ECCO Version 4:
Parameterized And Resolved Processes

Gaël Forget

ECCO Meeting MIT 2016/05/16

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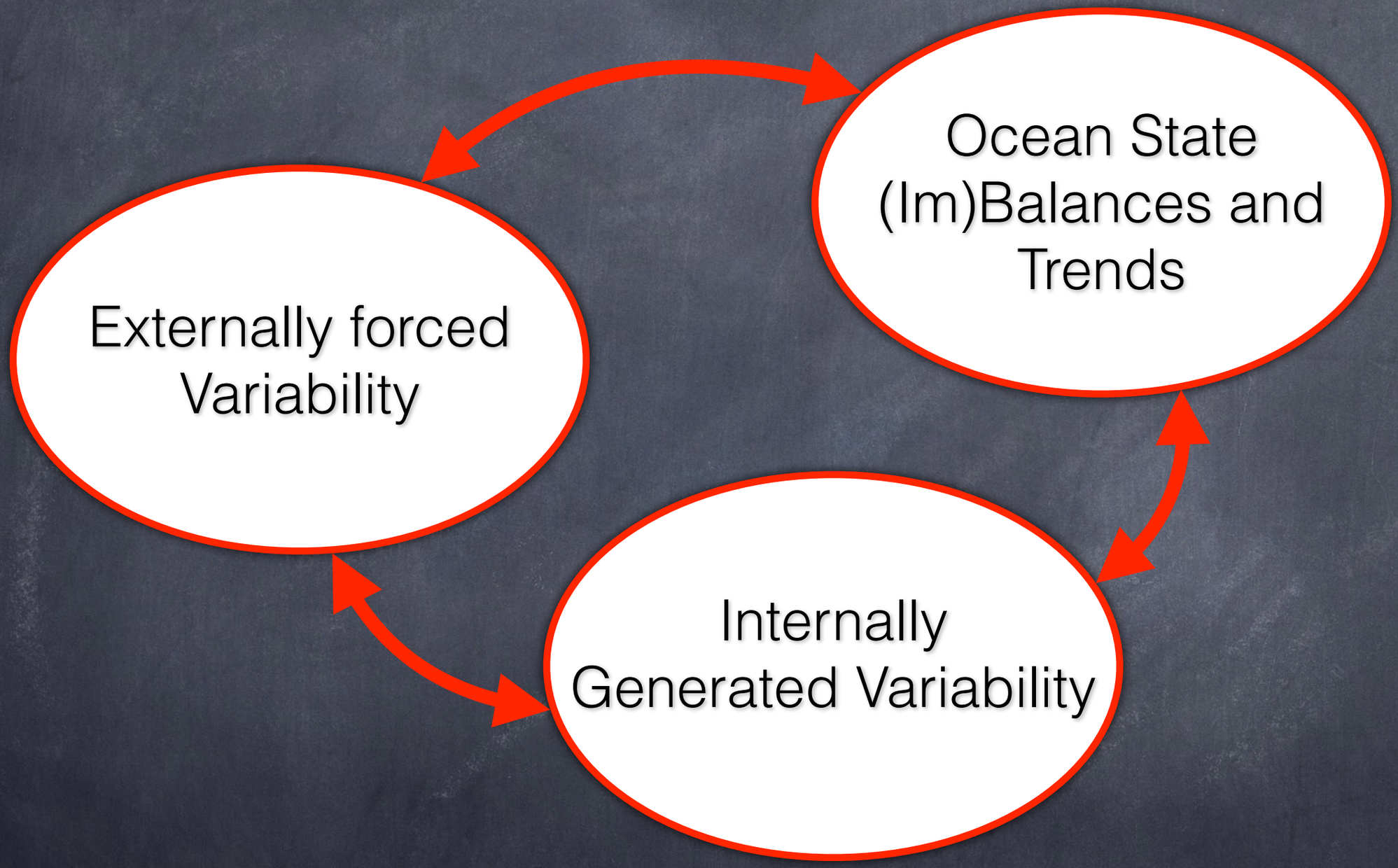
Intertwined Processes And Estimation Problems

2016 ECCO meeting



This presentation (which does not address energetics) will consider this problem from complementary point of views

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In-Situ Data Included In ECCO v4-r2

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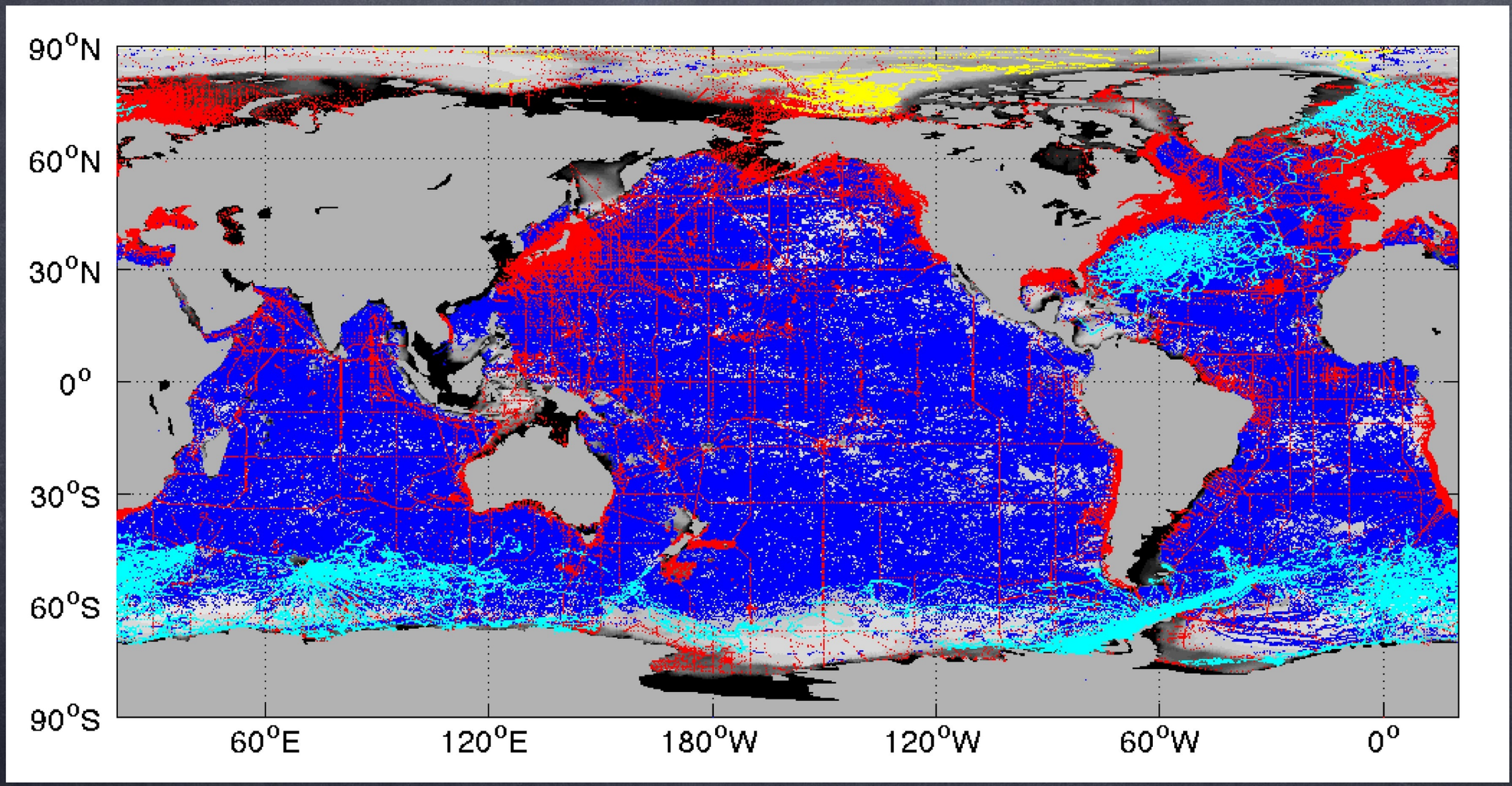

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Relating observed Altimetric And In-Situ variability

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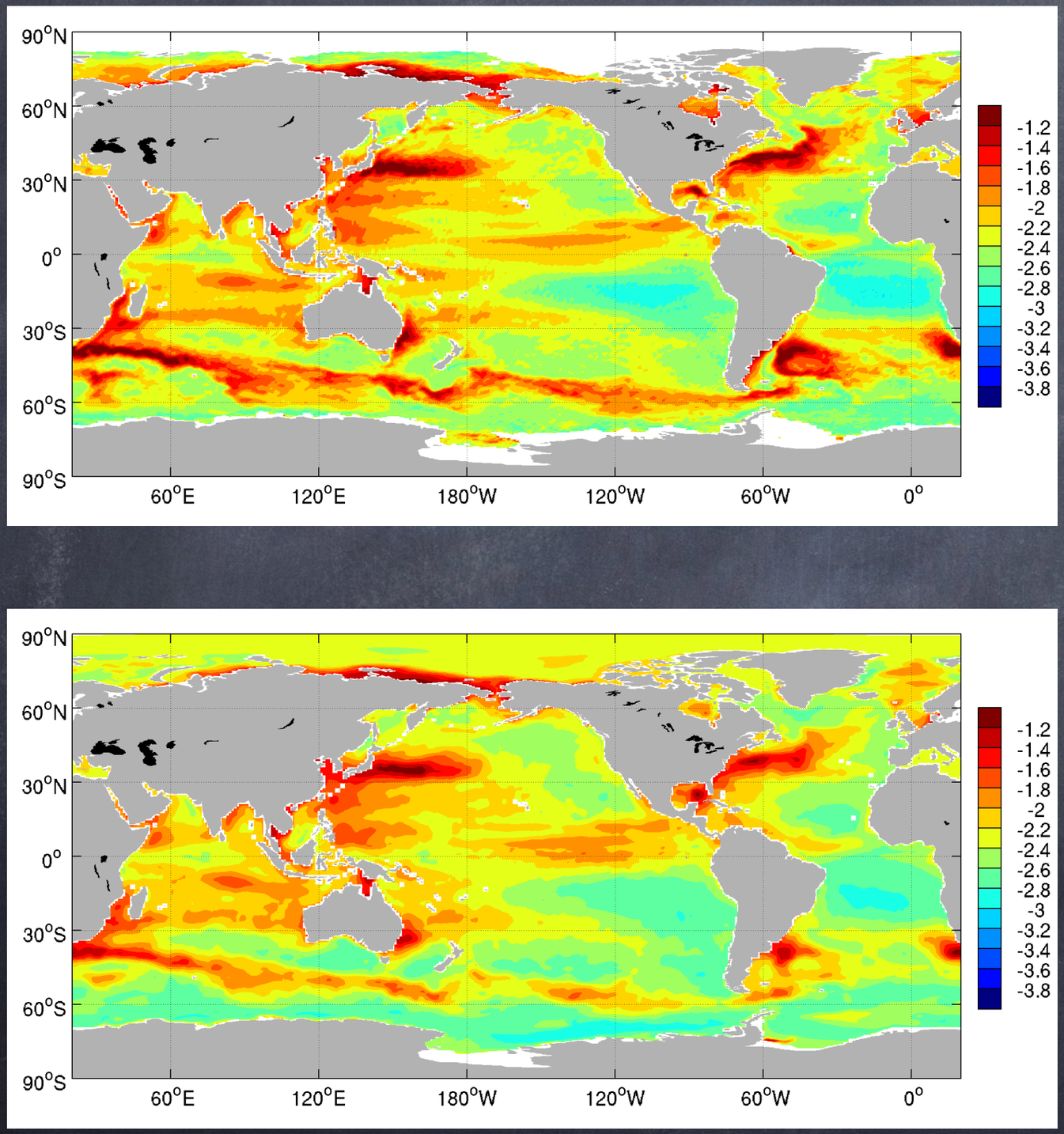

Top: log10 of altimetry variance. From bin average RADS data set (1 degree, daily).

Bottom: same but estimated based on in situ steric height anomalies (profile data - seasonal cycle)

+ 2.7cm instr. error (FP 2015)
+ BP varability (ECCO v4-r2)
+ seasonal cycle (ECCO v4-r2)

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Altimetry And ECCO Frequency Spectra

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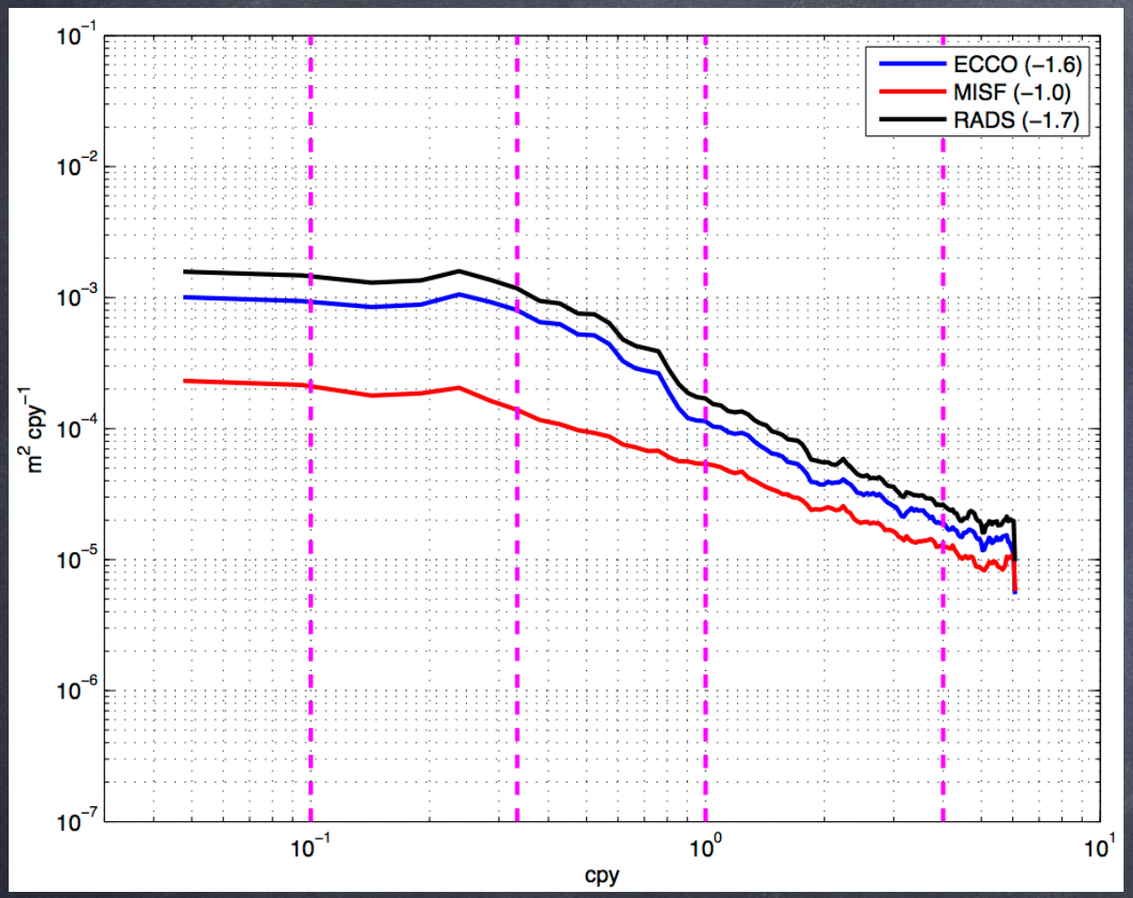
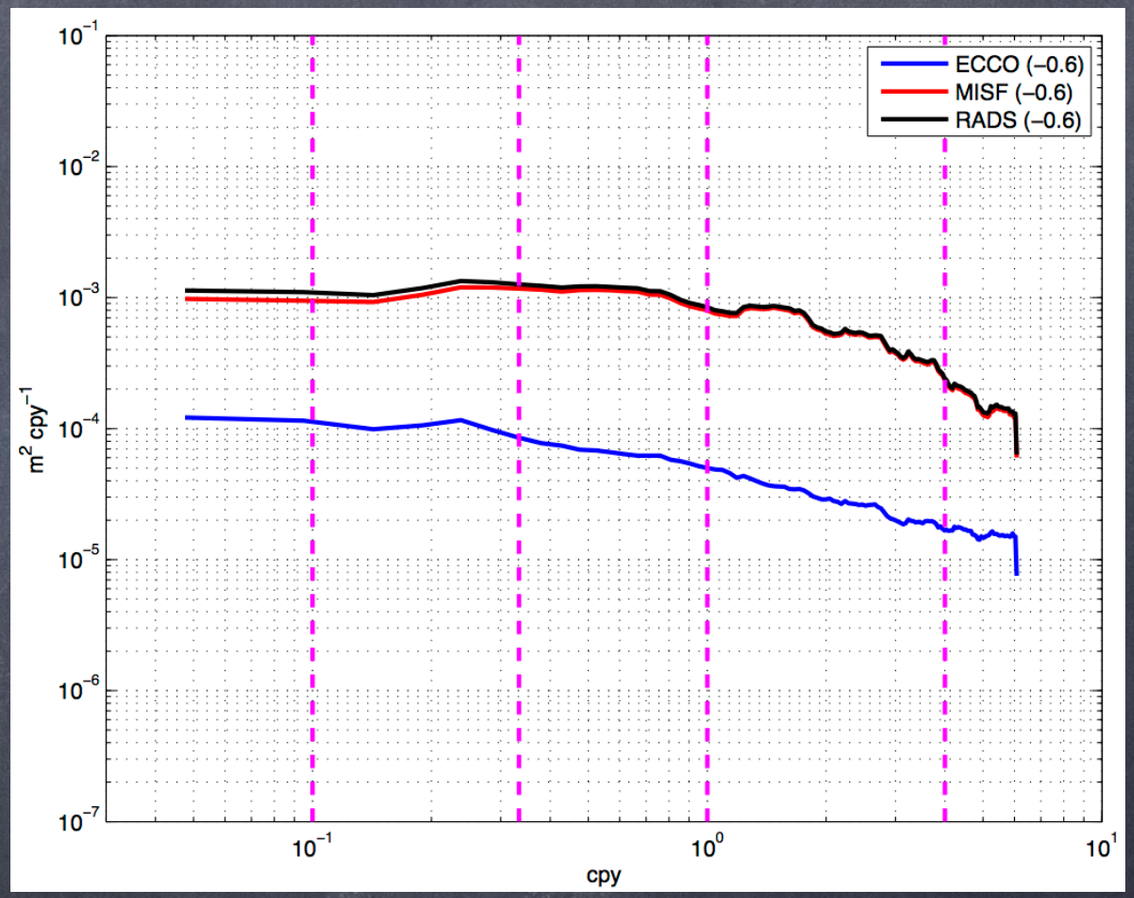


Large-Scale



Meso-scale

Forget and Ponte 2015 (PO)

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Daily Pointwise V. Large-Scale Uncertainty Levels

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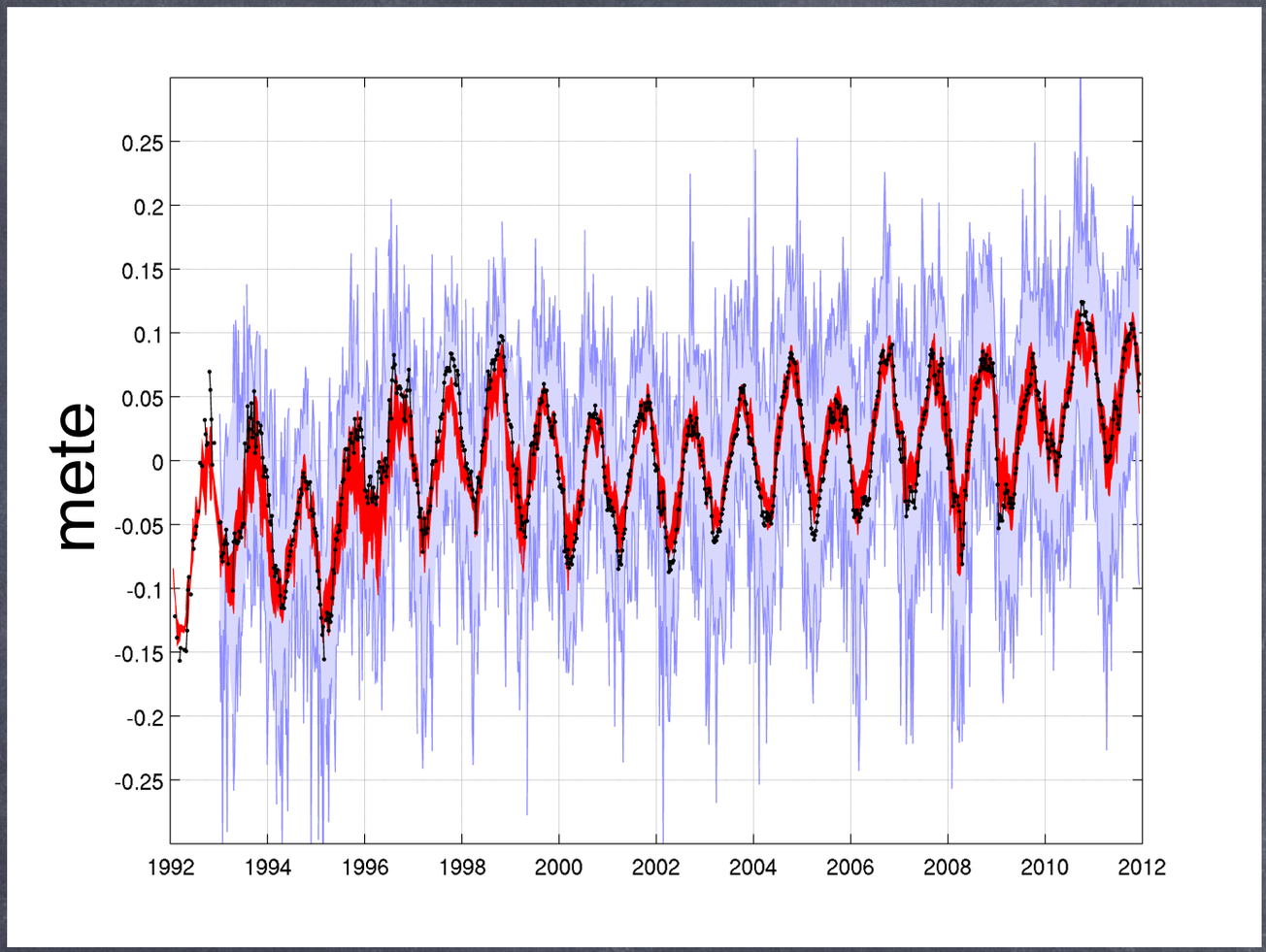

Monthly sea level anomaly over the central Labrador sea in ECCO v4-r2 displayed with 95% misfit interval computed from large-scale model-data misfits (red shading) or daily grid-scale model-data misfits (blue shading). The black curve is the corresponding altimetric average (large-scale).

This plot was generated from large-scale and daily grid-scale model-data misfits (Forget and Ponte 2015) available at ftp://mit.ecco-group.org/ecco_for_las/version_4/release2/nctiles_remotesensing/sealevel/

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Forced V. Intrinsic Sea Level Variability

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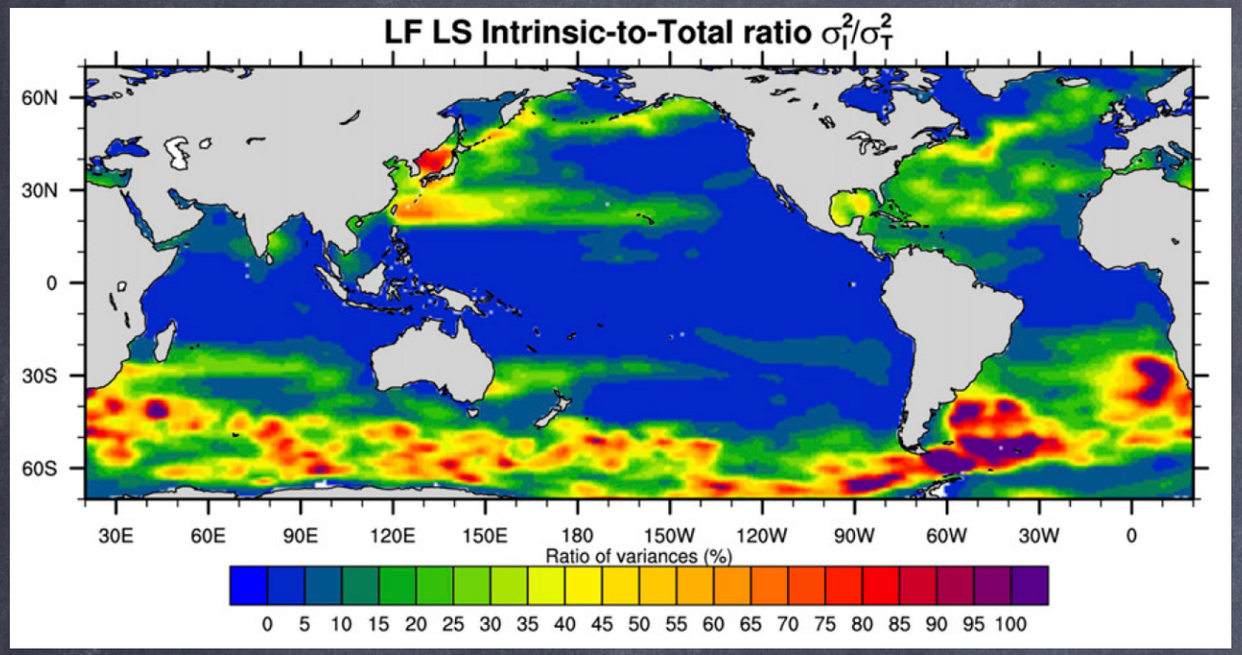
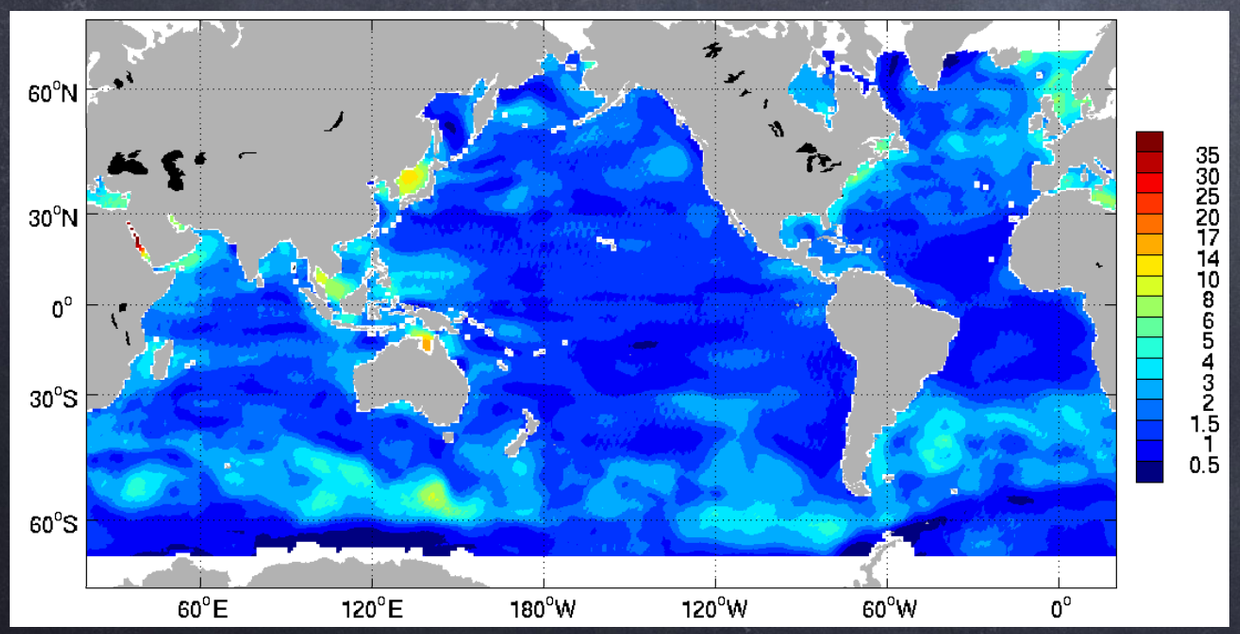


Fraction of intrinsic large-scale SLA variance in 1/12 deg. model.

Reproduced From Serazin et al 2015



Large Scale SLA cost function

ECCO version 4 release 2 (http://hdl.handle.net/1721.1/102062)

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Altimetric And In-Situ Constraints On Eddy Transports

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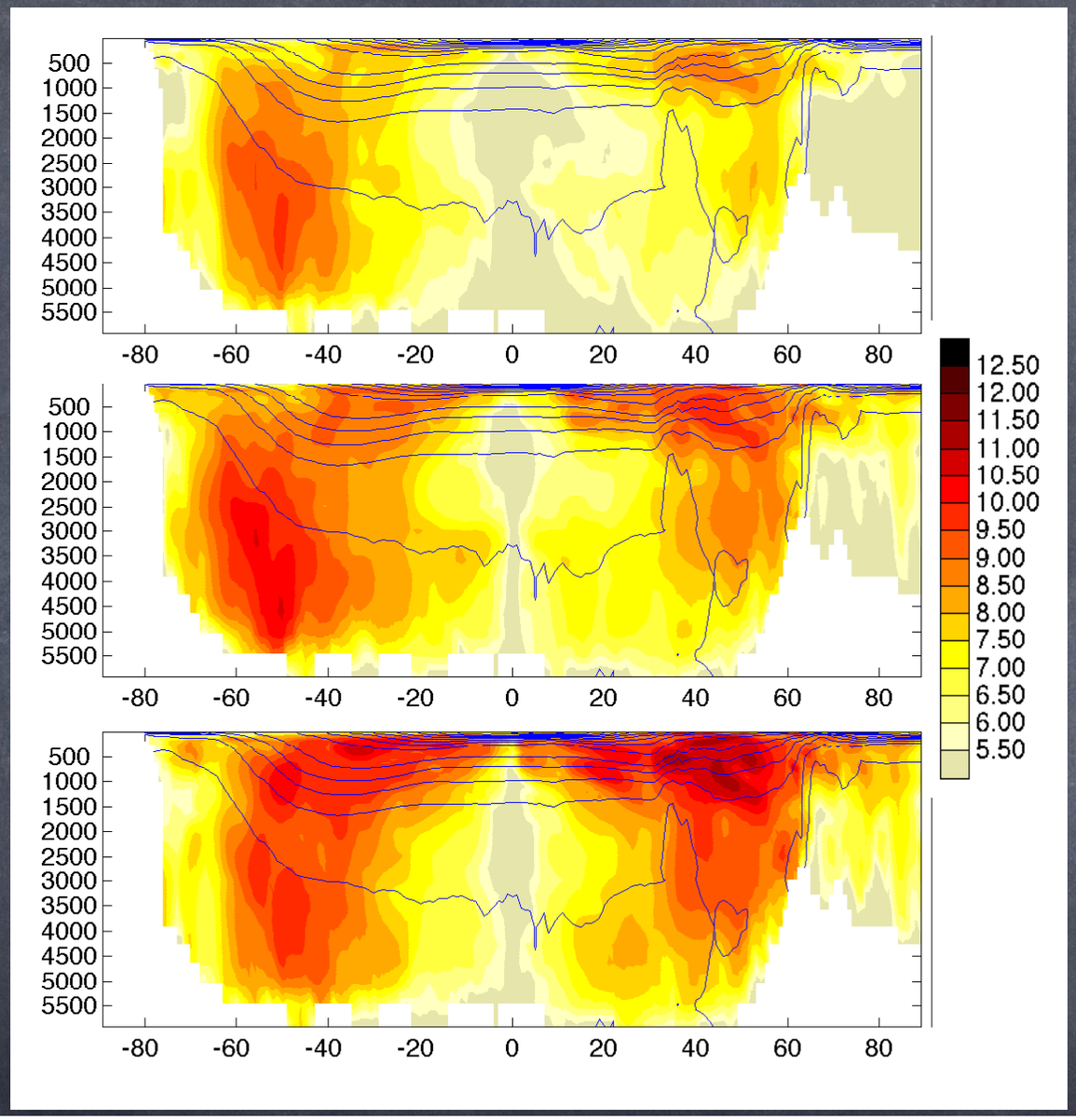

Forget, et al., 2015 (OS)

Figure 5. Sensitivity to $\mathcal{K}_{\mathrm{gm}}$ associated with 1992–2001 altimetry (top), 1992–2011 altimetry (middle), and Argo T and S profiles (bottom). More than 98% of Argo profiles were collected after 2001. In each case, the squared model–data distance J is selected accordingly, and $\frac{\partial J}{\partial \mathcal{K}_{\mathrm{gm}}}$ is computed with the adjoint model.

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Estimated Turbulent Tansport Parameters

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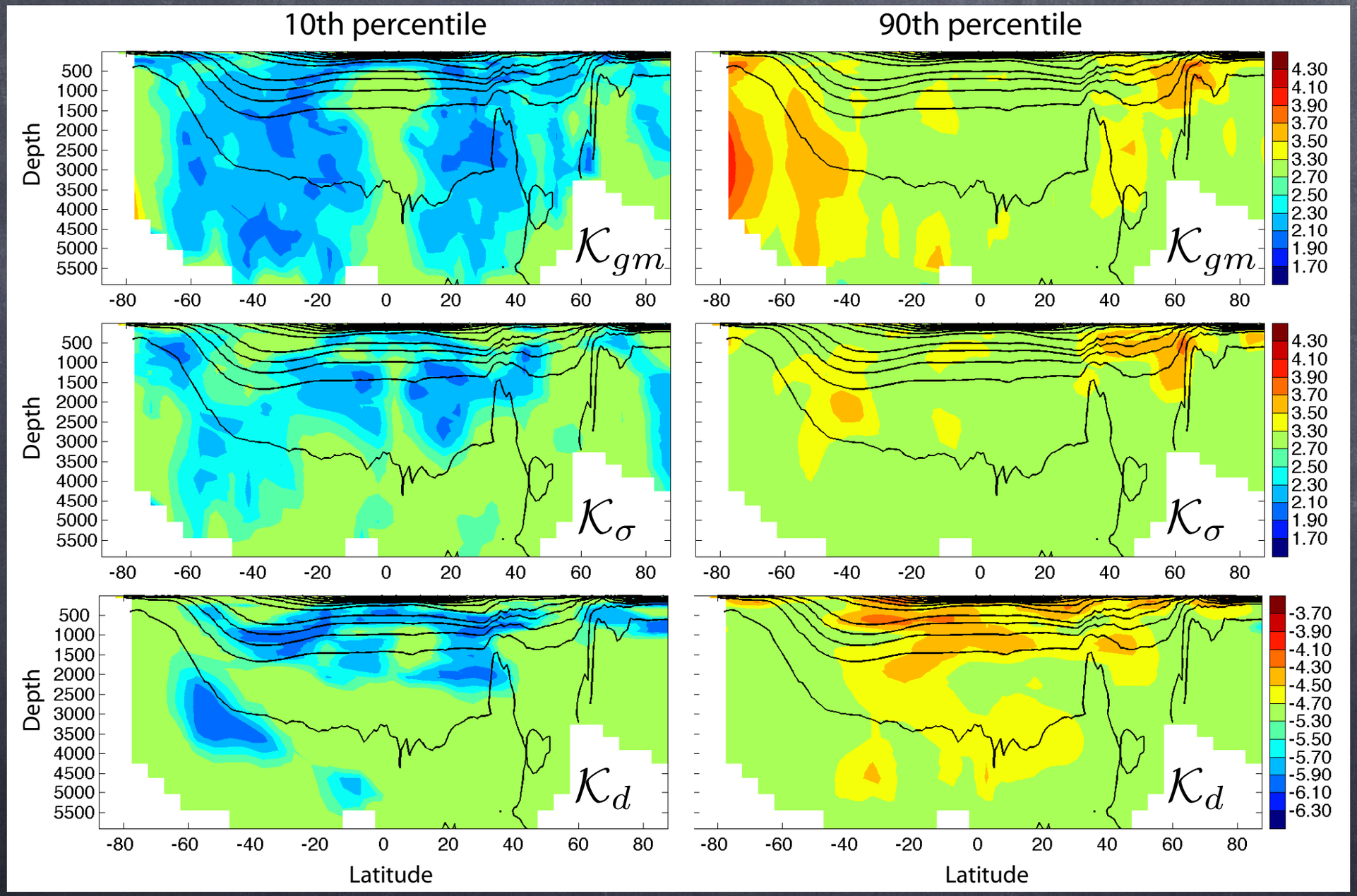

Forget, Ferreira, Liang 2015 (OS)

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Emerging Questions

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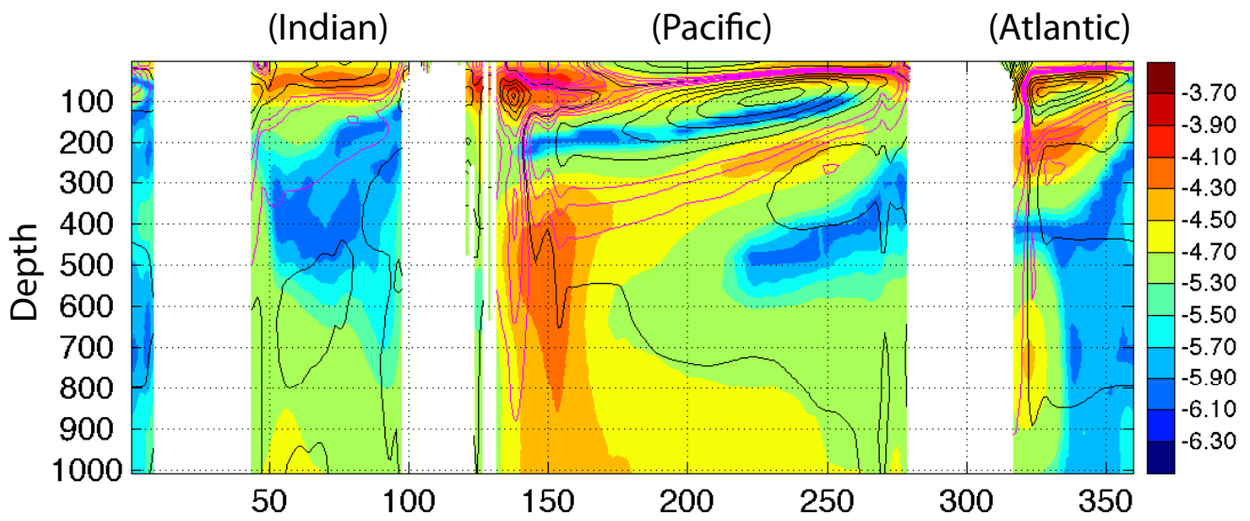
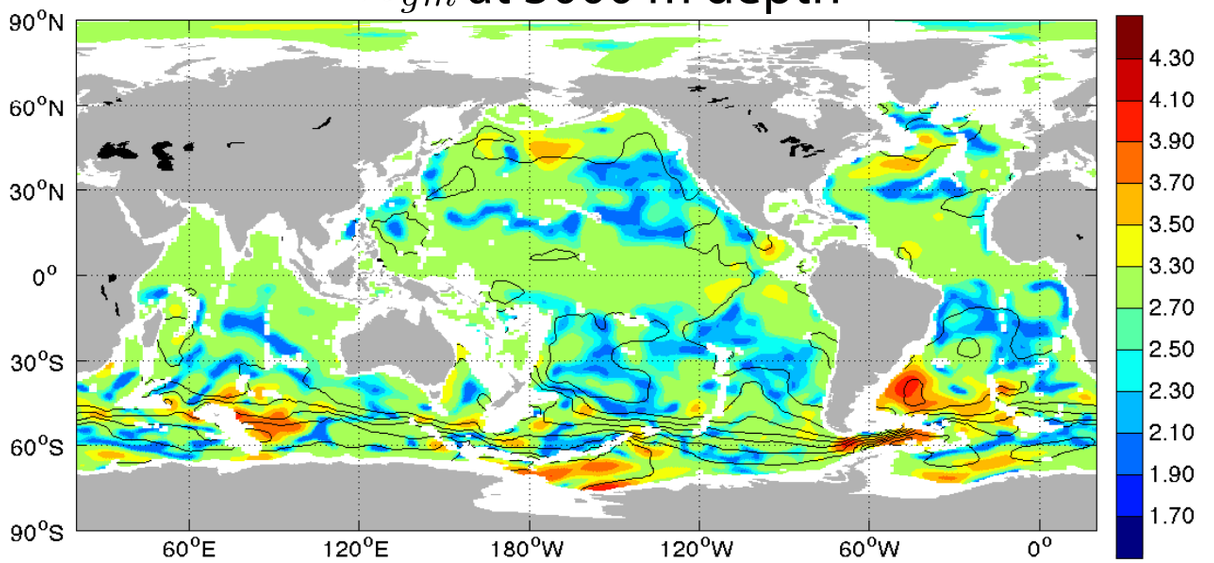
$\mathcal{K}_d$ at the equator



$\mathcal{K}_{gm}$ at 3000 m depth



Forget, Ferreira, Liang 2015 (OS)

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The Partition Of Observed Temperature Variability

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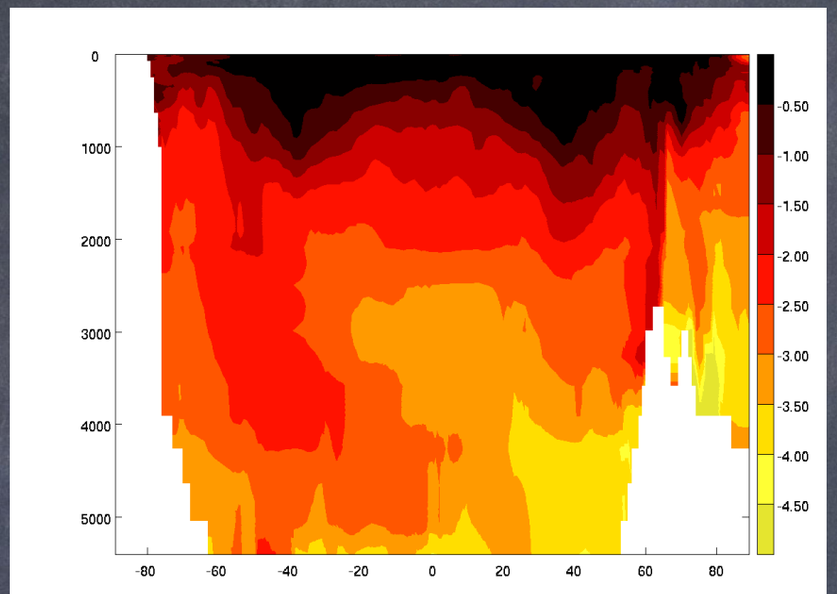
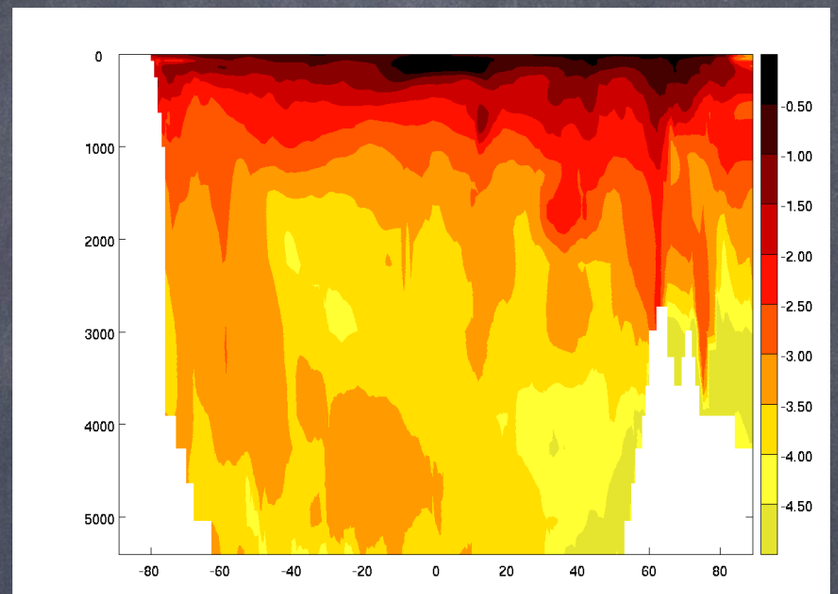
Observed



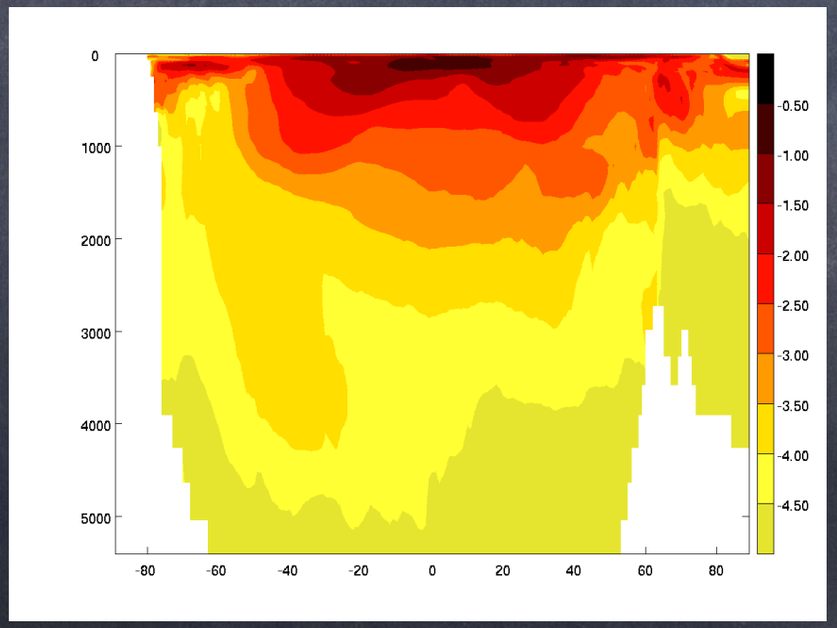


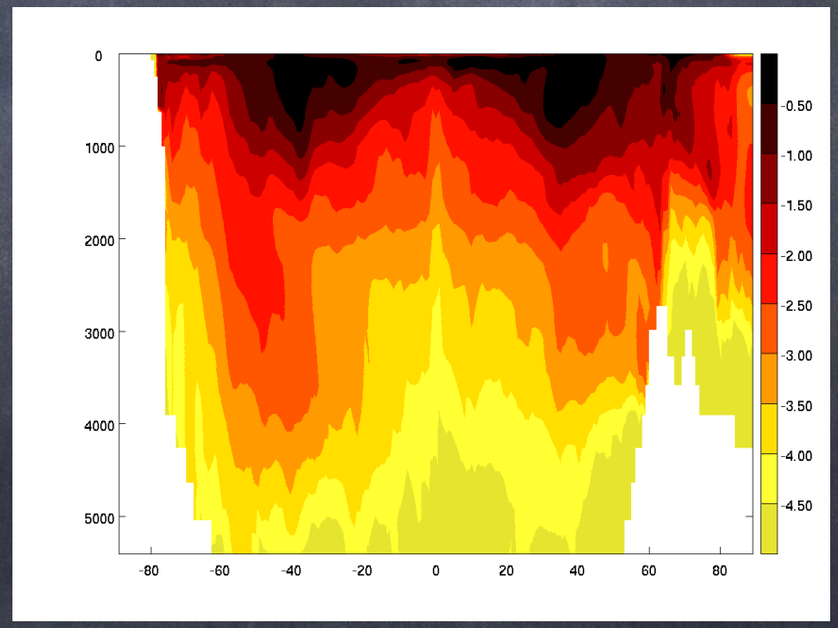
large-scale Forced responses

(ECCO)

Internal waves

(Munk 1981)





Meso-scale eddies

(ECCO2)

Forget (in prep.)

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Estimated Variograms And Spectral Slopes

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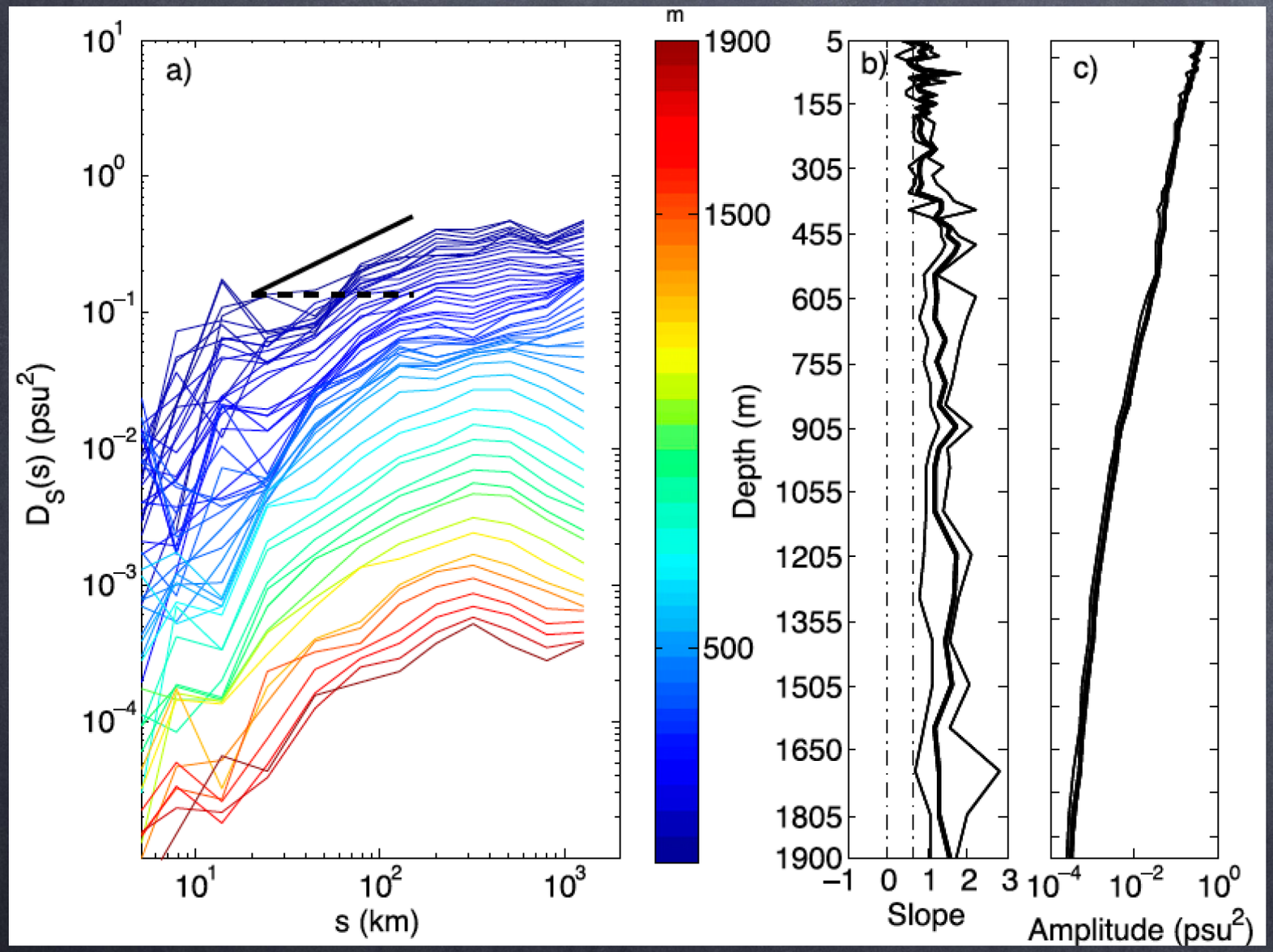

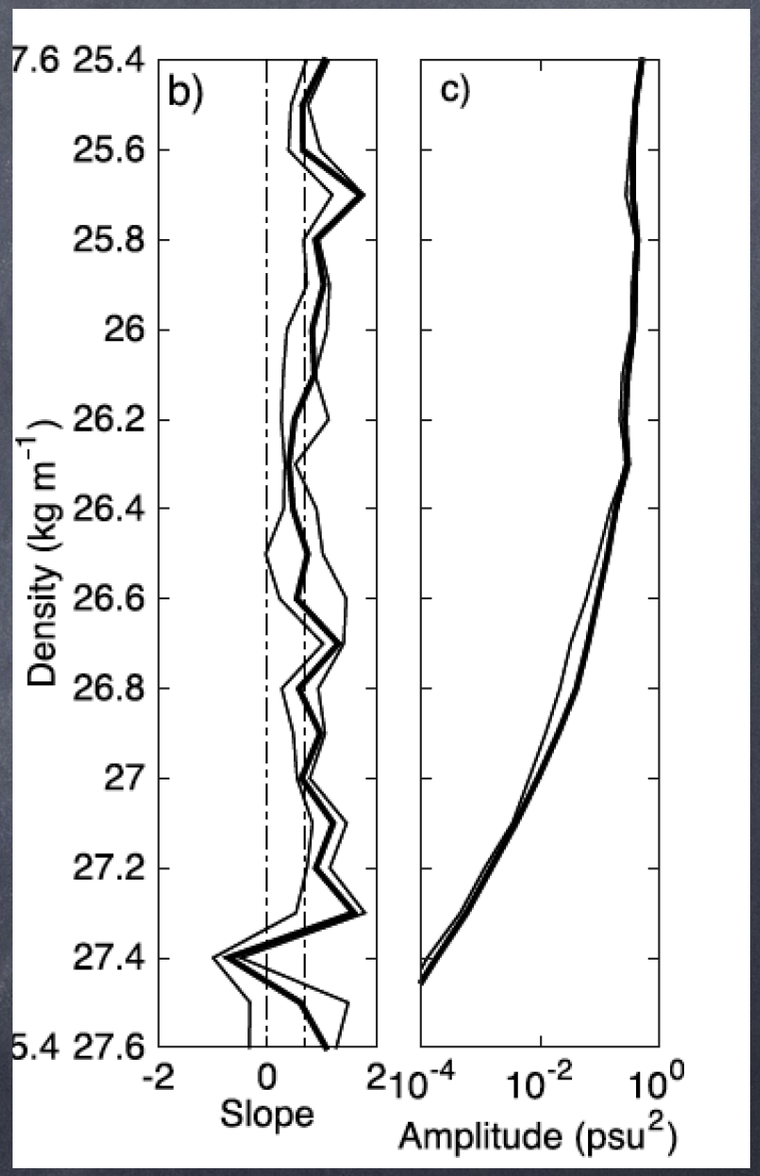

McCaffrey, Fox-Kemper, Forget 2015 (JPO)

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Eddy Indentification, Tracking, And Statistics

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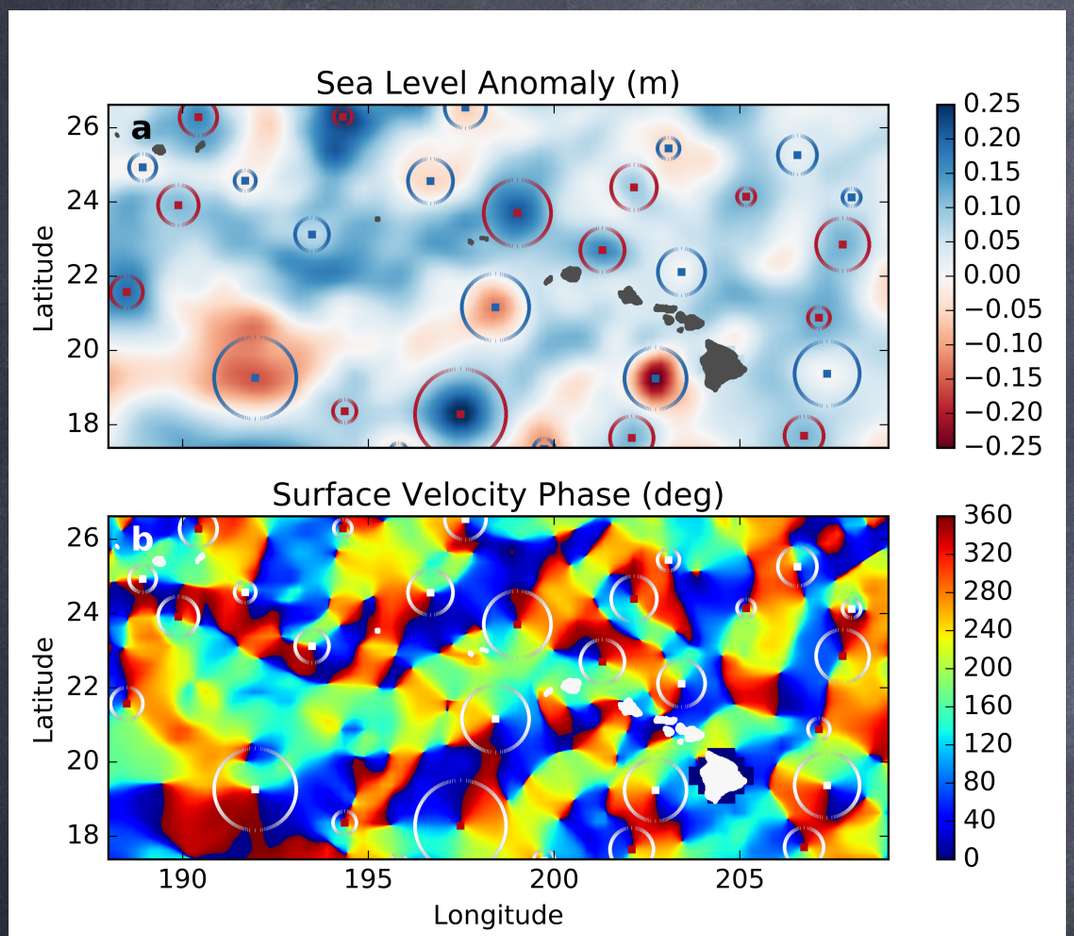

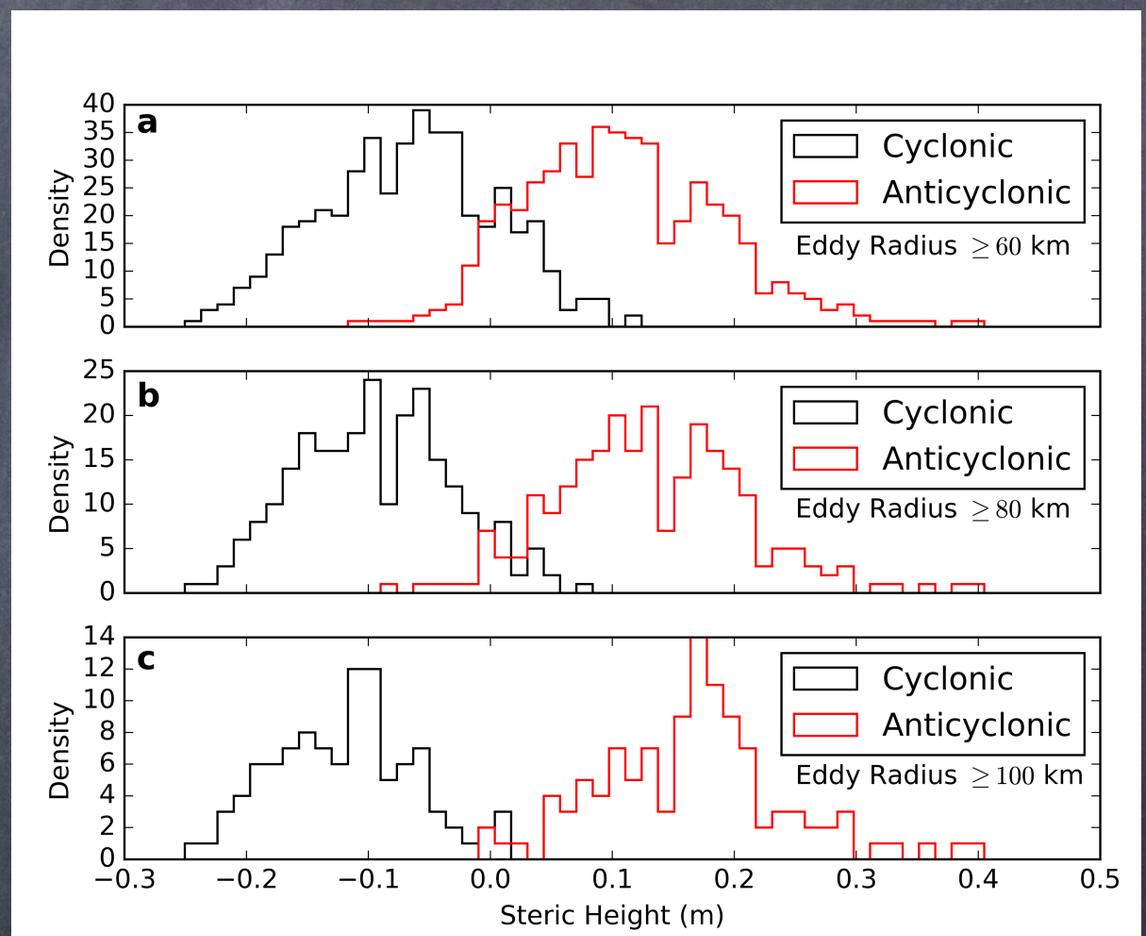

Ashkezari, Hill, Follett, Forget, and Follows (in prep.)

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Outlook

2016 ECCO meeting

- **ECCO v4, input data, misfits, and uncertainty fields:** allow users to assess quality of fit and are a useful research tool in their own right. They are included in release 2 (see ecco-group.org and eccco2016gf1.pdf slides).
- **ECCO v4 can be viewed as an effort to partition large-scale V eddy signals:** subtracting it from the data allow to focus on intrinsic variability – to the extent that large-scale variability is predominantly forced.
- **The estimation of time-mean turbulent transport parameters in ECCO v4:** was essential to an improved fit to in situ data and reduce spurious model drifts. Many question remains even w.r.t. time mean balances. A general question is whether available data may allow for time-variable inversions.
- **Analysis of meso-scale and small-scale variability from observations:** is a very complementary approach to what we do in ECCO – most immediately to refine our understanding of errors but also more generally.