Oceanic Sea Level Height Changes, Atmospheric Pressure Fluctuations and Temporal Geopotential Variations as Geophysical Indicators

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The Earth is a complex system with dynamical subsystems (such as the overlying fluid hydrosphere and atmosphere, underlying metallic core, and mantle) with complicated interactions among them (such as the melting of glaciers, sea level rise, and post-glacial rebound). Changes in the inertia tensor of the solid Earth are brought about by interfacial stresses, the gravitational attractions associated with astronomical objects and mass redistributions in the Earth's fluid and solid region. As the Earth's gravitational field changes only in response to net mass redistribution, observations and analysis of the Earth's time varying global gravitational field permits the isolation and study of the changing mass distributions and serves as a geophysical indicator.

Seasonal variations in the Earth's gravitational field are investigated through the analysis of LAGEOS I satellite laser ranging measurements spanning the period 1980 1994 and are compared with those produced by atmospheric mass redistribution as inferred from global surface pressure data from the National Meteorological Center. The effect of oceanic tides and groundwater are considered as well. Focusing on the even harmonics, atmospheric pressure fluctuations are the dominant cause of the observed zonal gravitational field variation at the annual period, explaining the observed amplitude to within 1 σ and the phase to within 2°. At the semi-annual period, the modeled effect of the self-consistent equilibrium ocean dominates; agreement is at the 1 σ level when both the tides and pressure fluctuations are considered. Analysis results of interannual and non-tidal ocean variations will also be presented.

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7. None

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