

# DIFFERENTIAL CORRECTION

GPS & GIS | Fall 2017

# Differential Correction

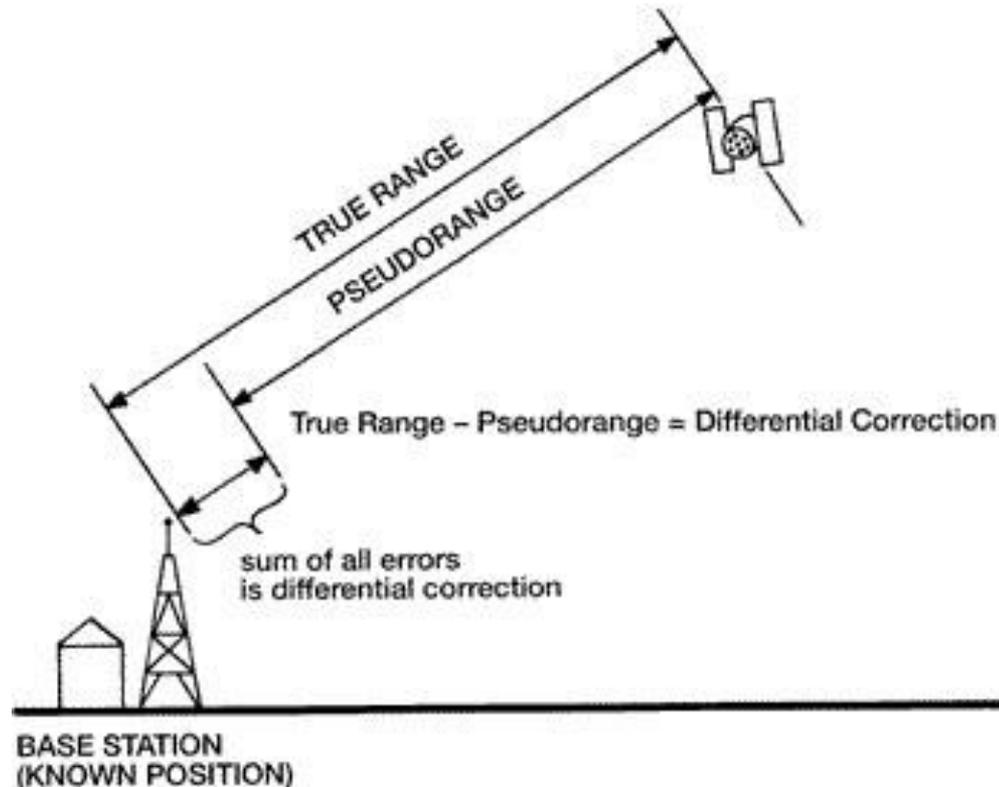


“Method of removing errors, both man-made & natural, that affect GPS measurements.”

Trimble, 2004. Why Postprocess GPS data

# Differential Correction

- Differential GPS (DGPS) can be calculated using information from a base station with known location



# Differential Correction

- Base stations locations are determined using precise surveying techniques
- Static positions can be corrected to less than a meter (horizontal)
- Dynamic (moving) positions can be corrected to 1-3 meters

# Pseudorange

Time that signal is transmitted from the satellite is encoded on the signal, using time from the satellite clock (atomic)

Time of signal reception recorded by the receiver

Receiver measures difference:

Pseudorange = (time difference) x (speed of light)



Rover

T

O

Base

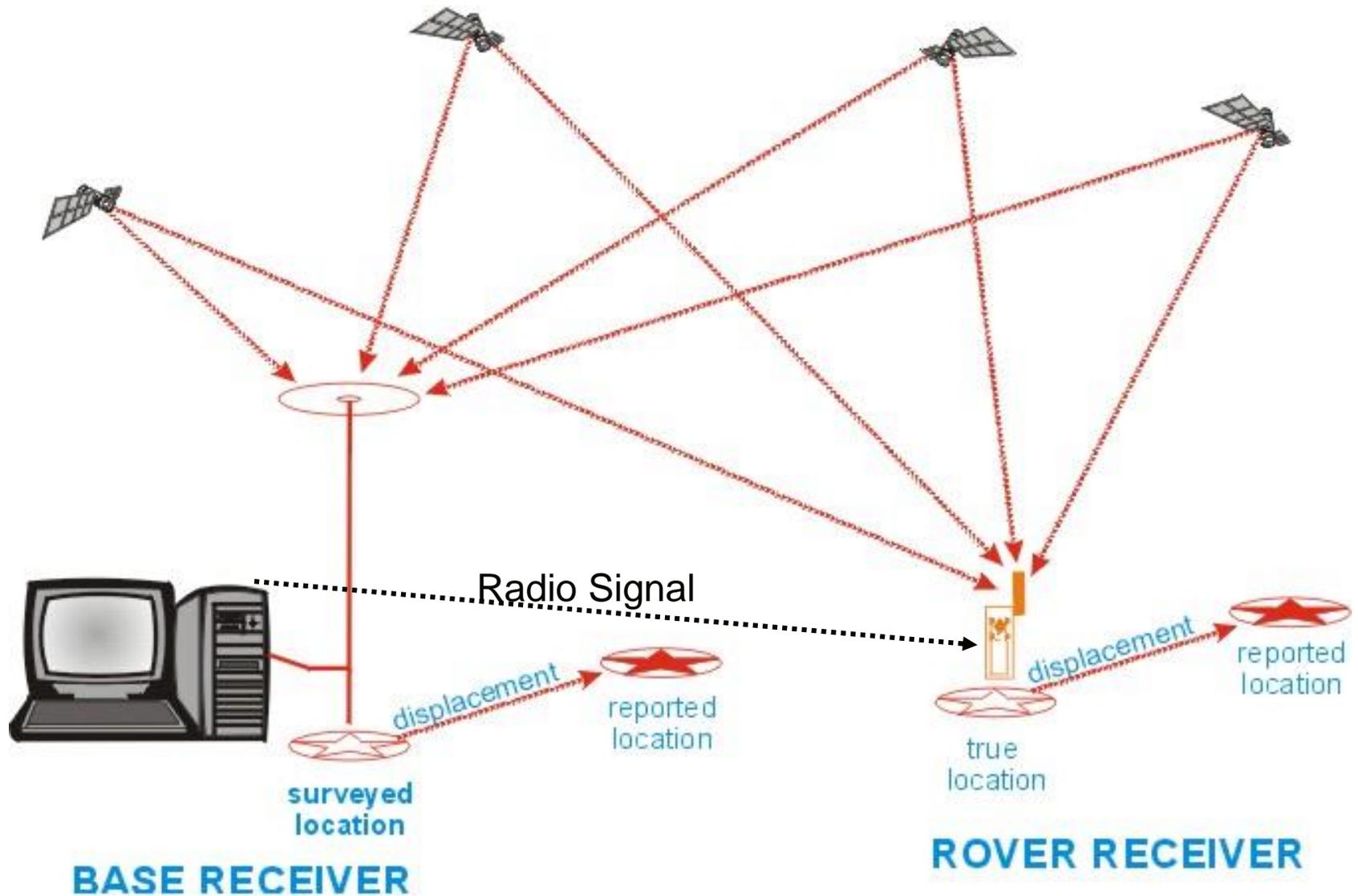
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# Differential Correction

- How it works:
  - ▣ If base station and receiver are within 300 miles (500km) of each other, the error received should be the similar, except for multipath & receiver errors
  - ▣ Base and rover (you with another receiver) collect data at the same time
  - ▣ Base station corrects errors in data and transmits a radio signal
  - ▣ The rover picks up the correction information from the base station and calculates the true position
  - ▣ This is real-time differential correction (RDGPS)

# DIFFERENTIAL CORRECTION



# Differential Correction

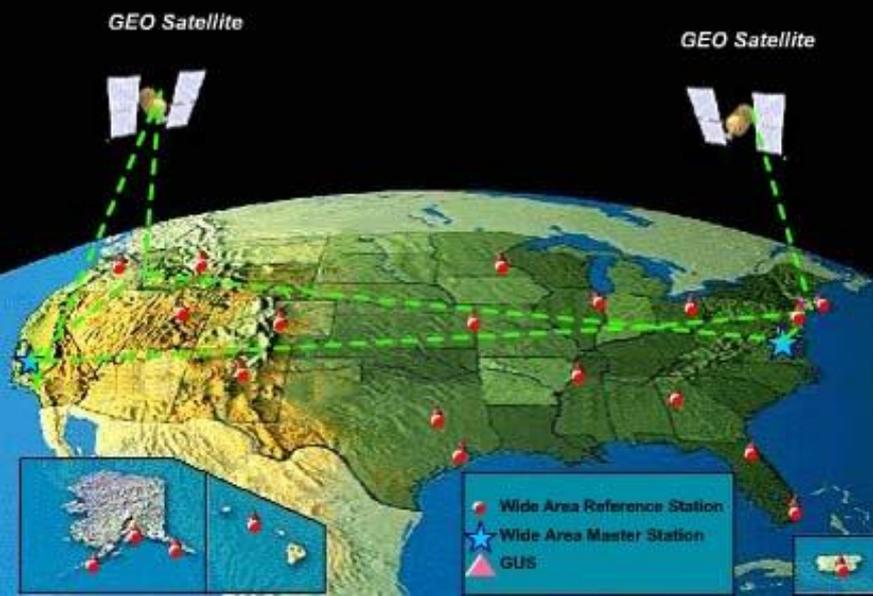
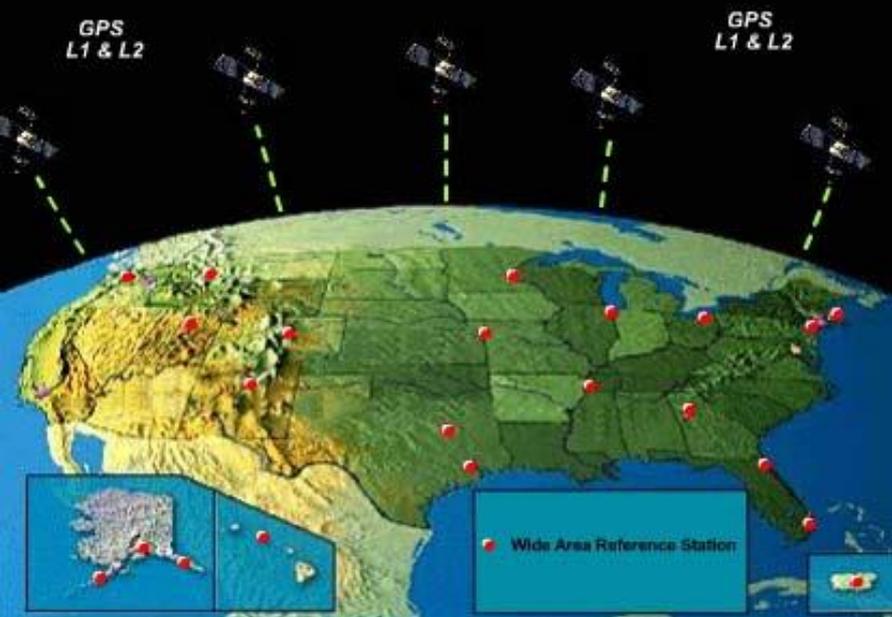
Source of Error	Standard GPS	Differential GPS
Ionosphere	5m	0m
Atmosphere	0.5m	0.2m
Noise/Receiver	0.3m	0.5m
Ephemeris	2.5m	0
Clock	1.5m	0
Multipath	0.6m	0.6m
<b>TOTAL</b>	<b>10 - 15m</b>	<b>0.5 - 1.5m</b>

# Real-time differential correction

- Beacon. US Coast guard radio network that broadcast data for marine users
- OmniSTAR. Subscription service which transmits corrections from network of reference stations
- **Satellite-Based Augmentation Systems**. Also a system of reference stations that transmits corrections, but usually more local
  - **Wide Area Augmentation System** – network available in the US & southern Canada

# WAAS

- 25 stations in U.S. receive signals
- Data is sent to master station that differentially corrects data and sends it to geo-stationary satellites
- Your WAAS enabled receiver picks up this corrected signal
- WAAS gets you to 2-3 meter horizontal accuracy
- In Terrasync, enable in Setup/Real-time Settings and select Integrated SBAS

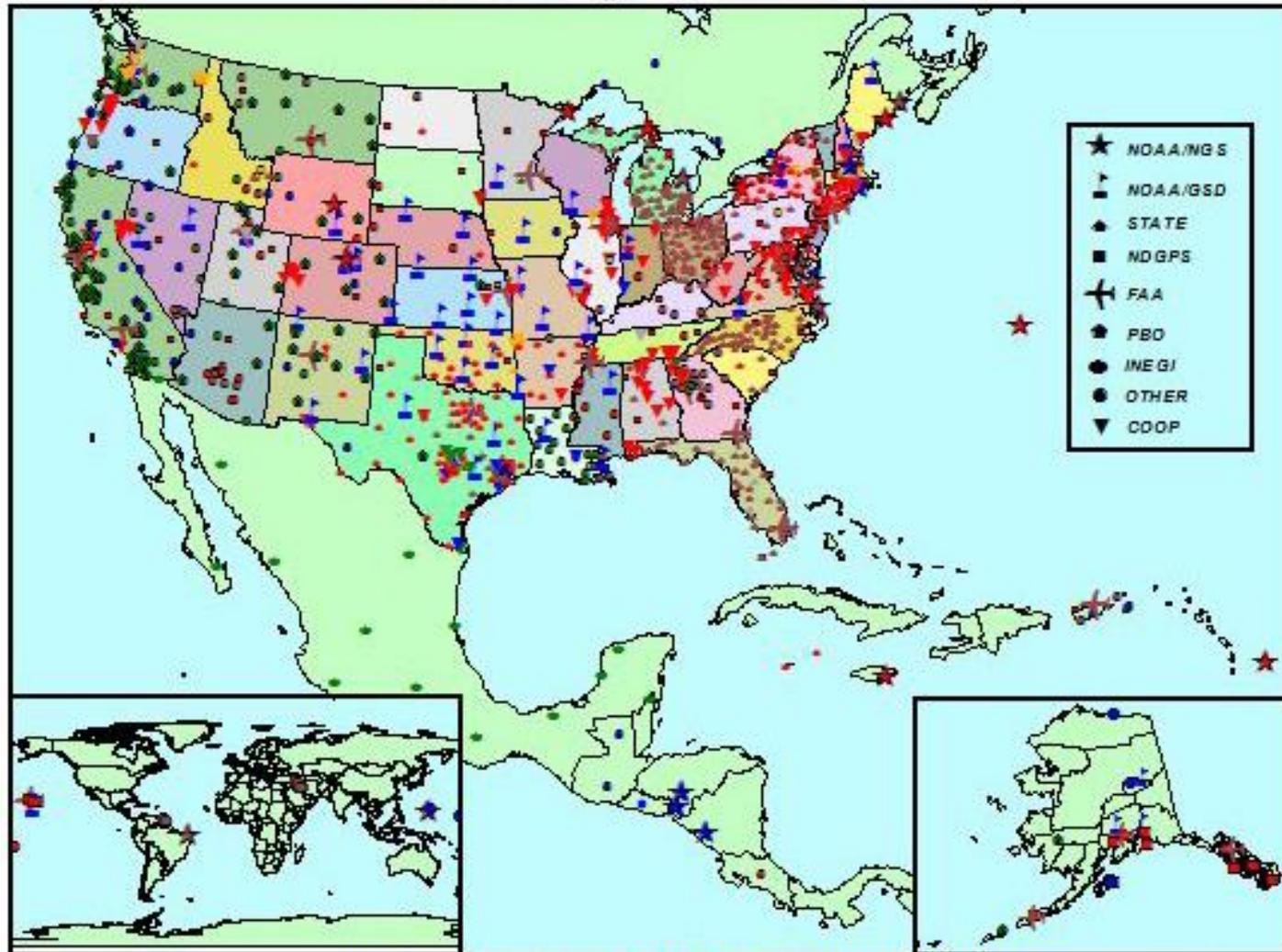


# Postprocessing differential correction

## How does it work?

- Collect data in the field
- Files have a time stamp
- Back at a computer, download Base Station files that were created at the same time you collected the data
  - ▣ Continuously operating reference stations (CORS)

# CORS coverage map



Symbol color denotes sampling rates:(1 sec)(5 sec)(10 sec)(15 sec)(30 sec)(Decommissioned)

# Postprocessing differential correction

- Select a site that is close (max 500 km)
  - ▣ Degradation because of distance is 1 ppm
  - ▣ 1 km of distance produces 1 mm of error
    - 1 km = 1 mm
    - 100 km = 10 cm
    - 1000 km = 1 m
- Use a site with a high integrity value (close to 100)

# Postprocessing differential correction

- Do this using Pathfinder software (proprietary)
- Sub-meter accuracy
- *Not real-time*

# Postprocessing differential correction

- Pathfinder has a utility for getting correction files (.ssf files)
- Once matched, it creates corrected files (.cor)

# Filtering Data

- In the differential correction utility click the *Change* button on the Correct Settings window
- Click *Use new filter* settings and set
  - ▣ Minimum elevation 15
  - ▣ Minimum SNR 43
  - ▣ Maximum HDOP 4.0
  - ▣ Only set max PDOP if vertical precision is important

- <http://www.oregon.gov/ODOT/HWY/theorgn/Pages/Coordinates.aspx>
- <http://www.ngs.noaa.gov/NGSDataExplorer/>