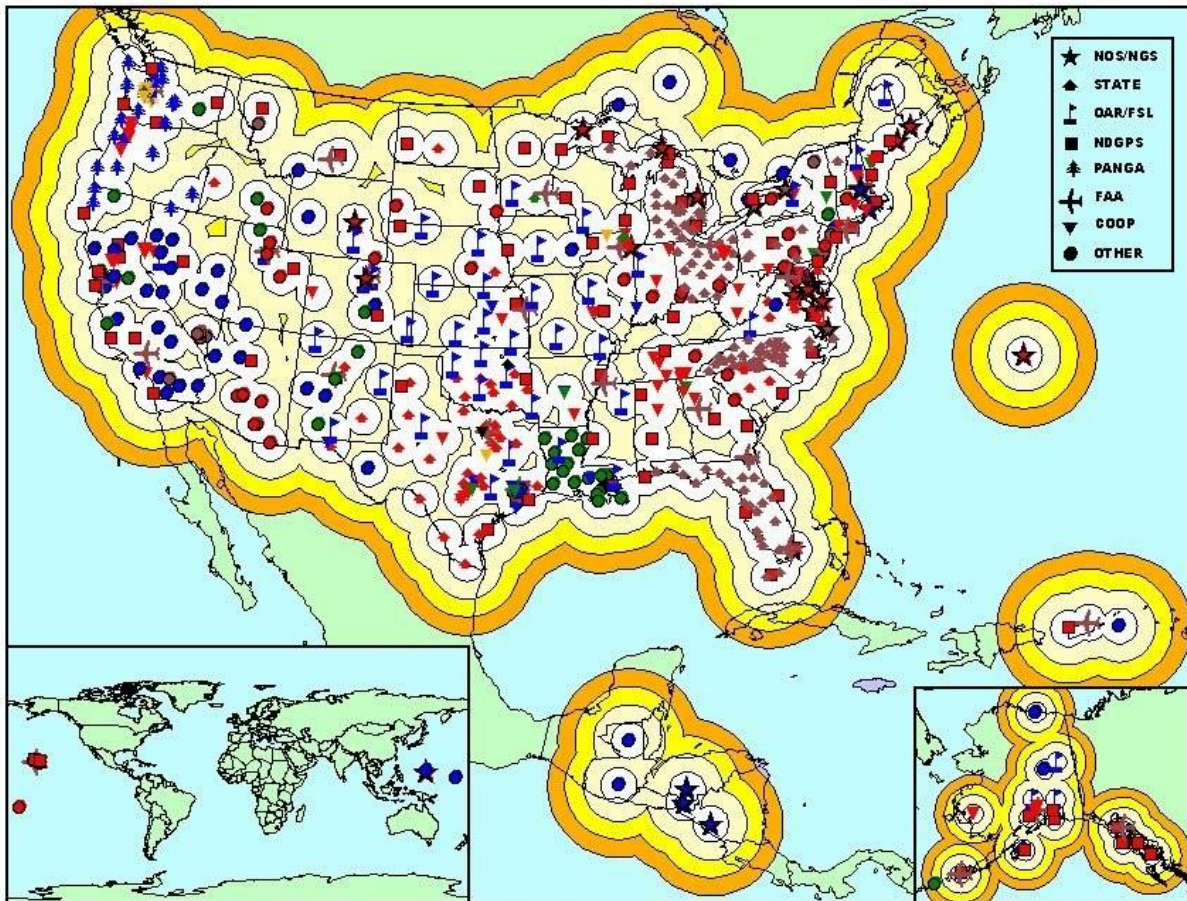# CORS Users Forum
Long Beach, California
September 21, 2004

CORS Coverage (100, 200, 300, and 400 km radius) September 2004

Symbol color denotes sampling rates: (1 second) (5 seconds) (15 seconds) (30 seconds)

Craig 11/23/2004

NOAA's National Geodetic Survey, in cooperation with the U.S. Department of Transportation and the U.S. Coast Guard, hosted the fourth annual Continuously Operating Reference Station (CORS) Users Forum on September 21, 2004 in Long Beach, CA.   This Forum convened in conjunction with the 44th Civil GPS Service Interface Committee meeting.

The Forum featured five short presentations followed by a question and answer session involving the panel of speakers. PowerPoint files for these presentations, as well as those delivered at the previous three forums, can be viewed at http://www.ngs.noaa.gov/CORS/information5/ . This Forum also featured a 1.5-hour interactive session for which the attendees reorganized into four separate discussion groups.

More than 100 people attended the five presentations. More than 30 people participated in the interactive sessions.

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AGENDA

1:30 - 1:40
    Welcome by Moderator
    Gordon Adams, NOAA's National Geodetic Survey
1:40 - 2:00
    The EarthScope Plate Boundary Observatory: An Update Moving Into Project Year 2
    Greg Anderson, UNAVCO, Inc.
2:00 - 2:20
    Design, Construction and Implementation of a Statewide Real-Time Kinematic
    Network
    John Ray, Ohio Department of Transportation
2:20 - 2:40
    Technical, Operational, and Political Challenges of Building a Regional
    Multi-purpose CORS Network Along the Gulf Coast
    Roy Dokka, Louisiana Spatial Reference Center
2:40 - 3:00
    CORS/OPUS: Status and Future Prospects
    Richard Snay, NOAA's National Geodetic Survey
3:00 - 3:10
    Ionosphere Monitoring Using NOAA's CORS Network
    Dru Smith, NOAA's National Geodetic Survey
3:10 – 3:30
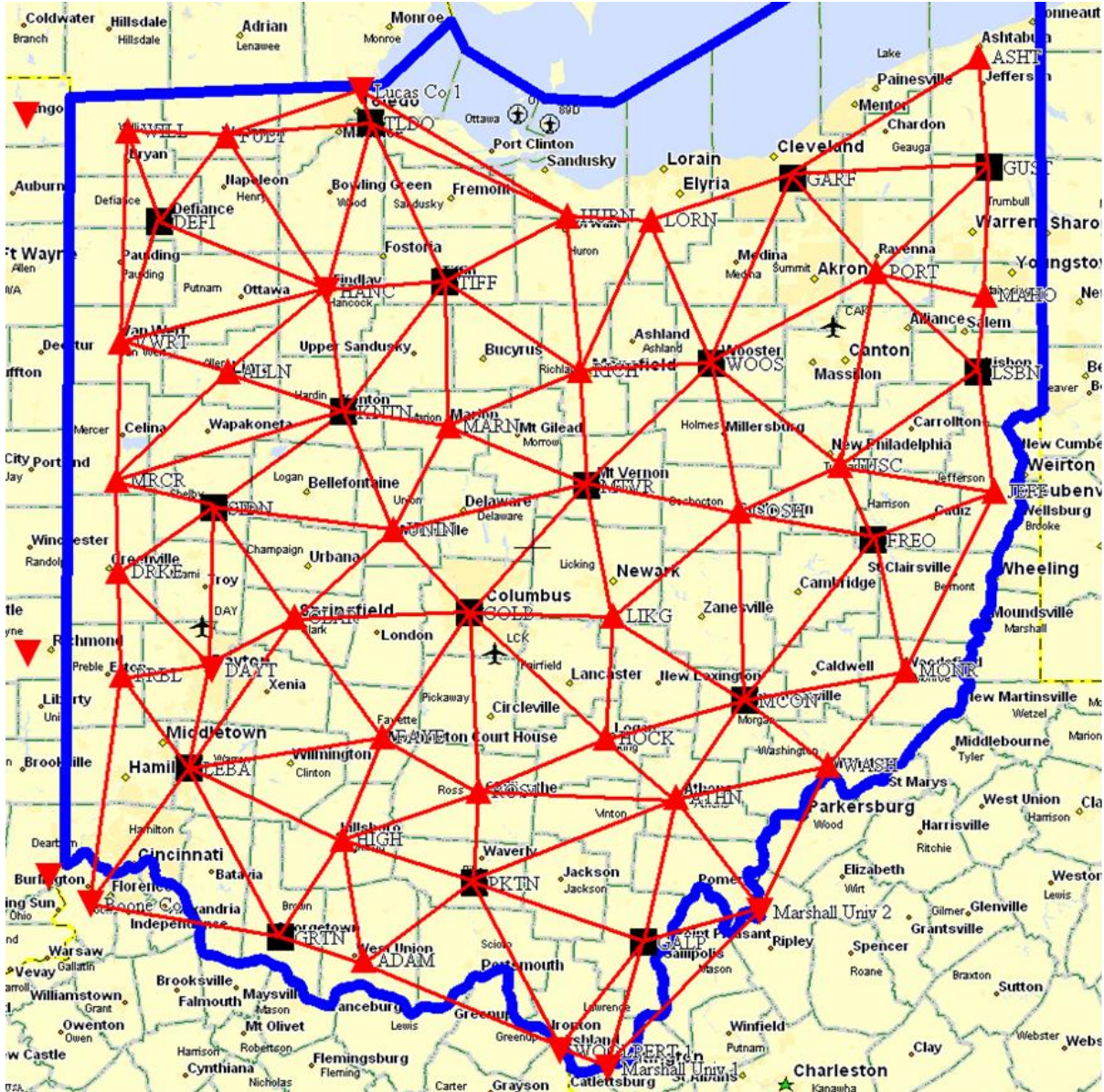   Question/Answer Session with the Panel of Speakers
3:30 - 3:45
    Break
3:45 - 5:15 Interactive Sessions within Small Discussion Groups

Session A: Towards Real-Time Positioning moderated by Miranda Chin and Marti Ikehara (both with NOAA's National Geodetic Survey)

Session B: OPUS moderated by Tomas Soler and Rick Foote (both with NOAA's National Geodetic Survey)

Session C: Modeling the Ionosphere and the Troposphere moderated by Seth Gutman (NOAA's Forecast Systems Laboratory), Joe Kunches (NOAA's Space Environment Center), and Dru Smith (NOAA's National Geodetic Survey)

Session D: Computer Friendly CORS moderated by Gordon Adams and Janet Irwin (both with NOAA's National Geodetic Survey)

Ohio's real-time kinematic network

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Session A Report: Towards Real-Time Positioning

Several participants shared their experiences in establishing CORS-like networks to enable real-time positioning. Others expressed their desire to have access to CORS data in real time; that is, with a latency of less than 1 second.

Participants:
    Marti Ikehara – NOAA's National Geodetic Survey
    Miranda Chin – NOAA's National Geodetic Survey

3

Kriss Larson – Towill, Inc.
Ron Buhmann – NOAA's National Geophysical Data Center
John Ray – Ohio Department of Transportation
Matt Shellenberger – American Electric Power
Jeff Evanson – Dougherty Co.
Thom Harrington – U.S. Coast Guard
Georg Weber – BKG, Frankfurt, Germany
Bob Twilley – Geoscience Australia
Knute Berstis – NOAA's National Geodetic Survey
Mark Caissy – Natural Resources Canada
Andre Fuegner – Texas Department of Transportation
Norman Beck – Natural Resources Canada
Karl Brown – U.S. Geological Survey
Roy K. Dokka – Louisiana State University
Greg Anderson – UNAVCO, Inc.
Richard Snay – NOAA's National Geodetic Survey

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 Session B Report: OPUS

Participants:
Ken Bays – U.S. BLM, Portland, OR
Jim Garster – U.S. Corps of Engineers
Greg Helmer – California Spatial Reference Center
DeLane Meier – North Dakota DOT
Rick Foote – NOAA's National Geodetic Survey
Tom Soler – NOAA's National Geodetic Survey

Ken Bayes of the Bureau of Land Management requested that the Online Positioning User Service (OPUS) apply a simultaneous least squares adjustment in computing positional coordinates. Currently this Web-based utility averages the results of three separate results—one for each of three baselines from the point of interest to a nearby CORS site. All participants concurred that this approach, mathematically speaking, makes more sense. NGS is studying the possibility of implementing this alternative.

Mr. Bayes also requested that OPUS report the accuracy of its derived positional coordinates at the 95% confidence level. Currently, OPUS reports the "peak-to-peak" error for the computed coordinate in each of several dimensions (X, Y, Z, latitude, longitude, ellipsoid height, orthometric height). Using the 95% confidence level would be in accordance with the spatial-accuracy-reporting requirements adopted by the Federal Geographic Data Committee. Mr. Bayes was informed that the OPUS "Extended output" contains the 95% radius of probability circle although based on optimistic formal errors. NGS is developing an empirical formula able to reflect a more realistic 95% confidence level.

Mr. Bayes also requested that NOAA's National Geodetic Survey express positional accuracies on their "data sheets" in terms of linear dimensions as opposed to proportional errors. This

query was transmitted to the personnel responsible for publishing "data sheets."

Mr. Helmer asked why some antennas in California don't have the right calibration model. This apparent anomaly was transmitted to the Antenna Calibration Team. The conclusion was reached that the type of antenna in question was calibrated with a different type of radome than was deployed at these CORS sites located in California.

Mr. Meier reported his inability to print CORS 60-day time series plots from his PC. The problem was traced to incompatibilities between various versions of Netscape and Internet Explorer available on the Web and has since being corrected.

Mr. Garster and others asked if OPUS can take less than 2 hours of data. Reference to the empirical equation published by the CORS-OPUS Team was mentioned. OPUS may take less than 2 hours of data but the results (primarily on the vertical component) are not reliable due to the current version of the PAGES software inability to reliably fix integer biases with less than 2 hours of GPS data. The effort by the researchers at the Ohio State University to rectify this problem was mentioned.

Finally, all participants wanted to know when OPUS is going to be able to process L1 only data. The answer given was that as soon as reliable ionospheric models are available the implementation of L1 only data through OPUS will start.

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Session C Report: Modeling the ionosphere and the troposphere

Approximately 10 people met during this session for about 45 minutes. NOAA was represented by Dru Smith, Seth Gutman, and Joe Kunches. Various GPS/CORS users discussed their needs for atmospheric models in their processing. The following points were raised by most people:

1) Need for real-time data seems very high. Although NOAA's Forecast Systems Laboratory is doing real-time tropo modeling, that seemed to be not as widely known as one would have assumed. Dr. Smith explained that NOAA's Space Environment Center (SEC) is doing real-time Ionosphere modeling with a subset of CORS but that NOAA National Geodetic Survey's (NGS) plans for now will be to wait for the whole CORS network to report, and provide models with some latency (1-3 days or so).

2) RTK is a high priority to most people, but lack of atmospheric models is keeping baselines to a limited length. Most users and/or RTK software developers are very eager to test any atmospheric models NOAA produces.

Joe Kunches and Dru Smith discussed the similarities and differences between SEC's real time MAGIC model (now commonly known as USTEC), and the method Dr. Smith developed. It seems clear that where these two products began with similar goals, they have diverged to different ways of serving different audiences and both have their place inside of NOAA.

Dr. Smith explained to the group that his model was near production ready earlier this year, but that he had been working on improving the code, but that given the demand of the audience, he would be motivated to return to NGS and get the code back to production ready and begin providing daily models during October 2004. (Note: Both NGS and SEC began production of their respective ionospheric models on November 1, 2004.)