WP5 - DATA INTEGRATION AND MANAGEMENT

Results and further work

INTAROS Steering Committee Meeting

Geological Survey of Denmark and Greenland (GEUS)
Øster Voldgade 10, 1350 Copenhagen

May 6th-7th 2019

Pedro Gonçalves, Terradue Srl (lead)
Torill Hamre, NERSC (co-lead)

Agenda

- iAOS cloud platform
- Integration of data repositories
- Geostatistical library for iAOS V1
- Service development with INTAROS iAOS
- Conclusion

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Terradue (Pedro)

iAOS Cloud Platform

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iAOS Cloud Platform
OBJECTIVES

- **Integrate data repositories** (*multidisciplinary* and *distributed*) into a scalable and resilient integrated Arctic observing system (iAOS)
  - Connect to observations & derived parameters together with EO data services (e.g. started with IMR, Uni.Bremen, …)
- **Develop processing services** for sea ice statistics, for integrated acoustics-remote sensing data analysis, and other geostatistics
  - Integrate a set of tools for data analysis, transformation and visualization.
  - Support geostatistical methods for interpolation of spatiotemporal datasets.
- **Support processing campaigns** of new observations from WP2-4
  - Enable users to run processing "within iAOS" (using iAOS-funded Cloud resources)
  - Store generated datasets in an iAOS-enabled repository

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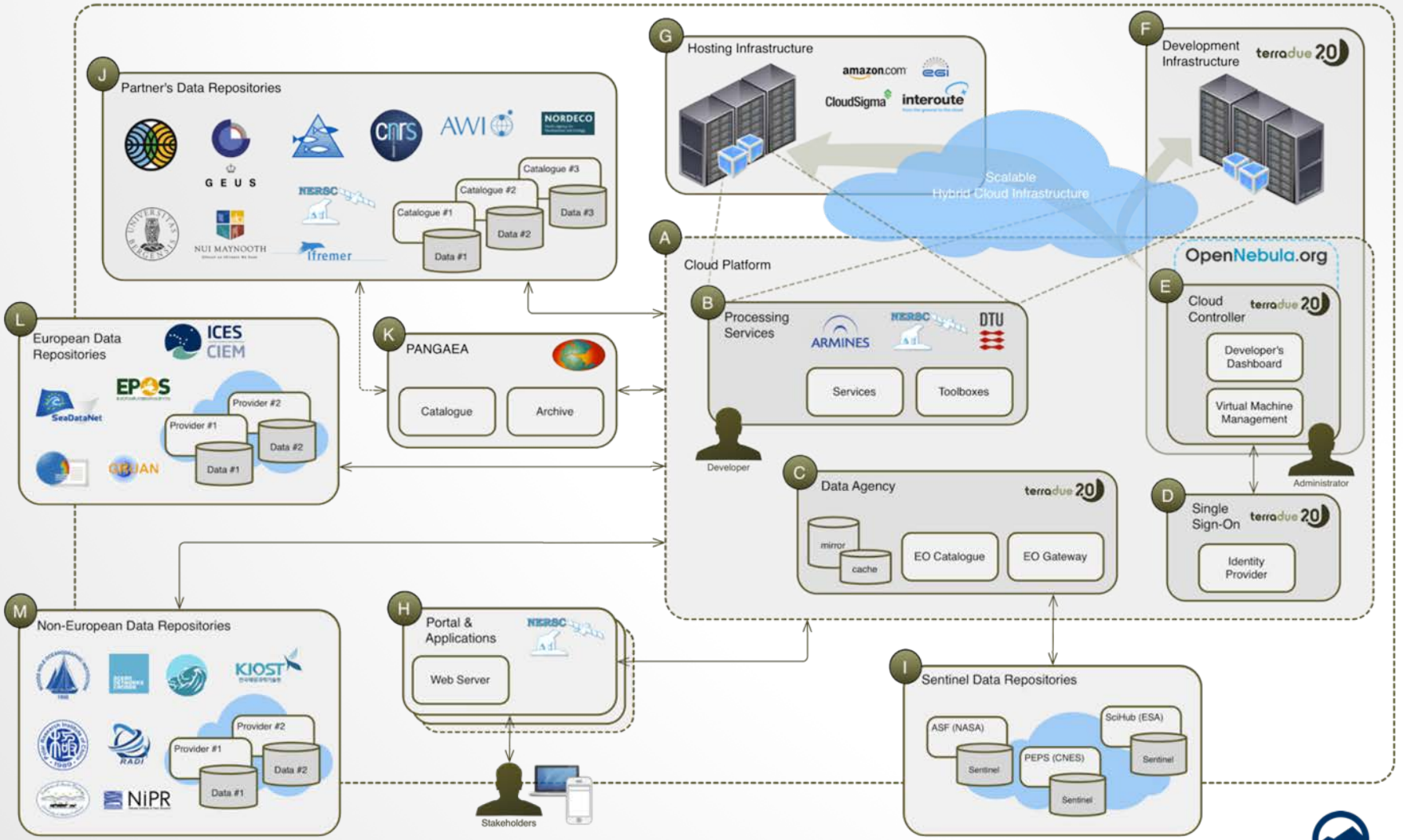
iAOS Cloud Platform

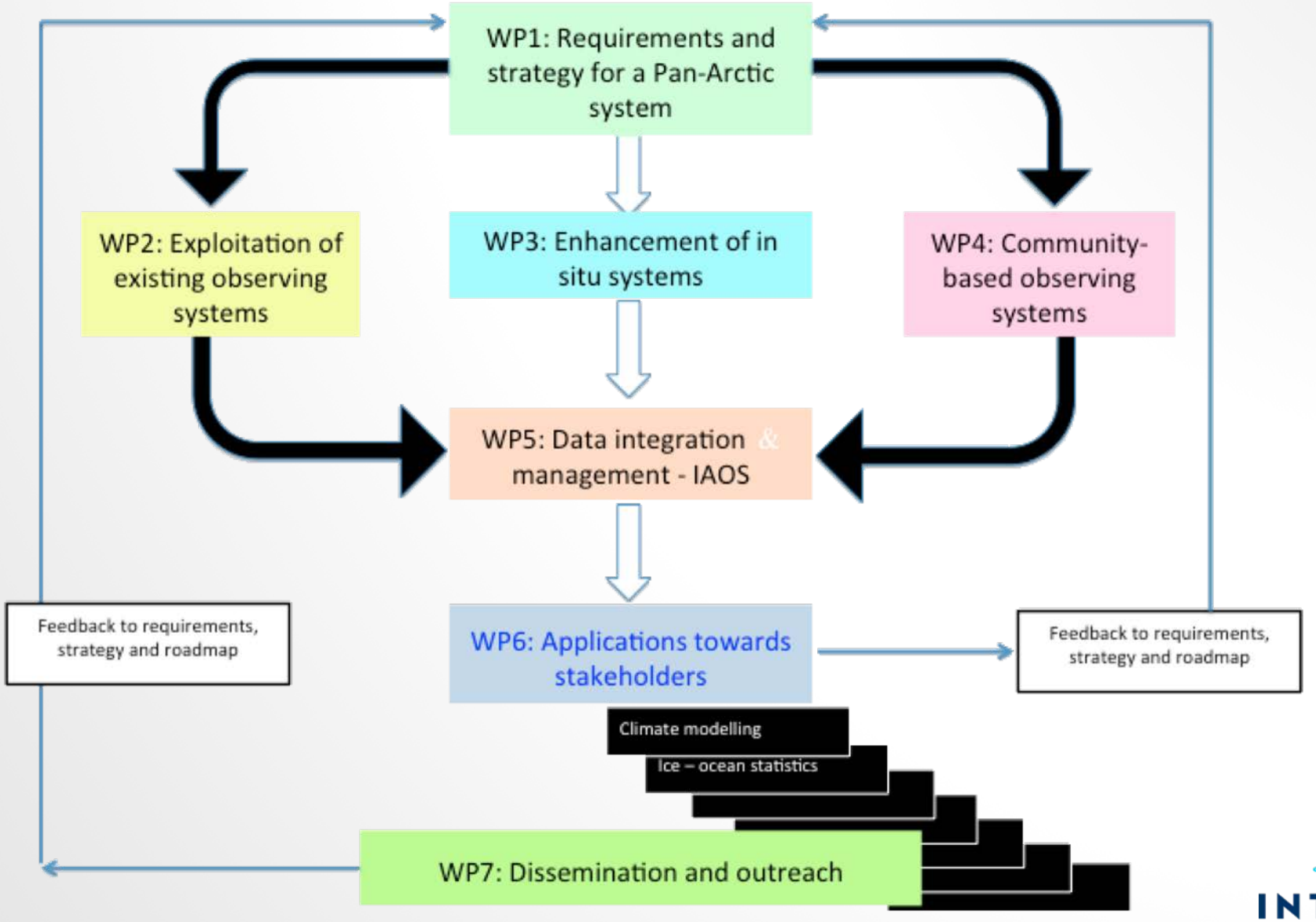
iAOS Platform Architecture

D5.1 - M12 (M36 update)
iAOS requirements and architectural design

D5.2 - M24 (M42 update)
iAOS platform and tools



WP5 DATA INTEGRATION & MANAGEMENT



iAOS Platform
Operational scenarios

Integration of Data Access facilities

- Focus on existing Observation Systems
  - Arctic, Copernicus services and other external data providers
- Supports a baseline for discovering services interoperability
  - With reference standards to facilitate the discovery and access observations archived in large distributed repositories.
- Allow complex queries dealing with different types of queries
  - Geographic, Temporal and core metadata

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iAOS Platform
Operational scenarios

Design and integration of scalable processing applications

- Focus on software developer capability to design, integrate and validate a scalable Data Processing application.
  - Create, browse and access Cloud Resources (e.g. Virtual Machines) for their application design tasks
- Provide software components supporting the development
  - Systematic source code versioning and libraries dependencies management in RPM repositories
  - Complete software life-cycle management based on git and maven tools, command line tools and APIs

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iAOS Platform
Operational scenarios

Management of Platform resources for hosted data processing

- Focus on the Platform adoption of software toolboxes
  - Pluggable resources, useful for the integration of Data Processing chains, including geostatistics analysis (cf. RGeostats toolbox)
- Support for integration of spatial data processing algorithms and the development of new services exploiting distributed computing infrastructures
  - enabled via code wrappers, i.e. without requiring the re-engineering in a new programming language.

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iAOS Platform
Operational scenarios

Exploitation of a data access services

- Focus on services allowing a Portal being able to explore the contents aggregated from Data Providers
  - By browsing and accessing the Platform's discovery services.
  - Search data collections from distributed data repositories integrated in the Platform, retrieve results and display it in its graphical interface.
- Supporting different types of queries to obtain dataset metadata using OpenSearch
  - Date of acquisition, spatial and temporal footprint, characteristics pertaining to the type of sensor, the type of platform on which sensors are mounted, the applied processing chain, and more.

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iAOS Platform
Operational scenarios

Exploitation of a data processing services

- Focus on a Portal being able to explore the Data Processing applications, including mechanisms for data discovery, service execution and monitoring.
- The Data Processing services exposed through Web Service endpoints following the OGC Web Processing Service (WPS)
  - Allow the portal to pass processing parameters, trigger a data processing requests and retrieve the information produced
  - Inputs parameters are discovered through data catalogue services

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iAOS Platform
Operational scenarios

- Integration of Data Access facilities (Data)
- Design and integration of scalable data processing applications (Cloud)
- Management of a Platform's resources for hosted data processing services (Cloud)
- Exploitation of data access services (Portal)
- Exploitation of data processing services (Portal)
- Administration of Cloud resources

Integration of Data Repositories

iAOS Platform
Data Access Context

- Data providers in INTAROS are responsible for:
  - delivery of dataset files and metadata files,
  - data products evolutions/updates.
- Data providers make these resources available to the iAOS:
  - solutions from simple file sharing to data access services (for M2M interfacing)
- WP5 supports WP2 with iAOS technical solutions, and recommendations for the harvesting of product metadata files:
  - e.g. into Pangaea,
  - into the iAOS CKAN server,
  - or into other catalogues hosted by the data providers, ...

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iAOS Platform
Data Access Approach

- **iAOS Registry service**: to make survey informations available via a registry service ("declare your resources")
  - support user search (e.g. from the INTAROS website) and data provider updates (e.g. ensure that the database supporting the registry can be updated).
  - Relies on the CKAN software solution that WP5 is handling for the use of T2.3 partners.

- **iAOS Catalogue services**: to harvest metadata files that INTAROS data providers curate
  - In the particular case of the INTAROS-funded new or improved datasets, WP5 provides an ad-hoc catalogue service (CKAN) for their discovery via the ingestion of their metadata files.

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iAOS Platform
Federation of Online Servers

Progress status on iAOS federation of Online Servers:

- IQOE server for Acoustic data
- IMR server for CTD campaigns at sea data
- iAOS server for SeaIce data (Uni.Bremen)
- FMI server for in situ & satellite crysopheric data
- GEUS server for Greenland Ice Sheet (Promice Data Portal)

Metadata Catalogue tool

- Catalogue records collected from WP2 surveys
  - Communities info + in-situ data + EO data
  - Input from three spheres (deliverables) into one metadata catalogue from WP2
- WP2/WP5 collaboration for their analysis
  - Must support machine-to-machine interface
  - Need additional (lots of!) information on how to access the data (AWI engaged with data managers), incl. updates
- Selected CKAN as iAOS Metadata Catalogue tool
  - Goal to feed the iAOS portal / website

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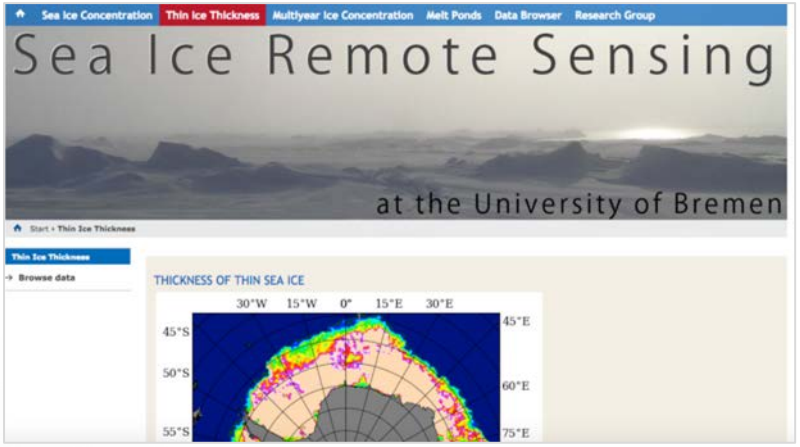
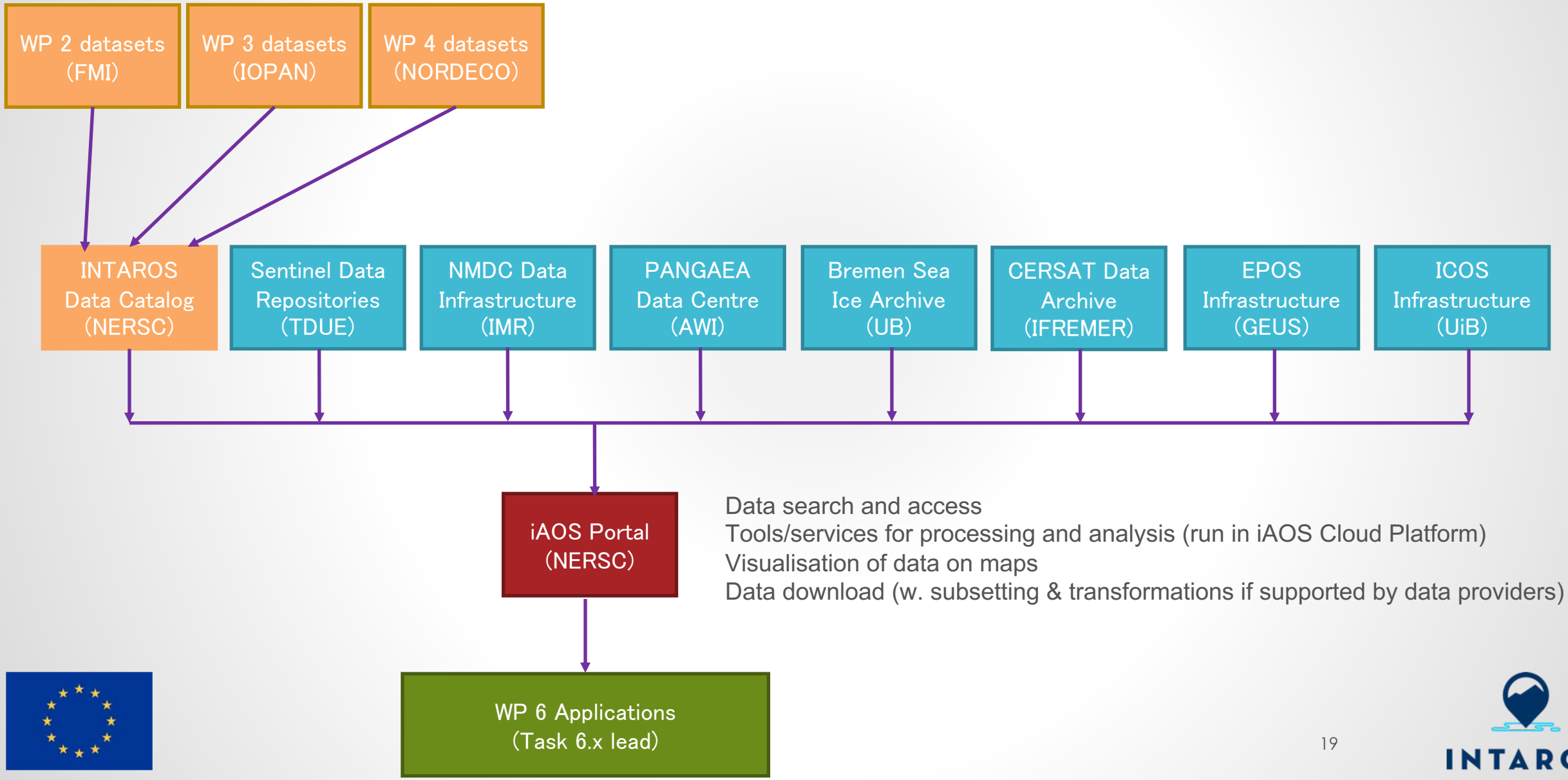
Sea Ice Remote Sensing data

- Connect to iAOS the Sea Ice Remote Sensing data from University of Bremen
  - Analysed the current online repository (accessible via FTP and HTTP)
  - Analysed the products and metadata, to create collections foreseen as most attractive to share with a greater community
    - sea ice thickness
    - ice concentration
  - Selected OpenDAP server solution
    - hosted on iAOS for initial experiment



Integration with iAOS Portal



Data search and access
Tools/services for processing and analysis (run in iAOS Cloud Platform)
Visualisation of data on maps
Data download (w. subsetting & transformations if supported by data providers)

Partner	PM	Data repository	Responsible
NERSC	2	CMEMS (sea ice products from satellite & model) NORMAP (sea ice products from satellite)	Frode Monsen
IMR	9	NMDC Data Infrastructure	Arnfinn Morvik
AWI	6	PANGAEA Data Centre	Ingo Schewe
GEUS	2	EPOS	Andreas Ahlstrøm
UIB	(WP2)	ICOS	Truls Johannessen
FMI	1	Atmospheric data (ACTRIS)	Mwaba Hiltunen
NORDECO	(WP4)	Community-based monitoring data	Finn Danielsen
NUIM	1	Atmospheric data from GRUAN network	Elena Zakharova
IFREMER	(WP2)	CERSAT (selected products)	Fanny Ardhuin
TDUE	5	Sentinel data	Pedro Gonçalves
CNRS-LOCEAN	(WP3)	Coriolis GDAC (glider data)	Marie-Noelle Houssais
UB	(WP2	Sea ice products from satellites	Georg Heygster

TAROS

iAOS Portal Main Functionalities

iAOS Portal	Data Catalog
Federated search across multiple repositories/catalogs	Registration of INTAROS datasets
Combined visualisation of multi-source data (e.g. WMS)	Harvesting of metadata from external repositories
Extraction of time-series and subsets of data (OPeNDAP)	Searching registered and harvested metadata
Access to Processing Services in the iAOS Cloud Platform (WPS)	Simple visualisation of datasets
Visualisation of output from Processing Services	Data download through data access links

Activities focusing on PANGAEA

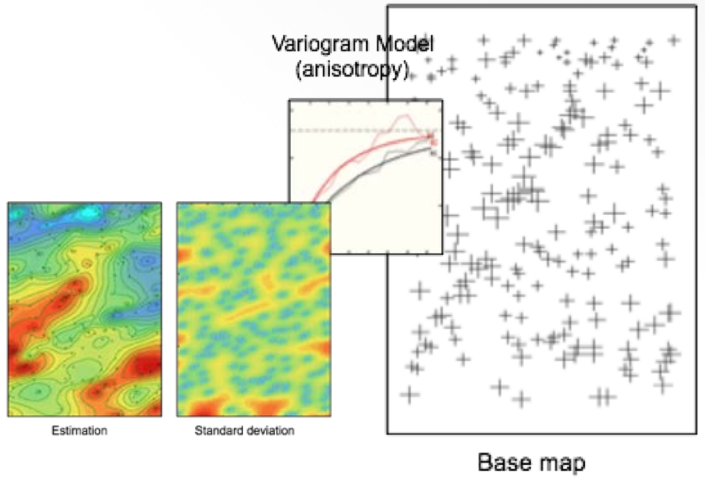
- Review of partners already in a cooperation with PANGAEA
  - Requires data-collections to be stored in an online public repository
  - Whether their institution already has a PANGAEA partnership.
- 24 partner institutions contacted, only 9 reported back
- No major needs to make data freely available.
  - Erik Buch points out that for marine data the CMEMS In Situ TAC (INSTAC) and EMODnet are also available and willing to support

ARMINES (Fabien)

Geostatistical library for iAOS

Integration of the RGeostats Toolbox Capabilities

- Unleashing the Potential of GeoStatistics for Data Analysis
- Focus on training INTAROS user community on the iAOS 'RGeostats' tools and services
- Installation and deployment of the RGeostats package on the Cloud platform, now available to the INTAROS community.



- Development of a first application example with data relevant to the Arctic research community.
  - Dissemination material prepared to outreach the iAOS users community
  - Held workshop in Paris to prepare the January 2019 trainings (GA in Bremen)

Geostatistical library for iAOS

Achievements:

- IMR data geostatistical analysis report
  M18
- OPeNDAP client for downloading NetCDF IMR data
  M22
- New RIntaros package relying on Rgeostats
  M24
- Jupyter Notebooks relying on RIntaros
  M24

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Geostatistical library for iAOS

INTAROS community diffusion:

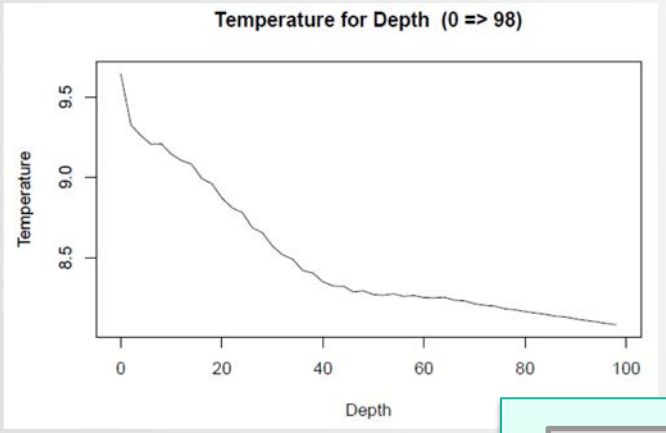
- RGeostats Workshop: Breme
  M24
- Terradue Seminar: Fontainebleau

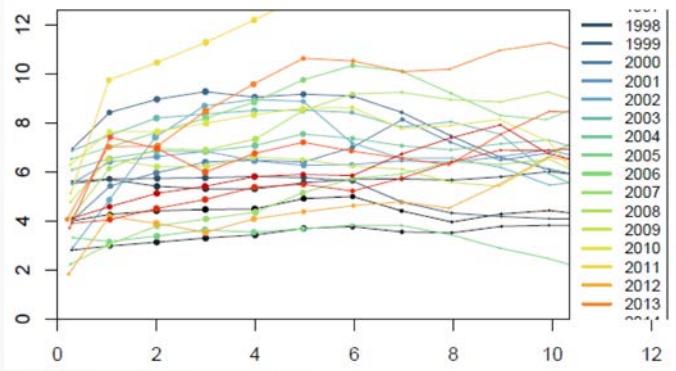
Geostatistical library for iAOS

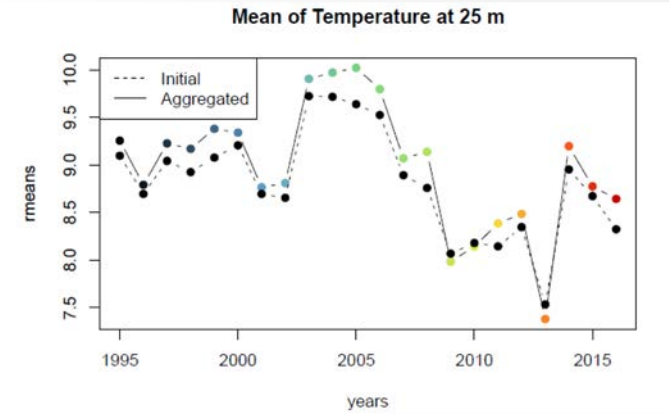
Future work:

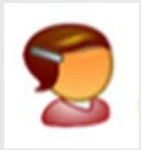
- Ellip workflow dcs-imr-estim parallelization (v1.3)
- New case study for sea ice classification statistics (Sentinel)
- New ***RIntaros*** version (v2.0)
- 6 months internship at NERSC: geostatistics applied to acoustic spatio-temporal data (WP6)

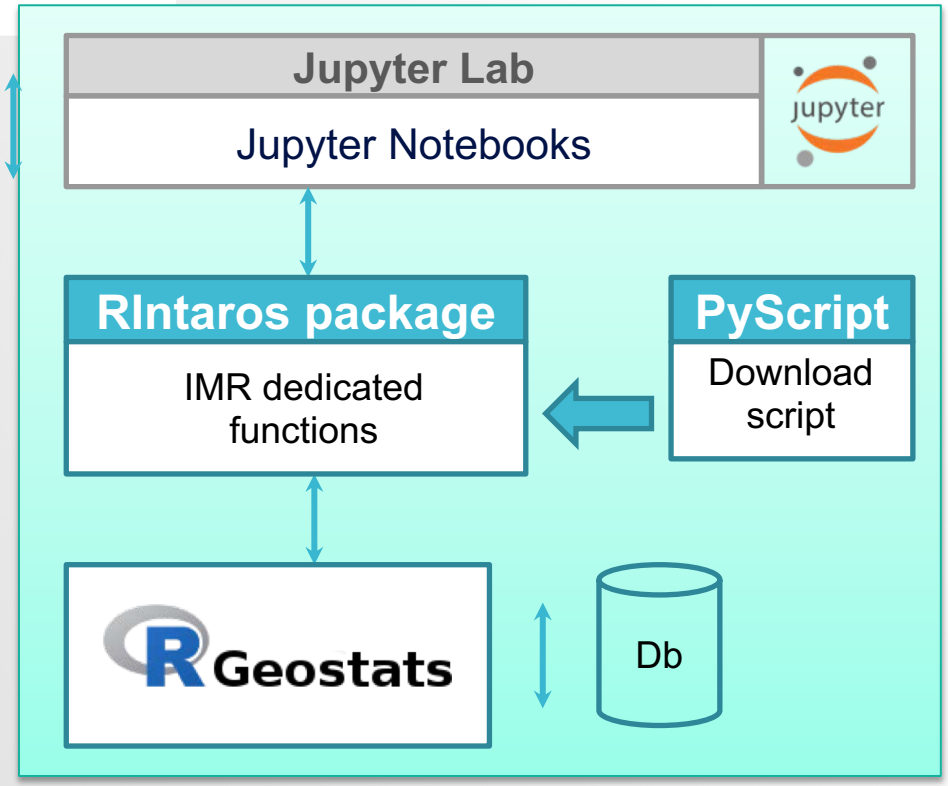
Jupyter Notebooks using RIntaros

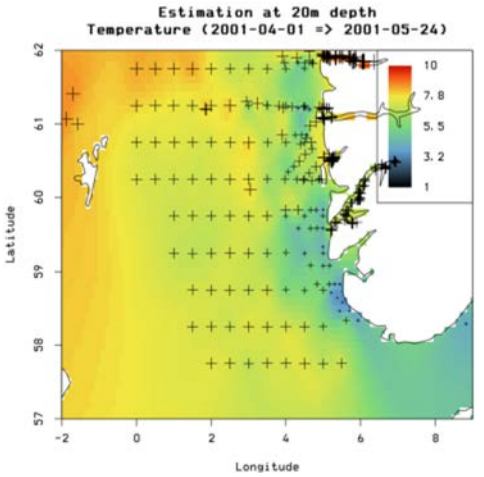




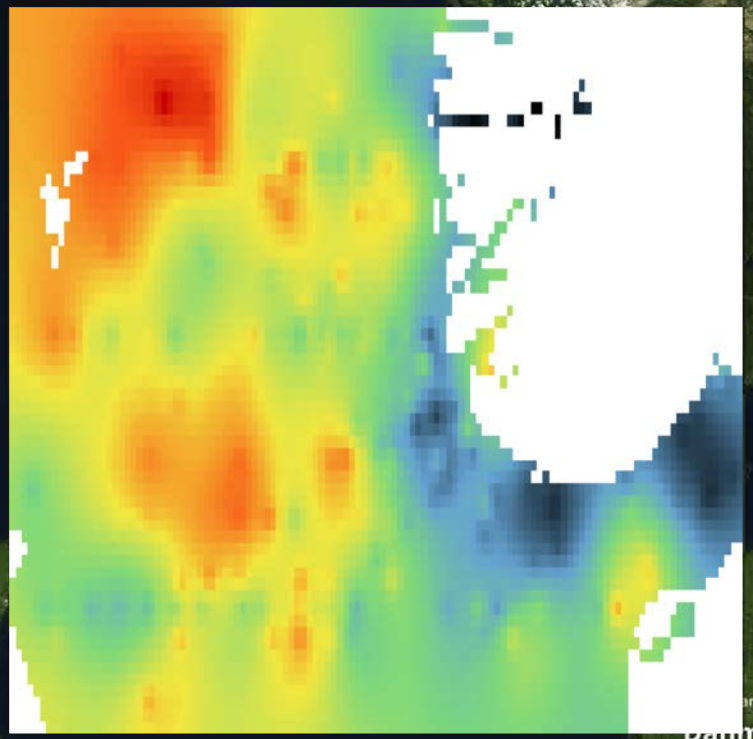


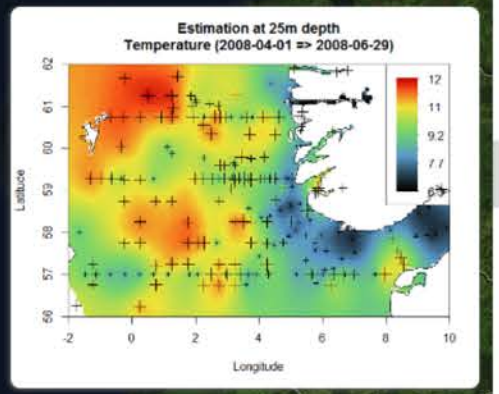






Ellip Workflow
dcs-imr-estim





PRODUCTS | EO DATA | CROSSI

Free text search

Sundsvall · Tampere · Falun · Turku · Helsin · Oslo · Stockholm · Tallinn · Linköping · Göteborg · Kalmar · Wick · Inverness · Scotland · Glasgow · Newcastle upon Tyne · Belfast · Isle of Man · United Kingdom · København · Danmark · Gdańsk · Vilni

2000-01-01 — 2040-01-01

Lon: -4.878 Lat: 58.608

Current search result

Discovery feed for local data — Total results 2

20_m_depth_Kriging_Temperature_estim.tif

20_m_depth_Kriging_Temperature_stdev.tif

Features Basket | Data Packages

Total results 0 | sel.all | inv.sel. | Remove all | Save

No results found.

Id	2e773f7d-6d91-4d04-90c4-18a3778afc20
Processing service	Download and Estimation workflow
Started at	Jan 9th 2019 10:17
Finished at	Jan 9th 2019 10:24
Created by	crossi
Status/Result Location	
Status	Success
Visibility	restricted
Share	

Parameters

Name	Value
source	http://opendap1-test.nodc.no/thredds/catalogs/physics/physics_point_yearly.xml
date_lim	2001/04/01,2001/06/30
long_lim	-2,10
lat_lim	56,62
depth_lim	18,22
var	Temperature
var_lim	0,11
mesh	0.1
vario_lag	0.1
vario_nlag	20
struct	1,3,12

Resubmit Job

Success
The job was completed successfully.

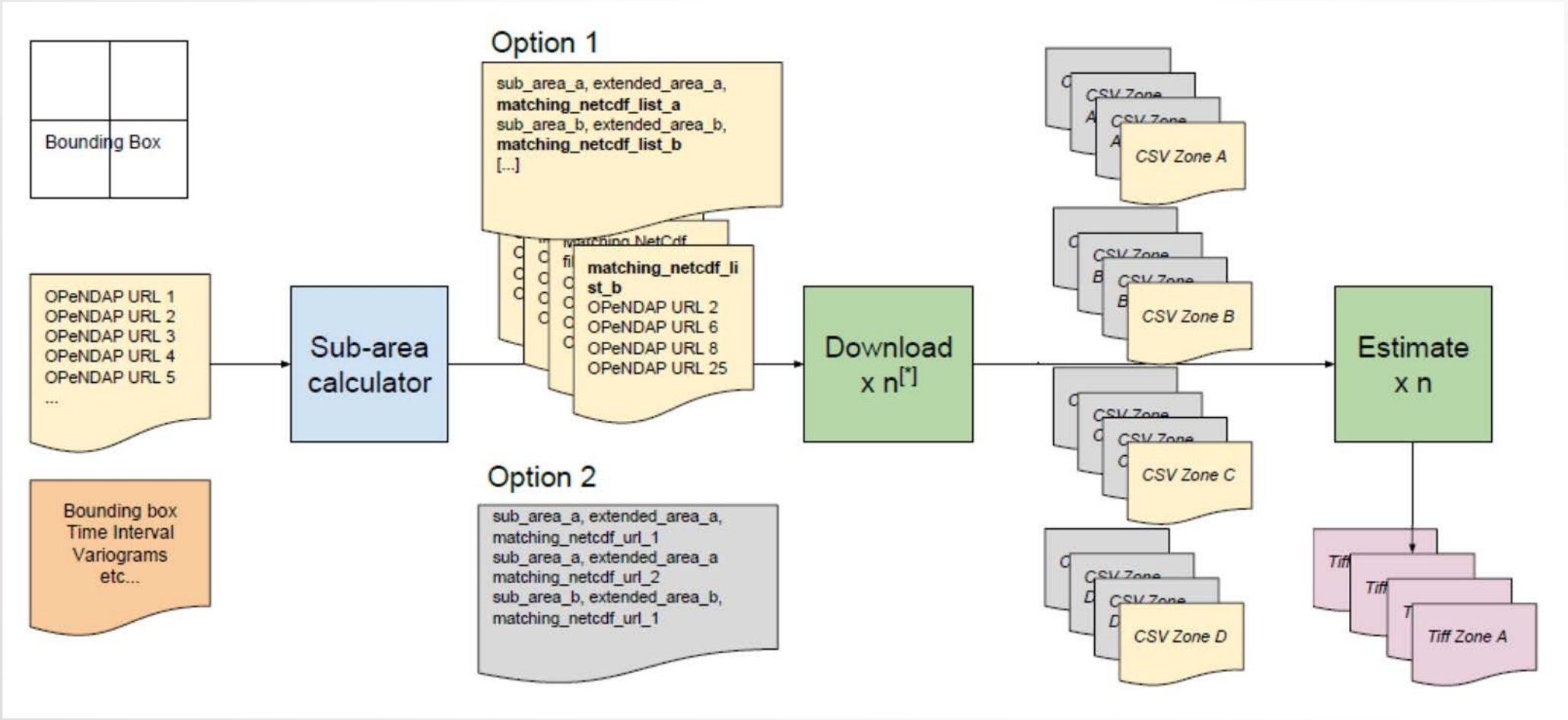
Results

Found layers in the result. Show results

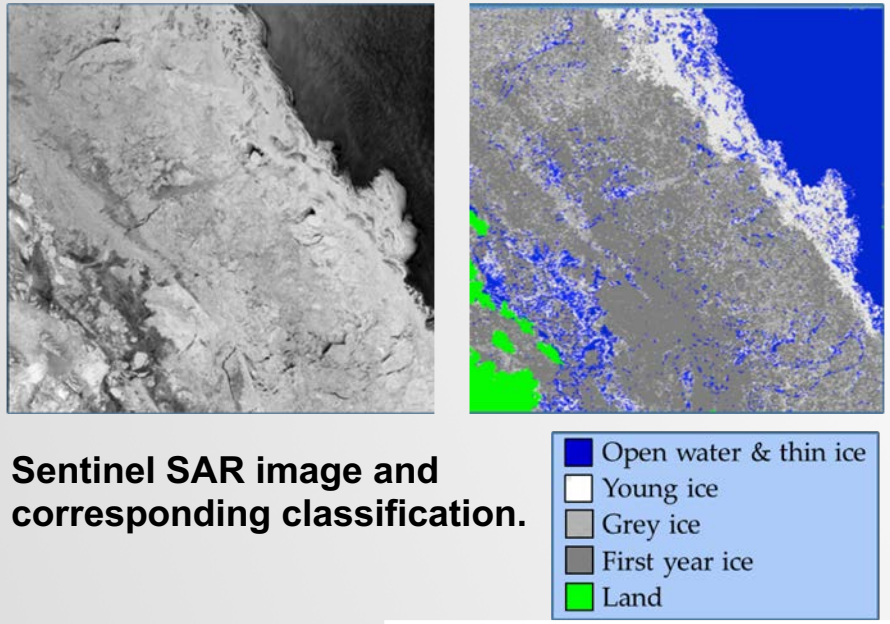
XML Result

Support

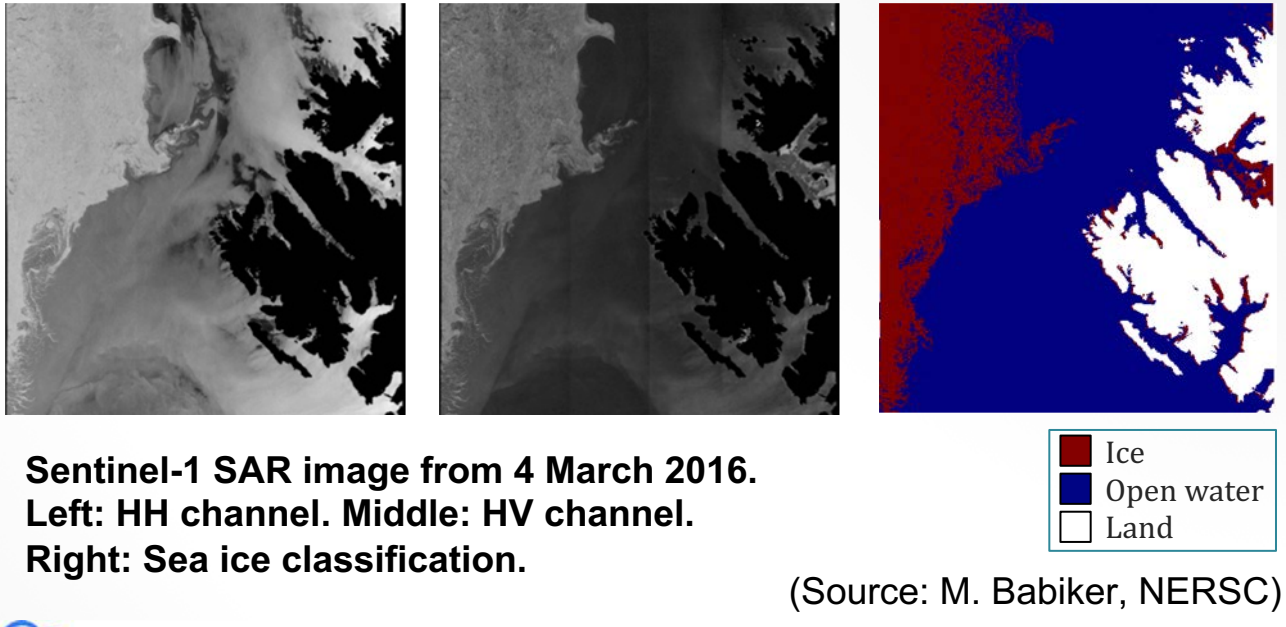
Workflow dcs-imr-estim parallelization



Sea Ice Classification Statistics

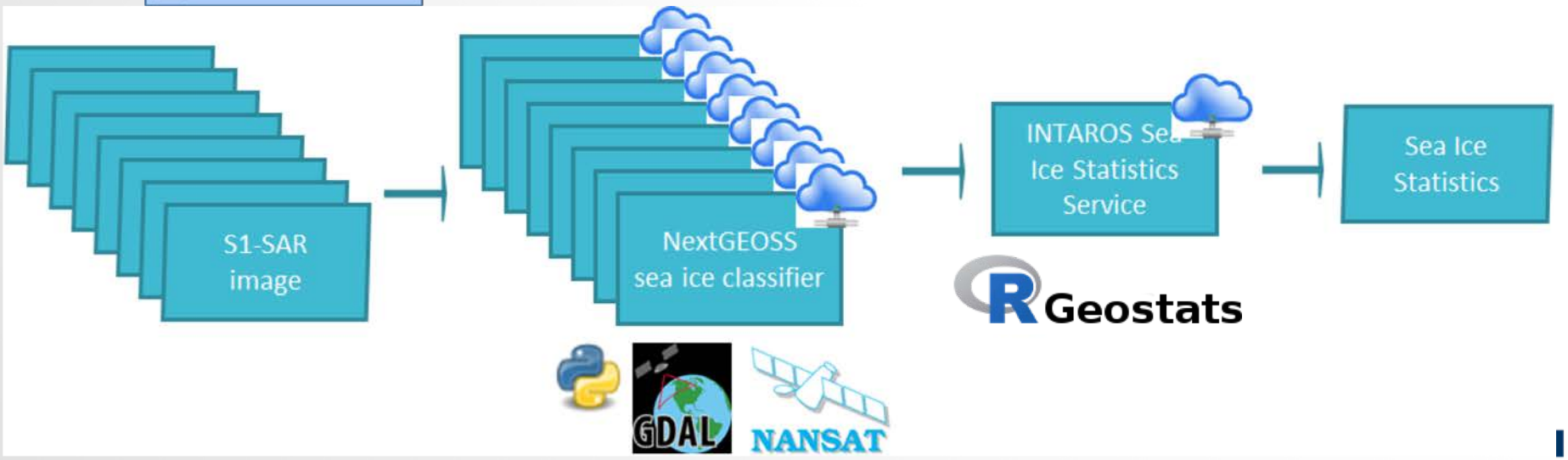


Sentinel SAR image and corresponding classification.



Sentinel-1 SAR image from 4 March 2016.
Left: HH channel. Middle: HV channel.
Right: Sea ice classification.

(Source: M. Babiker, NERSC)



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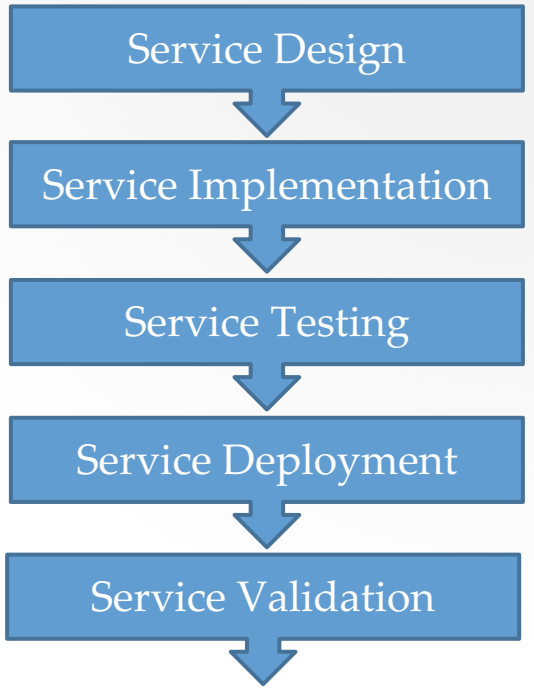
NERSC (Torill Hamre, Frode Monsen and Espen Storheim)

Service development with the integrated Arctic Observation System (iAOS)

iAOS Platform
Integrating Processing Services



- Exploit the data processing tools and geo-statistical algorithms as Cloud processing services
- Support the full lifecycle of the integration of new processing services, offering simultaneous access to data, tools and Cloud resources
- Maintain and operate the supporting Platform-as-a-Service (PaaS) environment for the iAOS services implementation
- Demonstrate the iAOS capabilities through integration and deployment of selected data processing services and user Portal

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NERSC, ARMINES & IMR

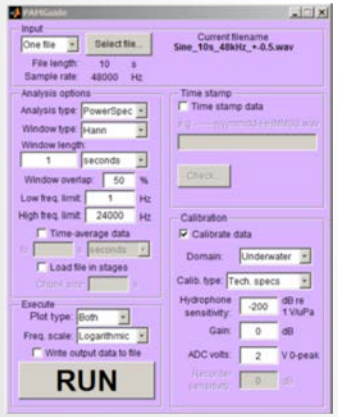
Examples of services

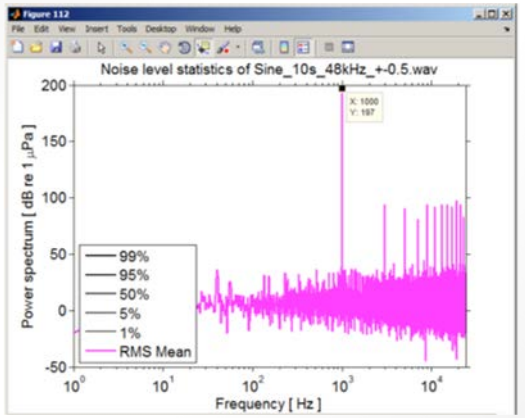
Examples of services

- Development of Cloud Processing Services:
  - Design, develop and test in Cloud Sandbox
  - Deploy and validate in production environment (e.g. EGI, AWS)
  - Package as Web Processing Service
  - Access through iAOS Portal or applications (e.g. INTAROS WP6)
  - Store results in an iAOS-enabled repository

Examples of services

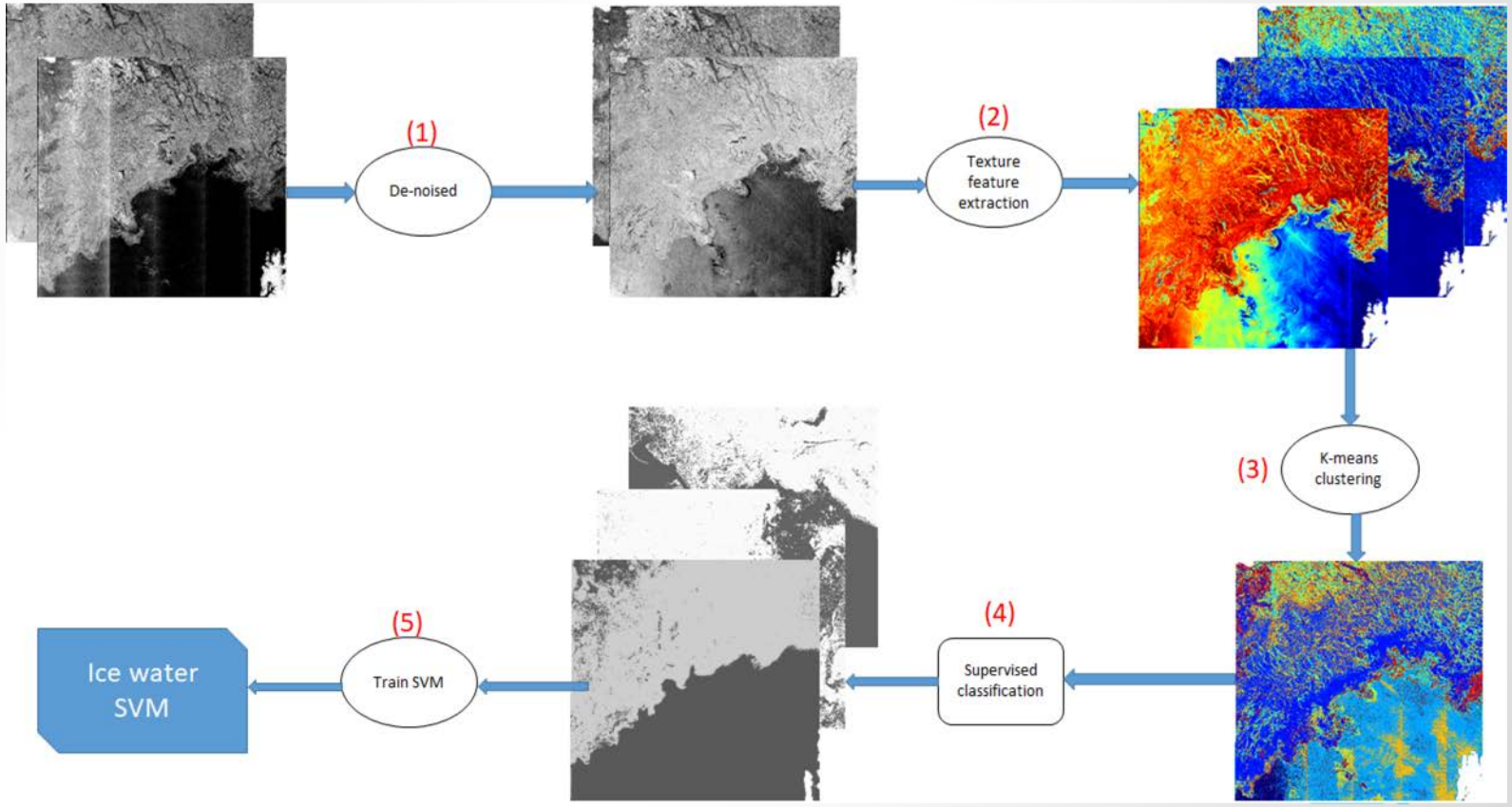
- Accessing Cloud Processing Services:
  - WPS (Web Processing Service) standard defines 3 operations
    - **GetCapabilities** - returns a list of processes that can be called
    - **DescribeProcess** - provides I/O parameters for a given process
    - **Execute** - runs a specific process
  - Using these operations, the iAOS portal/WP6 applications can set up correct input, run a process and access/display the result





Service #1

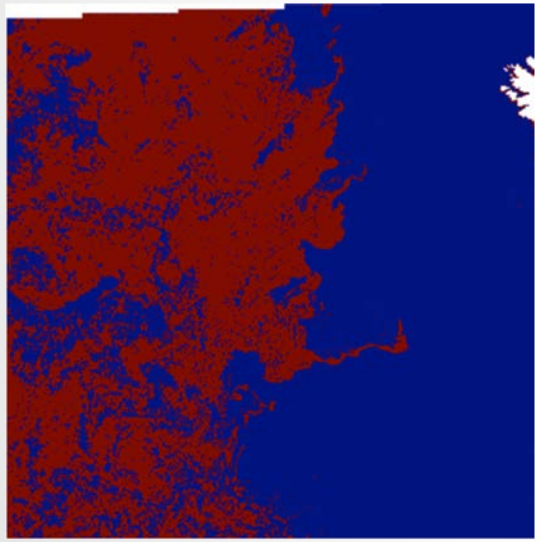
- Sea ice classification service
- Sentinel-1 SAR, EW, dual polarisation
- Algorithm uses ML techniques
- Thermal Noise reduction
- Coded in Python
- Open source libraries Nansat, GDAL, …
- Outputs GeoTIFF map
- Wrapped as cloud service in iAOS



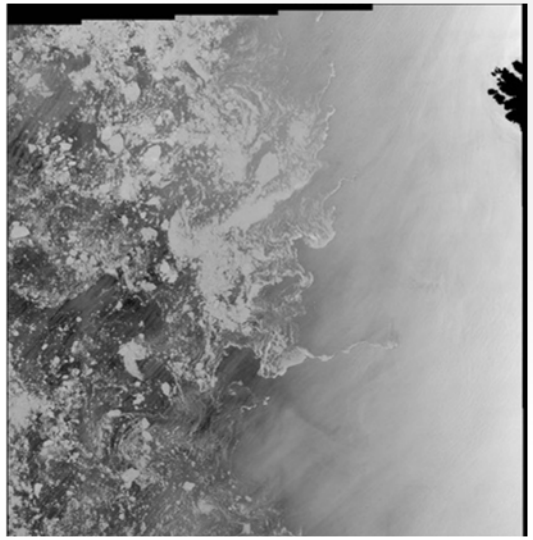
Service #1

- Sea ice classification – for INTAROS 2018 Cruise (29 Jul – 20 Aug)
  - Service deployed on EGI cloud infrastructure
  - Classified 200 Sentinel-1 SAR images from Fram Strait & North of Svalbard

29 July 2018

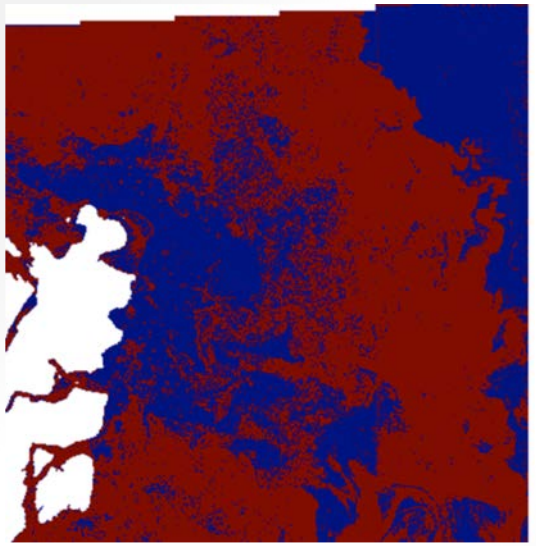


Blue - open water.
Red – sea ice.



S1-A SAR, EW, HH polarisation

11 Aug 2018



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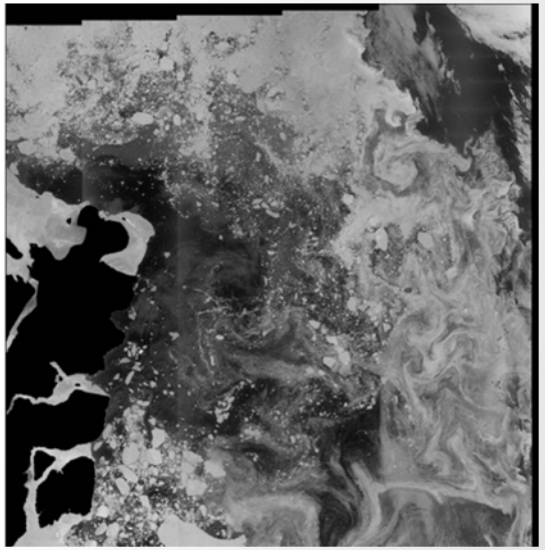
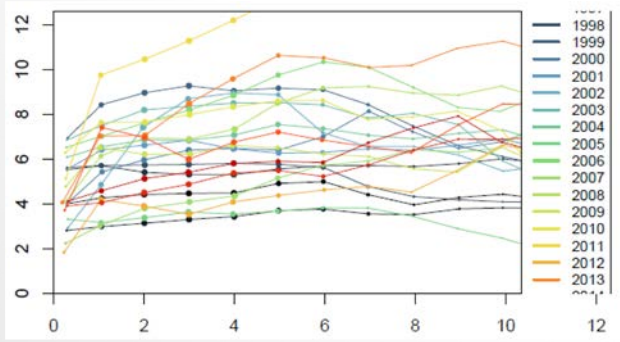
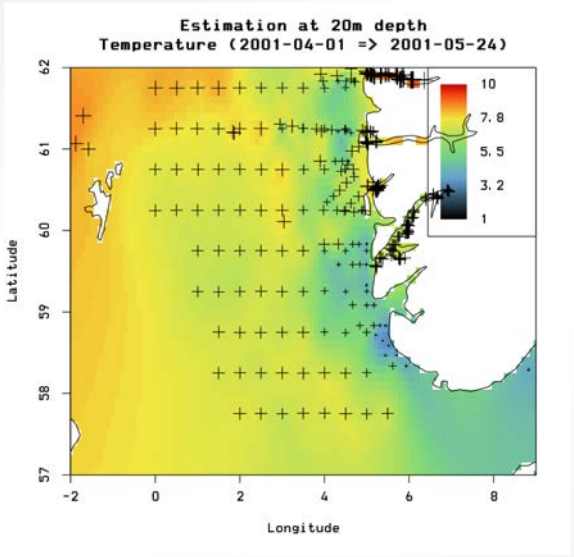


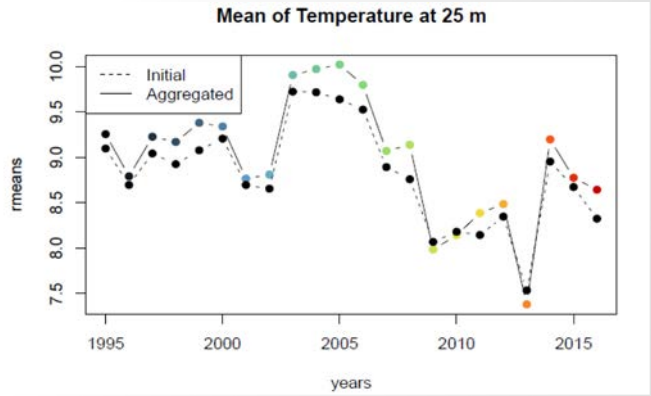
S1-A SAR, EW, HH polarisation

Service #2

- Use geo-statistics library **RGeostats** developed by ARMINES
- Service for interpolating in situ data to a (model) grid
  - Describe the spatial characteristics of the variable (variogram): classification, spatial correlation
  - Estimation, interpolation (kriging)
  - Simulations: possible alternative scenarios
  - Appraisal of uncertainty
  - Risk assessment



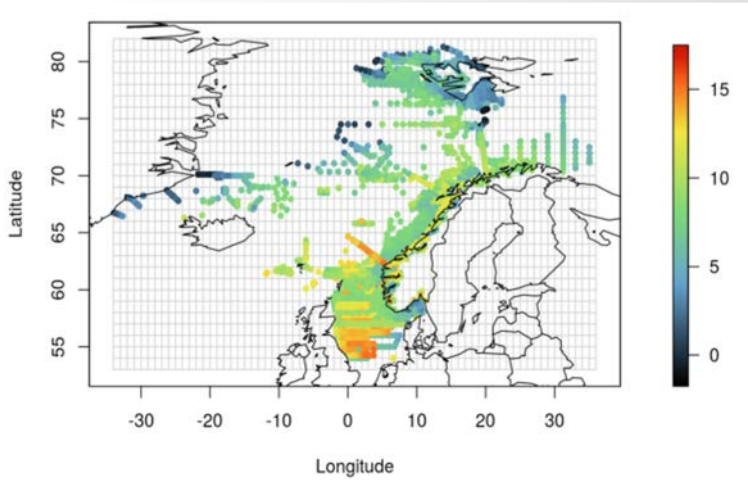


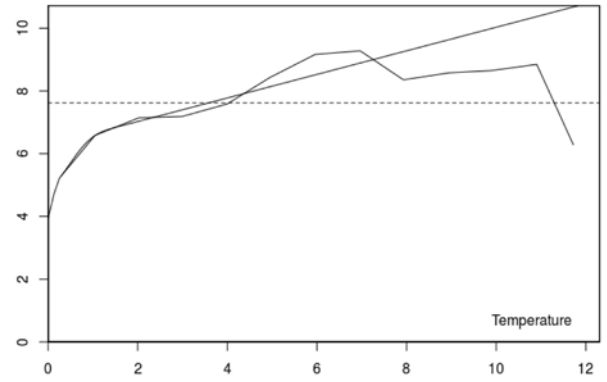


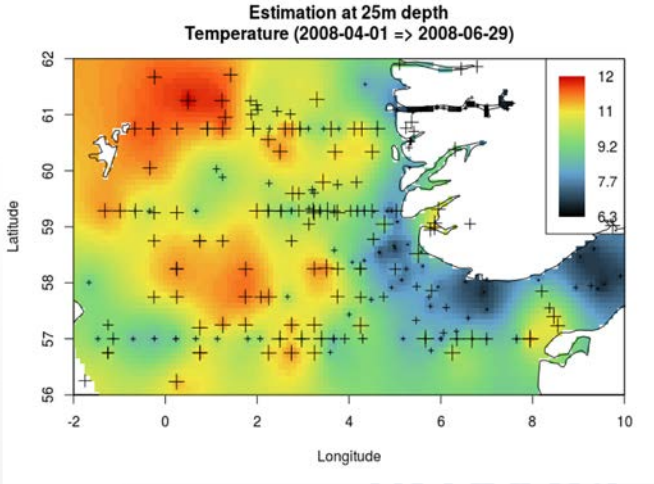
Service #2

Service implemented in Notebook environment

- Test data from IMR (7 vessels from 1995 to 2016)
- 3 variables measured:
  - Temperature
  - Salinity
  - Conductivity
- 63 500 positions {long, lat}
- 63 500 vertical profiles (in depth)
- 5 billions samples
- 84 NetCDF files (~60 Mb each)
- Interpolated to grid by Kriging
- Input to WP6 tasks

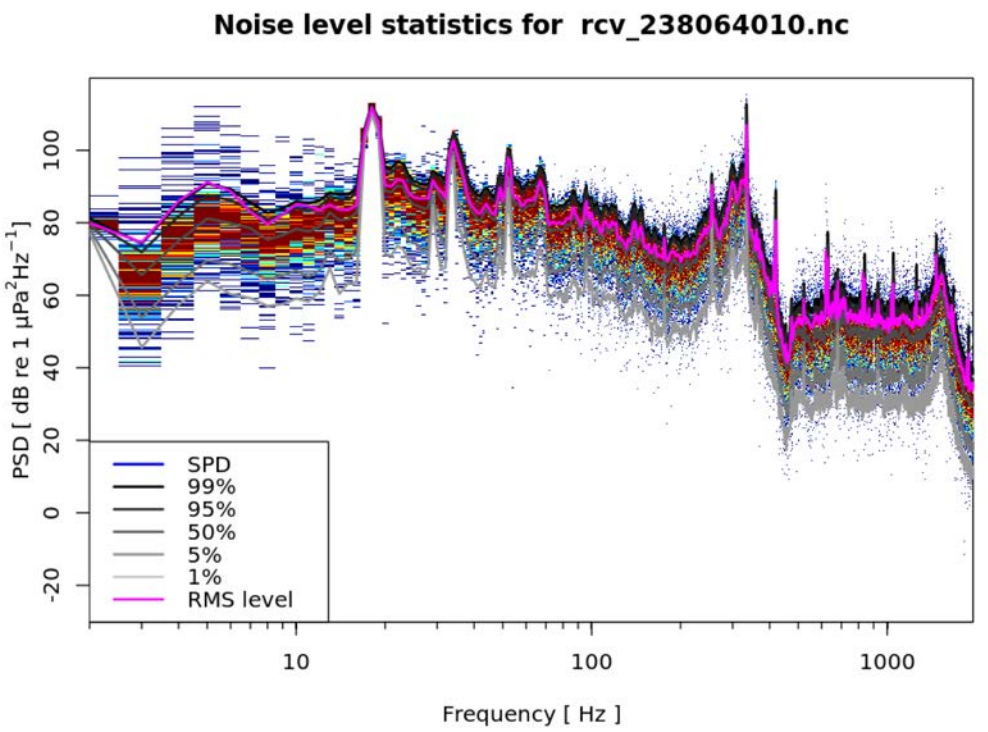


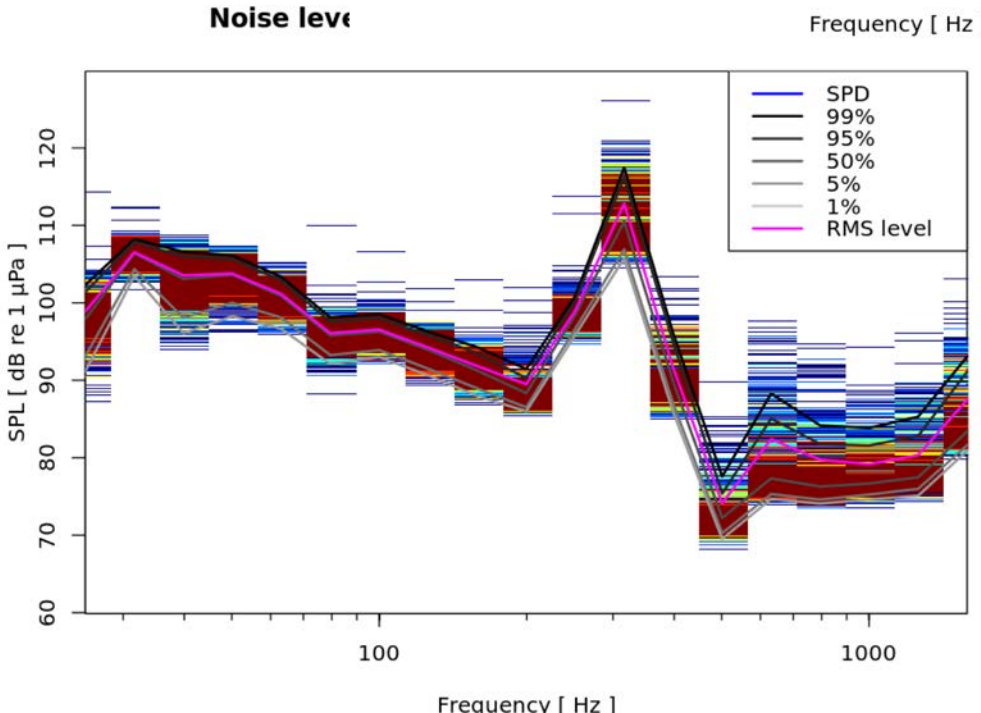


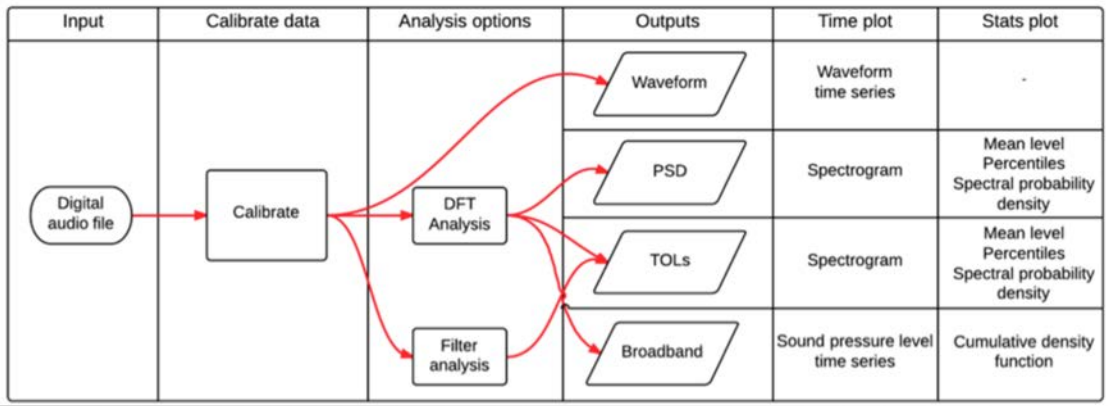


Service #3

- Acoustic data processing & analysis
  - PAMGuide tool (R version)
  - Calibration and processing
  - Different plots to investigate the data (spectrograms, noise statistics)
  - Supports WAV, NetCDF, …
  - Testing with WIFAR data





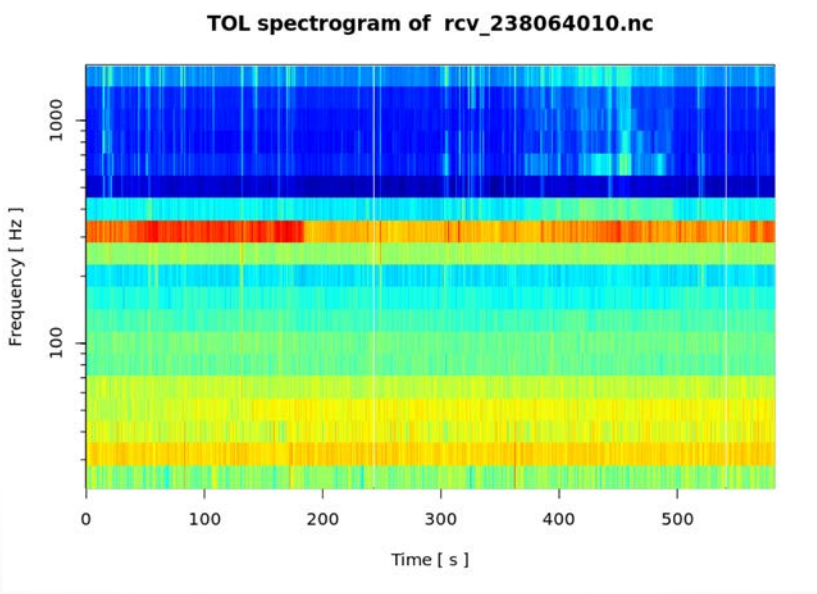


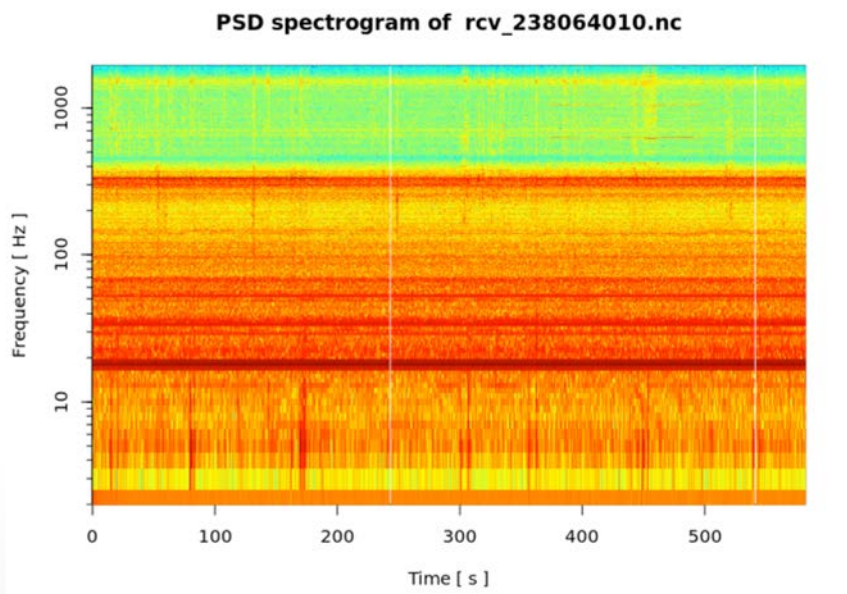
INTAROS

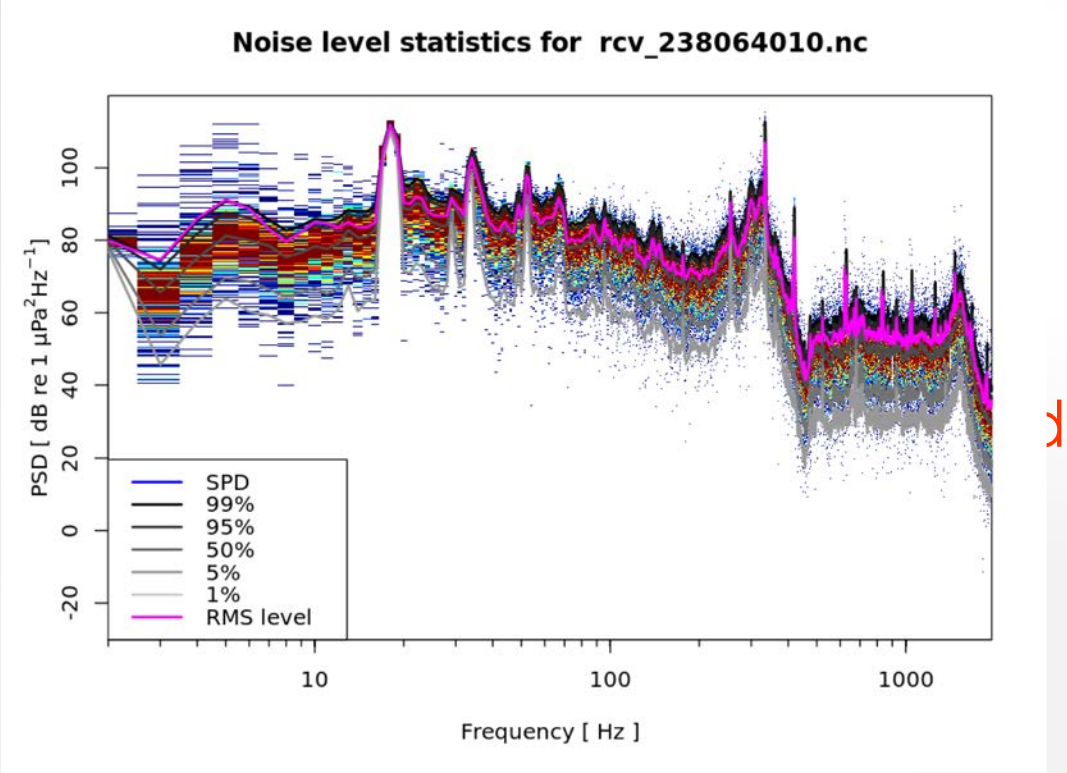
Service #3

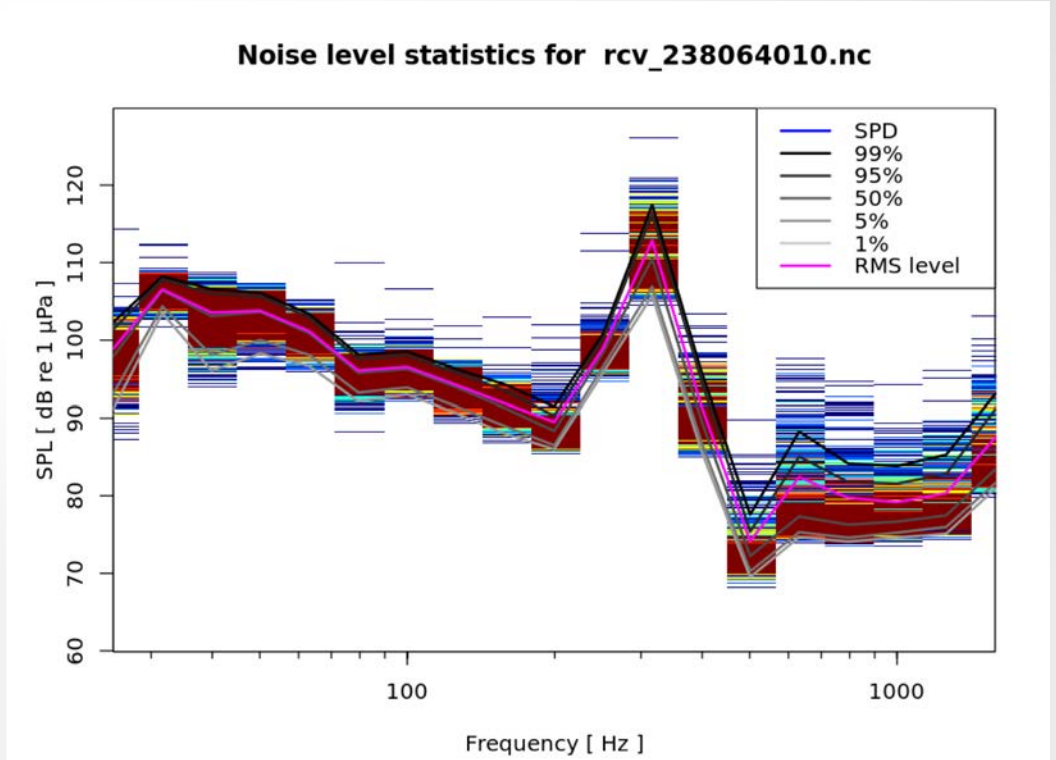
- Acoustic data processing and analysis
- Developed using Jupyter Notebook
- Initial version ready
- Including OPeNDAP support
- For INTAROS WP6 (PAMGuide installed, extended, packaged as cloud service)
- To be used in training

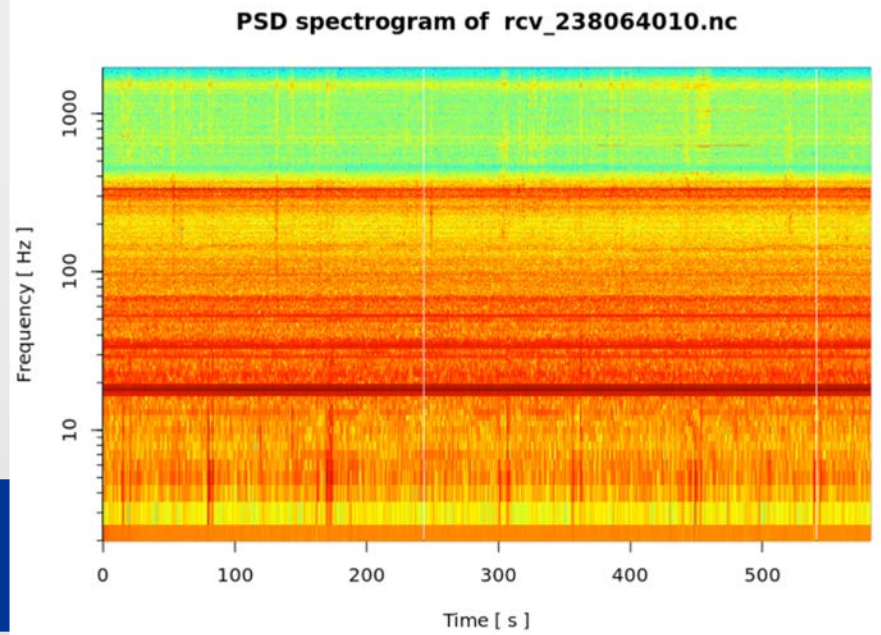
```
In [401]: # Get attributes:
          nc_atts <- ncatt_get(ncin,0)
          #print(nc_atts)

          print(nc_atts$summary)
          print(nc_atts$data_assembly_center)

          [1] "WIFAR/UNDER-ICE acoustic recording from an integrated ice station in the Fram Strait marginal ice zone"
          [1] "CONSORTIA/INSTITUTIONS>>>>NERSC >Nansen Environmental and Remote Sensing Centre>http://www.nersc.no/main/index2.php"

In [402]: # Sampling frequency [Hz]:
          fs <- ncvar_get(ncin, "sample_rate", verbose = F)

          # Time at start of recording:
          t0 <- ncvar_get(ncin, "start_time", verbose = F)

          # Samples:
          x <- ncvar_get(ncin, "samples", verbose = F)

          # Get the number of samples in the recording.
          Nsamp <- length(y)

          # Vertical bit resolution:
          Nbit = 24

In [403]: # Sensitivity of the hydrophone:
          HySens <- -168 # dB re 1 V/uPa


          # Gain of the voltage amplifier:
          Gain <- 12 # dB re 1 V/V

          # Digitizer information:
          B2V <- 2.5/2^(Nbit - 1) # Volt/Bit

          B2 <- 1/2^(Nbit - 1)

In [413]: # From samples to bit ...
          ybit <- x*B2

          # Want units in Pa => must add 120 dB
          pressure <- x*B2V/10^((HySens+120)/20)/10^(Gain/20) # Unit: Pascal [Pa]
          # Set up the time vector from t0 with dt
          dt = 1/fs
          t <- seq(0, Nsamp-1)*dt

In [405]: source("PAMGuide.R")

In [412]: PAMGuide(fullfile="rcv_238064010.nc", atype="TOL", plottype="Both", r=over1, lonlog="Lin",isvector=1, y=x,vADC=2
```

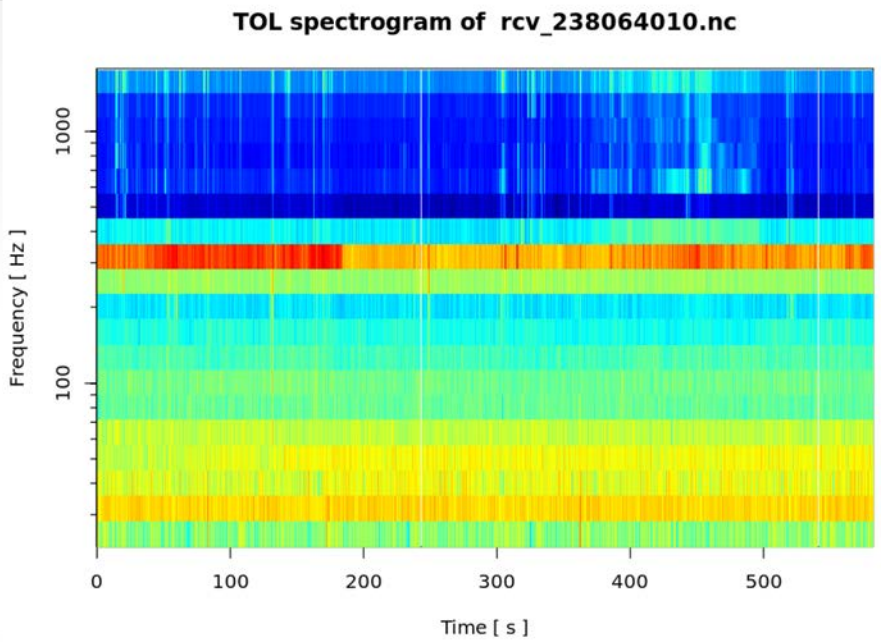





Noise level statistics for rcv_238064010.nc
PSD [dB re 1 µPa²Hz⁻¹]
Frequency [Hz]
SPD
99%
95%
50%
5%
1%
RMS level


Noise level statistics for rcv_238064010.nc
SPL [dB re 1 µPa]
Frequency [Hz]
SPD
99%
95%
50%
5%
1%
RMS level


PSD spectrogram of rcv_238064010.nc
Frequency [Hz]
Time [s]


TOL spectrogram of rcv_238064010.nc
Frequency [Hz]
Time [s]


DEMO

Terradue (Pedro)

Conclusion

Service Integration
Collaboration with NextGEOSS

NEXTGEOSS
Contributing to the Vision of GEO

- INTAROS contributed measurements for the area of "Fram strait + North of Svalbard"
- Ice Classification maps produced by NextGEOSS.
- NextGEOSS will run the processing campaign on EGI.eu resources (initially out of 4 weeks of Sentinel-1 acquisitions, for a Bounding Box over this area)
- INTAROS will share the results e.g. via the Geoserver at NERSC (Ice Classification maps)

INTAROS

Living Planet Symposium 2019

- Polar science is the "**most advanced thematic area**" where DG RTD and ESA coordinate, align and cluster research activities funded under H2020 and the ESA EO scientific programme
- Dedicated 2-hour round table session "**EC and ESA collaboration: Polar Science Challenges and future activities**"
  - to inform the scientific community about the cooperation,
  - to describe what EC and ESA already do to support Polar science,
  - to inform about our future common plans and
  - to receive feedback on how to develop the cooperation & support clustering activities
- Invited to "showcase" the project INTAROS by DG Research

INTAROS

WP5 DATA INTEGRATION & MANAGEMENT
ACHIEVEMENTS

- Monthly meeting with WP5 partners (actions and status review)
- Strong collaboration with WP2 on Classification Parameters
  - Data Catalogue
  - Data Access Online Servers
- Outreach for iAOS processing platform tools & services
  - Workshop, training
- RGeostats toolbox integration as an iAOS Processing Service
- Service Integration Collaboration with NextGEOSS

WP5 DATA INTEGRATION & MANAGEMENT
ACHIEVEMENTS

- Deliverables
  - D5.1 - iAOS Requirements and Architectural Design
  - D5.2 - iAOS platform and tools V1
  - D5.3 - Data integration from existing repositories V1
  - D5.4 - iAOS Portal with user manual V1

September 2018
Project Interim Review

- Provide seamless access to observations and derived parameters and products, more as a "federation" of data systems, than a single source.
- Work has also been done to provide a solid link between the observing systems and data identified in the observing assessments in WP2 and selecting "showcases" to be integrated into the iAOS to show the value of their use to INTAROS partners.
- Existing data repositories are being assessed for their technical readiness and maturity and potential for online integration into iAOS.

September 2018
Project Interim Review

- Cloud Platform tools and services will be of great value to INTAROS partners and should be encouraged
  - More extensive training will be required, and additional resources to do so will be needed.
  - Planning is underway with WP6 teams so that their needs for data and processing services can be accommodated.
- INTAROS should develop cooperation with:
  - NEXTGEOSS and has an ARCTIC pilot case.
  - Polar TEP from ESA
  - COPERNICUS DIAS

INTAROS

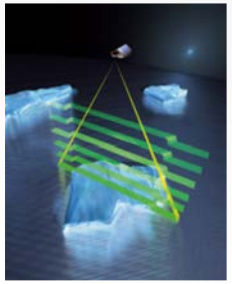
September 2018
Project Interim Review

- The first version of the requirements and architecture design was submitted as deliverable D5.1. Input were generated in preparation for the next release, which is due in November 2019.
  - Deliverable 5.1 is accepted.
- Work was also done for the Deliverable D5.2 "iAOS Platform and Tools" which is due in November 2018.
- A stronger integration should be developed between WP5 and WP1 in order to demonstrate to not-INTAROS users and stakeholders the usefulness of developed services and data sharing and integration agreements.

INTAROS

Winter School Svalbard (Dec. 2018)

- Training INTAROS user community on the iAOS tools and services and on the use of EO data sources
- Short review of existing radar sensors
- Introduce the different applications of SAR data to
  - map sea ice concentration
  - derive geophysical variables and products
  - focus over glaciers and ice sheets
- Followed by a hands-on exercises



EO Data Discovery

Polarstern enters uncharted Arctic waters in what once was thick perennial sea ice

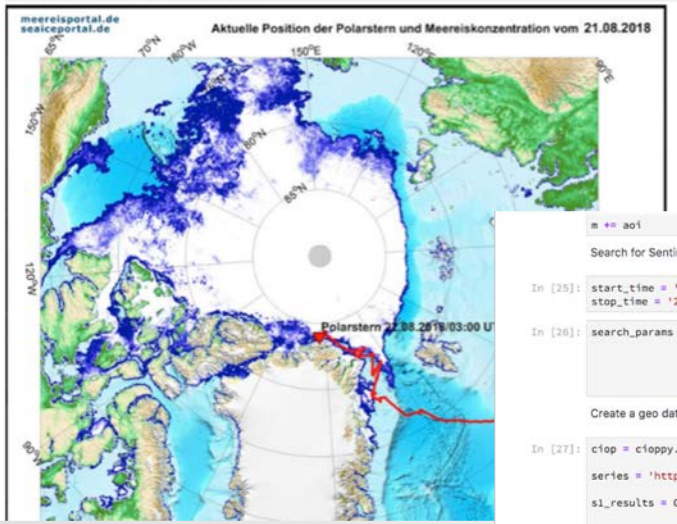
Mark Drinkwater's (@kryosat) tweet on August 22, 2018

https://twitter.com/kryosat/status/1032172161635639296

> Polarstern enters uncharted #Arctic waters in what once was thick perennial sea ice. Follow progress at https://t.co/BXpIVLWjDj @AWI_Media pic
>
> — Mark Drinkwater (@kryosat) August 22, 2018

```
In [1]: from IPython.display import Image
        Image(filename='resources/kryosat_tweet.png')
```

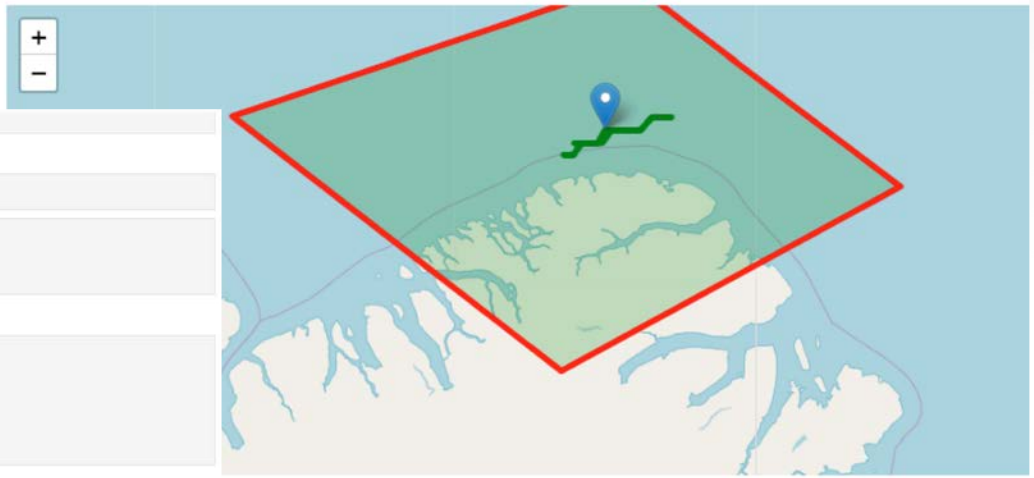
Out[1]:




```
In [21]: wkt = toi['geometry'].values[0].wkt
         wkt

Out[21]: 'POINT (-33.8 84)'
```

Add map with boat position

```
In [22]: global m

         from ipyleaflet import Map, Polygon

         m = Map(center=(toi['geometry'].values[0].centroid.y,
                         toi['geometry'].values[0].centroid.x), zoom=5)


         marker = Marker(location=(toi['geometry'].values[0].centroid.y,
                         toi['geometry'].values[0].centroid.x), draggable=False)

         m.add_layer(marker);

         m
```



```
m += aoi
```

Search for Sentinel-1 acquisitions of the Polarstern track on 2018-08-22

```
In [25]: start_time = '2018-08-22T00:00:00Z'
         stop_time = '2018-08-22T23:59:59Z'

In [26]: search_params = dict([('geom', ais_track),
                               ('start', start_time),
                               ('stop', stop_time),
                               ('do', 'terradue'),
                               ('pt', 'GRD')])
```

Create a geo data frame with the Sentinel-1 search results (more info about GeoPandas and GeoDataFrames)

```
In [27]: ciop = cioppy.Cioppy()

         series = 'https://catalog.terradue.com/sentinel1/search'

         s1_results = GeoDataFrame(ciop.search(end_point=series,
                                   params=search_params,
                                   output_fields='identifier,self,startdate,track,wkt,enclosure',
                                   model='EOP'))
```

Set the *wkt* field as a geometry (it contains the Sentinel-1 footprints)

```
In [28]: s1_results['wkt'] = s1_results['wkt'].apply(shapely.wkt.loads)

In [29]: s1_results
```

Out[29]:

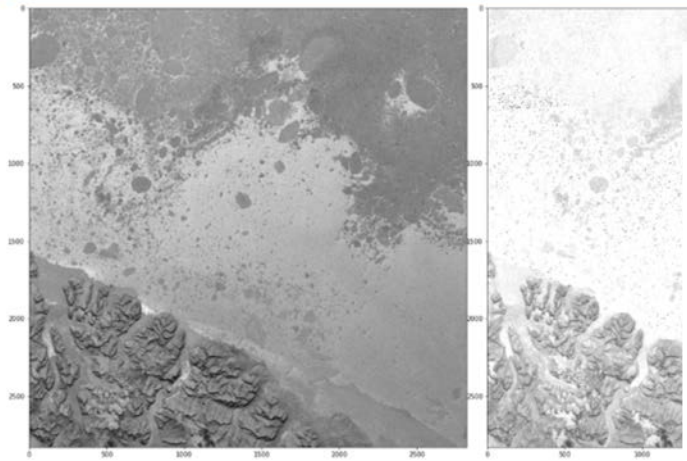
	enclosure	identifier	self	startdate	track	
0	https://store.terradue.com/download/sentinel1/...	S1B_EW_GRDM_1SDH_20180822T181427_20180822T1815...	https://catalog.terradue.com/sentinel1/search?...	2018-08-22T18:14:27.738000Z	103	83.508
1	https://store.terradue.com/download/sentinel1/...	S1B_EW_GRDM_1SDH_20180822T163558_20180822T1636...	https://catalog.terradue.com/sentinel1/search?...	2018-08-22T16:35:58.146000Z	102	-1
2	https://store.terradue.com/download/sentinel1/...	S1B_EW_GRDM_1SDH_20180822T145749_20180822T1458...	https://catalog.terradue.com/sentinel1/search?...	2018-08-22T14:57:49.769118Z	101	-6
3	https://store.terradue.com/download/sentinel1/...	S1B_EW_GRDM_1SDH_20180822T131947_20180822T1320...	https://catalog.terradue.com/sentinel1/search?...	2018-08-22T13:19:47.427000Z	100	-75.4
4	https://store.terradue.com/download/sentinel1/...	S1B_EW_GRDM_1SDH_20180822T114138_20180822T1142...	https://catalog.terradue.com/sentinel1/search?...	2018-08-22T11:41:38.660000Z	99	-6

ery

rack on 2018-08-22 as the geospatial filter for the discovery of Sentinel-1 data

EO Data Access and Processing

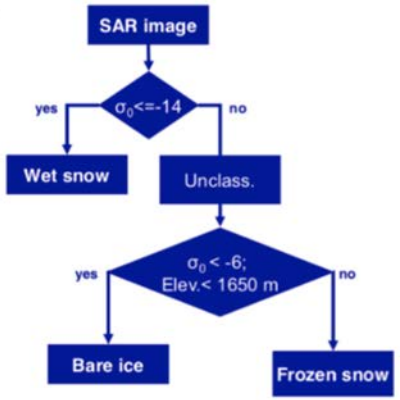
```
                    cmap=plt.cm.binary,
                    vmin=0,
                    vmax=1000)
else:
    imgplot = plt.imshow(band.ReadAsArray().astype(np.float),
                    cmap=plt.cm.binary,
                    vmin=-26,
                    vmax=6)

plt.tight_layout()
fig = plt.gcf()
plt.show()

fig.clf()
plt.close()
```



Create the band expression to classify the snow and ice

```
In [6]: from IPython.display import Image
        Image(filename='resources/sar_kb.png')
```

Out[6]:




```
In [7]: band_expression = Template('if $dem == -500 then 0 else if $sigma0 < -14 then 10 else if $sigma0 < -6 and $dem < 1650 then 20
```

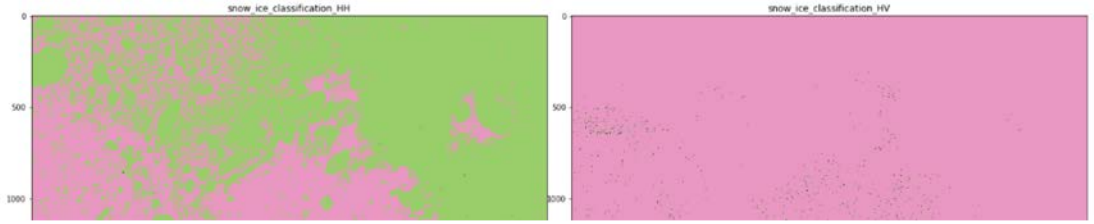
Use the SNAP BandMaths Operator to apply the expression for HH and HV sigma0 derived data:

```
In [8]: BandDescriptor = jpy.get_type('org.esa.snap.core.gpf.common.BandMathsOp$BandDescriptor')

        targetBands = jpy.array('org.esa.snap.core.gpf.common.BandMathsOp$BandDescriptor', 2)

        targetBand_HH = BandDescriptor()

        targetBand_HH.expression = band_expression.substitute(sigma0=list(band_names)[0], dem=list(band_names)[2])

        targetBand_HH.name = 'snow_ice_classification_HH'
        targetBand_HH.type = 'int8'

        targetBands[0]= targetBand_HH
```

Plot the results

```
In [9]: fig = plt.figure(figsize=(20,20))

        fig.suptitle('Snow and ice classification', fontsize=18, y=1.05)

        for i in [0,1]:

            a=fig.add_subplot(2, 2, i+1)

            data = snow_and_ice_product.getBand(snow_and_ice_product.getBandNames()[i])


            a.set_title(snow_and_ice_product.getBandNames()[i])
            w = data.getRasterWidth()
            h = data.getRasterHeight()

            band_data = np.zeros(w * h, np.float32)
            data.readPixels(0, 0, w, h, band_data)
            band_data.shape = h, w

            cmap = plt.cm.get_cmap('PiYG', 5)

            imgplot = plt.imshow(band_data,
                                 cmap=cmap,
                                 vmin=0,
                                 vmax=30)


        plt.tight_layout()
        fig = plt.gcf()
        plt.show()

        fig.clf()
        plt.close()
```

Snow and ice classification



WP5 CURRENT ACTIONS ON UPCOMING DELIVERABLES

- D5.1 iAOS requirements and architectural design (M36)
  - Evolve architecture to meet the main challenges of the observing system
- D5.6 - Geostatistical library for iAOS V1 (M36)
  - User manual and user guide for rGeoStats library exploitation
- D5.7 - Integration of new processing services V1 (M36)
  - Guidelines for exploitation

End of presentation

Backup Slides

INTAROS

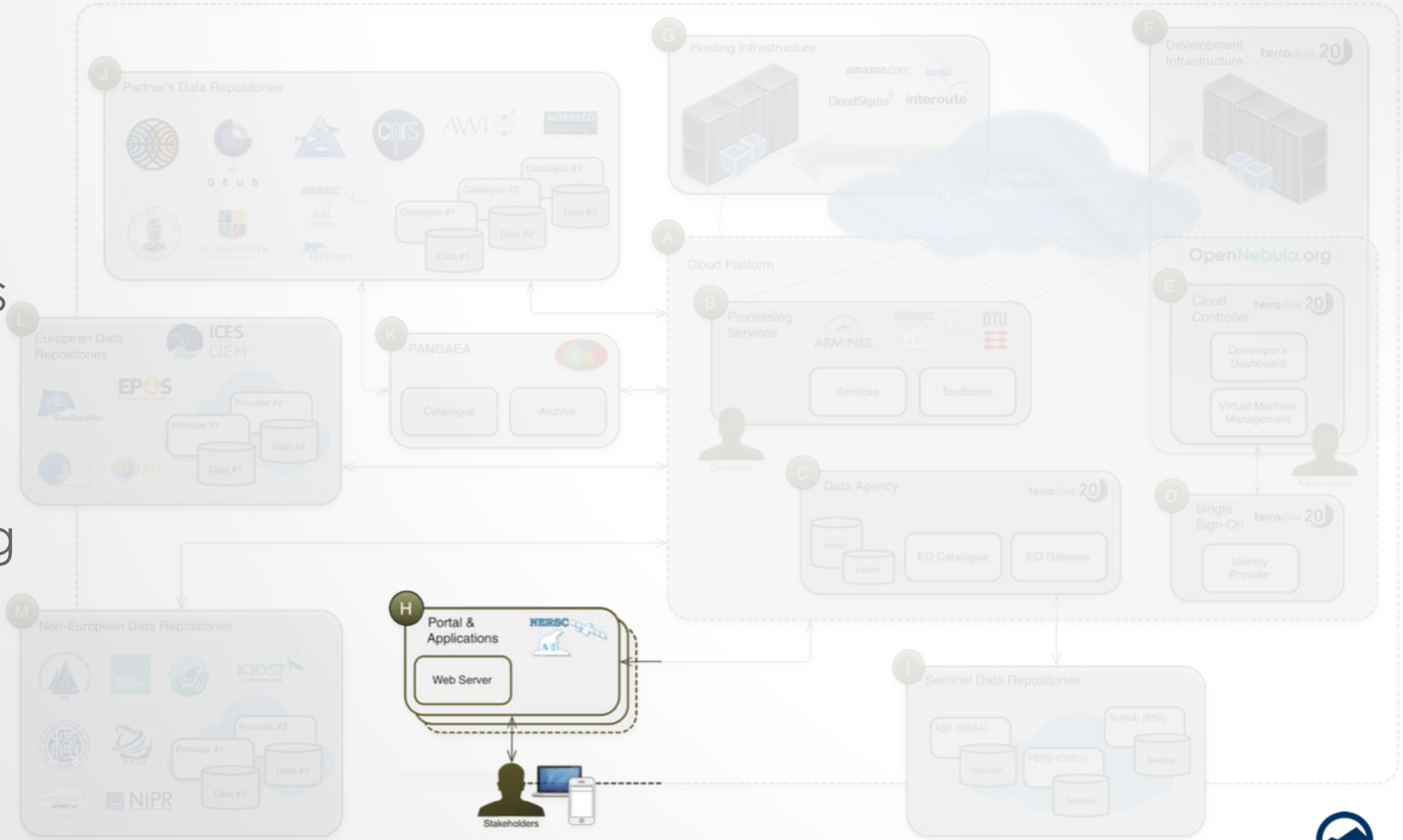
WP5 TECHNICAL OVERVIEW

iAOS Portal

End-user exploitation environment for Users

User stories defined

Development starting this year

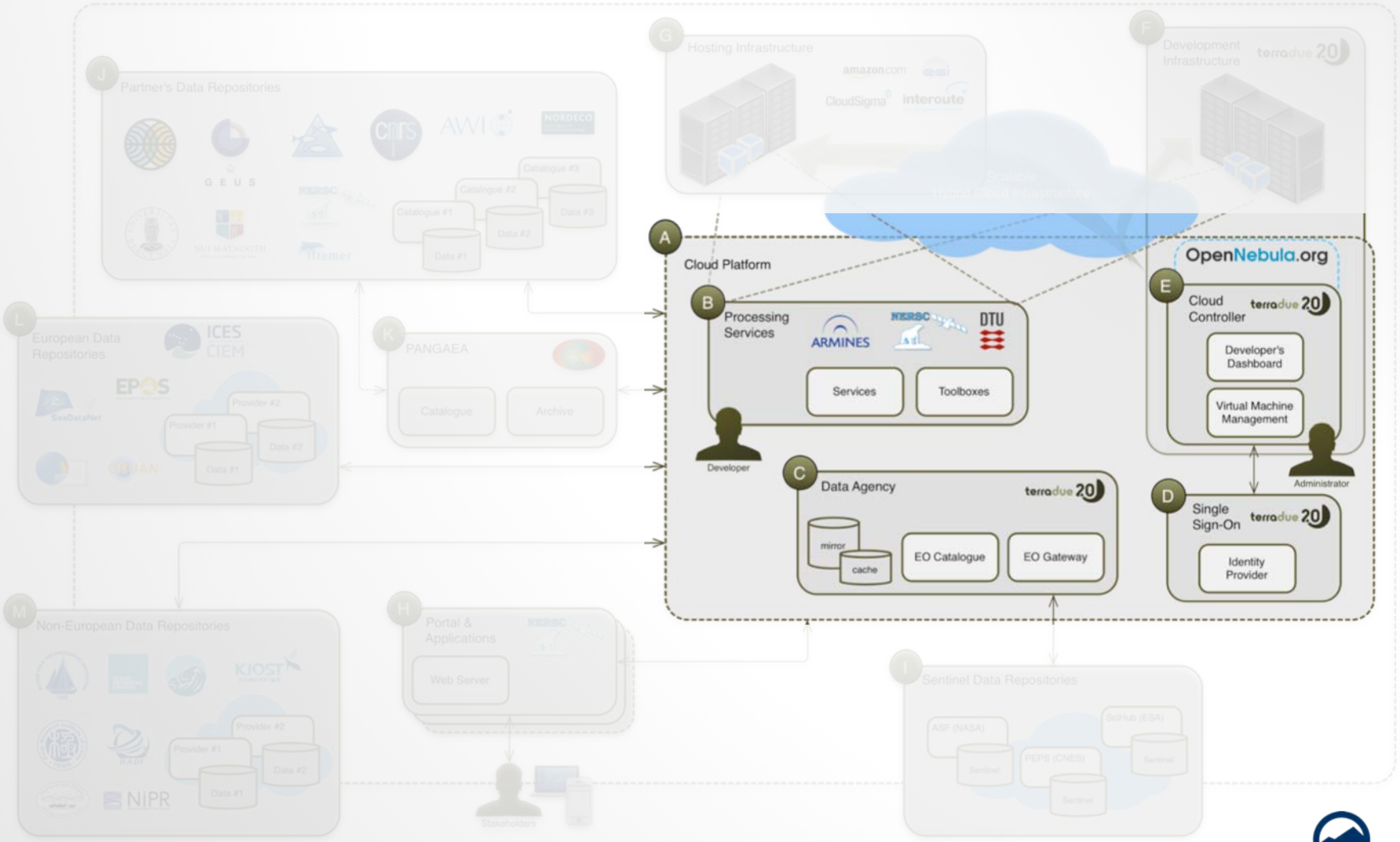


iAOS Platform architecture

iAOS Cloud Platform services

Collaborative workspace already available

Hosted on Terradue Cloud Platform

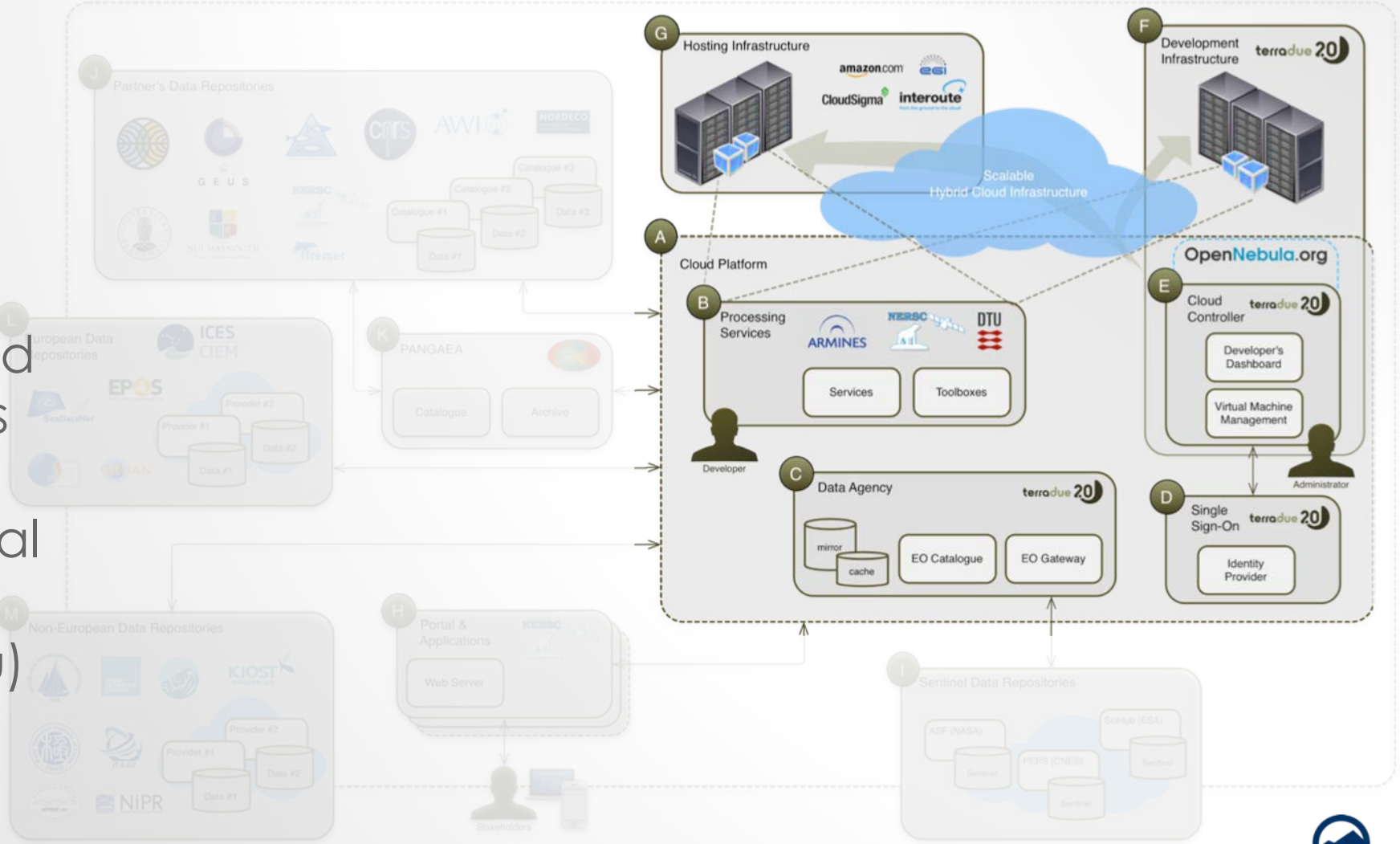


WP5 TECHNICAL OVERVIEW

Cloud Infrastructure

From development in private Cloud environment to Hosted Processing operations

Connections to several ICT providers already available (e.g. EGI.eu)



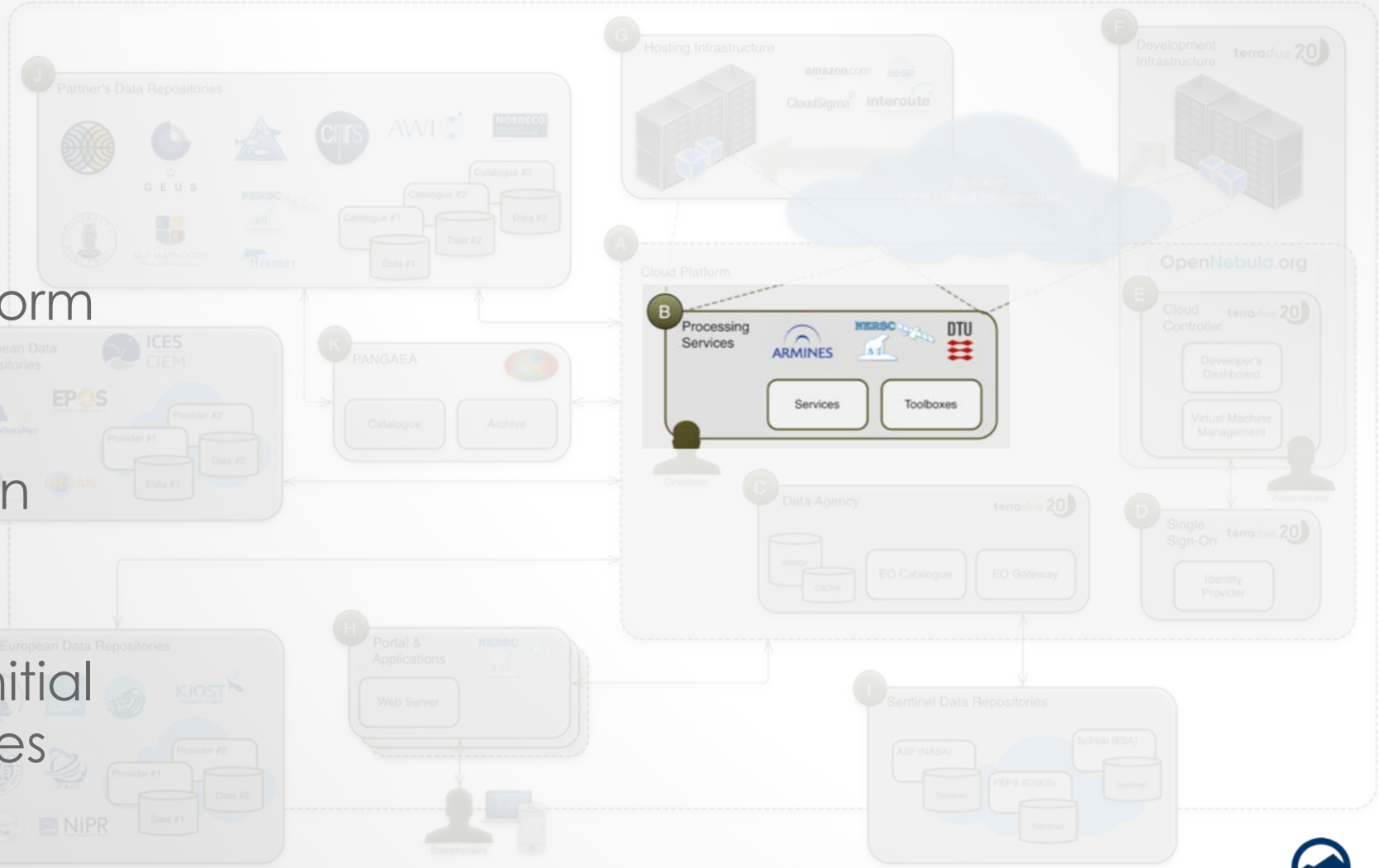
WP5 TECHNICAL OVERVIEW

Software toolboxes and processing services

Maintained on the Platform

From integration to deployment in operation on production servers.

First rGeoStat demo & initial design for NERSC Services



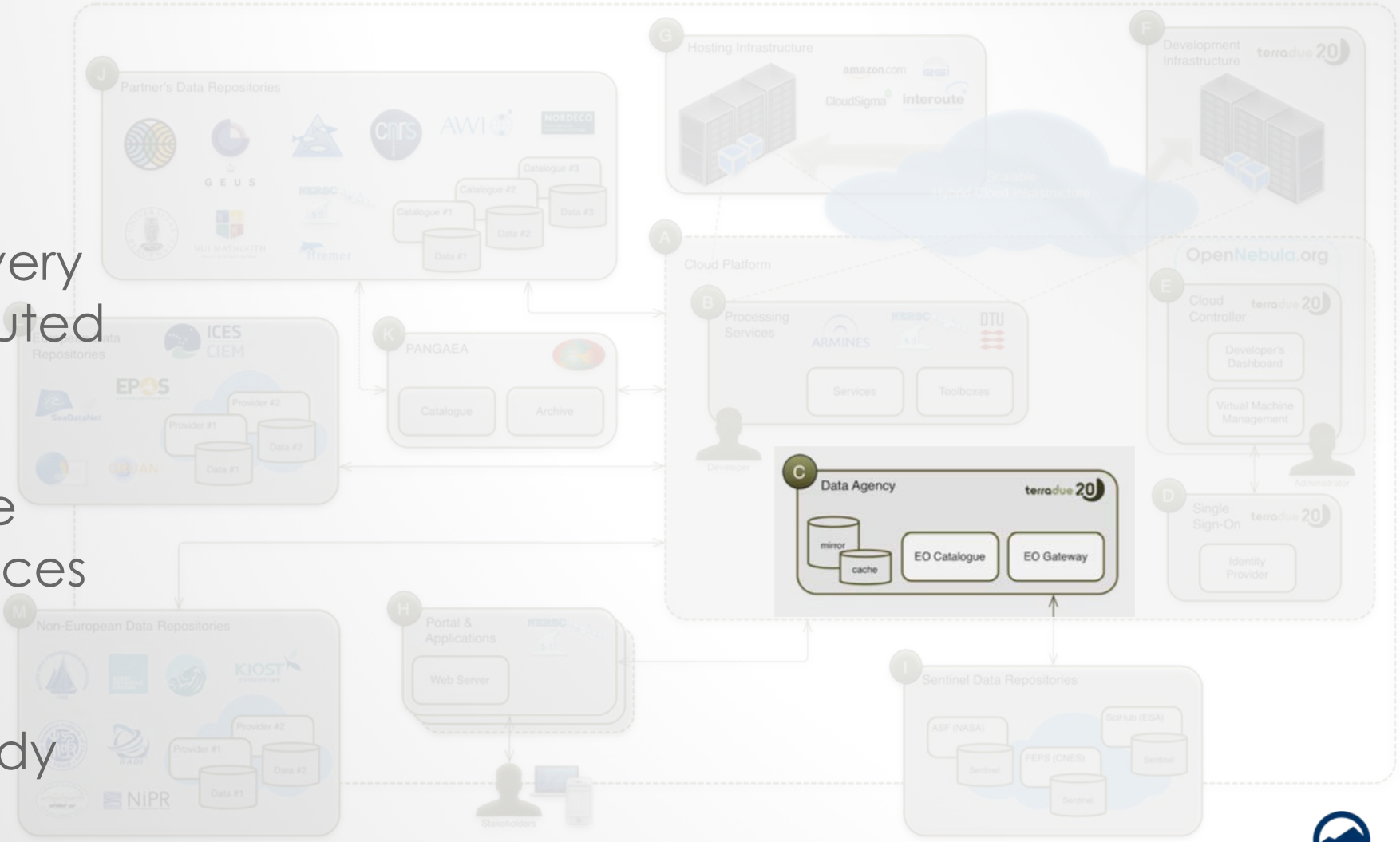
WP5 TECHNICAL OVERVIEW

Catalog and Data Gateway services

Programmatic discovery and access to distributed EO data repositories

Designed for scalable data processing services

Connections to Copernicus Hubs ready

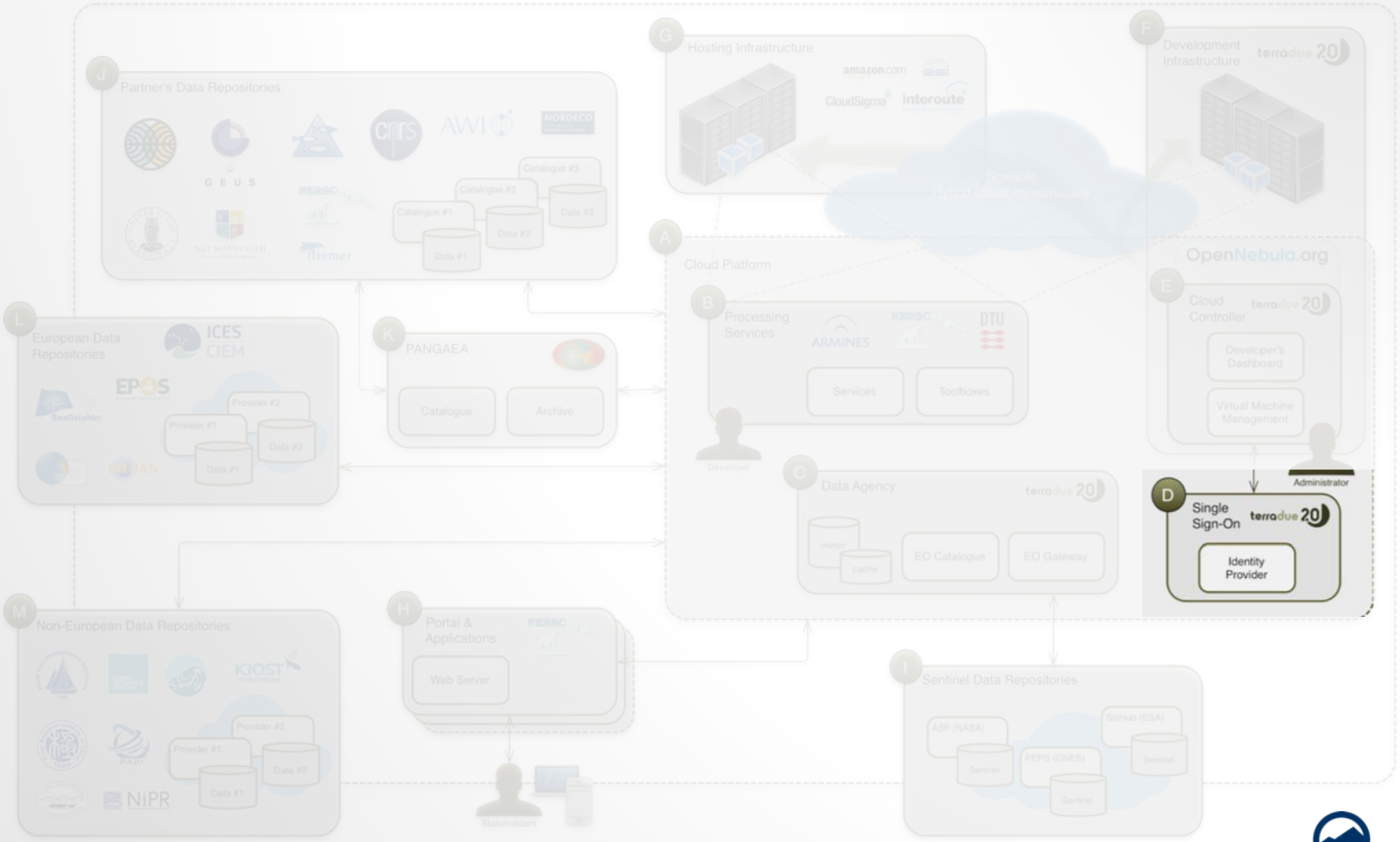


WP5 TECHNICAL OVERVIEW

Identity Provider

Management of Platform user accounts

Authentication and authorisation across all the Platform resources under the Single Sign-On (SSO)

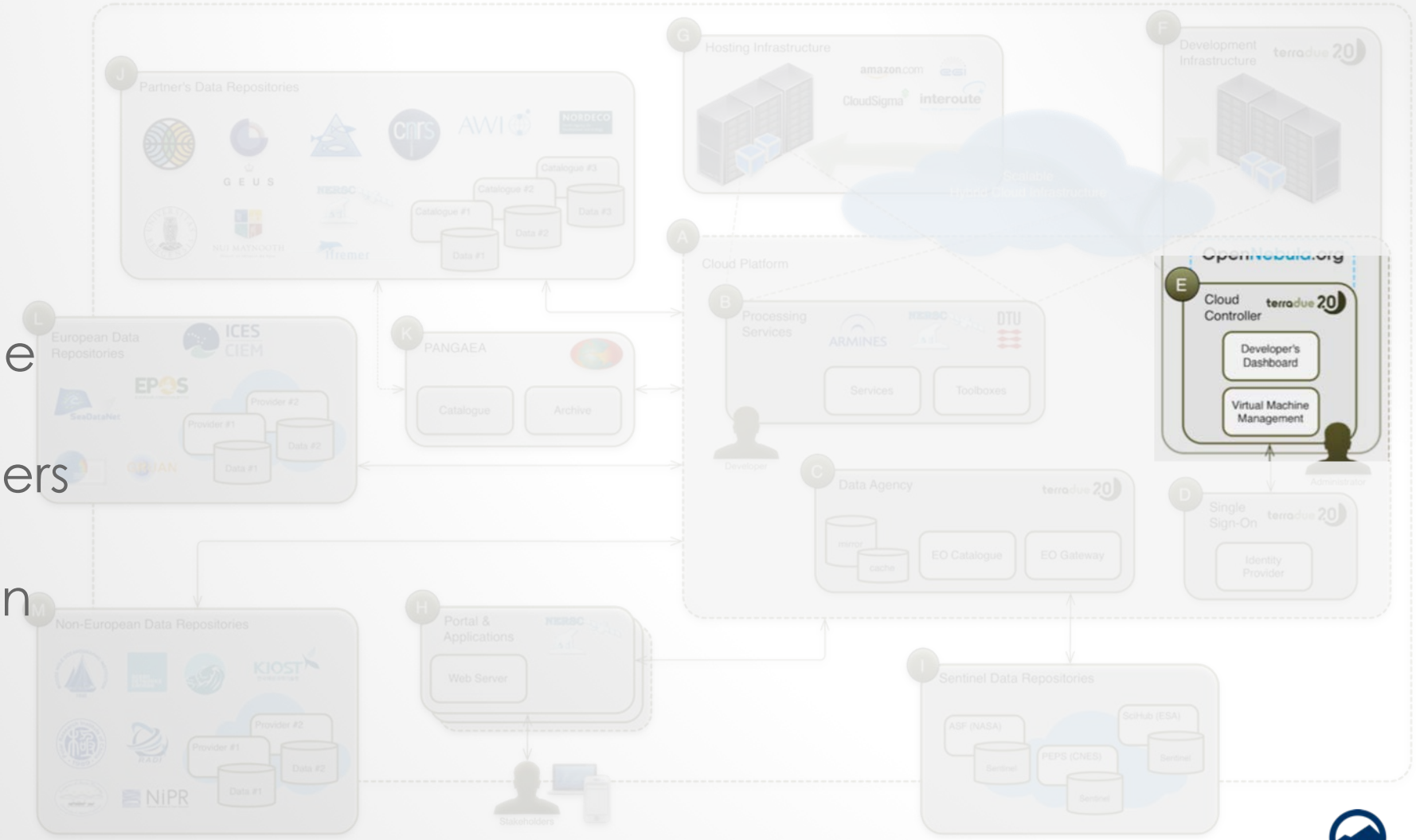


WP5 TECHNICAL OVERVIEW

Cloud Controller Service

Cloud Dashboard interfaces to manage Virtual Machines allocated to iAOS users

Operates Application Integration and Production Centers

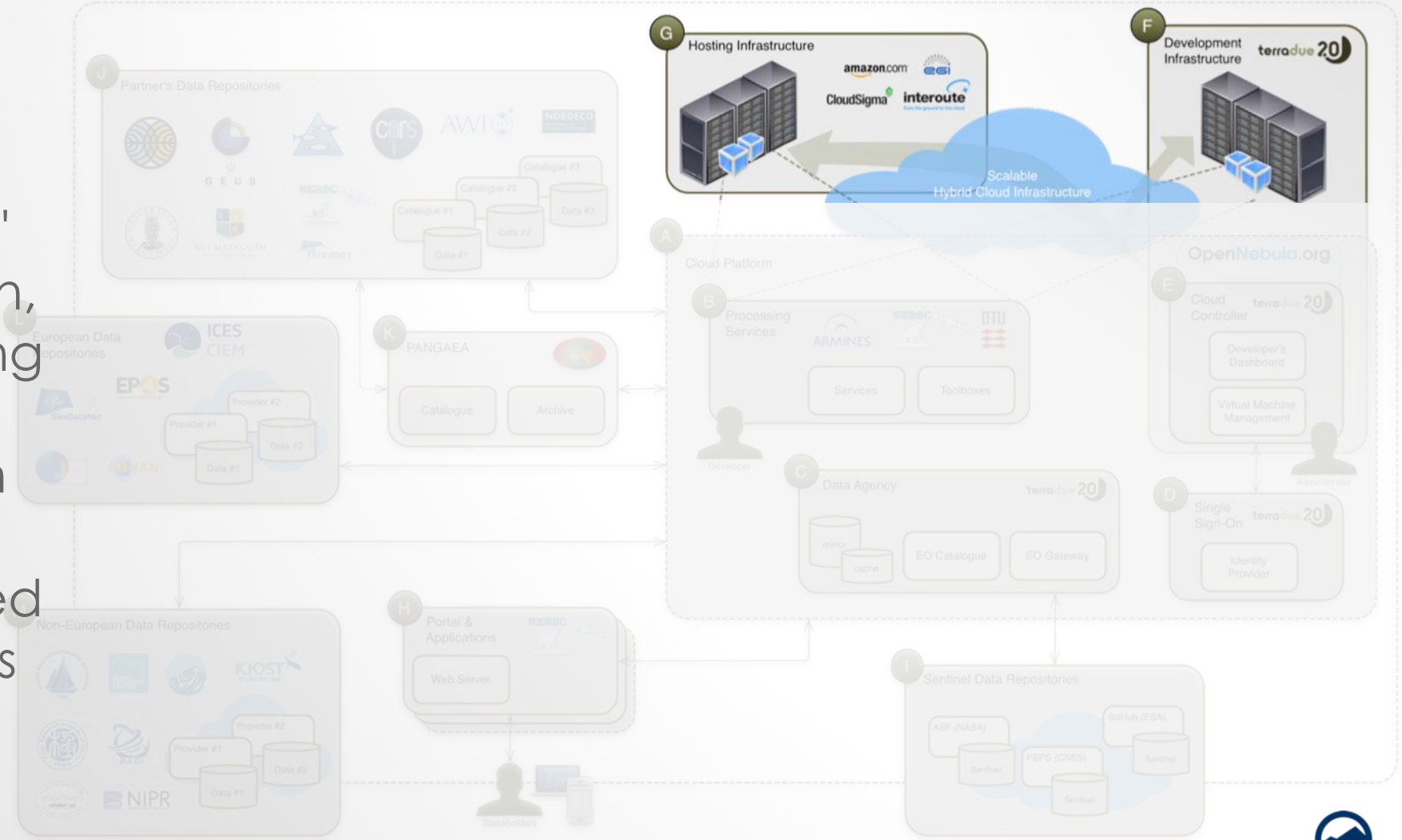


WP5 TECHNICAL OVERVIEW

Cloud Infrastructure

'Background facilities' supporting integration, testing and packaging

From development in private Cloud environment to Hosted Processing operations



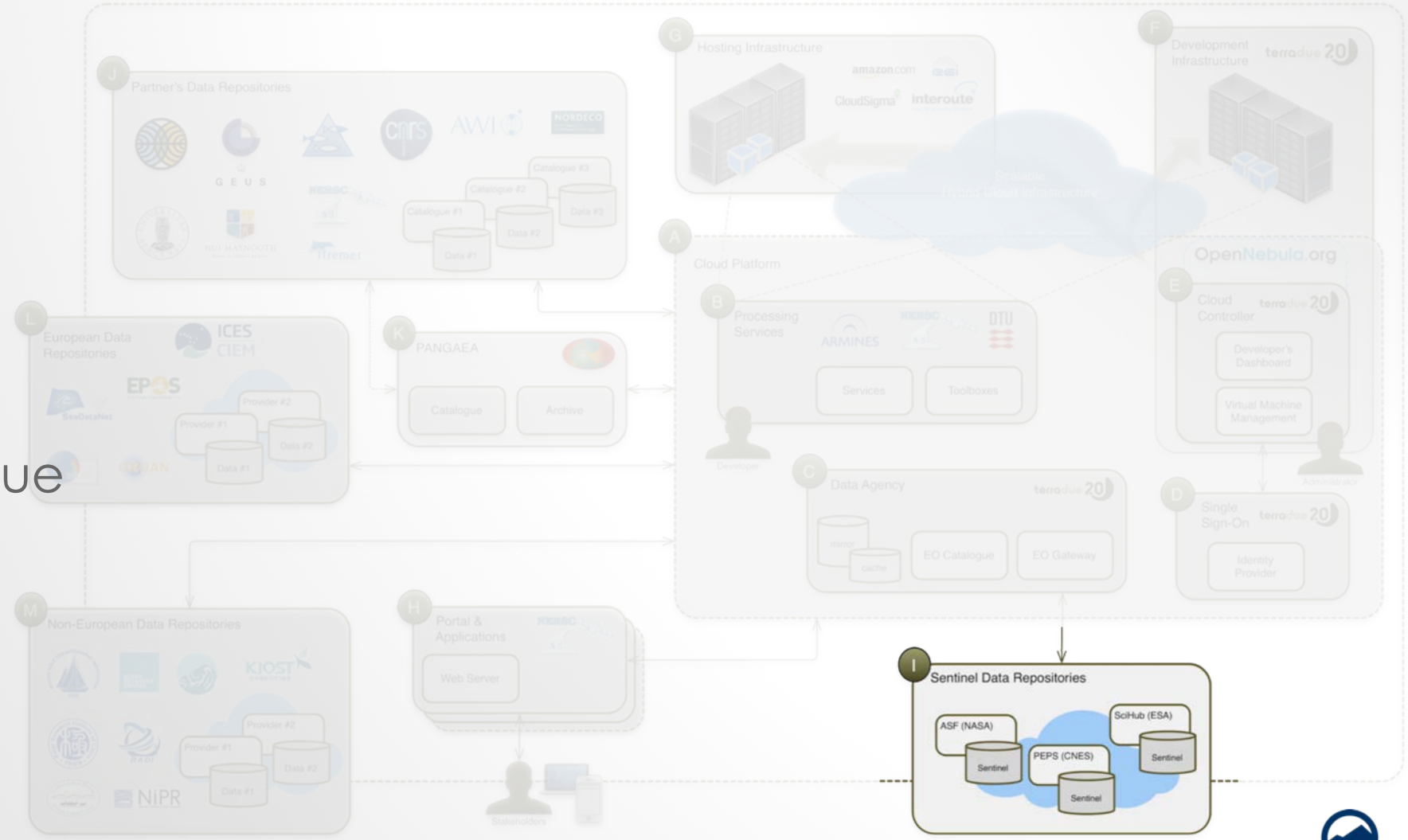
WP5 TECHNICAL OVERVIEW

Copernicus Sentinel data repositories

Pool of Copernicus data repositories

Federated on Terradue Cloud Platform

Available from the processing services.



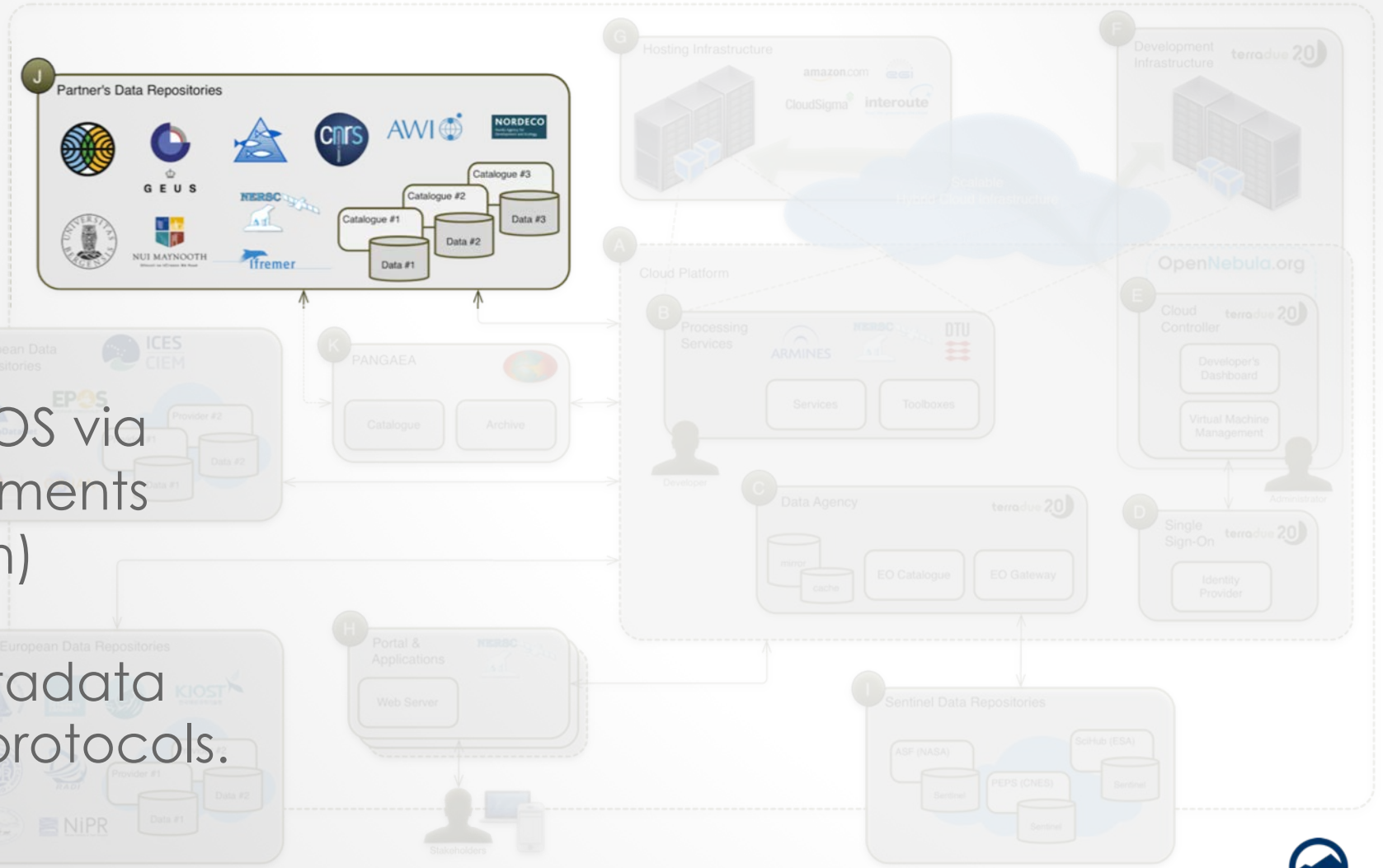
WP5 TECHNICAL OVERVIEW

Data Repositories

INTAROS Partner's data repositories

To be federated into iAOS via interoperability arrangements (WP2/WP5 collaboration)

Covering data and metadata formats, online access protocols.



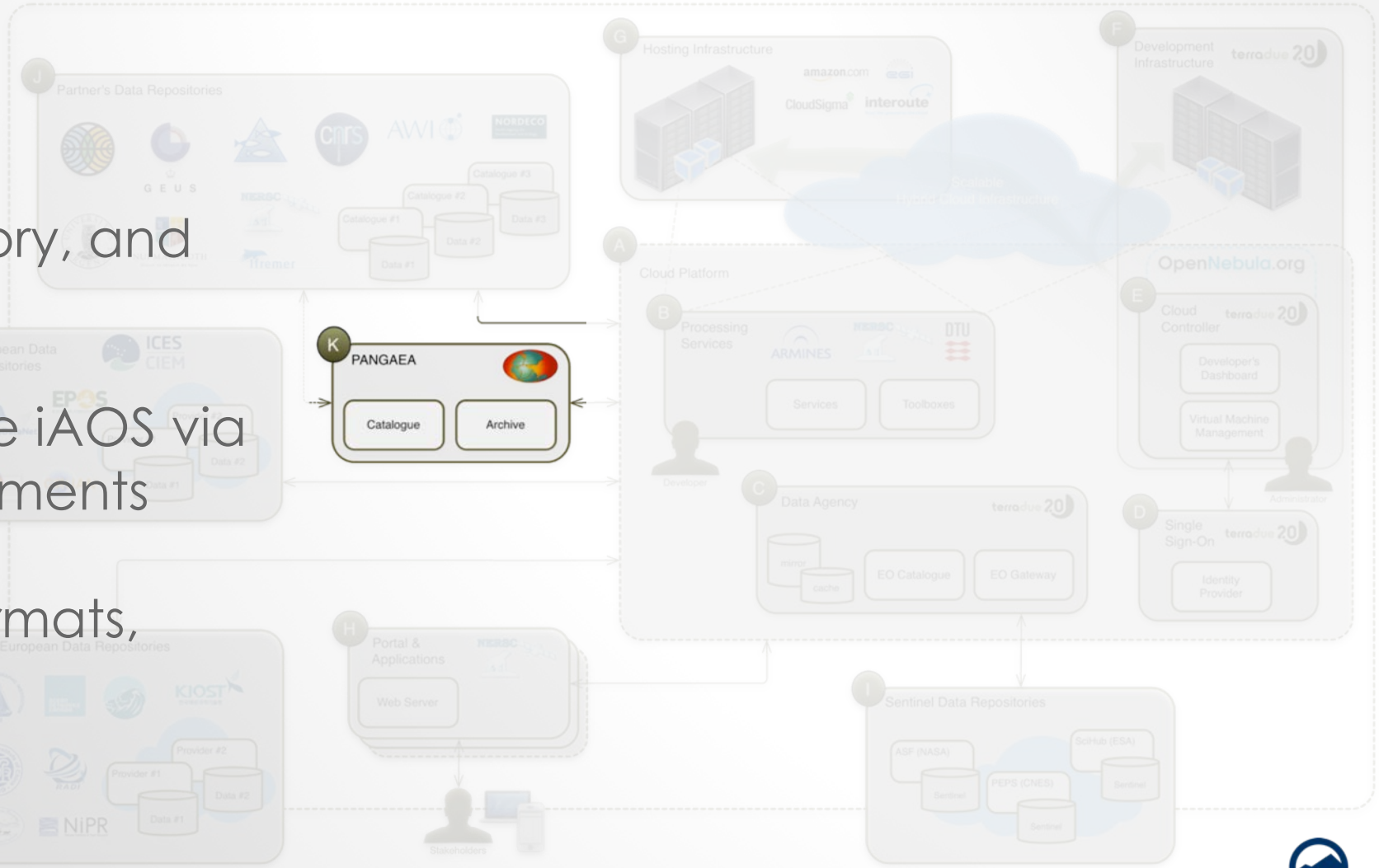
WP5 TECHNICAL OVERVIEW

PANGAEA Repository

PANGAEA data repository, and catalog entries

To be federated into the iAOS via interoperability arrangements

Data and metadata formats, online access protocols

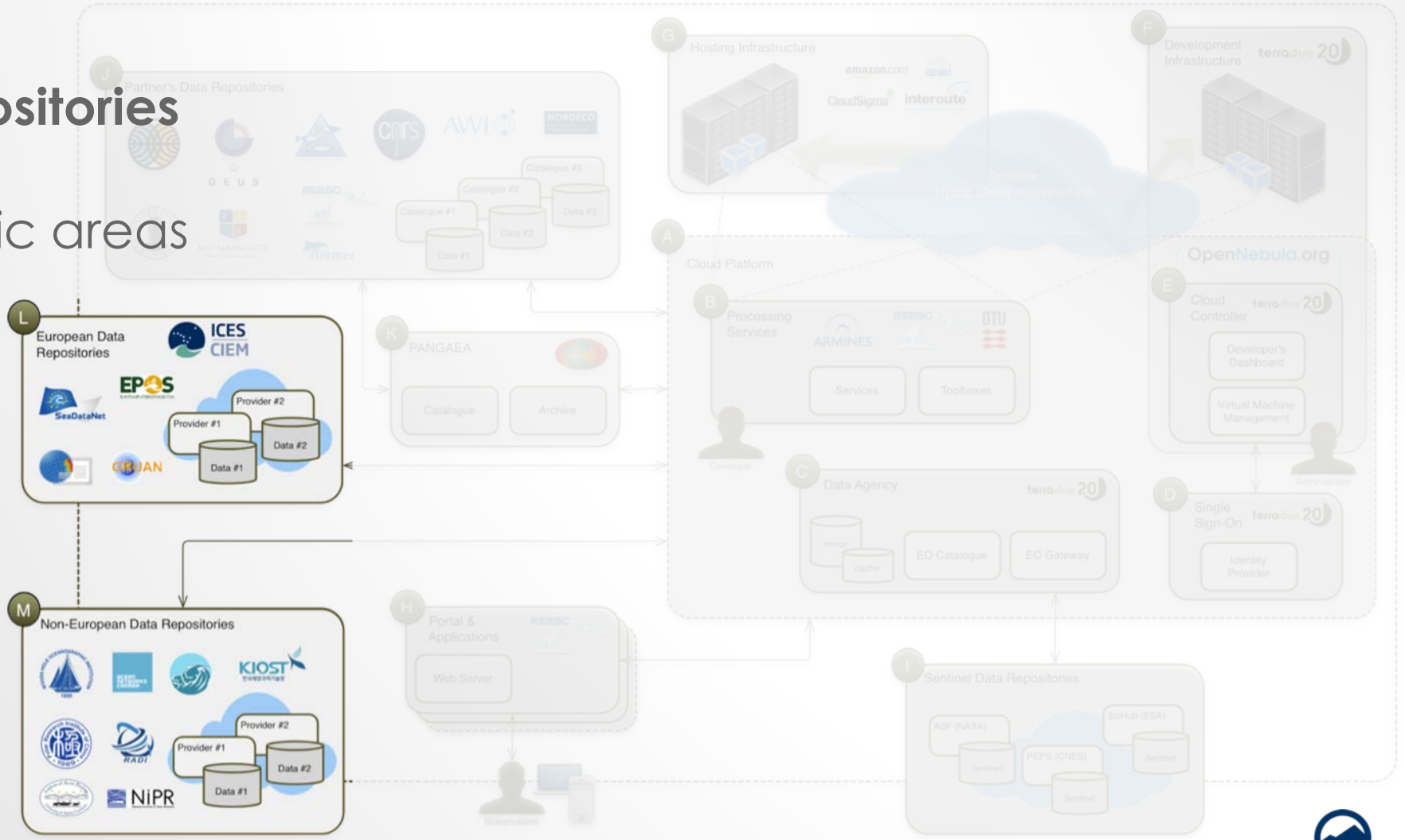


WP5 TECHNICAL OVERVIEW

Federated Data Repositories

Relevant for the Arctic areas management

To be Federated in iAOS (WP2/WP5 collaboration) by interoperability arrangements



INTAROS

WP5 TECHNICAL OVERVIEW

iAOS Portal

End-user exploitation environment for Users

Access to federated data repositories

User access to the Processing Services deployed on the Platform.

- Sea Ice + Acoustic Data + GeoStatistics