

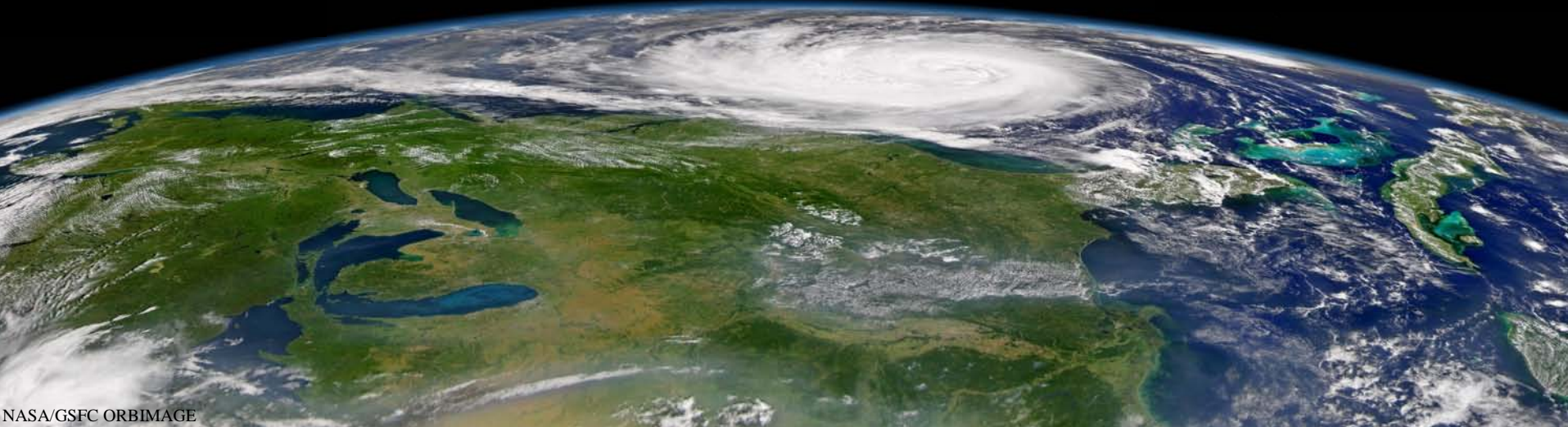
# A klímakutatás modern eszközei: a villámok statisztikájától a szélerenergia potenciál becsléséig

JÁNOSI IMRE

ELTE TTK KOMPLEX RENDSZEREK FIZIKÁJA TANSZÉK  
KÁRMÁN KÖRNYEZETI ÁRAMLÁSOK LABORATÓRIUM

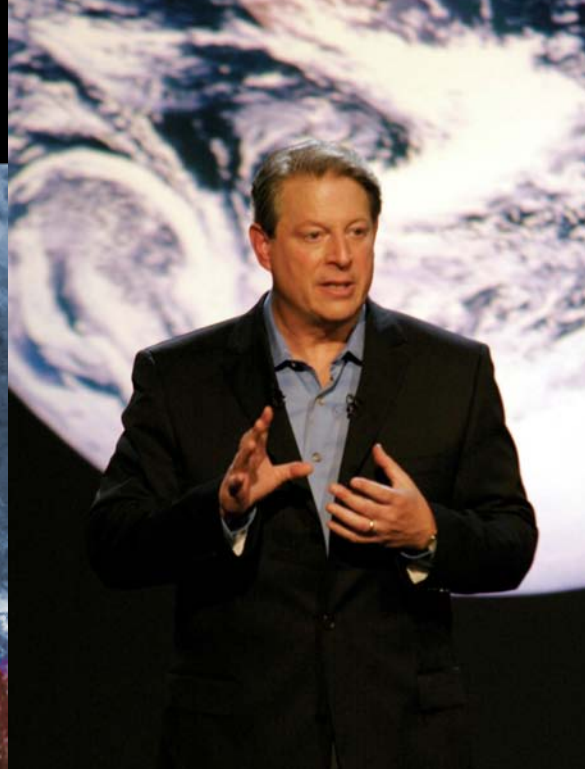
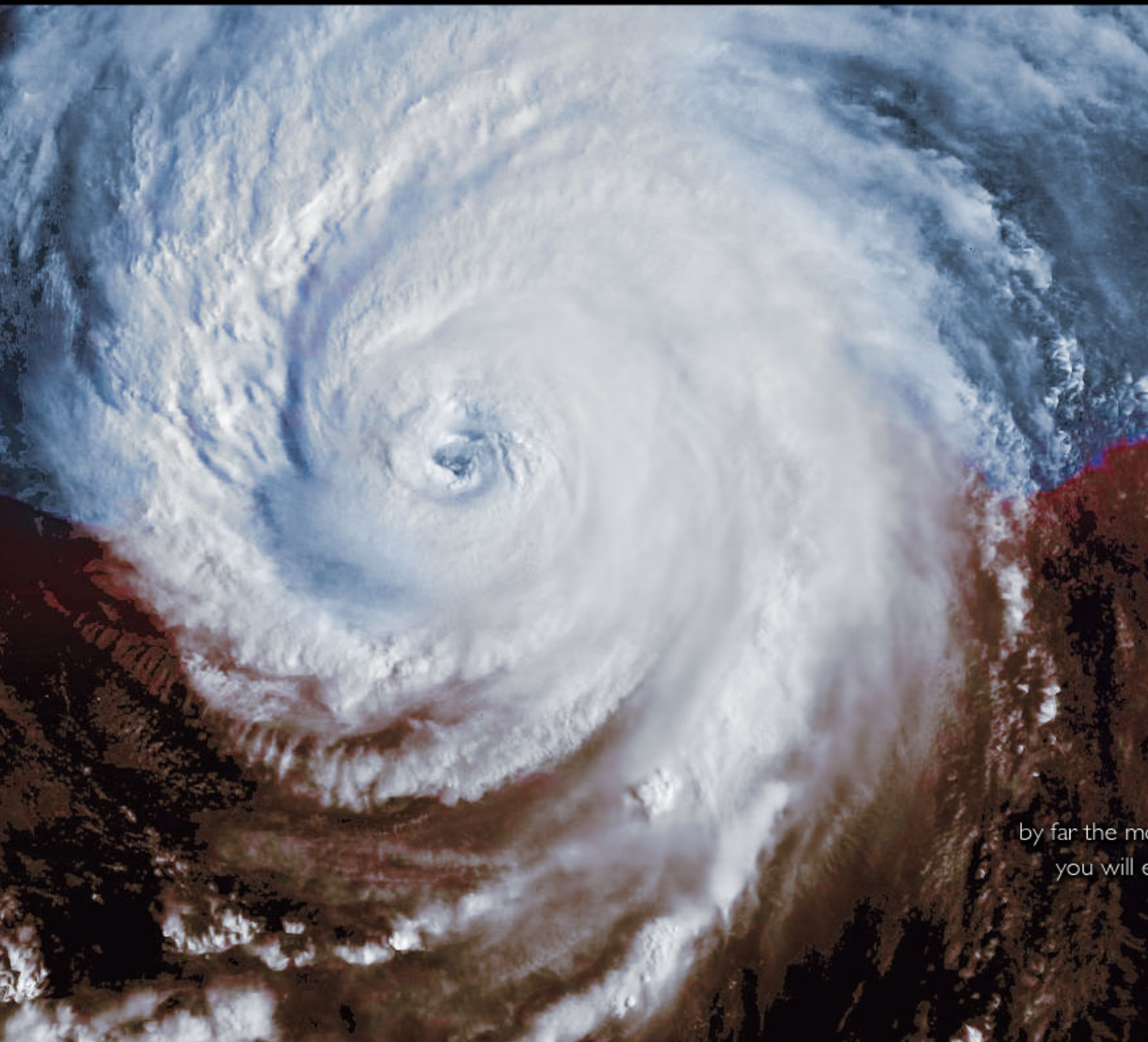
<http://www.atomcsill.elte.hu>

<http://lecco.elte.hu>



# an inconvenient truth

A GLOBAL WARNING



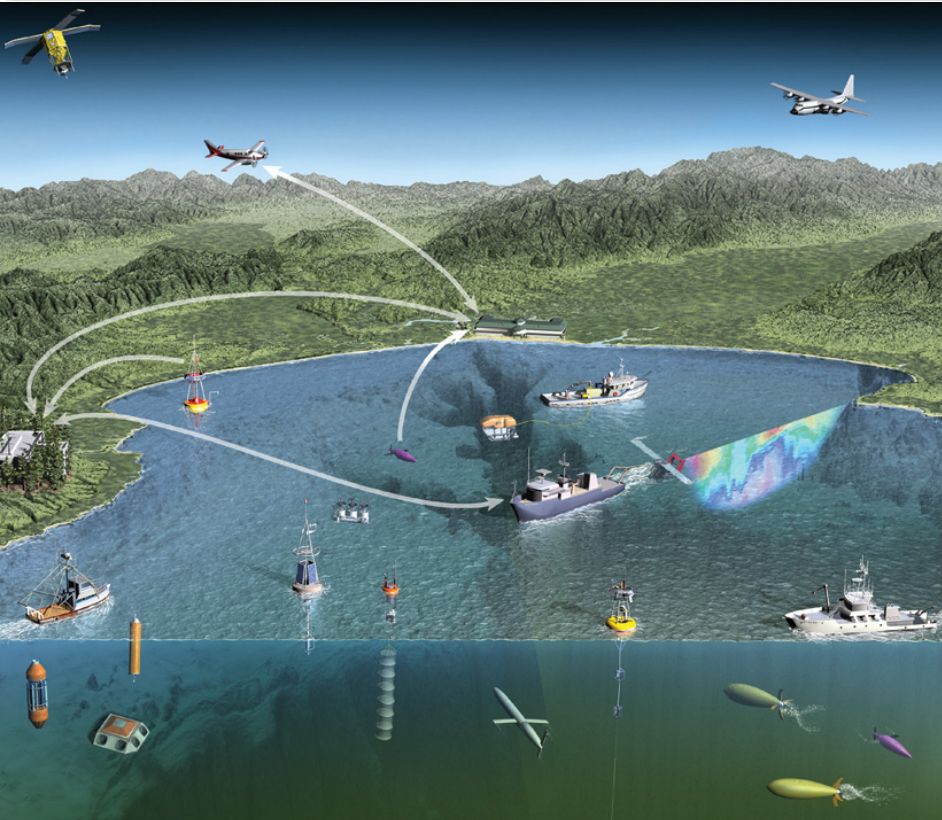
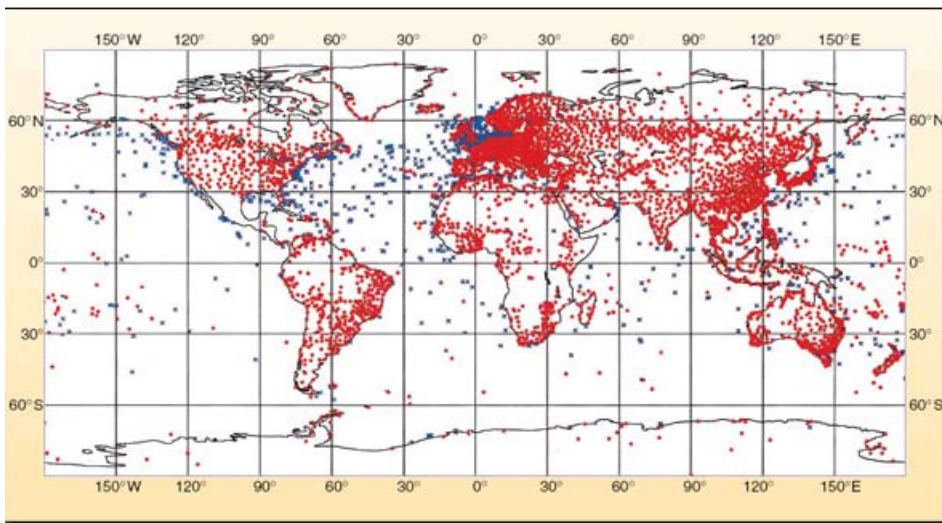
by far the most terrifying film  
you will ever see.







# Modern észlelő hálózatok

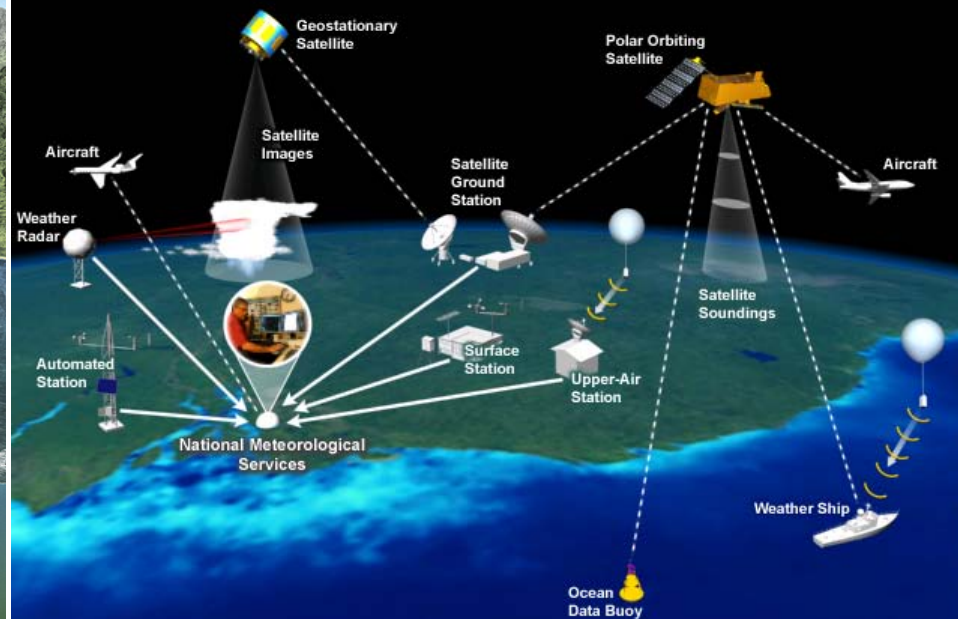


## Global Environmental Satellite Observation Network



The COMET Program / EUMETSAT / NASA / NOAA / WMO

## WMO Global Observing System



WMO / The COMET Program

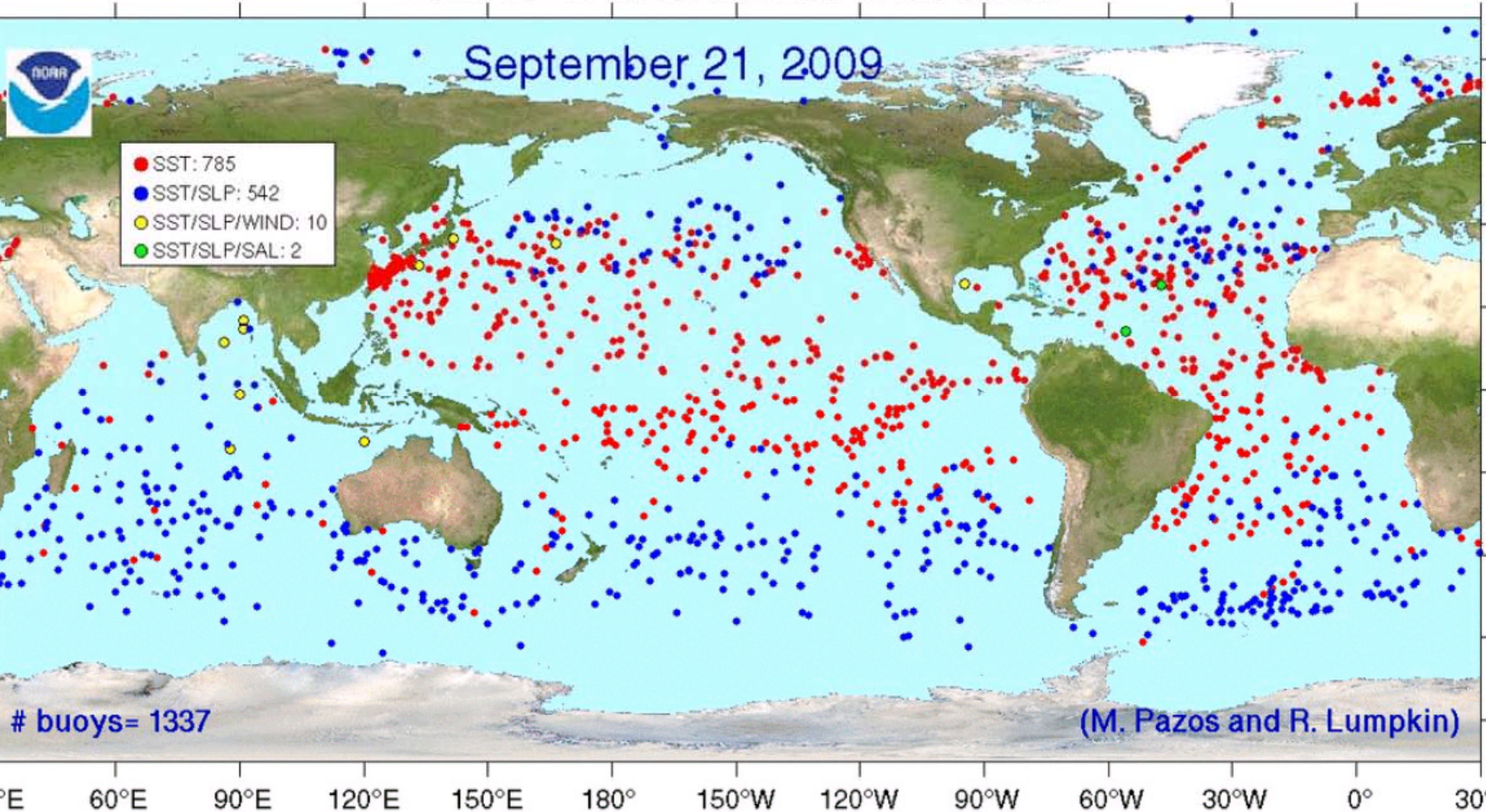


# STATUS OF GLOBAL DRIFTER ARRAY

September 21, 2009



- SST: 785
- SST/SLP: 542
- SST/SLP/WIND: 10
- SST/SLP/SAL: 2



# buoys= 1337

(M. Pazos and R. Lumpkin)

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ocean temperature, salinity ...



**Biosphere**  
ecosystems, vegetation...



**Paleoclimate**  
ice cores, land records ...



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animals/invertebrates, plants...



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geochemistry, seismology ...



**Climate Indicators**  
air temperature, drought ...



**Spectral / Engineering**  
radar, visible imagery ...



**Cryosphere**  
frozen ground, sea ice ...



**Sun-Earth Interactions**  
auroras, solar activity ...



**Human Dimensions**  
land use, population ...



**Terrestrial Hydrosphere**  
ground water, water quality ...



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- Climate Indicators
- Cryosphere
- Human Dimensions
- Land Surface
- Oceans
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- Sun-Earth Interactions
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<p><b>AEROSOLS</b> (576) ⓘ aerosol extinction, sulfate particles, aerosol optical depth/thickness, aerosol backscatter, aerosol particle properties...</p>	<p><b>ATMOSPHERIC RADIATION</b> (1556) ⓘ solar radiation, shortwave radiation, longwave radiation, heat flux, outgoing longwave radiation...</p>
<p><b>AIR QUALITY</b> (702) ⓘ visibility, tropospheric ozone, emissions, nitrogen oxides, carbon monoxide...</p>	<p><b>ATMOSPHERIC TEMPERATURE</b> (2754) ⓘ air temperature, surface air temperature, maximum/minimum temperature, temperature anomalies, temperature profiles...</p>
<p><b>ALTITUDE</b> (792) ⓘ geopotential height, tropopause, station height, barometric altitude, planetary boundary layer height...</p>	<p><b>ATMOSPHERIC WATER VAPOR</b> (2265) ⓘ humidity, water vapor, dew point temperature, precipitable water, evaporation...</p>
<p><b>ATMOSPHERIC CHEMISTRY</b> (1166) ⓘ oxygen compounds, carbon and hydrocarbon compounds, trace gases/trace species, nitrogen compounds, sulfur compounds...</p>	<p><b>ATMOSPHERIC WINDS</b> (2282) ⓘ surface winds, upper level winds, vertical wind motion, wind profiles, vorticity...</p>
<p><b>ATMOSPHERIC ELECTRICITY</b> (99) ⓘ lightning, electric field, atmospheric conductivity, total electron content...</p>	<p><b>CLOUDS</b> (1249) ⓘ cloud amount/frequency, cloud types, cloud liquid water/ice, cloud height, cloud top pressure...</p>
<p><b>ATMOSPHERIC PHENOMENA</b> (646) ⓘ storms, hurricanes, lightning, fog, cyclones...</p>	<p><b>PRECIPITATION</b> (2006) ⓘ precipitation amount, rain, snow, precipitation rate, precipitation anomalies...</p>

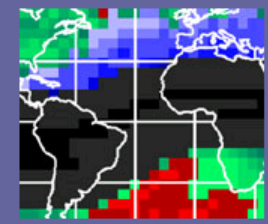
A „kozmos kapcsolat”





# A „kozmosz kapszula”



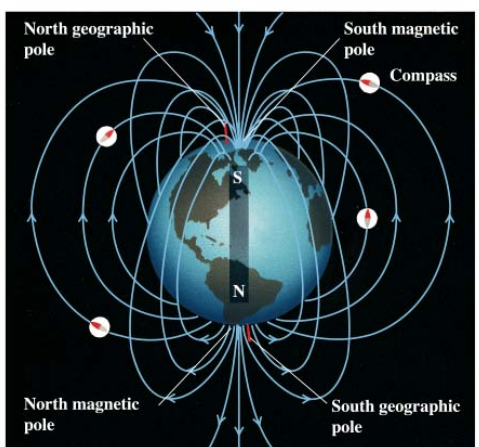
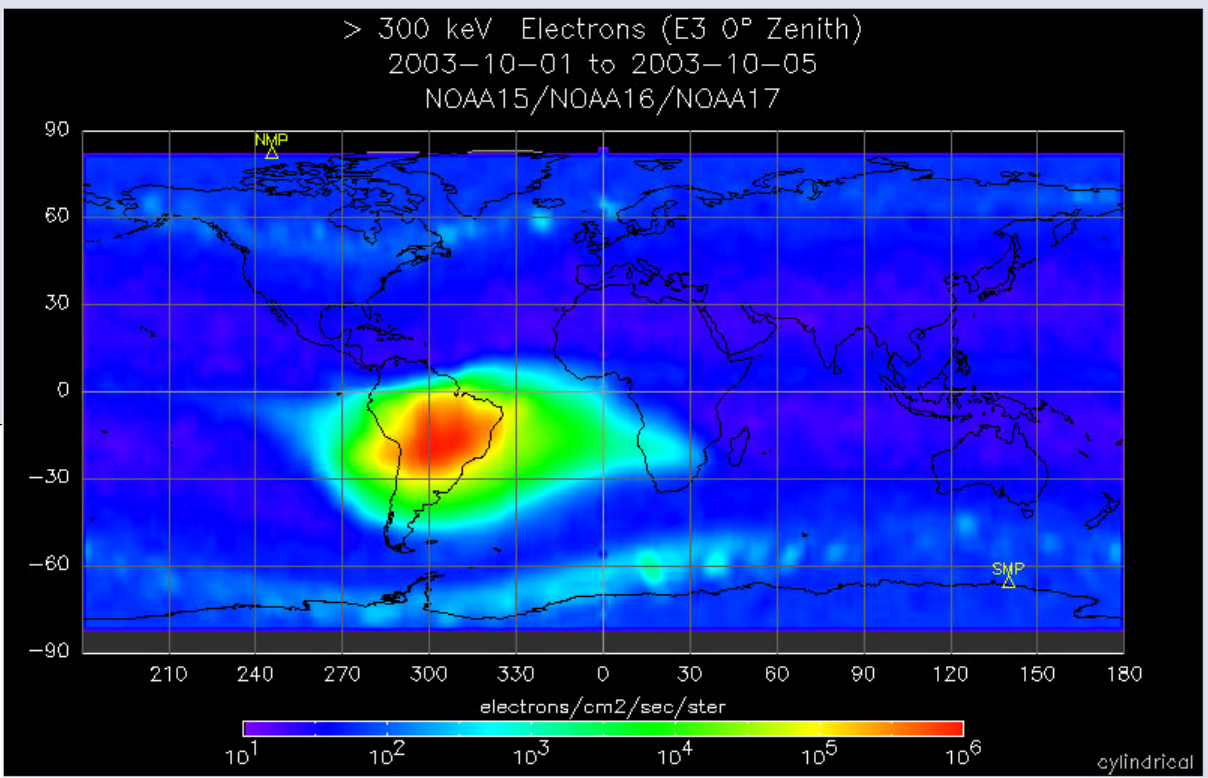


The NOAA series of polar-orbiting satellites carry onboard a Space Environment Monitor subsystem that measures Energetic Particles along the orbit path.

## NOAA / POES Space Environment Monitor

### A New Product for Visualizing Energetic Particle Data from NOAA`s POES Satellites

This product was developed by Ethan Peck, 2008 Hollings Scholar from Cornell University, and his summer program mentor Daniel Wilkinson with the National Geophysical Data Center (NGDC). The product was first announced to the user community in a poster presented at the 2008 Fall AgU meeting in San Francisco, CA. Paper # U13A-0048 was included in the session titled "The Van Allen Radiation Belts and Their Impact on Modern Space Science" View the poster [here](#) (SMB pdf version 8).

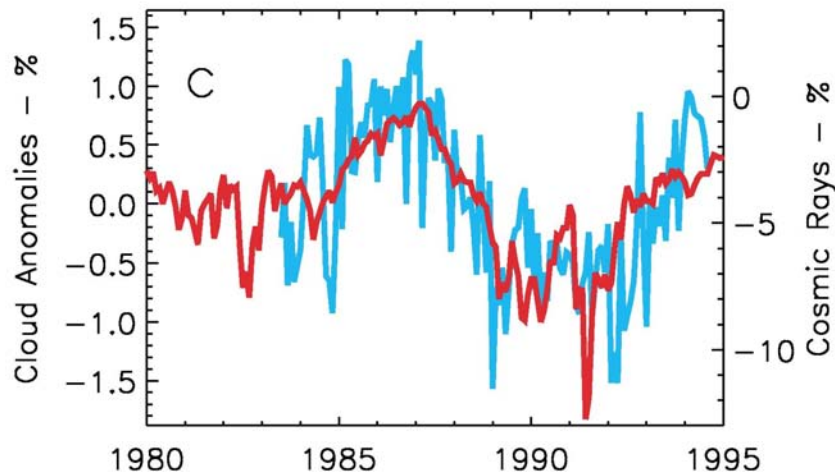
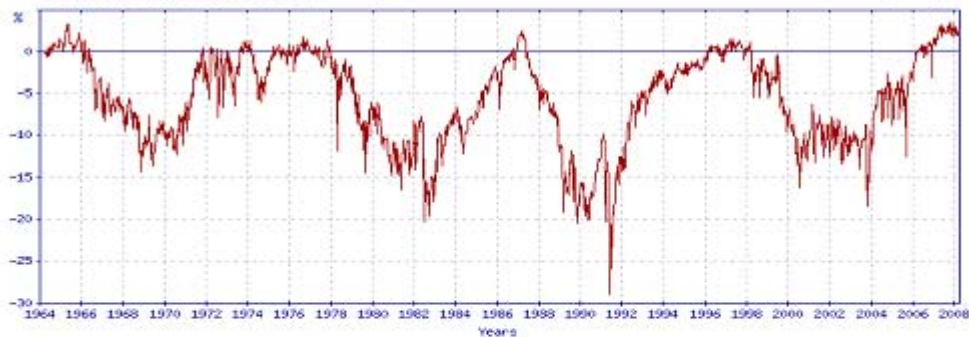




### Dulu Neutron Monitor

pressure corrected data

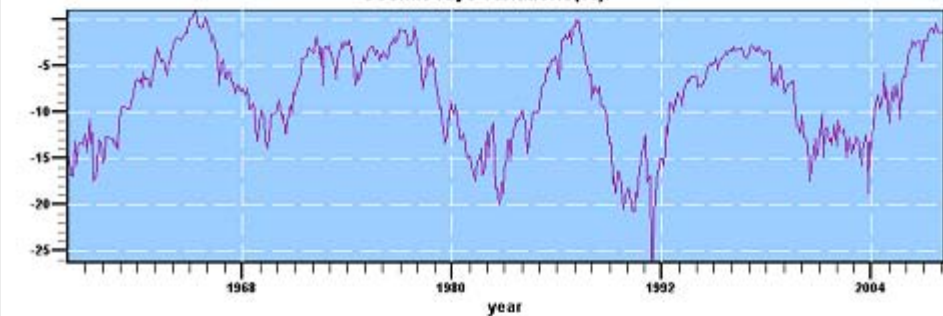
1-hour data → 10-day averages



N.D. Marsh, H. Svensmark, *PRL*, 2000.

### Moscow

Cosmic rays variations(%)



### Climax & Haleakala

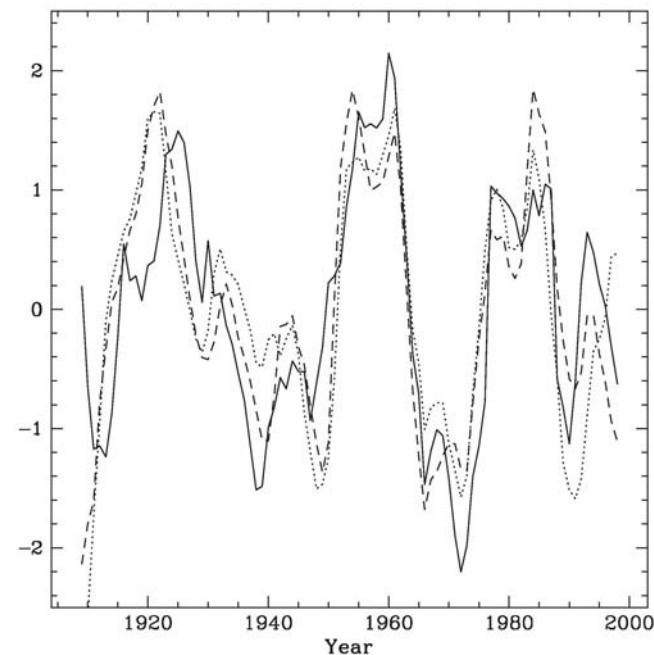
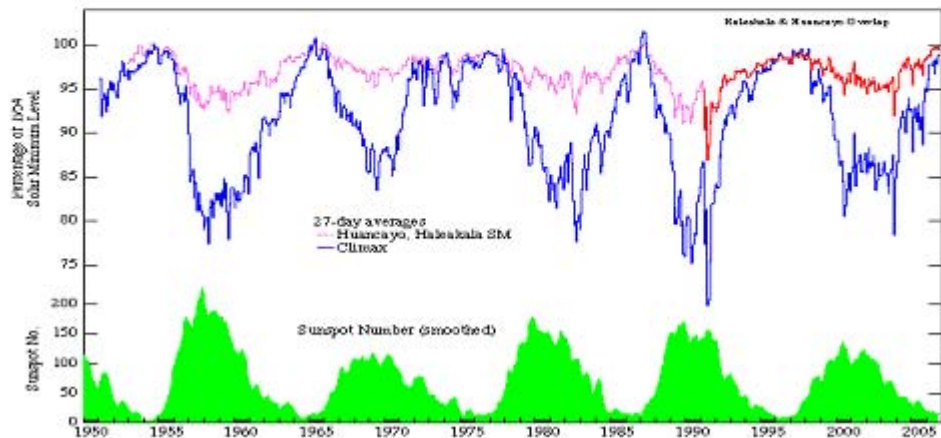


FIG. 2. The detrended time series for the Paraná's stream flow (full line), the sunspot number (dashed line), and the irradiance reconstruction (dotted line). The detrended series were obtained

P.J. Mauas, E. Flamenco, A.P. Buccino, *PRL*, 2008.

# A „kozmos kapcsolat” (?)

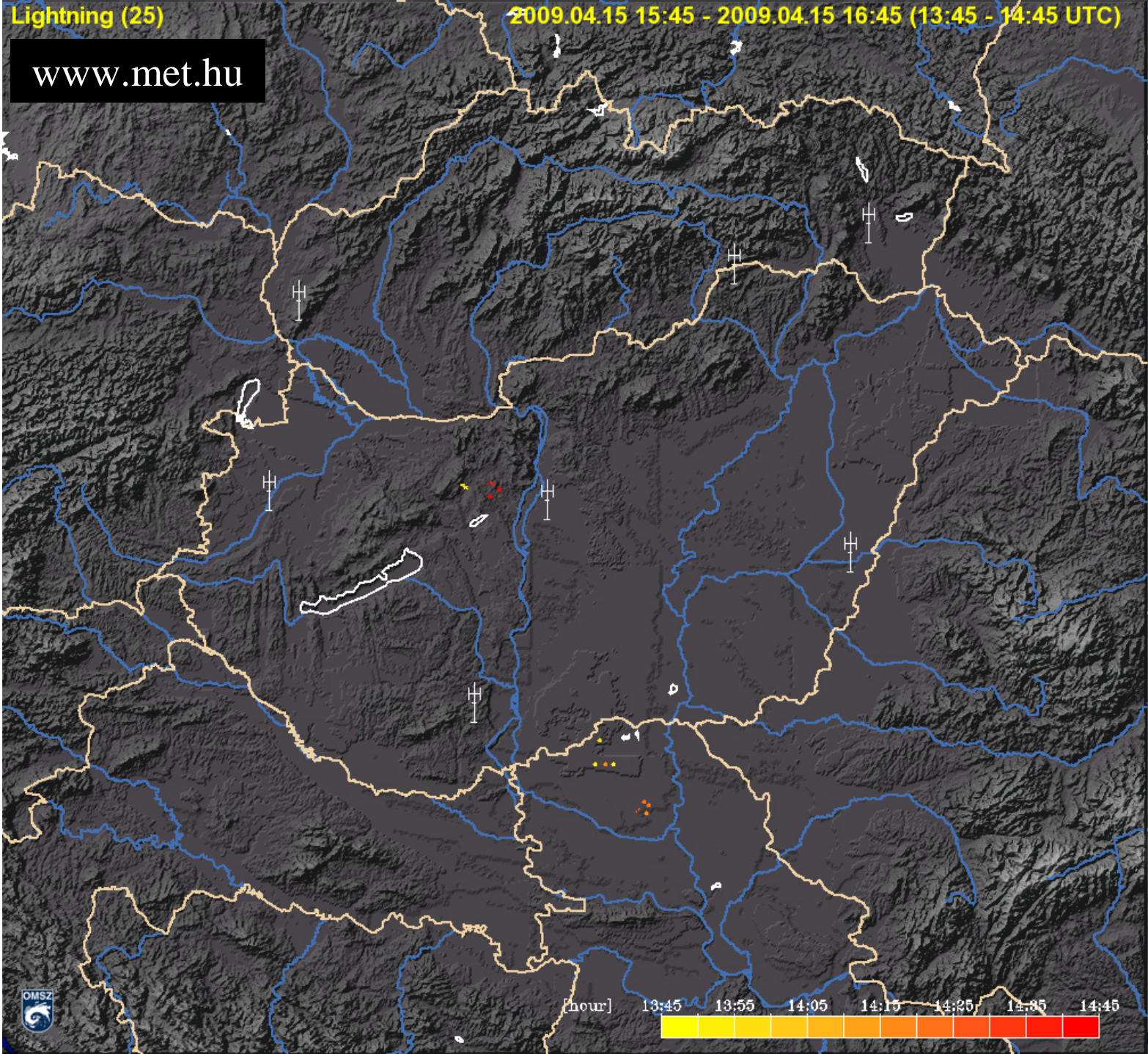




Lightning (25)

2009.04.15 15:45 - 2009.04.15 16:45 (13:45 - 14:45 UTC)

[www.met.hu](http://www.met.hu)



[hour] 13:45 13:55 14:05 14:15 14:25 14:35 14:45



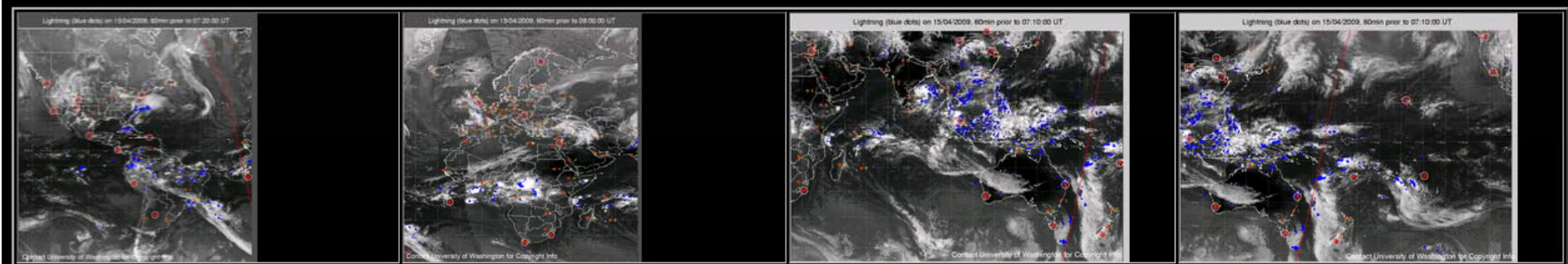
# WWLLN

## World Wide Lightning Location Network ([wwlln.net](http://wwlln.net))

SYSTEM MESSAGE: Welcome to several new hosts for stations in Yakutsk, Russia, Beijing and Nanjing, China, Scott Base Antarctica, and SANAE Base Antarctica.

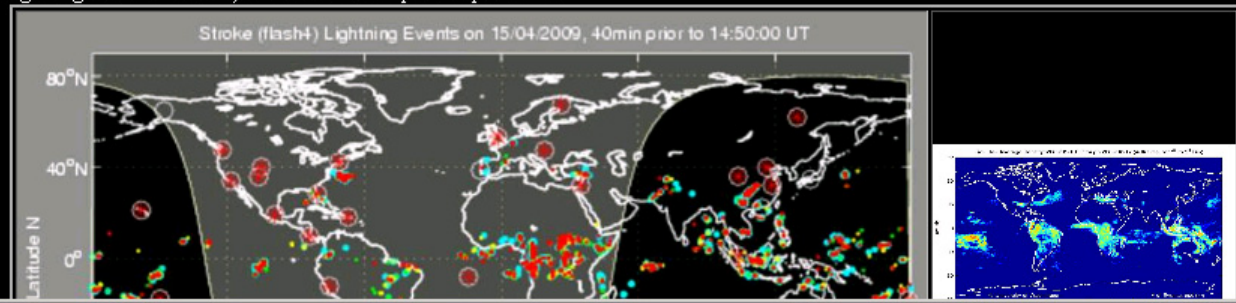
Have you tried our Google Earth overlays? Try the one offered by our high speed data distribution partner [GuiWeather](#) (and parent WDT) which includes a sample from the last 30 minutes - start with the tab at the top, or zoom in a little with our own 1-hour overlay distribution at [WWLLN 1-hour](#) or play them together! RHH

Contact Prof. Holzworth at [bobholz@washington.edu](mailto:bobholz@washington.edu), Director of WWLLN, with any questions you may have.

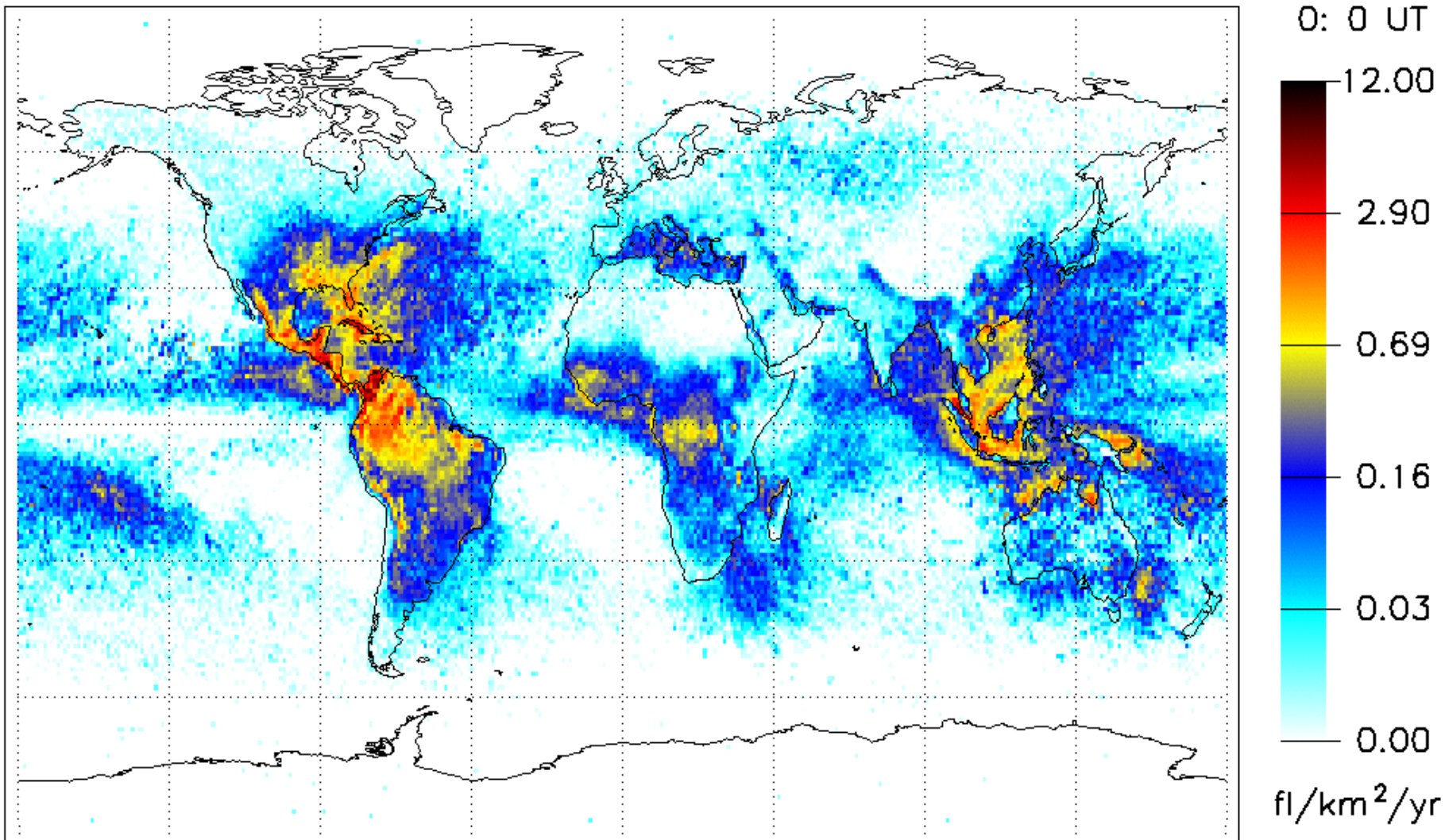


- click on image to get a bigger version -  
 (Notes: cloud data thanks to National Weather Service/Aviation Weather Center; blue overlay dots are WWLLN Lightning; Red circles are WWLLN receivers; Red line is the terminator)  
 University of Washington in Seattle operating a network of lightning location sensors at VLF (3-30 kHz). Most ground-based observations in the VLF band are dominated by impulsive signals from lightning discharges called "sferics". Significant radiated electromagnetic power exists from a few hertz to several hundred megahertz, with the bulk of the energy radiated at VLF.

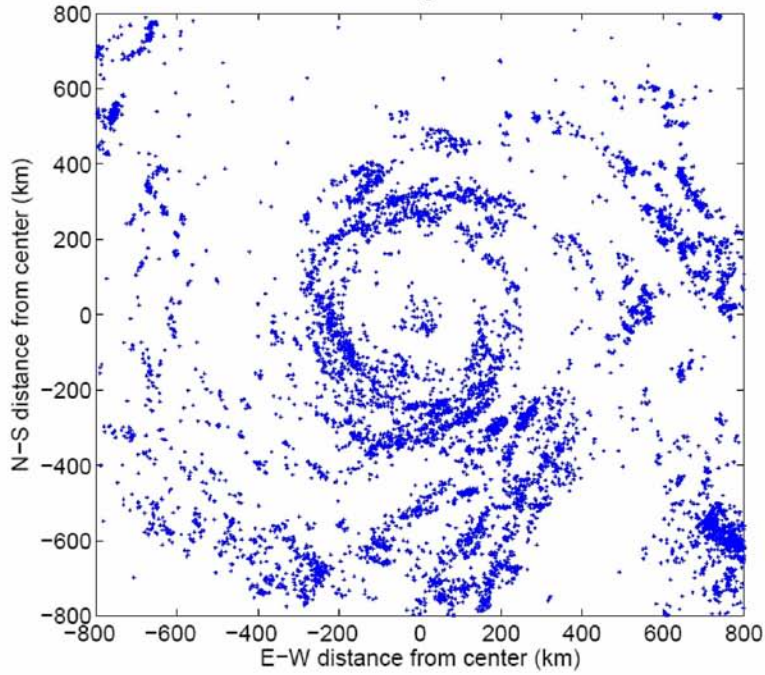
With our network of sferic sensors we are producing regular maps of lightning activity over the entire Earth. Our map showing the entire world uses coloured spots to indicate lightning strokes (red stars inside an open circle are active WWLLN lightning sensor locations). Click on the map for explanation.



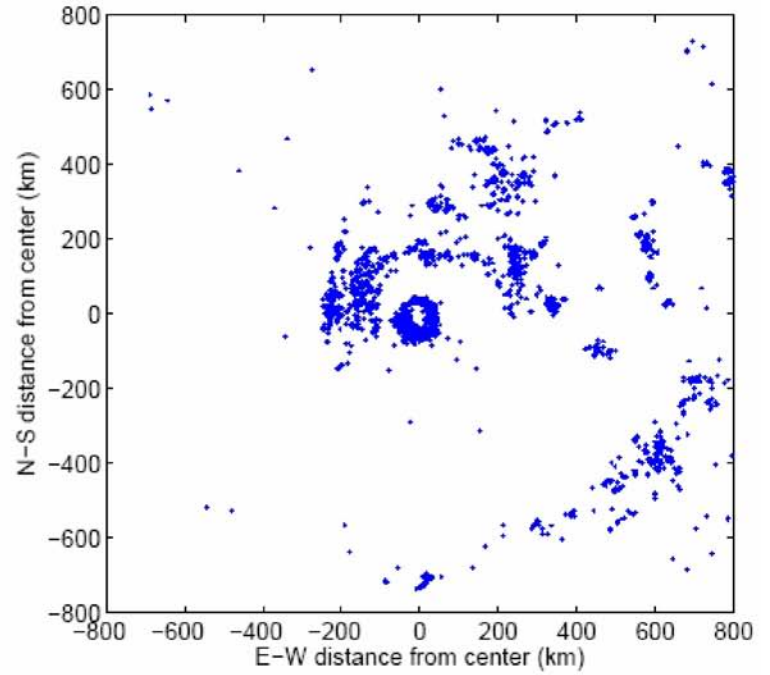




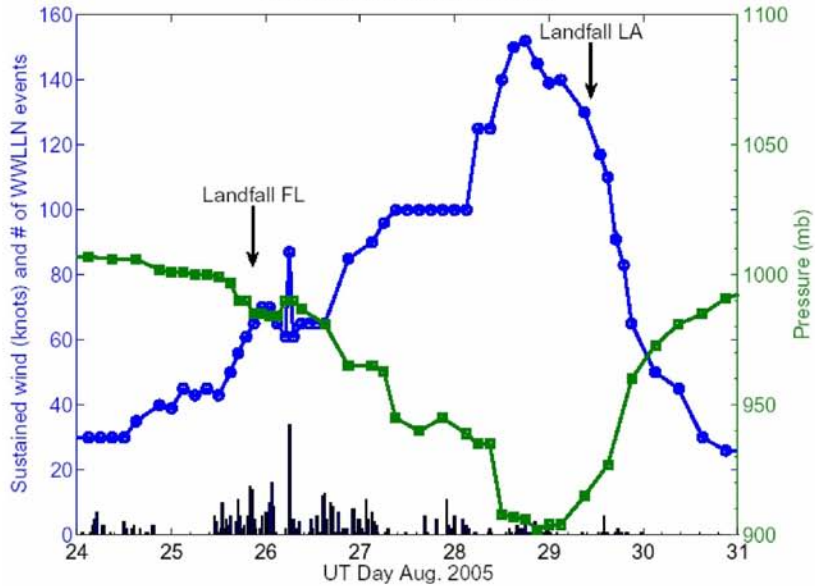
Katrina Aug 28 2005



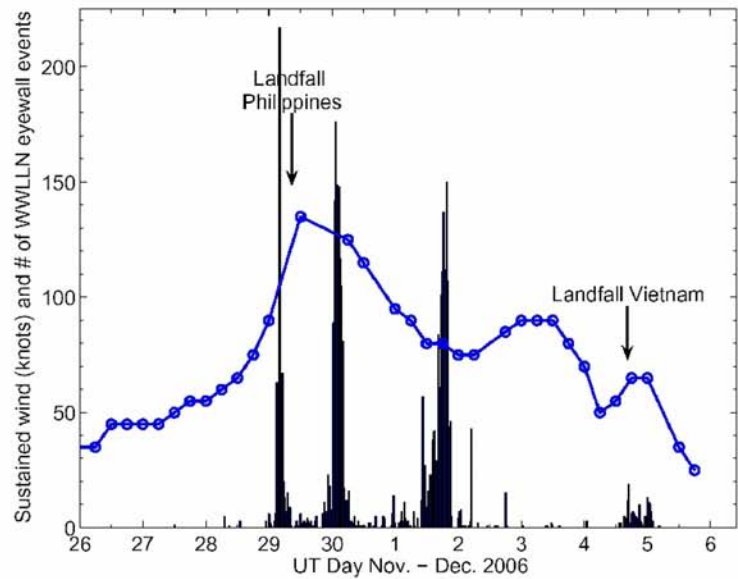
DURIAN-06 11\30\2006



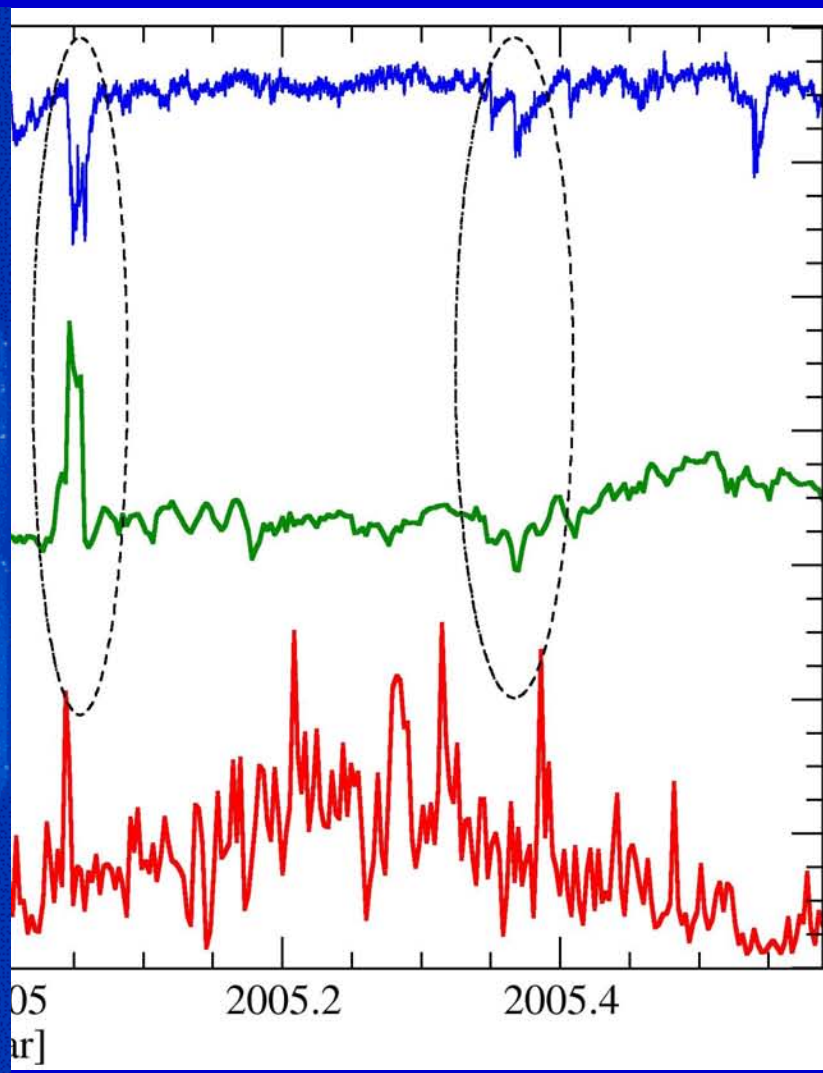
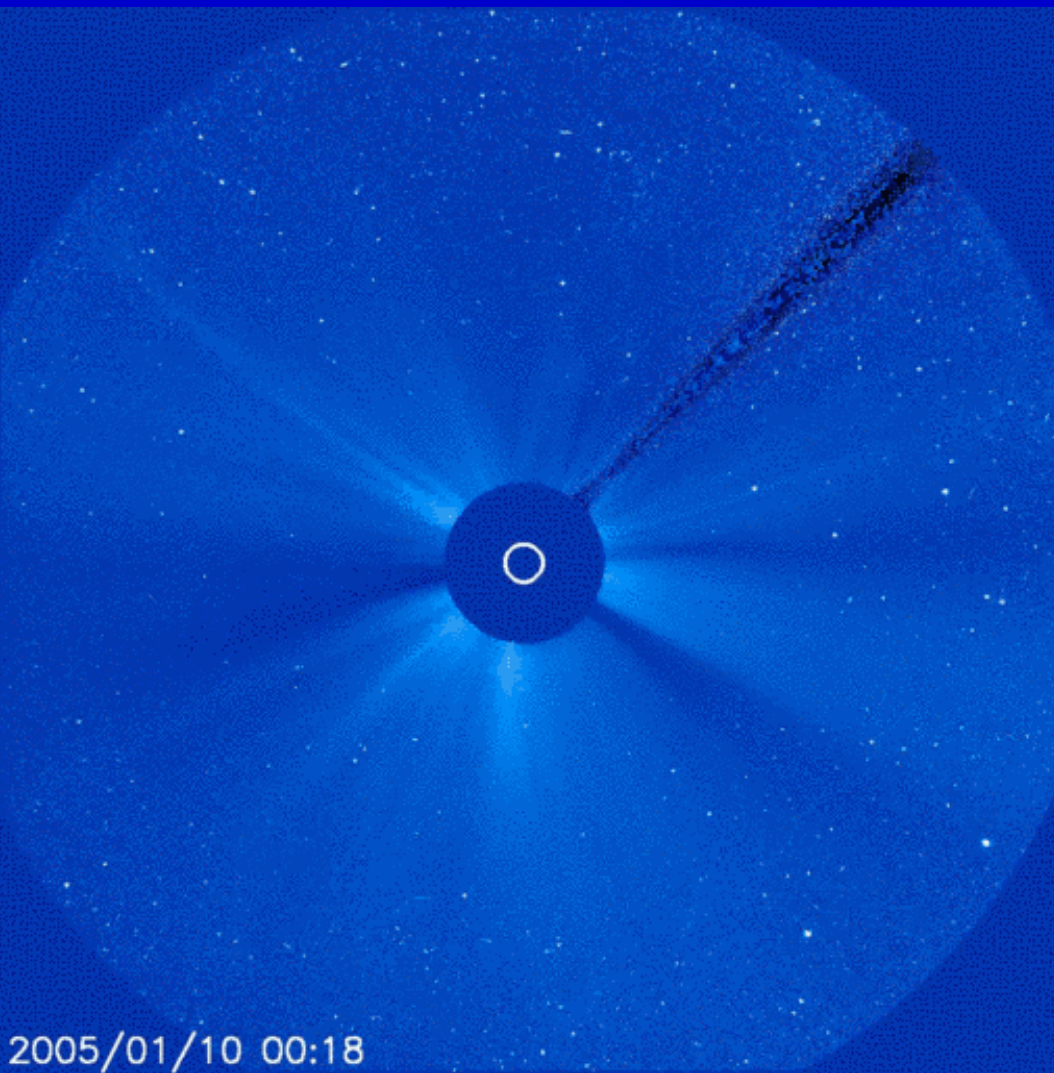
Atlantic Basin Hurricane Katrina

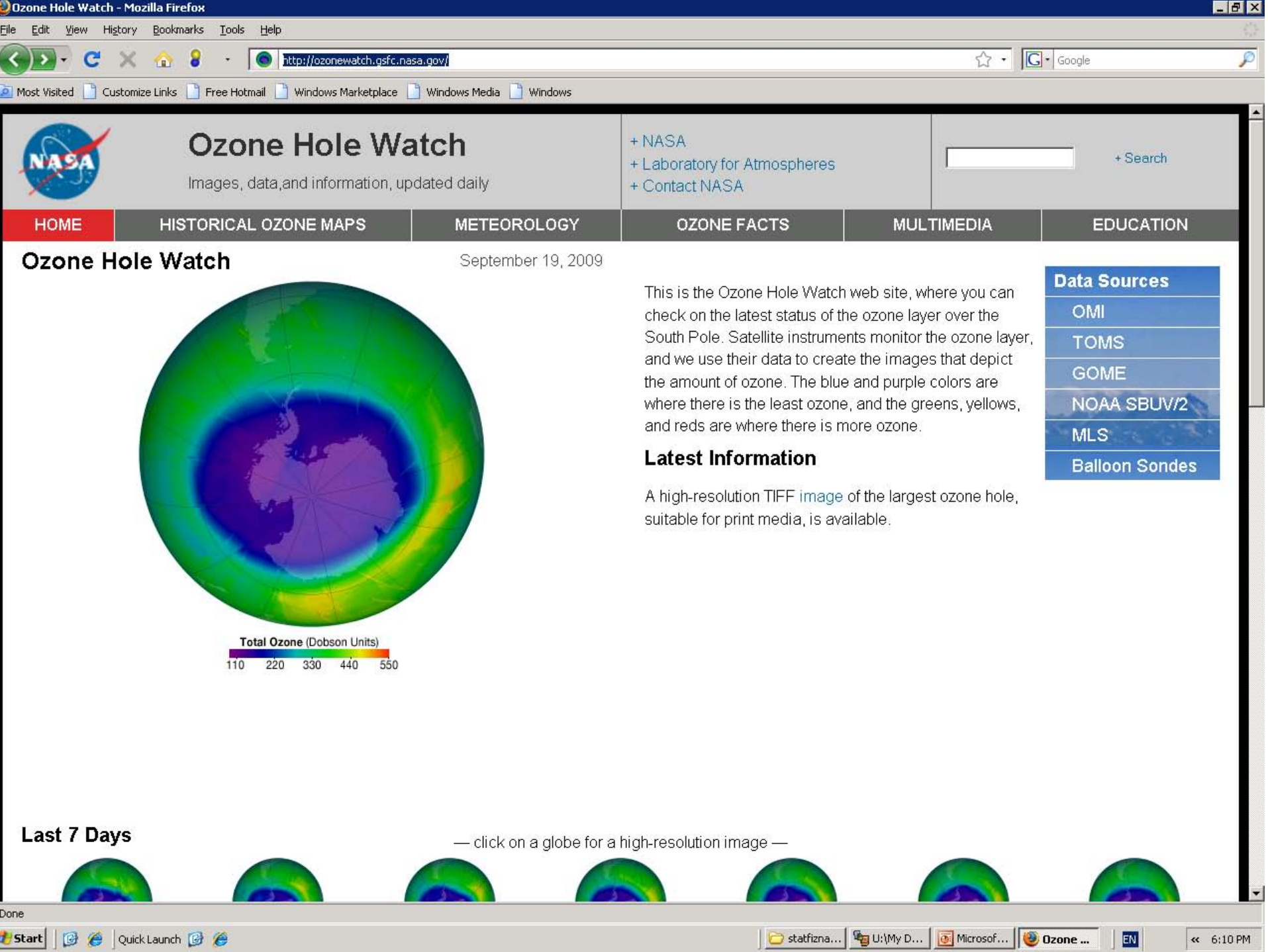


Western Pacific Typhoon Durian









# Ozone Hole Watch

Images, data, and information, updated daily

- + NASA
- + Laboratory for Atmospheres
- + Contact NASA

+ Search

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HISTORICAL OZONE MAPS

METEOROLOGY

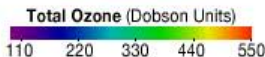
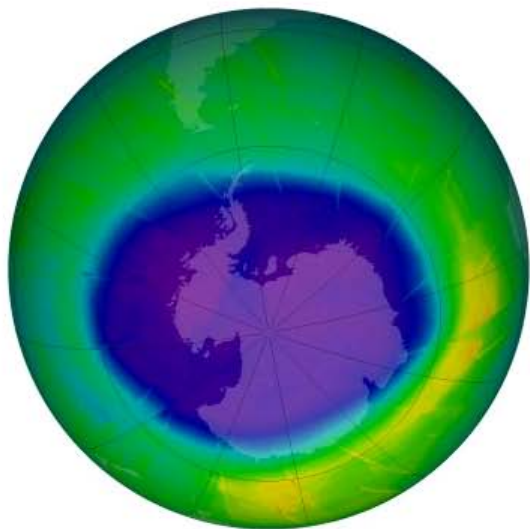
OZONE FACTS

MULTIMEDIA

EDUCATION

## Ozone Hole Watch

September 19, 2009



This is the Ozone Hole Watch web site, where you can check on the latest status of the ozone layer over the South Pole. Satellite instruments monitor the ozone layer, and we use their data to create the images that depict the amount of ozone. The blue and purple colors are where there is the least ozone, and the greens, yellows, and reds are where there is more ozone.

### Latest Information

A high-resolution TIFF [image](#) of the largest ozone hole, suitable for print media, is available.

### Data Sources

[OMI](#)

[TOMS](#)

[GOME](#)

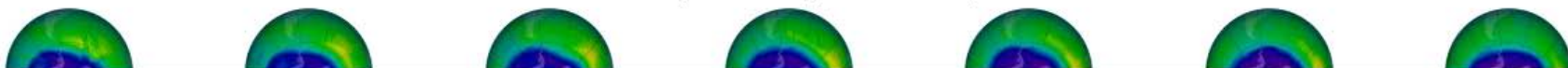
[NOAA SBUV/2](#)

[MLS](#)

[Balloon Sondes](#)

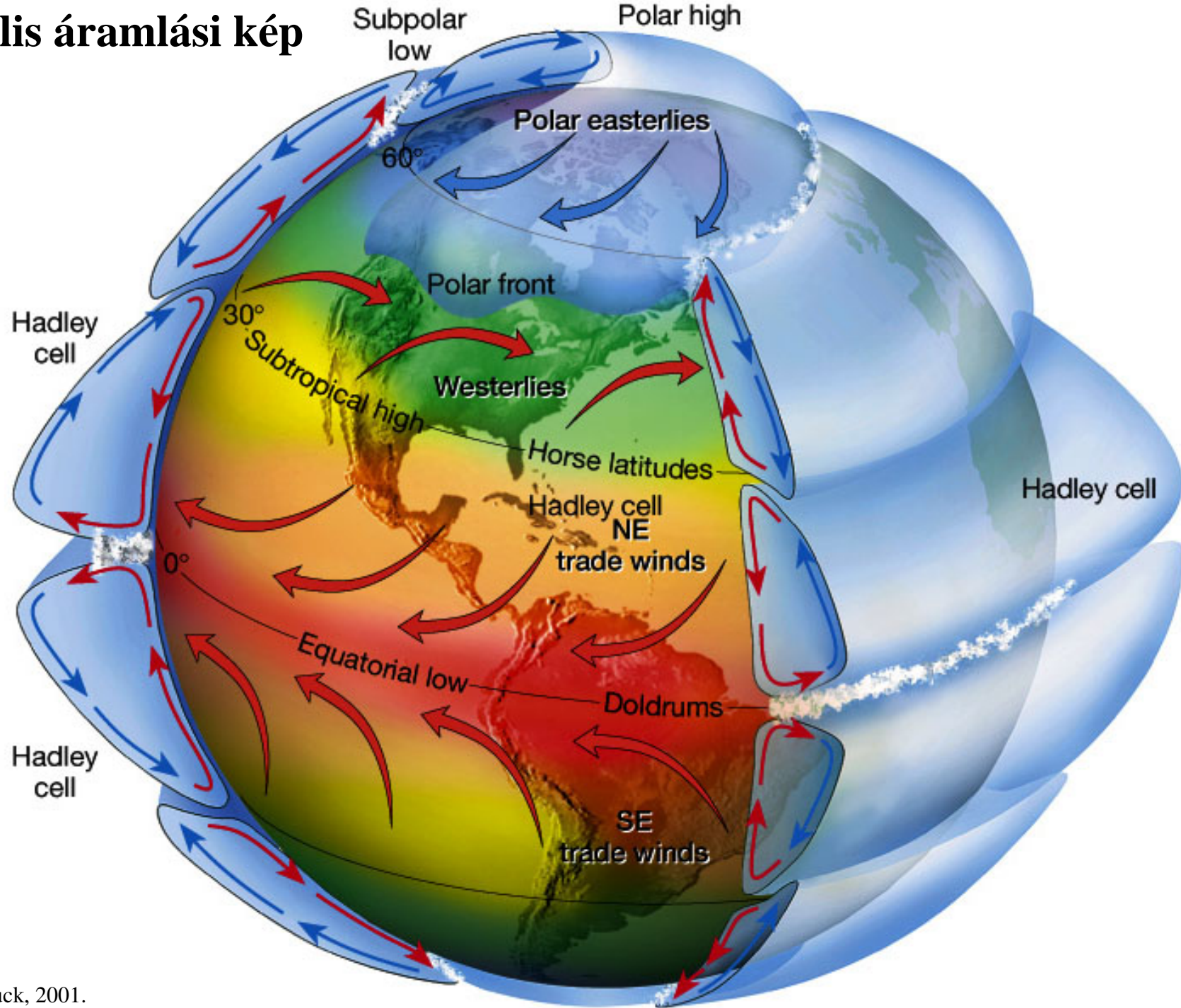
### Last 7 Days

— click on a globe for a high-resolution image —



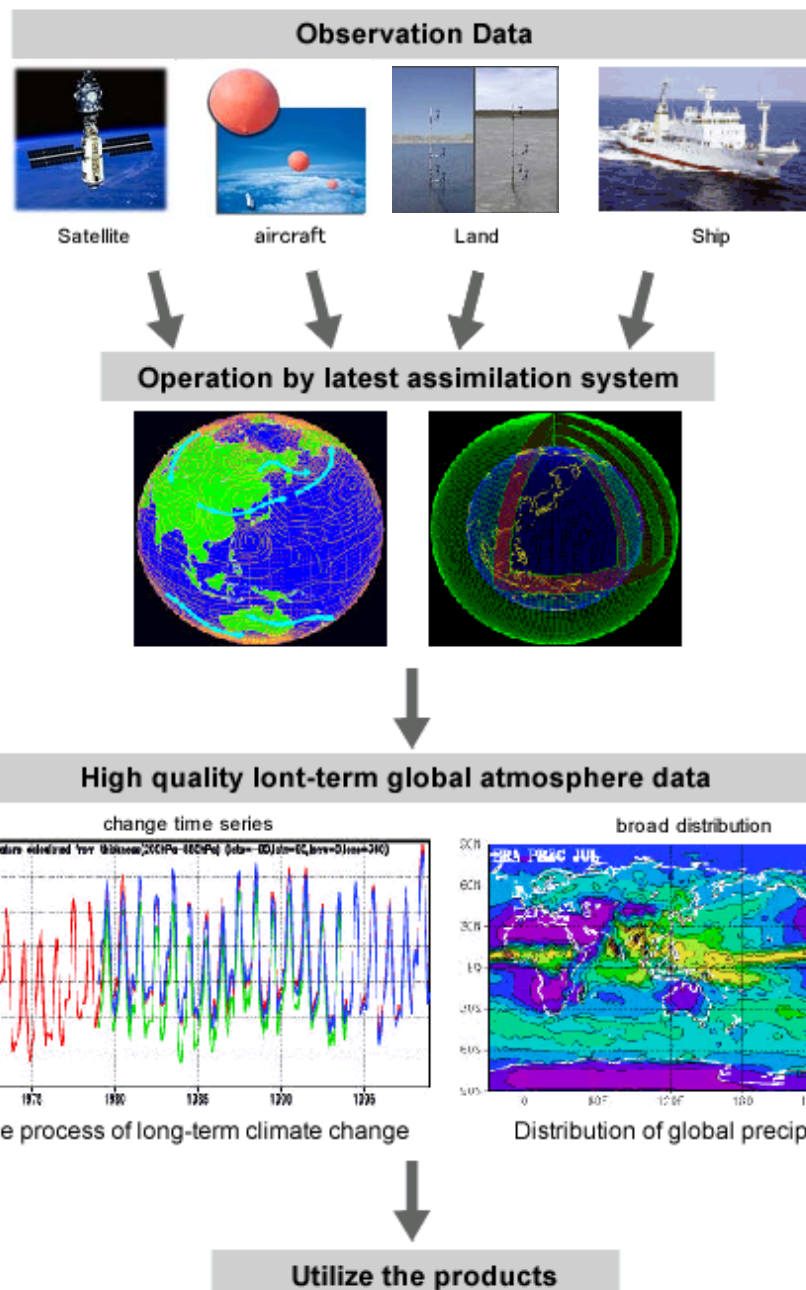
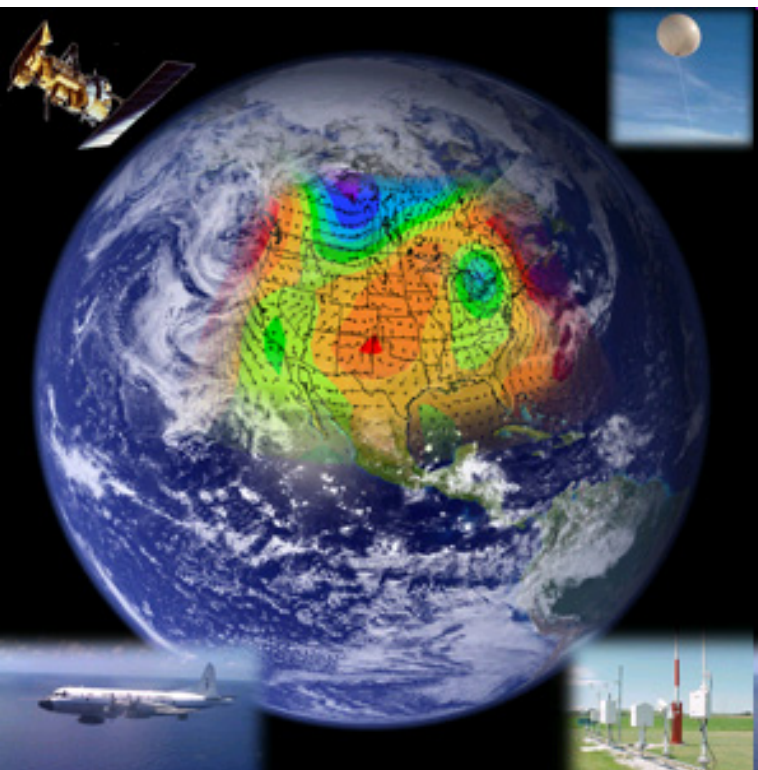


# A globális áramlási kép



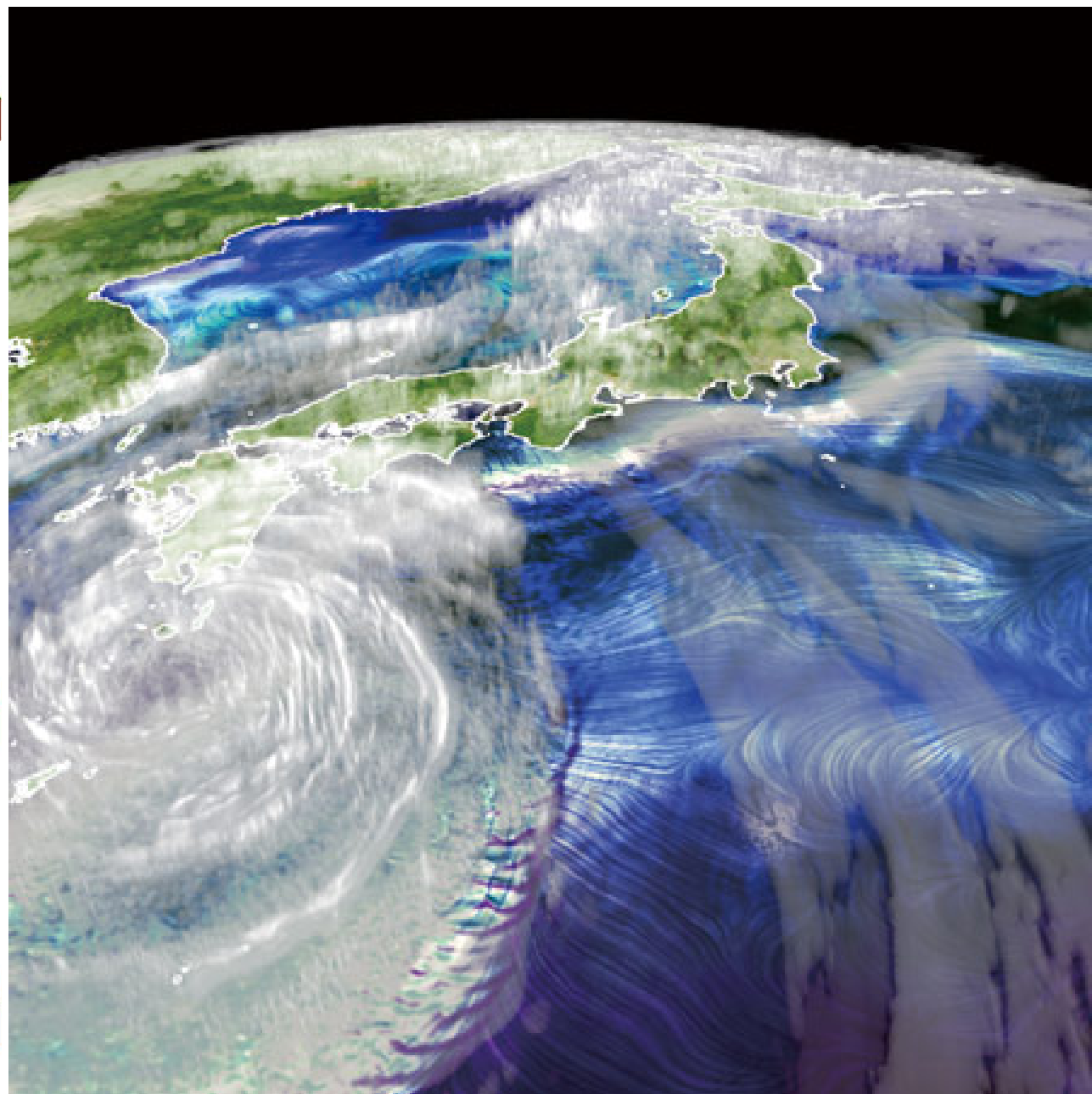
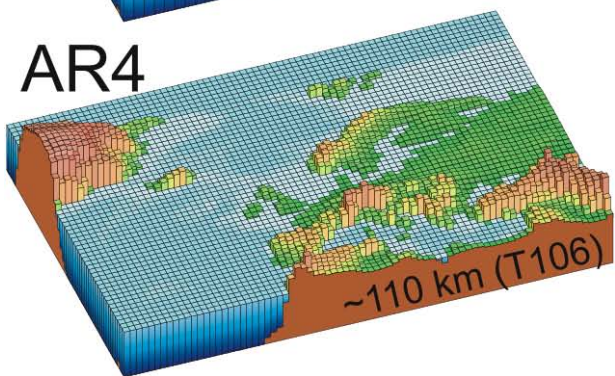
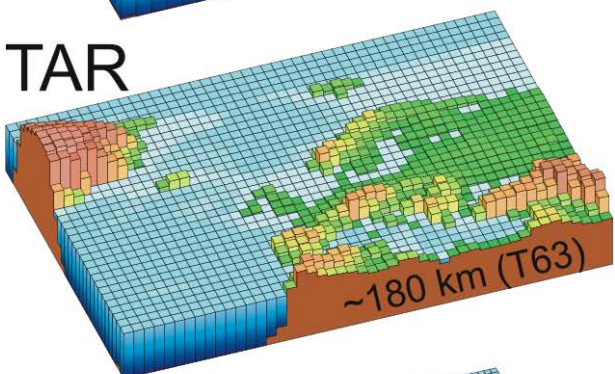
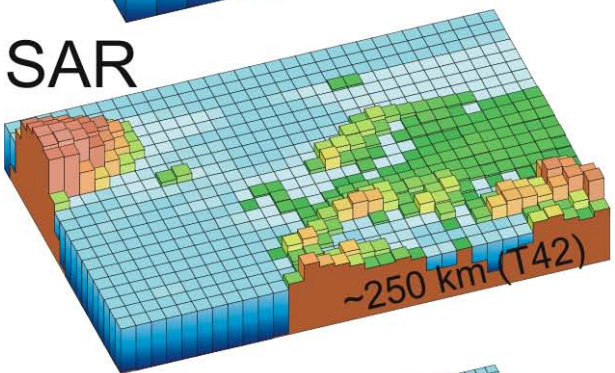
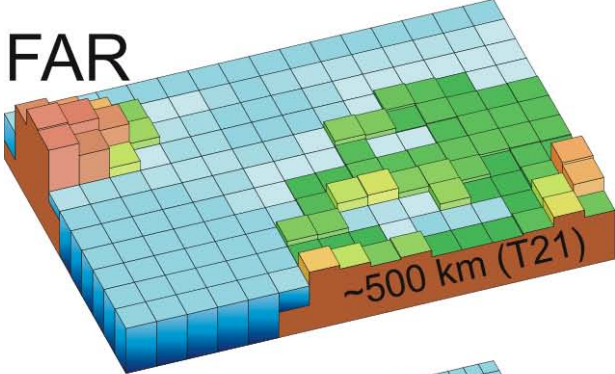
# Adatok forrása: reanalízis

ECMWF:	ERA-15
	ERA-40
	ERA-Interim
NCEP/NCAR:	R1
NCEP/DOE:	R2
JMA:	JRA-25
NASA:	GEOS-1
	...
	GEOS-5



- \* More accurate operational climate-system monitoring routines
- \* More accurate dataset for dynamical seasonal prediction
- \* Various research activities in climate system studies





Select Time

- 00:00:00
- 06:00:00
- 12:00:00
- 18:00:00

Select All or Clear

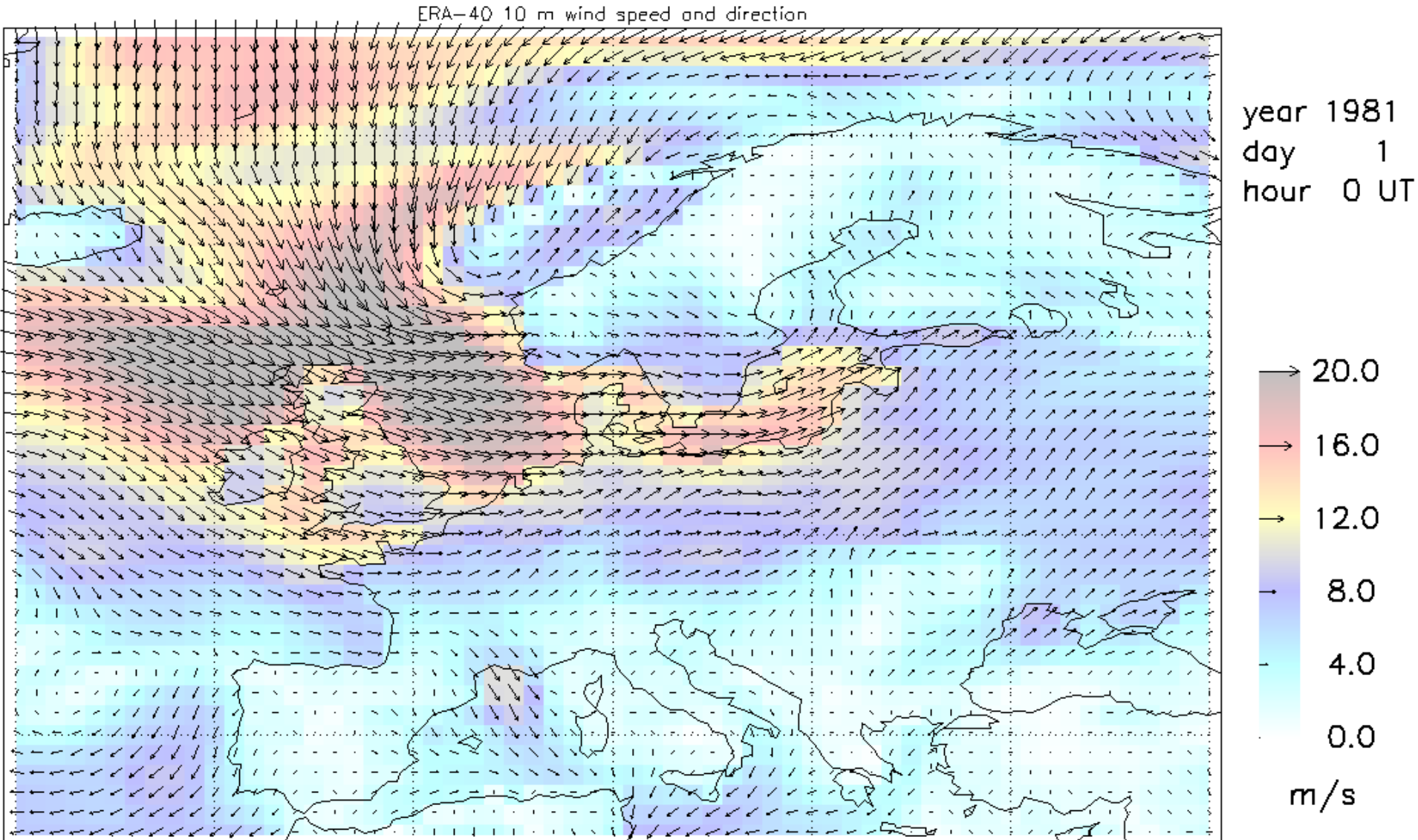
Select parameters

- |   |   |
|---|---|
| <input type="checkbox"/> 10 metre U wind component                            | <input type="checkbox"/> 10 metre V wind component                    |
| <input type="checkbox"/> 2 metre dewpoint temperature                         | <input type="checkbox"/> 2 metre temperature                          |
| <input type="checkbox"/> Boundary layer height                                | <input type="checkbox"/> Convective precipitation                     |
| <input type="checkbox"/> East-West surface stress                             | <input type="checkbox"/> Evaporation                                  |
| <input type="checkbox"/> High cloud cover                                     | <input type="checkbox"/> Ice surface temperature layer 1              |
| <input type="checkbox"/> Ice surface temperature layer 2                      | <input type="checkbox"/> Ice surface temperature layer 3              |
| <input type="checkbox"/> Ice surface temperature layer 4                      | <input type="checkbox"/> Latitudinal component of gravity wave stress |
| <input type="checkbox"/> Low cloud cover                                      | <input type="checkbox"/> Mean sea level pressure                      |
| <input type="checkbox"/> Mean wave direction                                  | <input type="checkbox"/> Mean wave period                             |
| <input type="checkbox"/> Medium cloud cover                                   | <input type="checkbox"/> Meridional component of gravity wave stress  |
| <input type="checkbox"/> North-South surface stress                           | <input type="checkbox"/> Runoff                                       |
| <input type="checkbox"/> Sea-ice cover  | <input type="checkbox"/> Significant wave height                      |
| <input type="checkbox"/> Snow depth   | <input type="checkbox"/> Snow evaporation                             |
| <input type="checkbox"/> Snowfall   | <input type="checkbox"/> Snowmelt                                     |
| <input type="checkbox"/> Soil temperature level 1                             | <input type="checkbox"/> Soil temperature level 2                     |
| <input type="checkbox"/> Soil temperature level 3                             | <input type="checkbox"/> Soil temperature level 4                     |
| <input type="checkbox"/> Stratiform precipitation (Large-scale precipitation) | <input type="checkbox"/> Surface latent heat flux                     |
| <input type="checkbox"/> Surface net solar radiation, clear sky               | <input type="checkbox"/> Surface net thermal radiation, clear sky     |
| <input type="checkbox"/> Surface sensible heat flux                           | <input type="checkbox"/> Surface solar radiation                      |
| <input type="checkbox"/> Surface solar radiation downwards                    | <input type="checkbox"/> Surface thermal radiation                    |
| <input type="checkbox"/> Surface thermal radiation downwards                  | <input type="checkbox"/> Temperature of snow layer                    |
| <input type="checkbox"/> Top net solar radiation, clear sky                   | <input type="checkbox"/> Top net thermal radiation, clear sky         |
| <input type="checkbox"/> Top solar radiation                                  | <input type="checkbox"/> Top thermal radiation                        |
| <input type="checkbox"/> Total cloud cover                                    | <input type="checkbox"/> Total column ozone                           |
| <input type="checkbox"/> Total column water                                   | <input type="checkbox"/> Total column water vapour                    |
| <input type="checkbox"/> Total precipitation                                  | <input type="checkbox"/> Volumetric soil water layer 1                |
| <input type="checkbox"/> Volumetric soil water layer 2                        | <input type="checkbox"/> Volumetric soil water layer 3                |
| <input type="checkbox"/> Volumetric soil water layer 4                        |   |

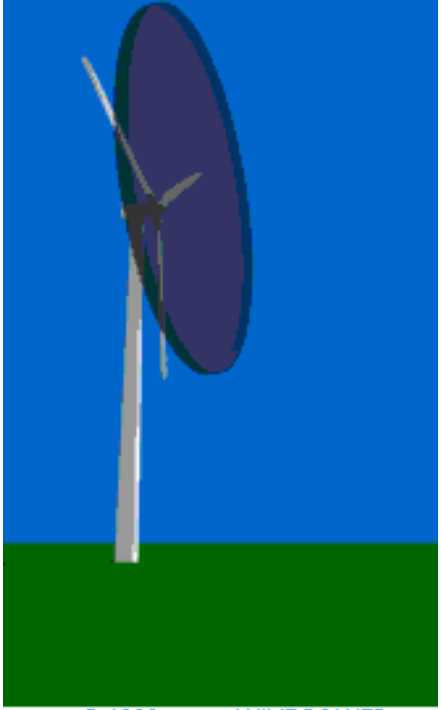
Select All or Clear



# Szélmező statisztikai vizsgálata

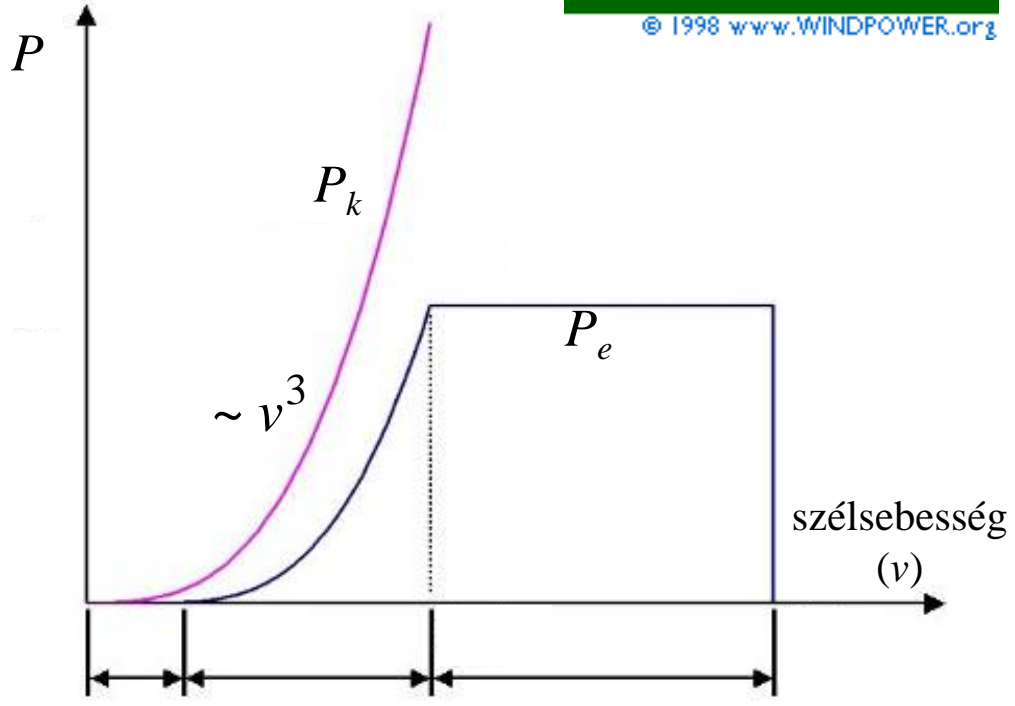


# Cél: hasznosítható szélenergia becslése



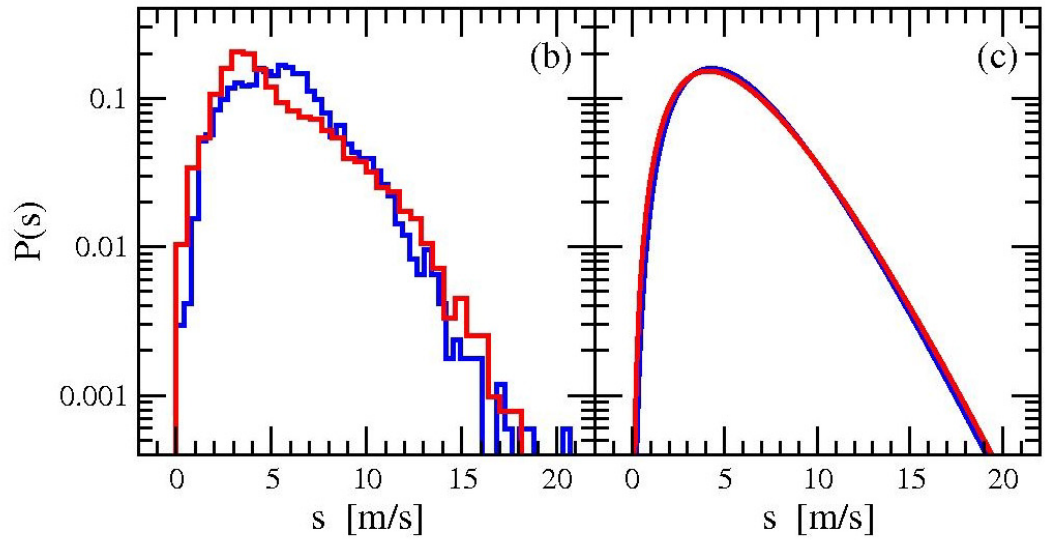
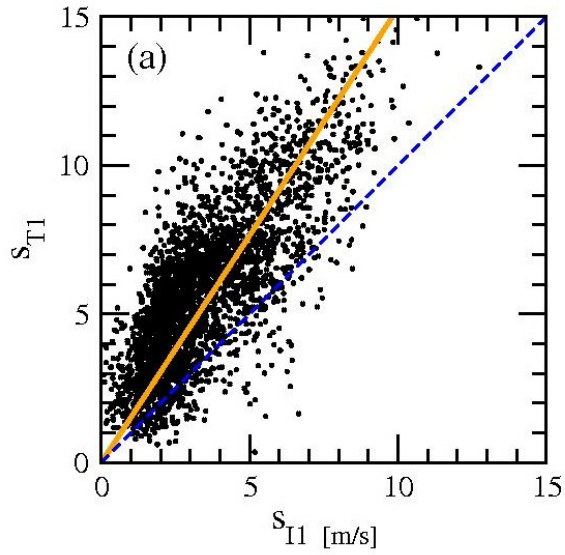
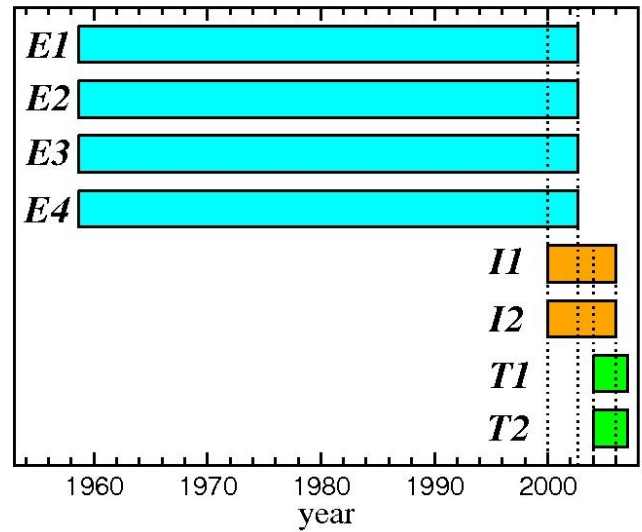
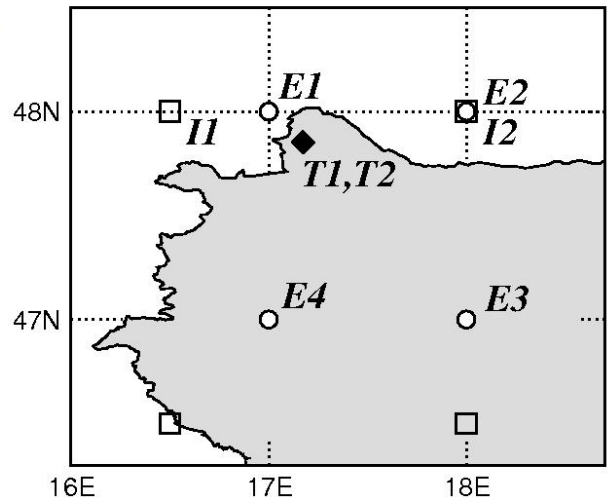
Betz limit (1926):

$$P_e^{\max} = \frac{16}{27} P_k$$





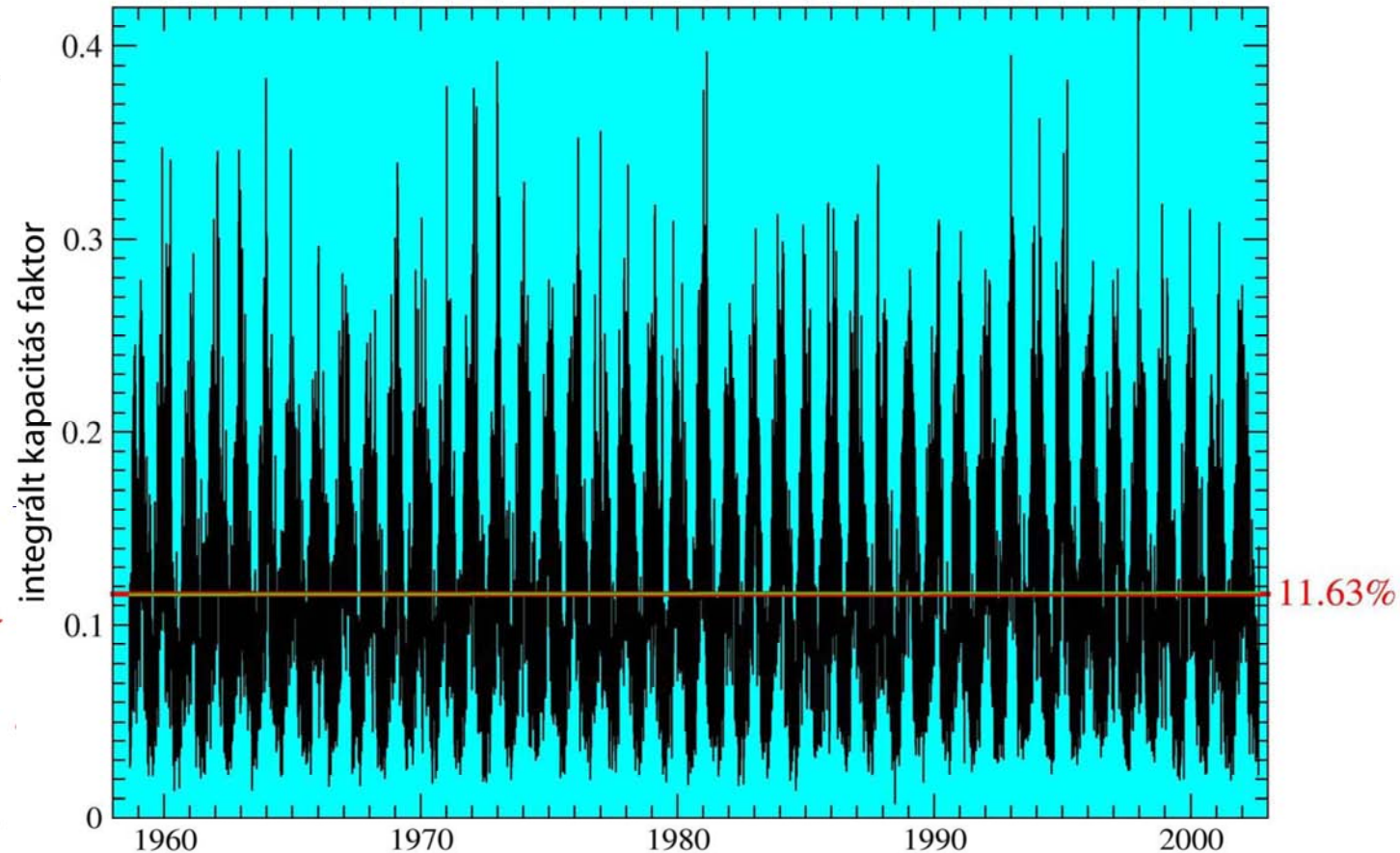
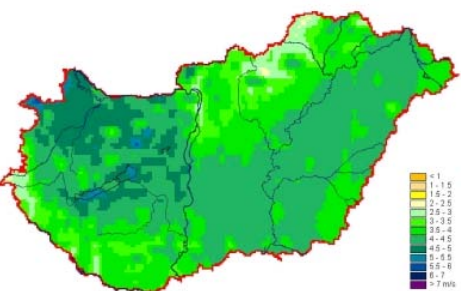
# Megfelelő a „minőség”?



## Megfelelő az ellátás „minősége”?

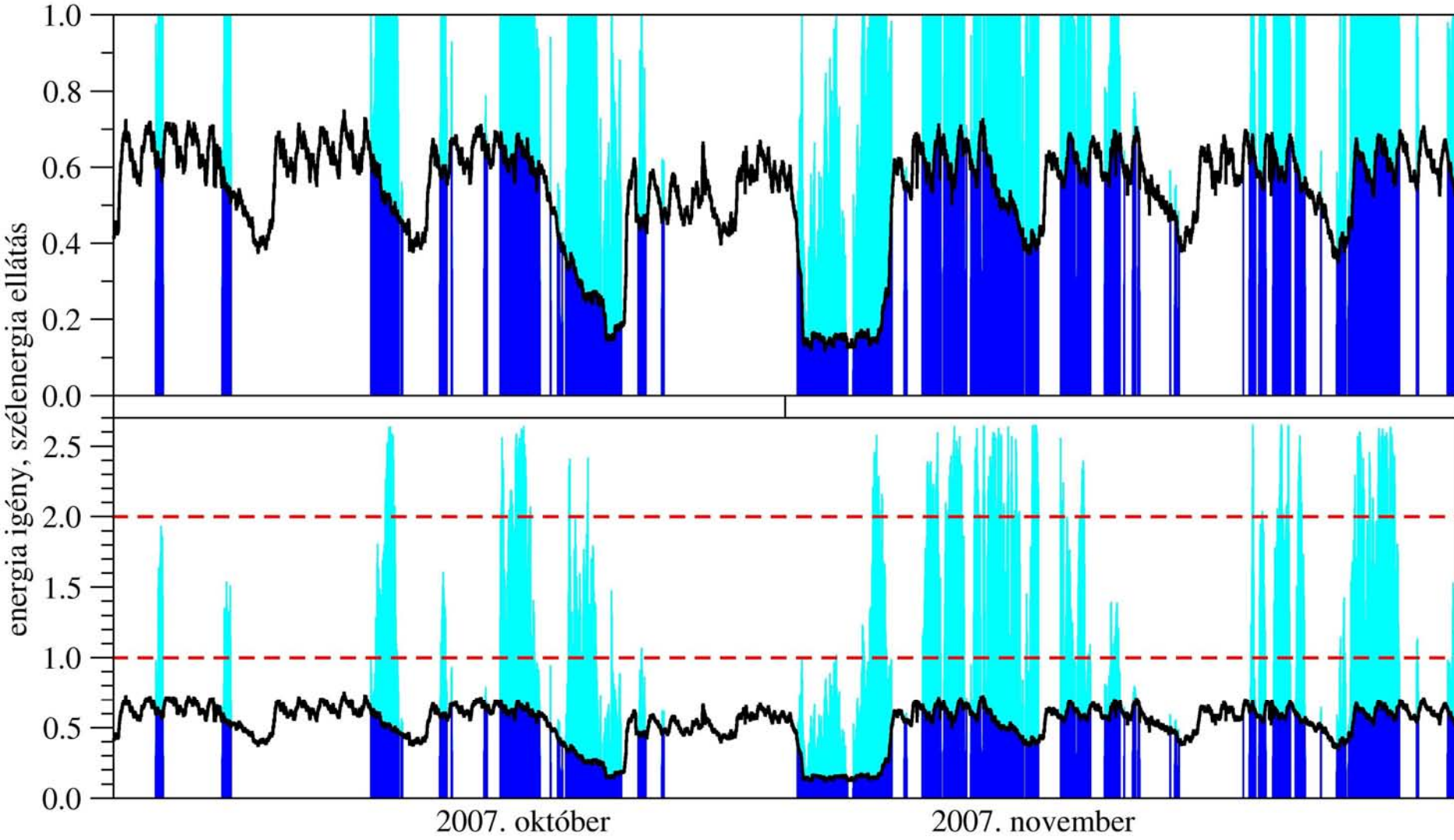
# Limitations of wind power availability over Europe: a conceptual study

P. Kiss<sup>1</sup> and I. M. Jánosi<sup>1,2</sup>





# Megfelelő az ellátás „minősége”?



# Szélmező Európa felett

