ALFRED-WEGENER-INSTITUT
HELMHOLTZ-ZENTRUM FÜR POLAR- UND MEERESFORSCHUNG

FIELAX

Master Track RV Heincke HE353

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 HE353 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.

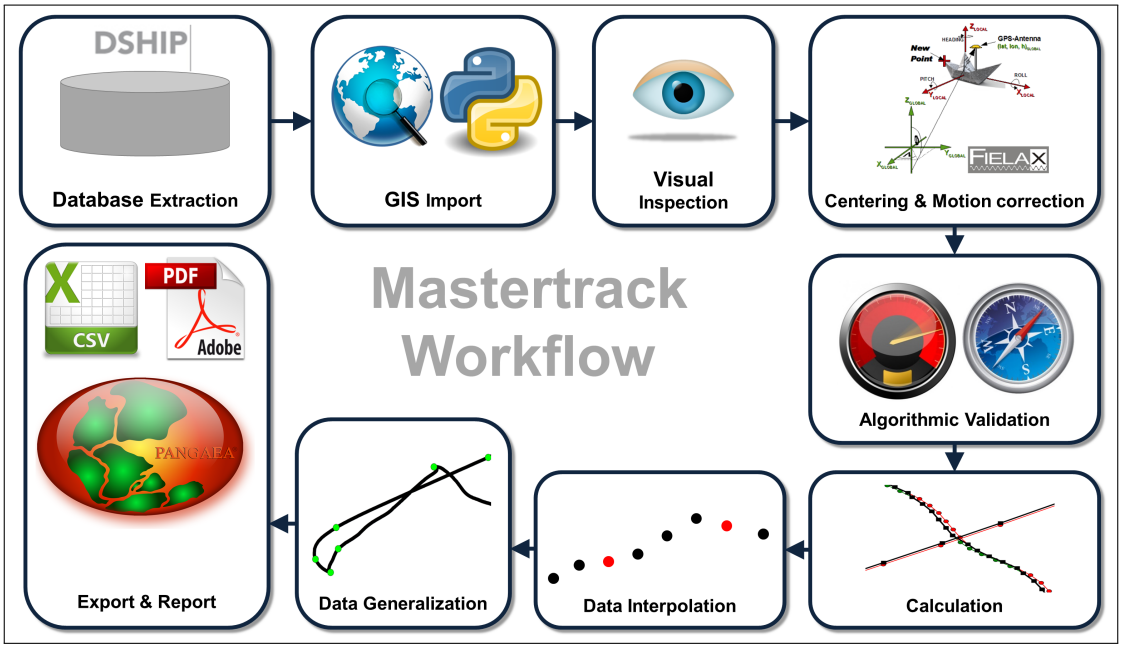

Figure 1: Workflow of master track data processing

3 Sensor Layout

This chapter describes the position sensors mounted during this cruise.

Cruise details

Vessel name	RV Heincke
Cruise name	HE353
Cruise start	05.04.2011 Bremerhaven
Cruise end	14.04.2011 Bremerhaven
Cruise duration	10 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	Masttop
Installation offset	Offset from master track reference point to sensor installation point X Positive to bow 5.298 m Y Positive to starboard -0.034 m Z Positive upwards 22.297 m

Sensor name	**DEBEG/Leica MX400**, short: DEBEG
Description	GPS-Receiver for navigation purposes
Accuracy	$\pm$ 7-15 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	± 0.01 roll, ± 0.01 pitch, ± 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	863941
First dataset	2011-04-05T00:00:00 UTC
Last dataset	2011-04-14T23:59:00 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 2. 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		DEBEG	
Missing	146	0.017%	17484	2.024%	449	0.052%
Speed	215	0.025%	37575	4.349%	1039	0.120%
Acceleration	100234	11.602%	48362	5.598%	21004	2.431%
Course	181294	20.985%	413504	47.863%	350777	40.602%
Manually	0	0.000%	3870	0.448%	329	0.038%

Master Track Generation

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

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

Filters applied: manual, speed.

Distribution of position sensor data in master track:

Sensor	Data points	Percentage
Total	863941	100.000 %
PHINS	863667	99.968 %
Trimble	179	0.021 %
DEBEG	61	0.007 %
Interpolated	34	0.004 %
Gaps	0	0.000 %

Remarks

Cruise ends already on 2011-04-12T15:38:10 UTC.

Score

For each cruise, a score is calculated ranging from 0 (no data) to 100 (only very good data). the score for the cruise HE353 is 95.

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	402 points
Data reduction	99.9535 %

Result files

Report in XML format:

The XML contains all information of the master track generation in a machine-readable format. In addition a XSD schema file is provided.

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 3	Latitude in decimal format, unit degree
Column 4	Longitude in decimal format, unit degree
Column 5	Flag for data source 1 PHINS 2 Trimble 3 DEBEG 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

Processing Report:

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Cruise map

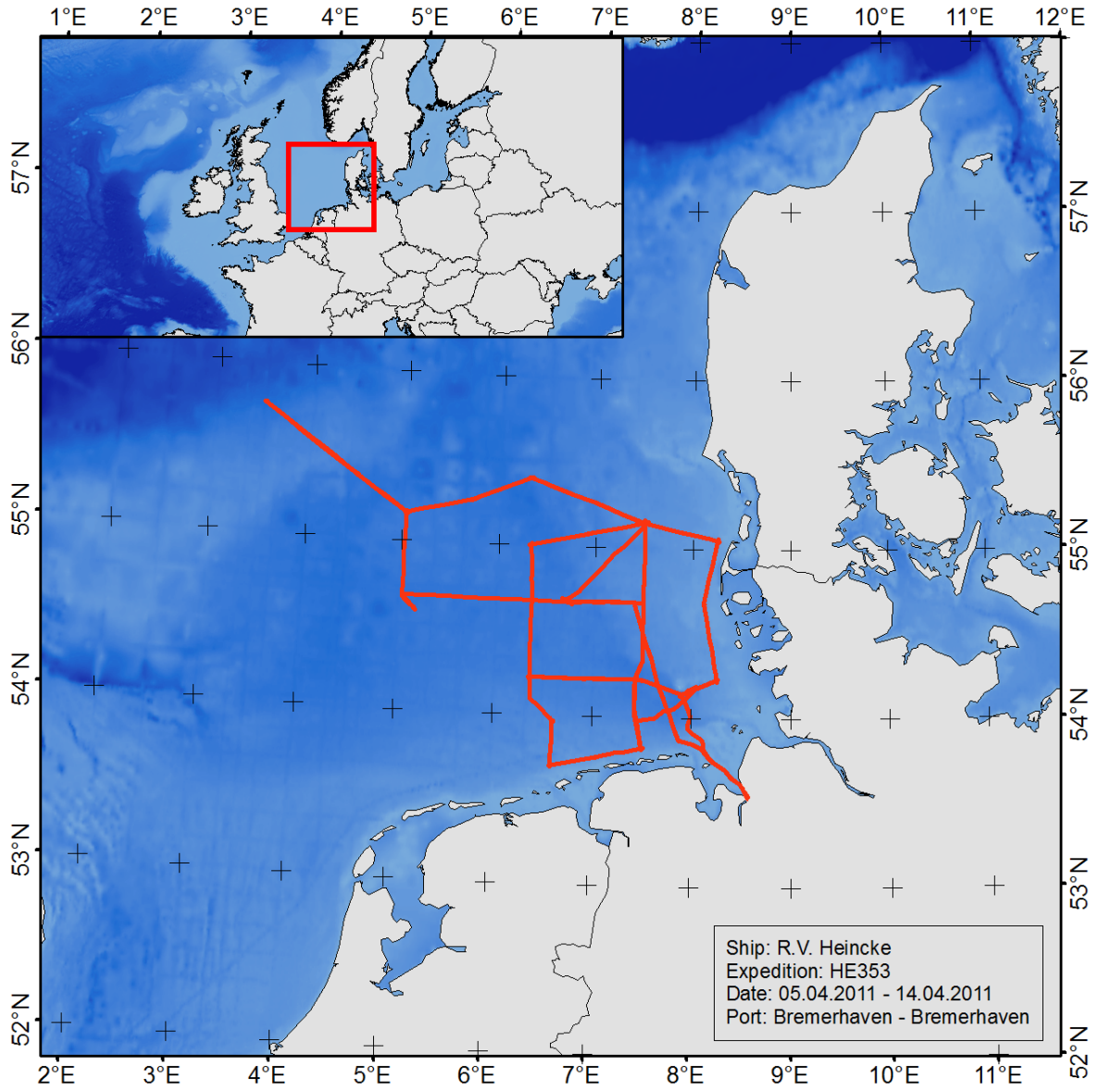

Figure 2: Map of the generalized master track