Federal Agency for Cartography and Geodesy

BKG
Wir geben Orientierung.

The IGS Real-Time Service: Status and Developments

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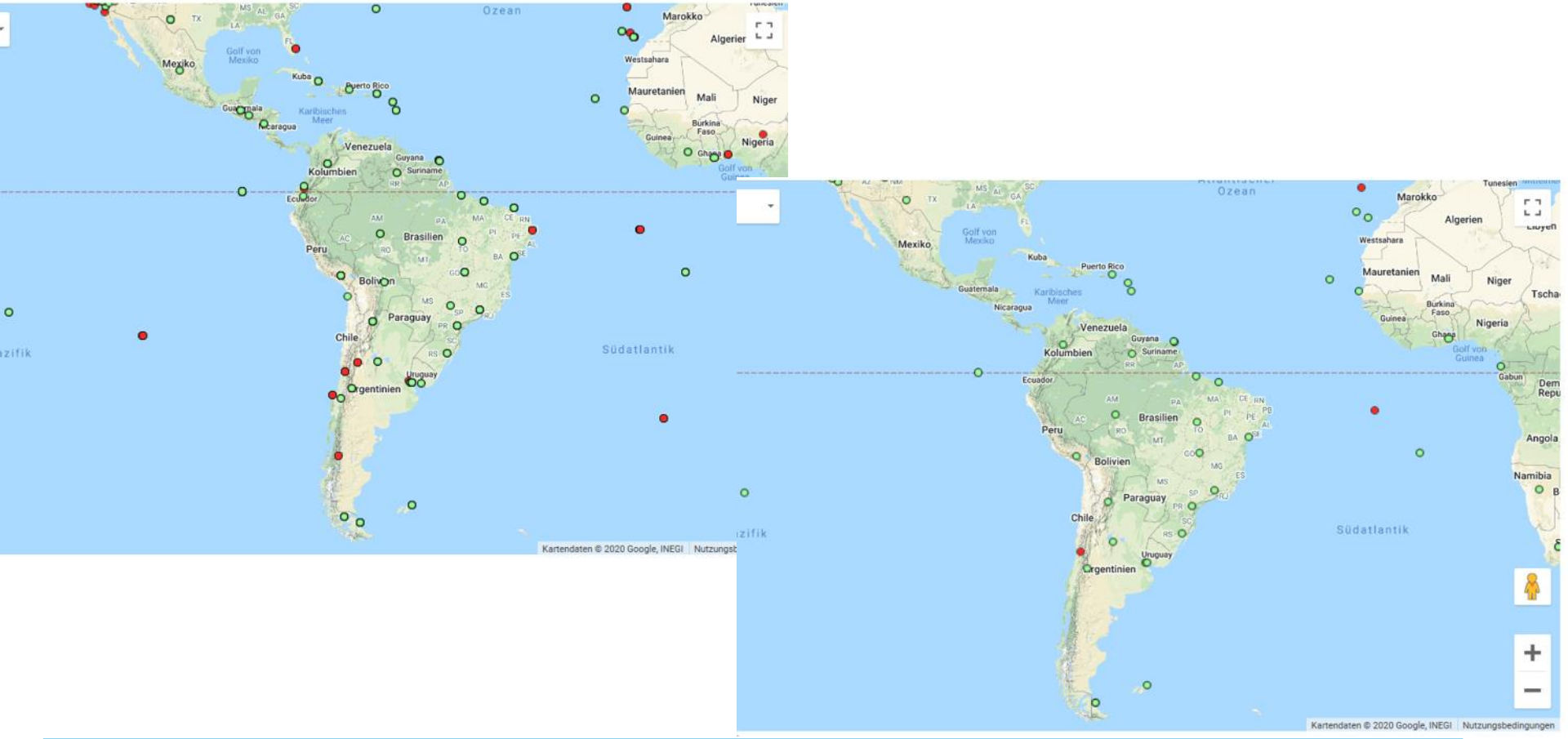
I. IGS Real-Time Service and it's Global Infrastructure

- 2007: CfP "IGS Real-time Pilot Project"
  - RT Tracking Stations
  - RT Data Centers
  - RT Analysis Centers
  - RT Associate Analysis Centers
  - RT Analysis Center Coordinator
  - RT Network Management and Monitoring
  - RT Users
- 2013: IGS Real-Time Service (RTS) Pilot Project
- 2017: IGS Real-Time Service (RTS) operational

I. IGS Real-Time Service and it's Global Infrastructure

- 500+ IGS Stations -> ~265 RT Stations (~ 235 at BKG www.igs-ip.net caster)



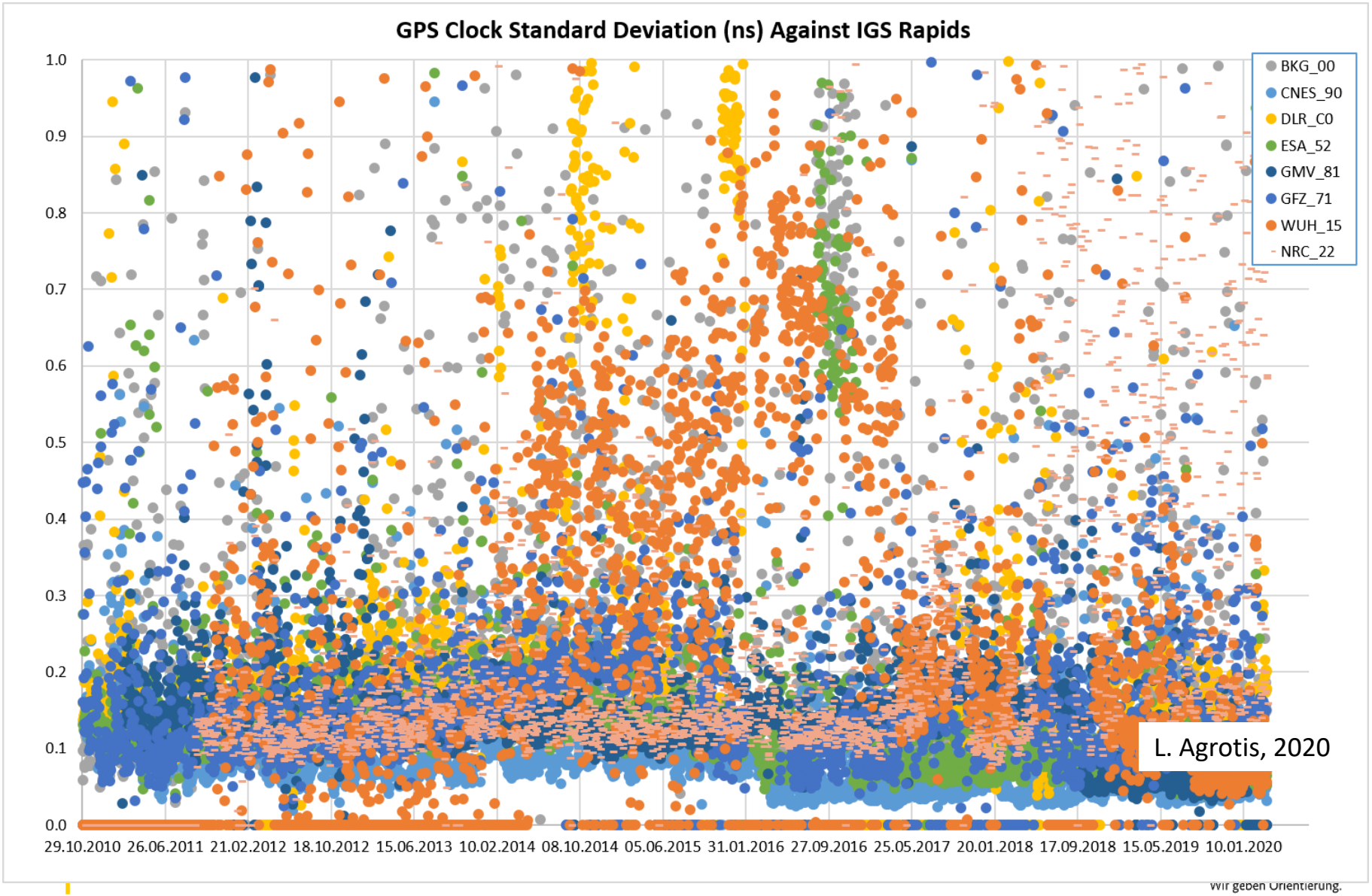
I. IGS Real-Time Service and it's Global Infrastructure

- Several Data Centers / Casters
  - Global broadcasters: BKG, CDDIS, IGSCB
  - Continental / regional broadcasters, e.g. EUREF (ASI, BKG, ROB), APREF (GA); SIRGAS experimental caster?
  - National / local broadcasters, e.g. IBGE (Brasil)
- Strategy / Goal
  - Each RT data stream available at all global broadcasters
  - Identical mountpoint name at each global caster
  - Upload independently to, at least, two different casters

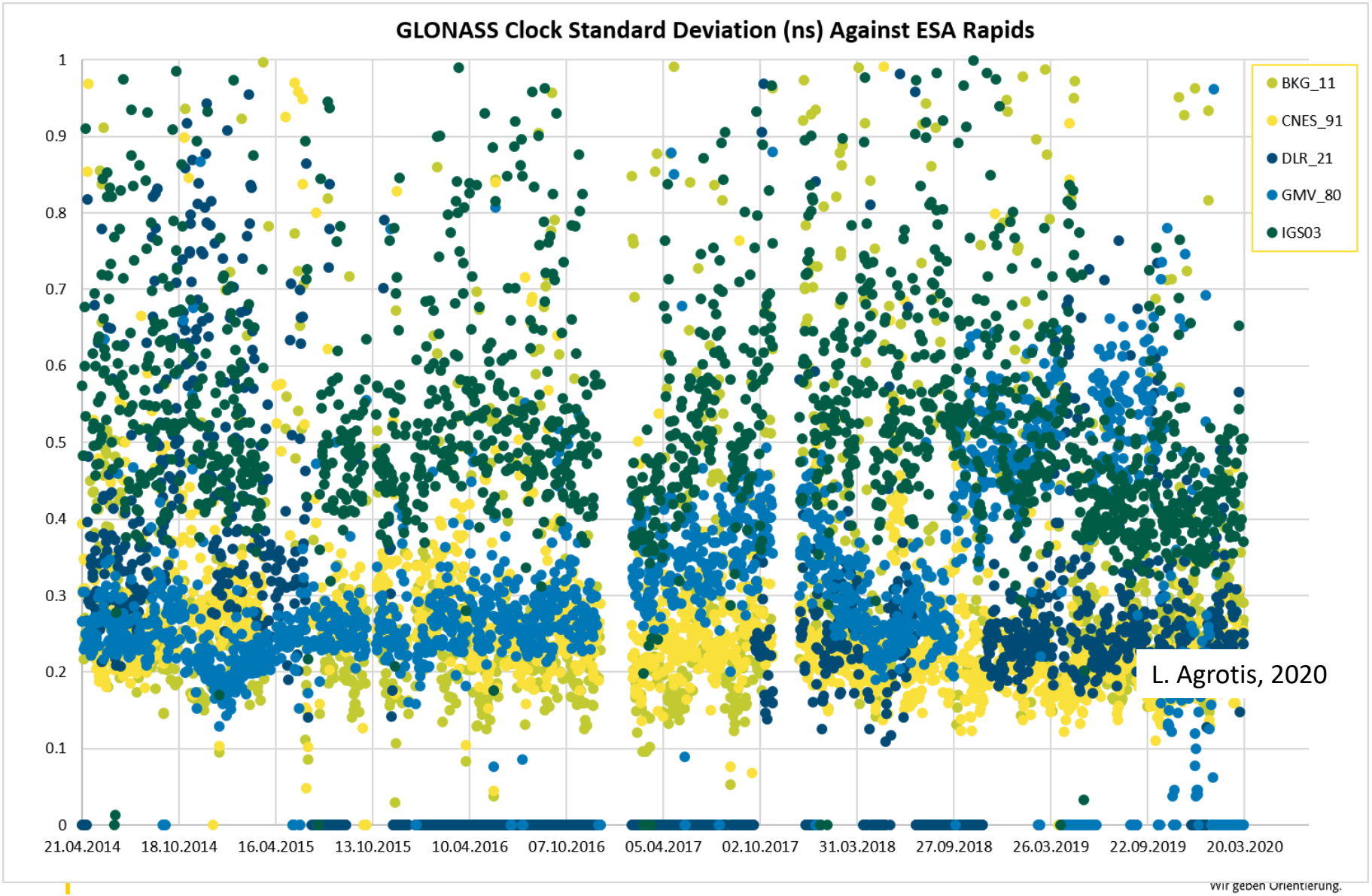
I. IGS Real-Time Service and it's Global Infrastructure

- Several Analysis Centers
  - GPS: ESA/ESOC, NRCan
  - GPS+GLONASS: BKG
  - Multi-GNSS: CAS, CNES, DLR, GFZ, GMV, WHU
- Combination Center(s)
  - ESA/ESOC (GPS – 9 ACs), BKG (GPS+GLO – 7 ACs)
  - Mountpoints from combined solutions
    - IGS01 -> SSRA01IGS0
    - IGS02 -> SSRA02IGS0
    - IGS03 -> SSRA03IGS0
    - IGC01 -> SSRC01IGS0

I. IGS Real-Time Service and it's Global Infrastructure



I. IGS Real-Time Service and it's Global Infrastructure



I. IGS Real-Time Service and it's Global Infrastructure

- Real-Time **Management** within the IGS:
  - IGS Real-Time Working Group, chaired by André Hauschild from DLR
    - mountpoint naming conventions
    - organisation of broadcaster structure
    - compiling IGS broadcaster guidelines
    - cooperation with IGS SSR Task Force
    - future RT data and product dissemination
    - establishment of the SSR Task Force to develop a format for Real-Time IGS products

II. Open Data and Open Formats

- Formats for **multi-GNSS Real-Time Observation Data**
  - Legacy RTCM Message Types
    - For GPS: 1001-4 and
    - For GLONASS: 1009-12
  - Replaced by RTCM **M**ultiple **S**ignal **M**essages (MSM)
    - For maximum compatibility with RINEX version 3
    - Universality for all existing and future GNSS
    - MSM1-5: standard precision messages
    - MSM6-7: high precision messages
    - MSM5/7: with GNSS phase range rates in addition
    - MSM5: for transmission of a complete set of RINEX v3 observations
    - MSM7: for transmission of a complete set of RINEX v3 observations with extended resolution

II. Open Data and Open Formats

- Formats for **multi-GNSS Real-Time Observation Data**
  - Available RTCM **M**ultiple **S**ignal **M**essages:
    - 1071-77 MSM1-7 for GPS
    - 1081-87 MSM1-7 for GLONASS
    - 1091-97 MSM1-7 for Galileo
    - 1101-07 MSM1-7 for SBAS
    - 1111-17 MSM1-7 for QZSS
    - 1121-27 MSM1-7 for BDS
    - 1131-37 MSM1-7 for IRNSS/NaviC
  - Recommended MSM type within the IGS Real-Time Network:
    - MSM7
    - MSM5 if the bandwidth for transmission is limited

II. Open Data and Open Formats

- Formats for **multi-GNSS Real-Time Navigation Data**
  - RTCM Message Type 1019 for GPS
  - RTCM Message Type 1020 for GLONASS

  - RTCM Message Type 1045 for Galileo F/NAV
  - RTCM Message Type 1046 for Galileo I/NAV, reference for SSR corrections
  - RTCM Message Type 1042 for BDS
  - RTCM Message Type 1043 for SBAS
  - RTCM Message Type 1044 for QZSS
  - RTCM Message Type 1041 for IRNSS/NaviC

II. Open Data and Open Formats

- Formats for **multi-GNSS Real-Time Products**

SSR	Multi-stage/scalability		RTCM-SSR	IGS-SSR	Compact SSR	STARTN	SSRZ
RTCM framing			yes	yes	yes	no	optional
SV clock	high rate clock		available	available	available	available	available
	low rate clock		available	available			available
SV orbit			available	available	available	available	available
SV code bias			available	available	available	available	available
SV phase bias			Prop/tested	available	available	available	available
Ionosphere	global	VTEC	Prop/tested	available		available	available
	global	STEC	under discussion	under discussion			available
	regional	STEC			available	available	available
	Residual	gridded/ station			available	available	available
Troposphere	global		under discussion	under discussion			in preparation
	regional					available	available
	residual	gridded/ station			available	available	available

II. Open Data and Open Formats

- Open Source Real-Time Software provided by BKG
  - **BKG Ntrip Client (BNC)**
    - current version BNC v2.12 supports Open Real-Time Formats for
      - ✓ Observation Data: Legacy RTCM and RTCM MSM 3-7 messages
      - ✓ Navigation Data: RTCM Messages for GPS, GLONASS, Galileo, QZSS, SBAS, BDS, IRNSS
      - ✓ SSR-Products: RTCM-SSR (standardized and proposed messages) and IGS-SSR
    - Development version BNC v2.13 will support
      - ➢ Different PPP approaches for 4 G: GPS, GLONASS, Galileo, BDS
      - ➢ Clock combination for 4 G: GPS, GLONASS, Galileo, BDS
  - **BKG Professional Ntrip Caster**
    - Current version is 2.0.37

III. Naming Conventions for IGS Real-Time Data Streams

- 10-character **mountpoint naming convention** of the IGS real-time working group (IGS-RTWG)

  - 2014 – Agreement on a new concept of file names based on the 9-digit station IDs, in connection with the introduction of the RINEX 3.02 file format (ftp://igs.org/pub/data/format/rinex302.pdf)
  - 2017 – First draft of a “white paper on the conventions of mount point naming for real time data streams“, presented to the IGS-RTWG (https://igs.bkg.bund.de/root_ftp/NTRIP/documentation/20180227_white_paper_mount_point_naming.pdf)
  - 2018 - Approval of the proposal by the IGS-RTWG in February 2018
  - 2020 - Final implementation at all IGS Global Casters (BKG, CDDIS, IGSCB)

III. Naming Conventions for IGS Real-Time Data Streams

- 10-character **Observation Data Stream** "TTTTMRAAAF", where
  - TTTT: station marker name
  - M: monument or marker number (0-9)
  - R: receiver number (0-9)
  - AAA: three-letter ISO country code
  - F: data stream format, recommended to use “0” for the best RTCM3 data stream (e.g. RTCM3 MSM7)

Examples for station WT21 (Wettzell)

- WT2100DEU0 - Station WT21, LEICA receiver, RTCM data stream
- WT2100DEU9 - Station WT21, LEICA receiver, LB2 data stream
- WT2101DEU0 - Station WT21, JAVAD receiver, RTCM data stream
- WT2101DEU9 - Station WT21, JAVAD receiver, SBF data stream

III. Naming Conventions for IGS Real-Time Data Streams

- 10-character **Navigation or Product Data Stream** "TTTTXXAAAF", where
  - TTTT: stream type (SSRA, SSRC, IONO, BCEP, etc.)
  - XX: two-digit solution ID
  - AAA: three-letter agency code
  - F: one digit format ID (0: RTCM3, 1: SAPA, 2-9: reserved)

  - Stream types TTTT could be as follows:
    - SSRA/SSRC: state space correction streams, referring to APC/CoM
    - DCBS: state space correction stream (DCBs only)
    - IONO: ionospheric correction stream
    - TROP: tropospheric correction stream
    - BCEP: broadcast navigation data (ephemeris) stream

  Example: BCEP00BKG0 - global broadcast ephemerides from BKG

IV. To Do / Open Issues

- IGS
  - Broadcaster guidelines
  - SSR Task Force: Publication of the new IGS SSR Format v1.0 (October 05, 2020)
- SIRGAS
  - At least one IGS reference station in each country
  - Experimental SIRGAS regional caster becoming operational
- General
  - Implementation of open SSR corrections within hardware (receivers)

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Thank you for your kind attention!

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