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## Geodetic measurements on Svalbard during Scientific Expedition Organized by the Warsaw University of Technology, Faculty of Geodesy and Cartography



Andrzej Pachuta, Janusz Walo, Marek Woźniak,  
Artur Adamek, Marcin Rajner, Dominik Próchniewicz,  
Zbigniew Malinowski, Kinga Wężka

**FIG Working Week 2008**  
**Stockholm, 14-19 June 2008**

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## Kazimierz Czarnecki 1939 - 2006



- President of the Association of Polish Surveyors
- Chairman of FIG Commission 2 „Professional Education and Literature”
- Dean of the Faculty of Geodesy and Cartography of the Warsaw University of Technology
- Professor of the Military University of Technology
- Initiator of the Polish students organization of geodesy

2

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## Association of Polish Surveyors Stowarzyszenie Geodetów Polskich (SGP)



- History of the first Polish surveyors organization starts in 1919
- SGP was established in 1953
- President – Krzysztof Cisek
- SGP is the biggest organization of Polish surveyors
- SGP is a member of FIG
- SGP consists of many committees, one of them is the Committee of Polar Research

3

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## The localization of HORNSUND



4

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## History of WUT's researches on the Spitsbergen

- 1988 – the first expedition from Warsaw University of Technology (2 supervisors, 4 students) – leader A. Pachuta
- 2002 – prof. Kazimierz Czarnecki – president of the Association of Polish Surveyors was the initiator of foundation of the „Club of Geodesy and Cartography Students” from all Polish Universities
- 2002 – 2003 the elaborating of programme of students scientific expedition to Spitsbergen
- 2003 – the organization of an expedition (12 students from the Club with leader A. Adamek from WUT); dr Z. Kurczynski as supervisor
- 2004 – the second Expedition – leader M. Woźniak
- 2005 – the 3rd Expedition – leader J. Walo
- 2006 – the 4th Expedition – leader A. Pachuta

5

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## HANS GLACIER



- Hansbreen is a grounded tidewater glacier, which flows into the Hornsund fjord in the Southern Spitsbergen near the Polish Polar Station.
- The glacier is about 16 km long and covers the area of 57 km<sup>2</sup>.
- The glacier tongue is 2.5 to 4 km wide and terminates as a 1.5 km long calving front.
- The lateral parts of the front are based on land.
- The glacier extends from 600 m above the sea level.
- The maximum ice thickness is about 400 m.
- Hansbreen retreats with an average rate of 17 meters per year during the last 70 years.
- It is one of better tested and monitored arctic glaciers.
- The World Glacier Monitoring Service have included the Hans glacier into its database and it is currently explored.

6

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# HANS GLACIER



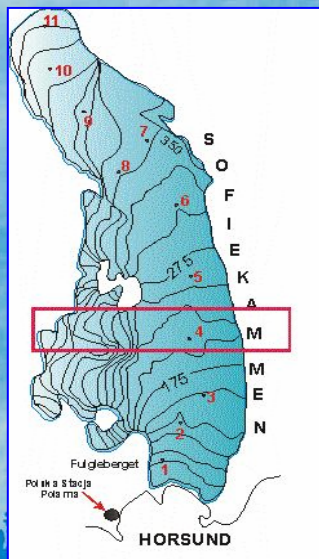
7

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15,5°E

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## Monitoring of thickness and movements of the Hans glacier surface in Spitsbergen by using GPS-RTK technology (2005-2006) – 1/2



8

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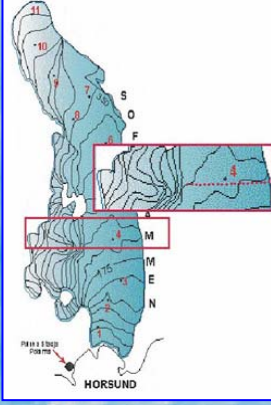

### Longitudinal Profiles

- Until 2004 measurements were conducted with classical surveying methods, using Leica TCR1100 electronic tachimeter.
- Measurements included only 5 poles placed in the front part of the glacier.
- The basis of these observations was the base stabilized on the slope of Fuglebert Mountain. Accuracy of determining the poles fluctuated about 3-5 centimeters.
- Position of the remaining points (6-11) were determined with tourist GPS receiver.
- Frequency of all the conducted observations depended in the great extent on the weather conditions and the season of the year.

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**Monitoring of thickness and movements of the Hans glacier surface in Spitsbergen by using GPS-RTK technology (2005-2006) – 2/2**

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**Lateral profile**

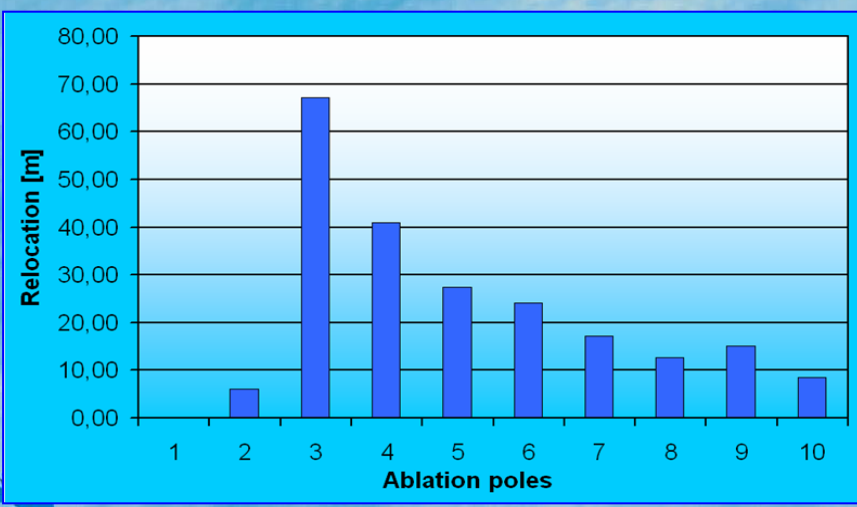
- Lateral profile set up near the 4th ablation pole allows to monitor miscellaneous movements of glacier along this profile.
- In 2005 the profile consisted of 20 measuring marks placed in distance of 125 m, in 2006 they consists of 18 measuring marks away 150 m from each other. It is placed 1 m deep in ice for better stabilization.
- Points have been measured using Rapid Static as well as GPS RTK technologies.
- Results of observations using both methods are similar (with 1-2 cm difference in positioning).

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**Horizontal vector of relocation of ablation poles placed in Hans Glacier (September, 2005 - August, 2006)**

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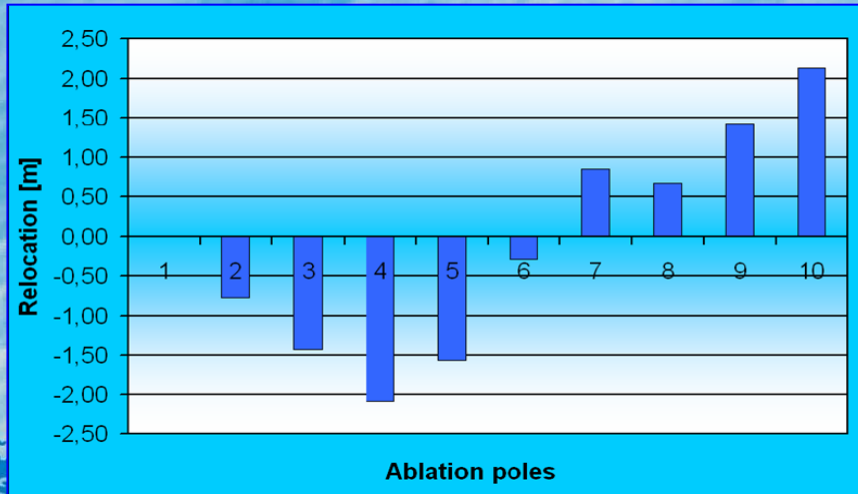
Ablation pole	Relocation [m]
1	0,00
2	5,00
3	68,00
4	41,00
5	28,00
6	24,00
7	18,00
8	13,00
9	15,00
10	9,00

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15,5°E

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### Vertical vector of relocation of ablation poles placed in HANS glacier September, 2005 - August, 2006)



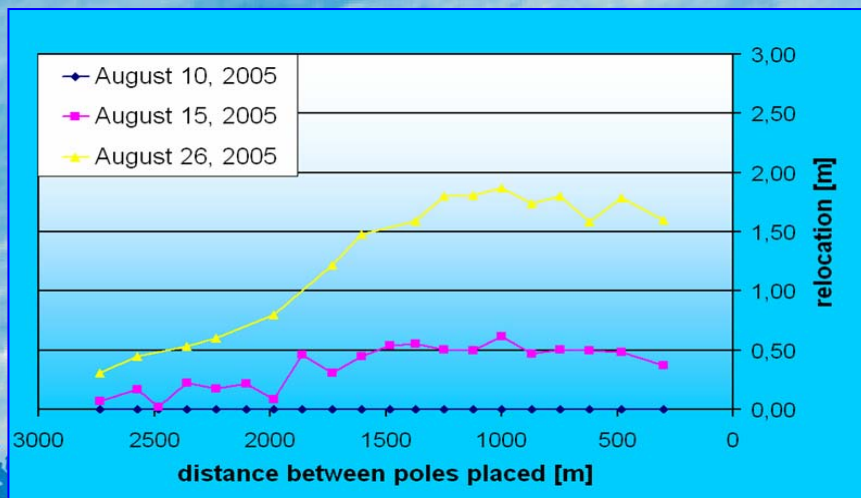
11

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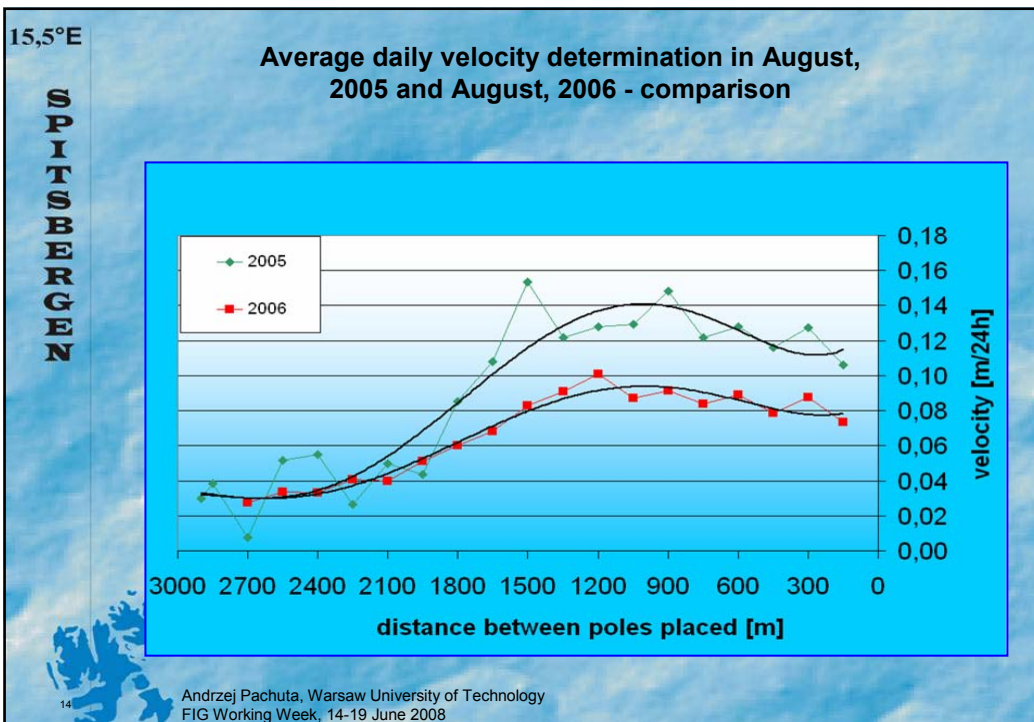
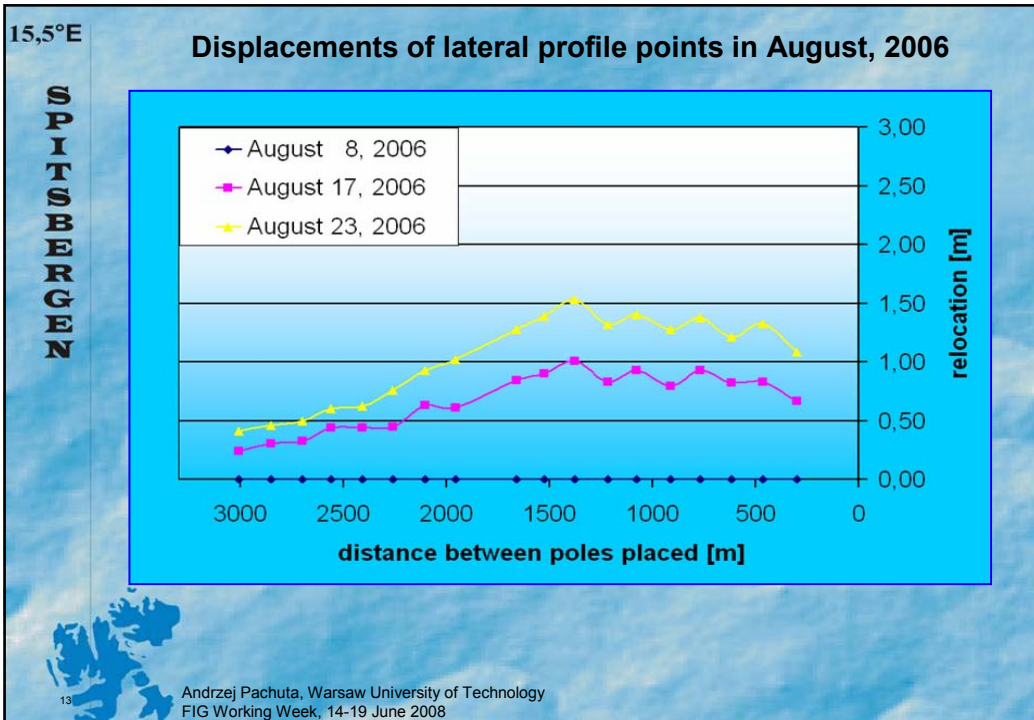
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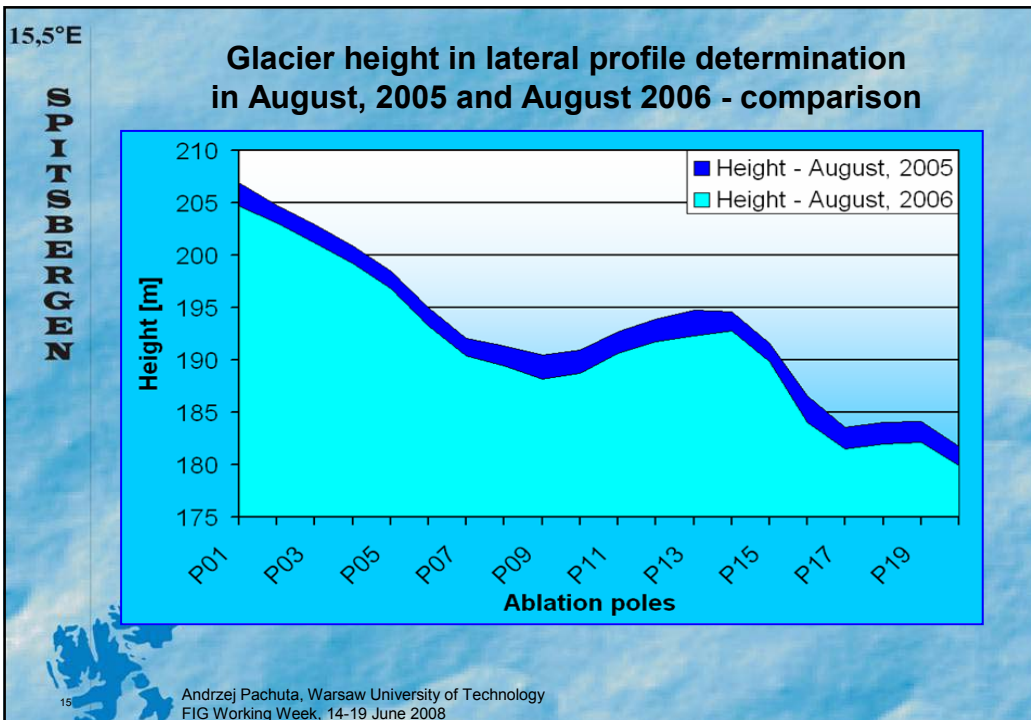
### Displacements of lateral profile points in August, 2005



12

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### Summary of monitoring of thickness and movements of the Hans Glacier

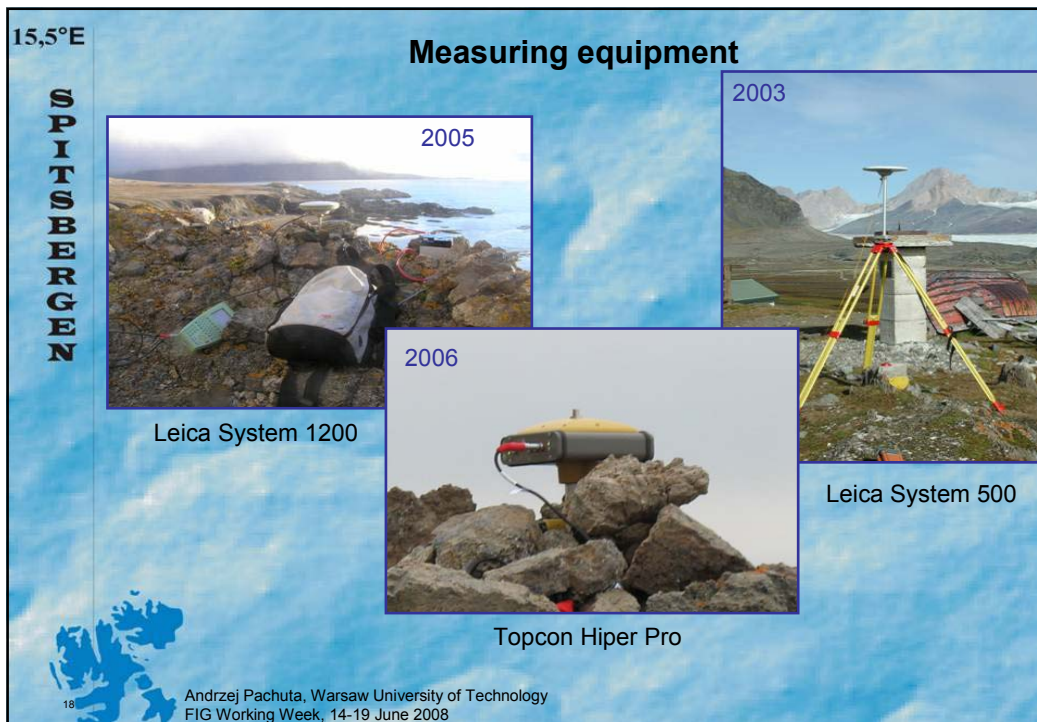
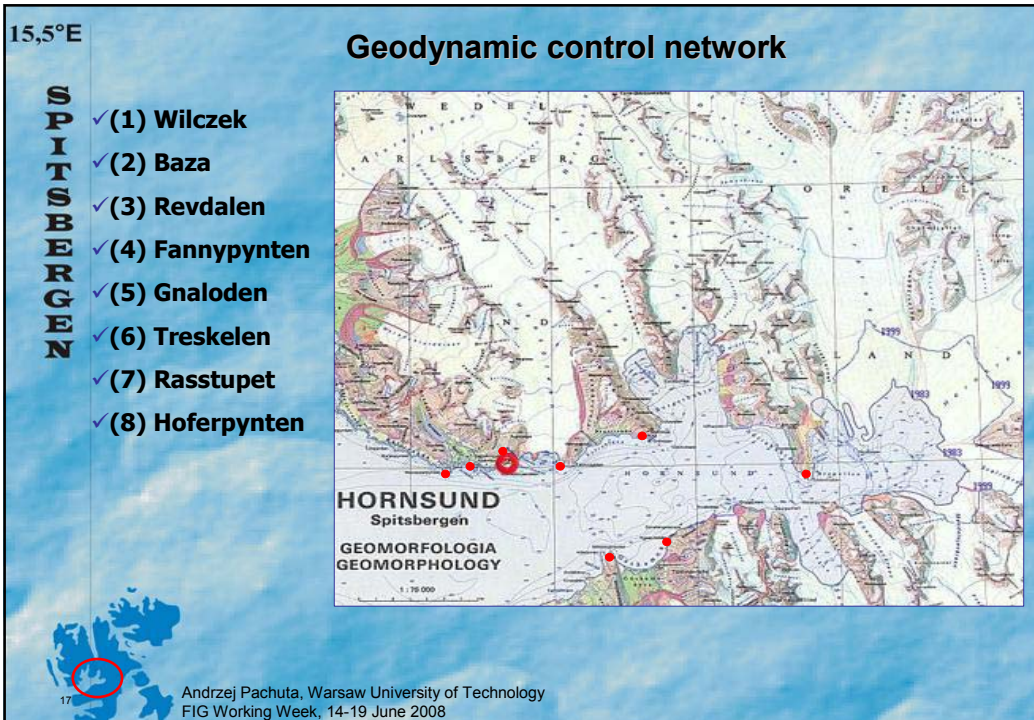
As a result of conducted experiments, following statements concerning research of glacier's movement may be defined:

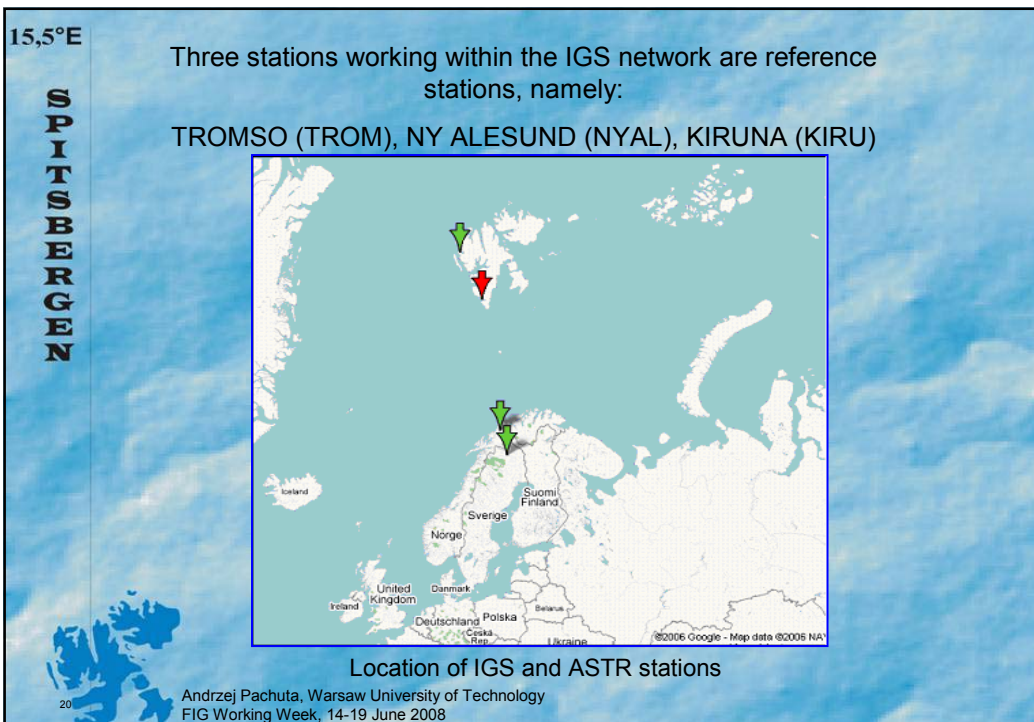
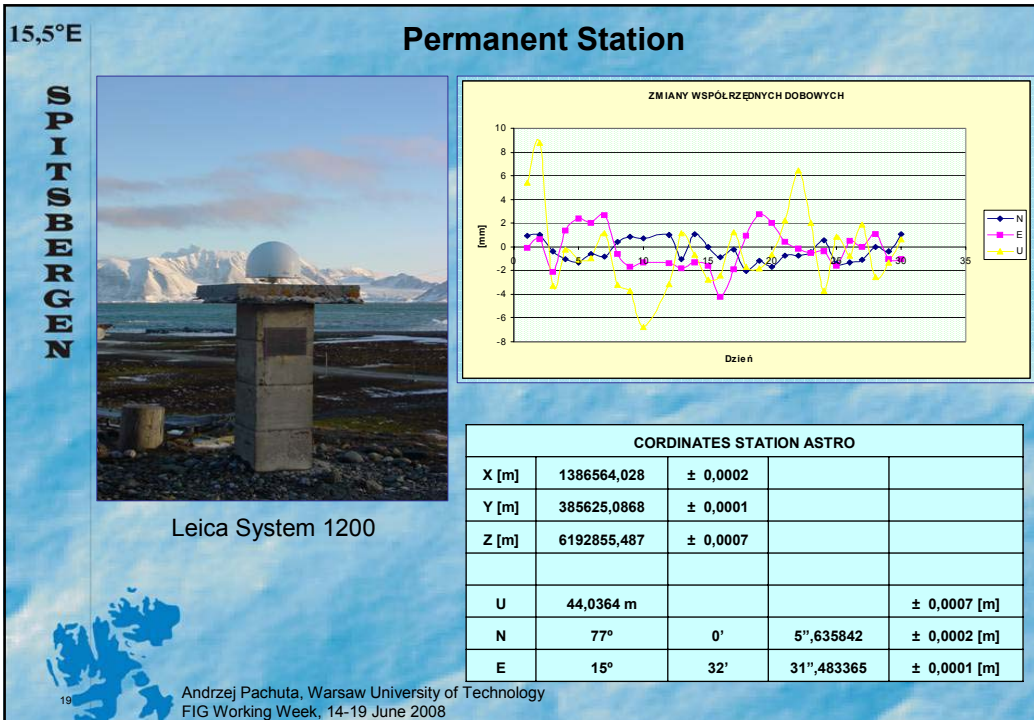
- Horizontal movement of the points of lateral profile indicates object's higher velocity in it's eastern part.
- Average melting speed of the glacier during measurements was 3 centimetres a day.
- Measurements analysis of longitudinal profile indicate that the researched object shows the greatest dynamic in the surrounding of the ablation pole nr 4.
- GPS RTK is suggested for pole movement determination. In case of real-time corrections limited availability (i.e. screening by mountains) using Rapid Static is a good choice.

16

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### Controlling of vertical movements of the fuel tanks foundations

- Positions of benchmarks on the foundations of fuel tanks.
- The height of the benchmarks was determined with the method of leveling of high precision.
- The first measurements were conducted in 2004
- Network will be connected to the base benchmark nearby the main building of the station.
- The movements were not greater than 2 cm but had the same value on all points (according to reference points)

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### Hansbreen – photogrammetric method of determination of ice displacement

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15,5°E

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Thank you for your attention



23

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