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Leibniz Institute of Freshwater Ecology and Inland Fisheries

Impact of the Russia-Ukraine armed conflict on water resources and water infrastructure

Dr. Oleksandra Shumilova

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Presentation outline:

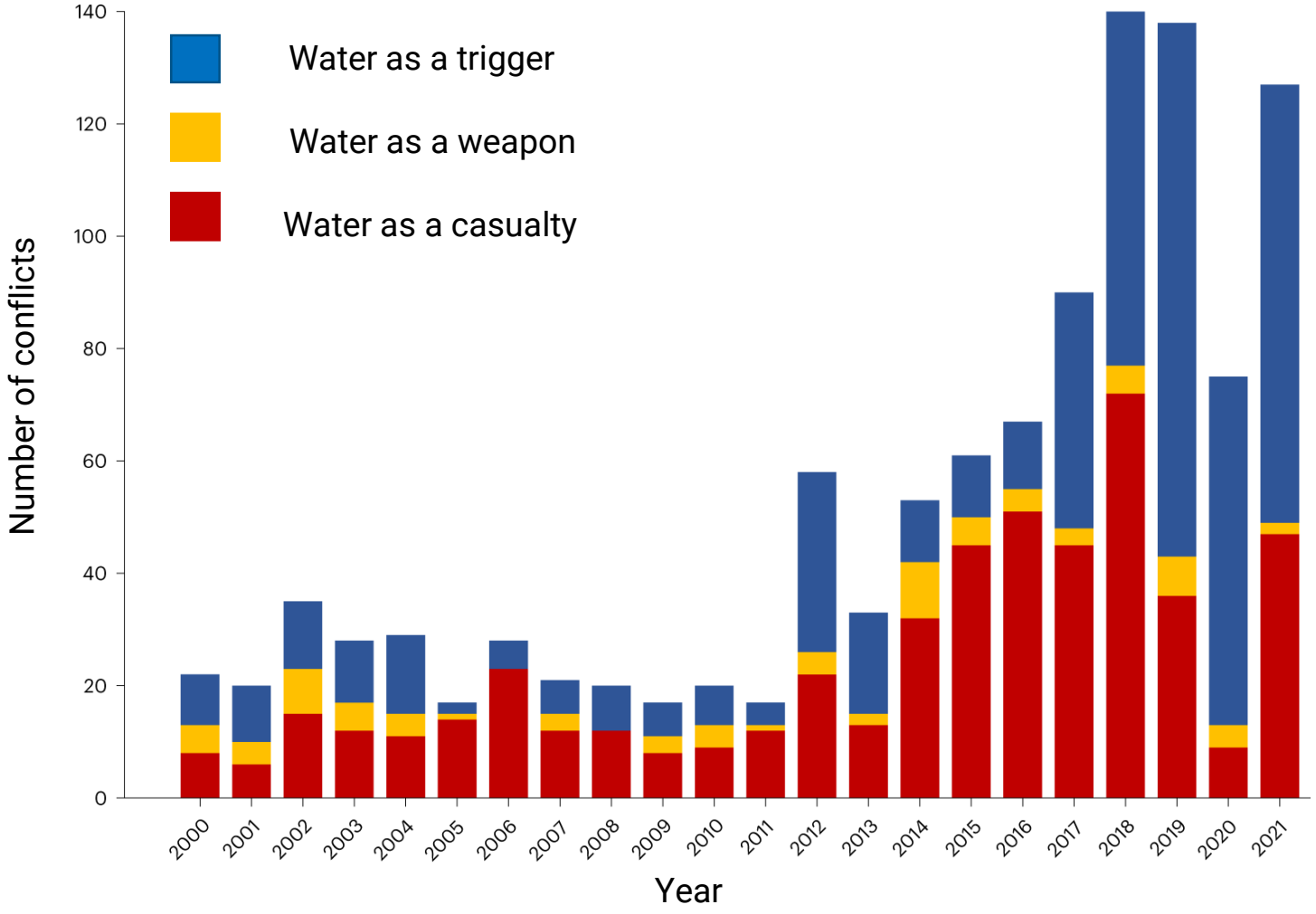
1. Water and War: why the case of Ukraine is unique

2. Examples of previous impacts

3. Ongoing scientific cooperation on environmental consequences of the Kakhovka Dam destruction

4. Concluding remarks (based on the lessons from Ukraine)

Number of water conflicts is increasing worldwide…



„Water Conflict Chronology“ according to Pacific Institute, USA https://www.worldwater.org.

In 2022 – more than 250 conflicts…

- Lack of scientific peer-reviewed studies
- Available studies focus on Middle East or African countries

Why the case of Ukraine is unique?

Water sector of the country is highly modified and industrilized, including:

- 1054 reservoirs (85% of the total volume is stored within the cascade along the river Dnieper and Dniester);
- Hydropower dams;
- Cooling facilities of nuclear power plants;
- Water transfer canals for drinking water supply and industry;
- Multiple irrigation systems in the south of Ukraine (total lenght of the Kakhovka irrigation system >1600 km)

Armed conflict in the east of Ukraine is lasting since 2014, but lack of attention to it already led to environmental crisis

Examples from the first days of war

Damaged Irpin Dam and flooded landscape close to the village Demydiv north from Kyiv, end of February 2022

North-Crimean canal in 2014 and after damage of the blocking dam in Cherson region in the end of February 2022

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Examples from the first days of war: Mykolaiv

- Since April 2022 – damage of the pipe that was delivering water from the river Dnieper

- For one month no central water supply at all;
- Since May 2022 – water supply only for domestic purposes

Examples from the first days of war: Mykolaiv

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The study of IGB team and international colleagues

nature > nature sustainability > analyses > article

Analysis | Open access | Published: 02 March 2023

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Oleksandra Shumilova, Klement Tockner, Alexander Sukhodolov, Valentyn Khilchevskyi, Luc De Meester, Sergiy Stepanenko, Ganna Trokhymenko, Juan Antonio Hernández-Agüero & Peter Gleick

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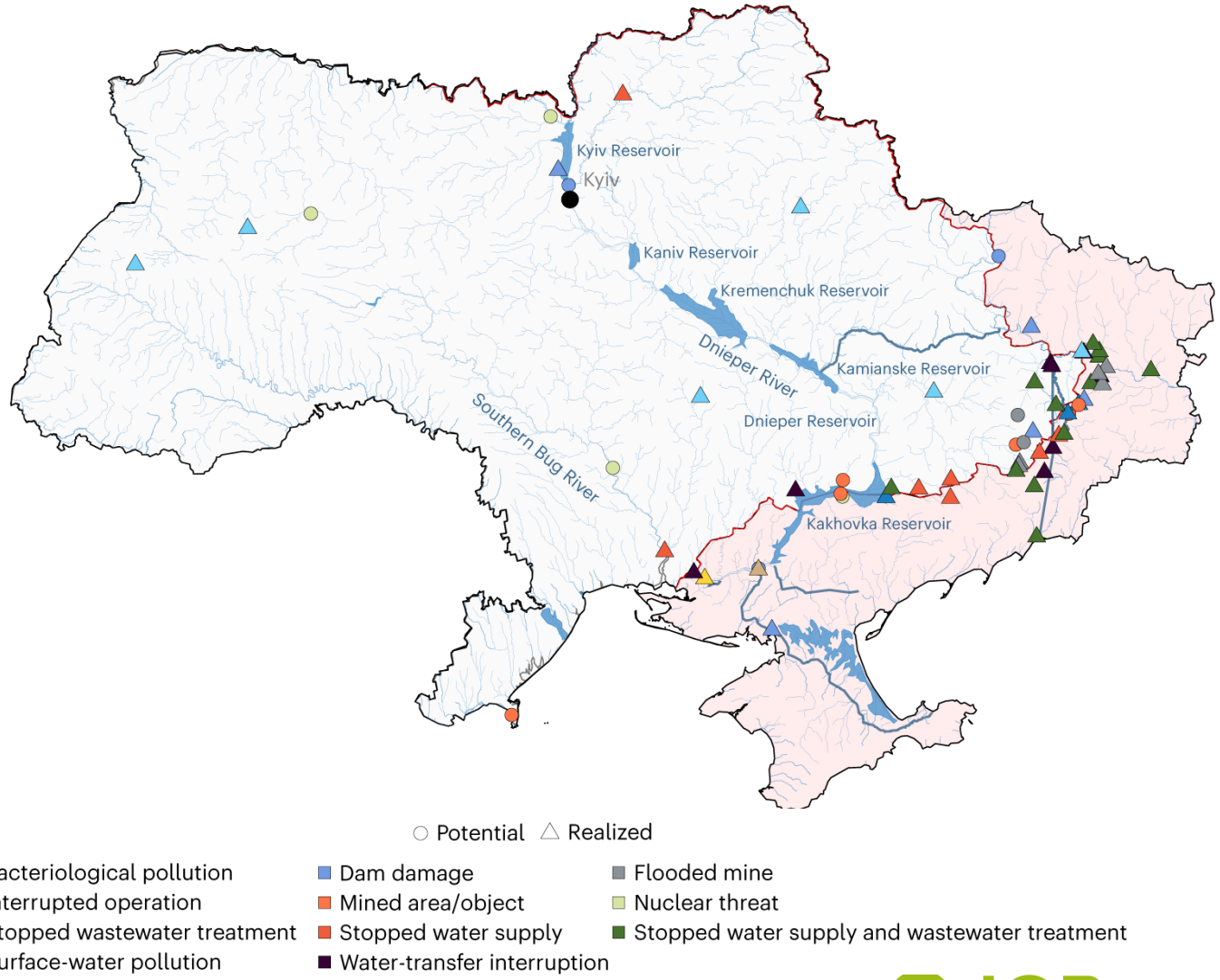
- First 3 months of conflict
- Sources of ukrainian, russian and international origin
- 64 impacts identified: 49 realized
  15 potential



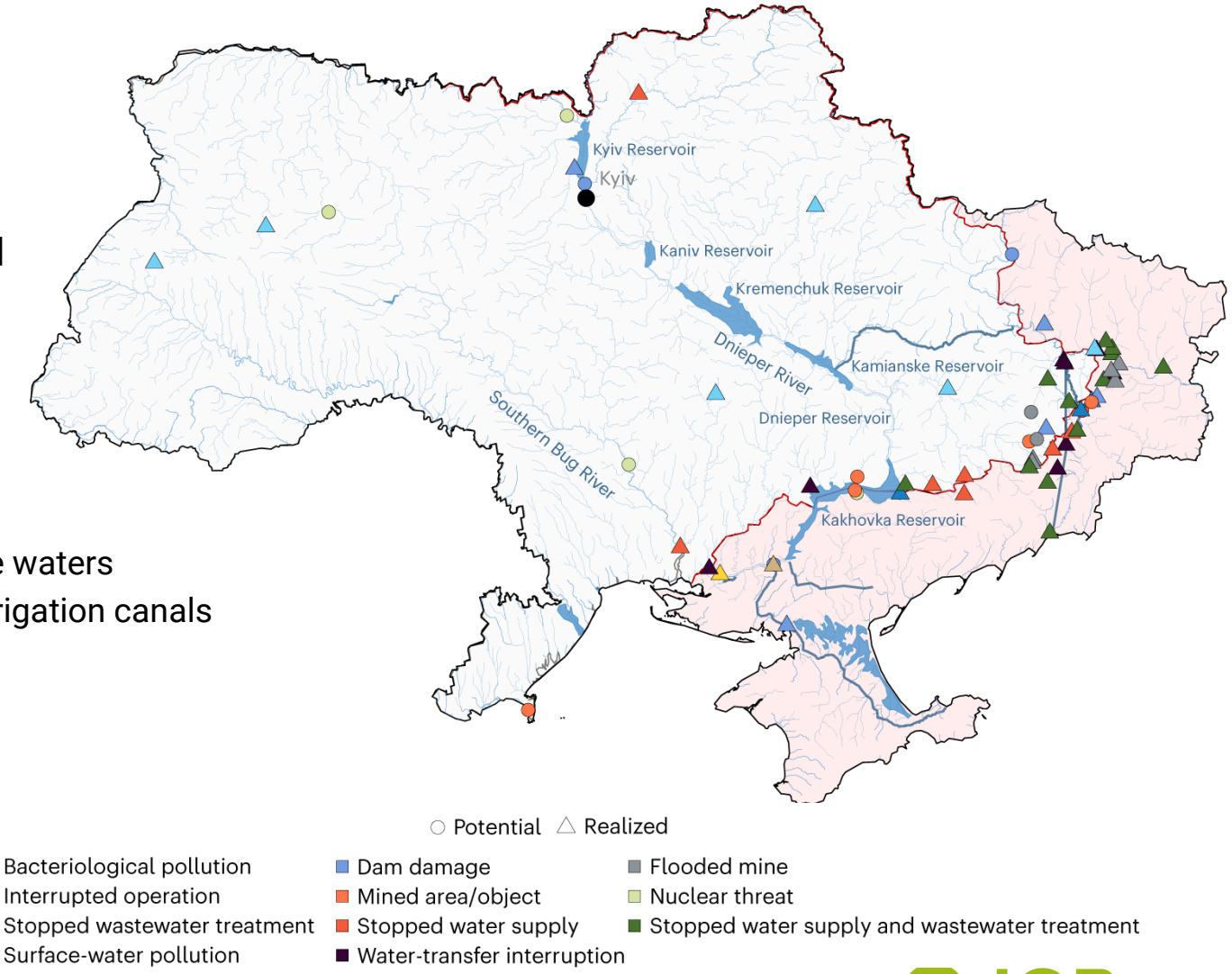
The study of IGB team and international colleagues

- Impacts of military confict are diverse
- Regions located far from the frontline are also affected
- There are direct and indirect impacts
- Regional specifics:

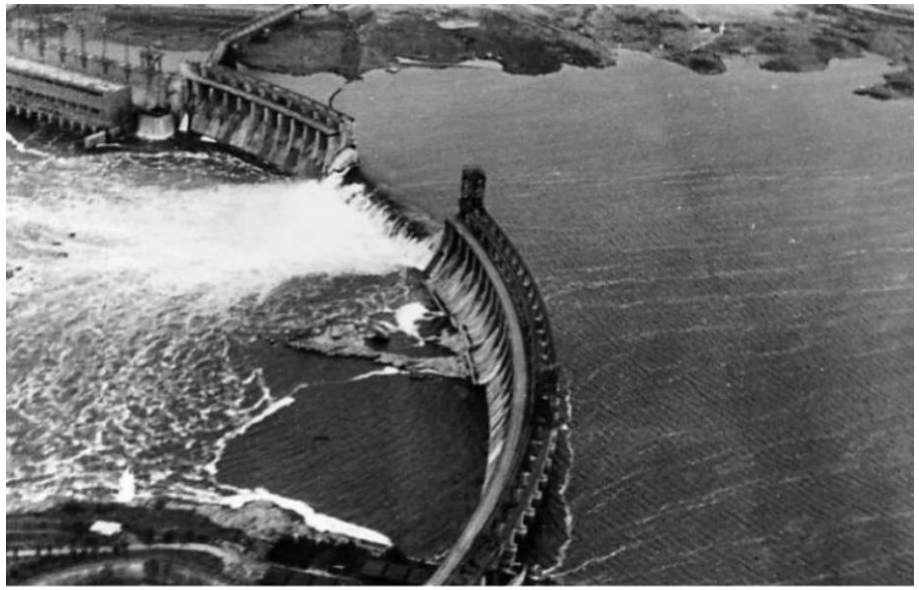
  East of Ukraine – uncontrolled rise of contaminated mine waters
  South of Ukraine – negative impacts on the network of irrigation canals

- Dramatic increase in the number of people who are in need for water, hygiene and sanitation access:

  April 2022 – 6 Millions
  November 2022 – 16 Millions



Dams and reservoirs are among the most affected



The dam on the Dnieper River near the city of Zaporizhzhia after reportedly being blown up by Soviet special forces in 1941 in an attempt to delay the offence of German troops

Kakhovka Dam on the Dnieper river, damaged in June 2023

Kakhovka Dam destruction: immediate hazards

Downstream catastrophic flood

Kakhovka HES 06.06.23

Drought in the upstream part

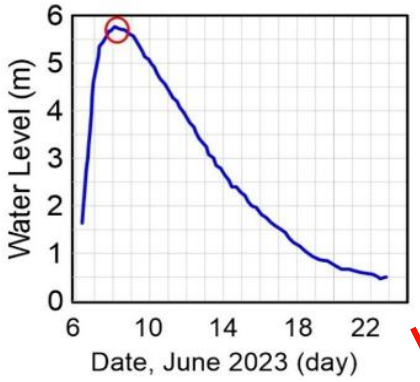
Kakhovka Dam destruction: immediate hazards, recovery trends and future threats

- What information do we need? How we can use limited information available during the times of war?
- Can we draw analogies to flooding in unmodified rivers and rivers were dams are being removed?
- What universal concepts of ecology can be applied to prognose recovery of affected ecosystems?

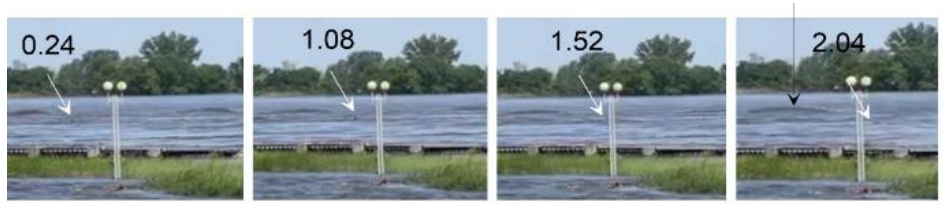
German-Ukrainian workshop at IGB, Berlin, October 2023

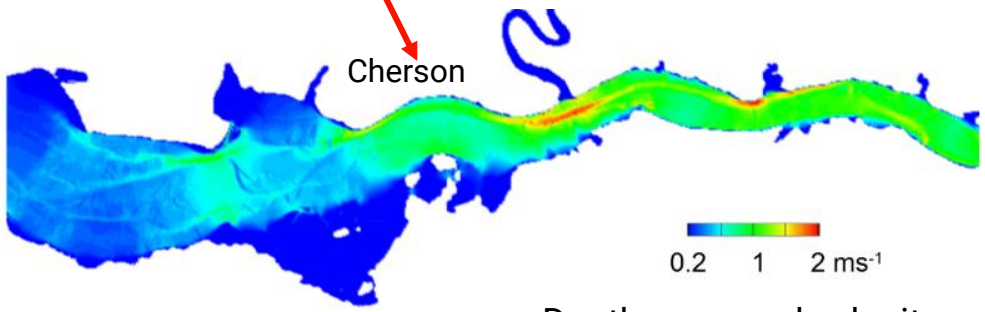
Environmental consequences of the Kakhovka Dam destruction

- **Numerical modeling of flow hydrodynamics on the lower Dnipro**



- Validation of model predictions

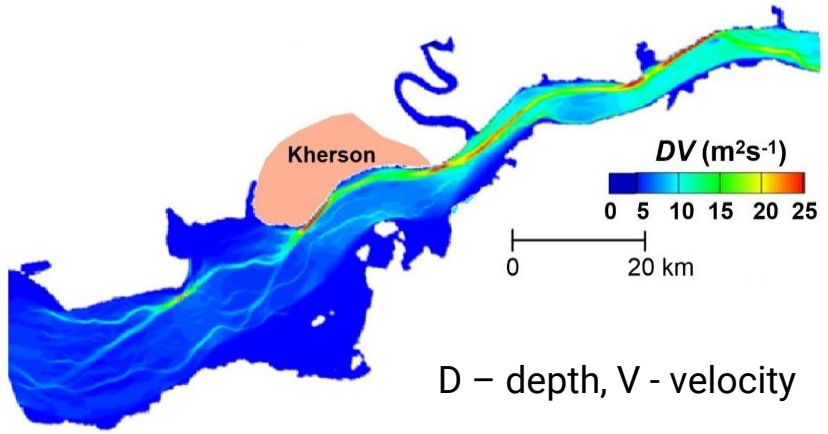




Depth-averaged velocity

Shumilova et al., unpublished

- Hazard assessment based on modelled values of DV index related to Life Losses



D – depth, V - velocity

average *DV* value: 10 m^2s^{-1}
officially reported life losses: 84

} hazard of medium severity*

* "Dam failure and flood event case history compilation" (RCEM, U.S. Bureau of Reclamation, 2015).

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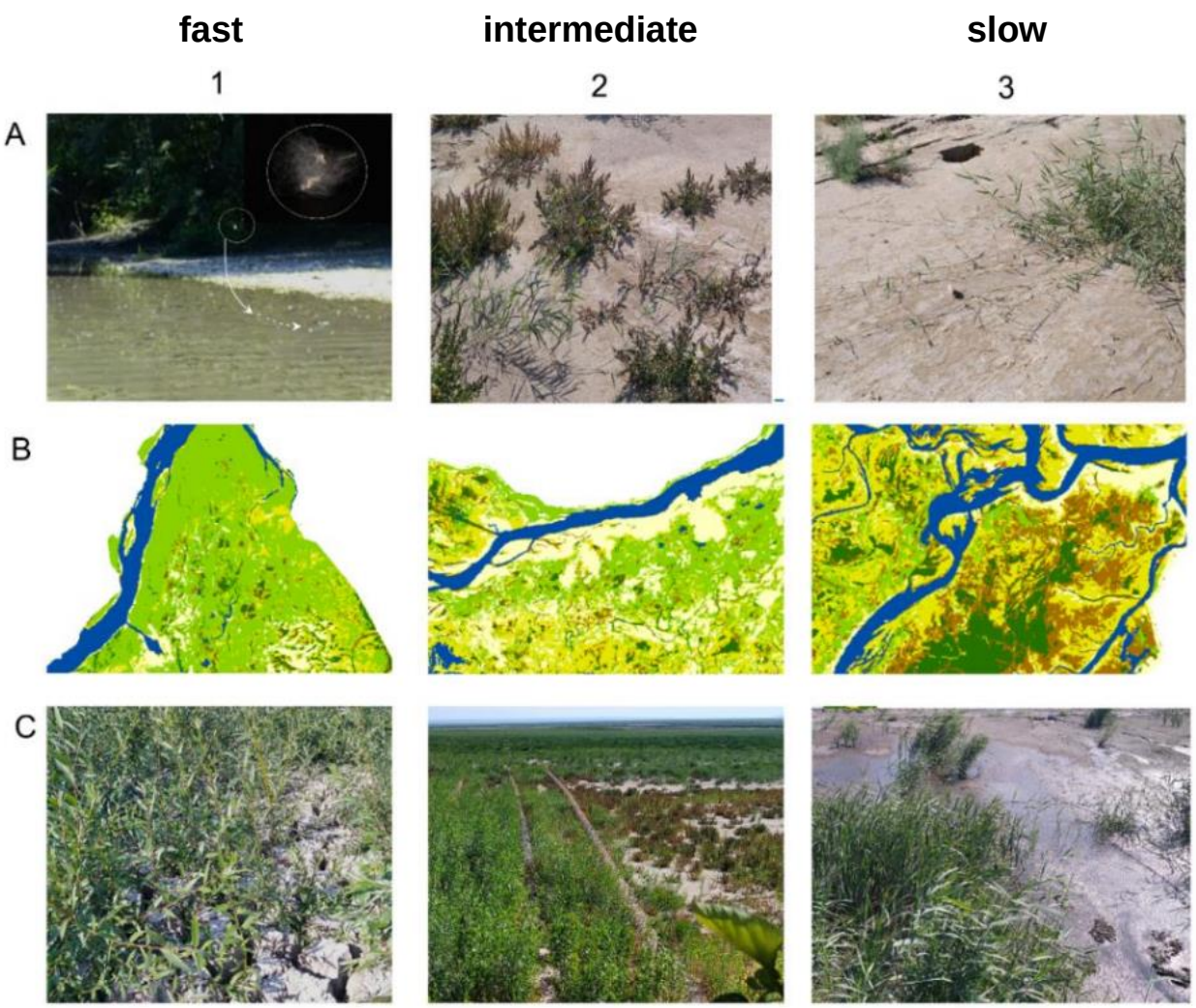
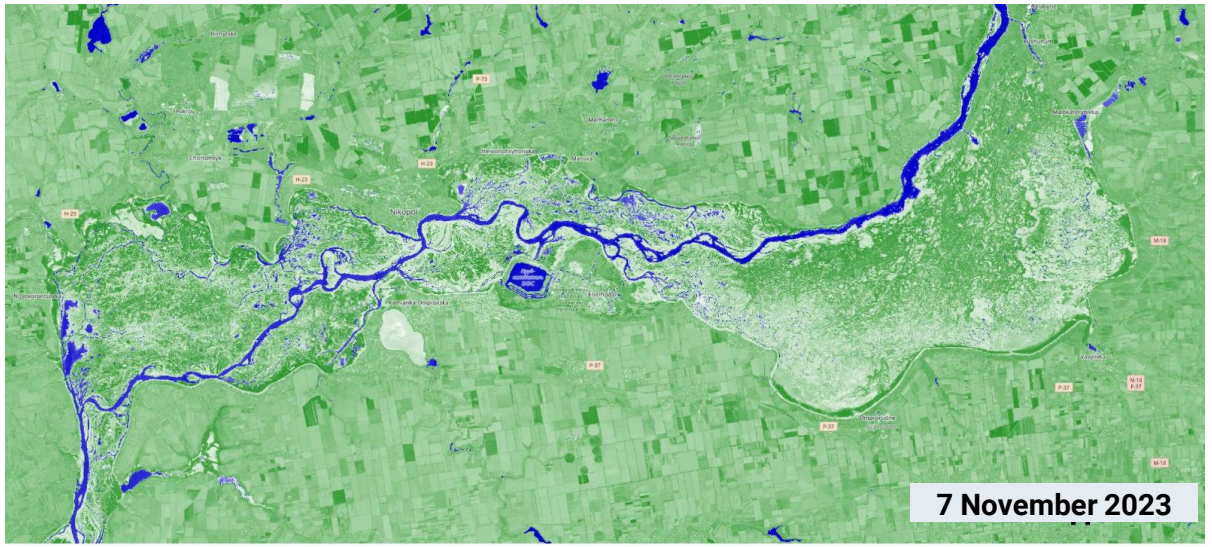
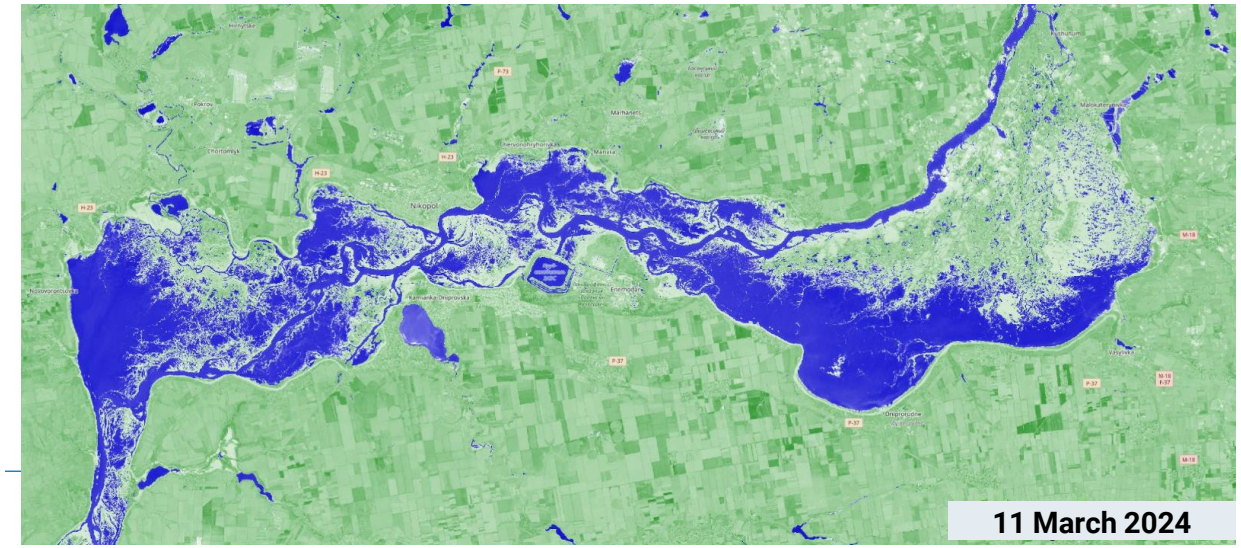
Environmental consequences of the Kakhovka Dam destruction

Colonization patterns of riparian vegetation on the former Kakhovka reservoir bottom:







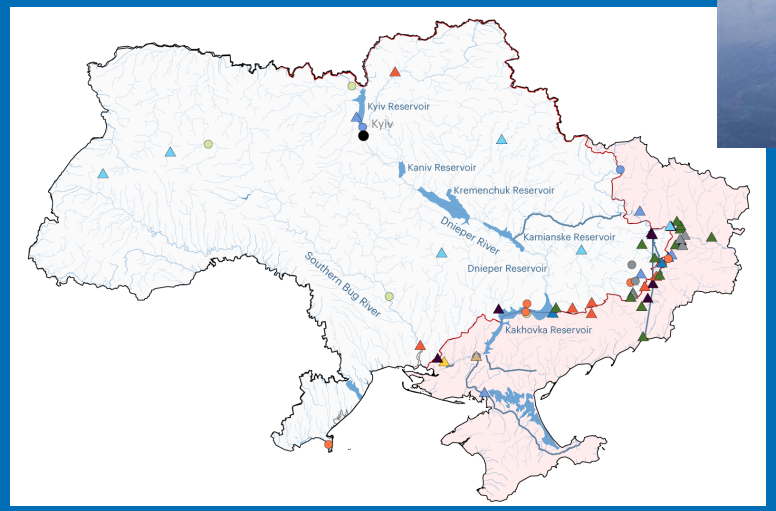
Concluding remarks based on examples from Ukraine

- Diverse and long-lasting consequences not only for local populations and ecosystems, but also for progress towards the global Sustainable Development Goals;

- Effectiveness of International declarations regulating access to water resources/infrastructure during armed conflicts should be re-evaluated;

- “Predictive Ecology” approach to better understand the environmental risks in the regions affected by military conflicts is urgently needed.

Thank you for your attention!



oleksandra.shumilova@igb-berlin.de
www.igb-berlin.de/en