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Low-degree surface mass loads estimated from geodetic measurements and geophysical models

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The solid Earth is surrounded by a fluid, mobile atmosphere and oceans and upon its land surface lies a continually changing distribution of ice, snow, and ground water. The changing distribution of mass associated with the migration of these surficial fluids changes the Earth's gravitational field, changes the Earth's rotation by changing its inertia tensor, and changes the Earth's shape by changing the load on the solid Earth. Changes in the Earth's rotation have been measured for more than a century. GRACE is currently measuring changes in the Earth's gravitational field at monthly intervals. And large-scale changes of the Earth's shape, and hence of the mass load causing the Earth's shape to change, can be measured using the global network of GPS receivers. Here, low-degree mass load coefficients determined from Earth rotation, GRACE, and GPS data are compared with each other and with atmospheric, oceanic, and hydrologic models. Good agreement is found between these independent estimates of the low-degree surface mass load, particularly at seasonal frequencies.