A map of the Arctic region showing Russia, Alaska, and parts of Canada. The map includes labels for the Arctic Ocean, Bering Sea, and various cities and geographical features. The title is overlaid in large blue text.

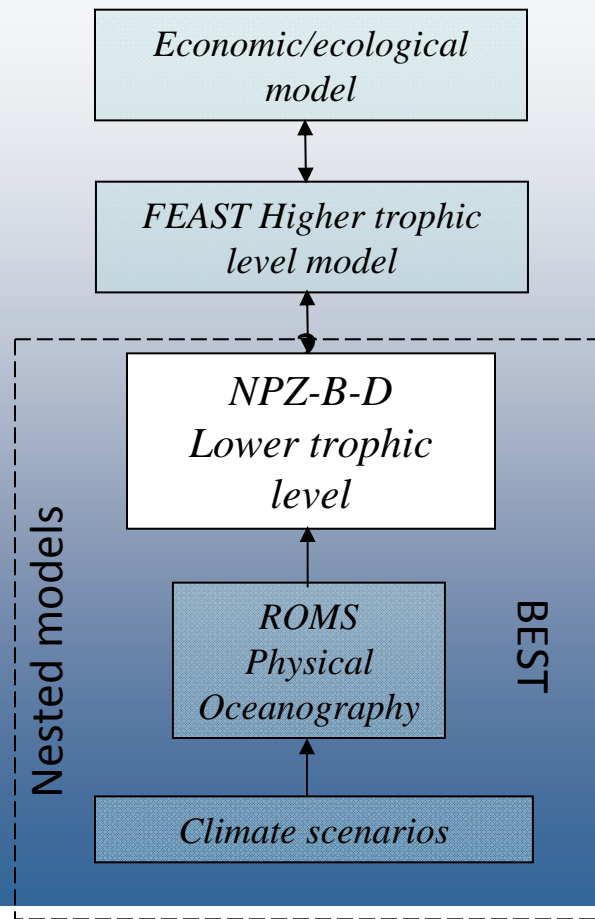
Evaluation of the Oceanographic Component of Climate Models used by the IPCC

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¹ University of Washington/JISAO

BSIERP Integrated modeling

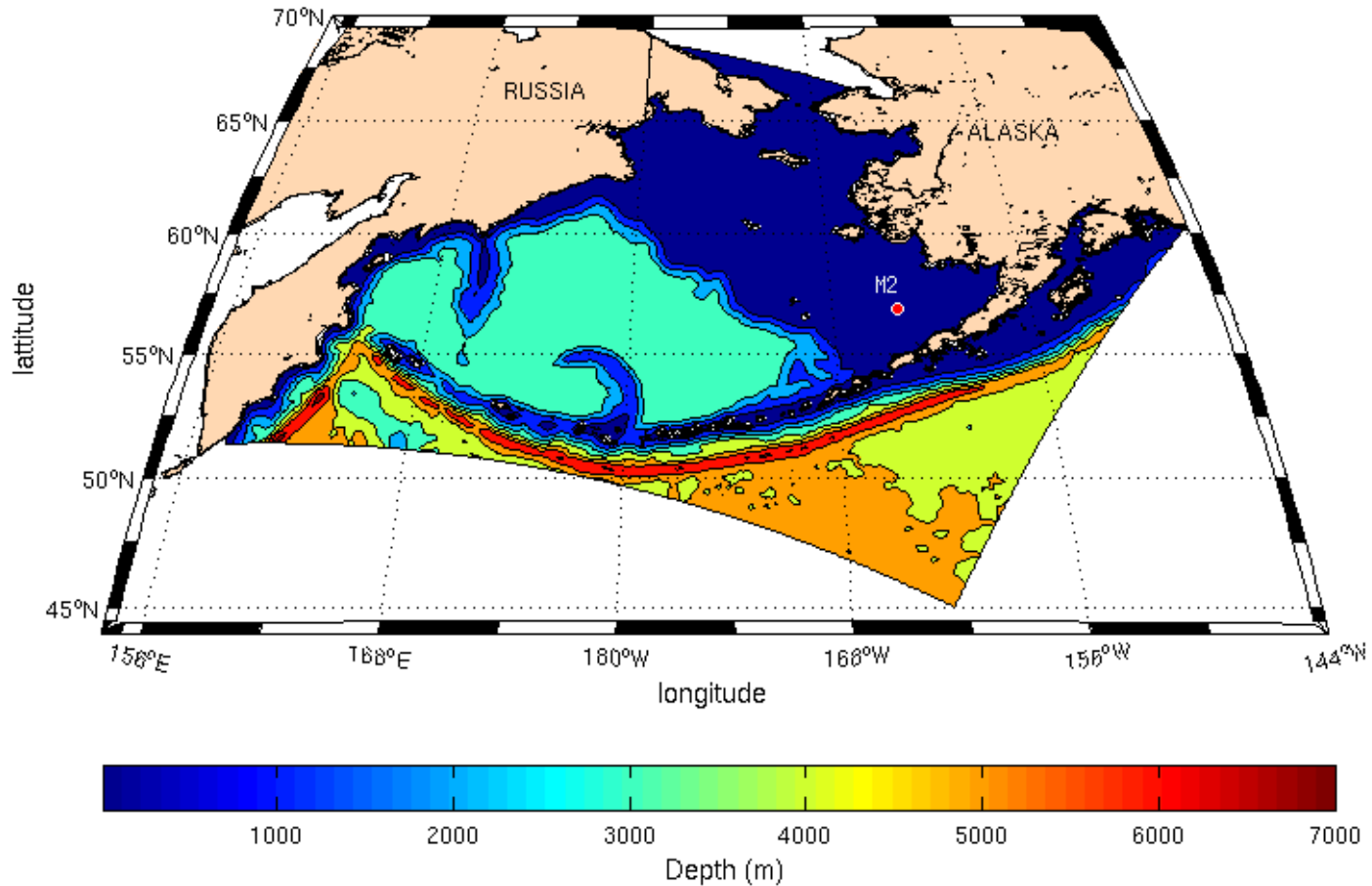


UNDERSTANDING ECOSYSTEM PROCESSES IN THE

Bering Sea



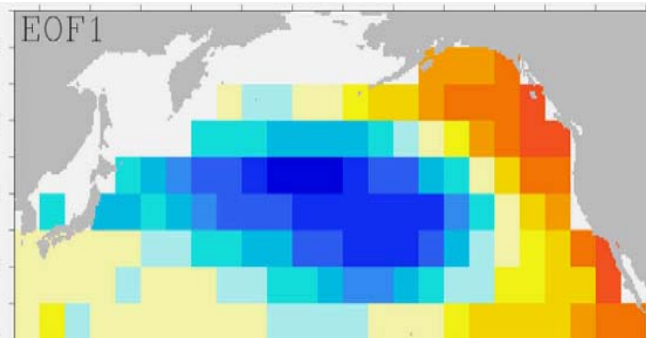
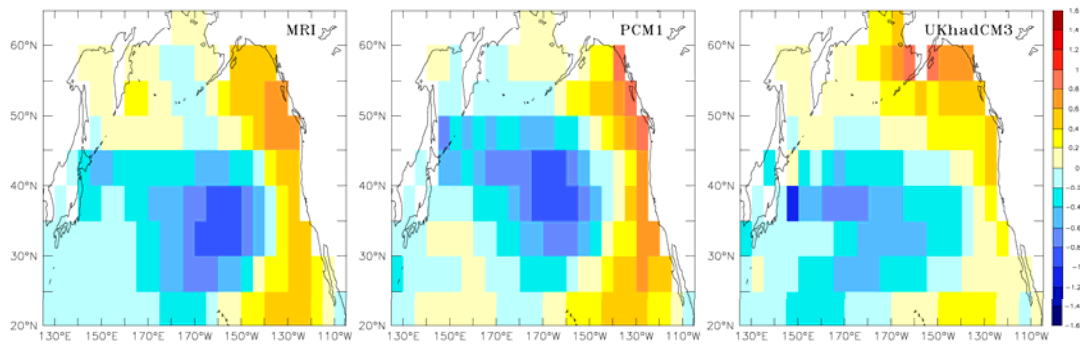
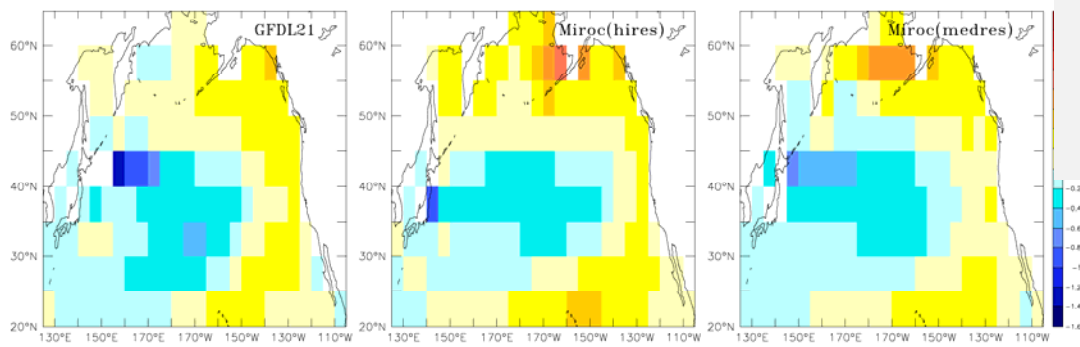
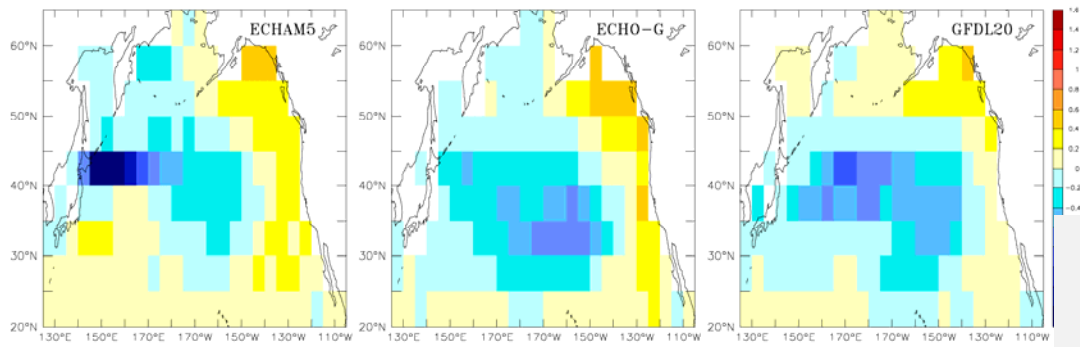
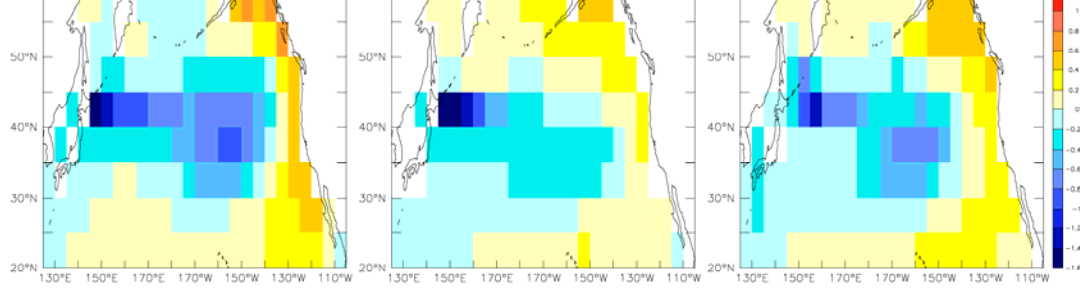
The Model Grids



3D grid has 10km resolution

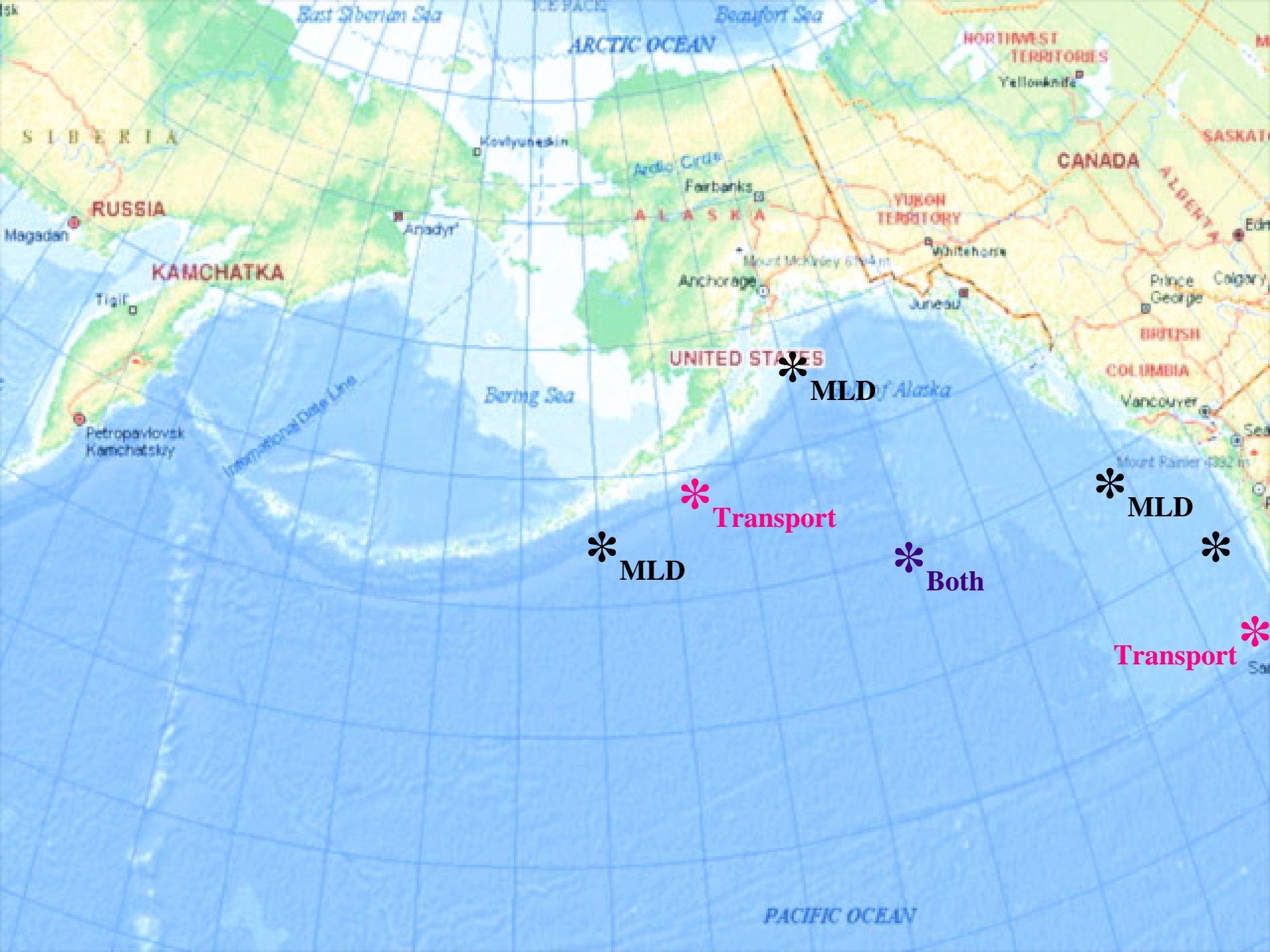
Models Contributed to IPCC AR4

	IPCC I.D.	Country	Atmosphere Resolution	Ocean Resolution	# of Control runs	# of 20c3m runs	# of A1B runs
1	BCCR-BCM2.0	Norway	T63L31	(0.5-1.5°) x 1.5°L35	2	1	1
2	CCSM3	USA	T85L26	(0.3-1.0°) x 1.0°L40		1	1
3	CGCM3.1(T47)	Canada	T47L31	1.9° x 1.9°L29	2	5	5
4	CGCM3.1 (T63)	Canada	T63L31	1.4° x 0.9°L29	1	1	1
5	CNRM-CM3	France	T42L45	182x152L31	3	1*	1
6	CSIRO-Mk3.0	Australia	T63L18	1.875° x 0.925° L31	3	3	1
7	ECHAM5/ MPI-OM	Germany	T63L31	1.5°x1.5°L40			
8	FGOALS-g1.0 (IAP)	China	T42L26	1°x1°xL30	9	3	3
9	GFDL-CM2.0	USA	2.5°x2.0° L24	1°x1°L50	5	3	1
10	GFDL-CM2.1	USA	2.5°x2.0° L24	1°x1°L50	5	5	1
11	GISS-AOM	USA	T42L20	1.4°x1.4°L43	2	2	2
12	GISS-EH	USA	5°x4°L20	2°x2° *cos(lat) L16	4	5	3
13	GISS-ER	USA	5°x4°L13	5°x4°L33	1	9	5
14	INM-CM3.0	Russia	5°x5°L21	2°x2.5°L33	2	1	1
15	IPSL-CM4	France	3.75°x2.5° L19	2°x1°L31	3	1	1
16	MIROC3.2(hires)	Japan	T106 L56	0.28°x0.188° L47	1	1	1
17	MIROC3.2(medres)	Japan	T42 L20	(0.5°-1.4°)x1.4° L44	3	3	3
18	ECHO-G (MIUB)	Germany/Korea	T30L19	T42L20	1	3	3
19	MRI-CGCM2.3.2	Japan	T42 L30	(0.5°-2. 5°) x 2° L23	3	5	5
20	PCM	USA	T42L18	(0.5-0.7°) x 0.7° L32		1	
21	UKMO-HadCM3	UK	3.7°5x2.5° L15	1.25°x1.25° L20	2+1*	1	1
22	UKMO-HadGem1	UK	1.25°x1.875°L38	(0.33-1.0°) x 1.0° L40	1+2*	2	1*
	Sum					55	40



Analysis of Coupled Atmosphere-Ocean Model Output

- Previous efforts focused on SST and atmospheric parameters
- Selection of parameters (MLD, stratification, upper ocean transports) following advice of Phyllis Stabeno
- Used data from Simple Ocean Data Assimilation (SODA) as verification, at locations of importance and/or real observations to constrain SODA



Sample Density Profiles at 45 N, 126.5 W

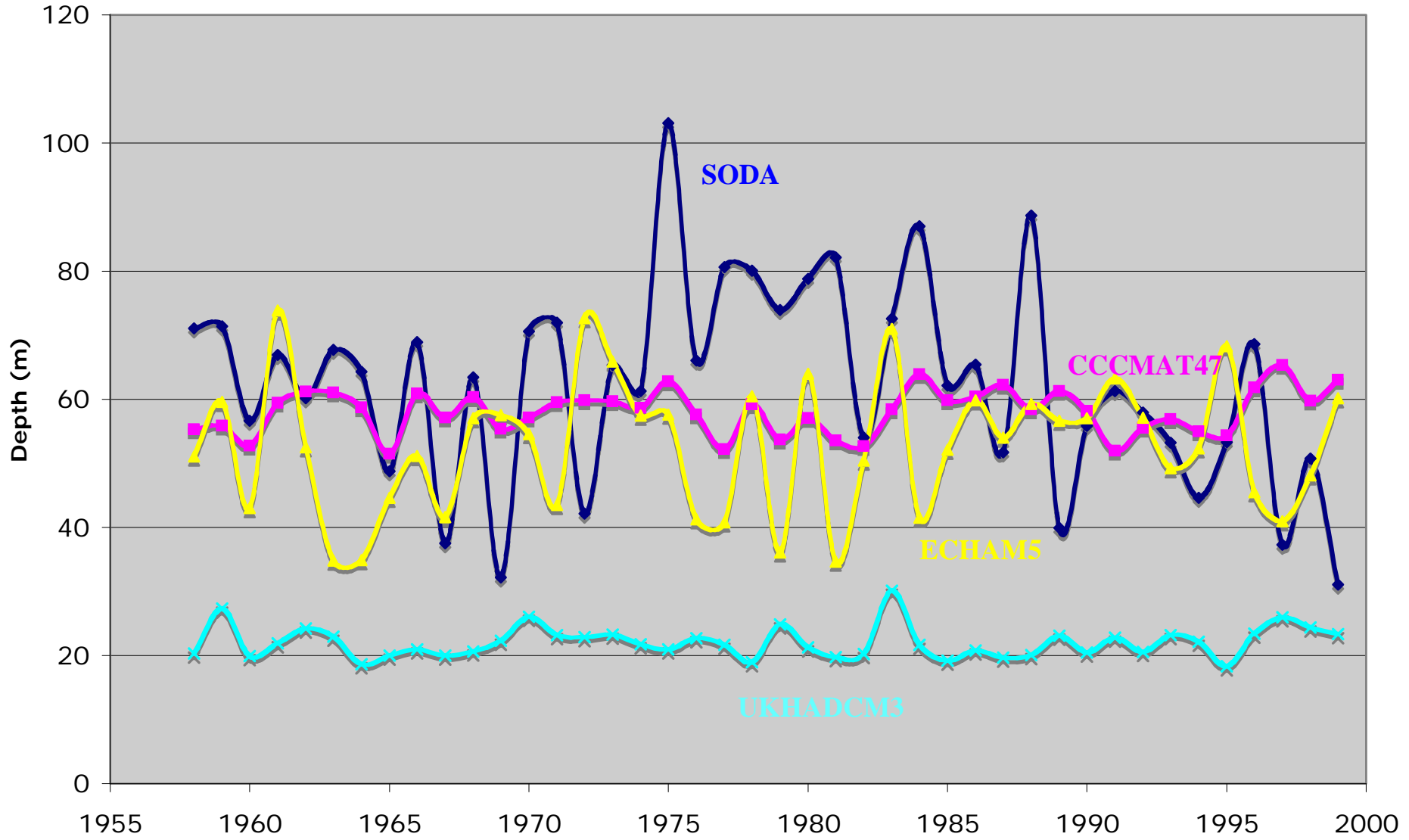
SODA (May)

SODA (Sep)

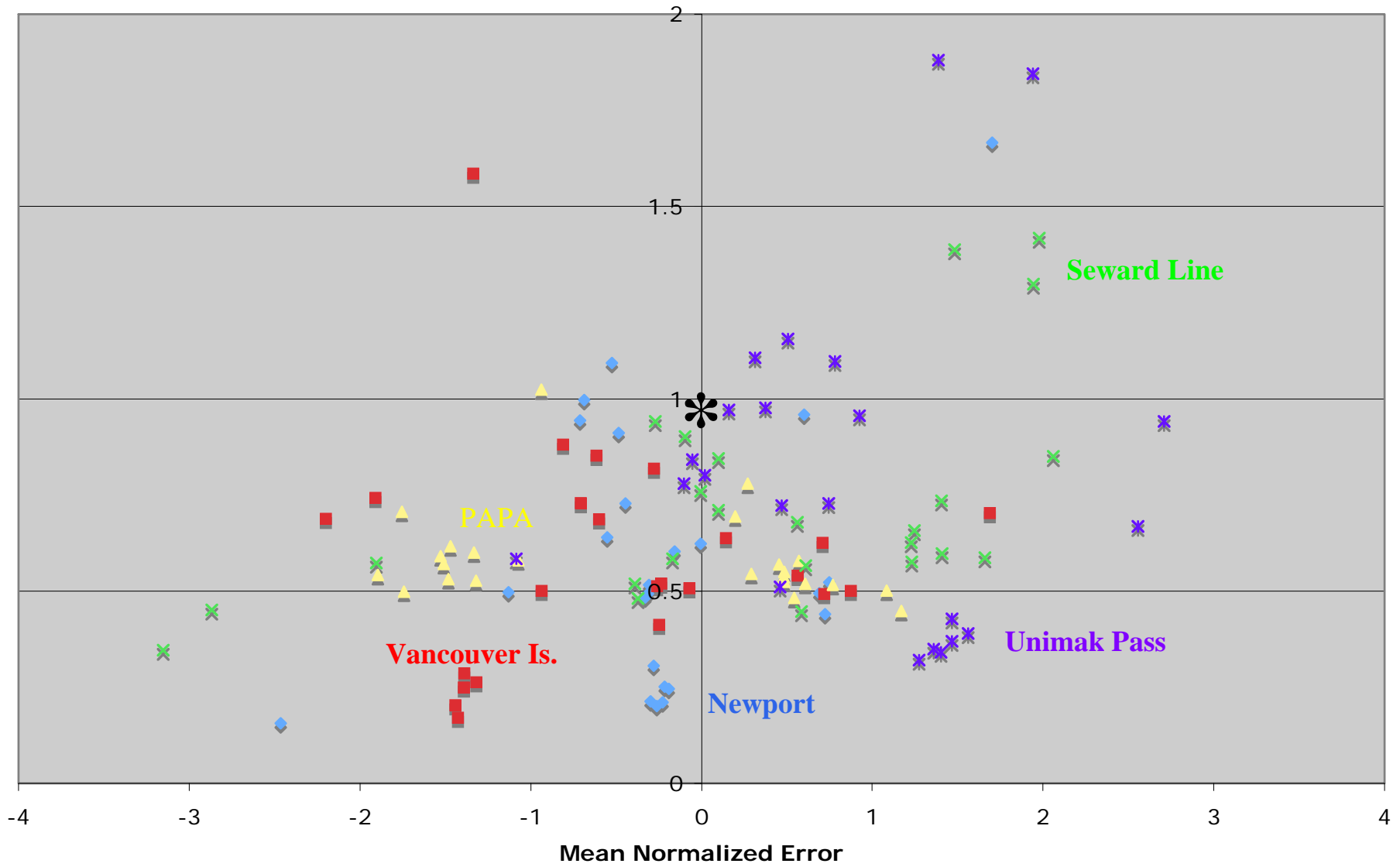
QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

Density (kg/m³)

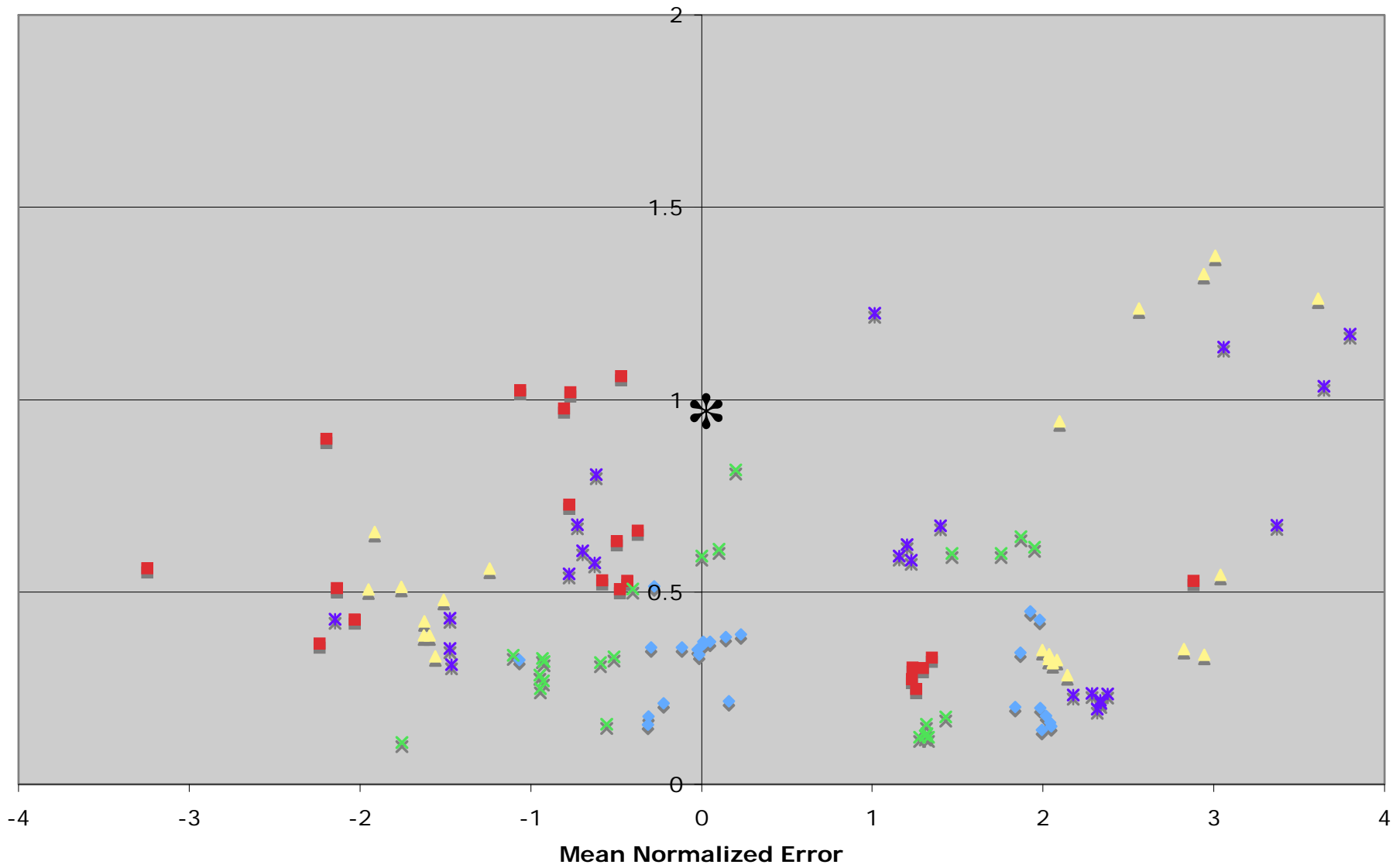
May Pycnocline Depths at 45N, 126.5W



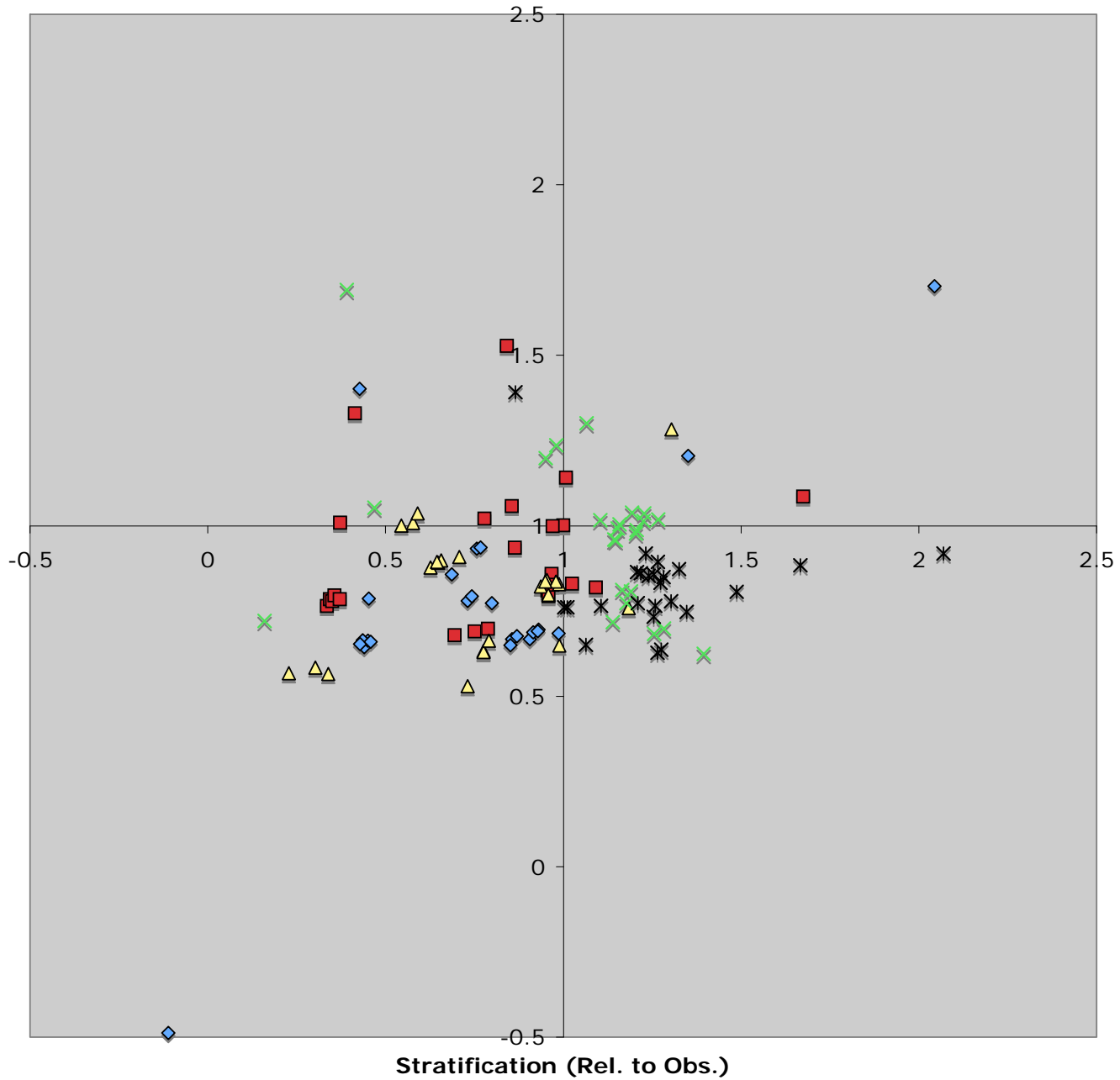
May Pycnocline Depth Errors



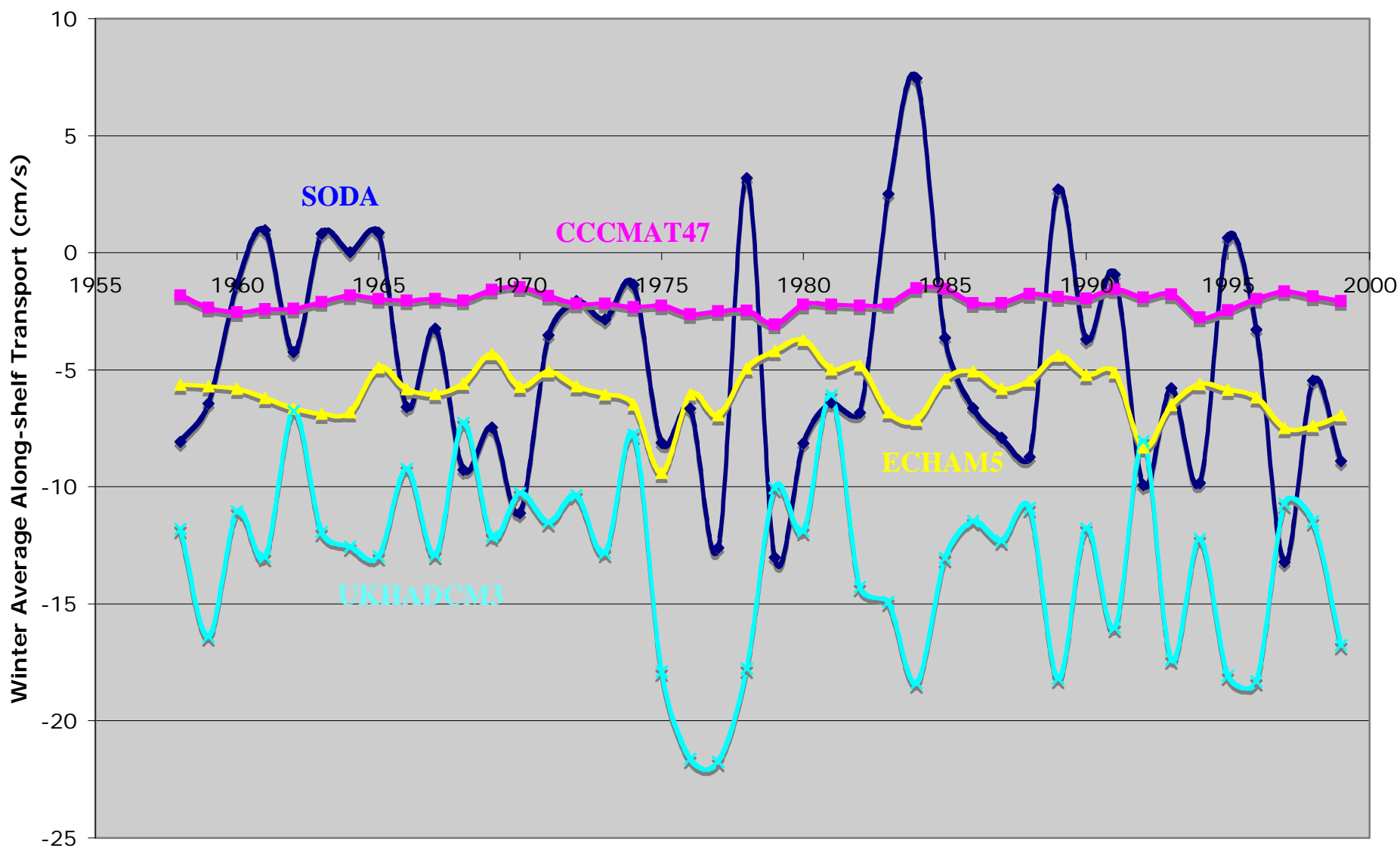
September Pycnocline Depth Errors



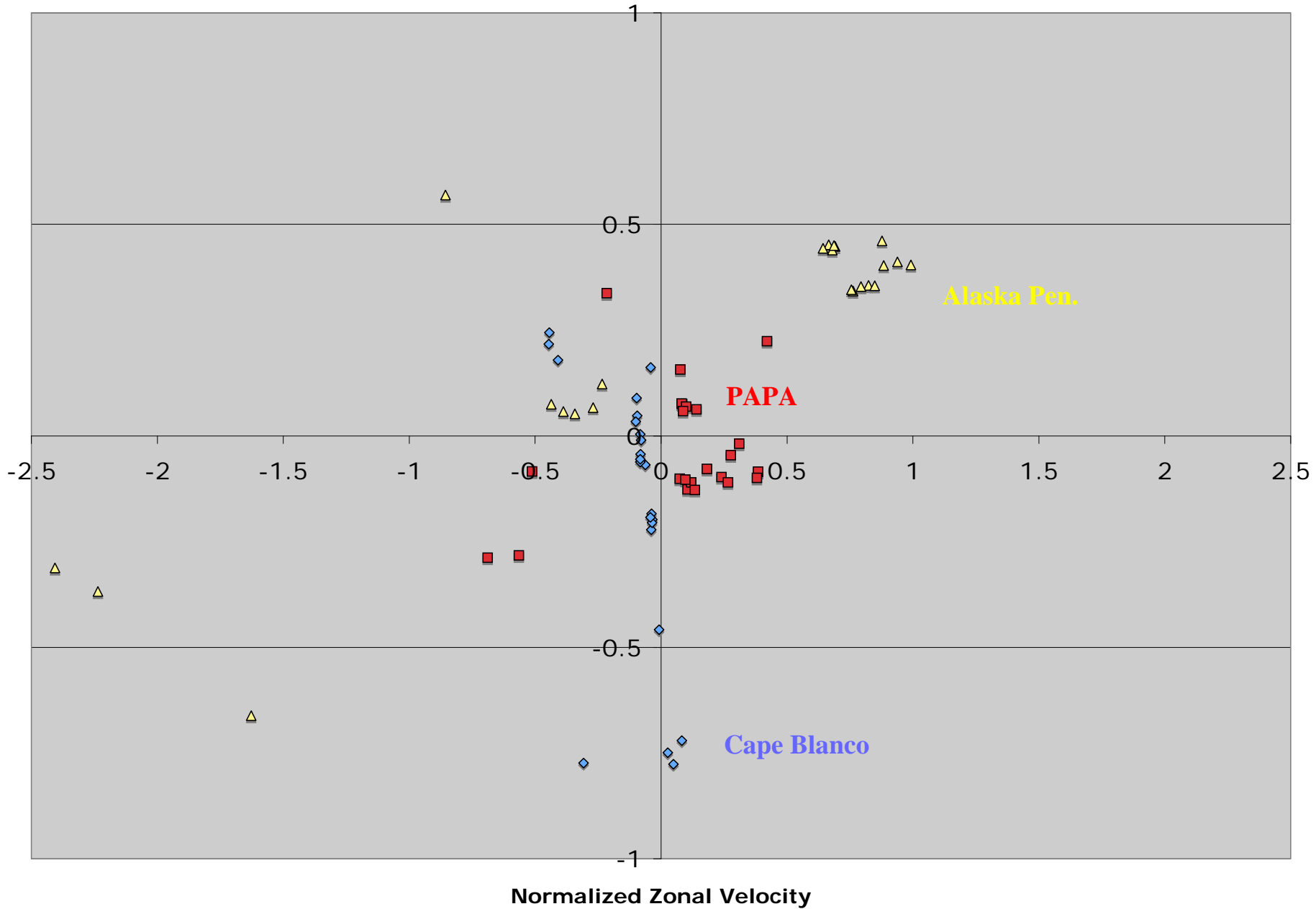
September-May Changes



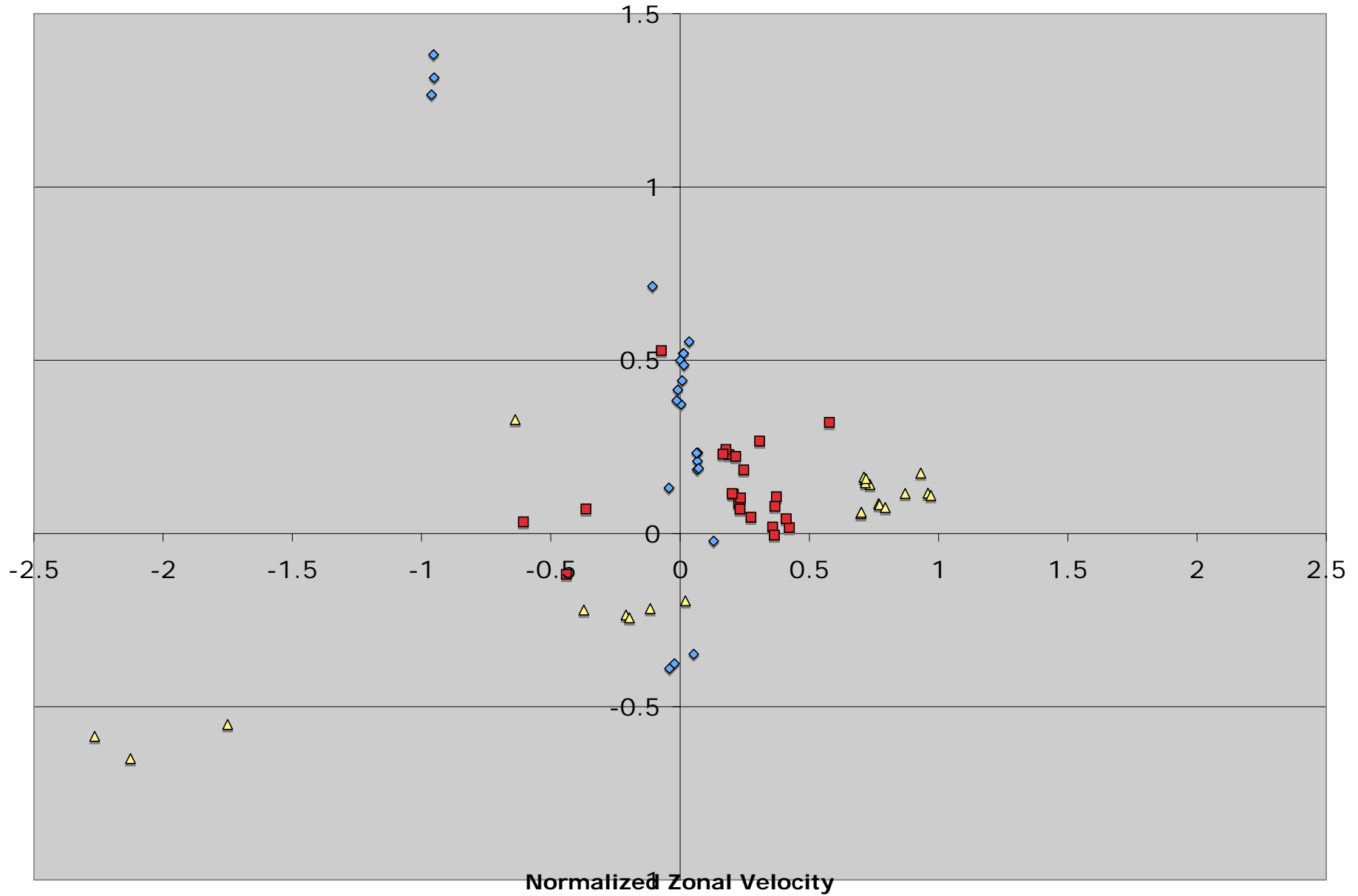
Interannual Variability Transports at 53N, 160W



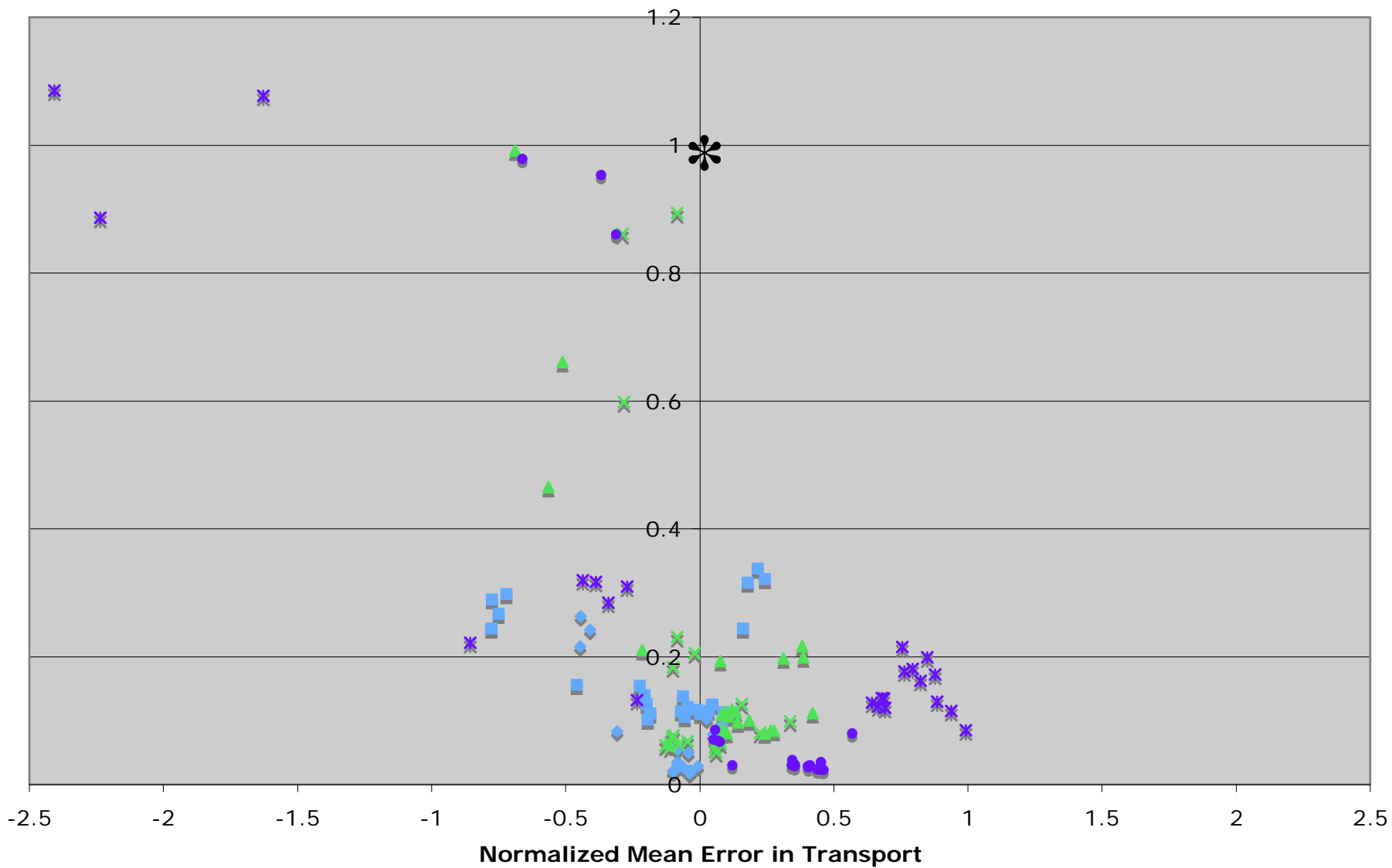
Errors in Upper 200 m Transports (Summer)



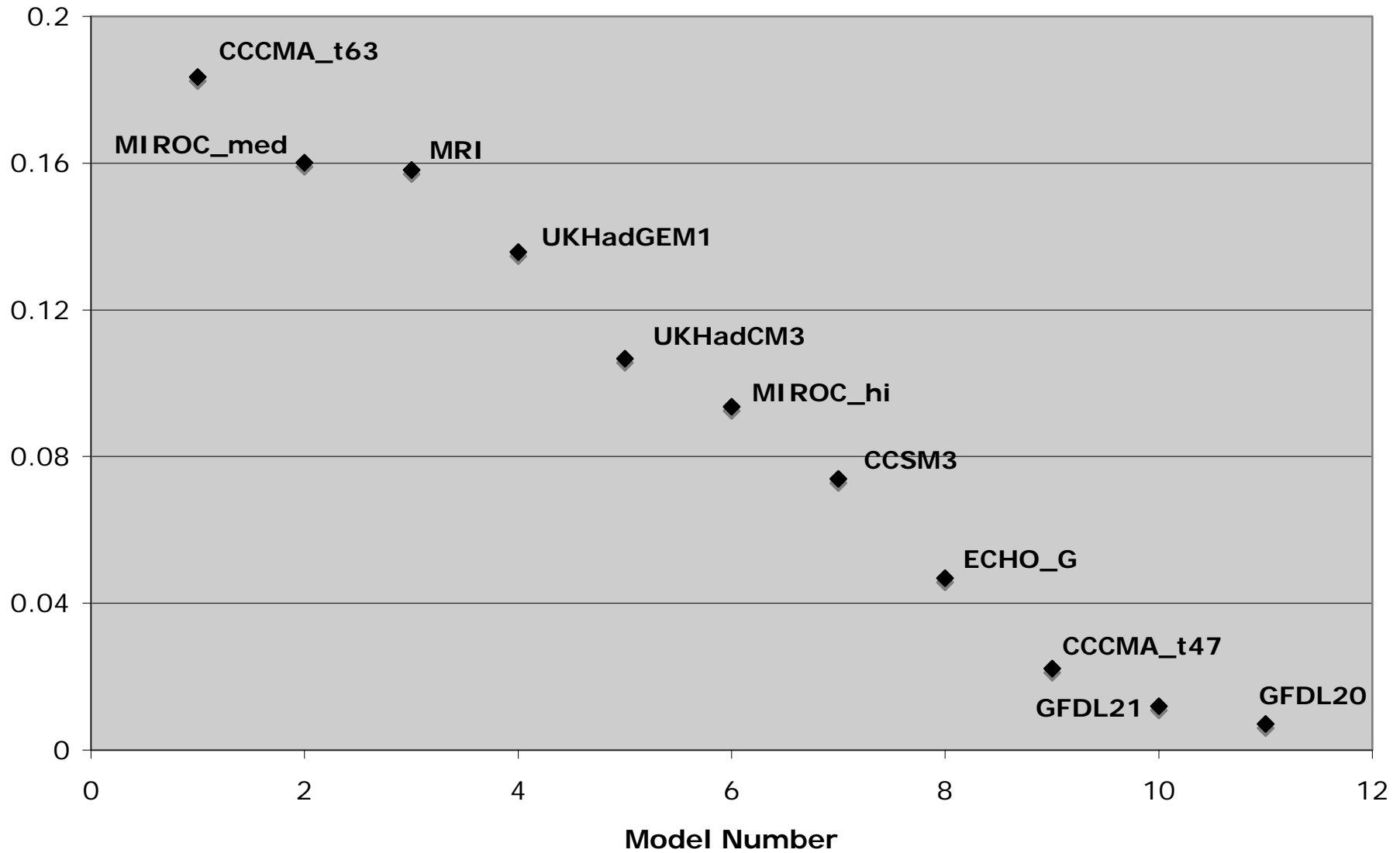
Errors in Upper 200 m Transports (Winter)



Normalized Errors vs. Relative Variability (Summer)



Model Weights - SE Bering SST



Mean Normalized Errors

Model	May Z	May Δ	Sep Z	Sep Δ	Win Tr	Sum Tr
cccm47	1.0	1.1	1.8	0.9	0.3	0.2
cccm63	0.9	1.0	2.1	0.9	0.3	0.3
ccsm3	1.4	1.8	1.2	2.0	0.3	0.3
echam5	0.4	0.5	1.1	0.9	0.2	0.3
mirocM	1.6	1.4	1.1	1.2	0.2	0.2
mirocH	1.5	1.5	1.9	1.9	----	----
miub	1.2	0.8	3.1	1.4	0.3	0.3
mri	0.5	0.6	0.7	0.7	0.3	0.2
pcm1	0.8	1.1	1.2	1.0	0.9	0.7
ukhadcm3	2.3	4.6	2.3	2.4	0.4	0.4

87 +/- 19 1.2 +/- 0.2 39 +/- 8 2.4 +/- 0.4 2.3 +/- 3.3 2.4 +/- 3.3
 (m) (kg/m³) (m) (kg/m³) (cm/s) (cm/s)

Summary

- Sub-surface properties in the NE Pacific from the 20th century hindcasts of coupled GCMs used by the IPCC have been evaluated.
- The mean errors in pycnocline depth and upper-level static stability vary substantially with model and location.
- The mean errors in upper ocean transports tend to be relatively small, but the models typically have too little interannual variability.
- The systematic errors in the IPCC models should be considered in making projections through both dynamical and empirical downscaling.