Oceans and ocean models seen from 10,000 years of current meters observation

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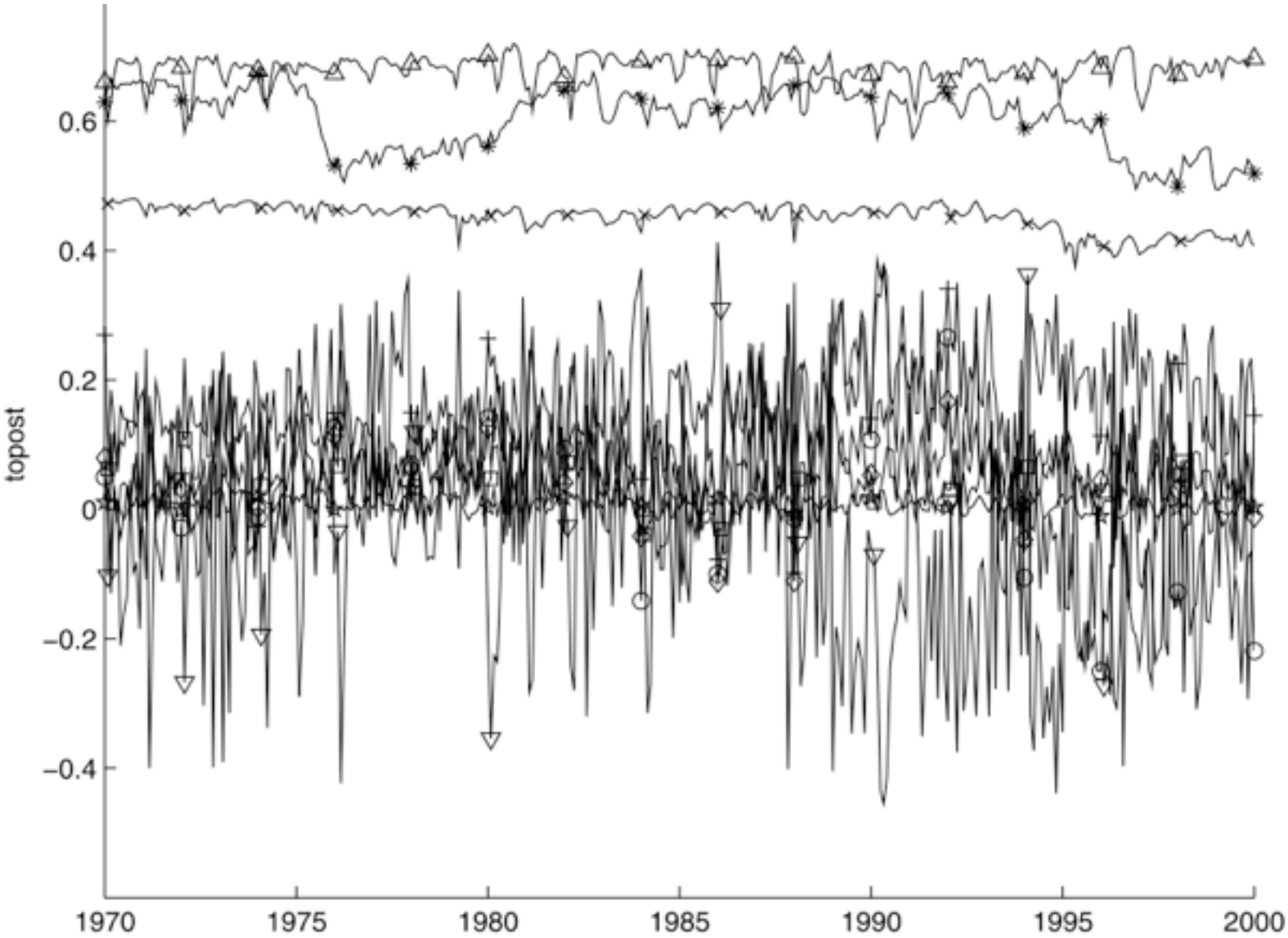
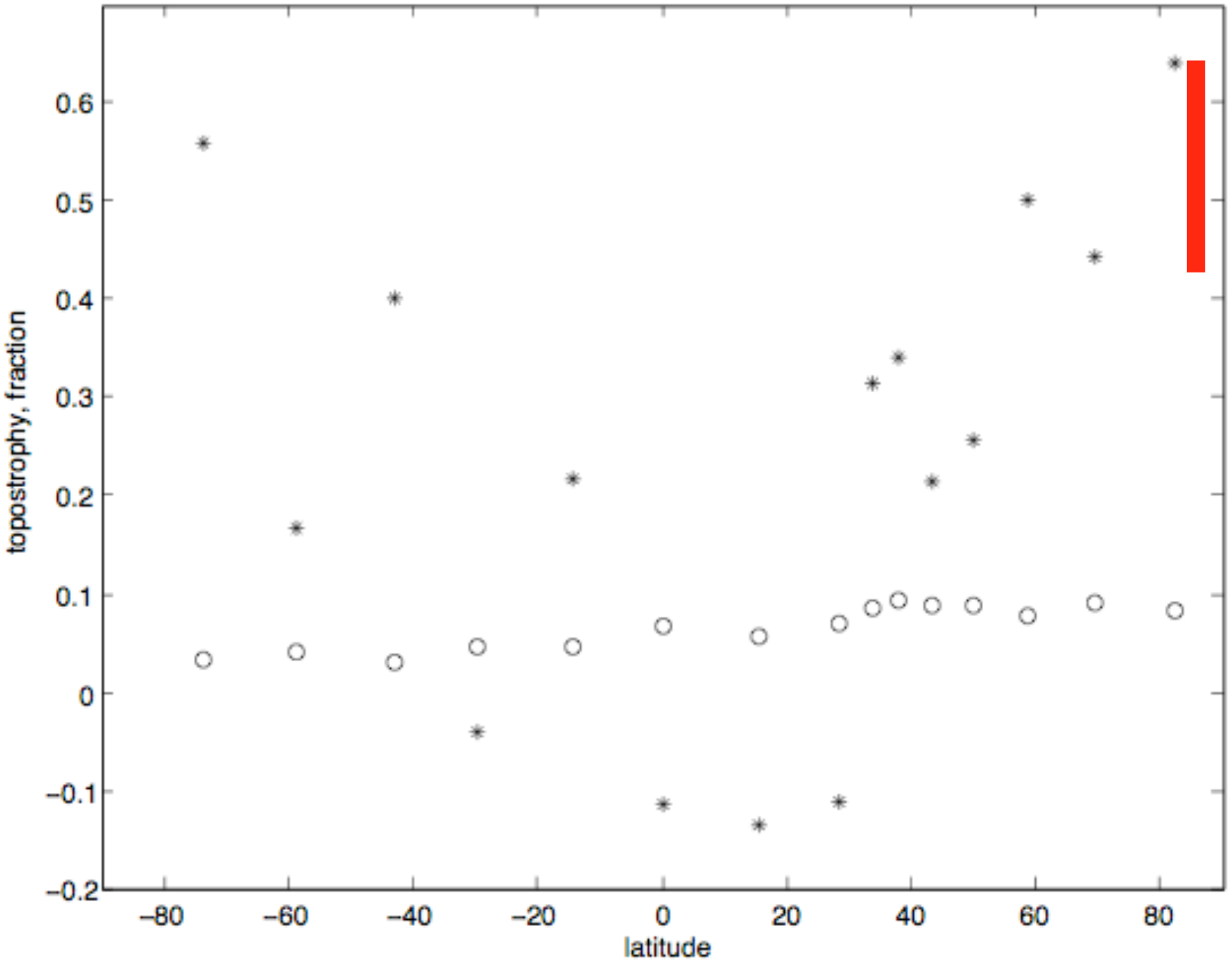
Recall a previous AOMIP result: basin averaged topostrophy, ($\mathbf{f} \times \mathbf{V} \cdot \nabla D$) here for 9 models. 3 models were "weird".



JGR 2007
(AOMIP)

What is observed? From 7593 current meter sites worldwide, plot topostrophy vs latitude (over all depth)

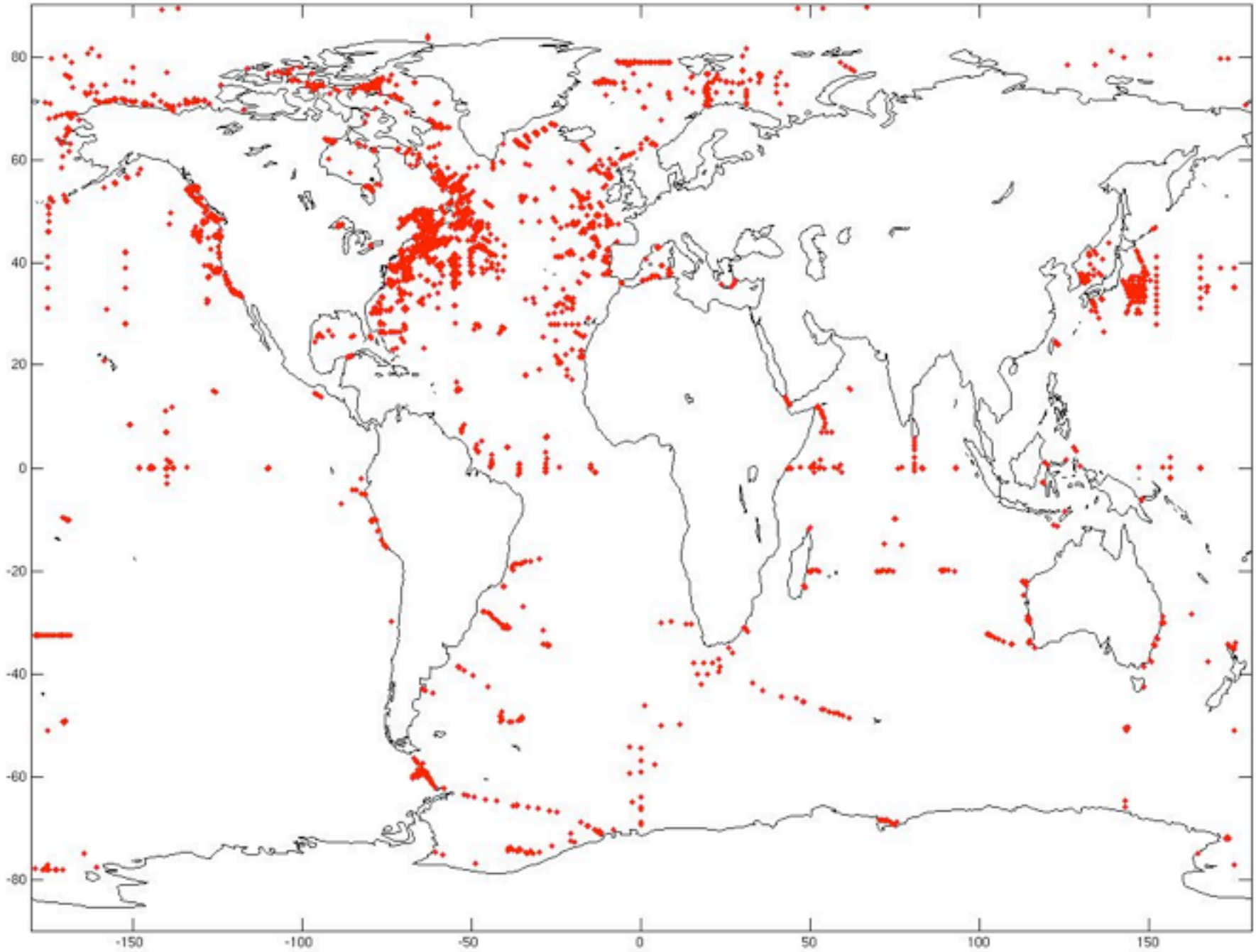


At high N lats see 0.4 to 0.6

JGR 2008

What's new in 2010?

1. Lots more current meter sites: 7593 => 12597
2. BIO/NEMO:
    a. Why were "weird" models "weird"?
    b. Compare CORE, OMIP, timeseries forcing
3. JPL/ECCO: 18km global and 9km Arctic regional
4. How to measure model skill?


80
60
40
20
0
-20
-40
-60
-80
-150
-100
-50
0
50
100
150

Measuring skill. $\text{model} = M + m + m'$, $\text{observ} = O + o + o'$

M, O are dataset & temporal means, m', o' are temporal flucts

$$sk1 = \frac{m \bullet o}{\sqrt{(m \bullet m)(o \bullet o)}},\quad sk2 = 1 - \frac{|m \bullet m - o \bullet o|}{m \bullet m + o \bullet o},\quad sk3 = 1 - \frac{|M - O|}{\sqrt{d_1 d_2}}$$

where $d_1 = \sqrt{m \bullet m + o \bullet o}$, $d_2 = |M| + |O|$, and

"•" is weighted by observed (duration / temporal variance)

Then $sk = (sk1)(sk2)(sk3)$

"skill" = 1 iff model=observed identically

sk1, sk = 0 if model is random guessing

sk1, sk < 0 if model is worse than guessing

and look at topostrophy $\mathbf{f} \times \mathbf{V} \cdot \nabla D \Big/ \sqrt{|\mathbf{f} \times \mathbf{V}|^2 |\nabla D|^2}$

Were "weird" models "weird" because of neptune?

(replace $A\nabla^2\mathbf{u}$ with $A\nabla^2(\mathbf{u}-\mathbf{u}^*)$ where $\mathbf{u}^* \equiv -L^2\mathbf{f}\times\nabla\log D$)

JGR 2009: Using NEMO at BIO at 925 current meter sites in Arctic portion, observed topostrophy = 0.48. Friction obtains 0.19, neptune 0.36.

New for 2010 -- 2869 Arctic sites (also common JPL)

Observed topostr = 0.51, friction 0.24, neptune 0.32

Skills: friction 0.071, neptune 0.113 (weak, 59% gain)

BIO/NEMO to compare CORE, OMIP, NCEPts

CORE	friction 0.071,	neptune 0.113
OMIP	friction 0.074,	neptune 0.116
NCEPts	friction 0.079,	neptune 0.124

JPL/ECCO compare 18 km => 9 km grid

topostr:	18 km 0.31,	9 km 0.50 *(vs 0.51?)*
skills:	18 km 0.265,	9 km 0.450

Conclusions?

We're learning (thanks to AOMIP)

1. Earth's oceans have topostr > 0, more at high lat

2. Representing eddies in non-eddy models helps,
   e.g. neptune helps (strongly) in topostr & skill

3. Finer grid (eddying) helps =>> eddy resolving?