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Strategy Workshop:

Tackling Environmental Challenges

On Zoom 2021-09-01

Kajsa Sigfridsson Clauss, Noelle Walsh, Kim Nygård

MAX IV

Program

9:00 - 9:15 **Welcome and introduction** *(Marjolein Thunnissen, Noelle Walsh & Kajsa Sigfridsson Clauss)*

9:15 – 9:35 **Strategy and Roadmap process** *(Martin Stankovski)*

9:35 – 9:45 **Current version of "Tackling Environmental Challenges" section** *(Kim Nygård)*

9:45 – 10:00 Break

10:00 – 11:00 **User session** *(please submit your contribution, latest Aug 31st)*

11:00 – 12:00 **General discussion** *(chaired by Noelle, Kim & Kajsa)*

12:05 – 12:15 **Conclusions**

TEC Community

- Environmental sciences (soil, water, geochemistry, etc.)
- Atmospheric science (aerosols, etc.)
- Climate
- Sustainability (materials, food, recycling, etc.)
- Biodiversity (mass extinctions, etc.)
- And more

In common
Dynamic processes rather than static properties
Multiple length and time scales
Real rather than model systems

MAX IV

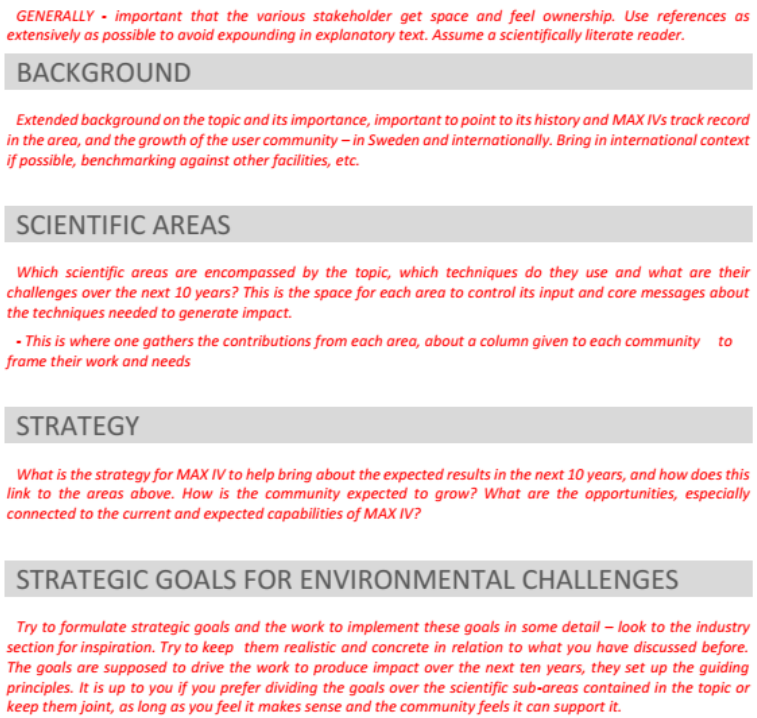
Goals of this workshop

- Bring together the TEC user community
- Collect input from TEC user community
  - What science will be in focus the next 10 years?
  - How can MAX IV provide the tools to facilitate?
- Form a working group for the “TEC strategy document”.
- Select TEC contributions to the forward-looking session on the 33rd MAX IV User meeting.

TEC Strategy document

- Working document for the TEC strategy – providing a detailed overview of the strategy
- Collect all written input – i.e. encompassing input from all TEC-relevant fields
- This working document will provide basis for a revised 2-page summary that represents TEC in the "MAX IV Strategy 2030"
- Importantly, this TEC strategy document will reflect the needs of the broader community and will be available as an attachment to the "MAX IV Strategy 2030" pamphlet.
- In shared folder (e.g. BOX).

TEC Strategy Template



GENERALLY - important that the various stakeholder get space and feel ownership. Use references as extensively as possible to avoid expounding in explanatory text. Assume a scientifically literate reader.

BACKGROUND

Extended background on the topic and its importance, important to point to its history and MAX IVs track record in the area, and the growth of the user community – in Sweden and internationally. Bring in international context if possible, benchmarking against other facilities, etc.

SCIENTIFIC AREAS

Which scientific areas are encompassed by the topic, which techniques do they use and what are their challenges over the next 10 years? This is the space for each area to control its input and core messages about the techniques needed to generate impact.

- This is where one gathers the contributions from each area, about a column given to each community to frame their work and needs

STRATEGY

What is the strategy for MAX IV to help bring about the expected results in the next 10 years, and how does this link to the areas above. How is the community expected to grow? What are the opportunities, especially connected to the current and expected capabilities of MAX IV?

STRATEGIC GOALS FOR ENVIRONMENTAL CHALLENGES

Try to formulate strategic goals and the work to implement these goals in some detail – look to the industry section for inspiration. Try to keep them realistic and concrete in relation to what you have discussed before. The goals are supposed to drive the work to produce impact over the next ten years, they set up the guiding principles. It is up to you if you prefer dividing the goals over the scientific sub-areas contained in the topic or keep them joint, as long as you feel it makes sense and the community feels it can support it.

½ Page /contribution

Timeline

September 15th - Forming working group

September 30th - 1st deadline for submission of contributions

September 30th - start 1st draft of the TEC strategy document

Questionnaire (deadline September 8)

4. What is your interest in the transformative science "Tackling Environmental Challenges" of the MAX IV strategy?

5. Do you think that there is something missing from the current version of the transformative science "Tackling Environmental Challenges" text?

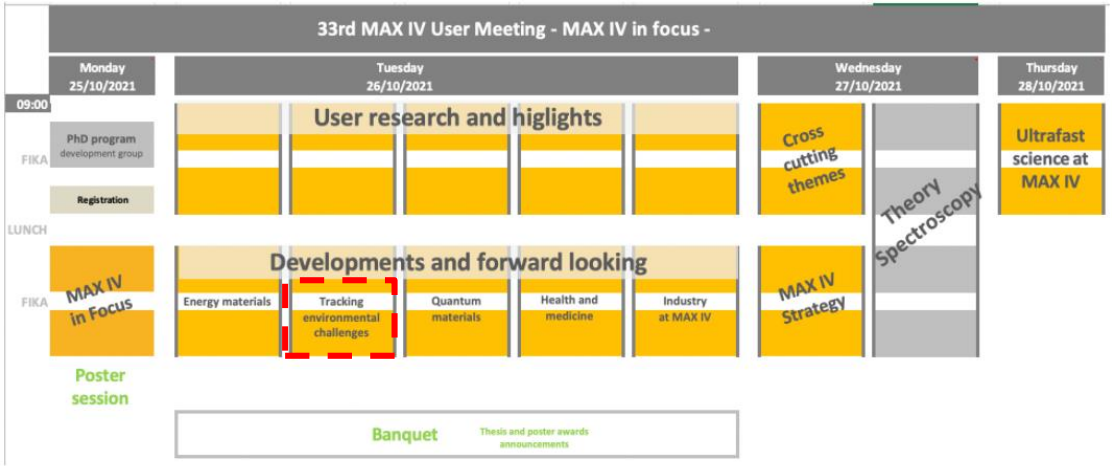
6. What **scientific questions** are you expecting to be working on over the next 10 years? In what way can MAX IV provide tools/services/infrastructure to **facilitate** your research?

7. Would you be willing to join the **working group** that will coordinate the development of the TEC strategy working document?

8. Would you be willing to make a **presentation** that highlights those directions that you see as relevant to your scientific work in the future on the workshops/**user meeting**?

33rd MAX IV User Meeting 25-27 October

- Working together - MAX IV in Focus -
- Abstract submission, deadline **September 3** (on Friday!)
  - https://indico.maxiv.lu.se/event/4907/abstracts/
  - https://indico.maxiv.lu.se/event/4907/registrations/378/
- Forward-looking session "Tackling Environmental Challenges"



Contact TEC session: kajsa.sigfridsson_clauss@maxiv.lu.se

Timeline

September 8th - Questionnaire

September 15th - Forming working group

September 30th - 1st deadline for submission of contributions

September 30th - start 1st draft of the TEC strategy document

October 25-27th - MAX IV User Meeting

TBA - 2nd TEC workshop

March 1st 2022 – Input for "MAX IV Strategy 2030" pamphlet.

The word to Martin Stankovski

STRATEGY AND ROADMAP PROCESS

The word to Kim Nygård

CURRENT VERSION OF “TACKLING ENVIRONMENTAL CHALLENGES” SECTION

Short history of the current version

- Initially three separate contributions: environment, climate, & sustainability
  - Informal input from the user communities
- Combined to a single contribution: tackling environmental challenges
  - Necessity due to space constraints
  - Broad user community, common identity?
- Further streamlined

Current version

3.3 TACKLING ENVIRONMENTAL CHALLENGES

In brief

Today we face many environmental challenges, ranging from human impact on climate and the environment to the phasing out of our dependency on fossil resources. Tackling these environmental challenges and achieving the global development goals are an essential part of four out five missions in the Horizon Europe funding programme. Common themes within these lines of research are dynamic processes rather than static properties, coupling of different length and time scales, and work on real rather than model systems.

Environmental science investigates the complex system of our natural environment and the anthropogenic impact. This challenge includes areas such as: Atmospheric Science and Aerosols, Renewable resources and Sustainable materials, Food with food production, and Soil & Water Science. MAX IV has unique capabilities to contribute to solving these challenges, and we will strengthen these over the next 10 years through the development of many new beamlines, enhancing these and upgrading existing beamlines with the appropriate support infrastructure, and finally by targeting the user experience and support of the scientific communities active in the area.

Mobilising for the challenge

MAX IV has a strong Swedish and international user community engaged in tackling environmental challenges. This research involves crucial investigations to understand the very complex system of our natural environment and the anthropogenic impact. Grand

challenges in focus are, for example, the carbon cycle, today a disturbed dynamic process with fast carbon emission (CO_2 and/or CH_4) com-pared to slower binding and its effect on the climate. Equally urgent topics include the unbalanced phosphor cycle due to the use of agricultural fertilizers, anthropogenic aerosols and their interactions with clouds, and replacement of fossil-based materials with sustainable alternatives.

Fundamental understanding is of the utmost im-portance to find mitigations for sustainable use of the biosphere. The C and P cycles are integrated parts of soils, which are the most important, but also the least understood ecosystems. To gain deeper under-standing of the biogeochemistry of the soil requires knowledge of chemical compositions on many different length scales.

Aerosol particles in the atmosphere influence both atmospheric chemistry and the earth radiation budget. A better molecular-level understanding of aerosol surface properties and processes is required to accurately describe aerosols in climate models.

Sustainability questions in general are high on the agenda of major industrial complexes in Sweden, tied to mining, processing, plastics, and forestry.

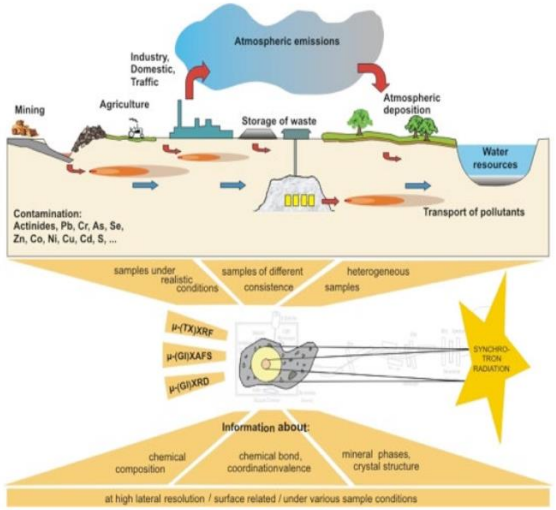


Figure 2 –Schematic over different contamination and pllution pathways in the ecosystem and a map over different X-ray-based techniques that can help map the circulation, transformation and concentration of pollutants. [Illustration design to be updated]

Several large research initiatives with strong academic and industrial participation exist today.

Future challenges

To advance environmental science there is a need to study as close to the real complex samples and systems as possible and move away from simple models. Moreover, the processes involved occur over many different time and length scales. To investigate the uptake and distribution of chemicals, nutrients and pollutants in soil, organisms or cells in *in-situ* soil reactions would require specialized controlled sample cells in combination with high chemical and spatial resolution.

The large surface-to-volume ratio of many aerosols influences the chemistry that takes place at the aerosol surface as well as nucleation processes. A complete understanding of the role of aerosols in atmospheric chemistry and climate change therefore requires a strong interdisciplinary approach. Many other challenges connected to sustainability relate to the development of both novel material concepts, utilizing the properties of complex bio-based materials, and new means of materials processing, due to the unique requirements of bio-based raw materials.

The role of MAX IV

The wide spectrum of X-ray techniques available at MAX IV can shed light on the complex nature of environmental systems. Thjs research area, which often requires a combination of techniques to unravel the details of processes, benefits from the the full range of techniques: spectroscopy, imaging scattering and time-resolved methods, and combinations of them in many instances, such as chemical contrast on different length and time scales.

The environmental science community would benefit from flexible access to a broad portfolio of such techniques at MAX IV in contrast to specific single beamline proposals.

Current version: pros and cons

- Highlights common themes
  - Dynamic processes rather than static properties
  - Multiple length and time scales
  - Real rather than model systems
- Does not give credit to the whole TEC user community
  - Environmental sciences (soil, water, geochemistry, etc.)
  - Atmospheric science
  - Climate
  - Sustainability (materials, food, recycling, etc.)
  - Biodiversity
  - And more
- Context, clarity?

Opportunity with TEC Strategy working document and the revised version

- ***User community*** will provide a detailed overview of the strategy
  - Input from all TEC-relevant fields
- ***User community*** will provide a revised 2-page summary in the "MAX IV Strategy 2030"
  - Coherent
  - Reflects the needs of the broader community

User session 10:00 – 11:00

10:00 “Towards a new LINXS theme connected to environmental and climate research” – *Dimitrios Floudas (LU)*

10:12 “XAS for studies of chemical forms of trace metals in 1) Industrial side streams and 2) emissions to the atmosphere” - *Jenny Rissler (RISE, LTH)*

10:18 "Organic matter in the dynamic soil pore space " - *Edith Hammer (LU)*

10:24 ”Using synchrotron radiation to understand the function and resilience of soils” - *Carin Sjöstedt (SLU)*

10:30 “Studying aerosols to understand climate change and improve air quality” - *Calle Preger (LTH)*

10:36 “Characterisation of carbon-capturing concrete” - *Päivö Kinnunen (Oulu)*

10:42 "Future microfocus beamline" - *Alexander Björling (MAX IV)*

10:48 "MIRARI – a future IR microscopy beamline" - *Milda Pucataite (LU)*

10:54 "Sustainable Challenges in Big Science Operations" - *Emilio Asensi (ESS)*

Discussion points

- Do you think that there is something missing from the current version of the transformative science "Tackling Environmental Challenges" text?
- What are your science questions the next 10 years?
  - In what way can MAX IV provide tools/services/infrastructure to facilitate your research?
  - Instruments, proposals (e.g. cross-beamline research), training, data pipeline, etc.
- What to highlight on the MAX IV user meeting?
- TEC Goals 2030

Other workshops

https://www.maxiv.lu.se/about-us/strategy/workshops/

June 17th , 2021 Tender X-ray e.g. HAXPES beamline workshop

August 24th, 09:00 – 12:00 CET, 2021 – Workshop on a future hard X-ray operando diffraction beamline – OPERA

August 26th, 13:00 – 17:00 CET, 2021 – Workshop on a Future µ-Spectro-microscopy Beamline

September 3rd, 13:00 – 16:15 CET, 2021 – Workshop for IR spectromicroscopy beamline MIRARI

September 8th, 09:00 – 12:15 CET, 2021 – Energy Technologies and Materials I – Workshop on photovoltaics and related materials

September 10th, 09:00 – 12.15 CET, 2021 – Energy Technologies and Materials II – Workshop Energy Conversion: Thermal- and Electrocatalysis

September 10th, 2021 – Upgrade of the "dirty matter" photoemission endstation at the FlexPES B-branch at MAX IV

September 23rd, 09:00 – 12.15 CET, 2021 – Energy Technologies and Materials III – Workshop Bioenergy Technologies

September 24th (tentative), morning, 2021 – Energy Technologies and Materials IV – Workshop Energy Storage

September 28th, 15:00 – 17:00 CET, 2021 – Presentation of the Conceptual Design Report for the Soft X-ray Laser@MAX IV (SXL)

October 5th – October 6th, 2021 – Workshop "ARPES in Sweden"

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Workshop conclusions

- **Mentor/Portal program to help inexperienced users (academic or industrial)** to **access** MAX IV and to **train/assist them in beamtimes**
- The availability of a **gateway environment**... to help prepare for beamtimes... (LINXS??)
- For **both of the above – long term funding is required**. Should be discussed with MAX IV and the universities...
- **More outreach** is required to highlight what can be done... (clear from the comments)
- The **community have highlighted the need for cross-beamline access** (possibility to apply for this via DUO?)
- Note: A **separate industry strategy document is also under production and will be published soon** and will give more insight on possibilities for industry
- With regards to the **TEC transformative science section of the MAX IV Strategy 2030** text :
- - the **connection between the future challenges and the role of MAX IV should be sharpened**.
- **– difficult to comment on the text until they see the next version that includes input from the universities**
- **- Martin S will provide the list of comments/feedback and v1 of the MAX IV Stratey 2030 draft so that the working group can ensure that these comments have been addressed**
- - Martin S urges everyone to think about what goals would make sense for the area.
- - we need to also **consider the existing beamlines and how can these help solve some of the future pressing questions**...
- - A question re **what are we (MAX IV and communities) aiming for at MAX IV? Place more emphasis on the science questions... this should be considered by evaluation committees**
- When to involve funding agencies in the EOI process?