

# Master Track RV Heincke HE451.2

## Data Processing Report

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# 1 Introduction

This report describes the processing of raw data acquired by position sensors on board RV Heincke during expedition HE451.2 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.

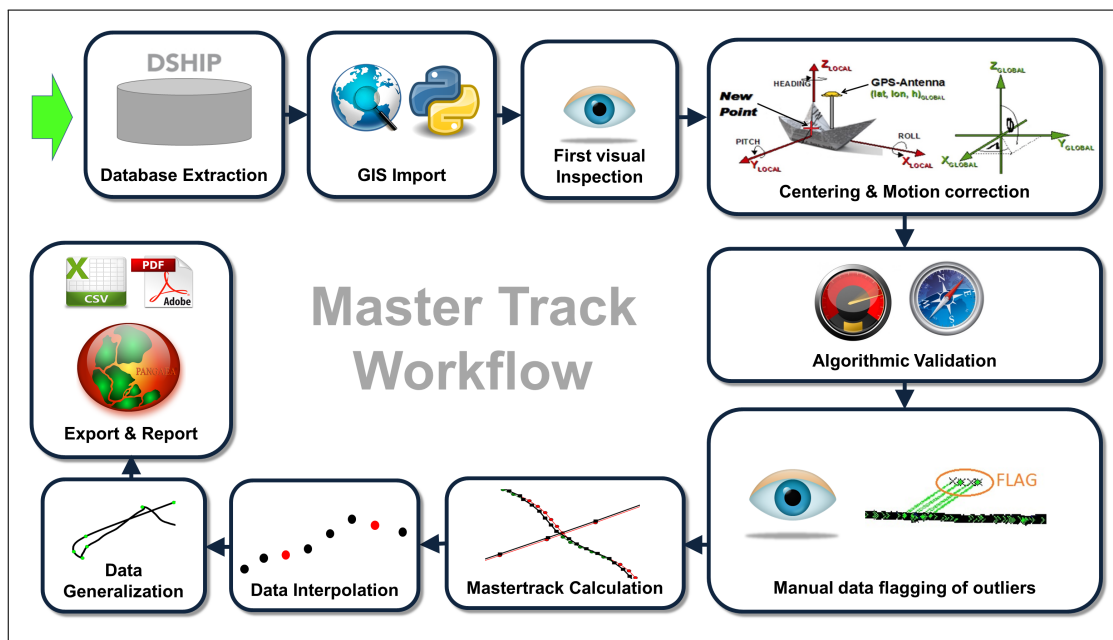


Figure 1: Workflow of master track data processing

### 3 Cruise details

|                               |   |
|-------------------------------|---|
| Vessel name                   | RV Heincke  |
| Cruise name                   | HE451.2   |
| Cruise start                  | 30.09.2015 Longyearbyen   |
| Cruise end                    | 12.10.2015 Bremerhaven  |
| Cruise duration               | 13 days   |
| Master track reference point: | Resulting master track is referenced to <i>PHINS installation point</i> . |

### 4 Sensor Layout

This chapter describes the position sensors mounted during this cruise.

#### Position sensors

|                     |   |
|---------------------|---|
| Sensor name         | <b>IXSEA PHINS III</b> , short: PHINS   |
| Description         | Inertial navigation system with reference positions from Trimble DGPS   |
| Accuracy            | ± 0.5-3.0 m   |
| Installation point  | Electrician's workshop, 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</b> , short: Trimble  |
| Description         | DGPS-Receiver, correction type DGPS RTCM 2.x, correction source DGPS Base via radio  |
| Accuracy            | Horizontal: ± 0.25 m + 1 ppm & Vertical: ± 0.50 m + 1 ppm  |
| Installation point  | Starboard railing above bridge deck  |
| Installation offset | Offset from master track reference point to sensor installation point<br>X Positive to bow 5.044 m<br>Y Positive to starboard 6.788 m<br>Z Positive upwards 11.489 m |

|                     |   |
|---------------------|---|
| Sensor name         | <b>SAAB R5 SUPREME NAV</b> , short: SAAB  |
| Description         | DGPS-Receiver, SBAS-correction with RTCM-104 input  |
| Accuracy            | GPS: ± 3.0 m; DGPS (2D RMS): ± 1.0 m  |
| Installation point  | Observational Deck, fore rail   |
| Installation offset | Offset from master track reference point to sensor installation point<br>X Positive to bow 12.985 m<br>Y Positive to starboard 2.958 m<br>Z Positive upwards 11.328 m |

## Motion sensor

|                    |   |
|--------------------|---|
| Sensor name        | IXSEA PHINS III, short: PHINS   |
| Description        | Inertial navigation system with reference positions from Trimble DGPS |
| Accuracy           | $\pm 0.01$ roll, $\pm 0.01$ pitch, $\pm 0.05$ heading (deg)           |
| Installation point | Electrician's workshop, close to COG                                  |

## 5 Processing Report

### Database Extraction

|                 |                               |
|-----------------|-------------------------------|
| Data source     | DSHIP database (dship.awi.de) |
| Exported values | 1123200                       |
| First dataset   | 2015-09-30T00:00:00 UTC       |
| Last dataset    | 2015-10-12T23:59:59 UTC       |

### Centering & Motion Compensation

Each position track has been centered to the *PHINS 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 IXSEA PHINS III.

### 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 "Heincke" (<hdl:10013/epic.45841>).

### Flagging result

|              | PHINS  |         | Trimble |         | SAAB   |         |
|--------------|--------|---------|---------|---------|--------|---------|
| Missing      | 19     | 0.002%  | 32      | 0.003%  | 19     | 0.002%  |
| Speed        | 2      | 0.000%  | 4       | 0.000%  | 2      | 0.000%  |
| Acceleration | 194873 | 17.350% | 9242    | 0.823%  | 8252   | 0.735%  |
| Course       | 168560 | 15.007% | 293287  | 26.112% | 288624 | 25.697% |
| Manually     | 0      | 0.000%  | 29      | 0.003%  | 0      | 0.000%  |

## Master Track Generation

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

Sensor priority used:

1. Trimble
2. PHINS
3. SAAB

Filters applied: manual, speed.

Distribution of position sensor data in master track:

| Sensor       | Data points | Percentage |
|--------------|-------------|------------|
| Total        | 1123200     | 100.000 %  |
| PHINS        | 6853        | 0.610 %    |
| Trimble      | 1113900     | 99.172 %   |
| SAAB         | 2098        | 0.187 %    |
| Interpolated | 349         | 0.031 %    |
| Gaps         | 0           | 0.000 %    |

## Remarks

None.

## Score

For each cruise, a score is calculated ranging from 0 (no data) to 100 (only very good data). the score for the cruise HE451.2 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 | 575 points |
| Data reduction               | 99.9488 %  |

## 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                          |                    |
|                  | 1   | PHINS              |
|                  | 2   | Trimble            |
|                  | 3   | SAAB               |
|                  | 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

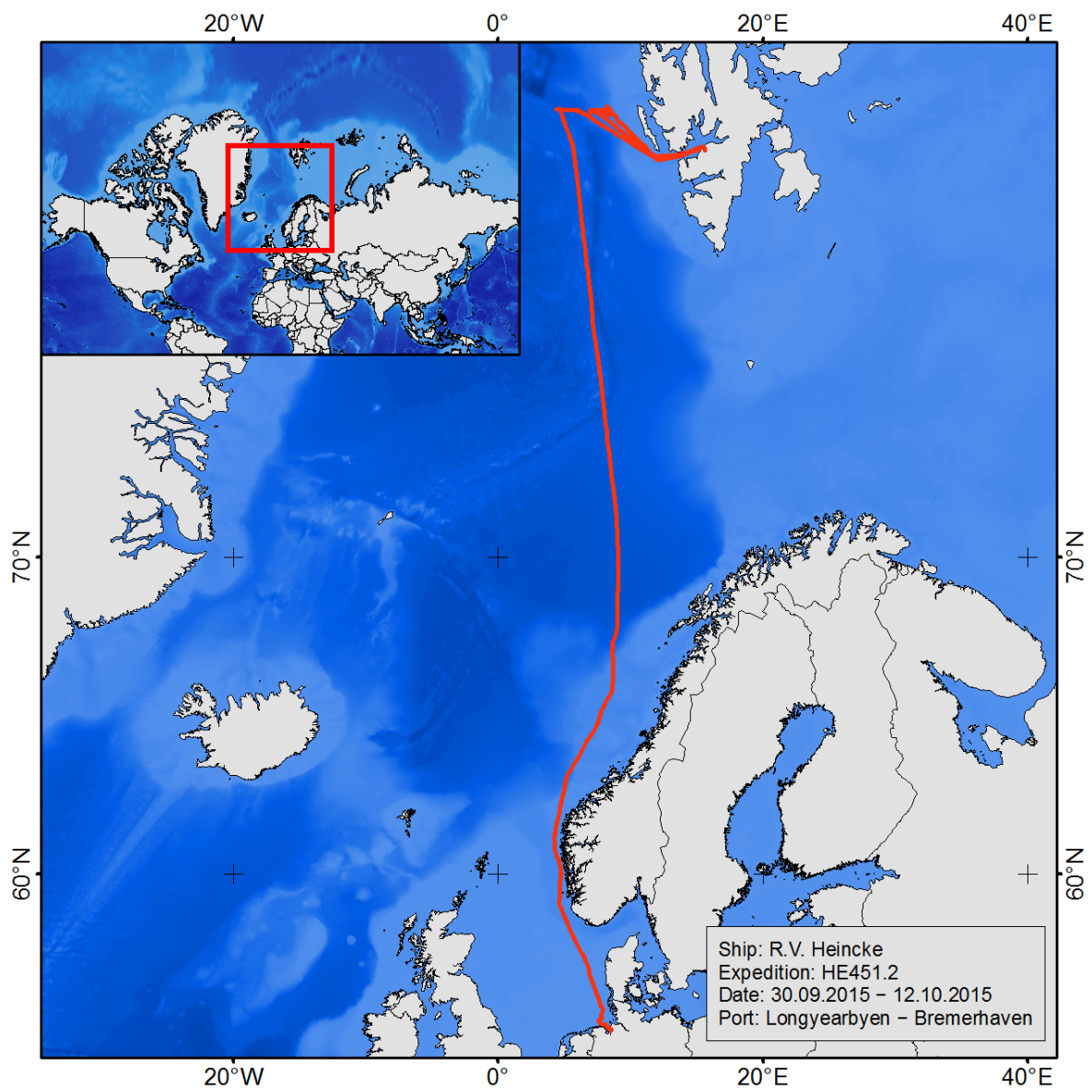


Figure 2: Map of the generalized master track