Those drops falling from sky

How to evaluate rainfall from remote sensing techniques and other tools

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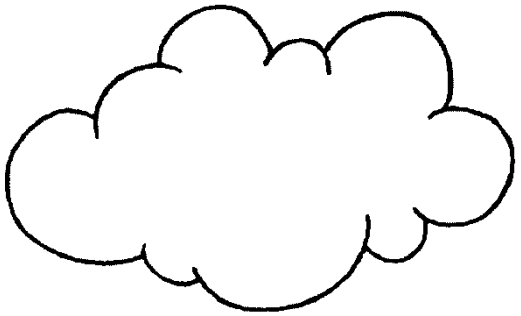
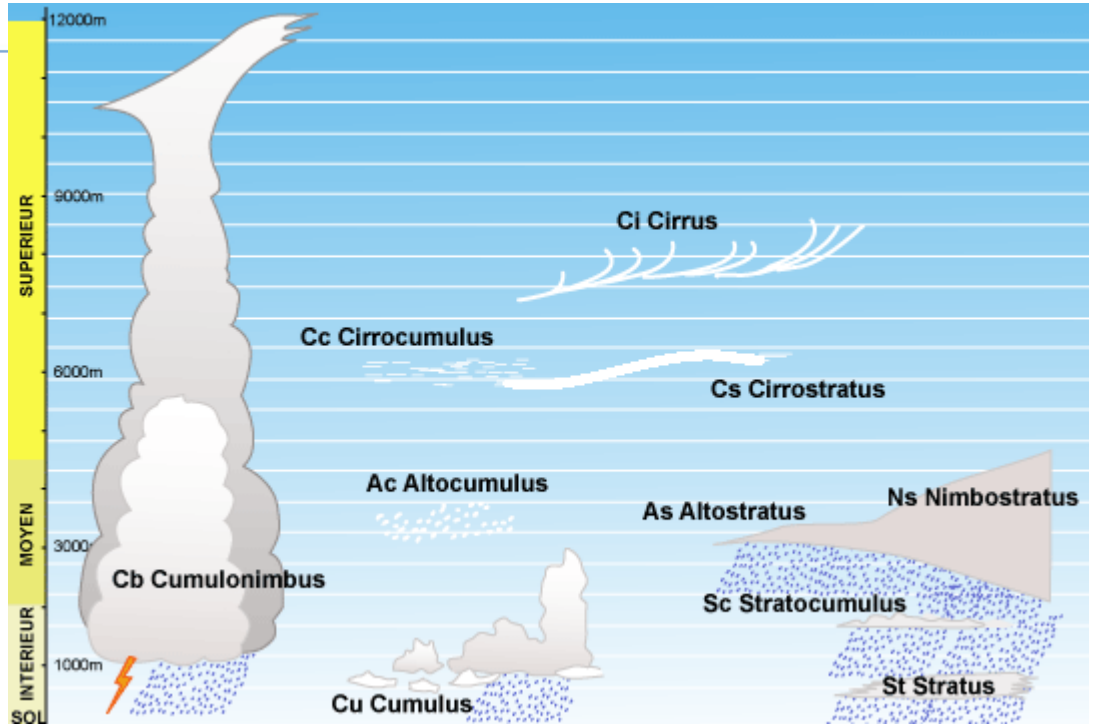
Cloud – Rainfall
(always drops or almost in the tropics)

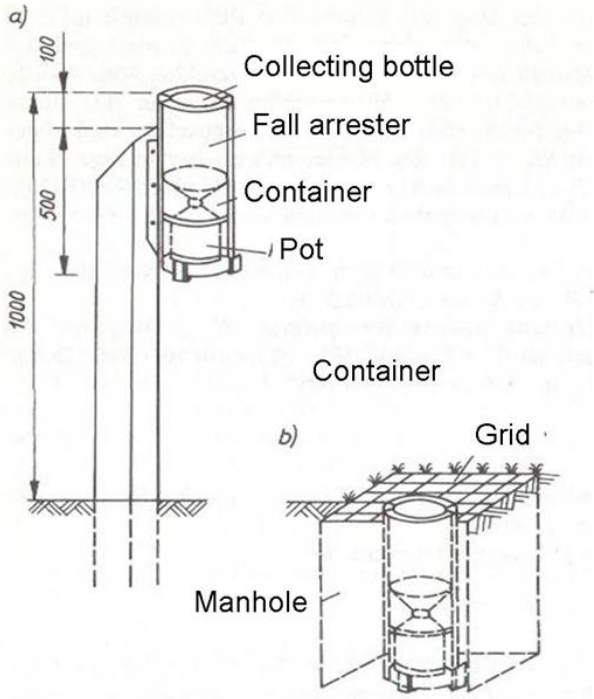


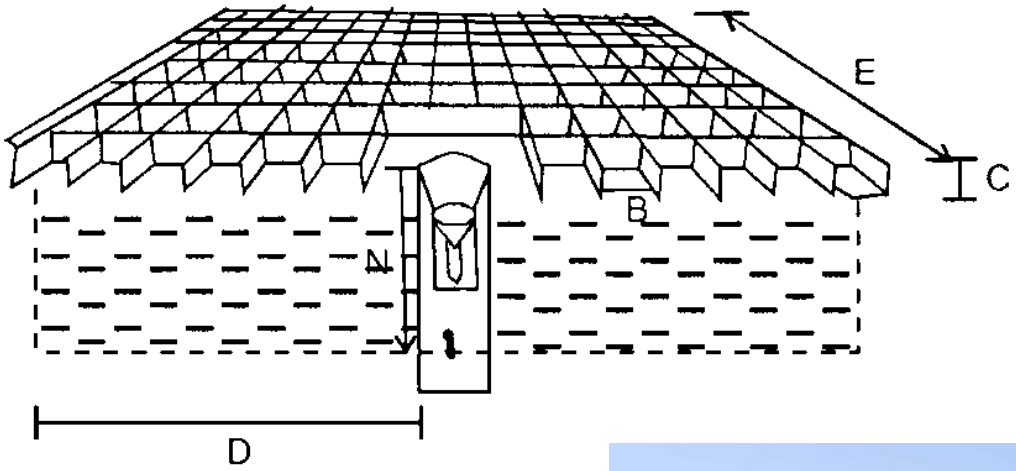


How to measure total rainfall or leaving rainfall intensity for an advanced training. Instruments

- Raingauges, buckets
- Weather radar
- Satellite (passive)
- Satellite (active)

Raingauges


a)
100
500
1000
Collecting bottle
Fall arrester
Container
Pot
Container
b)
Grid
Manhole


E
C
B
A
D

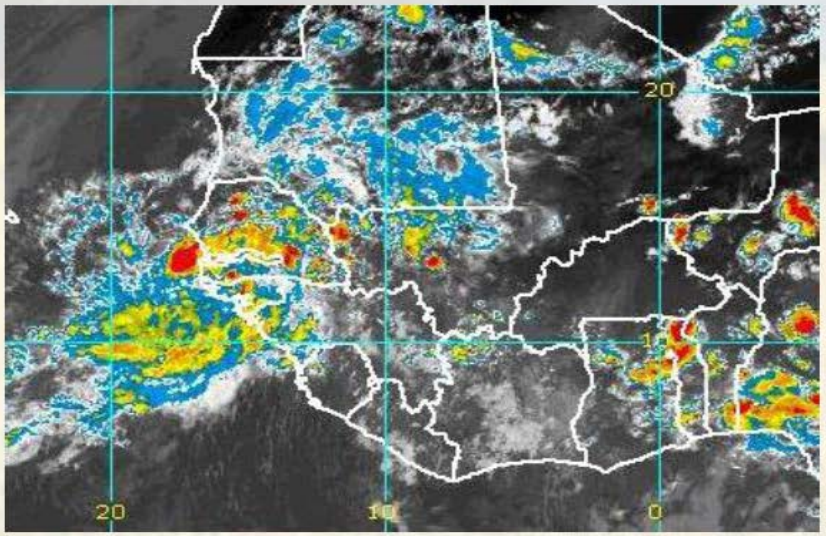

ISCO


Regenmesser
nach
Prof. Hellmann

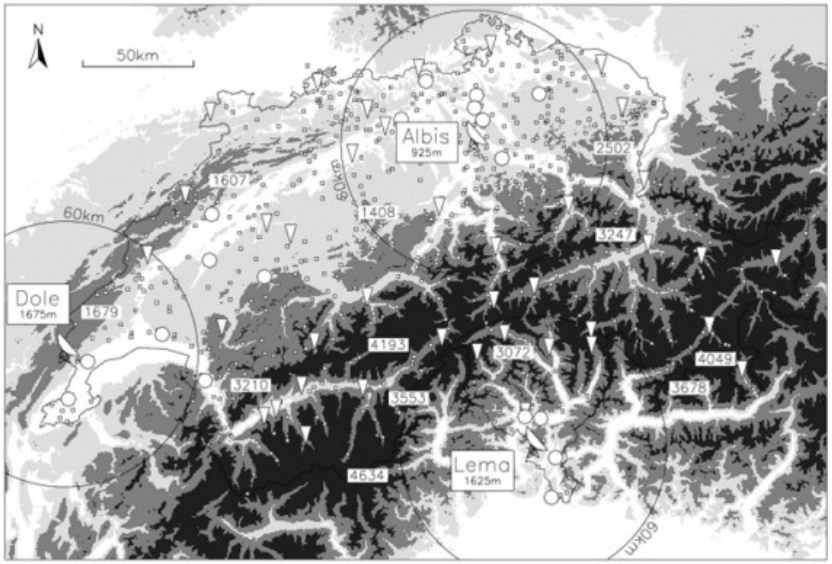
Raingauges or how much rain fell in my garden. But, what happened in my oncle village, 20 km/miles away from here?

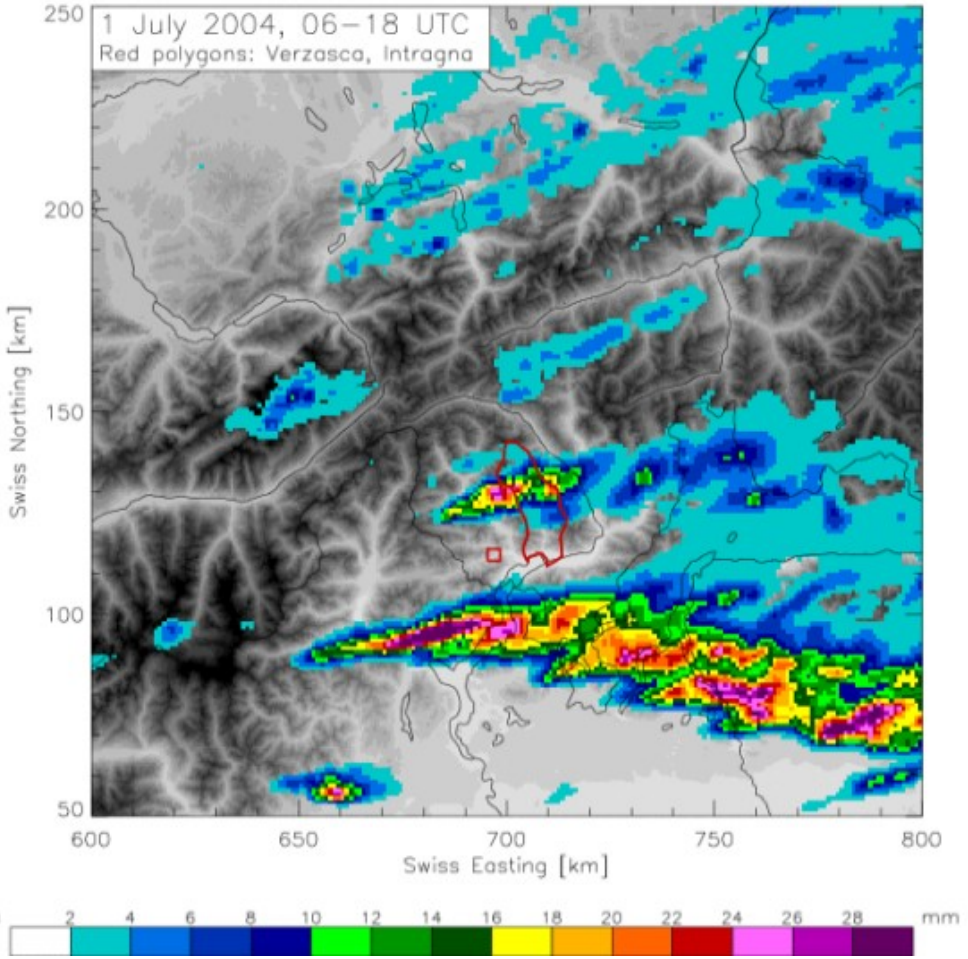
d

are spatially correlated

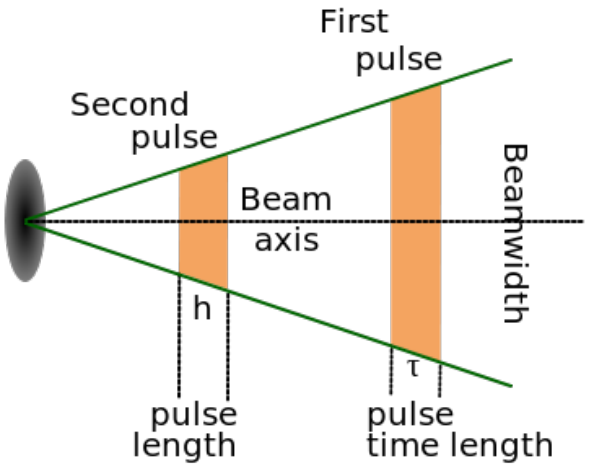


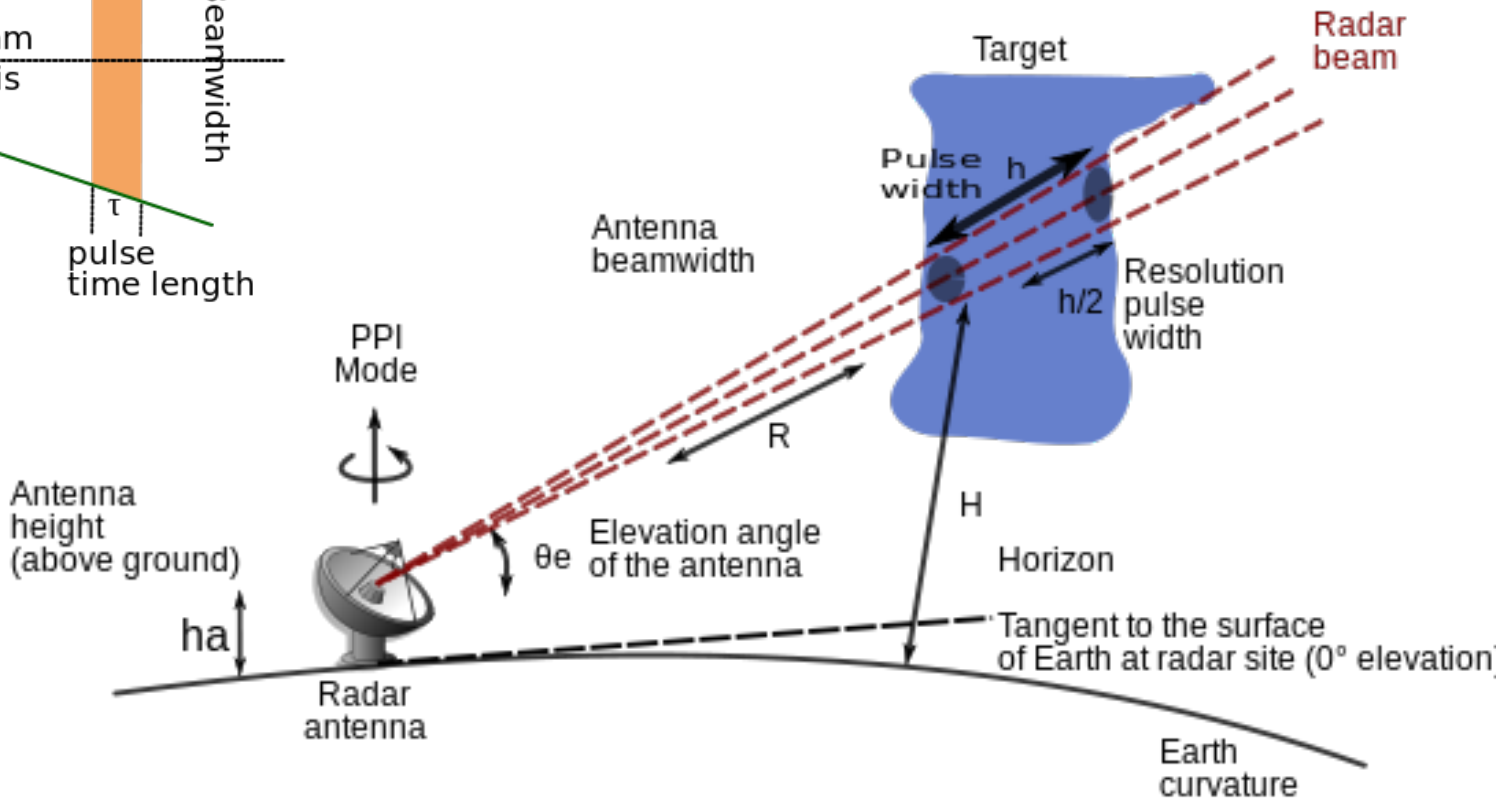
A good approach. Weather radar network – (Swiss quality)



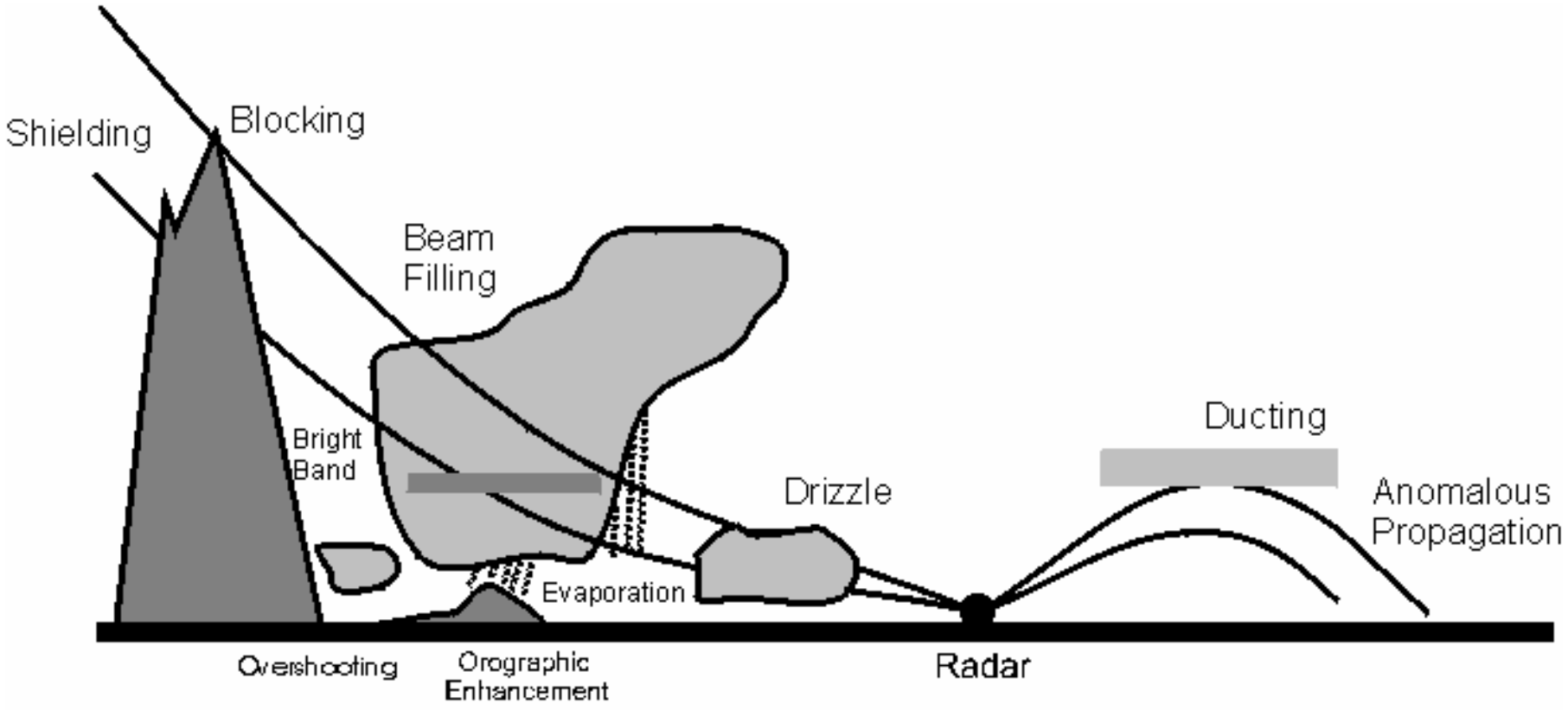


Weather radar rainfall measurement principles

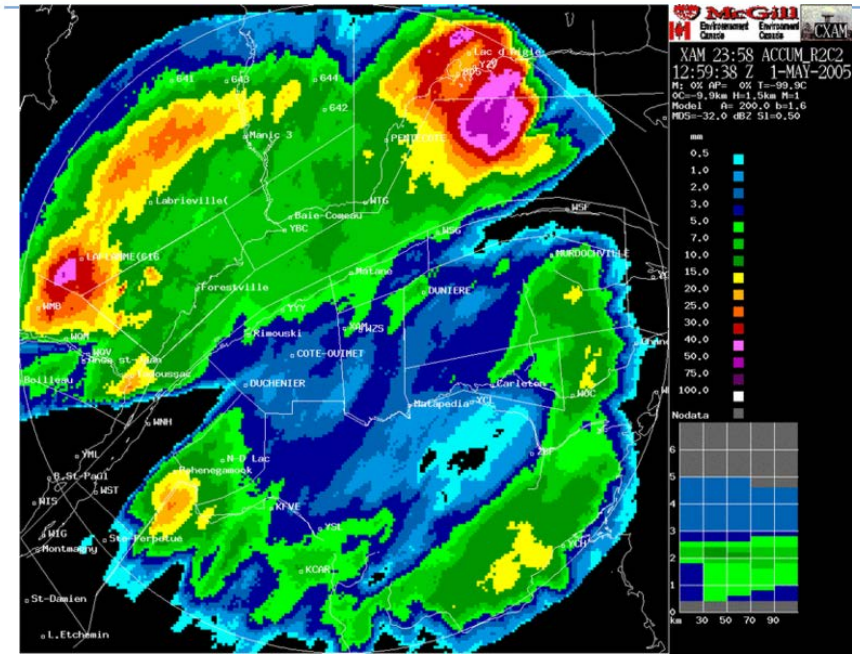




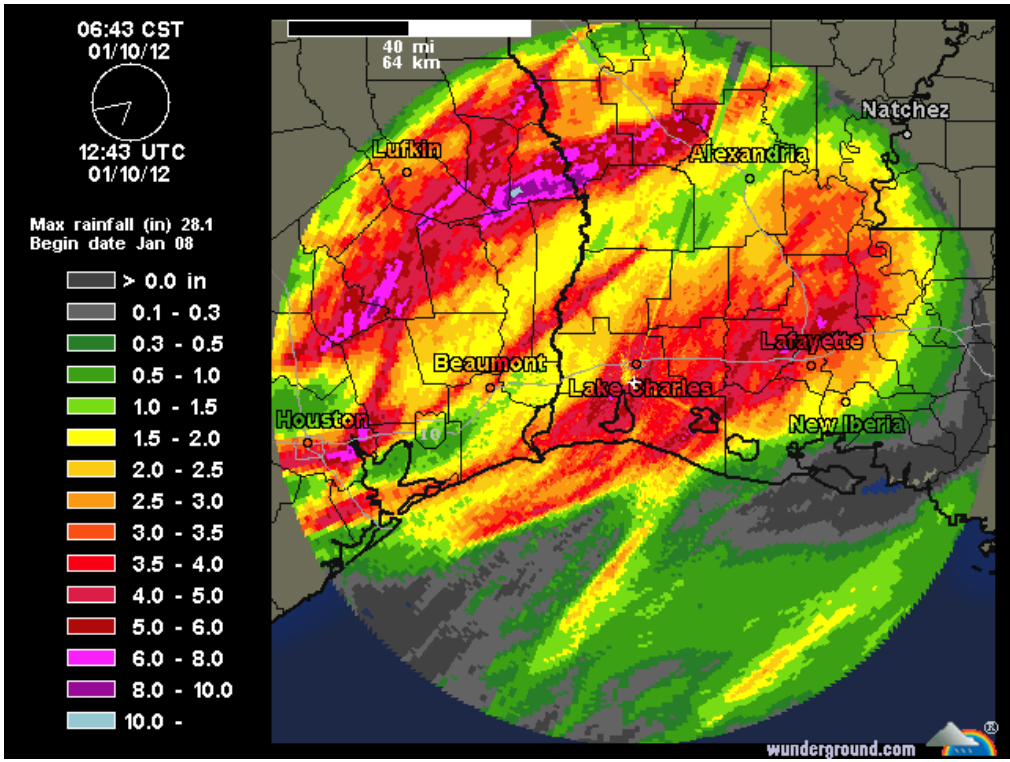
But there are some constraints. What is behind weather radar measurements



Weather radar rainfall outcomes. Total rainfall

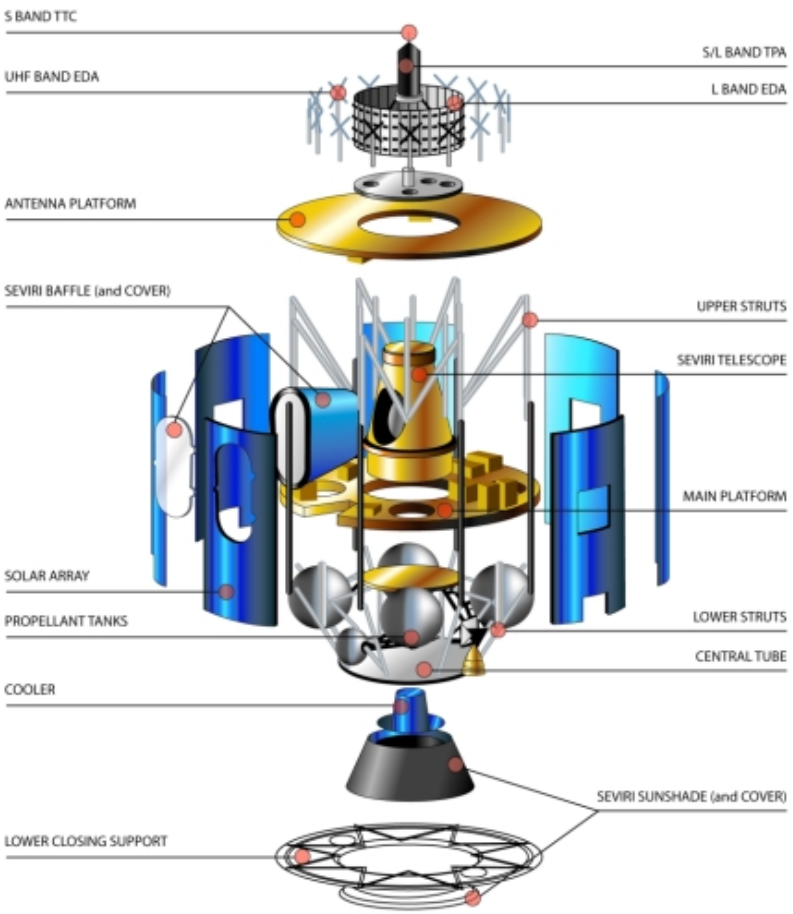


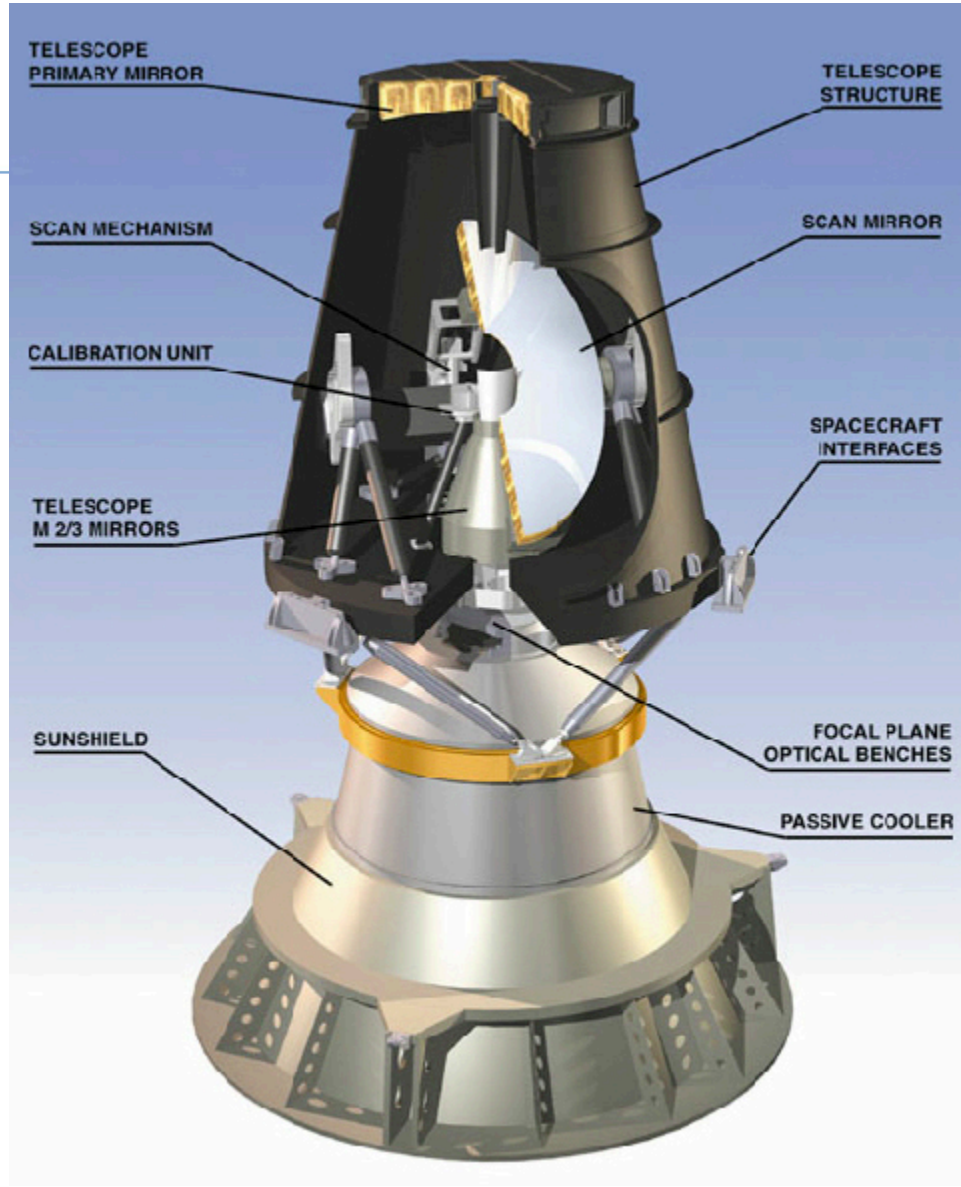
Radar-estimated precipitation ending Tuesday morning, January 10, 2012, shows a wide swath of 3 - 5 inches for much of Eastern Texas and Southern Louisiana.



24 hours rain accumulation on the Val d'Irène radar in Eastern Canada. Notice the zones without data in the East and Southwest caused by radar beam blocking from mountains.

SEVIRI - MSG

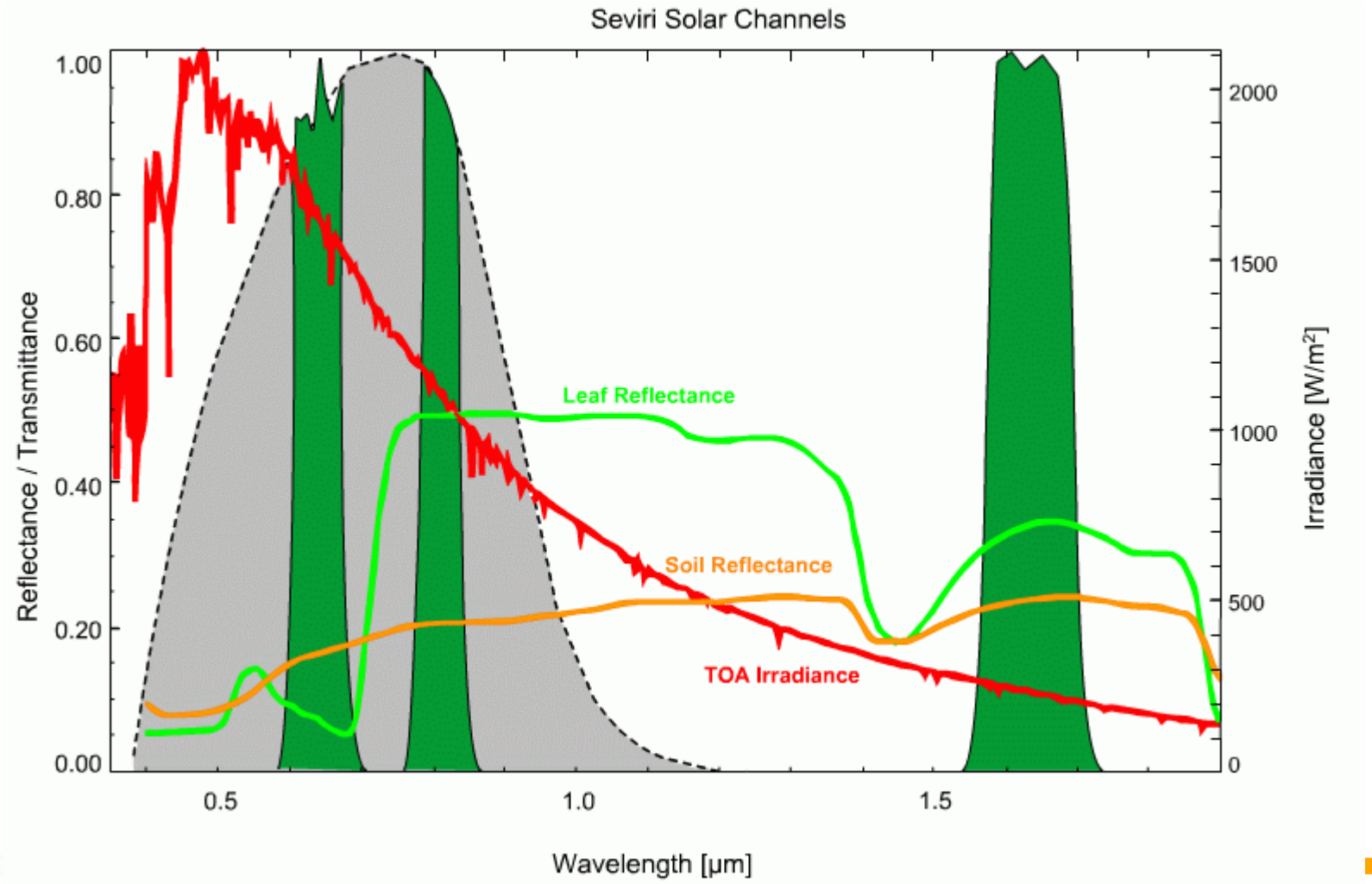

S BAND TTC
UHF BAND EDA
S/L BAND TPA
L BAND EDA
ANTENNA PLATFORM
SEVIRI BAFFLE (and COVER)
UPPER STRUTS
SEVIRI TELESCOPE
MAIN PLATFORM
SOLAR ARRAY
PROPELLANT TANKS
LOWER STRUTS
CENTRAL TUBE
COOLER
SEVIRI SUNSHADE (and COVER)
LOWER CLOSING SUPPORT


TELESCOPE PRIMARY MIRROR
TELESCOPE STRUCTURE
SCAN MECHANISM
SCAN MIRROR
CALIBRATION UNIT
SPACECRAFT INTERFACES
TELESCOPE M 2/3 MIRRORS
SUNSHIELD
FOCAL PLANE OPTICAL BENCHES
PASSIVE COOLER

SEVIRI - MSG

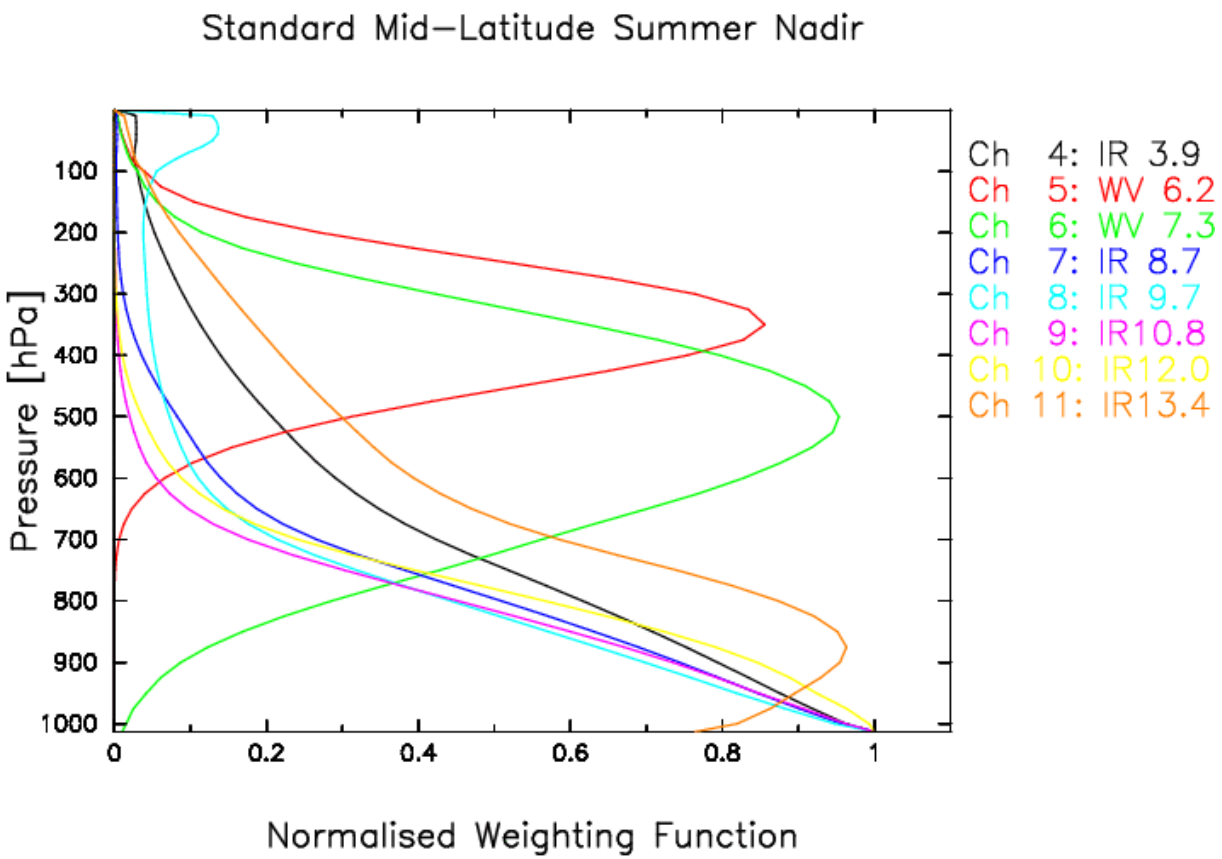
Channel	Spectral Band (µm)	Characteristics of Spectral Band (µm)			Main observational application
		λ_{cen}	λ_{min}	λ_{max}	
1	VIS0.6	0.635	0.56	0.71	Surface, clouds, wind fields
2	VIS0.8	0.81	0.74	0.88	Surface, clouds, wind fields
3	NIR1.6	1.64	1.50	1.78	Surface, cloud phase
4	IR3.9	3.90	3.48	4.36	Surface, clouds, wind fields
5	WV6.2	6.25	5.35	7.15	Water vapor, high level clouds, atmospheric instability
6	WV7.3	7.35	6.85	7.85	Water vapor, atmospheric instability
7	IR8.7	8.70	8.30	9.1	Surface, clouds, atmospheric instability
8	IR9.7	9.66	9.38	9.94	Ozone
9	IR10.8	10.80	9.80	11.80	Surface, clouds, wind fields, atmospheric instability
10	IR12.0	12.00	11.00	13.00	Surface, clouds, atmospheric instability
11	IR13.4	13.40	12.40	14.40	Cirrus cloud height, atmospheric instability
12	HRV	Broadband (0.4 – 1.1 µm)			Surface, clouds

SEVIRI - MSG


Seviri Solar Channels
Reflectance / Transmittance
Irradiance [W/m²]
Wavelength [µm]
Leaf Reflectance
Soil Reflectance
TOA Irradiance
1.00
0.80
0.60
0.40
0.20
0.00
2000
1500
1000
500
0
0.5
1.0
1.5

SEVIRI - MSG

Weighting functions for the MSG SEVIRI thermal channels, i.e. channels 4 to 11, for a satellite nadir view.
A mid-latitude summer standard atmosphere has been assumed for the simulation with a radiative transfer model.



Instruments orbiting Earth on satellites onboard – A sample

•Special Sensor Microwave/Imager (SSM/I) (passive) (Defence Meteorological Satellite-USA)

•Special Sensor Microwave Imager-Sounder (SSMIS) (passive) (Defence Meteorological Satellite-USA)

•PMW Advanced Scanned Radiometer-Earth Observing System (EOS-AMSR-E) (AQUA satellite-NASA)

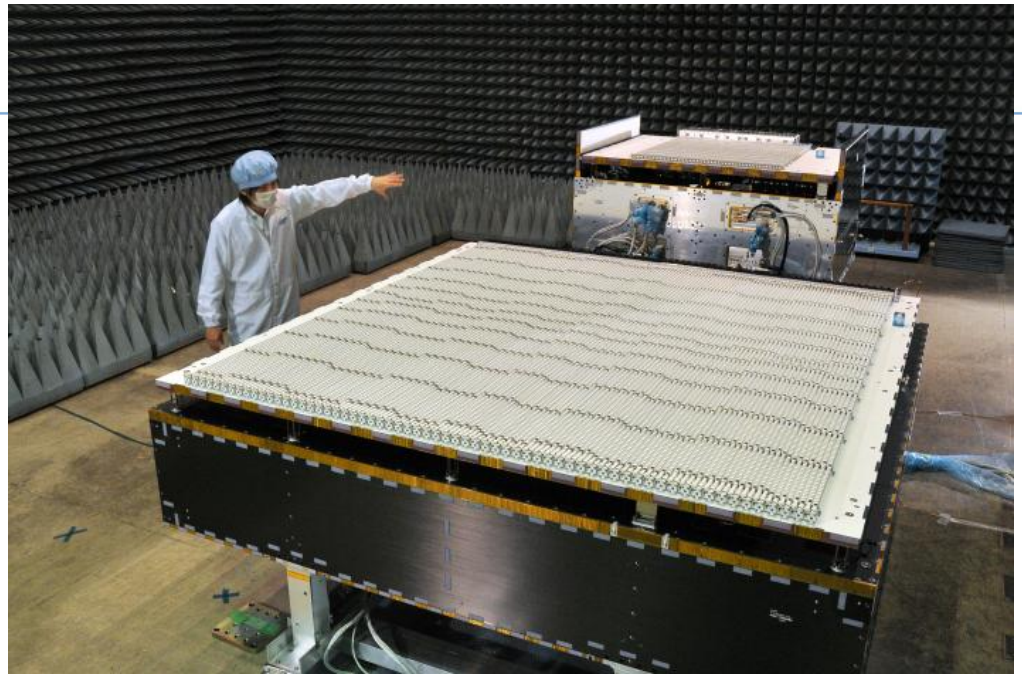
•MODIS (AQUA and TERRA satellites-NASA) (36 VIS/IR spectral bands

•Precipitation Radar and the TRMM Microwave Imager at the Tropical Rainfall Measuring Mission (TRMM)

•MADRAS at the MEGHA-TROPICS mission

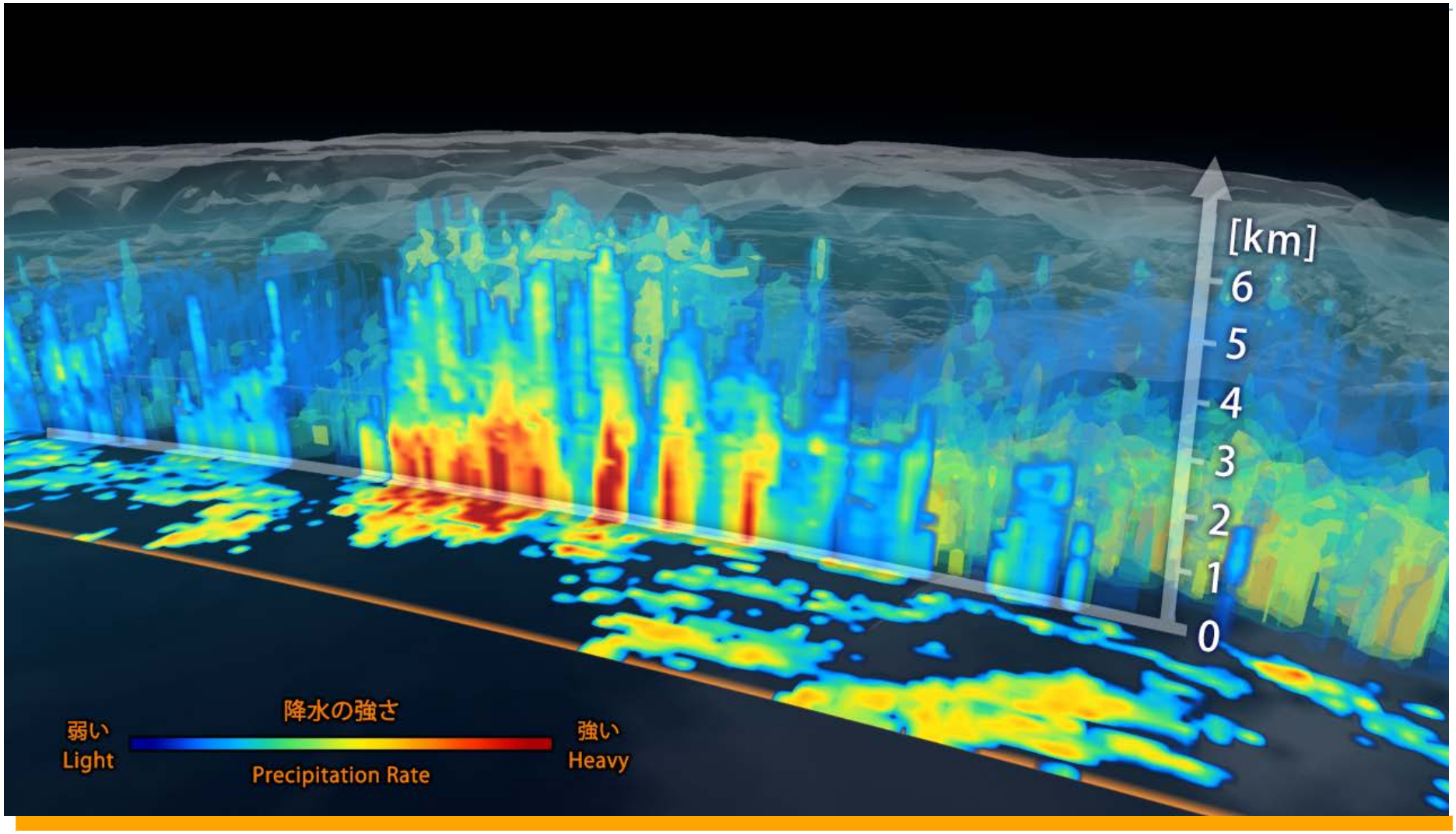
•Dual frequency precipitation radar on board at the GPM core observation satellite

Active remote sensing (put your radar orbiting Earth)



Dual-frequency Precipitation Radar (DPR) instrument (JAXA) integrated onto the GPM Core Observatory satellite on flight from February 2014. New instrument designed to take 3-D measurements of raindrops and snowflakes. Is a spaceborne precipitation radar capable of making accurate rainfall measurements. The DPR is expected to be more sensitive than its TRMM predecessor especially in the measurement of light rainfall and snowfall in high latitude regions. Rain/snow determination is expected to be accomplished by using the differential attenuation between the Ku-band and the Ka-band frequencies. The variable pulse repetition frequency (VPRF) technique is also expected to increase the number of samples at each IFOV to realize a 0.2 mm/h sensitivity. The KuPR and KaPR, together with GMI, are the primary instruments on the GPM spacecraft. These Earth-pointing KuPR and KaPR instruments will provide rain sensing over both land and ocean, both day and night.

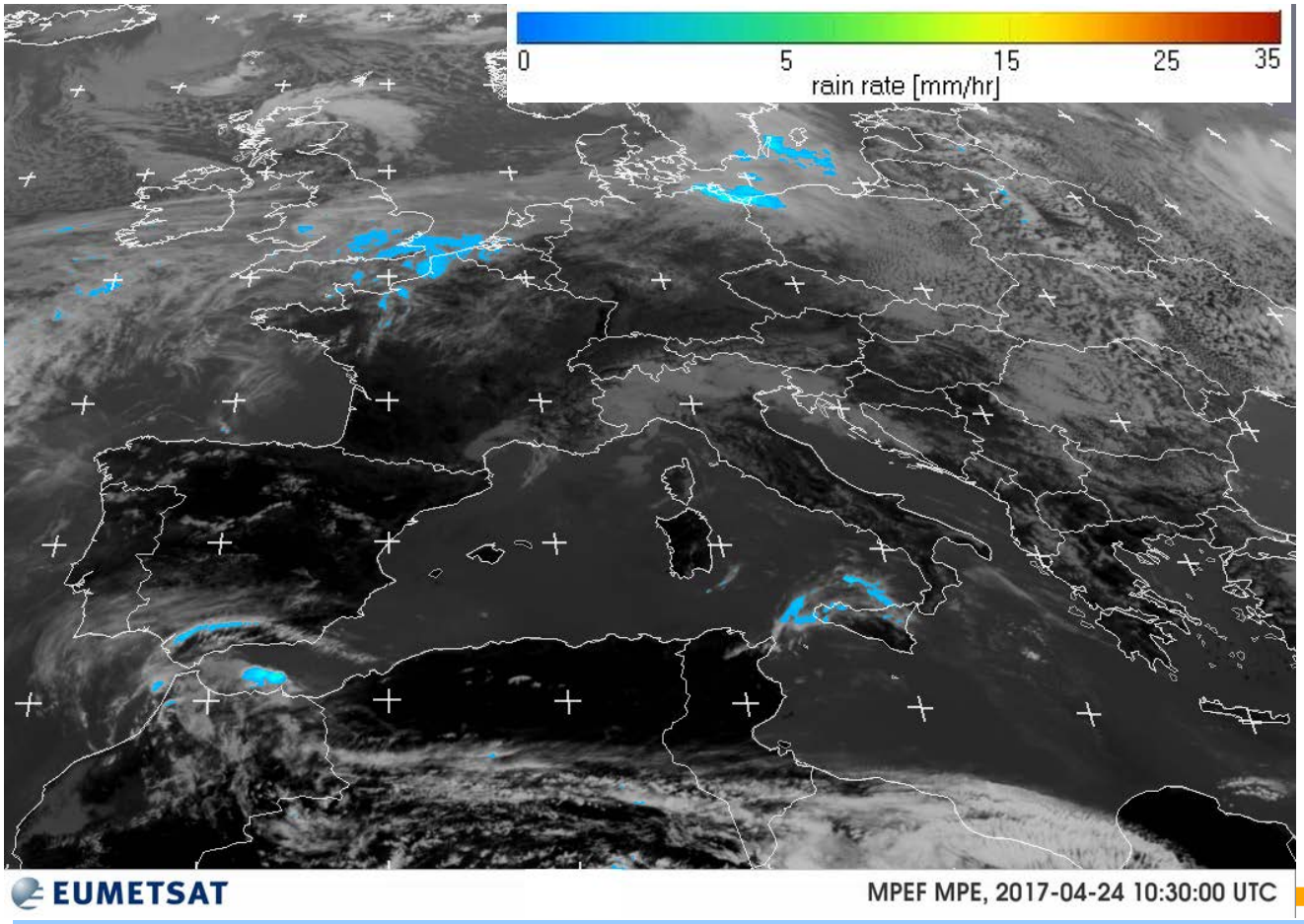
3D view inside an extra-tropical cyclone observed off the coast of Japan, March 10, 2014, by GPM's Dual-frequency Precipitation Radar.



Rainfall estimation in Europe

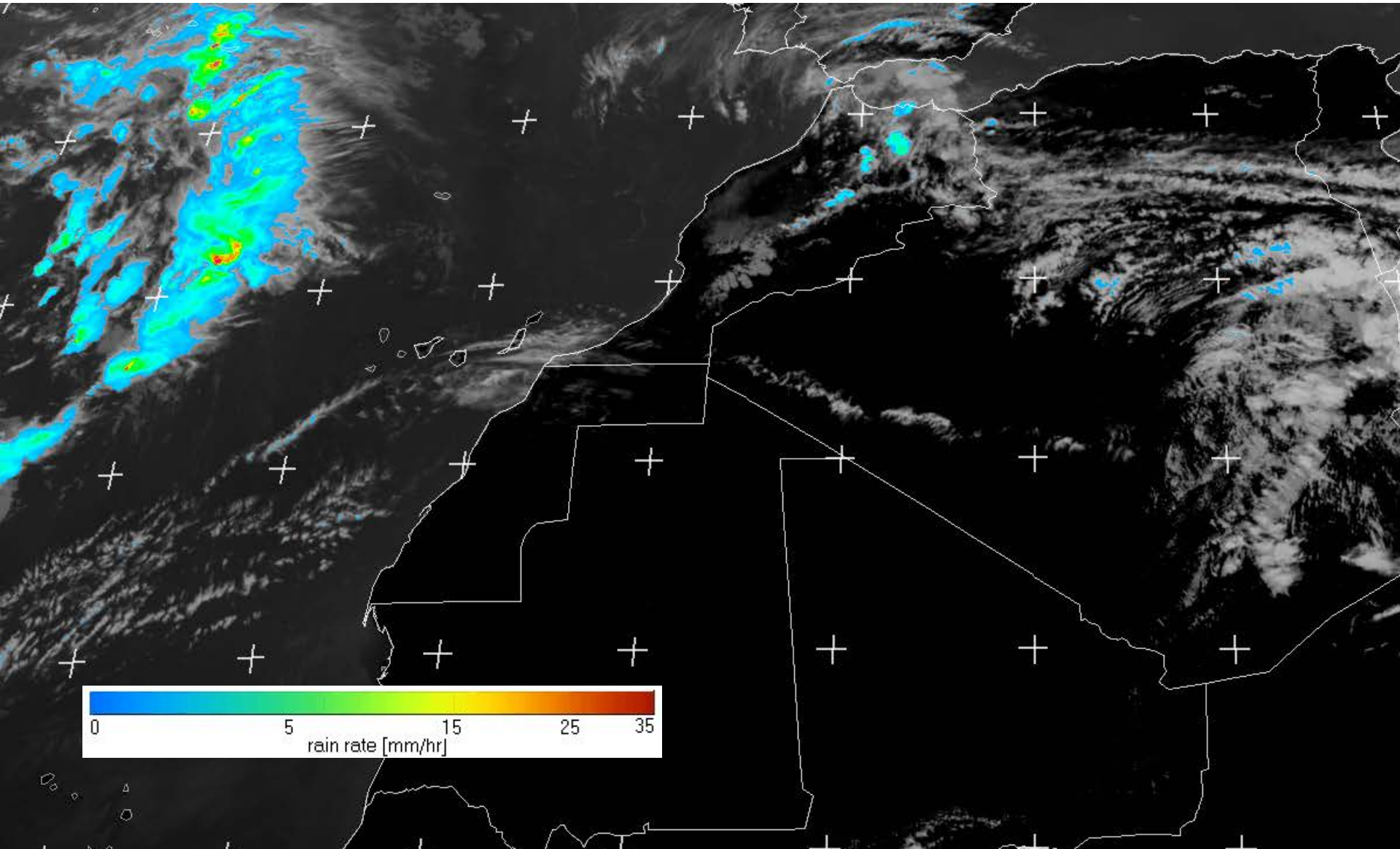
Meteosat 0 degree Visualised Products Multi-Sensor Precipitation Estimate)

(http://oiswww.eumetsat.org/IPPS/html/MSG/PRODUCTS/MPE/



Rainfall estimation in Europe

Meteosat 0 degree Visualised Products Multi-Sensor Precipitation Estimate)



Simple plastic raingauges

Thanks for your attention!