Geophysical Research Abstracts
Vol. 13, EGU2011-5335, 2011
EGU General Assembly 2011
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Overwash controls of basic barrier response to sea-level rise and the potential for transgressive instabilities

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Coupling a dynamic shoreface with a parameterization of overwash, we use a simplified numerical model of barrier evolution to investigate the transgression of a stable barrier system exposed to an increased rate of sea-level rise. Model results demonstrate that, over long timescales, overwash must dominate barrier response (and be sufficiently high) for barriers to remain intact during sea-level rise. If maximum overwash fluxes are insufficient to replace the passive gain of barrier deficit volume due to rising sea level, then a barrier will not be able to maintain itself as sea level rises. In an equilibrium rollover transgression, overwash and shoreface fluxes attain a long-term balance, with marine fluxes onshore. Correspondingly, a barrier in equilibrium with sea-level rise has shoreface fluxes directed onshore and a different shape than one in equilibrium with steady or slowly rising sea level—although the change in shape may be subtle, significant volume differences occur due to the low relief of the shoreface. Furthermore, model results demonstrate the potential for complex barrier evolution, including response lags and oscillatory behavior, with cycles of intermittent barrier overwash due to lagged shoreface response—instabilities that can arise even with constant forcing conditions. As the shoreface response rate and potential maximum overwash affect the types of predicted barrier response, further work is needed in calibration of these variables. The latter will be harder to determine as most barriers are not currently experiencing rollover, and therefore cannot be expected to be overwashing at their maximum rate; however, field investigations of current overwash rates of different barrier systems may provide useful values.