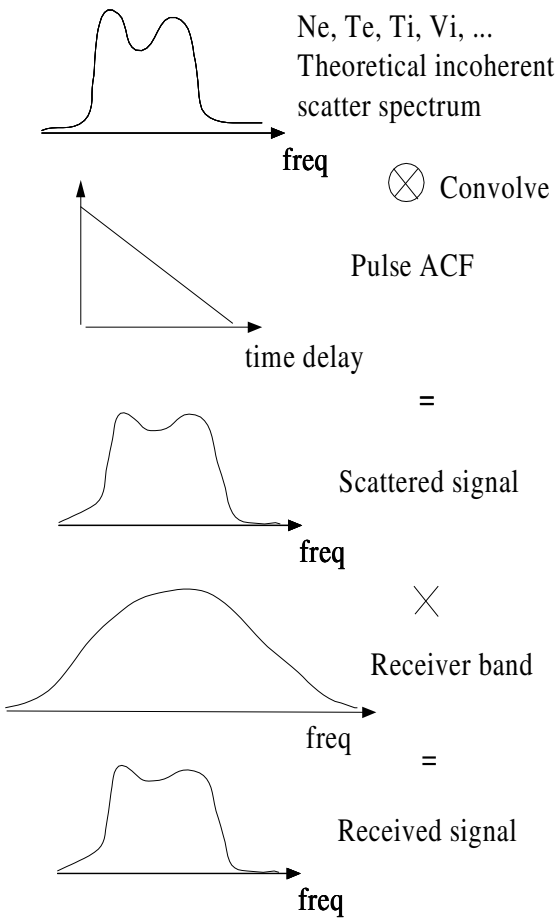

GUISDAP 8.3

GUISDAP

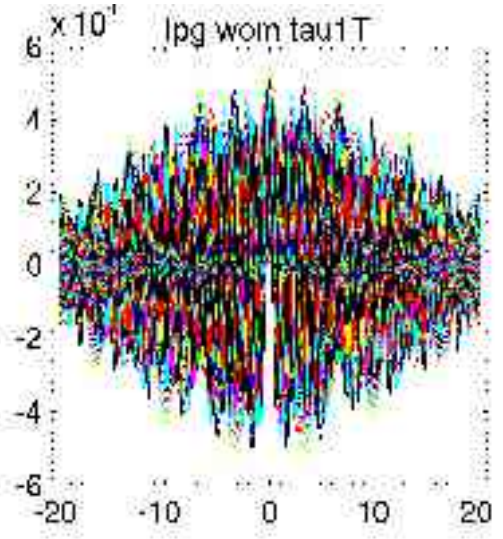
Classic analysis



Compare this with the measurements,
after proper transformation

Guisdap analysis

Initialisation calculates the spectral ambiguity function for all points in the data dump, lpg_wom
This contains the transmitting pulse shape (pulse ACF), receiver band and transformations



Directory setup

- Main distribution
  - guisdap8/bin
    - The executable guisdap
  - guisdap8/anal/
    - analysis scripts
  - guisdap8/init/
    - initialisation scripts
  - guisdap8/matfiles
    - analysis data files
  - guisdap8/exps
    - CP setups
  - guisdap8/mex6
    - compiled scripts
  - guisdap8/lib
    - libraries to mex routines
  - guisdap8/mexsources, guisdap8/models
    - source files to mex and libs
  - guisdap8/doc
- Additions
  - ~/gup/mygup
    - personal scripts
    - edited distribution scripts
      - fullinit.m
      - start_GUP.m
        - local structure
  - ~/gup/exps
    - SP setups
  - guisdap8/NW/mex6, guisdap8/NW/lib
    - Nigel Wade integration package

Setup files

- All files in the experiment directory
  - exps/[tau1]/
- Generate pat_PS.mat
  - t_to_ps.txt
  - t2ps.m
- Generate GUPvar.mat and init.mat
  - .fir files
  - [tau1T]vcinit.m
  - [tau1T]_LP.m
  - [tau1T]_specpar.m (optional)
    - ion species (16 30.5)
  - [tau1T]_init.m (optional)
    - theoretical resolution (1 μs)

Generate pat_PS.mat

- Need to tell guisdap about the experiment
  - t_to_ps.txt
    - Normally generated by the experiment python script
    - Contains actions
      - start and stop time in cycle
      - frequency used
        - noise injection=freq 0
      - action
        - 1 transmit phase 0°
        - -1 transmit phase 180°
        - 2 reception
  - t2ps.m script
    - non-cyclic parameters
      - filter, sampling interval, repetition time
    - sorts t_to_ps.txt into td_ parameters
    - Save everything to the pat_PS file

t2ps

t_to_ps.txt

```
100     160     1       13
160     220     -1      13
220     400     1       13
400     460     -1      13
460     520     1       13
520     820     -1      13
820     1000    1       13
1000    1060    -1      13
1365    10101   2       13
1365    10101   2       14
10938   11148   1       0
10968   11148   2       13
10968   11148   2       14
11260   11320   1       14
11320   11380   -1      14
11380   11560   1       14
11560   11620   -1      14
11620   11680   1       14
11680   11980   -1      14
...

704445          713181          2       14
704445          713181          2       13
714018          714228          1       0
714048          714228          2       14
714048          714228          2       13
```

t2ps.m

```
function dum=t2ps(site)
eval(['load t_to_ps.txt.' site])
p_offsetppd=0;
if site=='V'

else
   p_rep=714240;
   ch_adcint=[12 12];
   ch_filter={'b42d180.fir' 'b42d180.fir'};
   ch_f=[13 14];
end
[td_t1,f]=sort(t_to_ps(:,1)');
td_t2=t_to_ps(f,2)';
td_am=t_to_ps(f,3)';
td_ch=t_to_ps(f,4)';
for f=1:length(ch_f)
   td_ch(find(td_ch==ch_f(f)))=f;
end
eval(['save tau1' site 'pat_PS p_* td_* ch_*'])
```

tau1Tpat_PS.mat

td_t1
td_t2
td_am
td_ch
p_rep
p_offsetppd
ch_adcint
ch_filter
ch_f

Virtual channels

- "Mini" experiments inside the experiment
- Contains
  - 1 transmission
  - 1 signal reception
  - 1 background
  - 1 calibration
- Remote
  - Only receiving
  - Uses Tromso transmission

Parameters

- vc_t1 Start time in cycle
- vc_t2 Stop time in cycle
- vc_ch "Real" channel

tau1Tvcinit.m

```
% Complete virtual channel definitions
N_scan=64;

vc_ch=zeros(1,N_scan);
vc_t1=zeros(1,N_scan);
vc_t2=zeros(1,N_scan);
T_scan=11160;

for scan=0:N_scan-1
  SHIFT=scan*T_scan;
  vc_ch(1+scan)=1+rem(scan,2);
  vc_t1(1+scan)=0+SHIFT;
  vc_t2(1+scan)=T_scan*2+SHIFT;
end
```

Lag profiles

- Define what has been done with each virtual channel
- Compare to .fil and .DECO
- Groups all lag profiles (some 100 000) into
  - lag profile groups
    - lpg_
    - About 1000

tau1T_LP.m

```
N_SCAN=64;

COR_init(628*N_SCAN,43) %Create matrices
for vc=1:N_SCAN
   COR_fraclp(1456,vc,'s',728-5*15,16,60,(1:29)*12,1)
   COR_pp(rem(vc,2)*728,1,vc,'s',1,728,0,1)
   COR_pp(37086,1,vc,'c',1,15,0,1)
   COR_pp(36358,1,vc,'b',1,728,0,1)
end

COR_end % Shrink matrices
```

COR_ routines

- COR_fraclp(ra,vc,type,N_gates,Nbits,bitsep,lags,code)
  - Alternating code lag profiles a la EISCAT
- COR_pp(ra,ri,vc,type,gating,N_gates,N_skipped,code)
  - Power profiles
- COR_uprog(ra,ri,vc,type,gating,N_gates,lags,N_skipped,code)
  - Undecoded lag profiles
- COR_arclp(ra,vc,type,N_gates,Nbits,Ntaps,Norm,Skip0,Sample_skip,lags,code)
  - FIR filtered alternating code lag profiles a la arc experiment
- Historic
  - COR_box, COR_alter, COR_trilp, COR_ lp, COR_mp

- code: Same for all types that belong together
- ra: Start address in dump

fullinit

%guisdap -i

> start_GUP, name_expr='tau1'; name_site='T'; N_rcprog=1; init_KST, init_GUP

Or edit/copy fullinit.m and run it

-

- Will load pat_PS.mat, run through vcinit.m and _LP.m
  - If OK, probably setup is correct (Warning: Cryptic error messages!)
- Plots pulse ACFs, range ambiguity functions and finally lpg_wom
- Produces GUPvar.mat
  - Can be used for theoretical variance calculations
- and init.mat
  - Used in analysis

Other files

```
ingemar@lean guisdap8% ls exps/tau1
ana_def.m     tau1RGUPvar.mat  tau1Rvcinit.m     tau1Tvcinit.m     tau1Vvcinit.m
b21d360.fir   tau1Rinit.mat    tau1TGUPvar.mat   tau1VGUPvar.mat   t_to_ps.txt.R
b42d180.fir   tau1Rlpg_i.tex   tau1Tinit.mat     tau1Vinit.mat     t_to_ps.txt.T
              tau1R_LP.m       tau1Tlpg_i.tex    tau1Vlpg_i.tex    t_to_ps.txt.V
guispert.m    tau1Rpat_PS.mat  tau1T_LP.m        tau1V_LP.m
t2ps.m        tau1R_specpar.m  tau1Tpat_PS.mat   tau1Vpat_PS.mat
ingemar@lean guisdap8%
```

ana_def.m

Experiment specific analysis defaults

```
% Analysis defaults
if name_site=='V'
  analysis_code=[1 2];
end
```

guispert.m

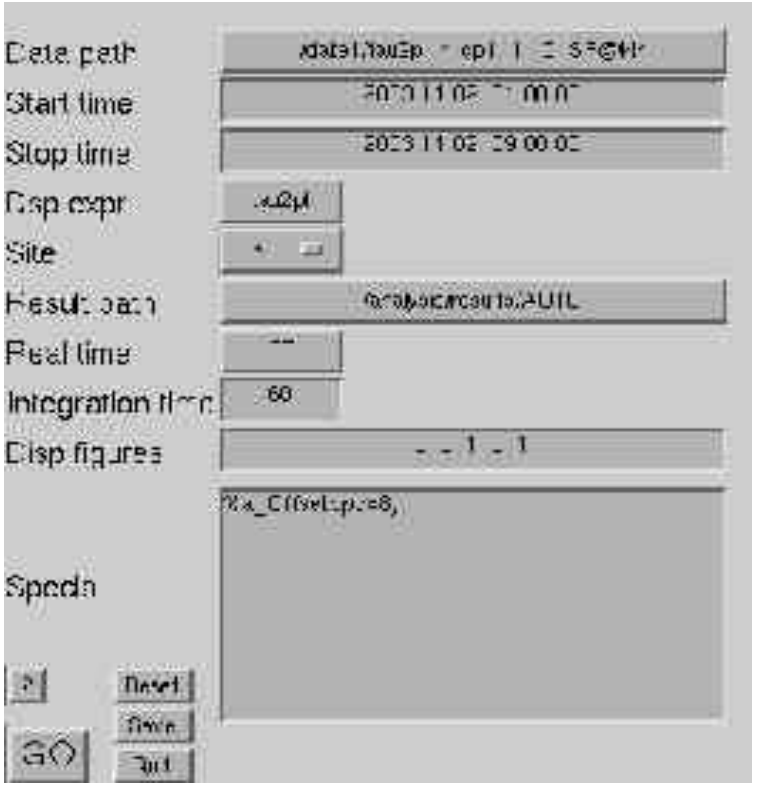
Data modification before analysis

```
% guispert.m: special experiment specific hacks
% GUISDAP v8.2   03-01-30 Copyright EISCAT
% See also: GUISPERT GUIZARD
ch_Pt=ch_Pt(1);
if name_site=='T'
  lp=728;
  d_data(1:lp)=mean([d_data(1:lp) d_data(lp+(1:lp))],2);
  d_var1(1:lp)=mean([d_var1(1:lp) d_var1(lp+(1:lp))],2);
  d_var2(1:lp)=mean([d_var2(1:lp) d_var2(lp+(1:lp))],2);
  d_data(lp+(1:lp))=d_data(1:lp);
  d_var1(lp+(1:lp))=d_var1(1:lp);
  d_var2(lp+(1:lp))=d_var2(1:lp);
elseif name_site=='V'
....
end
```

Analysis

% guisdap -a
• or
% guisdap
> analyse

Brings up the gfd setup window



Detailed instruction at
http://www.eiscat.se/GUISDAP/howto.html

•Special
  • Hundreds of parameters to tune if wanted

Analysis defaults

- ionospheric model, (iono_model)
  - IRI-2001 (International Reference Ionosphere)
  - Sets initial values of parameters
- Gating
  - analysis_altit
    - A vector defining heights to group the data together
      - Increased spacing with height
    - Assumes all points inside each interval describing the same plasma
  - analysis_maxwidth
    - Data points covering too large height interval will be skipped
      - Set to the gate spacing

Special (or in ana_def.m)

- a_satch[]
  - “Satellite” checking of data
  - Enable it with a_satch.do=1;
  - See satch.m for details
- f_[parameter]
  - Will force almost any parameter read from the data
    - f_ch_Pt Transmitter power (+ analysis_txlimit=0)
    - f_calTemp Calibration temperature (Sodankyla)
- a_Offsetppd[0]
  - Number of microseconds the remote site clock differs from Tromso
- Magic_const[1]
  - To tune the fitted electron densities, compared to ionosonde readings
- d_saveintdir[0]
  - Save the integrated data with measured variance to specified directory
  - Maybe together with analysis_do=0 or analysis_altit=[] (check tx,sat)
- analysis_code[]
  - Choose only lpg's with specified code (VHF, sliced data)

Special cont.

- analysis_control
  - a_control(1) Error limit of Ne for fit [100000]
  - a_control(2) Step limit for iteration [0.01]
  - a_control(3) Maximum number of iterations [10]
  - a_control(4) Variance calculation [1]
    - 1 estimated from data (fast)
    - 2 estimated using ambiguity functions (slow)
- analysis_intfixed[1]
  - integrate even if “fixed” parameters changes (el, az, loopc)
- analysis_save[1]
  - save results to a result directory
- display_results[0]
  - display fitted parameters or only status

Fit parameters

Default fit parameters and heights

Parameter	UHF (930 Mhz)	VHF (224 Mhz)	ESR (500 MHz)
Electron density	All heights	All heights	All heights
Ion temperature	Above 80 km	Above 100 km	Above 90 km
Temperature ratio	107-1500 km	120-1500 km	113-1500 km
Collision frequency	90-107 km	Never	Never
Ion drift velocity	All heights	All heights	All heights
Ion composition	Never	Never	Never

Can be changed by fit_altitude variable

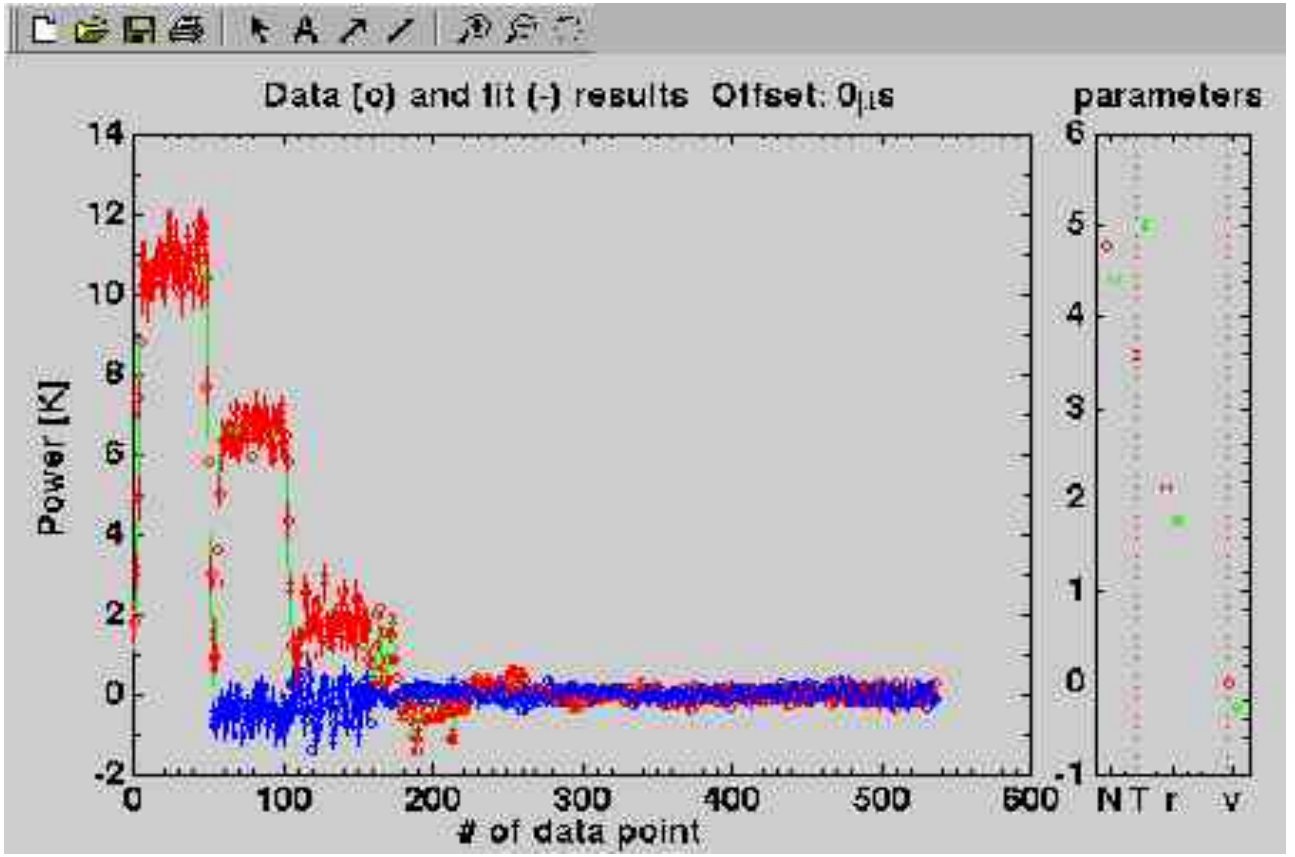
fit_altitude([Ne Ti Tr Coll Vi Comp1 Comp2],[h1 h2 dh a_priori_error rel_error_flag])

```
fit_altitude=[0  Inf 0 1e2 1
              80  Inf 0 1e4 0
             107 1500 0 1e1 0
              90  107 0 1e2 1
               0  Inf 0 1e5 0
               0    0 0   1 0
               0    0 0   1 0];
```

Plots

- Correlator dump
  - Plot of used part of the dump
  - Calibrated
  - Check that is corresponds to the data dump
- Power profile (Not remote)
  - Check that the densities are in proper range
- Fits
  - The line should follow the points
  - If not, check that the initialisation is correct
- Altitude profiles (Not remote)
- Vizu
  - Summary plot of all analysed parameters
  - final check that experiment/analysis is correct

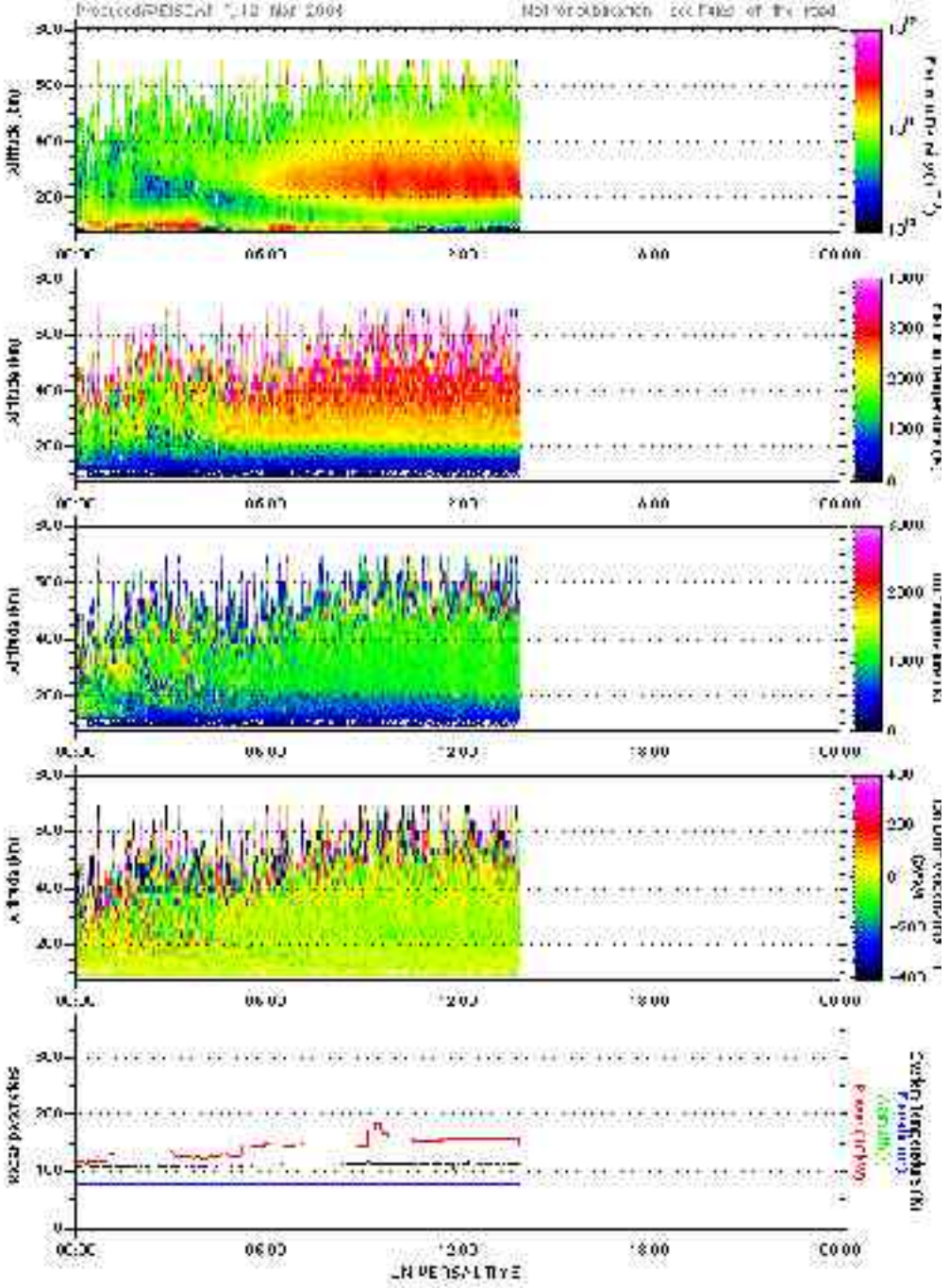
Fit_plot


Data (o) and fit (-) results Offset: 0 μs
parameters
Power [K]
# of data point
N T r v

EISCAT Scientific Association

EISCAT UHF RADAR

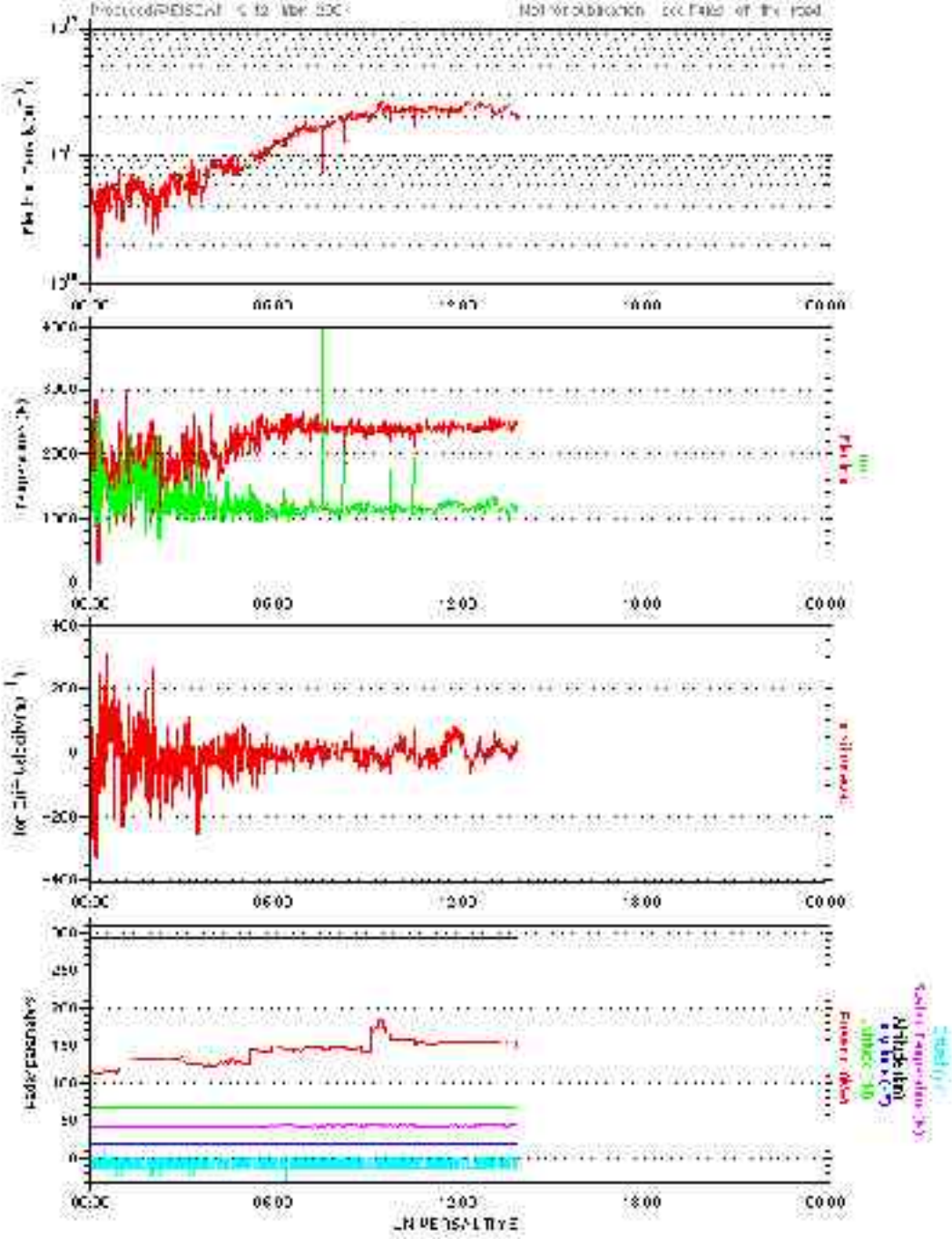
CP, uhf, tau2pl, 12 March 2004



EISCAT Scientific Association

EISCAT UHF RADAR

CP, uhf, tau2pl, 12 March 2004



Running guisdap

- Flags
  - a

    start with analysis
  - i

    enable initialisation scripts
  - b

    run in background
  - x

    don't use the mex routines
  - m path

    add another search path
  - g file

    start analysis with a setup defined in file
  - t

    run in text mode

Bugs

- Range
  - accurate within half sampling interval (a kilometer or so)
- Remote scattering volume
  - Non gaussian beam shapes
- Power readings
  - Read after the dump time
  - Average formula for all frequencies
- Theoretical variance
  - Do not account for missing dumps
- Maximum width, analysis_maxwidth
  - Do not check if ANY part of the data point have contribution outside the gate