Using coupled geo-economic models to explore the interplay between coastal protection, natural processes and economic values in developed shorelines

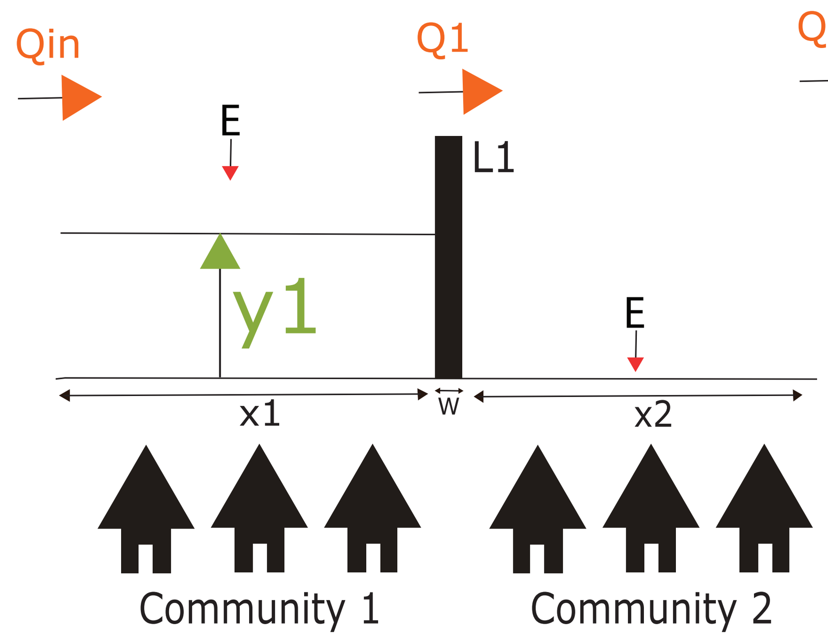
Jorge Lorenzo-Trueba[1], Arye Janoff[1], Jesse Kolodin[1], Porter Hoagland[2], Di Jin[2], and Andrew Ashton[3]

1. Earth and Environmental Studies Department, Montclair State University, Montclair, New Jersey.
2. Marine Policy Center, Woods Hole Oceanographic Institution, Woods Hole, Massachusetts.
3. Geology and Geophysics Department, Woods Hole Oceanographic Institution, Woods Hole, MA 02543

MONTCLAIR STATE UNIVERSITY

Effect of groin structures on adjacent communities

The Cove, Cape May, NJ. Photo: Google Earth Pro



$$\underset{L_1}{Max}\int_0^{T_{max}} e^{-\delta t}(B(t)-C(t))dt$$

Subject to:

$$\frac{dy_1}{dt}=\frac{Q_{in}-Q_1}{D\cdot x_1}-E$$

$$\frac{dy_2}{dt}=\frac{Q_1-Q_{out}}{D\cdot x_2}-E$$

Economic Equations

$$B=\alpha\cdot y^{\beta}$$

$$C=\frac{\psi\cdot\gamma\cdot W}{2}L^2$$

Right-Wooden Jetty, LBI, NJ. Photo: Google Earth Pro

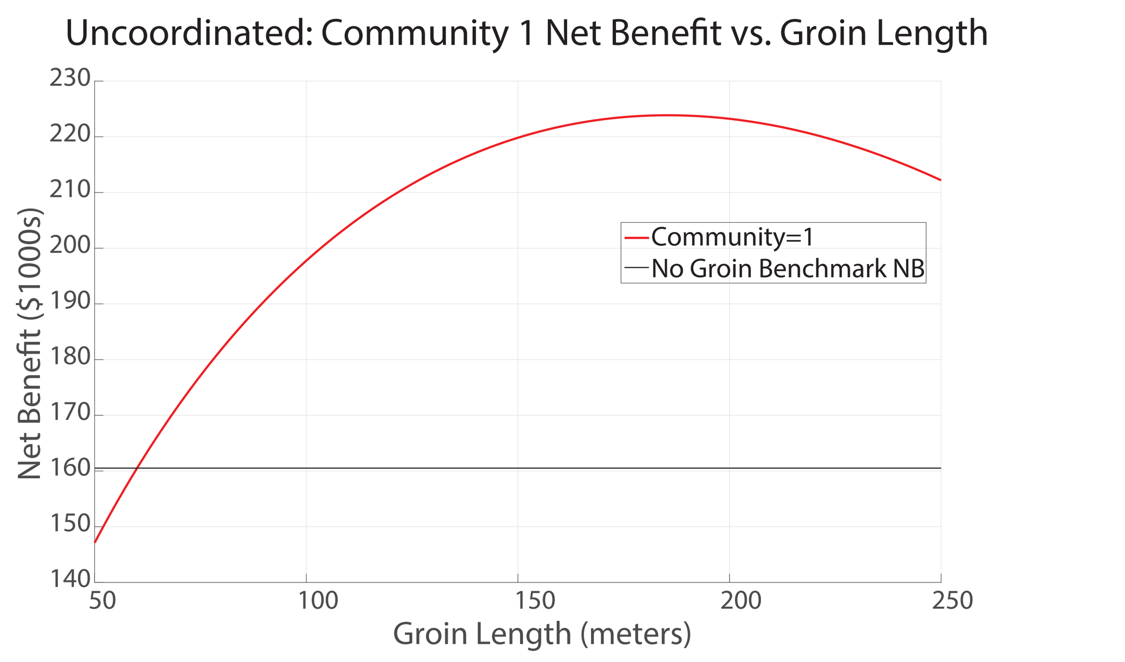


Figure 8. Community 1 net benefits plotted against Community 1 groin length vectors in non-coordination compared to benchmark net benefits for no groin (α1=1000, α2=100).

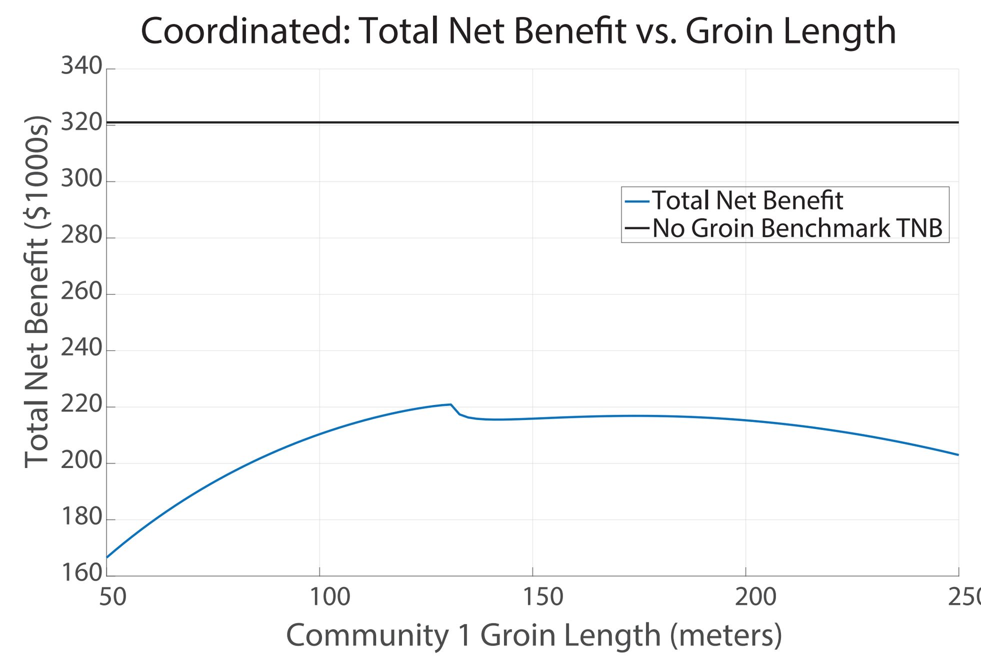
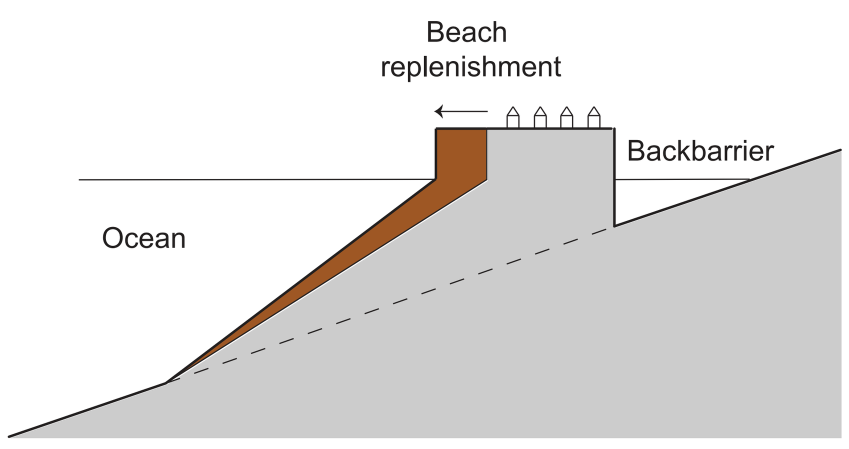
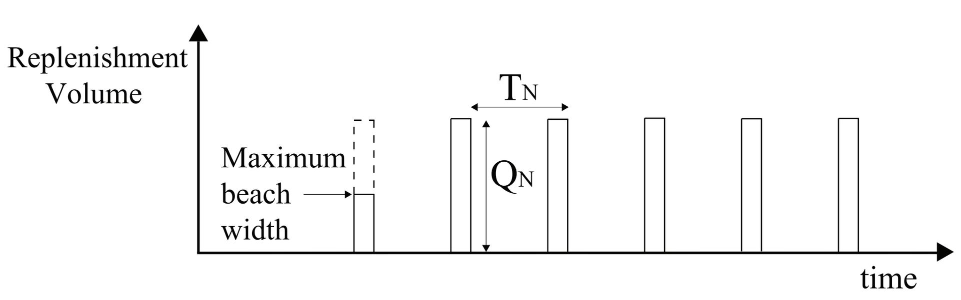


Figure 9. Total net benefits plotted against two communities in coordination compared to benchmark net benefits for no groin. (α1=1000, α2=100).

An integrated model of beach nourishment and cross-shore barrier evolution: beach replenishment or retreat?





Beach nourishment project, NJ 2007

$$\underset{T_N,Q_N}{Max}\int_0^{T_{max}} e^{-\delta t}(B(t)-C(t))dt$$

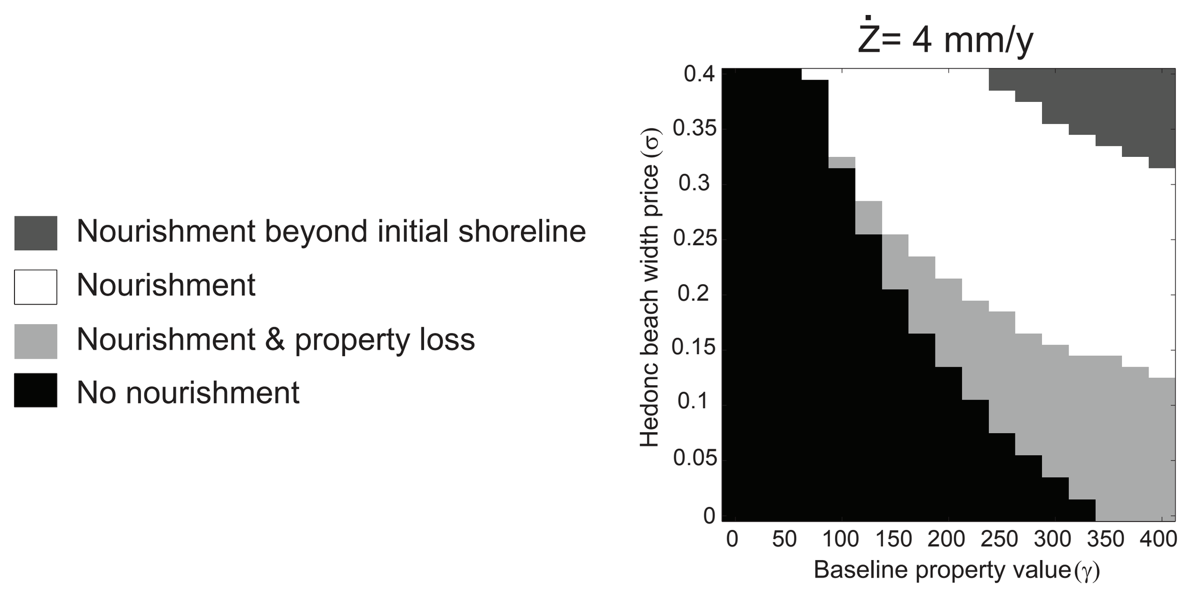
Subject to:

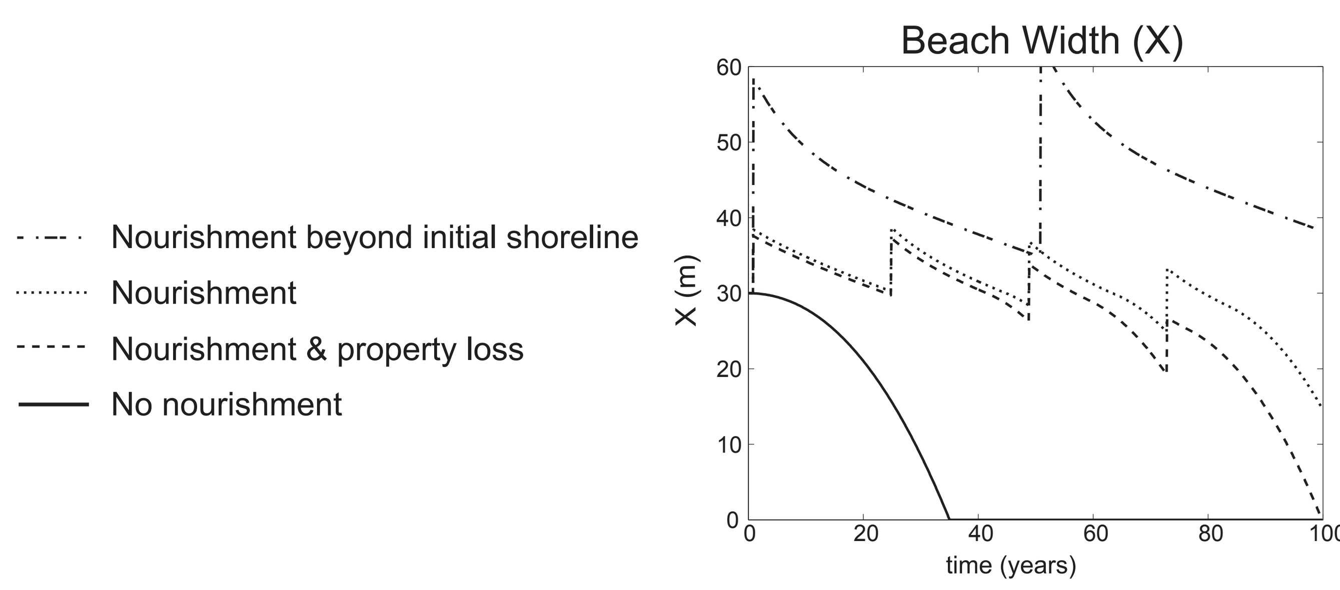
$$\frac{dH}{dt}=\frac{Q_{OW,H}}{W}-\dot{z}$$

$$\frac{dx_S}{dt}=\frac{2Q_{OW}}{2H+D_T}-4Q_{SF}\frac{H+D_T}{(2H+D_T)^2}-\frac{2v_n(t)}{2H+D_T}$$

$$\frac{dx_T}{dt}=\frac{4Q_{SF}}{D_T}\frac{H+D_T}{2H+D_T}+\frac{2\dot{z}}{\alpha}$$

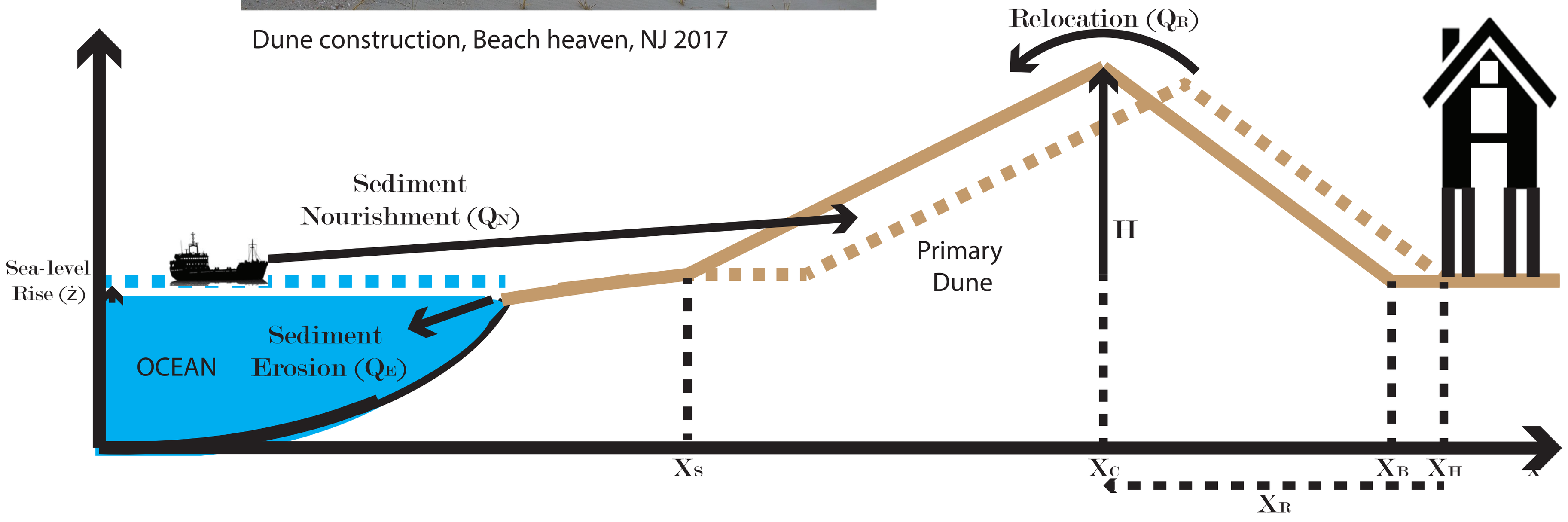
$$\frac{dx_B}{dt}=\frac{Q_{OW,B}}{H+D_B}$$





A coastal Geo-Economic Model for Artificial Dune Management in New Jersey

Dune construction, Beach heaven, NJ 2017



$$\underset{Q_N,Q_R}{Max}\int_0^{\infty} e^{-\delta t}(B(t)-C(t))dt$$

Subject to:

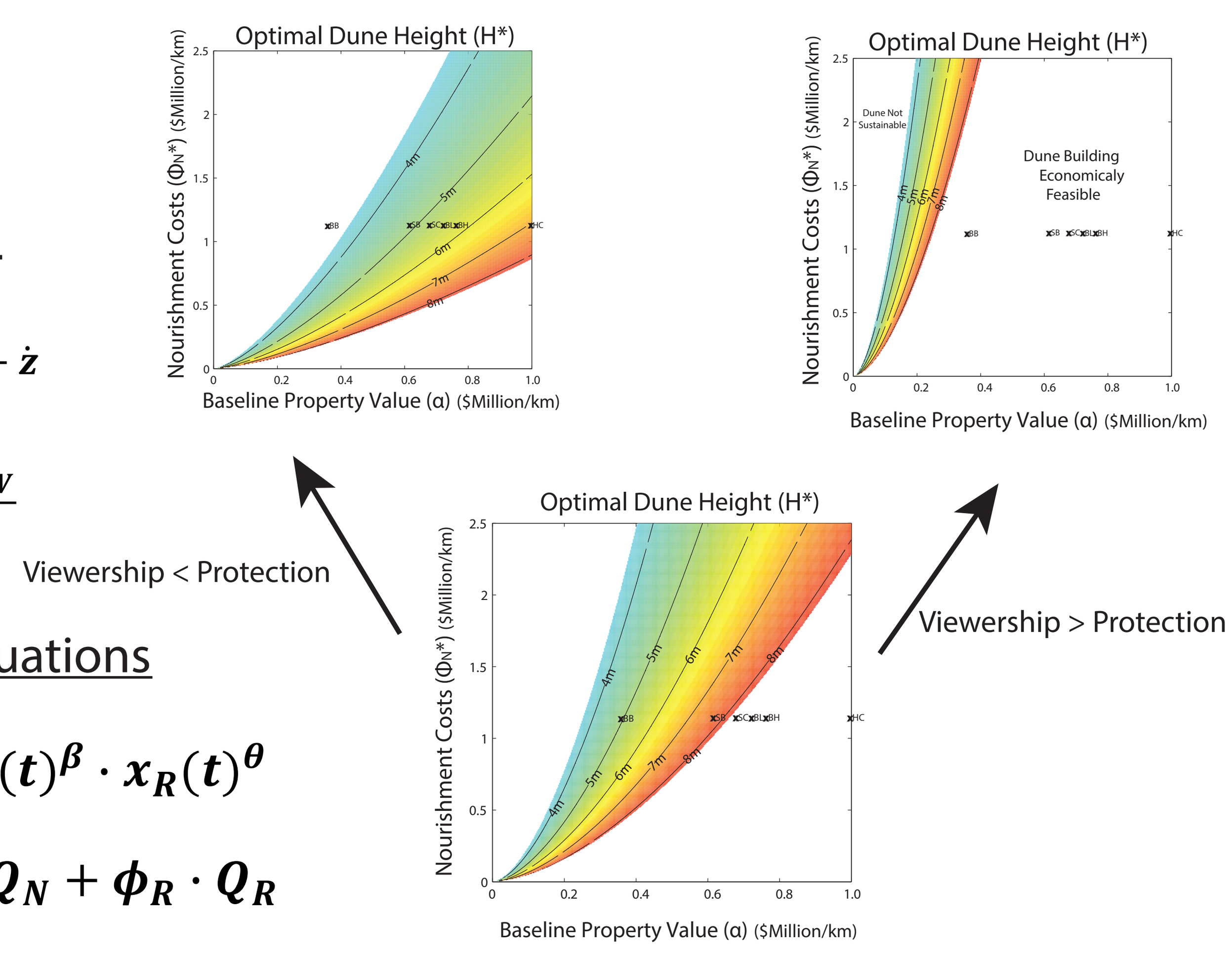
$$\frac{dH}{dt}=\frac{Q_N-Q_E}{p\cdot H}-\dot{z}$$

$$\frac{dX_R}{dt}=\frac{Q_R-Q_{OW}}{H}$$

Economic Equations

$$B(t)=\alpha\cdot H(t)^{\beta}\cdot x_R(t)^{\theta}$$

$$C(t)=\phi_N\cdot Q_N+\phi_R\cdot Q_R$$



REFERENCES:

Brad Murray, Dylan McNamara, Gopalakrishnan, S., Smith, M. D., Murray, A. B., etc.