

# SeaSonde 10

## LonLatUV (LLUV) File Format

1.05 Jun 20, 2007

There are three types of current maps produced by the SeaSonde

**Radials** show the radial current component towards a SeaSonde Radial Site.

**Ellipticals** show the Elliptical current component from a SeaSonde Bistatic Site.

**Totals** show the total current vectors combined from two or more SeaSonde Sites.

Each of these files has the same basic structure using the **CODAR Table Format** (CTF) layout with columnar tabular data consisting of a minimum of Longitude, Latitude, u velocity, and v velocity for each current vector.

Please read the **File\_CodarTableFormat** document as a prelude to the LLUV format.

(See the **%LLUVSpec**: key below for changes from previous versions)

### **Identification of the File:**

The first keyword of the file will typically be '%CTF: <version>' describing the version of the CTF file. Before version 1.00, the file will be missing this key; however, it is still readable with this standard.

Within the first ten lines of the file will must be a keyword of:

**%FileType: <type> <subtype> <name>**

The **<type>** must be **LLUV** to identify it as a current map.

The **<subtype>** identifies one of the three variations.

**rdls** for Radial Current Vectors.

**elps** for Elliptical Current Vectors.

**tots** for Total Current Vectors.

To determine if the file is a LLUV type, you should read the first ten lines looking for the '%FileType:' keyword. The **<type>** value will be **LLUV**. The **<subtype>** value tells you which variation it is.

### **File Naming:**

Filename should be use for archiving the data, not as a software determination of whether the file is a valid LLUV file.

The filenames follow the time-stamped CTF naming convention

*TTTS\_XXXX\_YYYY\_MM\_DD\_HHMM.ext'*

'TTTS' is the type of file where 'S' is the type of processing used:

**RDLi** Radials from Ideal Antenna Pattern.

**RDLm** Radials from Measured Antenna Pattern.

**RDLx** Short-time Radials from Ideal Antenna Pattern

**RDLy** Short-time Radials from Measured Antenna Pattern

**ELTi** Ellipticals from Ideal Antenna Pattern

**ELTm** Ellipticals from Measured Antenna Pattern

**TOTL** Total Current Vectors.

'XXXX' is the four character site name.

'YYYY' is the year

'MM' is the two character month from 01 to 12

'DD' is the two character day from 01 to 31

'HH' is the two character 24 hour from 00 to 23

'MM' is the two character minute from 00 to 59

‘.ext’ is the file type extension. This is used in OS X to assign icons and the default opener for the files.

.ruv for radial files.

.tuv for total files.

‘.euV’ for elliptical files.

‘.ctf’ for generic ctf file. Could be a LLUV file or something else. Always read for **%FileType**: key to be sure.

## **Keywords:**

### **%CTF: 1.00**

Identifies the file as a CODAR Table Format. The 1.00 version will change in the future if any changes are needed in reading the format.

### **%FileType: LLUV <subtype> <name>**

Identifies the file as a LonLatUV file. The <subtype> identifies whether is a Radial, Elliptical or Total Vector Current Map. <subtype>

**rdls** for Radials.

**elps** for Ellipticals

**tots** for Totals

### **%Manufacturer: CODAR Ocean Sensors. SeaSonde.**

Identifies that the file came from SeaSonde. If you create the LLUV, please put your Identity here.

### **%LLUVSpec: 1.05 2007 06 14**

LLUV File specification version followed by date year, month, day

This version will change when the fundamental LLUV data changes meaning, or indicates resolved problems.

The LLUV 1.00 version has each vector of longitude, latitude, u,v, vector flag where u,v is the current velocity towards East and North at the location of each vector.

### **%LLUVSpec: 1.05 2007 06 14**

This version indicates support for new tsunami detection wave map which does not conform fully to LLUV data as u,v is encoded as time-from-shore and angle of arrival. A future document will describe this new format in more detail.

### **%LLUVSpec: 1.04 2007 06 01**

This version indicates support for new LLUV Radial column ERTC, which is number of vectors that went into the Temporal Quality. This column is inserted after the Spatial Count, and the table subtype is updated to ‘RDL7’

### **%LLUVSpec: 1.03 2006 10 05**

This version indicates support for two new LLUV variations. Existing SeaSonde LLUV files remain the same as previous version 1.02

The first variant is new optional keywords **%XYUnits**: and **%UVUnits**: to describe the scalar of the distance and velocity vector table data. If these keys are missing, then the implied distance of kilometers and velocities of cm/s are used. The main reason for these new keys are to support RiverSonde radials, which require distance in meters and velocities in m/s. These keys don’t currently exist in SeaSonde LLUV outputs.

The second variant is support for a wave vector map, which does not fully conform fully to the LLUV as u,v is encoded as wave period and wave direction. A future document will describe this new format in more detail.

The reference key **%GridAxisOrientation**: was reported as NCW but was actually CCW from East. The value will now actually be NCW.

### **%LLUVSpec: 1.02 2006 01 11**

This version indicates two fixes to the format.

The first fix is that in LLUV Total Vectors files only, the vector Direction ‘HEAD’ column was actually CCW East. This has been fixed to be CW North. The table subtype TOT4 was updated to also indicate the fix **%TableType: LLUV TOT4**.

Previous versions 'TOT3', 'TOT2', 'TOT1' are all CCW from East for the HEAD column only the other bearing columns are still CW North.

The second fix is that for Radial LLUV only, the Spatial and Temporal columns were swapped. This means that the 'ETMP' is really Spatial and the 'ESPC' column is really Temporal. In the fixed version, just the columns %TableColumnTypes: ids are swapped ETMP EPSC marking the data correctly, but keeping the same column order for the data as the incorrect version. The table subtype was updated to %**TableType: LLUV RDL5**. Reader of previous version 'RDL4' should swap the Temporal/Spatial data. Table subtype 'RDL3' and earlier contains only Temporal values which were labeled as standard deviation 'STDV'

%LLUVSpec: 1.01 2005 12 30

There are no LLUV 1.01 files.

This would have marked the fix to the total vector Direction column, but didn't happen.

%LLUVSpec: 1.00 2005 03 25

This is first time the LLUVs are marked with this version key.

**%UUID: 1DDC51D1-1F3A-11DC-8B42-001451AA6464**

As of LLUVSpec 1.04, the SeaSonde LLUV files are being tagged with a UUID Universal Unique Identifier. This key is created using Mac OS X call CFUUIDCreate. Each UUID key has a very, very high chance of being unique. This key will change if the file is reprocessed. See the Web for more information on UUIDs.

**%Site: XXXX ""**

Contains the four-character site code followed by an optional user-friendly site name/info.

**%TimeStamp: 1999 08 16 13 00 00**

Identifies the **center** time in year, month, day, hour, minute, second of the data collected in the file.

**%TimeZone: "PST" -8.00 0**

Identifies the time zone of the TimeStamp. The first parameter is the time zone abbreviation in quotes. The second is the hours **from** UTC to the time zone. The third is an indicator, if not zero, indicating that daylight savings is in effect.

**%TimeCoverage: 60 Minutes**

Identifies the coverage time in minutes of the data collected in the file. The time the LLUV data covers is represented by the timestamp minus half the coverage time to timestamp plus half the coverage time

**%Origin: 28.033333 -90.016667**

Is the <latitude> <longitude> in fractional degrees (positive East and North) of where all Easting Distance(x), Northing Distance(y), Range, and Bearing data is relative to.

Typically the origin is the SeaSonde Radial Site for radials and ellipticals. For total vectors, the origin comes from the grid file origin, which was selected by the user when creating the combining grid.

**%ReceiverOrigin: 28.033333 -90.016667**

Is the <latitude> <longitude> in fractional degrees (positive East and North) where the receiver antenna was located. This will typically be the same for radials and for ellipticals. In a normal radial file this is always the same as the %Origin, but during combine processing, the %Origin is temporarily moved to the grid's origin in order to properly align all combining candidates to the same x,y referencing.

**%TransmitterOrigin: 28.033333 -90.016667**

Is the <latitude> <longitude> in fractional degrees (positive East and North) where the transmit antenna was located. This key is typically only included for ellipticals.

**%GreatCircle: "WGS84" 6378137.000 298.257223562997**

Identifies the model used to represent the Earth's surface as an ellipsoid. WGS84 is the world geodetic since 1984. 6378137 meters is the equator circumference, and the 298.2572 value is the 1/f roundness ratio.

**%GeodVersion: "CGEO" 1.00 2005 03 23**

Identifies the distance calculation for geo-location used. The first parameter is the name of the method. The second is the version number, followed by the year, month, and day timestamp. The CGEO is a c++ method which makes use of Vincenty's Great Circle calculation based upon NOAA Aug 9, 2002 FORTRAN source. This calculation measures the distance and bearings from/to any two points on the Earth using a great circle between the two points. A great circle is a circle on the globe, centered at the globe's center, and is the minimum distance between any two points. Because the SeaSonde is a surface based (follows the curvature of the Earth) the radial bearings also follow a great circle.

Another known method for this calculation is **%GeodVesion: "PGEO" 0.902 2005 11 04** which is a perl module also based upon the Great Circle calculation from NOAA source. This method is currently being used by UCSD to convert classic radials and totals.

**%RangeResolutionKMeters: 1.500**

This key is the range resolution in km of a SeaSonde Radial Site and is necessary to convert the LLUV to the older 'Rad' file format. This key will only be in radial and elliptical formats.

**%RangeResolutionMeters: 5.000**

This key is the range resolution in meters of a RiverSonde Site. This key will only be in radial and elliptical formats.

**%TransmitCenterFreqMHz: 4.537183**

Is the center transmit frequency used in megahertz of the SeaSonde. This key will only be in radial and elliptical formats.

**%DopplerResolutionHzPerBin: 0.000976563**

Is the Doppler bin resolution of the cross spectra used. It is use to determine current velocity. It is a calculation of the SeaSonde waveform sweep rate divided by number of Doppler cells used. This key will only be in radial and elliptical formats.

**%BraggSmoothingPoints: 2**

Is the number of smoothing points applied to the cross spectra in order to determine the first order region. This key will only be in radial and elliptical formats.

**%CurrentVelocityLimit: 100.0**

Is the maximum allowed current velocity cm/s in processing the cross spectra or combining into a total vector. You will not find any LLUV vector in this file with a larger velocity.

**%BraggHasSecondOrder: 0**

Is a flag if one used to tell radial processing whether to expect the cross spectra to contain second order. If no second order is expected then it is zero. This key will only be in radial and elliptical formats.

**%RadialBraggPeakDropOff: 15.000**

Is a factor used by radial processing to determine the first order region. This key will only be in radial and elliptical formats.

**%RadialBraggPeakNull: 7.500**

Is a factor used by radial processing to determine the first order region. This key will only be in radial and elliptical formats.

**%RadialBraggNoiseThreshold: 5.000**

Is a factor used by radial processing to determine the first order region. This key will only be in radial and elliptical formats.

**%PatternAmplitudeCorrections: 1.00 1.00**

Are factors used by radial processing to adjust antenna pattern. This key will only be in radial and elliptical formats.

**%PatternPhaseCorrections: 65.0 75.0**

Are phases used by radial processing to adjust antenna pattern. This key will only be in radial and elliptical formats.

**%PatternAmplitudeCalculations: 0.65 0.29**

Are factors calculated by radial processing from Bragg in last CSS. This key will only be in radial and elliptical formats.

**%PatternPhaseCorrections: 72.0 64.0**

Are phases calculated by radial processing from Bragg in last CSS. This key will only be in radial and elliptical formats.

**%RadialMusicParameters: 40.000 20.000 2.000**

Are the Music algorithm parameters used by radial processing. This key will only be in radial and elliptical formats.

**%MergedCount: 5**

Is the number of short-time radials merged into the final output. This key will only be in radial and elliptical formats.

**%RadialMinimumMergePoints: 2**

Is used by the radial processing merge to set a minimum threshold of the number of points that must exist for each range and bearing in order to merge into a final radial vector. This key will only be in radial and elliptical formats.

**%ReferenceBearing: 0 DegNCW**

This key is the reference angle in degrees clockwise from true North to use when converting the LLUV to the older 'Rad' file format.

**%RangeStart: 1**

This key identifies the first cross spectra range cell used by SeaSonde Radial Sites. It is needed when converting the LLUV to the older 'Rad' file format.

(Note: SeaDisplay 4.54 requires that this be always be 1, even if the first vector is not 1)

**%RangeEnd: 10**

This key identifies the last cross spectra range cell used by SeaSonde Radial Sites. It is needed when converting the LLUV to the older 'Rad' file format.

**%PatternType: Ideal**

Identifies the type of pattern used in radial processing. It is either 'ideal' for ideal pattern or 'Meas' for measured pattern.

**%PatternDate: 2005 01 17 17 38 27**

Is the file modification date of the pattern file used in year, month, day, hour, minute, second format

**%PatternResolution: 5.0**

Is the degrees resolution of the pattern file.

**%PatternSmoothing: 20.0**

Is the degrees of smoothing in the pattern file.

**%TransmitSweepRateHz: 1.00000**

Is the cross spectra sweep rate used a SeaSonde Radial Site.

**%TransmitBandwidthKHz: -25.634758**

Is the cross spectra bandwidth used a SeaSonde Radial Site. A negative value indicates a down sweep.

**%SpectraRangeCells: 128**

Is the number of range cells in the last cross spectra on a SeaSonde Radial Site.

**%SpectraDopplerCells: 1024**

Is the number of doppler cells in the last cross spectra on a SeaSonde Radial Site.

**%GridVersion: 2 2004 07 16 16 16 13**

Is the SeaDisplay Grid Version number and date stamp for the grid used by the Total vector

**%GridAxisOrientation: 0.0 degNCW**

Is the vertical (positive y) axis of the total vector source grid from north clockwise)

Note that previous to %LLUVSpec: 1.03 this value was reported as NCW but was actually CCW from East.

**%GridSpacing: 3.000 km**

Is the xy separation of total vector source grid points.

**%AveragingRadius: 4.000 km**

Is the radius distance surrounding each grid point to include source radial/elliptical vectors into a total vector.

**%DistanceAngularLimit: 20.0**

Is the required minimum angular difference between source radial/elliptical vectors, in order to combine into a total vector. See Geometric Dilution Of Precision.

**%CurrentVelocityLimit: 400.0 cm/s**

Is the maximum total vector current limit allowed in the output. Result above this value were filtered out because they were considered to be cause from noise or spurious.

**%SiteSource: 1 XXXX 20.4495000 141.6463000 60.000 3.034 Meas 0.0**

Is a site radial or elliptical source for a total vector file. There will be a key for each source.

The first parameter is the site index used in combining which, matches the contributors columns.

The second parameter is the radial or elliptical site code.

The third parameter is the radial or elliptical latitude origin in fractional degrees.

The fourth parameter is the radial or elliptical longitude origin in fractional degrees.

The fifth parameter is the radial or elliptical coverage time in minutes

The sixth parameter is the radial or elliptical range cell spacing in kilometers

The seventh parameter is whether the radial or elliptical was using Ideal or Meas antenna pattern.

The eighth parameter is the radial or elliptical site antenna bearing in degrees CW from North. This will be zero if classic radials were combined.

**%XYUnits: "km" 1000.**

This key when it is present before the LLUV table, will override the default assumption of kilometers for distance columns.

The affected columns are XDST, YDST, and RNGE. The first parameter "km" is the label used for the scale. The second column is a scalar to multiple the column distance value by to get meters.

**%UVUnits: "cm/s" .01**

This key when it is present before the LLUV table, will override the default assumption of cm/s for velocity columns. The

affected columns are VELU, VELV, VELO, VMAX, and VMIN. The first parameter "cm/s" is the label used for the scale.

The second column is a scalar to multiple the column velocity value by to get meters per second.

**%ProcessedTimeStamp: 2005 12 09 15 59 40**

The time the LLUV file was created/processed in standard Year month day hour minute seconds.

Typically near the end of the file.

**%ProcessingTool: "RadialsToCurrents" 10.1.7**

The processing application and version used on this file. There may be multiple entries of this key for every application involved with the data.

Typically near the end of the file.

**%End:**

Marks the end of the file.

Currently this is an indicator marker to show that the file was completed successfully. In the future this may indicate an end of the main section and any further data might be something other than what you were expecting. So unless you are expecting more, you should stop reading the LLUV at this point. In the future, if there is more data then a new %FileType: key will follow.

**%MergerMethod: 1 MedianVectors**

This key when present in radial and elliptical files is a reference to how RadialMerger 10.3.0 or later tool merges multiple vectors at the same range and bearing across the short-time radial list. The first parameter is the method type used followed a textual descriptor. If the method type is 0 or 1 MedianVectors, then RadialMerger picked the median velocity vector for the output radial; the quality valued will come from the median vector selected. If the method type is 2 AverageVectors, then RadialMerger averages the vectors. Previous to RadialMerger 10.3.0, the median method was always used and is implied when this key is missing.

### **%PatternMethod: 1 PatternVectors**

This key when present in radial and elliptical files is a reference to how SpectraToRadial 10.5.0 or later handles the pattern (Ideal and Measured) and angseg (Angular Area filter). The first parameter is the method type used followed a textual descriptor. If the method type is 0 or 1 PatternVectors then SpectraToRadial will place vectors using the pattern and remove those beyond the angseg area. If the method type is 2 OverwaterVectors then SpectraToRadial will force vectors to best fit within pattern and angseg area. If method type is 3 AnywhereVectors then SpectraToRadial will ignore the angseg area.

SpectraToRadial 10.3.9 and earlier places vectors using the pattern and cutout those beyond the angseg.

SpectraToRadial 10.4.0 to 10.4.9 place vectors using the pattern and force outliers beyond the angseg to fit with the pattern.

### **%FirstOrderCalc: 0**

This key when present in radial and elliptical files is a reference to how SpectraToRadial handled the First Order Bragg boundary calculations. The first parameter is the method type used. If the method type is 0 then SpectraToRadial uses its standard method. If the method type is 1, then SpectraToRadial uses external results from an alternate FirstOrderLimits tools which does the standard method plus uses alternate settings for specific range cells. If the method type is 2, then external limits are used from the temporary processing folder, which can come from anywhere.

## **Columnar Table Data:**

The **first** table in the file should be preceded by a **%TableType:** key.

In the future, Totals LLUV might have extra tables appending the source radials and ellipticals.

Radial LLUV might have radial and hardware diagnostic tables after the LLUV table.

### **%TableType: LLUV <subtype>**

**<type>** must be 'LLUV' which indicates that the first four columns are always lon,lat,u,v

**<subtype>** helps to identify the extra columns for the various current maps.

The current subtypes are:

'**TOT4**' for total vector data of lon, lat, u, v, flag, eu, ev, cov, E Dist, N Dist, Range, Bearing, Velocity, Direction, nSite1, nSite2, nSite3, nSite4, nSite5, nSite6

'**RDL7**' for radial data of lon, lat, u, v, flag, Spatial, Temporal, Max Vel, Min Vel, Doppler count, Temporal count, X Dist, Y Dist, Range, Bearing, Velocity, Direction, Spectra Range cell

'**ELP7**' for elliptical data of lon, lat, u, v, flag, Spatial, Temporal, Max Vel, Min Vel, Doppler count, Temporal count, X Dist, Y Dist, Range, Bearing, Velocity, Direction, Spectra Range cell, Angle of Arrival

A LLUV type will always contain a minimal of the first four columns of lon, lat, u, v

If there is no subtype then the data contains only lon, lat, u, v.

Future major changes or additions to the data will increment the last digit of the subtype and will also change the

'**%TableColumnTypes:**' keys. Using the key to read the columns will give the best result for handling future versions.

After the TableType key is the

'**%TableColumnTypes:**' key which describes the data in each column. Using this key will provide compatibility with future unknown **%TableType <subtype>**. The **%TableColumnTypes:** contains a list of fourcharcodes describing each column of the table data in order.

The known column codes are:

**LOND** is the current vector longitude in fractional degrees with positive East

**LATD** is the current vector latitude in fractional degrees with positive North.

**VELU** is the current vector velocity eastern component in cm/s

**VELV** is the current vector velocity northern component in cm/s

**VFLG** is a vector indicator flag. Indicates status of the vector like near coastline, ADCP location, interpolated value, and more. *See the Vector Indicator Flag document for the complete information on use of this flag.*

**STDV** is a radial or elliptical standard deviation of current velocity over coverage period. (outdated use ETMP)

**SCDV** is a radial or elliptical standard deviation of current velocity over the scatter patch. (outdated use ESPC)

**SCMX** is a radial or elliptical maximum change of current velocity over the scatter patch.

**XDST** is the current vector easting distance in km from the origin key.

**YDST** is the current vector northing distance in km from the origin key.  
**RNGE** is the current vector range in km from the origin key.  
**BEAR** is the current vector bearing in degrees clockwise from true North from the origin key.  
**VELO** is the current vector velocity in cm/s. (Negative velocity implies 180deg direction change)  
**HEAD** is the current vector direction in degrees clockwise from true North.  
**UQAL** is the current vector u-component standard deviation.  
**VQAL** is the current vector v-component standard deviation.  
**CQAL** is the current vector covariance.  
**S1CN** is the number of radial/elliptical vectors from site1, which contributed to the total vector  
**S2CN** is the number of radial/elliptical vectors from site2, which contributed to the total vector  
**S3CN** is the number of radial/elliptical vectors from site3, which contributed to the total vector  
**S4CN** is the number of radial/elliptical vectors from site4, which contributed to the total vector  
**S5CN** is the number of radial/elliptical vectors from site5, which contributed to the total vector  
**S6CN** is the number of radial/elliptical vectors from site6, which contributed to the total vector  
**SPRC** is the cross spectra range cell the data came from for Radials and Ellipticals  
**ESPC** is a radial or elliptical Spatial standard deviation of current velocity over the scatter patch.  
**ETMP** is a radial or elliptical Temporal standard deviation of current velocity over coverage period.  
**MAXV** is the maximum current velocity found over the coverage time.  
**MINV** is the minimum current velocity found over the coverage time.  
**EDVC** is the number of velocities at the same range and bearing that went into the Spatial value for Radial/Elliptical velocity.  
**ERTC** is the number of velocities at the same range and bearing that went into the Temporal value for Radial/Elliptical velocity.  
**RSVD** is a reserved column. The value will typically be zero. This is a placeholder column to sometimes make different table formats semi-compatible in columnar order.

Example for Radial:

**%TableColumnTypes:** LOND LATD VELU VELV VFLG ESPC ETMP MAXV MINV EDVC ERTC XDST YDST RNGE  
 BEAR VELO HEAD SPRC

**%TableRows: <count>**

tells reader software how many vectors to expect. Typically you should not count on this number being exact as the file might have been hand edited after its creation.

**%TableColumns: <count>**

can be used with the table type and subtype to determine if all the expected columns are in the file. This will always match the number of columns but you should rely on the TableColumnTypes key for column content.

The table data should then be preceded by a

**%TableStart: <tablename>**

**<tablename>** will be missing for the first table. Currently, the LLUV files contain only one table. In the future, Totals may optionally contain extra tables of the Radials and/or Ellipticals that went into creating the total.

Before the table data starts two comments are added to help visually identify the data columns

Example:

```
%% Longitude Latitude U comp V comp VectorFlag
%% (deg) (deg) (cm/s) (cm/s) (GridCode)
```

Followed by a line for each Table Row of data. Each line is preceded by a space. Spaces (no Tabs) are used between columns.

Followed by a

**%TableEnd:**

key after the data.

A table might look like this:

```
%TableType: LLUV_RDL4
%TableColumns: 16
%TableColumnTypes: LOND LATD VELU VELV VFLG ETMP ESPC MAXV MINV XDST YDST RNGE BEAR VELO HEAD SPFC
%TableRows: 627
%TableStart:
%% Longitude Latitude U comp V comp VectorFlag Temporal Spatial Velocity Velocity X Distance Y Distance Range Bearing Velocity Direction Spectra
%% (deg) (deg) (cm/s) (cm/s) (GridCode) Quality Quality Maximum Minimum (km) (km) (km) (deg NCW) (cm/s) (deg NCW) RngCell
%% -74.1183403 39.6834934 -0.630 -36.145 0 5.950 999.000 -30.770 -43.690 -0.1021 -5.8501 5.851 181.0 -36.15 1.0 1
%% -74.1123923 39.6836137 2.689 -38.486 0 2.970 0.270 -37.230 -40.460 0.4082 -5.8368 5.851 176.0 -38.58 356.0 1
%% -74.1064805 39.6841337 7.334 -46.343 0 1.030 0.000 -46.920 -46.920 0.9153 -5.7790 5.851 171.0 -46.92 351.0 1
%% -74.1006496 39.6850496 5.488 -22.027 0 5.540 1.610 -21.090 -21.090 1.4155 -5.6772 5.851 166.0 -22.70 346.0 1
%% -74.0949440 39.6863544 -1.051 3.054 0 1.930 999.000 4.950 1.510 1.9049 -5.5322 5.851 161.0 3.23 341.0 1
%TableEnd:
```

As of SeaSonde Release 3 Update 3, the RadialArchiver tool will add two extra tables containing part of the radial and hardware diagnostic status files whose time entries time are within the Radial coverage time. These extra tables have their row data prefixed with “% ” so that a MatLab blind matrix read will ignore these rows. The document ISS\_CH8\_DiagDisplay has detailed information on these tables.

## Vector Description:

Each line in the LLUV table describes a single current vector. The main component of the vector is the Lon,Lat,U,V data. We also supply x, y, range, bearing, velocity, and direction data as redundant reference information about the vector that helps to provide diagnostics when examining the data.

### Longitude, Latitude.

The first two columns are the geo location in fractional degrees of each current vector. This is the data that should be used to plot the current vector with. A positive longitude is East and a positive latitude is North.

### U, V Components.

The third and fourth columns show the ocean current vector's velocity and direction. These are in a x,y style in which U is the Easting velocity component and the V is the Northward velocity component in centimeters per second. These components are always oriented from True North at the location of each vector. For Total LLUV files this is the actual ocean current vector. For Radial LLUV files this is a radial component of the actual ocean current vector. For Elliptical LLUV files this is an elliptical component of the actual ocean current vector.

### Vector Flag

The Vector Indicator Flag in the fifth column is a composite value used by the Combine Grid and the LLUV files to indicate extra information about individual current vectors. See the File\_VectorIndicatorFlag document for complete information.

- Bit0 (+1) indicate disabled grid point and not outputted in LLUV files.
- Bit1 (+2) indicates that the grid point is near the coastline.
- Bit2 (+4) indicates that the grid point contains a point measurement like an ADCP.
- Bit4 (+16) indicates that the current vector was the result of interpolating across a baseline area.
- Bit5 (+32) indicates that the vector result exceeded the Maximum current limit. These points will not exist in standard Total Vector Files.
- Bit7 (+128) indicates that the vector is out of bounds. For radial vectors this means that the vector was outside the Angular filter area. Not used for Total Vectors. (Not yet implemented)
- Bit8 (+256) indicates that the Total vector does not have enough angular resolution from the contributing radials.

### X, Y Distance.

The x,y distances are given as a reference from the %Origin: keyword. They are the cos/sin of the range and bearing great circle distance from the %Origin location. This makes **x** an Easting distance and **y** a Northing distance. (Easting and Northing are terms to describe traveling in an Eastward or Northward direction but not necessarily directly traveling exactly East or North). The x,y coordinate can be thought of as a tangential plane to the earth at the location of the %Origin:. You should not compare or add x,y distances from different origins as orientation of their planar data will be different. For total vector files, these x,y points will typically be the same as the created combine grid file x,y distances. To find the lat,lon position convert this to range,bearing and apply the GreatCircle calculation.

## Range, Bearing

Range and Bearing is a reference location of the vector from the %Origin: keyword. The location is found by navigating a great circle from the %Origin starting with Bearing direction degrees clockwise from True North and traveling the Range in kilometers. For radial LLUV files, this is the radial spoke measured by the SeaSonde.

## Velocity, Direction

Velocity and Direction is the ocean current vector. This is the same info as the U, V data except that it is in magnitude of centimeters per second and direction degrees clockwise from True North at the location of the vector. For radials, the Direction will be close to 180 degrees from the Bearing but will vary depending on the latitude and the difference in the longitude from the %Origin. Also for radials and ellipticals, the sign of the velocity indicates whether the velocity is towards (positive) or away (negative) from the site.

## Quality Factors

There are three to five columns for *Quality Factors*. Their usage is dependent on the type of LLUV: radial, elliptical or total.

While we call these *Quality Factors*, it's really a misnomer; they are really measurement uncertainties but it is simpler to label them as quality. They indicate measurement uncertainty due to noise, a changing surface current pattern, and/or horizontal shear over each measured area. They represent a lower bound on the actual uncertainty in the current velocity. For example, errors due to contaminated radar spectra or incorrect first-order region boundaries will not be included in the estimate. We believe that most spatial uncertainty is due to horizontal current shear and most temporal uncertainty is due to the current pattern changing with time.

A resulting *Quality Factor* of 999 indicates a non-calculable result.

For **Radials & Ellipticals**, there are 6 columns: *Temporal* (ETMP), *Spatial* (ESPC), *Maximum Velocity* (MAXV), *Minimum Velocity* (MINV), *Temporal Count* (EDVC), and *Spatial Count* (ERTC)

*Radial Processing* starts with calculating temporary intermediate radials from a series of CSS cross spectra. We refer to these intermediate radials as the *Short-Time Radials*. The CSS files are typically created every 10 minutes for a *Standard Range SeaSonde* and 30 minutes for a *Long Range SeaSonde*. This also applies to *Elliptical Processing*.

*Short-Time Radials* are temporary by default. They can be saved and later examined if a switch in configuration file AnalysisOptions.txt Line 10 is set from 0 to 1. This saves the *Short-Time Radials* into folder Data/RadialShorts. *Short-Time Radials* created with ideal pattern radials will start with 'RDLx' and *Short-Time Radials* created with a measured pattern radials will start with 'RDLy'.

### Short-Time Radial Qualities:

The *Quality Factors* for **Short-Time Radial** are calculated for each vector from a list of different velocities found in the cross spectra doppler resulting in the same range and bearing as follows:

*Spatial Quality* (**ESPC**) is the standard deviation of the velocity list.

*Velocity Doppler Count* (**EVDC**) is the number of velocities that went into the Spatial Quality and also the radial velocity result. Then naming is in reference to the source doppler bins used from the cross spectra to determine the radial velocity.

*Temporal Quality* (**ETMP**) is always 999 for a *Short-Time Radial* because it cannot be calculated from a single time.

*Minimum Velocity* (**MINV**) is the lowest velocity found in the velocity list.

*Maximum Velocity* (**MAXV**) is the highest velocity found in the velocity list.

*Radial Processing* continues to collect *Short-time Radials* over the configured output time coverage and merges them into the **Final Output Radial** using the median of the radial velocities at the same range and bearing (default method).

### Merged or Final Output Radial Qualities:

The *Quality Factors* for the **Final Output Radial** are calculated using the *Short-Time Radials* as follows:

*Spatial Quality* (**ESPC**) is selected from the *Short-Time Radial Spatial Quality* corresponding to the radial velocity selected.

*Velocity Doppler Count* (**EVDC**) is also selected from the *Short-Time Radial Velocity Doppler Count* corresponding to the radial velocity indicating the number of value used to calculate the *Spatial Quality*.

*Temporal Quality* (**ETMP**) is the standard deviation of the velocities at the same range and bearing across the *Short-Time Radials*. The maximum number of velocities used here is the number of merged *Short-Time Radials*. This can be found

with the key '%MergedCount: 5'. The count for the Temporal might be less than this as there might not be a vector for the same range and bearing across all of the Short-time radials used.

*Temporal Count (ERTC)* is the number of velocities that went into the Temporal calculation. This is also the number of short-time radial found at the same bearing and velocity to merger. This value will be between the AnalysisOptions minimum radial vectors and the %MergedCount: in the LLUV file, inclusive.

Note that if the alternate configuration setting in AnalysisOptions.txt Line13 Merging method is set to 1, then the merging will average the radial velocities at the same range and bearing. The *Spatial Quality* will be an average of the *Short-Time Radials Spatial Qualities*. *Velocity Doppler Count* will be the total of the *Short-Time Radial Velocity Doppler Counts*. The *Minimum Velocity* and *Maximum Velocity* will be the Minimum and Maximum found over the *Short-Time Radial Minimum Velocity* and *Maximum Velocity*.

#### Total Vector Qualities:

For **Totals**, there are 3 columns of *U Quality*, *V Quality*, and *Covariance*. These are derived using linear error propagation along with *Temporal Quality* from the radials and/or ellipticals.

For more information, read the Velocity\_Uncertainties document.

#### **Contributors**

The contributor columns are strictly for total LLUV files. They indicate the number of contributing radial or elliptical vectors from each site that went into the total vector calculation. These are used for diagnostic purposes to help identify coverage problems.

## **Known Table Subtypes and Their Data Column Types:**

Latest Total:

**TOT4** LOND LATD VELU VELV VFLG UQAL VQAL CQAL XDST YDST RNGE BEAR VELO HEAD S1CN S2CN S3CN S4CN S5CN S6CN

Latest Radial:

**RDL7** LOND LATD VELU VELV VFLG ESPC ETMP MAXV MINV EDVC ERTC XDST YDST RNGE BEAR VELO HEAD SPRC

Latest Elliptical

**ELP7** LOND LATD VELU VELV VFLG ESPC ETMP MAXV MINV EDVC ERTC XDST YDST RNGE BEAR VELO HEAD SPRC

Older Elliptical without Temporal Count ERTC

**ELP6** LOND LATD VELU VELV VFLG ESPC ETMP MAXV MINV EDVC XDST YDST RNGE BEAR VELO HEAD SPRC

Older Radial without Temporal Count ERTC

**RDL6** LOND LATD VELU VELV VFLG ESPC ETMP MAXV MINV EDVC XDST YDST RNGE BEAR VELO HEAD SPRC

Older Radial without Spatial Count EDVC

**RDL5** LOND LATD VELU VELV VFLG ESPC ETMP MAXV MINV XDST YDST RNGE BEAR VELO HEAD SPRC

Older Radial where ETMP and ESPC should be swapped when read.

**RDL4** LOND LATD VELU VELV VFLG ETMP ESPC MAXV MINV XDST YDST RNGE BEAR VELO HEAD SPRC

Older Radial

**RDL3** LOND LATD VELU VELV VFLG SCDV SCMX STDV XDST YDST RNGE BEAR VELO HEAD

Older Total where HEAD should be read as CCWE instead of label CWN.

**TOT3** LOND LATD VELU VELV VFLG UQAL VQAL CQAL XDST YDST RNGE BEAR VELO HEAD S1CN S2CN S3CN S4CN S5CN S6CN

## **Revision Notes:**

070620 - LLUVSpec 1.05 & 1.04 Additions.

070120 - LLUVSpec 1.03 Corrected and improved Radial Qualities descriptions.

061005 - LLUVSpec 1.03 Support for RiverSonde distance and velocity scalars.  
060818 - LLUVSpec 1.02 'RDL6' added Doppler Velocity Count used in calculating quality values.  
060515 - Corrected TimeZone offset documentation to reflect that offset is hours from UTC not hours to UTC.  
060116 - LLUVSpec 1.02 'RDL5' for swapped spatial/temporal correction.  
051212 - LLUVSpec 1.01 'TOT4' for Heading fixed to be N CW from incorrect E CCW.  
051026 - LLUVSpec 1.00 'RDL4' radial format description which adds spatial,temporal,maxv,minv columns  
050325 - LLUVSpec 1.00 'RDL3' radial format. Added LLUVSpec keyword for first time.