# *Global Lunar Gravity Fields From Lunar Prospector Data: Preparations and Implications for SELENE*

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## Outline

- Lunar gravity field and SELENE
- Processing strategy
- Gravity field updates and assessment of the new model
- Issues for SELENE; expected improvements from *ΔVLBI*
- Conclusions and recommendations

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# Lunar Gravity Field

- SELENE will provide first truly global data set
- At 100 km altitude, SELENE is mostly sensitive to lower spherical harmonical degrees
- Lunar Prospector flew low (~30 km)
- Combination to use best of both data sets

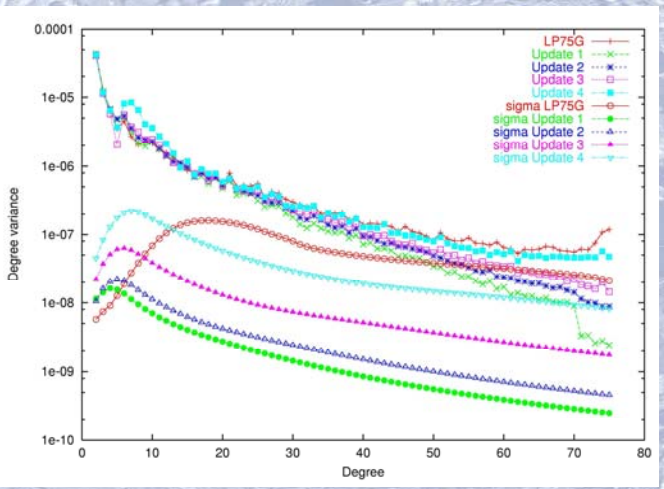


# Processing strategy

- A priori model: GLGM-2; a “smooth” model and *prior* to Lunar Prospector
- Use first three months of LP data – same as JPL model LP75G
- Regularisation

$$\sigma_l = \frac{\beta \times 10^{-5}}{l^2}; \quad \hat{x} = (A^T W A + K)^{-1} A^T W y$$

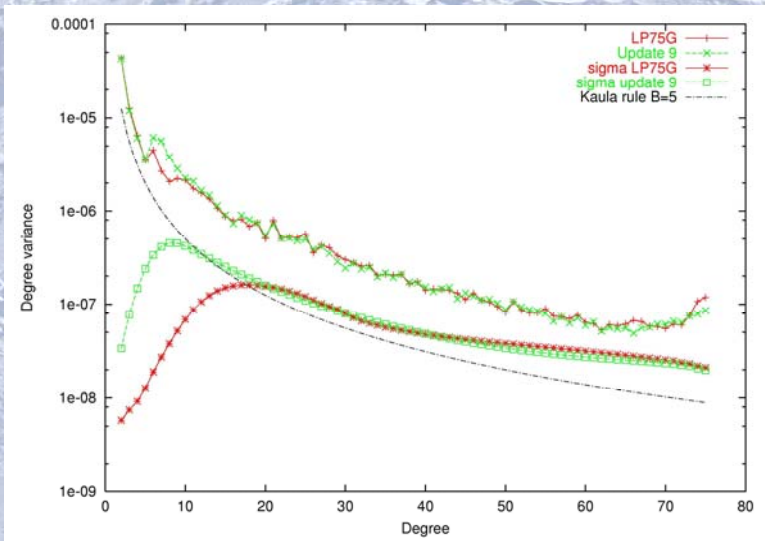
## Consecutive updates




| Update | β |
|---|---|
| 1 | $1/\beta^2=50$ |
| 2 | $1/\beta^2=15$ |
| 3 | $\beta=1$ |
| 4 | $\beta=5$ |



## Final update with Kaula rule β=5

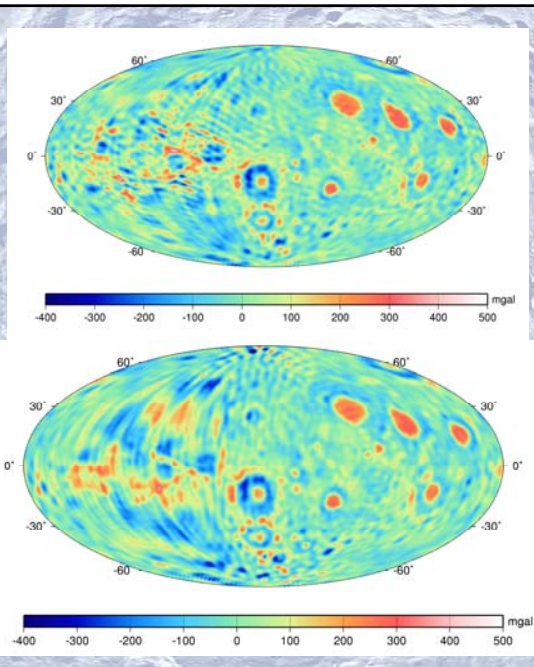


# Assessment of the new model

- Gravity anomalies
- Performance in orbit determination for (in)dependent data

  ⇒ expected improvements from *ΔVLBI*






LP75G




New model

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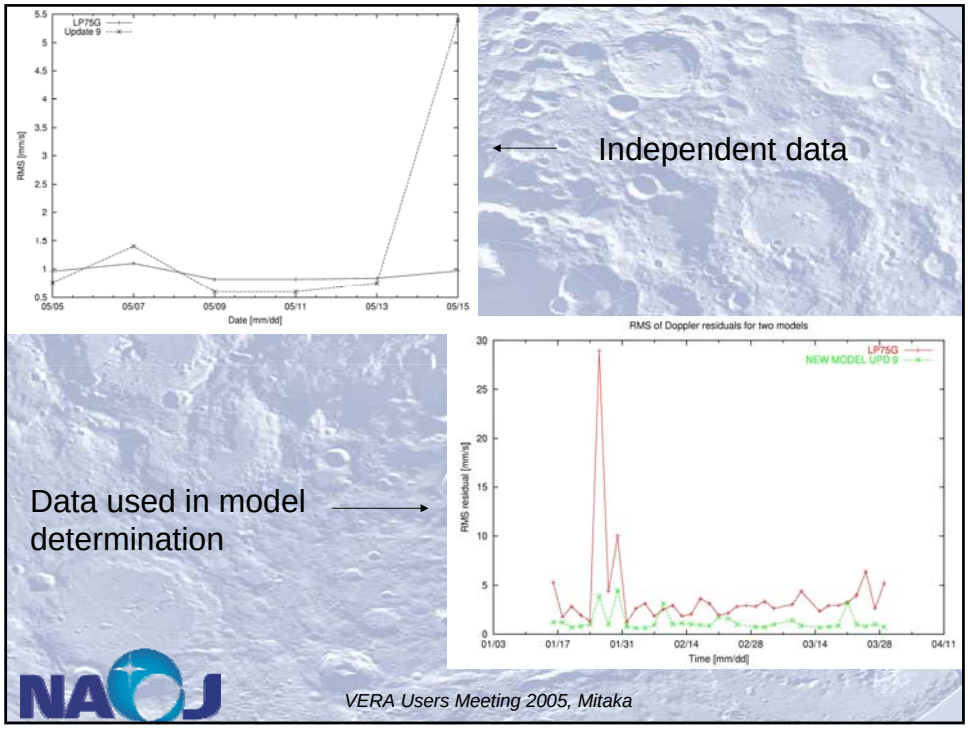
LP75G
Update 9
RMS [mm/s]
Date [mm/dd]
Independent data
RMS of Doppler residuals for two models
LP75G
NEW MODEL UPD 9
RMS residual [mm/s]
Time [mm/dd]
Data used in model determination
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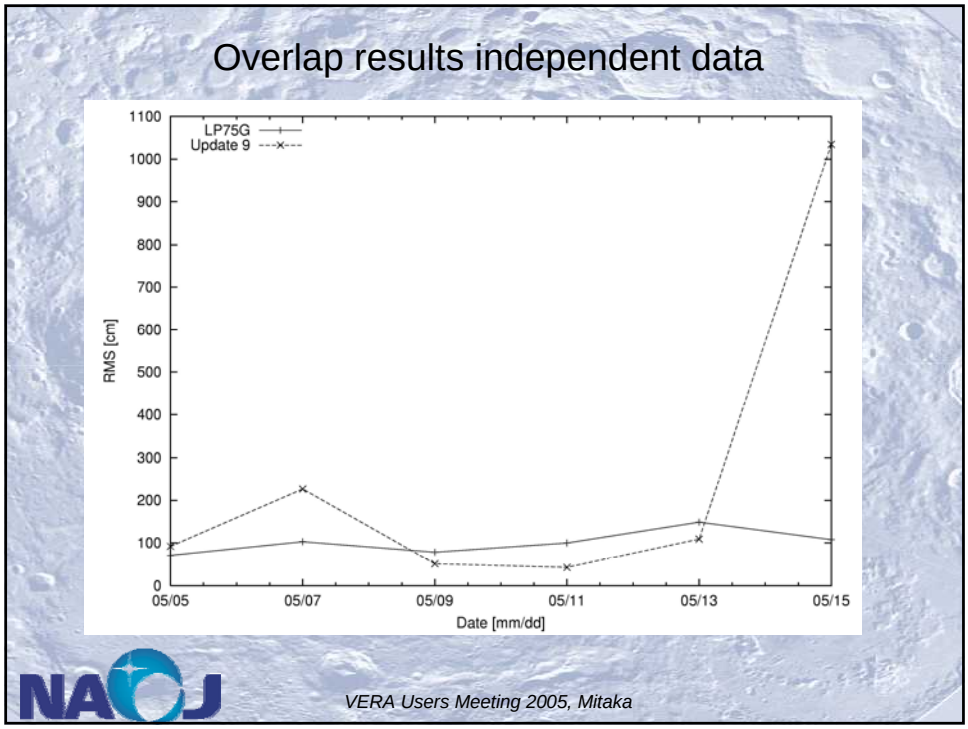
Overlap results independent data
LP75G
Update 9
RMS [cm]
Date [mm/dd]
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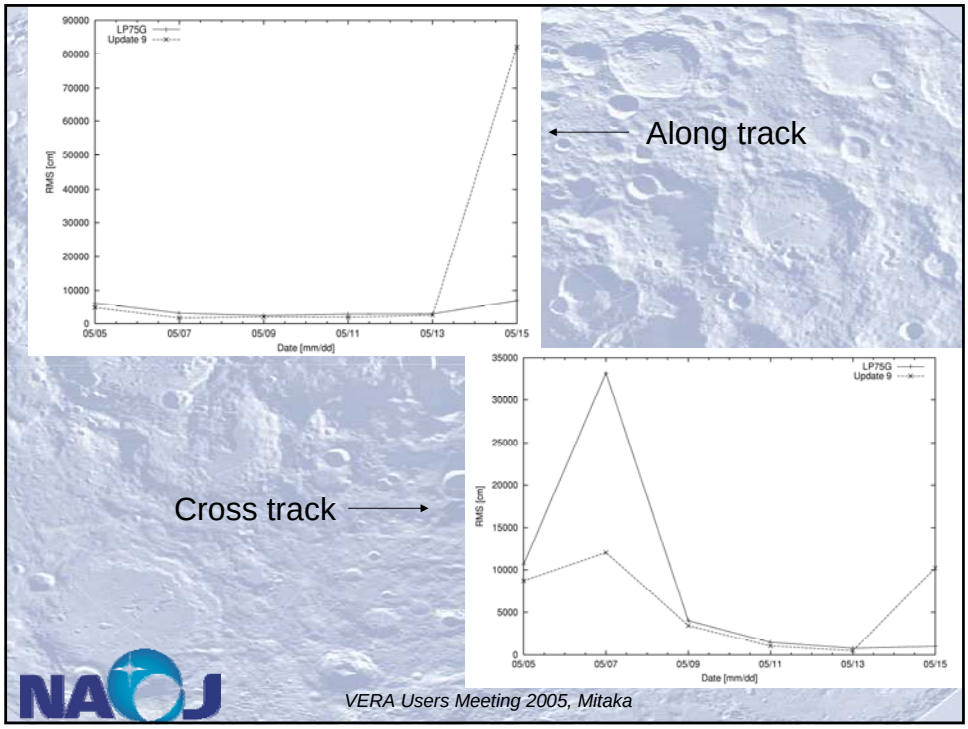
LP75G
Update 9
RMS [cm]
Date [mm/dd]
Along track
Cross track
LP75G
Update 9
RMS [cm]
Date [mm/dd]
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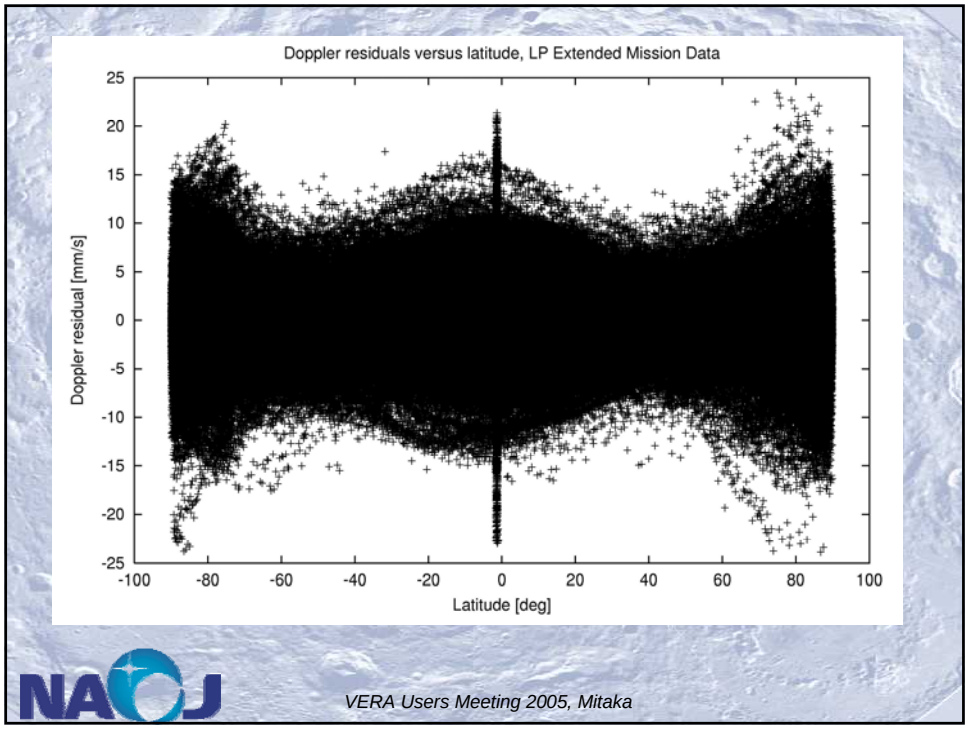
Doppler residuals versus latitude, LP Extended Mission Data
Doppler residual [mm/s]
Latitude [deg]
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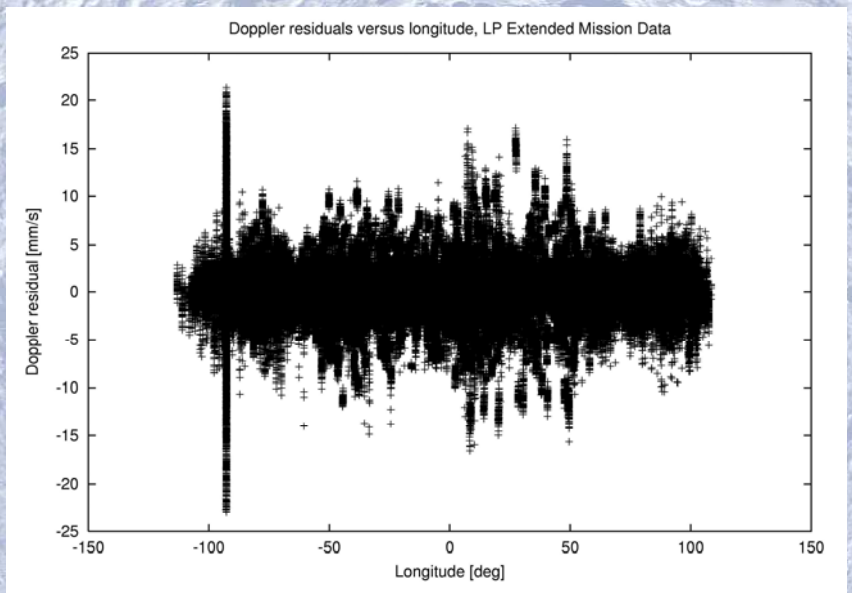




# Conclusions and recommendations

- Great influence of regularisation on solutions; using Clementine/historical data can improve estimate for lower degrees
- Despite large differences in anomalies over far side, both models perform equally well in terms of orbit precision!
- *ΔVLBI* will contribute to improvement of results over polar areas and 3D orbit determination

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