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# Geodesy with temporal scales from seconds to decades and on spatial scales of meters to global

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Over the past 50 years since the development of distance measurements using propagating electromagnetic signals and the launch of Earth orbiting satellites, the field of geodesy has been revolutionized. These two developments along with the massive increases in computing power and data storage have lead to geodetic measurements of nearly all of the dynamic motions occurring on and in the Earth. The detection of contemporary plate motions over intercontinental distances provided direct evidence of the consistency of million year and decadal plate motions. Currently, these classes of studies are revealing the subtle differences between the strain accumulation on decadal time scales and those over thousands (paleoseismology) and millions of years (geology). The effects of fluid motions (atmosphere, oceans and ground water) on Earth rotation, first detected with measurements of length-of-day and later with polar motions, became clearly evident with modern geodetic measurements. The smaller effects of the internal motions of the fluid core took longer to detect but once measured rapidly lead to revised estimates of the flattening of the core-mantle boundary and inferences about the magnetic coupling of the fluid-inner and solid-outer cores to the mantle. With improved accuracy and densification in time and space, many geophysical and hydrographic effects have been measured with modern geodetic methods ranging in time scales from seconds for earthquake generated surface waves, to days and weeks for slow earthquake events, to weeks to years for hydrographic phenomena, and to decades for post-seismic deformations and other possible slow transient effects from stress changes in the Earth. Spatial scales now span from tens-of-meters with interferometric synthetic aperture radar measurements, to tens of kilometers to global scales with dense space geodetic networks, to one hundred kilometers to global scale with satellite based gravity measurements. Vening Meinesz studied global geodesy with

gravimetry to determine the size and shape of the Earth. In this talk, we trace the modern developments and future applications of geodetic methods that show how combinations of geometric positioning methods with potential and magnetic field measurements are able reveal not only the size and shape but also the dynamic changes of Earth.