Dangerous surface expressions resulting in near-surface ground instability and powerful above ground eruptions of oil, water, steam, and rocks have been observed in mature oil fields of Central California that use thermal-based steam-injection recovery methods to produce heavy oil from a siliceous sedimentary rock called diatomite. In 2011, a Chevron employee lost their life in Midway-Sunset (MWSS) Oil Field when they stepped onto unstable ground and fell into a sink hole of hot oil and steam that was not known to exist. The cause of such surface expressions is unknown. Tiltmeter arrays, used by oil field operators to monitor ground deformation above active diatomite reservoirs, may provide information needed to develop deeper insights into the underlying dynamics and spatiotemporal scale of risk associated with surface expressions. Spatial grids of ground deformation, derived from a tiltmeter array in MWSS and sampled hourly at a resolution of 20 feet, were summed across time and examined in conjunction with the location and timing of surface expression events. Preliminary results suggest tiltmeter-based ground deformation data combined with advanced data science tools may help to inform the space-time evolution of surface expression risk dynamics.

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This research is supported by the State of California Department of Conservation, and the Computational Science Research Center (CSRC) at San Diego State University