



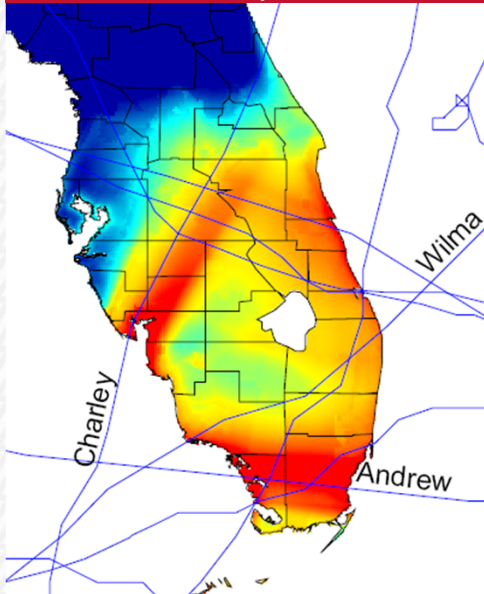
# 'LOSS & DAMAGE' PROBABILISTIC RISK MODELLING FOR CLIMATE CHANGE



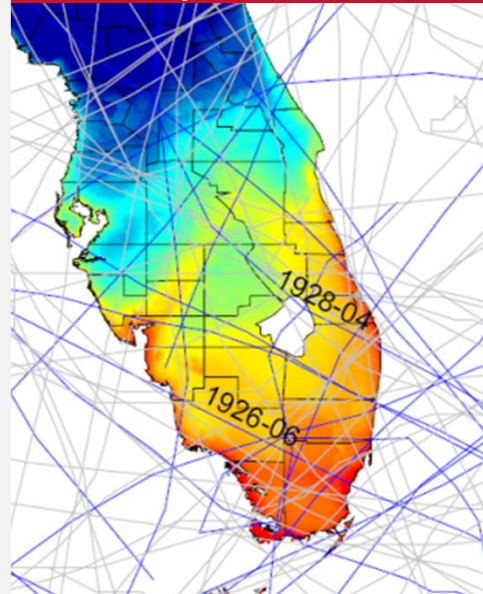
UFOORISK

# WHY WE NEED SYNTHETIC CATASTROPHE CATALOGUES

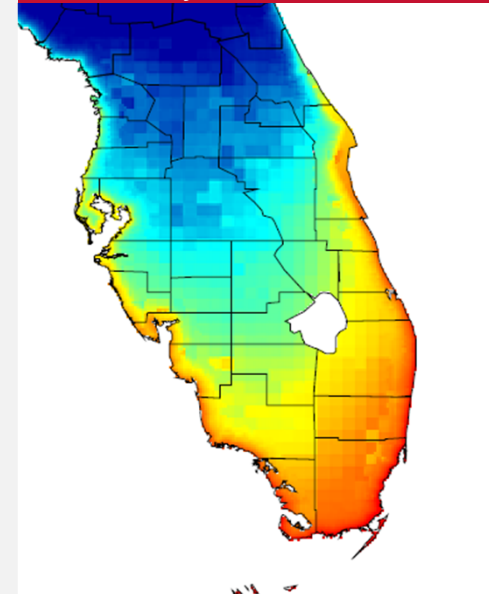
Recent experience



100 years of data



100,000 years of model



# MODELLING CLIMATE CHANGE IMPACTS: THE 2014 'RISKY BUSINESS' PROJECT

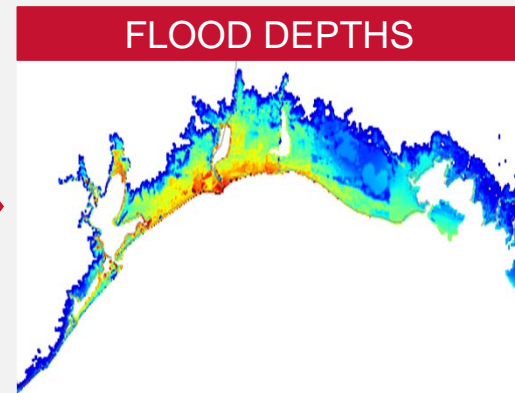
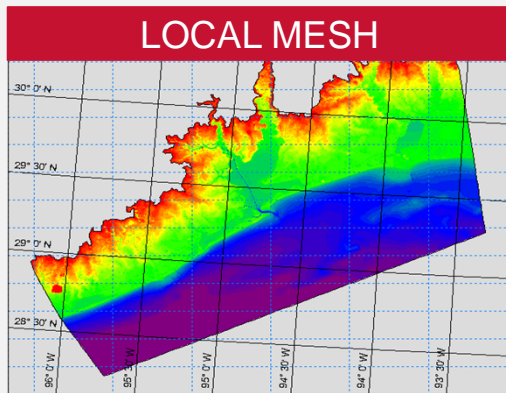
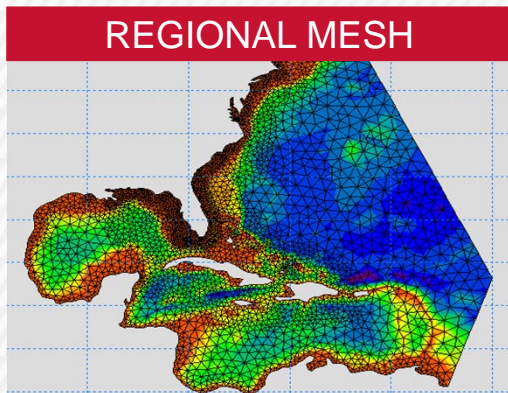
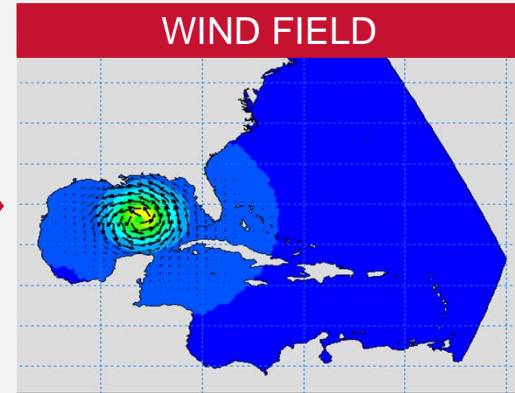
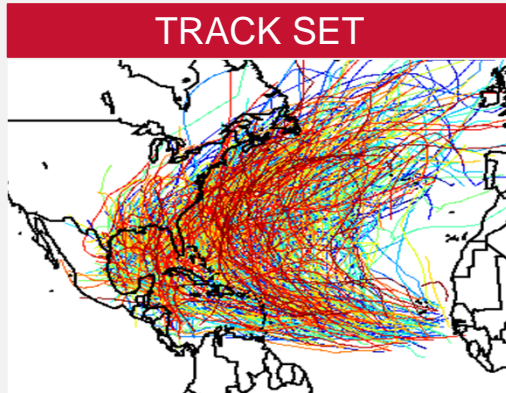
## Baseline Models'

- Use of pre-existing '100,000 year' synthetic hurricane catalogue.
- Full hydrodynamic representation of storm surges for each windfield and track
- Detailed high resolution exposure and building inventory data
- Building and business interruption vulnerabilities for wind and flood

## Climate Change Impacts

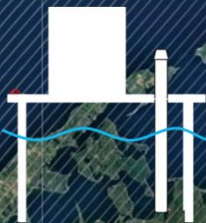
- Distributions of expected sea levels through to 2100
- Localized information to account for land level changes etc
- Multiple climate model outputs of expected changes in hurricane activity by Cat
- Explored altered regionalization of tracks

# SURGE MODELING: NESTED MESH FRAMEWORK

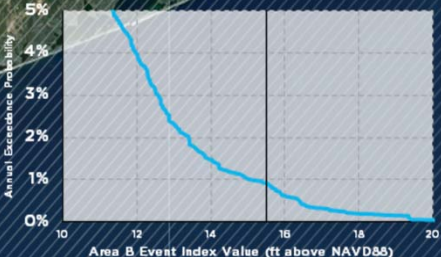




# MetroCAT Re



TIDAL GAUGE



EP CURVE

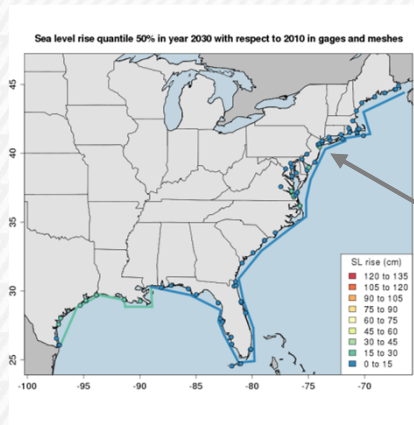
# 1.7%

ATTACHMENT  
PROBABILITY

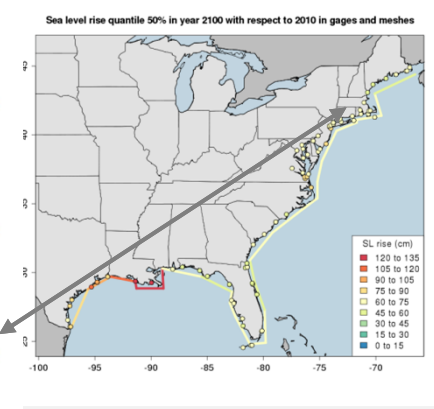
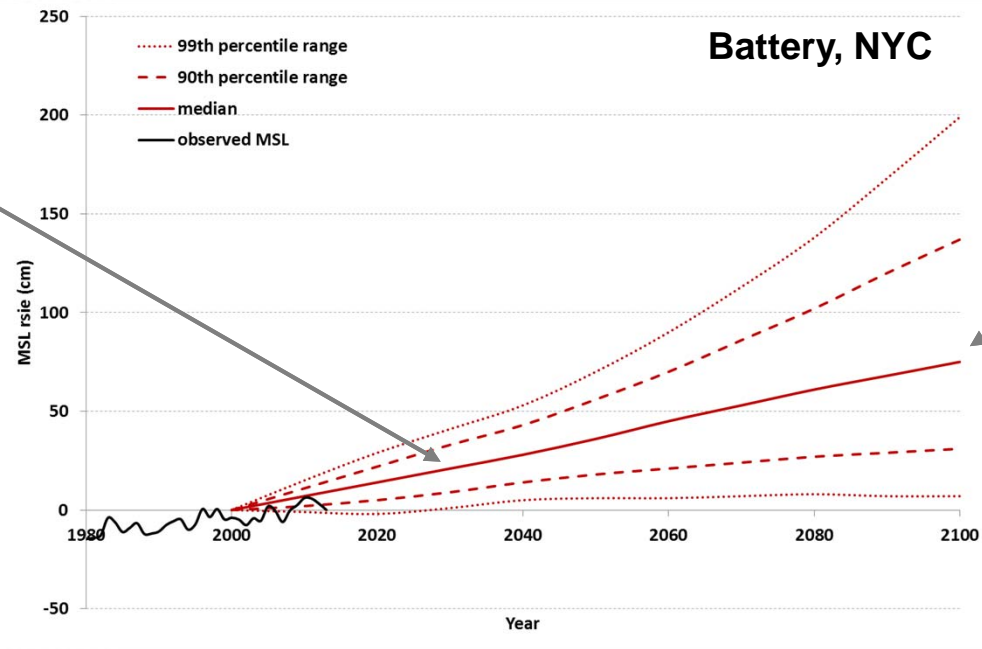
# \$200 M @ 450bps

East Creek  
Kings Point  
The Battery  
Rockaway Inlet  
Sandy Hook

# SEA LEVEL RISE: SURGE HAZARD ADJUSTMENTS BY REGION



**2030**

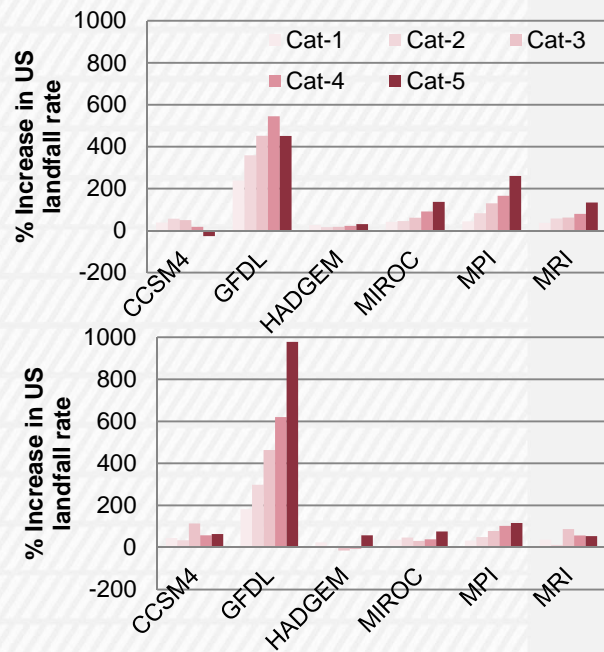


**2100**

**Distribution of SLR is sampled for each region of the US**

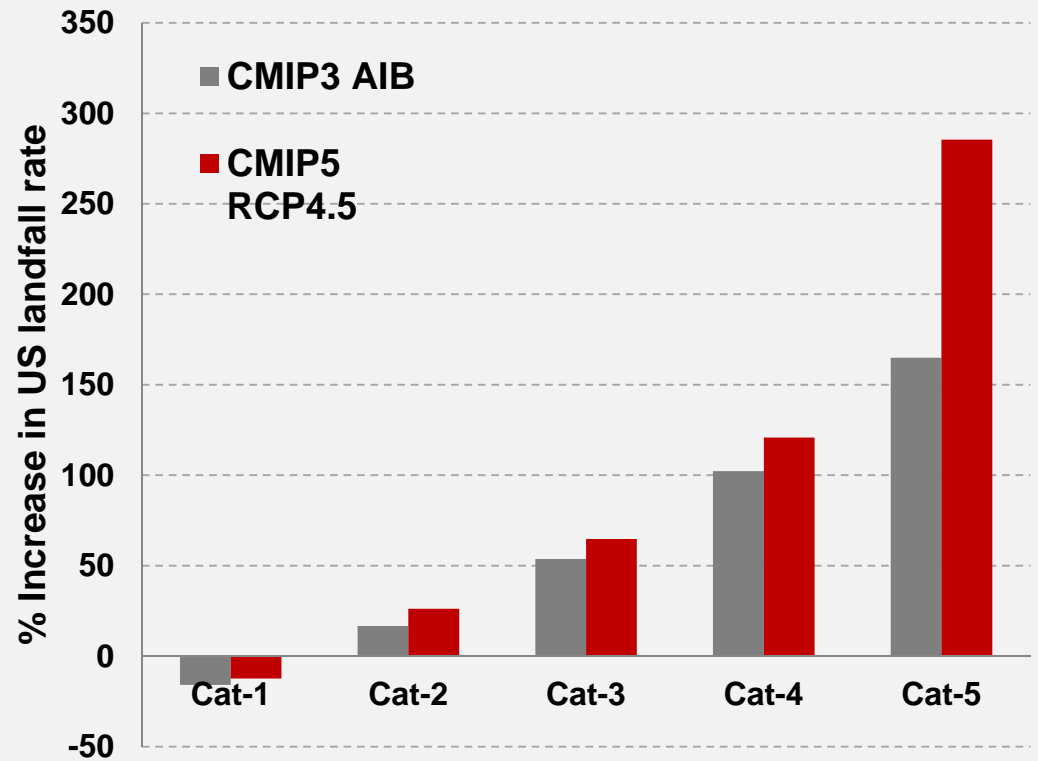
# HURRICANE ACTIVITY RATES

single-model end-of-century changes (RCP8.5)



Top panel, changes applied to basin activity  
 Bottom panel, changes applied to landfall activity

## multi-model ensemble end-of-century changes



Multi-model ensembles produce 'expected' changes  
 Individual models show significant variation



2100

**50<sup>TH</sup> CENTILE SEA LEVELS  
HISTORIC AND RCP4.5  
HURRICANE  
ACTIVITIES**

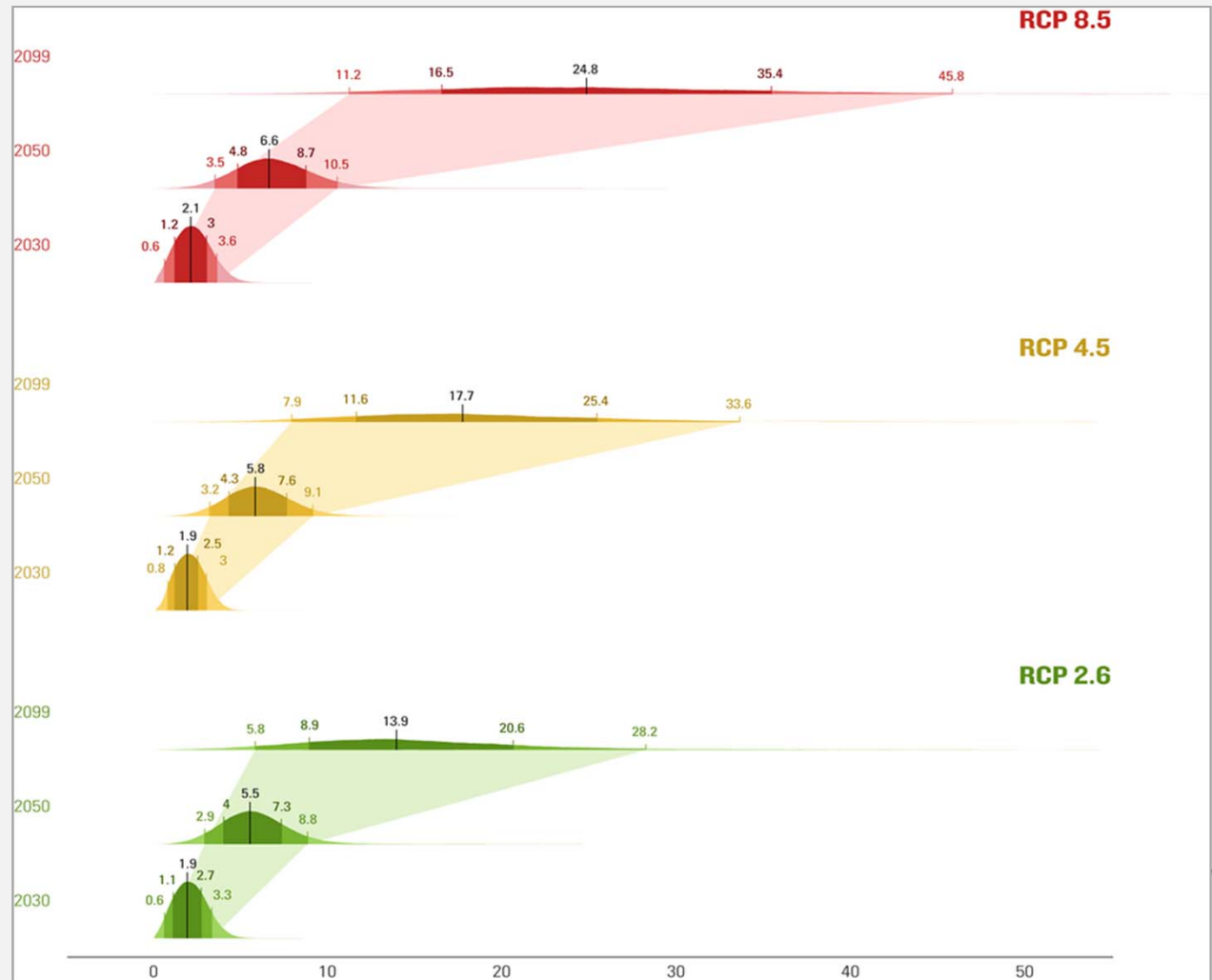
<b>Activities</b>	<b>Historic</b>	<b>Historic</b>	<b>Historic</b>	<b>RCP4.5</b>	<b>RCP4.5</b>	<b>RCP4.5</b>
<b>Increase in Risk Costs</b>	<b>Total</b>	<b>Wind</b>	<b>Surge</b>	<b>Total</b>	<b>Wind</b>	<b>Surge</b>
<b>Miami</b>	51%	0%	224%	262%	163%	599%
<b>Manhattan</b>	80%	0%	253%	186%	60%	457%
<b>Harris Co TX</b>	8%	0%	137%	132%	118%	358%
<b>Norfolk VA</b>	134%	0%	266%	247%	55%	436%



# CHAPTER 4: COASTAL COMMUNITIES

Increase in expected annual property losses as a result of SLR, assuming no change in hurricane activity (Billion 2011 USD)

**Current baseline is ~24bn (15bn wind only)**

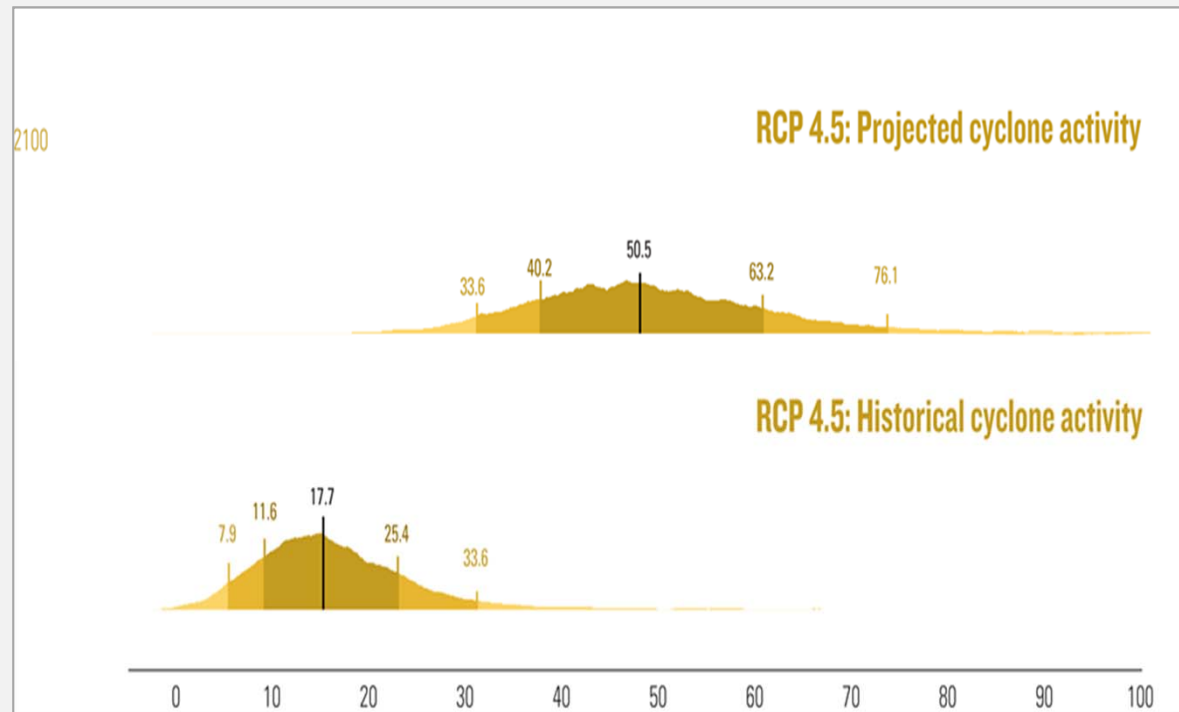


## INCREASE IN HURRICANE RISK COSTS

Increase in expected annual national property losses: 1) for historical activity rates and 2) if hurricane activity changes (Billion 2011 USD)

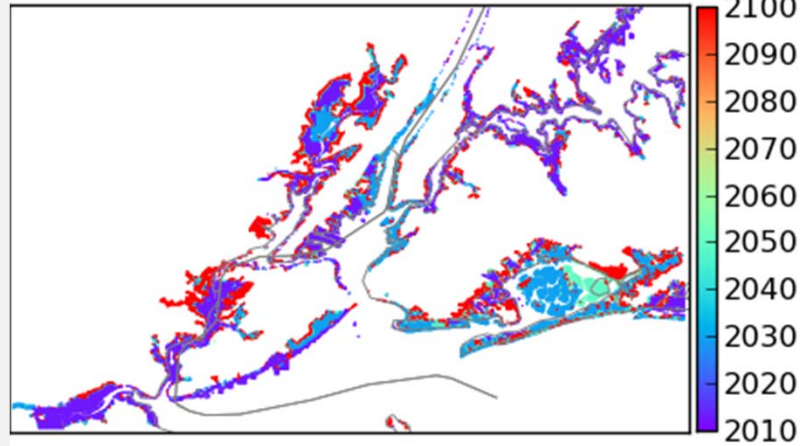
RCP 4.5 projections from Knutson et al. (2013)

**Current baseline is ~24bn (15bn wind only)**

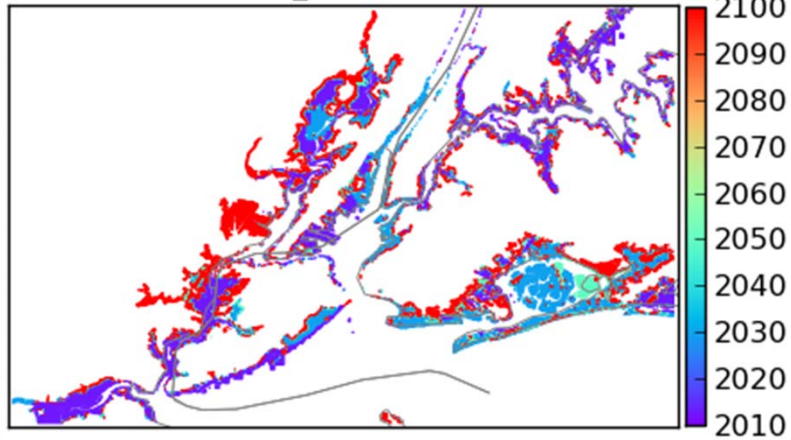


# DATE OF ADVANCE OF 100 YR RP FLOOD ZONE

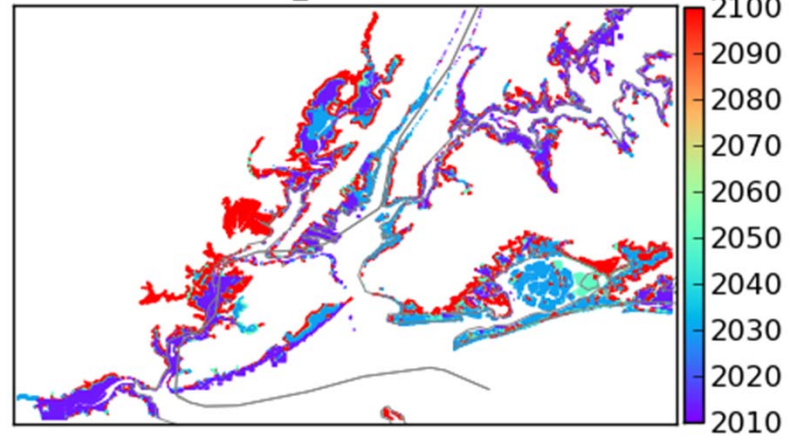
Historical rates



CMIP5\_RCP4.5 rates



CMIP5\_RCP8.5 rates



# THE 'LOSS AND DAMAGE' RISK MODELLING AGENDA

## Baseline Risk

- Evaluation of baseline climate hazards
- Modeled for current exposures
- Evaluation of key risk metrics including AAL, and Loss EPs.

## Climate Change Risks

- Distributions for future sea level
- Distributions for potential future activities
- Evaluation of key risk metrics
- Attribution question around recent catastrophes

## Range of Metrics

- Monetary loss,
- Land,
- Casualties,
- Agriculture,
- Poverty
- Adaptation decision-making and cost benefits