ACSA
ALCEN

innovation at sea

VASQUE PROJECT

SeaExplorer

for water quality monitoring

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20 March 2012

Cedre Ifremer ACRI IN ACRI ST Centre d'océanologie de Marseille

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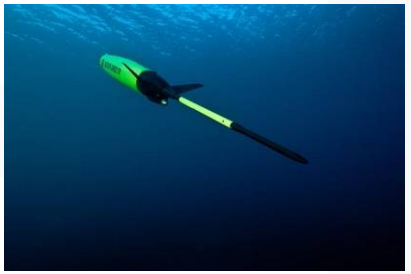


SeaExplorer for water quality monitoring

ACSA

Lite Tracking

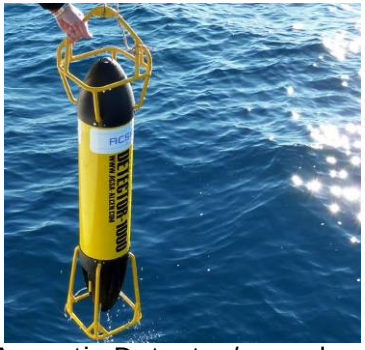
Long-range Tracking

Torpedo Tracking

USVs

UW Positioning & Robotics Systems

Supervision Software



Acoustic Detector/recorders

Custom designs

Clock references

Gliders (SeaExplorer™)

The VASQUE project

- **Presentation**
  - **To develop a long-endurance autonomous underwater vehicle**
  - **Able to constantly measure water quality**
  - **Suitable for different environments: coastal, offshore, sensitive areas**

- **Targets**
  - **Coastal environments:**
    - Bathing water quality
    - Industrial discharges into sea
    - Outfalls
    - …
  - **Offshore environments:**
    - Oil extraction areas
    - …
  - **In case of incidents:**
    - Incident area involving a ship carrying a hazardous substance

- **Timeline**
  - **3 year development programme**
  - **Commissioning: 2013**

The VASQUE project

- **Partners**

- ACSA: Project leader
- CEDRE: Requirement definition, operational aspects
- IFREMER: Sensor integration
- ACRI-IN: Hydrodynamics
- ACRI-ST: Data recovery/processing
- LOV: Sensor definition/development
- COM: Sensor definition/development

The SeaExplorer vehicle

- **Presentation**
  - **SeaExplorer = underwater glider**
  - **Propelled by buoyancy variation**
    - Heavy -> The vehicle moves down the slope
    - Light -> The vehicle moves up the slope
  - **Attitude controlled by moving mass control system**

- **Why SeaExplorer?**
  - **Long endurance (> 3 months)**
  - **Payload (5 kg, 10 L)**
  - **Only European glider**

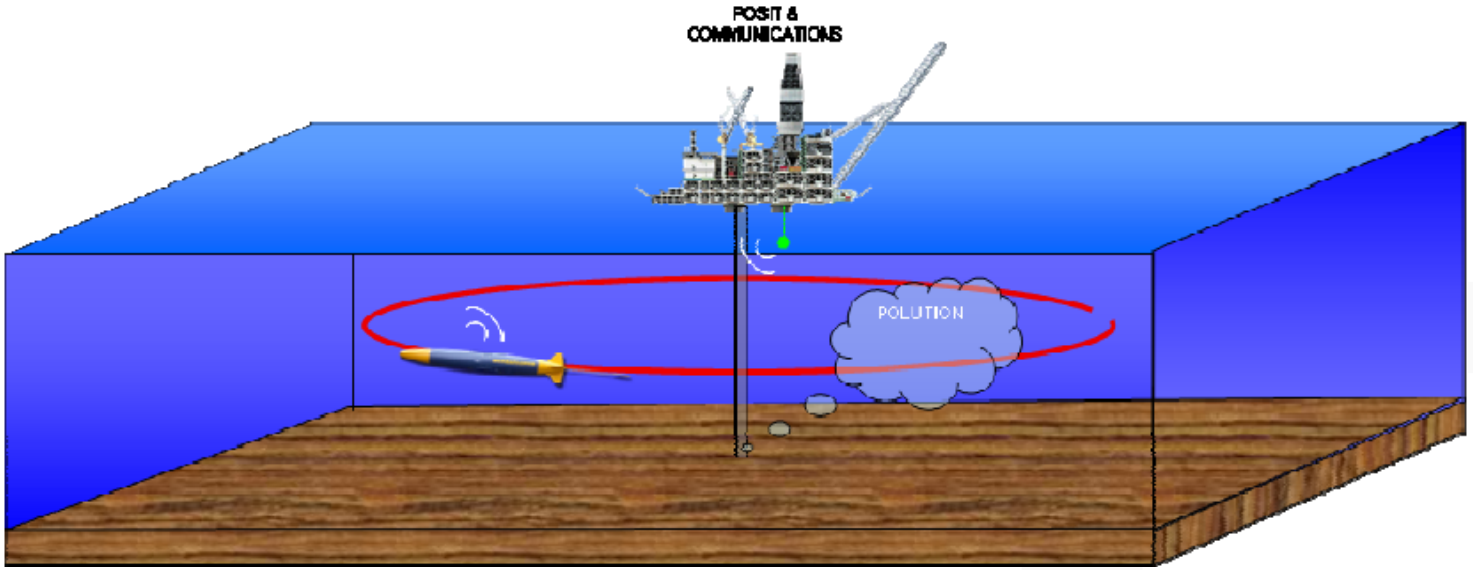
- **For the Vasque project**
  - **Addition of a thruster for horizontal gliding**
  - **Integration of 'pollution' sensors**

The SeaExplorer vehicle

- **Characteristics**
  - **Depth rating: 700 m (max 850 m)**
  - **Speed: 1.0 knot**
    - Against current
    - Highest speed
  - **Weight:**
    - 60 kg in air
    - +-200 g in water (max +-500 g)
  - **Dimensions: Ø0.24; Length 2.2 m + 0.8 m antenna**
  - **Endurance: 3 months (> 2000 km)**
  - **Communication:**
    - Iridium satellite
    - Radio (> 1000 m)
    - Acoustic (> 4 km)
  - **Sensors:**
    - Interchangeable payloads
    - 4 dry payloads
    - Wet payloads
    - Connected to body

Pollutant detection

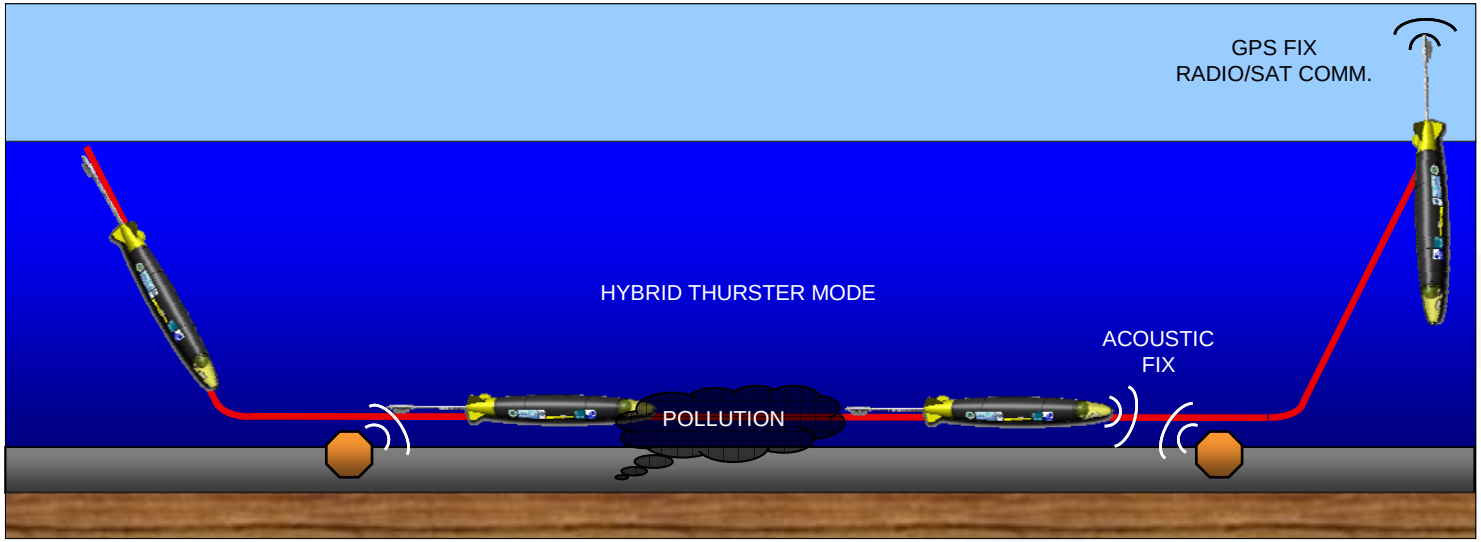
- **Typical missions:**
  - **Monitoring of a sensitive area**



- Totally autonomous
- Real-time alert upon detection

Pollutant detection

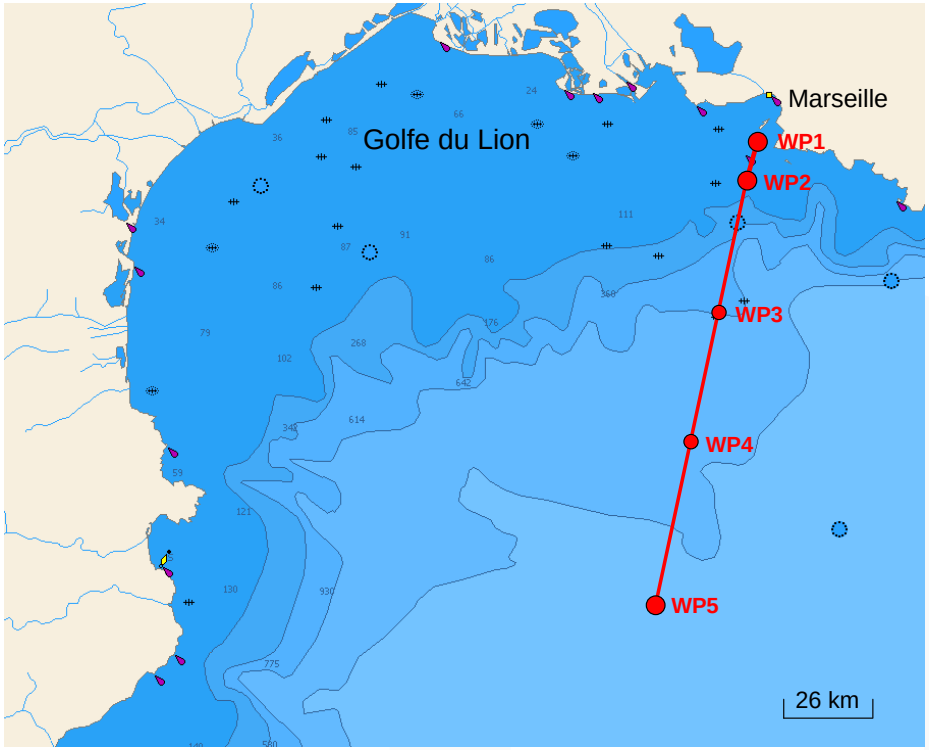
- **Typical missions:**
  - **Pipeline monitoring**



- Horizontal glide
- Acoustic guidance

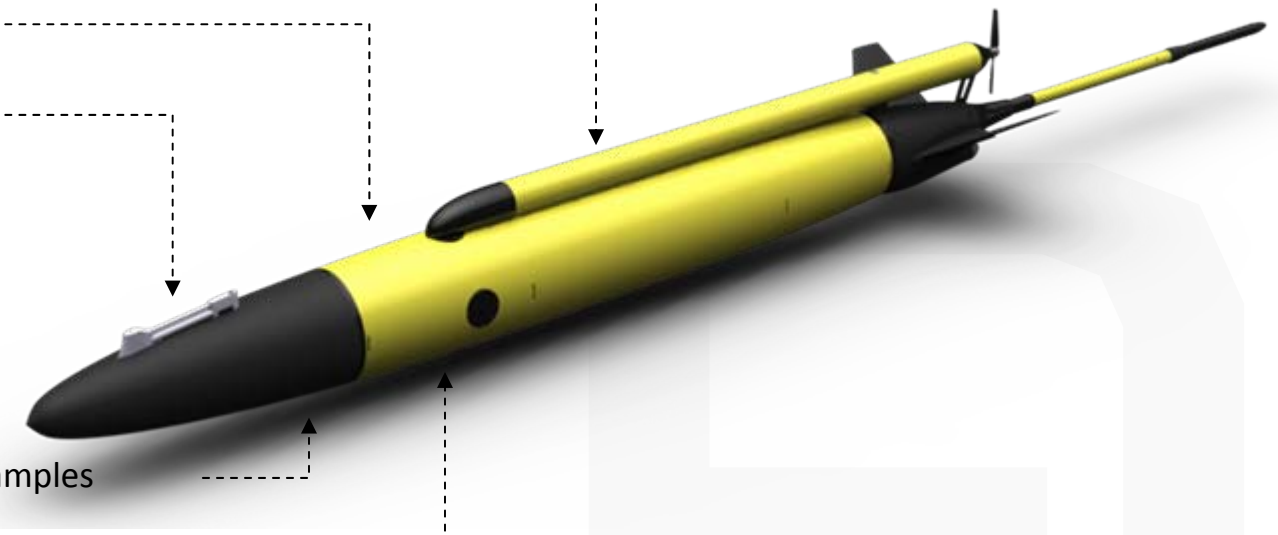
Pollutant detection

- **Typical missions:**
  - **Monitoring of an area of heavy shipping traffic**
    - Endurance
    - Programming / tracking
    - Acoustic guidance (no resurfacing)



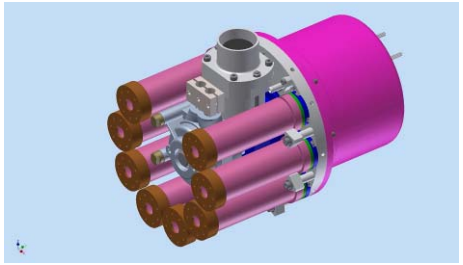
Pollutant detection

- **Sensors**
  - **Interchangeable/modular payloads**
  - **Integration of 'standard' sensors:**
    - Nitrate
    - Chlorophyll
    - Salinity
    - Pressure
    - O2
    - …
  - **2 developments:**
    - Mini Sampler -> Samples
    - Mini Fluo -> Hydrocarbon

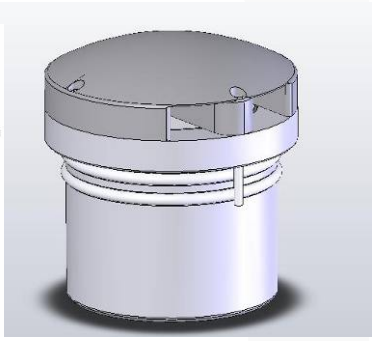


Pollutant detection

- **Sensor: Mini Sampler**
  - Developed by IFREMER
  - 8 x 50ml capsules
  - Fully controllable
  - Sampling by pumping
  - Sampling in front wet payload

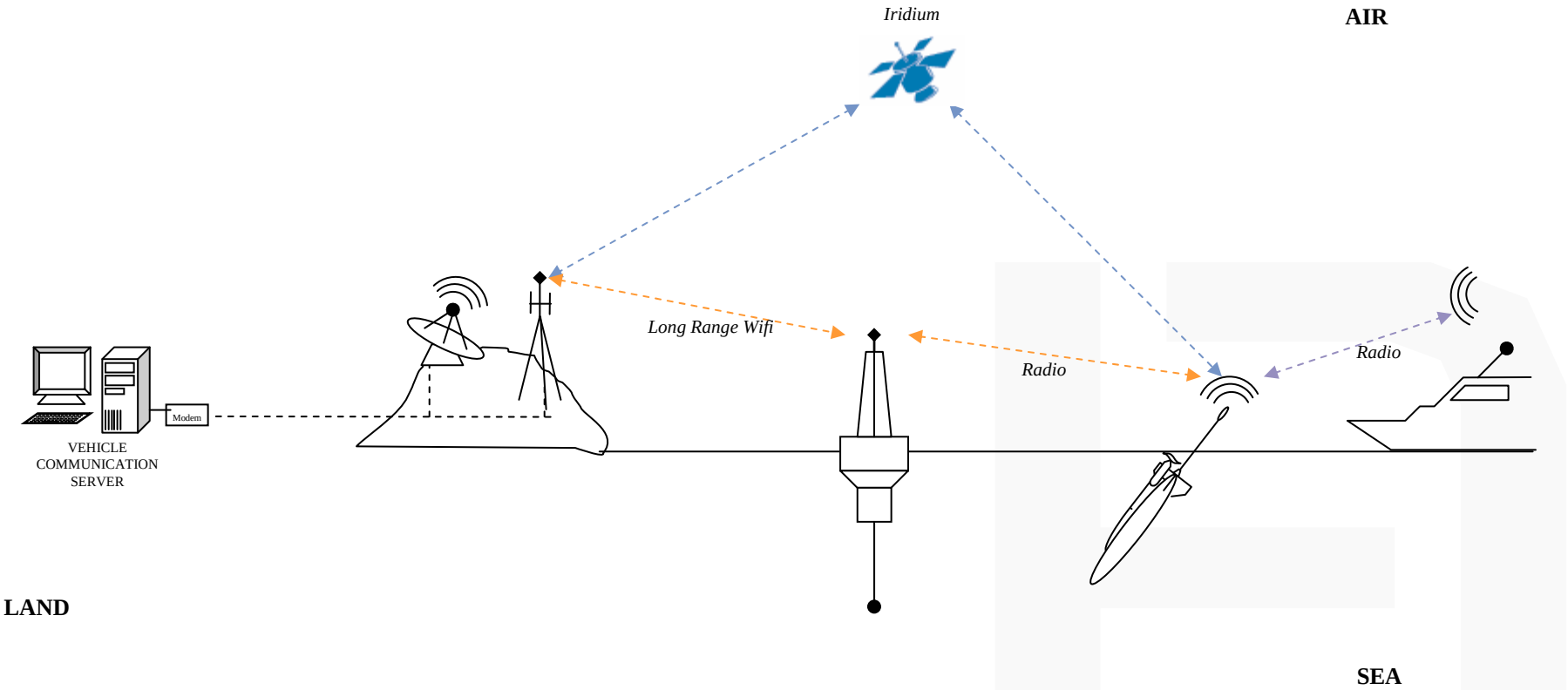


- **Sensor: Mini Fluo**
  - Collaboration between MicroModule and COM Laboratory (CNRS)
  - Patented
  - PUCK format (Standard: Ø75x100mm)
  - Fluorescence measurement
  - 2 versions:
    - MiniFluo-UV: Phenanthrene & Tryptophane
    - MiniFluo-H: Fluorene & Pyrene



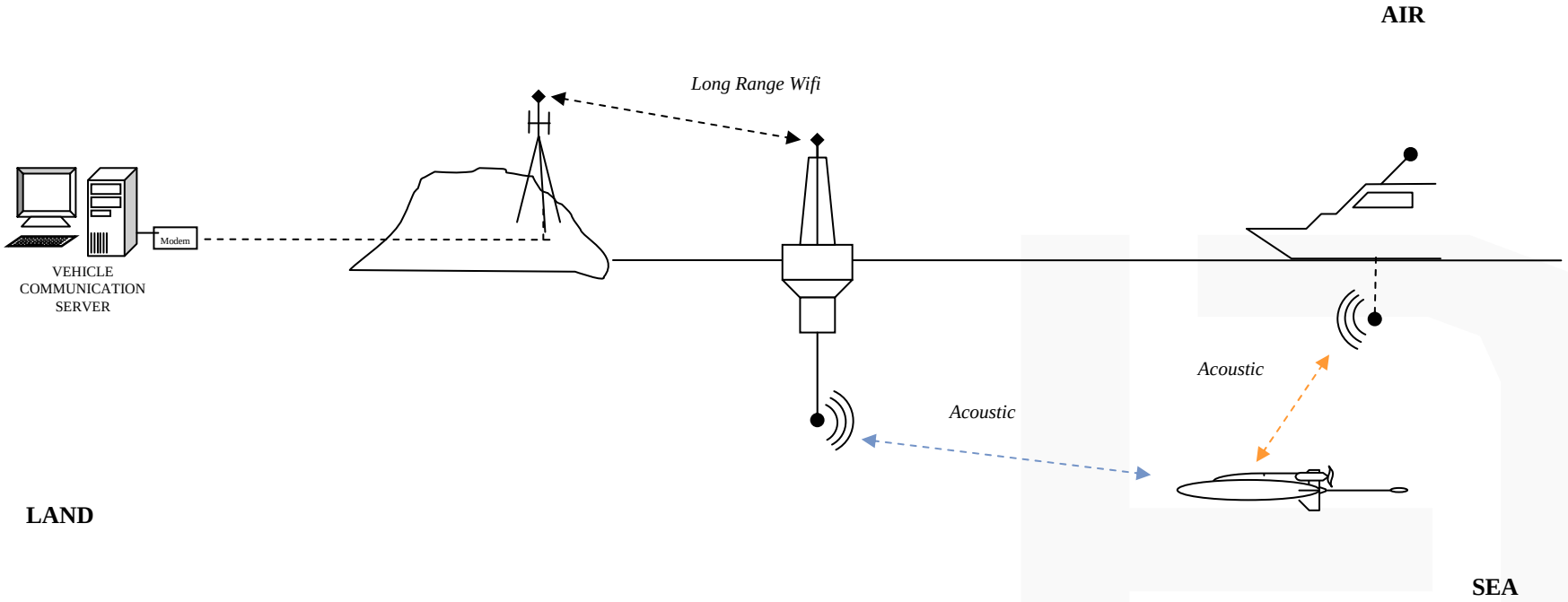
Pollutant detection

- **Processing & alerts**
  - **Aerial**



Pollutant detection

- **Processing & alerts**
  - **Underwater**



Pollutant detection

- **Conclusion**

  - **Problems identified**
    - Frequent resurfacing in coastal areas (risk of accidents)
    - Cost of classic operations (AUV, Boat, …)
    - Cost of communications
    - Positioning between resurfacings
    - Navigation in shallow waters/Crossing slicks
    - Sensor consumption/size
    - Fine-tuned pollutant characterisation

  - **Solutions provided**
    - Acoustic positioning system
    - Hybrid glider: Low investment and operating costs
    - Long Range Wifi on buoy
    - Development/integration of a thruster with similar consumption to ballast
    - Design and manufacture of specific sensors
    - Automated in situ sampling

Conclusion

Problems identified	Solutions provided
Frequent resurfacing in coastal areas (risk of accidents) and positioning between resurfacings	Acoustic positioning system
Cost of classic operations (AUV, Boat, …)	Hybrid glider: Low investment and operating costs
Cost of communications	Long Range Wifi on buoy
Navigation in shallow waters/Crossing slicks	Development/integration of a thruster with similar consumption to ballast
Sensor consumption/size	Design and manufacture of specific sensors
Fine-tuned pollutant characterisation	Automated in situ sampling

SeaExplorer for water quality monitoring

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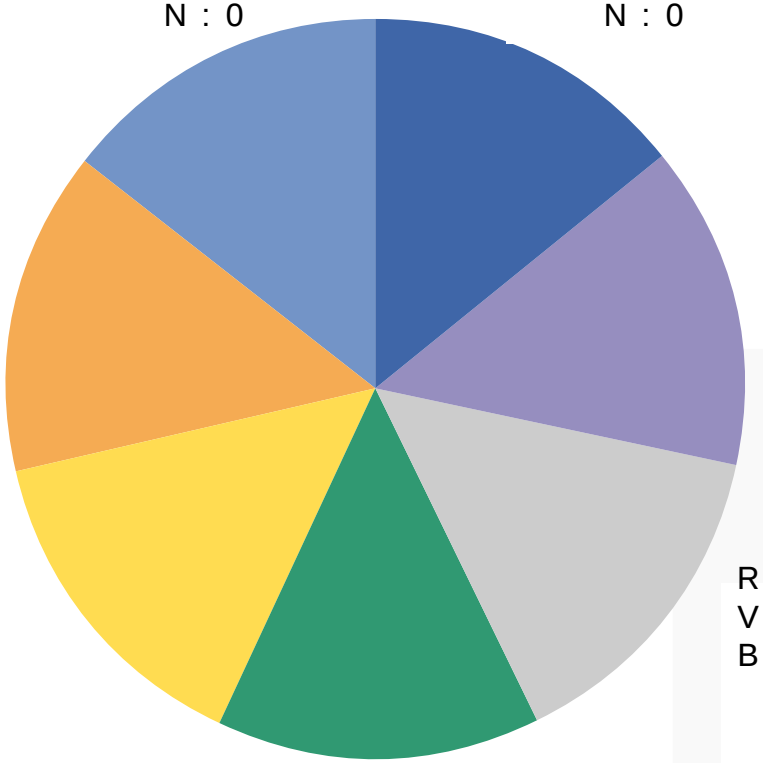
COLOUR GUIDE



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V : 148 M : 37
B : 199 J : 0
N : 0

R : 63 C : 80
V : 102 M : 60
B : 168 J : 0
N : 0

R : 245 C : 0
V : 171 M : 40
B : 83 J : 72
N : 0

R : 150 C : 47
V : 142 M : 45
B : 191 J : 0
N : 0

R : 255 C : 0
V : 220 M : 12
B : 81 J : 75
N : 0

R : 204 C : 0
V : 204 M : 0
B : 204 J : 0
N : 20

R : 48 C : 78
V : 158 M : 15
B : 114 J : 64
N : 0