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Improved tools for river flood preparedness under changing risk - Poland

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STAR FLOOD

- **Changing flood risk in Poland**
- **Improved tools for river flood preparedness**

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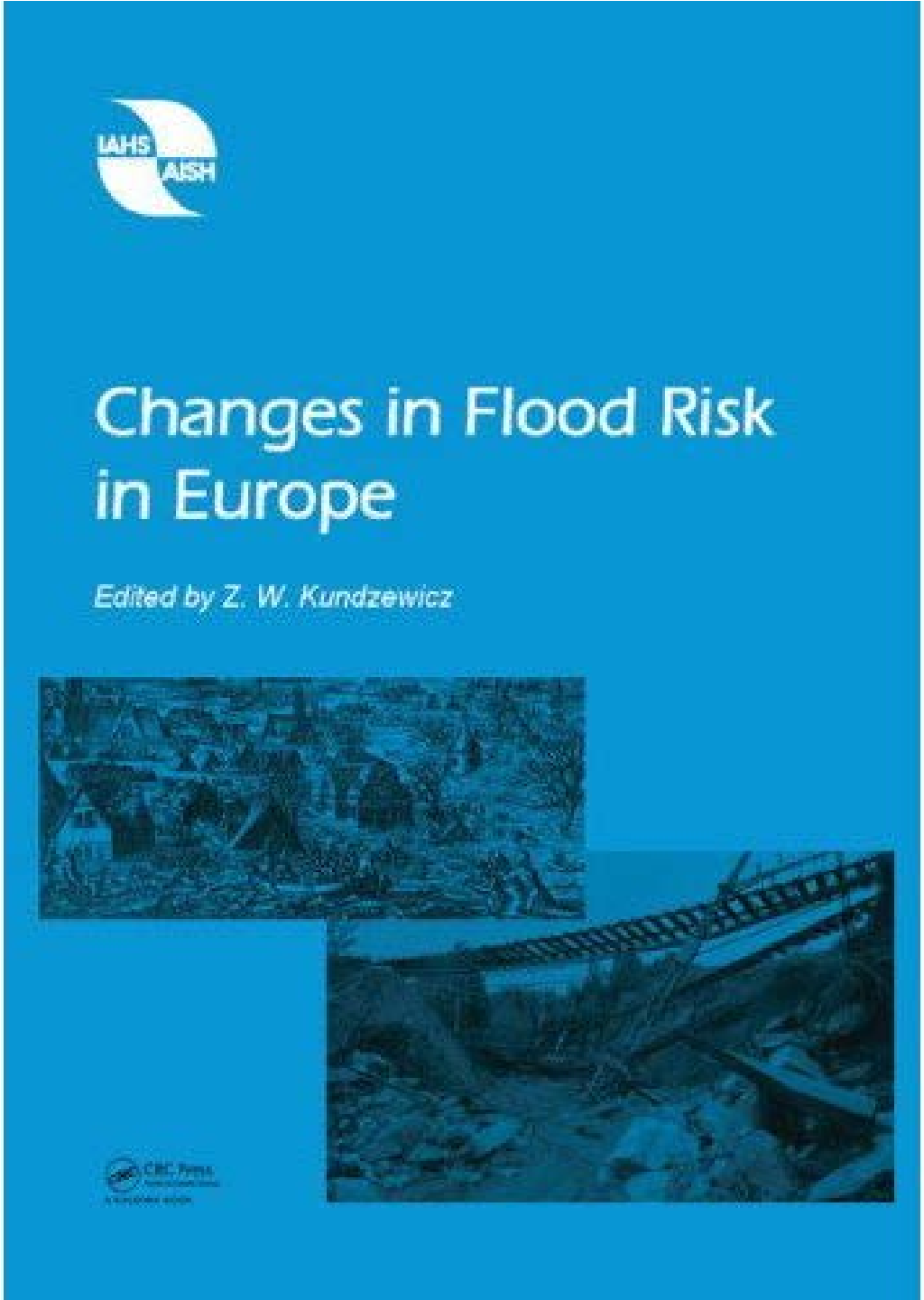
- Improved tools for river flood preparedness

River flooding in Poland

River flooding is the most destructive natural peril in the Baltic Sea Basin in general and in Poland in particular.

Flood risk and preparedness became matters of broad concern, following the dramatic floods in Poland in 1997 and 2010, when dozens of people were killed, national flood losses reached the level of billions of Euros and the topic made it to cover stories.

Floods in PL,
May-June 2013



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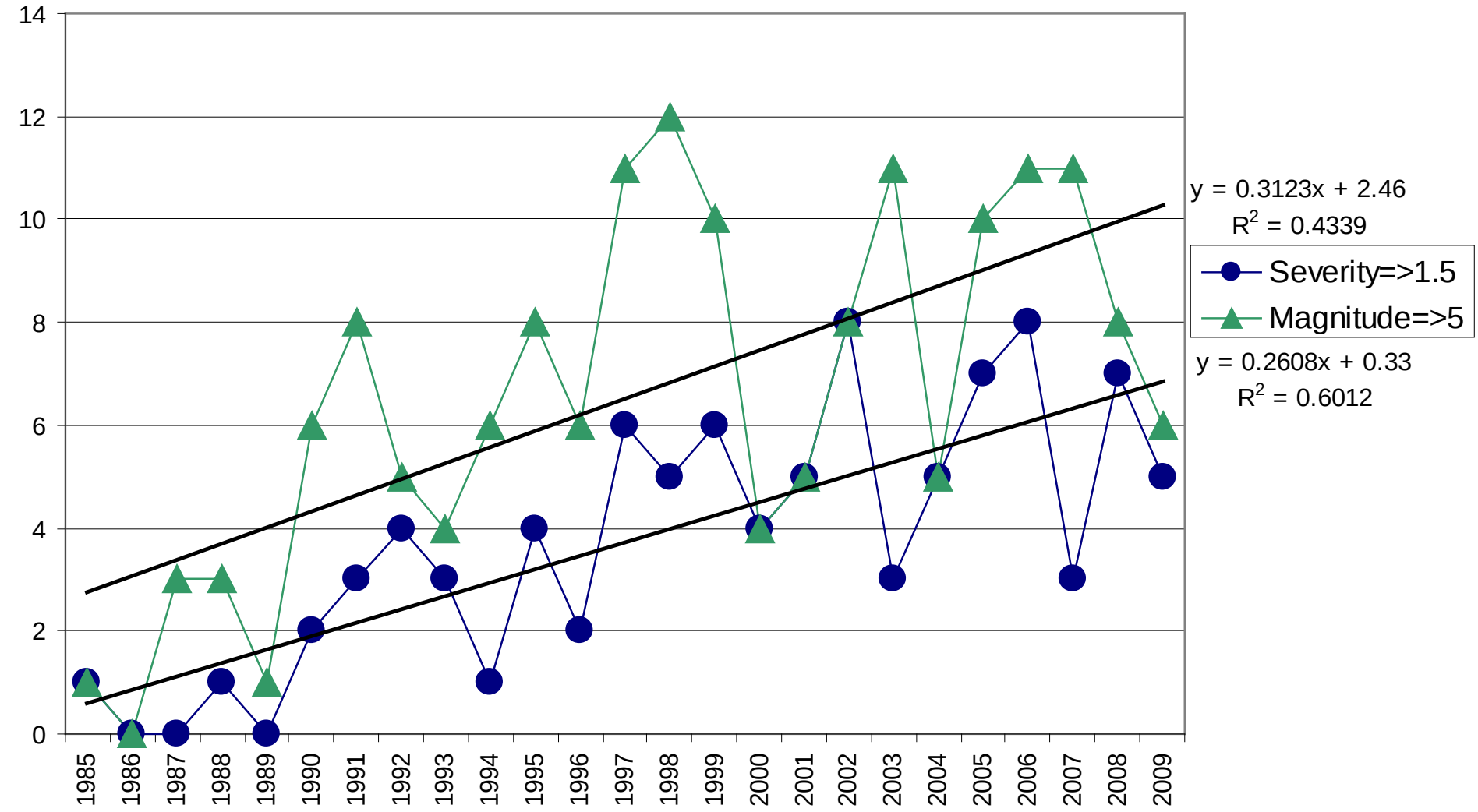

Increasing number of large floods, according to the data in Dartmouth Flood Observatory. Source: Kundzewicz et al. (2012)

17 Floods in Poland

ZBIGNIEW W. KUNDZEWICZ[1,2], ANDRZEJ DOBROWOLSKI[3], HALINA LORENC[4], TADEUSZ NIEDŹWIEDŹ[5], IWONA PIŃSKWAR[1] & PIOTR KOWALCZAK[1]

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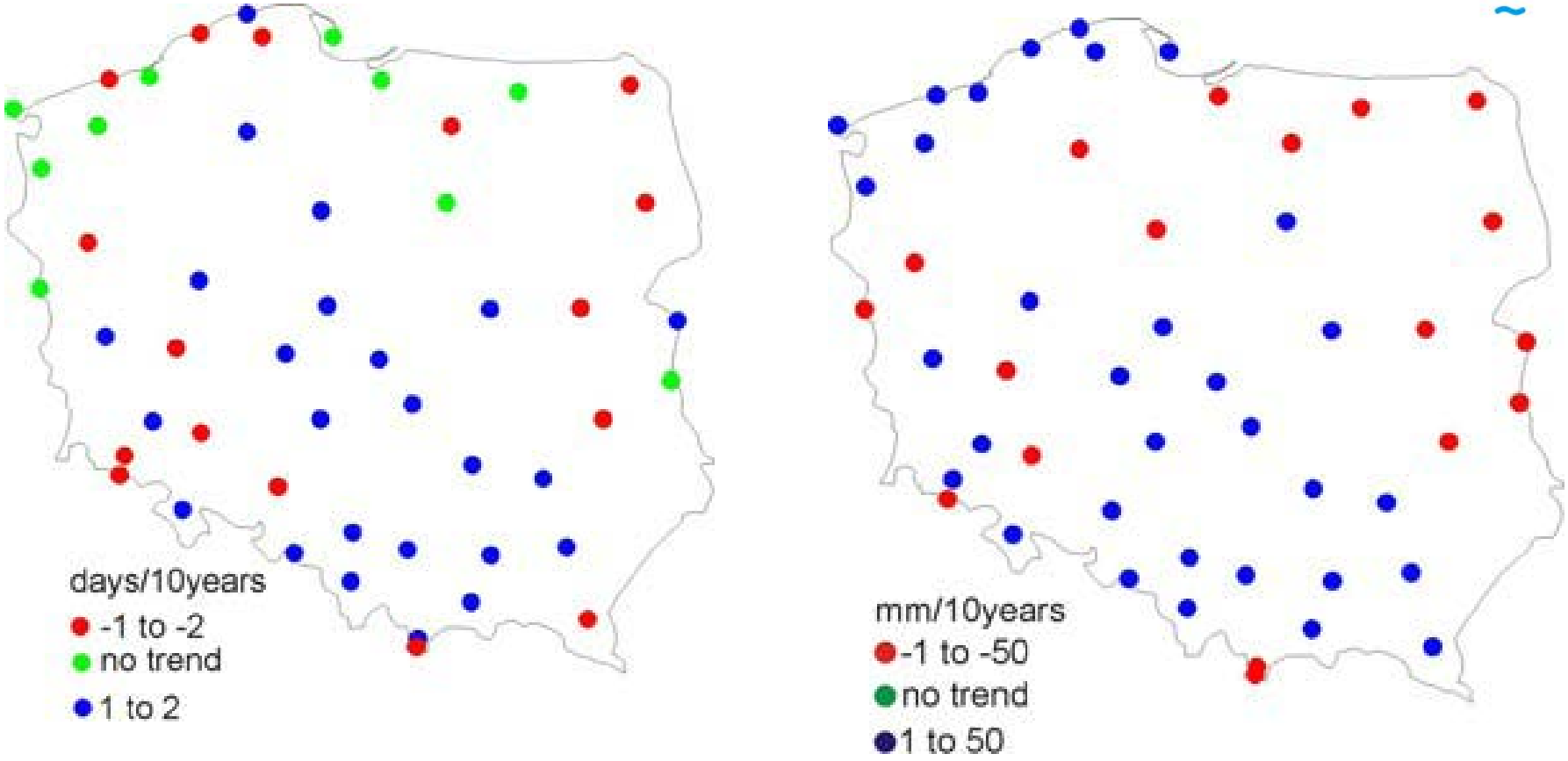
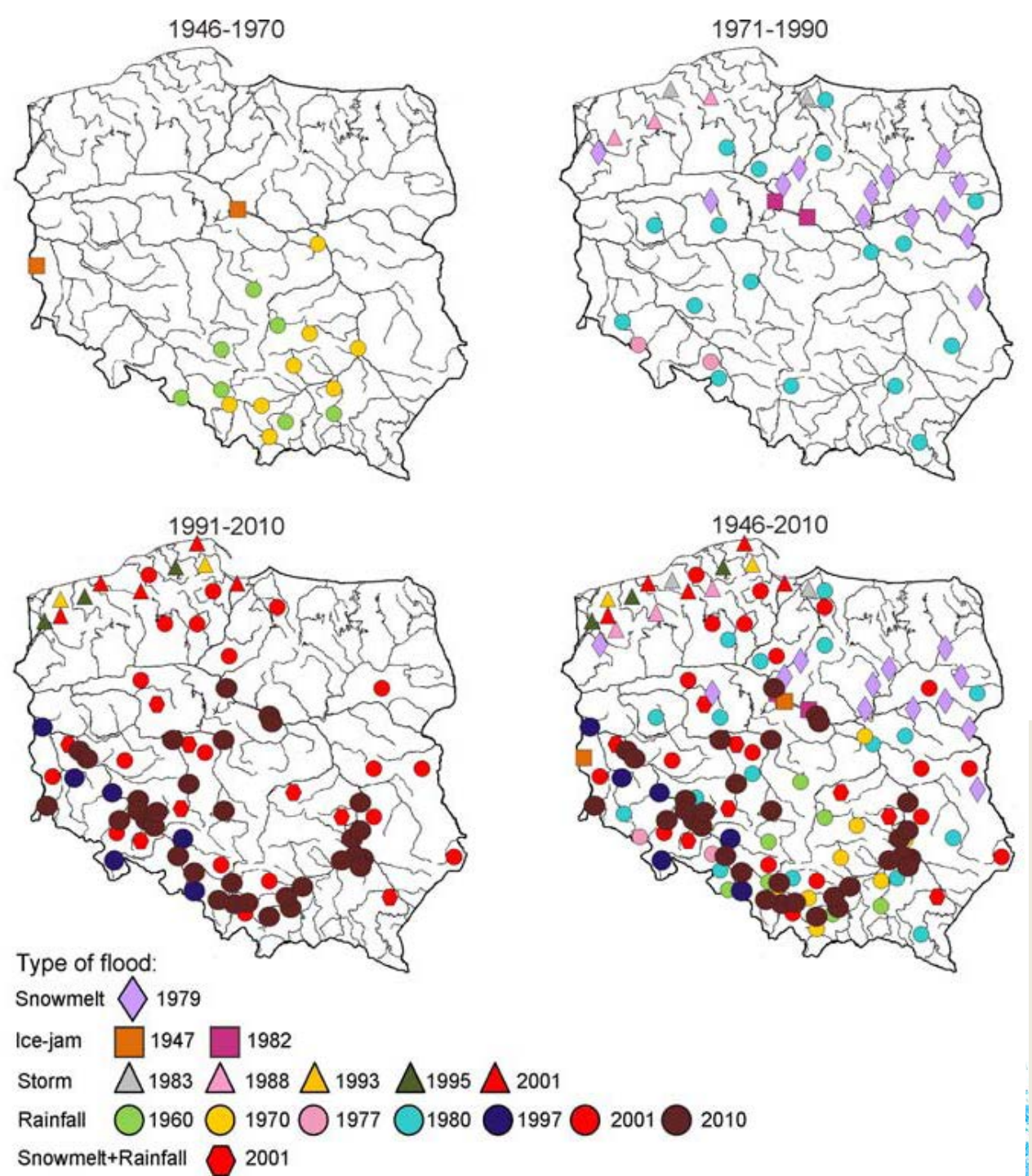


Trend in number of days with precipitation in excess of 30 mm, and (b) trend in maximum 5-day precipitation, 1971–2002 (after Lorenc & Olecka, 2006).



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Catastrophic floods of regional extent in Poland:

from 1946 to 1970; from 1971 to 1990; from 1991 to 2010;

from 1946 to 2010.

Source:

Kundzewicz et al. (2012)

The highest flood hazard can be attributed to the following situations of **multiple risk** type:

– A flood wave on a tributary **coincides** with a flood wave on the main river. Especially dangerous locations are: the confluence of the River Nysa Kłodzka with the Odra, the confluence of the River Warta with the Odra, and the confluences of the Dunajec, the San and the Narew rivers with the Vistula.

– **Intense rainfall during snow melting** (on the lowlands).

– Intense rainfall in **urban areas** during passage of a flood wave on a river.

Central Europe (July 1997)

Czech Republic, Poland, Germany	Regions: Hradec Králové, Moravian-Silesian (Cze), Malopolska, Silesia, Opole, Lower Silesia, Lubuskie (Pol), West Pomerania, Brandenburg (Ger). Rivers: Odra/Oder and its tributaries, Vistula and its tributaries	
Mechanism	Heavy rain	
Material damage	5.9 B US$ (MR) 5.597 B US$ (EM-DAT)	
Infl. adj. damage	2.758 – 8.340 B US$	
Fatalities	118 (MR) 113 (EM-DAT) 100 (NOAA/NCDC)	

The heavy and long-lasting rain in the period 4–10 July caused destructive flooding. precipitation between 5 and 9 July was recorded in Lysa Hora, Czech Republic (585 Polish drainage basin of the Odra, the highest precipitation amounts were recorded i and Międzygórze (455 mm). Then, a few days later, from 15 to 23 July, another seri occurred. The highest precipitation from 17 to 22 July was recorded in the drainage b Bystrzyca and Kaczawa (tributaries to the Odra; up to 120–300 mm) and of the river to 150–200 mm), while in the Klodzko valley the precipitation totals reached 100–2(spell in July 1997 took place basically in the drainage basin of the River Vistula (Ku

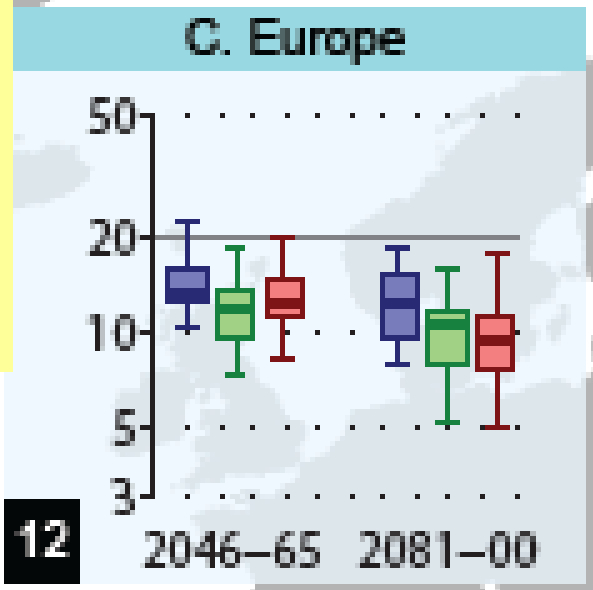
Source	Country	River	Station	Date	Max. disch. ($m^3 s^{-1}$)
IAHS	Poland	Skawa	Wadowice	08.07.1997	725
		Nysa Klodzka	Skorogoszcz	10.07.1997	1200
		Odra	Gozdowice	31.07.1997	3180
	Germany	Odra	Hohensaaten Finow	31.07.1997	3000

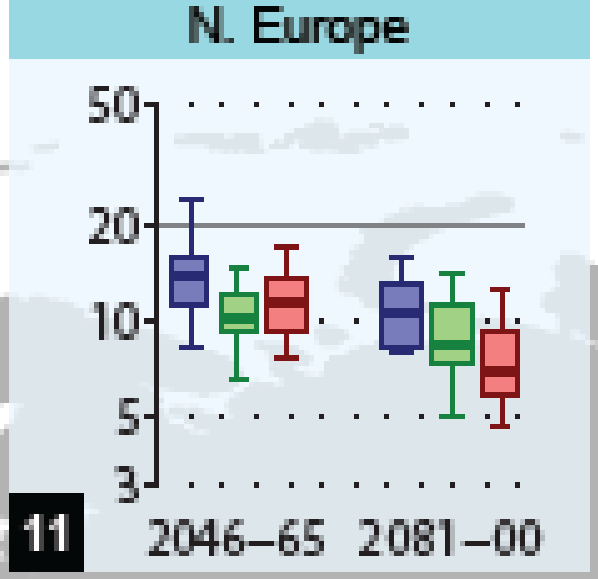
In summer 1997, the flood was the theme of cover stories of many issues of weekly magazines in Poland.

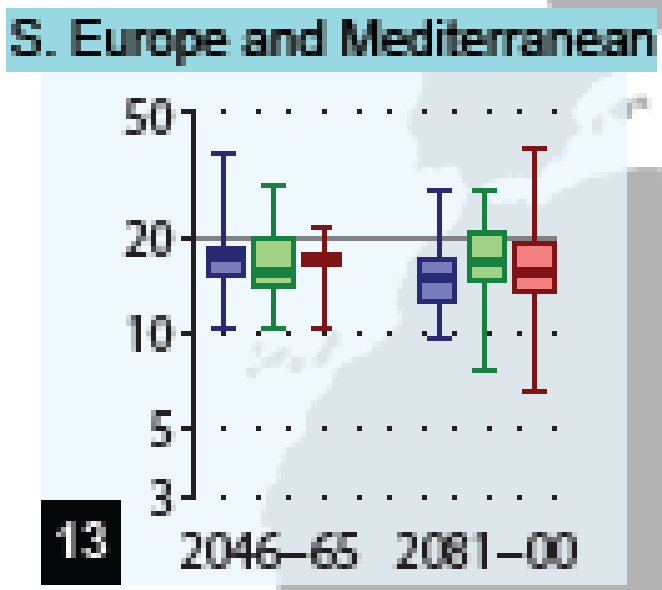
Projections of intense precipitation

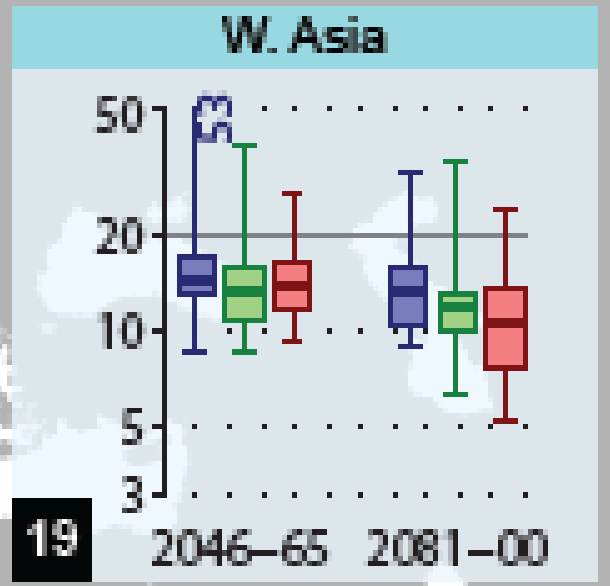
Source:

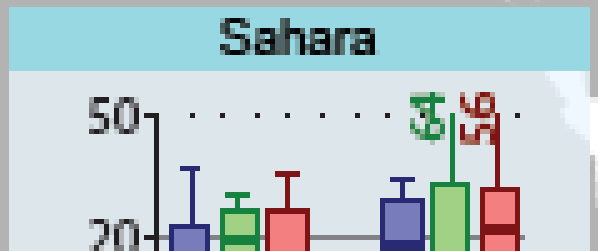
IPCC SREX











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Recurrence interval of today's 100-year floods (i.e. flood with a recurrence interval of 100 years during the period 1961-1990) at the end of the 21st century (2071-2100), for emission scenario SRES A2. Source: **Dankers & Feyen**, *J. Geoph. Res.* (2008).

- Changing flood risk in Poland

- Improved tools for river flood preparedness

Observations and projections

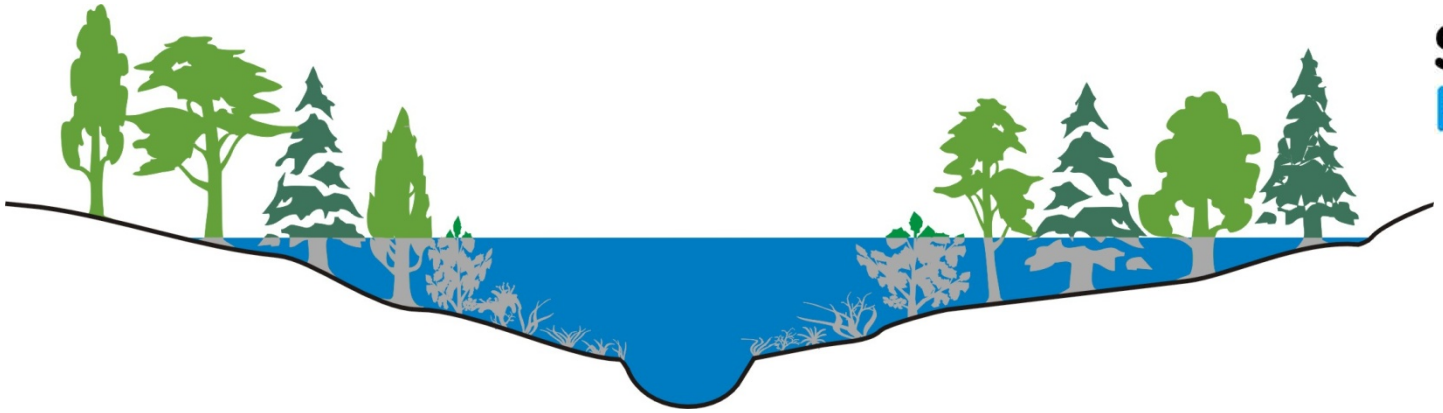
There has been an increasing number of local floods in urban areas (flash floods), including large towns, caused by intense rainfall, when the capacity of the urban sewer systems is too small.

The flood damage potential has considerably increased. Increasing flood exposure results from human encroachment into floodplains and economic development of flood-prone areas. The assets at risk from flooding are enormous, and growing, with the wealth of the nation.

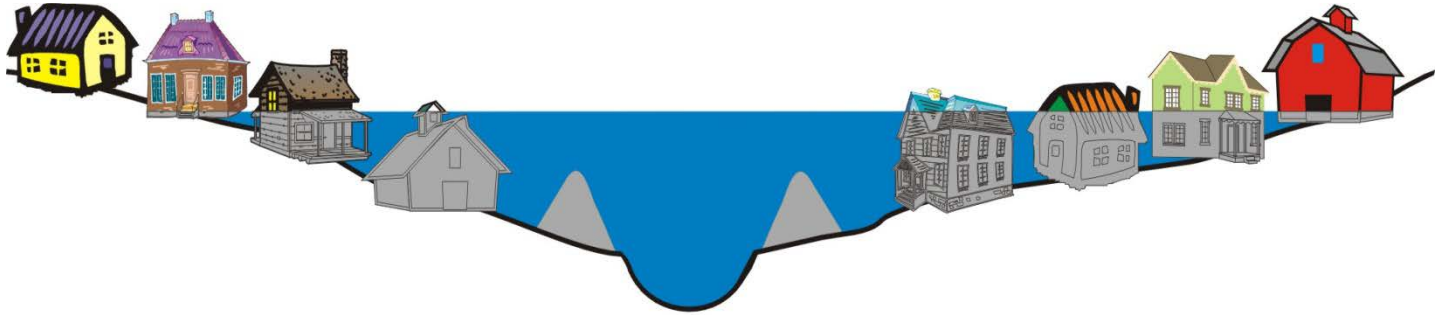
Projections for the future illustrate the possibility of increasing flood hazard in much of the country, due to increasing frequency and amplitude of intense precipitation and increasing frequency of “wet” circulation patterns. On the other hand, snowmelt flood hazard is expected to decrease.

Changes in flood risk

- Changes in climate and hydrological systems (heavy precipitation, land-use change, urbanization, deforestation, river regulation – channel straightening, embankments)
- Changes in socio-economic systems: (increasing exposure – flood plain development, growing wealth in flood-prone areas)

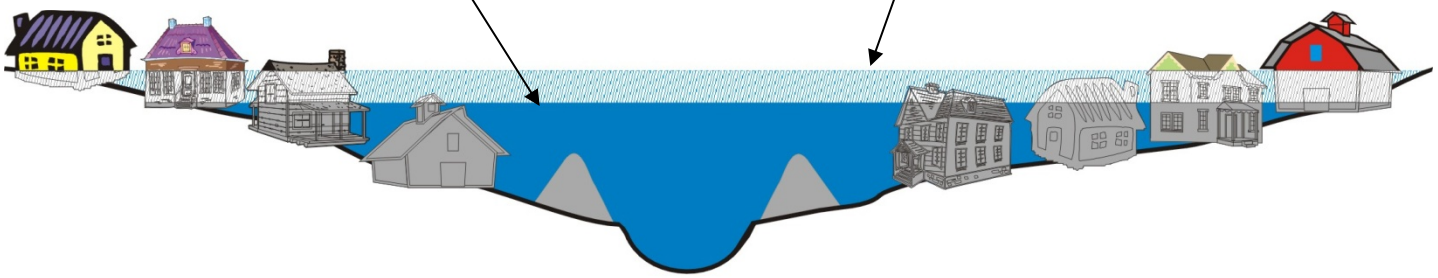


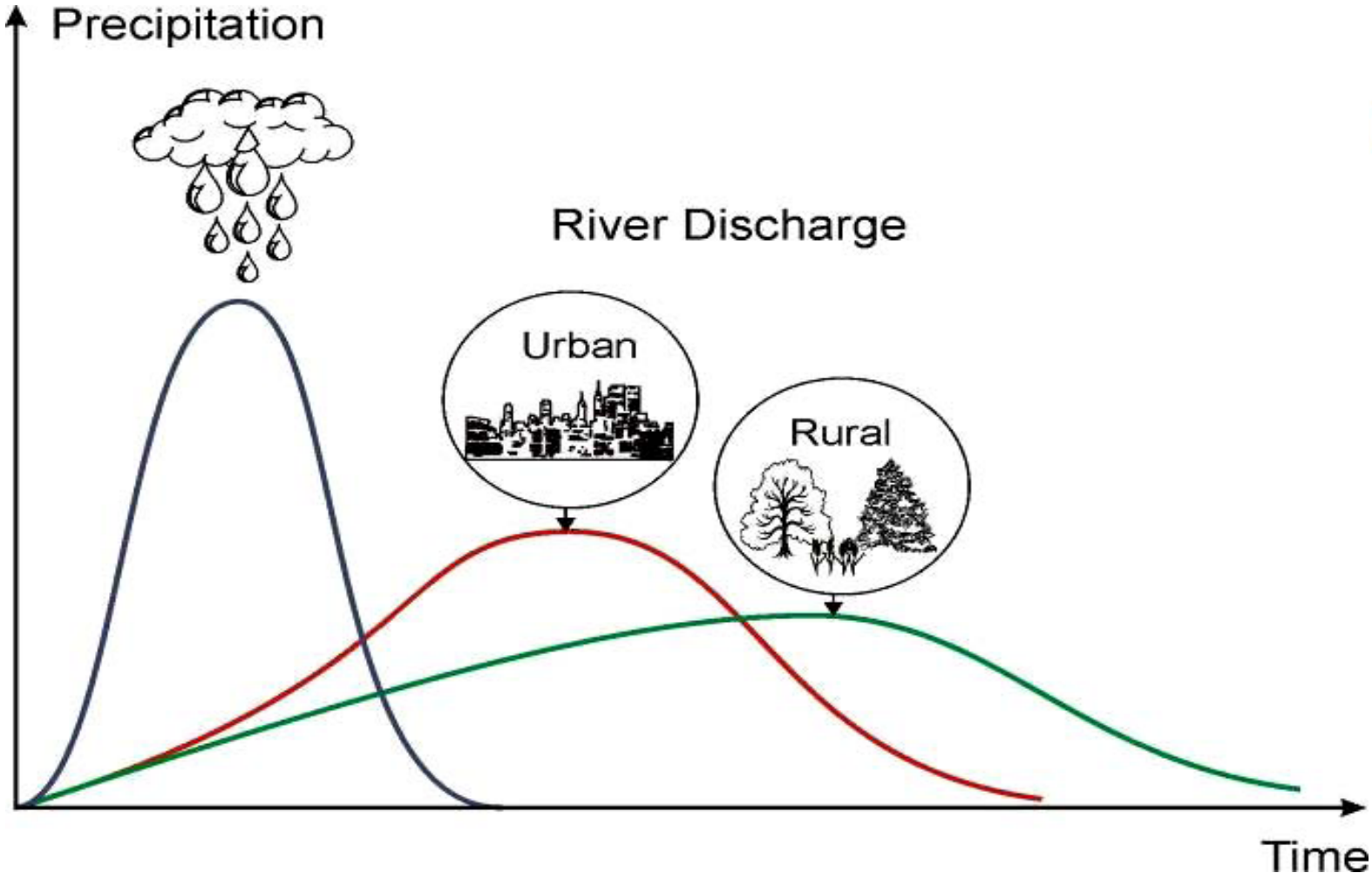
1000-year flood



Old 1000-year flood

New 1000-year flood





In comparison to rural areas, the peak flow corresponding to a given precipitation is higher and faster in urban areas.

Water holding capacity of the atmosphere

Clausius–Clapeyron equation

$$de_s(T) / e_s(T) = L\, dT / R\, T^2$$

where $e_s(T)$ is the saturation vapor pressure at temperature T,

L is the latent heat of vaporization,

and R is the gas constant.

T grows $e_s(T)$ grows

1ºC 6-7%

Why have the flood risk and flood damage grown in Poland?

- Floodplain management and watershed management
- Organization of flood protection
- Awareness of endangered population
- Gaps in information (QPFs deficient – need for probability range; FFA methods arbitrary and subjective)
- Insurance policy
- Technical state of structural defenses

Flood protection and management strategies modify either **flood waters**, or **susceptibility** to flood damage and **impact** of flooding.

Protect

[Absolute protection does not exist]

Accommodate

[Living with floods, learning from them]

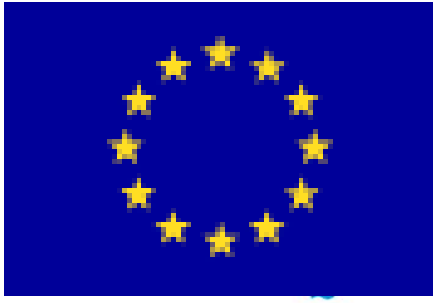
Retreat

[The state/province purchases land and property in flood-prone areas]

Flood defenses and preparedness systems

Flood defenses in the Vistula basin include embankments of approx. **4700** km in length, protecting an area of about **5300** km^2. The flood protection system in the Odra basin consists of embankments, weirs, reservoirs (including dry flood protection reservoirs), relief channels, and a system of polders. However, total capacity of water storage reservoirs in Poland is only **6**% of the mean annual runoff. Flood preparedness system includes also non-structural measures, e.g. forecast-warning component.

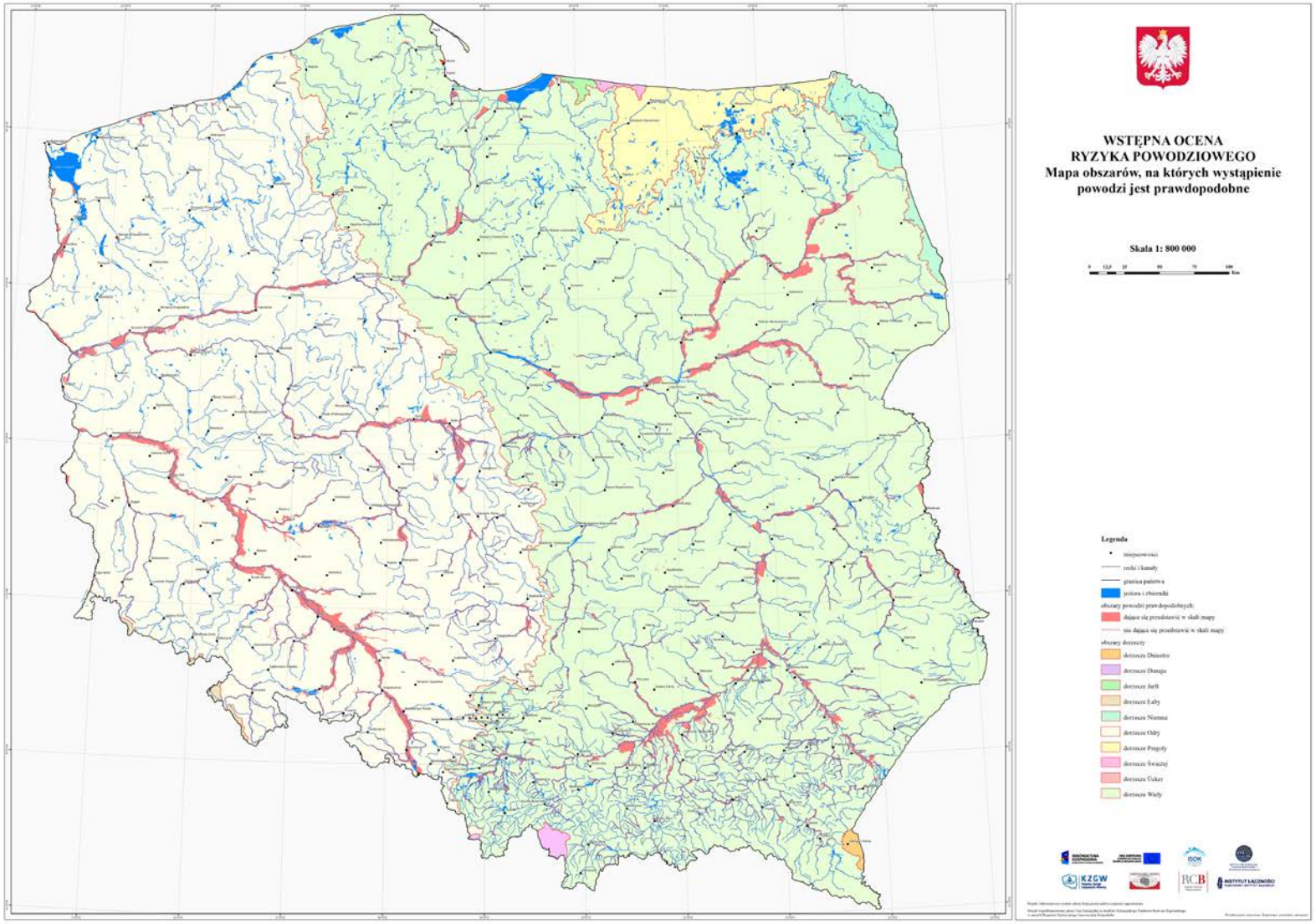
European Union Floods Directive



Preliminary **flood risk assessment** (including assessment of the projected impact of **climate change** trends; forecast of estimated consequences of future floods, …).

• Preparation of **flood maps** and indicative **flood damage maps**, covering the geographical areas which could be flooded with a high probability; with a medium probability, and with a low probability (extreme events).

• Preparation and implementation of **flood risk management plans**, aimed at achieving the required levels of protection.



WSTĘPNA OCENA RYZYKA POWODZIOWEGO
Mapa obszarów, na których wystąpienie powodzi jest prawdopodobne

Skala 1: 800 000

0 12,5 25 50 75 100 Km

Legenda

- miejscowości
- rzeki i kanały
- granica państwa
- jeziora i zbiorniki

obszary powodzi prawdopodobnych:

- dające się przedstawić w skali mapy
- nie dające się przedstawić w skali mapy

obszary dorzeczy

- dorzecze Dniestru
- dorzecze Dunaju
- dorzecze Jarft
- dorzecze Łaby
- dorzecze Niemna
- dorzecze Odry
- dorzecze Pregoły
- dorzecze Świeżej
- dorzecze Úcker
- dorzecze Wisły

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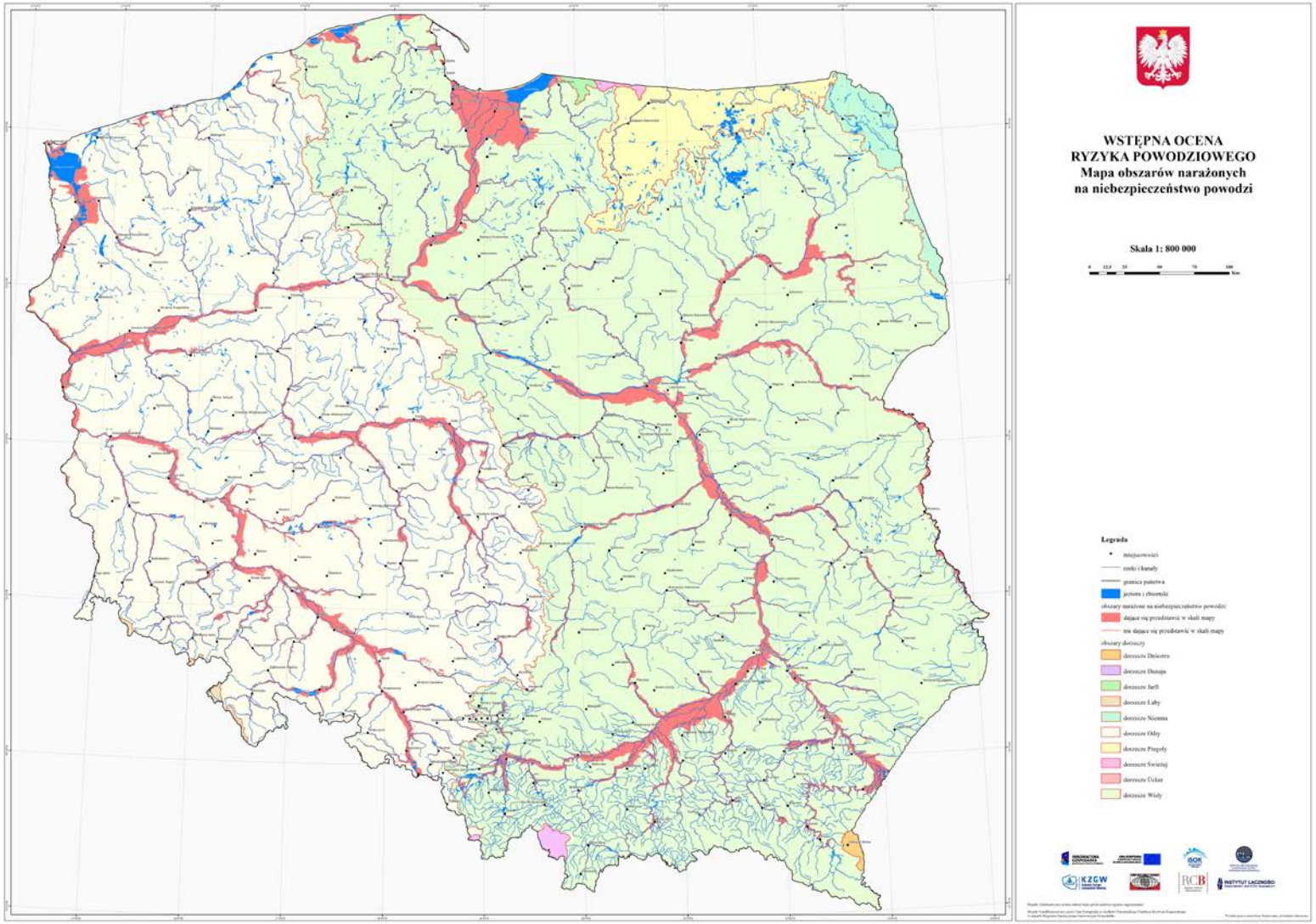

WSTĘPNA OCENA RYZYKA POWODZIOWEGO
Mapa obszarów narażonych na niebezpieczeństwo powodzi

Skala 1: 800 000

0 12,5 25 50 75 100 km

Legenda

- miejscowości
- rzeki i kanały
- granica państwa
- jeziora i zbiorniki

obszary narażone na niebezpieczeństwo powodzi:

- dające się przedstawić w skali mapy
- nie dające się przedstawić w skali mapy

obszary dorzeczy

- dorzecze Dniestru
- dorzecze Dunaju
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- dorzecze Ücker
- dorzecze Wisły

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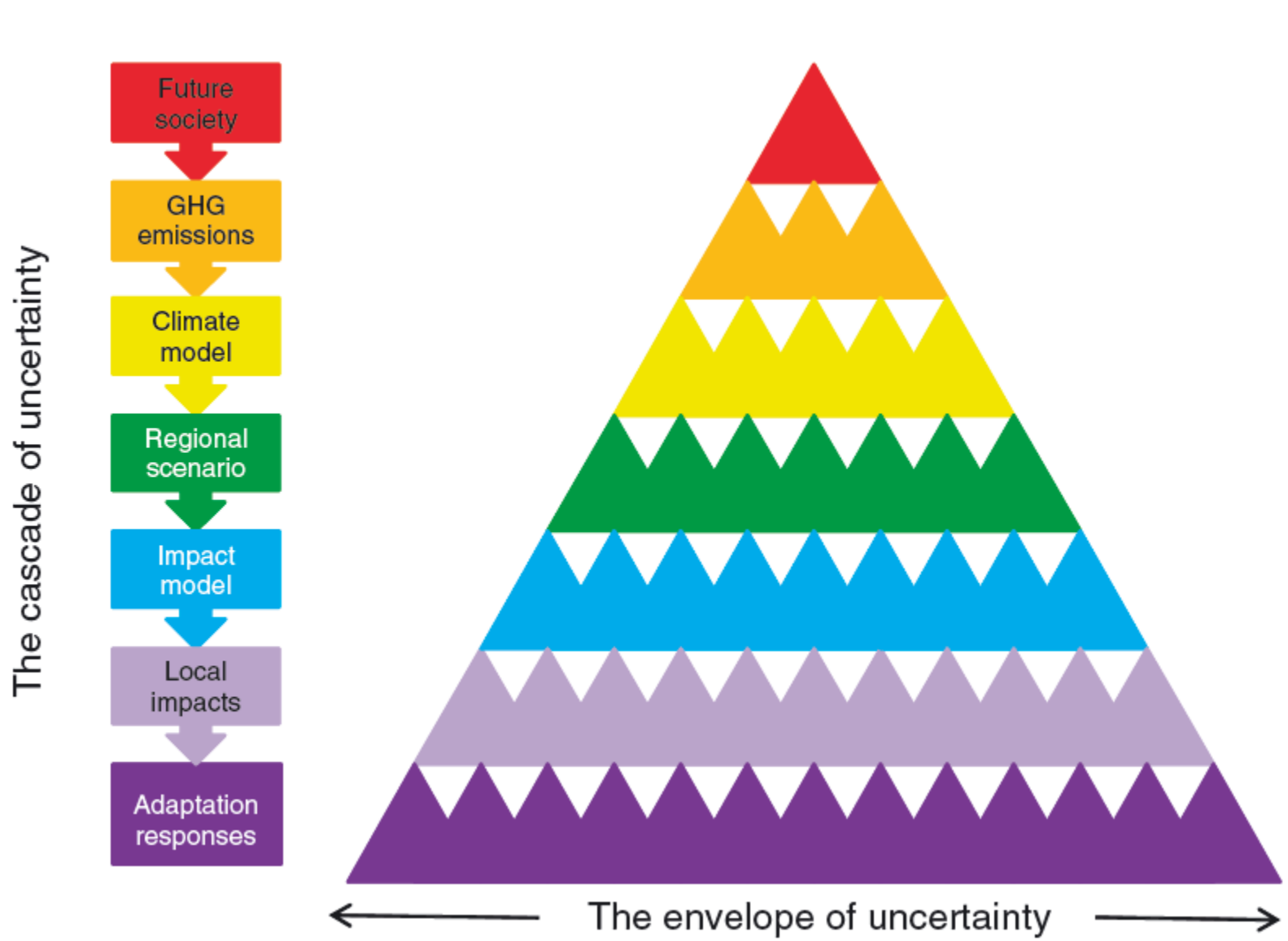
There is no doubt that better accommodation of extremes of present climate variability augurs better for the future climate, subject to change.

Since uncertainty in projections for the future is large, precautionary attitude should be taken when planning adaptation.



Source: Wilby & Dessai, 2010

Flood protection strategy:

- Rectification of principles of spatial policy (enforcement of zoning)
- Organization (basin scale management, personal responsibility)
- Technical measures (dikes, reservoirs, relief channels)
- Raising awareness of flood risk
- (Re)Naturalization of rivers
- Improvement of forecasts

„Program for the Odra 2006”

„Program of flood protection in the basin of Upper Vistula”

Criticism from the UE.
Strategy based on assumptions rather than serious efficiency consideration.
Structural approach: dikes and dams – insufficient.

Costs and effects of flood protection measures:

Costs – real

Effects – imaginary

4 czerwca 2010 r., Świniary. Żołnierze i strażacy budują tzw. opaskę w miejscu, gdzie Wisła przerwała wał. Opaska ma pomóc w zasypaniu wyrwy w wale oraz chronić pobliskie miejscowości przed ponownym zalaniem

Wzmocnić zabezpieczenia, dostosować się do „życia z powodzią” lub na trwałe opuścić tereny zagrożone – oto sposoby na nękające nas powodzie

Po powodzi, przed powodzią

PROF. ZBIGNIEW W. KUNDZEWICZ*

Dawno opadły wielkie wody polskich rzek. Temat prze-

klimacie. W prawdzie ryzyko powodzi roztopowych zmniejsza się wraz ze spadkiem grubości pokrywy śnieżnej, jednak również zagrożenia spowodowane desz-

towne wezbrania w górach spowodowane ulewą, bo strumień wzbiera bardzo szybko. Zupełnie inna jest skala czasowa ruchu wielkich mas wodnych

trema procesów losowych mogą wystąpić częściej lub rzadziej, a jeśli już zdarzy się powódź, prawdopodobieństwo szybkiego nawrotu znacznie ro-

rzeczne odpowiadające określonemu opadowi. Wraz z ociepleniem intensywne opady stają się częstsze i silniejsze, więc wysokie stany rzek powsze-

EU FP7 **STAR-FLOOD** Project (STrengthening And Redesigning European FLOOD risk practices: Towards appropriate and resilient flood risk governance arrangements)

Committee on Hazards related to Water, Polish Academy of Sciences

Thank you