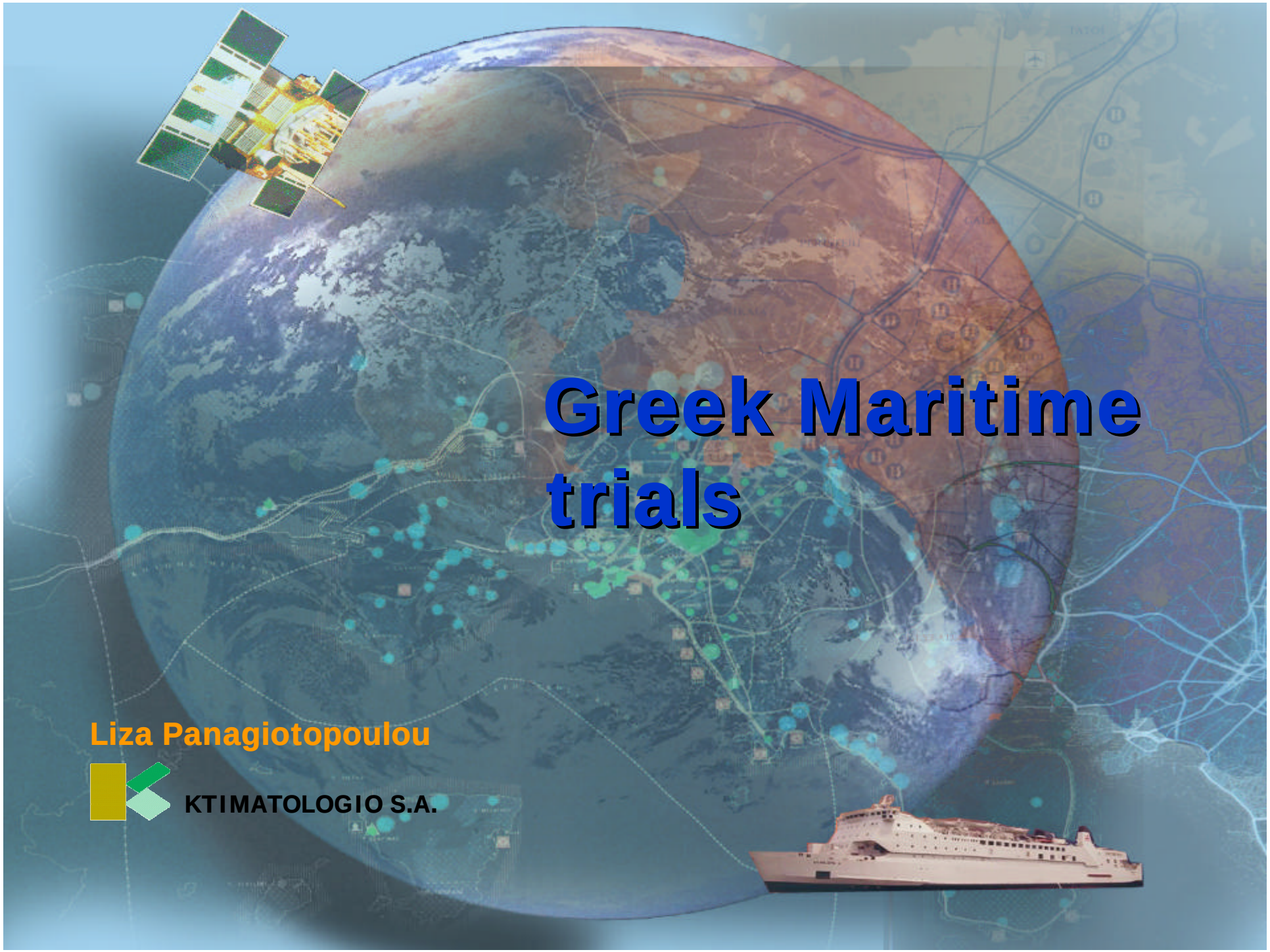


Greek Maritime trials

Liza Panagiotopoulou

KTIMATOLOGIO S.A.

Greek Maritime trials took place in the framework of GALILEO Future Applications

GALA (Galileo Overall Architecture Definition)

Work Package 8.2.6 “Maritime sector”

KTIMATOLOGIO S.A (KTI) is a Hellenic public company responsible for the development of the Hellenic Cadastre Project (budget 3 billion **€**). Interested in geo-information provision.

rationale

- Common Transport Policy: sustainable mobility and intermodality

- Significant importance of maritime sector for Europe

- **Europe handles more than half of the world's international shipping**
- **Annually more than 40 m passengers and 270 m tons of goods transported**

The number of accidents at sea is mostly caused by human error: up to 80% of accidents






Need for seafarers' technological support

Use of advanced Satellite Positioning Systems

IMO regulations

In the last IMO resolution A860(20) “World-wide radio navigation systems” the required horizontal accuracy is defined:

- Open sea (more than 50 miles away from land)
  10m
- Coastal waters (less than 50 miles away from land)
  10m
- Confined waters, approaches and harbours
  1m

positioning needs of maritime sector

This maritime application runs in a market segment that has increased requirements for accuracy, integrity, global coverage, certification and service level agreements.

- Performance requirements are partly met by the existing augmented GPS (DGPS-RTK) positioning systems.
- Their general drawbacks are the lack of integrity control and the fact that they operate over a limited distance.

GALILEO can guaranty a high level of accuracy, availability and integrity as well as the provision of certified services.

objectives

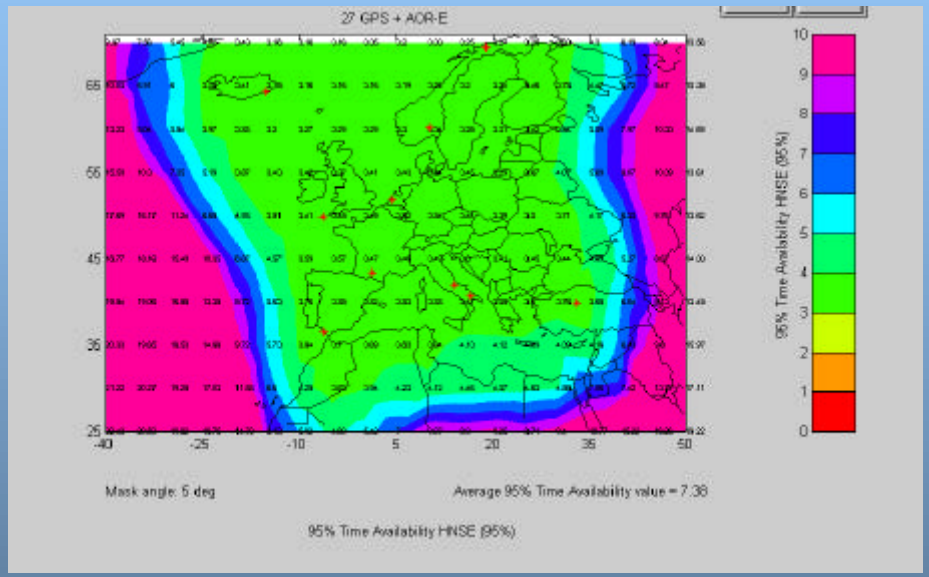
The aim of this application is to demonstrate the feasibility of the new European satellite positioning system as well as to present the competitive advantages of the use of GALILEO system in maritime sector.

The following objectives are pursued in order to promote GALILEO effectively:

- To highlight an application area with high growth potential and to point out the opportunities for GALILEO in such a market
- To provide an innovative real-time demonstration that will interest and impress decision makers and user communities
- To use a representative test-bed (ESTB), a precursor of GALILEO, in conjunction with existing satellite positioning system, as a way to emphasise the potential advantages and differentiators of GALILEO.

ESTB

- operational since January 2000
- accuracy of combined use of GPS - ESTB for 95% of the time horizontally: less than 3m vertically: 5m
- provision of an integrity service, represented by the vertical and horizontal protection levels
- February 2001, two new stations in Italy included/tested in the operational platform, called MTB connection

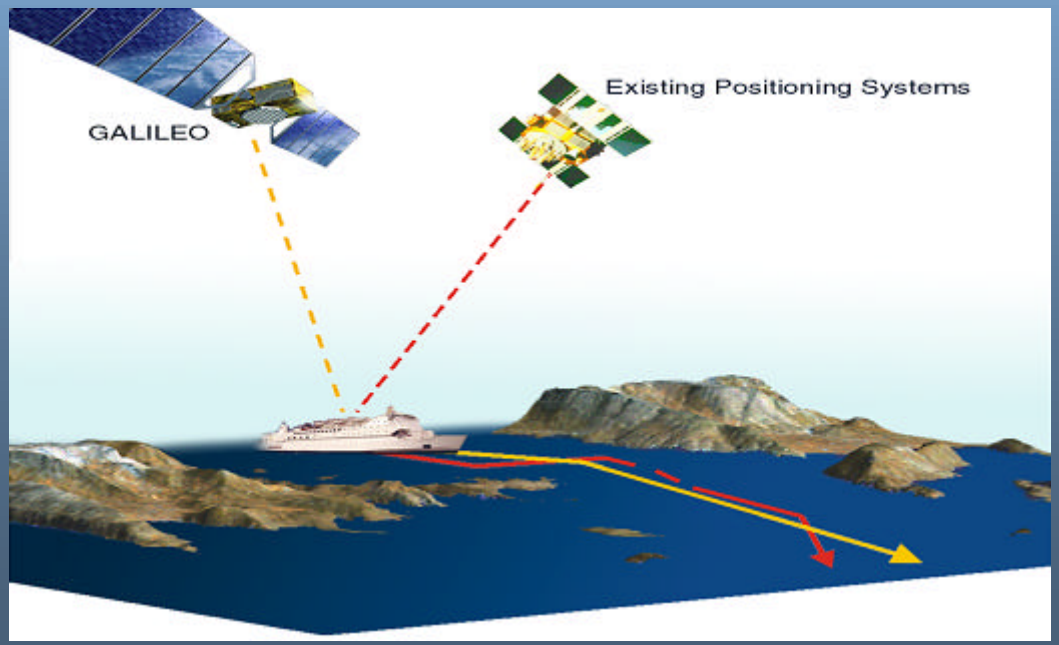


Simulated Horizontal Navigation System error with EGNOS ESTB (current RIMS baseline+MTB) guaranteed 95 % of the time

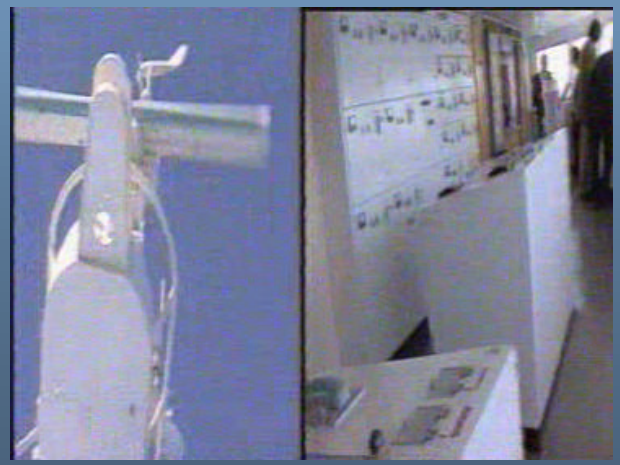
Greek Maritime trials: first combined use of ESTB - MTB

scenario

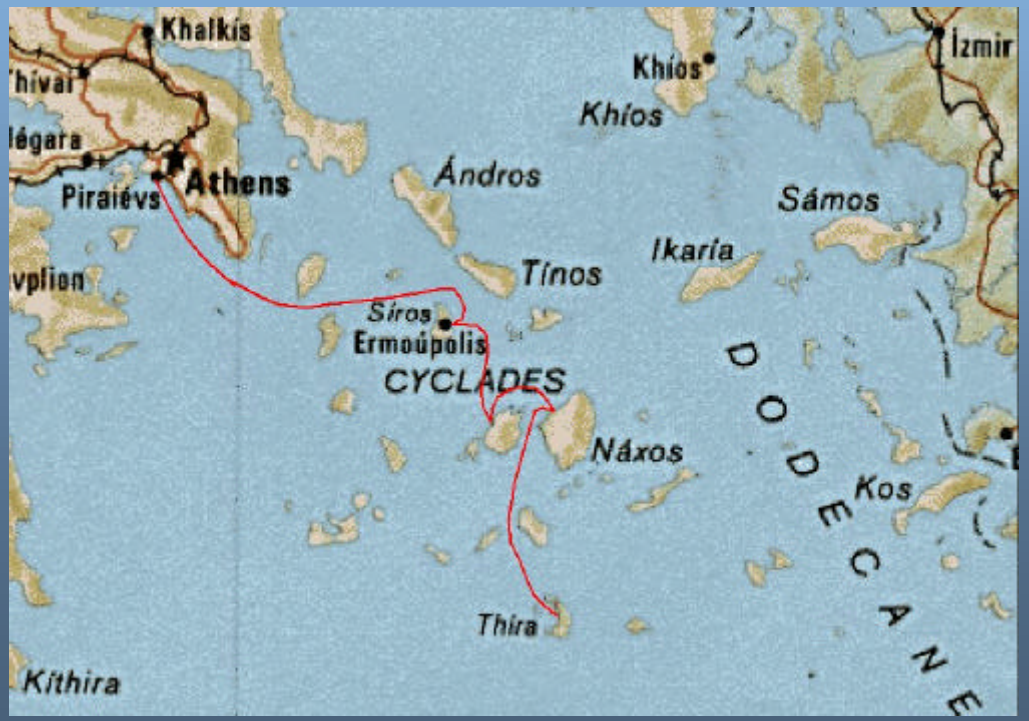
- Execution of trials in the Aegean Sea (Greece) by measuring the position of a vessel by Satellite Positioning Systems
- Comparison of two systems' performance:
  - GALILEO - EGNOS System Test Bed
  - Existing Positioning Systems (GPS)



16 March 2001



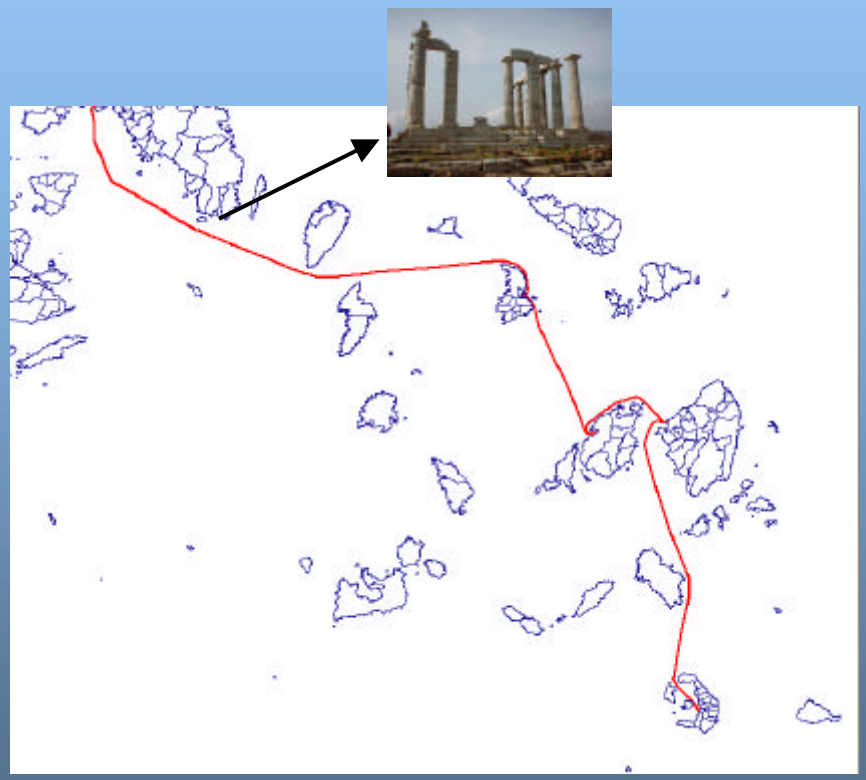
from Piraeus
to Santorini (Thira)
on board a ferryboat



equipment

- EGNOS, GPS and RTK/LRK receivers from Thales Navigation on board

- LRK-RTK station from Thales Navigation on a geodetic point at cape Sounio to get ground truth

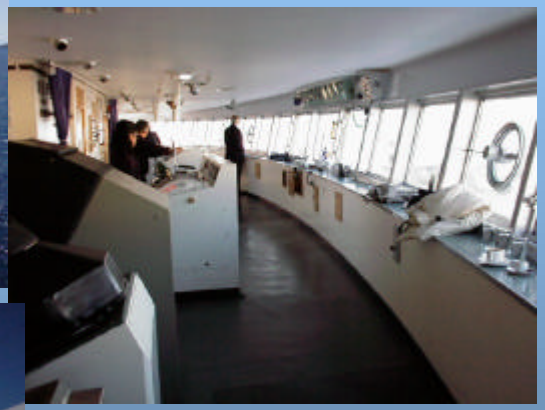


on board

2 Thales Navigation L1 receivers and 1 L1/L2 receiver.
One of the receivers was properly configured in GPS only mode, the second receiver was configured in EGNOS mode and the third one on RTK mode.

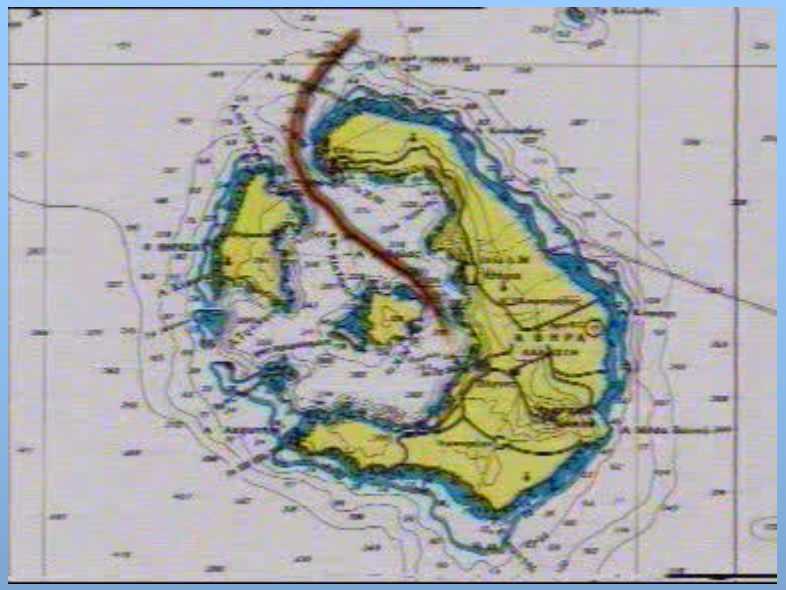
2 portable PCs connected to the receivers.
The two PCs were equipped with three serial (RS232) ports so as to be connected to the three onboard receivers. One of the PCs was equipped with mapping software, displaying the positions of the three receivers on the electronic charts. The second PC provided a graphical comparison of EGNOS and GPS position errors compared to RTK. Both the above mentioned PCs recorded all the necessary data for post processing activities.

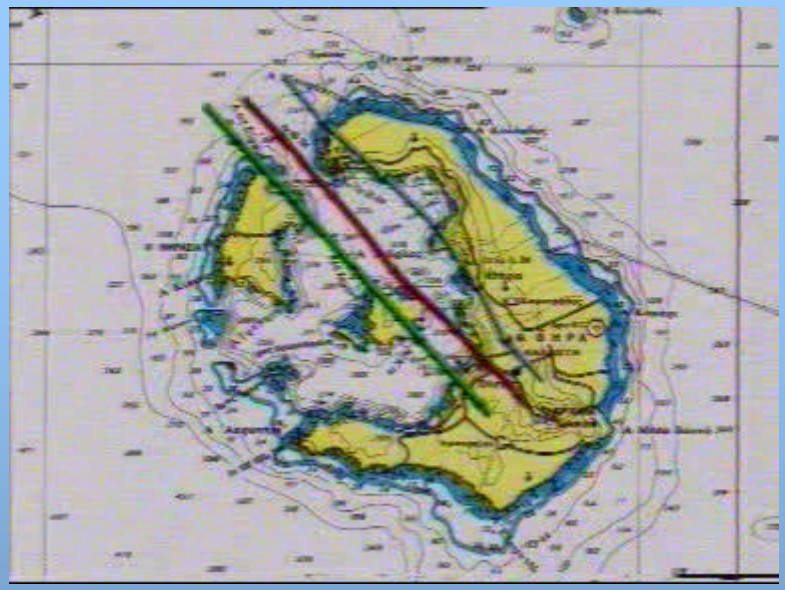
measurements

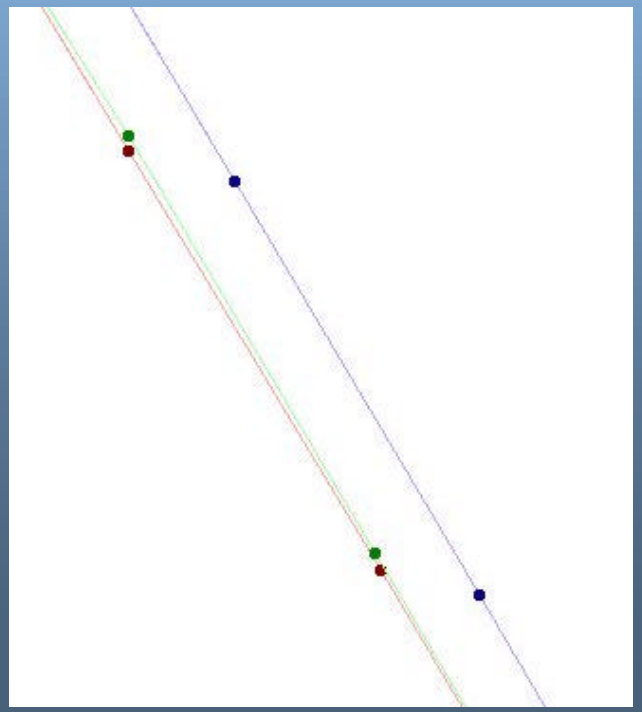


During the trip of the vessel, different approaches have been studied:

- **open sea**
- **coastal**
- **harbour approach**







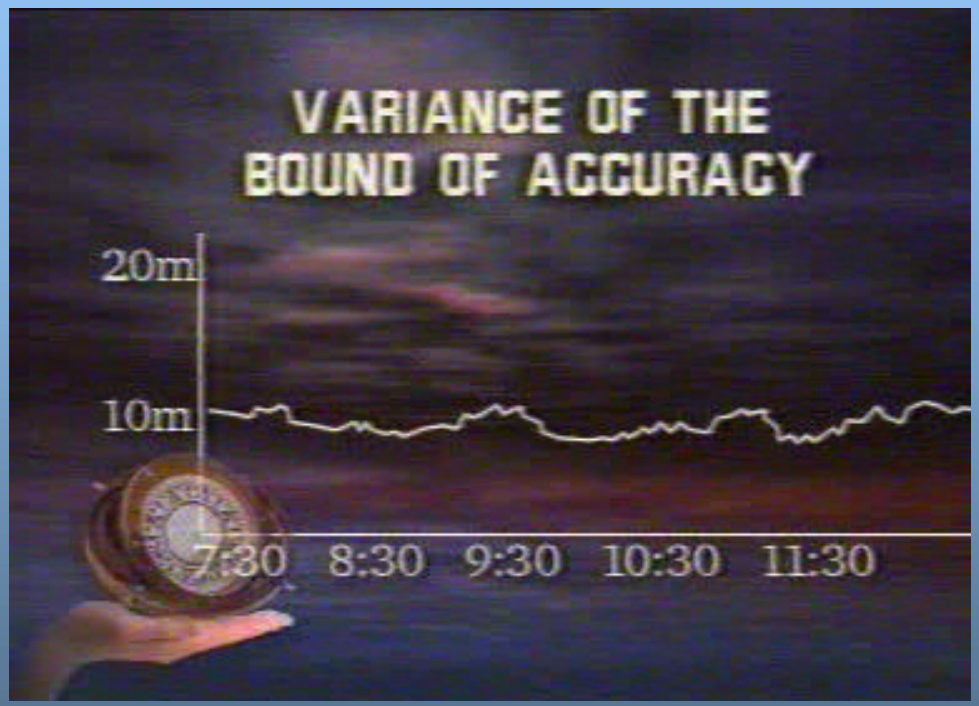
On the side figure, which shows a very small part of the trip (about 5 seconds), red is RTK, green is EGNOS and blue is GPS.

When EGNOS was available, the EGNOS provided position was usually closer to the RTK position, although GPS had also good accuracy throughout the trip.

EGNOS is reliable for harbour approaching (harbour docking was not studied).

results

The advantages of EGNOS: high level of accuracy, availability and integrity can be documented by the *Horizontal Protection Level*, which is a bound of accuracy that the system guarantees with very high probability (99.999 %). In a time-to-alarm of less than 6 seconds, the system warns you if your accuracy is degraded above this protection level.



The horizontal protection level for EGNOS during the trial was usually less than 10 meters (the graph displays the horizontal protection level from 7:40 am to 11:30 am local time). The positioning horizontal accuracy was for EGNOS close to 2m and for GPS about 5m.

EGNOS ensures accuracy with a very high probability (99.999%) inside a circle centred at the estimated position. As it may be observed on the following figure, during the trial, the RTK position (red dots) was always inside the EGNOS horizontal protection level circle. The radius of the circle is the *Horizontal Protection Level* and depends on the probability of guaranteed accuracy we want to have. It should be mentioned that 99.999 % is too high and can be relaxed for maritime applications to a level of 95 %. In other words with EGNOS we navigate with a kind of shield and this is very important for the avoidance of accidents.