O’Higgins as Part of the IGS and CONGO Network

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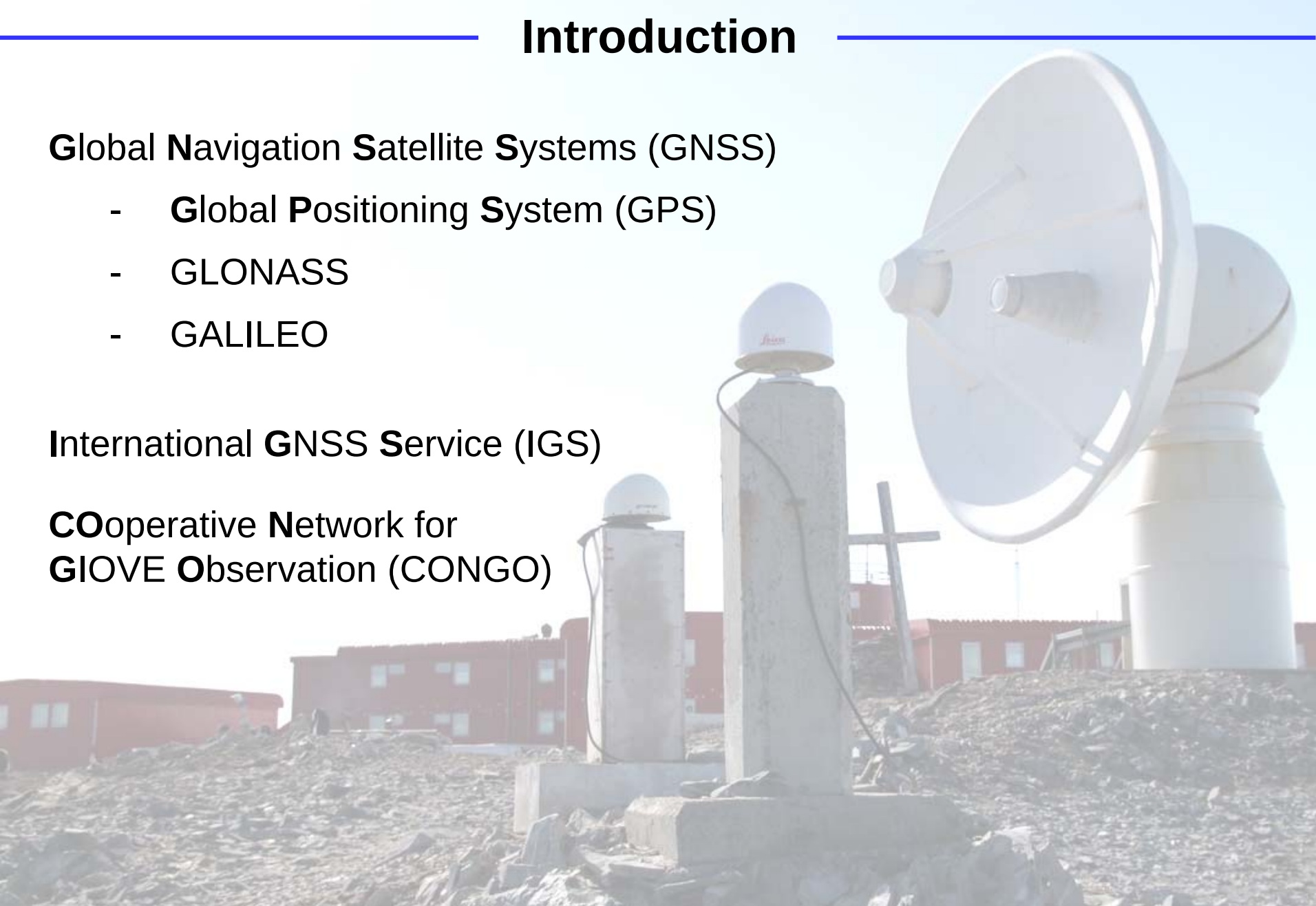
Introduction

Global **N**avigation **S**atellite **S**ystems (GNSS)

- **G**lobal **P**ositioning **S**ystem (GPS)
- GLONASS
- GALILEO

International **G**NSS **S**ervice (IGS)

COoperative **N**etwork for
GIOVE **O**bservation (CONGO)



Current GNSS Status

GPS:

- 31 active satellites
- Modernization of the system (L2C, L5)

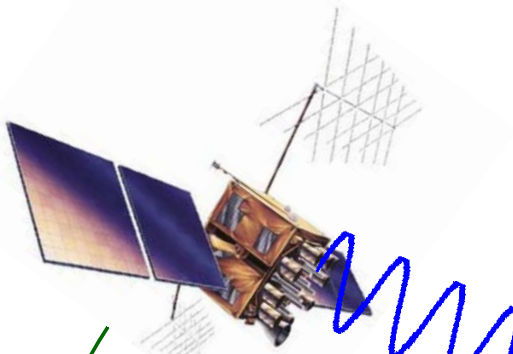
GLONASS:

- 24 active and 23 healthy satellites
- Completion and modernization of the system (L3, CDMA)
- Triple launch on 4 November 2011, not yet active

GALILEO:

- 2 **G**alileo **I**n **O**rbit **V**alidation **E**lement (GIOVE) satellites
- 2 **I**n **O**rbit **V**alidation (IOV) satellites launched, not yet active
- 2 IOV launches in 2012
- 14 further satellites until 2014

What can we do with GNSS?

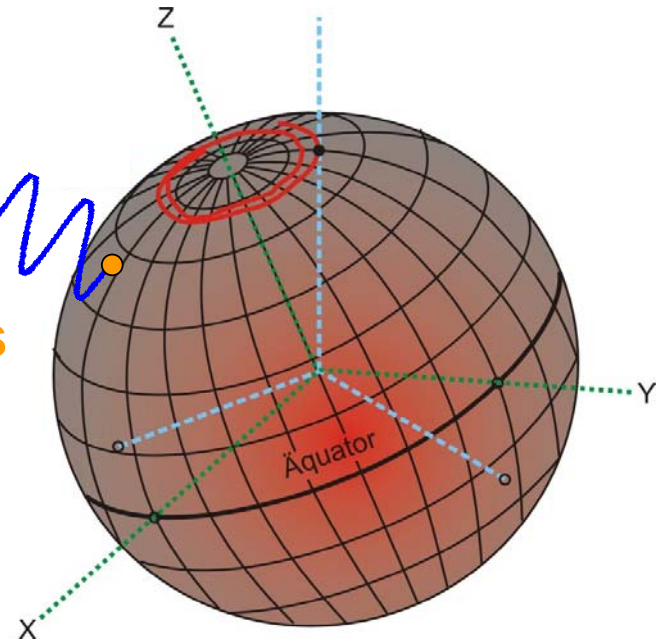


Atmosphere

Earth Rotation Parameters

Satellite Orbits and Clocks

Station Coordinates and Velocities



Why GNSS at O'Higgins?

- **Global coverage** of the tracking network is essential for GNSS orbit and clock determination
- **Real-time data streaming** for generation of near real-time products
- **Co-location** with geodetic VLBI (Very Long Baseline Interferometry): important for realization of the International Terrestrial Reference System (ITRS), currently ITRF2008
- **Geophysical studies**: plate tectonics, glacial isostatic adjustment, loading effects, …
- **Water vapor determination** (together with meteorological sensors)
- Mandatory for determination of **absolute sea level trends** with tide gauges (geometric uplift of the station)
- **Reference station** for regional projects, e.g., GPS sea level and sea-state measurements for JASON validation

GNSS History at O'Higgins

OHIG

- first GPS station
- operating from Feb. 1995 till Feb. 2002

OHIZ

- first GPS/GLONASS station
- operating from Feb. 2001 till Jan. 2003

OHI2

- replacement for OHIG in Feb. 2002
- upgraded to GPS/GLONASS in Nov. 2007

OHI3

- replacement for OHIZ in Feb. 2003

OHIX

- connected to OHI3 antenna in Nov. 2009
- GPS/GLONASS/GALILEO capable

International GNSS Service (IGS)

"The International GNSS Service provides the highest-quality GNSS data and products in support of the terrestrial reference frame, Earth rotation, Earth observation and research, positioning, navigation and timing and other applications that benefit society."
(IGS Terms of Reference, 2010)

Service of the International Association of Geodesy established in 1994

- Global GNSS **tracking network** (currently 370 active stations)
- **Data Centers** (regional and global)
- **Analysis Centers**:
  - Orbit and clock products with different latency and accuracy
  - Station coordinates and velocities, contribution to ITRF
  - Troposphere and ionosphere parameters

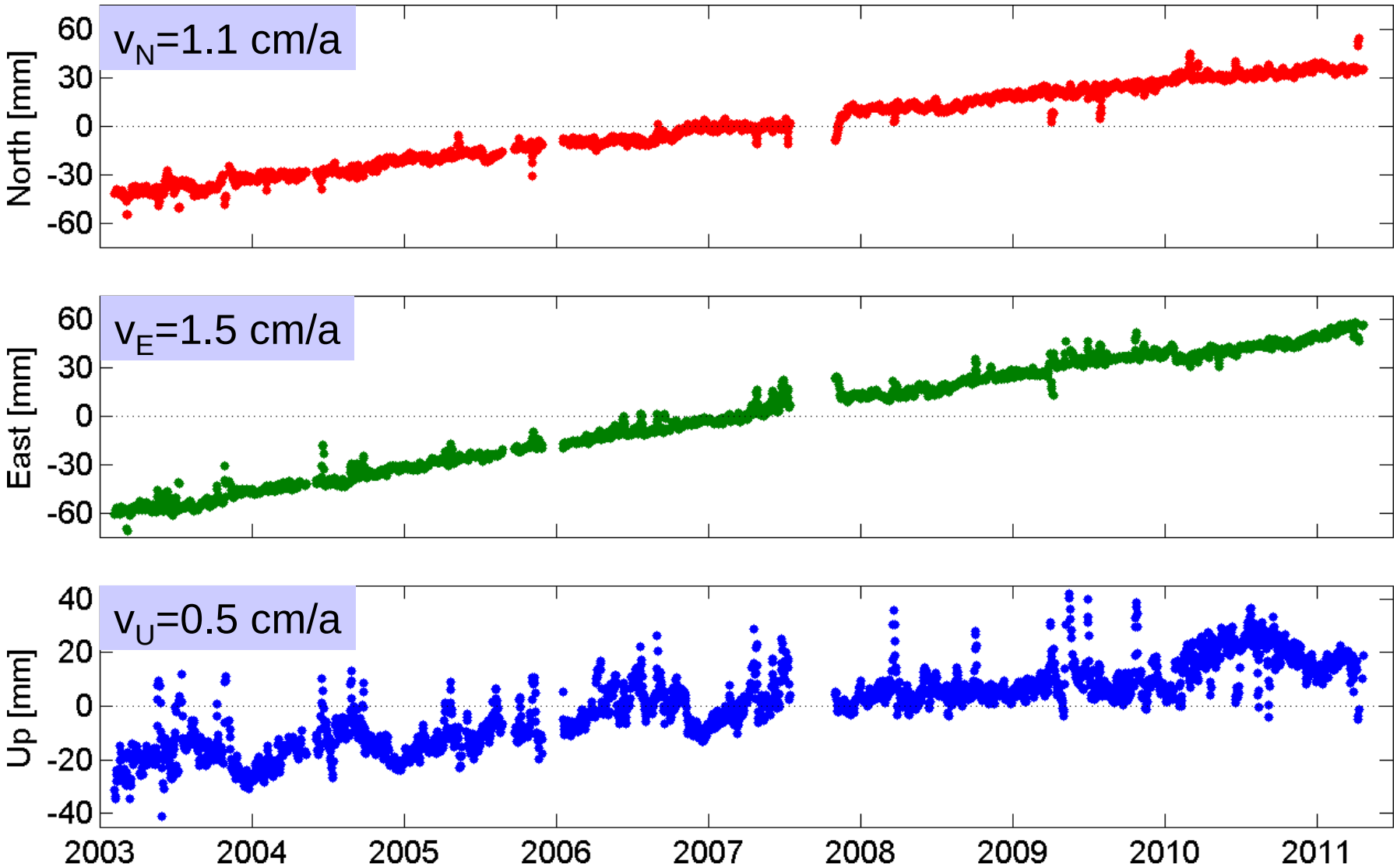
Usage by IGS Analysis Centers

Analysis Center	Final Orbit		Final Clock	
	OHI2	OHI3	OHI2	OHI3
CODE	x	x		x
ESOC	x	x	x	x
GFZ	x		x	
JPL	x	x	x	x
MIT	x	x		x
NOAA	x	x		
NRCan	x			
SIO	x	x		

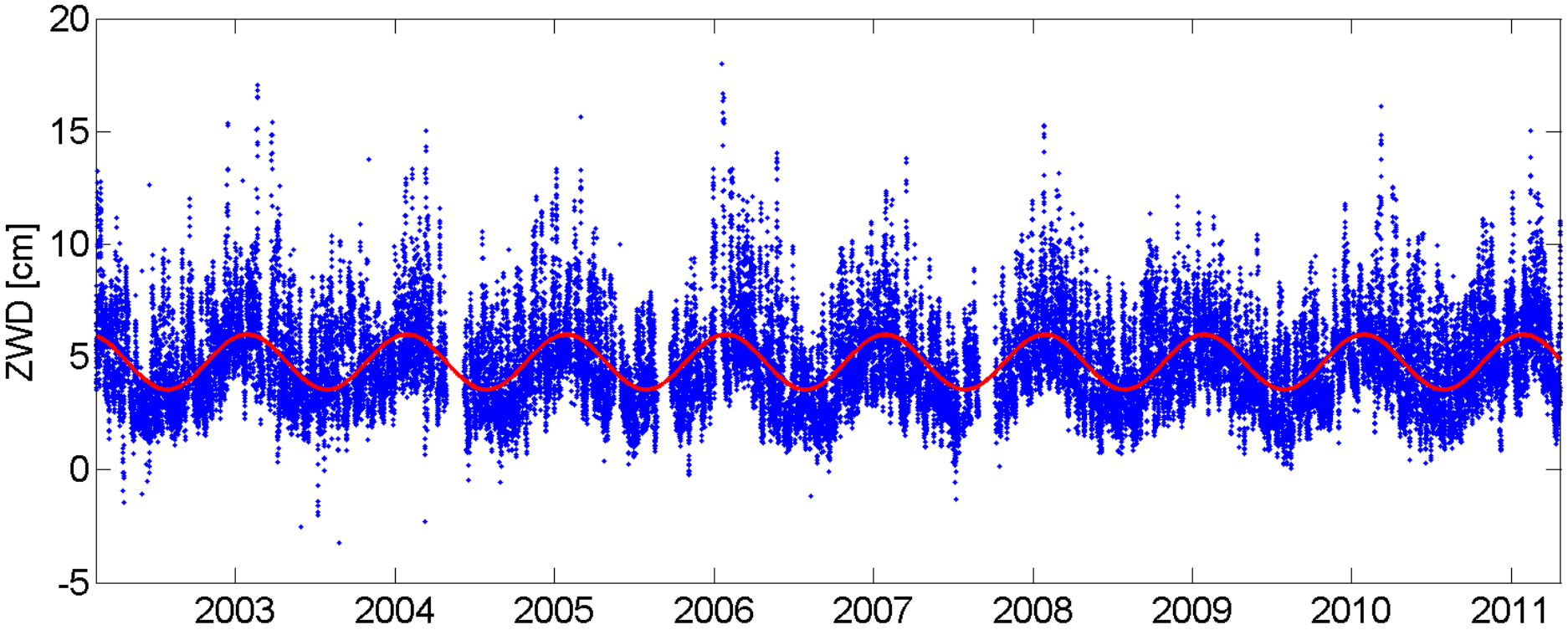
Product not generated by corresponding AC

OHI2, OHI3, and OHIG are IGS08 core stations

OHI3 Coordinate Time Series



Troposphere Zenith Delays



- GNSS-derived 2-hourly troposphere zenith wet delay (ZWD) estimates
- Reprocessed time series of the **C**enter for **O**rbit **D**etermination in **E**urope (CODE, consortium of Uni Bern, swisstopo, BKG, TU München)

COoperative Network for GIOVE Observations

- Global real-time tracking network for GPS, GLONASS and GIOVE signals
- Established in 2009, currently 22 stations
- O'Higgins added in 2010

Jointly operated by

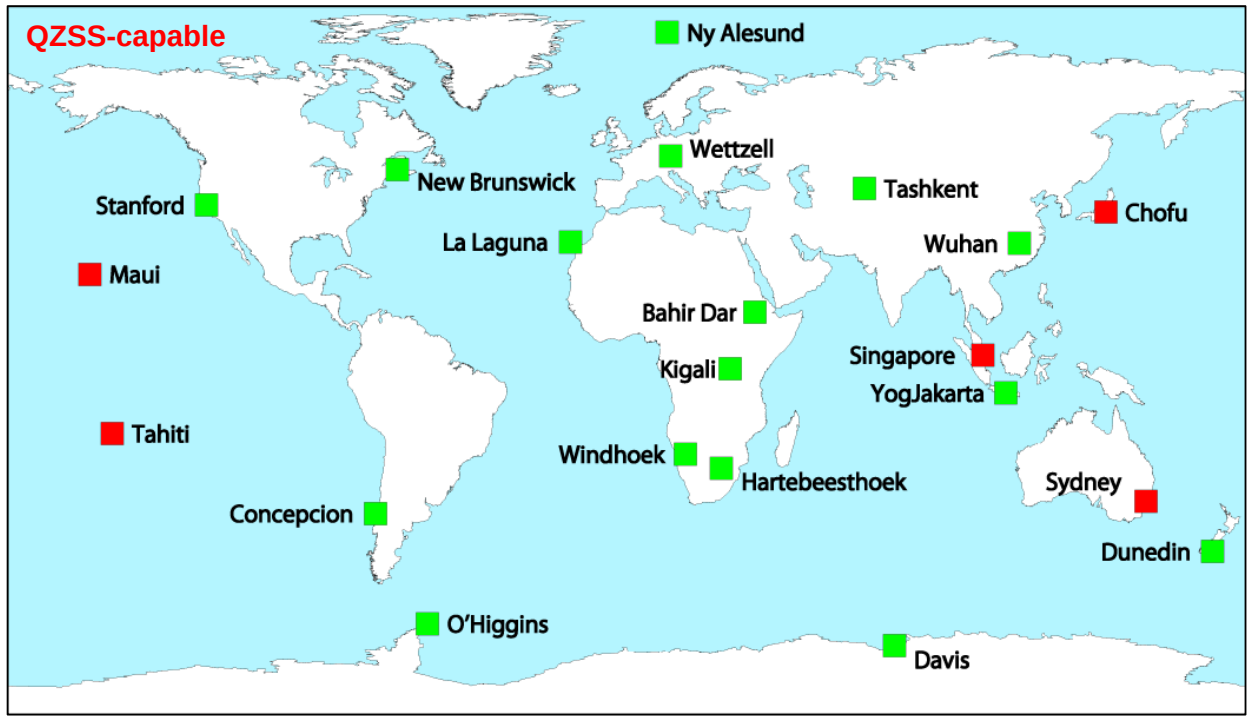
DLR

bkg

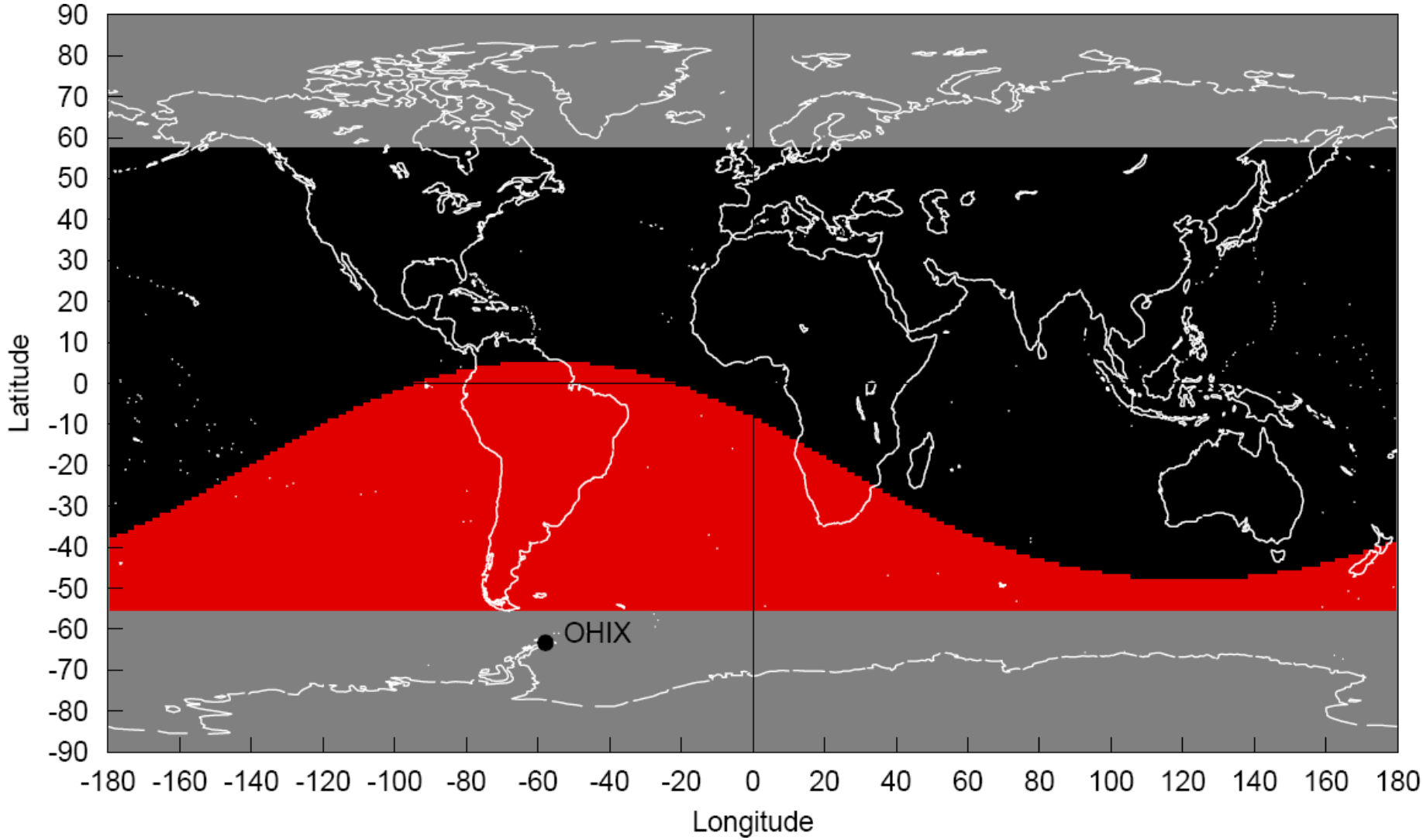
GFZ Helmholtz Centre Potsdam

cnes

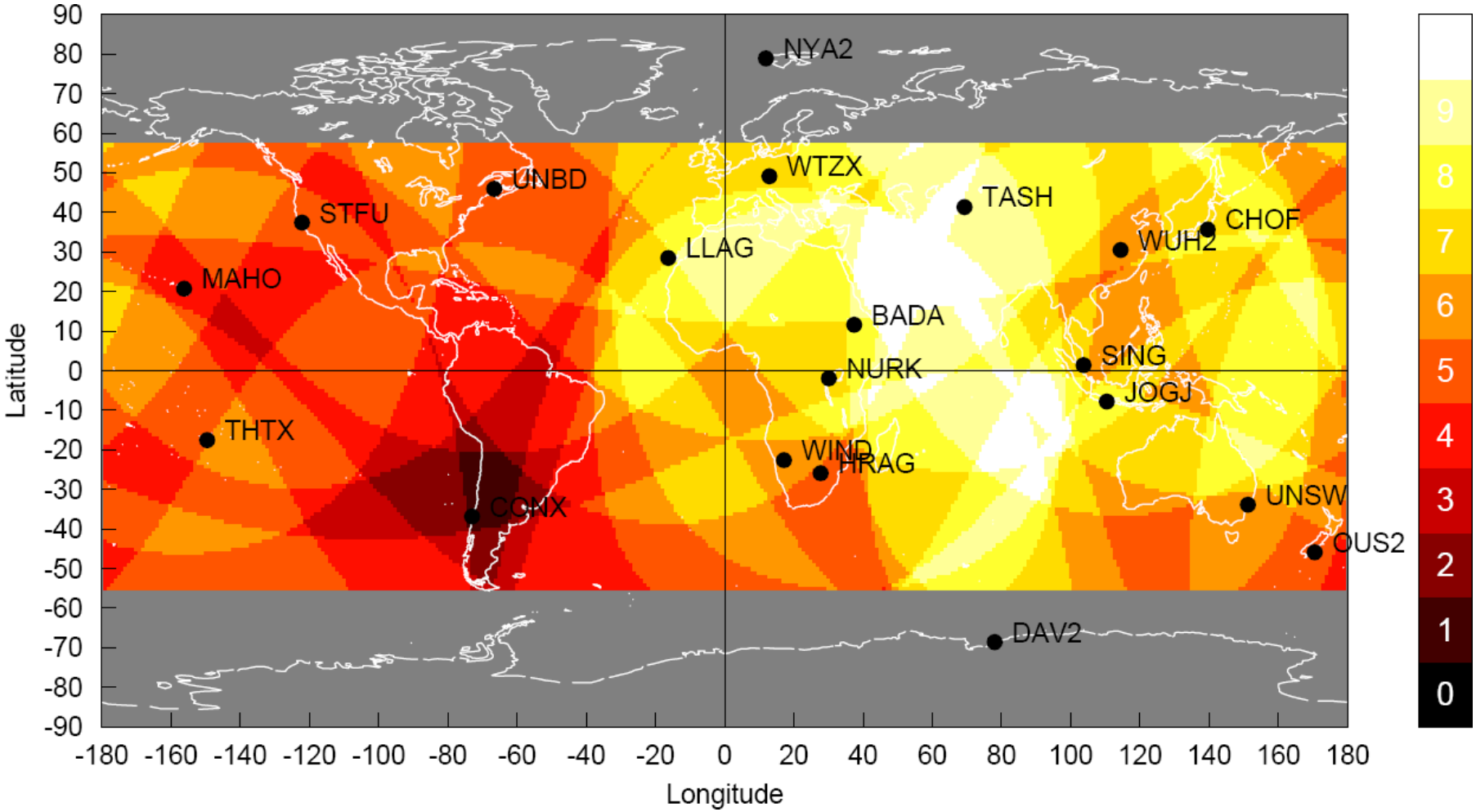
+ local station hosts



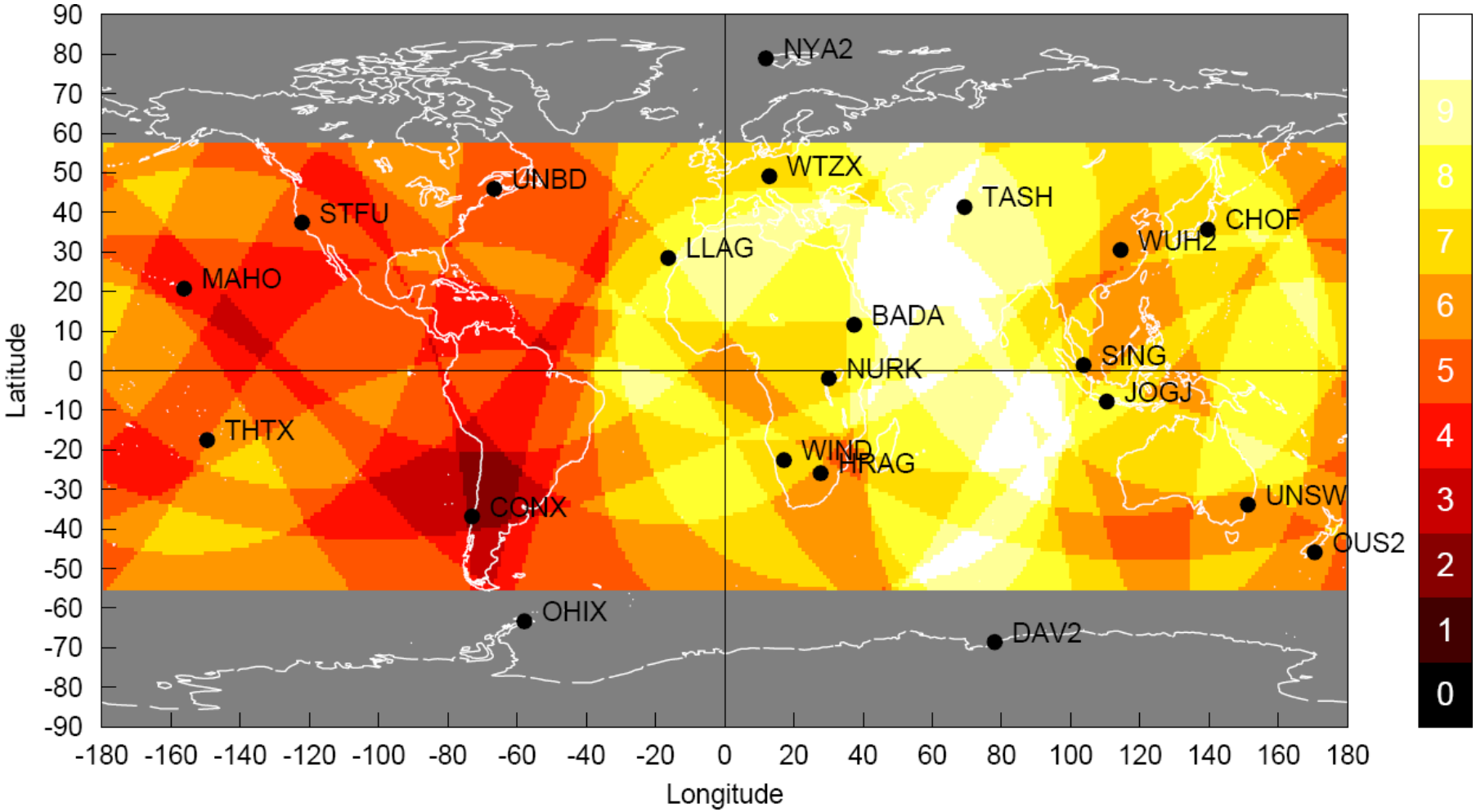
GIOVE/Galileo Visibility from O'Higgins



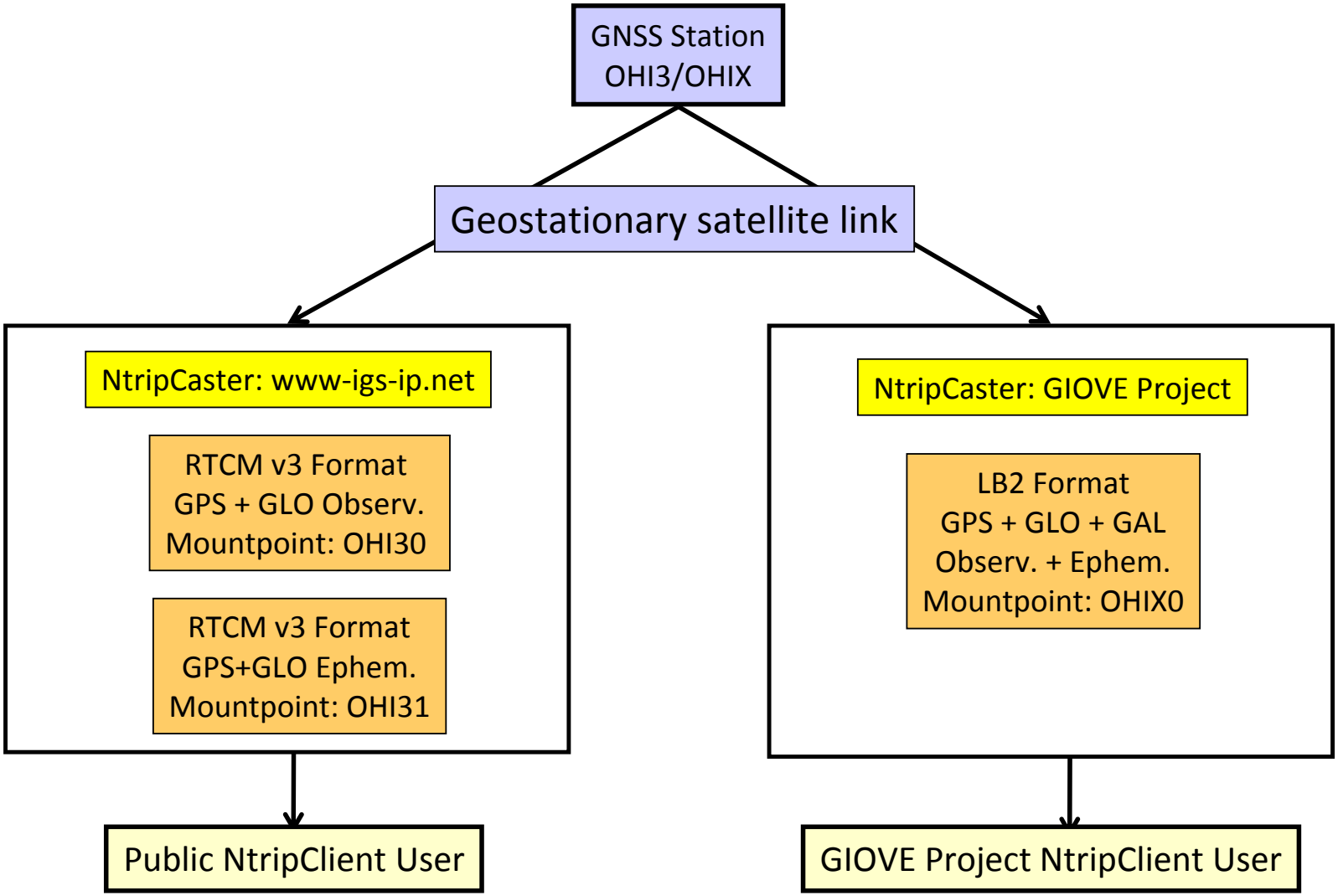
CONGO Depth of Coverage without O'Higgins



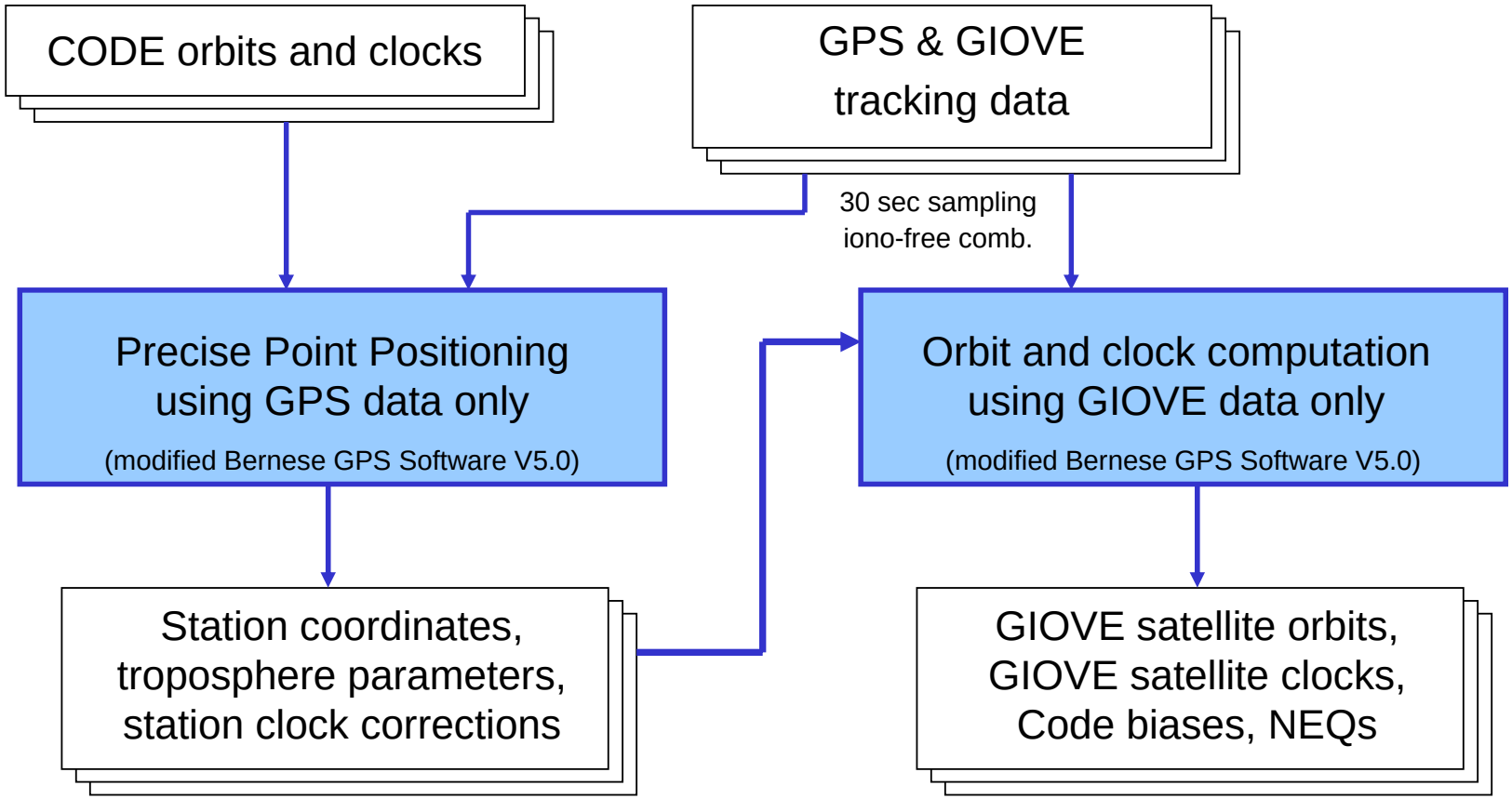
CONGO Depth of Coverage with O'Higgins



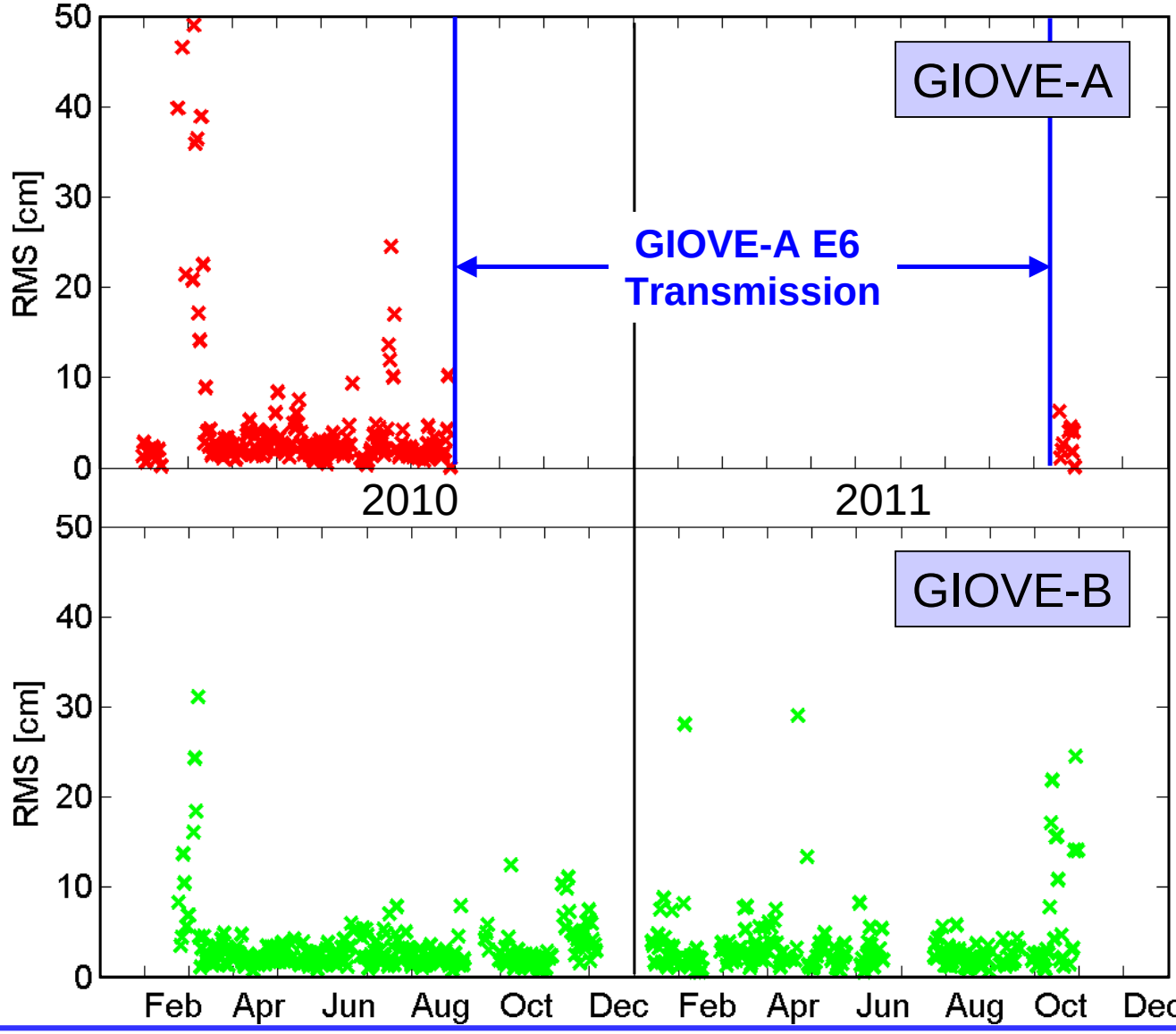
Real Time Data Streaming



Operational CONGO Processing



Internal Consistency: RMS of 2-day orbit fits



Median	2.8 cm
Mean	3.4 cm

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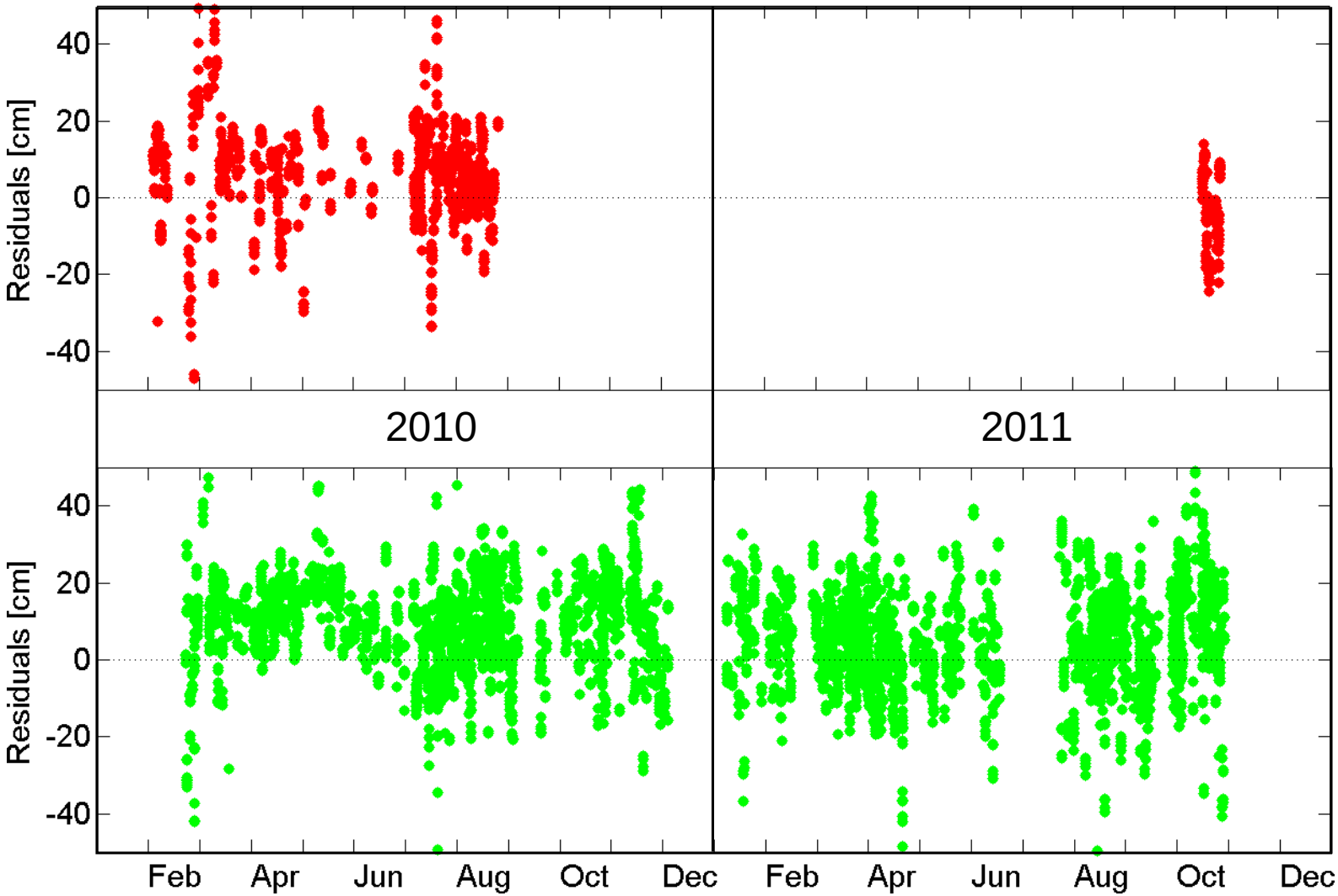
Mean	3.4 cm

Satellite Laser Ranging Residuals



GIOVE-A

Bias
5.2 cm

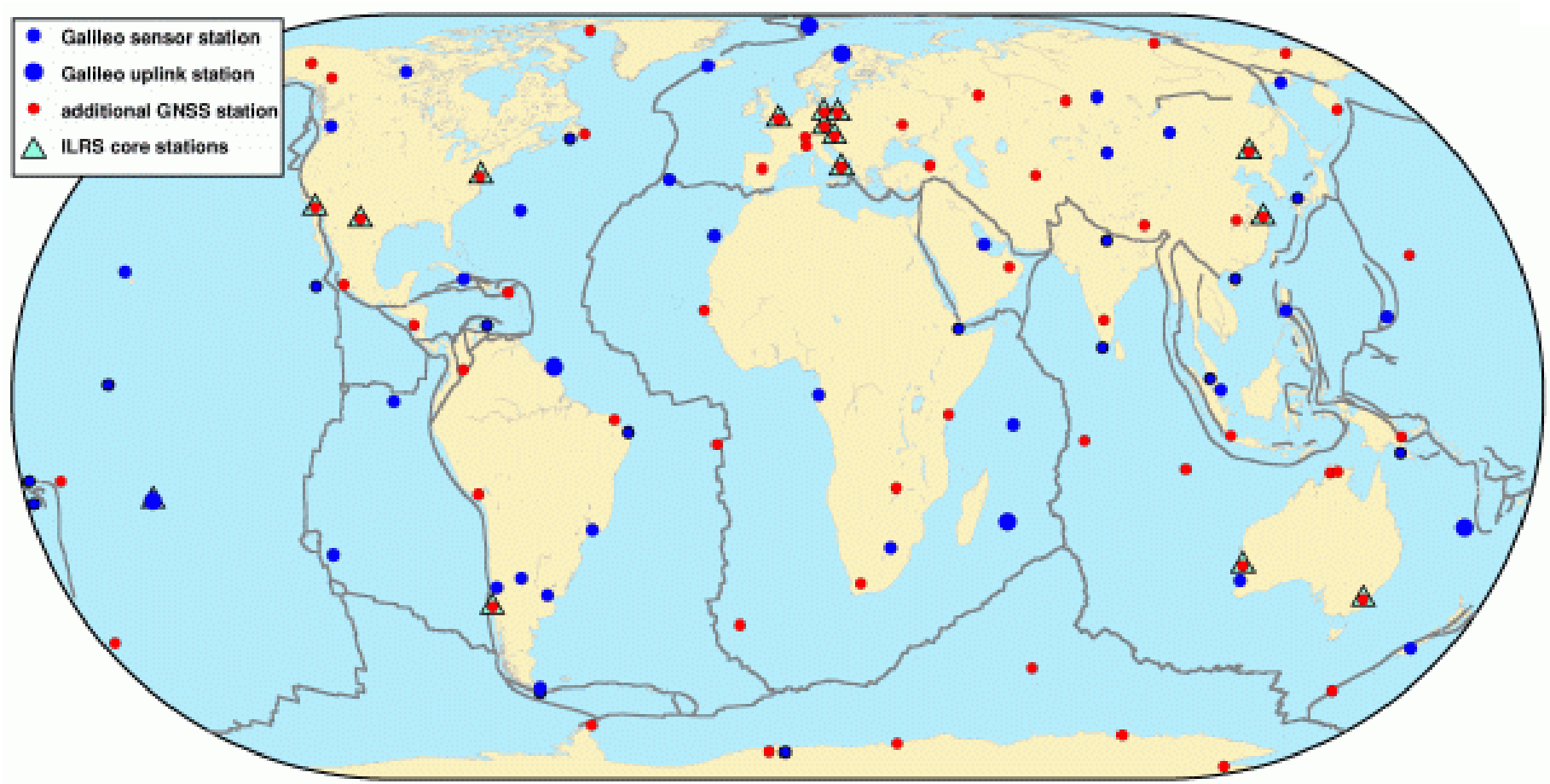
STD
11.6 cm

GIOVE-B

Bias
8.1 cm

STD
12.2 cm

Galileo Terrestrial Reference Frame (GTRF)



Summary and Conclusions

- The **IGS network**
  - provides the basis for the precise orbit, clock, and coordinate products computed by the IGS analysis centers
- The **CONGO network**
  - allows for a global real-time tracking of the GIOVE satellites
  - is ready for providing tracking data of the Galileo IOV as well as operational satellites
- O'Higgins is an **important contributor** to both networks
- O'Higgins would be a well suited location for a **Galileo Sensor Station**


Leica
Leica
TOPCON

GIOVE-B Hydrogen Maser