Sensor Web Standards for Interoperability between In-situ Earth Observation Networks

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Matthes Rieke, Raquel Casas, Oscar Garcia, **Simon Jirka**,
Lionel Menard, Thierry Ranchin, Christoph Stasch, and Lucien Wald

Motivation

- Existing earth observation networks deliver a multitude of in-situ data capturing the state of the earth
- Data sets delivered by these networks are of high value for scientists and other stakeholders
- Different domains and backgrounds
- Access and integration of the data sets made available by earth observation networks often complex → different data delivery methods and formats

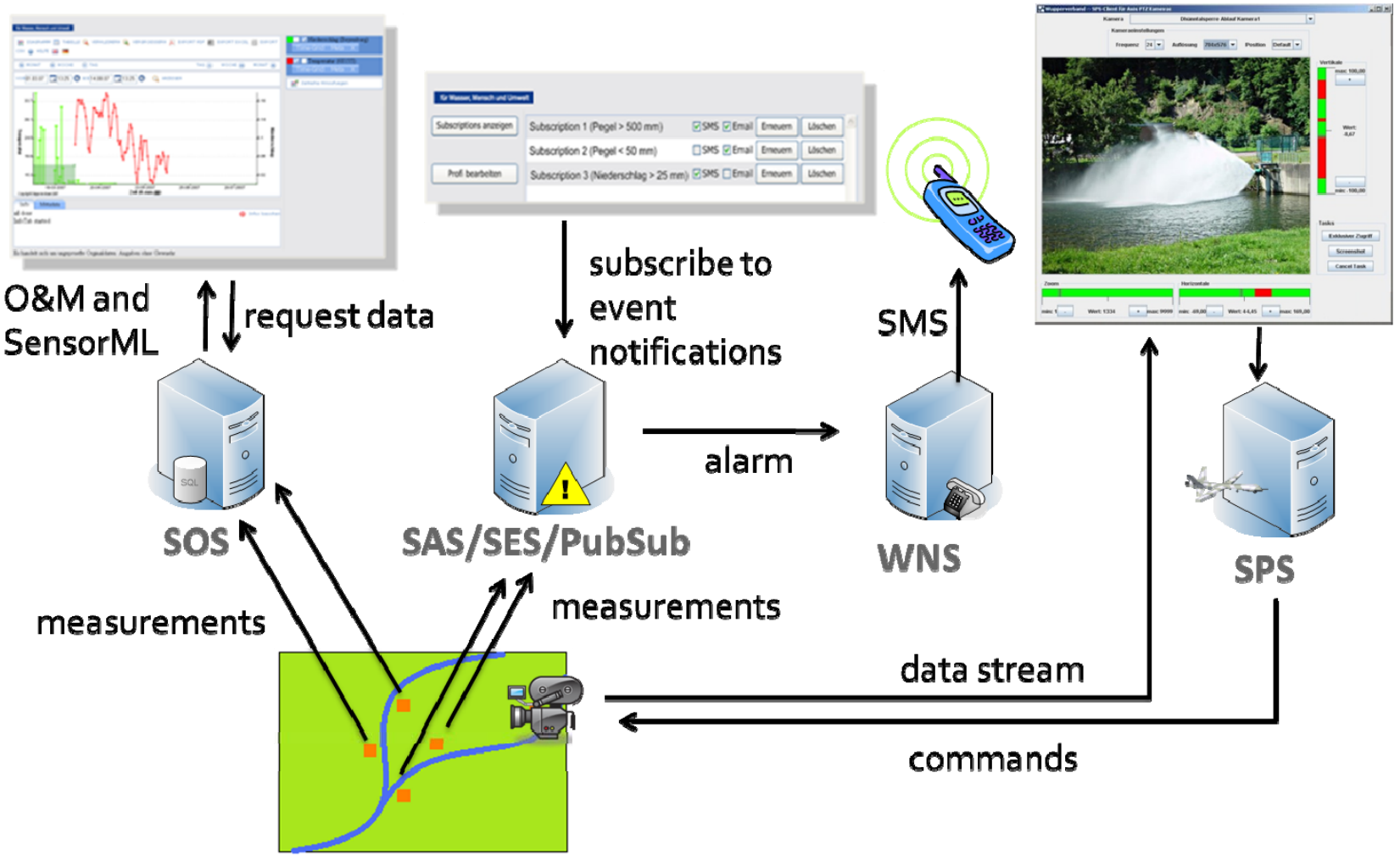
ENEON

- European Network of Earth Observation Networks
- Promoted by the European Horizon 2020 project ConnectinGEO (Coordinating an Observation Network of Networks EnCompassing saTellite and IN-situ to fill the Gaps in European Observations)
- Harmonization of standards is one of the core objectives of the ENEON initiative → Sensor Web Technolgoy

Sensor Web Technology

- Goal: Strengthen and broaden the use of the available data sets
- Offer efficient methods for accessing the data from different types of applications (e.g. for data analysis or data visualisation)
- Approach: Increase interoperability using the Sensor Web Enablement standards of the Open Geospatial Consortium
- Domain independent specifications → need for profiles

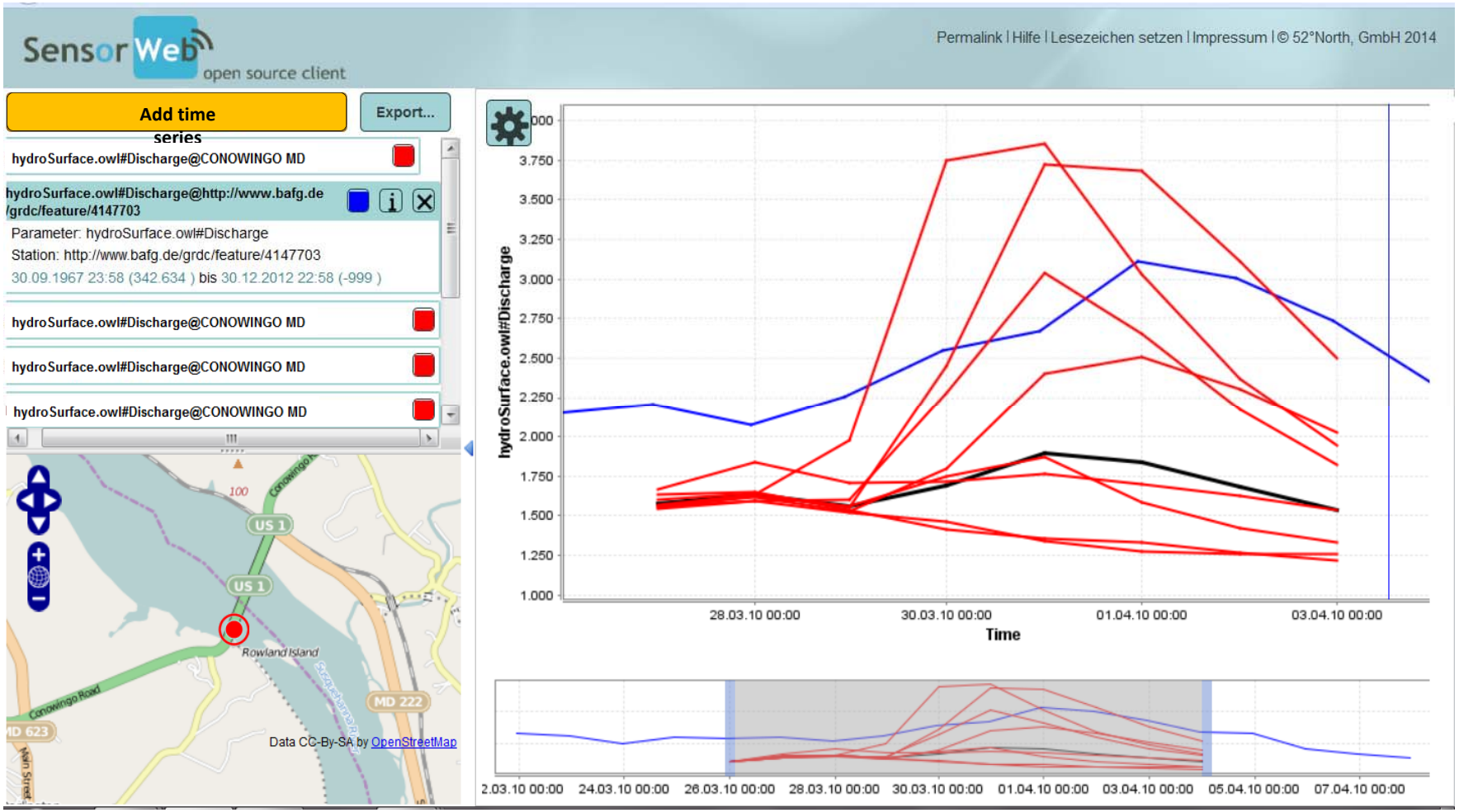
Introduction – OGC SWE



Hydrology

- WaterML 2.0 and Sensor Observation Service 2.0 Hydrology Profile
- Focus on time series data
- Additional functionality for hydrological applications (e.g. querying which time series are available)
- Implementations by KISTERS and 52°North
- Example use case implemented by the GEOWOW project:
  - Discharge data managed by the Global Runoff Data Centre (GRDC)
  - Validation of prediction data provided by the European Centre for Medium Range Weather Forecast (ECMWF)

Hydrology


SensorWeb
open source client
Permalink | Hilfe | Lesezeichen setzen | Impressum | © 52°North, GmbH 2014
Add time series
Export...
hydroSurface.owl#Discharge@CONOWINGO MD
hydroSurface.owl#Discharge@http://www.bafg.de/grdc/feature/4147703
Parameter: hydroSurface.owl#Discharge
Station: http://www.bafg.de/grdc/feature/4147703
30.09.1967 23:58 (342.634) bis 30.12.2012 22:58 (-999)
hydroSurface.owl#Discharge@CONOWINGO MD
hydroSurface.owl#Discharge@CONOWINGO MD
hydroSurface.owl#Discharge@CONOWINGO MD
US 1
MD 222
Rowland Island
Conowingo Road
Data CC-By-SA by OpenStreetMap
hydroSurface.owl#Discharge
3.750
3.500
3.250
3.000
2.750
2.500
2.250
2.000
1.750
1.500
1.250
1.000
28.03.10 00:00
30.03.10 00:00
01.04.10 00:00
03.04.10 00:00
Time
24.03.10 00:00
26.03.10 00:00
05.04.10 00:00
07.04.10 00:00

Air Quality

- Member states have an obligation to report air quality data to the European Environment Agency (EEA)
- Significant efforts for integrating very heterogeneous data deliveries
- Solution: Requirement to use a specific O&M profile
- Based on this profile, development of a SOS-based e-Reporting workflow
- Delivery of near-real time data as well as yearly data
- Implemented by EEA, Belgium, Lithuania, Sweden, The Netherlands, United Kingdom

Air Quality

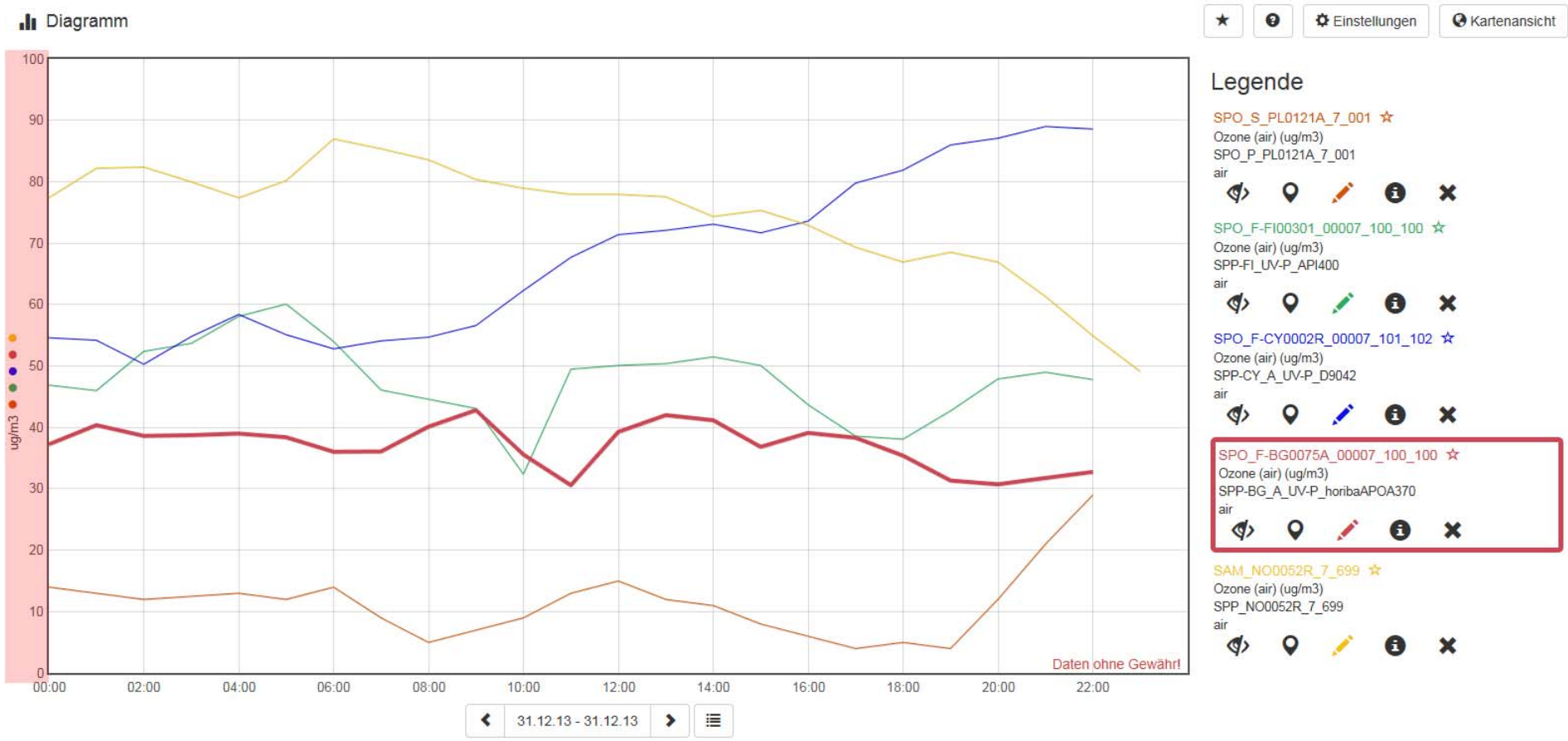
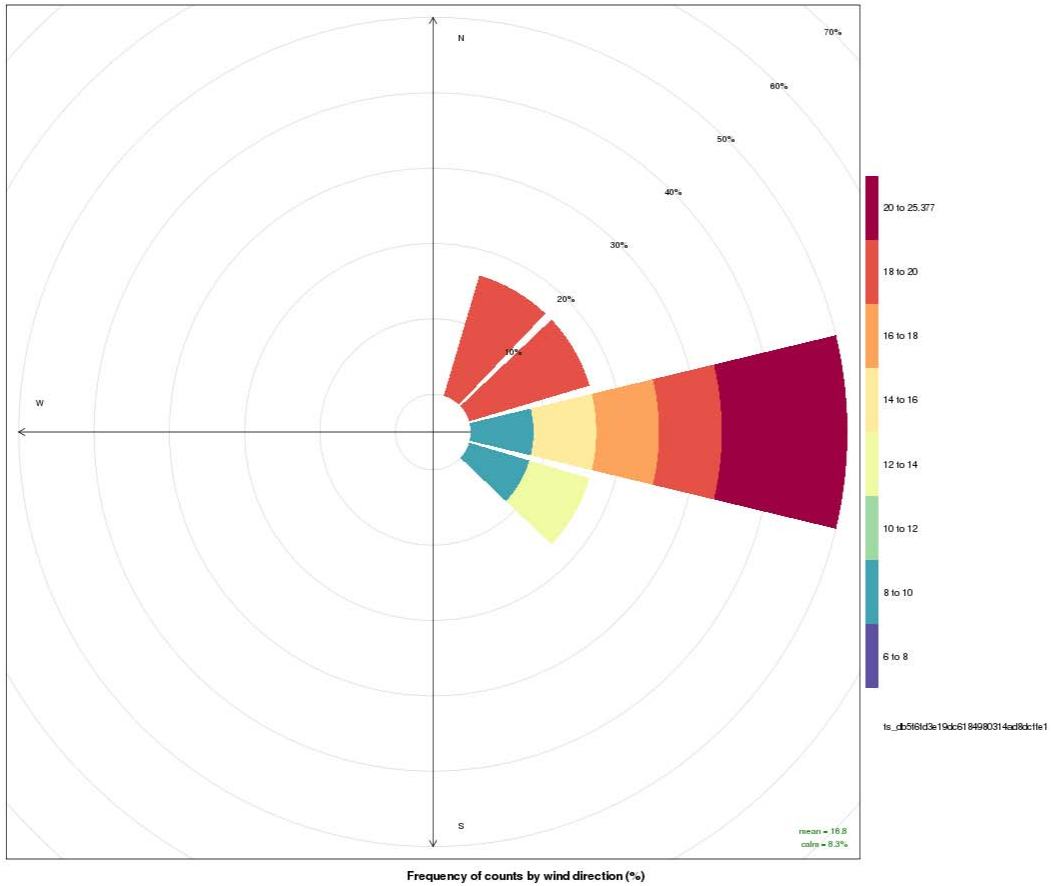


Diagramm
Einstellungen
Kartenansicht
Legende
SPO_S_PL0121A_7_001
Ozone (air) (ug/m3)
SPO_P_PL0121A_7_001
air
SPO_F-FI00301_00007_100_100
Ozone (air) (ug/m3)
SPP-FI_UV-P_API400
air
SPO_F-CY0002R_00007_101_102
Ozone (air) (ug/m3)
SPP-CY_A_UV-P_D9042
air
SPO_F-BG0075A_00007_100_100
Ozone (air) (ug/m3)
SPP-BG_A_UV-P_horibaAPOA370
air
SAM_NO0052R_7_699
Ozone (air) (ug/m3)
SPP_NO0052R_7_699
air
ug/m3
100
90
80
70
60
50
40
30
20
10
0
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
Daten ohne Gewähr!
31.12.13 - 31.12.13

Air Quality

Analysis



Settings | Map view | Chart view

Parameters

Analysis

Pollution Rose

Timeseries

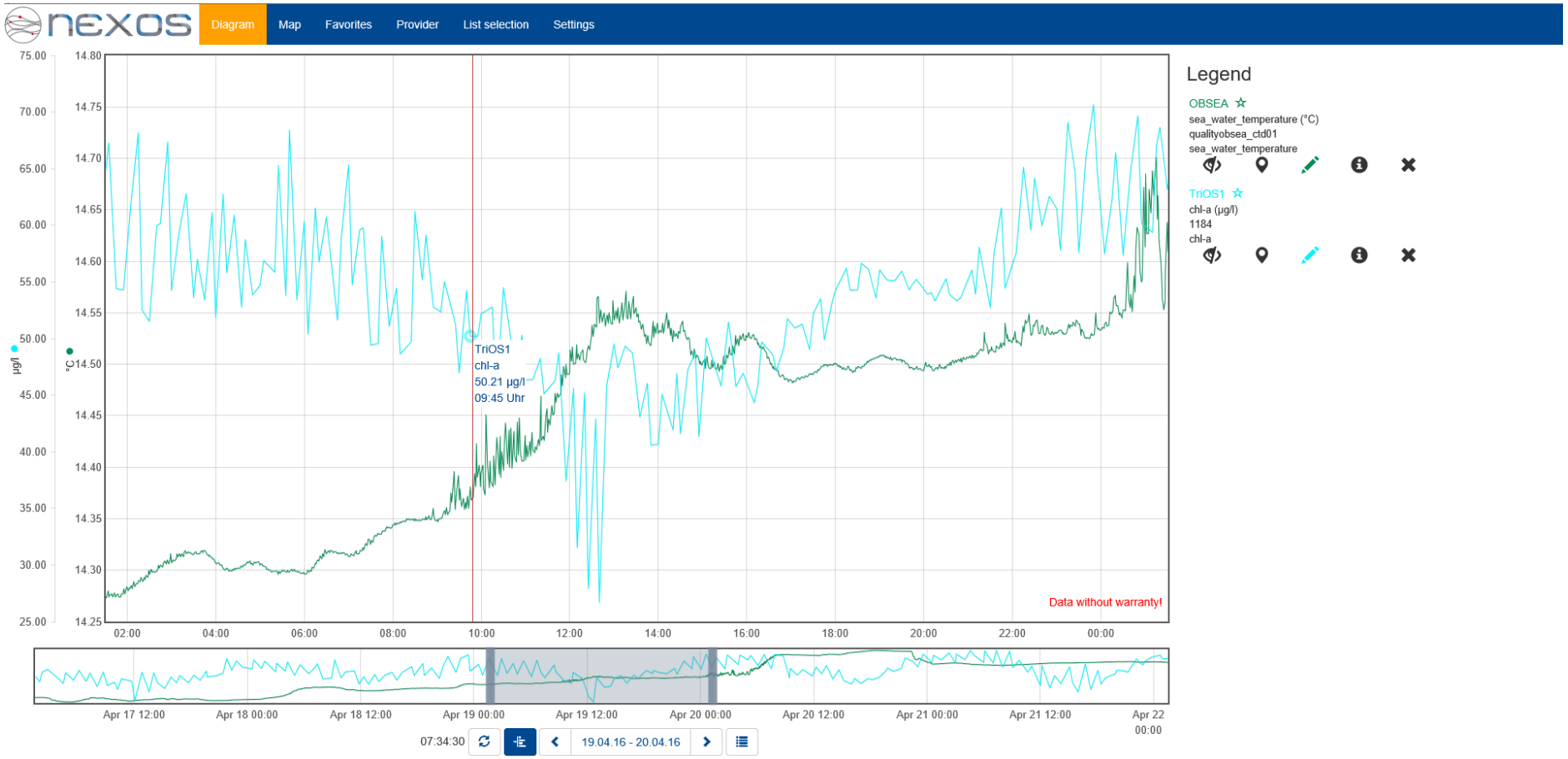
81104 - PM2.5@BETN063

44201 - O3@BETN063
42602 - NO2@BETN063
81102 - PM10@BETN063
81104 - PM2.5@BETN063
42401 - SO2@BETN063
42601 - NO@BETN063
42101 - CO@BETN063

Oceanology

- Several international projects dealing with interoperable sharing of ocean observation data
- Many types of sensors and platforms (e.g. gliders, buoys, research vessels)
- Cooperation to develop a common set of marine profiles for the OGC Sensor Web Enablement standards
  - Metadata: OGC SensorML
  - Observation data: ISO/OGC Observations and Measurements
  - Data access: OGC Sensor Observation Service
- In addition: Sensor plug & play
- Aim: Define common best practices to increase interoperability → work in progress

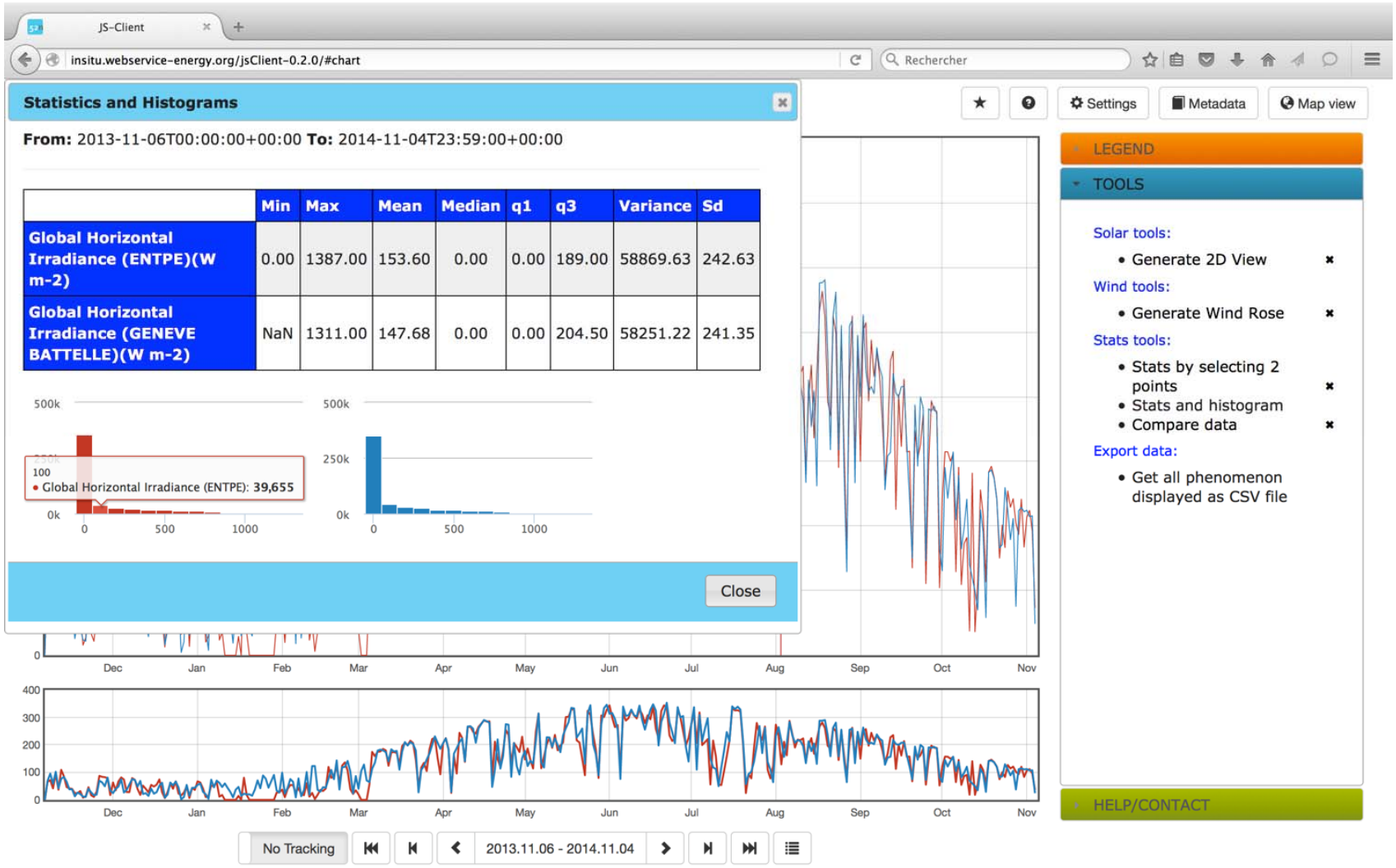
Oceanology


nexos
Diagram
Map
Favorites
Provider
List selection
Settings
µg/l
°C
TriOS1
chl-a
50.21 µg/l
09:45 Uhr
Data without warranty!
Legend
OBSEA
sea_water_temperature (°C)
qualityobsea_ctd01
sea_water_temperature
TriOS1
chl-a (µg/l)
1184
chl-a
07:34:30
19.04.16 - 20.04.16

Solar Energy

- Development coordinated by MINES ParisTech / ARMINES
- Sharing of solar irradiance observation data
- Additional variables: top of atmosphere, radiation under a cloud-free sky, solar zenith and azimuth angles
- Challenge: Handling of very large data volumes
- Provision of analysis functionality
- Development of a SensorML profile to provide the necessary metadata → will become available soon

Solar Energy



Cross-Domain Cooperation

- Standards-based approach increases interoperability within specific domains
- Aim: Use intra-domain interoperability for facilitate data sharing between different domains, e.g.
  - Meteorology and air quality
  - Hydrology and oceanology
  - …
- Idea: Use domain-standards to facilitate the link to brokering toolse
- Example: GEOSS Discovery and Access Broker → harvesting of content from hydrology SOS servers

Summary and Conclusion

- Earth observation networks benefit from the use of standards
  - Interoperability
  - Data re-use
- Cross-domain applications are supported
- Implementations in several domains: air quality, hydrology, energy, oceanology
- Software offered by different providers (open source as well as commercial licenses)

Thank You for Your Attention!

Further Information:

jirka@52north.org

http://52north.org/swe
http://www.connectingeo.net/
http://www.odip.org/
http://www.nexosproject.eu/
http://www.fixo3.eu/
http://www.eneon.net/