Master Track RV Polarstern PS83
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: Polarstern-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

Ref.: PS83_nav.pdf	Vers.: 1	Date: 2014/05/13	Status: final

1 Introduction

This report describes the processing of raw data acquired by position sensors on board RV Polarstern during expedition PS83 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:	PS83
Cruise start:	08.03.2014 in Cape Town
Cruise end:	13.04.2014 in Bremerhaven
Cruise duration:	37 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: ± 0.25 m + 1 ppm RMS
	Vertical: ± 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:	3196800
First dataset:	08.03.2014, 00:00:00 UTC
Last dataset:	13.04.2014, 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

Results:

MINS	7280	Speed > 20 kn
	12552	Acceleration difference between points > 1 m/s
Trimble 1	460	Speed > 20 kn
	1309	Acceleration difference between points > 1 m/s
Trimble 2	121	Speed > 20 kn
	1101	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. MINS
2. Trimble 1
3. Trimble 2

Distribution of position sensor data in master track:

Sensor	Data points	Percentage
MINS	3193603	99.9 %
Trimble 1	3147	0.1 %
Trimble 2	0	0.0 %
Interpolated	50	0.0 %
Gaps	0	0.0 %

Bounding coordinates of the master track:

	Lat	Lon
NW	54.146275	-21.024604
NE	54.146275	18.437337
SE	-33.912639	18.437337
SW	-33.912639	-21.024604

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:	596 points
Data reduction:	99.9814 %

Result files

<u>Master track text file:</u>

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

<u>Text file of the generalized master track:</u>

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

<u>Master track data in XML format:</u>

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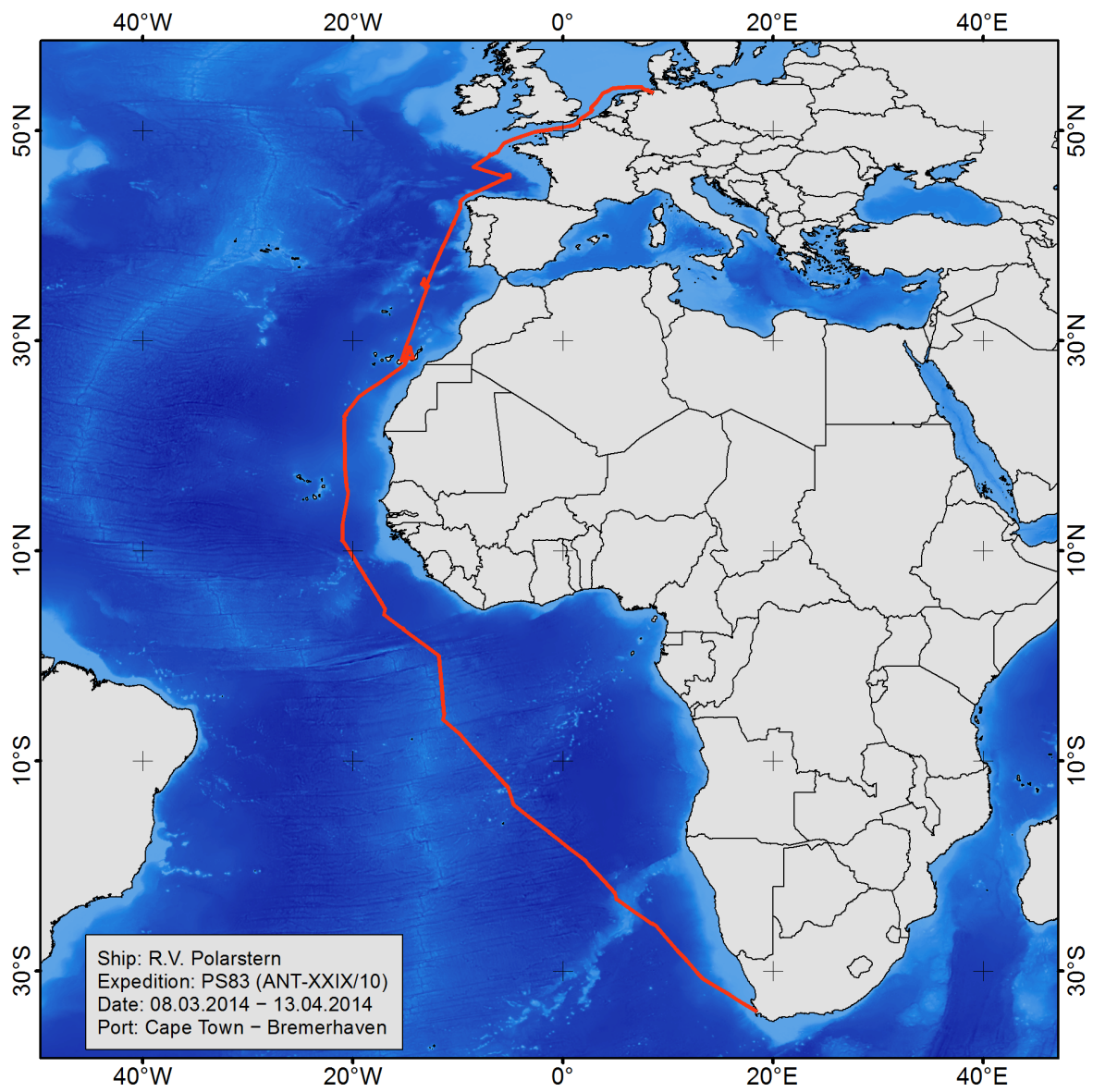
Cruise map

Figure 2: Map of the master track