Non-Structual Measures – Also Significant Factors of Flood Disaster Reduction

Babiaková Gabriela, Lešková Danica

Slovak Hydrometeorological Institute, Bratislava
Hydrological Forecasts and Warning Department

- **Floods are natural phenomena which can not be prevented sufficiently**

- **Natural condition of Slovakia are rather complex.**

  Narrow valleys result in a relatively short lag time and create favourable conditions for floods as well, as spatial flash floods.

The Slovak Republic

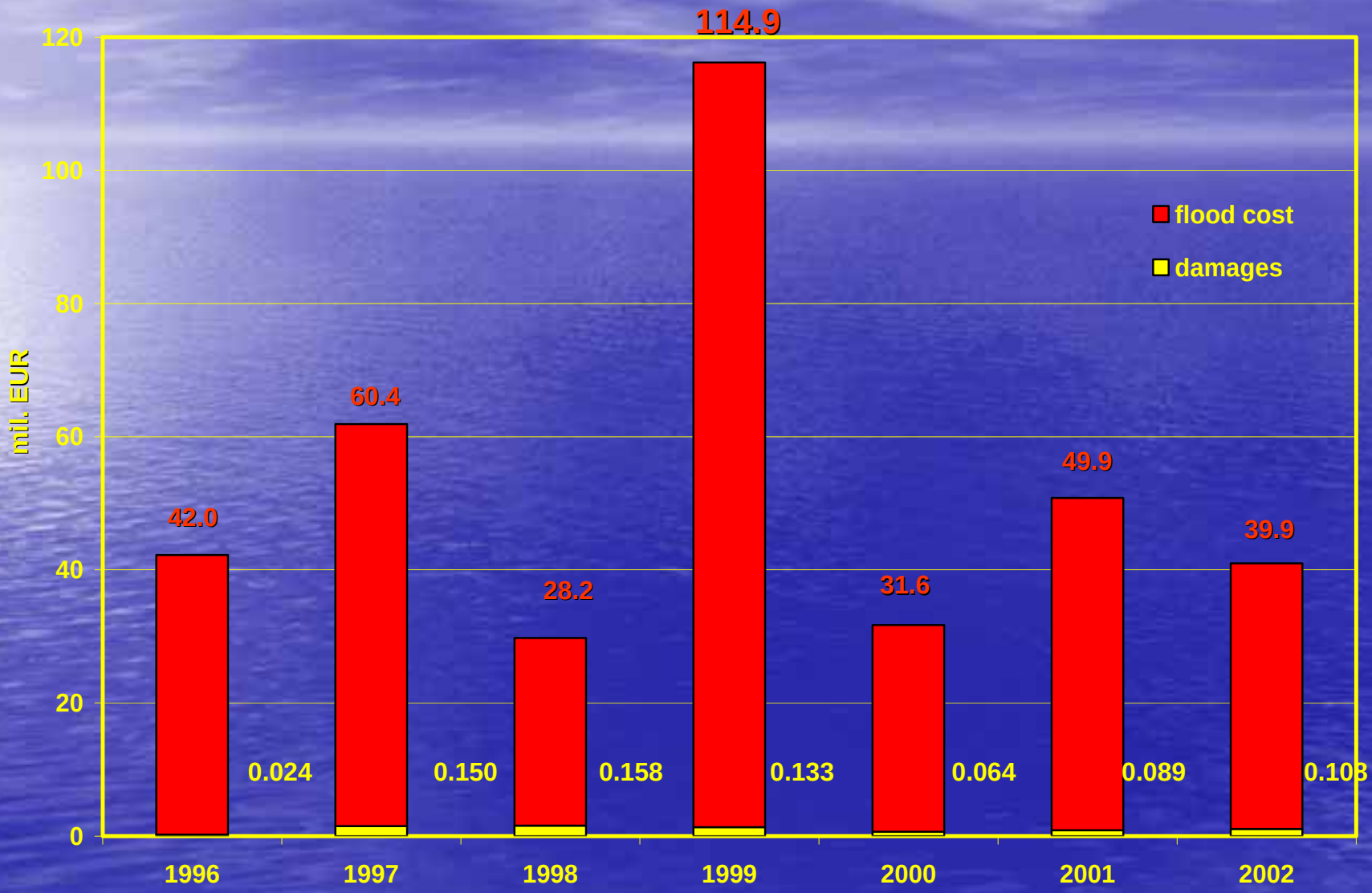
Area 49 036 km^2		Agricultural land	50%	Area mean temperature	7.5 °C
Over 300 m a.s.l.	60%	Forest land	41%	Area mean precipitation total	745 mm
Over 1000 m a.s.l.	5.4%	Water area	2%		
The lowest point	94 m a.s.l.	Built-up areas	3%		
The highest poit	2655 m a.s.l.				

- There are approximately 2,300 small catchments areas in range 5 – 50 km2 with a large potential risk for flooding, especially with respect to this type of flood
- Between 1996 and 2002, Slovakia suffered over 80 major floods causing damage, including catastrophic flash floods in the central and northern part of the country
- The majority of them have resulted in injuries to people, the displacement of hundreds of people and enormous economic losses
- Small catchments recorded 77 flash floods between 1997 and 2002

The floods that have frequently occurred on Slovak territory in recent years include the following:

- floods from extensive rainfall
- regional floods connected with snow melting as a result of rainfall
- ice floods – creation of ice jam
- locally distributed flash floods
- urban flooding

Flood damages and costs according to flood events



Determination of regions where the occurrence of classic regional floods as well as flash floods with extreme effects is much more frequent then on the rest of the territory.

Sensitivity of basins to the occurrence of flood extremes was applied using "flood index" K

$K = 1/n \Sigma Q_{max}/Q_{annual}$

Q_{max} – max. Q at a water gauge station for the period considered

Q_{annual} – annual of Q in a station

n – number of years of hydrological series

The results contain a K index evaluated from 300 water gauge stations:

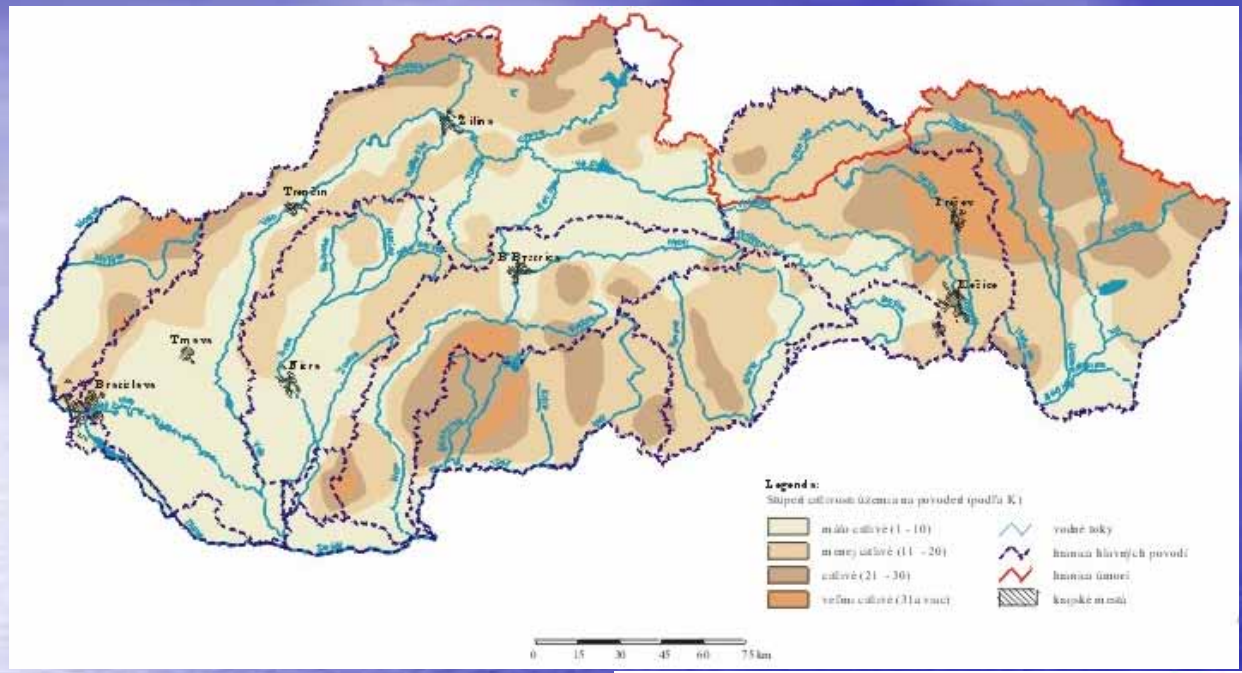
- **for a 12-year series of the vegetation seasons (April – September)**
- **for a 12-year series of the hydrological year**

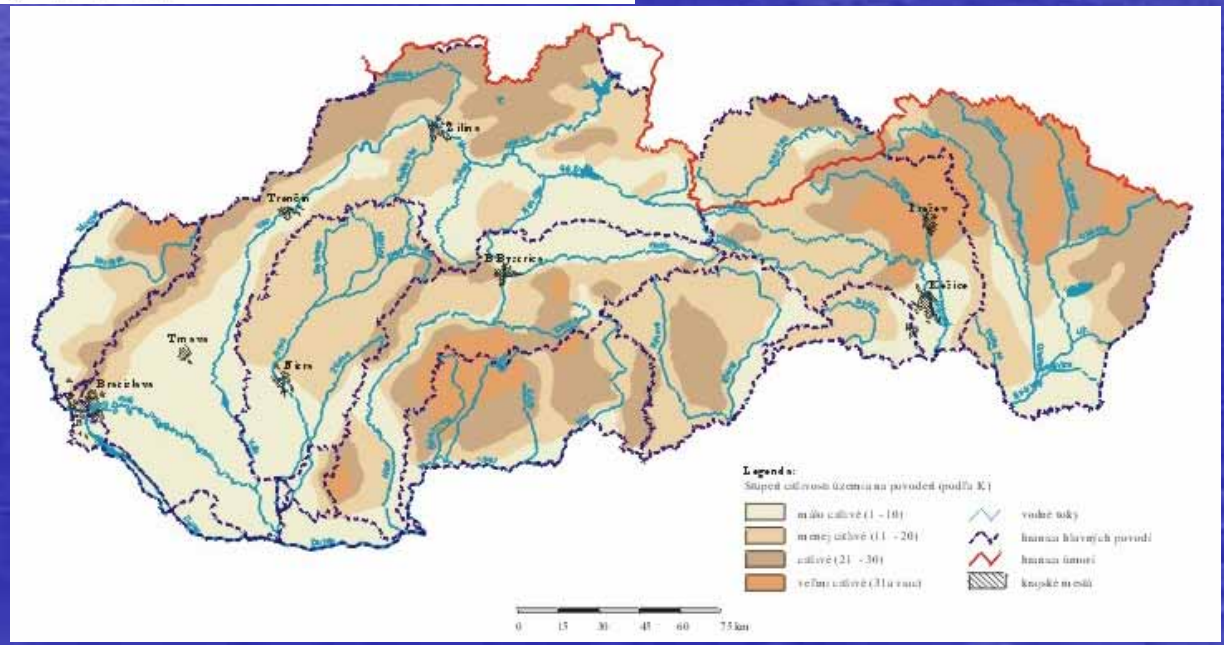
It follows from the definition that the higher K is, the more significant the flood situation, i.e. the territory of the basin is more sensitive to floods

K – significant values during the summer period

Selection of regions according to the "flood index" K criteria:

very sensitive	K = 30 or more
sensitive	K at an interval of 20 – 30
less sensitive	K at an interval of 10 – 20
negligible sensitivity	K of less than 10


Žilina
Trenčín
Prešov
B.Bystrica
Košice
Trnava
Nitra
Bratislava
Legenda:
Stupeň citlivosti územia na povodeň (podľa K.)
málo citlivé (1 - 10)
menej citlivé (11 - 20)
citlivé (21 - 30)
veľmi citlivé (31 a viac)
vodné toky
hranice hlavných povodí
hranice činností
krajské mestá
0 15 30 45 60 75 km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Non-Structural Measures

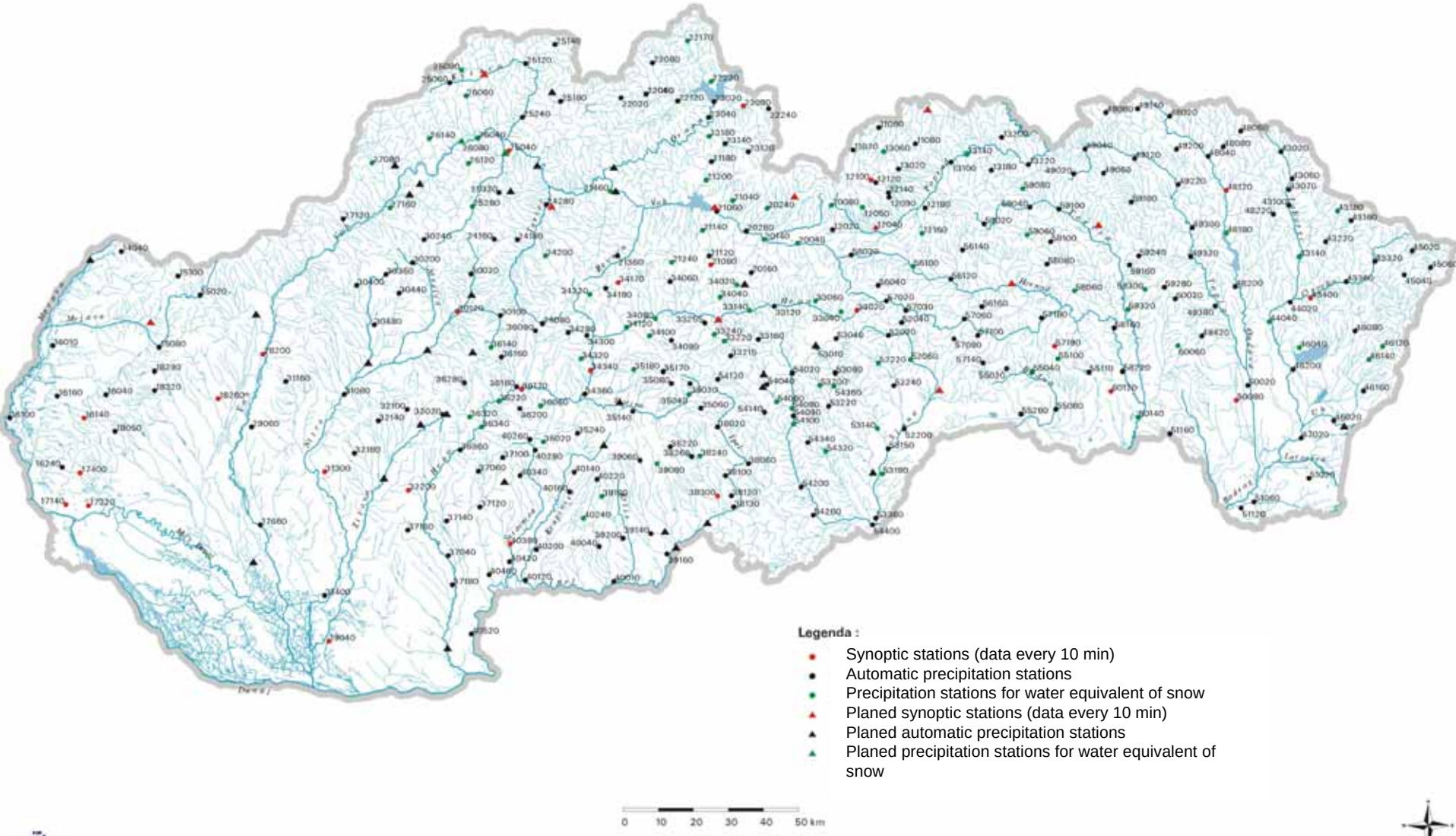
- **Forecasting and warning system**
  - Development of a flood monitoring system
  - Innovative forecasting method
  - Local warning system
- **Institutional and legal framework**
  - Legal approach
  - Co-operation on transboundary water
  - *Directive of the European Parliament and the Council on the Assessment and Management of Floods*

The basic data for the hydrological forecasting and warning system

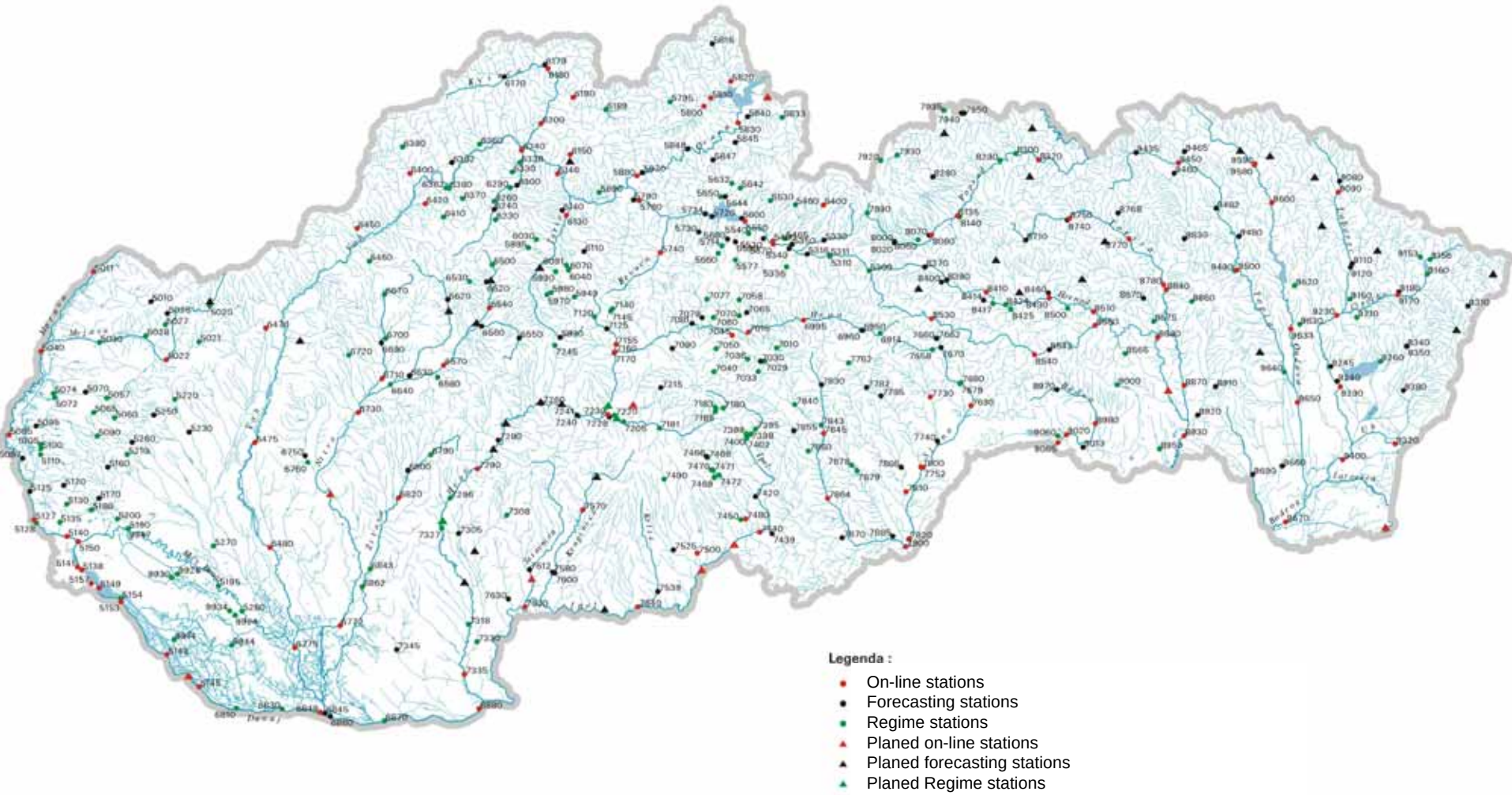
Data from the meteorological monitoring network

- Network of meteorological stations (24 synoptic and 10 additional synoptic stations)
- Network of climatological stations (a daily report sent from 59 stations to the centre)
- Network of rain gauge station (voluntary precipitation network with 568 stations); ***76 stations*** represent an automatic precipitation network with year-round measurements- ***equipped by alarm***
- Meteorological radar (2 radars at present), model ALADIN, satellite images for visual usage

Network of meteorological stations



Network of hydrological gauge stations



Distribution of water gauge station in the main basins

Basin	Number of stations	Number of telemetric stations out of total number
Morava	25	13
Dunaj	17	14
Váh	114	70
Nitra	27	20
Hron	50	30
Ipeľ	26	20
Slaná	28	20
Bodva	8	6
Hornád	34	34
Bodrog	42	42
Poprad	15	15
Total	386	205

Approximately 1 station for every 125 km2

205 telemetric stations

80 station on line (forecasting)

125 operative during the floods

All equipped by alarm system

The department of Hydrological Forecasting and warning Service operated with 80 operation water gauge stations (profiles) and provides sets of various types of forecasts:

- Numerical forecast are provided for 11 hydrological forecasting stations
- Daily forecasts for 13 reservoirs
- Forecasting trends in water stages –increases, decreases, stability are provides for other rivers.

During Winter season proceed and issued once a week:

- Information about sow conditions for whole territory (depth of snow)
- Water equivalent of the snow – development from 219 climatic stations
- Accumulation of water in the snow cover for 13 water reservoirs and 14 measurement gauge profiles

- **Local warning system (LWS)**

Goals: To provide the local authorities with sufficient lead time to warm about the origin of floods in small basins and to eliminate their destructive consequences. Several criteria were considered in the selection of these basins:

- **Sensitive regions according to K**
- **Climatological indicators such as the intensity of the precipitation, the mapping of any storms, etc.**

- **Locality of the basins:** ***upper part of Myjava basin – the western part of Slovakia, K = 30***
- ***Tributary of the upper part of the Hron river basin – the Čierny Hron stream, K = 20***

Institutional and legal framework

The legal approach:

Act No. 666/2004 Coll. of Laws

on flood protection chiefly deals with:

- **Conditions for protecting life, health and property from flooding;**
- **Responsibility of the Civil Service, the government and cooperate bodies and subjects concerning the scope of flood protection in all the river basins;**
- **The flood-protection commissions, their duties and responsibilities in the field of flood protection;**
- **Delivering personal assistance and devices for flood protection;**
- **Sanction for legal violations.**

The specific flood protection measures include

- Flood plans
- Flood inspections
- Forecasting and warning service
- Patrol service
- Flood prevention work
- Salvage operation

Co-operation on the transboudary water

- bilateral agreements with Austria, The Czech Republic, Hungary, Ukraine, Poland

Co-operation on EARLY FORECAST ALERT SYSTEM (EFAS)

Joint Research Centre – IES ISPRA

Co-operation on the EU Framework on the assessment and management of floods - being prepared

Deals with

- Preliminary flood risk assessment
- Flood risk maps (selection probability, damage maps)
- Flood risk management plans

Final comments

There are many structural measures in the Slovak Republic to help mitigate flood damages, but without the development of the above mentioned measures, they will all lose their effectiveness.

Thanks for attention

gabriela.babiakova@shmu.sk; danica.leskova@shmu.sk