

Water Quality Session 1: Modeling protocol

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Task Group 3.9 in PROCLIAS Cost Action
Coordination team



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Large international community



Water quality sessions

- Session 1 (today 15.30-17.00): modelling protocol
- Session 2 (tomorrow 10.00-11.30): regional modelling
- Session 3 (tomorrow 13.00-14.00): updates, posters, next steps

Program 15.30-17.00

15.30-15.50 Introduction to the protocol

15.50-16.45 Discussion

16.45-17.00 Follow-up activities

Important terminology

- **WQ-MIP: Water Quality Model Intercomparison Project**
- **ISIMIP: Inter-Sectoral Impact Model Intercomparison Project**
- **Proclias: Process-based models for climate impact attribution across sectors**
- **CMIP: Coupled Model Intercomparison Project (climate forcing)**
- **WWQA: World Water Quality Alliance**
- **SSP: Shared Socio-economic Pathways**
- **RCP: Representative Concentrative Pathways**

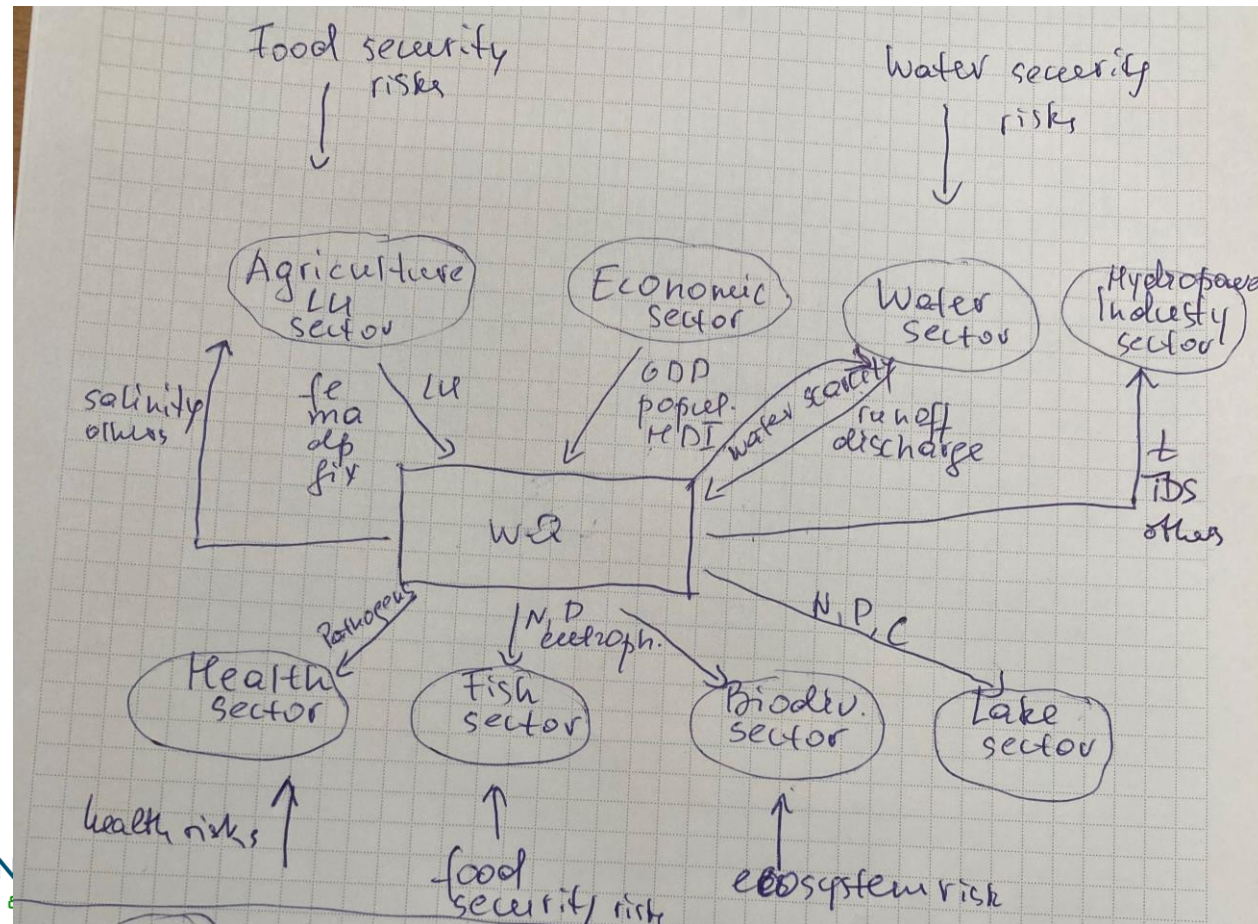
ISIMIP2 vs ISIMIP3

	ISIMIP2	ISIMIP3
Pre-industrial	1661-1860	1661-1850
Historical	1860-2005	1850-2014
Projections	2005 -2100	2015 -2100
RCP	2.6 6.0 8.5	2.6 7.0 8.5
RCP-SSP	2.6-ssp2 6.0-ssp2	2.6-ssp1 7.0-ssp3 8.5-ssp5
WQ scenarios (available)*	4.5/2.6-ssp1 6.0-ssp2 8.5-ssp5	Next steps / update
CMIP	CMIP5	CMIP6

*The scenarios of the UN-World Water Quality Alliance (WWQA)

Why Model Intercomparison Projects for Water Quality (WQ-MIP):

- Water quality is key in understanding **cross-sectoral processes**



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- **Build the water quality community within ISIMIP/Proclias**
- **Together, we can contribute to new insights**

Why Model Intercomparison Projects for Water Quality (WQ-MIP):

- Water quality is key in understanding **cross-sectoral processes**
- **Build the water quality community within ISIMIP/Proclias**
- **Together, we can contribute to new insights**
- **1) Identify, assess and compare water pollution**
 - Hotspots
 - Sources
 - Trends

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 - Trends
- **2) Identify and set priorities for water quality**
 - Data collection
 - Data monitoring

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- **1) Identify, assess and compare water pollution**
 - Hotspots
 - Sources
 - Trends
- **2) Identify and set priorities for water quality**
 - Data collection
 - Data monitoring
- **3) Perform scenario analyses** to test strategies to
 - Improve water quality
 - Under climate change and socioeconomic developments

Five types of diversity challenge WQ-MIP

1) Different **modeling approaches**: 1) laws & assumptions; 2) spatial representation (lumped vs. distributed) and 3) temporal representation (static vs. dynamic)

2) Different **water quality constituents and dimensions**

- Different forms (dissolved vs. particulate)
- Loads, concentrations, export

3) Different **types of water resources**:

- Streams, rivers
- Lakes, reservoirs
- Groundwater
- Coastal/estuarian areas

4) Different **spatial resolutions and extend**

- Basin, subbasin
- Gridded e.g. 0.5 deg (50 km), 5 arcmin (10 km)
- Hydrological response unit

5) Different **temporal resolutions and time periods**:

- Annual
- Monthly
- Daily

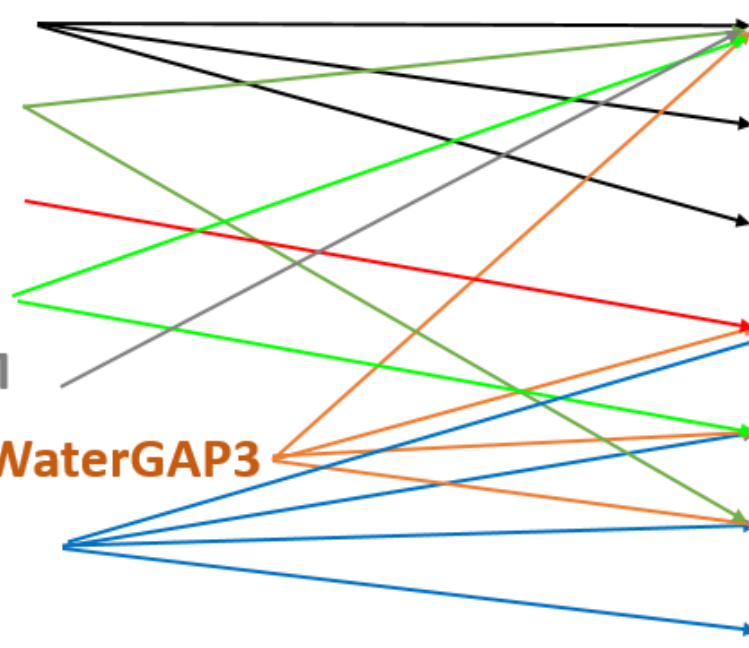
Examples of large-scale models

Models:

- MARINA
- SWAT
- GloWPA
- GREEN
- IMAGE-GNM
- WorldQual-WaterGAP3
- DynQual

Water quality variables:

- Nutrients
- Plastics
- Chemicals
- Pathogens
- Organic (BOD)
- Salinity (TDS)
- Temperature




Based on the overview of the World Water Quality Assessment

Modelling protocol for WQ-MIP: 1st draft

- A guide for water quality modelers
- August 2022 workshop

Water Quality Protocol

Working document



Proclias Task Group 3.9: Coordination team


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PRoCI CLIAS



ISIMIP
Inter-Sectoral Impact Model
Intercomparison Project



WAGeningen
UNIVERSITY & RESEARCH

DRAFT (August 2022)

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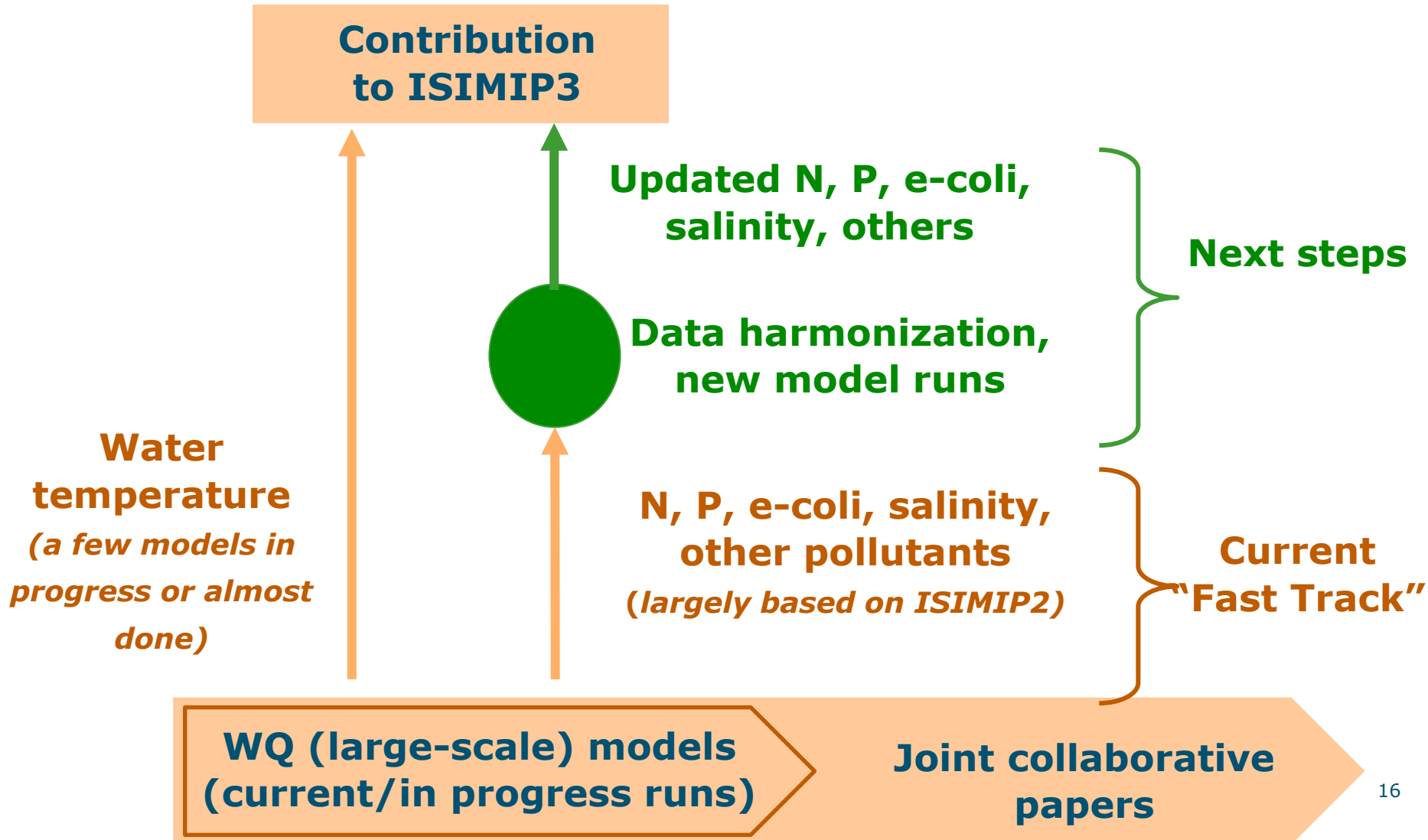
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Note:
This document is draft. It is not complete. The document aims to start discussions on developing protocol(s) for large-scale water quality models. It follows the template of ISIMIP, but adjusted to water quality.

Modelling protocol for WQ-MIP: **1st draft**

- A guide for water quality modelers
- August 2022 workshop
 - Model inputs and outputs
 - Challenges: inconsistencies and harmonization
 - Opportunities:
 - Keep It Simple (KIS approach)
 - Acknowledge inconsistencies
 - Be transparent
 - **Everyone should feel welcome to join/contribute**
 - The basis to develop the 2nd draft of the protocol

Strategy to build our water quality community within ISIMIP



Modelling protocol for WQ-MIP: **2nd draft**

- **A “Fast track” water quality protocol (2023-2024)**

Modelling protocol for WQ-MIP: **2nd draft**

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 - Focuses on better understanding water pollution levels, their hotspots, and sources as well as trends at different temporal and spatial scales

Modelling protocol for WQ-MIP: 2nd draft

- **A “Fast track” water quality protocol (2023-2024)**
 - Focuses on better understanding water pollution levels, their hotspots, and sources as well as trends at different temporal and spatial scales
 - Aims to build largely on existing model runs (large flexibility and transiency in inconsistencies)
 - Aims to give an opportunity for all water quality modelers to participate who want to contribute their model results
 - Example: the WWQA “Fast Track” scenarios (a poster in session 3 tomorrow)

Modelling protocol for WQ-MIP: 2nd draft

- **A “Fast track” water quality protocol (2023-2024)**
- **Six aspects** – the basis of today’s discussion to make the next steps
 - Aspect 1: ISIMIP2 (CMIP5) and ISMIP3 (CMIP6)
 - Aspect 2: Water quality constituents
 - Aspect 3: Spatial and temporal resolution
 - Aspect 4: Period
 - Aspect 5: Scenarios
 - Aspect 6: Units

Modelling protocol for WQ-MIP: **2nd draft**

- **A “Fast track” water quality protocol (2023-2024)**
- **Six aspects** – discussion for 35-40 minutes

Modelling protocol for WQ-MIP: **2nd draft**

- **A “Fast track” water quality protocol (2023-2024)**
- **Six aspects** – discussion
- **Instructions:** during discussions
 - **If you are a water quality modeller:** think whether you (or your team) can provide model results using this protocol by **February 2024** (either existing runs or re-run your model if you wish when input data become available)

Modelling protocol for WQ-MIP: 2nd draft

- **A “Fast track” water quality protocol (2023-2024)**
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- **Instructions:** during discussions
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 - **If you are a (potential) user of model outputs:** think whether submitted outputs using this protocol can be useful for your sector (e.g., scales, pollution levels)

Modelling protocol for WQ-MIP: 2nd draft

- **A “Fast track” water quality protocol (2023-2024)**
- **Six aspects** – discussion
- **Instructions:** during discussions
 - **If you are a water quality modeller:** think whether you (or your team) can provide model results using this protocol by **February 2024** (either existing runs or re-run your model if you wish when input data become available)
 - **If you are a (potential) user of model outputs:** think whether submitted outputs using this protocol can be useful for your sector (e.g., scales, pollution levels)
 - **If you are a (potential) provider of model inputs:** think if your sector can provide/suggest input data using this protocol for water quality models (e.g., land use, livestock numbers)

Modelling protocol for WQ-MIP: **2nd draft**

- **A “Fast track” water quality protocol (2023-2024)**
- **Six aspects** – discussion
- **Instructions:** in groups
 - Look at the six aspects, their 1st priority and “if available” (optional) choices
 - Identify aspects/choices that many of you agree
 - Identify aspects/choices that many of you do not agree and list suggestions for them

Six aspects document

- 3 pages with 6 tables
- For each table:
 - You can (if needed) add missing elements
 - You are asked to indicate “Yes” or “No” if you do not agree
 - If “No”, then specify suggestions
- Fill in together as the group (feel free to fill in individually)

Six aspects for the MIP-WQ (Fast Track)

Aspect 1: Focus on both ISMIP2 (CMIP5) and ISMIP3 (CMIP6)

<input type="checkbox"/>	Yes, considering that this is the first “Fast Track” MIP-WQ and diversity in the water quality models
<input type="checkbox"/>	No, specify alternatives, but keep in mind that water quality models are very diverse (in time, space, variables etc.):
.....	

Aspect 2: Water quality constituents (add missing if needed)

Constituent*	Suggested focus
Nutrients (at least one: total N or P)	1 st priority
Water temperature	If available
Organic pollution (e.g., BOD)	
Salinity (e.g., TDS)	
Microorganisms or fecal coliform (e.g., FC)	
Plastics (e.g., microplastic)	
Contaminants (e.g. Arsenic)	If available
DOC (not a contaminant per se but likely to have big ecological implications)	
Silicon
.....	

Suggestions for the 1st priority and “if available” choices sound promising for the “Fast Track” MIP-WQ while acknowledging inconsistencies:

Yes

No, specify alternatives:

.....

*To participate in the WQ-MIP project: Constituents from at least two model simulations or two individual models have to be provided

Aspect 3: Spatial and temporal resolution (add missing if needed)

Spatial resolutions	Suggested focus
0.5 degree grid for outlets of sub-basins / river mouths (coordinates will be provided)	1 st priority
0.5 degree grid	If available
5 arcmin	
.....	
Temporal resolution	Suggested focus
Annual	1 st priority
Monthly / daily	If available
.....	

Suggestions for the 1st priority and “if available” choices sound promising for the “Fast Track” MIP-WQ while acknowledging inconsistencies:

Yes

No, specify alternatives:

.....

Aspect 4: Period (add missing if needed)

Period	Suggested focus
A 3-year average around 2010, 2020 and 2050*	1 st priority
Specific years of 2010, 2050, and 2050 (if no averages)	If available
Specific years or their 3-year averages between 1970-2100	
.....	

Suggestions for the 1st priority and “if available” choices sound promising for the “Fast Track” MIP-WQ while acknowledging inconsistencies:

Yes

No, specify alternatives:

.....

*the baseline: 2010 (CMIP5) / 2015 (CMIP6); the future years: 2030 to justify SDGs and 2050 to justify the Green Deal agenda and for-future trends.

Aspect 5: Scenarios (add missing if needed)

Scenarios	Suggested focus
SSP5-RCP8.5	1 st priority
SSP1-RCP4.5	If available
SSP1-RCP2.6	
SSP3-RCP6.0	
SSP2-RCP4.5 and other combinations
.....	

Suggestions for the 1st priority and “if available” choices sound promising for the “Fast Track” MIP-WQ while acknowledging inconsistencies:

Yes

No, specify alternatives:

.....

Aspect 6: Units (add missing if needed)

Units	Suggested focus
For nutrients: Loads (kg/year)	1 st priority
For temperature: degree Celsius	
Other pollutants: loads or similar units	If available
Concentrations (mg/l)	
.....	

Suggestions for the 1st priority and “if available” choices sound promising for the “Fast Track” MIP-WQ while acknowledging inconsistencies:

Yes

No, specify alternatives:

.....

Discussion

- People online
 - Chairs and assistants:
 - Six aspects: use the link
- People offline:
 - Chairs and assistants
 - Six aspects: use the printed copy and/or the link
- 16.35 come back to the plenary

Discussion outcomes

- 2-3 main outcomes from discussions
- Chairs:
 - Online: Carolien Kroeze, Michelle van Vliet
 - Offline: Rohini Kumar, Maryna Strokal

Discussion outcomes – Questions 1 & 2

- www.menti.com
- 6861 0468



Sources of data for model inputs

- Examples of most common model inputs:
 - Socio-economic: e.g., population, income
 - Agricultural: livestock numbers, fertilizers (chemical and organic), land use, soil balances,
 - Urbanization-related: e.g., wastewater treatment, sanitation,
 - Hydrology: e.g., water discharges, runoff
- ISIMIP sectors: e.g., nitrogen synthetic fertilizers, nitrogen deposition, population, land use, water discharges and runoff
- IMAGE (Beusen et al., 2022): nitrogen and phosphorus fertilizers, manure, crop uptake, nitrogen deposition and nitrogen fixation (to be uploaded to ISIMIP)
- Other sources: e.g., van Puijenbroek et al., (2019) on sanitation

Questions

Program 15.30-17.00

15.30-15.50 Introduction to the protocol

15.50-16.45 Discussion

16.45-17.00 Follow-up activities

Ideas for collaborative water quality papers

- www.menti.com
- 1764 0094



Follow-up activities

- **REMINDER: Lake sector -> survey**
- **This workshop:**
 - Session 2 (tomorrow 10.00-11.30): regional modelling
 - Session 3 (tomorrow 13.00-14.00): updates, posters, next steps
- **Important dates:**
 - **August 28th-29th:** water quality workshop (finalizing the protocol)
 - **Sept 2023:** Protocol submission to ISIMIP (by coordinators)
 - **Sept 2023-Feb 2024:** Model output submission to ISIMIP (using guides) and online 1-2 meetings
 - **March-June 2024:** A paper-writing workshop

Thank you



Mirjam Bak



Ilaria Micella



Mengru Wang



Carolien Kroeze



Maryna
Strokal



Michelle
van Vliet



Simon
Gosling



Martina
Flörke



Rafael
Marcé



Rohini
Kumar