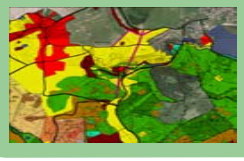

3D data in climatology

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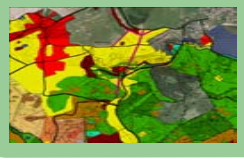


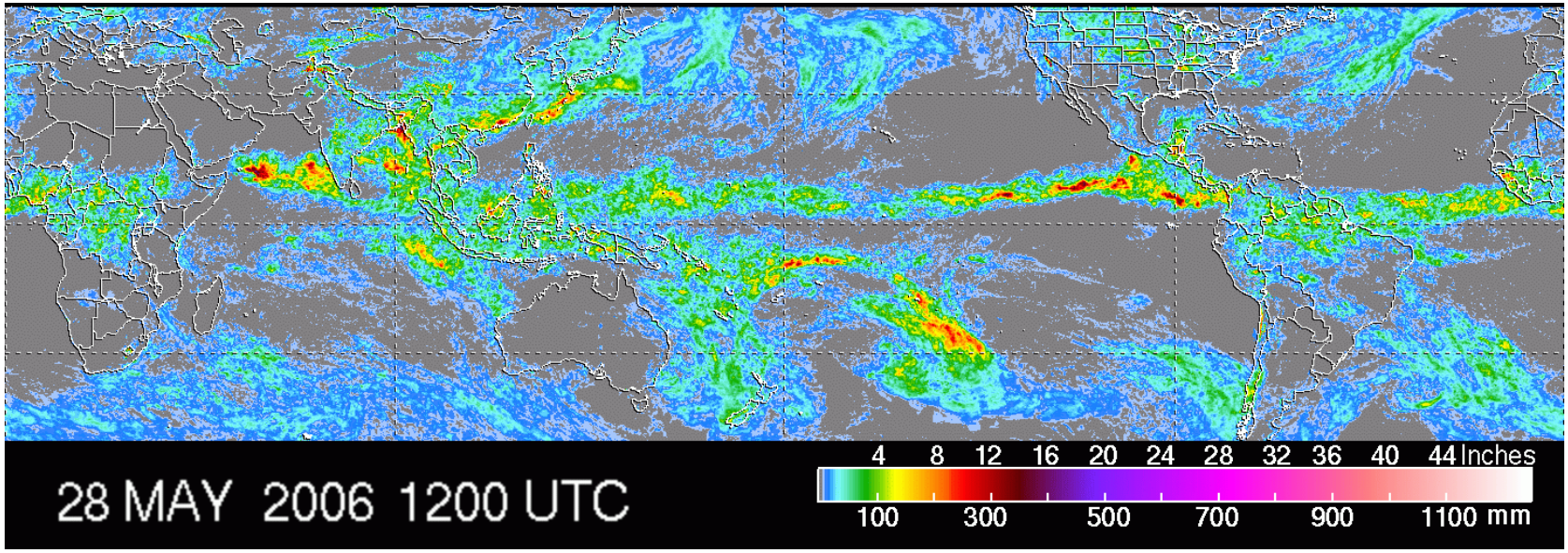
3D applications

There are at least three distinct fields of Earth sciences, were 3D data play an important (or fundamental) part.
These are:

- geology
- oceanography
- climatology

In climatology, data are sampled for specific locations determined by *x*, *y* co-ordinates (e.g. longitude and latitude)

Rainfall data from TRMM (Tropical Rainfall Measurment Mission)



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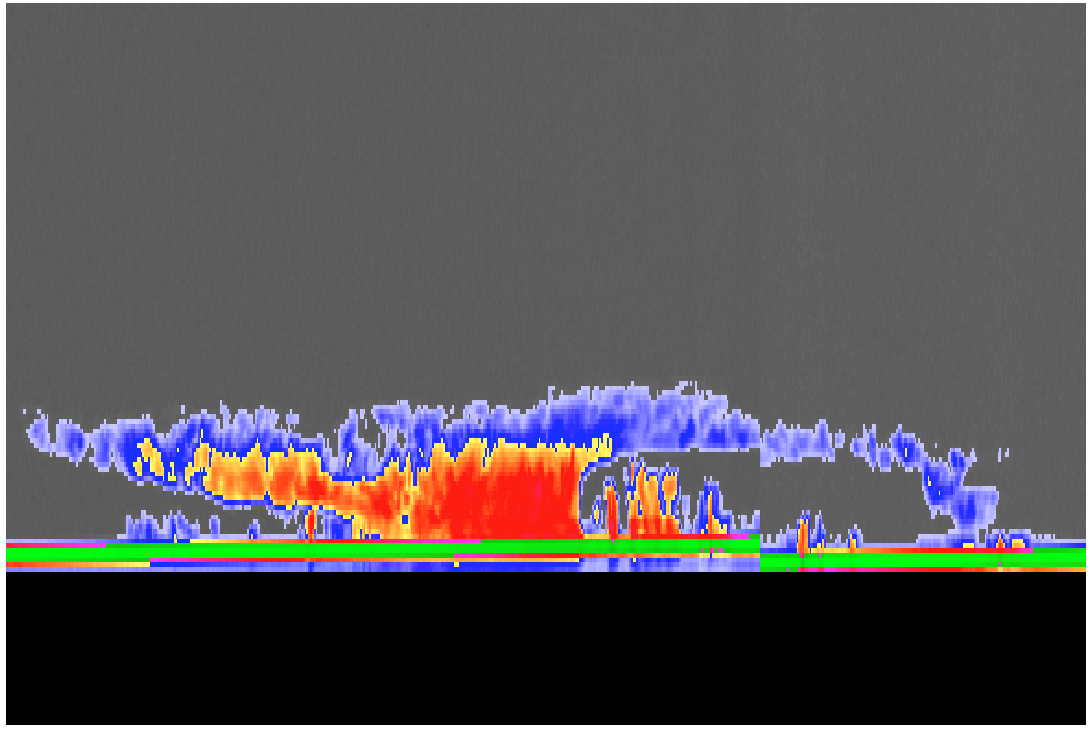
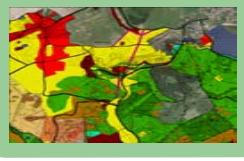
or in the vertical profile in the atmosphere
(that is for different *z* values)

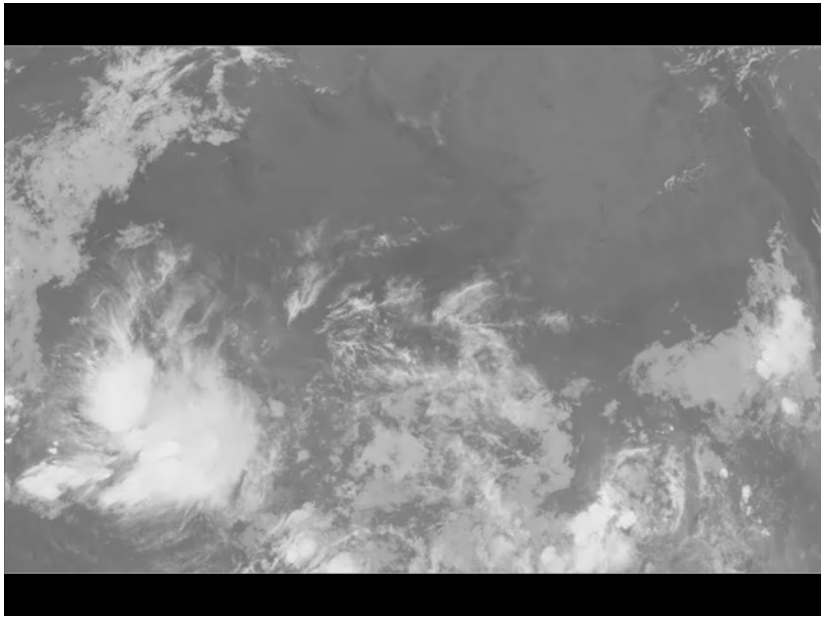
Recent test data from Cloudsat, showing vertical profile of a typical Cumulonimbus cloud





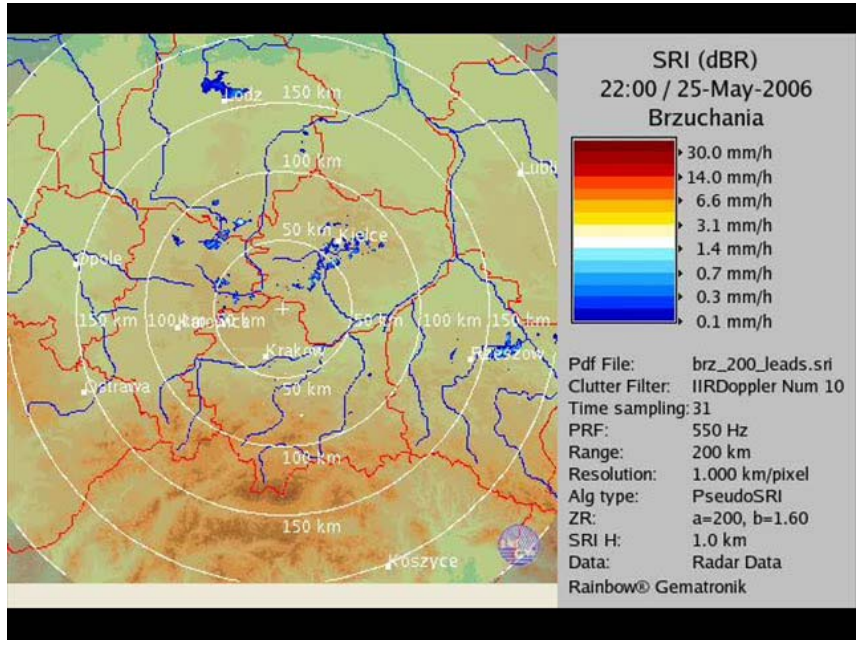
3D data in climatology

Climatological data are collected with typically high temporal frequency, due to the variability of climatic phenomena and importance of climatic phenomena for the society, at all spatial scales (from local to global)



Clouds over Africa, from Meteosat, 23-25 May 2006, animation based on 144 scenes taken every 30 minutes. Note the Red Sea in the top right corner

Rainfall data, from the radar station located nearby Kraków, sampled every 10 minutes



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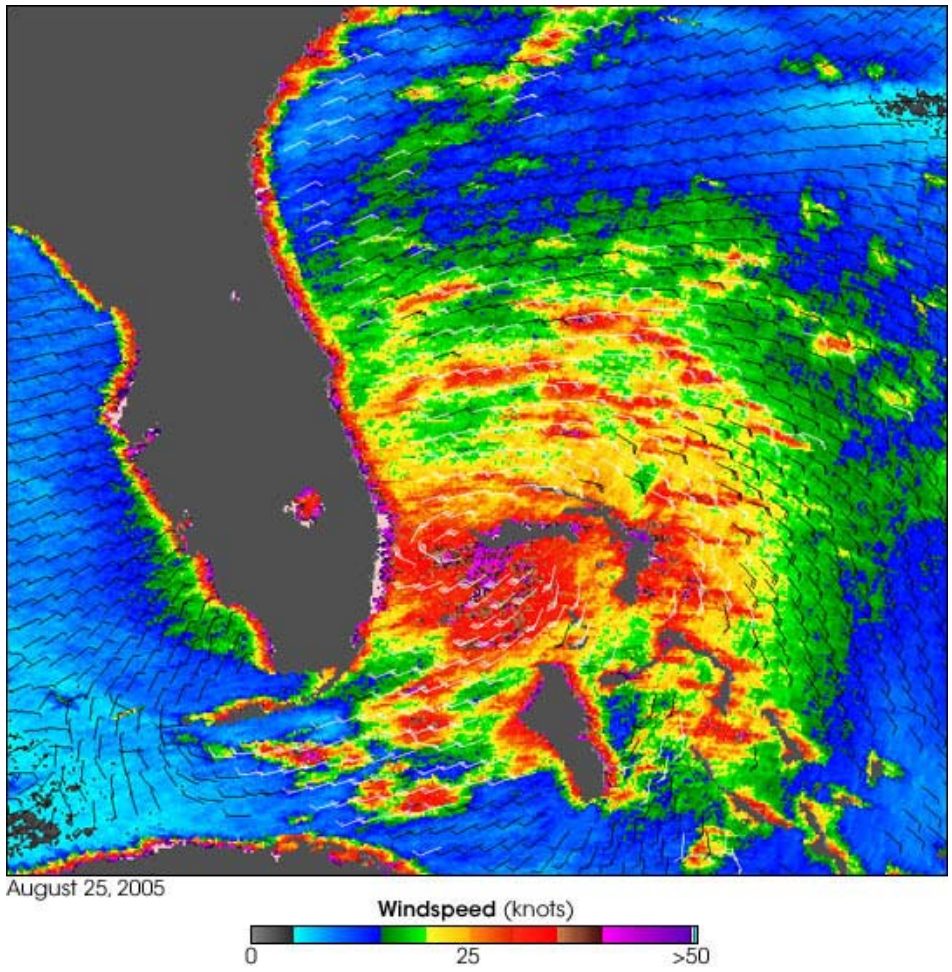
3D data in climatology

In climate reasearch, third dimension, elevation in the atmosphere (*z*), and fourth, time (*t*), are equally important as *x*, *y* co-ordinates.

Katrina: windspeed and direction



A devastating hurricane, like Katrina, is a 3D system: its vertical dynamics (e.g. convection of air masses) is as important as its 'flat' spatial dimension shown with wind vectors and colours

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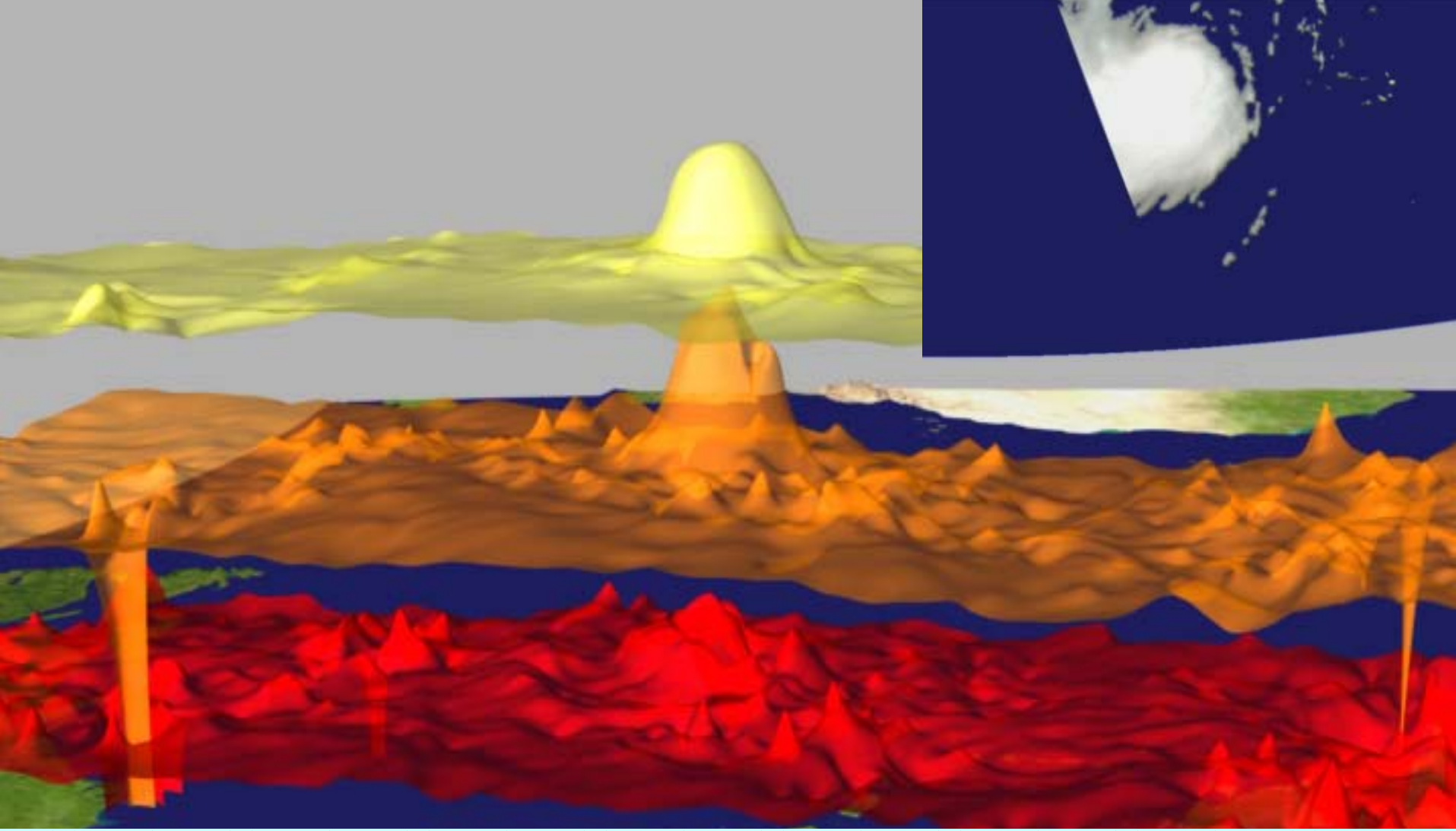
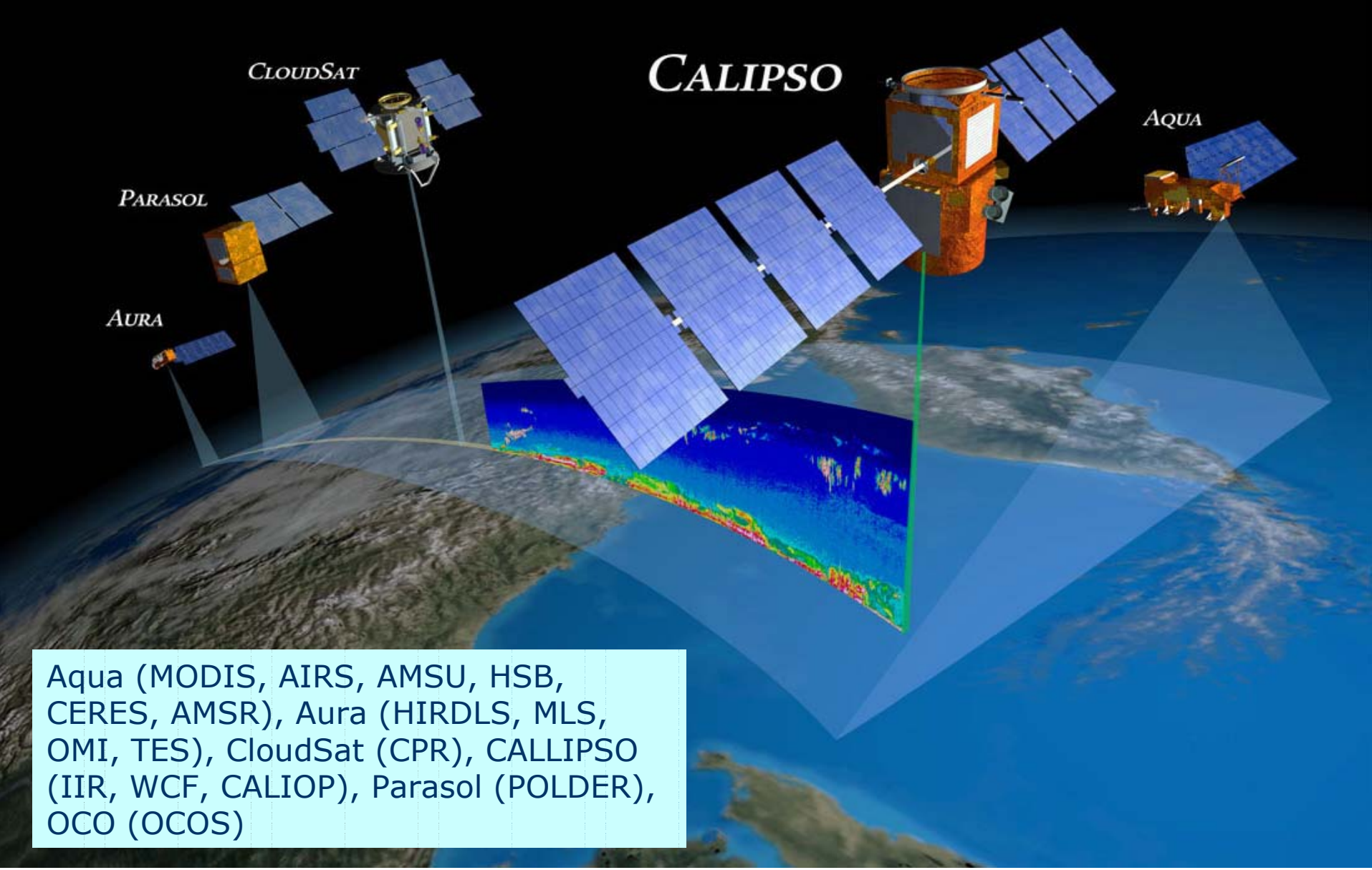


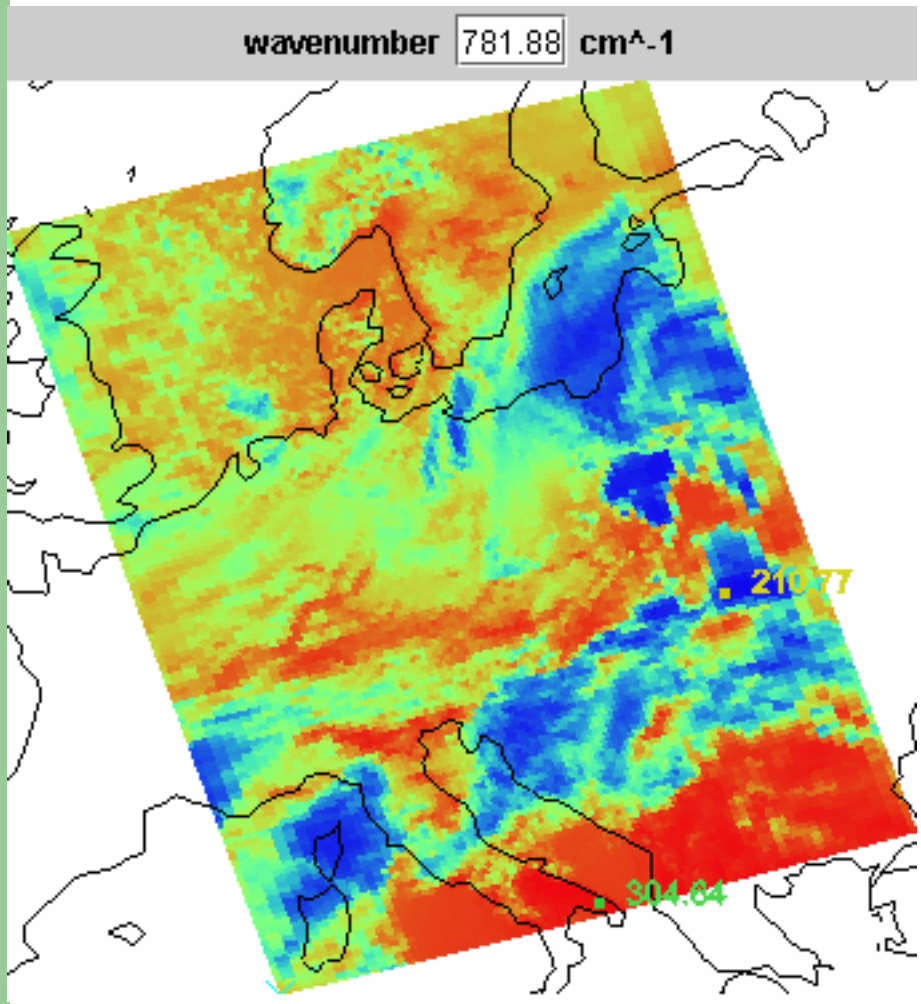
This data show surfaces of equal temperature over an area affected by hurricane Isabel. ‘Bumps’ in the centre show the effect of warm air convection on isothermal surfaces. Warm air convection is the ‘heat engine’ of the hurricane. The example proves the importance of sampling in 3D for monitoring of atmospheric phenomena

Animation shows the same data, however we may observe both changes in space and through time, as the hurricane moves towards US coast - this illustrates the importance of sampling in time for understanding the dynamics of climate



The complexity of climatological data requires sophisticated techniques of acquisition. Recently, climatological data are collected by complex observation systems, like that presented on the slide (so-called A-train). Sensors acquire a huge range of data almost immediately one after another.

3D data in climatology



A specific sensor example is AIRS (Atmospheric Infrared Sounder on board of AQUA). Using different frequencies, it scans the vertical profile of the atmosphere; the result is a stack of 2D images over one location, each image for a different elevation (*z* value) in the atmosphere … The sequence of images on the left (click to start) shows temperatures from the top of troposphere to its lowest layers; cold objects (typically clouds) are visible below a certain elevation. Note min and max temperature (Kelvin).

the animation shows how AIRS works …

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