Vaisala LAP®-8000, Mid Troposphere Wind Profiler

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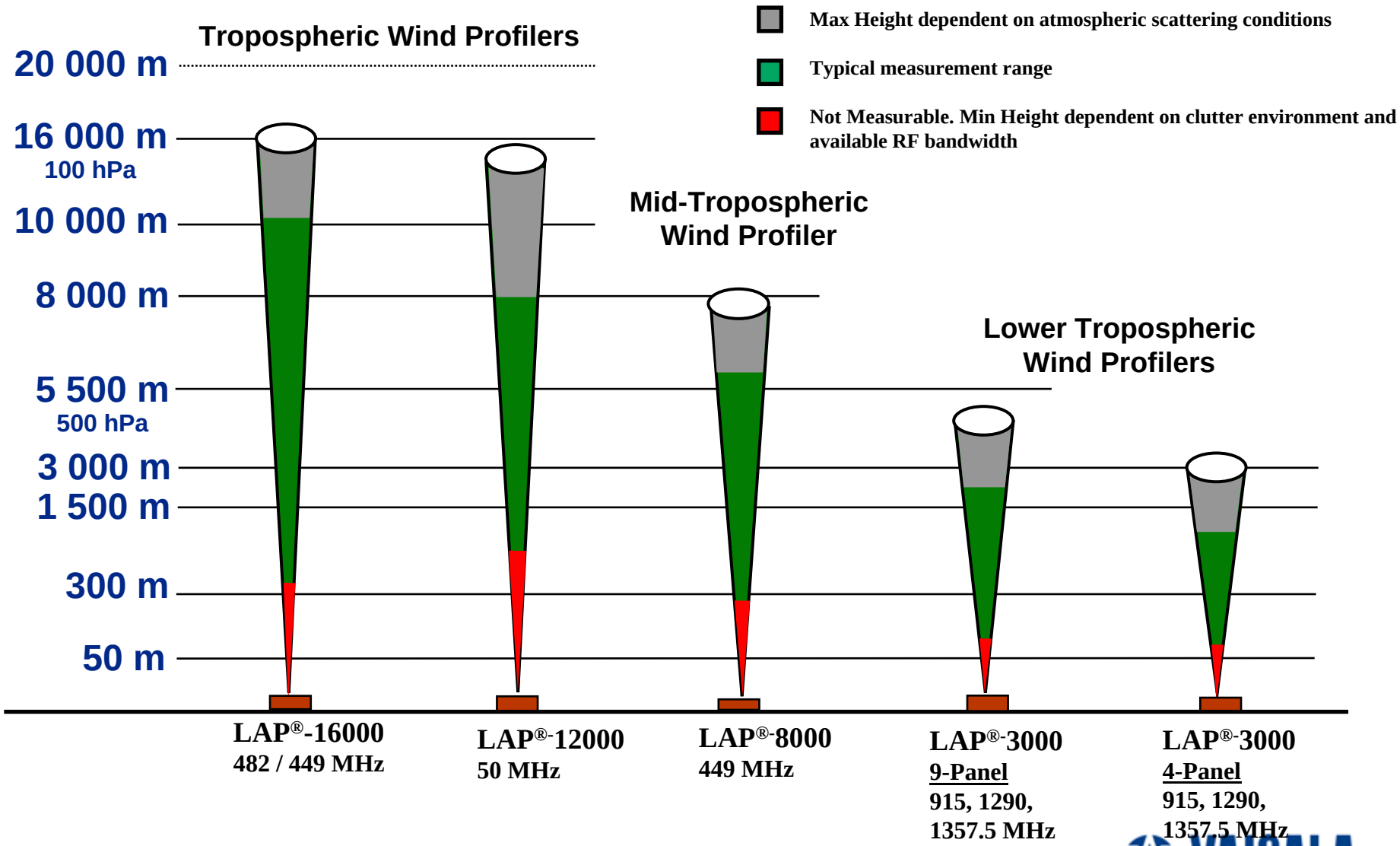
Vaisala Wind Profiler Portfolio



Cooperative Research & Development Agreement (CRADA)

Vaisala is Commercial Provider of U.S. Government (National Oceanic and Atmospheric Administration = NOAA)

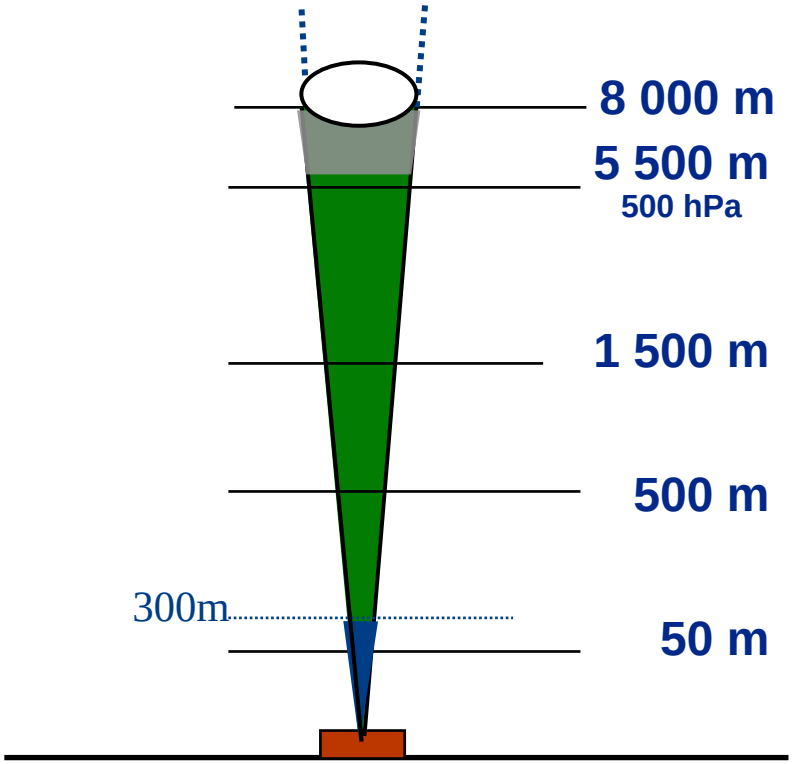
- NOAA is the world's leading Institute in Radar technology

Advancements in Wind Profiler Technology

- Use of the latest Technology (hardware and signal processing) and transfer is possible in Wind Profiler Applications
- By this agreement the latest algorithms developed by NOAA will be available for Vaisala and Vaisala's customers
  - Such as Wavelets, Multiple peak picking, Running Consensus, Weber-Wuertz Wind and Temperature QC, Cn2, Snow Level Detection, Boundary Layer Detection etc
- All product enhancements are reviewed and validated by NOAA

Vaisala has benefited from CRADA with NOAA since 1991

LAP®-8000, Mid Troposphere Wind Profiler



Operating Frequency:

440 - 490 MHz

449 or 482 MHz Recommended

Key Customer segments:

Defense

Research

Meso-scale Forecasting

Regional/Synoptic Modeling

Max Height Dependent on atmospheric scattering conditions and system operating parameters

Min Height Dependent on clutter environment and available radio frequency emission bandwidth

LAP®-8000, 449 MHz Mid Troposphere WP, Ft. Huahuca AZ

Specifications

- Minimum Detection Altitude 300 m, depending on atmospheric conditions
- Maximum Detection Altitude 6-8 km, depending on atmospheric conditions
- Vertical resolution
  - 100 - 1000 m in low mode
  - 300 - 1000 m in high mode
- Wind speed accuracy
  - <1 m/s
- Wind direction accuracy
  - <10°
- Transmitter peak power 2000 Wpk
  - Average power <350 W
- Occupied bandwidth
  - Less than 8.6 MHz @ 0.67 ms pulse duration (ITU 99%)

LAP-8000 Antenna

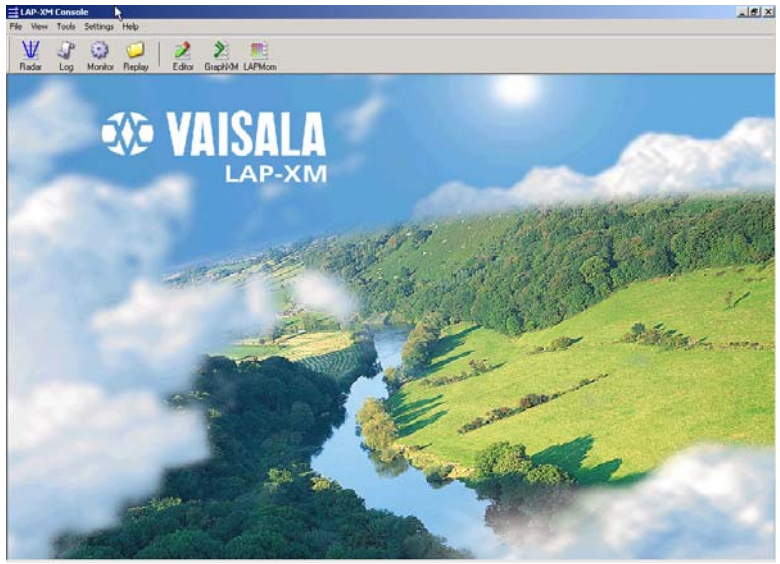
- Coaxial collinear
  - 12 x 12 = 144 elements
- Antenna aperture 28 m^2 = 6 x 6 m
- Gain 29 dB@449 MHz

LAP-8000 Configuration

- LAP processing
  - Radar processor
    - Digital IF architecture
    - LAP-XM software
  - Transmitter
  - Antenna
- Options:
  - RASS
    - For virtual temperature measurements
  - Hardware monitor
  - Graph-XM
    - Graphical visualization
  - LAPMom
    - Advanced Moments display software

LAP-XM application software

- Acquiring and processing new signal data
- Computing, displaying and saving meteorological data products
- Converting data products to new formats
- Monitoring data products
- Controlling operation of the profiler from remote locations
- Generates wind and temperature outputs
  - Text and BUFR formats



Digital IF receiver

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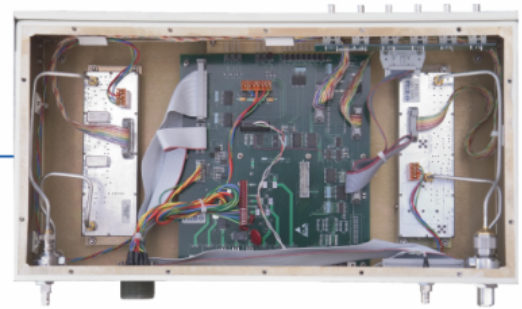
Exclusively-Licensed Digital IF Technology

Profiler RF infrastructure

New Digital IF hardware



Modulator, IF, and Interface unit

Modulator, IF, and Interface Unit

Power Supply Unit

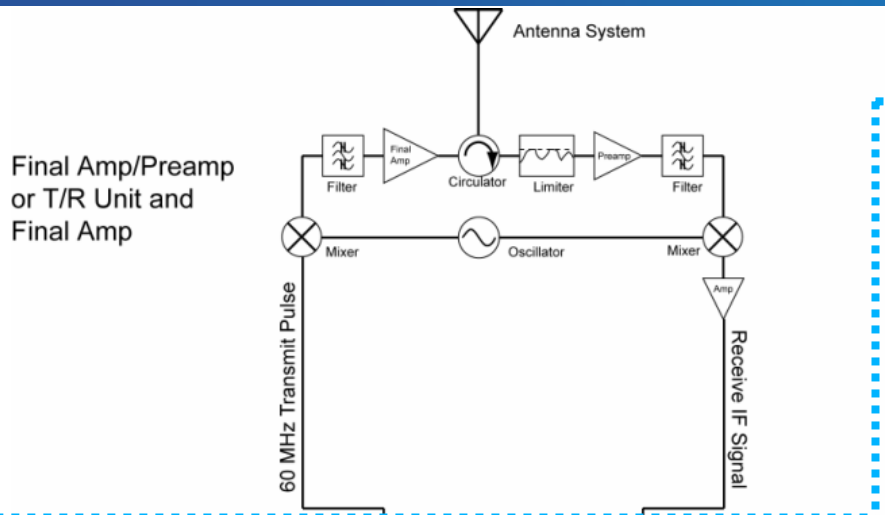
Radar Processor Unit

Digital IF

Radar Controller

Reference Oscillator

RASS Source (optional)

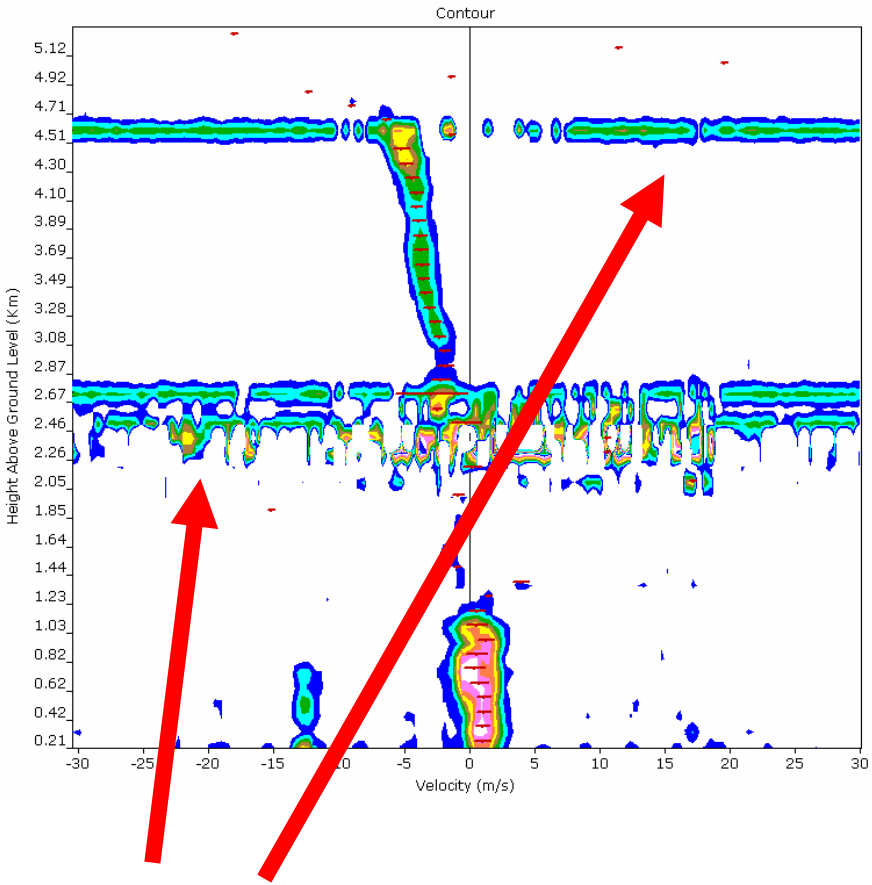


Digital Receiver

- Employs state-of-the art digital signal processing hardware
- Provides enhanced system performance
  - improved dynamic range
  - high signal sensitivity
  - improved data quality
- Supports an expanded software set
  - Wavelets - eliminate clutter effects caused by Aircraft, Birds, Ground Clutter
  - WMO BUFR messaging - New data transfer standards
  - Multiple Peak Picking (MPP) - selection of atmospheric signals
  - Running consensus - for more frequent data updates
  - Weber-Wuertz – QC for error-free data
  - C_n^{2} - for air quality and dispersion applications
- Provides upgrades to current LAP® installed base

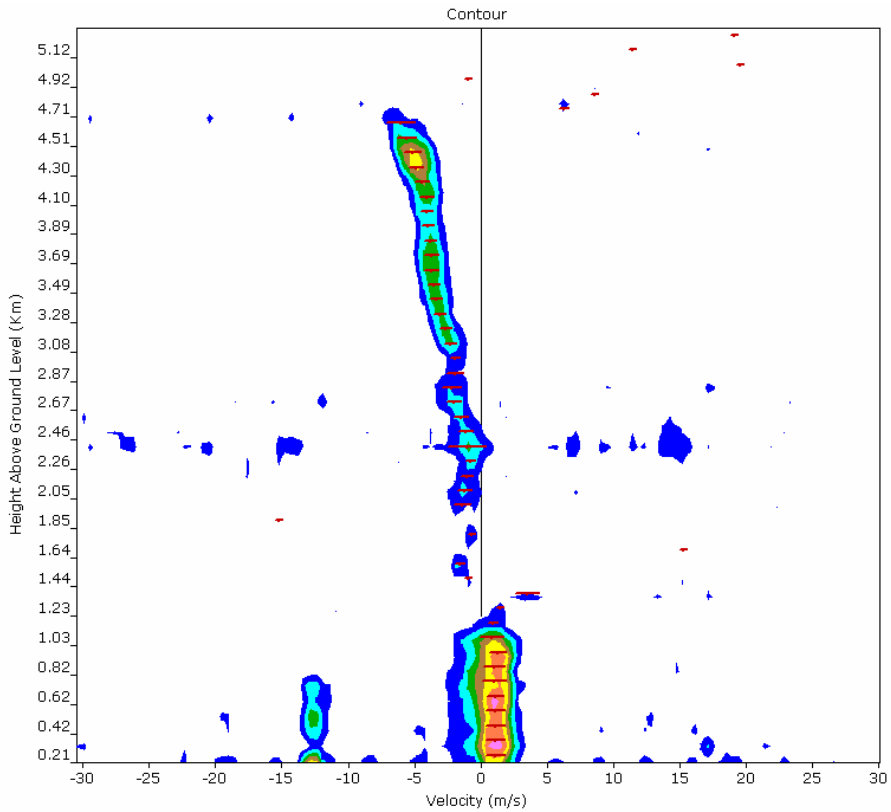
Example of Wavelet Clutter Rejection

Before Wavelet:



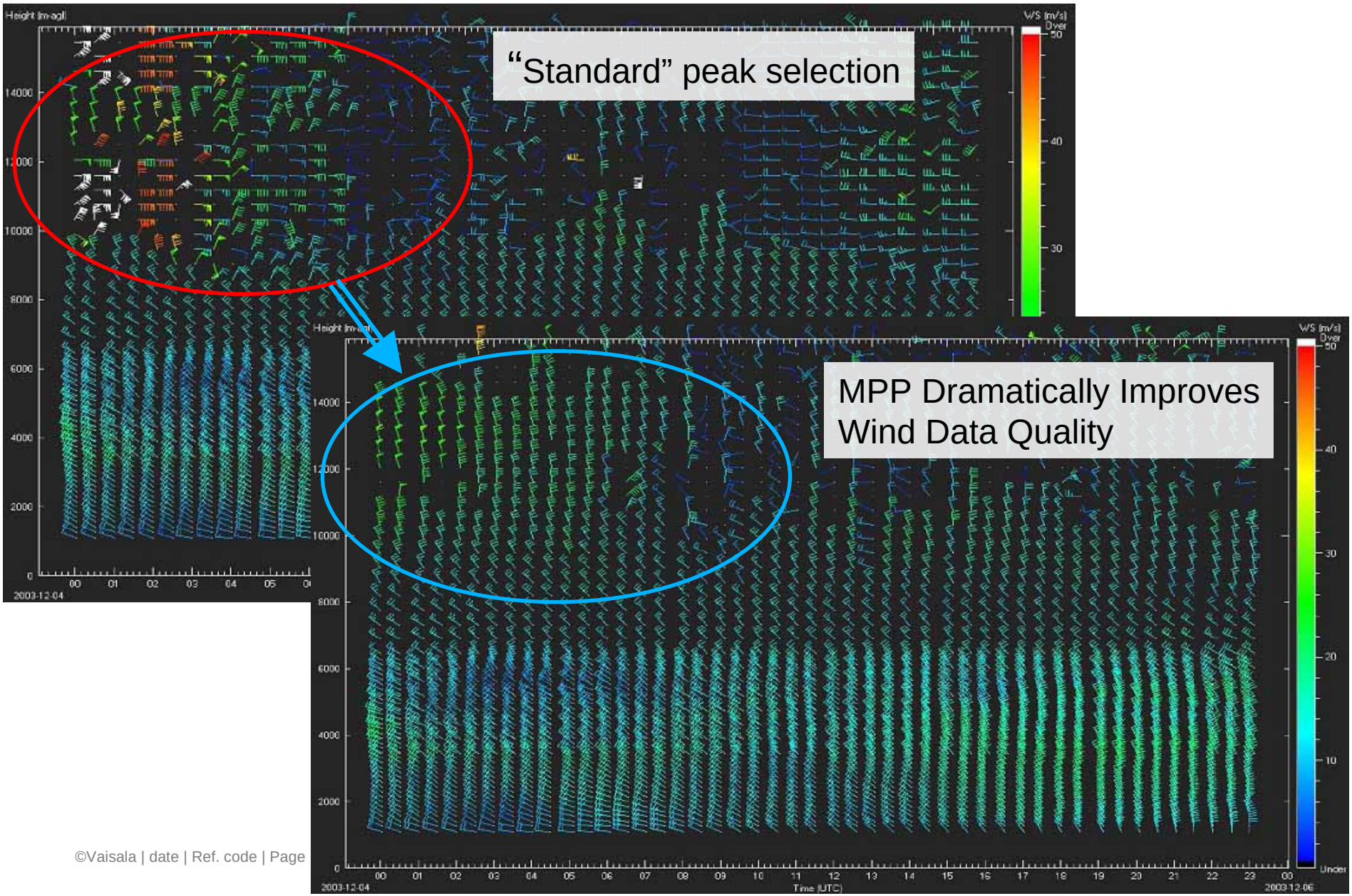
Bird interference

After Wavelet:



Wavelet eliminates much of the clutter due to birds

Example of Winds With Multiple Peak Picking Algorithm



Wind profiler options

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Wind profiler options

- RASS
  - For virtual temperature measurements
- Graph-XM™ display software
  - For graphical data representation
- LapMOM™ moments display software
  - For graphical moments data representation
- GPS timing
  - For autonomous, precise timekeeping
- Hardware Monitor
  - To monitor the condition of the hardware
- Services

Optional RASS

- Radio Acoustic Sounding System (RASS)
  - Provides profiles of virtual temperature
  - Achieved by transmitting a short acoustic energy source vertically
  - Tone burst travels as a compression wave with the speed of sound upwards in the atmosphere
  - Wind profiler measures the speed of propagation of the sound burst
  - Since the speed of sound depends mostly on the air temperature, virtual temperature can be computed from the received signal

LAP-8000 RASS specifications

- Minimum height: 300 m, depending on clutter environment and available RF bandwidth
- Maximum height: 1-2.5 km, depending on atmospheric scattering conditions
- Range resolution: 60, 100, 200, 400 m
- Temperature measurement uncertainty: 1°C

Optional Graph-XM™ Display Software

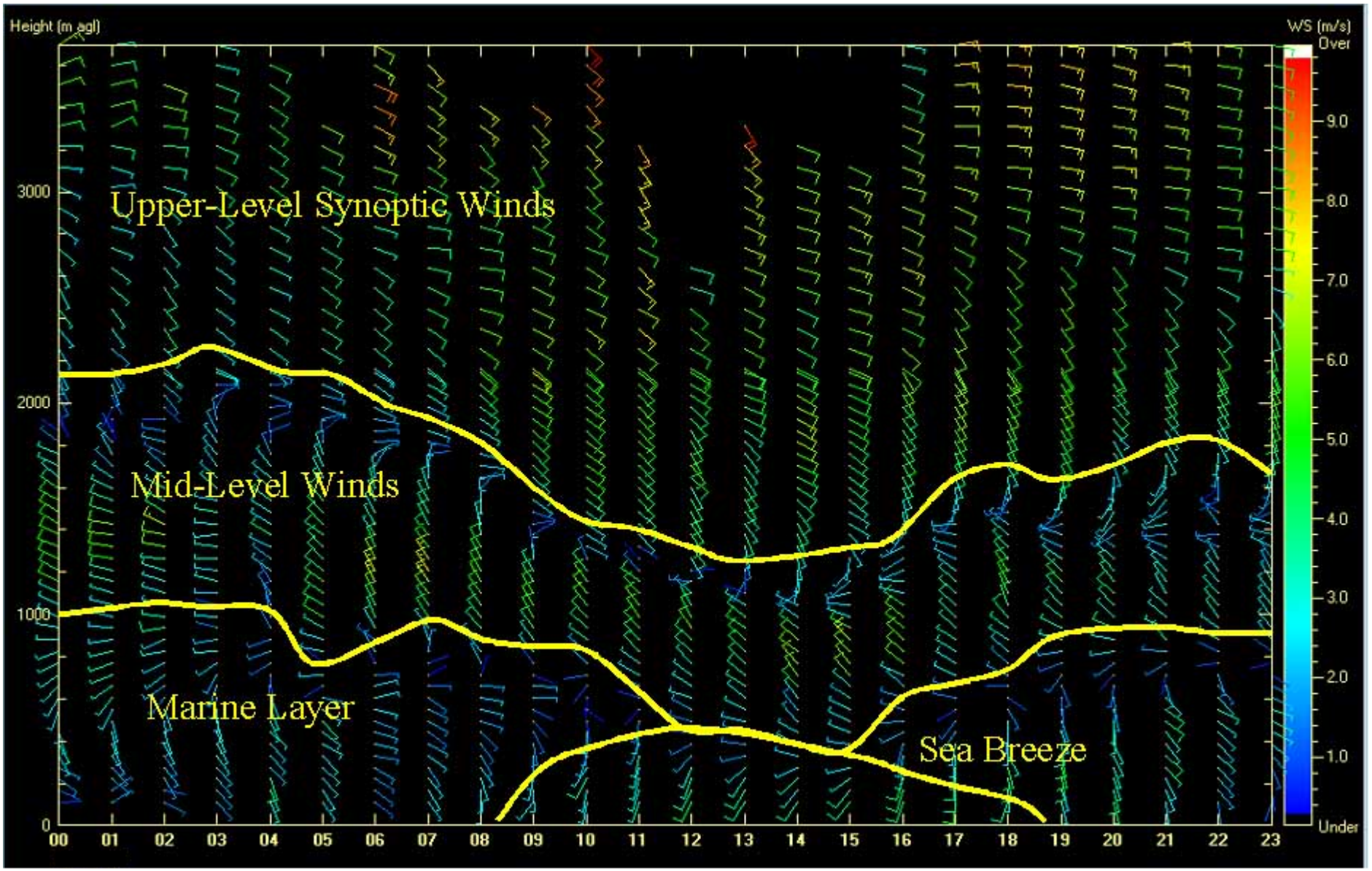
Graph-XM™ provides graphical displays of wind and temperature data

- Provides visualization displays of:
  - wind barb, wind vectors and temperature
    - As symbols or color contours
  - vertical profile data spectral width
  - SNR (Signal to Noise)
  - radial velocity

Many presentation choices for the data

- The operator can scale the display of data or zoom in on a particular area
- Batch files can be printed
- Custom configurations can be saved and edited

Example Graph®-XM Display
Multi-Level Shear Layers



Optional LapMOM™ Display Software

Graph-XM™ provides graphical displays of moments, mixing layer and melting layer data

- Provides visualization displays of:
  - Reflectivity
    - SNR (Signal to Noise)
    - Spectral width
    - Vertical velocity
  - Mixing layer
    - Planetary boundary layer
  - Melting layer
    - From reflectivity and vertical velocity
    - With optional software package

Many presentation choices for the data

- The operator can scale the display of data or zoom in on a particular area
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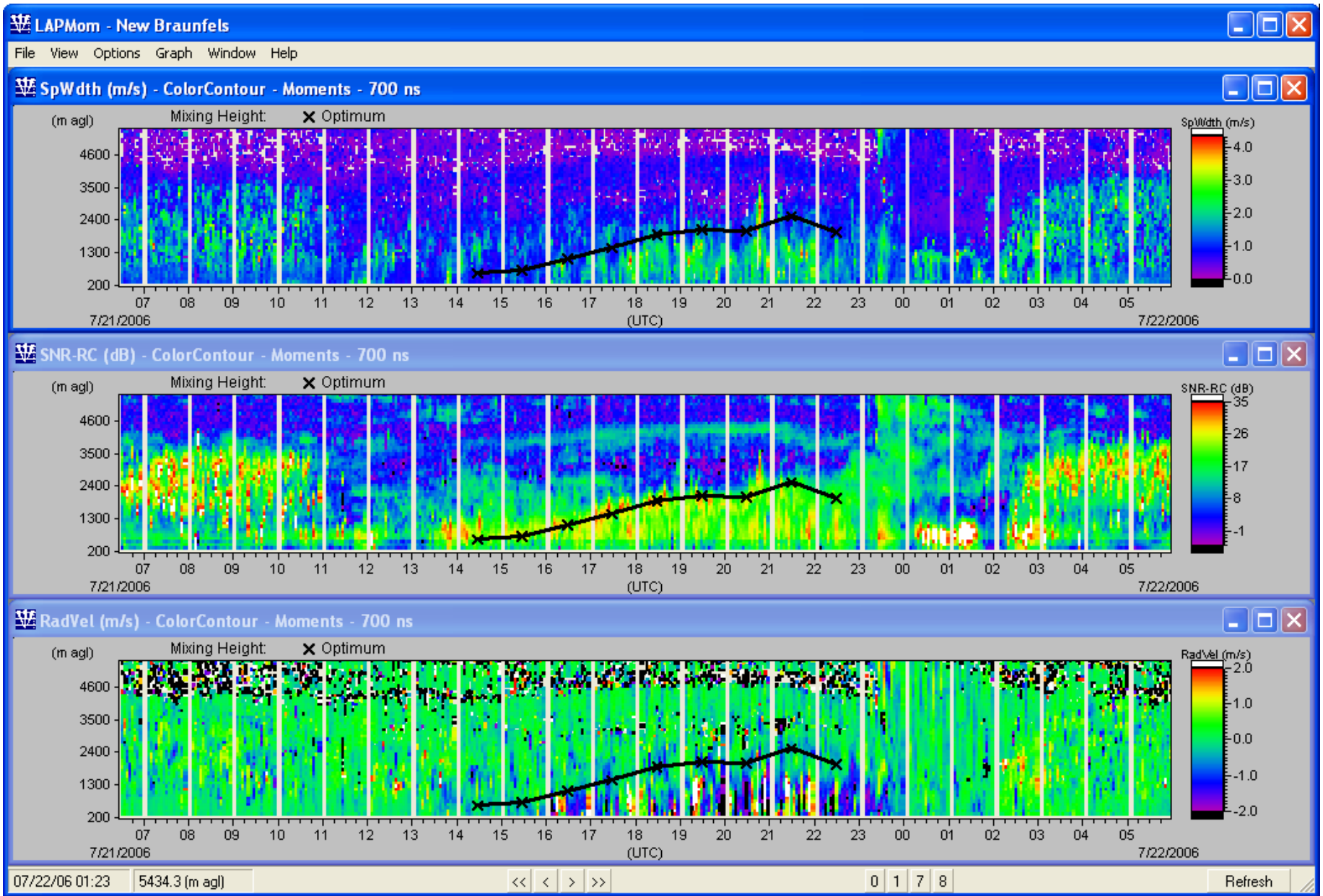
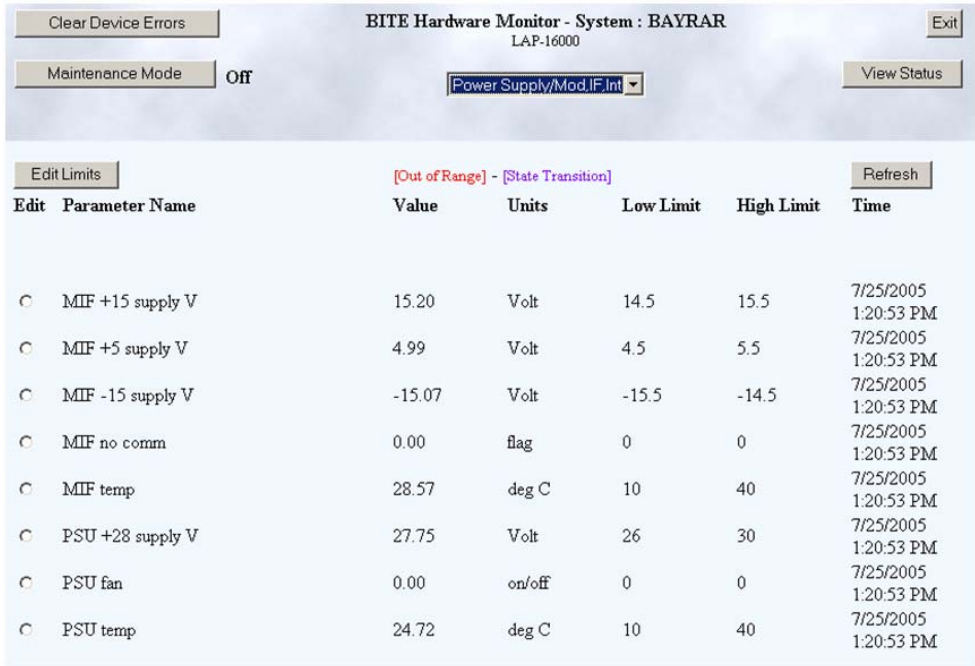
LapMOM: Displaying mixing layer data



Optional LAP® Monitor

- Data acquisition subsystem
  - To monitor the health of the LAP®-hardware components
  - Assist maintenance personnel with fault diagnosis
  - Even shut down the system should certain critical conditions exceed predetermined limits
- Communicates directly with the radar computer
  - Remote fault diagnosis
  - Log file of operational performance and out-of-limit measurements
- The profiler monitor resides within the system electronics (BITE)
- Measured parameters
  - Multiple voltage levels, currents, temperatures, forward and reflected RF power, processor test output, minutes left on UPS etc



Edit	Parameter Name	Value	Units	Low Limit	High Limit	Time
○	MIF +15 supply V	15.20	Volt	14.5	15.5	7/25/2005 1:20:53 PM
○	MIF +5 supply V	4.99	Volt	4.5	5.5	7/25/2005 1:20:53 PM
○	MIF -15 supply V	-15.07	Volt	-15.5	-14.5	7/25/2005 1:20:53 PM
○	MIF no comm	0.00	flag	0	0	7/25/2005 1:20:53 PM
○	MIF temp	28.57	deg C	10	40	7/25/2005 1:20:53 PM
○	PSU +28 supply V	27.75	Volt	26	30	7/25/2005 1:20:53 PM
○	PSU fan	0.00	on/off	0	0	7/25/2005 1:20:53 PM
○	PSU temp	24.72	deg C	10	40	7/25/2005 1:20:53 PM

WP Services

- Site survey
- Installation
- FAT (Factory Acceptance Test)
- SAT (Site Acceptance Test)
- Training (at Vaisala or at site)
  - Operator’s training
  - Maintenance training
  - Application training
- Extended warranty
- Service Contract