Master Track RV Heincke HE511
Data Processing Report

Contents

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1 Introduction

This report describes the processing of raw data acquired by position sensors on board RV Heincke during expedition HE511 to receive a validated master track which is used as reference of further expedition data.

2 Workflow

The different steps of processing and validation are visualized in figure 1. Unvalidated data of up to three sensors and ship-motion data are extracted from the DAVIS SHIP data base (https://dship.awi.de) in a 1-second interval. They are converted to ESRI point shapefiles and imported to ArcGIS. A visual screening is performed to evaluate data quality and remove outliers manually. The position data from each position sensor are centered to the destined master track origin by applying ship-motion data (angles of roll, pitch and heading) and lever arms. For all three resulting position tracks, a quality check is performed using a ship's speed filter and an acceleration filter. Filtered positions are flagged. In addition, a manual check is performed to flag obvious outliers. Those position tracks are combined to a single master track depending on a sensor priority list (by accuracy, reliability) and availability / applied exclusion of automatically or manually flagged of data. Missing data up to a time span of 60 seconds are linearly interpolated. To reduce the amount of points for overview maps the master track is generalized by using the Ramer-Douglas-Peucker algorithm. This algorithm returns only the most significant points from the track. Full master track and generalized master track are written to text files and imported to PANGAEA (http://www.pangaea.de) for publication.
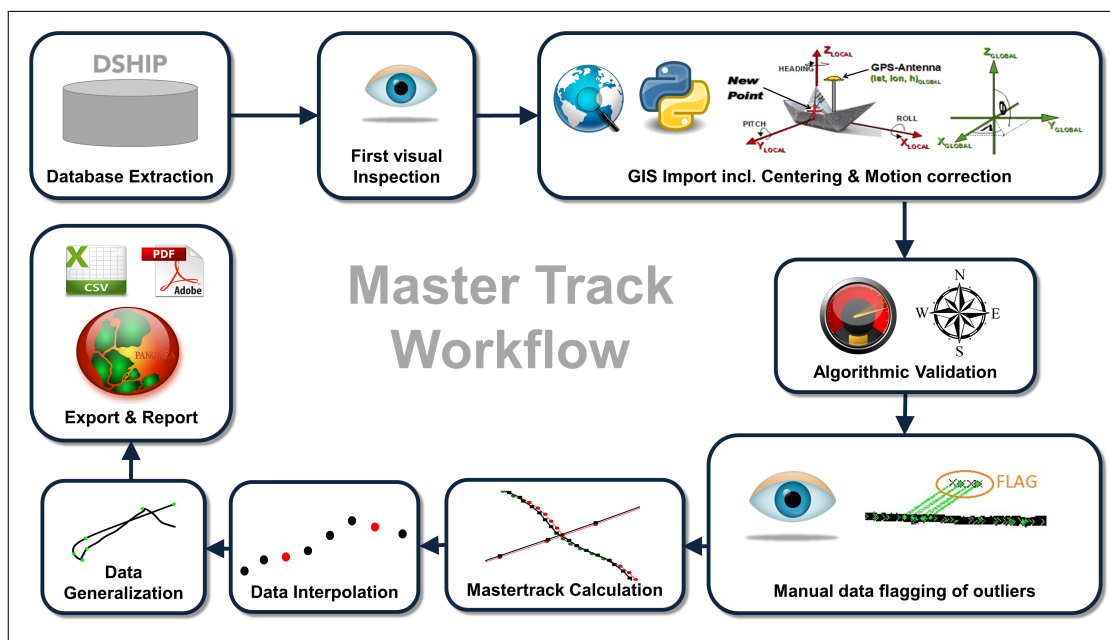

Figure 1: Workflow of master track data processing

3 Sensor Layout

This chapter describes the position sensors mounted during this cruise.

Cruise details according to Cruise Report `https://www.pangaea.de/expeditions/`

Vessel name	RV Heincke
Cruise name	HE511
Cruise start	2018-05-17 Bremerhaven
Cruise end	2018-05-29 Bremerhaven
Cruise duration	12 days
Master track reference point:	Resulting master track is referenced to *PHINS installation point*.

Position sensors

Sensor name	**IXSEA PHINS III**, short: PHINS
Description	Inertial navigation system with reference positions from Trimble DGPS
Accuracy	$\pm$ 0.5-3.0 m
Installation point	Electrician's workshop, close to COG
Installation offset	Offset from master track reference point to sensor installation point X Positive to bow 0.000 m Y Positive to starboard 0.000 m Z Positive upwards 0.000 m

Sensor name	**Trimble Marine SPS461**, short: Trimble
Description	DGPS-Receiver, correction type DGPS RTCM 2.x, correction source DGPS Base via radio
Accuracy	Horizontal: $\pm$ 0.25 m + 1 ppm & Vertical: $\pm$ 0.50 m + 1 ppm
Installation point	Observational Deck, fore rail
Installation offset	Offset from master track reference point to sensor installation point X Positive to bow 13.648 m Y Positive to starboard 2.976 m Z Positive upwards 11.406 m

Sensor name	**SAAB R5 SUPREME NAV**, short: SAAB
Description	DGPS-Receiver, SBAS-correction with RTCM-104 input
Accuracy	GPS: $\pm$ 3.0 m; DGPS (2D RMS): $\pm$ 1.0 m
Installation point	Observational Deck, fore rail
Installation offset	Offset from master track reference point to sensor installation point X Positive to bow 12.985 m Y Positive to starboard 2.958 m Z Positive upwards 11.328 m

Motion sensor

Sensor name	**IXSEA PHINS III**, short: PHINS
Description	Inertial navigation system with reference positions from Trimble DGPS
Accuracy	$\pm$ 0.01 roll, $\pm$ 0.01 pitch, $\pm$ 0.05 heading (deg)
Installation point	Electrician's workshop, close to COG

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Database Extraction

Data source	DSHIP database (dship.awi.de)
Exported values	1094401
First dataset	2018-05-17T04:30:00 UTC
Last dataset	2018-05-29T20:30:00 UTC

Centering & Motion Compensation

Each position track has been centered to the *PHINS installation point* by applying the correspondent motion angles for heading, roll and pitch as well as the installation offsets from chapter **??**. The motion data were acquired by IXSEA PHINS III.

Automatic Validation

The following thresholds were applied for the automatic flagging of the position data:

Speed	Maximum 20 kn between two datapoints.
Acceleration	Maximum 1 m/s^2 between two datapoints.
Change of course	Maximum 5° between two datapoints.

Manual Validation

Obvious outliers were removed manually. For details see Processing Logbook of RV Heincke (hdl:10013/epic.45841) .

Flagging result

	PHINS		Trimble		SAAB	
Missing	0	0.000%	5	0.000%	4	0.000%
Speed	0	0.000%	10	0.001%	8	0.001%
Acceleration	836	0.076%	130	0.012%	6	0.001%
Course	283240	25.881%	379466	34.673%	355121	32.449%
Manually	0	0.000%	0	0.000%	0	0.000%

Master Track Generation

The master track is derived from the position sensors' data selected by priority.

Sensor priority used:
1. PHINS
2. Trimble
3. SAAB

Filters applied: manual, speed, acceleration.

Distribution of position sensor data in master track:

Sensor	Data points	Percentage
Total	1094401	100.000 %
PHINS	1093565	99.924 %
Trimble	836	0.076 %
SAAB	0	0.000 %
Interpolated	0	0.000 %
Gaps	0	0.000 %

Remarks

N

Score

For each cruise, a score is calculated ranging from 0 (no data) to 100 (only very good data). the score for the cruise HE511 is 97.

Generalization

The master track is generalized to receive a reduced set of the most significant positions of the track using the Ramer-Douglas-Peucker algorithm and allow a maximum tolerated distance between points and generalized line of 4 arcseconds.

Results:

Number of generalized points	821 points
Data reduction	99.9250 %

Result files

Master track text file:

The format is a plain text (tab-delimited values) file with one data row in 1 second interval.

Column separator	Tabulator "\t"	
Column 1	Date and time expressed according to ISO 8601	
Column 2	Latitude in decimal format, unit degree	
Column 3	Longitude in decimal format, unit degree	
Column 4	Flag for data source	
	1	PHINS
	2	Trimble
	3	SAAB
	INTERP	Interpolated point
	GAP	Missing data

Text file of the generalized master track:

The format is a plain text (tab-delimited values) file.

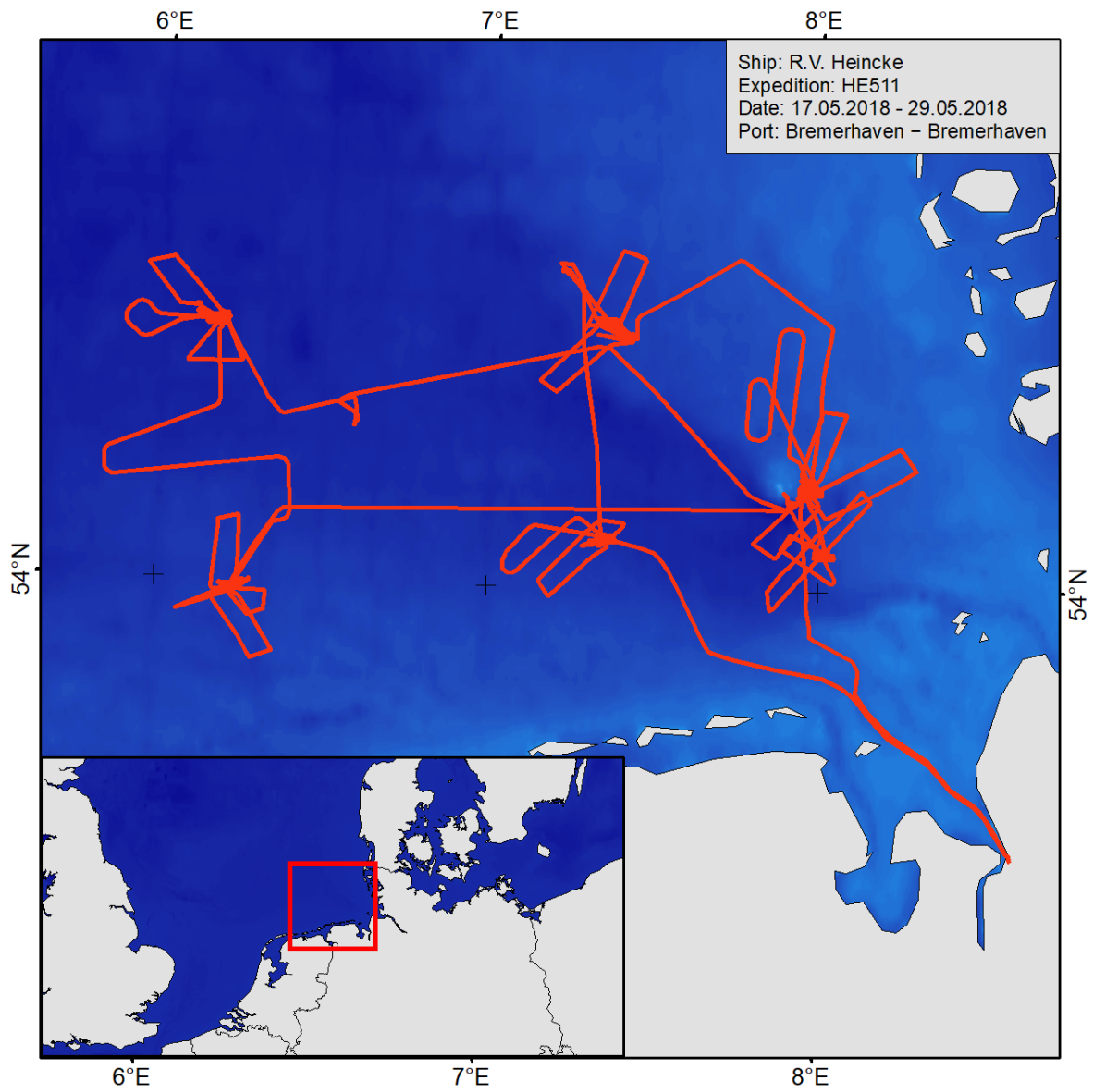| Column separator	Tabulator "\t"
Column 1	Date and time expressed according to ISO 8601
Column 2	Latitude in decimal format, unit degree
Column 3	Longitude in decimal format, unit degree

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This PDF document.

Cruise map

Figure 2: Map of the generalized master track