GNSS real-time activities on a global and regional scale

Wolfgang Söhne & Loukis Agrotis

Outline

- **IGS real-time working group (RTWG) and IGS real-time pilot project (IGS-RT PP)**

- **EUREF Permanent Network real-time activities and EPN special project "Real-time analysis"**

- **IGS-RT PP – orbit & clock corrections & combination**

- **Real-time data & product streaming – dissemination concept**

- **Conclusions and Outlook**

IGS-RT PP – Key objectives

- **Manage and maintain a global IGS real-time GNSS tracking network**

- **Generate real-time products**

- **Investigate standards and formats for real-time data collection, data dissemination and delivery of derived products**

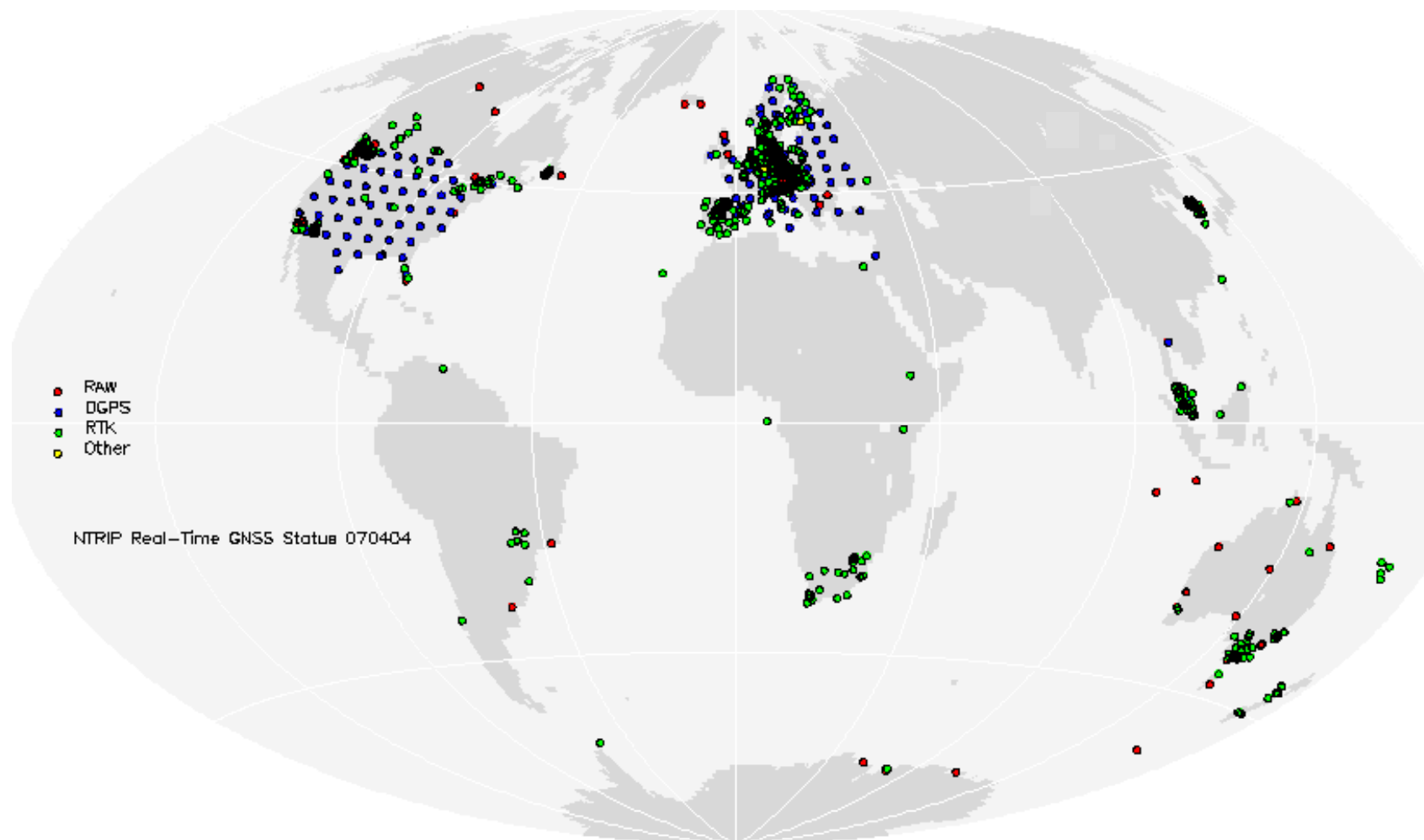- **Monitor the integrity of IGU predicted orbits and GNSS status**

IGS-RT PP – Service concept

- **Statement from Mark Caissy (RTWG chairman):**
  - ◆ **IGS is on a path to enable access to a global reference frame in real-time through the availability of real-time clock and orbit correction information.**
  - ◆ **This information will be available through IP channels.**
  - ◆ **Targeted accuracies (0.3 ns for clocks; 5-6 cm for orbits).**
  - ◆ **IGS cannot guarantee delivery but will rely on its track record for acceptance.**
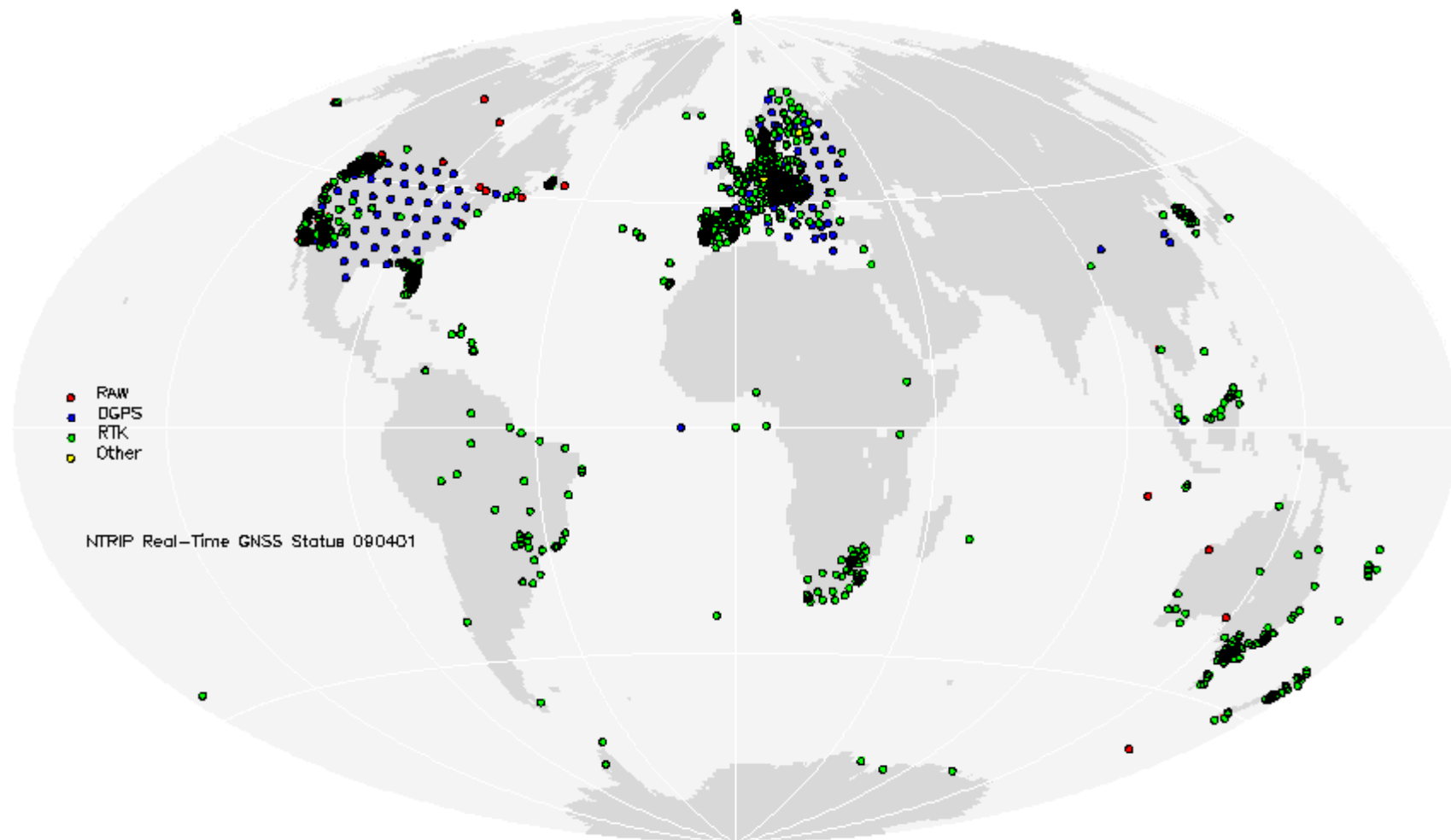
EPN real-time activities

- **Streaming GNSS data over the open Internet**

- **PP EUREF-IP successfully transferred to routine operation**

- **New SP on „Real-time analysis" (EUREF mail 4259 (March, 13))**

➢ **Call for participation**

  - **Re-dissemination of GNSS real-time data and products in Europe via NTRIP Broadcasters**

  - **Validation of clock and orbit correctors to Broadcast Ephemeris**

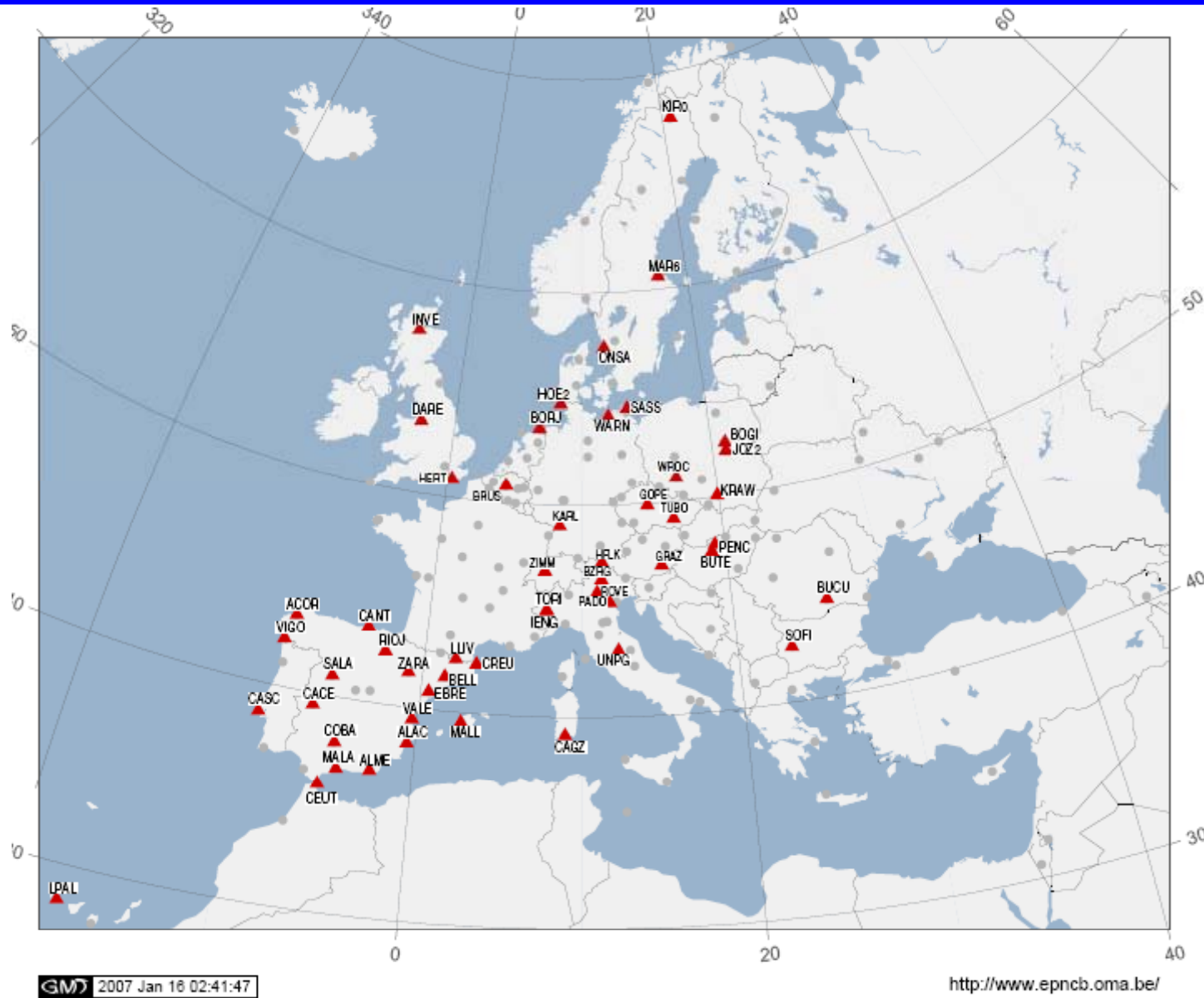 - **Backup for all critical real-time service components**
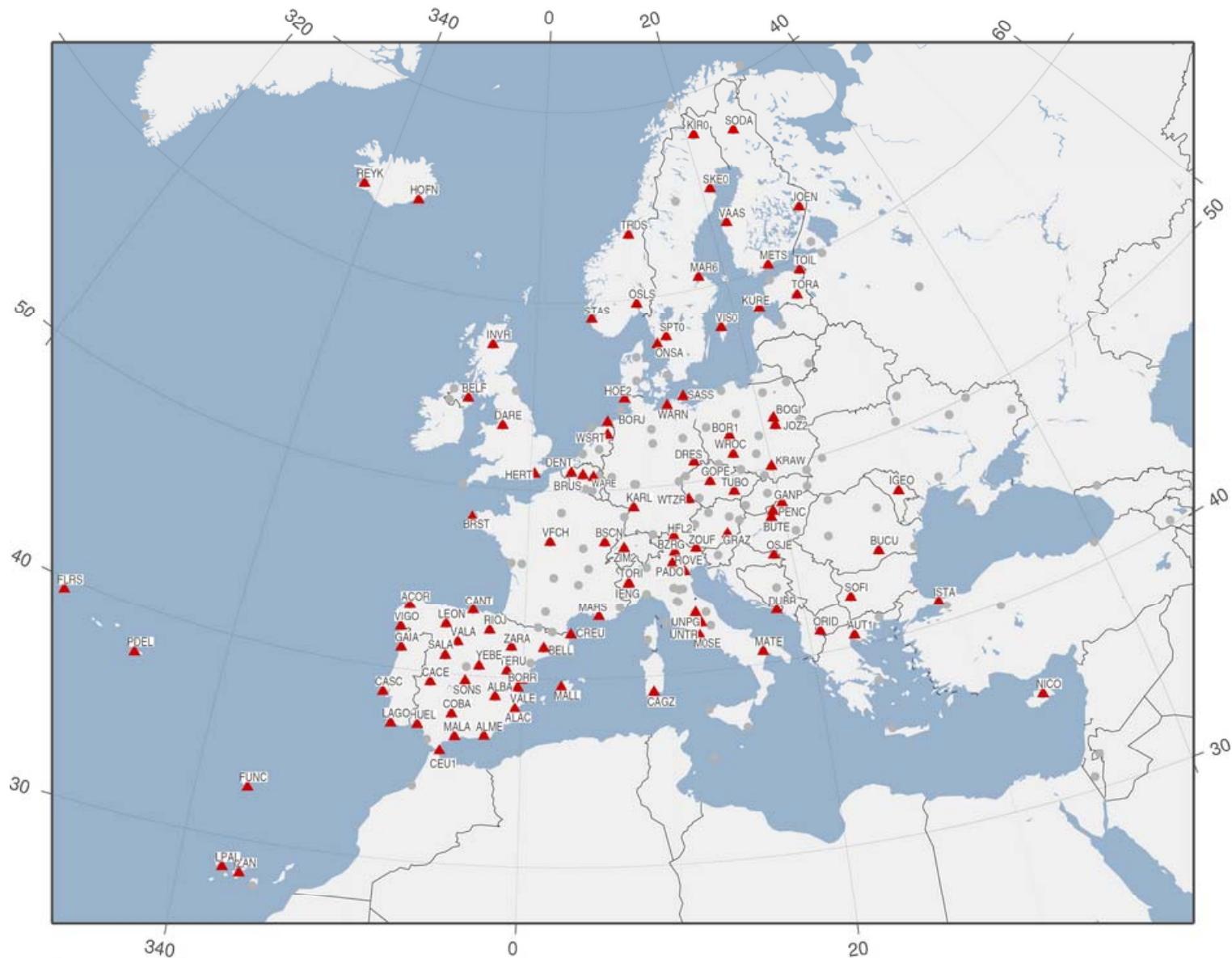
Global Ntrip Network – 2007

RAW
DGPS
RTK
Other

NTRIP Real-Time GNSS Status 070404

Global Ntrip Network – 2009

NTRIP Real-Time GNSS Status 090401

RAW
DGPS
RTK
Other

EUREF RT network – 2007

EUREF RT network – 2009
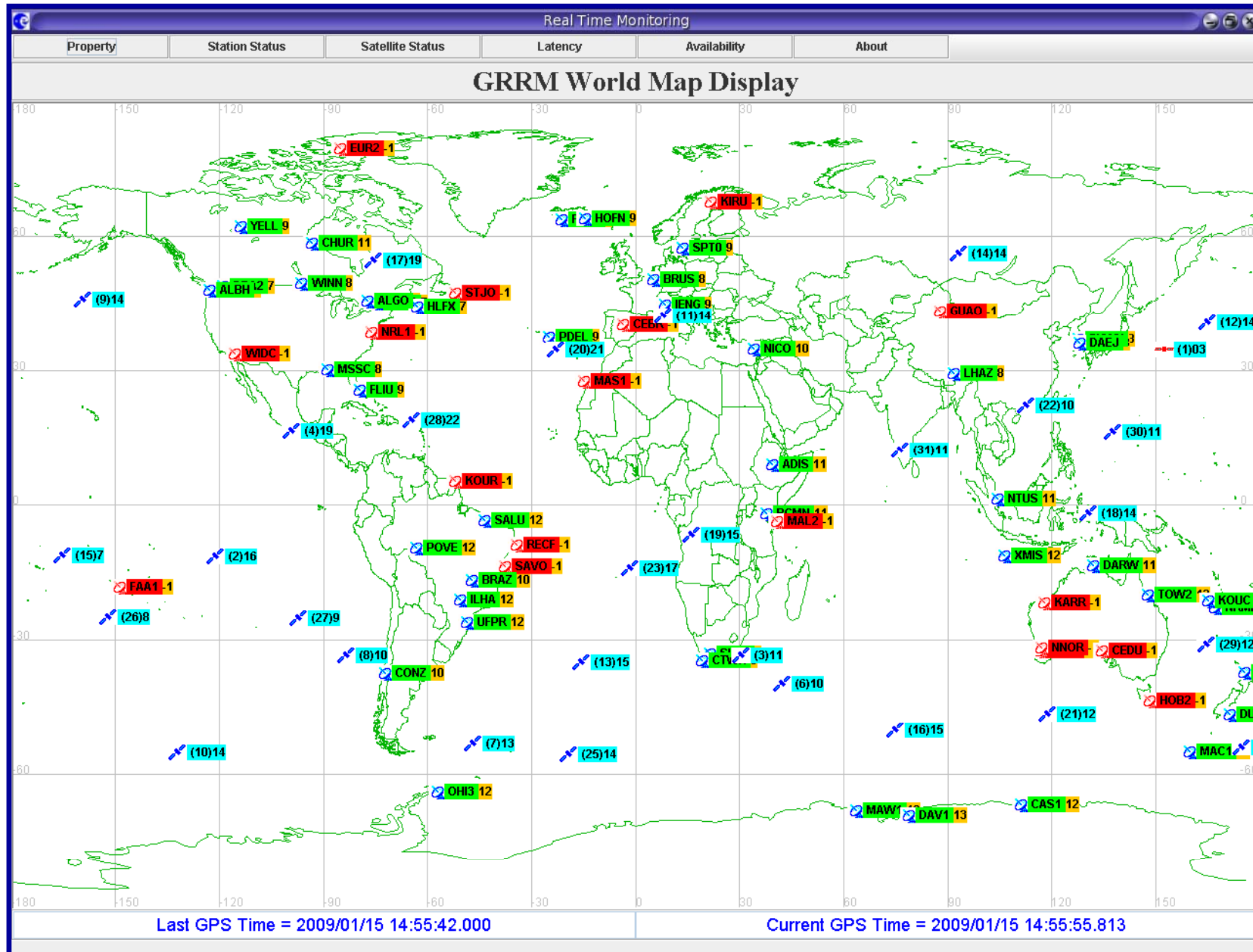

GMD 2009 May 15 02:31:26

http://www.epncb.oma.be/

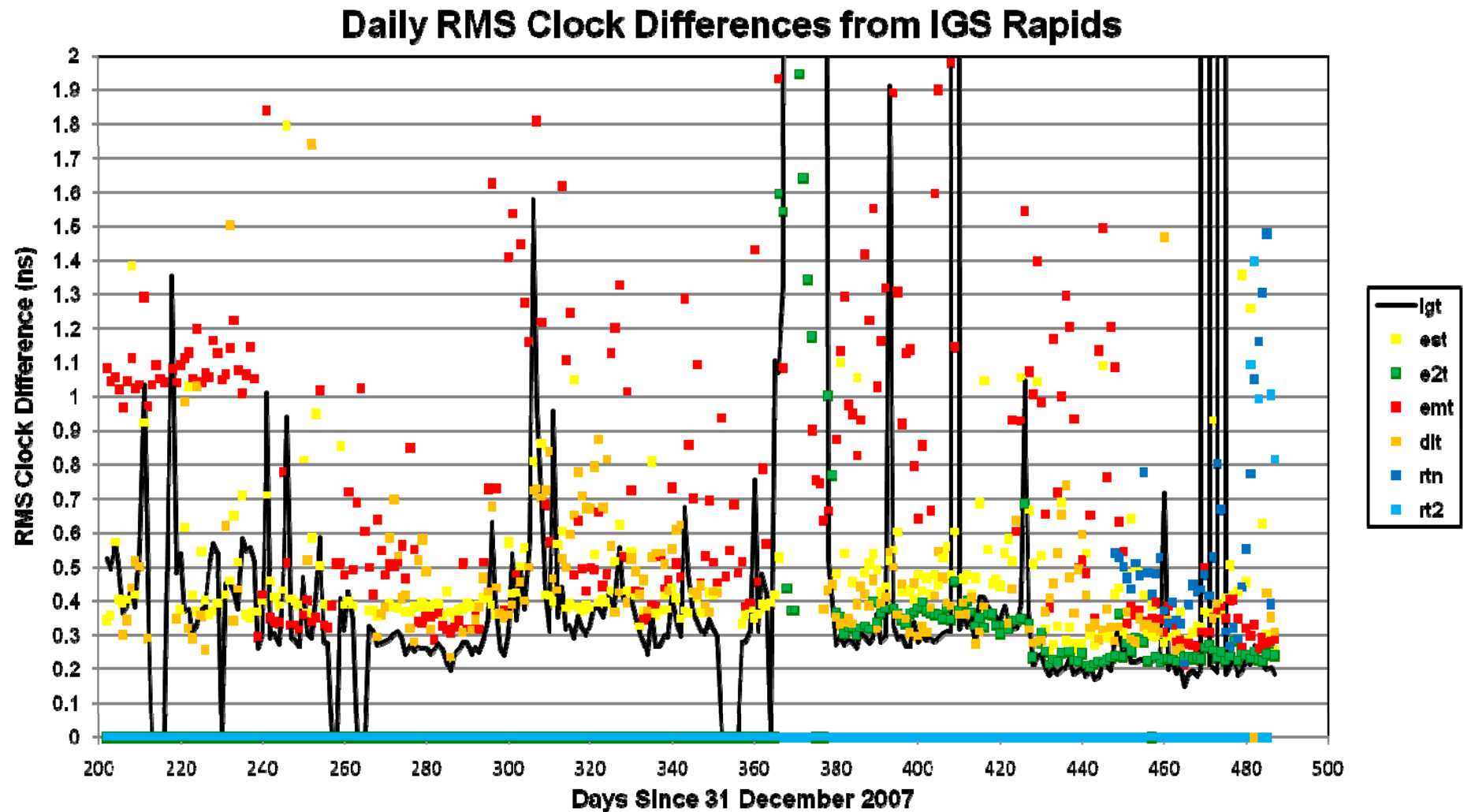# IGS-RT PP – Tracking Network

IGS-RT PP – Current Performance

Example of Daily Comparison Statistics (May 14 2009)

AC	nSats	Orbit RMS (mm)	Samples	Satellite Clock RMS (ns)	Satellite Clock Sigma (ns)
Comb.	30	-	8513	0.20	0.14
BKG	30	33.7	8483	0.38	0.13
BKG2	48	80.8	8395	0.55	0.17
DLR	30	35.7	8502	0.53	0.46
ESOC	30	63.8	8512	0.53	0.48
ESOC2	30	31.4	8320	0.22	0.20
NRC	30	30.3	7993	0.31	0.25
GMV[1]	30	61.0	8484	0.85	0.83

[1]The GMV solution is a 1-2 hour prediction and is not used in the combination

Daily RMS Clock Differences from IGS Rapids

IGS-RT PP – Solution Performance History

Daily Sigma Clock Differences from IGS Rapids

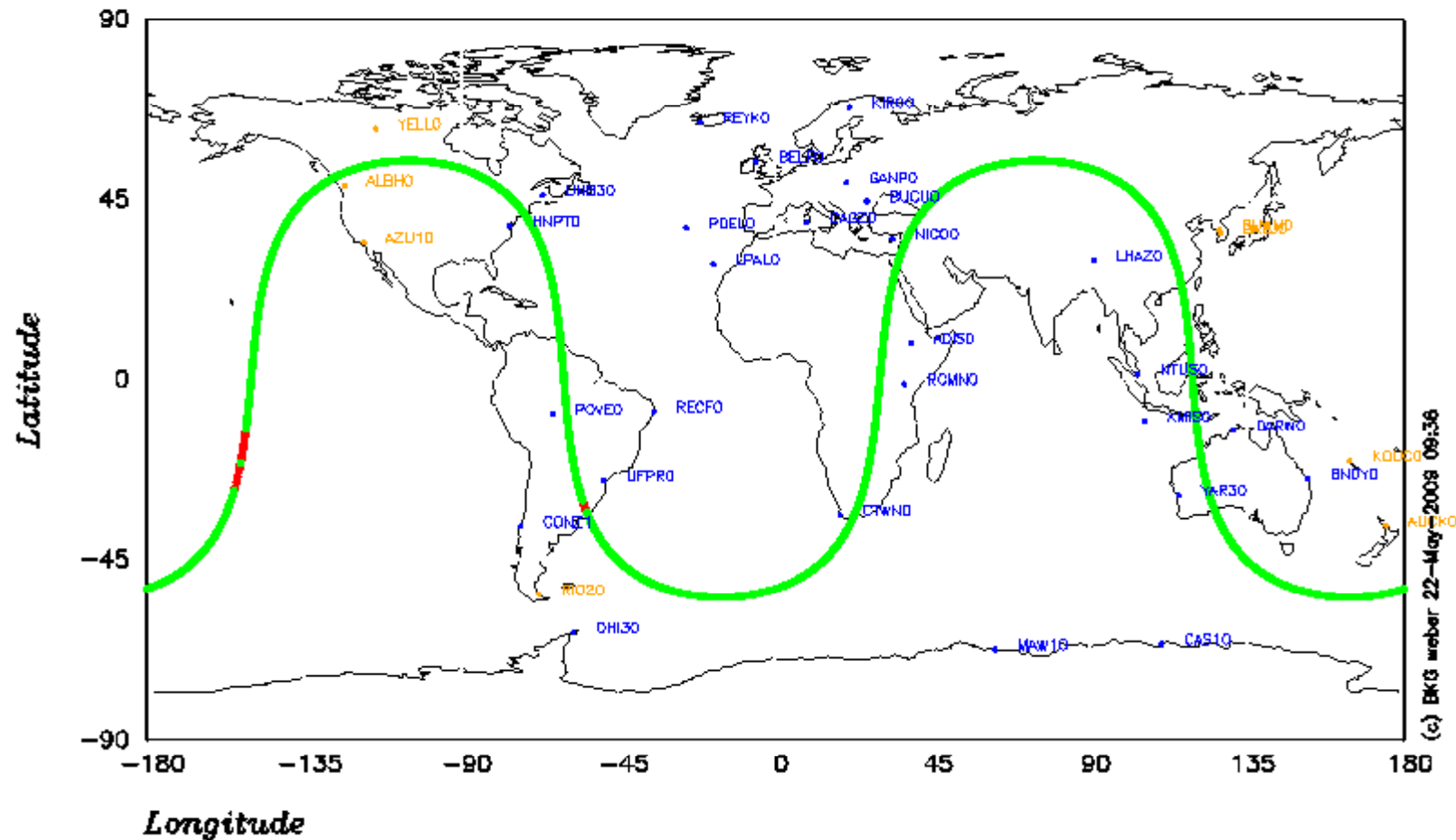Daily Typical RMS Orbit Differences from IGS Rapids
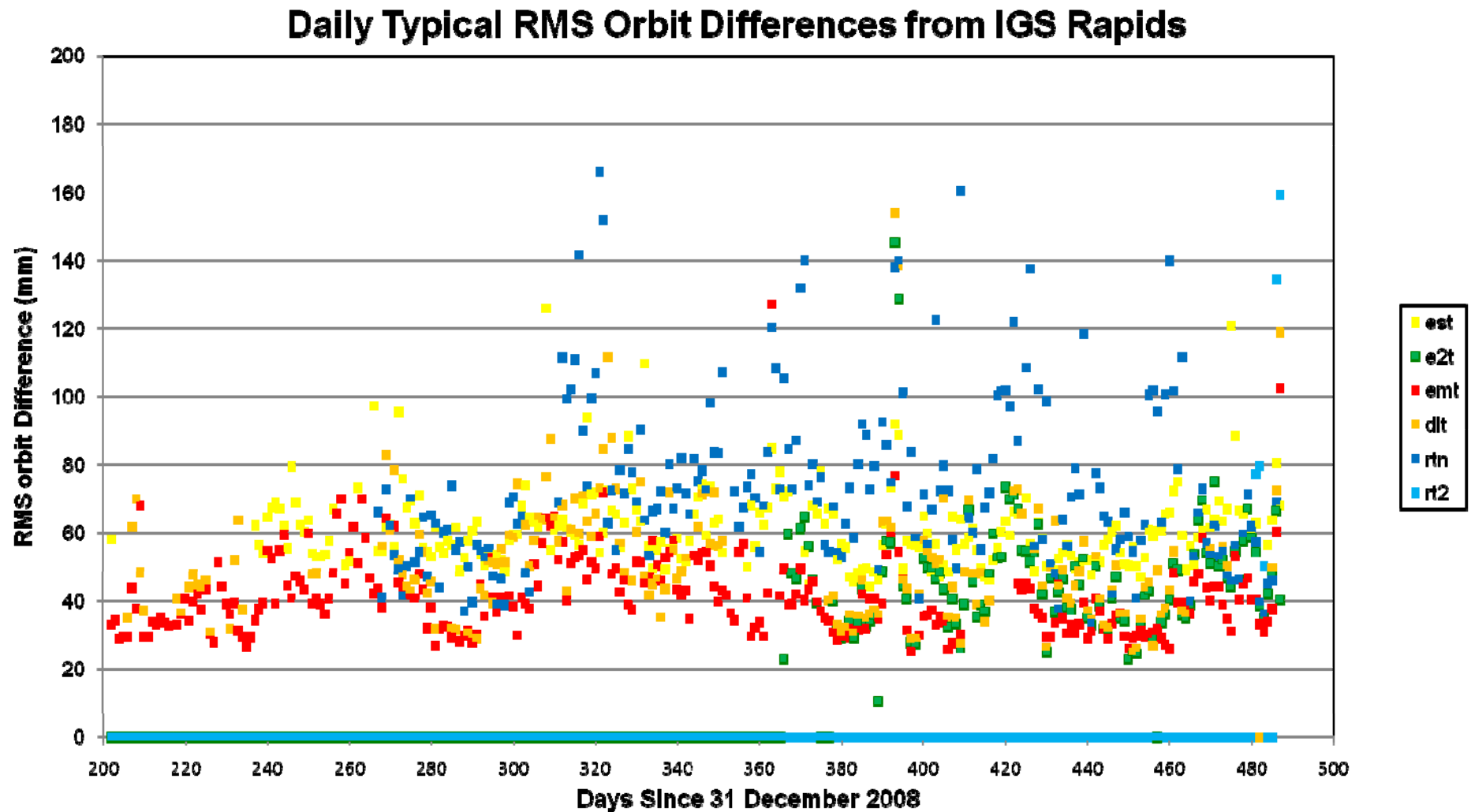
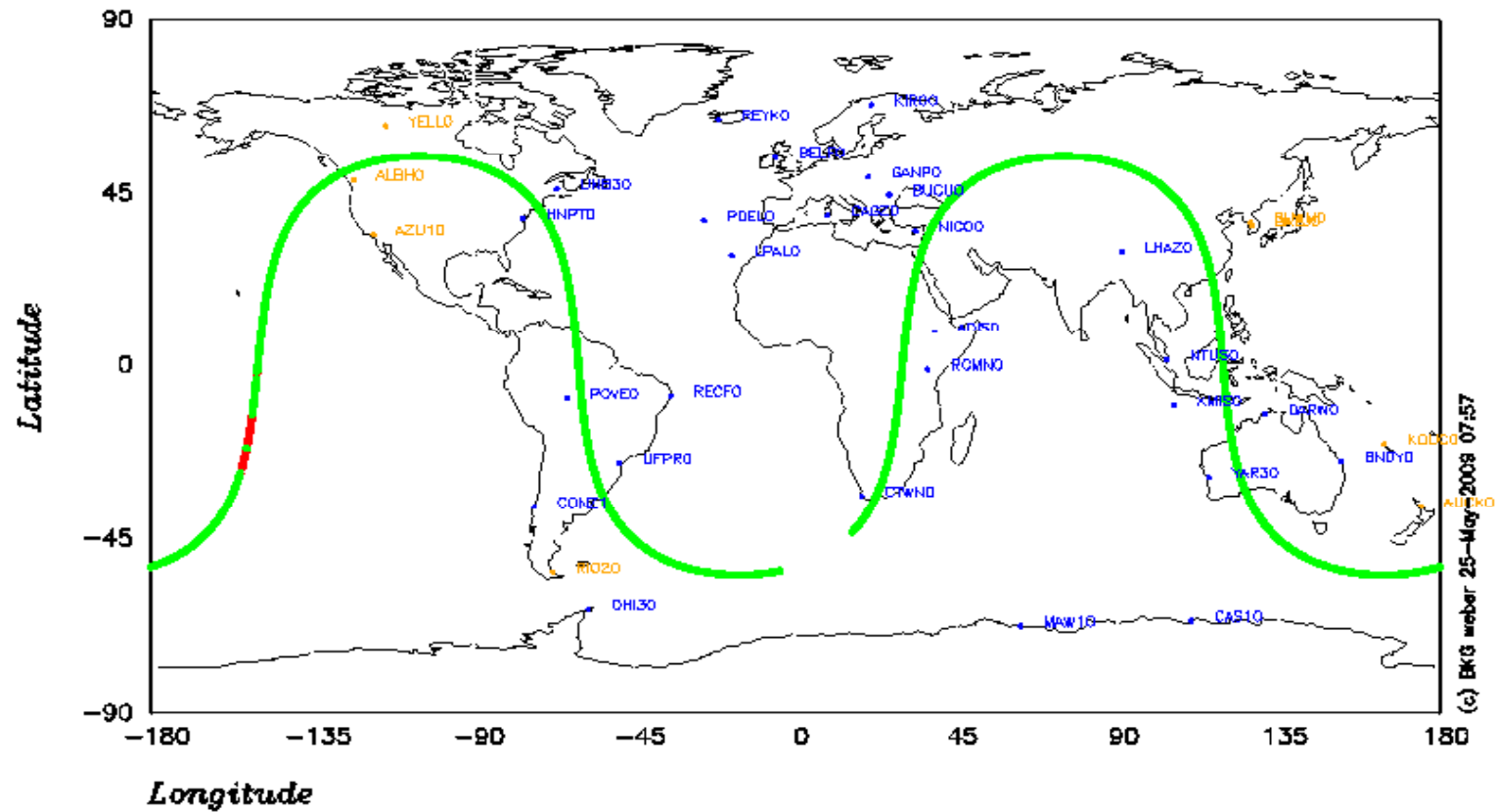# BKG/TUP GPS clock solution w.r.t. IGR
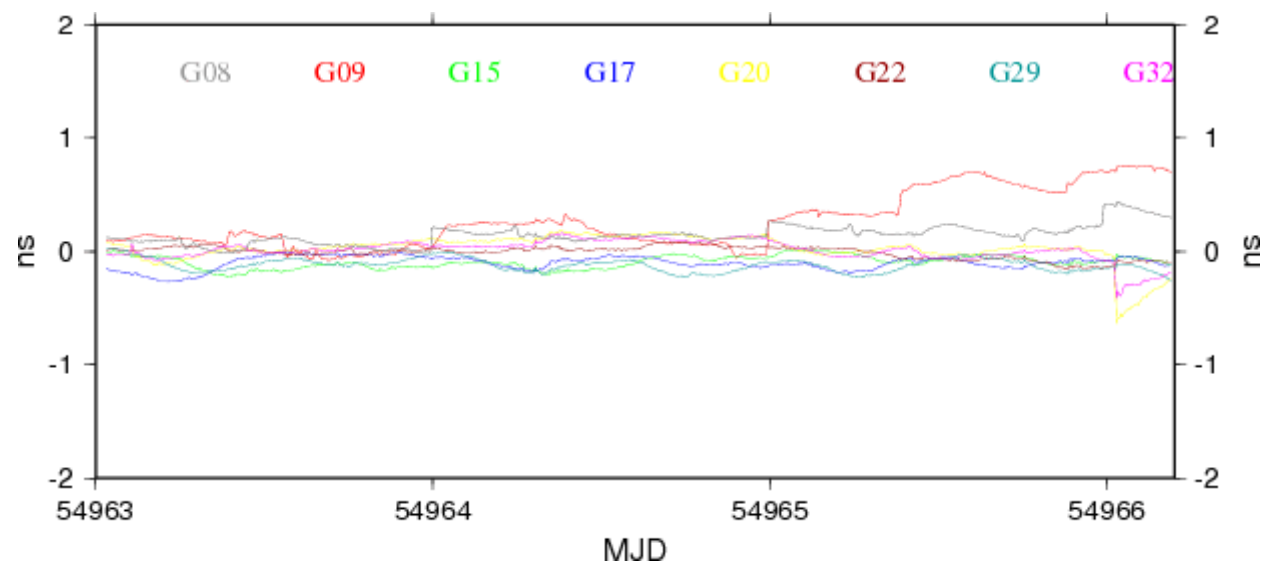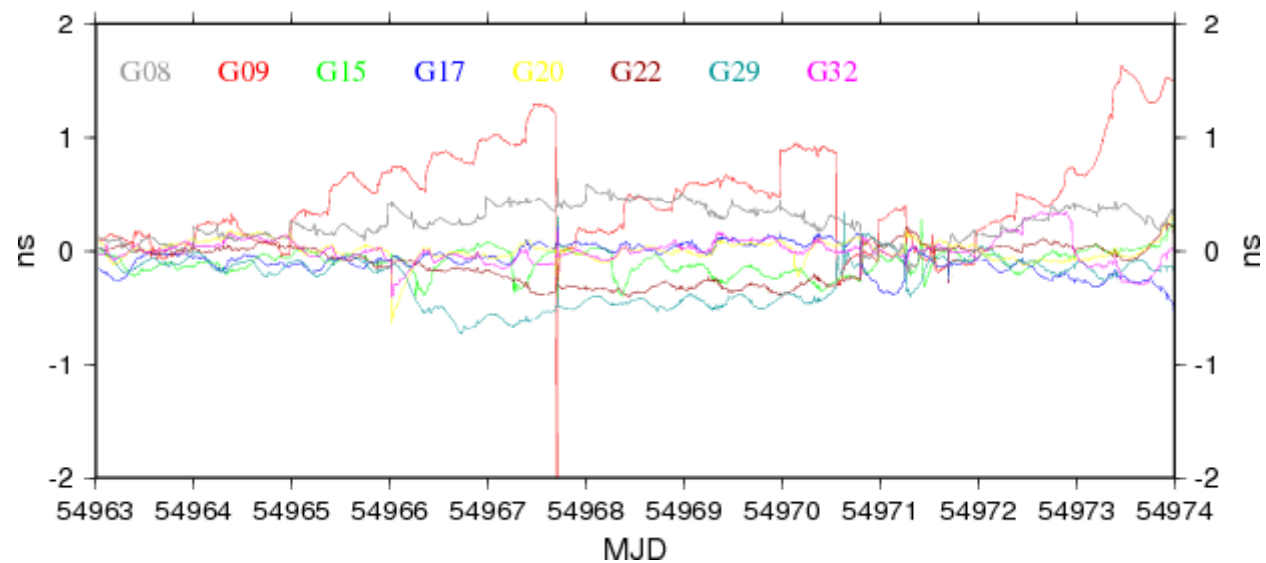
Availability of satellite clocks

Real–time track PRN G24, 090521 , Red: lt. 4 stations, Orange: GPS only

Availability of satellite clocks

Real–time track PRN G24, 090524 , Red: lt. 4 stations, Orange: GPS only
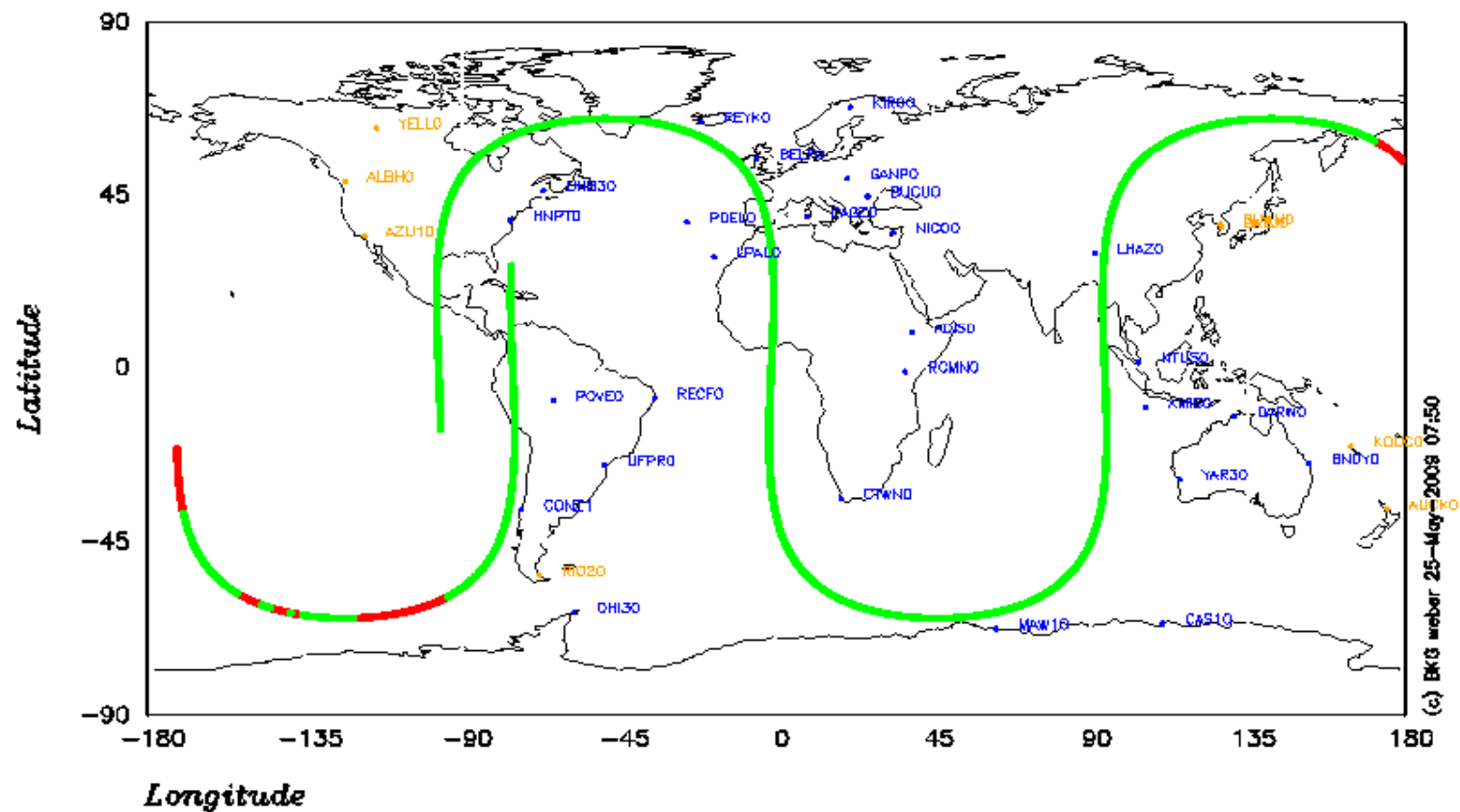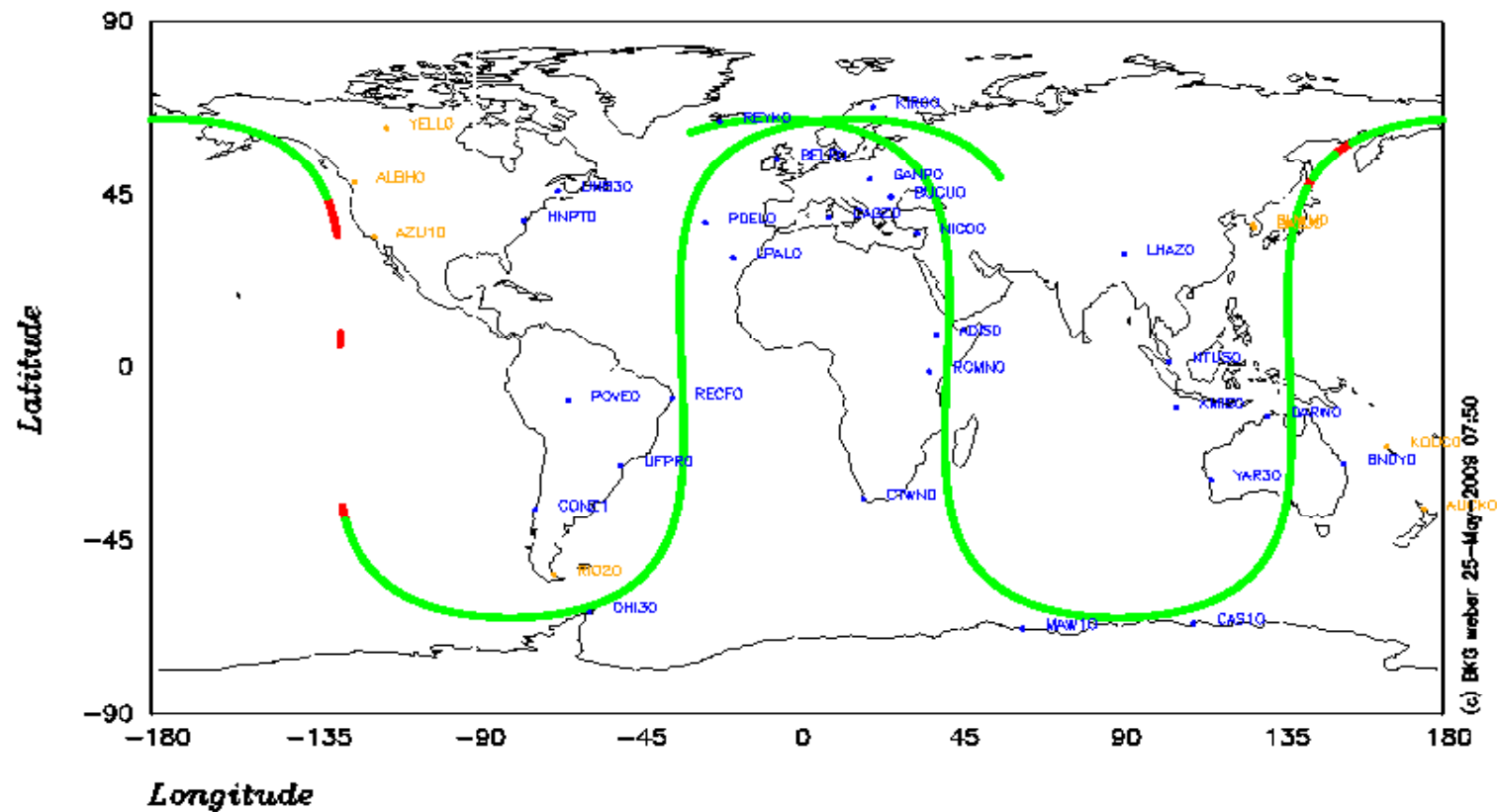
Availability of satellite clocks

Real-time track PRN R24, 090524 , Red: It. 4 stations, Orange: GPS only
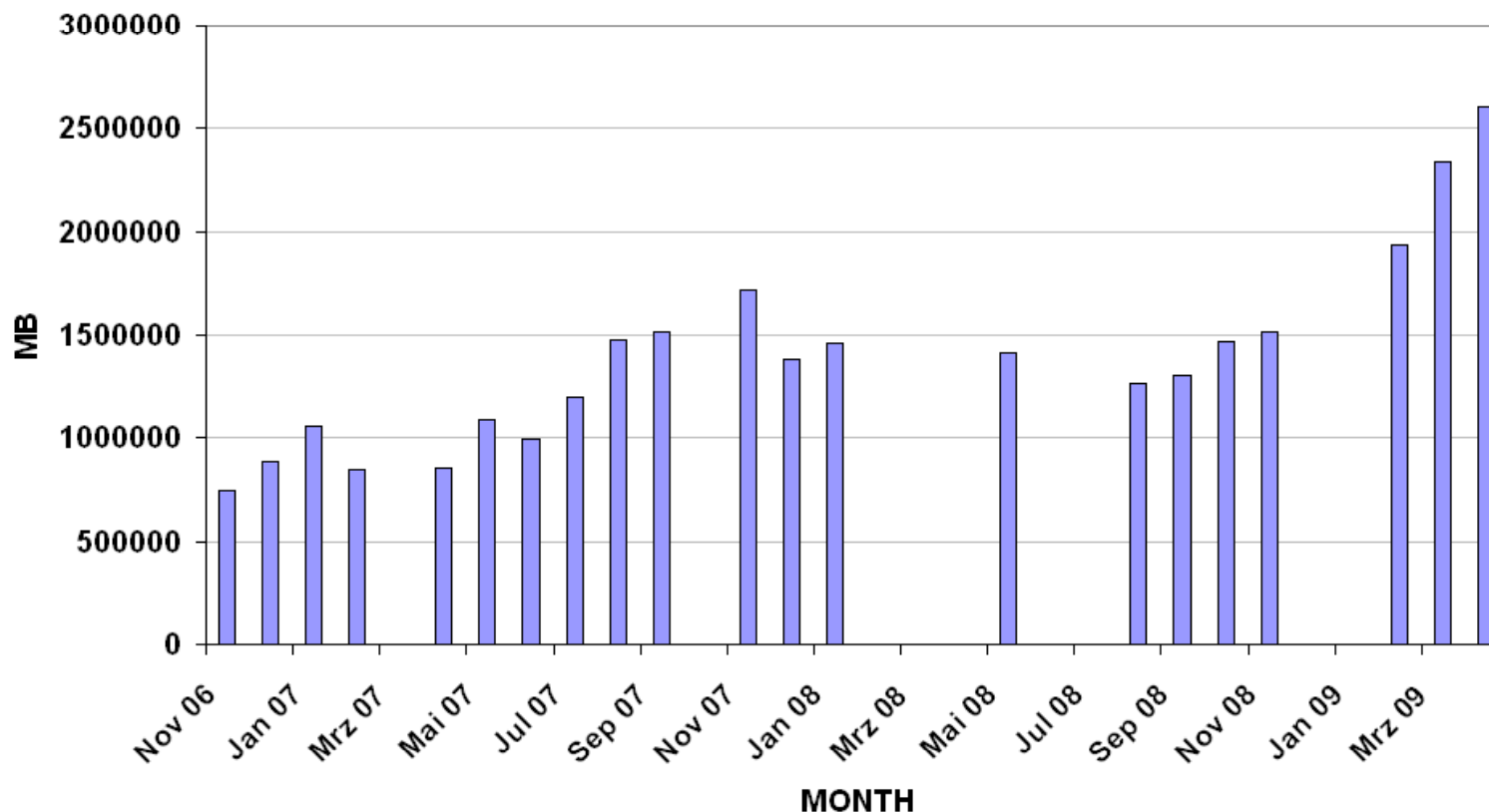
Availability of satellite clocks

Real-time track PRN R22, 090524 , Red: lt. 4 stations, Orange: GPS only
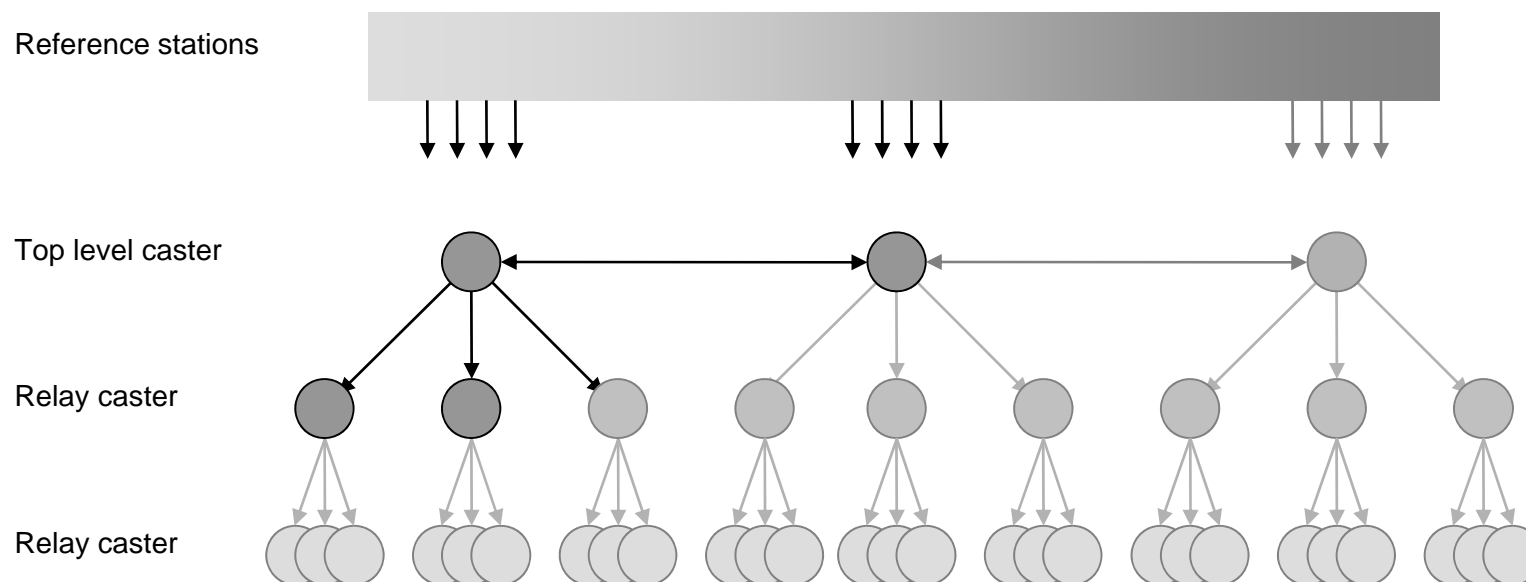
RT dissemination strategy

➢ **RT streaming mainly using** www.igs-ip.net **and** www.euref-ip.net **(and caster at GA)**

➢ **Data volume (up-, download) in MB**

Serverhousing: monthly traffic in MB at BKG's broadcasters

RT dissemination strategy

➢ **Dissemination concept**

Reference stations

Top level caster

Relay caster

Relay caster

RT dissemination strategy

- **Ntrip broadcaster operation requirements**
  - ◆ **Number of simultaneous incoming streams: 100**
  - ◆ **Number of simultaneous outgoing streams: 1000**
  - ◆ **Mean bandwidth per stream: 2500 bits per sec**
  - ◆ **Total incoming plus outgoing stream bandwidth: 3Mbits per sec**
  - ◆ **Total stream volume per month: 1 TB**
  - ◆ **Availability of the broadcaster's host and Internet connection: 95+ percent**

Conclusions and Outlook

- **IGS-RT PP orbit & clock correction combination in PP is working**

- **Real-time combination and real-time dissemination of combined product as goals for the future**

- **Concept for improving the GNSS stream dissemination capability for EUREF and IGS ready to be distributed to the list of potential organizations**