
Air Pollution from Ships in the Mediterranean Sea

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What is the problem?

- . Sulfur content of fuel for marine sea ships can be about 3,500 times as high as on shore (cars, trucks)
- . Sulfur content of fuel for marine sea ships on average it is 2,700 times higher
- . From 2020 sulfur content will be limited
- . To 0.5 %, in ECA and EU harbors: S- max 0.1 %
- . Toxic emissions:
 1. Particulate Matter (PM) and
 2. Black Carbon (BC)
 3. Sulfur Dioxides (SO_2)
 4. Poly Aromatic Hydrocarbons (PAH)
 5. Heavy Metal Oxides
 6. Nitrogen Oxides (NO_x)



Problem: BlackCarbon(1)

- results from the incomplete burning of fossil fuels and biomass
- component of PM
- shortens life expectancy
- causes respiratory and cardiovascular diseases
- can cause lung-cancer



🔍 Calle Scuola, Venedig, Italien



Google





Black Carbon Measurements

microAeth[®] / AE51



Measurement Principle

Real-time analysis by measuring the rate of change in absorption of transmitted light due to continuous collection of aerosol deposit on filter. Measurement at 880 nm interpreted as concentration of Black Carbon ('BC').

Measurement Range

0-1 mg BC/m³, filter life time dependent on concentration and flow rate setting:

avg. 5 µg BC/m³ for 24 hours @ 100 ml/min

avg. 100 µg BC/m³ for 3 hours @ 50 ml/min

avg. 1 mg BC/m³ for 15 minutes @ 50 ml/min

Measurement Resolution

0.001 µg BC/m³

Measurement Precision

±0.1 µg BC/m³, 1 min avg., 150 ml/min flow rate

Measurement Timebase (User setting)

1, 10, 30, 60, or 300 seconds

Ultrafine Particle

P-TRAK™ ULTRAFINE PARTICLE COUNTERS (CPC)

Model 8525

- + Counts ultrafine particles less than 1 micron diameter in real time
- + Tracks particles to the source
- + Portable, battery operated
- + Data logs to document results



Model 8525

SPECIFICATIONS

P-TRAK ULTRAFINE PARTICLE COUNTER MODELS 8525

Concentration Range

0 to 5×10^5 particles/cm³

Particle Size Range

0.02 to 1 micrometer

Temperature Range

Operation

32 to 100°F (0 to 38°C)

Storage

-40 to 160°F (-40 to 70°C)

Flow Rate

Sample

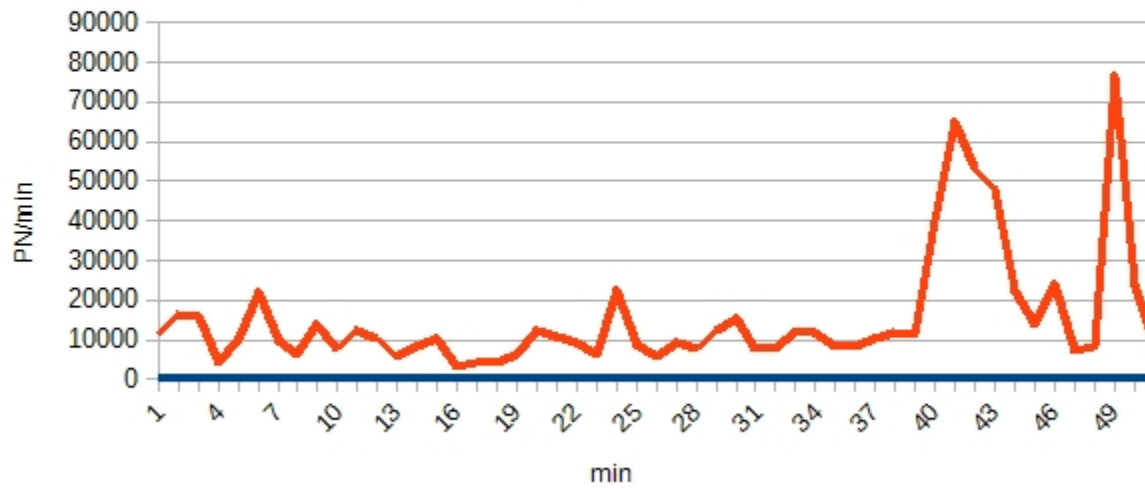
100 cm³/min

Total

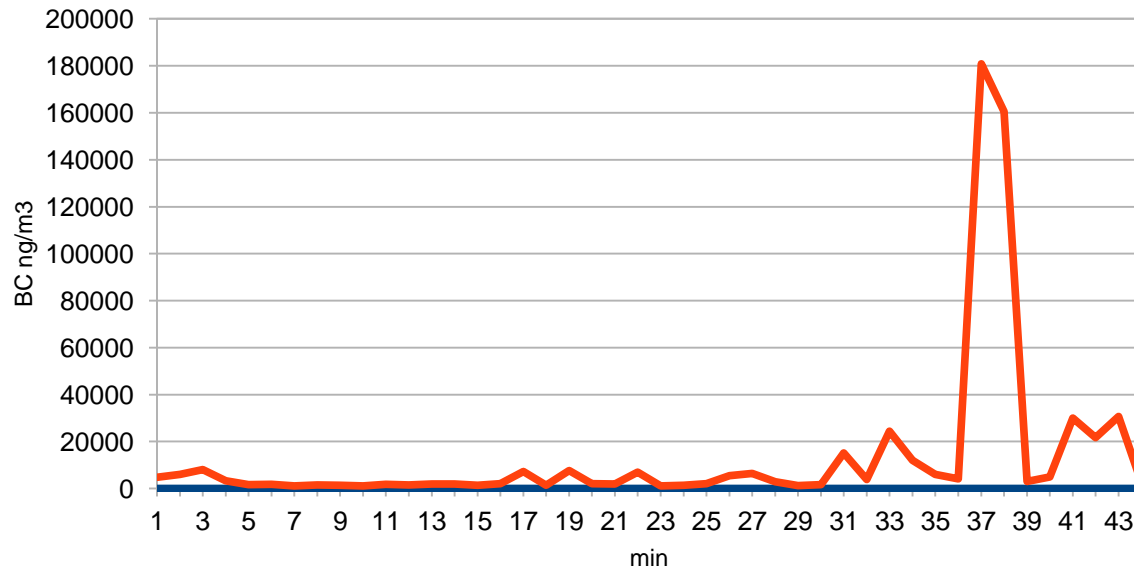
700 cm³/min (nominal)

Particle Number Venice

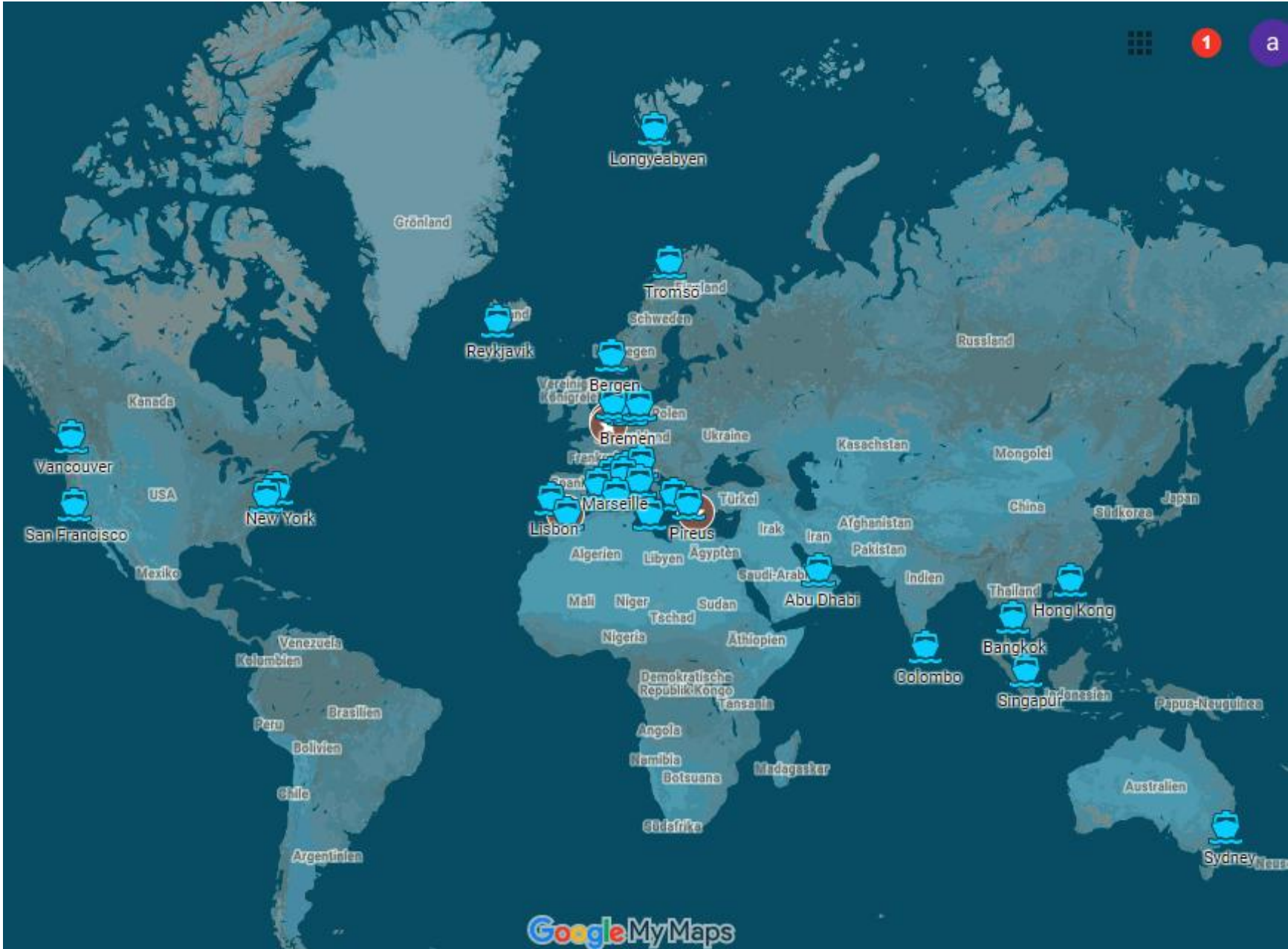
Av. min



BC units = ng/m³



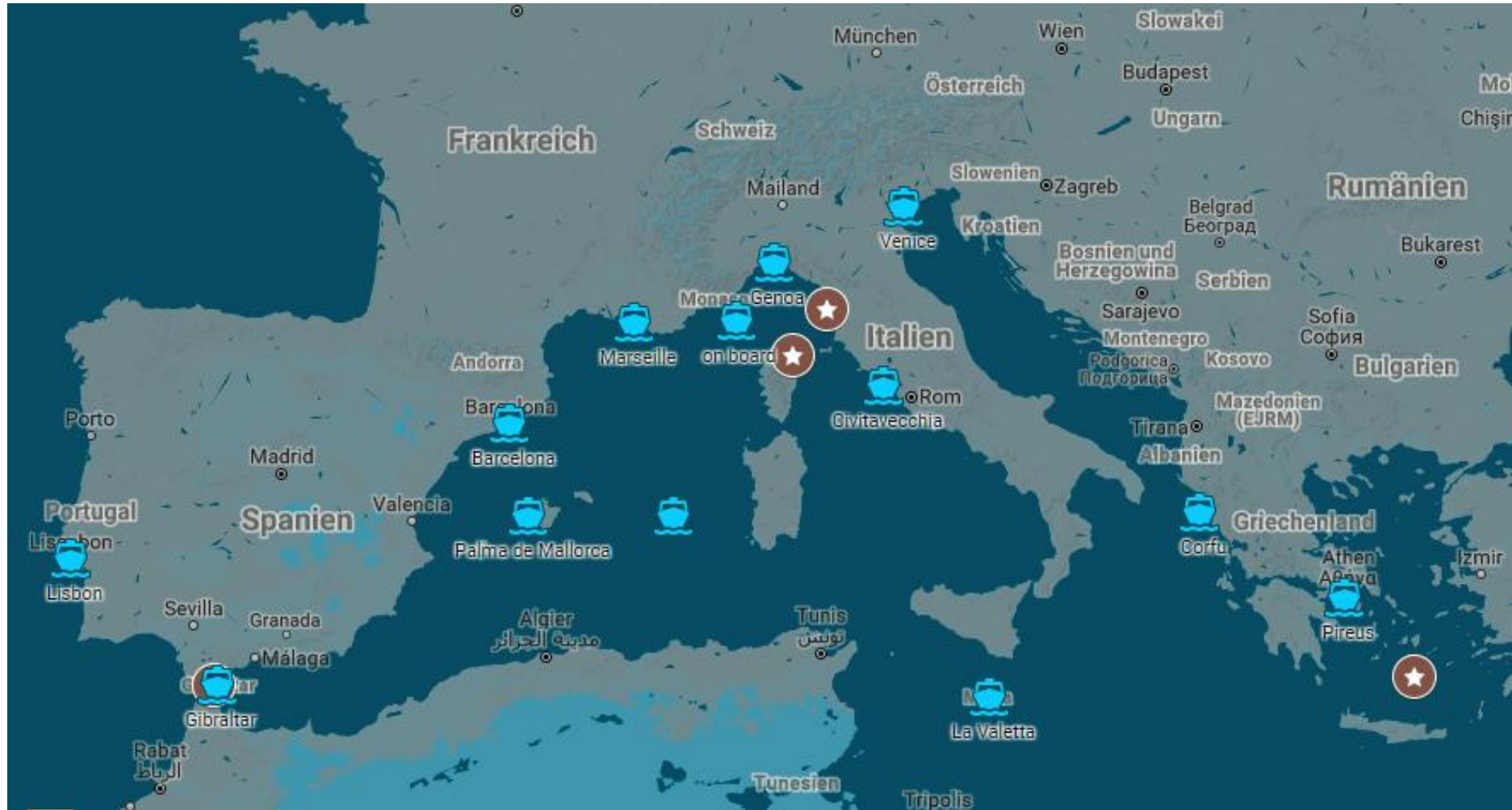
Measurements in Ports and on Cruise Ships



Air Pollution Measurements in European Waters



Measurements in the Mediterranean Sea



Cruise ships

Activities in Venice (Italy), Bergen (Norway) and Barcelona (Spain) and many harbor cities with very



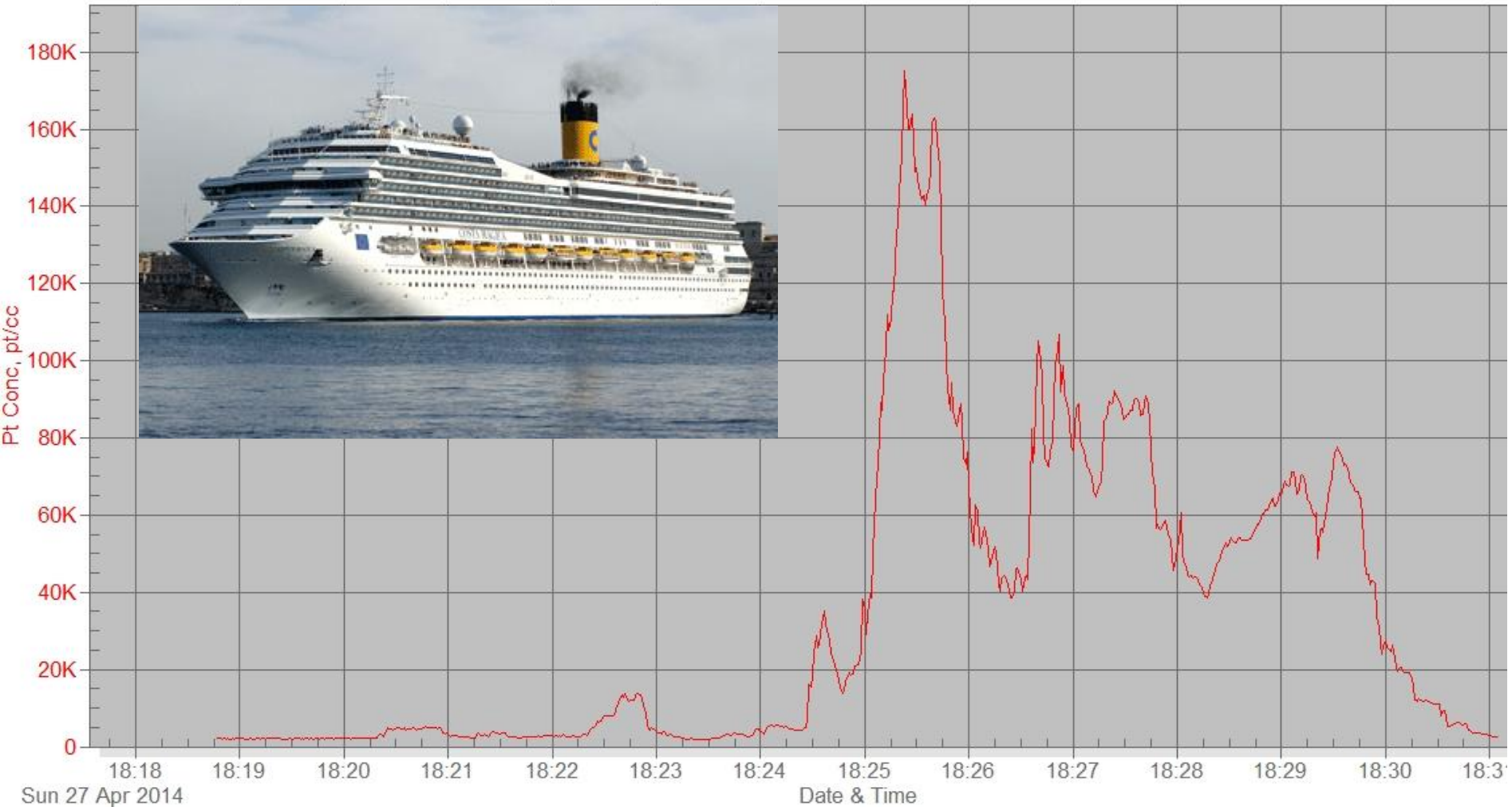
Los cruceros también contaminan el aire de Barcelona



Particle Number Measurements

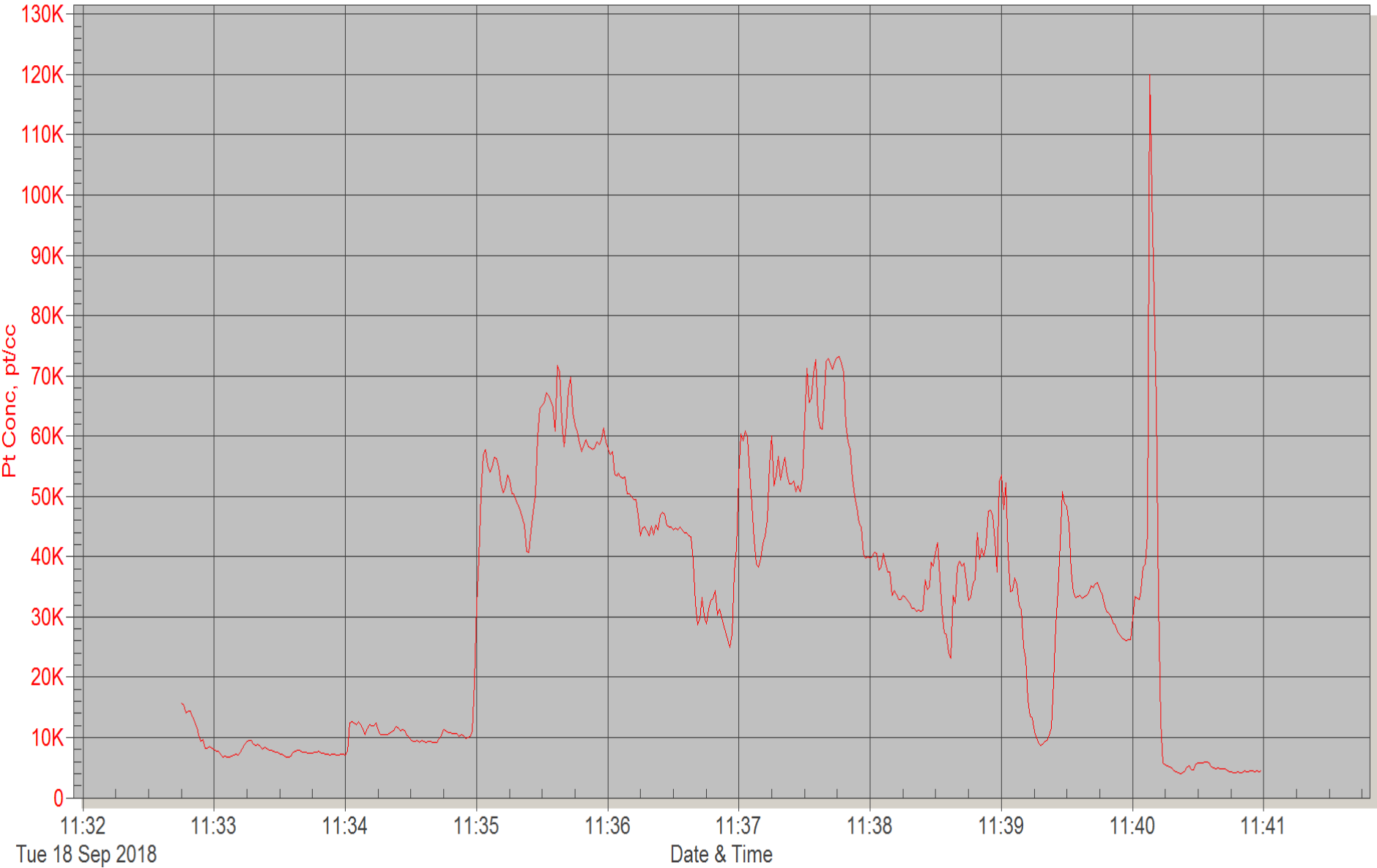
Cruise ship emissions: Peanuts?

Costa_Magica
S_Elena



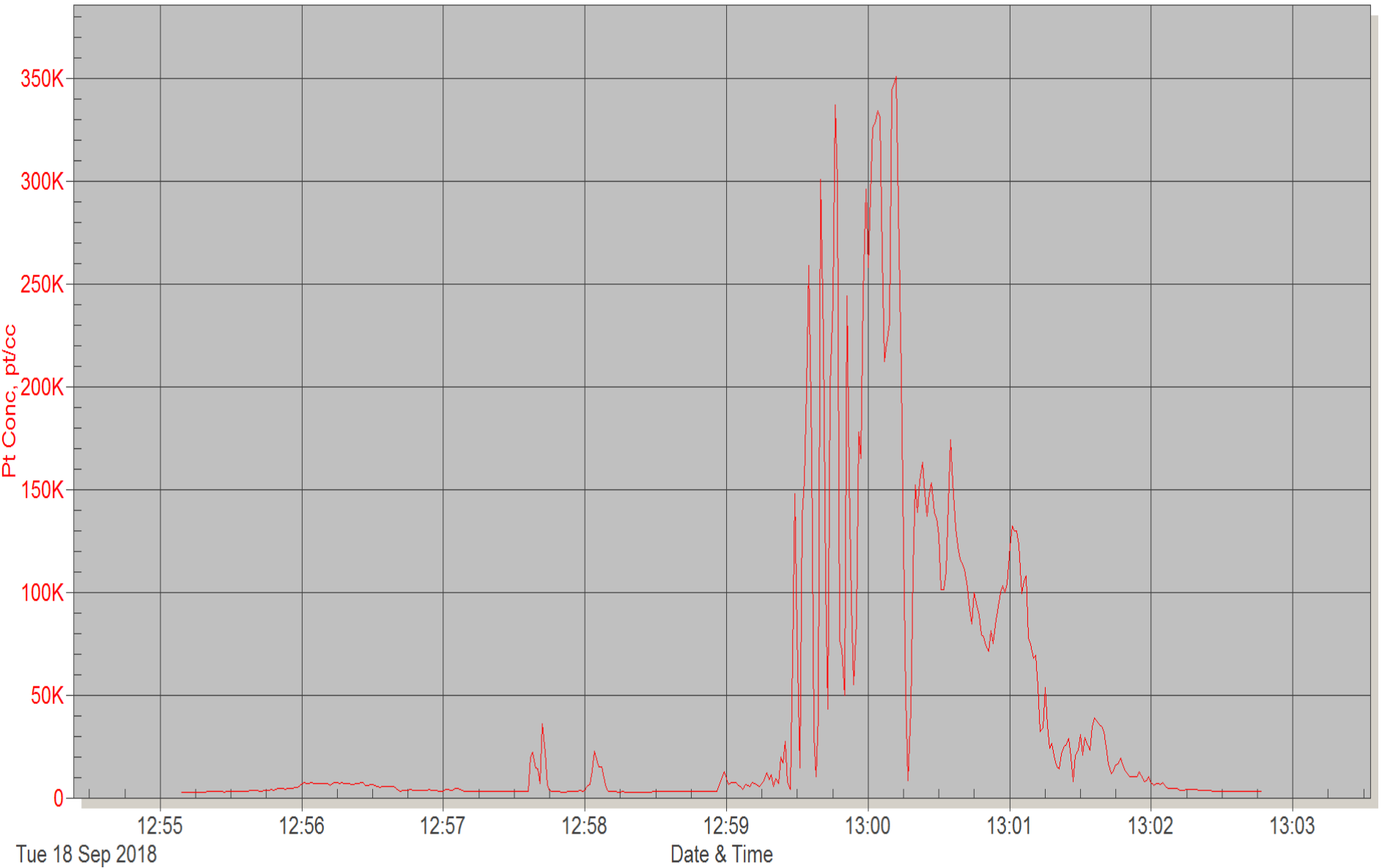
Santorini Port 18.09.2018 11:32

NABU Sönke Diesener



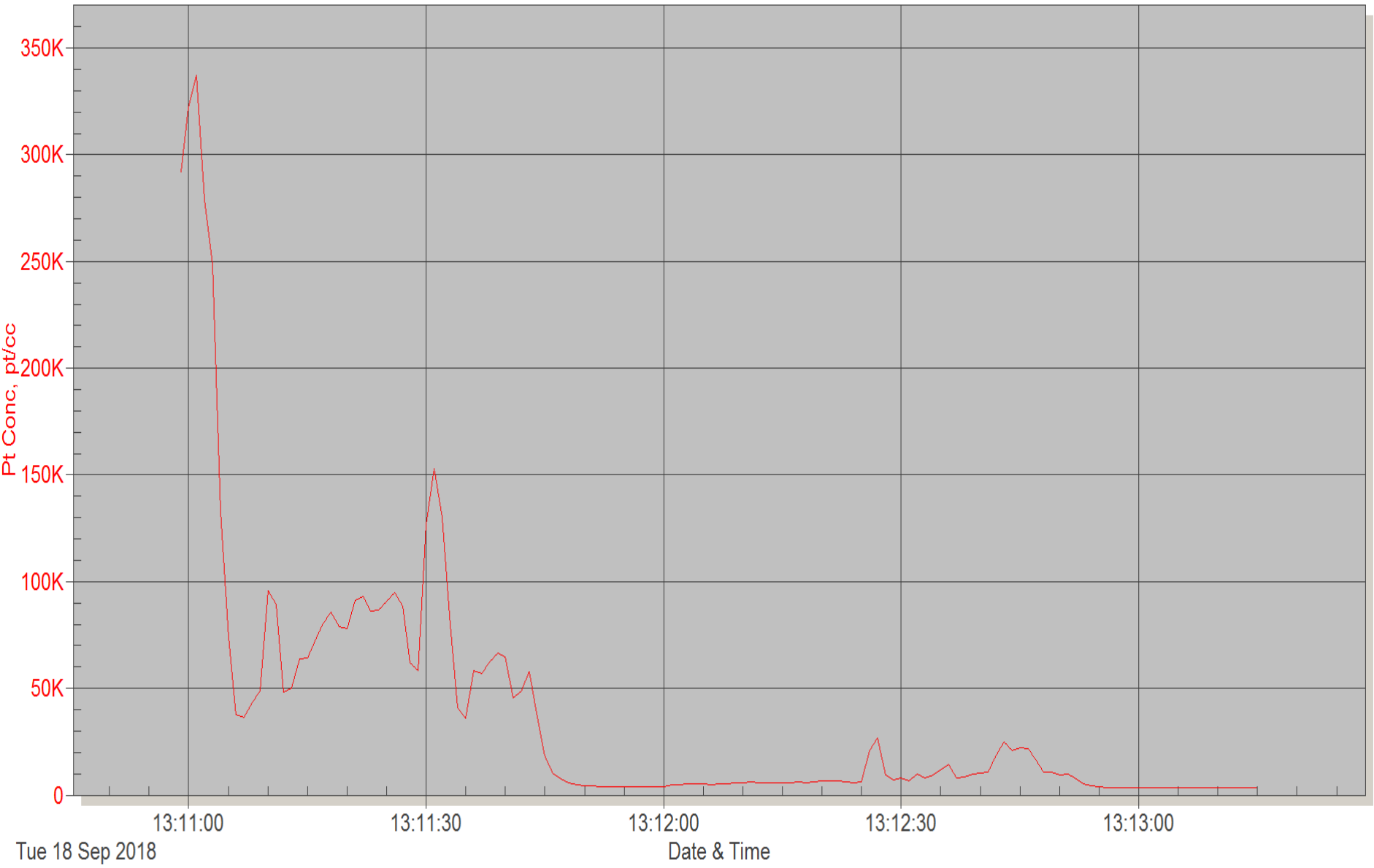
Santorini Port 18.09. 12:55

NABU Sönke Diesener



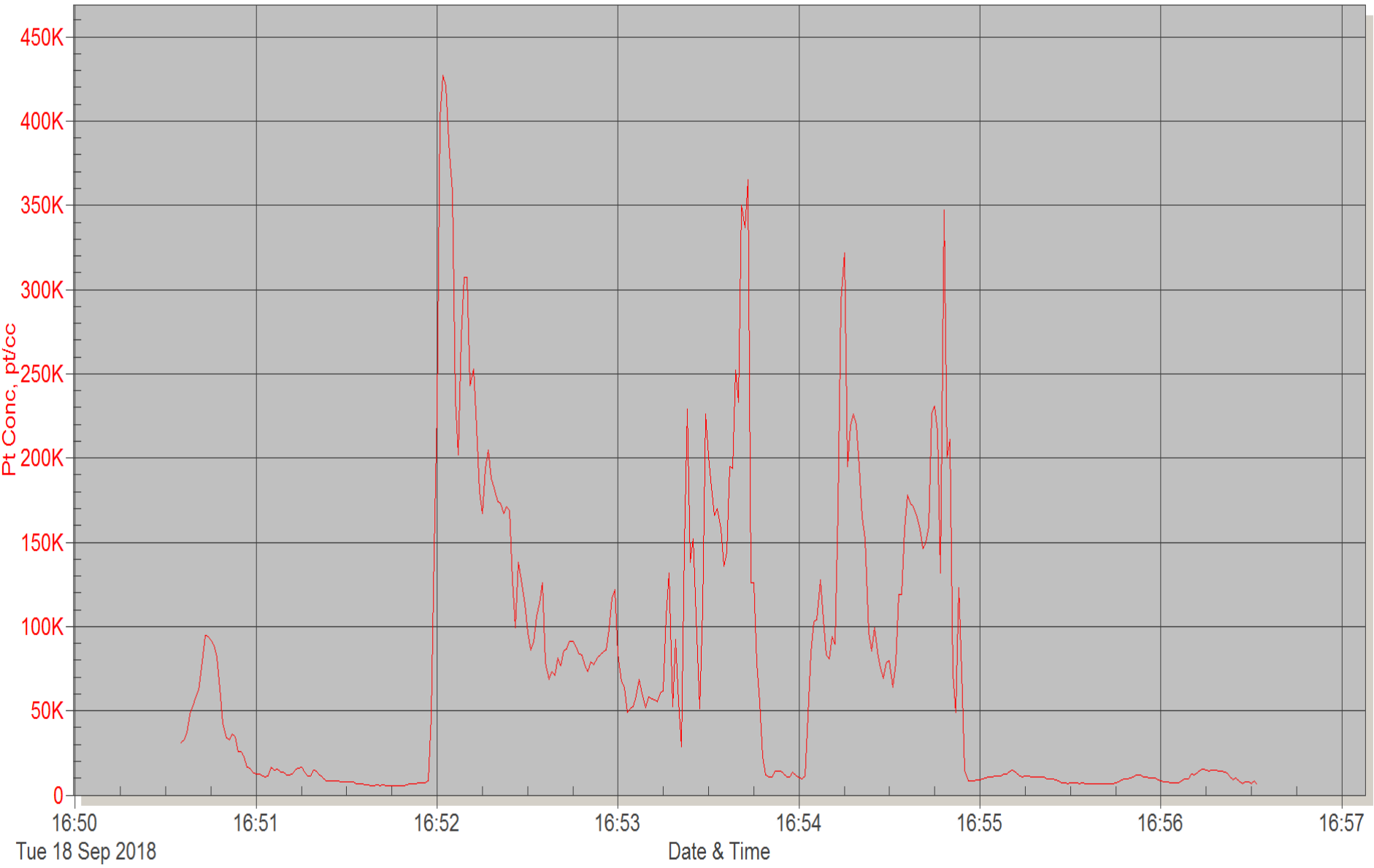
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NABU Sönke Diesener



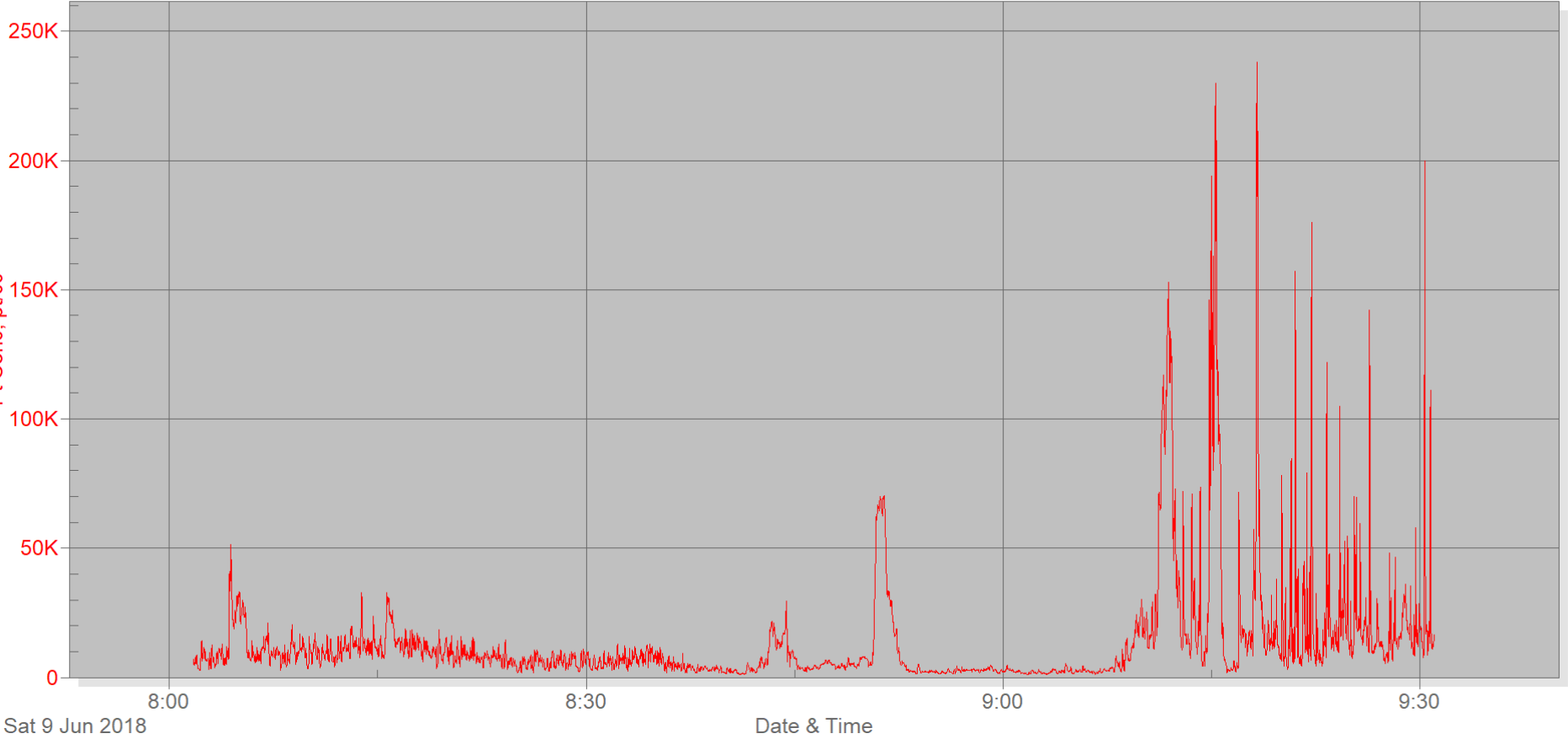
Santorini Port 18.09.2018 16:50

NABU Sönke Diesener

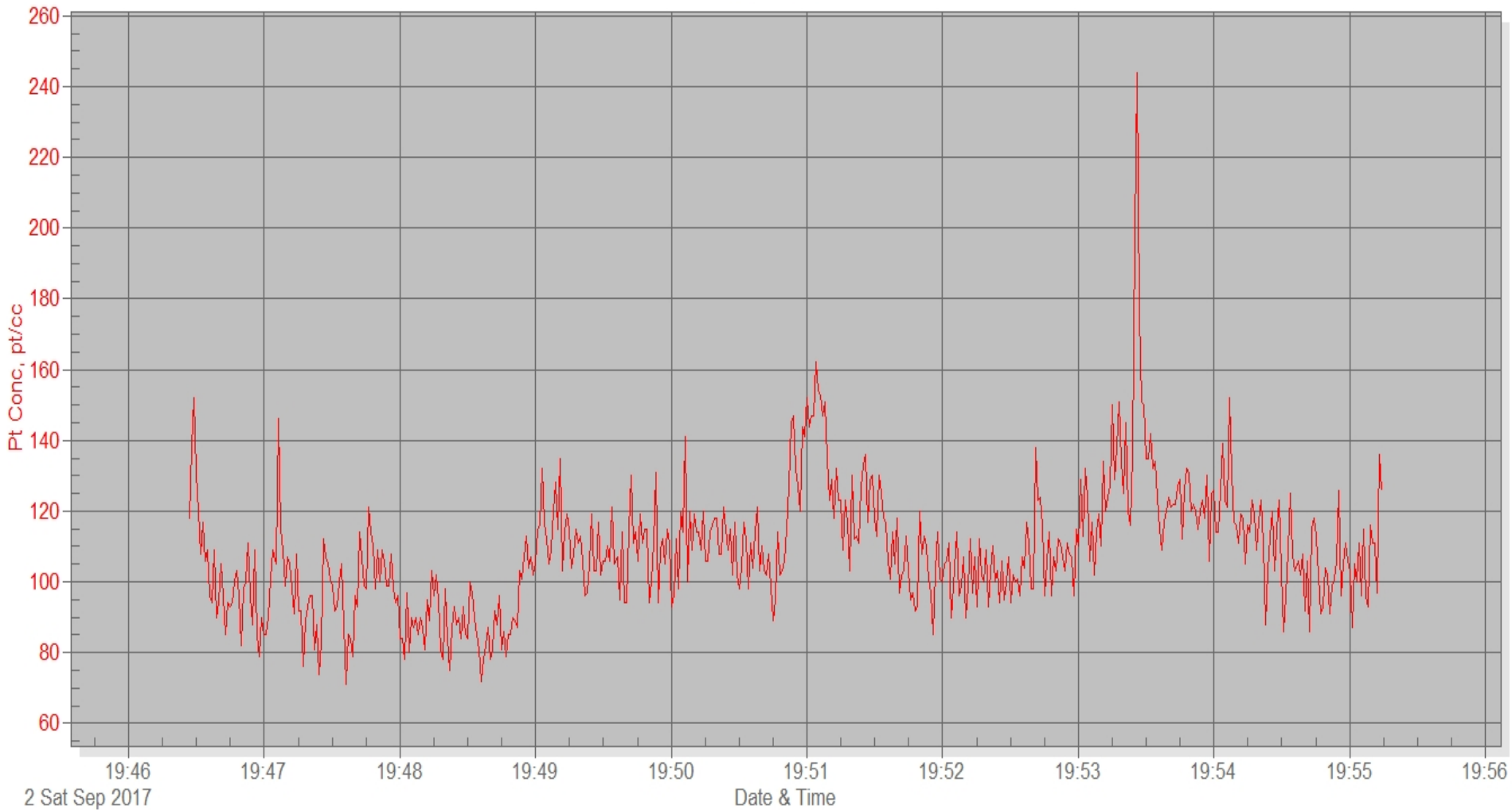


Particle Number Concentration on a Deck of a Ferry

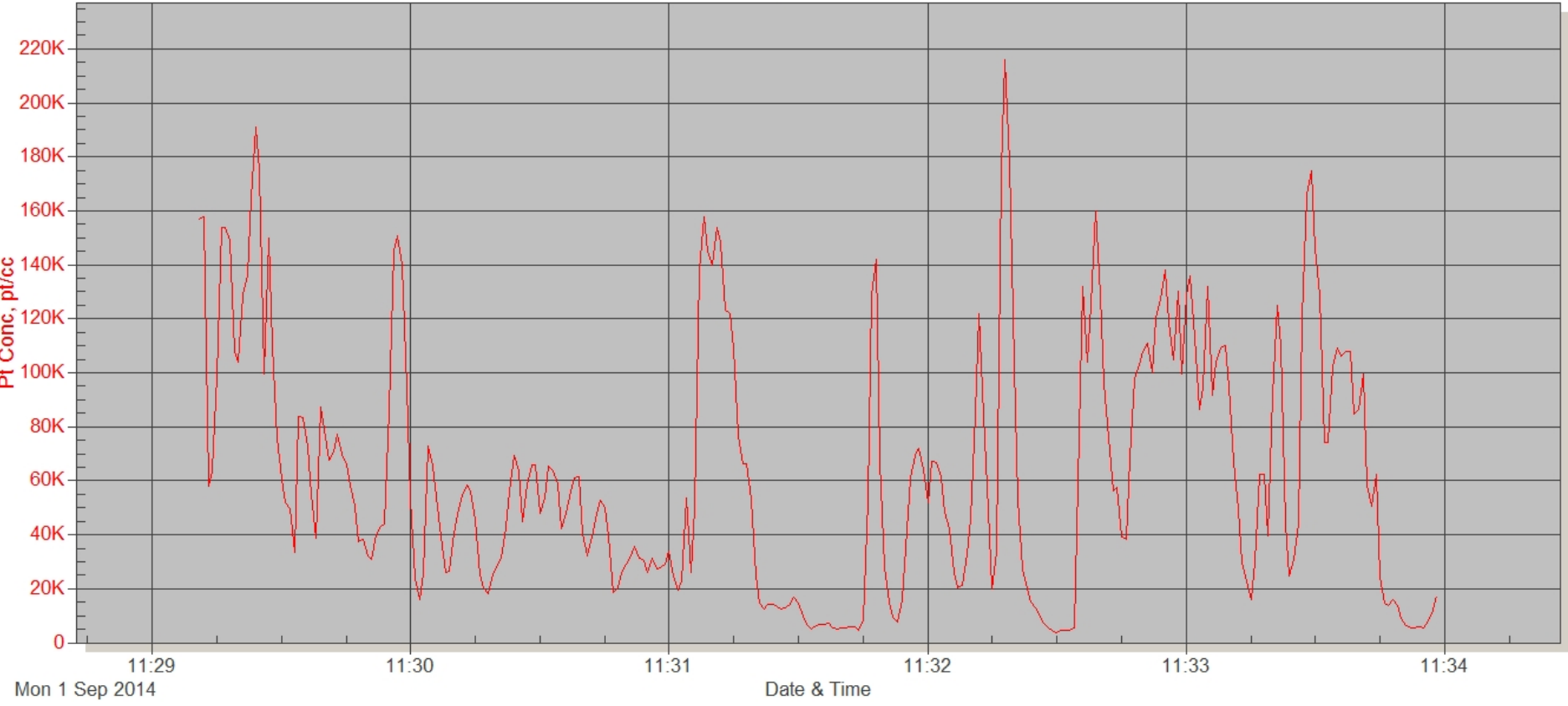
on the ferry
Livorno - Bastia

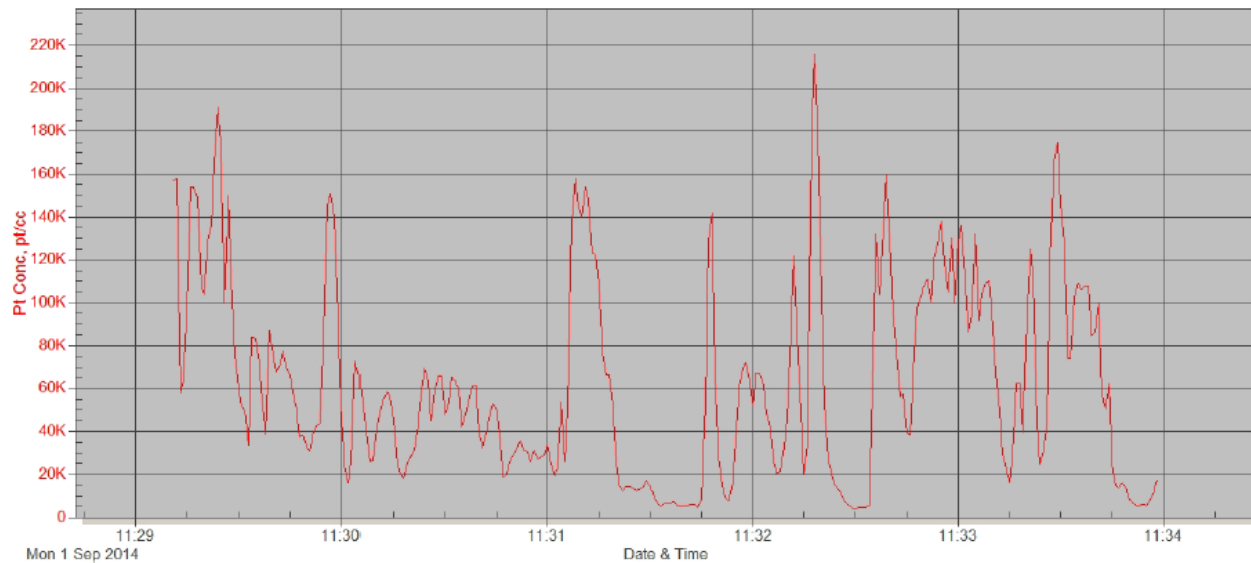


Clean Air Spitsbergen

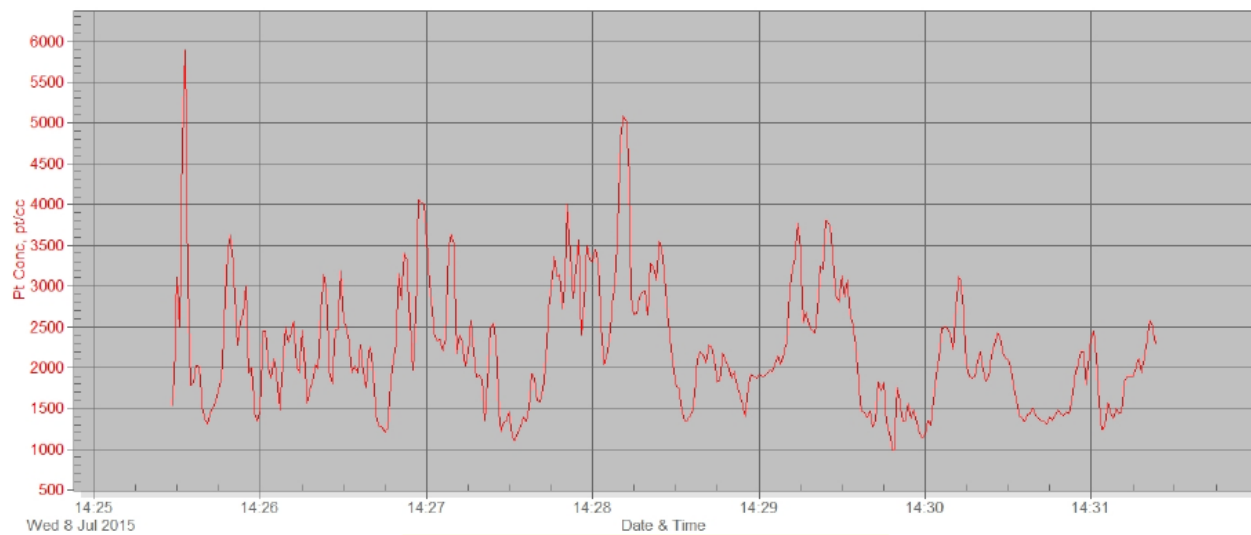


BMBF Heincke
Bergen Port





Graph 1: UFP concentration 09/01/2015 Heincke, Bergen



Graph 2: UFP concentration 08/07/2015 Heincke, Bremerhaven

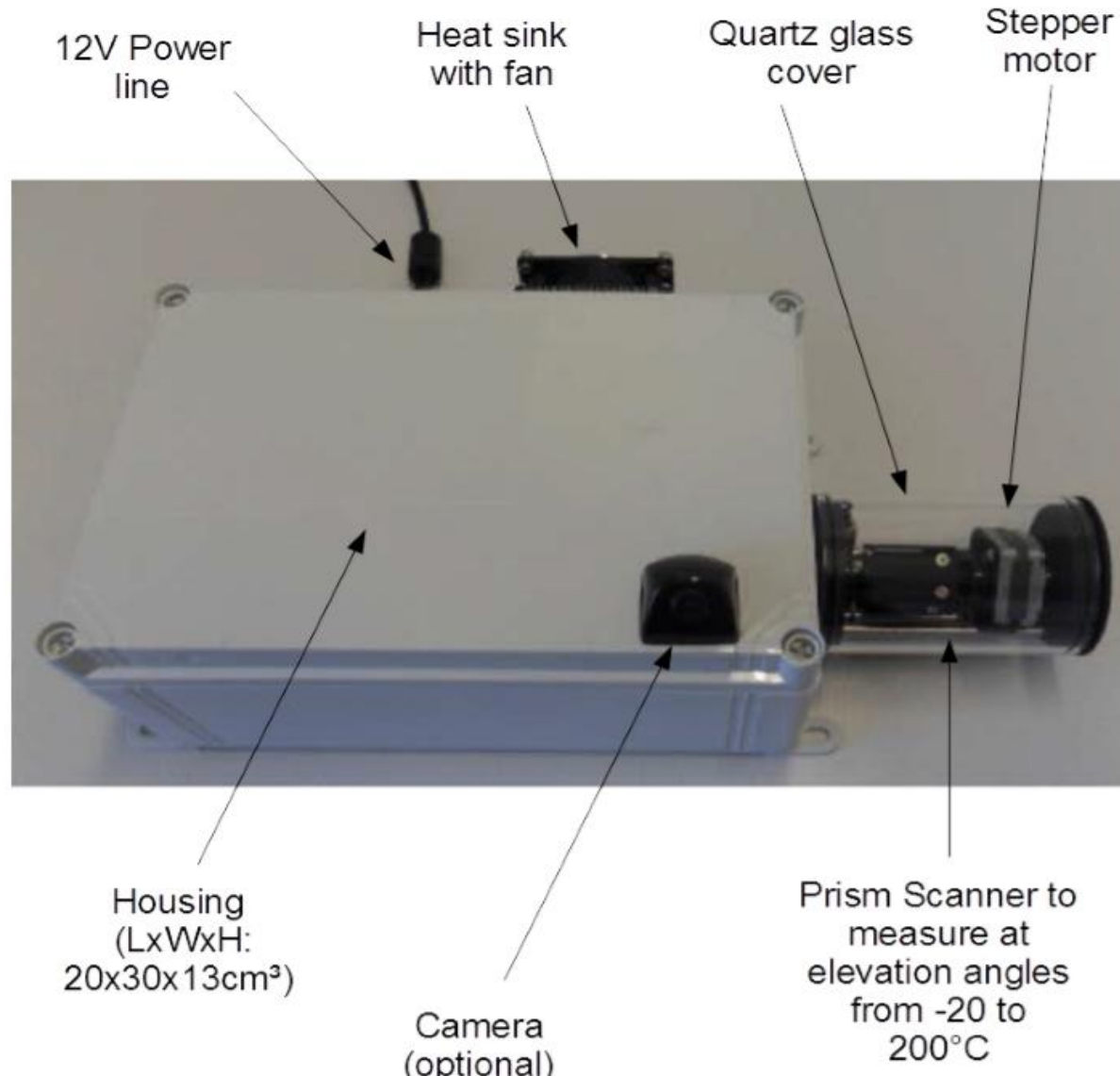


Particulate counter shows very low UFP concentration directly next to the smoke stack.

Foto:NABU/Diesener

As any other Regulation also an ECA in the Mediterranean Sea must be controlled

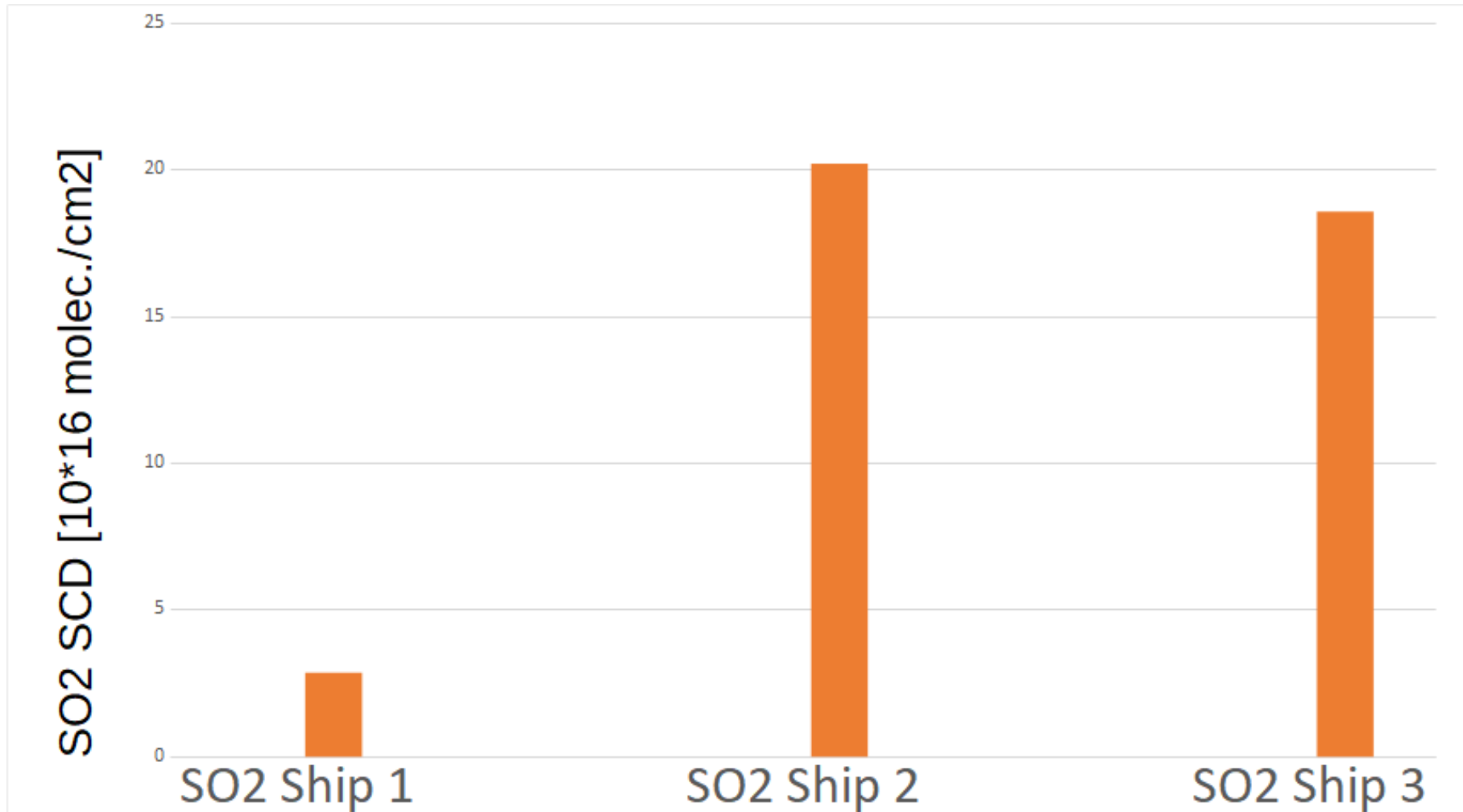
Remote Measurement of SO₂ and NO₂ by a MAXDOAS Instrument



Cruise Ship Terminal Funchal, Madeira



SO₂ Concentrations in the Plume of Cruise Ships in Funchal



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Merry Christmas and a Happy New Year 2020



White Christmas on the Sea. ECA everywhere