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IVS Plans and Perspectives

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Abstract. Plans and future perspectives of the IVS are presented and discussed. This includes ongoing activities within VLBI2010 but also future technological developments, new tasks and goals, and the general strategies of the Service. Its role with respect to GGOS is also described.

1. Role of the IVS w.r.t. GGOS

In the past several years the International Association of Geodesy (IAG) has established the Global Geodetic Observing System (GGOS) as one of its main components. GGOS works with all other IAG components to provide the geodetic infrastructure necessary for monitoring the Earth system and for global change research. GGOS is the IAG contribution to the realization of GEOSS (Global Earth Observation System of Systems) which aims at integrating Earth observations in order to better serve users in a number of societal benefit areas, including disaster prevention and mitigation. Thus, GGOS can be seen in the frame of the scientific and political activities of the intergovernmental Group on Earth Observations (GEO).

The major scientific and technological challenges for GGOS are consistency across the three areas of geodesy (geometry, gravity, and rotation) and consistency between observations and models. The structure of GGOS is shown in Fig. 1 and, being one of the key IAG Services, the IVS plays a critical role within GGOS, because several of the geodetic parameters are uniquely provided by VLBI (Tabl. 1). Further information about GGOS can be obtained on the web sites http://geodesy.unr.edu/ggos/ and http://www.ggos.org/.

Recently, at the GGOS Unified Analysis Workshop in Monterey, CA (Dec. 5–7, 2007) consistent models and parameterization for the various space geodetic techniques and also for gravity analyses were thoroughly discussed by representatives of all Services, e.g. models of pole tide and of reference pressure and temperature, and finally 27 action items were defined (see the aforementioned web sites).

Table 1. Geodetic parameters provided by the various space geodetic techniques

Parameter Type	VLBI	GNSS	DORIS	SLR	LLR	Altimetry
ICRF	X					
Nutation	X	(X)		(X)	X	
Polar Motion	X	X	X	X	X	
UT1	X					
Length of Day	(X)	X	X	X	X	
ITRF (Stations)	X	X	X	X	X	(X)
Geocenter		X	X	X		X
Gravity Field		X	X	X	(X)	X
Orbits		X	X	X	X	X
LEO Orbits		X	X	X		X
Ionosphere	X	X	X			X
Troposphere	X	X	X			X
Time Freq./Clocks	(X)	X		(X)		

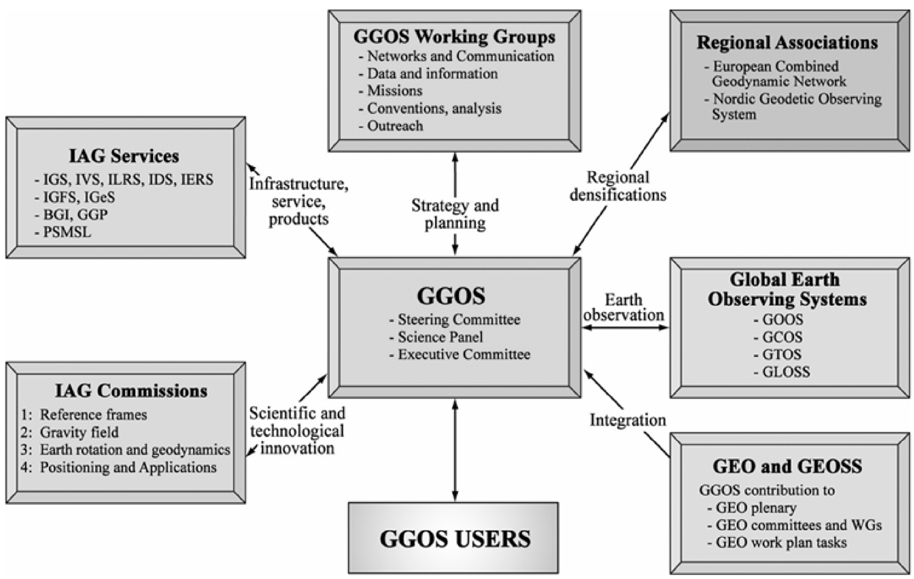

Figure 1. Structure of GGOS, the Global Geodetic Observing System of the IAG

2. Status of the IVS Network of Radio Telescopes

In spite of the cessation of the VLBI operations of the Algonquin radio telescope in Canada in 2007, the worldwide number of stations available for geodetic VLBI is increasing and there are several very promising plans for new radio telescopes in countries such as:

- Germany (Twin Telescope at Wettzell station, funded by the German BKG);
- Korea (Korean VLBI Network, KVN, with three antennas; plus another one to be operated by the National Geographic Information Institute, NGII);
- Australia/New Zealand (Australian Geodetic VLBI Network Project of Geoscience Australia with three new antennas and New Zealand with one new site);
- USA (Fairbanks, possible installation of a new antenna by NASA/GSFC);
- India, Turkey, Saudi Arabia (plans).

3. Working Groups within the IVS

Since its start the following Working Groups have been established within the IVS which very successfully provided valuable results that usually have been summarized in published reports:

- WG 1: Phase Center Mapping (2001/2002);
- WG 2: IVS Product Specification and Observing Programs (2001/2002);
- WG 3: VLBI2010 (2003-2005);
- IERS/IVS Working Group: Second Realization of the ICRF (since 2006);
- WG 4: VLBI Data Structures (Chair: J. Gipson) (since 2007).

4. Realization of the VLBI2010 Concept

Based on the recommendations for the next generation VLBI system defined by IVS Working Group 3 (http://ivscc.gsfc.nasa.gov/about/wg/wg3/index.html), the VLBI2010 Committee (V2C) has intensively worked on the realization of the new VLBI system since 2005. A large number of simulations have been carried out and the results have shown that a VLBI system with about the following technical specifications:

- broadband observations from 2 to 15 GHz (or 18 GHz),
- small (12-m) antennas,
- slew speeds larger than 7.5 °/sec,
- recording rates 8-16 Gbps,
- new feeds.

will be able to provide the required accuracy of 1 mm for position and 0.1 mm/y for velocity of a station.

5. e–VLBI and Software Correlation

Today, high-speed optical fiber connections exist worldwide which will soon allow the application of VLBI in near real-time. As an e–VLBI example we present the ultra-rapid e–Intensives between Europe and Japan (baselines Onsala-Tsukuba and Metsähovi-Kashima) that have successfully proven to provide UT1 estimates within 3 min 45 sec after the observation had been taken (Fig. 2) [1].

Another promising development are software correlators that already exist e.g. in Kashima and Bonn [2].

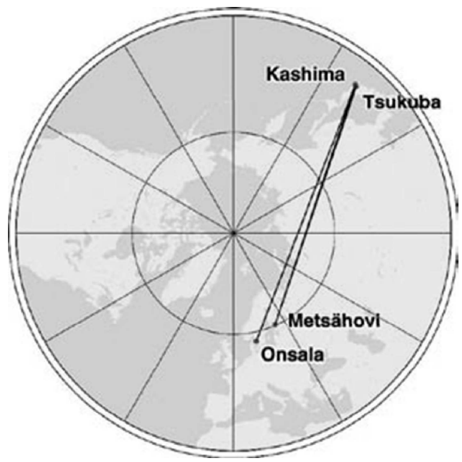

Figure 2. Baselines of ultra-rapid e–Intensives between Europe and Japan

6. CONT08 Campaign

An upcoming highlight for the IVS will be the CONT08 campaign to be observed over 15 continuous days in the second half of August 2008. In total, 11 stations will participate. It is planned to encourage other space geodetic techniques to join with their best efforts and after having carefully analyzed the CONT08 data and combined with other measurements a special issue of Journal of Geodesy will be published.

7. Visions for VLBI in the Next Decades

One of the goals that might be realized with the VLBI2010 system are phase delay solutions that will provide a significantly higher precision of the observables than current group delay measurements. Another task that requests a lot of additional research is the link of the quasi-inertial celestial reference frame

(CRF) realized by VLBI to dynamical reference frames.

Finally, we would like to mention frequency dissemination by optical fiber that will be feasible applying the so-called frequency comb technique (Fig. 3) for which Theodor Walter Hänsch was awarded the Physics Nobel Prize 2005. It can be assumed that in a few years optical clocks will outperform microwave clocks and that frequency dissemination by optical fiber can be done with unprecedented stability (various publications by H. Schnatz, G. Grosche, N.R. Newburry, and many others).

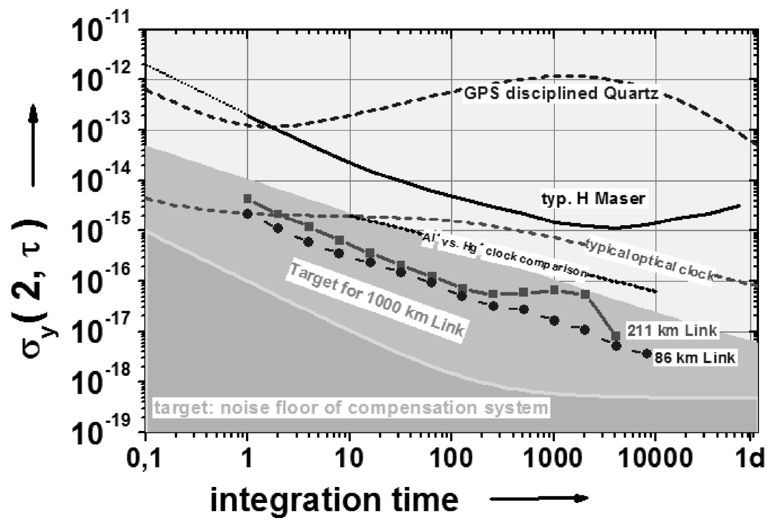

Figure 3. Stability of clocks and target performance of optical links (courtesy of H. Schnatz, PTB Braunschweig, Germany)

References

[1] Koyama, Y., M. Sekido, T. Hobiger, et al. Developments of Automated Data Processing System for Ultra Rapid dUT1 e–VLBI Sessions. This volume.

[2] Sekido, M., et al. Publications of NICT, 2008.