

Mass Transport and Dynamics in the Earth System

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The solid Earth is subject to a wide variety of forces including external forces due to the gravitational attraction of the Sun, Moon, and planets, surficial forces due to the action of the atmosphere, oceans, and water stored on land, and internal forces due to earthquakes and tectonic motions, mantle convection, and coupling between the mantle and both the fluid outer core and the solid inner core. The solid Earth responds to these forces by displacing its mass, deforming its shape, and changing its rotation. Satellite laser ranging can measure the change in the Earth's gravity caused by mass displacement, the change in the Earth's shape, and the change in the Earth's rotation. Consequently, satellite laser ranging can be used to study both the mechanisms causing the Earth's shape, rotation, and gravity to change, as well as the response of the solid Earth to these forcing mechanisms. As a result, satellite laser ranging can be used to gain greater understanding of the Earth's interior structure and of the nature of the forcing mechanisms including their temporal evolution. A few selected scientific questions will be examined here as a way of illustrating the role that satellite laser ranging plays in understanding the Earth and its interacting systems.