

# Master Track RV Polarstern PS111

## Data Processing Report

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Contact:

Dr. Rainer Knust  
Alfred-Wegener-Institute  
Am Handelshafen 12, D-27570 Bremerhaven, GERMANY  
Mail: [info@awi.de](mailto:info@awi.de)

Processing Agency:

FIELAX  
Schleusenstr. 14, D-27568 Bremerhaven, GERMANY  
Mail: [info@fielax.de](mailto:info@fielax.de)

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# 1 Introduction

This report describes the processing of raw data acquired by position sensors on board RV Polarstern during expedition PS111 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.

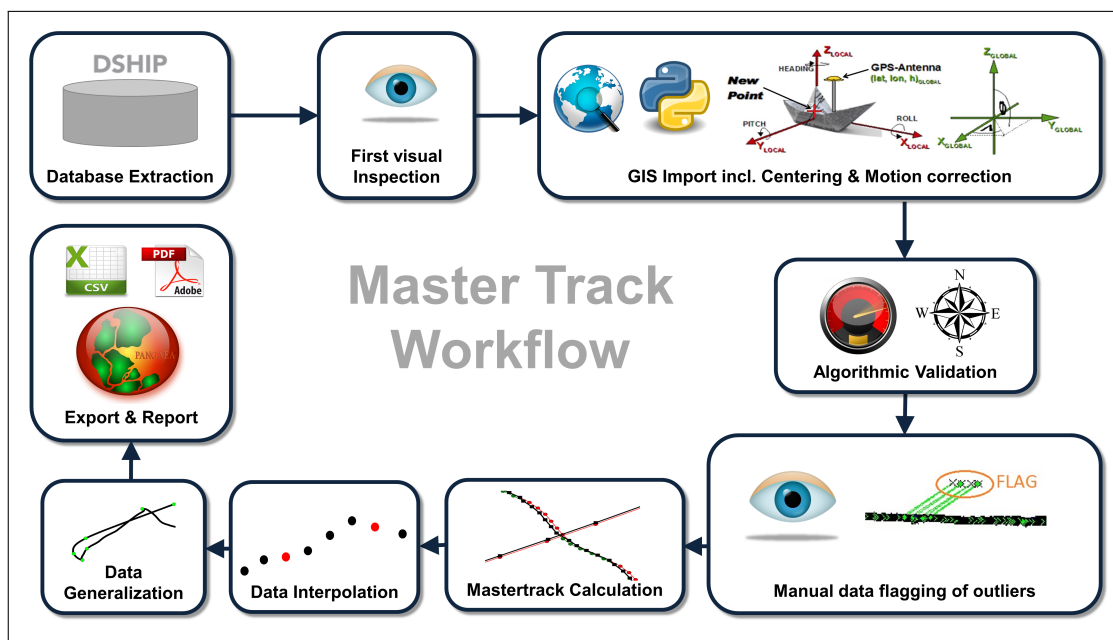


Figure 1: Workflow of master track data processing

### 3 Sensor Layout

This chapter describes the position sensors mounted during this cruise.

#### Cruise details according to Polarstern Cruise Report

<https://www.pangaea.de/expeditions/>

Vessel name	RV Polarstern
Cruise name	PS111
Cruise start	2018-01-19 Cape Town
Cruise end	2018-03-14 Punta Arenas
Cruise duration	55 days
Master track reference point:	Resulting master track is referenced to <i>HYDRINS installation point</i> .

#### Position sensors

Sensor name	<b>iXBlue HYDRINS hydrographic survey INS</b> , short: HYDRINS
Description	Marine inertial navigation system with reference positions from Trimble DGPS
Accuracy	No aiding for 1 min / 2 min: 0.8 m / 3.2 m (CEP 50)
Installation point	Gravimeter room on F-Deck, 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	<b>Trimble Marine SPS461 (1)</b> , short: Trimble 1
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	Observation deck (starboard)
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	<b>Trimble Marine SPS461 (2)</b> , short: Trimble 2
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	Observation deck (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	<b>iXBlue HYDRINS hydrographic survey INS</b> , short: HYDRINS
Description	Marine inertial navigation system with reference positions from Trimble DGPS
Accuracy	$\pm 0.01$ roll, $\pm 0.01$ pitch, $\pm 0.01$ heading (deg)
Installation point	Gravimeter room on F-Deck, close to COG

## 4 Processing Report

### Database Extraction

Data source	DSHIP database (dship.awi.de)
Exported values	4651199
First dataset	2018-01-19T12:00:01 UTC
Last dataset	2018-02-17T10:26:40 UTC

### Centering & Motion Compensation

Each position track has been centered to the *HYDRINS installation point* by applying the correspondent motion angles for heading, roll and pitch as well as the installation offsets from chapter 3. The motion data were acquired by iXBlue HYDRINS hydrographic survey INS.

### Automatic Validation

The following thresholds were applied for the automatic flagging of the position data:

Speed	Maximum 20 kn between two datapoints.
Acceleration	Maximum $1 \text{ m/s}^2$ between two datapoints.
Change of course	Maximum $5^\circ$ between two datapoints.

## Manual Validation

Obvious outliers were removed manually. For details see Processing Logbook of RV Polarstern (hdl:10013/epic.45909) .

## Flagging result

	HYDRINS		Trimble 1		Trimble 2	
Missing	1041	0.022%	163525	3.516%	174746	3.757%
Speed	56	0.001%	115242	2.478%	1266	0.027%
Acceleration	80	0.002%	152420	3.277%	7183	0.154%
Course	456473	9.814%	1176956	25.304%	630012	13.545%
Manually	0	0.000%	160821	3.458%	177	0.004%

## Master Track Generation

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

Sensor priority used:

1. HYDRINS
2. Trimble 2
3. Trimble 1

Filters applied: manual, speed, acceleration.

Distribution of position sensor data in master track:

Sensor	Data points	Percentage
Total	4651199	100.000 %
HYDRINS	4650102	99.980 %
Trimble 1	46	0.001 %
Trimble 2	34	0.001 %
Interpolated	166	0.004 %
Gaps	851	0.018 %

## Remarks

Trimble 1 had unstable data income during the second half of PS111.

## Score

For each cruise, a score is calculated ranging from 0 (no data) to 100 (only very good data). the score for the cruise PS111 is 98.

## 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	5549 points
Data reduction	99.8807 %

## 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 2	Latitude in decimal format, unit degree	
Column 3	Longitude in decimal format, unit degree	
Column 4	Flag for data source	
	1	HYDRINS
	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

Processing Report:

This PDF document.

### Cruise map

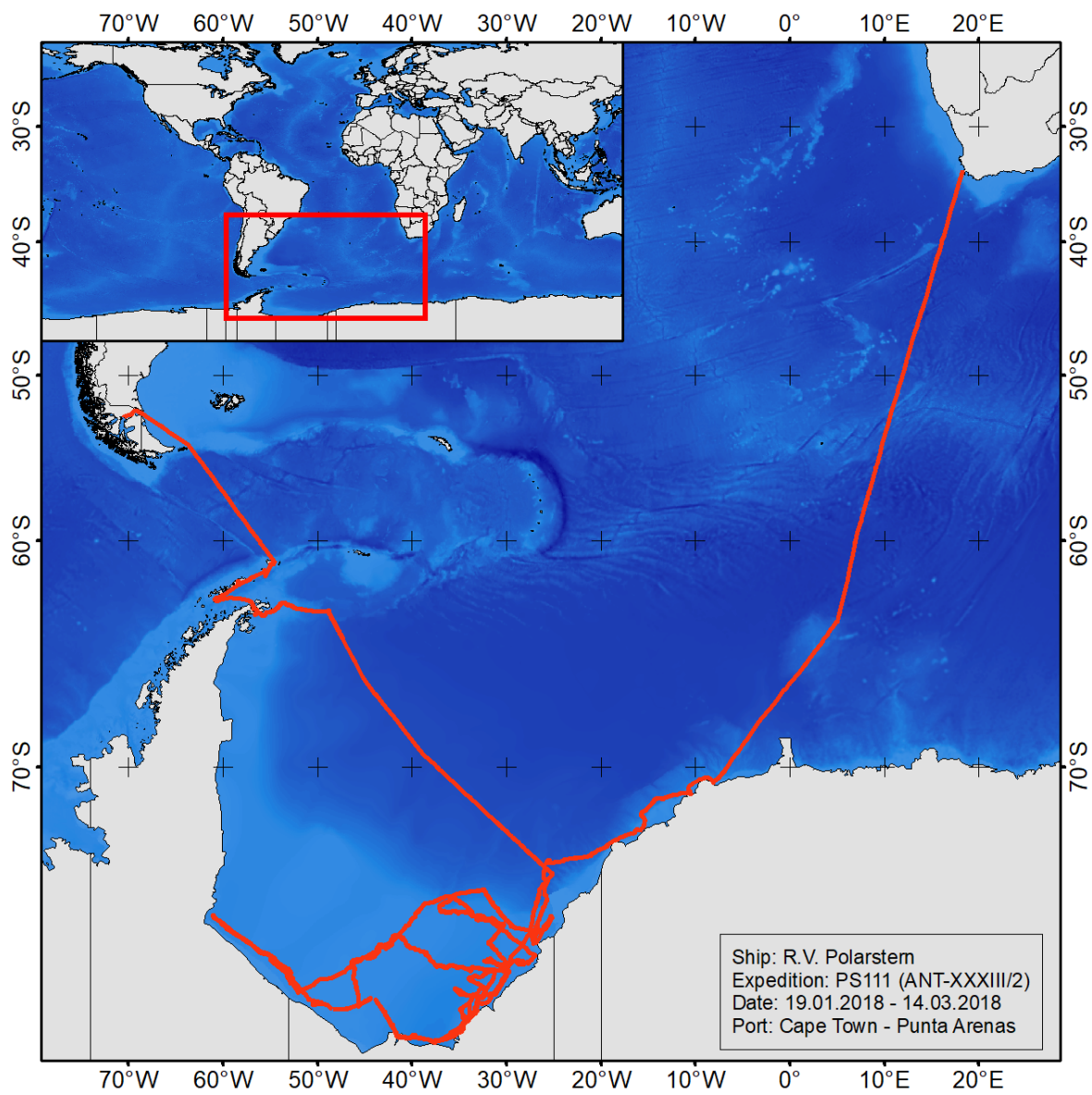


Figure 2: Map of the generalized master track