rtdemo_anza

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Antelope User Group Meeting, ZAMG, Vienna
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Objectives

- **Provide local/regional live demo similar to `rtdemo_gsn` using data from Anza network**
- **Will become a tuning testbed**
- **Can be used as a first-pass configuration template**
- **First version tuned for rapid results from small earthquakes**

BRTT

Kinemetrics

rtdemo_anza rtm

Anza processing demo

File Edit View Refresh — Antelope dev — 2017-143 19:09

Start / Stop — System is up

Load Average: 1min 3.42 | 5min 2.70 | 15min 2.42

Cpu Usage (24 cpus): 300 processes

Memory Usage: ram 65536 Mb | swap 32768 Mb

Disk Usage: root, logs

Orb Ring Buffer Status :anzademo — pkts/s 17 connections — In 26.404 — Out 79.212

Processing Tasks

Task	Pid	cpu	cpu	rss	rss	To Orb	To Orb	From Orb	From Orb	Latency	Latency
rtexec	46745	0.00	10.00	11.5	10000						
orbserver	47044	0.10	10.00	5138.0	10000						
orb2db	47100	0.20	10.00	7.8	10000	0.0 bps	50.00	26.4 Kbps	10000000	2.545 seconds	5000
orb2dbt	47165	0.00	10.00	9.3	10000	0.0 bps	50.00	0.0 bps	10000000	48.387 seconds	5000
orbdetectP	47229	0.20	10.00	14.0	10000	0.0 bps	50.00	26.4 Kbps	10000000	2.545 seconds	5000
orbdetectS	47299	0.30	10.00	16.6	10000	0.0 bps	50.00	26.4 Kbps	10000000	2.545 seconds	5000
orbassoc	47354	7.20	10.00	40.6	10000	0.0 bps	50.00	0.0 bps	10000000	48.387 seconds	5000
magnitude	47414	0.00	10.00	58.0	10000	0.0 bps	50.00	0.0 bps	10000000	2:43 minutes	5000
AZimport	47497	0.40	10.00	17.5	10000	26.4 Kbps	50.00	0.0 bps	10000000	2.545 seconds	5000
USGSimport	47584	0.00	10.00	51.1	10000	0.0 bps	50.00	0.0 bps	10000000	2:43 minutes	5000
USGScatalog	47683	0.00	10.00	50.0	10000	0.0 bps	50.00	0.0 bps	10000000	1:40 minutes	5000
orb2catalog	47788	0.00	10.00	6.9	10000	0.0 bps	50.00	0.0 bps	10000000	N/A	5000

Cron Job Status — *patches* — *rtdbclean*

Network Operation

processes | Orbstat | Dlmon | ORB_Data | DB_data | Event_Map | Grid_Map | Stations_Map

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- **`orb2db`** instead of **`orb2wf`**
- Two different **`orbdetect`** instances
- Customized **`Mlrichter.pm`**
- Tuned for rapid pick list processing in **`orbassoc`**

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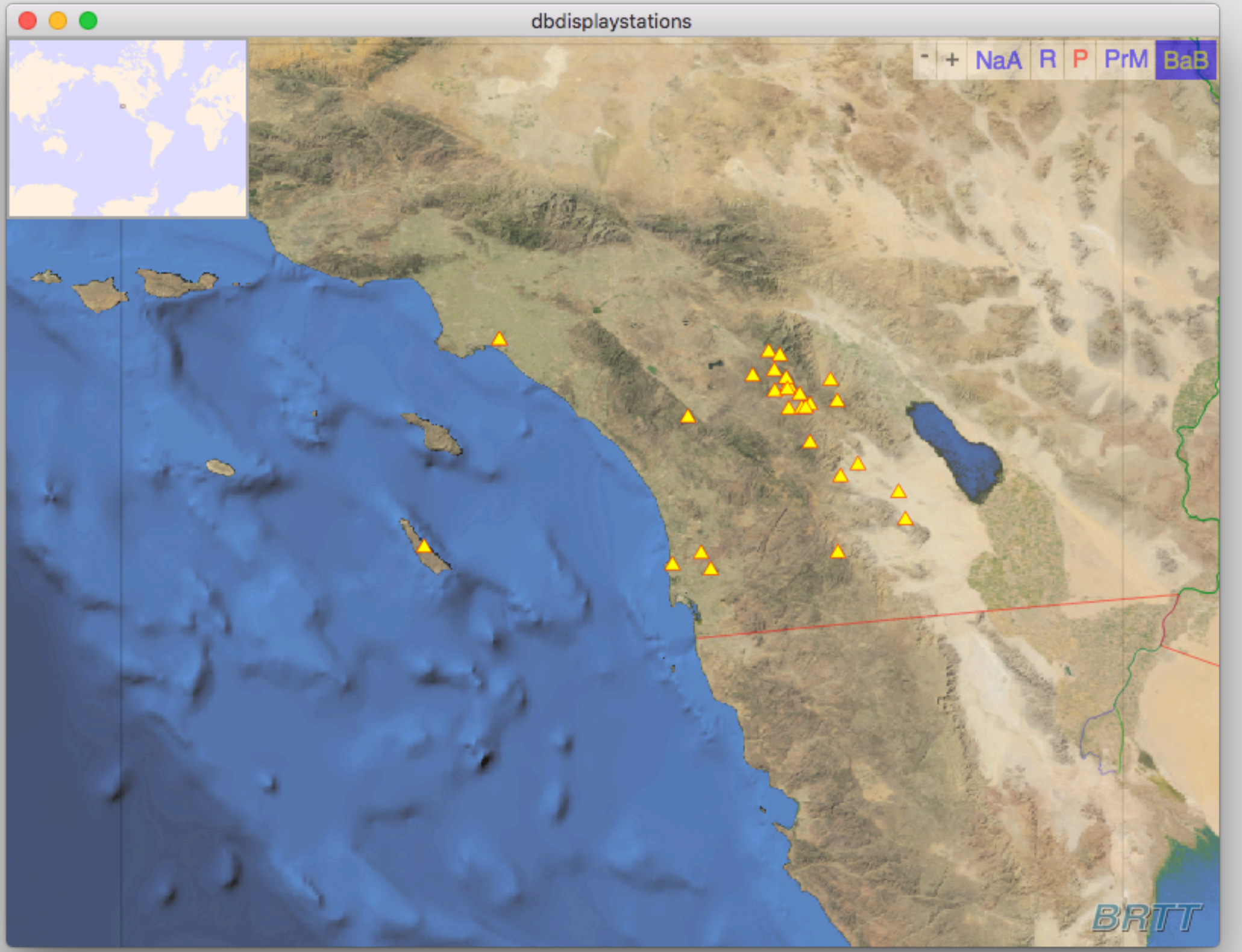
Kinemetrics

stations



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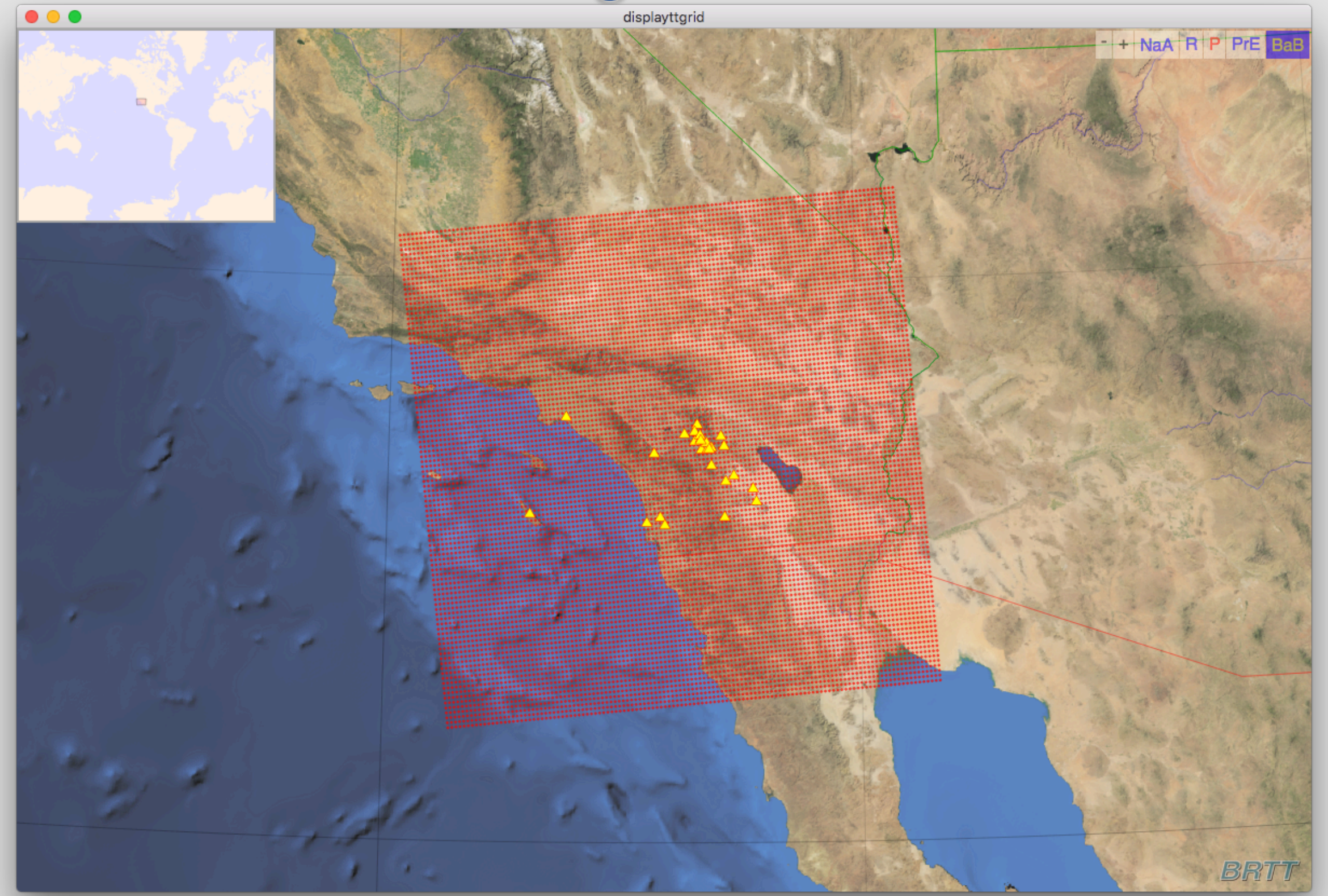
Kinemetrics

grid



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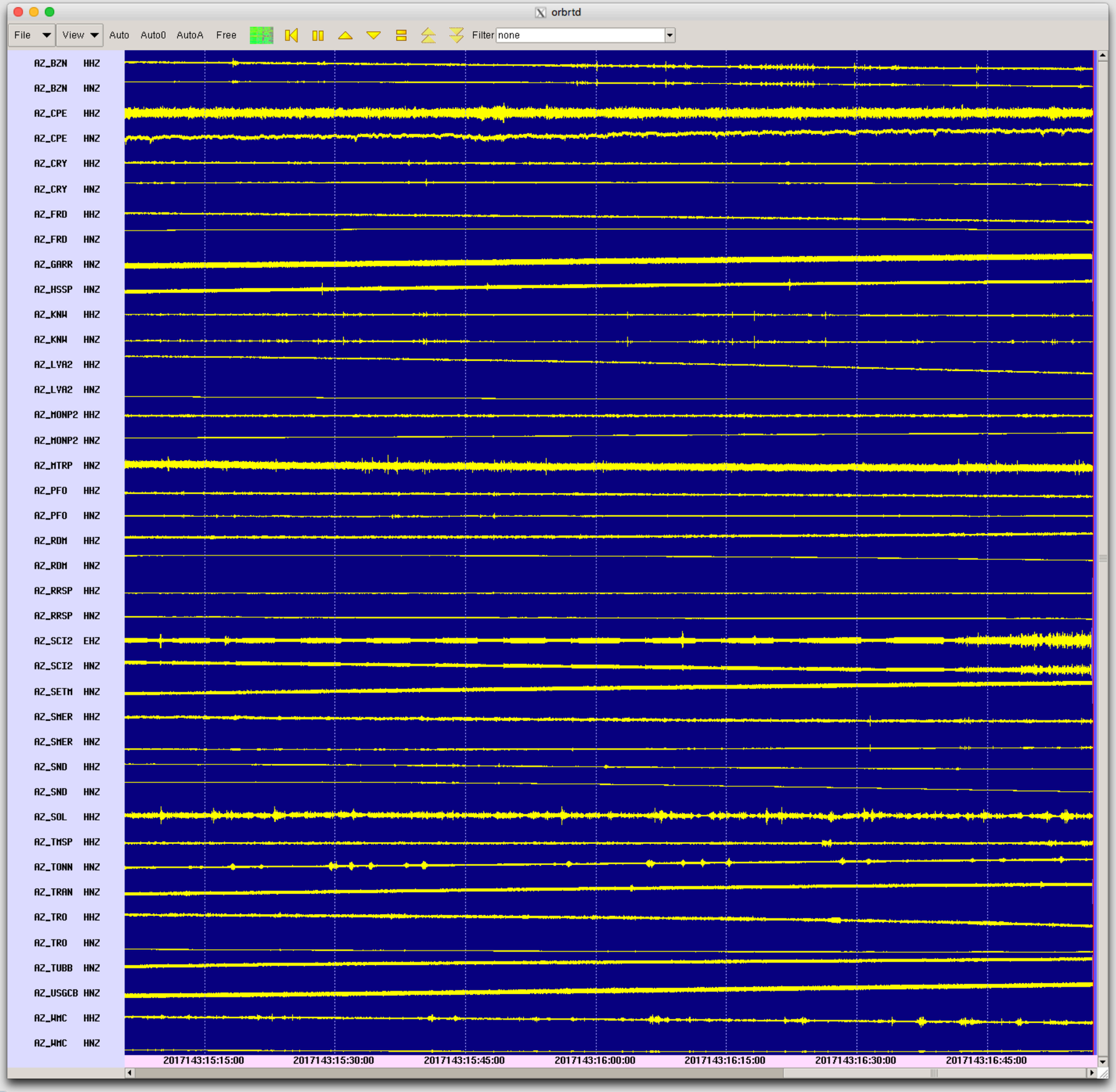

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Kinemetrics

rtdemo_anza – orbdetect_P.pf

```
iphase      D   # default iphase for detections
maxfuturetime   600.0   # Maximum number of seconds after system wall clock time
otime_noise_tfac 1.0    # ratio of noise tapering time constant to
            #  signal tapering time constant for onset
            #  time estimation
goodvalue_min   0   # Minimum "good" data value
goodvalue_max   0   # Maximum "good" data value

#   At least one default band must be set set up in the bands table
#   parameter values override default values above for each band

bands   &Tbl{
    &Arr{
        sta_twin        2.0
        sta_tmin    2.0
        sta_maxtgap     0.1
        lta_twin        20.0
        lta_tmin    20.0
        lta_maxtgap     0.1
        pamp        500.0
        filter      BW 0.8 4 3.0 4
        iphase      t
        nodet_twin  0.0 # no detection if on time is less than this
    }
    &Arr{
        sta_twin        0.5
        sta_tmin    0.5
        sta_maxtgap 0.1
                thresh      5.0
                threshoff   2.5
        lta_twin        10.0
        lta_tmin    10.0
        lta_maxtgap 0.1
        pamp        500.0
        filter      BW 10.0 4 0.0 0
        iphase      lp
        nodet_twin  0.0 # no detection if on time is less than this
    }
}
#   At least one data channel must be specified in the netstachanlocs table

netstachanlocs  &Tbl{
    .*_[HE]HZ
}


```

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Kinemetrics

rtdemo_anza – orbdetect_S.pf

orbdetect_S.pf

.dbpickrc | orbdetect_S.pf

```
18  latency     0   # input packet pipe latency (per channel) in packets
19  h       0   # plot channel height in pixels
20  filter      none    # default filter
21  iphase      D   # default iphase for detections
22  maxfuturetime   600.0   # Maximum number of seconds after system wall clock time
23  otime_noise_tfac 1.0    # ratio of noise tapering time constant to
24              #  signal tapering time constant for onset
25              #  time estimation
26  goodvalue_min   0   # Minimum "good" data value
27  goodvalue_max   0   # Maximum "good" data value
28
29  #   At least one default band must be set set up in the bands table
30  #   parameter values override default values above for each band
31
32  bands   &Tbl{
33      &Arr{
34          sta_twin    1.0
35          sta_tmin    1.0
36          sta_maxtgap 0.1
37          lta_twin    5.0
38          lta_tmin    5.0
39          lta_maxtgap 0.1
40          det_tmin    2.0 # detection minimum on time
41          det_tmax    5.0 # detection maximum on time
42          thresh      4.0
43          threshoff   2.5
44          pamp        500.0
45          filter      BW 2.0 4 10.0 4
46          iphase      ls
47      }
48  }
49  #   At least one data channel must be specified in the netstachanlocs table
50
51  netstachanlocs  &Tbl{
52      .*_[HE]H[NE12]
53  }
54
55
```

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Kinemetrics

How to tune the detector parameters?

- Parameters need to be tuned according to the data and the network and seismicity geometry.
- The most important parameter is the `filter` parameter.
- You need to look at event data from your network and determine what filters will give you the best event signal to noise enhancements.
- **`dbspgram`** is your friend.

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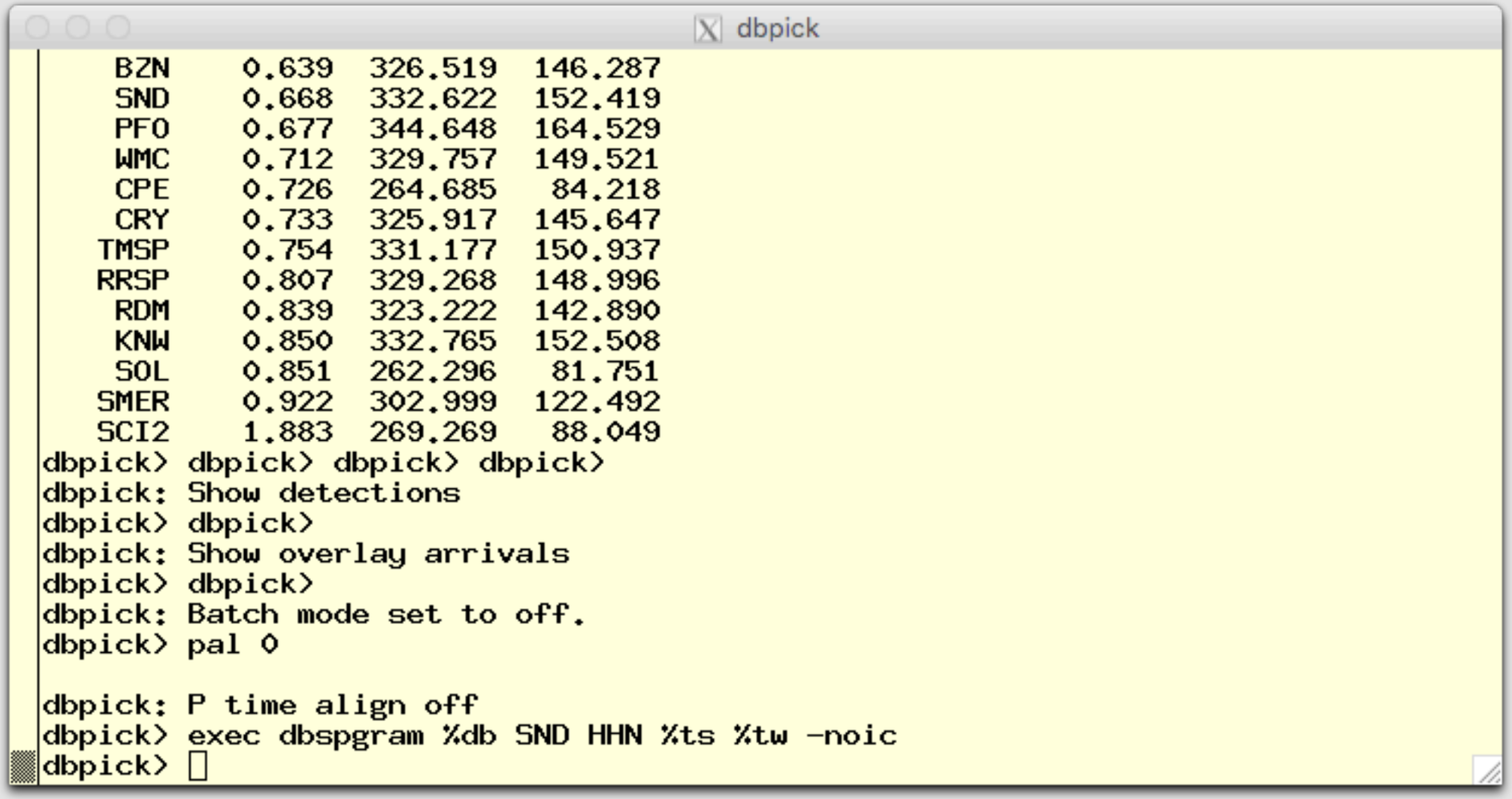
Running dbspgram

- Get an event waveform in your **dbpick** window.
- Type the following in the **dbpick** typein window:



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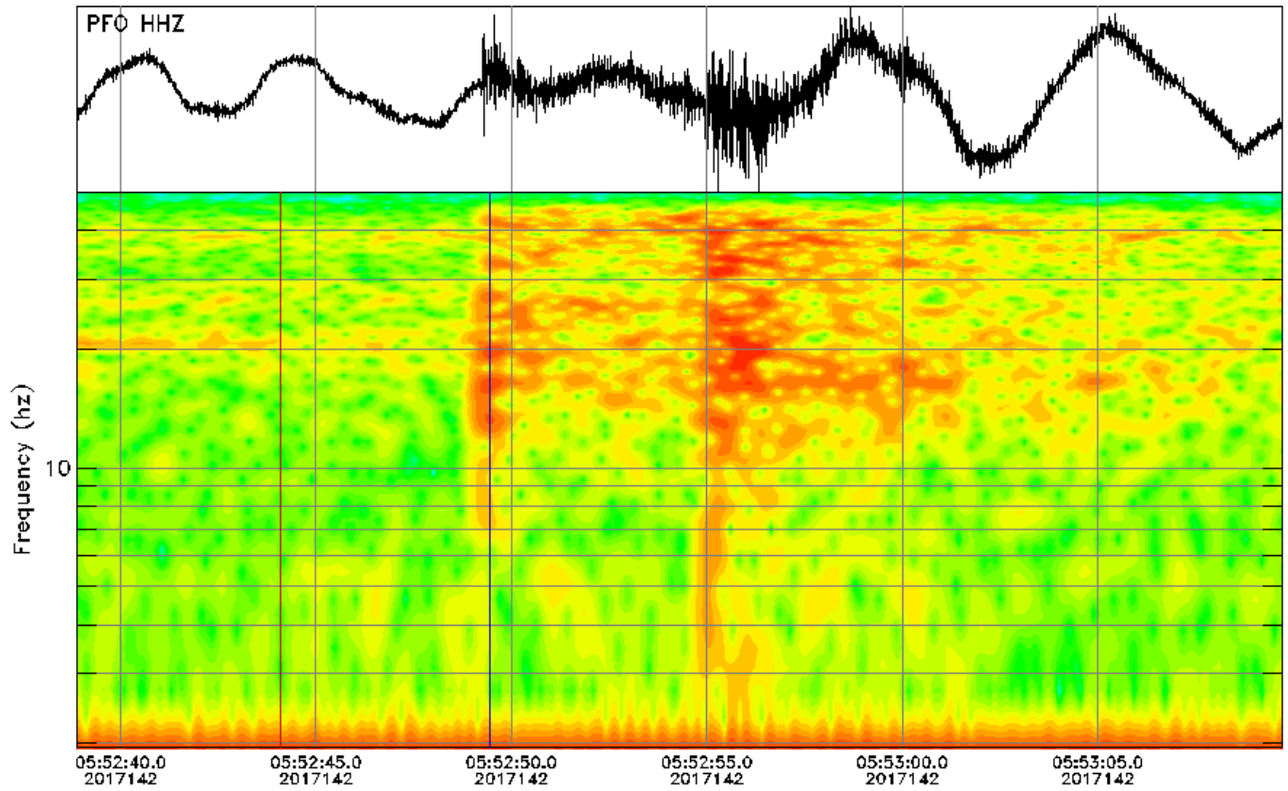
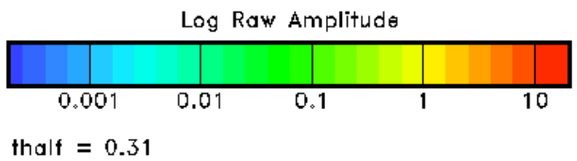
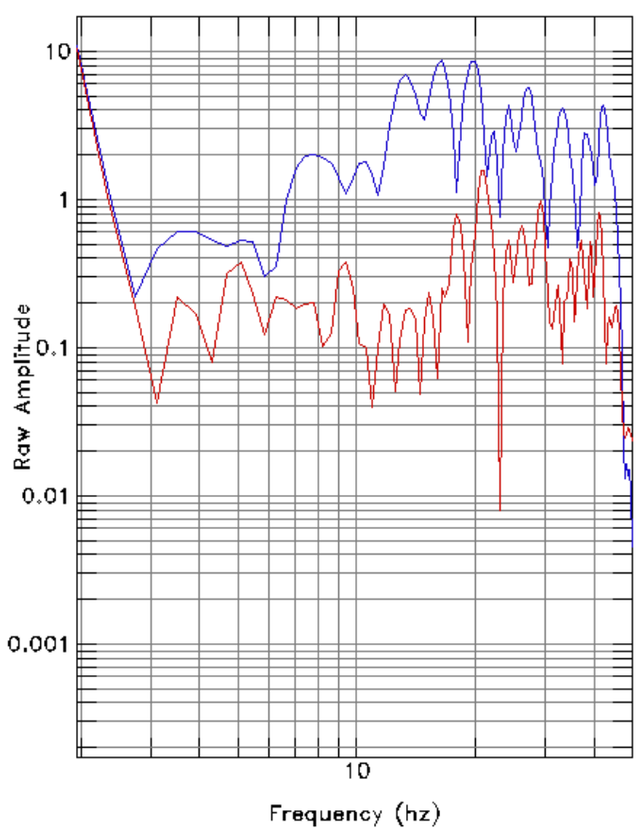
Kinemetrics

dbspgram





thalf = 0.31



Instrument Correction: None

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Kinemetrics

rtdemo_anza – orbdetect_P.pf

```
iphase      D   # default iphase for detections
maxfuturetime   600.0   # Maximum number of seconds after system wall clock time
otime_noise_tfac 1.0    # ratio of noise tapering time constant to
            #  signal tapering time constant for onset
            #  time estimation
goodvalue_min   0   # Minimum "good" data value
goodvalue_max   0   # Maximum "good" data value

#   At least one default band must be set set up in the bands table
#   parameter values override default values above for each band

bands   &Tbl{
    &Arr{
        sta_twin        2.0
        sta_tmin    2.0
        sta_maxtgap     0.1
        lta_twin        20.0
        lta_tmin    20.0
        lta_maxtgap     0.1
        pamp        500.0
        filter      BW 0.8 4 3.0 4
        iphase      t
        nodet_twin  0.0 # no detection if on time is less than this
    }
    &Arr{
        sta_twin        0.5
        sta_tmin    0.5
        sta_maxtgap 0.1
                thresh      5.0
                threshoff   2.5
        lta_twin        10.0
        lta_tmin    10.0
        lta_maxtgap 0.1
        pamp        500.0
        filter      BW 10.0 4 0.0 0
        iphase      lp
        nodet_twin  0.0 # no detection if on time is less than this
    }
}
#   At least one data channel must be specified in the netstachanlocs table

netstachanlocs  &Tbl{
    .*_[HE]HZ
}


```

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Kinemetrics

How to tune the detector parameters?

- For S-arrival detectors you need to consider the shadowing effect of the P-arrival and associated coda.
- You need to look for a frequency range that tends to filter out the P-arrival and associated coda but still enhance the S-arrival.
- Generally, the S-detector filter will be in a lower frequency range than the P-detector filter.
- The S-detector time window parameters will also probably need adjustment in cases where stations are close to events (short S-P times)

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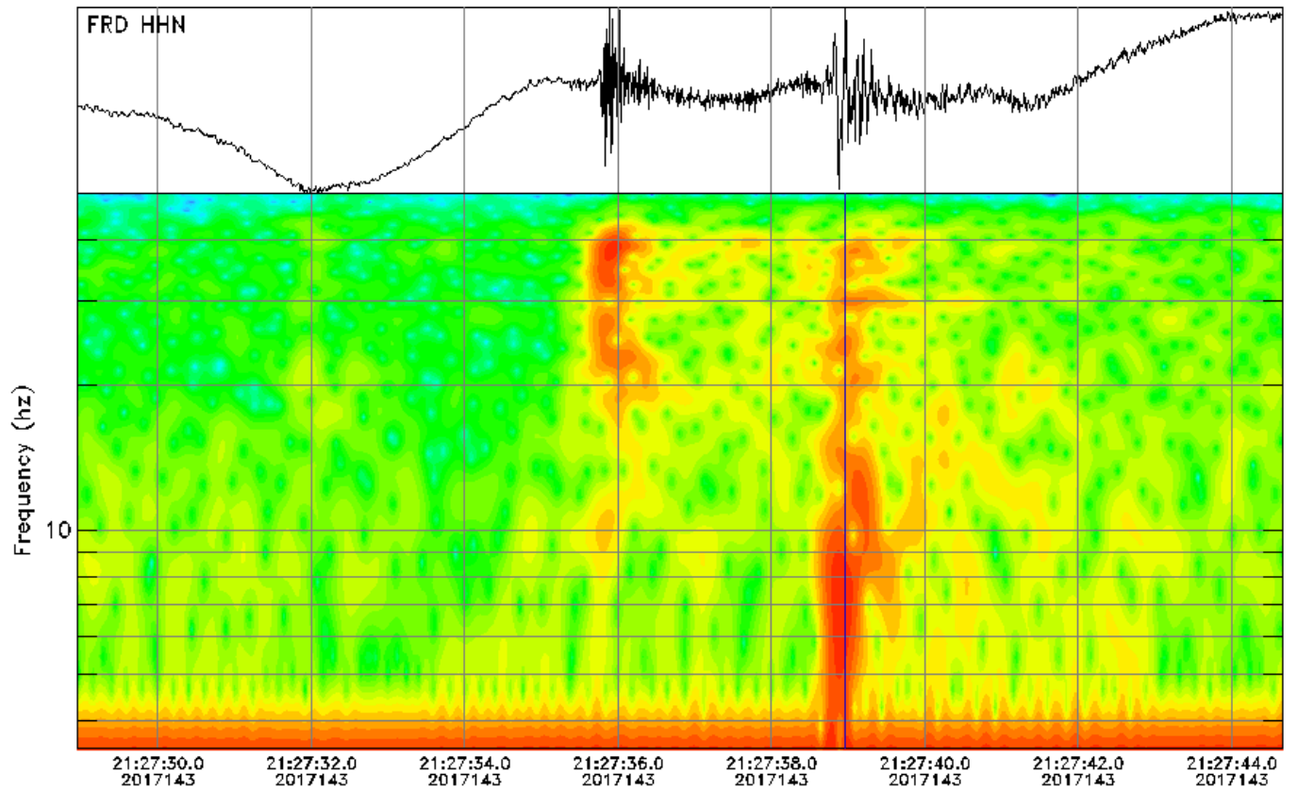
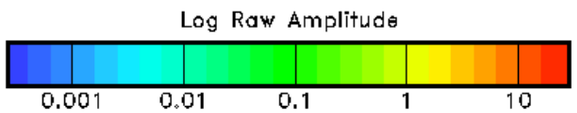
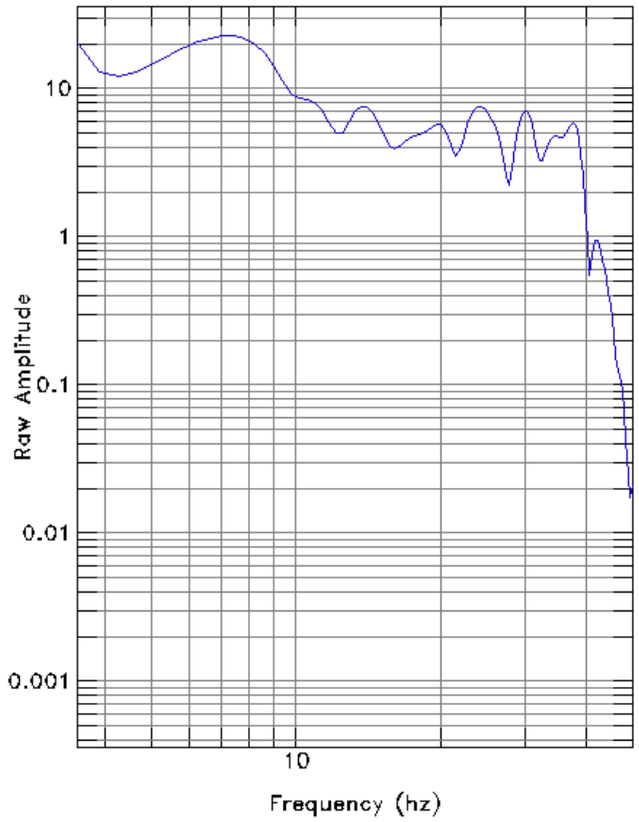
Kinemetrics

dbspgram





thalf = 0.16



Instrument Correction: None

BRTT dbspgram: /Volumes/Extra/rtsystems/rtdemo•anza/db/anza none danny Tue M

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Kinemetrics

rtdemo_anza – orbdetect_S.pf

orbdetect_S.pf

.dbpickrc | orbdetect_S.pf

```
18  latency     0   # input packet pipe latency (per channel) in packets
19  h       0   # plot channel height in pixels
20  filter      none    # default filter
21  iphase      D   # default iphase for detections
22  maxfuturetime   600.0   # Maximum number of seconds after system wall clock time
23  otime_noise_tfac 1.0    # ratio of noise tapering time constant to
24              #  signal tapering time constant for onset
25              #  time estimation
26  goodvalue_min   0   # Minimum "good" data value
27  goodvalue_max   0   # Maximum "good" data value
28
29  #   At least one default band must be set set up in the bands table
30  #   parameter values override default values above for each band
31
32  bands   &Tbl{
33      &Arr{
34          sta_twin    1.0
35          sta_tmin    1.0
36          sta_maxtgap 0.1
37          lta_twin    5.0
38          lta_tmin    5.0
39          lta_maxtgap 0.1
40          det_tmin    2.0 # detection minimum on time
41          det_tmax    5.0 # detection maximum on time
42          thresh      4.0
43          threshoff   2.5
44          pamp        500.0
45          filter      BW 2.0 4 10.0 4
46          iphase      ls
47      }
48  }
49  #   At least one data channel must be specified in the netstachanlocs table
50
51  netstachanlocs  &Tbl{
52      .*_[HE]H[NE12]
53  }
54
55
```

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Kinemetrics

rtdemo_anza – orbassoc.pf

orbassoc.pf

```
process_time_window 600.0       # 10 minute time window
process_ncycle      50      # every 50 new detections
process_timeout     5.0     # every five seconds

schema          css3.0

grid_params &Arr{
    socal  &Arr{
        nsta_thresh &Tbl{       # Minimum allowable number of stations
                                #     expressed as a function of maximum
                                #     source-receiver distance
            0.5     4
            1.0     5
            2.0     6
            180.0   6
        }
        nxd     11  # Number of east-west grid nodes for depth scans
        nyd     11  # Number of north-south grid nodes for depth scans
        cluster_twin    0.5 # Clustering time window
        try_S       no  # yes = Try observations as both P and S
                        # no  = Observations are P only
        associate_S yes # yes = Try to associate S arrivals
        reprocess_S yes # yes = Relocate with new S associations
        P_channel_sifter ..Z
        S_channel_sifter ..[NE12]
        phase_sifter    l.  # only use picks with phase "lp" or "ls"
        auth            Ol  # set origin auth field to "orbassoc_l"
        priority    10
        closest_stations 30
        drop_if_on_edge     yes
        relocate    rundbgenloc # use dbgenloc to relocate
        relocate_params &Arr{
            depth_floor 15.0    # set dbgenloc.pf depth_floor
        }
        use_only_relocation yes
        number_threads      4   # use 4 threads for grid search
    }
    tele &Arr{
        nsta_thresh 8   # Minimum allowable number of stations
        cluster_twin    1.5 # Clustering time window
        try_S       no  # yes = Try observations as both P and S
                        # no  = Observations are P only
        P_channel_sifter ..Z
        phase_sifter    t   # only use picks with phase "t"
        priority    1
        auth            Ot  # set origin auth field to "Ot"
    }
}
```

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How to tune the associator parameters?

- Parameters need to be tuned according to the network and seismicity geometry and to achieve latency requirements.
- It is usually advisable to include some kind of teleseismic grid and to add teleseismic detections on vertical channels.
- The most effective parameter for achieving minimum stations, low latency locations as well as minimizing spurious associations is using the `nsta_thresh` table input.
- Match `cluster_twin` with the grid spacing and the expected residuals.
- Match `phase_sifter` with appropriate detection bands.
- Match `P_channel_sifter` and `S_channel_sifter` with appropriate channels

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Kinemetrics

rtdemo_anza – orbevproc.pf

orbevproc.pf

orbassoc.pf × | orbevproc.pf ×

```
#    This is the orbevproc parameter file

max_events_to_thread    100 # maximum number of events to process concurrently

#    This is the list of processing modules to be run

event_processes &Tbl{
    #perl_file  perl_class      parameters
    Magnitude.pm
    pf/Mlrichter.pm Mlrichter       mlrichter_params
}

#    These are parameter templates for each of the processing modules

mlrichter_params &Arr{
    channels &Tbl{
#   snet_expr chan_expr                 noise_twin signal_twin  snr_thresh
#          sta_expr      filter                    noise_toffset signal_toffset
        .* .*     [EH]H[12NE]  auto                30.0 10.0  70.0    10.0 2.0
    }
    reject &Tbl{
#   snet_expr sta_expr
    PB    B946
    }
    update_time     10.0
    maximum_wait_time   300.0
    maximum_bad_fraction    0.2
    station_number_minimum  4
    uncertainty_maximum 0.5
    auth_accept     0.*
    output_magtype      ml
    output_auth     orbevproc
    output_stamag       yes
    output_wfmeas       no
}
```

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Kinemetrics

Custom Mlrichter.pm

```
92          (580.0,          4.9),
93          (590.0,          4.9),
94          (600.0,          4.9) ) ;
95
96      sub compml {
97          my $self = shift ;
98          my $sta = shift ;
99          my $millimeters = shift ;
100
101         my $distance = $self->{stations}{$sta}{delta}*111.11 ;
102         my $depth = $self->{stations}{$sta}{odepth} ;
103
104         if ($distance < 0.0 || $distance > 600.0) {return;}
105         if ($distance < 2.0 * $depth) {return;}
106         if ( $millimeters <= 0.0 ) {return;}
107         my $i;
108         for ($i=0; $i<scalar(@mltab); $i+=2) {
109             if ($distance <= $mltab[$i]) {last;}
110         }
111         my $ml = log($millimeters)/log(10) + $mltab[$i+1];
112         return $ml ;
113     }
114
115     sub new {
116         return Magnitude::new @_ ;
117     }
118
```

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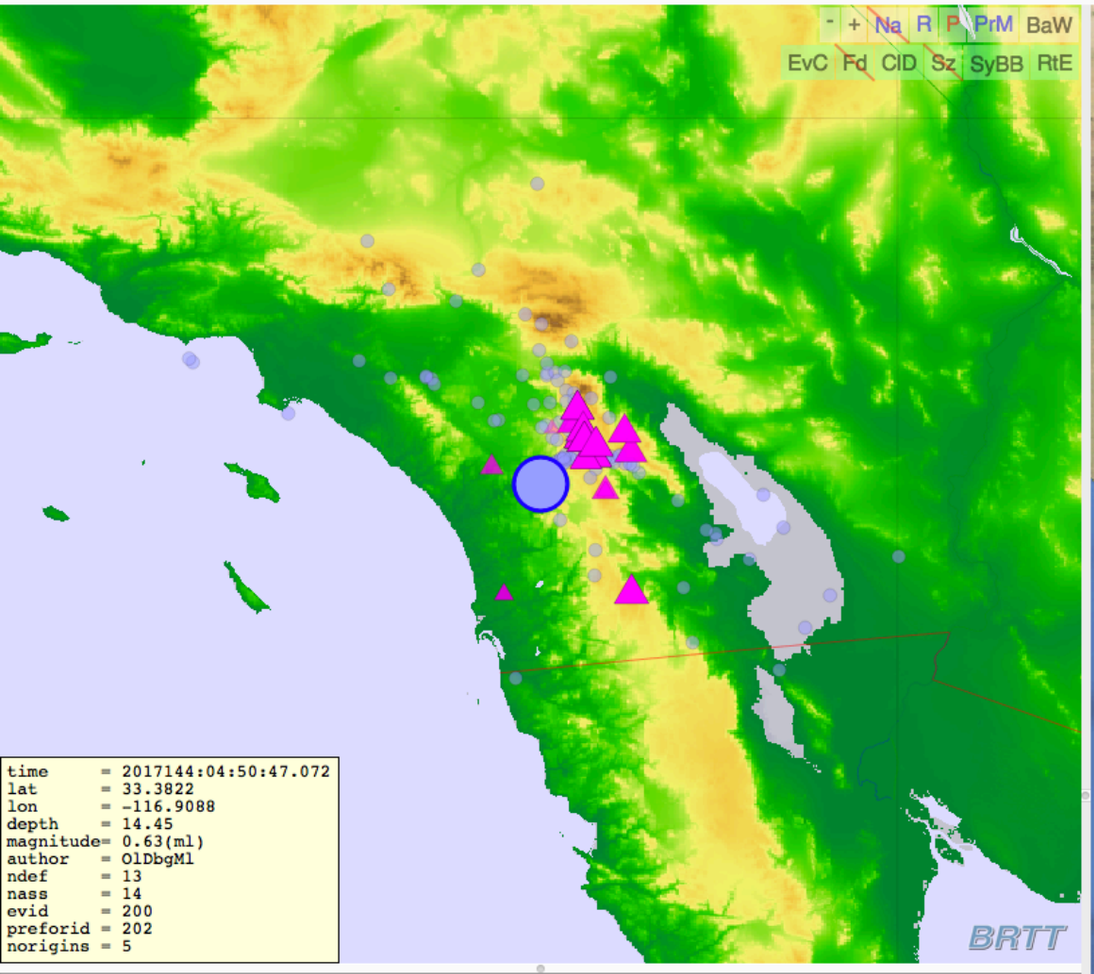
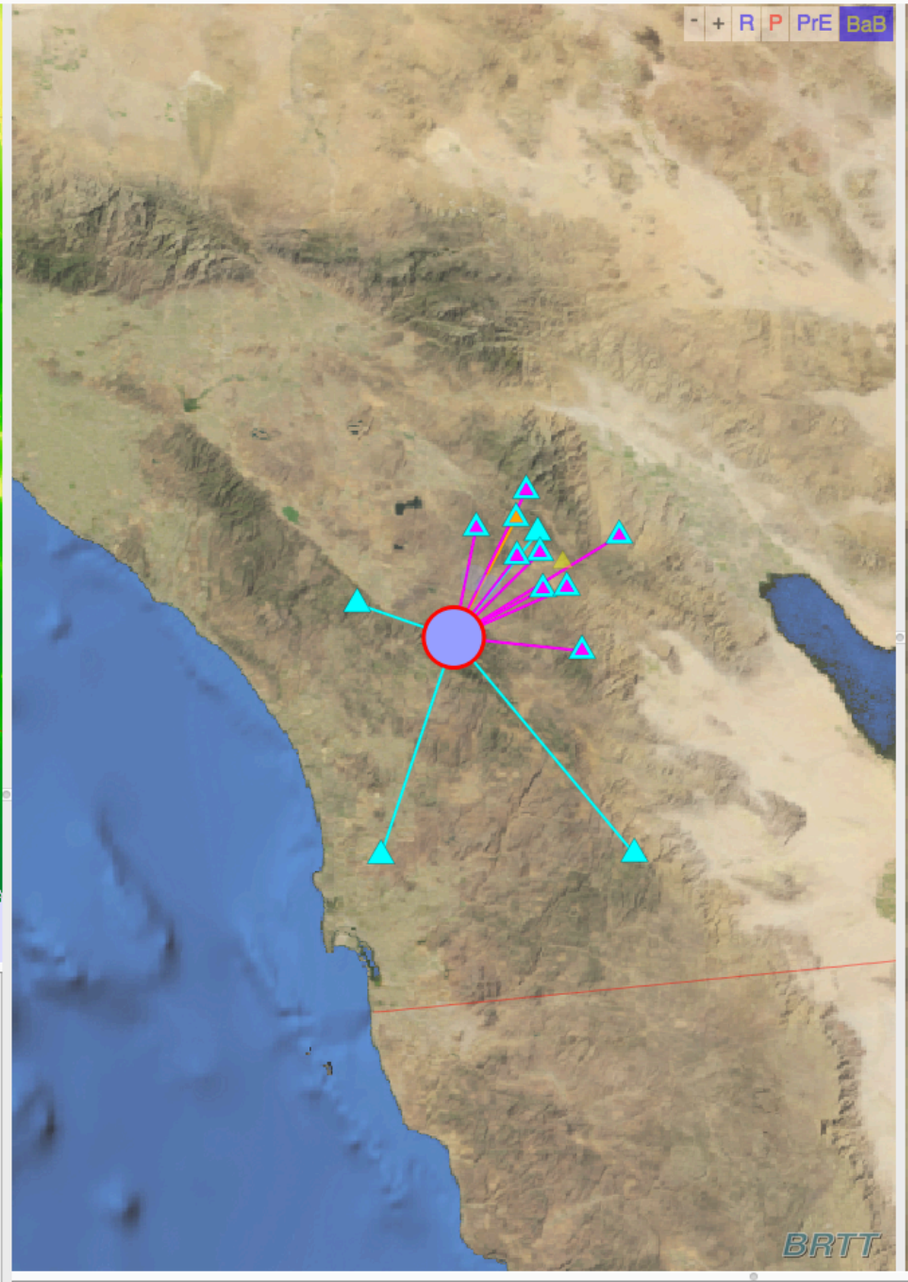
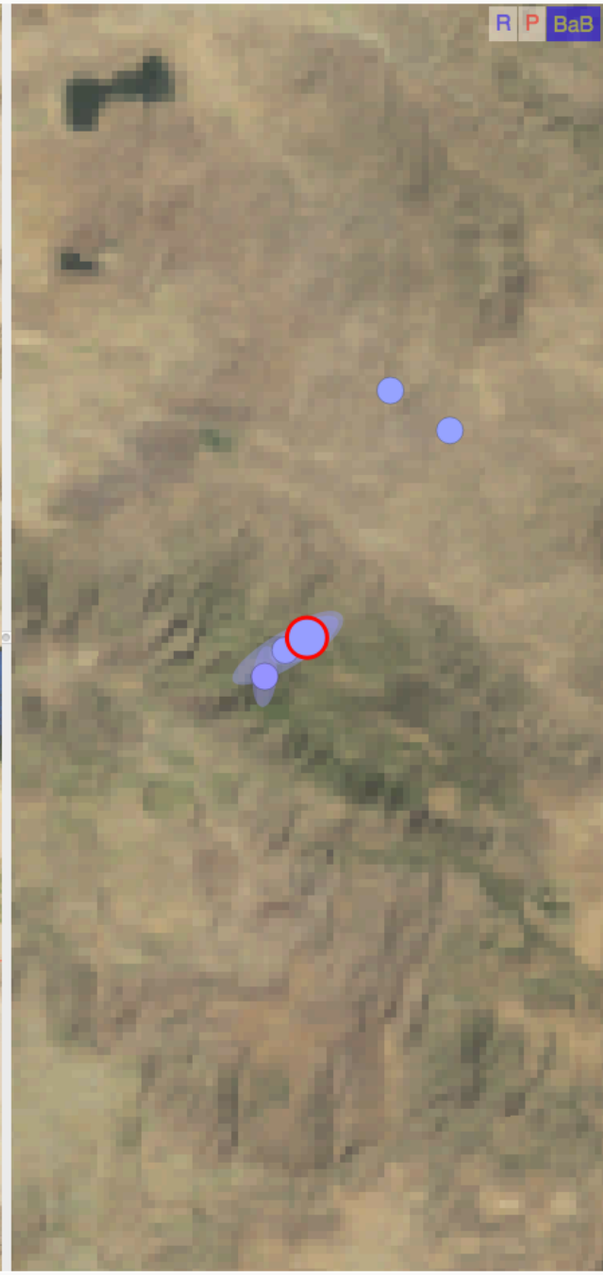
Kinemetrics

File View







evid	magnitude	auth	time	region	latitude	longitude	depth
217		Ot	2017144 05/24 11:06:58.837	GILBERT ISLANDS, K…	1.9508	176.1677	30.00
215	1.52(ml)	OlDbgMl	2017144 05/24 10:27:09.621	SOUTHERN CALIFORNIA	34.1944	-117.3619	14.92
214	1.02(ml)	USGS:ci	2017144 05/24 09:20:59.150	SOUTHERN CALIFORNIA	33.9775	-116.9172	4.43
208	0.28(ml)	OlDbgMl	2017144 05/24 07:42:42.798	SOUTHERN CALIFORNIA	33.3455	-116.8501	11.88
206	1.75(ml)	USGS:ci	2017144 05/24 05:20:16.970	SOUTHERN CALIFORNIA	33.9245	-118.7703	9.11
207	1.74(ml)	USGS:ci	2017144 05/24 05:20:16.940	SOUTHERN CALIFORNIA	33.9407	-118.7900	11.27
200	0.63(ml)	OlDbgMl	2017144 05/24 04:50:47.072	SOUTHERN CALIFORNIA	33.3822	-116.9088	14.45
196	0.99(ml)	OlDbgMl	2017144 05/24 02:55:30.825	SOUTHERN CALIFORNIA	34.0174	-116.7445	15.00
194	1.46(ml)	USGS:ci	2017144 05/24 00:06:36.300	SOUTHERN CALIFORNIA	33.6447	-116.8800	29.63
195	1.83(ml)	USGS:ci	2017144 05/24 00:06:35.730	SOUTHERN CALIFORNIA	33.6348	-116.9030	34.27
192	-0.02(ml)	OlDbgMl	2017143 05/23 23:06:17.617	SOUTHERN CALIFORNIA	33.5006	-116.7840	6.93
190		OlDbgMl	2017143 05/23 21:27:31.676	SOUTHERN CALIFORNIA	33.6325	-116.7192	14.59
189		OlDbgMl	2017143 05/23 20:26:01.798	SOUTHERN CALIFORNIA	33.5792	-116.8214	8.08
45	0.95(ml)	USGS:ci	2017143 05/23 19:01:45.660	SOUTHERN CALIFORNIA	33.8628	-117.5215	-0.54
42	1.36(ml)	OlDbgMl	2017143 05/23 17:56:54.623	SOUTHERN CALIFORNIA	33.7547	-116.7281	15.00
41	1.33(ml)	USGS:ci	2017143 05/23 17:30:23.710	SOUTHERN CALIFORNIA	33.1875	-115.6097	2.06
43	1.37(ml)	USGS:ci	2017143 05/23 17:18:13.180	SOUTHERN CALIFORNIA	33.8265	-117.4773	-0.52
186		OlDbgMl	2017143 05/23 15:48:12.264	SOUTHERN CALIFORNIA	33.7510	-116.7714	15.00
40	1.18(ml)	OlDbgMl	2017143 05/23 15:03:42.078	CALIF.-BAJA CALIF.…	32.9185	-116.1444	1.04
39	1.42(ml)	USGS:ci	2017143 05/23 15:03:03.190	SOUTHERN CALIFORNIA	33.3345	-115.7173	5.48
184	1.31(ml)	OlDbgMl	2017143 05/23 14:31:34.374	SOUTHERN CALIFORNIA	33.0457	-115.7920	15.00
183	0.09(ml)	OlDbgMl	2017143 05/23 12:55:55.296	SOUTHERN CALIFORNIA	33.4800	-116.7797	2.52
33	1.33(ml)	OlDbgMl	2017143 05/23 12:46:17.714	SOUTHERN CALIFORNIA	33.8650	-116.8768	15.00
180		OlDbgMl	2017143 05/23 12:02:17.596	SOUTHERN CALIFORNIA	33.8435	-116.8182	14.42
178	0.24(ml)	OlDbgMl	2017143 05/23 11:45:05.184	SOUTHERN CALIFORNIA	33.4102	-116.6432	1.03
177		OlDbgMl	2017143 05/23 11:08:12.905	SOUTHERN CALIFORNIA	33.7648	-116.6385	4.13
34	1.09(ml)	OlDbgMl	2017143 05/23 11:05:33.105	SOUTHERN CALIFORNIA	33.8762	-116.8751	15.00
173		OlDbgMl	2017143 05/23 11:00:23.780	SOUTHERN CALIFORNIA	33.6564	-116.6889	14.99

orid	latency	auth	magnitude	time	latitude	longitude	depth	ndef	nass	origin_row
200	12.446 seconds	OlDbgMl		2017144 05/24 04:50:47.122	33.3610	-116.9364	0.00	7	7	198
201	19.335 seconds	OlDbgMl	0.67(ml)	2017144 05/24 04:50:46.962	33.3753	-116.9230	12.77	12	13	199
202	26.255 seconds	OlDbgMl	0.63(ml)	2017144 05/24 04:50:47.072	33.3822	-116.9088	14.45	13	14	200
204	2:04 minutes	USGS:ci	1.10(ml)	2017144 05/24 04:50:44.220	33.5170	-116.8542	25.20	30	13	201
205	3:47 minutes	USGS:ci	0.96(ml)	2017144 05/24 04:50:44.100	33.4952	-116.8153	26.80	15	13	202

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dbpick: /Volumes/Extra/rtsystems/rtdemo_anza/db/anza

Traces | Amp: A | Fil: 10 HP | Add Time Mrk

KNW HHE
KNW HHN
KNW HHZ
RDM HHE
RDM HHN
RDM HHZ
RRSP HHE
RRSP HHN
RRSP HHZ
TMSP HHE
TMSP HHN
TMSP HHZ
CRY HHZ
WMC HHN
WMC HHZ
SND HHE
SND HHN
SND HHZ
BZN HHZ
FRD HHE
FRD HHN
FRD HHZ
PFO HHE
PFO HHN
PFO HHZ
SMER HHE
SMER HHZ
TRO HHE
TRO HHN
LVA2 HHZ

-300.0 nm/sec

11:05:28.000 2017143
11:05:30.000 2017143
11:05:32.000 2017143
11:05:34.000 2017143
11:05:36.000 2017143
11:05:38.000 2017143
11:05:40.000 2017143
11:05:42.000 2017143
11:05:44.000 2017143
11:05:46.000 2017143
11:05:48.000 2017143

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Further developments

- Continue tweaking configuration parameters to get best results. Changes will come out in future patches
- Development of several "inspector" apps that will show and analyze the inner workings of the detector and associator; **`inspect_detection`**, **`inspect_association`**
- Improvements to core processing software

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