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to the challenges of modern world"
FIG WORKING WEEK
17–21 MAY SOFIA BULGARIA 2015
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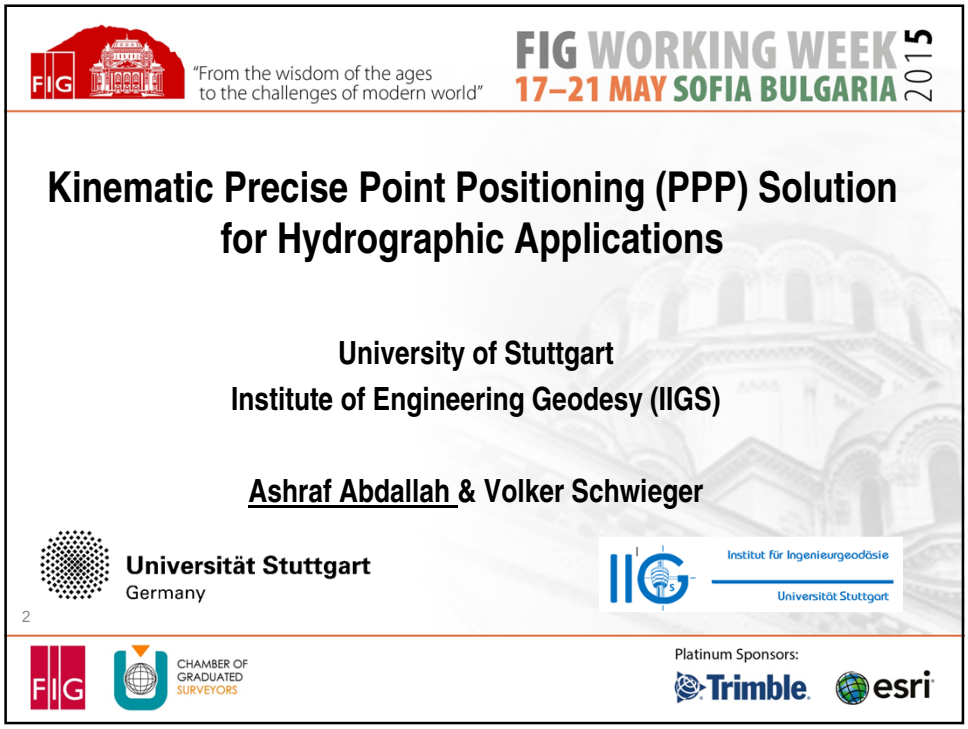
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FIG WORKING WEEK
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Kinematic Precise Point Positioning (PPP) Solution
for Hydrographic Applications
University of Stuttgart
Institute of Engineering Geodesy (IIGS)
Ashraf Abdallah & Volker Schwieger
Universität Stuttgart
Germany
Institut für Ingenieurgeodäsie
Universität Stuttgart
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Structure

1. MOTIVATION
2. DGNSS vs. PPP
3. PROCESSING PROCEDURE
4. DATA ACQUSITION
5. RESULTS AND ANALYSIS
6. CONCLUSIONS

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1. MOTIVATION

- Investigate the accuracy of kinematic PPP solution for the hydrographic applications for the Rivers.
- Prove the ability of Bernese software for PPP estimation in kinematic mode.

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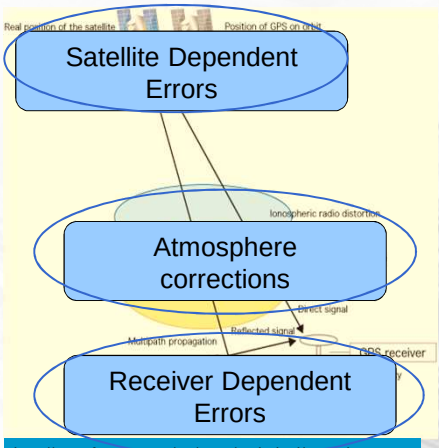
2. DGNSS vs. PPP

- Satellite clocks and orbits
- Satellite antenna phase centre
- Satellite phase wind up
- Ionosphere error
- Troposphere error
- Receiver clocks
- Receiver antenna phase centre
- atmosphere tidal loading & ocean tidal effects.



http://www.furuno.com/en/gnss/technical/tec_what_gps2

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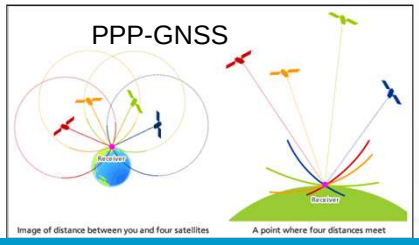
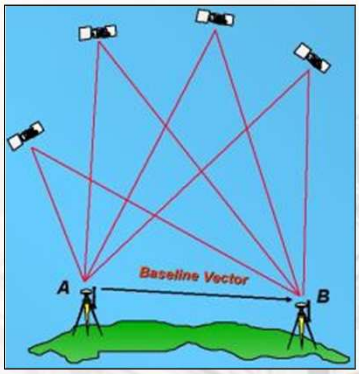
2. DGNSS vs. PPP

PPP-GNSS



http://global.jaxa.jp/countdown/f18/overview/gps_e.html

- Using of only one GNSS receiver for positioning,
- Based on the ionosphere-free linear combination,
- Higher order ionospheric terms is recommended for precise applications,
- The ambiguity is no longer an integer (float solution), constant as long as no loss of lock in carrier phase,



http://www.accuratemapssurvey.com/gps.htm

Differential GNSS

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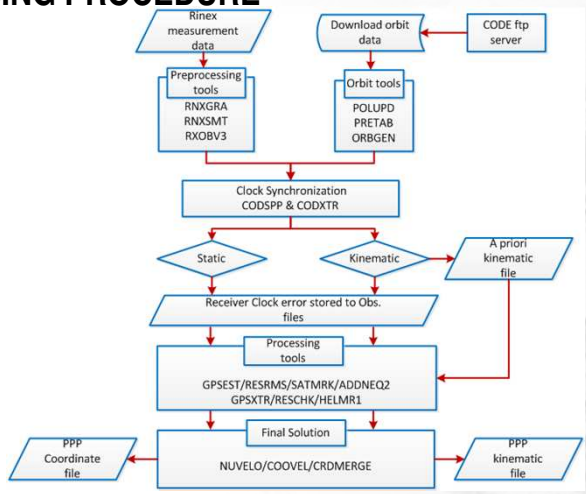
3. PROCESSING PROCEDURE

Bernese Software General Processing flowchart



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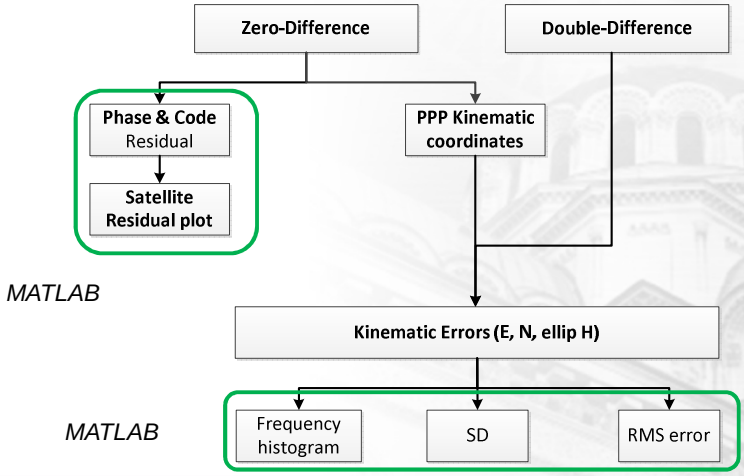
3. PROCESSING PROCEDURE



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4. DATA ACQUSITION

- Two kinematic trajectories on the Rhine River, Duisburg, Germany,
- GNSS antenna on the surveying vessel,
- Virtual SAPOS reference station.

Data set	Year/DOY	Start time			End time		
		hh	mm	ss	hh	mm	ss
First trajectory	2014/126	06	54	50	10	10	05
Second trajectory	2014/127	06	14	20	11	34	30

Photo by: Annette Scheider (IIGS)

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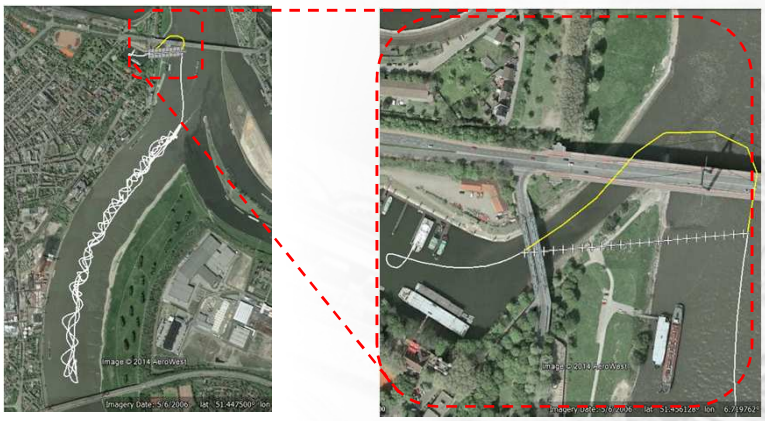

Layout of the first trajectory [DOY: 2014/126] © Google Earth

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4. DATA ACQUSITION

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Layout of the second trajectory, © Google Earth [DOY: 127/2014]

5. RESULTS AND ANALYSIS

General processing parameters

Parameter	Model	
Satellite system	GPS	
Coordinate format	XYZ/LLh	
Satellite clock	CODE/5 sec	
Geodetic datum	ITRF2008	
A priori troposphere model	Dry	GMF/GPT
	Wet	GMF/GPT
	Mapping Function	GMF
	Troposphere gradient	No
Ionospheric model	Linear ionospheric free combination Higher order parameters	
Satellite phase centre offsets	PCV.I08 (IGS08 format)	
Receiver phase centre offsets	PCV.I08 (IGS08 format)	
Tidal correction	IERS CONVENTIONS 2000	
Nutation model	IAU2000R06	
Sub daily pole model	IERS2010	
Ocean tidal loading	FES2004 model	
Atmosphere tidal loading	Ray and Ponte 2003 model based on ITRS 2010	
Elevation angle	10°	
Sampling interval	5 seconds	

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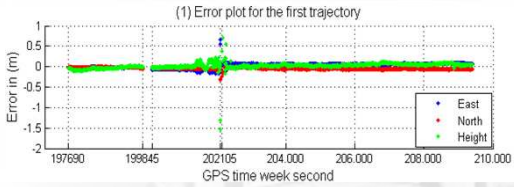
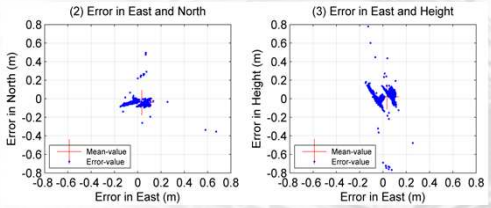
5. RESULTS AND ANALYSIS

	East [m]	North [m]	height [m]
Max.	0.65	0.015	0.713
Mean	0.022	-0.043	0.021
Min.	-0.163	-0.330	-1.152
RMS	0.064	0.047	0.071
SD	0.060	0.021	0.068
$SD_{95\%}$	0.050	0.012	0.050





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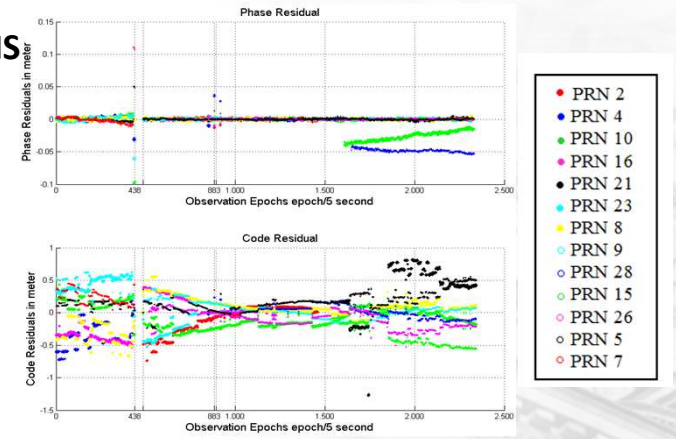

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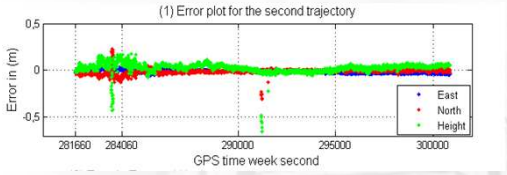
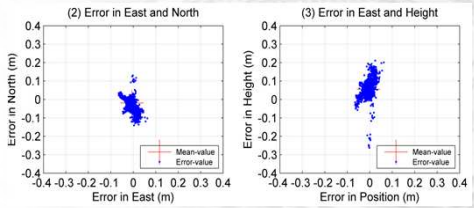
5. RESULTS AND ANALYSIS

	East [m]	North [m]	height [m]
Max.	0.064	0.228	0.180
Mean	-0.012	-0.012	0.026
Min.	-0.064	-0.307	-0.655
RMS	0.021	0.029	0.056
SD	0.017	0.026	0.049
$SD_{95\%}$	0.015	0.015	0.030





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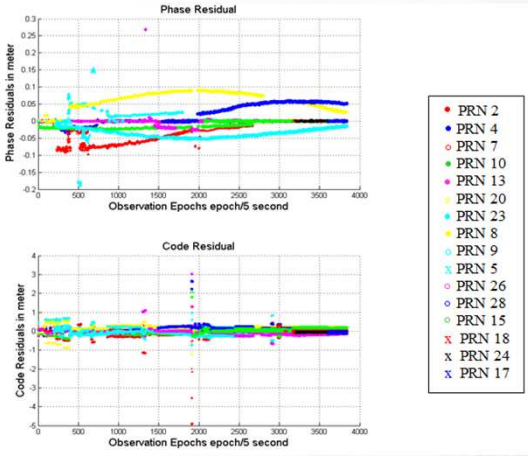
5. RESULTS AND ANALYSIS



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6. CONCLUSIONS

- Main goal of the study to invistigate the kinematic PPP solution for hydrographic applications.
- First trajectory:
  - RMS 6.4 cm, 4.7 cm, 7.1 cm for East, North, Height.
  - $SD_{95\%}$ 5 cm, 1.2 cm, 5 cm for East, North, Height.
- Second trajectory:
  - RMS 2.1cm, 2.9 cm, 5.6 cm for East, North, Height.
  - $SD_{95\%}$ 1.5 cm, 1.5 cm, 3 cm for East, North, Height.

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Thank you for your Attention!

☺ Your Feedback ☺

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