Processing of Shipboard ADCP Data
Collected with VmDAS

File Definitions:

- ENR – Raw ADCP binary data file
- ENS – ADCP binary data screened for RSSI and Correlation cutoffs
  Has navigation data.
  If EB has a value, that value will be used to correct the compass immediately and the corrected compass value will be saved
- ENX – Single ping ADCP binary data file with navigation data
  Bin-mapped, Transformed to Earth coordinates (using ADCP or GPS)
  Screened for Error Velocity, Vertical Velocity, and False Target cutoffs
  If EA has a value, the value will be used to correct the compass in the ENX data
- N1R – Raw NMEA ASCII data file

Processing Steps Required:

1. Read ENS data into Matlab using rdradcp
    a. To check, load ENR, ENS, and ENX data and compare
2. Correct EB command in ENS file if needed.
3. Bin mapping, if needed. See if pitch and roll of the boat is larger than the bin size. If it is, bin mapping may be necessary. If not. It may be skipped.
4. Use coordinate transformation to convert
    a. Beam velocities to XYZ (instrument coordinates)
    b. XYZ velocities to ENU coordinates
        i. Up is not useful for ship data
    c. Bottom track velocities to XYZ (instrument coordinates)
    d. Bottom Track XYZ to ENU coordinates
5. Correct for magnetic declination after velocities have been converted to Earth coordinates
6. Remove the ship's motion by subtracting the bottom track velocity value from the water column velocity value in each bin for each ensemble.
7. Correct backscatter for distance from beam by normalizing the backscatter. This will allow a better comparison for backscatter collected close to the beam and far from the beam. Basically, converting the counts back to a 'dB' scale, which is essentially a logarithmic scale.
        i. Backscatter + 20 * log(distance)
8. Bin average in time to smooth data. Similar to recreating the LTA and STA data files from VmDAS.
9. Trim data below the bottom velocities by using the 94% of data (Clark)
10. Average backscatter from all four beams and then depth integrate to see plume or shear within water column
11. Rotate velocities to along channel and across channel coordinates
12. Depth average velocities and plot using quiver to check data

13. Convert latitude and longitude to xr and yr to match rotated velocities
14. Interpret ur to the xr and yr points and plot
15. Load bathymetry for more plotting (WG12 from Laura Stevens)

Set-up file for the WG13 Shipboard deployment

```
;--------------------------------------------------------------------------\
; ADCP Command File for use with VmDas software.
;
; ADCP type:     300 Khz Workhorse
; Setup name:    default
; Setup type:    Low resolution, long range profile(broadband processing)
;
; NOTE:  Any line beginning with a semicolon in the first
;        column is treated as a comment and is ignored by
;        the VmDas software.
;
; NOTE:  This file is best viewed with a fixed-point font (e.g. courier).
; Modified Last: 12August2003
;--------------------------------------------------------------------------/

; Restore factory default settings in the ADCP
cr1

; Turning off the recorder
CF11110

;Disable power conservation
cl0

; set the data collection baud rate to 38400 bps,
; no parity, one stop bit, 8 data bits
; NOTE:  VmDas sends baud rate change command after all other commands in
; this file, so that it is not made permanent by a CK command.
cb611

; Set for reduced bandwidth (extended range) profile mode (WB), single-ping
ensembles
; (WP), fifty (WN) 4 meter bins (WS), 3 meter blanking distance (WF), 330 cm/s
; ambiguity vel (WV)
WB1
WP00001
WN050
WS400
WF300
WV330
```

```
; Enable single-ping bottom track (BP),
; Set maximum bottom search depth to 300 meters (BX)
BP001
BX3000

; output velocity, correlation, echo intensity, percent good
WD111100000

; One half second between bottom and water pings
TP000050

; One second between ensembles
; Since VmDas uses manual pinging, TE is ignored by the ADCP.
; You must set the time between ensemble in the VmDas Communication options
TE00000100

; Set to calculate speed-of-sound, use internal depth sensor (if available), use
internal
; compass heading sensor, use internal pitch or roll being used, no salinity sensor,
use
; internal transducer temperature sensor
EZ1111101

; Output beam data (rotations are done in software)
EX00000

; Set magnetic compass offset or compass bias offset (hundredths of degrees)
EB-4500
EA4500

; Set transducer depth (decimeters)
ED00000

; Set Salinity (ppt)
ES35

; save this setup to non-volatile memory in the ADCP
CK
```

Note: The ADCP was set up to record the heading from the transducer and not the GPS. The GPS (N1R file) did not record heading which would have been the NMEA string GPHDG (heading, deviation, and variation) or GPHDT (heading-true).

Step 1: Read data into Matlab using rdradcp.m

enr =	ens =	enx =
name: 'adcp'	name: 'adcp'	name: 'adcp'
config: [1x1 struct]	config: [1x1 struct]	config: [1x1 struct]
mtime: [1x212 double]	mtime: [1x212 double]	mtime: [1x212 double]
number: [1x212 double]	number: [1x212 double]	number: [1x212 double]
pitch: [1x212 double]	pitch: [1x212 double]	pitch: [1x212 double]
roll: [1x212 double]	roll: [1x212 double]	roll: [1x212 double]
heading: [1x212 double]	heading: [1x212 double]	heading: [1x212 double]
pitch_std: [1x212 double]	pitch_std: [1x212 double]	pitch_std: [1x212 double]
roll_std: [1x212 double]	roll_std: [1x212 double]	roll_std: [1x212 double]
heading_std: [1x212 double]	heading_std: [1x212 double]	heading_std: [1x212 double]
depth: [1x212 double]	depth: [1x212 double]	depth: [1x212 double]
temperature: [1x212 double]	temperature: [1x212 double]	temperature: [1x212 double]
salinity: [1x212 double]	salinity: [1x212 double]	salinity: [1x212 double]
ssp: [1x212 double]	ssp: [1x212 double]	ssp: [1x212 double]
pressure: [1x212 double]	pressure: [1x212 double]	pressure: [1x212 double]
pressure_std: [1x212 double]	pressure_std: [1x212 double]	pressure_std: [1x212 double]
east_vel: [50x212 double]	east_vel: [50x212 double]	east_vel: [50x212 double]
north_vel: [50x212 double]	north_vel: [50x212 double]	north_vel: [50x212 double]
vert_vel: [50x212 double]	vert_vel: [50x212 double]	vert_vel: [50x212 double]
error_vel: [50x212 double]	error_vel: [50x212 double]	error_vel: [50x212 double]
corr: [50x4x212 double]	corr: [50x4x212 double]	corr: [50x4x212 double]
status: [50x4x212 double]	status: [50x4x212 double]	status: [50x4x212 double]
intens: [50x4x212 double]	intens: [50x4x212 double]	intens: [50x4x212 double]
bt_range: [4x212 double]	bt_range: [4x212 double]	bt_range: [4x212 double]

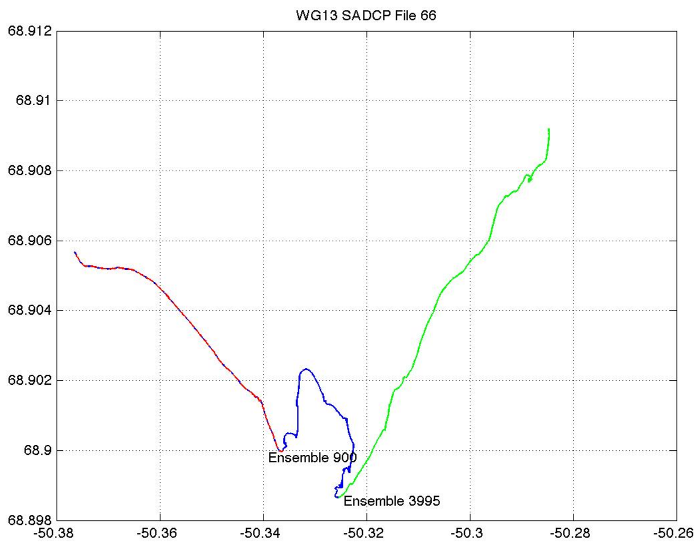
bt_vel: [4x212 double]	bt_vel: [4x212 double]	bt_vel: [4x212 double]
bt_corr: [4x212 double]	bt_corr: [4x212 double]	bt_corr: [4x212 double]
bt_ampl: [4x212 double]	bt_ampl: [4x212 double]	bt_ampl: [4x212 double]
bt_perc_good: [4x212 double]	bt_perc_good: [4x212 double]	bt_perc_good: [4x212 double]
perc_good: [50x4x211 double]	nav_smtime: [1x212 double]	nav_smtime: [1x212 double]
	nav_emtime: [1x212 double]	nav_emtime: [1x212 double]
	nav_slongitude: [1x212 double]	nav_slongitude: [1x212 double]
	nav_elongitude: [1x212 double]	nav_elongitude: [1x212 double]
	nav_slatitude: [1x212 double]	nav_slatitude: [1x212 double]
	nav_elatitude: [1x212 double]	nav_elatitude: [1x212 double]
	nav_mtime: [1x212 double]	nav_mtime: [1x212 double]
	perc_good: [50x4x211 double]	perc_good: [50x4x211 double]

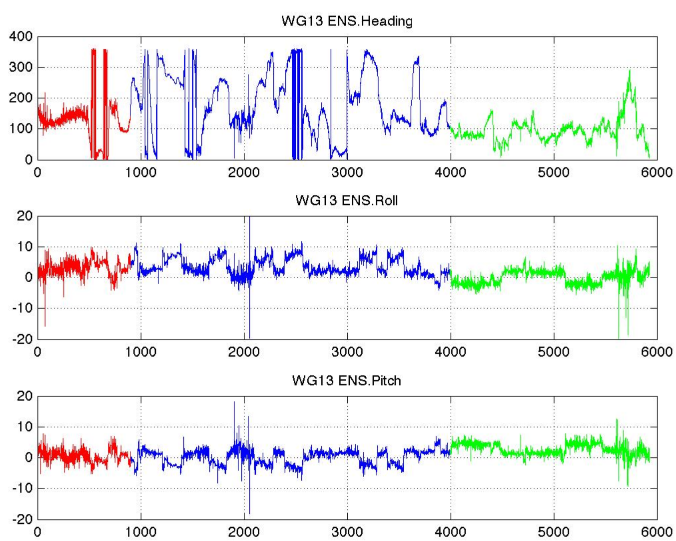
enr.config =	ens.config =	enx.config =
coord: '00000000'	coord: '00000000'	coord: '00011111'
coord_sys: 'beam'	coord_sys: 'beam'	coord_sys: 'earth'
use_pitchroll: 'no'	use_pitchroll: 'no'	use_pitchroll: 'yes'
use_3beam: 'no'	use_3beam: 'no'	use_3beam: 'yes'
bin_mapping: 'no'	bin_mapping: 'no'	bin_mapping: 'yes'
xducer_misalign: 45	xducer_misalign: 45	xducer_misalign:45
magnetic_var: -45	magnetic_var: -45	magnetic_var: -45
sensors_src:'01111101'	sensors_src:'01111101'	sensors_src:'01111101'
sensors_avail:'00011101'	sensors_avail:'00011101'	sensors_avail:'00011101'

Step 2: Plot to determine begin and end of straight transects for WG13 ADCP 066

Line 1: ensembles 1:900
Line 2: ensembles 3995:5929

For 30 second average
Transect 4 = 133:197





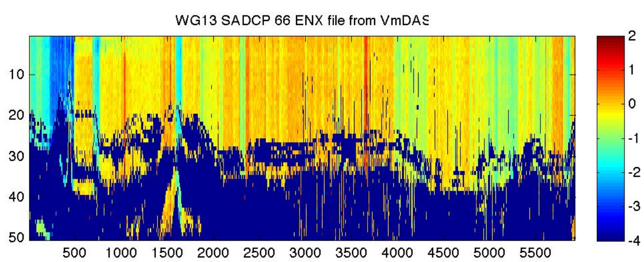
Step 2b: Read in ensembles 1 to 900 into Matlab using rdradcp. The structure is called ens.

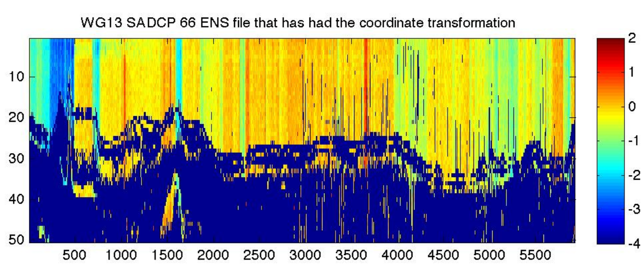
Step 2c: Corrected heading by adding 45° to the heading variable. The new structure is ensEB0

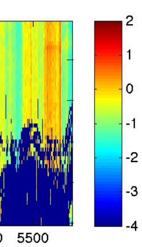
Step 3a. Coordinate Transformation for Beam Velocities

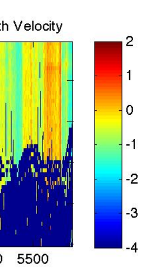
Coordinate transformation using rdi_coordTransform_ALR converts the beam velocities into xyz velocities (Ship) and ENU velocities (East, North, Up). The heading, pitch, and roll variables do not change.

Variable	Minimum (m/sec)	Maximum (m/sec)
enx.east_vel	-7.9120	6.6020
coordTx.ve	-4.3407	2.0765
enx.north_vel	-7.1940	5.8060
coordTx.vn	-2.7134	3.1302









Step 3b. Coordinate Transformation for Bottom Track Velocities. Be sure to convert bottom track velocities from mm/sec to m/sec. (bt_vel*0.001) and replace fill values with NaNs.

Variable	Minimum (m/sec)	Maximum (m/sec)
enx_vel.ve	-7.7270	6.0010
velocity.ve	-3.1676	3.0913
enx_vel.nn	-7.1240	5.8750
velocity.vn	-2.2381	2.5926

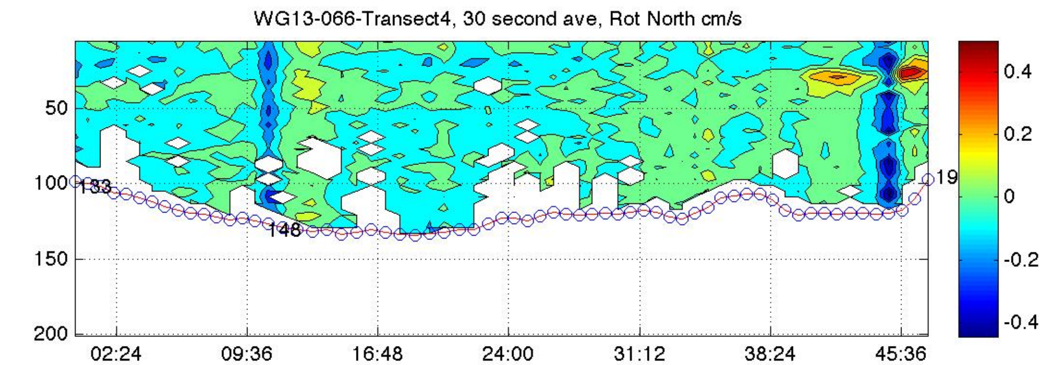
Resulting file: WG13_sadcp66
Structures included: raw – the raw data read straight from rdradcp
EB0 – if EB has a value, compass data is corrected to 0
Using correctEB

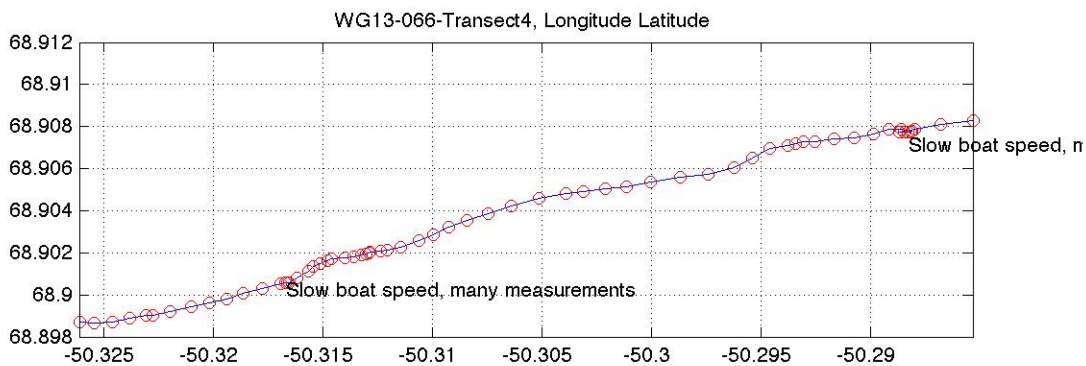
According to ngdc.noaa.gov website:

- 2010 the magnetic declination was 34 degrees West of North
- 2015 the magnetic declination at WG fjord will be 33 degrees west of North
- [-50.3765 68.9057]
- On July 25, 2013 it was 32.55 W

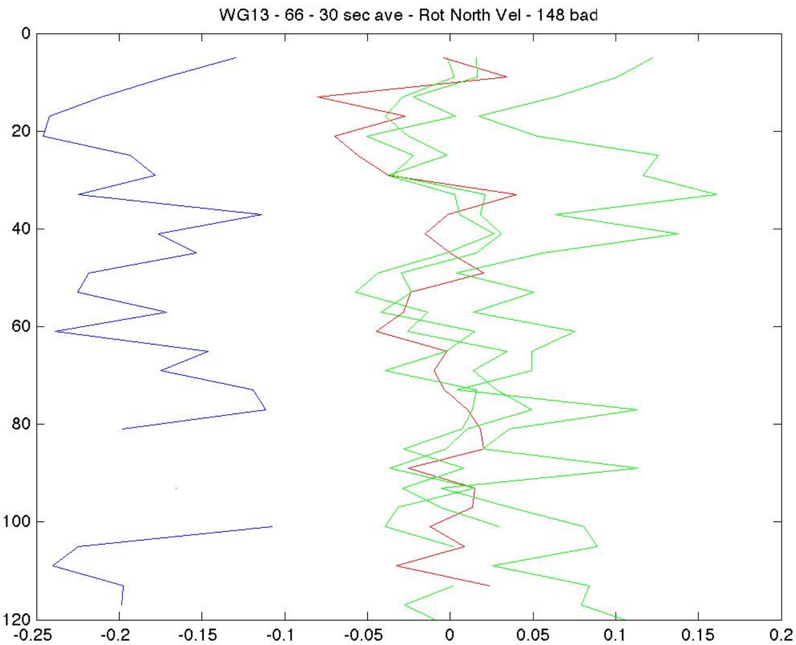
WG13_sadcp_66_30s.mat

- Processed with rdradcp using 30 second average and despike of [0.3 0.3 0.3].
- The last transect along the fjord face are indices 133:197
- Contour plot of Rotated North Velocities for last transect show a slow in the boat speed with multiple readings in one spot at indices 148 and 194
- Looking at the profiles of indices 146 to 150, index 148 does stand out as having much larger velocities

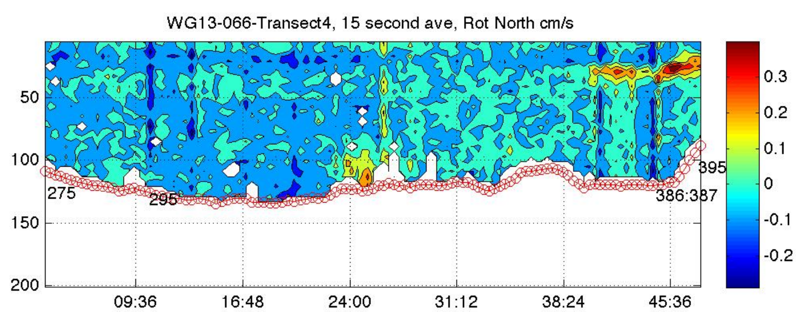


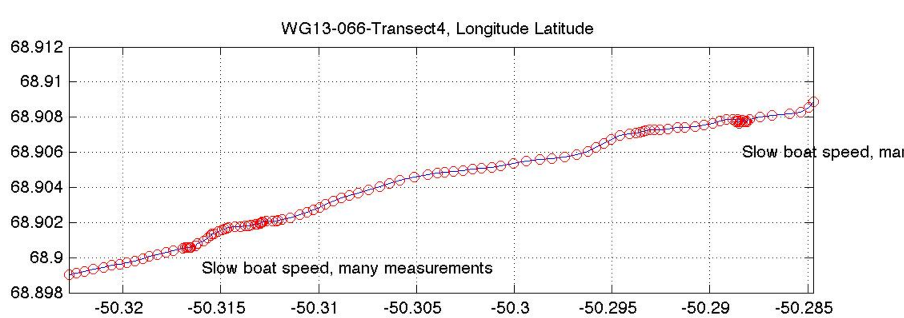


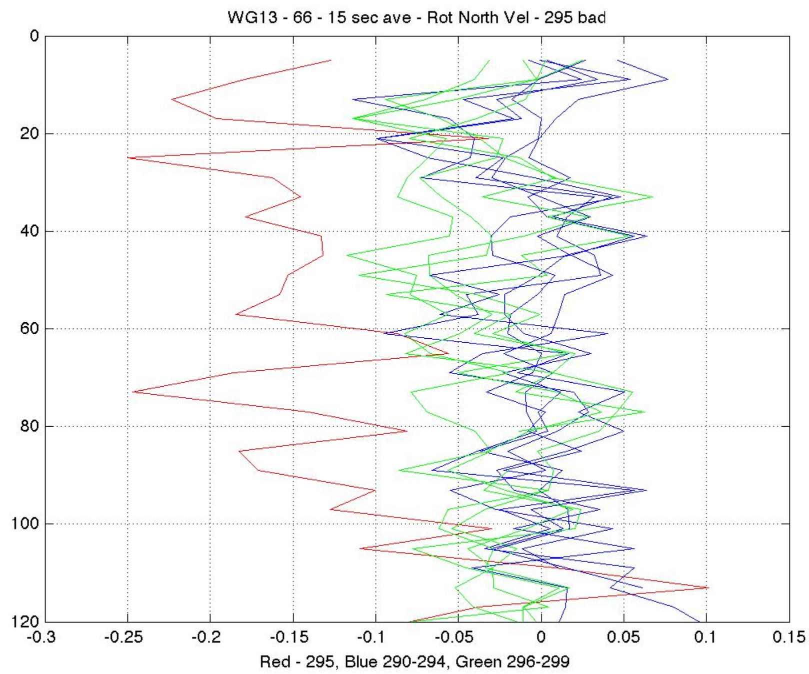
WG13_sadcp_66_15s.mat



- Processed with rdradcp using 15 second average and despike of [0.3 0.3 0.3]
- The last transect along the fjord face are indices 275:395
- Contour plot of Rotated Nnorth Velocities for last transect show slow in boat speed with multiple readings in one spot at indices 295 and 386:387
- Looking at profiles of indices 290:299, index 295 does stand out as having much larger velocities







WG13 - 66 - 15 sec ave - Rot North Vel - 295 bad
0
20
40
60
80
100
120
-0.3
-0.25
-0.2
-0.15
-0.1
-0.05
0
0.05
0.1
0.15
Red - 295, Blue 290-294, Green 296-299