Progress Seminar

Seminar Title	: Assessment of Fluid-Induced Crustal Deformation Using Integrated Geodetic Techniques
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Venue	: ER 303
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Abstract : Mechanical interactions between Earth&rsquos solid interior and its hydrosphere are central to many geophysical problems of crucial societal importance: changing conditions in the global water cycle deform the solid Earth the groundwater storage capacity of aquifer systems is controlled by its interaction with geological materials and crustal water &mdash either natural occurring or added through anthropogenic activities &mdash affects earthquakes, fault slip processes, land surface deformations, and slope stability. Hydrospheric mass changes, whether from freshwater systems, oceans, or cryosphere, cause surface deformation that is essential for monitoring water resources and the global water cycle. Such deformation also informs us about Earth&rsquos elastic and viscoelastic properties. Additionally, small stresses from hydrological loading and unloading can modulate seismic activity, influencing earthquakes in various regions. Groundwater, through mechanical interactions with porous geological materials, plays a crucial role in aquifer storage capacity. Small fluctuations in groundwater levels typically maintain an elastic regime, allowing aquifers to preserve their capacity. However, rapid or extensive groundwater extraction can result in irreversible changes and land subsidence, shifting the system into an inelastic regime. This interaction also impacts slope stability in hilly terrains, where pore-water pressure from water infiltration can weaken slopes, increasing the risk of landslides. Conversely, reduced water pressure during dry periods temporarily stabilizes slopes. At deeper levels, water influences earthquake physics by altering shear resistance and loading conditions in fault zones through fluid pressure. This is especially relevant in areas with induced seismicity from water injections used in energy production, where water pressure changes have been linked to fault reactivation and seismic slip. The growing concern around induced seismicity in quiescent regions underscores the need for hazard forecasting, as these regions often lack infrastructure to withstand large earthquakes. In recent decades, remote sensing technologies like InSAR and GPS have transformed the study of crustal deformation. These technologies enable the collection of vast data that, when integrated with physics-based models and advanced statistical methods, help monitor and predict natural hazards. Despite limitations in subsurface data, combining these techniques provides civil authorities with essential information for managing risks related to earthquakes, subsidence, and other geophysical phenomena. Further advancements are required to refine the understanding of poroelastic deformation and subsurface mechanical properties.