

# Master Track RV Polarstern PS104

## Data Processing Report

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|                     |          |                  |               |
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|---------------------|----------|------------------|---------------|

# 1 Introduction

This report describes the processing of raw data acquired by position sensors on board RV Polarstern during expedition PS104 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.

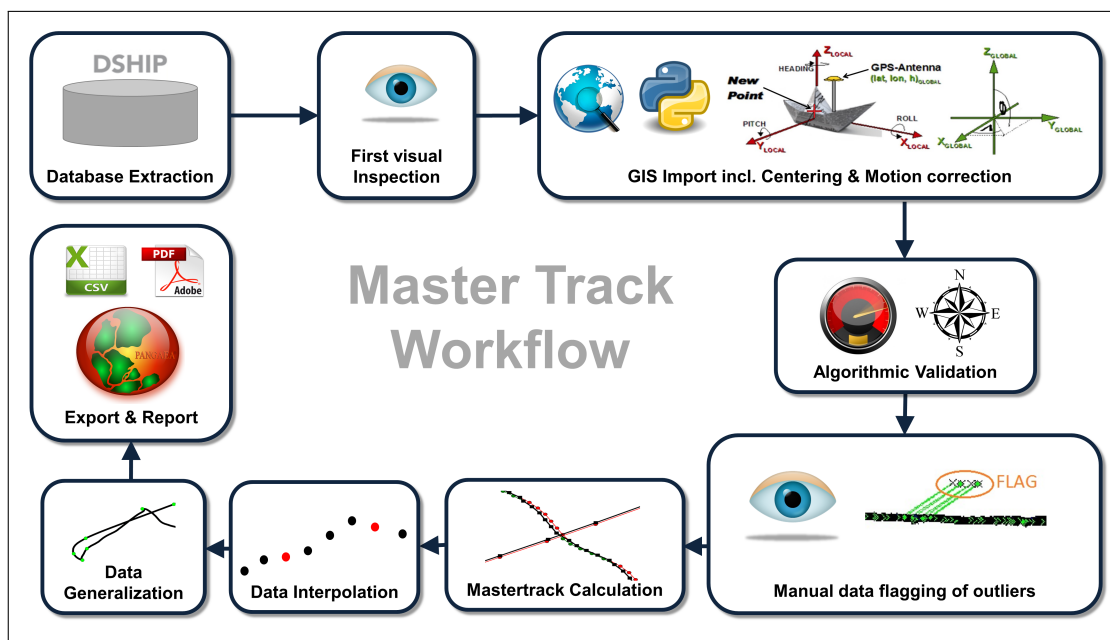


Figure 1: Workflow of master track data processing

### 3 Sensor Layout

This chapter describes the position sensors mounted during this cruise.

#### Cruise details

|                               |   |
|-------------------------------|---|
| Vessel name                   | RV Polarstern   |
| Cruise name                   | PS104   |
| Cruise start                  | 2017-02-05 Punta Arenas   |
| Cruise end                    | 2017-03-18 Punta Arenas   |
| Cruise duration               | 42 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<br>X Positive to bow 0.000 m<br>Y Positive to starboard 0.000 m<br>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<br>X Positive to bow 22.777 m<br>Y Positive to starboard -5.460 m<br>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<br>X Positive to bow 16.527 m<br>Y Positive to starboard 12.408 m<br>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 | 3628799                       |
| First dataset   | 2017-02-05T00:00:00 UTC       |
| Last dataset    | 2017-03-18T16:14:29 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      | 35271   | 0.972%  | 35397     | 0.975%  | 35575     | 0.980%  |
| Speed        | 30      | 0.001%  | 60        | 0.002%  | 974       | 0.027%  |
| Acceleration | 39      | 0.001%  | 4744      | 0.131%  | 2925      | 0.081%  |
| Course       | 760322  | 20.952% | 1169697   | 32.234% | 1183269   | 32.608% |
| Manually     | 0       | 0.000%  | 9         | 0.000%  | 5197      | 0.143%  |

## Master Track Generation

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

Sensor priority used:

1. Trimble 2
2. Trimble 1
3. HYDRINS

Filters applied: manual, speed, acceleration.

Distribution of position sensor data in master track:

| Sensor       | Data points | Percentage |
|--------------|-------------|------------|
| Total        | 3600870     | 99.230 %   |
| HYDRINS      | 103         | 0.003 %    |
| Trimble 1    | 8093        | 0.225 %    |
| Trimble 2    | 3585333     | 99.569 %   |
| Interpolated | 188         | 0.005 %    |
| Gaps         | 7153        | 0.199 %    |

## Remarks

Cruise starts on 2017-02-06 and data only available until 2017-03-18T16:14:29 UTC. Trimble 1 and Trimble 2 have been exchanged.

## Score

For each cruise, a score is calculated ranging from 0 (no data) to 100 (only very good data). the score for the cruise PS104 is 97.

## 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 | 2193 points |
| Data reduction               | 99.9391 %   |

## 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 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

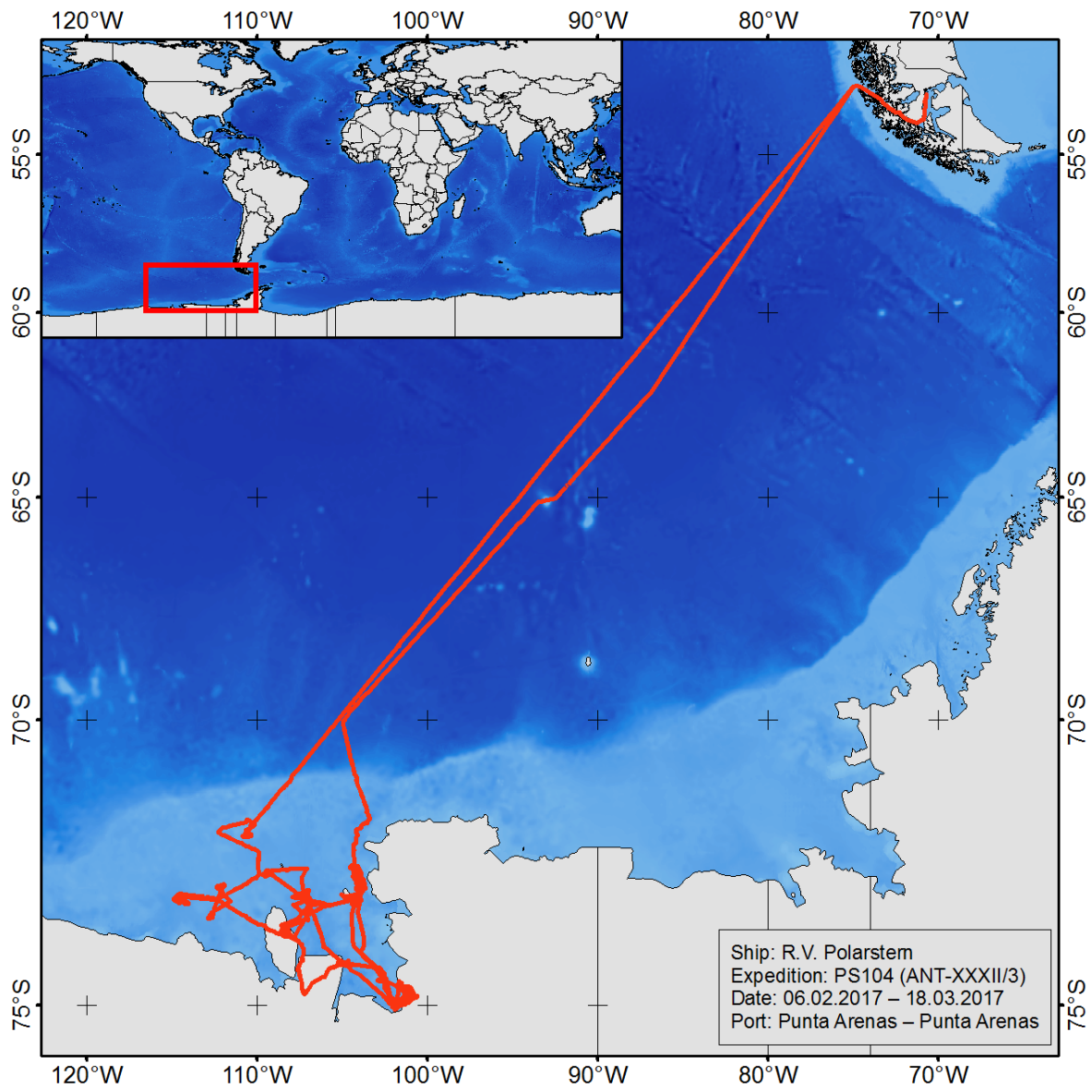


Figure 2: Map of the generalized master track