METEOROLOGICAL RISKS

Hungarian Meteorological Service

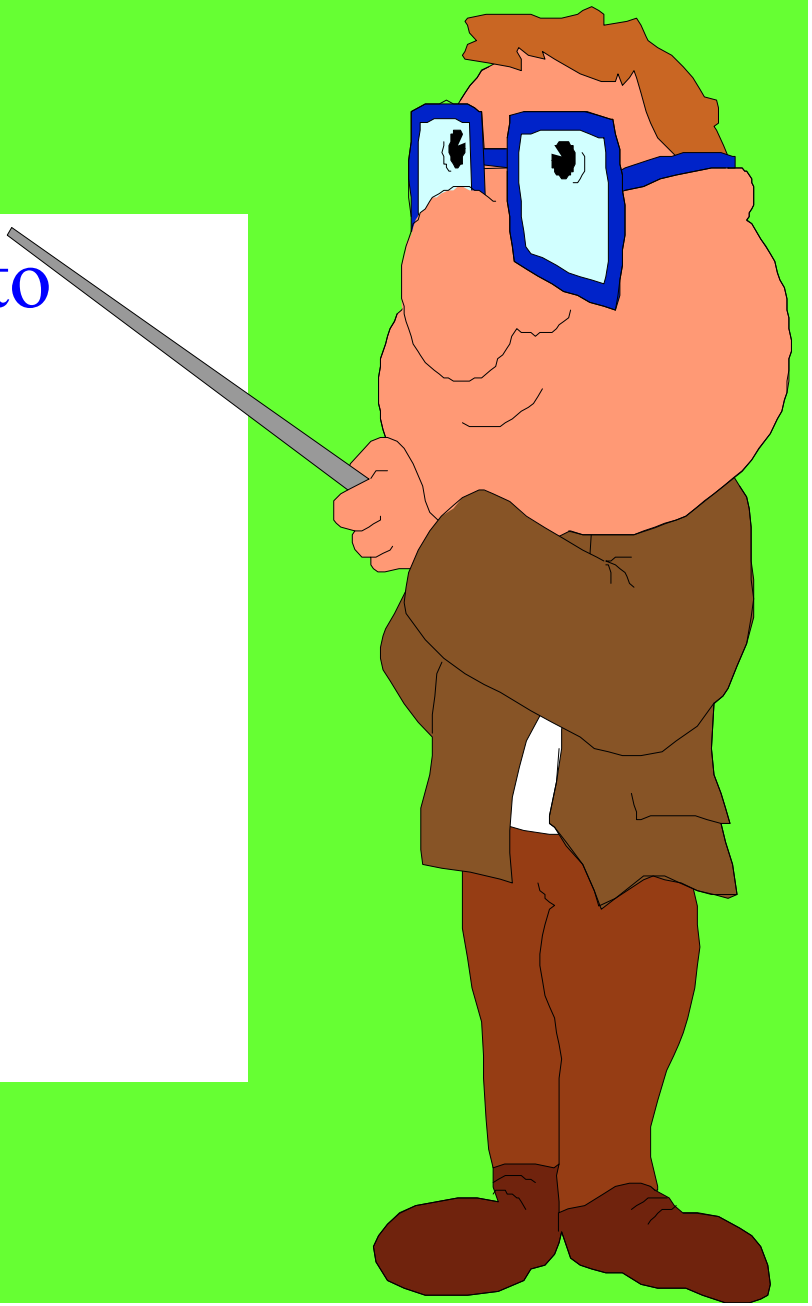
Overview:

Meteorological satellites help to

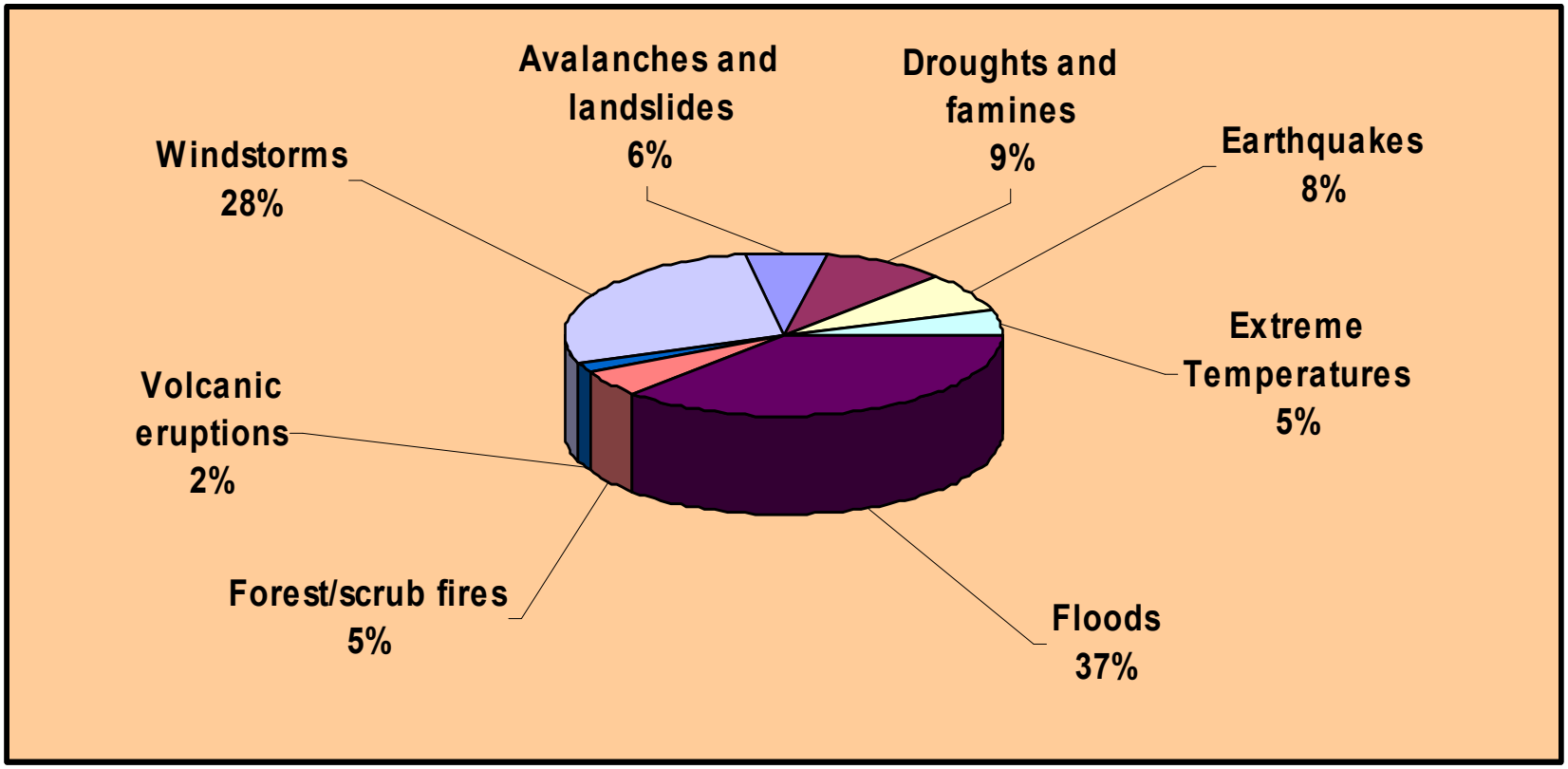
- nowcasting
- forecasting (numerical weather prediction)
- breathe (atmospheric chemistry)

  + try

- divine future (climate change);

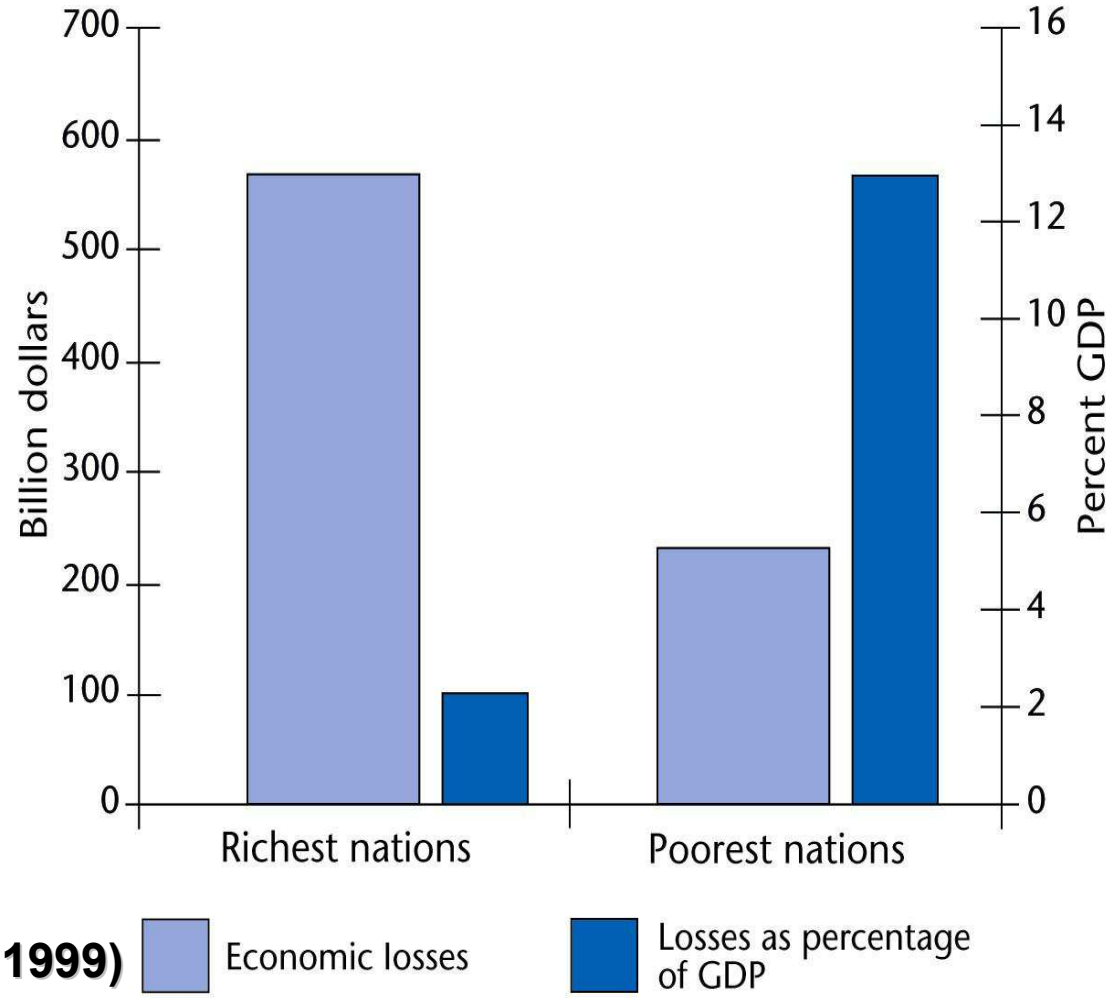


Global distribution of natural hazards (1993-2002)



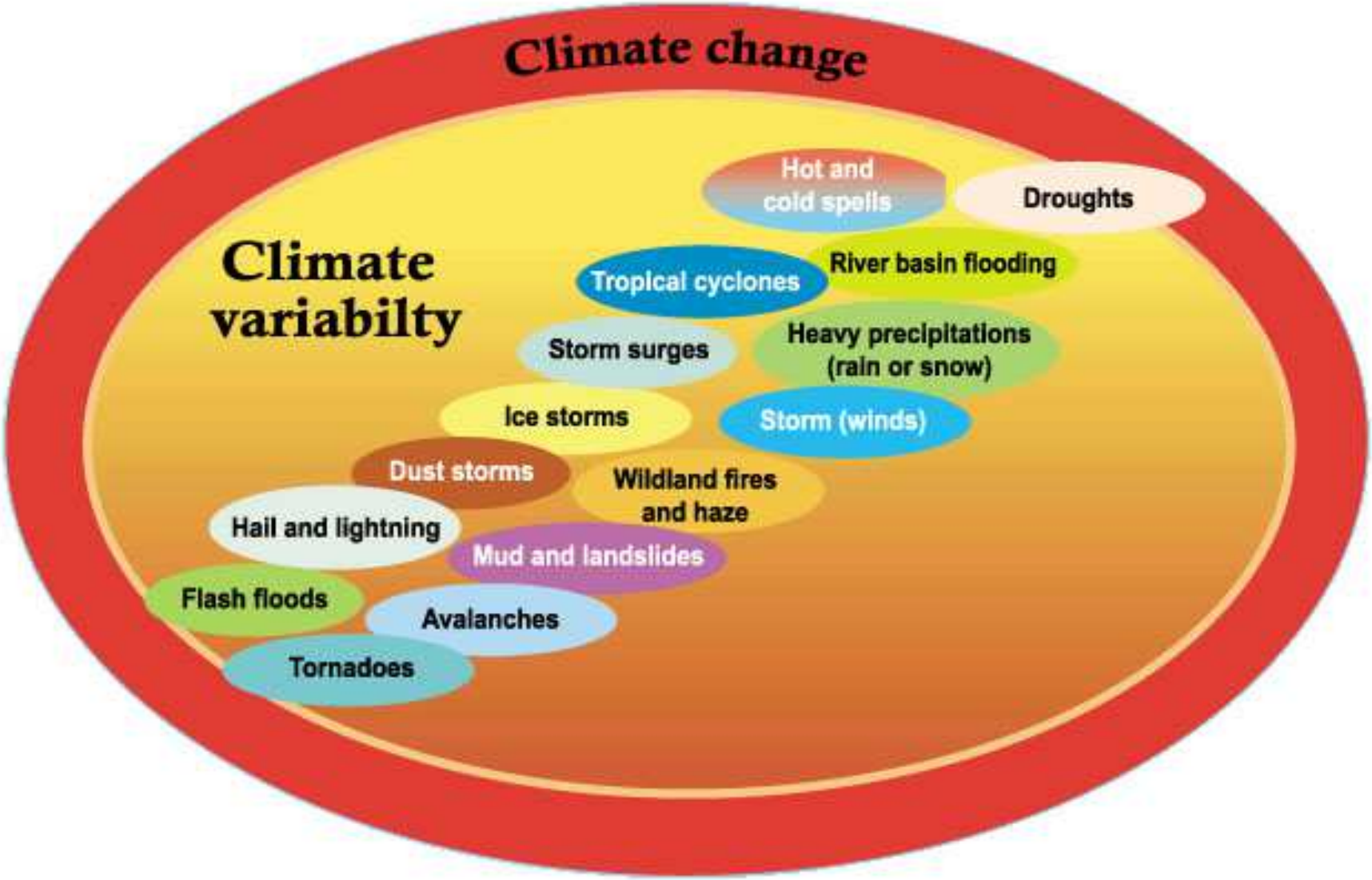
About 90% are of hydrometeorological origin

Disasters Losses, Total and as Share of GDP, in the Richest and Poorest Nations (1985-1999)



(Adapted from MunichRe, 1999)

Climate, Hazards & Disasters

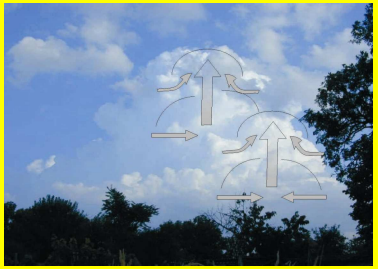


Tornadoes


hail

Types convection

1. Thermals, cumulus clouds

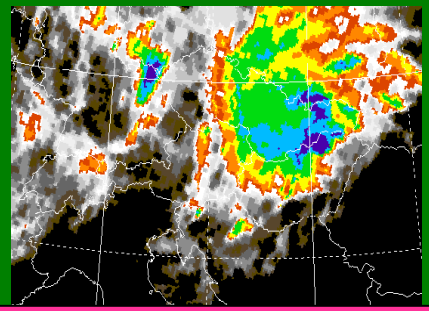


2. Local thunder-storms are rarely dangerous

3. Multi-cell thunderstorms (nodules) rainsorms, hail, gusty winds.

4. Supercell: hurricane forcs winds, destructive hail, rainstorms, tornadoes

5. MCC

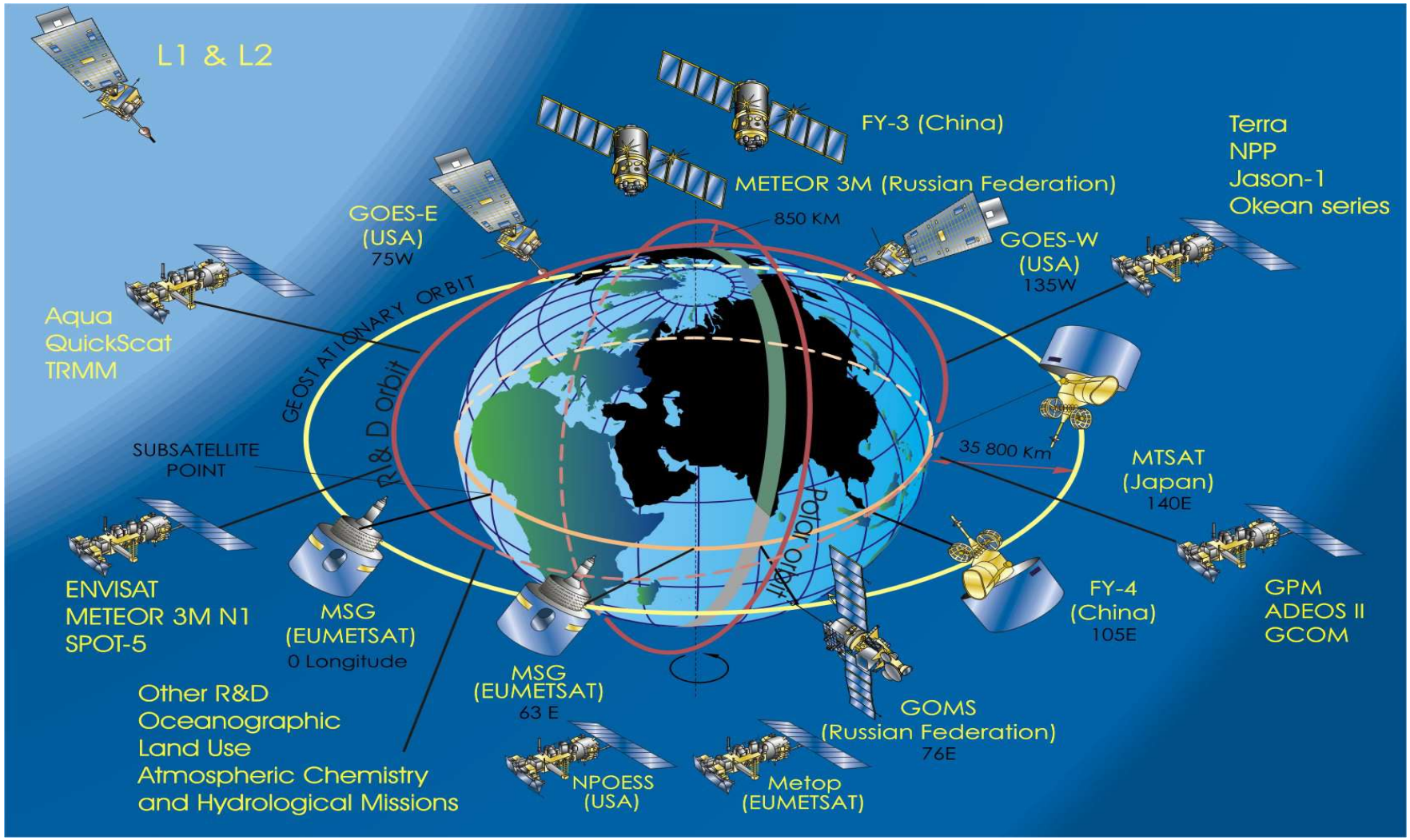


6. Orderly line of thunderstorms

squall lines, strong winds, hail, intense rainfall

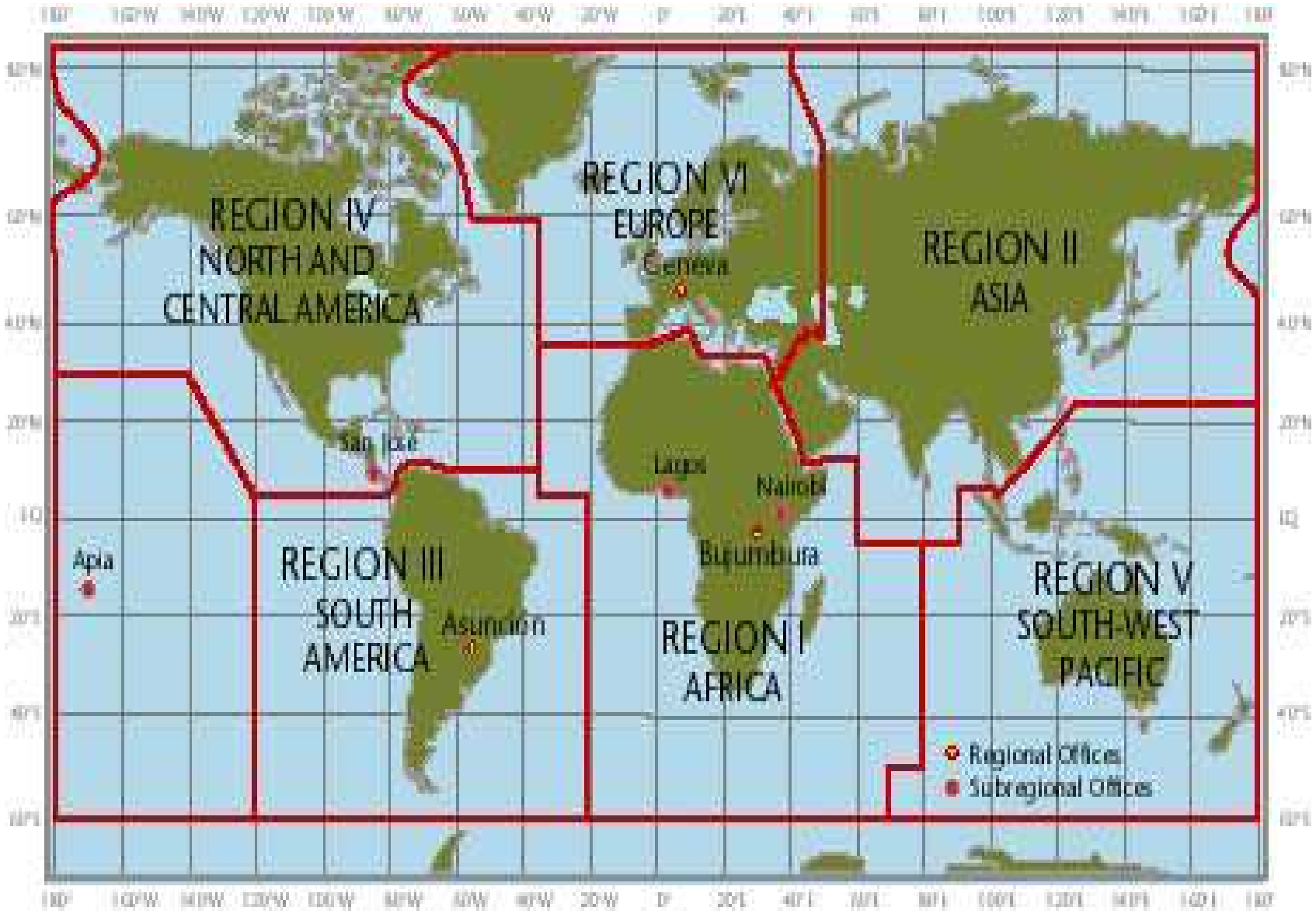
7. Hurricanes (3-500 km)

Observations



The WMO Space Programme: an unprecedented amount of freely-available observations

WMO's 6 Regional Associations



Hungarian Meteorological Service

- **Based:**
  in 1870
- **Regulation:**
  Governement rule
  (20 December 2005)

History of the Hungarian Meteorological Service

- ***1717:*** First regular instrumental observations beginning in Sopron;
- ***1780:*** Societas Meteorologica Palatina;
- ***1850:*** Austrian Institute for Meteorology in Vienna
- ***1867:*** Compromise, Austro-Hungarian Monarchy;

History of the Hungarian Meteorological Service

- ***ECMWF*** 1995
  (European Centre for Medium-Range Weather Forecasts)
- ***EUMETSAT*** 1998
  (European Organisation for the Exploitation of Meteorological Satellites)
- ***ISO 9001:2000*** 2002
  (International Organization for Standardization)
- ***EUMETNET*** 2005
  (European Meteorological Networking)
- Staff: 270 people (2006)

Measurement, observations

Terrestrial measurements

27 synop stations (hourly measurements)

68 climate stations

556 rain gauge stations

Radioactivity monitoring network

Remote sensing

Satellites

Radar

Lightning localization

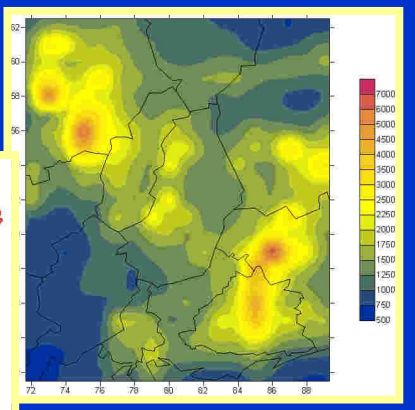
Radiosondes

Wind profiler

UV-B

Global radiation

Air pollution measurement and modeling



Network of automatic stations of the Hungarian Meteorological Service

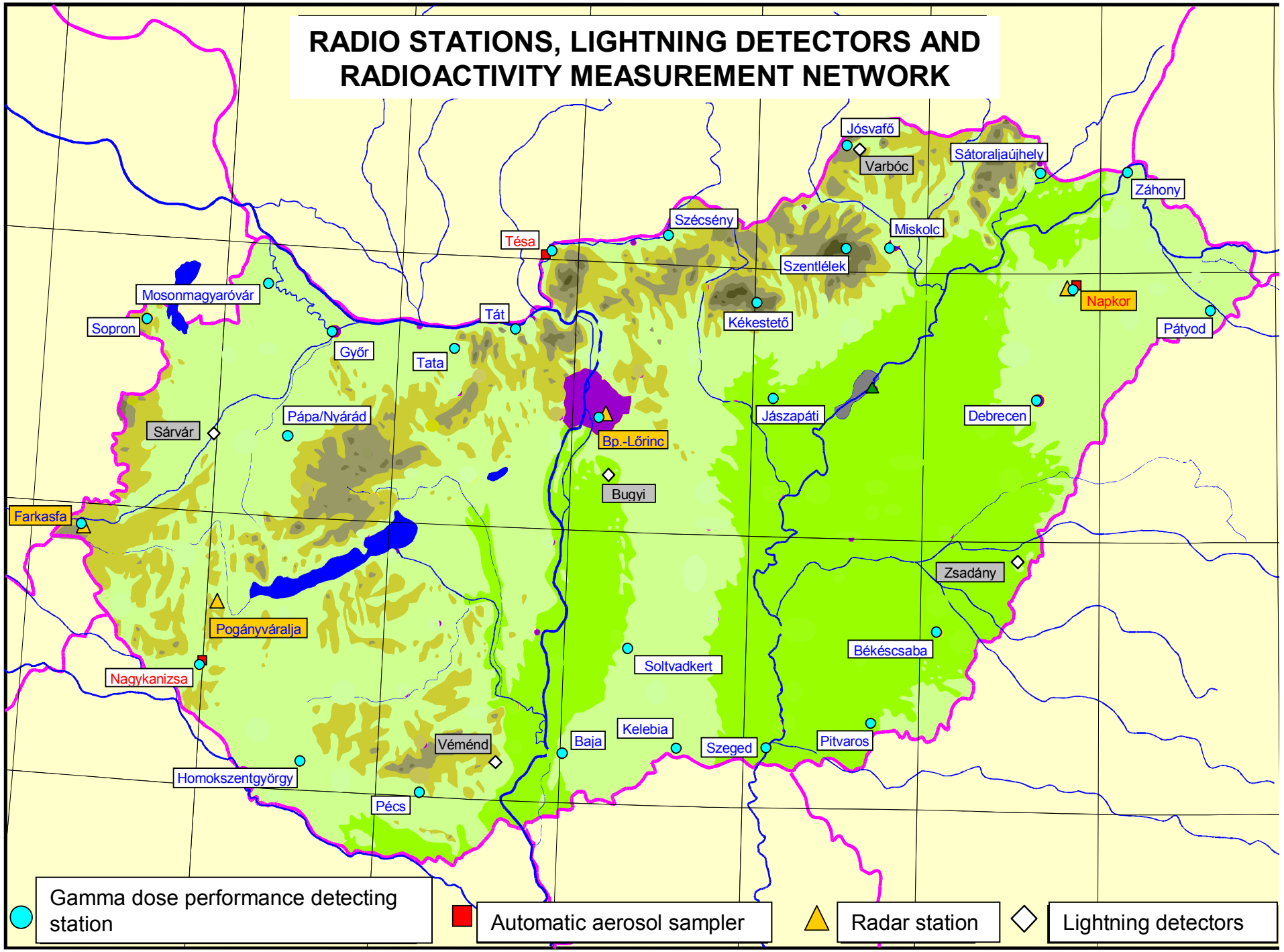
January 1, 2006

Conventional Climate Station

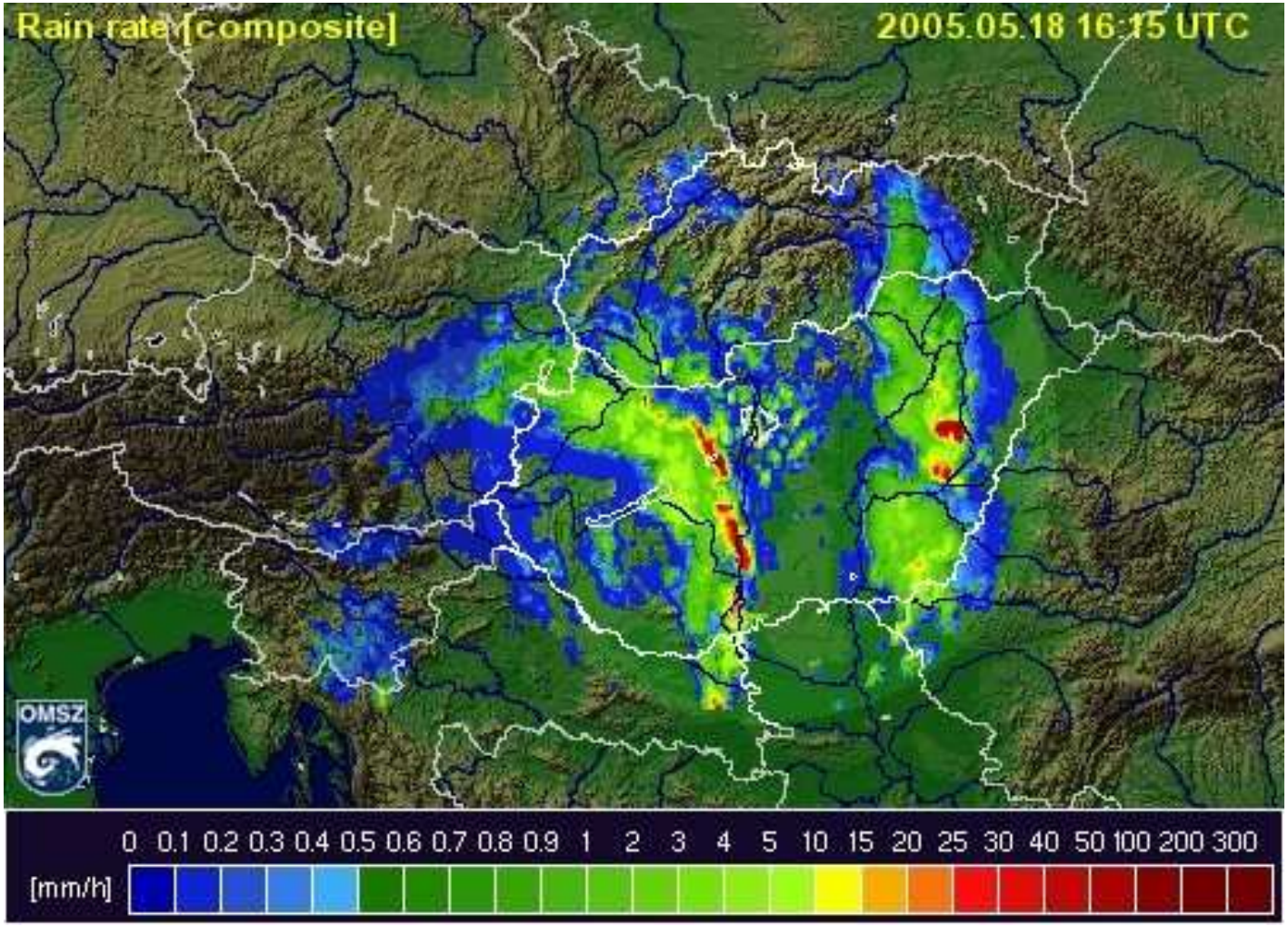
AWS for Climate Purposes

Observation

Stations and measurement program of the Hungarian Meteorological Society terrestrial monitoring system	
Before 1993	In 2005
23 synoptic master stations with hourly measurements and traditional tools;	14 synoptic master stations with 5 full-time fellows, + 15 synoptic master stations without fellows, report via telecommunication lines, 10-minute measurements with automatic tools;
36 climate stations – hourly measurements; 50 small climate stations, with voluntary social envoys;	59 automatic climate stations – 10-minute measurements hourly report via telecommunication lines, 9 climate stations, With voluntary social envoys, report twice mothly via letters;
634 rain gauge stations with voluntary social envoys and traditional receptacle, report monthly via postcards;	558 rain gauge stations with voluntary social envoys and traditional receptacle, report monthly via postcards;


RADIO STATIONS, LIGHTNING DETECTORS AND RADIOACTIVITY MEASUREMENT NETWORK
Jósvafő
Varbóc
Sátoraljaújhely
Záhony
Szécsény
Miskolc
Tésa
Szentlélek
Napkor
Mosonmagyaróvár
Sopron
Tát
Kékestető
Pátyod
Győr
Tata
Pápa/Nyárád
Jászapáti
Debrecen
Sárvár
Bp.-Lőrinc
Bugyi
Farkasfa
Zsadány
Pogányváralja
Békéscsaba
Soltvadkert
Nagykanizsa
Kelebia
Véménd
Baja
Szeged
Pitvaros
Homokszentgyörgy
Pécs
Gamma dose performance detecting station
Automatic aerosol sampler
Radar station
Lightning detectors

Composite Radar Image



Meteorological Model

Conservation relations

$$\frac{\partial \rho}{\partial t} = -(\nabla \cdot \rho \vec{V}) \qquad \textit{(mass)}$$

$$\frac{\partial \theta}{\partial t} = -\vec{V} \cdot \nabla \theta + S_\theta \qquad \textit{(potential temperature)}$$

$$\frac{\partial V}{\partial t} = -\vec{V} \cdot \nabla \vec{V} - \frac{1}{\rho} \nabla p - g\vec{k} - 2\vec{\Omega} \times \vec{V} \qquad \textit{(momentum)}$$

$$\frac{\partial q}{\partial t} = -\vec{V} \cdot \nabla q + S_q \qquad \textit{(water vapor)}$$

Surface energy balance

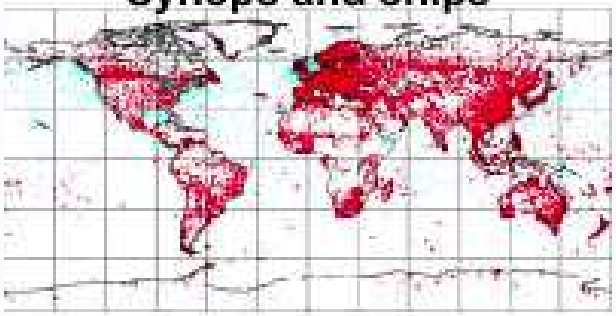
$$(1-a)K\downarrow + L^{*} = \rho C_p \overline{w'\theta'} + \rho L_v \overline{w'q'} + G$$

Data coverage

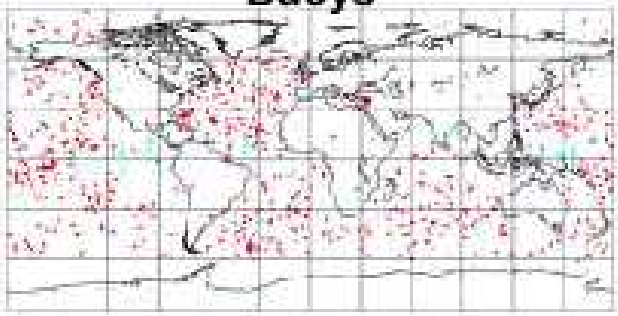
09 – 15 UTC5
September 2003 +

AQUA (Airs,AMSUA)
and 5 geo rads.

Synops and ships



Buoys

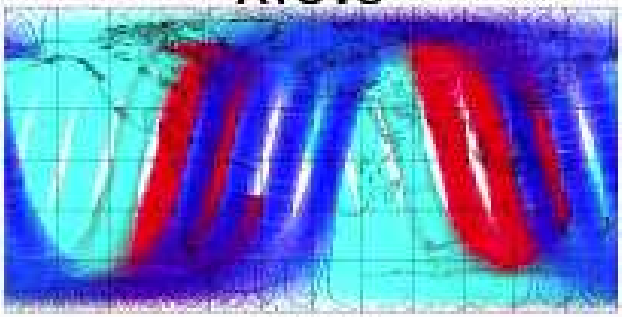


Radiosondes

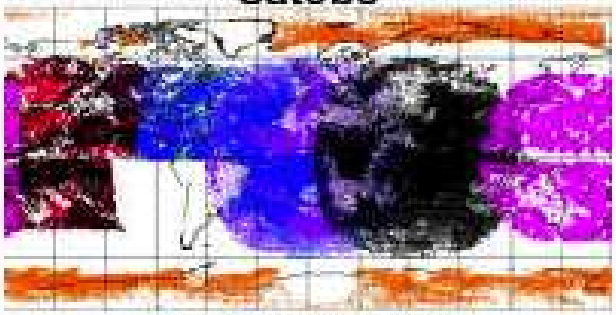
Pilots and profilers

Aircraft

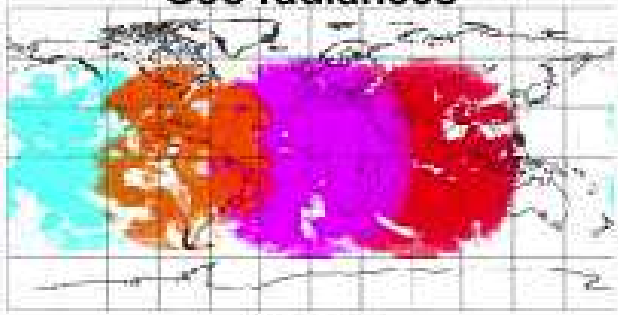
ATOVS



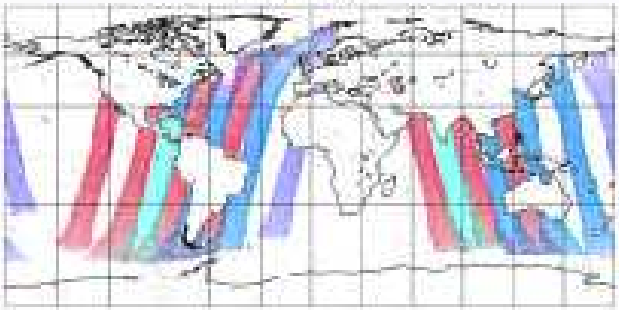
Satobs



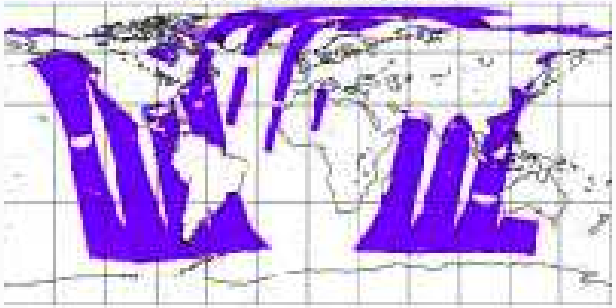
Geo radiances



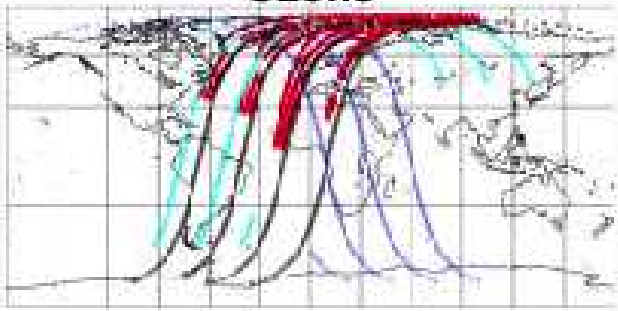
SSM/I



Scatterometer



Ozone

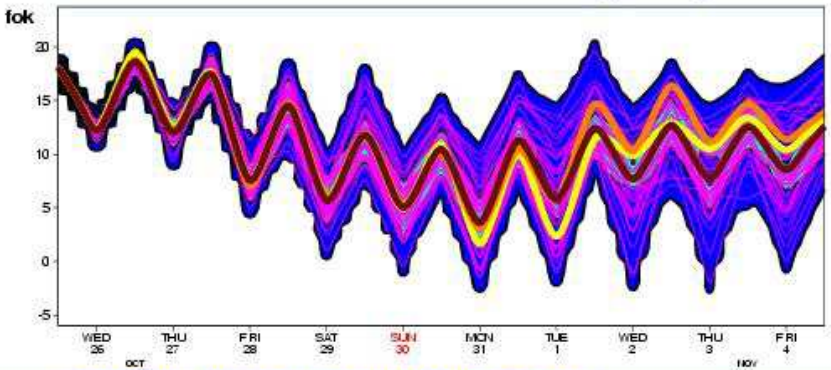


ECMWF ENSEMBLE ELOREJELZES
DATUM: 20051025_12_utc Budapest

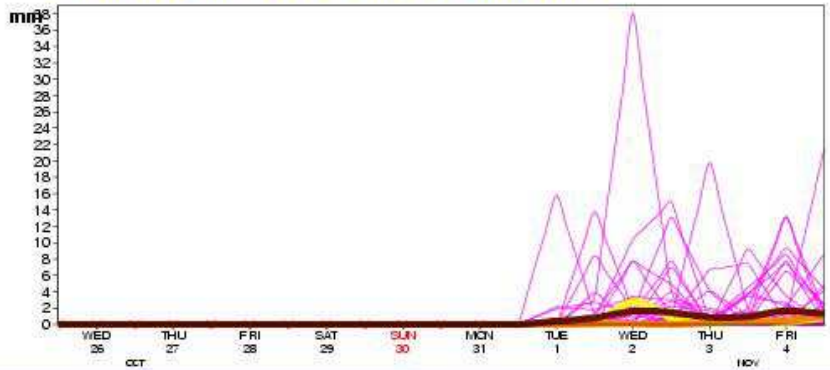
0.5 - 10 % | 10 - 30 % | 30 - 50 % | 90

Oper | CTRL | Mean | El

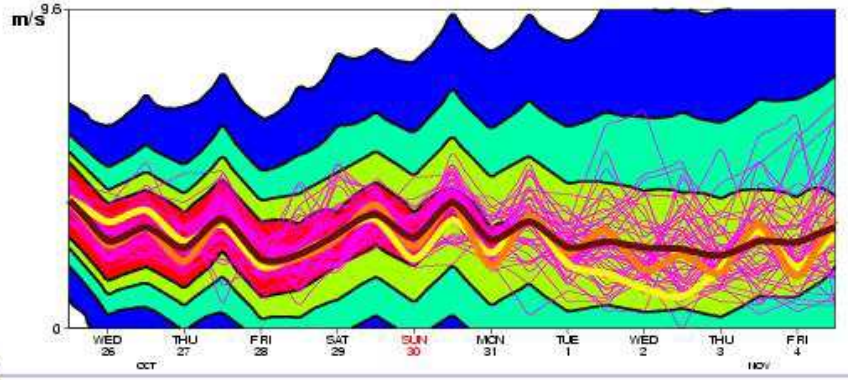
2m HOMERSEKLET - 1.0 Celsius fok intervallumba eso gyakorisag



CSAPADEK OSSZEG ensemble tagok - mm/12ora



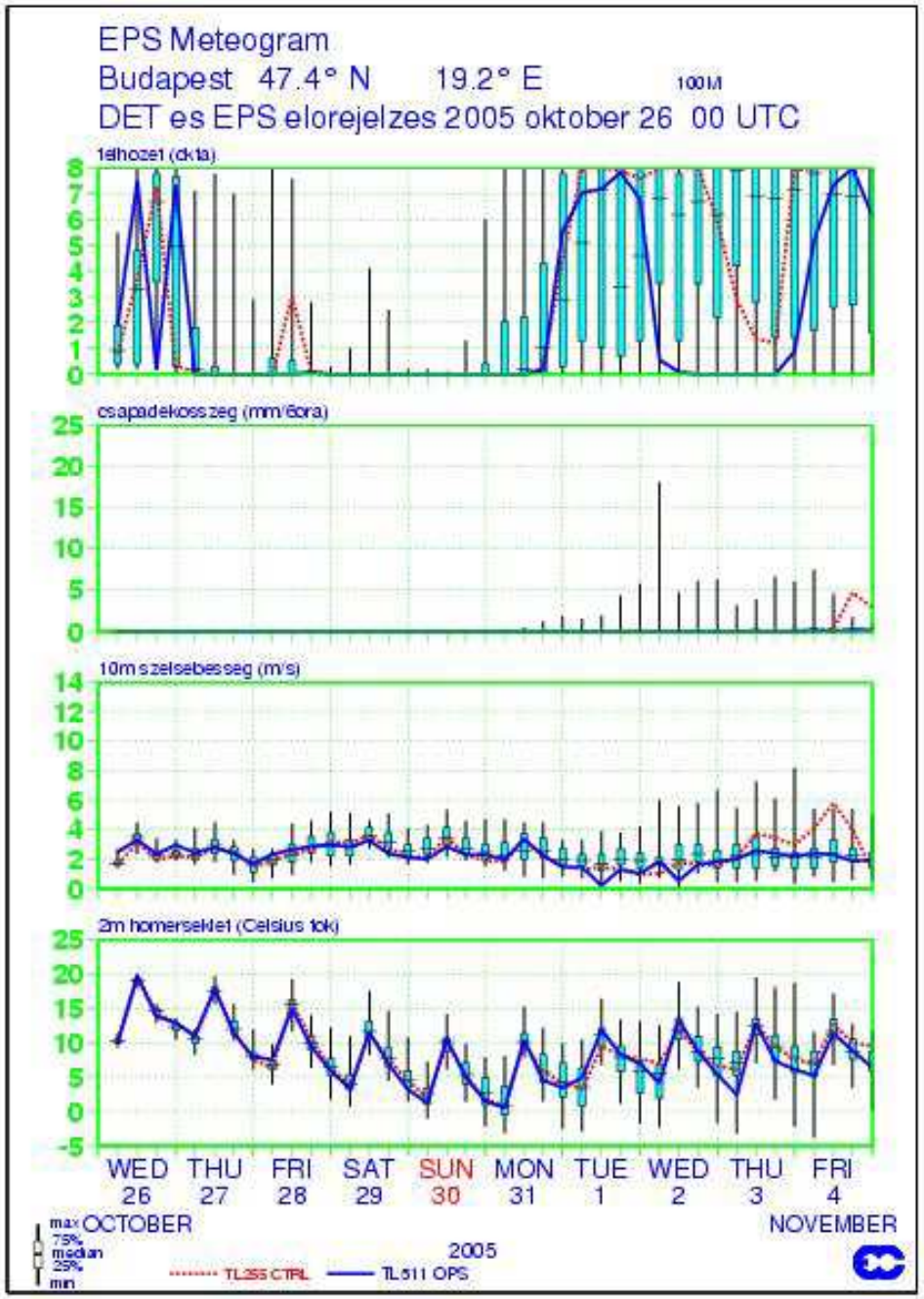
10m SZELSEBESSEG - 2.5 m/s intervallumba eso valoszinuseg

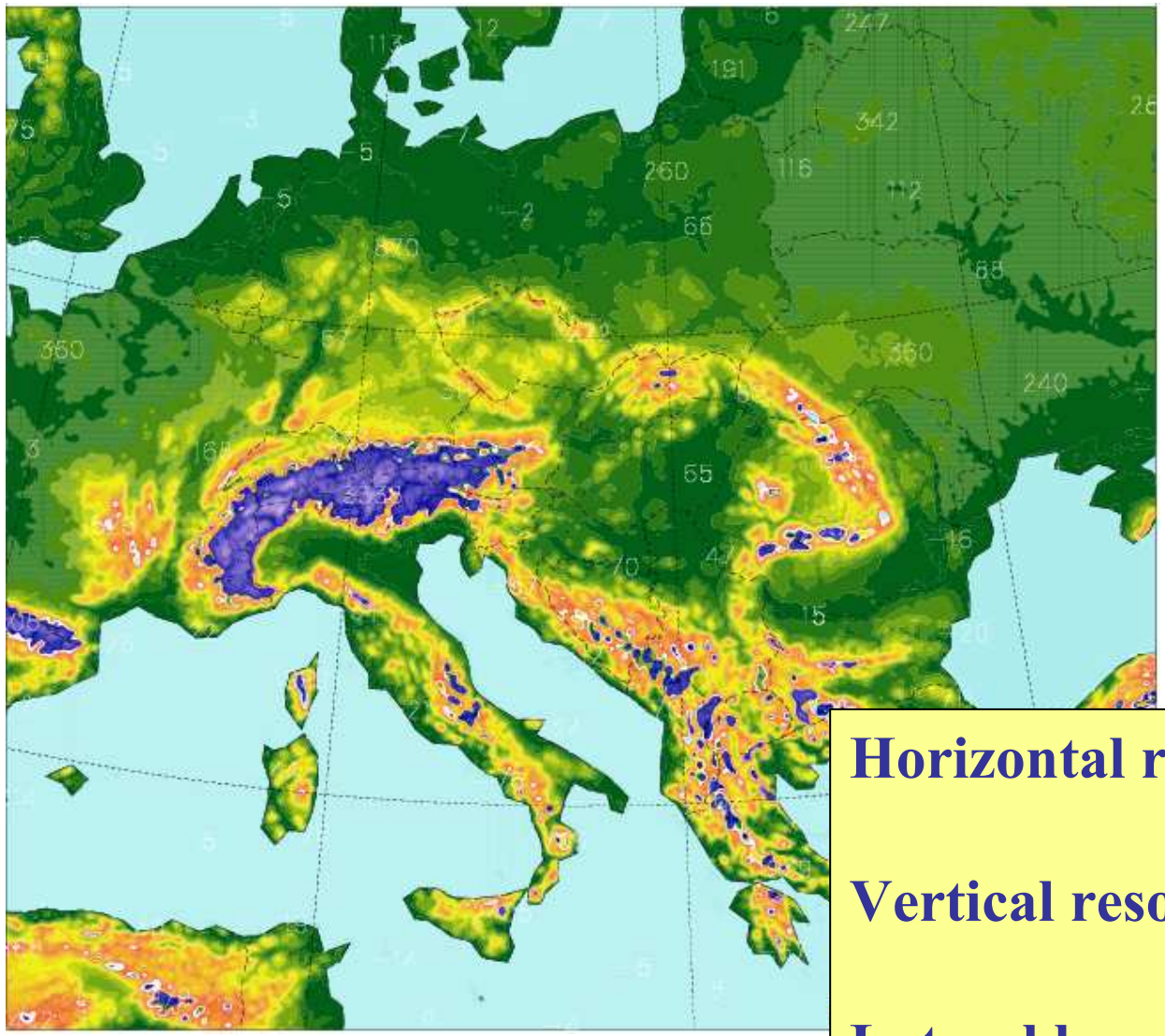


EPS Meteogram

Budapest 47.4° N 19.2° E 100M

DET es EPS elorejelzes 2005 oktober 26 00 UTC





Horizontal resolution: 8 km

Vertical resolution: 49 levels

Lateral boundary conditions from ARPEGE/IFS at every 3 hours

3d-var data assimilation scheme

Here is discussed the weather

Lots of info on the screen, but …

A szinoptikus monitorján
a HAWK 2 megjelenítő
rendszer látható

The HAWK-2 visualization
system on the monitor of
the forecaster

. . .paper maps are also needed for the analysis

Current activities of the Hungarian Meteorological Service in disaster management

1. Tasks related to nuclear emergency;
   - measurement;
   - forecast;
2. The Balaton lake and Velence lake storm forecasts;
3. Forecast of hazardous weather situations – alarms;

Forecast of hazardous weather situations

- Heavy precipitations covering a large area;
- Heat waves, freeze waves;
- Locally falling heavy precipitations;
- Wind storms;
- Etc.

Meteorological risks

- Activities of the Hungarian Meteorological Service against risks – operation and limitations of the danger signal system, lake storm warning;

- Hazardous weather events, risks (frost, fog hail, draught, windstorms, rainstorms, extreme winter weather, heat, tornadoes) and the ability to defend against them;

Dangers, risks

1. Natural origin

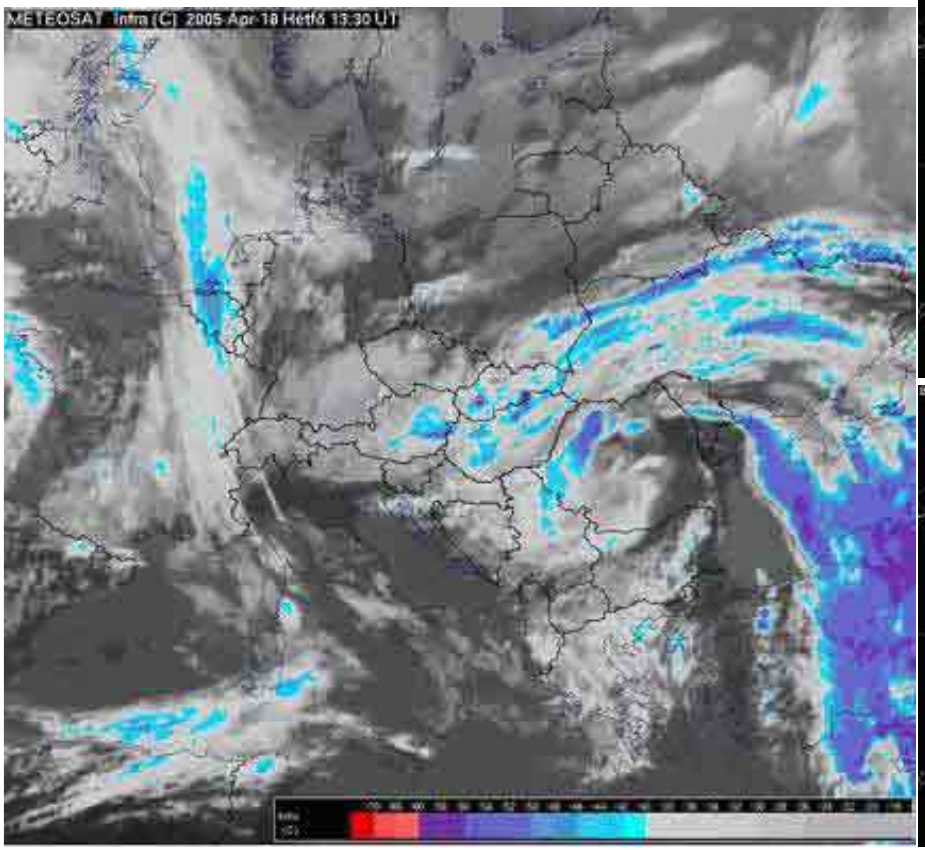
hydrological	geological	meteorological	
flood	earthquake	windstorm	winter hazards
inland water	landslide	drought	extreme cold
flash flood		heat	downpour
		tornadoes	lightning

2. Civilization origin

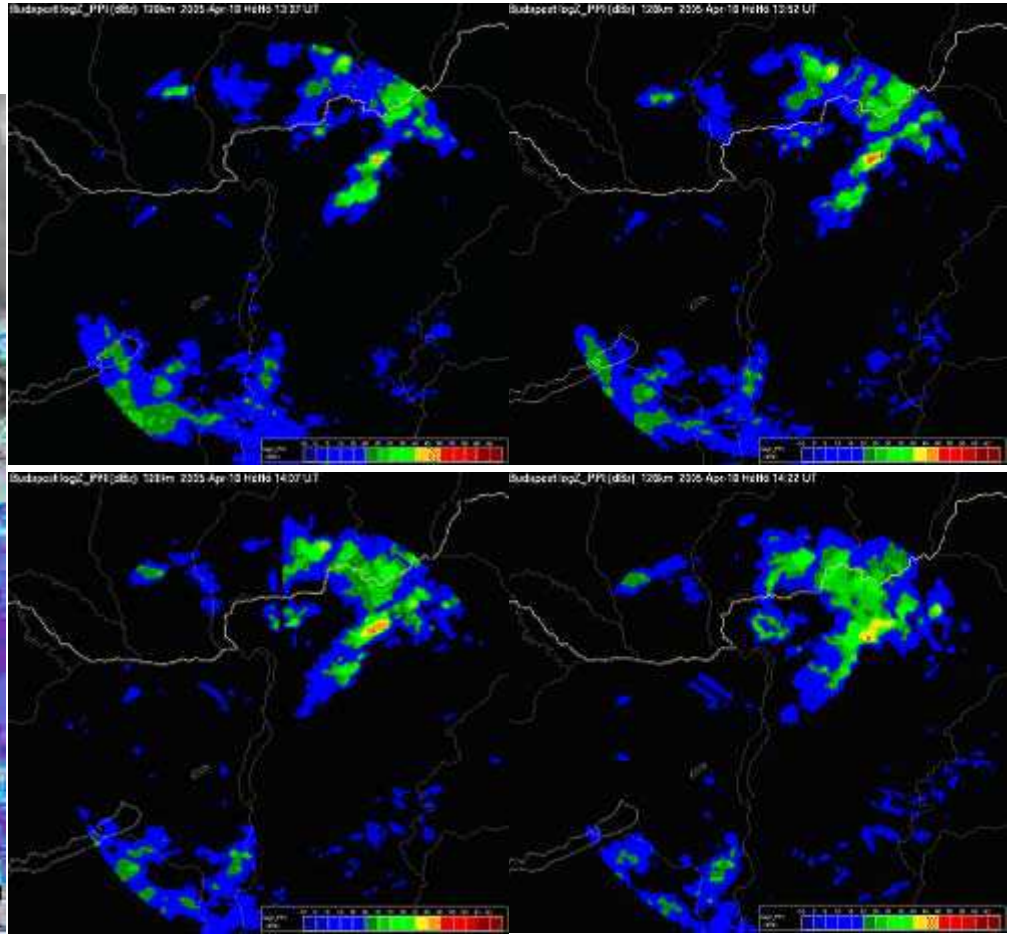
Nuclear accidents, chemical accidents, production / supply of hazardous materials, traffic accidents, epidemics, **migration,** terrorism, fires (forest fires, building fires), mass events biological hazards (invasion of arthropods, mosquitoes and bees);

(Subdivision of the Directorate General for Disaster Management,
Ministry of Internal Affairs)

Mátrakeresztes
18 April, 2005

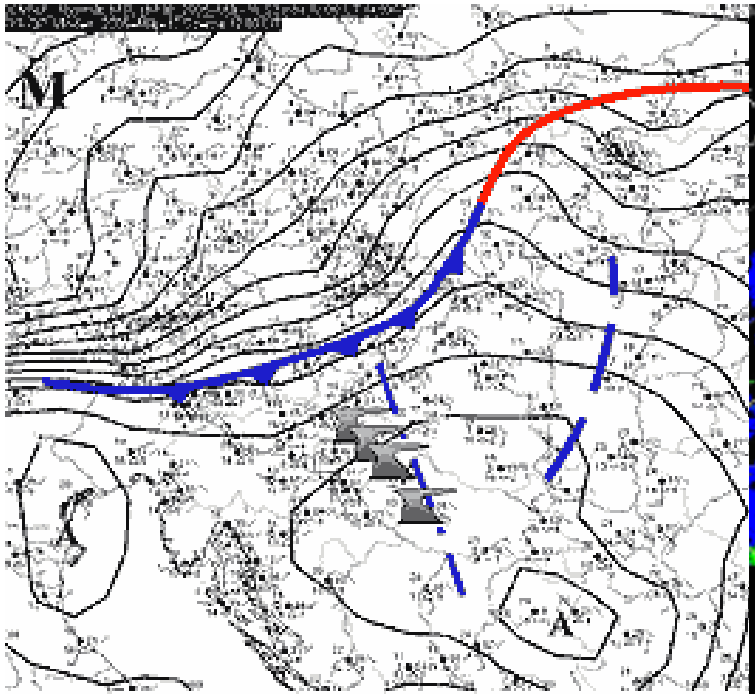


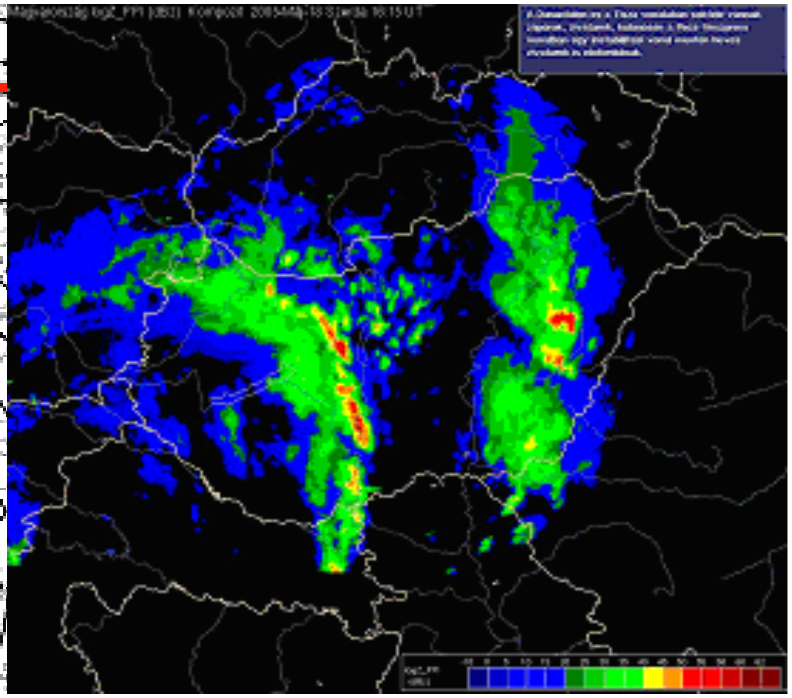
13:30 UTC (Source: HMS)



13:37, 13:52, 14:07, 14:22 UTC (Source: HMS)

Hosszúpályi
18 May 2005

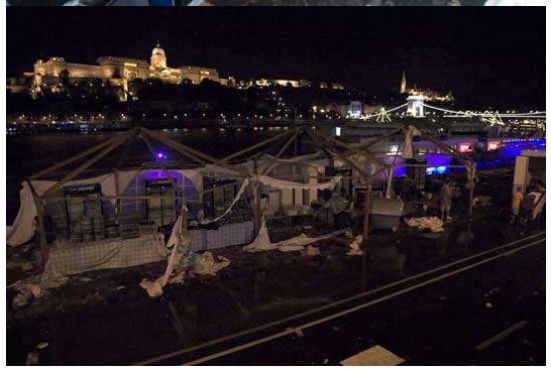


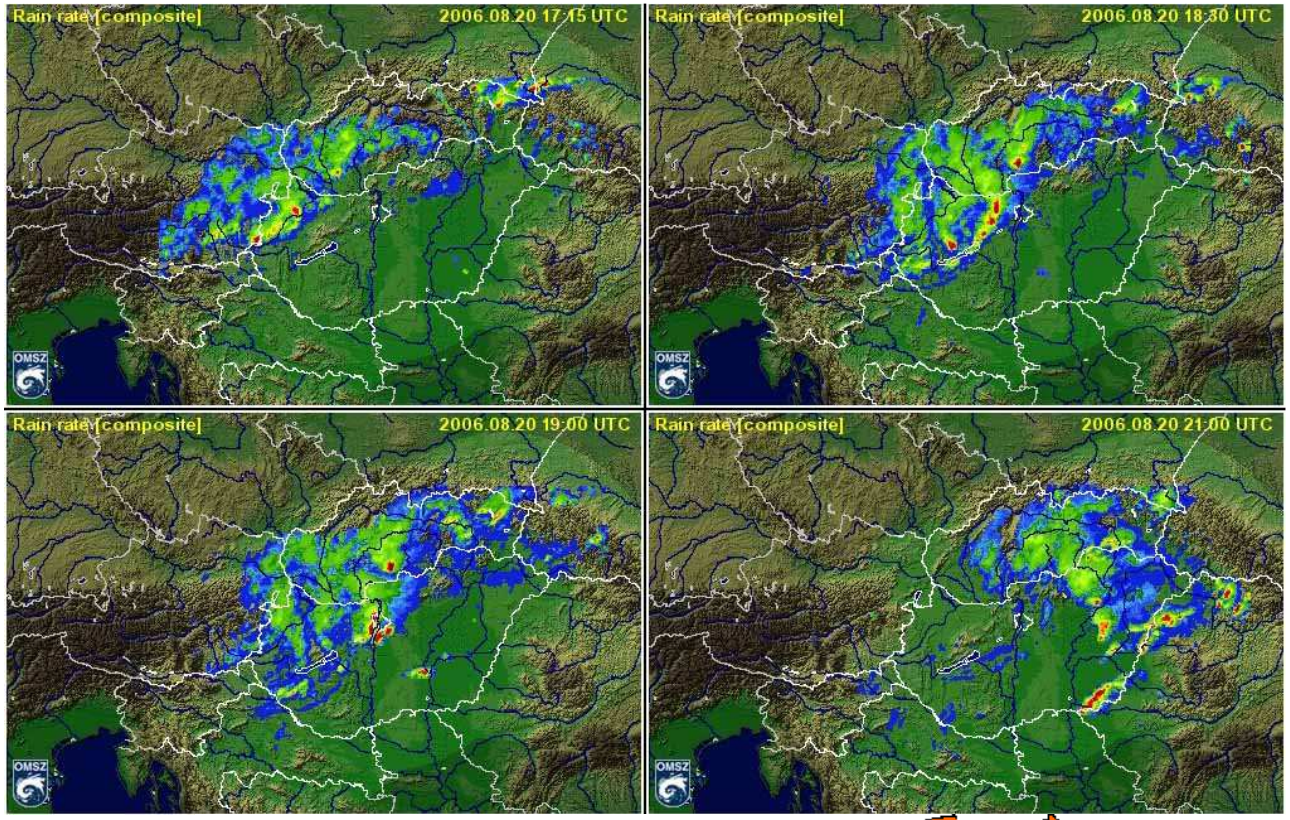


16:15 UTC (Source: HMS)

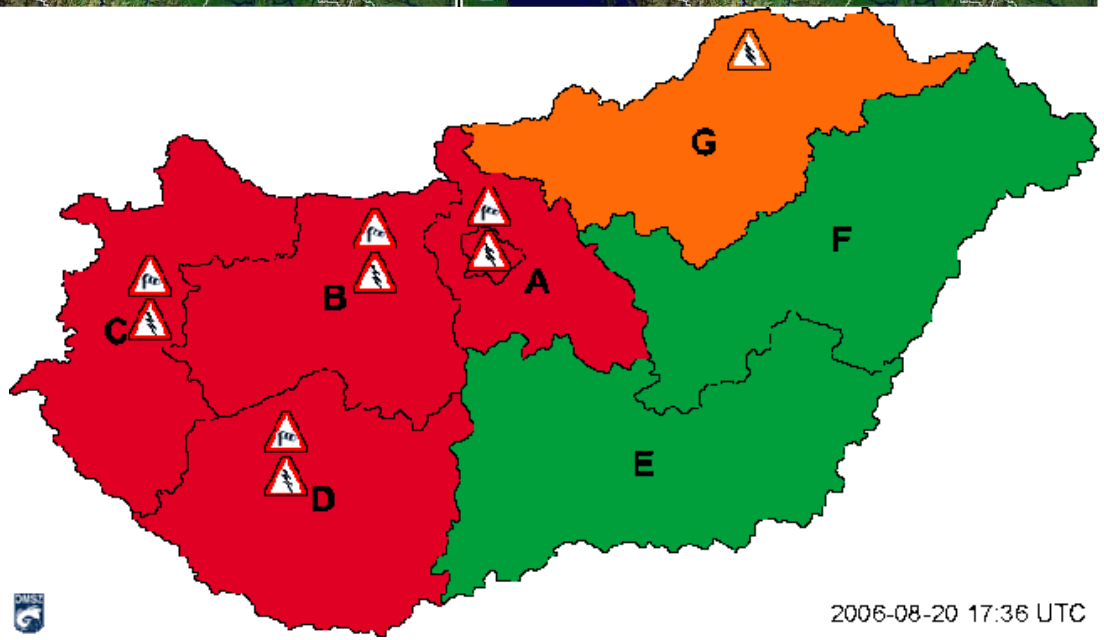
(Photos: Kálmán Csirmaz)

Budapest
20 August 2006





(Photo: Zoltán Balogh)



(Source: HMS)

Somogyszob
16 June 2009

Budapest
1 March 2008

Gátér
20 May 2008

Balaton
13 March 2006

Budapest
29 June 2006

Main core activities of the Hungarian Meteorological Service

• Terrestrial, aerological, atmospheric remote sensing, meteorological and background air pollution measuring, observing, telecommunication and data processing system;
• Data collection, -control, -processing, -systematization,- storage, archiving, international data exchange;
• Calculations, analyses, forecasts and their transfer to the general public and qualified entities (life-, health- and property protection, disaster management, agriculture and water management, in order to prevent water damage);
• Short- (<48 h), medium- (2-10 days) and long-range weather forecasts, hydrometeorological forecasts, synoptic-climatological researches, climate modeling, analysis of the ambient air, etc.
• Key partners: media (TV, teletext, radio, internet, newspapers, dispatcher), transport, energy providers, industry, bulding industry, companies for maintaining public areas, agriculture, event organizers;

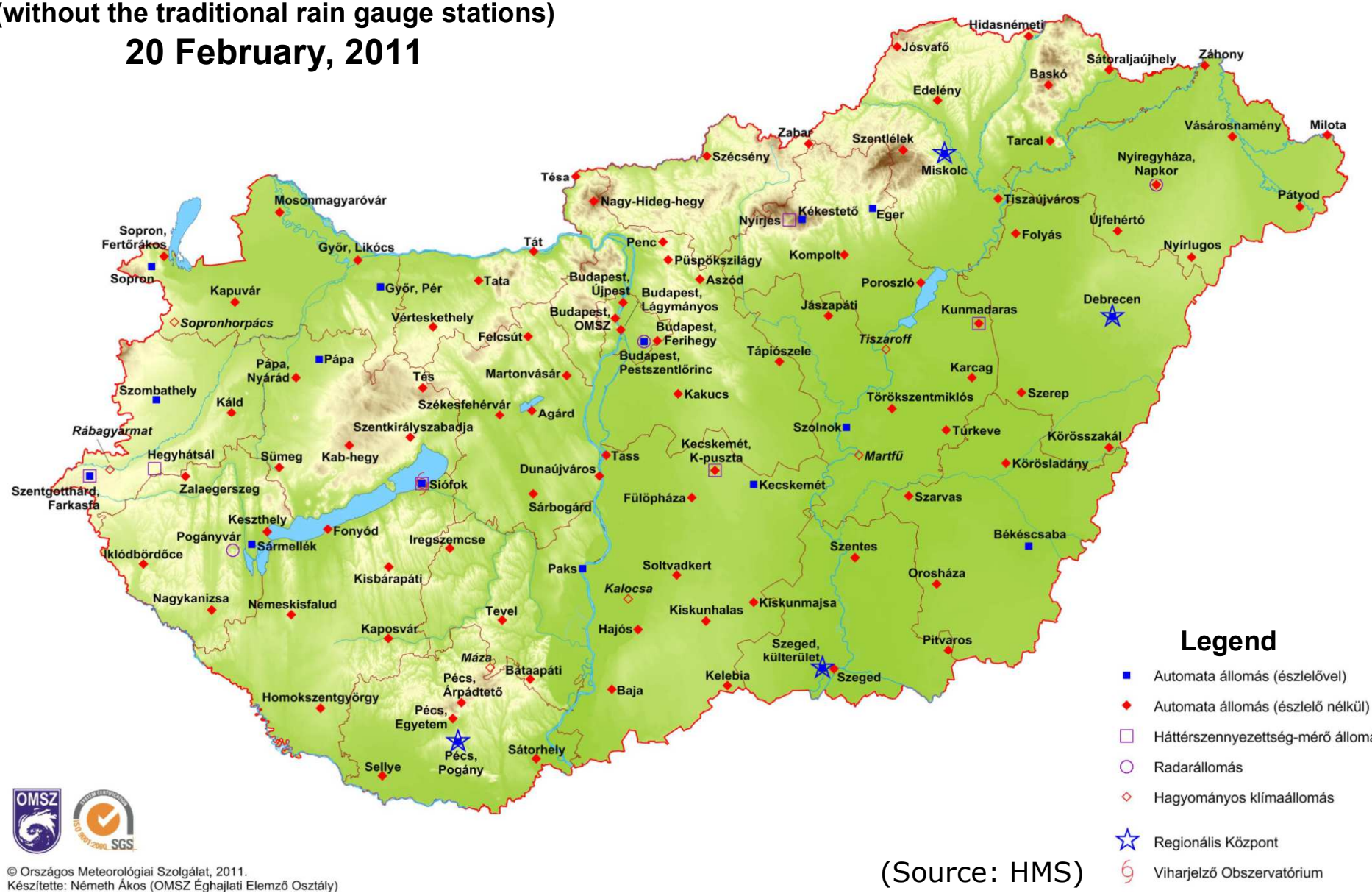
(Source: HMS)

*(*Core activities provided: instructions for Minister of the Rural Development *12/2011. (VII. 8.) to issue Organizational and Operational Rules of the Hungarian Meteorological Service)*

Surface station network of HMS

(without the traditional rain gauge stations)

20 February, 2011



(Source: HMS)

Cca. 110 automatic stations, of which cca. 30 with extended measuring programme (synoptic stations), fellows in 14 stations in 24 hours/day, cca. 550 rain gauge stations, 3 radar stations, 3 and 2 lightning detectors in Hungary and Slovakia, respectively; 6 stations for measuring background air pollution

Hazard warning system of the Hungarian Meteorlogical Service

- Owing to the risks induced by the atmospheric processes, the role of forecast and warnings increases;
- HMS: in recent years significant improvements occurred in the development of the methodology of the ultra-short-term (nowcasting) forecasts;
- Danger alert refers to a period and not a date;
- It warns not to the possible consequences but to the loss of events;

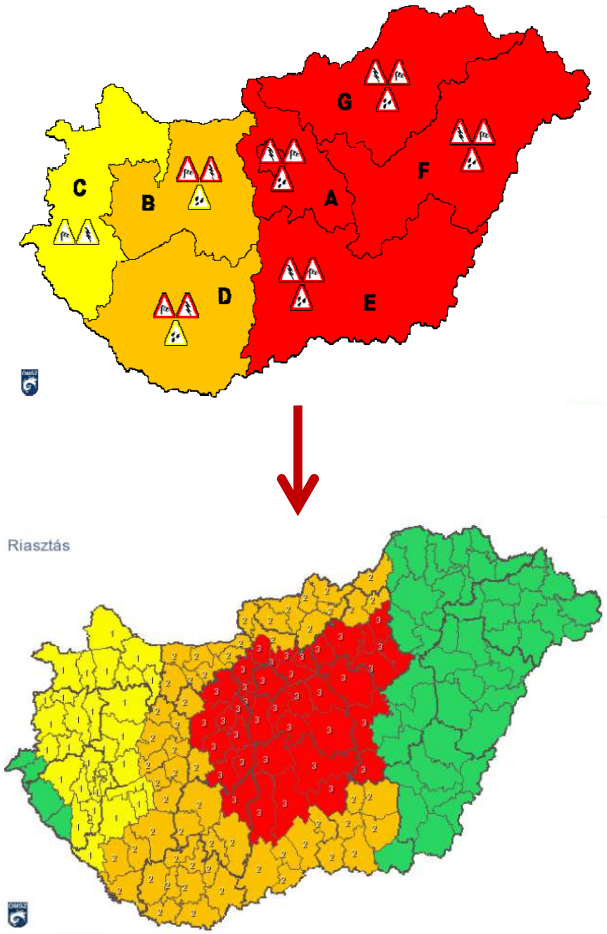
Objectives:

- General life- and property protection;
- Providing authorative information to the public and the media;
- Weather hazards warning system has been running in Hungary since 1 February, 2006;

Building and operation of the subregional weather alert and alarm system of Hungary

In he frame of the project KEOP - 6.3.0/2F/09 - 2009 - 0004

- Objectively based weather hazard alert for all **subregions** (174) of Hungary 1–3 hours ahead (formerly: for all the 7 administrative regions, regional alarms). **Alarms** should be updated every 15 minutes.
- **Warning** to all country administrations 6–12 hours ahead, which includes the possibility of occurrence of emergencies. Warnings should be updated four times a day.
- Operation of a new supercomputer;
- Beginning of the implementation of the project: November 2009, while its close: July 2011;
- Beginning of the alarm system for the subregions: August 2011;



(Source: HMS)

Limitations of the hazard signal

- Different weather conditions can be predicted by not the same accuracy and time advantages;

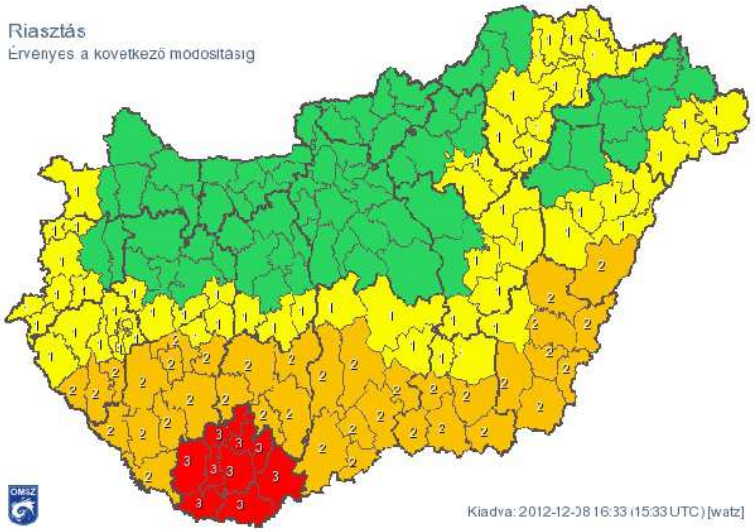
- Warning, alert: weather conditions are favourable for the development of hazardous weather events for the (nearly) warned and (nearly) alerted areas ⇨ this does not mean a guarantee, only the possibility of occurrence!

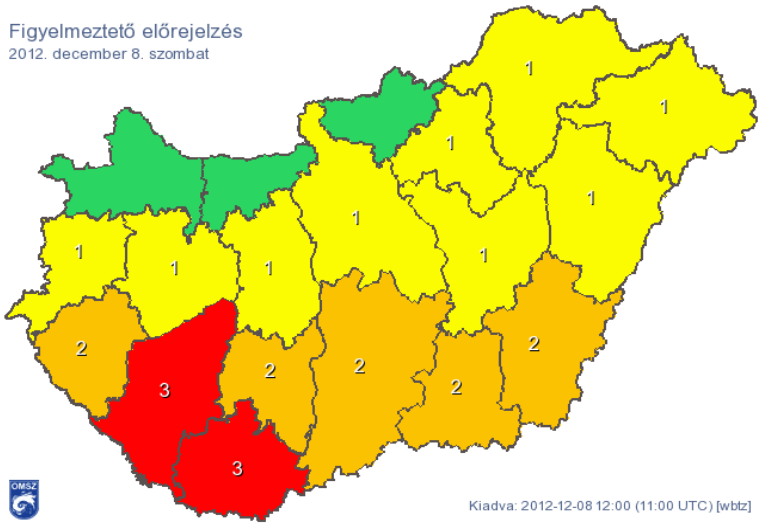
  ⇨ it is not possible in every case issuing the appropriate level of alert signals with appropriate time advantages;

- It is not a goal alerting events that occur on small space and time scales (they cannot be properly detected);

Hazard levels of warnings and alerts (HMS)

- **1. Yellow:** not unusual but azardous events with a potential risk;
- **2. Orange:** an event carrying a risk, potential damage, personal injury, accident;
- **3. Red:** dangerous, causing serious damage, or loss of life, rare incidents that threaten extensive areas;





(Source: HMS)

The operation of the hazard warning system of the HMS 1.

1. Warning forecast and alert

– heavy thunderstorm
– downpour
– gust
– sleet
– snowdrift

– **warning forecast** for the given day and the next day (within this, the particular hazard can occur at any time) (map + text);

– **alerts** occur, if necessary, by 0,5–3 hours prior to the incident (map);

Heavy thunderstorm		1 Violent thunderstorm may develop less likely (with damaging winds or heavy hail).
		2 A violent thunderstorm may occur with medium risk (with damaging winds or heavy hail).
		3 Violent thunderstorm is expected in a high risk of occurrence (with damaging winds or heavy hail).
Downpour		1 Intense shower, thunderstorm. Rainfall may exceed 25-30 mm within a short time.
		2 Intense shower, thunderstorm. Rainfall may exceed 50 mm within a short time.
Gust		1 The strongest gusts expected may exceed 70 km/h.
		2 The strongest gusts expected may exceed 90 km/h.
		3 The strongest gusts expected may exceed 110 km/h.
Sleet		1 Poor sleet. The expecetd rainfall is usually a few tenth (> 0.1) mm.
		2 Long-term (several-hour) sleet. The expected rainfall may exceed 1 mm.
		3 Long-term (several-hour) sleet. The expected rainfall may exceed 5 mm.
Snowdrift		1 Poor snowdrift. Wind may raise snowdrifts in fresh snow covered areas.
		2 Strong snowdrift. Stormy wind may raise high snowdrifts in fresh snow covered areas.
		3 Strong snowdrift. High snowdrofts are expected in fresh snow covered areas, due to strong wind.

The operation of the hazard warning system of the HMS 2.

2. Warnings for large amount of rain, snow

– the possibility of occurrence;
– anticipated at least to an average county area in Hungary;
– alarm is not connected to it;

Rain	1	More than 20 mm precipitation may fall during 24 hours.
	2	More than 30 mm precipitation may fall during 24 hours.
	3	More than 50 mm precipitation may fall during 24 hours.
Snow	1	More than 10 cm fresh snow may fall during 24 hours.
	2	More than 20 cm fresh snow may fall during 24 hours.
	3	More than 30 cm fresh snow may fall during 24 hours.

The operation of the hazard warning system of the HMS 3.

3. Special warnings

- heat
- extreme cold
- permanent heavy fog
- ground-frost

– **the possibility of the occurrence;**
– anticipated at least to an average county area in Hungary;
– **alarm is not** connected to it;

Extreme cold	1	**Temperature may reduce below -15°C.**
	2	**Temperature may reduce below -20°C.**
	3	**Temperature may reduce below -25°C.**
Heat (25°C mean temperature)	1	**Daily mean temperature may increase above 25°C.**
	2	**Daily mean temperature may permanently occur above 25°C.**
Heat (27°C mean temperature)	2	**Daily mean temperature may increase above 27°C.**
	3	**Daily mean temperature may permanently occur above 27°C.**
Permanent heavy fog	1	**Permanent (> 6 hours) heavy fog (visibility is a few hundred m) is expected.**
Ground-frost (April 1 - October 31)	1	**The temperature could drop below 0°C near the surface.**

Hazardous weather events 1.

1. Heavy thunderstorm:

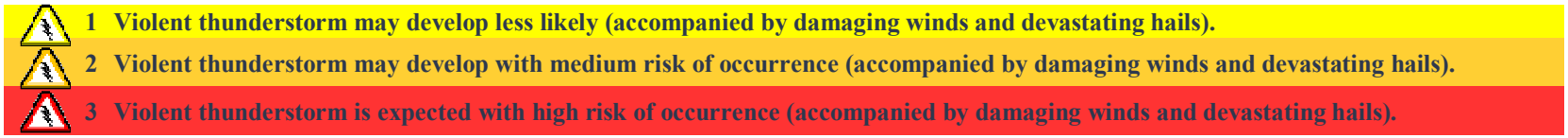
– The strongest gust > 90 km/h and/or ice diameter > 2 cm (in this case, the risk of occurrence of damages is high, human life is in danger);

– **Yellow** warning: short-lived, isolated (violent) storm is expected (low risk of occurrence in the vicinity of ~30 km radius of the given point);

– **Orange** warning: usually "well-organized", violent thunderstorms of longer life and greater coverage are expected (medium risk);

– **Red** warning: "well organized", long-lived thunderstorm systems (e.g. squall lines) over a large area > 90 km / h gusts (high risk);

Violent storm



Hazardous weather events 1.

An example for the application of of risk occurrence (Source: HMS)

The measure of risk is of three-stage. In the warning text forecasts **the indicators for the expected coverage area (”somewhere”, ”sporadically”, ”over several areas”,** etc.) dnote the appearance of risk of a violent thundestorm, as well.

Warning forecast for the territory of Hungary:

*Monday afternoon and night in the Great Plains **sporadically** violent thunderstorms may occur. (Occurrence of risk: **medium.**)*

*In West-Hungary, from Monday afternoon hours more and more thunderstorms may develop. From the afternoon hours the weather conditions are favourable for the formation of violent thunderstorms in the Great Plains. The **sporadic** violent thunderstorms may be accompanied by violent hails and **sometimes** gusts exceeding 90-100 km/h may also be associated to it.*

*On Tuesday daytime violent thunderstorms may occur **somewhere** at the northeastern part. (Occurrence of risk: **low.**)*

*On Tuesday, especially in the morning, thunderstorms may **still** occur in the Tiszántúl area, some of which may develop an intense thunderstorm in the northern part of the Tiszántúl area. In the surroundings of the intense thunderstorms the strongest gusts may exceed 90 km/h. Heavy afternoon thunderstorm activity is unlikely.*

Hazardous weather events 2.

2. Downpour:

– Locally, during a short period (typ. 30–60 minutes) precipitation exceeding 25–30 mm falls.

– **Yellow:** over a small area > 25–30 mm
(maybe at 1-2 spots with low probability > 50 mm)

– **Orange:** locally > 50 mm

Downpour

1 From an intense shower or thunderstorm 25-30 mm precipitation may fall within a short period.

2 From an intense shower or thunderstorm 50 mm precipitation may fall within a short period.

Hazardous weather events 3.

3. Gust

– It occurs over large areas, non-local, not connected with intense showers / thunderstorms;

– In regions, extremely important with life and property protection point of view (e.g. Balaton, Lake Velence, Lake Tisza storm warning), specific wind forecasting and warning system operates in cooperation with partner organizations;

Gust		1 The expected strongest gusts exceed 70 km/h.
		2 The expected strongest gusts exceed 90 km/h.
		3 The expected strongest gusts exceed 110 km/h.

Hazardous weather events 4.

- **4. Sleet**

Sleet		1 Poor sleet. The expected rainfall is usually a few tenth (> 0.1) mm.
		2 Long-term (several-hour) sleet. The expected rainfall may exceed 1 mm.
		3 Long-term (several-hour) sleet. The expected rainfall may exceed 5 mm.

- **5. Snowdrift**

Snowdrift		1 Poor snowdrifts. Wind may raise small drifts over fresh snow covered areas.
		2 High snowdrifts. Stormy wind may raise high drifts over fresh snow covered areas.
		3 High snowdrifts. High drifts are expected because of stormy winds over fresh snow covered areas.

- **6. Rainfall**
- **7. Snow**

Rain		1 More than 20 mm precipitation may fall during 24 hours.
		2 More than 30 mm precipitation may fall during 24 hours.
		3 More than 50 mm precipitation may fall during 24 hours.
Snow		1 More than 10 cm fressh snow may fall during 24 hours.
		2 More than 20 cm fressh snow may fall during 24 hours.
		3 More than 30 cm fressh snow may fall during 24 hours.

Hazardous weather events 5.

- **8. Extreme cold**

Extreme cold	1	The temperature may decrease below -15°C.
	2	The temperature may decrease below -20°C.
	3	The temperature may decrease below -25°C.

- **9. Heat**

Heat (25°C mean temperature)	1	The daily mean tenperature may increase above 25°C. [between 25-27°C for 1 or 2 days]
	2	The daily mean tenperature may increase permanently above 25°C. [between 25-27°C at least 3 consecutive days]
Heat (27°C mean temperature)	2	The daily mean tenperature may increase above 27°C. [1 or 2 days]
	3	The daily mean tenperature may increase permanently above 27°C. [at least 3 consecutive days]

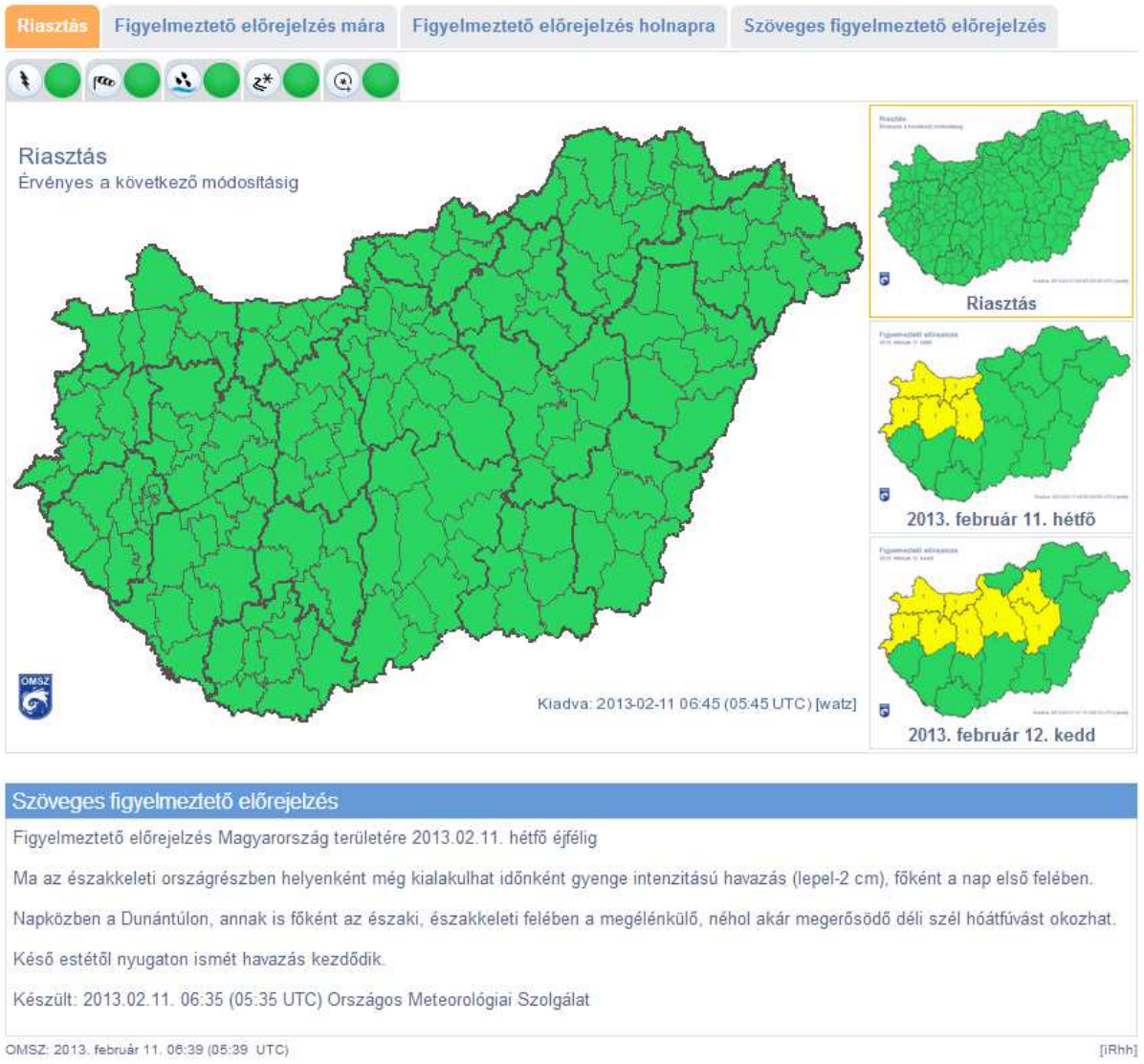
- **10. Fog**

Long-lasting thick fog	1	Long-lasting (> 6 hours) thick fog (visibility is only a few hundreds m) is expected.

- **11. Ground-frost**

Ground-frost (April 1 - October 31)	1	The temperature could drop below 0°C near the surface.

Current danger signal



(Source: HMS)

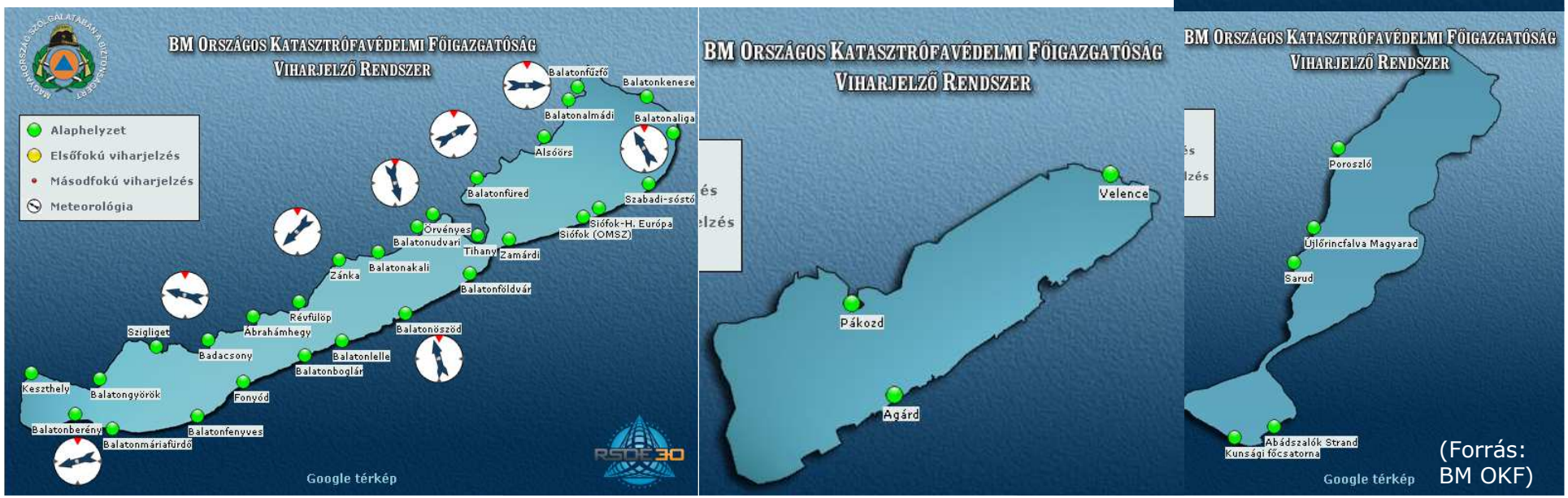
Lake storm warning 1.

- Seasonal storm forecasting and storm warning: April 1-October 31, Balaton Lake, Velence Lake, Tisza Lake, Fertő Lake;
- Tisza Lake: since 2012 it has been operating in the whole season, under the auspices of HMS;
- Since 2012 the Balaton Lake pool has been divided 3 parts: the western pool from Keszthely to the gorges Badacsony-Fonyód, the middle pool between Fonyód and Tihany, and the easten pool east from the Tihany Peninsula ⇨ owing to touristic targets (let it be only at absolutely necessary places, and let it be less maintenance time alerts);
- Storm alerts and forecasts are made at the Storm Prediction Observatory of the HMS at Siófok, and are issued from here;
- Operationally are informed the following services: Balaton Lake Water Police Headquarters; Chief Dispatcher of the National Disaster Management Inspectorate, Ministry of Internal Affairs; Water Rescue Special Service, Lake Balaton; Lake Balaton Shipping Company;
- Meteorological monitoring of larger sailing competitions or mass evenst (swimming across the Lake Balaton) from the Storm Prediction Observatory of the HMS at Siófok;

(Gebei Gergely felvételei)

Lake storm warning 2.

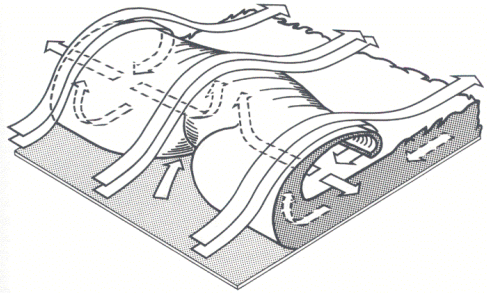
- At Balaton Lake 29, Velence Lake 3, Tisza Lake 5 strom-warning indicator unit are placed, in addition at priority beaches at Balaton Lake further 16, while at Velence Lake 1 mobile informative light unit is placed (operator: National Disaster Management Inspectorate, Ministry of Internal Affairs);
- Degree I: yellow flashing light flashes, 45 flashes per minute (strong wind warning: ~40-60 km/h);
- Degree II: yellow flashing light flashes, 90 flashes per minute (gale alert: > 60 km/h);



(Forrás: BM OKF)

Lake storm warning 3.

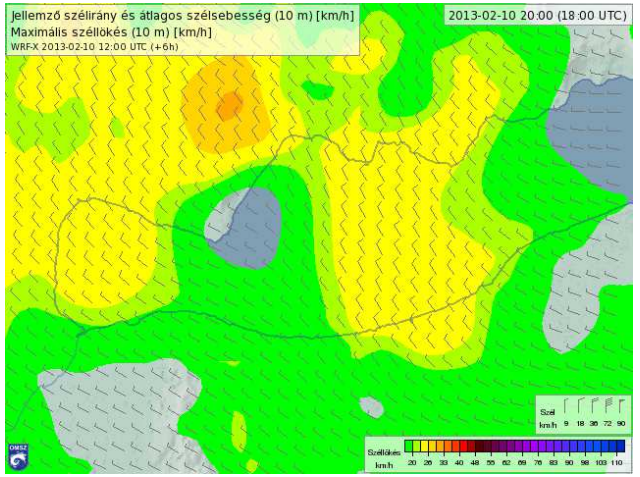
- **Storm warning, level I:** bathing within 500 m distance from the shore, water sport equipment;
- **Storm warning, level II:** bathing and boating is prohibited (only sailing ships are allowed to run until 80 km/h wind speed, over this speed only specialized rescue ships);
- **Water spraying:** if wind speed > 80 km/h ⇒ above the water surface up to the height of 40–50 cm air humidity is 80–90%, while visibility is ~ 0 m, **danger of suffocation**;
- **Cold dome;**

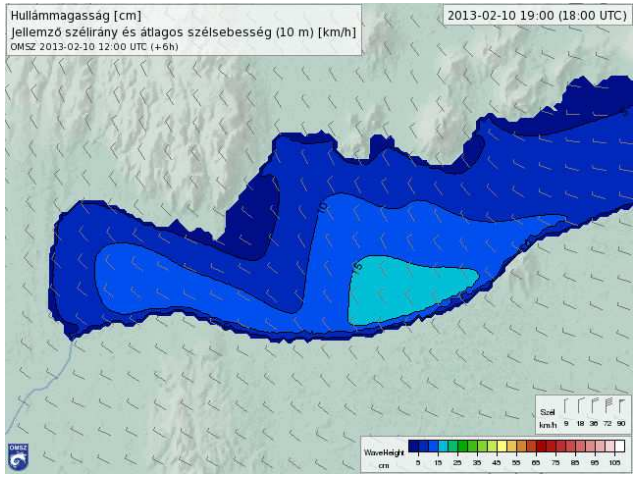


Balaton, 2005.05.18. 15:15 UTC (Source: HMS)

Lake storm warning 4.

- HMS website: Balaton Lake and Velence Lake storm warning; text predicition; Balaton Lake measuring stations: wind data, updated in every 10 minutes; model forecasts (WRF): runs four times a day – temperature-, precipitation- and wind fields in hourly resolution, 36 hours ahead; wave height forecast;
- Use of the mos advanced professional and technical tools: computerized geographical information system, high quality automatic weather station network, satellite-, radar- and lightning detector networks using powerful computers;
- Around the Balaton Lake 11, Velence Lake 1 and Tisza Lake 1 coastal stations, respectively;





(Source: HMS)

Year 2012 at the Lake Balaton

- Strong storm (> 90 km/h): 14 days (max: 7 Oct, Balatonöszöd, 118 km/h);
- Western pool: 2143 h strom warning (degree 2: 15.7% of the whole period), middle pool: 2076 h strom warning (degree 2: 14.2%), eastern pool: 2125 h strom warning (degree 2: 14.2%);
- Velence Lake: 1512 h (2. fok: 8.7%);
- Tisza Lake: 1214 h (degree 2: 5.6%);

2012. Balaton medencék	a kiadott viharjezések száma db.	IV.	V.	VI.	VII.	VIII.	IX.	X.	összesen:	IV.-X. db.
Nyugati	I. fok db	20	14	21	24	19	15	7		120
	II. fok db	8	17	11	29	9	11	6		91
Középső	I. fok db	22	16	19	28	20	12	11		128
	II. fok db	8	19	10	29	7	8	7		88
Keleti	I. fok db	22	13	22	32	19	11	11		130
	II. fok db	10	20	10	33	6	9	7		95

2012. Balaton medencék	fenntartott órák száma	IV.	V.	VI.	VII.	VIII.	IX.	X.	összesen:	IV.-X. óra.
Nyugati	I. fok óra	223,7	210,0	159,4	279,5	171,4	185,1	106,5		1335,6
	II. fok óra	106,0	160,0	89,2	162,3	69,0	144,8	76,5		807,8
Középső	I. fok óra	239,5	229,5	166,0	287,2	135,0	188,6	99,9		1345,7
	II. fok óra	100,0	146,4	95,7	133,3	72,3	116,0	66,5		730,2
Keleti	I. fok óra	240,0	218,7	192,3	291,5	145,0	183,4	123,0		1393,9
	II. fok óra	103,7	158,8	101,0	125,8	66,5	117,5	58,4		731,7

(Source: HMS Storm Prediction Observatory, Siófok)

Lake storm warning 5.

Beaufort-fokozat	Szélsebesség			Meghatározás	Viharjelzés	Hatása	
	csomó	km/h	m/s			a Balatonon	a szárazföldön
0	0	0 - 1	0 - 0,3	Szélcsend	ALAPFOK	Tükörsima vízfelület.	A füst egyenesen száll felfelé.
1	1 - 3	2 - 6	0,4 - 1,7	Gyenge szellő, fuvallat		Lépcsőzetes, pikkelyszerű fodrozódás habos taraj nélkül.	A felszálló füst gyengén ingadozik, a szél alig érezhető.
2	4 - 6	7 - 11	1,8 - 3,1	Enyhe szél		Még rövid, de már határozottabb alakú kis hullámok, üvegszerű hullámtarajjal, amely még nem törik meg.	A fák levelei zizegnek, az arcon érezhető a légmozgás.
3	7 - 10	12 - 19	3,2 - 5,3	Gyenge szél		Már megtörő tarajú hullámok, üvegszerű habbal, esetenként fehér tarajos hullámokkal.	A szél a fák leveleit, vékony hajtásait mozgatja.
4	11 - 15	20 - 29	5,4 - 8,1	Mérsékelt szél		Hosszabbá váló hullámok, gyakoribbak a fehér tarajos hullámok.	A szél a fák gallyait, kisebb ágait állandóan mozgatja.
5	16 - 21	30 - 39	8,2 - 10,9	Élénk szél		Közepes hullámok, határozottabb hosszú alakkal, sok fehér tarajos hullámmal, hullámpermet is megjelenik.	A nagyobb faágak is mozognak, a levegő mozgása jól hallható.

(Source: 39/2003. (VI. 13.) GKM regulation of the order of Shipping)

6	22 - 26	40 - 49	11,0 - 13,7	Erős szél	ELSŐFOK	Magas hullámok, fehér habos tarajjal. Helyenként az átbukó hullámokról hullámpermet szakad le. *Csónak illetve vitorlás vízi sporteszköz csak a parttól számított 500 illetve 200 m távolságon belül közlekedhet.*	Már a legvastagabb ágakat is mozgatja, a drótkötelek, villanyvezetékek zúgnak. *Jelzés: percenként **45 felvillanással** működő sárga villogó fény.*
7	27 - 32	50 - 60	13,8 - 16,9	Viharos szél		Tornyosuló hullámok. A megtörő hullámok tetejéről a fehér habot a szél keskeny csíkokat alkotva viszi tovább a víz felszínén.	A kisebb fák törzsei erősen hajladoznak, vékonyabb gallyak letörnek. A széllel szemben nehéz a gyaloglás.
8	33 - 39	61 - 72	17,0 - 20,0	Élénk viharos szél, vihar	MÁSODFOK	Magas és hosszú hullámok. A hullámtaraj pereme tajtékosan törik meg, a hab feltűnő, hosszú és széles csíkokat alkotva sodródik. *Csónak és vitorlás vízi sporteszköz nem közlekedhet.*	A szél a fákról ágakat tör le, a nagyobb fák törzsei is erősen hajladoznak. *Jelzés: percenként **90 felvillanással** működő sárga villogó fény.*
9	40 - 46	73 - 85	20,1 - 23,7	Heves vihar		Magas hullámok, sűrű habcsíkok sodródnak a szél irányában. A hullámok taraja kezd előre bukni és átgördülni. A hullámpermet csökkenti a láthatóságot.	A vihar a gyengébb fákat kidönti, a vastagabb ágakat letöri. Kisebb épületek megrongálódnak, a tetőcserepek lesodródnak.
10	47 - 54	86 - 100	23,8 - 27,9	Dühöngő vihar, szélvész		Nagyon magas hullámok átbukó hullámtarajjal. A keletkező hab nagy foltokban, sűrű csíkokban sodródik és a vízfelszín fehérré válik. A hullámok átbukása rengésszerűvé erősödik. A láthatóság csökken.	A vihar gyökerestül forgatja ki a fákat, az épületekben jelentős károk keletkeznek.
11	55 - 62	101 - 115	28,0 - 31,9	Heves szélvész		Igen magas hullámok, a vízfelületet elborítják a szél irányában fekvő, hosszú, fehér habfoltok. A hullámok teteje mindenütt tajtékzik és erősen korlátozott a láthatóság.	Súlyos anyagi károk, a téglaépítésű házak is megsérülnek.
12	63 - 65	115 - 120	32,0 - 33,3	Orkán		A levegő megtelik habbal és hullámpermettel. A víz fehér a szél által elragadott hullámpermettől. A láthatóság erősen csökken.	A szél épületeket, tetőket rombol, súlyos pusztítást végez.

(Source: 39/2003. (VI. 13.) GKM regulation of the order of Shipping)

Frost protection

- Ground-frost: the temperature of the surface (soil, plant, etc.) is below 0°C;
- Irradiance frost, advection frost;
- Passive control: frost-resistant species, shifting sowing time, selection of the proper site (valley, basin, depression and avoiding foreground of objects), use of the thermal belt;
- Active control modes:

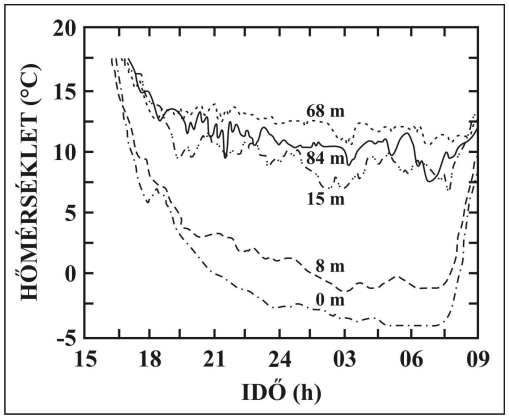
– radiation: reducing long-wave radiation loss (with radiation-reflecting layer, e.g. artificia clouding or fogging, fumigation, wooden slats, glass cover);

– preservation of soil heat content: covering surface (with insulating layer), increasing thermal conductivity of the upper soil layer (increasing heat transport up to the soil);

– regulation by latent heat: water spraying;

– percieved control by heat: turbulent air mixing and increase in sensible heat flow to the surface (thermo-fan, wind machine, floating helicopter – expensive);

– direct heating: artificial heat (electric heating elements, hot air hose, oil- and gas fired ovens);



Damages caused by winter weather

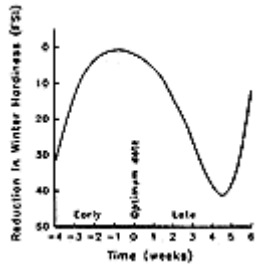
www.images.google.com

Freezout innwinter for overwintering plants
(especially winter cereals);

Partly crop destruction

Its degree depends on:

- Strength, depth and length of freezing;
- Hatching conditions – condition of the plant;
- Presence or lack of snow cover



Frost injury in alfalfa →

Necrosis (destruction)

Frost – in spring because of the soil „harmonica” (daytime thaw – at night freeze);

⇒ root breaks – withering;

Defence – no, or soil rolling, or soil trumpling by animals;

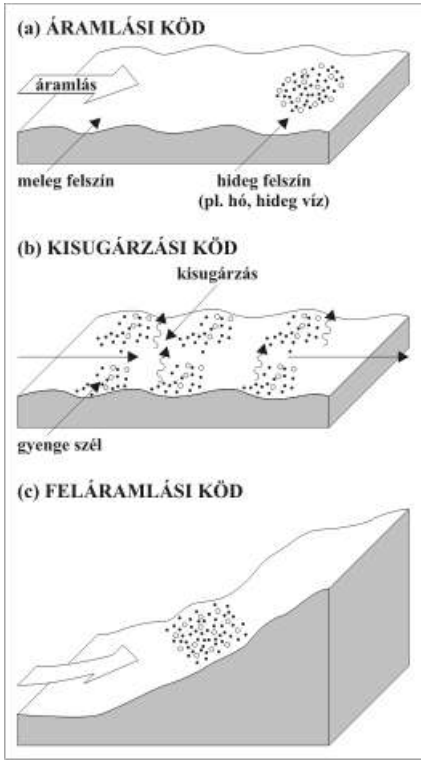
Winter- or physiological drought – the air temperature has already been positive, but the ground is still frozen;

Sun is shining – photosynthesis could start, **but:**

no water absorption from the frozen soil ⇒ the plant withers;

Dissolution of fog

- Visibility < 1 km;
- According to their generation: advection, radiation-; upwelling-, warm rain fog
- According to the methods of their classification: warm (> 0 °C), supercooled (-30–0 °C), ice fog (< -30 °C);
- Dissolution of warm fog: mechanical stirring (fan helicopters – simple but it is only effective for thin fog patches), dispersion of hygroscopic particles (drying by airplane, e.g. NaCl – fats improvement), direct heating (evaporation, e.g. aircraft engines along runways – effective but expensive);
- Dispersion of supercooled fog: frozen carbon dioxide scattered from airplane, liquid propane emitted from ground level (form ice condensation nuclei) – efficient, economical;



Hail prevention 1.

Damages caused by hail

Figure 90. Goose-neck and stem bruising caused by hail injury.

www.images.google.com

Circular patches – light or necrotic

Hail prevention 2.

- Emission of reagents (e.g. AgI) to the upper layer of the atmopshere prior to the formation of hailstones ⇨ collecting liquid supercooled water droplets;
- More but smaller-sized hailstones are formed (lower fall rate, melt or become smaller);
- The hailstones already formed cannot be destroyed;
- Methods:

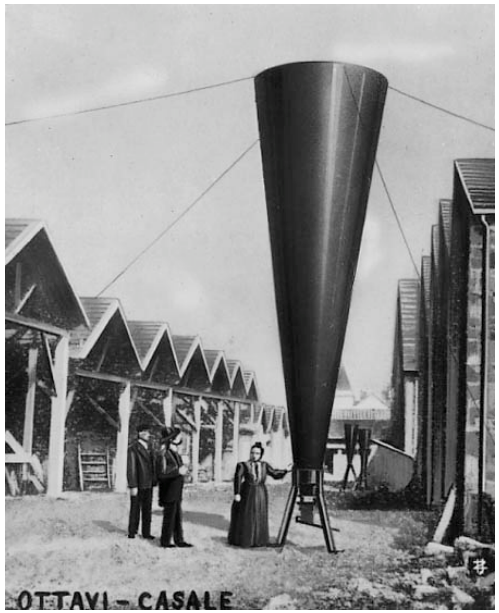
– background nuclei generation (by airplane) – even for smaller areas but it can be **dangerous** and **expensive**;

– direct injection (by rockets) – **expensive**;

– nuclei generation when upwelling (by soil generator); – rising humidity gets to the height of nuclei formation saturated with the reagent ⇨ **simplest, most efficient, lowest cost;**

(www.jegesoelharitas.com)

Hail prevention 3.



Hail cannon

Mesh for frost protection

www.images.google.com

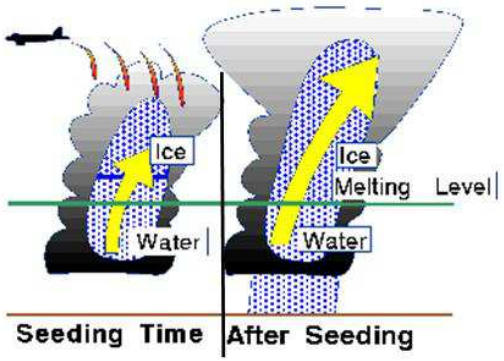
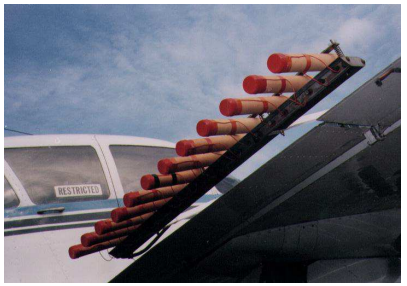


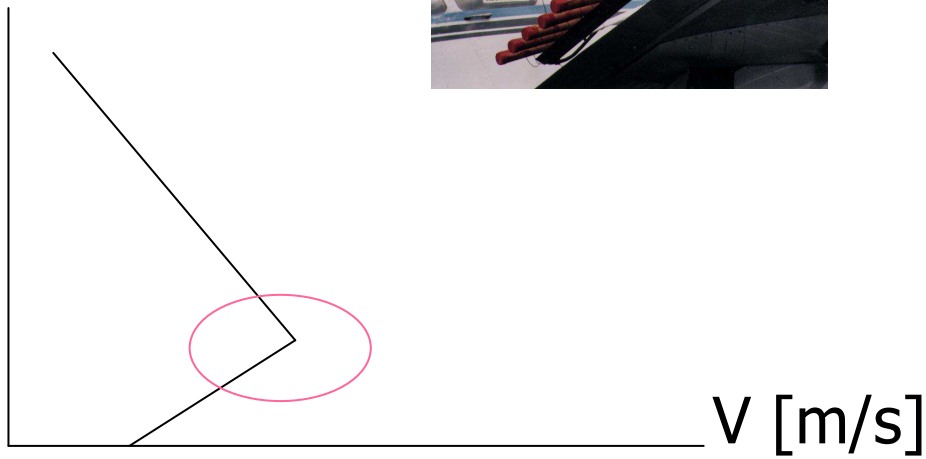
Diagram of the seeding of the upper part of a cloud by airplane, after which more rain is hoped to develop (graphic: NOAA Hurricane Research Division).

Silver-iodide, AgI (lead-iodide, PbI_2)
It is forwarded into the cloud from the soil or air. **TIME!!!**

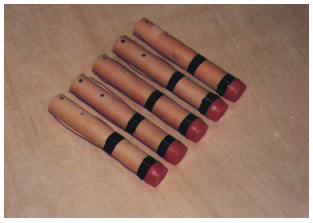
Hail prevention 4.

It is expected from the most developed thunderstorm cloud





Charge: 50 g AgI

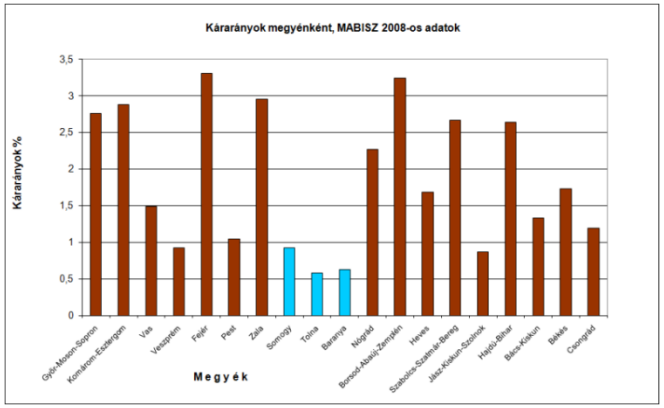


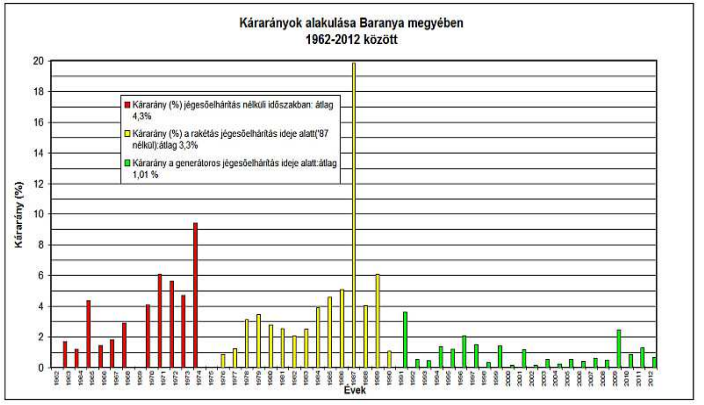
www.images.google.com

Hail prevention 5.

1991: NEFELA Hail Response Association, Southern Hungary (100 million HUF)

- Baranya, Somogy, Tolna: 1,3 million ha; 141 soil generators);
- 100 large plants, 2 insurance company, HMS (machines, equipments);
- Control: radar station, Hármas-hegy;
- Launching: around 2 hours before thunderstorms;
- May 1 – September 30;





(Source: NEFELA)

Drought

- WMO - drought: „drought is lack of water exceeding the averege rate significantly and persistantly”;
- Meteorological drought: precipitation amount is less than the average value or a predetermined precentage for the given area in a prolonged period;
- Agricultural drought: „…sustained and significant water deficit of a particular crop field or forest, which greatly limits the life processes of plants” (Pálfai, 2007). Due to the absence of ground water the development and yield formation of plants slows.
- Hydrological drought: a significant narrowing of surface and groundwater resources due to prolonged lack of precipitation (WMO, 1998) ⇨ reduction in water height and water flow (quantification: with the indicators of the hydrological cycle, too);
- Economic drought: monetary value of the damage incurred as a result of the water shortage (estmated value);

Hajdú-Bihar county, summer 2012 (Czeglédi Zsolt/MTI)

Tisza, Nagykörű, August 2012 (Mészáros János/MTI)

Drought

- Soil drought: soil moisture drops to a level that the root system is not able to absorb the water entered (DV below 30-50%);
- Atmospheric drought: it is not due to insufficient soil moisture but the high degree of saturation deficit of the air around the plant (low relative humidity and a high degree of moisture deficit caused by warm and dry winds);
- Physiological drought: water shortage as a water absorption disorder of the root, due to the high temperature difference between the root zone and the transpiration zone;

  Drought is not true: not the lack of water but the low current soil temperature (possibly due to ground frost) is the limiting factor (relative water shortage).

Hajdú-Bihar county, summer 2012 (Czeglédi Zsolt/MTI)

Tisza, Nagykörű, August 2012 (Mészáros János/MTI)

Drought

The causes of drought

- Climatic reasons:
  - low precipitation in the winter half-year, vegetation period;
  - high temperature;
  - high evaporation and transpiration;
- Soil reasons:

  probability of developing drought is different;
  - on sandy soil (DV - 100 mm), mint
  - on loamy chernozems (DV - 200 mm);
- Hydrological reasons:

  e.g. groundwater movements (during the vegetation period) it occurs in layers deepar than 5-6 m;
- Agronomic reasons:

  e.g. tooo dense plant cover, improper tillage, poor nutrition;

Hajdú-Bihar megye, 2012. nyár
(Czeglédi Zsolt/MTI)

Tisza, Nagykörű, 2012. aug.
(Mészáros János/MTI)

Drought

Effects of drought

- restrictive:
  ecologically and technologically;

- risk:
  economically – on plant economic level;
  - on macroeconomic level;
  (international, as well!)
  - ✓ the amount of crop decreases;
  - ✓ the quality of crop deteriorates;
  - ✓ the expenses increase;
  - ✓ the loss increases;
  - ✓ the profit declines;

  politically – destabilizer;

Hajdú-Bihar county, summer 2012 (Czeglédi Zsolt/MTI)

Tisza, Nagykörű, August 2012 (Mészáros János/MTI)

Drought

What can be done?

- **Social responses**
  - ✓ prevention;
  - ✓ mitigation;
  - ✓ tolerance;

  A consciously adapted drought tolerance is cheaper.

Hajdú-Bihar county, summer 2012 (Czeglédi Zsolt/MTI)

- **Biological responses**
  - ✓ Drought-tolerant secies, breed improvement;
  - ✓ A wide variety selection;

- **Ecological types of interventions**:
  - ✓ Deep relaxation / plowing;
  - ✓ **irrigation;**

Tisza, Nagykörű, August 2012 (Mészáros János/MTI)

Drought

What can be done?

Cultivation technology responses:

- ✓ choice of a good forecrop;
- ✓ good quality seeds;
- ✓ good fertiliziation, organic fertilizer;
- ✓ cultivation reducing evaporation;
- ✓ application of anti-transpirants;

Economic responses:

drought plan per farm (based on value analysis);

- ✓ what should be tolerated (where?);
- ✓ what should be preceded;
- ✓ what should be mitigated by the economy;

Hajdú-Bihar county, summer 2012 (Czeglédi Zsolt/MTI)

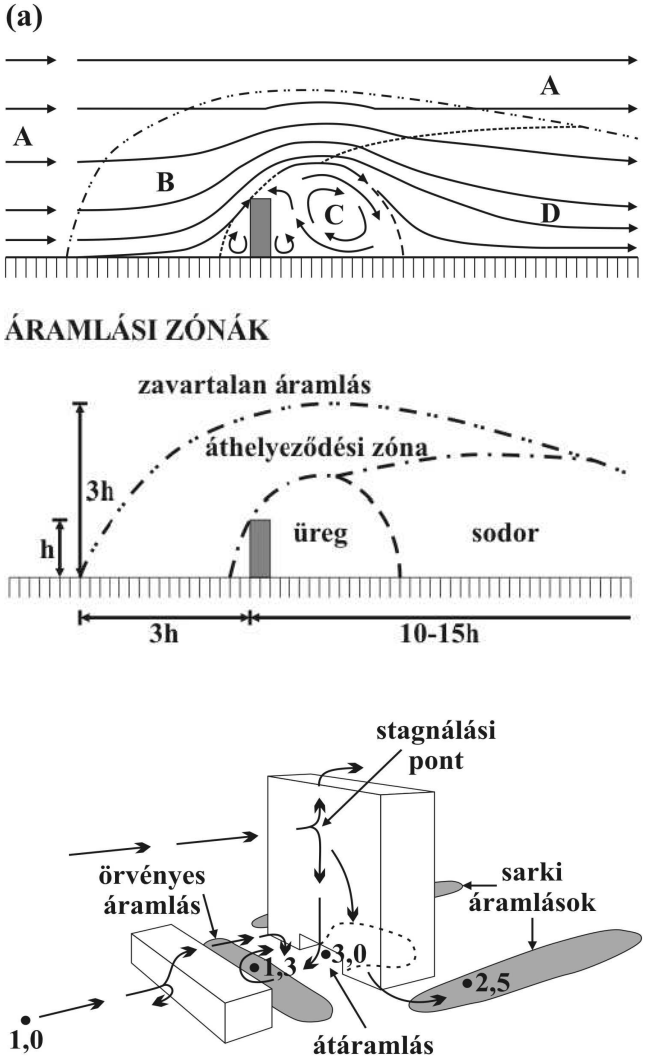
Tisza, Nagykörű, August 2012 (Mészáros János/MTI)

Protection against drought

- Technical systems for water transfer, water retention by the technical equipments, ensuring the timely use of water (e.g. pump water delivery systems, water transfers, reservoirs, dams, water retention and water management structures, underground soil pipe networks);
- More action (double) cultivation for preventing hazards of drought and inland waters: drainage and irrigation systems, which can be converted to a reatre or less supplimenting each other, complemented each other;
- Amelioration (soil improvement): preservation and improvement of soil fertility (agronomical, agrotechnical and technical activities) ⇨ the role of the soil in water management (appropriate agricultural techniques, e.g. deep plowing and deep loosening) ⇨ keeping and storage locally fallen precipitation, improving water reception capability, insure water usage of plants in optimal time ⇨ reduction of damage caused by lack of water during drought (summer) or water surplus during inland water (spring);
- Technologies for water saving, and increasing the efficiency of water use, e.g. saving irrigation technology, teritorial extension of irrigation, cultivation of optimum plant species, land use changes;
- Preservation of surface and underground water resources, minimization of their decrease and overload, protection of their quality;

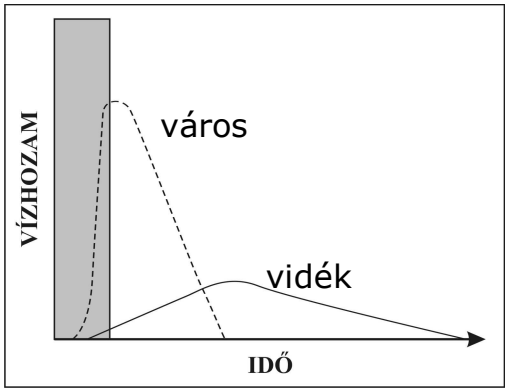
Protection against wind

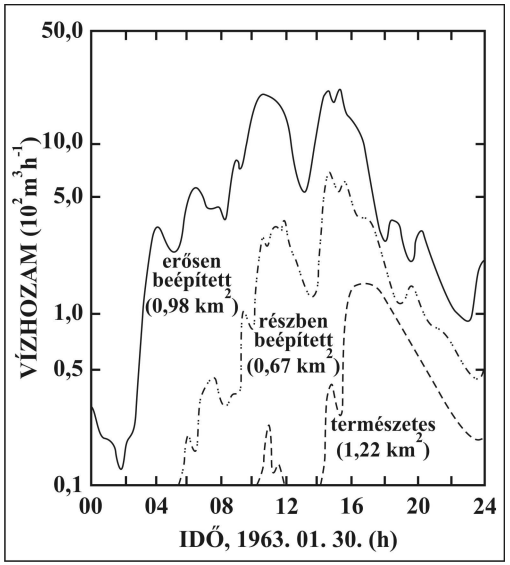
- Construction of protective walls. Purpose: to protect agricultural plants (inreasing yields), animals, buildings, protectiion of transport routes, entrances, snow cover, soil moisture and to preserve topsoil;
- Wind load of buildings (cladding, roof rupture, pressure difference between the interior and exterior parts of the buildings, closed windows and ventilation rate, entrances usability);
- Knowledge of the wind environment around the building (prevention of wind damages, comfort, pollutants distribution);
- Effcet of swirls around buildings to comfort and protection of the people;
  ⇨ soultions: avoid building high-rise houses, increase foundation of high-rise houses (increase legs + low-level roofs);
- Distribution of air pollution: H/W (height/width) dependent (crushing/cross-ventilation);



Downpour

- Mountains: a single storm centre over a small catchment area , damming up the stream, in the valley flash flood and alluvium trasport;
- City: poor water permeability ⇨ lower evapotranspiration and water storage ⇨ more runoff;
- Water impermeable materials shorten transmission time of rain (or melt) to waterways + drainage ditches and channels amplify this effect ⇨ high water (flood) risks;
- At a given location the rate of runoff is influenced by the ratio of water permeable and water-impermeable surfaces;
- Natural surface: more infiltration and storage + greater interception and evaporation ⇨ smaller runoff;
- Variations of water discharge due to intense rainfall in the function of the built-up areas ⇨ urban channels should lead a huge amount of water within a short period;





Extreme winter wetaher, winter hazards

- **Blizzards, snowdrifts,** freezing of rails, formation of ice, sleet ⇨ disruptions in transport, occlusion of settlements, deterioration of public supply;
- **Freezing of gas piplines** ⇨ piped gas supply may stop temporarily;
- **Increase in use of electricity**, frozen ice layer on electrical wires ⇨ temporary disruptions to energy services;
- **Weight of snow, ice** ⇨ roof damaged buildings, wirings falling behind, branches broken off;
- **Sleet, snow, ice**: ⇨ slipping;
- **Frostbite** (layered dressing, movement);
- **Hazards of sports on ice:**

  – **stagnant water (lakes):** melting, influent streams, hot springs, ice near shore, ports, cracks in the ice, dense – snow covered areas ⇨ dangerous;

  – **running water (rivers):** drift line, the concave side of the bend, spee flow - steep riverside protected by stone ⇨ dangerous;

  – **do not stay on frozen water surface of a river!**

  – 8 cm: 1 adult, 12 cm: groups, sports, 18 cm: sledges as well;

  – secure: fattening ice > 12-16 cm ice;

  – collapse: within 20-30 s cold shock, survival max. 15 min;

Heat

- Hőhullám (ÁNTSZ = National Public Health and Medical Officer Service): daily mean temperature on 3 consecutive days > 26.6°C;

- **Heat alert degrees** (OKI + ÁNTSZ + OMSZ)

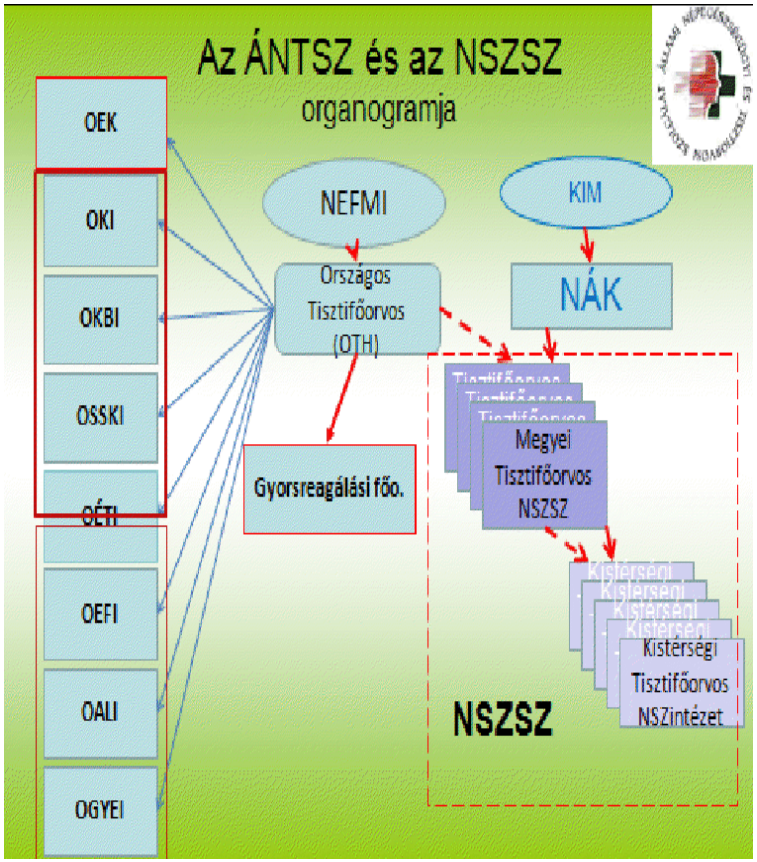
  Degree 1: (alerts for internal use): daily mean temperature is expected ≥ 25°C (15% increase in daily mortality) (at least 1 day);

  Degree 2: (readiness alert, informing the public and the health care system): daily mean temperature ≥ 25°C expectedly for at least 3 consecutive days (about 15% increase in daily mortality); **OR** if daily mean temperature reaches 27°C on one day (about 30% increase in daily mortality);

  Degree 3: (alarm signal, emergency / disaster situation): daily mean temperature ≥ 27°C expectedly for at least 3 consecutive days (about 30% increase in daily mortality);

Tasks of ÁNTSZ during heat

- **Level I:** no action, az OKI will notify HMS;
- **Level II:** organogram starts (2 days before the heat wave), ÁNTSZ OTH notify co-authorities (OMMF, OKF, OMSZ – by email) and the public (by print and electronic media, press release). OTH circular to NSZSZ (district, regional, sub-regional). NSZSZ notify the hospitals, municipalities and population in the required action to be taken.
- **Level III:**(catastrophe): for the initiative of OTF, the HVM on emergency measures to be taken;



(Source: ÁNTSZ)

Protection against tornadoes

- Supercell, or non-supercell tornadoes;
- Development, advanced, degradable, shrinkage phase;
- Protection (based on US Disaster Protection [FEMA] Security Council [Safety Tipps])

  – Always stay under the surace, or under a firmly fixed object;

  – Search shelter in the basement (under a sturdy table). If there is no basement, stay in the opposite room to the arrival of the tornado, stay farthest distance possible from windows/walls, lie down. It is prohibited staying in elevator or car.

  – Car: drive to the right of the direction of the tornádó; search shelter below overpass, low bridges, underwater passageway, felüljáró, alacsony híd, vízátvezető csatorna alatt menedékkeresés. Vehicles remain prohibited.

Mezőkövesd, August 2010
(Photo: Pázmándi Pál)

Szeged-Algyő, June 2008
(Photo: Boci/Idokep.hu)

Main references

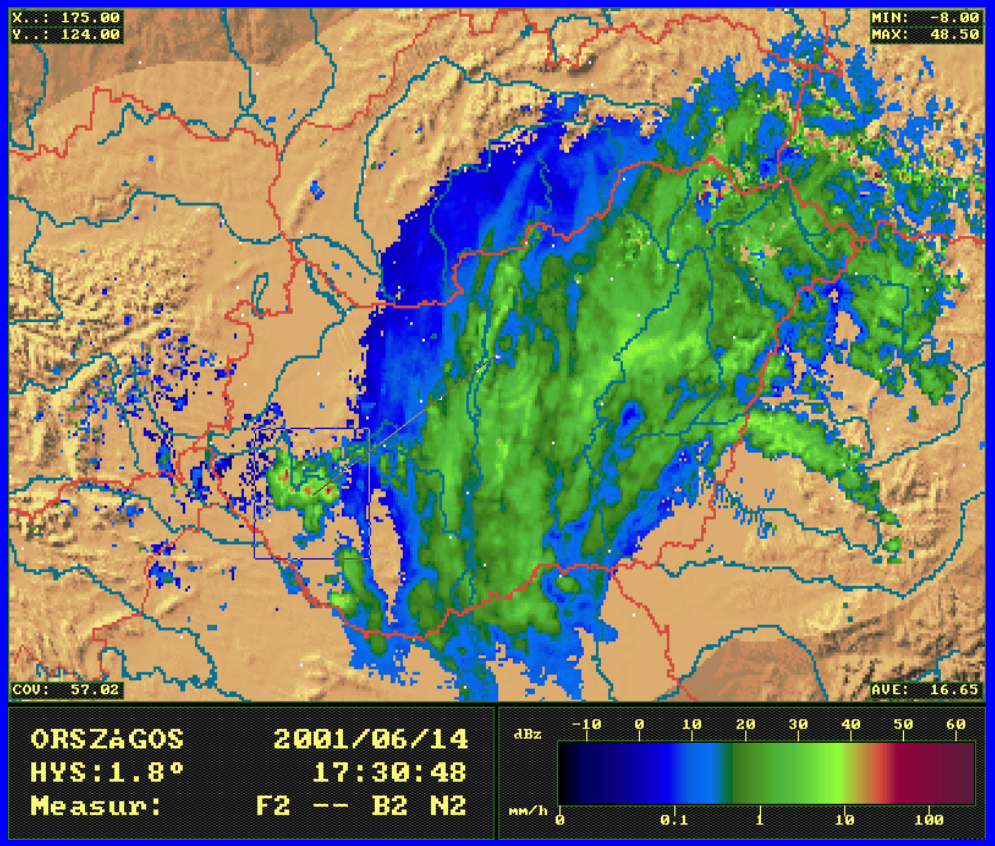
- Páldy A. (2011): Az ÁNTSZ kiemelt szakmai feladatai hőséghullámok esetén. (Professional tasks of ÁNTSZ during heat waves.) OKI (in Hungarian)
- http://www.met.hu
- http://www.katasztrofavedelem.hu
- http://www.antsz.hu
- http://www.nefela.hu
- http://www.rsoe.hu
- http://www.metnet.hu

MSG (Meteosat Second Generation) satellites

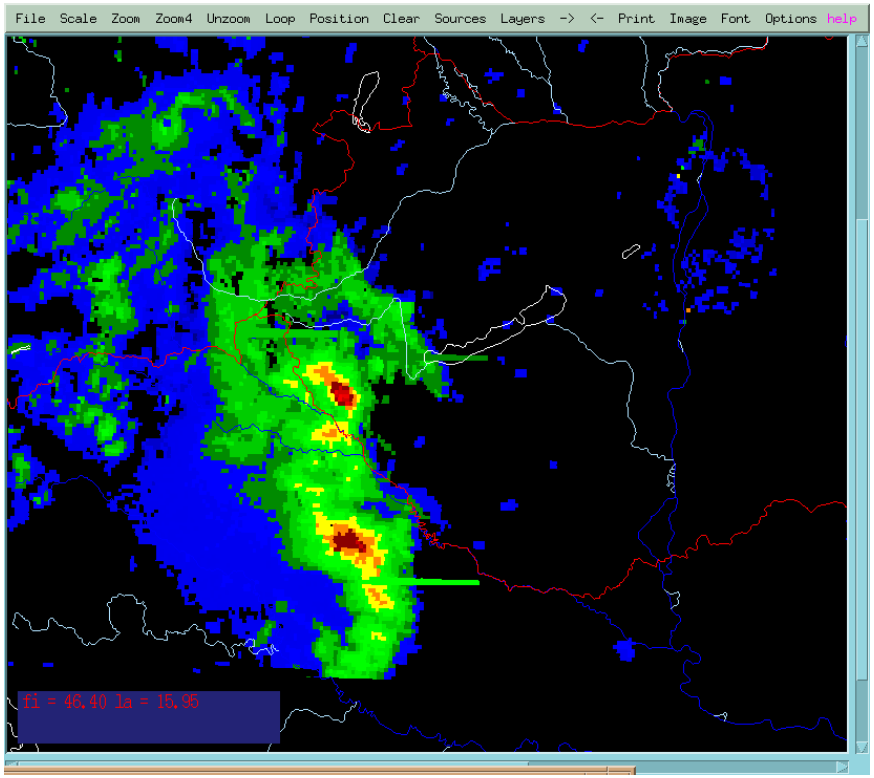
- First: August 2002 – with improved instrumentation;
- 15-minute frequency – an opportunity to observe fast-changing phenomena (thunderstorm development);
- 12 channels – composite images;

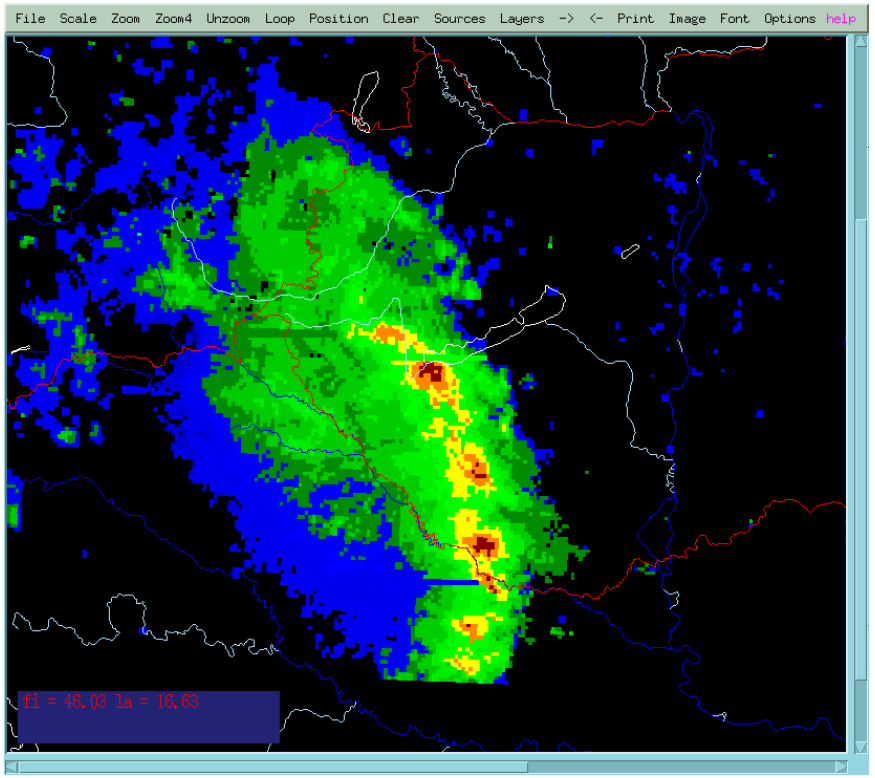
Weather radar

- 3-station radar network (Doppler, dual-polarization radar);
- National and unique images;
- Vertical sections;



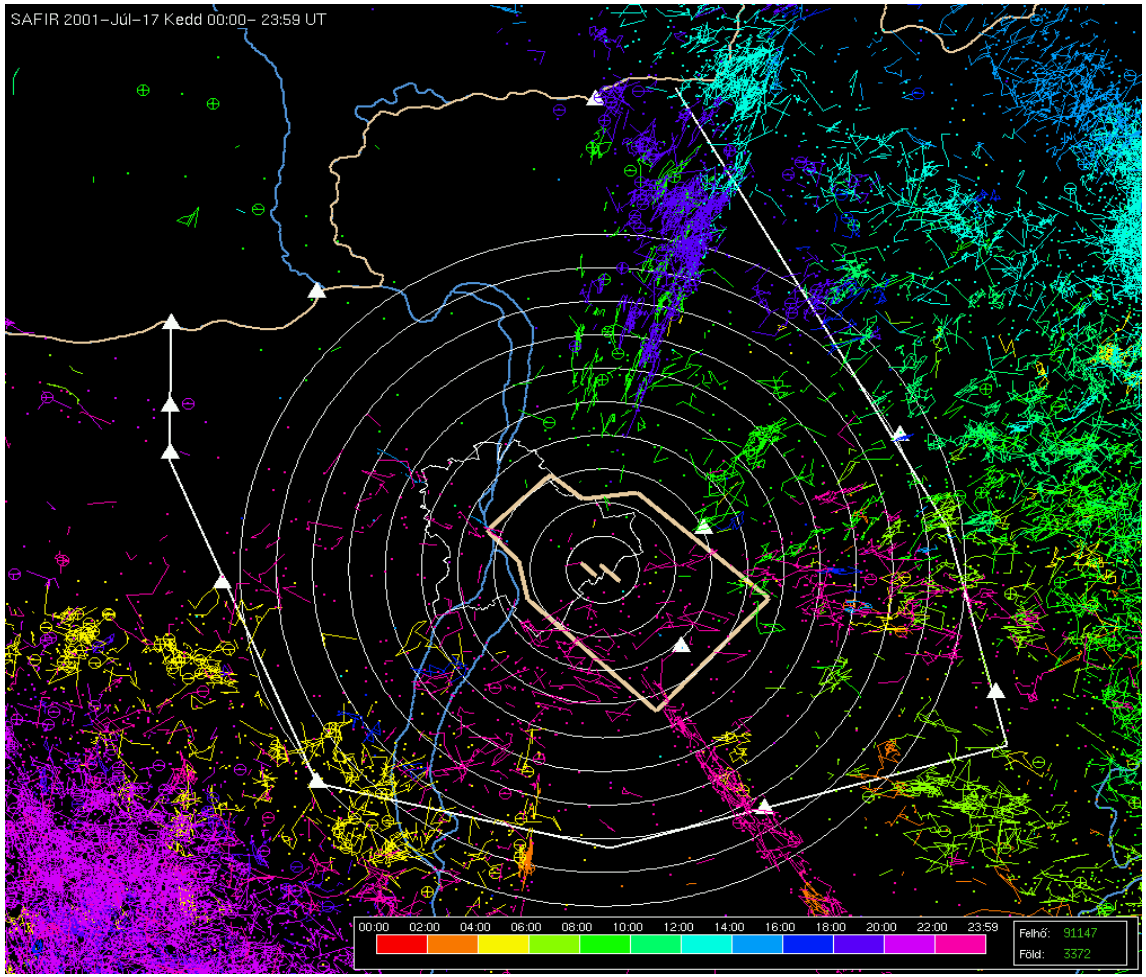
Radar measurements





Lightning detection system

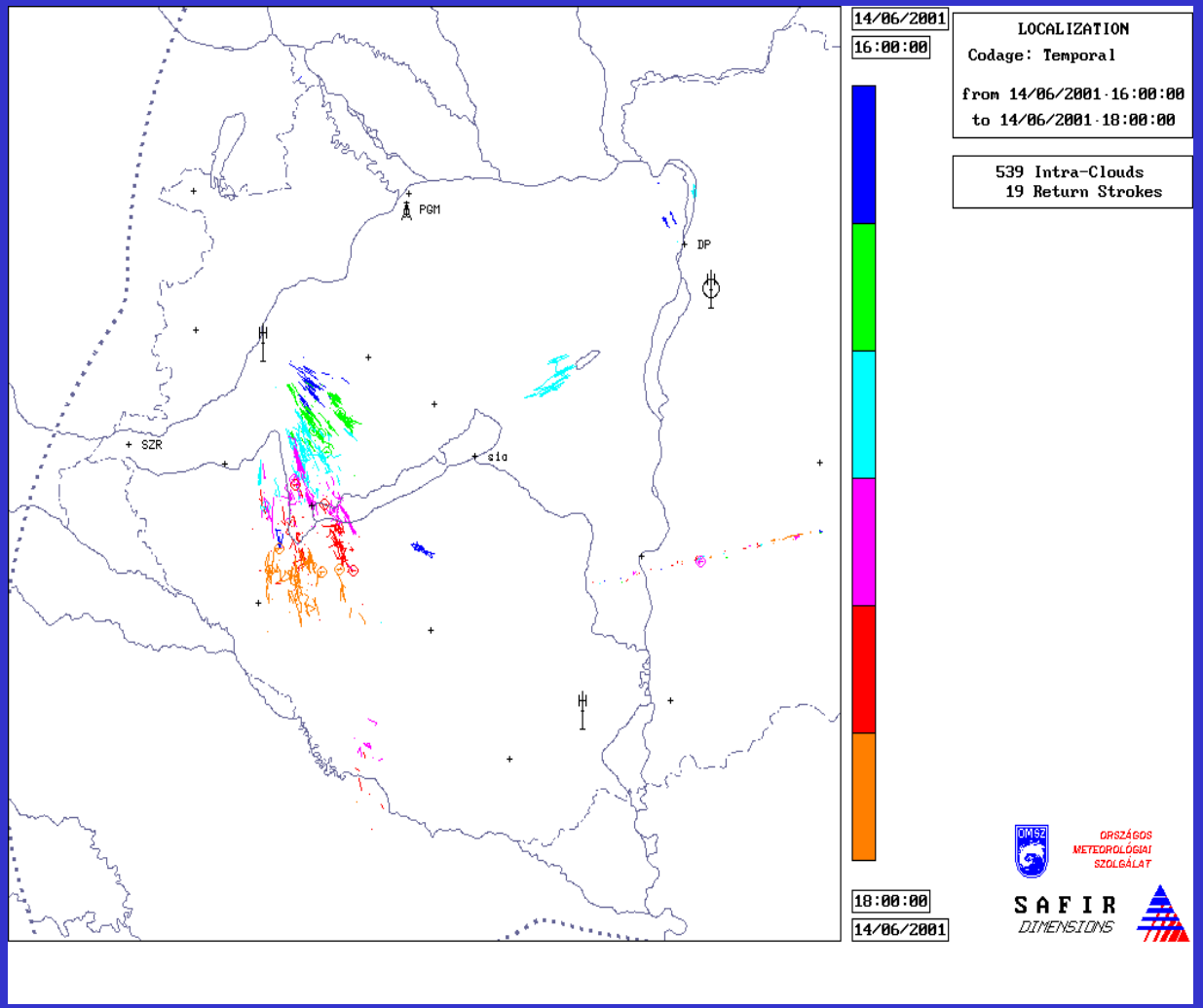
- It measures the electromagnetic radiation in the lightning discharge channel.
- Precision of the location of lightnings: 2 km.



Lightning localization system

A system consisting of 5 antennas

Operating since 1998



Models

Basically two types:

- Medium-term – for 10 days
  Global model;
- ALADIN model (ALADIN-HU model);

For smaller area ⇒ it is of high resolution;

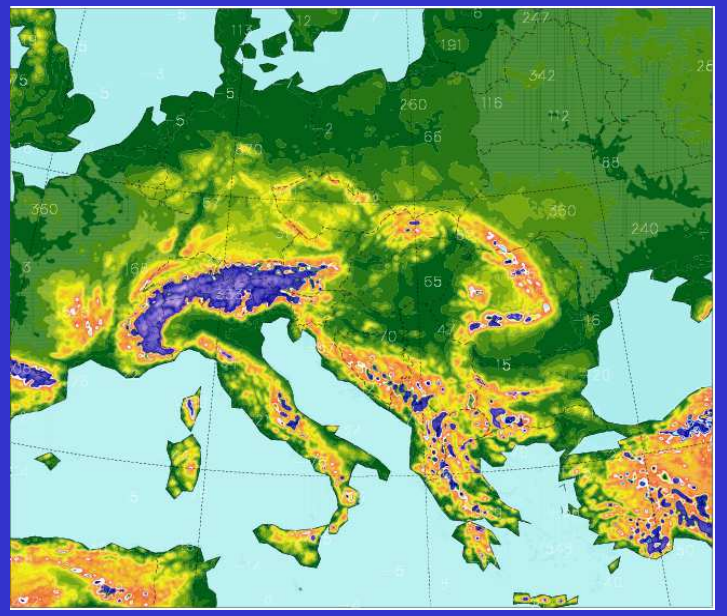
horizontal resolution: 11 km (8 km);

vertical resolution : 27 levels;

run: twice daily,

data: 00 UTC and 12 UTC;

Forecast duration: 48 hours;



OMSZ

Nowcasting

Definition: it comprises analysis of meteorological phenomena and processes along with the forecasts for 0-6 hours;

Method: accurate current analysis, its extrapolation e.g. movement of thunderstorms), and application of very good forecasting methods;

Instruments: new type of measurement data – satellite, radar, aircraft measurements, lightning detector, wind profile measurements, etc.;

Forecast duration: most frequently 1-2 hours, but at most 6-hour duration.

Department o Aviation and Meteorological Hazards - RVO

Tasks: *short-term forecasting and nowcasting;*

- Aviation meteorology;
- Protection of life and property;
  - Storm forecast (Balaton Lake and Velence Lake);
  - Nuclear accident prevention, industrial accident;
  - Life and property protection forecasts and alerts for Disaster Protection;
  - Smog forecasts;
- Managing public alarm interface;
- Alarm of contractors;

1005/2006. (I. 20.) Goovt. decision on a forecasting and alert system associated with dangerous situations caused by local, heavy precipitations

Start: February 1, 2006

Subtasks of the decision preparation, prevention and alarm system

1. Forecast of macro-scale, multi-day advance predictable high rainfall situations (time advantage 1-3 days);

2. Alert to local-scale, suddenly falling heavy precipitation (cloudburst), predictable only just before its formation (time advantage from half an hour up to 2-3 hours);

Alarm events issued by the HMS

Nowcasting alert (1-3 hours)	Short-term alert (12-36 hours)
Stormy wind (gust above 20 m/s)	Stormy wind (gust above 20 m/s)
Extreme strong wind (gust above 25 m/s)	Extreme strong wind (gust above 25 m/s)
Poor sleet, drizzle	Poor sleet, drizzle
Severe icing (extensive, permanent sleet)	Severe icing (extensive, permanent sleet)
Violent thunderstorm (with hail and gusty winds)	Violent thunderstorm (with hail and gusty winds)
Cloudburst (> 50 mm rainfall within 3 hours)	High amount of rainfall (> 50 mm rainfall during 24 hours)
Poor snow (2-5 cm snow during 3 hours)	Poor snow (5-20 cm snow during 24 hours)
Strong snow (> 5 cm snow during 3 hours)	Strong snow (> 20 cm snow during 24 hours)
Snowdrift	Snowdrift
Widespread dense fog	Widespread dense fog
	Freeze (soil temperature is below 0°C)
	Extreme cold (daily mean temperature is below 10°C)
	Extreme warm (daily mean temperature is above 27°C)

Alert criteria

Wind:

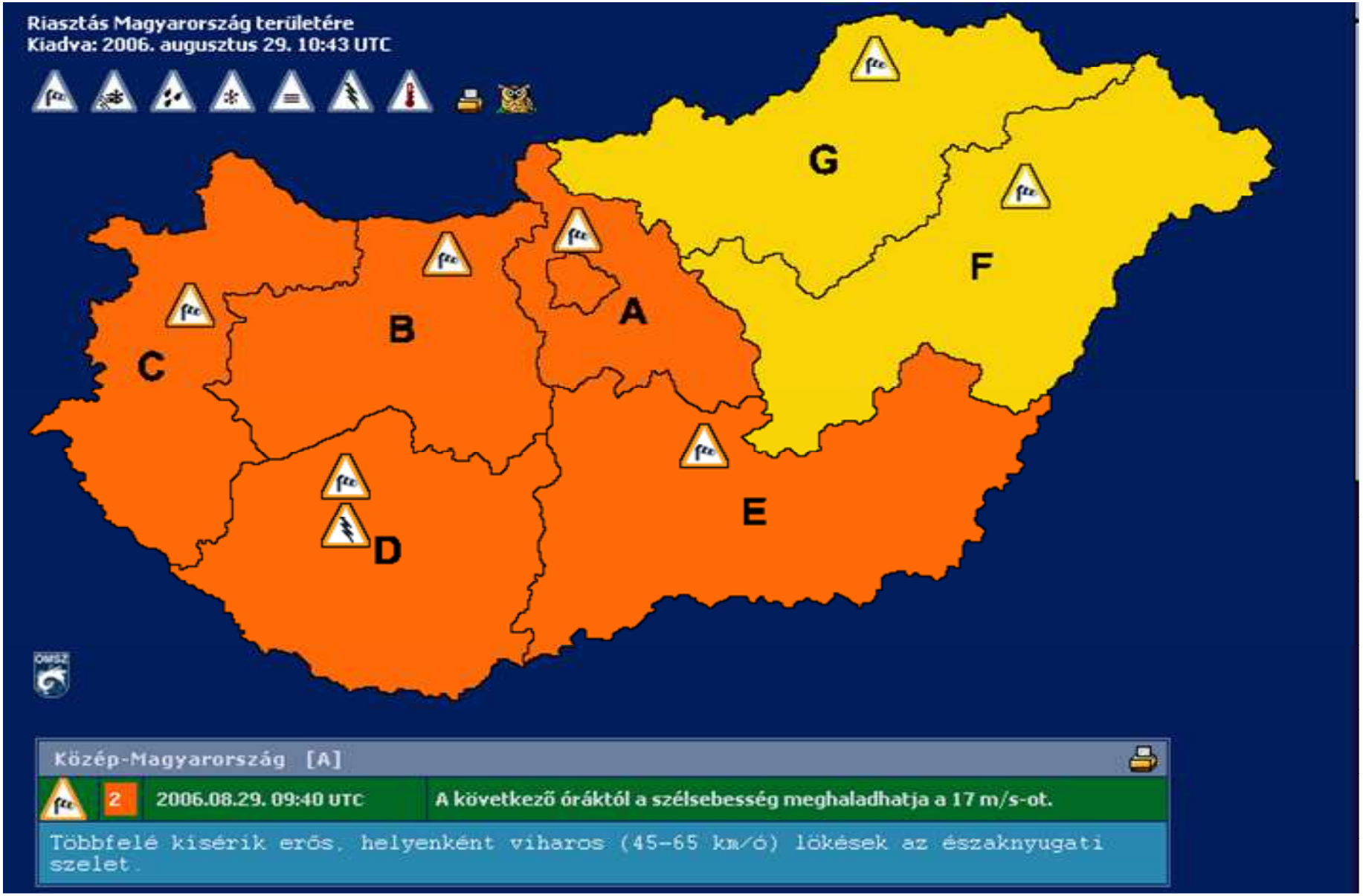
- ***Strong wind:*** *Wind speed may exceed 12 m/s in the following hours.* Gusts will exceed 12 m/s (43 km/h) speed, but do not reach the 17 m/s (61 km/h) storm strength degree.
- ***Stormy wind:*** *Wind speed may exceed 17 m/s in the following hours. Strongest g*usts will exceed 17 m/s speed (61 km/h), but do not reach the 25 m/s (90 km/h) strong storm degree.
- ***Extreme storm wind:*** *Wind speed may exceed 25 m/s in the following hours. Strongest g*usts will exceed 25 m/s (90 km/h) strong strom category, or even ,az reach or exceed the 33 m/s (119 km/h) hurricane degree.

Alert criteria

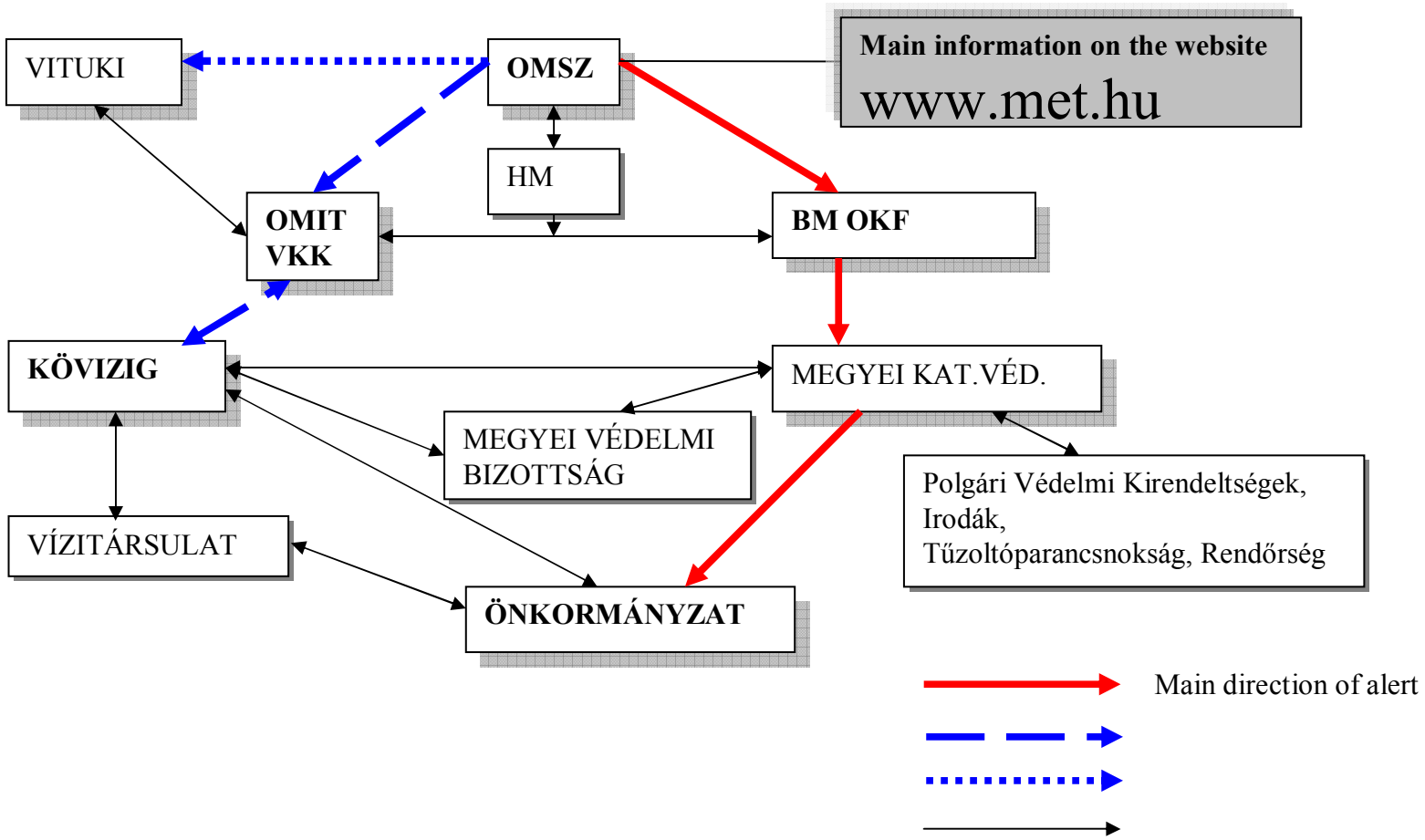
- Sleet;
- Rain;
- Snow;
- Visibilty;
- Thunderstorm;
- Temperature extrema;

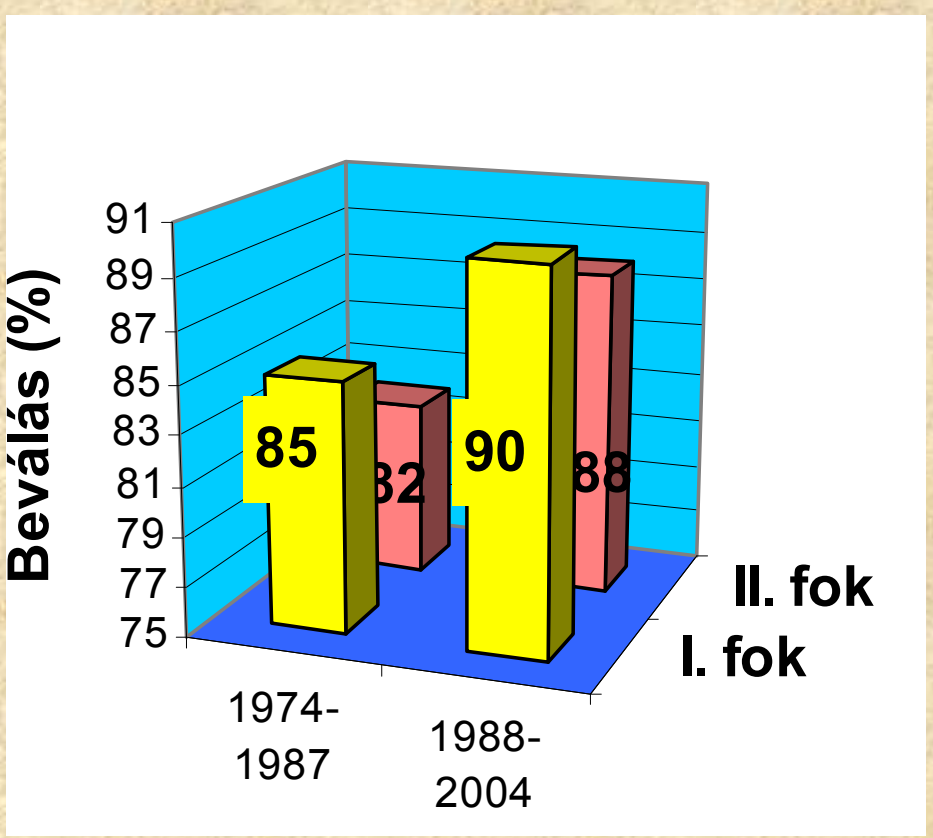
Alert system of HMS

Időjárási kategória	jel	Időjárási esemény / küszöbérték	időelőny	
			~3ó	~24ó
SZÉL		60 km/órát meghaladó széllökések	x	x
		80 km/órát meghaladó széllökések	x	x
		100 km/órát meghaladó szellokések	x	x
ZIVATAR		zivatar (villámtevékenység, kisebb méretű jég, vagy a zivatarfelhő közelében viharos széllökés)	x	x
		néhol, vagy helyenként előforduló heves zivatar (80-100 km/órát meghaladó széllökések, vagy 2 cm-t meghaladó jégméret)	x	x
		többfelé előforduló heves zivatar	x	x
ESÖ (rövid idő alatt nagy mennyiség)		néhol, vagy helyenként intenzív záporokhoz/zivatarokhoz kapcsolódó rövid idő (1-3 óra) alatt lehulló nagy mennyiségű csapadék (50 mm)	x	x
		többfelé előforduló intenzív záporokhoz/zivatarokhoz kapcsolódó rövid idő (1-3 óra) alatt lehulló nagy mennyiségű csapadék (50mm)	x	x
ESŐ (tartósabb és kiterjedtebb)		12 óra alatt több mint 20 mm csapadék (1-2 megyére, vagy 1 régióra kiterjedő területi átlagban értelmezve)		x
		12 óra alatt több mint 30 mm csapadék (1-2 megyére vagy 1 régióra kiterjedő területi átlagban értelmezve)		x
		12 óra alatt több mint 50 mm eső (1-2 megyére, vagy 1 régióra kiterjedő területi átlagban értelmezve)		x
ÓNOS ESŐ		legfeljebb helyenként előforduló és rövidebb ideig tartó, vékony jégbevonatot képző gyenge ónos eső/szitálás	x	x
		többfelé előforduló gyengébb, esetleg néhol előforduló intenzívebb és tartósabb ónos eső/szitálás	x	x


Riasztás Magyarország területére
Kiadva: 2006. augusztus 29. 10:43 UTC
G
F
A
B
C
D
E
OMSZ
Közép-Magyarország [A]
2
2006.08.29. 09:40 UTC
A következő óráktól a szélsebesség meghaladhatja a 17 m/s-ot.
Többfelé kisérik erős, helyenként viharos (45-65 km/ó) lökések az északnyugati szelet.

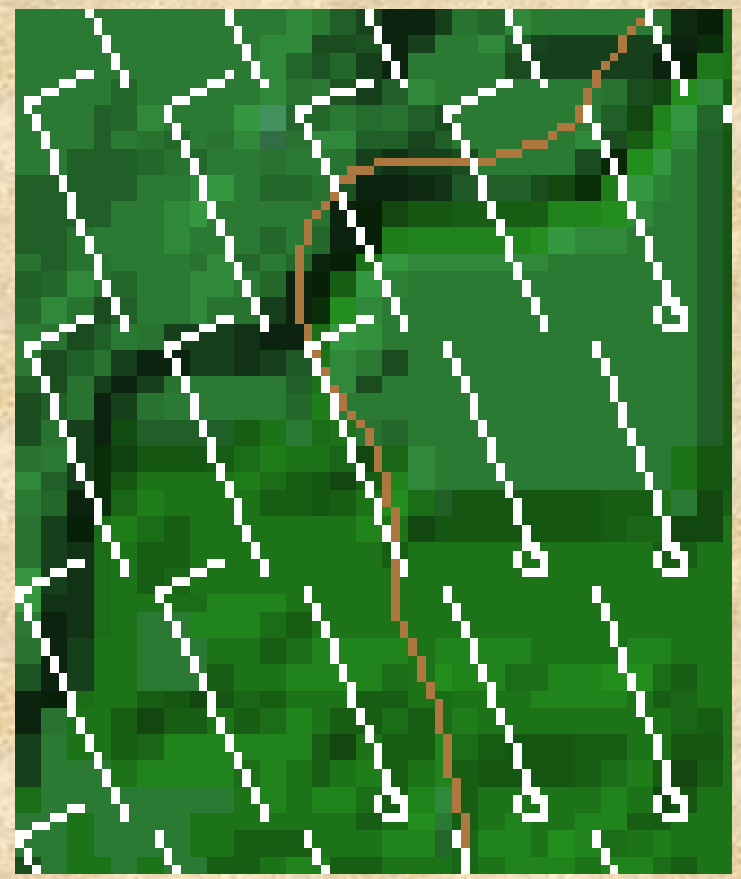
SCHEME OF THE ALERT SYSTEM

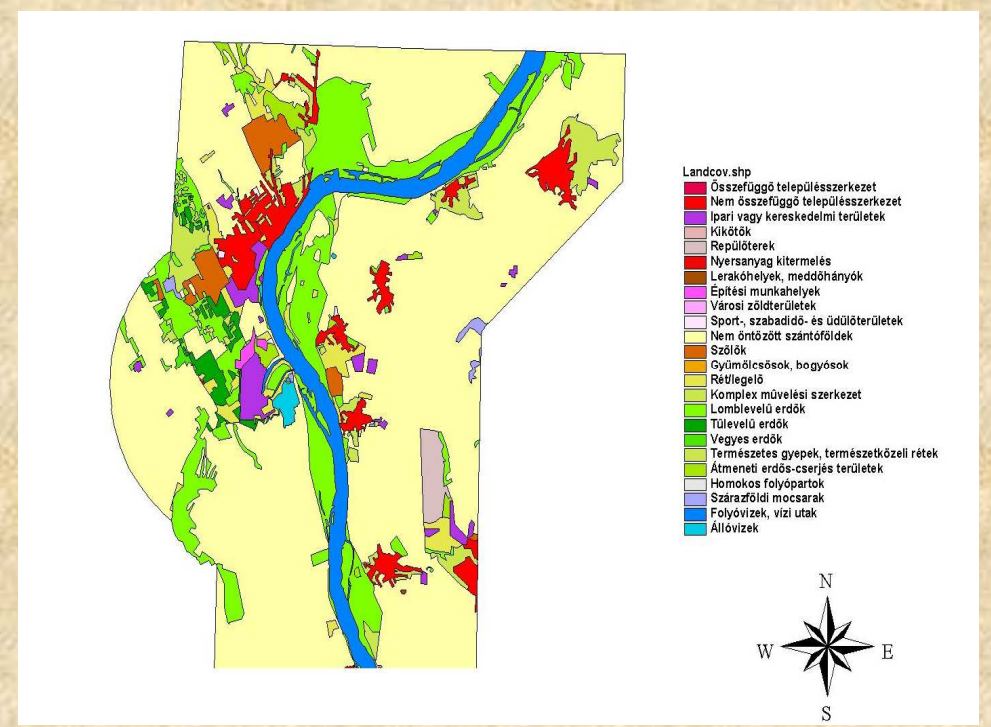


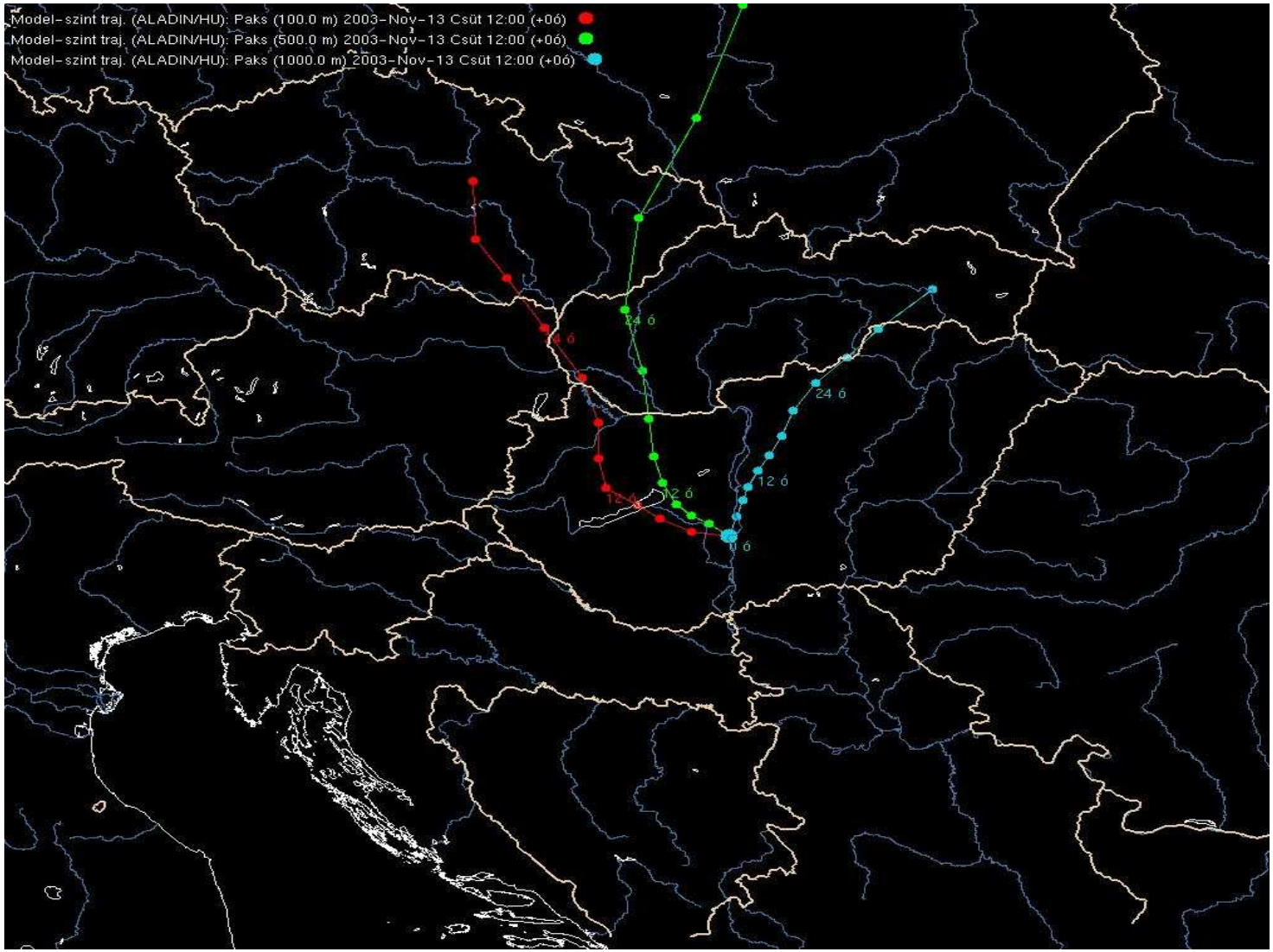


The storm signals suitability verification for the rocket (1974-1987) and the light (1988-2004) indication periods.

The MM5 non-hidrostatic model in 2 x 2 km resolution





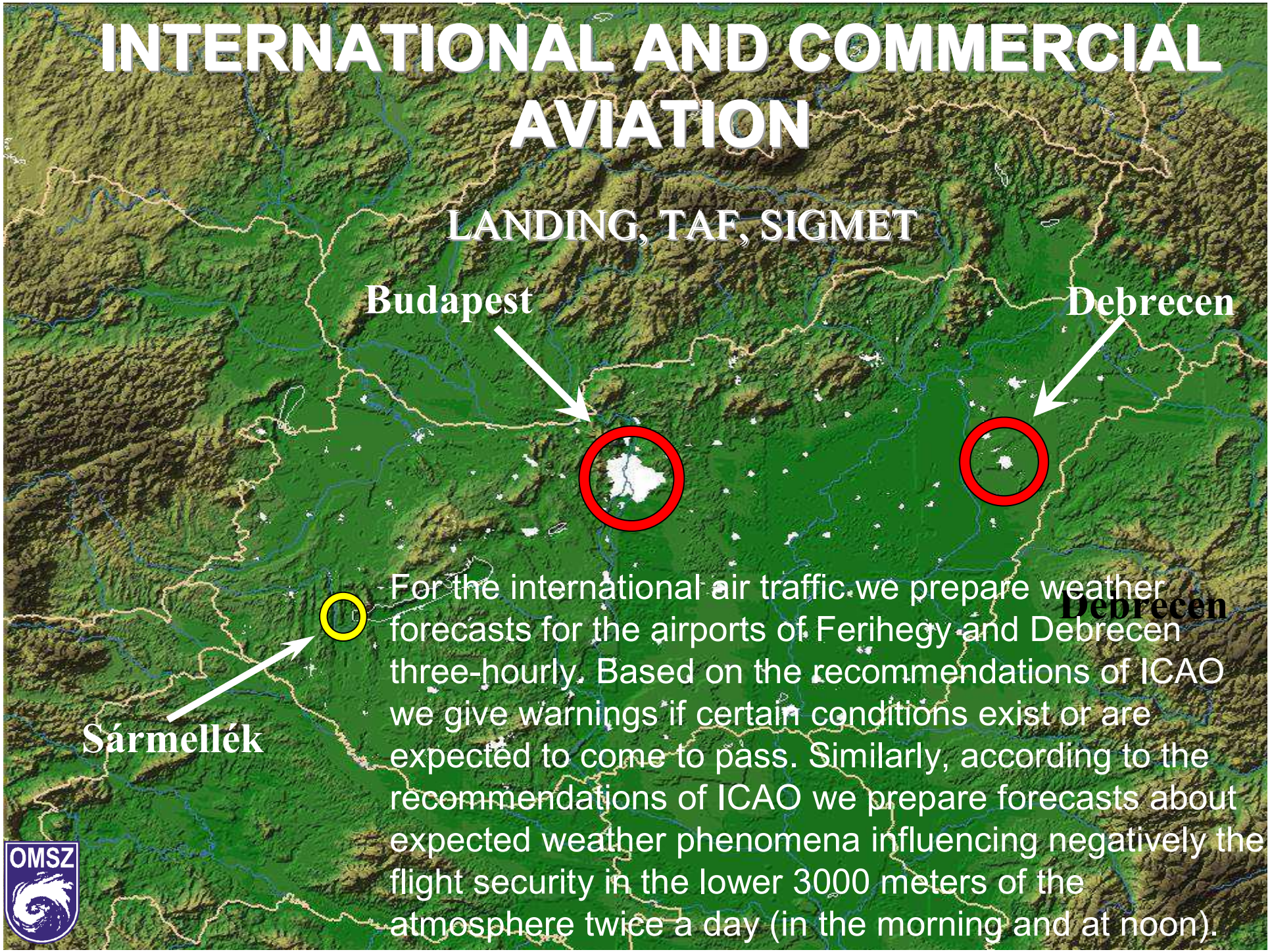


OMSZ

Trajectory forecast based on ALADIN model

INTERNATIONAL AND COMMERCIAL AVIATION

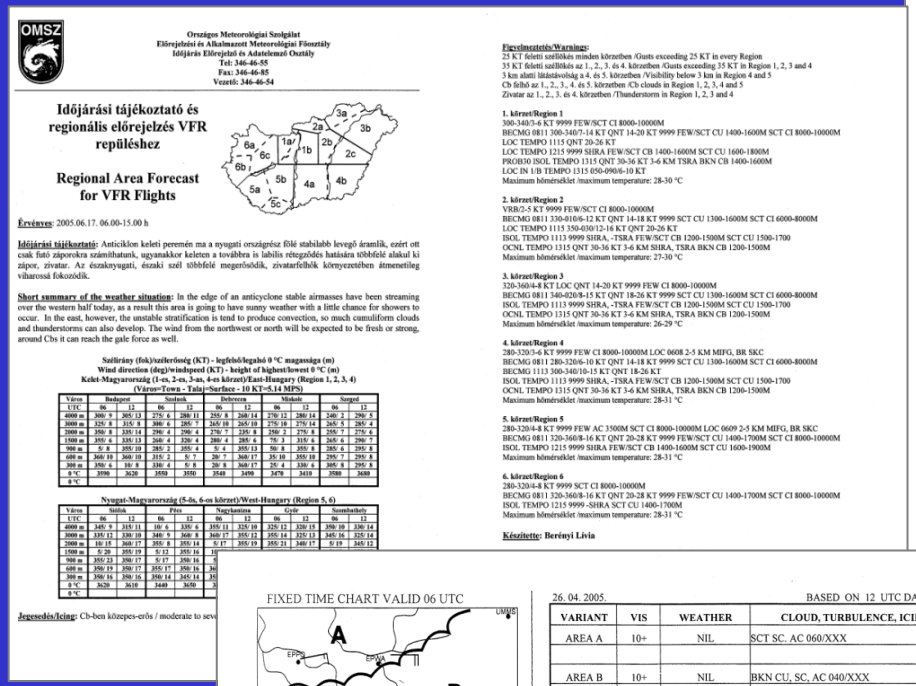
LANDING, TAF, SIGMET



For the international air traffic we prepare weather forecasts for the airports of Ferihegy and Debrecen three-hourly. Based on the recommendations of ICAO we give warnings if certain conditions exist or are expected to come to pass. Similarly, according to the recommendations of ICAO we prepare forecasts about expected weather phenomena influencing negatively the flight security in the lower 3000 meters of the atmosphere twice a day (in the morning and at noon).

OMSZ

VFR and sport flights



Országos Meteorológiai Szolgálat
Előrejelzési és Alkalmazott Meteorológiai Főosztály
Időjárás Előrejelzési és Adatelemző Osztály
Tel: 346-46-55
Fax: 346-46-85
Vezető: 346-46-54

Időjárási tájékoztató és regionális előrejelzés VFR repülőhöz

Regional Area Forecast for VFR Flights

Érvényes: 2005.06.17. 06.00-15.00 h

Időjárási tájékoztató: Anticiklon keleti peremén ma a nyugati országrész fölé stabilabb levegő áramlik, ezért ott csak futó záporokra számíthatunk, ugyanakkor keleten a továbbra is labilis rétegződés hatására többfelé alakul ki zápor, zivatar. Az északnyugati, északi szél többfelé megerősödik, zivatarfelhők környezetében átmenetileg viharosná fokozódik.

Short summary of the weather situation: In the edge of an anticyclone stable airmasses have been streaming over the western half today, as a result this area is going to have sunny weather with a little chance for showers to occur. In the east, however, the unstable stratification is tend to produce convection, so much cumuliform clouds and thunderstorms can also develop. The wind from the northwest or north will be expected to be fresh or strong, around Cbs it can reach the gale force as well.

Szélirány (fok)/szélerősség (KT) - legfelső/legalsó 0 °C magassága (m)
Wind direction (deg)/windspeed (KT) - height of highest/lowest 0 °C (m)
Kelet-Magyarország (1-es, 2-es, 3-as, 4-es körzet)/East-Hungary (Region 1, 2, 3, 4)
(Város=Town - Talaj=Surface - 10 KT=5,14 MPS)

Város	Budapest		Szolnok		Debrecen		Miskolc		Szeged	
UTC	06	12	06	12	06	12	06	12	06	12
4000 m	300/ 9	305/ 13	275/ 6	280/ 11	255/ 8	260/ 14	270/ 12	280/ 14	240/ 2	290/ 5
3000 m	325/ 8	315/ 8	300/ 6	285/ 7	265/ 10	265/ 10	275/ 10	275/ 14	265/ 5	285/ 4
2000 m	350/ 8	335/ 14	290/ 4	290/ 6	270/ 7	285/ 8	260/ 2	270/ 8	255/ 7	275/ 6
1500 m	355/ 6	335/ 13	260/ 4	320/ 4	280/ 4	285/ 8	75/ 3	315/ 6	265/ 6	290/ 7
900 m	5/ 8	355/ 10	285/ 2	355/ 4	5/ 4	355/ 13	50/ 8	355/ 8	285/ 6	295/ 8
600 m	360/ 10	360/ 10	315/ 2	5/ 7	20/ 7	360/ 17	35/ 10	355/ 10	295/ 7	295/ 8
300 m	350/ 6	10/ 8	330/ 4	6/ 8	20/ 8	360/ 17	25/ 4	330/ 6	305/ 8	295/ 8
0 °C	2090	2620	3550	3550	3540	3490	3470	3410	3580	3680
0 °C										

Nyugat-Magyarország (5-ös, 6-os körzet)/West-Hungary (Region 5, 6)

Város	Siófok		Pécs		Nagykanizsa		Győr		Szombathely	
UTC	06	12	06	12	06	12	06	12	06	12
4000 m	345/ 9	315/ 11	310/ 6	335/ 6	355/ 11	325/ 10	325/ 12	320/ 15	350/ 10	330/ 14
3000 m	335/ 12	330/ 10	340/ 9	360/ 8	360/ 17	355/ 12	355/ 14	325/ 13	345/ 16	325/ 14
2000 m	10/ 15	360/ 17	355/ 8	355/ 14	5/ 17	355/ 19	355/ 21	340/ 17	9/ 19	345/ 12
1500 m	6/ 20	355/ 19	5/ 12	355/ 16						
900 m	355/ 23	350/ 17	5/ 17	350/ 16						
600 m	350/ 19	350/ 17	355/ 17	350/ 16						
300 m	350/ 16	350/ 16	350/ 14	345/ 14						
0 °C	3620	3610	3440	3450						
0 °C										

Jegesedés/Icing: Cb-ben közepes-erős / moderate to sev

Figyelmeztetés/Warnings:
25 KT feletti széllökés minden körzetben /Gusts exceeding 25 KT in every Region
35 KT feletti szélllökés az 1., 2., 3. és 4. körzetben /Gusts exceeding 35 KT in Region 1, 2, 3 and 4
3 km alatti látástávolság a 4. és 5. körzetben /Visibility below 3 km in Region 4 and 5
Cb felhő az 1., 2., 3., 4. és 5. körzetben /Cb clouds in Region 1, 2, 3, 4 and 5
Zivatar az 1., 2., 3. és 4. körzetben /Thunderstorm in Region 1, 2, 3 and 4

1. körzet/Region 1
300-340/3-6 KT 9999 FEW/SCT CI 8000-10000M
BECMG 0811 300-340/7-14 KT QNT 14-20 KT 9999 FEW/SCT CU 1400-1600M SCT CI 8000-10000M
LOC TEMPO 1115 QNT 20-26 KT
LOC TEMPO 1215 9999 SHRA FEW/SCT CB 1400-1600M SCT CU 1600-1800M
PROB30 ISOL TEMPO 1315 QNT 30-36 KT 3-6 KM TSRA BKN CB 1400-1600M
LOC IN 1/B TEMPO 1315 050-090/6-10 KT
Maximum hőmérséklet /maximum temperature: 28-30 °C

2. körzet/Region 2
VRB/2-5 KT 9999 FEW/SCT CI 8000-10000M
BECMG 0811 330-010/6-12 KT QNT 14-18 KT 9999 SCT CU 1300-1600M SCT CI 6000-8000M
LOC TEMPO 1115 350-030/12-16 KT QNT 20-26 KT
ISOL TEMPO 1113 9999 SHRA, -TSRA FEW/SCT CB 1200-1500M SCT CU 1500-1700
OCNL TEMPO 1315 QNT 30-36 KT 3-6 KM SHRA, TSRA BKN CB 1200-1500M
Maximum hőmérséklet /maximum temperature: 27-30 °C

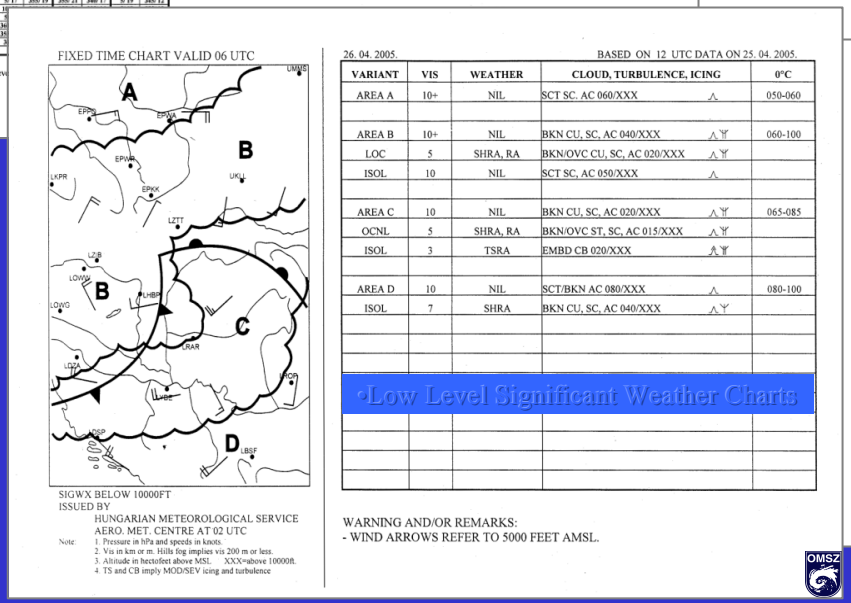
3. körzet/Region 3
320-360/4-8 KT LOC QNT 14-20 KT 9999 FEW CI 8000-10000M
BECMG 0811 340-020/8-15 KT QNT 18-26 KT 9999 SCT CU 1300-1600M SCT CI 6000-8000M
ISOL TEMPO 1113 9999 SHRA, -TSRA FEW/SCT CB 1200-1500M SCT CU 1500-1700
OCNL TEMPO 1315 QNT 30-36 KT 3-6 KM SHRA, TSRA BKN CB 1200-1500M
Maximum hőmérséklet /maximum temperature: 26-29 °C

4. körzet/Region 4
280-320/3-6 KT 9999 FEW CI 8000-10000M LOC 0608 2-5 KM MIFG, BR SKC
BECMG 0811 280-320/6-10 KT QNT 14-18 KT 9999 SCT CU 1300-1600M SCT CI 6000-8000M
BECMG 1113 300-340/10-15 KT QNT 18-26 KT
ISOL TEMPO 1113 9999 SHRA, -TSRA FEW/SCT CB 1200-1500M SCT CU 1500-1700
OCNL TEMPO 1315 QNT 30-36 KT 3-6 KM SHRA, TSRA BKN CB 1200-1500M
Maximum hőmérséklet /maximum temperature: 28-31 °C

5. körzet/Region 5
280-320/4-8 KT 9999 FEW AC 3500M SCT CI 8000-10000M LOC 0609 2-5 KM MIFG, BR SKC
BECMG 0811 320-360/8-16 KT QNT 20-28 KT 9999 FEW/SCT CU 1400-1700M SCT CI 8000-10000M
ISOL TEMPO 1215 9999 SHRA FEW/SCT CB 1400-1600M SCT CU 1600-1900M
Maximum hőmérséklet /maximum temperature: 28-31 °C

6. körzet/Region 6
280-320/4-8 KT 9999 SCT CI 8000-10000M
BECMG 0811 320-360/8-16 KT QNT 20-28 KT 9999 FEW/SCT CU 1400-1700M SCT CI 8000-10000M
ISOL TEMPO 1215 9999 -SHRA SCT CU 1400-1700M
Maximum hőmérséklet /maximum temperature: 28-31 °C

Készítette: Berényi Lívia



FIXED TIME CHART VALID 06 UTC

SIGWX BELOW 10000FT
ISSUED BY
HUNGARIAN METEOROLOGICAL SERVICE
AERO. MET. CENTRE AT 02 UTC

Note: 1. Pressure in hPa and speeds in knots.
2. Vis in km or m. Hills fog implies vis 200 m or less.
3. Altitude in hectofeet above MSL. XXX=above 10000ft.
4. TS and CB imply MOD/SEV icing and turbulence

26. 04. 2005. BASED ON 12 UTC DATA ON 25. 04. 2005.

VARIANT	VIS	WEATHER	CLOUD, TURBULENCE, ICING	0°C
AREA A	10+	NIL	SCT SC. AC 060/XXX	050-060
AREA B	10+	NIL	BKN CU, SC, AC 040/XXX	060-100
LOC	5	SHRA, RA	BKN/OVC CU, SC, AC 020/XXX	
ISOL	10	NIL	SCT SC, AC 050/XXX	
AREA C	10	NIL	BKN CU, SC, AC 020/XXX	065-085
OCNL	5	SHRA, RA	BKN/OVC ST, SC, AC 015/XXX	
ISOL	3	TSRA	EMBD CB 020/XXX	
AREA D	10	NIL	SCT/BKN AC 080/XXX	080-100
ISOL	7	SHRA	BKN CU, SC, AC 040/XXX	

Low Level Significant Weather Charts

WARNING AND/OR REMARKS:
- WIND ARROWS REFER TO 5000 FEET AMSL.

Mountain wave forecast for gliders

Date: 30.10.1996.

Synoptic summary: Post-frontal situation. The north-westerly wind will be strong, on the eastern part of Hungary stormy. In the higher layers the characteristic wind direction will be NW too. Some showers will be possible in the afternoon because of the high level cold drop above the Carpathian-Basin. The development of mountain waves may be expected in the afternoon.

Outlook: Westerly airstream, stable stratification, variable clouds.

User's guide:
On the following two pages you can find the meteorological information for gliding in the mountain wave areas of the mountain Börzsöny, Mátra, Mecsek and the Alps.
The values are calculated for 06, 12 UTC and for the next day 06 UTC.
The information are the follows:
- The average temperature of the 500 m layers (^{0}C)
- The average temperature gradient of the 500 m layers (^{0}C/100 m)
- The average wind direction (degree)
- The average wind speed (m/s)
- The wind component normal to the ridge (m/s)
- The Scorer parameter calculated from the average wind speed ($1/km^2$)
- The Scorer parameter calculated from the wind component normal to the ridge

The Scorer parameter is defined as
$l^2 = (g/T)\,(\gamma_{ac} - \gamma)\,/\,(u)^2$, where
T: the temperature of the layer
g: the gravity acceleration
γ_{ac}: the dry adiabatic temperature gradient
γ: the temperature gradient
u: the wind speed

There are good conditions for the mountain wave gliding, when the values of the Scorer parameter is between 1 and 2 in the 1000m-2000m layer, and the values are between 0.6 and 0 above 2000m in decreasing manner

Forecaster :János Bozó

Forecast for Hot Air Balloonists

Date: 03-07-2001

Synoptic situation: Cold and wet air is situated above Hungary. Sky will be covered in NE part of Hungary, and there will be much rain and showers. In other places it will be cloudy with local showers. In the afternoon hours thunderstorms and strong gusts are possible.

Warnings: Gusts above 12 mps, Cb clouds and thunderstorms are possible.

Outlook: Warming, local showers and thunderstorms.

Forecaster: István Fóti

Wind forecast
(Heights above sea level !!!)
2001.07. 03. 06 UTC

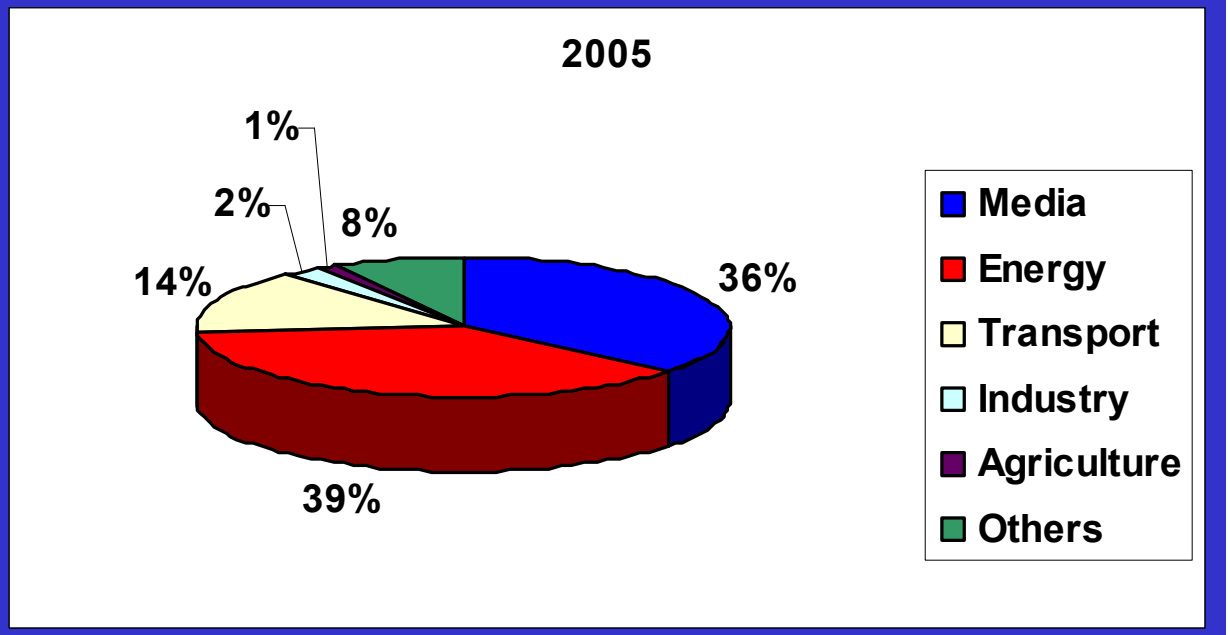
City	Budapest		Debrecen		Miskolc		Szeged		Siófok		Pécs		Győr		Szombathely	
	fok	m/s	fok	m/s	fok	m/s	fok	m/s	fok	m/s	fok	m/s	fok	m/s	fok	m/s
2000 m	5	5	350	5	335	6	10	4	15	5	340	4	350	8	10	5
1500 m	355	5	10	5	15	6	20	5	10	6	335	6	5	8	10	5
900 m	350	5	25	8	25	9	25	7	5	10	5	9	5	9	5	10
600 m	350	5	25	8	15	7	25	7	355	10	350	8	350	8	350	9
300 m	340	4	10	8	340	5	15	6	335	8	350	6	345	7	350	7
10 m	350	3	5	4	330	3	360	3	340	4	340	3	340	4	345	4
Height of 0 degree	2587		2968		2740		2766		2528		2754		2410		2526	

Commercial activity

The market sectors:

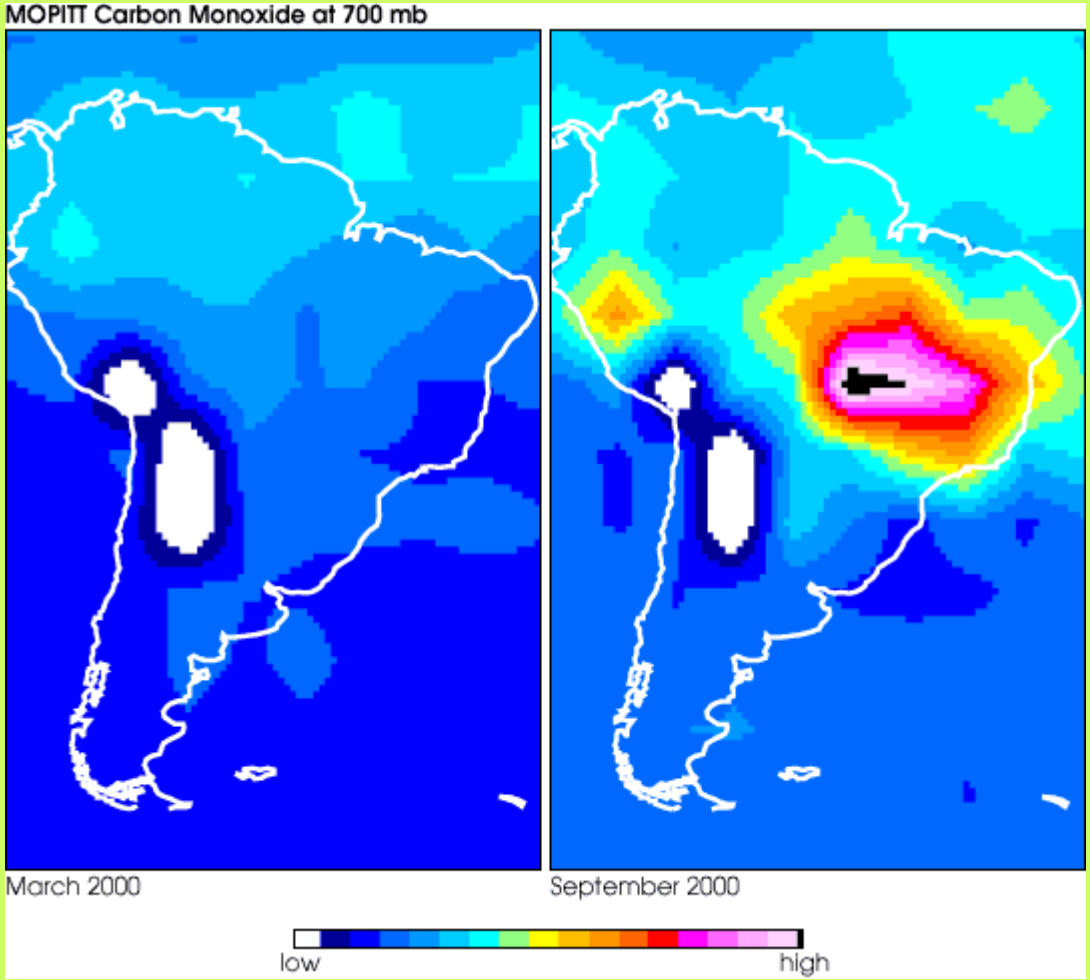
- Media (Radio, TV, press)
- Energy
- Land transport
- Industry
- Construction
- Agriculture
- Others

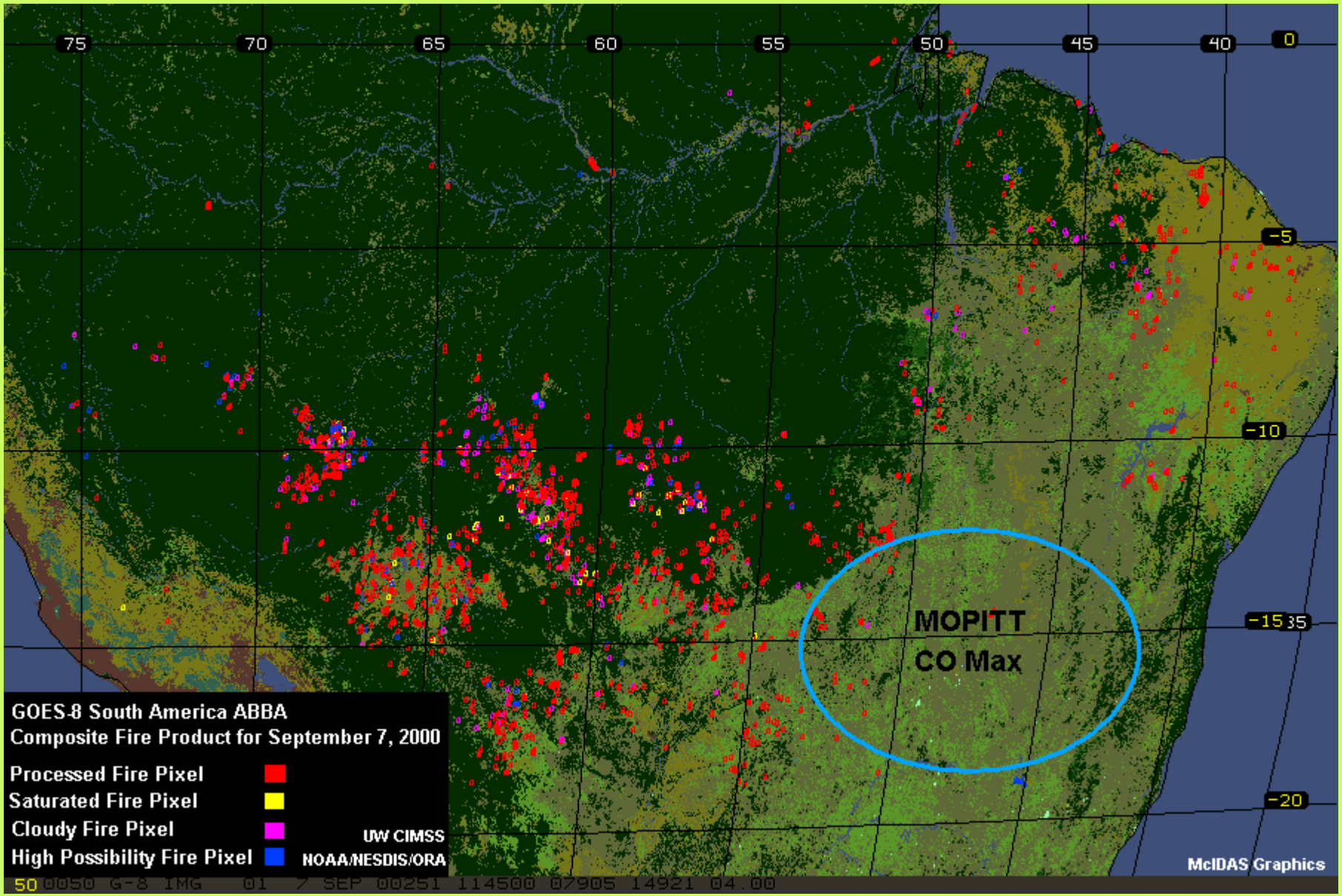
Distribution of Commercial Revenue



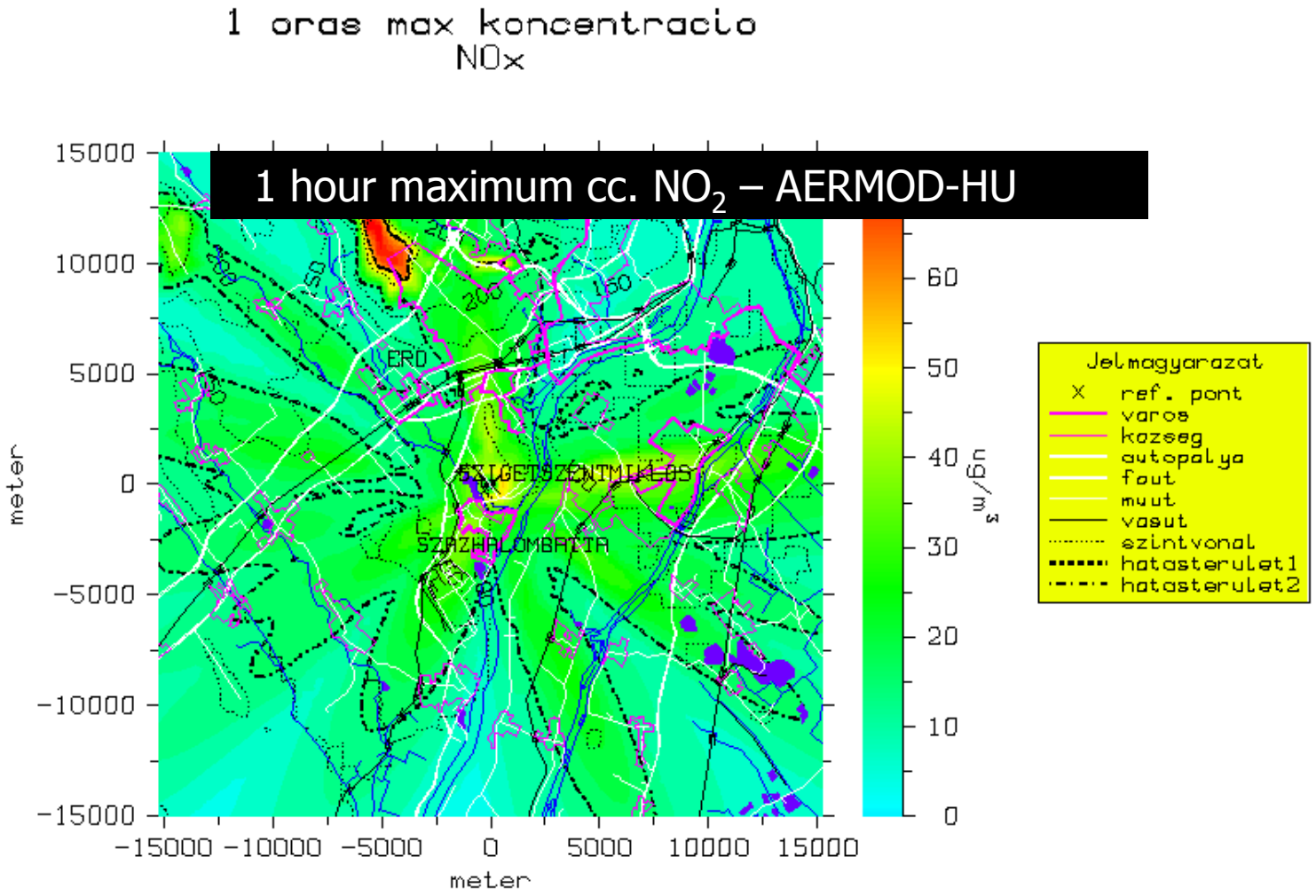
Commercial revenue in 2005: 1.5 million EURO

CO - peaks: South America




75
70
65
60
55
50
45
40
0
-5
-10
-15
-20
35
MOPITT
CO Max
GOES-8 South America ABBA
Composite Fire Product for September 7, 2000
Processed Fire Pixel
Saturated Fire Pixel
Cloudy Fire Pixel
High Possibility Fire Pixel
UW CIMSS
NOAA/NESDIS/ORA
McIDAS Graphics
50 0050 G-8 IMG 01 7 SEP 00251 114500 07905 14921 04.00

Air Quality Modelling – Local Scale



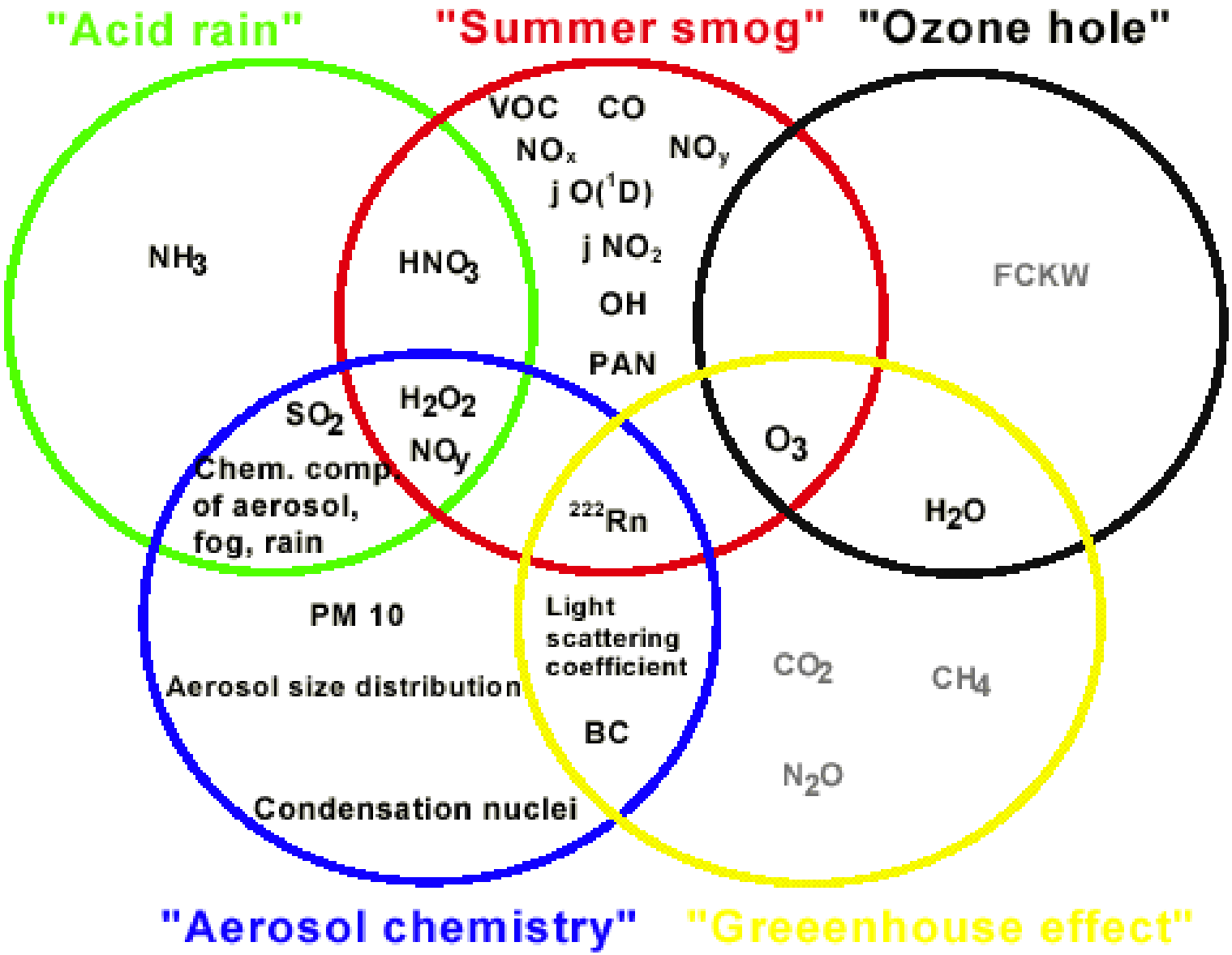
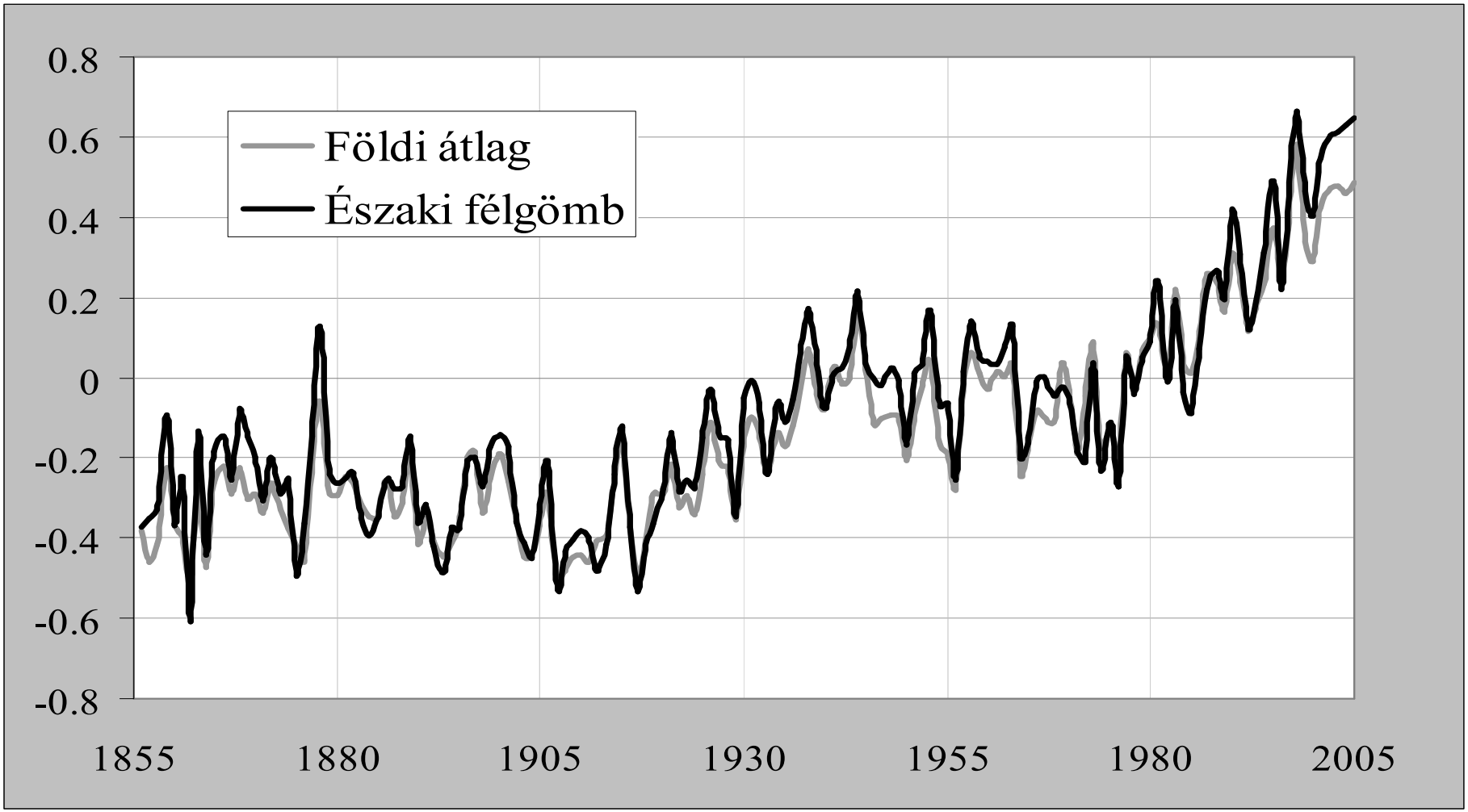


Fig. 2: *Actual research topics in atmospheric chemistry. Black: parameters measured at MOHp. Grey: Parameters only measured at Zugspitze by Umweltbundesamt*


0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
Földi átlag
Északi félgömb
1855
1880
1905
1930
1955
1980
2005

Activities on climate

Database: monitoring, recording, „meta"-data;

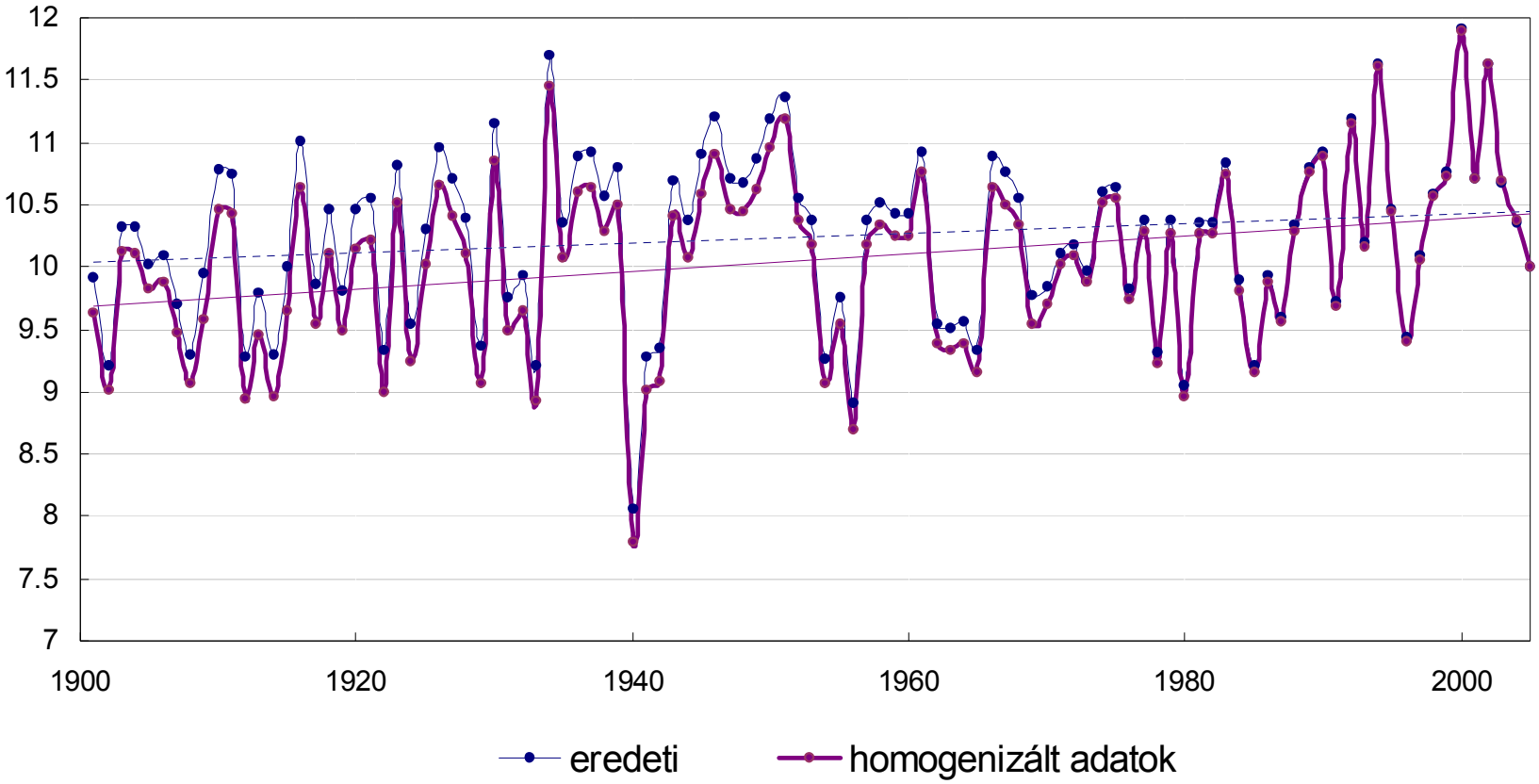
Diagnose of the climate change: homogenization, trend analysis of averages and extremities, statistical downscaling;

Services, expertise: data services, extreme value estimations, soatial interpolation;

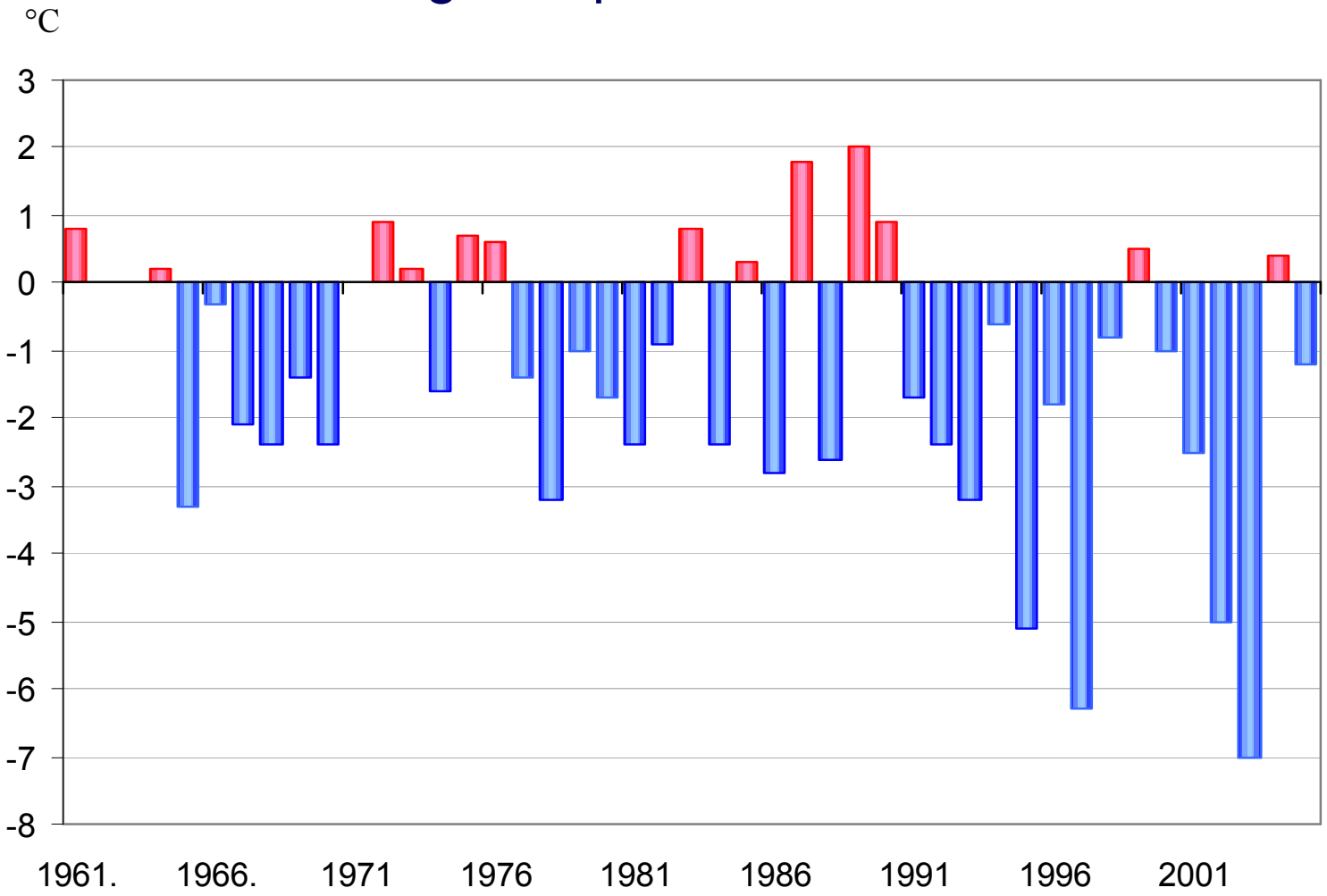
Climate applications: agro-, hydro- and human bio-climatology; energy-meteorology, environmental protection;

Regional climate modeling: development, verification, dinamic downscaling;

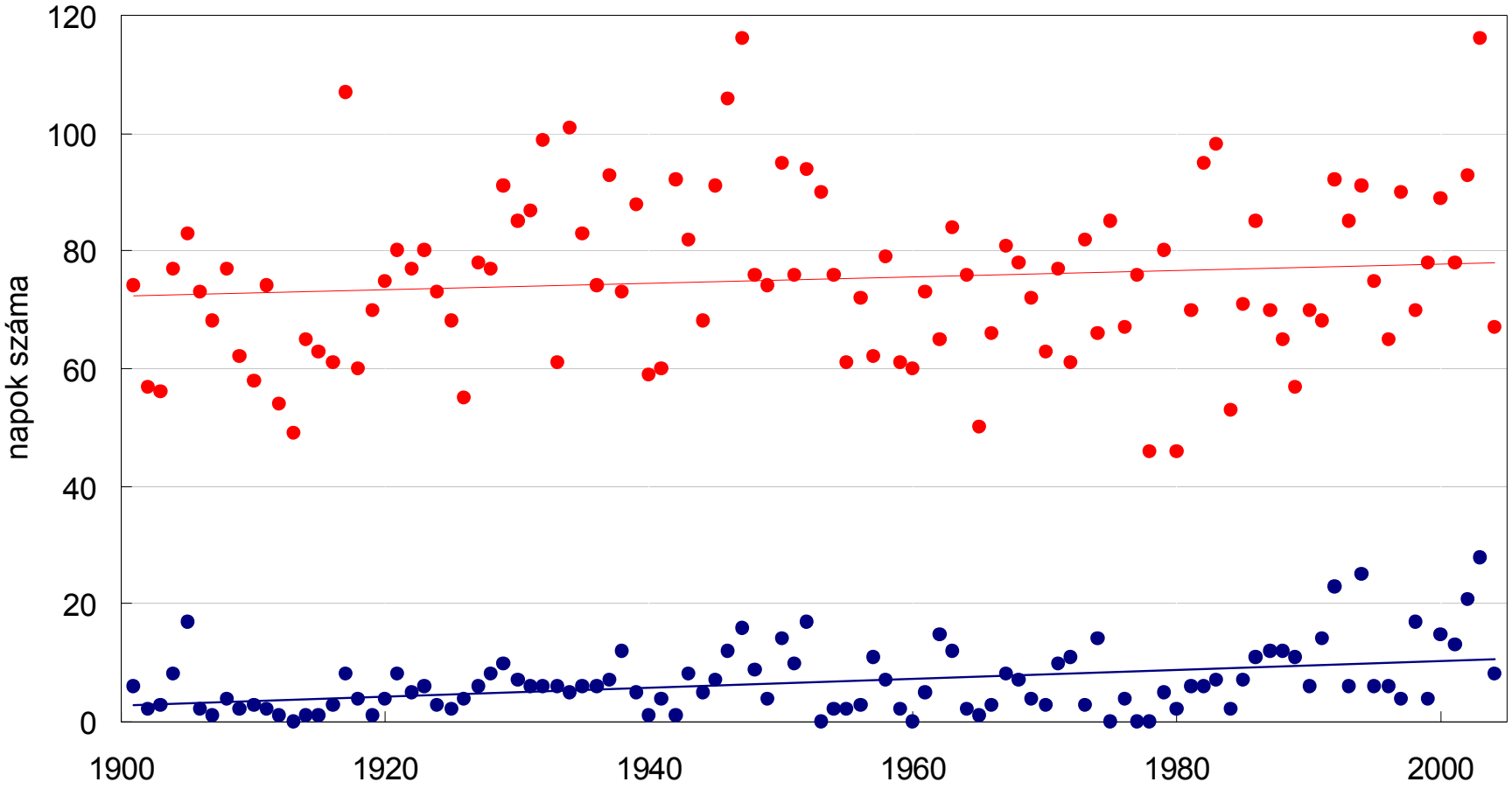
Original and homogenized annual mean temperature data calculated from the data 15 stations in Hungary (1901-2005), with the fitted linear trend lines



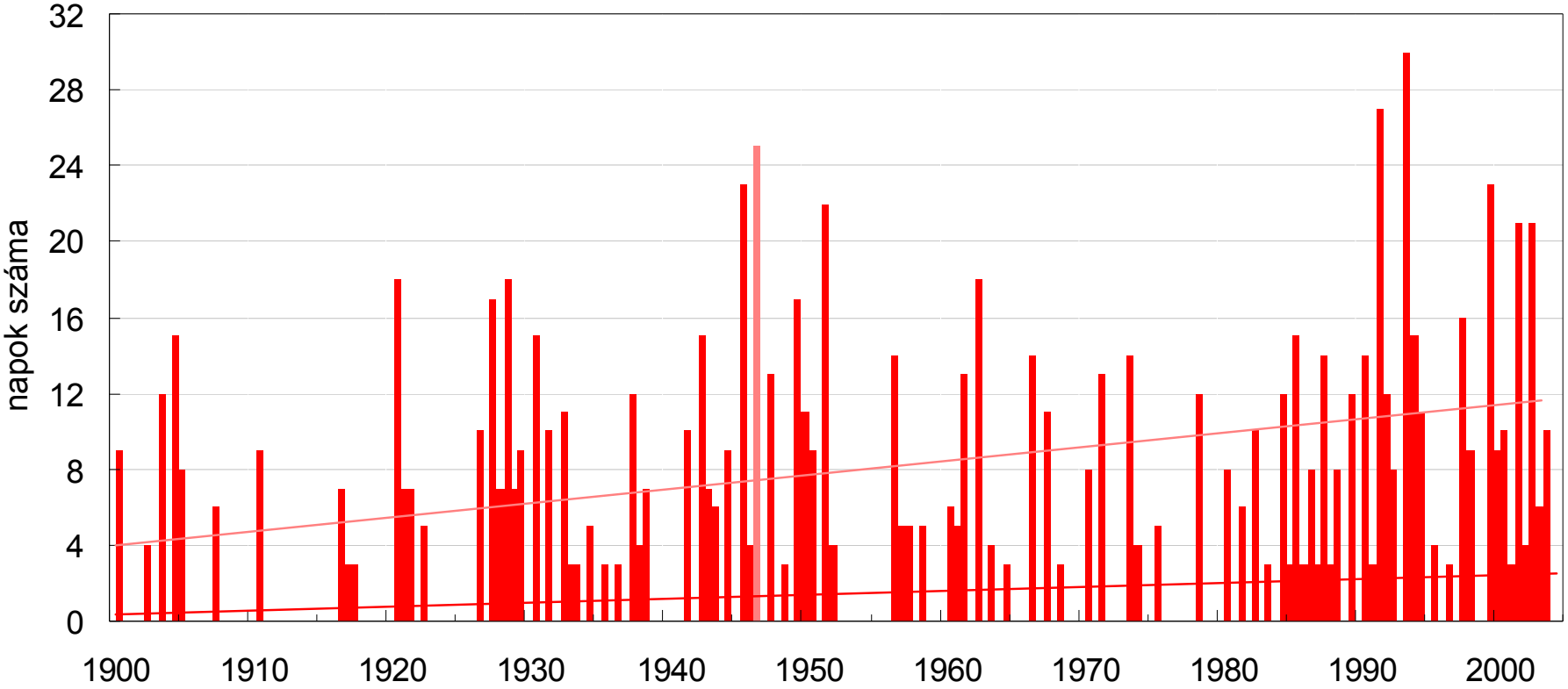
Absolute minimum temperatures, Szeged, April, 1971-2005



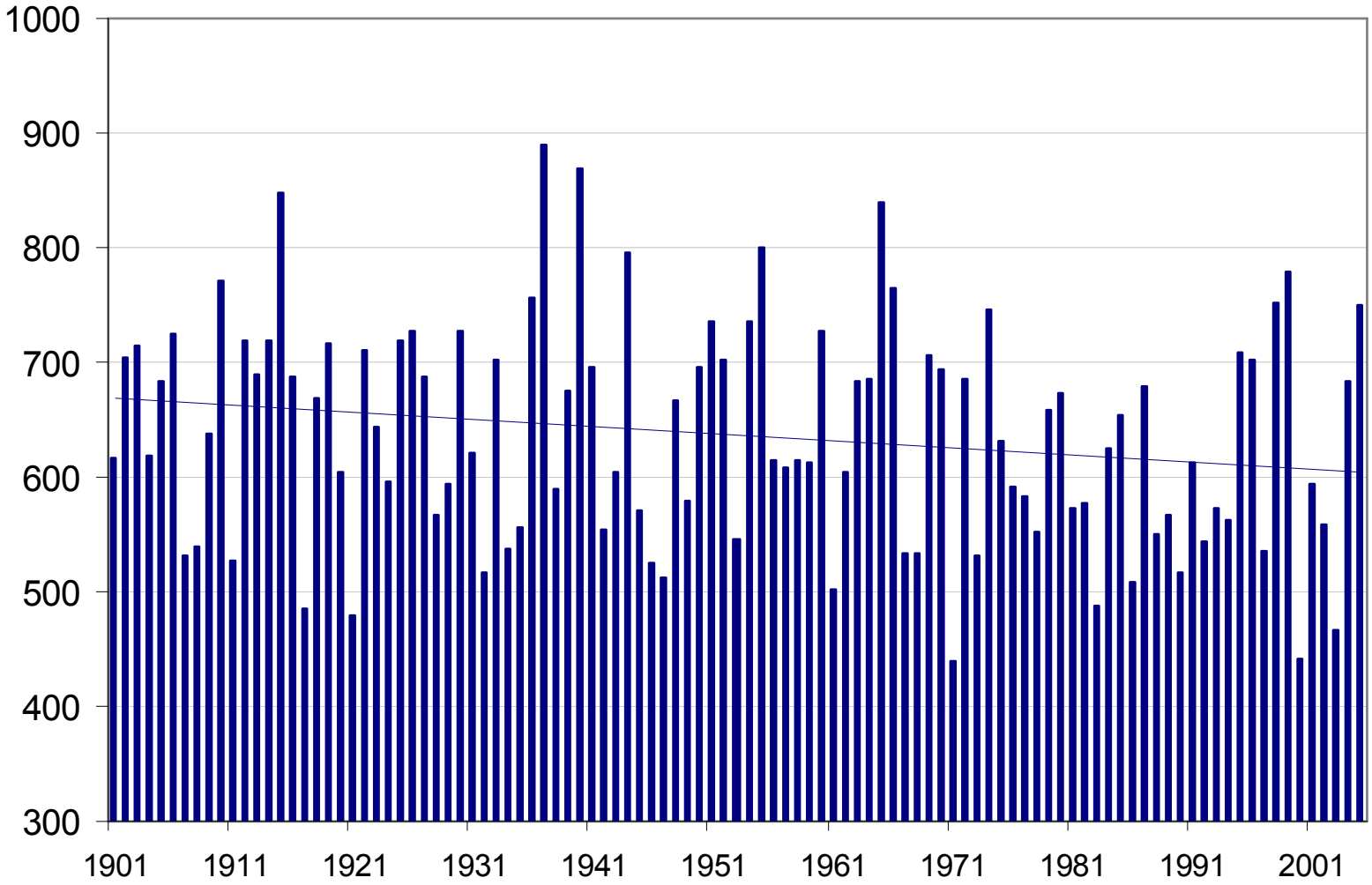
Summer days (T_{max} > 25°C) and tropic nights (T_{min} > 20 °C), Budapest, 1901-2004



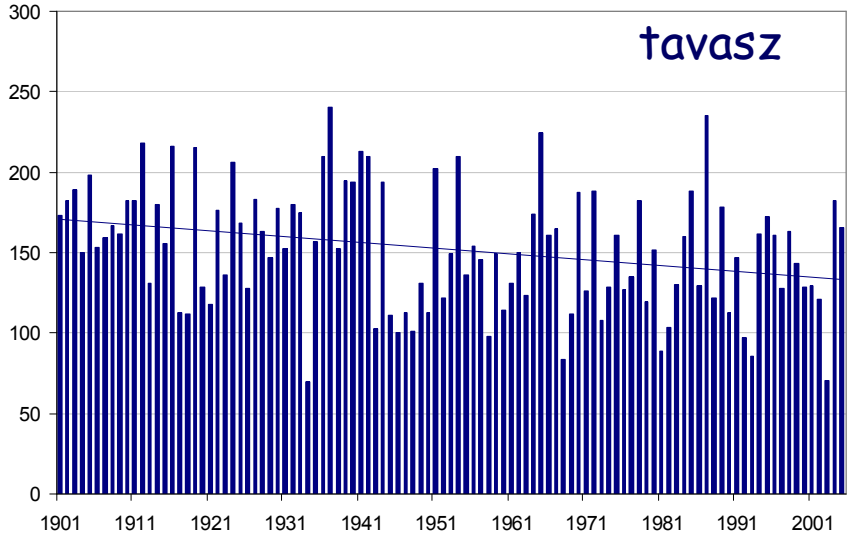
Heat waves (daily mean temperature ≥25°C at least on 3 consecutive days), Budapest, 1901-2004

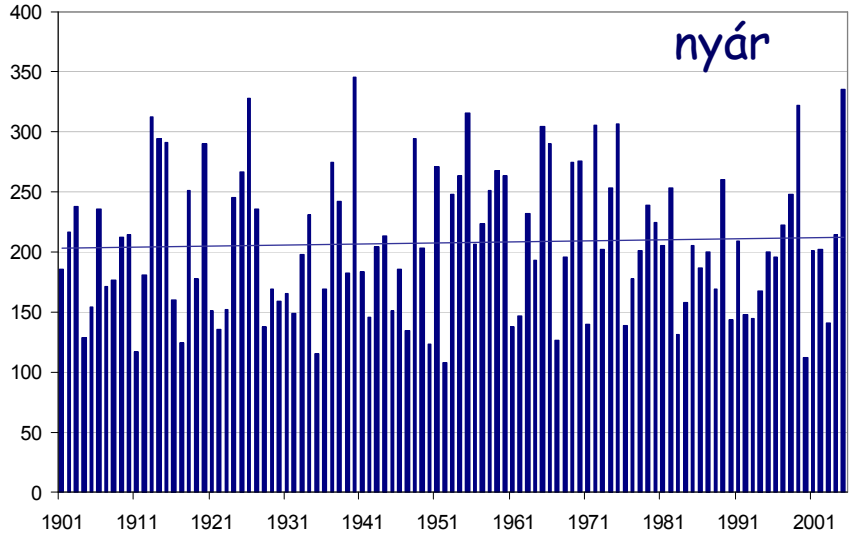


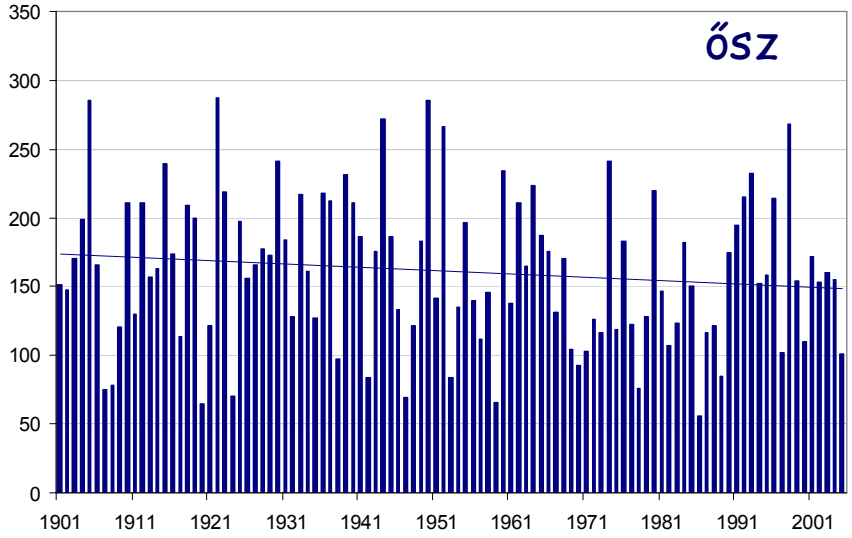
National mean of the annual sum of precipitation with linear trend, 37 stations, homogenized data

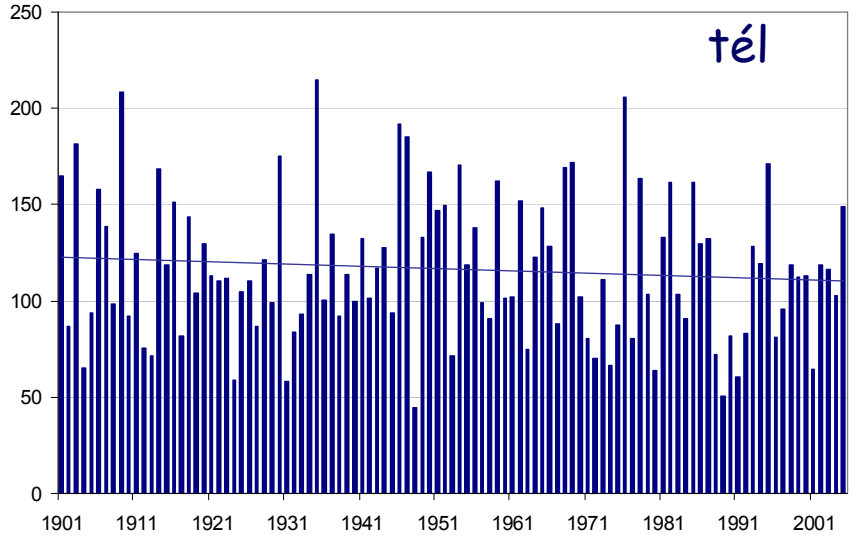


National means of the seasonal sum of precipitation, 37 stations, 1901-2005



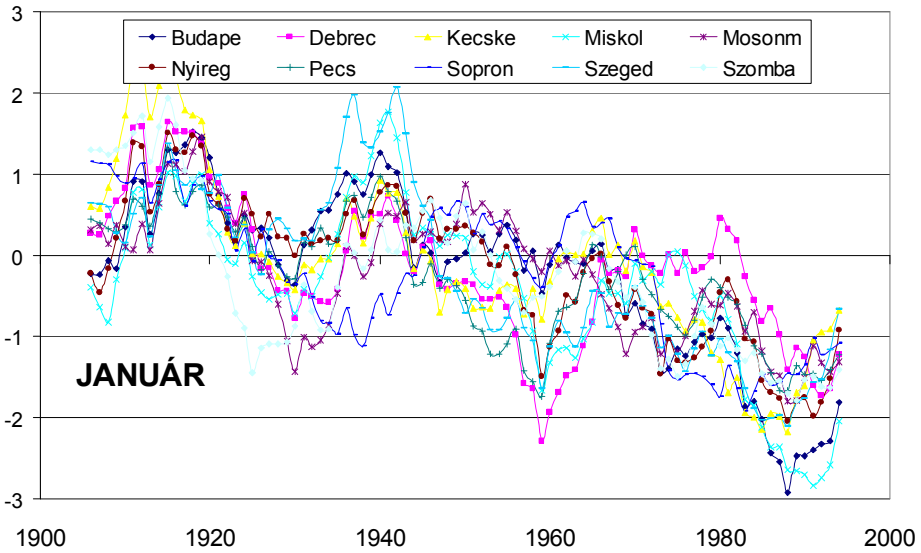


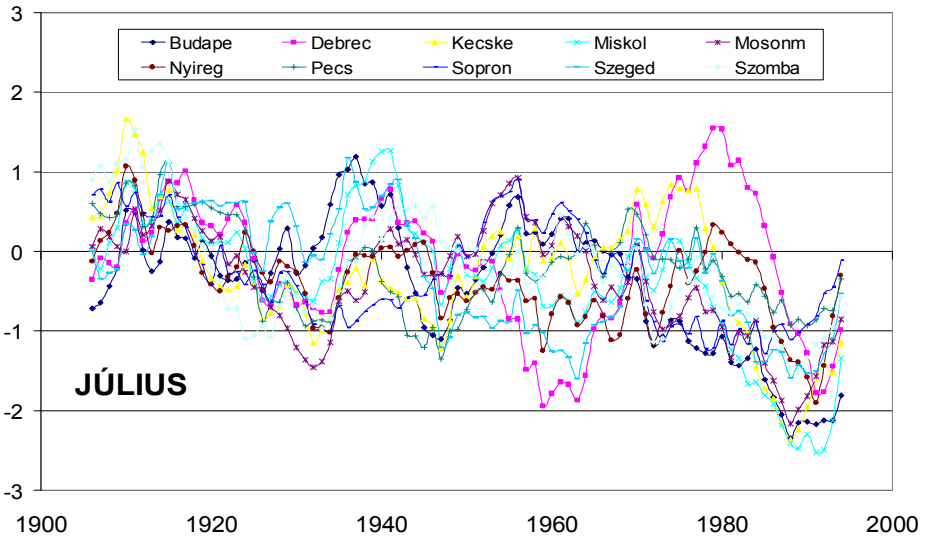


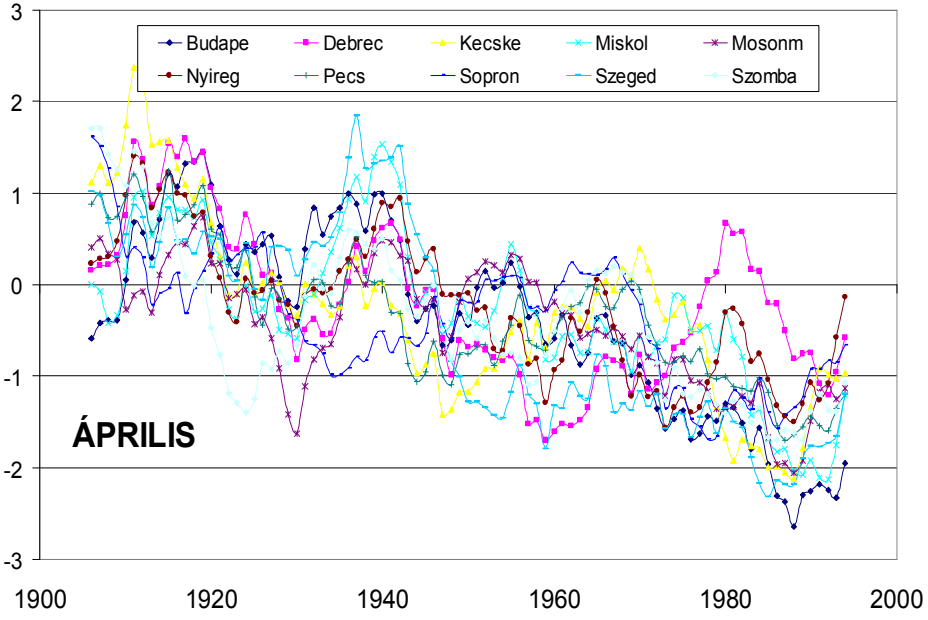


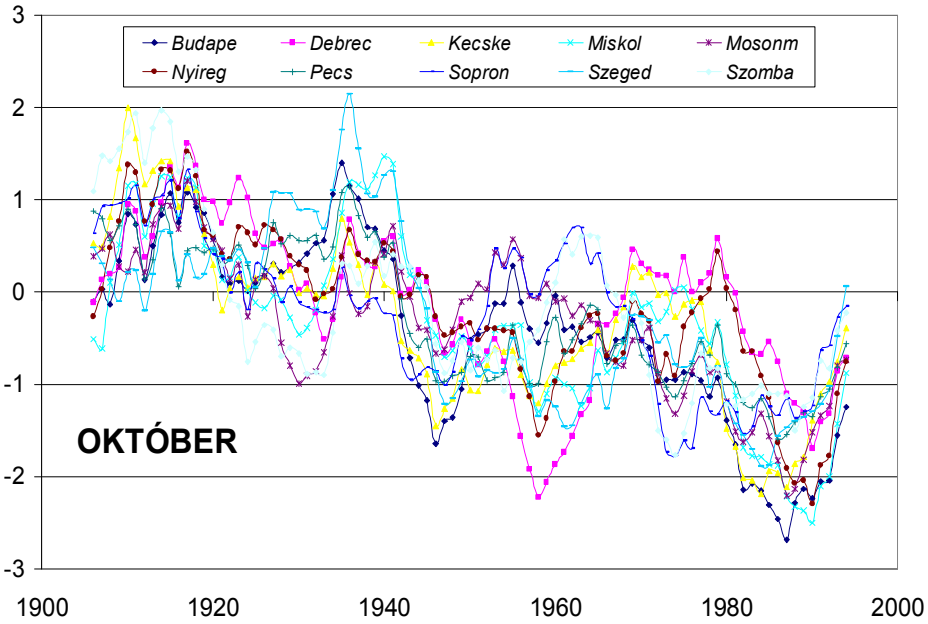
OMSZ

Thermal and hygric trends: drying (PDSI)

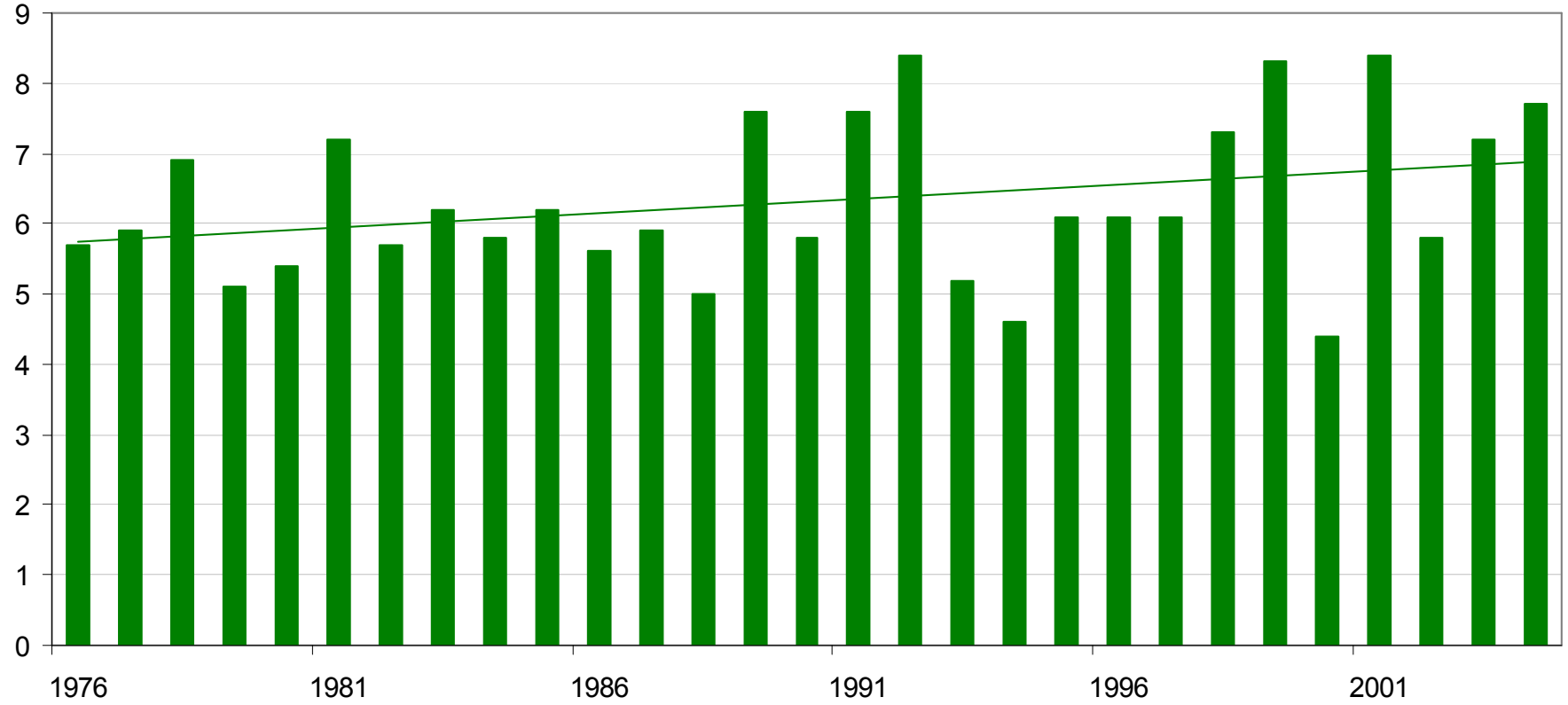




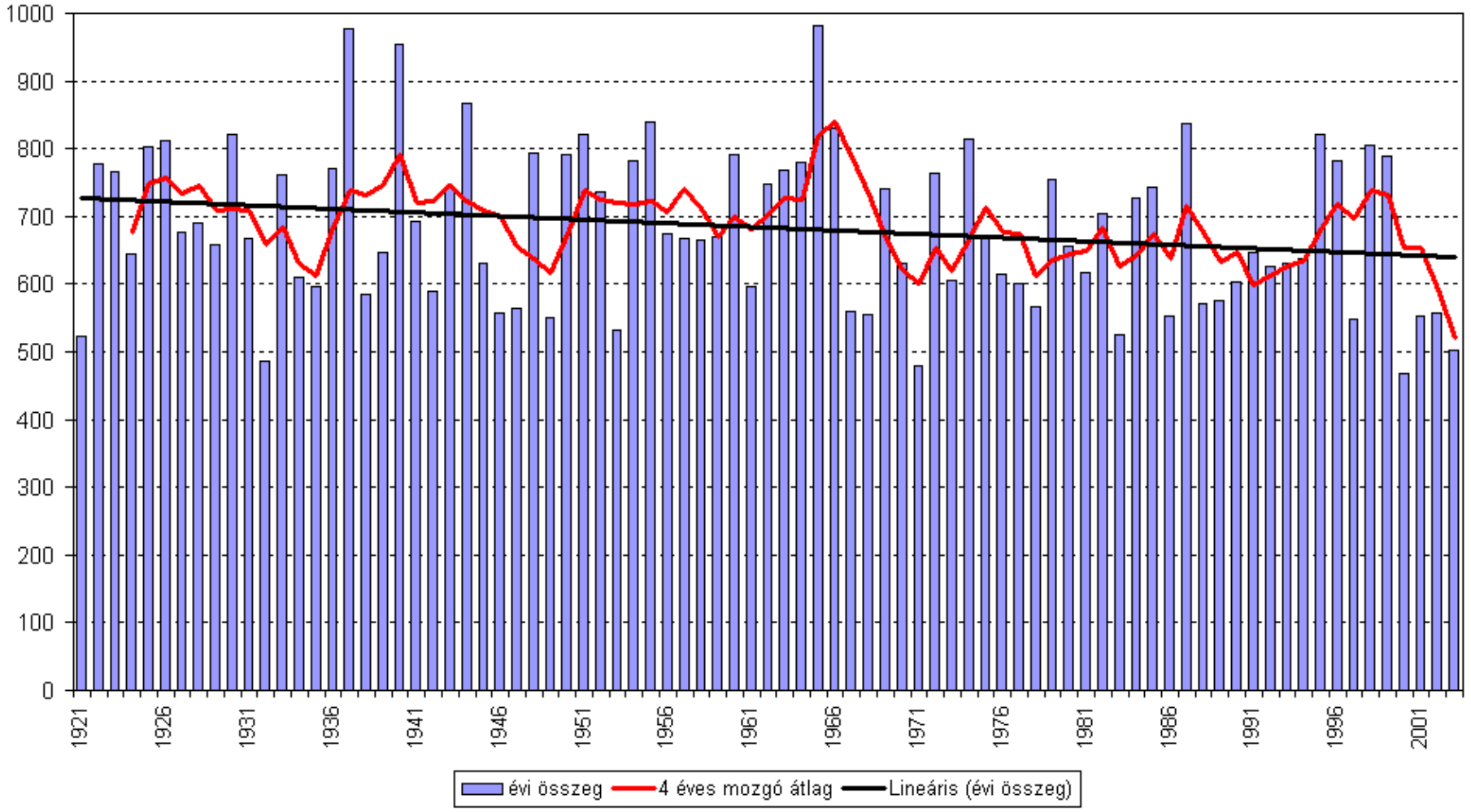




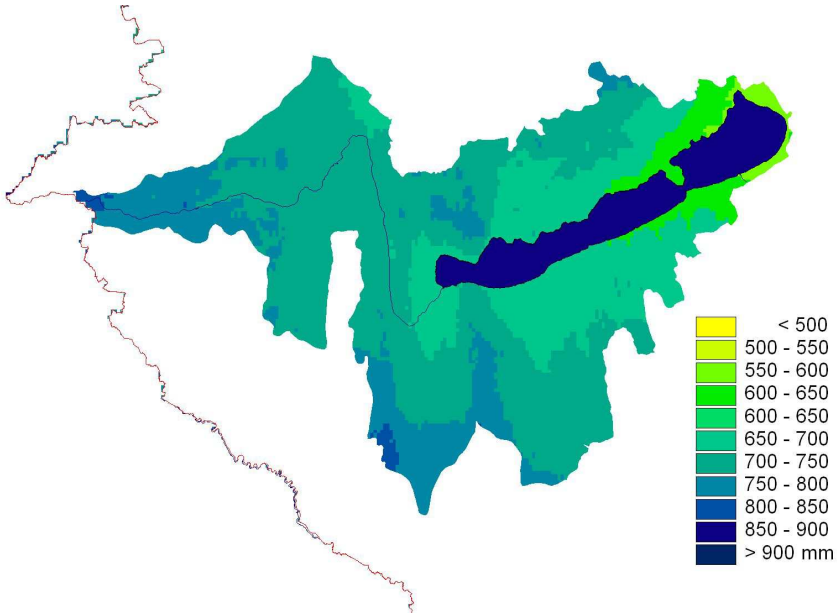
Daily mean precipitation (mean precipitation amount on rainy days), mm/day Szeged, 1976-2004



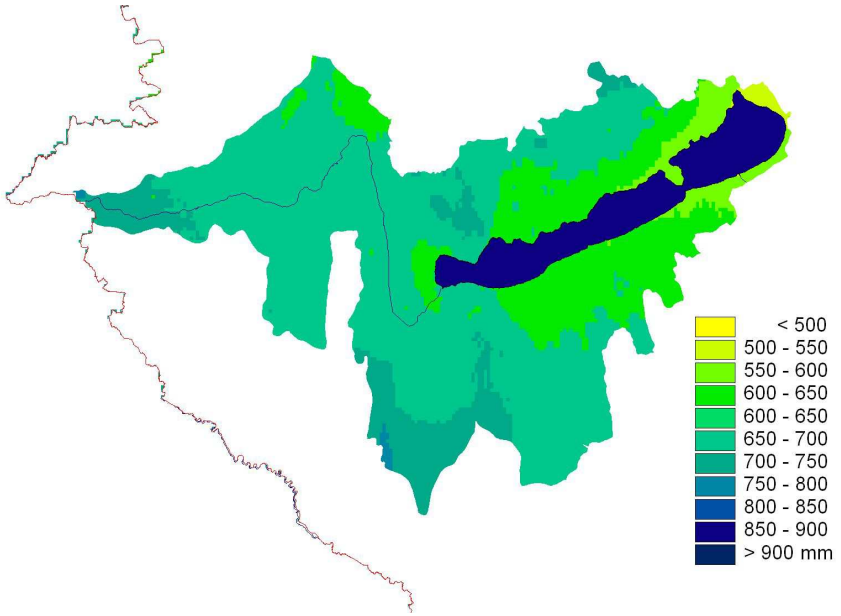
Annual sum of precipitation (mm) at the catchment area of the Lake Balaton, 1921 - 2003



Change of the annual sum of precipitation at the catchment ara of the Lake Balaton, 1955 - 2004



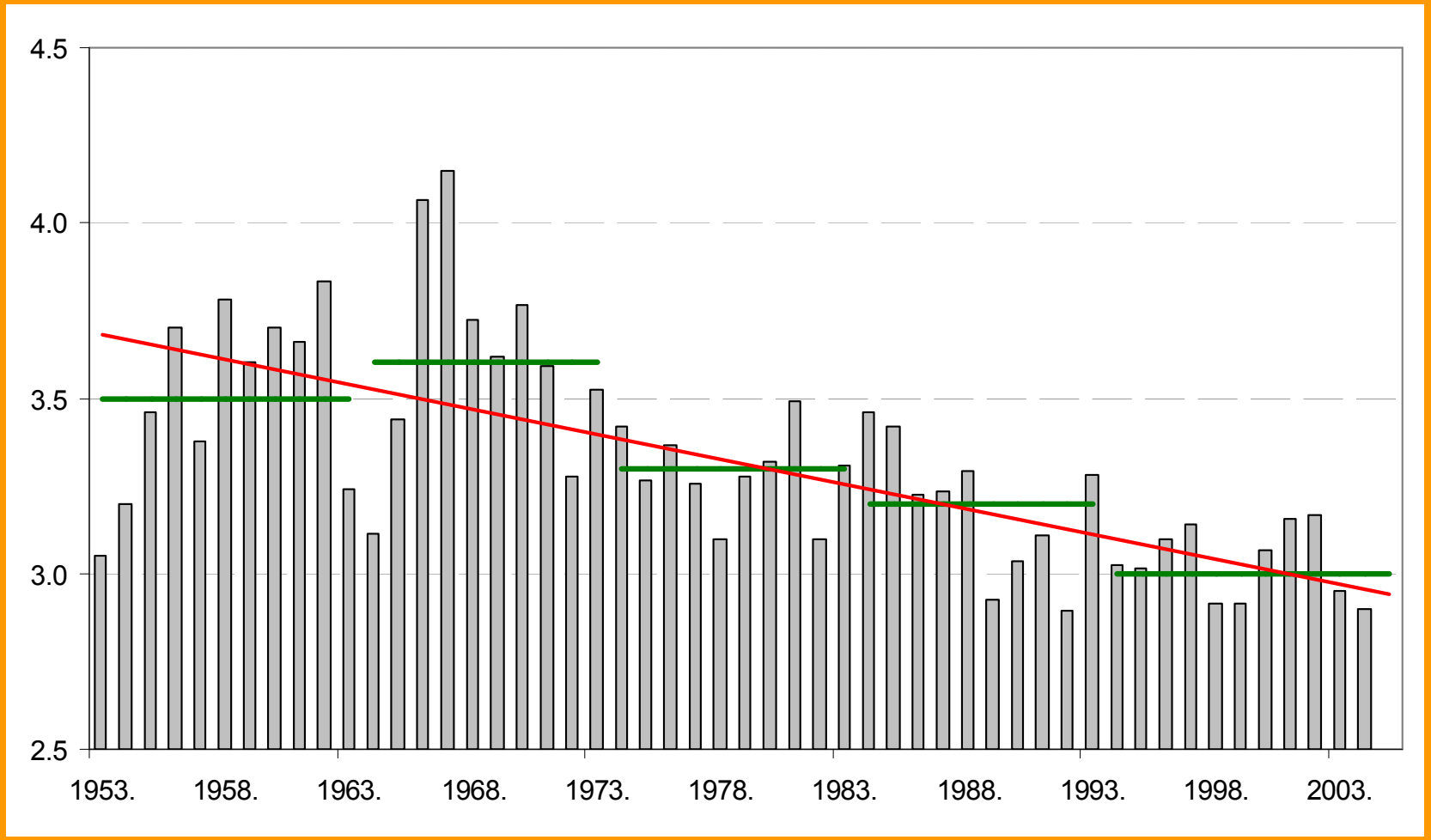
Annual sum of precipitation,
1955 - 1984



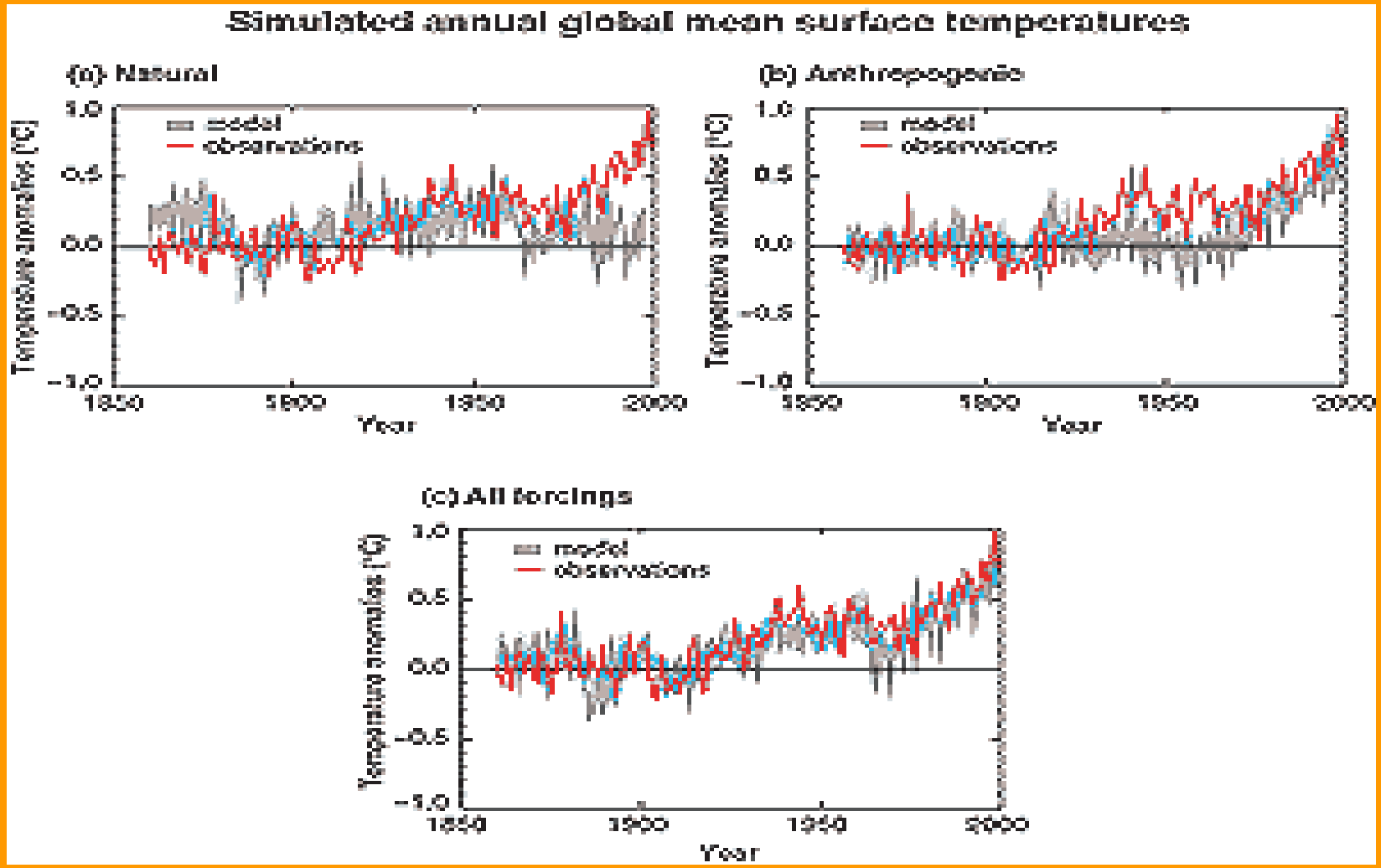
Annual sum of precipitation
1975 - 2004

OMSZ

Mean annual wind speed at Szeged, with the linear trend (red) and the 10-year averages (green)

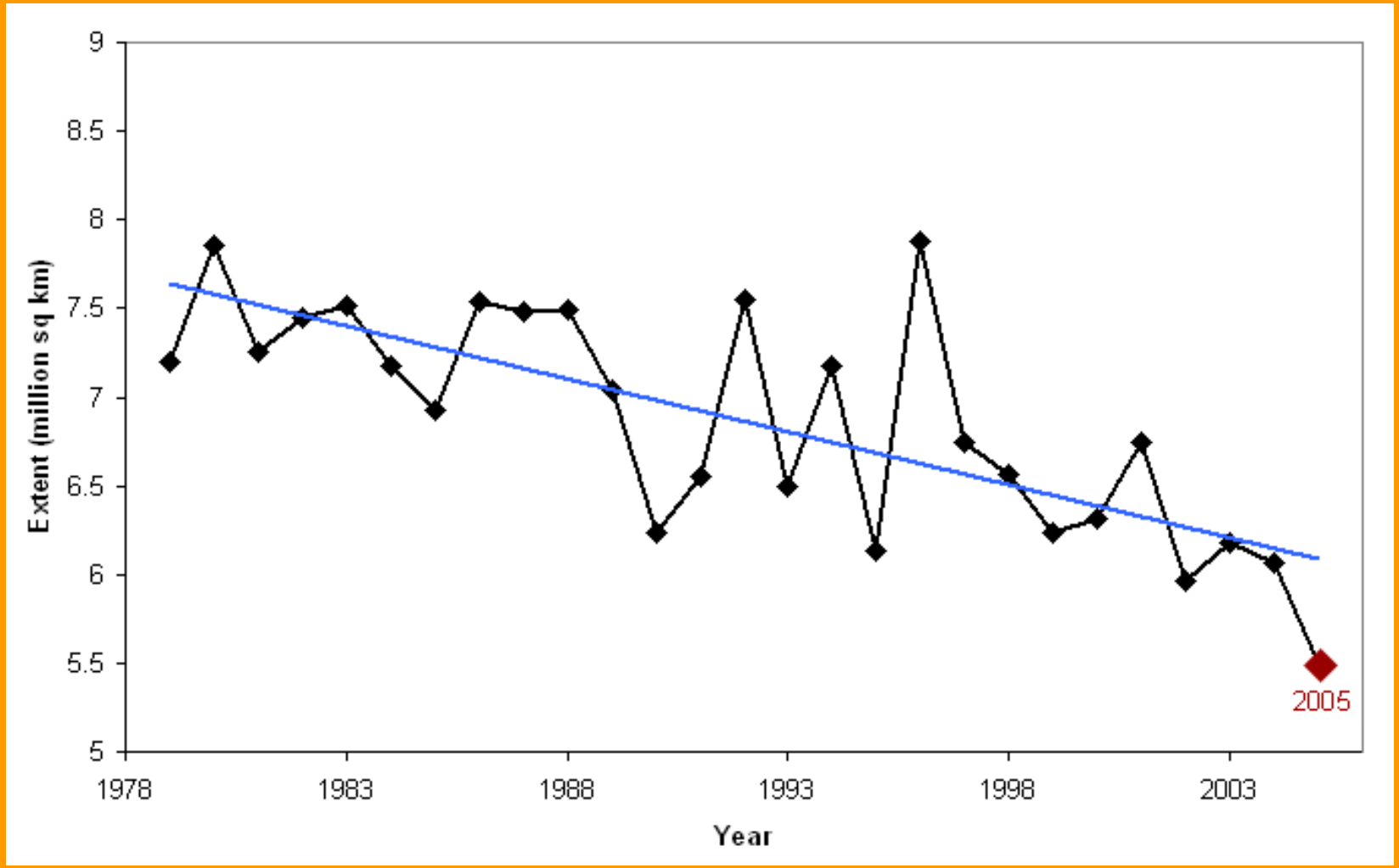


Natural and anthropogenic factors explain together

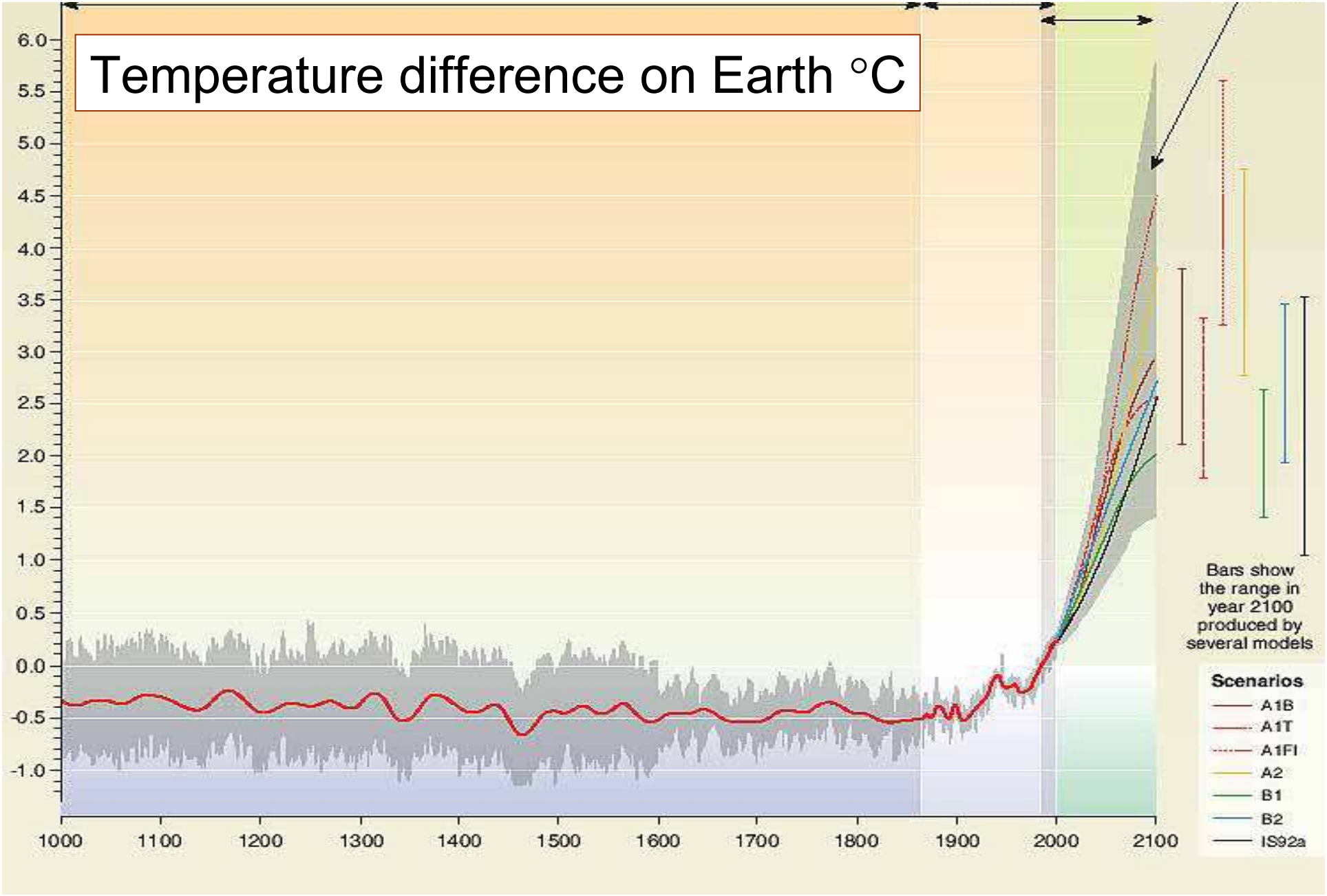


2005 – the lowest sea ice extent

since the start of the measurements



Indirect reconstruction measurement scenario

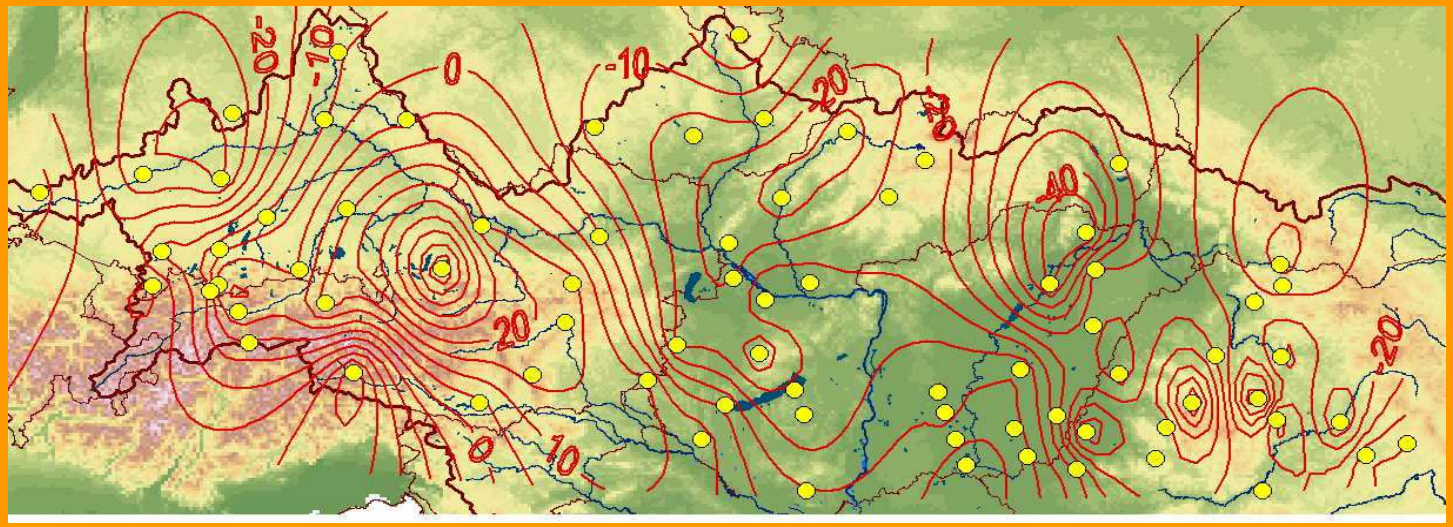


Impact assessment apllications

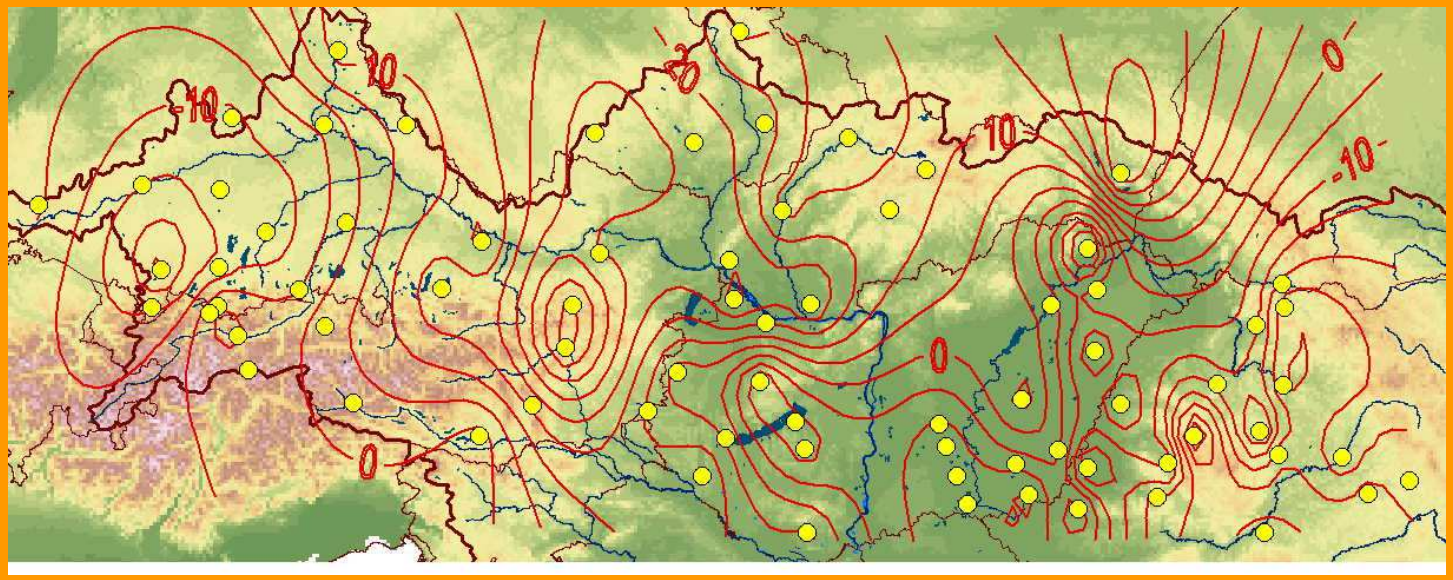
Hidrológiai hatások (0,3 - 0,8 K között):	*Agro-hidrológiai hatások* (0,5 - 4 K között):	*Ökológiai és növénytermesztési hatások* (0,5 - 4 K között):
• A vízkészlet-jellemzők néhány %-tól néhány tíz %-ig csökkennek. • A Tisza vízgyűjtőin e változások, a Dunával összevetve, még inkább kedvezőtlenek. *Ökológiai hatások(folyt.)* • A nagy változásokra adott ökológiai válaszok már minden esetben **kedvezőek**, • kivéve az erdőtűz-gyakoriság több száz %-os emelkedését.	• A vízmérleg-tagokban a kis változások párszor tíz százaléknyi csökkenést okoznak. • A víz-stressz gyakorisága viszont egyes növénykultúráknál közel 100 %-kal nő! • Nagyobb változásra a romlás ennél kisebb; • sőt, a CO_2-többlet hatására a vízmérleg már kissé **inkább javul**.	• A kis változások hatására az ökológiai jellemzők néhányszor tíz %-kal romlanak. • Különösen súlyos a homokpuszta-gyepek fajszámának csökkenése és az erdőtüzek gyakoribbá válása. • A CO_2 direkt hatása **sokat javít**, sőt néhány esetben pozitívra fordítja a zöldtömeg jellegű változásokat.

Change in the sum of precipitation in case of 0.5°C global warming (%) (Mika and Bálint, 2000)

Winter half-year



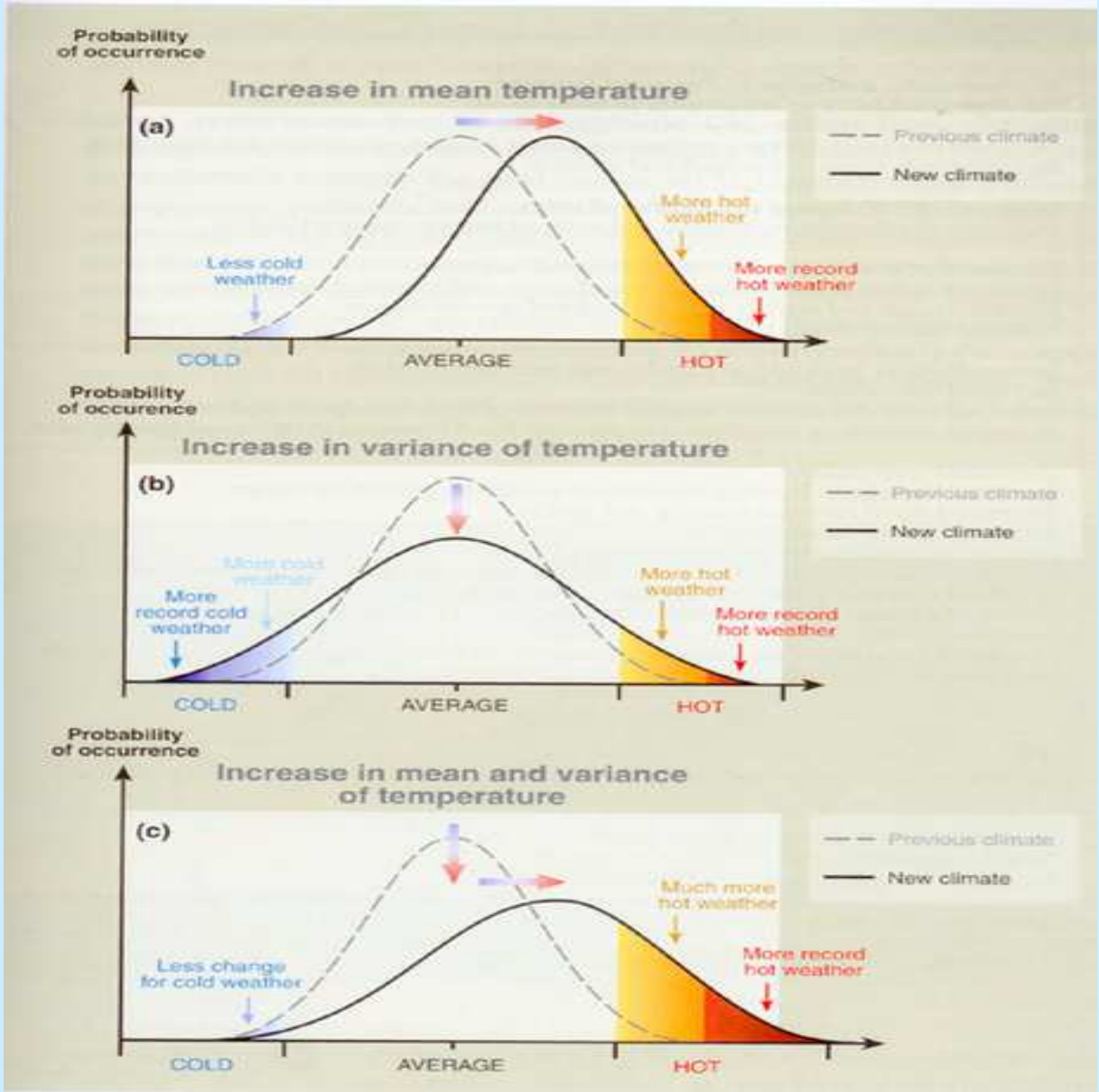
Summer half-year



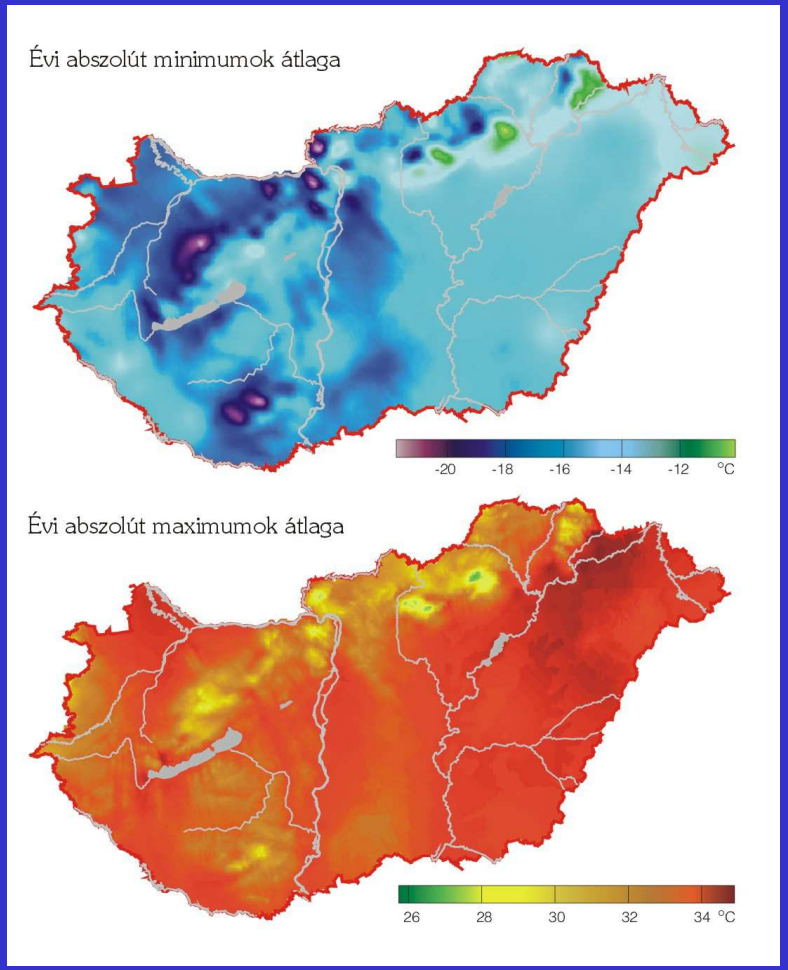
Goegraphical analogies
to domestic changes

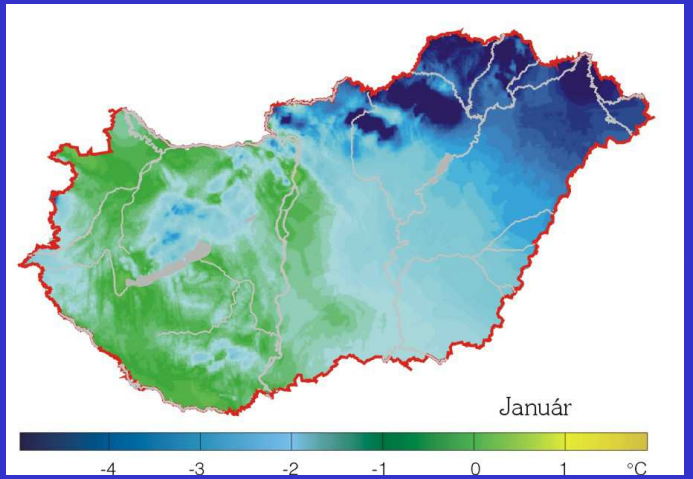
After Mika, (1996) (graphics: Ákos Németh)

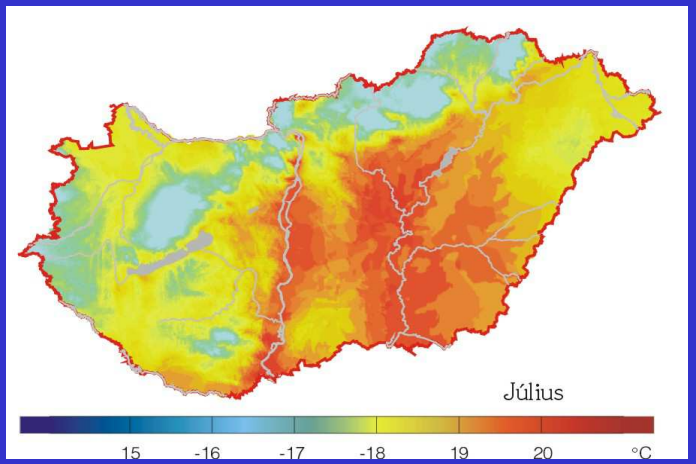
Chnages in variability, extreme values

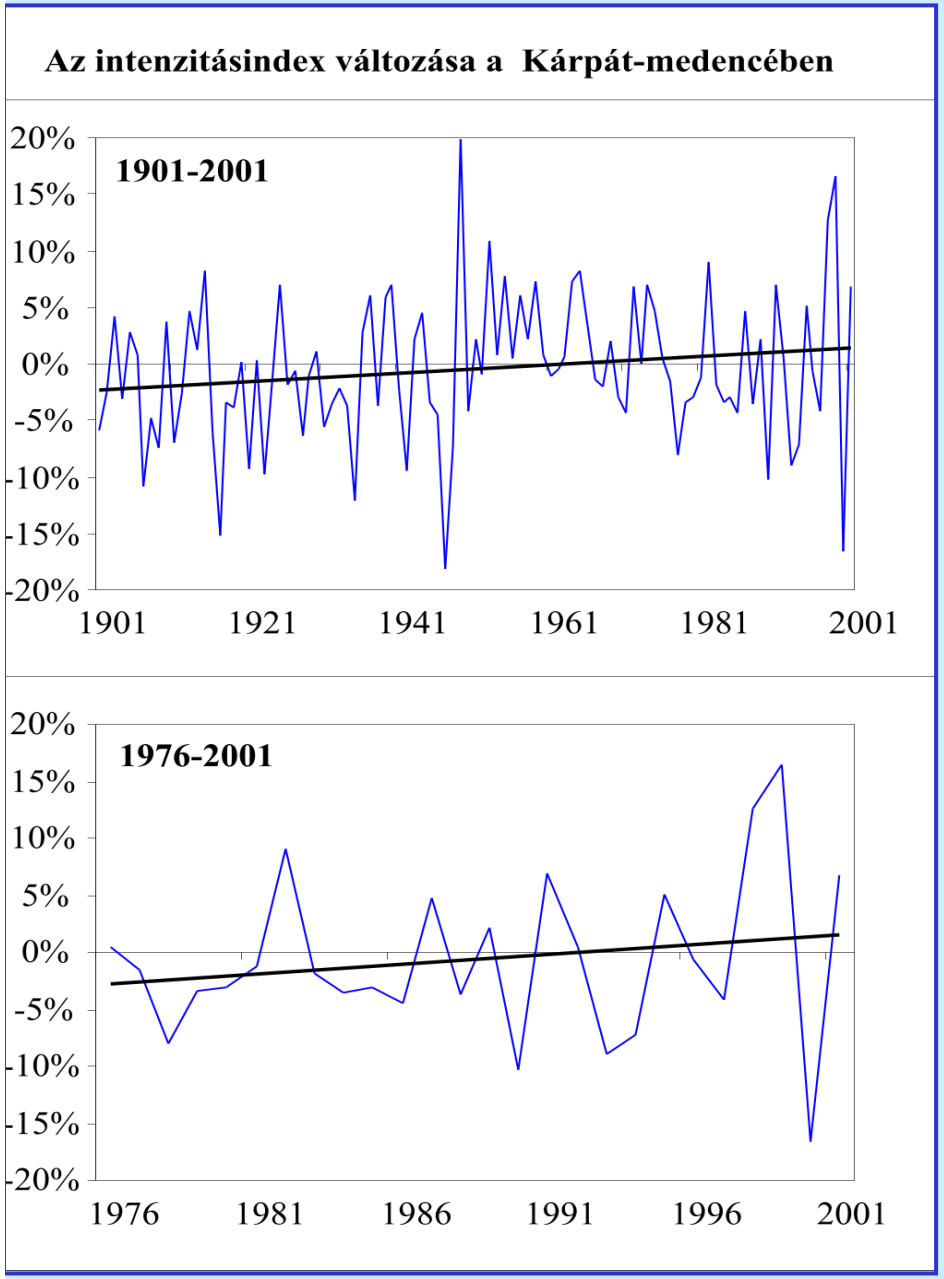


Extremities (min-max) – Average (Jan.-Jul.)



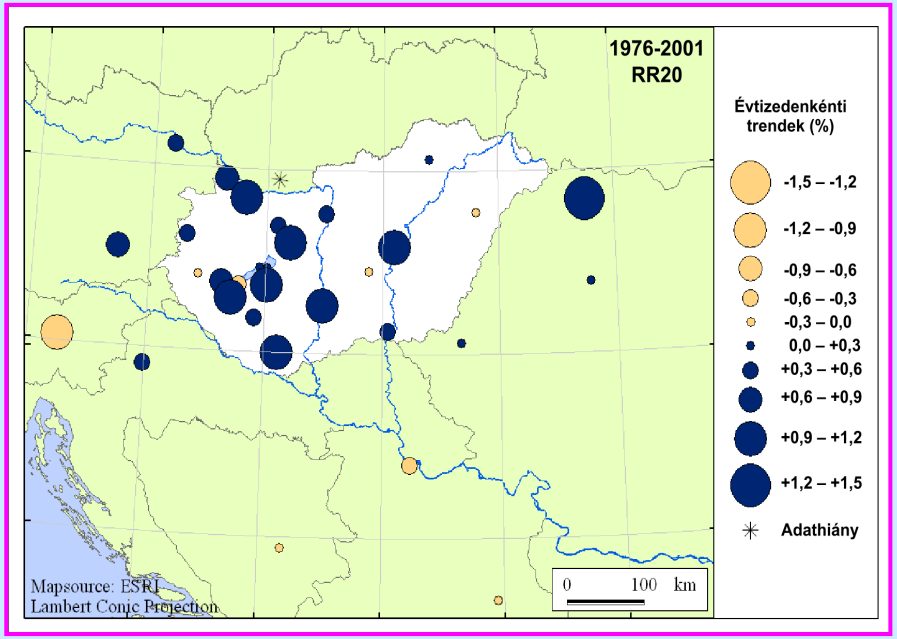






Changes in the average amount of precipitation

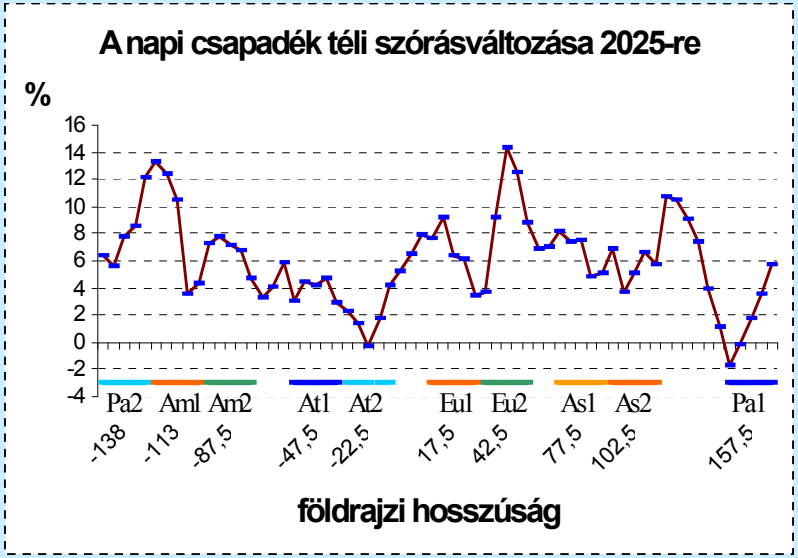
>20 mm/day change in precipitation frequency

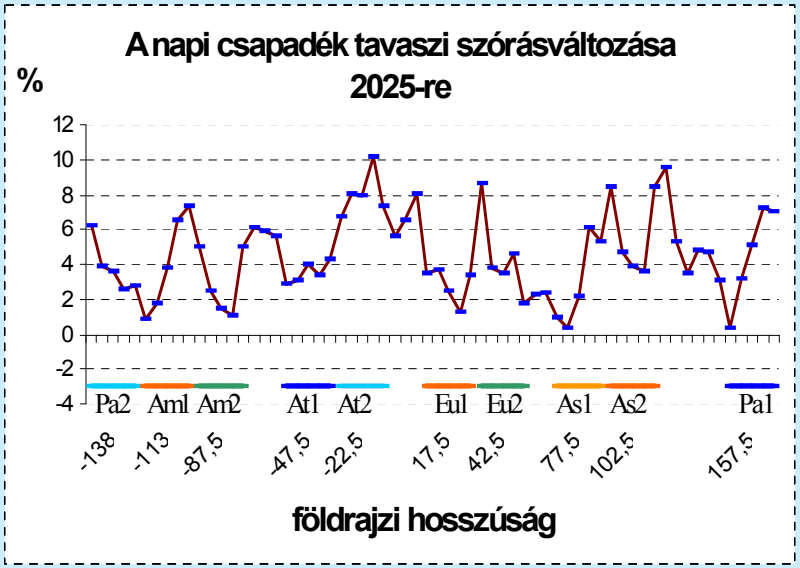


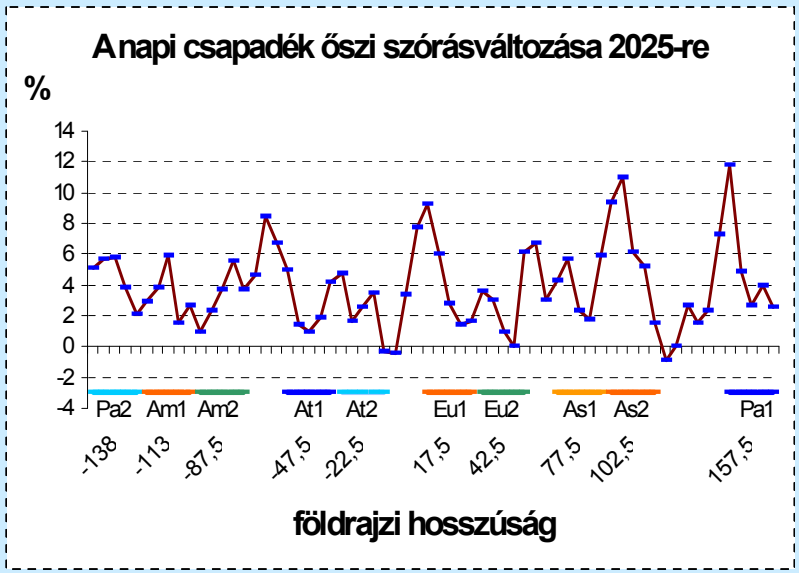
ELTE Dept. of Meteorology

Bartholy et al., 2004

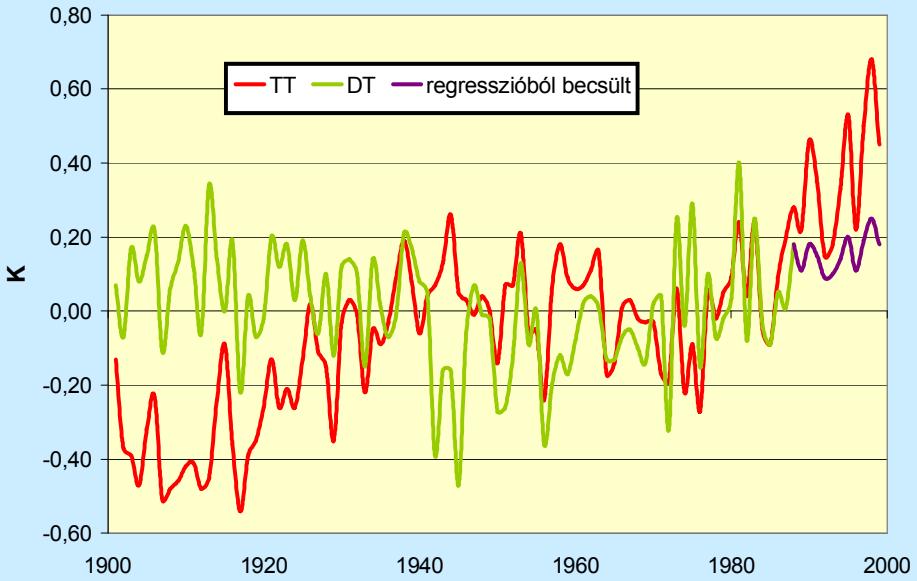
Change in standard deviation of daily precipitation by 2025 in the 45-50°N latitude band: Máthé and Mika, 2005

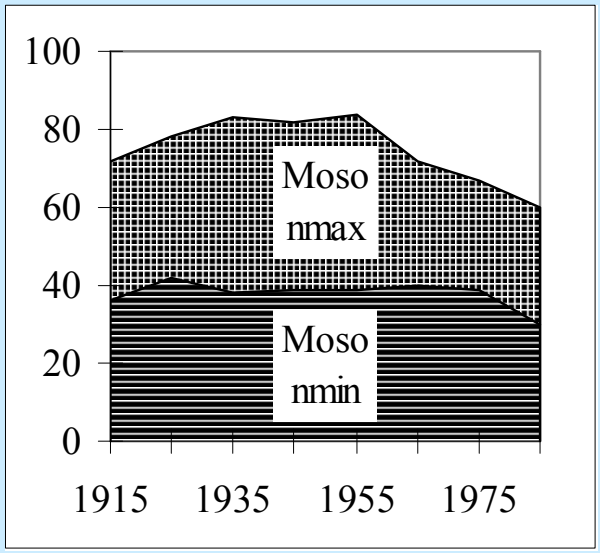


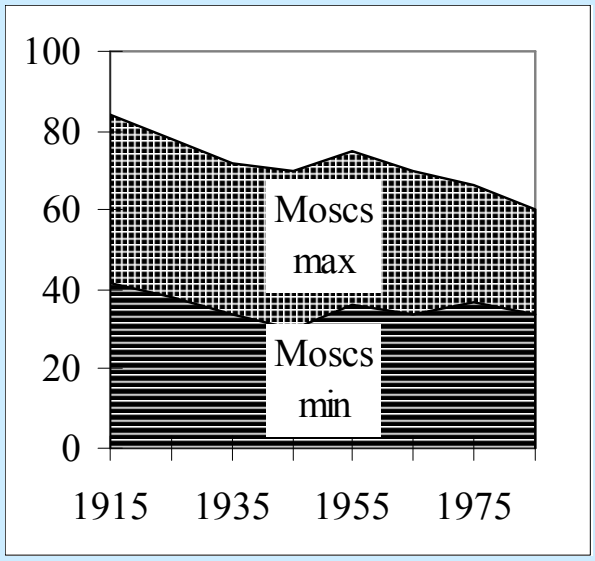




Is it true that EXTREMITIES BECOME MORE FREQUENT?

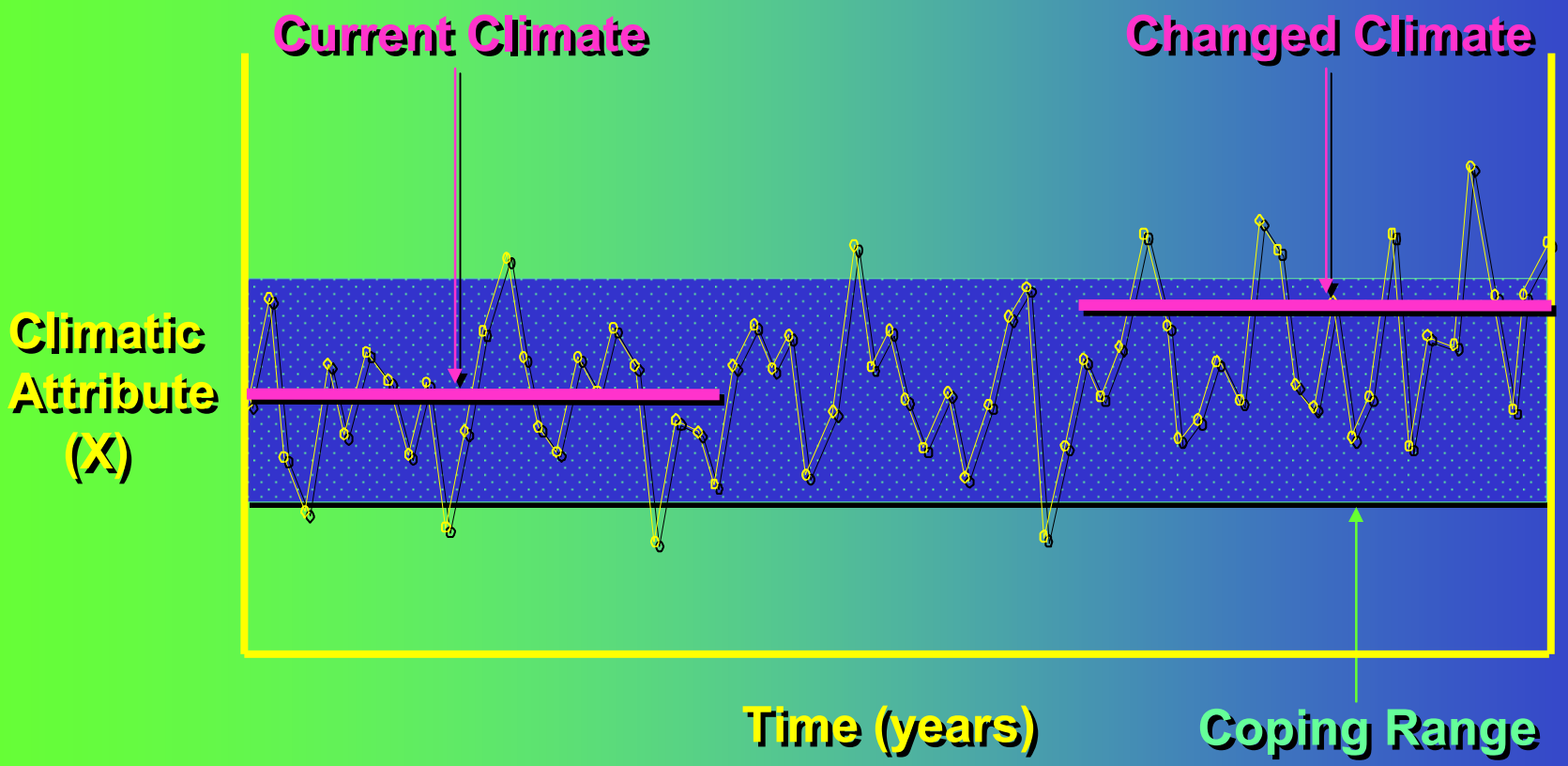




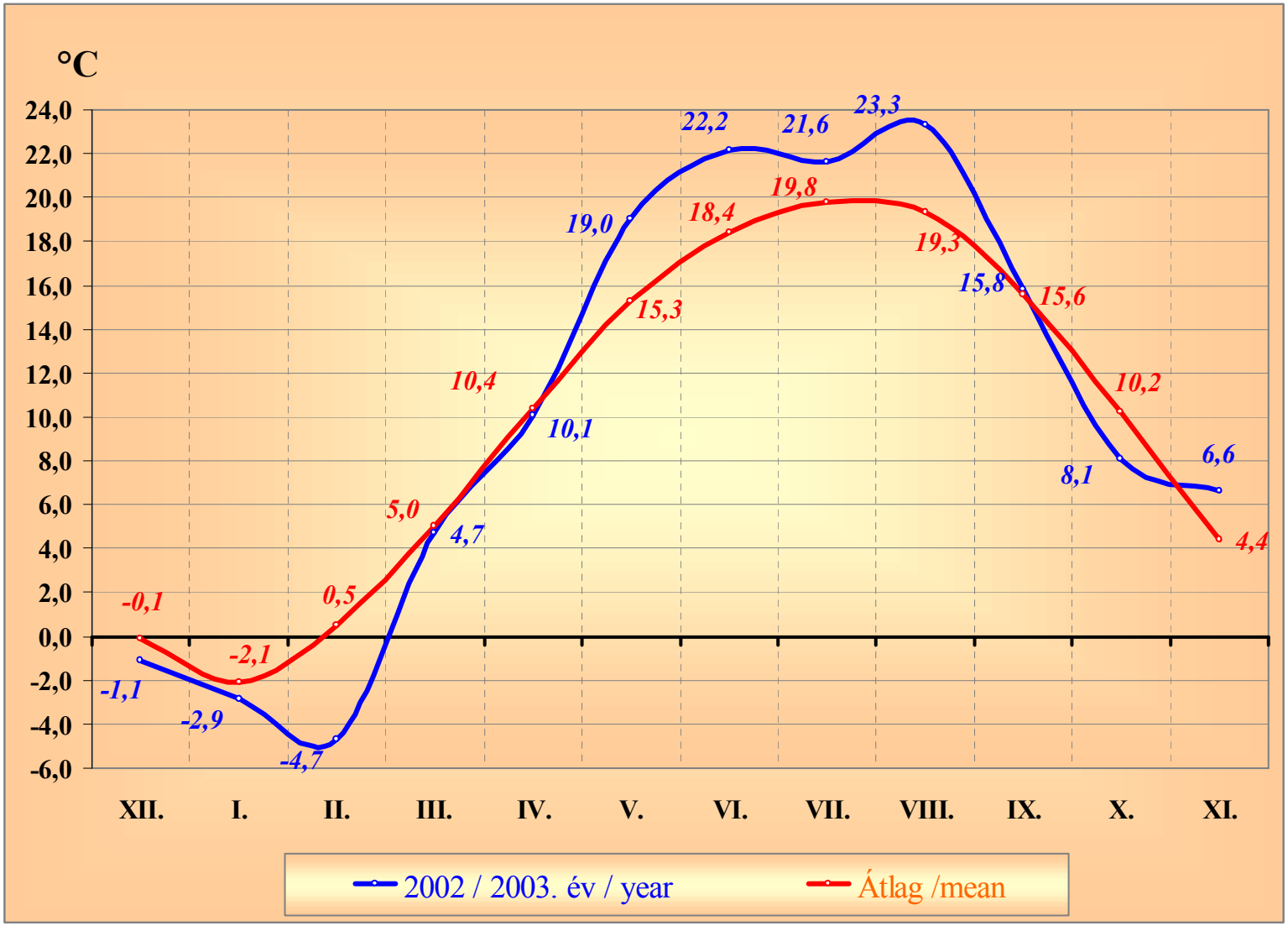


Share of the minimum and maximum 10% of temperature (left) and precipitation (right) from extremities at Mosonmagyaróvár

Climate Change Extremes and Coping Range

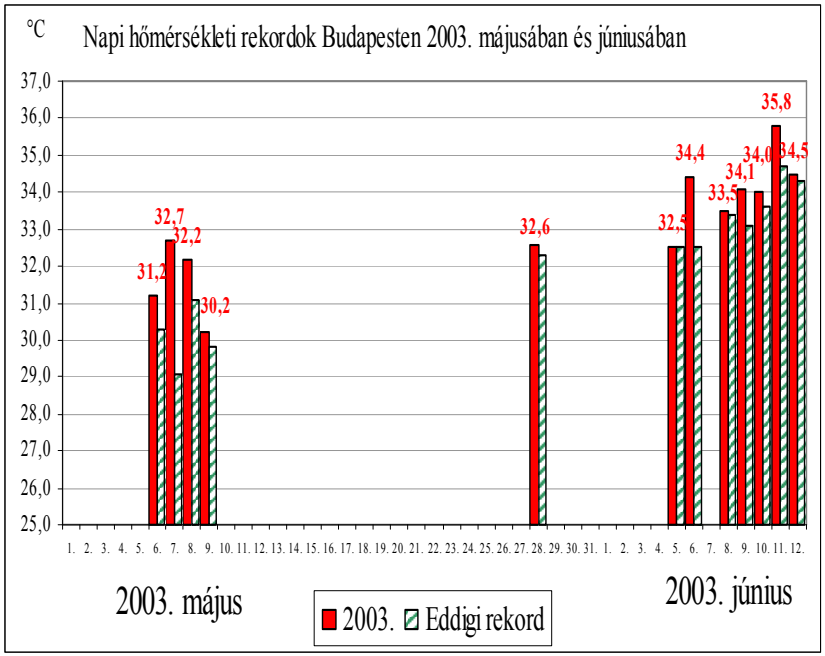


National monthly mean temperature: 2002/2003, and 30-year averages

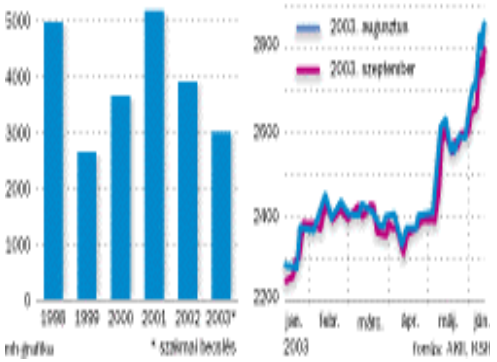


May surprises:

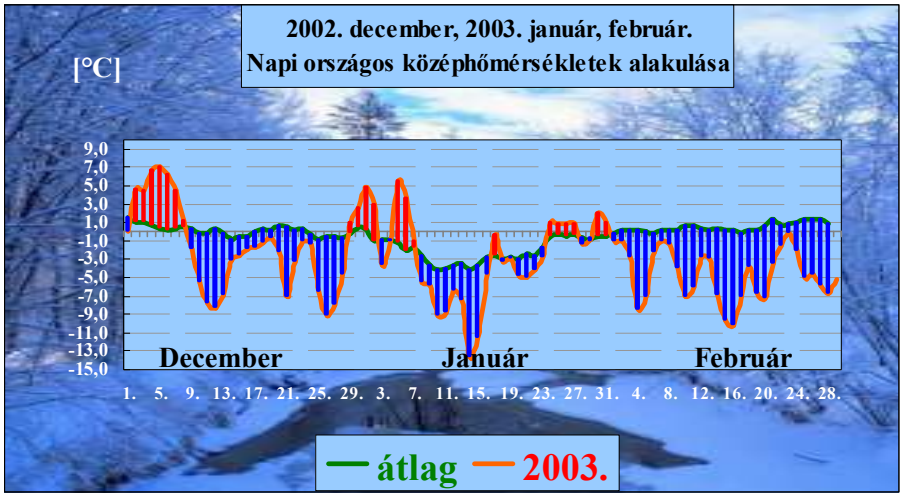
Daily absolute extreme values

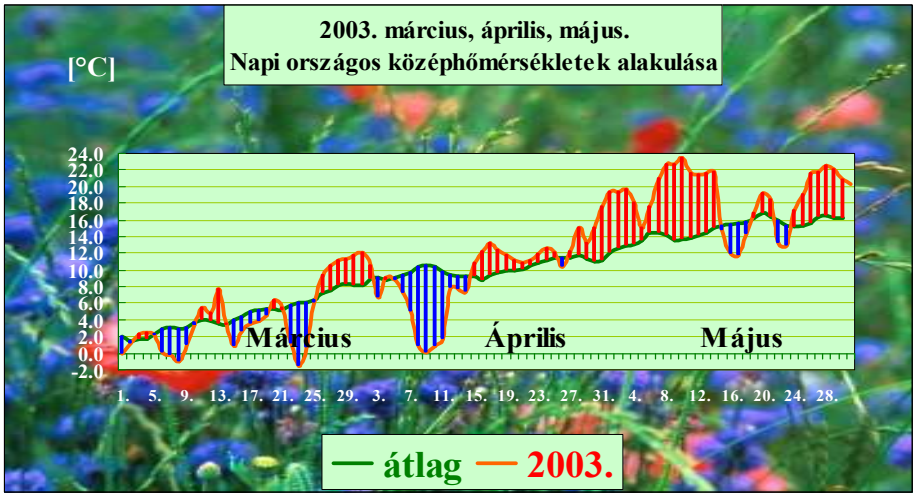


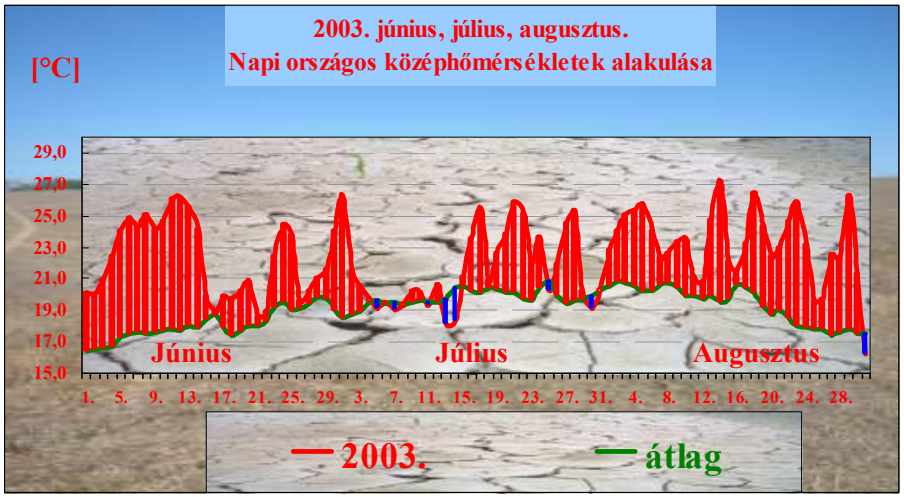
Wheat production and prices at the stock exchange

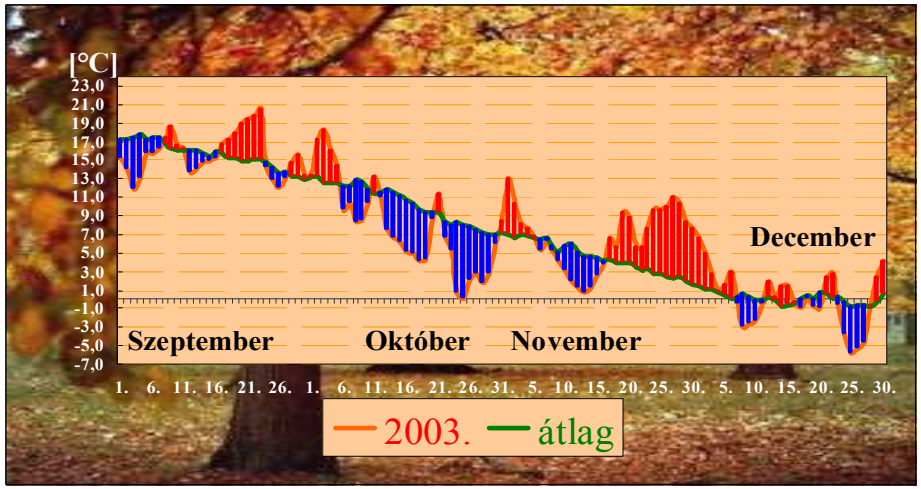


LESSONS (also from 2003): There are shorter periods different from the climate anomaly and characteristics of the season that can cause opposite effect









CLIMATE DERIVATIVES

- Agriculture
- Water Management
- Human Health
- Energy
- Tourism & Leisure
- Urban Development
- Natural Disasters
- Insurance

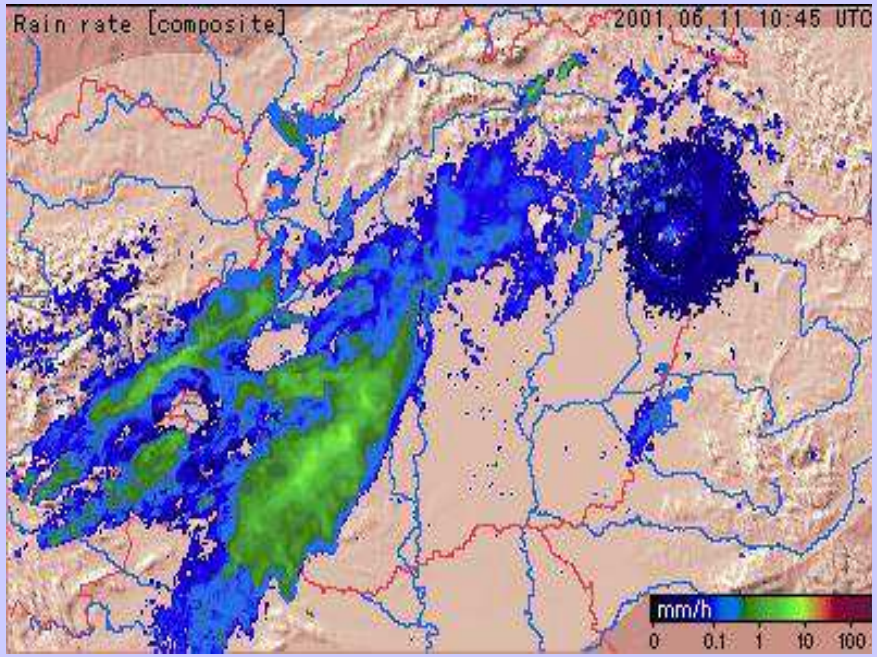
AGRICULTURE

Agricultural parameters influenced by climate:

- **Land preparation and sowing;**
- **Choice of crop;**
- **Planting density;**
- **Timing of fertilizer & pesticides application;**
- **Harvest date;**
- **Livestock;**

January – Church of our Lady

If rain beats January, pantry and purse suffer.



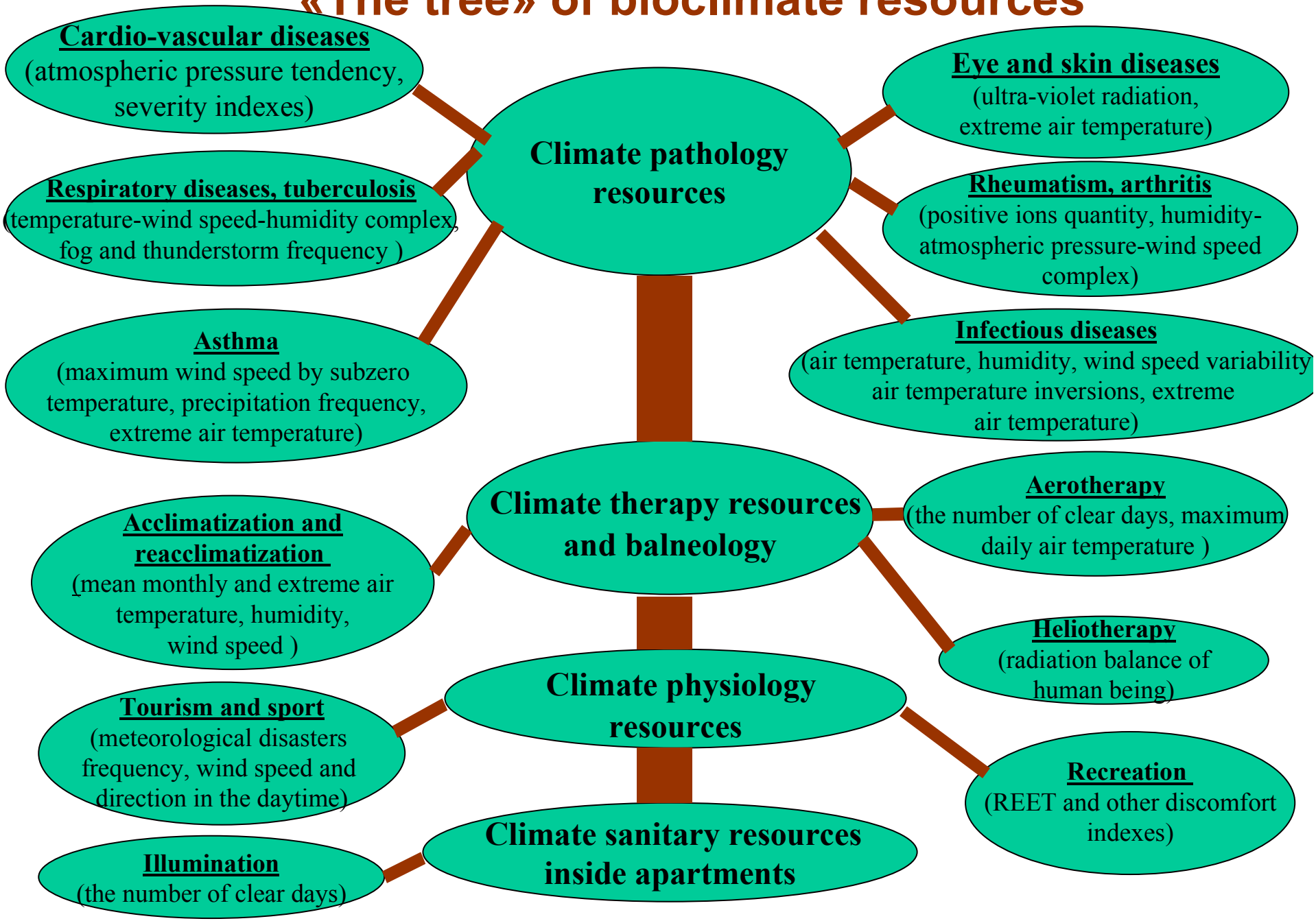
May - Pentecost

Coolness of May, salvation of host.

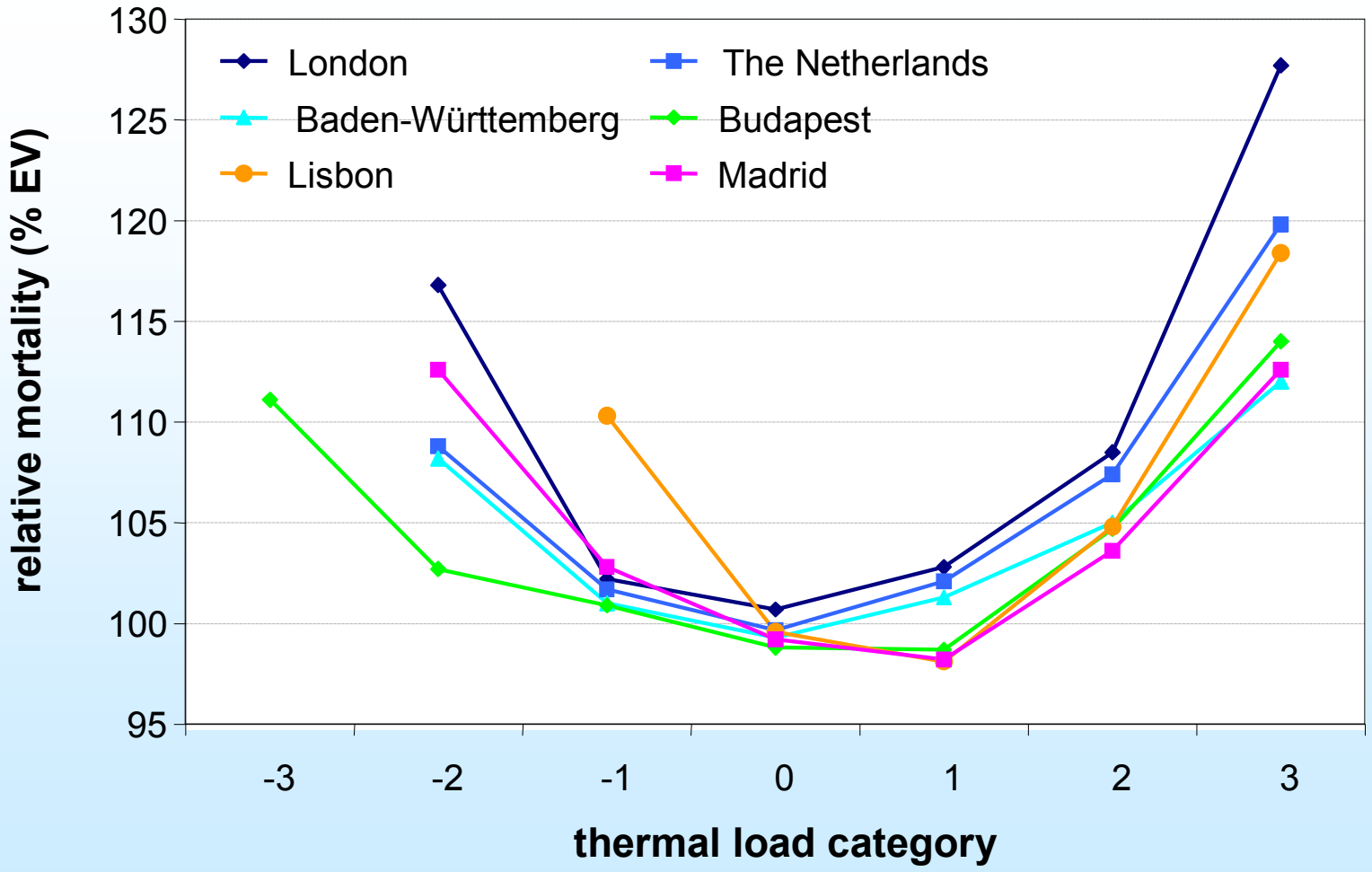
Michael (September 29)

East wind on the day of St. Michael promises a very hard winter.

«The tree» of bioclimate resources

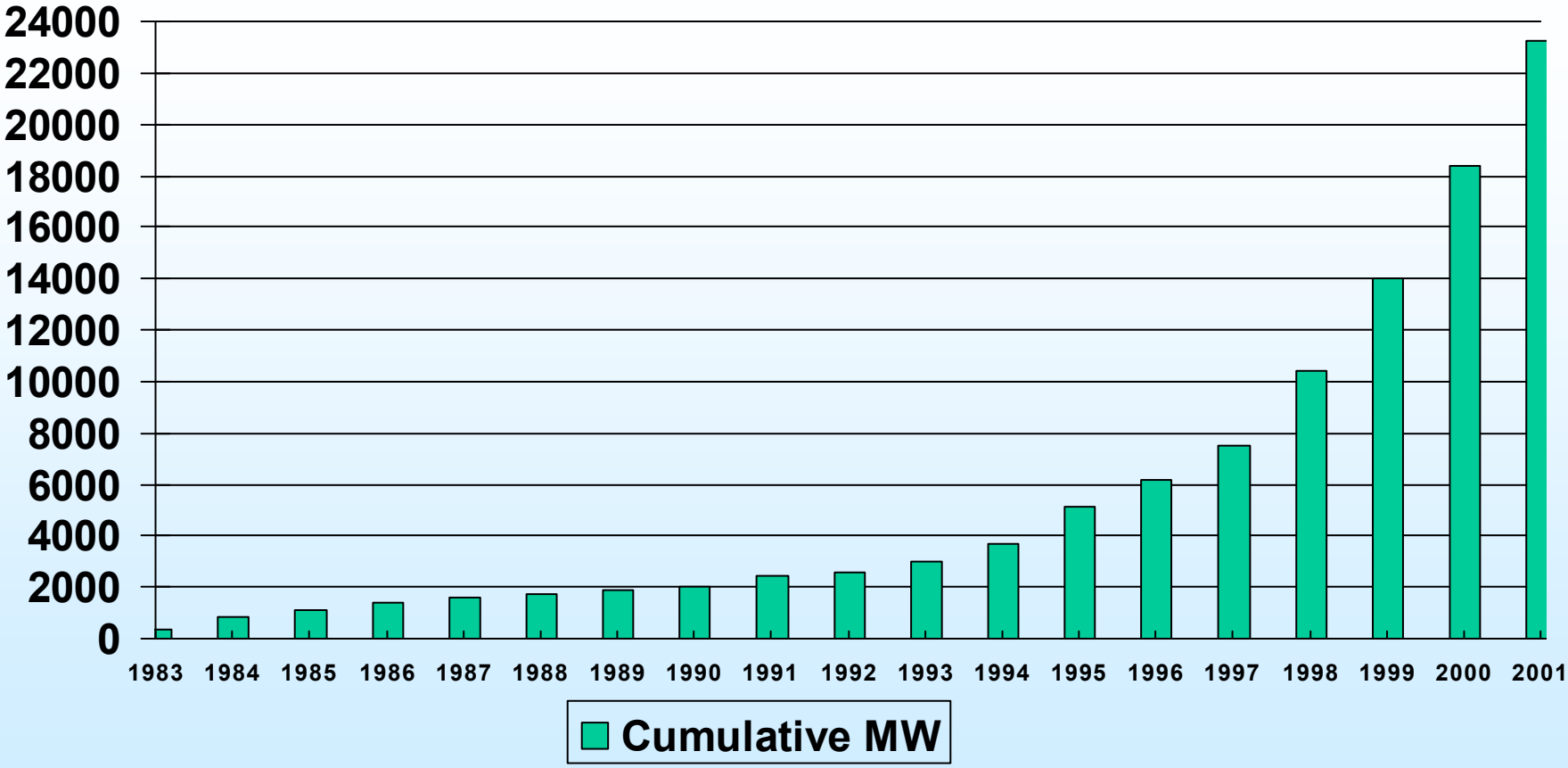


Relative mortality: Europe 1986-1996

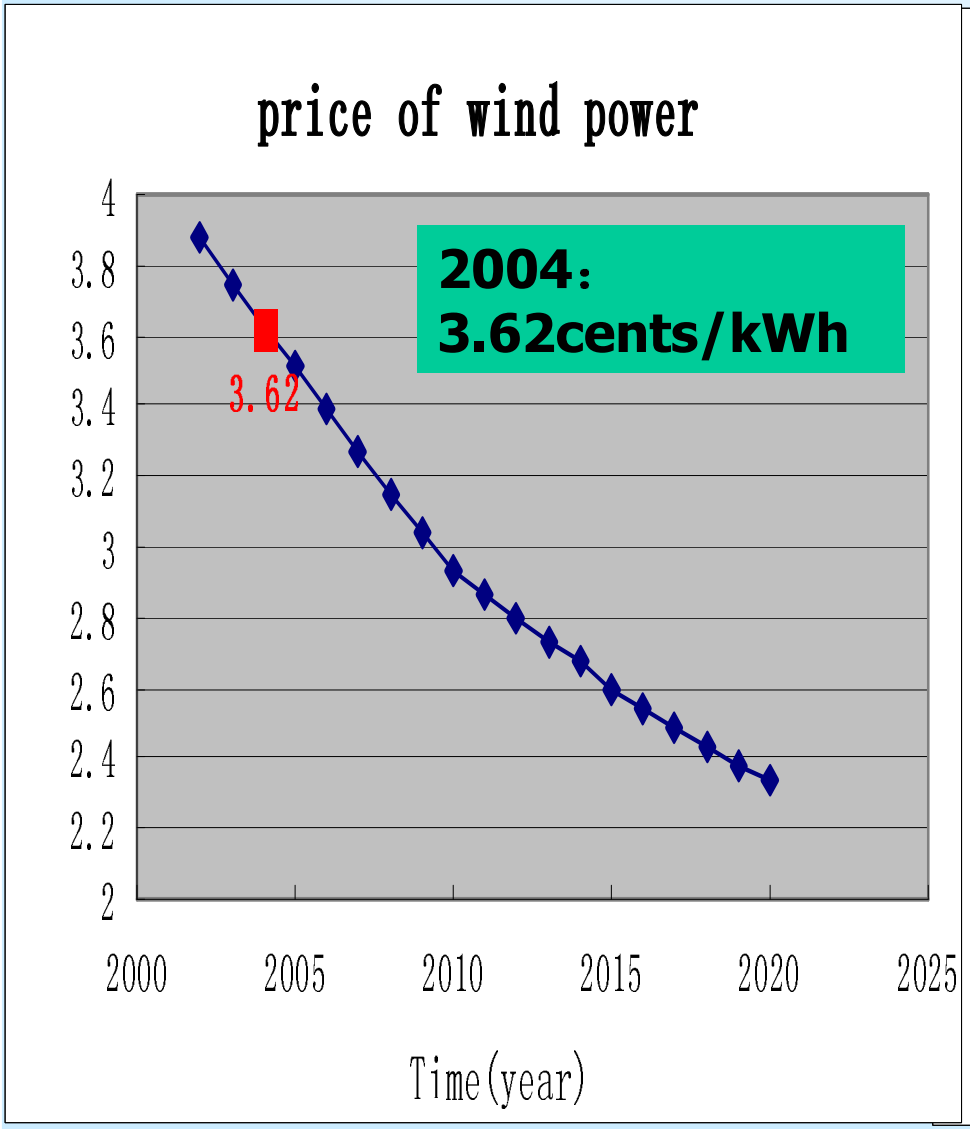


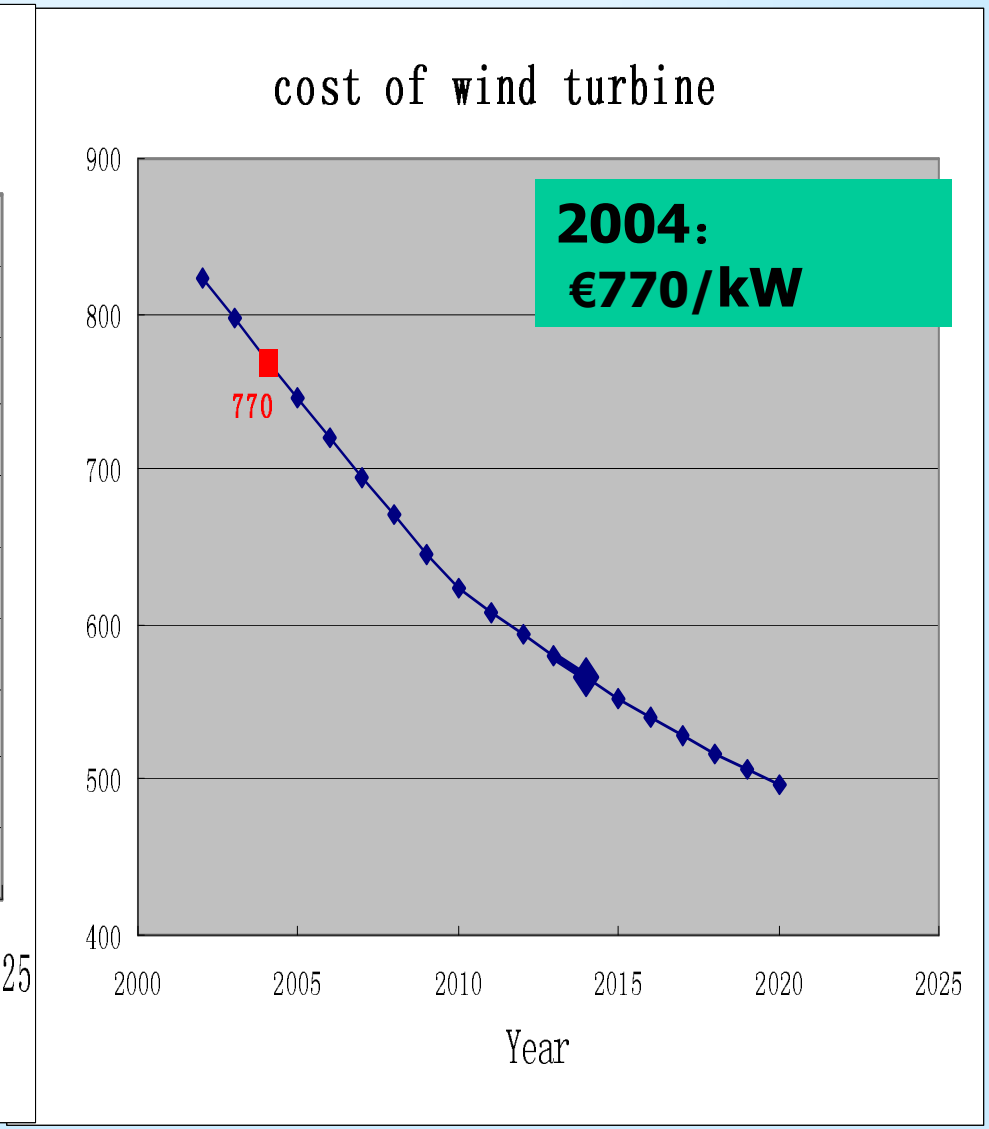
christina.koppe@dwd.de

Wind Power development in the world



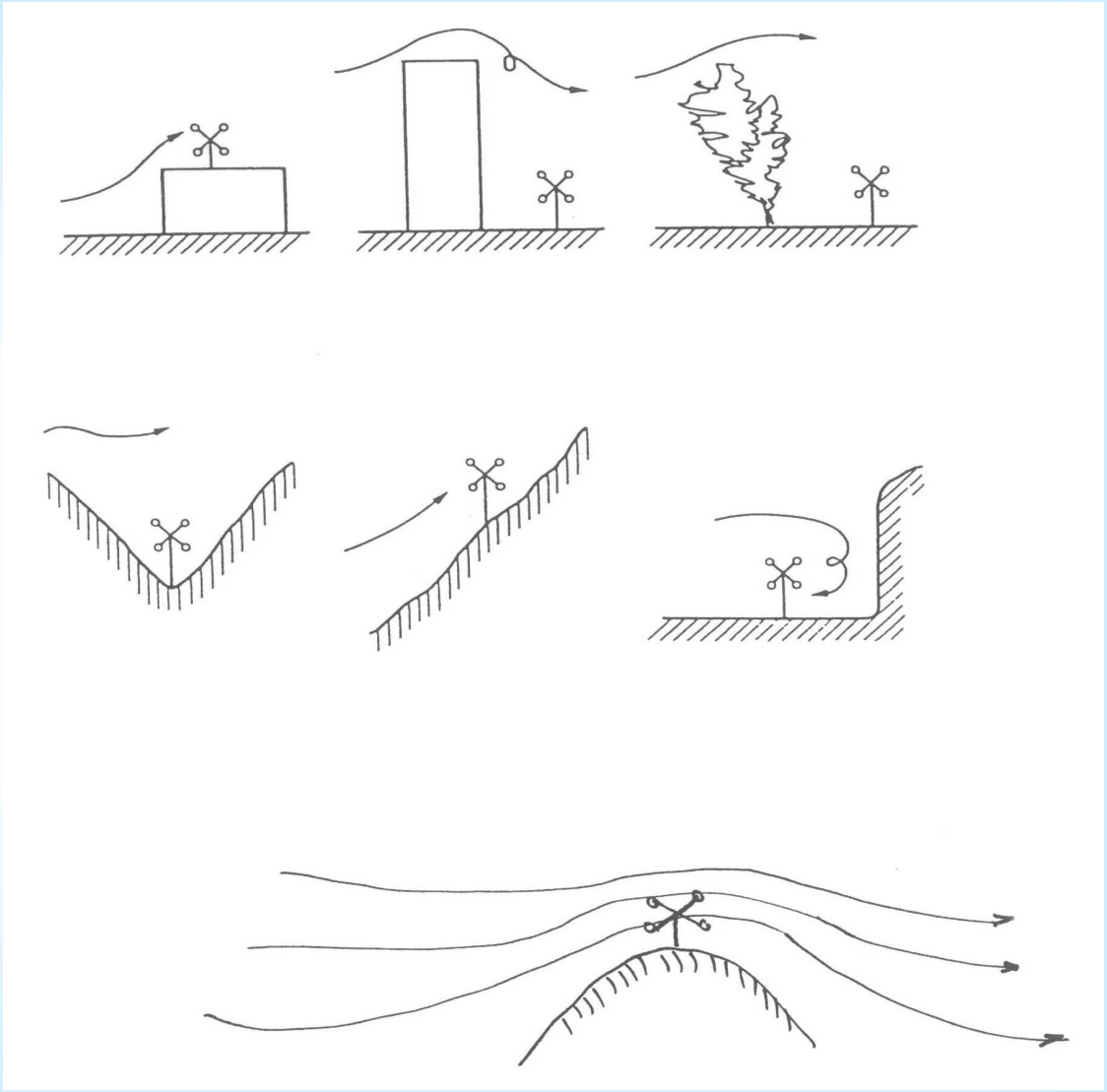
Cost of Wind Power Generation Worldwide



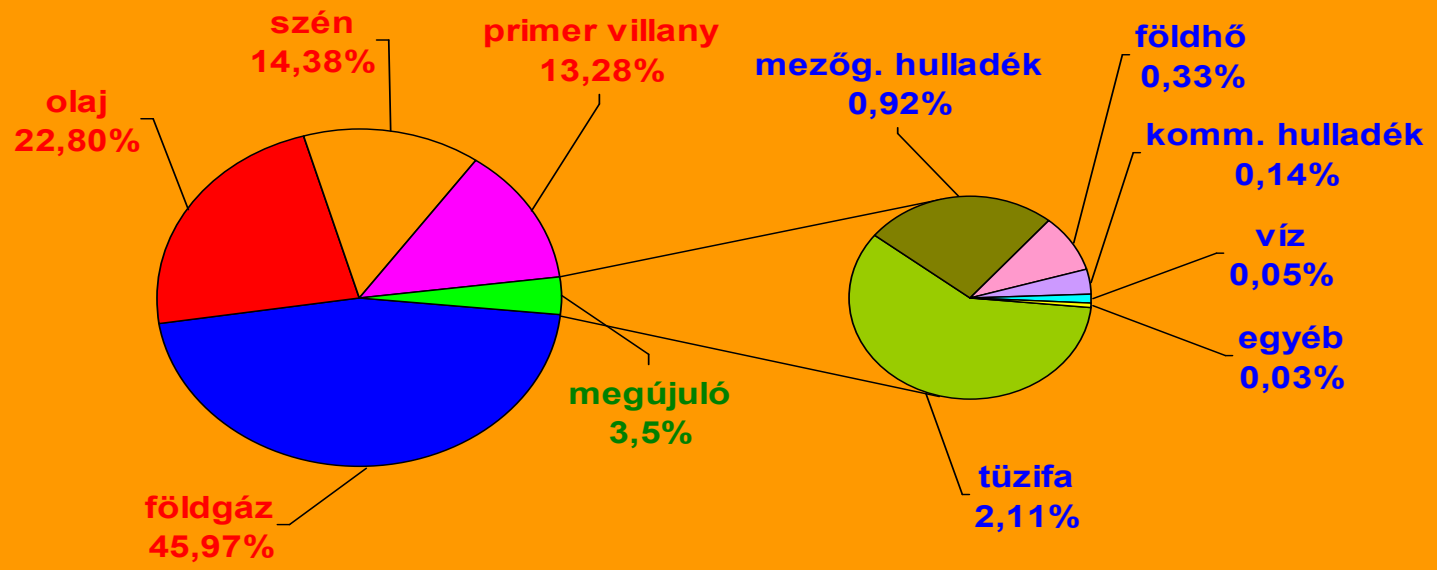


Wind measurements

Sites may (*hopefully not*) look like this (schematically)

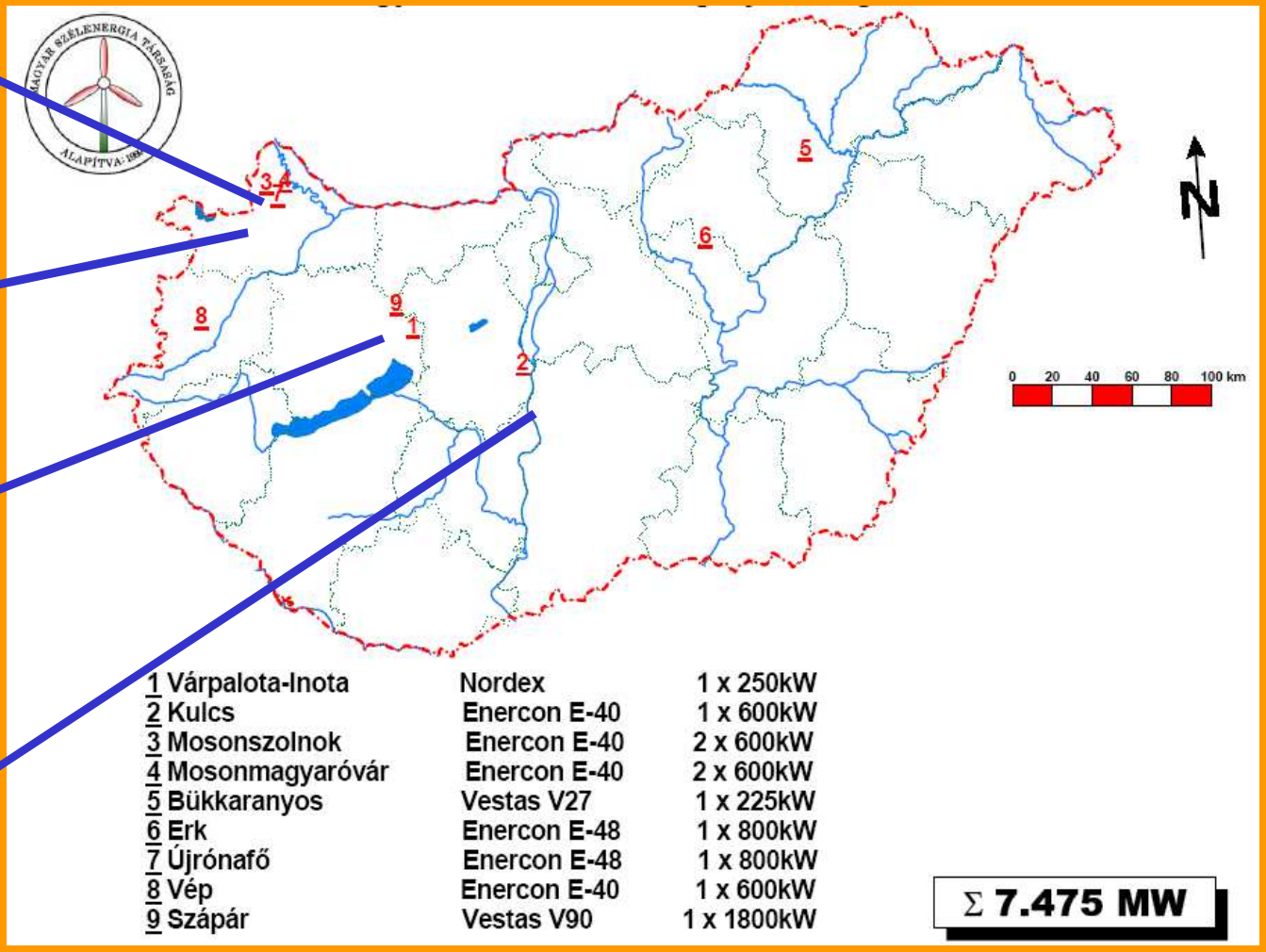


Energy consumption in Hungary in 2003: 1091 PJ, from this renewable: 39 PJ



Power Statistical Yearbook, 2003

Operating wind farms, 2005 (MSZET)

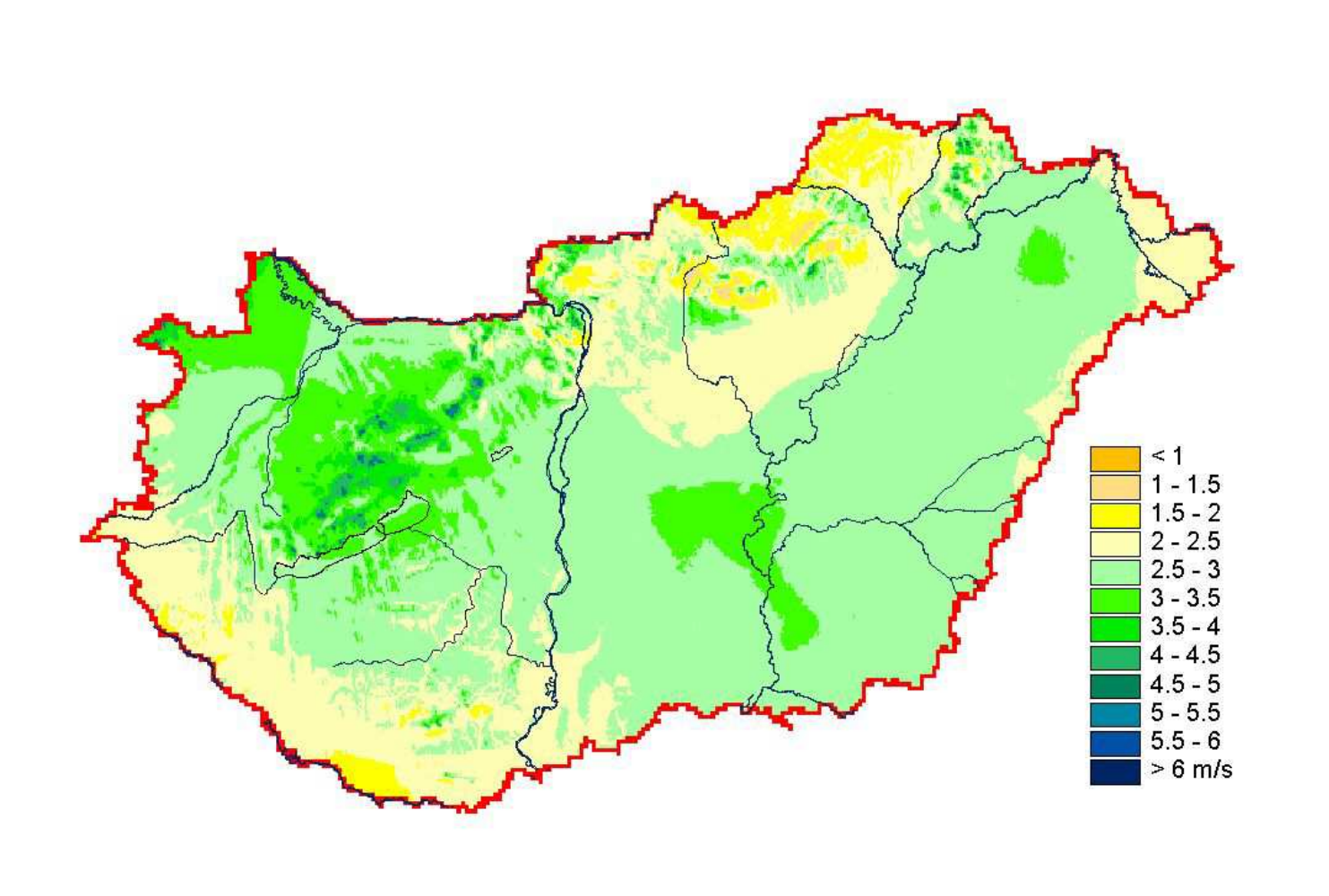


1 Várpalota-Inota	Nordex	1 x 250kW
2 Kulcs	Enercon E-40	1 x 600kW
3 Mosonszolnok	Enercon E-40	2 x 600kW
4 Mosonmagyaróvár	Enercon E-40	2 x 600kW
5 Bükkaranyos	Vestas V27	1 x 225kW
6 Erk	Enercon E-48	1 x 800kW
7 Újrónafő	Enercon E-48	1 x 800kW
8 Vép	Enercon E-40	1 x 600kW
9 Szápár	Vestas V90	1 x 1800kW

Σ 7.475 MW

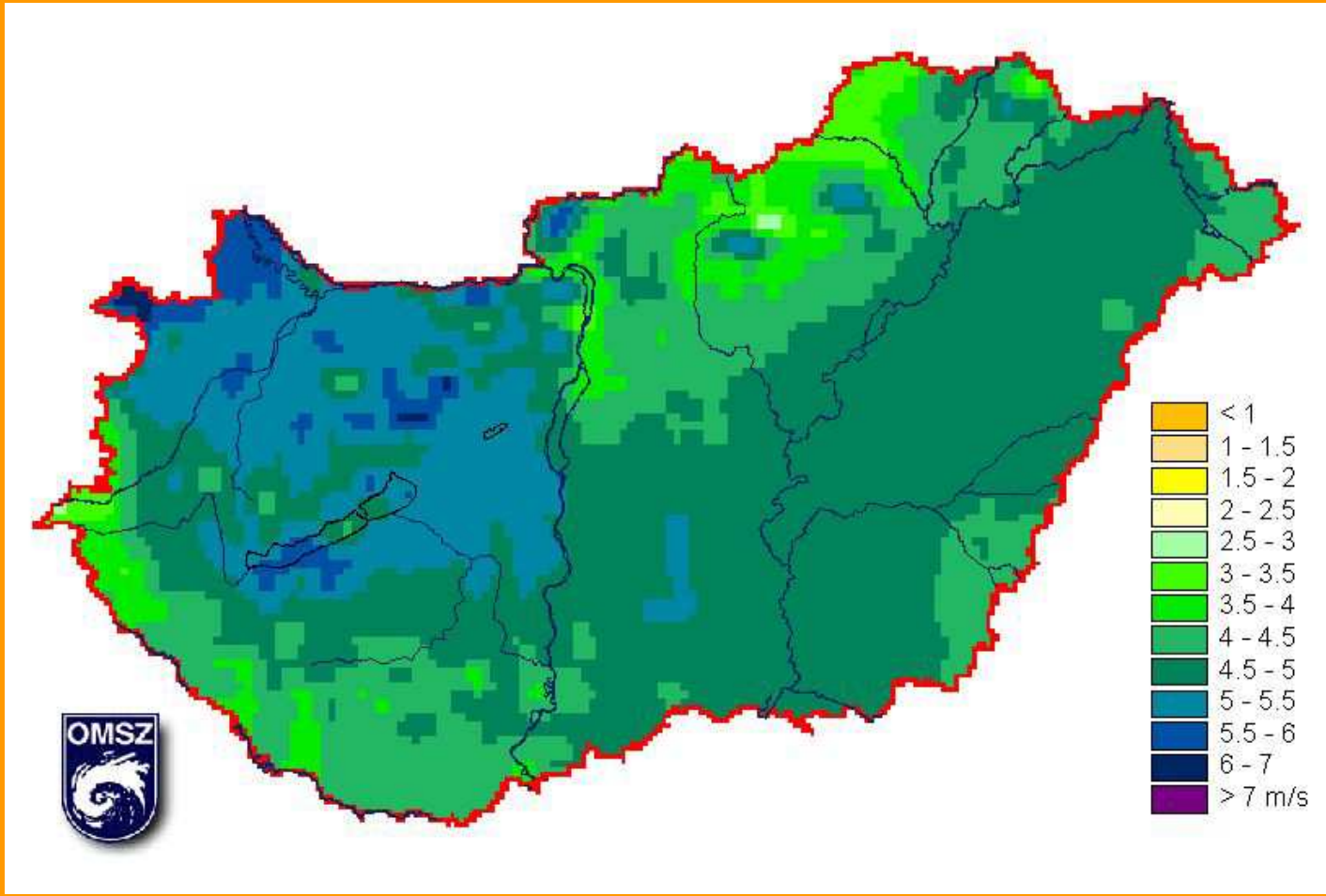
Source: Lecture of Dr. Péter Tóth; Debrecen, 28 September, 2005

Average wind sped at 10 m height



The average annual wind speed is 3-4 m/s at 72% of the country.

Average wind sped at 50 m height



Average annual wind speed exceeds 5.5 m/s at 75 m height over 20% of the country, at 100 m height over 43% of the country, while at 125 m height over 74% of the country.

Test with SZIE measurements

Wind forecast, verification

•ECMWF

- 0 – 72 hours: every 3 hours
- 72 – 240 hours: supplies data every 6 hours.
- ~ 40 km (horizontally)
- 60 levels (vertically)

ALADIN:

- 37 vertical levels,
- 0 – 36 hours: every hour
- 36 – 48 hours: every 3 hours

6.5 *km* horizontal resolution

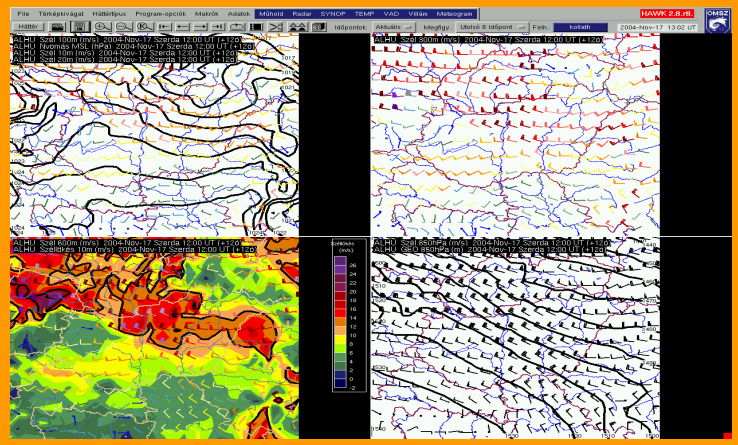
(384 * 432 grids)

5 meteorological variables

MM5

- for 12 hours ahead (ultra-short period)
- 6 km grid distance
- running 6 times a day
- Boundary condition: ECMWF + data: updated measurement
- Thunderstorms, outflows associated with thunderstorms

They can be predicted.

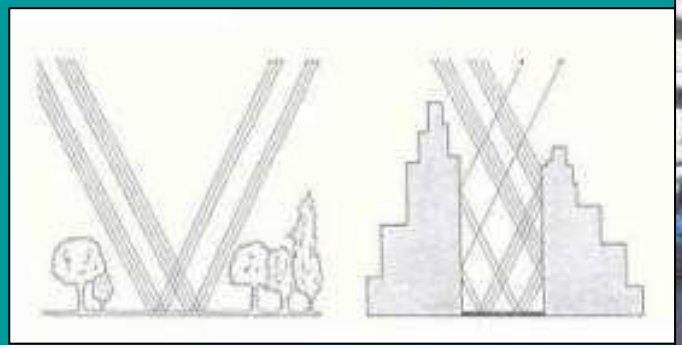


Evaluating the needs in function of the climate zone

- Hot humid climates: (to maximize ventilation, to reduce solar radiation and temperature, to minimize flood risks, to promote evaporative cooling);
- Hot arid climates: (to reduce solar gain and temperature, to increase evaporation, to minimize wind exposure);
- Cold climates: (to maximize solar gain, to minimize wind exposure and snow accumulation);
- Climates with contrasting seasons: case to case decisions are necessary;

Mitigating UHI?

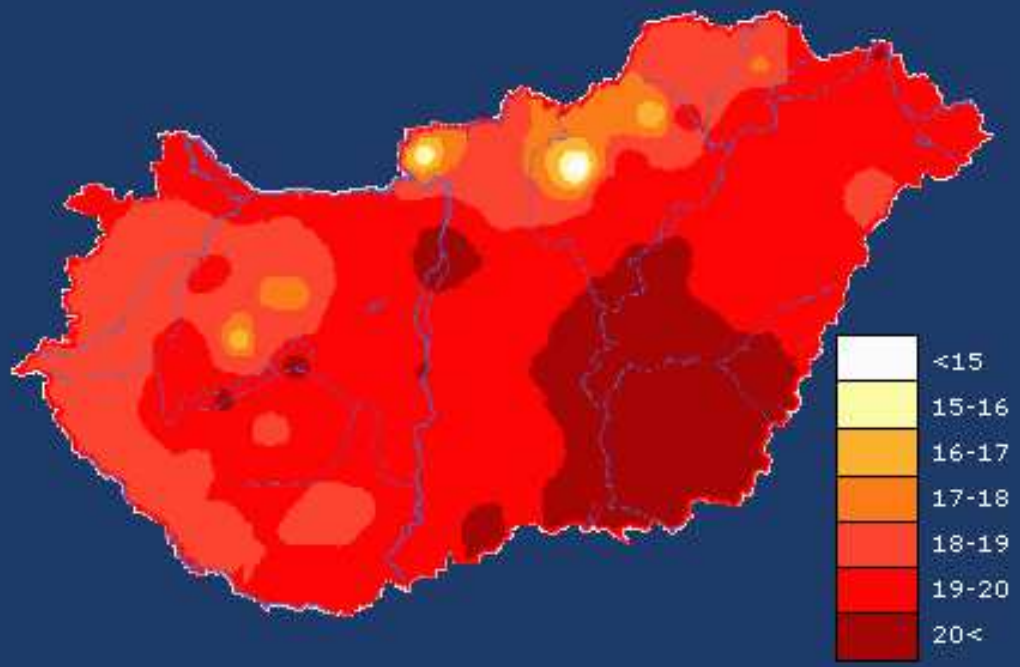
- Increasing **green areas;**
- Increasing the **albedo;**
- Reducing **building density;**
- Increasing Sky View Factor (SVF);
- Integrating **water bodies;**



Public website of the Hungarian Meteorological Service

2005 nyarának időjárása

Hőmérséklet



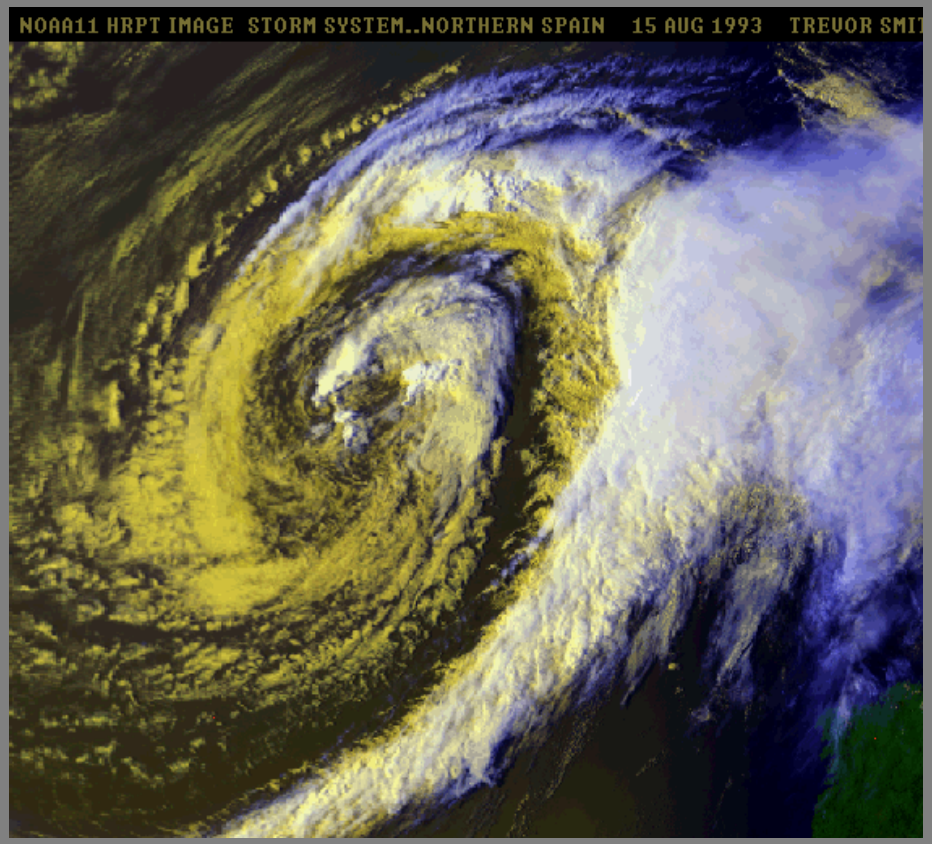
1.ábra: Az évszak középhőmérséklete °C-ban

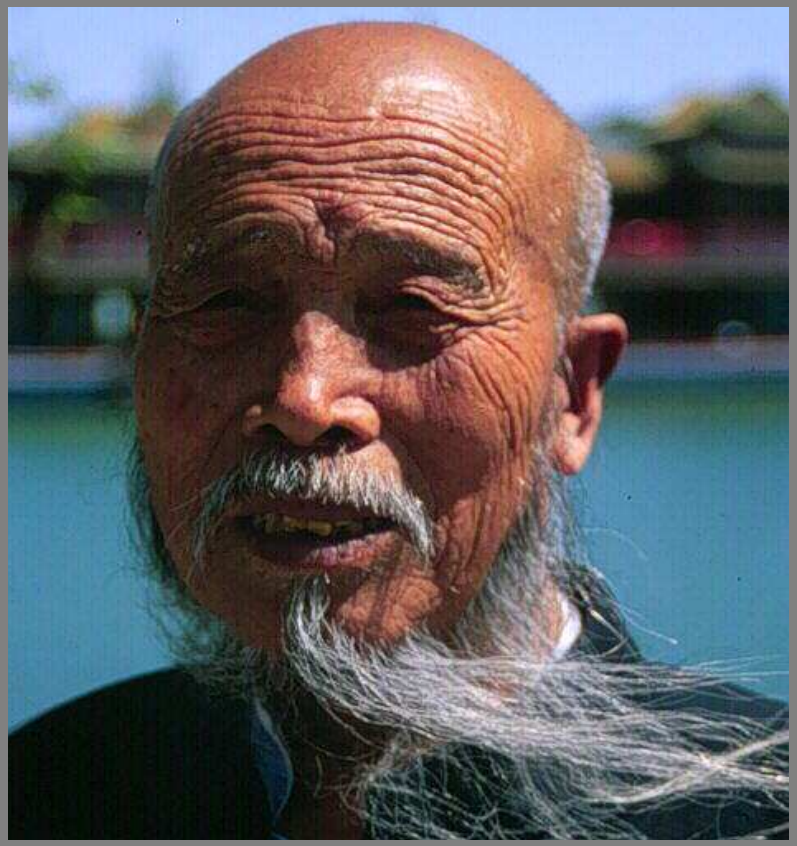
Júniusi hőmérséklet

Június a május végi meleg után átlag feletti hőmérséklettel köszöntött be, amit az első napokban igen erős lehűlés követett. Június 9-én százéves csúcshőmérsékleti hidegrekord dőlt meg, Magyarországon a meteorológiai mérések kezdete óta ilyen alacsony maximumhőmérsékletet június 9-én még nem mértek. 2005. június 9-én a szokásostól eltérően délutánra nem melegedett, hanem egyre hűlt az idő, így dőlhetett meg a hidegrekord Pécsett, ahol a napi maximum- és minimumhőmérséklet is 7 fok volt június 9-én. Az ilyenkor szokásos 25 fok helyett országszerte is csupán 6-14 fokot mutattak a hőmérők.
A hónap második felében átlag felett alakultak a napi középhőmérsékletek, így június átlaghőmérséklete összességében a normálnál közel fél fokkal magasabbnak, 18,4 °C-nak adódott.

Tartalom
Az elmúlt hónapok időjárása
Az elmúlt évszakok
2004
2005
Az elmúlt évek időjárása
Az elmúlt évtized időjárása
Az elmúlt évszázad időjárása

In the buildings of the Hungarian Meteorological Service free guided tours are available according to negotiation!


NOAA11 HRPT IMAGE STORM SYSTEM..NORTHERN SPAIN 15 AUG 1993 TREVOR SMI




OMSZ
3
2
4
6
12
11
16
17

Always look on the bright side of things!

We finished for today, goodbye!

ямарваа нэг зүйлийн гэгээлэг талыг нь үргэлж олж харцгаая

өнөөдөртөө ингээд дуусгацгаая, баяртай

让我们总是从光明的一面来看待事物吧！

今天的课程到此结束，谢谢！

دعونا ننظر دائما إلى الجانب المشرق من الأشياء!

انتهينا لهذا اليوم، وداعا!