CloudSat

Seminar zur planetarischen Grenzschicht

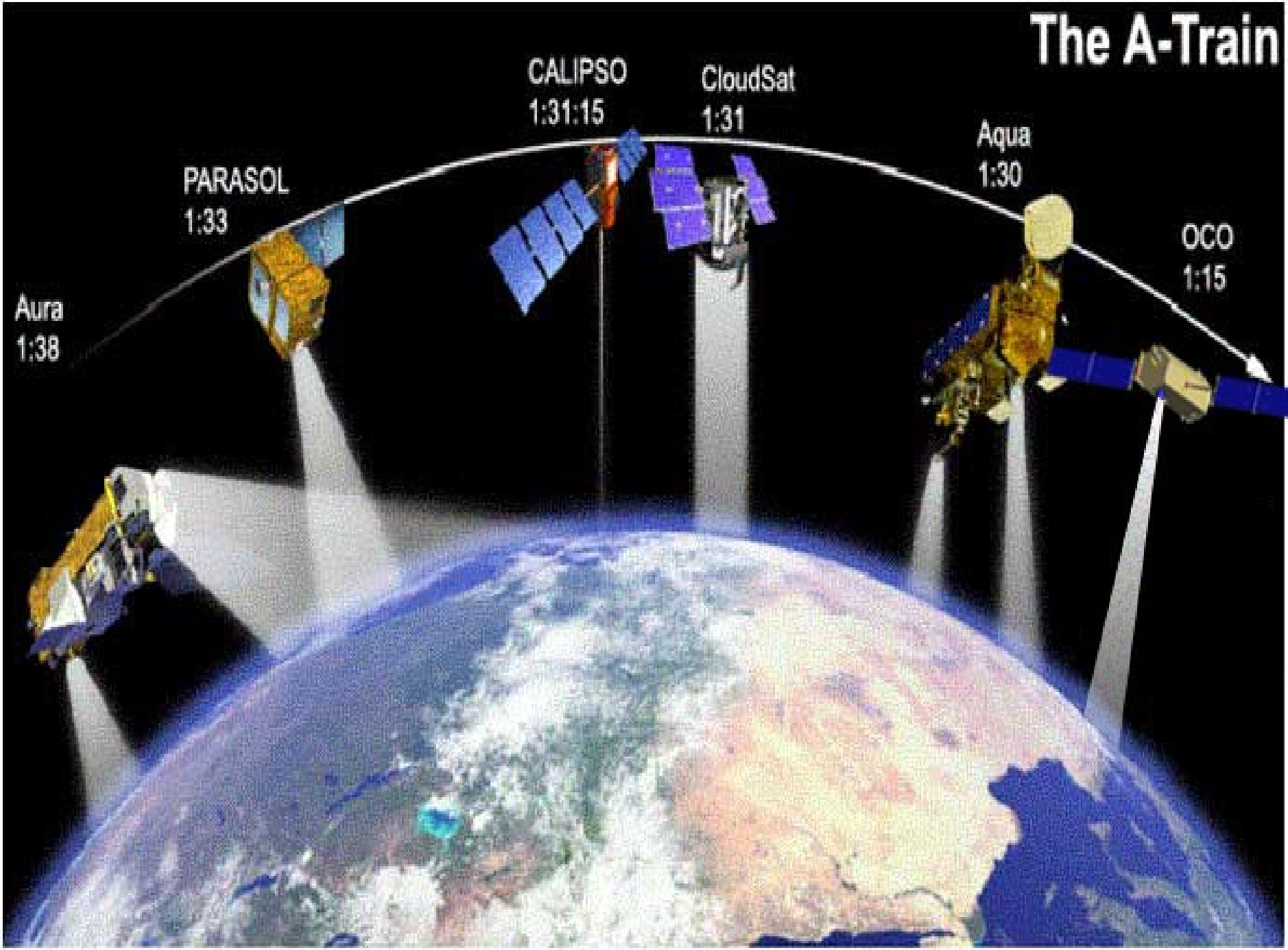
Überblick

A – Train

Die CloudSat Mission

Cloud Profiling Radar (CPR)

Messungen von CloudSat


The A-Train
CALIPSO
1:31:15
CloudSat
1:31
PARASOL
1:33
Aqua
1:30
OCO
1:15
Aura
1:38

Spacecraft	Position in the A-Train/ Formation Requirements	Summary of Mission	Instruments Carried
Aqua	Lead spacecraft in formation until the launch of OCO.	Synergistic instrument package studies global climate with an emphasis on water in the Earth/atmosphere system, including its solid, liquid and gaseous forms.	AIRS/AMSU-A/HSB AMSR-R CERES MODIS
CloudSat	Lags Aqua by between 30 seconds and 2 minutes. Must maintain extremely precise positioning relative to both Aqua and CALIPSO to permit synergistic measurements with Aqua and CALIPSO.	Cloud Profiling Radar (CPR) will allow for most detailed study of clouds to date and should better characterize the role clouds play in regulating the Earth's climate.	CPR
CALIPSO	Lags CloudSat by no more than 15 seconds. Must maintain position relative to Aqua to permit synergistic measurements with Aqua.	Observations from spaceborne lidar, combined with passive imagery, will lead to improved understanding of the role aerosols and clouds play in regulating the Earth's climate, in particular, how the two interact with one another.	CALIOP IIR WFC
PARASOL	Lags CALIPSO by about 1 minute.	Polarized light measurements will allow better characterization of clouds and aerosols in the Earth's atmosphere,in particular, distinguishing natural and manmade aerosols.	POLDER
Aura	Lags Aqua by about 15 minutes but crosses equator 8 minutes behind Aqua due to different orbital track to allow for synergy with Aqua.	Synergistic payload will study atmospheric chemistry, focusing on the horizontal and vertical distribution of key atmospheric pollutants and greenhouse gases and how these distributions evolve and change with time.	HIRDLS MLS OMI TES
OCO	Will precede Aqua by 15 minutes when it is launched.	Will make global, space-based observations of the column integrated concentration of carbon dioxide, a critical greenhouse gas.	Three grating spectrometers

Umlaufbahn von CloudSat

- CloudSat fliegt in A – Train ca. 120s (~ 460km) hinter Aqua
- CALIPSO folgt CloudSat im Abstand von ca. 15s (~ 93.8km)

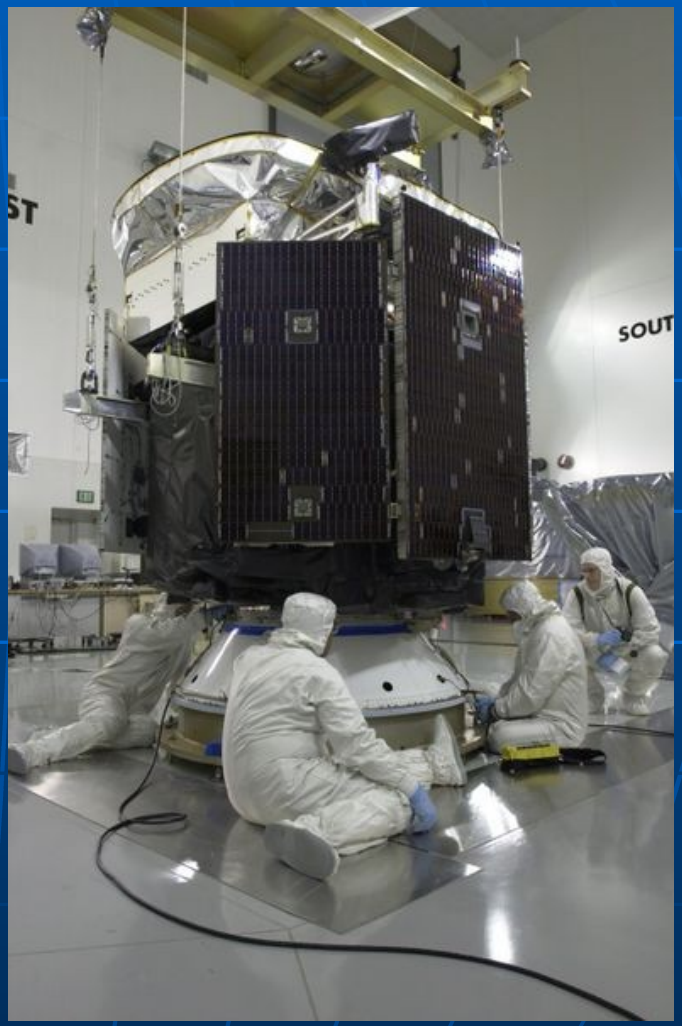
  ⟶ Bildbereiche überlagern sich um mind. 50%
- Äquator Überquerung 1.30p.m. Lokalzeit (Afternoon Constellation)
- Sonnensynchroner Orbit in 705 km Höhe
- Periode: 98.88min
- Abdeckung: 233 Orbits / alle 16d

CloudSat Instrument

- A Millimeter - Wellen Radar System

  (~3 mm oder bei einer Frequenz von 94 GHz)

- Antenne: 1.85m *1.85m



Die Mission

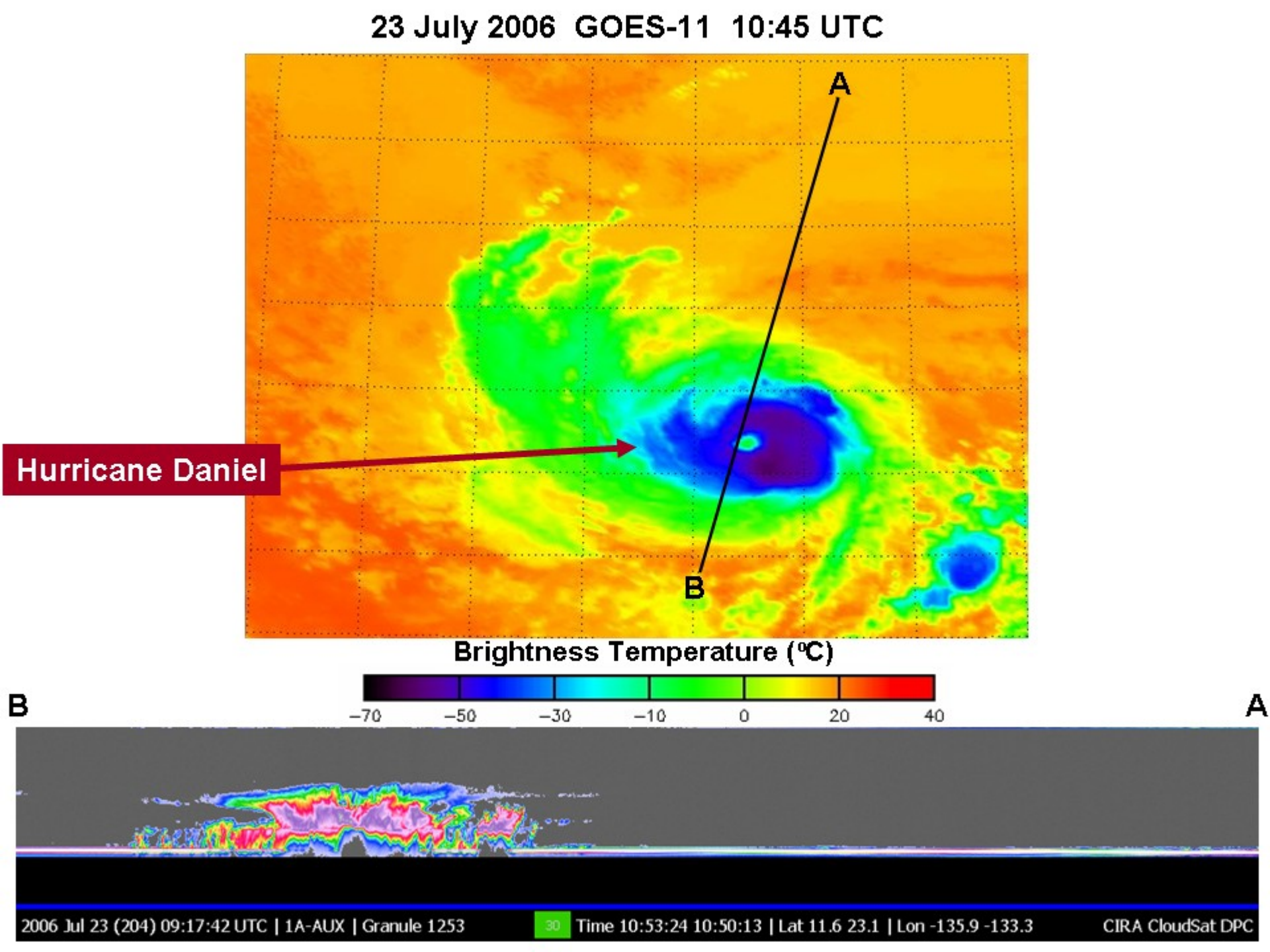
- Die zentrale Frage:

  Wie formen, entstehen und beeinflussen Wolken unser Wetter, Klima und Wasserhaushalt?

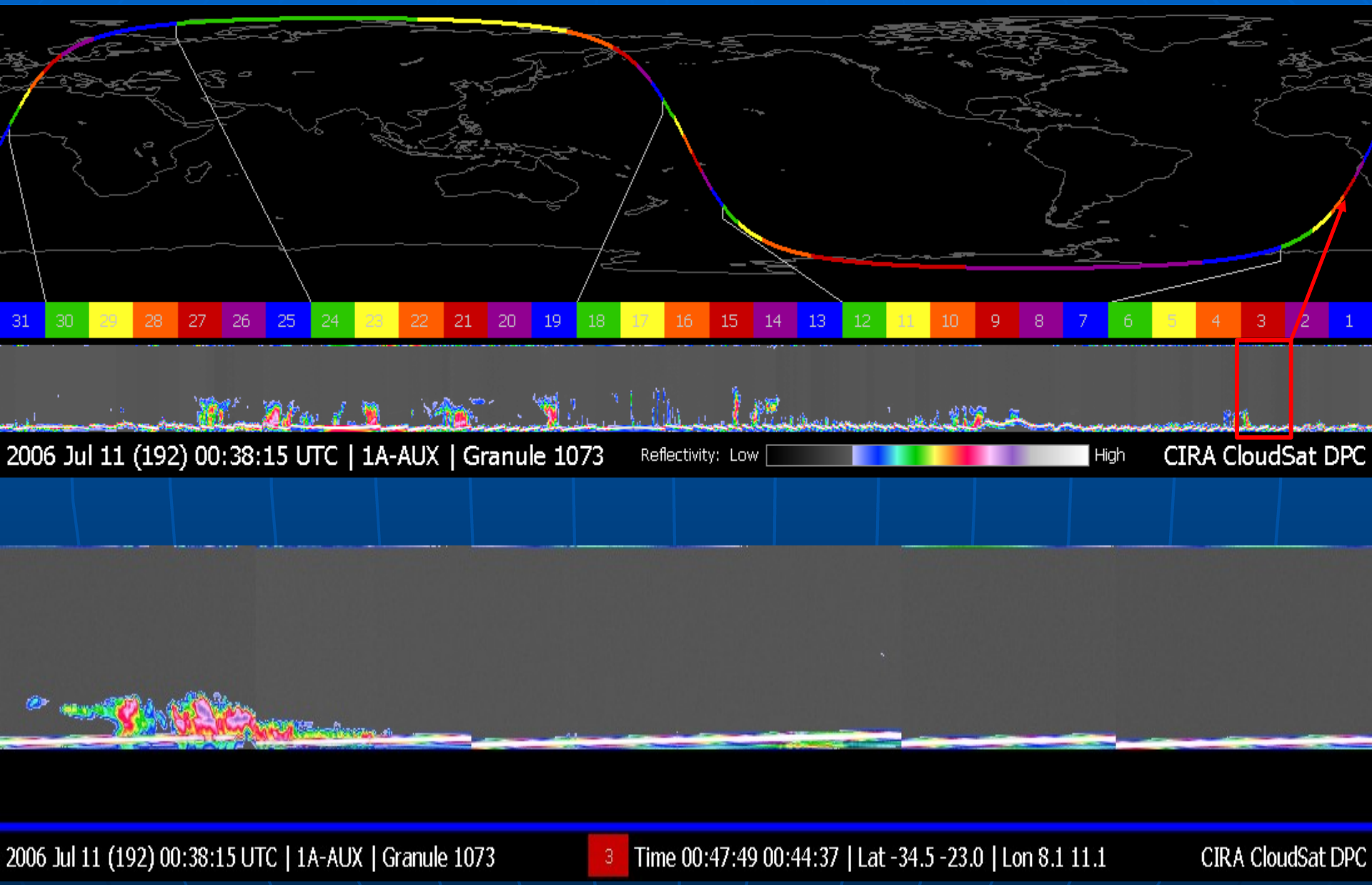
- Original Mission:

  Kombination aus einem Lidar und einem Radar
  > zu teuer

- Die Observationsdaten von verschiedenen Satelliten des A – Trains (Aqua, CloudSat, Calipso) werden miteinander kombiniert und aneinander verifiziert.


23 July 2006 GOES-11 10:45 UTC
A
B
Hurricane Daniel
Brightness Temperature (°C)
−70
−50
−30
−10
0
20
40
B
A
2006 Jul 23 (204) 09:17:42 UTC | 1A-AUX | Granule 1253
30
Time 10:53:24 10:50:13 | Lat 11.6 23.1 | Lon -135.9 -133.3
CIRA CloudSat DPC

Produkt ID	Produkt Name
1B-CPR-FL	Radar Backscatter Profiles (First-Look)
1B-CPR	Radar Backscatter Profiles
2B-GEOPROF	Cloud Geometrical Profile (Cloud Mask)
2B-CLDCLASS	Cloud Classification
2B-LWC-RO	Cloud Liquid Water Content (Radar-only)
2B-IWC-RO	Cloud Ice Water Content (Radar-only)
2B-TAU	Cloud Optical Depth
2B-LWC-RVOD	Cloud Liquid Water Content (Radar-Visible Optical Depth)
2B-IWC-RVOD	Cloud Ice Water Content (Radar-Visible Optical Depth)
2B-FLXHR	Fluxes and Heating Rates
2B-GEOPROF-LIDAR	Radar-Lidar Cloud Geometrical Profile
2B-CLDCLASS-LIDAR	Radar-Lidar Cloud Classification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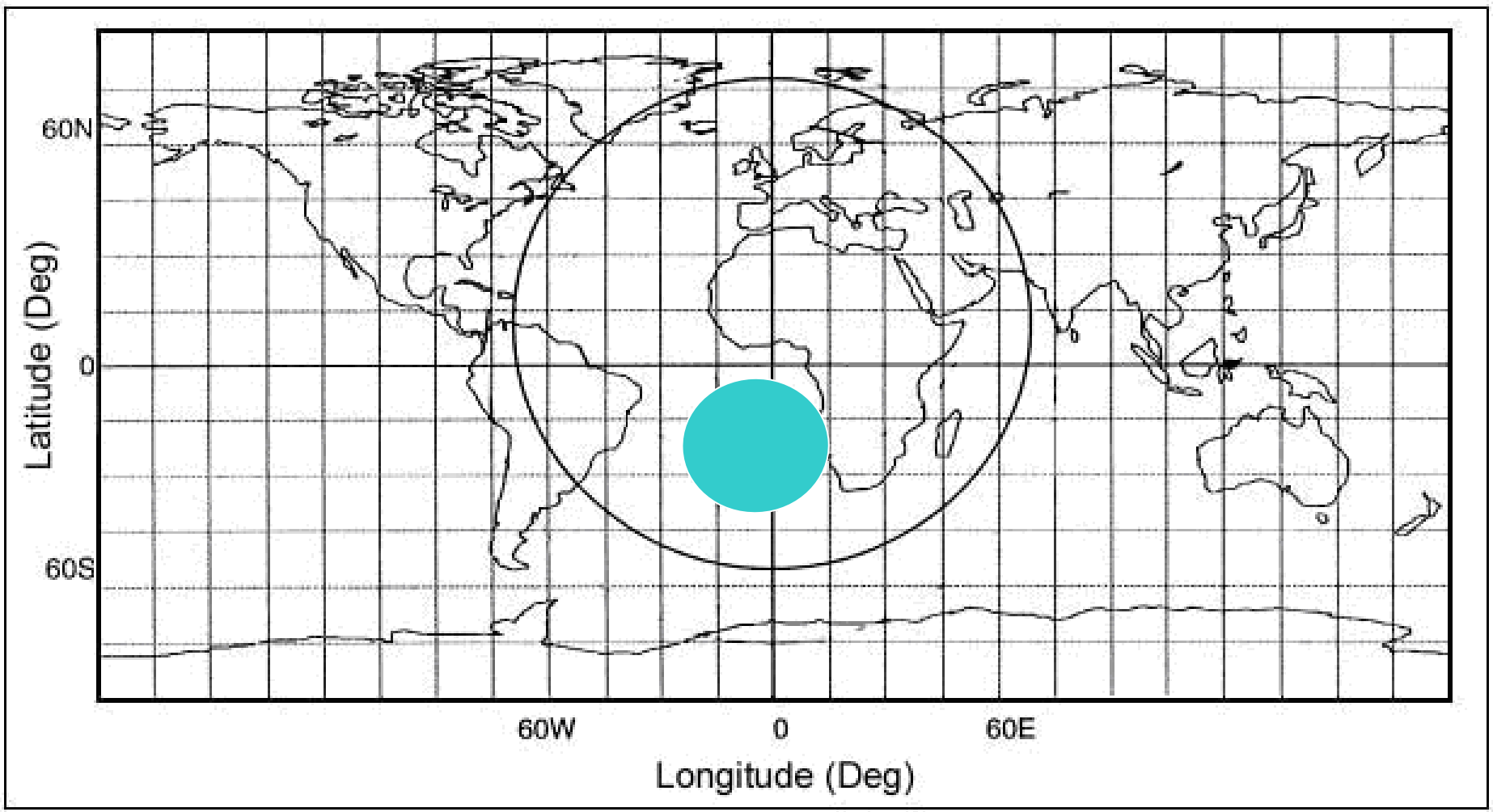
2006 Jul 11 (192) 00:38:15 UTC | 1A-AUX | Granule 1073
Reflectivity: Low High
CIRA CloudSat DPC
2006 Jul 11 (192) 00:38:15 UTC | 1A-AUX | Granule 1073
3
Time 00:47:49 00:44:37 | Lat -34.5 -23.0 | Lon 8.1 11.1
CIRA CloudSat DPC

Bildbereich von MSG



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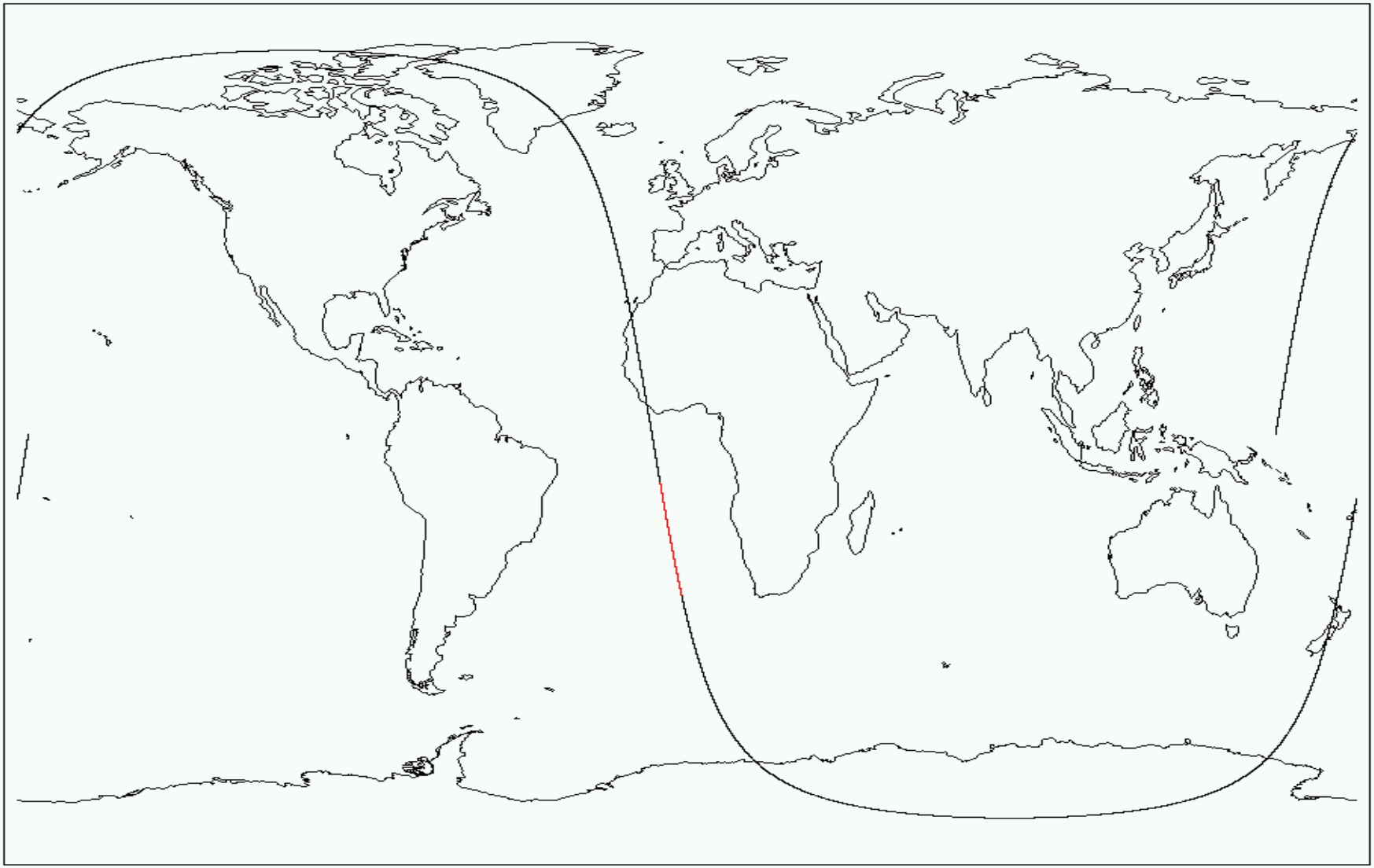
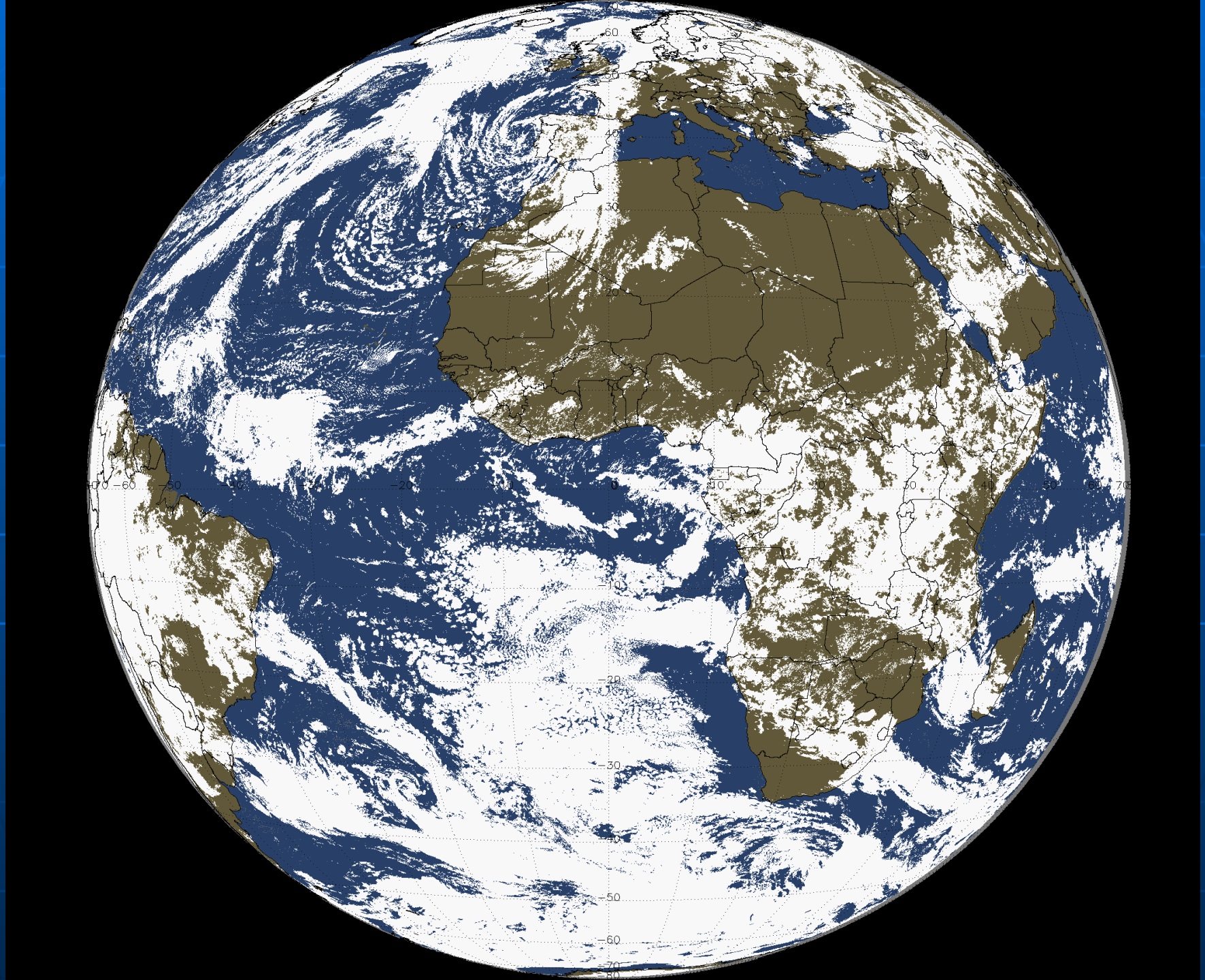
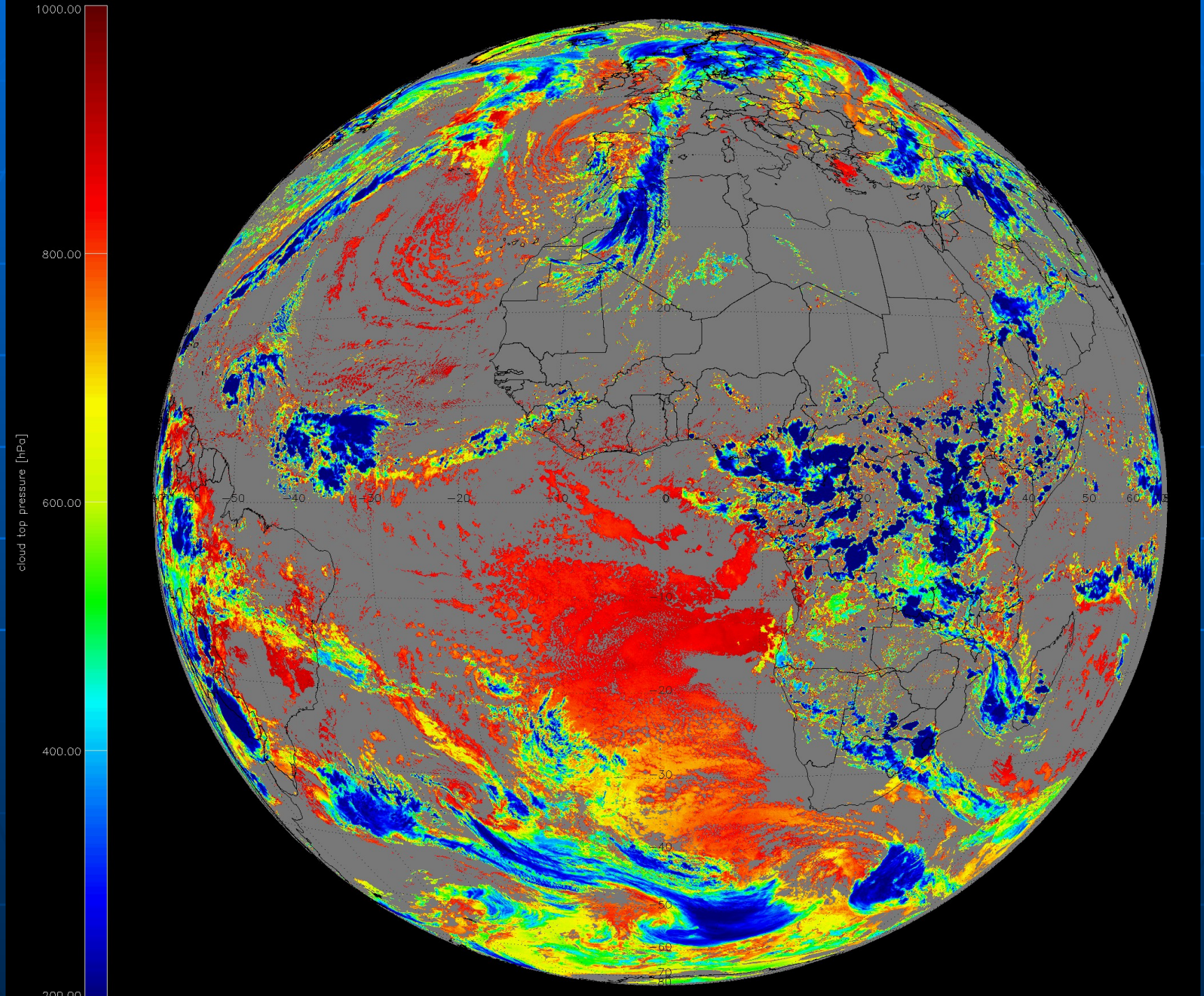
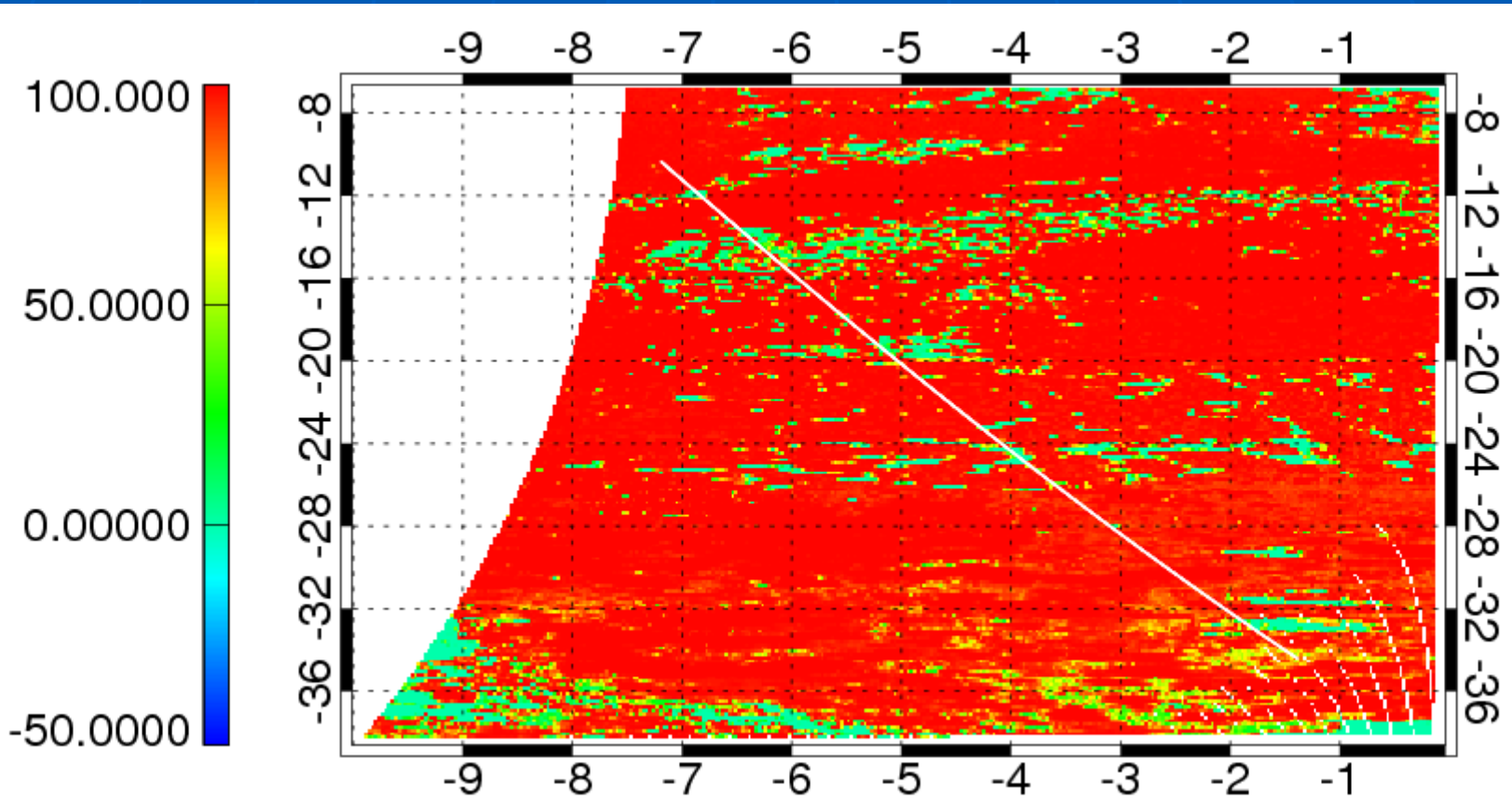
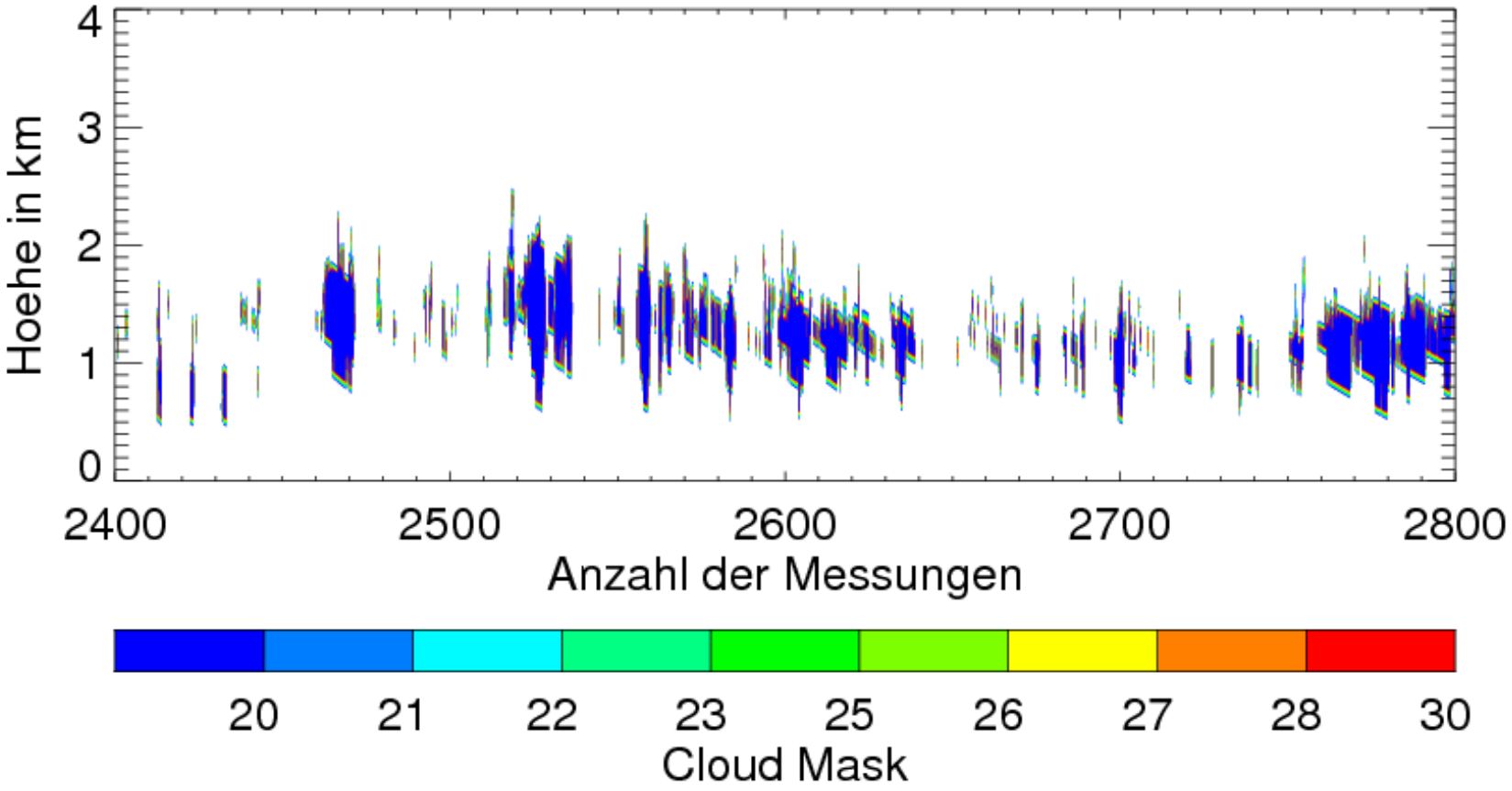
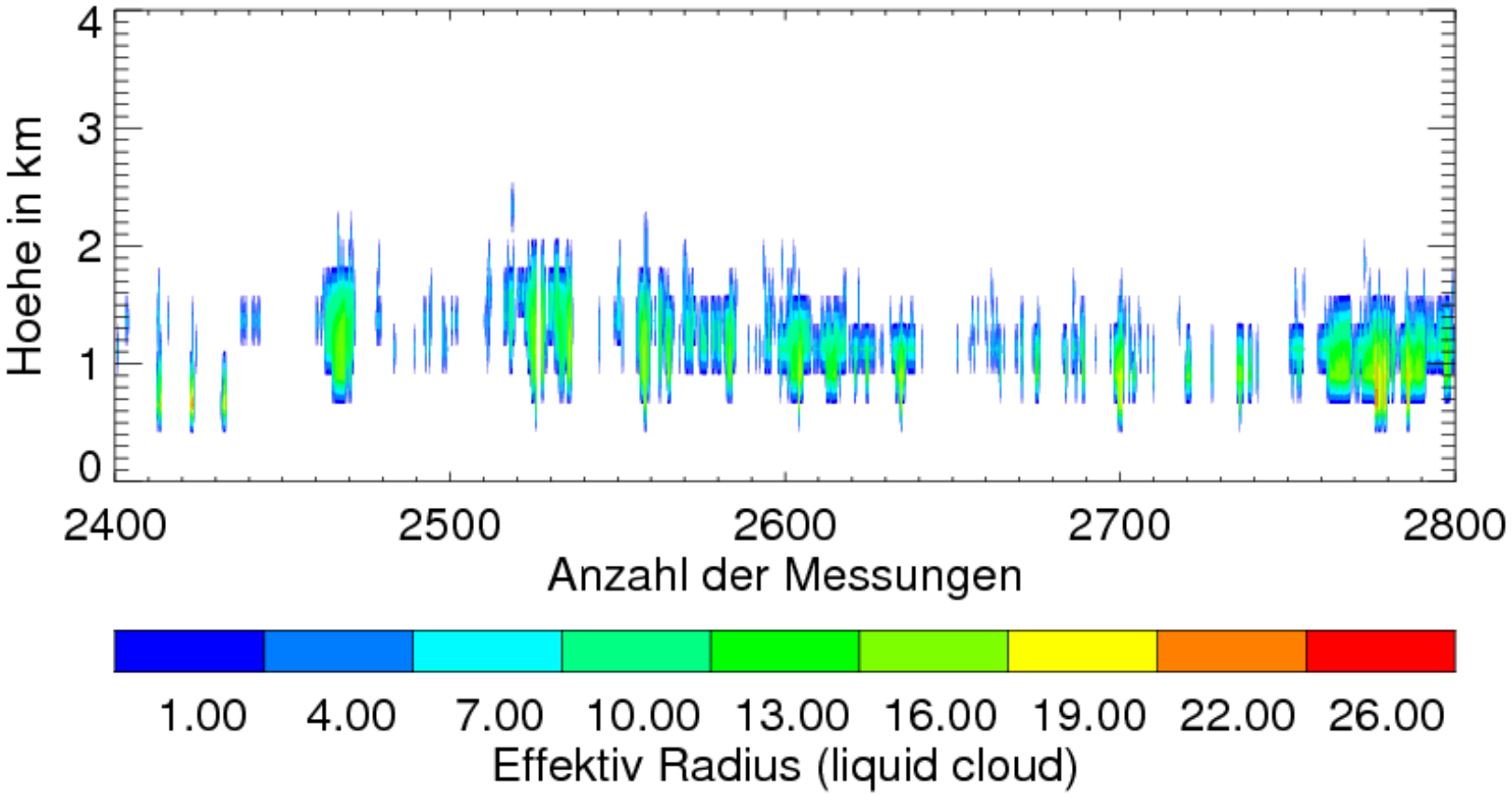


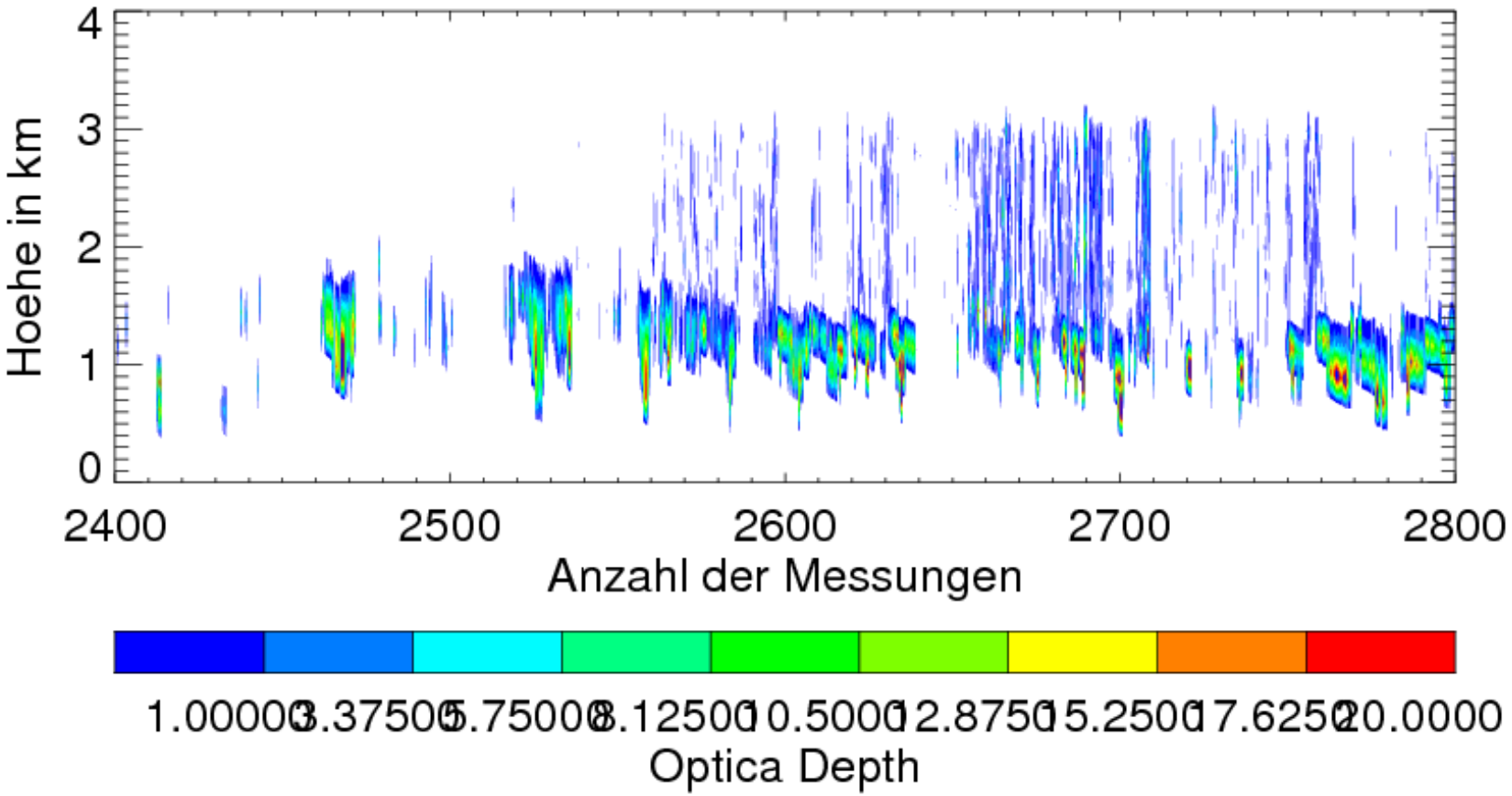

60
40
30
20
0
10
20
30
40
50
60
70
80

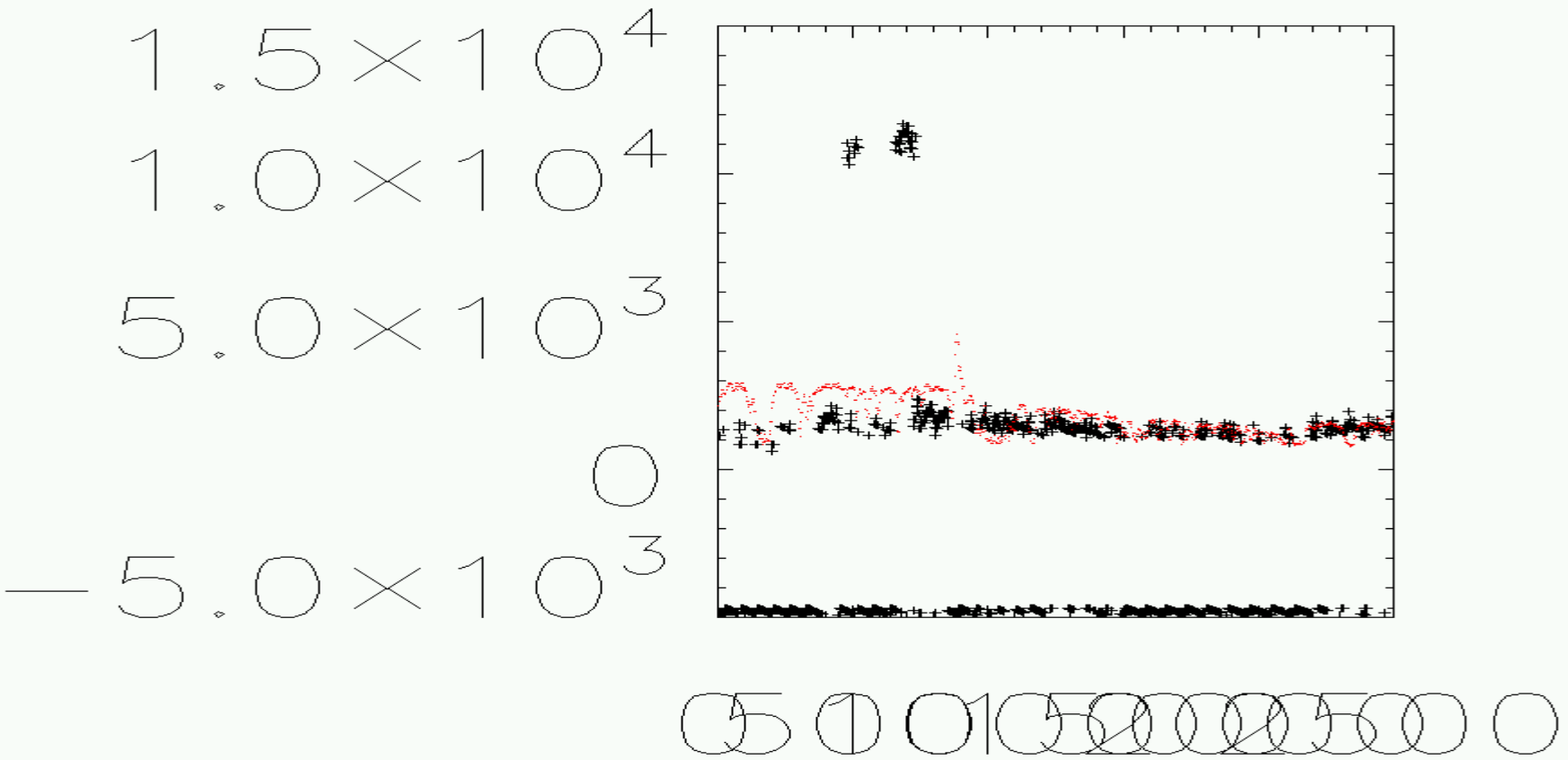

1000.00
800.00
600.00
400.00
cloud top pressure [hPa]

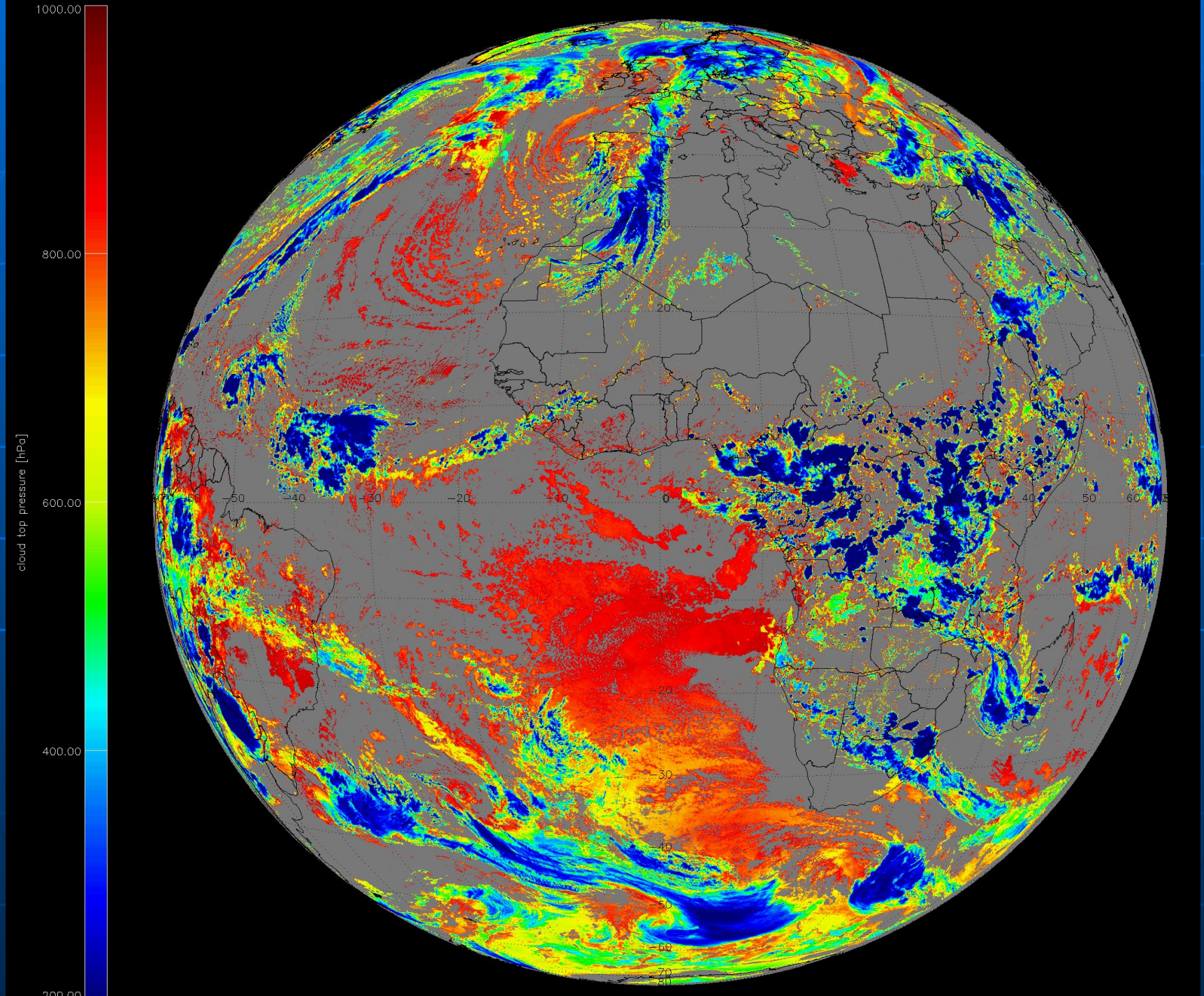

100.000
50.0000
0.00000
-50.0000
-9 -8 -7 -6 -5 -4 -3 -2 -1
-8 -12 -16 -20 -24 -28 -32 -36


Hoehe in km
0
1
2
3
4
2400
2500
2600
2700
2800
Anzahl der Messungen
20
21
22
23
25
26
27
28
30
Cloud Mask


Hoehe in km
0
1
2
3
4
2400
2500
2600
2700
2800
Anzahl der Messungen
1.00
4.00
7.00
10.00
13.00
16.00
19.00
22.00
26.00
Effektiv Radius (liquid cloud)


Hoehe in km
0
1
2
3
4
2400
2500
2600
2700
2800
Anzahl der Messungen
1.0000
3.3750
5.7500
8.1250
10.5000
12.8750
15.2500
17.6250
20.0000
Optica Depth


1.5×10^4
1.0×10^4
5.0×10^3
0
−5.0×10^3


1000.00
800.00
600.00
400.00
cloud top pressure [hPa]

Literatur

- CloudSat homepage by NASA
- CloudSat homepage by Colorado State University
- www.fu-berlin.de/iss/nrt