GGOS and IAG Commission 4 "Positioning & Applications"

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Outline:

- **Who are we?**
- **What is special about us?** *What role could Comm4 play in GGOS?*
- **What can GGOS do for us?** *What functions can GGOS play? What value could it bring to Comm4?*
- **Comments to GGOS Reference Document**

Sub-Commissions:

- SC4.1 “Multi-sensor Systems” *(D. Brzezinska)*
- SC4.2 “Applications of Geodesy in Engineering” *(H. Kahmen)*
- SC4.3 “GNSS Measurement of the Atmosphere” *(S. Skone & H. van der Marel)*
- SC4.4 “Applications of Satellite & Airborne Imaging Systems” *(X. Ding)*
- SC4.5 “Next Generation RTK” *(Y. Gao)*

Who are we?

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Study Groups:

- SG4.1 “Pseudolite Applications in Positioning & Navigation” *(J. Wang)*
- SG4.2 “Statistics & Geometry in Mixed Integer Linear Models, with Applications to GPS & InSAR” *(A. Dermanis - joint with ICCT)*
- SG1.1 “Ionospheric Modelling and Analysis” *(C. Brunini - joint with IAG Com1 & COSPAR)* *- Dead?*
- SG1.2 “Use of GNSS for Reference Frames” *(R. Weber - joint with IAG Com1 & IGS)*

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SC4.1 "Multi-sensor Systems"

- WG4.1.1 Advances in Inertial Navigation & Error Modelling Algorithms
- WG4.1.2 Indoor & Pedestrian Navigation
- WG4.1.3 Advances in MEMS Technology & Applications

http://www.ceegs.ohio-state.edu/IAG-SC41/

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SC4.2 "Applications of Geodesy in Engineering"

- WG4.2.1 Measurement Systems for the Navigation of Construction Processes
- WG4.2.2 Dynamic Monitoring of Buildings
- WG4.2.3 Application of Knowledge-based Systems in Engineering Geodesy
- WG4.2.4 Monitoring of Landslides & System Analysis

http://info.tuwien.ac.at/ingeo/sc4/sc42.html

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SC4.3 "GNSS Measurement of the Atmosphere"

- WG4.3.1 Ionospheric Scintillation
- WG4.3.2 Performance Evaluation of Ionosphere Tomography Model
- WG4.3.3 Numerical Weather Predictions for Positioning

http://www.gmat.unsw.edu.au/iag/iag_sc43.htm

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SC4.4 "Applications of Satellite & Airborne Imaging Systems"

- WG4.4.1 Permanent Scatterer / Corner Reflector / Transponder InSAR
- WG4.4.2 Atmospheric Effects in InSAR / InSAR Meteorology
- WG4.4.3 InSAR in Polar Regions
- WG4.4.4 Imaging Systems for Ground Subsidence Monitoring

http://www.gmat.unsw.edu.au/iag/iag_sc44.htm

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SC4.5 "Next Generation RTK"

- WG4.5.1 Network RTK
- WG4.5.2 Carrier Phase Based Precise Point Positioning
- WG4.5.3 High Precision Positioning of Buoys & Moving Platforms
- WG4.5.4 Multiple Carrier Phase Ambiguity Methods & Applications

http://www.ucalgary.ca/~ygao/iag.htm

Who are we?

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What's special about IAG Comm4?

- Commission 4 topics are "applied" - *hence **not** one of the fundamental "Three Pillars of Geodesy"*
- But have close relations with IAG sister organisations - *e.g. FIG, ISPRS,…*
- Close links to survey/mapping professional bodies, GNSS communities & ION organisations…
- *Collection of "miscellaneous" topics… (good/bad?)*
- But many activities (directly or indirectly) concerned with high accuracy GNSS "navigation"…

http://www.gmat.unsw.edu.au/iag/iag_comm4.htm

What is special about us?

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What may be the role of Comm4? (1/5)

- **Interface** with IAG sister organisations - *e.g. FIG, ISPRS,ION…and other organisations*
- **Promote** Geodesy & GGOS to the wider (professional) community…
- Offer **outreach** opportunity through its conferences & seminars (often jointly organised with above bodies)…
  - Mobile Mapping Workshops, Joint FIG International Symposium on Deformation Measurements and Analysis/ IAG Symposium on Geodesy for Geotechnical and Structural Engineering, joint sessions at ION meetings, etc.
  - IAG, FIG, ISPRS, ION, geo-industry
- ***See following <u>examples</u> of DInSAR, engineering geodesy, multi-sensor systems & GNSS-RTK***

What is special about us?

What may be the role of Comm4? (2/5)

- **Currently only IAG entity involved in DInSAR (SC4.4)***…increasing importance of this "geodetic remote sensing" technology*
- Assist the IAG & GGOS to "claim" DInSAR as a space geodetic tool*…not just radar remote sensing tool… hence*
- **Interface** to outside SAR community… *IEEE/IGARSS, ISPRS*

What is special about us?

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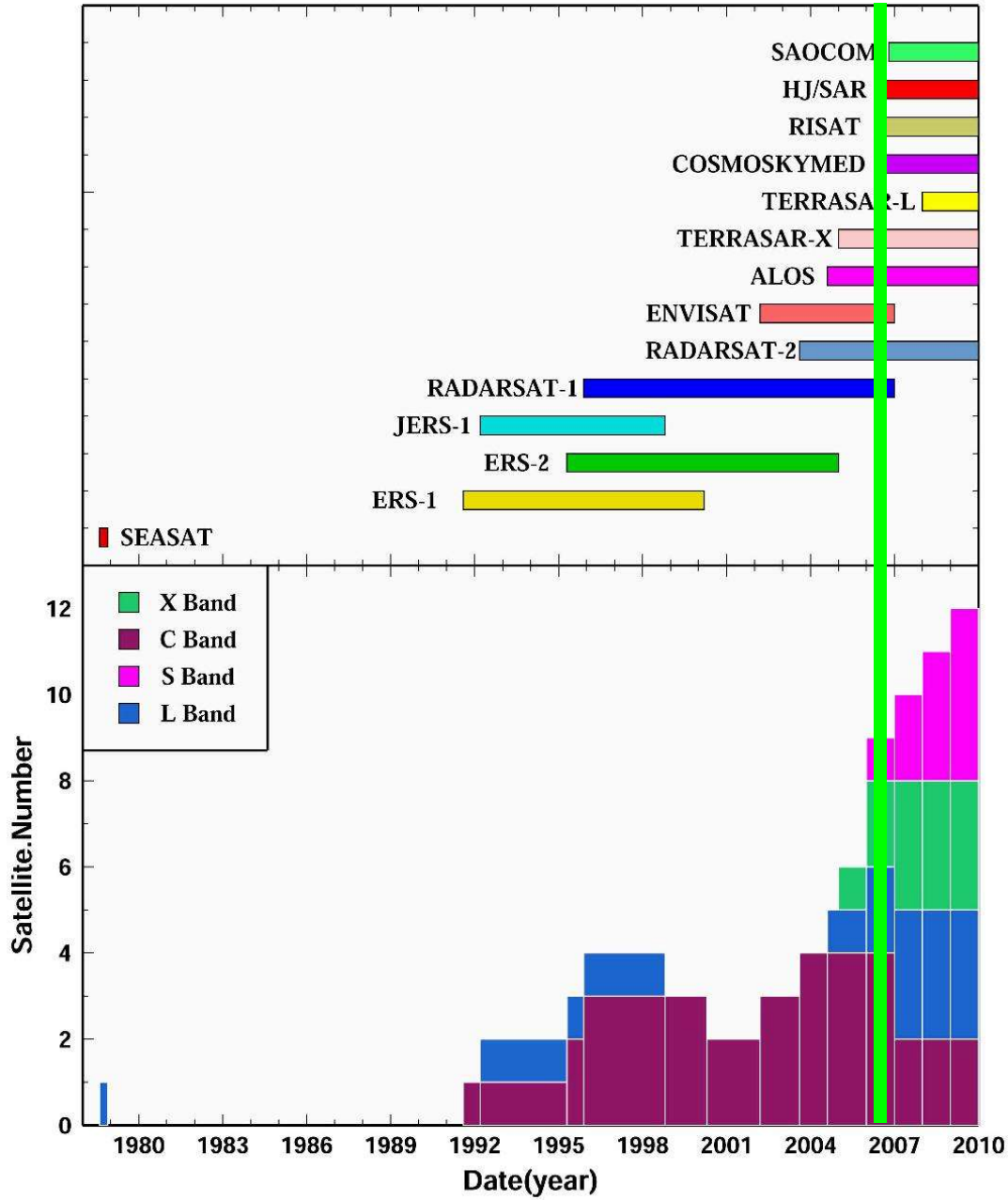

Outlook: Many Opportunities!

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What may be the role of Comm4? (3/5)

- **“Multi-sensor systems” (SC 4.1)**
- Practical connection to high-accuracy GNSS applications
- Reflect current trend: *Paradigm shift: static → kinematic, point → image, post-processing → real-time*
- Data and sensor fusion → increased automation and autonomous navigation
- Exploration of new/available “signals of opportunity”, and their integration with GNSS/IMU technology
- Seamless navigation algorithms for indoor/outdoor navigation
- New algorithmic approaches:
  - Knowledge-based systems, (Artificial Neural Networks, Fuzzy Logic, Fuzzy Kalman filtering, etc.) supporting indoor/personal navigation
  - Signal processing and advanced sensor error modeling
- Direct links to ISPRS, IEEE, ION, FIG

What may be the role of Comm4? (4/5)

- **"Engineering geodesy" (SC4.2) is small-scale counterpart to classical geodynamics***… Global Change at the local level!*
- Volcano monitoring, landslides, deforming structures*…geohazards/deformation that can be studied from a geodetic framework*
- **Interface** to outside "engineering" community, e.g. FIG & ISPRS, …
- Almost universal use of GNSS in various ways … *surveying & civil eng. see "practical geodesists" as the GNSS experts*

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Many geohazards are local!

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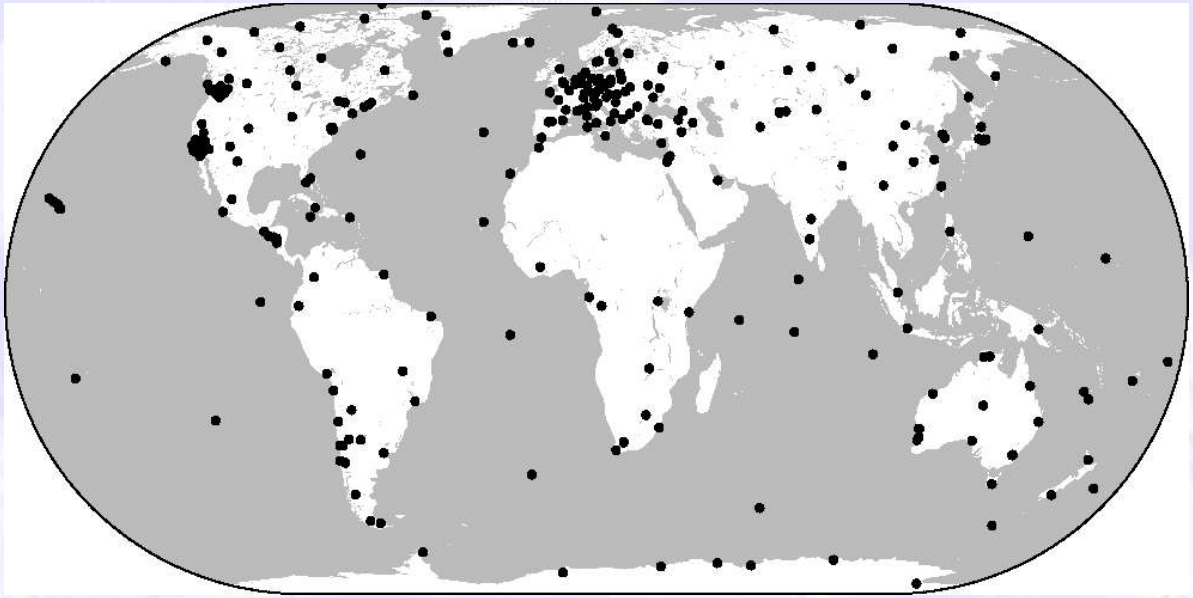
What may be the role of Comm4? (5/5)

- **"Practical" high-accuracy GNSS (SC4.5)**
  …crucial technology
- GNSS is demanding of reference frame, IGS products & CORS networks*…"blurring" of distinction between geodetic GNSS networks and state/national CORS networks…hence*
- **Interface** to outside GNSS communities …*FIG & ION*

What is special about us?



Infilling the global network with local CORSs

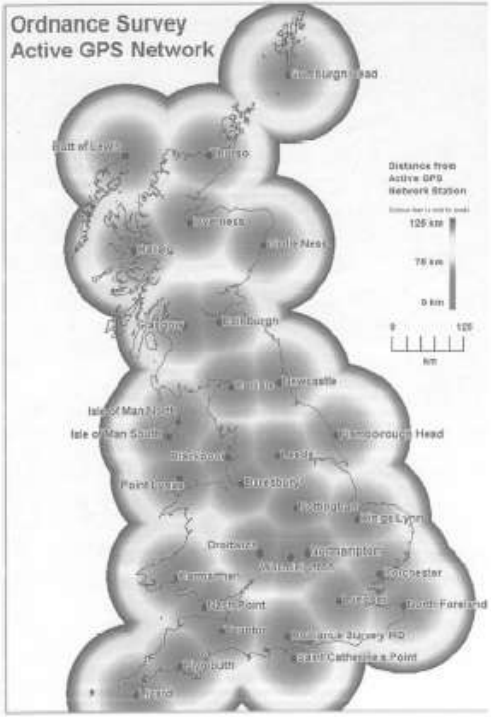


Figure 1. Distribution of Ordnance Survey's CORS's

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What does Comm4 expect from GGOS?

- Recognition of special role that Comm4 could play
  … we're part of the family!
- "Authority" to continue to represent the practical/ applied side of Geodesy … *and to help "sell" GGOS to the surveying/mapping, navigation & engineering communities*

What can GGOS do for us?

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Comments to GGOS Reference Document (1/2)

- 9.1 “Three pillars of Geodesy” *… are we part of “geometry”?*
- 9.3.1… *where does DInSAR fit? (another service?) & terrestrial techniques?*
- 9.3.3… *why not combined VLBI tracking/processing of GNSS satellites?*

Chapter 9?

Comments to GGOS Reference Document (2/2)

- No comments to Chapter 8… *seems comprehensive*
- Contributions mainly have been made to Chapter 5 **"Maintaining a modern society":**
  - Navigation
  - Engineering, Surveying & Mapping
  - Agriculture
  - Timing Applications
  - Emergency Management
  - Infomobility
  - Water Management & Hydrology
  - Ice Caps & Global Warming
  - GPS Meteorology & Space Weather
  - Energy Supply

Other Chapters?

Commission 4: A Summary of Activities

- Expanded GNSS: GPS, GLONASS & GALILEO…
- New navigation sensor technologies…
- New (deformation) measurement technologies…
- Increased number of SAR missions…
- Drive to real-time processing/operations…
- New applications in “precise navigation”, “geodetic remote sensing”, “engineering geodesy”…
- Linkages with FIG, ION, IEEE & ISPRS…
- ***Fully support the GGOS Project…***