IT SYSTEM FOR COUNTRY PROTECTION AGAINST EXTREME HAZARDS (ISOK)

METEOROLOGICAL HAZARD MAPS – METHODOLOGICAL APPROACH

Agnieszka WYPYCH, Zbigniew USTRNUL, Ewelina HENEK & Co

Budapest, 15 May 2014

NATIONAL COHESION STRATEGY

EUROPEAN UNION
EUROPEAN REGIONAL DEVELOPMENT FUND

Project is carried out by Consortium:

Main Office for Geodesy and Cartography - Supplier of data: Digital Terrain Model (DTM), Data Base of Topographical Objects (DBTO) and Ortophotomaps.

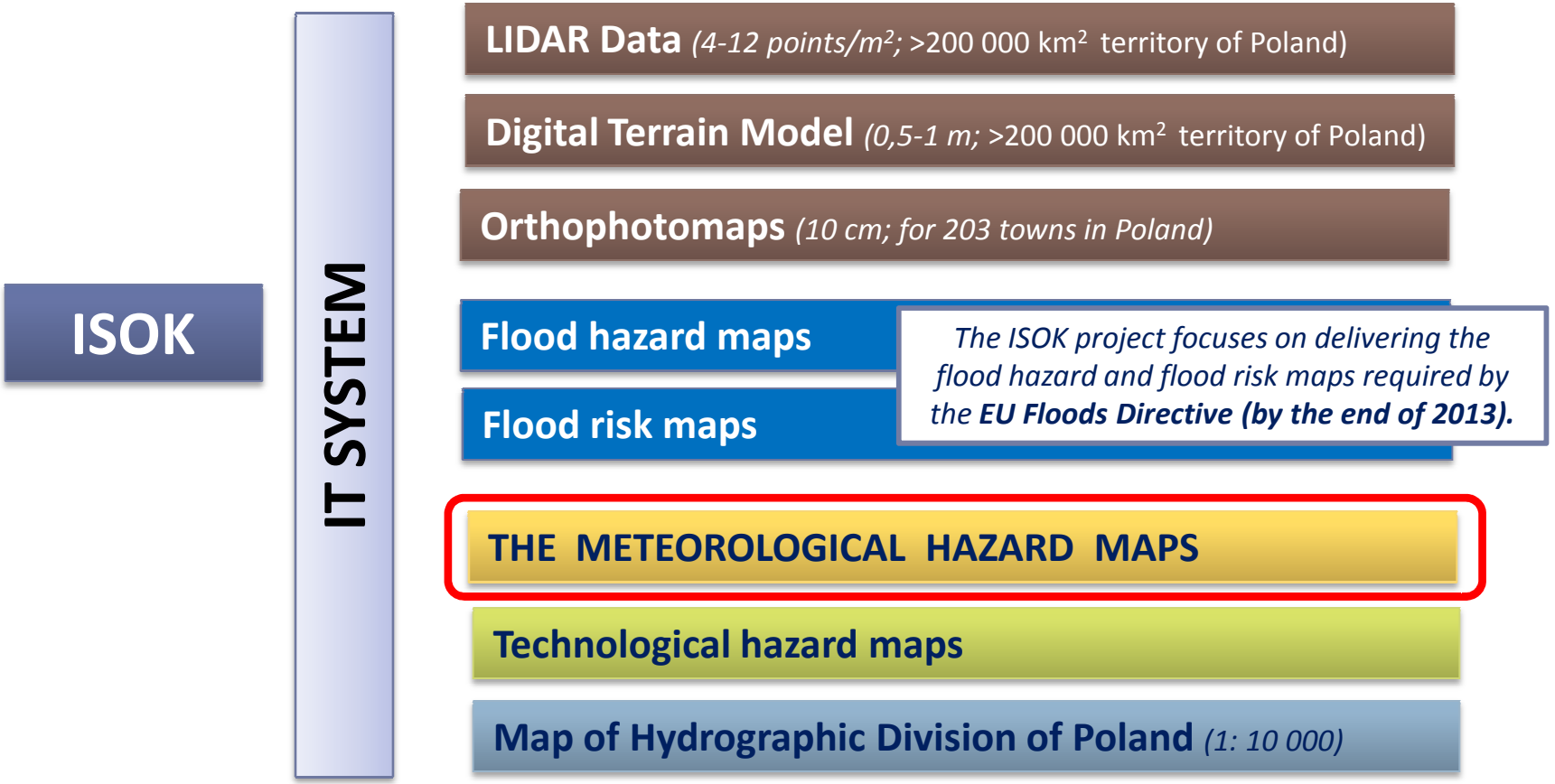
National Water Management Authority - Leader of Consortium - Supplier of data.

National Institute of Telecommunications - Supplier of data.

Government Centre for Security – Advices.

Institute of Meteorology and Water Management - National Research Institute - Supplier of data: A Raster Hydrographical Map of Poland (MPHP), Meteo hazards maps, Technological hazard maps, Flood hazard maps and Flood risk maps.

THE MAIN COMPONENTS OF THE ISOK SYSTEM:



„The main goal of the project is to give citizens assurance that they are safe and to limit the losses caused by technological and natural disaster ”.

The MAIN GOAL of **METEOROLOGICAL HAZARD MAPS**
is to estimate the hazard related to the weather extremes

Temperature extremes
Heavy rainfalls (affecting floods)
Strong winds
Intensive snowfalls
Thunderstorms and hail
Fogs
Glaze
Rime

climatological analysis

estimation of spatial differentiation
of weather extremes

current analysis

– hazard forecasting –
due to weather extremes

CHALLENGES / PROBLEMS:

→ DATA:

sparse station network
spatially discontinuous phenomena (dependent on local environmental conditions)
observations not measurements

→ DATA HOMOGENEITY:

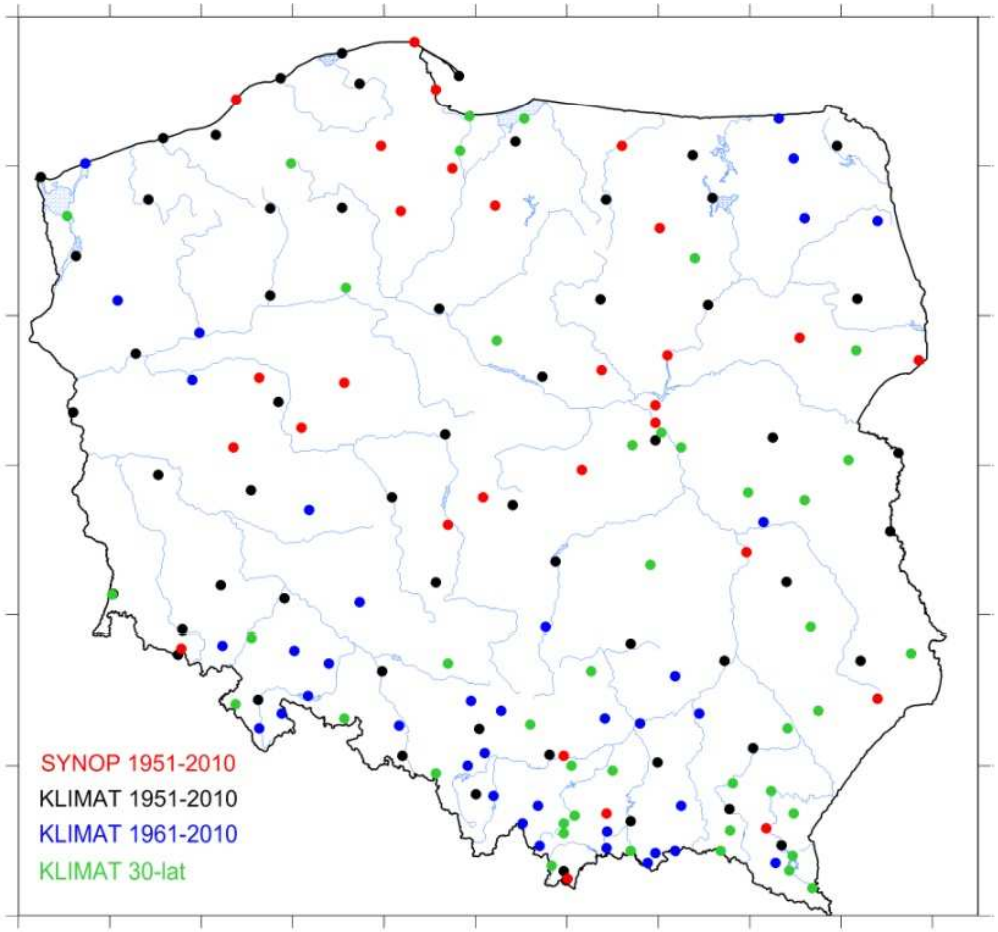
data sources
observations not measurements
extremes

→ DATA SPATIALIZATION:

information vs. appearance
reality vs. modeled world

DATA: daily resolution
1951-2010 (1966-2010)
app. 60 – 350 stations/posts

METHODS: …



HISTORICAL (CLIMATOLOGICAL) MAPS

Air temperature
Precipitation
Snow cover
Wind

Maps present the selected quantiles of weather parameters as well as the events freqency

Thunderstorms with hail
Fog
Glaze
Rime

Maps present the frequency of days with selected weather parameters as well as the probability of conditions favourable for their occurence

OPERATIONAL (FORECASTING) MAPS

Maps will present the weather-endangered regions: extreme phenomena or favourable conditions occurence (with possible hazard: very high, high, moderate and weak)

CLIMATOLOGICAL MAPS
(721)

CONTOUR MAPS
decades / months

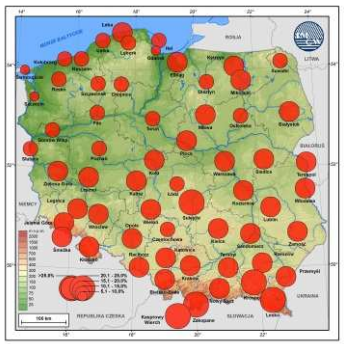
AIR TEMPERATURE

PRECIPITATION

SNOW COVER

WIND

SYMBOL MAPS
months / decades



WIND

SNOW COVER

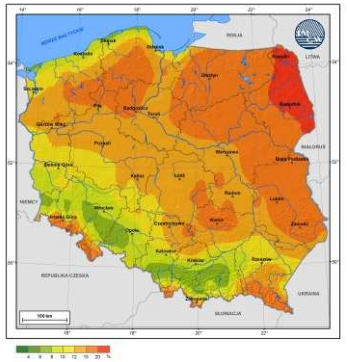
THUNDERSTORMS WITH HAIL

FOG

GLAZE

RIME

CONTOUR MAPS of FAVOURABLE CONDITIONS
year / season
spatialisation of modeled RegCM values
(defined algorithms)



THUNDERSTORMS WITH HAIL

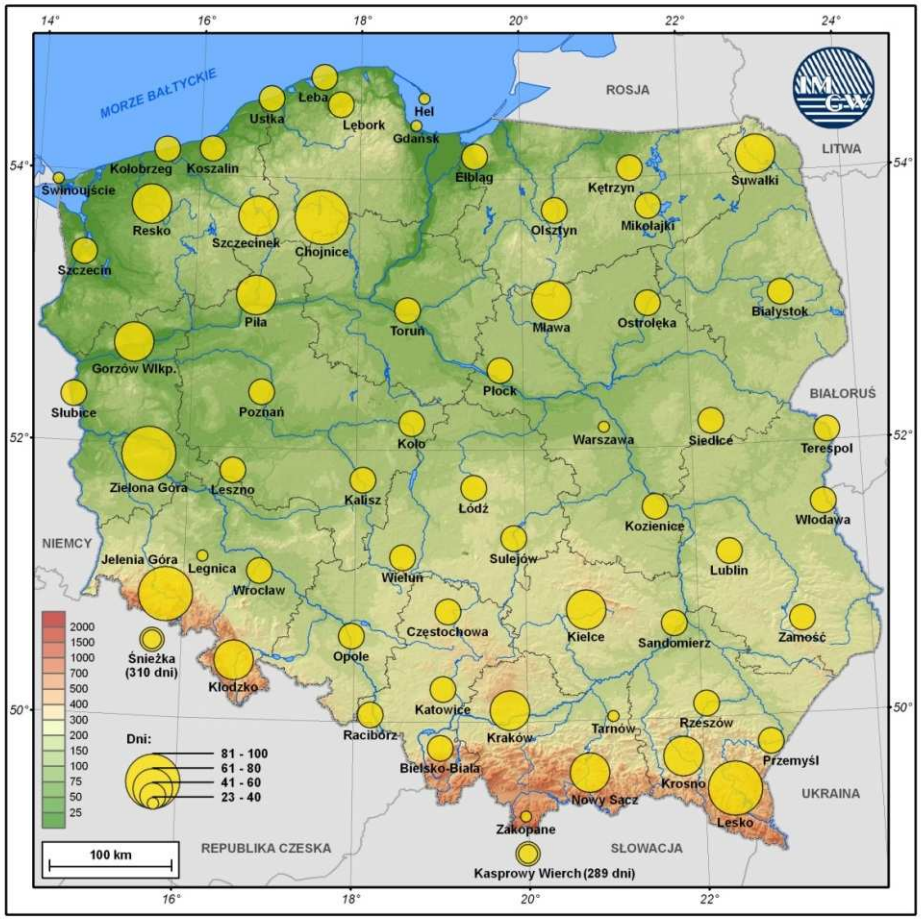
FOG

GLAZE

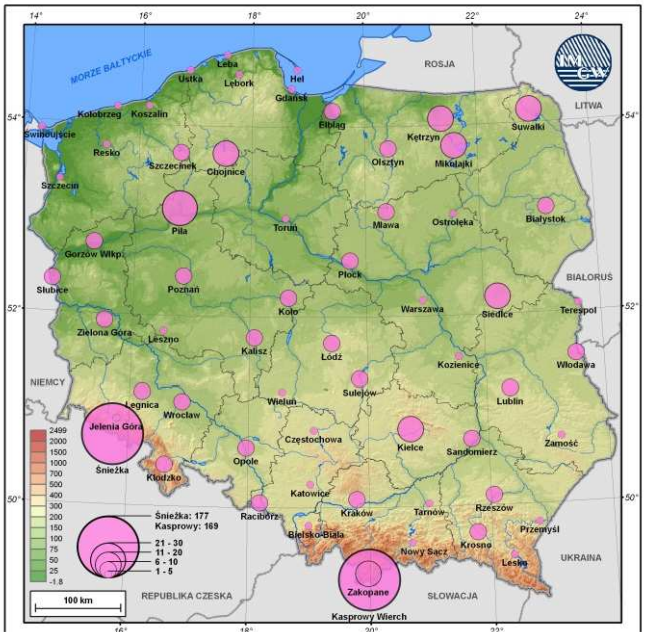
RIME

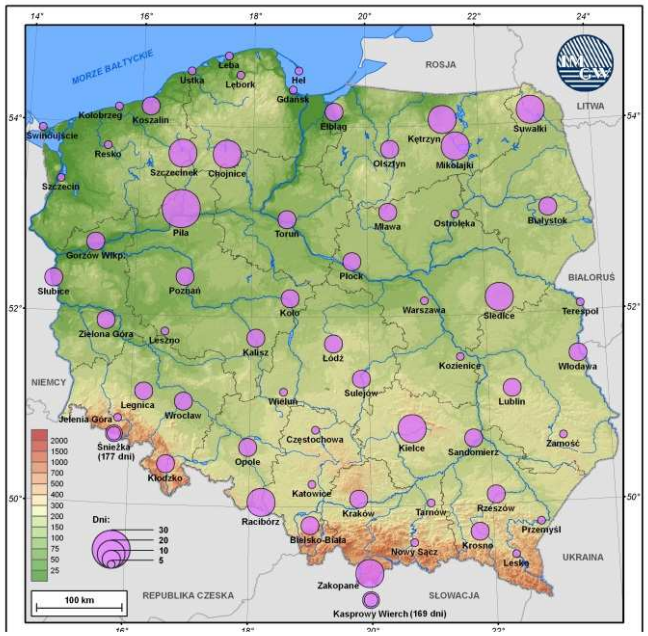
SYMBOL MAPS

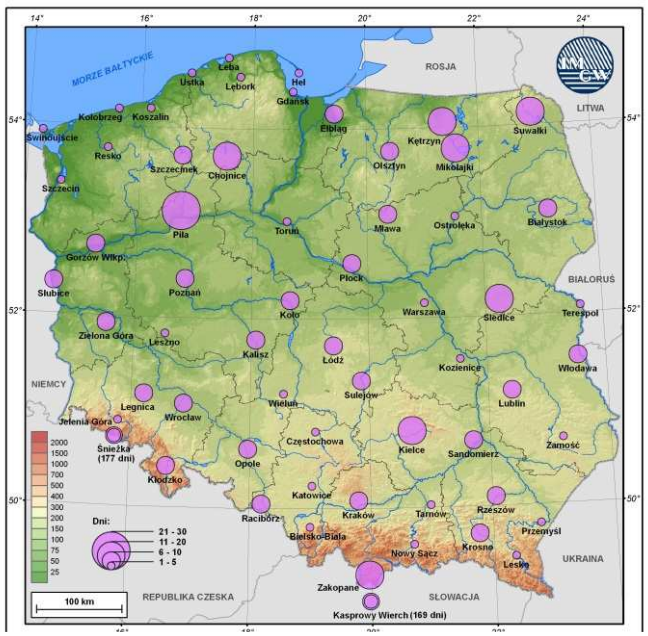
THUNDERSTORMS with HAIL GLAZE RIME FOG

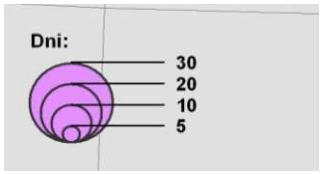


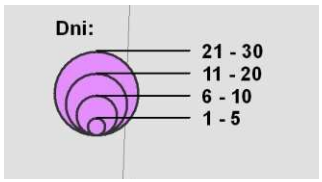
Average annual number of days with fog (1966-2010)

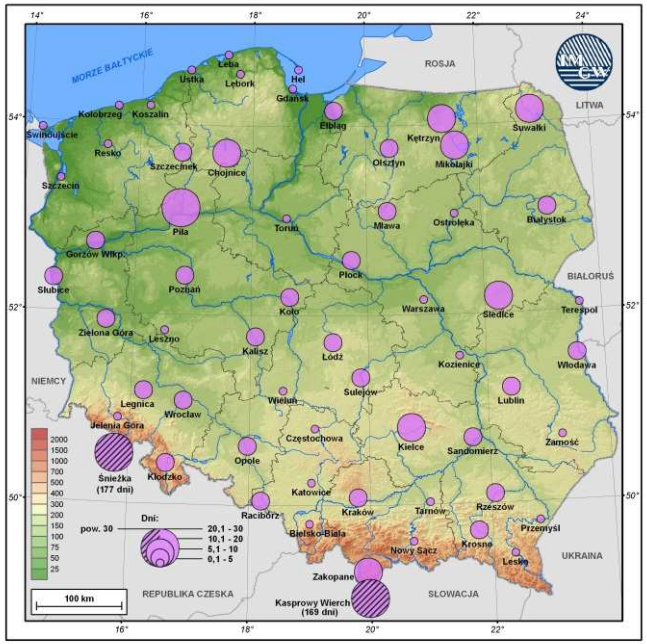


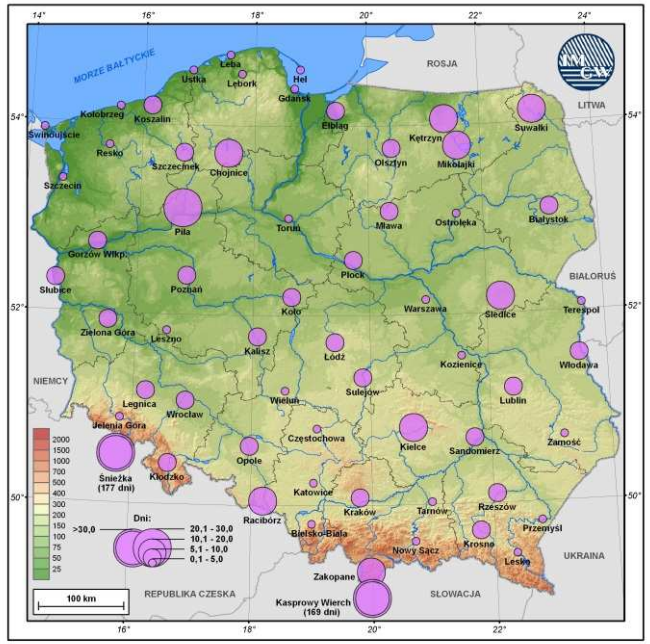


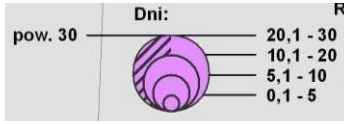


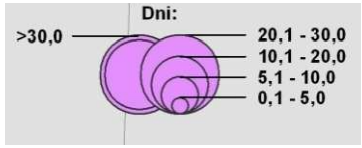












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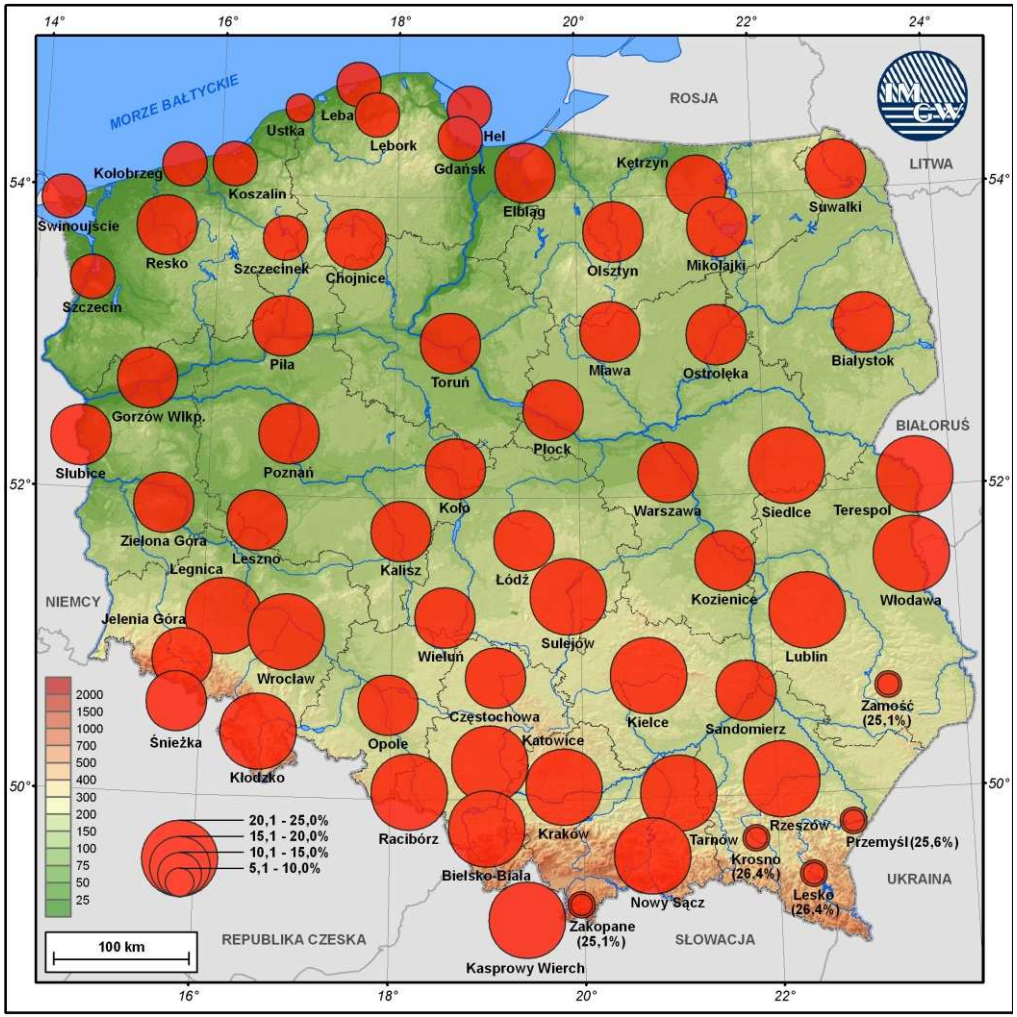
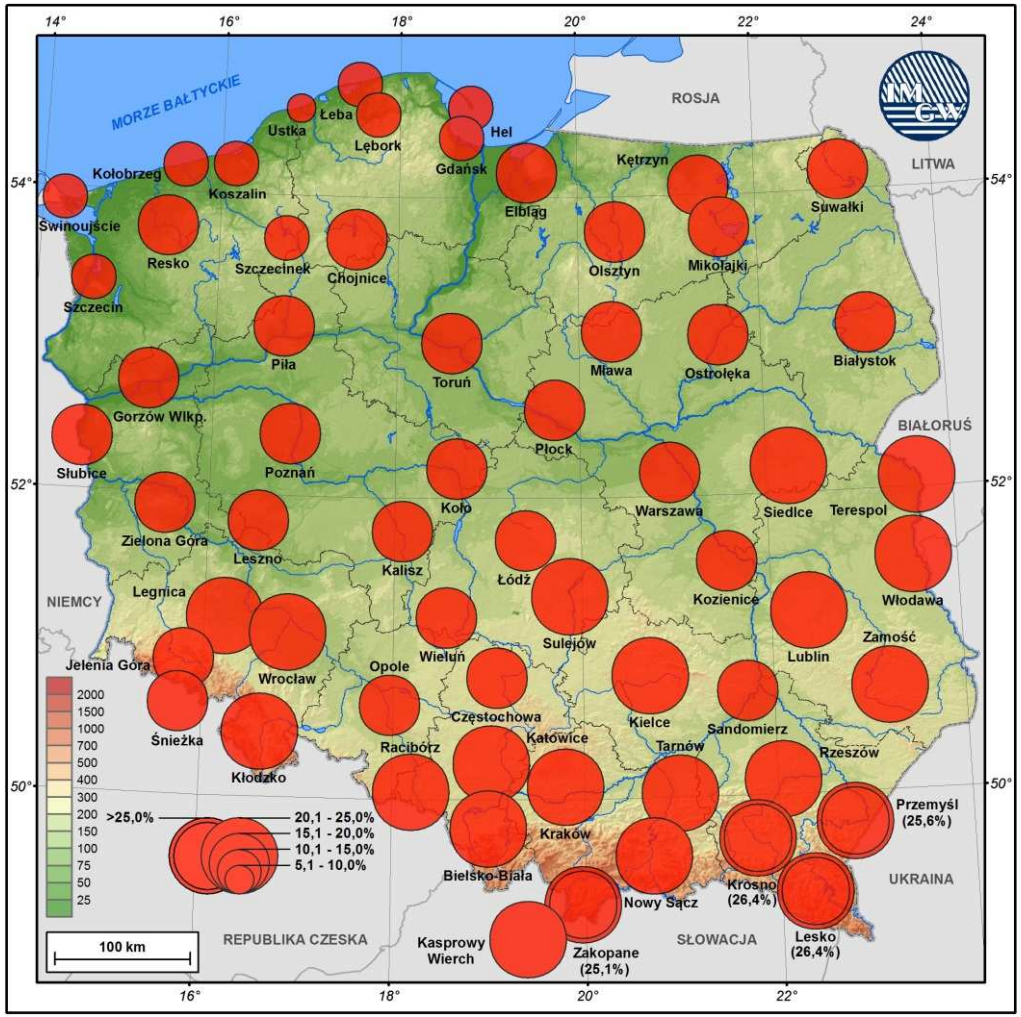
before



after



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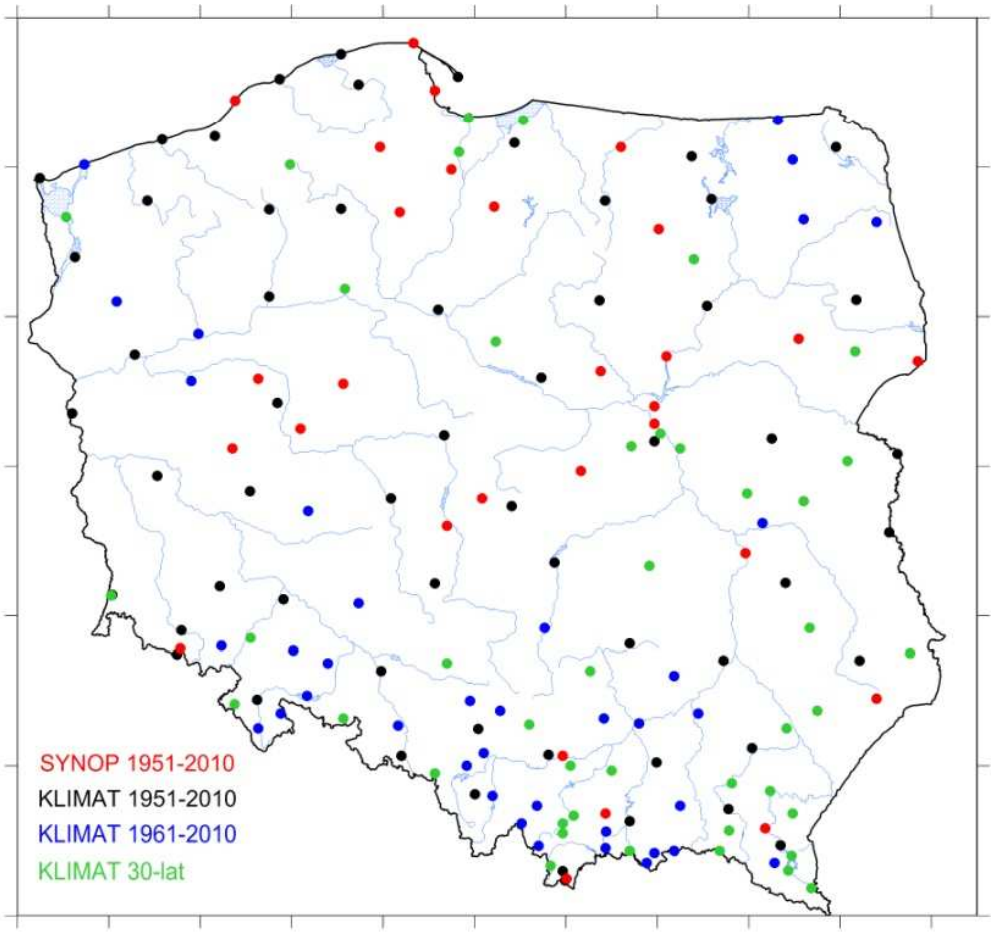
CONTOUR MAPS

AIR TEMPERATURE **PRECIPITATION** **SNOW COVER** **WIND**

CONTOUR MAPS

AIR TEMPERATURE / SNOW COVER

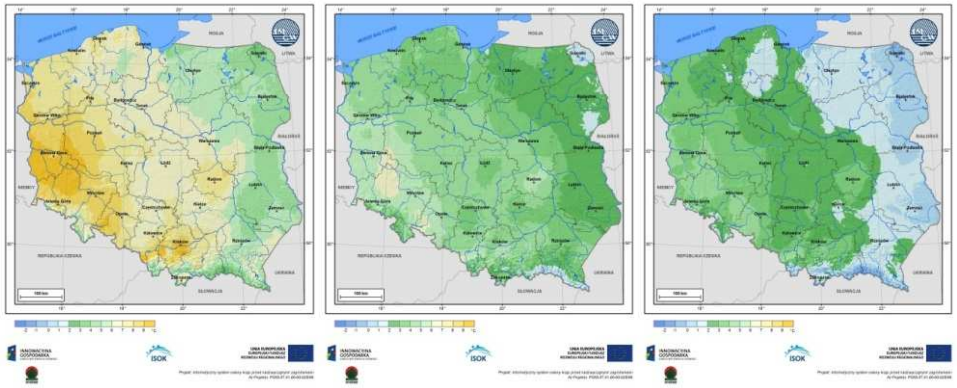


Residual kriging
(probability maps)

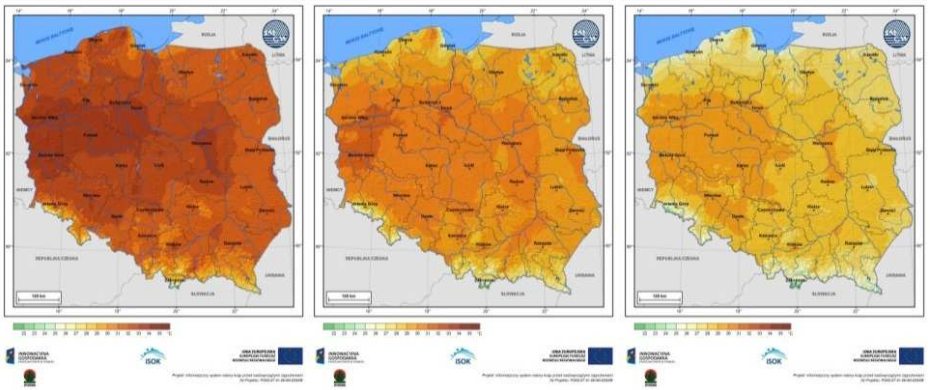
Simple kriging
(frequency maps)

- TMAX with the occurence probability of 1, 5 and 10% (for 36 decades):

TMAX (p90, p95 and p99) – January (1st decade)

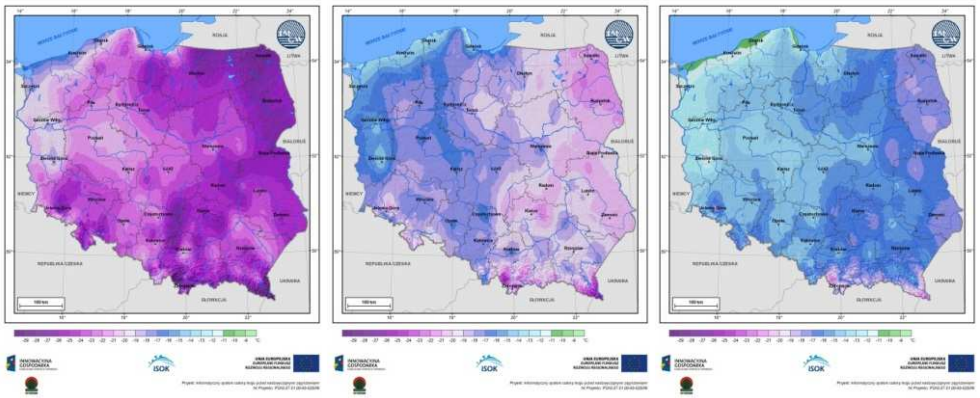


TMAX (p90, p95 and p99) – July (1st decade)

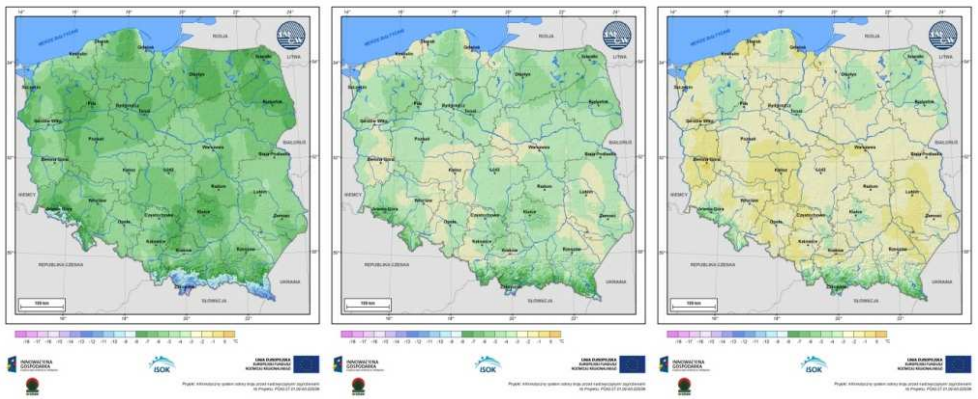


- TMIN with the occurrence probability of 1, 5 and 10% (for 36 decades):

TMIN (p1, p5 and p10) – January (1st decade)



TMIN (p1, p5 and p10) – April (1st decade)



CONTOUR MAPS

PRECIPITATION

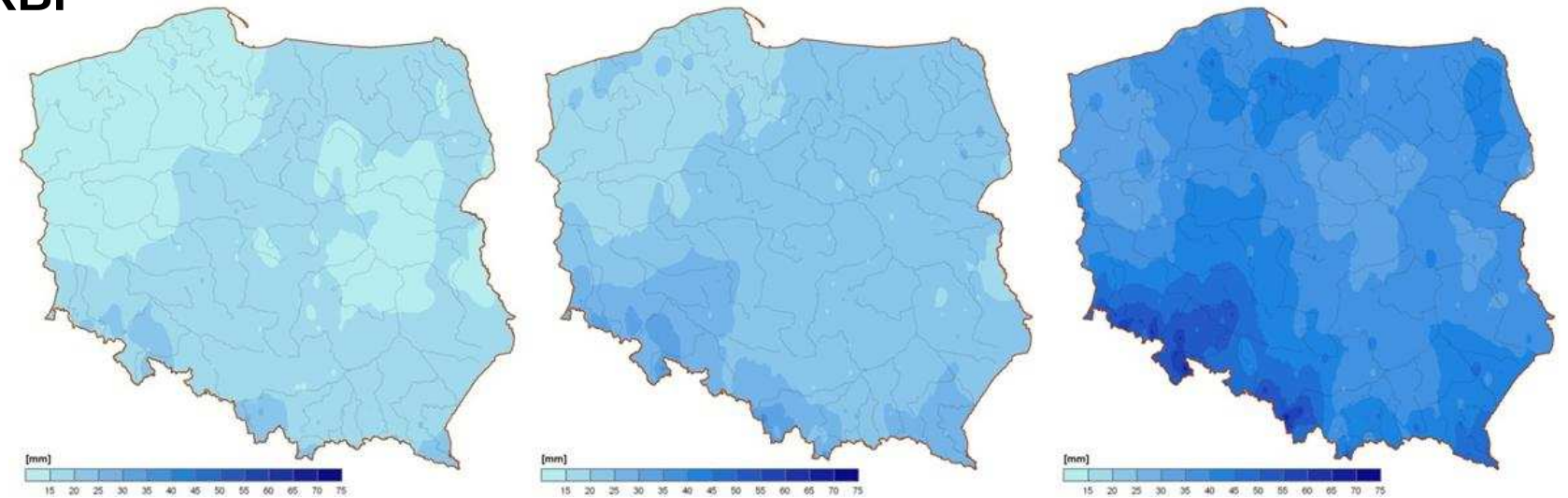
~~Natural neighbour~~
~~IDW (Inverse Distance Weighted)~~
RBF (Radial Basis Functions)

OK (Ordinary kriging)

„combined” methods

EBK (Empirical Bayesian Kriging)

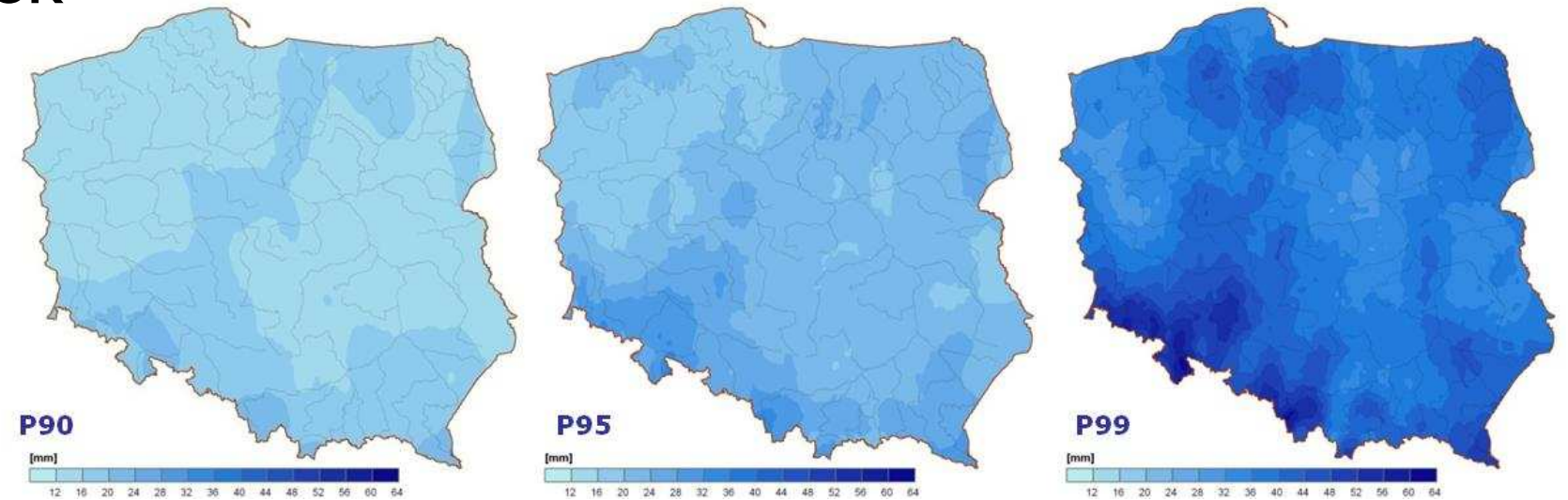
RBF



BIAS – RR MAX

P90 – 0,3 mm
P95 – 0,5 mm
P99 – 2,09 mm

OK

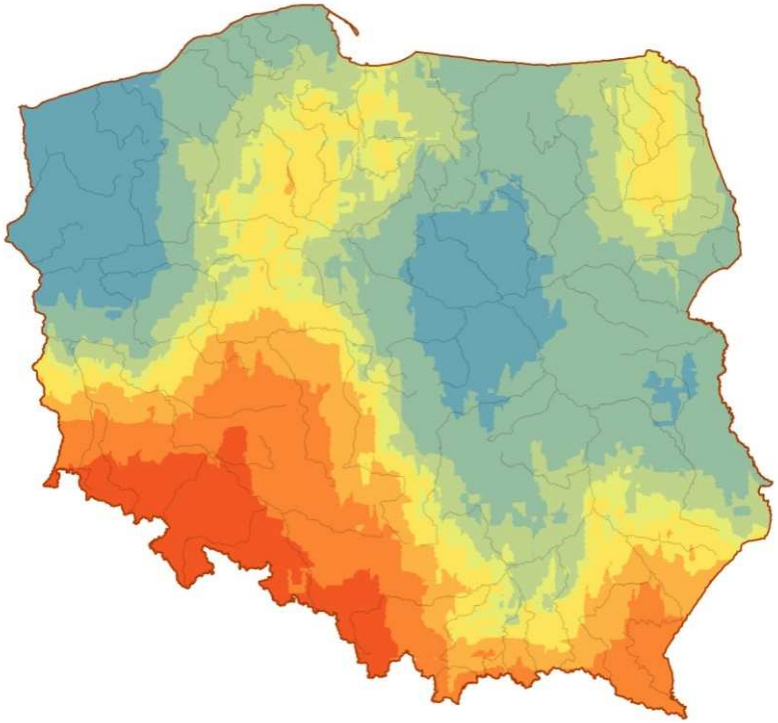


BIAS – RR MAX

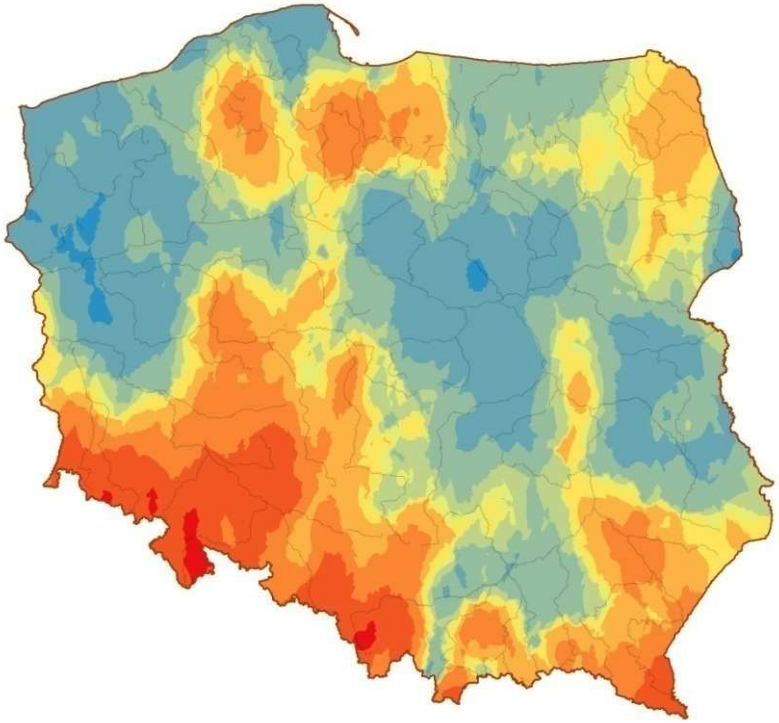
P90 – 6,43 mm
P95 – 7,13 mm
P99 – 14,35 mm

CONTOUR MAPS

OK - defaults



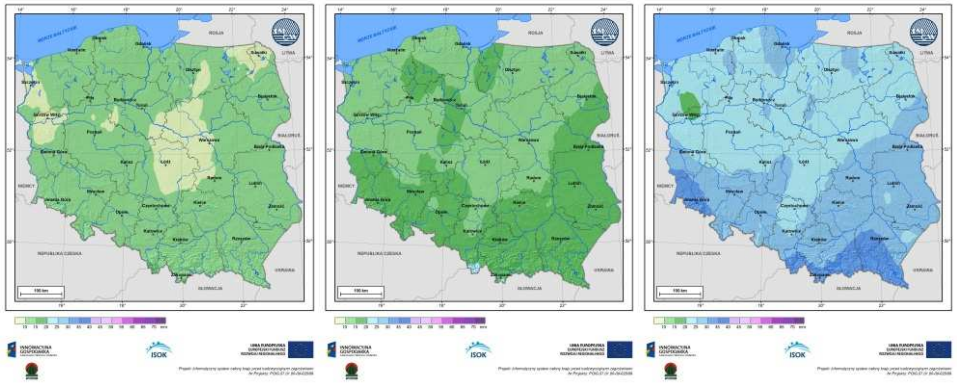
OK - individuals



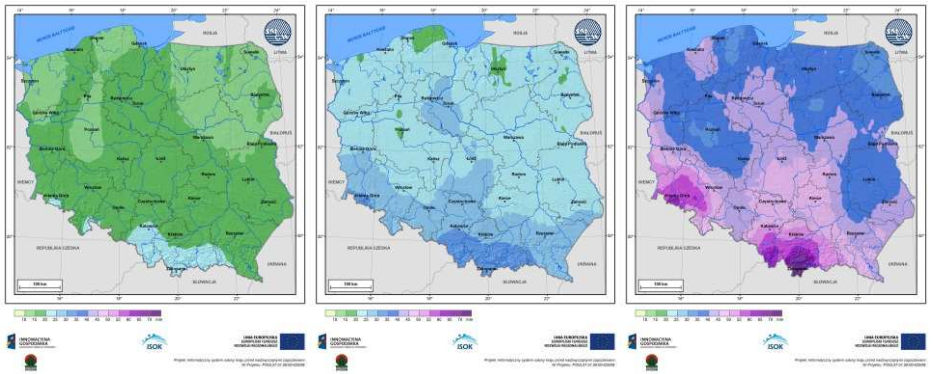
defaults – *RMSE – 6,9*
individuals – *RMSE – 5,9*

Daily RR with the occurence probability of 1, 5 and 10% (for 36 decades):

MAY – 1st decade



JULY – 2nd decade



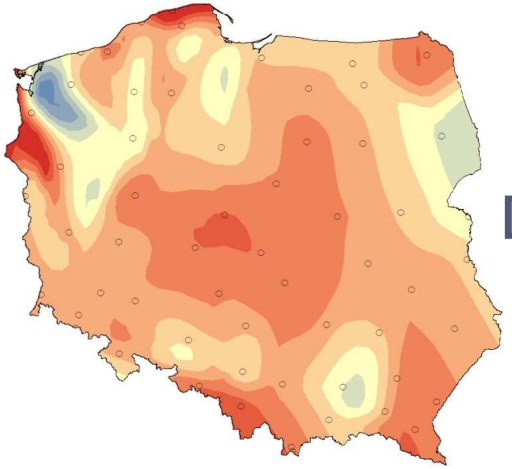
EBK (Empirical Bayesian Kriging)

→ geostatistical interpolation
→ automated data model (individual parameters)

CONTOUR MAPS

WIND

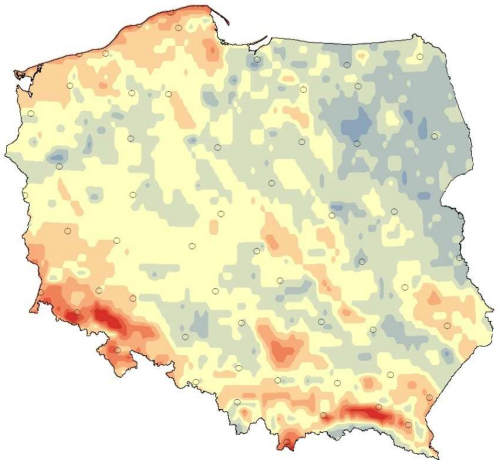
in-situ data*



bilinear interpolation

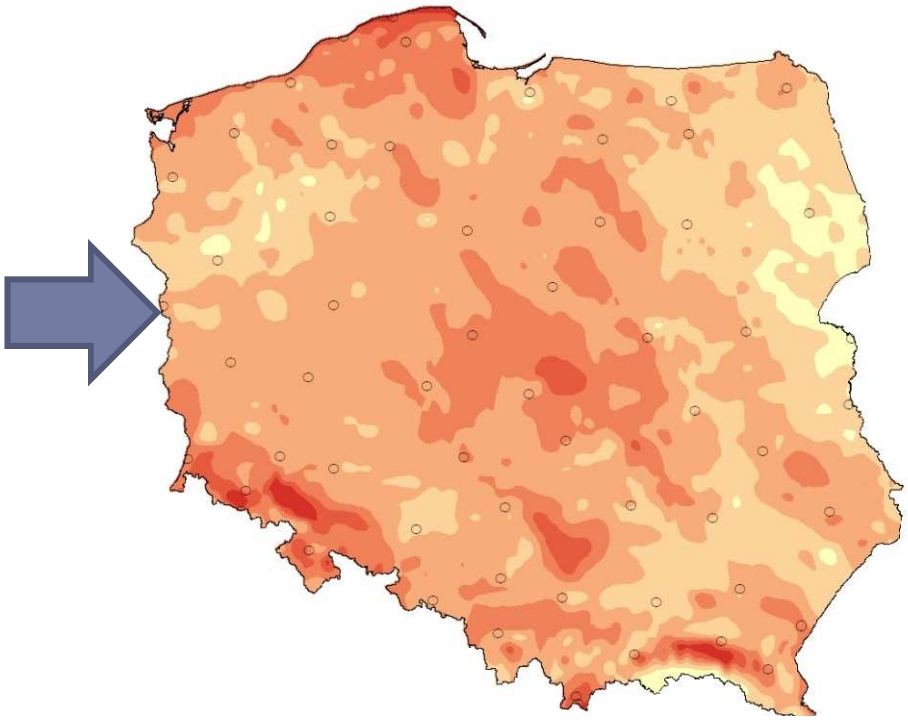
*data inhomogeneity

modeled data*



ordinary kriging

*WRF

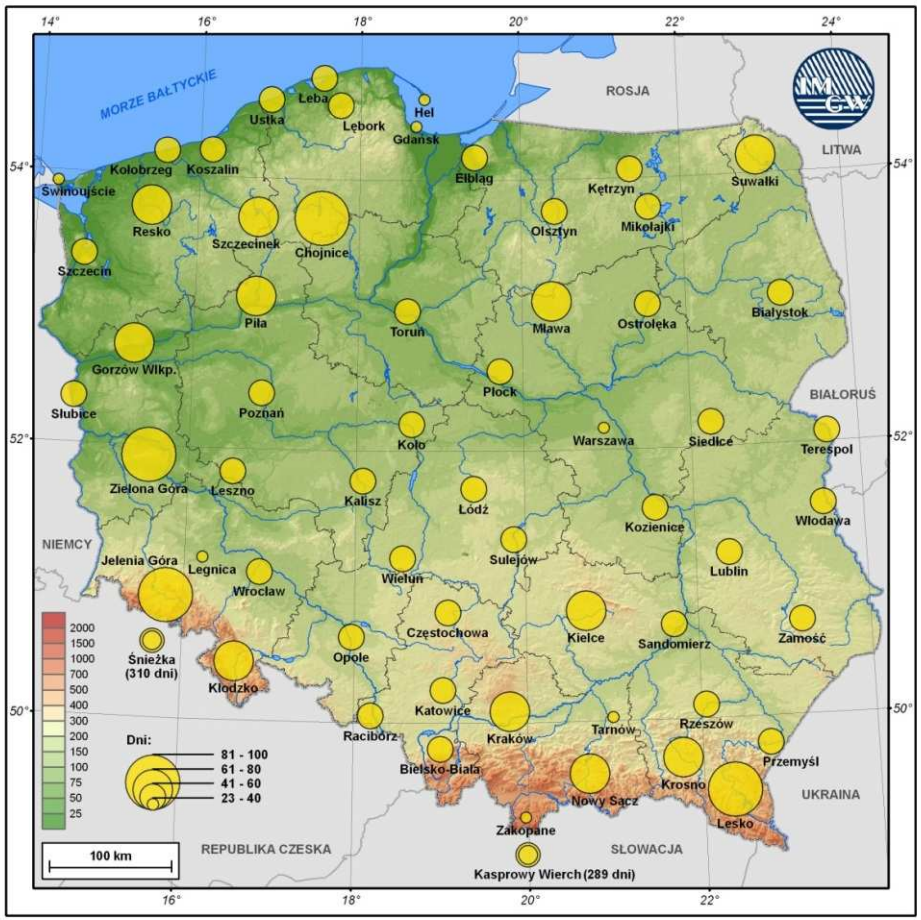


regression kriging

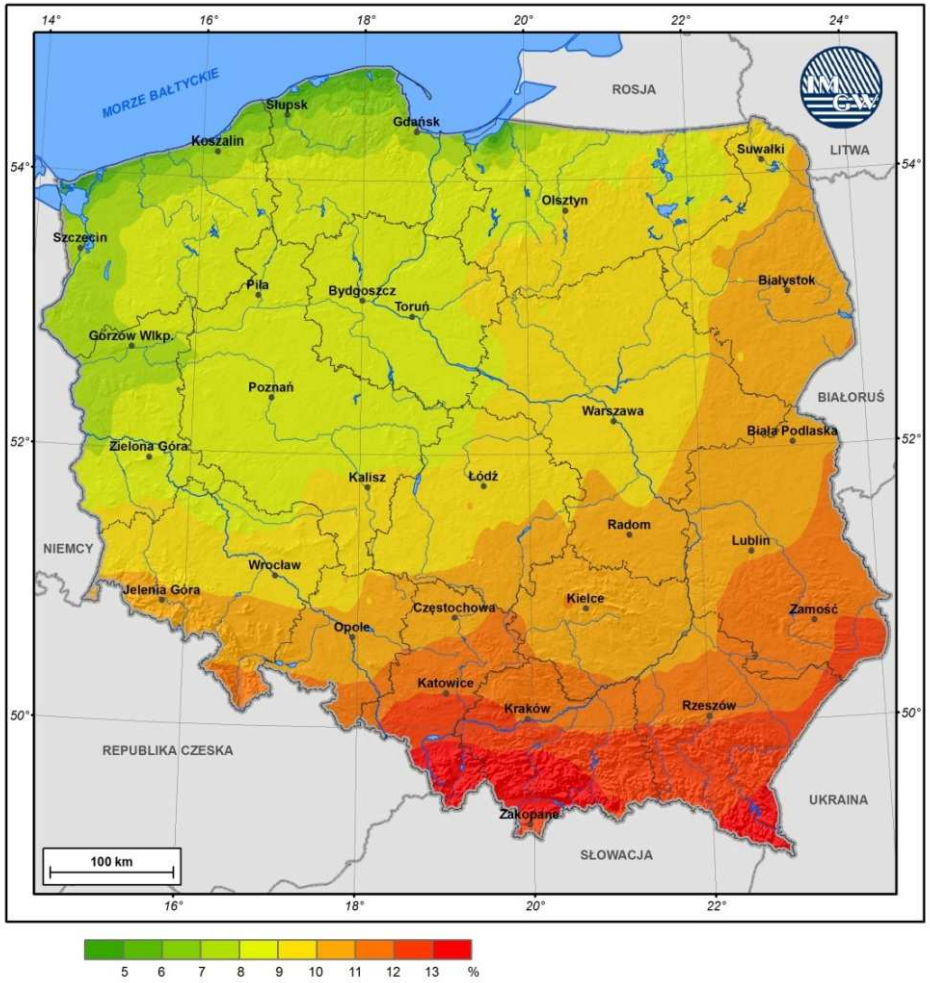
Modeled wind gust speed with the occurence probability of 2, 5 and 10 years

CONTOUR MAPS of FAVOURABLE CONDITIONS

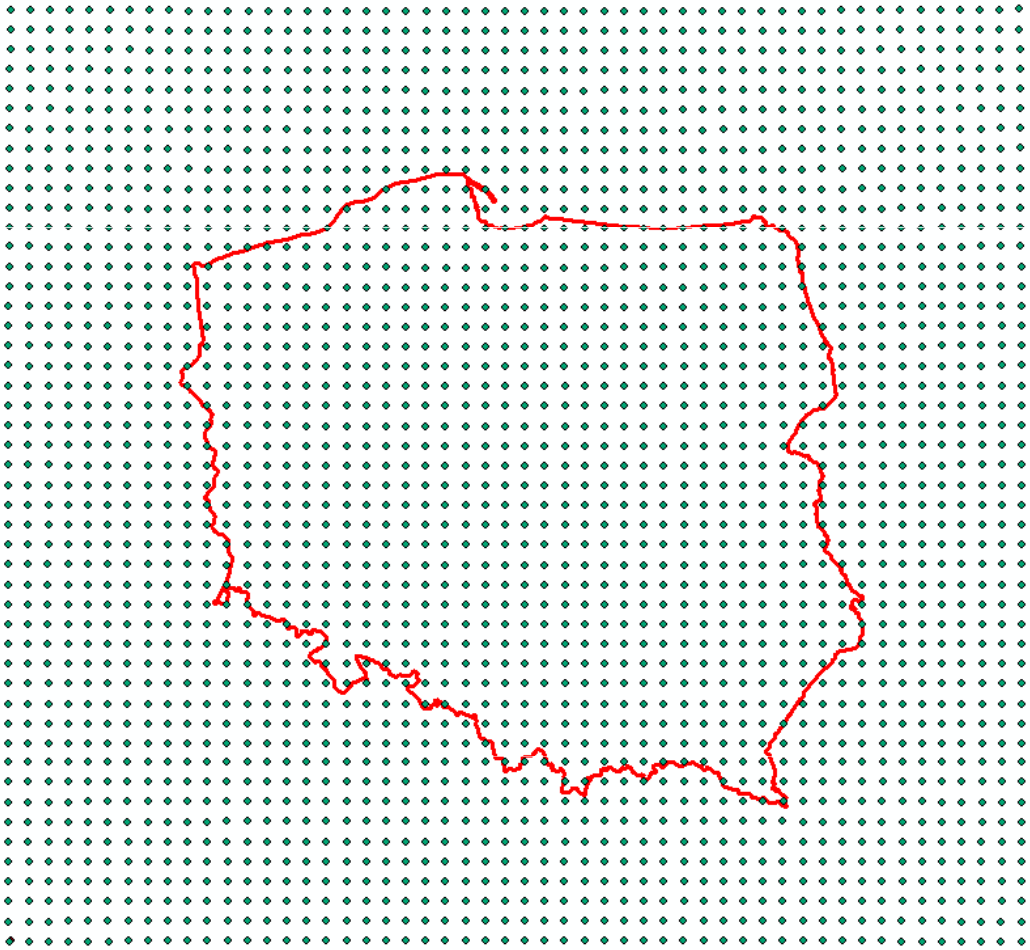
THUNDERSTORMS with HAIL GLAZE RIME FOG



Average annual number of days with fog (1966-2010)



Probability of thunderstorms-favourable conditions (1966-2010)

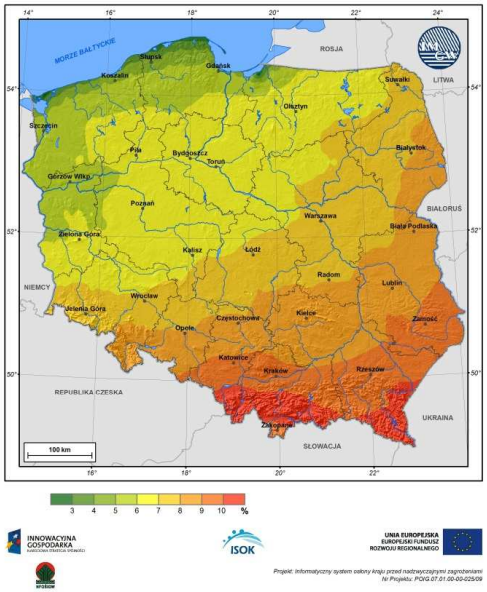


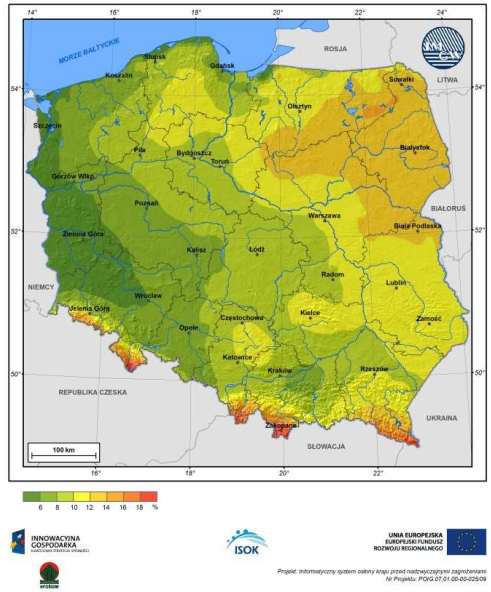
NCEP/NCAR reanalysis (2.5°x 2.5)

RegCM model
DOWNSCALLING

~20 km spatial resolution gridded 1966-2010 data with 3h temporal resolution

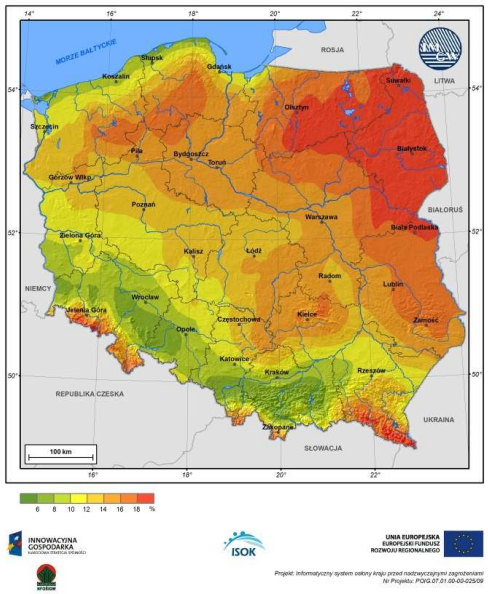
THUNDERSTORM:
- MUCAPE > 200 J/kg
- convective precipitation (for 23 isobaric levels)



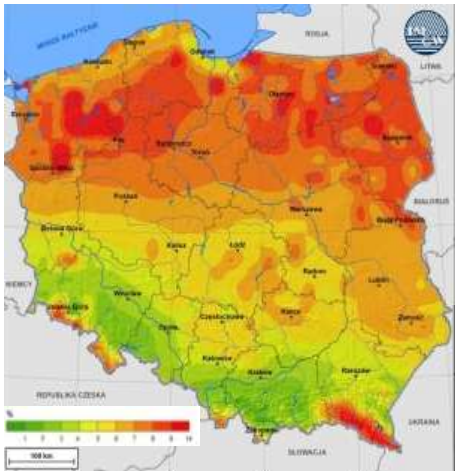


GLAZE:
- precipitation
- temperature on 700, 850 and 925 hPa isobaric level and near the ground (5 cm)

RIME:
- probability of rime as a function of relative humidity and 2m air temperature
- lack of precipitation



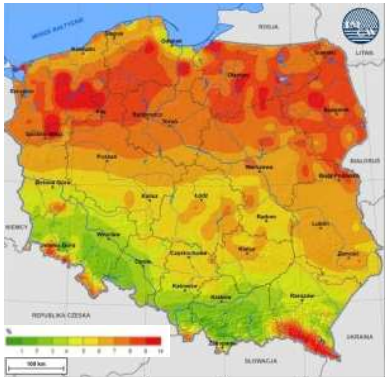
FOG:
- visibility as a function of relative humidity
- lack of precipitation



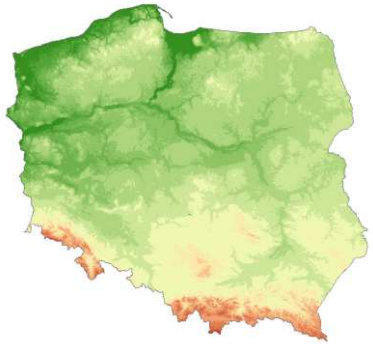
EXPLANATORY VARIABLES

→**relief**:
elevation (m a.s.l.)
topography (landform)

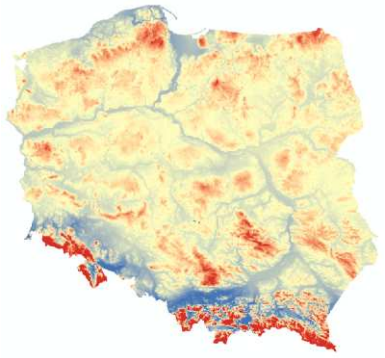
→**landuse**:
forest / non forest
water bodies
urbanisation



visibility

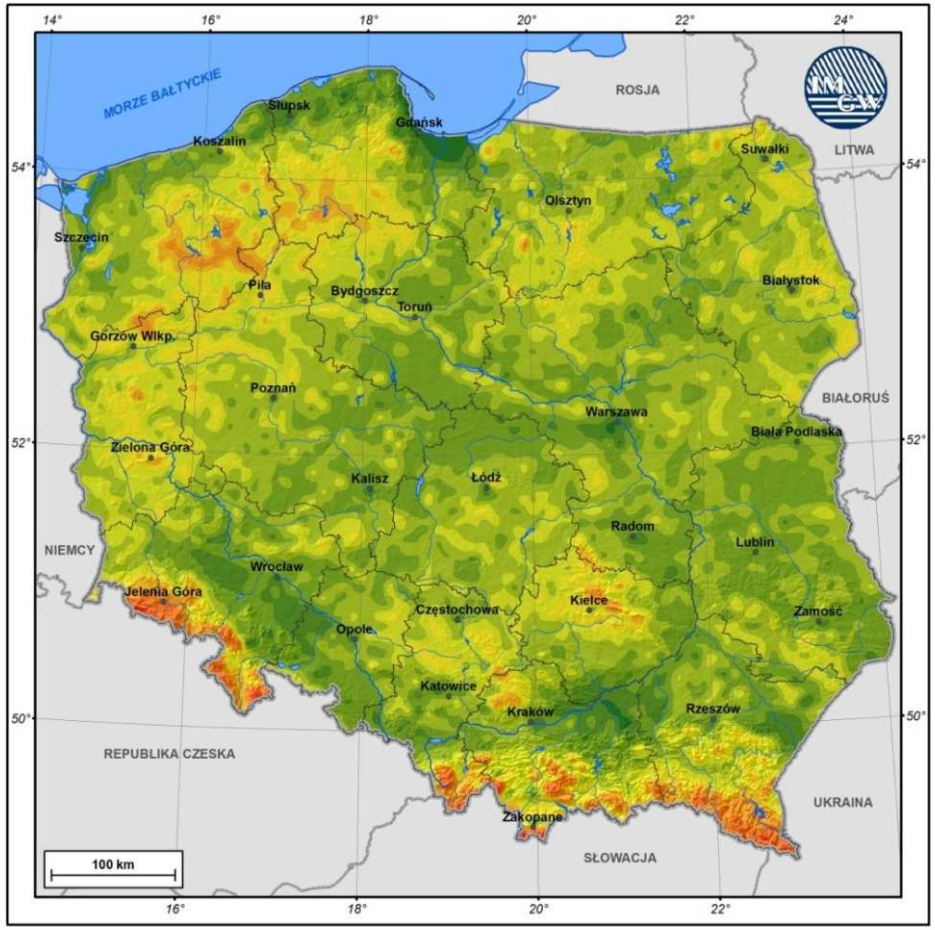


elevation



TPI -Topography Position Index

Probability of occurence fog-favourable conditions



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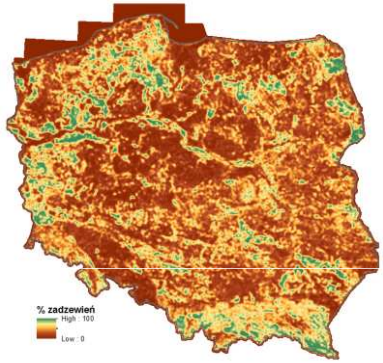
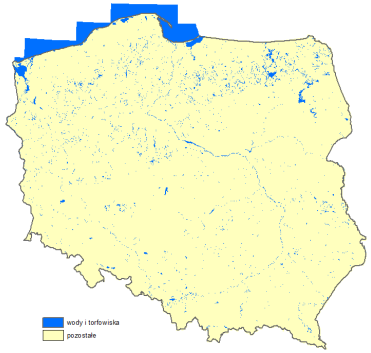
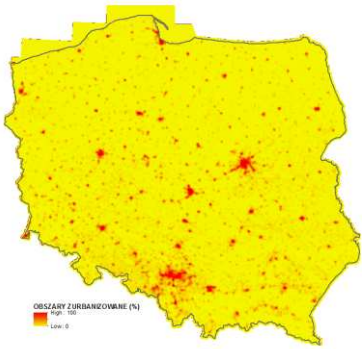


vegetation



water bodies

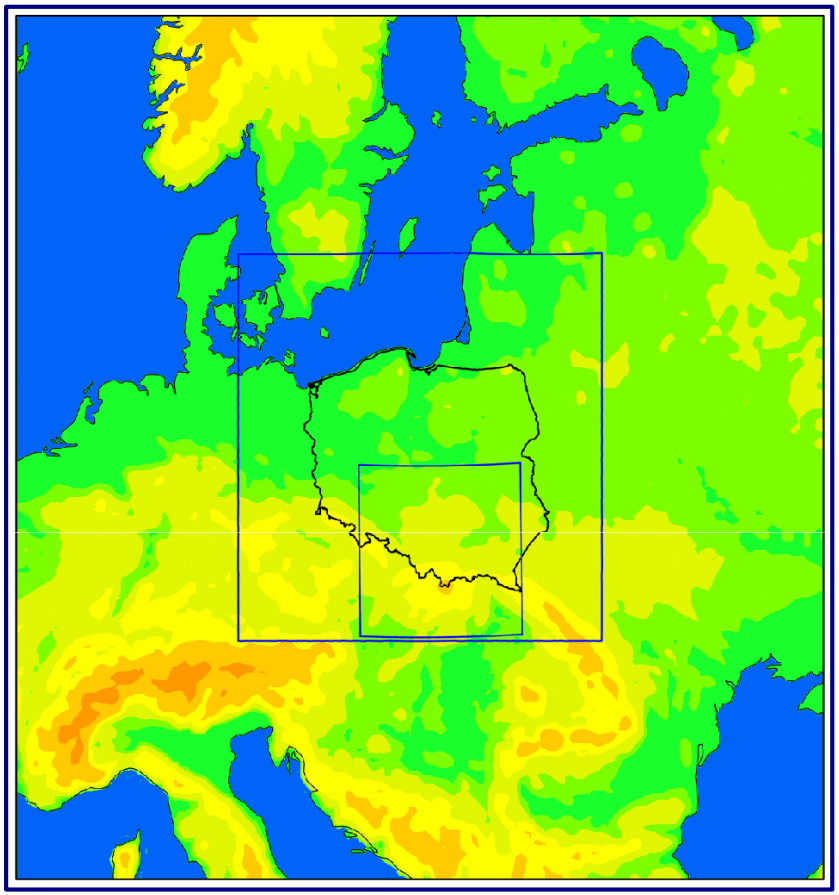


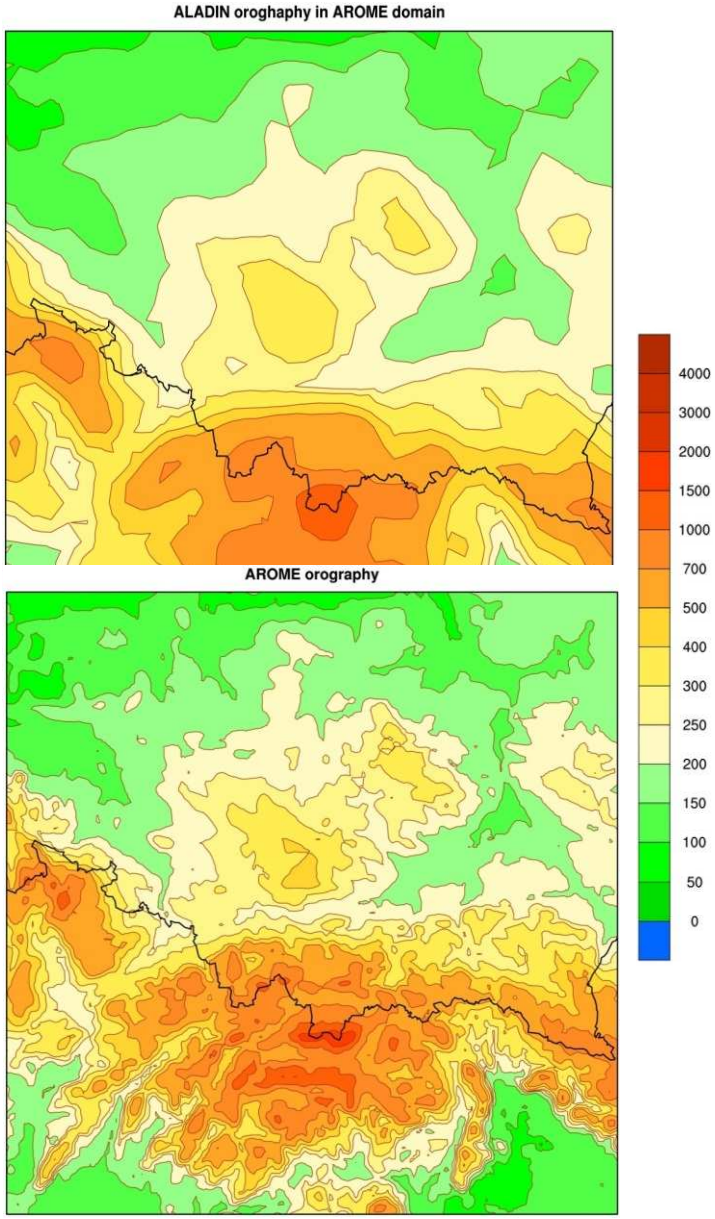
urbanisation

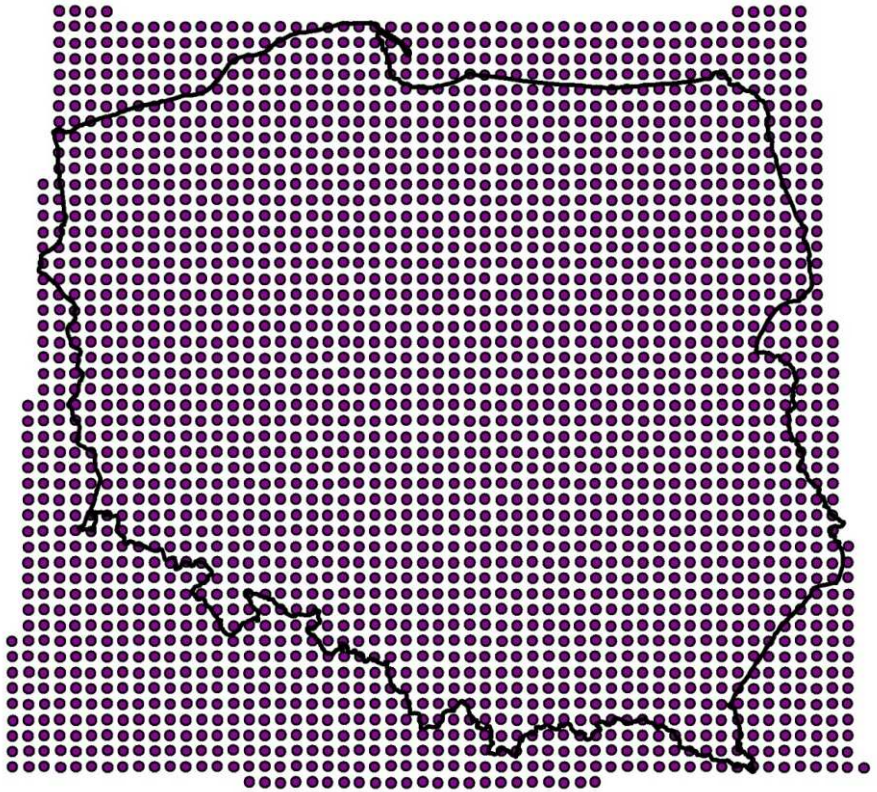
FORECASTING MAPS

ALADIN – mesoscale model, horizontal spatial resolution 13 km (→ 7.5 km)

AROME – convective model, horizontal spatial resolution 2,7km

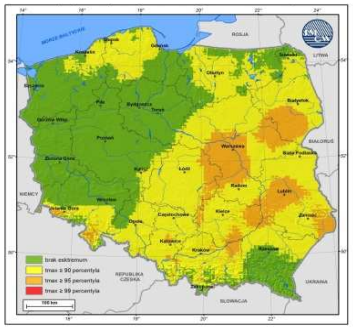
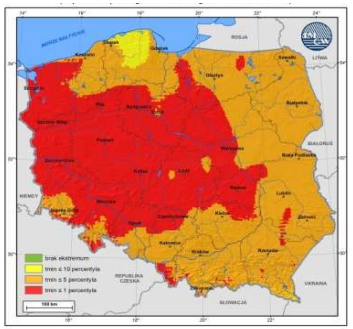
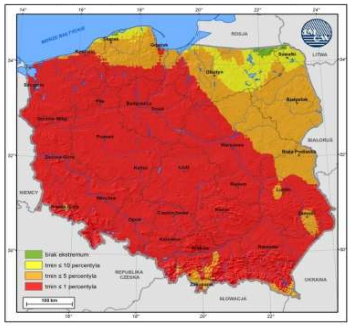


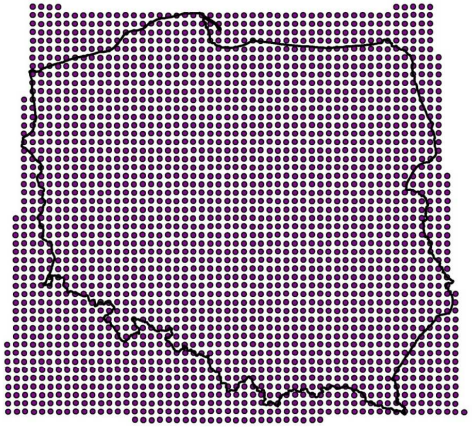




WIND SPEED (GUSTS)
SNOW COVER
THUNDERSTORM WITH HAIL
FOGS
RIME
GLAZE

„simple” exact interpolation (?)

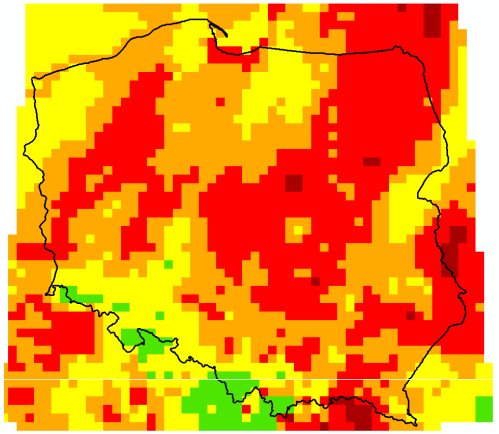


AIR TEMPERATURE
PRECIPITATION

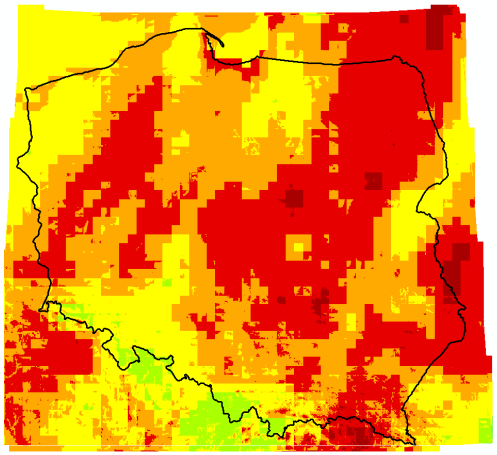
thresholds dependant on historical information

0.01°

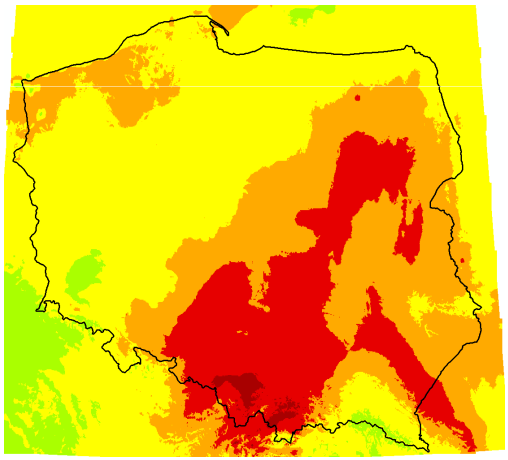
1) „point to point” (nearest neighbour)



2) „point to points”



3) „points to points”



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CONCLUSIONS / CONCERNS:

→ Weather extremes „rule their own rules" – difficult to homogenize and spatialize

→ Defining conditions favourable for phenomena occurence seems to be the solution if spatial information is needed

→ There is no universal interpolation / spatialization method (!) – trying to automate maps „production" the best at the time should be chosen with the respect to map dedication

THANK YOU FOR YOUR ATTENTION!