



Space Geodesy and the 4-D challenge of the Earth System Science (Vening Meinesz Medal Lecture)

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Some fifty years ago with the beginning of the artificial satellite age and the discovery of quasars, geodesy was borne into a new and exciting life. This discipline has always provided fundamental data for studying the Earth's physical environment at global as well as regional and local scales. However, it is only with the advent of the artificial satellites and the development of the radio-interferometry technique that the time-variant aspects of the Earth's shape, gravity field and rotation could be observed for the first time with high accuracy and high spatial and temporal resolution using data acquired by global networks of stations. Nearly at the same time, the idea of regarding the Earth as a system of interacting components became appreciated and accepted. Geodesy has gone far beyond the static knowledge of the Earth's geometric and physical parameters, and with the increasing measurement capability and accuracy, makes it possible to monitor, by space techniques, the dynamical response of the system to mass transport. These data are crucial for a deeper understanding and for reaching new insights on the main geodynamic processes thus abating risks within the complex and evolving Earth system science. One critical example is the monitoring of the water cycle, since it is vital for the society to protect the water supply at global and local scales, and for understanding the hydrological signals embedded in the space geodetic data. The contributions to and the connections and synergies with other disciplines -main examples are geophysics, oceanography and atmospheric science to name only a few- shed light on the interdisciplinary role of space geodesy and address the need for the integration of techniques and data sets. A central contribution of geodesy to Earth science is the provision of a stable reference frame and the international geodetic community is actively working within the Group of Earth Observations (GEO) towards further developments of the Global Geodetic Observing System (GGOS).