Agenda

Wednesday, 8 August

10:30 – 10:45	**Overview of Agenda and Review of Last Meeting's To Do List**	**Ivan**
10:45 – 12:15	**Final Wasatch Central Segment Parameters**	**Chris/Nico**
12:15 – 1:00	Lunch	
1:00 – 2:00	**Review Wasatch Fault Logic Tree**	**Patricia**
2:00 – 2:30	**Update on Consensus Wasatch Front Earthquake Catalog**	**Walter**
2:30 – 2:45	Break	
3:45 – 3:30	**Geodetic Modeling**	**Mark**
3:30 – 4:30	**Preliminary Results**	**Patricia**

Thursday, 9 August

8:00 – 8:30	Continental Breakfast	
8:30 – 10:00	**Preliminary Results (continued)**	**Patricia**
10:00 – 10:15	Break	
10:15 – 11:00	**Preliminary Results (continued)**	**Patricia**
11:00 – 11:30	**Review OGSL Logic Tree**	**Patricia/Susan**
11:30 – 12:30	**To Do List / Final Report / Schedule**	**Ivan**
12:30	**Adjourn**	

URS

Update on Consensus Wasatch Front Catalog

Walter Arabasz

(with thanks to Jim Pechmann
for various input)

University Of Utah
Seismograph Stations
The University of Utah

WGUEP
August 8, 2012

Tasks (1of 2)

A. Compile and evaluate available info on EQ size in the WGUEP/Utah region, both for pre-instrumental and instrumental data

B. Assess magnitude uncertainties and rounding errors

C. Derive relationships between M_W and other size measures, carefully using orthogonal regression, when appropriate, to avoid propagation of systematic errors into frequency-magnitude relations

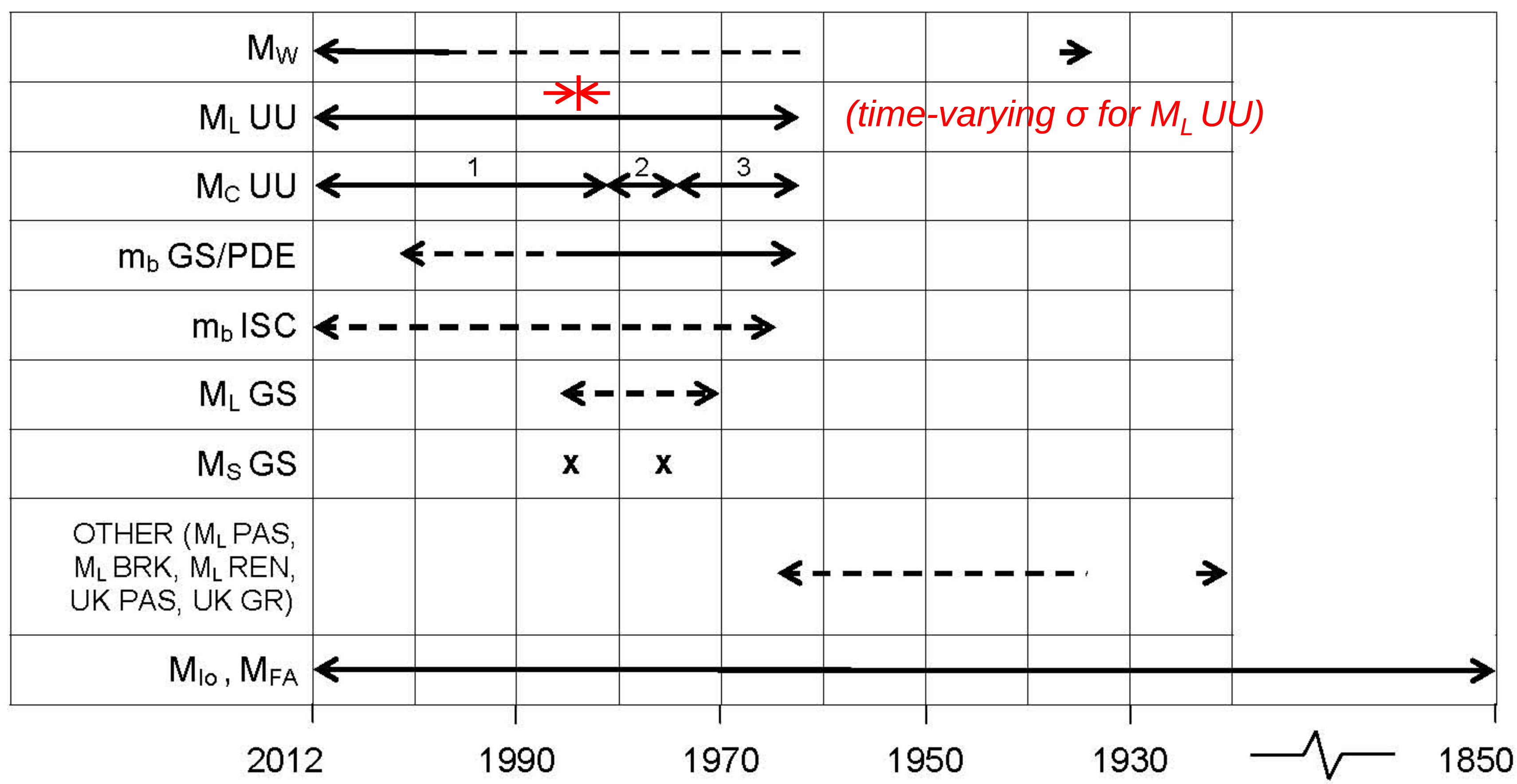
D. Calculate uniform magnitudes and tabulate uncertainties needed for rate corrections

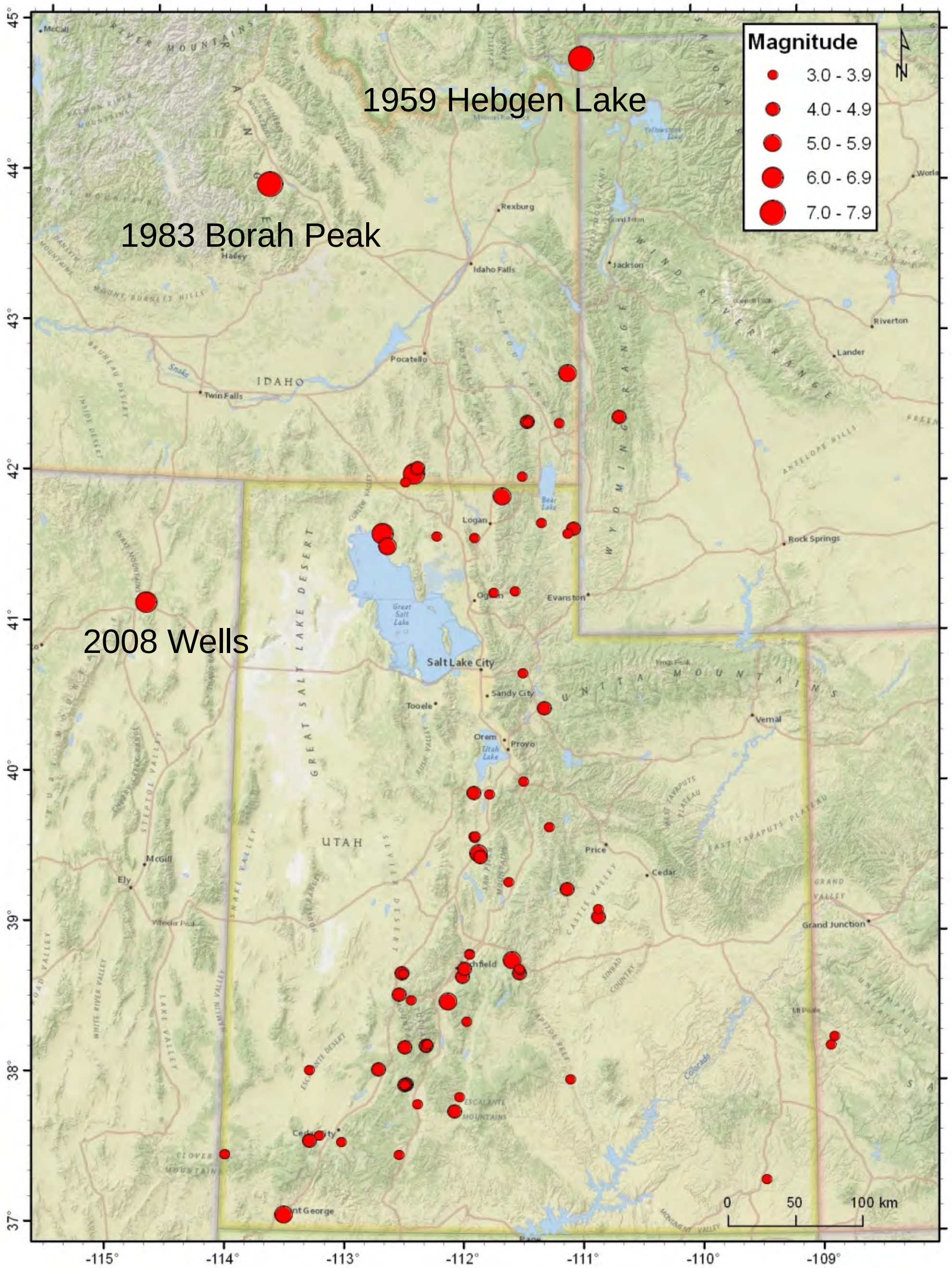
E. Compile catalog for the WGUEP study region (and surrounding buffer region for declustering), including merging of UUSS and key USGS catalogs

Tasks (2 of 2)

E. Remove duplicates and non-tectonic events
F. Substitute hypocenters from special studies
G. Assess completeness
H. Pass catalog to URS and USGS analysts for declustering and processing

Available info on EQ size for WGUEP catalog





Distribution of EQS in current WJA master file of instrumentally measured Mw's

Global CMT	7
Whidden and Pankow (2012)	43
Herrmann et al. (2011)/SLU MT catalog	7
Oregon State Univ. MT catalog	7
Pre-1989	
Doser (1989)	2
Patton and Zandt (1991)	8
Other (geometric mean of multiple M_0's)	3
TOTAL	**77**

$3.17 \leq Mw \leq 7.35$

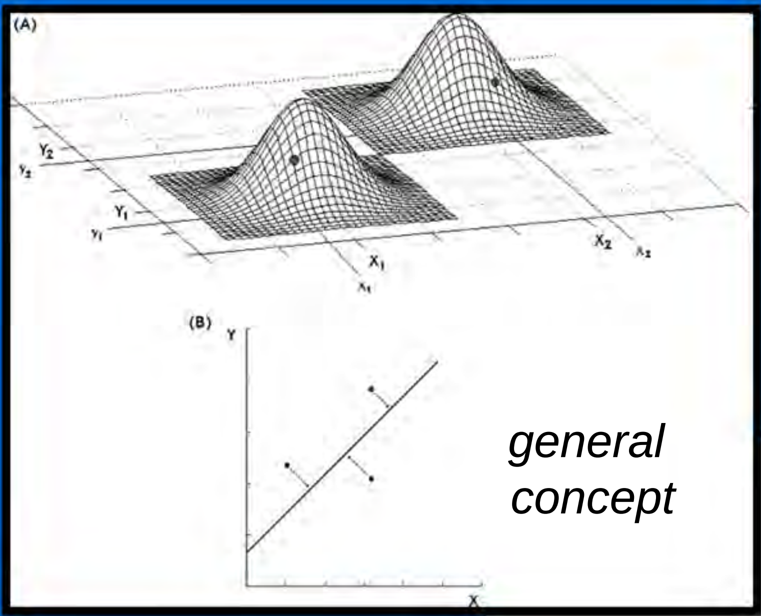
Regression in EQ magnitude conversions
(getting to uniform M_W)

Error variance ratio $\eta = \sigma_y^2 / \sigma_x^2$ between the dependent and independent variables is fundamentally important in regression methods applied to earthquake magnitude conversions (Castellaro et al., 2006: *Geophys. J. Int.* **165**, 913–930; Castellaro and Borman, 2007: *BSSA* **97**, 1167–1175; Lolli and Gasperini (2012: *Geophys. J. Int.* **190**, 1135–1151).

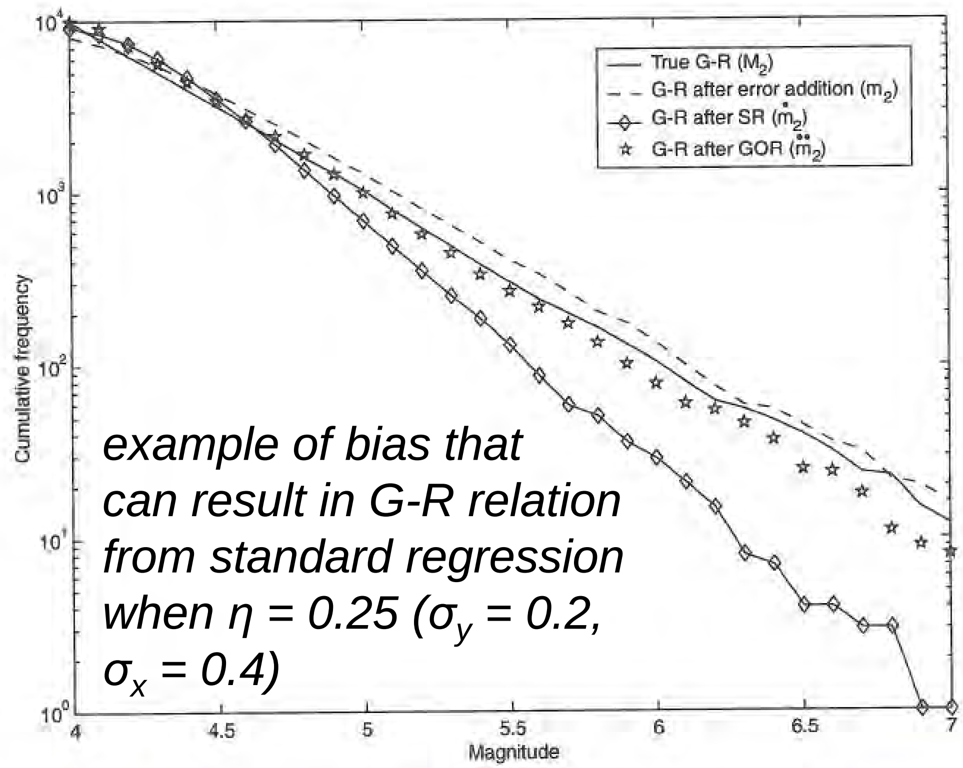
BOTTOM LINE:

- Unless uncertainty on x << uncertainty on y, ordinary least squares can lead to significant distortion of seismicity and seismic hazard estimates.
- "[General orthogonal regression] should always be used, rather than standard regression, in magnitude conversions, provided that at least an order of magnitude of η is available" (Castellaro et al., 2006)

Orthogonal Regression (from Castellaro et al., 2006)

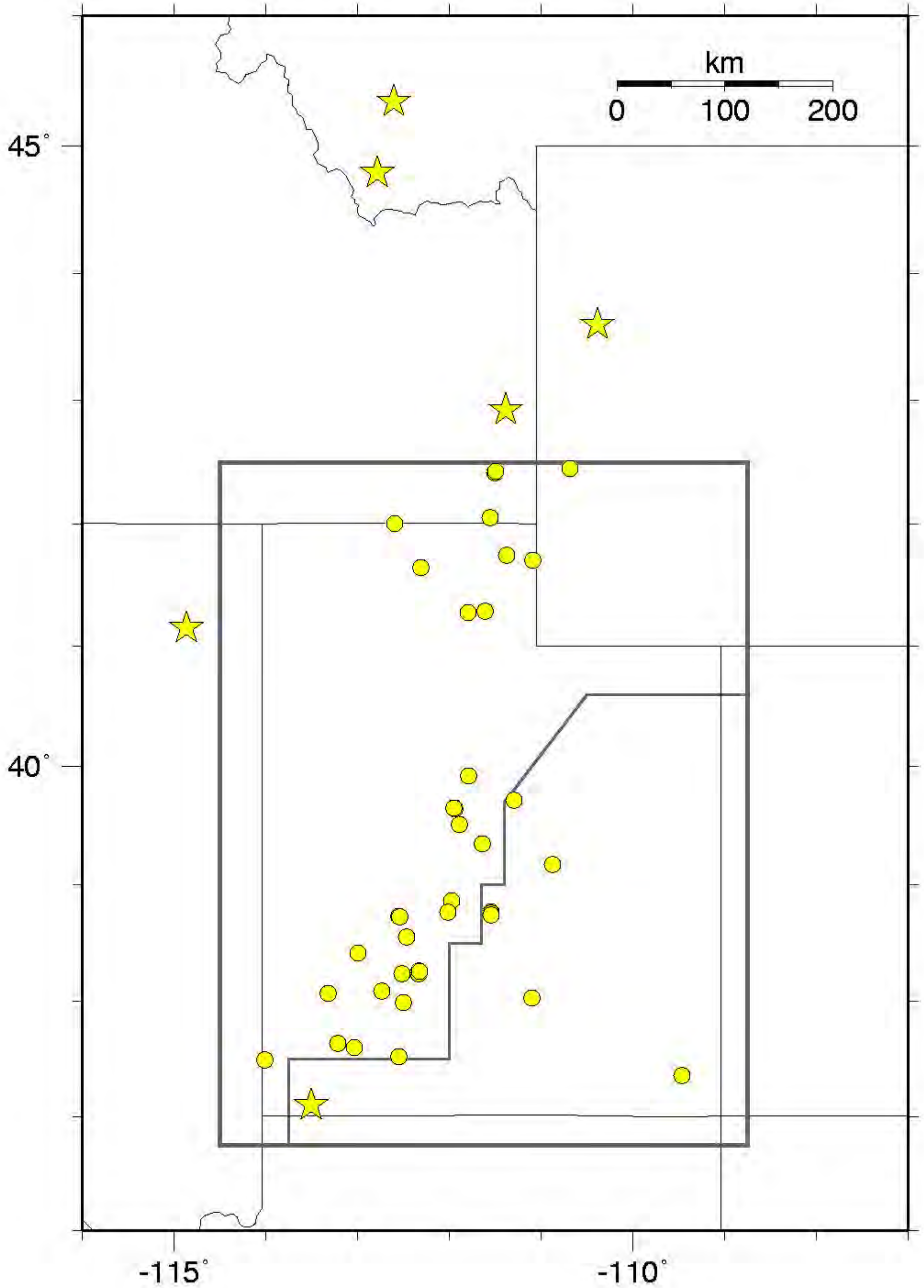


general concept



example of bias that can result in G-R relation from standard regression when $\eta = 0.25$ ($\sigma_y = 0.2$, $\sigma_x = 0.4$)

Figure 15. As in Fig. 13 but stars (⋆): G-R of $\ddot{m}_2$ data, estimated from m_1 through general orthogonal regression with $\eta = 0.25$ ($\sigma_{m2} = 0.2, \sigma_{m1} = 0.4$).



Pechmann and Whidden (2012)

Catalog of 54 M_w's (1998-2011)

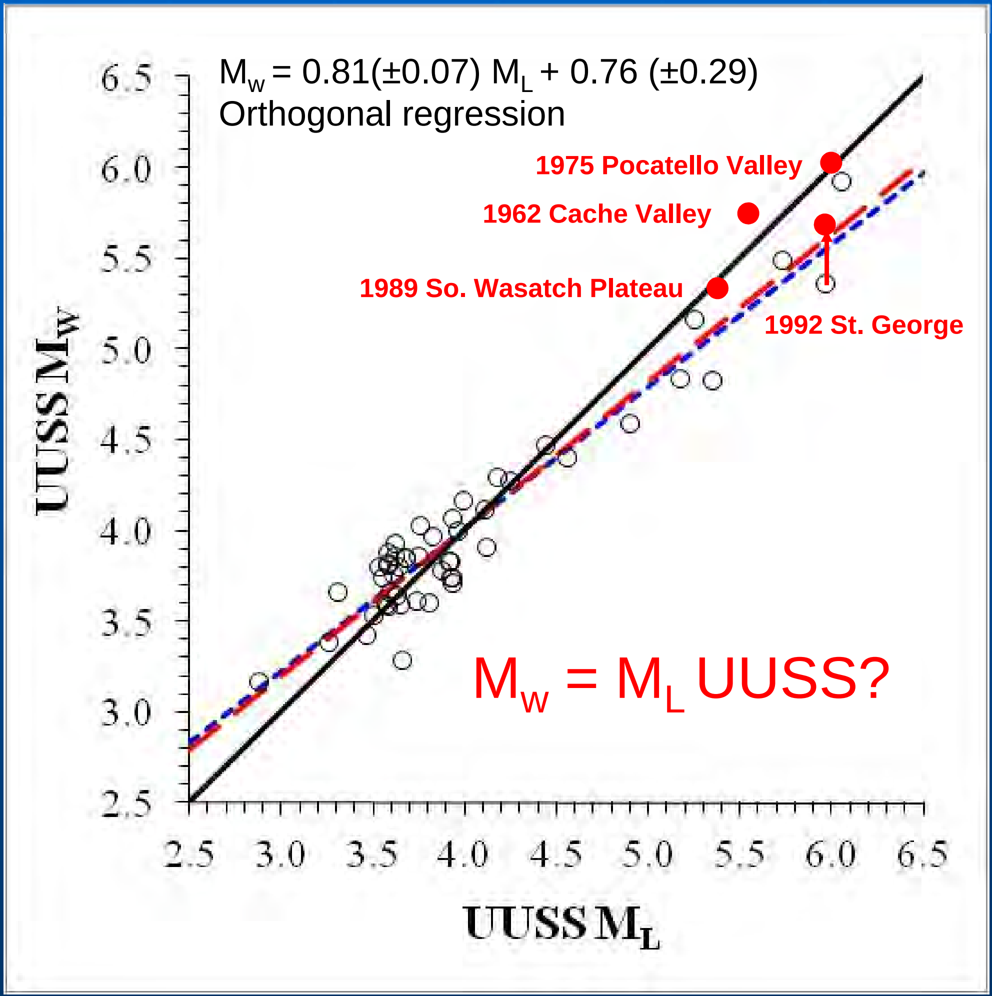
Naturally-Occurring Earthquakes with UUSS Moment Tensor Solutions

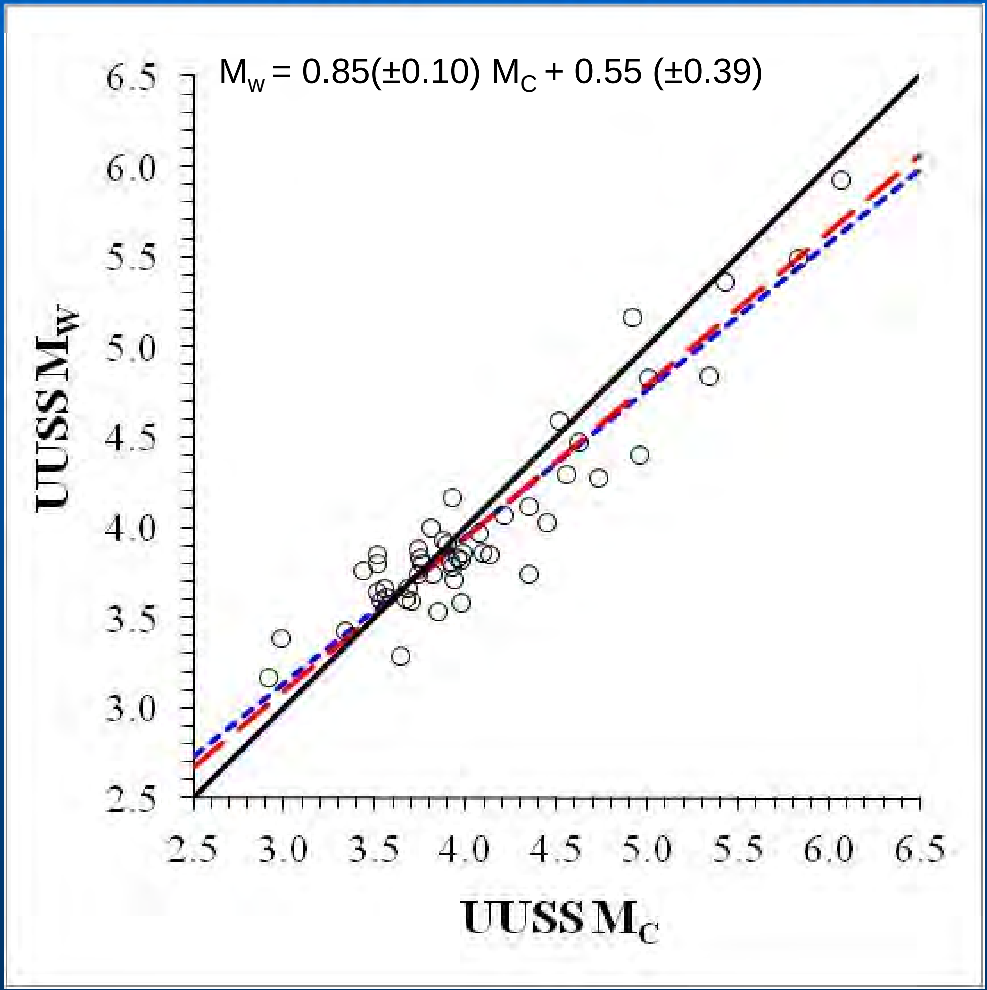
Circles: Whidden and Pankow (submitted to SRL), Utah Region, 1998-2011

Stars: M_L > 5 events added for this this study

Pechmann and Whidden (2012), continued

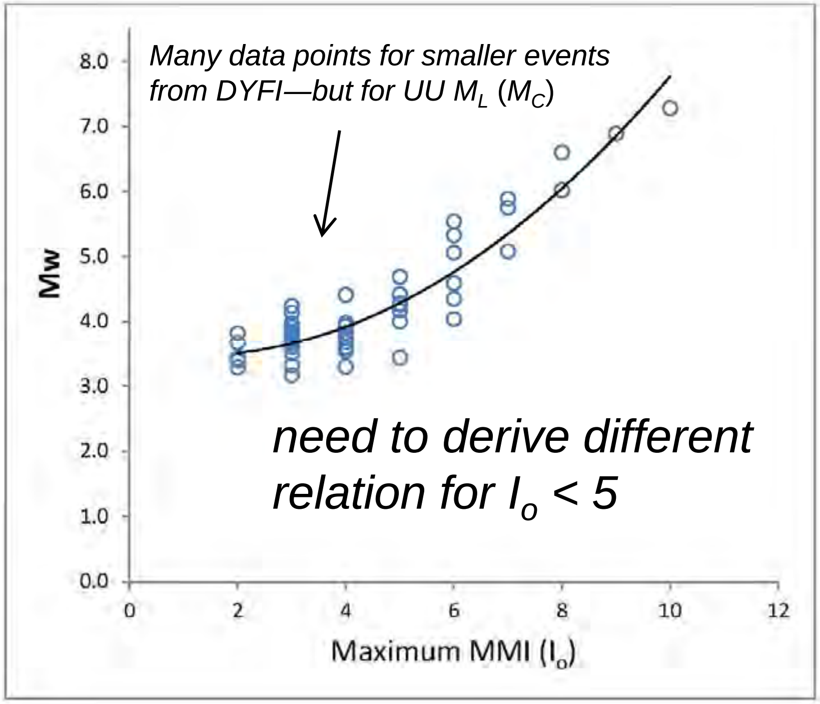
Correlations of UUSS M_L, M_C with M_w (STILL AN OPEN ISSUE BUT CRITICAL TO RESOLVE)

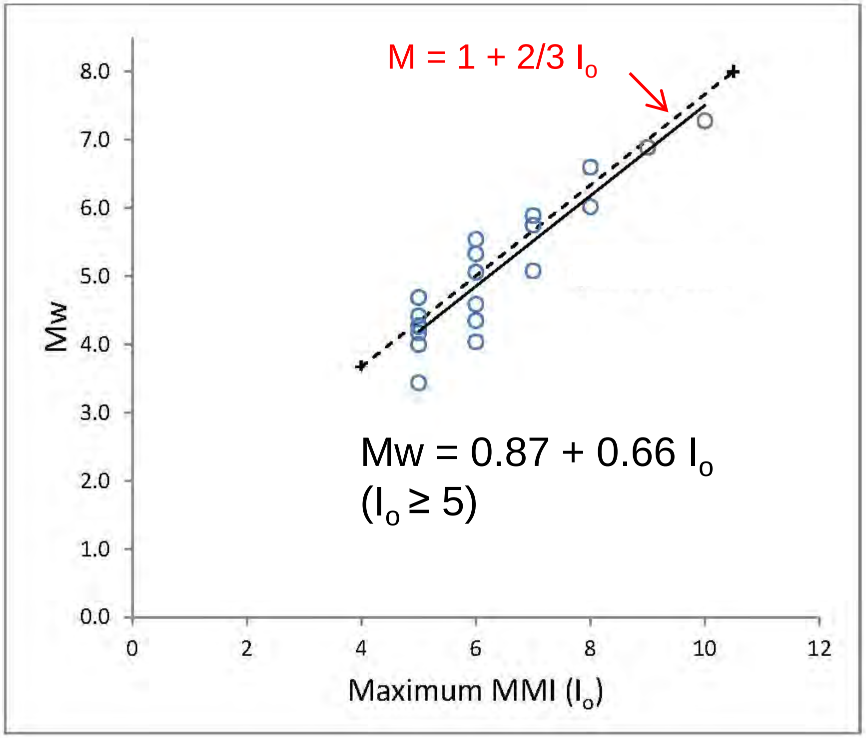




Mw vs Maximum MMI (I_o)

PRELIMINARY





ISOSEISMALS OF SOME HISTORICAL EARTHQUAKES AFFECTING THE WASATCH FRONT AREA, UTAH Q9 5

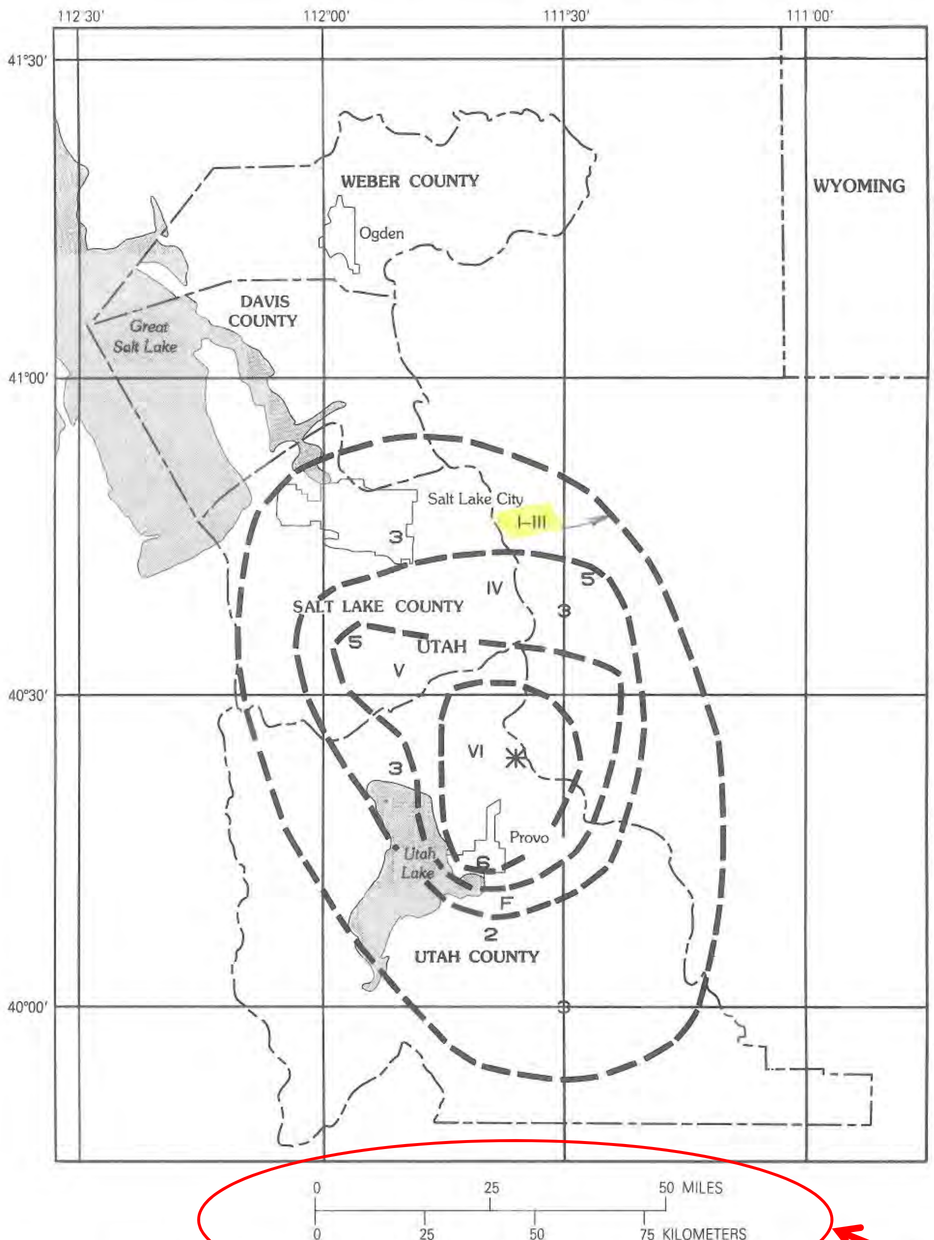


FIGURE 6.—Isoseismal map for the earthquake of July 15, 1915, Provo, Utah. The maximum Modified Mercalli Intensity (MMI_0) is VI. The star indicates the epicenter. Arabic numbers indicate site intensities (*MMI*), and roman numerals indicate isoseismal intensities. F indicates a report of "felt" that was not assigned a *MMI*. Isoseismals are dashed where uncertain.

1915-07-15_Provo.pdf

4, 5, 6, I–III

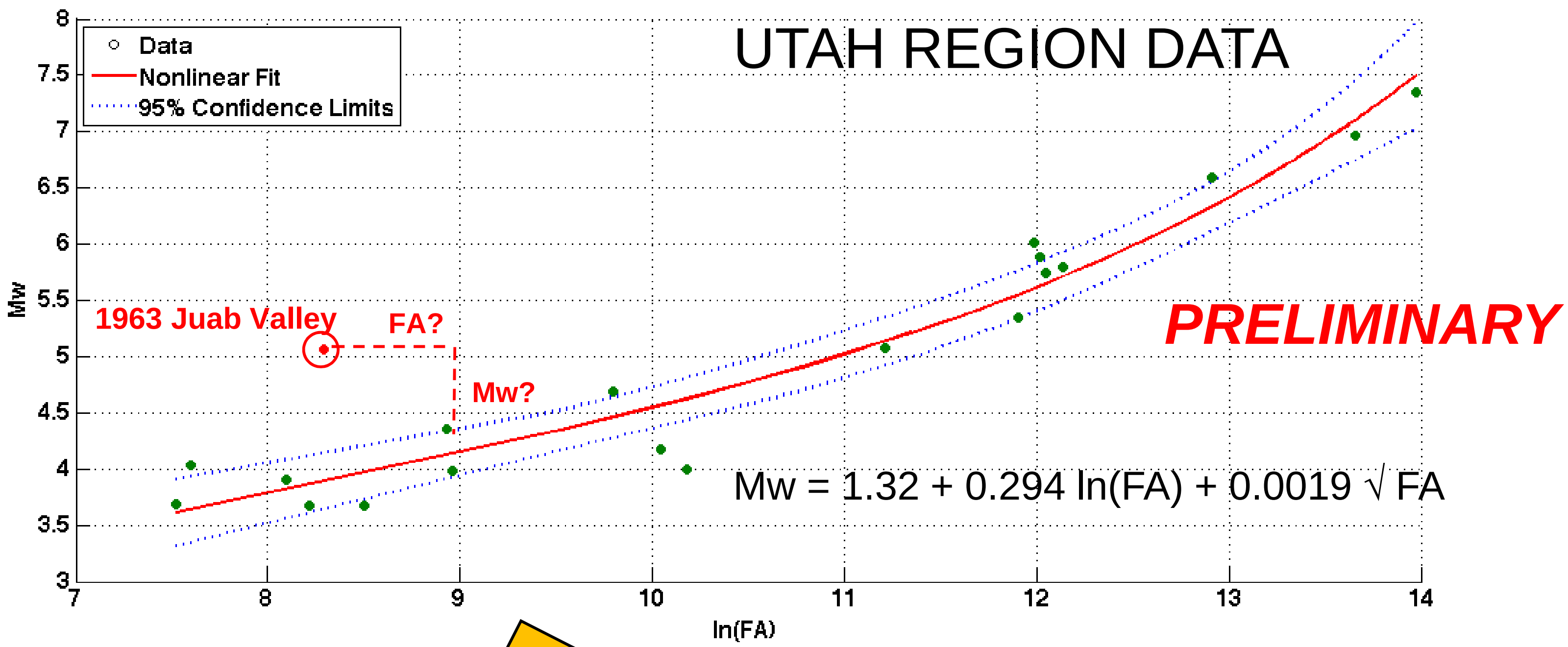
Example data for felt area (FA)

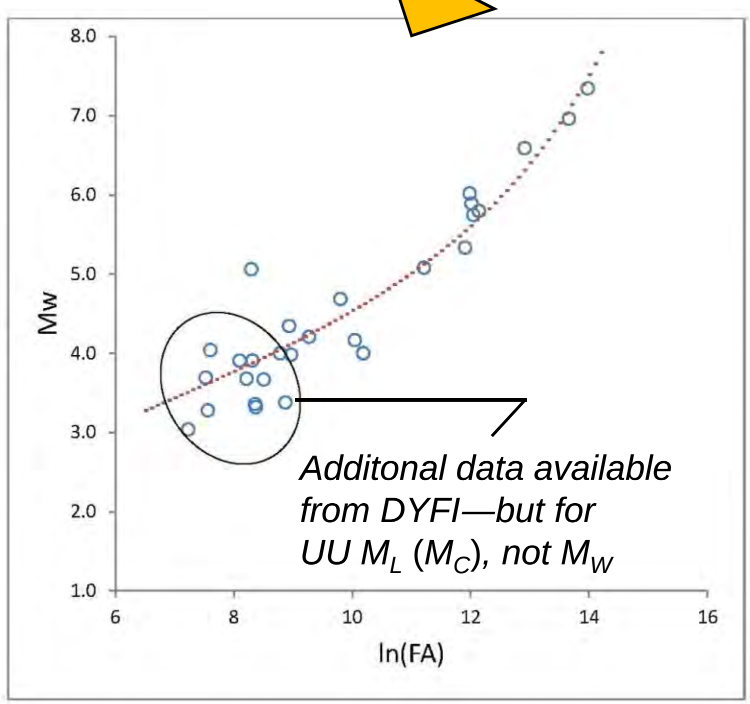
One of 13 isoseismal Maps for EQs in the Wasatch Front area, 1900-1983, published by Hopper (2000: USGS Prof. Paper 1500-Q)

Isoseismal contours were digitized and FA's measured using ArcGIS

If you ever use these maps, Note that scale is wrong!

Mw vs Felt Area (FA)





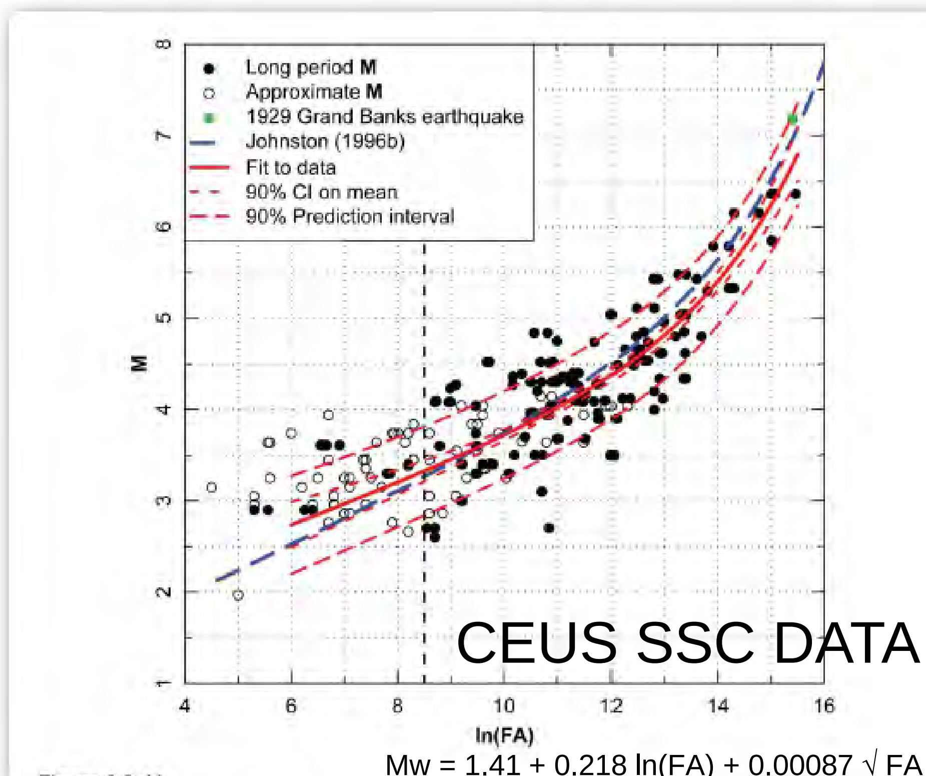
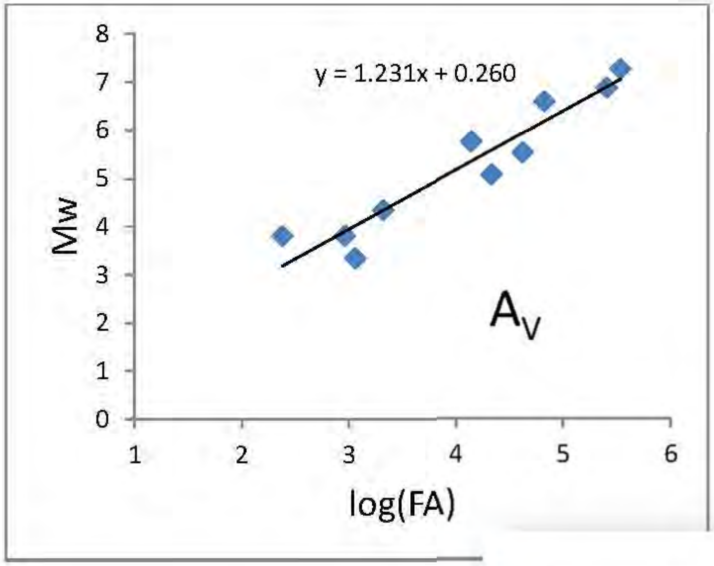
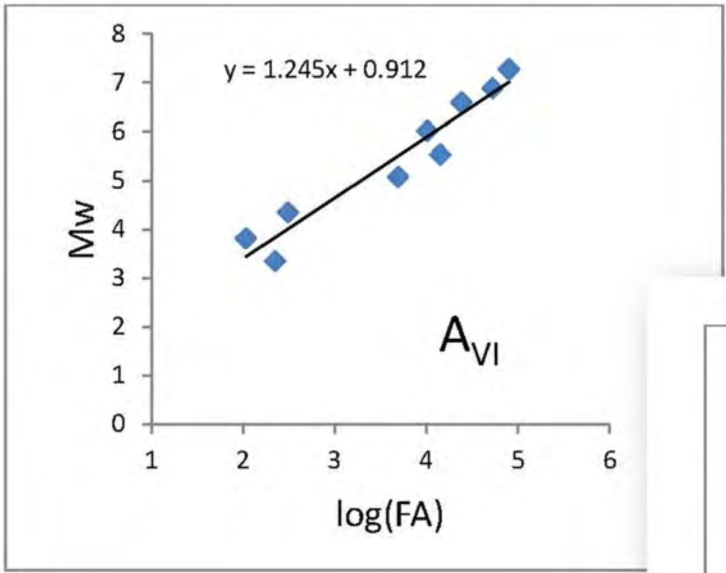


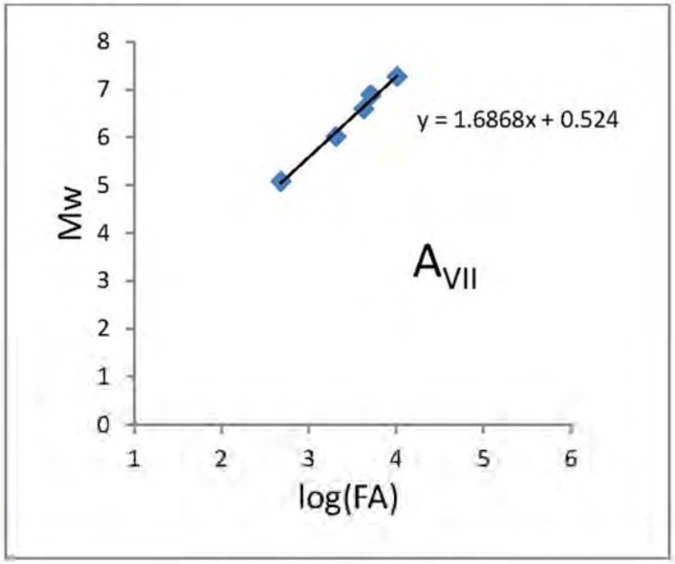
Figure 3.3-44
Catalog ln(FA)–M data and fitted model

Mw vs log(FA) for A_V, A_{VI} and A_{VII}

PRELIMINARY



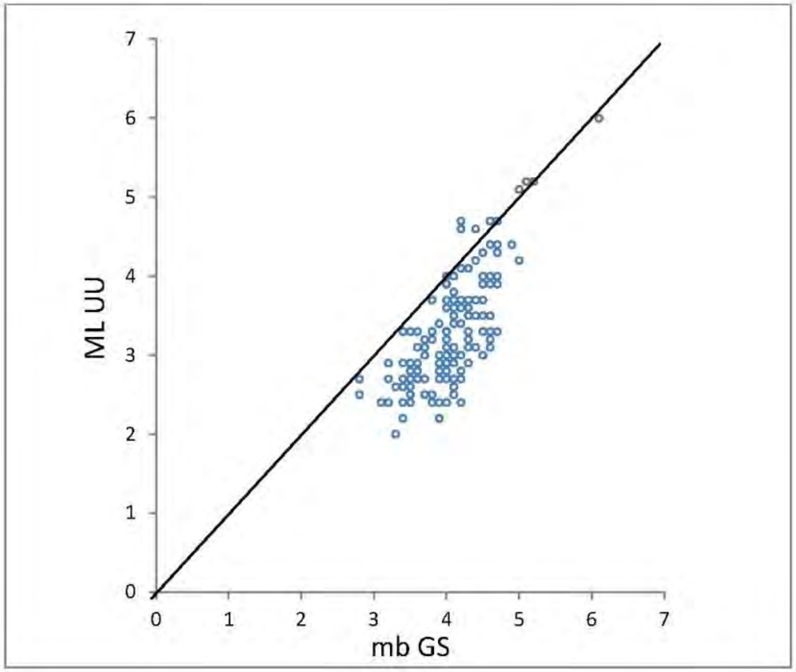


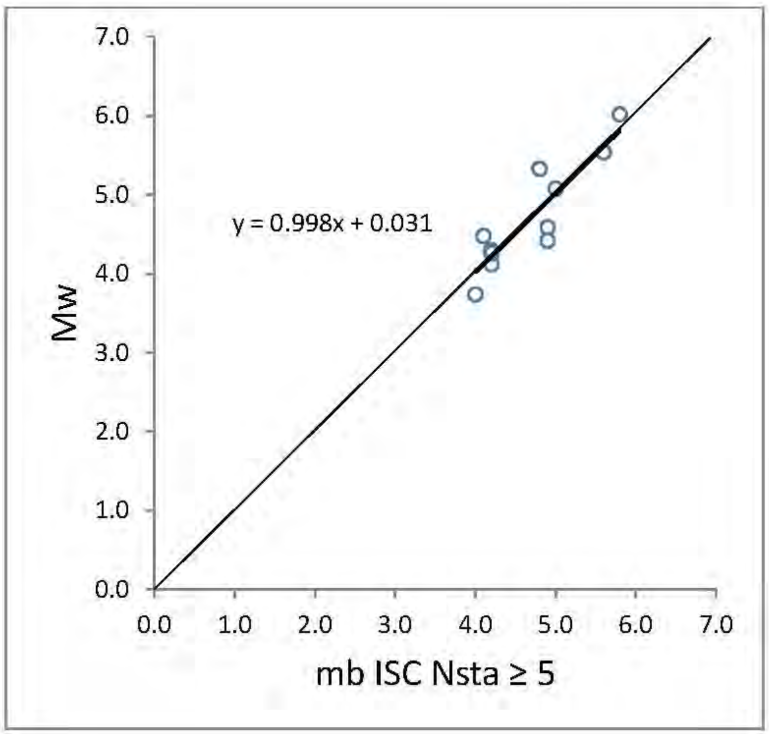


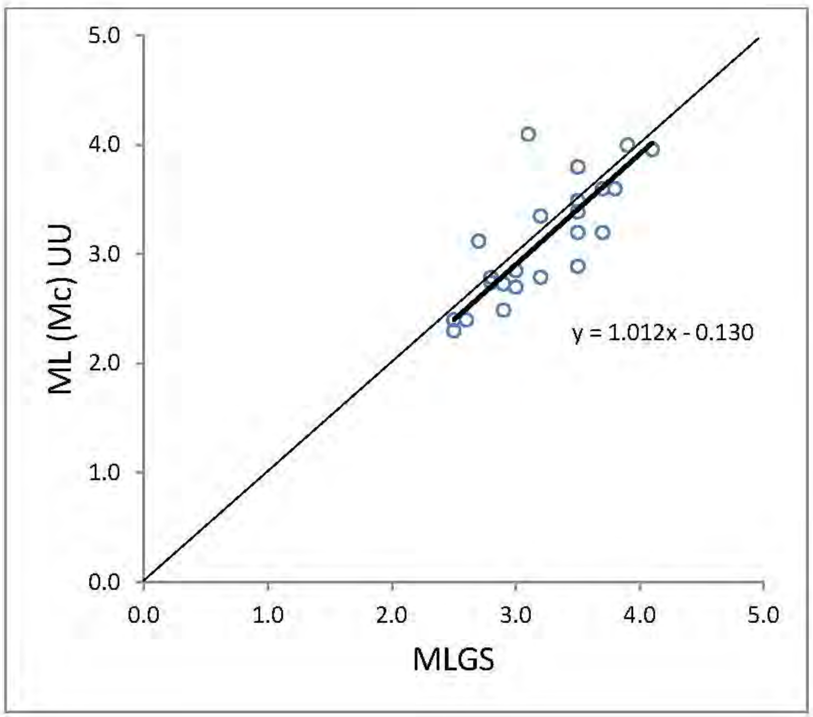
Data from 22 isoseismal maps, measurements using ArcGIS

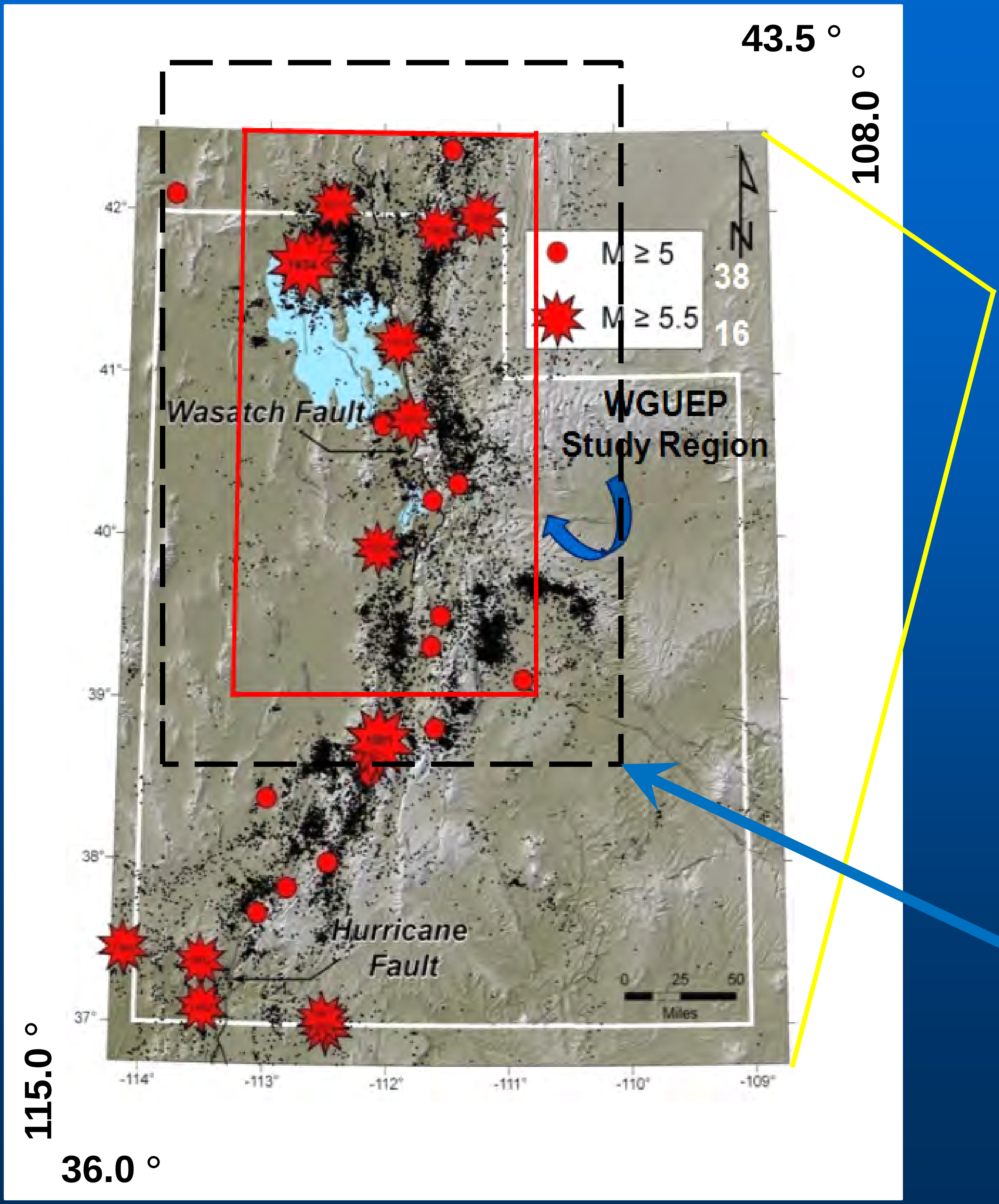
Example magnitude conversions

PRELIMINARY









Desired goal:
Unify UUSS and NSHM catalogs for entire Utah region

Immediate goal:
WGUEP + 0.5º buffer zone for declustering

WJA worksheet (in progress), 1850-1962.5

Largest mainshocks in the WGUEP region, 1850 through June 1962 (merged UUSS/USGS catalogs)
(MMI ≥ VI and/or M ≥ 4.5)

Year	Date	Hr:Min (UTC)	Lat. °N	Long. °W	Geographic Area	M_W	$E[M_W \|FA]$ PRELIM	UUSS Catalog		NSHM Catalog		Other
								MMI	M_L (M_{lo})	MMI	M	
1876	Mar. 22	--	39.527	-111.581	Moroni, Utah			6	(5.0)	6[1]	--	
1884	Nov.10	08:50	42.000	-111.267	Bear Lake, Utah		5.1-5.8	8	(6.3)	7[2]	6.30	
1894	July 18	22:50	41.224	-111.959	Ogden, Utah			6	5.0	6[2]	5.00	
1900	Aug. 1	07:45	39.952	-112.114	Eureka, Utah		< 4	7	(5.7)	7[2]	5.50	
1909	Oct. 6	02:41	41.767	-112.767	Hansel Valley Utah		4.8	8	(6.3)	7[2]	6.00	
1910	May 22	14:28	40.749	-111.849	Salt Lake City, Utah		4.5	7	(5.7)	7[2]	5.00	
1914	May 13	17:15	41.224	-111.959	Ogden, Utah		4.3	7	(5.7)	7[2]	5.50	
1915	July 15	22:00	40.239	-111.656	Provo, Utah		4.1	6	(5.0)	6[2]	5.00	
1934	Mar. 12	15:05	41.700	-112.800	Hansel Valley, Utah	**6.60**	6.33	9	6.6	8[2]	6.56	6.6 UKGR; 6.56 Mw D&S82
1943	Feb. 22	14:20	40.700	-112.080	Salt Lake Valley, Utah		4.2	6	(5.0)	6[2]	5.00	
1949	Mar. 7	06:50	40.749	-111.849	Salt Lake City, Utah			6	(5.0)	6[2]	5.00	
1958	Feb. 13	22:52	40.342	-111.440	Wallsburg, Utah		4.0	6	(5.0)	6[2]	5.00	
1961	Apr. 16	05:02	39.340	-111.660	Ephraim, Utah			6	(5.0)	6[2]	5.00	

[1] Stover and others (1986); [2] Stover and Coffman (1993); [3] USGS (PDE); [4] USGS (PDE, DYFI)

WJA worksheet (in progress), 1962.5-2011

Largest mainshocks in the WGUEP region, July 1962 through 2011 (merged UUSS/USGS catalogs)
(MMI ≥ VI and/or $M_L \geq 4.5$)

Year	Date	Hr:Min (UTC)	Lat. °N	Long. °W	Geographic Area	M_W	$E[M_W \mid X]$	UUSS Catalog		NSHM Catalog		Other
								MMI	M_L (M_C)	MMI	Mw	
1962	Aug. 30	13:35	42.035	-111.741	Logan, Utah	**5.75**		--	5.6 rev.	7[2]	5.83	5.86 Mw D&S82
1962	Sep. 5	16:04	40.715	-112.089	Magna, Utah			--	5.0 rev.	6[2]	5.00	5.03 Mw D&S82; 5.1 mbGS
1963	July 7	19:20	39.533	-111.909	Juab Valley, Utah	**5.06**		--	4.4	6[2]	5.03	4.99 Mw D&S82; 4.9 mbGS
1964	Oct. 18	18:33	41.726	-111.730	Logan, Utah			--	4.1	3[1]	5.02	5.05 Mw D&S82; 4.3 mbGS
1966	Mar. 17	11:47	41.661	-111.561	Logan, Utah			--	4.5 rev.	5[2]	5.21	5.24 Mw D&S82; 4.4 mbGS
1972	Oct. 1	19:42	40.506	-111.349	Heber, Utah	**4.35**		--	4.3	6[2]	4.32	4.92 Mw D&S82; 4.7 mbGS
1973	Apr. 14	06:45	42.043	-112.631	Pocatello Valley, Idaho			--	4.2	5[5]	4.95	4.98 Mw D&S82; 4.4 mbGS
1975	Mar. 28	02:31	42.063	-112.525	Pocatello Valley, Idaho	**6.02**		--	6.0	8[2]	5.99	6.2 MLPAS; 5.8 mb ISC; 6.1 mbGS; 6.15 Mw D&S82
1976	Nov. 5	02:48	41.810	-112.698				--	4.0	5[1]	4.00	4.48 Mw D&S82
1978	Mar. 9	06:30	40.764	-112.088				--	3.2	6[2]	--	
1978	Nov. 30	06:53	42.101	-112.491	Pocatello Valley, Idaho	**4.69**		--	4.6	5[3]	4.70	
1980	May 24	10:03	39.937	-111.960	Goshen Valley, Utah	**4.42**		--	4.4	5[1]	5.00	4.9 mb ISC; 5.0 mbGS
1981	Feb. 20	09:13	40.322	-111.737				--	(3.84)	6[2]	3.90	4.7 mbGS
1983	Oct. 8	11:57	40.748	-111.993				--	(3.85)	6[2]	4.30	4.5 MLGS
1987	Sep. 25	04:27	41.218	-113.177	Lakeside, Utah			--	4.71	5[2]	4.99	4.6 mb ISC
1988	Aug. 14	20:03	39.133	-110.890	San Rafael Swell, Utah			--	5.17	6[2]	5.30	5.4 mb ISC
1988	Nov. 19	19:42	41.994	-111.477				--	(4.32)	6[2]	4.80	4.7 mb ISC
1989	July 3	22:44	41.706	-112.375	Tremonton, Utah			--	~~(4.14)~~ 4.70	5[2]	4.80	
~~1989~~	~~July 5~~	~~22:51~~	~~41.707~~	~~-112.384~~	~~Tremonton, Utah~~			--	~~4.50~~	4[2]	~~4.60~~	
2010	Apr. 15	23:59	41.703	-111.094	Randolph, Utah	**4.59**		--	4.90	6[4]	4.60	

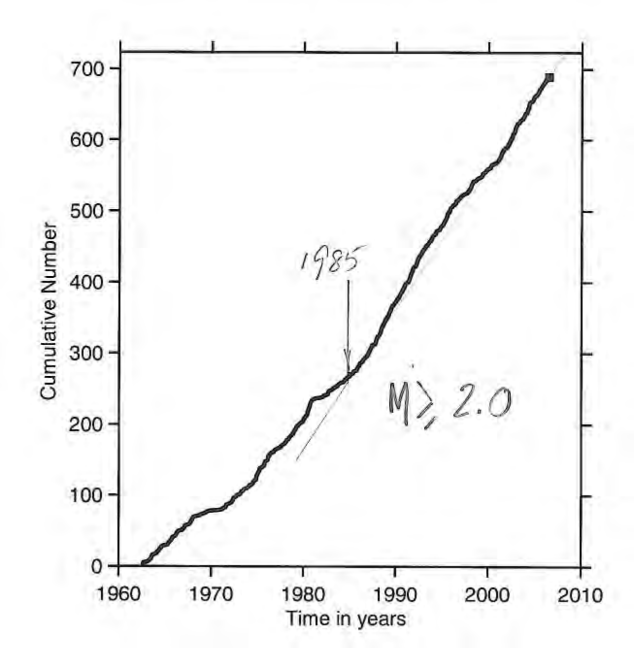
[1] Stover and others (1986); [2] Stover and Coffman (1993); [3] USGS (PDE); [4] USGS (PDE, DYFI); [5] USGS ("SRA" catalog)

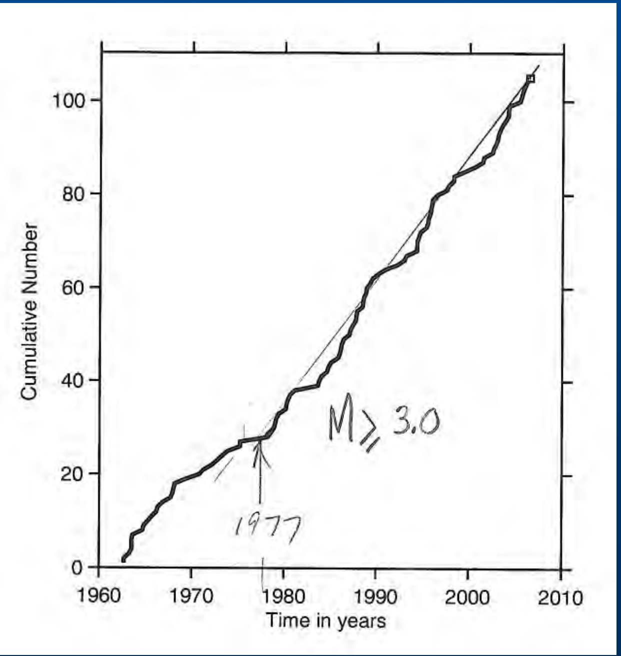
Planned Approach to Completeness

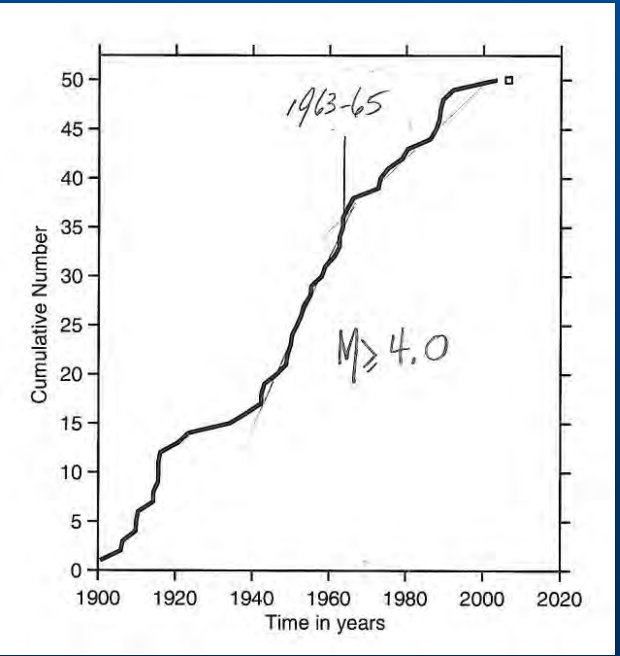
PRELIMINARY

BINNING (tentative)		
	Magnitude range	Completeness period (initial estimate)
	$2.0 \leq M < 2.5$	Jan 1985 – Dec 2011
	$2.5 \leq M < 3.0$	Jan 1981– Dec 2011
	$3.0 \leq M < 3.5$	Jan 1977 – Dec 2011
	$3.5 \leq M < 4.0$	Jan 1968 – Dec 2011
	$4.0 \leq M < 4.7$	Jan 1963 – Dec 2011
	$4.7 \leq M < 5.3$	Jan 1940 – Dec 2011
	$5.3 \leq M < 6.0$	Jan 1880 – Dec 2011
	$6.0 \leq M < 6.7$	Jan 1880 – Dec 2011

Need to analyze final declustered catalog as a check







Conclusion

- Complexity of task far greater than bargained for
- Methodology well in hand
- Important part of the end game is a unified UUSS/ NSHM catalog for the Utah region
- Working on expedited processing for WGUEP purposes