

# Master Track RV Heincke HE319

## 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 HE319 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 Heincke  |
| Cruise name                   | HE319   |
| Cruise start                  | 04.03.2010 Bremerhaven  |
| Cruise end                    | 11.03.2010 Bremerhaven  |
| Cruise duration               | 8 days  |
| Master track reference point: | Resulting master track is referenced to <i>PHINS installation point</i> . |

#### 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  | Masttop   |
| Installation offset | Offset from master track reference point to sensor installation point<br>X Positive to bow 5.298 m<br>Y Positive to starboard -0.034 m<br>Z Positive upwards 22.297 m |

|                     |   |
|---------------------|---|
| Sensor name         | <b>DEBEG/Leica MX400</b> , short: DEBEG   |
| Description         | GPS-Receiver for navigation purposes  |
| Accuracy            | ± 7-15 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                                  |

## 4 Processing Report

### Database Extraction

|                 |                               |
|-----------------|-------------------------------|
| Data source     | DSHIP database (dship.awi.de) |
| Exported values | 691141                        |
| First dataset   | 2010-03-04T00:00:00 UTC       |
| Last dataset    | 2010-03-11T23:59:00 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 |         | DEBEG  |         |
|--------------|--------|---------|---------|---------|--------|---------|
| Missing      | 228    | 0.033%  | 16079   | 2.326%  | 468    | 0.068%  |
| Speed        | 256    | 0.037%  | 33821   | 4.894%  | 1014   | 0.147%  |
| Acceleration | 91669  | 13.263% | 39725   | 5.748%  | 14661  | 2.121%  |
| Course       | 120098 | 17.377% | 291574  | 42.187% | 234042 | 33.863% |
| Manually     | 0      | 0.000%  | 2017    | 0.292%  | 30     | 0.004%  |

## Master Track Generation

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

Sensor priority used:

1. PHINS
2. DEBEG
3. Trimble

Filters applied: manual, speed.

Distribution of position sensor data in master track:

| Sensor       | Data points | Percentage |
|--------------|-------------|------------|
| Total        | 691141      | 100.000 %  |
| PHINS        | 690766      | 99.946 %   |
| Trimble      | 250         | 0.036 %    |
| DEBEG        | 69          | 0.010 %    |
| Interpolated | 56          | 0.008 %    |
| 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 HE319 is 96.

## 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 | 361 points |
| Data reduction               | 99.9478 %  |

## 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   | DEBEG              |
|                  | 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

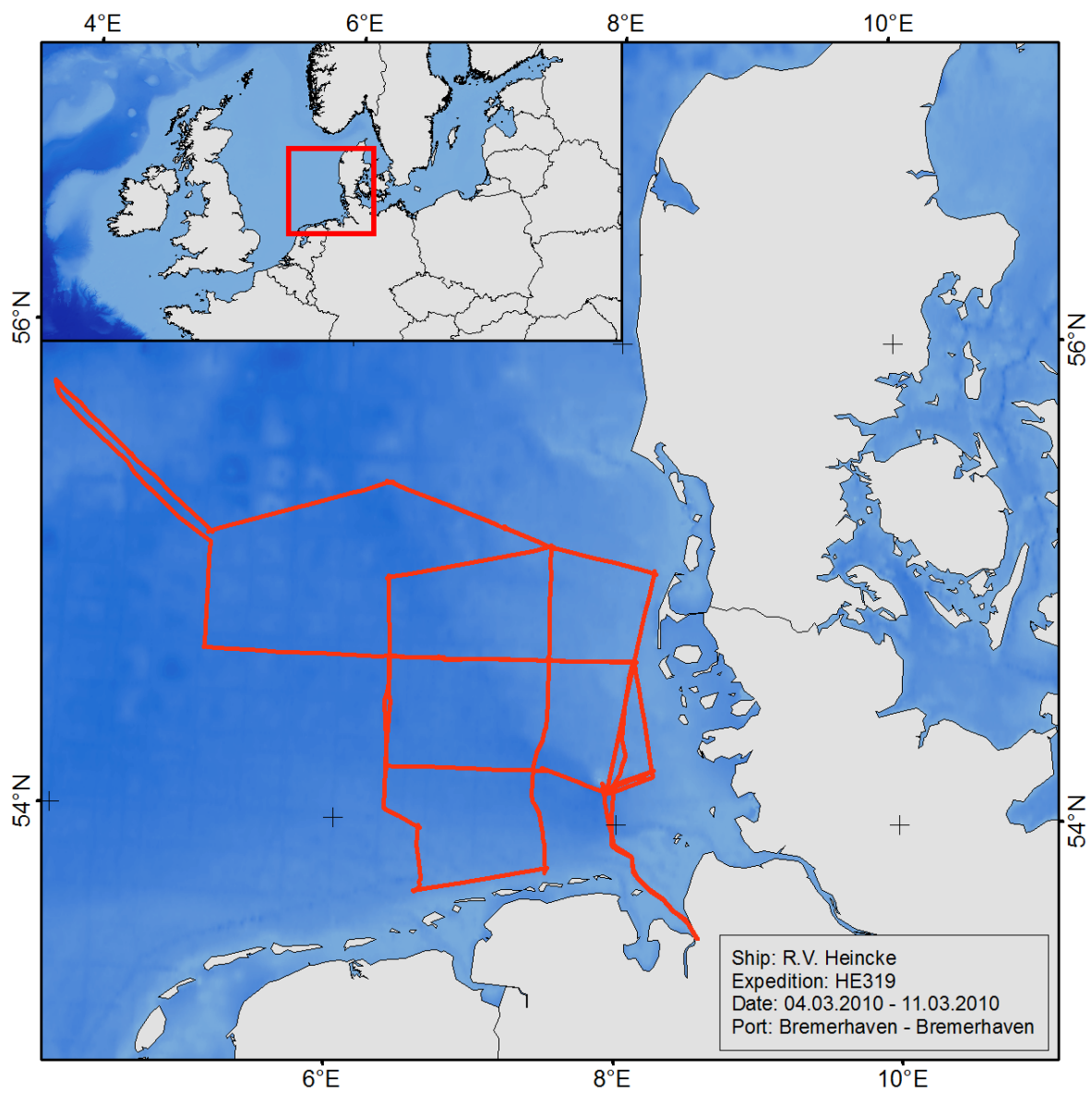


Figure 2: Map of the generalized master track