GGOS Retreat 2007 and Eighth Steering Committee

Mandalay Beach Resort, Oxnard, California

February 19-21, 2006

Minutes (Version 0.3)

Written by
Hans-Peter Plag

(Version of 2007- 3- 5 21:38).

Participants:

Ruth Neilan, JPL (*Vice-Chair, GGOS Steering Committee*)
Markus Rothacher, GFZ (*Chair, GGOS Steering Committee*)
Hans-Peter Plag, NBMG (*Vice-chair, GGOS Steering Committee*)
Bernd Richter, BKG (*Chair, GGOS WG Data and Infrastructure*)
Harald Schuh, University Vienna (*Invited Participant*)
Dirk Berend, GSFC (*Delegate, IVS*)
Chopo Ma, GSFC (*Executive Committee; Delegate, IERS*)
Victor Zlotnicki, JPL (*Member Science Panel*)
Reiner Rummel, Technial University Munich (*Science Panel*)
Zuheir Altamimi, IGN (*Invited Participant*)
Riccardo Barzaghi (*Substitute, IGeS*)
Susanna Zerbini, University of Bologna (*Executive Committee*)
Hermann Drewes, DGFI (*Delegate, Commission 1, Chair WG on Convensions*)
John Dow, ESA (*Delegate, IGS*)
Rene Forsberg, Danish Spacecenter (*Delegate, IGFS*)
Dorota Brzezinska, Ohio State University (*GGOS 2020 Writing Team*)
Michael Pearlman, Smithonian (*Executive Committee; Chair, GGOS WG Network and Communications*)
Erricos Pavlis, JCET/UMBC (*Delegate, ILRS*)
Frank Webb, JPL (*Invited Participant*)
Carey Noll, GSFC (*GEO Committee Representative*)
Philip Woodworth, POL/PSMSL (*Delegate, PSMSL*)
Bente Lilja Bye, NMA (*Chair, GGOS WG User Linkage and Outreach*)
Gerhard Beutler, UNIBE (*IAG President*)
Steve Kenyon (*Substitute, IGFS*)
Tom Herring, MIT (*GGOS2020 Writing Team, Lead Author Chapter 8*)
Richard Gross, JPL (*Science Panel*)
Andrea Donnellan, JPL (*Science Panel*)

Agenda:

1 **Welcome and Discussion of Agenda**

During the Welcome, it will be explained that the Retreat has three main focuses, with

1st Part: Reports from the Working Groups and GEO Representatives, including presentation of on-going work,

2nd Part: Discussion of the GGOS 2020 process, the preliminary results, and the consequences for implementation,

3rd Part: Building GGOS on the IAG Services and Commissions as well as regional implementations; discussing their potential contribution, and the challenge of integration, including the new ToR.

2 **Minutes of SC7**

The draft minutes of SC7 are available as ../scm7/minutes_sc7.html and ../scm7/minutes_sc7.pdf

. The minutes will not be discussed in any detail. The participants are asked to identify necessary changes and/or corrections.

3 **Action Item Status**

The list of action items from the previous Steering Committee meetings is available as ailist.html and ailist.pdf .

4 **Brief report from the Chair(s)**

- Markus Rothacher: Overview over the main activities of the GGOS Executive Committee since the 7-th Steering Committee meeting.
- Hans-Peter Plag: Report on recent developments with respect to GGOS2020 and IGOS-P Theme

5 **Decision on new Steering Committee members**

Representation of new Services on the Steering Committee, in particular IAS.

6 **Reports from GGOS WG**

The tentative program is:

- Hermann Drewes: WG on Conventions
- Michael Pearlman: WG on Networks and Communication
- Bernd Richter, Carey Noll: WG on Infrastructure and Data
- Bente Lilja Bye: WG on Outreach and User Linkage

7 **Reports from GEO Representatives**

The tentative program is:

- Markus Rothacher: Report on activities of the principals
- Hans-Peter Plag: Report on recent relevant developments in GEO
- Susanna Zerbini: Science and Technology Committee
- Bernd Richter, Carey Noll, Hans-Peter Plag: Architecture and Data Committee
- Hermann Drewes: Outreach and Capacity Building
- Hans-Peter Plag: User Interface Committee
- Hans-Peter Plag/ Tilo Schoene: Tsunami Working Group
- Discussion of GGOS - GEO relationship, with focus on active contributions and interactions, including the Task AR-07-03.

8 **The GGOS 2020 Process**

The preliminary program is:

- Hans-Peter Plag: Overview
- Reiner Rummel: Science requirements
- Dork Sahagian: Earth observation requirements

- Dorota Brzezinska: Societal requirements
- Jim Zumberge: Space requirements
- Richard Gross: Integrated requirements and functional specifications
- Tom Herring: New reference frame
- Markus Rothacher: Design of GGOS
- Gerhard Beutler: GGOS structure and implementation
- Hans-Peter Plag: Recommendations and discussion

9 **Building GGOS on the IAG Services**

The tentative program is:

- John Dow: IGS and GGOS
- Michael Pearlman: ILRS and GGOS
- Dirk Berend: IVS and GGOS
- nn: IDS and GGOS
- Chopo Ma: IERS and GGOS
- Rene Forsberg, Steve Kenyon: IGFS and GGOS
- Fernando Sanso: IGeS and GGOS
- nn: BGI and GGOS
- Hans-Peter Plag for David Crossley and Jacques Hinderer: GGOS and in situ gravimetry: GGP and GGOS
- nn: GGOS and time
- Philip Woodworth: PSMSL and GGOS
- Philip Woodworth: IAS and GGOS
- Andrea Donnellan: InSAR and GGOS
- Discussion

10 **Science and support for GGOS from the IAG Commissions**

The tentative program is:

- Commission 1, Hermann Drewes: Input to GGOS related to the reference frames
- Commission 2, Rene Forsberg: Input to GGOS related to gravity field determination and interpretation
- Commission 3, Harald Schuh: Input to GGOS related to Earth rotation and geodynamics
- Commission 4, Dorota Brzezinska: Input to GGOS related to positioning and applications
- Discussion

11 **Discussion: Building GGOS on existing and new components: The challenge of integration**

The discussion will focus not only on the integration of the existing services and the contribution of the commissions, but also consider the need for new services, components (e.g. bureaus, centers, regional implementations). Questions like the relation of GGOS to FAGS will also be addressed.

12 **Future structure of GGOS**

13 **Future GGOS ToR**

14 **GGOS 2007 Workshop**

15 **GGOS Meeting Schedule**

16 **Any other business**

17 **Summary of Action Items**

Welcome and Discussion of Agenda

Markus Rothacher welcomed the participants and opened the Retreat. He emphasized the importance of the meeting, and hoped that there would be a lot of discussions bringing GGOS further. There was a brief round of introduction.

Markus Rothacher introduced the scope and goals of the workshop (see his presentation available as presentations/rothacher_GGOS_Goal_Scope.pdf). The initial part of the meeting would be devoted to reports from the Working Groups and GEO Representatives, including presentation of on-going work. In a second part, there would be a discussion of the GGOS 2020 process, with a presentation of the preliminary results and the consequences for implementation. The third, most important part would focus on the building of GGOS on the IAG Services and Commissions, with time to discuss their potential contribution and the challenge of integration, including the new ToR.

Ruth Neilan gave some information on the logistics

The agenda was accepted without changes.

Minutes of SC7

The draft minutes of SC7 were made available as ../scm7/minutes_sc7.html and ../scm7/minutes_sc7.pdf . The minutes were not discussed in any detail. The participants were asked to identify necessary changes and/or corrections. There were no comments and the minutes were accepted as they were.

Action Item Status

The list of action items from the previous Steering Committee meetings was made available as ailist.html and ailist.pdf .

Bente Lilja Bye reported on ***Action Item GGOS-SC-7-1:*** Bente Lilja Bye to contact the IAG Outreach Branch in order to ensure coordination of GGOS and IAG outreach activities. ***Responsible: Bente Lilja Bye, Deadline: 2007-02-15.***

The IAG Outreach Branch is invited to join the GGOS Outreach WG.

Following up ***Action Item GGOS-SC-7-6:*** Markus Rothacher to clarify whether the GGOS session at IUGG can be extended to one day. ***Responsible: Markus Rothacher, Deadline: 2007-01-31.***

Markus Rothacher reported that the GGOS session at IUGG cannot be extended and the presentations will have to be selected carefully.

Concerning ***Action Item GGOS-SC-7-8:*** The three GGOS Chairs to plan and organize a side event at IUGG for the introduction of the GGOS 2020 documents to the public, with the IAG President giving

the main presentation at this side event. ***Responsible: Markus Rothacher, Hans-Peter Plag, Ruth Neilan, Deadline: 2007-03-31.***

Markus Rothacher pointed out that this will be followed up.

Action Item GGOS-SC-7-9: Markus Rothacher to contact the IAG Secretary and investigate whether there are any funds to support participants at the Retreat. ***Responsible: Markus Rothacher, Deadline: 2007-01-31.***

was not followed up and is obsolete.

Brief report from the Chair(s)

Markus Rothacher gave an overview over the main activities of the GGOS Executive Committee since the 7-th Steering Committee meeting (See presentations/rothacher_chairs_report.pdf). Main activities included the preparation of the Retreat, work on the program for the GGOS Workshop 2007, developing GGOS2020 further, and the writing of several letters. The latter included a letter concerning laser retro-reflectors on GNSS, a letter supporting a proposal for a GGOS Troposphere project by Johannes Boehm, University of Vienna, a letter concerning the WMO recommendation on reference frames, and a support letter for a proposal by Carey Noll on a Space Geodesy Data and Product Archive and Information System.

Harald Schuh explained that the proposal on GGOS Troposphere was submitted for national funding in Austria, and that the proposal was for six years and six persons. The proposal also addresses real time application.

As the next major step for GGOS, Markus Rothacher identified the finalization of the GGOS 2020 documents. He also mentioned the drafting of new ToR. With respect to the ToR, Gerhard Beutler pointed out that By-Law Changes need to be on the IUGG Council agenda by February 20, 2007. Markus Rothacher responded that IAG By-Law changes are not considered necessary. Depending on the discussion in GGOS 2020 and the proposed ToR, calls for proposals will be necessary, in particular for a GGOS Portal and a Central Bureau or Secretariat. Markus Rothacher also mentioned that the IGOS-P Theme proposal needs to be written and submitted to IGOS-P.

Subsequently, Hans-Peter Plag reported on recent developments with respect to GGOS 2020 and IGOS-P Theme (see presentations/plag_ggos2020_igosp_status.pdf). He gave an overview of the process since SC7, with the main points being the establishment of a team of reviewers and the release of two new version, namely version 0.15 and 0.16 on February 2, 2007 and February 17, 2007, respectively. With respect to IGOS-P, he reported that at the IGOS-P meeting on November 13, 2006 in Buenos Aires, he informed IGOS-P of the GGOS 2020 progress, and as a result, IGOS-P asked GGOS to prepare a Theme proposal for the next IGOS-P meeting in May 2007.

Decision on new Steering Committee members

Markus Rothacher introduced the request of the *International Altimetry Service* (IAS) and recommended that IAS should be represented on the Steering Committee (see the presentations/20070109_bosch_ggos_ec.eml). He asked whether there were any opposition. The Steering Committee accepted IAS as a new member unanimously. This led to ***Action Item GGOS-SC-8-1:*** Markus Rothacher to inform the IAS of the unanimous decision of the GGOS Steering Committee to include IAS in the Steering Committee and to ask IAS to nominate a IAS representative and substitute for the GGOS Steering Committee. ***Responsible: Markus Rothacher, Deadline: 2007-03-01.***

Reports from GGOS WG

WG on Conventions, Modeling and Analysis

Hermann Drewes introduced the work of the WG, which so far was focused on inconsistencies (see presentations/drewes_WG_CMA.pdf). In summary, the WG found that there are many inconsistencies with respect to constants, models, and procedures.

Erricos Pavlis reported on the view of the ILRS on *Conventions, Modeling, and Analysis* (CMA) (see presentations/pavlis_WG_CMA.pdf). ILRS has a WG that decides on CMA issues, and as a general role, ILRS aims to follow the standards and conventions of IERS. However, results may differ for the same software, same standards and conventions. Implementation of certain models differ from software to software. Revisting SLR analysis, he pointed out the different error sources.

Erricos Pavlis also gave a recommendation for GGOS Outreach by referring to the summer schools organized by the IGFS. Summer schools of GGOS could be comparable to those of the IGFS. GGOS could design such courses at various levels.

Gerhard Beutler commented that the work of the WG is important and that it is responding to a task given by the IAG Executive Committee to GGOS, namely the creation of a bureau for standards and conventions.

Reiner Rummel commented that the presentation was very interesting, and that the weakest links seem to be the gravity services. He suggested that gravity modeling groups would have to be involved (e.g. Texas), including those with terrestrial data.

Zuheir Altamimi underlined that gravity services have to work with the IERS to ensure that what has been done in this frame is taken into account. Along the same line, Bernd Richter commented that the work done under the IERS conventions is often underestimated and not valued enough. A new Bureau should therefore not go alone but rather be closely aligned to the IERS Conventions group. He also saw the main deficites in gravity field, while geometry has developed good conventions. Hermann Drewes responded that IERS conventions are actually not underestimated, but acknowledged that conventions are not followed enough. Hans-Peter Plag asked whether the work of the GGOS WG was coordinated sufficiently with the IERS Advisory Board on Conventions, and Hermann Drewes confirmed that coordination was ensured through several personal linkages.

Reiner Rummel pointed out that the conventions and modeling is more a matter of how to view the Earth. He stated that there is a wish to use the best available models, but that at the same time one has to ensure consistency. This trade-off is a very complex issue. Bernd Richter remarked that conventions do not follow the best model. They are always behind the scientific development and based on well validated models.

Gerhard Beutler requested that conventions and standards should be at a more visible level, e.g. through a specific bureau. This would not deny the work done by IERS but rather make it more visible. Erricos Pavlis also agree that one does not want to have the lastest and best model everywhere, but that one has to strive for consistency. Victor Zlotnicki contributed the thought that standards and their documentation are needed to document the differences of observations and procedures with respect to these standards. Tom Herring identified the need to distinguish a production level, which requires firm standards or conventions, and a scientific research part, which needs freedom to develop and progress models, procedures, and conventions. Hans-Peter Plag supported this by underlining the importance of having an operational part, particular if IAG recommends ITRF for WMO, GEO and others as the global geodetic reference frame.

Markus Rothacher reported that solutions start to combine geometry and gravity, and these solutions might be placed in between IGFS and IERS. He speculated that in the future, this may become a standard solution and separate products will not be appropriate. Harald Schuh identified a need for a specification of what should be IERS conventions and what should be left to the services for their internal conventions, and he recommended that only the technique-specific aspects should be left to the services. Riccardo Barzaghi pointed out that both standard and non-standard solutions are required, with the latter being crucial for scientific progress. Rene Forsberg emphasized the need for a bureau for standards and conventions. Bente Lilja Bye ask who would get the authority to decide on the conventions and standards inside the IAG and what the procedure for accepting the standards would be. Hermann Drewes responded that fundamental constants are decided by IAG.

WG on Networks and Communication

Michael Pearlman introduced the work of the WG by reviewing the Charter and work plan (see presentations/pearlman_WG_GNC.pdf). He commented that concerning inventory tasks, a lot of information is already available through the INDIGO project. However, gravity and tide gauges are still missing. As a key issue, he identified the question of how many stations are needed to achieve certain goals, such as constraining the center of mass with a mm accuracy over decades.

Erricos Pavlis reported on NASA Next Generation Geodetic Network Simulations (NNGGNS) done in order to answer this question (see presentations/pavlis_WG_GNC_NGN.pdf). Simulations are done with a layered approach, starting from an optimal combination of VLBI and SLR, and then successively including more techniques. In the simulation, the covariance of the 14-parameter similarity transformation is considered for successively smaller networks. The Z-component of the origin and the scale as well as their rates are the parameters most affected by decreasing station numbers. A minimum of twelve stations with collocated SLR and VLBI is found in order to get the 1 mm in coordinates and 0.1 mm/year in rates.

Several participants, including Harald Schuh critizied the fact that the number of twelve stations is given. Erricos Pavlis clarified that this number will not be given somewhere else, it is just showing a geometric property, not taking into account other error sources and the need for redundancy. It only clarifies the necessary amount of overlap on stations.

In a second part of the presentation, Erricos Pavlis reported on AuScope (see presentations/pavlis_GNC_AuScope.pdf), which includes the extension of the geodetic network in Australia. The new collocated SLR/VLBI site in northeastern Australia (KATH) adds to the global network, and simulations show that this site will improve accuracy of the rate for Tz.

Chopo Ma reported on the VLBI simulation, which have the goal to specify antenna locations, and antenna sensitivity (see presentations/ma_GNC_vlbi.pdf). Status is that the validation has been done, and the steps to carry out the simmulation runs are prepared. However, the runs still need to be done.

Dirk Berend briefly summarized the work on local ties (see presentations/behrend_GNC_local_ties.pdf). Typical accuracies of local ties are 1 to 3 mm, but the number of collocation sites is too small. He explained the observational routines, including an automated procedure for local tie determination. Reiner Rummel commented that in previous discussions of local ties, a certification was brought up and asked whether this would not be an approach to ensure that the local ties are on the necessary level. Dirk Berend responded that the high cost of the automated procedure might be in favor of a certification. Michael Pearlman pointed to the fact that geodetic techniques are measuring mm displacements over thousands of kilometers while locally distances of 50 m cannot be measured to

better than 1 cm. Bernd Richter pointed out that it is not the distance measurement that is the problem, but rather the reference point definition, which introduces the large uncertainties.

In the last presentation of the GNC WG, Michael Pearlman spoke about the retroreflector arrays on GPS III (see presentations/pearlman_WG_GNC.pdf), for which hollow cube arrays are used. Bernd Richter asked how these corner cubes work, and Michael Pearlman explained that the coating ensures the reflections. Main advantage of the cubes is a significant saving in weight (factor 3).

WG on Infrastructure and Data

Bernd Richter gave a report on the activities of the WG (see presentations/richter_DIS.pdf). He declared that the WG will support GGOS in data management aspects, including coordination, and implementation of the GGOS data and information system, support the evolution of a GGOS data portal, promote the use of standards and conventions, and recommend the implementation of meta data management for GGOS with the goal to guarantee the interoperability with other databases and services. Building on the successful history of IAG and aligning GGOS with GEOSS are important guiding principles for the WG. He reported that lists of available data and products are already set up, which show that the IAG Services already produce very important and valuable products. The promotion of these products for Earth sciences and applications through an internet portal is considered a central task. Metadata are of crucial importance for interoperability. The WG is working on a proposal for a GGOS Core metadata template. As next steps, he identified the completion of the catalogue of GGOS products, a decision on the metadata catalogue, the creation of metadata, and setting up of service applications, with the final point being the GGOS data portal. The following action item was identified:

Action Item GGOS-SC-8-2: Bernd Richter to facilitate a decision of GGOS concerning the future metadata standard to be adopted by GGOS. ***Responsible: Bernd Richter, Deadline: 2007-05-01.***

Victor Zlotnicki commented the large number of small files may result in more metadata than data, or large files having sets of metadata. Victor Zlotnicki asked whether the metadata also describes the format, and Bernd Richter responded that this is not the case. Those who want to use the data need to get to know the format. Philip Woodworth doubted the need to have the metadata associated with the data. Ruth Neilan asked whether the proposal for metadata included in the presentation could be considered a standard for geodetic metadata. Bernd Richter explained that the underlying ISO metadata standard was used by, for example, WMO, and if one wants to use the available tools and to be compatible with other catalogues, it would not make sense to set up an own standard.

WG on Outreach and User Linkage

Bente Lilja Bye summarized the work of the WG (see presentations/bye_OUL.pdf). She reported that the IAG Outreach Branch was contacted and that a representative will join the OUL WG. Cooperation with IYPE is initiated. The GGOS Web pages, which she considers crucial for outreach, were discussed in a meeting with Markus Rothacher at GFZ. There was considerable discussion with respect of how to improve the pages. Hans-Peter Plag requested that the pages are brought up to date, pointing out that some pages state since 2004 that they are under construction. He reported that comments sent to Katrin Gundrum are normally followed up very rapidly and urged all to look at the pages and provide comments and suggestions. Asked to whom to send these comments, Markus Rothacher stated that these mails should be sent to Achim Helm.

Action Item GGOS-SC-8-3: All to look at the GGOS Web Pages at http://www.ggos.org and provide comments, suggestions, and material to Achim Helm. ***Responsible: All GGOS Steering Committee, Science Panel and WG Members, Deadline: Continuously.***

Bente Lilja Bye asked how the future relation between the main GGOS web site at http://www.ggos.org and the more internal page at http://geodesy.unr.edu/ggos/ should be and who should do what. There was agreement that the GGOS-UNR web page was important for the internal GGOS activities and that this page should be maintained for the time being.

As the next steps for the WG, Bente Lilja Bye identified the improvement of the Web Page, work on a broschure/leaflet for GGOS, and the implementation of the GGOS outreach plan, which should follow the GEO outreach plan. Hans-Peter Plag asked to add the first circular for the GGOS Workshop to the to-do-list.

Reports from GEO Representatives

Markus Rothacher opened the sequence of GEO representatives reporting on the activities of the principals (see presentations/rothacher_GEO.pdf). He mentioned the GEO Plenary in November 2006, where the Work Plan 2007-2009 was accepted. The preliminary Task Sheets became available in January 2007.

Hans-Peter Plag added some comments on the preparation of the Ministerial Summit, which will take place in November 2007 (see presentations/plag_geo_status.pdf) and emphasized the need for GGOS to get involved in Task Forces 1 and 2.

Susanna Zerbini reported on the work of the Science and Technology Committee (see presentations/zerbini_STC.pdf). She participated in the STC meeting on February 2nd in Paris, where the draft science paper was discussed. IAG had provided an alternative draft with a suggestion of a science panel for GEO, but this suggestion was not supported by the STC Co-chairs. The new STC draft paper was a merge of the old draft with some new ideas without any clear line visible, and this latest draft was heavily criticized in Paris. She noticed that there is some resistance in the STC towards GEO out of fear of loosing funding. Susanna Zerbini also summarized the structure of the new draft.

Gerhard Beutler asked how IAG is accepted in that community. Susanna Zerbini responded that it is important to be present and to contribute.

Bernd Richter reported on the work of the Architecture and Data Committee (see presentations/richter_ADC.pdf). A main topic in the ADC is interoperability. Interoperability arrangements will be the main method for incorporating components into a pilot implementation of GEOSS Architecture. He also mentioned DA-07-01 (*DEM Interoperability: Facilitate interoperability among Digital Elevation Model (DEM) data sets with the goal of producing a global, coordinated and integrated DEM*), and pointed out that it was not clear who is in there for IAG. Concerning AR-06-11 (*Radio Frequency Protection: Prepare a series of appropriate advocacy activities, including representations to the International Telecommunication Union. For example, evaluation of challenges presented by the industrial development of automobile anti-collision radar and the implications for the use of radio frequencies essential for tropospheric sounding*), it was pointed out that IAG should be involved. Hans-Peter Plag mentioned a recent CEOS report on protection of radio frequencies for Earth observations, where VLBI is not even mentioned. The following action item was agreed:

Action Item GGOS-SC-8-4: Hans-Peter Plag to make available the CEOS report on radio frequency protection for Earth observations. ***Responsible: Hans-Peter Plag, Deadline: 2007-03-15.***

Subsequently, Hans-Peter Plag reported on AR-07-03 (see presentations/plag_geo_adc_task_ar0703.pdf). He pointed out that GGOS 2020 as well as the organization of the GGOS 2007 Workshop are

deliverables of this task. It will also be important that IAG/GGOS motivate other Participating Organizations to join the task team.

Hermann Drewes reported on the activities of the Capacity Building Committee (see presentations/drewes_CBC.pdf). He summarized the goals of this committee and reported on its activities. He pointed out that capacity building is understood in the sense of actually building up the capacity to carry out Earth observations by facilitating the establishment and maintenance of baseline sites for global in situ and remote sensing networks that cannot always be justified on national grounds alone. The CBC has four tasks assigned and he briefly summarized these tasks.

Reporting on the User Interface Committee (UIC), Hans-Peter Plag summarized the recent activities (see presentations/plag_UIC.pdf) and reviewed the 28 tasks assigned to the UIC. Most of these tasks are related to coordination or activation of users. A main achievement of the UIC is the initiation of about eight Communities of Practice. He pointed out that GGOS needs to continue to be represented in the UIC.

Concerning the GEO Working Group on Tsunamis, Hans-Peter Plag pointed out that since February 2006, this group had not be active. It was not clear what this group is going to do in the future.

Subsequently, there was a brief discussion on GGOS representation in the various committees. Chris Rizos had announced that he was not able to continue as representative in the CBC. Michael Pearlman had also mentioned that he may not be able to contribute to the STC. Hans-Peter Plag emphasized the importance of active participation of GGOS in the GEO Committees and relevant Tasks. He mentioned in particular Task DI-06-02 (*Seismographic Networks Improvement and Coordination: Facilitate improvement of capabilities for global seismographic networks such as GSN, FDSN, DAPHNE, GNSS networks and new ocean bottom networks such as VENUS and NEPTUNE and sharing of data and event products among GEO members*), and Ruth Neilan reported that she is actively involved in this task. However, no decissions concerning new representatives in the committees were made.

The GGOS 2020 Process

Hans-Peter Plag opened his presentations on the GGOS 2020 process with an overview of the activities since December 2006 (see presentations/plag_ggos_2020_introduction.pdf). Main points were the establishment of a group of reviewers and the release of versions 0.15 and 0.16 on February 2 and February 17, respectively. He then continued to summarize the Executive Summary and the Introduction. For Chapter 2, he gave an overview of the current status and the main gaps, and asked for additional contributions. Gerhard Beutler requested that the overlap between the geometric and Earth rotation part be reduced. Gerhard Beutler agreed to review the historic part of the chapter, while Zuheir Altamimi agreed to look at the section on reference systems and frames. As a result of the discussions, two action items were agreed:

Action Item GGOS-SC-8-5: All Writing Team members to review Chapter 2 and to contribute input where possible. ***Responsible: All GGOS 2020 Writing Team members, Deadline: 2007-03-10.***

Action Item GGOS-SC-8-6: Susanna Zerbini to contact experts on time and ask for contributions to Chapter 2. ***Responsible: Susanna Zerbini, Deadline: 2007-03-05.***

Reiner Rummel presented thoughts on the chapter on science user requirements. He had asked eleven potential authors, and ten of them provided input. He collected these contributions and put them into an original version of the Chapter. This Chapter had then been restructured by the lead editor Hans-Peter Plag. In general, he agreed with the present structure although some parts still were missing. Moreover, there was considerable overlaps internally and externally with Chapter 4. Some

of the figures were difficult to understand, in particular those in the Earth rotation section provided by Veronique Dehant. He also commented on Chapter 6, which he did not find in a very good shape. For planetary geodesy, only the rotation was covered, while topography and the needs of planetary physics were missing. He suggested that the planetary chapter should be comparable to the Earth science chapter.

Concerning the logic of the Earth science chapter, he pointed out that it was important to decide whom we are addressing with this chapter. For the reference document, he identified three groups, namely (1) ourself, (2) young scientists, and (3) Earth scientists in general. For (1), he considered the chapter in good shape. For (2), the situation was not as good. The chapter should identify a list of topics, which young scientists could pick as phd thesis. Currently, the chapter does not clearly identify these issues. For (3), serious criticism can be made, since the chapter is not directed well enough to other scientists. It contains too much text of the 'we are really good' type. He saw the need to twist the chapter more to 'what are geodetic contributions to Earth system science'? Earth system science starts with conservation laws (mass, angular momentum). Taking sea level as an example, geodesy can help to separate the contribution of mass and heat to sea level rise. He pointed out that Section 2 of the chapter tries to address the geodetic work and its logic, and what is needed for the observing system. All other sections talk about Earth system science, which is fine. What should be elaborated is the work done by Hermann Drewes on constants and consistency. What model do we aim at? What models do we have? The models should be the same for all fields. Another class of problems he identified is spectral: local, regional and global data have to be combined. He also mentioned the need for complementary measurements and the expectation of neigbouring scientists that geodesy provides the metric.

Concerning the Earth scientific challenges, he pointed out that the contributions in the chapter can be divided into two classes, namely a first class of contributions written with the eyes of an Earth scientist, addressing questions of what geodesy can do for oceanography, meteorology, and solid Earth science, and a second class of contributions written by those who know what geodesy can do. He contemplated that a mix of these two aspects may not be the right thing to do. It would be more useful to have two levels.

He also identified the parts not yet done. The work still pending includes adding tables of quantitative requirements, and a so-called science fiction part, which would address future science possible with a much improved geodetic observing systems. Examples are much better clocks, three GNSS, future gravity missions, and sea floor geodesy.

After the presentation, Hans-Peter Plag explained that the part on planetary geodesy was compiled by him from a contribution that was submitted by Veronique Dehant for the Earth science chapter. Thus, most of that part was still to be written.

Gerhard Beutler asked Reiner Rummel whether he could go through the chapter, remove overlaps, and get it polished. Reiner Rummel responded that it is very difficult for him to cut out some of the good parts. Hans-Peter Plag emphazised the need to cut and make the different parts equal in their weight. Richard Gross pointed out that this editing is a task of the lead authors. Victor Zlotnicki commented that he can increase the contribution on oceanography along the lines indicated by Reiner Rummel, but that it is not clear how glaciology could be brought up to the level. As a result of the discussions, the following action item emerged:

Action Item GGOS-SC-8-7: Reiner Rummel to revise the GGOS 2020 chapter on Earth science requirements for geodetic observations. ***Responsible: Reiner Rummel, Deadline: 2007-03-10.***

Hans-Peter Plag briefly presented the chapter on the geodetic requirements of Earth observation (see presentations/plag_ggos_2020_introduction.pdf). He pointed out that the chapter is organized around the nine societal benefit areas of Earth observations identified by the Earth Observations Summits and central in GEO. He mentioned that besides the general requirements for positioning, estimates of mass transport were key contributions of the geodetic observation system to Earth observations. Michael Pearlman and Tom Herring pointed out that geodetic measurements can contribute to observations of carbon with lasers. This resulted in ***Action Item GGOS-SC-8-8:*** Michael Pearlman and Tom Herring to provide input for GGOS 2020 with respect to future observations of atmospheric carbon based on geodetic measurements, which is relevant for the GEO SBA on ecosystems. ***Responsible: Michael Pearlman, Tom Herring, Deadline: 2007-03-10.***

Dorota Brzezinska presented the chapter on societal requirements (see presentations/brzezinska_chapter4.pdf). She emphasized the importance of *Positioning, Navigation, and Timing* (PNT) for a modern society. GNSS is central in providing these functions to society, while the reference frame is crucial, too. With respect to engineering, she identified current trends from static to kinematic, from point positions to image, and from post-processing to real-time. Her presentation gave an impressive overview of how much society depends on geodetic utilities for its functioning.

Hans-Peter Plag asked how questions of liability and integrity come into the picture. A key issue here is the consistency of databases and positioning in a reference frame, which also determines the lifetime of databases. The discussion resulted into the action item ***Action Item GGOS-SC-8-9:*** Chris Rizos and Dorota Brzezinska to revise the chapter on societal requirements according to the discussions at the Retreat and to ensure that liability, integrity, and database lifetime are addressed appropriately. ***Responsible: Chris Rizos, Dorota Brzezinska, Deadline: 2007-03-10.***

Based on the fact that the chapter shows impressively how geodesy supports societal applications, Gerhard Beutler suggests to exchange the sequence of this chapter and the one on Earth observations. Hans-Peter Plag asked whether it would make sense to actually start with the societal chapter, then go to Earth observations and Earth science, and have the planetary geodesy as last of the four chapters. However, there was clear opposition against this sequence, and Reiner Rummel emphasized that the geodetic observing system is mainly science-driven. Ruth Neilan supported this view by stating that the current chapter on Earth science puts the requirements part in balance and should come first.

Action Item GGOS-SC-8-10: Hans-Peter Plag to switch the chapter on Earth observation and the chapter on societal applications in sequence. ***Responsible: Hans-Peter Plag, Deadline: 2007-03-05.***

Bernd Richter noted that the chapter only considers the geometrical part of geodesy, and he asked whether gravity should be added. Hans-Peter Plag added that the aspect of exploring the ocean should be extended, including offshore ocean bottom engineering.

Richard Gross presented the chapter on requirements of planetary geodesy and solar system exploration (see presentations/gross_chapter6.pdf). Reiner Rummel asked why the examples are the ones chosen? Richard Gross explained that the choice was based on what we know and on the importance of the planets. Gerhard Beutler suggested to include an introduction outlining what can be done and what do we expect for the future. Tom Herring pointed out that the dynamical reference frame for the solar system was not addressed. Richard Gross agreed and added that also the reference frame on the planets and the Moon should be addressed. There was general agreement that planetary geodesy needs to be addressed in a more comprehensive way. ***Action Item GGOS-SC-8-11:*** Hans-Peter Plag

and Jim Zumberge to ensure that planetary geodesy is addressed comprehensively in the chapter on planets and solar system exploration. ***Responsible: Hans-Peter Plag, Jim Zumberge, Deadline: 2007-03-15.***

Richard Gross presented an overview on the chapter on integrated requirements and functional specifications (see presentations/gross_chapter7.pdf). He reviewed the structure of the chapter, discussed the list of tasks, and considered the future products of GGOS. He pointed out that the current version does not include tables of quantitative requirements. Moreover, the current text on functional specifications was based on a biased understanding of the term 'functional specifications'. Hans-Peter Plag added a few suggestions with respect to tables of quantitative requirements and functional specifications (see presentations/plag_ggos_2020_additional.pdf) He suggested that the tables provided in Plag (2006) could be a starting point. ***Action Item GGOS-SC-8-12:*** Richard Gross to add quantitative tables for requirements to the chapter and to include tables on functional specifications. ***Responsible: Richard Gross, Deadline: 2007-03-15.***

In the subsequent discussion, it was pointed out that the products should not be listed as GGOS products, but rather as products facilitated by GGOS.

Tom Herring presented considerations on the future reference frame (see presentations/herring_chapter8.pdf). He emphasized that the method to realize the reference system is still under discussion. However, two systems are needed, namely the rotating terrestrial and the external inertia system. For the former, he suggested to base it on potential and to have surface coordinates correspond to surface mass elements. The problem is then how to determine the motion of these mass elements, which could be done with a sufficiently complex dynamical model. He described two classes of sites, namely those for frame realization, which should have relatively simple motion, and other reference sites with more complex motion. Anomalous motion would be deviations from the predicted positions. With respect to height, he pointed out that the gravimetric concept is embedded in the frame but the spatial resolution may not be sufficient. Future missions might help to resolve this problem.

Zuheir Altamimi emphasized the need to preserve the link between the geometric measurements and the frame. Reiner Rummel pointed out that the title of the chapter addresses the reference frame, not the reference system, but Zuheir Altamimi maintained that the system is also important. Reiner Rummel suggest to collect all parts related to the reference frame in the chapter so that other chapters could cross-reference to that. Hermann Drewes supported this proposal. Reiner Rummel also identified that there is very much evolution in specific aspects and suggested that the chapter should not formulate the specific products, but rather indicated the direction.

In his presentation, Markus Rothacher discussed the design of GGOS in detail (see presentations/rothacher_chapter9.pdf). He emphasized that GGOS as an organization does not own the infrastructure, while GGOS as the observing system does have the infrastructure. His chapter addresses the latter meaning of GGOS. Besides the instrumental infrastructure, which is the core of GGOS as a system, GGOS has far more, including data infrastructure, operational data analysis and the GGOS Portal. The structure of the chapter takes this into account.

Gerhard Beutler reviewed the chapter on the future GGOS structure and implementation in detail. He emphasized the need to make a statement that an uninterupted series of gravity satellites is needed. With respect to the organizational diagram proposed by Gerhard Beutler, Markus Rothacher stated that *Bureau* may imply a longterm orientation, and some of the work could be done be a WG. It was agreed to rename the 'bureaus' to 'entities'. Michael Pearlman suggested that the Science Panel

could recommened satellite missions. Ruth Neilan commented that the Science Panel may not be the right group to advocate satellite missions to the space agencies and suggested that this task should be handled by a coordination group. Ruth Neilan also preferred the name Secretariat instead of Central Bureau. There was agreement to keep the name Steering Committee instead of a Governing Board.

Action Item GGOS-SC-8-13: Hans-Peter Plag to modify the organizational diagram for the future GGOS according to the discussions at the Retreat (renaming bureaus to entities, use of Steering Committee and Secretariat, changing arrows, no surrounding box). ***Responsible: Hans-Peter Plag, Deadline: 2007-03-05.***

Chopo Ma identified that the chapter mixes the organizational and technical aspects, and requested that the chapter addresses more the organizational aspects. Michael Pearlman commented that there may be a trade-off between satellites and ground stations when specifying the future infrastructure. Hans-Peter Plag emphasized the need to have some non-geodetic products, in particular some related to the Earth system. He asked whether there is a need for a Earth system or mass transport center, and suggested that an upgraded GGFC might be able to take that role. However, there was little support for this suggestion.

In a final presentation, Hans-Peter Plag summarized the status of the chapter on recommendations (see presentations/plag_ggos_2020_introduction.pdf). The chapter is currently in a preliminary status, with some initial recommendations on framework conditions, infrastructure, products, organization, and specific actions. As target groups for the recommendations, he identified GEO, CEOS, and IGOS-P. He urged all lead authors to critically review the recommendations and to added additional aspects. Gerhard Beutler stated that the number of recommendations should be kept small. In the discussion, it was emphasized that the recommendations also should include as target group IAG, the Commissions and Services.

Building GGOS on the IAG Services

John Dow started this part of the program on Wednesday morning with a presentation on IGS and GGOS (see dow_igs.pdf). He introduced the IGS with its products and station network, and mentioned the GLONASS pilot project. He mentioned that at the IGS Workshop in May 2006, a session was devoted to GGOS, and some of the Workshop participants were surprised by the high political level of the activities. He then proceeded to introduce the IGS Strategic Plan, in which GGOS is prominently present. In answering the questions posed by the GGOS Executive Committee, he emphasized the readiness to contribute to GGOS with network, products, common working groups, and logistics. He also mentioned a real-time component (real-time point positioning).

IGS has a number of non-GGOS activities that will have to be continued. The added values of GGOS could be an increased interaction with the other services, a better focus on societal objectives, highlighting the need for more stable funding, and a collective voice of GGOS making the important role of geodesy for many applications more visible. He also mentioned a number of technical improvements including retro-reflectors on GNSS satellites, a better approach to site ties.

As critical points, he addressed the question how GGOS will affect what people do, steps towards making GGOS concrete (e.g. through a pilot project), strengthening the links to the gravity services, bringing in altimetry, and using SAR.

Organizational, he noted that IGS is well represented in the GGOS Executive Committee, that the IGS Governing Board is fully behind GGOS, GGOS is firmly embbeded in the IGS Strategy Plan, and that the current proposed GGOS structure appears to be adequate. The technical components are

expected to reflect the current structure and elements. With respect to the GGOS portal, he mentioned that the IGS website can be embbeded in a GGOS portal, and IGS fully supports this integration. A similar look of the services' web pages could be a longterm goal.

Michael Pearlman presented the answer of the ILRS to the questions posed by the GGOS Executive Committee (see presentations/pearlman_ilrs.pdf). Concerning the role in GGOS, he stated that the Services are the action elements and should be partners, with GGOS being the overarching element. As outside relations to be maintained, he mentioned specific mission support. Concerning expectations towards GGOS, he identified scientific guidance, explicit measurement requirements, and a higher level of scientific justification for what the services do. He saw the added value in improved guidance for service operations. While the general organization proposed for the future GGOS looked okay, he requested a better definition of the interaction of the components and asked where the decision authorities lay. Concerning the technical components, he saw the need for a better clarification of what GGOS really is, and suggested that GGOS is a clearinghouse based on the products of the Services. The main contribution of the ILRS would be to continued the current operation. The ILRS is appropriately represented in GGOS and the GGOS 2020 documents, except for LLR. With respect to standardization, he requested that the portal should be dramatic and exciting. A common portal should be built through links with a layered structure based on meta data. Thus, the portal should be the front door, leading to everything, maybe through links. ILRS would agree to GGOS standards, but it also should be clear that meta data is not selling GGOS, while the products are. Concerning a common layout for all web pages, ILRS responded with a clear NO since too much has already been done for the individual pages.

Markus Rothacher asked what additional products could be made available. Michael Pearlman responded that additional information about the geodetic products would be an important step. Hans-Peter Plag added that Earth system products would be very important, e.g. similar to EarthScope, with its outreach to schools, education, and public. The vision should be that GGOS is the point of contact for all aspects of global geodesy. Tom Herring pointed out that EarthScope has funding for its outreach activities, and eventually GGOS would need such funding, too. Erricos Pavlis suggested that GGOS could link to existing sources including EarthScope and WEGENER. Bernd Richter proposed the idea to combine all the individual portals, and emphasized the importance of the right keywords that would lead searches to the right pages and products.

Dirk Berend presented IVS' responses (see presentations/behrend_ivs.pdf). He started by outlining the role of IVS, which is based on the unique strength of VLBI. IVS has a number of outside activities that will continue, including radio astronomy, networking, independent technology developments, data recording, and storage. IVS expects from GGOS a frame for geodetic activities, stimulation of new ideas, motivatation of new developments, a better user interface, and help in getting funds. As added value of GGOS, he identied product improvements through combination, synergies, coordination, and increased visibility. With VLBI2010, IVS had already developed the perspective in view of GGOS. Concerning GGOS 2020, he pointed out that the Services should remain independent to a certain stage. The consistency of the reference document should be checked by passing it through the Services' CBs. He asked the questions whether the required network sizes should be specified. Detailed comments on the report included that the CRF is missing in Table 1. Concerning the GGOS Portal, IVS would like to see it as common entry point. As critical points, he identified the fact that all activities are based on voluntary contributions with the dependence on good will of the contributors. As a consequence, the structure and operation of Services could change.

Subsequently, there was considerable discussion on whether we should have numbers on network size in the report. The consensus was that numbers should be included, with a discussion of redundancy,

and minimum numbers. Ruth Neilan reported that John LaBrecque would like to have some quantitative requirements in terms of station numbers, but this is not easy to achieve with justification for the numbers. Chopo Ma voiced concerns that there may be many questions on where the numbers came from. Reiner Rummel pointed out the need for having an internal document that does specify the network size numbers, while others stated that such a document potentially might do damage.

Zuheir Altamimi presented some input from IDS (see presentations/altamimi_IDS.pdf). He summarized future missions to be supported by DORIS and showed the DORIS network. There is a new IDS web site, including a virtual tour of the IDS network. There was a DORIS special issue in Journal of Geodesy. Concerning the relation of IDS and GGOS, he saw the main role in provision of routine geodetic products, and keeping suitable satellite constellations. Outside activities include the support for the altimetry community. IDS can potentially accept GGOS standards if they do not conflict with already existing standards The added value of GGOS is seen in coordination of services, and lobbying for space geodesy. The proposed organization structure for GGOS is supported. IDS provided some thoughts on the GGOS 2020 document, and pointed out that DORIS is not mentioned in a specific chapter. With respect to co-location of instruments, the question was what a 1 mm level means. Some satellite missions are missing in the respective tables and should be added. A common GGOS portal would be supported if it would not be a disturbance, but it should be limited to meta data. IDS compliance with meta data standards would depend on the man-power required for this. Also, a common design of the web pages would be okay, but IDS asked who would be able to do the job.

Andrea Donnellan reported on InSAR and GGOS (see presentations/donnellan_InSAR_1.pdf and presentations/donnellan_InSAR_2.pdf). She mentioned the 2004 workshop, and she summarized the decadal summary. Concerning a future international InSAR organization, she mentioned the international partners in Japan, Europe, Brazil, Taiwan. CEOS is important for InSAR and coordinates activities with GEOSS. For the ground segments, there is a concept proposal for the *International SAR Information Service* (ISIS), but it is not implemented. She reported that NASA sees a role for GGOS here. She also mentioned several relevant international years such as the IPY and the IYPE. Concerning geodetic networks, she saw a support for InSAR through geodetic control, atmospheric maps, calibratation and validation of InSAR, and the general complementarity of the two methods. InSAR provides complementary measurements of crustal deformation, changes in cryosphere, hydrology, land cover, and oceanography. With respect to reflectors, she described the new concept of reflector arrays. Ruth Neilan pointed out that more text on InSAR is needed in the GGOS 2020 document. Markus Rothacher asked who the main players in ISIS are, and Andrea Donnellan informed that John LaBrecque and Craig Dobson are aiming for a service. They hope that GGOS can go in and support this development. Tom Herring pointed to the potential conflict of such a service with commercial companies. This stimulated some discussion, with some participants supporting this view and others being more optimistic. Ruth Neilan asked about ISPRS' interest in InSAR, and Hans-Peter Plag suggested that IAG and CEOS together might work out a solution for a future service.

Chopo Ma presented IERS views on GGOS (see presentations/ma_iers.pdf). Formal responsibilities of the IERS are the terrestrial reference system, the celestial reference system, and the monitoring of Earth rotation. IERS has scientific as well as non-scientific users, with the latter outnumbering the first. He explained the structure of IERS, which depends fully on the Services. Therefore, coordination is important. With respect to IERS' role in GGOS, the main function is a combination service for geometry and rotation. IERS has the mandate for ICRF and ITRF. The conventions have to interface with GGOS Geodetic Standards. IERS is also a data center for various data sets.

IERS' expectations to GGOS are related to a better representation of geodesy in the public, an interface to international programs, the development and promotion of an Earth science rationale, co-

ordinated user feedback, unification of geometry and gravimetry, and a forum for the services. The proposed organization is considered overly structured, while the interaction of IERS and a future entity on geodetic standards needs to be determined. Concerning the technical components, IERS commented that the overall GGOS description is misleading, and the IERS is not sufficiently described and identified. Greater details are needed for the current IAG Services. In particular, a list of the contributing institutions should be added.

With respect to the GGOS Portal, Chopo Ma pointed out that IERS already has data and meta data standards. GGOS standardization should not be in conflict with these. The Portal should contribute to a better user linkage.

In the discussion, it was suggested that a list of all institutions should be added (with help of the Services). Hans-Peter Plag pointed out that it would be good to have an estimate of the resources required to maintain the current infrastructure and services. This led to the

Action Item GGOS-SC-8-14: Hans-Peter Plag to request from the Services an overview on which institutions contribute to the individual services and estimates on the personyears reaquired to maintain the infrastructure and services. ***Responsible: Hans-Peter Plag, Deadline: 2007-03-05.***

Rene Forsberg presented the gravity part related to IGFS (see presentations/forsberg_IGFS.pdf). He explained the structure of IGFS, which includes BGI, IGeS, ICET, ICGEM, IDEMS as technical Center. The IGFS has a web page, but all services included in the IGFS have their own web pages, too. Rene Forsberg made a point that GRACE is not giving a 1 mm geoid in general, only on long wavelength. However, the geoid is a point quantity, therefore, local data is important. He also provided an overview of activities, include regional conferences focusing on data access, summer schools, and work towards a new GGOS reference model. This model, the EGM 2007, has a higher resolution than EGM97, and a lower RMS. As main problem, he pointed out that local data are not available in large parts of the world. Rene Forsberg emphasized the need to validate the local geoid with GPS leveling. He mentioned that an absolute gravity database is being built up, and recommended that some of these sites should be designated as GGOS stations. The products of IGFS should be limited to global quantities, such as the global fields, a global vertical datum at 6 mm level, and global geoid models. In terms of improved services, the IGFS expects GGOS to contribute to or facilitate improved conventions and recommendations, improve databases, data web, and unified gravity model for GGOS. However, this needs a Central Bureau. The vision of IGFS is a seamless service, based on well defined standards and conventions, providing coordination for global services, and encompassing the complete set of gravity-relevant services.

Victor Zlotnicki informed that JPL will make available three GIA models, which give the two extremes and a medium prediction. Philip Woodworth asked where sea level comes in.

Reiner Rummel commented that the IGFS and the other gravimetric services are in a shape much better than what he expected. He also mentioned the GGFC, and suggested that the model center should include topography, and other Earth model related parameters. Hans-Peter Plag pointed out that the name of the ICGEM gives the impression of a center for comprehensive global Earth models, while it is focused on the gravity field only. He emphasized the need for the ICGEM to be coordinated with the GGFC, particularly if the proposal by Tom Herring for the future reference frame is to be followed up.

Philip Woodworth presented PSMSL (see presentations/woodworth_psmsl.pdf). He summarized the main objectives and achievements of the PSMSL and its relation to GLOSS. GLOSS is under IOC and JCOMM, and PSMSL supports GLOSS functions, e.g. in Africa. He identified that GGOS 2020

currently has nothing on PSMSL. Concerning PSMSL, the funding situation recently was secured for the next 6 years, and he stated that PSMSL can contribute to GGOS particularly with respect to the geodetic fixing of tide gauges.

Concerning PSMSL's role in GGOS, PSMSL can provide the link between GGOS on the one side and GOOS and GCOS on the other side. PSMSL has links to IGS, and PSMSL is involved in capacity building. However, outside links of PSMSL are about 90% while links to GGOS are of the order of 10%. Most links are to IUGG/IOC/GLOSS.

PSMSL's compliance to GGOS standards would depend on the standards. Ocean activities have IODE to advice on standards, and GGOS standards would have to be compliant with these. Therefore, GGOS needs to talks to IODE concerning future standards.

The added value of GGOS is seen to be in improved services, better estimates of land movement, and increased benefits in public view. However, sea level seems to be slightly off this line. Commenting on PSMSL's expectations, he repeated that PSMSL is not included in GGOS 2020. This is also true for FAGS, which is not considered in the document. He pointed out that FAGS intends some standardizations of the web pages of the FAGS, and this should be taken into account in the GGOS web page developments.

Subsequently, Philip Woodworth introduce the IAS (see presentations/woodworth_IAS.pdf), which is in a phase of being established. The IAS is interdisciplinary and serves others than GGOS, too. In the GGOS documents, the IAS should be represented properly with its contributions. Philip Woodworth stated that the IAS does exist, and he presented a summary of activities. The proposed ToR were not accepted in spring 2006, mainly because they seemed to be overly structured. Instead, a pilot project was set up, and a call for participation was published on January 15, 2007 (see presentations/call4IAS-office_2007-01-14.pdf) with the goal to set up an Integrating Office. Selected applicant will be nominated for approval by IAG and IAPSO at IUGG 2007. The role of IAS within FAGS (now CAGS) is not clear.

Victor Zlotnicki pointed out that the problems with the ToR were caused by the fact that there was no information on the output of the IAS, but the Call clarifies this issue now. It is however not yet clear who is going to respond to the Call. Bernd Richter asked what datasets the IAS will provided. Victor Zlotnicki explained that a lot of what the IAS can provide is already made available.

Markus Rothacher asked whether we in the frame of the GGOS 2020 documents should assume that the IAS already exists. This was confirmed, and it was agreed that in a footnote, it should be explained that it is expected that the IAS will be established formally at IUGG.

Riccardo Barzaghi reported on the IGeS (see presentations/barzaghi_IGeS.pdf), giving an overview of the activities and the possible integration into GGOS. IGeS has carried out projects, organized schools and maintained a web bulletin. The IGeS contributes to GOCE and the European Gravity Gradiometry Consortium. For the bulletin, the BHI and IGeS bulletins have been merged into Newton's Bulletin, with 13 issues published so far. The IGeS is integrated into the IGFS which should be linked to GGOS. The possible role of IGeS could be to provide a forum for standardization, validation, and testing. Moreover, schools on geoid estimation could be organized every two years. The IGeS could also be a service on physical height reference system and relations to geometric heights.

Harald Schuh asked whether IGeS also would aim at national geoids, and Riccardo Barzaghi replied that this is difficult since these are often restricted. Zuheir Altamimi emphasized the importance of merging geometric and physical heights. Ruth Neilan pointed out that the schools get very positive

comments, and are well done. She recommended that IAG might consider to start something like these schools again.

Hans-Peter Plag presented the input provided by David Crossley and Jacques Hinderer concerning the links between GGP and GGOS (see presentations/plag_ggp.pdf). GGP considers itself as occupied with the operation of the global SG network, and as such is ready to contribute to GGOS by making its database available. It has external relations to, for example, IRIS, and intends to continue these. Compliance to GGOS standards and requirements would depend on the specific circumstances. With respect to GGOS meta data standards and interoperability, the data centers of GGP, i.e. ICET and the GFZ center, would need to be involved in the discussion. GGP is concerned about inadequate data archives and expects that GGOS can improve the situation. Collocation of SG and AG with geometric stations is another issue where GGOS may facilitate improvements. GGOS also might contribute to a wider use of the SG and AG data. Technically, GGP provides a component complementary to GRACE-type satellite missions.

Hans-Peter Plag also reported on recent work using a combination of absolute gravity and vertical motion trends to constrain the Reference Frame Origin (RFO) to the Center of Mass of the Earth system (CM). Based on this work, he proposed to include a global network of collocated geometeric and absolute gravimetric sites which would be complementary to SLR in constraining the tie between CM and RFO.

Science and support for GGOS from the IAG Commissions

Hermann Drewes reported on Commission 1 and input to GGOS related to the reference frames (see presentations/drewes_Commission1.pdf). In his presentation, he gave a detailed overview of what Commission 1 does. He emphasized that all coordinates are referred to reference frame, but reference frames are not only for geometry, they also are for gravimetry. However, Commission 1 is focused on geometry only. The Commission directly contributes to the GGOS WG on Conventions, Analysis and Modeling. He mentioned that the vertical reference level connected to sea level shows a decrease of potential energy due to sea level rise. This requires adjustments. He also mentioned the work of intercommission study groups. For example, ICSG1.1 on Ionosphere modeling aims to come up with a physical model of the ionosphere.

After the presentation, Bernd Richter stated that Hermann Drewes described the tasks of Commission 1 very well, but the questions concerning the relation of the Commission to GGOS were not clearly addressed. Hermann Drewes responded that the Commission is an independent entity in IAG but strongly involved in GGOS. However, young people are not sufficiently involved, particularly from developing countries.

Steve Kenyon gave a presentation on behalf of Commission 2 (see presentations/kenyon_Commission2.pdf). The presentation responded to the questions posed to the Commissions. Commission 2 can provide input to GGOS related to gravity field determination and interpretation. The Commission considers GGOS a valuable link to groups providing information on societal requirements, and GGOS can play a role in coordination and ensuring consistency. In the organizational diagram, the relations between Commissions and GGOS could be better defined, in particular who is reporting to whom. The wide engagement of GGOS from observation to data products is considered to be potentially in conflict with GGOS's mission and IAG's role. A narrower description of GGOS as a coordinating component could be more appropriate. The Commission is ready to get involved in GGOS at a higher level.

Harald Schuh presented the considerations of Commission 3 (see

presentations/schuh_Commission3.pdf). He explained the subject of Commission 3, and focussed in his presentation mainly on nutation, while other aspects of Earth rotation and geodynamics were not covered to the same extent. He made five statements, which addressed the relevance of rotation for Earth and planetary science and the potential contribution that might come from GGOS. The latter included improved determination of the effect of fluids on Earth rotation.

Reiner Rummel pointed out that Commission 3 in its presentation focused solely on nutation. Harald Schuh confirmed that over the last few years nutation has been the main focus of the Commission. Tom Herring asked whether Commission 3 discusses the new theory of nutation.

Dorota Brzezinska presented the presentation for Commission 4. She introduced the Commission, which addresses positioning and applications (see presentations/brzezinska_Commission4.pdf) and pointed out that the Commission is special in the sense that it is "applied" and thus not one of the three pillars. But the Commission has close relations to neighbouring organizations, including FIGS and ISPRS. Therefore, Commmission 4 could be a good interface for GGOS to these organizations and offer outreach chanels. It is also the only IAG Commission involved in DInSAR and could help to integrate this technology into GGOS. Other contributions could be, for example, in the fields of multi-sensor systems, exploitation of new signals (GNSS), engineering geodesy, and practical high-accuracy GNSS. Commission 4 expects from GGOS a recognition of its special role and the authority to continue to represent the practical aspects of geodesy. Open questions are in which pillar the Commission belongs (geometry?), where DInSAR fits, and whether VLBI tracking of GNSS could be established. The main contribution of the Commission to the GGOS 2020 so far has been focused on the chapter on societal applications. The Commission fully supports GGOS.

In the discussion, several comments expressed respect for the wide range of activities of this Commission.

Discussion: Building GGOS on existing and new components: The challenge of integration

Markus Rothacher gave a presentation on potential GGOS projects (see presentations/rothacher_GGOS_projects.pdf). He suggested to organize a unified workshop before AGU in December 2007, for example, on Thursday and Friday.

Future structure of GGOS

Markus Rothacher asked whether there is still a need for discussion of the GGOS structure. There were no further comments. However, Hans-Peter Plag brought up FAGS again and asked what the relation between GGOS and FAGS could be. Ruth Neilan summarized the recent development. She is on the council and prepared a report. This resulted in the action item:

Action Item GGOS-SC-8-15: Ruth Neilan to distribute the report on the future of FAGS prepared by the respective council. ***Responsible: Ruth Neilan, Deadline: 2007-03-05.***

In terms of sustainable environments FAGS was not doing much, and therefore it should not be part of ICSU. ICSU made an attempt to streamline. In meetings, the Services pushed back as they considered it important to be recognized by ICSU. The last general assembly considered a proposal to eliminate FAGS but it was countered and overturned by the assembly. In the next three years, a solution needs to be found.

Future GGOS ToR

A brief presentation of the key issues related to the ToR was given by Markus Rothacher (see presentations/rothacher_GGOS_ToR.pdf). Zuheir Altamimi pointed out that setting up the ToR also

defines the structure of GGOS, and these two aspects are directly related. He also questioned the name 'Project' and suggested to call it a program. He requested a clear structure for GGOS. Markus Rothacher responded that GGOS has a clear structure, which needs to evolve as ideas and conditions change.

Hans-Peter Plag pointed out that a IAG project may not be the right frame in the future, but currently, the By-Laws do not have an entity that would fit better than projects.

Erricos Pavlis stated the need for funding for the development of the Data Portal, e.g. from GEO in the frame of the reference frame-related task. Hans-Peter Plag explained that the various GEO Member Countries need to join the task, and thus improve the conditions for the national institutions to get funding for their participation in GGOS and the work related to the Data portal.

GGOS 2007 Workshop

Hans-Peter Plag briefly informed the participants concerning the 2007 Workshop. More information can be found at http://geodesy.unr.edu/ggos/ggosws_2007/ . A preliminary program is available at http://geodesy.unr.edu/ggos/ggosws_2007/ws_program.php . Most keynote speaker have been invited, and some have confirmed. The keynote speakers will be finalized in the next weeks. A first circular is almost ready. An attempt is made to reduce the registration fee to zero.

GGOS Meeting Schedule

The next GGOS SC meeting will take place on Tuesday, April 17, 12:00-15:30, in Vienna at the EGU in meeting room SM1 (see Splinter Meeting 32 at http://www.cosis.net/members/meetings/programme/view.php?p_id=261)

At the EGU, there will also be a GGOS 2020 Forum, see the http://www.cosis.net/members/meetings/programme/view.php?p_id=291 .

The Tenth GGOS Steering Committee will take place during the IUGG, most likely close to the weekend in the middle of the two weeks.

Any other business

There was no other business.

Summary of Action Items

Action Item GGOS-SC-8-1: Markus Rothacher to inform the IAS of the unanimous decision of the GGOS Steering Committee to include IAS in the Steering Committee and to ask IAS to nominate a IAS representative and substitute for the GGOS Steering Committee. ***Responsible: Markus Rothacher, Deadline: 2007-03-01.***

Action Item GGOS-SC-8-2: Bernd Richter to facilitate a decision of GGOS concerning the future metadata standard to be adopted by GGOS. ***Responsible: Bernd Richter, Deadline: 2007-05-01.***

Action Item GGOS-SC-8-3: All to look at the GGOS Web Pages at http://www.ggos.org and provide comments, suggestions, and material to Achim Helm. ***Responsible: All GGOS Steering Committee, Science Panel and WG Members, Deadline: Continuously.***

Action Item GGOS-SC-8-4: Hans-Peter Plag to make available the CEOS report on radio frequency protection for Earth observations. ***Responsible: Hans-Peter Plag, Deadline: 2007-03-15.***

Action Item GGOS-SC-8-5: All Writing Team members to review Chapter 2 and to contribute input where possible. ***Responsible: All GGOS 2020 Writing Team members, Deadline: 2007-03-10.***

Action Item GGOS-SC-8-6: Susanna Zerbini to contact experts on time and ask for contributions to Chapter 2. ***Responsible: Susanna Zerbini, Deadline: 2007-03-05.***

Action Item GGOS-SC-8-7: Reiner Rummel to revise the GGOS 2020 chapter on Earth science requirements for geodetic observations. ***Responsible: Reiner Rummel, Deadline: 2007-03-10.***

Action Item GGOS-SC-8-8: Michael Pearlman and Tom Herring to provide input for GGOS 2020 with respect to future observations of atmospheric carbon based on geodetic measurements, which is relevant for the GEO SBA on ecosystems. ***Responsible: Michael Pearlman, Tom Herring, Deadline: 2007-03-10.***

Action Item GGOS-SC-8-9: Chris Rizos and Dorota Brzezinska to revise the chapter on societal requirements according to the discussions at the Retreat and to ensure that liability, integrity, and database lifetime are addressed appropriately. ***Responsible: Chris Rizos, Dorota Brzezinska, Deadline: 2007-03-10.***

Action Item GGOS-SC-8-10: Hans-Peter Plag to switch the chapter on Earth observation and the chapter on societal applications in sequence. ***Responsible: Hans-Peter Plag, Deadline: 2007-03-05.***

Action Item GGOS-SC-8-11: Hans-Peter Plag and Jim Zumberge to ensure that planetary geodesy is addressed comprehensively in the chapter on planets and solar system exploration. ***Responsible: Hans-Peter Plag, Jim Zumberge, Deadline: 2007-03-15.***

Action Item GGOS-SC-8-12: Richard Gross to add quantitative tables for requirements to the chapter and to include tables on functional specifications. ***Responsible: Richard Gross, Deadline: 2007-03-15.***

Action Item GGOS-SC-8-13: Hans-Peter Plag to modify the organizational diagram for the future GGOS according to the discussions at the Retreat (renaming bureaus to entities, use of Steering Committee and Secretariat, changing arrows, no surrounding box). ***Responsible: Hans-Peter Plag, Deadline: 2007-03-05.***

Action Item GGOS-SC-8-14: Hans-Peter Plag to request from the Services an overview on which institutions contribute to the individual services and estimates on the personyears reaquired to maintain the infrastructure and services. ***Responsible: Hans-Peter Plag, Deadline: 2007-03-05.***

Action Item GGOS-SC-8-15: Ruth Neilan to distribute the report on the future of FAGS prepared by the respective council. ***Responsible: Ruth Neilan, Deadline: 2007-03-05.***