ECCO Version 4:
Water Masses And Tracer Applications

Gaël Forget

ECCO Meeting MIT 2016/05/18

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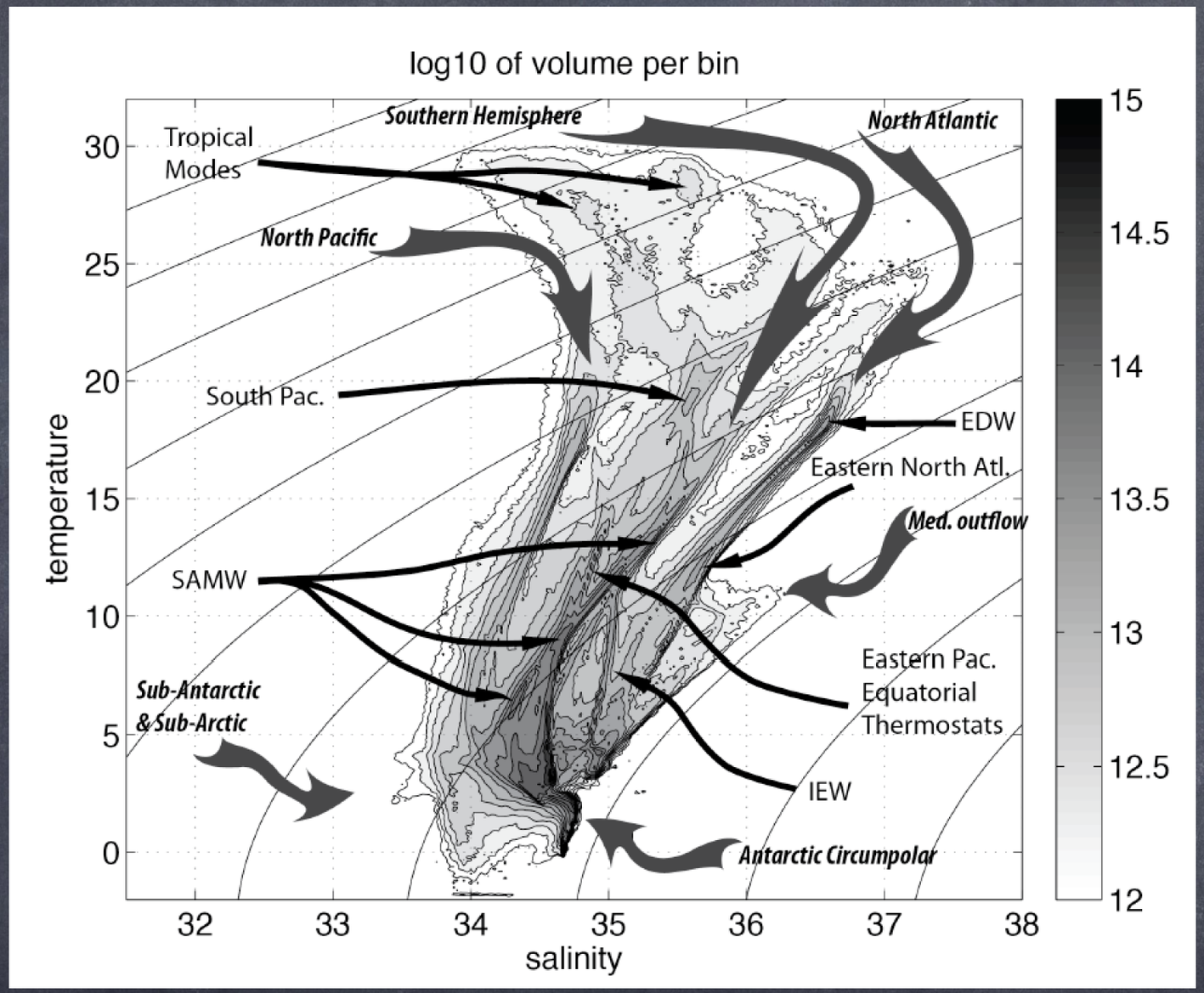
Global Volumetric Census (Argo)

2016 ECCO meeting



Speer and Forget 2013 (Global Distribution and Formation of Mode Waters – chapter 9: in Ocean Circulation and Climate: A 21 Century Perspective)

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EDW Layer Census (Argo)

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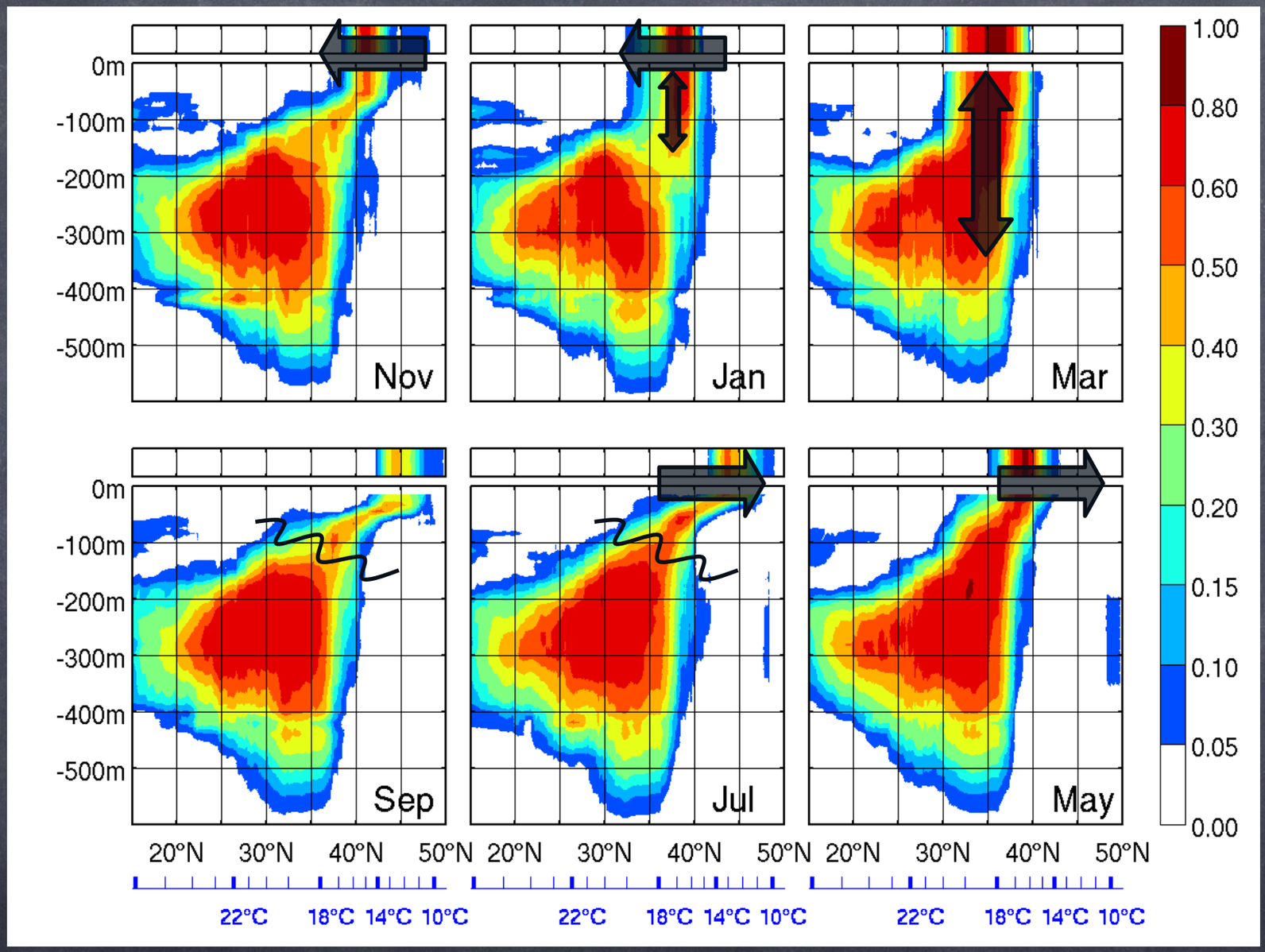

From Forget, Maze, Buckley, Marshall 2011 (JPO)

In Progress: study interannual variability in relation to AMOC by Evans, Toole, Forget, Zika, Naveira Garabato, Nurser, Yu (JPO; being revised).

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Global Seasonal Water Mass Formation (Argo & ECCO v4)

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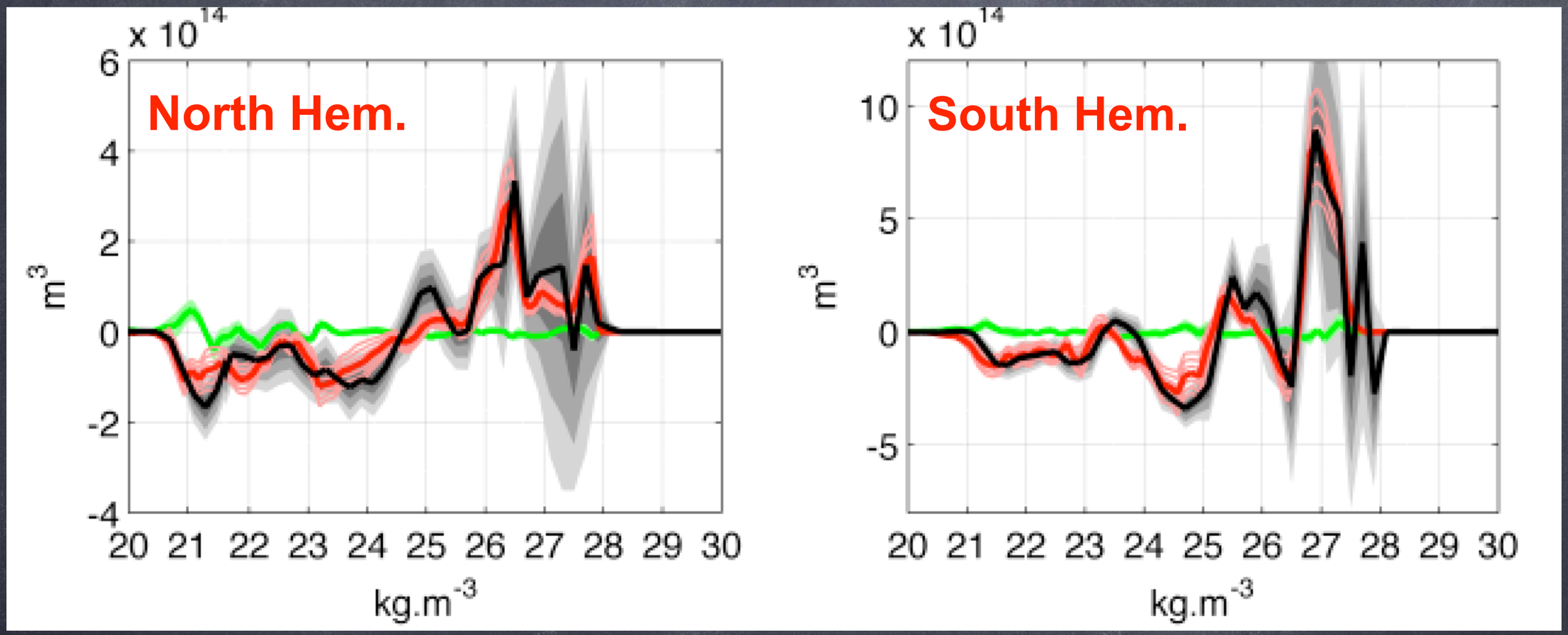

Speer and Forget 2013 (OCC). See also R. Abernathey's slides for more on water mass transformation.

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Mixed Layer Depth Geography (90th percentile)

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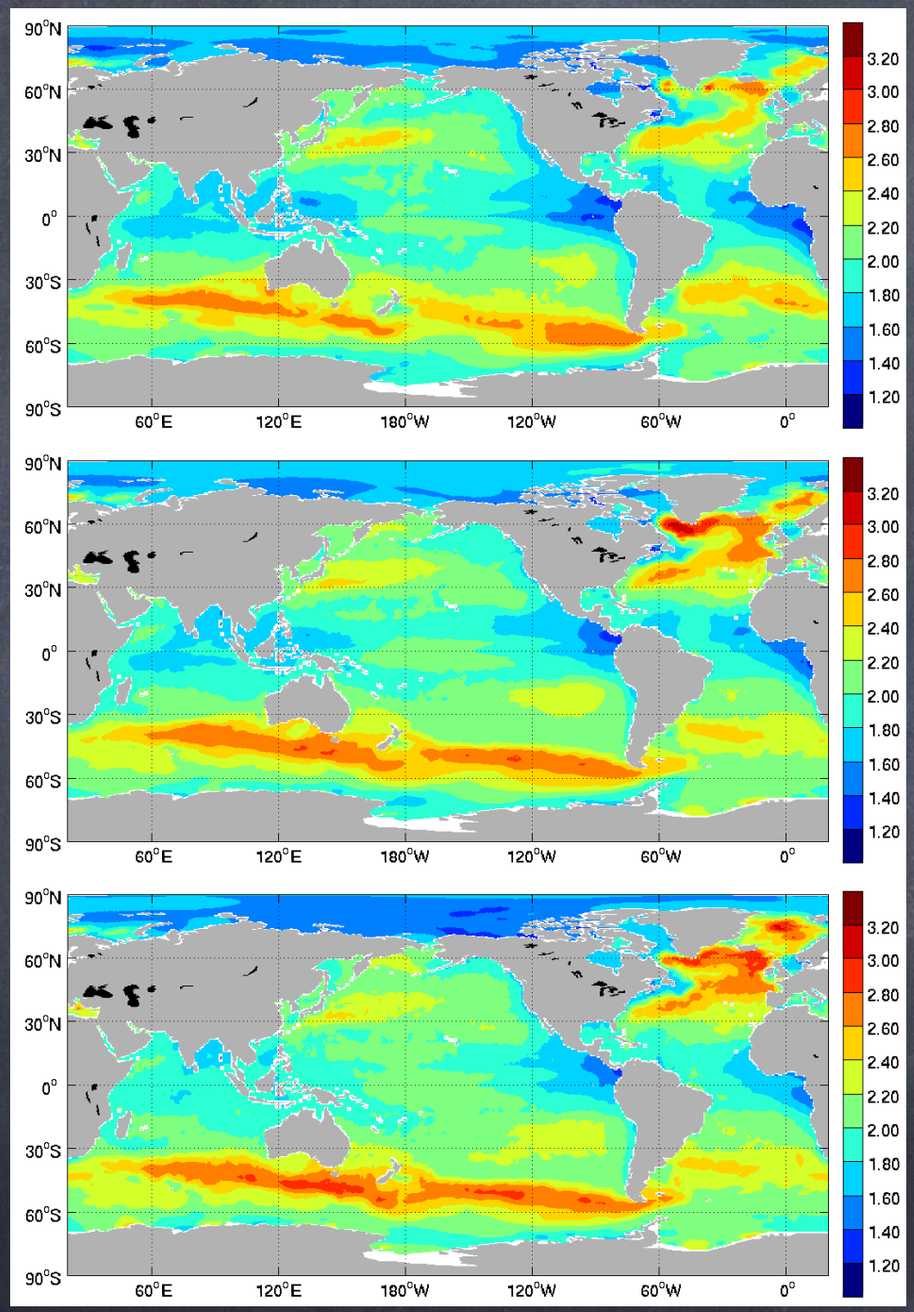

← using **first guess** parameters

← using **estimated** parameters

← **Observed** Mixed Layer depth (90th percentile)

Forget, Ferreira, and Liang, 2015 (OS).
See also Speer and Forget 2013 (OCC).

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Ventilation tracer movies were created by using ECCO v4-r1 (20y) in a perpetual loop (300y).

http://mitgcm.org/viewvc/*checkout*/MITgcm/MITgcm_contrib/gael/comm/movies/TRAC08_20.gif @300m

http://mitgcm.org/viewvc/*checkout*/MITgcm/MITgcm_contrib/gael/comm/movies/TRAC08_28.gif @900m

http://mitgcm.org/viewvc/*checkout*/MITgcm/MITgcm_contrib/gael/comm/movies/TRAC08_44.gif @3500m

For MITgcm/pkg/ptracers user directions see

http://mitgcm.org/public/r2_manual/latest/online_documents/manual.pdf

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Oxygen Concentration after 500y cycling of ECCO v4-r1

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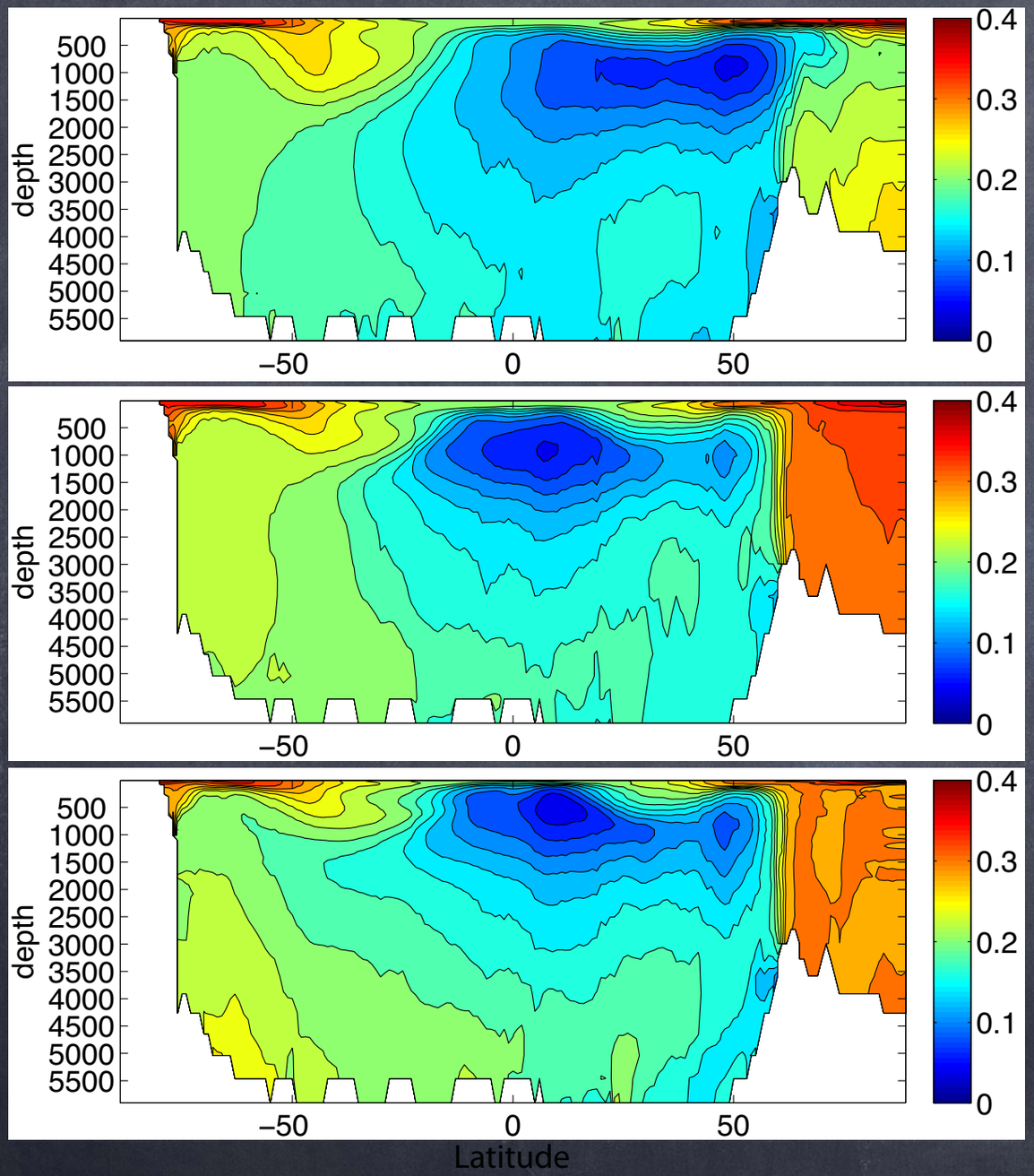

← using **first guess** parameters

← using **estimated** parameters

← **WOA Climatology**

Forget, Ferreira, and Liang, 2015 (OS). H. Song graciously provided initial conditions and parameters for pkg/dic

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Source Waters To Patagonian Shelf Biological Productivity

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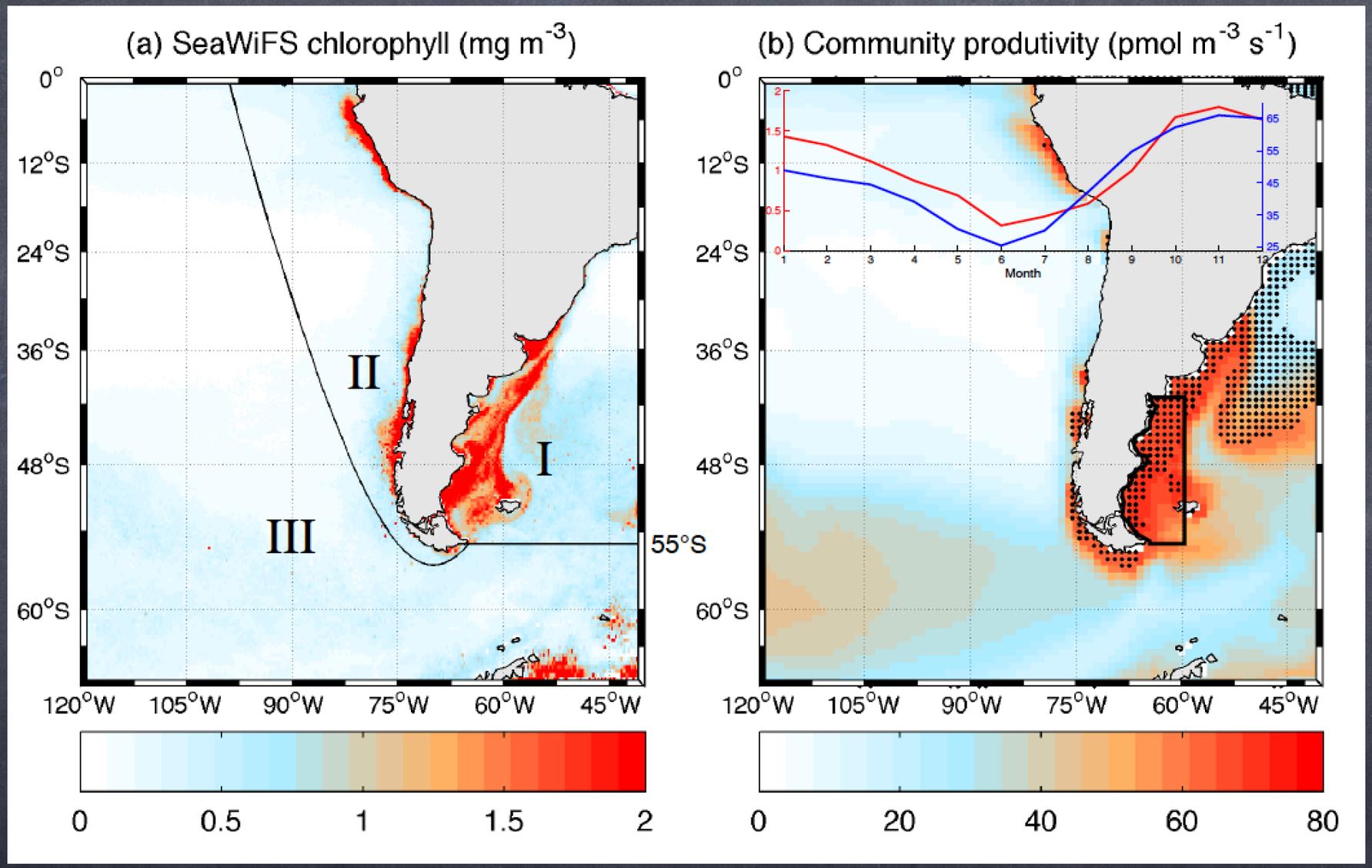

Song, Marshall, Follows, Dutkiewicz, Forget 2016 (JMS)

using LLC90, core2, and pkg/dic forward

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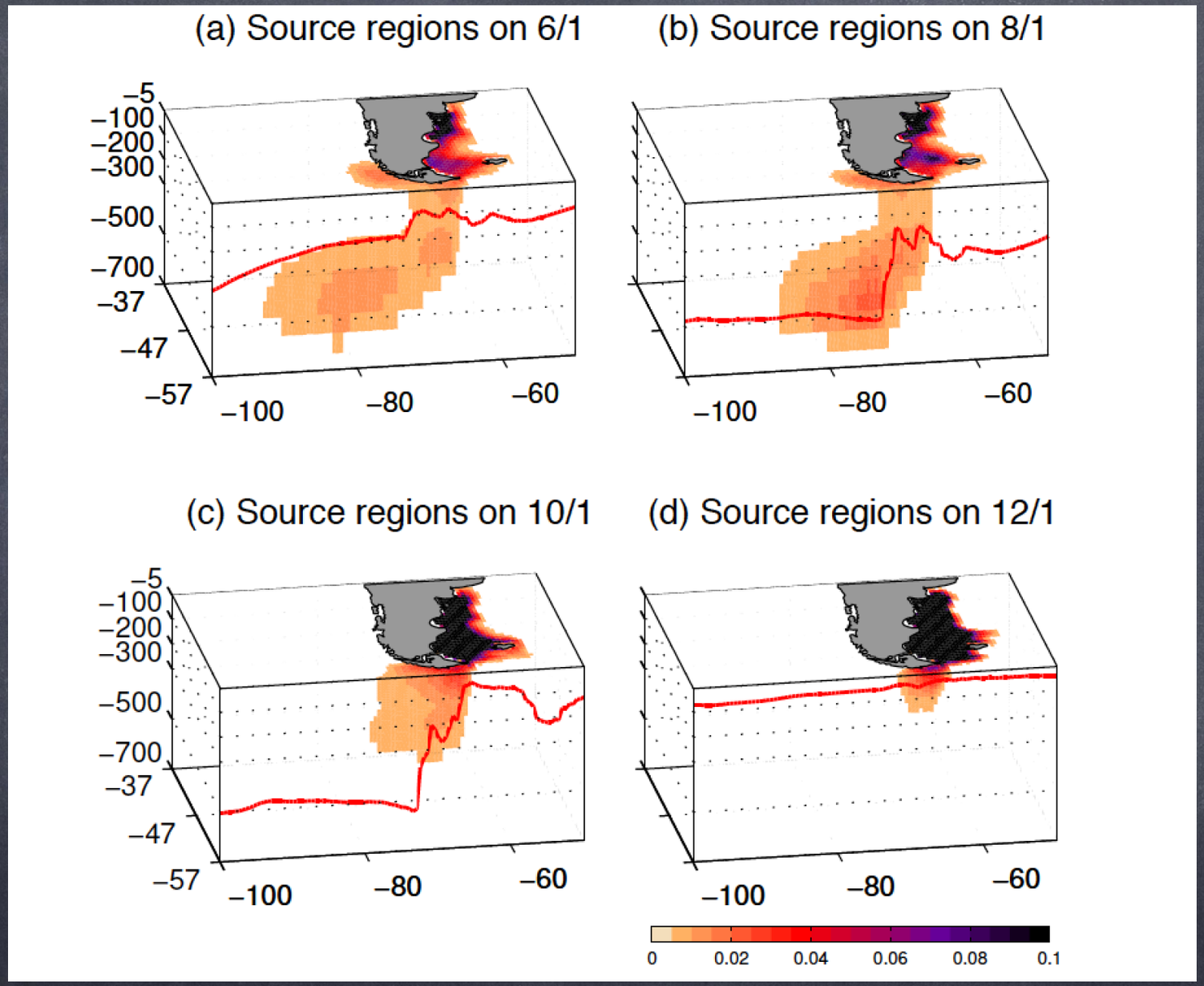
Source Waters To Patagonian Shelf Biological Productivity

2016 ECCO meeting



Song, Marshall, Follows, Dutkiewicz, Forget 2016 (JMS)
using LLC90, core2, and pkg/tracer adjoint

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Contamination by PCB (PolyChlorinated Biphenyl)

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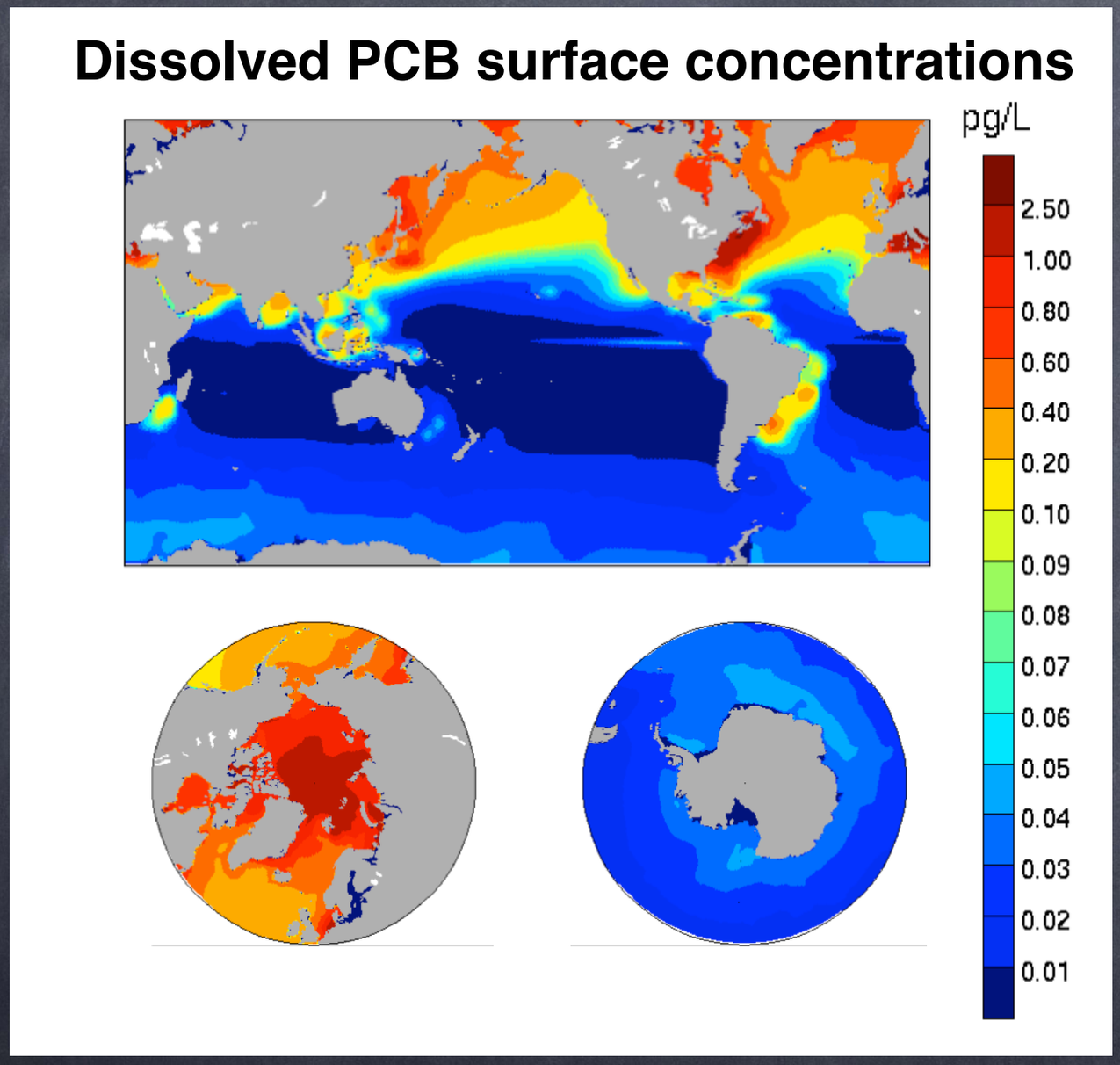

2010 surface ocean PCB concentration simulated using ECCO v4-r1 (4x20y), Darwin biogeo, and GEOS5-chem boundary conditions

Acknowledgement: Helen Amos (PCB), Yanxu Zhang , Elsie Sunderland, and Stephanie Dutkiewicz (DARWIN, Mercury), Carey Friedman and Noelle Selin (GEOS5-chem), ... (in prep)

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Outlook

2016 ECCO meeting

- **A close fit to in-situ hydrography:** opens up a wide range possibilities for quantitative water mass analyses and tracer applications (e.g. Forget et al 2011, Speer and Forget 2013, Forget, Ferreira, and Liang 2015).

- **ECCO v4 (release 1 or 2) readily:** has realistic seasonal water mass formation rates (i.e. air-sea fluxes), mixed layer depth distributions (and interior stratification), and steady circulation (spurious model drifts were alleviated).

- **Running ECCO v4 (see http://ecco-group.org/model.htm):** provides a computationally efficient benchmark (~8h for 20 years on 96 CPUs) to compare and optimize biogeochemical models of different complexity (dic, bling, darwin – see S. Dutkiewicz and M. Mazloff slides) in the context of a near correct physical state.

- **Forward passive tracers:** see MITgcm manual for documentation and tutorials (http://mitgcm.org/public/r2_manual/latest/online_documents/manual.pdf).

- **Adjoint tracers and transports using generic pkg/ecco implementation:** see examples are provided in http://mitgcm.org/viewvc/*checkout*/MITgcm/MITgcm_contrib/gael/verification/global_oce_cs32/input_ad.sens/data.ecco (documentation coming soon). Web interface is in planning by JPL (see I. Fukumori slides).