Static Gravity Field Recovery and Accuracy Analysis Based on Reprocessed GOCE Level 1b Gravity Gradient Observations

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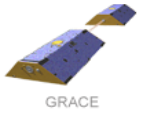
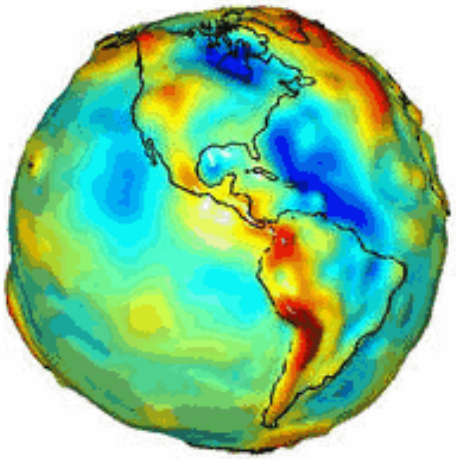
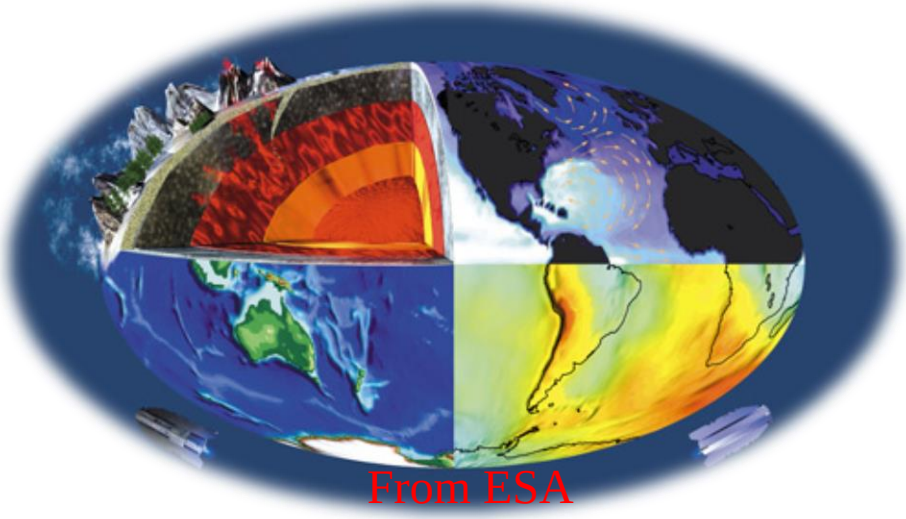
Contents

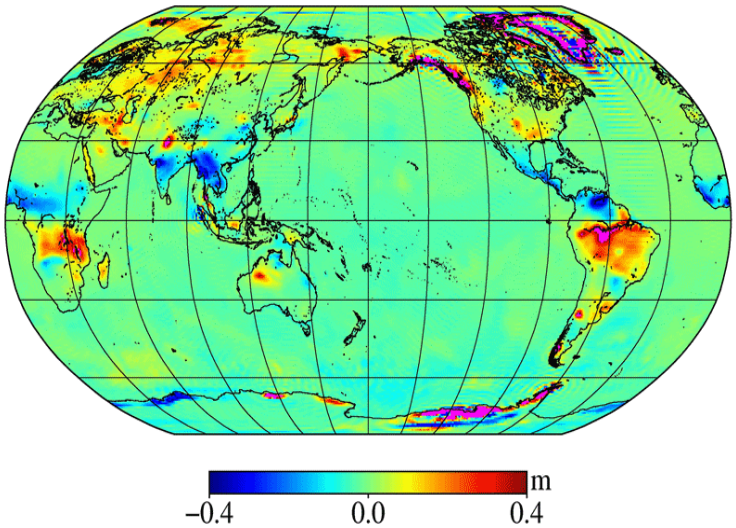


Introduction

Application of gravity field model







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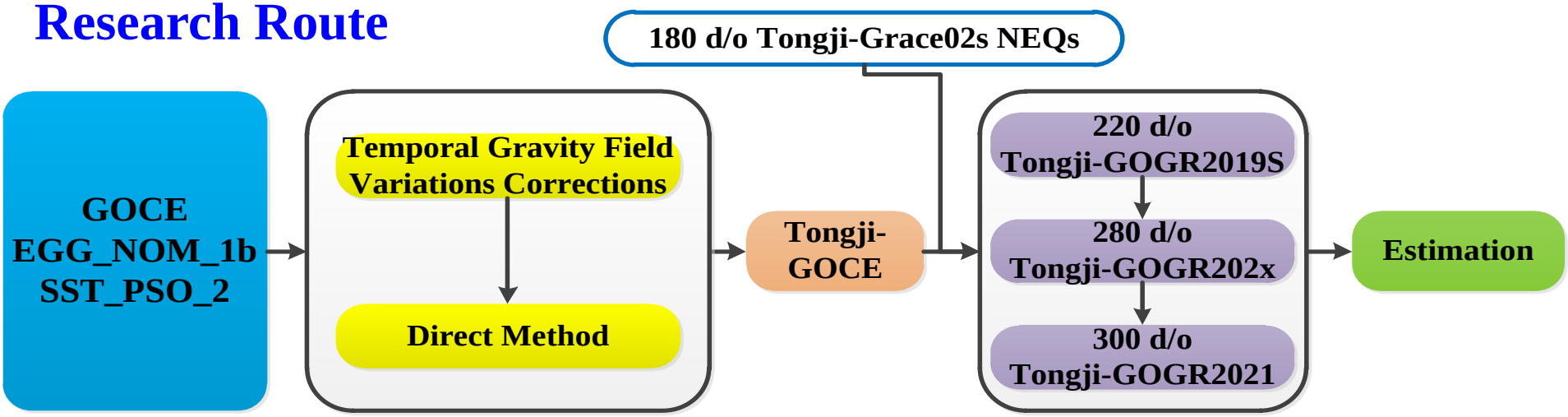
Introduction

Research Route



Tab.1 Model Solutions

Solution	Tongji-GOGR2019S	Tongji-GOGR202x	Tongji-GOGR2021
d/o	220	280	300
GOCE	SGG ≈ 2a	SGG ≈ 1148 d	SGG Mission Period
GRACE	180d/o Tongji-Grace02s NEQs		
Method	Direct Method		
Ref. Model	GIF48	Tongji-GOGR2019S	Tongji-GOGR202x
Other	No Constraint	Kaula Constraint	Kaula Constraint

Theory of Satellite Gravity Recovery

$$V(\theta,\lambda,r) = \frac{GM_{\oplus}}{r}\left[1+\sum_{n=2}^{N}\left(\frac{R}{r}\right)^{n}\sum_{m=0}^{n}\left(\bar{C}_{n,m}\cos m\lambda + \bar{S}_{n,m}\sin m\lambda\right)\bar{P}_{n,m}\left(\cos\theta\right)\right]$$

$$\Rightarrow V_r, V_\theta, V_\lambda, V_{rr}, V_{\theta\theta}, V_{\lambda\lambda}, V_{r\theta}, V_{r\lambda}, V_{\theta\lambda} \Rightarrow V_{xx}, V_{yy}, V_{zz}, V_{xy}, V_{xz}, V_{yz}$$

$$V_{xx}, V_{yy}, V_{zz}, V_{xz} \Rightarrow \boldsymbol{v}_{SGG} = \boldsymbol{A}_{SGG}\delta\boldsymbol{u} - \boldsymbol{y}_{SGG}$$

Combination of GOCE SGG and GRACE

Tongji-Grace02s

$$\left(\frac{\sigma_0^2}{\sigma_{SGG}^2}\boldsymbol{N}_{SGG} + \frac{\sigma_0^2}{\sigma_{GRACE}^2}\boldsymbol{N}_{GRACE} + \alpha\boldsymbol{K}_{kaula}\right)\delta\boldsymbol{u} = \left(\frac{\sigma_0^2}{\sigma_{SGG}^2}\boldsymbol{w}_{SGG} + \frac{\sigma_0^2}{\sigma_{GRACE}^2}\boldsymbol{w}_{GRACE}\right)$$

GOCE

$$\hat{\sigma}_i^2 = \frac{\boldsymbol{v}_i^T\boldsymbol{P}_i\boldsymbol{v}_i}{n_i - \mathrm{tr}\left(\boldsymbol{N}^{-1}\boldsymbol{N}_i\right)}$$

$$\sigma_0 = 0.02m$$

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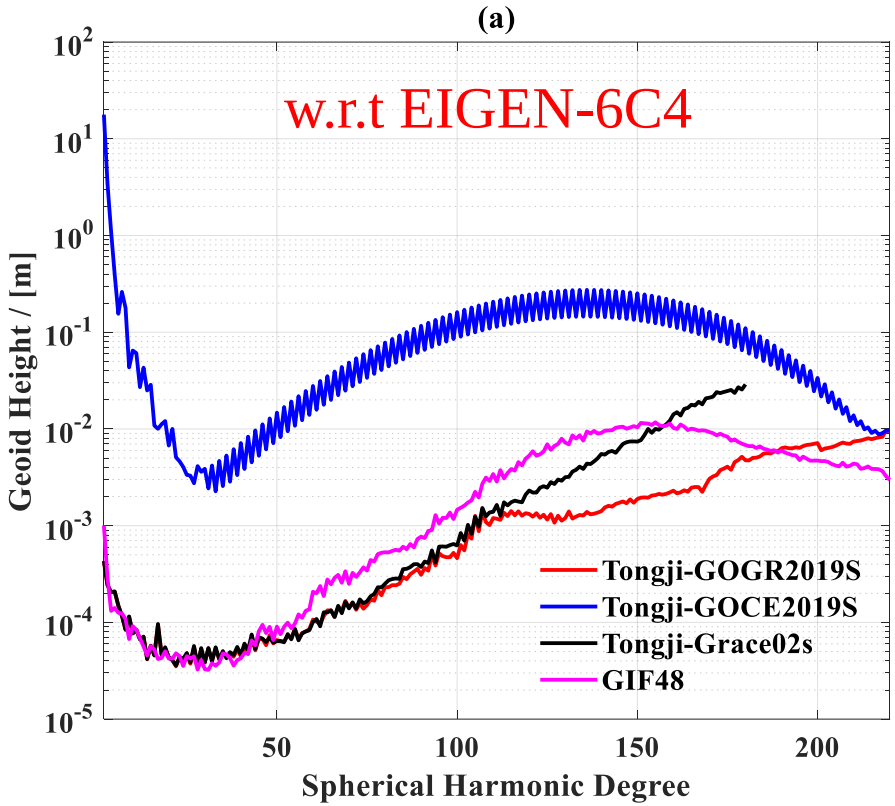
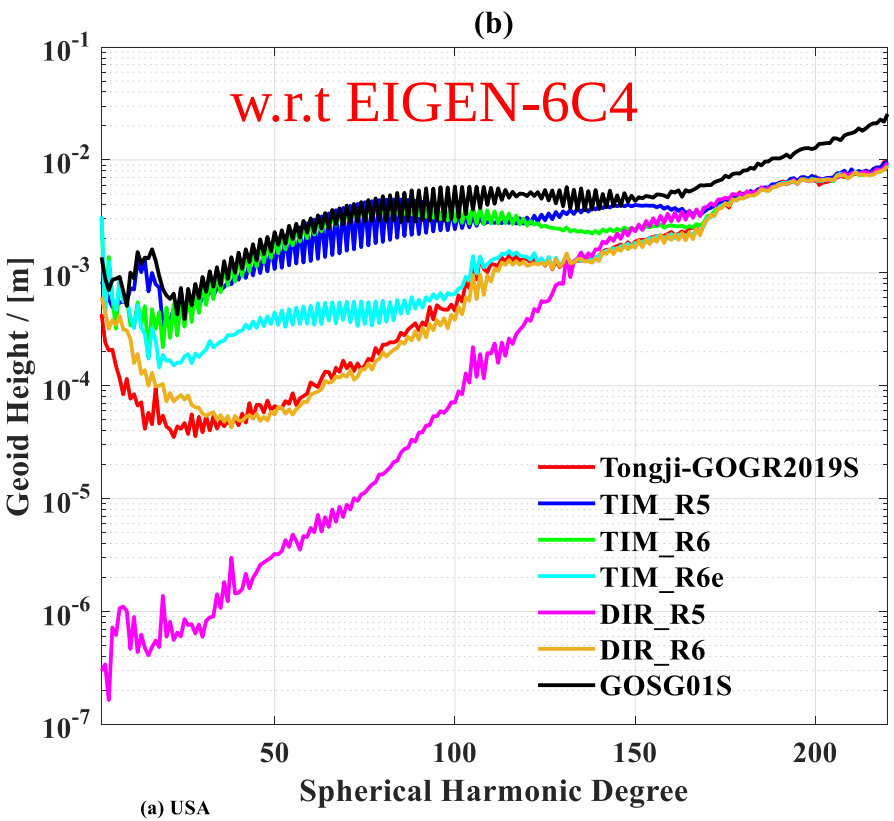
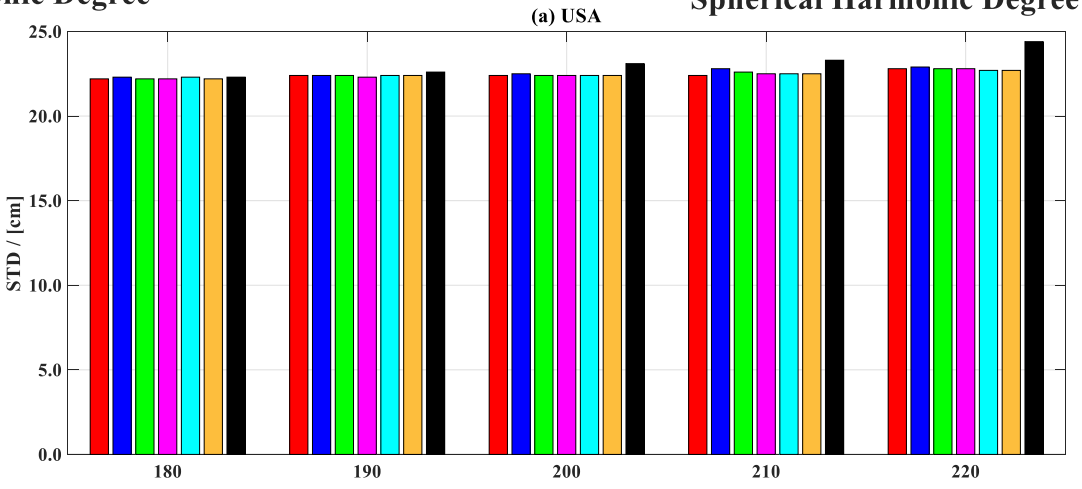
Combined Recovery and Accuracy Analysis







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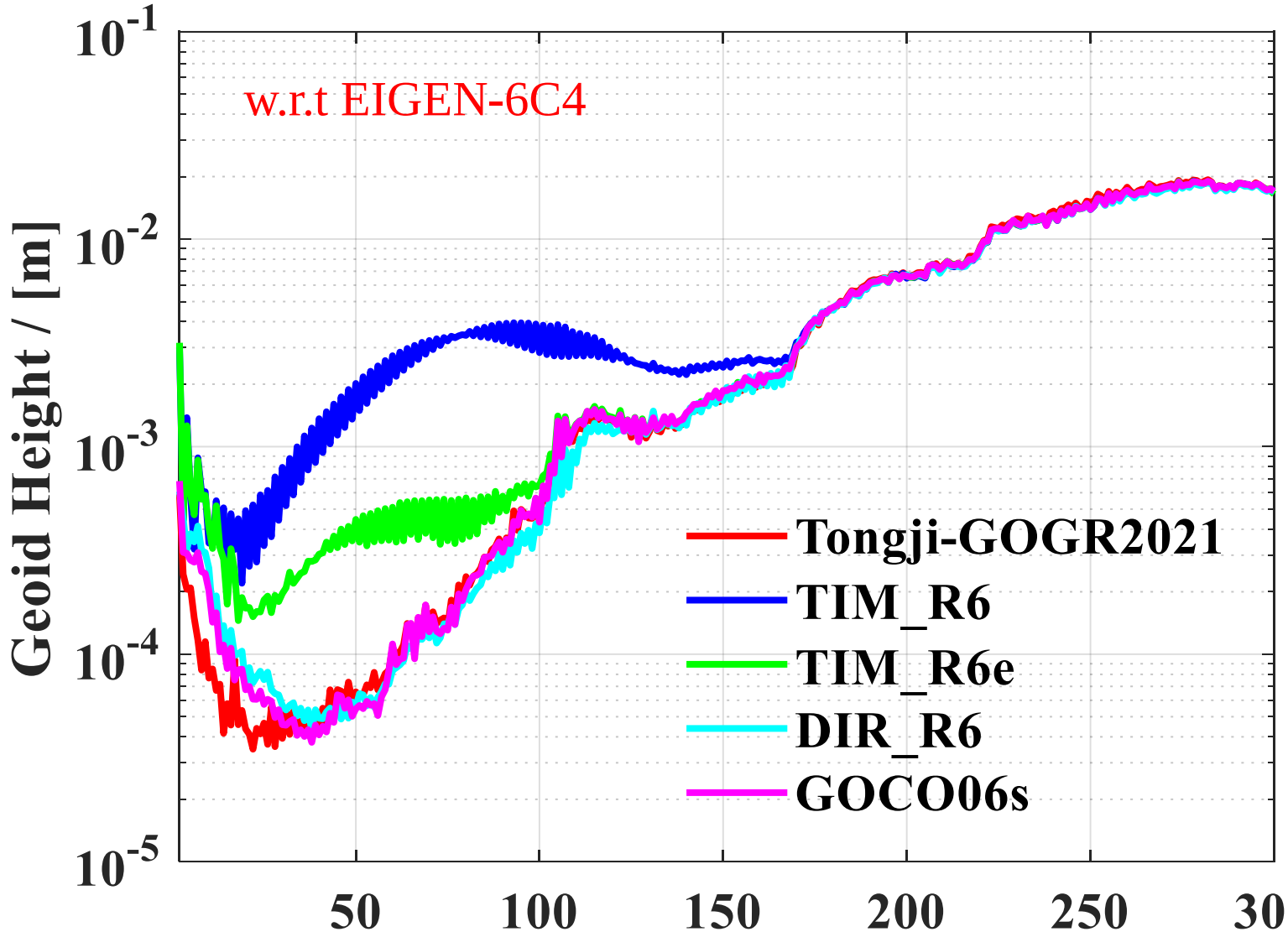
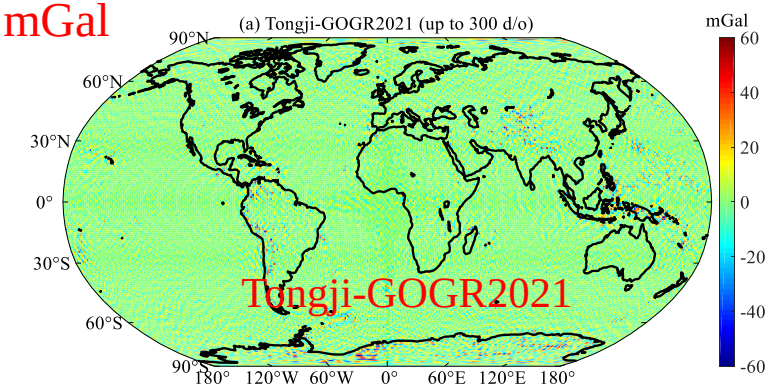
Combined Recovery and Accuracy Analysis

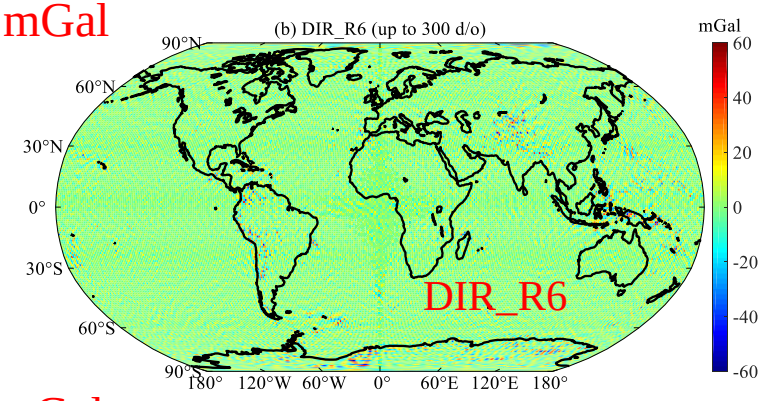


Combined Recovery and Accuracy Analysis

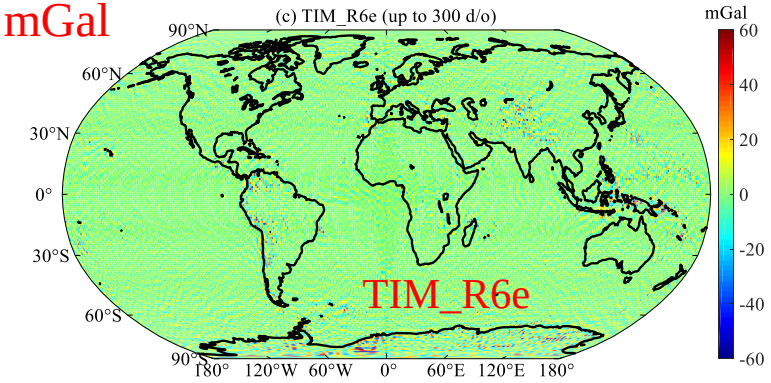
8.64 mGal



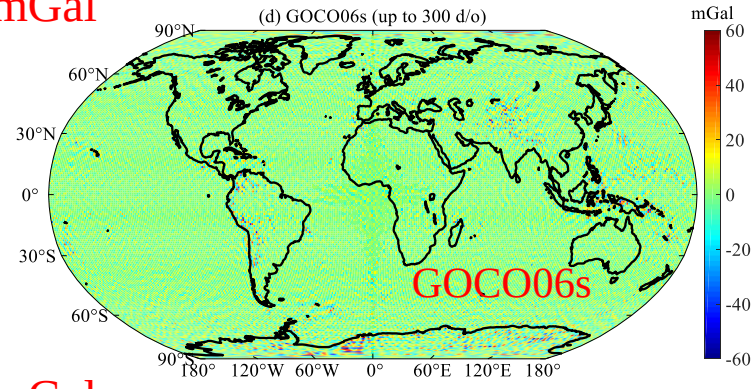
7.76 mGal



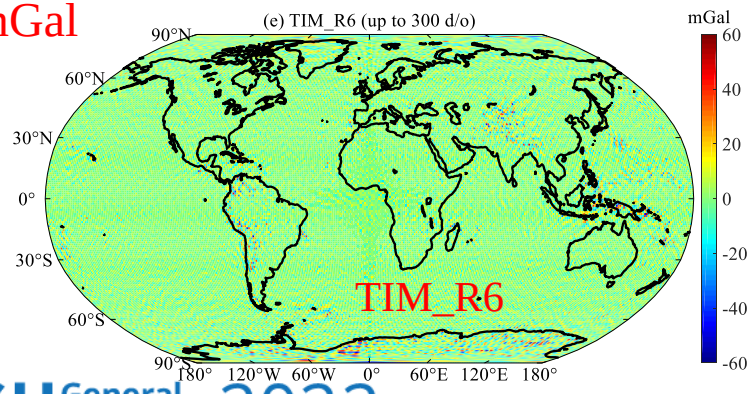
8.33 mGal



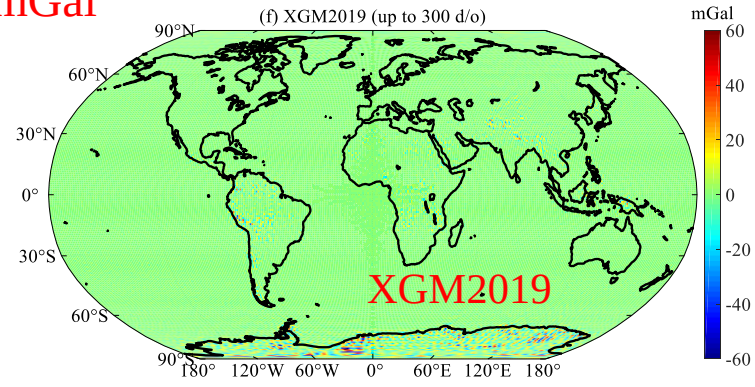
8.96 mGal



8.78 mGal



5.34 mGal



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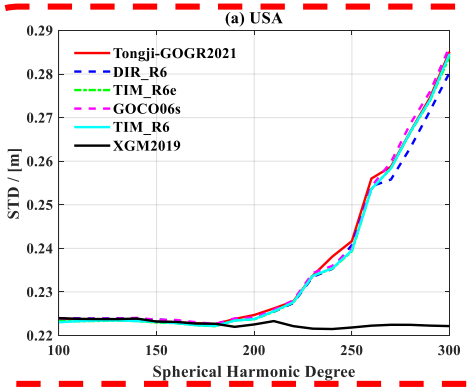
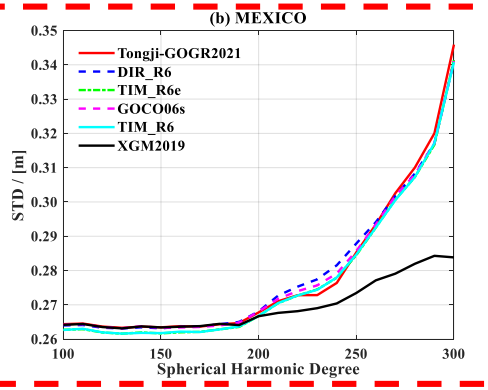
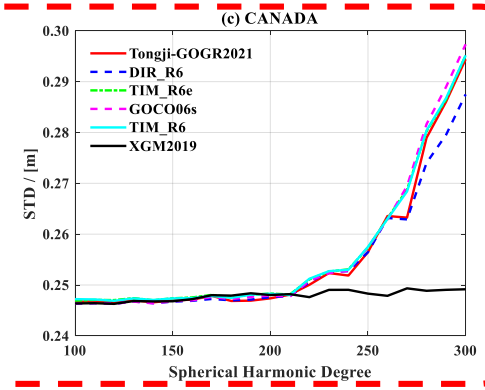
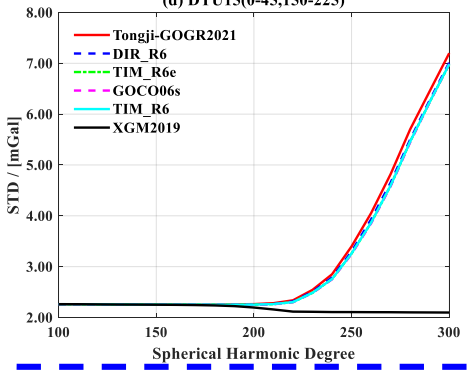
w.r.t EIGEN-6C4 Gravity Anomaly

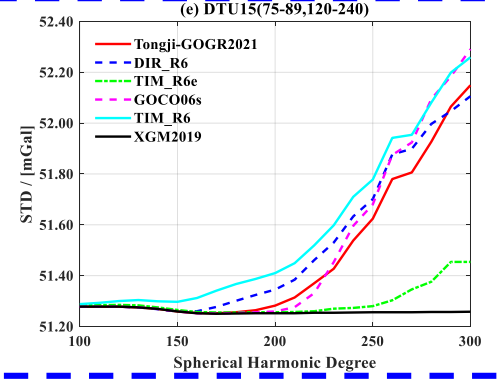
Combined Recovery and Accuracy Analysis

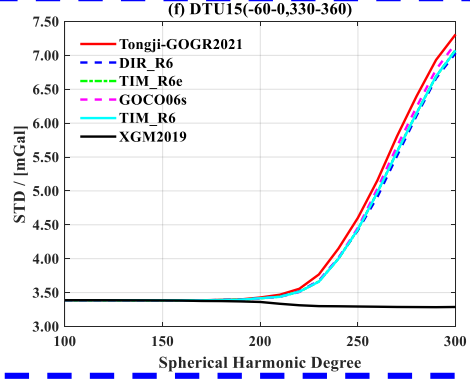


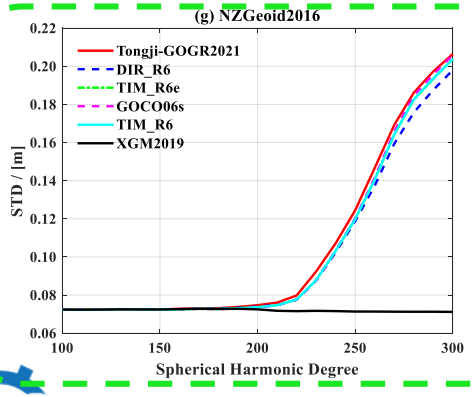


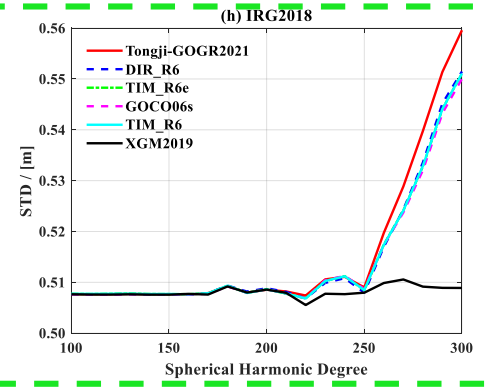


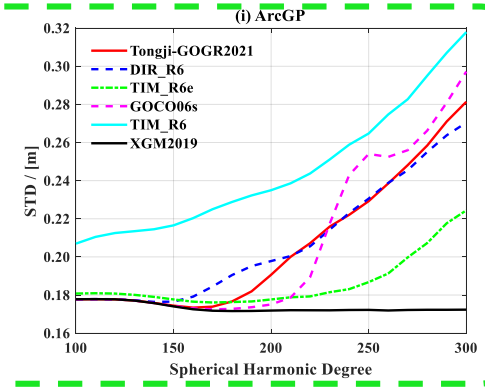




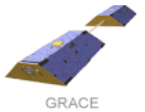








➢ Conclusion

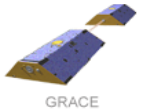


- The accuracy of the Tongji-GOGR2019S model of 220 degree/order is close to that of the GOCE R6 models.

- The constrained solution Tongji-GOGR2021 model of 300 degree/order is comparable to the GOCE R6 models in resolution and accuracy.

Outlook:

- We will combine satellite gravity data, ground gravity data, and Satellite altimetry data to recover the static gravity field model with higher resolution and higher accuracy.



Thanks for your attention!