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# FIG WORKING WEEK 2023

28 May - 1 June 2023 Orlando Florida USA

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New Frontiers

## The Future of Ground Marks for Geomatics: Stability and Utility

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## GPS: The Promise and The Hype

- When we only had Transit Doppler, there were lots of promise about what GPS would do when it arrived:
  - GPS will change everything
  - We don't need any ground marks, it'll all be "Marks in the Sky"
  - We'll never need total stations or anything like that again!
- Things didn't quite work out like that...

## GPS In Action

- In the Gulf War in 1991, the US managed GPS to its battlefield advantage
- Nations started to question the wisdom of placing the foundation of their geospatial infrastructure in the hands of a foreign military
- This was one of the factors driving the development of Galileo
- With the running down of the USSR, GLONASS nearly disappeared
- Recent jamming efforts of GPS signals emphasize this problem

## Relative Positioning

- Ground surveying is based on relative positioning
- Cadastral, engineering and topographic surveys all work this way
- Survey-grade GNSS gives you vectors relative to CORS (in the US)
- Ground marks are a critical part of relative positioning

## Vertical Location

- GNSS's weakest component is vertical location
- But vertical location is critical to developing models that allow conversion between ellipsoidal and orthometric heights
- We can't risk a circular definition process for heighting
- This would also weaken the utility of GNSS

## Geospatial Infrastructure

- Ground marks are a critical part of our geospatial infrastructure
- "By computerizing everything, we need to make everything explicit for the computer to use" – David Rhind
- Investing in geospatial infrastructure starts with good quality ground marks
- Placing marks is expensive, so we need to consider the return on this investment

## Different Marks or Multi-Purpose Marks

- Traditionally, we use different marks for different purposes
- It may be more efficient to make them multi-purpose
- Studies in the past have indicated significant vertical movement in all but the deepest benchmarks, which are more expensive
- Previous studies have also found that being able to co-ordinate surveys produced significant savings across broad geospatial systems, and this kind of co-ordination starts with good-quality ground marks

## Maximizing the Efficiency and Effectiveness of Ground Marks

- Regular maintenance
- Build maintenance into the project or process that established the mark
  - Note that marks may last a century or more, especially with effective maintenance
- Multi-purpose marks
- Monitor the infrastructure and risks



## Conclusions

- Physical ground marks are as important as they ever were, perhaps even more so
- Maintenance (in the broadest sense) is critical to efficient operation and to maximizing return on investment in geospatial infrastructure
- High-quality, multi-purpose marks are a good up-front investment
- We need better ways of funding infrastructure maintenance



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# Thank you!

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