Towards a new VLBI system for geodesy and astrometry

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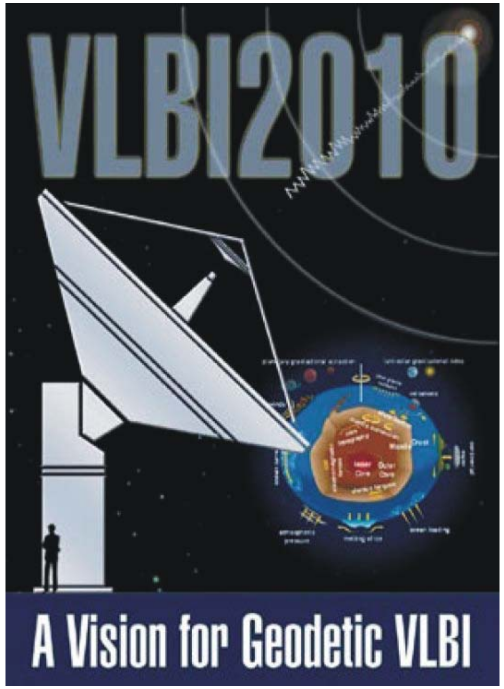


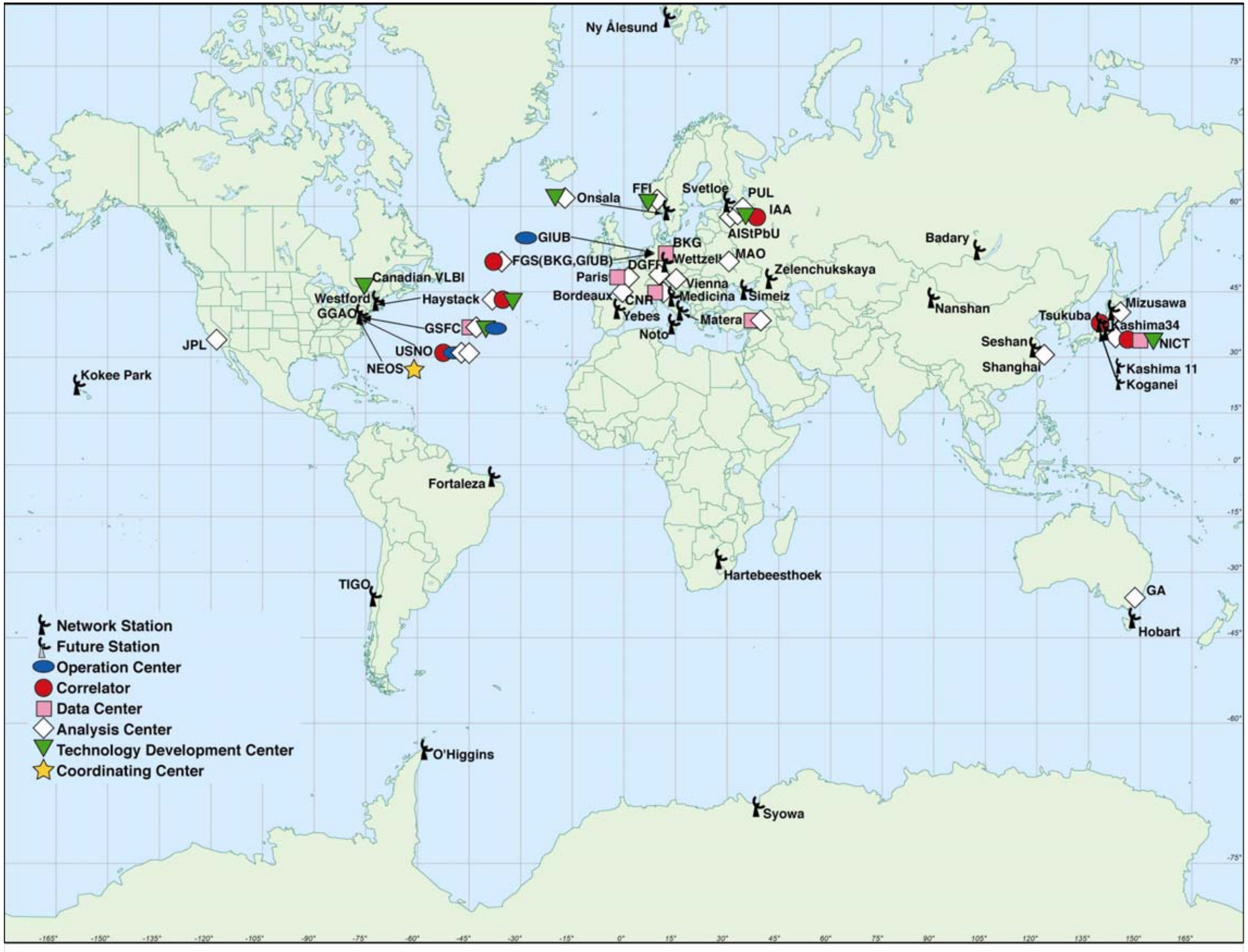
Very Long Baseline Interferometry

- Unique technique for
  - CRF
  - Celestial Pole
  - UT1 - UTC
- Primary technique for
  - EOP (complete set of parameters)
  - TRF (most precise for long baselines, scale)

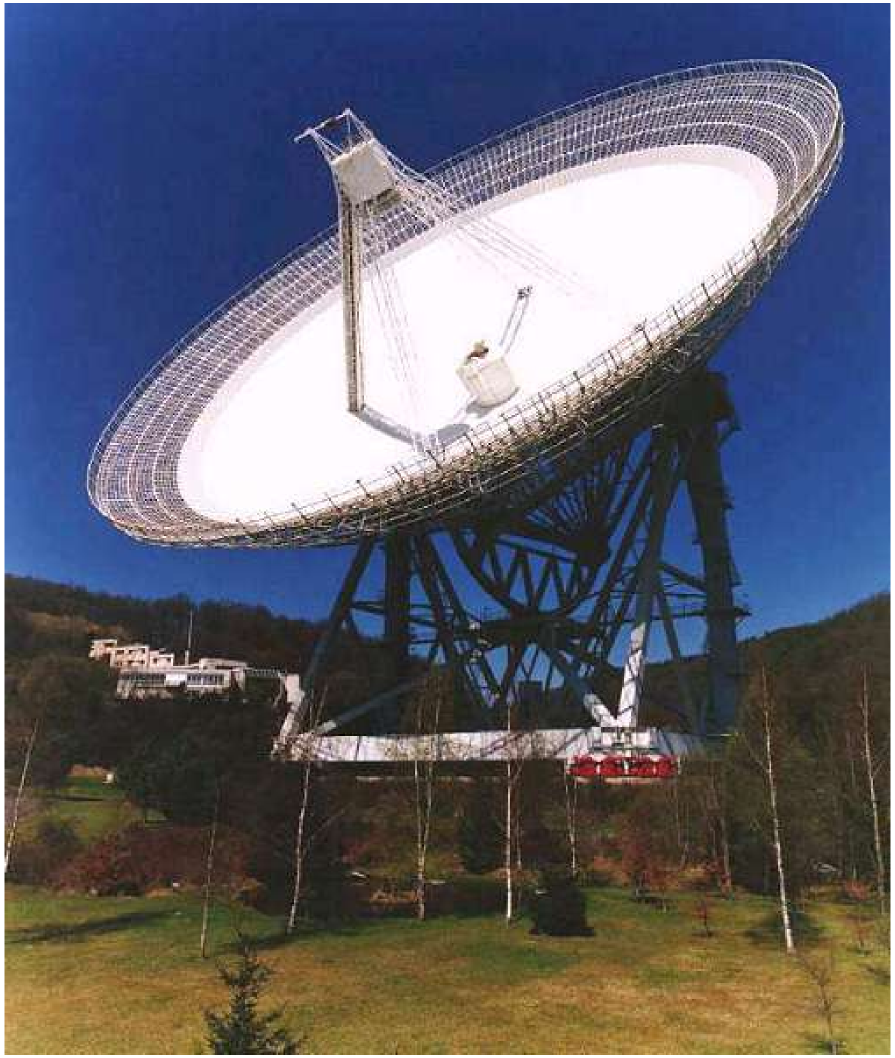
IVS - International VLBI Service for Geodesy and Astrometry

- IVS is a Service of
  - IAG (International Association of Geodesy)
  - IAU (International Astronomical Union)
  - FAGS (Federation of Astronomical and Geophysical Data Analysis Services)
- IVS Goals
  - provide a service to support geodetic, geophysical and astrometric research and operational activities
  - promote research and development in the VLBI system
  - interact with the community of users of VLBI products and integrate VLBI into a global Earth observing system

IVS Component Map



Radio telescopes: Wettzell (20m), Effelsberg (100m)



IVS Products (1)
ICRF (Ext. 1, Ext. 2)

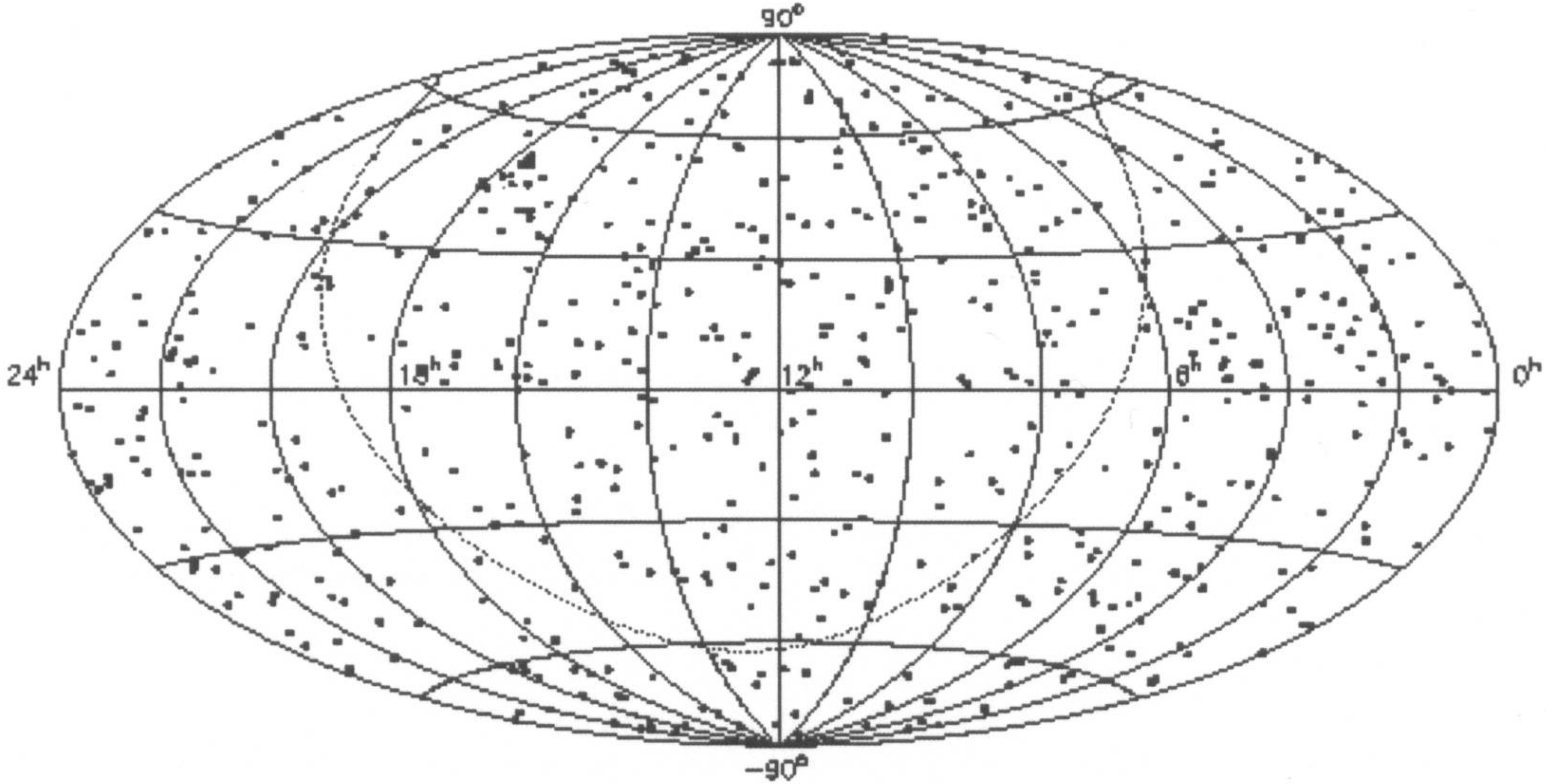
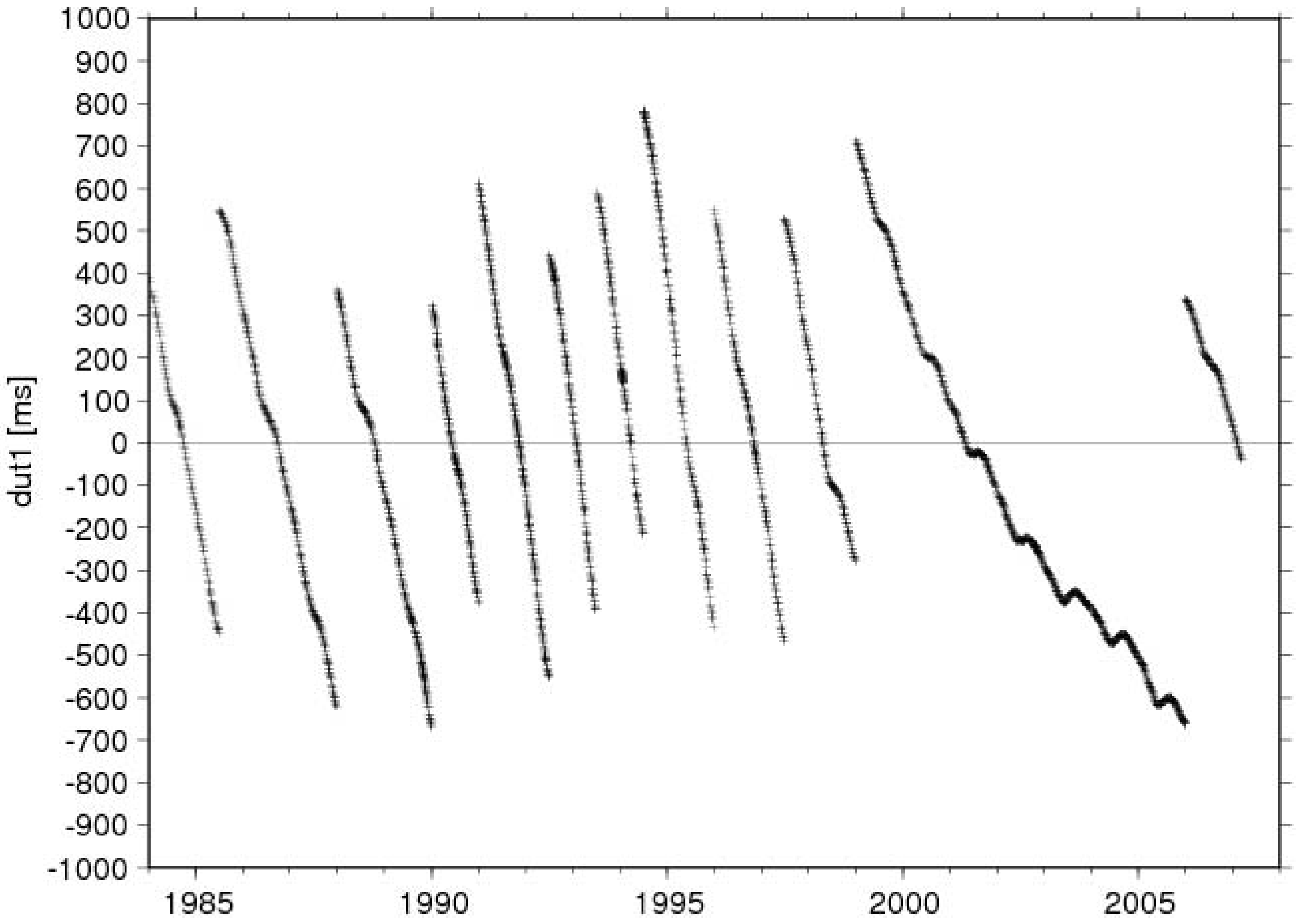


Figure 1: Distribution of the 608 ICRF sources on an Aitoff equal-area projection of the celestial sphere. The dotted line represents the Galactic equator.

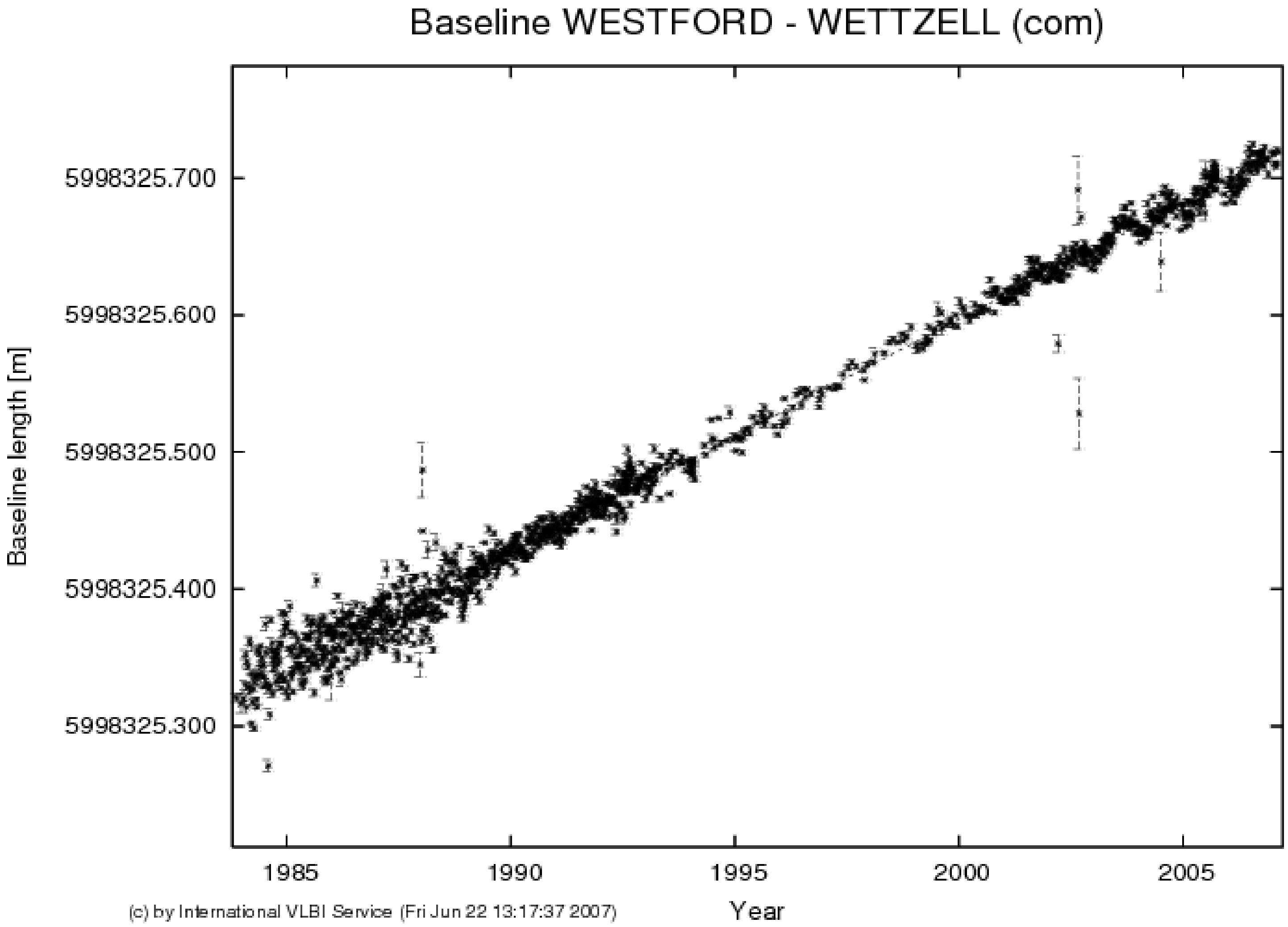
IVS Products (2)
dUT1 = UT1 - UTC



IVS Products (3)
Scale for the ITRF2005

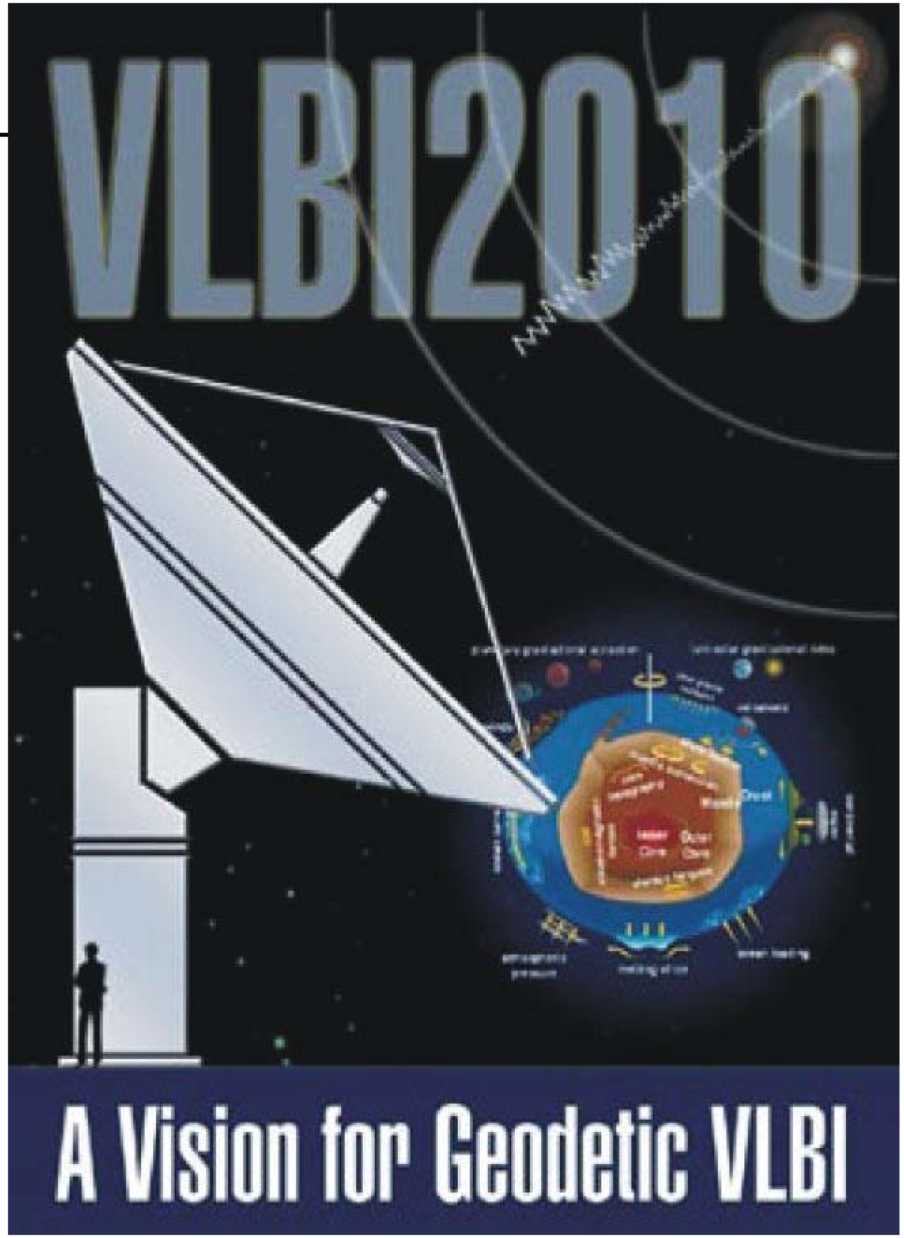
Altamimi et al.
(2007)

IVS Products (4)
Baseline lengths



IVS VLBI2010 WG 3 Goals

- 1 mm position accuracy
- 0.1 mm/year velocity accuracy
- continuous measurement of EOP
- rapid generation and distribution of IVS products



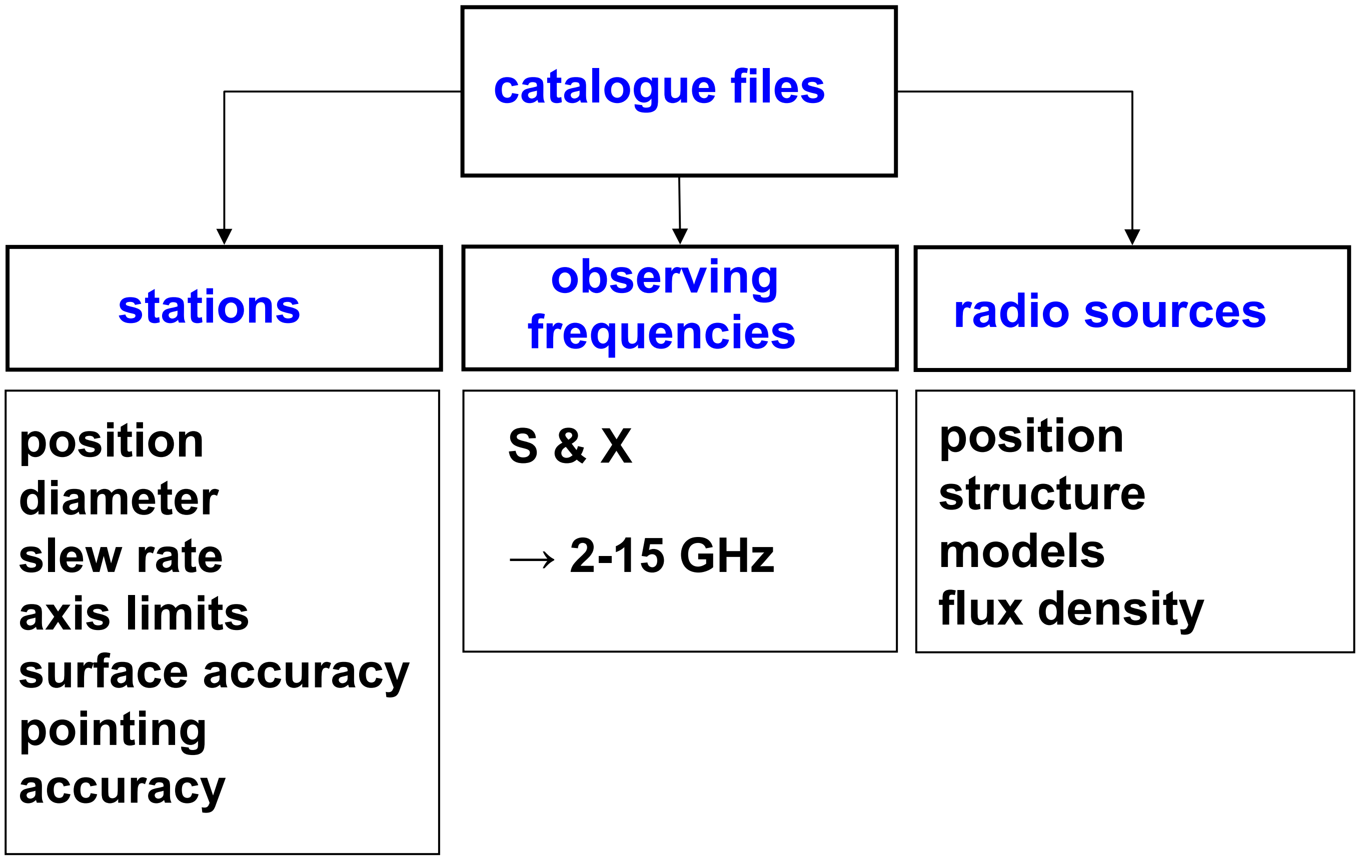
IVS VLBI2010 WG3 Recommendations

- Design a new observing system based on small antennas (12m), fast moving, operated unattended, mechanically reliable
- Broad continuous frequency range (2-15 GHz) which includes S- and X-Band
- Upgrade of large antennas to preserve continuity
- Transfer data with combination of high speed networks and high rate disk systems
- Examine the possibility for a new correlator system (software correlator?)

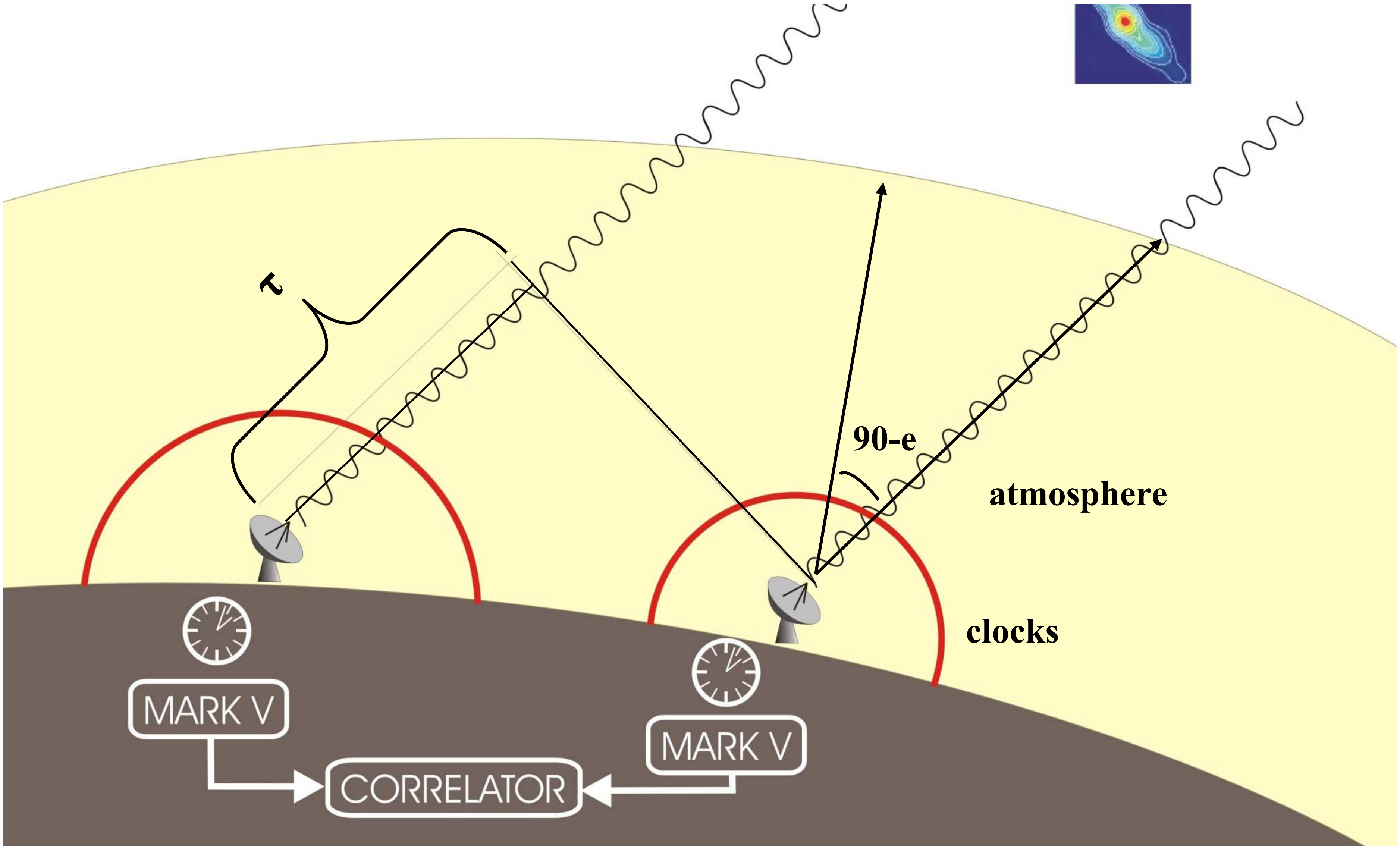
IVS VLBI2010 Committee

- Established September 2005
- Promote and guide research into the improvement of the "technique" of geodetic VLBI
- Take an integrated view of VLBI, evaluate effectiveness of proposed system changes with respect to final products
- Take responsibility for encouraging the implementation of the recommendations of WG3

VLBI2010 Simulations



VLBI2010 Simulations



Monte Carlo Simulations

$$o - c = \left(wzd_2 \cdot mfw_2(e) + cl_2\right) - \left(wzd_1 \cdot mfw_1(e) + cl_1\right) + wn_{Bsl}$$

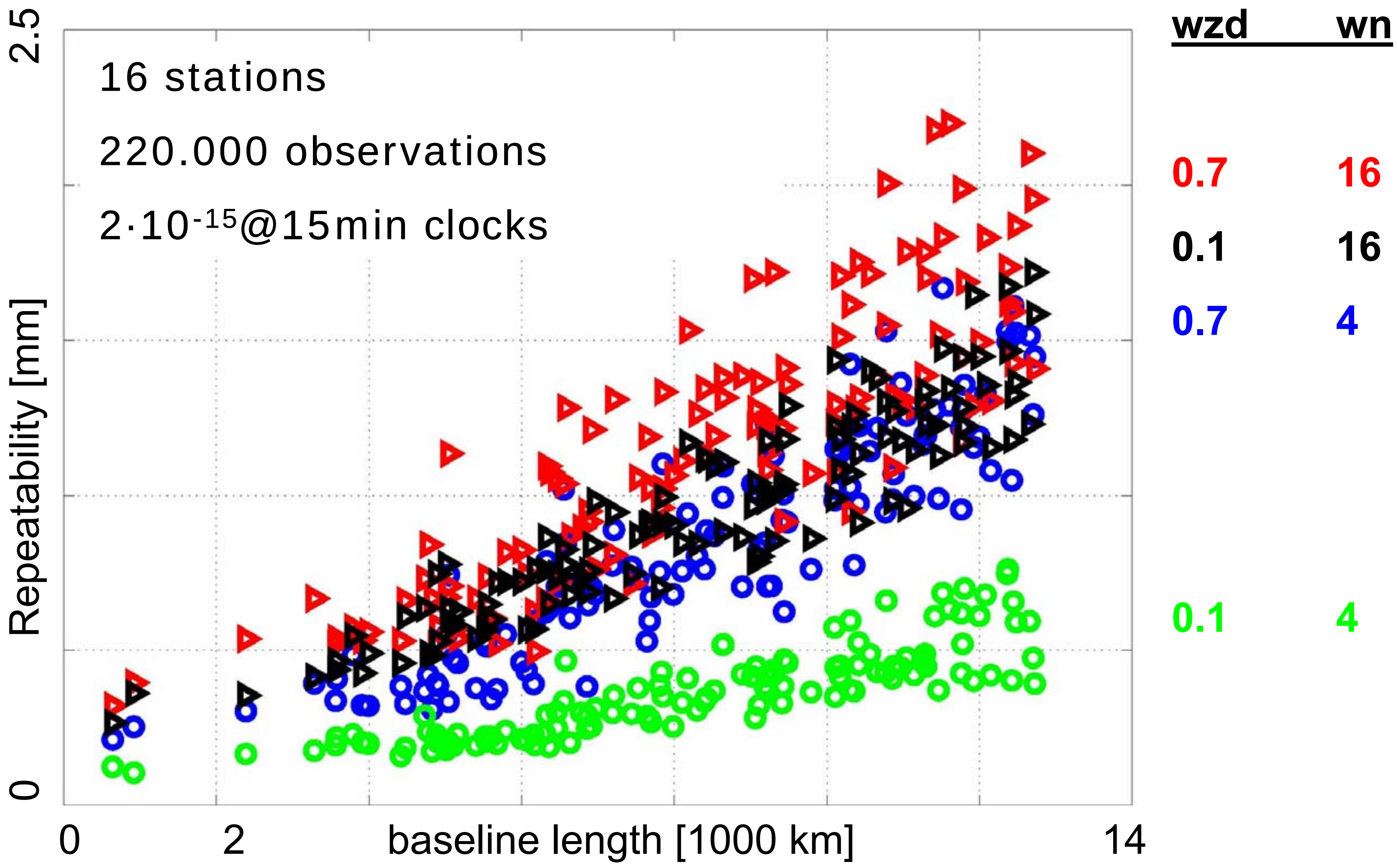
wet zenith delays:
random walk
PSD: 0.1 psec²/s
0.7 psec²/s
turbulence model
(Onsala, Sweden)

clocks:
ASD
$1 \cdot 10^{-14}$@50min
$2 \cdot 10^{-15}$@15min

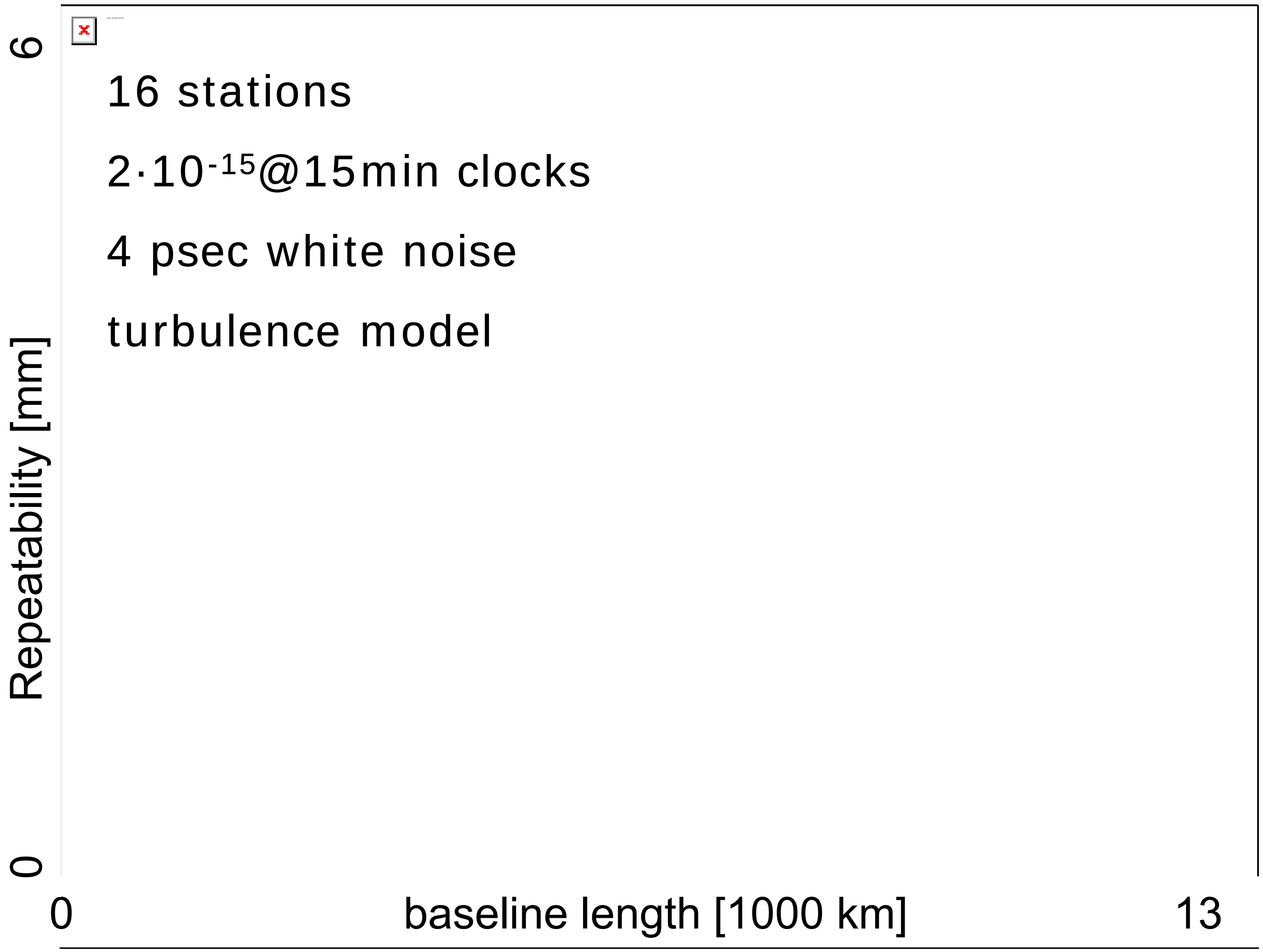
observation error:
4, 8, 16 psec

Simulate 25 identical 24 hour sessions

Wet delay is the limiting factor



Slew rate studies



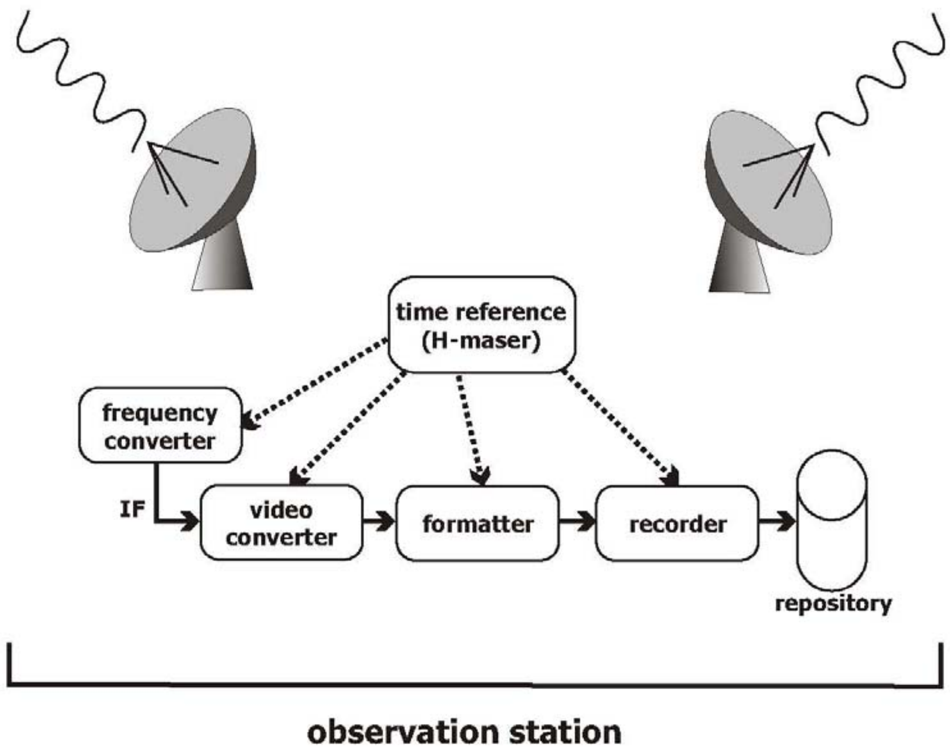
azim.	elev.
1.5°/s	0.7°/s
3.0°/s	0.7°/s
4.5°/s	2.1°/s
6.0°/s	2.1°/s
12.0°/s	3.5°/s

VLBI2010 is supporting several proposals (1)

- Korean Institutes (KASI, NGII, Ajou University)
- Geoscience Australia: proposal for 3 fundamental stations
- Univ. Tasmania (Hobart): getting operation money
- University of Concepciòn (Chile): developing telescope
- ISRO, India: 32m telescope for lunar mission extended for geodetic VLBI
- NASA Haystack: support of VLBI 2010 telescope

VLBI2010 is supporting several proposals (2)

- BKG: twin-telescope 2008-2010



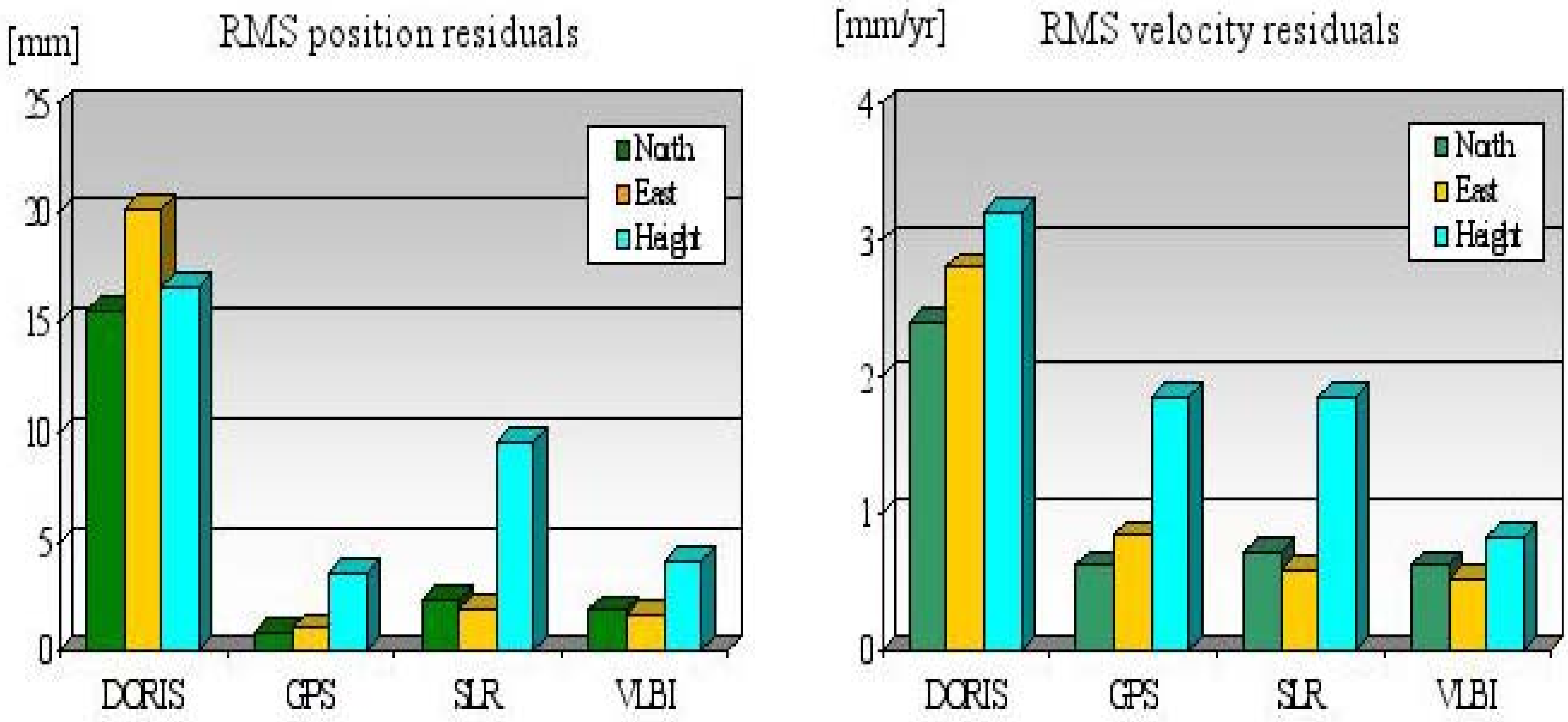
- higher observation density
- continuous observations
- better determination of systematic effects (one clock)
- one more local tie

Summary - Role of IVS in GGOS

- Contributes unique strength of VLBI technique
  - CRF products (quasar positions)
  - Complete set of EOP parameter; uniquely UT1-UTC and nutation; provides link CRF ↔ TRF
  - TRF products (station positions, velocities, scale, baseline lengths)
  - Tropospheric and ionospheric parameters
  - other geodynamical and astronomical parameters (e.g., Love numbers, relativistic parameters)
  - Support for satellite tracking

Thanks for your attention!

IVS Products (5)
Station coordinates / velocities



(from a global TRF solution derived by the DGFI, Munich)