



**International Association of Geodesy**  
**Commission 1 *Reference Frames*, Commission 2 *Gravity Field***  
**ICP 1.2 *Vertical Reference Frames***

## **ICP 1.2 Splinter Meeting Minutes**

23 June, 2008

IAG International Symposium  
Gravity, Geoid and Earth Observation 2008  
23-27 June 2008  
Chania, Crete,  
Greece.

**Participants of the meeting:** Robert Čunderlík, Heiner Denker, Hermann Drewes, Will Featherstone, Rene Forsberg, Karl Heinz Ilk, Roger Hipkin, Petr Holota, Cheinway Hwang, Johannes Ihde, Juraj Janák, Juan Jose Martinez-Benjamin, Bill Kearsly, Jan Krynski, Jian Liang Huang, Jaakko Mäkinen, Urs Marti, Peter Morgan, Jürgen Müller, Otakav Nesvadba, Pavel Novák, Spiros Pagiatakis, Zuzana Fašková, Dan Roman, Diethard Ruess, Laura Sánchez, Fernando Sanso, Uwe Schäfer, Michael Sideris, Zdislav Šíma, Jaroslav Šimek, Dru Smith, Giovanna Sona, Herbert Wilmes, Hartmut Wziontek  
(See Annex 1 and Annex 2)

**Begin:** June 23, 2008, 6:30 p.m.; **End:** June 23, 2008 8:00 p.m.

### **Vertical Reference Frames - IAG Inter-Commission Project 1.2**

Presentation: Johannes Ihde (see Annex 3)

- ICP1.2 history
- IAG Inter-commission Project (ICP) 1.2 Vertical Reference Frames: Jointly by Commissions 1 and 2 for the period 2007 – 2011:
- Terms of Reference: Definition and realization of a global vertical reference system (GVRs), documented in Conventions for the Definition and Realization of a Conventional Vertical Reference System (CVRS).
- Open topics:
  - information system about vertical reference frames and their relation to a GVRs
  - Determination of transformation parameters
  - Relationships between a GVRs and the ITRS.
- Objectives: Further development of the GVRs conventions and decision about numerical standards
- Program of Activities of ICP 1.2
  - regional vertical systems and their relations to a global vertical reference system
  - combination procedures
  - basic relationships between ITRS and IVRS conventions
  - Unification of regional (continental) height systems
  - Pilot project for realization of a GVRs
- Realization Concept/Action Items: Six components
  - global network of stations (ITRF)
  - global reference level (CGGM)

- combination with global sea level (satellite altimetry)
  - local and regional gravity observations
  - Consistent conventional numerical standards.
  - Service providing relevant information.
- Proposed continuation as item of the IAG project GGOS, cooperation with other organizations: IAHS, IAPSO, IHO, FIG

## Discussion

- R. Forsberg:
  - importance of vertical reference system for ESA's TIGER project
  - Significant effect of height datum error on European geoid computations.
- H. Drewes:
  - joint treatment of the global reference level from a Conventional Global Gravity Model (CGGM) and absolute Sea Surface Topography (SST) proposed
- D. Smith:
  - suggests not to fix  $W_0$  since gravity field is time dependent
  - even for CGM with high degree/order the commission error is too large to use such a model as a reference
- F. Sanso:
  - recommends the use of EGM08 for realization of  $W_0$
  - agrees to H. Drewes with respect to a consistent treatment of CGGM and SST
- W. Bosch:
  - Pronounces importance to distinguish btw. definition and realization of a height system, realization might become more precise without change of definition
  - MSL not suitable as a reference for  $W_0$  because of too large dynamics
  - a constant should be used to define an equipotential surface as close as possible to MSL
  - argues against definition of  $W_0$  behalf CGGM, refers to paper of D. Smith: There is no such thing as "The" EGM96 geoid ([IGeS Bulletin No. 8, International Geoid Service, Milan, Italy, p. 17-28, 1998](#))
- H. Drewes:
  - Statement to geocenter problem: geocenter should be considered as a fixed reference, sea level changes should be described with respect to geocenter.
  - time variations of gravity field and MSL have impact on VRF

## Future of the commission

(question Z. Šima)

- J. Ihde: Future of ICP1.2:
  - continuation of ICP1.2 to develop terms of reference
  - proposal of a workshop in 2009 in combination with an other event to discuss technical questions
  - Tests of a combination of VRF with stations of the GGP project as an aspect of GGOS
- R. Forsberg:
  - Emphasizes the importance of a pilot project, consisting of 50 stations with complementary local observations.
- H. Drewes:
  - stresses the importance of a worldwide homogeneous station distribution

## Role of IGFS

(Question M.G. Sideris)

- Standardization linked to GGOS, working groups are transformed to bureaus: Bureau for standards and conventions established
- IGFS future role in gravimetry comparable to IERS for space techniques in establishing standards and conventions in interaction with GGOS bureau
- unification of different groups developing standards and conventions

### **Action Items**

- Preparation of a Workshop in Spring 2008 (until Dec. 15, 2008)
  - The ICP1.2 members were asked to propose a meeting place and date. BKG offer to host the meeting in April 2008 one week before the EGU GA in Vienna.
  - The ICP1.2 members were asked to propose discussion items for the agenda
- Development of the concept for a pilot project (j. Ihde and interested members of ICP1.2, until end of January 2009)
- Discussion of the continuation of Work at the IAG GA 2008


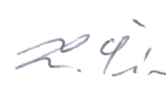
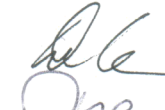
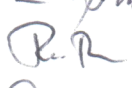



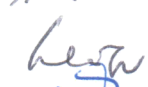

**Keeper of the Minutes:** Hartmut Wziontek, Johannes Ihde

### **Annexes:**

1. Participants of the ICP1.2 Meeting Chania
2. Participants of the ICP1.2 Meeting Chania
3. Workshop presentation (J. Ihde)

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# IAG ICP 1.2 Meeting June 23, 2008, GGEO Symp. Catania List of participants

Name	Inst.	e-mail	Sig.
1. Jan Krynski	Institute of Geodesy & Cartography	krynski@igik.edu.pl	
2. Michael Sideris	Univ. of Calgary	sideris@ucalgary.ca	
3. Zdislav ŠÍMA	Astron. Inst. AV CR	simaz@ig.cas.cz	
4. DRU SMITH	National Geodetic Survey, U.S.	DRU.SMITH@NOAA.GOV	Please, involve me into members.
5. PETR HOLOTA	Res. Inst. Geodesy, PRAGUE	holota@peeny.asu.cas.cz	
6. RENE FORSBERG	DTU-SPACE, Denmark	rf@space.dtu.dk	
7. ROBERT CUNDERLIK	SvF-STU, BRATISLAVA	CUNDERLIK@SVF.STUBA.SK	
8. ZUZANA FÁSKOVÁ	CE-SUT, BA	faskova@math.sk	
9. ROGER HIPKIN	Edinburgh University	roger.hipkin@ed.ac.uk	
10. UWE SCHÄFER	BUNDESAMT FÜR KARTOGRAPHIE UND GEODÄSIE, LEIPZIG	uws@bkg.bund.de	
11. Jaroslav ŠIMEK	Res. Inst. of Geod. Brno	jaroslav.simik@peeny.cz	
12. Fernando Sanso	IGES/Politecnico di Milano	fernando.sanso@polimi.it	
13. GIOVANNA SONA	IGES - Politecnico di Milano	giovanna.sona@polimi.it	
14. JIANLIANG HUANG	GGSD, NRCAN	jianliang@NRCan.gc.ca	
15. PAVEL NOVÁK	Res. Inst. of Geodesy	panovak@peeny.asu.cas.cz	
16. JUAN JOSE MARTINEZ-BENJAMIN	Technical University of Catalonia Barcelona	jj.benjamin@upc.edu	
17. JURAJ JANÁK	Slovak Univ. of Technology	juraj.janak@stuba.sk	
18. Cheinway Hwang	Dept. of Civil Eng., NCTU	cheinway@mail.nctu.edu.tw	
19. JAAKKO MÄKINEN	FINNISH GEODETIC INSTITUTE	JAAKKO.MAKINEN@FGI.FI	
20. Otakar NESVADBA	Land Survey Office of The	nesvadba@bonbox.cz	

21. Spiros Pagiatakis, YORK UNIVERSITY, Canada spiros@yorku.ca
- 22 Will Featherstone, Curtin Univ of Tech, Aus w.featherstone@curtin.edu.au
- 23 Karl Heinz ILK, University Bonn, Germany ilk@geod.uni-bonn.de
- 24 Heiner Denker, Leibniz Universität Hannover, denker@ife.uni-hannover.de
- 25 Jürgen Müller, Leibniz Universität Hannover, mueller@ife.uni-hannover.de
- 26 Urs Marti, Federal Office of Topography, Wabern, Switzerland; urs.marti@swisstopo.ch
- 27 Hartmut Winkler, BKG
- 28 Herbert Wilmes, BKG
- 29 Bill Kearsley, w.kearsley@unsw.edu.au
- 30 Peter Morgan petermorgan@grapevine.net.au
- 31 Dan Roman dan.roman@noaa.gov (NGS/NOAA)
- 32 Hermann Drewes, DGF I Knaich, Germany, drewes@dgfi.bodw.de
- 33 Laura Sánchez DGF I sanchez@dgfi.bodw.de
- 34 Diethard Ruess, BEV (Bundesamt für Eich- u. Vermessungswesen)  
Federal Office of Metrology and Surveying  
diethard.ruess@bev.gv.at

Robert Čunderlík	SVF-STU Bratislava	SK cunderli@svf.stuba.sk
Heiner Denker	Leibniz Universität Hannover	DE denker@ife.uni-hannover.de
Hermann Drewes	DGFI Munich	DE drewes@dgfi.badw.de
Will Featherstone	Curtin Univ. of Tech. Aus	AU w.featherstone@curtin.edu.au
Rene Forsberg	DTU-SPACE Denmark	DK rf@space.dtu.dk
Karl Heinz Ilk	University Bonn, Germany	DE ilk@geo.uni-bonn.de
Roger Hipkin	Edinburgh University	UK roger.hipkin@ed.ac.uk
Petr Holota	Res. Inst. Geodesy Prague	CZ holota@pecny.asu.cas.cz
Cheinway Hwang	Dept. of Civil Eng. NCTW	TW cheinway@mail.nctu.edu.tw
Johannes Ihde	BKG Germany	DE johannes.ihde@bkg.bund.de
Juraj Janák	Slovak Univ. of Technology	SK juraj.janak@stuba.sk
Juan Jose Martinez-Benjamin	Technical University of Catalonia Barcelona	ES jj.benjamin@upc.edu
Bill Kearsley		AU w.kearsley@unsw.edu.au
Jan Krynski	Institute of Geodesy and Cartography	PL krynski@igik.edu.pl
Jan Liang Huang	GSD NRCan	CA jianhuang@NRCan.gc.ca
Jaakko Mäkinen	Finnish Geodetic Institute	FI jaakko.makinen@fgi.fi
Urs Marti	Federal Office of Topography Switzerland	CH urs.marti@swisstopo.ch
Peter Morgan		AU petermorgan@grapevine.net.au
Jürgen Müller	Leibniz Universität Hannover	DE mueller@ife.uni-hannover.de
Otakav Nesvadba	Land Survey Office CZ	CZ nesvadba@bonbox.cz
Pavel Novák	Res. Inst. of Geod.	CZ panovak@pecny.asu.cas.cz
Spiros Pagiatakis	York University, Canada	CA spiros@yorku.ca
Zuzana Fašková	SVF-STU Bratislava	SK faskova@math.sk
Dan Roman	NGS/NOAA	US dan.roman@noaa.gov
Diethard Ruess	BEV	AT diethard.ruess@bev.gv.at
Laura Sánchez	DGFI Munich	DE sanchez@dgfi.badw.de
Fernando Sanso	IGeS/Politecnico di Milano	IT fernando.sanso@polimi.it
Uwe Schäfer	BKG Germany	DE ufer@bkg.bund.de
Michael Sideris	University of Calgary	CA sideris@ucalgary.ca
Zdislav Šíma	Astron. Inst. AV CR	CZ sima@ig.cas.cz
Jaroslav Šimek	Res. Inst. of Geod. GO Pecny	CZ jaroslav.simek@pecny.cz
Dru Smith	National Geodetic Survey U.S.	US dru.smith@noaa.gov
Giovanna Sona	IGeS/Politecnico di Milano	IT giovanna.sona@polimi.it
Herbert Wilmes	BKG Germany	DE herbert.wilmes@bkg.bund.de
Hartmut Wziontek	BKG Germany	DE hartmut.wziontek@bkg.bund.de

# **Vertical Reference Frames - IAG Inter-Commission Project 1.2**

**(Joint with Commission 2 and IGFS)**

*Johannes Ihde and Members of  
ICP1.2Project*

*Splinter Meeting, June 23, 2008*

**International Symposium on  
Gravity, Geoid & Earth Observation 2008,  
23-27 June, Chania, Crete, Greece**





## ICP1.2 history, first term

- **Formation 2003 in Sapporo/Japan (IUGG GA)**
- **First Working Group Meeting 2004 in Porto/Portugal (GGSM)**
- **Second Working Group Meeting 2005 Cairns/Australia (IAG GA)**
- **Workshop April 2006 in Prague/Czech Republic**
- **WG Meeting Aug. 2006 in Istanbul/Turkey (1<sup>st</sup> IGFS Symposium)**
- **Final discussion on IUGG GA, July 2007 in Perugia/Italy**





# **IAG Inter-commission Project (ICP) 1.2**

## **Vertical Reference Frames**

### **Jointly by Commissions 1 and 2 for the period 2007 - 2011**

## **Outline**

**I. ToR**

**II. Objectives**

**III. Program of Activities**

**IV. Realization Concept**

**V. Proposed continuation**



GVRS = WHS

CVRS

IVRS

IVRF

## Members 2007 - 2011:

- **Zuheir Altamimi (France),**
- **Matt Amos (New Zealand)**
- **Alireza A. Ardalan (Iran)**
- **Claude Boucher (France)**
- **Wolfgang Bosch (Germany)**
- **Carine Bruyninx (Belgium)**
- **Milan Bursa (Czech Republic)**
- **Gleb Demianov (Russia)**
- **Will Featherstone (Australia)**
- **Bernhard Heck (Germany)**
- **Johannes Ihde (Germany)**
- **Rene Forsberg (Denmark)**
- **Satoru Fukuda (Japan)**
- **Bill Kearsley (Australia)**
- **Gunter Liebsch (Germany)**
- **Teixeira Luz (Brazil)**
- **Markku Poutanen (Finland)**
- **Laura Sanchez (Colombia)**
- **Steve Shipman (UK)**
- **Marc Véronneau (Canada)**
- **Viliam Vatrť (Czech Republic)**

# Terms of Reference

The IAG Inter-commission Project 1.2 studied during the period **2003 – 2007** the possibilities of the

- definition and realization of a global vertical reference system (GVRS) based
- on the classical and modern observations and
- a consistent modeling of both, geometric and gravimetric parameters.



- The **results** of the work of the Inter-commission Project 1.2 are documented in **Conventions** for the Definition and Realization of a Conventional Vertical Reference System (CVRS).
- In the CVRS conventions a general concept for the definition and realization of a unified, global vertical reference system is described.
- The CVRS conventions are **aligned** to the **IERS 2003 Conventions**.



## Open topics are

- the **establishment of an information system** describing the various regional vertical reference frames and their relation to a GVRS,
- the **determination of transformation parameters** between regional vertical reference frames and the unified global height system as well as
- the **relationships between a GVRS and the ITRS.**

# Objectives

- Considering the **open topics** of the period 2003 - 2007
- **Further development of the GVRS conventions**
- Preparation of **decision about numerical standards** as task in cooperation with International Astronomical Union (IAU) and international hydrological associations.
- **Initiation of a pilot project** for a GVRS realization on the basis of the IGS TIGA-PP, GGP and IGFS for AG and a CGGM





# Program of Activities of ICP 1.2

- Study of information on regional vertical systems and their relations to a global vertical reference system for practical applications;
- Study of combination procedures of height data sets from different techniques;
- Development of the basic relationships between ITRS and IVRS conventions, parameters, realization, models
- Unification of regional (continental) height systems
- Preparation of a pilot project for the realization of a GVRS.



# Realization Concept - 1

**A global unified vertical reference system for an International Vertical Reference System (IVRS) can be realized by six components (mostly a combination of existing IAG products):**

- A global network of stations with coordinates in ITRF and geopotential numbers referred to a conventional global reference level. This network should include co-location of permanent GNSS, tide gauges, permanent (SG) and periodical (AG) gravity stations.**
- A global reference level derived from a conventional global gravity model (CGGM) on the basis of a satellite gravity mission only solution.**



# Realization Concept - 2

- In combination with a global sea level model from satellite altimetry.
- In addition local and regional gravity observations around the IVRS stations are required.
- All based on a set of consistent conventional numerical standards.
- A service providing all relevant information.

**Regional and national height reference systems can be integrated into an IVRS by GNSS/levelling aligned to ITRF and using the CGGM and the numerical standards.**



# Proposed continuation

## Statements

- The realization of an IVRS is a typical item of the IAG project GGOS, mainly as a combination of different products of IAG services.
- The IAG has to clarify inconsistencies in the numerical parameters for integrated geodetic applications. Conventions for the definition and realization of the parameters of the MSSL have also to be agreed. (IERS 2003 Convention WS in Sept. 2007, Revision of IERS 2003 Convention, GGOS WG)



# **GEO 2007 Work Plan**

## **Architecture Task AR-07-03**

<input type="checkbox"/> Task Number	<b>Global Geodetic Reference Frames</b>
<b>AR-07-03</b>	<p><b>This Task has the purpose to ensure the availability of accurate, homogeneous, long-term, stable, global geodetic reference frames as a mandatory framework and the metrological basis for Earth observation. Identification of steps towards ensuring consistent, high-accuracy, homogeneous, and long-term stable global geodetic reference frames for Earth observation and the observing systems contributing to GEOSS..</b></p>
<b>Area</b>	
<b>Architecture</b>	
<b>Relevant Committee</b>	
<b>ADC</b>	



## **Proposed items for continuation:**

- **Discussion of the results of ICP1.2 (GGOS action)**
- **Initiation of a pilot project for an IVRS (WHS) realization on the basis of the IGS TIGA-PP, GGP and IGFS for AG and a CGGM (call for participation as an IGFS action)**
- **Further development of the CVRS conventions**
- **Decision about numerical standards as task of GGOS in cooperation with International Astronomical Union (IAU) and international hydrological associations.**



**The project continuation shall be realized, in cooperation with other organizations, especially**

- **the International Association of Hydrological Sciences (IAHS),**
- **the International Association for the Physical Sciences of the Oceans (IAPSO), the International Hydrographic Organisation (IHO),**
- **the International Federation of Surveyors (FIG),**
- **Inter-Service Geospatial Working Group (IGeoWG) of NATO**





# Realization Concept Action Items of ICP1.2

**Six components:**

- 1. A global network of stations with coordinates in ITRF (and geopotential numbers referred to a conventional global reference level). This network should include co-location of permanent GNSS, tide gauges, permanent (SG) and periodical (AG) gravity stations. –**

**Initiation of a pilot project for a GVRS (WHS) realization on the basis of the IGS TIGA-PP, GGP and IGFS for AG  
(call for participation as an action of IGFS or GGOS or both?)**



**2. A global reference level derived from a  
conventional global gravity model (CGGM) on  
the basis of a satellite gravity mission only  
solution and a high resolution global gravity  
model -**

**IGFS – ICGEM**

**Recommendation: EIGENG05S?, EGM08?**

**3. In combination with a global mean sea surface (MSS) model from satellite altimetry. –**

**IGFS, IAS? Absolute Sea Surface Topography (SSTop) Model**

**4. In addition local and regional gravity observations/geoid around the IVRS stations are required.**

**IAG SC 2...?**



**5. All based on a set of consistent conventional numerical standards. –**

**GGOS WG about standards**

**ISO Registry for geodetic parameters – IAG control group**

**6. A service providing all relevant information –**

**IERS Information System**

**Regional and national height reference systems can be integrated into an IVRS by GNSS/levelling aligned to ITRF and using the CGGM and the numerical standards. –**

**IAG SC 1.3**

