Poster #08

Assessment of Low Degree Gravitational Changes from GRACE, Earth Rotation, and Geophysical Models

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Objectives

- **Independent determination of degree-2 Stokes coefficients ΔC_{21}, ΔS_{21}, and ΔC_{20} from Earth rotation**
  - **Observed Earth rotational excitations**
  - **Atmospheric wind excitations**
  - **Oceanic current excitations**
- **Independent determination of ΔC_{21}, ΔS_{21}, and ΔC_{20} from atmospheric, oceanic, and hydrological models**
  - **Atmospheric surface pressure**
  - **Oceanic bottom pressure**
  - **Continental water storage change**
- **Comparison with GRACE observations – validation & interpretation**

Data and Processing

- **Observed EOP Excitations**
  - IERS combined EOP time series X, Y, & LOD (C04), Daily
- **Atmospheric wind excitations**
  - Daily NCEP Reanalysis wind data
  - Surface – 10 mb
- **Oceanic current excitations**
  - ECCO Data Assimilating OGCM (kf049f)
  - U & V velocity every 10-day

Data and Processing (cont.)

- **Atmospheric surface pressure**
  - Daily NCEP Reanalysis surface pressure, Daily
- **Oceanic bottom pressure**
  - ECCO data-assimilating (kf049f), 12-hourly
- **Continental water storage**
  - NASA GLDAS, 3-hourly, Jan. 2002 – Dec. 2004
- **AOW = Atmosphere + Ocean + Water**
  - Mass balanced
  - Averaged into daily average.

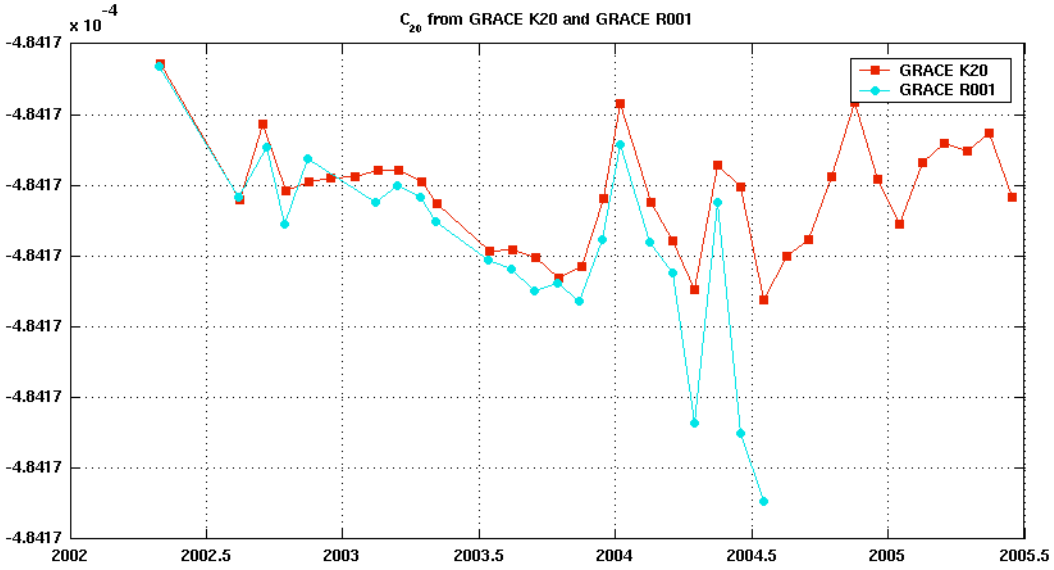

Figure 1. Comparison of C_{20} time-series from the constrained (K20, 35 pts) and R001 (22 pts) solutions

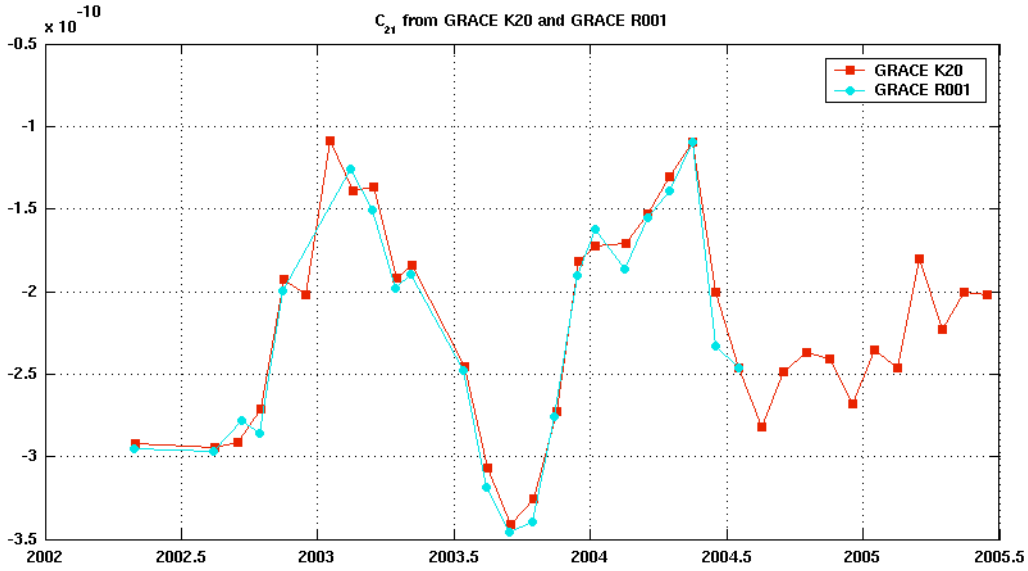

Figure 2. Comparison of C_{21} time-series from the constrained (K20, 35 pts) and R001 (22 pts) solutions

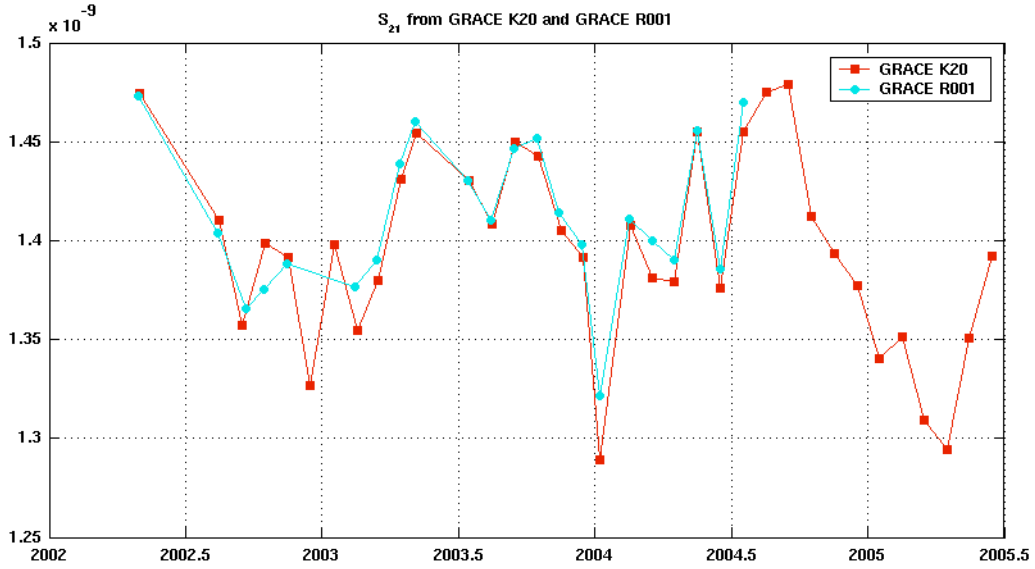

Figure 3. Comparison of S_{21} time-series from the constrained (K20, 35 pts) and R001 (22 pts) solutions

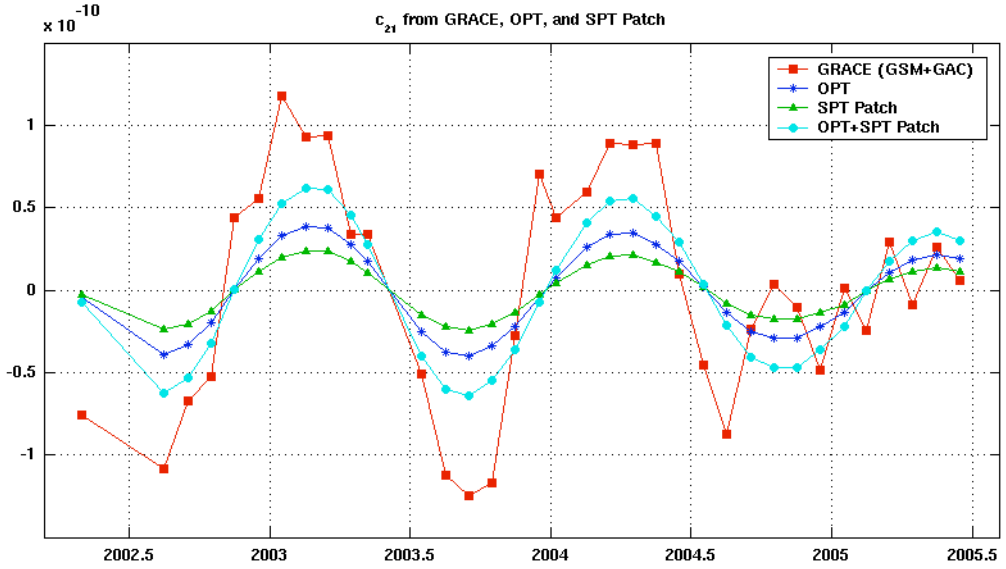

Figure 4. C_{21} time-series from the constrained (K20, 35 pts) solutions, compared with potential effects from the ocean pole tide (OPT, not applied in K20 yet) and and solid Earth pole tide (SPT, owing to model difference to IERS2003).

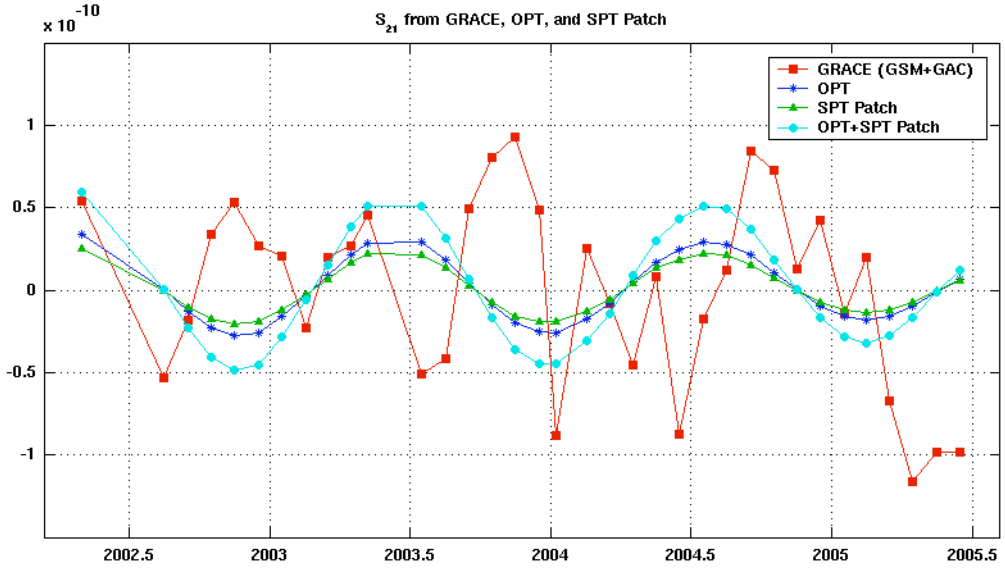

Figure 5. S_{21} time-series from the constrained (K20, 35 pts) solutions, compared with potential effects from the ocean pole tide (OPT, not applied in K20 yet) and and solid Earth pole tide (SPT, owing to model difference to IERS2003).

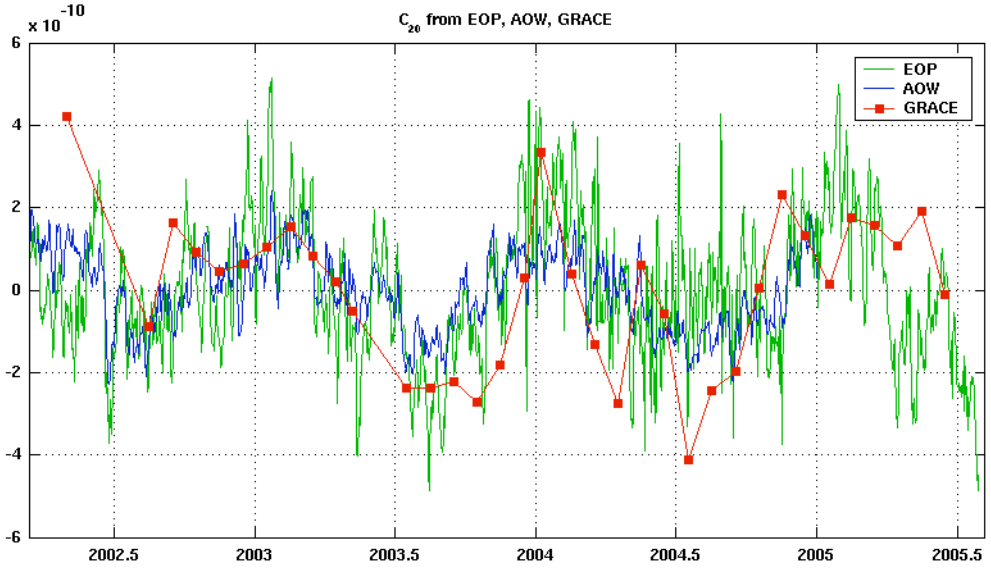

Figure 6. Comparison among C_{20} variations from 3 independent estimates: Earth rotation (EOP), geophysical models (AOW: atm. + ocean + water), and GRACE K20 solutions.

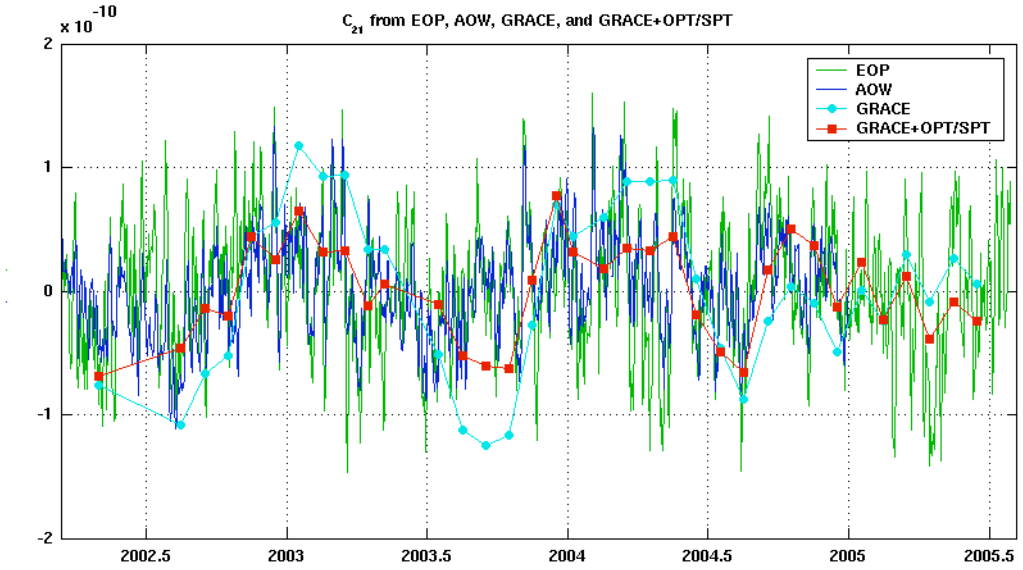

Figure 7. Comparison among C_{21} variations from 3 independent estimates: Earth rotation (EOP), geophysical models (AOW: atm. + ocean + water), and GRACE K20 solutions (with or without OPT/SPT corrections).

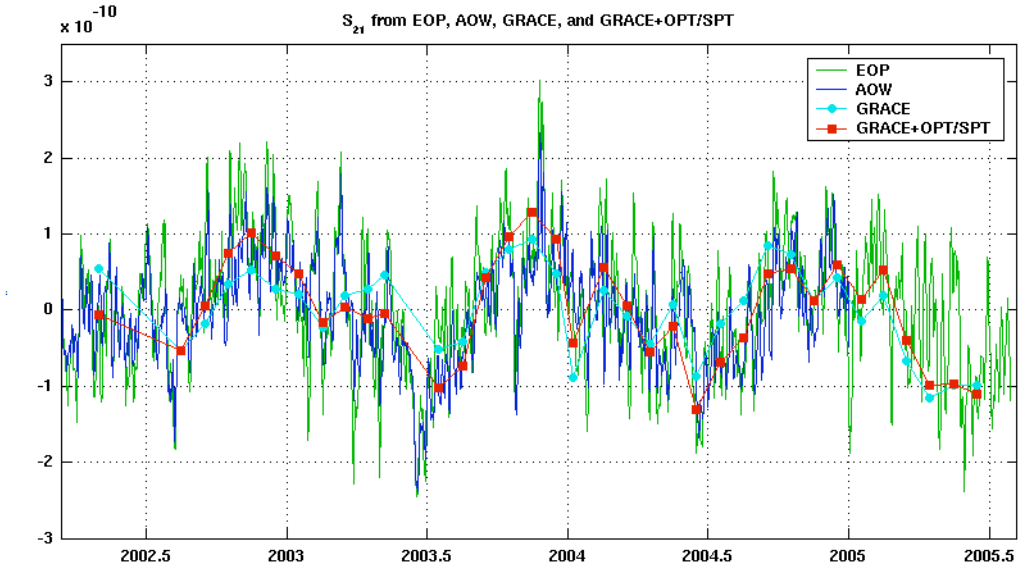

Figure 8. Comparison among S_{21} variations from 3 independent estimates: Earth rotation (EOP), geophysical models (AOW: atm. + ocean + water), and GRACE K20 solutions (with or without OPT/SPT corrections).

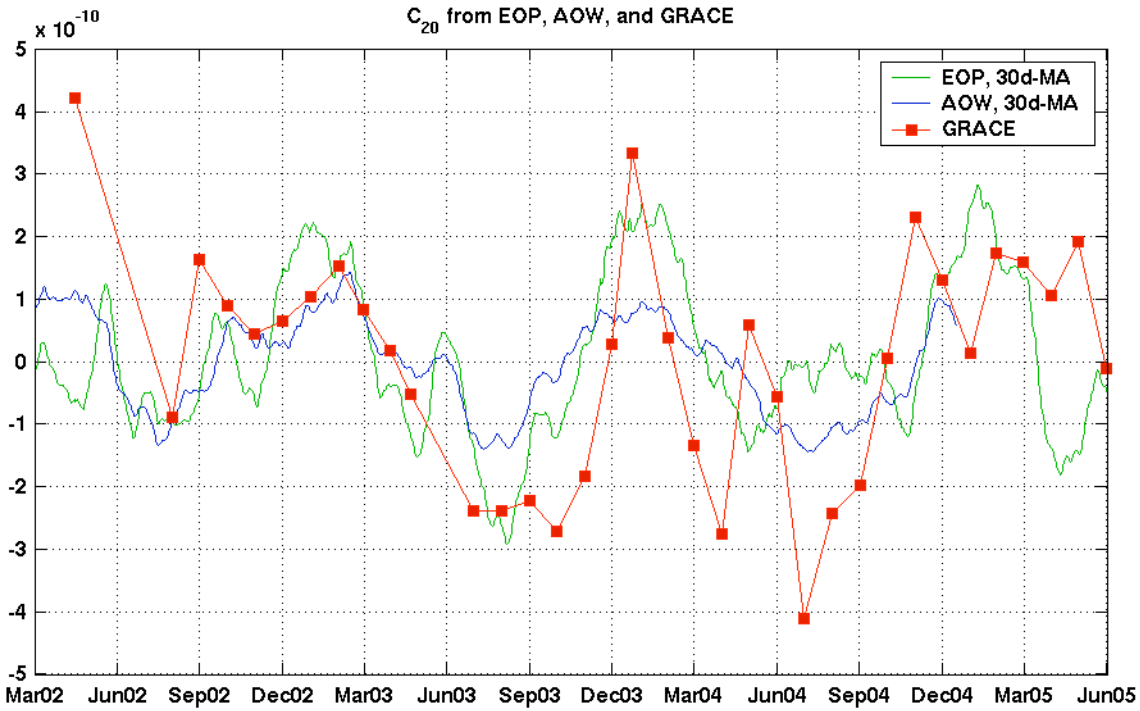

Figure 9. Comparison among C_{20} variations from 3 independent estimates: Earth rotation (EOP), geophysical models (AOW: atm. + ocean + water), and GRACE K20 solutions.

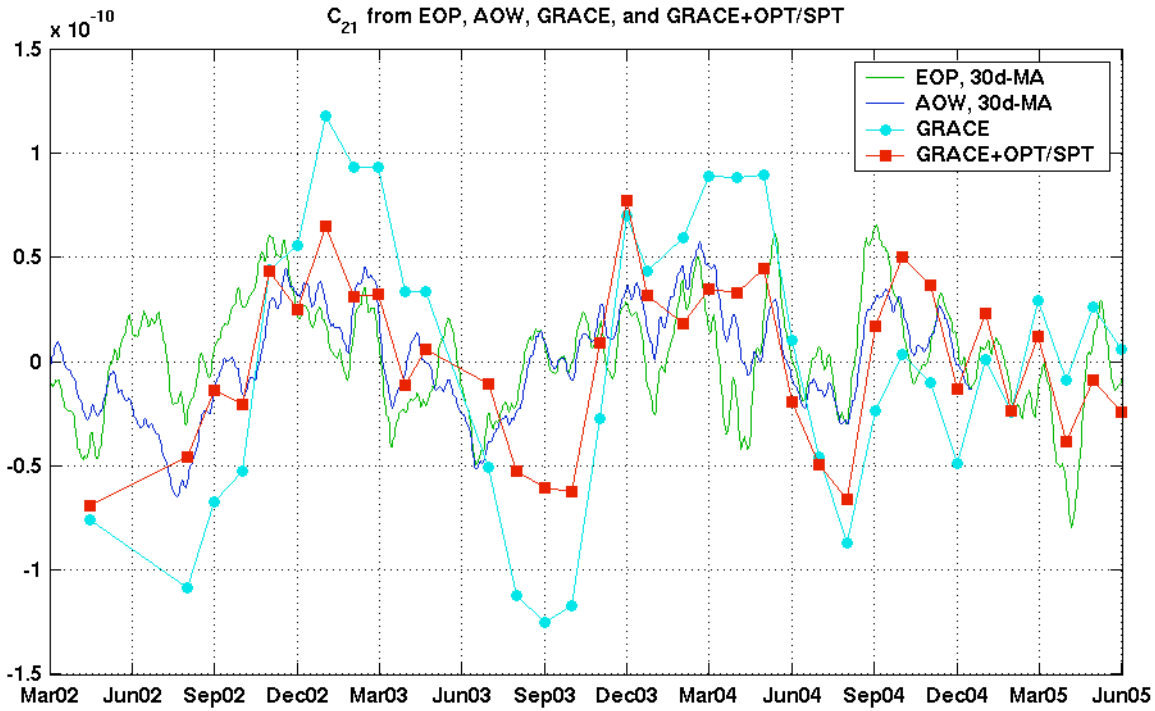

Figure 10. Comparison among C_{21} variations from 3 independent estimates: Earth rotation (EOP), geophysical models (AOW: atm. + ocean + water), and GRACE K20 solutions (with or without OPT/SPT corrections).

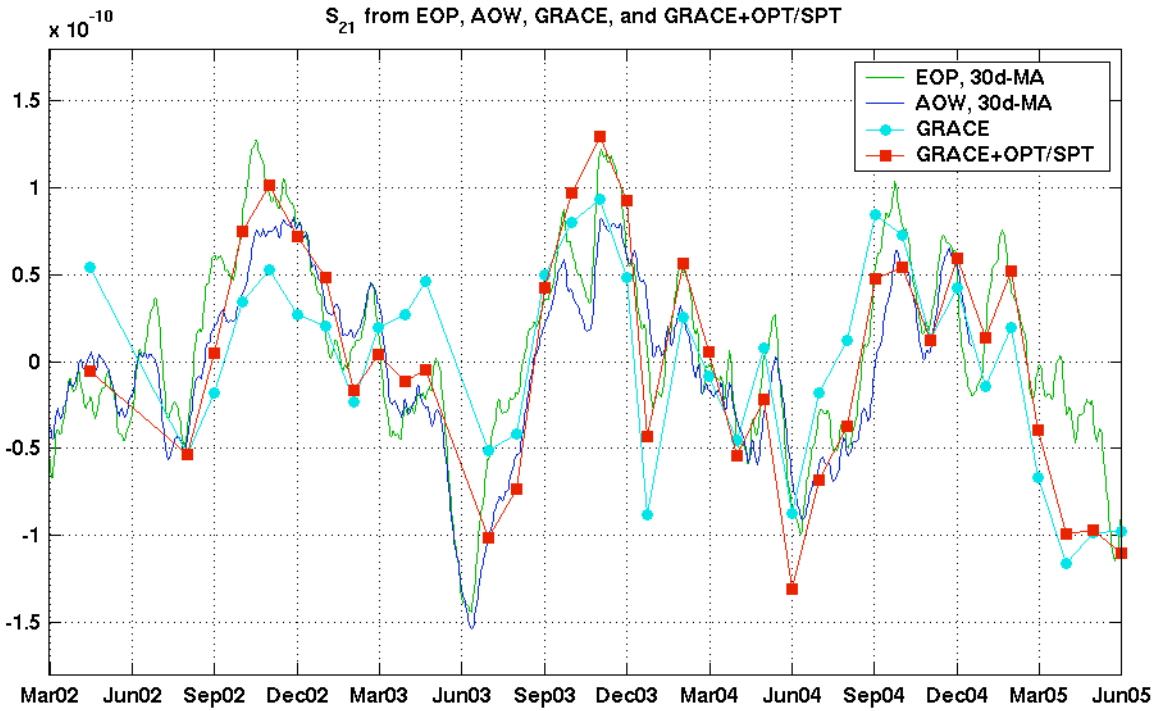

Figure 11. Comparison among S_{21} variations from 3 independent estimates: Earth rotation (EOP), geophysical models (AOW: atm. + ocean + water), and GRACE K20 solutions (with or without OPT/SPT corrections).

Conclusions

- EOP derived ΔC_{21}, ΔS_{21}, and ΔC_{20} variations agree remarkably well with AOW model predictions at a broad band of frequencies.
- GRACE observed ΔS_{21} and ΔC_{21} agree well with EOP derived results and model predictions, especially in ΔS_{21}.
- Ocean pole tide and the update of solid Earth pole tide have significant effects on GRACE observed ΔC_{21} and ΔS_{21}. When the corrections are applied, the agreement between GRACE and EOP/AOW is significantly improved.
- The constrained (K20) solutions show evident improvement in ΔC_{20} estimates.

Additional Notes

- **This research was supported by NASA's Solid Earth and Natural Hazards, GRACE, and NIP Programs (under grants NNG04GF10G, NNG04GF22G, NNG04G060G, NNG04GP70G) .**

- **Some similar early results are published in**

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Thanks !