The JCET/GSFC (SLR) TRF Solution 2004

Erricos C. Pavlis
JCET and NASA Goddard Space Flight Center
Univ. of Maryland Baltimore County
Baltimore, Maryland (epavlis@JCET.umbc.edu)

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Outline

- SLR analyses for ILRS and IERS
- SLR targets used
- Supported products and studies:
  - “Geocenter” Variations
  - Moment of Inertia Variations
  - EOP (PM & LOD)
  - Gravitational modeling (static & TVG)
  - Refraction model validation
  - Comparison with geophysics
  - Other…
- Present status
SLR for ILRS & IERS

- Contributing to ILRS weekly products:
  - SINEX for Positions and EOP
  - EOP wrt ITRF2000 for NEOS
  - ILRS GLTN QC of L-1, L-2, E-1 and E-2
- Contributing annually a multi-year solution
- Weekly products for IERS CPP (same as above)
- Annual multi-year solution (unconstrained) for IERS TRF development
- Long series of EOP from an ITRF2000-based multi-year solution
SLR Targets Used

- **At present:**
  - LAGEOS 1 & 2
    - 1993 - present
  - ETALON 1 & 2
    - April 2001 - present

- **Considering to add:**
  - Starlette
  - Ajisai
  - ???
GM Estimate and Uncertainty

\[ GM_{\text{IERS}} = 398600.441500 \times 10^9 \, [\text{m}^3/\text{s}^2] \]
\[ GM_{\text{SLR}} = 398600.441644 \times 10^9 \, [\text{m}^3/\text{s}^2] \]
\[ 1-\sigma_{GM_{\text{SLR}}} = 0.000006 \times 10^9 \, [\text{m}^3/\text{s}^2] \]

TRF scale at \approx 0.02 \text{ parts in } 10^9
Supported Products & Studies - 2

- $x^2$ smoothed
- $y^2$ smoothed
- $z^2$ smoothed

Date
Supported Products & Studies - 5

![Graph showing linear a priori J\textsubscript{2} trend, ΔJ\textsubscript{2} x 10\textsuperscript{11}, ΔJ\textsubscript{2} Smoothed, and ΔJ\textsubscript{2} GRACE over time.](image-url)
Supported Products & Studies - 6

Erricos C. Pavlis
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Supported Products & Studies -- 6

RMS Geoid JEM11096X
- RMS Geoid 96X
- EGM96 Geoid Error
- Dynamic Ocean Topography Signal
- Geoid Undulation Signal JEM11096X

Geoid RMS per Degree [m]

Degree

JEM-110-96X
QuickTime™ and a TIFF (LZW) decompressor are needed to see this picture.
Equatorial Trajectory of the Geocenter

Polynesia

Indonesia

$\Delta x \text{ [mm]}$

$\Delta y \text{ [mm]}$

1993 - 2003

Indonesia 110E

Polynesia 120W

$\text{Equatorial Trajectory of the Geocenter}$
JCET Analysis Schedule

Weekly Analysis of L-1, L-2, E-1 and E-2 to produce normal equations for:

- SINEX of weekly ILRS AWG contribution
- Annual solution (after end-of-year)
- Incremental solution of multi-year solution
- NEOS solution for EOP and network QC
JCET Incremental Solution

The JCET multi-year solution is updated sequentially on a weekly basis, delivering a new “multi-year” TRF realization weekly, along with a new weekly estimate of the change in the “geocenter”, and an extension of the long EOP series that is delivered annually:

\[
\begin{bmatrix}
V_1 \\
V_2
\end{bmatrix} =
\begin{bmatrix}
A_{11} & \varnothing & X_1 \\
A_{12} & A_{22} & X_2
\end{bmatrix}
+ \begin{bmatrix}
L_1 \\
L_2
\end{bmatrix}
\]

The sequential solution allows for new “parameters” (e.g. new sites), and for a modification of the existing parameters due to the inclusion of new data.
DATA:

- Analysis of LAGEOS 1 SLR data will be extended “backwards” in time to include data as early as 1983, and possibly since 1976.

- Since weekly-resolution normal equations prior to 1990 will be developed, we are processing Starlette and Ajisai data at the same period to strengthen the solution and to allow daily resolution of EOP.
MODELS:

- GEODYN is upgraded to conform fully with IERS Conventions 2003.
- New analysis will be based on new gravitational (GGM02S) and tidal (Earth, oceans, and loading) models.
- Atmospheric loading will be included for all sites using NCEP fields, (temporal gravitational effects included).
- New refraction model (zenith delay and mapping function).
- LAGEOS 1 & 2 spin axes modeled with LOSSAM.
Summary

- The JCET/GSFC ILRS AC will contribute to the CPP with a set of weekly SINEX files starting in 1990 and possibly, as early as 1976.

- The standard analysis routine is under modification to allow the re-analysis of the current as well as the expanded data set with new, improved models and procedures, adhering to the IERS 2003 conventions.

- The new products will be delivered in January 2005, at the same time that we will deliver the standard annual contribution to IERS.
SLR Analysis @ JCET

The End

... a re-analysis to be released in January 2005!