

NILU - Air quality and deposition monitoring

Cristina Guerreiro
Research Director NILU



Short about NILU

Non-profit private foundation, since 1969
180 employees from 25 nations

Competence areas:

- Atmospheric composition and processes
- Climate change drivers and pressures
- Air quality & deposition
- Environmental toxicants
- Environmental and health effects
- Environmental and sustainable measures

Infrastructure

- Laboratories (advanced instruments, chemistry, genotox, corrosion)
- Observatories (atmospheric composition & deposition)
- International databases



EMEP's Chemical Coordinating Centre & Observatories from pole to pole

NILU is the Chemical Coordinating Centre for the European Monitoring and Evaluation Programme (EMEP) under the LRTAP Convention

emep *Co-operative programme for monitoring and evaluation of the long-range transmission of air pollutants in Europe*

NILU is monitoring long-range transport and deposition of air pollutants at four observatories:

- Zeppelin in the Arctic
- Troll in Antarctica
- Birkenes and ALOMAR in Norway



Birkenes (Norway)



Zeppelin (The Arctic)

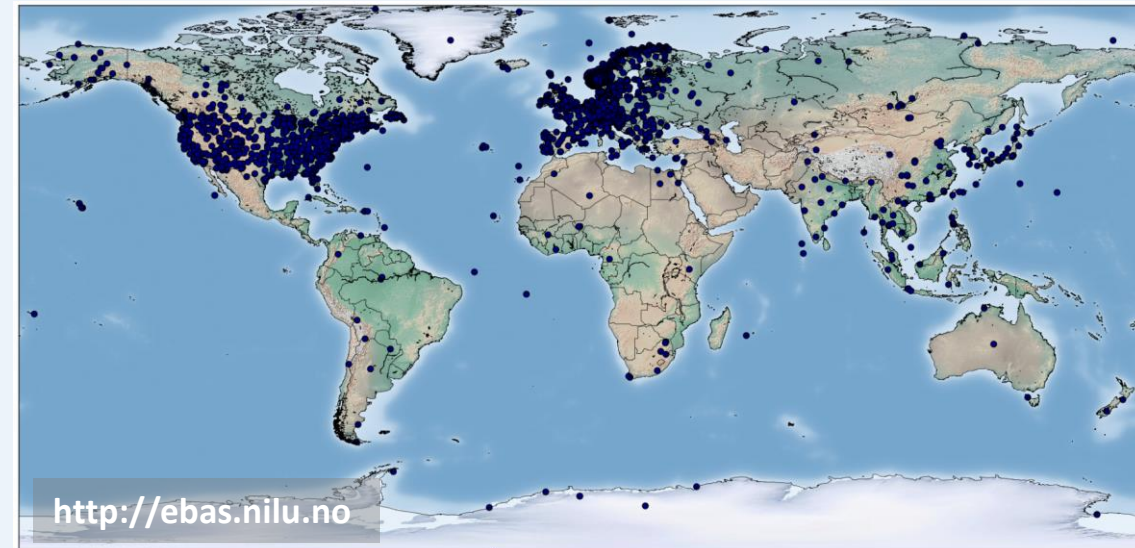


Troll (Antarctica)

A global dataserter

NILU hosts global data centres on atmospheric composition and deposition:

- EMEP - European Monitoring and Evaluation
- AMAP – Arctic Monitoring and Assessment Program,
- OSPARCOM (Commission for the protection of the North-East Atlantic and its resources),
- HELCOM (Baltic Marine Environment Protection Commission),
- WMO Global Atmosphere Watch
- ACTRIS – Aerosols Clouds and Trace Gases Research Infrastructure



Support the EEA, conventions, European networks

NILU supports the European Environmental Agency (EEA) & member countries on i.a.:

- Air quality and deposition monitoring, data reporting, and assessment
- Review of European Air Quality Directives (also in CAMS & for DG-Env.)

Through participation and leading several European Topic Centers, currently leading

European Environment Agency
European Topic Centre
Human health and the environment



and participating in

European Environment Agency
European Topic Centre
Data integration and digitalisation



and

European Environment Agency
European Topic Centre
Climate change mitigation



and European networks:

eeagrants.org



FAIRMODE: The Forum for Air Quality Modelling



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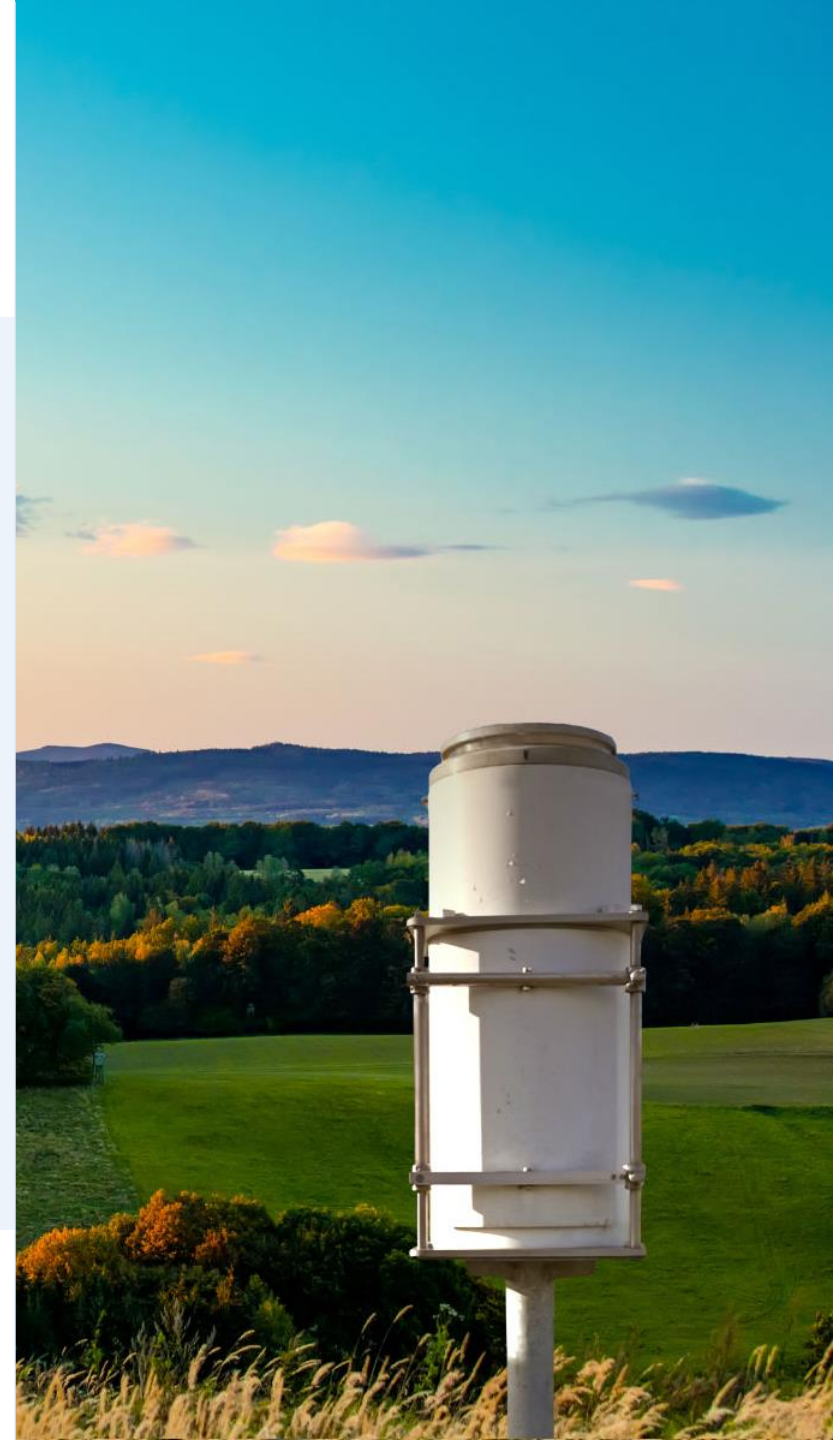
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Activity 1: The concept of revision and optimization of deposition measurements in Poland

Wenche Aas, Joana Soares, Sabine
Eckhardt, Cristina Guerreiro

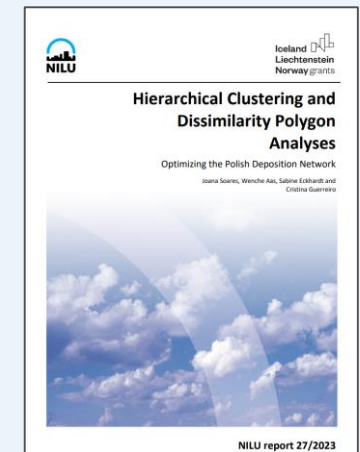
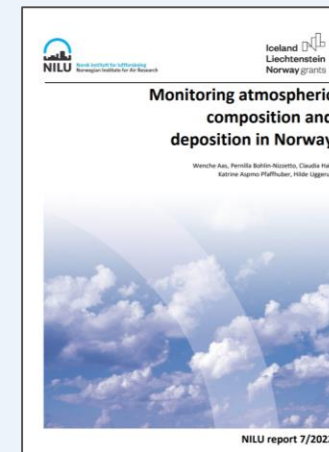
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Main tasks for NILU in Activity 1

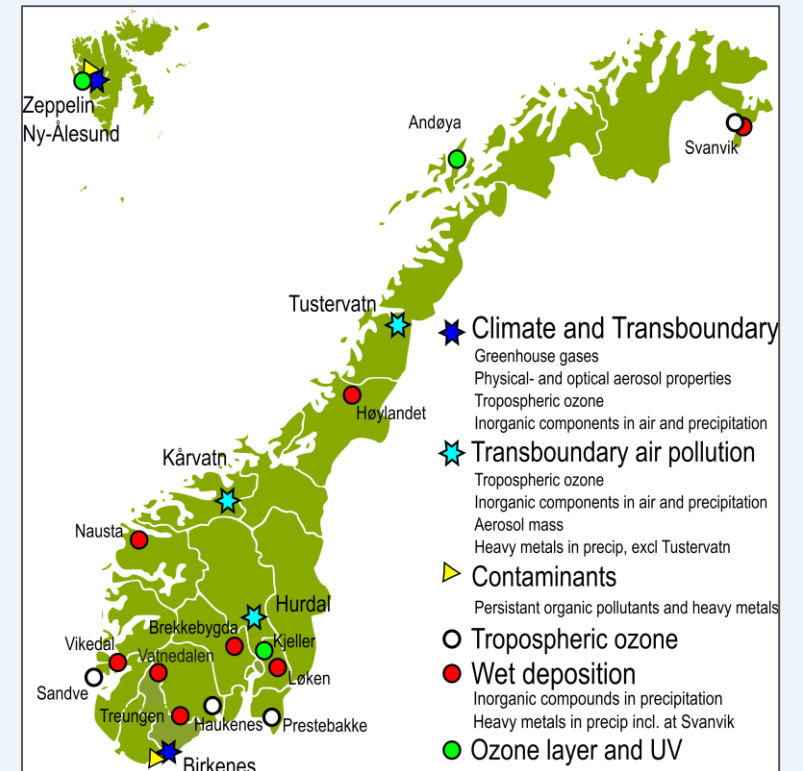
Review the Polish monitoring programme to give guidance on how to improve/strengthen the assessment of atmospheric deposition, using the Norwegian experience:

- Opening conference in Norway with study visit to the Birkenes Observatory
- Report on how monitoring programme in Norway fulfils its purposes
- Use the Polish deposition data and modelling data to assess the functioning of the current system (i.e., locations of sites, number of sites and components included)



The Norwegian national monitoring programme

- **Fulfill several purposes**
 - Transboundary fluxes, contaminants, climate change, ozone layer
 - Provide data for effect studies (i.e. LRTAP WGE) and research on atmospheric processes
 - Trends (compliance monitoring, i.e for LRTAP EMEP)
- **Sites of different complexities**
 - From very advanced/research oriented to only include a few compounds
- **Long term (financial) commitment**
(50 year –start in 1973)



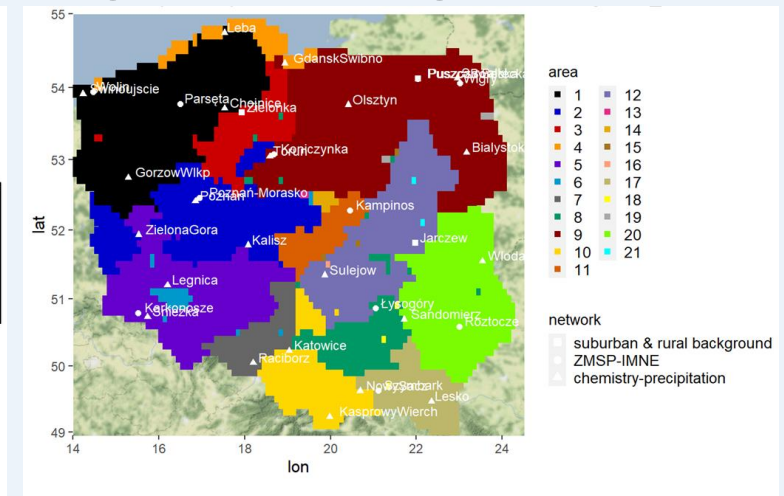
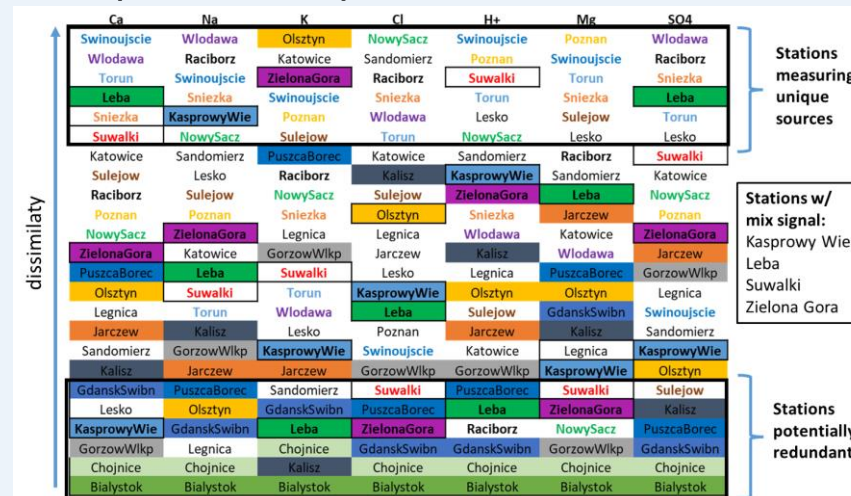
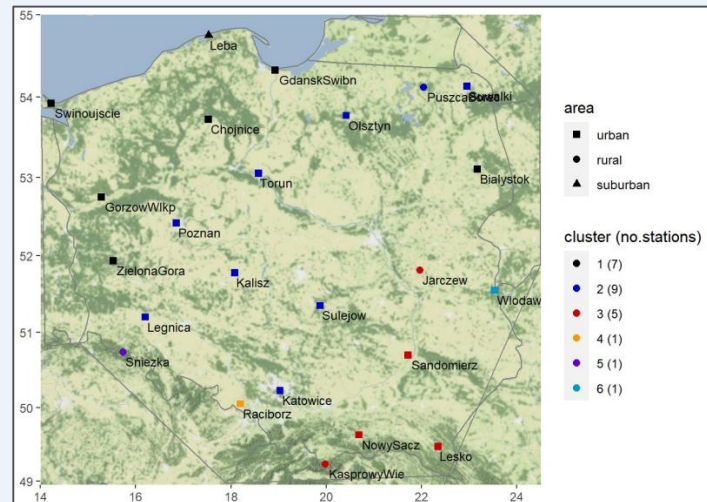
Use of clustering analysis for optimisation of the Polish deposition network

NILU developed a screening tool to:

Assess the similarity on deposition levels and temporal behavior between sites

Ranking stations according to their similarity and indicate uniqueness & potential redundancies

Inferring the area of representativeness for a single station using model data

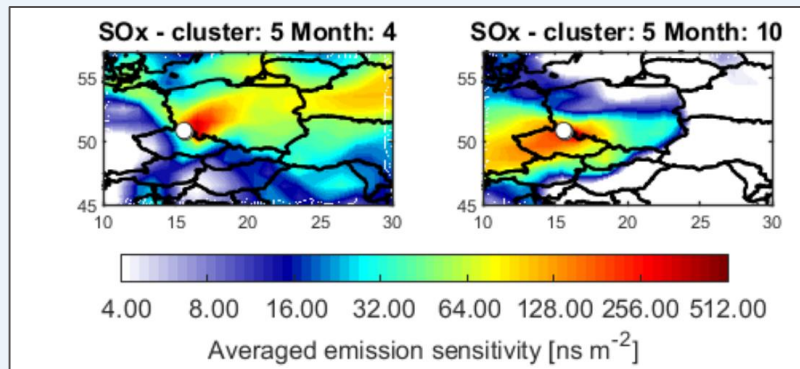


Assess the most relevant source regions for different stations/clusters

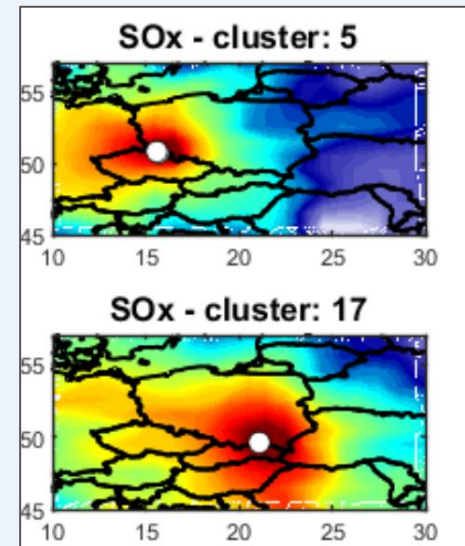
Investigate which emission regions potentially will influence specific stations of the network.

- Mostly influence by Polish sources
- Differences between sites and seasons

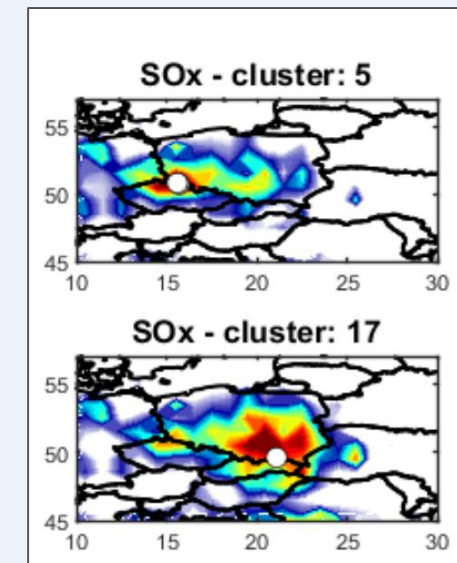
Seasonal differences



Emission sensitivity
(residence time of air masses)



Emission contribution
(using the ECLIPSE SO₂ inventory).



Remarks

The Norwegian perspective

- Norway has some of the longest time series of high-quality atmospheric observations
- Assessment of deposition across Norway is done every 5 years to support calculations of exceedances in critical loads
- Too few sites to estimate spatial deposition of heavy metals and POPs

Evaluating and improvement of the polish monitoring programme regarding the:

- Measurement programme
- Site representativity and characterization
- Number of sites needed

Lessons learned

- Open and transparent communication
- Co-benefits –learned from each other
- The polish monitoring data and results are important also in a European perspective

Note: EMEP Task force of measurement and modeling (TFMM) meeting in **Warsaw 6-7 May 2024**

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Activity 2: The concept of the quality assurance/quality control system (QA/QC) for deposition measurements

Helene Lunder Halvorsen, Wenche Aas,
Erik Andresen, Pernilla Bohlin-Nizzetto,
Leif Marsteen, Hilde Uggerud

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Main tasks for NILU in Activity 2

Give guidance on how the QA/QC system for atmospheric wet deposition measurements can be optimized under the Polish monitoring programme, using the Norwegian experience:

- Report describing the Norwegian methodology for precipitation measurements, with focus on the QA/QC measures involved during sampling and analysis.
- Opening conference in Norway with study-visit to NILU's research laboratory and demonstration of the Laboratory Information Management System (LIMS).
- Support the development of the QA / QC system for atmospheric deposition measurements in Poland, incl. discussion on methodologies for the measurement of chemistry precipitation based on NILU's expertise and experience in this field.
- Training workshop in Warsaw, with focus on chemical analysis of Persistent Organic Pollutants (POPs) and mercury in precipitation.



QA/QC of precipitation measurements in Norway

SAMPLING:

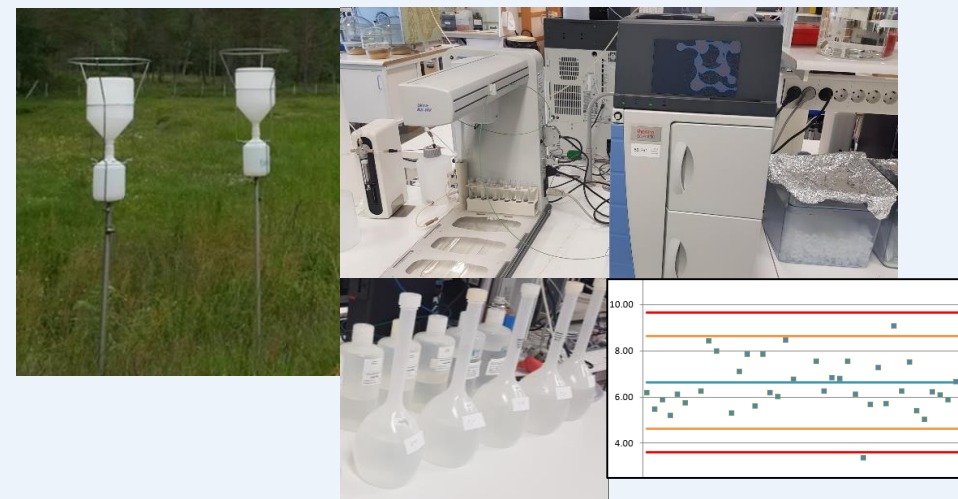
- Bulk sampler (funnel + bottle type)
- Daily/weekly sampling (continuity)
- Sampling equipment: Analyte dependent material and pre-cleaning
- Preservation and storage of the sample

CHEMICAL ANALYSIS:

- Sample preparation (e.g. POPs)
- Instrumental analysis (e.g. ion chromatography, ICP-MS, CV-AFS, GC-MS)
- Calibration and control samples (e.g. high-grade quality standards)
- Certified reference materials
- Laboratory intercomparisons
- Blank control (e.g. high-grade quality solvents, clean environment, field/lab blanks)

GENERAL:

- Traceability at all levels, documentation of deviations
- Standard operation procedures
- Trained operators
- Data quality control

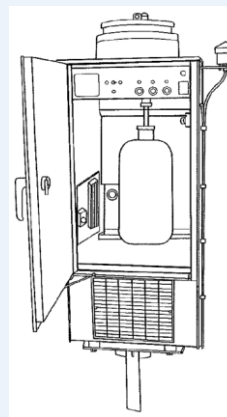


Modernization and optimization of precipitation measurements in Poland

- Measurement network of 19 stations (incl. EMEP; Łeba, Puszcza, Borecka, Jarczew, Szymbark and Karkonosze)
 - Plan to analyze inorganic components (e.g. pH, conductivity, anions/cations), heavy metals (incl. Hg), PAHs and POPs
- Frequency (daily/weekly) and analytes depending on the station (EMEP level 1/2)

SAMPLING:

- wet-only precipitation collector with temperature control and comparison with a rain gauge
- Bottles/funnels specific to the collector type (polyethylene or glass)
- Inorganic components/heavy metals and POPs in separate bottles
- Cooling and temperature control during transport
- Storage cold (or in freezer)



CHEMICAL ANALYSIS:

- In-situ measurements of pH and conductivity
- Splitting if determination of both heavy metals and inorganic components
- Monthly bulk samples

Remarks

- The targeted analytes fulfill (and exceed?) EMEP requirements
- General broad experience and satisfactory QA/QC of analytical procedures
- The guidelines from EMEP and GAW, in addition to relevant reference standards, complemented the Norwegian experience
- Less experience with measurements of POPs and Hg in precipitation
 - POPs: Method adopted from surface water
 - Expected to be applicable
 - NILU recommends to include PCB-52 in the list of PCBs (reported in the sum of 7 indicator PCBs)
 - Hg: Planned to be analyzed with CV-AFS, on the sample for heavy metals?
 - NILU recommends a dedicated sampler (IVL type) to avoid loss. Eigenbrodt NSA181 might be an alternative if wet-only.
 - Glass/PTFE bottle recommended for sampling
 - Immediate preservation necessary, i.e. recommended to add HCl to glass bottle prior to sampling



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Activity 3: Review and recommend techniques for atmospheric deposition assessment

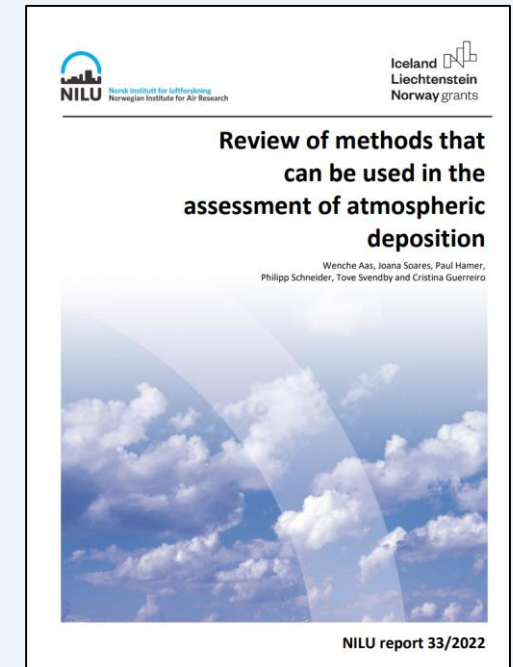
Joana Soares, Wenche Aas, Cristina Guerreiro, Paul Hamer, Philippe Schneider, Tove Svendby

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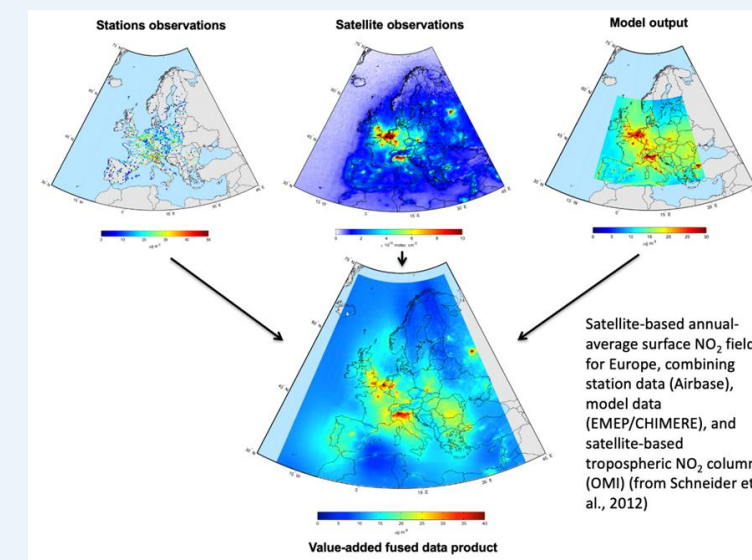
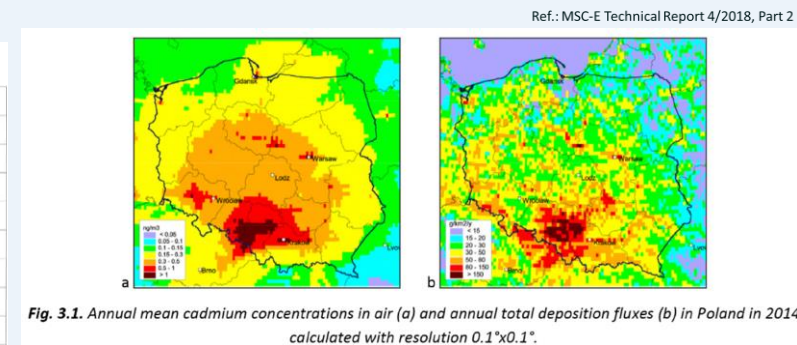
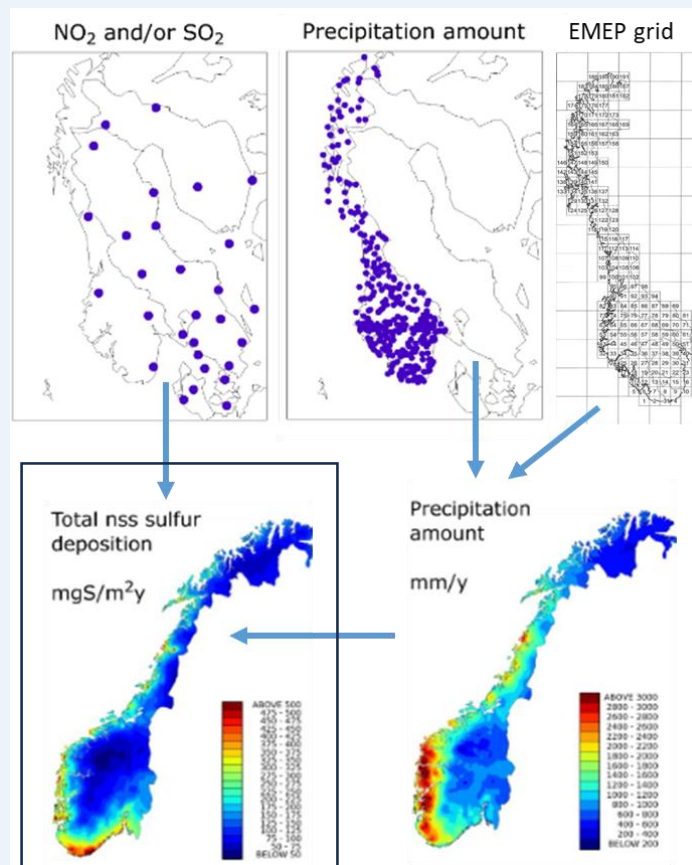
Main tasks for NILU in Activity 3

- Make a review of which methods are being used for the assessment of atmospheric deposition
- Norwegian perspective and experiences
- European perspective (CAMs, EMEP, EEA)
- Recommend and give guidance to the Polish assessments on the use of various statistical and modelling techniques



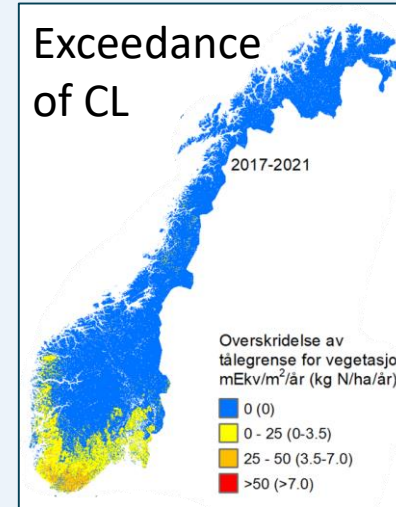
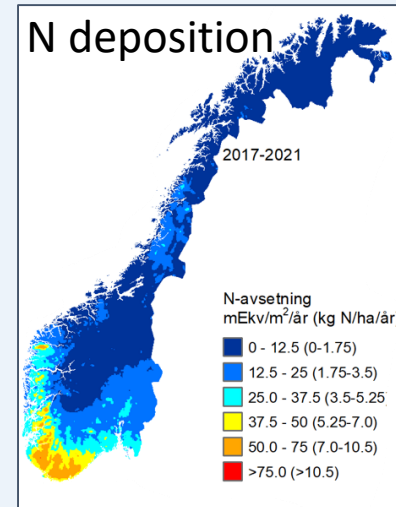
Approaches for estimating the atmospheric deposition

- Using measurements of air and precipitation chemistry combined with statistical interpolation (kriging)
- Using chemical transport models
- Combining observations and atmospheric model calculations: using data assimilation or measurement-model fusion

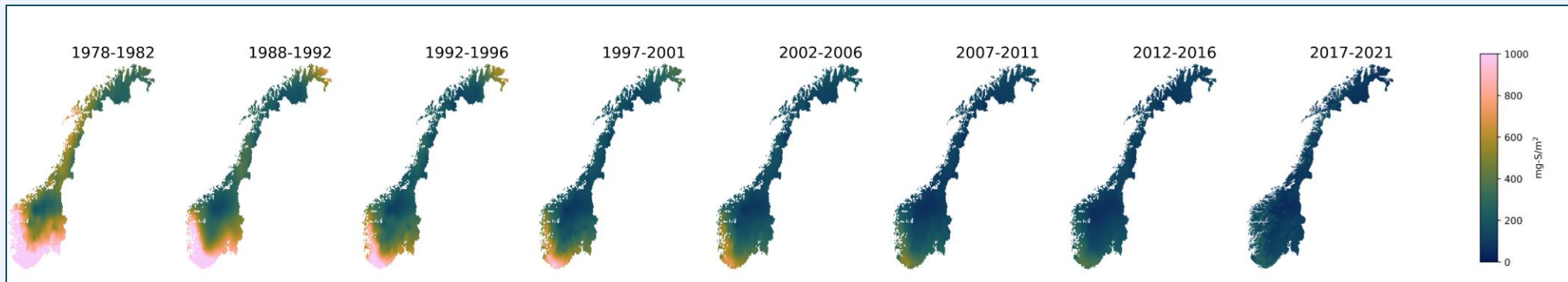


Approaches in Norway

Measurement-model-fusion
for assessing exceedance of
critical loads (CL)



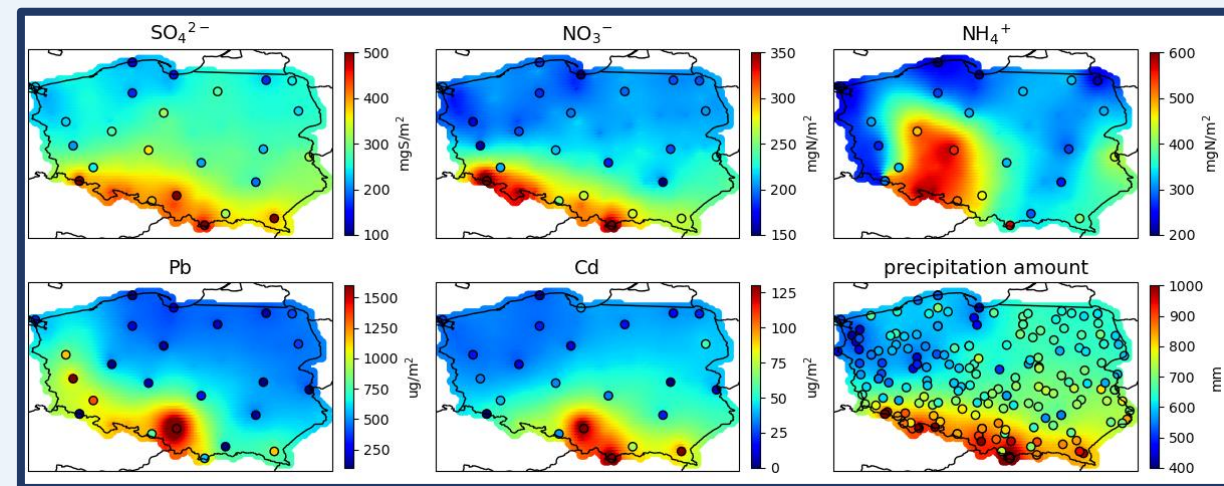
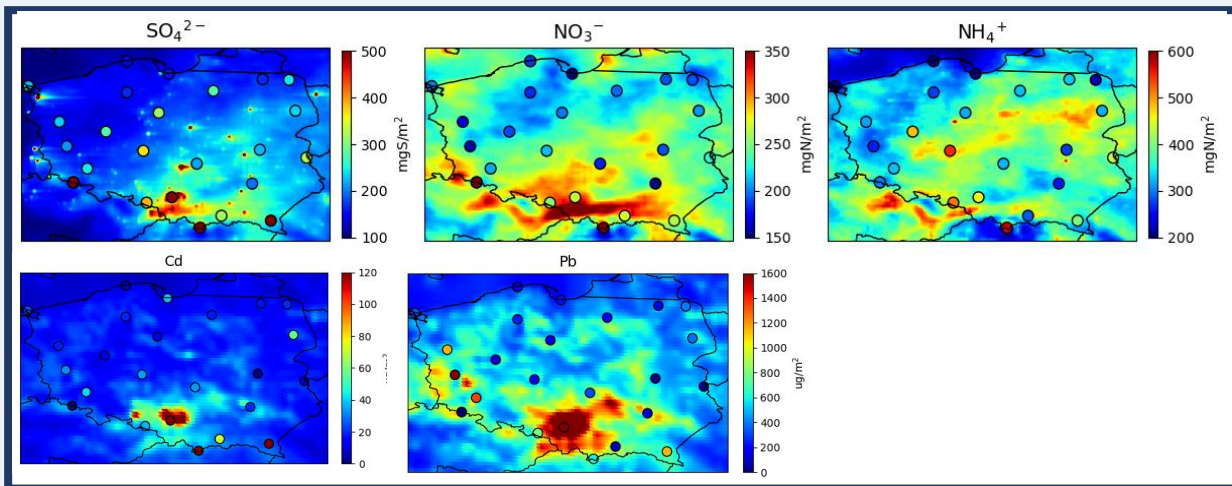
Observational
based (**kriging**)
method used
for trends (tot S)



Assessed methods possible to use in Poland for deposition estimates

Model calculations available from EMEP

Calculations from observations using Kriging



Remarks

The Norwegian perspective

- Used the statistical kriging technique for more than 40 years
- Not sufficient sites to get good representation, and biased distribution along the coast and in mountain regions
- Transport models and reported emissions have improved considerably over the years
- Use of data model fusion improved results

The Polish perspective

- Relatively large network with good coverage of the different regions in Poland for several components
- Long experience in statistical interpolation
- Improved deposition estimates using the Kriging technique

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Activity 4: Visualisation and making available atmospheric deposition data via the CIEP 'Air Quality' website

Rune Ødegård, Nechrvan Murad,
Mona Johnsrud, Wenche Aas, Joana
Soares, Claudia Hak, Christoffer Stoll

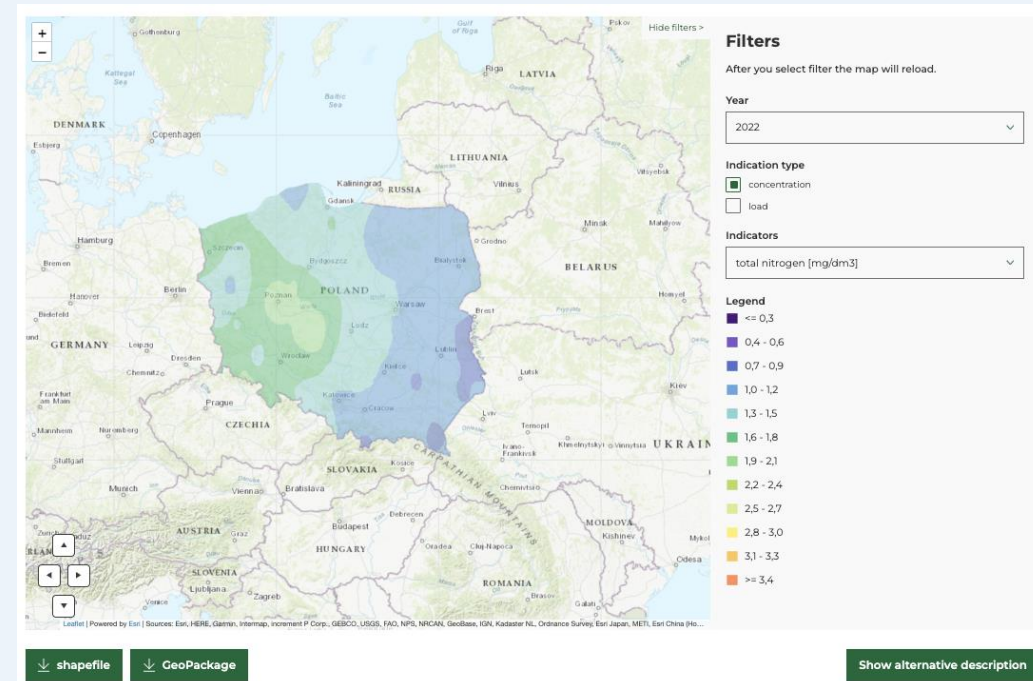
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New GIOS website dedicated to atmospheric deposition

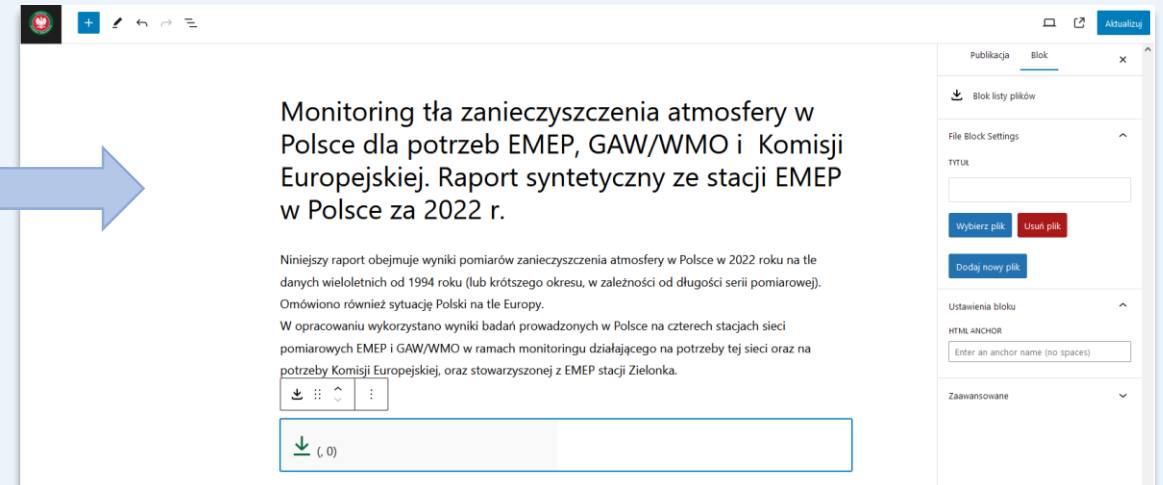
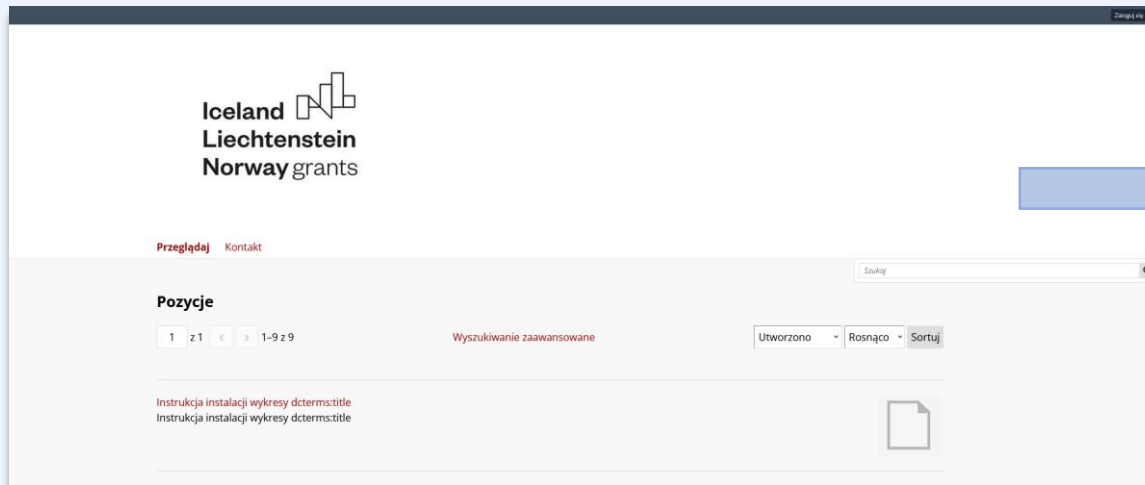
- Review of the description of the procurement "The concept of visualization and sharing atmospheric deposition data via the CIEP's Air Quality portal and its implementation".
- Testing and providing feedback on the English version of the portal, including the production version for final testing.

*Comment from one of the testers:
"Very impressive and nice portal!"*



New GIOS website dedicated to atmospheric deposition

- As part of the activity, NILU adapted / modified the file repository for the needs of storing files published on the new CIEP website dedicated to atmospheric deposition, such as publications, reports and assessments.
- The use of the repository will streamline file management and editorial work.



Modification/adaption of the file repository Omeka S (open-source project) to fulfill GIOS's requirement

File Transfer Mechanism: A system to identify and copy marked files from an internal server (within the intranet) to a server located in the DMZ, ensuring that only selected files are made available for public access.

URL Collection Mechanism: A tool to gather and store the URLs of the files that are publicly available on the DMZ server.

File Tagging Mechanism: A feature that allows users to tag files with "Public" or "Private" statuses. This tagging will determine which files are eligible to be copied to the DMZ for public access.

Creation API services for public address of the file and the state of the checkbox Public/Private.

Making a connection/link between Omeka-S and WordPress (the portal).

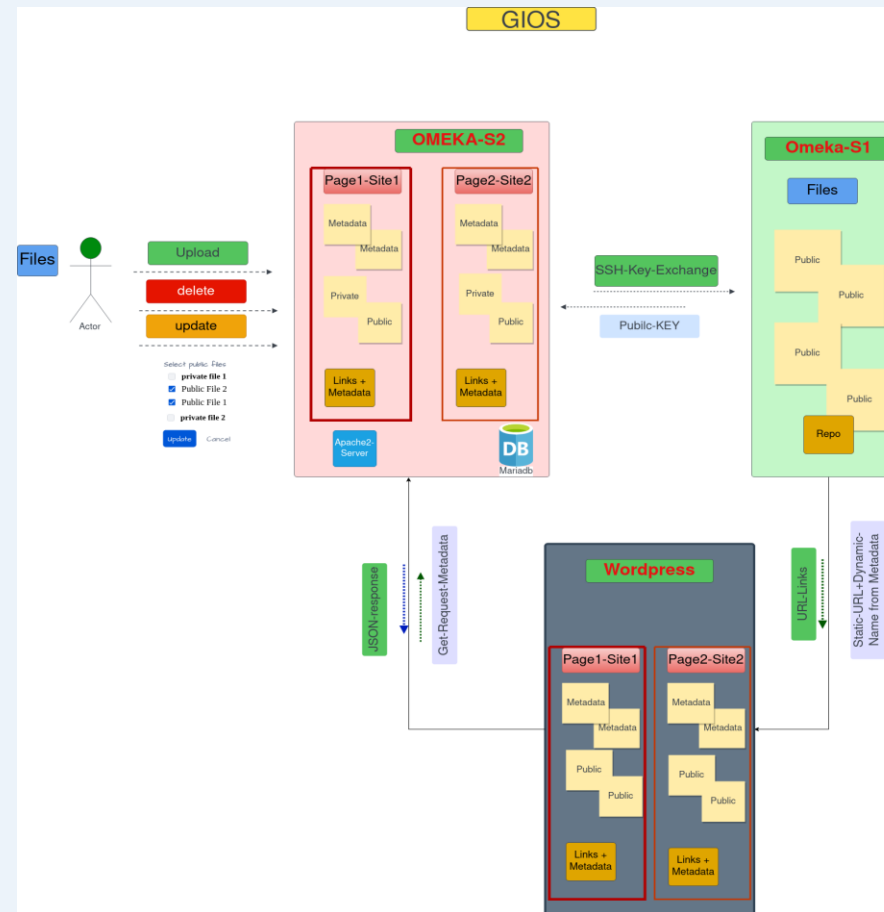
Adjusting the design of the tools.

*There was some functionality that was not possible for the developer to do, for instance configuration of **KeyCloak** Authorization Services for Omeka-S for handling one common user management database.*

Modification/adaption of the file repository Omeka S (open-source project) to fulfill GIOŚ's requirement

Created and submitted:

- codes for modified software,
- documentation



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