FINAL TECHNICAL REPORT

AWARD NUMBER: 1434-HQ-98-GR-00048

Roland Bürgmann, P.I.

THE BARD PERMANENT GPS NETWORK:
CONTINUOUS MONITORING OF ACTIVE DEFORMATION AND STRAIN ACCUMULATION IN THE SAN FRANCISCO BAY AREA:
Collaborative research with UC Berkeley, UC Davis, Stanford University, and U.S. Geological Survey, Menlo Park

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TECHNICAL ABSTRACT

Geodetic measurements show that crustal deformation in the San Francisco Bay area varies both in space and time. Much of this deformation is due to strain accumulation and release along the San Andreas, one of the most seismically hazardous fault systems in the U.S. To better understand the distribution and rate of loading of its individual faults, and the timing and hazards posed by future earthquakes, our collaborative group installed and maintains the Bay Area Regional Deformation (BARD) network of Global Positioning System (GPS) permanent stations. This network provides continuous, near real-time monitoring of crustal deformation in the Bay area and northern California. As part of this effort, the Berkeley Seismological Laboratory (BSL) has installed 3 new stations and converted 2 other stations to continuous operational mode, all located in the Bay Area. We performed significant upgrades on all existing stations, including firmware upgrades to make the receivers Y2K and GPS week rollover compliant, and installed antenna adapters and domes at most stations to provide greater protection and uniformity to the network. We have prepared many stations to transmit the data through collocated seismic dataloggers for more robust real-time telemetry. We have helped to develop database schema and file formats for the UNAVCO-sponsored GPS Seamless Archive Centers project, which will provide an easier, more reliable, and more uniform method to retrieve data from a distributed system of archives, including the NCEDC archive maintained by the BSL. We have tested an experimental single-frequency receiver developed by UNAVCO to improve our monitoring capability in the vicinity of hazardous faults. We determined a self-consistent deformation field for northern California and Nevada, and the Pacific Northwest that shows extension across the Basin and Range Province, a relatively stable Sierra Nevada-Great Valley block, and right-lateral shear across the San Andreas fault system accommodating about 35 mm/yr of the Pacific-North America relative plate motion. Deformation in the Pacific Northwest is generally consistent with interseismic strain accumulation along the Cascadia megathrust, particularly in Washington where the velocity vectors are nearly parallel to the oblique convergence direction. Greater arc-parallel motion in Oregon and northern California may be due to the influence of the SAF system to the south and spreading in the Basin and Range Province to the east. We also detected transient deformation at one station associated with the August 1998 M=5.1 San Juan Bautista earthquake.

NON-TECHNICAL ABSTRACT

Geodetic measurements show that crustal deformation in the San Francisco Bay area varies both in space and time. Much of this deformation is due to strain accumulation and release along the San Andreas, one of the most seismically hazardous fault systems in the U.S. To better understand the distribution and rate of loading of its individual faults, and the timing and hazards posed by future earthquakes, the Bay Area Regional Deformation (BARD) network of Global Positioning System (GPS) permanent stations was installed and is maintained by a collaborative group of many academic, government, and commercial institutions. This network provides continuous, near real-time monitoring of crustal deformation in the Bay area and northern California. As part of this effort, the Berkeley Seismological Laboratory has installed 3 new stations, converted 2 other stations to continuous operational mode, and performed significant hardware and firmware upgrades on all existing stations to make the network more secure and uniform. We have improved our data telemetry, archive, and processing capabilities. We have tested an experimental GPS receiver that will improve our monitoring capability in the vicinity of hazardous faults. We estimated deformation in northern California and Nevada, and the Pacific Northwest that shows extension across the Basin and Range Province, a relatively stable Sierra Nevada-Great Valley block, right-lateral shear across the San Andreas fault system, and interseismic strain accumulation along the Cascadia subduction zone. We also detected transient deformation at one station caused by the 1998 M=5.1 San Juan Bautista earthquake.