WAAS Technical Report
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DR#79: Doppler Spike caused CRW Signal In Space Outage
GPS Week/Day: Week 1515 Day 6

Discussion:

On GPS Week 1515 Day 6 (January 24, 2009), a large Doppler spike caused a sequence of events that resulted in a CRW Signal in Space outage that lasted 592 seconds. The order of events and GUS mode details are shown in Table 1.

Table 1: Sequence of Events

Time	Gus Mode	Gus Mode	Signal in Space	Event
	LTN(Littleton)	APC(Napa)		
13:04:03	Primary	Backup	Good	Large Doppler Spike
13:04:04	Primary	Backup	Good	
13:04:05 – 13:04:09	Primary	Backup	None	5 Missed Messages on CRW
13:04:13	Backup	Backup	None	LTN switched to Backup
13:05:18	Maintenance	Backup	None	LTN put in Maintenance mode
13:06:45	Maintenance	Backup	None	Failed attempt to switch APC
				from Backup to Primary
13:07:01	Maintenance	Maintenance	None	APC put in Maintenance Mode
13:13:57	Backup	Maintenance	None	LTN restored to Backup Mode
13:14:05	Primary	Maintenance	Good	LTN switched to Primary Mode
13:21:56	Primary	Backup	Good	APC restored to Backup Mode

At 13:04:03, a large doppler spike of 5-6 Hz caused the Littleton GUS to not receive any WAAS User Messages from the CRW Geosynchronous satellite from 13:04:05 to 13:04:09. Because more than three consecutive WAAS User Messages were not received at Littleton, the GUS initiated a GUS switchover. Littleton first was set to backup mode and then commanded the Napa GUS to switch from backup mode to primary mode. At the time Littleton commanded Napa to change modes from backup to primary, Napa was in a “No Loop Lock” state due to the doppler spike that occurred at 13:04:03. Because of the “No Loop Lock” state at Napa, the mode change failed and Napa remained in backup mode. Following the failed CRW GUS switchover, both Napa and Littleton were in backup mode and the CRW Signal in Space was lost for approximately 10 minutes. The WAAS Operators were able to restore Littleton to primary mode at 13:14:05.

The CRW Signal In Space outage had a small effect on Alaska Coverage because the use of CRW as a ranging source was lost for approximately 10 minutes. Figures 1 and 2 show LPV and LPV200 Coverage for January 24, 2009.

Figure 1: LPV Coverage on January 24, 2009

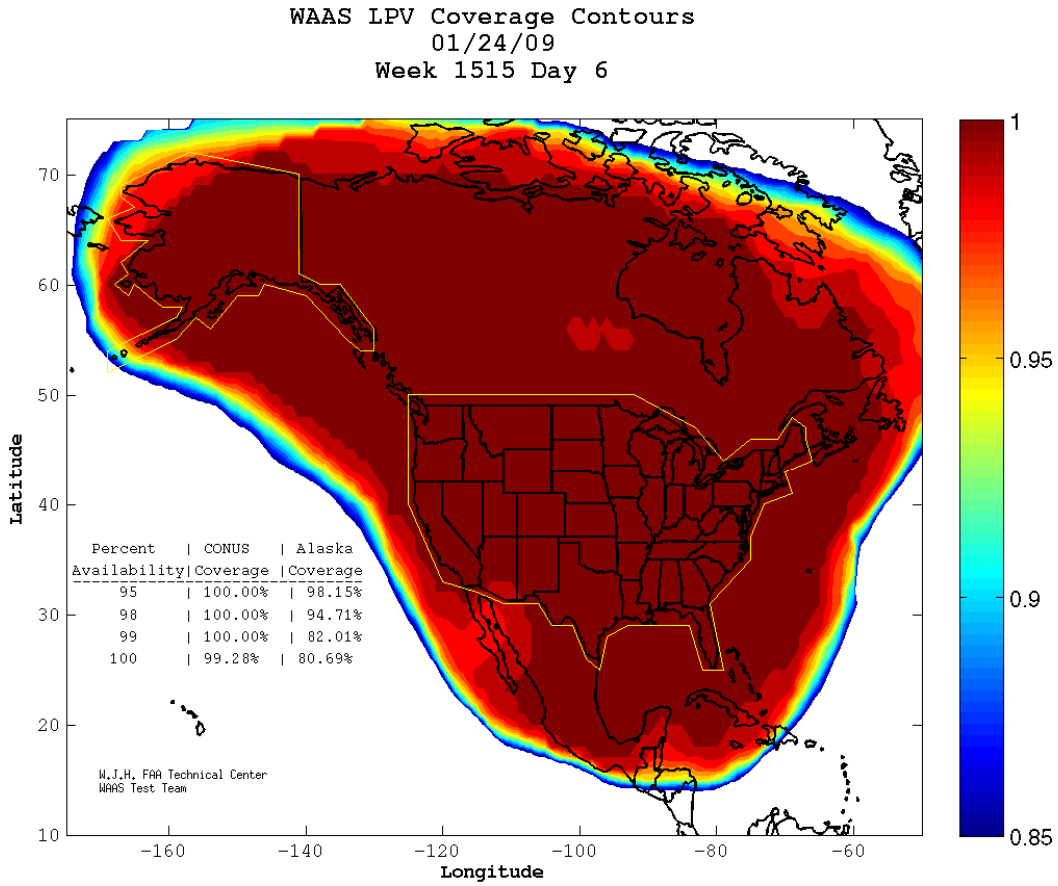
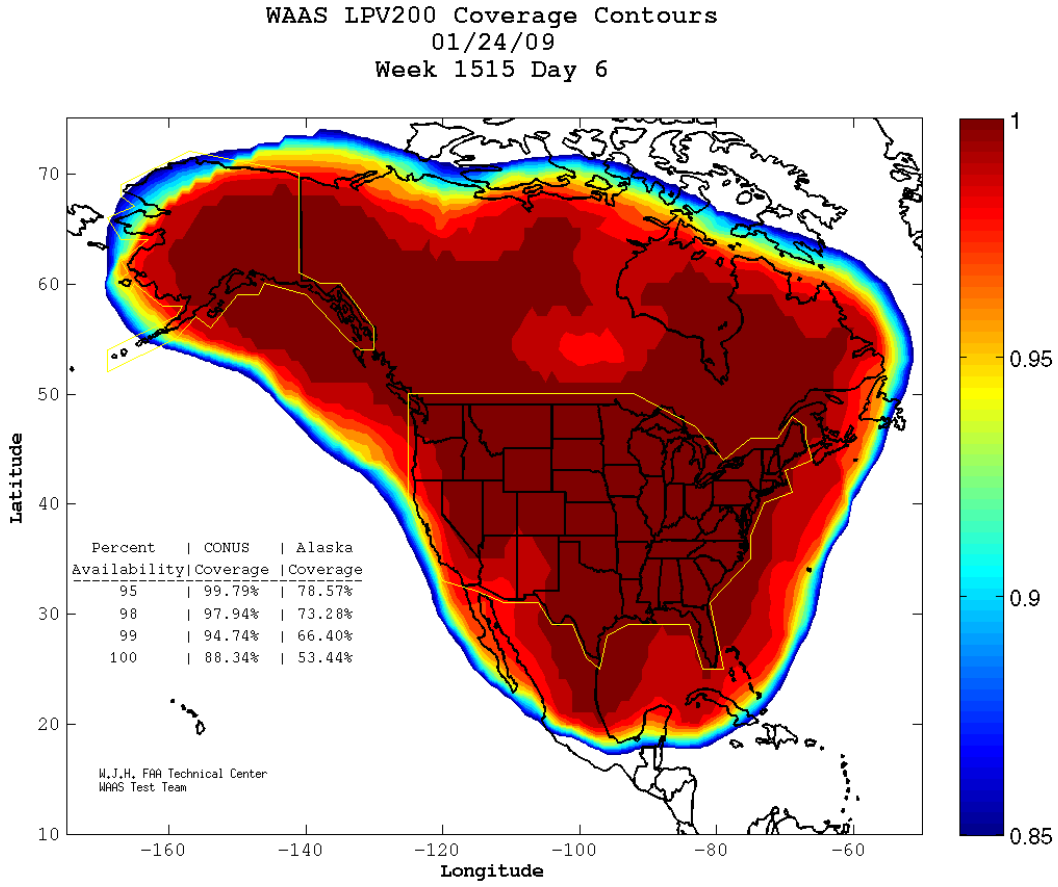


Figure 2: LPV200 Coverage on January 24, 2009



Conclusion:

A large doppler spike on January 24, 2009 led to a CRW Signal In Space outage that lasted for approximately ten minutes. There was a small effect on WAAS Coverage due to the loss of CRW as a ranging source during that time.