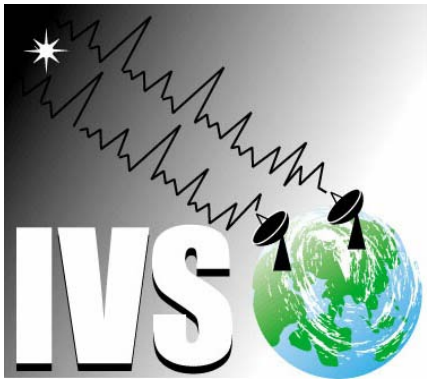


Prospects for the new geodetic VLBI Global Observing System VGOS

Axel Nothnagel

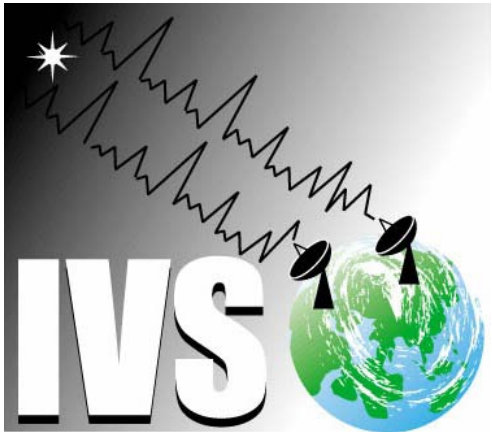
Chairman International VLBI Service for Geodesy and Astrometry

c/o Institute of Geodesy and Geoinformation, University of Bonn

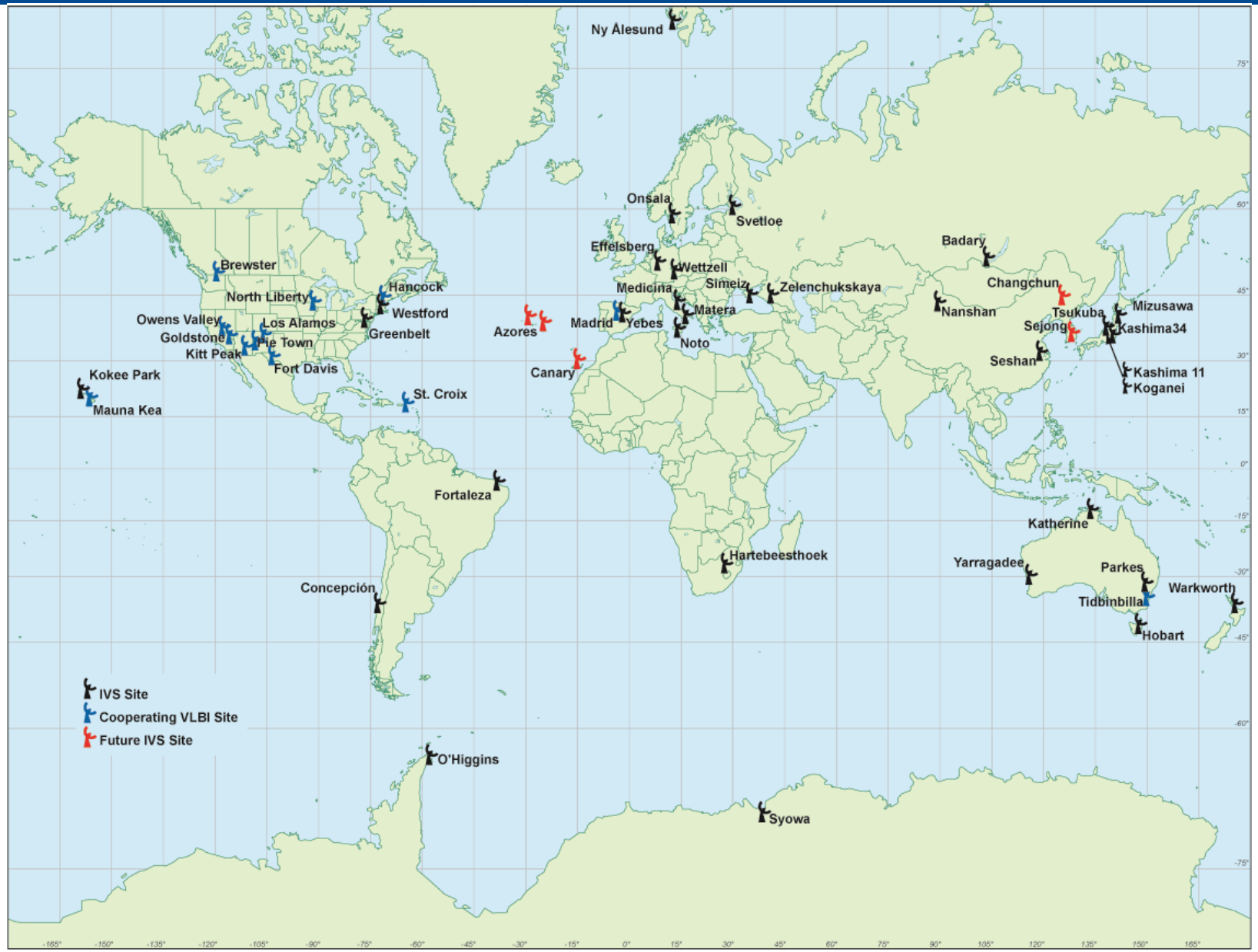
International VLBI Service for Geodesy and Astrometry

Contents

- Developments towards VGOS
  VLBI(2010) Global Observing System
- Telescopes, Correlation
- Organisational aspects
- Global Geodetic Observing System (GGOS)

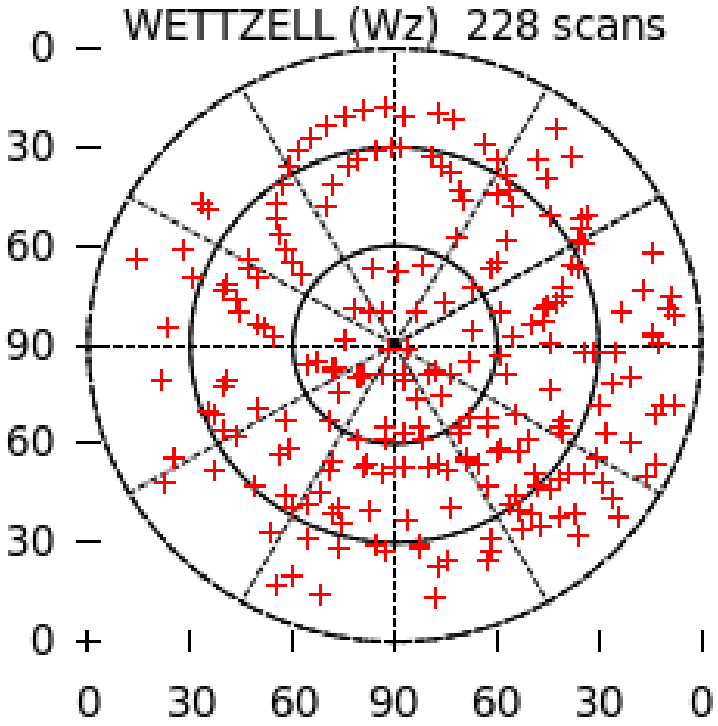


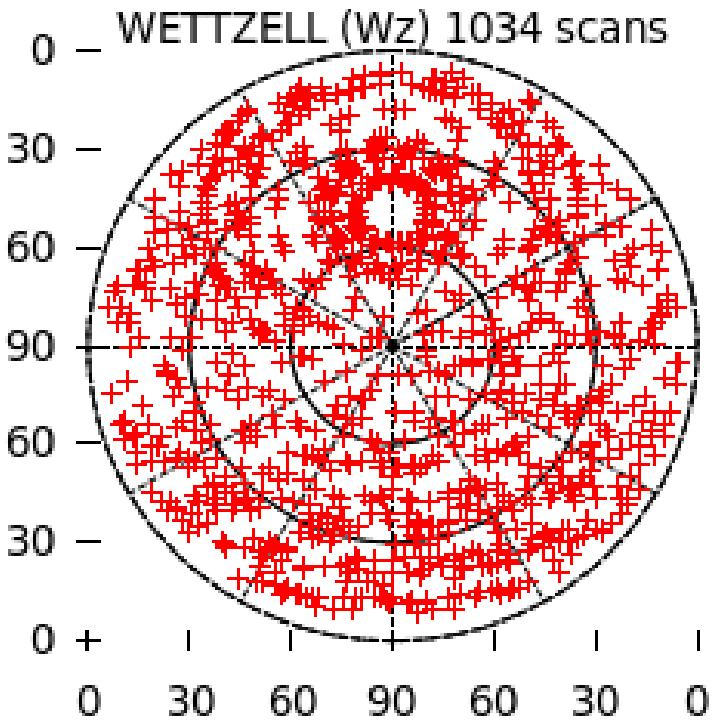
Current IVS Station Network



Concept of VLBI2010

- New generation VLBI infrastructure
  - dense sampling of local sky
    for optimal estimation of atmosphere parameters





Concept of VLBI2010

- New generation VLBI infrastructure
  - dense sampling of atmosphere
  - agile telescopes
    → small (12 – 13 m)
    12º/sec
  - up to 2 observations per minute (2880/day)

$$\sigma_\tau \propto \sqrt{\frac{1}{A_1 A_2 \cdot B}}$$

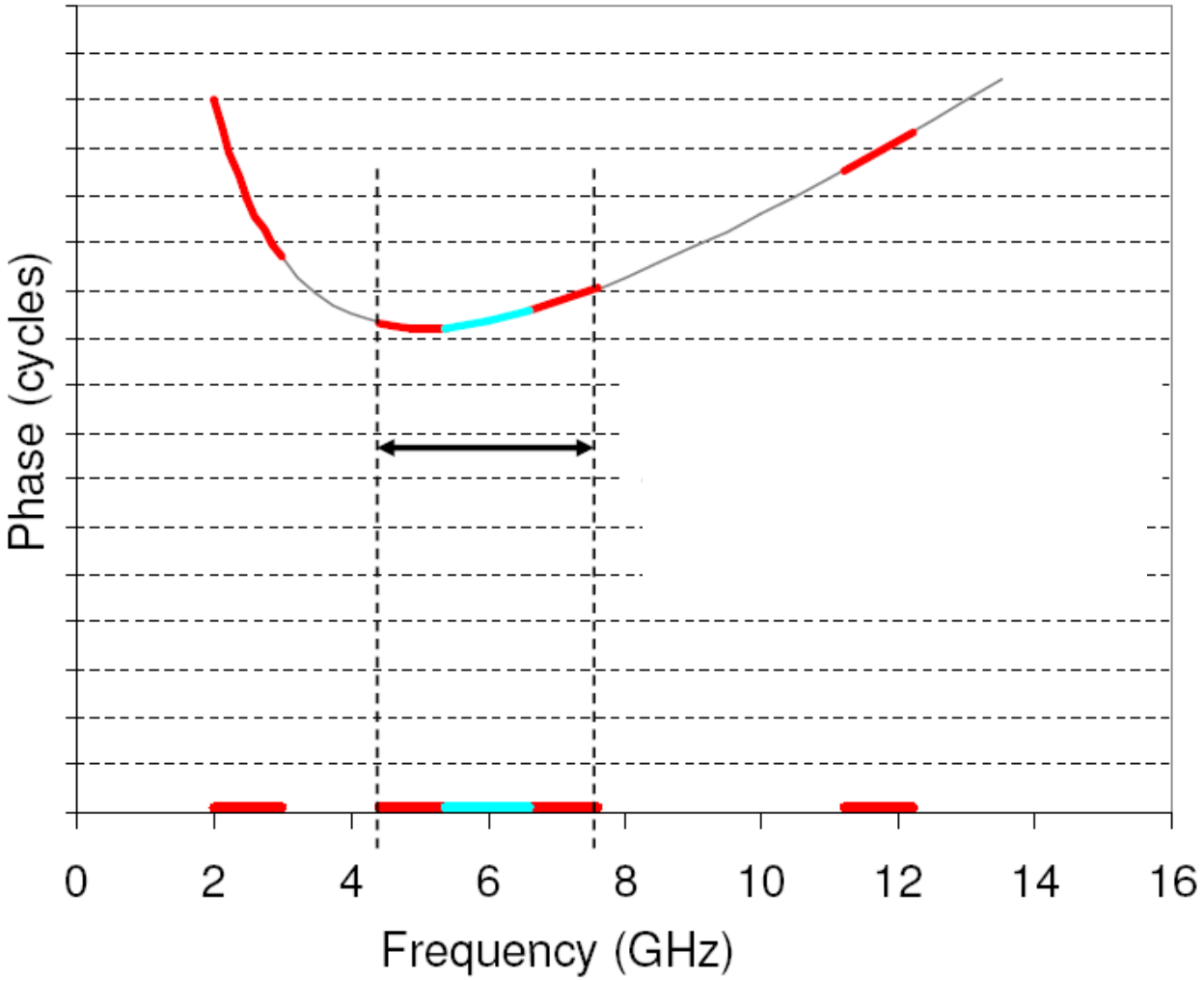
- Large bandwidth needed
  - wide band receivers (2 – 14 GHz)

VLBI Global Observing System

VLBI2010 Global Observing System
became
VLBI Global Observing System – VGOS

Small and agile telescopes
Large bandwidth (2 – 14 GHz)
Flexible frequency allocation
Dual linear polarization

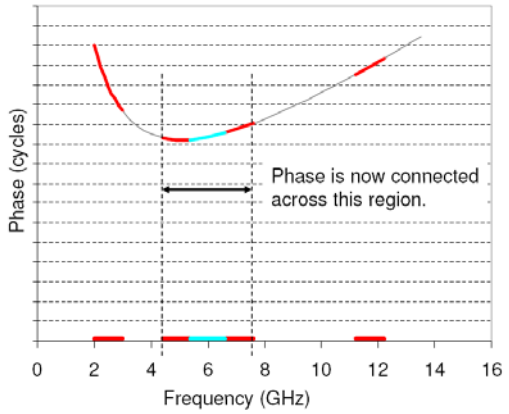
Frequency allocation for VGOS

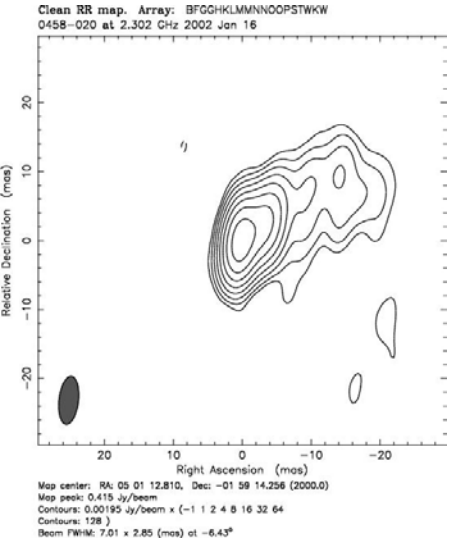


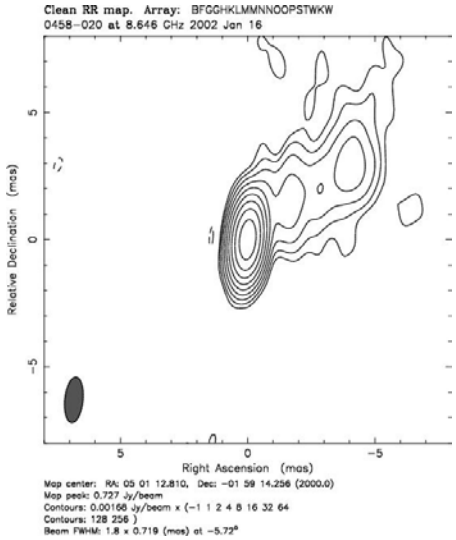
Courtesy B. Petrachenko

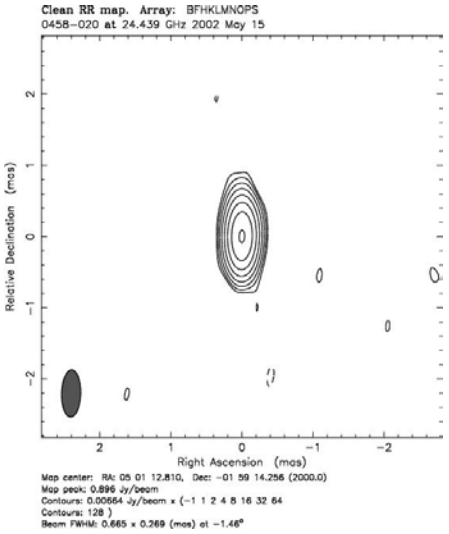
Challenges

- Frequency band selection
  - Radio frequency interference
  - Phase connection requirements
- Source structure effects









Images credit:
P. Charlot et al, AJ, 139, 5, 2010

S-band
2.3 GHz
13.6 cm

X-band
8.6 GHz
3.6 cm

K-band
24 GHz
1.2 cm

New VGOS radio telescopes

NyAlesund (NO)

Courtesy L. Langkaas

Zelenchukskaya (RU)

Courtesy
A. Ipatov

Ishioka (JP) Courtesy Y. Fukuzaki

GGAO (US)
Courtesy A. Niell

Badary (RU)

Courtesy
A. Ipatov

STATUS OF THE SPANISH/PORTUGUESE RAEGE PROJECT

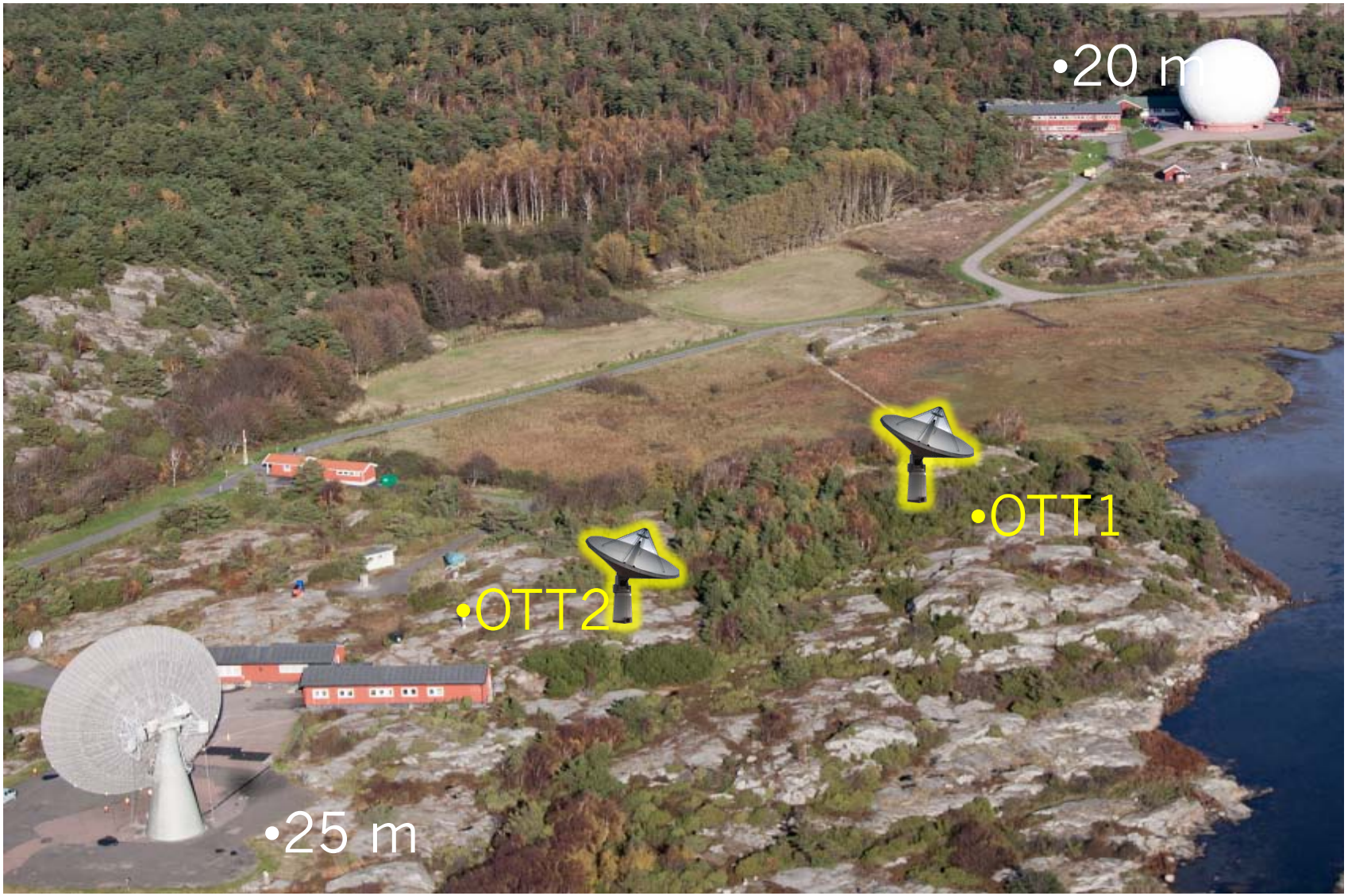
Gómez-González et al .(2013)

Yebes (Spain)
(August 2013) Courtesy: J.A. Lopez

Santa Maria (Eastern Azores)
(Sep. 2014) Courtesy: F. Colomer

Twin Telescope Wettzell

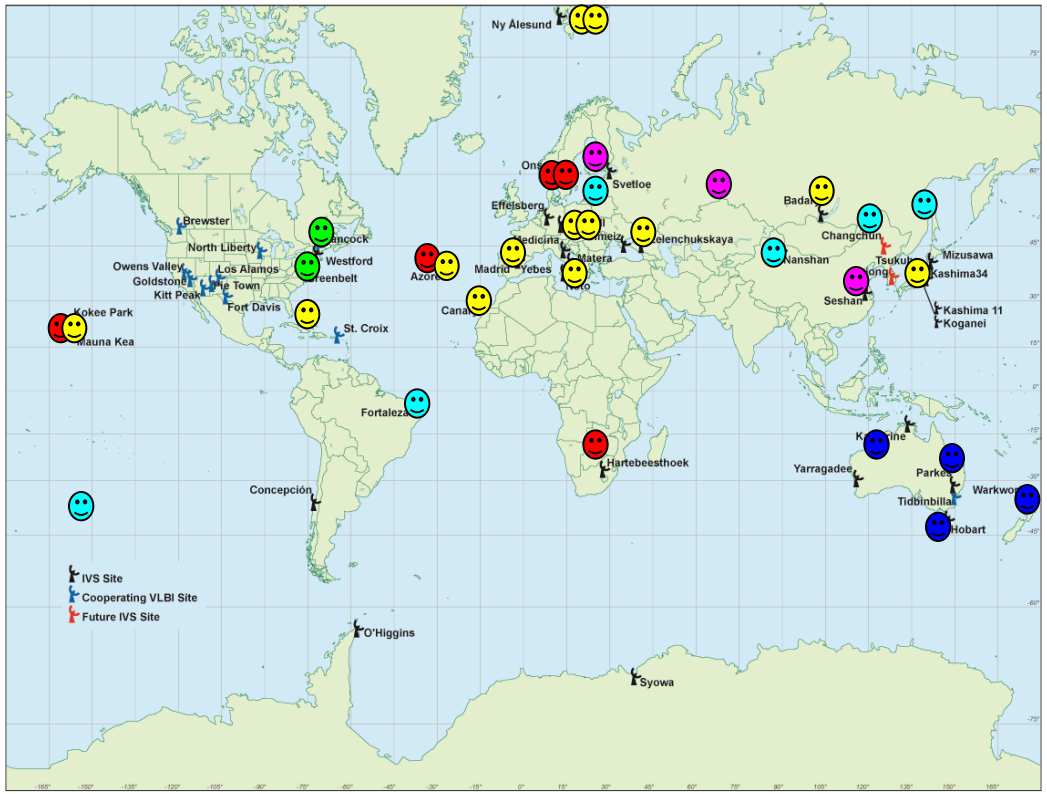
Twin Telescope Onsala



Courtesy R. Haas

VGOS World

New VGOS radio telescopes for IVS



- operational
- under construction
- funded
- proposal submitted
- planning phase
- planning phase upgrade

Courtesy H.Hase/VPEG,
based on available information
February 2015

Correlation

Software Correlators

Estimated correlator cores required

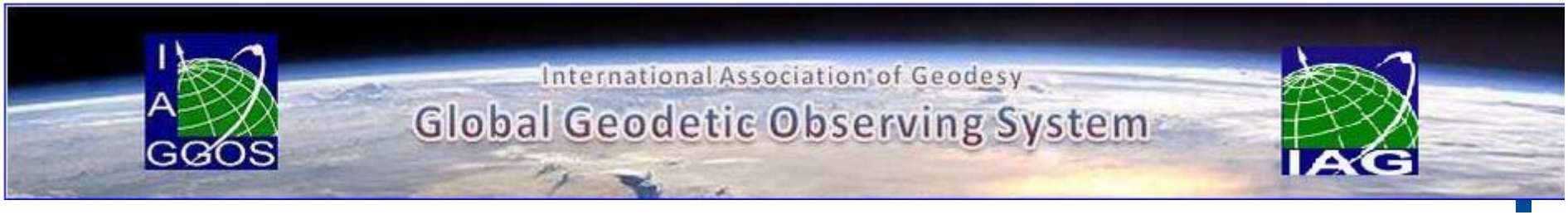
Year	# of correlator cores
2015	200
2016	600
2017	900
2018	1400
2019	2000
2020	3900

Expected developments

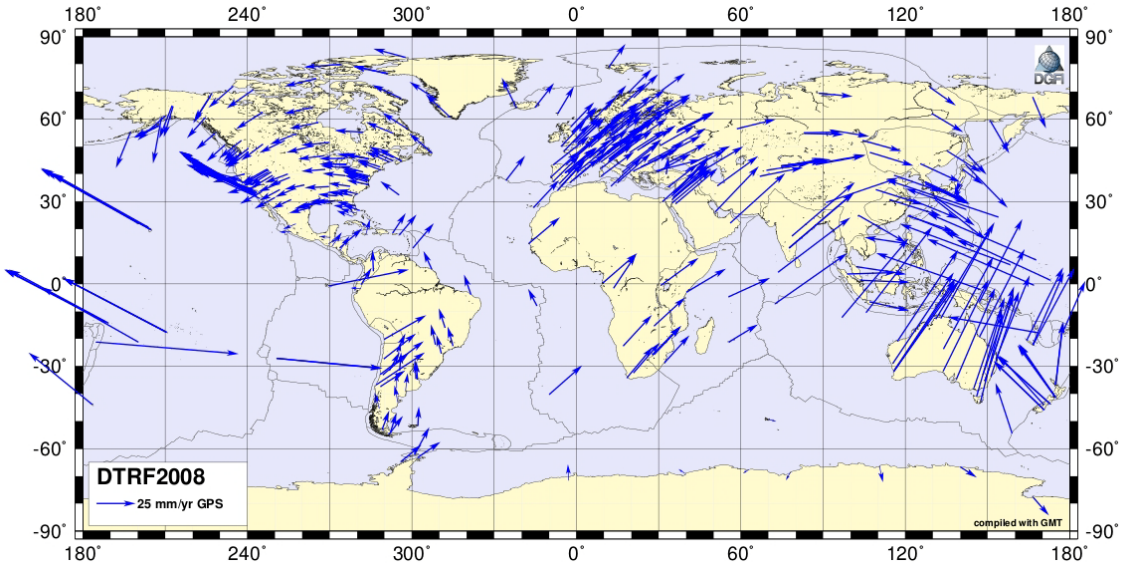
Location	Correlator Cores		External Network (Gbps)	
	Now	Planned	Now	Future
Bonn	488	1000-1500	1	??
USNO	512	1024	1	10
Haystack	100	~300	20	no plan
Shanghai	64	1000	1	no plan
Tsukuba	92	256	10	no plan

PC cluster with off-the-shelve components (scalable)

Challenge: Power consumption (for processors and for cooling)

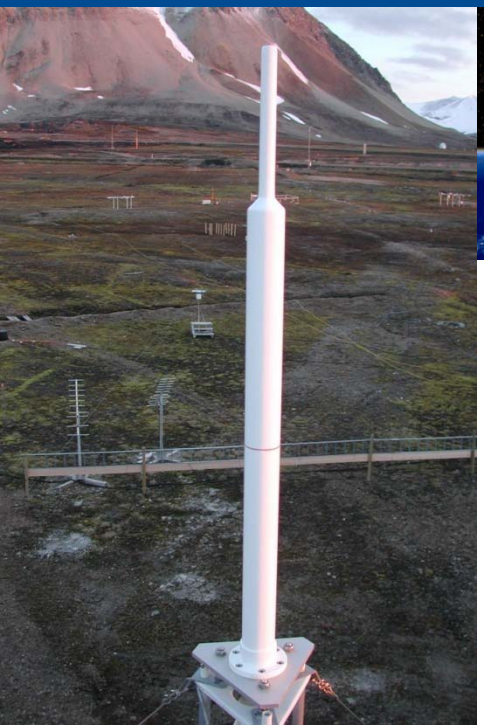


VGOS will be part of the Global Geodetic Observing System (GGOS)

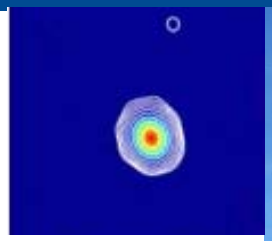


IAG 150 years
International Association of Geodesy

Global Geodetic Observing Techniques



DORIS

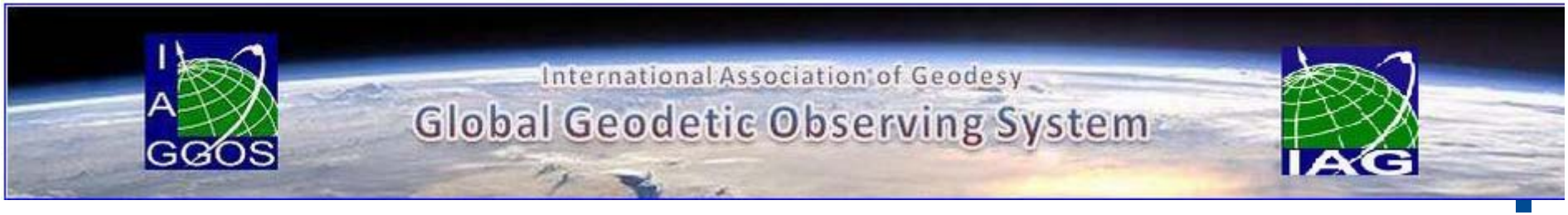


VLBI

GPS

SLR

GGOS

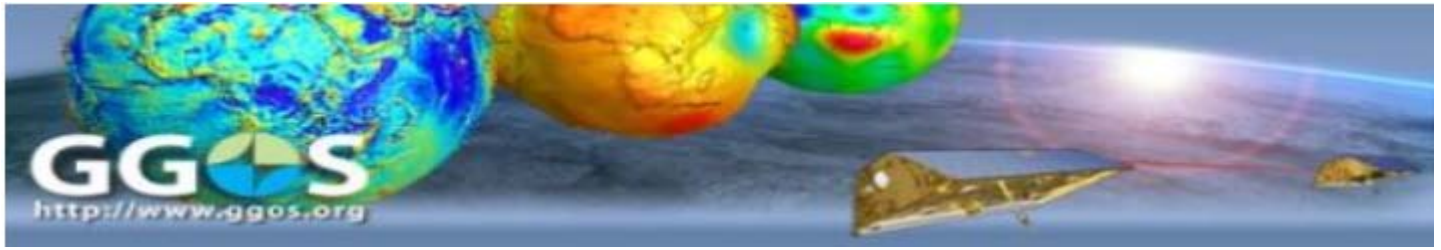


The mission of GGOS is:

- to provide the observations needed to monitor, map and understand changes in the Earth's shape, rotation and mass distribution;
- to provide the global frame of reference that is the fundamental backbone for measuring and consistently interpreting key global change processes and for many other scientific and societal applications;
- to benefit science and society by providing the foundation upon which advances in Earth and planetary system science and applications are built.

IAG 150 years International Association of Geodesy

Global Geodetic Observing System

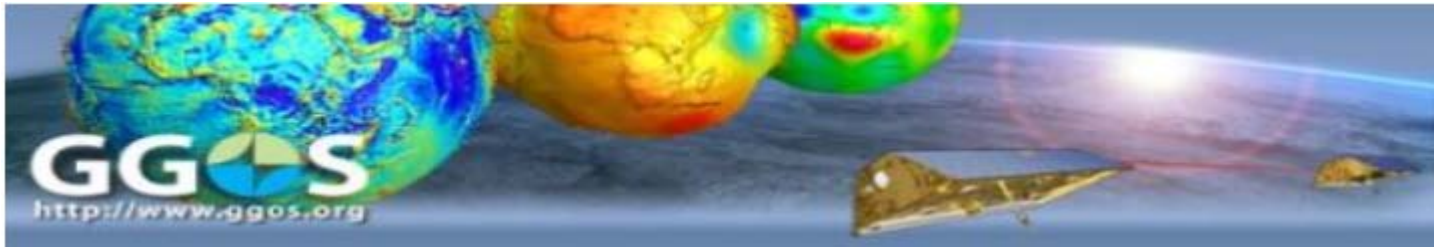


IVS → VGOS → GGOS

Requirements of GGOS

- Global distribution
- Continuous
- Stable over decades
- 1 mm/0.1 mm/y

Global Geodetic Observing System



IVS → VGOS → GGOS

Contribution to GGOS

- Global distribution → Well-designed network
- Continuous → Economic operations
- Stable over decades → Monitoring of telescopes and local ties
- 1 mm/0.1 mm/y → Improved technology, better modeling

Wettzell Geodetic Observatory

Courtesy T. Schüler, BKG