Abstract:
The Nakdong Estuary, located within the coastal zone of Busan, South Korea, has been subjected to a series of engineered alterations typical of many eastern Asian estuaries. The construction of two estuarine dams (1934 and 1983) and numerous seawalls associated with land reclamation projects has altered the timing and flux of sediment, and resulted in three contrasting discharge energy regimes. Additionally, the impoundments have appreciably reduced the tidal prism by at least 50%. Consequently, vast geomorphologic changes have occurred including the development of five new barrier islands. In order to assess the impacts of these modifications, 1980s cross-sectional data were obtained throughout the estuary. The dispersal and accumulation of sediment was evaluated utilizing 137Cs and 210Pb radioisotope geochronology of six cores. Average sediment accumulation rates range from 2.19 cm yr$^{-1}$ adjacent to the first constructed dam to as high as 6.55 cm yr$^{-1}$ in the middle region of the estuary. These high rates are further supported by comparison of bathymetric survey data from 1985 to 2009. Laser diffraction grain size analyses and X-radiographs revealed distinctive changes associated with dam construction, and correlation of events between cores conveys the episodic sedimentation corresponding to floodgate releases. Ultimately, anthropogenic alterations have resulted in a shift from a tide-dominated to a wave-dominated estuary. The increase in sediment trapping efficiency that has ensued resulting in extensive coastal construction provides the basis for reevaluating traditional facies models for estuaries. A conceptual model is developed here to characterize the alterations in sediment depositional patterns according to relative discharge energy of the adjacent floodgate.

Methods:

1980 cross-sections of 7.5m diameter were collected between Oct. 9-12, 2012.
X-radiographs taken at 64 kV for 1.6 mAs with a Medison X-ray source
Grain size analyses and X-radiographs revealed distinctive changes associated with dam construction, and correlation of events between cores conveys the episodic sedimentation corresponding to floodgate releases. Ultimately, anthropogenic alterations have resulted in a shift from a tide-dominated to a wave-dominated estuary. The increase in sediment trapping efficiency that has ensued resulting in extensive coastal construction provides the basis for reevaluating traditional facies models for estuaries. A conceptual model is developed here to characterize the alterations in sediment depositional patterns according to relative discharge energy of the adjacent floodgate.

Conclusions:
The construction of two estuarine dams and numerous seawalls has greatly modified the sediment transport dynamics of the Nakdong Estuary. These modifications have eliminated large areas of intertidal zone, and appreciably reduced the tidal prism and river discharge. Sediment flux to the estuary is restricted to fluvial inputs which produce high flow velocities and episodic deposition. The implications of these alterations are evident in a rapid geomorphologic shift from tide-dominated to wave-dominated. High sediment accumulation rates within the central estuary are due to a reduction in accommodation space in the upper estuary. Additional evidence for this reclassification occurs as a series of barrier islands that have developed post-dam construction accompanied by a redistribution of facies. The increase in sediment trapping efficiency that has ensued resulting from extensive coastal construction provides the basis for reevaluating traditional facies models for unaltered estuaries. The observations made within this study have allowed the development of a conceptual model for facies distribution according to relative discharge energy of the adjacent floodgate.