A Brief Introduction to the Puerto Rico and Virgin Islands GPS Network

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- Location, Installation, Data Archiving, and Applications
- A Big Lesson Learned From the Chile EQ

29 Total, 18 Active Stations (Feb. 2011)
GPS + Weather + Seismic + TideGauge
A Real-Time Velocitymeter–Accelerometer–GPS Integrated Earthquake Observation Station at Mona Island, Puerto Rico

June 14, 2009
GPS + Strong Motion Sensor

StrongMotion Accelerograph—Short and Middle Periods
GPS Seismometer---Middle and Long Periods
GPS + TideGauge

- Verify a Tsunami --- Absolute Sea-Level Change
- Long-term sea level monitoring
GPS + Weather Sensors

- Weather Forecasting
- Improve “Wet-Delay Model” in the Caribbean Region
Installation

- Pre-Investigation: 1-2 week
- MOU (Memorandum of Understanding): 2 months

**A Great Challenge: Signatures Acquisition**

- Field Installation: 2-3 days
Data and Data Archiving

- **15-sec**
  - 2.5 years

- **1-Hz**
  - 2.5 years

- **10-Hz**

January 12, 2010 Haiti EQ (M 7.0)
May 16, 2010 Puerto Rico EQ (M 5.7)
Data Archiving

Backup---Puerto Rico Seismic Network
Real Time Data Streams (RTCM3.0)
NTRIP Server and Caster: gps1.uprm.edu

- **Major Users:**
  - Local Land Surveying
  - Local Landslide Monitoring
  - IGS real-time GNSS data dissemination network.
  - NASA’s JPL-GPS Real Time Earthquake and Tsunami Alert Project
Applications

- Plate Tectonics, Micro-Plate Tectonics
- Large Earthquake Monitoring & Tsunami Early Warning (PRSN)
- Hurricane Intensity Forecasting (UCAR)
- Landslide Monitoring

An Infrastructure for Multi-Hazard Minimization
GPS Landslide Monitoring

- Post Static Monitoring
- Real-Time Kinematic Monitoring
- Near Real-Time Rapid Static Monitoring (30 minutes)
Real-Time Kinematic Monitoring

- TrackRT Developed at MIT
- JPL’s GREAT (GPS Real Time Earthquake and Tsunami) Alert Project
- Real-Time PPP
GPS Real Time Earthquake and Tsunami Alert Project

The NASA Global Differential GPS System

Local Networks Augmentation

GDGPS-based PPP enables local networks to be anchored to the ITRF

Yoaz et al.
Near Real-Time Rapid Static Monitoring

- **Real Time GAMIT**
  FTP—Hourly Raw Data
  FTP---IGS Ultra-Rapid Orbits (updated every 6-hours)
  GAMIT---Hourly Position

**Precision:**
Single Base 1--3 cm

**Spurious Excursions**
A Challenge for GPS Landslide Monitoring!

Does GPS work in all weather conditions?

- Most catastrophic landslides happened during or after heavy rainfall events.
- Rainfall events can significantly degrade the precision of GPS measurements.

Reasons: unmodeled wet delay, multipath, liquid water
A Big Lesson Learned from The Chile Earthquake

- Can our GPS stations resist large earthquakes?
CONZ, CONT 1-Hz GPS

SANT 1-Hz GPS

Epicenter

Talcahuano (100 km) - Chillan (95 km) - Concepcion (105 km)

CONZ, CONT 1-Hz GPS
GPS Lost Track on Satellite Signals

SNR---Signal to Noise Ratio
GPS Seismograms Were Clipped!
Evaluation of Earthquake Resistant Ability of a Total GPS Seismic station
Future COCONET GPS
The Invention of a Seismic Isolation Device for Mounting GPS Receivers

- The failure of (Loss-of-Track) was caused by
- *large Acceleration or Jerk* suffered by the GPS receiver and/or antenna.
Thank You!