

Half – page contributions

Product Centres	2
Global Geophysical Fluid Centres	7
ITRF Combination Centres	11
Combination Research Centres	13
Technique Centres	17
Experts	21

IERS Product Centres

Description of the products:

Rapid Service/Prediction (Wooden)

- Rapid EOP data and predictions, including IERS Bulletin A, standard and daily rapid data files.
- Standard Rapid EOP Data files (updated weekly on Thursdays) includes x/y pole, UT1-UTC, LOD, dPsi, dEps, dX, dY, and their errors.
- Daily Rapid EOP Data files (updated daily at 17:05 UTC) includes x/y pole, UT1-UTC, LOD, dPsi, dEps, dX, dY, and their errors.
- Two new files added this year: finals2000A.data and finals2000A.daily (dPsi and dEps replaced by dX and dY).
- Modified software to handle new VLBI data formats, improved data handling/editing, and automated data retrieval.

EOP (Gambis)

- CURRENT EOP SERIES
 - Bulletin B
Smoothed values of Polar Motion, UT1-UTC, dPsi, dEps at daily/5-day intervals for one month and predictions for 3 months at 5-day intervals Normal values of Polar Motion, UT1-UTC, dPsi, dEps at 5-day intervals for one month
 - IERS C04
Update of Bulletin B on a near real-time basis
 - IERS EOP_GPS
Combination of operational EOP series at 1 day intervals
 - Long term Earth Orientation data, Normal point raw values
 - EOP_C01 (at 0.05 year intervals)
 - EOP_C02(at 5-day intervals)
 - EOP_C03(at 1-day intervals)
- TIME DISSEMINATION BULLETINS
 - Bulletin C: Announcement of Leap Seconds in UTC, every six months.
 - Bulletin D: Announcements of DUT1, irregular
- OTHER
 - Mean pole motion. Table available in Conventions 2000

ITRS/ITRF (Boucher)

- Current product (ITRF2000) obtained before the new organization, but well appreciated by a growing user community in many areas, scientific or applied
- **Initial implementation** in progress, but not yet fully operational :
 - ITRF network management not yet realized
 - ITRF Combination Centres appointed (DGFI,IGN,NRC) but not yet activated

Conventions (McCarthy)

- The Conventions Product Center is provided jointly by the U.S. Naval Observatory (USNO) and the Bureau International des Poids et Mesures (BIPM). Its tasks are:
 - Edit the IERS Conventions, continuously maintaining the documents in electronic form [<http://maia.usno.navy.mil/conv2000.html>] and making available an updated printed version at the request of the Directing Board,
 - Maintain software in electronic form compatible with the IERS Conventions, and
 - Examine the consistency of the procedures used by the IERS analysis centers with the adopted conventions and study the impact of possible inconsistencies on the IERS products.

CB (Richter)

- The general management of the IERS consistent with the directives and policies set by the Directing Board
- Facilitates communications (IERS messages, emails via mailing lists, address data base, distribution of reports)
- Coordinates activities (surveys, workshops, conference meetings, etc.)
- Maintenance of documentation (CB bureau archive, Annual Report, Technical Notes, static WEB pages, links)
- Deficits : Data base

Future products:

Rapid Service/Prediction (Wooden)

- No new products planned at this time.
- Examination of an alternative prediction technique,
- Automating more of our error estimation software, and converting to the new nutation theory.

EOP (Gambis)

- Determination of Sub-diurnal EOP solution(12, 6 hours)
- EOP as results of a global determination of the various techniques
- using a single package (GINS/DYNAMO) in cooperation within the CRC GRGS.
- Simultaneous determination of both EOP and the terrestrial reference frame (cooperation with CRC LAREG/IGN)

ITRS/ITRF (Boucher)

- a new ITRF global solution, possibly based on TRF-EOP model and time series input (so called ITRF03 product in ZA note)
- other products (e.g. a dynamical operational TRF solution using time series and Eulerian description)

Conventions (McCarthy)

- The Conventions Product Center hopes to improve IERS product consistency by updating existing Conventions and formalizing new conventions as needed (e.g. geocentre motion ..)
- Assisting analysis centers in the use and application of existing conventions for constants, models and software
- Participating in on-going and new studies to estimate the impact of inconsistencies on the IERS products, to define conventional procedures for analysis, and to assist the Analysis Coordinator in developing rigorous multi-technique product combinations

CB (Richter)

- Dynamic WEB pages
- Archives products and relevant information
- IERS information system (meta data base)
- IERS News letter
- Electronic bulletin board (?)

Proposals for new products in other PCs/SBs:

Rapid Service/Prediction (Wooden)

- Recommend that work be done to combine raw data types directly rather than combining "processed" data as is currently done.

EOP (Gambis)

- Better Oceanic Angular Momentum series

CB (Richter)

- Common data format: SINEX, time series, GGFC information, supplementary information

IERS changes in management, organisation:

EOP (Gambis)

- In order to optimize the collect of individual series of EOP, we propose to develop an EOP Data Center; this site should be mirrored by one or two mirroring sites (similarly to the IVS data centers).
- Improve relationships with Technique Centres, IVS, IGS, ILRS, IDS (data exchange, formats of EOP files, ..)

ITRS/ITRF (Boucher)

- In the frame of IGGOS, IERS should remain concentrated on its initial mission CRF-TRF-EOP, and therefore IGGOS should include at the same level than IERS the IGGFS and possibly a service derived from GGFC
- GGFC should become an independent service because it serves IERS as well as the gravity community or individual techniques
- Similarly, the IERS conventions should be removed from IERS and established at the same level, for instance as an IGGOS working group
- the proposed WG on collocations is also to be considered at the IGGOS level, especially because it is relevant for individual techniques as well as their combinations I propose to have an IGGOS working group dealing with all related issues :
 - collocation design and strategy
 - site effects and quality
 - local survey monitoring
- Finally, the WG on ITRF datum should be replaced by the suitable sub-structure of the new IAG Commission 1

Conventions (McCarthy)

- Survey IERS members and users on how to make the Conventions evolve and how they should be maintained in the future.

CB (Richter)

- More visibility of GGFC SB
- Faster flow of information

Other remarks, comments:

EOP (Gambis)

- Role of the IERS in the future:
Fundamental question to address to users primarily concerned..

ITRS/ITRF PC (Boucher)

- IERS should be an active member of IGGOS, which in turn should be basically an association of the existing (and forthcoming) services, aiming to ensure a better consistency, synergy and completeness between them, in other words the operational face of IAG
- IERS should play its role in good conformity of the new IAG organization, especially Commission 1 and IGGOS
- IERS should remain a joint venture between geodesists and astronomers, i.e. IUGG/IAG and IAU
- IERS should remain at an efficient size, not too narrow but not too large, with a reasonably coherent community

CB (Richter)

- Search for funds

Global Geophysical Fluid Centre

Short description of your product(s) (please read the product list <<http://www.iers.org/iers/products/>> as basis and just add information if necessary):

SB Atmosphere (Salstein)

- Atmospheric angular momentum data analysis
- Forecasts from wind and pressure fields of four different operational weather centers, and the consistent reanalyses.
- Pressure term with and without inverted barometer. These parameters relate to excitations of Earth rotation (length of day) and polar motion.
- Pressure terms, both global average and harmonics that related more properly to the gravitational and loading signatures.

SB Ocean (Gross):

- Model for global oceanic angular momentum: ([Ponte 1998](#)), ([Johnson 2001](#)).
- [Two models for oceanic center-of-mass \(Dong 1997\)](#)
- [Model for ocean bottom pressure \(ECCO\)](#)
- [Measurements of ocean bottom pressure \(GLOUP\)](#)

SB Core (Véronique Dehant and Tim Van Hoolst):

- Data of core angular momentum changes: [A. Jackson](#), [S. Petrov](#), [D. Jault](#), [A. Pais](#), [D. Boggs](#)

SB Loading (van Dam):

- Web site with information on the SBL - position papers, plans, and description of products to be delivered

SB Hydrology (Wilson)

- Global Daily Water Storage from NCEP Reanalysis, 1979-2001. Links to the data: <ftp://ftp.csr.utexas.edu/pub/ggfc/water/>
- Global Daily Water Storage from ECMWF , 1979-1993. Links to the data: <ftp://ftp.csr.utexas.edu/pub/ggfc/water/>
- Global Monthly Water Storage from NCEP Reanalysis, 1993-1998. Links to the data: <ftp://ftp.csr.utexas.edu/pub/ggfc/water/>
- Global Monthly Water Flux from NCEP Reanalysis, 1993-1998. Links to the data: <ftp://ftp.csr.utexas.edu/pub/ggfc/water/>
- Daily hydrological excitations of polar motion and LOD from NCEP/NCAR Reanalysis (1948-2001). Links to the data: <ftp://ftp.csr.utexas.edu/pub/ggfc/ham/>
- List of global major artificial reservoirs. Links to the data: http://www.csr.utexas.edu/research/ggfc/reservoir_list.html

Are there new products in your PC / SB planned for the future, how they will be realized (schedule, action items, ...):

SB Atmosphere (Salstein):

- More data centres. This will be realized after some research and development, as well as realization of further funding for the SBAtmosphere.

SB Loading (van Dam):

- Atmosphere
 - Mirror web site to be established at ECGS - June, 2003
 - Test of Global gridded estimates of loading effects - June, 2003
 - Actual Global gridded loading effects
 - NCEP and ECMWF - June, 2003
 - (2.5 deg x 2.5 deg)
 - 1995 - 2002 the present - 6 hour increments
 - 3-D deformations
 - 4.gravity
- Ocean
 - Ocean bottom pressure - Aug., 2003
 - 2.1 12 hourly
 - 2.2 1993 to the present - 12 hour increments
 - 3-D deformations and gravity
- Continental water storage - Undetermined deadline -
We still need to do some analyses to determine which data set (if any) to implement
 - 3.1.temporal determined by the model used
 - 3.2.spatial sampling determined by the model used

SB Hydrology (Wilson):

- Global gridded water storage data from a recent NASA GSFC land surface model surface model
- The newly released 50-year climatology from Willmott's group at the University of Delaware to our data lists.
- Water storage change estimated from GRACE to the public when data become available.

Do you have proposals for new products in other PCs / SBs:

SB Atmosphere (Salstein):

- High temporal resolution length of day data.
- Fuller coordination of ocean data.

SB Ocean (Gross):

- The most important service the IERS can provide in support of these activities is to continue, to strive, to improve the reference frames and connecting EOPs
- Ensuring consistency of the EOPs with the frames is important in this regard. This can be accomplished by applying corrections to the combined EOPs to enforce consistency after-the-fact.
- The rigorous combination approach will also enforce consistency.
- Also, many applications rely on just the ITRF, or just the ICRF, and do not require consistency of the EOPs with the frames. Rather, they require the most accurate possible ITRF and/or ICRF. Thus, it is important that future approaches such as the rigorous combination approach do not lead to degradation of the reference frames.
- Similarly, many Earth orientation studies require the most accurate EOPs available, regardless of their consistency with the frames. Much can be done to improve the accuracy of the combined EOPs. Rigorous combination is one approach which may lead to more accurate EOPs, but there are other approaches which should also be pursued and which should also be encouraged.

- A fundamental contribution that the IERS can make in support of Earth orientation studies is to produce inter-technique EOP combinations.
- AAM estimates are currently available every 6 hours. An IERS EOP series given at 6-hour intervals (at least) would open up this portion of the spectrum to investigations and the IERS should work with the appropriate technique services to accomplish this.

SB Loading (van Dam):

- Reliable continental water storage data set

SB Hydrology (Wilson):

- Comments on data formats: At some point in the future it would be useful to have a standard file format for gridded water storage values, and a standard way to assess the exchange of water between land and oceans.

What should be changed in the organisation, management, of the IERS?

SB Atmosphere (Salstein):

- As many discussions and notes about activities of the Directing Board should be sent to the SB heads as well.

SB Ocean (Gross):

- The IERS has been proactive in facilitating geodetic research by establishing the GGFC and its SBs. The GGFC and its SBs, while still young and in many cases still in need of further development, have the potential to have a major impact on geodetic research and should continue to be nurtured. The GGFC could take on a more active role by providing specialized products required by future space missions and projects, but such customers would need to pay for this service.

SB Loading (van Dam):

- No suggested changes in the IERS management

SB Core (Véronique Dehant and Tim Van Hoolst):

- New bodies for the geodesy communities not sufficiently represented, such as gravimetry and altimetry, could be included as Technique Centres like IGS, IVS, etc.

Other remarks / comments

SB Ocean (Gross):

- Funding of IERS activities. There is clearly much that should and can be done within the IERS but which will be difficult to accomplish by volunteers.

SB Core (Véronique Dehant and Tim Van Hoolst):

- The IERS has an important role in the IGGOS project. The primary goals of the IERS, as stated on their website, are to serve the astronomical, geodetic, and geophysical science communities by providing the ICRF/ICRS, the ITRS/ITRF, the EOP, geophysical data that enable the interpretation and modelling of space/time variations in the ICRF, the ITRF, and the EOP, and standards, constants and models (e.g. conventions) encouraging international adherence.
- With the creation in 1998 of the GGFC, the IERS already addresses a wide range of geodesy disciplines.
- Both the IERS and the IAG would benefit from IGGOS in terms of visibility, coherency, and future developments. We think that the IERS should be the starting structure for IGGOS

ITRF Combination Centres

Short description of your product(s) (please read the product list <http://www.iers.org/iers/products/> as basis and just add information if necessary):

IGN (Altamimi):

see WEB page information

NRC (Ferland):

- The objective of the TRF combination project is to develop and apply the capability to combine solutions containing station coordinates and velocity determined with the DORIS, GPS, SLR and VLBI techniques, available using the Software INdependent EXchange (SINEX) format. At NRCan, the data combination is currently done using a two-step procedure.
 - In the first step, the solutions within each technique are combined.
 - In the second step, all the intra-technique solutions obtained in the first step are combined to generate the final solution.

Are there new products in your PC / SB planned for the future, how they will be realized (schedule, action items, ...):

IGN (Altamimi):

- The ideal way to achieve the compatibility of the current IERS products, mainly the ITRF, ICRF and IEOP (International Earth Orientation Parameters) is to treat the geodetic observations using a unique and coherent modelling (i.e. implemented in one software). Before embarking on this ambitious project due to many technical limitations (and in particular the no existence of a validated software), an alternative way is to simultaneously combine TRF, CRF and EOPs of the individual techniques. Until now this simultaneous combination is not yet realized. As a first step, multi-technique TRF and EOP simultaneous combination is now possible.
- One specific long term and continuous action should absolutely be to envisage new design of Core Collocation Sites (CCS), the indispensable "ITRF Pillars", with global coverage, stable and solid monumentation, regularly/repeatedly surveyed and geophysically monitored. Otherwise, having irregular distribution/quality of collocation sites, the ITRF and in particular the concomitant IEOP will drift in time.
- Establish new ITRF solutions, starting with ITRF03, combining TRF and EOPs, based on times series (weekly or monthly) of TRF and EOP. It is preferable to use weekly solutions in order to better monitor station non linear motions. The ITRF03 could be constructed over 5 years of TRF&EOP multi-technique solutions. The EOP parameters resulted from this combination should be used to recalibrate the current IERS C04 series, so that ITRF and IEOP consistency will be ensured.

NRC (Ferland):

- The following applies to the TRF project and to the SINEX Combination project.
 - Constrain removal and numerical stability are of concern.
 - Standard least squares procedures are followed.The combinations currently require sometimes several outlier detection/rejection iterations. Although the combination of the techniques solutions is progressing relatively well, in the long term, these techniques specific activities are probably best handled within each service.
- The combination activities of this (and the others) combination center could be dedicated to the inter-technique combination, which is addressed in the second step

Do you have proposals for new products in other PCs / SBs:

NRC (Ferland):

- Potentially, corrective measures can be put in place by the techniques if they do this analysis themselves.

What should be changed in the organisation, management, of the IERS?

IGN (Altamimi):

- Establish as soon as possible an active Collocation Working Group as already recommended during the IERS workshop in Munich (November 2003). New concepts and design of CCS should be recommended by this working group. Extensive description and specifications of the IGS Reference Stations were recently formulated by Jim Ray, which should be extended/adapted to the ITRF CCS.

Combination Research Centres

Short description of your product(s) (please read the product list <<http://www.iers.org/iers/products/>> as basis and just add information if necessary):

CRC Prague (Vondrak):

- In 2000 production of EOP based on re-analysis of now historical observations by optical astrometry (1899.7-1992.0) referred to Hipparcos Catalogue.
- More or less regularly (several solutions per year), the combined GPS/VLBI solutions for those EOP's that are directly referred and sensitive to celestial reference frame (i.e., LOD/UT1 and celestial pole offset rates/celestial pole offsets), using the method of combined smoothing.

CRC Munich (Rothacher):

- Analysis and combination of sub-daily ERP-series from various techniques.
 - IERS SINEX Combination Campaign
 - IERS Analysis Campaign to align EOPs to ITRF2000 / ICRF
- Analysis and combination of nutation series from various techniques (create new IERS product?).
- Rigorous combination of ITRF, EOP and ICRF.
- Examine the contribution of LLR.

CRC Norway (Andersen):

- Continue the establishment of consistent observation models
- study technique-specific systematic errors
- continue the development of improved analysis strategies
- produce estimated eccentricity vectors for collocated stations.

CRC Potsdam (Zhu):

- study the possible systematic error sources of various space techniques (effects on translation, scale, rotation).
- develop new combination methods to benefit from the advantages of each techniques.
- study the possible combination between reference frame and gravity field.

CRC Petersburg (Malkin):

- Comparison of various EOP series, TRF, CRF realizations in routine activity of the IAA
- Strategy of combining EOP
- Comparison of EOP obtained with OCCAM and ERA.
- Comparative analysis of VLBI nutation
- TRF results of BSL93 and BSL97 GPS campaigns
- UT1 prediction
- SLR+VLBI comb.

Are there new products in your PC / SB planned for the future, how they will be realized (schedule, action items, ...):

CRC Prague (Vondrak)

- Plan to prepare another analysis of old optical astrometry observations, based on the prepared Earth Orientation Catalogue (combination of space and ground-based star observations). We hope that the new EOP series will be available at the end of 2003.
- Production of the combined solution of VLBI/GPS/SLR UT1/LOD and celestial pole offsets/rates on quasi-regular basis.

CRC Munich (Rothacher):

- "IERS Combination Pilot Project" should be defined:
 - Call for Participation in the IERS Combination Pilot Project.
 - Possible contributions:
 - Combination Centres: They routinely combine "weekly" (=session for VLBI, =week for GPS, SLR, DORIS) SINEX files from all major space geodetic techniques containing station coordinates, EOPs and quasar coordinates into combined consistent weekly IERS products (series of weekly station coordinates and daily EOPs).
 - Technique Combination Centres: contribute routinely with "weekly" technique-specific SINEX files to the IERS combination pilot project.
 - Associated Combination Centres: They routinely produce at least one special combined product for the IERS. Examples might be combined sub daily EOP series, combined nutation offset series, combined troposphere or ionosphere products etc.
 - Time frame:
 - June 1, 2003: Call for Participation
 - August 1, 2003: Deadline for Proposals
 - September 1, 2003: Evaluation of Proposals finished
 - January 1, 2004 (???): Start of pilot project

- "IERS Working Group on ITRF Site Information" should be formed with the following task:
 - Set up of an ITRF site information database together with the IERS Central Bureau containing all relevant information on ITRF sites, especially all information that is concerning inter-technique issues:
 - Local ties in SINEX format including variance covariance information
 - All documentation concerning local ties and site changes
 - A technique-independent list of site events for the handling of site problems in the combination, etc.
 - Combined information from all site logs, technique-independent site logs for all ITRF sites (?)
 - Recrute surveying teams that are ready to perform local survey at the most important collocation sites. Local ties of important sites should be monitored similarly to the site coordinates of the global solutions, i.e. at least remeasured every 1-2 years.
 - Coordinate the issues of global site distribution, collocation strategies, advice for site changes and possible new collocation sites, etc.

Do you have proposals for new products in other PCs / SBs:**CRC Prague (Vondrak)**

- One of the IERS TC, IGS, produces the celestial pole offset rates on a regular basis (so far, only CODE is doing this, but not regularly as their official product).

CRC Munich (Rothacher):

- Possible new products:
 - Sub daily EOP series from VLBI and GPS, and the combination thereof
 - Combined nutation series from VLBI and GPS
 - High-resolution time series of site coordinates
 - Atmospheric corrections from atmosphere models for troposphere dry delays, tropospheric dry gradients, site-specific mapping functions, ...
 - Products concerning loading phenomena
 - New products concerning GGFs

CRC Norway (Andersen):

- Increase the number of observation techniques per site, improve observation quality
- Improve eccentricity information in quantity and precision,
- Analyse all the different techniques simultaneously at the observation level with the same models where this is appropriate. As you know this is the philosophy of the GEOSAT software. I have found out that with 10 - 13 Pentium 4 computers (total cost 25 K USD) its possible to process 365 days of VLBI, GPS and SLR days (60 GPS stations) within one week.
- Improve the models. The IERS PC's should estimate "fundamental" dynamical parameters instead of "kinematic" parameters. An example is the practice that we estimate daily nutation corrections. This leads to thousands of solve-for parameters and weakens the solution. Instead, we should estimate the 14 (I think) fundamental parameters of the newest nutation models. This would improve the understanding, improve solution redundancy, improve prediction ability. The product of the IERS PC for EOP could still be corrections in longitude and obliquity. Probably some of these parameters should have a week degree of stochasticity. This is another idea I have: I think there is a potential for improvement with improved statistical methods. For example with stochastic parameterization where the statistics are adapted to the behaviour of the parameter in the real world. Today we do not fully use such information. There is a lot of examples that this improves the solutions.
- In principle, all parameter correlations should be taken into account.

CRC Potsdam (Zhu):

- Develop methods and procedures which make current products being more consistent and homogeneous. (e.g. EOP and ITRF should be consistent, ...).
- Pilot campaign performed by individual CRCs or cooperated by several CRCs, which could lead to the improvement of the quality of the IERS products.
- CRC makes proposal to (or together with) Analysis Coordinator concerning possible new form of the existing products (e.g. time series for ITRF)
- New types of products: e.g. Gravity, at least the lower degree coefficients as time series

CRC Petersburg (Malkin):

- As analysis of solutions currently provided by ACs, there is quite a mess of geophysical models (polar tide, loading, VLBI antenna deformation, relativity, etc.). These effects can produce systematic differences between solutions at the cm level of accuracy. So, models must be more standardized, or/and combination centre should take care of unification of contributed EOP/TRF series before combination.
- timely update of ITRF (and ICRF, but is less actual, I think), at least ones per year.

What should be changed in the organisation, management, of the IERS?**CRC Prague (Vondrak)**

- No major change of the organization of the IERS should take place in near future; minor changes, reflecting new products (if agreed upon during the IERS Retreat) are however not ruled out. E.G., some of the GGFC sub-bureaus with regular products can be represented directly in the Directing Board.

CRC Munich (Rothacher):

- Formation of an IERS Working Group on ITRF Site Information
- Initialisation of IERS Combination Pilot Project

CRC Potsdam (Zhu):

- If a CRCproduct type is accepted by IERS and if this CRC wants to continue to provide this product on a regularly base, then it should be renamed as the PC of this product, no more as a CRC. One must clearly distinguish between PC and CRC. CRC does not need to provide routine products, their relation with the IERS seems looser than other ACs or TCs;

Other remarks / comments

CRC Petersburg (Malkin):

- EOP+TRF(+CRF)(+Geopotential) combination. Not all details are known or/and clear for me here. I would propose that the IERS Analysis Coordinator take some time for more explanation of his plan (I see here some analogy with the NRO approach to TRS \leftrightarrow CRS transformation; its authors provide many explanations and clarifications during last years). Maybe it's evident for persons quite familiar with all details of IGS procedure which serves, as I can see, as "prototype" for IERS approach which is under development at the moment.

Those points I would like to clarify are:

- how final ITRF solution will be constructed;
- what will be ITRF status, in other words, how it should be used inside IERS, e.g. during preparation of operational and final solutions;
- how the long-time stability of combined EOP and TRF IERS combined solutions will be provided; in particular how new solution will be connected with "before EOP+TRF" epochs.

The reason of my questions is that, as I can understand, discussed procedure of combining EOP+TRF contributed solutions based on simple linear model (shift-rotation-scale) is not adequate to reality. This can be easily seen from comparison of EOP series computed using ITRF and e.g. global VLBI solutions aligned to the ITRF in the same way as discussed now. The reasons is well known for you and others - deformations of "global" TRF solutions, and non-linear systematic differences between contributed solutions use for combination. So, it's important to develop adequate model of systematic errors of contributed EOP and TRF solutions used during combination, if we want to have result at the mm level of accuracy.

Technique Centres

What the TC's contribute / will contribute to the IERS?

IGS (Bruyninx, Gendt, Weber):

- polar motion and PM-rates (IGS is most important)
- UT1/LOD (via biased LOD estimates) (SINEX / weekly), (IERS Format / daily),
- ITRF (station coordinates (SINEX, weekly), station velocities (yearly, input to plate motion models) for a large, well distributed, global network).

ILRS (Gurtner, Noomen, Shelus):

- absolute station coordinates and velocities
- geocentre and scale
- earth orientation parameter solutions
- validation and calibration of radio navigation satellite parameters
- validation and calibration of gravity field solutions
- validation of other parameters and/or models (troposphere, relativity, ...)

IVS (Ma, Nothnagel):

- EOP series
 - series by individual IVS Analysis Centers
 - x pole, y pole, UT1-UTC, $d\psi$, $d\epsilon$ - time series (discontinuous)
 - quasi-daily UT1-UTC - time series (discontinuous)
 - datum-free session SINEX files
 - combined IVS series
 - Rapid series
 - x pole, y pole, UT1-UTC, $d\psi$, $d\epsilon$ and dX/dY - time series (discontinuous)
 - two rapid sessions per week (Mon, Thu)
 - delay 16 - 18 days
 - 1999.0 - recent
 - updated weekly
 - Long series
 - x pole, y pole, UT1-UTC, $d\psi$, $d\epsilon$ and dX/dY - time series (discontinuous)
 - all VLBI sessions suitable for EOP determination
 - 1979.6 - recent
 - updated quarterly
- TRF (station coordinates and velocities)
 - realizations by individual IVS Analysis Centers
 - uneven geographic distribution
- CRF (radio source positions)
 - extensions of the ICRF by individual IVS Analysis Centers

New products IVS can contribute to the IERS:

- source position time series
- more research into improving the ICRF
- baseline length time series
- datum-free session SINEX files
- datum-free TRF SINEX files
- planned / future products:
 - daily UT1-UTC
 - daily x pole, y pole, UT1-UTC, nutation offsets

IDS (Feissel-Vernier, Willis):

Presently several DORIS analysis groups have started to produce regularly the following products that are freely available at the CDDIS data centre :

- global solutions in SINEX format of positions and velocities of DORIS tracking stations (over more than 10 years of observations)
- weekly and monthly solutions of coordinates of tracking stations (SINEX format)
- geocentre and scale determination (presently on a weekly basis)
- EOP in IGS format (on a daily basis)
- Orbits of the 'collocation' satellites: Topex/Poseidon, Jason 1, Envisat, where DORIS tracking is collocated with SLR and/or GPS tracking: link to combination with altimetry products

Major strengths of DORIS in connection with the IERS mission are:

- a station network with an excellent geographical distribution that is stable in time;
- a dense and well distributed collocation network with GPS;
- a strong radial connection, from geocentre through stations to satellite orbits;
- a primary role as satellite altimetry orbital references.

What does the IERS contributes to the TC's?**IGS (Bruyninx, Gendt, Weber):**

- ITRF, which is used as the fundamental datum for all IGS products via an internal IGS realization which is very closely aligned to ITRF,
- predicted UT1 variations, since this is not well determined by GPS and is needed for the real-time IGS predicted orbits, Nutation-Precession Model, etc.,
- the models recommended in the IERS Conventions, although there are some additional GPS-only conventions that the IGS has adopted separately (such as satellite antenna offsets),
- some products of the GGFC (such as ocean loading coefficients) are widely used for routine operations and others (such as AAM) are used for research purposes.

ILRS (Gurtner, Noomen, Shelus):

- analyses standards
- station site ties (inter-technique, incl. validation)
- coordinates of new stations
- political support

IVS (Ma, Nothnagel):

- IERS Conventions
- ITRF2000 as primary reference for ITRS geocentre and axis orientation
- conversion program $d\psi/d\varepsilon$ to dX/dY

IDS (Feissel-Vernier, Willis):

Groups are using 2 different types of products :

- stations coordinates and EOP
For stations coordinates, all groups expect to get access to the most precise terrestrial reference frame available (positions and velocity of stations using all techniques and the longest time series of observations available).
- For EOP, there are several needs :
 - for real time on-board orbit computation (DIODE) predicted values for UT1-UTC needed
 - the best available EOP series even with a long delay for computation (2-3 week delay)
 - a rapid estimation/prediction of EOP (1-2 day delay)

What do the TC's expect to obtain in the future from the IERS (products)?**IGS (Bruyninx, Gendt, Weber):**

- Improvements in the accuracy of basic products, particularly in eliminating systematic differences (errors?) in the polar motion parameters obtained by the IERS and the IGS, need for the development of fully rigorous product combination processes,
- need for products from the GGFC, for atmospheric loading information e.g. within a grid of about 1x1 degree and a time resolution to account for effect of 0.5 mm (e.g. 6 hour resolution), best models for ocean tide loading including regional effects which become important for projects like TIGA, AAM, OAM, and similar geophysical effects.

ILRS (Gurtner, Noomen, Shelus):

- the geocentre (explicitly),
- planetary "geodesy",
- relativistic products and
- satellite orbit solutions.

IVS (Ma, Nothnagel):

- more frequent realizations of the ITRF
- investigations of systematic errors of VLBI results

IDS (Feissel-Vernier, Willis):

- On-going improved solutions (every 6-month or every year) including the latest available observations from all techniques.
- Permanently monitoring and easy access to the local tie information (space-geodetic techniques, tide gauges, gravimeters):
SINEX files as well as documentation information such as, when was the local tie performed, by whom, point of contact, where to find the documentation, plans for future surveys,...
- For test purposes,
IDS would like to have also regularly (every 6 month or every year) a non-DORIS reference (obtained using all techniques except DORIS + the local tie information) that includes all DORIS collocation stations that have been observed (past and recent observations).
- Concerning the EOP,
IDS would like to obtain from IERS a solution that would be close to IERS Bulletin B but that could be received on a more frequent basis (at least twice a week) and with a reduced delay (less than a few days).
- Providing evaluations/recommendations:
 - to the IVS, IGS, ILRS and IDS for the evolution of their respective networks, for best fulfilling the need for accuracy, reliability and accessibility of IERS references.
 - to the relevant bodies for the collocation of tide gauges and gravimeters with space-geodetic stations.

- New products:
 - Including orbit comparison/combination into the IERS global analyses.
 - Considering common determination of atmospheric parameters where applicable.

Other remarks, comments.

IGS (Bruyninx, Gendt, Weber):

- The IERS could play a bigger role in coordinating network issues between the techniques, esp. at the co-location sites. Since the inter-technique co-location ties are not the responsibility of any single technique, it would be helpful if the IERS took the lead in this area. Also in promoting more co-locations.
- There are other opportunities for improved inter-technique comparisons and coordination where the IERS could be more important. For example, studies of technique-related systematic errors (e.g., antenna effects) and studies of common-mode geophysical effects (e.g., atmosphere loading) could benefit from more coordinated and focused efforts that the IERS could promote.
- The work of the IERS Combination Research Centres is not very visible to outsiders. It seems that the research efforts are not well coordinated and may be poorly directed to improve IERS products. It would be good to see more visible results from the CRCs.
- And, of course, the most important thing would be for the IERS to begin to produce fully rigorous products, at least for the ITRF/EOP combination (it is OK to delay rigorous integration of the ICRF).

ILRS (Gurtner, Noomen, Shelus):

- The main role of the IERS is to represent space geodesy and individual space geodetic techniques. Also, it must combine the best elements of these individual techniques. The IERS should continue, expand and further improve its current products.

IDS (Feissel-Vernier, Willis):

- IDS would like to encourage the IERS to use solutions coming from a multi-technique analysis (ex TOPEX using DORIS, GPS and Laser simultaneously). Presently, such solutions are very few and do not fit properly in a one of the specific IAG Services.
- Concerning some of our products, IDS would encourage IERS to use our products in their global determinations, even if some appropriate weighting is required. It does not make to much sense for groups to produce series of geocentre and EOP if they are not used at all. Resources are scarce everywhere and services need to focus on products that are really needed.
- Finally, it seems important to us that, concerning terrestrial reference frame aspects, the IERS really focus on time series of coordinates as the position/velocity is only an approximation of the physics and requires a lot of documentation for certain sites (breaks related to jumps in stations coordinates or change in velocity). The position/velocity and time series approach must be conducted in parallel to help the users, depending on their level of knowledge.
- The time series structure is no longer a specific character of the EOP, as time series of terrestrial parameters are available from the DORIS technique as well as from the other space techniques. Until now, the EOP data are treated as a time process only in the case where they are dealt with independently. The EOP start to be processed in TRF-EOP combinations, but not really as time series. The situation is similar for the series of station or TRF origin (geocentre) coordinates.

Taking into account in a proper way the nature of the physical processes underlying the time series is a difficult endeavour, which gets even more complex when mixing techniques that cannot keep unified time tags for all the phenomena involved. Whereas classical time series analysis techniques are most developed for the case of one-dimension parameters, the parameters we are dealing with are multi-dimensioned and mutually correlated, which adds to the difficulty.

Although the exploration of this new field of data analysis goes beyond the boarder of a single service, another key expectation is that: IERS foster research in geodetic time series analysis, considering multi-dimension, correlated variables.

External Experts

What the “Project / Service / Union” contributes / will contribute to the IERS?

Astronomy (Capitaine):

The astronomical community should :

- be involved in providing the best possible models for use by the IERS,
- contribute to the IERS Conventions and be involved in the *IERS Conventions Editorial Board*,
- help the IERS in the tests and comparisons of models and products,
- participate in the IERS Analysis Centers and Combination Research centers,

IGGOS (Beutler):

IGGOS identifies:

- a consistent set of geodetic products.
- the requirements concerning accuracy, time resolution, and consistency.
- IAG Services (IERS) gaps, stimulates cooperation between IAG services.

Altimetry (Bosch):

Ocean (Ice) mass redistribution to estimate:

- geocentre variation (degree one harmonics C_{10}, C_{11}, S_{11})
- Ocean Angular Momentum, OAM
- (orientation of rotation axis, C_{21}, S_{21})
- LOD-variations (C_{20})

New Satellite Missions (Schutz):

- These missions can be expected to validate the consistency and accuracy of those products and, possibly, contribute to the improvement of the IAG Service products.

Global gravity field and missions (Reigber / Schwintzer):

- Time series of gravity field model parameters are going to provide direct observations of the combined effect of mass variations of solid Earth, atmosphere, ocean, ice and hydrology. The degree 2 geopotential relates to the Earth's principal axes of inertia and polar motion. Thus, dynamic and reference system related quantities are derived being relevant for IERS product generation and interpretation. Moreover, for the future a combined processing of high- and low-flying satellites, using different measurement techniques, might become important to get a consistent estimation of reference system and gravity field related quantities.

Recommendations for a Rigorous IERS Combination (Ray):

- via products of the IGS.
- Contribution to ITRF

What does the IERS contribute to the “Project / Service / Union”?

Astronomy (Capitaine):

- The IERS accomplishes its mission through a number of components of which the following are of special interest for astronomy:
 - **Earth Orientation Centre**, responsible for monitoring EOP including long term consistency,
 - **ICRS Centre**, responsible for the maintenance of the ICRS/ICRF.
 - **Convention Centre**, responsible for the maintenance of the IERS conventional models, constants and standards.
- The IERS has a very significant role for astronomy regarding its responsibility for the celestial reference system and the implementation of the Astronomical Standards in the IERS work. The implementation of the IAU 2000 Resolutions through the IERS Conventions 2000 is a very significant contribution of the IERS to the IAU objectives.
- The IAU should:
 - consider the IERS as a very significant Service of the IAU,
 - recognize the importance of the IERS for the fundamental astronomical reference system,
 - encourage the best possible coordination between the development of models and software for IERS and astronomical use (SOFA: Software of Fundamental astronomy),
 - rely on the IERS for the primary implementations of the IAU Resolutions.

IGGOS (Beutler):

(in preparation phase, no products are presently contributed)

IGGOS will be based on the existing IAG Services and is not taking over tasks of the well working IAG services.

Altimetry (Bosch):

- Precise Orbits from ILS, IGS, and IDS (DORIS Service)
- Precise Terrestrial Reference Frame realisations
- Range corrections for ionospheric delay (tomography by IGS)

New Satellite Missions (Schutz):

- The role of the ITRF, for example, in radar altimeter missions is evident.
- Example NASA Mission ICESat (Ice, Cloud and land Elevation Satellite):
The generation of primary data product (time, latitude, longitude and geodetic height of the laser footprint on the surface) from the on-board and ground instrumentation requires input from the IERS (ITRF, ICRF, and EOP), as well as directly and indirectly from the IGS, ILRS, IVS and IDS.
The directional information relies on a system of star cameras to determine the spacecraft orientation to the arc-sec level (in the ICRF), but determination of the surface location requires application of the EOP to provide the laser foot-print location in the ITRF.

Global gravity field and missions (Reigber / Schwintzer):

- The generation of global gravity field models from satellite data relies on precise orbit determinations and is linked to IERS via the use of reference frames (ICRF, ITRF) and its connections (EOP) as well as international computational and modelling standards (IERS Conventions).

Recommendations for a Rigorous IERS Combination (Ray):

- The ITRF, EOP predictions
- models in the IERS Conventions.
- the AAM products from the GGFC.

Consistency considerations of IERS products (Kouba)

- The consistency of all IERS products is one of the most important aspect, apart from others such as model standards, inter-technique coordination and inter-disciplinary ties, which IERS has been pursuing vigorously.
- From the beginning IERS attempted to make EOP and ITRF consistent, but relatively low precision and biases present in submitted solutions limited the consistency. Further more,

consistency suffered from independent EOP and reference frame combinations, each of which used different and subjective weighting.

What does the “Project / Service / Union” expects to obtain in the future from the IERS (products)?

Astronomy (Capitaine):

- The astronomical community expects that the IERS products of significant interest for astronomy (Celestial Reference System, the Earth Orientation Parameters, Conventions) are available in the best convenient form and with the best possible accuracy.
- Expert’s opinion in many points regarding reference systems and Earth Rotation is also required from the IERS.

IGGOS (Beutler):

IGGOS monitors the Earth system as a whole through the IAG Services and is based on the 3 pillars of geodesy, namely:

- geometry and kinematics,
 - Earth orientation and rotation, and
 - gravity field and its variability.
- IERS delivers the IGGOS products and is recognized as the basis for its success. In this context the IERS will contribute to:
 - geometry and kinematics,
 - Earth orientation and rotation
 - Products from the GGFC’s

Altimetry (Bosch):

- Orbits of the 'collocation' satellites: Topex/Poseidon, Jason 1, Envisat, where DORIS tracking is collocated with SLR and/or GPS tracking: link to combination with altimetry products (see IDS)

New Satellite Missions (Schutz):

- It is important that the products of the contributing services be internally consistent at this level or better. In the coming years, however, the development of follow on missions and new missions that have strong geodetic components can be expected to make even greater use of the high accuracy of the IAG Services.

Global gravity field and missions (Reigber / Schwintzer):

- The new generation satellite gravity field missions are characterized by extreme accuracy and reliability requirements, and in the case of CHAMP and GRACE provide long gravity monitoring time series. This implies that the underlying reference systems, its evolution with time and modelling standards guarantee highest quality and a long-term consistency. For modelling temporal gravity variations and the evaluation of results, the products provided by the IERS Global Geophysical Fluids Centre (GGFC) have to be up-to-date, complete and processed according to the user requirements.

Recommendations for a Rigorous IERS Combination (Ray):

- Products from the GGFC
 - loading information
 - AAM and OAM values.

Consistency considerations of IERS products (Kouba)

- The IERS multi-technique combinations then should try reconcile single technique combination consistency (biases) before any IERS combination of the single technique combinations.
- Single and multi-technique combinations, when properly designed and coordinated, should provide sufficiently precise and efficient solutions. Such approximations should be even more robust and precise than an observation level combination (e.g. due to inability/difficulty to mitigate systematic errors/biases of different solutions / techniques at the observation level)
- IERS reference products (EOP, ICRF and ITRF in particular) and its derivatives can play an important role (often supplying datum/origin/initiation) to most GGFC products. With increasing precision/(long-term) consistency, it is important that the IERS reference products are also properly propagated / used in the individual GGFC components of IERS.

Other remarks, comments.**Astronomy (Capitaine):**

- There is a valuable synergy within the IERS community between geodesy, astronomy and geophysics working in different and complementary topics. It is very important that the IERS should not be considered as restricted to a geodetic institution. Its responsibility for the ICRS and the Conventions is very significant for astronomy.
- It may be possible and useful, in the future, to enlarge the role of the IERS in astronomy by a stronger coordination with the almanac offices. Note that the IERS Conventions are more and more used by this community as the official basis for standards and models.
- In the upcoming reorganization of the IAU, it should be necessary to identify which commission would be the most appropriate for the most efficient scientific work in the domain of Earth's rotation and reference systems.

Altimetry (Bosch):

- Ocean mass redistribution can also be estimated from the new gravity field missions CHAMP, GRACE, and GOCE. There is mass redistribution not only in the ocean, but also in the atmosphere, due to soil moisture, snow cover, ...
- Modelling Earth mass redistribution is an interdisciplinary research task with „forward modelling“, use of geodetic space techniques and constraining by CHAMP & GRACE results

Recommendations for a Rigorous IERS Combination (Ray):

- There is a need for quality improvements in some areas
 - the polar motion offsets between the IERS and the IGS (maybe other techniques) are too large and they do cause minor problems that should be eliminated.
 - improve the IERS Conventions; there is a strong need to improve the explanation and justification for the models recommended rather than simply pick them. There is also no information on the impact when models are changed, or even any explanation for why.
 - inconsistencies between various models has also not been completely eliminated.
- The GGFC products are improving but there remains a lot of room for further improvement in range of products to cover user needs and in better explanatory materials to go with the data files.

Consistency considerations of IERS products (Kouba)

- Through the GGFC components also promoted / used within the corresponding Earth science disciplines. This is also one of the key requirements of the IGGOS concept.