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Uncertainty in GNSS-positions from meters to centimetres - a short overview of observation methods

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Offset overview

- Ephimeres
 - satellite orbit - 24 h predicted average transmitted
- Satellite clock offset
 - Individual satellite clock offset - 24 h predicted average transmitted
- Ionospheric delay
 - frequency dependent delay, dependent on amount of free electrons
 - 24 h predicted model transmitted (Klobuchar model)
- Tropospheric delay
 - frequency independent delay
- Earthtide and other effects

Observation terminology

- Pseudorange
 - Estimated apparent distance from satellite to antenna
- Code
 - Pseudorandom code pseudorange
- Carrier phase
 - RF carrier wave phase pseudorange
 - Integer ambiguous (which carrier cycle aligns with known code chip)
- Double frequency (L₁/L₂)
 - Observing two frequencies allows for direct measure of ionospheric delay and compensate it out

Position/time estimation methods

- Broadcast model code 10 m
 - 24 h predicted average transmitted
- SBAS code 2 m – Satellite Based Augmentation System
 - Rapid ephemeris, clock and ionospheric corrections
- DGPS code 1 m – Differential GPS
 - Pseudorange corrections (difference) from nearby fixed station
- RTK 2 cm – Real Time Kinematik
 - Doublefrequency carrier phase, realtime corrections from base to rover station
- PPP 1 cm – Precise Point Positioning
 - Earthtide, unwinding etc. postprocessing



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