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

FIELAX
Gesellschaft für wissenschaftliche Datenverarbeitung mbH

Master Track RV Heincke HE422

Data Processing Report

Contents

Contact:
Dr. Rainer Knust
Alfred Wegener Institute
Columbusstrasse, D-27568 Bremerhaven, GERMANY
Phone: +49(471)4831-1709
Fax: +49(471)4831-1918
Mail: Heincke-Coordination@awi.de

Processing Agency:
FIELAX
Gesellschaft für wissenschaftliche Datenverarbeitung mbH
Schleusenstr. 14, D-27568 Bremerhaven, GERMANY
Phone: +49 (0) 471 30015 0
Fax: +49 (0) 471 30015 22
Mail: info@fielax.de

1 Introduction

This report describes the processing of raw data acquired by position sensors on board RV Heincke during expedition HE422 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 fig. 1. Unvalidated data of up to three sensors and ship-motion data are extracted from the DAVIS SHIP data base (dship.awi.de) in 1-second interval. They are converted to ESRI point shapefiles and imported to a GIS. 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 roll, pitch, 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. Those position tracks are combined to a single master track depending on a sensor priority list (by accuracy, reliability) and availability / filter flag 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 TXT files and imported to PANGAEA (www.pangaea.de) for publication.

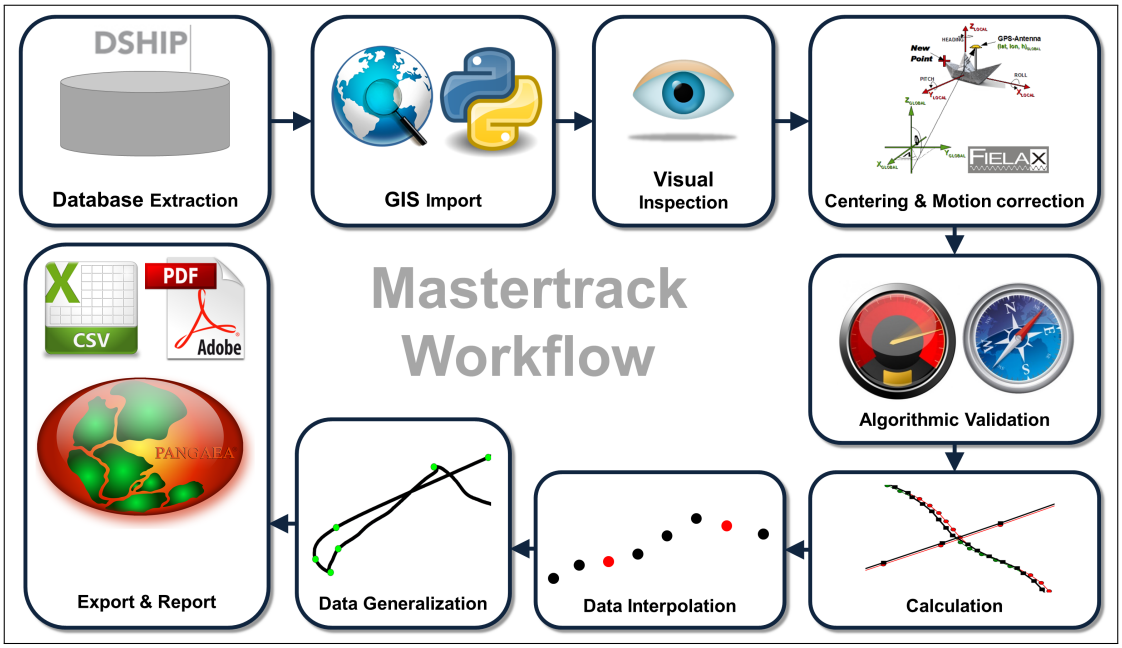

Figure 1: Workflow of master track data processing

3 Sensor Layout

This chapter describes the position sensors mounted during this cruise.

Cruise details

Vessel name:	RV Heincke
Cruise name:	HE422
Cruise start:	02.05.2014 in Bremerhaven
Cruise end:	14.05.2014 in Bremerhaven
Cruise duration:	13 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:	± 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: ± 0.25 m + 1 ppm Vertical: ± 0.50 m + 1 ppm
Installation point:	Starboard railing above bridge deck
Installation offset:	Offset from master track reference point to sensor installation point X Positive to bow 5.044 m Y Positive to starboard 6.788 m Z Positive upwards 11.489 m

Sensor name:	**SAAB R5 SUPREME NAV**, short: SAAB
Description:	DGPS-Receiver, SBAS-correction with RTCM-104 input
Accuracy:	GPS: ± 3.0 m; DGPS (2D RMS): ± 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 12.986 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

4 Processing Report

This section describes each processing step with its parameters and results.

Database Extraction

Data source:	DSHIP database (dship.awi.de)
Number of exported values:	1123200
First dataset:	02.05.2014, 00:00:00 UTC
Last dataset:	14.05.2014, 23:59:59 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.

Algorithmic Validation

Input parameters:

Maximum speed for data filter:	20 kn
Maximum acceleration offset for data filter:	1 m/s

Results:

PHINS	6	Speed > 20 kn
	155711	Acceleration difference between points > 1 m/s
Trimble	74	Speed > 20 kn
	66	Acceleration difference between points > 1 m/s
SAAB	7	Speed > 20 kn
	7	Acceleration difference between points > 1 m/s

Master Track Generation

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

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

Distribution of position sensor data in master track:

Sensor	Data points	Percentage
Trimble	1074234	95.6 %
PHINS	105	0.0 %
SAAB	2	0.0 %
Interpolated	0	0.0 %
Gaps	48859	4.3 %

Bounding coordinates of the master track:

	Lat	Lon
NW	55.5396853	4.0762557
NE	55.5396853	8.5804278
SE	53.5230878	8.5804278
SW	53.5230878	4.0762557

Remarks
DSHIP offline from 2014-05-05T18:01:52 until 2014-05-05T18:12:05
DSHIP offline from 2014-05-12T19:34:58 until 2014-05-12T19:47:00
DSHIP offline from 2014-05-12T19:49:26 until 2014-05-13T09:01:29

Generalization

The master track is additionally generalized to receive a reduced set of the most significant positions of the track.

Input parameters:

Algorithm:	Ramer-Douglas-Peucker
Maximum tolerated distance between points and generalized line:	4 arcseconds

Results:

Number of generalized points:	683 points
Data reduction:	99.9392 %

Result files

Master track TXT file:

The format is a plain text file with one data row in 1 second interval.

Column separator:	Tab "\t"
Column 1:	Date/Time (UTC) in ISO 8601 format YYYY-MM-DDThh:mm:ss
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

TXT file of the generalized master track:

The format is a plain text file.

Column separator:	Tab "\t"
Column 1:	Date/Time (UTC) in ISO 8601 format YYYY-MM-DDThh:mm:ss
Column 2:	Latitude in decimal format, unit degree
Column 3:	Longitude in decimal format, unit degree

Master track data 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.

Cruise map

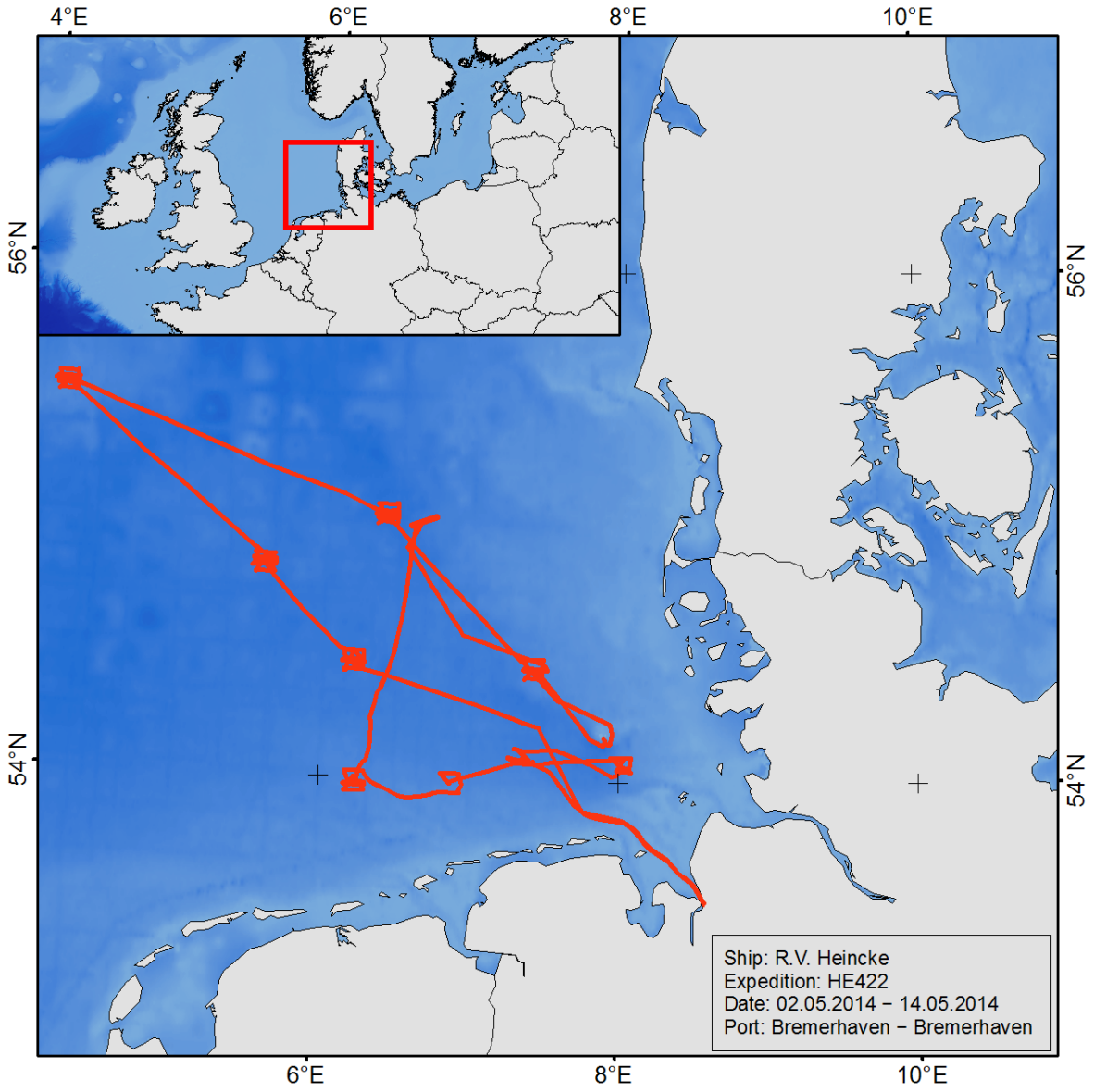

Figure 2: Map of the master track