Implementation of WGS84 and GPS for Marine Navigation

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The Project Consortium

- IESSG, The University of Nottingham
- General Lighthouse Authorities
  - Trinity House Lighthouse Service
  - Northern Lighthouse Board
  - Commissioners of Irish Lights
- Port of London Authority
- United Kingdom Hydrographic Office

Project Overview
Implementation of WGS 84

- **WGS 84 for Navigation Charts**
  - UK Hydrographic Office
- **Coordination of Port Facilities**
  - Port of London Authority
- **Coordination of Aids to Navigation**
  - General Lighthouse Authorities
- **WGS 84 as a Vertical Datum**
  - Port of London Authority

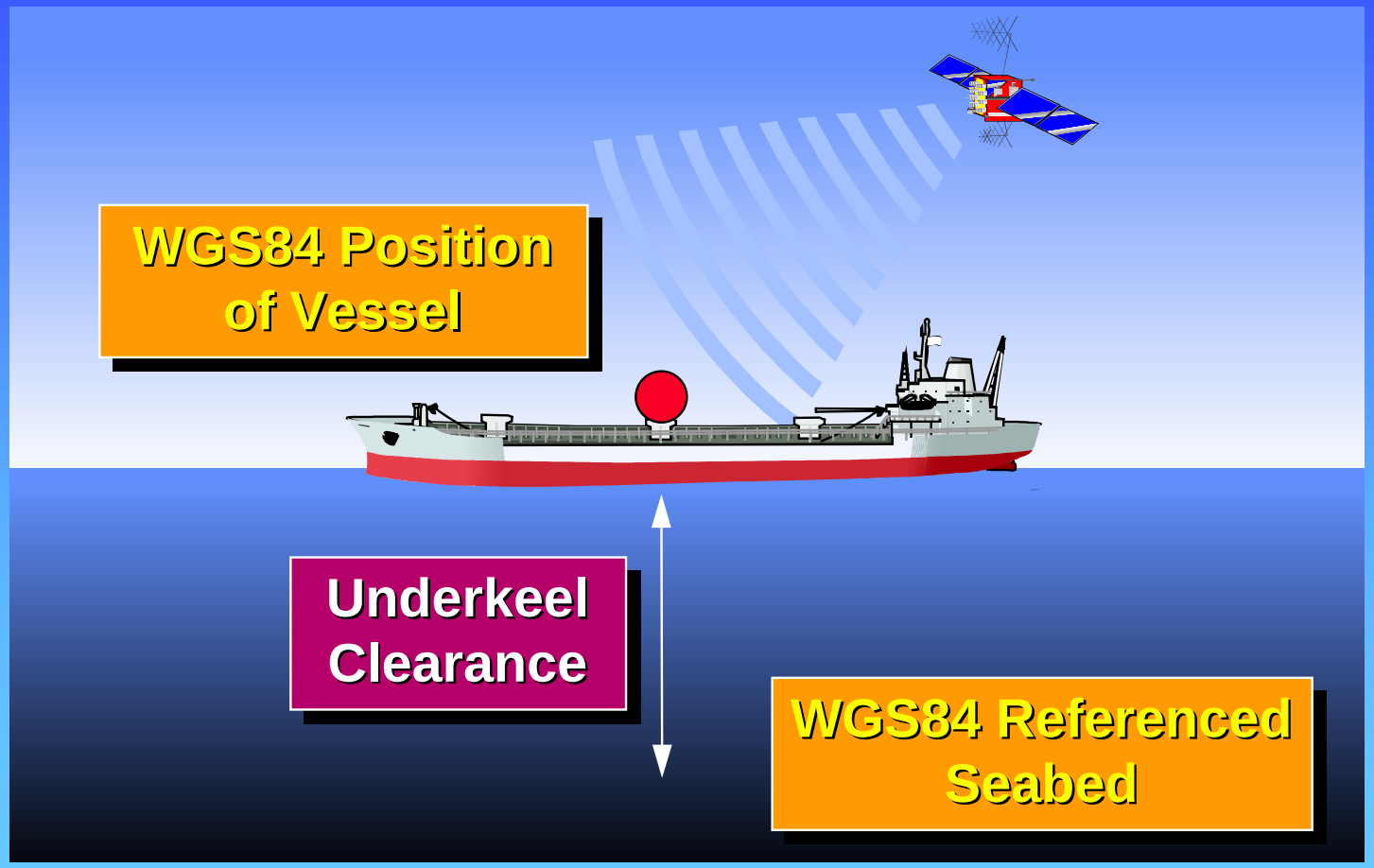
Project Overview
Implementation of GPS

- **Precision Navigation**
  - Port of London Authority
- **GNSS Systems Integration**
  - Port of London Authority (VTS)
  - General Lighthouse Authorities (Loran-C)
- **GNSS Integrity Assessment**
  - All Partners

Chart Datum Transformations

- Test areas in UK and Ireland
- Current chart shift parameters show good agreement on average with transformed coordinates
- Variations (up to 20m at long range)
- Agreement between OSTN97 and UKHO method better than 2m
- UK and Ireland OK - but what about other regions?
- What if no published datum, or known parameters?

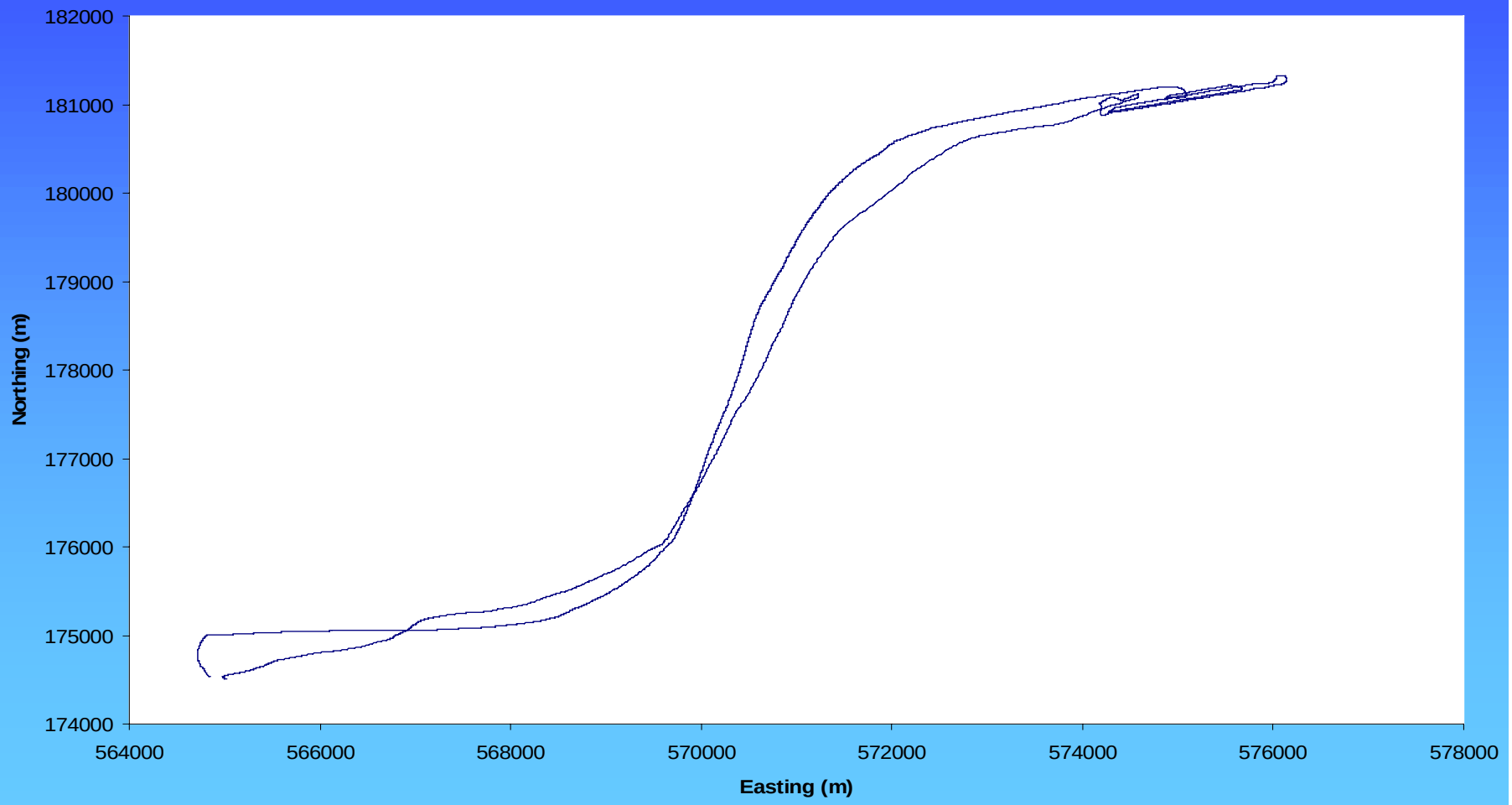
WGS 84 as Vertical Reference Datum



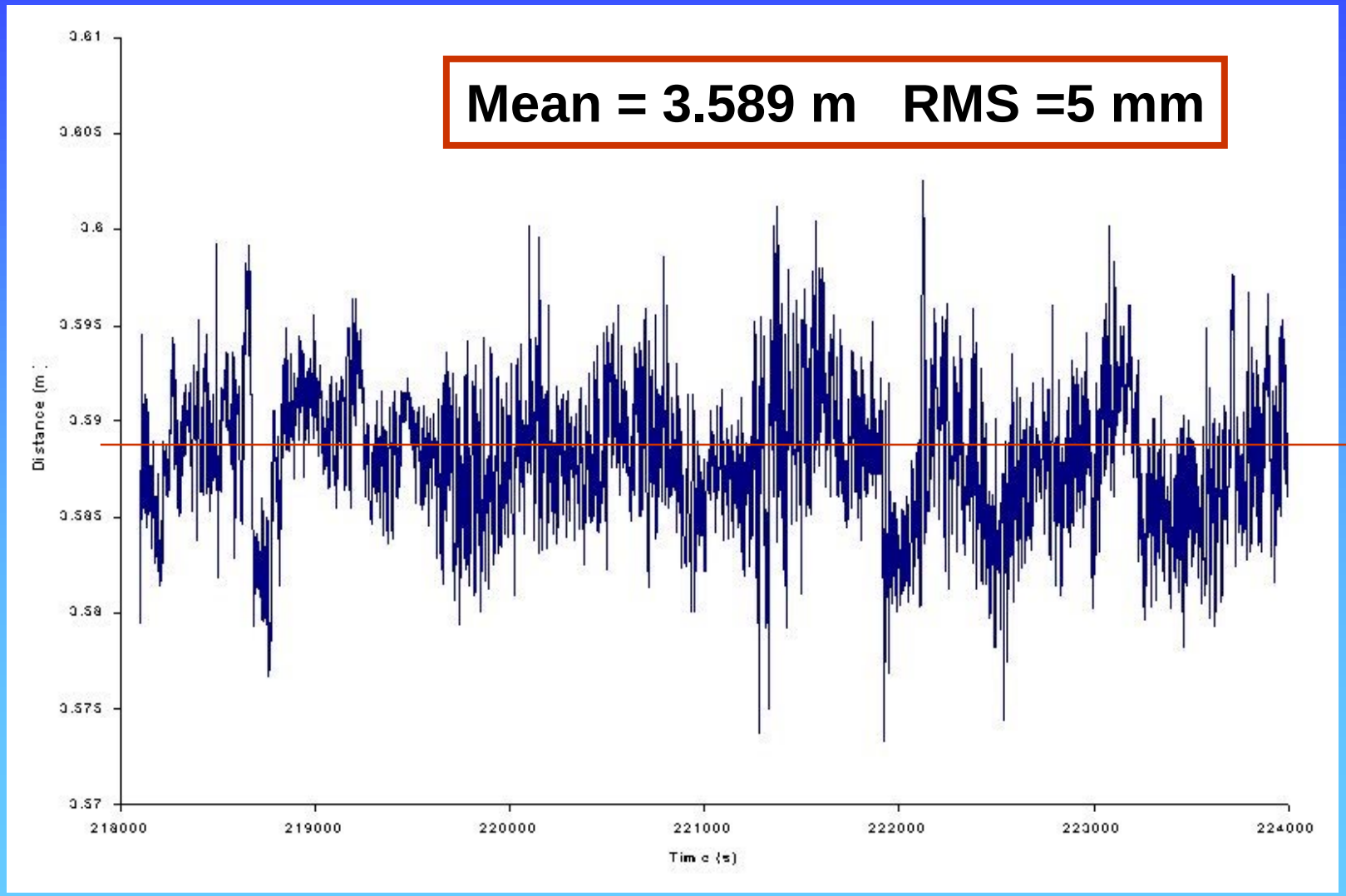
Ignores Sea, Tides etc..

Port of London Trials

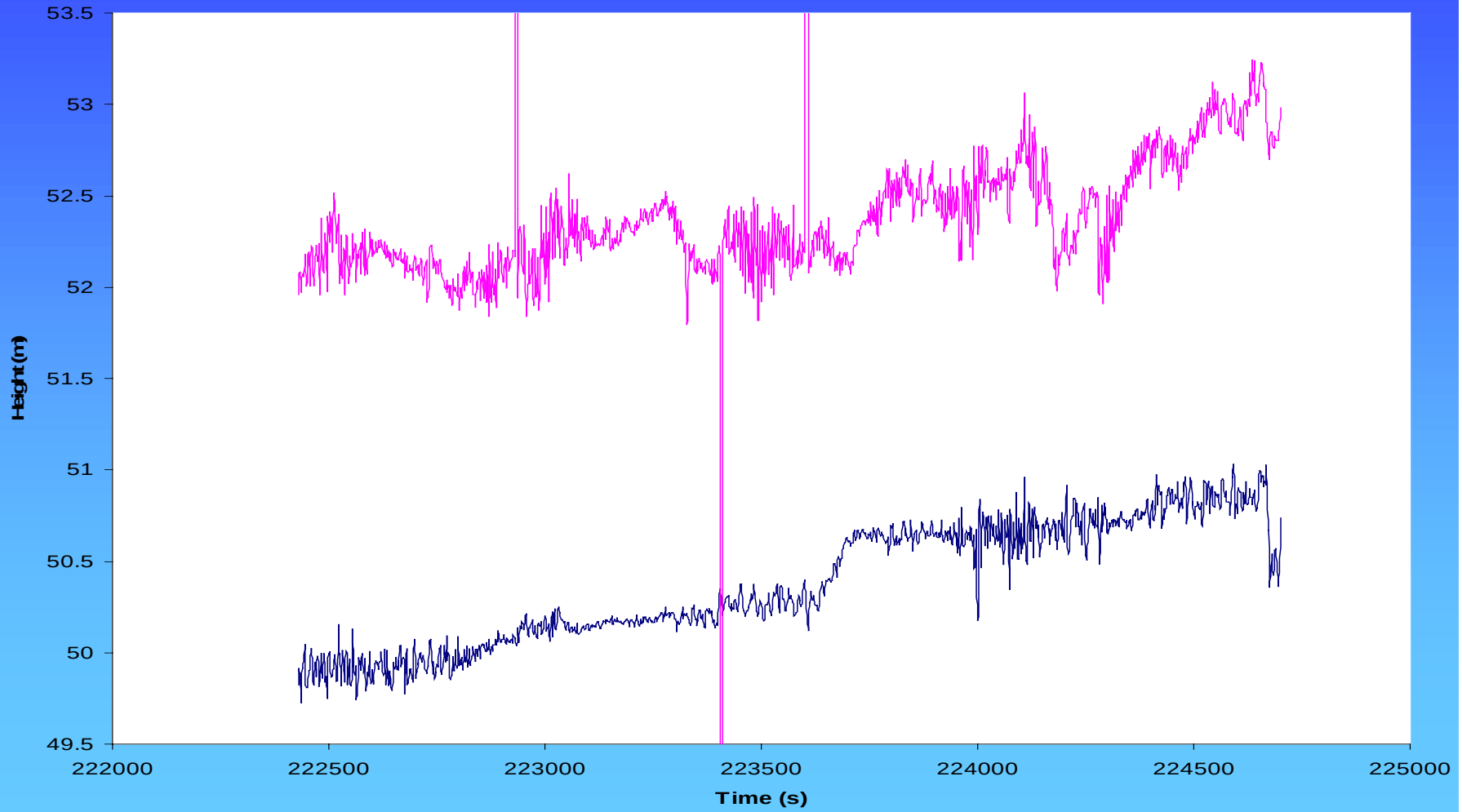
River Thames Trial Trajectory



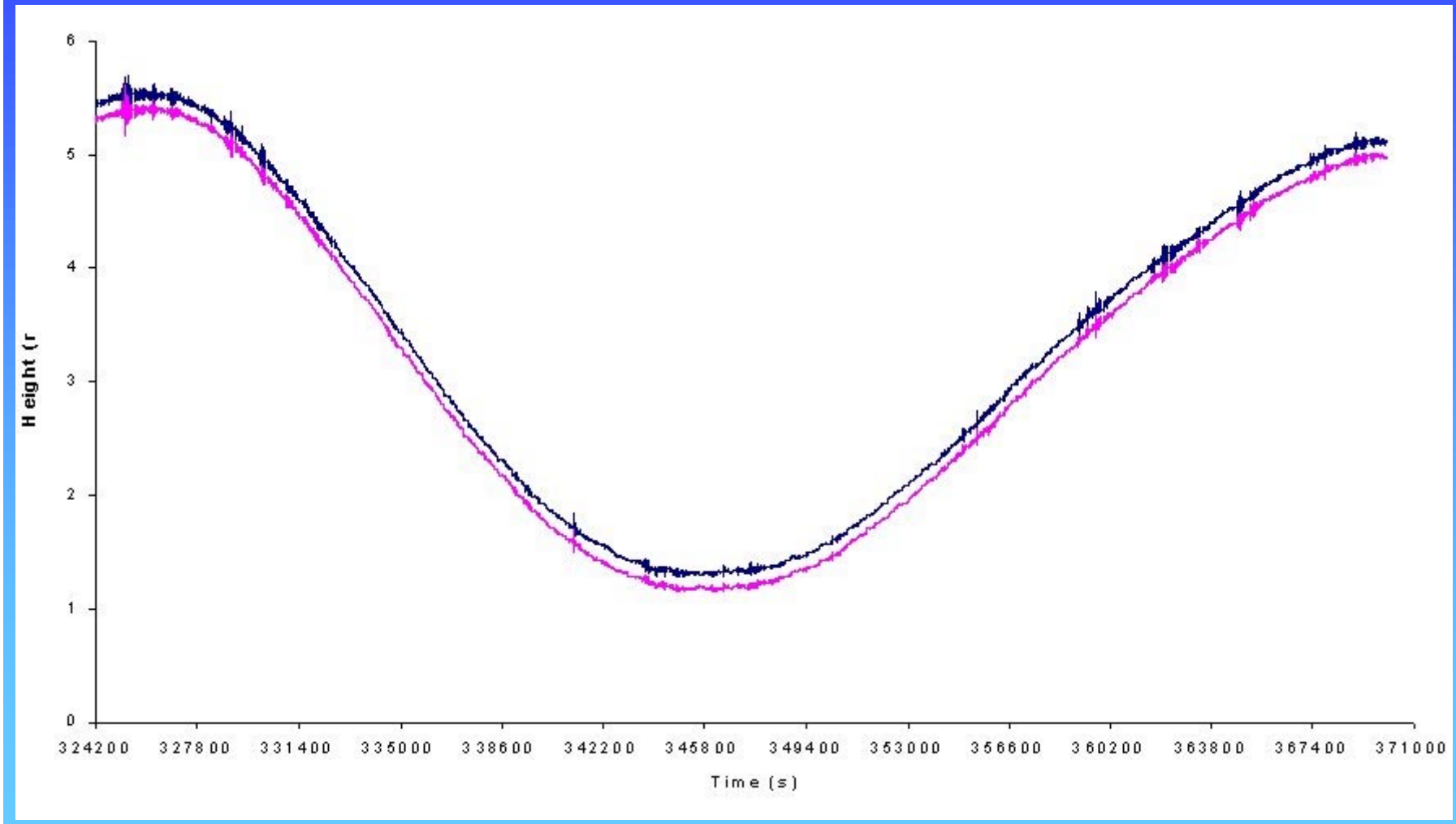
GPS Accuracy Evaluation



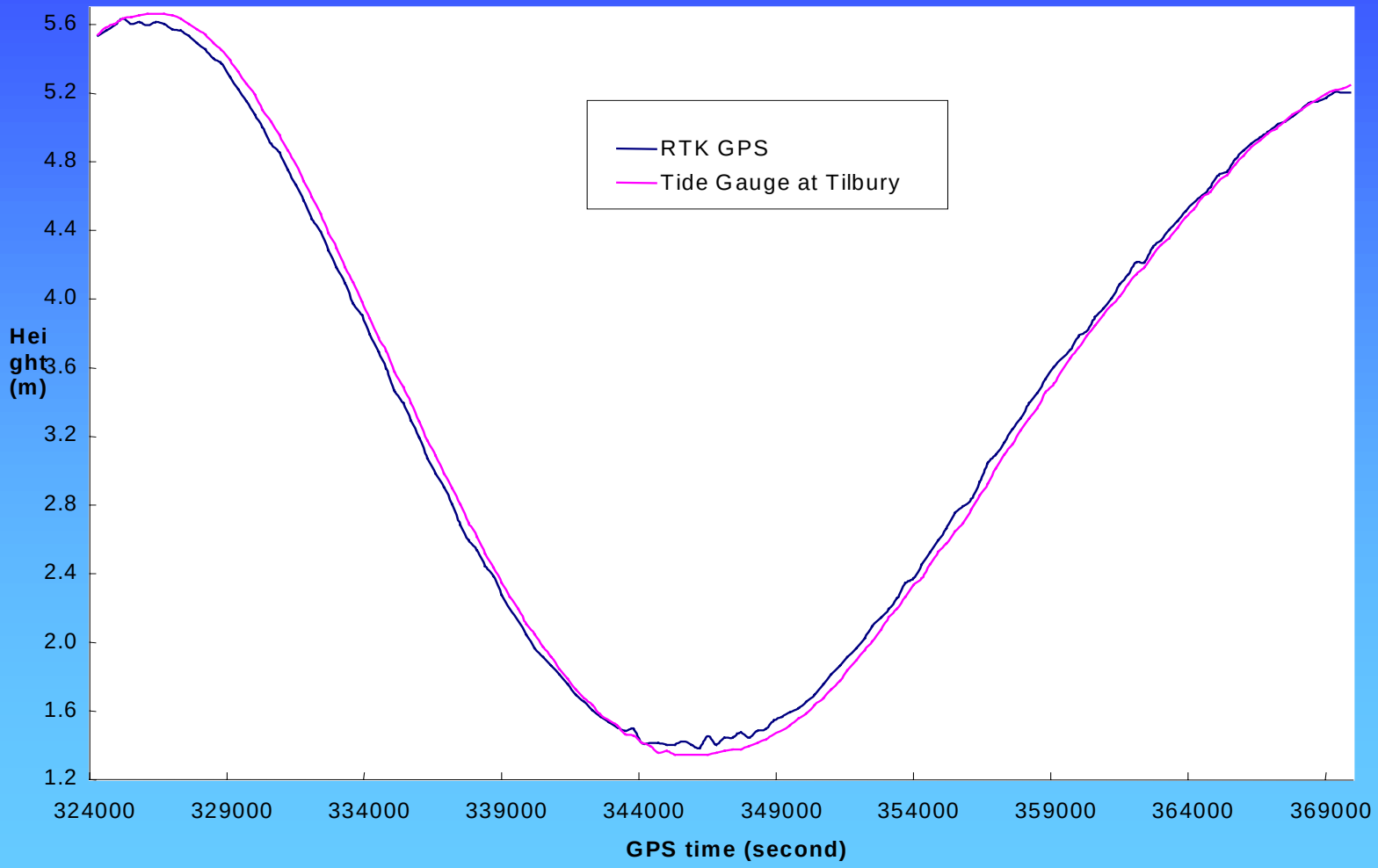
Height of Vessel



GPS Heights of Survey Boat



GPS River Level

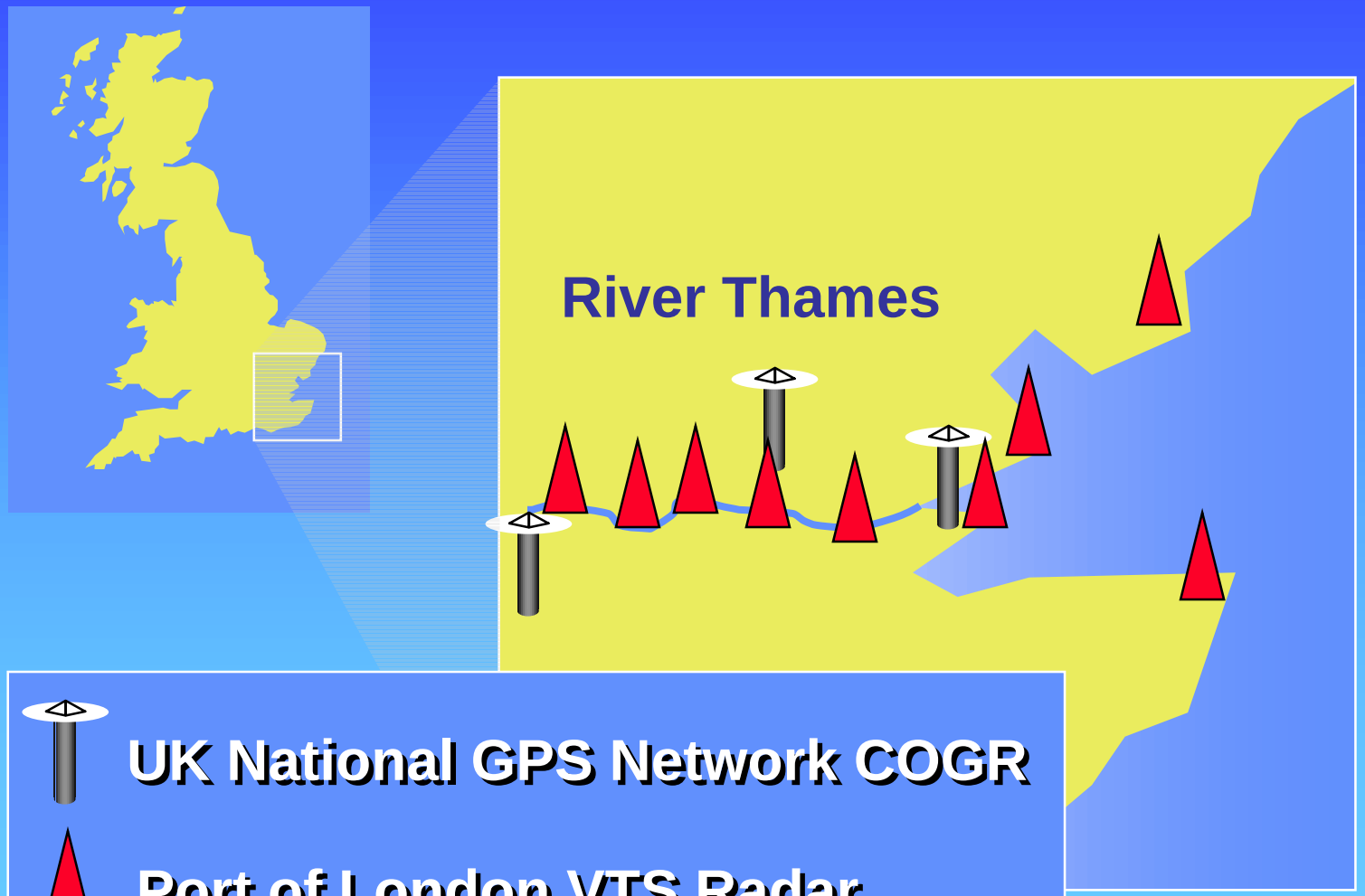


Pilot Survey of a Typical European Port

Aims

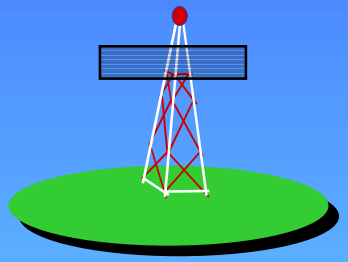
- Assess Quality of Existing Coordinates
- Identify Potential Problems
- Define Survey Procedure(s)
- Estimate Effort Required
- Estimate Scale and Cost of WGS84 Implementation

Port of London Authority

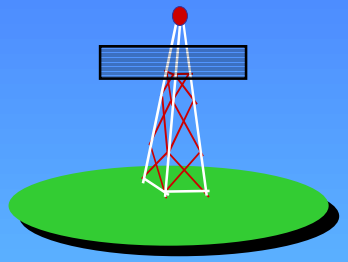


Pilot Survey

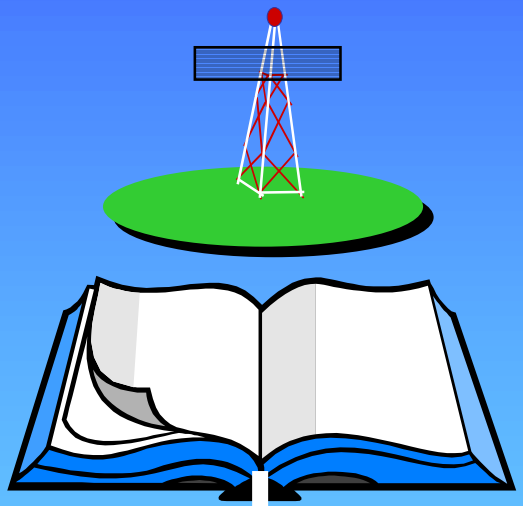
Surveyed WGS84 Coordinates



Transformed New Coords



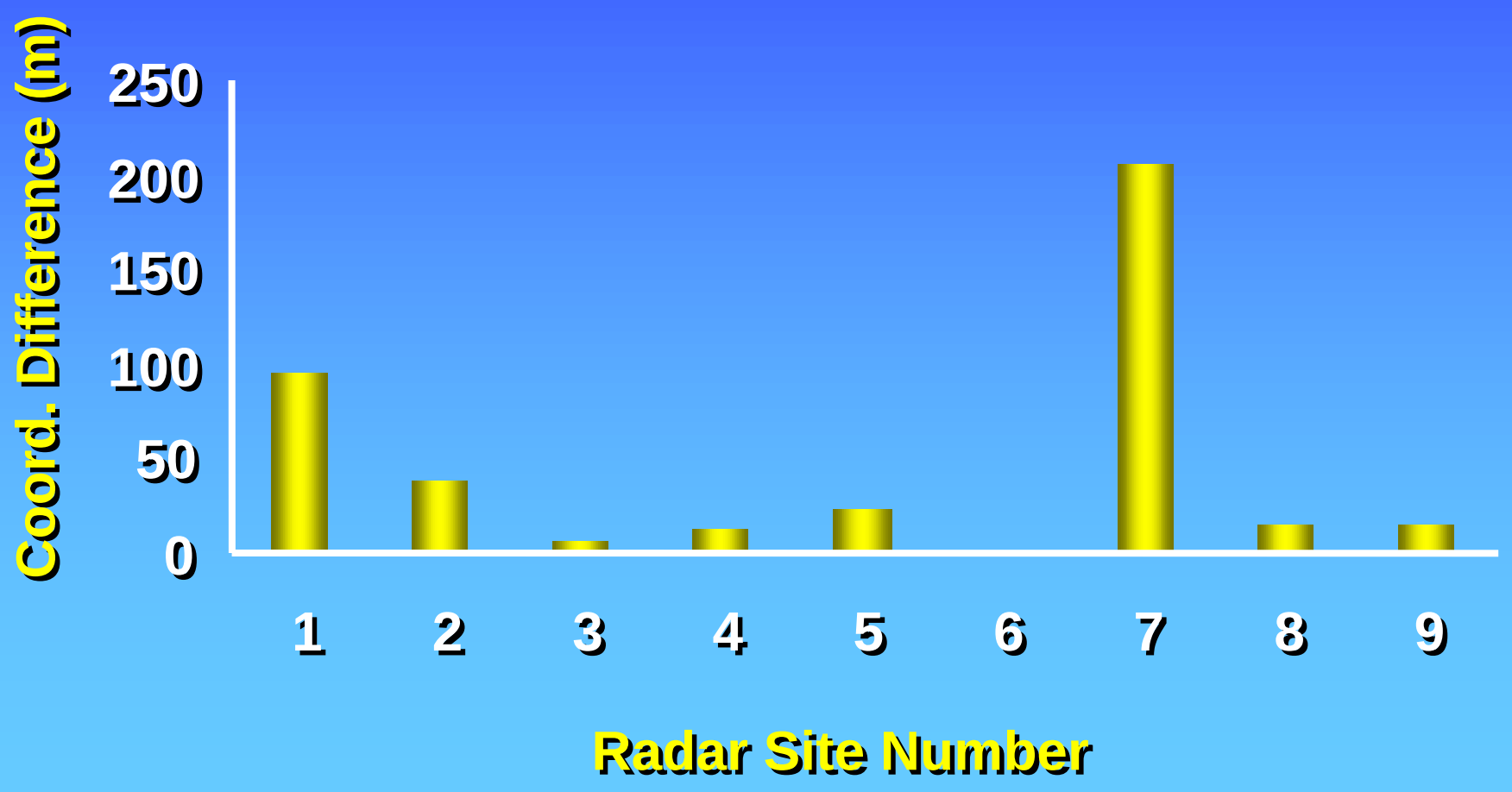
Published VTS Radar Coordinates



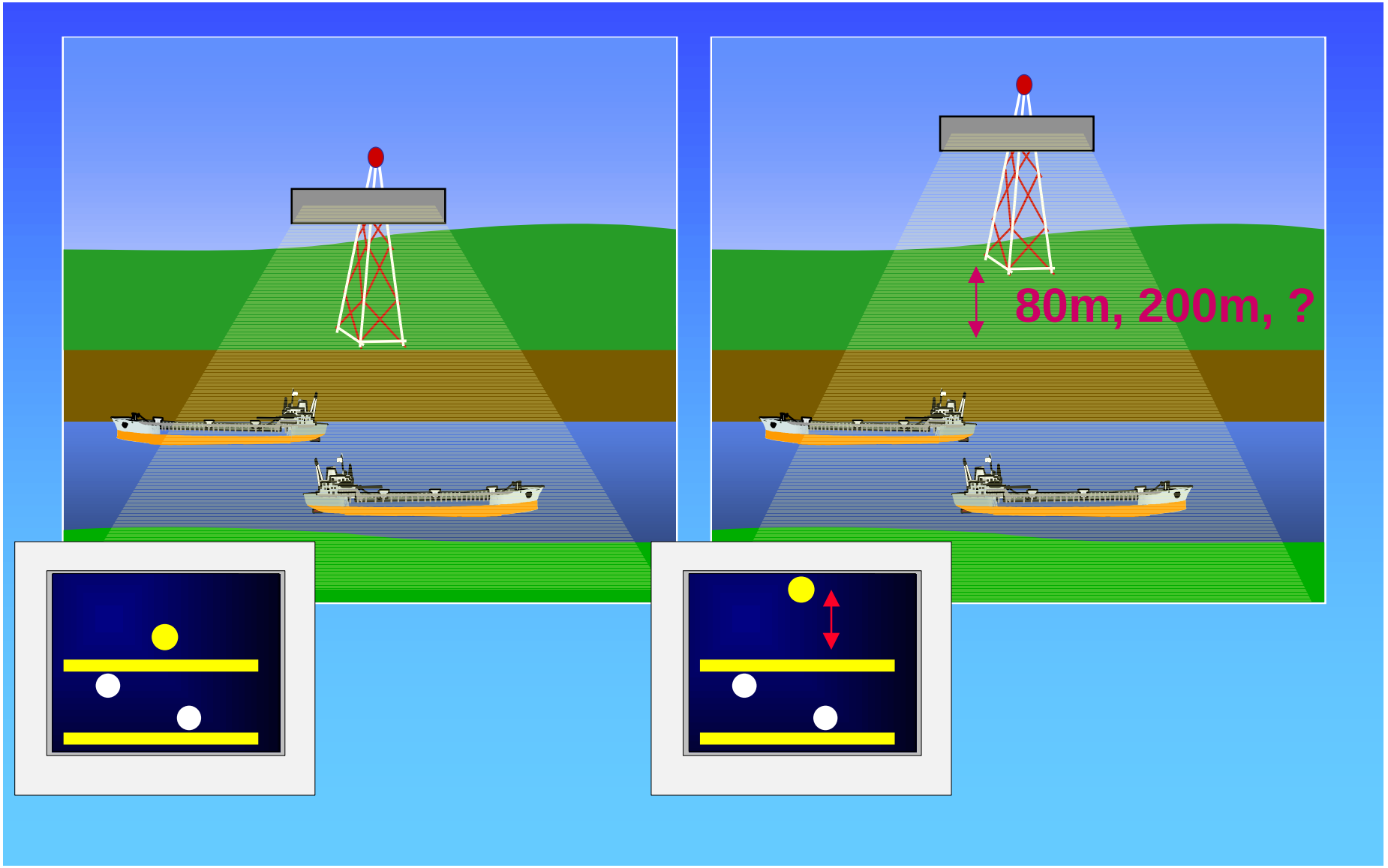
OSGB Transformation Parameters

Compare

Quality of Existing Coordinates



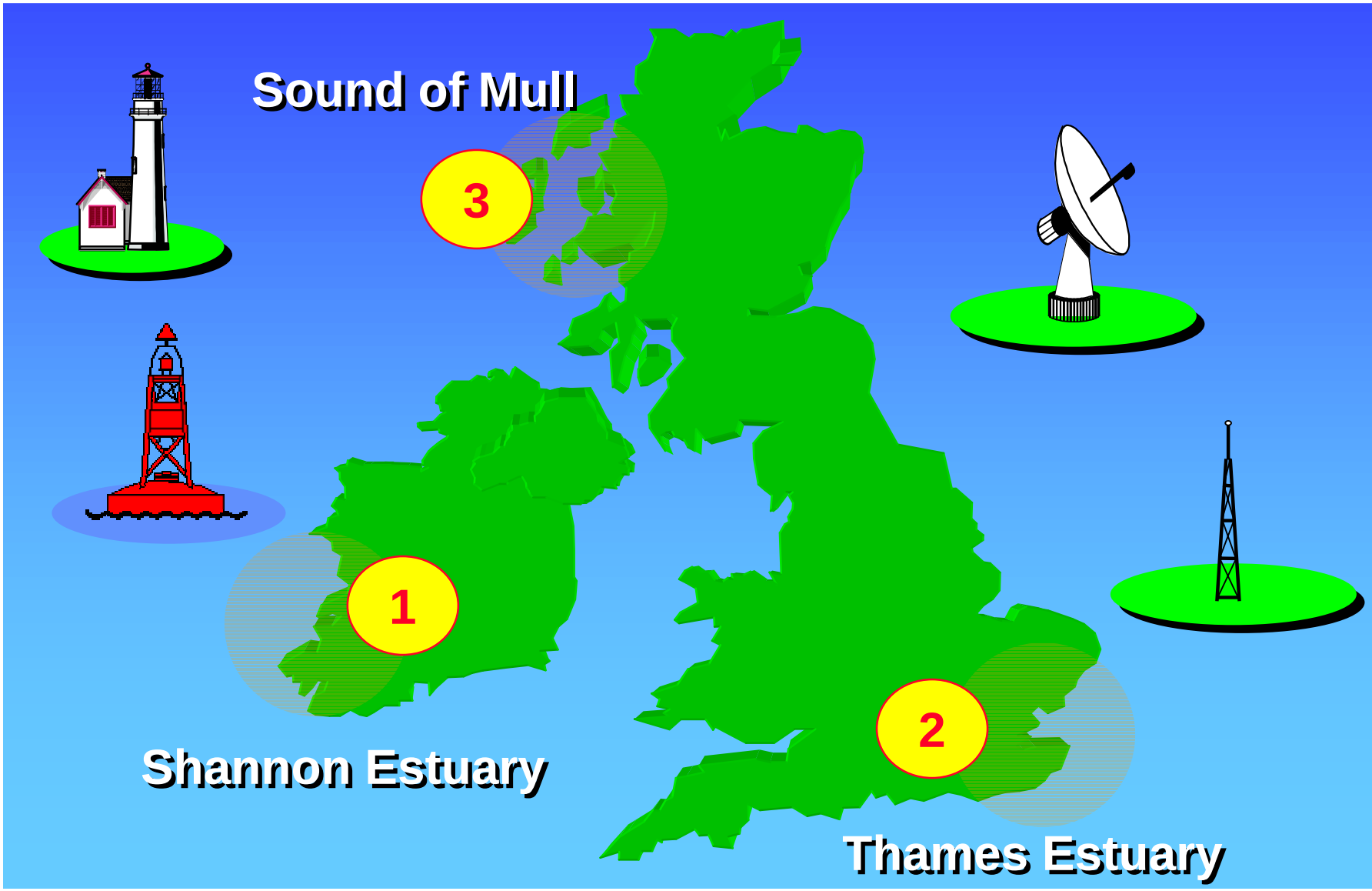
Why then no Incidents ?



Coordination of Navaids to WGS 84

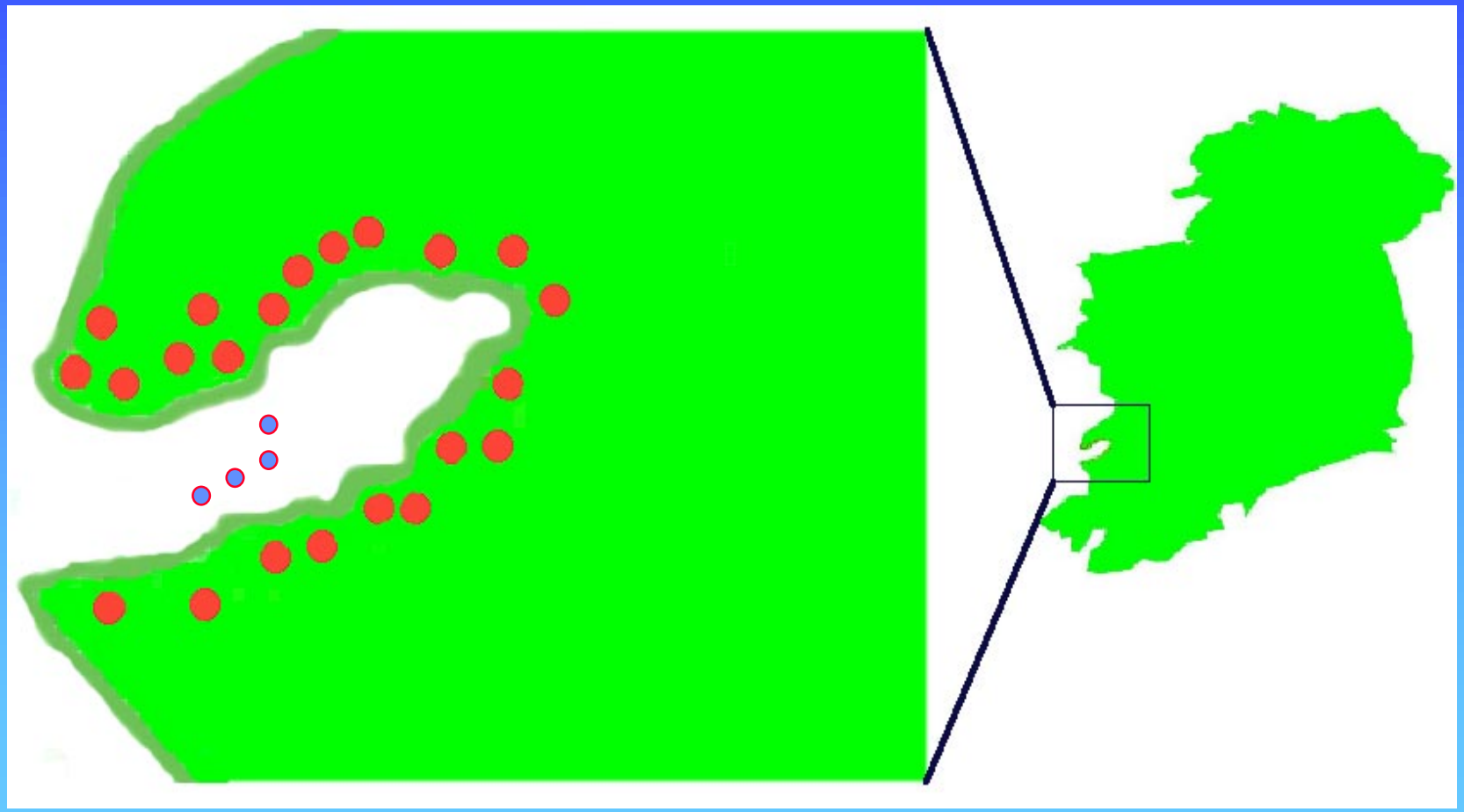
Implementation of WGS84

Coastal Aids to Navigation



Aids to Navigation

Shannon Estuary

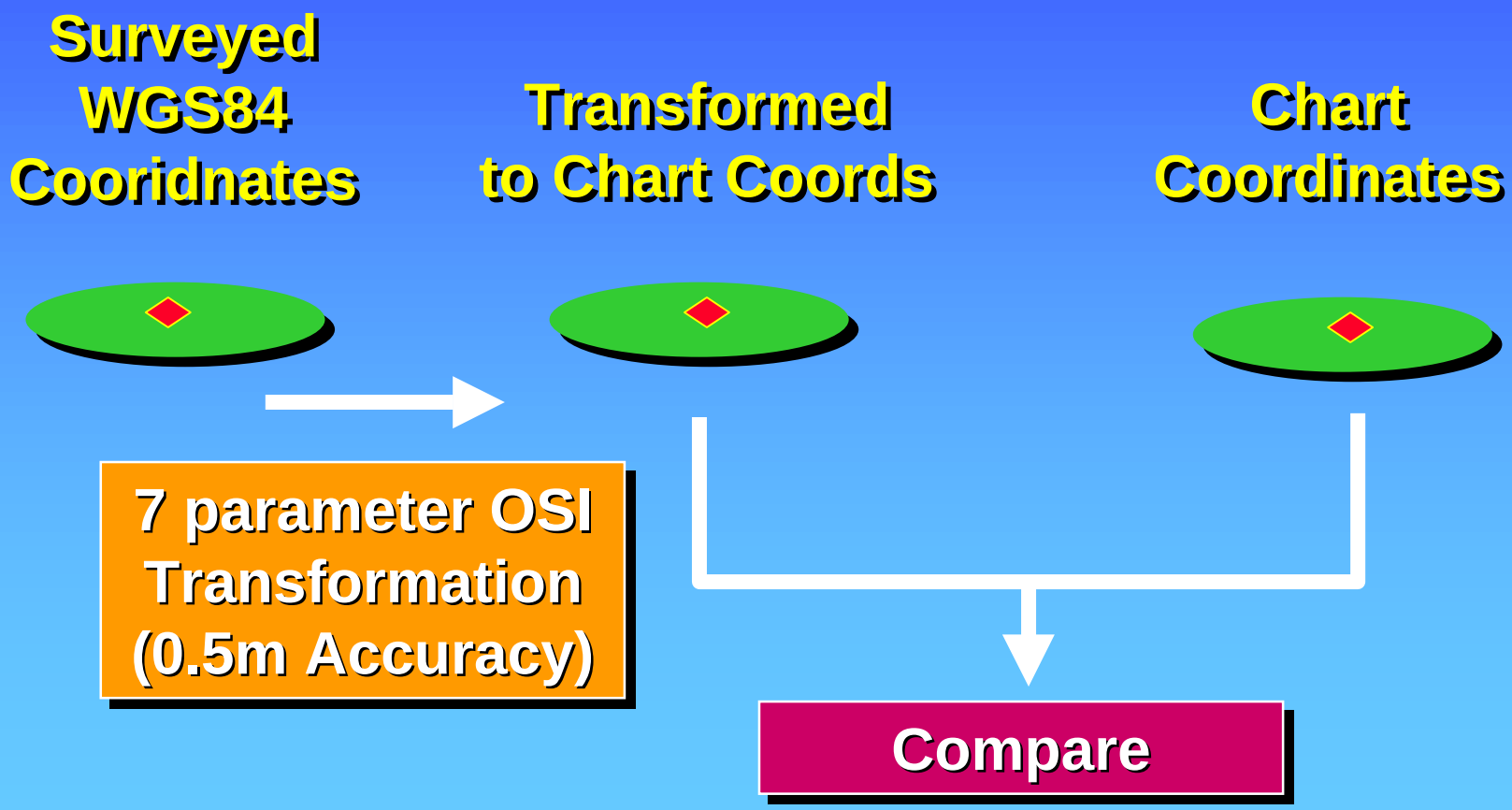


Shannon Estuary Survey Ship

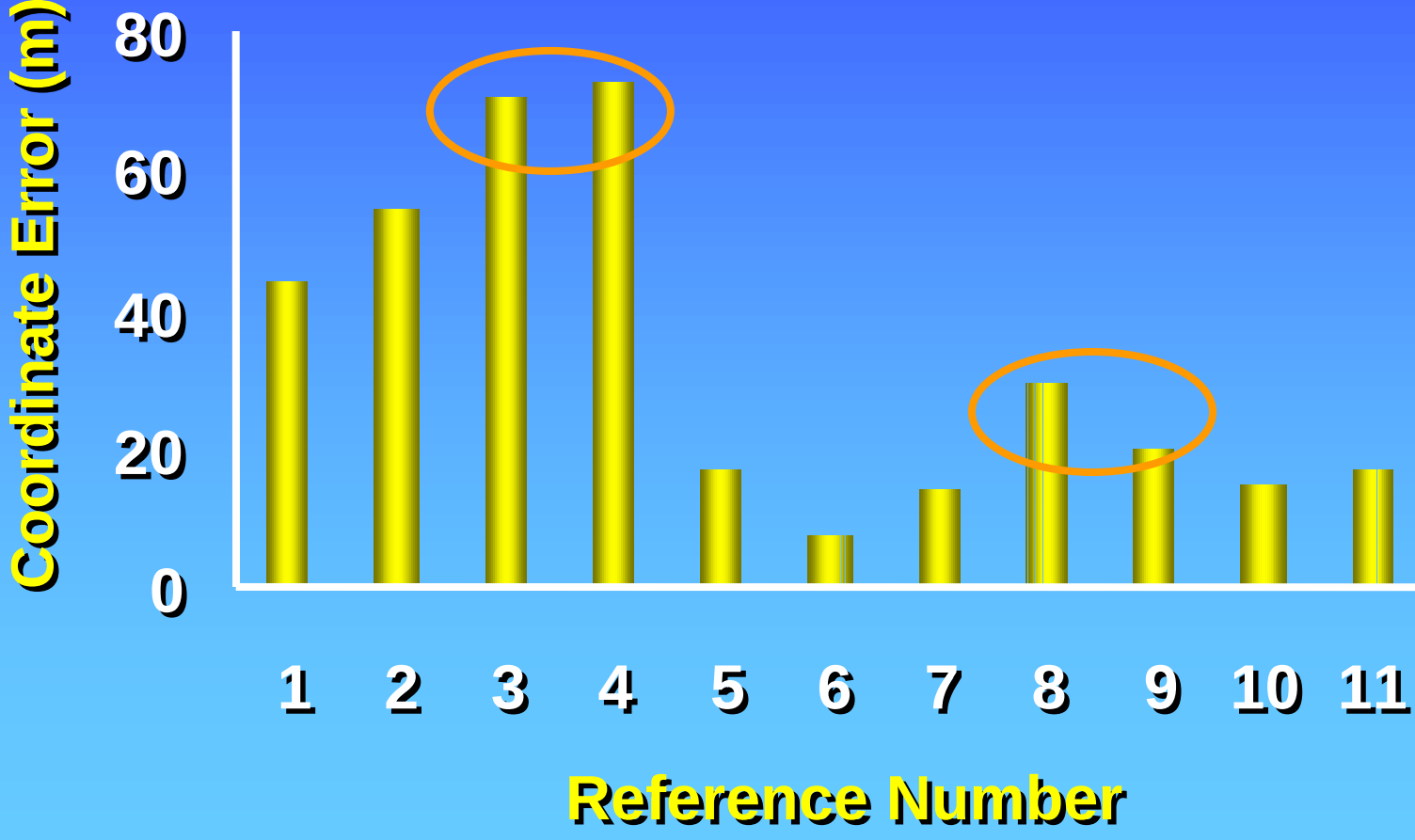
Classification of Surveyed Points

Type	Number
Lighthouse	6
Leading Light	4
Navigational Light	2
Radar Site	1
Tide Gauge	1
OSI Mark	7
Buoy	3
Others	4
Total	**28**

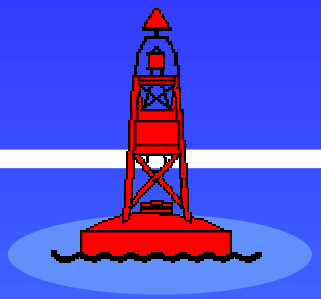
Approach

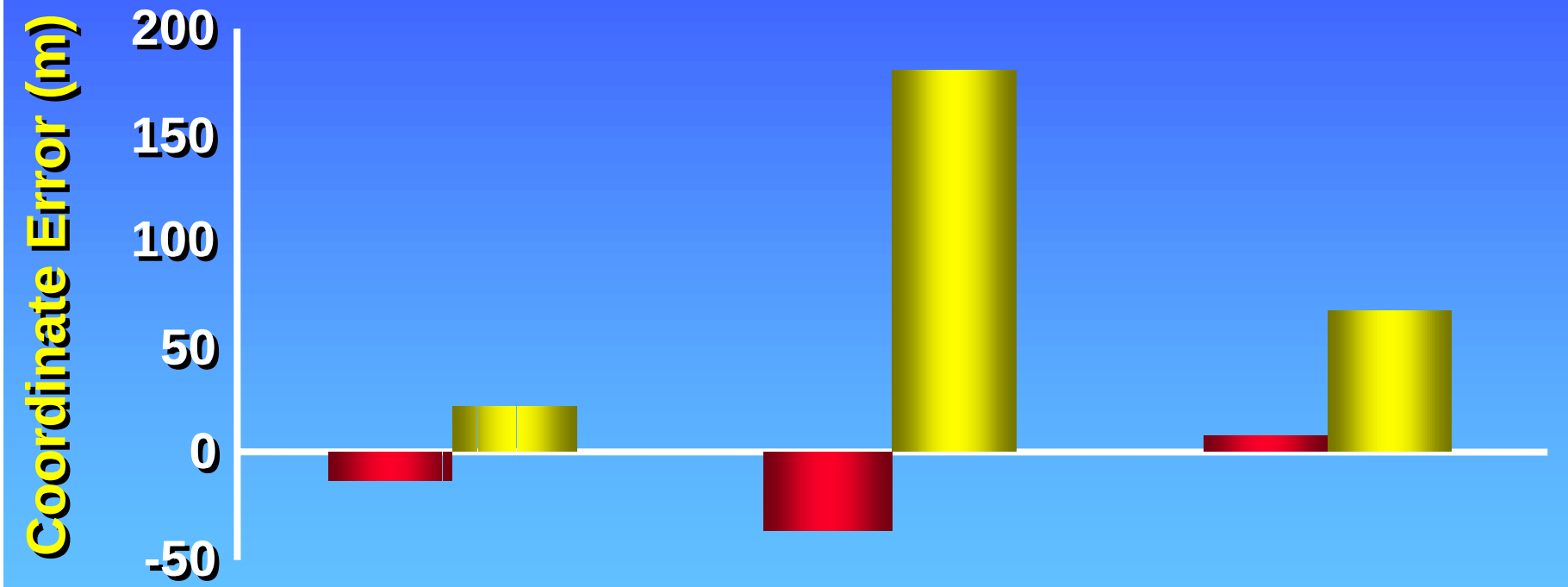

Surveyed WGS84 Cooridnates
Transformed to Chart Coords
Chart Coordinates
7 parameter OSI Transformation (0.5m Accuracy)
Compare

Lights and Lighthouses



Buoys



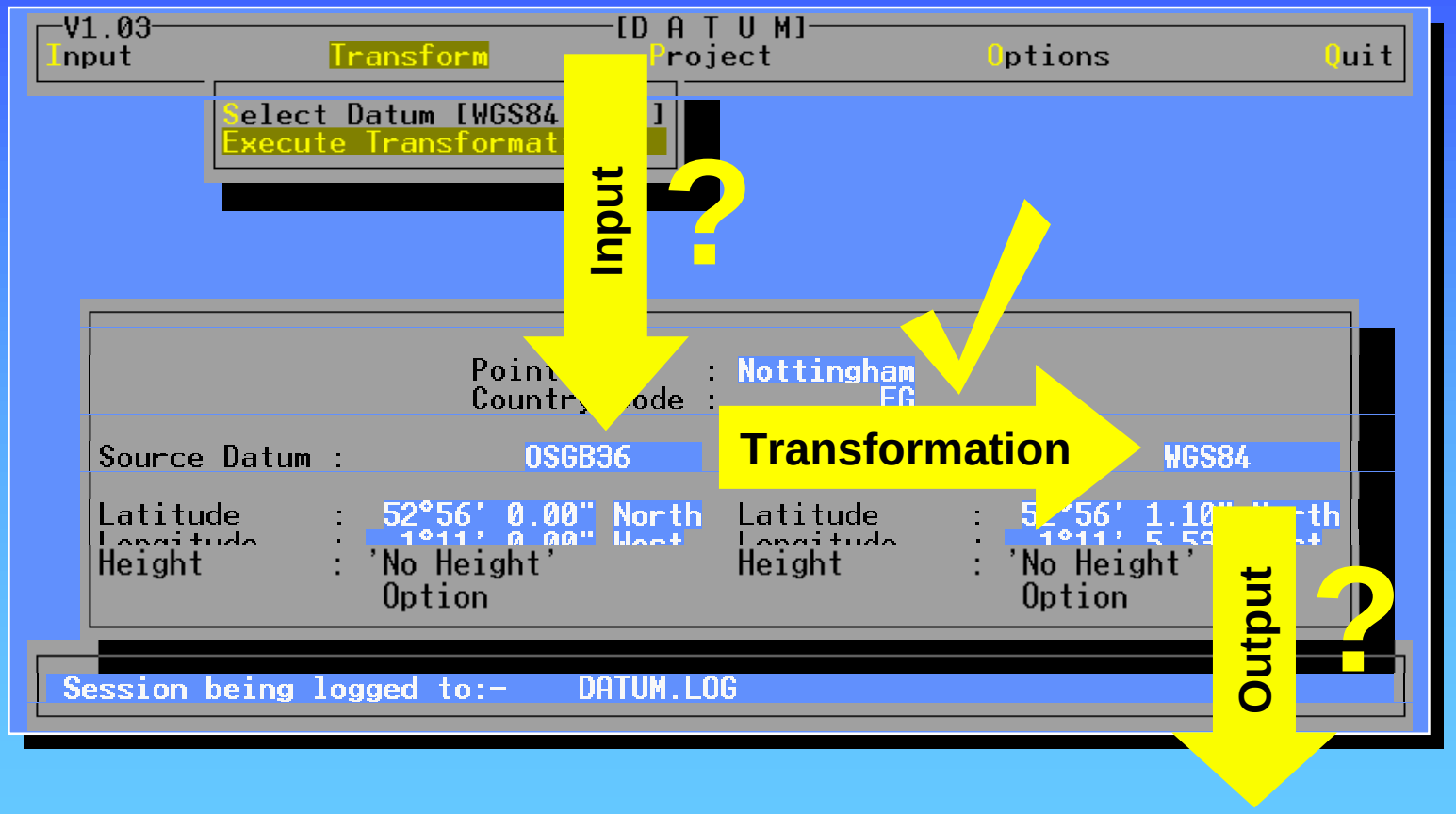

Coordinate Error (m)
200
150
100
50
0
-50
Letter Point
Beal Bar
Doonaha

VTS Radar

Brown's Castle B'Bunnion Landmark

However,

Rubbish In

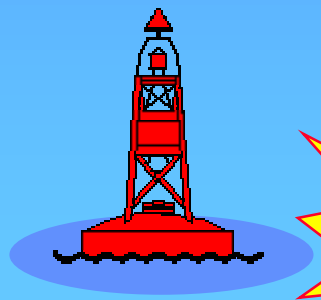


Rubbish Out

Size of the Task

343

- **Lighthouses**
  - THLS 67
  - NLB 196
  - CIL 80



743

- **Buoys**
  - THLS 413
  - NLB 185
  - CIL 147

The Broad Financial Implications

Fixed Aids to Navigation

Requirement	10cm Accuracy
Approach	Static GPS positioning
Production	5 points per day (average)
Resources	2+1 staff, plus equip & mobility

Floating Aids to Navigation

Requirement	10m Accuracy
Approach	DGPS positioning
Production	10 points per day (average)
Resources	2+1 staff, plus equip & mobility

A Recommended Approach : Navaids

1) Re-Position All Fixed Facilities

2) Re-Position all Critical Floating Aids to Navigation

3) Transform Coordinates of Non-Critical AtoN

   Provided the transformation is extensible

4) Verify Coordinates of Non-Critical AtoN

   Preferably during routine operations