Hurricane preparedness

The recent super-storm Sandy was an unprecedented tragedy for the north-eastern coastal areas of the USA. Sandy and Irene (which occurred a year earlier) were both "100-year storms" (i.e., based on historical data, a storm of that strength has less than 1% probability of occurring on a given year). Both resulted in "100-year-floods" in New York City. Both have caused numerous casualties and damage in the billions of dollars.

To protect the city of New York from floods, a group of scientists and engineers has recommended erecting several gigantic "sea gates" -- movable barriers that would be closed during hurricanes, preventing the storm surges from entering Hudson and East rivers. Such measures are quite expensive – the current rough estimates put construction costs at 10 billion dollars.

To be realistic/conservative, you will assume a 20 billion construction cost + 500 million per year in additional costs (e.g., maintenance, security, impact on industry/trade/ecology) once they are built.

a) Suppose Sandy never happened and that storms like Irene occur with probability P1=0.01 per year. Are the barriers economically justifiable?

b) Many researchers have found that climate change and rising sea levels will dramatically increase the probability of such events in the future, making such costly flood-prevention measures more attractive. Find the lowest value of P1 that would justify erecting the sea gates to protect NYC.

c) Suppose that Irene-strength storms happen with the annual probability of P1 while the corresponding annual probability of Sandy-strength storms is P2.
Find all "lowest" (P1,P2) pairs that justify the sea gates.

d) The high cost is not the only disadvantage of the sea gates. While protecting Manhattan and parts of other boroughs , they will likely also increase the flooding in several unprotected areas of Brooklyn, Queens and New Jersey. Develop a model for the future changes in real estate prices and/or population density in Breezy Point (Queens) and Manhattan Beach (Brooklyn) in the next 50/100 years. Your model should make predictions for two different scenarios (i.e., with and without sea gates).

e) A preliminary version of your report somehow found its way to a journalist, who rushed to publicize the simulation results, alarming the general population & frustrating the engineers/scientists/authorities. Write a non-technical, half-page-long open "Letter to the Editor" to explain the limitations of your model's applicability.

A few words of advice from the contest organizers:

- Always start with simpler models and then include additional features (and/or more realistic data) later – only if you have enough time.
- Much of the data you might need for your model can be easily found on the web.
- If the full problem is too long for your team, you can choose between solving subproblems (c) and (d).

Several useful links (to save you some initial googling time):

http://stormy.msrc.sunysb.edu/Telegraph11-5.pdf

http://www.nytimes.com/2012/09/11/nyregion/new-york-faces-rising-seas-and-slow-city-action.html

http://stormy.msrc.sunysb.edu/MESC/MESC%20distribution%20copy%2002-15-07.pdf

http://www.nytimes.com/2012/11/04/opinion/sunday/deciding-where-future-disasters-will-strike.html

http://sealevel.climatecentral.org/surgingseas/place/cities/NY/New_York

http://www.trulia.com/home_prices/New_York/Brooklyn-heat_map/

http://ajrae.staff.shef.ac.uk/img/nyc_popdens_2010.png