Tide Correction Errors

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Topics:

1. Barotropic deep-ocean tides (diurnal + semid'l)
2. Near-coastal tides (diurnal + higher orders)

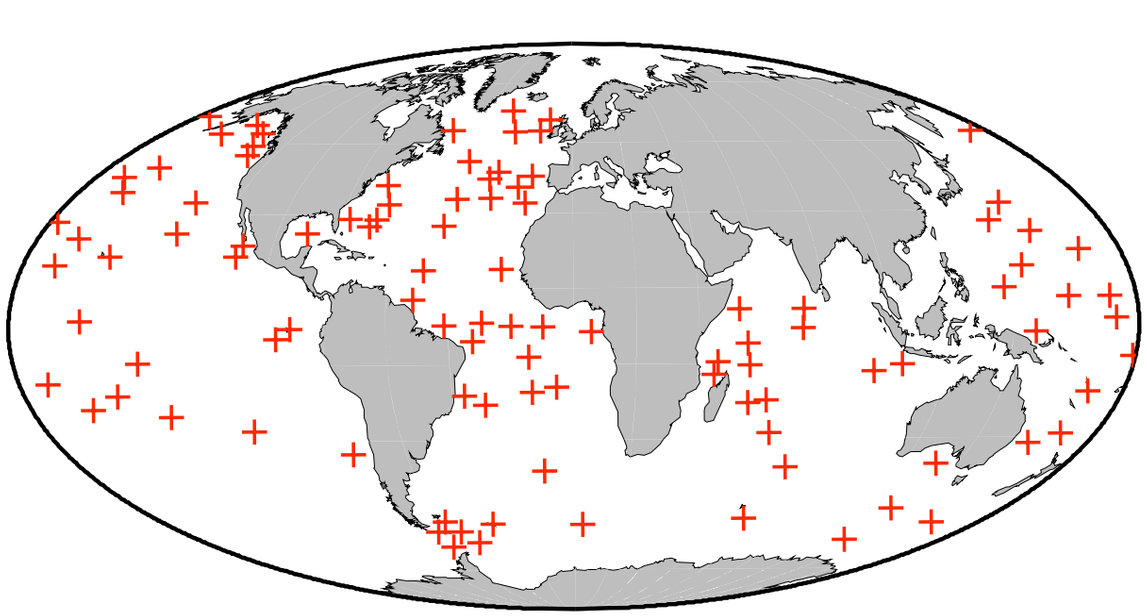
Not topics:

1. Deep-ocean internal tides & their variability
2. Long-period tides

OST Science Team Meeting **Seattle** **22-24 June 2009**

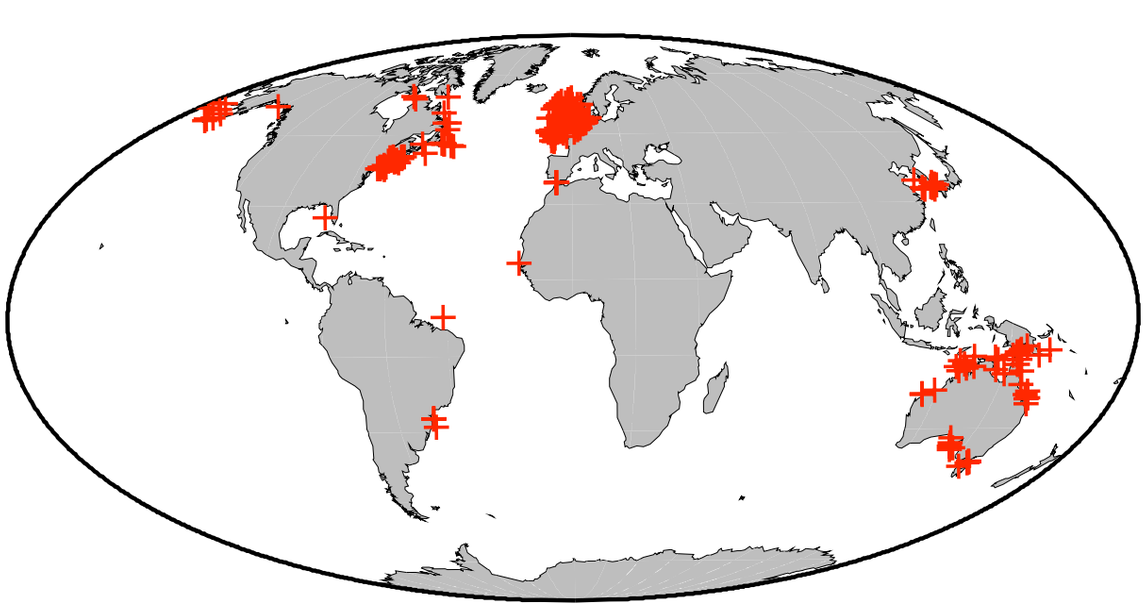
RMS differences (cm) with validation gauge data: GOT00.2

	Q1	O1	P1	K1	N2	M2	S2	K2	Inferred minors	Error of Omission	Total RSS
Deep water	0.28	0.86	0.37	1.02	0.63	1.45	0.93	0.42	0.28	0.53	2.43
Shallow water	0.89	1.50	0.99	2.02	2.48	7.89	5.80	2.48	4.71	6.36	13.38



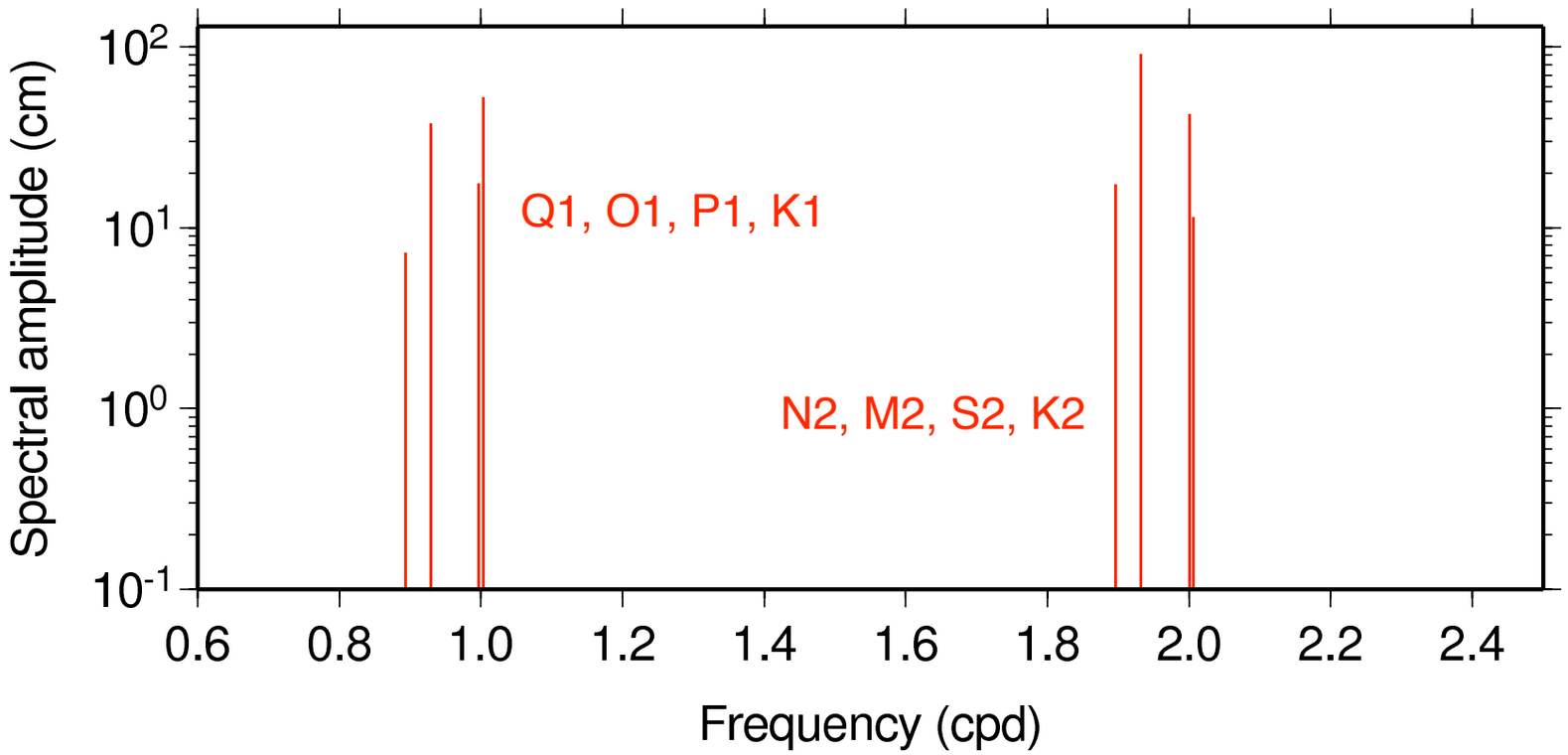
Deep-water sites

102 stations

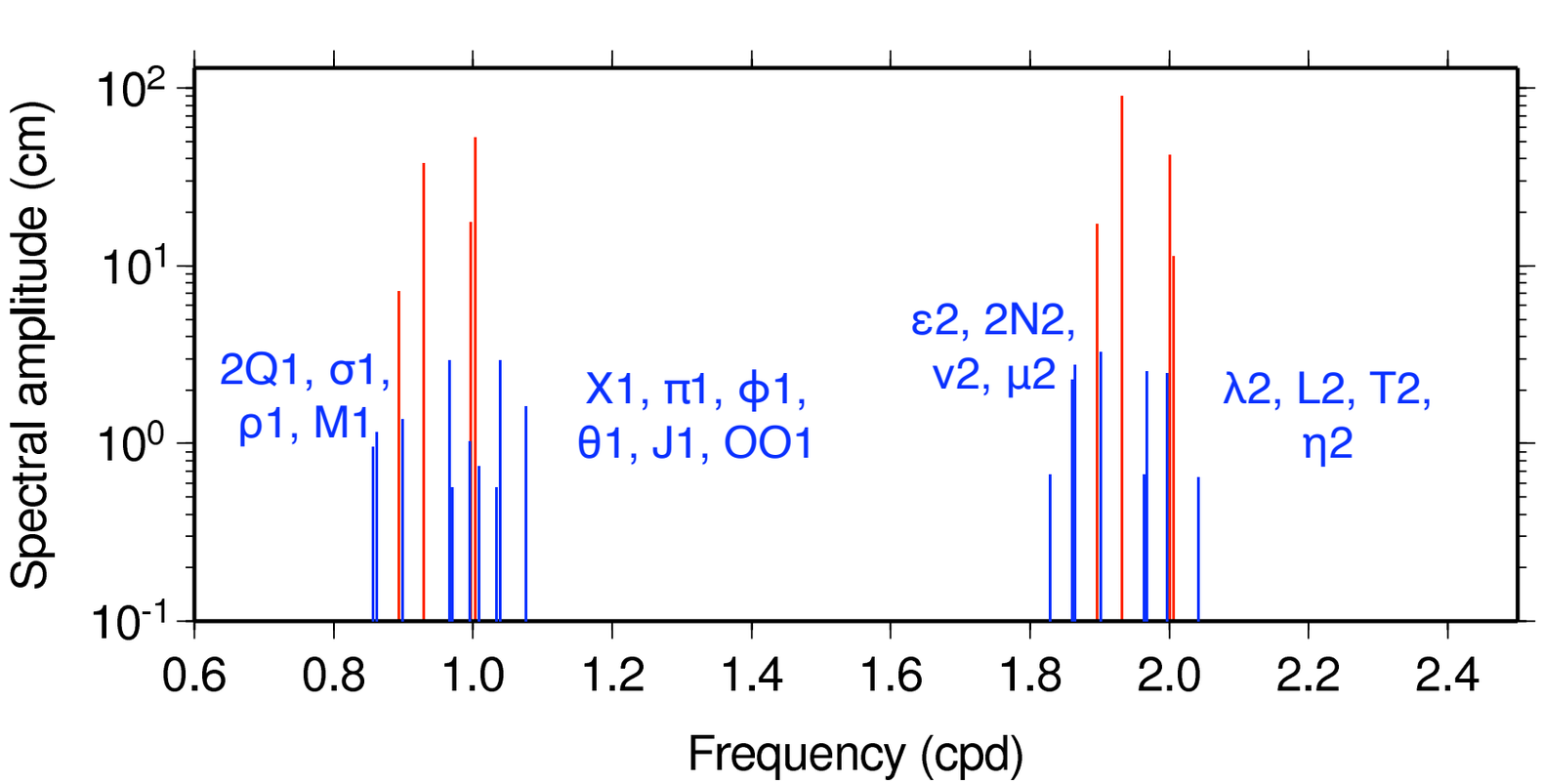


Shallow-water sites

179 stations
mostly offshore,
includes compound lines



Modeled Constituents



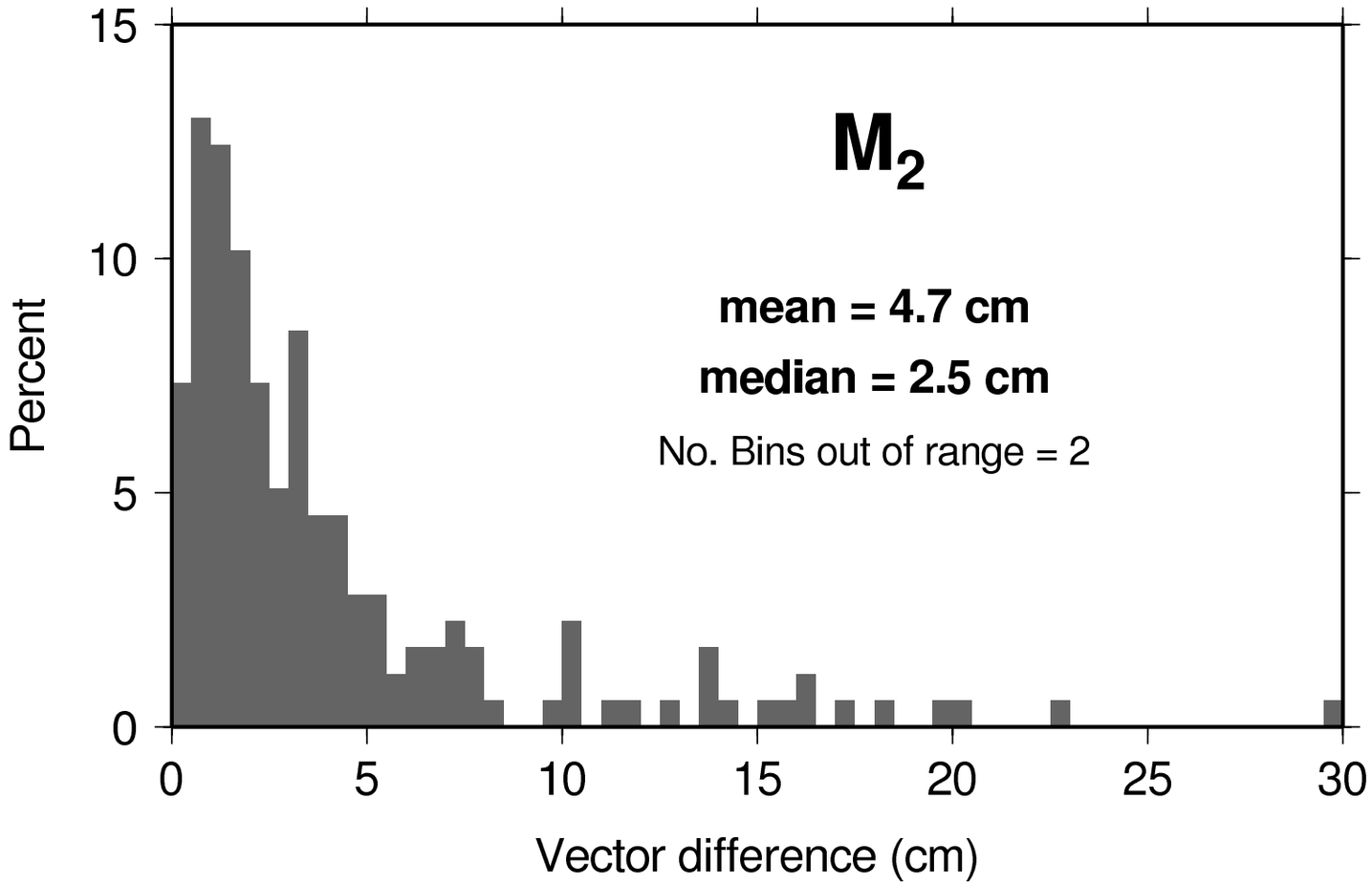
Inferred Constituents

Omission Errors from Unmodeled Compound Tides

Tide	No.Stations	Max (cm)	RMS (cm)
OQ2	10	1.2	0.521
MNS2	27	2.7	0.713
MSN2	28	3.7	0.919
2SM2	78	5.3	1.162
M3	70	4.0	0.999
MO3	69	2.4	0.548
MK3	78	2.7	0.628
SK3	10	0.7	0.315
SO3	10	1.1	0.425
M4	81	26.1	4.340
MS4	81	16.9	2.596
MN4	78	8.9	1.665
MK4	10	4.7	1.529
S4	10	1.6	0.588
SN4	52	2.4	0.539
2MN6	78	4.7	0.928
M6	78	8.3	1.633
MSN6	78	1.7	0.374
2MS6	78	8.1	1.479
2MK6	10	2.0	0.817
2SM6	78	1.4	0.309
MSK6	10	0.8	0.353
3MS8	28	3.1	0.961
M8	28	2.0	0.682

Total RSS = 6.7 cm

Shallow-water Station RMS Differences for GOT00



Implication:

In near-coastal regions, model accuracy is very location-dependent.

Four worst stations:

1.	**IAPSO 1.2.20**	**North Hudson Bay**
2.	**IAPSO 1.1.89**	**Strait of Gibraltar**
3.	**GLOUP 262**	**North Channel between Scotland & Ireland**
4.	**Stephens Isl.**	**Torres Strait (between Queensland & New Guinea**

Formal Posterior Errors of Global Inverse Solutions

1. Depends on Σ_d – data error covariance

   Σ_f – dynamics error covariance

2. Σ_d scaled for consistency with solution's data residuals.

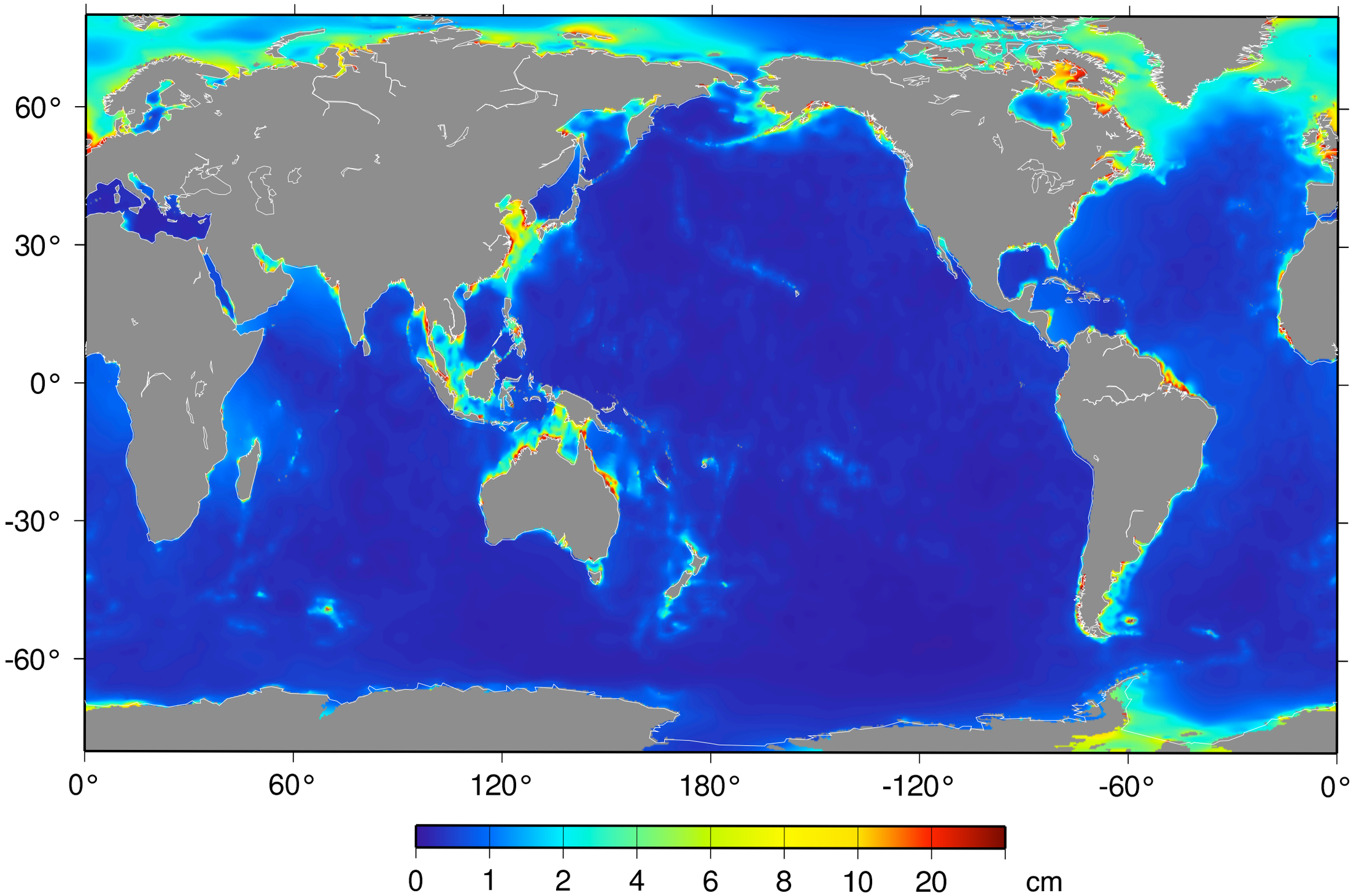
   Σ_f scaled for consistency with adjustments to prior model.

3. Details in:

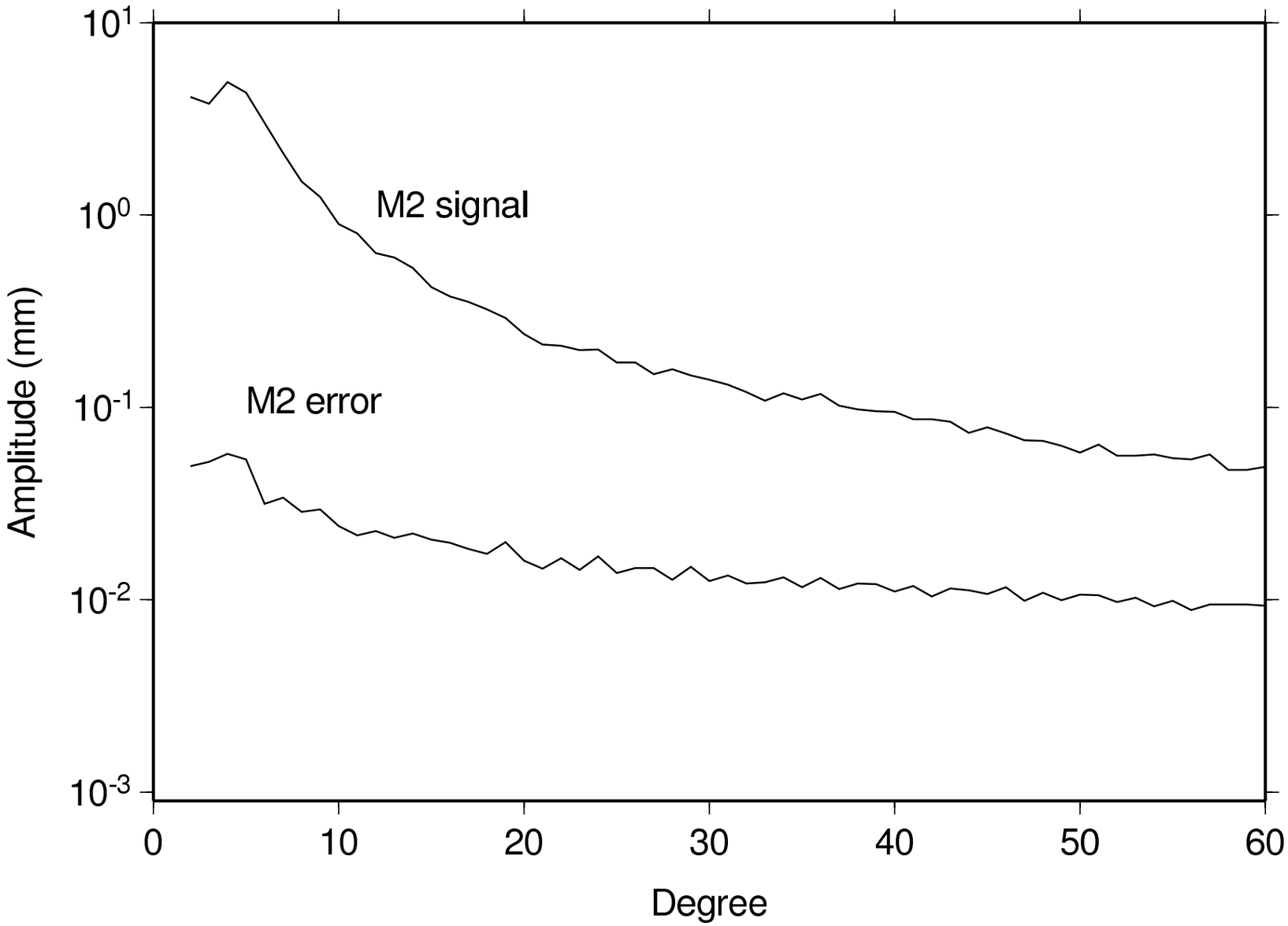
   Egbert & Erofeeva, "Efficient inverse modeling of barotropic tides,"

   JTech, 2002.

M2 Tide -- Standard Error (cm)
TPXO.7



TPXO7 Degree Variance Spectrum



Consistency of TPXO.7 M_2 Errors

	TPXO–Gauge RMS Diffs (cm)	TPXO Formal RMS Errors (cm)
102 deep-ocean sites	1.45	0.74
179 shelf sites	10.41	6.36

Conclusions

Barotropic tide prediction in deep ocean is accurate to ~2 cm rms.

Tide prediction in shallow seas is location-dependent.
~ a few cm in some places; 10's of cm in other places.

Egbert's formal error fields are a reasonable guide.

Correction of altimetric slopes are affected by internal tides.
~ several cm over 100 km.

Lee Fu asks: Can tide-model errors explain the 60-day variability (3-4 mm) seen in all calculations of global mean sea level?

My answer: Uncertain. If so, then M2 & S2 are main culprits (60-d alias).

RMS of TPXO7 global (±66°) mean error = 0.6 mm (M2 only)

Increase this by 50% to reflect error under-estimation = 1 mm

S2 errors may be smaller — S2/M2 potential = 0.46

or larger — errors from radiational effects (air tide, IB, etc.)

If S2 comparable to M2, then sum = 2 mm.

My hunch: Other effects depending on solar β′ also contribute.

E.g., thermal effects on spacecraft, tracking stations.

atmospheric drag

residual ionospheric errors at S2 frequency

residual wet-trop errors at S2 frequency