

ALASKA
EARTHQUAKE
CENTER

Recent Significant Earthquakes in Alaska and Lessons Learned

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ALASKA
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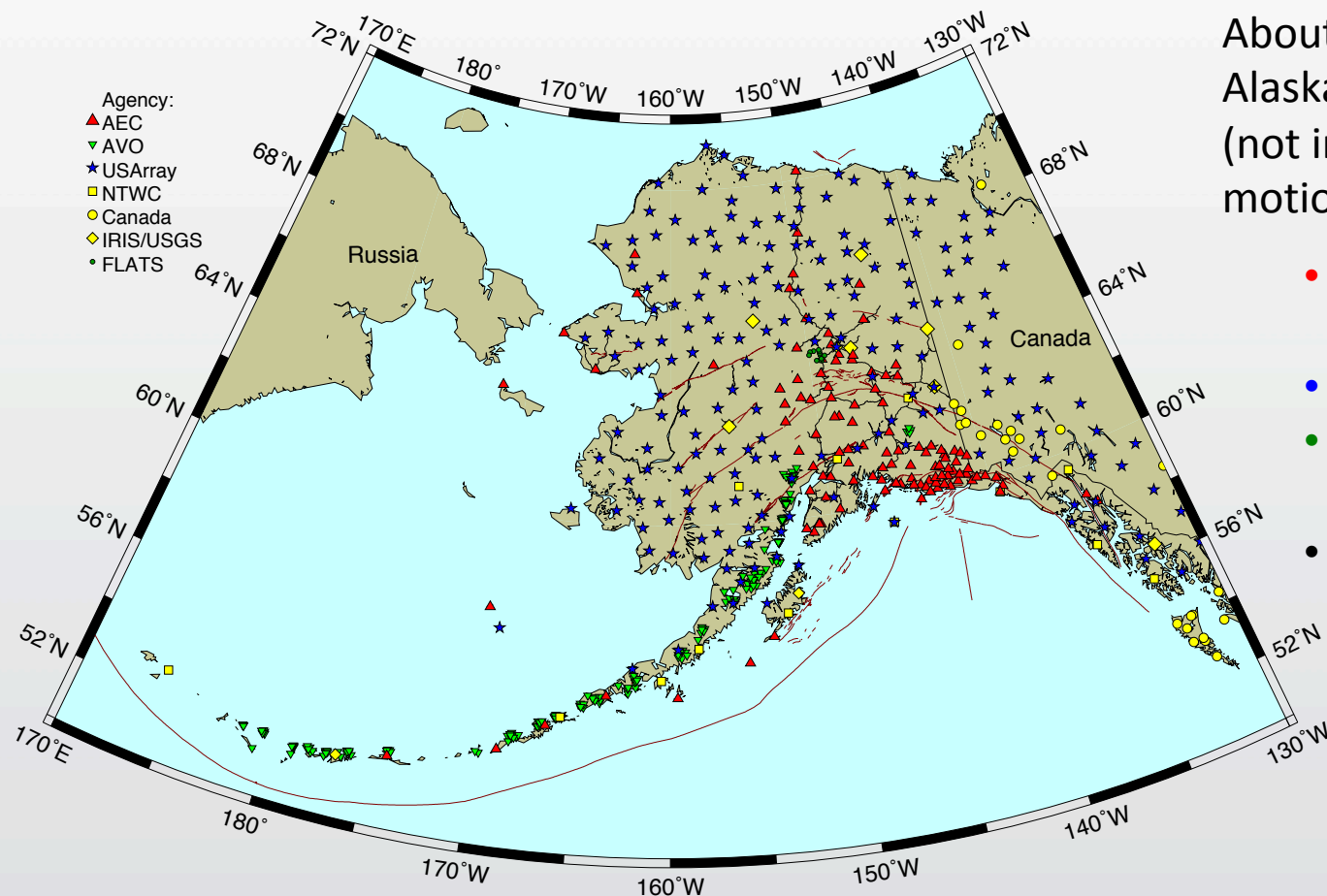
Earthquake Center mission and historical perspective

- Regional seismic network established in Alaska in late 60s-early 70s, in the wake of the 1964 M9.2 Great Alaska earthquake.
- AEC formally established in 1987 to:
 - Assess seismic hazards for Alaska;
 - Monitor earthquake activity by collecting and analyzing seismic data;
 - Provide information and assistance to State and local agencies, public and research community in planning to reduce risks to lives and property.
- We have multiple state, federal and private industry partners.

Earthquake Center - Current state

- We are members of ANSS – Advanced National Seismic System. One of our key responsibilities is real time earthquake reporting for Alaska region.
- We collect, analyze and archive data from about 600 seismic sites in the State, and also from our neighbors Canada and Russia and Global Seismic Network.
- In recent years we have been reporting over 40,000 local and regional earthquakes.
- We are responsible for maintenance of 150 seismic sites.
- We provide seismic monitoring of the Trans-Alaska Oil Pipeline, and hydro-electric dams.
- We participate in the Tsunami Hazard program by producing tsunami inundation maps for coastal communities in the State.
- We have staff of about 15 (we'll be hiring 4 new positions within next few months).

Regional seismic network (2018)



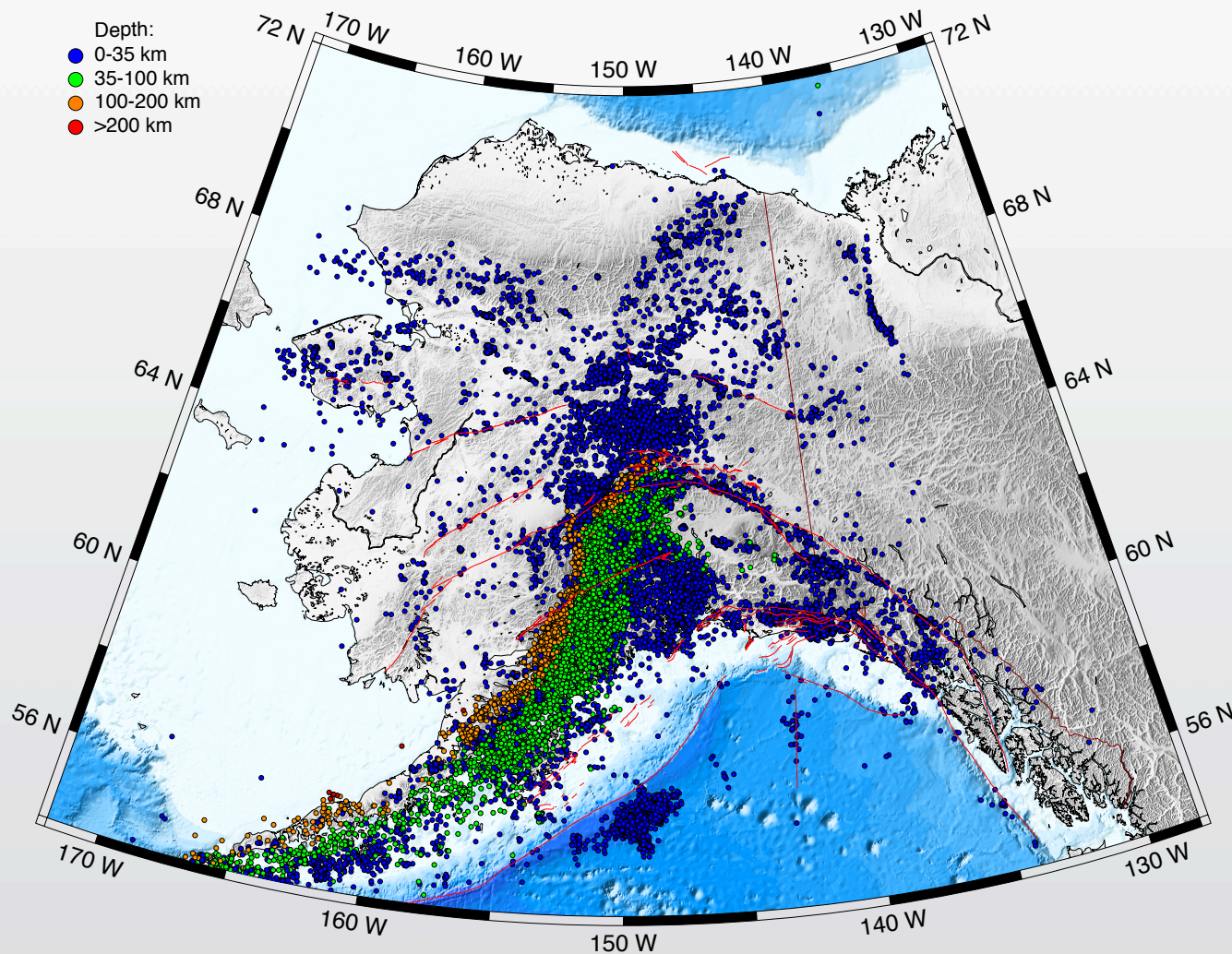
About 585 sites total in Alaska and western Canada (not including urban strong motion networks)

- Alaska Earthquake Center (AK)
- USArray (TA)
- Alaska Volcano Observatory (AV)
- Other: GSN, US, AT, CN, FLATS

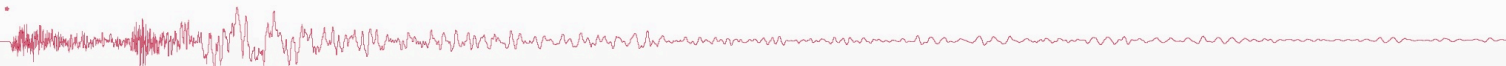
Network Summary

- AEC operates 150 seismic monitoring sites:
 - About 70 sites have co-located broadband and strong motion sensors
 - 32 sites are strong motion only, including Fairbanks and Anchorage urban networks
 - 1 structural array (Engineering building on UAF campus)
 - 1 short period site (last remaining in the network)
- 100% digital telemetry (radio, cell, satellite, microwave network, internet)
- Digitizers: Kinometrics Q330, Q330S, Basalt, Etna2
- Sensors:
 - Kinometrics STS2, STA5a, Episensor
 - Nanometrics T120, T240, Titan
 - Guralp (very few) GMT5T, CMG5Tc, 3EST, 3T
- Acquisition, processing and archival is via Antelope software (BRTT, Inc.)

Recent Seismicity

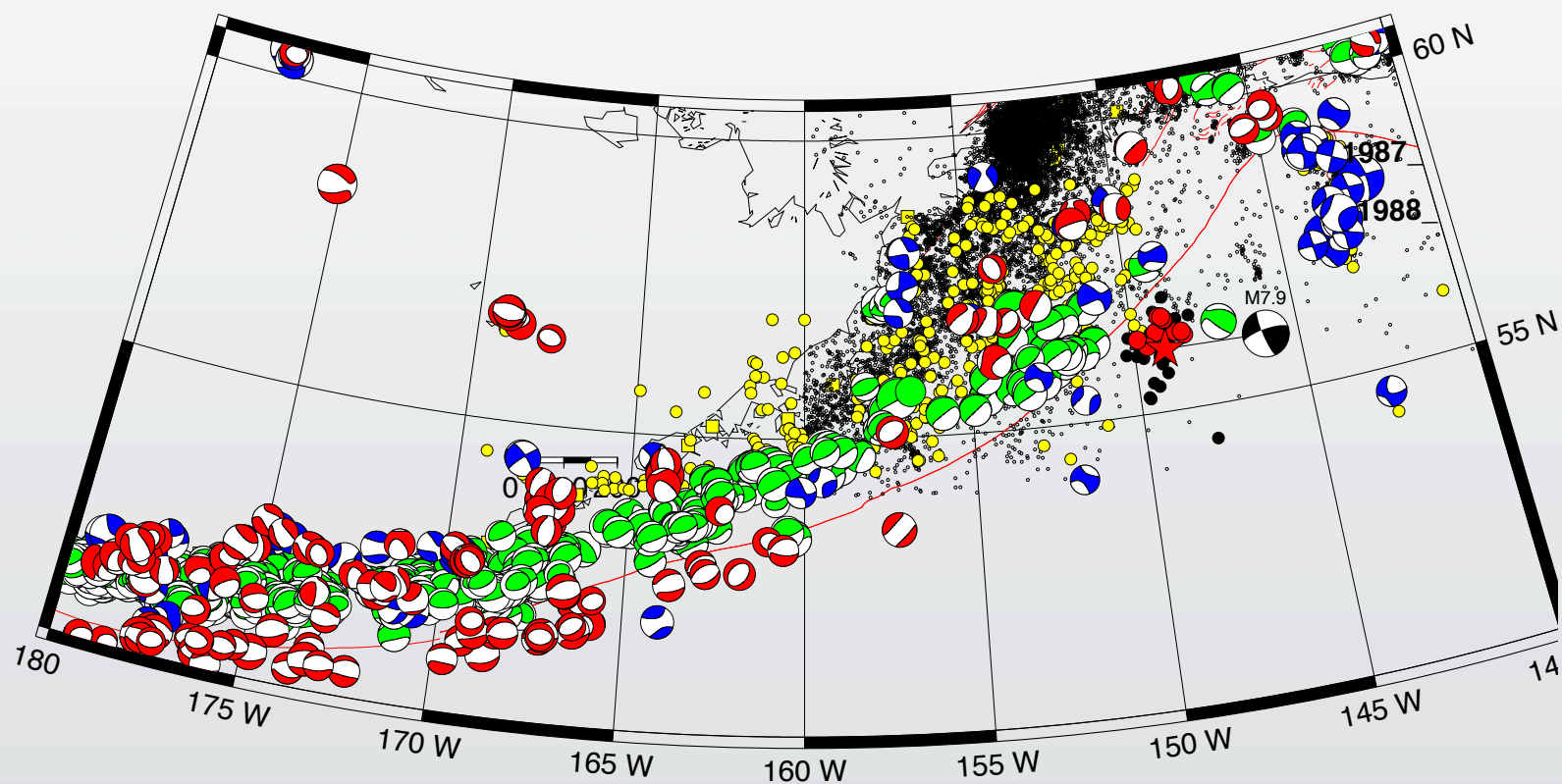


Significant Earthquakes – 10 years

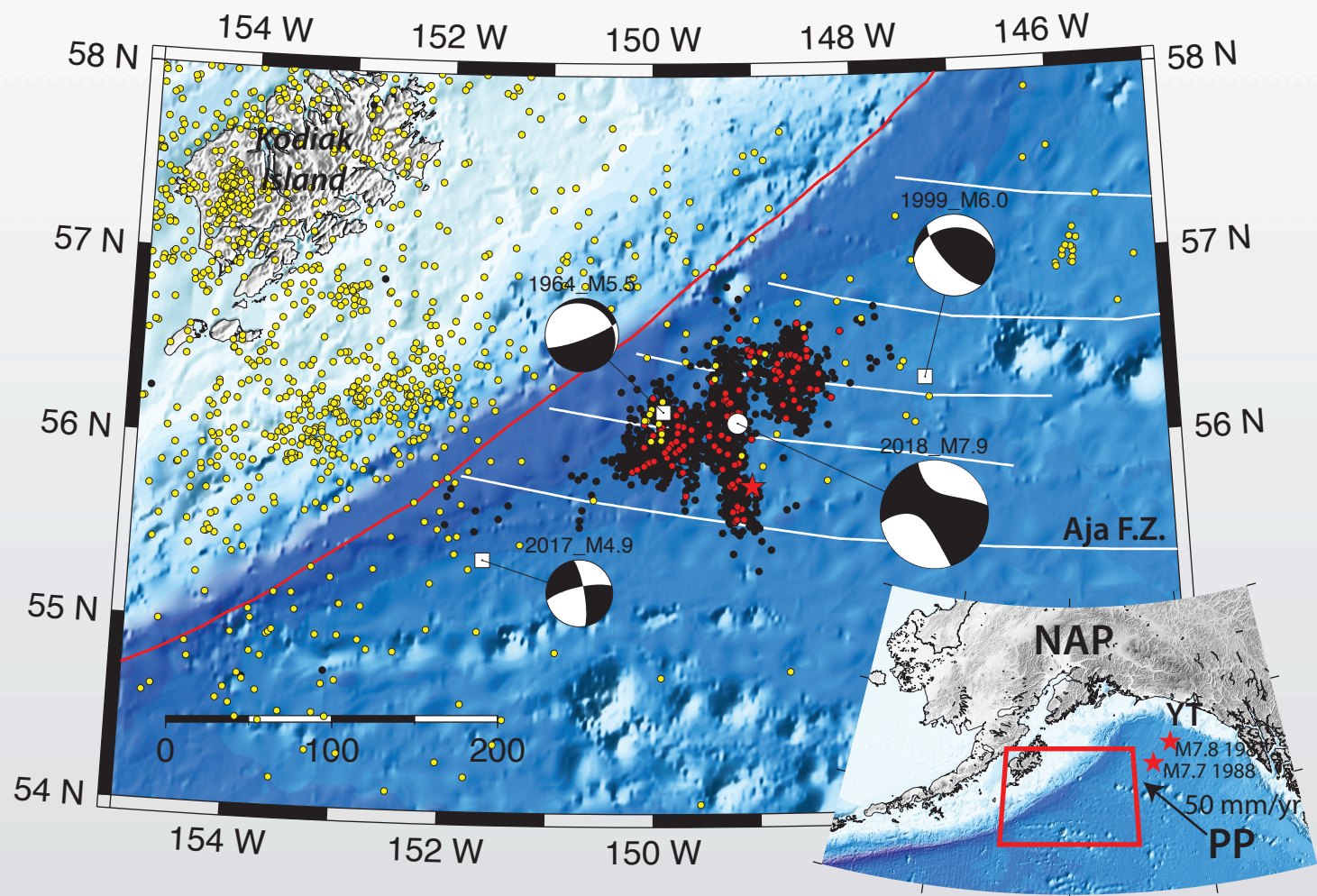


Date	Magnitude	Region	Mechanism	Significant Ops impact
6/24/2011	7.3	Fox Islands	Intraplate, slab	N
1/5/2013	7.5	Southeast Alaska	Interplate, strike-slip	Y
8/30/2013	7.0	Andreanof Islands	Interplate, megathrust	N
6/23/2014	7.9	Rat Islands	Instraplate, slab	Y
1/24/2016	7.1	Southern Alaska	Intraplate, slab	Y
7/17/2017	7.8	Komandorskiye Ostrova	Interplate, strike-slip	N
1/23/2018	7.9	Offshore Kodiak Island	Outer rise, strike-slip	Y
8/12/2018	6.4	Northeast Brooks Range	Intraplate, strike-slip crustal	Y

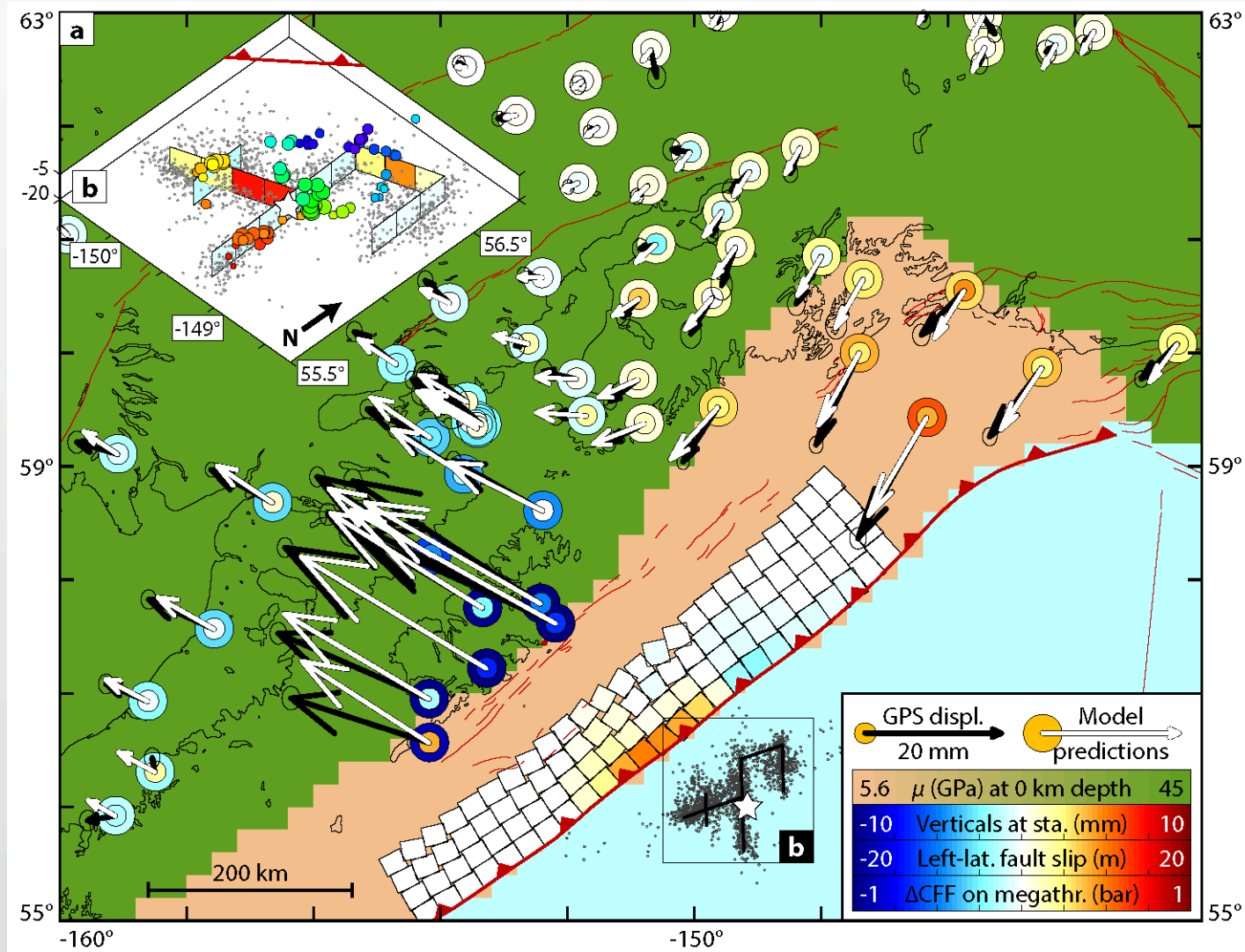
2018 M7.9 Offshore Kodiak Earthquake



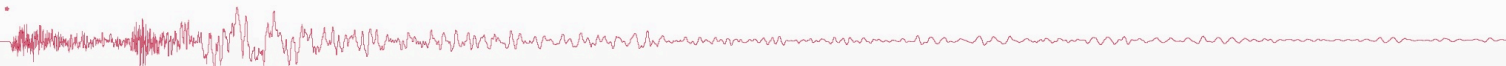
2018 M7.9 Offshore Kodiak Earthquake



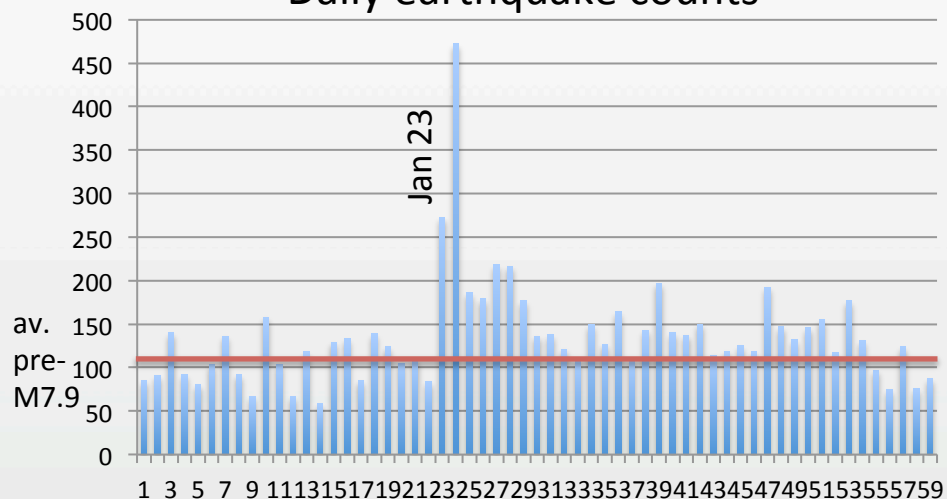
2018 M7.9 Offshore Kodiak Earthquake



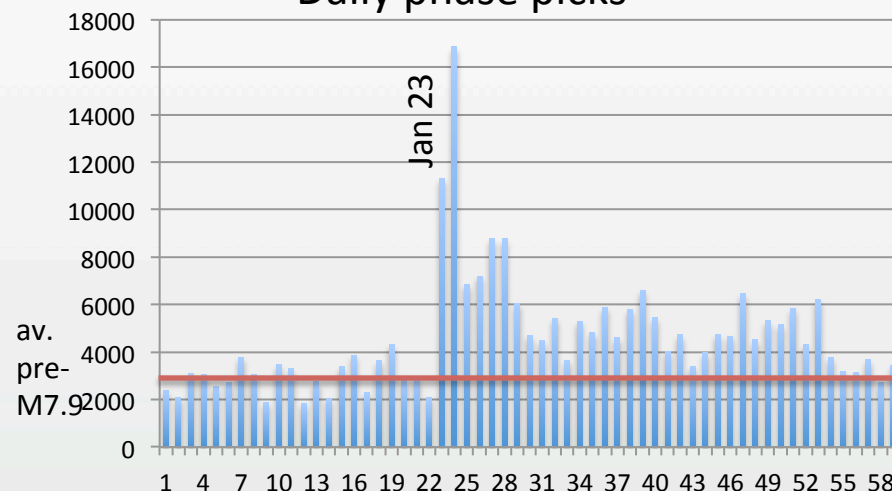
2018 M7.9 Offshore Kodiak Earthquake



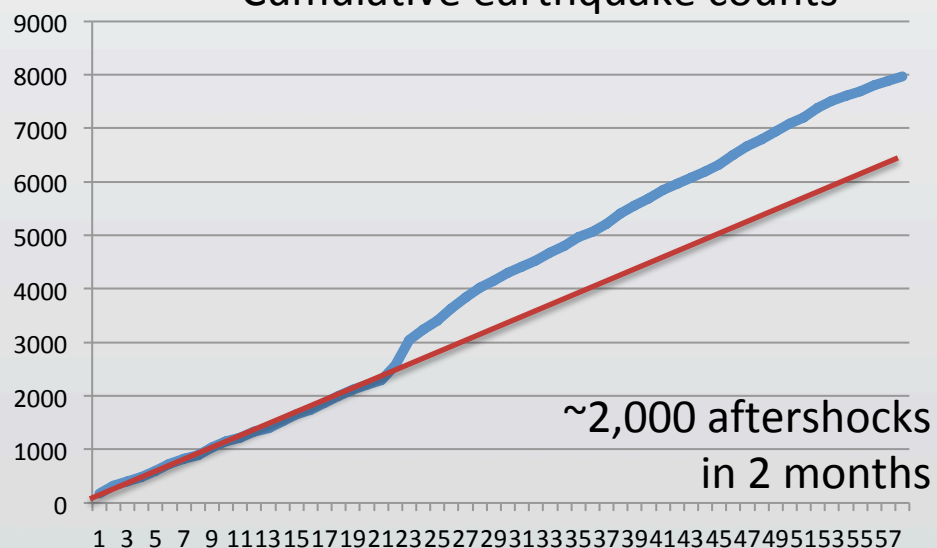
Daily earthquake counts



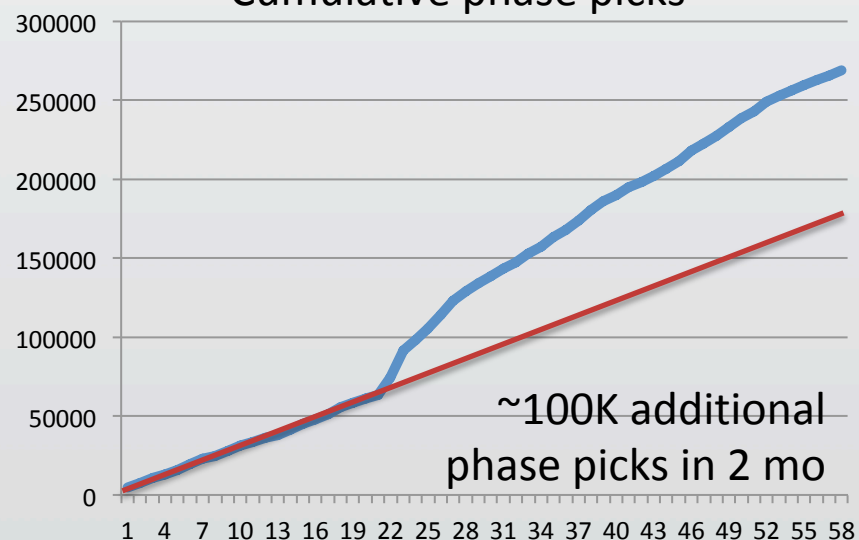
Daily phase picks



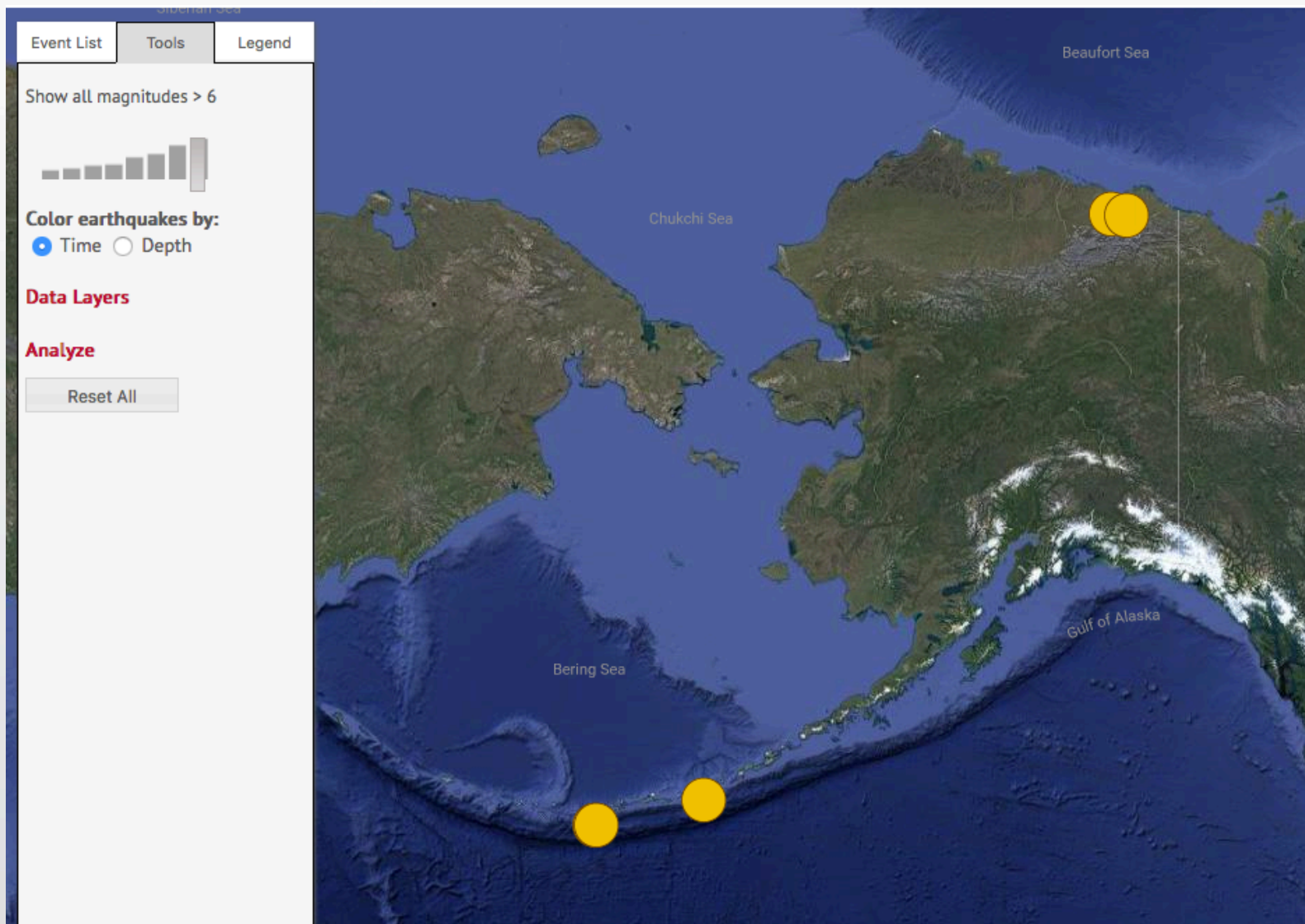
Cumulative earthquake counts

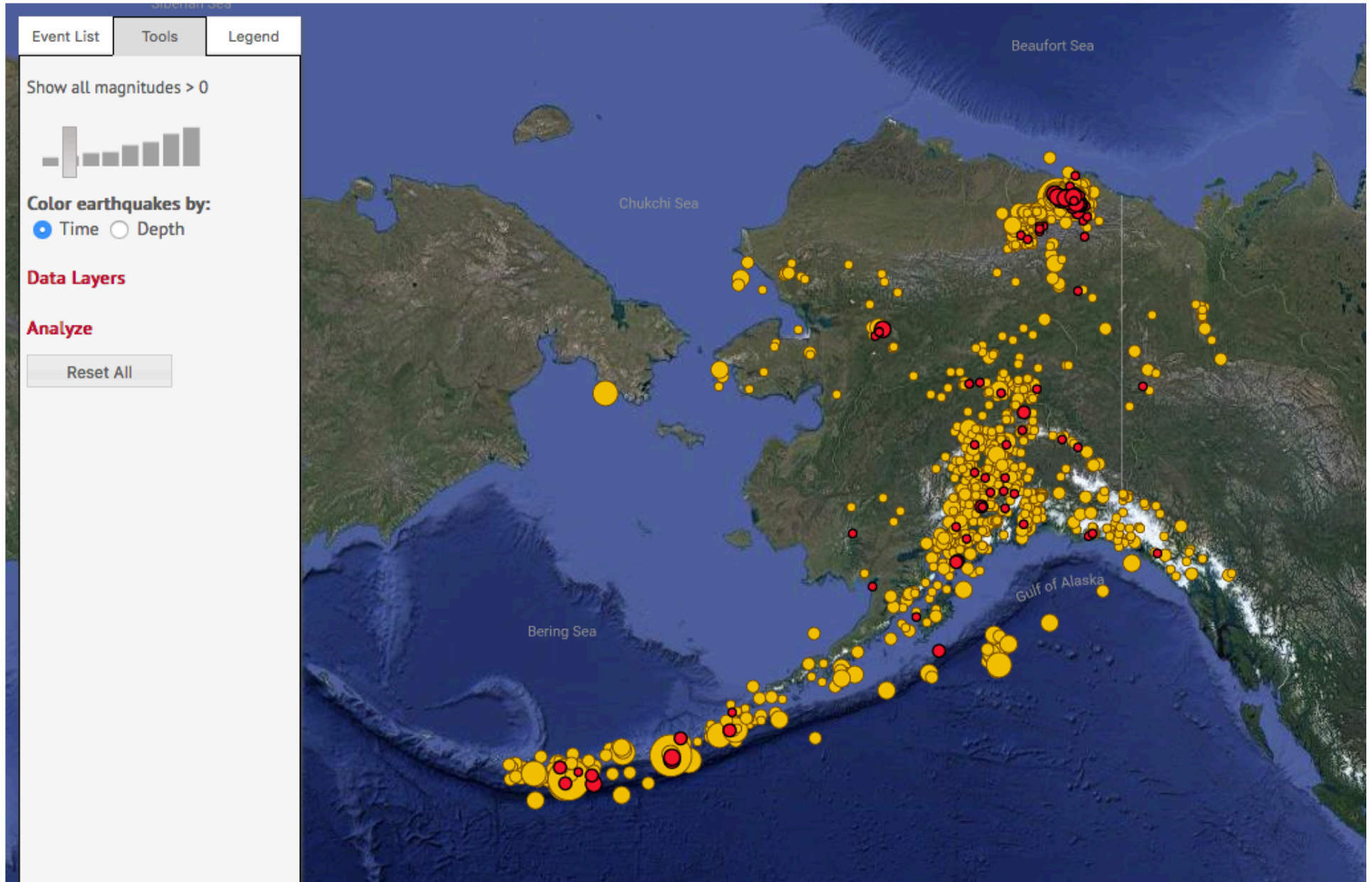


Cumulative phase picks

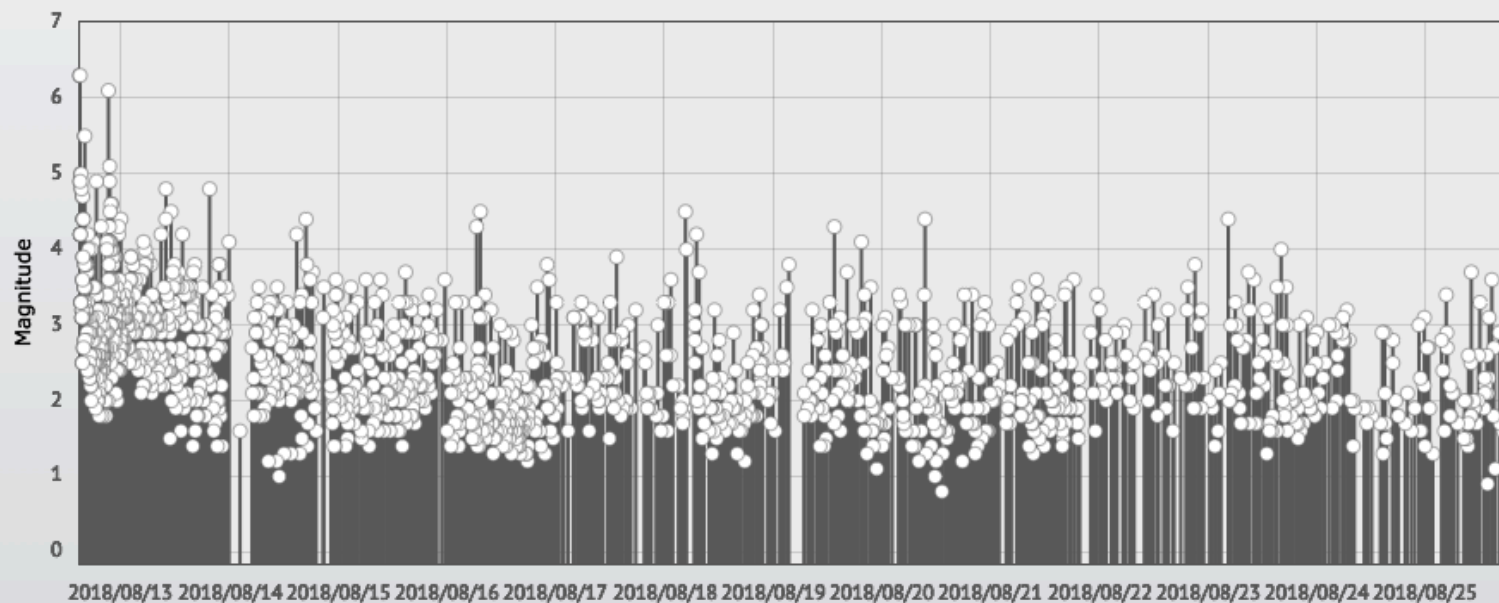
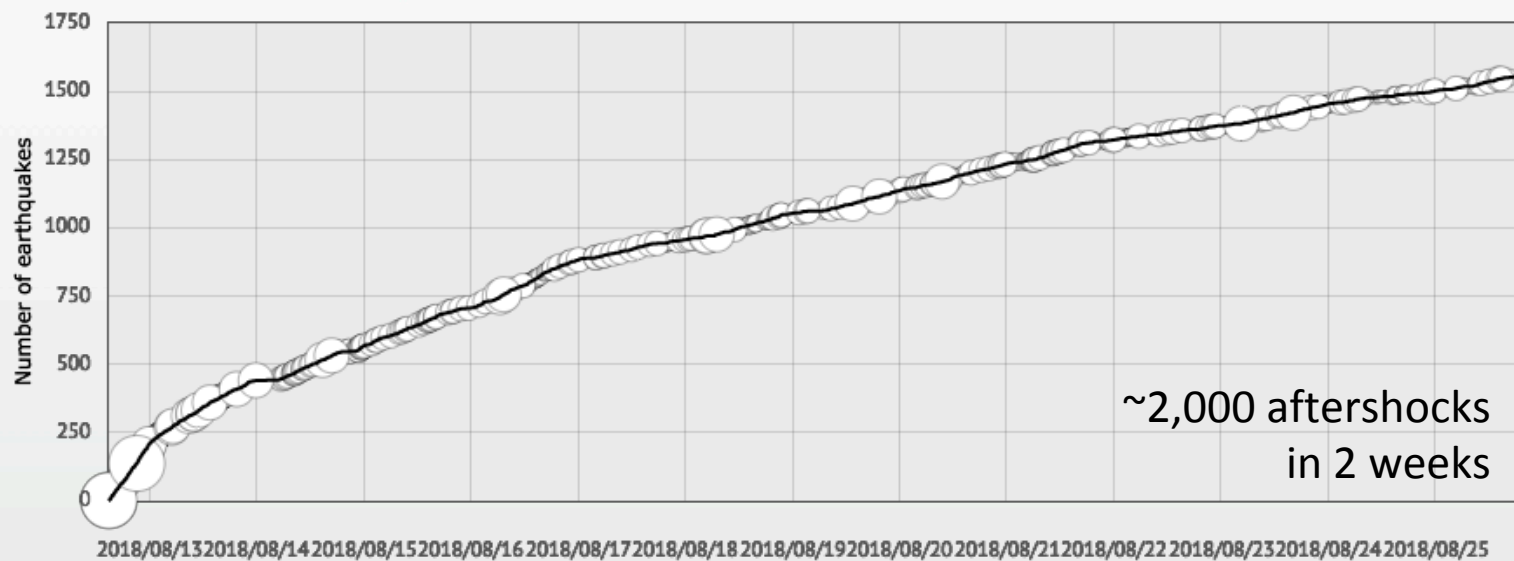


Four M \geq 6 events since August 12

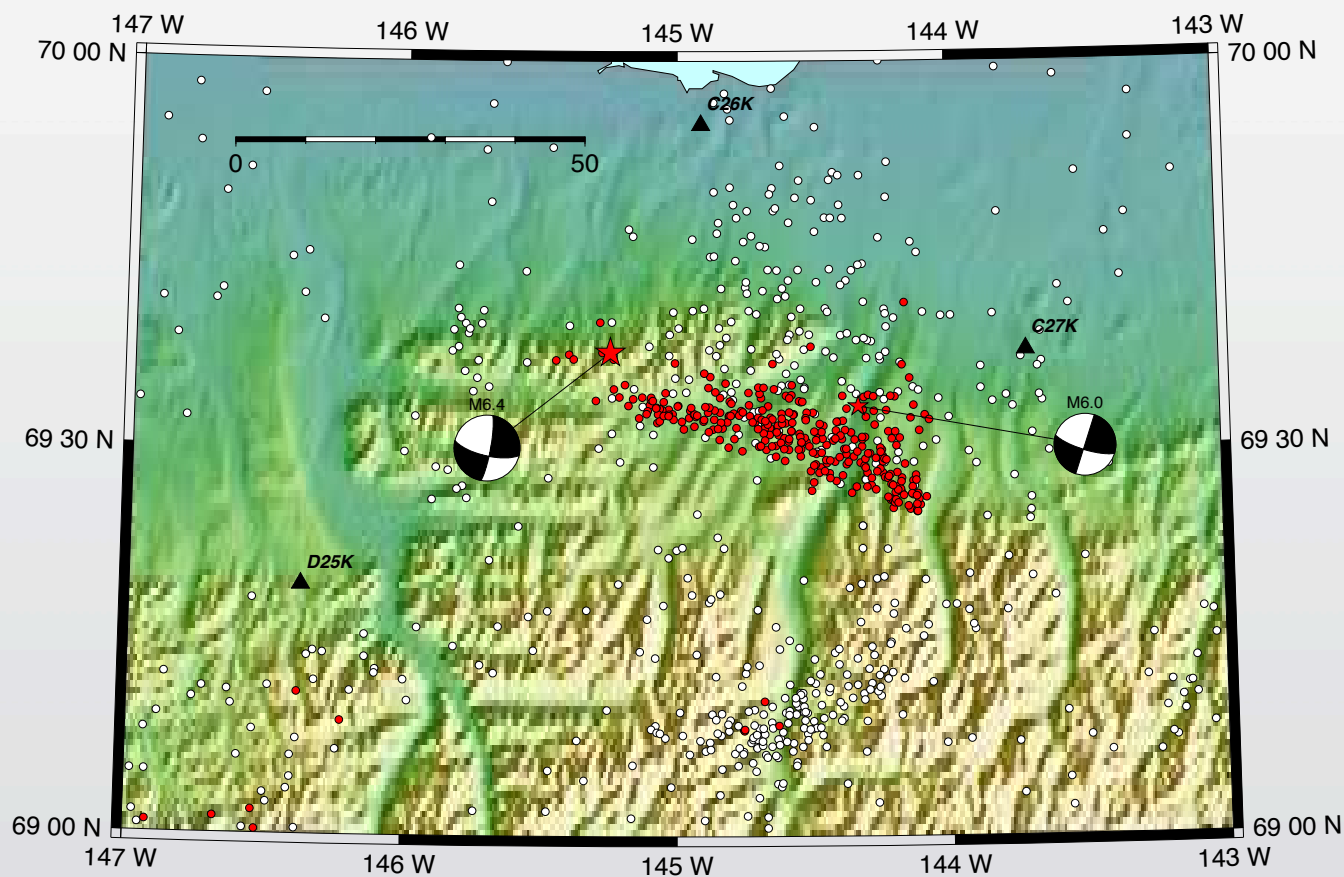




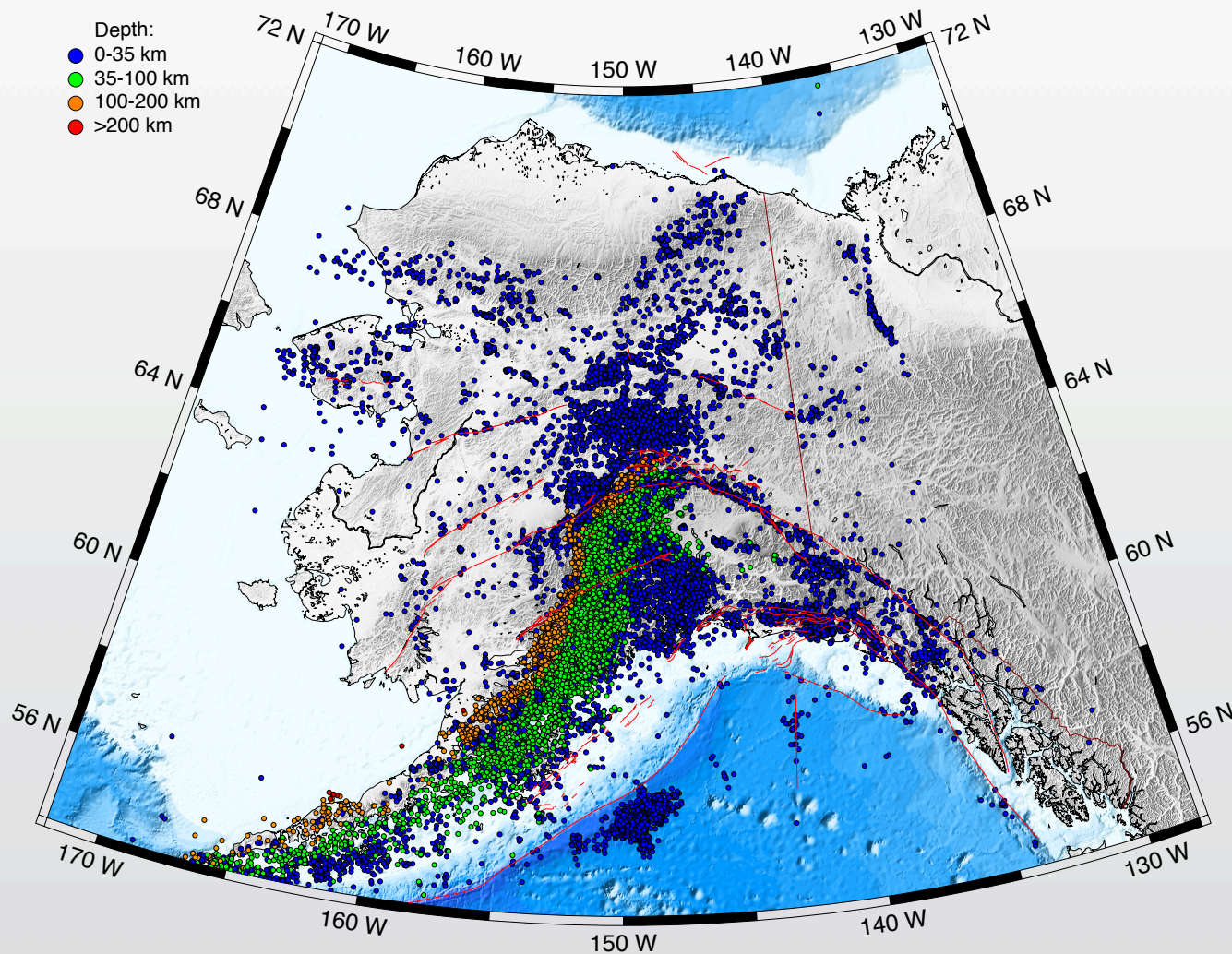
M6.4 Kaktovik Earthquake



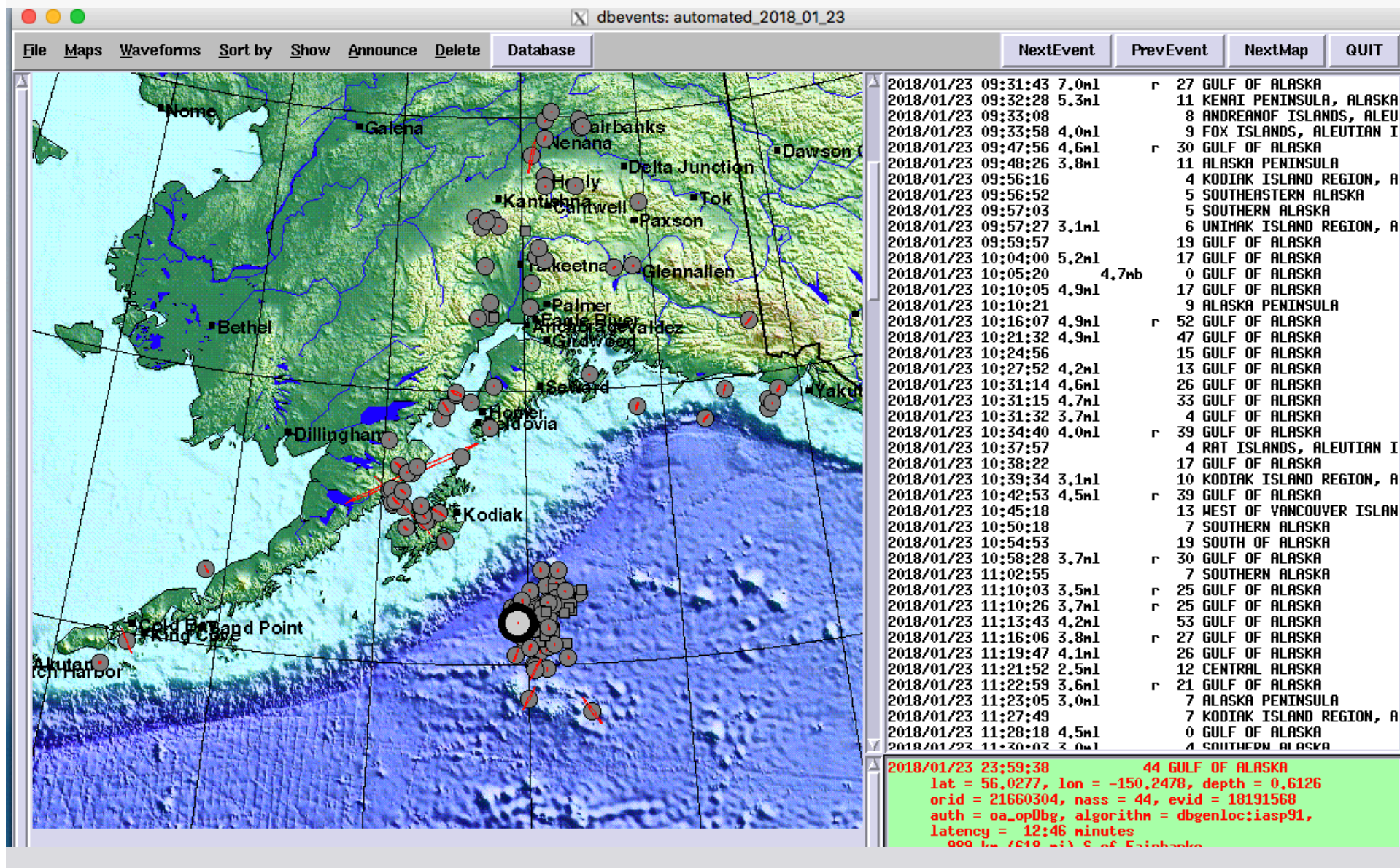
M6.4 Kaktovik Earthquake



Recent Seismicity



Magnitude calculations issue



Magnitude calculations issue

dbevents: automated_2018_01_23

File Maps Waveforms Sort by Show Announce Delete

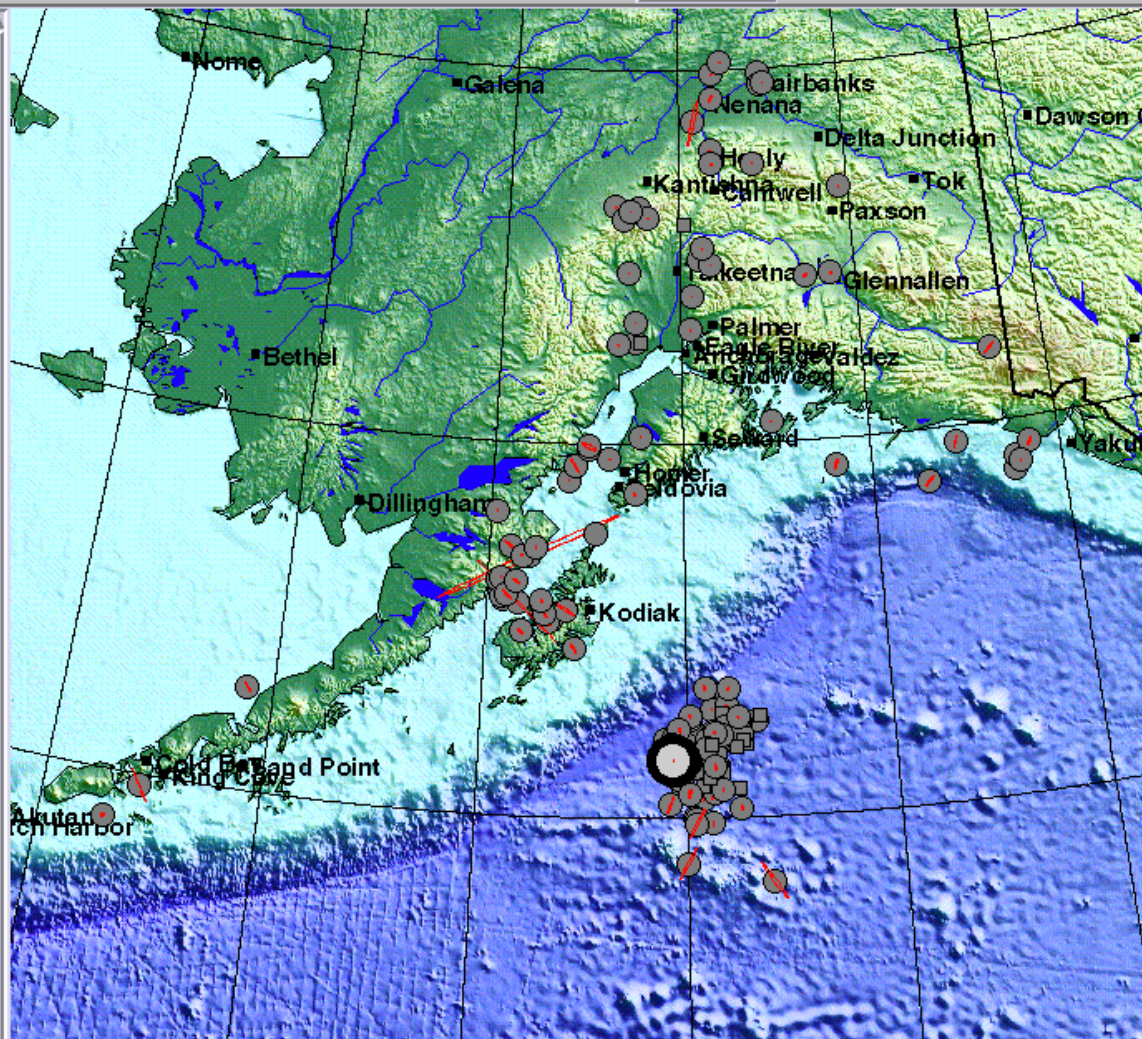
Database

NextEvent

PrevEvent

NextMap

QUIT



2018/01/23 12:31:26	4.0nl	41	GULF OF ALASKA
2018/01/23 12:32:24	3.9nl	51	GULF OF ALASKA
2018/01/23 12:48:57	3.8nl	76	GULF OF ALASKA
2018/01/23 13:00:58	3.8nl	43	GULF OF ALASKA
2018/01/23 13:04:12	3.7nl	16	GULF OF ALASKA
2018/01/23 13:09:07	4.1nl	78	GULF OF ALASKA
2018/01/23 13:20:38		7	SOUTHERN ALASKA
2018/01/23 13:20:51		23	GULF OF ALASKA
2018/01/23 13:23:27		27	GULF OF ALASKA
2018/01/23 13:26:36		39	GULF OF ALASKA
2018/01/23 13:31:46	3.9nl	r 32	GULF OF ALASKA
2018/01/23 13:34:09	4.3nl	r 58	GULF OF ALASKA
2018/01/23 13:39:09		12	GULF OF ALASKA
2018/01/23 13:41:12	3.7nl	r 37	GULF OF ALASKA
2018/01/23 13:44:17	3.9nl	r 40	GULF OF ALASKA
2018/01/23 13:45:33	4.4nb	0	PERU-ECUADOR BORDER REG
2018/01/23 14:01:55		24	CENTRAL ALASKA
2018/01/23 14:10:51	3.3nl	r 30	GULF OF ALASKA
2018/01/23 14:17:57		9	SOUTHERN ALASKA
2018/01/23 14:22:16		4	SOUTHERN ALASKA
2018/01/23 14:22:57		7	SOUTHEASTERN ALASKA
2018/01/23 14:25:24		15	GULF OF ALASKA
2018/01/23 14:37:20		7	GULF OF ALASKA
2018/01/23 14:38:27	3.6nl	r 34	GULF OF ALASKA
2018/01/23 14:42:06		22	GULF OF ALASKA
2018/01/23 14:49:31	3.4nl	r 30	GULF OF ALASKA
2018/01/23 14:50:14		6	CENTRAL ALASKA
2018/01/23 14:51:16		4	KODIAK ISLAND REGION, A
2018/01/23 15:02:21		13	GULF OF ALASKA
2018/01/23 15:14:59		8	SOUTHERN ALASKA
2018/01/23 15:16:23		4	ALASKA PENINSULA
2018/01/23 15:16:53		4	ALASKA PENINSULA
2018/01/23 15:19:32		29	GULF OF ALASKA
2018/01/23 15:22:03		10	ALASKA PENINSULA
2018/01/23 15:22:32		20	GULF OF ALASKA
2018/01/23 15:30:14		15	NORTH PACIFIC OCEAN
2018/01/23 15:35:28		24	GULF OF ALASKA
2018/01/23 15:36:39	1.4nl	r 24	CENTRAL ALASKA
2018/01/23 15:38:23	3.6nl	r 30	GULF OF ALASKA
2018/01/23 15:43:12	4.3nl	0	GULF OF ALASKA
2018/01/23 15:48:59		5	CENTRAL ALASKA
2018/01/23 15:51:05	3.2nl	r 50	GULF OF ALASKA
2018/01/23 15:55:06		62	GULF OF ALASKA

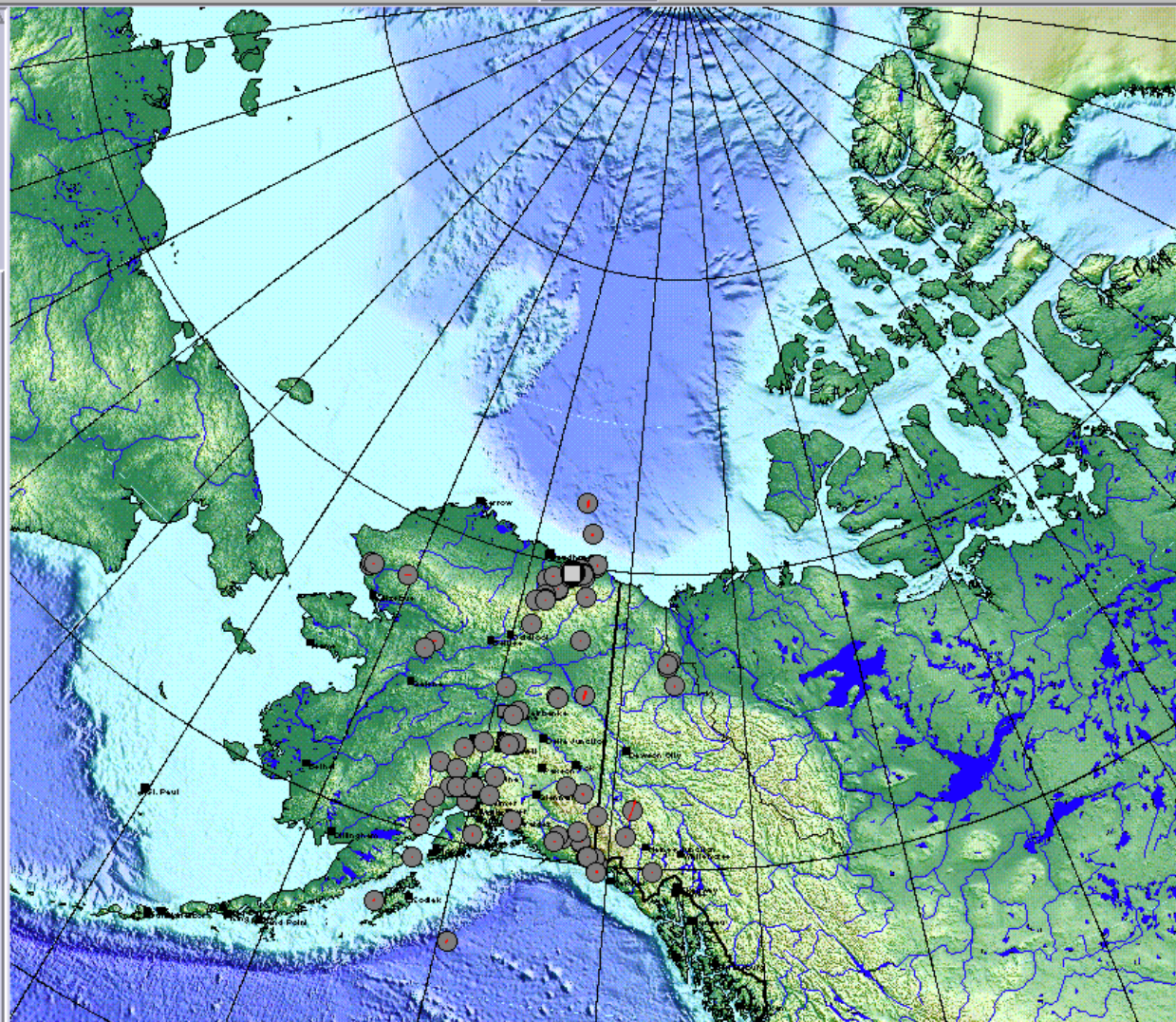
2018/01/23 23:59:38 44 GULF OF ALASKA
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auth = oa_opDbg, algorithm = dbgenloc:iasp91,
latency = 12:46 minutes
989 km (618 mi) S of Fairbanks

Magnitude calculations issue

dbevents: automated_2018_08_12

File Maps Waveforms Sort by Show Announce Delete Database

NextEvent PrevEvent NextMap QUIT



NextEvent	PrevEvent	NextMap	QUIT
2018/08/12 10:21:50	4,6nb	33	KURIL ISLANDS
2018/08/12 10:28:39		4	NORTHERN ALASKA
2018/08/12 10:46:17	4,7nb	0	NEAR NORTH COAST OF IRI
2018/08/12 10:52:45	1,2nl	12	NORTHERN YUKON TERRITOR
2018/08/12 11:22:59	1,8nl	13	SOUTHEASTERN ALASKA
2018/08/12 11:41:50	1,5nl	9	SOUTHERN YUKON TERRITOR
2018/08/12 12:09:15		7	NORTHERN ALASKA
2018/08/12 12:17:03	1,1nl	5	NORTHERN ALASKA
2018/08/12 12:18:24	2,1nl	32	NORTHERN ALASKA
2018/08/12 12:25:08	1,1nl	5	SOUTHERN ALASKA
2018/08/12 12:29:59	1,9nl	33	SOUTHERN ALASKA
2018/08/12 12:57:57		10	SOUTHERN YUKON TERRITOR
2018/08/12 13:09:38	1,2nl	11	SOUTHERN ALASKA
2018/08/12 13:42:22	4,3nb	0	TURKEY
2018/08/12 13:42:38	1,4nl	14	CENTRAL ALASKA
2018/08/12 13:44:47	2,3nl	30	SOUTHEASTERN ALASKA
2018/08/12 14:12:22	2,1nl	36	SOUTHERN ALASKA
2018/08/12 14:20:35	1,8nl	9	NORTHERN ALASKA
2018/08/12 14:21:39		9	NORTHERN ALASKA
2018/08/12 14:31:33		9	NORTHERN ALASKA
2018/08/12 14:42:11	4,6nb	0	GUERRERO, MEXICO
2018/08/12 14:58:54	6,1nl	r 53	NORTHERN ALASKA
2018/08/12 15:14:21	4,9nl	r 58	NORTHERN ALASKA
2018/08/12 15:18:08		30	BEAUFORT SEA
2018/08/12 15:18:38	4,7nl	r 47	NORTHERN ALASKA
2018/08/12 15:21:07	3,0nl	4	NORTHERN ALASKA
2018/08/12 15:27:45	3,4nl	14	NORTHERN ALASKA
2018/08/12 15:28:56	3,4nl	13	NORTHERN ALASKA
2018/08/12 15:33:38	3,7nl	16	NORTHERN ALASKA
2018/08/12 15:34:50	4,3nl	r 41	NORTHERN ALASKA
2018/08/12 15:39:33	3,8nl	r 29	NORTHERN ALASKA
2018/08/12 15:40:28		5	SOUTHERN ALASKA
2018/08/12 15:42:06	4,1nl	r 29	NORTHERN ALASKA
2018/08/12 15:42:24	4,2nl	r 32	NORTHERN ALASKA
2018/08/12 15:55:47	3,7nl	42	NORTHERN ALASKA
2018/08/12 16:00:23	3,1nl	19	NORTHERN ALASKA
2018/08/12 16:02:09	5,4nl	r 73	NORTHERN ALASKA
2018/08/12 16:04:20	2,6nl	6	SOUTHERN ALASKA
2018/08/12 16:06:42	3,2nl	5	NORTHERN ALASKA
2018/08/12 14:58:54	6,1nl	53	NORTHERN ALASKA
lat = 69.6239, lon = -145.2468, depth = 9.8550			
orid = 23545682, nass = 53, evid = 20076877			
auth = AK:dbrazitis, algorithm = dbgenloc:northa,			
latency = 33:48 minutes			
84 km (52 mi) SW of Kaktovik			
130 km (81 mi) E of {Pump Station #23}			
137 km (85 mi) ESE of Deadhorse			
137 km (86 mi) ESE of {Prudhoe Bay}			
146 km (92 mi) ESE of {Pump Station #13}			
2018/08/12 14:58:55	6,7nb	193	NORTHERN ALASKA
lat = 69.6721, lon = -145.5499, depth = 0.1526			
orid = 23545607, nass = 243, evid = 20076877			
auth = oa_opDbgMHB, algorithm = dbgenloc:iasp91,			
latency = 12:45 minutes			
2018/08/12 14:58:58	6,8nl	44	NORTHERN ALASKA

Magnitude calculations issue

File Maps Waveforms Sort by Show Announce Delete

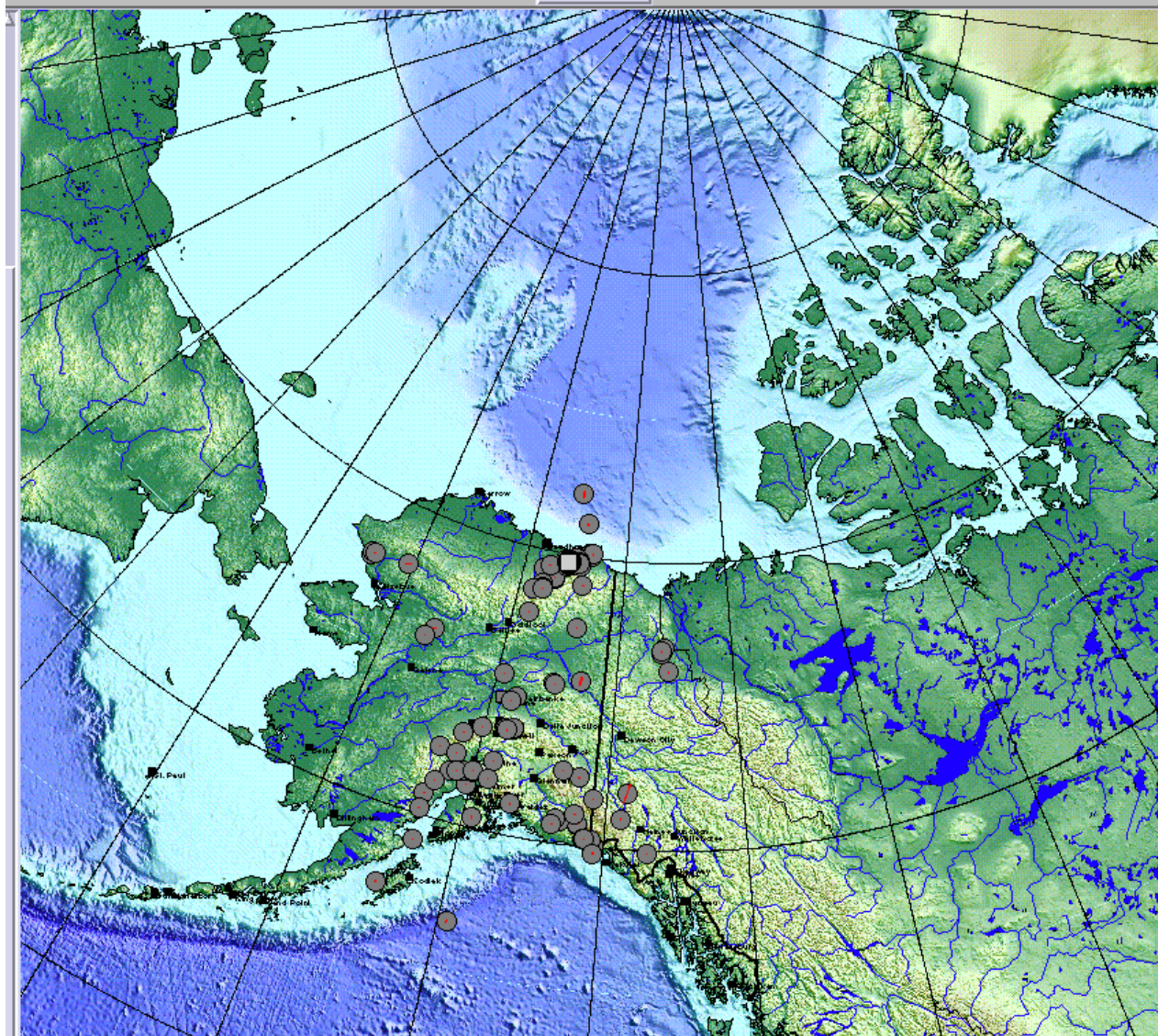
Database

NextEvent

PrevEvent

NextMap

QUIT



2018/08/12 16:18:05		28 SOUTHEASTERN ALASKA
2018/08/12 16:19:56 3.2nl		18 NORTHERN ALASKA
2018/08/12 16:22:06 3.7nl	r	48 NORTHERN ALASKA
2018/08/12 16:23:52		7 CENTRAL ALASKA
2018/08/12 16:24:24		8 NORTHERN ALASKA
2018/08/12 16:28:57		43 NORTHERN ALASKA
2018/08/12 16:30:41		12 NORTHERN ALASKA
2018/08/12 16:31:38		13 NORTHERN ALASKA
2018/08/12 16:32:56		29 NORTHERN ALASKA
2018/08/12 16:33:27		30 CENTRAL ALASKA
2018/08/12 16:33:30		7 NORTHERN ALASKA
2018/08/12 16:39:29 3.7nl	r	46 NORTHERN ALASKA
2018/08/12 16:43:54 5.0mb		0 TONGA ISLANDS
2018/08/12 16:44:40		100 NORTHERN ALASKA
2018/08/12 16:44:41 4.3nl	r	36 NORTHERN ALASKA
2018/08/12 16:53:12		117 NORTHERN ALASKA
2018/08/12 16:53:14 4.2nl	r	40 NORTHERN ALASKA
2018/08/12 17:00:25		32 NORTHERN ALASKA
2018/08/12 17:02:19 5.2mb		0 VANUATU ISLANDS
2018/08/12 17:03:56		12 NORTHERN ALASKA
2018/08/12 17:05:36		11 NORTHERN ALASKA
2018/08/12 17:19:06		33 NORTHERN ALASKA
2018/08/12 17:22:29		17 NORTHERN ALASKA
2018/08/12 17:23:07		17 HALMAHERA, INDONESIA
2018/08/12 17:29:01		29 NORTHERN ALASKA
2018/08/12 17:30:45		65 NORTHERN ALASKA
2018/08/12 17:32:52		6 SOUTHEASTERN ALASKA
2018/08/12 17:39:44		59 NORTHERN ALASKA
2018/08/12 17:43:46		41 NORTHERN ALASKA
2018/08/12 17:44:26 5.0mb		0 YUNNAN, CHINA
2018/08/12 17:46:42		14 BALTICS-BELARUS-NW RUSS
2018/08/12 17:54:25 3.9nl	r	51 NORTHERN ALASKA
2018/08/12 17:55:27		13 NORTHERN ALASKA
2018/08/12 18:04:17		73 NORTHERN ALASKA
2018/08/12 18:06:38		11 NORTHERN ALASKA
2018/08/12 18:09:04		19 NORTHERN ALASKA
2018/08/12 18:09:33		55 NORTHERN ALASKA
2018/08/12 18:16:15		17 NORTHERN ALASKA
2018/08/12 18:20:43		26 NORTHERN ALASKA

2018/08/12 14:58:54 6.1ml	53 NORTHERN ALASKA
lat = 69.6239, lon = -145.2468, depth = 9.8550	
orid = 23545682, nass = 53, evid = 20076877	
auth = AK:dbrazitis, algorithm = dbgenloc:northa,	
latency = 33:48 minutes	
84 km (52 mi) SW of Kaktovik	
130 km (81 mi) E of {Pump Station #2}	
137 km (85 mi) ESE of Deadhorse	
137 km (86 mi) ESE of {Prudhoe Bay}	
146 km (92 mi) ESE of {Pump Station #1}	

2018/08/12 14:58:55 6.7mb	193 NORTHERN ALASKA
lat = 69.6721, lon = -145.5499, depth = 0.1526	
orid = 23545607, nass = 243, evid = 20076877	
auth = oa_opDbgM1Mb, algorithm = dbgenloc:iasp91,	
latency = 12:45 minutes	

2018/08/12 14:58:58 6.8ml	44 NORTHERN ALASKA
lat = 69.7349, lon = -144.3234, depth = 16.1607	
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Lessons learned

- Ongoing issues for large earthquake sequences:
 - too many auto origins for larger events (already tuned orbassoc parameters in attempt to reduce their number)
 - prefors without magnitudes (prefor is set based on number of associations)
 - stalled magnitude calculations (already made several changes to deal with it)
 - split events (need to work more on tuning grids/orbassoc)
 - increased processing load on data analysts

Lessons learned

- It's important for us (the Earthquake Center) to disseminate information quickly. We've been working really hard on making sure that we compile and distribute a number of various data product following large earthquakes (FB, twitter, website news stories, media interviews).
- Following significant earthquakes we implement Incident Response structure and follow prescribed set of actions within the chain of command.