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The Ups and Downs of Low-Lying Coastal Land Elevation

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As sea levels rise, many low-lying coastal areas are undergoing profound alteration through subsidence, inundation and land loss. Natural landscape evolution balances land elevation decreases from the diverse processes driving subsidence with sediment accretion and production of organic material. However, in many areas this natural balance cannot be maintained due to sediment starvation and a host of other anthropogenic activities and natural processes that challenge land sustainability. Although wetland loss is particularly high, land sustainability issues arise in all settings, be they natural, agricultural, urban, or industrial. In fact, subsidence is often highest in developed areas, where groundwater extraction can drive high rates of subsidence that are not offset by natural recharge. In this presentation, we discuss a series of studies of the Mississippi River delta (Louisiana, USA) and the Sacramento delta (California, USA), ongoing since 2009, that make use of the L-band UAVSAR synthetic aperture radar (SAR) to quantify subsidence and land loss in these low-lying areas. Although InSAR is an excellent tool for measuring subsidence in urban areas and particularly for identifying areas of rapid and large change, it is challenged by temporal decorrelation in agricultural and natural settings where subsidence at relatively low rates of order 1 cm/yr can slowly but steadily cause inundation from rising seas or increase stress on levees that currently maintain the land. We discuss the methods and results obtained in these areas in particular. But besides documenting detrimental impact, SAR can be used to study wetland gain and to evaluate methods for remediation of wetland loss. Because sediment, nutrients, and carbon are transported by water, knowledge of the timing and spatial extent of water is key to determining the distribution and capture of exogenous sediment and is also important for evaluating whether net soil accretion can occur in a given area. We discuss results of a recent study of coastal hydrology at the Wax Lake Delta, Louisiana, which is a small but growing delta on the Louisiana coast. We used rapid repeat imaging with UAVSAR to investigate the exchange of surface water between the Gulf and coastal wetlands on the time scale of a tidal cycle and at the spatial scale of the geomorphic zones that control sediment capture and soil accretion. Plans for future study are presented.