

Seismic Analysis User Requirements

Antelope User Group

Compiled by:

T. Mulder, Geological Survey of Canada, NRCan

T. Cox, ANF, UCSD

Antelope User Group Meeting

Papagayo, Costa Rica

Hosted by Universidad Nacional OVSICORI-UNA

Gather Requirements

- Group of experienced users from 4 organizations got together to brainstorm.
- Went to a number of mtgs across the world and interviewed Seismic Networks
 - Mandated Work
 - What works well
 - What can be improved

AntelopeUserGroup 'dbloc' Requirements

- Users want a seismic analysis tool
- Some common requirements are:
 - More detail and ability to see and choose magnitudes
 - Rotating waveforms
 - Cross-correlation tools
 - Quickly scanning network wf data
 - Focal mechanisms
 - Moment tensors
 - Spectrograms
- Lots of cool ideas!!

- Functions on...
 - Desktop
 - Laptop
 - iPad ;-)
 - Smartphone ;-)

Then What?

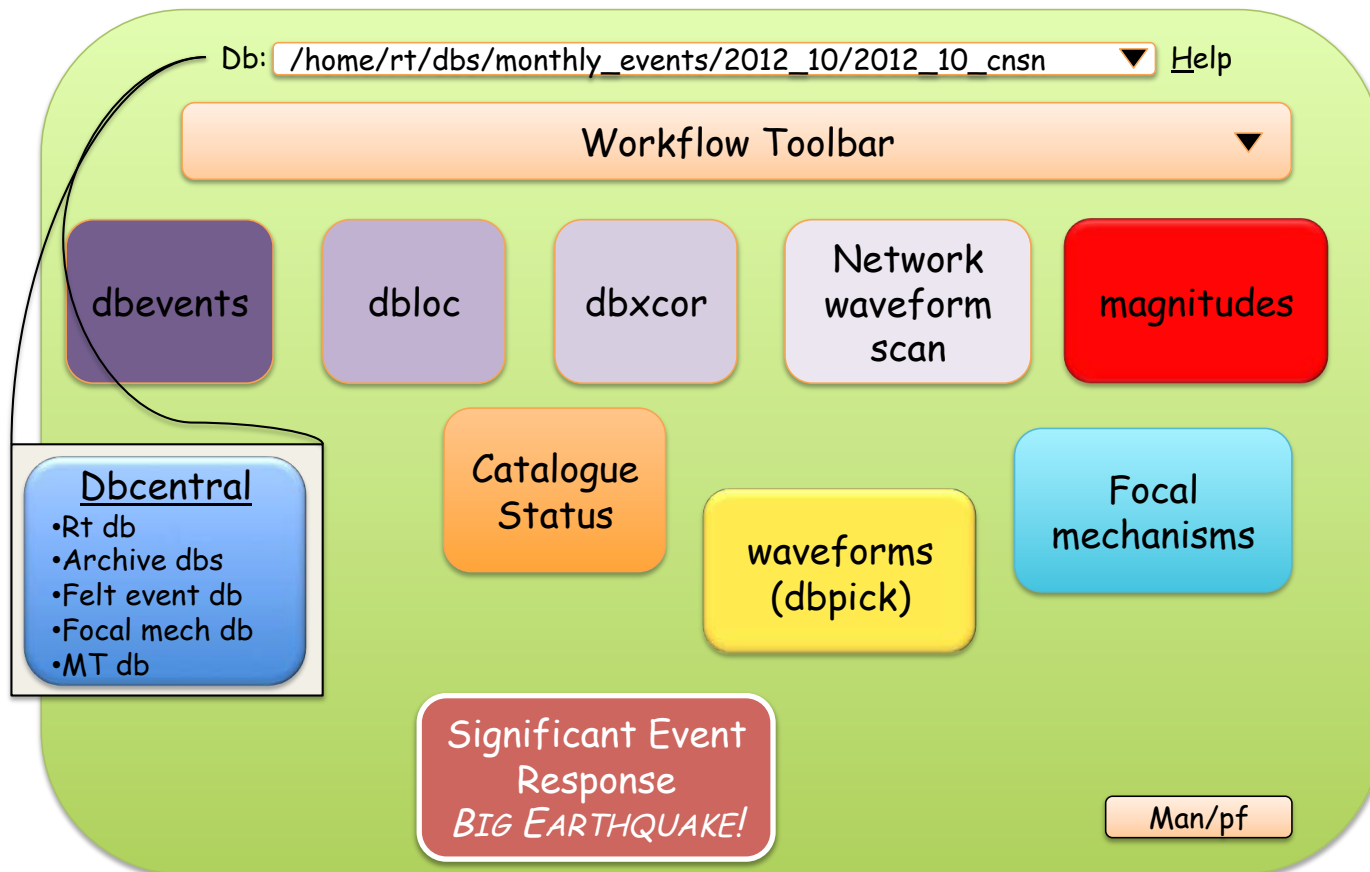
- Lots & lots of head scratching...

TOOLS IDEAS

- Dbdashboard
- Workflow_toolbar
- Dbloc
- Catalogue Processing Status

DBDASHBOARD

Db Dashboard



WORKFLOW TOOLBAR

Daily Event Review

Db: /home/rt/dbs/monthly_events/2012_10/2012_10_cnsn

Start: 2012 Oct 28

End: 2012 Oct 28

Claim day
Events complete
Health check complete

Locate
events

Wf scan

REMINDERS:

- Error bars (deltim)
- First motions (fm)

Verify regional
rules

Verify
dbhealth

Monthly Event Review

Db: /home/rt/dbs/monthly_events/2012_10/2012_10_cnsn

Claim month
Month complete
Health check complete

Locate
events

Missed
bulletin
events

Wf scan

Verify regional
rules

Verify
dbhealth

Merge
back

Fix Ids

Magnitudes

DMC send

ISC send

Significant Event

Db: /home/rt/dbs/monthly_events/2012_10/2012_10_cnsn

Start: 2012 Oct 28-29 03:04

End: 2012 Oct 28 03:10

UT/Local

Locate
event

Wf
scan

Call List:

- ☐ SOC-E xxx.xxx.xxxx
- ☐ SOC-W xxx.xxx.xxxx
- ☐ GOC xxx.xxx.xxxx
- ☐ PEP BC xxx.xxx.xxxx

Press-
release
/tweet

Make
maps

Publish

Focal
mechanism

RMT

Database Admin

Db cluster: Archive dbs

Start: 2012 Jan

End: 2012 Dec

idserver: Archive_dbs:xxxx

Dbclean

Fix ids

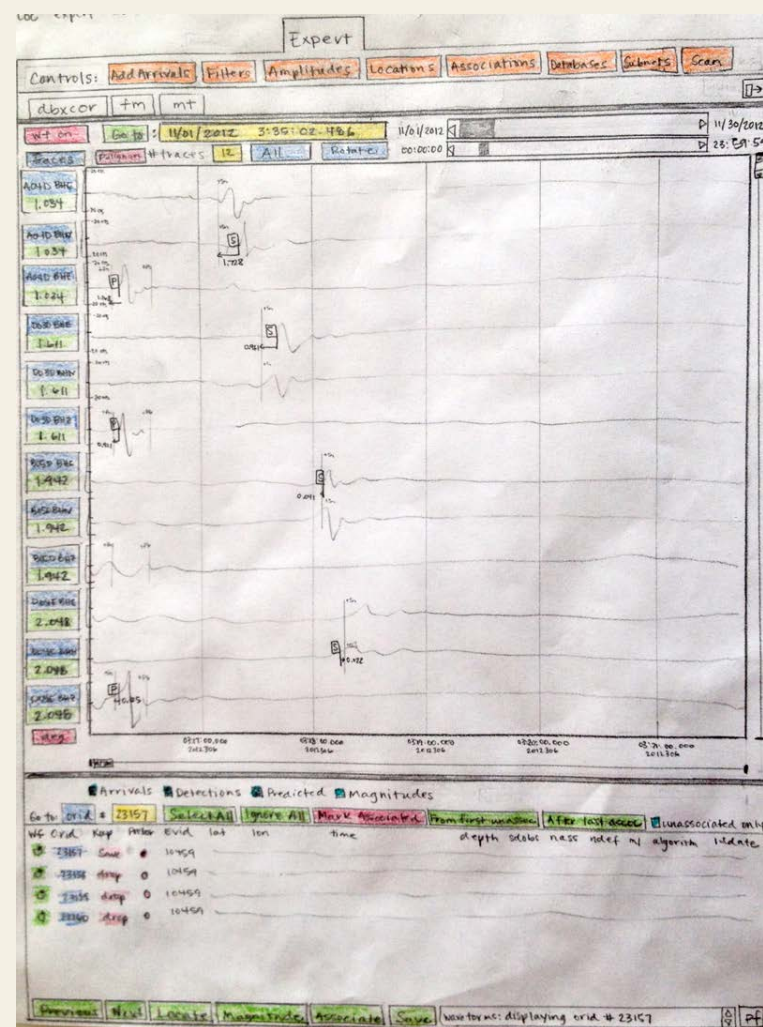
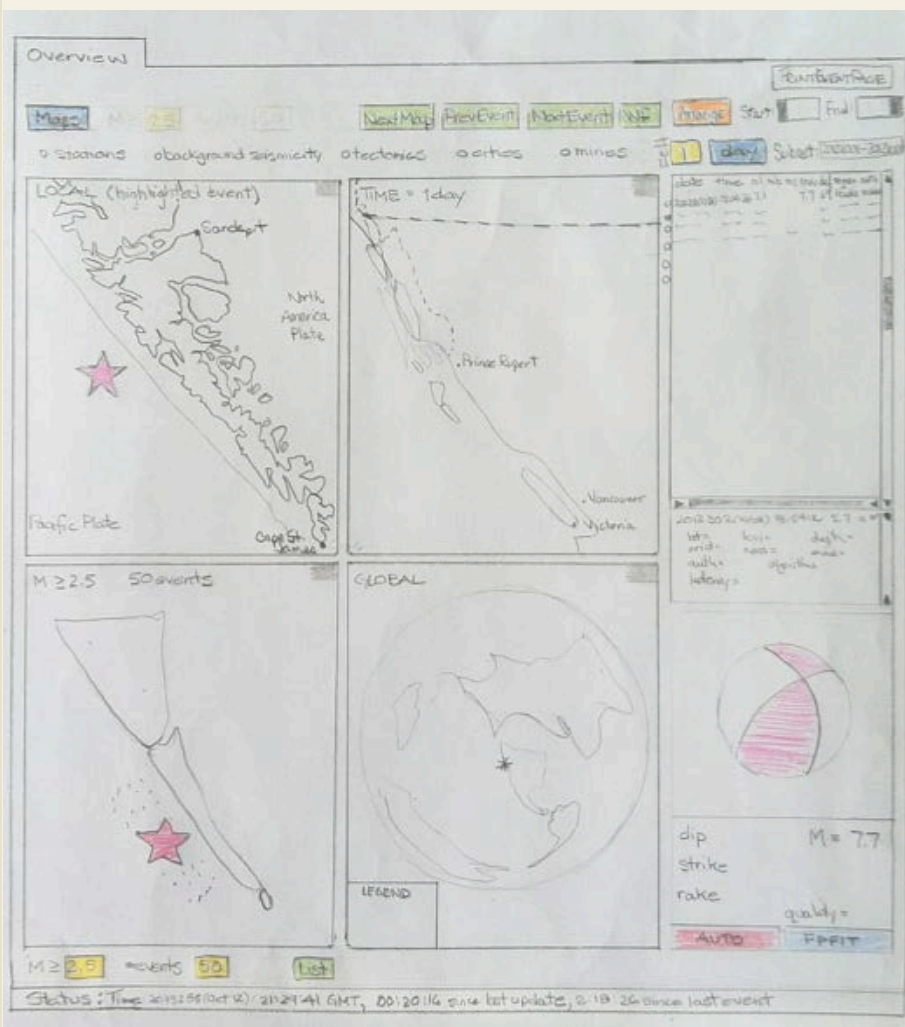
Check cluster
descriptor files

Import db
Import wfs

Recalculate
magnitudes

Reset id
server

DBLOC



CATALOGUE PROCESSING STATUS

Catalogue Processing Status

(an example - needs more thought)

Daily review

2012 Mar 3

No. orbassoc events = 5

No. located events = 12

- ☐ Network scan
- ☐ Wf quality control
 - Timing
 - Noise levels
 - Glitches
- ☐ Calibration
- ☐ Picked first motions
- ☐ Pick amplitude & period
- ☐ Moment tensor solns
- ☐ First motion focal mechanisms

Monthly review

- ☐ 2013 Jan
- ☐ 2012 Dec
- ☐ 2012 Nov
- ☐ 2012 Oct
- ☐ 2012 Sep
- ☐ 2012 Aug

Send data to ISC, EMSC, etc.

- ☐ 2013 Jan
- ☐ 2012 Dec
- ☐ 2012 Nov
- ☐ 2012 Oct
- ☐ 2012 Sep
- ☐ 2012 Aug

Managing a/s sequences

- ☐ Adding in a/s deployment wf data & phase picks
- ☐ Identify a/s: assign origin to unlocatable a/s, calculate magnitude

TOOLS:

- Dbdashboard
- Workflow_Notebook Pages
- Overview
- Catalogue Processing Status
 - Simple
 - Magnitudes
 - Focal Mechanism
 - Moment Tensor
 - Felt

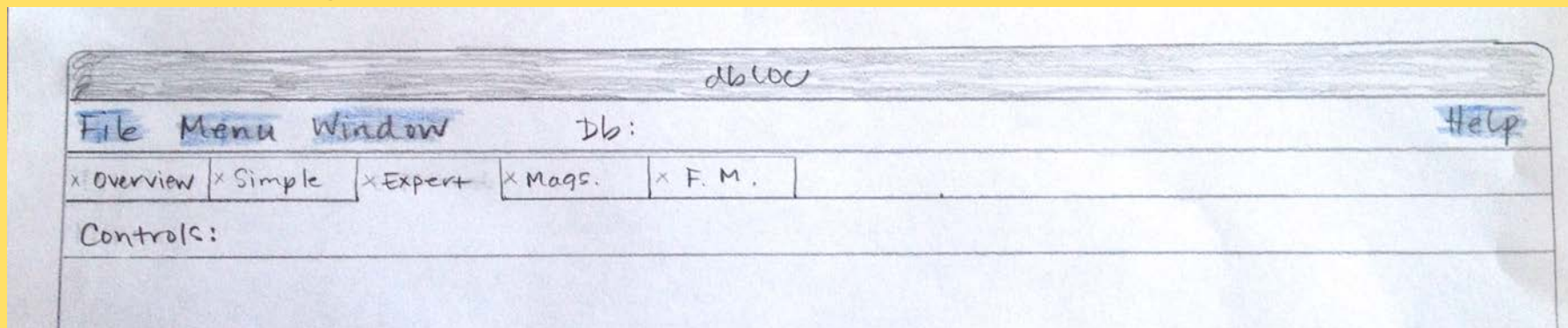
Trilby



DBLOC

...with notebook pages...

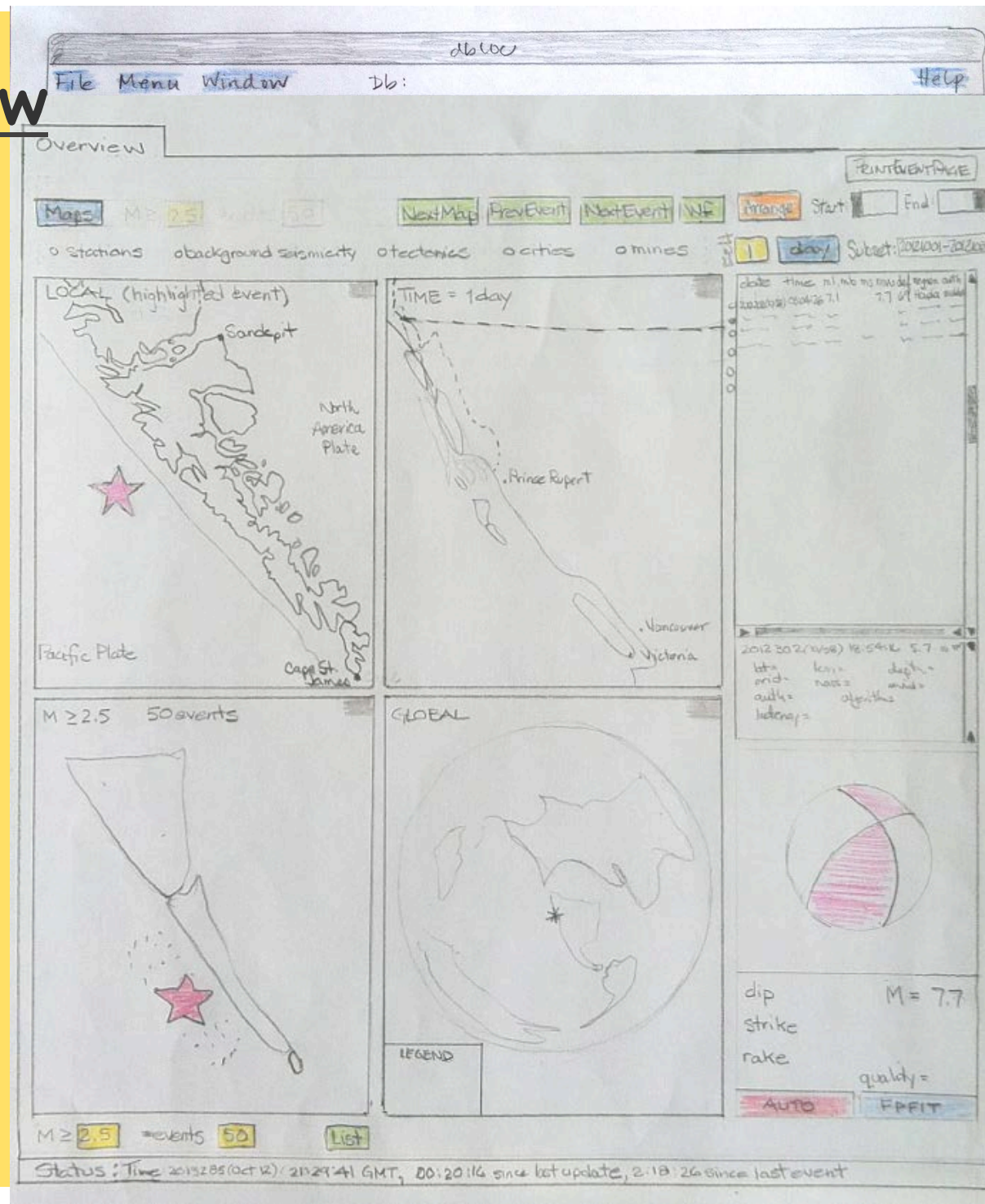
- Overview
- Display
- Simple
- Expert
- Magnitudes
- Felt
- Significant Event Response



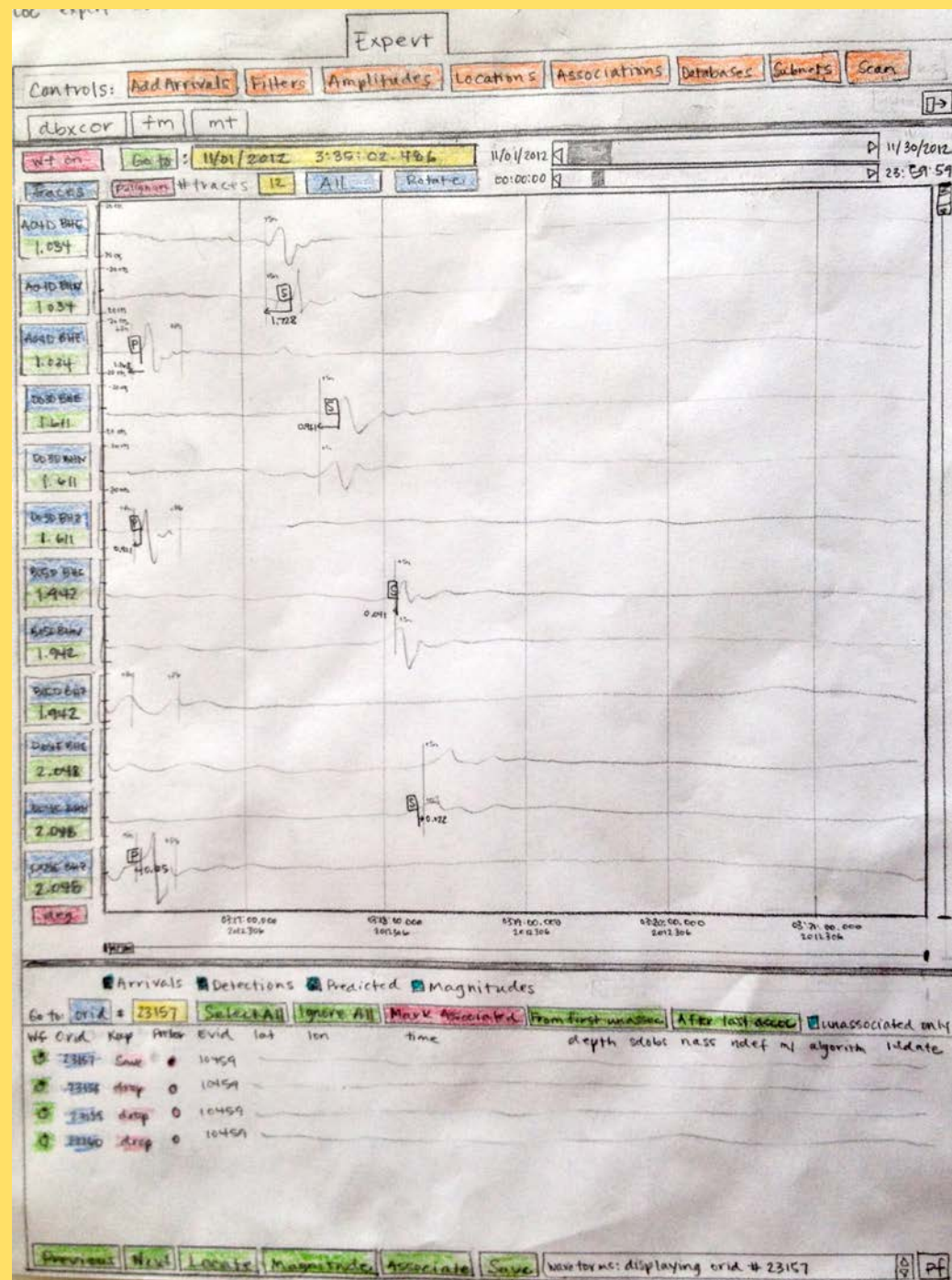


Overview

DBLOC



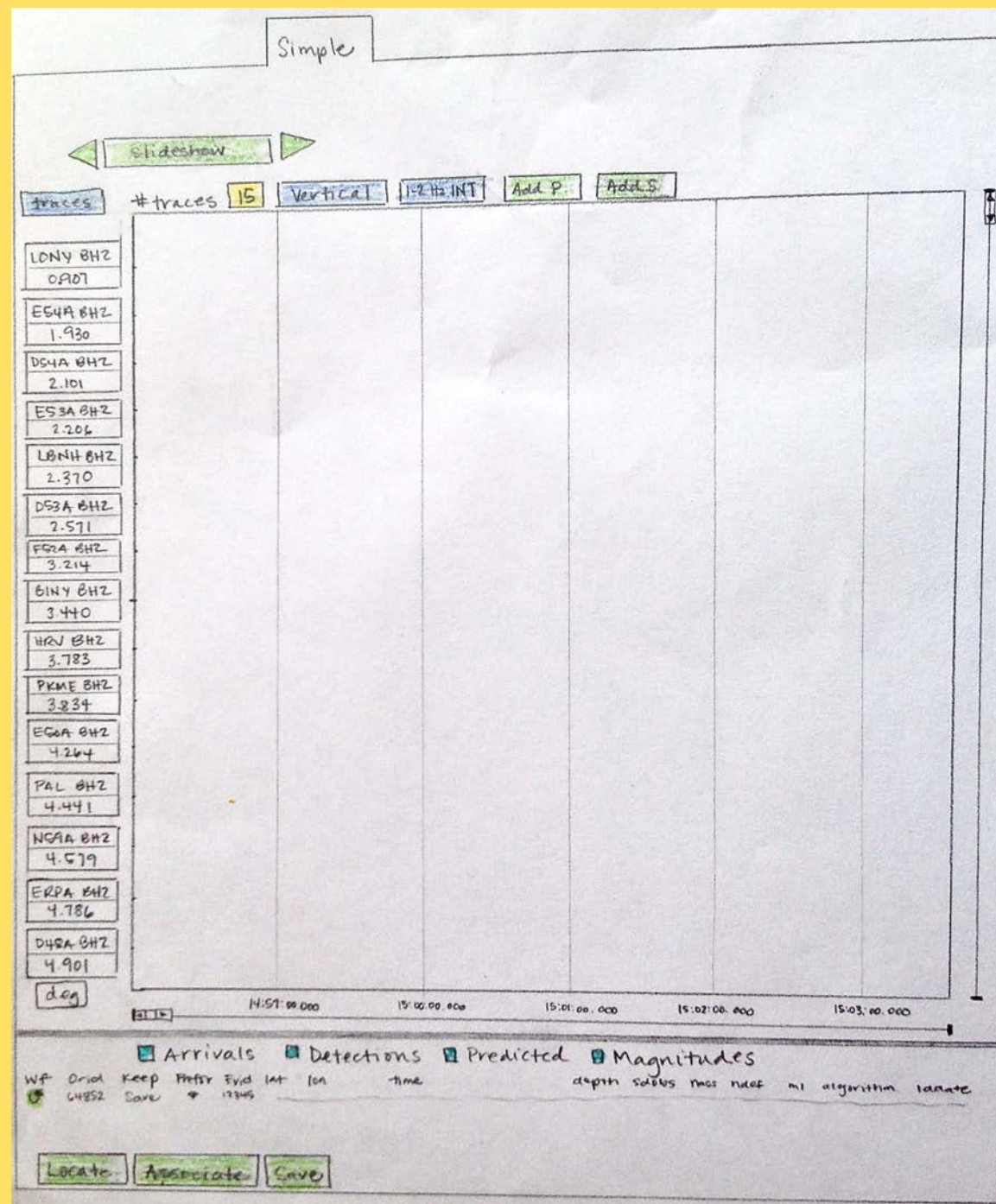
Expert



DBLOC

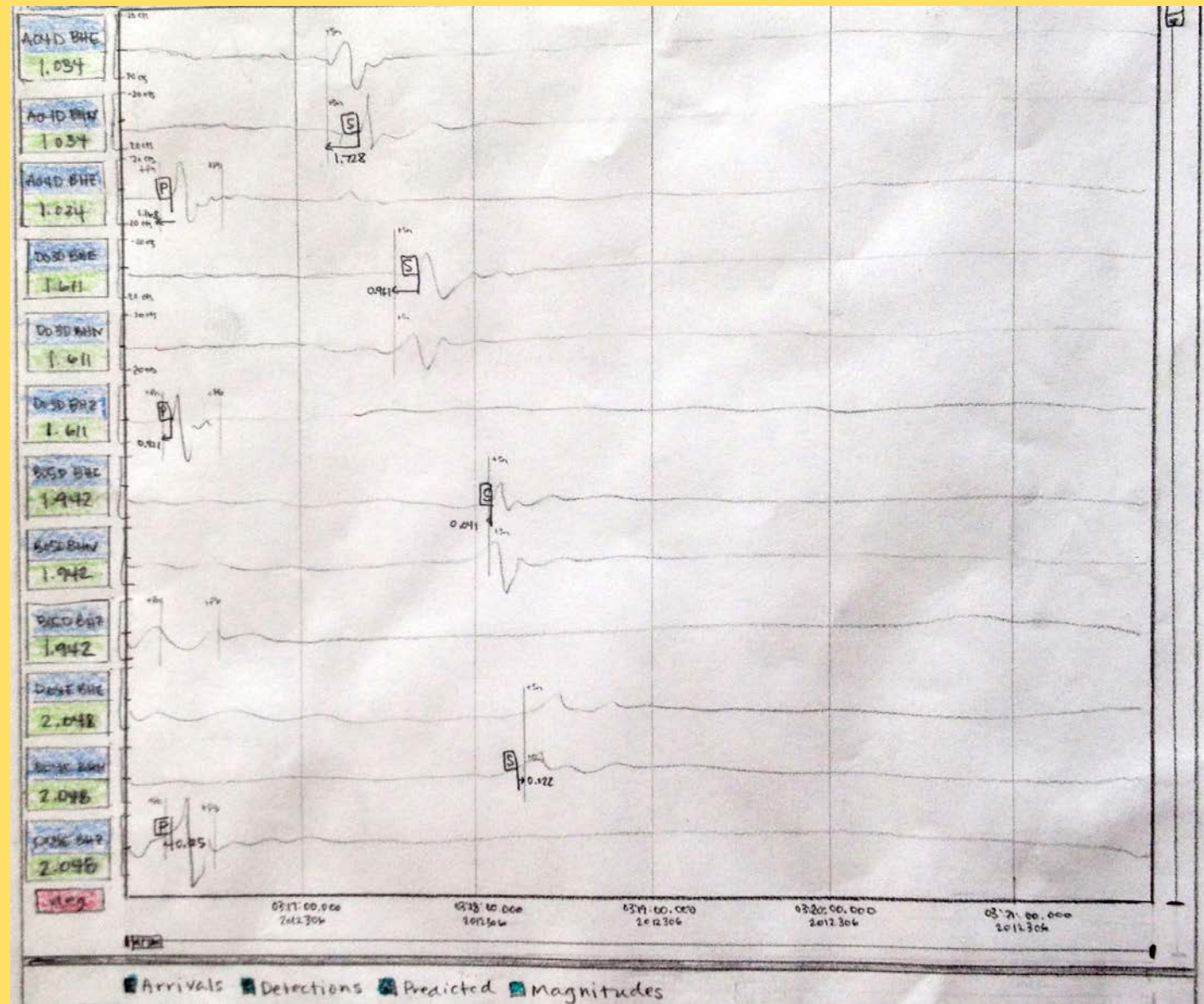
Simple

DBLOC



Display

- Just Waveforms



Magnitudes

DBLOC

Magnitudes

Magtype: **M2**

keep	sta	chan	starmag	snr	thresh	dist (°)	azm	auth
☐	NBC4	HHE	1.6	2.5	1.6	0.282	225	Pgc:mulder
☐	CMBC	BHE	2.8	2.8	1.6	0.995	278	Pgc:mulder
☐	NBC5	HHN	3.2	3.2	1.6	2.045	322	Pgc:mulder
☐	FSB	EHZ	3.6	3.5	1.6	2.678	240	Pgc:mulder
☐	NBC6	HHE	3.5	3.0	1.6	2.718	348	orbexproc
☐	HILA	HHN	3.0	2.6	1.4	3.201	032	Pgc:mulder
☐	FNBB	BHE	3.0	2.6	1.6	3.276	335	Pgc:mulder
☐	UBRB	HHE	3.6	3.1	1.6	3.716	218	Pgc:mulder
☐	NBC1	HHN	3.1	2.7	1.6	4.167	344	Pgc:mulder
☐	EDM	BHE	—	1.5	1.6	4.878	121	Pgc:mulder

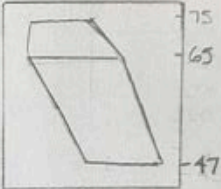
Netmag: **3.2**

Refmag	magtype	netmag	magerr	#stn	auth
☒	M2	3.2	0.26	12	Pgc:mulder
☐	M2(Sn)	2.5	0.28	12	Pgc:mulder
☐	M2(Lg)	3.1	0.31	10	Pgc:mulder
☐	MW	3.5		4	HERVIG

SAVE

VALID MAGNITUDE REGIONS

M2(Lg)



Polygon 1	+ Polygon 2
75 -136	65 -136
75 -132	65 -123
65 -123	47 -116
65 -136	47 -120

STATION CORRECTIONS

NBC6	+0.3
HILA	-0.1

Focal Mechanism

DBLOC

Focal Mechanism

FFFIT

hyp **Split hyp**

cut **Split cut**

sum **Split sum**

pol **Split pol**

tit

for

amp

for

bet

comp

mag

obs

dis

res

ain

dir

dip

rak

Rep

hor

mer

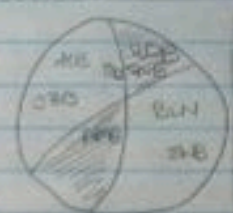
rev

rev

rev

COMPUTE **SAVE**

RESULTS



dip ☐

strike ☐

rake ☐

INPUT DATA **det. azm**

ALB	+	in	20
TXB	+	in	20
QZE	+	in	20
QFB	+	in	20
BLB	+	in	20
SFB	+	in	20
NCE	-	in	20
TXB	-	in	20

*code

C = impulsive compression (up) + = emergent compression

D = impulsive dilatation (down) - = emergent dilatation

Felt

Felt

◀ ◀ • Felt ▶
Event Summary
◀ 2012-10-28 03:04 UT ▶

Comment

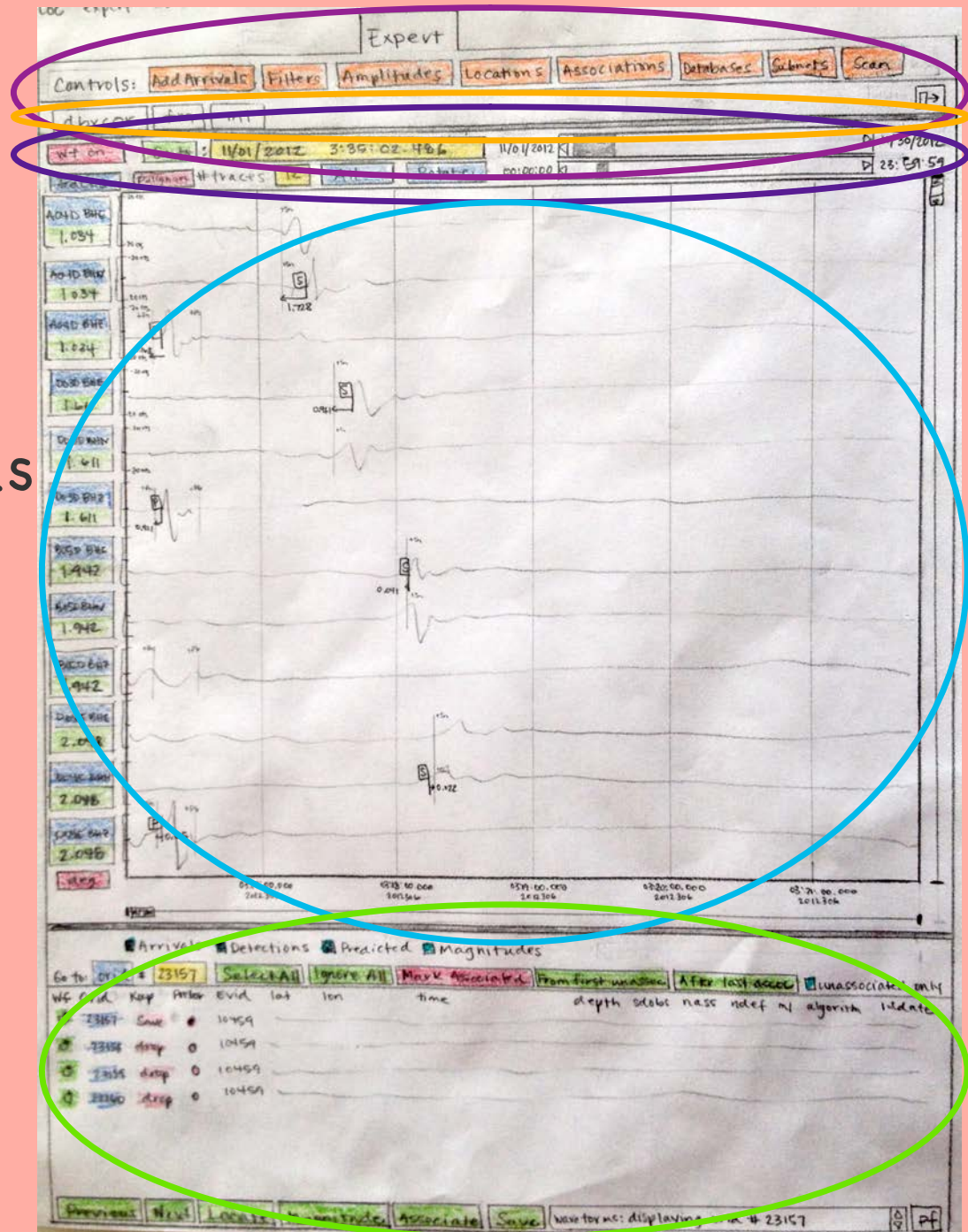
Location	MMI	-	MMI	Comment
Queen Charlotte City	V			
Sandspit	V			
Prince Rupert	IV			
Terrace	III	-	IV	
Kitimat	III			

SAVE

- Dbloc – Notebook Pages
 - Overview
 - Expert
 - Simple
 - Magnitudes
 - Focal Mechanism
 - Moment Tensor
 - Felt

DBLOC - Expert

- Controls
- Programs
- Waveform Controls
- Waveforms
- Origin Pane



Controls

Add Arrivals Filters Amplitudes Locations Associations Databases Subnets Scan

Add Arrivals

Add Arrivals

P	S	Lg	
Pn	Sn	PKKP	
Pb	Sb	PcP	
Pg	Sg	ScP	
Delete	Copy	Paste	pf

Filters

Filters

none	none
local	1-2 Hz INT
regional	1-5 Hz BP
tele	0.8-3 Hz BP
F1	

pf

Locations

Locations

Setup: dblocsat iasp91 options

Starting location

Stations Station

lat 32.8889

lon -117.1051

Depth 5

☒ Fix depth

Maximum Iterations

40

pf

Amplitudes

Amplitudes

Auto

Gain = 1

Gain x 1.2

Gain / 1.2

Gain x 2

Gain / 2

Gain x 10

Gain / 10

Fixed

Invert

Databases

Databases

/tmp

usarray

/home/tcox/catalogs/cit_2012-11

/home/tcox/catalogs/nceec_2012-11

/home/tcox/catalogs/qed-weekly

Scan

movie

play

speed: 1x 2x 4x

slideshow

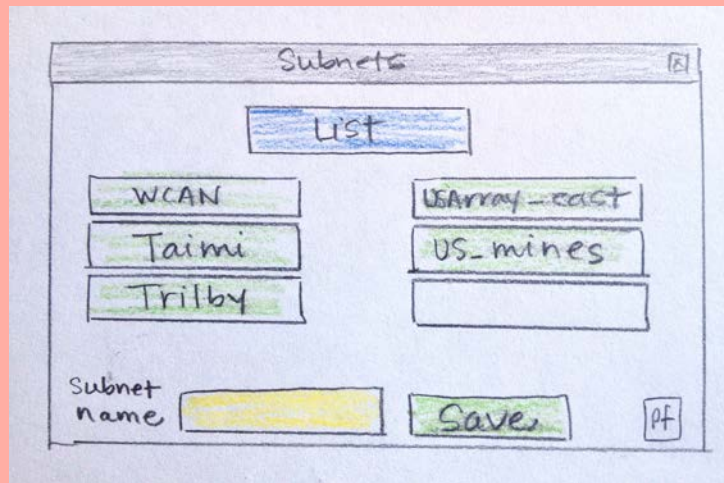
play

speed: max 1x 2x 4x

display time window 1 hr

Controls

-Subnets



Subnets

List

WCAN

Taimi

Trilby

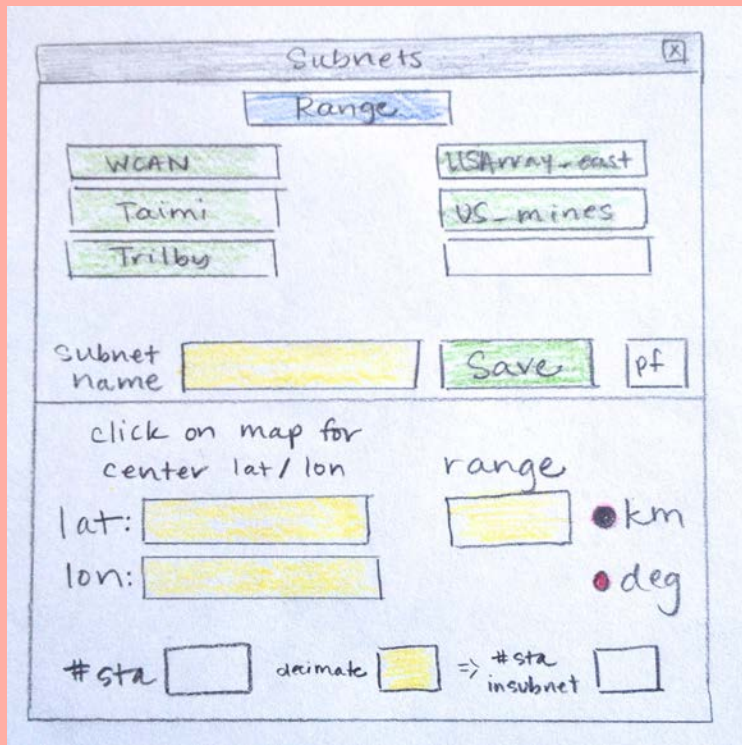
USArray-east

US-mines

Subnet name

Save

pf



Subnets

Range

WCAN

Taimi

Trilby

USArray-east

US-mines

Subnet name

Save

pf

click on map for center lat/lon

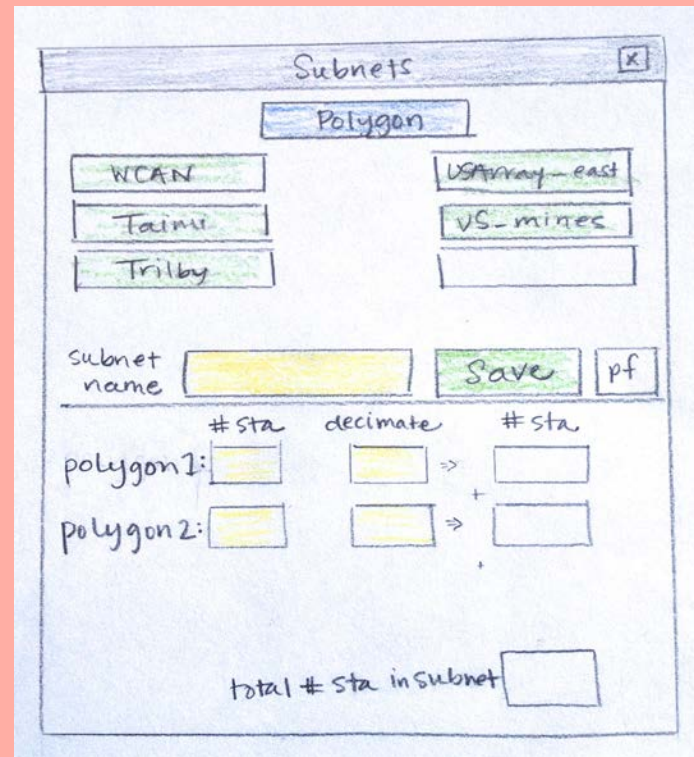
lat:

lon:

range km

☐ deg

#sta decimate $\Rightarrow$ #sta in subnet



Subnets

Polygon

WCAN

Taimi

Trilby

USArray-east

US-mines

Subnet name

Save

pf

#sta decimate #sta

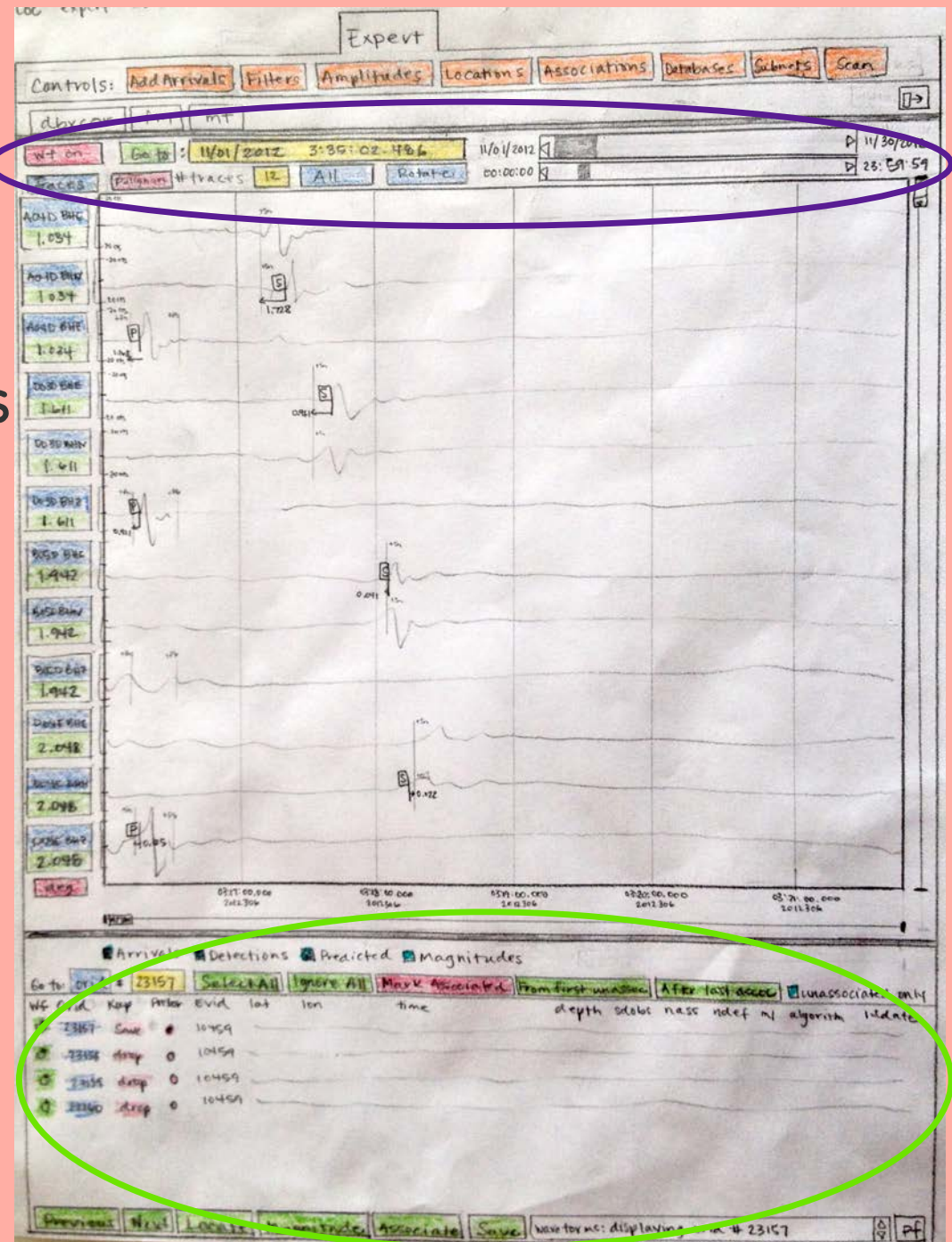
polygon1: $\Rightarrow$

polygon2: $\Rightarrow$

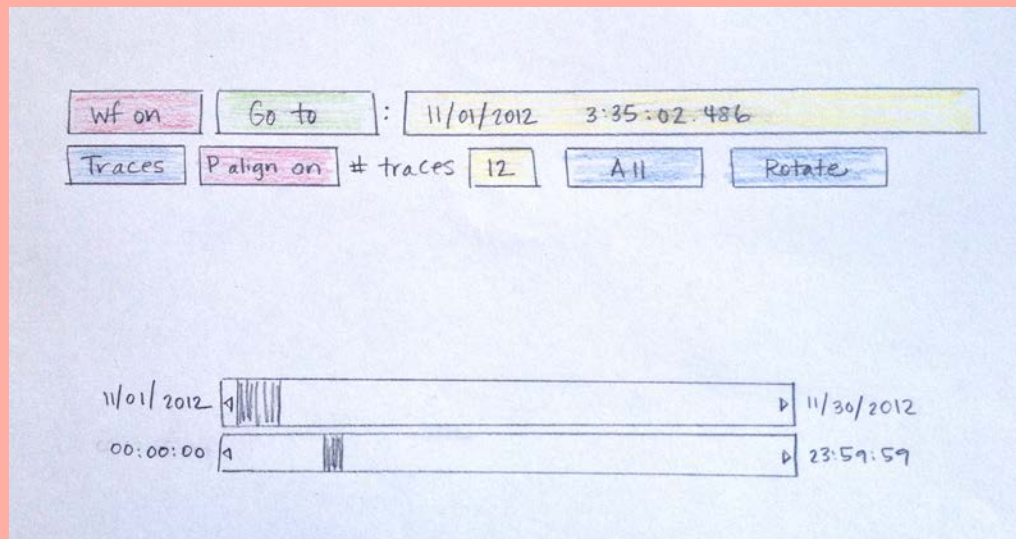
total #sta in subnet

Dbloc - Expert...

- Waveform Controls
- Origin Pane



Waveform Controls



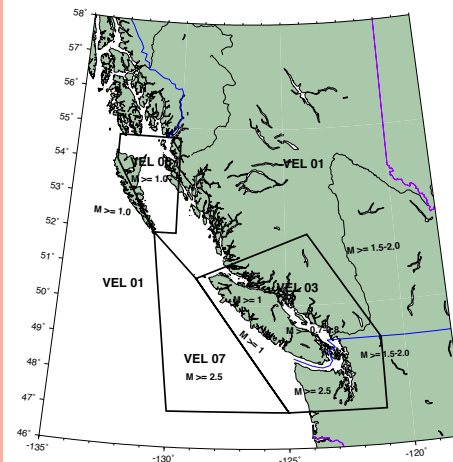
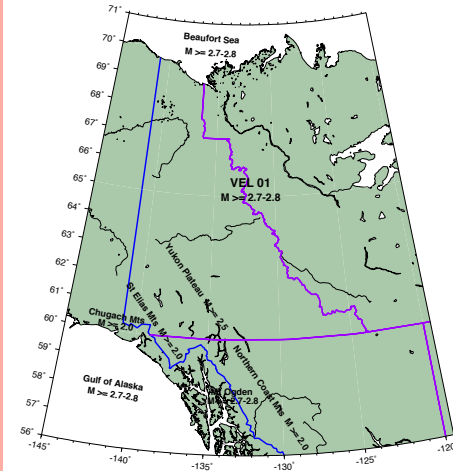
Origin Pane

Arrivals ☒ Detections ☒ Predicted ☒ Magnitudes

Go to: ☐ Unassociated only

US Crd	Mag	Per	Evid	lat	lon	time	depth	slabs	nass	ndef	nj	algorithm	update
2387	Small	0	10459										
2388	drop	0	10459										
2389	drop	0	10459										
2390	drop	0	10459										

view format: displaying crid # 23157



E.G. WESTERN CANADA

Region	Subregion	Completeness level	Velocity model	Depth
Washington state/Utah	lat < 49, lon > -121	ML >= 1.5-2.0	cn01	
NW Washington state	47 >= lat < 49, lon >= -121 NOTE: Lat <= 48 and well located by UW, fix PGC soln to UW soln.	ML >= 2.5	cn03	
SW BC	Southern VI	ML >= 0.7-0.8	cn03	free
	Northern VI	ML >= 1.0		
	Offshore NAM plate	ML >= 1.0		
	Southern Coast Mountains	ML >= 0.7-0.8		
	Offshore VI	ML(Sn) >= 2.5	cn07	1, 5 km if no stn >= 50 km
Queen Charlotte Islands	Eastern QC, Dixon Entrance, Hecate Strait	ML >= 1.0	cn06	10 km
	Western QC, QC fault	ML >= 1.0	cn01	free
SE BC & Alberta		ML,mb(Lg) > 1.5-2.0	cn01	20 km
Northern BC, YT, & western NWT	lon >= -140	ML >= 2.7-2.8	cn01	
	-145 <= lon <= -141	ML > 3.0		
	Northern Coast Mountains	ML > 2.0		1, 5, 10 km
	Northern Coast Mountains (Mt. Ogden swarms)	ML >= 2.7-2.8		5 km
	Southeastern Alaska (Panhandle)	ML >= 2.0		1, 5, 10 km
				Fairweather fault = 1 km
				Glacier Bay = 10 km
	Gulf of Alaska	ML >= 2.7-2.8		10 km
	Chugach Mts, Alaska	ML >= 2.0		1, 5, 10 km
	St. Elias Mts	ML >= 2.0		1, 5, 10 km
	Richardson Mountains, YT/NWT	ML >= 2.7-2.8		20 km
	Ogilvie Mountains, YT	ML >= 2.7-2.8		1, 5, 10 km
	Wernecke Mountains, YT	ML >= 2.7-2.8		1, 5, 10 km
	MacKenzie Mountains, NWT	ML >= 2.7-2.8		1, 5, 10 km
	Yukon Plateau	ML >= 2.5		1, 5, 10, 15 km
	Beaufort Sea	ML(Sn),mb,Ms >= 2.7-2.8		35 km

Verify regional rules – catalogue consistency

- What might this look like?:

Start_time	End_time	Region	Subregion	Completeness level: $M \geq x$	Velocity model	Depth
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- Catalogue time histories:

Location Program History

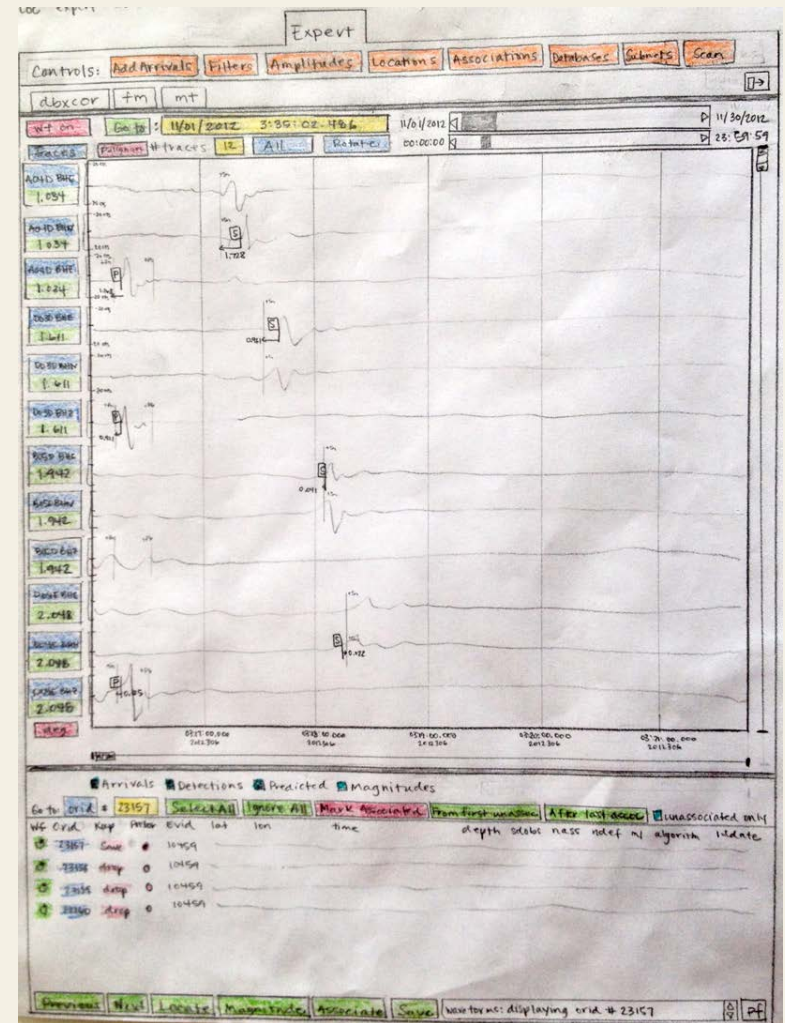
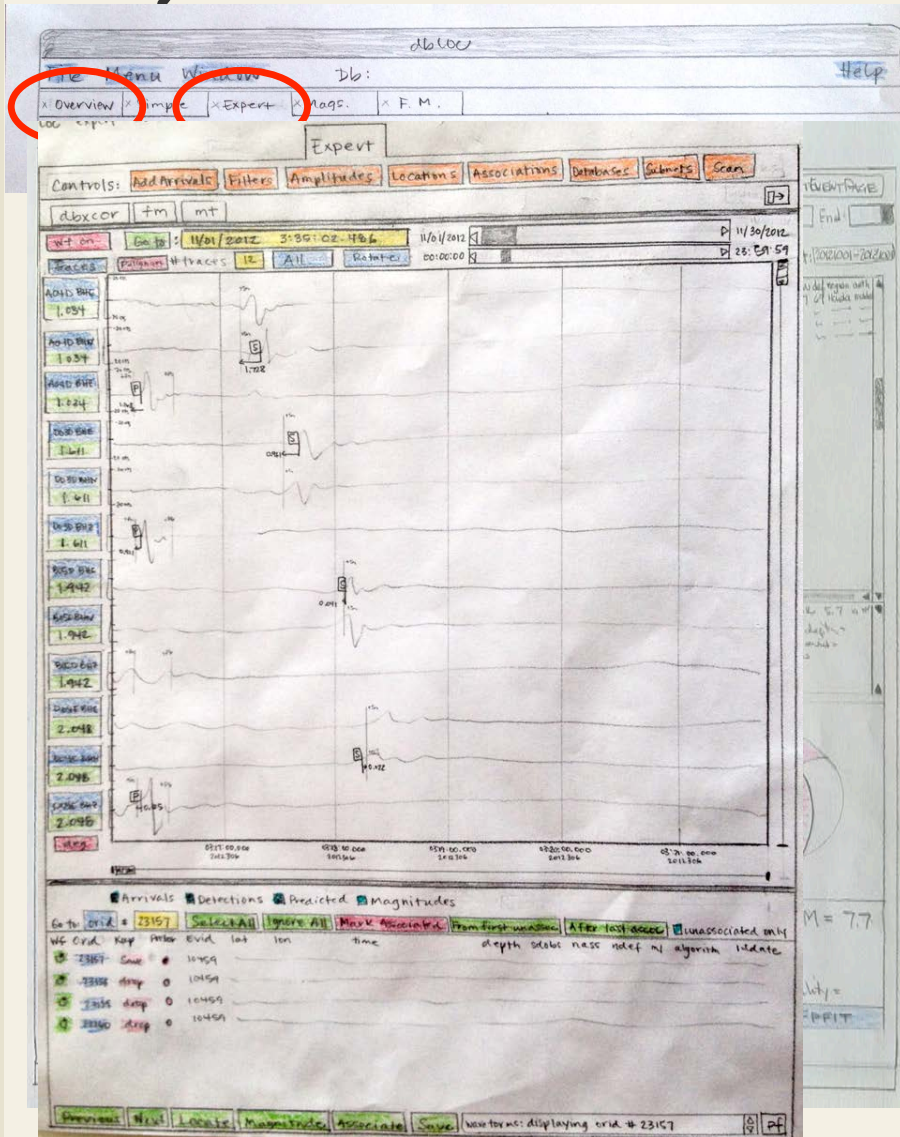
Year	Location Programs
prior to 1972	Hand locations
1972 – 1976	CANCESS
1976 – 1980	CANCESS; for southwestern BC – Hypo71
1980 – 1991	CANCESS; for southwestern BC – Hypoellipse
1991 – 2006	LocEq
2006 to present	Genloc

Date	Change	Details
2004 11 01	$M_w' = M_L(S_n) + 0.6$ Offshore VI (all events within JDF plate system)	-interim magnitude before $M_w(JR)$ is released, specifically wrt web and media -2004 Nov offshore swarm
2002 11 01	Denali aftershocks $M \geq 2.5$	
2002 11 03	Denali aftershocks $M \geq 3.0$	Denali mainshock $M=7.9$
2000 01 01	For earthquakes fix depth to 1.0 km (previously fixed to 0km), For blasts fix depth to 0 km.	Rupture never starts at the surface, it starts at some depth and moves upwards. Assumption is that the minimum realistic depth rupture could commence would be 1km. Hence if an event free depth wants to be 0km, this cannot be true, so fix event to 1km depth.

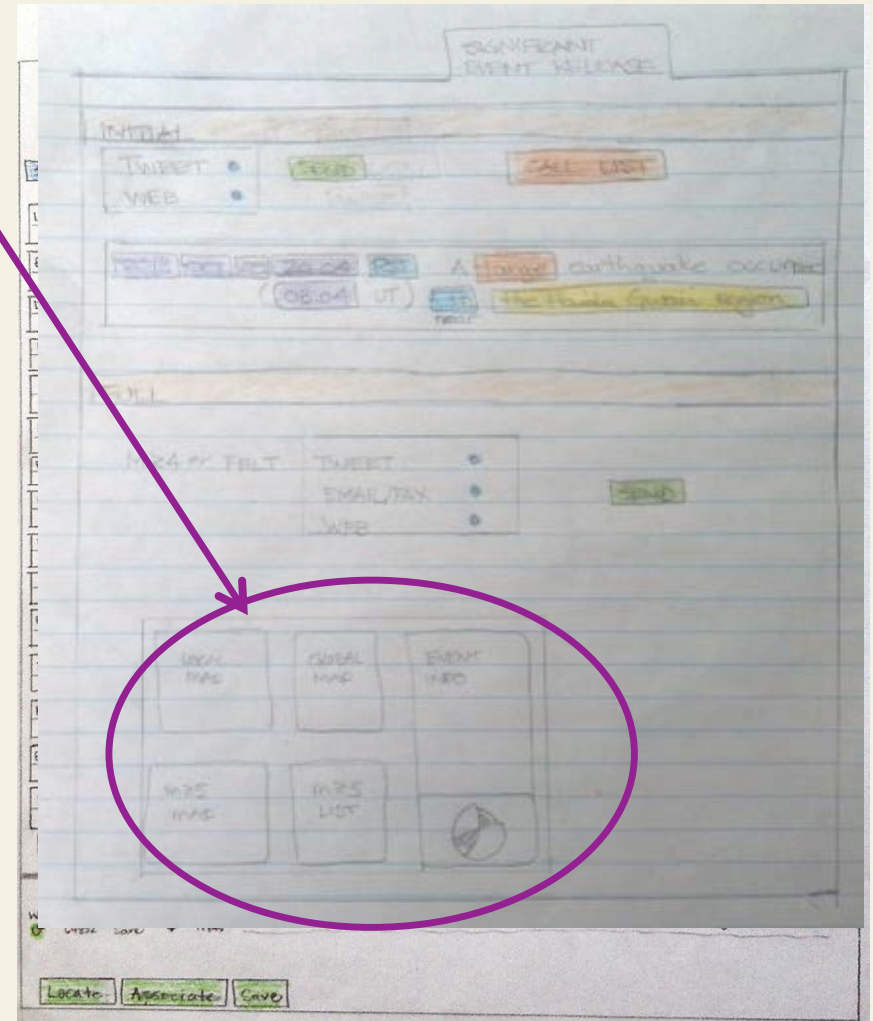
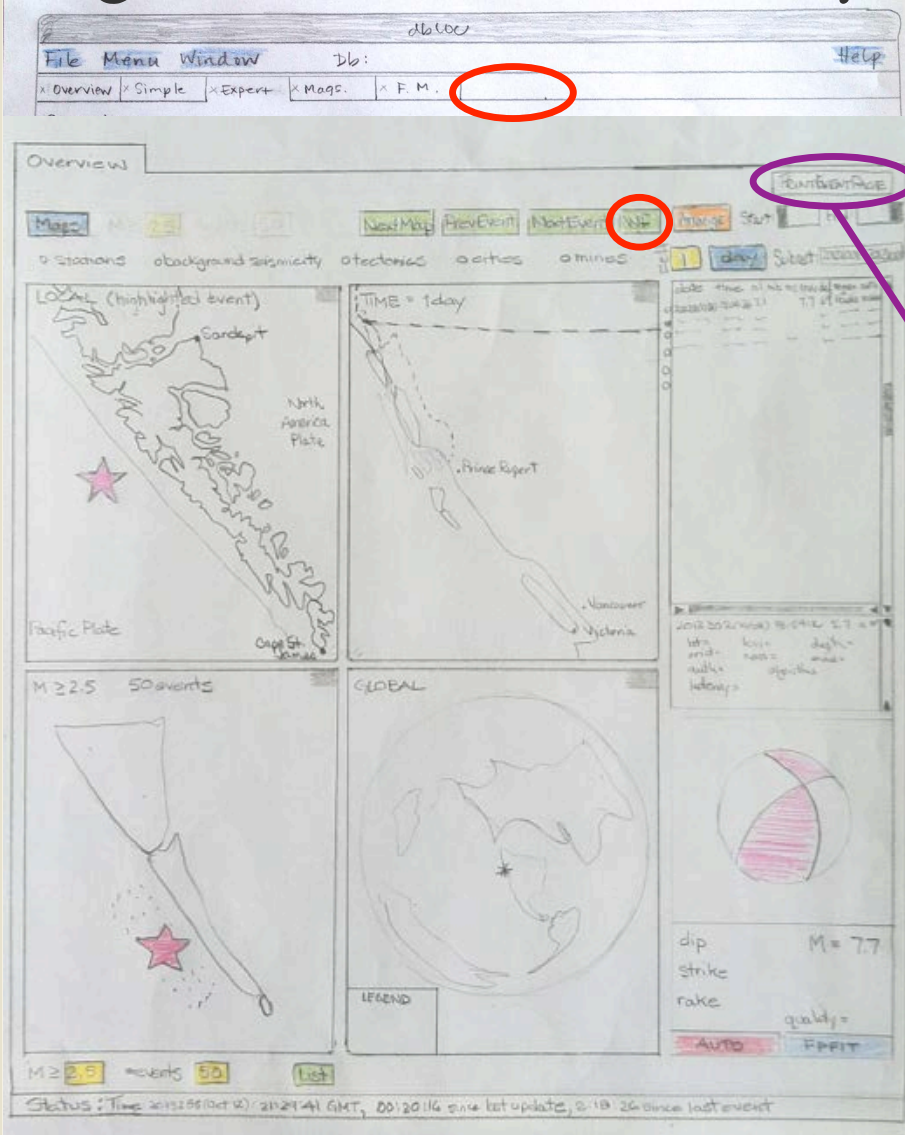
MINI STORYBOARD

HOW TOs

Daily Event Location



Significant Event Response





MORE IDEAS?!

