

Orange County Real Time Network



OCR TN

County of Orange, California
Presented by Arthur R. Andrew III

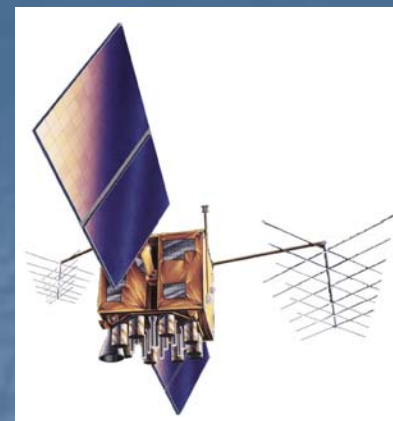
Chronology of OCRTN

- Concept – winter 2000
- Design network and order hardware – fall 2001
- Installation – late spring 2002
- **Start of real-time streaming – May 7, 2002**
- RTK testing began in August 2002

OCRTN
was declared 100% operational at the
CSRC – OCRTN/BARTN meeting in Orange County on
February 20th, 2003.



What is OCRTN?



- OCRTN is a real-time network of 10 permanent GPS stations (CORS) that stream 1-second raw GPS data to a dedicated server for real-time processing and archiving
- From this data, RTK corrections (RTCM) are generated and made available to anyone at no cost via the Internet

How can we benefit from OCRTN?

- GPS static post-processing
 - Data is now collected at 1 second epochs
 - Rinex files can be created at any interval (1, 5, 15, 30, etc, files)
 - Faster turn around time of Rinex availability
- RTK surveying
 - Local base stations are no longer needed
 - RTK rover receives base station data via Internet
 - Only 1 receiver needed
 - Less personnel
 - Multiple base stations for enhanced reliability and range.



Possible Users

- *Public and Private Surveyors*
- GIS Specialists
- Emergency Response
- Police Department
- Vehicle Tracking
- Aircraft Navigation
- Bridge and Dam Deformation
- *Scientific Community*
- Anyone needing real-time precise positioning

Current users

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graph LR; A[Current users] --> B[Public and Private Surveyors]; A --> C[GIS Specialists]; A --> D[Scientific Community];
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Current OCRTN RTK Users

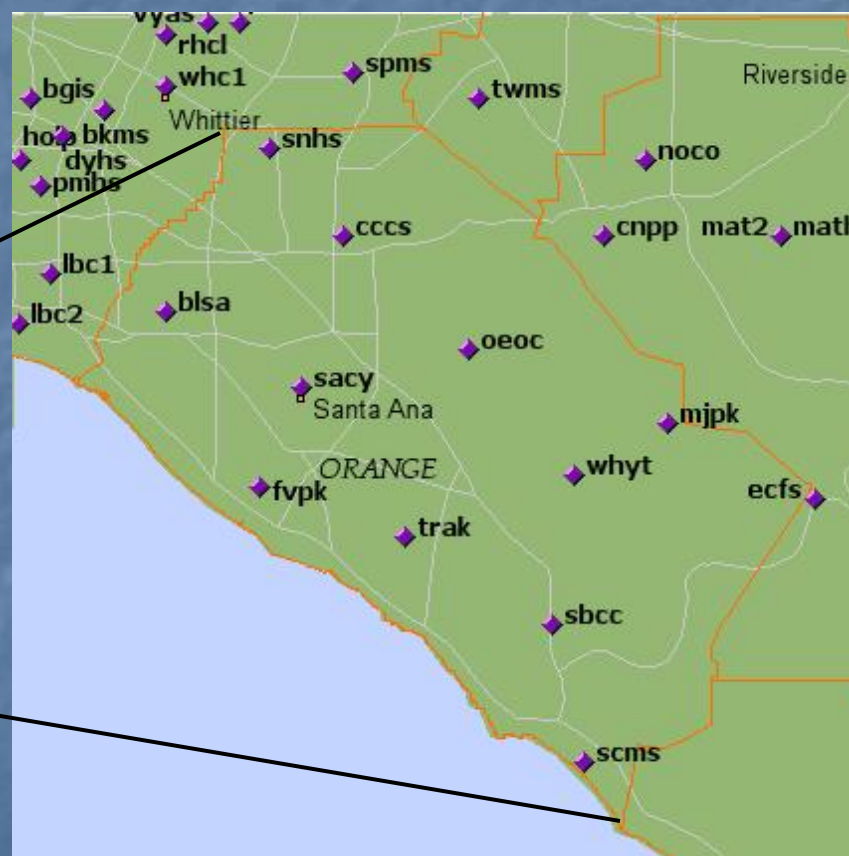
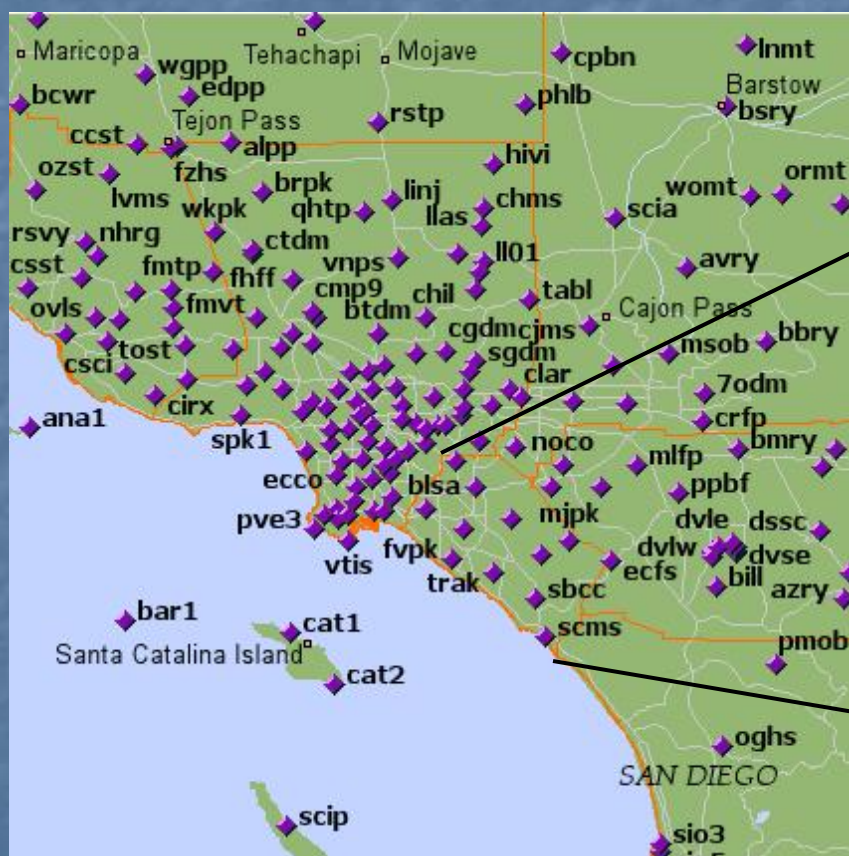
- Orange County crews – 8 rovers
 - Ashtech, Leica
- Caltrans – 4 rovers
 - Trimble
- ? Private Survey Firms
 - Leica, Trimble
- GPS Venders/Rentals
 - Ashtech, Leica, Trimble

Types of Surveys

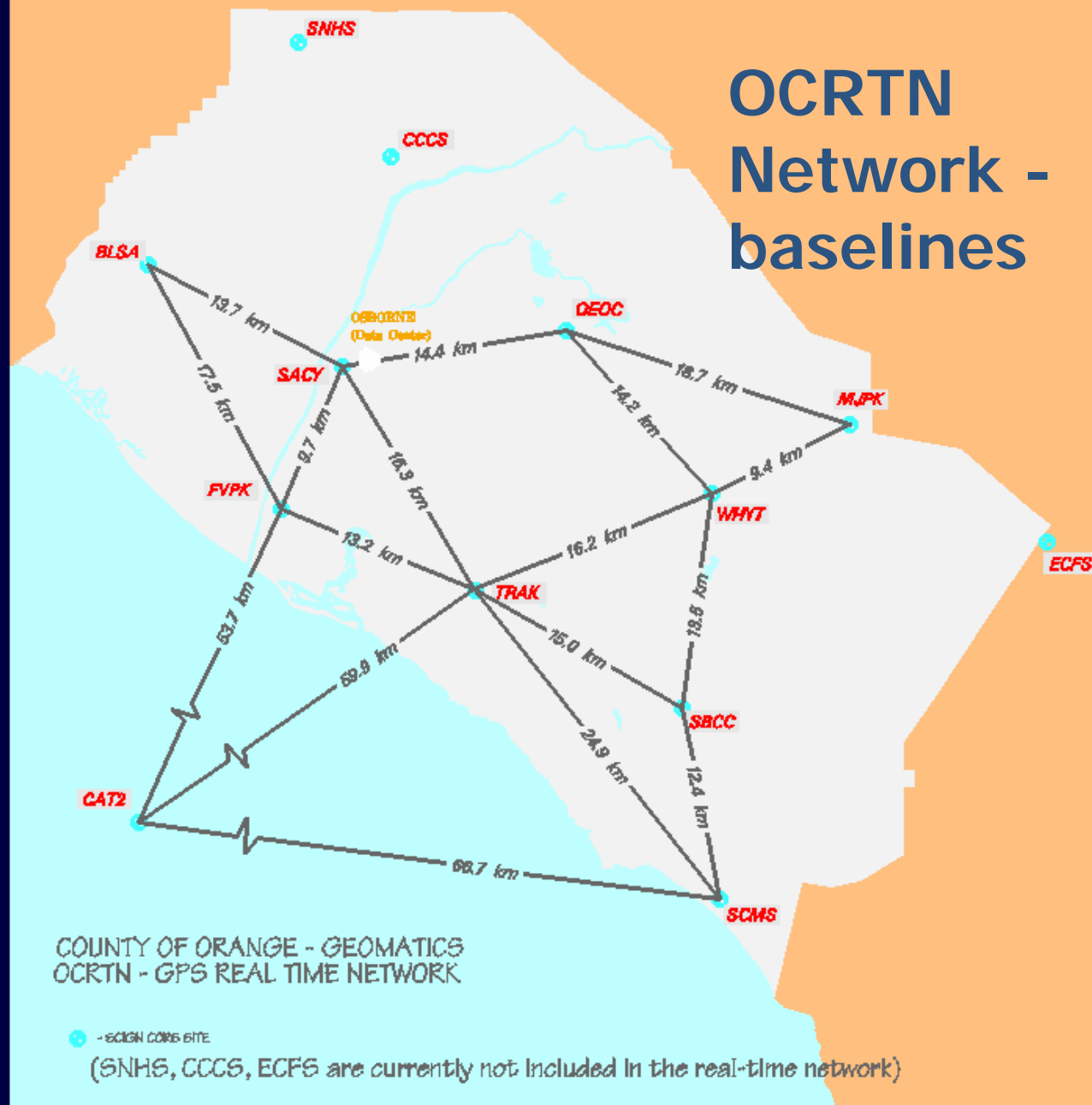
- Reconnaissance
- Aerial Target Control
- Landfill Quantities
- Monument Location Verification
- Construction
- GIS Inventory
- Topographic

SCIGN

OCRTN

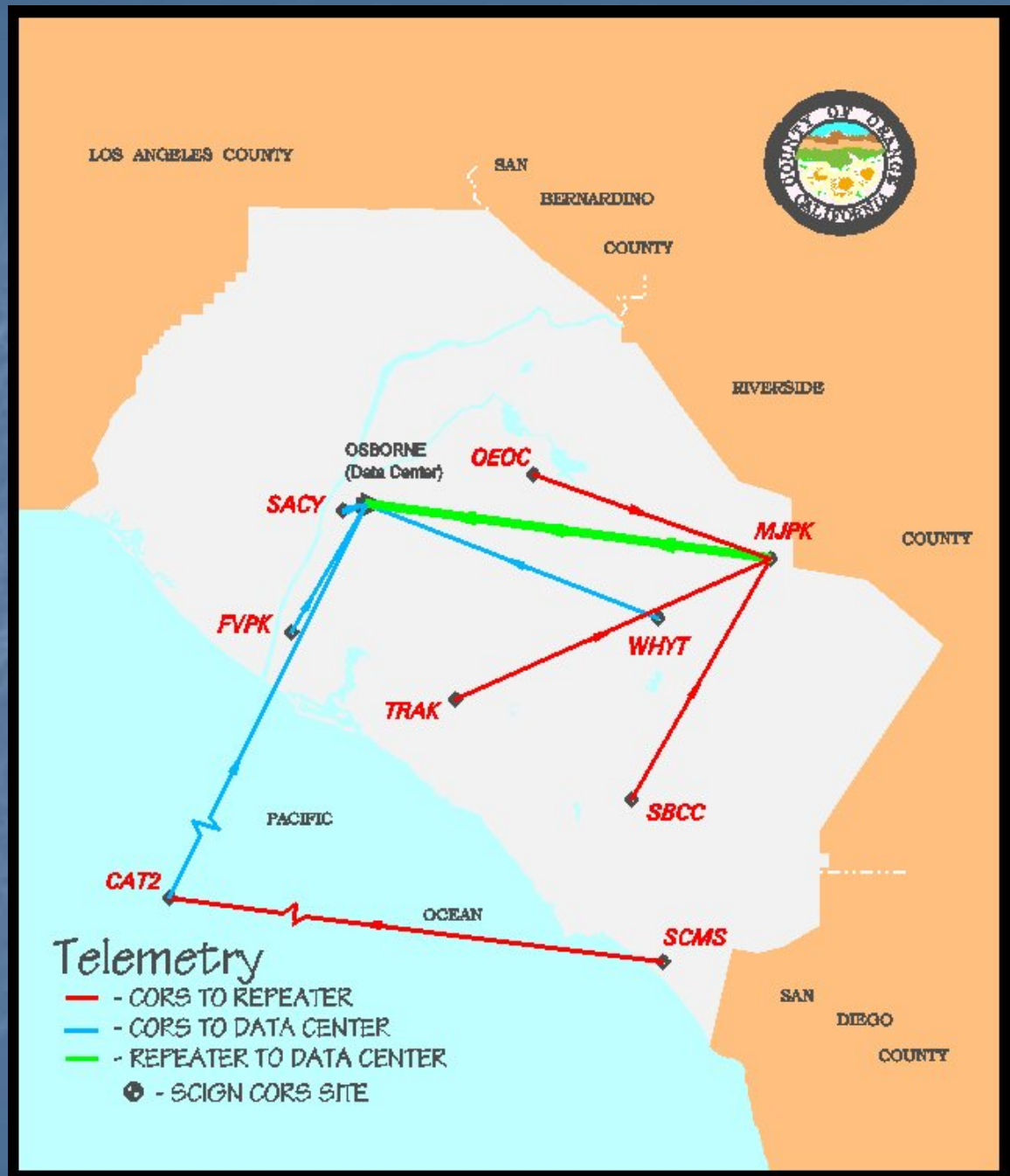


OCRTN Network - baselines



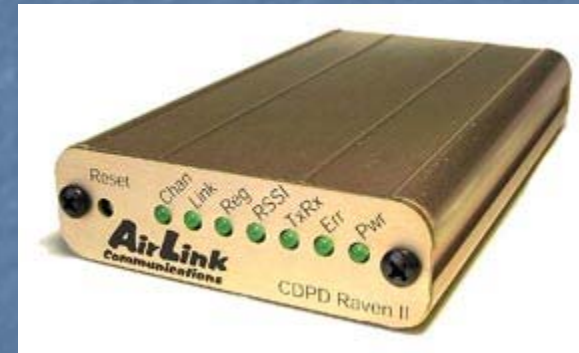
Telemetry Connections:

Data streamed at 1 second using Spread Spectrum radios (900 MHz)



Telemetry Connections:

Testing at BLSA:
Stream data at 1 second
rate using CDMA modem

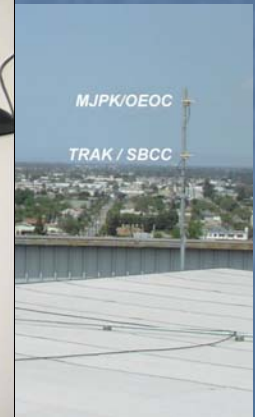
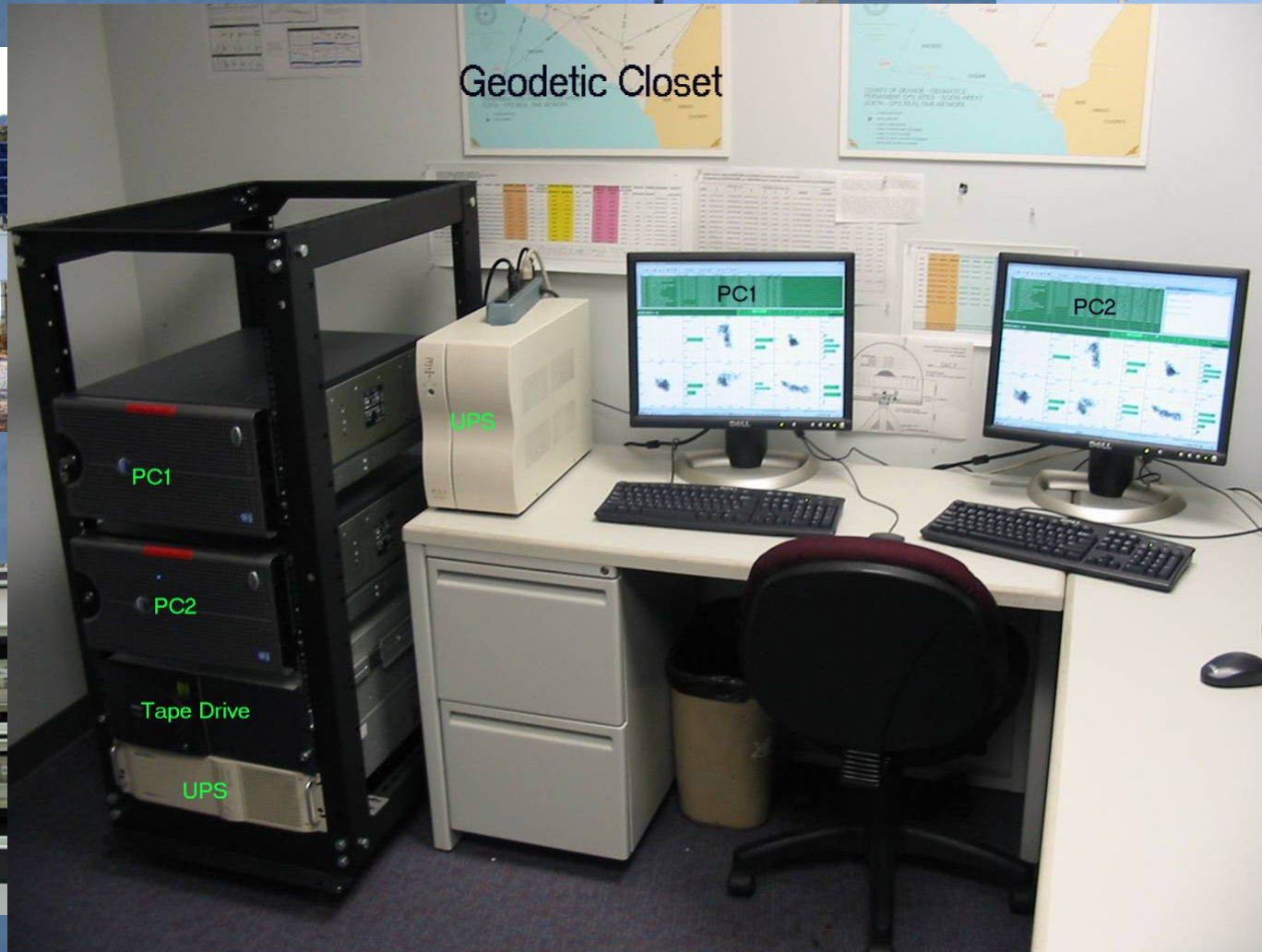


Typical OCRTN Site

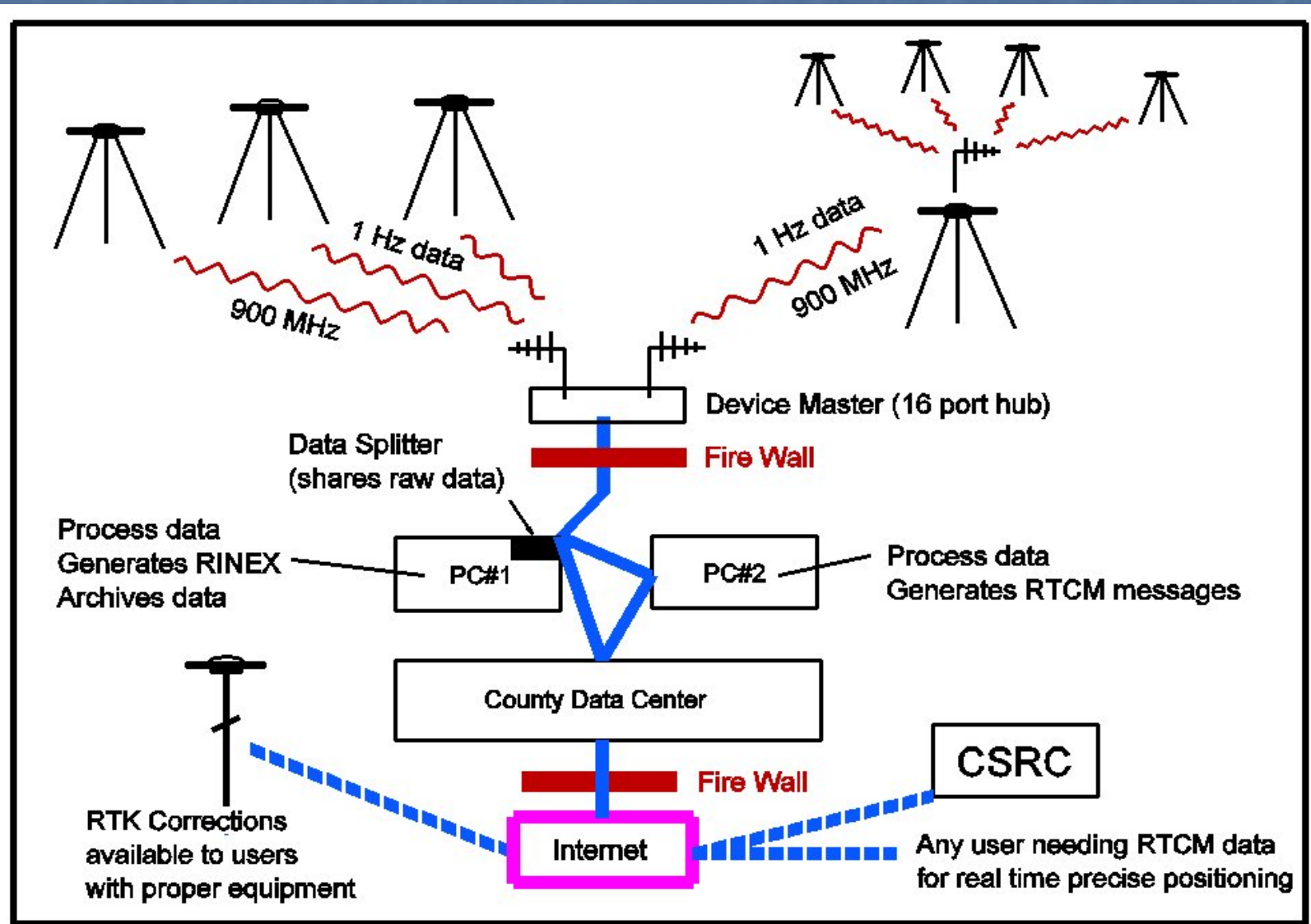
- Ashtech Z-XII/Micro-Z receiver w/ Choke Ring antenna
- FreeWave Spread Spectrum Radio w/ Yagi antenna



Real Time Data Flow:



Current Network



Current RTK Solution

- **Single Base Station Mode:**

- RTK rover picks which base station to use by dialing the IP and port address. This method allows rover to compute multiple positions from multiple base stations on a single point.
- Rover must have ability to control wireless modem (choose different port assignments)

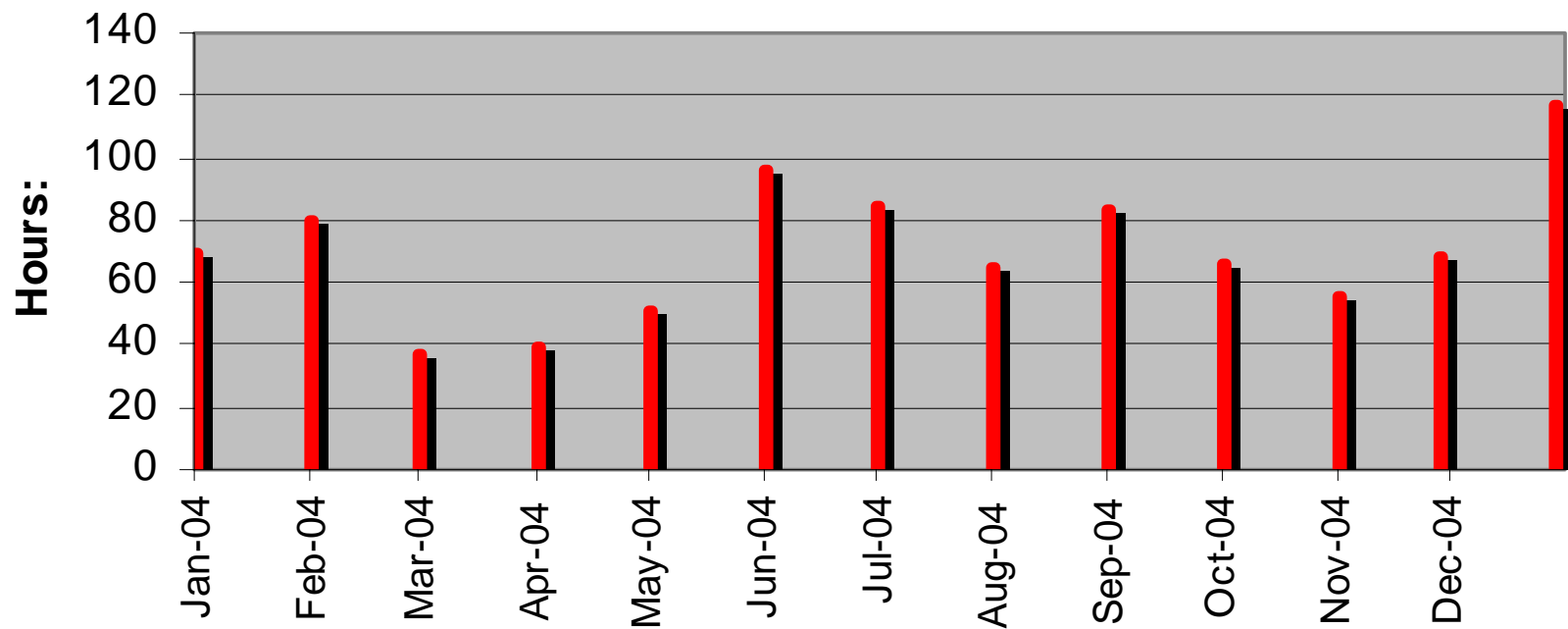
- **Nearest Base Station Mode:**

- Server picks the closest base station to the rover position. Does not have the ability to pick and choose different base stations.
- Rover must send NMEA GGA autonomous position (latitude, longitude, height) to network software via Internet.

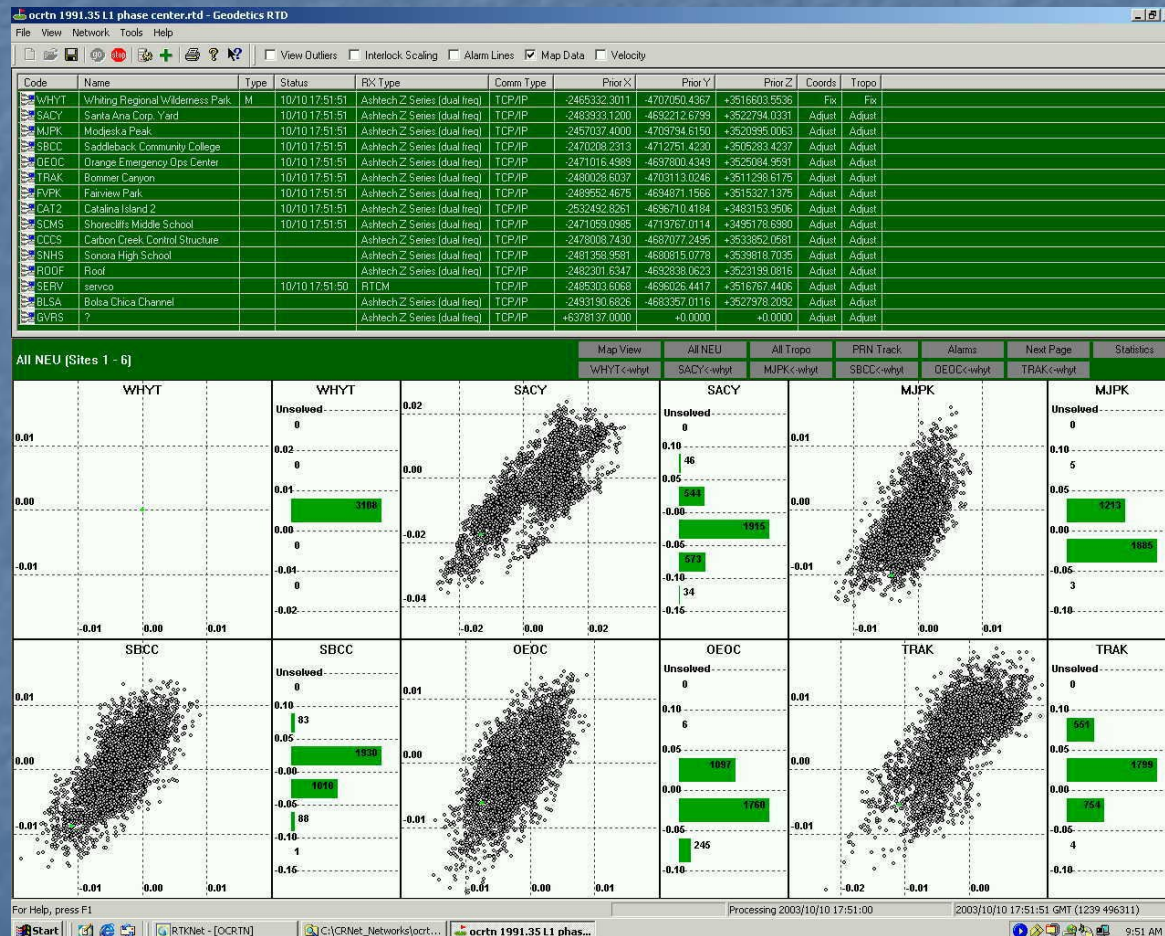
- **Server streams RTCM version 2.2, message types 3, 18, 19, and 22 from selected base station to rover.**

RTD Server RTCM Usage

OCRTN RTCM Stream - Client Connection Time



Current Software Solution:



RTD

OCRTN Network RTK

How does it work?

It works no different than standard RTK. The standard RTK radios that are restricted by line-of-sight are replaced with wireless modems that use the cellular provider's cell site network.



OCRTN IP Address: 206.194.127.187

The site port assignments are as follows:

8000 – Nearest Base Station

8001 – BLSA
8011 - WHYT
8002 - CAT2
8013 - MJPK
8012 – SACY
8015 - SBCC
8014 – OEOC
8017 – SCMS
8016 – TRAK
8018 – FVPK

8010 - Geodetics Smart RTCM Client



RTK Receivers operating with OCRTN

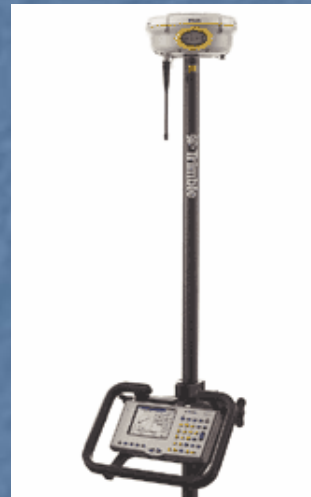
- Ashtech – Ranger (TDS Survey Pro)

- Z-Extreme
- Z-Surveyor



- Leica – System 500

- SR530



- Trimble – TSCE & TSC1

- 5700
- 4700, 4800



- Spent considerable time in getting different receivers to work.
- Most limitations are do to interface software. Some can control the modem settings, some cannot.



Wireless Internet Modems

allows access to Internet data (TCP/IP)

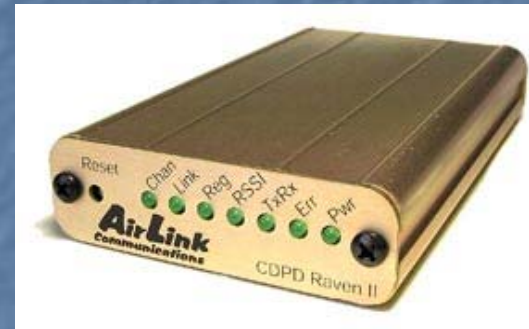
- **CDMA/1XRTT - Code Division Multiple Access**

Static and Dynamic IP, uses TCP/IP

Cost around \$200 - 800 per modem

In Orange County, Verizon and Sprint are the providers.
Service charge is \$79.99 per month, unlimited use.

Operates @ 50 – 70 Kbps



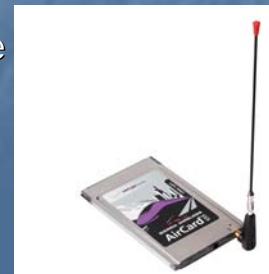
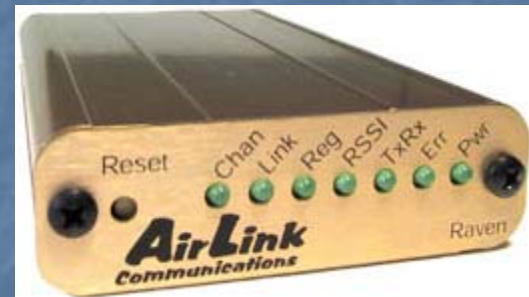
- **GSM/GPRS – General Packet Radio Service Access**

Dynamic IP, uses TCP/IP

Cost around \$200 - 800 per modem

In Orange County, AT&T / Cingular are some of the the providers. Service charge is \$79.99 per month, unlimited use.

Operates @ 50 Kbps



OCRTN Network RTK

How *well* does it work?

It works only as good as the GPS receiver you're using works.

Some receivers may do better on longer lines.

Some receivers may fix the ambiguities (TTF) quicker than others.



RTK Field Test

- Instrument – Leica SR530 GPS receiver
- Locate two monuments located on County parking garage
- Position monuments multiple times from 6 different base stations at different baseline lengths
- Compare positions to “truth” positions

“Truth” = six - 4 hour static sessions over a period of 2 weeks



#9000

looking east

southwest



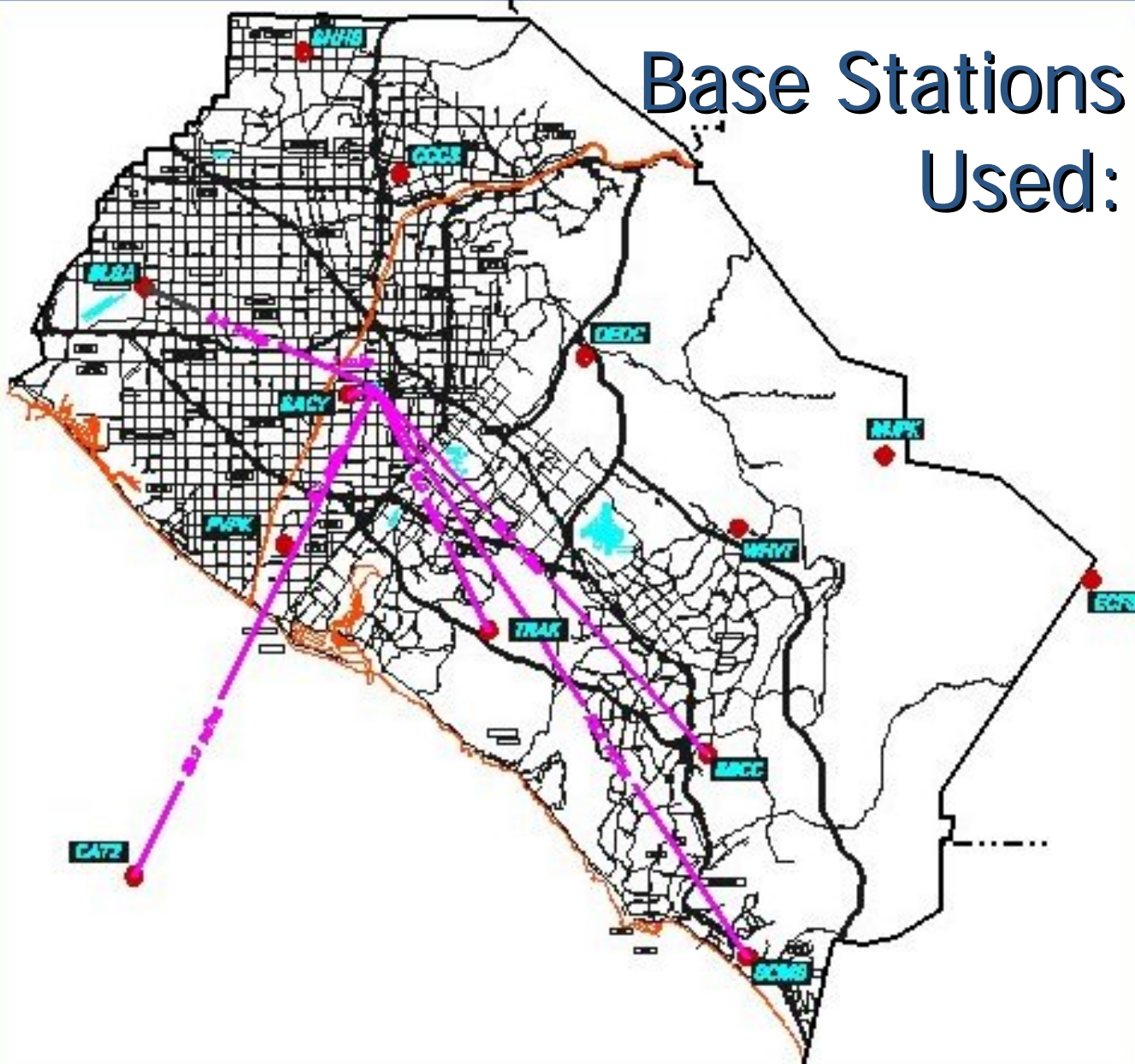
#9001

looking north

west



Base Stations Used:



SACY

2km/1.2 miles



BLSA

15km/9.3 miles



TRAK

16km/10 miles



SBCC

29km/18 miles



SCMS

41km/26 miles



CAT2

64km/40 miles

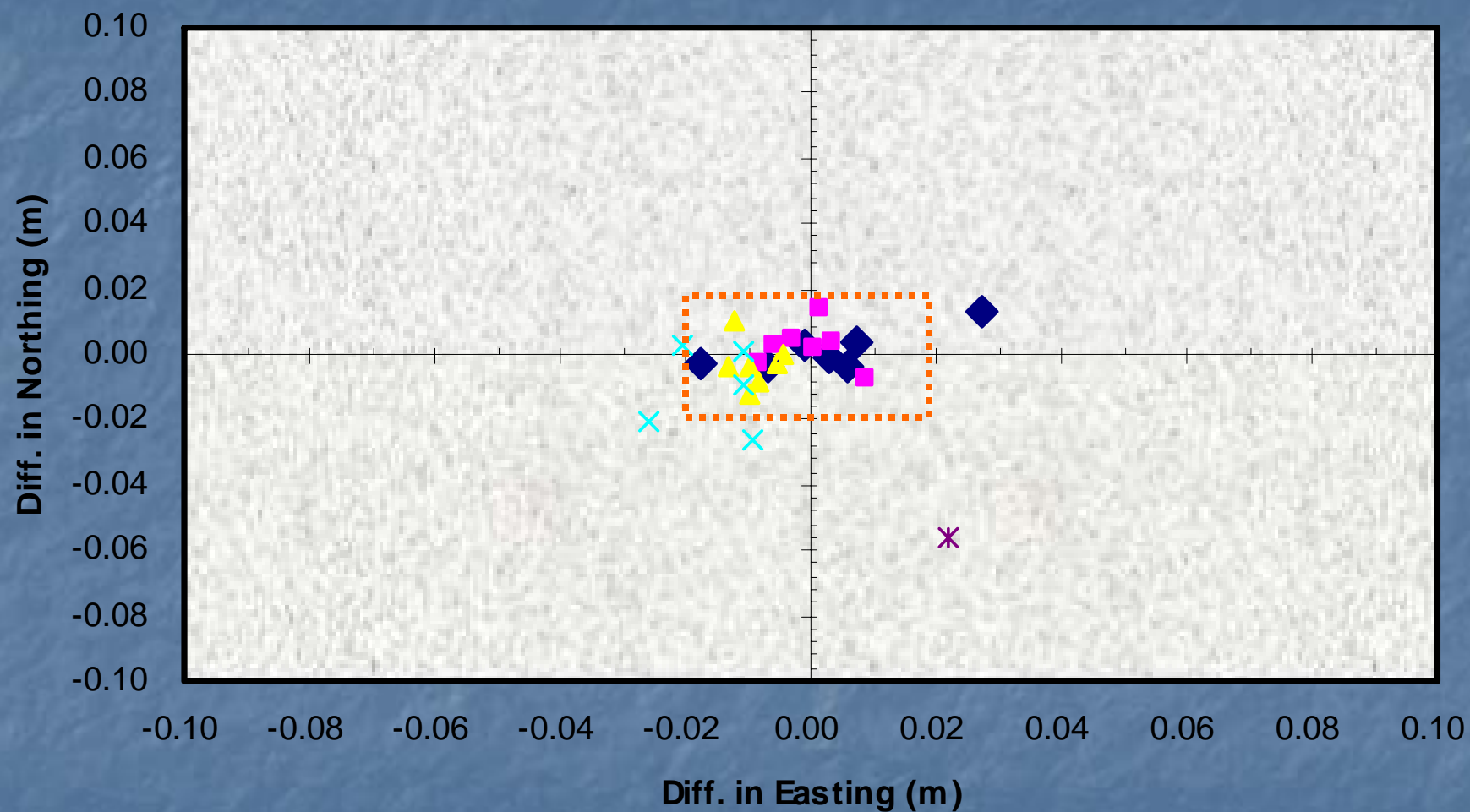


Procedures:

- Single Base Station RTK observations
- Integer Fixed Solutions
- Observation = 20 epochs @ 1 second
- Waited no longer than 3-4 minutes to obtain fix

<u>Base Station</u>	<u>#9000</u>	<u>#9001</u>
SACY (2km)	7 / 7	9 / 9
BLSA (15km)	7 / 7	7 / 9
TRAK (16km)	7 / 7	9 / 9
SBCC (29km)	7 / 7	7 / 9
SCMS (41km)	2 / 7	5 / 9
CAT2 (64km)	0 / 7	5 / 9

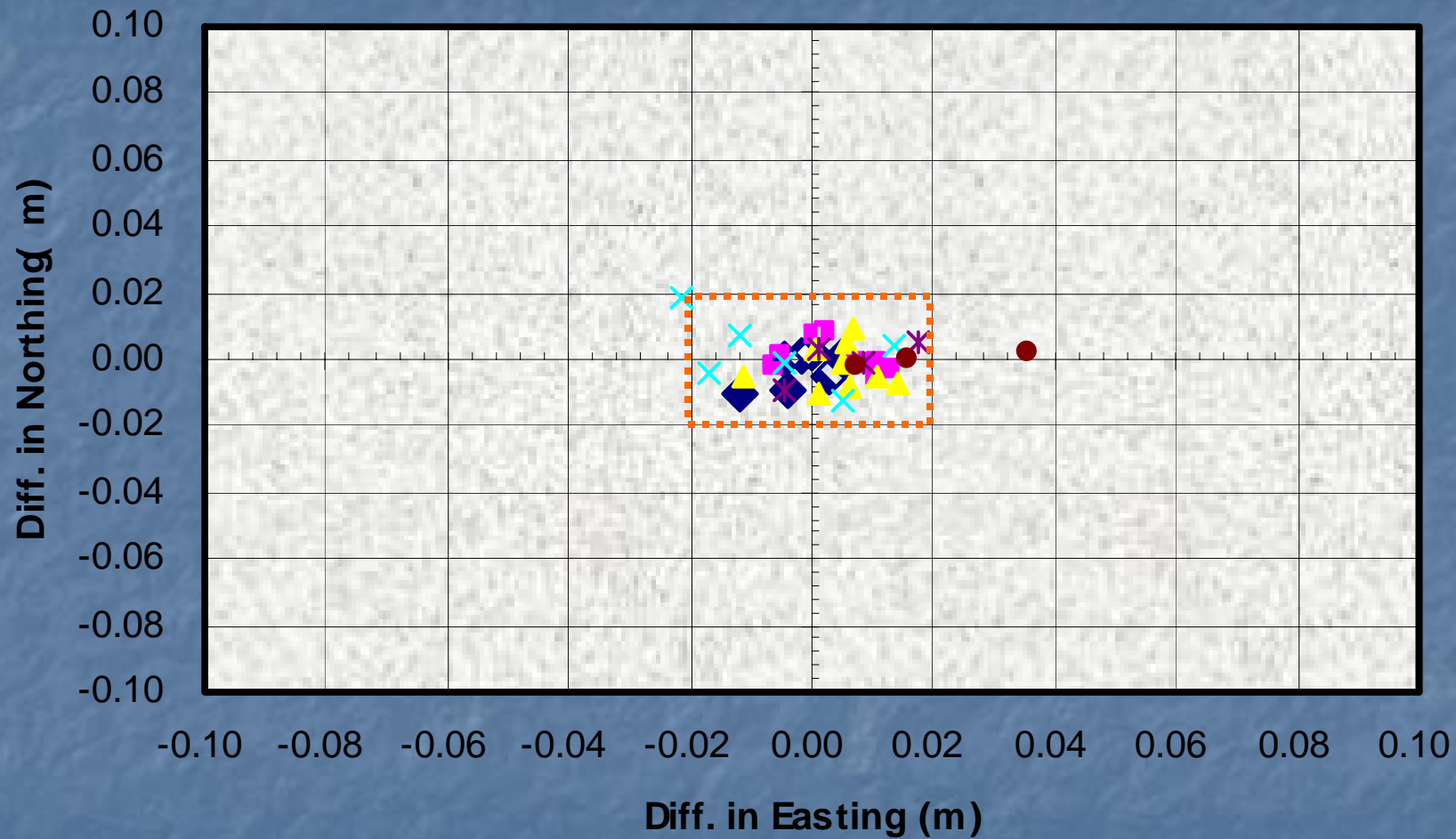
OCRTN - RTK Field Test 2005 - Pt. 9000
Horizontal Difference from Static "Truth" Positions



◆ SACY (2km) ■ BLSA (15km) ▲ TRAK (16km) × SBCC (29km) * SCMS (41km) ● CAT2 (64km)

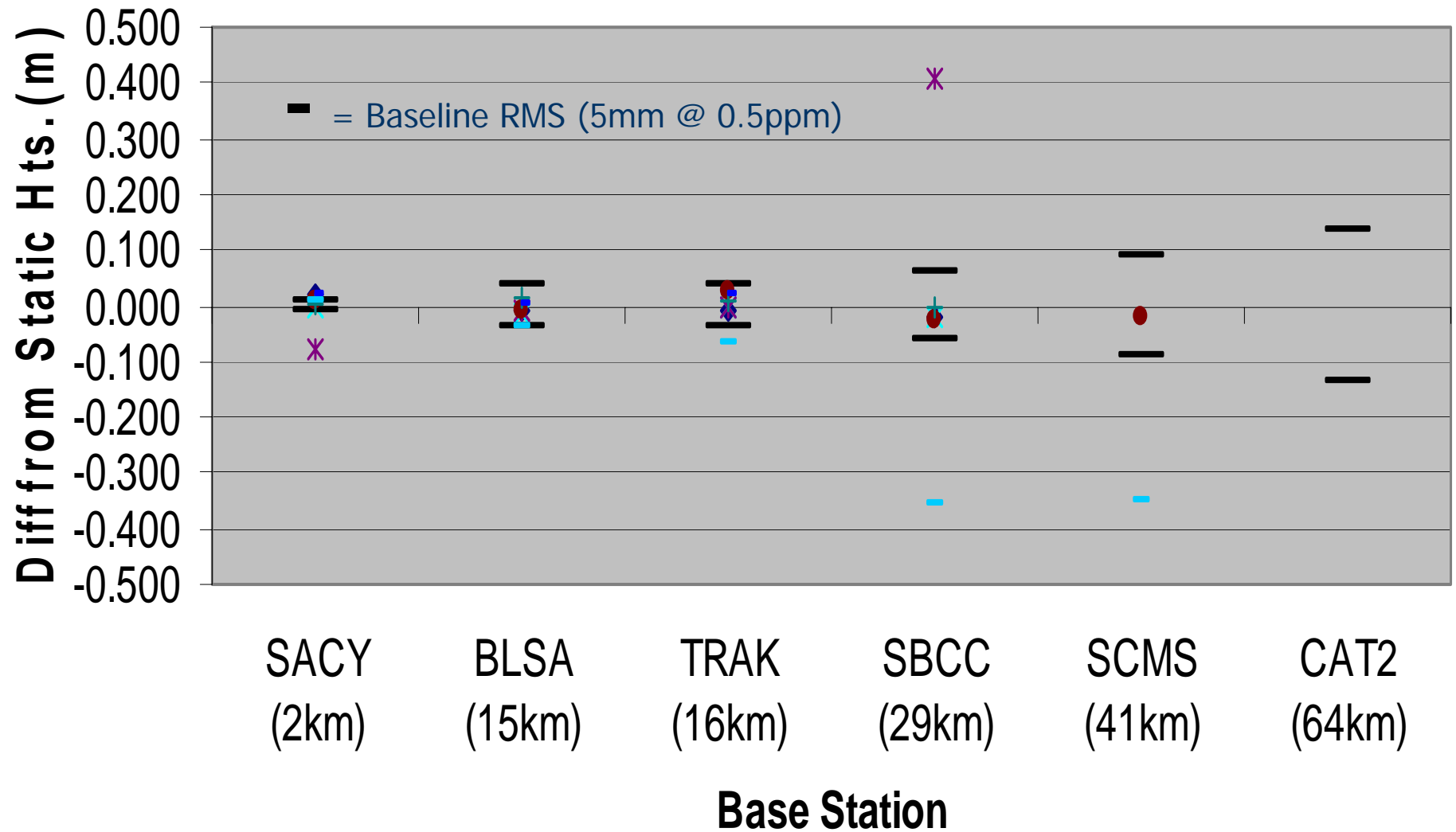
OCRTN - RTK Field Test 2005 - Pt. 9001

Horizontal Difference from Static "Truth" Positions

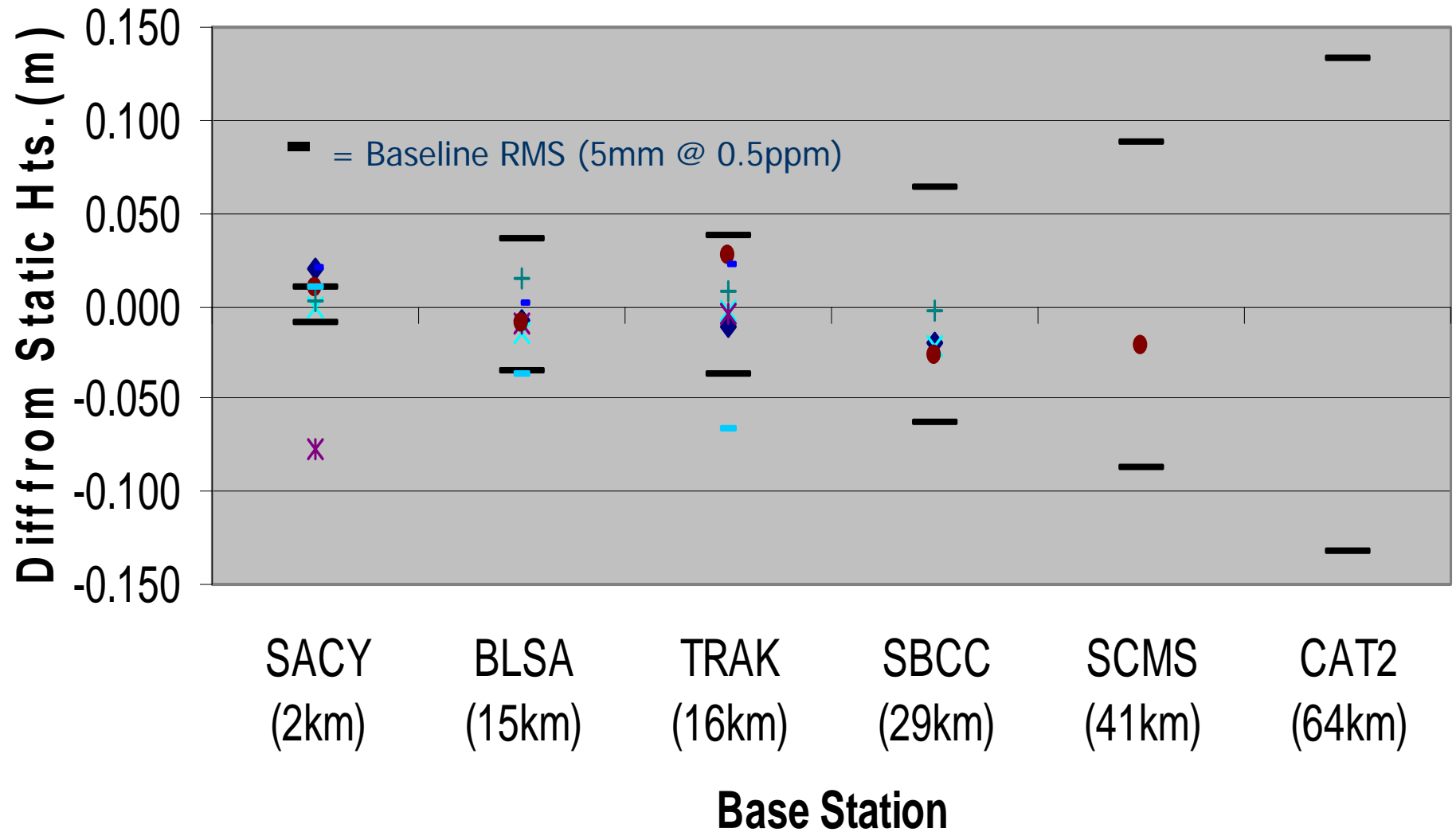


◆ SACY (2km) ■ BLSA (15km) ▲ TRAK (16km) × SBCC (29km) ✖ SCMS (41km) ● CAT2 (64km)

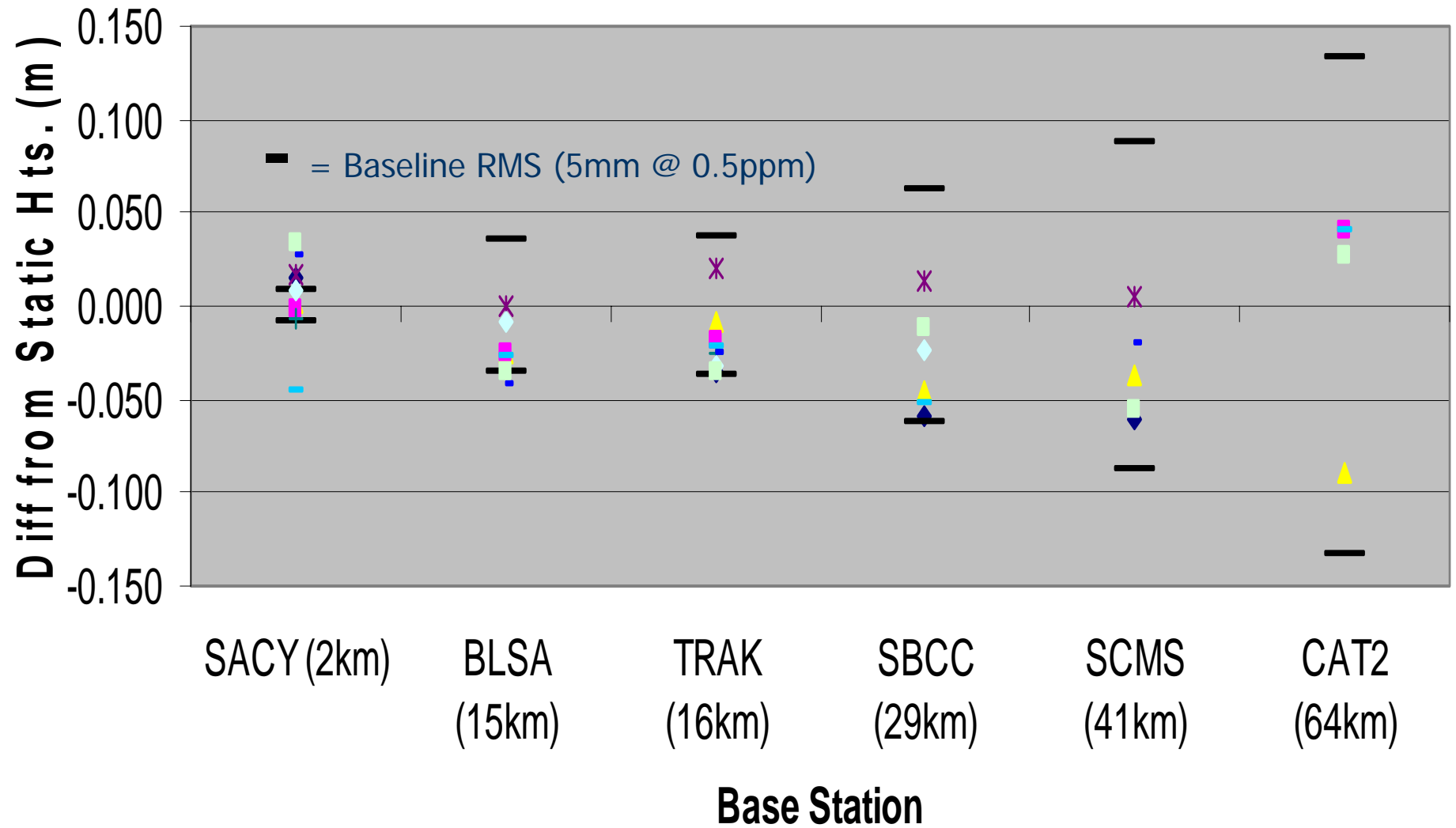
9000 RTK Heights relative to Published Base Hts.



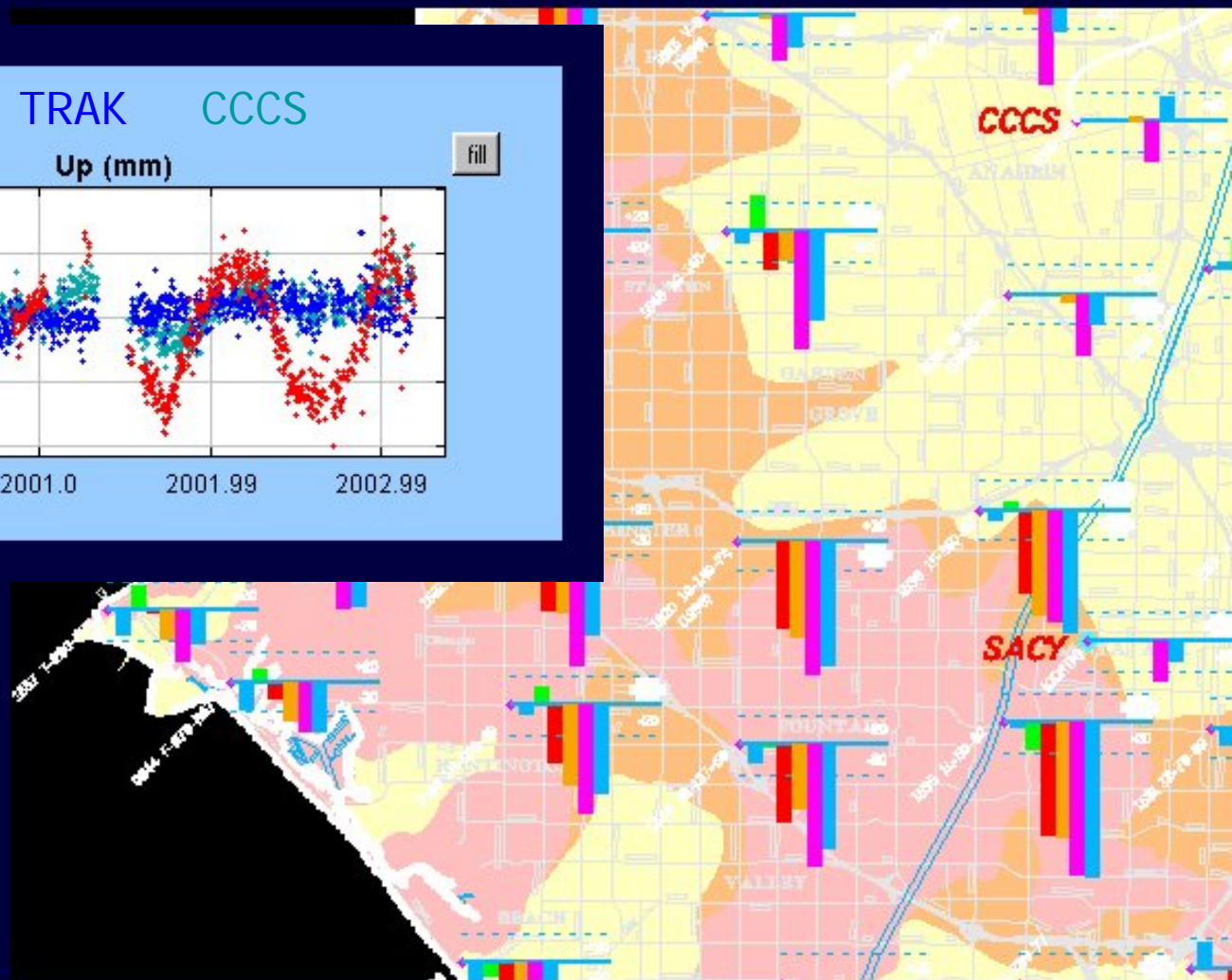
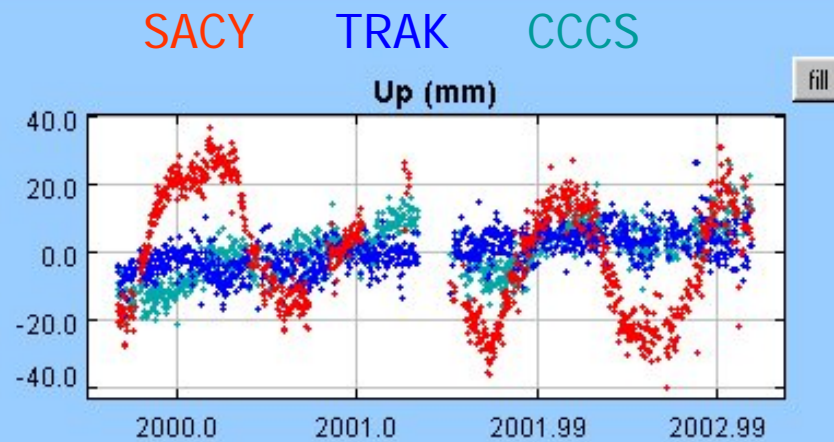
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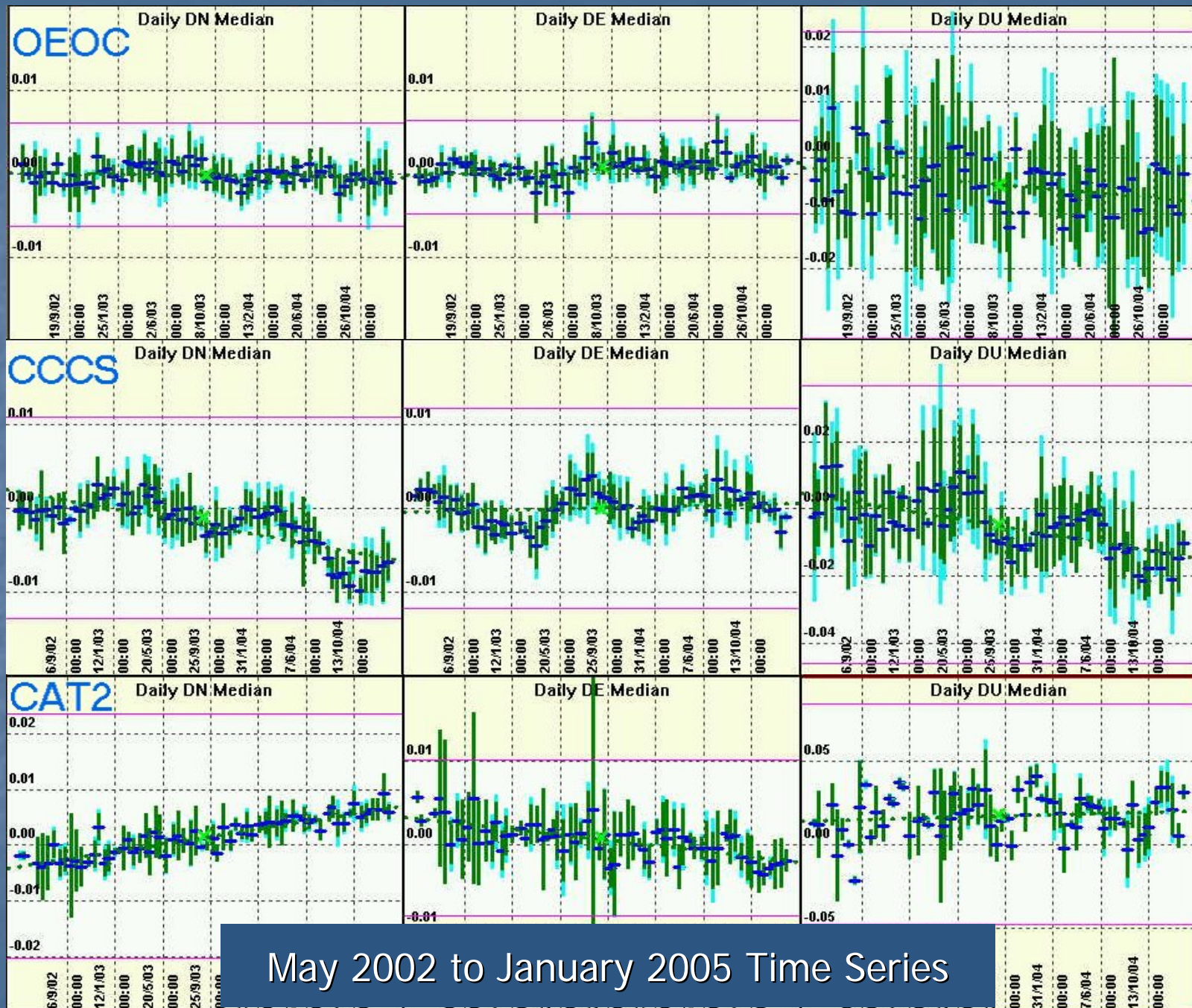


Issues effecting RTK Heights

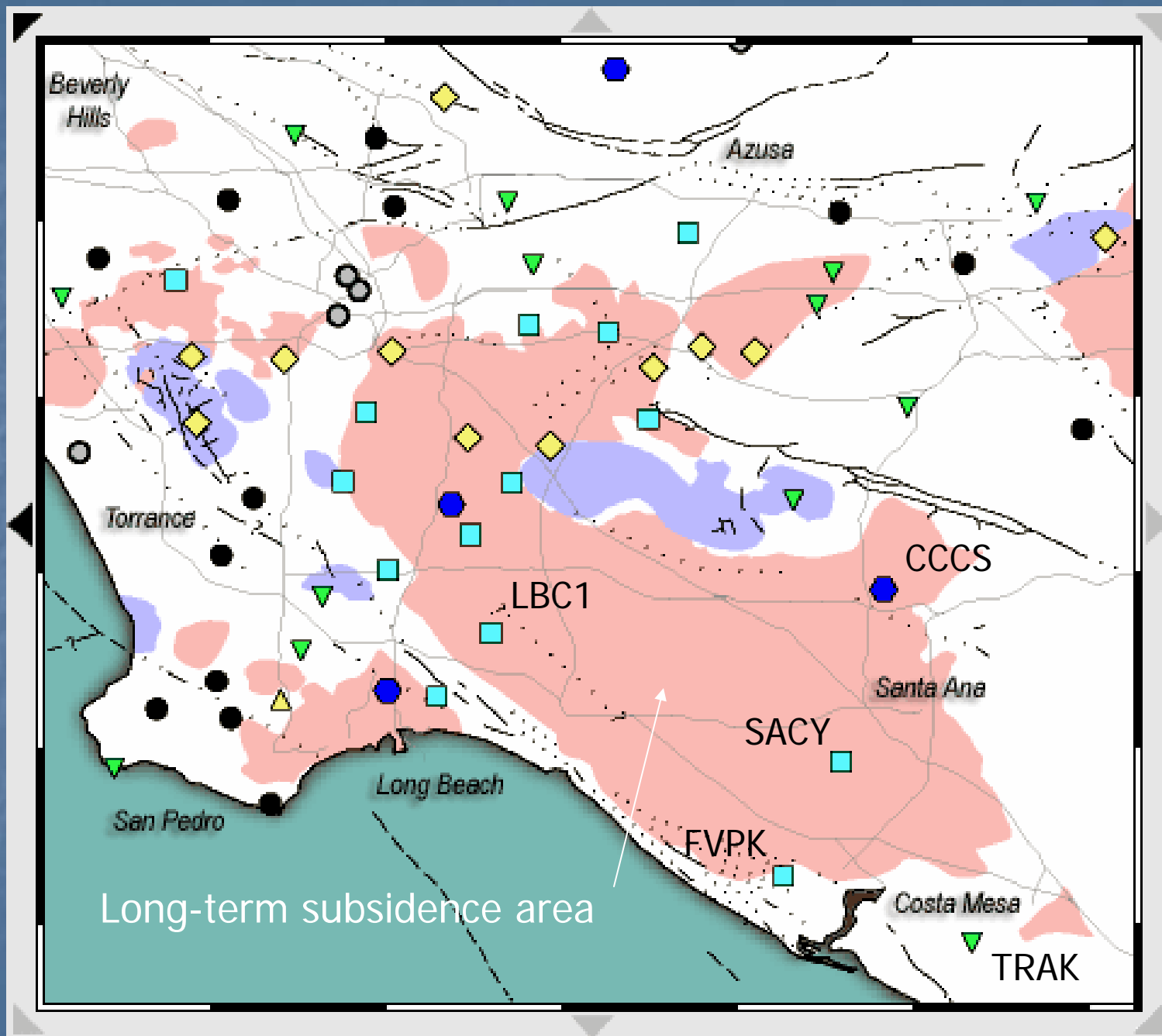


Base Station Characteristics

- Each Base Station has its own characteristics related to:
 - Geology
 - Sky Visibility
 - Obstructions



May 2002 to January 2005 Time Series

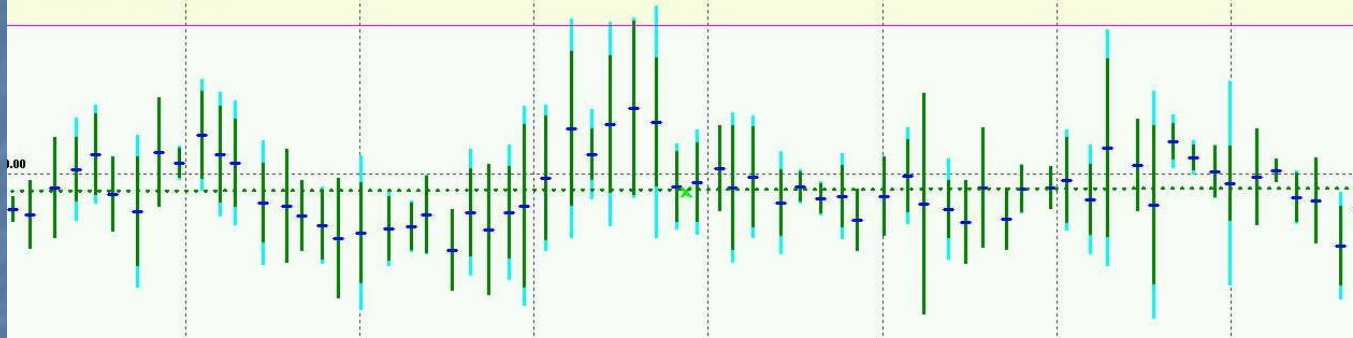


May 2002 to January 2005 Time Series

FVPK - NORTH



FVPK - EAST



SACY - UP



How to start using OCRTN

- Call Art Andrew @ (714) 834-3804
 - Explain what you'll need to upgrade your existing equipment.
 - I'll meet with you to help setup equipment and explain how OCRTN works.

Thank you



Questions?