Master Track RV Meteor M126

Data Processing Report

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1 Introduction

This report describes the processing of raw data acquired by position sensors on board RV Meteor during expedition M126 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.

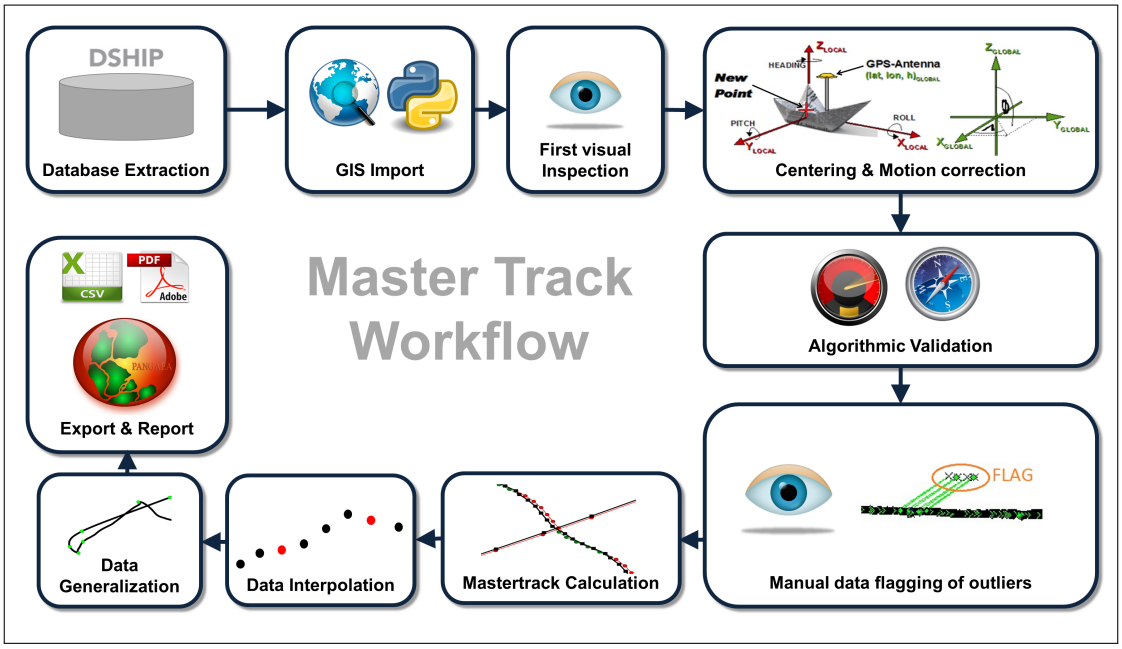

Figure 1: Workflow of master track data processing

3 Sensor Layout

This chapter describes the position sensors mounted during this cruise.

Cruise details

Vessel name	RV Meteor
Cruise name	M126
Cruise start	20.04.2016 Fortaleza
Cruise end	21.05.2016 Bridgetown
Cruise duration	32 days
Master track reference point:	Resulting master track is referenced to *MRU installation point*.

Position sensors

Sensor name	**C&C Technologies C-Nav 3050 (1)**, short: C-Nav 3050/1
Description	DGPS-Receiver, correction type DGPS RTCM 2.3 and 3.0, SBAS and C-Nav
Accuracy	Horizontal: ± 0.45 m + 3 ppm & Vertical: ± 0.90 m + 3 ppm
Installation point	Masttop (starboard)
Installation offset	Offset from master track reference point to sensor installation point X Positive to bow -4.807 m Y Positive to starboard -0.352 m Z Positive upwards 32.817 m

Sensor name	**C&C Technologies C-Nav 3050 (2)**, short: C-Nav 3050/2
Description	DGPS-Receiver, correction type DGPS RTCM 2.3 and 3.0, SBAS and C-Nav
Accuracy	Horizontal: ± 0.45 m + 3 ppm & Vertical: ± 0.90 m + 3 ppm
Installation point	Masttop (starboard)
Installation offset	Offset from master track reference point to sensor installation point X Positive to bow -5.998 m Y Positive to starboard -0.356 m Z Positive upwards 32.807 m

Motion sensor

Sensor name	**Kongsberg MRU 5**, short: MRU
Description	Motion Reference Unit
Accuracy	± 0.02° roll, ± 0.02° pitch, ± 0.02° heading
Installation point	Measurement and Hydroacoustic room

4 Processing Report

Database Extraction

Data source	DSHIP database (dship.awi.de)
Exported values	2511404
First dataset	2016-04-21T12:23:17 UTC
Last dataset	2016-05-20T14:00:00 UTC

Centering & Motion Compensation

Each position track has been centered to the *MRU 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 Kongsberg MRU 5.

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.

Flagging result

	C-Nav 3050/1		C-Nav 3050/2	
Missing	0	0.000%	7678	0.306%
Speed	12	0.000%	37	0.001%
Acceleration	394	0.016%	420	0.017%
Course	1356156	54.000%	1349272	53.726%
Manually	20	0.001%	31	0.001%

Master Track Generation

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

Sensor priority used:
1. C-Nav 3050/1
2. C-Nav 3050/2

Filters applied: manual, speed, acceleration.

Distribution of position sensor data in master track:

Sensor	Data points	Percentage
Total	2511404	100.000 %
C-Nav 3050/1	2505418	99.762 %
C-Nav 3050/2	332	0.013 %
Interpolated	163	0.006 %
Gaps	5491	0.219 %

Remarks

Data only available from 2016-04-21T12:23:17 UTC until 2016-05-20T14:00:00 UTC.

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	456 points
Data reduction	99.9818 %

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 2 — C-Nav 3050/1 3 — C-Nav 3050/2 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

Processing Report:

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Cruise map

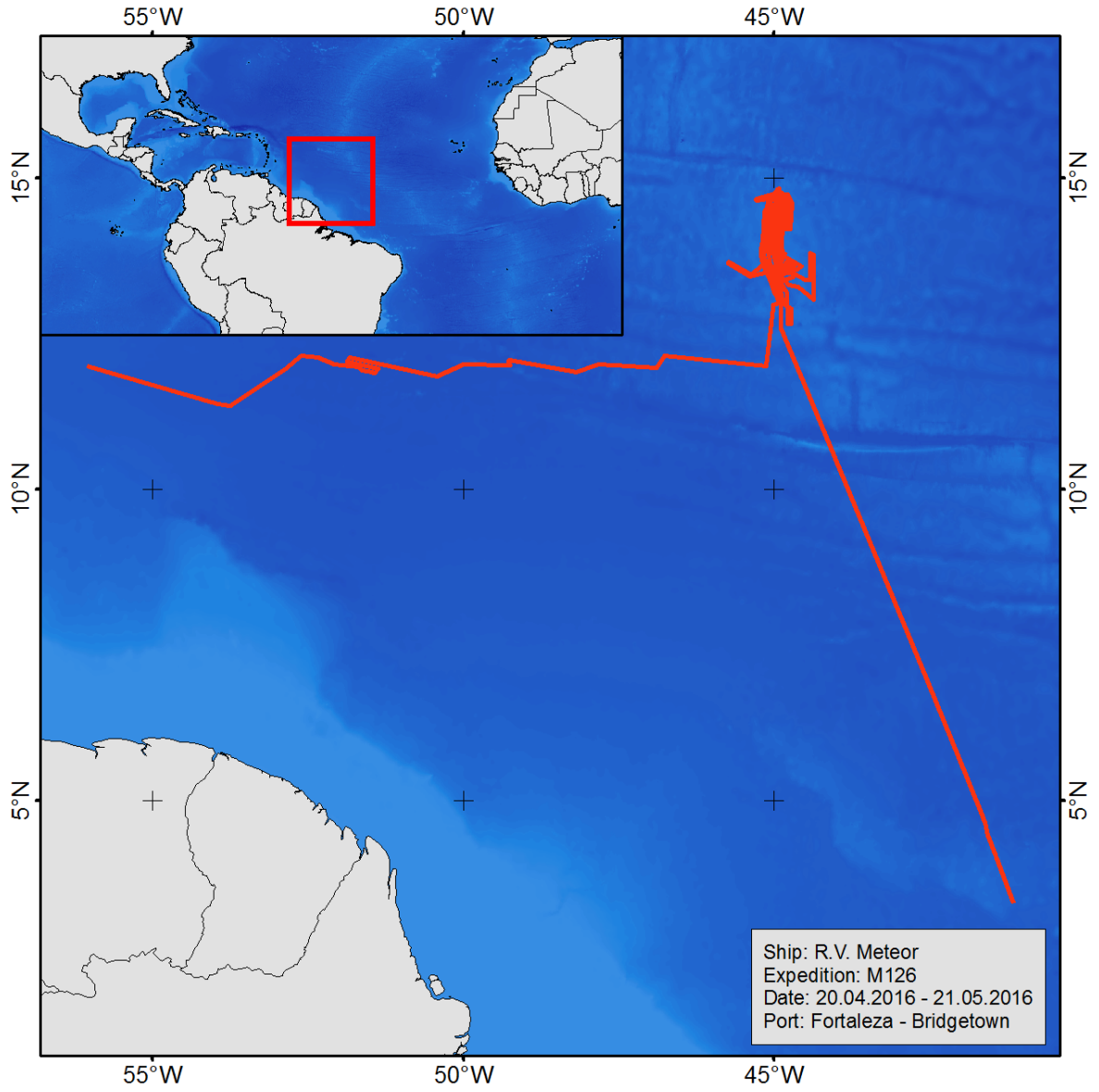

Figure 2: Map of the generalized master track