The State of CSRC

April 4, 2013

Geospatial Symposium

Riverside County Flood Control & Water Conservation District
California Spatial Reference Center

- Established in 2000
- The CSRC’s mandates include:
  - Establish and maintain the CSRS.
  - Provide the necessary geodetic services to ensure the availability of accurate, consistent, and timely spatial referencing data.
  - Monitor temporal changes in geodetic coordinates due to tectonic motion, earthquakes, volcanic deformation and land subsidence.
  - Establish the legal spatial reference system for California.
**SOPAC/CSRC Staff**

- Director: Yehuda Bock
- Researcher: Jennifer Haase
- Coordinator: Maria Turingan
- Analysis: Peng Fang
- Lead Programmer: Mindy Squibb
- System Administrator: Anne Sullivan
- SCIGN and CRTN Engineer: Glen Offield
- Graduate Students: Brendan Crowell, PhD, Diego Melgar
- Postdoctoral Researchers: Jianghui Geng, Yuval Reuveni
- PLS Consultant: John Canas
Chairperson: Art Andrew
Vice-Chairperson: Dan Gilleland
Secretary: Richard Maher
Treasurer: Bill Hofferber
Member: Armand Marios
Member: Brian Wiseman
Member: Larry Gill
Member: Dave Olander
Member: Vacant
Past Chairperson: Dick Davis

CSRC Executive Committee
2013-2014 Vacancy
Outline

CSRN – Challenges in Maintaining a State-Wide Network
CSRC Website
California Real Time Network (CRTN)
CSRN – NGS COR
CRTN – Funding
CSRC – Future Projects
CSRN
Challenges in Maintaining a State-Wide Network
The natural reference frame of GPS/GNSS is an Earth-Centered Earth-Fixed Reference Frame (ITRF). ITRF is defined by the positions and velocities of a global network of space geodetic tracking stations, to account for plate tectonic motions. Precise GPS orbits (IGS) and broadcast ephemeris are with respect to ITRF (currently ITRF2008).

In California:
- We experience tectonic motion, earthquakes, subsidence, and volcanic activity so the reference network is deforming, while surveyors would like a static datum.
- Multiple reference frames in use are tied to North America and the National Spatial Reference System (e.g., NAD83).
- Multiple epoch dates are in use.
- Multiple positioning sources are available.

CSRC/CRTN Can Help!
Current Reference Frames & Epochs

NGS
Reference Frame, Epoch
IGS08, epoch 2005.00
NAD83(2011), epoch 2010.00

CSRC
Reference Frame, Epoch
ITRF2005, epoch 2011.00
NAD83(NSRS2007), epoch 2011.00
<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>Magnitude</th>
<th>Depth (km)</th>
<th>Type</th>
<th>Distance Measures</th>
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<td>10/16/1999</td>
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<td>7.1</td>
<td>142</td>
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<td>11/3/2002</td>
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<td>Cambria, San Simeon, Central California</td>
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<td>23</td>
<td>log</td>
<td>P278: 4 km</td>
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<td>6/28/2004</td>
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<td>9/28/2004</td>
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<td>Superstition Hill Seismic Swarm - silent slip</td>
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<td>Alum Rock, San Jose, California</td>
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<td>Eureka Earthquake, Offshore Northern Califor</td>
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<td>P159: 60 km</td>
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<td>Aftershock, El Mayor-Cucapah</td>
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<td>7</td>
<td>exp</td>
<td>P481: 16 km</td>
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<td>7/7/2010</td>
<td>Borrego Springs, Southern California</td>
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<td>P490: 13 km</td>
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<td>8/26/2012</td>
<td>Brawley Swarm, Imperial Valley</td>
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<td>2</td>
<td>none</td>
<td>P506: 8 km</td>
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</table>
TRAK – Epoch Differences

2.67' / 19.65 years = 0.136' (0.041m) per year
- Stations built to strict standards for mm-level crustal deformation research (SCIGN, BARD, PBO)
- With a few exceptions, monumentation consists of braced, deeply-anchored stainless steel rods or braced, shallow-anchored rods in bedrock – a few rooftops at legacy stations
- Mix of receivers (Trimble, Topcon, Ashtech, Leica) but choke rings antennas used almost exclusively
California Spatial Reference Network (CSRN)
Continuous GPS Stations (CGPS) only

- Data sampled at 15 s rate and downloaded once per day by several groups (archived at SOPAC)
- Daily 3-D position time series basis for California Spatial Reference System (CSRS) maintained by CSRC
- CGPS daily position time series modeled for tectonic motion (station velocities), coseismic deformation (offsets), postseismic deformation, subsidence, and seasonal effects
http://csrc.ucsd.edu/

Forums

Published Coordinates

Real-Time Map

Various CSRN & CRTN Maps

Presentations
CRTN

Featured links:

- Current CRTN and CSRN Maps
- CRTN North/South Stations(kme)
  Google Earth Map showing all current active real-time
  CGPS stations available via NTRIP separated by
  North/South
- CRTN All Stations(pdf)
  Map showing all current active real-time CGPS stations
  available via NTRIP
- CRTN Backbone(pdf)
  Map showing proposed CRTN Backbone network as well as
  NGS CORS stations
- CSRN 2011.00 Epoch
  Map showing all CGPS stations included in the 2011.00
  Epoch adjustment
Google Earth

Featured links:

- **CRTN North/South Stations(kml)**
  Google Earth Map showing all current active real-time CGPS stations available via NTRIP separated by North/South

- **CRTN All Stations(pdf)**
  Map showing all current active real-time CGPS stations available via NTRIP

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**CRTN Backbone**

**Featured links:**

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CRN backbone sites shown only. For all CRTN sites and additional information, please visit:

http://sopac.ucsd.edu/projects/realtime/
CRTC – 2013

Backbone Network
Based on 50 km Grid

Blue Circles = 25km (15.5 mile) Radius

170 existing CGPS stations from various networks:

115 stations (93 in 2012) currently streaming in real-time (22 new)
CRTN – 2013

All CRTN sites

Orange Circles = 16km (10 mile) Radius

339 stations (303 in 2012) currently streaming in real-time (36 added)
Topcon GNSS Receivers – GPS/GLONASS

- Topcon NET-G3A GNNS capable receivers at 96 CRTN stations
- Only 23 of these stream GLONASS data – all in southern California by CRTN Consortium members
- Working on extending capability to USGS and BARD Topcon receivers, in southern California, the greater SF Bay Area and northern California
CSRN 2011.00

Featured links:

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CSRN
2011.00 Epoch

Coordinates, velocities, and uncertainties

830 CGPS

ITRF2005 & NAD 83(NSRS2007)

EPOCH - 2011.00
# Forums

## Forums

**SOPAC Geophysical Forums**

Welcome to our newest member: Bob Mackenzie

Registered Members: 1247

Forums

**You are not logged in. Login or register**

Forum Categories

<table>
<thead>
<tr>
<th>Category</th>
<th>Total Forums in Category</th>
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<tbody>
<tr>
<td>MEASURES/REASON</td>
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<tr>
<td>SOPAC</td>
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<td>CSE/CCP</td>
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<td>CRTN</td>
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<td>SOMI</td>
<td>6</td>
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<tr>
<td>GPS Explorer</td>
<td>7</td>
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</table>

**SOPAC Geophysical Forums Recent Visitors:** 50

**50 guest(s)**

**Forum Categories**

1. **MEASURES/REASON**
   - Total Forums in Category: 7
   - Description: CRTN
     - The California Real Time Network provides real-time GPS connectivity in California. Visit the forum to view general notices or participate in discussions pertaining to CRTN.

2. **SOPAC**
   - Total Forums in Category: 7
   - Description: CRTN
     - CRTN Community Notices
       - CRTN notices of community-wide relevance. All messages posted here (by moderator) go to the [CRTN]@[gmail.ucsc.edu] mailing list. Go to the [CRTN] to register.

3. **OSAC**
   - Total Forums in Category: 1
   - Description: CRTN
     - CRTN General Discussion
       - CRTN-related topics, user-specified and updated. Topics may be posted here by any user.

4. **CSE/CCP**
   - Total Forums in Category: 16
   - Description: CRTN
     - RYO Format
       - Discussion of the RYO format, streaming and conversion.

5. **CRTN**
   - Total Forums in Category: 3
   - Description: CRTN
     - CRTN Community Notices
       - CRTN notices of community-wide relevance. All messages posted here (by moderator) go to the [CRTN]@[gmail.ucsc.edu] mailing list. Go to the [CRTN] to register.

6. **SOMI**
   - Total Forums in Category: 6
   - Description: CRTN
     - CRTN General Discussion
       - CRTN-related topics, user-specified and updated. Topics may be posted here by any user.

7. **GPS Explorer**
   - Total Forums in Category: 7
   - Description: CRTN
     - CRTN Community Notices
       - CRTN notices of community-wide relevance. All messages posted here (by moderator) go to the [CRTN]@[gmail.ucsc.edu] mailing list. Go to the [CRTN] to register.

**Contact Us | SOPAC Homepage**

**Powered by:** UBB.classic™ 6.7.2

**Forum Legend**

- ![New Posts Since Your Last Visit](image)
- ![No New Posts Since Your Last Visit](image)
CRTN Community Notices

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<thead>
<tr>
<th>Topic</th>
<th>Topic Starter</th>
<th>Replies</th>
<th>Last Post</th>
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<tbody>
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<td>UNAVCO Network Upgrades and Outages</td>
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Ybook

CRTN transmits RTCM3.0 data streams obtained from the Caltrans' Central Valley Spatial Reference Network (CVSRN) server. We now stream data from all 22 stations (P056, P300, P302, P544, P566, RBRU, ALTH, CRCN, *DQNO, RAPT, CHOW, DCND, DLNG, LEBD, LEMA, *MULTN, TEHAA, TAFT, TRLK, SHP5, *LINS, SIMM). The stations with an asterisk are not currently available. We've also updated the transmitted Epoch 2011.00 (NAD83(NRCS2007)) coordinates for those stations that were not part of the Epoch 2011.00 adjustment (except for LINS from which we have not yet obtained any data). As such they should be considered as provisional. See http://sopac.usgs.gov/inputrealtime/CRTN_Access.xls, which will be updated later today, for details. The changes are reflected in the CRTN Northern California NTRIP source table at http://10.32.236.154/101-21032. Thanks to Anthony Beliew who pointed out a problem with our RBRU coordinates and to Eric Kedney and Bryan Banister at Caltrans for their assistance. Please notify us of any problems that you may experience.

--Yehuda

[Link to CRTN CVSRN stations topic]
**CRTN General Discussion**

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<td>Trouble connecting to CRTN stations</td>
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<td>High data (1.25G) data</td>
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<td>CRTN Coordinates</td>
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Presentations

Note many presentation files are large in size.

September 2012 CRTN Workshop

- California's RealTime Network (CRTN), Art Andrew
- CRTN and CORS: Usage Advantages and Limitations, Yahuda Bock
- Connecting to the CRTN, Richard Maher
- Record Models on the Future of Urban Areas, Gregory Hoffman
- Geodetic Data and Reference Frames, Michael R. McGee
- Guidelines for Surveying with the CRTN, Dave Olander

October 2008 Semi-Annual Meeting

- Director's Report

May 2008 CSRC Coordinating Council Meeting

- Wisconsin Height Modernization
- CRTN Discussion
- Director's Report

April 2006 CSRC Semi-Annual Meeting

- Future of NGS, Dru Smith
- Public Resources Code Revision, Dick Davis
- Director's Report, Yahuda Bock
- REASON Project Update, Frank Webb
- PBO Update, Ethan Coyle, Chris Walls
California Real Time Network

- CRTN is a multipurpose statewide real-time network that utilizes the existing geophysical CGPS infrastructure in California.

- CRTN provides the backbone for the geodetic control network that is outlined in the CSRC Master Plan.

- CRTN provides accurate and reliable real-time positioning services that are consistent and in a common reference system – California Spatial Reference System (CSRS).

- CRTN fulfills the requirements of the California Public Resources Codes 8856(c)(e), 8857(c), and 8858(b) for GPS-derived geodetic coordinates and orthometric heights.

- CRTN offers (free) RTCM data streams for single-base RTK positioning with respect to the CSRS reference epoch (2011.00).

- CRTN offers multiple real-time data streams to Contributing and Consortium members.
CRTN – Real-Time Data Access

- March 1, 2012 – real-time data available with NTRIP
- A user account is required and requested by emailing the CSRC director, Yehuda Bock (ybock@ucsd.edu)
- 162 organizations registered
- 194 individual NTRIP accounts
CRTN – NTRIP

Northern California
IP: 132.239.154.101
Port: 2103

Southern California
IP: 132.239.152.74
Port: 2103

RTCM 3.0

CSRC 2011.00 Epoch
NAD83 (NSRS2007)
Coordinates
176 – North
163 - South
Number of CRTN NTRIP Connections by Station from February 2012 to January 2013 (Top 50 Stations with Total Connections ≥ 66)
Relevant CRTN Metadata

Essential:
• Coordinates of CGPS stations – CSRS Epoch 2011.00 NAD83 (NSRS2007)
• Type/manufacturer of antenna
• Type/manufacturer of receiver
• Antenna reference point (ARP)
• Antenna offsets from reference point (height, mainly)

Optional:
• Receiver serial number
• Antenna serial number

Transmitted in RTCM 3.0 message for real-time stations
NGS CORS
NGS CORS
NAD83(2011), epoch 2010.00

258 in California

235 (91%) are part of CSRN

148 (57%) are part of CRTN Backbone

93 (36%) are part of CRTN
CRTN Backbone / NGS CORS

Based on 50 km Grid

Blue Circles = 25km (15.5 mile) Radius

170 existing CGPS stations from various networks

148 (87%) are part of the NGS CORS Network
Current budget is based on CRTN Consortium fees. CSRC benefits from other funded SOPAC projects.
CRTN – Consortium/Contributing Members

- **CRTN Consortium Membership Tiers:**

  - **CRTN Contributing Members:** donate $1,000 annually, which provides access to a *second* NTRIP account for real-time access to RTCM 3.0 data (all users have free access to a single account). Additional access increases by $1,000 per account. Please note that contributing members do not participate in oversight/management of the network.

  - **CRTN Consortium Members:** contribute $15,000 annually, which provides access to any 20 real-time CGPS sites 24/7. This membership has voting privileges on the CRTN Consortium, which oversees the development and management of the network.

  - **Statewide CRTN Consortium Members:** contributes $150,000 annually to fund CRTN and has access to *ALL* real-time CGPS sites 24/7. This membership has voting privileges but is limited to three voting members, and also includes being part of the team that will oversee the development and management of the network.
Current Membership

• Consortium Members
  • County of Orange
  • San Diego County
  • City of Los Angeles
  • Riverside County Flood Control District
  • Santa Clara Valley Water District
  • Riverside County Transportation
  • Long Beach Gas & Oil (pending)

• Contributing Members
  • East Bay Municipal Utility District
  • East Bay Regional Park District
CSRC/CRTN Donations

Gift and Personal Information

Online Giving

Your Gift Information

The California Real Time Network (CRTN) is a multipurpose statewide real-time network that utilizes the existing geophysical GPS infrastructure in California and provides the backbone for the geodetic control network that is outlined in the California Spatial Reference Center (CSRC) Master Plan. It provides accurate and reliable real-time positioning services that are consistent and on a common reference system, the California Spatial Reference System (CSRS), which fulfills the requirements of the California Public Resources Codes 8657(c), 8657(c), and 8657(c) for GPS-derived geodetic coordinates and orthometric heights. CRTN offers multiple real-time data streams to CRTN Consortium Members as well as free open access to RTCM data streams for single-base RTK positioning with respect to the CSRS.

Your donation will be used towards operating and maintaining CRTN and our data services. You will receive a charitable donation receipt for your files. If you would like to become a CRTN Consortium Member or need additional information, please call or email Maria Taminger at (619) 534-4493 or mtaminger@ucsd.edu.

When you submit personal information taxes, we use a secure server and a secure server software (SSL) that encrypts all information you input. We keep information about you secure and confidential. However, if you would prefer to send your donation by mail, please write a check to "The Regents of the University of California," email Maria so we can be on the look out for it, and address it as follows: Attention: Maria Taminger, Dept. K515P, SIO, UCSD, 9500 Gilman Drive #1225, La Jolla, CA 92030.

Thank you for your donation!

- Fund: California Real Time Network Support (8034)
- Comment: 

Payment
Projects at SOPAC/CSRC

- Developing prototype early warning system along the West coast
- Re-analyzing of all CGPS data since 1992 in ITRF2008
- Planning to publish new CSRS epoch-date coordinates tied to NGS National Adjustment of 2011 (NA2011), NAD 83(2011) epoch 2010.00 – can be provided for multiple reference epochs
- Planning to implement statewide “network solution” for CRTN users, based on precise point positioning (PPP) architecture developed at SOPAC using troposphere and ionosphere models, accessible through NTRIP servers and existing field equipment
- Planning to modernize websites (CSRC, SOPAC, CRTN)
Questions?

(Left to right) Charlie Challstrom - NGS Director; Yehuda Bock, Bill Young, Charles Kennel - SIO Director