ES1206: Advanced GNSS tropospheric products for monitoring severe weather and climate (GNSS4SWEC)

Management Committee Meeting

Golden Sands Resort, Bulgaria, Sept 11th 2014

COST is supported by the EU Framework Programme

ESF provides the COST Office through a European Commission contract

Agenda

- Wifi – Bolero freeaccess
- Action Overview
  - Finances
  - STSMs
  - Achievements
- National Reports
- Other discussion topics
  - H2020
  - Publications
  - Next Meetings

Advanced GNSS tropospheric products for monitoring severe weather and climate (GNSS4SWEC)

Action Overview

COST is supported
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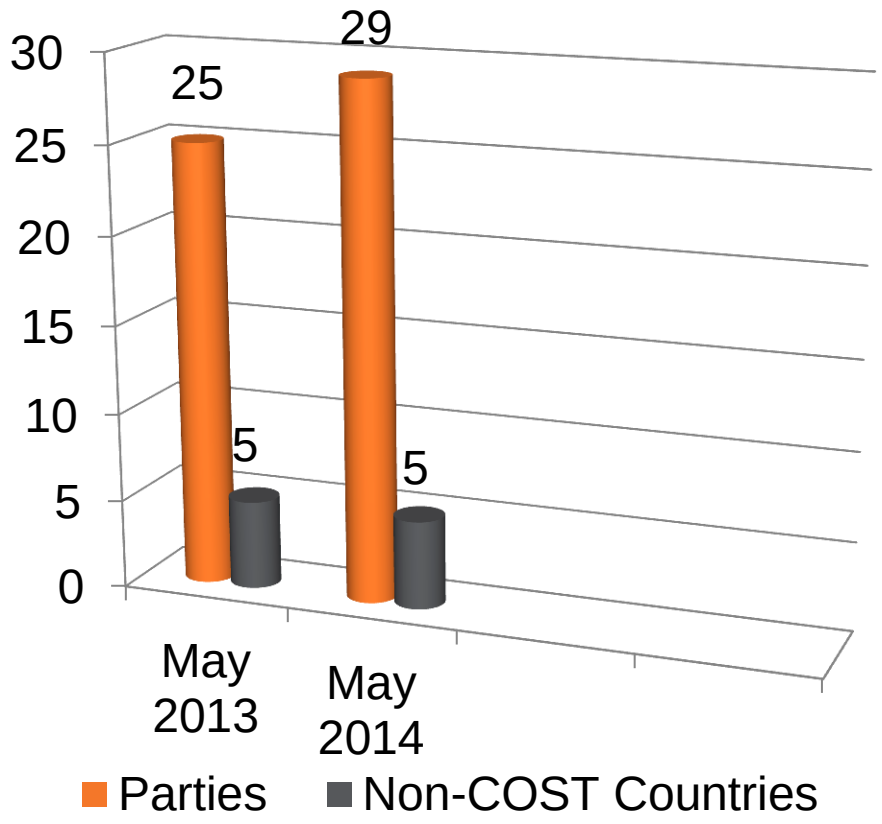
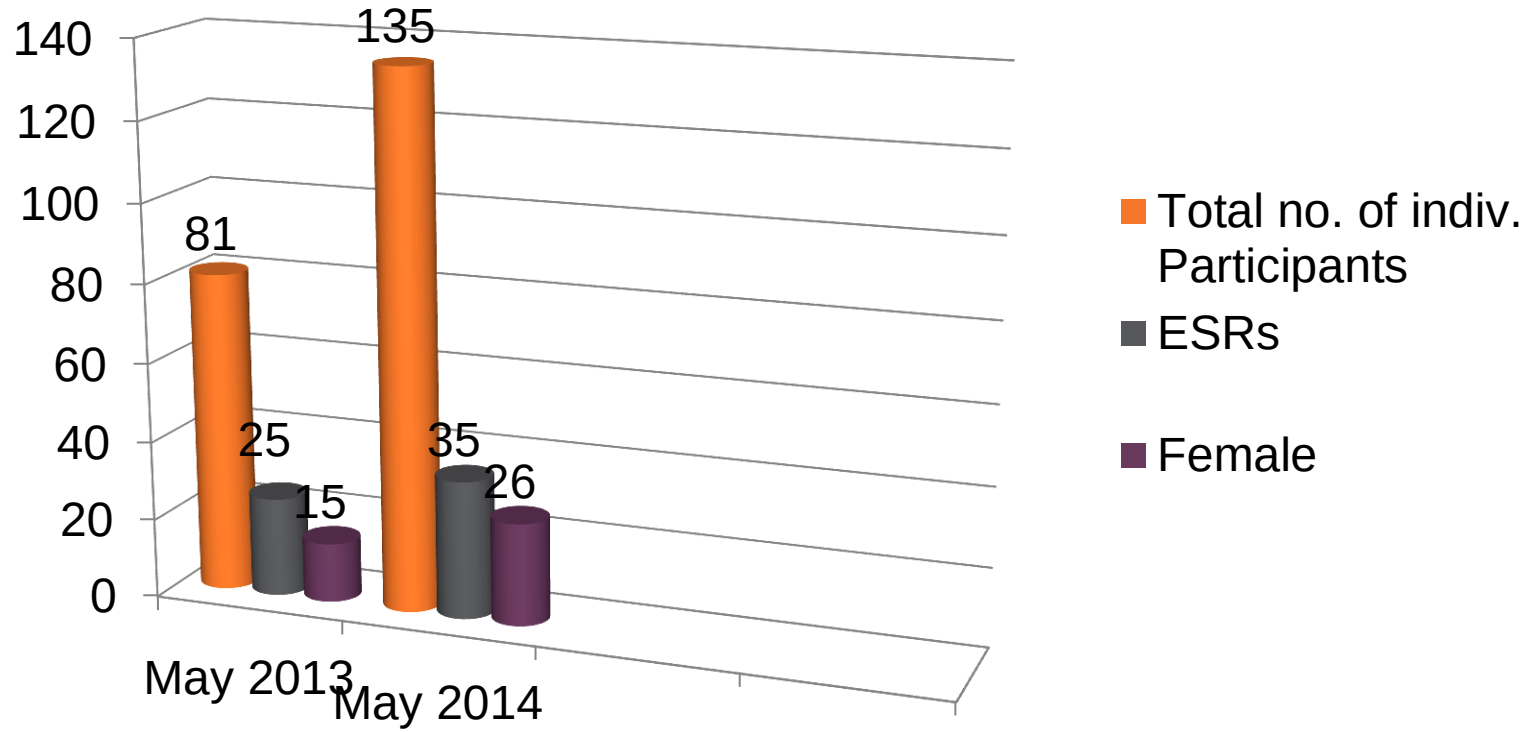
Action Parties



4 new since kick-off (Lithuania, Serbia, Turkey and Croatia)

8 NCIs involved with 3 more in the process of joining

Action participants



Year 1 Achievements

- Kick-off MC Meeting, Brussels, May 2013
- WG and MC Meeting, Valencia, Oct 2013
- Workshop held in conjunction with the ISDA, Munich, Feb 2014
- 7 STSMs completed
- Established the Action website: http://gnss4swec.knmi.nl/
- Started work 'State-of-the-art review' paper
- 22 peer reviewed publications and 13 conf. proceedings linked to Action
- Database established for climate validation (at GOP, CZ)
- Database established severe weather case studies (at Met Office, UK)
- 22 sub-groups created with allocated leaders to coordinate work
- 130+ new stations added to operational European GNSS network
- Warsaw University (PL) now processing GNSS in near real-time
- Sofia University (BG) soon to be processing GNSS (with aid of STSM)

Year 1 WG1 Deliverables

	Year 1	Year 2	Year 3	Year 4
Workshop on reviewing the state-of-the-art	X			
Support for establishment of new GNSS ACs, to cover gaps within Europe	X	X	X	X
Develop new multi-GNSS processing algorithms (GPS+GLONASS+Galileo ready) in collaboration with the IGS and EUREF working groups	X	X	X	X

Year 1 WG2 Deliverables

	Year 1	Year 2	Year 3	Year 4
Workshop on reviewing the state-of-the-art	X			
Review/define requirements for data exchange format for GNSS gradients, slant delays etc in collaboration with WG1	X			
Set up atmospheric NWP data repository for support of GNSS positioning in collaboration with WG1	X			
Identify periods of severe weather cases to define WG1 campaign periods (for estimation of gradients, slant delays etc	X			

Year 1 WG3 Deliverables

	Year 1	Year 2	Year 3	Year 4
Workshop on reviewing the state-of-the-art	X			
Set up database of reprocessed tropospheric products in close collaboration with IGS and EUREF working groups and in cooperation with WG1	X			
Develop, evaluate and standardize methods of ZTD to IWV conversion in collaboration with WG1 and WG2	X	X		
Detect and mitigate discontinuities in the ZTD and IWV time series.	X	X	X	X

Year 1 STSM Topics

Name	From	To	Title
Furqan Ahmed	Luxenbourg	France	Impact of Assimilating GNSS-derived ZTD from Luxembourg and the Greater Region into NWP model AROME
Kalev Rannat	Estonia	Germany	Improved processing and use of GNSS Zenith Total Delay and Integrated Water Vapor data for Climatolo
Tomasz Hadas	Poland	Canada	Neutral atmosphere delay model for Precise Point Positioning
Witold Rohm	Poland	UK	Application of GNSS tomography for severe weather studies
Pavel Vaclavovic	Czech Republic	ROB	Developing of ultra-fast tropospheric products
Tzvetan Simeonov	Bulgaria	Luxenbourg	Tropospheric products processing for Bulgarian ground-based GNSS network
Peter Szabo	Hungary	Bulgaria	Tropospheric products from GNSS and ALADIN-Climate regional climate model for East-Southeast Europe

Year 2 STSM Topics

Name	From	To	Title
Jan Dousa	Czech Republic	Turkey	Installing new analysis center for near real-time GNSS troposphere monitoring in Turkey
Jan Dousa	Czech Republic	Greece	Installing new analysis center for near real-time GNSS troposphere monitoring in Greece
Gokhan Gurbuz	Turkey	Hungary	Develop a near real-time GNSS processing system for the Turkish GNSS stations (Istanbul and Ankara).
Karina Wilgan	Poland	Switzerland	Parameterized refractivity models and GNSS path delays in view of GNSS Severe Weather Monitoring
Riccardo Biondi	Italy	Belgium	GNSS atmospheric water vapour detection for extreme events
Rita Nogherotto	Italy	La Reunion	Tropical cyclone intensification, water vapor distribution and GNSS measurements

Excellent participation thus far !

1st WG and MC Meeting, Valencia, September, 2013

1st Workshop, Munich, February, 2014

Year 1 Financial Overview

Instrument	Budget	Rolling workplan			
		Forecasts	Estimations	Claims	Payments
>> Meetings	**EUR 134 760.00**	EUR 129 560.00	EUR 137 690.00	EUR 118 826.75	**EUR 118 965.28**
>> Training Schools	**EUR 0.00**	EUR 0.00	EUR 0.00	EUR 0.00	**EUR 0.00**
>> Short Term Scientific Missions	**EUR 18 000.00**	EUR 20 000.00	EUR 12 610.00	EUR 12 610.00	**EUR 12 610.00**
>> Dissemination	**EUR 8 000.00**	EUR 4 999.00	EUR 2 999.00	EUR 2 999.00	**EUR 2 999.00**
>> Other Expenses Related To Scientific Activities	**EUR 0.00**	EUR 0.00	EUR 0.00	EUR 0.00	**EUR 0.00**
TOTAL EXPENDITURE	**EUR 160 760.00**	EUR 154 559.00	EUR 153 299.00	EUR 134 435.75	**EUR 134 574.28**

Year 2 Financial Forecast

Instrument	Budget	Rolling workplan			
		Forecasts	Estimations	Claims	Payments
>> Meetings	**EUR 123 380.00**	EUR 62 500.00	EUR 42 760.00	EUR 27 203.82	EUR 10 517.33
>> Training Schools	***EUR 33 300.00***	EUR 41 340.00	EUR 36 440.00	EUR 8 172.17	EUR 568.96
>> Short Term Scientific Missions	**EUR 16 000.00**	EUR 16 000.00	EUR 9 845.00	EUR 7 345.00	EUR 825.00
>> Dissemination	**EUR 2 000.00**	EUR 2 000.00	EUR 0.00	EUR 0.00	EUR 0.00
>> Other Expenses Related To Scientific Activities	**EUR 0.00**	EUR 0.00	EUR 0.00	EUR 0.00	EUR 0.00
TOTAL EXPENDITURE	**EUR 174 680.00**	EUR 121 840.00	EUR 89 045.00	EUR 42 720.99	EUR 11 911.29

Year 2 Activities

- Training School, Bulgaria, Sept 2014
- WG and MC meetings, Bulgaria, Sept 2014
- MC Meeting + 2nd Action Workshops, Thessaloniki, early May 2015
  - WG1: Ultra-fast and multi-GNSS products
  - WG2: Strengths/weaknesses of NWP in GNSS
  - WG3: Assessment of reprocessed GNSS products
  - Suggested guest speakers?
- 6 STSMs already planned

WG1 Deliverables

	Year 1	Year 2	Year 3	Year 4
Support for establishment of new GNSS ACs, to cover gaps within Europe	X	X	X	X
Develop new multi-GNSS processing algorithms (GPS+GLONASS+Galileo ready) in collaboration with the IGS and EUREF working groups	X	X	X	X
GNSS processing workshop on 1) ultra-fast/real-time tropospheric products for nowcasting and on 2) exploitation of NWP data in real-time GNSS data processing		X		
Develop tropospheric models based on NWP data for enhancing real-time GNSS processing in close collaboration with WG2		X	X	X
Develop new operational GNSS tropospheric products (gradients, slant delays, 3D water vapour and refractivity by tomographic reconstruction) in close coordination with WG2		X	X	X

WG2 Deliverables

	Year 1	Year 2	Year 3	Year 4
GNSS NWP workshop: Strengths and weaknesses of the current NWP models regarding assimilation of ground-based GNSS data		X		
Establish database of obs. and products for severe weather case studies		X	X	X
Evaluation of data quality of GNSS processing algorithms including GLONASS		X	X	
Evaluation of new operational GNSS tropospheric products (gradients, slant delays, 3D tomography) based on selected test cases in collaboration with WG1		X	X	X
GNSS nowcasting workshop on tools and practices for monitoring and forecasting severe weather			X	
QC of the operational GNSS tropospheric products delivered by the new ACs		X	X	X
Develop/fine tune and test methods for initialisation of NWP models with the new GNSS troposheric products		X	X	X
Test impact of new operational GNSS troposheric products for selected severe weather cases		X	X	X

WG3 Deliverables

	Year 1	Year 2	Year 3	Year 4
Develop, evaluate, and standardize methods of ZTD to IWV conversion in collaboration with WG1 and WG2.	X	X		
Detect and mitigate discontinuities in the ZTD and IWV time series.	X	X	X	X
GNSS climate workshop on the assessment of reprocessed GNSS tropospheric products.		X		
Exploit reprocessed GNSS tropospheric products for evaluation of NWP reanalysis products, in collaboration with WG2 (e.g. ERA-Interim, MERRA, CFSR) and climate models simulations (e.g. IPCC-AR5, CORDEX) in collaboration with climate community.		X	X	X
Development of relevant diagnostics and indexes for quantifying climate trends and variability.		X	X	X

Summary of Year 2 Objectives

- Coordinate development of new GNSS tropospheric products
- Develop models which input NWP data to real-time GNSS processing schemes
- Evaluate the quality and assess impact of new GNSS products (slants, gradients etc) for severe weather
- Develop diagnostic tools for quantifying climate trends and variability
- Assess impact of reprocessed GNSS tropospheric products in NWP reanalysis and in climate models
- Populate Severe weather and climate databases
- Improve connection with climate + forecaster communities
- Finish ‘State-of-the-art review’ paper

Advanced GNSS tropospheric products for monitoring severe weather and climate (GNSS4SWEC)

National Status Reports

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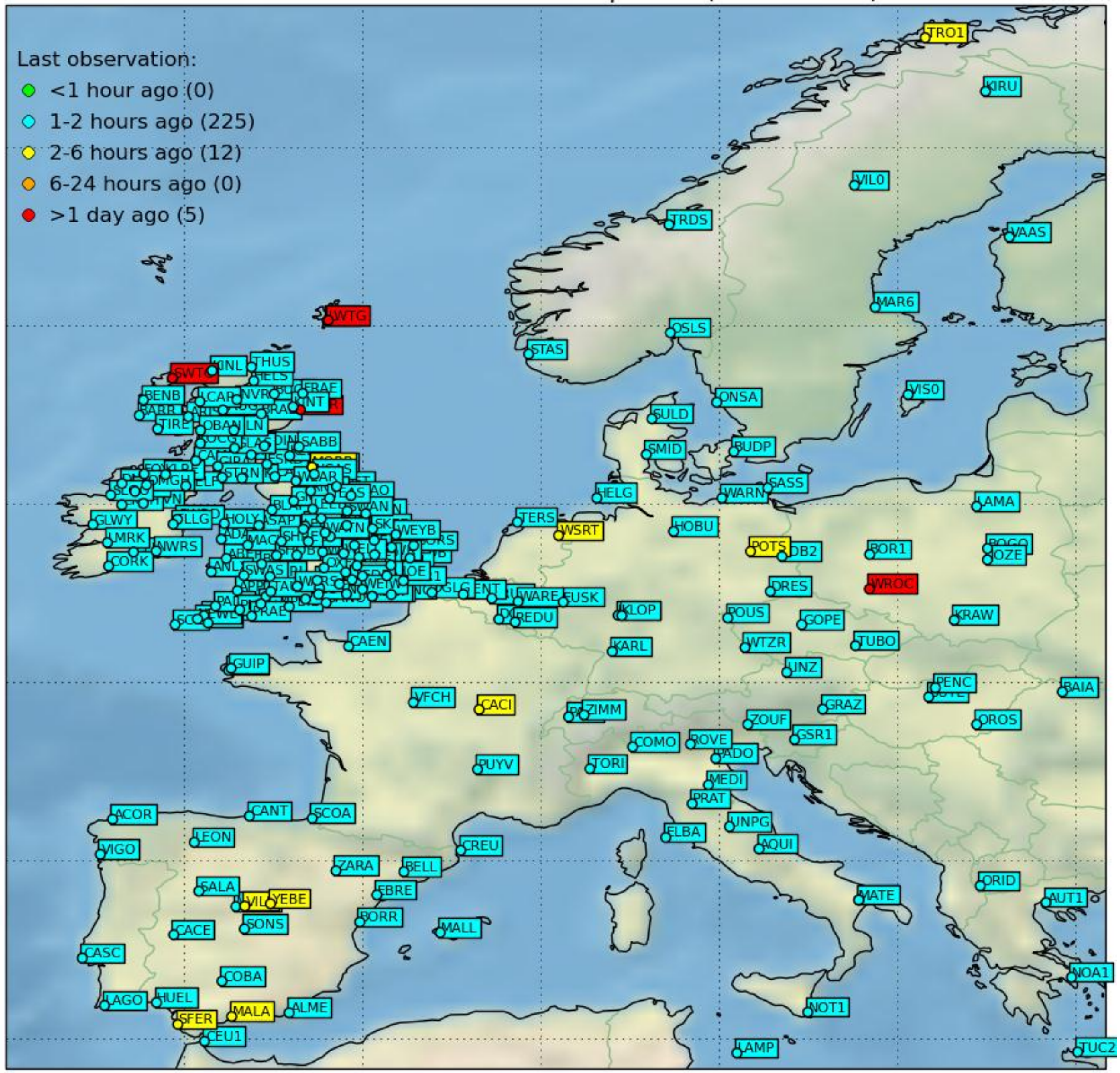
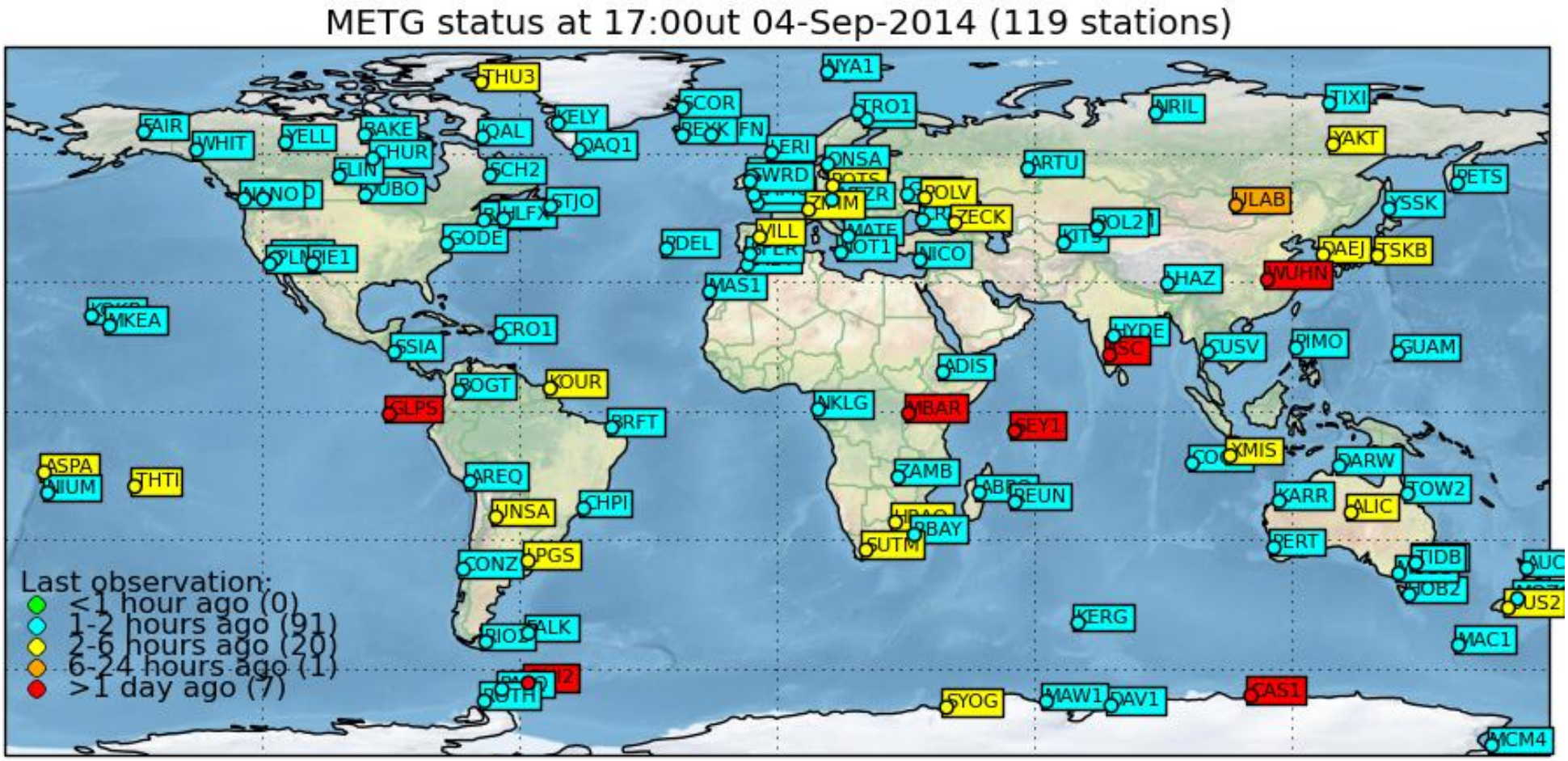
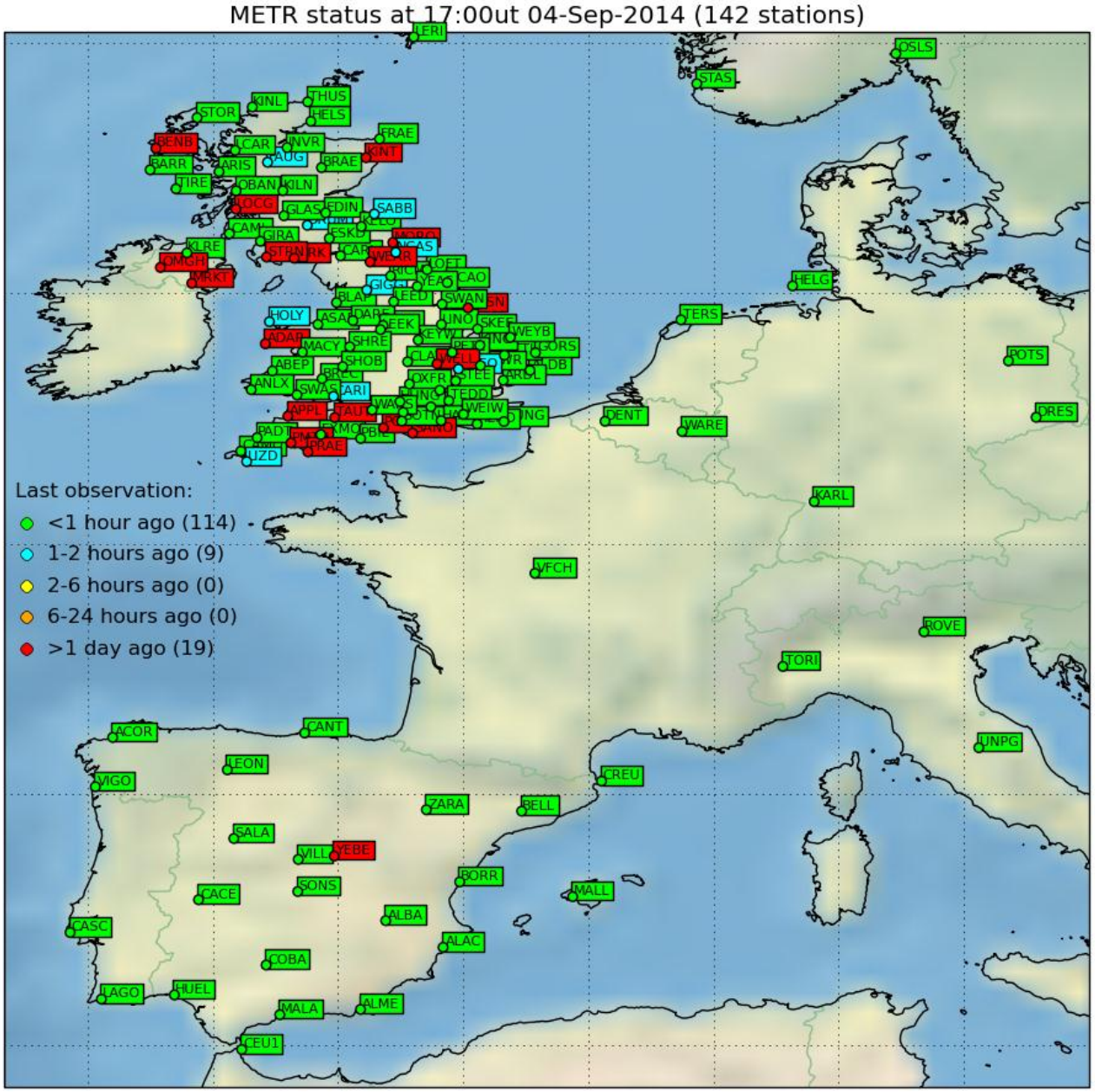
GNSS-Met status in the UK

- MoUs in place with national GNSS data providers
- 5 Operational GNSS processing systems
  - METO, European, hourly, ZTD/IWV
  - METG, Global, hourly, ZTD/IWV
  - METR, UK-specific, 15min, ZTD/IWV (RINEX from ntrip)
  - METI, Global, hourly, TEC
  - METT, Global, 15min, TEC
- All based around BSW50 in DD mode
- Operational assimilation into UK and Global NWP models
- UKV moving to 4DVAR (METR data operational)

METO status at 17:00ut 04-Sep-2014 (242 stations)



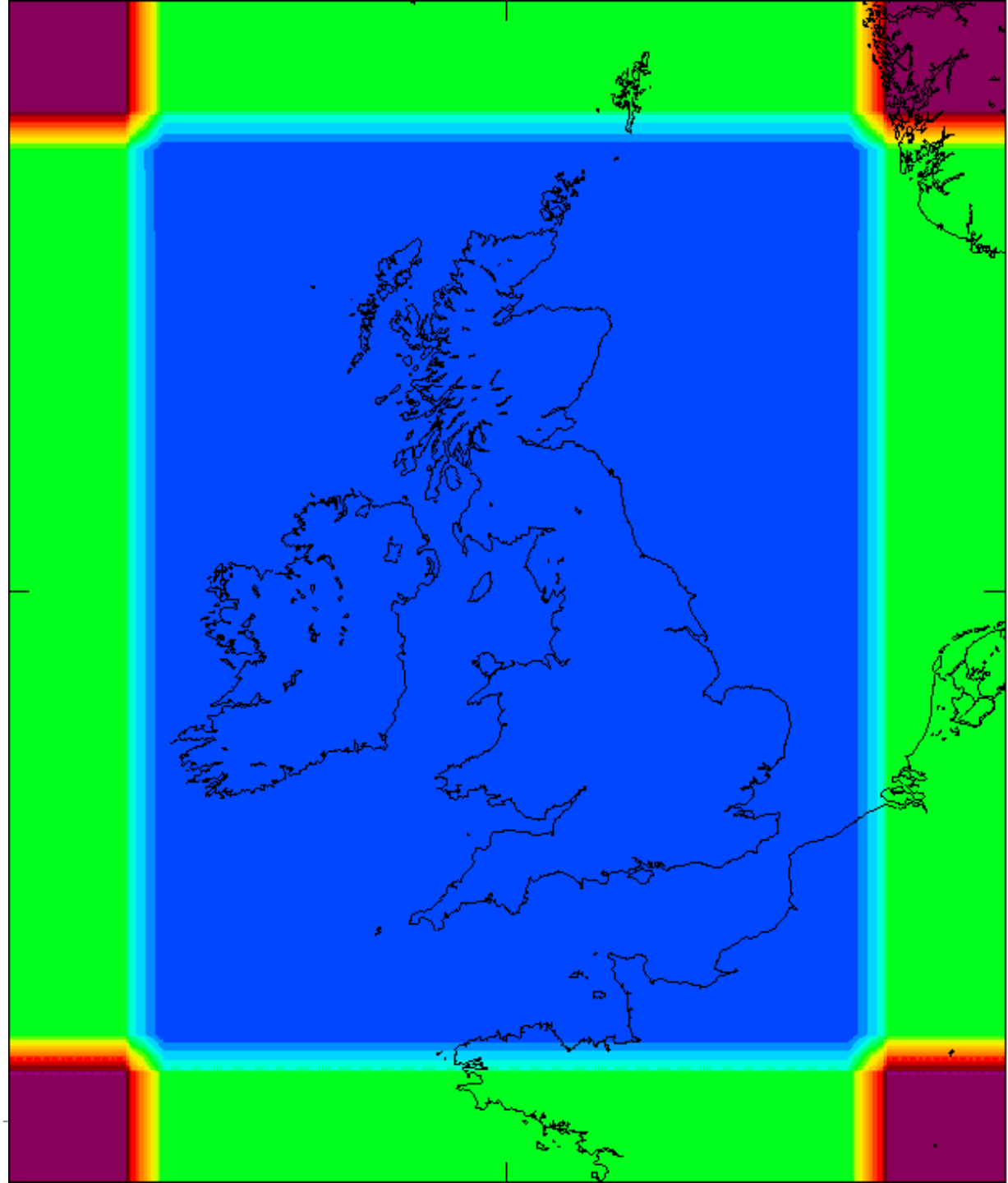

METG status at 17:00ut 04-Sep-2014 (119 stations)
Last observation:
<1 hour ago (0)
1-2 hours ago (91)
2-6 hours ago (20)
6-24 hours ago (1)
>1 day ago (7)


METR status at 17:00ut 04-Sep-2014 (142 stations)
Last observation:
<1 hour ago (114)
1-2 hours ago (9)
2-6 hours ago (0)
6-24 hours ago (0)
>1 day ago (19)
LERI
OSLS
STAS
THUS
KINL
STOR
HELS
FRAE
KINT
BENB
ACAR
INVR
AUG
BRAE
BARR
ARIS
TIRE
OBAN
KILN
EDIN
SABB
GLAS
GIRA
ESKD
KLRE
CAR
LOFT
CAO
HELG
HOLY
ASAR
SHRE
MACY
SHOB
ABEP
ANLX
SWAS
ARI
TERS
POTS
ORES
DENT
WARE
KARL
VFCH
ROVE
TORI
UNPG
ACOR
CANT
LEON
VIGO
CREU
ZARA
BELL
SALA
YEBE
VILL
BORR
MALL
CACE
SONS
ALBA
CASC
ALAC
COBA
LAGO
HUEL
MALA
ALME
CEU1

Met Office NWP

2014/2015

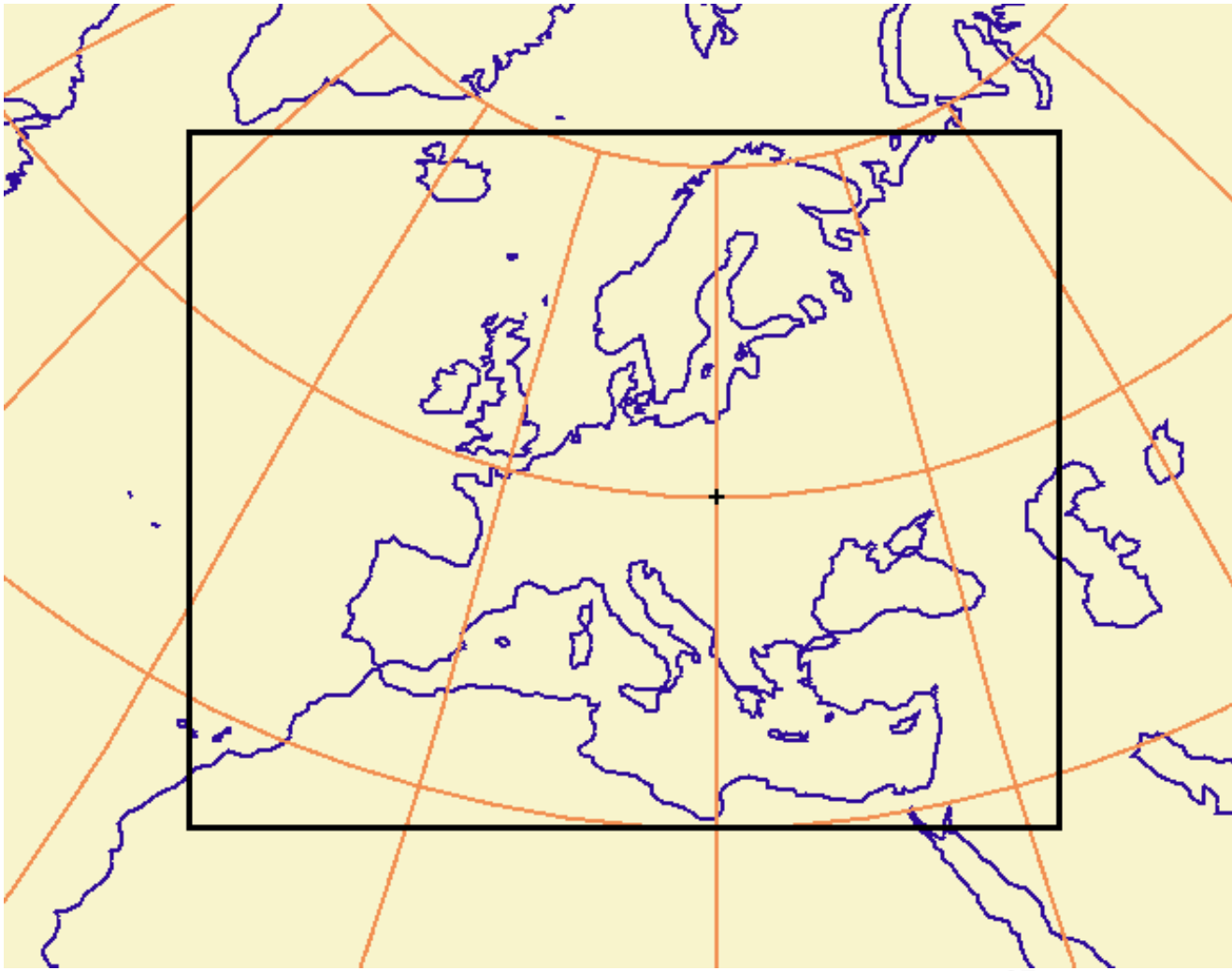
- Trialling of hourly cycling 4D-VAR for the UKV domain, to include assimilation of Zenith Total Delay
- 1.5km horizontal resolution (blue area) with variable resolution grid around the boundaries



Met Office NWP

2014-2016

- European reanalysis ‘UERRA’ project
- 12km horizontal resolution covering domain shown in box
- Reanalysis to cover 1979 to present
- Plan to assimilate reprocessed ZTD available through WG3 (~1996 onwards)



University of Nottingham

- University of Nottingham provides support and parallel processing for Met Office's three GPS ZTD/IWV NRT DD processing systems (i-GNSS around BSW5.0)
  - Regional hourly METO: ~240 stations, including all British, all Irish, and many European.
  - Global hourly METG: ~125 stations, ideal is to have even ~100km network spacing around whole globe (unlikely!)
  - Regional sub-hourly METR: ~100 stations available, mostly UK, some Irish and some European - restricted due to the lack of availability of timely, 15 minute RINEX at EPN and IGS, but using many more UK and Irish stations by creating own 15 minute RINEX from ntrip streams

University of Nottingham

- Daily RMS values of differences in ZTD (mm) and IWV (kg/m^2) between a regional hourly and a regional sub-hourly GPS ZTD/IWV NRT processing system (706 days, 12255-14229, for 2-4 common stations in Britain and Northern Ireland)
  - 3.4 to 10.3mm, 0.51 to 1.63kg/m^2
  - Sub-hourly slightly noisier due to processing of 15 minutes in GPSEST

- Daily RMS values of differences in ZTD (mm) and IWV (kg/m^2) between a regional hourly and a global hourly GPS ZTD/IWV NRT processing system (706 days, 12255-14229, for 4-7 common stations in Britain and Northern Ireland)
  - 2.0 to 7.1mm, 0.30 to 1.11kg/m^2
  - Global slightly noisier due to sparser, global network

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Other Discussion Points

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Publications

- Review of the state-of-the-art and future prospects of the ground-based GNSS meteorology in Europe
- Proposing a Special Issue (GNSS4SWEC-SI) in a peer-reviewed journal
  - Nomination of editors and guest editors?
  - Community interest?
  - Suggested titles?
  - Likely submission dates?
  - Can your institution cover the publication fees?

Horizon 2020

- 1) The benefit of new tropospheric products (Galileo/multi-GNSS/gradients) and NWP data in geodetic data processing
- 2) Ground based GNSS (and GNSS-RO?) for regional climate models
- Getting ideas together now, mode information after end Sept.
- Another possibility are the Future and Emerging Technologies (FET) calls: http://ec.europa.eu/programmes/horizon2020/en/h2020-section/future-and-emerging-technologies

Next Meeting

- E-GVAP meeting, 22nd and 23rd October, Exeter, UK
- Next Workshop and MC meeting, early May 2015, Thessaloniki, Greece (exact date TBC, in between EGU 12-17th April and EUREF 3-5th June)