Multi-GNSS Based Processing at the USNO

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**Purpose**
- Describe Experimental Processing of Multi-GNSS Based Products
- Focus on Ultra-Rapid
- Compare to Similar GPS-based Signal Processing
- Future Plans

**Software Setup & Processing**
- Generated Using Bernese 5.0 Software or Bernese 5.2 Software (as noted)
- A Priori: Most Recent IGS Ultra-rapid GNSS Clocks, ERPs, and Orbits (IGV)
- 27 or 40 (Long-arc) hour Observation Window with GPS+GLONASS Observations (as noted)
- Network Processing (Ultra-Rapids and Rapids):
  - Use Subset of the Available Stations that Define the IGB08 Reference Frame
  - 25% of Stations Receive GLONASS + GPS Signals
  - Estimate GNSS Satellite Orbits, EOP, Receiver- and Satellite-Clock Offsets
  - Precise Point Positioning (PPP) (Rapids):
    - Remaining Available Stations Yield Receiver Clock Estimates
    - Network Solutions as PPP Inputs
    - No Process Tuning to Account for GLONASS Signal Difference or Biases

**Future Plans**
- Explore and Implement GLONASS Observations Processing Enhancements
- Incorporate into IGS Final Troposphere Estimates (Improve Estimates at Higher Latitude Stations?)
- Inclusion into IGV Combination?
- Test 40 hr Long-arc Solution in Bernese 5.2

**Conclusions**
- GLONASS Signal Processing Integrated into Experimental Ultra-Rapid-like Product
- Updated Models and Processing in Bernese 5.2 Show Improvement as Does 40 hr Long-arc Solution
- Process Enhancements Still Needed for Using GLONASS Data

**Comparison to 40 hr Long-arc Ultra-Rapid Solution**
- Comparison of 27 hr Arc GLO+GPS Solution, 40 hr Long-arc GLO+GPS, and GPS Based Solutions wrt IGV/IGV Combinations
- Different Baselines and Station Set Used
- All Processed with Bernese 5.0

**Helmet Transformation**
- 7-Parameter Helmert Transformation wrt IGV/IGV Ultra-Rapid Orbit Combination

**Significant Improvement in RMS for 40 hr Arc Over 27 hr Arc**

**Earth Orientation**
- Difference in the Polar Motion wrt IGV
- Significant Improvement in the X Direction Polar Motion 40 hr Arc Over 27 hr Arc GLO+GPS

**Comparison to Bernese 5.2 Processing**
- Comparison of 27 hr Arc GLO+GPS Solution to IGV/IGV Combinations
- Different Baselines and Station Set Used

**Observed 24 hrs**
- 7-Parameter Helmert Transformation wrt IGV/IGV Ultra-Rapid Orbit Combination

**Predicted 6 hrs**
- 7-Parameter Helmert Transformation wrt IGV/IGV Ultra-Rapid Orbit Combination

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**USNO Products Available Online:** ftp://maia.usno.navy.mil/GPS/

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