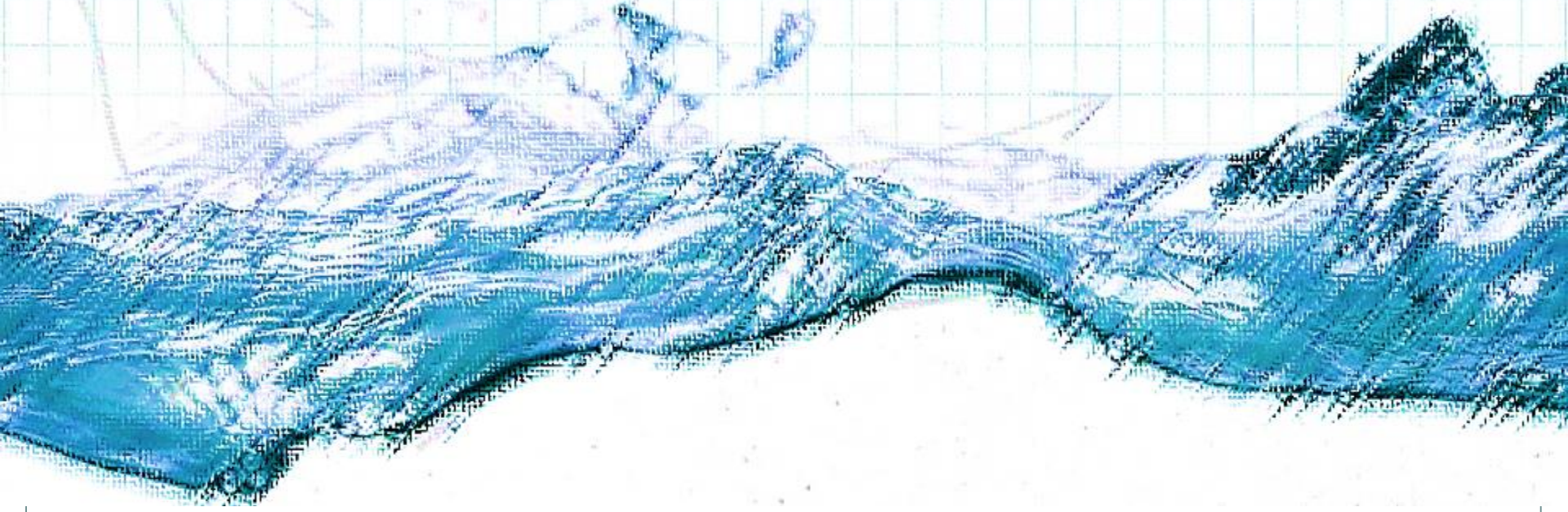
CLIMATE CHANGE IMPACT ON HYDROLOGICAL EXTREMES

CHIHE (2014-2016)

Wpływ zmian klimatu na ekstrema hydrologiczne



Supported by a grant from the Norwegian Financial Mechanism

Institute of Geophysics
Polish Academy of Sciences

Norwegian Water Resources and Energy Directorate

Plan of presentation

1. Introducing CHIHE
2. Project outcomes
3. Projections of future extreme flows
4. Adaptation to floods
5. Conclusions and future work

Project contributors

Institute of Geophysics, Polish Academy of Sciences, Poland
Renata J. ROMANOWICZ,
Ewa BOGDANOWICZ,
Sisay E. DEBELE,
Joanna DOROSZKIEWICZ,
Hadush K. MERESA,
Jaroslaw J. NAPIORKOWSKI,
Marzena OSUCH,
Witold G. STRUPCZEWSKI

Norwegian Water Resources and Energy Directorate, Norway
Hege HISDAL,
Deborah LAWRENCE,
Donna WILSON,
Wai Kwok WONG

Climate Change Impact on Hydrological Extremes (2014-2016)

- **PI** – Prof. Renata Romanowicz, Inst. Geophys., Polish Academy of Sciences

PhD student

- **WP1** – Changes in **observed hydro-meteorological time series** in Polish and Norwegian catchments (Leader – Prof. Jarosław Napiókowski, IGP PAS)
- **WP2** – **Projections for climate change impacts** on hydrological extremes under a future climate: Methods, results and their uncertainties (Leader – Dr. Deborah Lawrence, NVE)

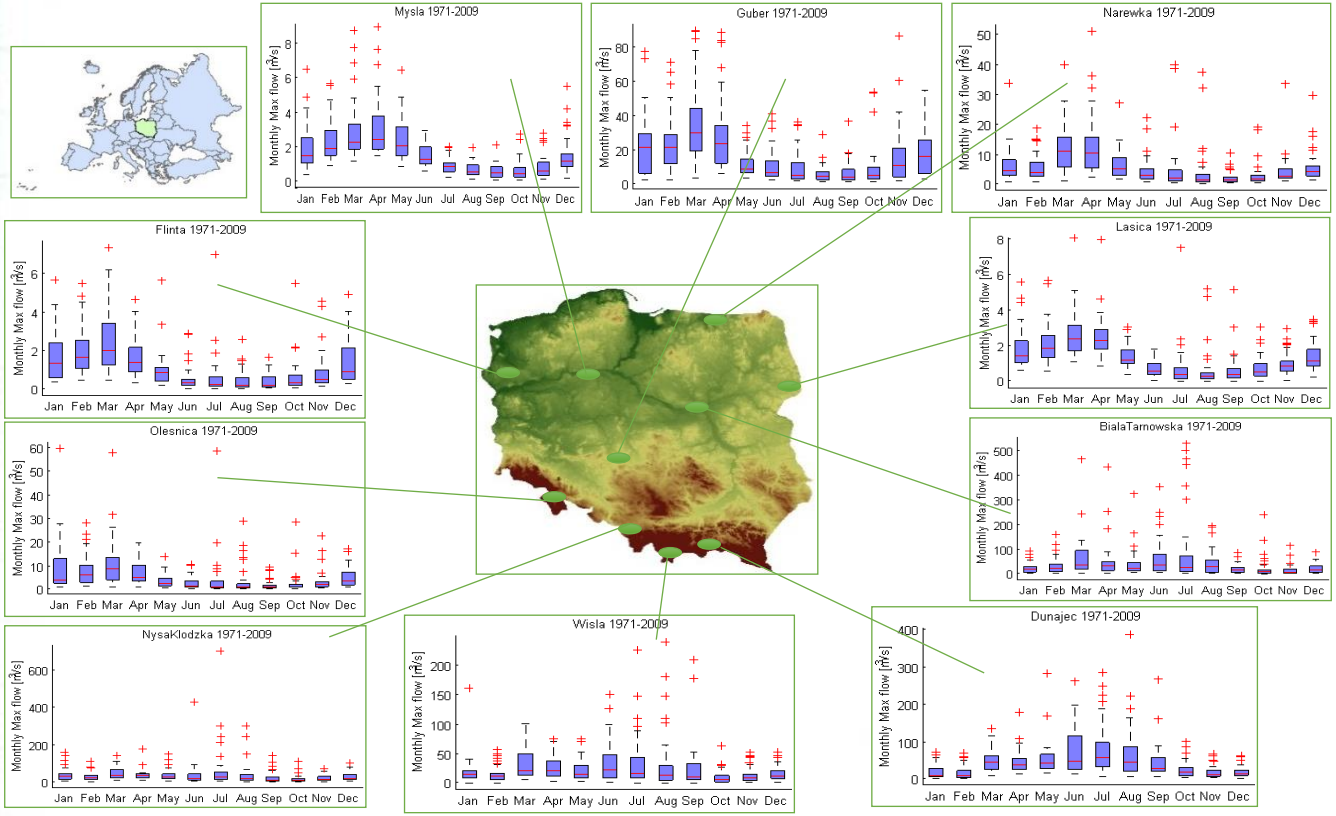
PhD student

- **WP3** – Flood and drought frequency analysis within a **non-stationary framework**: Methodology and application (Leader – Prof. Witold Stupczewski, IGP PAS)

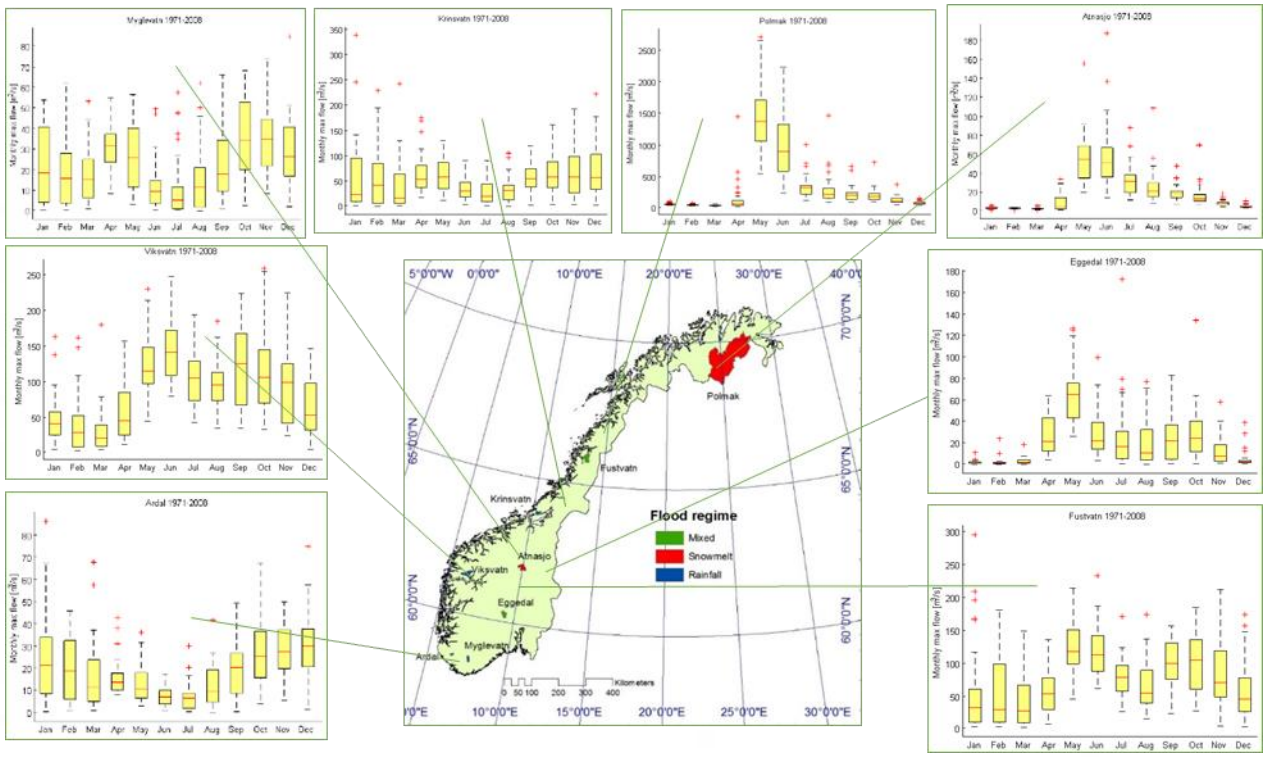
PhD student

- **WP4** – **Adaptation** to floods under a future climate (Leader – Hege Hisdal, NVE)

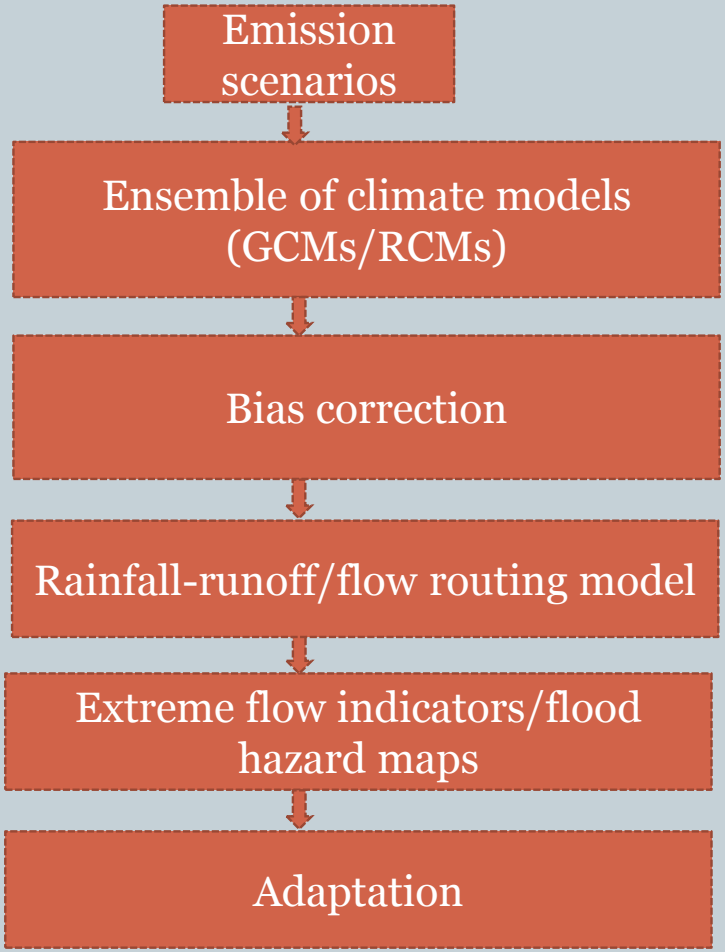
Polish catchments



Norwegian catchments



Methodology



RCP45 and RCP85

7 sim, 4 RCMs driven by three GCMs (CNRM-CM5, EC-EARTH, MPI-ESM-LR)

Precipitation: single gamma,
Temp: QUANT on residuals

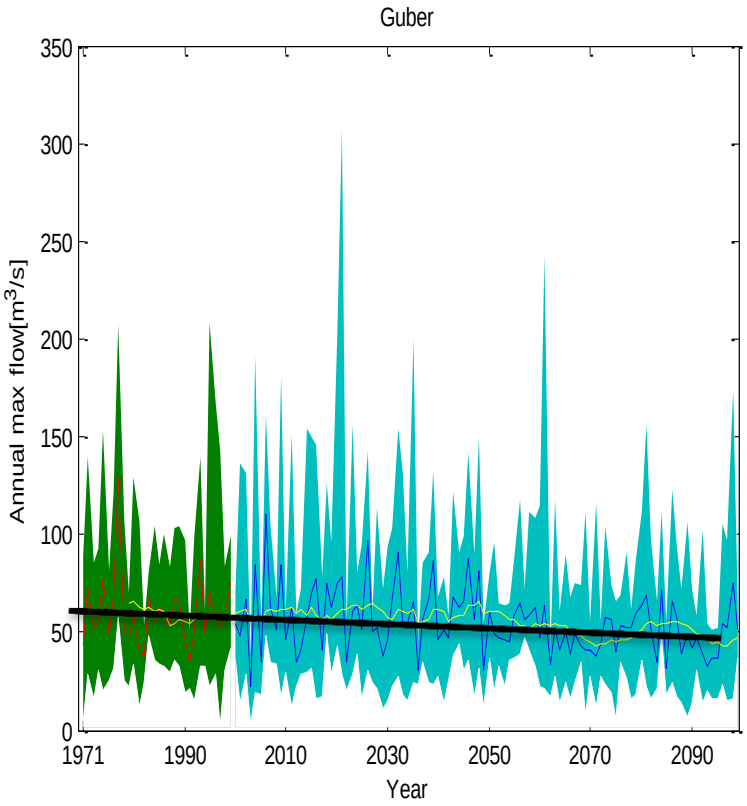
HBV/MIKE11, Calibration 1971-2000;
Validation 2001-2010;
Climate projections 1971-2100

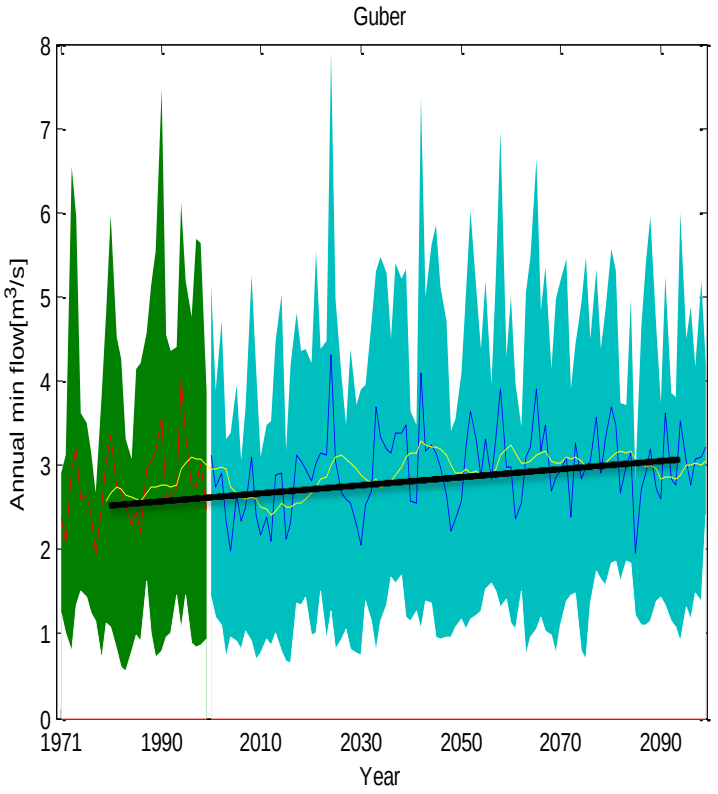
Flood & Drought Frequency Analysis

Scenario analysis

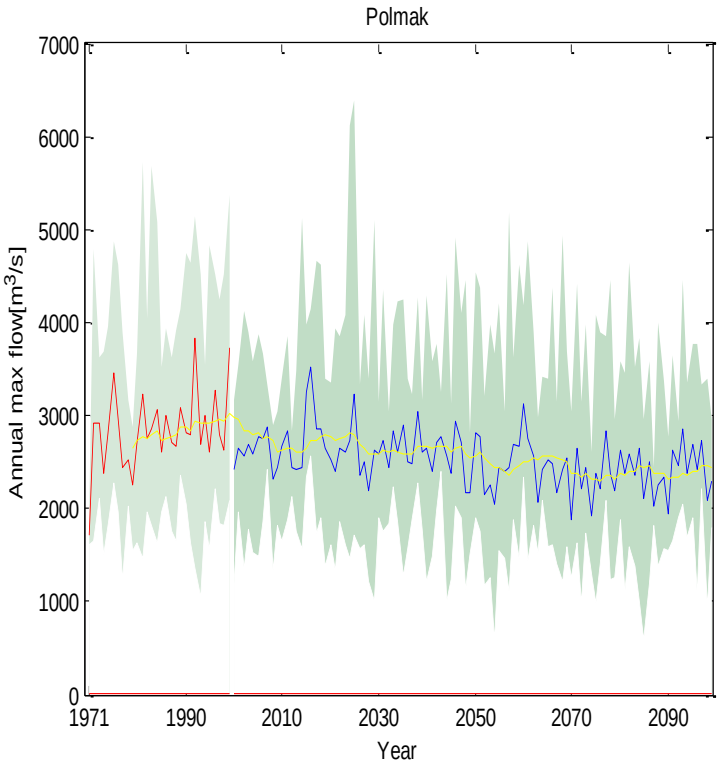
RESULTS

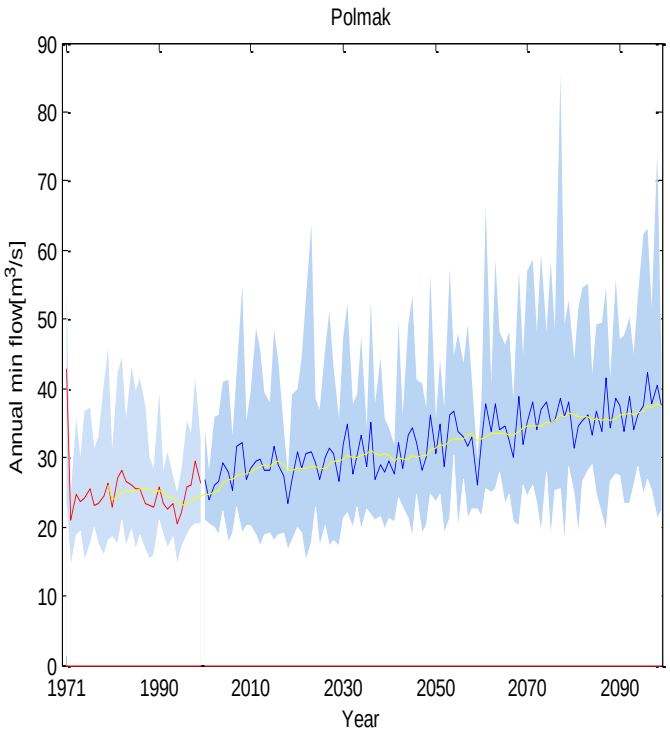
Projections of annual maximum (right panel) and minimum (left panel) flows for the Guber catchment from 7 GCM/RCM models



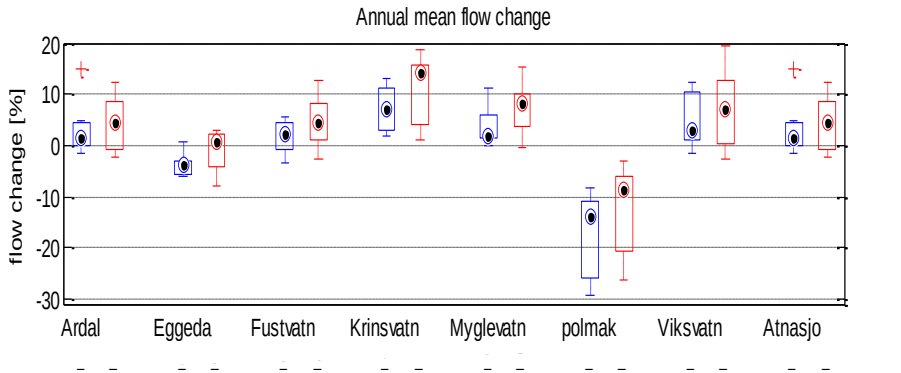


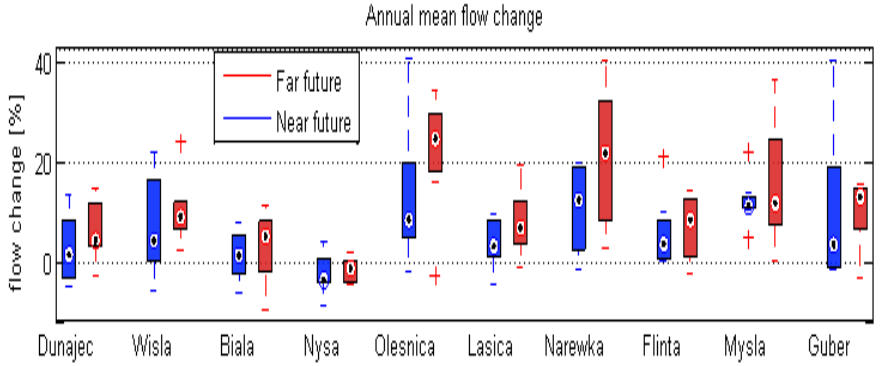
Projections of annual maximum (left panel) and minimum (right panel) flows for the Polmak catchment from 7 GCM/RCM models

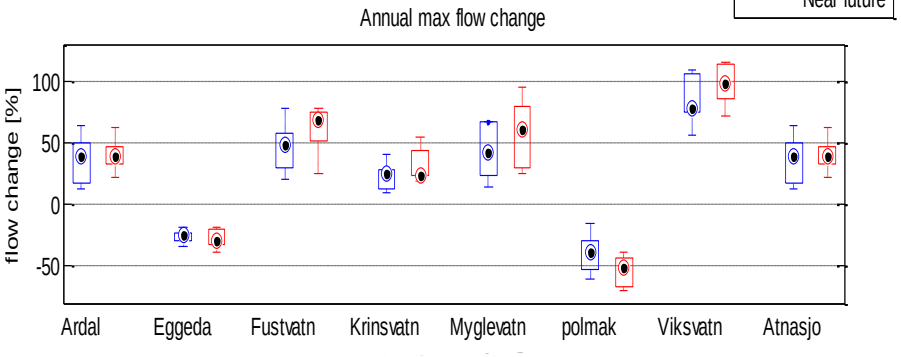


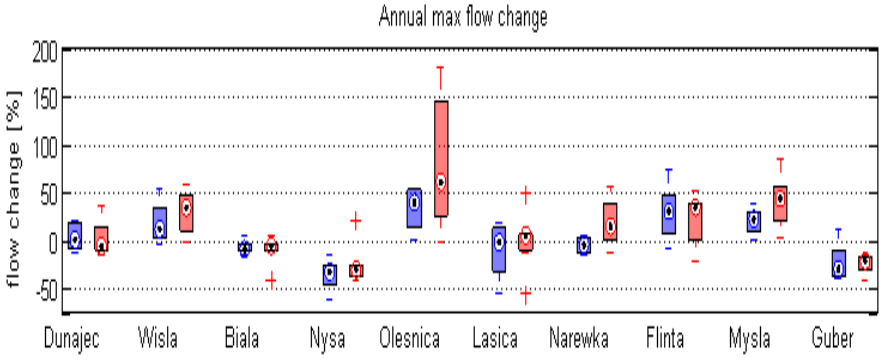


Comparison of projected changes of flow between reference period 1971-2000 and near future: 2021-2050 and far future: 2071-2100









*There is a significant trend variation from catchment to catchment. Mean annual flow increases both in the near- and far-future in all catchments except in the Eggadal and Polmak catchments, where it decreases.

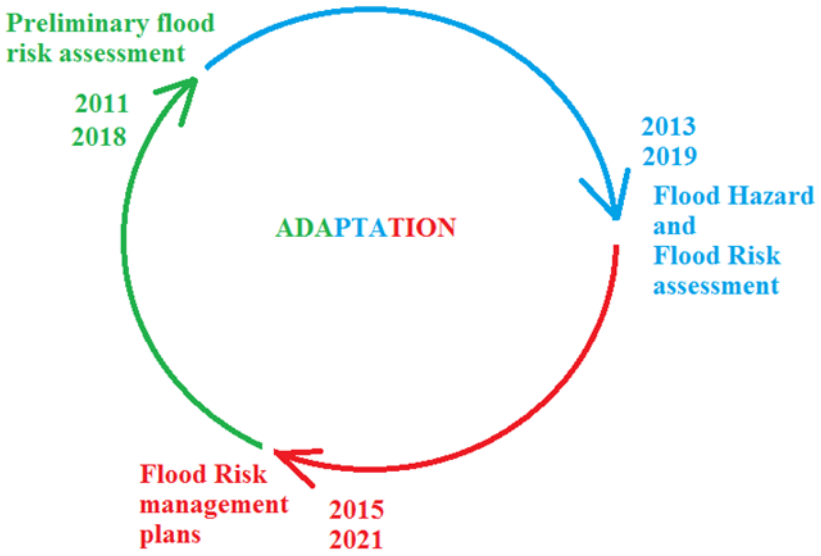
Conclusions

- ✓ In most of the selected catchments, more extreme (both high and low) precipitation and streamflow events are likely to occur in the far future compared to the near future period.

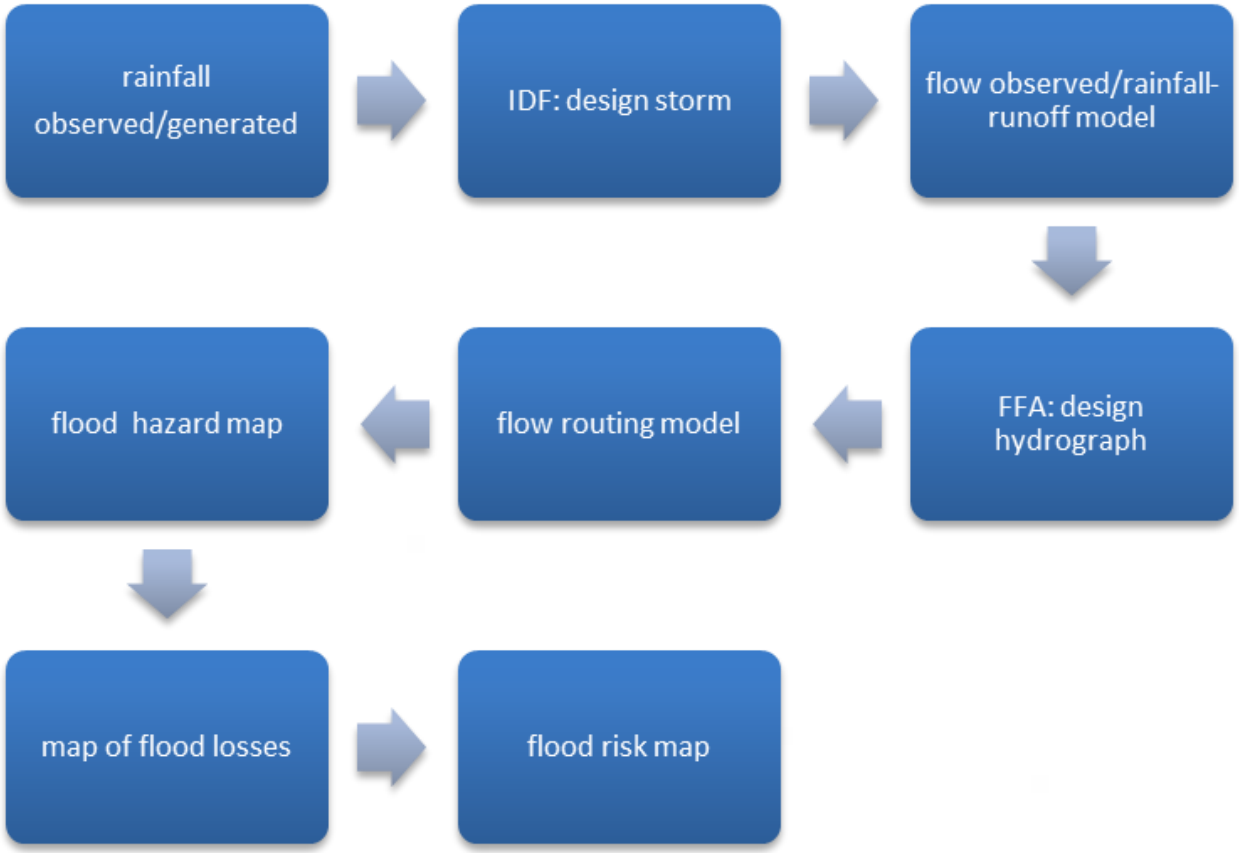
- ✓ Therefore, in order to mitigate the potential environmental threats, it is essential to build appropriate adaptation strategies, and then, act according to them.

ADAPTING TO CLIMATE CHANGE IN POLAND AND NORWAY

SCHEME OF ADAPTATION PROCEDURE



THE SCHEME OF THE INTEGRATED FLOOD RISK ASSESSMENT



AN EXAMPLE OF A FLOOD HAZARD MAP WITH PROBABILITY OF OCCURRENCE 0.5%, IN NORWAY

Legend

present 200- year flood

- <0,5
- 0,5 - 1
- 1 - 1,5
- 1,5 - 2
- >2

Lavpunkter - områder som ikke har direkte forbindelse med elva (bak flomvern, kulvert, m.v). Sannsynlighet for overvannmelse må vurderes nærmere

Sone med fare for vann i kjeller - områder som ligger mindre enn 2,5 m høyere enn flomsonen

Analyseområde

Flomutsatte bygninger

Bygninger med fare for vann i kjeller

flooded road

Climate change in the years 2100

flooded area while 200 year flood in year 2100

the lowest point while 200 year flood in 2100

Ikke flomutsatte bygninger

Elv og vann

Gravplass

Tverrprofil med profilnummer

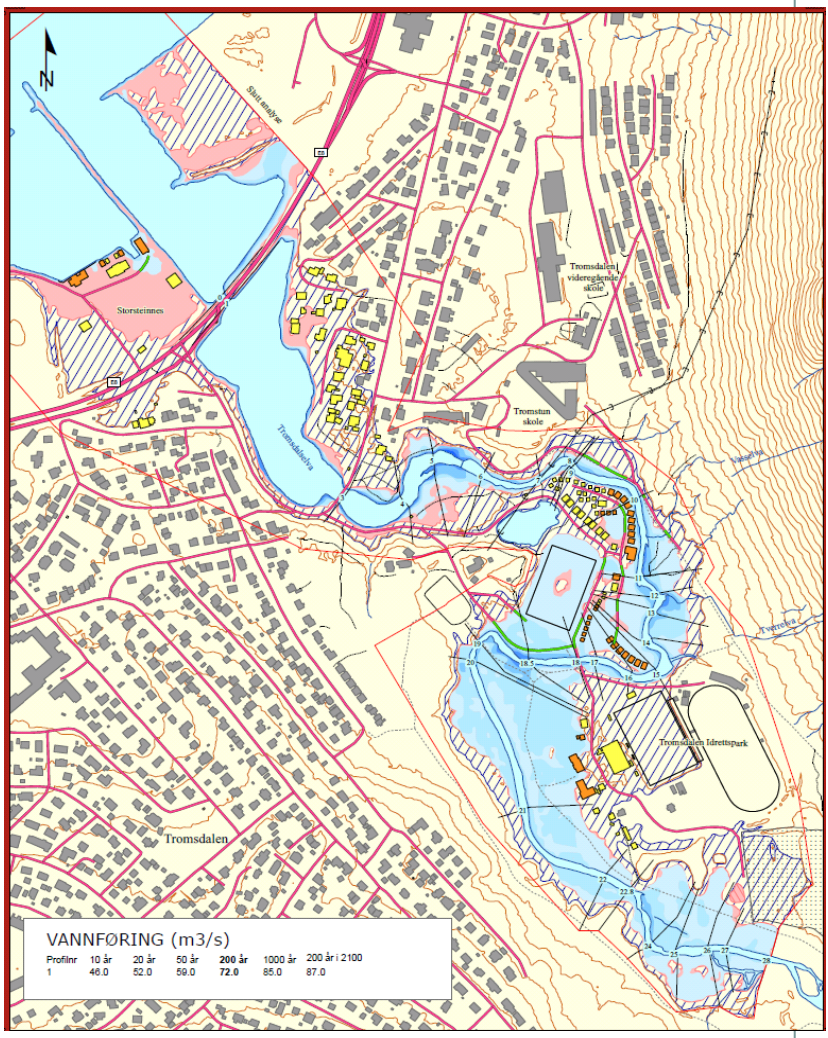
Europa-, riks- og fylkesvei med vegnummer

Kommunal og privat vei

Kraftline

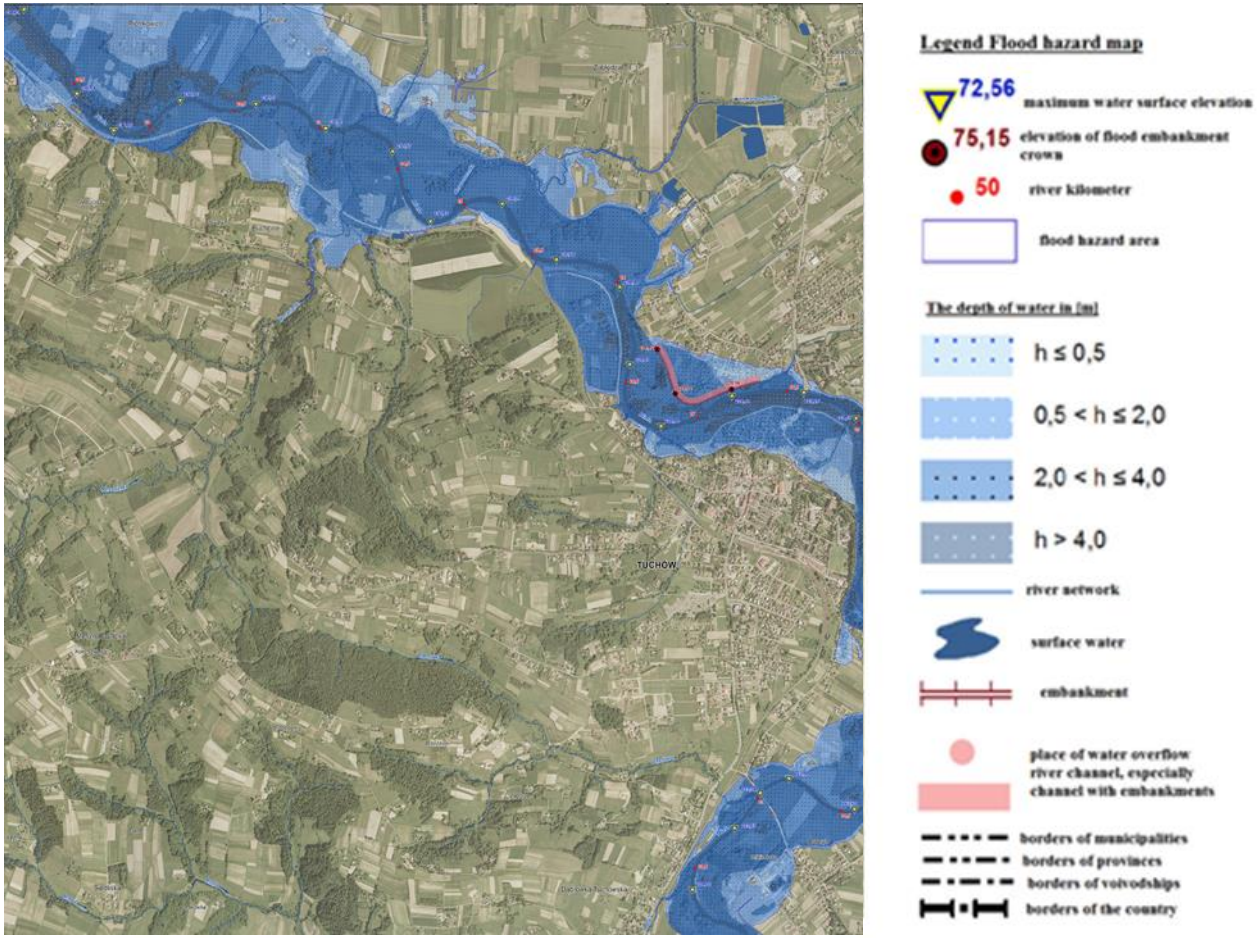
Bekk

Høydekurver med fem meters ekvidistanse



An example of flood inundation map with probability of flood occurrence 0,5%, in Norway, for the City of Tromsdalen

AN EXAMPLE OF A FLOOD HAZARD MAP WITH PROBABILITY OF OCCURRENCE 1%, IN POLAND



Flood hazard map: Biała Tarnowska near Tuchów (15.04.2015)

http://www.kzgw.gov.pl/

FLOOD RISK MANAGEMENT USING SPATIAL PLANNING

- to prevent / avoid urban development in areas with high risk of flooding
- to determine the conditions for the possible development of embankment protected areas
- to establish conditions for urban development in areas with a low probability of flooding
- to maintain and enhance the existing catchment retention capacity

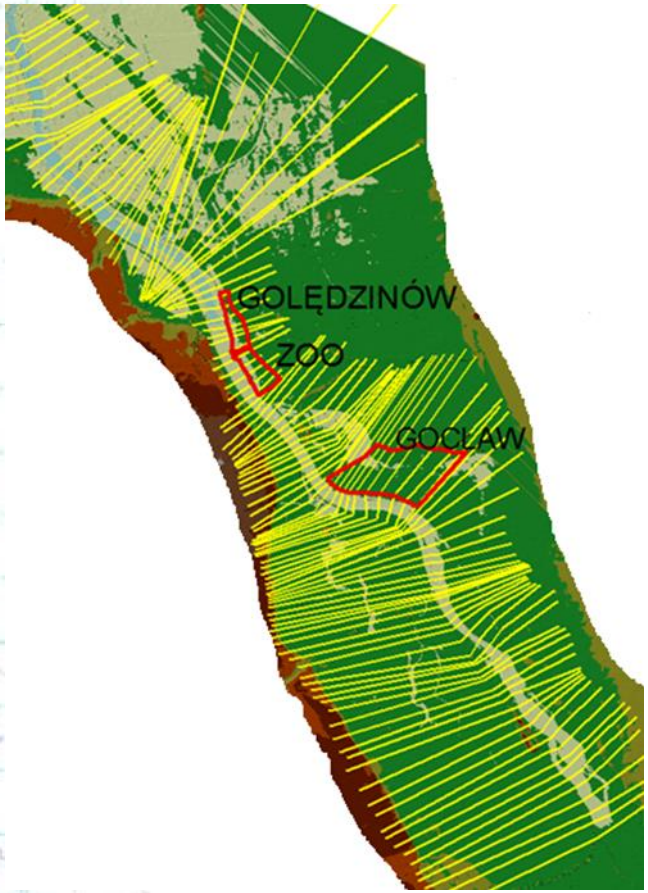
Application of controlled breaching scenarios in flood risk management

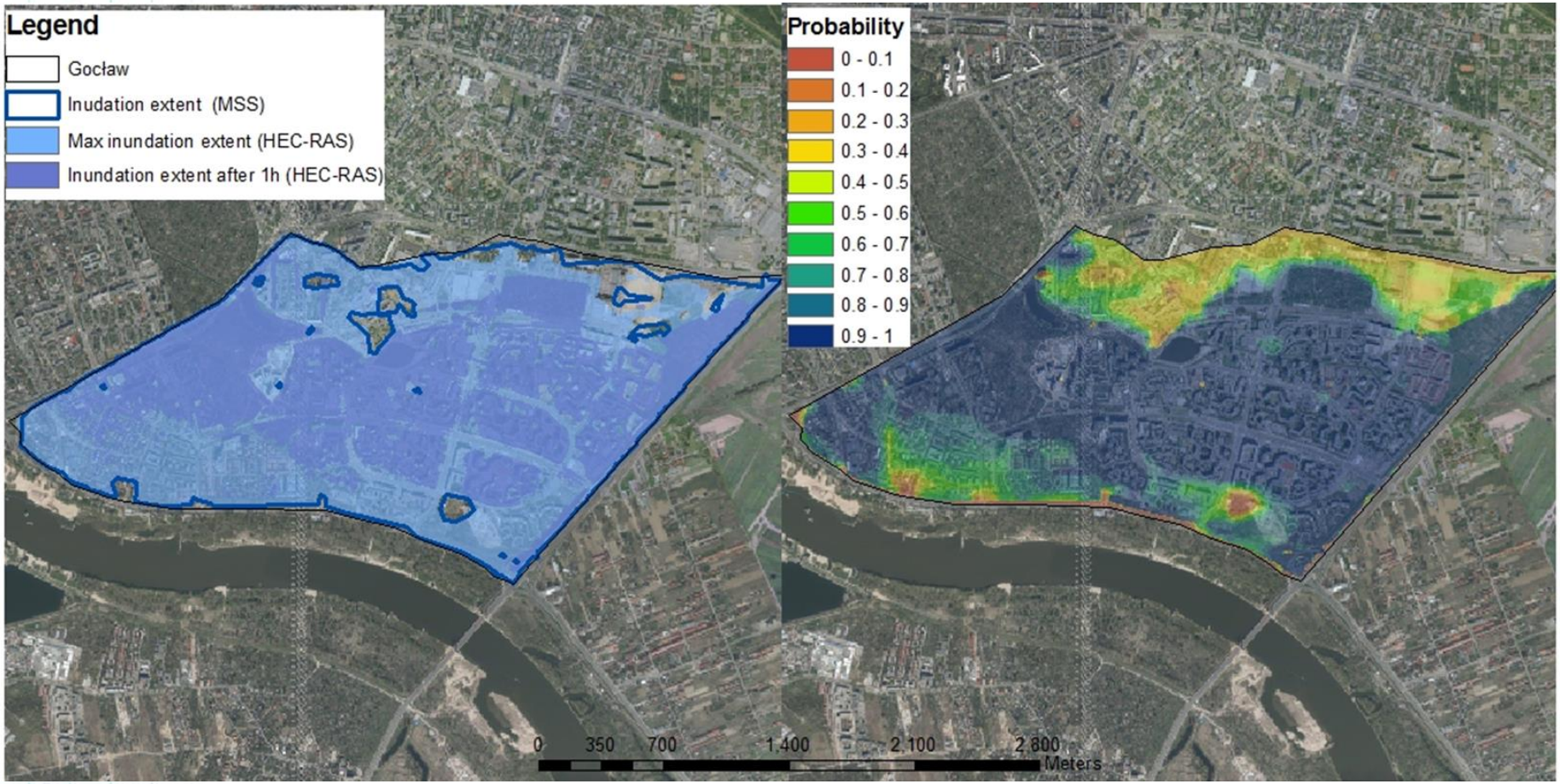
Flood risk management requires specification of flood risk and choice of tools that would be most appropriate to determine the risk of floods and a guideline for decision makers to reduce the flood risk.

We present a study on the application of controlled breaching scenarios for the reduction of potential flood losses.

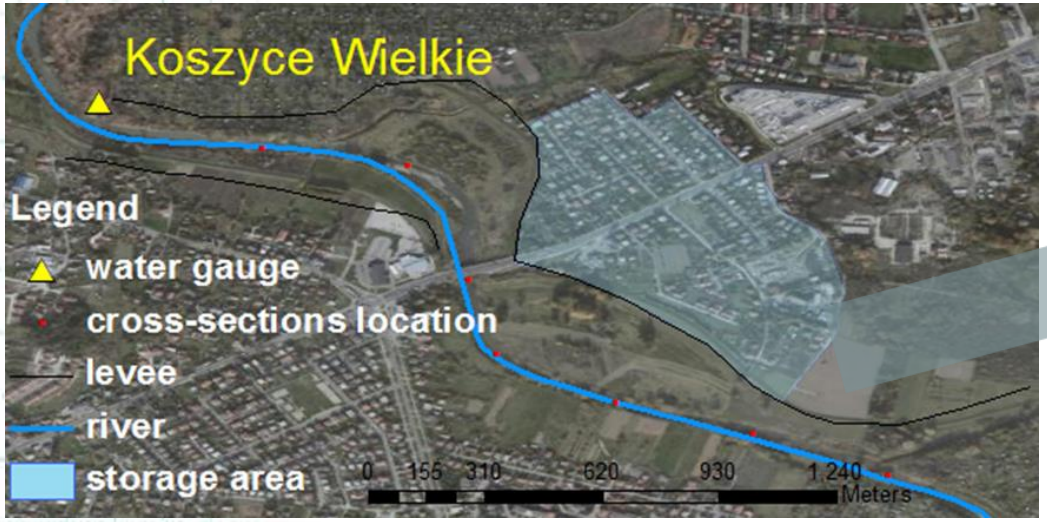
The aim of the ongoing study is an estimation of sensitivity of water levels at the cross-section of the river of highest flood hazard, including vulnerability, to breaching of the river embankments upstream.

Case study: Warsaw area





Maximum inundation extent for Gocław area, under three different width breaching scenaria (50, 100, 150 m respectively). Left panel shows deterministic approach and comparison of the results of the steady state flow model (MSS) with unsteady HEC-RAS model. Right panel shows stochastic approach.



Planned storage area in Koszyce

Planned storage area in Ciężkowice

Conclusions and future work

1. The main objectives of national flood adaptation strategy in Poland and Norway are to minimize the vulnerability to flood risks associated with changes in climate, and include this issue in the planning phase of future investments.
2. Vulnerable sectors include water management, urban and rural spatial planning. However, the legislative regulations relating to local spatial planning still have to be established.
3. Future needs include:
   - Clear definition of the duties and responsibilities of different governmental and non-governmental units involved in water management
   - Clear guidelines refering to spatial planning created by national authorities;
   - Taking into account climate change in the next cycle of flood adaptation process

Thank you for your attention

Sources:

- Flood hazard and flood risk maps http://geoportal.kzgw.gov.pl/imap/
- Water Management Regional Boards map : http://www.kzgw.gov.pl/
- Water regions map : http://www.powodz.gov.pl/

Instytut Geofizyki PAN
Warszawa

5.12.2016r

KONFERENCJA

Adaptacja Polski do zagrożenia powodziowego w warunkach przyszłego klimatu: od teorii do praktyki

Tematyka:

- Gospodarka Wodna w Polsce w świetle Dyrektyw Unijnych na szczeblu regionalnym i lokalnym
- Zmiany klimatu w Polsce i Norwegii
- Wpływ zmian klimatu na ekstremalne zjawiska hydrologiczne
- Praktyczne problemy związane z określaniem i zarządzaniem zagrożeniem powodziowym
- Określanie i komunikowanie niepewności zagrożeń powodziowych

Zapraszamy do zgłaszania uczestnictwa i nadsyłania abstraktów: chiheconf@igf.edu.pl
w terminie do 10 listopada 2016 r.

UDZIAŁ W KONFERENCJI JEST BEZPŁATNY