

**Mid-Atlantic Regional Coastal
Ocean Observing System (MARCOOS)
HF Radar Quality Control/Quality Assurance Document
April 2008**

The Maritime Safety priority for MACOORA is evidenced by its focus on establishing the region-scale Mid-Atlantic HF Radar network. Measured surface current maps by the Mid-Atlantic HF Radar Consortium (MAHFRC) are recognized (1) by the Coast Guard to improve their Search And Rescue (SAR) activities and (2) by NOAA HazMat to improve emergency response to hazardous spills. Nationally, the Coast Guard receives an average of 13 SAR calls per day, of which 10 are successful rescues. To reduce the lives lost, the critical USCG need is to optimize SAR operations to minimize Search time. HF Radar information in the gap between the inshore NOAA PORTS and recommended offshore NDBC buoys will allow SAR operations to be optimized. The basic infrastructure for CODAR operations is in place to fill the gap.

The community, in numerous MACOORA-wide meetings, has concluded that the existing observational infrastructure and resident expertise can be leveraged to produce sustainable products to improve Maritime Safety. Recent statistical comparisons between surface drifter trajectories, those produced by Short Term Prediction System (STPS) and the pre-SAROPS methodology using climatology or nearest NOAA coastal station data indicate that the STPS/CODAR fields lead to more accurate results. In another recent study, comparisons between Coast Guard drifter-inferred currents and CODAR surface currents indicate *a factor of 2 improvement in uncertainty*, as compared to the existing models in the EDS and available to SAROPS. Thus, the USCG Office for Search And Rescue has concluded that by using CODAR currents (with their estimated uncertainty) in the existing EDS for SAROPS, an additional 50 lives per year will be saved at the national level.

Background:

During an actual SAR event, or test, a cluster of a few hundred virtual objects is deployed in surface wind and current fields downloaded from the Environmental Data Server (EDS) and allowed to drift over time. The cluster disperses based on the uncertainty estimates in the winds and currents. If SAROPS data has lower uncertainties there is lower dispersion in the cluster, a smaller search area, and greater likelihood for success. Coast Guard operational SAR controllers are trained in how to use SAROPS and get data from the EDS. As part of the MARCOOS effort and the delivery of regional and sub-regional HF radar data, there is a need to define the uncertainty bounds of the data for effective utility in SAROPS. In order to deliver on this need, MARCOOS has formed a region-wide HF radar QA/QC working group. As of the draft of this document the MARCOOS QA/QC group consists of Chris Jakubiak (UMass Dartmouth), Adam Houk (UConn), Ganesh Gopalakrishnan (Stevens Institute), Josh Kohut (Rutgers), Hugh Roarty (Rutgers), Teresa Garner (ODU), Sara Haines (UNC-CH) and Pat Burke (NOAA). It is anticipated that this group will produce a QA/QC recommendation document every 6 months of the MARCOOS project. This document will provide the HF radar operators in

the region with criteria to ensure quality data delivery to the Coast Guard and other end user communities.

This document outlines the initial recommendations for quality data delivery to the Coast Guard. These recommendations are based on SAR demonstrations/drifter comparisons, interactions with NOAA QARTOD, and Radiowave Operators Working Group (ROWG). Since all systems presently operating in the MARCOOS region are SeaSondes manufactured by Codar Ocean Sensors, these recommendations are specific to these systems.

Recommendations:

1) Radials to Merge: There must be at least 2 radial vectors in each grid point for the Merge. The present software takes Short Term Radials (STR) files and merges them together to get the final radial product. Based on the averaging parameters a particular cell will have 1-7 (1-5) vectors for the standard range (long range) systems.

Analysis Options, line 1 second number should be set to at least 2.

*Operators can increase this number but cannot operate with a value less than 2.

2) Noise Factor: We recommend that all systems increase the noise factor for regular processing. The noise factor is used to define the threshold signal to noise of a given Doppler cell for current processing. Only Doppler cells with noise factors greater than this threshold will be used to estimate surface currents.

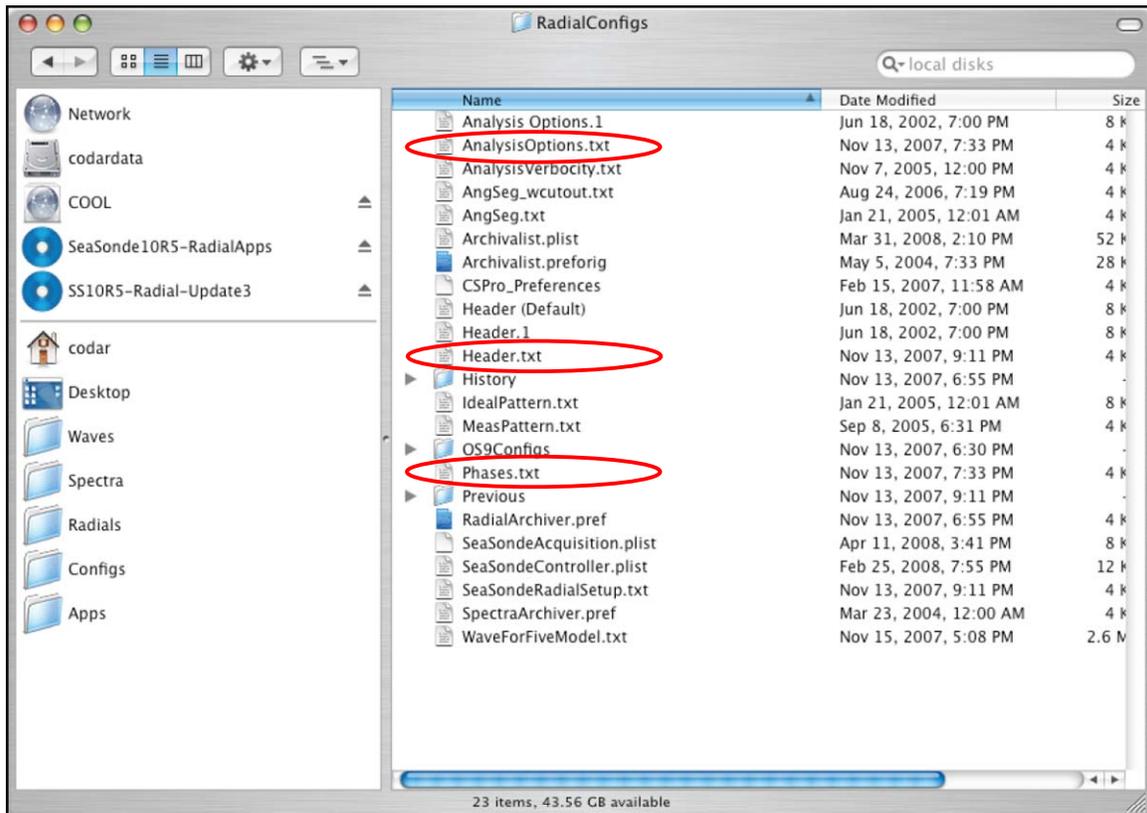
Header.txt, line 15 second number should be set to 5.0.

**This will require that all Doppler cells used in current processing have a signal at least 7.0db above the background noise.

3) Antenna Patterns: Measured patterns should be used for all radial data processing within the Mid-Atlantic bight. For some of the newer sites to the network, patterns have not been measured. For these sites, ensure that phases measured from sea echo are properly set in the phases.txt file. All sites in the MARCOOS footprint should have patterns measured before the next issue of this document in October 2008. The particular file type going to the national server is at the discretion and experience of the site owner.

4) Monitoring: It is recommended that operators monitor the real-time calculated phase and amplitude measurements in the diagnostic files at least once per week. MARCOOS operators have setup an online diagnostic page for more convenient access to these data (<http://www.marcoos.us/products.htm>). Operators should note sudden changes in these parameters and check the radial displays at these times for anomalous radial values or diminished coverage.

Appendix 1: Relevant Screenshots



Radial Configs directory with appropriate files for QA/QC recommendations.

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AnalysisOptions.txt
1 2 0 ! 1 Current Processing: 0 Disabled,1 Enabled; Rad Pts: 0 Off, 2 Need 2pts; RadSm: 0 None,1 Gauss Smooth, 2 Interp
1 ! 2 Wave Processing: 0 Disabled,1 Enabled;
0 ! 3 File Archiving: 0 Keep All CSA,CSS,Rad Files, 1 Limit # of CSA,CSS,Rad files according to Header file
2 0 ! 4 Antenna Pattern: 0 Use Ideal, 1 Use Measured; ForcedAmp: 0 Disabled, 1 Use Header Ampl Entry for Ampl Correction
0 ! 5 Header Override: 0 Use CSA,CSS info in processing, 1 Use Header file info in processing.
1 ! 6 CSA Processing: 0 Process CSA->'Rad ', 1 Do only CSS->'Rads'
0 0 0 ! 7 Offshore: 0 Disabled,1 Enabled; 0 Symetry Off, 1 Symetry On
0 ! 8 Currents Bragg Split: 0 Normal(Rads), 1 Pos(Rade)/Neg(Radf) split, 2 Normal plus splits
1 ! 9 Ionospheric Noise: 0 Ignore, 1 Remove Offending RangeCells
0 !10 ShortTime Rad/Ellipticals: 0(Off), 1(Output)
0 !11 Special FirstOrder: 0(Off), 1(Enable)
0 !12 Aver CS FirstOrder: 0(On), 1(Disable)
0 !13 Merging Method: 0(Median), 1(Averaged)
0 !14 Vectors OverWater: 0(Anywhere), 1(WaterOnly)
1 !15 Waves Follow Wind Direction: 0(Don't), 1(Do)
0 !16 FirstOrder close to Bragg: 0(check), 1(dont check)
1 !17 WaveModelSlider Method: 0(Average), 1(Median)

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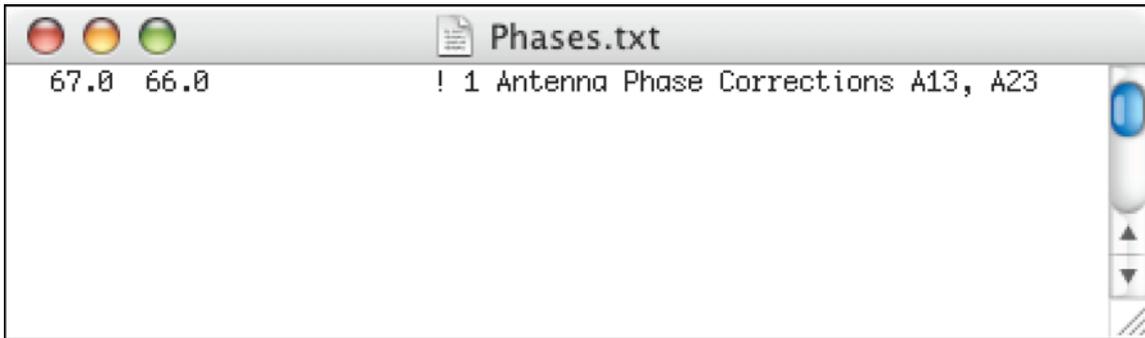
Recommendation 1: AnalysisOptions.txt

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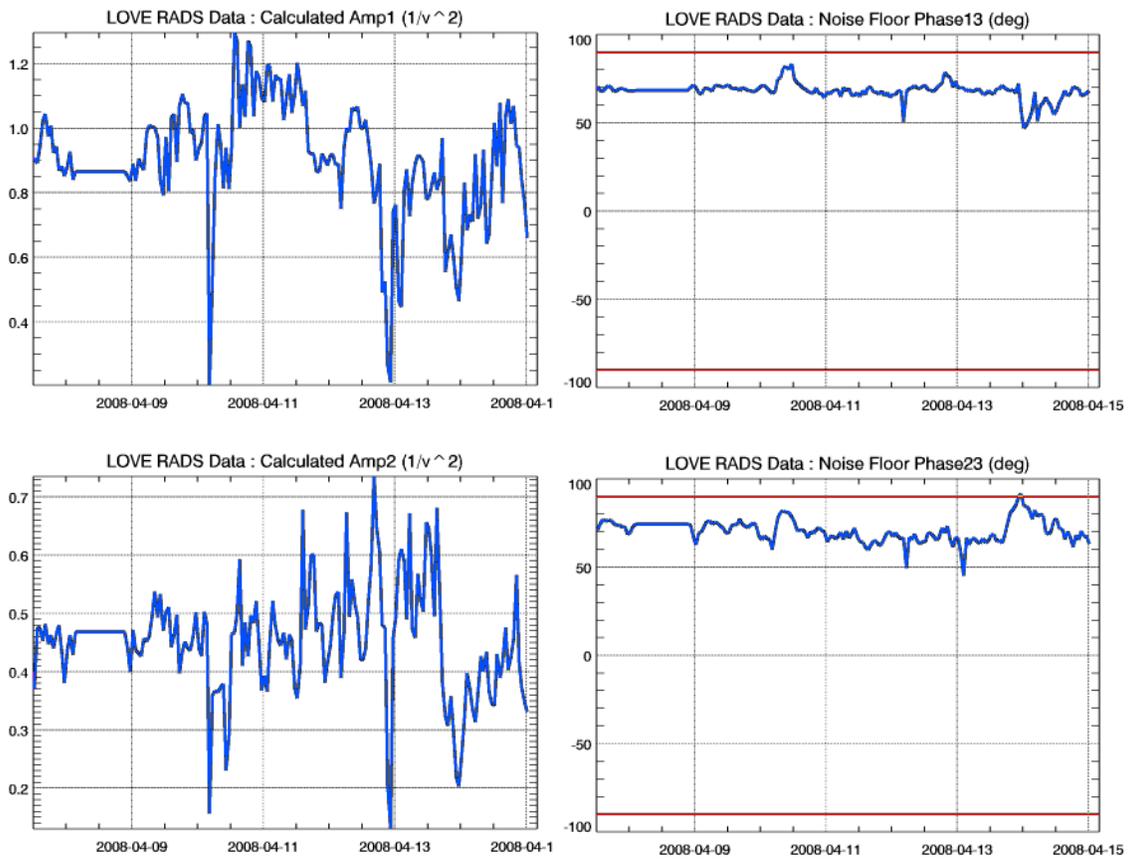
Header.txt
1 LOVE ! 1 Site #, Name
39*44.171 'N,074*07.029 'W ! 2 Latitude and longitude of site
161 ! 3 Bearing of antenna 1 clockwise from true north
38 5.8510 5.8510 ! 4 Process Range Cells, 1st Range (km), Range Step (km) from SSC
90.0 ! 5 Baseline angle--between line from site 1 to site 2 & east
1.0 ! 6 Averaging time (hours)
4.537183 ! 7 Tx Center Freq MHz from SSC
1024 ! 8 Number of frequency points
0.00390853 ! 9 Frequency increment (Hz)
GMT 0.000 GMT !10 Time zone
100 2 !11 Estimate of maximum current (cm/s), # pts for running average in firmss
15.0 0 100.0 !12 Factor down peak limit 1st order Radials , 0 = no 2nd order, Factor down 1st order Waves
15 !13 Spectra averaged (not used)
2 17 !14 Wave Process Range Cell, Estim. Max Wave Period (seconds)
7.5 5.0 10.0 2.0 !15 Radials:Factor down peak nulls, Noise factor, Waves:Factor down peak nulls, Noise factor
168 168 288 !16 Keep Proc CSA, Keep Rad+4xOlderRad, Keep Proc CSS
1.00 1.00 1.00 1.00 !17 Forced Ideal Amp1,Amp2; Patt Amp1,Amp2
195 015 !18 RH, LH coast angle, integer deg. True (0-360deg), looking toward sea.
40 20 2 20 20 25 15 !19 Music params eigrat,sigprat,diagrat; Gaussian Smooth med width*, smear width, vel thresh, gap
-- !20 FileName Rad,Tot Separators date,space chars (old compat is '/' )
100 60 0 0 !21 Rads: Coverage min., Output Interval min., Interval Offset min., 0=watch timespan
5.0 !22 Bearing Resolution
100 60 0 0 !23 WaveModel: Coverage min., Output Interval min., Interval Offset min., 0=Watch Timespan
1.0 !24 Ionosphere Noise Removal Factor
0 !25 Doppler Noise Limit
195 015 !26 RH, LH wave limits deg NCW.
1 2 !27 Radial First Range Cell, WaveModel First Range Cell.

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Recommendation 2: Header.txt



Recommendation 3: Phases.txt



Recommendation 4: Diagnostic webpage plots Amplitude (left) and Phase (right)