

Introduction

The commonly used filters applied to GRACE spherical harmonic solutions generally lead to reduced resolution, signal damping and leakage.

In this study, we create spatial constraints from the a priori information of GRACE spherical models and further transfer the spatial constraints into the spectral domain according to the law of variance-covariance propagation.

Applying the spectral constraints, we produced **the first time series of high-resolution spherical solutions called Tongji-RegGrace2019 expressed as geopotential coefficients complete to degree and order 180.**

Our analyses in the spectral, time and spatial domain show that Tongji-RegGrace2019 is in good agreement with CSR and JPL mascon solutions.

Constraints in spectral domain

Obs equation :

$$v = Ax - y$$

Criterion :

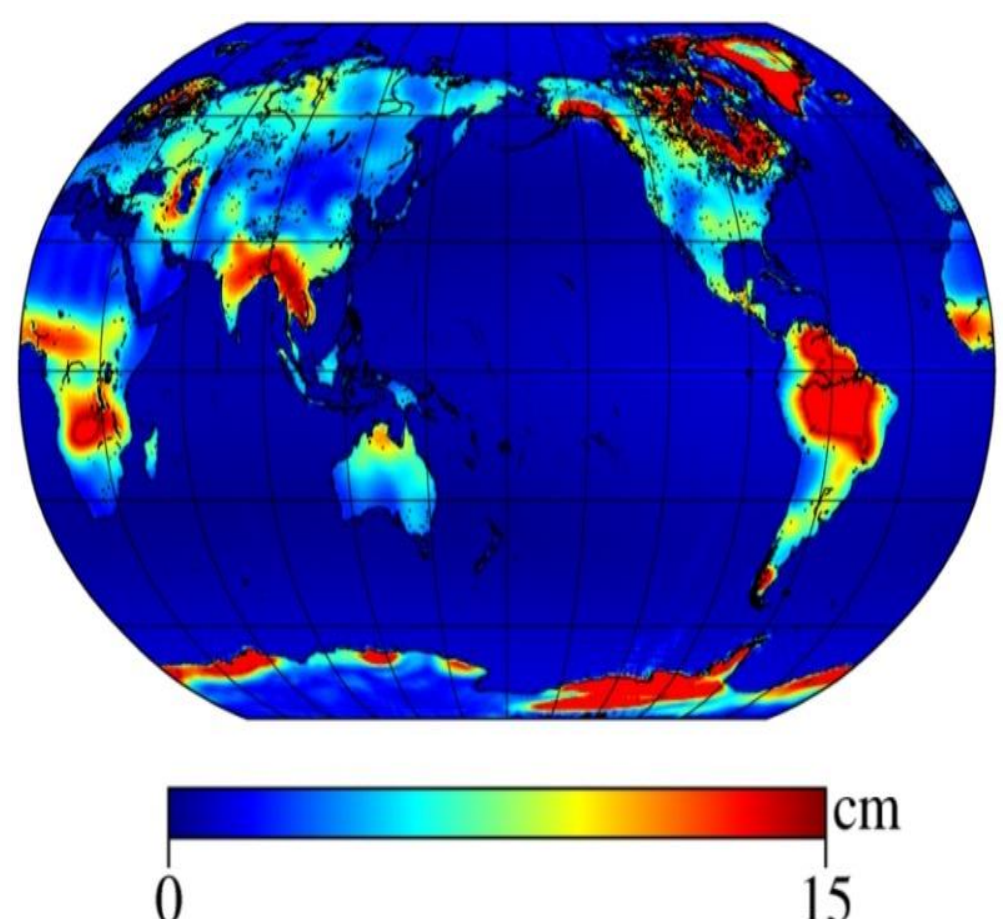
$$\Phi = v^T P v + \alpha \delta u^T S \delta u$$

Regularized equation :

$$(\bar{N}_{uu} + \alpha S) \delta u = \bar{Y}$$



Constraints from spatial to spectral domain



Tongji-RegGrace2019: Spectral domain

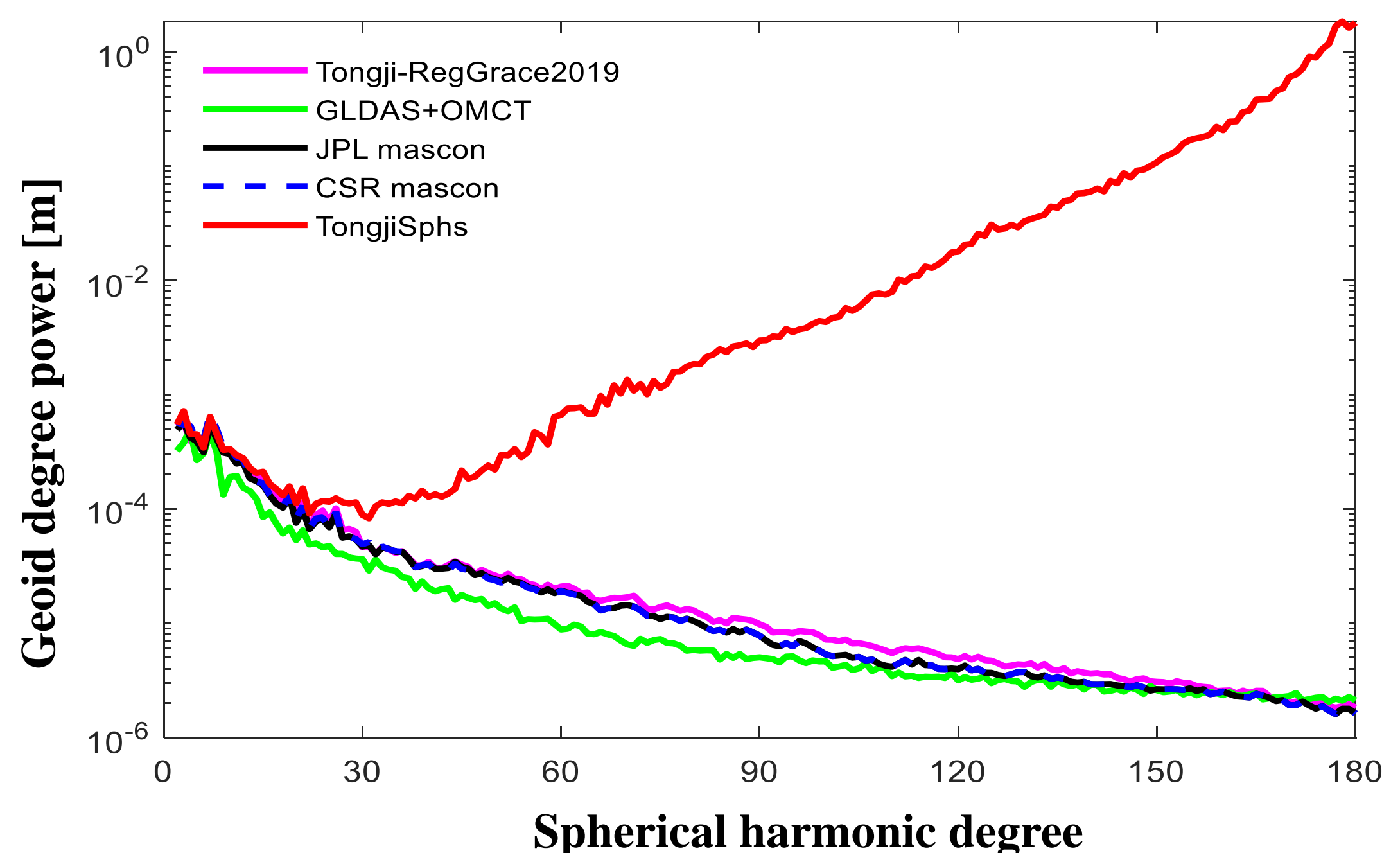


Figure 1. Geoid degree power of various models and solutions.

Tongji-RegGrace2019: Time domain

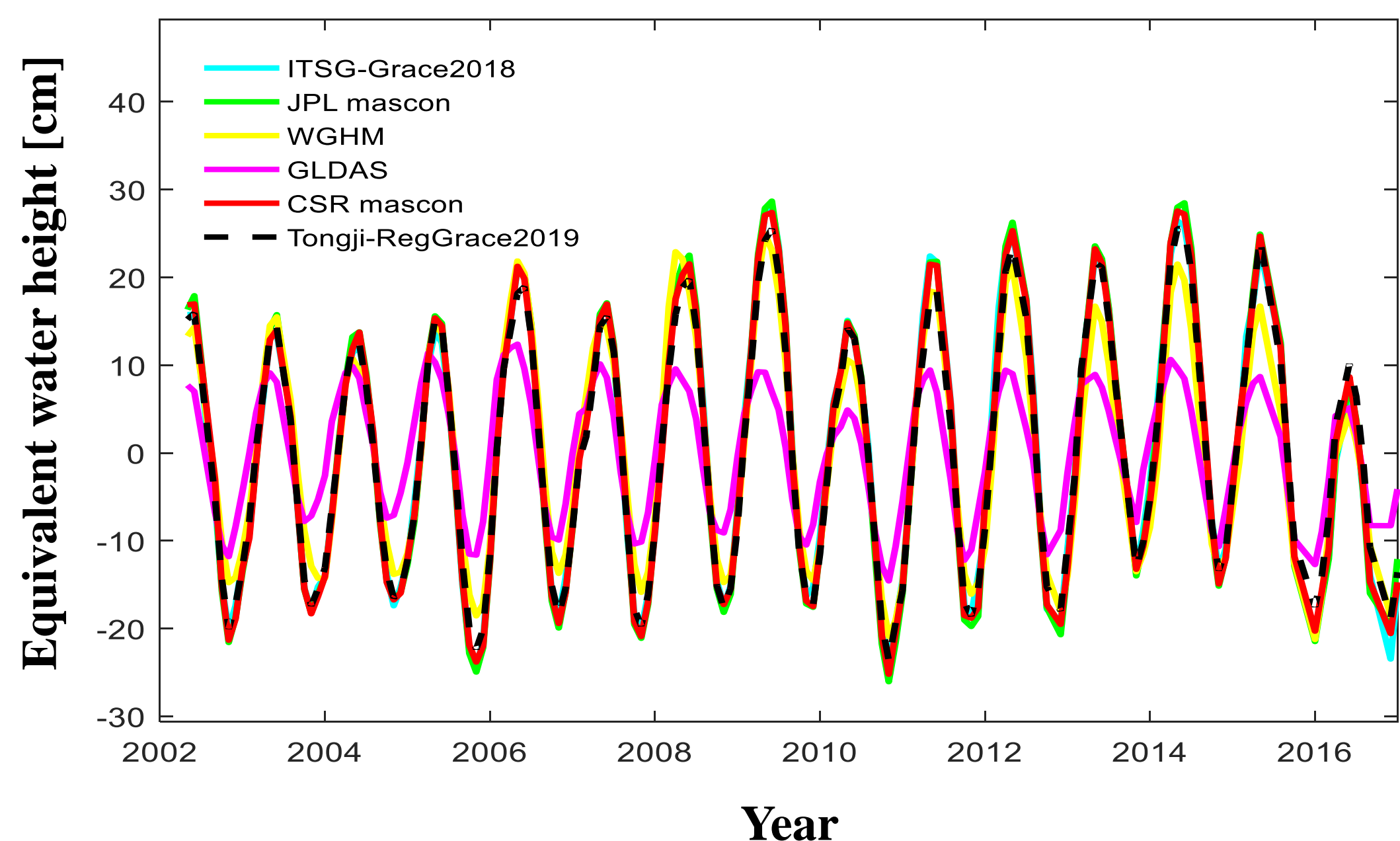


Figure 2. Time series of mass variations over Amazon.

Tongji-RegGrace2019: Spatial domain

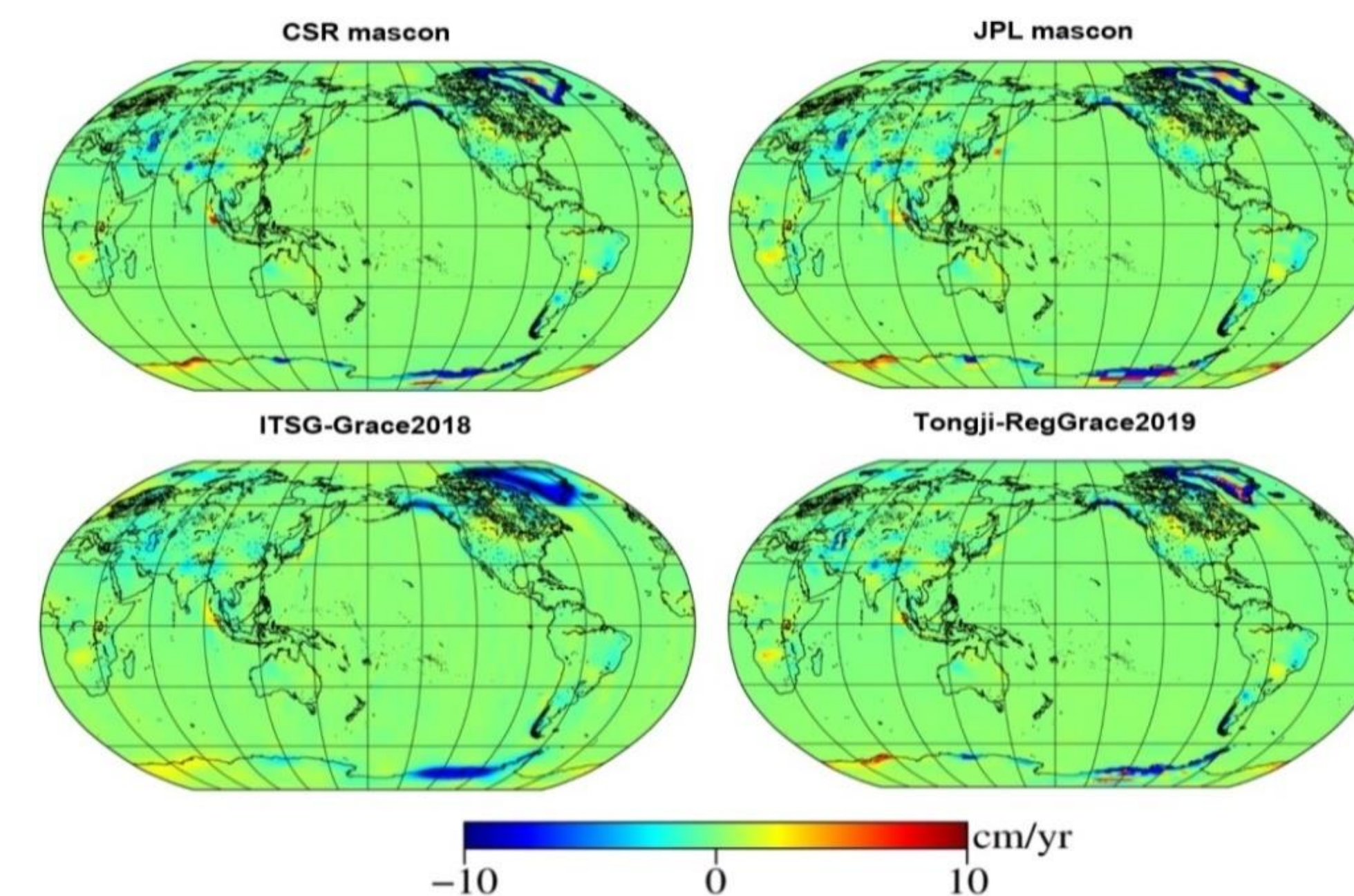


Figure 3. Mass variation trends at global scale.

Remarks

1. High-resolution GRACE monthly spherical harmonic solutions Tongji-RegGrace2019 up to d/o 180 have been developed via regularization with spatial constraints.
2. The signal contexts of Tongji-RegGrace2019 are generally comparable with the official mascon solutions.

Citation

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