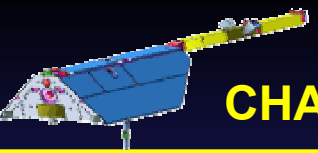

CHAMP

GPS radio occultation with CHAMP: Operational data processing and validation of vertical atmospheric profiles

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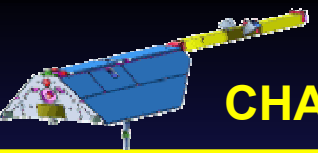
GeoForschungsZentrum Potsdam

(jens.wickert@gfz-potsdam.de)

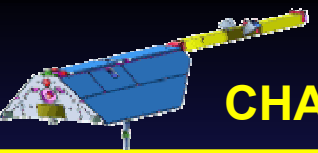
Potsdam Telegrafenberg with GFZ


AGU

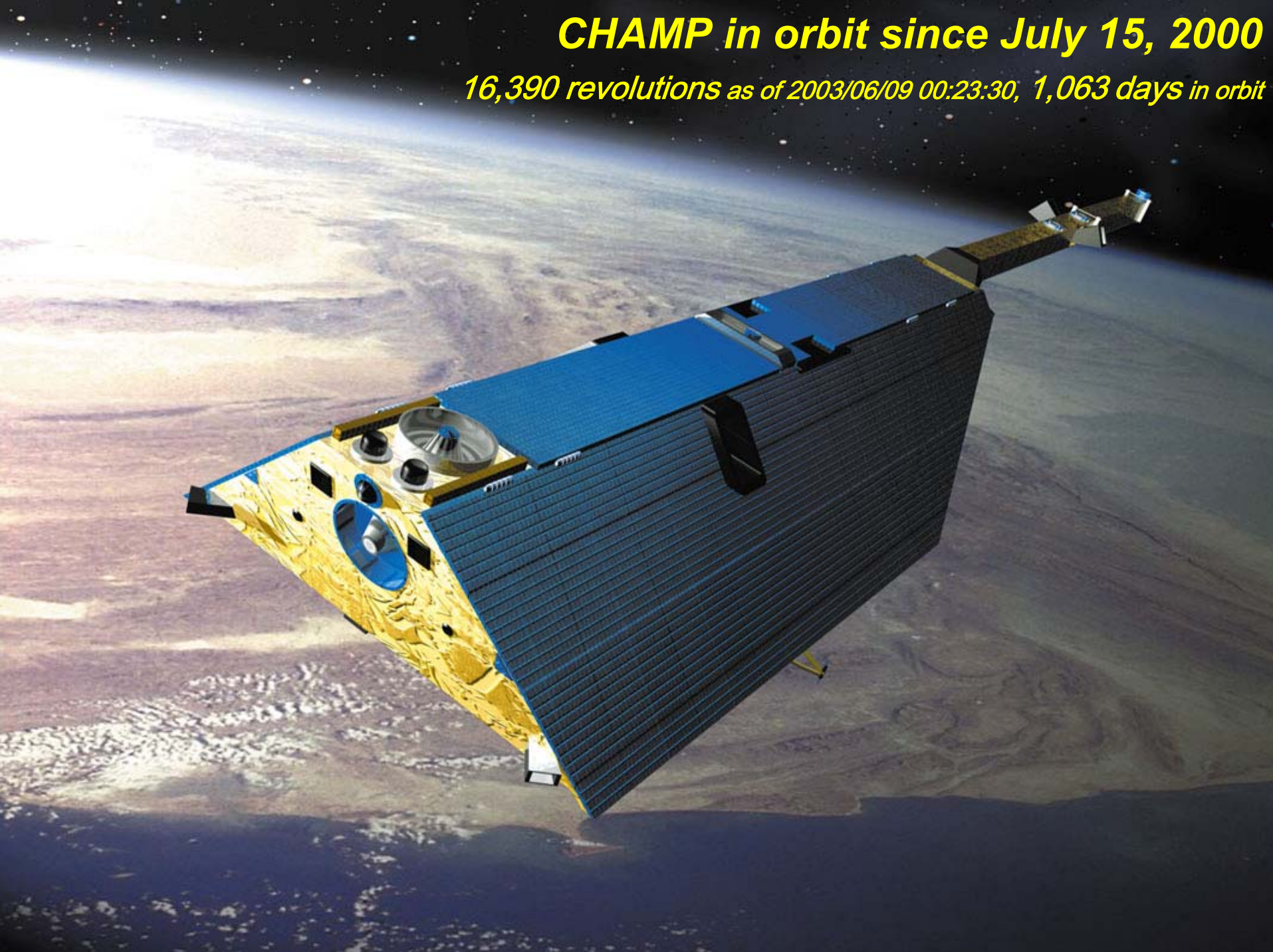


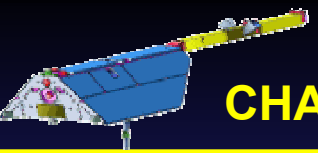
Content

- *Status of the CHAMP occultation experiment*
- *Operational data processing*
- *Advanced retrieval methods (LT) & Validation*
- *Access to the data products*
- *Summary & Outlook*



Status
CHAMP occultations

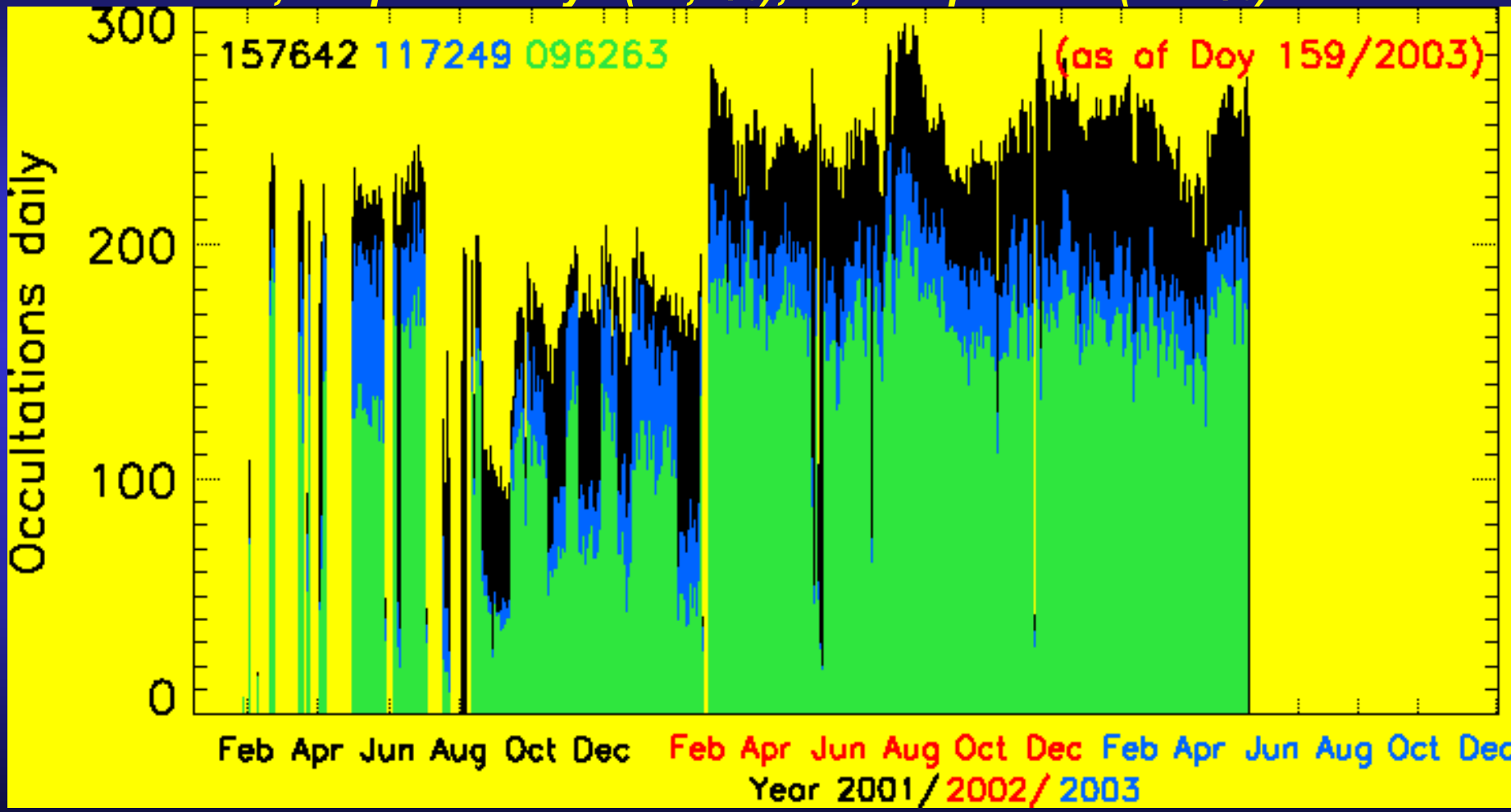

CHAMP in orbit since July 15, 2000
16,390 revolutions as of 2003/06/09 00:23:30, 1,063 days in orbit



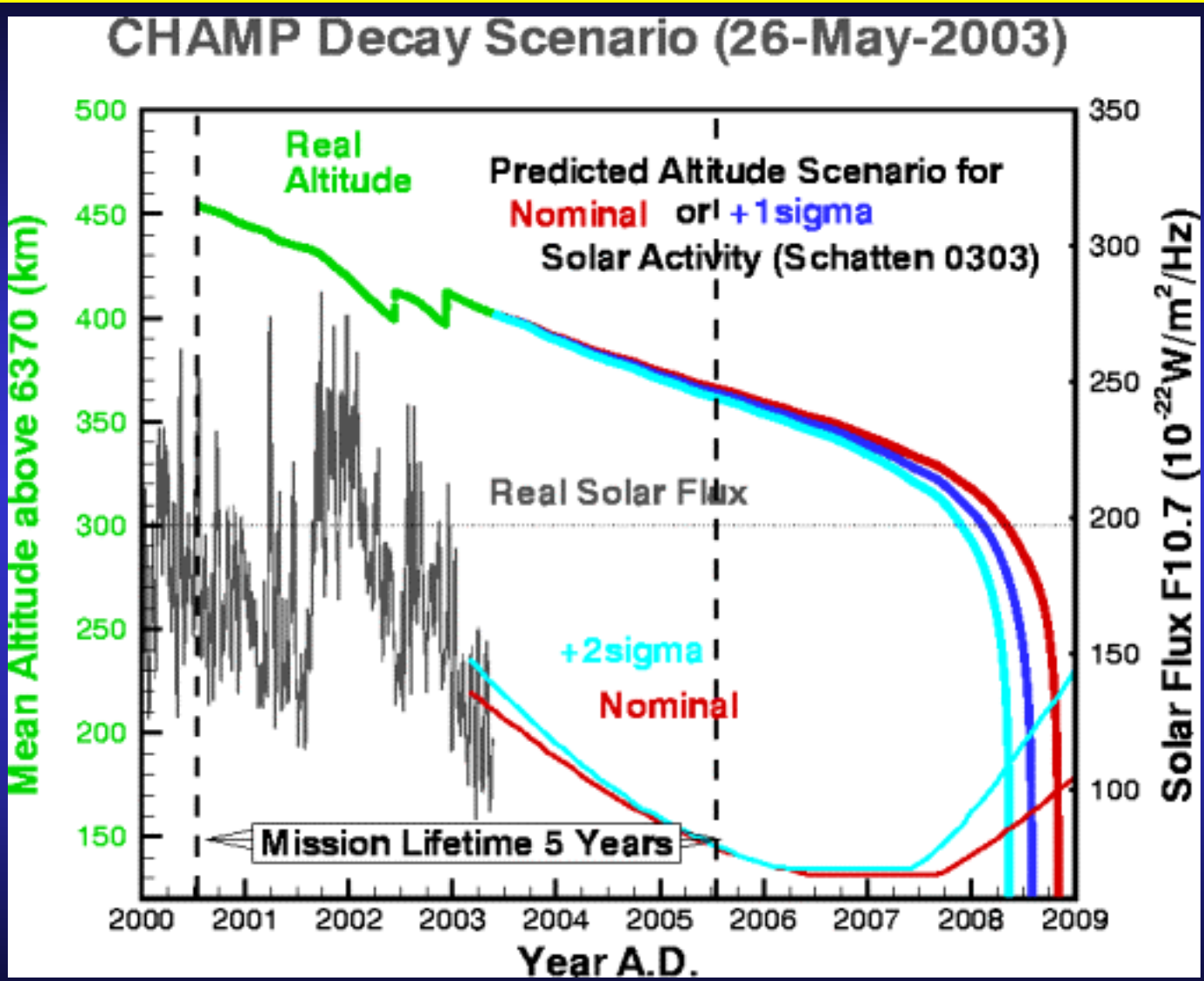
CHAMP

Neutral atmosphere Occultations 2001-2003

737 days; 157,642 occultations (~213 daily);
117,249 path delays (74,3%); 96,263 profiles (61.1%)

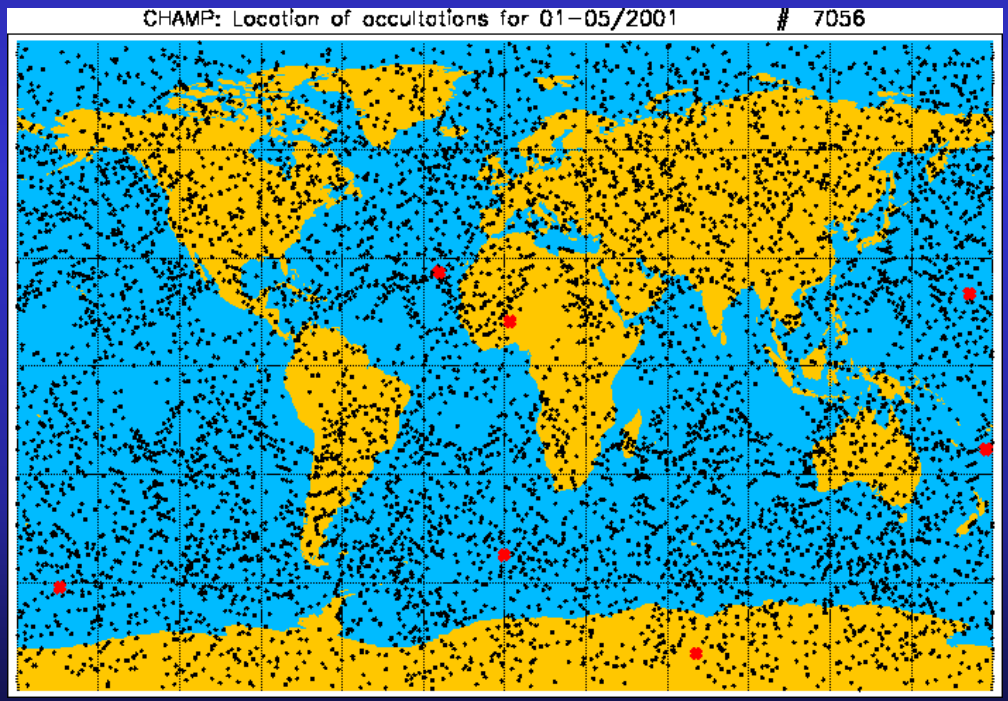


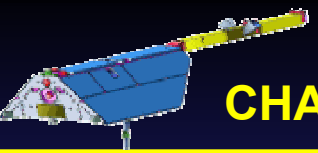
Expected mission duration



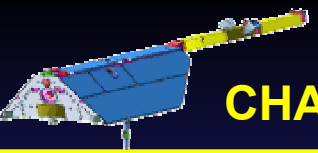
Status information via WWW

Occultations statistics



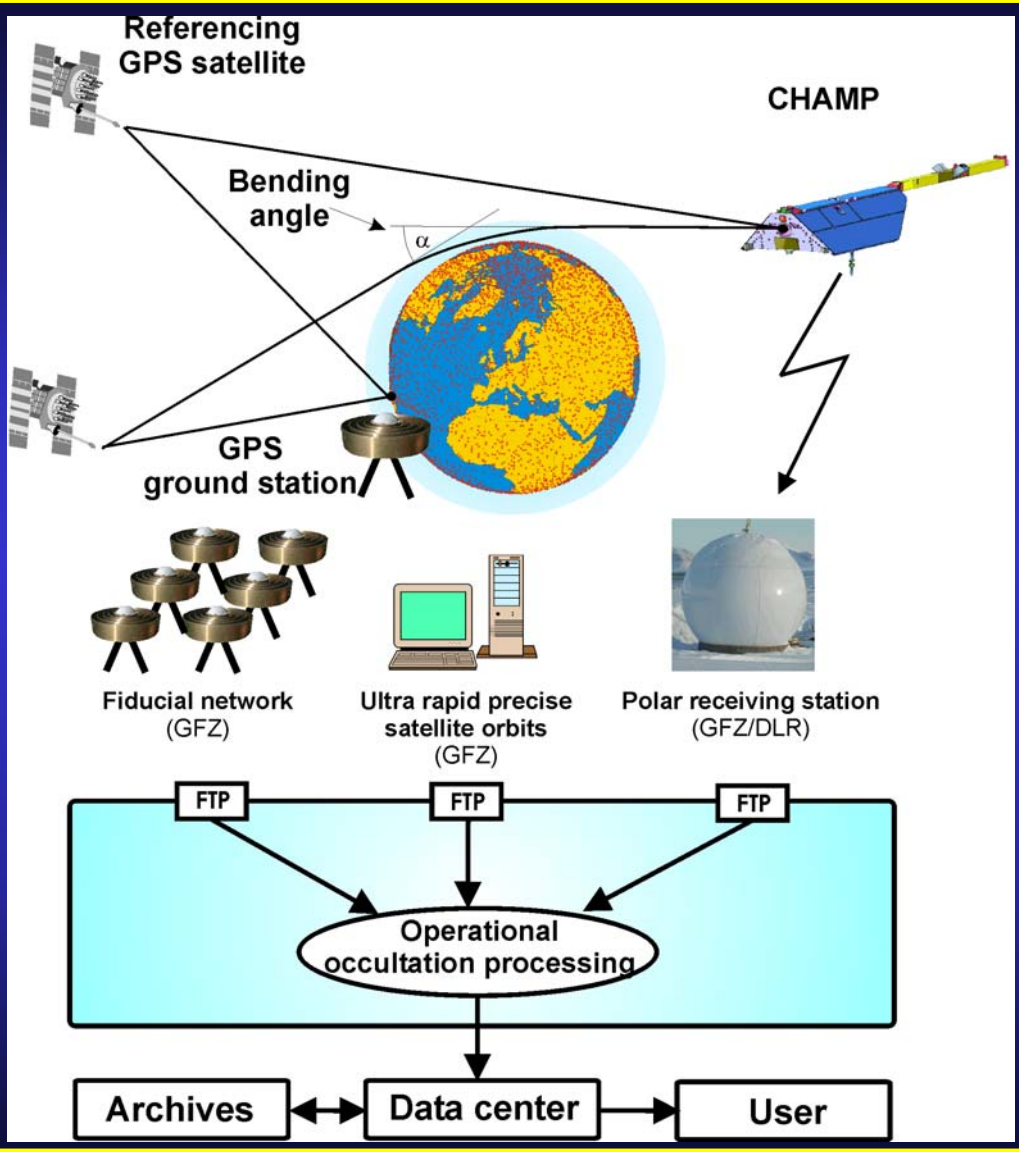


Occultation infrastructure and operational data processing



CHAMP

GPS Radio occultation at GFZ Potsdam



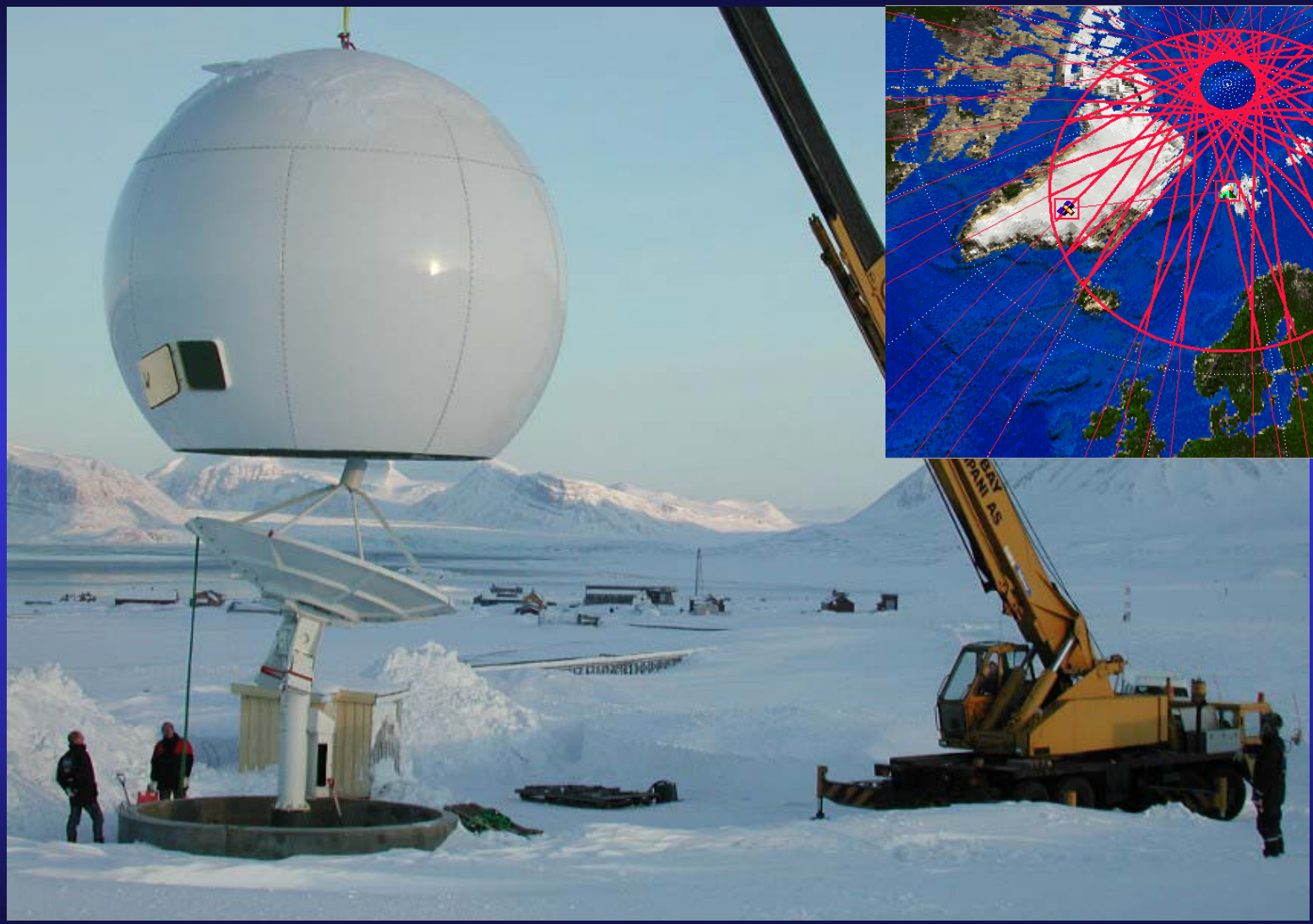
GPS Atmosphere Sounding Project (2000-2002)
Ground & space based GPS

Infrastructure for operational data analysis and provision

Validation

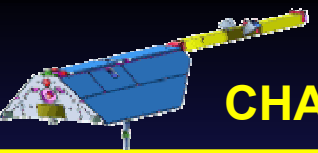
Assimilation

Downlink antenna Ny Alesund



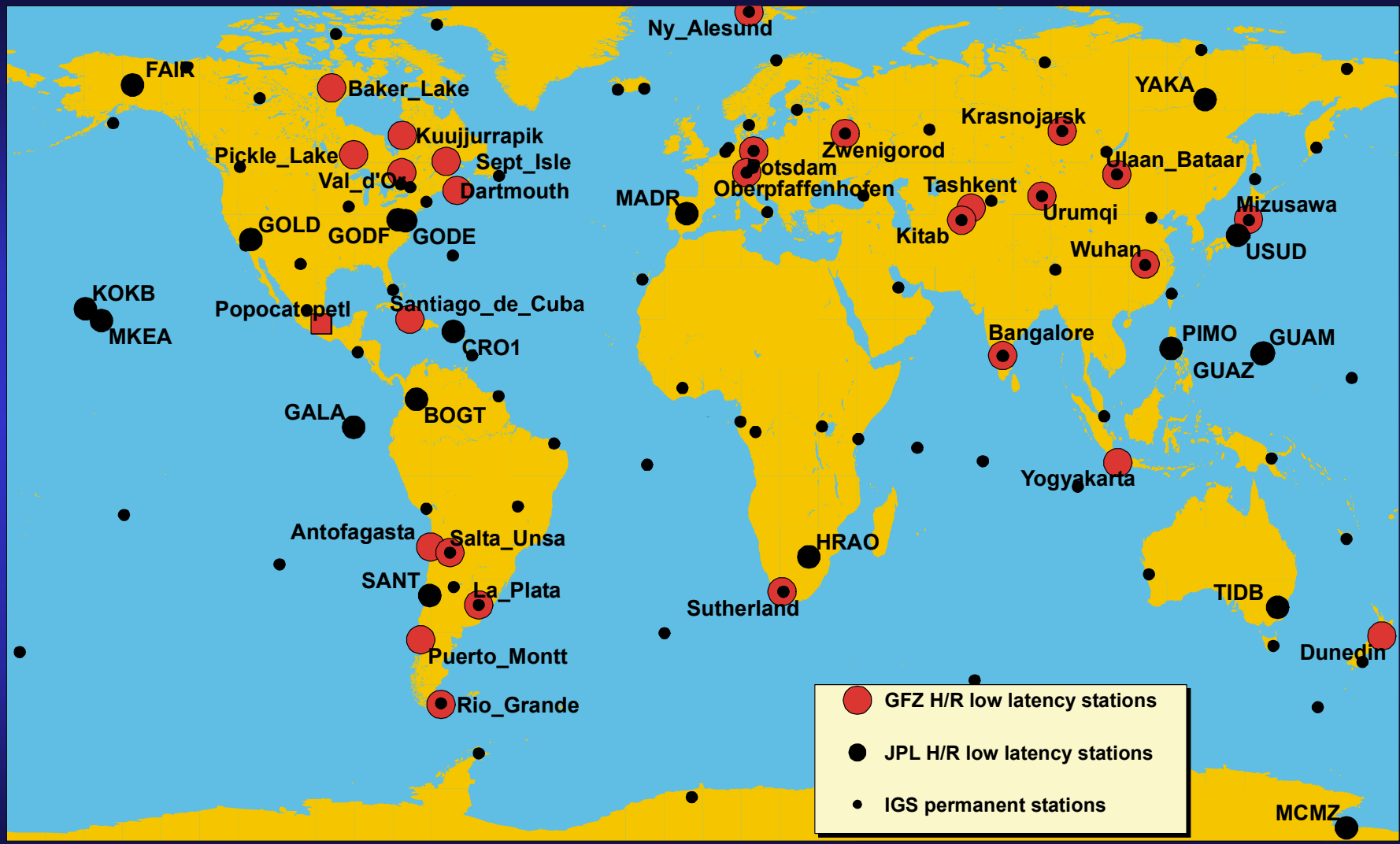
Contact every orbit: 5-10 min

Delay: 90 min

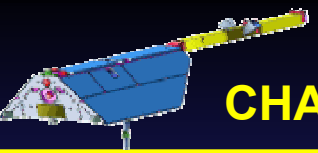


CHAMP

GPS ground station network



GFZ POTSDAM



GPS Ground station data flow

Time delay for hourly files: ~ 90 minutes

GFZ Subnetwork
~ 25 stations (August 2002)

GPS High Rate Ground Stations
- 1 Hz sample rate
- 15 min Files
- Format:Turbo Binary, compressed

JPL Subnetwork
~ 18 stations (August 2002)

~ 300 MByte/day

GFZ Potsdam Level-1-Data processing
- Data Format Conversion
- Sampling (1sec, 10 sec, 30 sec sampling rate)
- Collection (15 min to 1 hour files)
- Meta Data Creation

~ 250 MByte/day

JPL Data Base

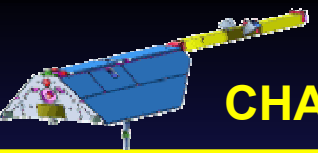
GPS Occultation Processing

CHAMP Information System and Data Center

GPS ground data products:

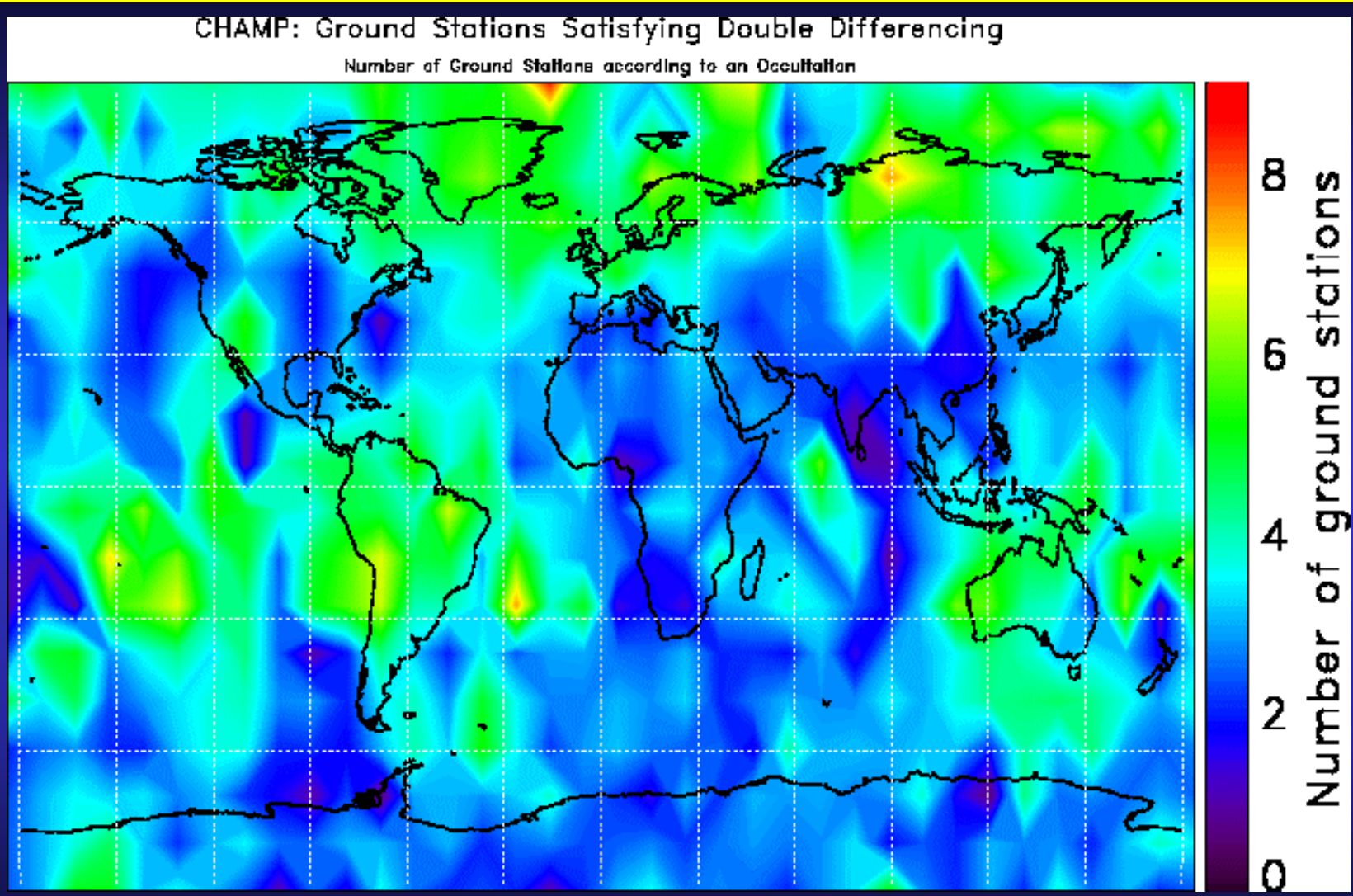
CH-OG-1-GPS-30S	CH-OG-1-GPS-10S	CH-AI-1-GPS-01S
- Rinex Format	- Rinex Format	- Rinex Format
- 30 sec. Sample Rate	- 10 sec. Sample Rate	- 1 sec. Sample Rate
- 1 hour files	- 1 hour files	- 1 hour files

User Interface

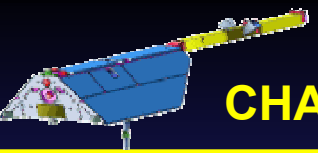


CHAMP

Ground station data (Redundancy)



Doy 135-160, 2001 (26 stations used)



Precise orbit determination (POD)

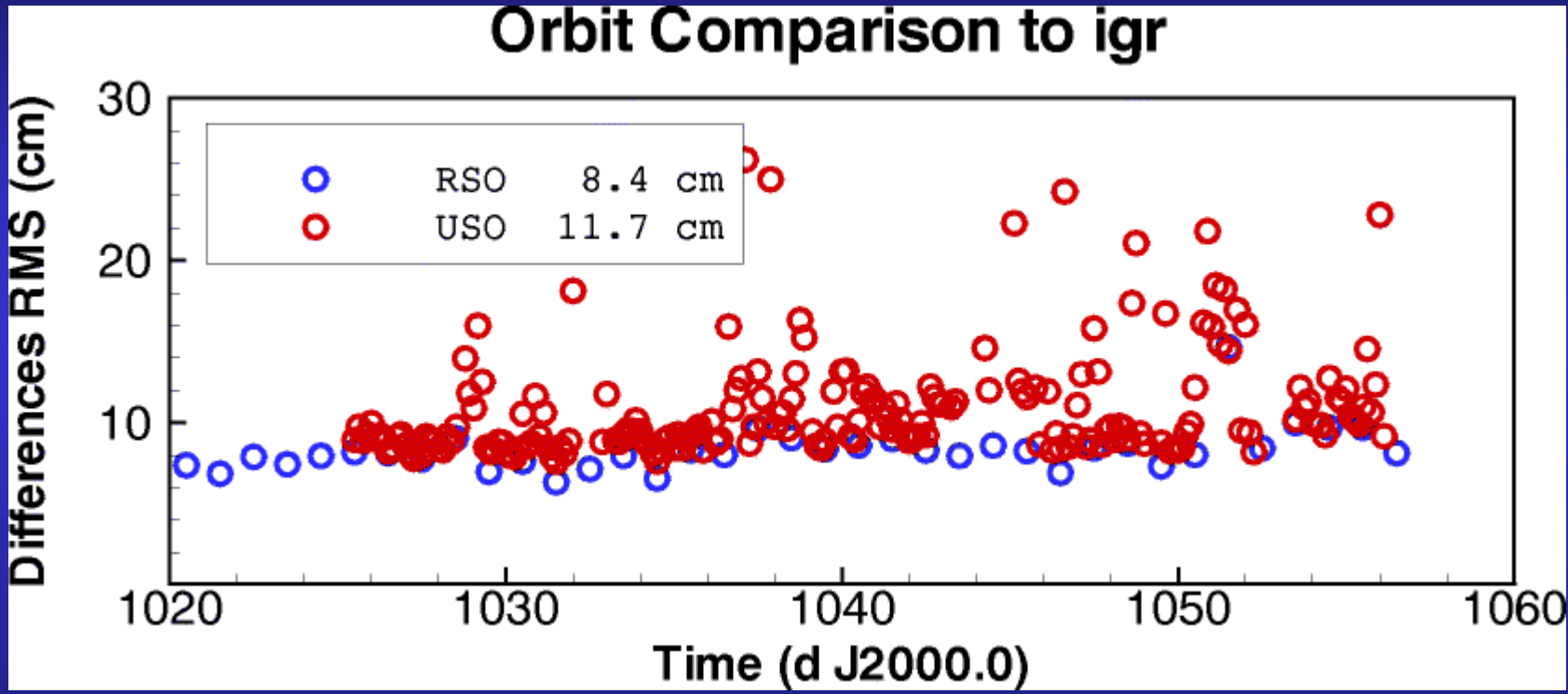
Rapid Science Orbits (RSO)

- since March 2001
- delivered daily for the preceding day
- latency: 14 h for GPS, 16h for CHAMP
- accuracy (3D): GPS ~10 cm; CHAMP ~5 cm

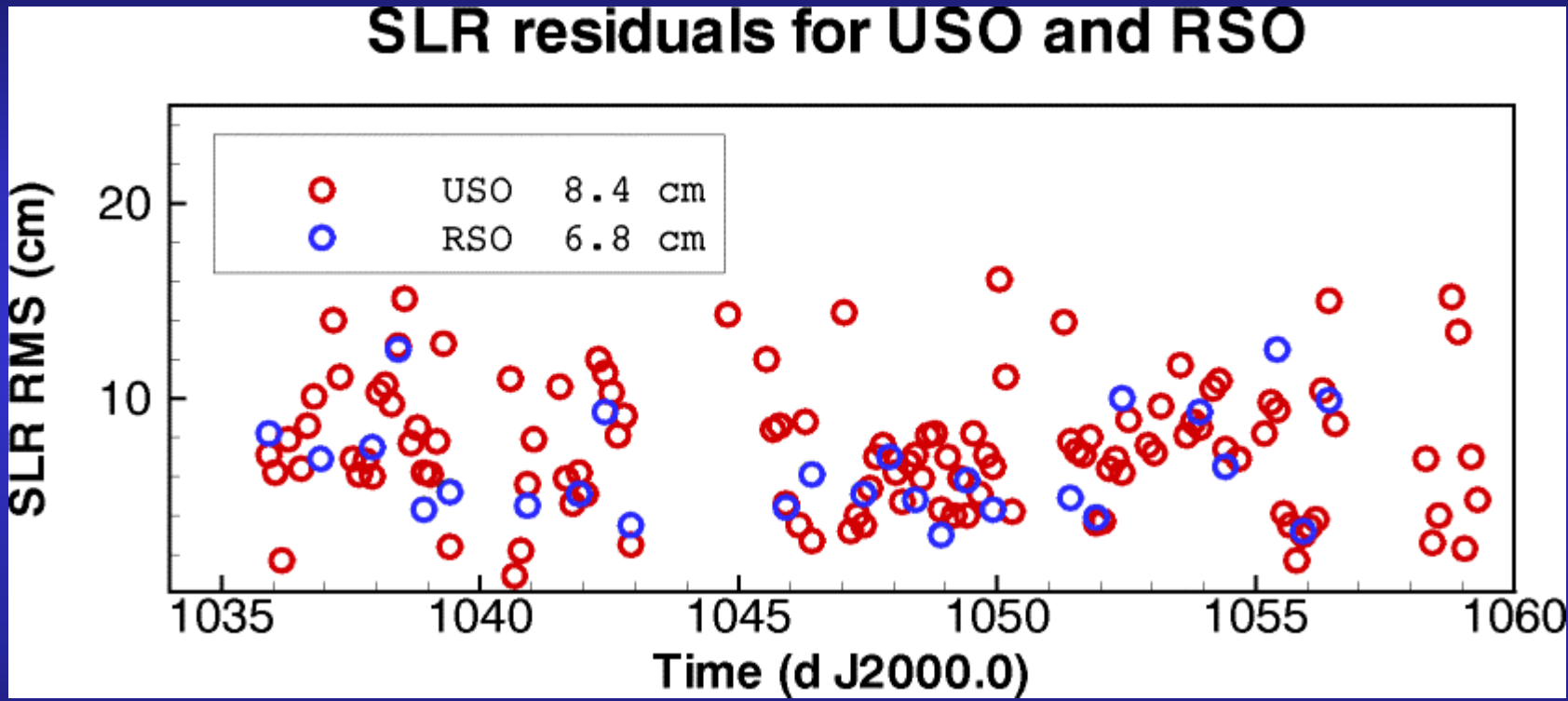
Ultra Rapid Science Orbits (USO)

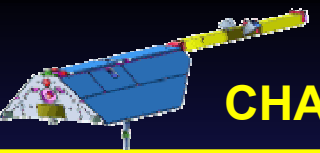
- Since Mid 2002
- latency: ~3h (further reduction possible)
- accuracy slightly worse than RSO

GPS RSO/USO Accuracies



CHAMP RSO/USO Accuracies

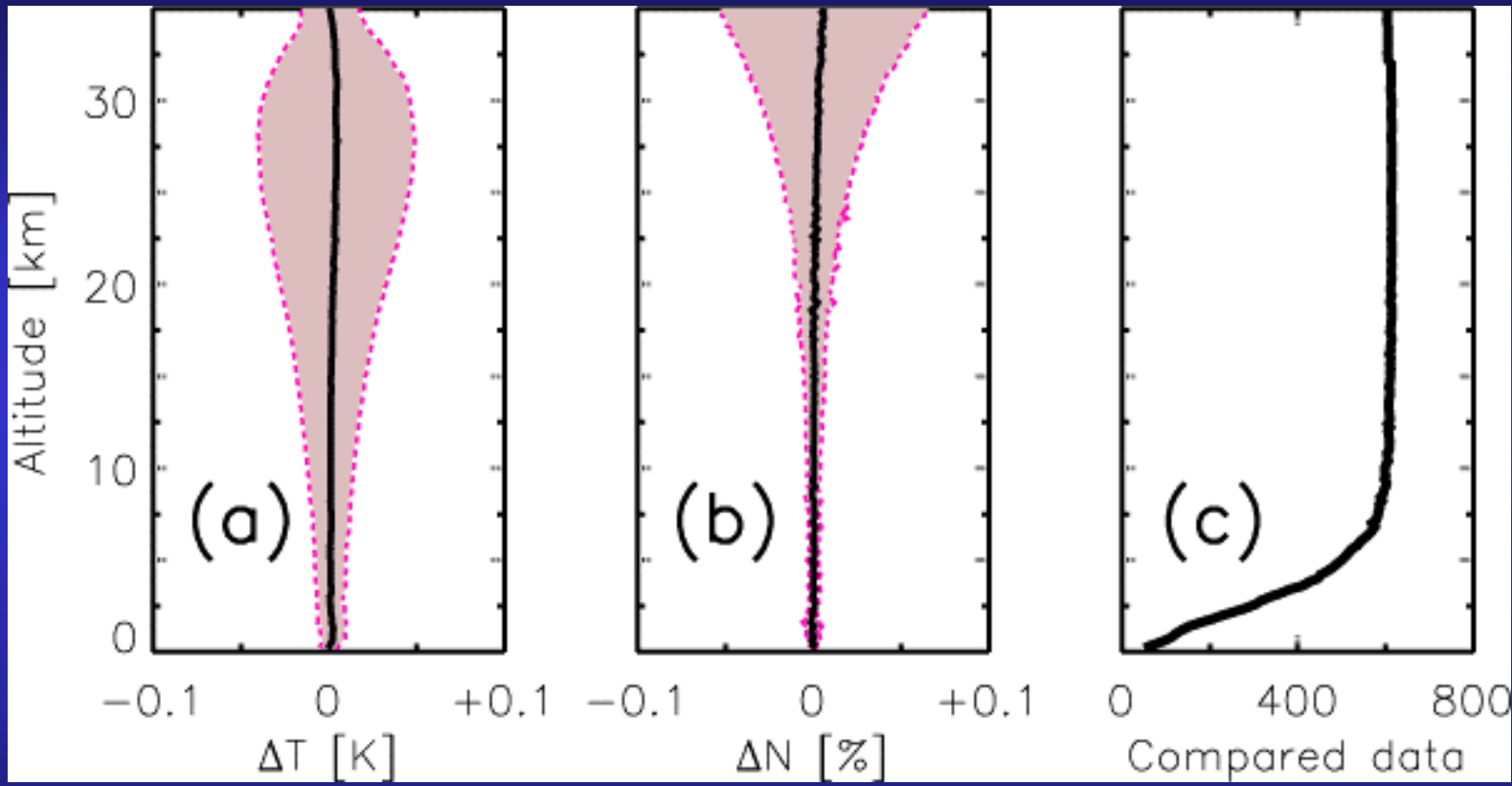




CHAMP

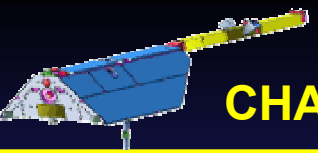
Orbit accuracy for occultations

614 profiles, Feb. 4-8, 2003, processed using RSO and USO



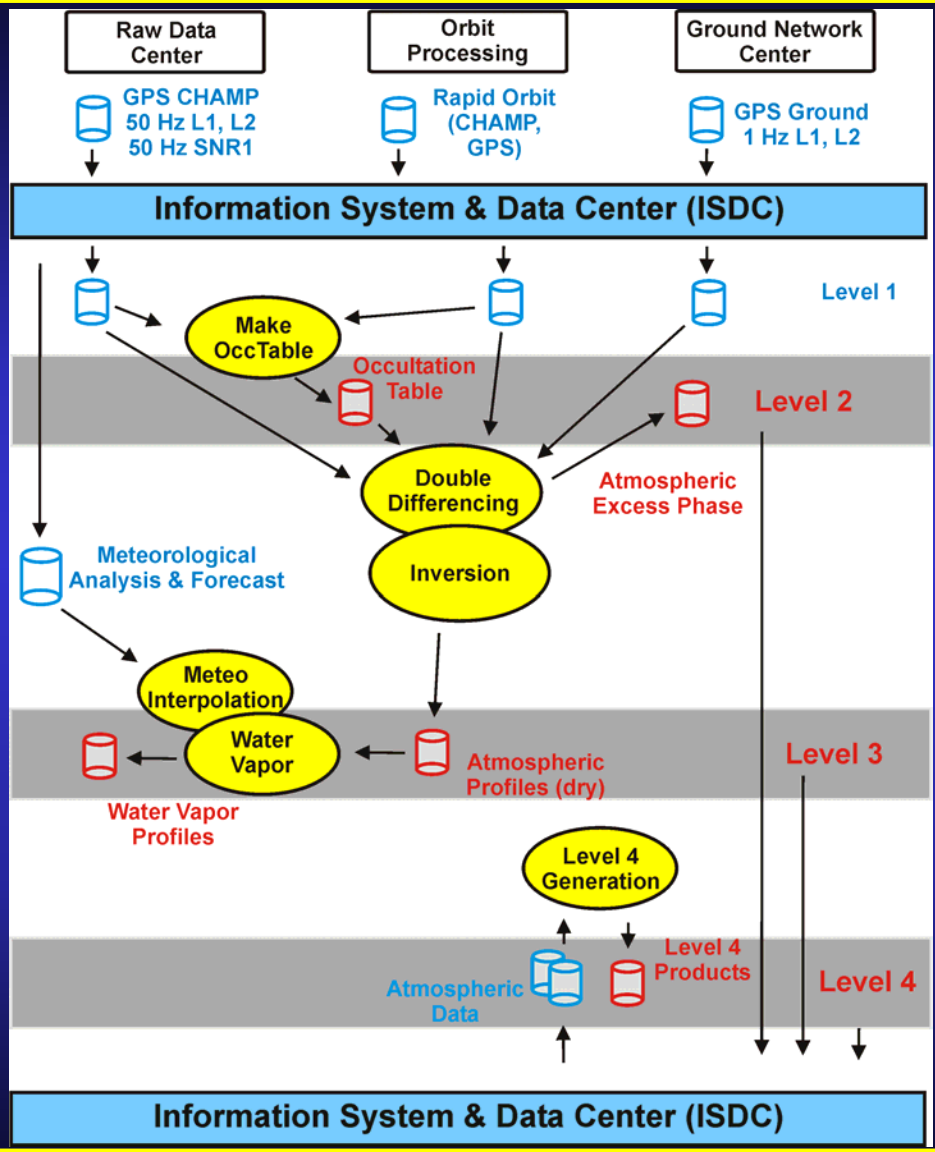
Av. delay between measurement and data provision: ~5 hours for each profile

GFZ POTSDAM

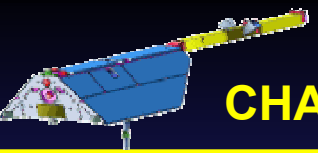


CHAMP

Operational occultation processing

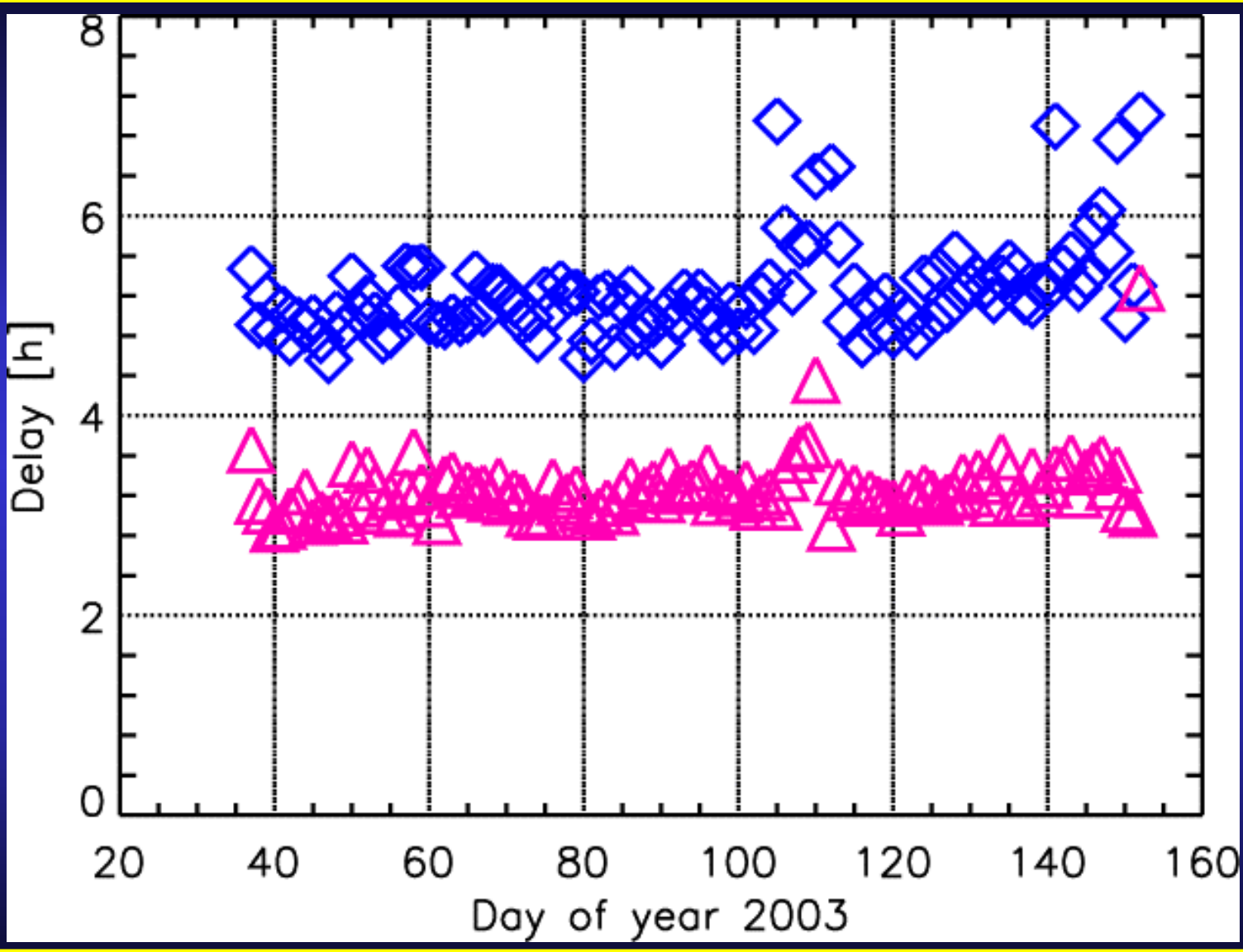


GFZ POTSDAM

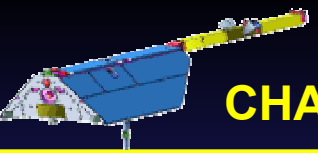


CHAMP

Latency of path delays (Transfer to MPI)

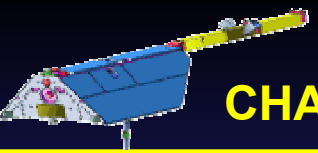


GFZ POTSDAM



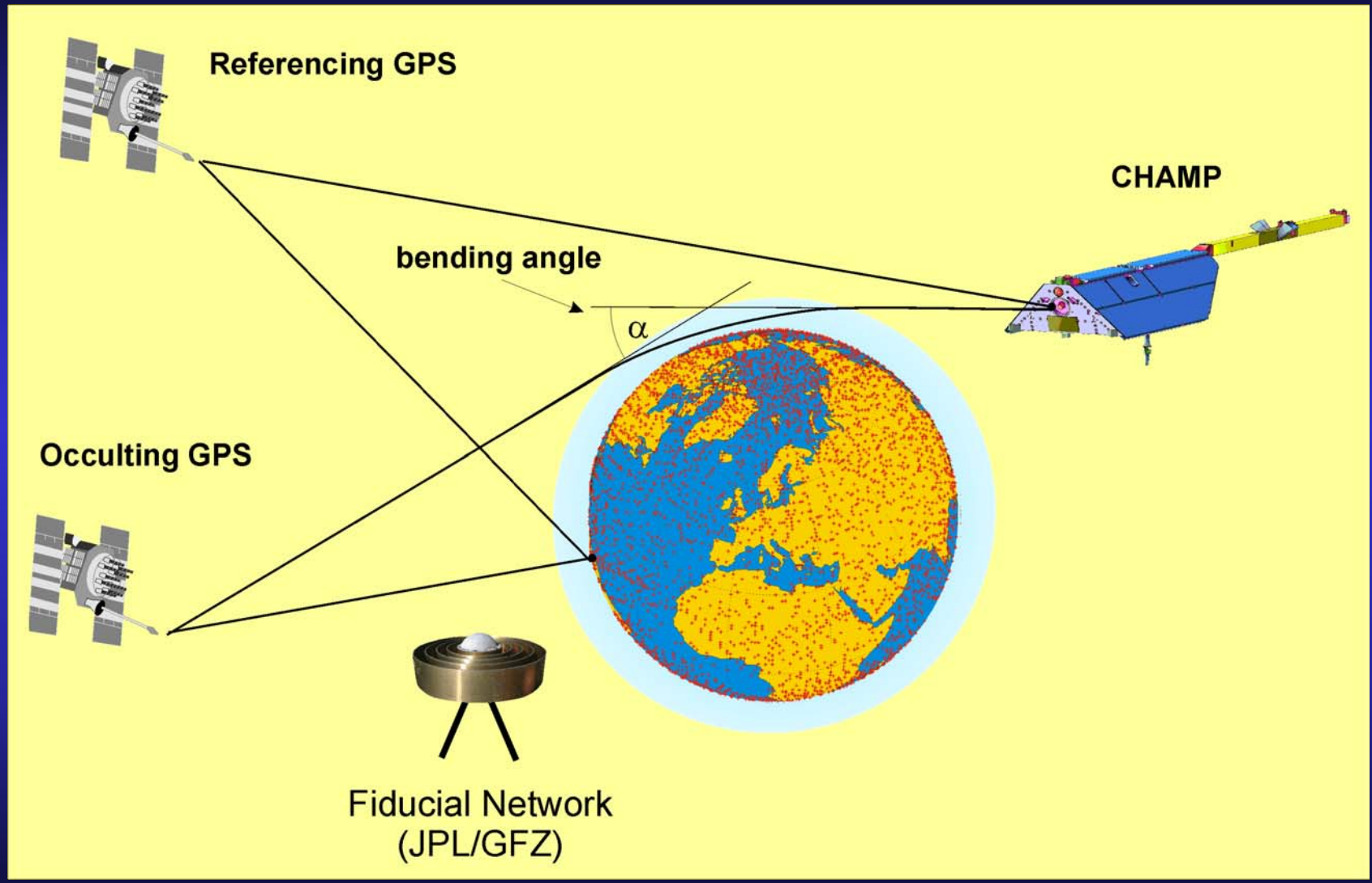
Processing software (POCS 1.4 and 1.5)

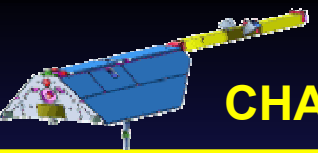
- Operational Inversion Software (currently: geometric optics assumption, data product version 004, since December 2002), Several improvements in relation to previous versions (data handling, quality control, usage of geoid EGM96, additional metadata)
- Due to minor quality of the GO data in the lower troposphere (known refractivity bias) new product version 005 (for ATM and WVP) in preparation: usage of „heuristic“ wave optics based methods for MT/LT
- First results of 1dvar implementation (Healy, UKMO) for T and WVP retrieval, provision of *VAR* profiles planned in parallel (first results presented at EGU 03)



GPS processing

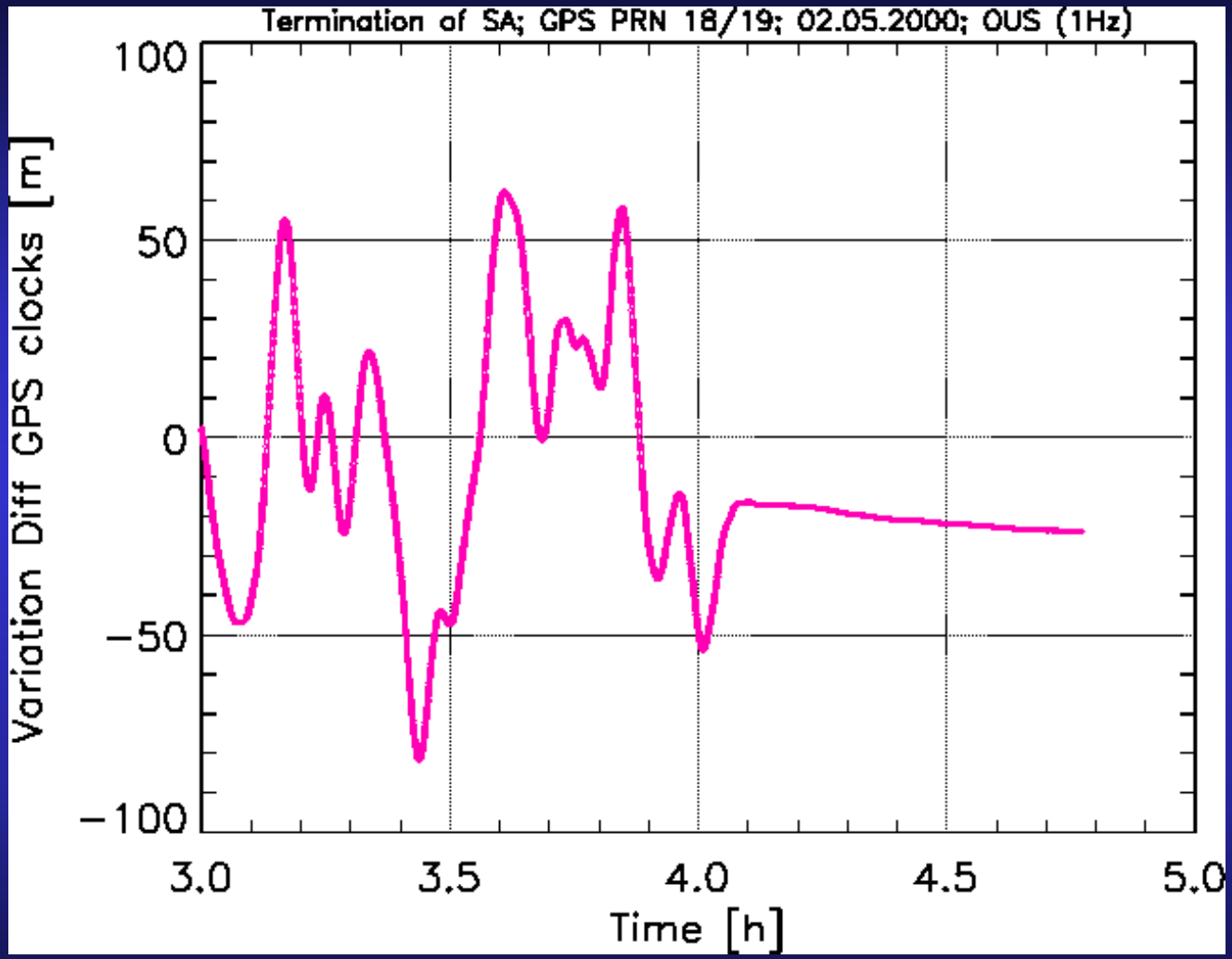
GPS processing: double differences





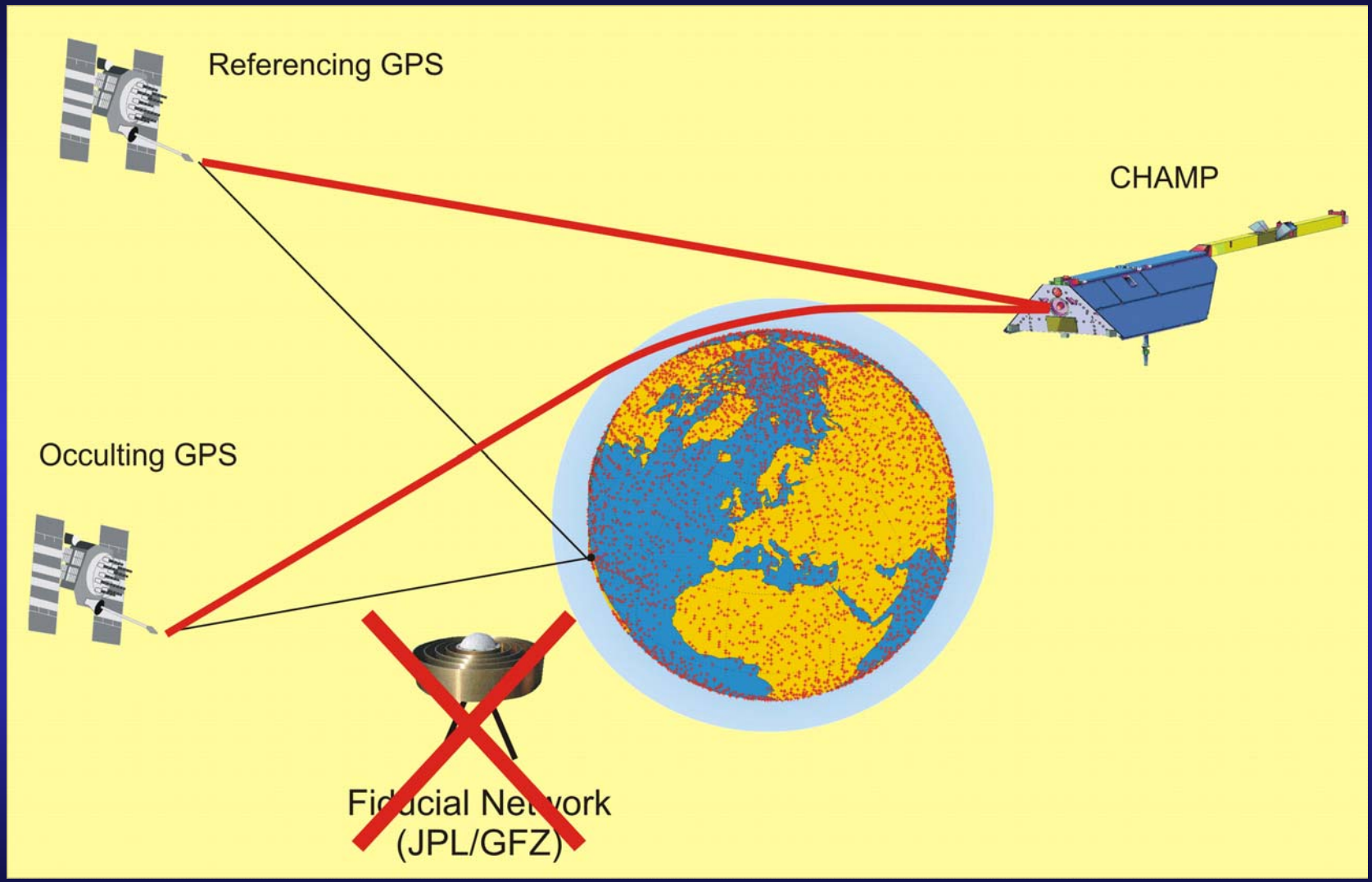
CHAMP

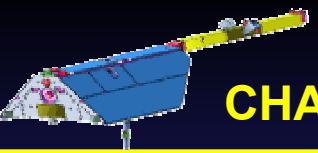
Termination of SA on May 2, 2000



SA activated: rates of ~ 1 m/s

Space-based single differencing

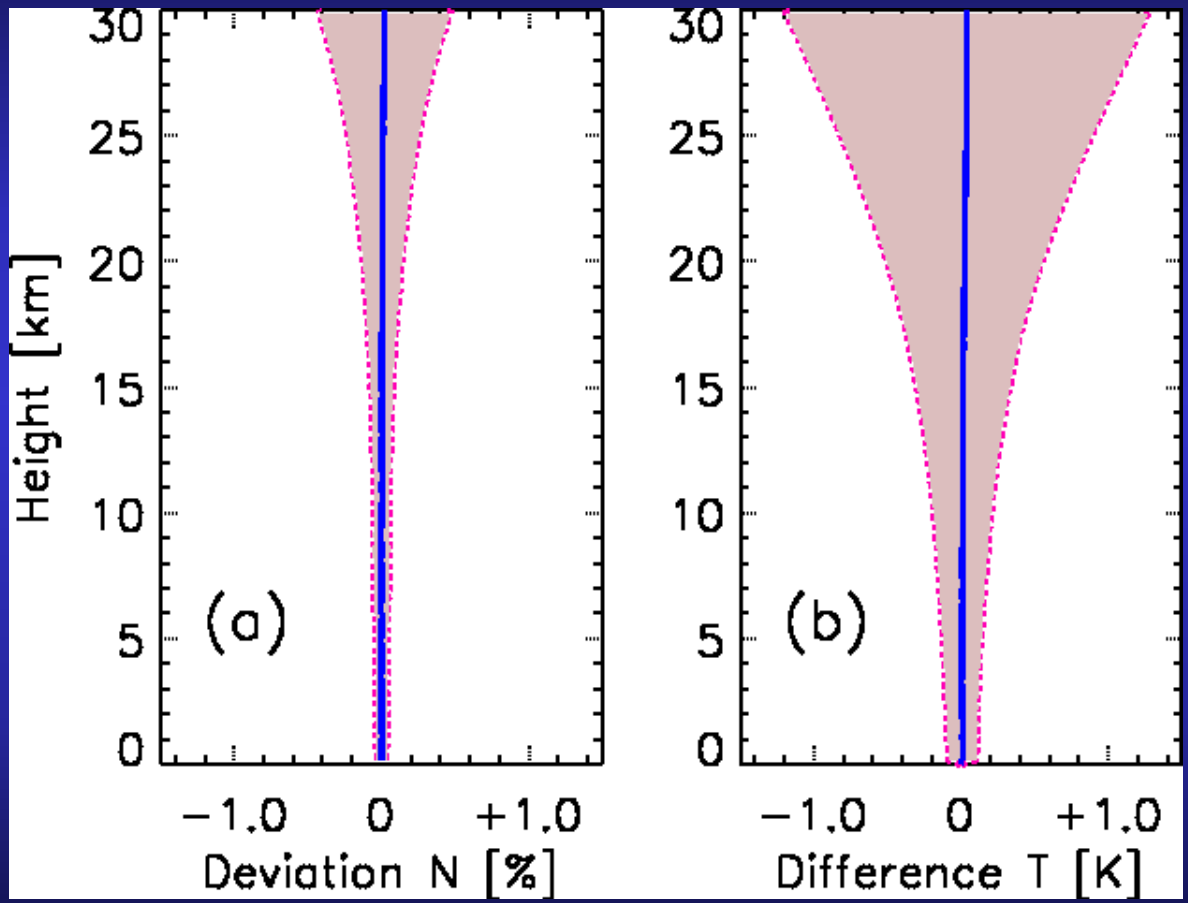




CHAMP

Space-based single differencing

Comparison of two sets of 436 profiles April 19-21, 2001 DDIFF/SDIFF.



CHAMP receiver error

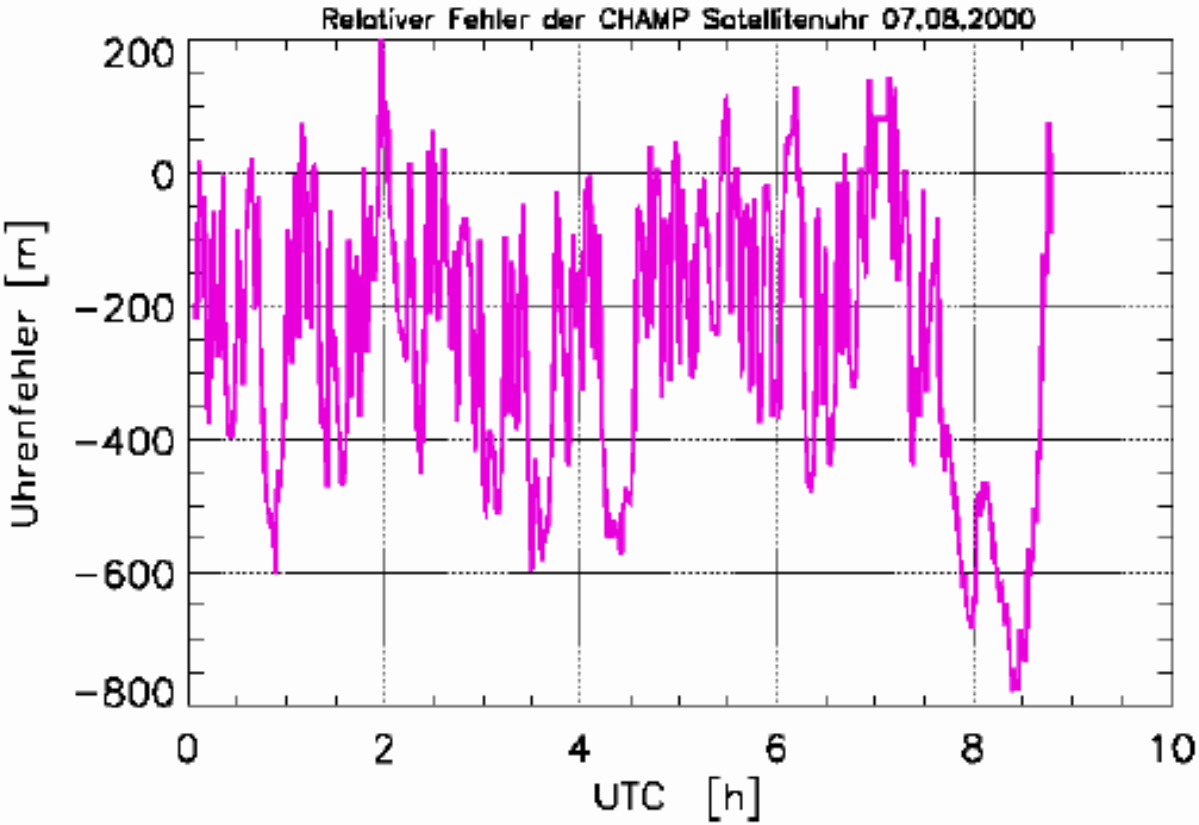
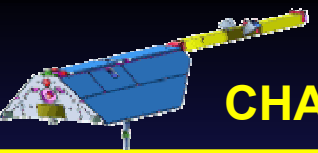
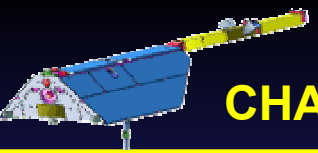


Abb. 3.5: *Relatives zeitliches Verhalten des CHAMP-Satellitenuhrenfehlers (10 s- Uhrenlösungen dargestellt in Längeneinheiten; 7. August 2000).*

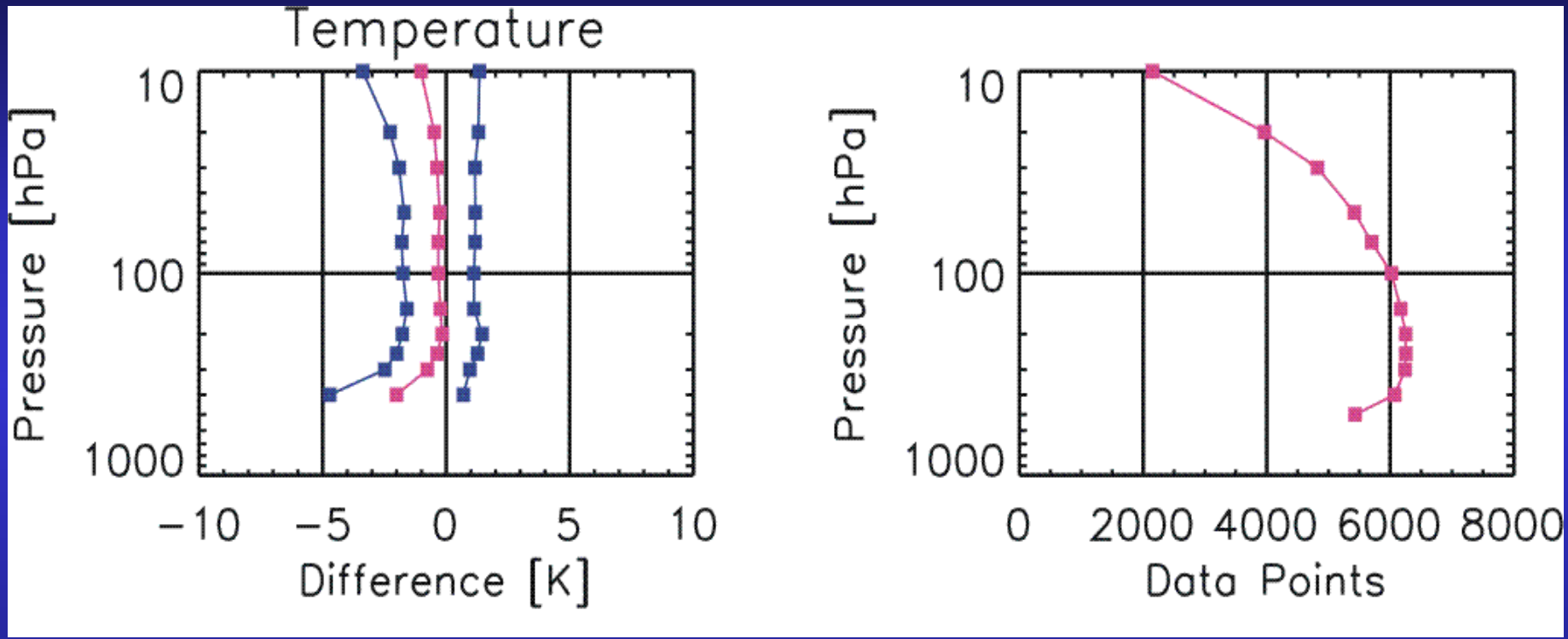


Advanced retrieval methods & Validation



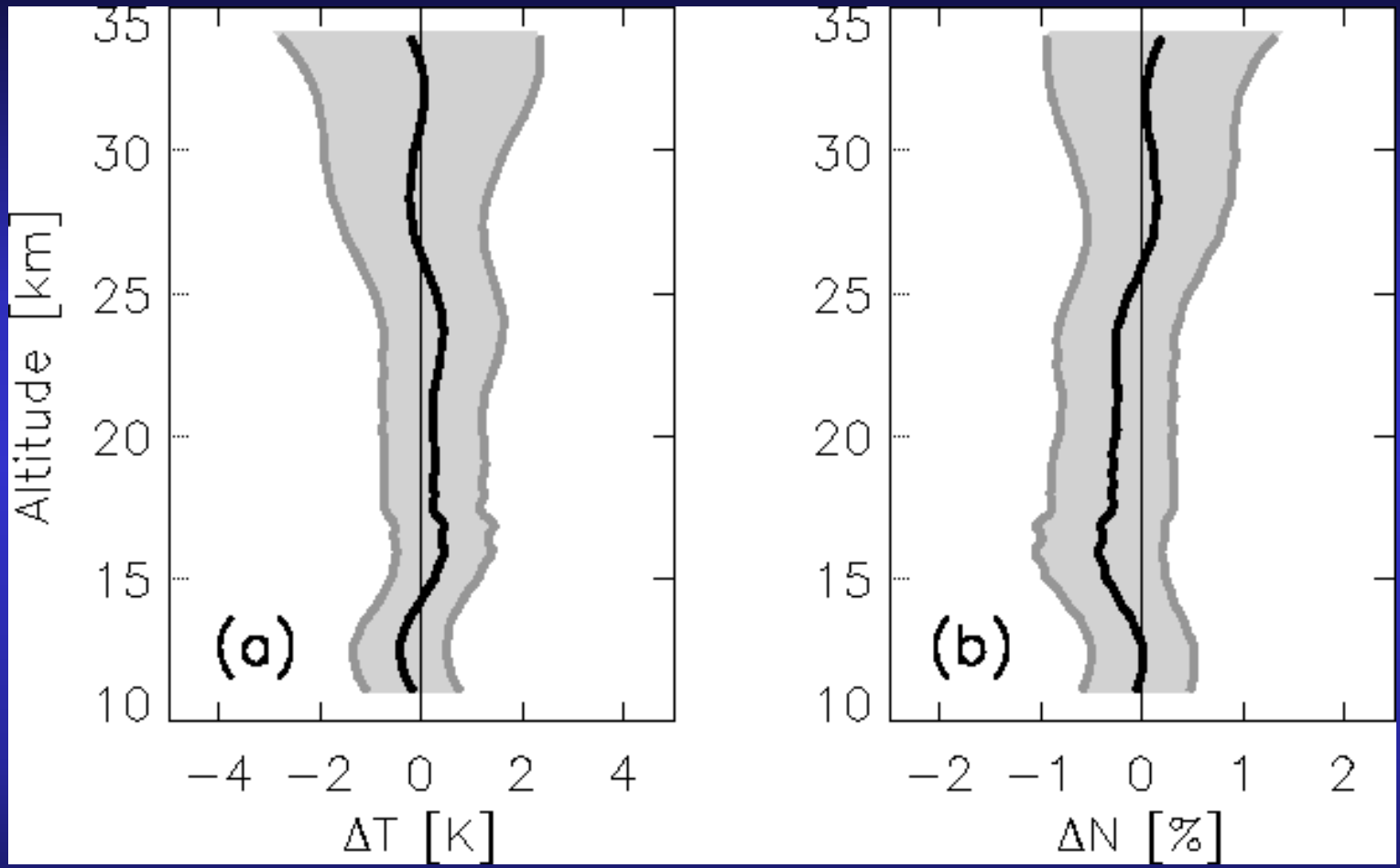
CHAMP

Radiosondes 03/2002 – 2003



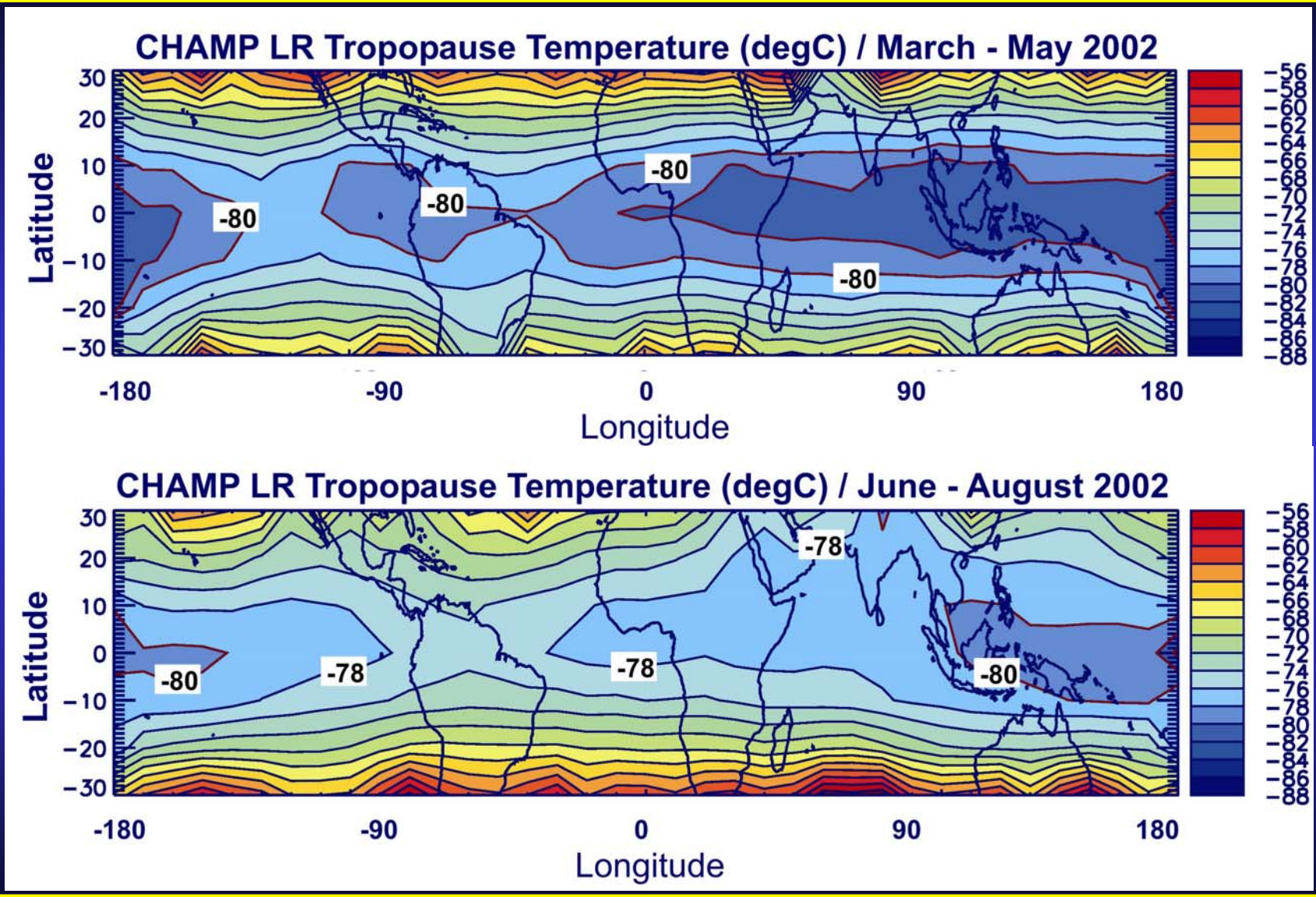
Δd < 300 km
Δt < 3 h

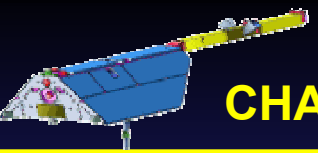
Comparison with ECMWF



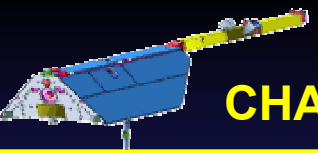
46,000 CHAMP profiles March-Dez 2002

Tropical tropopause temperature



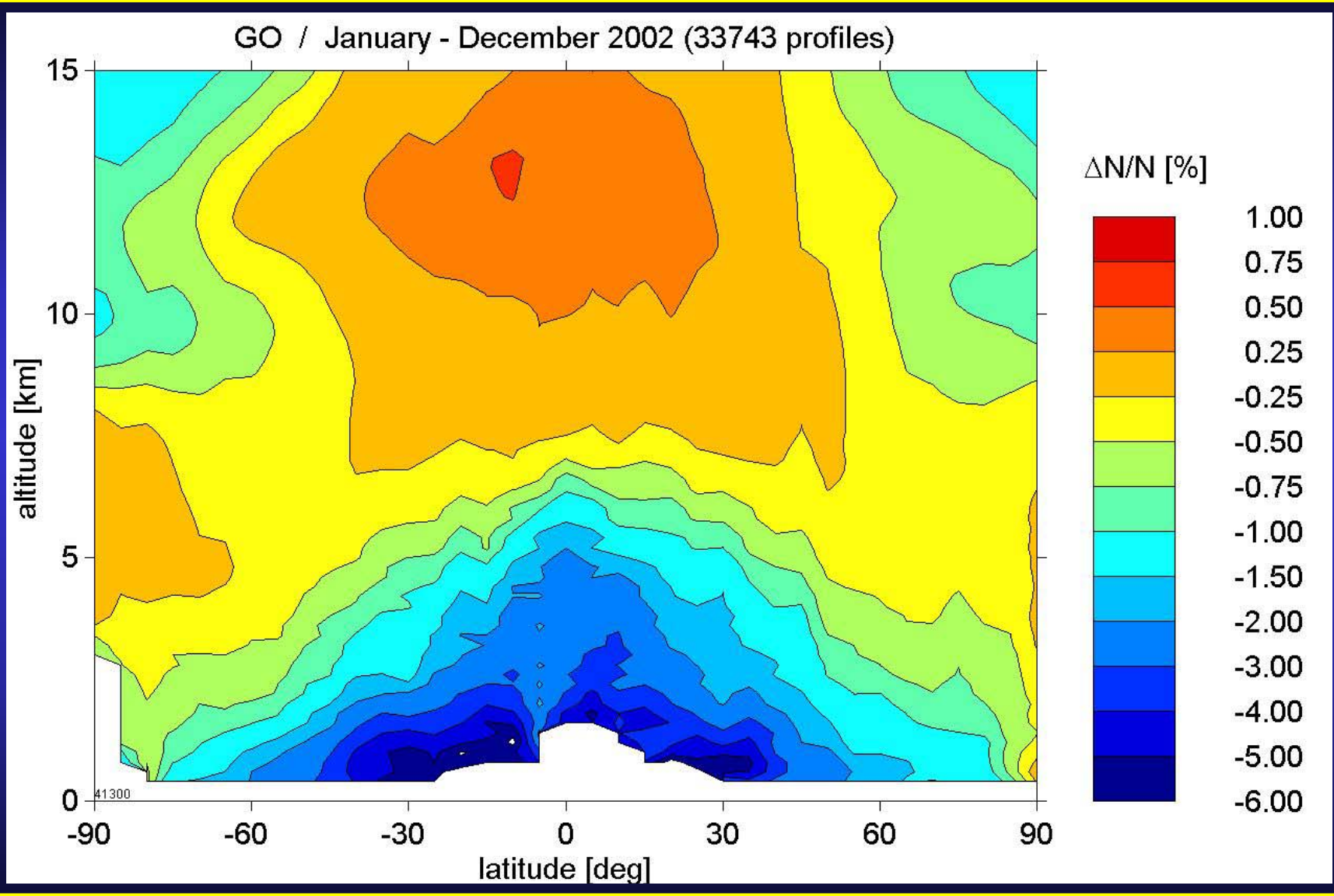


Lower troposphere refractivity bias

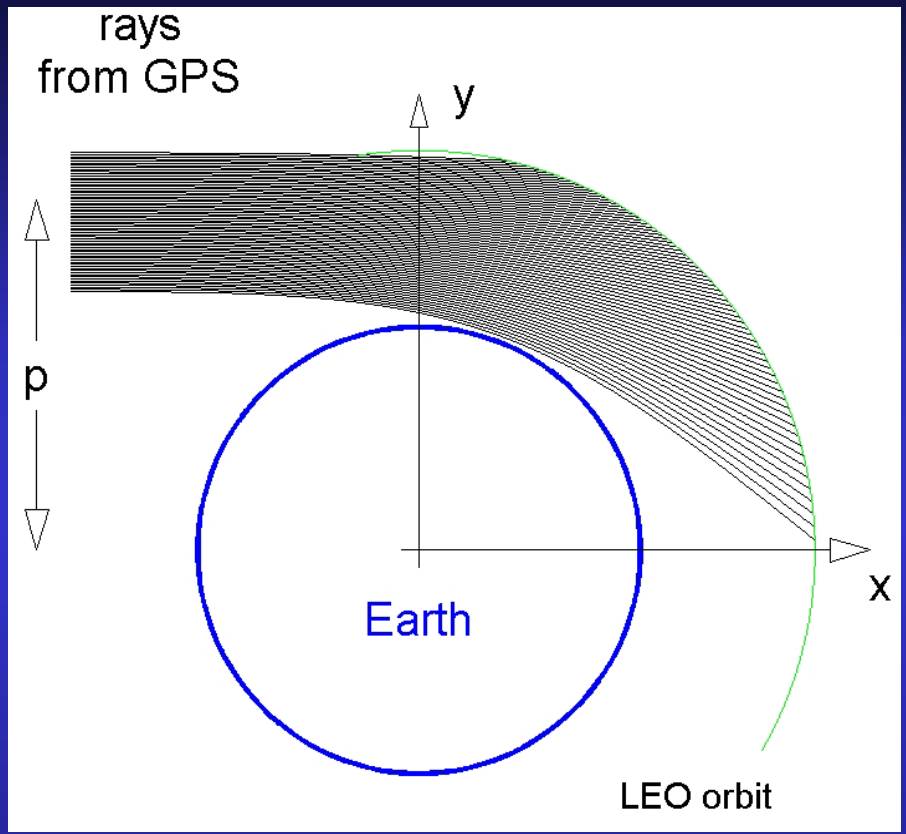


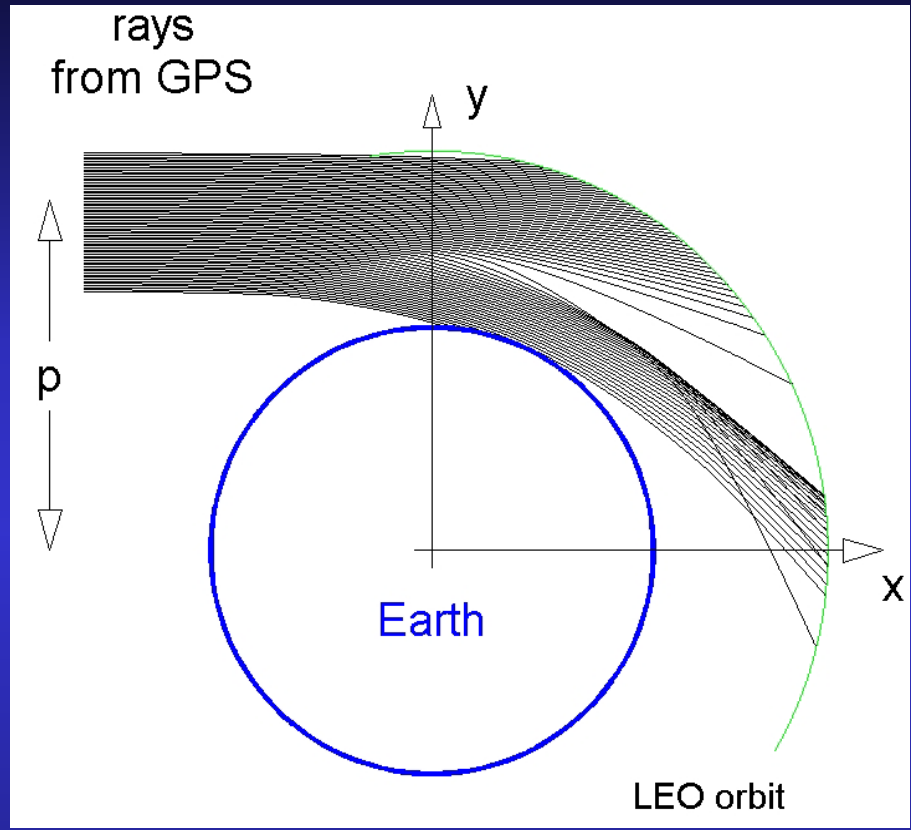
CHAMP

Fract. refractivity bias (GO)



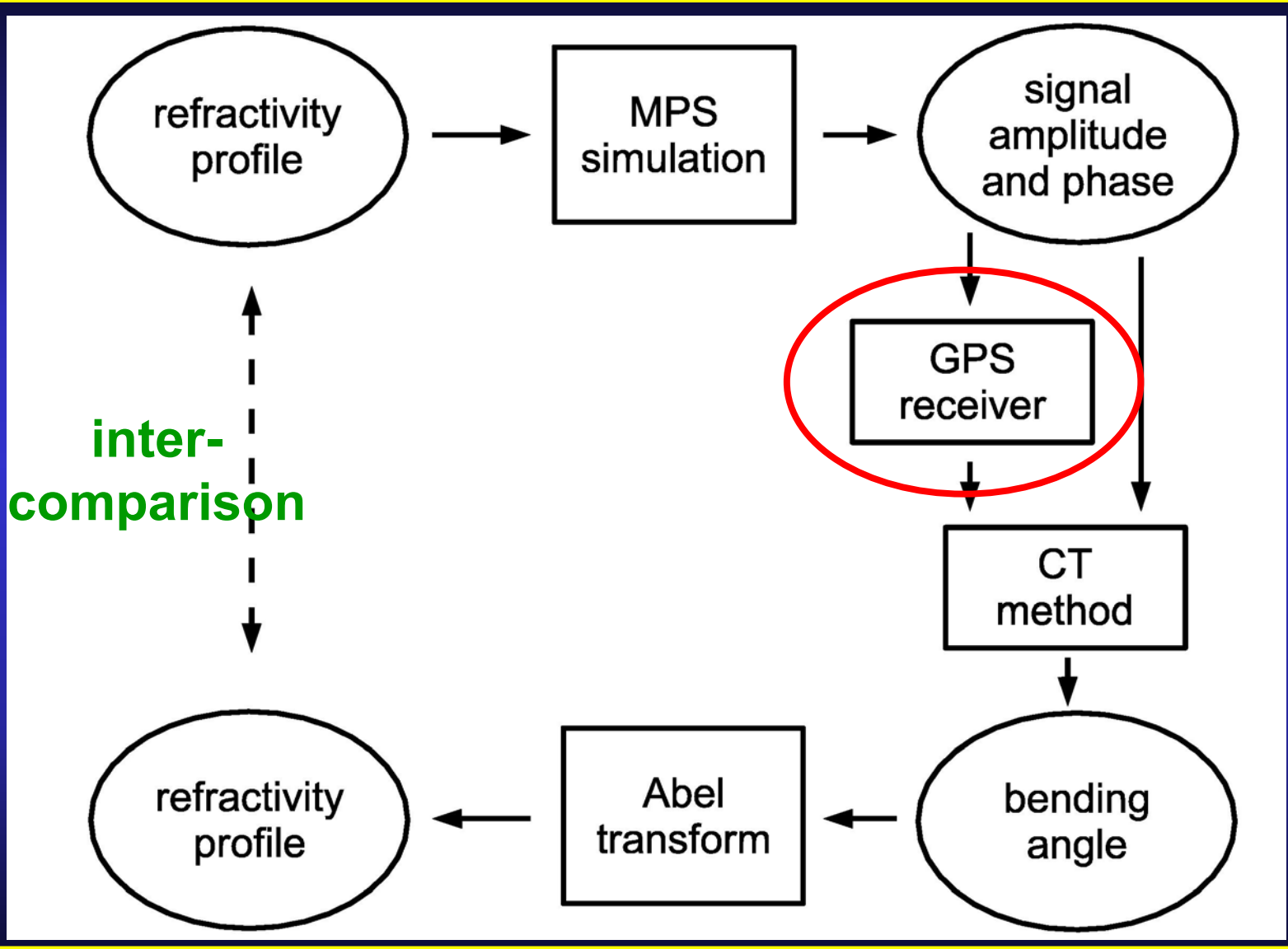
Causes for neg. refractivity bias



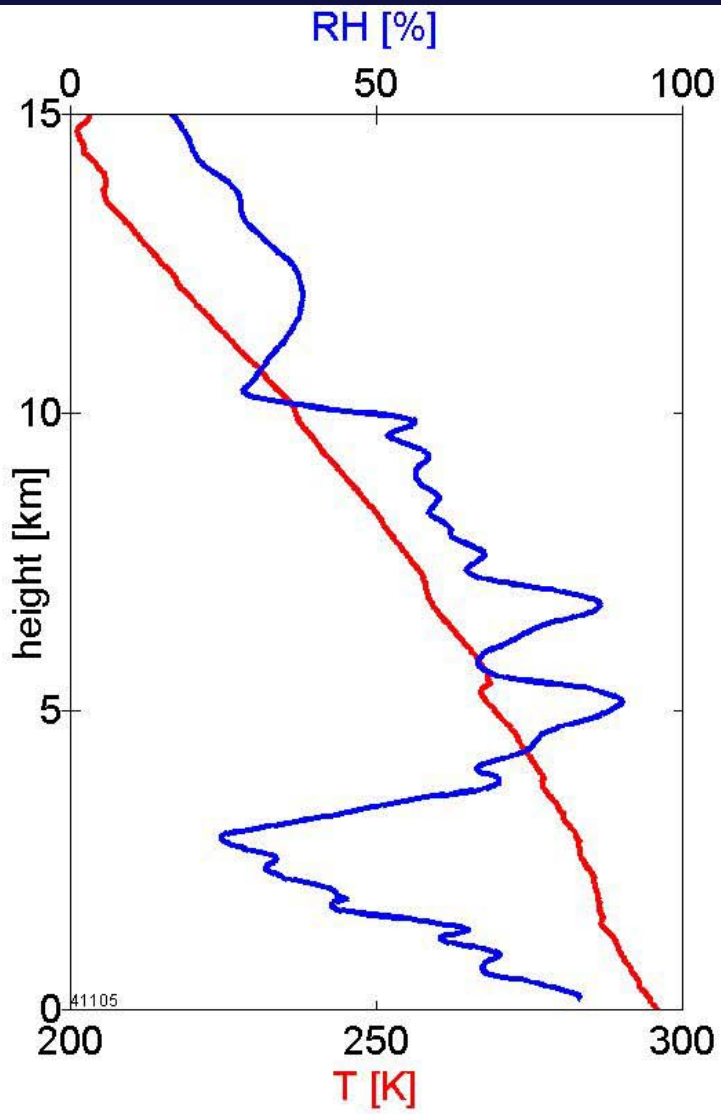


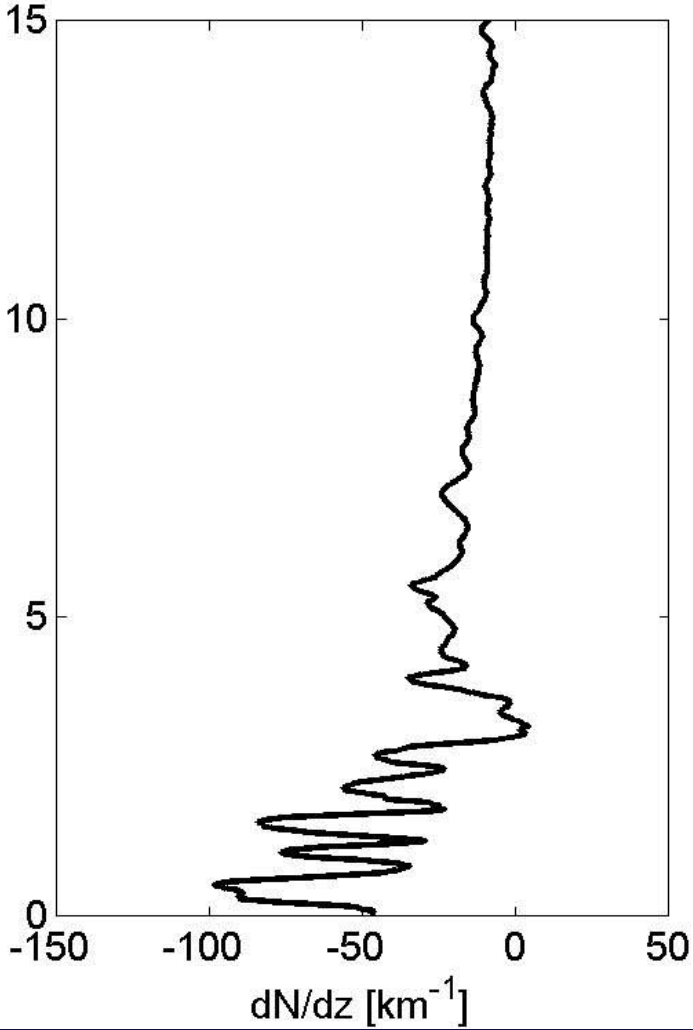
- *multipath ray propagation*
- *signal loss due to critical refraction ($dN/dz < -157\ km^{-1}$)*
- *receiver tracking errors*

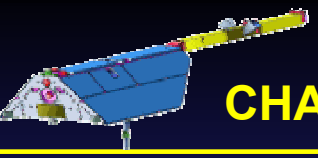
Simulation chain



CHAMP *Radio sonde profile (23.1°S, 26.0°W, 29 Oct. 1996*

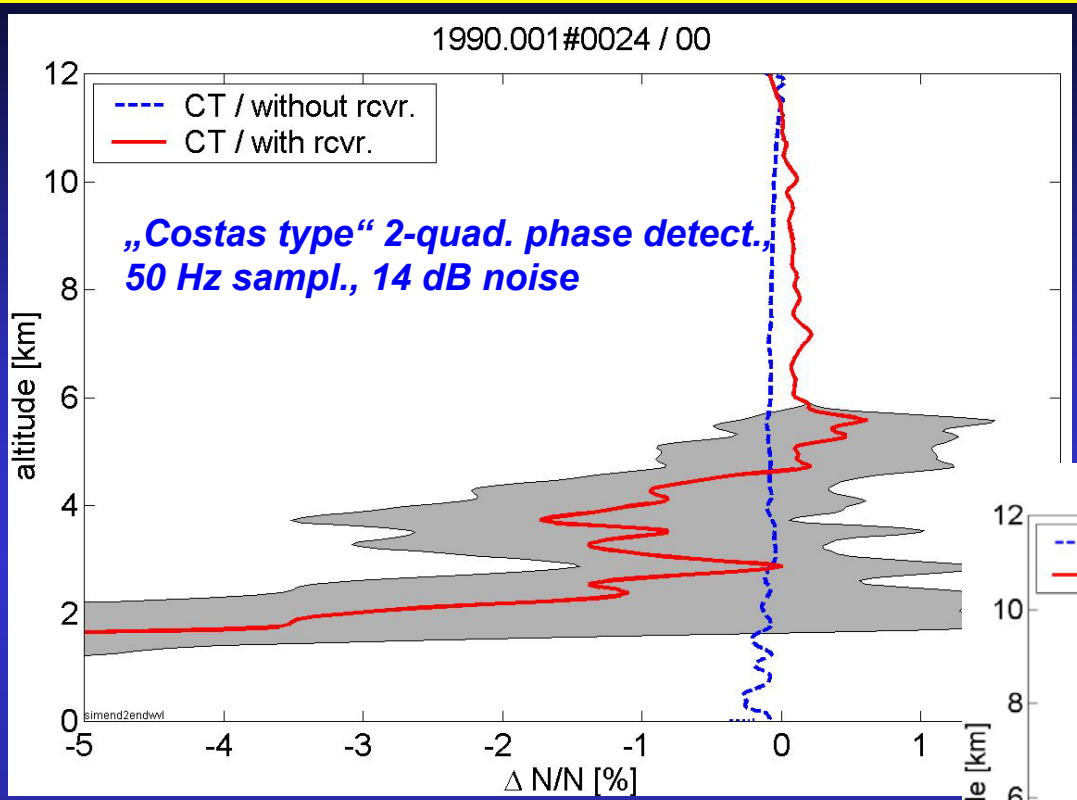


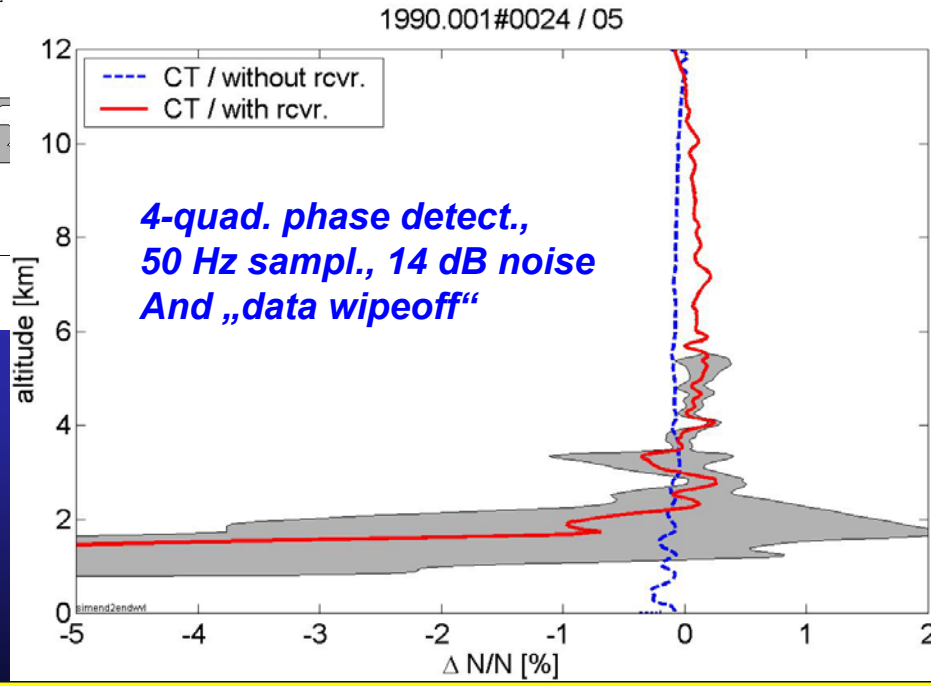




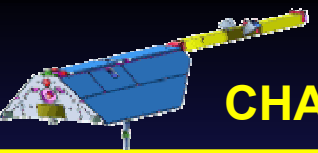
CHAMP

Influence of the GPS receiver tracking



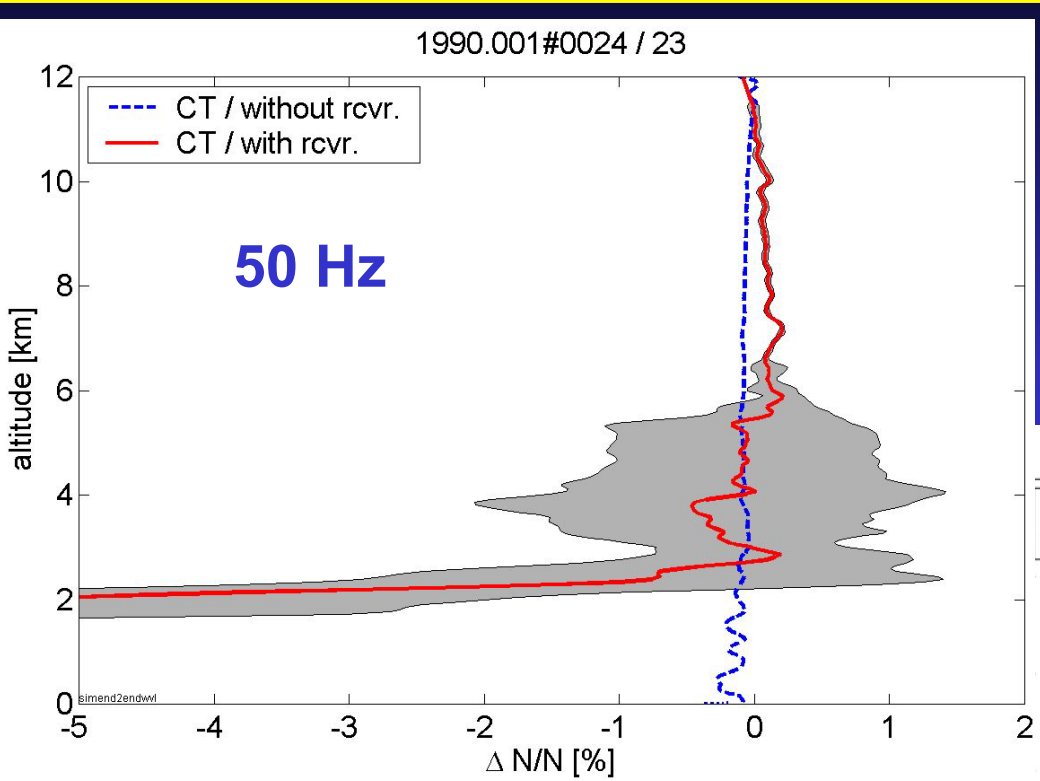


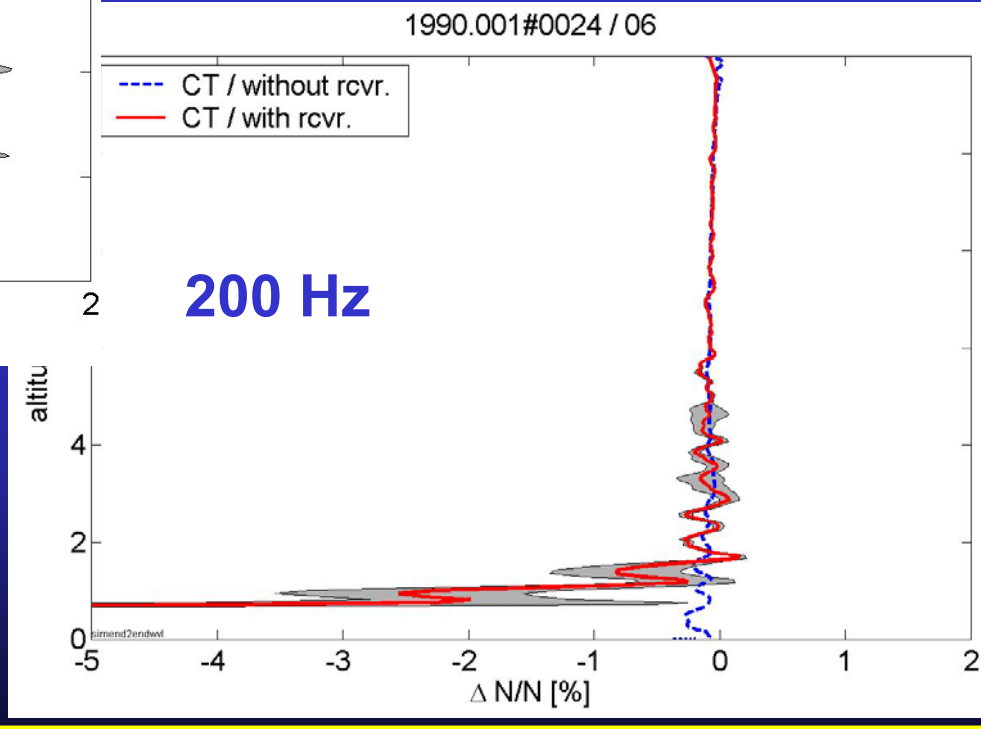
! Planetary boundary layer



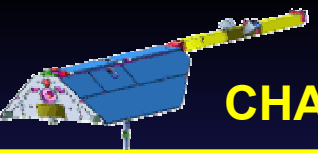
CHAMP

Influence of the GPS receiver tracking



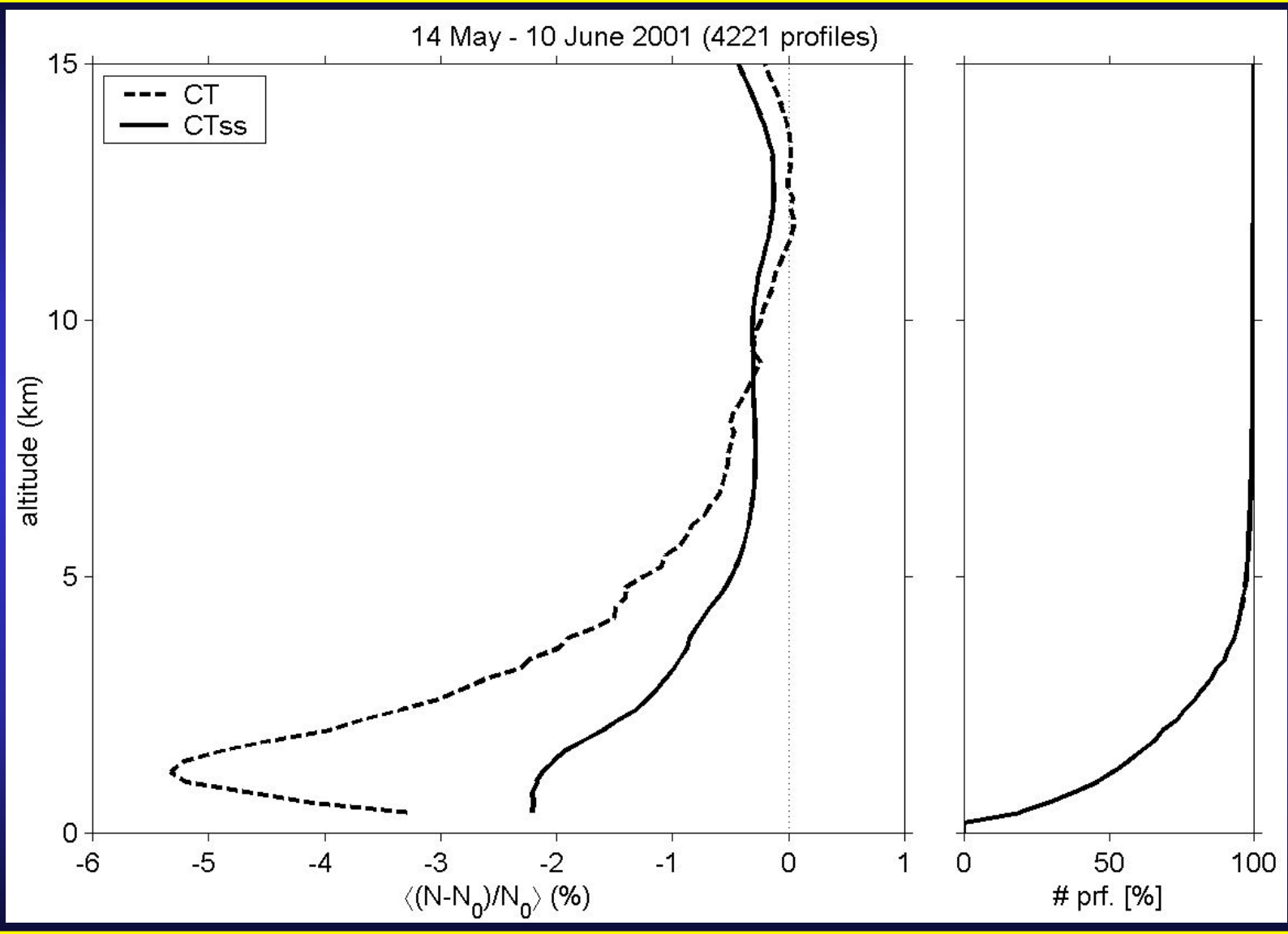


Tracking frequency

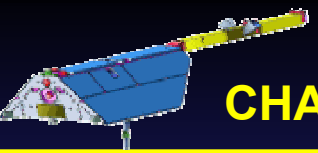


CHAMP

Average fractional refractivity bias

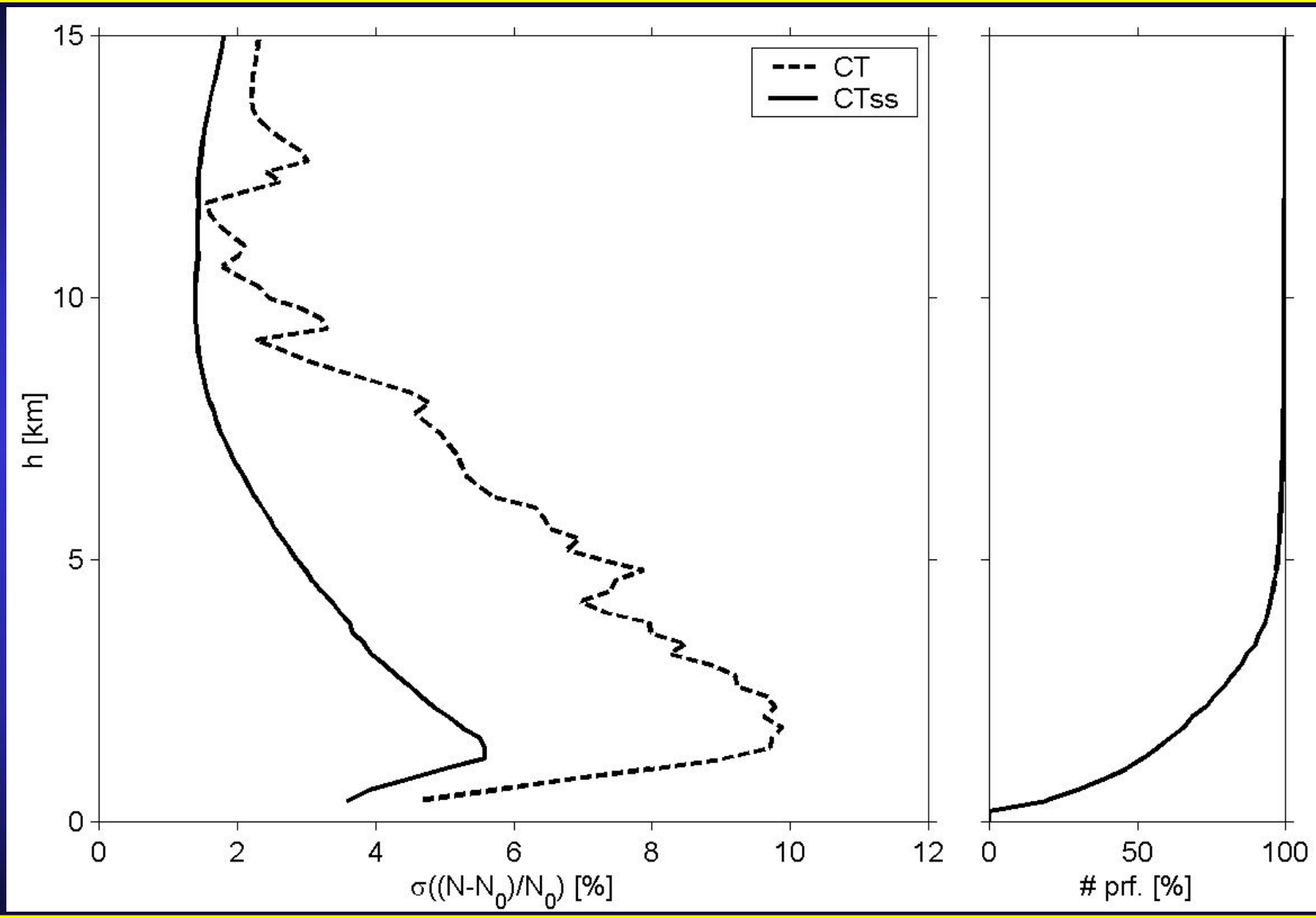


GFZ POTSDAM



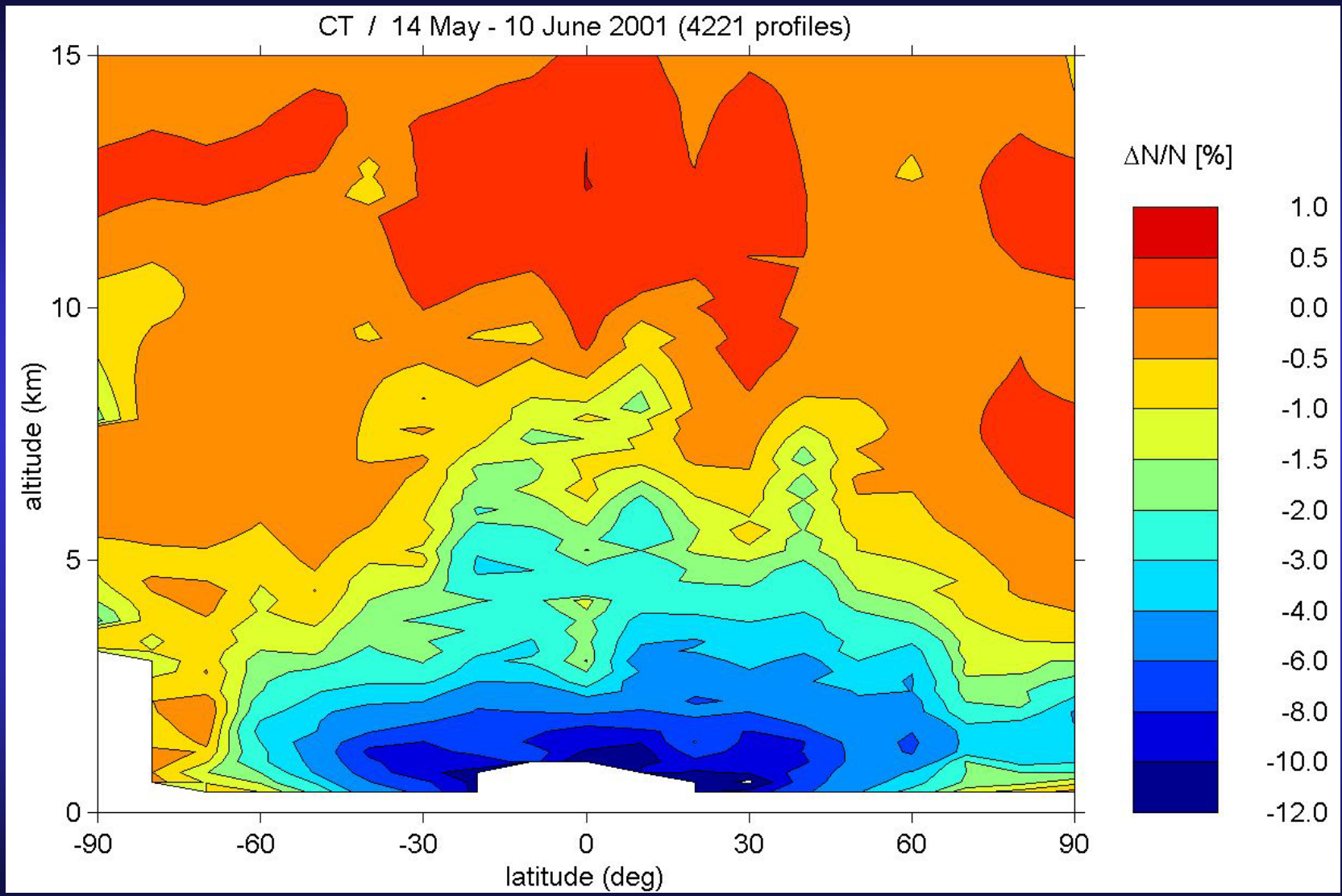
CHAMP

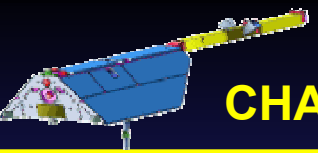
Frac. refractivity standard deviation



GFZ POTSDAM

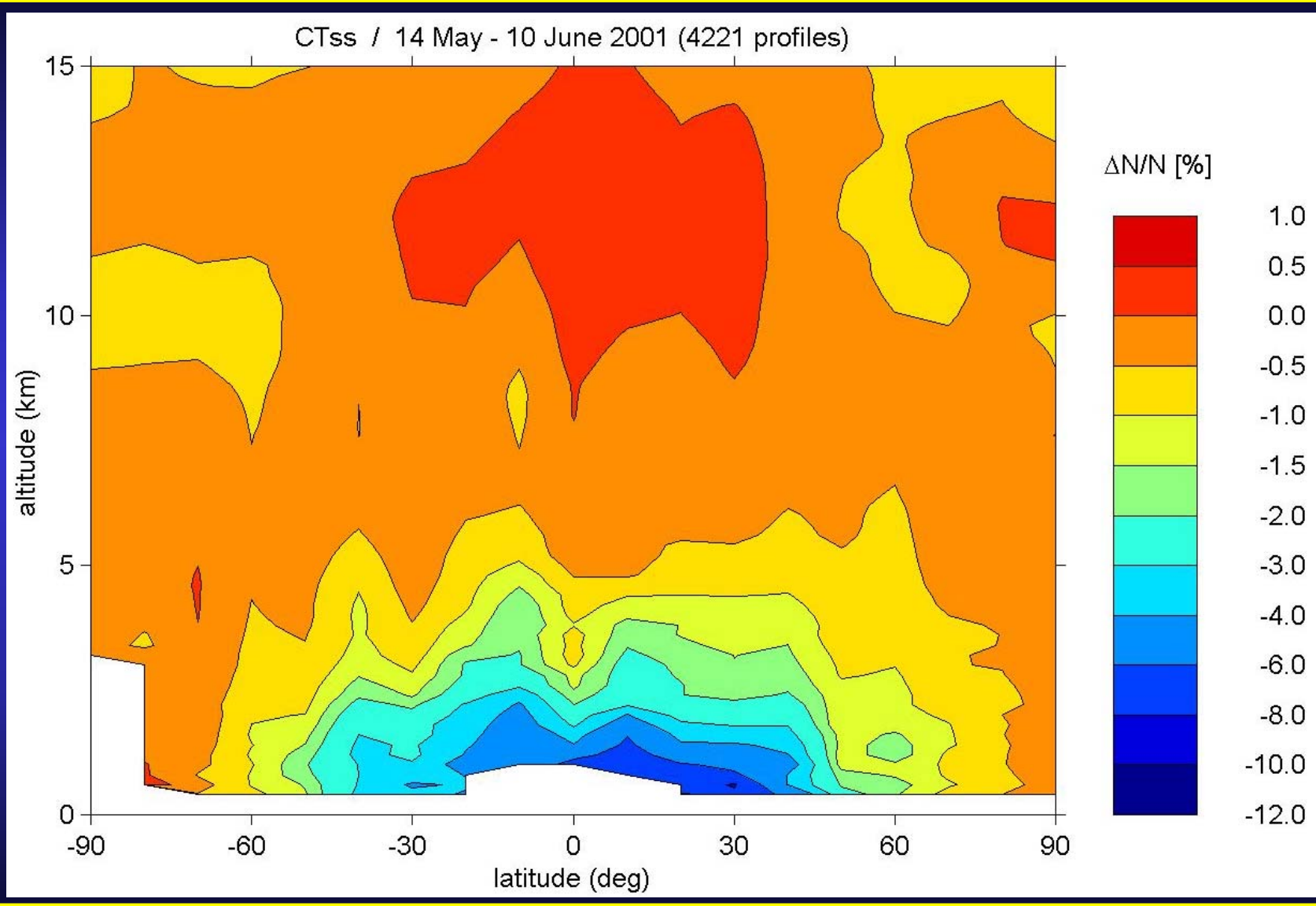
Fractional refractivity bias (CT)

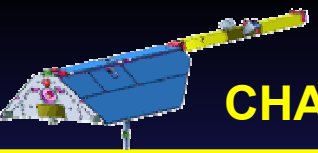




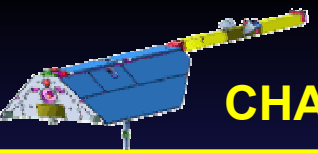
CHAMP

Fractional refractivity bias (CTss)





Operational data processing (Data provision via: http://isdc.gfz-potsdam.de



CHAMP data products

CH-AI-1-HR	Occultation measurements from CHAMP
CH-AI-1-FID	Fiducial network data
CH-AI-2-TAB	List of daily occultation events
CH-AI-2-PD	Atmospheric excess phase for each occultation event
CH-AI-3-ATM	Vertical atmospheric profile (dry atmosphere assumed)
CH-AI-3-WVP	Water vapor profile
CH-OG-3-RSO	Rapid Science Orbit data for CHAMP and GPS satellites

Home
Scientific Products
Authorization
Retrieval
Download
Delivery
Monitoring

CHAMP ISDC Project

I II III IV
Hierarchy Level

Search Engine

Challenging Mini-Satellite Payload
for Geoscientific Research and Application
Information System and Data Center

Important Project Information you find within the Home and News section.

Use one of these Internet Browser.

Retrieval

Atmosphere & Ionosphere Products

Level 1

Level 2

Level 3

Level 4

Free Selectable

I II III IV
Hierarchy Level

Search Engine

Public Area Grant

CH-AI-3-ATM
Vertical Profiles of Atmospheric Parameters

Public Retrieval Area

Detailed information about your specific requested product are provided in the appropriated *Product Description* and *Data Format* documents.

Please enter qualifiers in the fields below and press the **Search** button.

Search | Reset | Home | Spatial Search

Projection: Geographic

Longitude[°]:		...	179.99
Latitude[°]:		...	89.87
Altitude[km]:	0.20	...	145.69
Occultation No:			
Revision:	- All -		

use wildcard * (many chars) or ? (one char only) below

Entry Id: CH-AI-3-ATM*

☑ use time period below

Map Server - Microsoft Internet Explorer

Datei Bearbeiten Ansicht Favoriten Extras ?

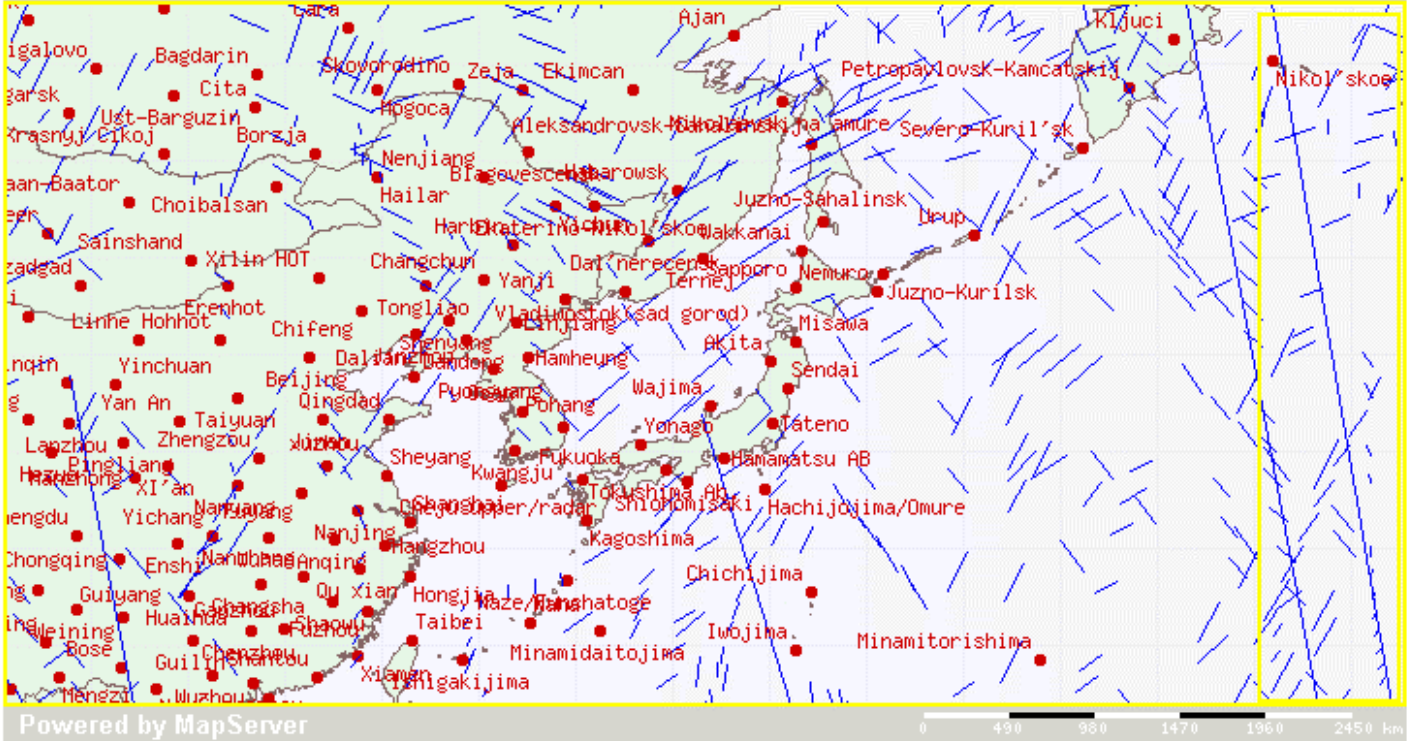
Zurück Suchen Favoriten Verlauf

Links SP RZ n-tv com CNN HTM Go GFZ LEO GASP bibo_pots ARBEIT COMPUTER EINKAUF FOTO&VIDEO

Adresse http://dc.gfz-potsdam.de/0/isdc/sr Wechseln zu

Public Retrieval Area

Autosubmit | DIF | XML | Pic. | Radiosondes



Legend

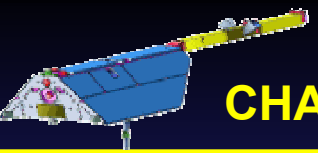
- CH-AI-3-ATM
- Radiosonde Stations

Current Boundary Coordinates: 100.75 22.00 172.75 50.00

Selected Boundary Coordinates:

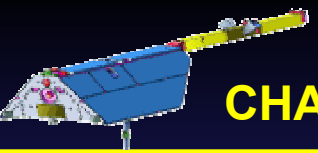
(165.25, 22) dd

Internet



Summary

- *Quasi-continuous provision of GPS occultation data and analysis results, (operational CHAMP processing of CHAMP data at GFZ Potsdam since February 2001), more than 120,000 atmospheric profiles available, recent status via WWW (GPS Atmosphere Sounding Project homepage), first long term RO data set expected*
- *Demonstration of „Near-real-time“ occultation processing, av. 5h delay*
- *Demonstration of advantageous consequences of the Termination of SA (Acquisition rate GS, Space based single differencing)*
- *Improvements of processing software based on various validation activities with focus to the lower troposphere (current version 004 available via ISDC at GFZ, 005 in preparartion)*
- *Continuation of the GASP work within the Helmholtz's society research program "Atmosphere and Climate" (ground and space based activities)*
- *Last but not least: CHAMP Science Meeting (September 1-4, 2003)*



CHAMP

GPS radio occultation missions

	Sat
CHAMP	1
GRACE	2
TerraSAR-X	1
SAC-C	
GPS / MET	
COSMIC	6
METOP	3
NPOESS	3
ACE+/SWARM	(3-6)

With GFZ Potsdam

pioneering

1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010