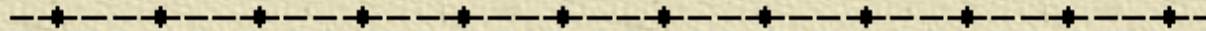


# Preparations for Galileo in Poland and in some other new EU members



*Janusz B. Zieliński*

Space Research Centre, Polish Academy of Sciences,  
Warsaw

Naval University, Gdynia

Poland



# Outline of the presentation

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- ✦ Overview of the Galileo works in Poland
  - a. EGNOS-RIMS in Warsaw
  - b. Time scale and transfer
  - c. ESTB campaign
  - d. Maritime applications
  - e. Agriculture applications
- ✦ Activity of the Galileo Info Point, Poland
- ✦ Cooperation with other countries of the Central Europe

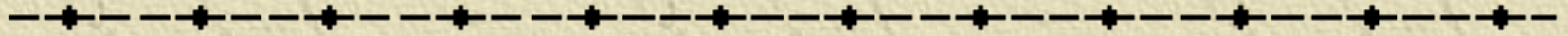


# GALILEO - flagship project of EU

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- ✦ First EU continental technical infrastructure
- ✦ Development and management of the complex space system
- ✦ New legal structure
- ✦ European answer for GPS
- ✦ Integration of the aero-space industry
- ✦ Private Public Partnership
- ✦ Space technology for the society
- ✦ **We can contribute to GALILEO**

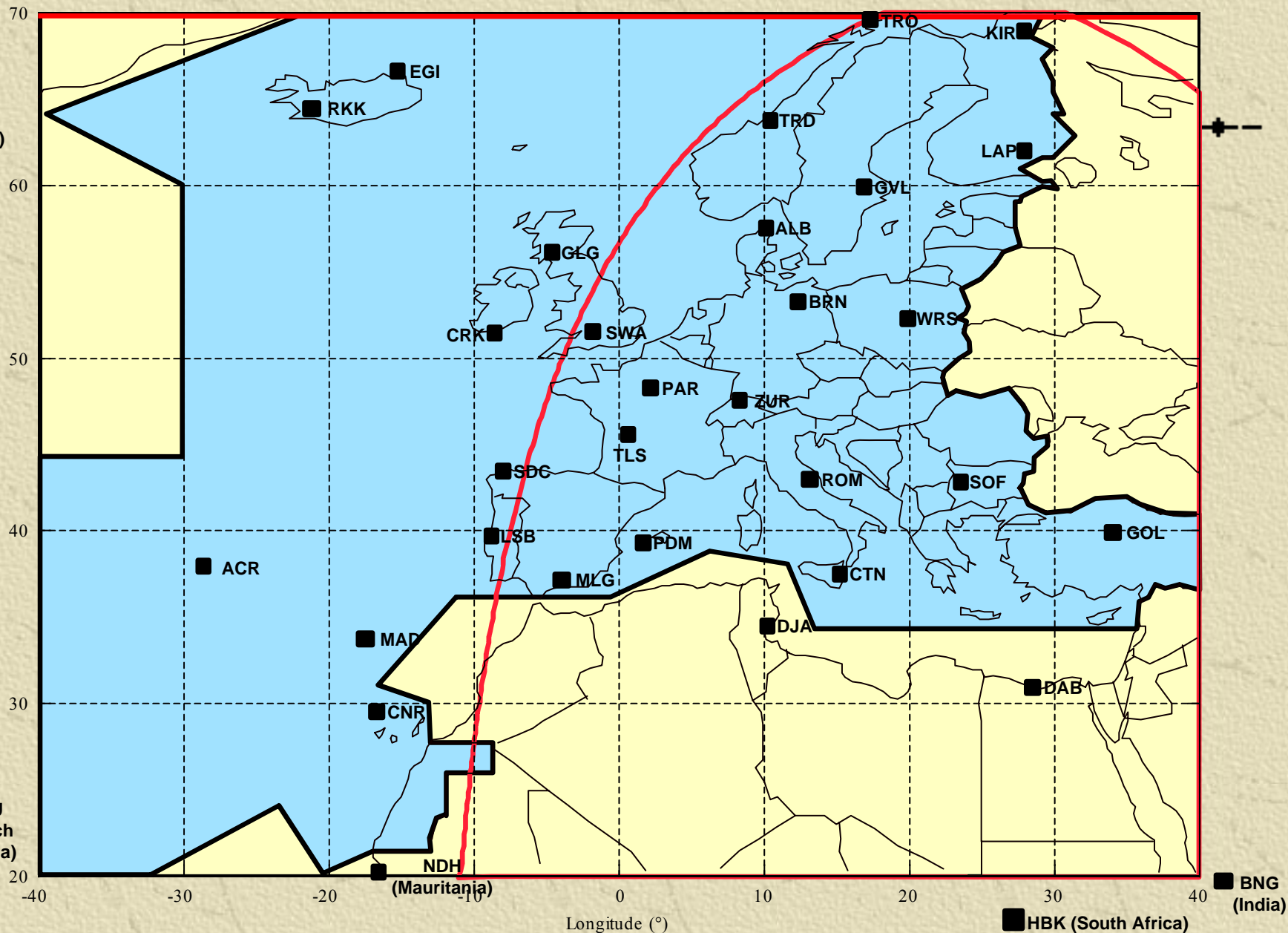
# EGNOS – forerunner of GALILEO



- ✦ Uses GPS and GLONASS signals
- ✦ Provides corrections to GPS positions
- ✦ Improves geometry of the position determination
- ✦ Provides the integrity flag
- ✦ Operational phase starting 2005



# EGNOS RIMS Map









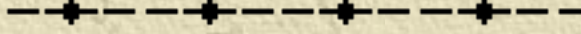
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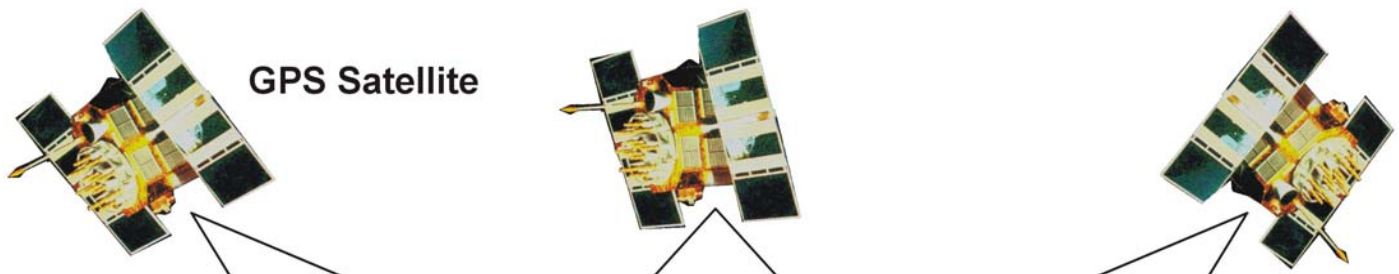












GPS Satellite

GPS Antenna



Atomic Clock

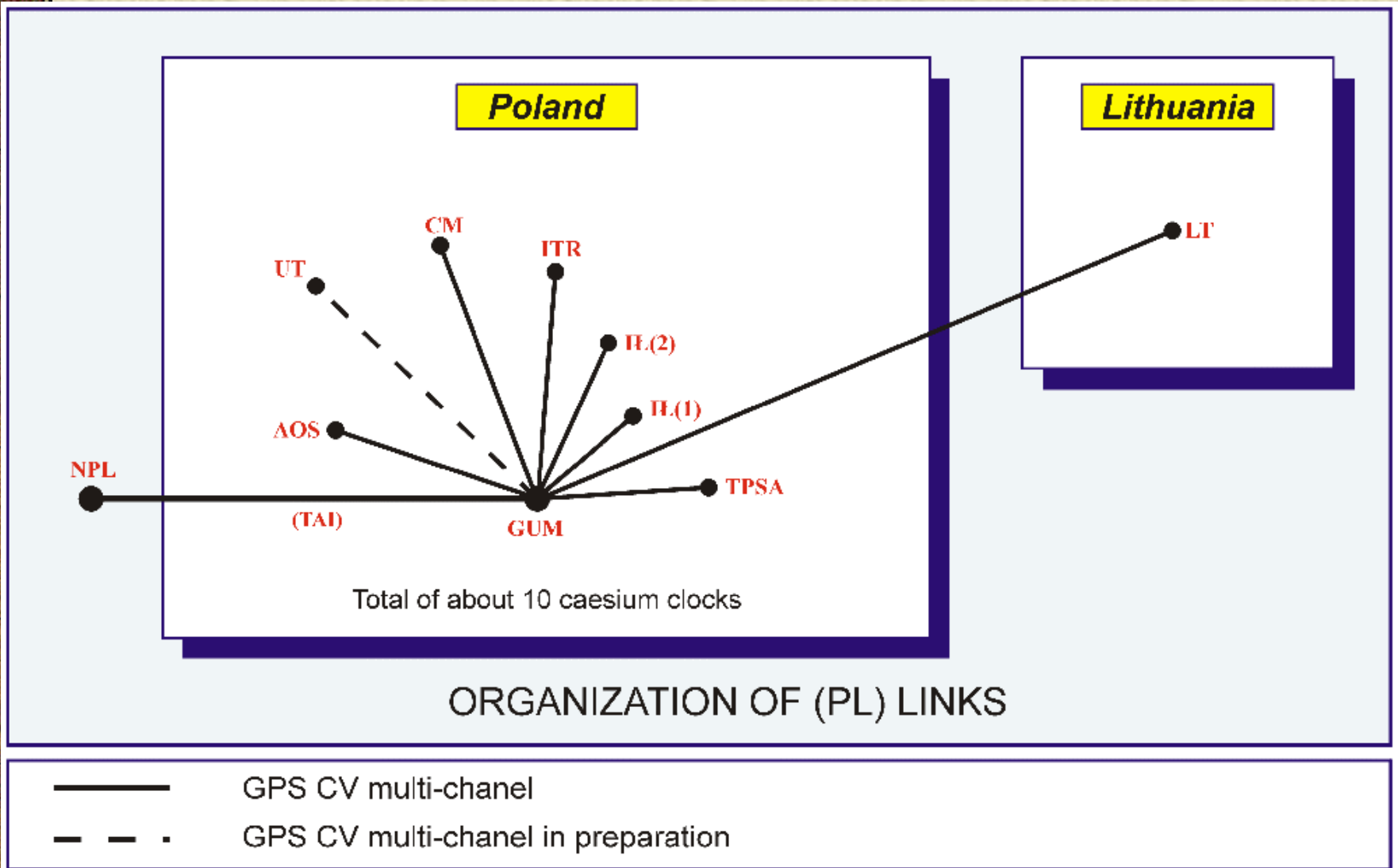
GPS Receiver

# MULTI-CHANNEL GPS TIME TRANSFER



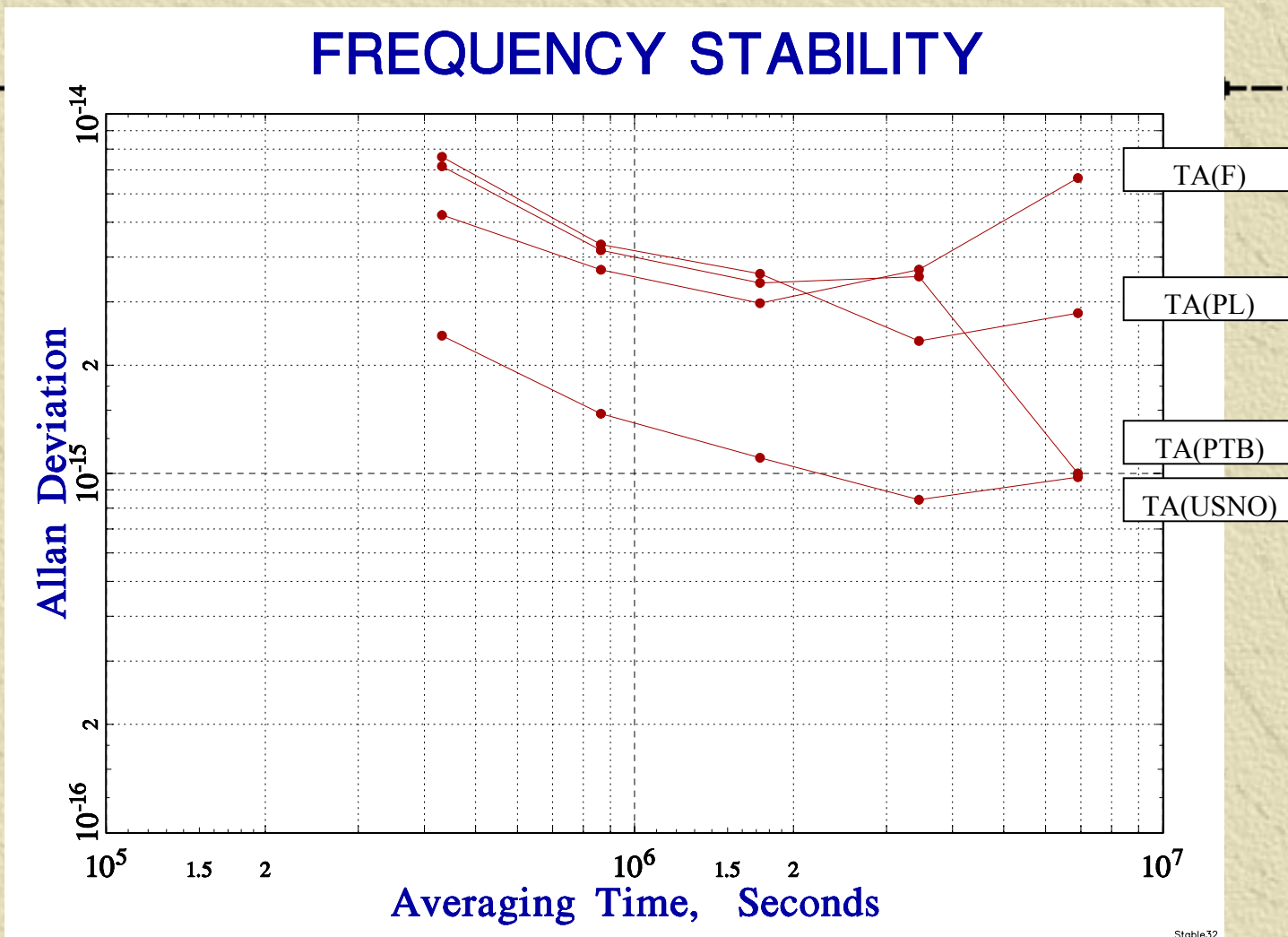


# ATOMIC TIME SCALE IN POLAND



# TA(PL), TA(F), TA(PTB), TA(USNO)

## FREQUENCY STABILITY







TTS-2 receiver with a termally stabilised antenna installed in BIPM, Paris.

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# Time Transfer System TTS-3

The TTS-3 system consists of:

- PC industrial computer,
- PC card time interval counter,
- software





# The maritime experiments verifying the EGNOS/ESTB performance in Poland:

- ✦ University of Warmia and Masury (S.Oszczak)
- ✦ Maritime Academy in Gdynia (J. Cydejko)
- ✦ Maritime Office in Gdynia (M. Dziewicki)

- July 2001 – first tests in Gdynia - focused on the comparison of ESTB performance with other GPS-based methods of satellite positioning, such as maritime DGPS and standalone GPS;
- April 2002 – tests in Gdynia (East Coast) and Dziwnów (West Coast) – focused on the comparison of ESTB performances observed in different locations on the edge of system nominal coverage.

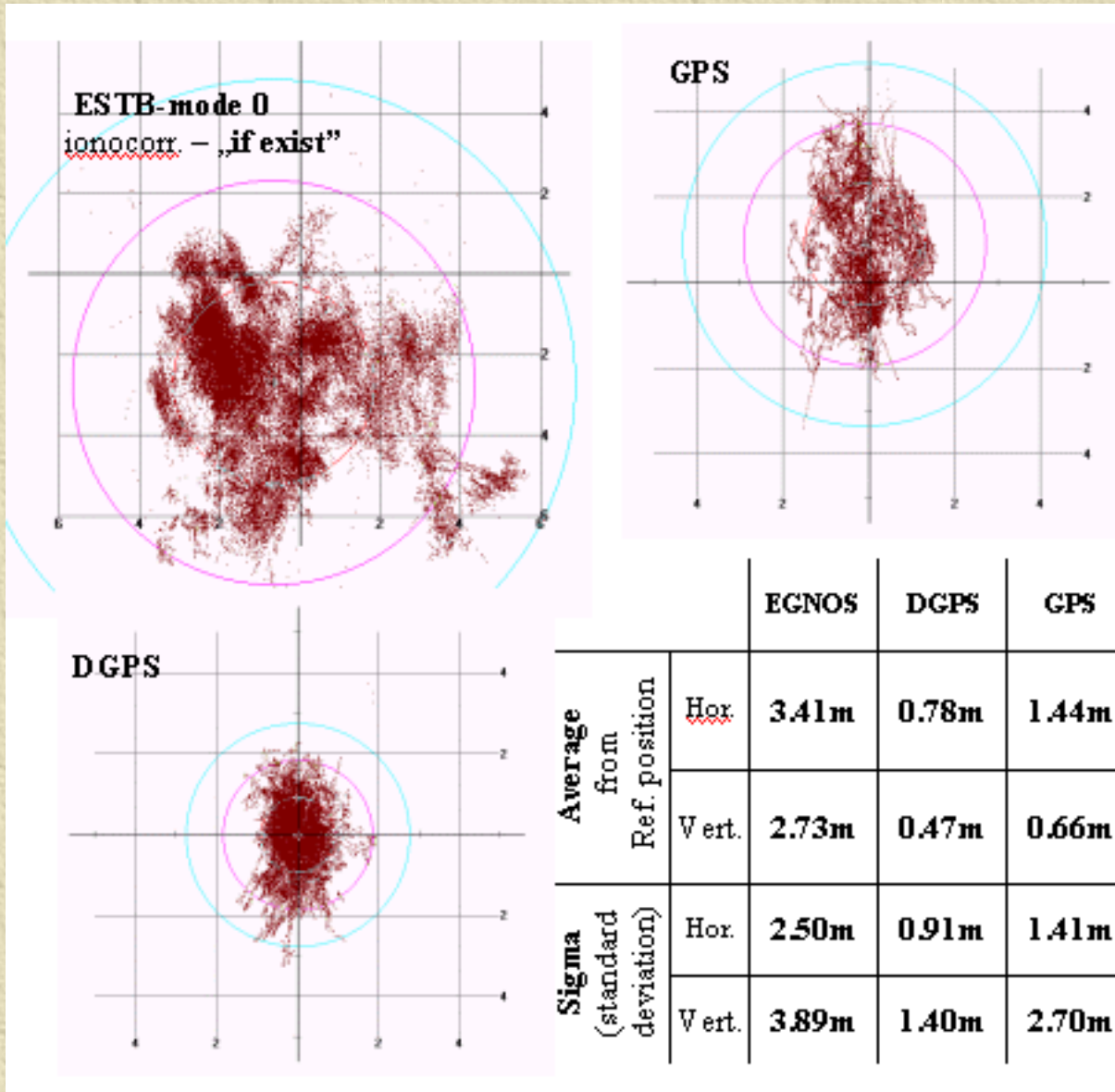
NB: *Tests in static conditions; The receivers' antennas located in known positions; Simultaneous observations for different systems, modes and locations;*

- August 2003 – maritime tests conducted at sea, in the area of Gdańsk Bay within traffic separation scheme established on the approach waters to Gdynia and Gdańsk Harbours.

NB: *Tests in dynamic conditions, on vessel navigating at sea;*

*The ESTB position estimations referred to simultaneous RTK GPS observations; Simultaneous observations for different systems and modes;*

# Position scatter plots – „all day” measurements, ESTB „mode 0” – ionocorr. – „if exist”



- FIRST PHASE:**
- July 2001
  - all data collected in Gdynia;
  - 10 RIMS;
  - EGNOS, GPS DGPS (Rozewie);



# Maritime Tests (August 2003)

## The Survey Vessel „TUCANA”



### Equipment Setup:

**TOPCON “Legacy-E” (1) GPS L1 – differential GPS using the ESTB signal;**  
**TOPCON “Legacy-E” (2) GPS L1 - non-differential GPS standalone;**  
**Leica MX 9212 GPS L1 – maritime DGPS (Rozewie),**  
**Trimble 4700 Total Station – L1/L2 GPS RTK receiver.**

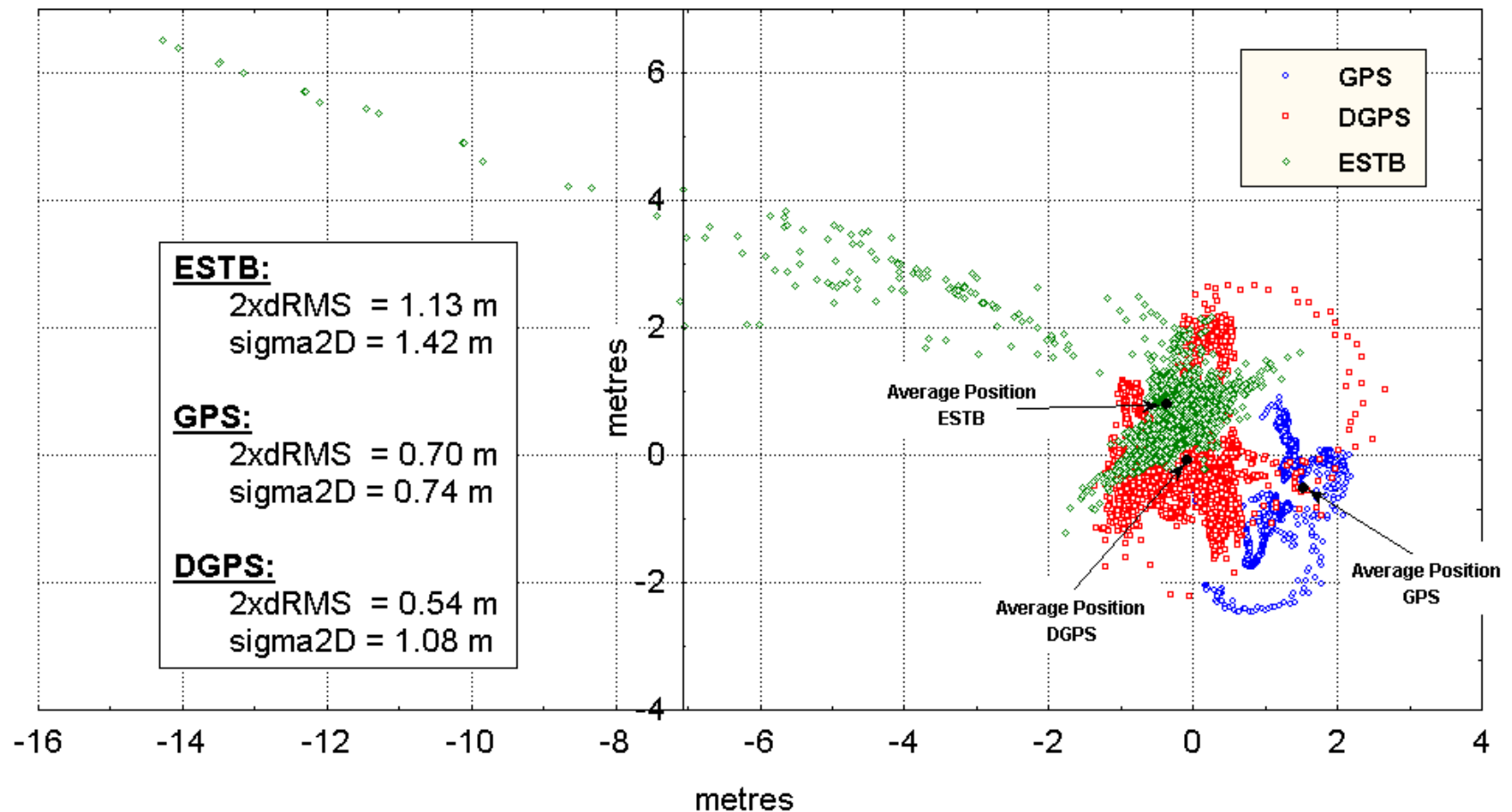
# Results (2)

## Position scatter plots - ESTB, DGPS, GPS

*Vessel navigating in Gdynia harbour approach fairway*

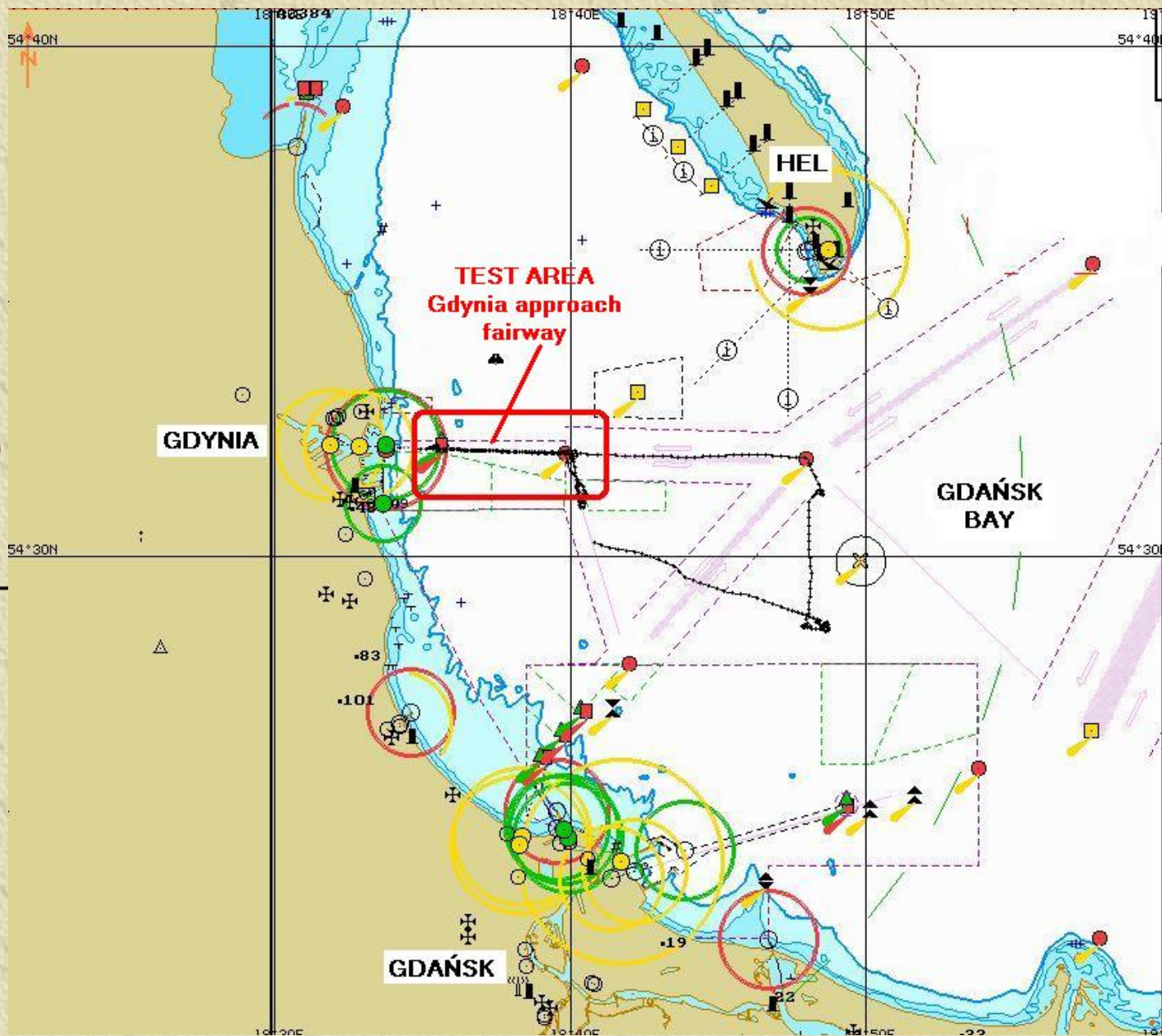
RTK GPS position estimation used as "moving true" reference point (0,0)

ESTB mode 2, ionocorrections included





Test area of  
EGNOS (ESTB)  
in Gdańsk Bay  
29 August 2003



# Air navigation experiments

- Air Force Academy in Deblin (Col. Dr. M. Grzegorzewski)

TS 11 Iskra jet plane:

- ~~June 2003 – BRDA experimet~~ — + — — + — — + — — + — — + — — + — — + — — + — — + — —
- November 2003 – ODRA experimet

Equipment used in the experimental flights:

- Ashtech Z-Surveyor (on-board)
- Garmin GPS Map 76S with EGNOS option,
- Javad Legacy with EGNOS option,
- Ashtech Z-Surveyor and Ashtech Z-XII (5 reference stations)

Recording interval

- 1 sec – Ashtech
- 2 sec – Garmin
- 1 sec – Javad

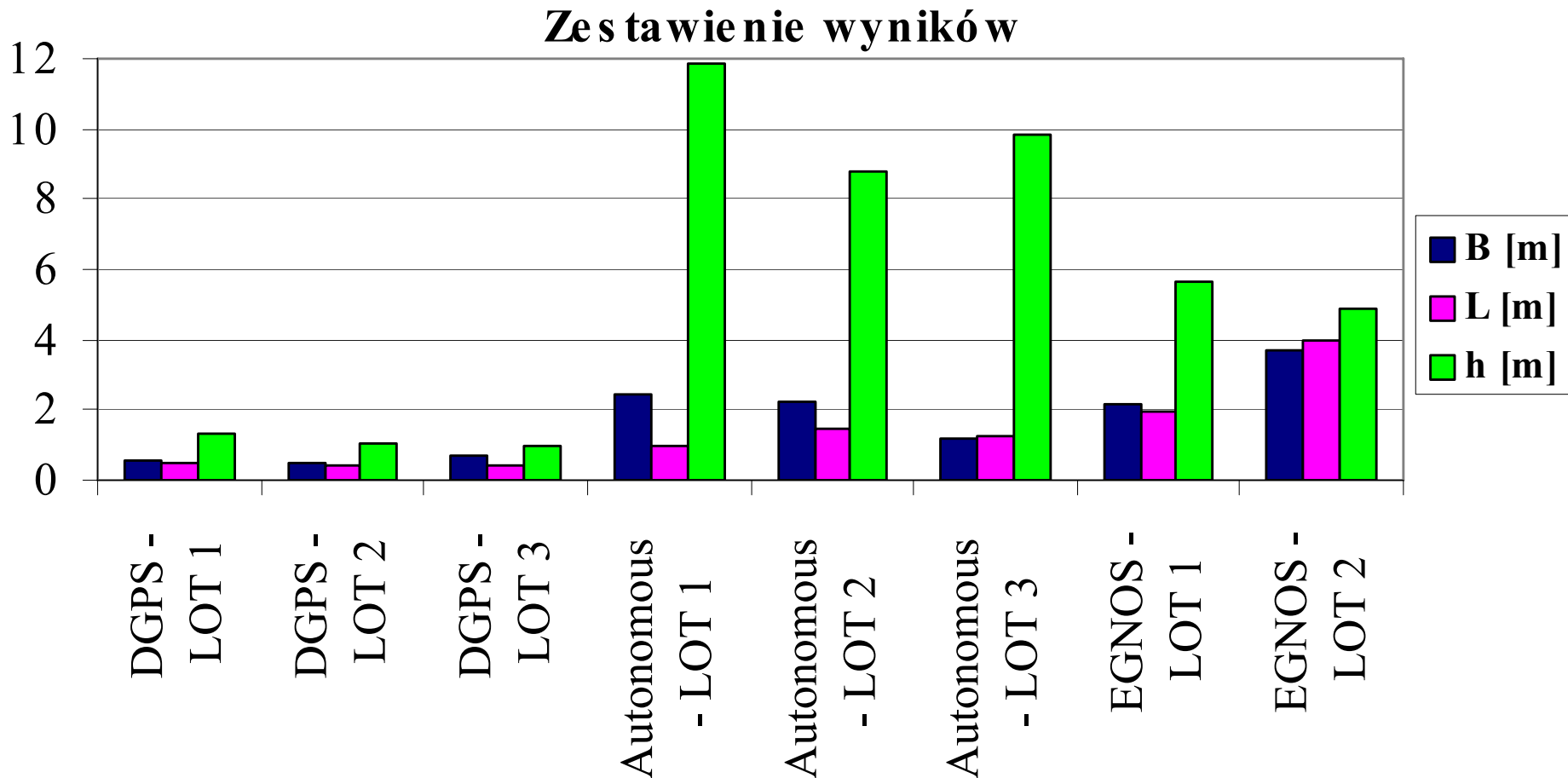


# TS 11 Iskra aircraft EGNOS experiment in Air Force Academy in Deblin-2003

Anteny GPS



# Aircraft positioning – accuracy of different satellite techniques - 2003



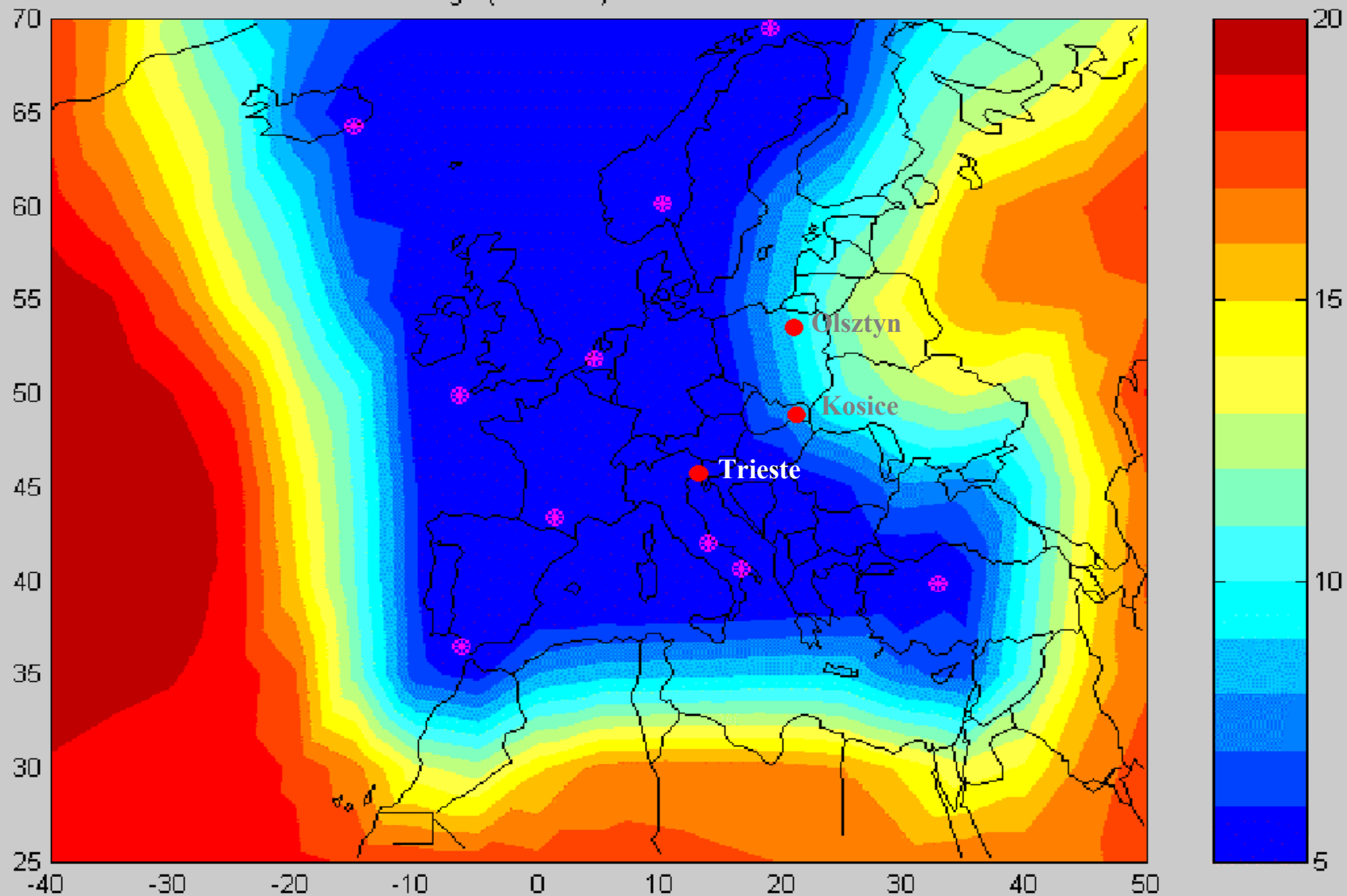


# Land navigation tests performed in Central European Countries in 2002

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- The main goal of performed trials was the use ESTB signal in satellite car navigation.
- The tests were performed in August – September 2002. **North-East Poland, East Slovakia and North-East Italy** were chosen as test areas.
- At that time, the area of Poland and Slovakia is on the eastern edge of the predicted ESTB coverage.

Average (over 24 h) HNSE in ECAC



*Location of the test area and predicted Horizontal Navigation System Error - HNSE(95%) of EGNOS System Test Bed (for 10 reference stations network).*





*Experiment in Olsztyn.*



*Experiment in Trieste.*



# Application of EGNOS/DGPS to parcel measurements for IACS



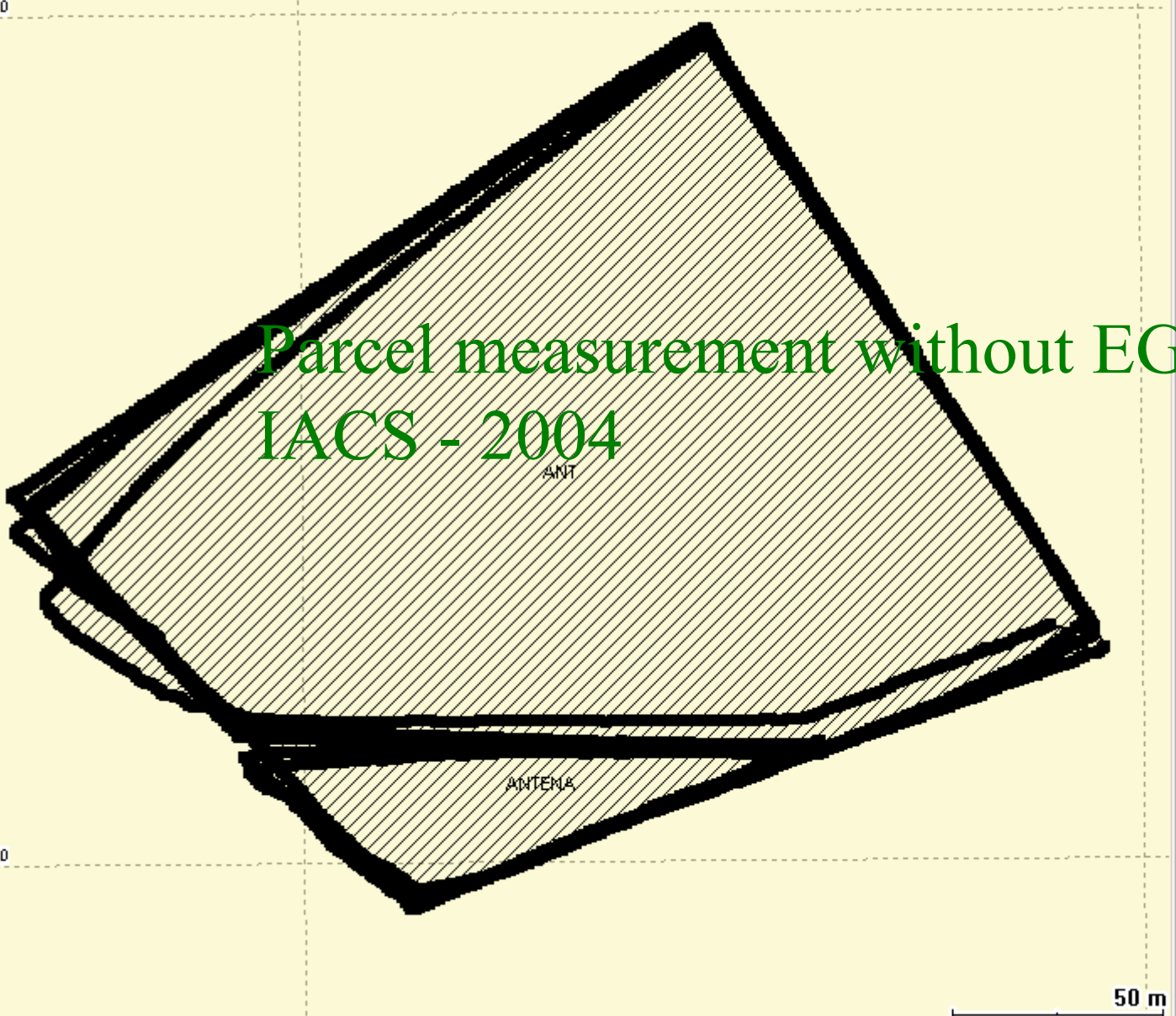




462800 46300

Layers

- Point
- Line
- Area
- Grid
- Waypoints
- Background Map



# Parcel measurement without EGNOS for IACS - 2004

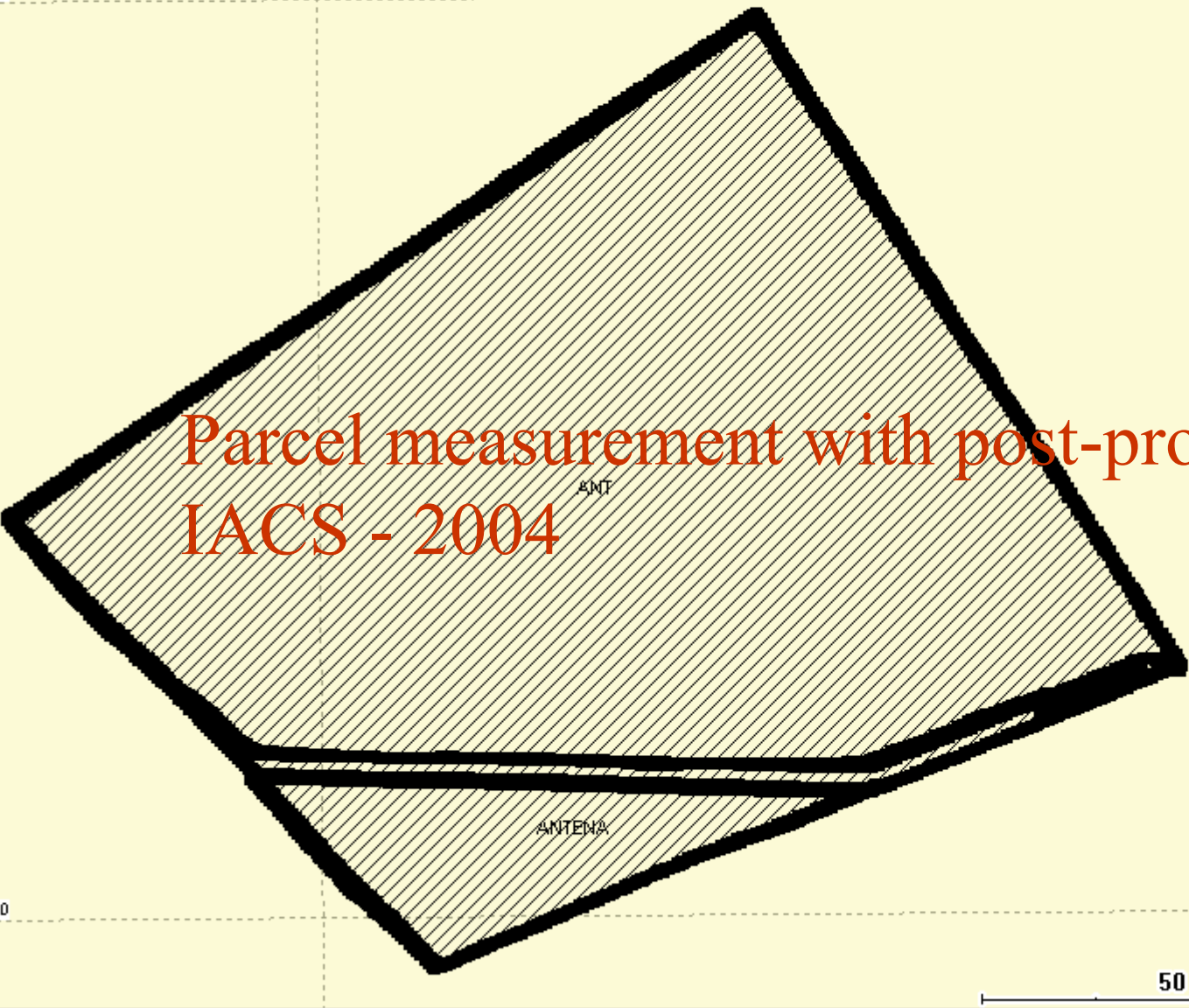


Set Scale

462800

0

0



# Parcel measurement with post-processing for IACS - 2004

Layers

- Point
- Line
- Area
- Grid
- Waypoints
- Background Map



# Some EGNOS/DGPS receivers for IACS parcel measurement



# Conclusions

The performed tests show that GPS positioning with the use of ESTB correction gives very promising results. Even better than expected.

The horizontal positioning of moving vehicles with errors around 1-2 meters would be satisfactory for the majority of users of the satellite navigation systems.





# New concept and business opportunities for vessel traffic management systems using EGNOS/GALILEO

Prof. Dr. Andrzej Stateczny,  
Maritime University Szczecin  
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Arne Jungstand  
Dornier Consulting GmbH  
[Arne.Jungstand@dornier-consulting.com](mailto:Arne.Jungstand@dornier-consulting.com)

# Opportunities

## Safety


- Increased safety of maritime and inland waterway transport
- Reduction of work load for pilots and port authority

## Commercial

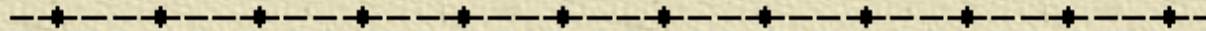
- Improved use of infrastructure (port, waterway)
- Increased efficiency of port operations and inland waterway cargo transport
- Broadband communication infrastructure enables additional value added services for logistics







**Support for the development and  
utilisation of Galileo applications in  
Poland and other accession  
countries**

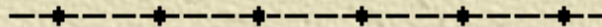


**Galileo App**

SIXTH FRAMEWORK PROGRAMME

PRIORITY [4] [Aeronautics and Space]

SPECIFIC SUPPORT ACTION



Objective of the project:

**the promotion of the development and utilisation of Galileo applications in Poland and in other new EU members.**

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The project activities will:

- ✦ Support research and commercial sectors in the development of Galileo-based applications
- ✦ Provide background and support for the development of a national policy related to utilisation of Galileo services
- ✦ Demonstrate to EU the potential of Poland and other new members

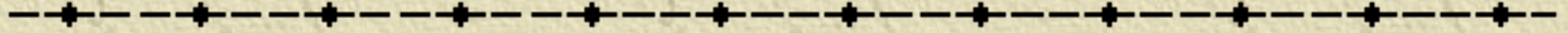


# Project organisation

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- ✦ Polish Space Office (PSO) is a public body established by the President of the Polish Academy of Sciences (PAS)
- ✦ Galileo Point (GP) established as a part of PSO
- ✦ Advisory Board of the project (AB)
- ✦ Galileo Platform (GPtf)
- ✦ Working Group of the GPtf

# Advisory Board



- ✦ Guenter Hein (Germany) –Chairman
- ✦ Istvan Fejes (Hungary)
- ✦ Daniel Ludwig (GJU)
- ✦ Giorgio Manzoni (Italy)
- ✦ Alexandre Steciw (ESA)
- ✦ Stanisław Oszczak (Poland)



# Galileo Platform activity (1)

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- ✦ **Galileo Info Day** is addressed to the business community, companies and enterprises of any size, technical groups and market oriented public institutions interested in applications but not yet involved in realisation. The programme will consist of presentations prepared by experts and discussion with participants.
  
- ✦ The main elements of the programme will be
  - ✦ \* Presentation of existing, planned and envisaged applications
  - ✦ Results of studies carried on in the frame ESA and EU Galileo programme will be presented to the extend possible.
  - ✦ · Discussion of market feasibility of selected application development trends
  - ✦ · Overview of funding opportunities

# Galileo Platform activity (2)

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- ✦ **Galileo workshops** will be organised for people and groups actively involved in works related to GNSS development and applications. The programme will consist of technical papers and technical discussions. The main purpose will be the exchange of information and experiences.
  - ✦ ● Presentation of technical papers by experts from NM institutions or companies
  - ✦ ● Presentation of opportunities for cooperation in 6FP consortia.
  - ✦ ● Overview papers by experts from Galileo leading institutions
- ✦ **Financial support for presenters from NM possible**



# National Galileo Information Day, Warsaw, June 29, 2004

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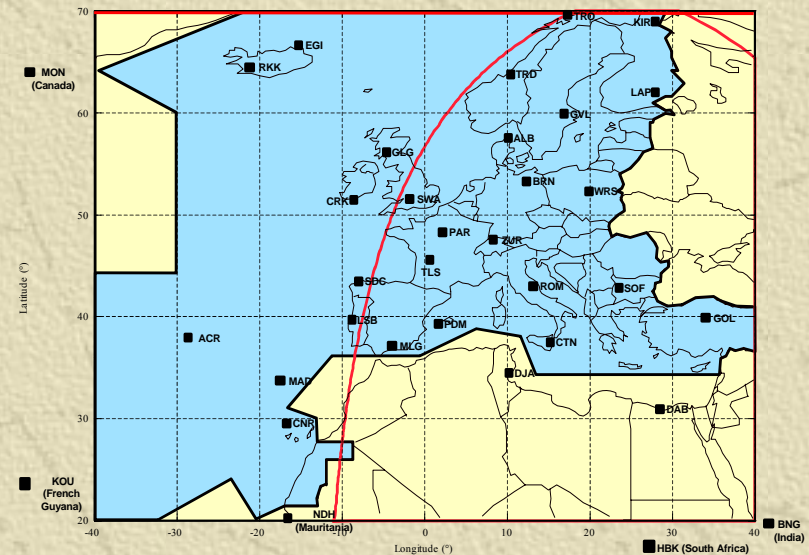
- ✦ Galileo overview
- ✦ State of the satellite positioning in Poland
- ✦ GNSS applications examples
- ✦ Financial and organisational problems



# EGNOS Workshop, Cracow , 23-24 September, 2004

- ✦ Overview of the EGNOS system
- ✦ RIMS stations deployment and experience
- ✦ ESTB results
- ✦ Receivers performance

EGNOS RIMS Map





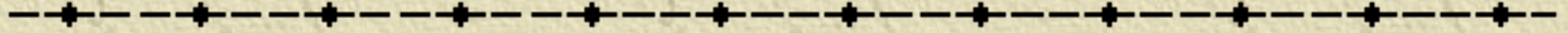
# European Cooperation Day, Warsaw, 30 November, 2004

(organised jointly with FDC, France)

- ✦ **European Industry Networks**
- ✦ **Experiences from GNSS/Galileo related projects**
- ✦ **Presentations of candidates for Galileo operator concession**
- ✦ **Polish Industry strengts and opportunities for cooperation**



# Cooperation with other new EU members in 2004



- ✠ Cracow - EGNOS Workshop
- ✠ Gdynia - 14-th Conference on Maritime Navigation
- ✠ Warsaw - European Cooperation Day



# Future planned actions

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- ✠ 2-nd European Cooperation Day in Riga, Latvia – May 2005 (tbc)
- ✠ International EGNOS Workshop – Gdynia, September 2005 (tbc)

# Contact:

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✦ Coordinator of the project:

Janusz B. Zieliński – [jbz@cbk.waw.pl](mailto:jbz@cbk.waw.pl)

✦ Web site:

<http://galileo.kosmos.gov.pl>

✦ Polish Space Office:

Anna Nalecz Kobierzycka [spaceoffice@cbk.waw.pl](mailto:spaceoffice@cbk.waw.pl)

Tomasz Michałowski [tgm@cbk.waw.pl](mailto:tgm@cbk.waw.pl)



# Acknowledgment

*This report is based on publications by*

- 
- ✦ Z. Krysiński – Space Research Centre, Polish Academy of Sciences
  - ✦ S. Oszczak – University of Warmia and Masury
  - ✦ J. Nawrocki – Space Research Centre, Polish Academy of Sciences
  - ✦ J. Cydejko – Maritime University, Gdynia
  - ✦ M. Dziewicki – Maritime Office, Gdynia
  - ✦ J. Grzegorzewski – Air Force Academy, Dęblin
  - ✦ A. Stateczny – Maritime University, Szczecin

A detailed illustration of a satellite in space. The satellite has a central body wrapped in gold thermal insulation, with various instruments and antennas. A large, prominent antenna array with a hexagonal grid of circular elements is visible. The satellite is positioned against a black background filled with stars, with a view of the Earth's blue and white clouds in the upper left. The text 'THANK YOU FOR YOUR ATTENTION' is written in a bold, yellow, italicized font in the lower-left quadrant.

***THANK YOU FOR  
YOUR  
ATTENTION***