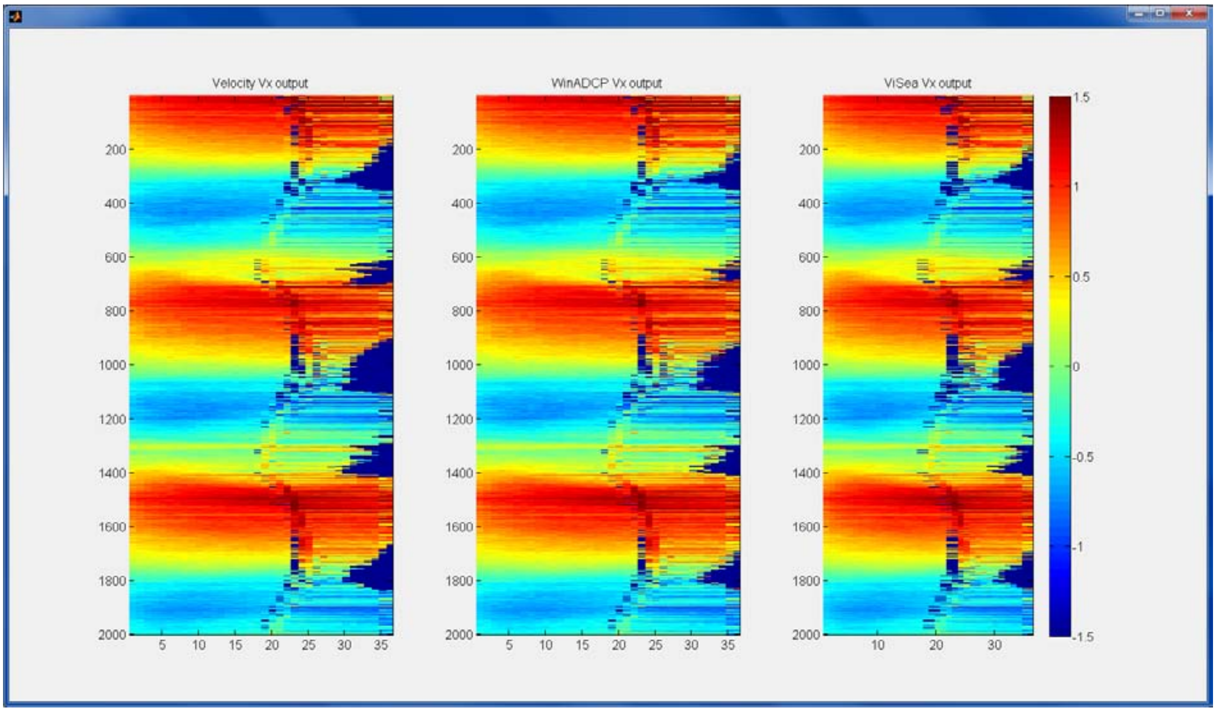
ViSea DAS Application note
comparison ViSea DAS and Velocity

April 2015



Application note

AV_AN_150401

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Client	: DHI Singapore, miscellaneous

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Contents

1. Introduction

In February 2015 DHI Singapore sent data to Aqua Vision's support, it was acquired with a Sentinel V from TRDI. Besides some general questions a remark was made about possible differences in results between ViSea DAS and Velocity (the postprocessing software from TRDI). This document describes the results from a comparison made between Velocity and ViSea DAS.

The Sentinel V's data format differs from the Sentinel/WorkHorse ADCP, also the hardware is different, most importantly: the beam angle is 25 degrees.
So to analyse the question whether ViSea Das results differ from Velocity it must be noted there are actually 2 issues, the relatively new Sentinel V ADCP and the relatively new postprocessing software Velocity.

In the past, results from ViSea DAS have always been validated by comparison with TRANSECT, WinRiver and WinADCP. It is therefore decided to start with making a comparison between Velocity, WinADCP and ViSea DAS. The eliminate possible differences introduced by the Sentinel V hardware first data will be used for this comparison that is acquired with Sentinel/workhorse hardware.

Following this, a comparison will be made between Velocity and ViSea DAS by processing a Sentinel V data file.

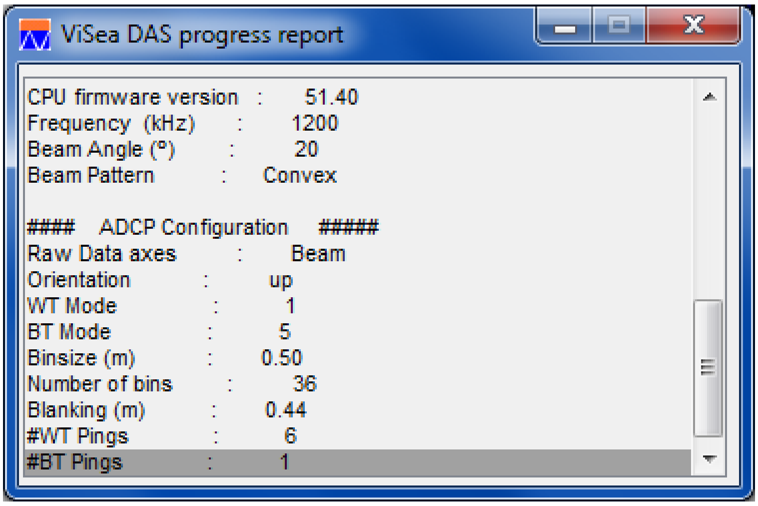
2. Software used

The following software has been used:
ViSea DAS 4.03;
WinADCP 1.14;
Velocity 1.4.

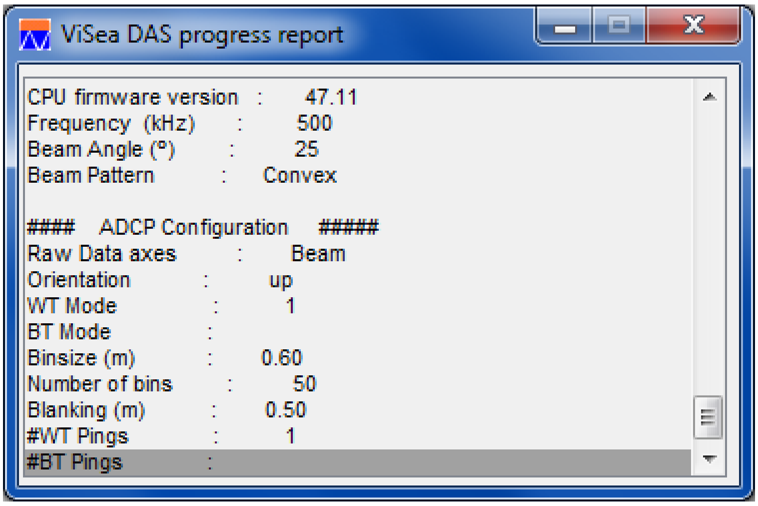
3. Data used

The data file selection is made based on the following requirements;
No external data like Gyro etc.
Acquired in Beam coordinates.
Significant signal/variation in velocity magnitude and direction.
A tilt of more then 5 degrees to be sure binmapping must be applied.

Based on these requirements a data file was selected from an upwards looking system in a tidal area acquired with a Sentinel WorkHorse ADCP. The data was collected in March 2012 in the North Sea. The system had a pitch of +/- 8 degrees.



For the Sentinel V system a data file was used provided by an end user. The tilt was ~-2 degrees.



4. Processing

For processing settings we must follow the implicit processing of WinADCP, since this software package allows for the least settings to be changed. Also note that WinADCP is not capable of processing Sentinel V data.

In general the settings used are salinity 35 ppt, calculate sound velocity, reference none, apply bin mapping.

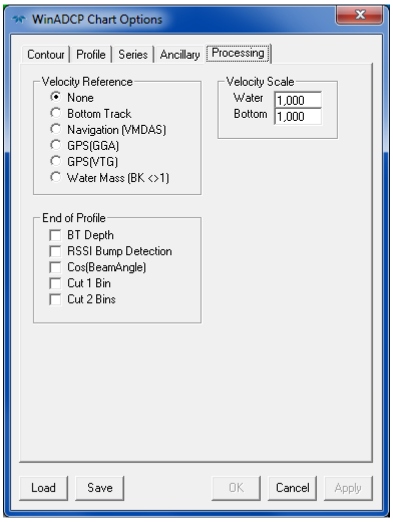


Figure 1 Configuration WinADCP.

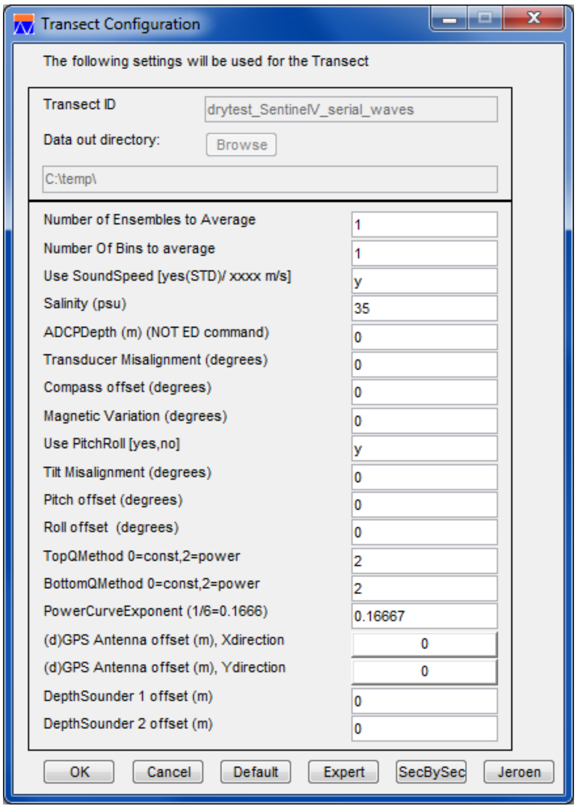


Figure 2 Configuration ViSea DAS, general settings.

Figure 3 Configuration Velocity.

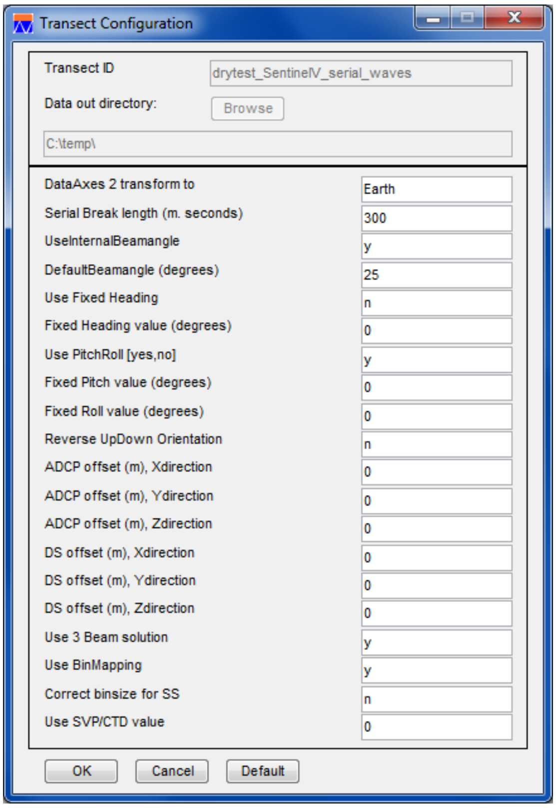


Figure 4 Configuration ViSea DAS, expert settings.

For comparison the export functionality to matlab format has been used, available in all 3 software packages.

5. Results comparison Sentinel/WorkHorse data

The comparison is focussed in the resulting water velocity in 1 direction – Vx. This to be sure possible directional differences will show up more pronounced.

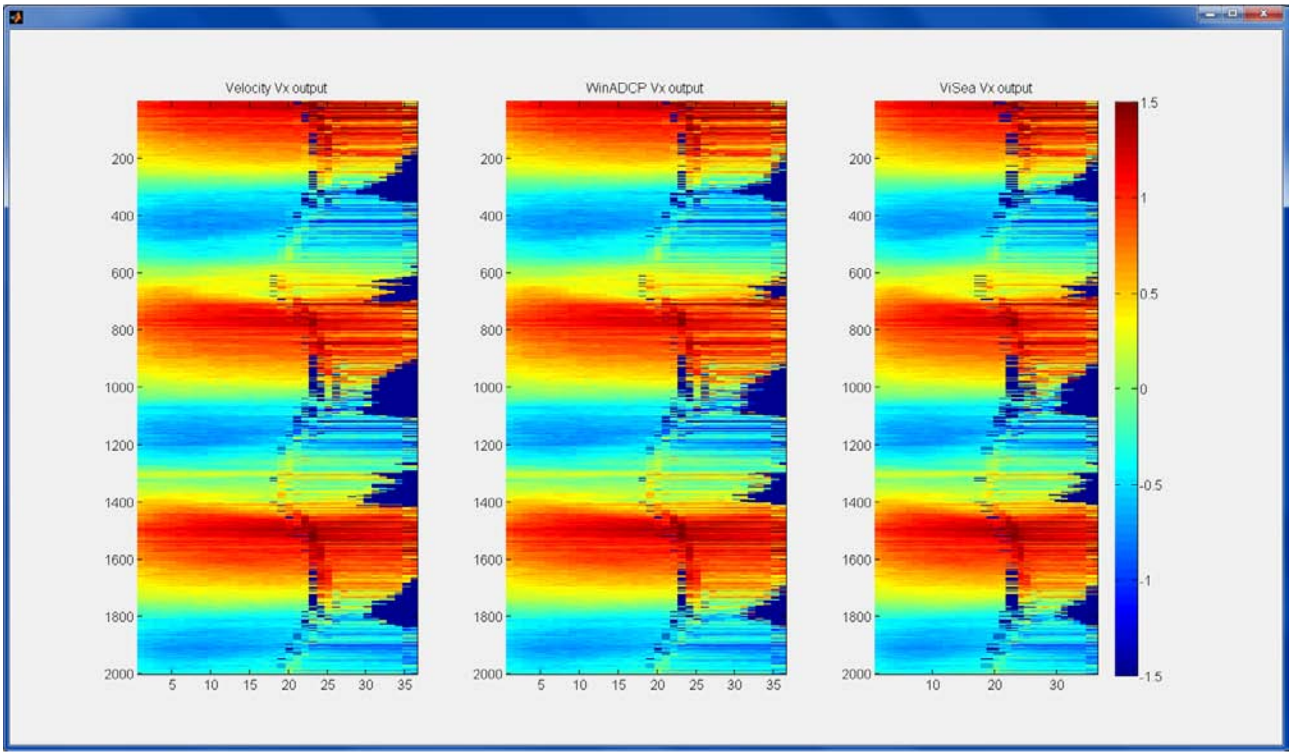


Figure 5 Resulting water velocity east components (Vx), in m/s. Time/ensemble from top to bottom, depth range along the horizontal (in m).

At a glance there is no difference to be seen between all 3 resulting water velocities, they all 3 show the same tidal signal.

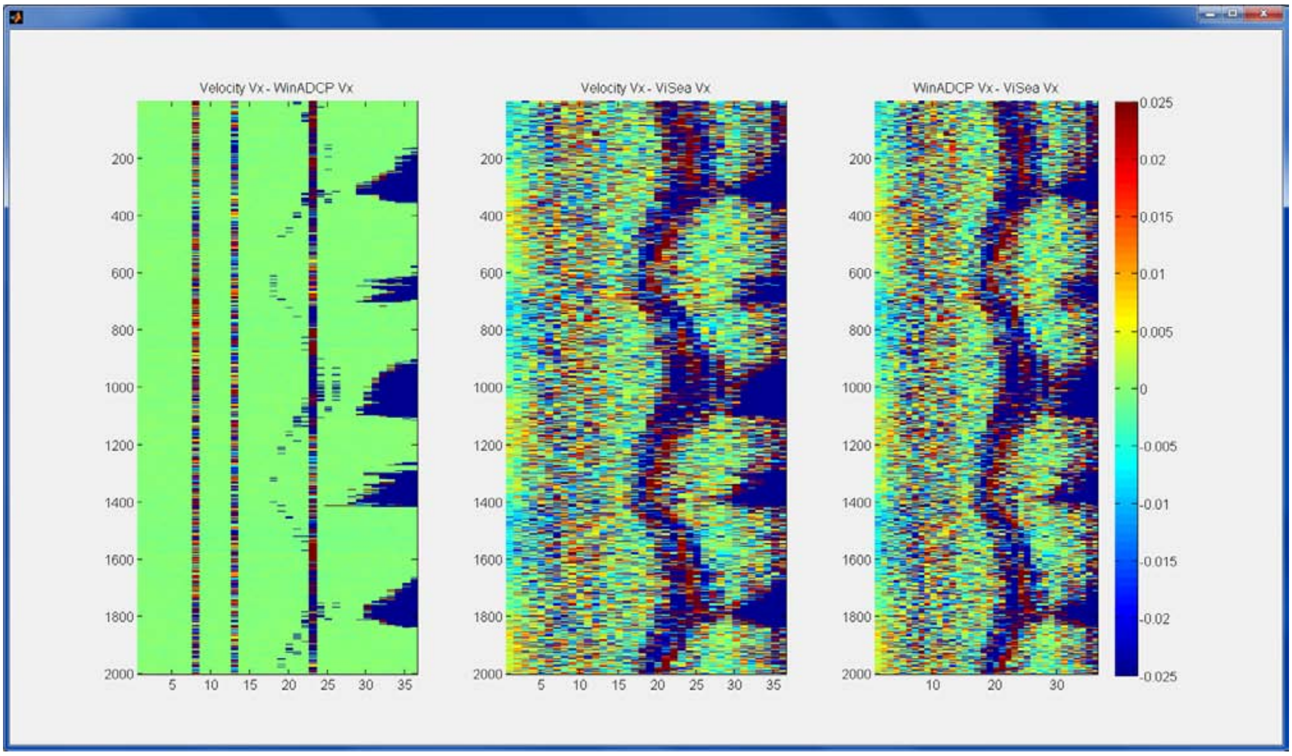


Figure 6 Differences in resulting water velocity east components (Vx), in m/s.

To compare in more detail the differences are plotted as well. Note the plot range, +/- 2.5 cm/s.

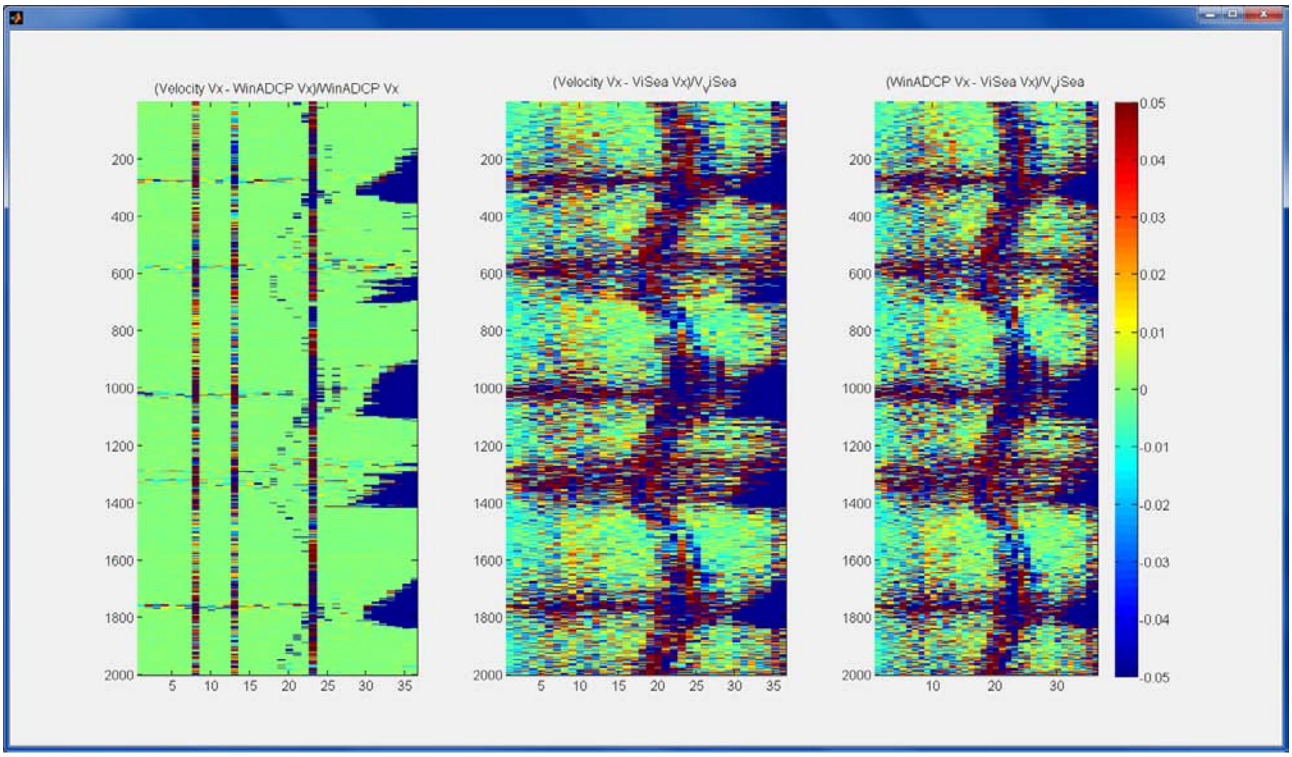


Figure 7 Relative differences in resulting water velocity east components (Vx).

In general the resulting water velocities from ViSea DAS compared to both WinADCP and Velocity show differences of more than 5% in periods with high water velocity within the water column with higher values in the BadBelowBottom area.

The differential plot between Velocity and WinADCP show much smaller differences except for 3 cells at constant depth at 3 discrete depth intervals.

6. Discussion results comparison Sentinel/WorkHorse data

From former comparisons between ViSea DAS and WinADCP we know there are differences originating in bin mapping algorithms. ViSea DAS interpolates linearly while WinADCP interpolates using the nearest neighbour option. Also, in the bin mapping algorithm in WinADCP the blanking is ignored, which is actually an error. The large deviations in the near surface area are caused by bin mapping, since also 3 beam solutions are applied, leading to bins having 3 valid cells with relatively larger differences.
Purely for this analysis we have set the interpolation method in ViSea DAS also to nearest neighbour, and also omit the blanking taken into account. Note, this is not an option in the software but changed in the code for this analysis only.

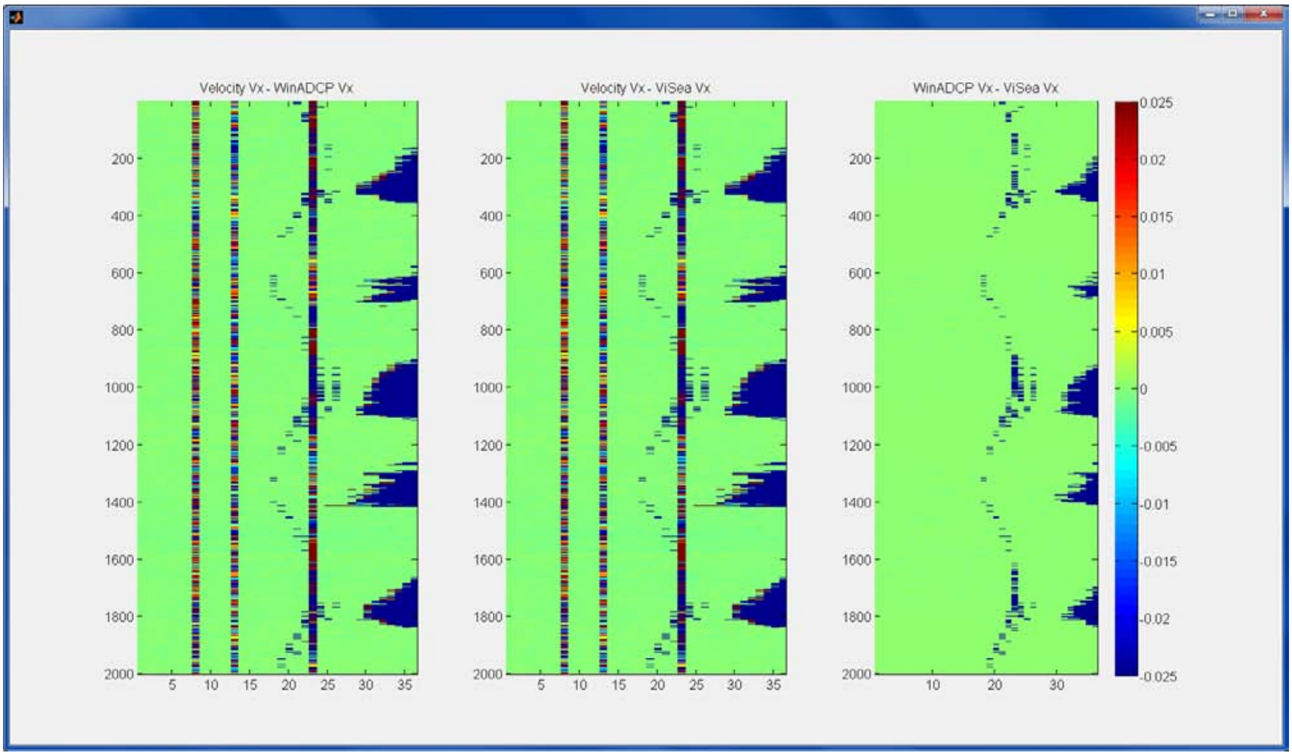


Figure 8 Differences in resulting water velocity east components (Vx), in m/s. In this case the bin mapping interpolation is in ViSea DAS set at nearest and an error is introduced, i.e. omit the blanking in the algorithm. In this case the results from ViSea DAS and WinADCP are identical.

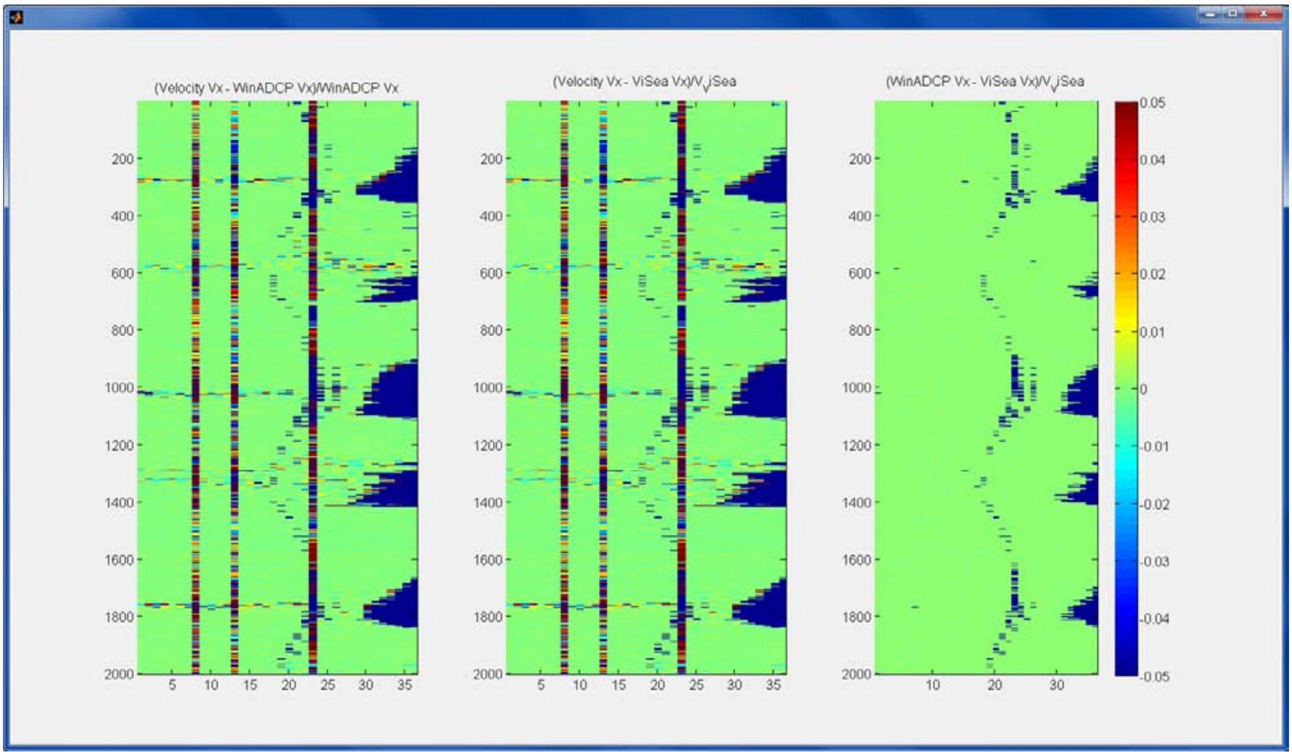


Figure 9 Relative differences in resulting water velocity east components (Vx). In this case the bin mapping interpolation is in ViSea DAS set at nearest and an error is introduced, i.e. omit the blanking in the algorithm. In this case the results from ViSea DAS and WinADCP are identical.

The results after applying these code changes show that the differences between ViSea DAS and WinADCP are all below 1% and can be addressed as being caused by machine precision in the calculations. In other words they are identical.
Also the higher differences in the near surface area are disappeared.
Also the differences between ViSea DAS and Velocity, and WinADCP and Velocity are now equal.
The cause of these differences can not be explained.

7. Results comparison Sentinel V data

The comparison is focussed in the resulting water velocity in 1 direction – Vx. This to be sure possible directional differences will show up more pronounced.

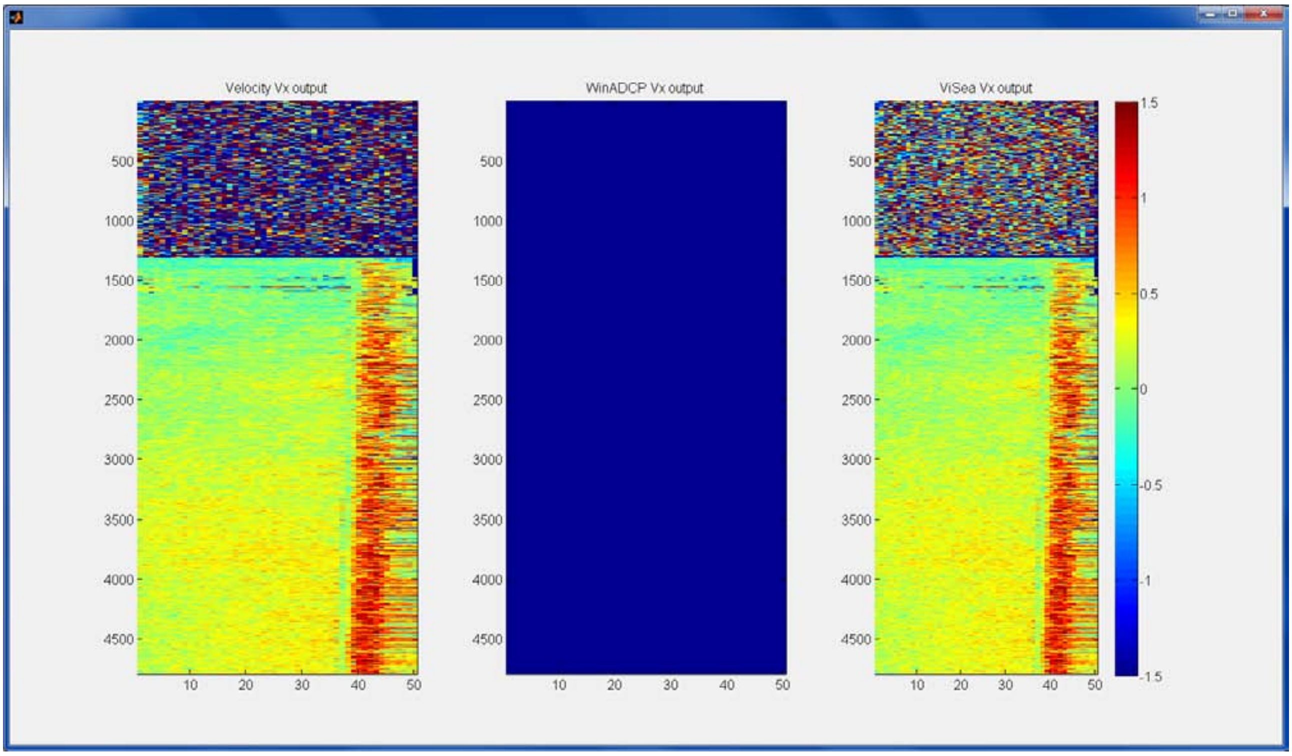


Figure 10 Resulting water velocity east components (Vx), in m/s. Time/ensemble from top to bottom, depth range along the horizontal. Note, WinADCP can not be used for Sentinel V data.

At a glance there is no clear difference to be seen between the resulting water velocities, they both show the same velocities.

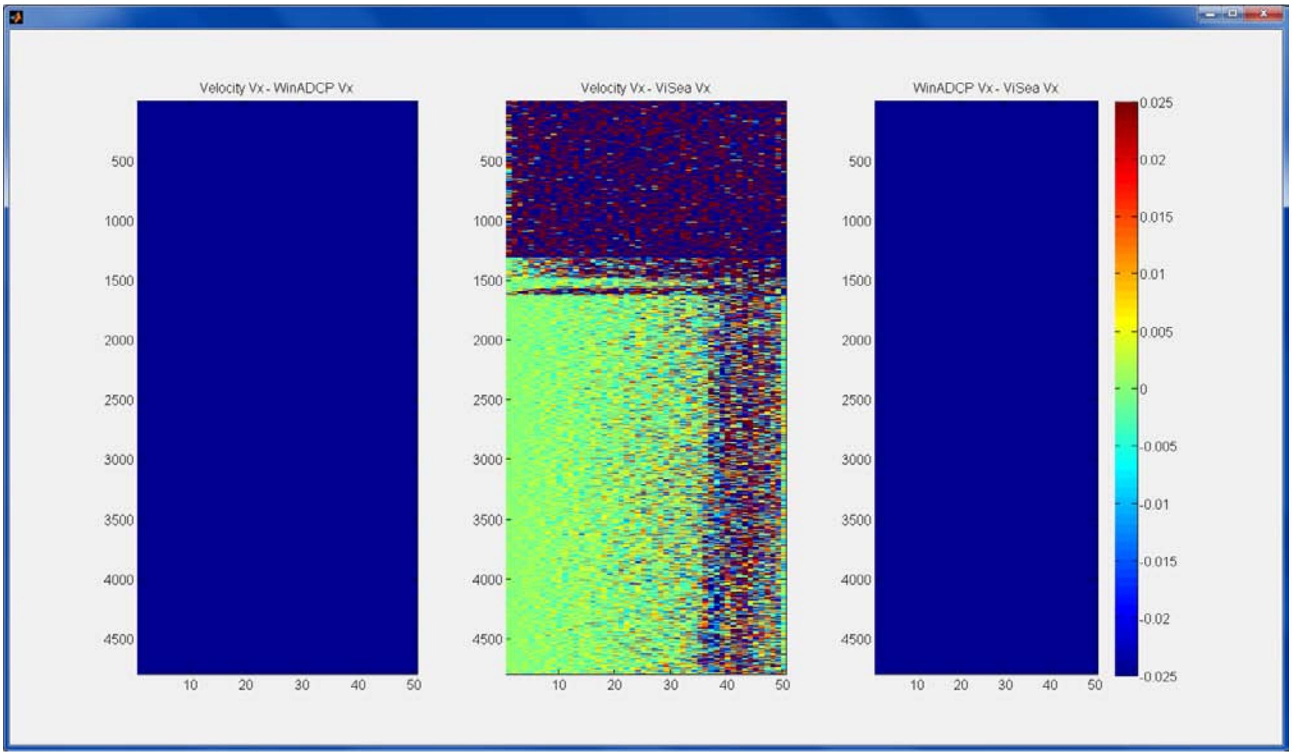


Figure 11 Differences in resulting water velocity east components (Vx), in m/s. Note since we only have ViSea DAS and Velocity results we have only 1 difference plot.

To compare in more detail the differences are plotted as well. Note the plot range, +/- 2.5 cm/s.

8. Discussion results comparison Sentinel V data

In analogy with the above we know there are differences originating from bin mapping algorithms. ViSea DAS interpolates linearly while WinADCP interpolates using nearest neighbours, above shown results indicate the same holds for Velocity.
Purely for this analysis we have set the interpolation method in ViSea DAS also to nearest neighbours. Note, ViSea DAS takes the blanking distance into account. Also note, this is not an option in the software but changed in the code for this analysis only.

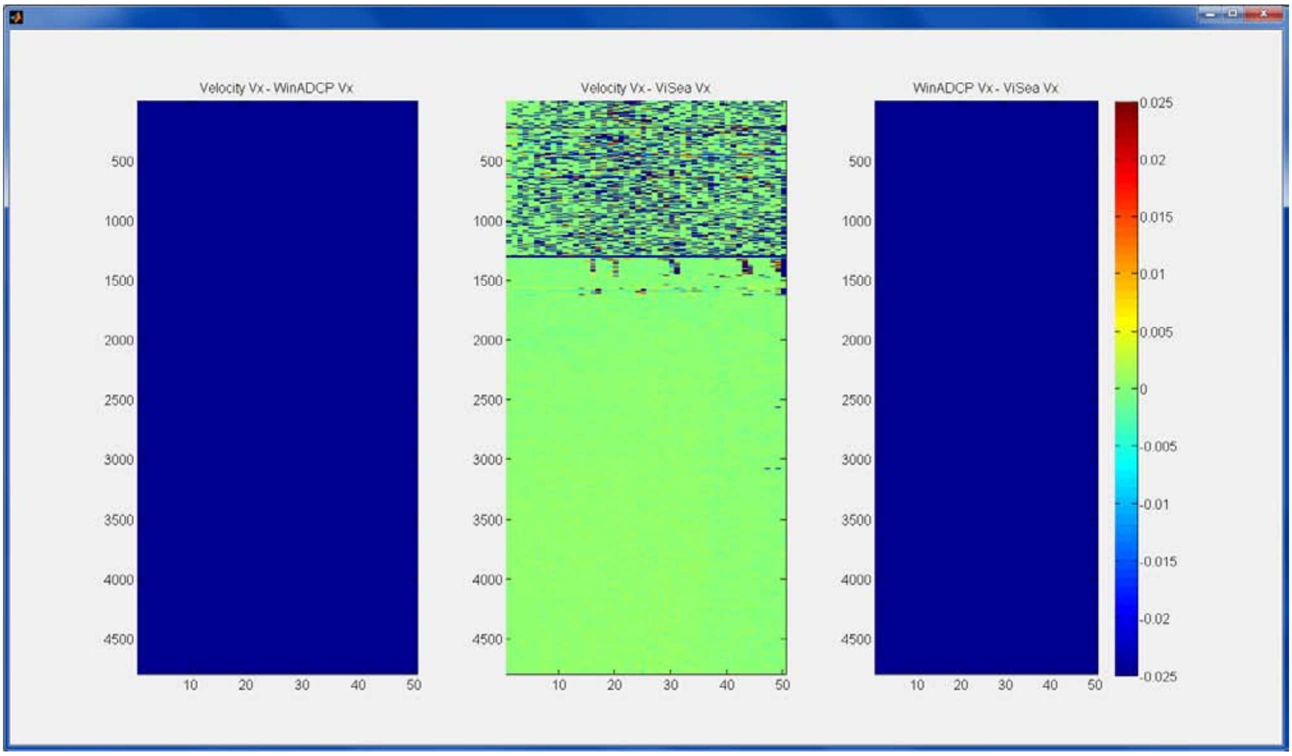


Figure 12 Differences in resulting water velocity east components (Vx), in m/s. In this case the bin mapping interpolation is in ViSea DAS set at nearest.

The results after applying these code changes show that the differences between ViSea DAS and Velocity are marginal and can be addressed as being caused by machine precision in the calculations.
Note that the tilts are low (smaller than 3 degrees), so bin mapping does not have enough influence in this data set to induce the different velocities at fixed bins as the WorkHorse data set showed.

9. Conclusions

Comparisons have been made between resulting water velocities processed by ViSea DAS, Velocity and WinADCP.
This comparison has been made for Sentinel/WorkHorse data and for Sentinel V data.

It has been demonstrated the differences between ViSea DAS and WinADCP are caused by the bin mapping algorithm. WinADCP and Velocity use nearest neighbour interpolation while ViSea DAS uses linear. Also, WinADCP erroneously neglects the blanking of the system.

Since to our opinion the blanking should not be neglected and linear interpolation is physically more correct we state that ViSea DAS renders the most accurate results.

There is a difference between Velocity and WinADCP&ViSea DAS. The pattern in these differences – at fixed bin numbers – are very likely also in the bin mapping algorithm of Velocity and only show up with tilts large enough to take binmapping effect.