VERIPOS Tides Service Description

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VERIPOS Tides Service Description

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CONTENTS

1. INTRODUCTION

This service description outlines the functionality and performance characteristics of the VERIPOS Tides service.

VERIPOS provides a range of positioning services for a multitude of hydrographic applications. The primary service, VERIPOS Ultra, is a high-accuracy service that offers highly accurate and stable positions with real-time accuracies of 10cm in 2D and in height. The positions derived using this service can be used to detect and estimate the variations of the actual sea surface from mean sea surface resulting in a tide observation.

The real-time observation of tidal variations using high-accuracy GPS offers many benefits over conventional methods, i.e. the deployment of tide gauges or the use of tidal prediction software. The use of real-time tide information allows bathymetric data to be corrected in real-time and thus removing the requirement for post-processing. Real-time tide information also offers a better representation of the real tides compared to model based predictions. Major cost savings can be achieved on hydrographic projects if no tide gauges have to be deployed.

2. VERIPOS ULTRA TIDES

2.1 DESCRIPTION

VERIPOS Tides uses the highly stable and accurate positions from the VERIPOS Ultra service.

VERIPOS Ultra is the next generation positioning service from VERIPOS offering decimetre level position accuracy globally. The service is based around a positioning technique known as PPP (Precise Point Positioning) where all errors in the GPS system are either independently corrected or modelled to a high degree of accuracy. VERIPOS Ultra delivers a high accuracy position using a proprietary PPP algorithm developed by VERIPOS that minimises or removes all of the main GPS errors sources such as satellite orbit, satellite clock, troposphere, ionosphere and multi-path.

To carry out this absolute positioning technique orbit and clock correction information is broadcast for each and every GPS satellite to allow removal of satellite based error components. Use of dual-frequency GPS hardware at the user-end permits the calculation and removal of local ionosphere errors, whilst troposphere delays are estimated within the calculation. Other sources of error are also modelled and these include effects of ocean loading, earth tides and phase windup. To obtain the high-accuracy solution, multi-path and GPS receiver noise errors are minimised through use of carrier phase observables, which are precise to the millimetre level. In all, VERIPOS Ultra provides truly global and seamless high-accuracy positions, which are not only robust but effective in all areas of operation, including areas of ionosphere disturbance.

Since VERIPOS Ultra offers highly accurate and stable positions with real-time decimetre level accuracies in 2D and most relevantly in height these high-accuracy positions can be used to detect height variations relative to a vertical reference offshore. In order to derive tidal height variations, the real-time tide estimation process has to manage those height variations caused by vessel motion and by inaccuracies in the GPS position calculation process itself. The VERIPOS real-time tide calculation does that and presents the current and historic tidal information to the user via numerical and graphical displays in Verify-QC.

An extensive range of tide and position related information is stored to file. This information allows users to incorporate relevant parameters into their real-time and/or post-process hydrographic data management activities.

2.2 VERTICAL REFERENCE TERMINOLOGY

In order to describe the vertical references for the VERIPOS tides estimates it is necessary to define the terminology.

Mean Sea Surface (MSS).	The MSS represents the height of the ocean surface (measured from the surface of some reference ellipsoid), averaged over some specific time interval (and corrected for ocean and earth tides). MSS models are developed based on data provided by altimetry satellites. The MSS is not an equipotential surface.
Mean Sea Level (MSL):	There are two different interpretations: 1] In geodesy, MSL usually means the local height, i.e. vertical offset, of the global Mean Sea Surface above a level reference surface called the Geoid 2] In tidal analysis, MSL means the still water level averaged over a period of time such as a month or year so periodic changes in sea level due to, e.g. the tides, are also averaged out. MSL values are measured with respect to the level of benchmarks on land, and as such a change in an MSL can result from either a real change in sea level or a change in the height of the land on which the tide gauge is located (e.g. from isostatic rebound).
Geoid:	The Geoid is a surface over which the gravity potential is constant (i.e. water does not "flow" on the Geoid but it remains in equilibrium). It also is the equipotential surface of the Earth's gravity field which best fits, in a least squares sense, global MSS.
Dynamic Ocean Topography (DOT):	The difference between MSS and the Geoid. It originates from the fact that the major ocean circulation has a (more or less) time-invariant non-zero component (i.e., a component that does not average to zero over time).

If the oceans were static and not affected by winds and air pressure, then MSS and Geoid would be the same surfaces. However, there are steady currents in the ocean, driven by winds and atmospheric heating and cooling, which give rise to differences in sea level around the world. These local differences between the Geoid and MSS are described by the Dynamic Ocean Topography. The DOT values range between (approximately) -2.5m and +1.2 m.

Therefore, Geoid models like EGM96 and EGM2008 can be considered an approximation of MSS, but only to the 2-3m level.

Verify-QC does not consider chart datums and therefore can’t convert tidal values relative to MSS to other tidal references like Lowest Astronomical Tide (LAT).

The relationship between Chart Datum/LAT and MSS is a vertical offset 'Z0'. The value Z0 can only be determined by deploying a seabed tide gauge logging @ 15mins over at least two Lunar Cycles (i.e 60 days). Z0 is not constant and varies from place to place. The vertical offset between LAT and MSS is published for specific ports around the world in Admiralty Tide Publications.

2.3 VERIPOS TIDAL ESTIMATES

The VERIPOS Tides process provides two real-time tide observations relative to different vertical references.

The first method estimates the tide relative to a Geoid Model, either EGM96 or EGM2008, which is a global approximation of MSS but only to the 2-3m level since it ignores the presence of Dynamic Ocean Topography. This observation, called Geoid Tide, is available instantaneously and is most suitable for short projects.

The second method first derives MSS using the VERIPOS Tide filter and then estimates the tide relative to this surface. This observation, called Ultra Tide, is independent of uncertainties in the Geoid model. It does however require 40 hours of continuous Verify-QC operation and is therefore only suitable for long-term offshore projects. The Ultra Tide observation is more accurate since its vertical reference (MSS) is accurate at the cm level.

2.4 RECOMMENDATIONS ON USING VERIPOS TIDAL ESTIMATES

An extensive range of tide and position related information is stored to file. This information allows users to incorporate relevant parameters into their real-time and/or post-process hydrographic data management activities and to do further calculations.

The formats for these files are described in Appendix A.

There are fundamental differences between real-time GPS-based tide estimation and a predicted tides model or a tide gauge. A predicted tides model will only calculate the predicted vertical movement of the sea surface caused by gravitation effects of mainly the sun and moon and ignore atmospheric and storm surge effects – hence a very smooth tidal curve is produced. A tide gauge can observe tide at a much higher frequency and correct for atmospheric pressure effects but may be effected by storm surge effects.

The VERIPOS Tides estimates provide the real-time **total variation** from a vertical reference (MSS for Ultra Tide or EGM model for Geoid Tide). Fact is that the sea surface varies not only due to tidal effects but also due to additional effects like atmospheric effects (variations in pressure and wind) which in extreme cases will cause tidal surges.

The benefit of estimating a real-time total variation from a vertical reference is that a single vertical correction can be applied to marine survey depth information. In addition, VERIPOS Tides can be estimated with a high frequency, as low as once per minute, such that a very detailed sea surface variation pattern can be build up.

Verifications of VERIPOS Ultra Tide against tide gauges have demonstrated that the VERIPOS Ultra Tide estimates, relative to MSS, are unbiased compared to tide gauges.

Similar verifications of VERIPOS Geoid Tide have demonstrated that the VERIPOS Geoid Tide estimates, relative to an EGM model, can be biased. Such biases are caused by one or more of the following:

- incorrect measurement of the height of the GPS antenna phase centre above the waterline
- residual errors in the EGM model
- Dynamic Ocean Topography

Users of VERIPOS Geoid Tide are recommended to match the profile of the high-frequency Geoid Tide estimates to a tide profile from a predicted tides model such that a vertical offset can be determined. An unbiased high-frequency tides dataset can be obtained once the vertical offset, to MSS or for example LAT, is applied to the Geoid Tide time series.

Verify-QC v1.08 also estimates the bias between Ultra Tide and Geoid Tide to help users identify any of the possible causes listed above.

3. VERICY-QC IMPLEMENTATION

3.1 FUNCTIONALITY

The real-time tide process has been implemented in the Verify-QC software. Verify-QC is a suite of processing software for the professional positioning user that has been designed to provide real-time position and quality control information with full calculation configuration flexibility as well as performance monitoring.

It is a prerequisite for the tide calculation to receive the VERIPOS Ultra orbit & clock corrections via one of the VERIPOS satellite data links and to have the Verify-QC software enabled for calculating the high-accuracy VERIPOS Ultra heights.

Within Verify-QC the user makes the following real-time tide configuration choices:

1. **Logging Directory**: the location where the tide information files are stored
2. **Interval**: the interval at which tide information is logged and made available in the view. The user can choose from 1, 2, 5, 10, 15, 20, 30 and 60 minutes
3. **Antenna Height**: the height of the GPS antenna phase centre above the waterline
4. **Hold-off**: the amount of time for which the VERIPOS Ultra heights are ignored after the start of an Ultra filter convergence
5. **Accuracy**: the accuracy threshold (based on the height standard deviation) of the VERIPOS Ultra heights in order to filter out inaccurate height information

The most important information to be entered is the height of the antenna above the waterline. It should be measured from the phase centre of the antenna to the average waterline and be entered as exactly as possible.

A representative Geoid Tide estimate can only be generated if the antenna height above the waterline is entered.

The Geoid Tide calculation provides an instantaneous tides estimate. The Ultra Tide calculation however has an initialisation period of 40 hours and therefore uses 40 hours of historic data. Should the user wish to reset the process, for example because the work area has changed or essential input information has changed (for example antenna height above the waterline) the option exists to reset the Tide calculation process. Previously logged data will be deleted and the Tides logging process will start afresh.

The logged Tide information can also be archived during the Tide calculation and logging process. The user can browse to a preferred archive location.

3.2 VIEWS

The Tides view in Verify-QC consists of a set of table and a time series view.

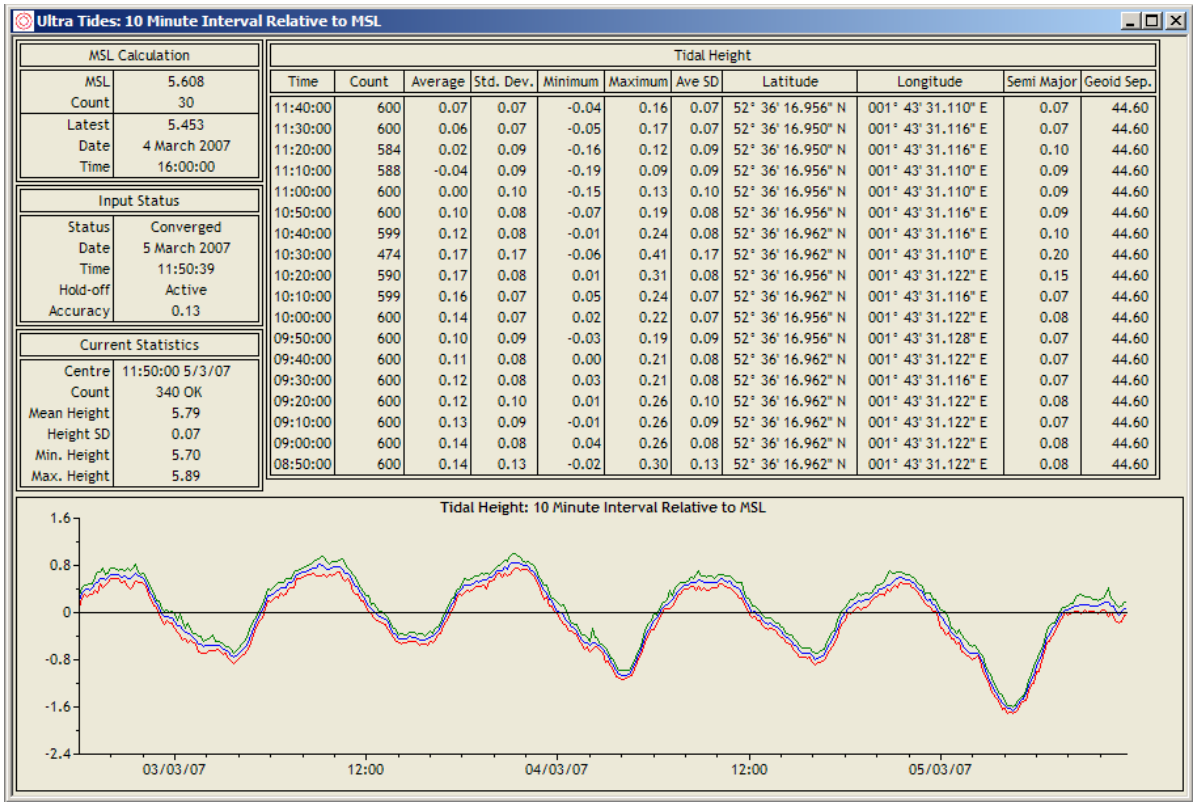


Figure 1 – Tides View

This view amongst others shows the real-time status of the tide calculation. The time series view will show the last 7 days of tide observations. Users have a choice from six time series views:

1. Antenna Height: a time series plotting the minimum, maximum and mean height of the GPS antenna relative to the Geoid model (EGM96 or EGM2008). Points are added at the user selected interval

2. Geoid Tide: a time series, plotting the minimum, maximum and mean height of the vessel waterline relative to the Geoid model (EGM96 or EGM2008). Points are added at the user selected interval

3. Tidal Height: a time series plotting the minimum, maximum and mean height of the vessel waterline relative to the Tide filter estimate of Mean Sea Surface. The values displayed are called the Ultra Tide. Points are added at the user selected interval. The Tide filter estimate is only available after 39 hours of continuous operation and therefore this view requires 39 hours of continuous operation to populate

4. Hourly Height: a time series, plotting the minimum, maximum and mean height of the GPS antenna relative to the Geoid model (EGM96 or EGM2008). Points are added at an hourly interval

5. Hourly Tide: a time series plotting the minimum, maximum and mean height of the vessel waterline relative to the Tide filter estimate of Mean Sea Surface. The values displayed are called Ultra Tide. Points are added at an hourly interval. The Tide filter estimate is only available after 40 hours of continuous operation

6. MSS Estimate: a time series plotting the Tide filter estimate of Mean Sea Surface. Points are added at an hourly interval. The Tide filter estimate is only available after 40 hours of continuous operation.

The first five time series views contain three separate lines for the minimum (red), mean (blue) and maximum (green) height or tide values.

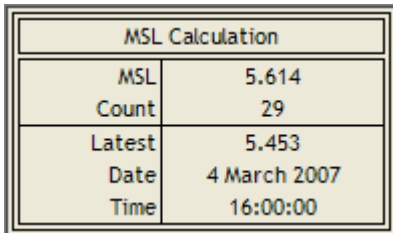
The set of tables in the Tides view include the Tidal Height table, the MSS Calculation table, the Input Status Table and the Current Status table.

Tidal Height table:

Time	Time for which information is valid
Count	Number of height samples used for deriving listed results
Average	Height average
Std. Dev.	Standard deviation of height values included in average
Minimum	Minimum of height values included in average
Maximum	Maximum of height values included in average
Ave SD	Average of the standard deviation of height values included in average
Latitude	Latitude at given time
Longitude	Longitude at given time
Semi Major	Average of semi major of height values included in average
Geoid Sep.	Separation between the Geoid and the WGS84 reference ellipsoid

MSS Calculation table:

MSS	Tide filter overall estimate of MSS
Count	Sequence number of local hourly estimate of MSS
Latest	Most recent Tide filter local estimate of MSS
Date	Date for which information is valid
Time	Time for which information is valid



MSL Calculation	
MSL	5.614
Count	29
Latest	5.453
Date	4 March 2007
Time	16:00:00

Figure 2 – Tides View – MSS Calculation Table

Input Status table:

Status	Status of height input into Tide filter. Can show ‘No Position’, ‘Converging’, ‘Converged’
Date	Date for which information is valid
Time	Time for which information is valid
Hold-off	Can show ‘Active’ or time until hold-off period expires
Accuracy	Shows reported standard deviation of the current height input. If the standard deviation exceeds the threshold it also shows the threshold

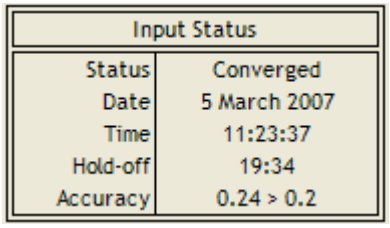


Figure 3 – Tides View – Input Status Table

Current Statistics table:

Centre	Shows time and date for the current averaging period
Count	The number of accepted height input values during the current averaging period, followed by ‘OK’ if the count exceeds the minimum 50% required to generate a valid result
Mean Height	Average of the heights during the current averaging period
Height SD	Standard deviation the heights during the current averaging period
Min. Height	Minimum of the height during the current averaging period
Max. Height	Maximum of the height during the current averaging period

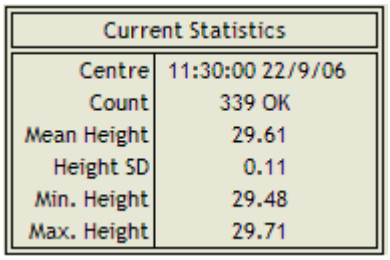


Figure 4 – Tides View – Current Status Table

3.3 PERFORMANCE

Verification of the real-time observation methodology has demonstrated that the real-time tide observations agree with tide gauge observations by approximately 10cm on average, showing a standard deviation of 10-15cm. A similar level of agreement is seen with predicted tides.

3.3.1 Against Predicted Tide

The VERIPOS Tides observations were compared to the predicted tide values during two 24-hour periods in Singapore. The C-O values were derived at hourly intervals. During the first 24-hour period the C-O showed a standard deviation of 11 cm and an average of 1 cm. During the second 24-hour period the C-O showed a standard deviation of 9 cm and an average of 4 cm.

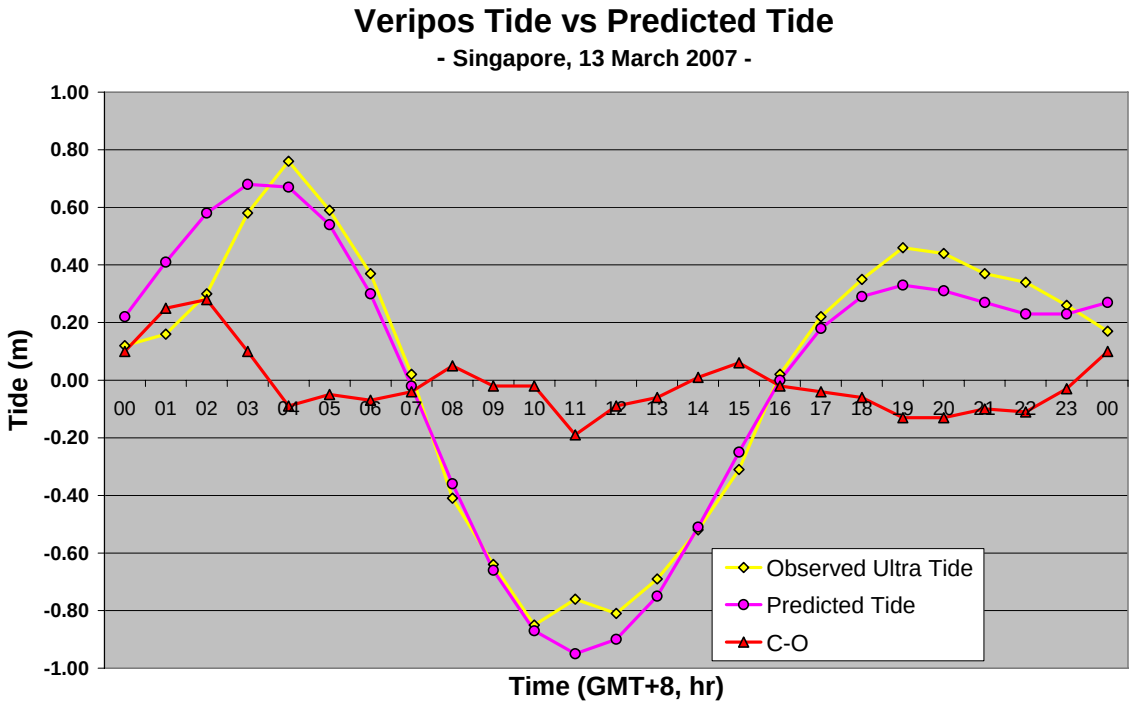


Figure 5 – Ultra Tide vs Predicted Tides (13 March 2007)

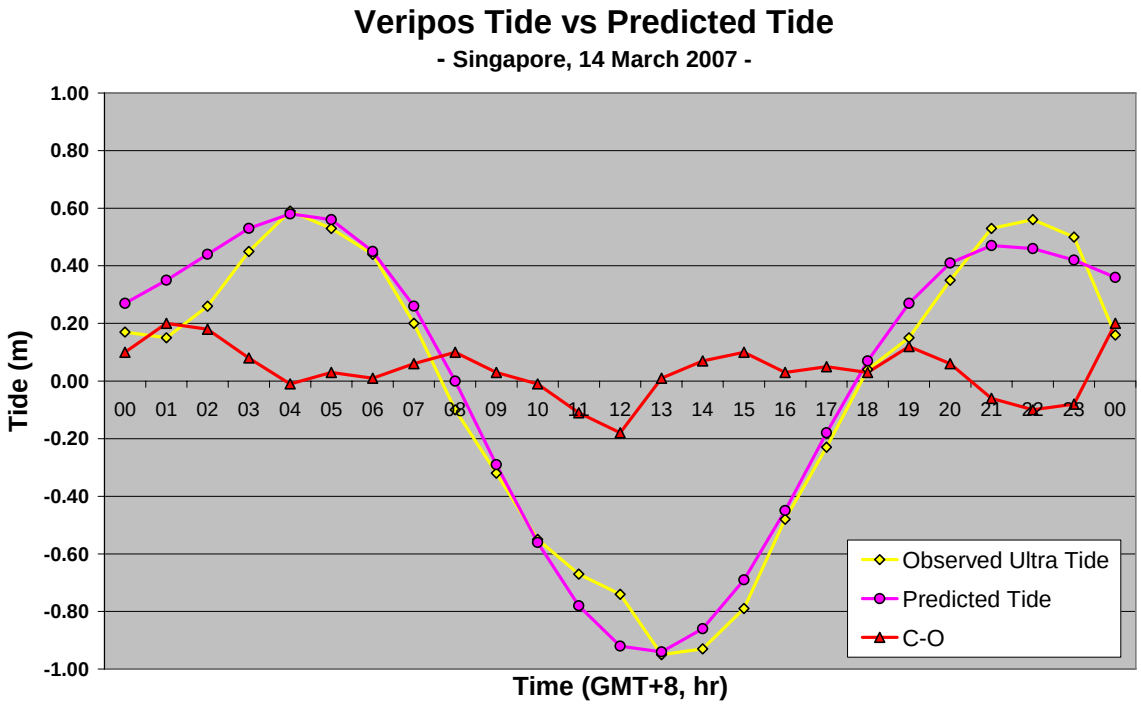


Figure 6 – Ultra Tide vs Predicted Tides (14 March 2007)

The comparison against predicted tides shows that the VERIPOS Tides provide a real-time tide observation at the decimetre level. The C-O values during both 24-hour periods are within a 20cm range. The C-O time series plots further illustrate that the VERIPOS Ultra Tides follow the tidal trend and that there is no time shift in the phase of the tidal wave pattern.

3.3.2 Against Tide Gauge

The VERIPOS Tide observations were compared to nearby tide gauge readings over a three day period in the United Kingdom. Both the Ultra Tide and the Geoid Tide observations were recorded. The C-O values at 10 minute intervals were derived. During the three day period the C-O of the Ultra Tide showed a standard deviation of 10 cm and an average of 5 cm. The C-O of the Geoid Tide, relative to EGM96, showed a standard deviation of 8 cm and an average of 12 cm.

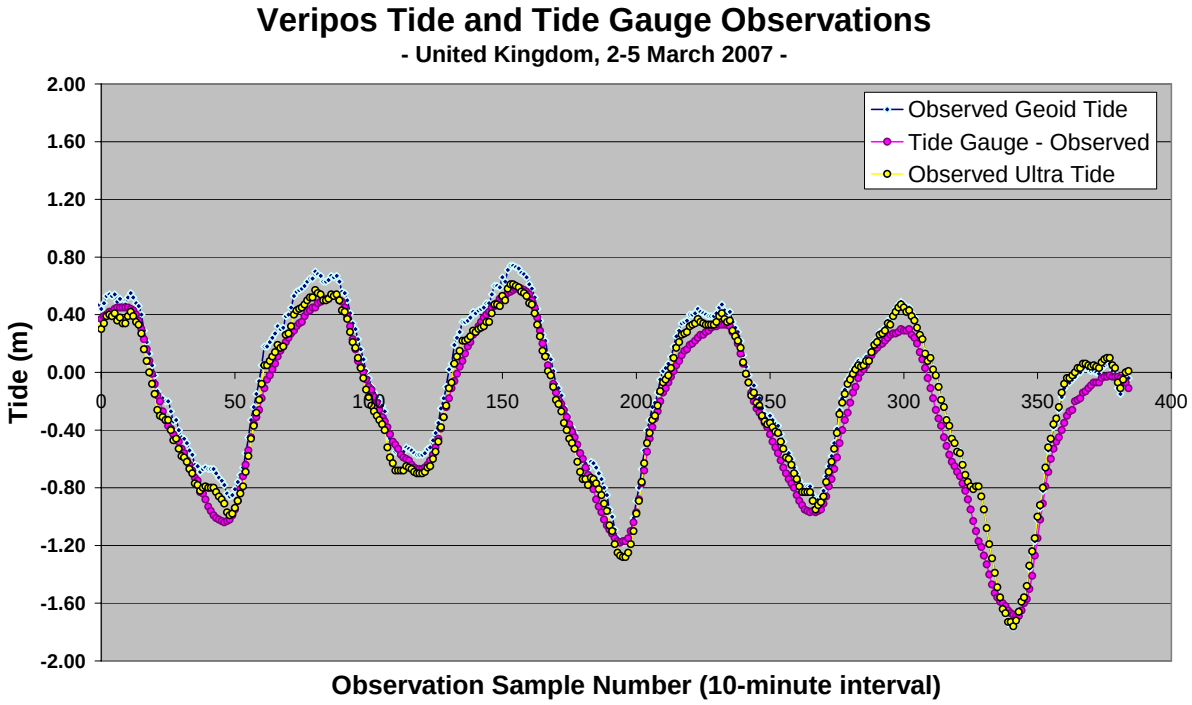


Figure 7 – Ultra Tide, Geoid Tide and Tide Gauge Observations (2-5 March 2007)

Similar to the predicted tide verification the comparison against tide gauge observed tides shows that the VERIPOS Tides provide a real-time tide observation at the decimetre level. The differences are typically less than 20cm with the Ultra Tide observation showing the best agreement with tide gauge readings. The C-O time series plot further illustrate that the VERIPOS Tides follow the tidal trend and that there is no time shift in the phase of the tidal wave pattern.

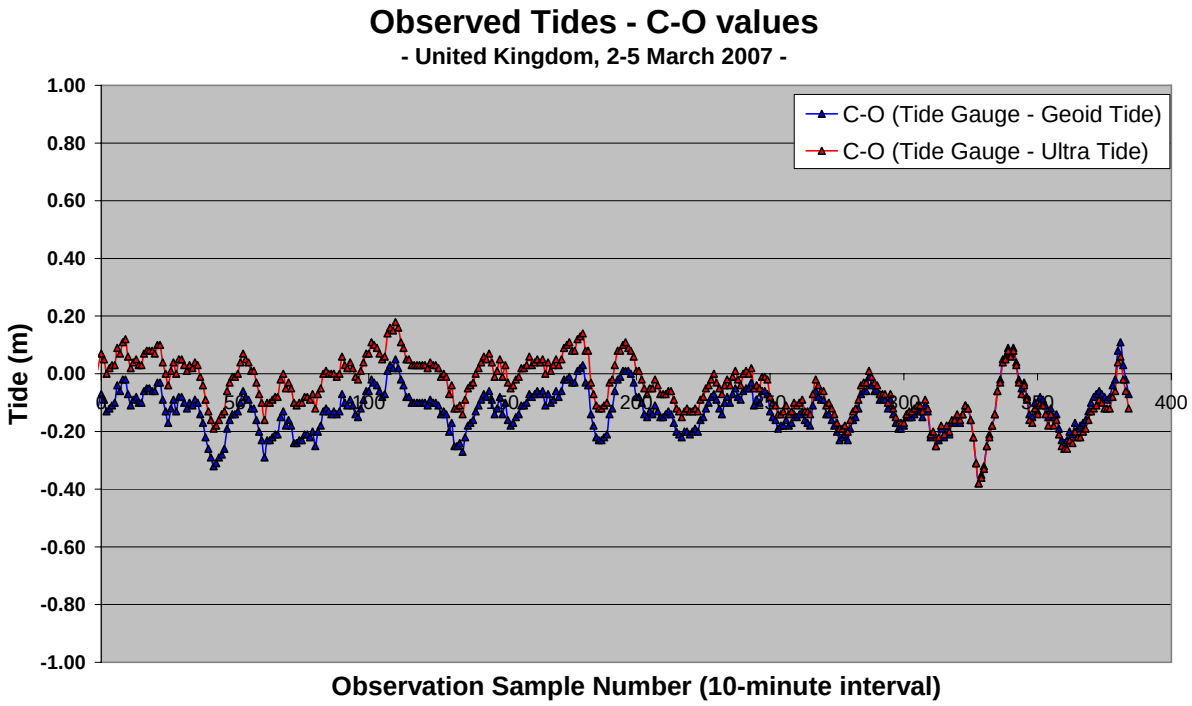


Figure 8 – Differences between Ultra Tide, Geoid Tide and Tide Gauge Observations

3.4 TECHNICAL SPECIFICATION

VERIPOS Tides technical specifications:

- Process type: Precise Point Position (PPP)
- GNSS observations used: CA & P code + L1 & L2 carrier phase
- Tide observation interval: 1, 2, 5, 10, 15, 20, 30 and 60 minutes
- Tide observation accuracy: 20cm (2DRMS)
- Software module: Verify-QC
- Geoid Model: EGM96
- Availability: worldwide

Geoid Tide vs. Ultra Tides comparison:

	Geoid Tide	**Ultra Tide**
Vertical reference	EGM96	MSS
Availability	Worldwide	Worldwide
Lead-in time	< 30 minutes	40 hours
Vessel range	No restrictions	Up to 300km recommended
Accuracy	15-20 cm	< 15-20cm

APPENDIX I.

TIDES LOGGING FORMATS

An extensive range of tide and position related information is stored to file. This information allows users to incorporate relevant parameters into their real-time and/or post-process hydrographic data management activities. User for example can use this information to relate the results to alternative vertical datums or to apply corrections to echo sounder readings.

The VERIPOS Ultra Tides functionality will create two files in ASCII format: *Tideinfo.txt* and *Doodson.txt*. The structure of each of these files is outlined in the tables below.

The logging file in Verify-QC v1.07 was extended in Verify-QC v1.08 with two extra column to provide users with information about changes in the mean height above the waterline (draft) and the bias between the MSS estimate and the Geoid model (vertical bias).

Tideinfo.txt **(*Verify-QC v1.07*)**

Filename			
Tideinfo.txt			
General Description			
The TideInfo.txt file contains current system height and tide information at the Averaging Period as configured by the Verify-QC user. This file contains comma delimited strings with variable length fields. Null fields indicate that no information is currently available; they should not be interpreted as 'zero'. A checksum is included for extra robustness. Negative tide is low tide and positive tide is high tide respectively.			
Sample			
$Ultra Tide,20060922,11:40:00,5,600,600,5627.9082,N,00255.4851,W,29.75,0.07,0.10,29.65,29.89,,,0.72,29.03,51.81,EGM96*05			
Field Number	**Field Name**	**Format or Units**	**Description & Comments**
0	TalkerID	-	$Ultra Tide
1	Date	yyyymmdd	Identifies year, month and day for which all information in the string is valid.
2	Time	hh:mm:ss	Identifies time in UTC for which all information in the string is valid.
3	Sequence Number	numerical	Sequential number incrementing by 1 for every extra string. Maximum is 99999999 after which an automatic reset back to 1 takes place.
4	Averaging Period	numerical	User selected period over which VERIPOS Ultra heights are averaged in seconds. Minimum is 60, maximum is 3600.
5	Sample Count	numerical	Number of VERIPOS Ultra height samples that were included to derive the antenna height average. Minimum is 50% of 'Averaging Period', maximum is 'Averaging Period'

6	Latitude	ddmm.mmmm (degrees, minutes and decimal minutes)	Location where height and tide information is valid.
7	Latitude Hemisphere	c	N or S
8	Longitude	dddmm.mmmm (degrees, minutes and decimal minutes)	Location where height and tide information is valid.
9	Longitude Hemisphere	c	E or W
10	Mean Height	hh.hh (metres)	Mean of the VERIPOS Ultra heights during the 'Averaging Period'
11	Mean of Height SD	hh.hh (metres)	Mean of the Height SD's associated with the VERIPOS Ultra heights during the 'Averaging Period'. This is an indication of the quality of the VERIPOS Ultra heights
12	SD of Heights	hh.hh (metres)	Standard deviation of the VERIPOS Ultra heights during the 'Averaging Period'. This is an indication if the variation of the height due to vessel motion and position quality.
13	Minimum of Heights	hh.hh (metres)	Minimum of the VERIPOS Ultra heights during the 'Averaging Period'
14	Maximum of Heights	hh.hh (metres)	Maximum of the VERIPOS Ultra heights during the 'Averaging Period'
15	Doodson	hh.hh (metres)	Estimated tide-less antenna height above Mean Sea Surface from the Doodson filter. First available after 39 hours.
16	Ultra Tide	hh.hh (metres)	Local tide based on the Mean Sea Surface derived from the Doodson filter. First available after 39 hours.
17	Geoid Tide	hh.hh (metres)	Local tide relative to the Geoid (see field 17). Available instantaneously after user configured 'hold-off' time
18	Antenna Height	hh.hh (metres)	User entered height of the antenna above the waterline.
19	Geoid Separation	hh.hh (metres)	Local offset between the Geoid and the WGS84 reference ellipsoid.
20	Geoid Model	-	EGM96, EGM2008 or USER, depending on user configuration
	*	c	Fixed end delimiter
		cc	Checksum

Doodson.txt (*Verify-QC v1.07*)

Filename
Doodson.txt
General Description
The TideInfo.txt file contains current system height and tide information at hourly intervals. The information in this file is consistent with the information contained in the file TideInfo.txt but information has been condensed to a fixed averaging period of one hour. This file contains comma delimited strings with variable length fields. Null fields indicate that no information is currently available; they should not be interpreted as 'zero'. A checksum is included for extra robustness. Negative tide is low tide and positive tide is high tide respectively.
Sample
$Ultra Tide,20060922,13:00:00,3,3600,2280,5627.9079,N,00255.4853,W,30.74,0.10,0.74,30.00,31.17,,,1.71,29.03,51.81,EGM96 *04

Field Number	Field Name	Format or Units	Description & Comments
0	TalkerID	-	$Ultra Tide
1	Date	yyyymmdd	Identifies year, month and day for which all information in the string is valid.
2	Time	hh:mm:ss	Identifies time in UTC for which all information in the string is valid.
3	Sequence Number	numerical	Sequential number incrementing by 1 for every extra string. Maximum is 99999999 after which an automatic reset back to 1 takes place.
4	Averaging Period	numerical	Fixed period (3600 seconds) over which VERIPOS Ultra heights are averaged in seconds.
5	Sample Count	numerical	Number of VERIPOS Ultra height samples that were included to derive the antenna height average. Minimum is 50% of 'Averaging Period', maximum is 'Averaging Period'
6	Latitude	ddmm.mmmm (degrees, minutes and decimal minutes)	Location where height and tide information is valid.
7	Latitude Hemisphere	c	N or S
8	Longitude	dddmm.mmmm (degrees, minutes and decimal minutes)	Location where height and tide information is valid.
9	Longitude Hemisphere	c	E or W
10	Mean Height	hh.hh (metres)	Mean of the VERIPOS Ultra heights during the 'Averaging Period'

11	Mean of Height SD	hh.hh (metres)	Mean of the Height SD's associated with the VERIPOS Ultra heights during the 'Averaging Period'. This is an indication of the quality of the VERIPOS Ultra heights
12	SD of Heights	hh.hh (metres)	Standard deviation of the VERIPOS Ultra heights during the 'Averaging Period'. This is an indication if the variation of the height due to vessel motion and position quality.
13	Minimum of Heights	hh.hh (metres)	Minimum of the VERIPOS Ultra heights during the 'Averaging Period'
14	Maximum of Heights	hh.hh (metres)	Maximum of the VERIPOS Ultra heights during the 'Averaging Period'
15	Doodson	hh.hh (metres)	Estimated tide-less antenna height above Mean Sea Surface from the Doodson filter. First available after 39 hours.
16	Ultra Tide	hh.hh (metres)	Local tide based on the Mean Sea Surface derived from the Doodson filter. First available after 39 hours.
17	Geoid Tide	hh.hh (metres)	Local tide relative to the Geoid (see field 17). Available instantaneously after user configured 'hold-off' time
18	Antenna Height	hh.hh (metres)	User entered height of the antenna above the waterline.
19	Geoid Separation	hh.hh (metres)	Local offset between the Geoid and the WGS84 reference ellipsoid.
20	Geoid Model	-	EGM96, EGM2008 or USER, depending on user configuration
	*	c	Fixed end delimiter
		cc	Checksum

Tideinfo.txt (*Verify-QC v1.08*)

Filename			
Tideinfo.txt			
General Description			
The TideInfo.txt file contains current system height and tide information at the Averaging Period as configured by the Verify-QC user. This file contains comma delimited strings with variable length fields. Null fields indicate that no information is currently available; they should not be interpreted as 'zero'. A checksum is included for extra robustness. Negative tide is low tide and positive tide is high tide respectively.			
Sample			
$UltraTide,20070228,21:40:00,28,600,600,5236.2830,N,00143.5184,E,5.74,0.08,0.07,5.66,5.82,5.45,0.29,0.02,5.72,44.84,0.00,0.27,EGM96*2B			
Field Number	**Field Name**	**Format or Units**	**Description & Comments**
0	TalkerID	-	$Ultra Tide
1	Date	yyyymmdd	Identifies year, month and day for which all information in the string is valid.
2	Time	hh:mm:ss	Identifies time in UTC for which all information in the string is valid.
3	Sequence Number	numerical	Sequential number incrementing by 1 for every extra string. Maximum is 99999999 after which an automatic reset back to 1 takes place.
4	Averaging Period	numerical	User selected period over which VERIPOS Ultra heights are averaged in seconds. Minimum is 60, maximum is 3600.
5	Sample Count	numerical	Number of VERIPOS Ultra height samples that were included to derive the antenna height average. Minimum is 50% of 'Averaging Period', maximum is 'Averaging Period'
6	Latitude	ddmm.mmmm (degrees, minutes and decimal minutes)	Location where height and tide information is valid.
7	Latitude Hemisphere	c	N or S
8	Longitude	dddmm.mmmm (degrees, minutes and decimal minutes)	Location where height and tide information is valid.
9	Longitude Hemisphere	c	E or W
10	Mean Height	hh.hh (metres)	Mean of the VERIPOS Ultra heights during the 'Averaging Period'

11	Mean of Height SD	hh.hh (metres)	Mean of the Height SD's associated with the VERIPOS Ultra heights during the 'Averaging Period'. This is an indication of the quality of the VERIPOS Ultra heights
12	SD of Heights	hh.hh (metres)	Standard deviation of the VERIPOS Ultra heights during the 'Averaging Period'. This is an indication if the variation of the height due to vessel motion and position quality.
13	Minimum of Heights	hh.hh (metres)	Minimum of the VERIPOS Ultra heights during the 'Averaging Period'
14	Maximum of Heights	hh.hh (metres)	Maximum of the VERIPOS Ultra heights during the 'Averaging Period'
15	Doodson	hh.hh (metres)	Estimated tide-less antenna height above Mean Sea Surface from the Doodson filter. First available after 39 hours.
16	Ultra Tide	hh.hh (metres)	Local tide based on the Mean Sea Surface derived from the Doodson filter. First available after 39 hours.
17	Geoid Tide	hh.hh (metres)	Local tide relative to the Geoid (see field 17). Available instantaneously after user configured 'hold-off' time
18	Antenna Height	hh.hh (metres)	User entered height of the antenna above the waterline.
19	Geoid Separation	hh.hh (metres)	Local offset between the Geoid and the WGS84 reference ellipsoid.
20	Draft	hh.hh (metres)	The draft. Calculated as the current Doodson value minus the Doodson value for the first record.
21	Vertical Bias	hh.hh (metres)	The vertical bias detected between Ultra Tide and Geoid Tide. Calculated as Antenna Height minus Doodson plus Draft.
22	Geoid Model	-	EGM96, EGM2008 or USER, depending on user configuration
	*	c	Fixed end delimiter
		cc	Checksum

Doodson.txt (*Verify-QC v1.08*)

Filename
Doodson.txt
General Description
The TideInfo.txt file contains current system height and tide information at hourly intervals. The information in this file is consistent with the information contained in the file TideInfo.txt but information has been condensed to a fixed averaging period of one hour. This file contains comma delimited strings with variable length fields. Null fields indicate that no information is currently available; they should not be interpreted as 'zero'. A checksum is included for extra robustness. Negative tide is low tide and positive tide is high tide respectively.
Sample
$UltraTide,20070301,23:00:00,31,3600,3599,5236.2829,N,00143.5183,E,5.90,0.09,0.11,5.74,6.06,5.45,0.45,0.18,5.72,44.84,0.00,0.27,EGM96*22

Field Number	Field Name	Format or Units	Description & Comments
0	TalkerID	-	$Ultra Tide
1	Date	yyyymmdd	Identifies year, month and day for which all information in the string is valid.
2	Time	hh:mm:ss	Identifies time in UTC for which all information in the string is valid.
3	Sequence Number	numerical	Sequential number incrementing by 1 for every extra string. Maximum is 99999999 after which an automatic reset back to 1 takes place.
4	Averaging Period	numerical	Fixed period (3600 seconds) over which VERIPOS Ultra heights are averaged in seconds.
5	Sample Count	numerical	Number of VERIPOS Ultra height samples that were included to derive the antenna height average. Minimum is 50% of 'Averaging Period', maximum is 'Averaging Period'
6	Latitude	ddmm.mmmm (degrees, minutes and decimal minutes)	Location where height and tide information is valid.
7	Latitude Hemisphere	c	N or S
8	Longitude	dddmm.mmmm (degrees, minutes and decimal minutes)	Location where height and tide information is valid.
9	Longitude Hemisphere	c	E or W
10	Mean Height	hh.hh (metres)	Mean of the VERIPOS Ultra heights during the 'Averaging Period'

11	Mean of Height SD	hh.hh (metres)	Mean of the Height SD's associated with the VERIPOS Ultra heights during the 'Averaging Period'. This is an indication of the quality of the VERIPOS Ultra heights
12	SD of Heights	hh.hh (metres)	Standard deviation of the VERIPOS Ultra heights during the 'Averaging Period'. This is an indication if the variation of the height due to vessel motion and position quality.
13	Minimum of Heights	hh.hh (metres)	Minimum of the VERIPOS Ultra heights during the 'Averaging Period'
14	Maximum of Heights	hh.hh (metres)	Maximum of the VERIPOS Ultra heights during the 'Averaging Period'
15	Doodson	hh.hh (metres)	Estimated tide-less antenna height above Mean Sea Surface from the Doodson filter. First available after 39 hours.
16	Ultra Tide	hh.hh (metres)	Local tide based on the Mean Sea Surface derived from the Doodson filter. First available after 39 hours.
17	Geoid Tide	hh.hh (metres)	Local tide relative to the Geoid (see field 17). Available instantaneously after user configured 'hold-off' time
18	Antenna Height	hh.hh (metres)	User entered height of the antenna above the waterline.
19	Geoid Separation	hh.hh (metres)	Local offset between the Geoid and the WGS84 reference ellipsoid.
20	Draft	hh.hh (metres)	The draft. Calculated as the current Doodson value minus the Doodson value for the first record.
21	Vertical Bias	hh.hh (metres)	The vertical bias detected between Ultra Tide and Geoid Tide. Calculated as Antenna Height minus Doodson plus Draft.
22	Geoid Model	-	EGM96, EGM2008 or USER, depending on user configuration
	*	c	Fixed end delimiter
		cc	Checksum