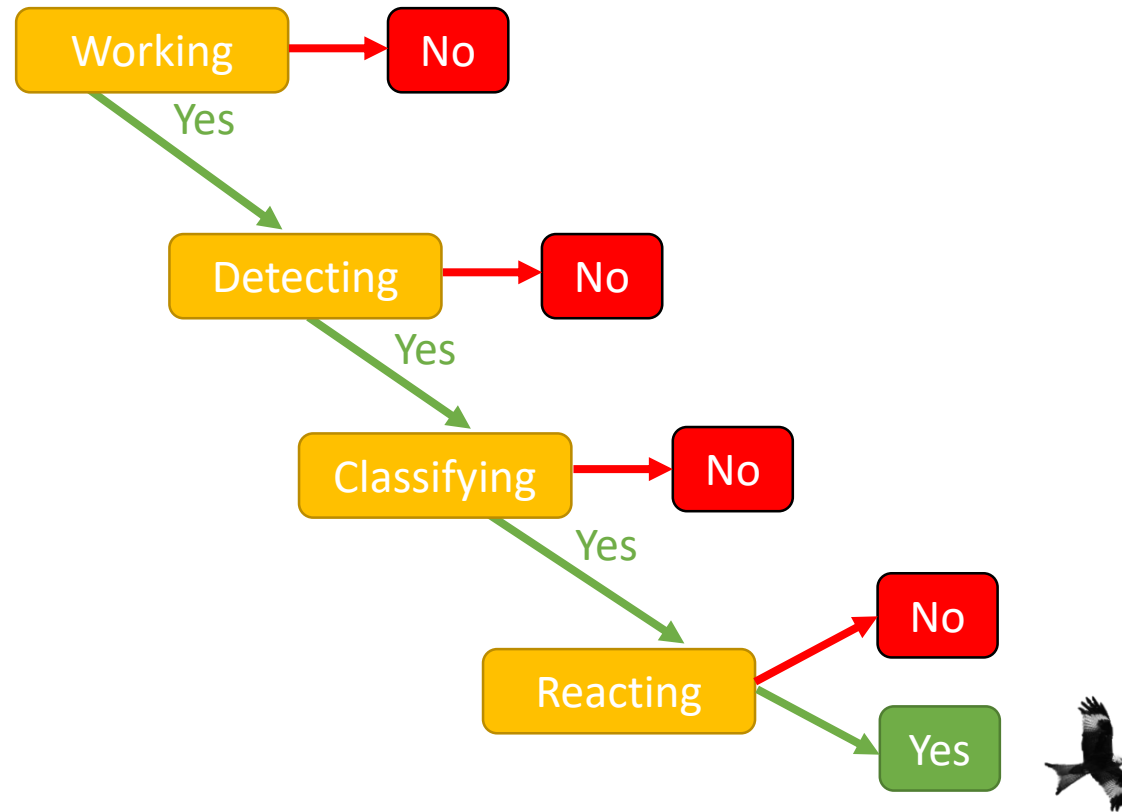
Protocol (i): A standard protocol for comparing systems and setting/describing their performances

Objective: Draw a performance distance graph

The graph presented here is fictitious

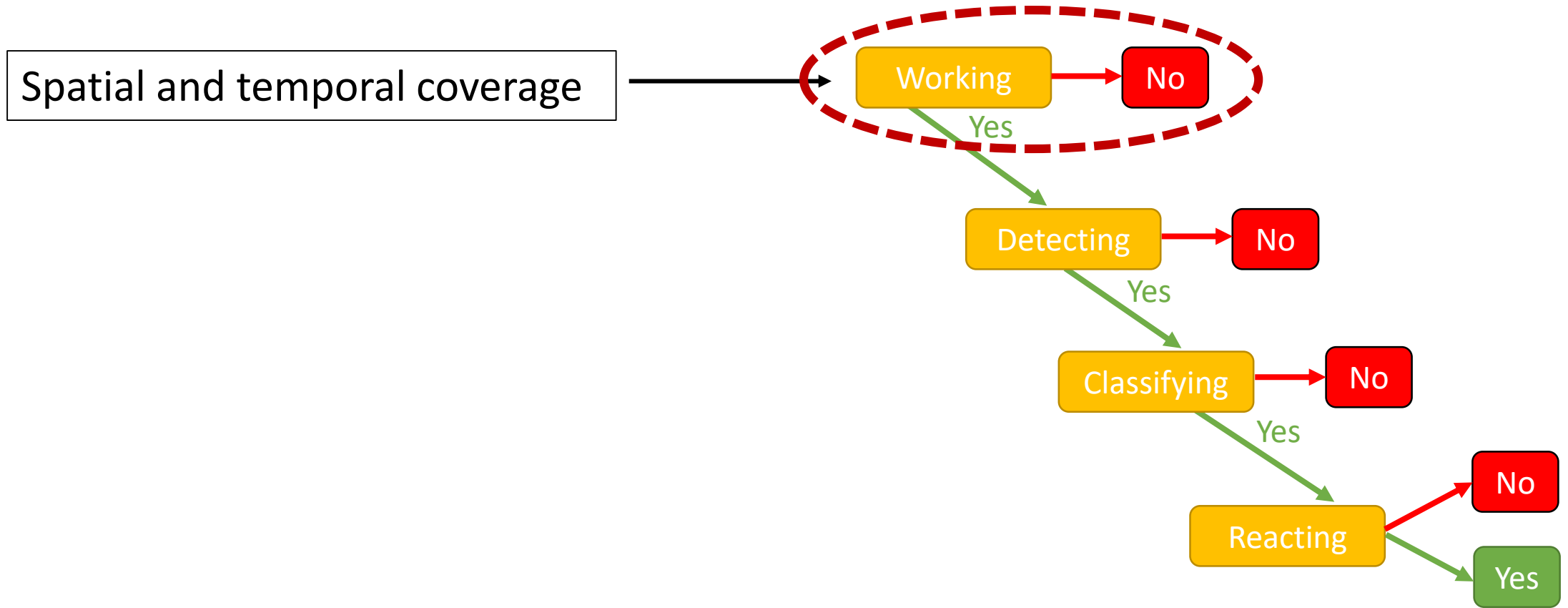


Protocole (ii): A protocol for verifying that the performance of a system is in agreement with prefectoral decree in force on a given wind farm



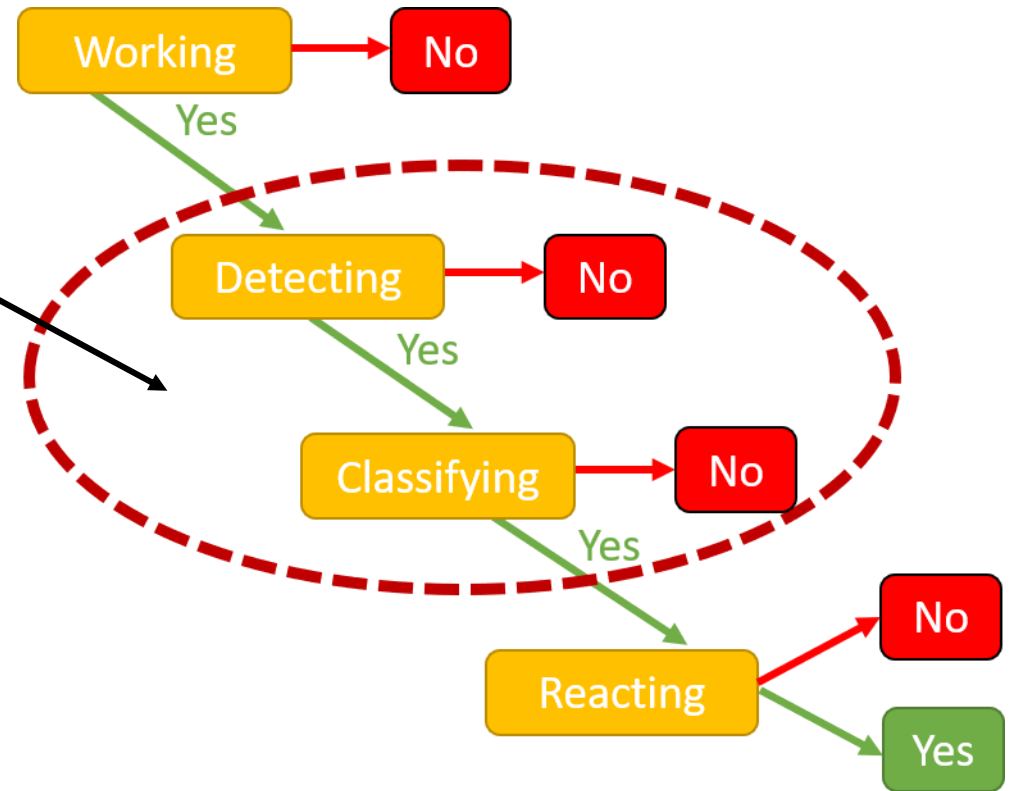
Regulatory requirement to demonstrate the effectiveness in each wind farm

Parameters to estimate

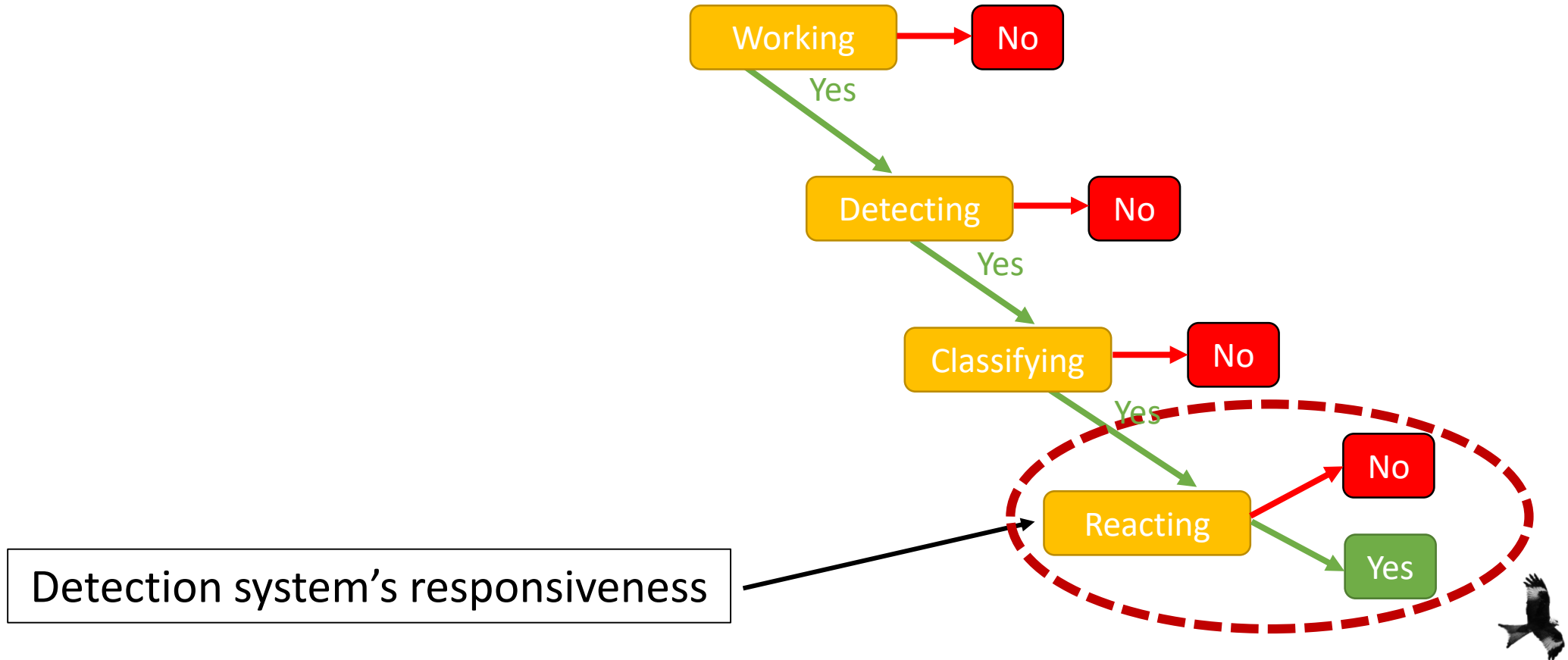


Parameters to estimate

Detection/classification probability compared with the performance table obtained with the protocol (i)
 &
 False positive number



Parameters to estimate



Provisional timetable

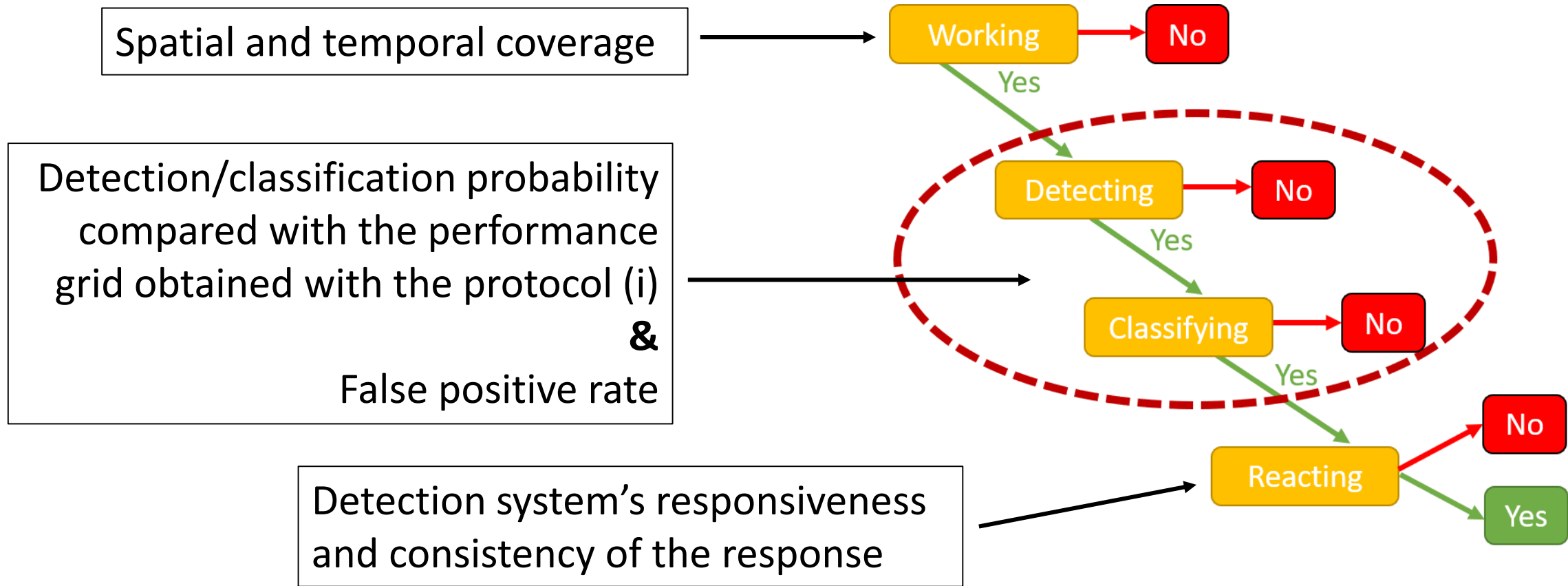
- Early 2022: Validation of the protocols by all the actors
- First semester 2022: Test phase
- Rest of the year: Full-scale test



Merci de votre attention !



Protocole (ii): A protocol for verifying that the performance of a system is in agreement with prefectoral decree in force on a given wind farm



Regulatory requirement to demonstrate the effectiveness in each wind farm





Protocole (ii): A protocol for verifying that the performance of a system is in agreement with prefectoral decree in force on a given wind farm

Influencing variables

- Operationality of the equipment and connections
- Time of the day
- Meteorological conditions



Protocole (ii): A protocol for verifying that the performance of a system is in agreement with prefectoral decree in force on a given wind farm

Influencing variables

- Stability of the connection
- Consideration of system shutdown request by the SCADA
- Condition of the wind turbine