Chapter 5

Bay Area Regional Deformation Network

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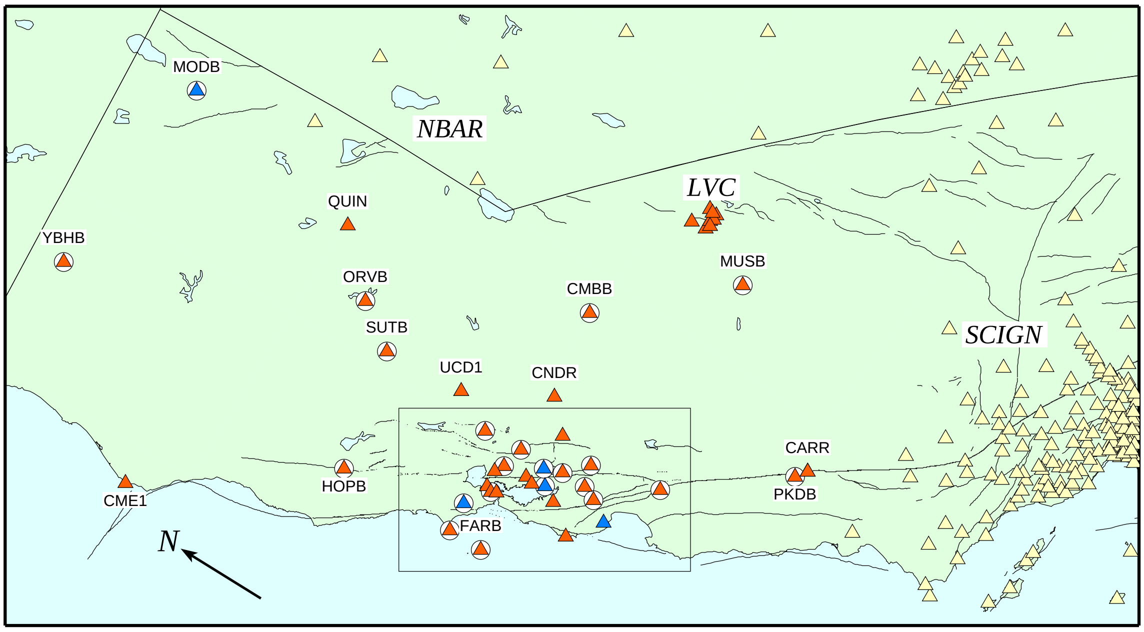
1. Introduction

The Bay Area Regional Deformation (BARD) network of permanent, continuously operating Global Positioning System (GPS) receivers monitors crustal deformation in the San Francisco Bay area ("Bay Area") and northern California (*Murray et al.,* 1998a). It is a cooperative effort of the Berkeley Seismological Laboratory at UC Berkeley (BSL), the US Geological Survey (USGS), and several other academic, commercial, and governmental institutions. Started by the USGS in 1991 with 2 stations spanning the Hayward fault (*King et al.,* 1995), BARD now includes 40 permanent stations and will expand to about 50 stations in 2000 (Figure 5.1). The principal goals of the BARD network are: 1) to determine the distribution of deformation in northern California across the wide Pacific–North America plate boundary from the Sierras to the Farallon Islands; 2) to estimate three-dimensional interseismic strain accumulation along the San Andreas fault (SAF) system in the Bay Area to assess seismic hazards; 3) to monitor hazardous faults and volcanoes for emergency response management; and 4) to provide infrastructure for geodetic data management and processing in northern California in support of related efforts within the BARD Consortium and with surveying, meteorological, and other interested communities.

BARD presently includes 40 permanent, continuously operating stations, 8 of which monitor the Long Valley caldera near Mammoth. The remaining 32 stations (Table 5.1) include 18 maintained by the BSL (including two with equipment provided by Lawrence Livermore National Laboratory (LLNL), and the Satloc Corporation), 2 each by the USGS and Trimble Navigation, and one each by LLNL, Stanford University, and UC Davis. Other stations are maintained by institutions outside of northern California, such as the National Geodetic Survey, the Jet Propulsion Laboratory, and the Scripps Institution of Oceanography, as part of larger networks devoted to real-time navigation, orbit determination, and crustal deformation.

Between 1993 and 1996, the BSL acquired 5 Ashtech Z-12 receivers from UC Berkeley and private (EPRI) funding, which together with 2 USGS receivers, formed the nucleus of the initial BARD network. Since 1996, the BSL has acquired additional Ashtech Z-12 receivers with Dorne-Margolin design choke ring antennas: 13 in 1996 from a combination of federal (NSF), state (CLC), and private (EPRI) funding, and 4 in the last year from federal (USGS) funding. All but 6 of these receivers have been permanently installed to enhance continuous strain measurements in the Bay Area and to consolidate the regional geodetic network. The network includes several profiles between the Farallon Islands and the Sierra Nevada in order to better characterize the larger scale deformation field in northern California (Figure 5.1). Four more of the BSL receivers and a receiver owned by UC Santa Cruz will be installed during the next year.

In 1996, researchers from the BSL, the USGS, Stanford University, LLNL, UC Davis, and UC Santa Cruz formed a consortium of institutions involved in studies of the tectonic deformation in the San Francisco Bay area and northern California. Members of the BARD consortium agreed to pool existing resources and coordinate development of new ones in order to advance an integrated strategy for improving the temporal and spatial resolution of the strain field. They agreed in principle to the continued development of the network of permanently deployed GPS receivers, to the development and maintenance of a pool of GPS receivers for survey-mode operations that may be deployed in semi-permanent mode in the Bay Area when not otherwise in use, to archiving of all data at the NCEDC, and to the development



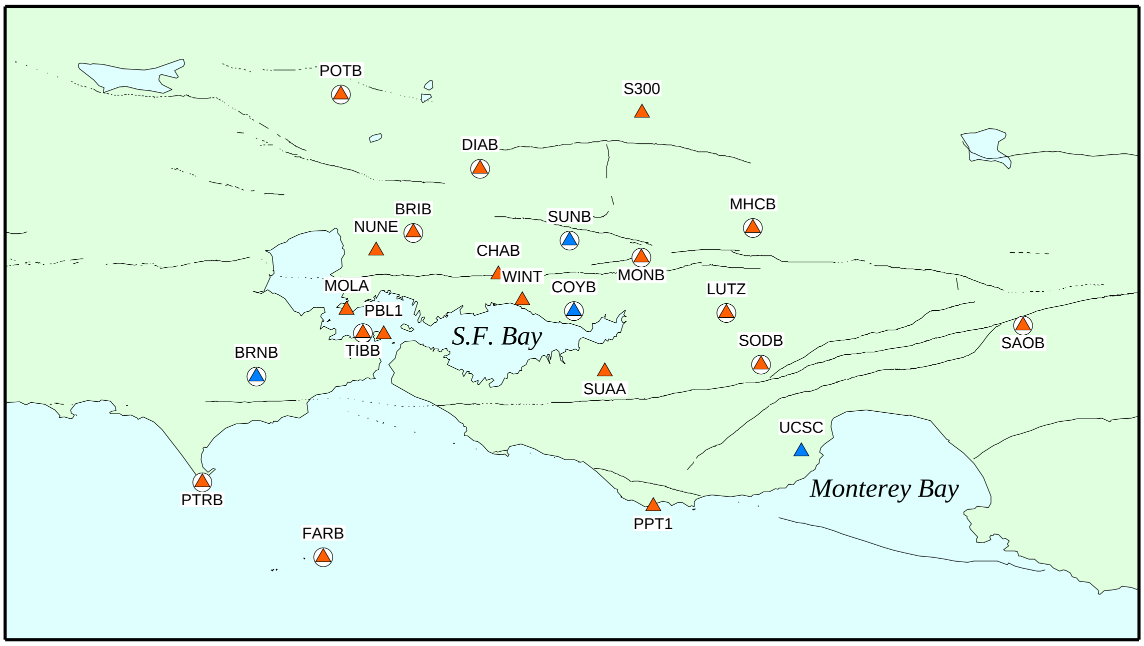


Figure 5.1: Operational (red triangles) and planned (blue triangles) BARD stations in northern California (top) and in the San Francisco Bay area (bottom). The oblique Mercator projection is about the NUVEL-1 Pacific–North America Euler pole so that expected relative plate motion is parallel to the horizontal. Circled stations (will) use continuous telemetry. The eight station Long Valley Caldera (LVC) network is shown with red triangles. Other nearby networks (yellow triangles) include: Northern Basin and Range (NBAR), and Southern California Integrated GPS Network (SCIGN). *Courtesy of M. Murray.*