Creating storylines of hurricane Sandy

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Hurricane Sandy

- Second-costliest hurricane in U.S.

- Worst natural hazard to occur in NYC;
  - Not a lot of precipitation;
  - Extremely high storm surge.

- Conditioned adaptation plans for NYC.

- *How would Sandy affect NYC under different conditions (such as climate change)*?
Creating storylines of Sandy

1. Set of scenarios;

Set of scenarios

Climate scenarios

Sea level rise (SLR) scenarios

Maximised precipitation (MP) scenarios
Climate scenarios

- Spectrally nudging technique:
  - Forces large scale atmosphere to reanalysis;
  - Changes boundary conditions to global warming levels;
  - 3 global warming levels: pre-industrial, present day and +2C;
  - 3 members in each global warming level for climate variability.
Sea level rise scenarios

- IPCC multi-model projections:
  - +2C warmer world;
  - Different time periods (uncertainty in core processes of ice mass loss):
    - 2100 – 0.71m;
    - 2150 – 1.01m.
Maximised precipitation (MP) scenario

- TCs have spatial variability due to stochastic processes;

- Plausability: The landfall location could be slightly different;

- Move the highest precipitation part of the storm during landfall to NYC;

- Exploration of internal variability.
Modelling framework

Alternative Sandy realisations

Climate scenarios

MSLP & wind speed

Tide and surge modelling

Water level

Tide and surge modelling

SLR scenarios

MP scenario

Precipitation

Compound flood modelling

Flood maps

CI exposure
Results
Spectrally nudged storms

• Synthetic runs show **spatial variability**;

• GW **increases** precipitation at peak values;

• No changes in **NYC** between GW levels.
Coastal flooding

- Coastal flood is **compound**

![Compound and univariate flood volumes](image)

- Variability in intensity;
- Variability in hazards leading to different impacts.
Sea level rise scenarios

- Sea level rises consistently increase the flooding volume;
- Most of added flooded is on the coast.
Maximum precipitation scenarios

- More flooding due to precipitation location;
- Widespread flooding, including inland, but flooding level is lower.
Critical infrastructure exposure

- MP leads to the highest increase in exposed assets;
- SLR leads to highest increase in assets exposed to high water levels;
- CI systems differ greatly, and decision making should account for that.
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Take home messages

- **Societal-relevant scenarios**: set of alternative (and plausible) scenarios offering insights into alternative impacts of historical events;

- **Modelling framework**: providing direct and accessible information for decision makers.

Storylines can be a valuable tool for future risk assessment and decision making.