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A Near Real-time GPS Interference Detection System in the United States Using the CORS Network

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 XXIV FIG International Congress 2010
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Sydney, Australia

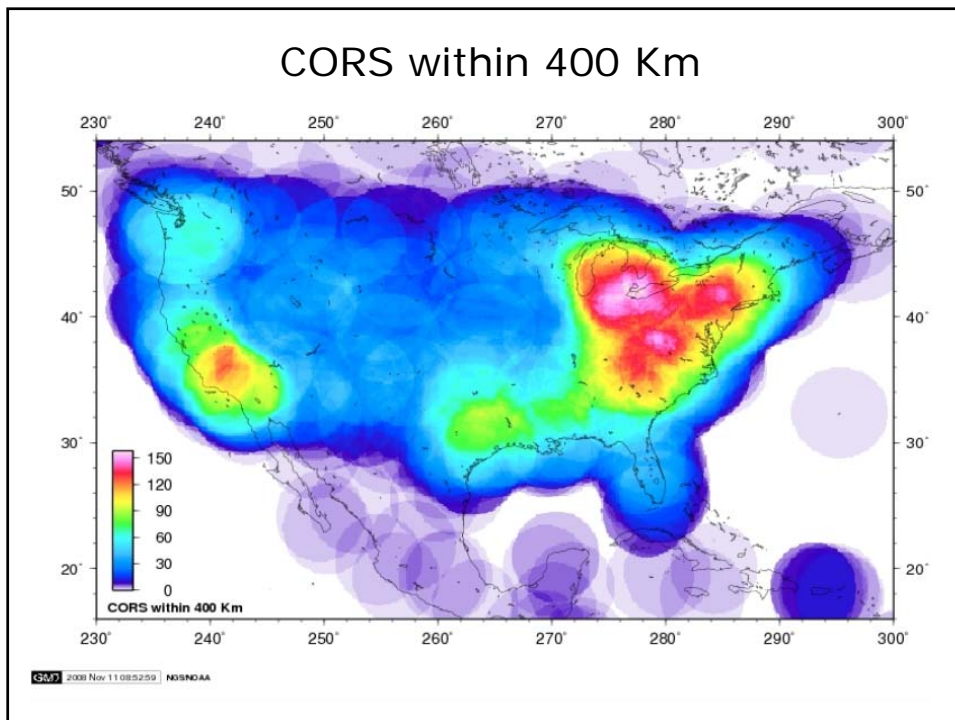
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CORS Network – Array of Sensors

- CORS network is a multi-purpose cooperative endeavor involving government, academic, commercial and private institutions
- Each CORS site provides Global Positioning System (GPS) access throughout the United States and its territories (~1400)
- CORS network helps define the National Spatial Reference System (NSRS)
- Provides carrier phase and code range measurements to support 3-D positioning activities
- Measurements from the CORS network enables positioning accuracies that approach a few centimeters
- Engineers, surveyors, GIS/LIS professionals and scientists rely on the CORS network for their positioning and navigation needs

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GPS Interference

- Intentional
 - Number of jamming incidences worldwide continues to rise
 - Jamming hardware – small, easy to build, inexpensive
 - Frequency spectrum similar to GPS with overlapping portions
- Accidental
 - Many cases from ultra-wide band devices
 - Harmonic bands
 - Spectrum encroachment
 - Amplifiers to boost a signal


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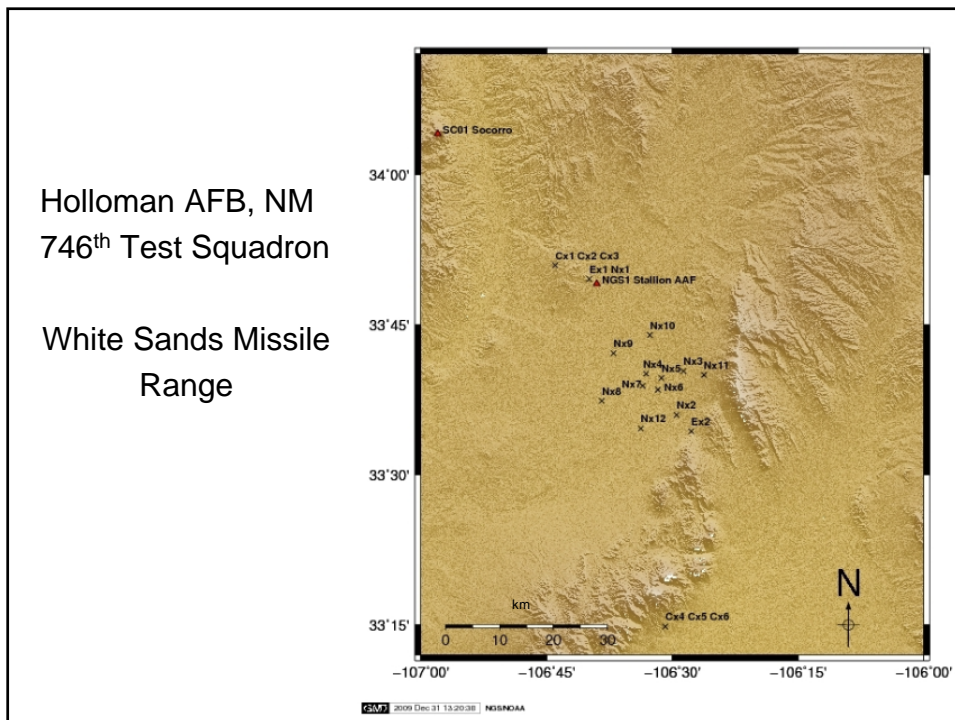
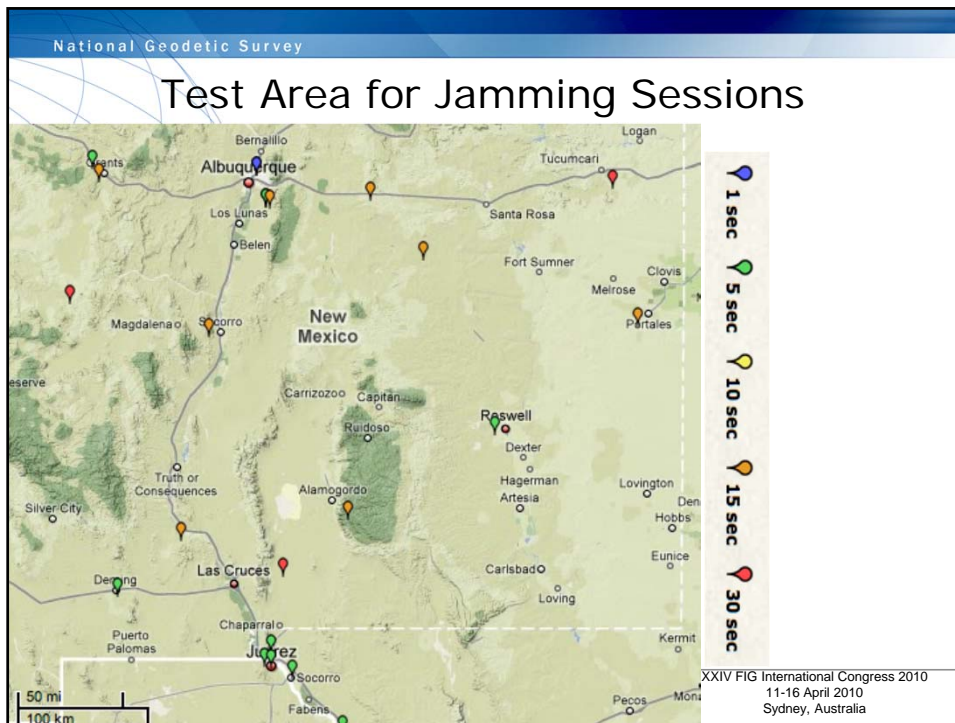
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Test Objectives for Jamming Experiment

- Determine if the CORS network can be used for GPS interference detection
- Evaluate interference detection software
- Determine effective range for interference detection
- Identify data characteristics
 - Clean data
 - No data - receiver could not track/record observables
 - Noisy data
 - Spoofing

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Jamming Sessions

Scenario	Duration (min)	Monday	Tuesday	Wednesday
1	20	Low power omni, BBN	Low power omni, BBN	Low power omni BPSK
2	30	Crossroads, BBN, CW	Crossroads, BBN, CW	All noise ramp
3	30	Crossroads, BPSK	Crossroads, BPSK	Crossroads, BBN
4	30	ET #1, KO pulse	ET #1, KO pulse	KO pulse

Scenario	Low power omni	Crossroads	All noise ramp	ET 1, KO pulse	ADAP BBN
1	Nx3				
2		Nx4 – Nx7	Nx1-Nx12		
3		Nx4-Nx7			
4		Nx1-Nx12		Cx1-Cx6, Ex1	

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Scenario 1

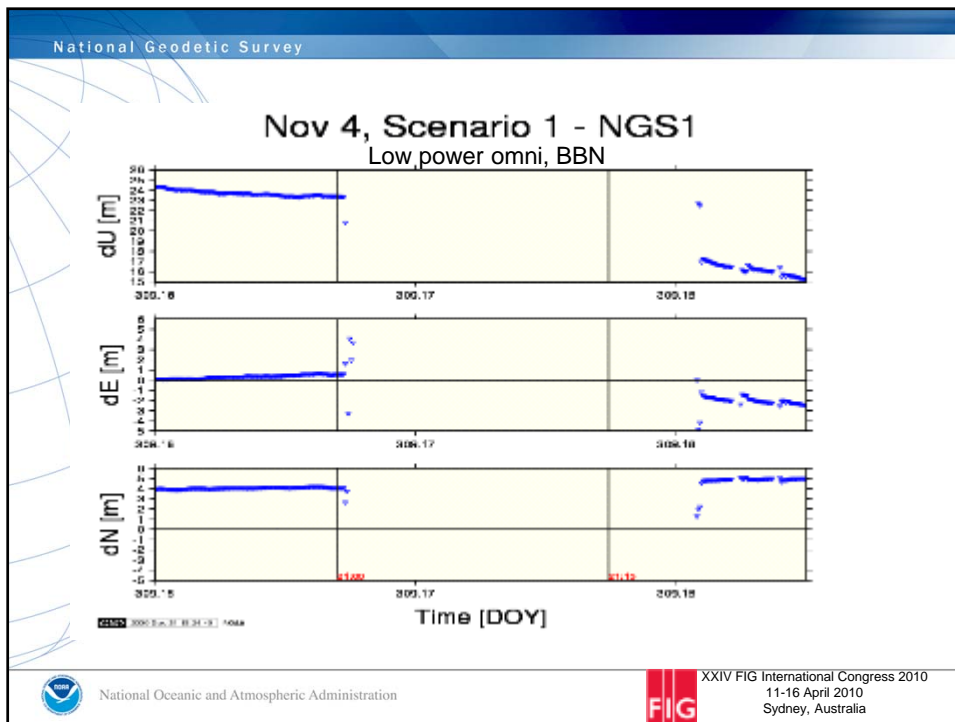
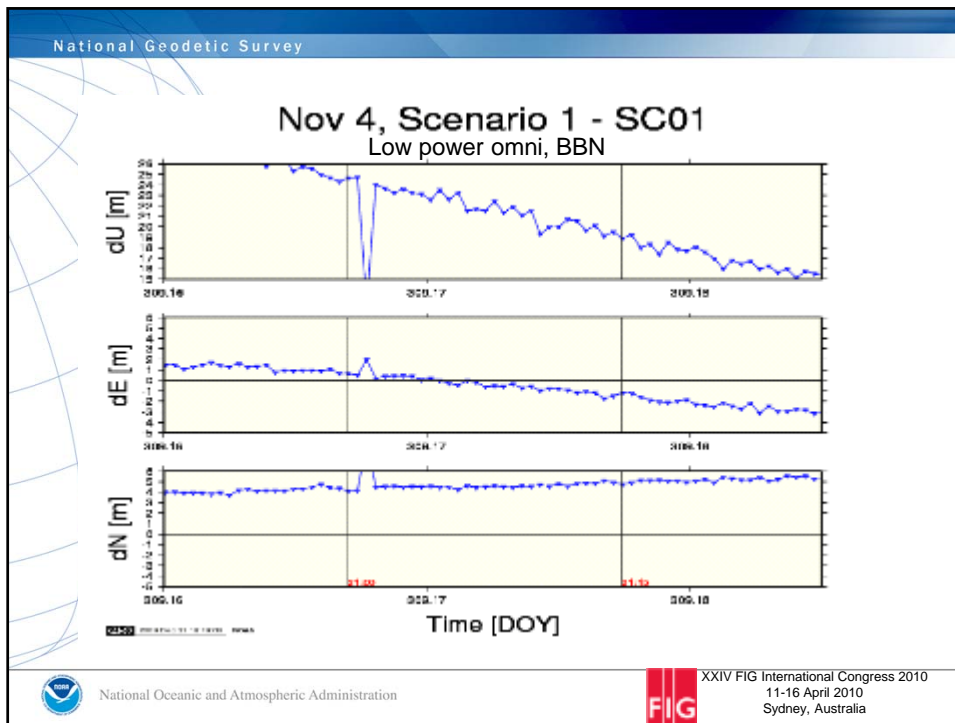
Start: 21:00
End: 21:20

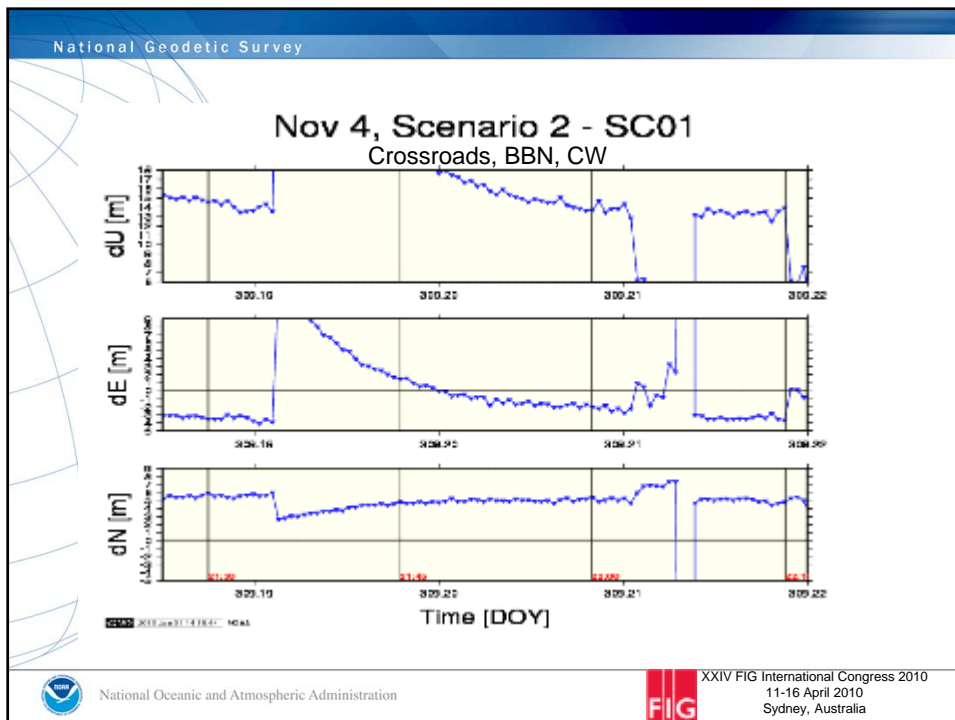
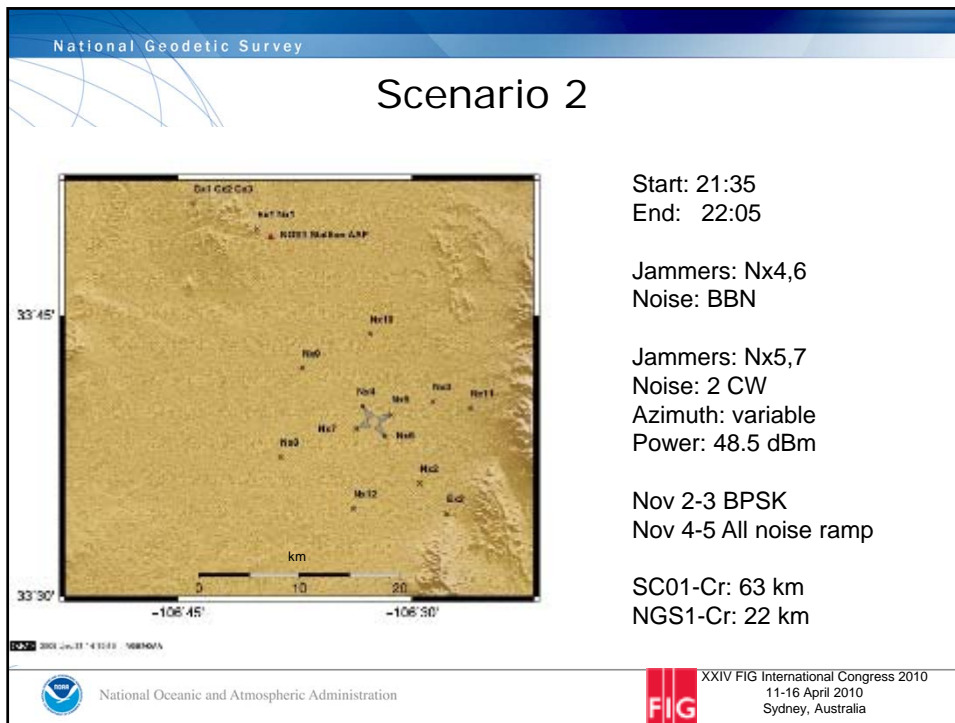
Jammer: Nx3
Noise: BBN, BPSK
Azimuth: Omni
Power: 48.5 dBm

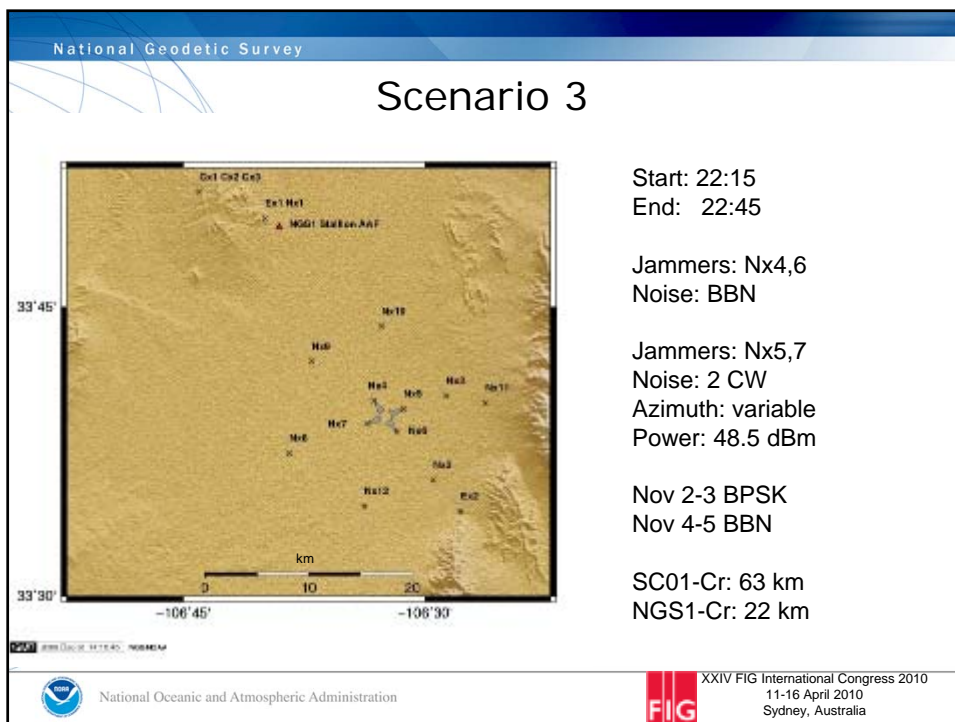
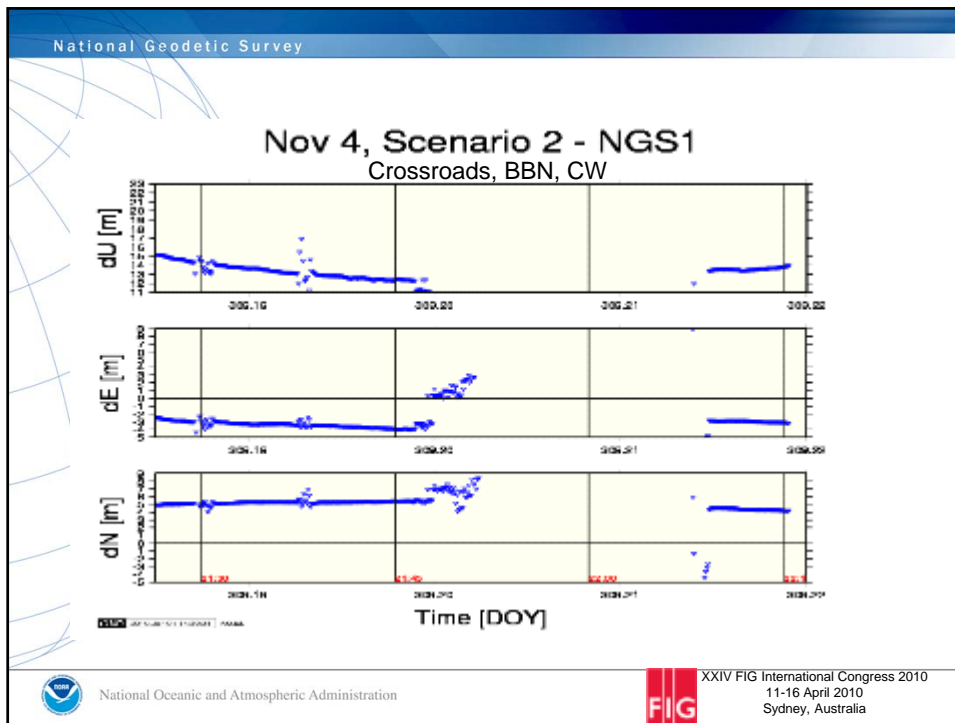
BBN Nov 2-3
BPSK Nov 4-5

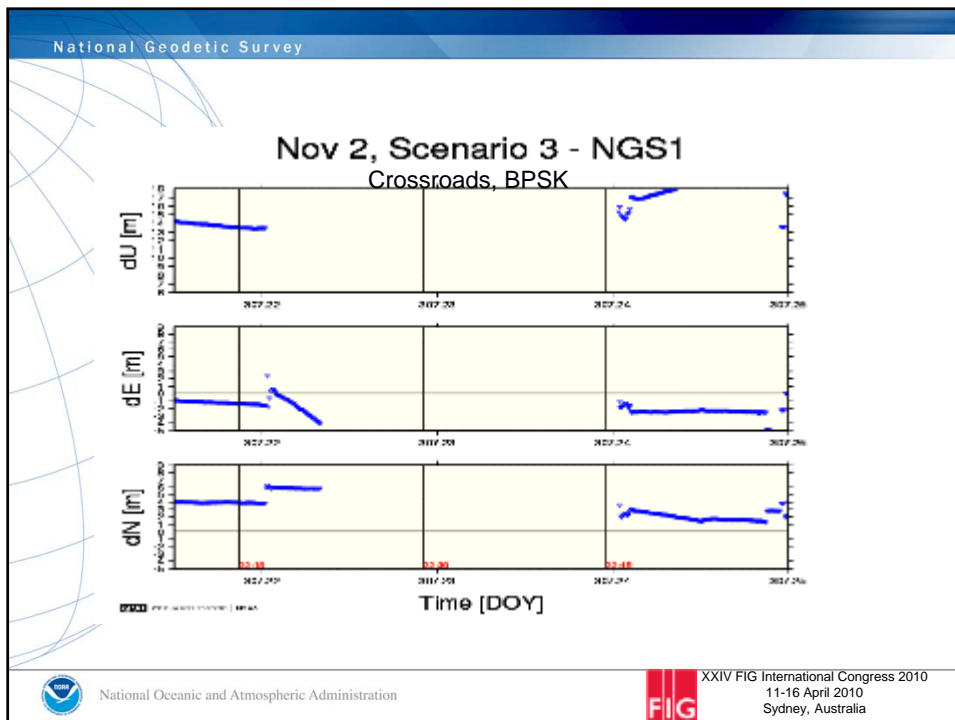
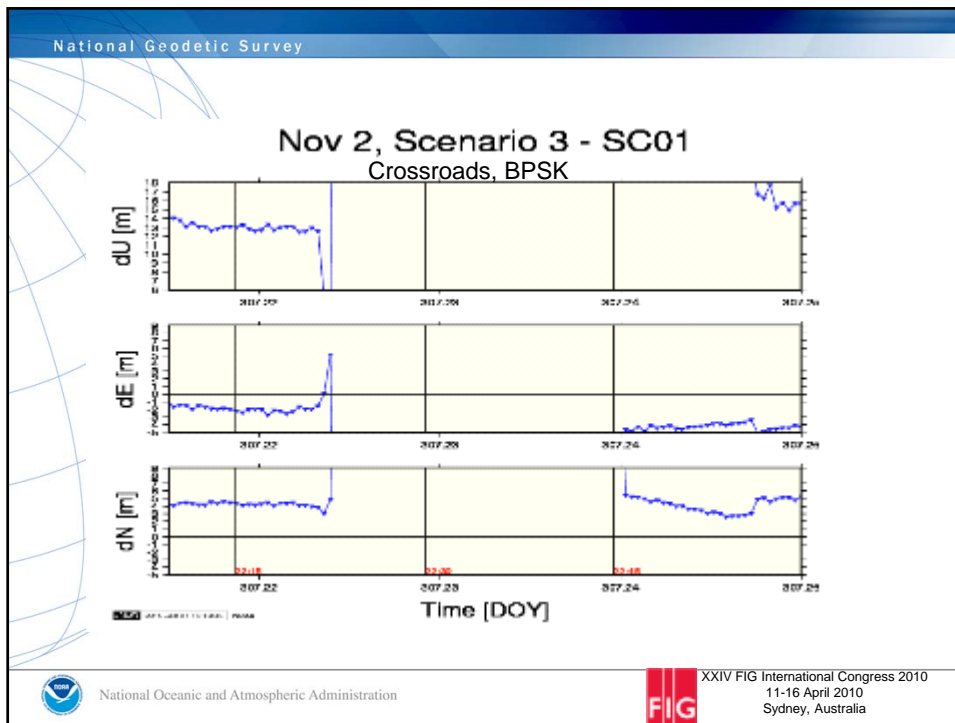
SC01-Nx3: 64 km
NGS1-Nx3: 23 km

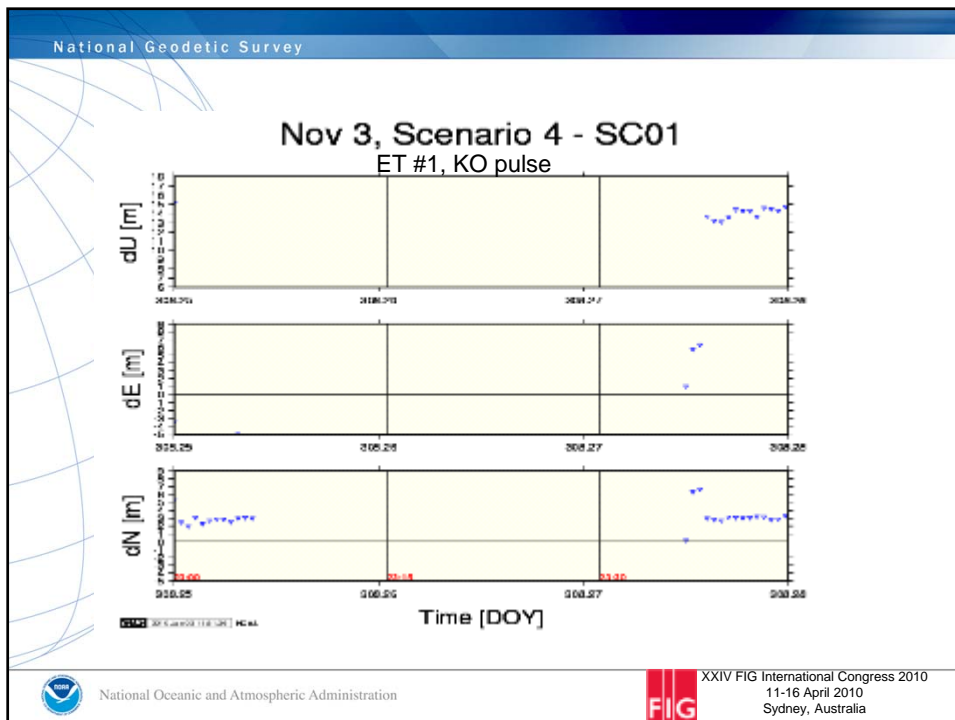
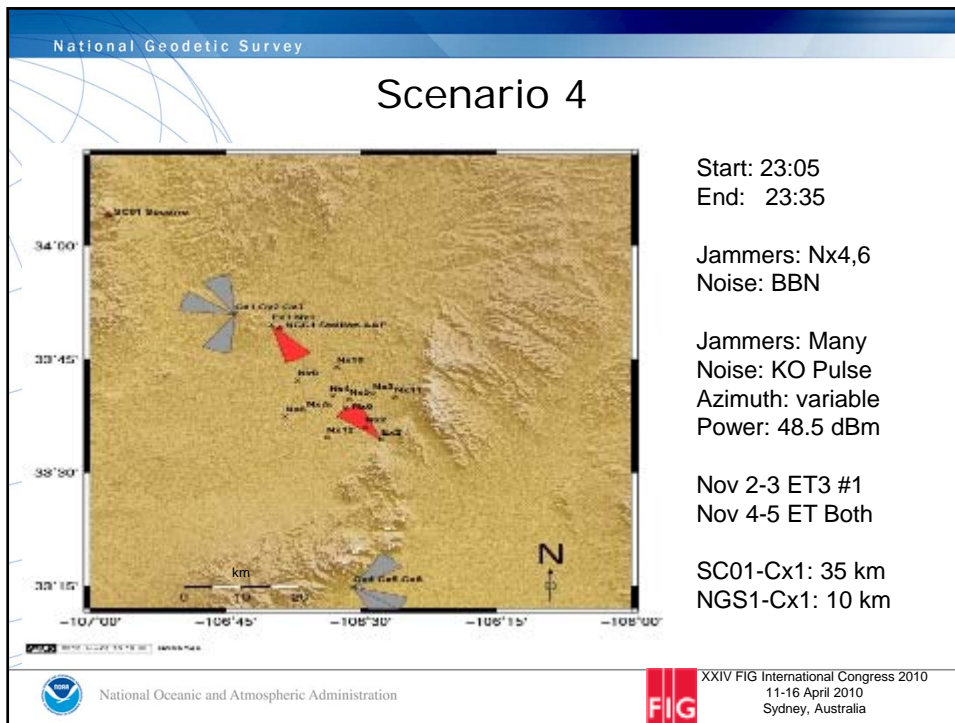
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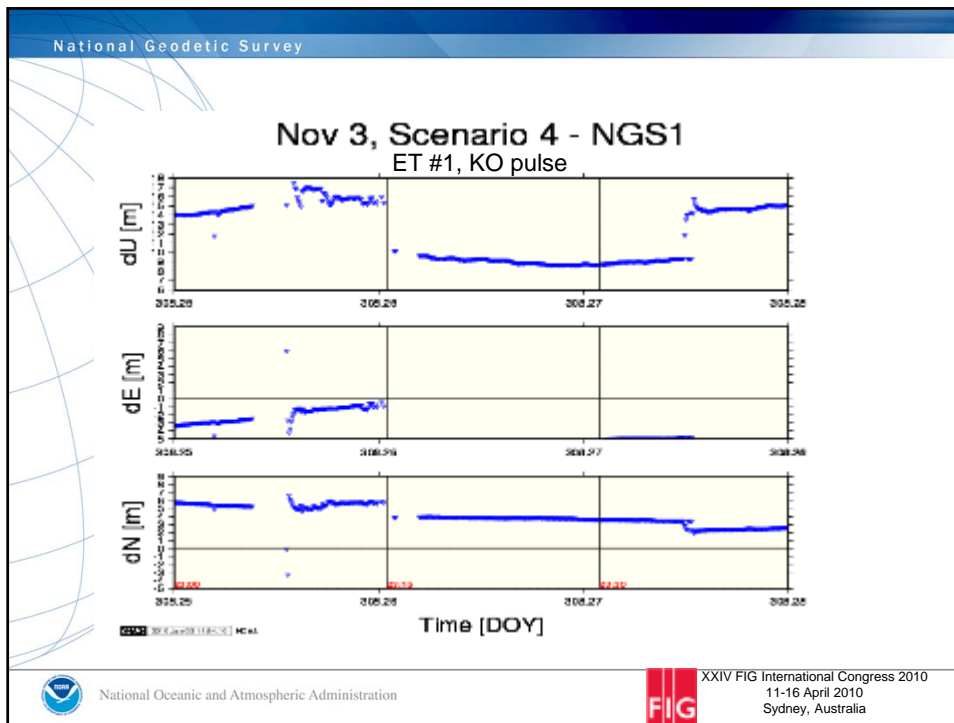












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Concluding Remarks

- It is possible to use CORS stations as a sensor for GPS interference detection
- Detection is a function of emitter signal strength, noise characteristics, emitter beam direction, terrain
- CORS station spacing - metropolitan vs. open countryside
- United States Air Force, Department of Defense, Department of Homeland Security, NOAA

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