Master Track RV Polarstern PS88
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 Po-larstern during expedition PS88 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 CSV files and imported to PANGAEA (www.pangaea.de) for publication.
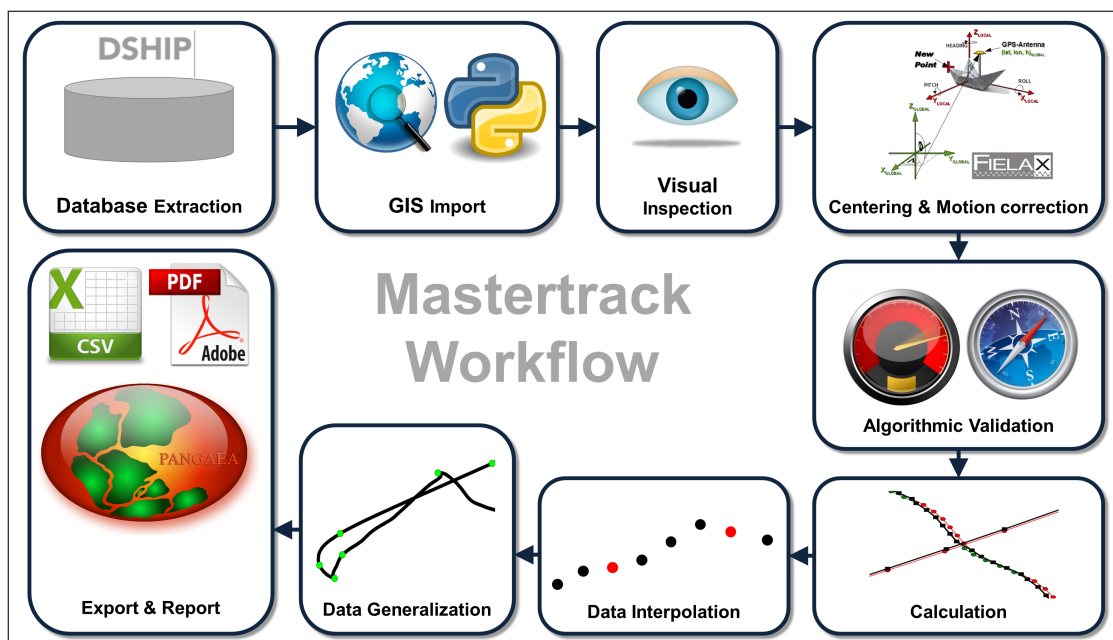

Figure 1: Workflow of master track data processing

3 Sensor Layout

This chapter describes the position sensors mounted during this cruise.

Cruise details

Vessel name:	RV Polarstern
Cruise name:	PS88
Cruise start:	25.10.2014 in Bremerhaven
Cruise end:	29.11.2014 in Cape Town
Cruise duration:	36 days
Master track reference point:	Resulting master track is referenced to *MINS installation point*.

Position sensors

Sensor name:	**Raytheon Anschuetz MINS2**, short: MINS
Description:	Marine inertial navigation system with reference positions from Trimble DGPS
Accuracy:	< 0.1 nm CEP
Installation point:	Gravimeter Room on F-Deck
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 SPS852 (1)**, short: Trimble 1
Description:	Modular GPS receiver for navigation purposes
Accuracy:	Horizontal: $\pm$ 0.25 m + 1 ppm RMS
	Vertical: $\pm$ 0.50 m + 1 ppm RMS
Installation point:	Mast (stbd)
Installation offset:	Offset from master track reference point to sensor installation point X Positive to bow 22.777 m Y Positive to starboard -5.460 m Z Positive upwards 21.525 m

Sensor name:	**Trimble SPS852 (2)**, short: Trimble 2
Description:	Modular GPS receiver for navigation purposes
Accuracy:	Horizontal: $\pm$ 0.25 m + 1 ppm RMS
	Vertical: $\pm$ 0.50 m + 1 ppm RMS
Installation point:	Mast (port)
Installation offset:	Offset from master track reference point to sensor installation point X Positive to bow 16.527 m Y Positive to starboard 12.408 m Z Positive upwards 21.538 m

Motion sensor

Sensor name:	**Raytheon Anschuetz MINS2**, short: MINS
Description:	Marine inertial navigation system with reference positions from Trimble DGPS
Accuracy:	Heading: < 3 arc min sec RMS, Pitch/Roll: < 1.4 arc min RMS
Installation point:	Gravimeter Room on F-Deck

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:	2989740
First dataset:	25.10.2014, 00:00:00 UTC
Last dataset:	29.11.2014, 23:59:59 UTC

Centering & Motion Compensation

Each position track has been centered to the *MINS 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 Raytheon Anschuetz MINS2.

Algorithmic Validation

Input parameters:

Maximum speed for data filter:	20 kn
Maximum acceleration offset for data filter:	1 m/s^2

Results:

MINS	11316	Speed > 20 kn
	12230	Acceleration difference between points > 1 m/s^2
Trimble 1	77	Speed > 20 kn
	677	Acceleration difference between points > 1 m/s^2
Trimble 2	131	Speed > 20 kn
	1706	Acceleration difference between points > 1 m/s^2

Master Track Generation

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

Sensor priority used:
1. MINS
2. Trimble 1
3. Trimble 2

Distribution of position sensor data in master track:

Sensor	Data points	Percentage
MINS	2985636	99.9 %
Trimble 1	4104	0.1 %
Trimble 2	0	0.0 %
Interpolated	0	0.0 %
Gaps	0	0.0 %

Bounding coordinates of the master track:

	Lat	Lon
NW	54.1945279	-24.2855159
NE	54.1945279	18.4372179
SE	-33.9112507	18.4372179
SW	-33.9112507	-24.2855159

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:	555 points
Data reduction:	99.9814 %

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

Master track data in XML format:

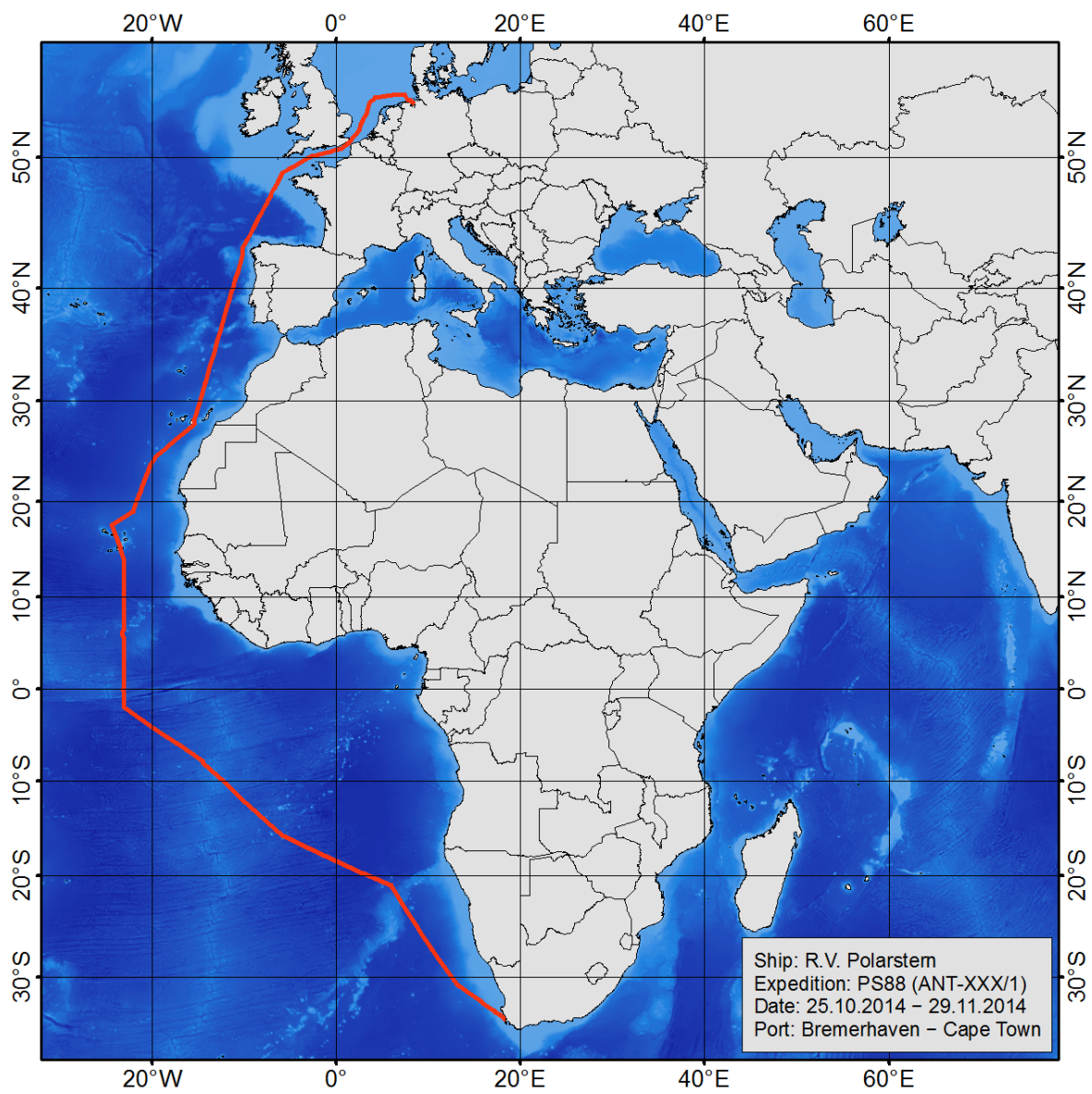The XML contains all information of the master track generation in a machine-readable format. In addition a XSD schema file is provided.

Cruise map

Figure 2: Map of the master track