A picture of electrical conductivity structure in the mid-lower crust and upper mantle in the northwestern quadrant of North America has emerged that is spatially coherent with regional geologic structure, and with large scale features evident in seismic tomograms and in receiver function analyses. The data set used to build this emerging set of large-scale 3D conductivity inverse models has been acquired by the EarthScope US Array magnetotelluric program (i.e. “EMScope”), which includes seven quasi-permanent backbone stations (MT BB) installed at sites in Oregon, California, Montana, New Mexico, Minnesota, Missouri and Virginia, and a transportable array of stations (MT TA) installed typically for several weeks at sites located on an approximately 70 km spaced national grid of large regional footprints. The MT field program and data quality control activity is carried out on behalf of IRIS by Oregon State University and its subcontractors, with advice from the IRIS Electromagnetic Working Group (EMWoG). All EMScope time series data and primary derived data products (e.g. magnetotelluric impedances and induction vectors) are distributed without restriction through IRIS DMC.

From 2006-2010 EMScope acquired 271 MT TA stations, forming a contiguous grid covering all of Washington, Oregon, N. California to within 50 km N of Sacramento, and extending eastward through Idaho, Nevada and much of Montana and Wyoming. In 2011 the remainder of this first MT footprint will extend eastward through Utah and into the NW quadrant of Colorado and SW Wyoming before the next footprint is acquired in the upper Midwest targeting a region encompassing the Mid-Continent Rift.

We report on principal results-to-date of inversions of EMScope MT data carried out independently by a number of different groups, using data available from IRIS DMC. Key features in regional scale conductivity structure include electrically resistive crustal blocks along the western margins of continental Cascadia that correspond to inferred mechanically rigid blocks associated with the N and S Siletzia and Klamath provinces of Oregon; the S Cascades conductive anomaly that has been inferred to result from crustal magma accumulations and hydrothermal activity; the transition from the flood basalt province to the Basin and Range; substantial conductivity contrasts between the Juan de Fuca/Gorda mantle wedge and the ocean-ward mantle; extremely high conductance beneath the Yellowstone Caldera that extends toward and along the Snake River Plain to the west where it deepens; and areas of enhanced conductance that appear to be associated with large scale features of the Cascadia volcanic arc. A number of these features correspond to seismically delineated crust and upper mantle anomalies, including indications of crustal melt accumulations from receiver function analysis, and plume-like mantle melt sources from seismic tomography.
Additional fieldwork is underway (e.g. CAFÉ-MT) or proposed (Cascadia onshore-offshore MT) to provide high spatial resolution additions to the regional scale view provided by EMScope data. A large set of commercial contractor wideband MT data has also been made available to this effort, providing very high resolution 3D sampling of the upper through mid-crust. Various groups are currently working to advance the joint interpretation, and ultimately the joint inversion of magnetotelluric, seismic and other complementary data sets in order to constrain the underlying physical and compositional conditions in the crust and mantle.