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The Role of Subjective Risk Perceptions in Shaping Coastal Development Dynamics

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Abstract: In highly dynamic socio-environmental systems, particularly those affected by frequent natural hazards, the ways in which people perceive their environment, formulate expectations of risk, and make decisions influence the long-term vulnerability of the built landscape to natural hazards. A common observation in landscapes prone to natural hazards, such as flooding and/or hurricanes, is the emergence of overly reactive (i.e., out-of-equilibrium, or ‘boom-bust’ cycles) market dynamics. Housing prices and insurance uptake rates have been shown to decline and spike, respectively, immediately after hazard events and then return to long-term trends as time since the event increases. Theoretical explanations for such dynamics typically point to psychological factors, but conclusive evidence is difficult to extract from empirical data alone. Here, we use an economic agent-based model (ABM) of coupled housing and land markets (CHALMS) to investigate the explanatory ability of alternative decision-making models to explore potential behavioral mechanisms driving such reactive market dynamics in response to coastal storm events: a) full information, b) dynamic subjective risk perception, and c) salience theory. Online behavioral experiments were conducted to solicit individual preferences for various adaptive responses, such as relocation, raising house height, or purchasing flood insurance, under conditions of varied past storm frequencies. Experimental results were used to inform and calibrate individual decision-level preferences. The well-known pattern-oriented modeling (POM) approach and a novel hierarchical genetic algorithm are then used to simultaneously select and calibrate the set of decision rules and parameter values that most accurately reproduce observed housing price dynamics and insurance uptake rates. Our modeling results provide tentative support for economically rational yet subjective decision-making as a driver of reactive market dynamics.

Keywords: Agent-based modeling; natural hazards; vulnerability; behavioral theories.