
2019
AIR European
Seminars
London

Updates to Modelling Floods in Europe

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AIR

Agenda

Introduction

AIR's Inland Flood Model for Central Europe

- Updates to the Hazard Component
- Updates to the Vulnerability Component
- Modelled Losses

The Addition of Great Britain Storm Surge to AIR's Extratropical Cyclone Model for Europe

- Updates to the Hazard Component
- Hazard Model Validation
- Modelled Losses
- Upcoming Software Changes

Introduction

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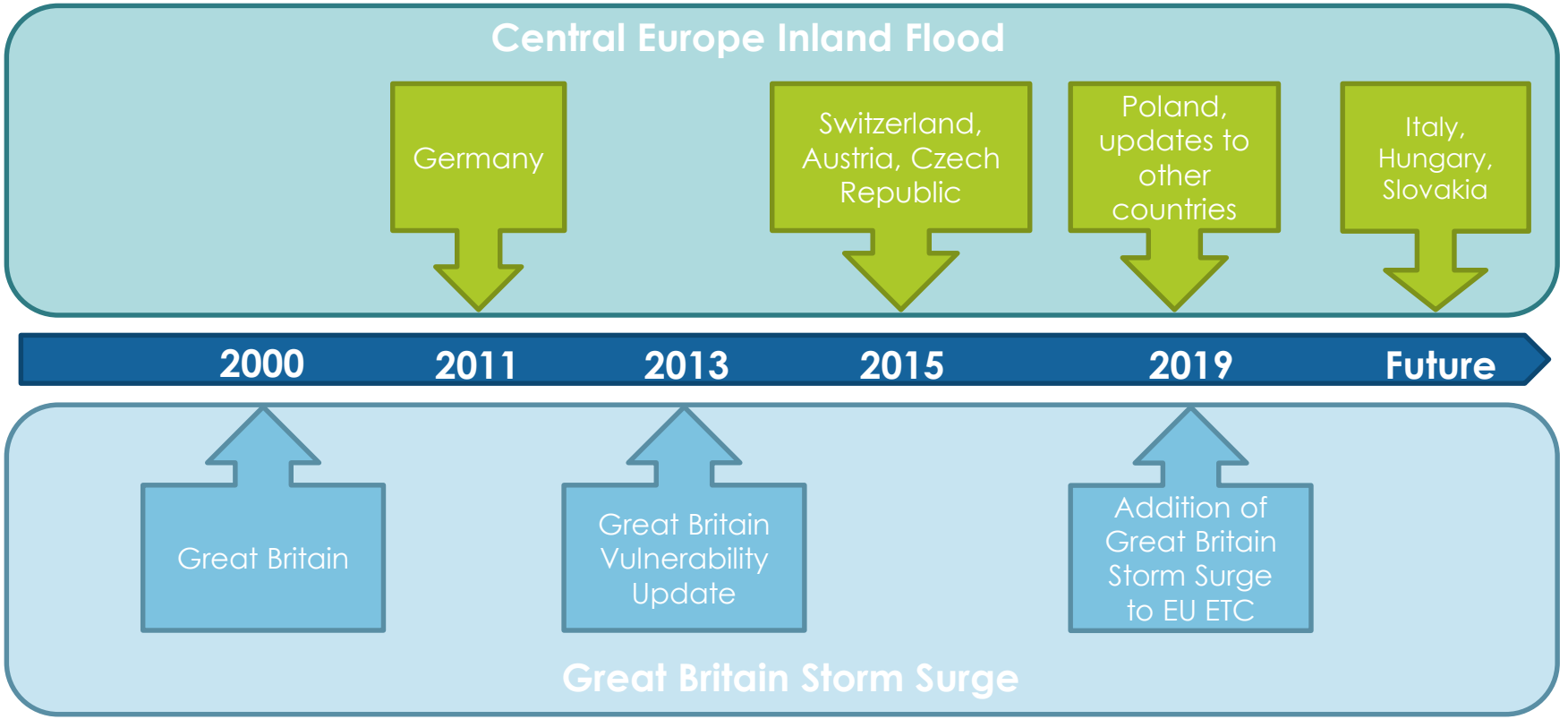
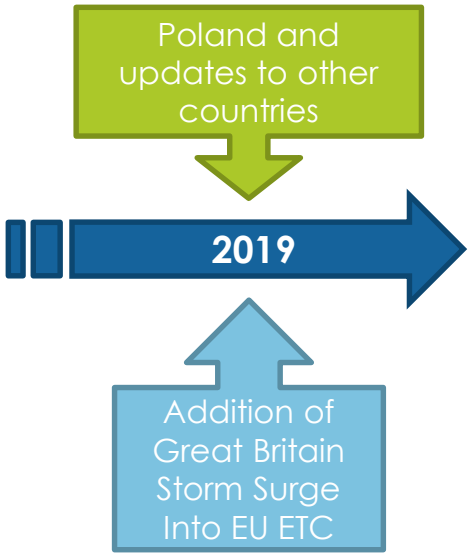
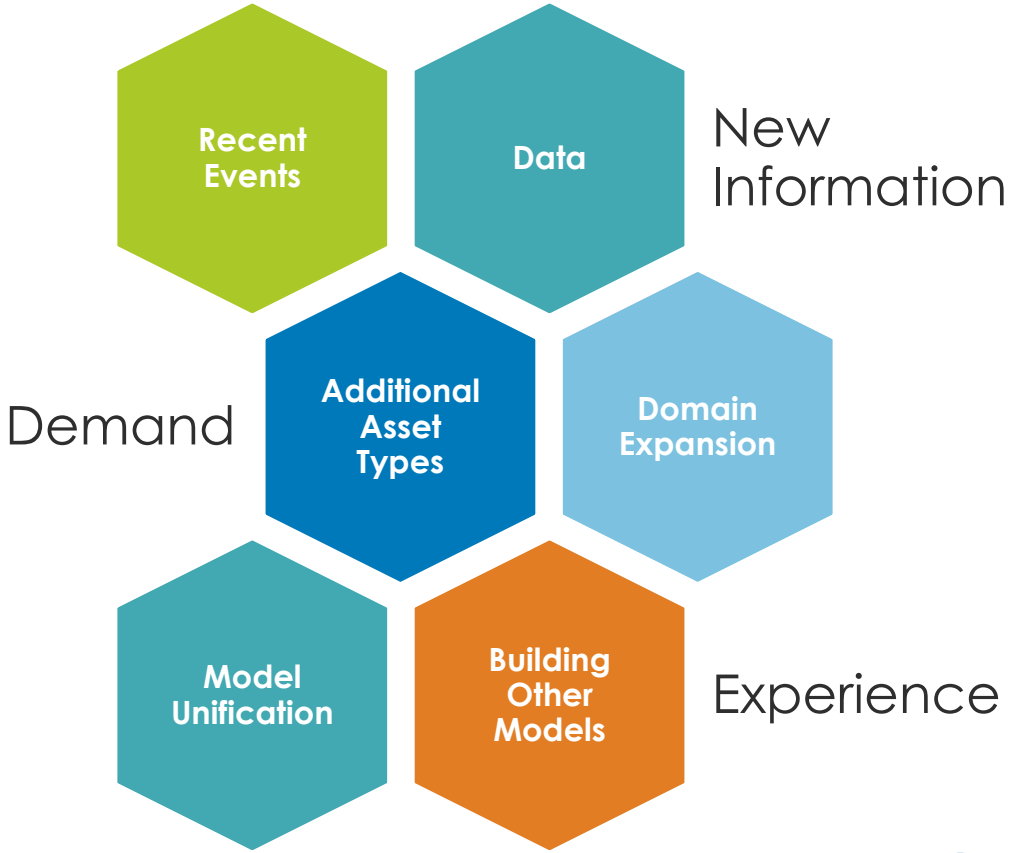
Milestones in Model Development

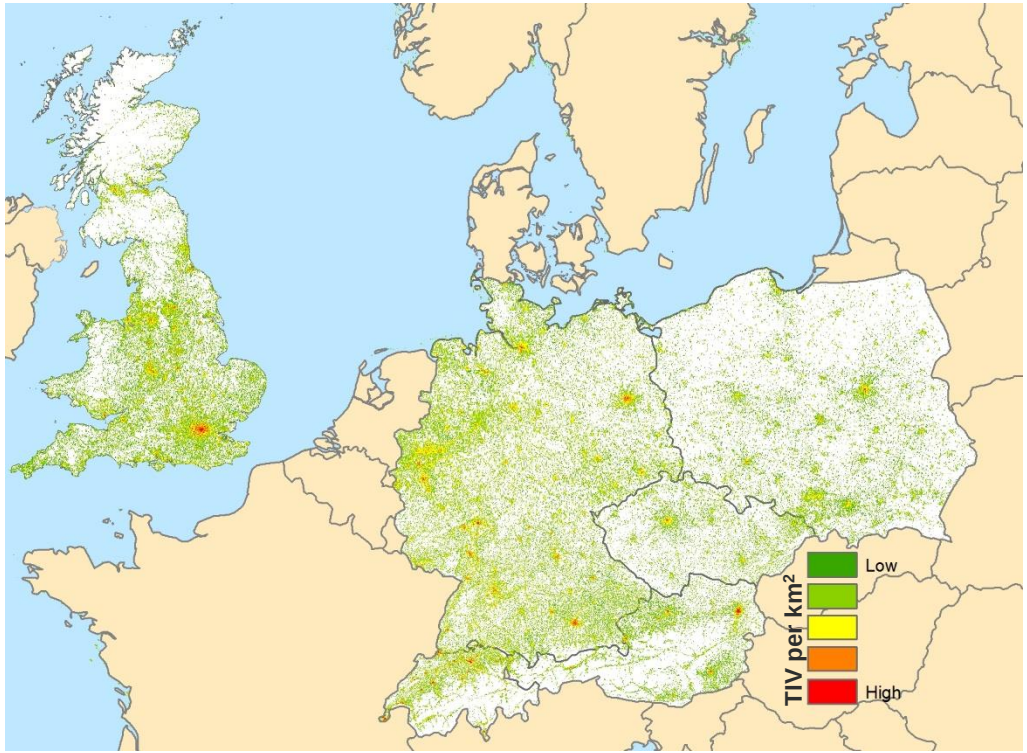


What Is Driving the Updates?





New Industry Exposures Modelled at 90-Metre Resolution



- Utilised best available building footprint data sets to accurately locate risks
- Updated construction splits, replacement costs, coverage splits, and policy conditions
- Improved automobile valuation methodology
- Identified high-value industrial facilities

Vulnerability Updates Leverage a Unified Framework Across Models in Europe

- Addition of marine cargo, marine hull, industrial facilities, wind turbine, and builder's risk
- Incorporation of unknown damage functions at CRESTA level
- Updated secondary damage distributions

Support for New Secondary Risk Characteristics

Custom Flood Protection

Presence of Basement

Floor of Interest

First-Floor Height

Custom Elevation

Inland Flood Model for Central Europe

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Poland Is Now Included In the Model

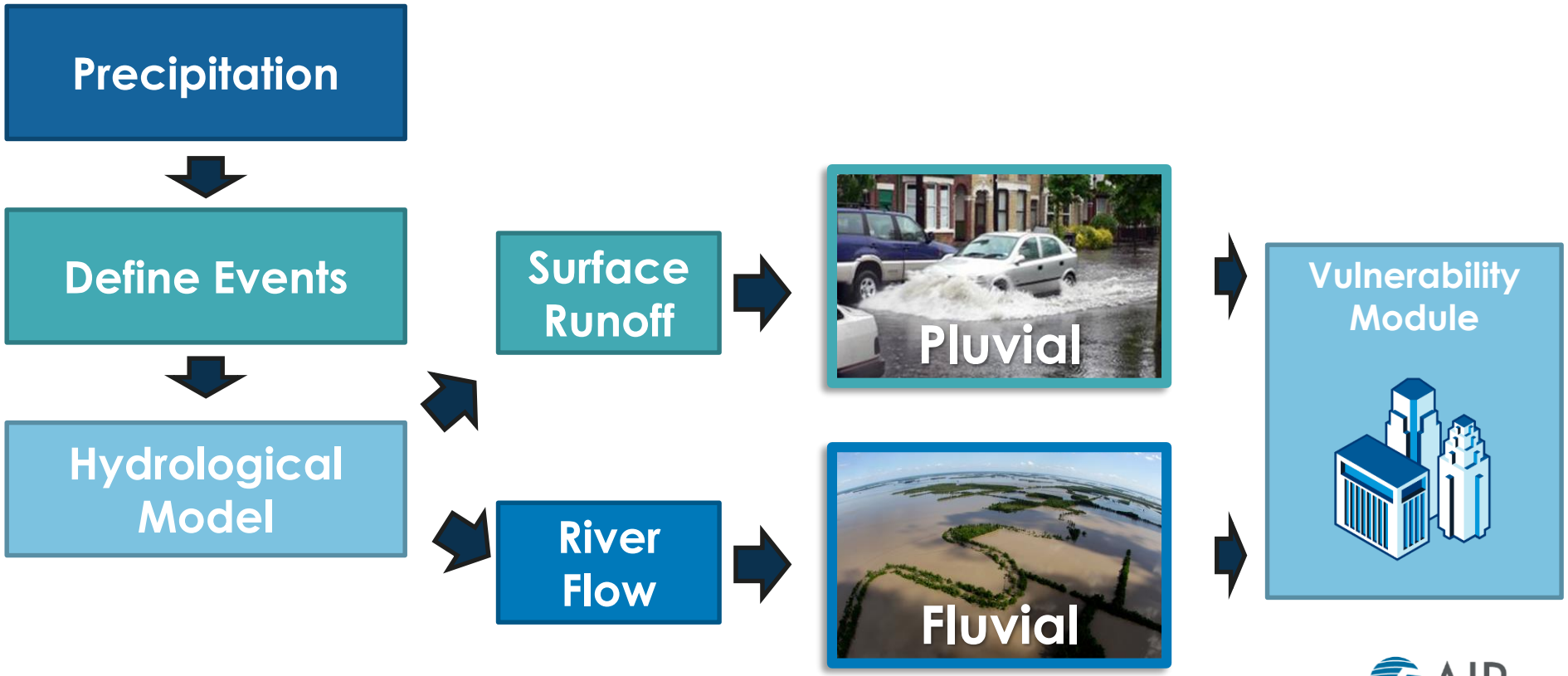
Addition of:

- Two major river basins: Oder and Vistula
- 14,470 catchments
- More than 86,873 km of river network
- More than 110,649 river cross sections at intervals of roughly 500 metres

The Number of Marquee Historical Events Has Increased

Event Year	Existing Events
2002	Austria, Czech Republic, Germany
2005	Austria, Switzerland
2007	Switzerland

The Precipitation Simulation Initiates the AIR Flood Model



Updates to the Hazard Component

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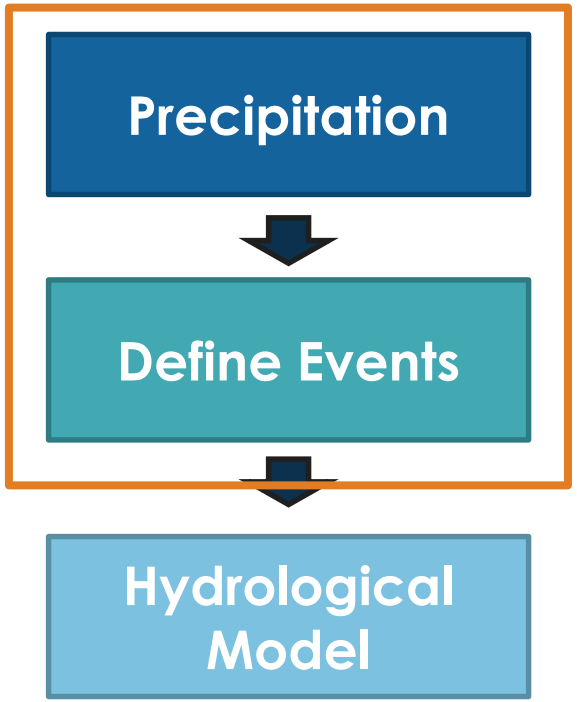
AIR Has Enhanced the Precipitation Catalogue

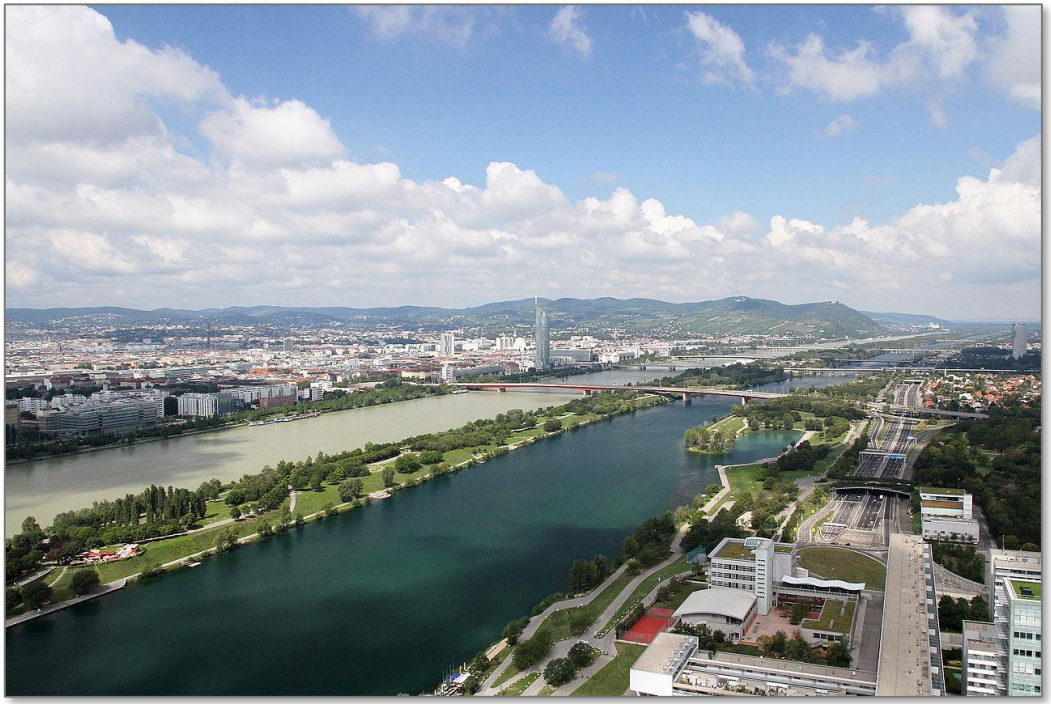


- Precipitation downscaling upgraded for better consistency across country boundaries leads to more realistic footprints for extreme events
- Addition of Poland resulted in redefining of events

Hazard Is Updated to Reflect Fluvial and Pluvial

- Germany hazard was re-evaluated based on new information
- Improved pluvial hazard consistencies across political boundaries
- Updated levee information

Latest Data Updates Standard of Protection (SoP)



Source: Wikipedia

Data Sources

- National and State-Level Flood Authorities
- Municipal Flood Protection Authorities
- CORINE Land Cover

Updates to the Vulnerability Component

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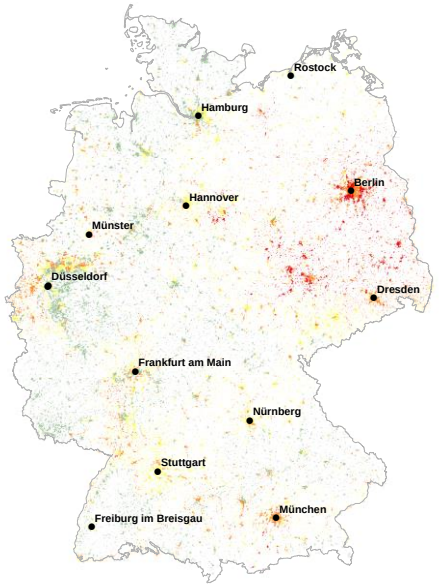
The Updated Pluvial Module Uses a Statistical Model

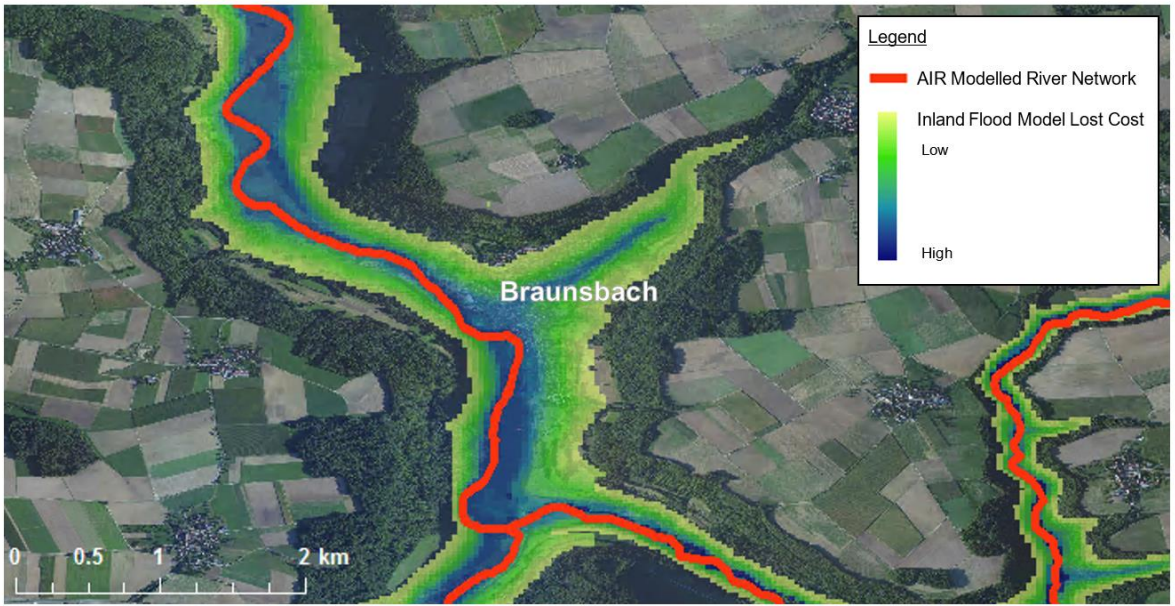
- Design relative runoff and urban land use are used to estimate pluvial drainage in urban areas



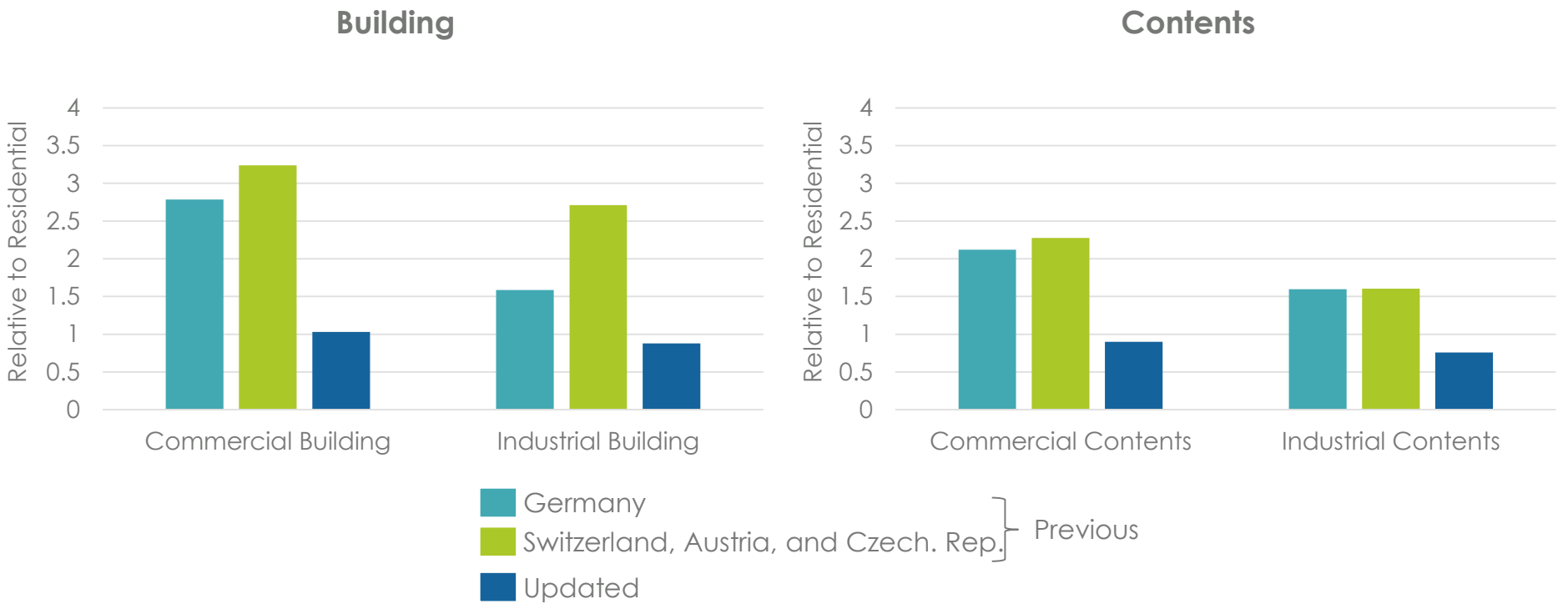
Drainage Capacity

Low

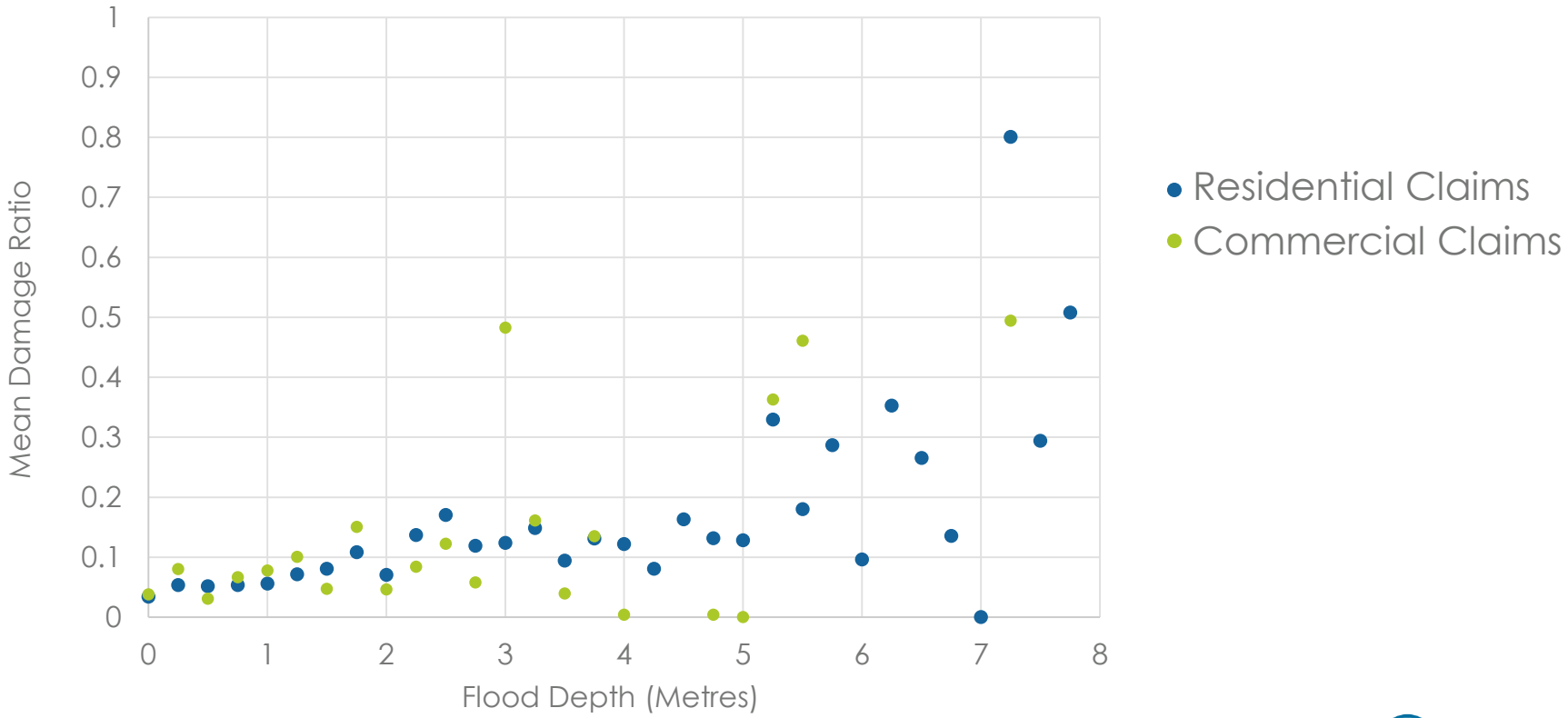
High



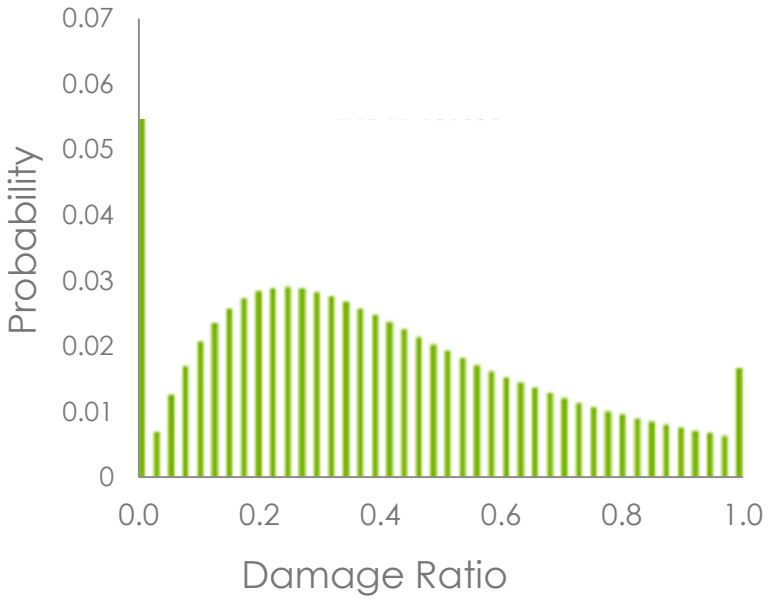
Unified and Updated Relative Vulnerabilities

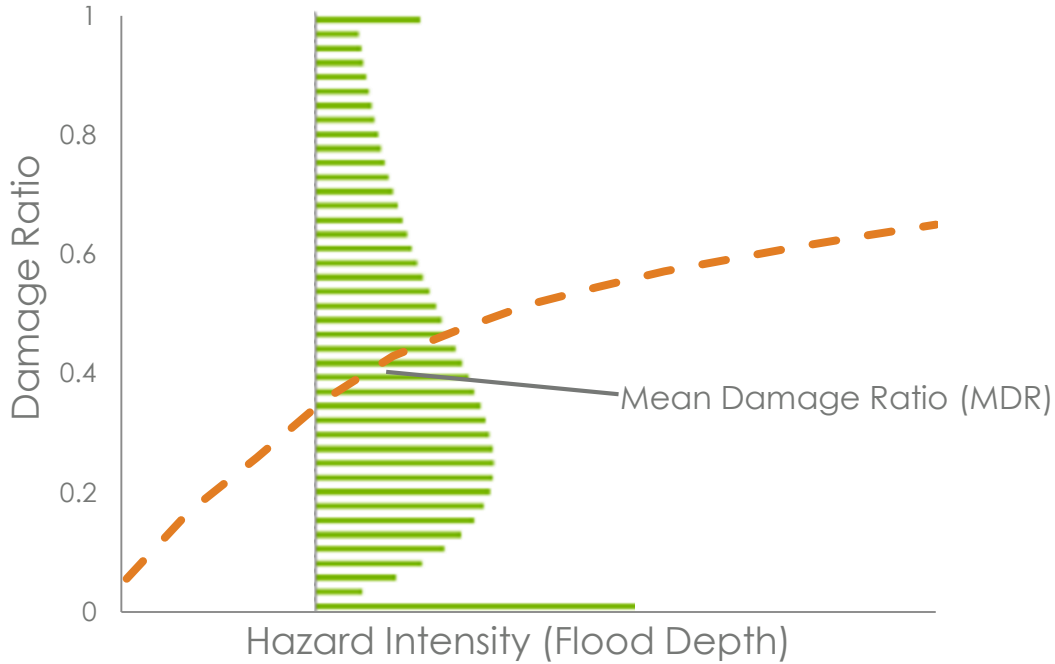


Residential and Commercial Damage Functions from Claims Data



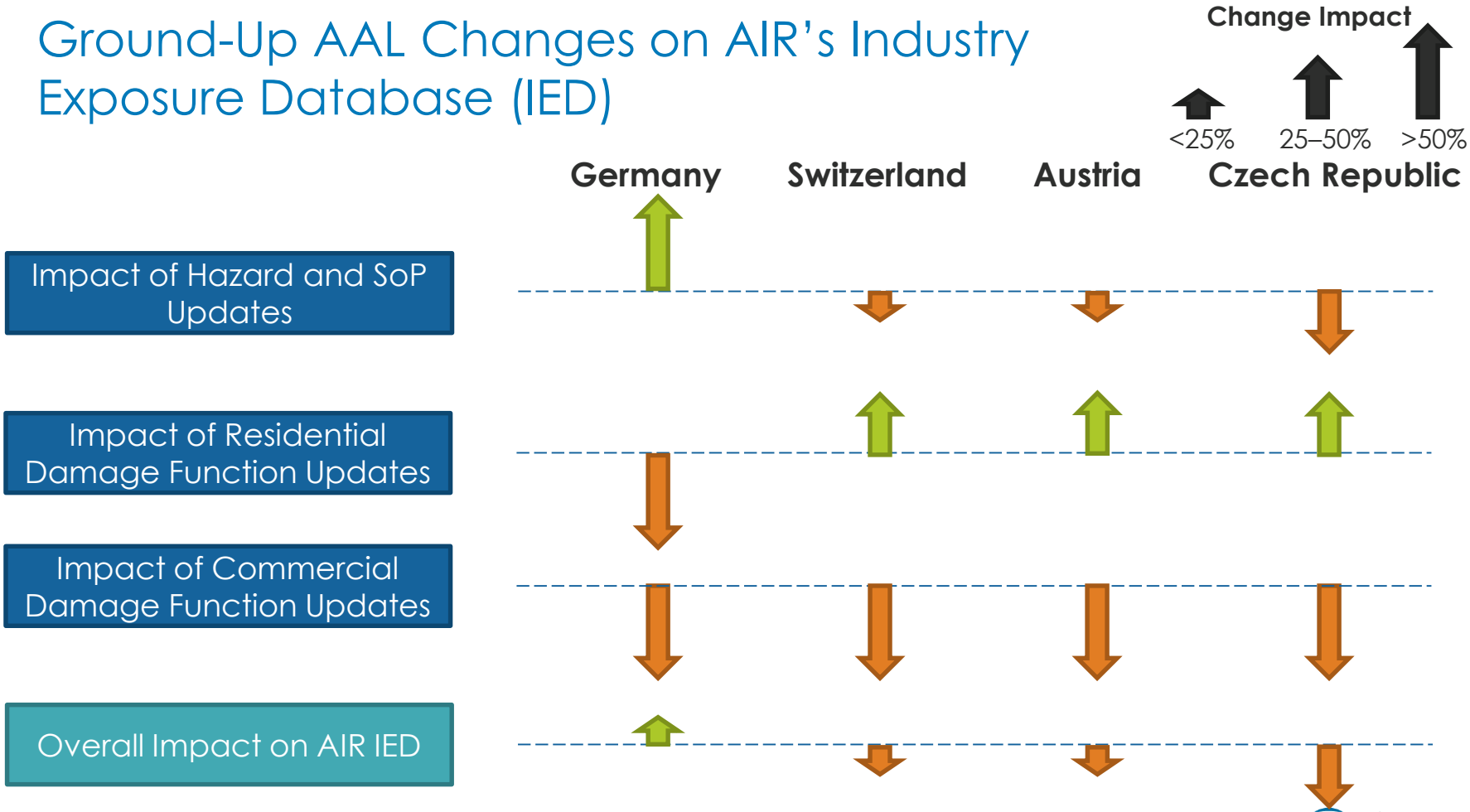
Updated Secondary Damage Distributions



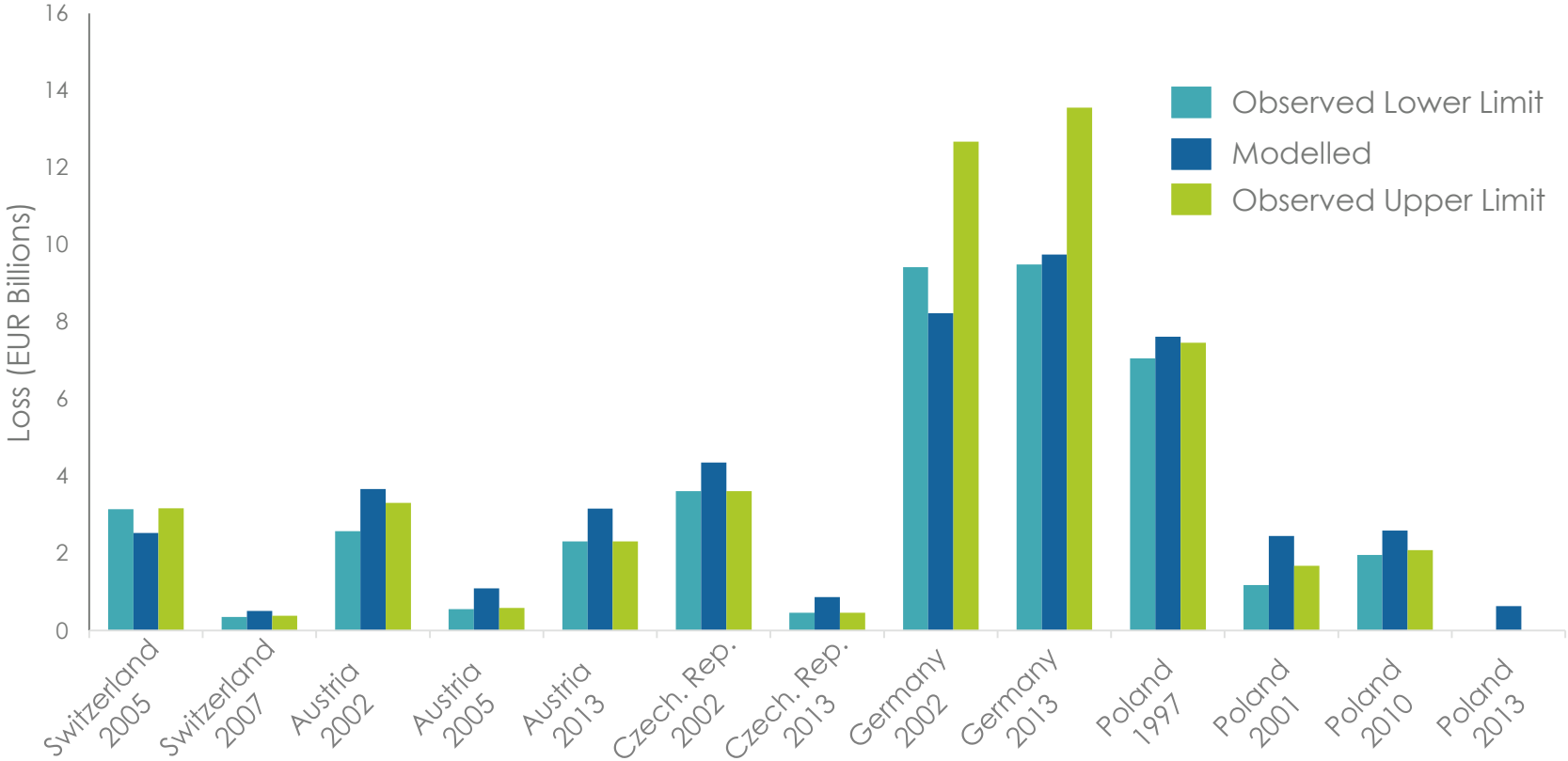


Modelled Losses

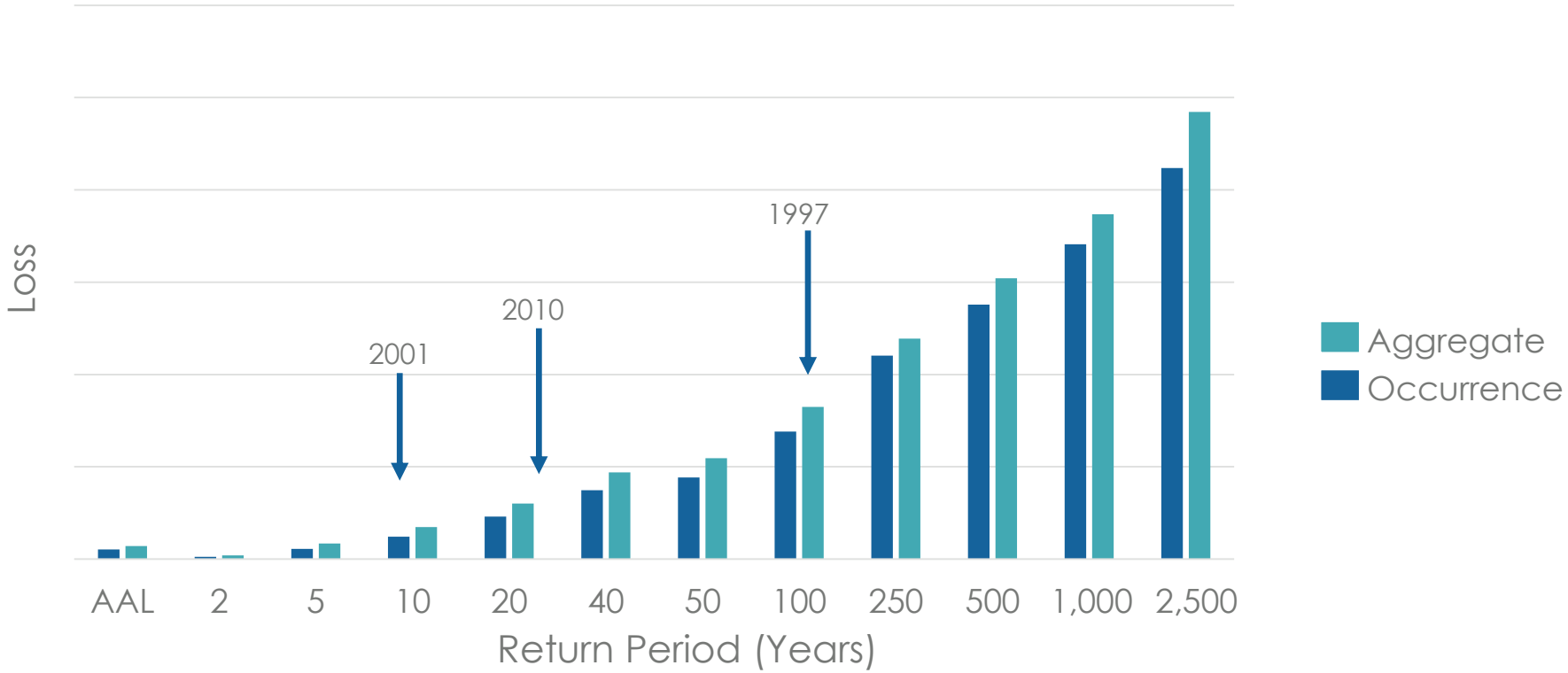
Ground-Up AAL Changes on AIR's Industry Exposure Database (IED)



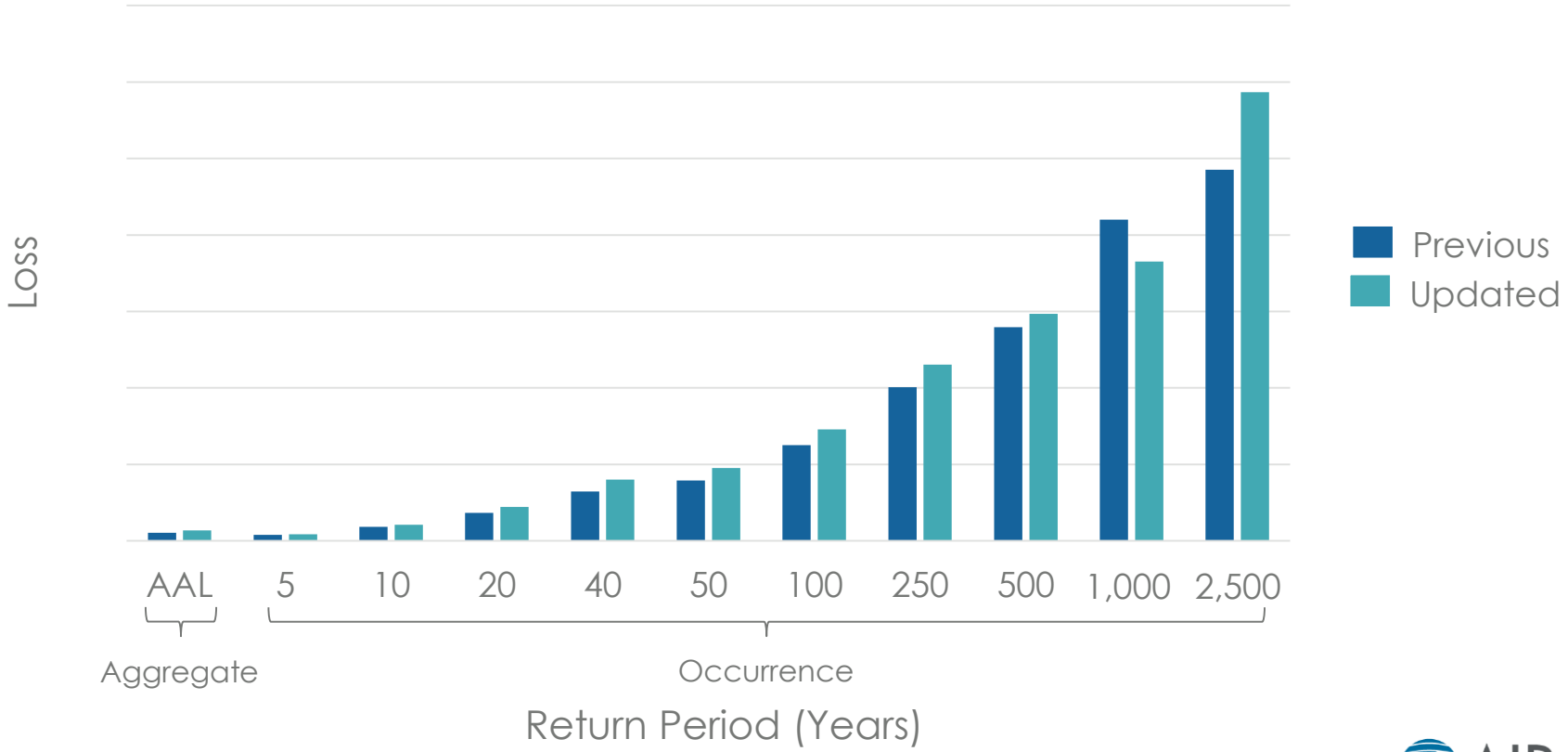
Historical Event Ground-Up Total Loss Validation



Poland Insurable Ground-Up Exceedance Probability

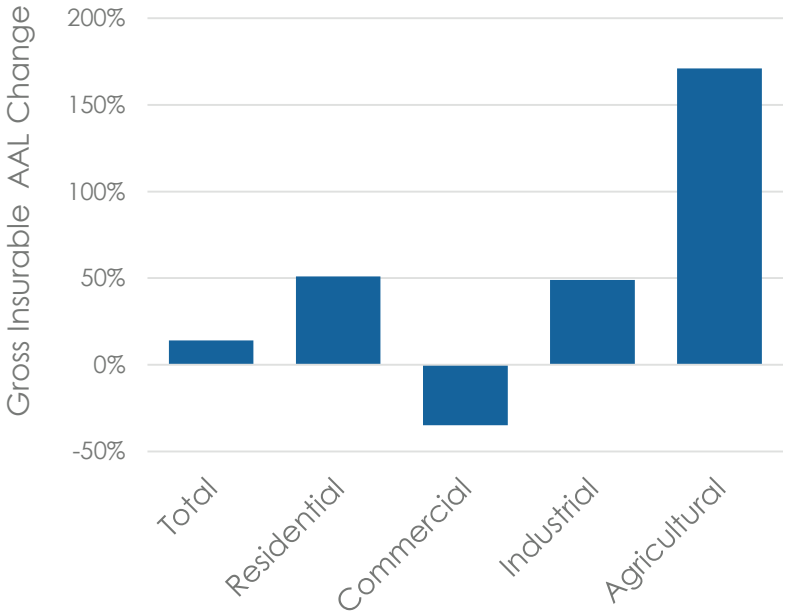


Germany Insured Gross Loss Change

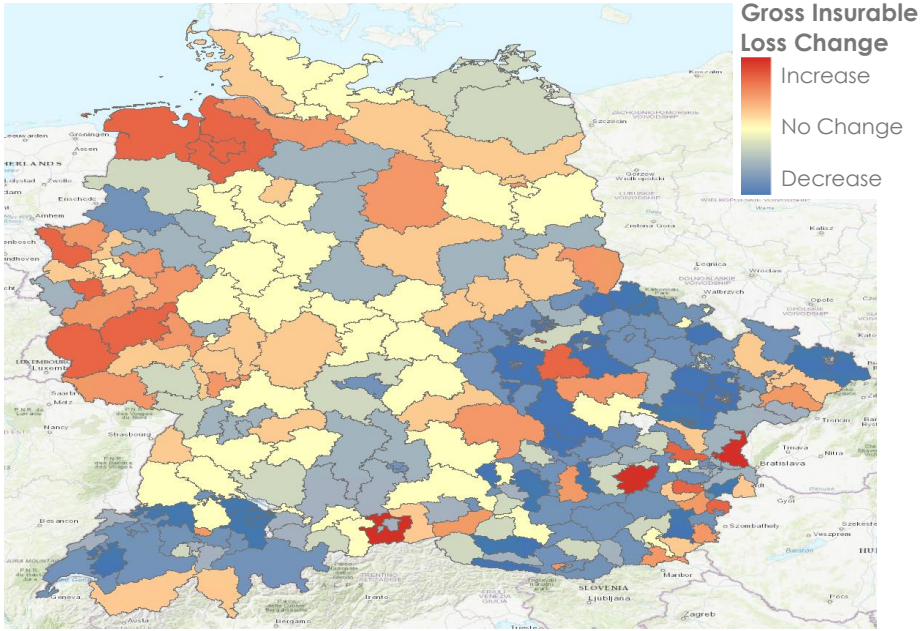


Change by Line of Business and CRESTA in Touchstone®

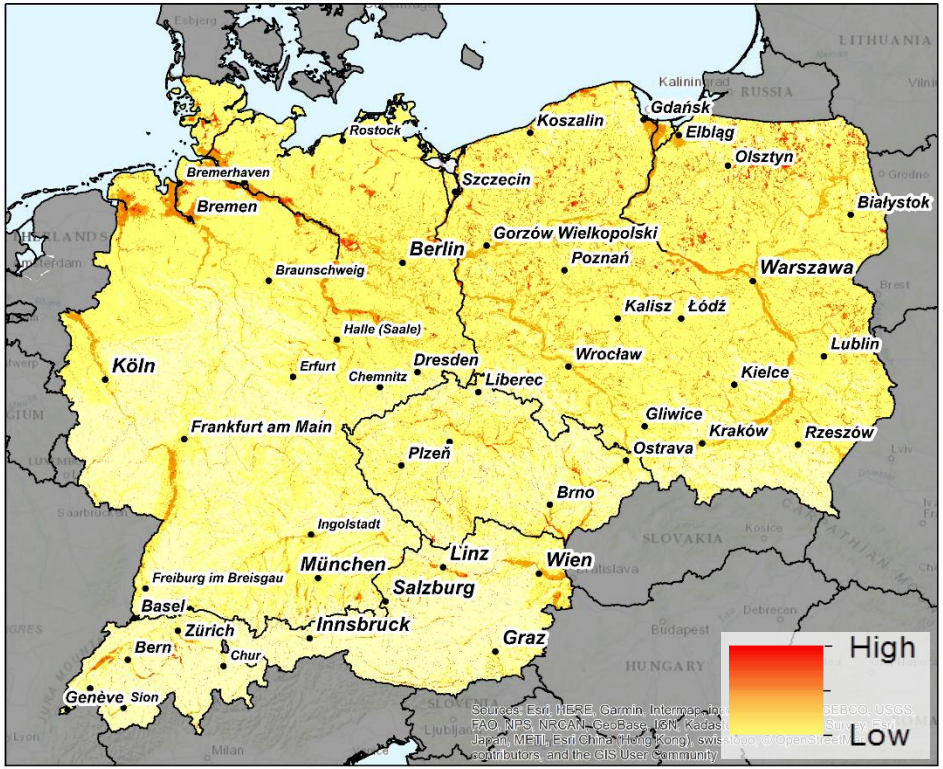
AIR Industry Exposure Database (IED): Germany

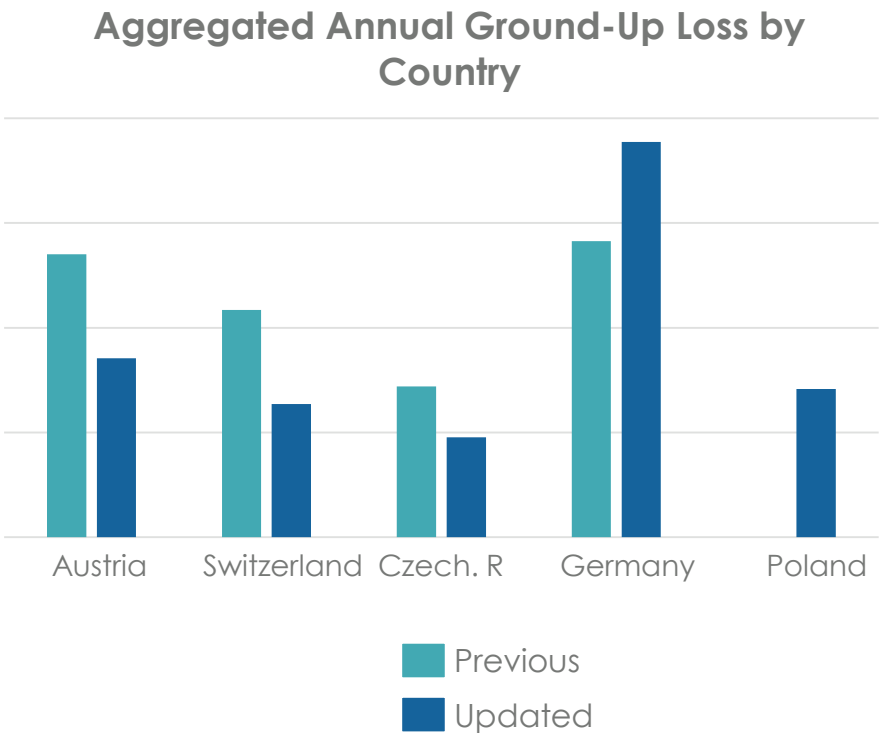


IED: Gross Insurable AAL Change by CRESTA



Loss Cost Map and Total Modelled Losses





The Addition of Great Britain Storm Surge to AIR's Extratropical Cyclone Model for Europe

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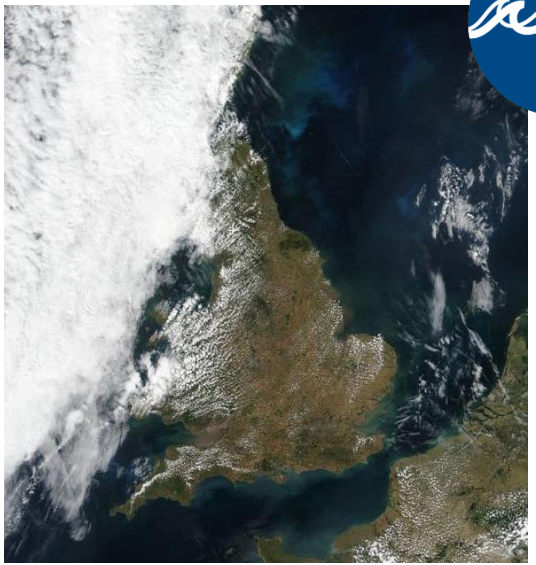
Changes in Model Configuration

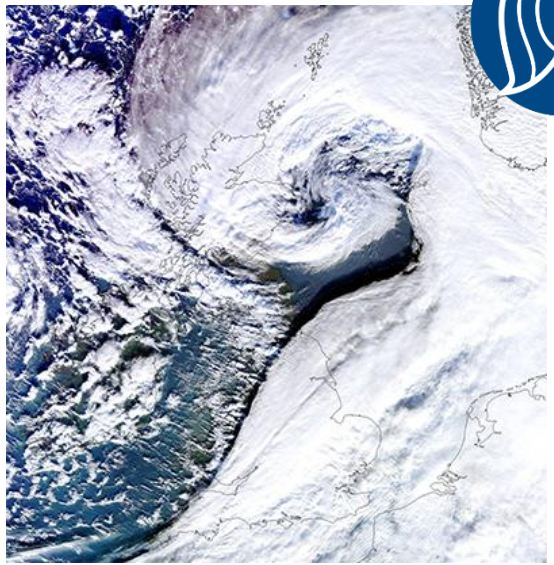
Previously:

AIR Coastal Flood Model for Great Britain

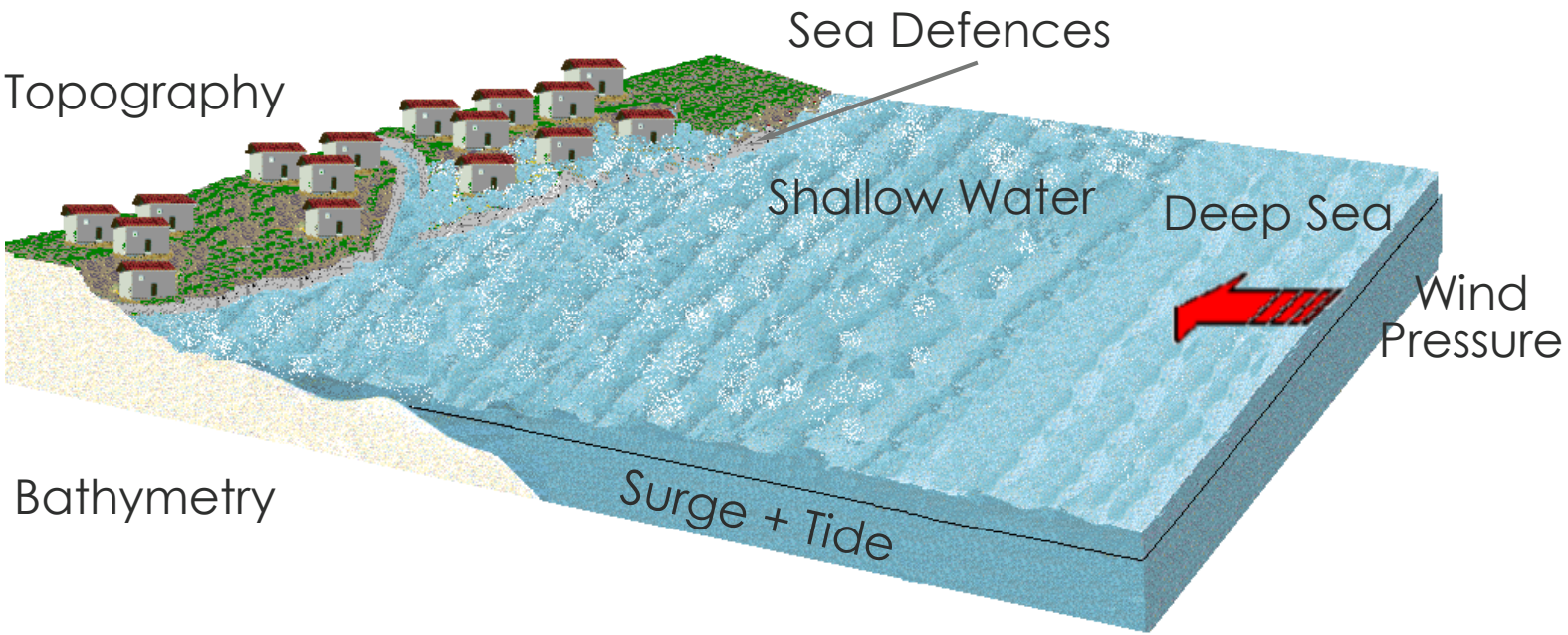


2019 Update:

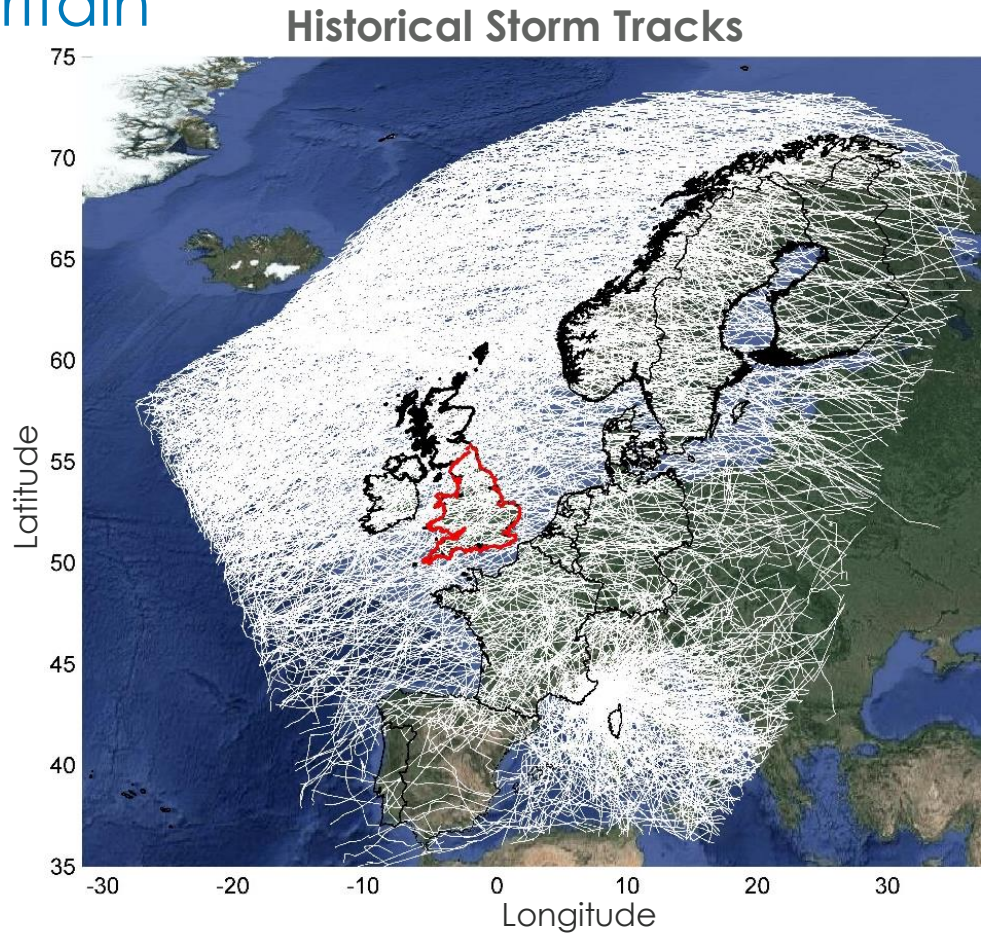
Storm Surge sub-peril in the AIR Extratropical Cyclone Model for Europe



What Is Storm Surge?



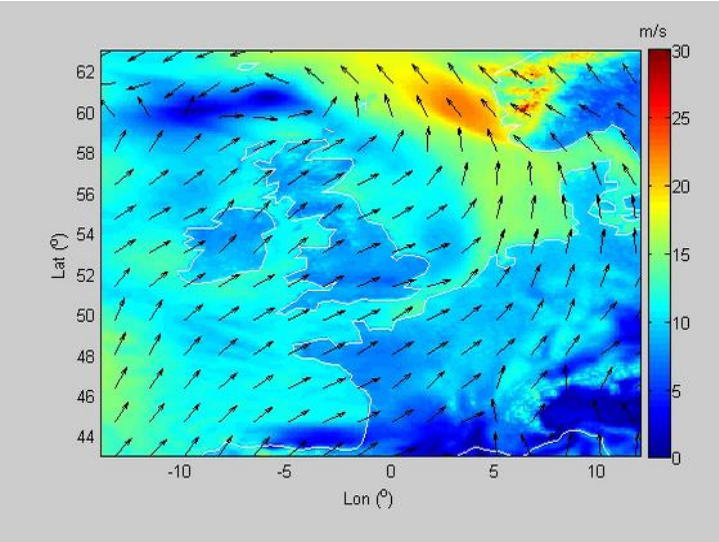
Extratropical Cyclones Generate Storm Surge in Great Britain



Historical Events Affect Both the West and East Coasts

Storm Anne (2014): West Coast Example*

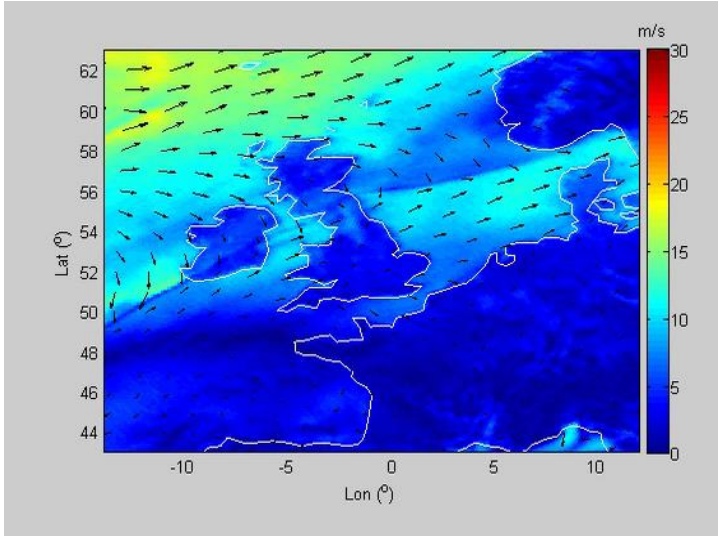
*another example is Storm Undine (1991)



Southerly wind pushes water into Irish Sea

Storm Xaver (2013): East Coast Example**

**another famous example is North Sea Flood (1953)



Northerly wind pushes water into the Channel

Updates to the Hazard Component

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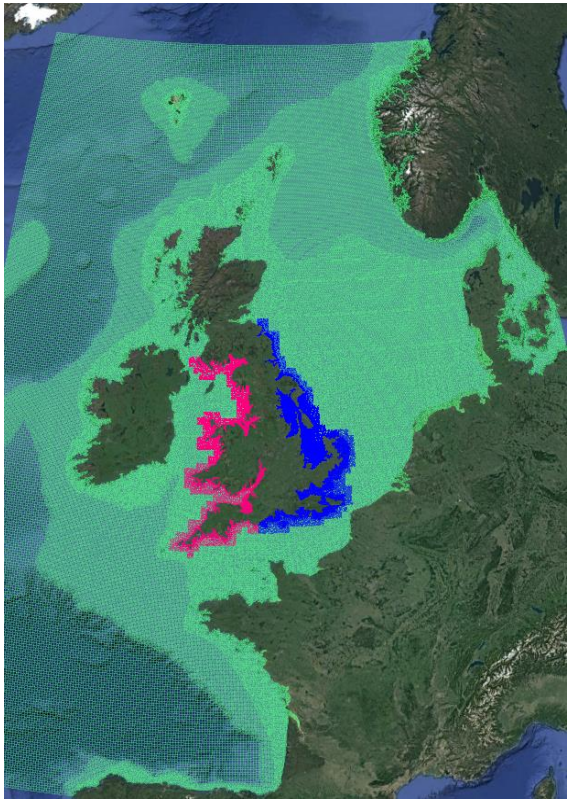
New Hydrodynamic Coastal Flood Model

- Expanded domain covers all of England and Wales
- Uses Delft3D Flexible Mesh
- Dynamic simulation of tides and surge
- Driven by wind and pressure from EU ETC model catalogue
  (see Keshtpoor, Carnacina, and Yablonsky, 2019: New Statistical Approach to Select Coastal Flood-Producing Extratropical Cyclones from a 10,000-Year Stochastic Catalog. *J. Waterway, Port, Coastal, and Ocean Eng.*)
- Surge depth at 10-metre resolution via downscaling and topography subtraction



CORINE Land Use/Land Cover Database

1. Artificial surfaces

1.1 Urban fabric

- 1.1.1. Continuous urban fabric
- 1.1.2. Discontinuous urban fabric

1.2 Industrial, commercial and transport units

- 1.2.1. Industrial or commercial units
- 1.2.2. Road and rail networks and associated land
- 1.2.3. Port areas
- 1.2.4. Airports

1.3 Mine, dump and construction sites

- 1.3.1. Mineral extraction sites
- 1.3.2. Dump sites
- 1.3.3. Construction sites

1.4 Artificial, non-agricultural vegetated areas

- 1.4.1. Green urban areas
- 1.4.2. Sport and leisure facilities

2. Agricultural areas

2.1 Arable land

- 2.1.1. Non-irrigated arable land
- 2.1.2. Permanently irrigated land
- 2.1.3. Rice fields

2.2 Permanent crops

- 2.2.1. Vineyards
- 2.2.2. Fruit trees and berry plantations
- 2.2.3. Olive groves

2.3 Pastures

- 2.3.1. Pastures

2.4 Heterogeneous agricultural areas

- 2.4.1. Annual crops associated with permanent crops
- 2.4.2. Complex cultivation patterns
- 2.4.3. Land principally occupied by agriculture
- 2.4.4. Agro-forestry areas

3. Forest and seminatural areas

3.1 Forests

- 3.1.1. Broad-leaved forest
- 3.1.2. Coniferous forest
- 3.1.3. Mixed forest

3.2 Shrub and/or herbaceous vegetation associations

- 3.2.1. Natural grassland
- 3.2.2. Moors and heathland
- 3.2.3. Sclerophyllous vegetation
- 3.2.4. Transitional woodland shrub

3.3 Open spaces with little or no vegetation

- 3.3.1. Beaches, dunes, and sand plains
- 3.3.2. Bare rock
- 3.3.3. Sparsely vegetated areas
- 3.3.4. Burnt areas
- 3.3.5. Glaciers and perpetual snow

4. Wetlands

4.1 Inland wetlands

- 4.1.1. Inland marshes
- 4.1.2. Peat bogs

4.2 Coastal wetlands

- 4.2.1. Salt marshes
- 4.2.2. Salines
- 4.2.3. Intertidal flats

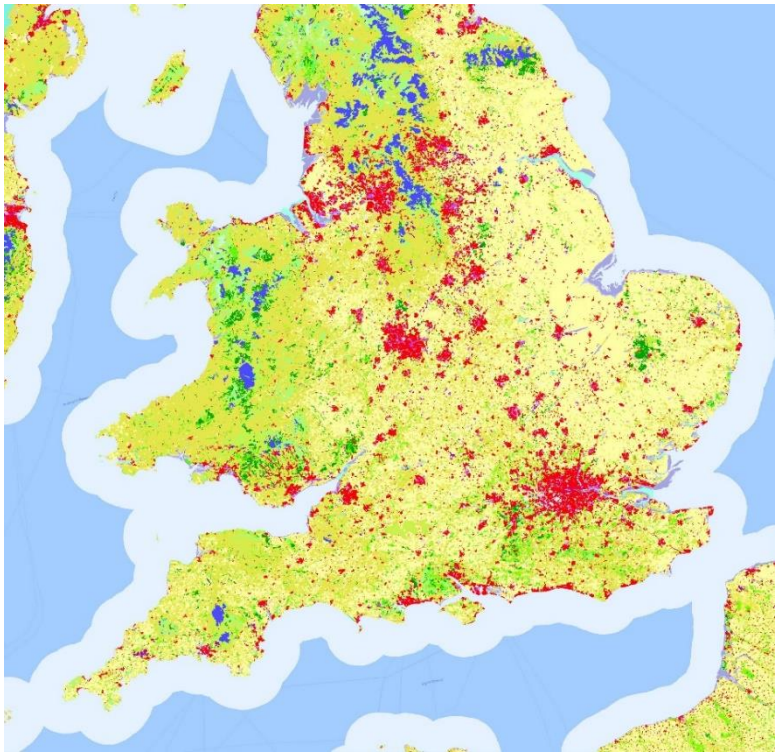
5. Water bodies

5.1 Inland waters

- 5.1.1. Water courses
- 5.1.2. Water bodies

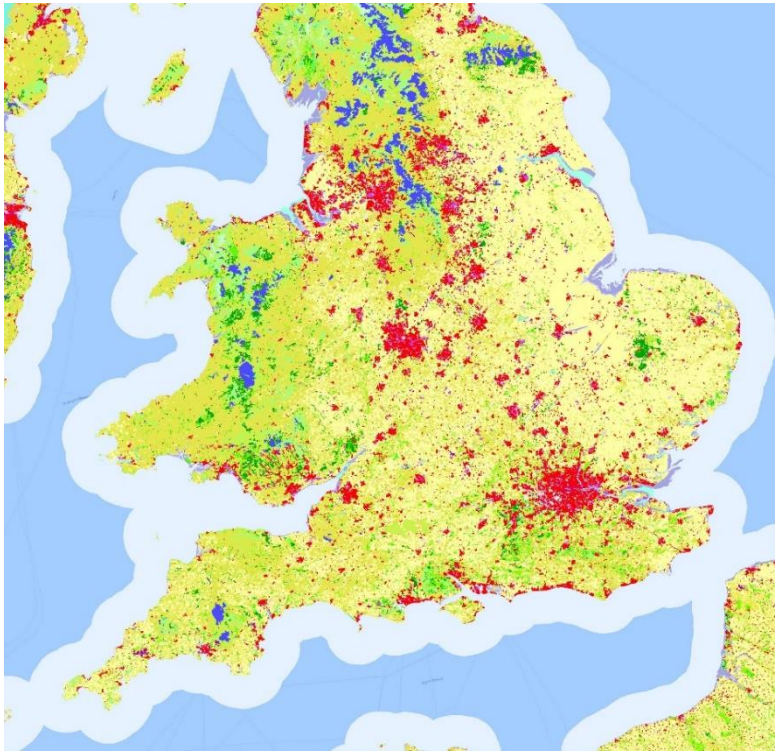
5.2 Marine waters

- 5.2.1. Coastal lagoons
- 5.2.2. Estuaries
- 5.2.3. Sea and ocean



CORINE Land Use/Land Cover Database

- Data can be mapped to a Manning friction coefficient
- Helps to ensure proper flood extent over land
- Particularly challenging in urban areas



Incorporation of the Latest Levee Data Sources

UK Environment Agency Spatial Flood Defences Dataset

- 2016 vintage defence data set for the entire United Kingdom: defined crest heights, material, quality condition, and design type
- Undefined heights were extracted from 2- to10-metre topography (DTM) sources

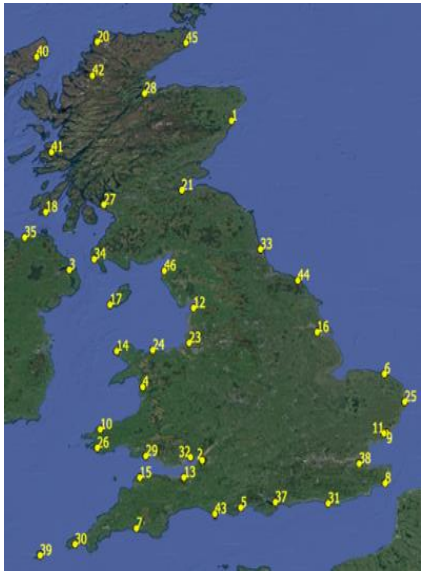
Thames River Defences

- The Thames Barrier was completed in 1984
- During construction, flood defences were raised by ~2 metres for ~30 km downstream to match the Barrier
- Defences for ~5 km upstream were also raised to increase protection and match protection of Central London

Accounting for Breached Levees in Addition to Overtopping Levees

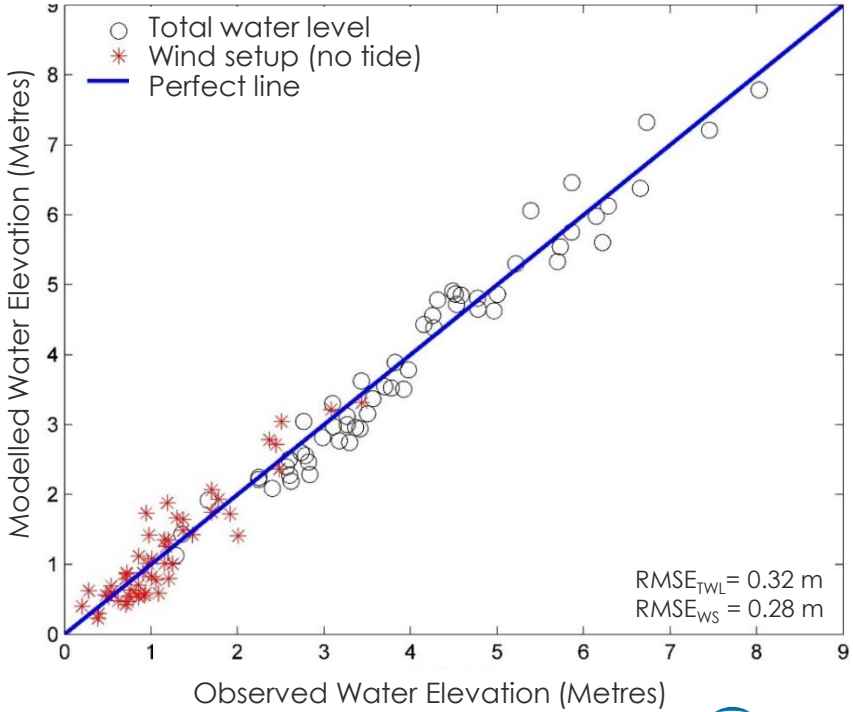
Hazard Model Validation

Storm Surge Model Validation at Great Britain Tide Gauges for Four Storms



Tide Gauge Locations

Four Storms Combined:
1953, Undine, Xaver, and Anne



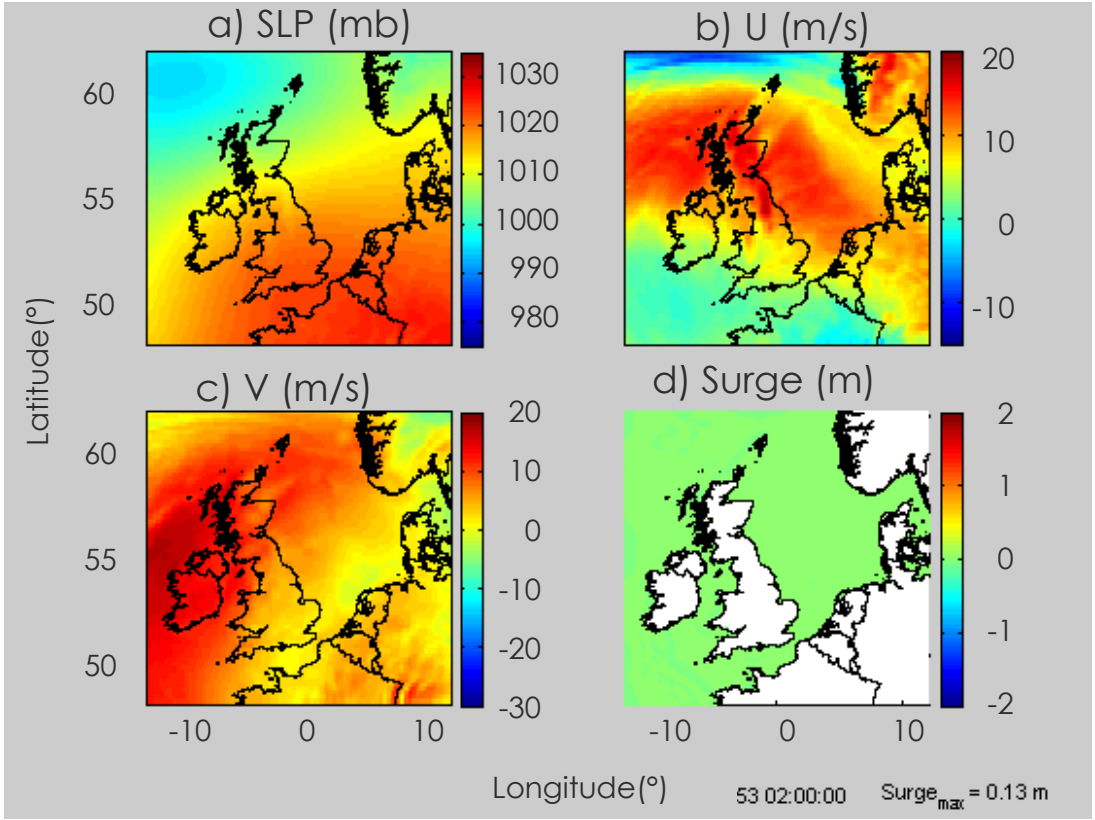
Modelled Pressure, Wind, and Surge During North Sea Flood of 1953

a) Sea level pressure

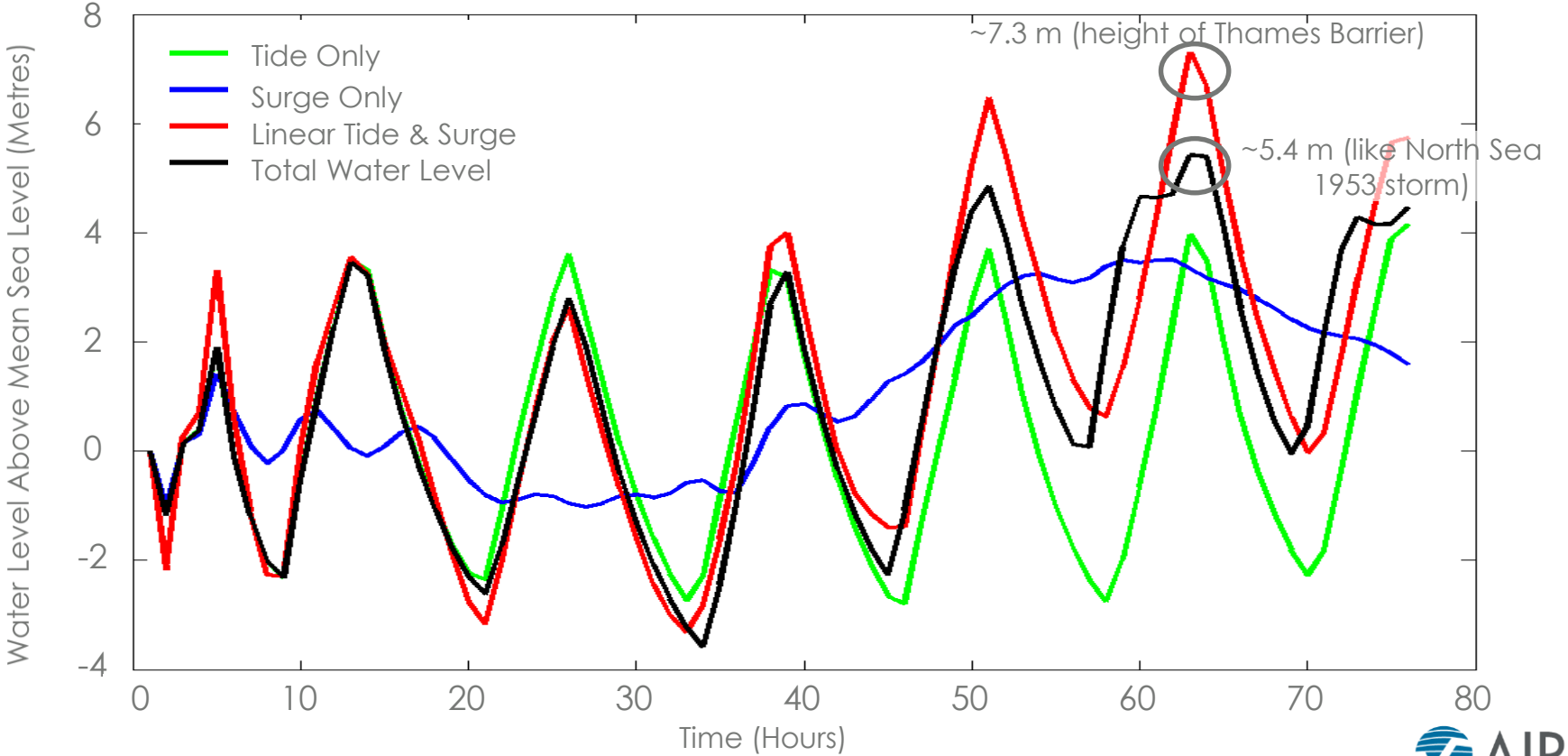
b) West-to-east wind speed (U) ~180 metres above ground

c) South-to-north wind speed (V) ~180 metres above ground

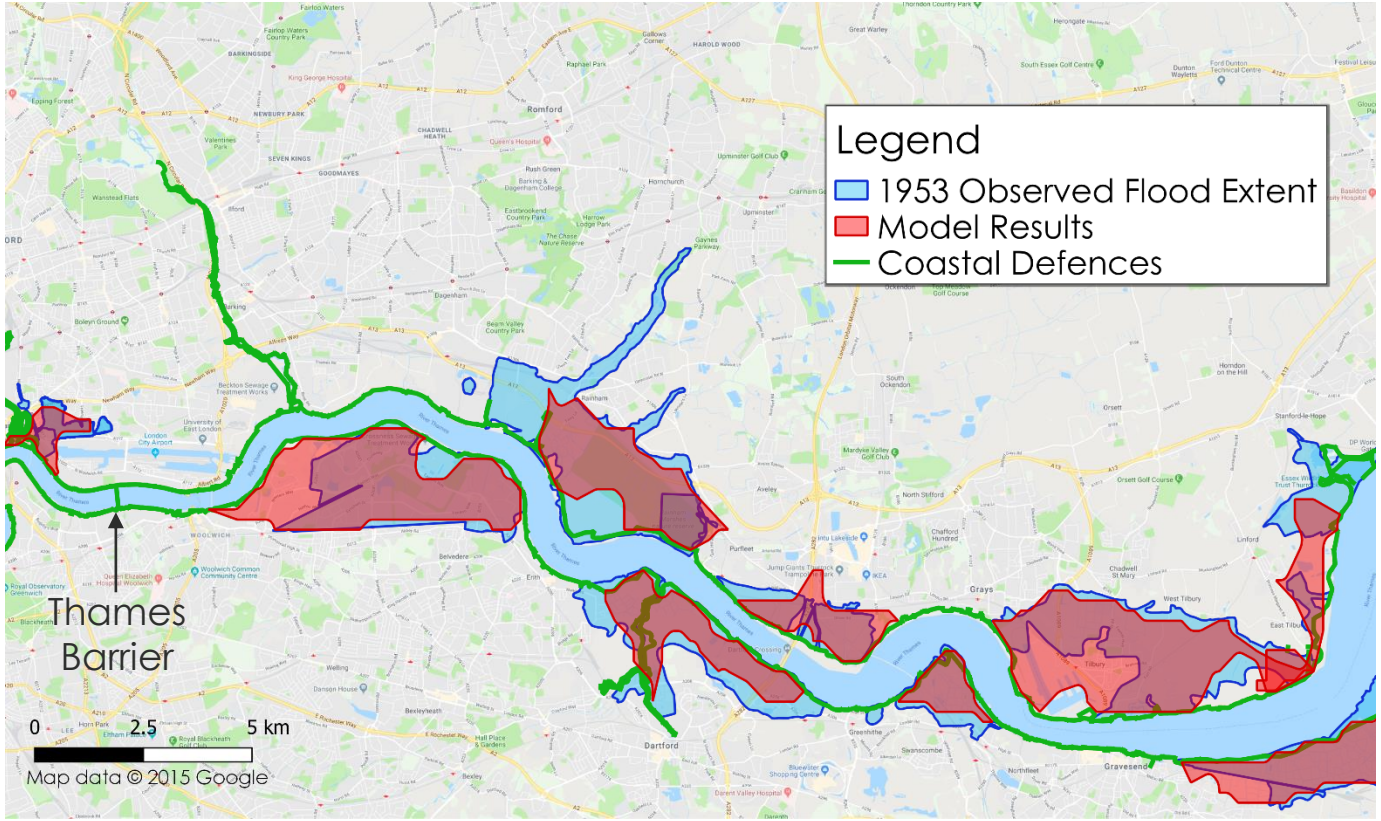
d) Water level due to wind setup (without tide)



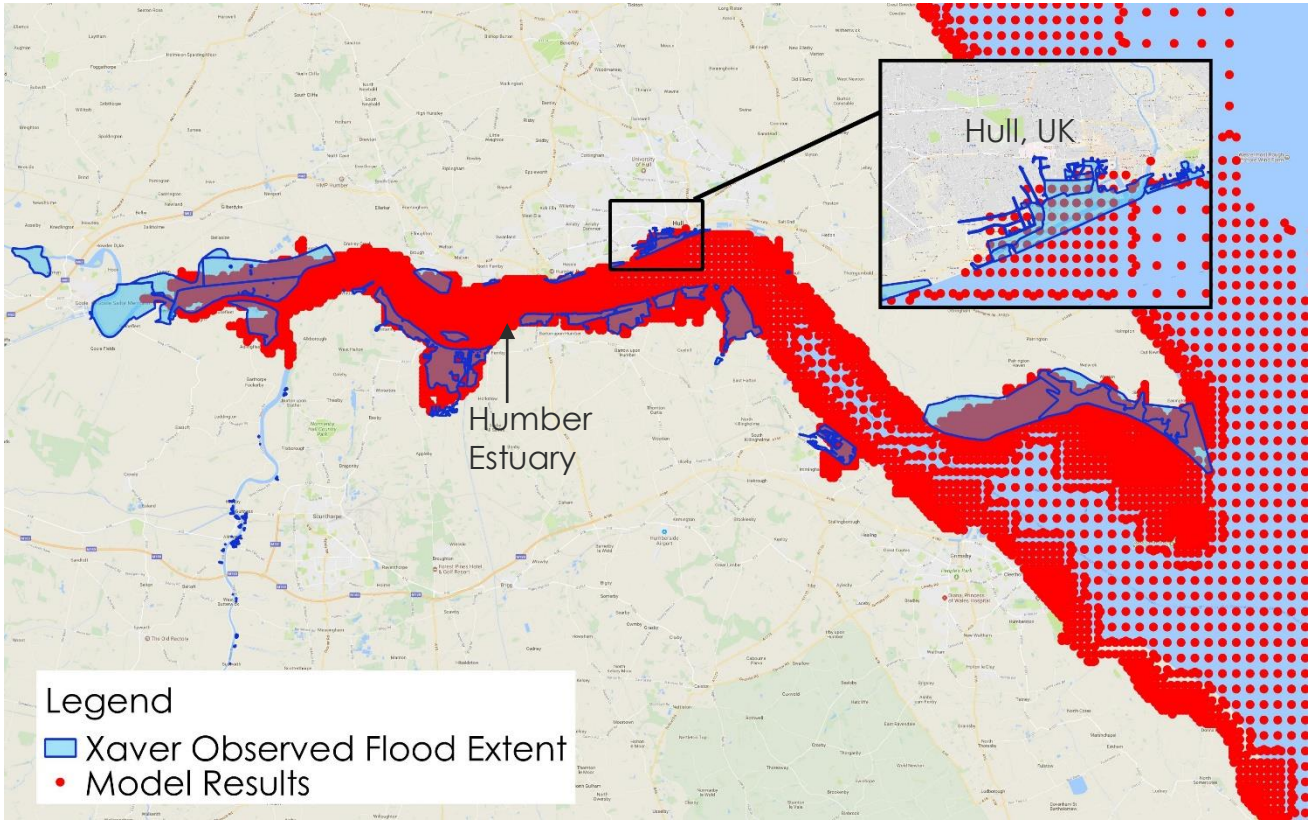
Modelled Water Level Near Thames Barrier from a Storm Like the 1953 North Sea Flood



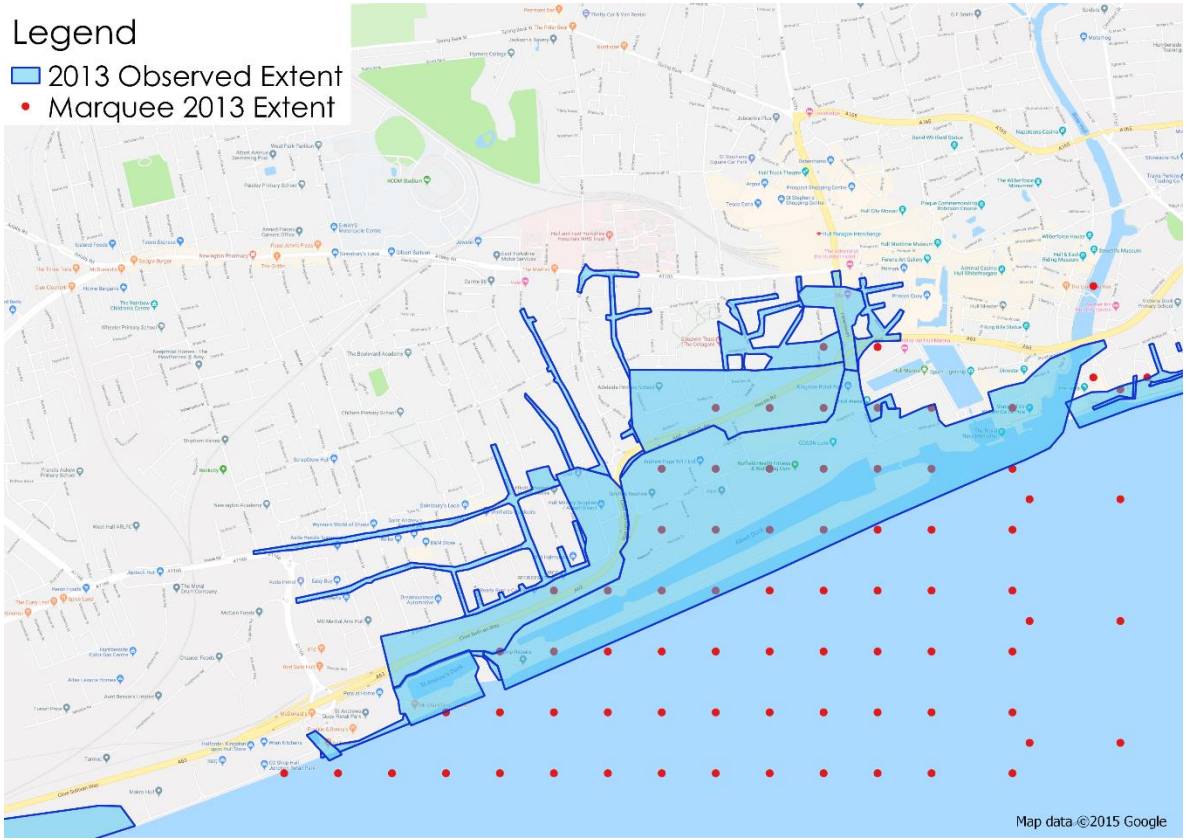
Flood Extent Validation for the 1953 North Sea Flood Event (Thames River)



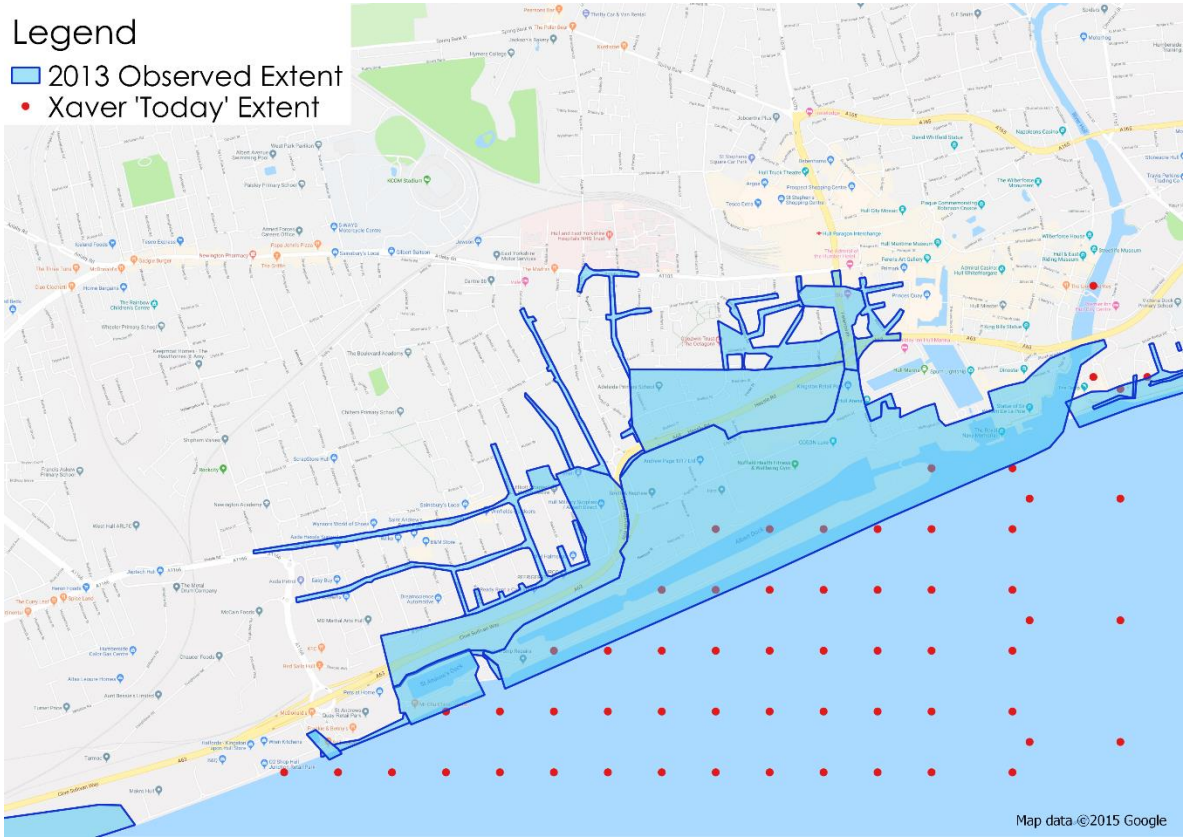
Flood Extent Validation Along the Humber Estuary for 2013 Storm Xaver



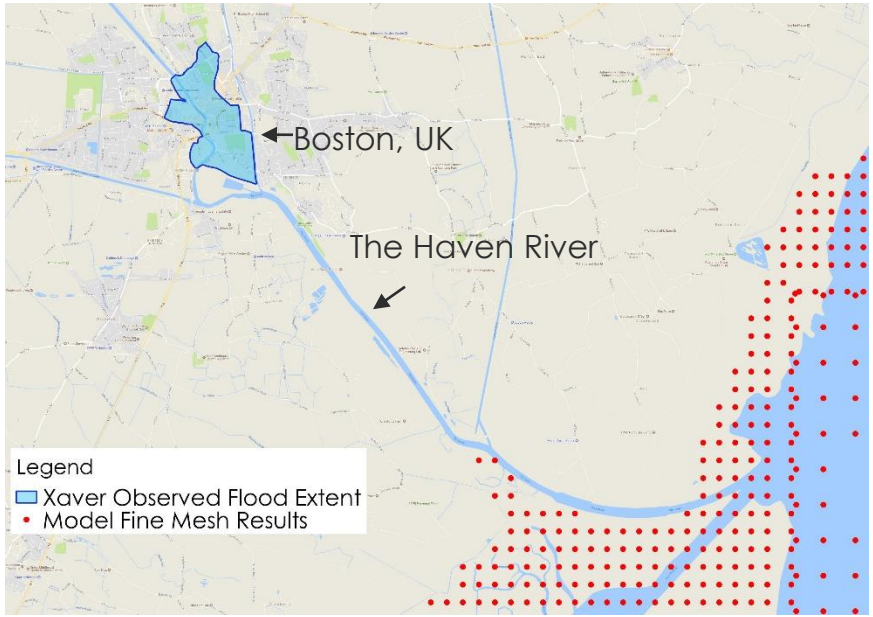
City of Hull Close Up: Storm Xaver in 2013



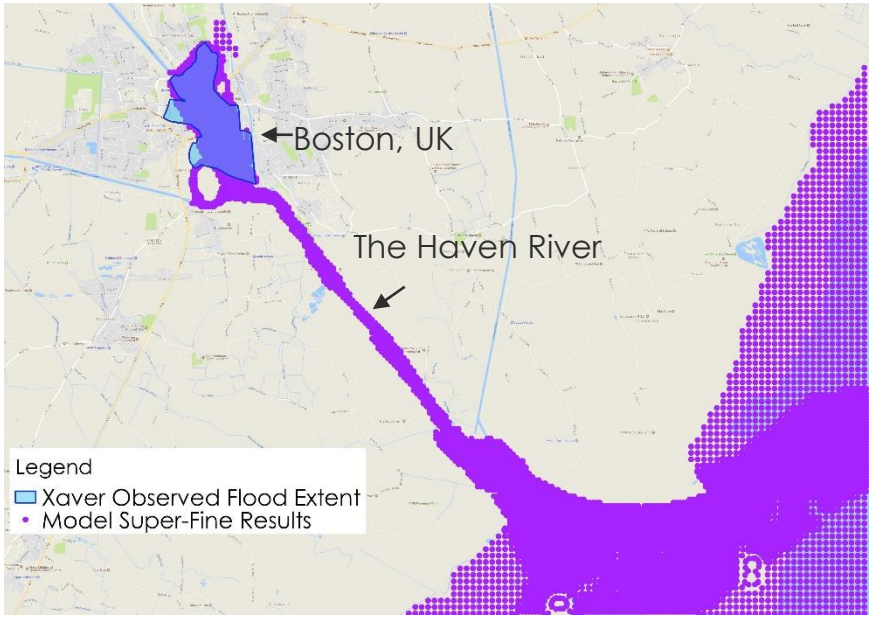
City of Hull Close Up: Storm Xaver "Today"



Flood Validation for Storm Xaver in Boston, UK: Fine Mesh vs Super-Fine Mesh



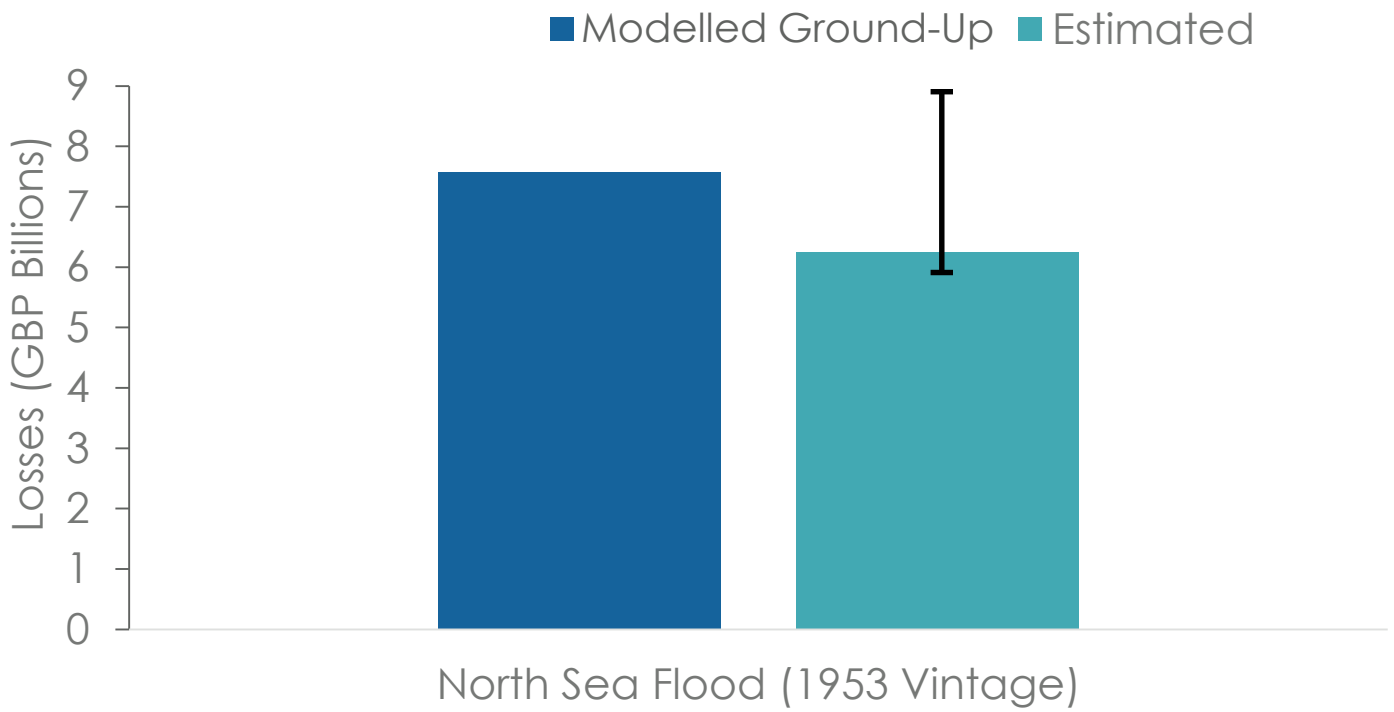
Insufficient resolution (~220 m) for water to reach Boston, UK



Sufficient resolution (up to 35 m) for water to reach Boston, UK

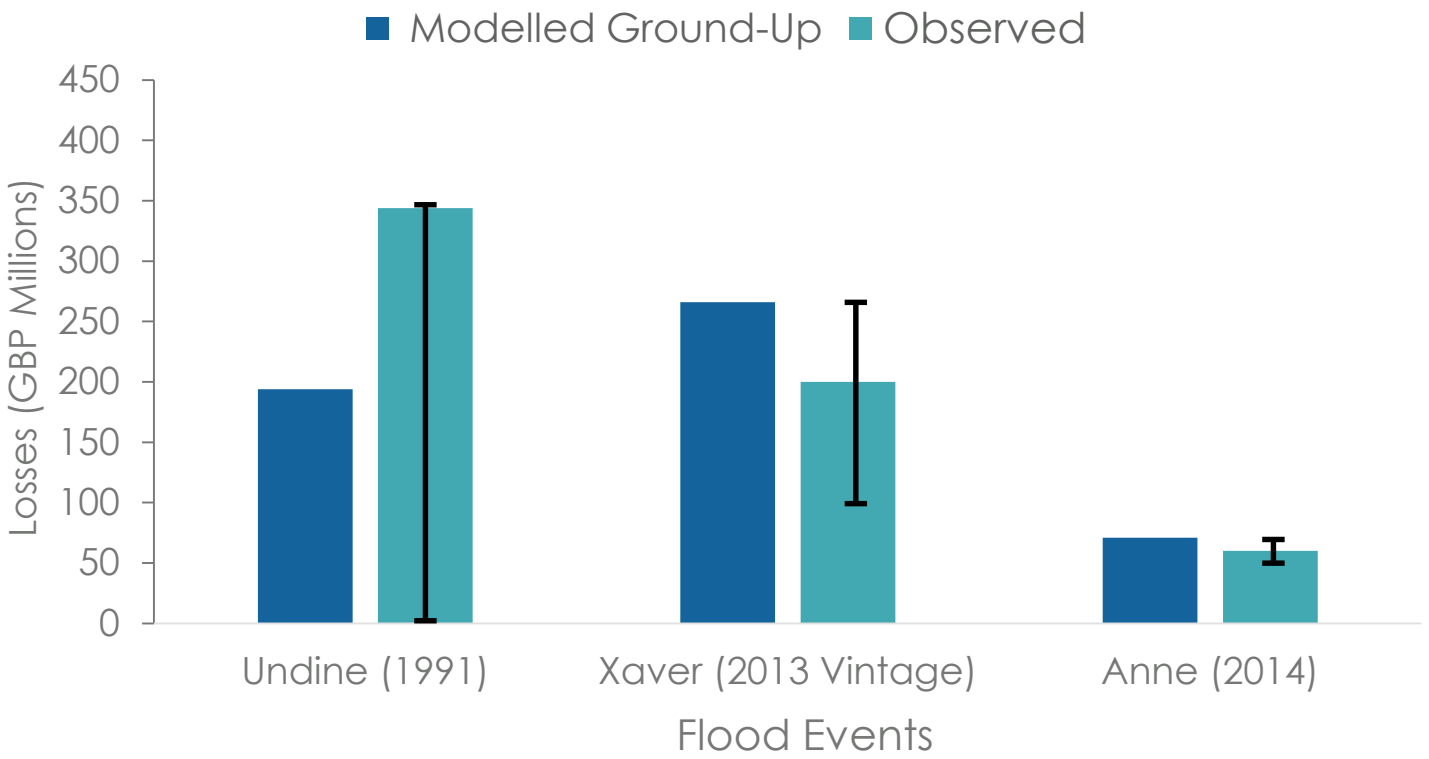
Modelled Losses

Historical Event Loss Validation



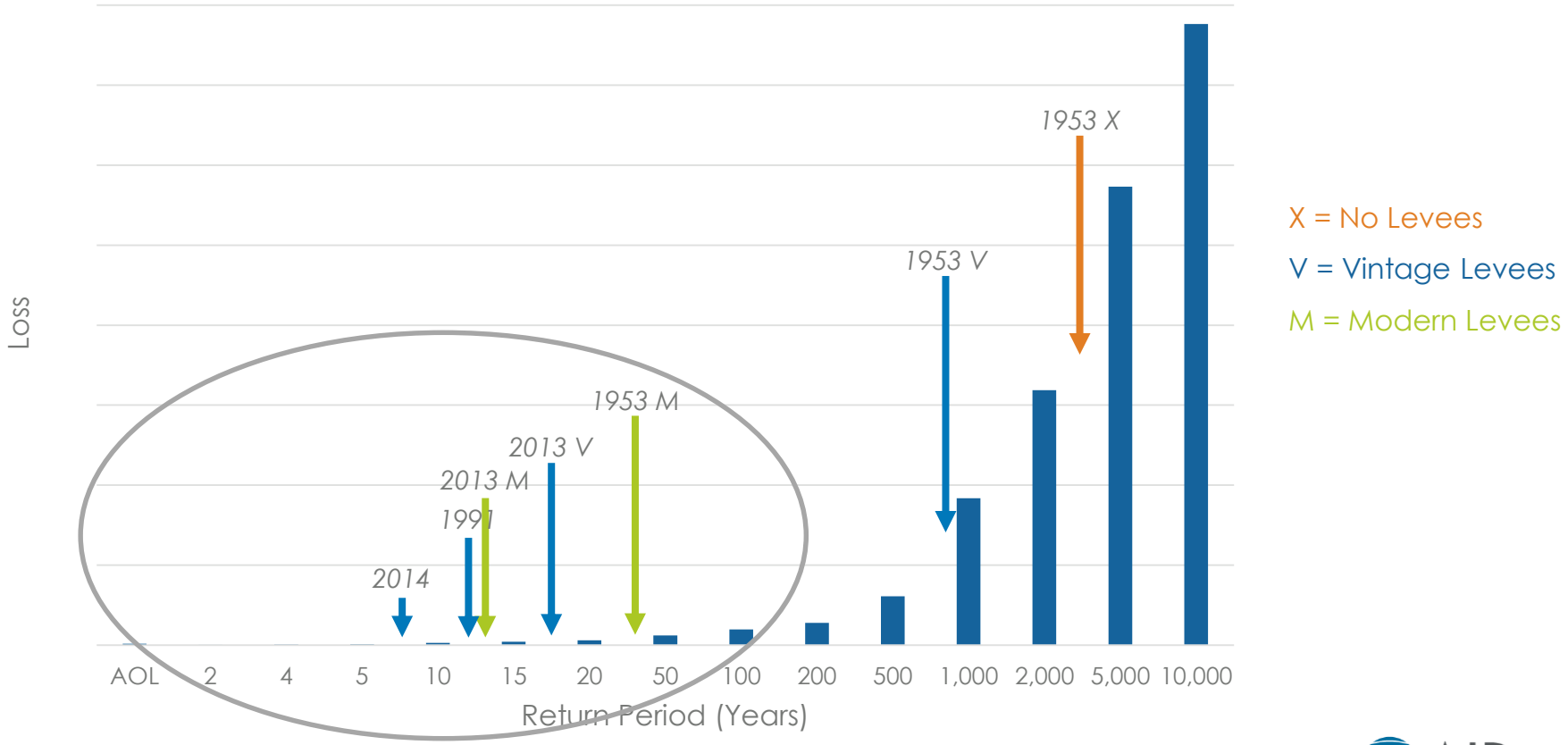
Observed Data Sources: UK Met Office, Munich Re, ABI

Historical Event Loss Validation

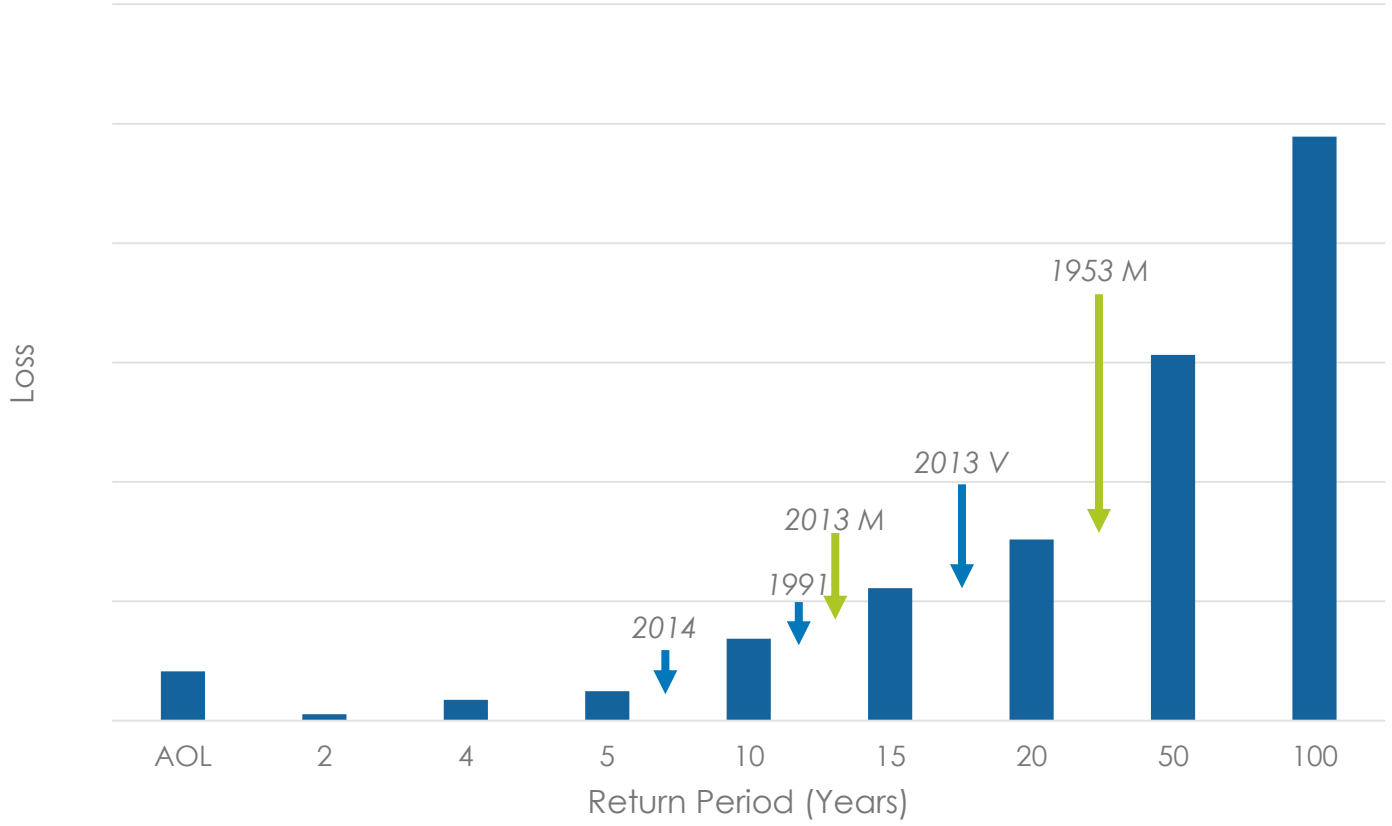


Observed Data Sources: UK Met Office, Munich Re, ABI

Exceedance Probability of Insurable Gross Loss



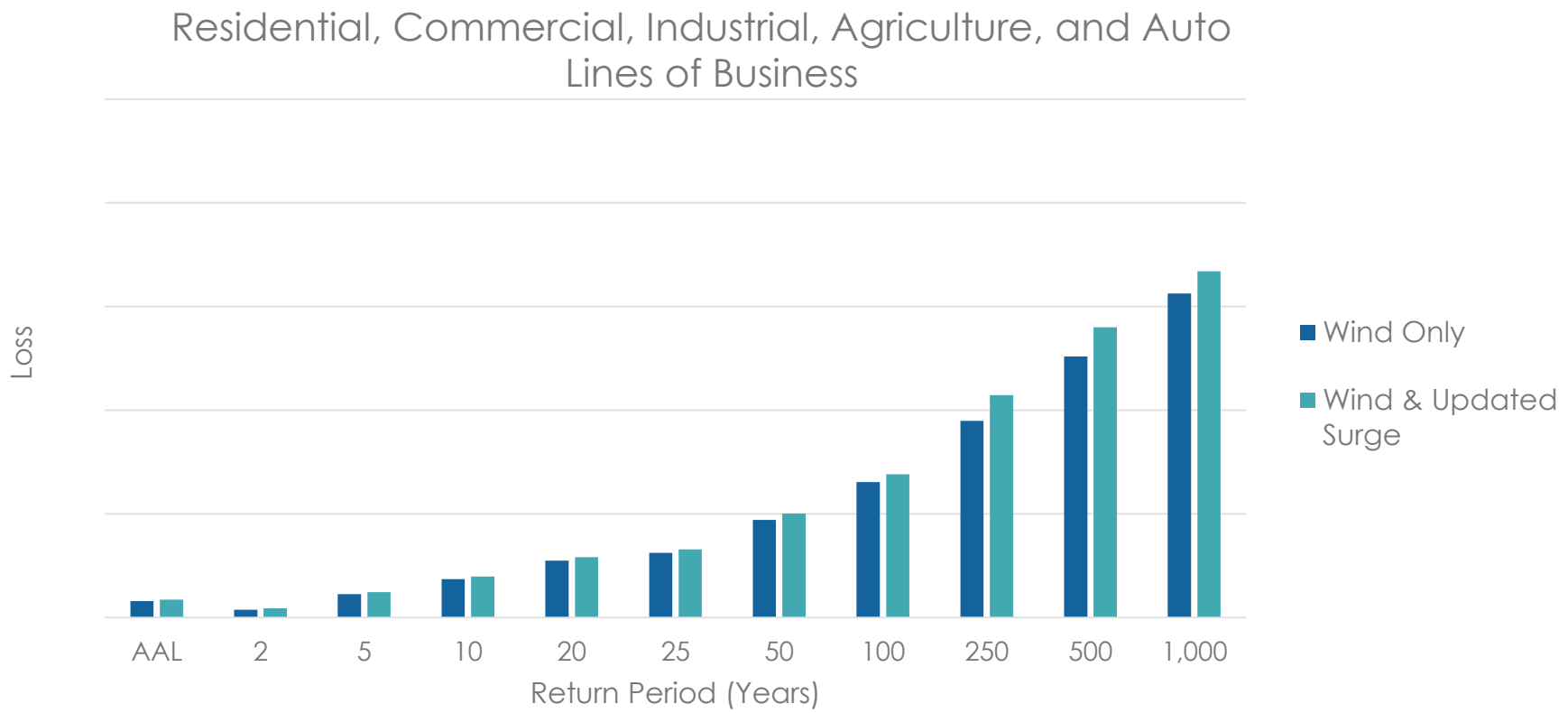
Exceedance Probability of Insurable Gross Loss



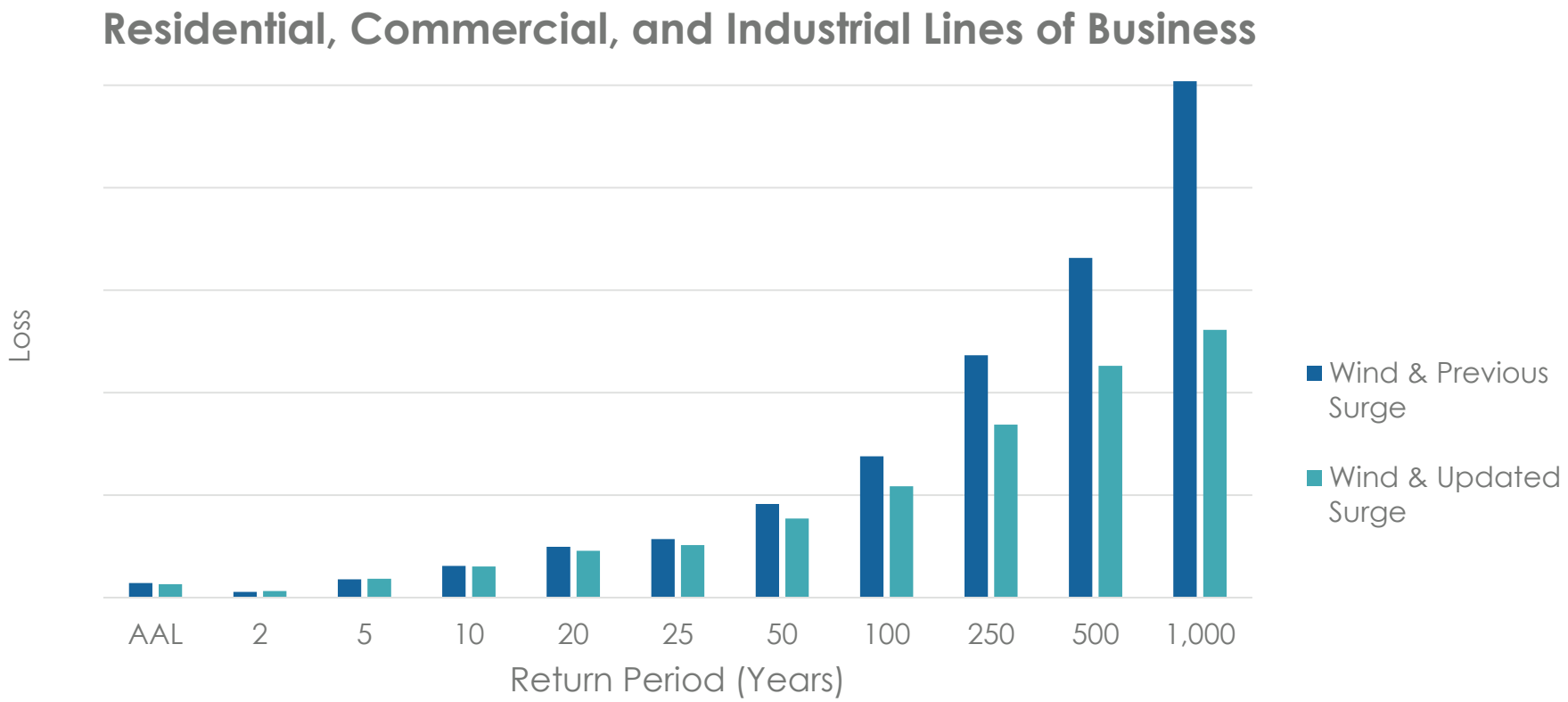
V = Vintage Levees

M = Modern Levees

Insured Aggregate Loss Comparison: Adding Surge



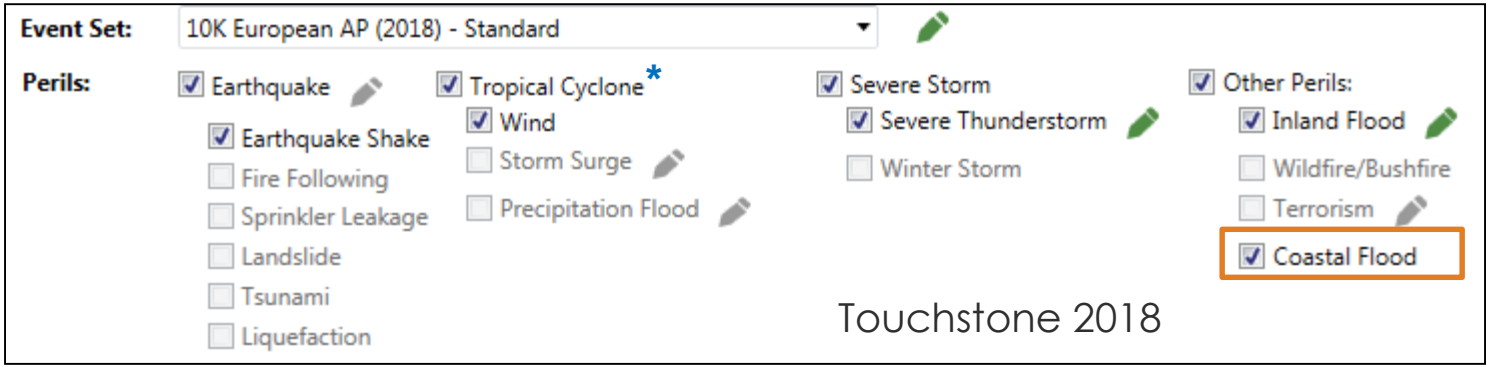
Insured Aggregate Loss Comparison: Wind and Surge



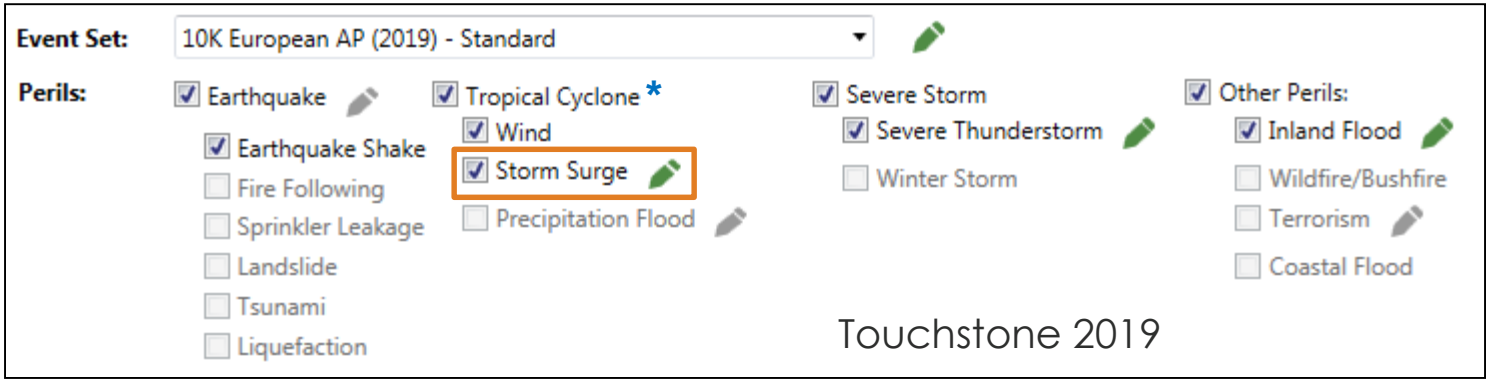
Upcoming Software Changes

AIR

Functional Changes in Touchstone



* Europe Extratropical Cyclone is still categorised as a "Tropical Cyclone" peril in Touchstone®



Summary

The Updated AIR Inland Flood Model for Central Europe:

- Expanded model coverage includes Poland and new historical events
- Updated existing model domain, including standard of protection
- Updated vulnerability for coverage and secondary risk characteristics

The Addition of Storm Surge to the AIR Extratropical Cyclone Model for Europe:

- Expanded model coverage includes all of England and Wales
- Updated with modern-day levee information to improve surge footprints
- Utilised the Delft3D Flexible Mesh hydrodynamic model
- Used wind and pressure from EU ETC model catalogue to drive surge

Questions?


2019
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