Precise point positioning of a surveying vessel in the Baltic Sea

H. Blechschmied, P. Neumaier, W. Söhne, J. Dostal, and K. Binder*
The FAMOS project

- Finalising Surveys for the Baltic Motorways of the Sea (FAMOS)
The FAMOS project

© by NormanEinstein, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=810328
The FAMOS project

- Finalising Surveys for the Baltic Motorways of the Sea (FAMOS)
- Baltic Sea
  - 9 adjoining countries
  - Highly frequented motorways
  - Sea floor not fully mapped to modern standards
- 7 countries (15 partners) participating to FAMOS project (lead by Sweden)
The FAMOS project

© FAMOS Odin, proposal number 26603257, Part D Annex 2 v2.0
The FAMOS project

- FAMOS Odin consists of
  - Hydrographic surveying and chart production (Activity 1)
  - Improving vessel navigation for the future (Activity 2)
    - Shipborne gravimetry measurements and processing, maintenance of databases, geoid computations
    - Shipborne GNSS for precision navigation and geoid evaluation at sea
    - Change of chart datum in some countries (homogenisation of datums)
  - Surveying infrastructure (Activity 3)
  - Data workflow from sounding to bridge (Activity 4)
The FAMOS project

- FAMOS Odin consists of
  - Hydrographic surveying and chart production (Activity 1)
  - Improving vessel navigation for the future (Activity 2)
    - Shipborne gravimetry measurements and processing, maintenance of databases, geoid computations
    - Shipborne GNSS for precision navigation and geoid evaluation at sea
    - Change of chart datum in some countries (homogenisation of datums)
  - Surveying infrastructure (Activity 3)
  - Data workflow from sounding to bridge (Activity 4)
The FAMOS project – sub-activity 2.4

- Vermessungs- und Forschungsschiff „Deneb“ of „Bundesamt für Seeschifffahrt und Hydrographie“ (BSH)
- This year’s campaign 31.07. – 09.08.2018
The FAMOS project – sub-activity 2.4
The FAMOS project – sub-activity 2.4
The FAMOS project – sub-activity „GNSS“

- Equipment onboard, data and software used
  - Various receivers onboard, e.g. Alberding A10 receiver, JAVAD
  - SAPOS (German Positioning Service, RTK)
  - BNC (BKG) used with various clock & orbit correction streams
  - RTNet (GPS Solutions Inc., used as server as well as client)
  - PPPWizzard (CNES)
  - CSRS PPP Service (NRCan)
Results – SAPOS

A10 SAPOS results

<table>
<thead>
<tr>
<th>Color</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>RTK fixed</td>
</tr>
<tr>
<td>Yellow</td>
<td>RTK float</td>
</tr>
<tr>
<td>Blue</td>
<td>DGPS</td>
</tr>
<tr>
<td>Red</td>
<td>SPP</td>
</tr>
</tbody>
</table>
Results – SAPOS

SAPOS stations

Denmark
Sweden
Poland
Results – SAPOS, BNC and RTNet Client

Ellipsoidal height

- SAPOS
- BNC with CLK11
- BNC with CLK93

RTNet client on vessel
Results – SAPOS, BNC and RTNet Client

Ellipsoidal height

[03/Aug/2018:12:19:15] [Source died] connected for 2 days, 3 hours, 30 minutes and 11 seconds on mountpoint [/CLK93]
Results – SAPOS, BNC and NRCan

![Diagram showing height variation over time for SAPOS-DREF91, BNC-CLK93, and NRCan PPP.]
Results – Differences

BNC CLK11_DREF91 minus A10 SAPOS fixed

BNC CLK93 minus A10 SAPOS fixed
Results – Differences

BNC CLK11_DREF91 minus NRCan PPP

BNC CLK93 minus NRCan PPP
Conclusions

- Relevance to the IGS work program: IGS RTS
  - Usage of IGS broadcasters and broadcaster technology
  - Usage of IGS RTS (individual) products

- Results
  - Use of IGS RTS correction streams for positioning a vessel possible on dm level
  - Use of CLK93 shows the best results (stability, availability, accuracy)
  - Agreement of NRCan PPP vs. SAPOS RTK fixed was very good
Conclusions

- Available data
  - BNC raw data containing A10BKG, RTCM3EPH, CLK11, CLK11_DREF91, CLKF01, CLKF01D, CLK93
  - A10 15' high-rate RINEX v2 files (GPS+GLO)
  - A10 SAPOS NMEA files
  - RTNet NMEA files and log files
  - PPPWizard raw data (few days)
  - JAVAD raw data

- Recommendation to the IGS
  - More and stable IGS RTS correction streams needed, in particular GPS+GLO

- To be done
  - Look into the horizontal positioning
Thank you for your kind attention!

Contact:
Federal Agency for Cartography and Geodesy
Section G2
Richard-Strauss-Allee 11
60598 Frankfurt, Germany

contact person
Dr. rer. nat. Jan Dostal
G2@bkg.bund.de
www.bkg.bund.de
Tel. +49 (0) 69 6333-496