

Imprints of Ocean **Chaotic Intrinsic Variability** on Bottom Pressure and Implications for GRACE Data Interpretation and Dealiasing

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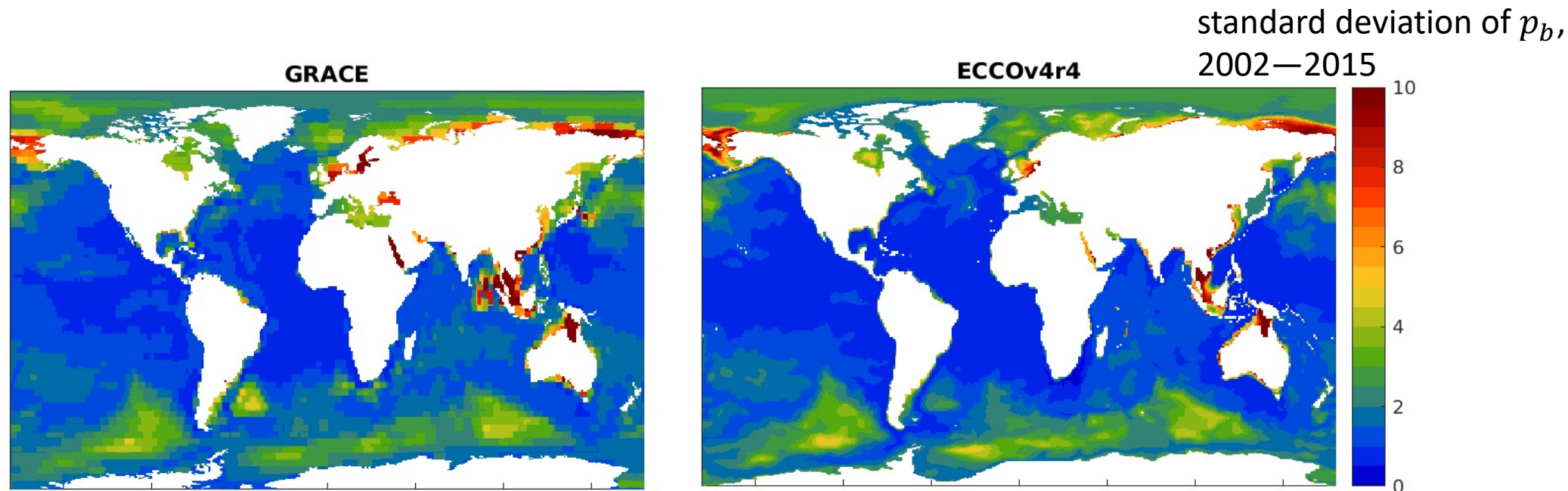
Background

Chaotic Intrinsic Variability:

Generated by nonlinear oceanic processes, rather than driven directly by the atmosphere.

Implications for GRACE/GRACE-FO:

- Interpreting ocean bottom pressure (p_b) in non-eddy-resolving models and GRACE/GRACE-FO measurements
- Dealiasing procedure



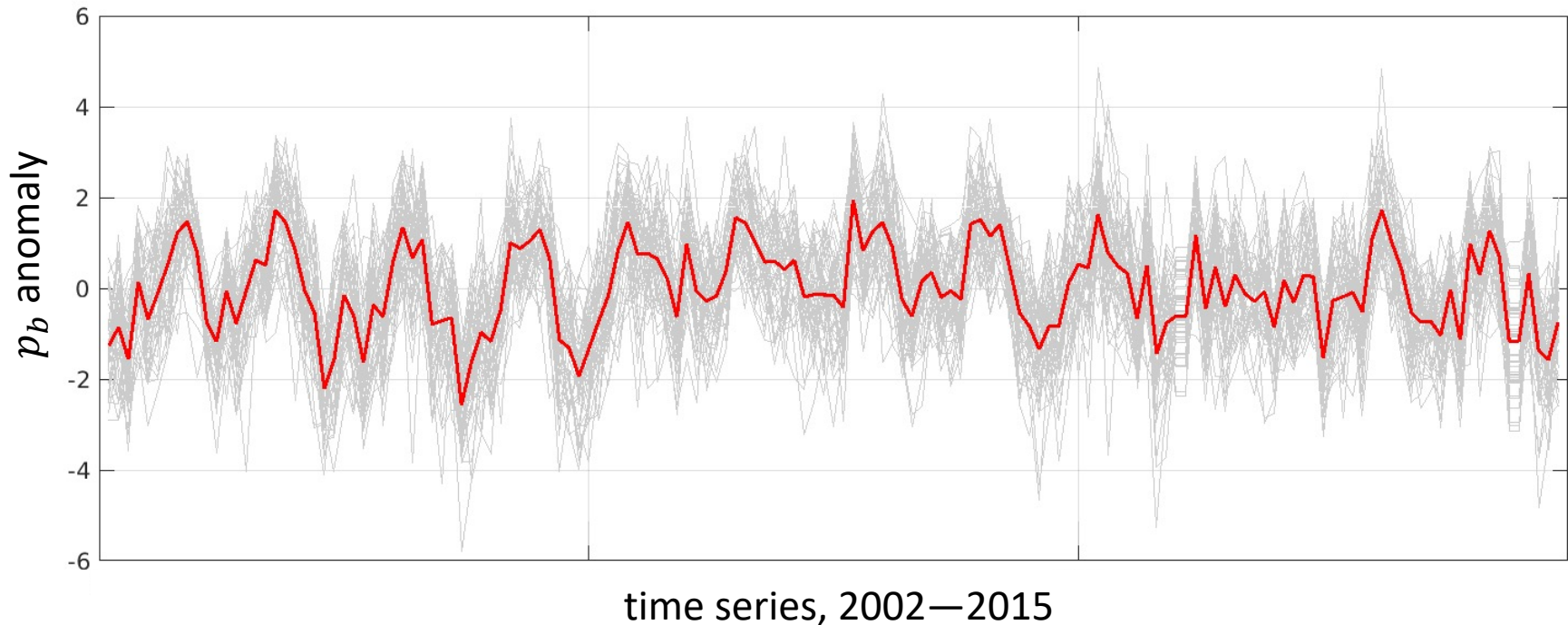
Key Points

Intrinsic variations on p_b are

- substantial in many regions and exceed atmospherically driven ones in eddy-rich areas,
- important on scales larger than mesoscale over a range of spatiotemporal scales, which have imprints on GRACE measurements.

OCCIPUT Large Ensemble Simulation

- OceaniC Chaos — ImPacts, strUcture, predictability (OCCIPUT)
- 50 ensemble members, driven by the same atmospheric forcing
- Ensemble members distinguished by perturbations in initial conditions
- Horizontal resolution $\sim 1/4^\circ$, eddy permitting, 1995—2015

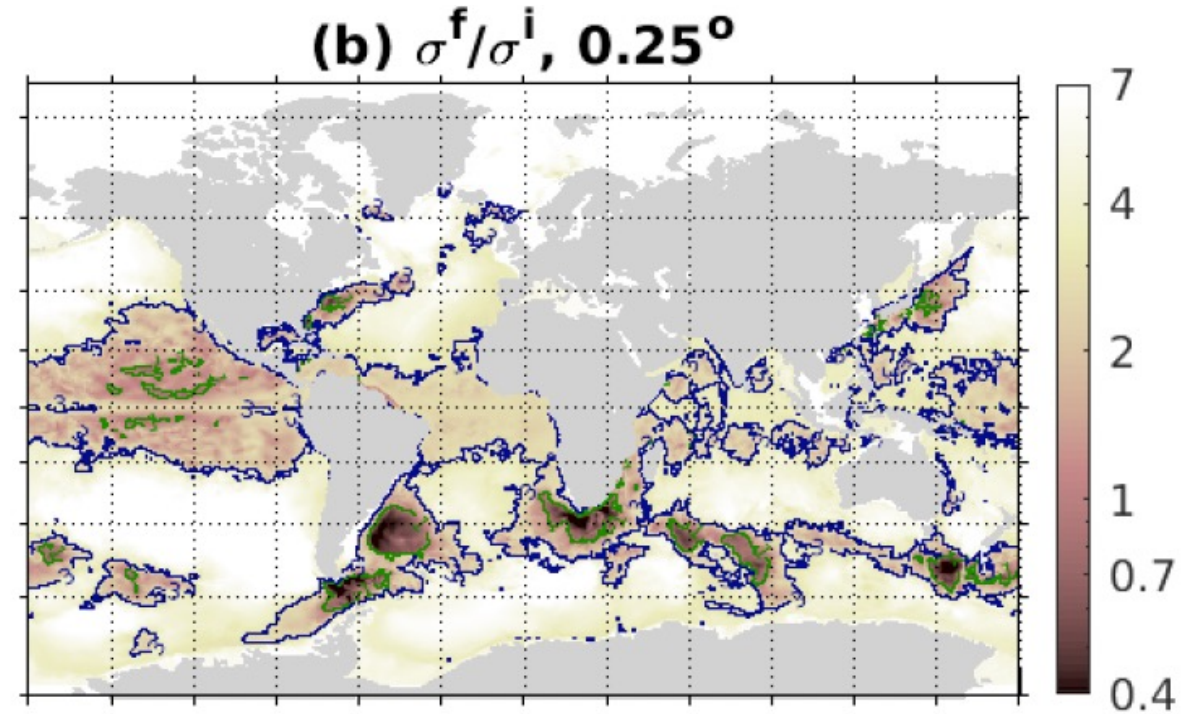
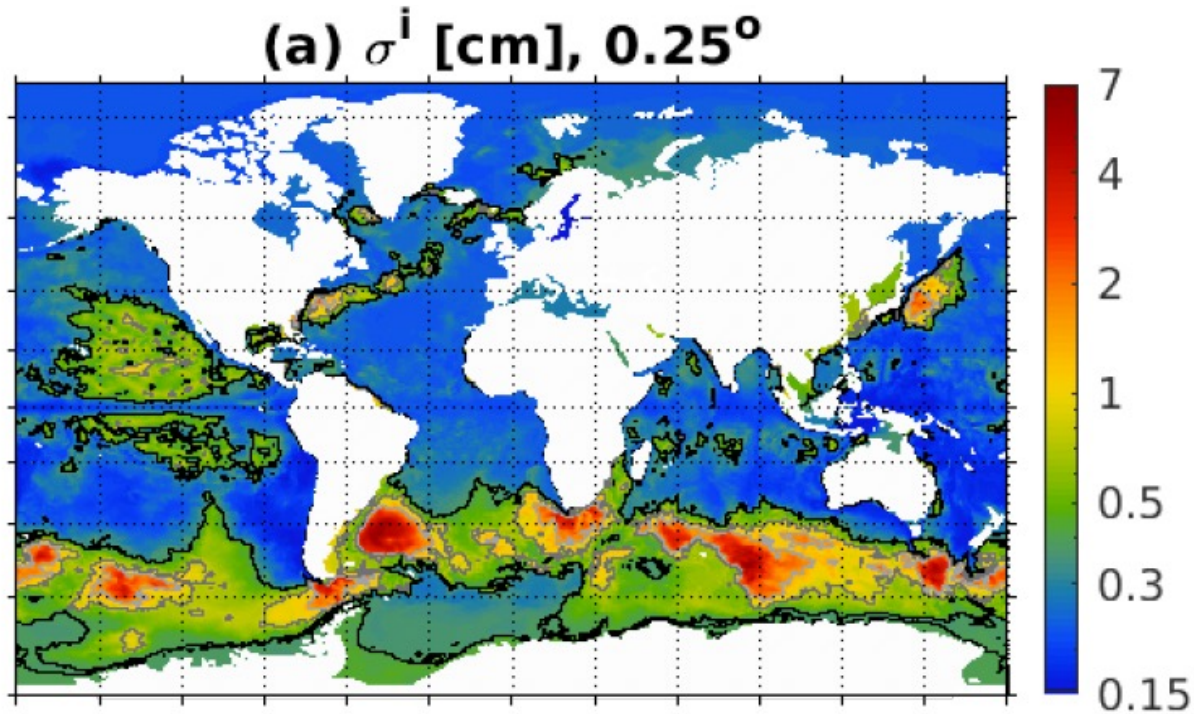


forced amplitude σ^f : standard deviation of the ensemble-mean

intrinsic amplitude σ^i : standard deviation of the deviation from the mean

Intrinsic Variations in Subseasonal Band

- period <60 days, GRACE/GRACE-FO dealiasing period:

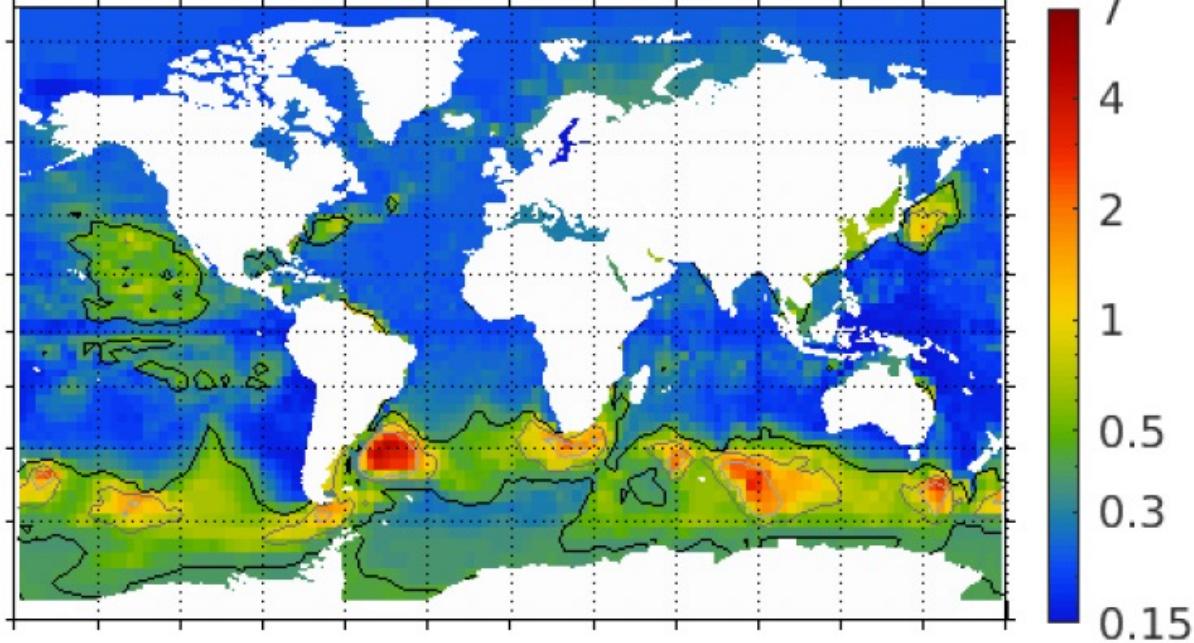


- Highest σ^i (>1.5 cm) in regions with strong instabilities and eddies.
- In lower-latitudes and eddy-rich regions, p_b fields are more chaotic and less predictable from just knowledge of the atmospheric forcing fields.

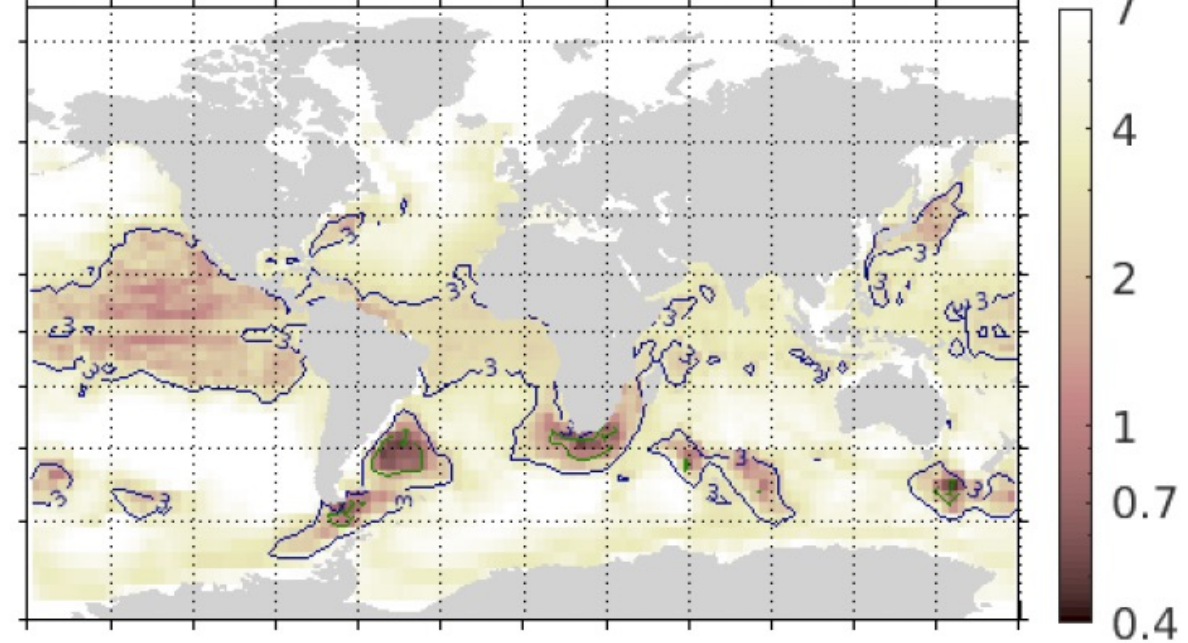
Intrinsic Variations in Subseasonal Band

- Importance of σ^i in GRACE/GRACE-FO aliasing:

(c) σ^i [cm], 3°



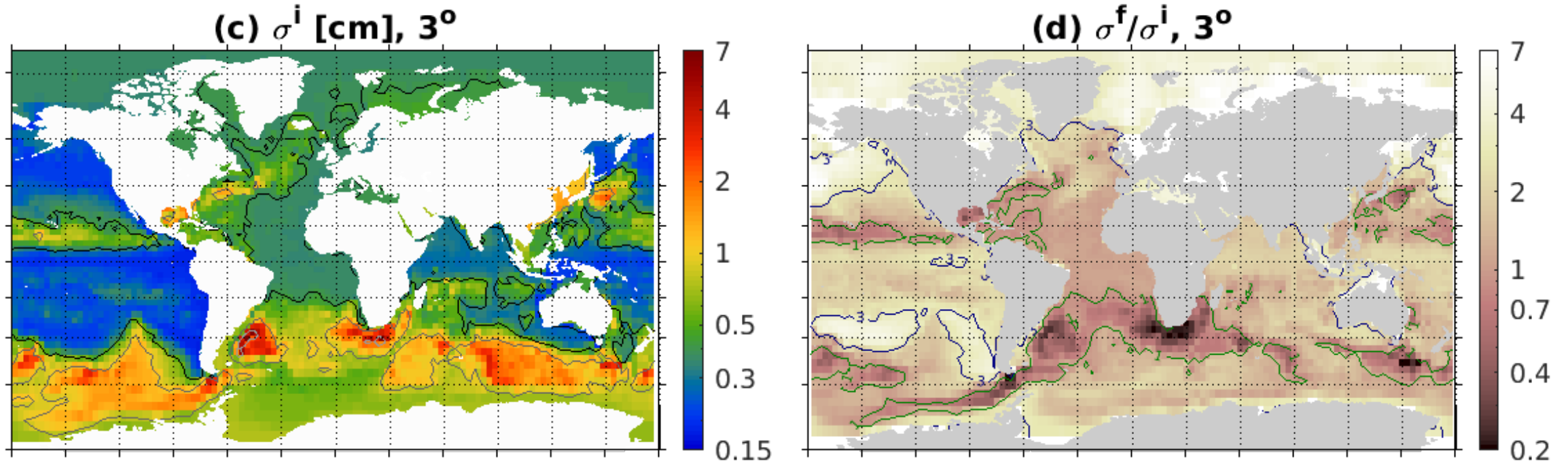
(d) σ^f/σ^i , 3°



- σ^i is important at spatial scales resolved by GRACE data, over lower latitudes and eddy-rich sites.
- Important intrinsic variations indicate challenges to accurately dealias GRACE data.

Intrinsic Variations in Intra-annual Band

- Importance of σ^i in GRACE/GRACE-FO measurements:



- Intrinsic variations are substantial almost everywhere. $\sigma^i > \sigma^f$ in almost 1/4 of the ocean area.
- Two factors contribute to the large σ^i for intra-annual band: [1] dominant timescale for mesoscale eddies; [2] energy inverse cascade.

Conclusions

Intrinsic variations on p_b are

- substantial in many regions and exceed atmospherically driven ones in eddy-rich areas,
- important on scales larger than mesoscale over a range of spatiotemporal scales, which have imprints on GRACE measurements.

Our results highlight the necessity of addressing effects of intrinsic variations when interpreting and dealiasing GRACE/GRACE-FO data.