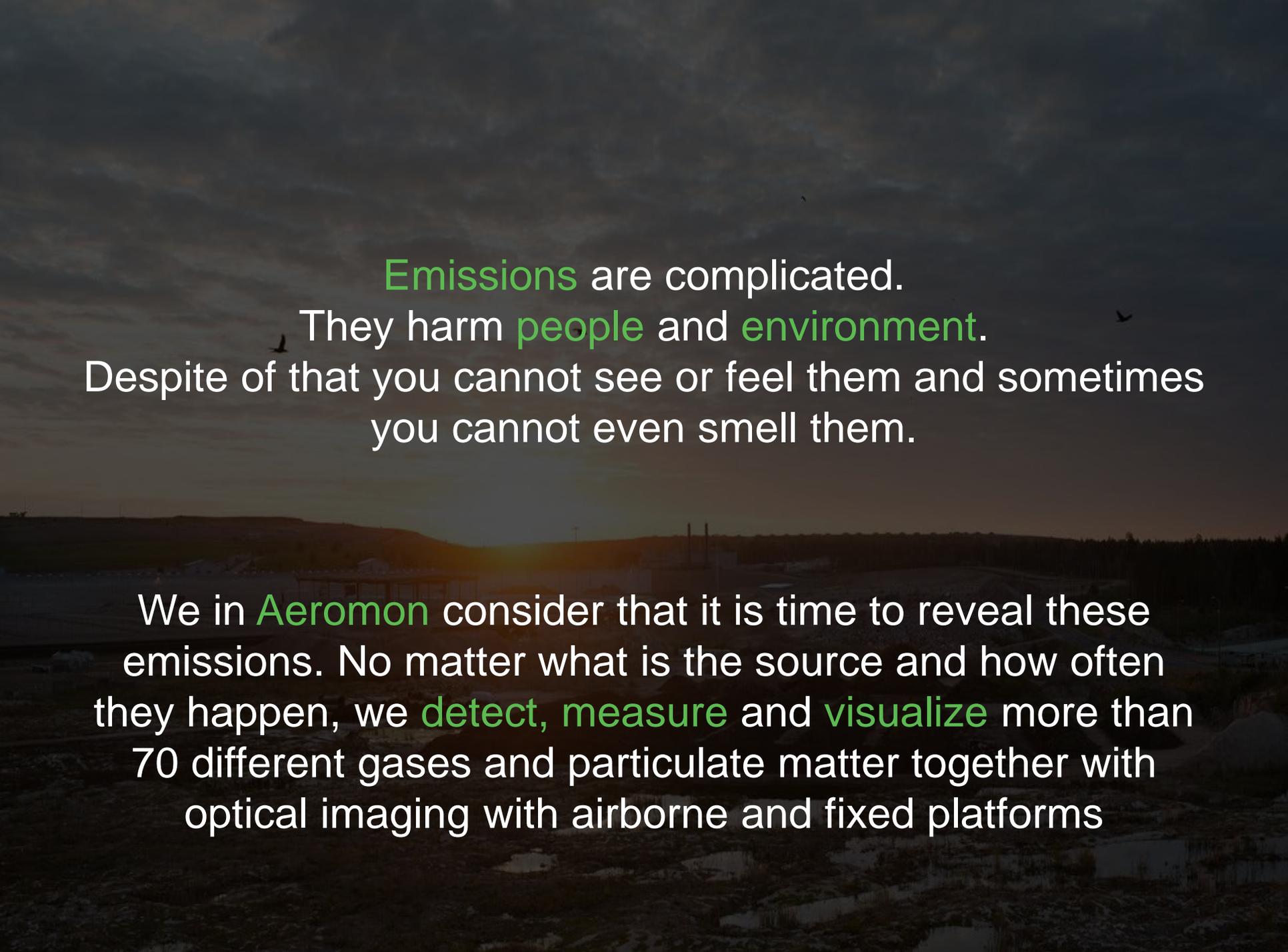




Aeromon

Airborne emission monitoring





Emissions are complicated.
They harm people and environment.
Despite of that you cannot see or feel them and sometimes
you cannot even smell them.

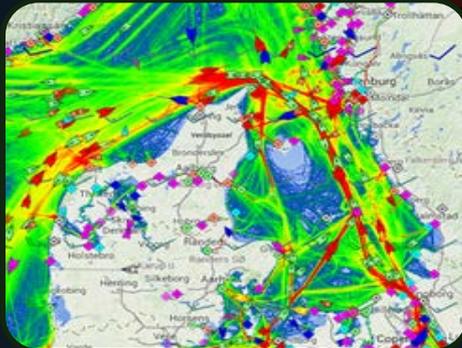
We in Aeromon consider that it is time to reveal these emissions. No matter what is the source and how often they happen, we detect, measure and visualize more than 70 different gases and particulate matter together with optical imaging with airborne and fixed platforms

Aeromon Ltd - IoT measurement service

- **Aeromon Ltd.** utilizes readily available UAV/RPAS platforms and sensor technologies together with open data sources. **We are an integrator.**
- Aeromon delivers **verified and real-time results** from airborne, mobile and fixed measurement environments. We provide multidimensional and multisource measurements with **accurate location information.**
- **Point-of-source, 2D- and 3D-mapping** of parameters.
- Aeromon solution can be used e.g. in naval vessel, industry, power or recycling plant emission monitoring to ensure regulation compliance and to identify different sources of leaks and pollution.
- Aeromon solution is **highly cost-effective.**

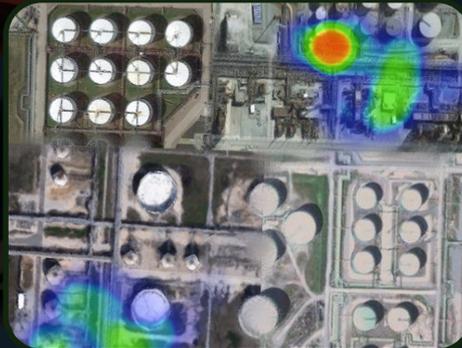


Core markets



Maritime

- Vessel emission monitoring and validation
- Surveying gas emissions from tank purging operations
- Fixed monitoring stations on vessels
- **Ongoing measurement project onboard R/V Aranda**
- **Europe-wide measurement service in construction (EMSA)**



Industrial and Environmental

- Process leaks
- Gas pipeline leakages
- Enhancing environmental awareness and third party audit
- **Several successful measurement pilots done at customer locations**
- **Several new pilots upcoming**



Health and Safety

- Mapping of accident areas for toxic gases – **real time situation awareness**
- Monitoring large areas for secondary leakages
- Reducing risk of biomass storage by mapping combustion gases from storage heaps

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We Serve You With

Emission monitoring

For **vessel** and industrial emission validation and monitoring to enforce regulation and identify fugitive emissions and map TRS compounds. Aeromon high quality BH-8 sensor module utilized.



Gas concentration Mapping

For pinpointing and quantifying emissions (leak detection). Diffuse point-of-source emission mapping in 2D and 3D to reveal gas concentrations. Aeromon high quality BH-8 sensor module and diffusion model utilized.



Aeromon as a platform

For multisource measurements with accurate location information. Aeromon delivers verified and real-time results from airborne, mobile and fixed measurement environments with customer sensors.



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BH-8 – The Secret Ingredient

Aeromon has developed BH-8 sensor package for airborne and stationary measurements. It can carry 8 different gas sensors simultaneously. In addition, it provides accurate GPS, AIS and weather information.

BH-8 is fully integrated to Aeromon's Gasmon software and cloud service thus providing automated web reports with data visualization.

Aeromon can measure more than 70 different gases with BH-8 calibrated sensors and provide gas concentration map in real time.



**8 GAS
SENSORS**

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Aeromon sensor module BH-8



Size	140 mm – 210 mm – 90 mm
Weight	0,85 kg with a typical 8 gas sensor setup
Gas sensor ports	8 pcs
Datalink	e.g. radio, GSM, satellite modem
Datalink range	Adjustable, from 1 km to global
Sampling frequency	Adjustable, typically 0,5 – 5 Hz
Data storage	Local storage and Aeromon Cloud Service database
GPS	Internal, 10 Hz update
Sampling method	Free-flow (adjustable) and/or sample capture (automatic or manual)
Sample filter	Quartz wool membrane
Mechanical interface	Customized for each platform



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Technology base



SENSORS

Aeromon provides various combinations of gas monitoring addition to other parameters – up to **8 different gases monitored simultaneously** (per standard BH-8 module).

Sensor integrations and algorithms to compensate cross effects etc. are developed and validated together with our **partner network of companies and universities**.

AEROMON CLOUD SERVICE

Most common gases to monitor:

- combustible gases
- toxic gases
- explosive gases
- oxygen deficiency gases (asphyxiant hazard)
- refrigerants
- VOC emissions (Volatile Organic Compound)

Different measuring technologies:

1. Electrochemical EC
 2. Sensors which absorb infrared light IR
 3. Catalytic sensors CAT
 4. Semiconductor sensors SS
 5. Photo-ionization detector PID
- + Other commercially available technologies

Aeromon

Technology base

SENSORS

AEROMON
CLOUD
SERVICE

- Aeromon cloud service (ACS) collects all sensor data together with user ID and provides **automated analysing and reporting** through web interface.
- A versatile **signal processing, algorithms and cross-effect compensations generate high quality results** even from budget sensor technology.
- Visualization of the results can be provided on top of a map or an aerial image in real time.

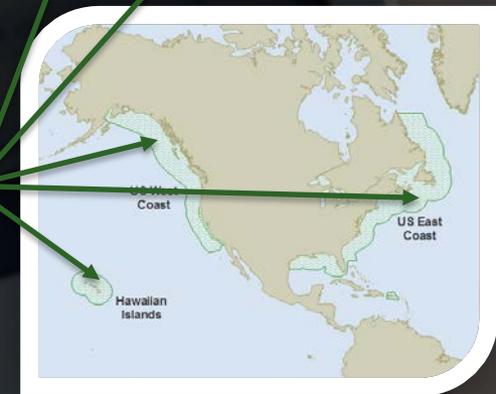


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Aeromon & vessel emissions

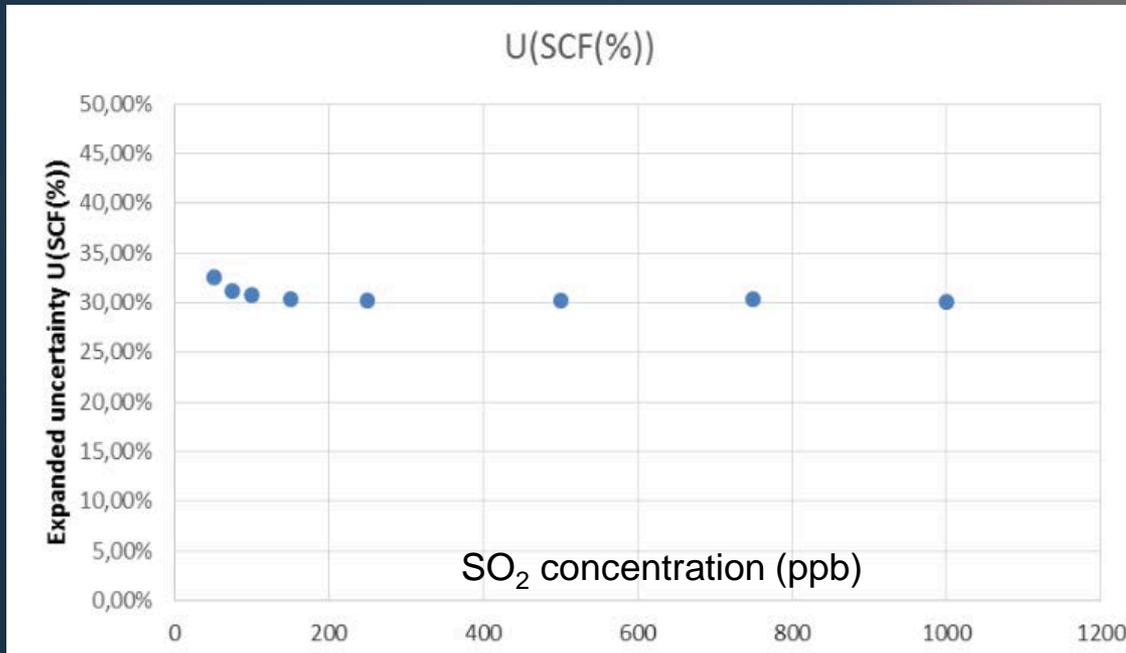
- Technological feasibility study "MeriSOx" was done 2015-2016 in collaboration with Finnish Meteorological Institute (FMI) and VTT Technical Research Centre of Finland
 - Sensor module BH-8 with CO₂, NO, NO₂, SO₂, O₂, RH%, temperature and pressure sensors.
 - Sensors were tested in the FMI in controlled laboratory environment together with field conditions.
 - Field tests were made in collaboration with VTT test engine laboratory, Neste Ltd. and the Port of Helsinki.

- 0.1% SOx limits on SECA areas from 2015 onwards.
- 0.1 % sulphur content not reachable with heavy fuel oil (HFO) → marine gas oil (MGO) must be used or exhaust gases must be washed (scrubbers)
- MGO is about 2x the price of HFO → benefit from non-compliance at the magnitude of 10 000 €/day
- States must have a credible method for emission monitoring to enforce the regulation and prevent the market from being distorted by non-complying companies.



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Performance results from the national gas measurement quality assurance laboratory in the FMI and from VTT engine laboratory



VTT engine laboratory campaign

- 0.5% FSC measured with BH-8 onboard RPAS with 26% standard deviation
- 2.5% FSC measured with BH-8 onboard RPAS with 19% standard deviation

Aeromon system showed 30 % uncertainty for fuel sulphur content (FSC) determination above the SO₂ detection limit (65 ppb) with 0,1 % FSC with 95 % confidence interval¹.

¹Determined by FMI reference laboratory

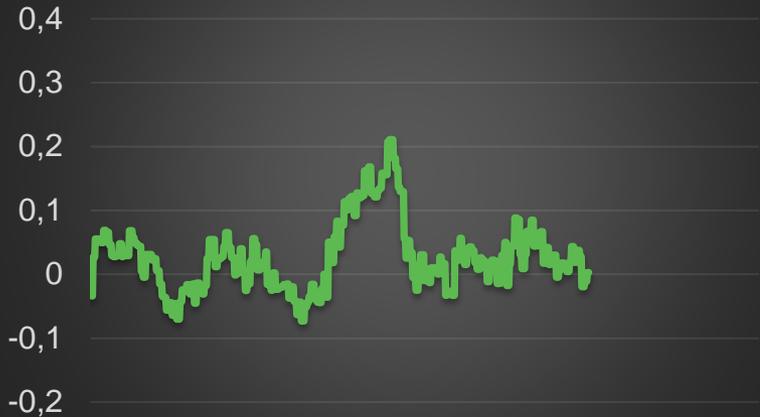
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A vessel measurement example from MeriSOx project



SO2 ppm

0,4
0,3
0,2
0,1
0
-0,1
-0,2



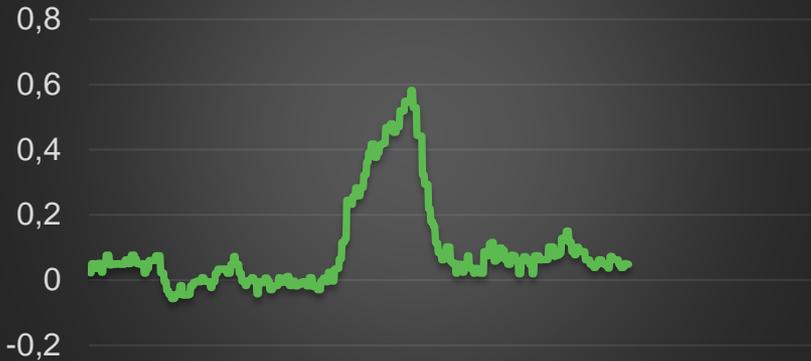
CO2 ppm, background removed

500
400
300
200
100
0
-100



NO2 ppm

0,8
0,6
0,4
0,2
0
-0,2



Analysis:

FSC [%] = $0,10 \pm 0,03\%$

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Vessel emission example in Aeromon Cloud Service

Aeromon Cloud Service

https://demo-dot-massive-journal-128019.appspot.com/sessions/exh#/session/6677/1485952811324.361

Flights Results Reset

Flight path Measurements AIS data Data download

Map Satellite

Tallinn-Åland (Mariehamn)

Selected point in time: Wed Feb 01 2017 14:40:12 GMT+0200 (FLE Daylight Time) [Unselect](#)
 View follows RPAS

Symbol legend [-]

- RPAS
- Camera footprint
- Flight plan
- Vessel

Icons with white outline represent the position at the selected point in time, other icons the position at the last video position.

Vessels

- 230145999
- 230145333
- 230145123

Measurements Results

Display mode: Last 5 minutes Last 30 minutes **Entire session**

2017-02-01 14:40:22
 NO2: 0.28 ppm
 NO: 5.67 ppm
 SO2: 0.21 ppm
 CO2: 900 ppm
 RH: 48.28%
 T: 14.59°C
 p: 103.45kPa
 FSC: 0.10%

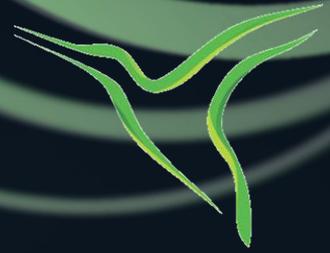
Inside the chamber			
	RH%	T (°C)	p (kPa)
Live	44.00	16.60	103.44
Displayed	46.22	16.58	103.45

RPAS video feed RPAS telemetry data

LIVE

Map data ©2017 Google Imagery ©2017, Cnes/Spot Image, DigitalGlobe, Landsat / Copernicus Terms of Use

Airborne vessel emission monitoring



BENEFITS:

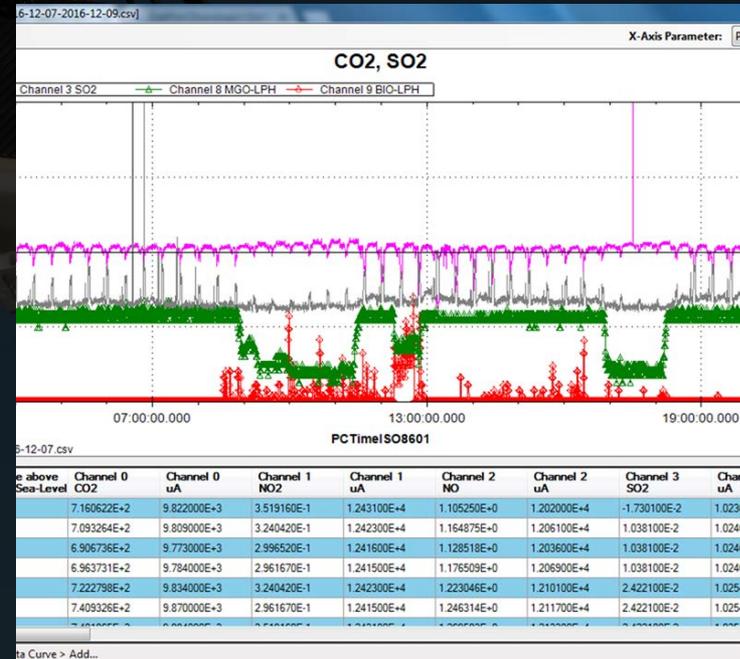
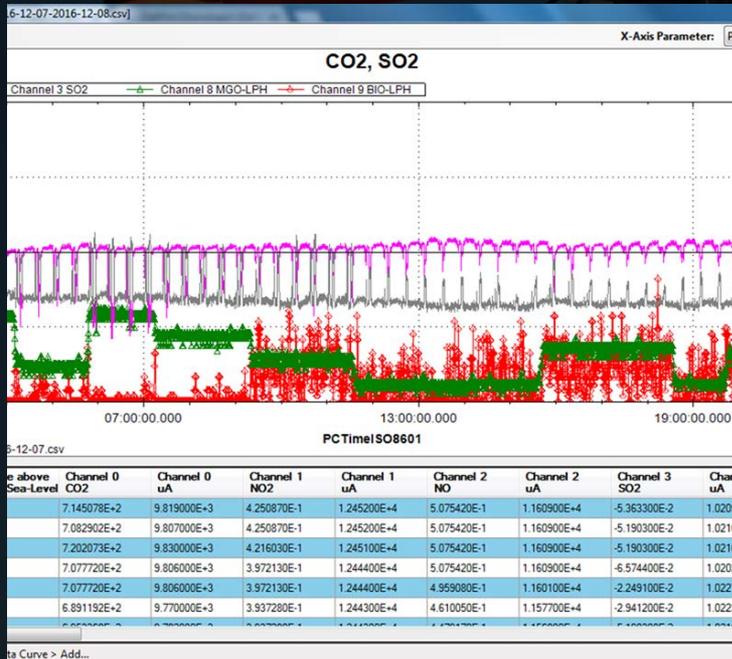
- More effective port state control
- Reduced cost of port state control
- Better accuracy for the vessel targeting
- Early detection to enable early actions
- Fast and verified monitoring

Aeromon

Fixed vessel emission monitoring

24/7 monitoring, logging and reporting of

- Exhaust gas composition
- Vessel fuel consumption
- Vessel speed, location, heading etc.
- Onboard R/V Aranda in collaboration with Finnish Environment Institute, SYKE.
- Aeromon BH-8 as a fixed installation.



Aeromon

In Collaboration

Tekes

Gasum



HSY



UPM
The Biofore
Company



SYKE

Finnish Environment Institute



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