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# **JPL Planetary Ephemeris Status Report**

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# Summary

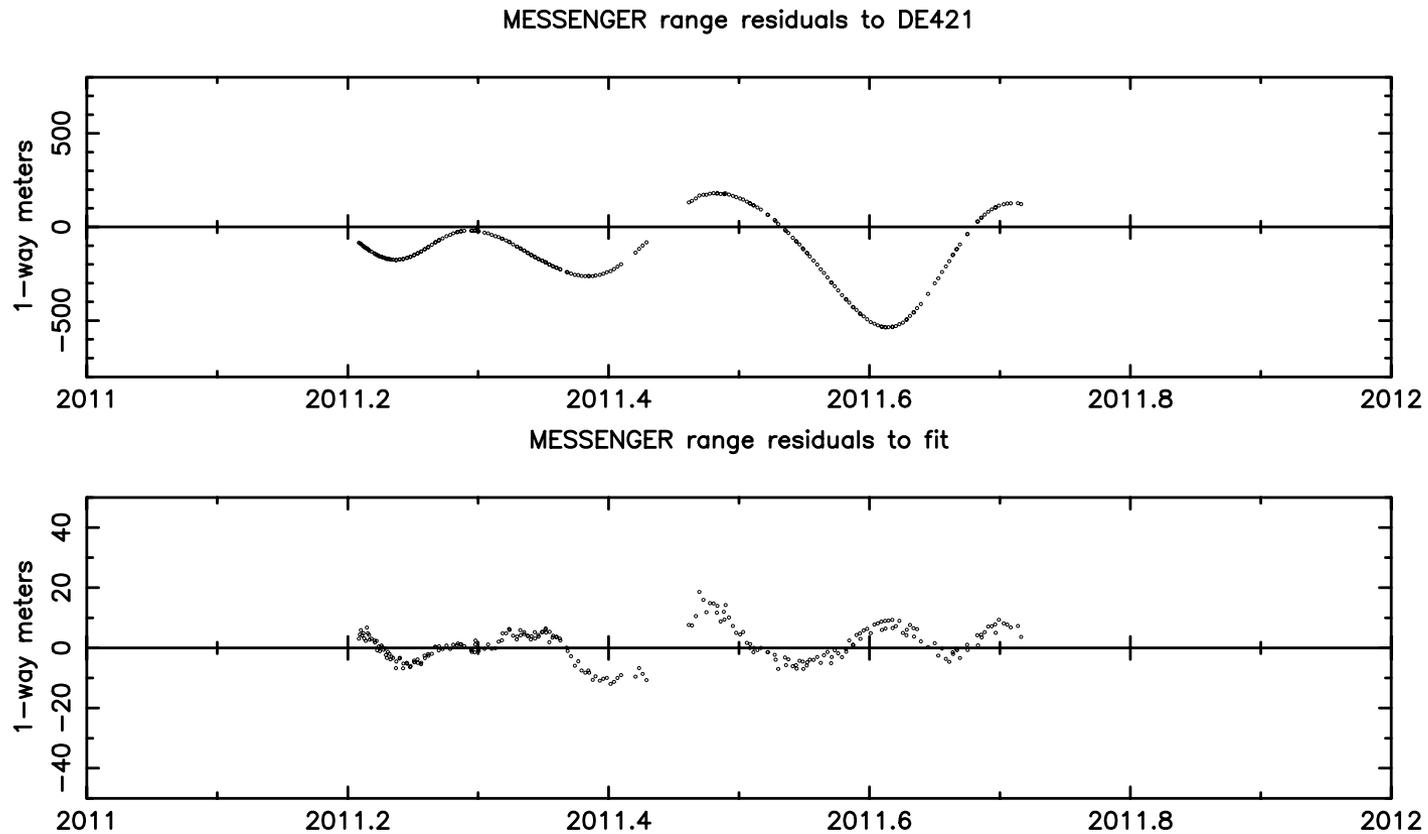
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- Main effort for last 3 years was determining Earth & Mars orbits to 200 m accuracy to support MSL landing
  - Tie to ICRF 2.0 through VLBI will be discussed at JD7
  - Improved asteroid modeling will be discussed at JD7 by P. Kucyhanka
- Mercury orbit improving from range to MESSENGER
  - Systematic signatures due to only northern spacecraft periapses
- Venus orbit relative to Earth largely unchanged
  - Continuing VEX range & VLBI not showing significant change
- Progress on systematic effects on Saturn range
  - Improving spacecraft orbits with iteration of ephemeris
- Pluto orbit showing systematic errors in declination
  - Possible color refraction effect
- TT-TDB implemented for next release (September)



# MESSENGER Range

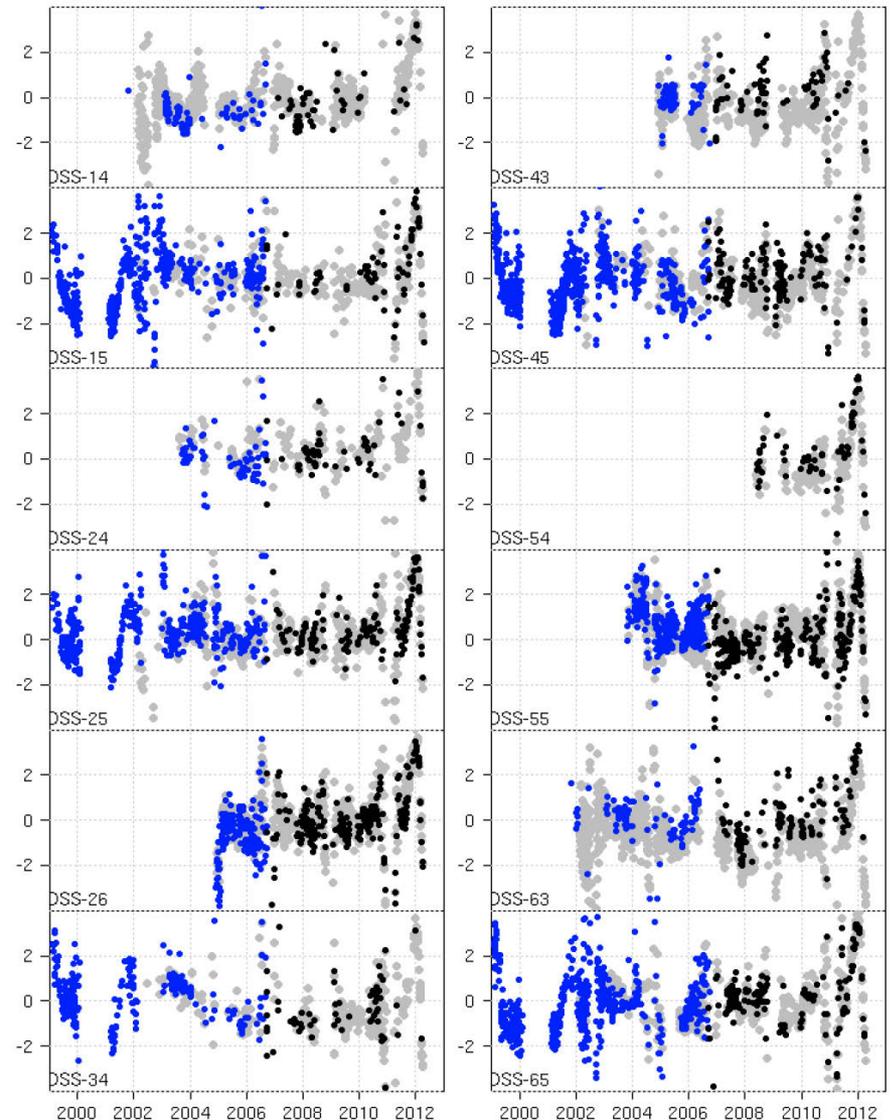
- Spacecraft orbits have systematic errors due to elliptical orbit with only northern periapsis (and other effects!)
  - Extended mission will give some southern coverage so should improve
  - Residuals to 421 are consistent with accuracy of radar range





# Mars orbiter ranging improvement

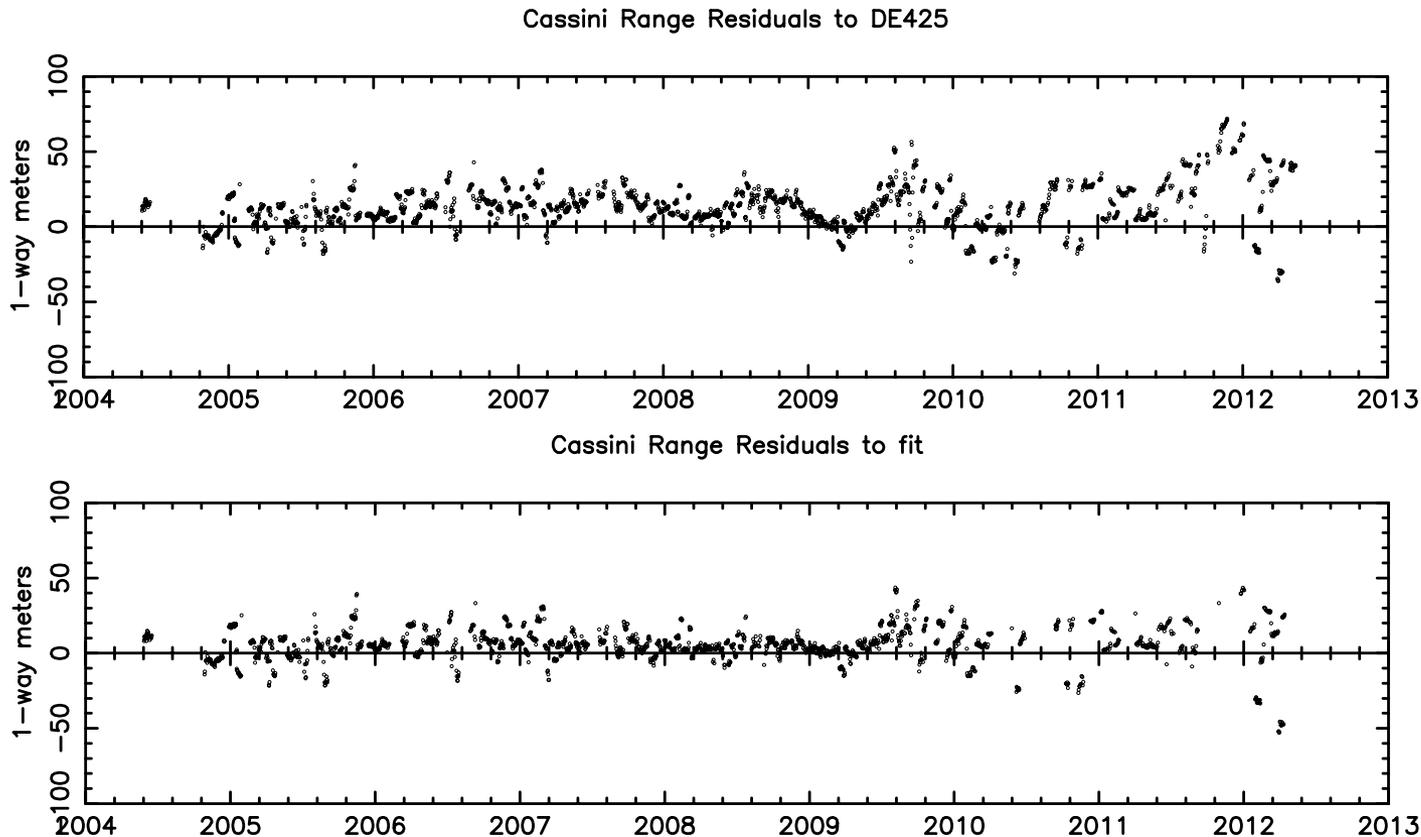
- Improving Mars gravity field has produced improved spacecraft orbits, allowing range to be fit to  $<1$  m on average
  - Station and spacecraft-specific measurement effects are generally small
  - Data from some stations have clear calibration issues prior to 2008
- Kuchynka et al., Station-Specific Errors in Mars Ranging Measurements, IPN Progress Report 42-190, 2012, [http://ipnpr.jpl.nasa.gov/progress\\_report/42-190/190C.pdf](http://ipnpr.jpl.nasa.gov/progress_report/42-190/190C.pdf)





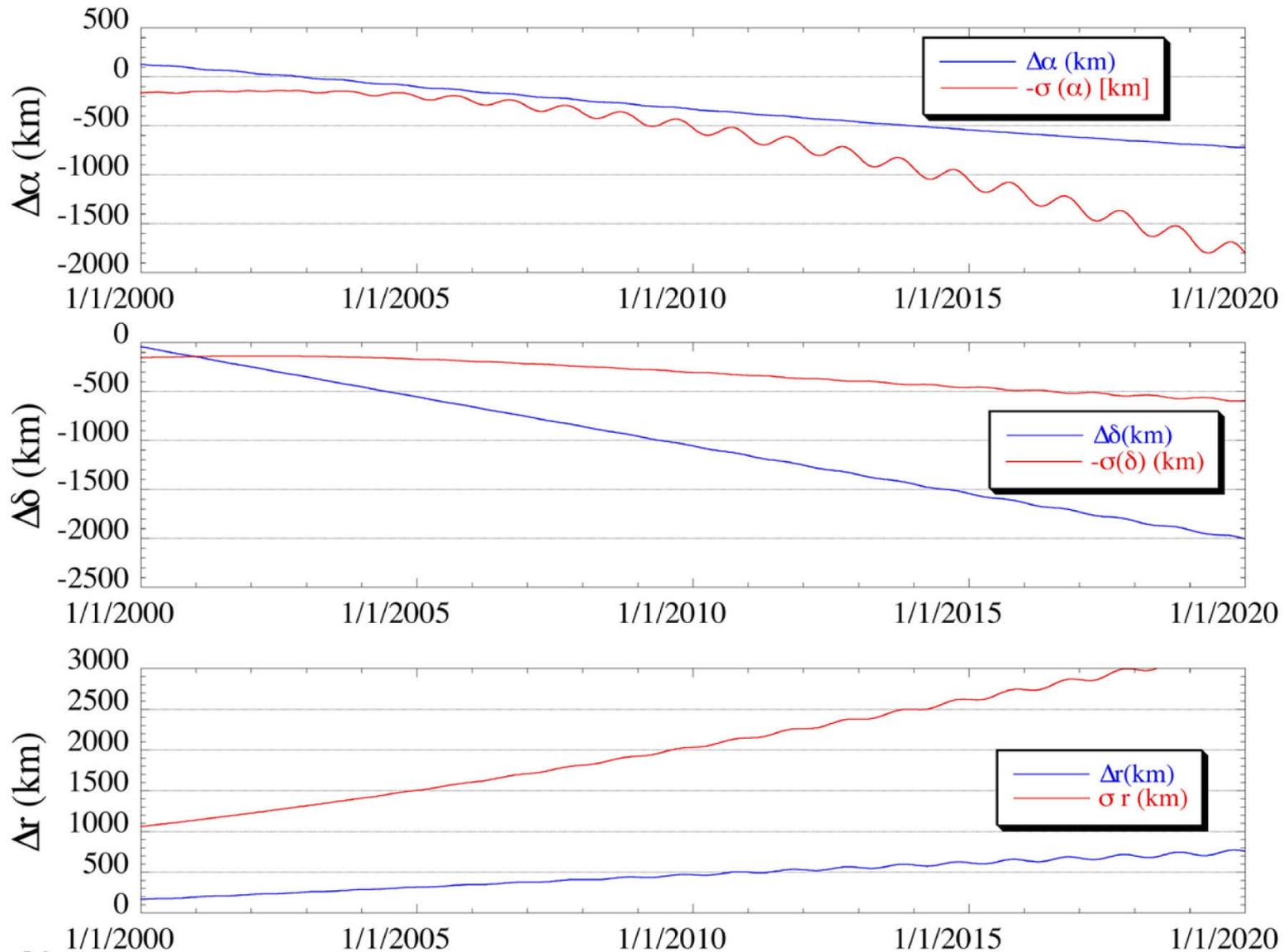
# Cassini Range to Saturn

- Cassini orbits relative to Saturn are subject to systematic errors due to long orbit period/large semi-major axis
  - Range improve spacecraft orbits but correlate with Saturn ephemeris signature
  - Iterating s/c and Saturn orbits appears promising, systematic errors being evaluated





# Pluto Orbit & Uncertainty





# Plans

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- September 2012 ephemeris with LLR combination
- New and/or re-measured data for Pluto for New Horizons deliveries in 2013 and 2014 for encounter July 2015
- Southern hemisphere coverage for Mercury 2012-2013
- Juno arrival at Jupiter July 2016



# Acknowledgements

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- Mercury range - Tony Taylor (Kinetx), Alex Konopliv (JPL)
- Venus r, VLBI - Trevor Morley (ESOC)
- Mars range - Alex Konopliv (JPL); Trevor Morley (ESOC)
- Mars VLBI - Jim Border (JPL)
- Asteroids - Petr Kuchynka (JPL)
- Saturn r,  $\alpha$ ,  $\delta$  - Bob Jacobson (JPL)
- Astrometry - W. Owen (JPL), A. Monet, H. Harris (USNO)