RTCM-SSR Strategy of Bias Treatment

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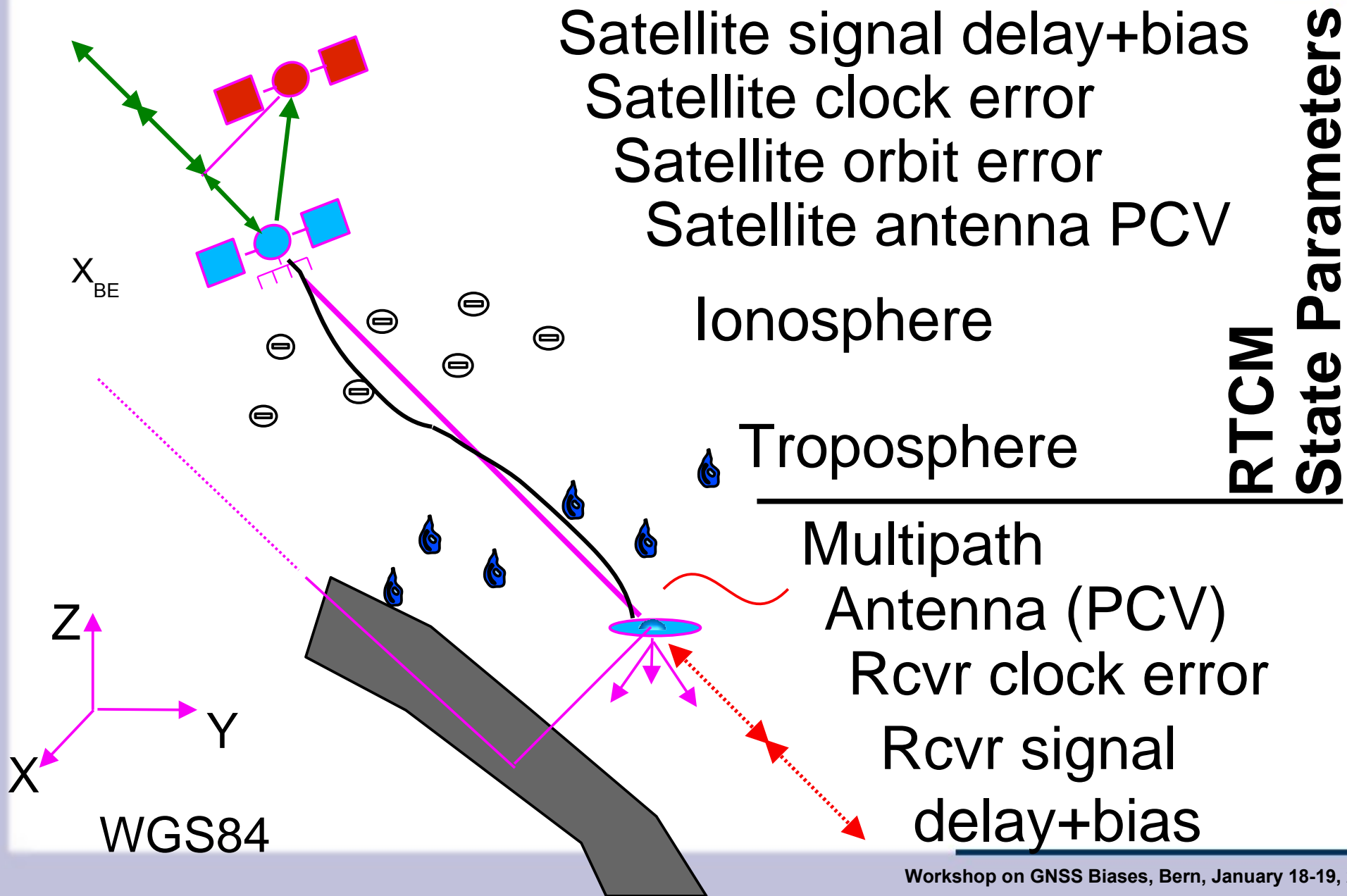# RTCM-SC104 SSR development

- Working group established in 2007

- 3 development stages:

  1. Development of messages for the transmission of **satellite orbit corrections**, **satellite clock corrections**, **satellite code biases** and **URA** values (currently GPS and GLONASS).
     Enables real-time dual frequency code based PPP.
     Completed in May 2011 and published in RTCM standard document:
     „*RTCM STANDARD 10403.1 with Amendments 1-5*", July 1, 2011

  2. Development of messages for the transmission of **phase biases** and **VTEC**. In preparation.
     Shall enable real-time phase based PPP including ambiguity resolution and real-time single frequency PPP.

  3. Development of messages for the transmission of **STEC** and **tropospheric parameters**.
     Shall enable PPP-RTK applications (centimeters in seconds)

General Requirements / Rules

- RTCM-SSR shall be a **self-contained** format as far as possible. I.e. all necessary information for consistent processing of an RTCM-SSR stream shall be contained in the stream or shall be specified as part of the standard document. The need for external information should be avoided.

- The definition of RTCM-SSR contents shall not limit/restrict the generation of such streams to certain generation models or approaches.

- International conventions for observation modeling and/or corrections shall be applied as far as necessary and as long as they are well defined and documented and freely usable.

- The standard shall allow **different update rates for different state parameters** in a flexible way.

- **Consistent processing** of SSR stream contents must be ensured.

- The RTCM-SSR standard shall allow global, continental, regional and/or local applications.

Satellite signal delay+bias
Satellite clock error
Satellite orbit error
Satellite antenna PCV

Ionosphere

Troposphere

Multipath
Antenna (PCV)
Rcvr clock error
Rcvr signal
delay+bias

RTCM State Parameters

X_{BE}

Z

Y

X

WGS84

SSR to OSR transformation

- Transformation from State Space Representation (SSR) to Observation Space Representation (OSR)

    - Complete RTCM state vector can be transformed to OSR in form of PseudoRange and PhaseRange corrections, comparable to standard RTCM V2 corrections

    - PseudoRange and PhaseRange corrections (may) contain (average) receiver dependent effects („average" receiver = SSR_{RX})

        - SSR_{RX} residual receiver clock effects

        - SSR_{RX} residual receiver signal biases

        - Most residual effects are common to all satellites

        - RTCM-SSR does not contain specifications defining characteristics (amount or time variations) of such SSR_{RX} residual effects

    - SSR_{RX} receiver/antenna type shall be transmitted using 1033 message

RTCM-SSR Consistency Sketch
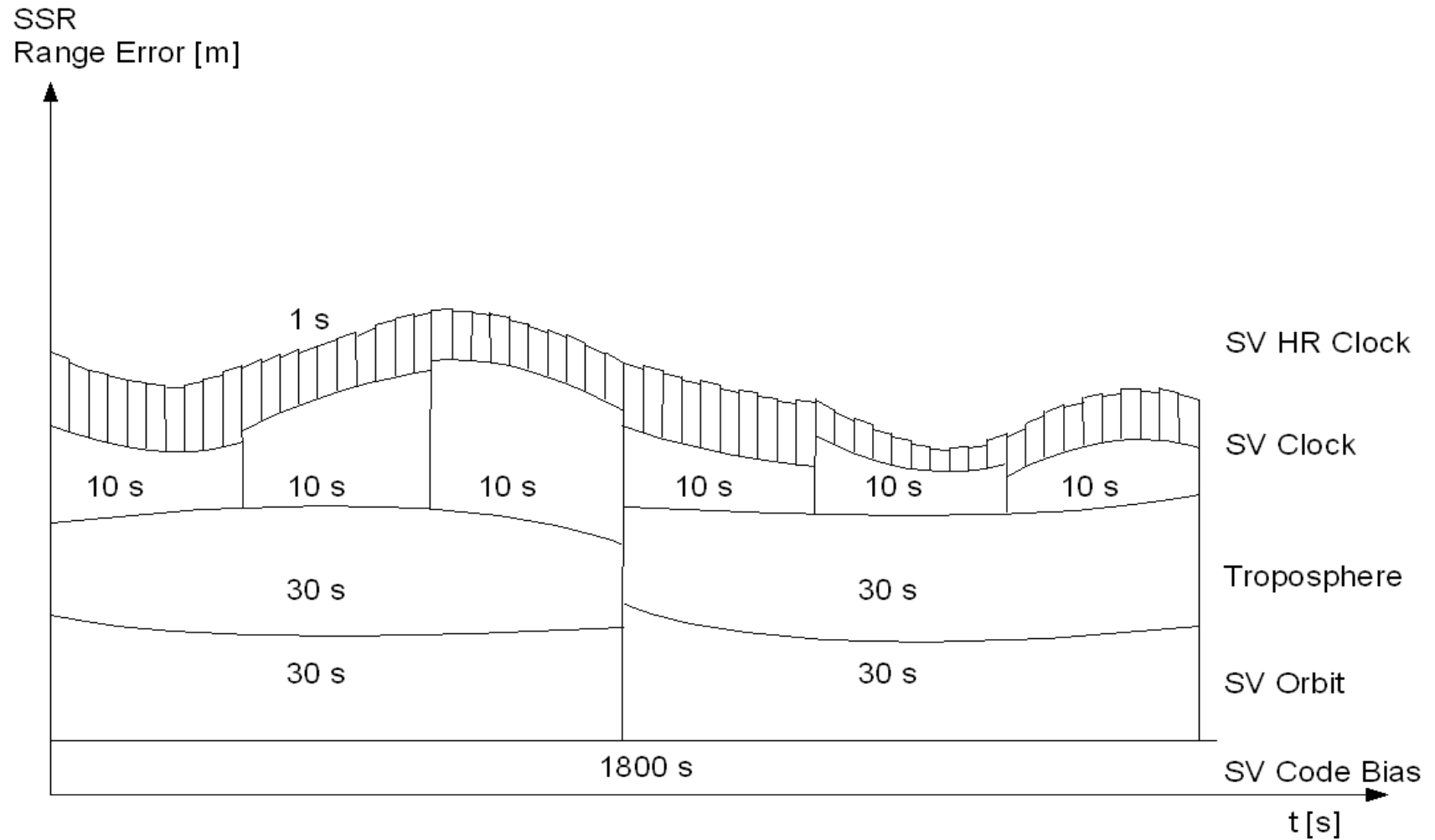
RTCM-SSR and Signal Biases

- RTCM-SSR messages for satellite and signal dependent Code and Carrier Biases are (will be) defined as

    - „absolute biases" (instead of differential biases)

        - No need to define reference signals or reference linear combinations

        - Flexible approach with respect to signal selection

        - SSR generating applications working with Differential Biases (DBs) shall chose absolute values in a way that the DBs a correctly represented and consistency is maintained

- RTCM-SSR biases may contain remaining/average/reference receiver biases

    - Biases common to all satellites

        - Easily eliminated through differencing or

        - Changing the estimates of corresponding rover parameters

    - In case of non-common biases (GLONASS FDMA)

        - a type 1033 message describing the type or instance of a reference receiver/antenna shall be sent with the RTCM-SSR stream