New WERA Software Implementation

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- New functions in WeraDesk
- WERA processing of permanent mode data
- WERA processing software update
- Future extensions (To-Do List)

New WERA Software Implementation

1. New Functions in WeraDesk

1. Dual-Frequency
2. Permanent Acquisition
3. Interrupt Acquisition
4. Clock 90 [keep chirp length]
5. RX-Attenuation
6. Internal Fullcal

New WERA Software Implementation

1. New Functions in WeraDesk

WeraDesk at Wangerooge

Acquisition Mode:	Permanent Acquisition	☐ **Interrupt Acquisition**	
Process after Measurement:	☐ **Sea Echos**	☐ **Calibr. Data**	☐ **FM Raw Data**
Time Slot:	Master		
Receiver Attenuation:	off		
FMICW Mode:	off		
Calibration Power:	000 [dB]	☐ **TX off**	

Location:	Wangerooge		
True North:	90 ° [1 to 360]	**Time Code:**	UTC
Latitude:	54 ° 7.18 ' N	**Cont. Acqu. Start Time:**	00 [min]
Longitude:	8 ° 51.47 ' E		

Freq. Management(1):	12.500 **to** 13.500 [MHz]	☑ **Prescan**	☑ **Adapt Frequency**
Freq. Management(2):	12.000 **to** 12.400 [MHz]	☑ **Enable 2nd Frequency Range**	
Bandwidth Reduction:	1500 m [100.0 kHz]	max. allowed Range Cell Depth	

Working Frequency:	13.000 [MHz]	**Perm. Repetition Time:**	60 [min]
Range Cell Depth:	600 m [250.0 kHz]	**Number of Range Cells:**	256
Permanent Samples:	13184	**Maximum Range:**	154 [km]
Chirp Length:	0.260000 [sec]	**Data Acquisiton Time:**	1 : 07 [min:sec]
Range Offset:	600 [m]	**RX Offset:**	0 Hz

Data Path:	/home/wera/data/ wooge/	Open Status Window
File Location ID:	wog [3 characters]	

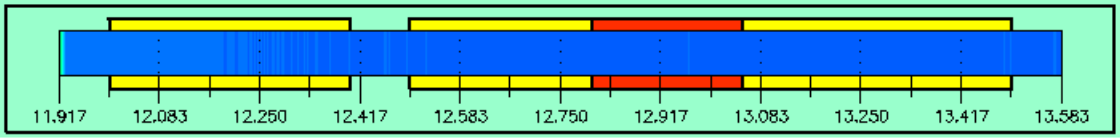
Comment: WERA Lab Tests at University of Hamburg.

Submit Reset Vers. 3.0.0

New WERA Software Implementation

WeraDesk Status at Wangerooge 2009-05-07 18:06:01

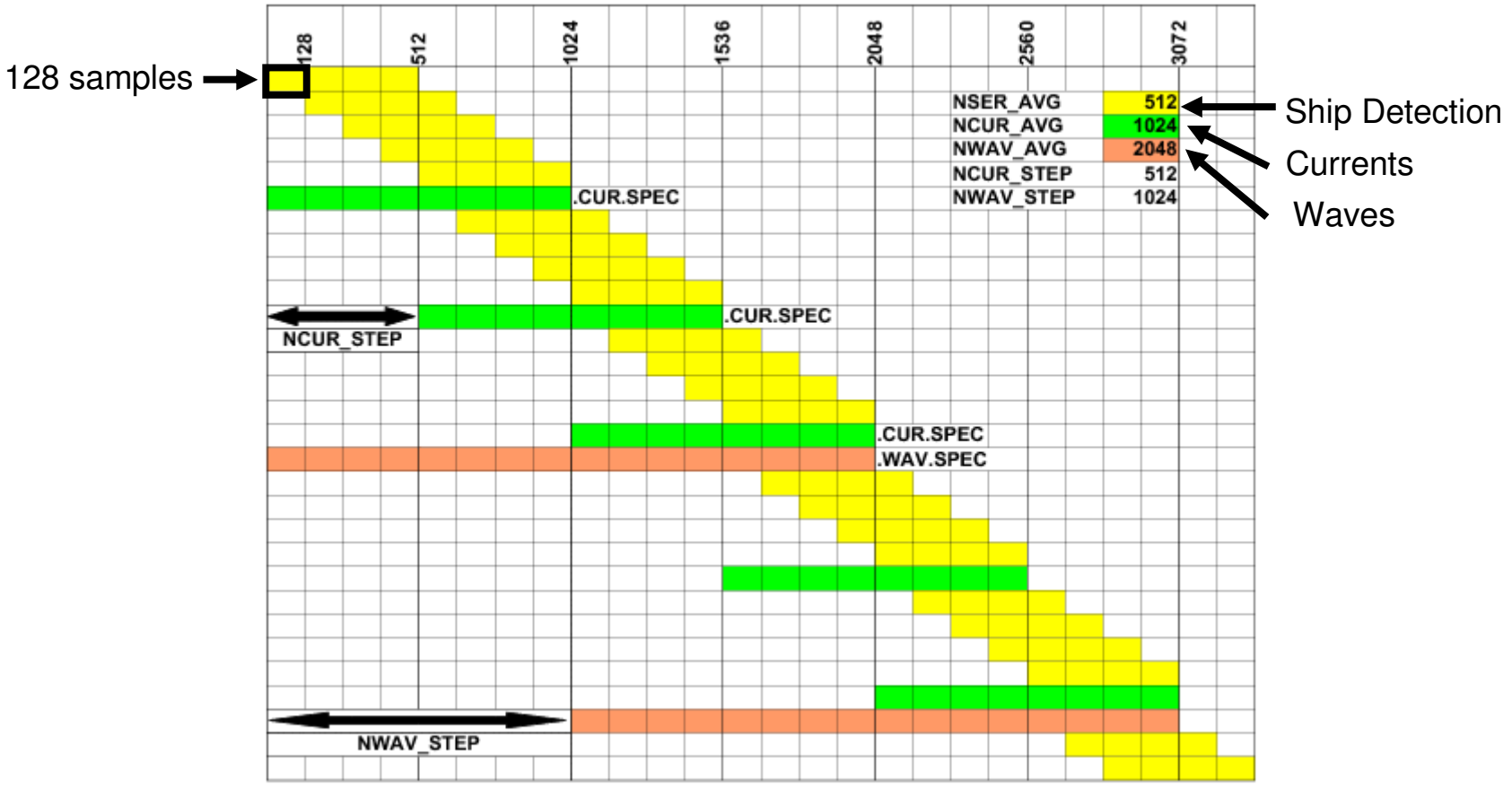
Acquisition Mode:	Permanent Acquisition				
Process after Measurement:	☐ Sea Echos	☐ Calibr. Data	☐ FM Raw Data		
Time Slot:	Master				
Receiver Attenuation:	off				
FMICW Mode:	off				
Calibration Power:	0 [dB]	☐ TX off			
Location:	Wangerooge				
True North:	90 ° [1 to 360]		**Time Code:**	UTC	
Latitude:	54 ° 7.17 ' N		**Cont. Acqu. Start Time:**	00 [min]	
Longitude:	8 ° 51.47 ' E				
Freq. Management(1):	12.500 **to** 13.500 [MHz]	☑ Prescan	☑ Adapt Frequency		
Freq. Management(2):	12.000 **to** 12.400 [MHz]	☑ Enable 2nd Frequency Range			
Bandwidth Reduction:	600 **to** 1500 [m]				



Working Frequency:	13.027 [MHz]	**Cycle Repetition Time:**	60 [min]
Range Cell Depth:	600 [m]	**Number of Range Cells:**	256
Samples per Data Run:	13184	**Maximum Range:**	154 [km]
Chirp Length:	0.260000 [sec]	**Data Acquisiton Time:**	57 : 08 [min:sec]
Range Offset:	600 [m]	**RX Offset:**	0 [Hz]
Data Path:	/home/wera/data/ wooge/		Close This Window
File Location ID:	wog [3 characters]		
Comment:	WERA Lab Tests at University of Hamburg.		
Status:	Running 1376	**Automatic Cycles:**	Active
Available Diskspace on /data: 58G (89%used)			Vers. 3.0.0

New WERA Software Implementation

2. WERA Permanent Acquisition Processing Software



New WERA Software Implementation

2. WERA Permanent Acquisition Processing Software

https://ifmaxp1.ifm.zmaw.de/weradocs/wera16_grid_ol.shtml

wera16_grid_ol

wera16_grid_ol reads a series of coherent **.USORT** files (128 samples each) and combines them to form sub-spectra from **NSER_AVG** samples [yellow]. The parameters **REPROC**, **UNAM_nnn**, **CALF_nnn** and **GADJ_nnn** in **params*.cfg** define file names to control this process. Once the coherent series of .USORT files is interrupted, the process to combine files is restarted.

If **CUR_SPEC** is defined to **.TRUE.**, these sub-spectra [yellow] are averaged until **NCUR_AVG** samples are covered to form the gridded spectra file yyyydddhhmmss_cod.CUR.SPEC [green]. These files are written at time increments of **NCUR_STEP** samples.

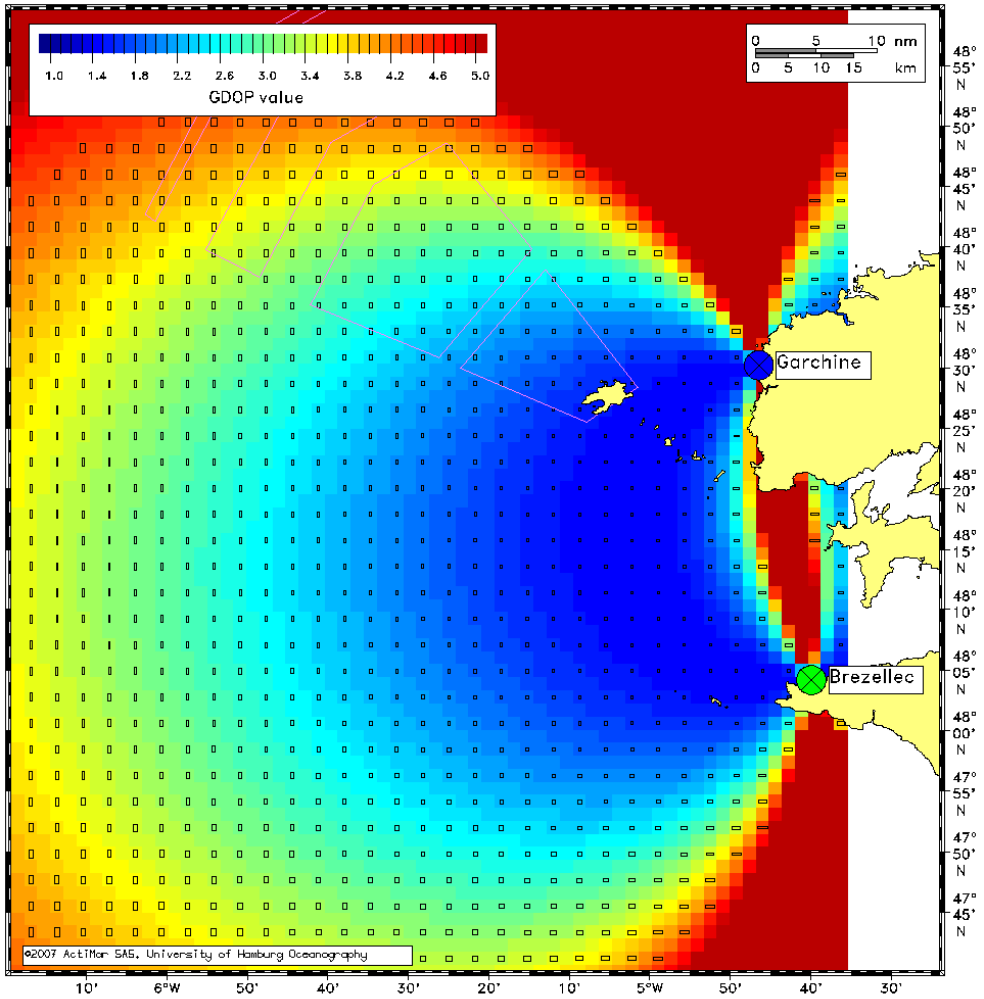
If **WAV_SPEC** is defined to **.TRUE.**, these sub-spectra [yellow] are averaged until **NWAV_AVG** samples are covered to form the gridded spectra file yyyydddhhmmss_cod.WAV.SPEC [red]. These files are written at time increments of **NWAV_STEP** samples.

NSER_AVG, NCUR_AVG, NCUR_STEP, NWAV_AVG, NWAV_STEP must be multipes of 128 and are defined in **params*.cfg**.

New WERA Software Implementation

3. WERA processing software

GDOP with coloured background

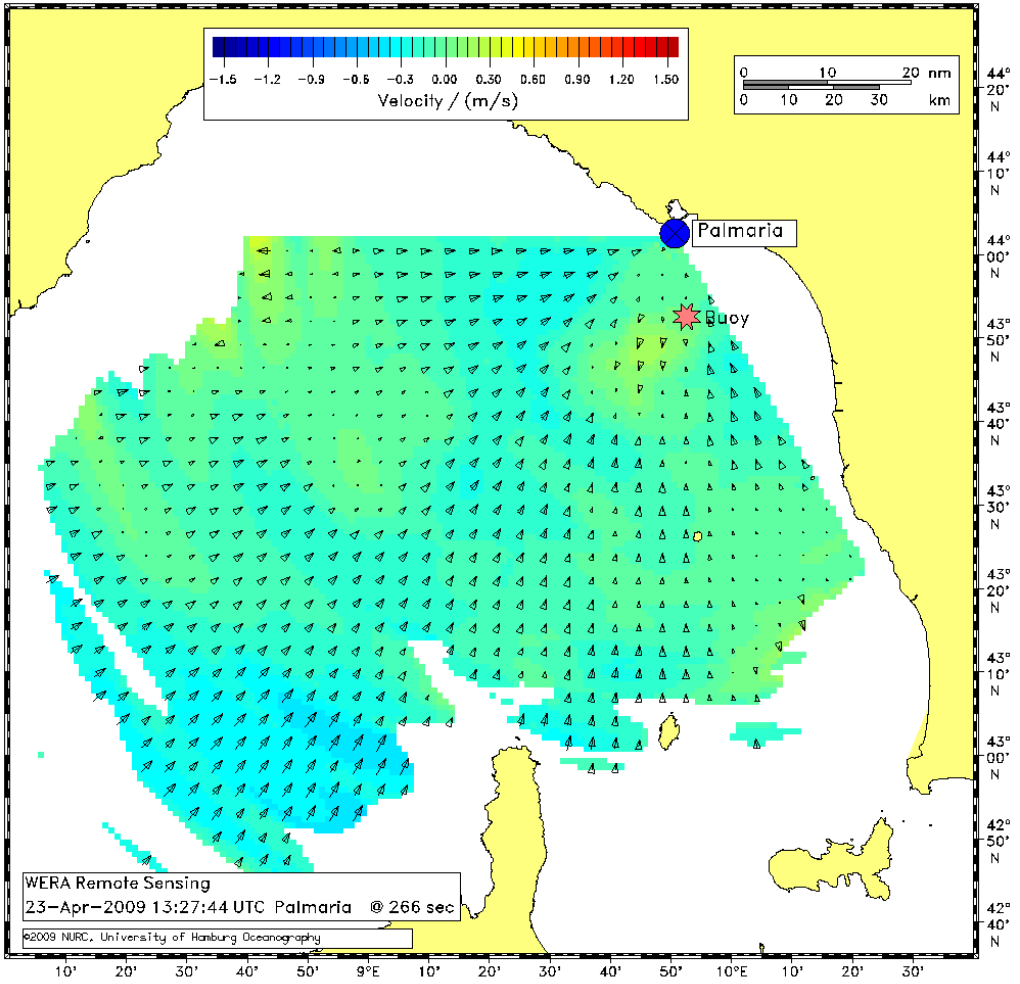


New WERA Software Implementation

3. WERA processing software

Code the direction of radial currents in colour

Set PM_RAD = .TRUE. in params.cfg



New WERA Software Implementation

3. WERA processing software

New data format for .SPEC files

The old .SPEC data format contained power spectra for all NX x NY grid points. Points not reached by the radar due to range or angle limitations were filled with white noise.

The new .SPEC data format starts with a list of covered grid points followed by the power spectra at these points. If a large grid is defined, e.g. all along the coast covering multiple radars, the new format significantly reduces the file size.

To enable the new .SPEC data format, define SPEC2 = .TRUE. In params.cfg . All programs involved in the processing chain will automatically use the new format.

New WERA Software Implementation

4. Remarks on Calibration Files

In the first version of WERA, we needed to take account of different cable lengths and different time delays in the receivers (phases), as well as slightly different gain for I and Q channels and for normalizing between antenna channels. This is done by the calibration procedure, connecting all antenna cables to the calibration box and feeding it with a signal at -80 Hz offset (~Range cell 20). The calibration data set is processed by "Plott_WERA_Cal_lsq" and generates the file **/home/wera/etc/calibration.wera**, which is used by the real-time CL7 software during range resolving FFTs and sorting of data to the .SORT files.

As there are high- and lowpass filters in the receivers, we need to apply **/home/wera/etc/wera_gain.dat** to get equal gain at all range cells during processing. We had built the receivers with 0.1% tolerance components (e.g. selected by hand) to make the receivers equal in frequency response, i.e. gain vs. range.

The commercial WERA does not use these hand-selected components and to compensate for differences in receiver frequency response (in gain and amplitude), I implemented the "**FullCalibration procedure**". 256 calibration measurements are done for the 256 range cells. The FullCalibration procedure makes two files:
/home/wera/etc/calibration.wera and
/home/wera/etc/WERA_Site.fullcal
The first file is compatible with the old calibration approach and the second file contains the "fine adjustment vs. range" for **amplitude and phase**. Like /home/wera/etc/wera_gain.dat, this file is read and used during processing whenever beam foring or direction finding is needed.

Finally, there may be some environmental changes for the receiver array antennas due to rain, changing ground humidity, and coupling of the antennas to the ocean. This is done by a **gain normalization procedure**, which looks at the integrated 1st order backscatter energy of the single antennas. This is the final step and done after all other corrections have been done.

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5. Future Software Extensions

- Implement bi-static operation (MIMO)
- Further optimize RFI reduction
- Archives are now encrypted by GnuPG