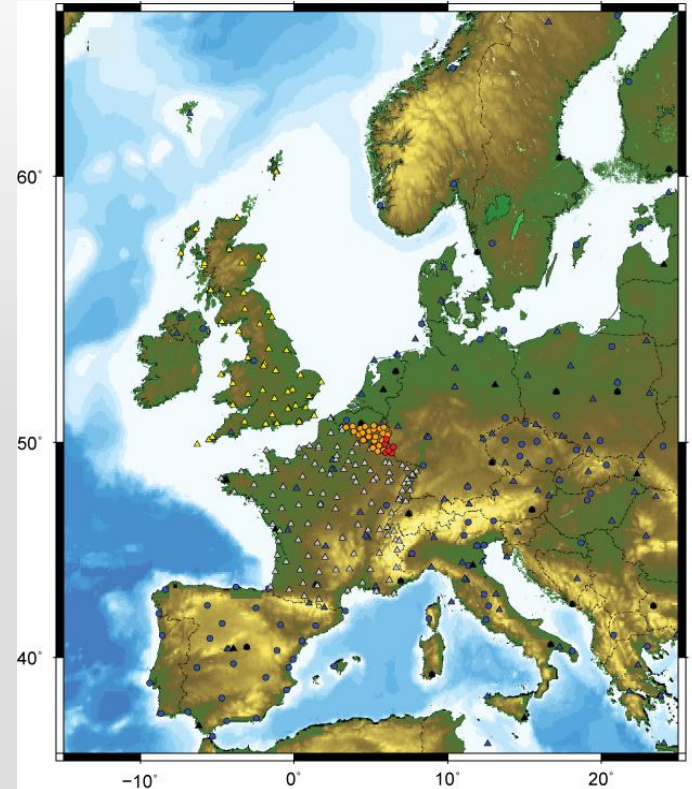


# GNSS Meteorology in Luxembourg

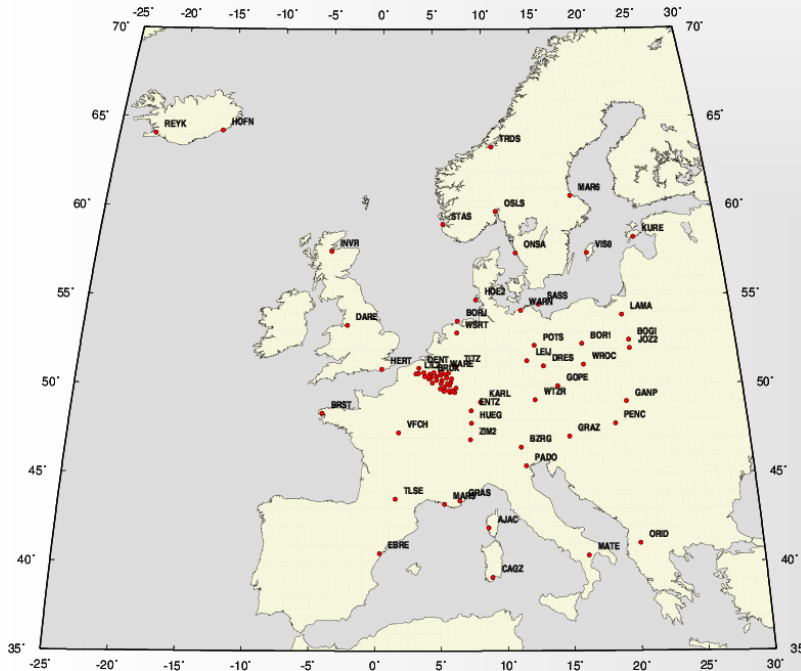
## GNSS Data Processing Systems

Network of Stations (hourly NRT)



Red: *SPSLux*, orange: *WALCORS*  
gray: *RGP*, yellow: *OSGB+Geonet*  
blue: *EPN*, black: *IGS*

Network of Stations (RT)



# GNSS Meteorology in Luxembourg

## GNSS Data Processing Systems

General characteristics of GNSS processing systems at UL

System	Update Cycle	Output Sampling	Processing Engine
PP	Post processed	1 hour	Bernese GNSS Software 5.2
NRT	Hourly	15 min	Bernese GNSS Software 5.0
RT-I	10 min	1 sec	BKG Ntrip Client 2.7
RT-II	10 min	5 sec	PPP-Wizard

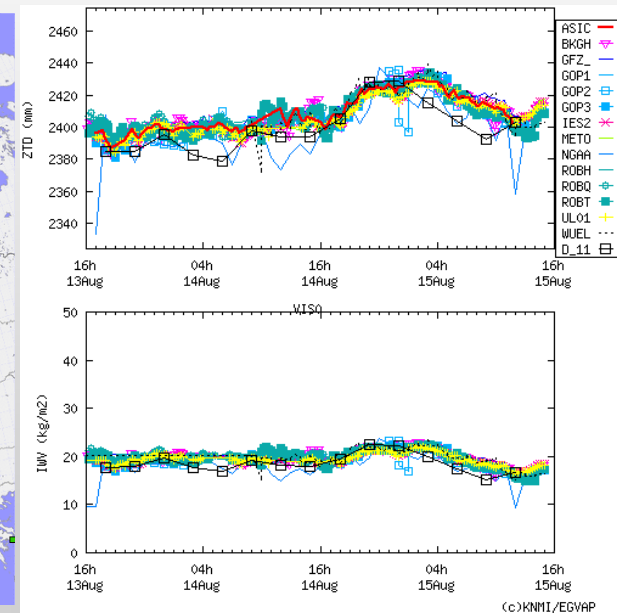
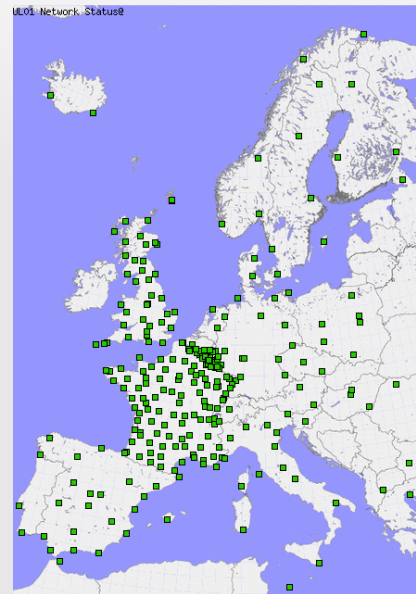
Bias with the IGS Final Troposphere Product

System	Mean [mm]	SD [mm]	RMS [mm]
PP	-0.7	7.1	6.2
NRT	-0.3	4.7	4.8
RT-I	8.6	27.9	30.4
RT-II	23.3	27.6	46.0

# GNSS Meteorology in Luxembourg

## Contribution to E-GVAP

- Hourly NRT solution “UL01” submitted to EGVAP
  - Sub-millimetre level agreement with IGS Final Troposphere Product
  - Based on Bernese GPS Software 5.0
  - Uses IGS Ultra-Rapid products



# GNSS Meteorology in Luxembourg

## Evaluation of real-time ZTD estimates

- Relative accuracy of real-time PPP ZTD estimates from 3 software packages evaluated
  - Using IGS Final Troposphere Product
  - Using radiosonde observations
- Relative accuracy compared to user requirements for NWP nowcasting
  - Estimates from BKG Ntrip Client (BNC) and G-Nut/Tefnet software packages meet the threshold
  - Estimates from PPP-Wizard currently exceed the threshold
- The effect of real-time integer ambiguity resolution studied
  - 4-5 mm difference in ZTD

# GNSS Meteorology in Luxembourg

## Impact of GNSS ZTD assimilation in AROME 3D-Var (Collaboration with MétéoFrance – STSM)

- Impact assessment through three experiments:

Experiment Name:	NOGPS	EGVAP	UL01
GNSS ZTD Assimilated	No	Yes	Yes
GNSS Networks Used for ZTD Assimilation	-	<ul style="list-style-type: none"><li>▪ E-GVAP Operational Solutions only</li></ul>	<ul style="list-style-type: none"><li>▪ E-GVAP Operational Solutions</li><li>▪ UL01 Test Solution</li></ul>

- GNSS ZTD assimilation showed a positive impact on AROME forecasts
- UL01 solution found to be suitable for assimilation with a positive impact
- Results to be published (manuscript ready)

# GNSS Meteorology in Luxembourg

## Outlook

- Long-term reprocessing for climate monitoring
  - To be completed by April 2015
  - Reprocessing using consistent IGS repro2 products for the whole period
  - Global network (1994-2014)
  - GNSS stations in Luxembourg (2007-2014)