MONITORING SYSTEM, DATABASE AND POSSIBLE SCENARIOS

AS ESSENTIAL BACKGROUND FOR ADAPTATION PLANNING, REDUCING VULNERABILITY AND RISK DISASTER – SHARING OF POLISH EXPERIENCES

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ENVIRONMENT PROTECTION INSTITUTE
NATIONAL RESEARCH INSTITUTE

Institute of Meteorology and Water Management
National Research Institute

IUNG
Institute of Soil Science and Plant Cultivation
State Research Institute

Weather monitoring and forecasting

TOMASZ KNOPIK

Institute of Meteorology and Water Management
National Research Institute

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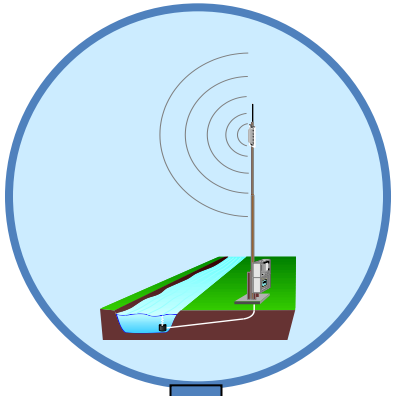
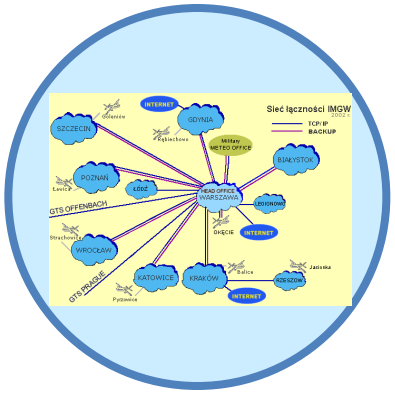
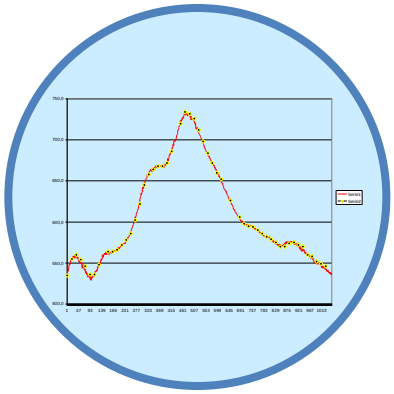
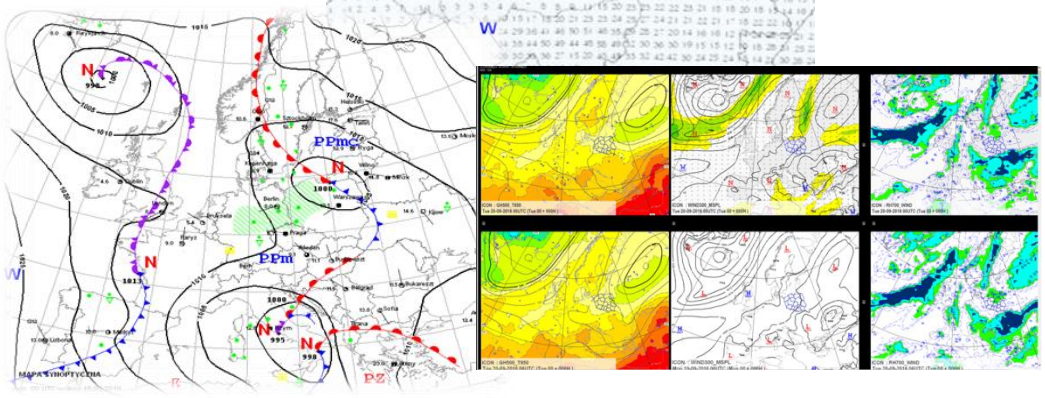
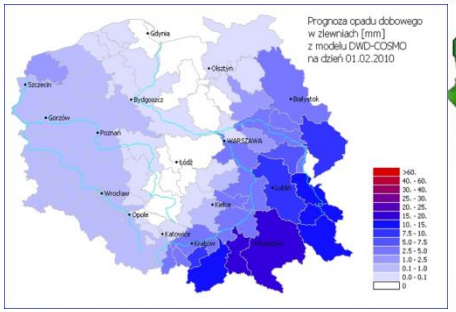


The National Hydrological and Meteorological Service – wide range of measurement and detection systems

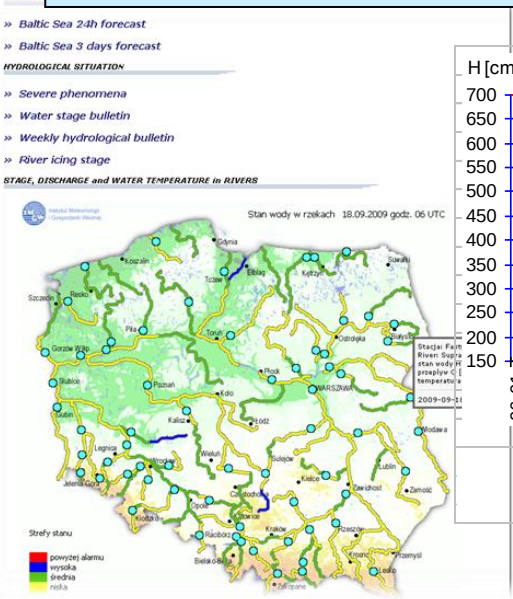


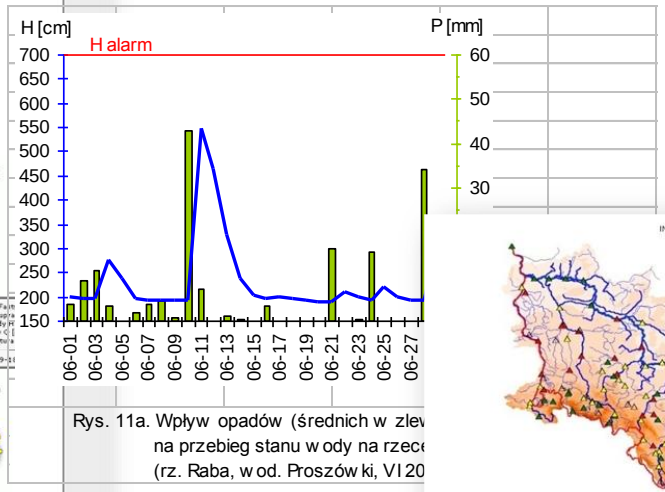






The National Hydrological and Meteorological Service – provide both meteorological and hydrological services





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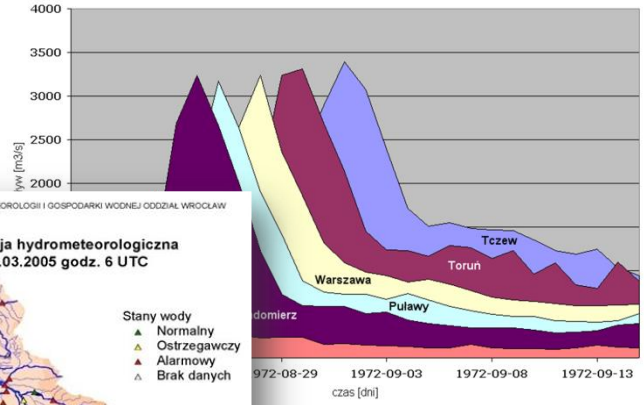
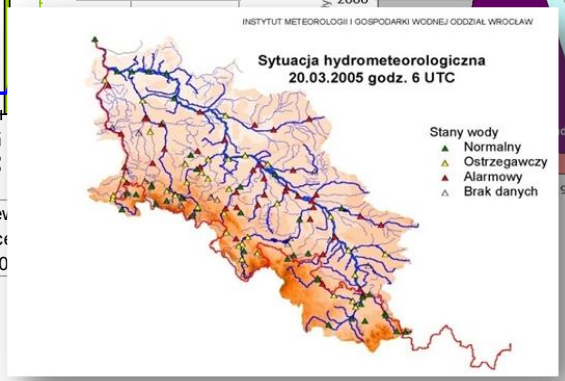
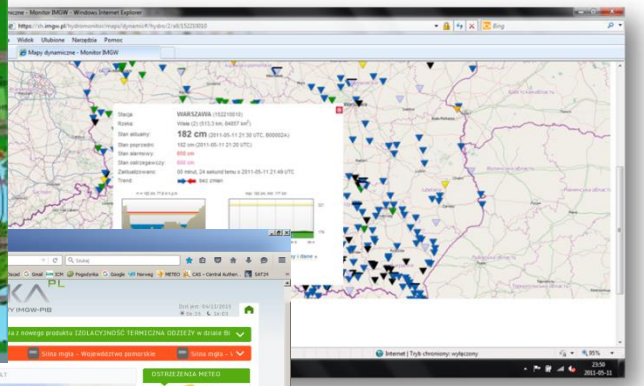
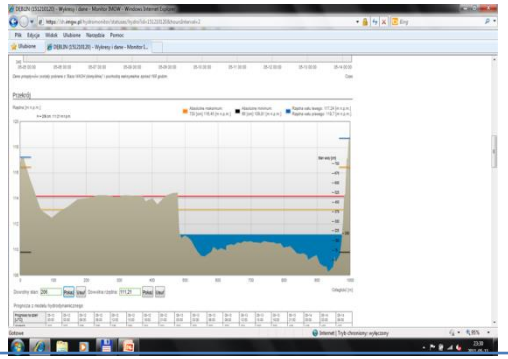




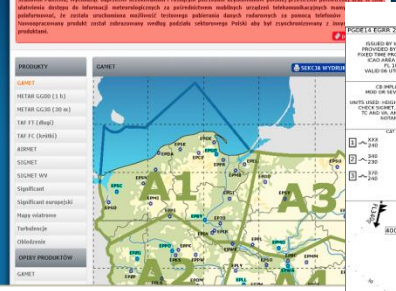
www.imgw.pl

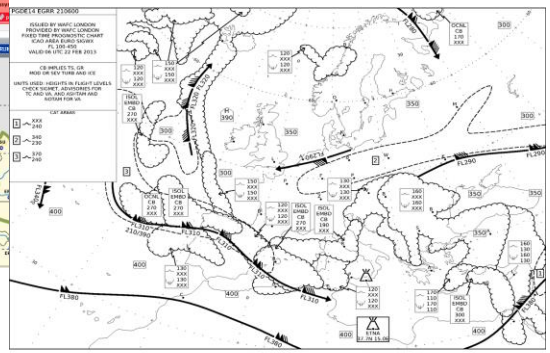




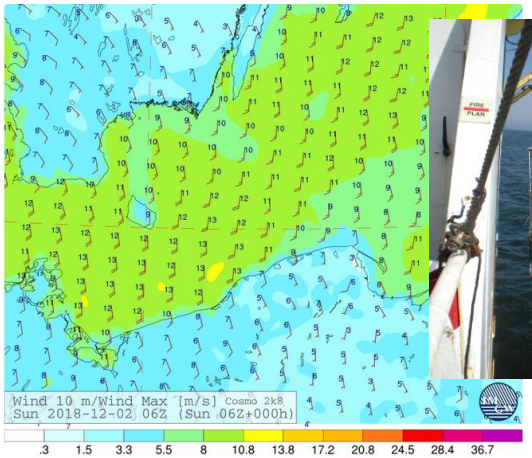
General measurements and forecasting service

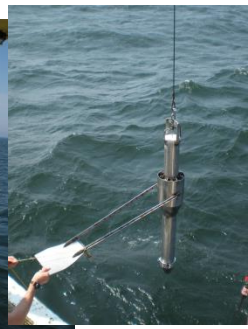
The National Hydrological and Meteorological Service – provide multiscope services – general, marine, aviation





Meteorological servise for Aviation

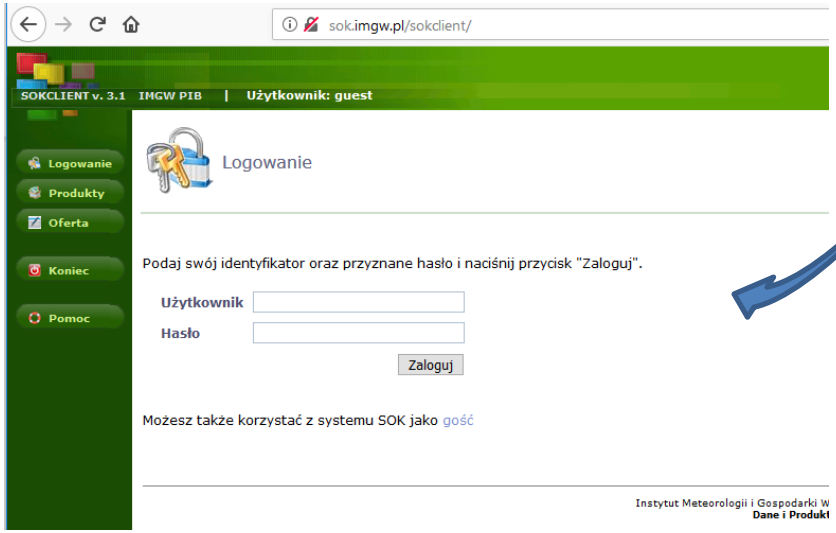


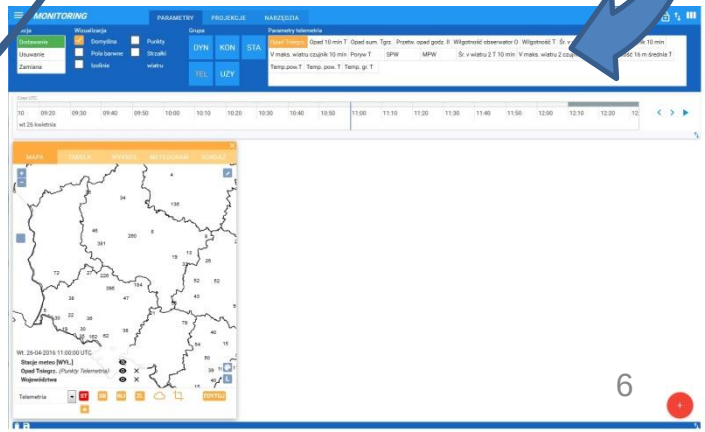


Marine measurements and forecasting service

- ✓ One software to forecasts edition
- ✓ One weather forecasters suport software
- ✓ One customer service and products distribution system
- ✓ One database

The National Hydrological and Meteorological Service – fully standardized system of forecast offices operation





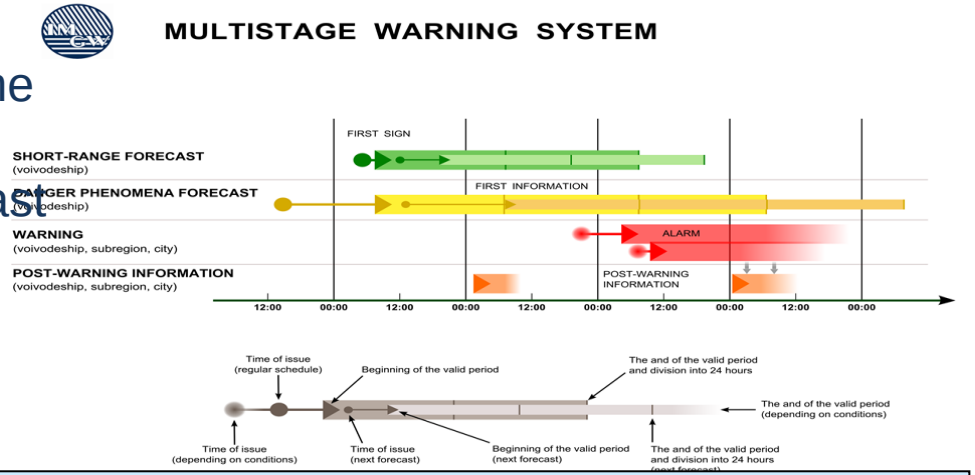
I. **Preliminary** information – ahead of time up to 7 days

II. **Approximate** information – ahead of time up to **72 hours**

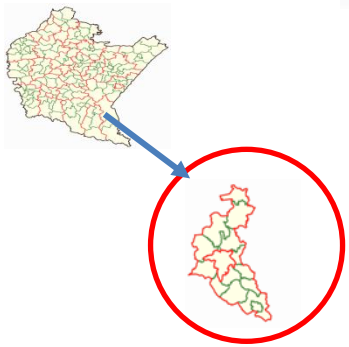
III. **Warning** information – ahead of time up to **48 hours**

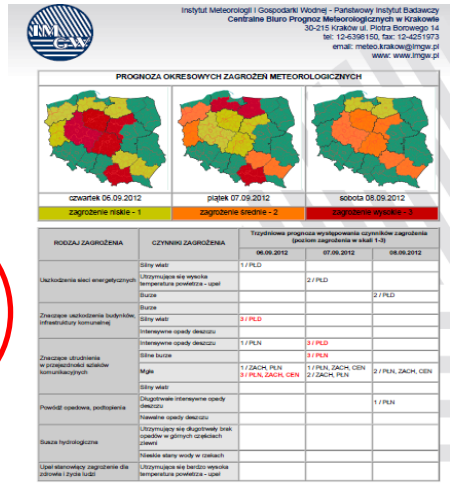
IV. **Post-warning** information – forecast up to 3 hours

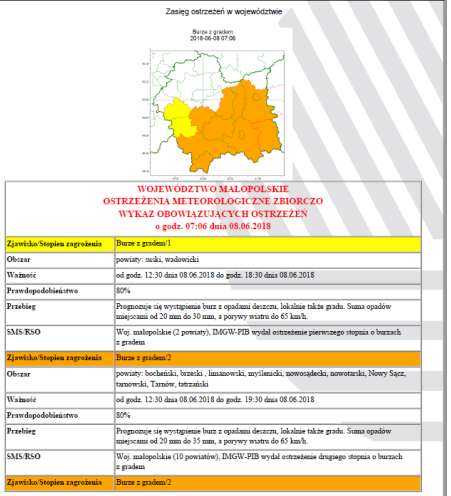
www.imgw.pl



The National Hydrological and Meteorological Service – provide multistage warning system







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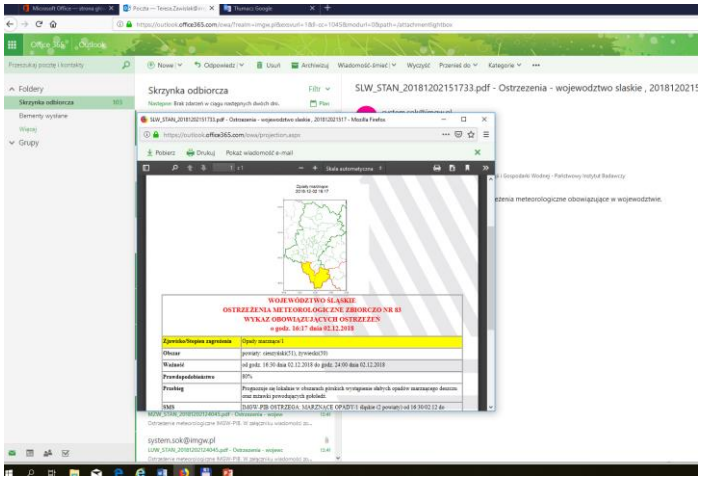
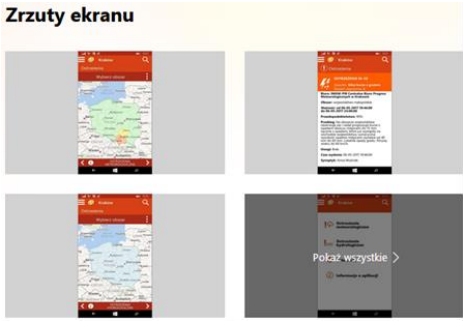
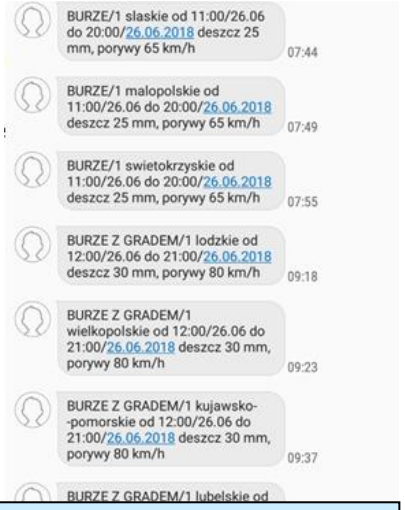
Crisis Management Centers



SMS system

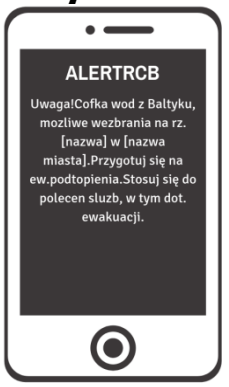




The National Hydrological and Meteorological Service – multiple warning dissemination system

Regional Warning System – in cooperation with The Ministry of the Interiol – any warning, mobile application

Alert Warning System – in cooperation with the Government Centre for Security



State of immediate life threat, Everyone in the affected area

Ground-water

AGNIESZKA KOWALCZYK, MAŁGORZATA WOŹNICKA, MICHAŁ WYSZOMIERSKI

Polish Geological Institute
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In Poland monitoring and groundwater research is carried out by:

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www.pgi.gov.pl

The Polish Hydrogeological Survey

as part of **The Polish Geological Institute**

- **Monitoring**
- **Database**
- **Research & analysis**

Possible short and long-terms scenerios - GWL

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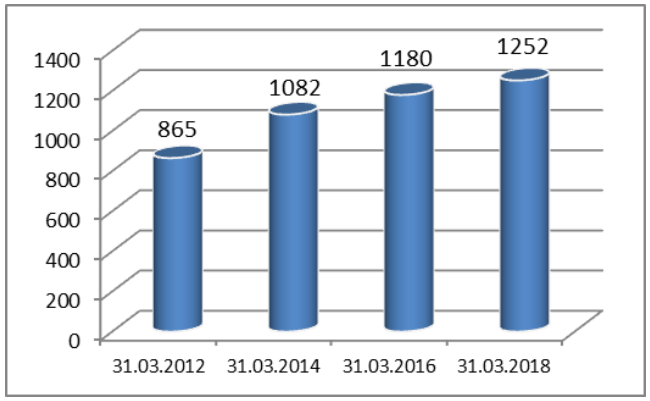
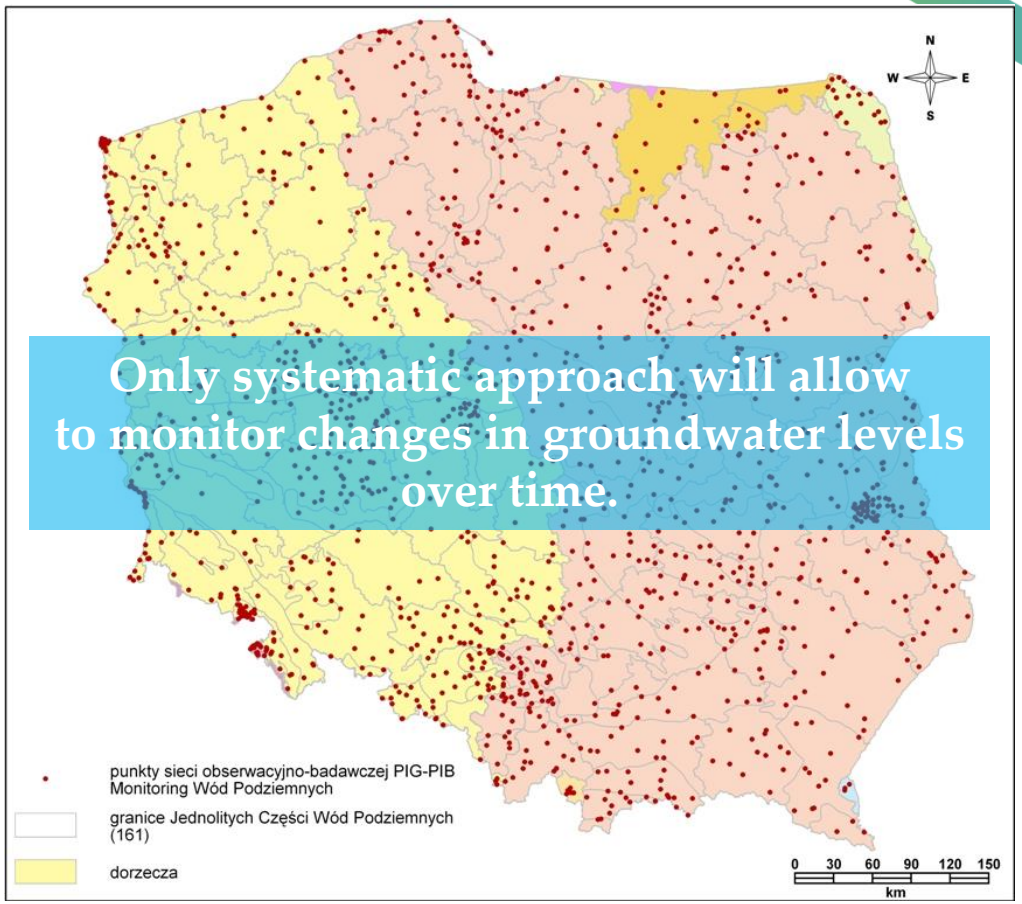
Good Monitoring – basis for reliable diagnosis



Number of PHS groundwater observation points

- ≈ **Quantitative monitoring**
  - → daily measurements (constant – on line)
  - → weekly measurements
- ≈ **Chemical monitoring**
- ≈ **Research monitoring**



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PHS Databases:

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- The Groundwater Monitoring database
- The HYDRO Bank
- Intake Database
- GIS DB of the main groundwater reservoirs
- GIS DB of The Hydrogeological Map of Poland 1:50 000
- Disposable Groundwater Resources Database

PHS data processing system (SPD PSH)
searching and viewing of data

e-PSH browser

From parameterization to risk assessment

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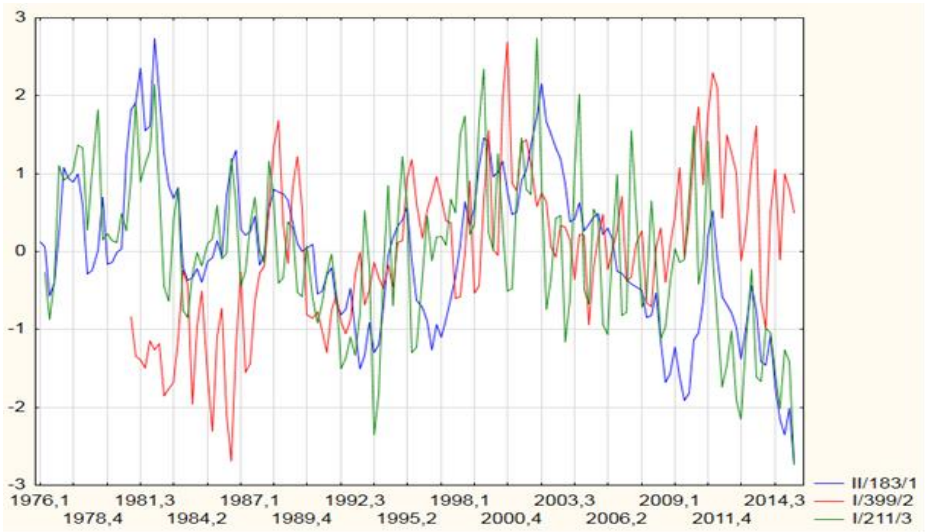
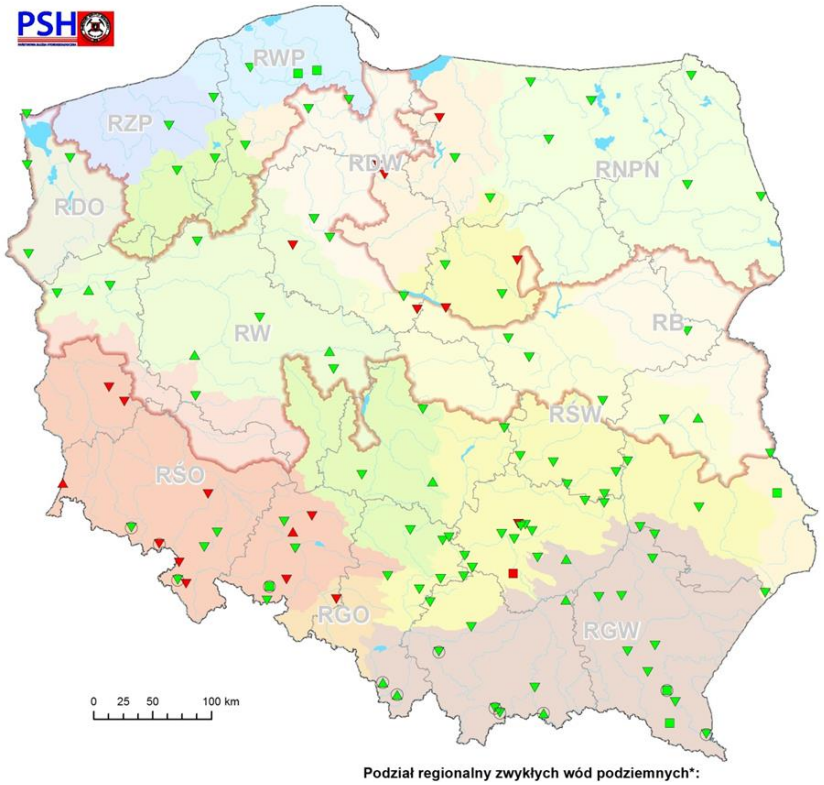
Investigation of drought due to the various indexes:

- Low groundwater index – k_n
- Standardized Groundwater Level Index





Podział regionalny zwykłych wód podziemnych*:

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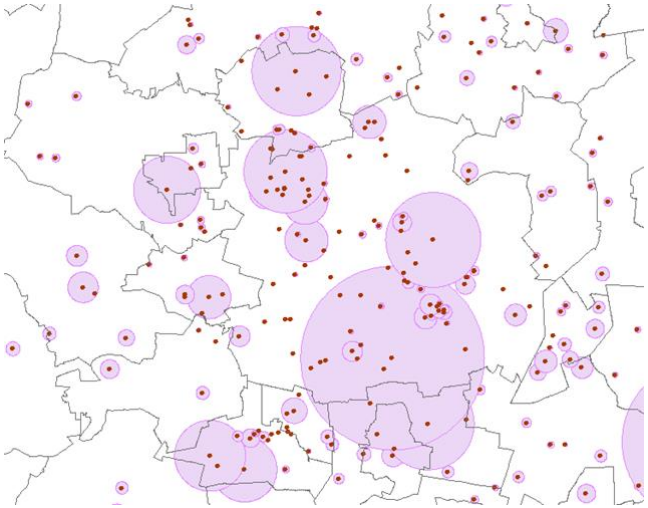
Maps & reports



PHS provides information about localizations of alternative groundwater supplies.

As far PHS has done such work for:

- cities and agglomerations,
- agricultural lands,
- forests.

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Dedicated maps

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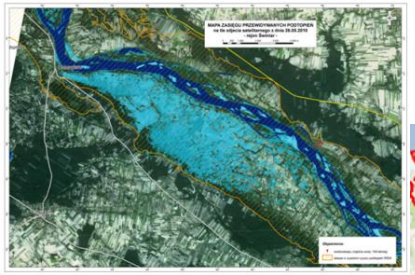
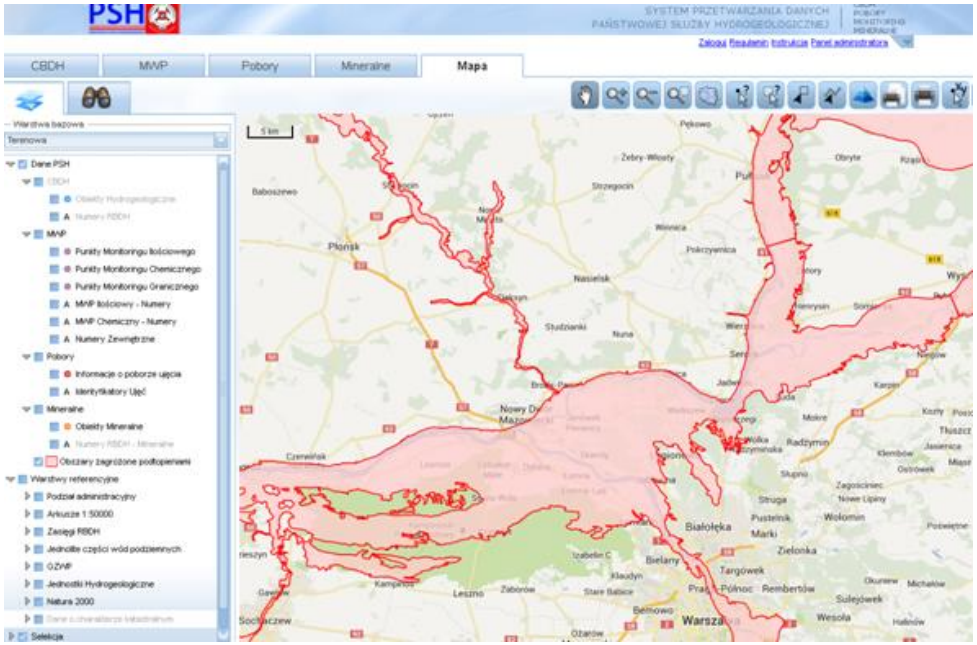
Flooding map risk of Poland - areas at high risk of flooding from groundwater

GIS layer provided as shp or WMS
https://spdpsh.pgi.gov.pl/PSHv7/
www.PSH.gov.pl
www.geoportal.gov.pl





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Investigation of low and high groundwater level periods in the past

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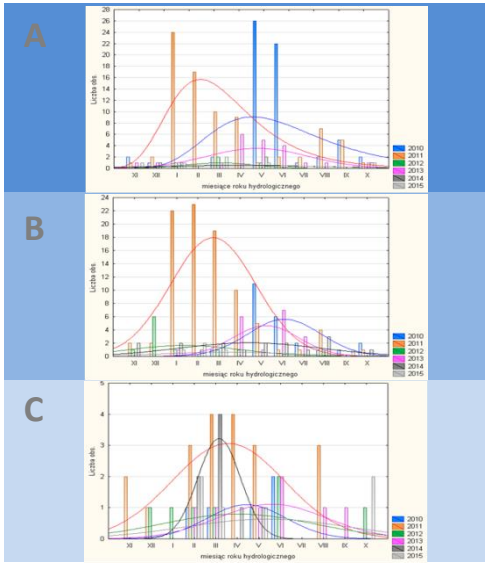
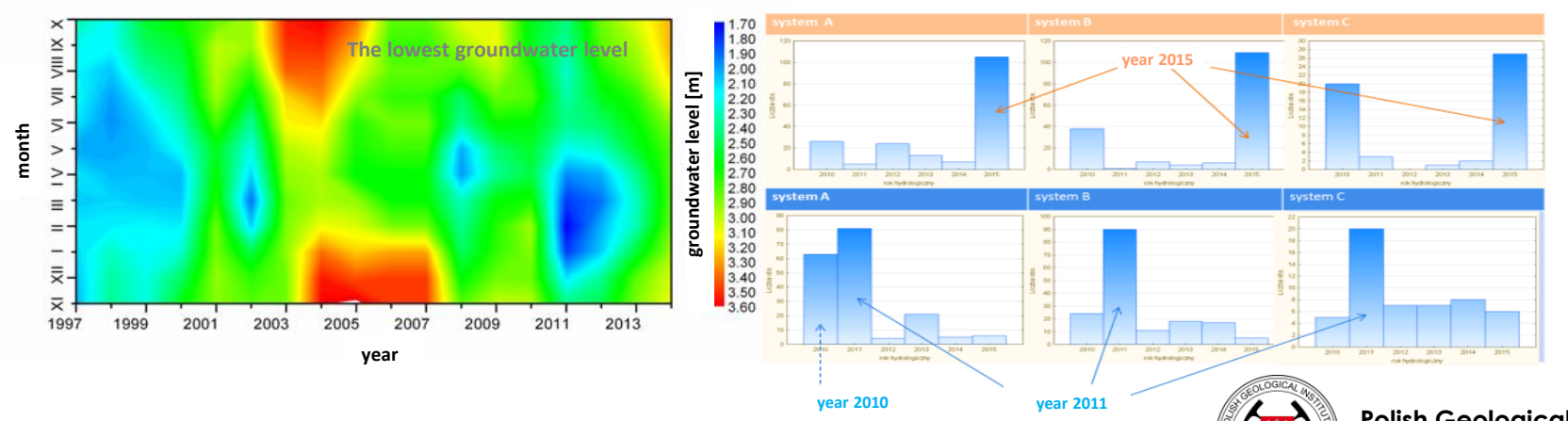
- Spatio-temporal analysis of extreme GWL values
- Analysis of the reaction to the drought and flood in distinguished (due to the depth of aquifer) hydrogeological systems across the country
- Indicating areas most vulnerable to drought in groundwater
- Distinguishing between natural and anthropogenic trends in GWL variability





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Research & analysis
Maps & reports

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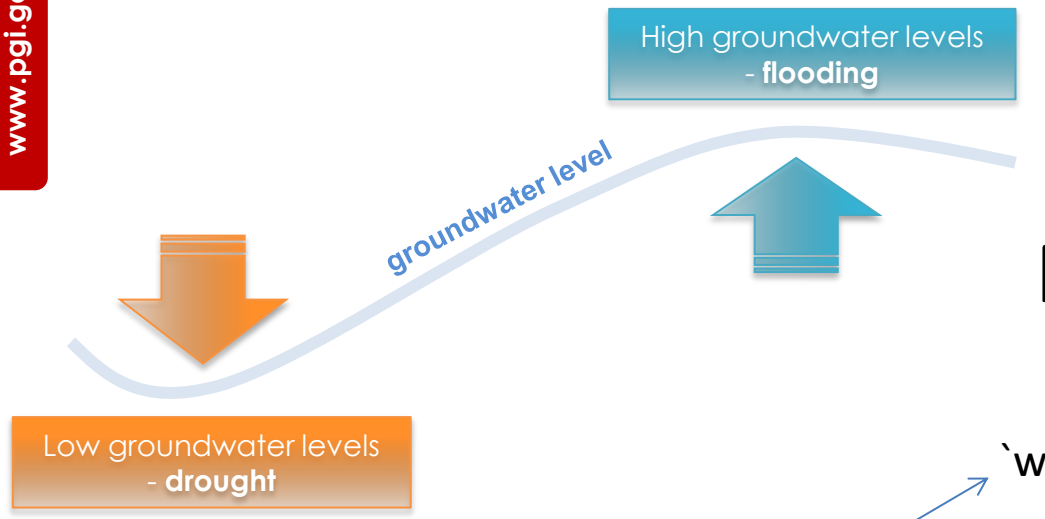
Distinguishing between natural and anthropogenic trends in GWL variability



Possible scenarios

Extrem scenarios
- `wet conditions'
- `dry conditions'

short and long-term forecast of GWL

Forecast of groundwater chemical status

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Warning - hydrogeological situation shorterm forecasts

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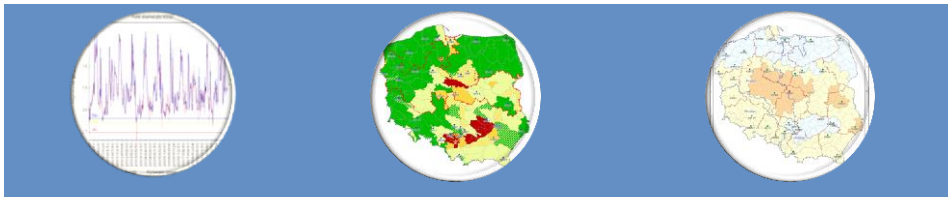

GWL FORECAST | **WATER RESOURCES FORECAST** | **RISK FORECAST**

Early Warnings System

Normal procedure
one forecast per three months

Special procedure
one forecast per month

Alarm
one forecast per week

Forecasts available @
www.psh.gov.pl

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Example map of drought risk from the recent short-term forecast of GWL – shallow aquifers

Short-term forecast of risk related to groundwater

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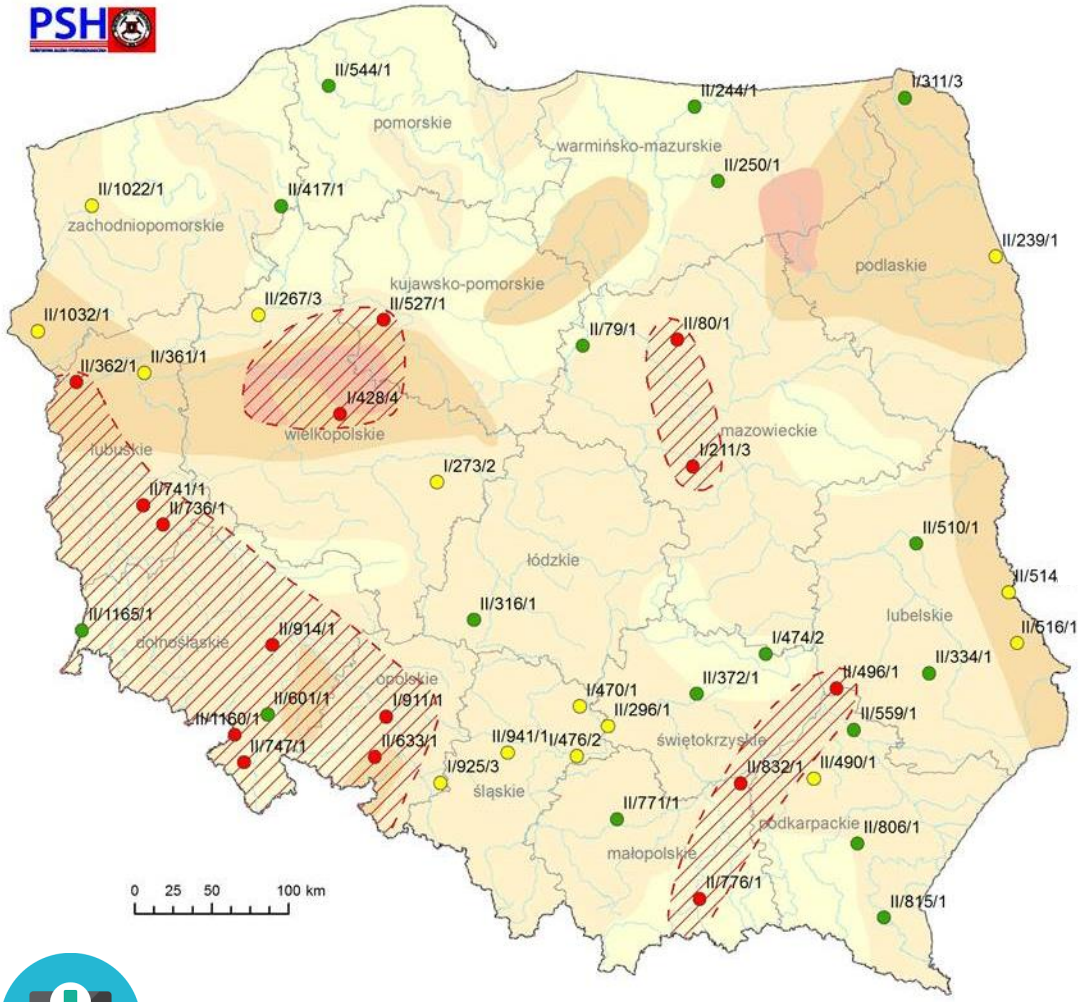
www.pgi.gov.pl



Forecast for the February 2019 - scenerio B

I/211/3 selected representative points of the groundwater monitoring network

risk index distribution:

- no hazard
- low grondwater levels hazard
- forecasted low groundwater levels

areas with forecasted low gruondwater levels according to "B" scenario

Namber of hydrological lows in years 1951-2000 (source: The Meteorology and Water Management Institute):

<7	16-23
8-15	>24

borders of voivodeships

borders of Poland

Current forecasts are published on the PHS website @ http://www.psh.gov.pl/

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Agrometeorological and phenological service as an example of climate change monitoring

MAŁGORZATA KĘPIŃSKA-KASPRZAK

Institute of Meteorology and Water Management
National Research Institute

Institute of Meteorology and Water Management
National Research Institute

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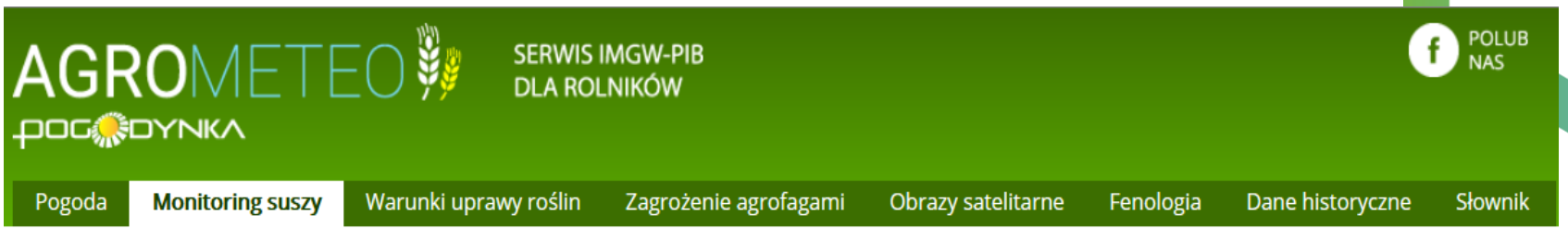

Weather forecast

Drought monitoring

Conditions of plants cultivation

Risk of pests

Satellite pictures

Phenology

Historical data

Dictionary

monitoring of short-term changes

monitoring of long-term changes

Drought monitoring

for 389 districts in Poland

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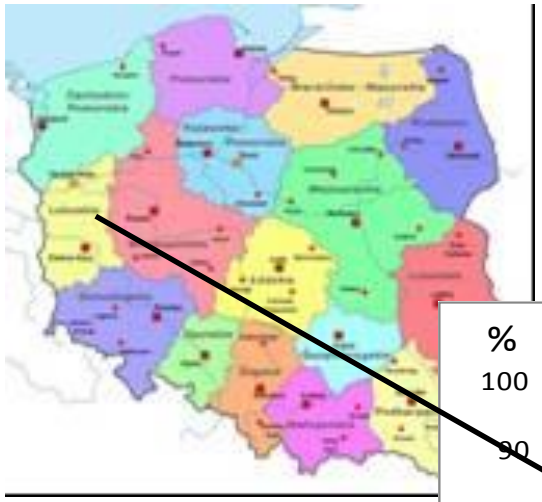

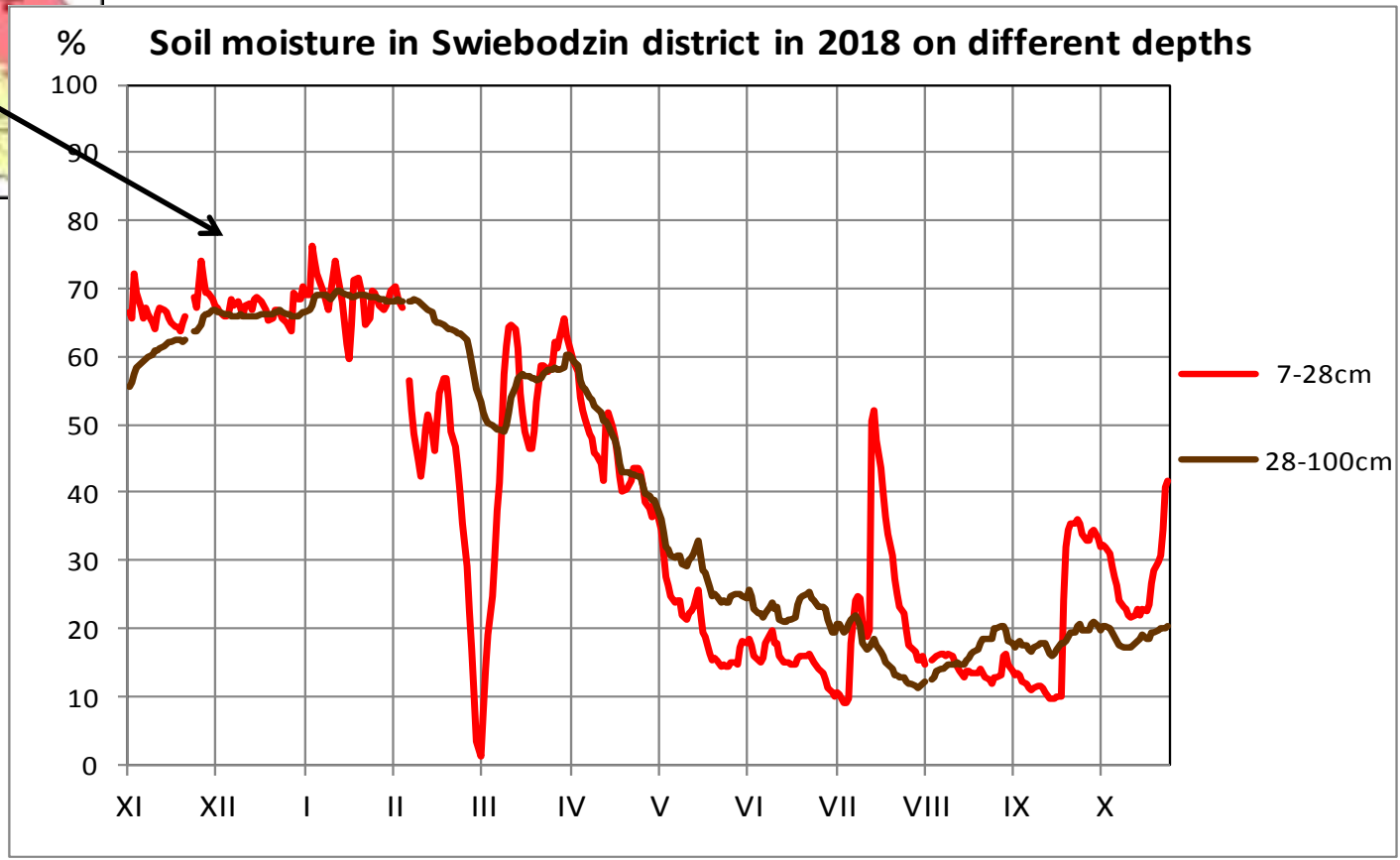

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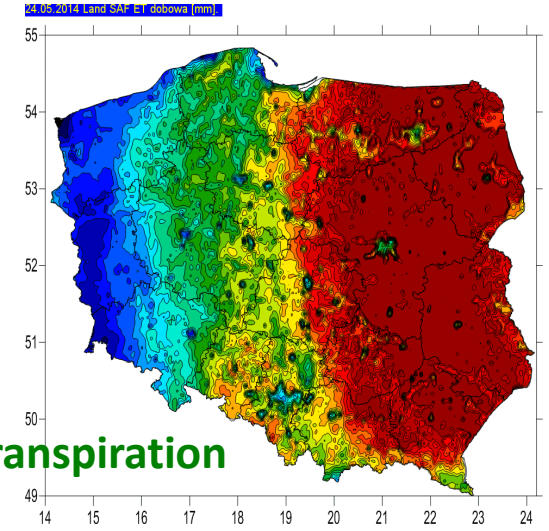
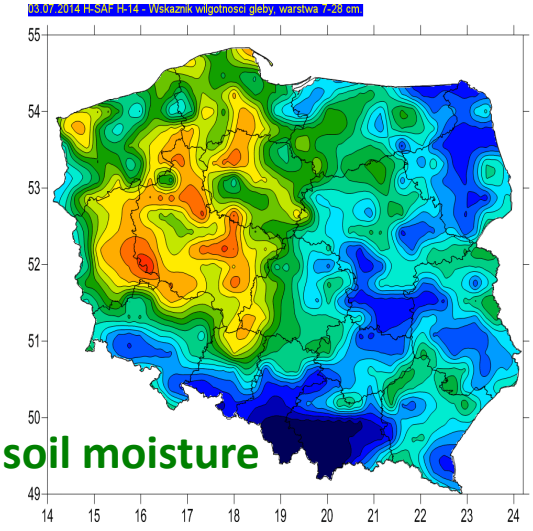
Satellite pictures

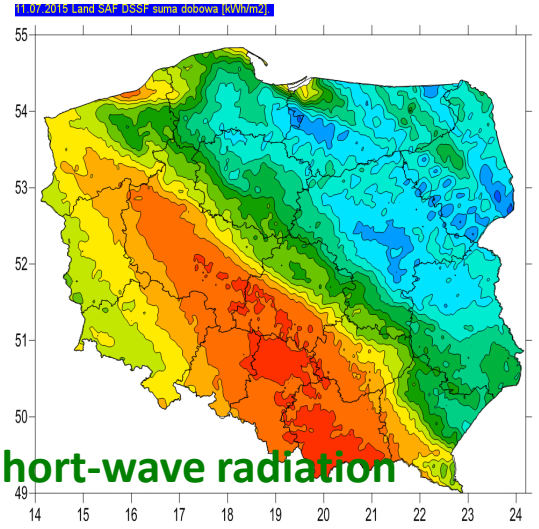


evapotranspiration

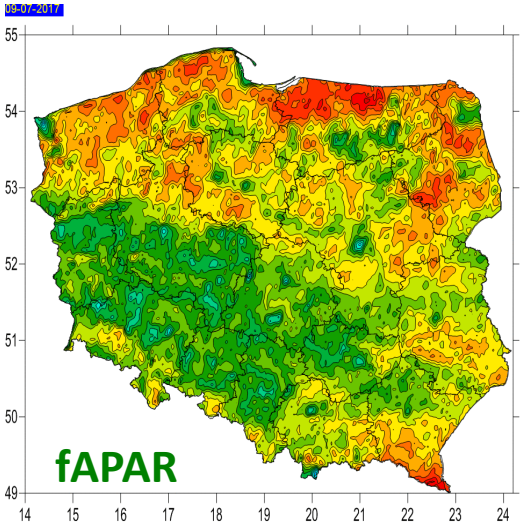


soil moisture

allow for drought monitoring and plant conditions monitoring



short-wave radiation



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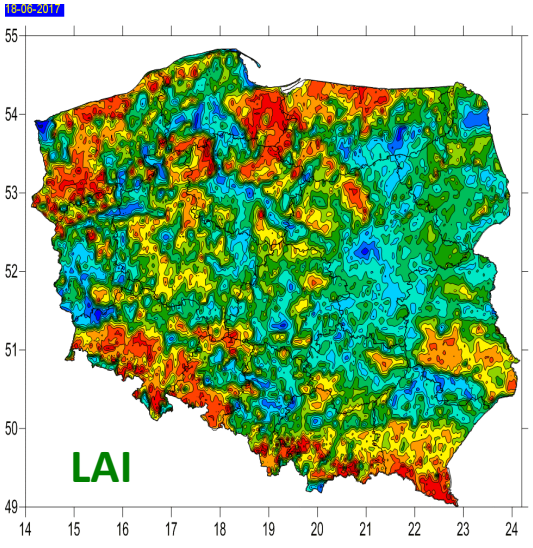

LAI

Phenology

Phenological service:

- since 2007
- 51 stations in the whole Poland
- 10 wild plants observed (Common Hazel, Coltsfoot, Bird Cherry, Common Dandelium, Silver Birch, Common Lilac, Horse Chestnut, Black Locust, Small-leaved Lime, Common heather)
- 5 phenophases observed
- 7 phenological seasons determined (earliest spring, early spring, spring, early summer, summer, early autumn, autumn)

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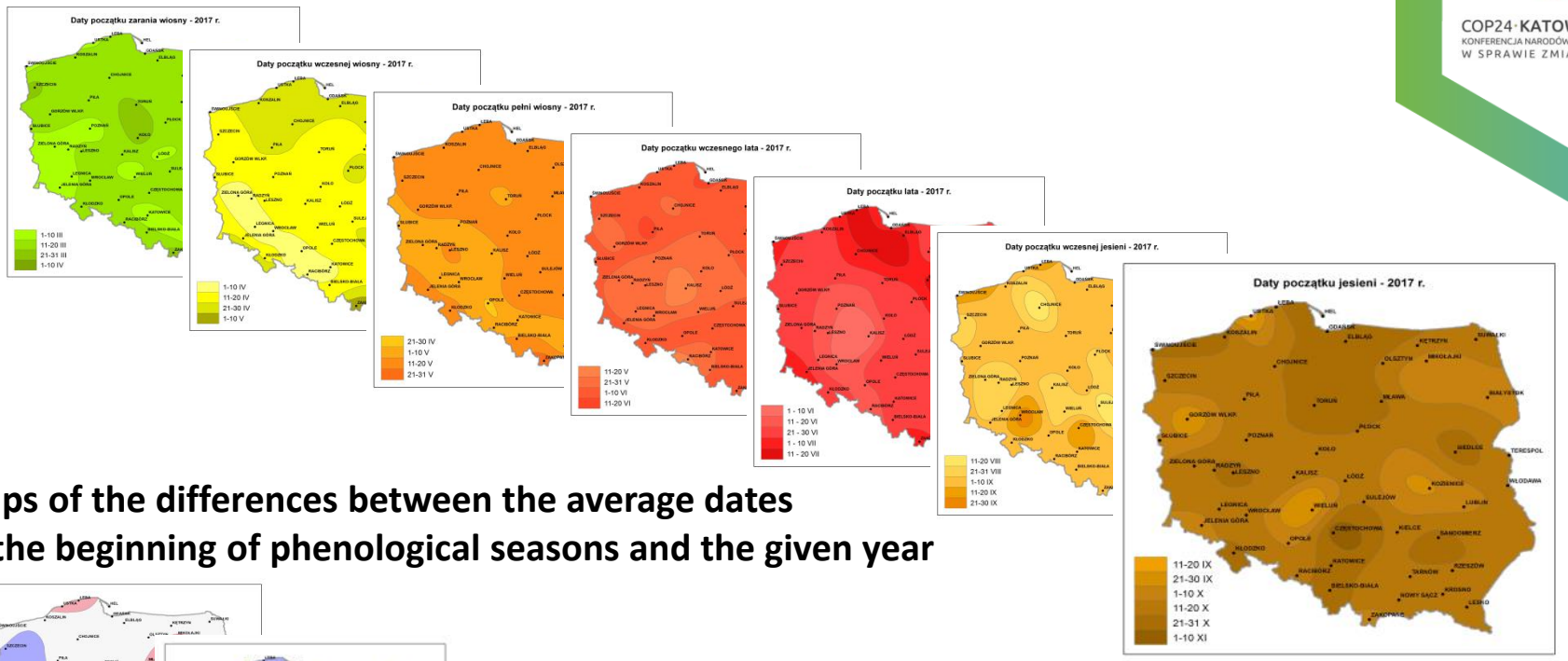
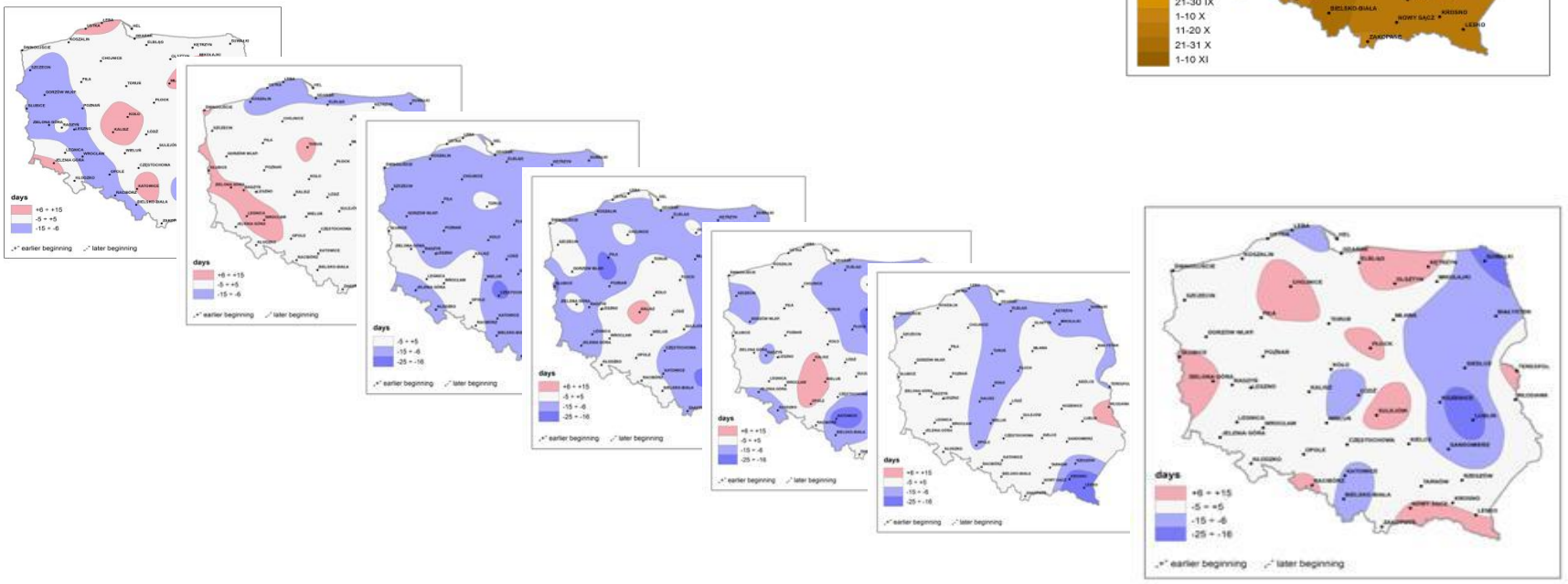
Maps of the beginning of phenological seasons



Maps of the differences between the average dates of the beginning of phenological seasons and the given year



Variability of phenological phases in Poland in years 2007-2016

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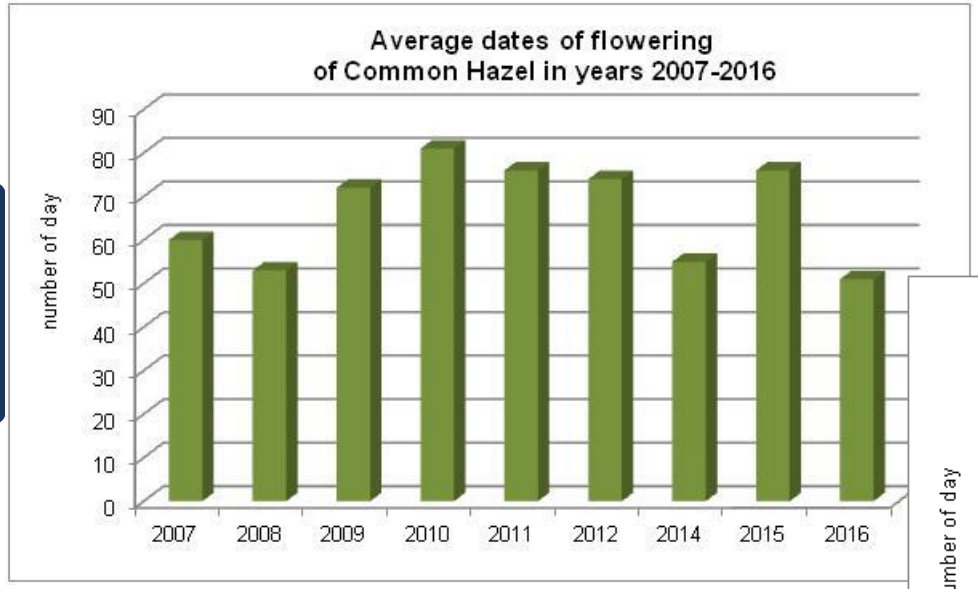

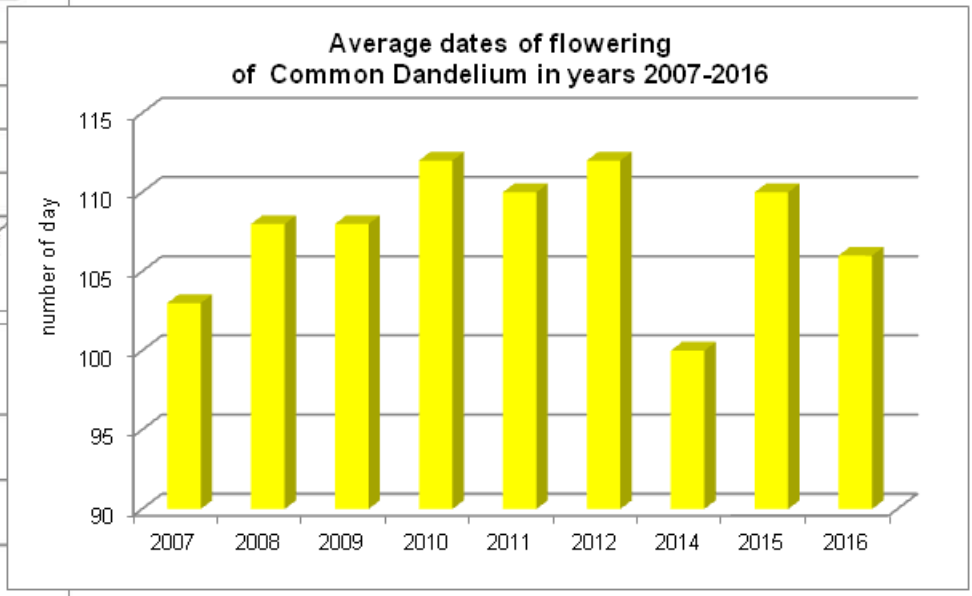

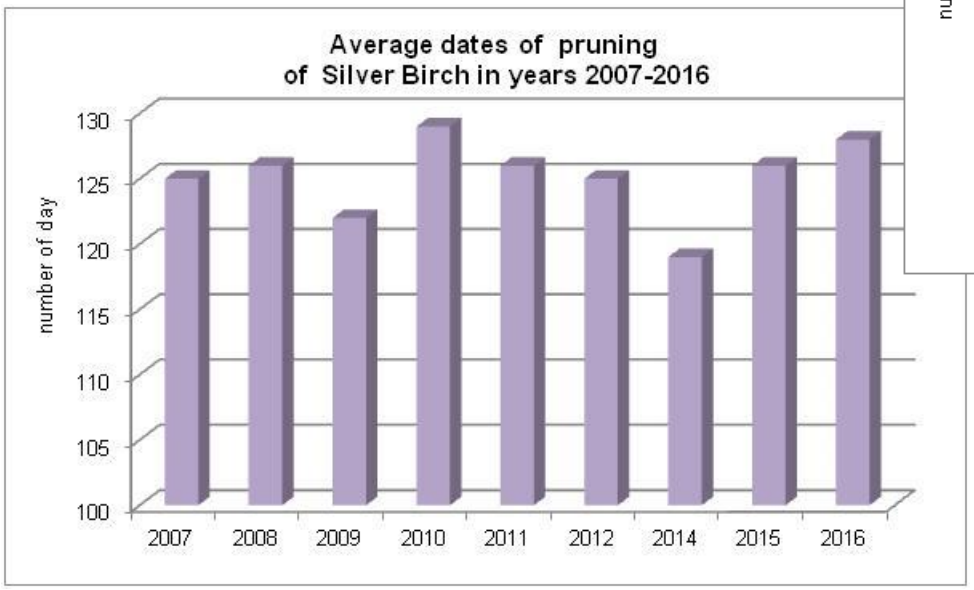

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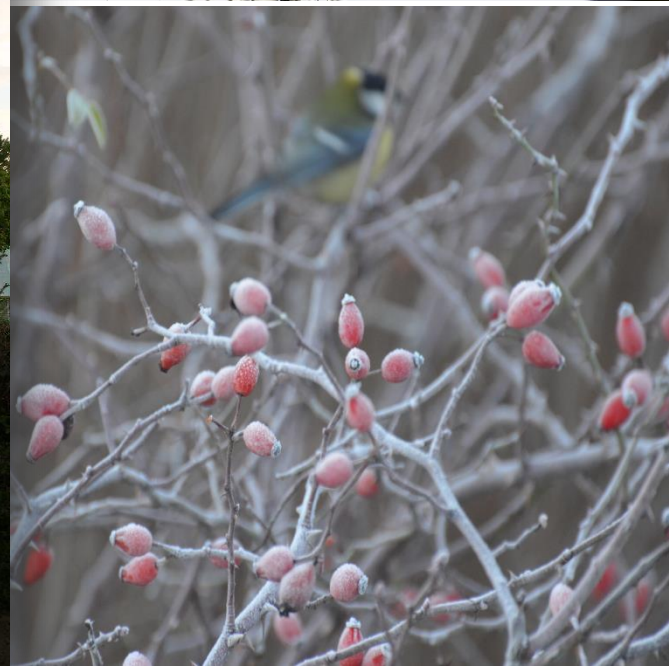
Automatic station of phenological observations



Historical data

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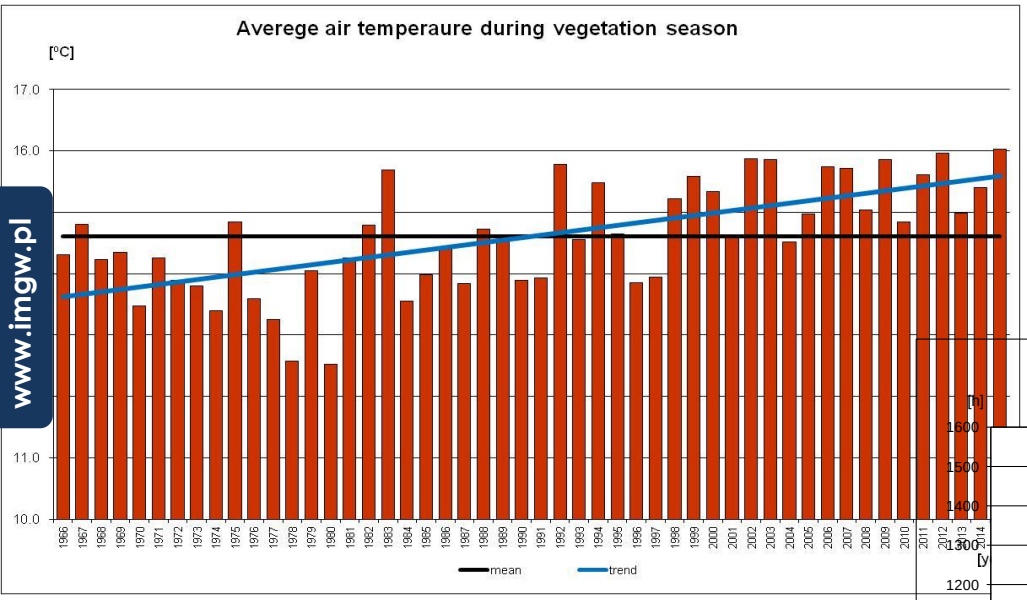

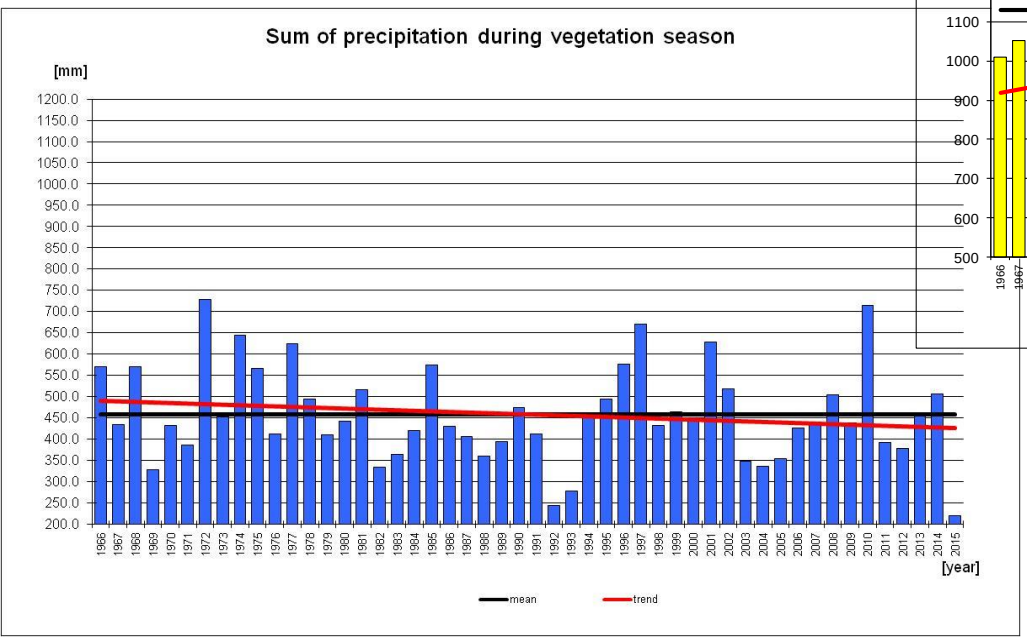

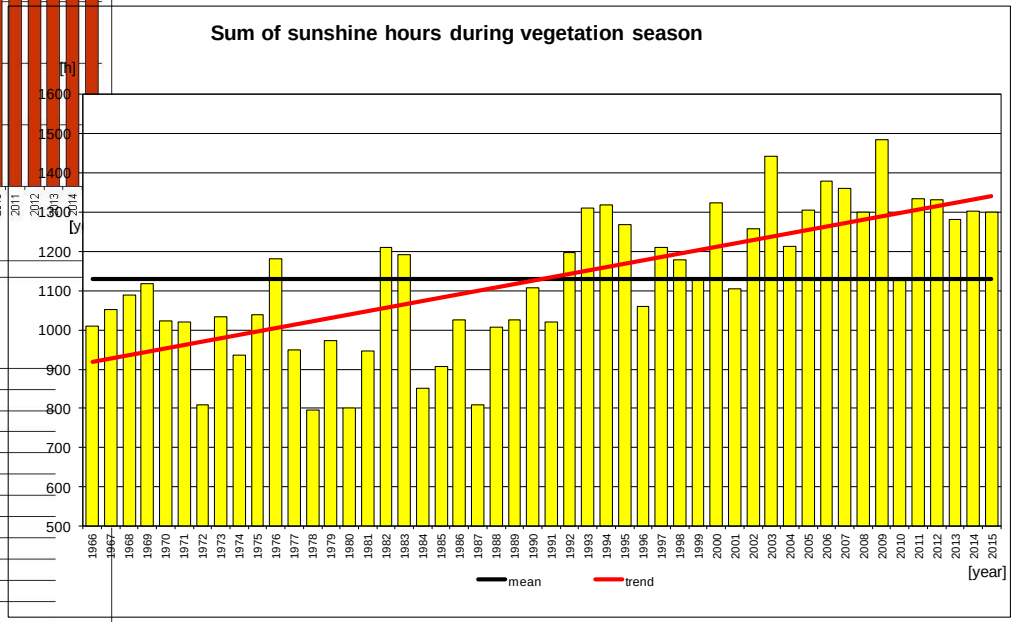

Land-slides

JACEK RUBINKIEWICZ

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System Osłony PrzeciwOsuwiskowej SOPO

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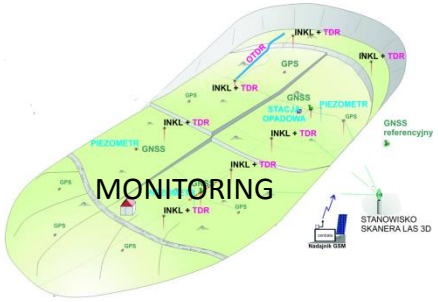
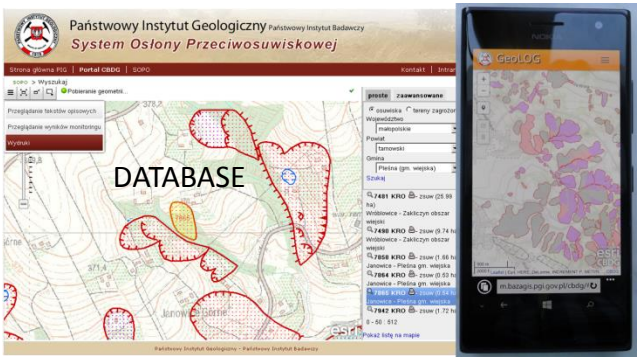
SOPO – Landslides Counteracting System

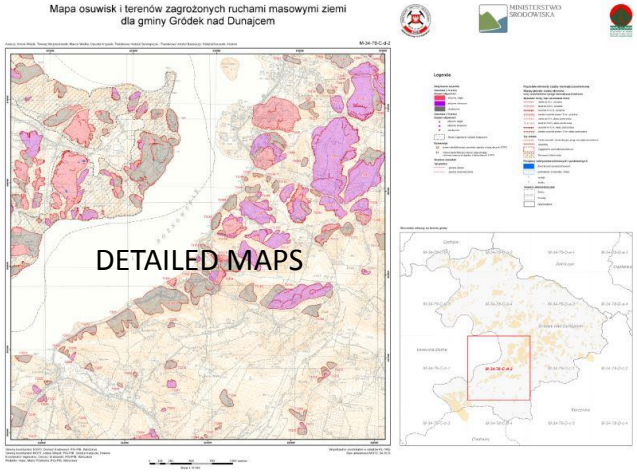
BBN
RCB Rządowe Centrum Bezpieczeństwa
GDDKiA
PIU Polska Izba Ubezpieczeń

- ✓ COLLECTING DATA FOLLOWING UNIFIED INSTRUCTION
- ✓ PREPARING DETAILED LANDSLIDE MAPS
- ✓ SOPO LANDSLIDE DATABASE
- ✓ MONITORING SYSTEMS ON SELECTED LANSLIDES
- ✓ SUSCEPTIBILITY MAPS, RISK ANALYSIS,

RECIPIENTS: - VARIOUS LEVELS OF ADMINISTRATION
- COMPANIES
- CITIZENS







System Osłony PrzeciwOsuwiskowej
SOPO

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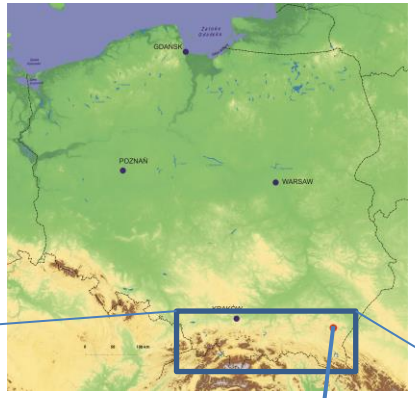
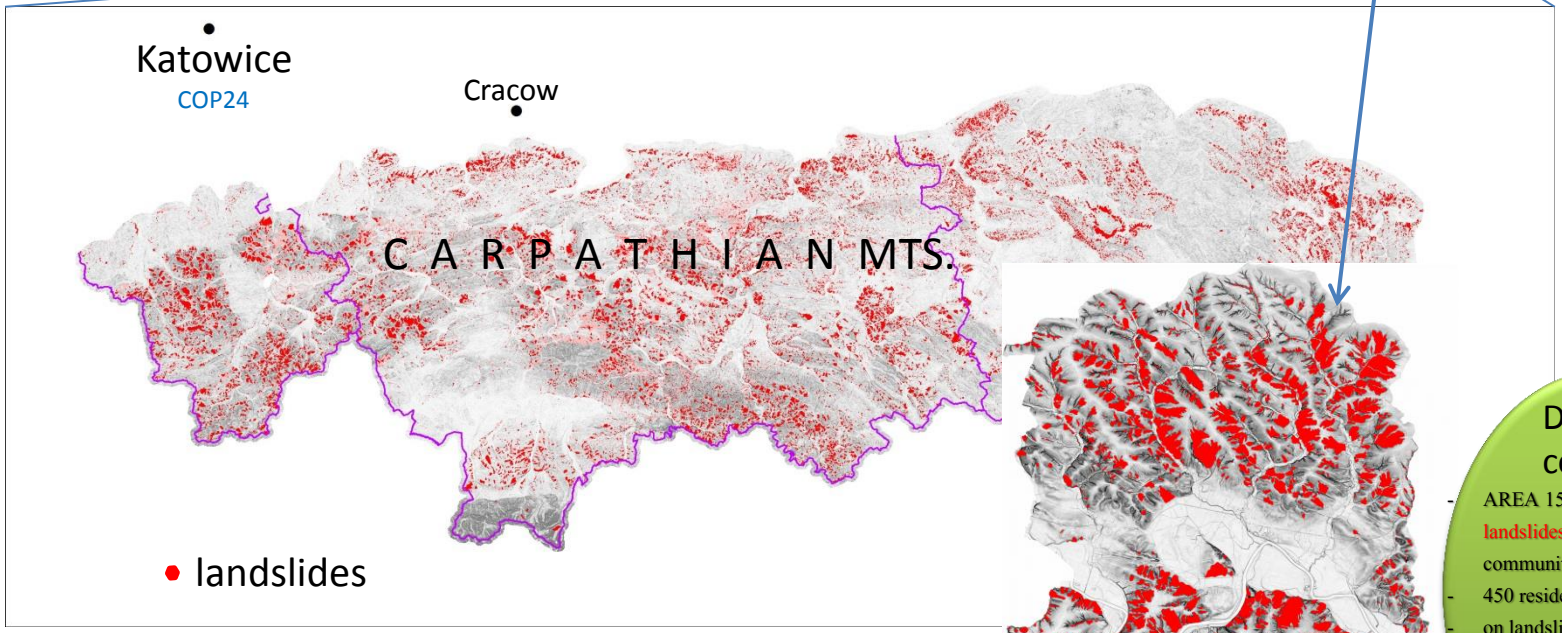
SOPO DATABASE - Landslide inventory

consists **61 251** landslides to date





Dubiecko community

- AREA 154, 26 sq km – 1623 landslides covering 16% of the community
- 450 residential building
- on landslides (10% damaged)
- 6 km road sections
- 34,5 km of power line sections

Carpathians covers 5% of territory of Poland
but accumulates 95% of landslides

CLIMATE CHANGES

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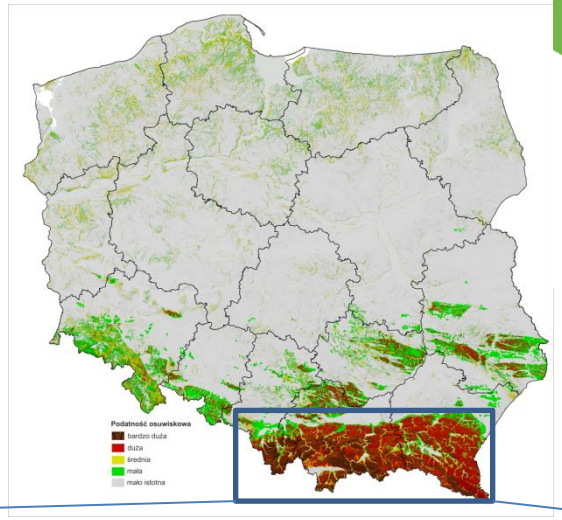
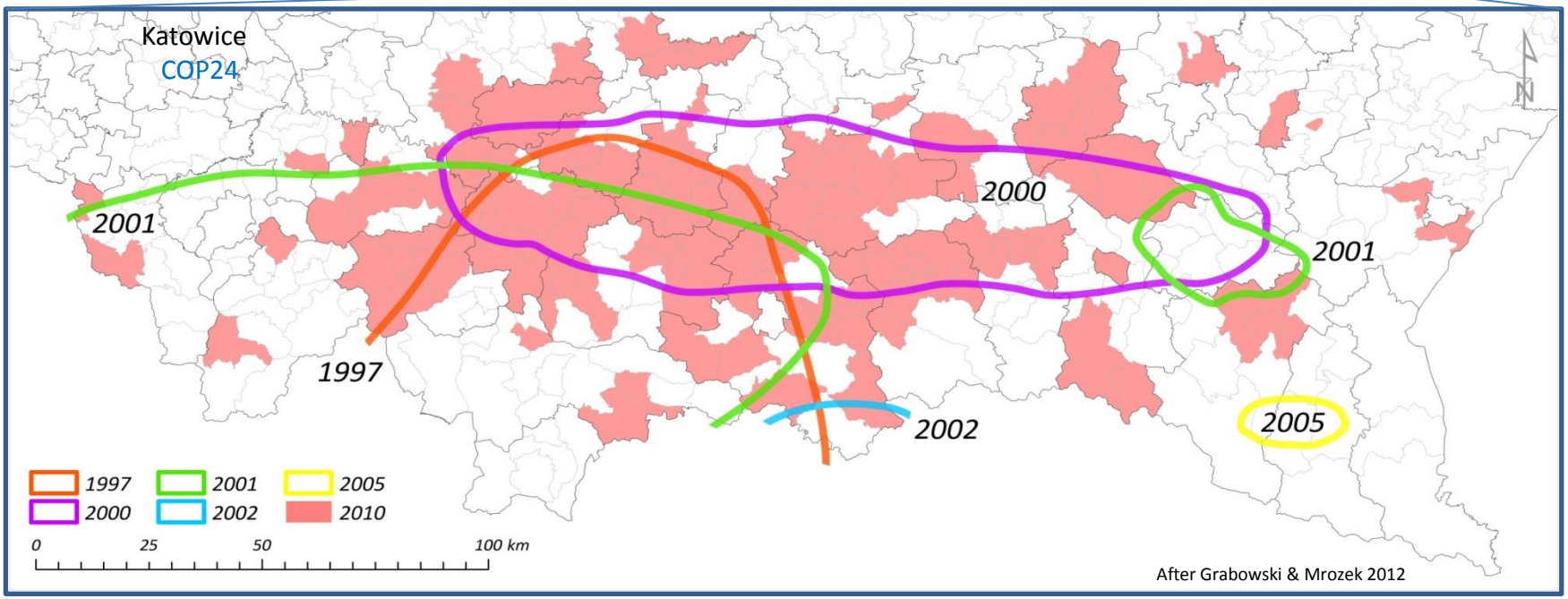
INCREASED NUMBER OF LANDSLIDES RELATED TO HEAVY RAINFALLS AND LONG-LASTING PRECIPITATION

Catastrophic landslide movements during last 30 years in the Carpathian Mts. (southern Poland): 1997, 2000, 2001, 2002, 2010



Landslide susceptibility map of Poland (1:500 000) after Wojciechowski et al.



After Grabowski & Mrozek 2012

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MONITORING

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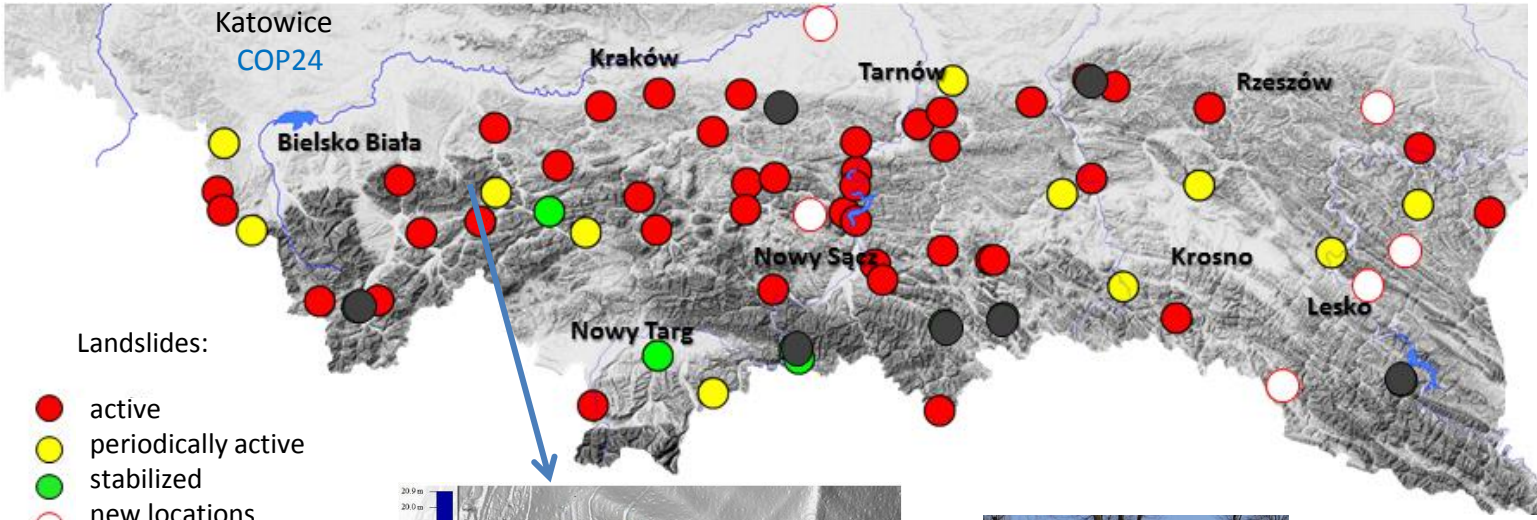
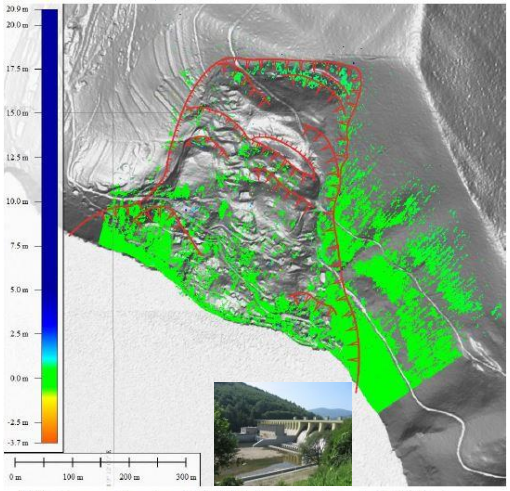
Landslide monitoring locations in Poland (Carpathians)



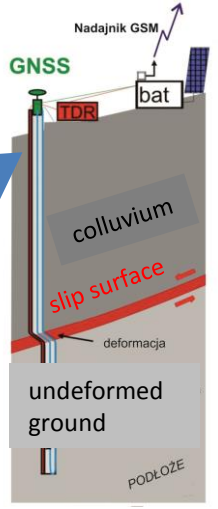
Landslides:

- active
- periodically active
- stabilized
- new locations
- cancelled monitoring

Ground (terrestial) laser scanner



Model różnicowy pomiędzy pomiarami 2017.03.30 (naziemny skaning lazerowy) a 2017.09.24 (naziemny skaning lazerowy).



Inclinometer system

Coastline

GRZEGORZ
UŚCINOWICZ

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The Southern Baltic Coast

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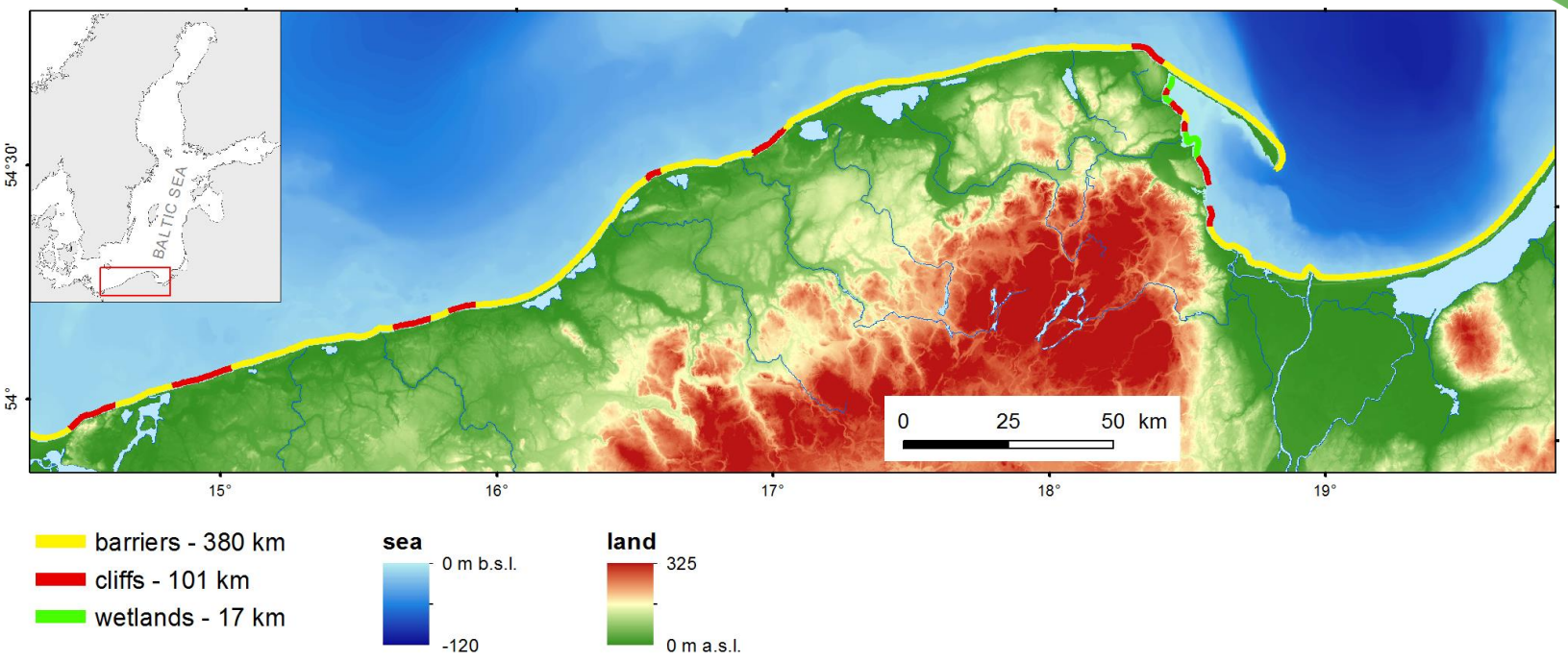
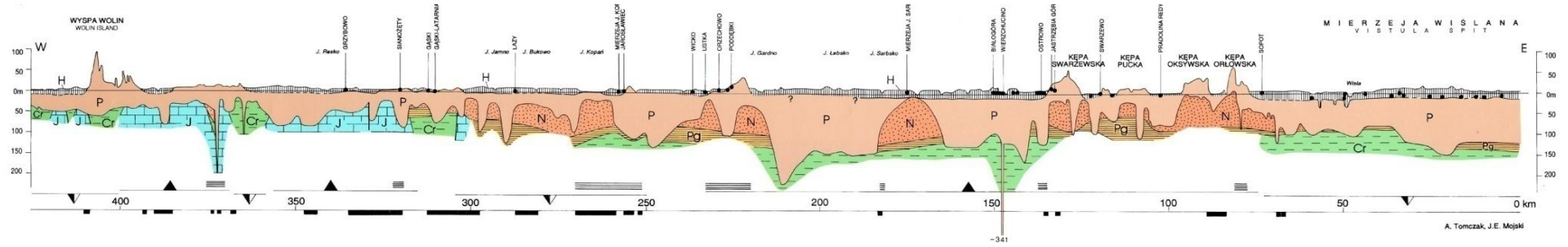


Geological cross-section along the Southern Baltic coast *(acc. to: Geological atlas of the Southern Baltic, PGI – NRI, 1995)*



The need of coastal research

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Methods of coastal research

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Data implementation -reconstruction-

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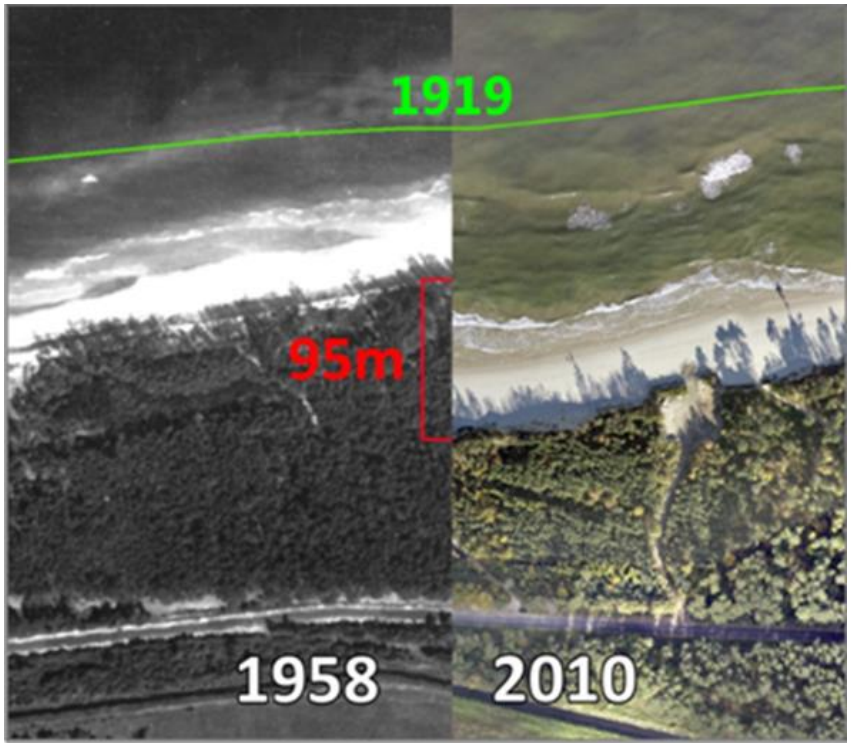

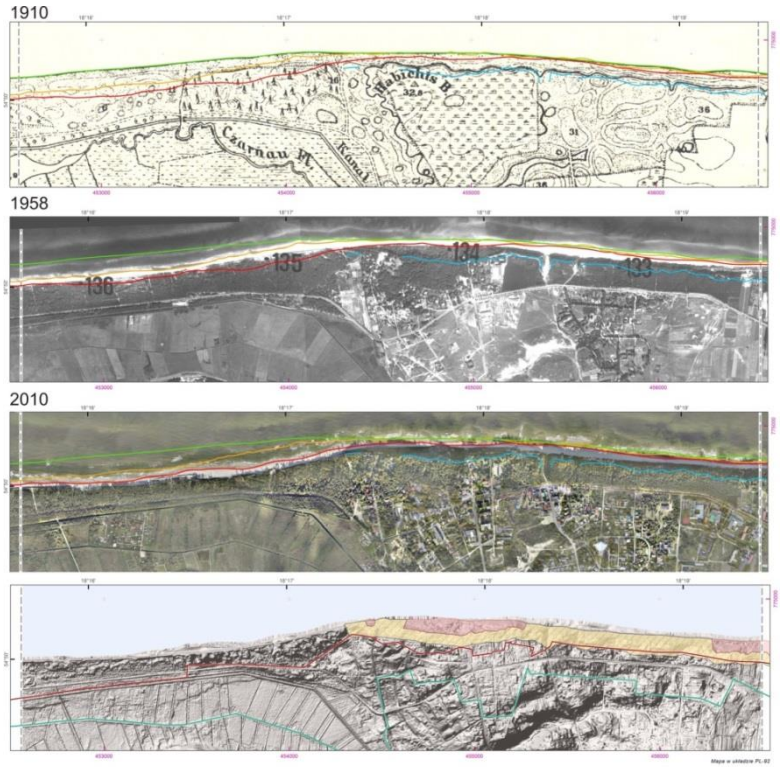

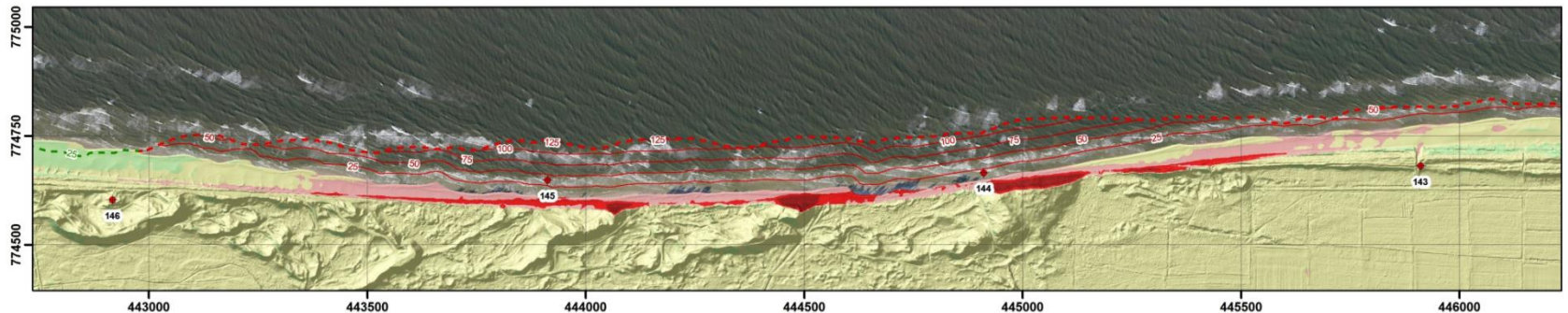

Data implementation -forecasts-

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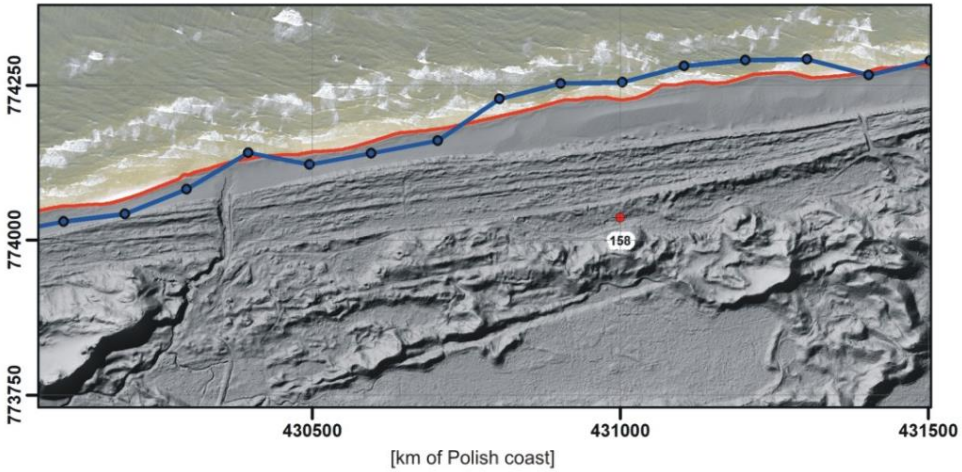
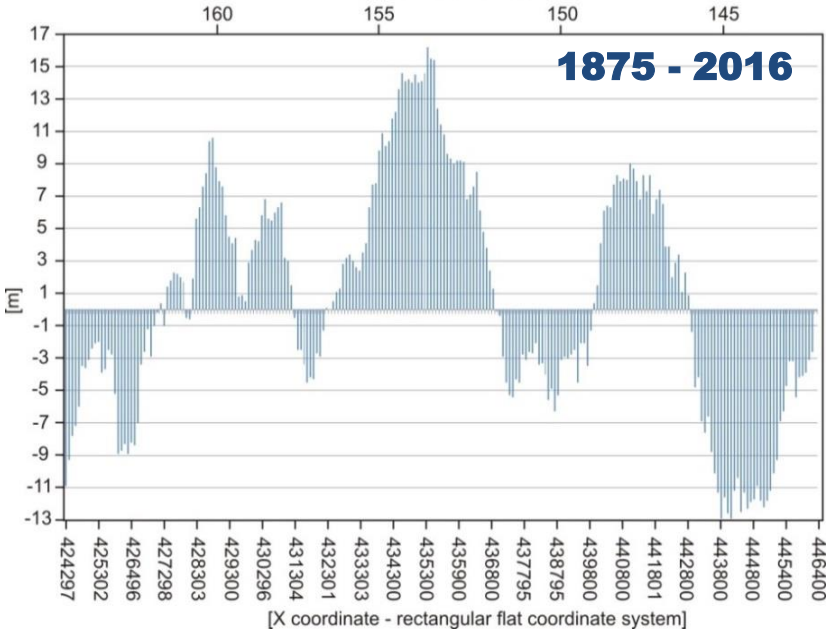
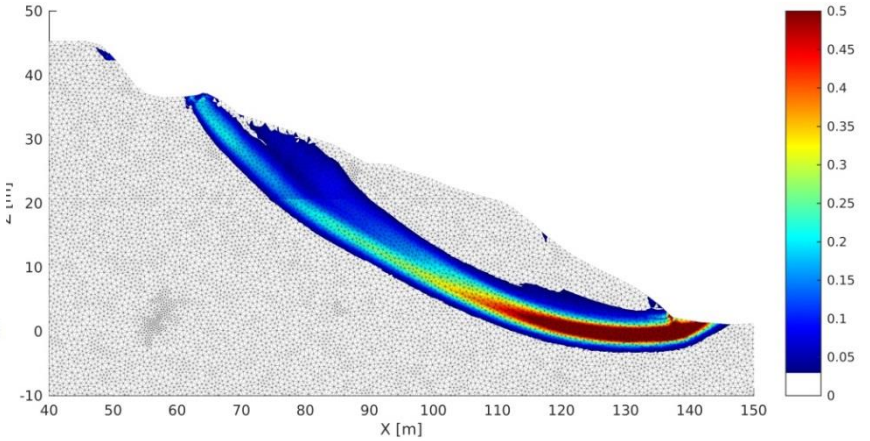
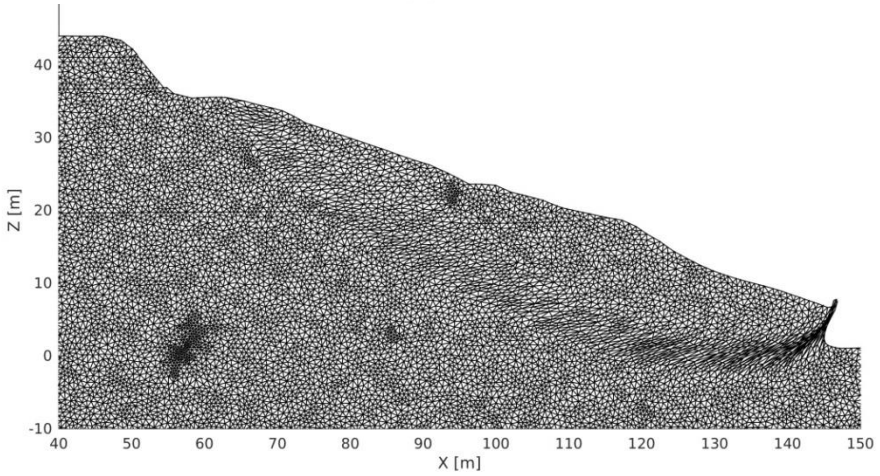
Prediction of shoreline changes





Cliff coast stability analysis





Paleocli-mate

WOJCIECH GRANOSZEWSKI

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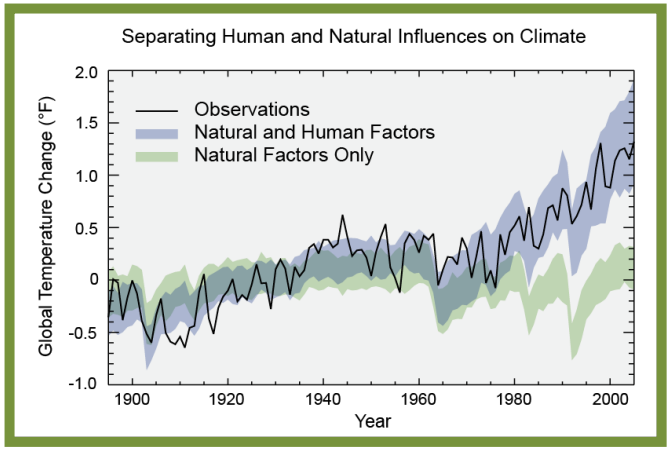
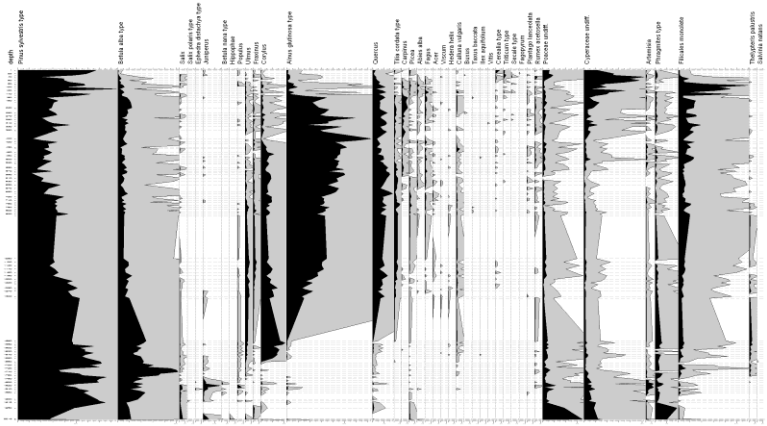
Natural versus man-induced climate changes



Source: WP of United States Environmental Protection Agency



Ca. 12 000 yrs long vegetational changes in W Poland archived in lake sediments

<u>Palaeoclimate studies</u>:

Vegetation - is one of the most sensitive indicators of climate changes. Fluctuations of vegetation in the past interglacials (without or with very weak human impact) tell us how deep the vegetational-climatical changes can be.

The most important lesson from the past teach us that climate changes might be of great variety and include: drop/rise in temperature, in precipitation (droughts / floods), rise /drop in sea levels (the coastline during the last interglacials went significantly further South in C Europe comparing to the present one), changes in monsoon system. Some of the palaeoclimate changes were substantially bigger than those we are facing nowadays. It gives a chance to be prepared for them.

Agricultural Drought Monitoring

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This part of presentation was prepared in frame of long-term IUNG-PIB program Task 1.7

JERZY KOZYRA
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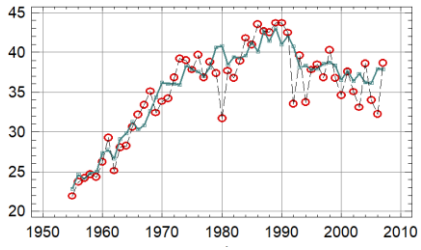
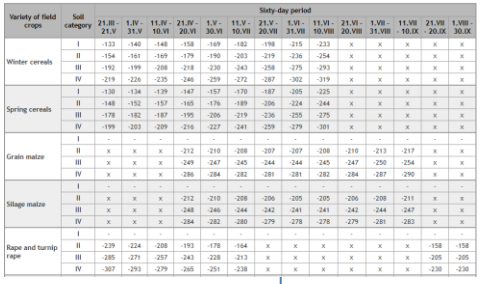
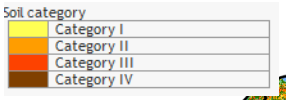
Statistical models describing yield-weather indices relations during vegetation season



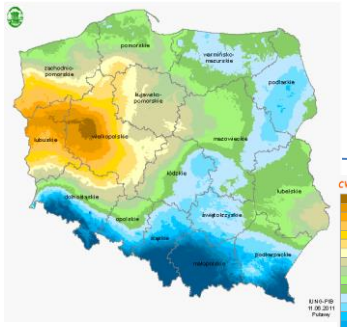
Temporal and soils specific climatic water deficit threshold indicated drought conditions for 14 crops





Meteorological stations used in ADMS

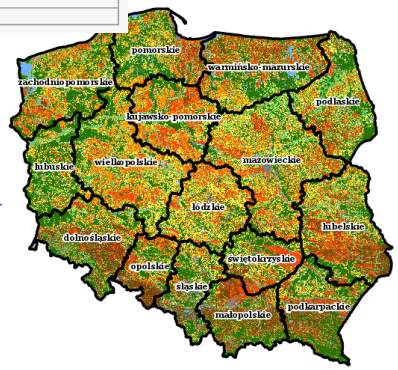
GIS



CWB for monitoring period

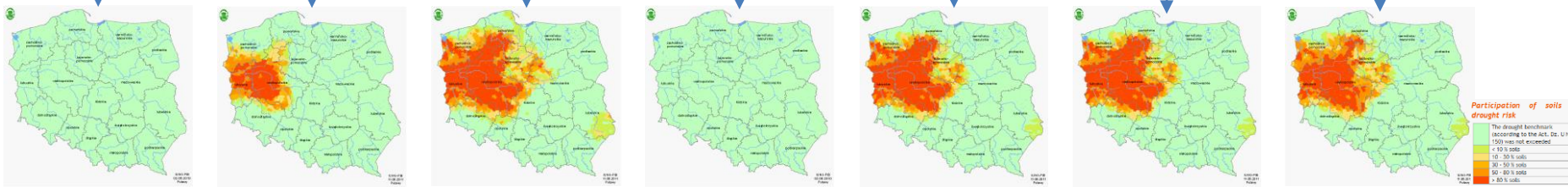
Crop Drought definition based on CWB threshold for 4 category of soils, 14 crops and 14 reports per year

GIS



Map of susceptibility of soils to drought

% of soil affected by drought (NUTS-5)



Sugar beet | Fruit trees | Fruit shrubs | Rape and turnip rape | Strawberries | Spring cereals | Winter cereals

Agricultural Drought Monitoring System in Poland - how it's working

http://www.susza.iung.pulawy.pl/en/

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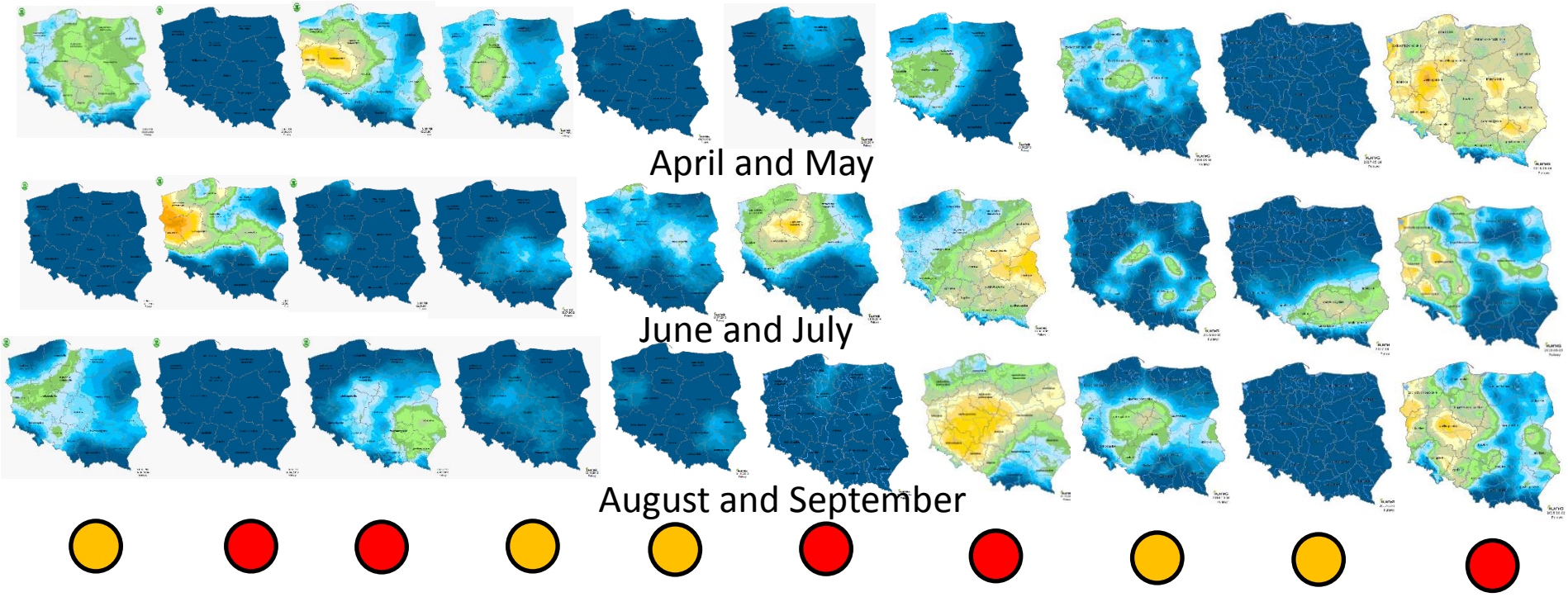
Agricultural Drought Monitoring System – Climatic water balance

KBW [mm]

-209 - -200
-199 - -190
-189 - -180
-179 - -170
-169 - -160
-159 - -150
-149 - -140
-139 - -130
-129 - -120
-119 - -110
-109 - -100
-99 - -90
-89 - -80
-79 - -70
-69 - -60
-59 - -50
> -50

2009 2010 2011 2012 2013 2014 2015 2016 2017 2018



April and May

June and July

August and September

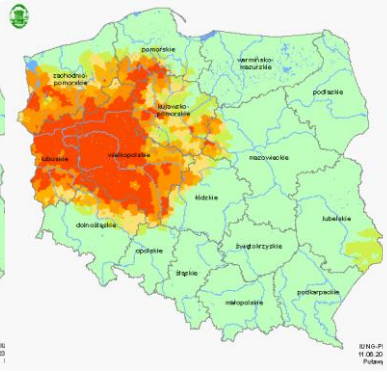
Winter wheat drought risk area (losses higher than 20% of average yield)

	The drought benchmark (according to the Act. Dz. U No. 150) was not exceeded
	< 10 % soils
	10 - 30 % soils
	30 - 50 % soils
	50 - 80 % soils
	> 80 % soils

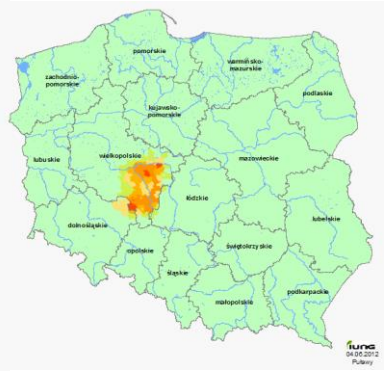
2009

2010

2011



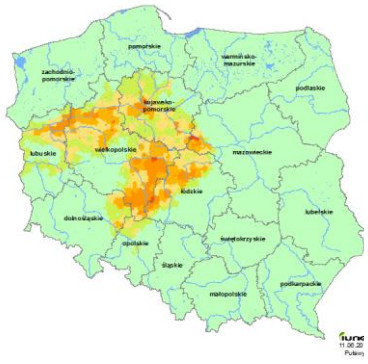
2012



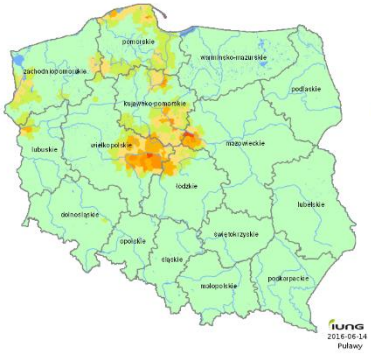
2013

2014

2015

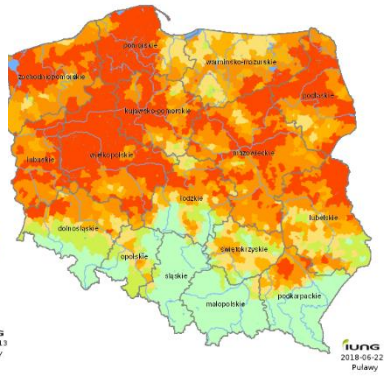


2016



2017

2018



Methodology for economic assessment of climate change impacts and adaptation in the water management sector in urban areas

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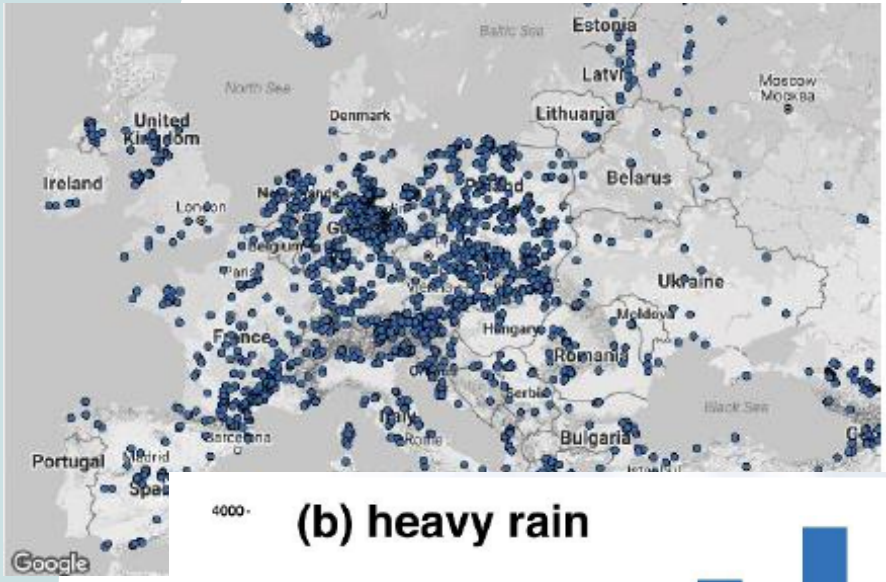
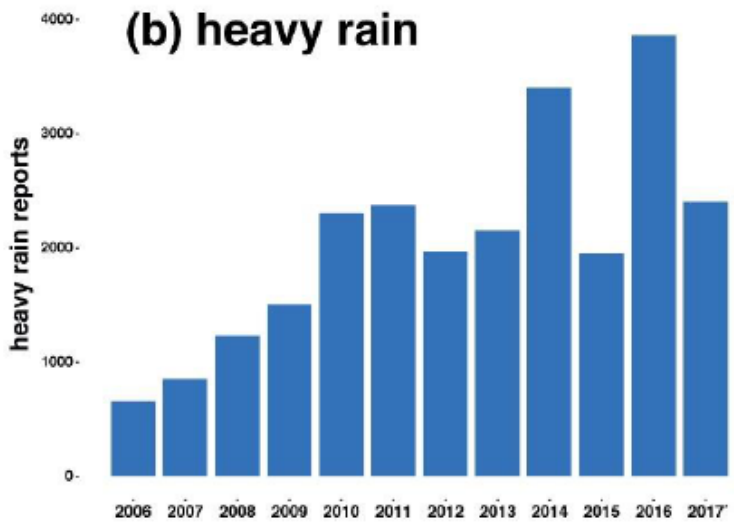
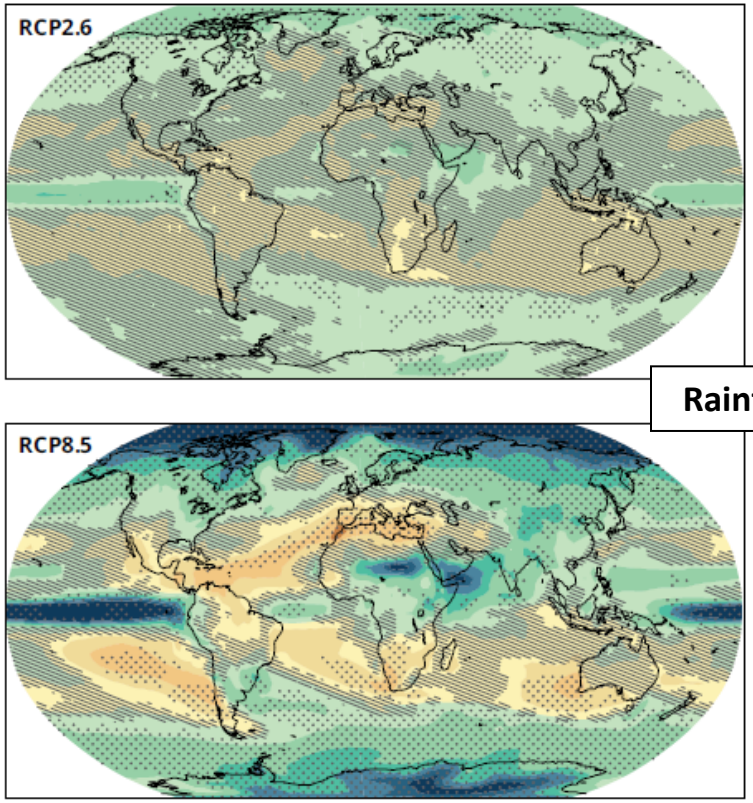
Climate challenge

Precipitation – one of the main climate risk factors





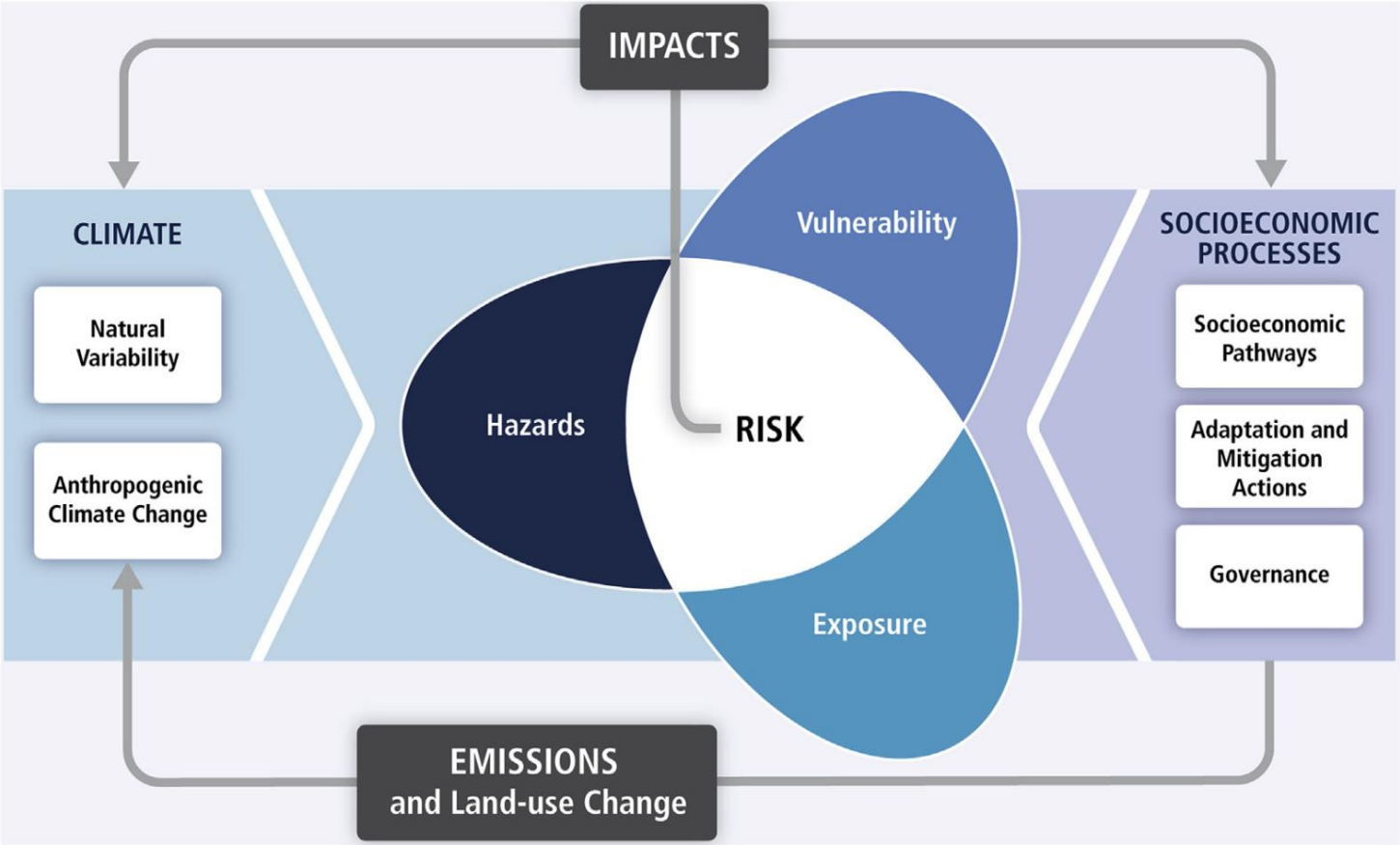
Source: Annual Report 2017, European Severe Storms Laboratory (ESSL) e.V, Weßling, 2018.



Rainfall

Source: T. F., Qin, D., Plattner, G.-K., et al. (eds), Climate change 2013: The physical science basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge; New York.

Climate and diaster risk assessment method



Source: IPCC 2014

Multi-dimention challenge

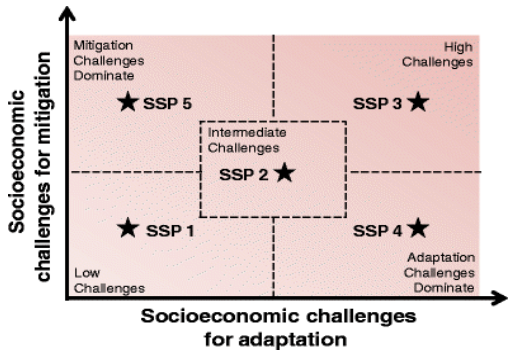
- **sectors**
- **hazards** (any climate related changes)
- **vulnerability**, adaptation potential and capacity
- **exposure** (elements at risk/assets)
- **timescale**: sudden-onset (e.g. flooding, storms) slow-onset (e.g. sea level rise, desertification) events
- **probability of occurrence** (e.g. low-probability, high impact events)
- **uncertainties** about future climate change, future development paths affect climate change impact estimates
- **trade-offs**: adaptation/mitigation, adaptation options
- **equity**: who gains and who loses
- **cross-sectoral** interelations

SECTORS
Agriculture
Forestry
Health
Energy
Transport
Water management
Tourism
Biodiversity

SUB-SECTORS
orchards
winter crops
summer crops
…
road transport
rail transport
…
population
population 65+

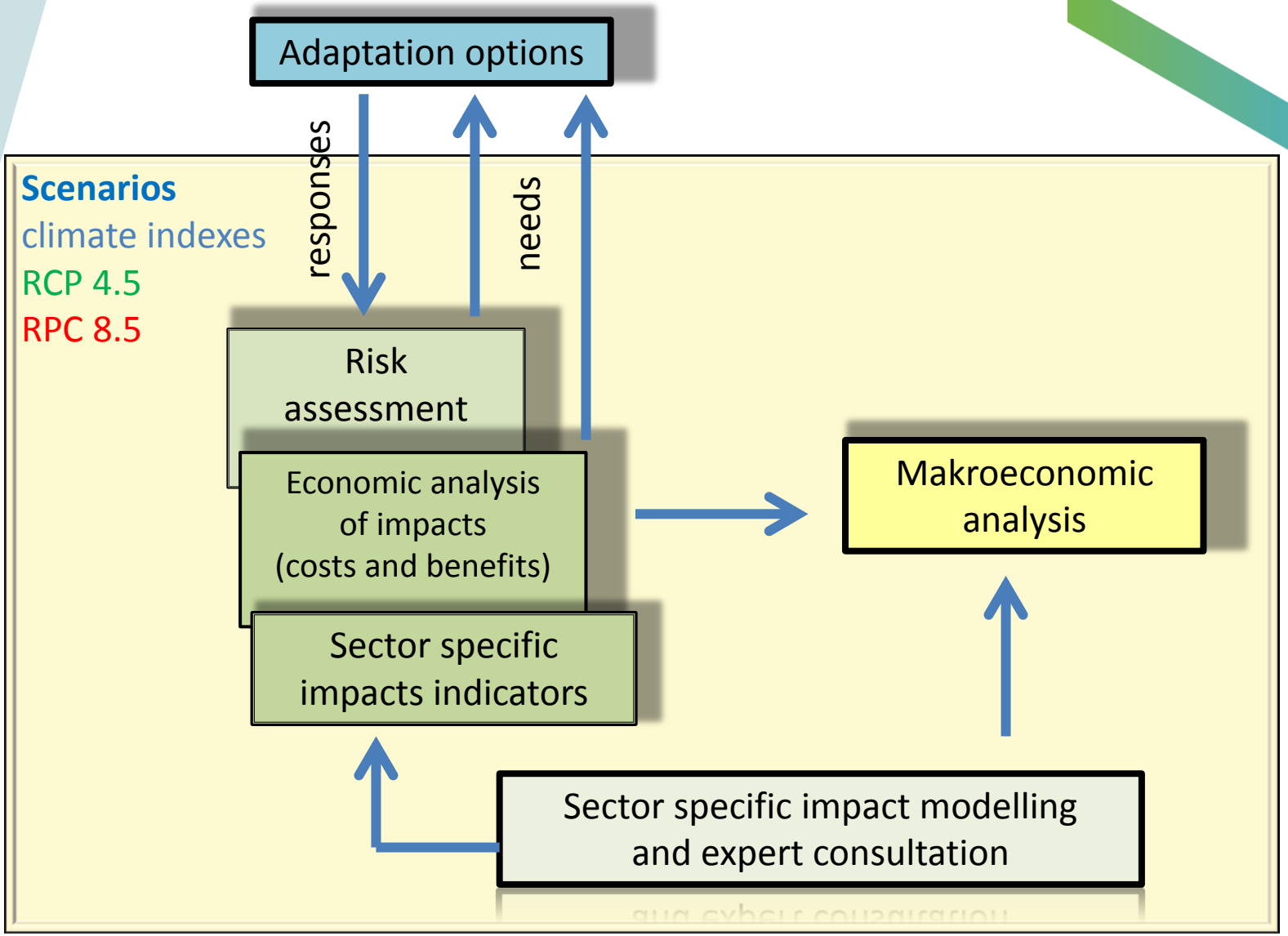
DATABASES
FHM
FRM
BDL, GUS
geoportals
…

HAZARDS
Flood
Drought
Water scarcity
Heat-waves
Storms
Frost
Landslides
Strong wind
High/low temperature
High/low precipitation
…

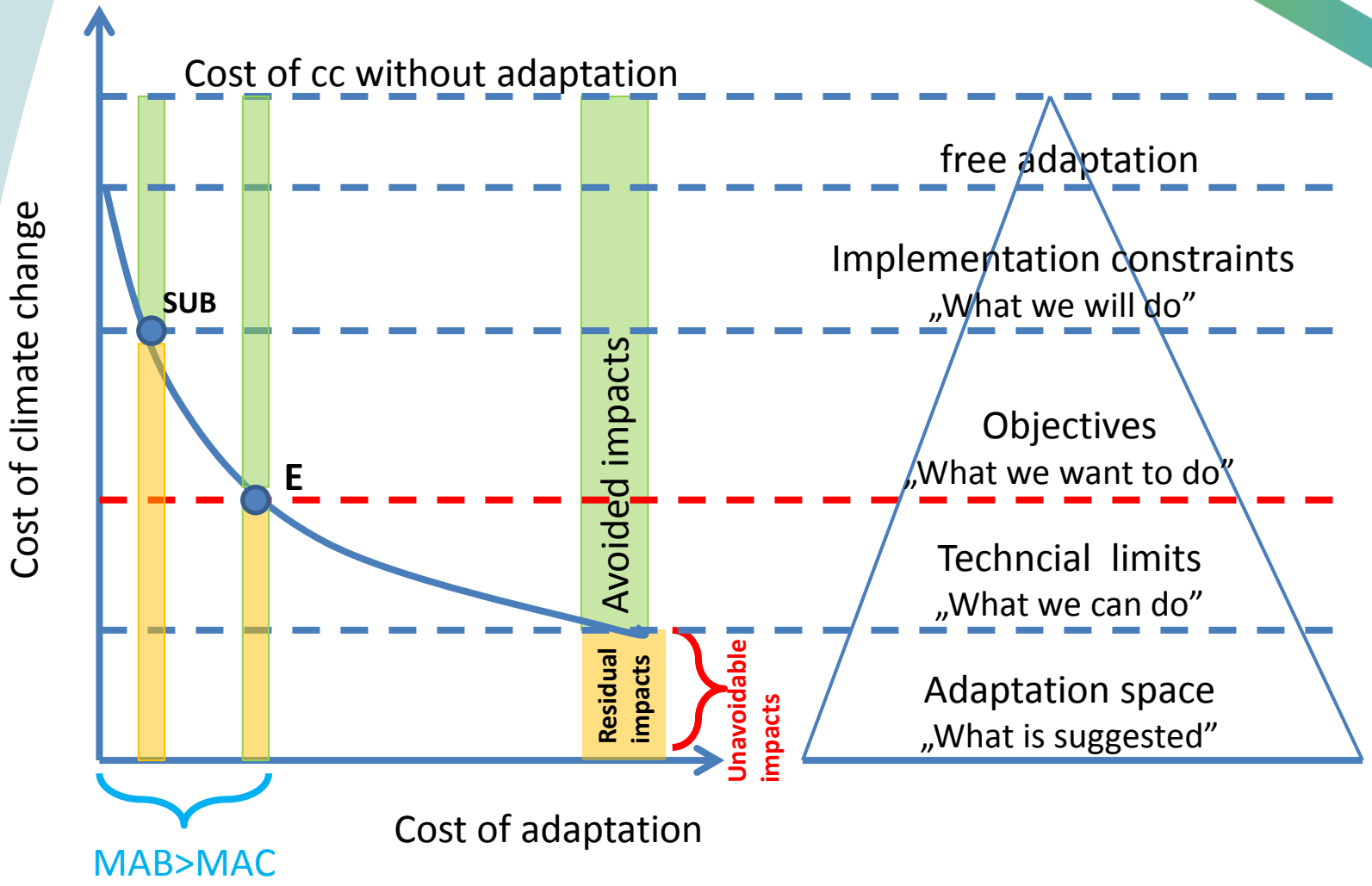


Source: Van Vuuren et al. 2014

Impacts quantification

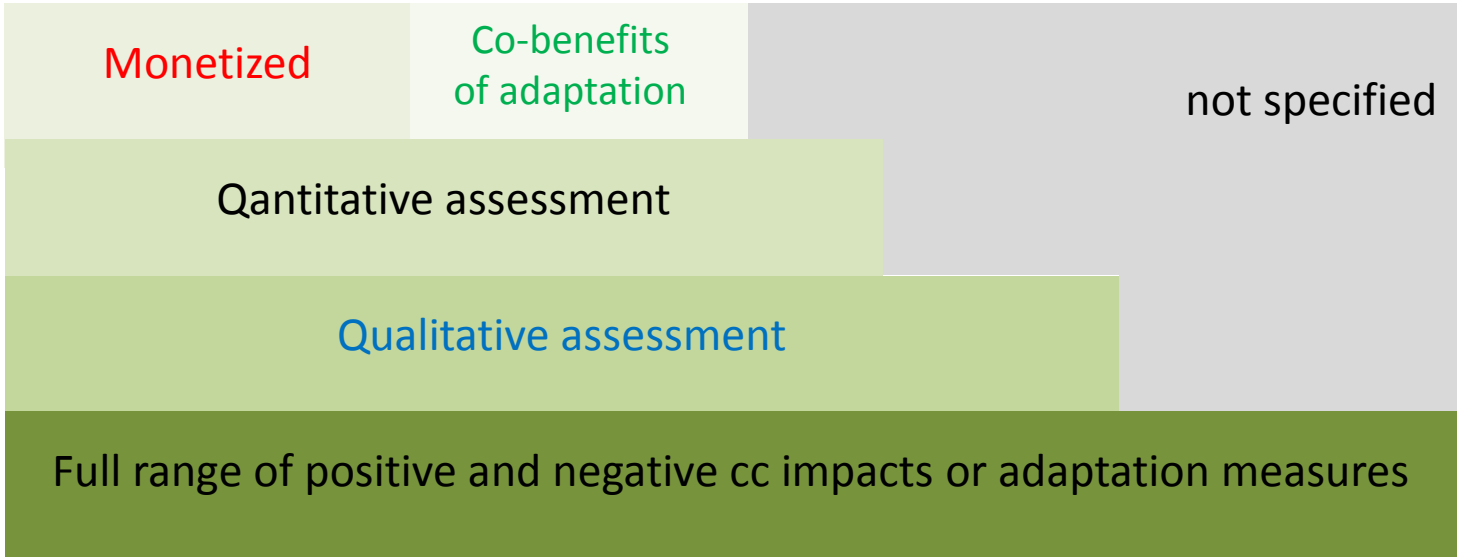


Costs of climate change and adaptation



Source: Dubel A. based on IPCC 2014

Impacts quantification and net benefits from adaptation



Lost benefits from the reduction of available water resources for water users: industry, energy, agriculture, fisheries.
Sectoral water productivity index:
gross income [PLN] / water consumption [m3] x productivity index

Blue-Green Infrastructure: reduces the risk of floods, improves water quality, improves air quality, reduces the heat island effect, reduces noise, absorbs CO2, has a positive effect on biodiversity, positively affects health and well-being.
BGI Net benefits: WTP for BGI - investment and operation costs

Economic assessment of climate change impacts: methods

- data mining, trends analysis
- primary research
- impact modelling
- expert consultation

- transfer methods
- ecosystem servicess approach

- economic valuation methods

- costs of extreme events
- costs of sector specific impacts

- benefits valuation

- costs and benefits of action and inaction

Assessment

needs

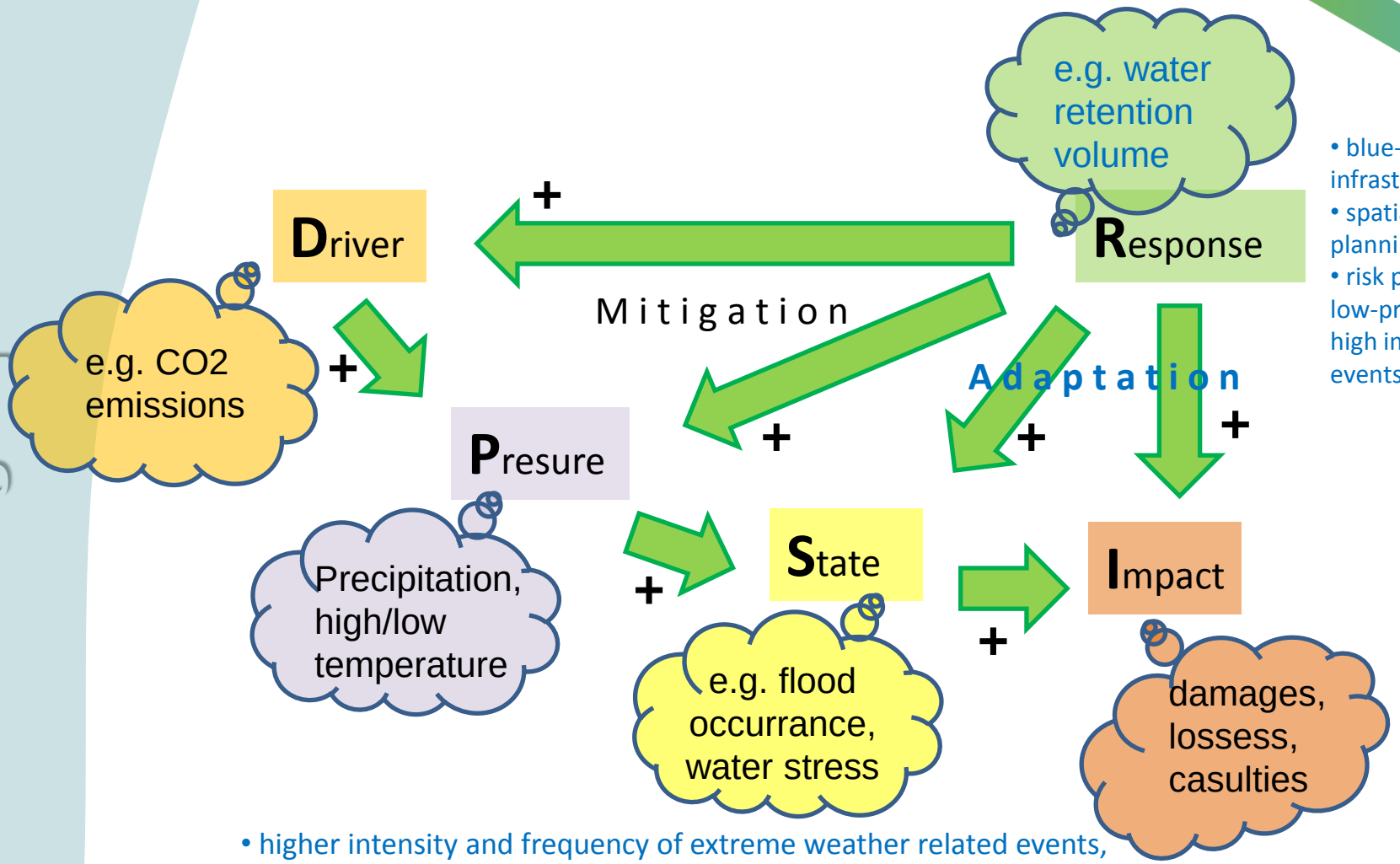
disaster risk management, policy and strategy development and assessment, insurance, financing losses, financing mitigation and adaptation measures, participatory decision making, private or public investment decisions, cross country comparisons, etc.

tools

Source: IIASA and Zurich Insurance (2015) Turning knowledge into action: processes and tools for increasing flood resilience. Zurich, Switzerland

Support of adaptation decision making through economic analysis

Impacts analysis and assessment



- blue-green infrastructure
- spatial planning
- risk pooling for low-probability high impact events

- higher intensity and frequency of extreme weather related events, such as floods, droughts, heat-waves, storms, etc.
- increased water demand, lower water supply

Klimada 2.0
BAZA WIEDZY O ZMIANACH KLIMATU

RH: flood, precipitation

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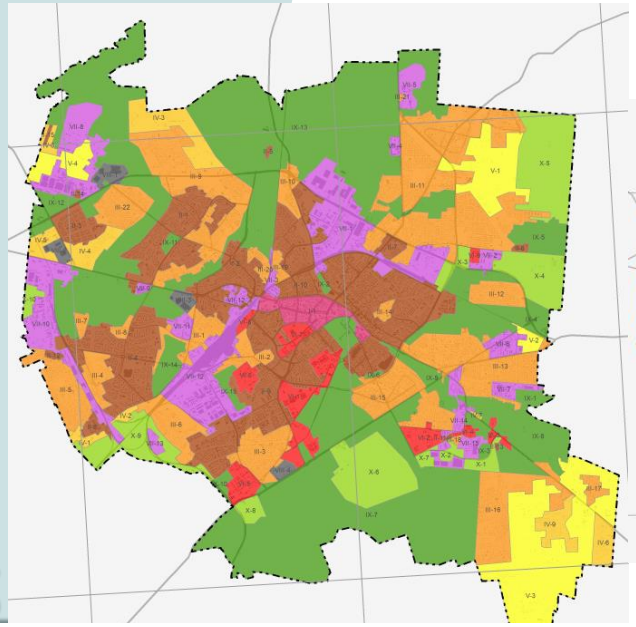
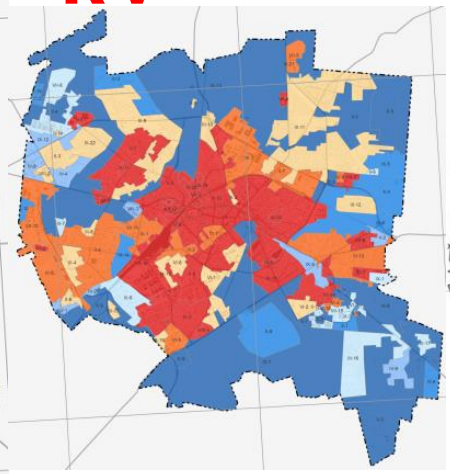
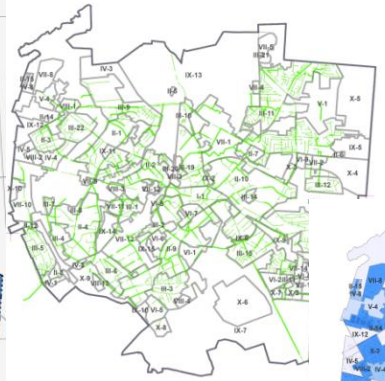
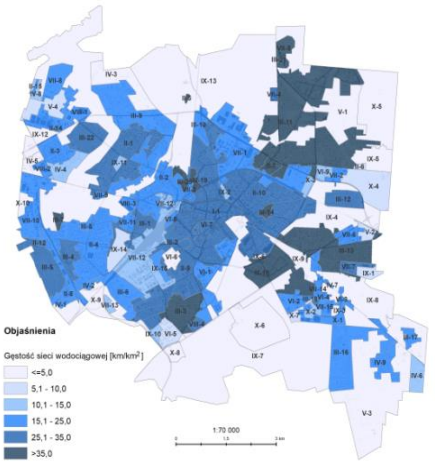


RV

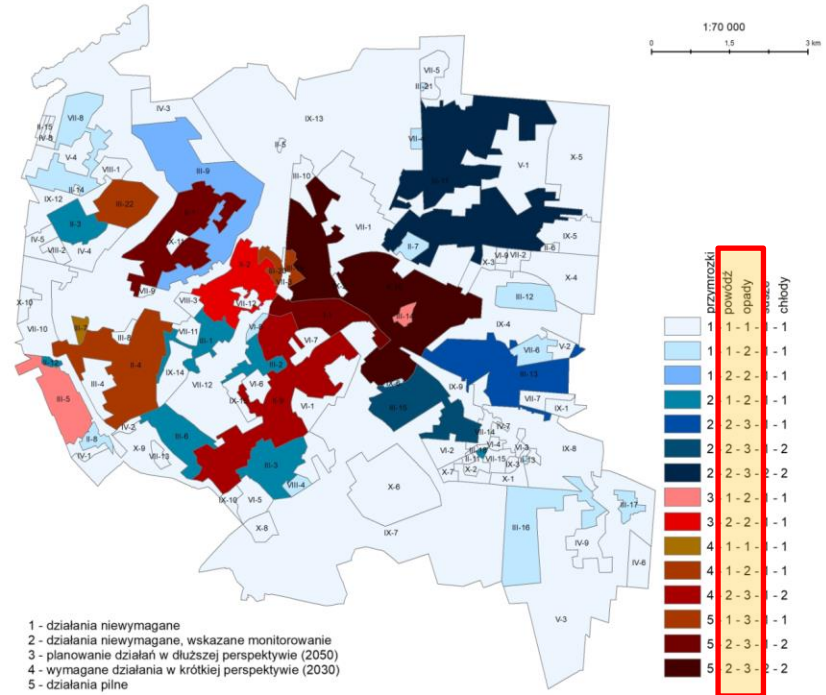




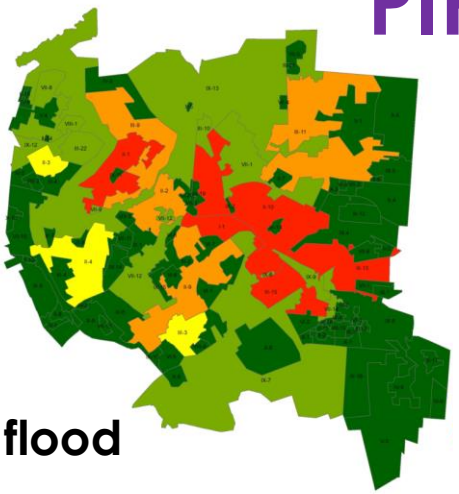
RE



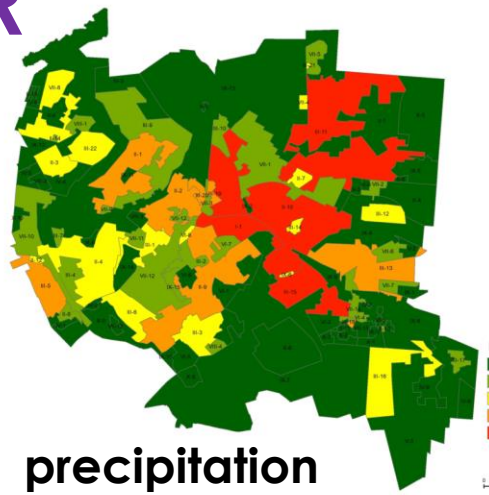
RISK ANALYSIS



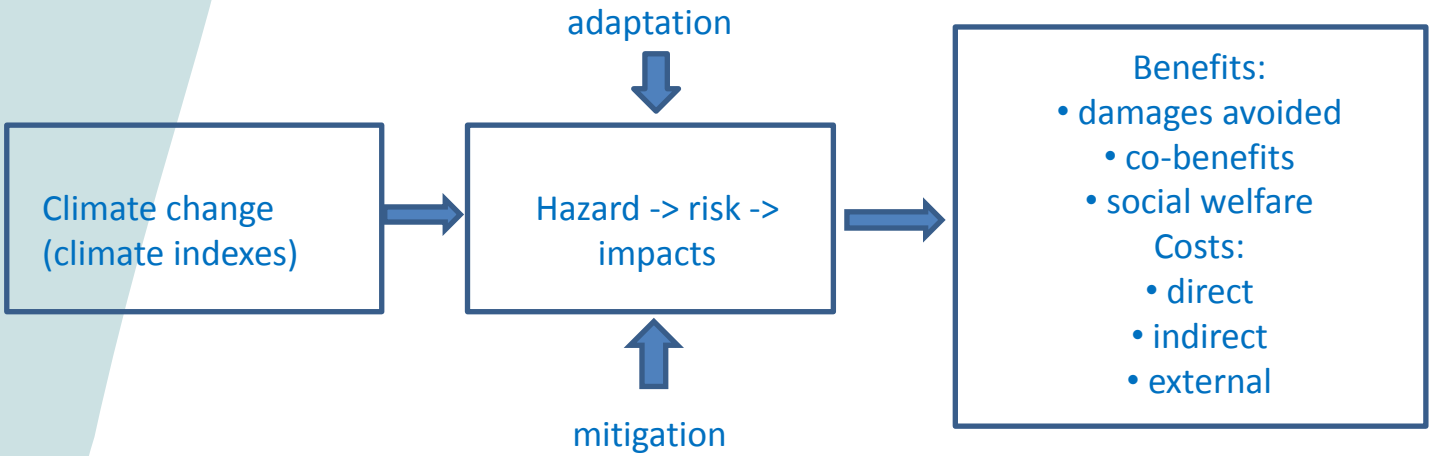
PIR



flood



precipitation



For each analysed **SECTOR** (e.g. agriculture, water management, energy,…)

for each relevant (identified) climate related **HAZARD** (e.g. flood, drought, precipitation, extreme temperature, winds, storms, water stress, etc.)

for each defined **space unit**
(e.g. land use unit, municipality)

for each relevant **exposure-vulnerability** impact indicator, taking into account adaptation potential and adaptive capacity

total **cost** per space unit will be calculated.

sector:	water management	
RH:	flood	
space unit:	land use unit	
category	Element / impact indicators	unit
RE+RV	damages / lossess of various land use categories	PLN/km2
RV: Adaptation Potential	investments in water infrastructure per km of water and sewage network	PLN/km of network
Climate Cost Avoided	damages / lossess avoided in response to the investments in water infrastructure	PLN/km2