Marine Institute — *Foras na Mara*

OLLSCOIL NA GAILLIMHE — UNIVERSITY OF GALWAY

Combined statistical, hydrodynamic and machine learning modelling of water levels in coastal basins

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INTRO

- High coastal water levels and high river flows can result in flooding of coastal floodplains.
- Twenty-first century climate change is expected to alter these flood mechanisms.
- Aim: provide a methodology for comprehensive forecasting and assessment of urban flooding in consideration of climate change and to investigate changes in flood mechanisms, dynamics and extents due to climate change.
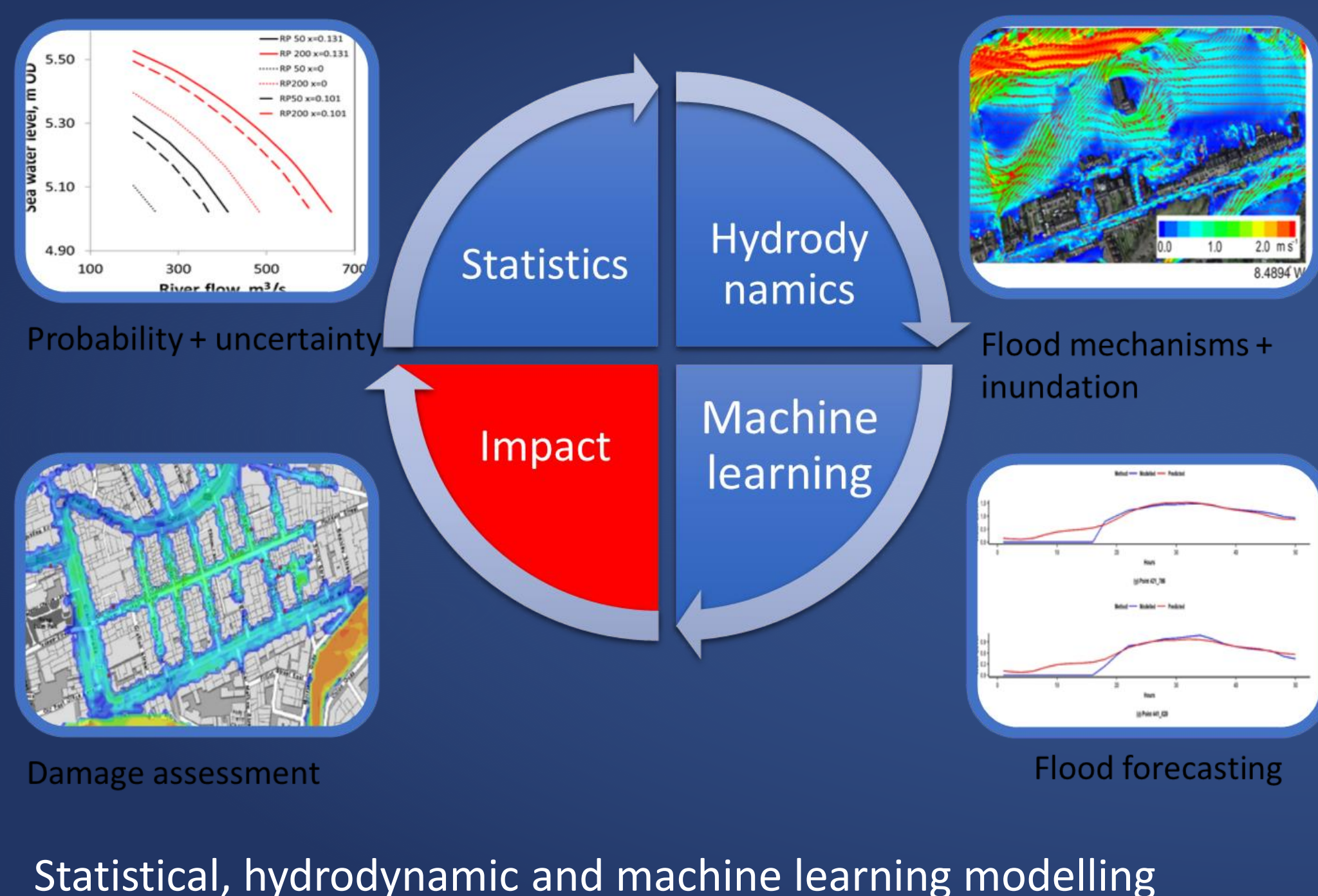
METHODS

- A coastal city of Cork, Ireland was used as a case study.
- MSN_Flood 4-level nested model was used to compute potential future inundation pattern for current, medium-range and high-end projections of extreme river flows and sea levels.
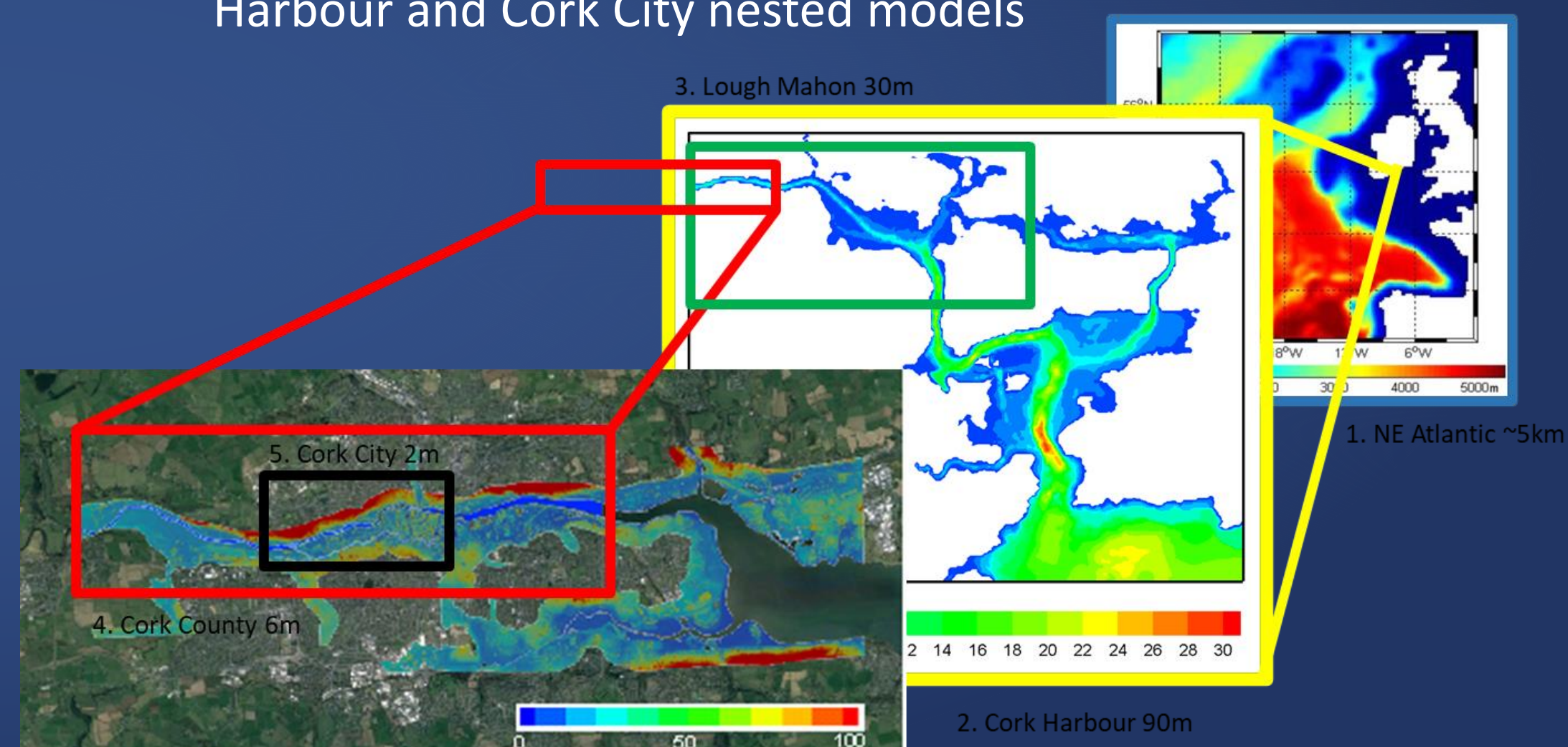
RESULTS

This research establishes a best practice methodology for assessment of urban coastal-fluvial flood risk under a changing climate and can be used to determine climate-resilient flood management measures so that flood prevention or alleviation schemes can be evaluated and/or optimized.
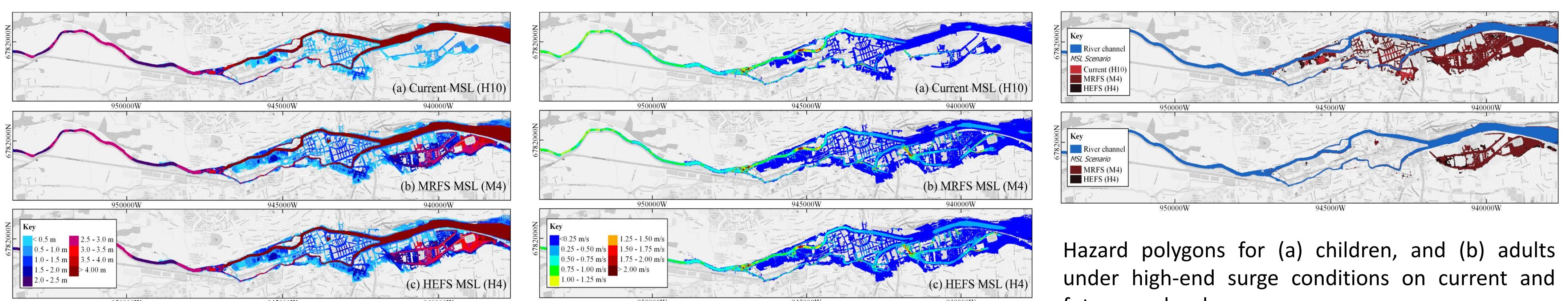
MODELLING FRAMEWORK

Probability + uncertainty

Statistics — Hydrodynamics — Machine learning — Impact

Flood mechanisms + inundation

Damage assessment

Flood forecasting

Statistical, hydrodynamic and machine learning modelling

Cascade of Hydrodynamic Models
Dynamic downscaling
MPIOM → POM → MNS_Flood

Study area, with four-level nesting structure of Cork Harbour and Cork City nested models

3. Lough Mahon 30m
5. Cork City 2m
4. Cork County 6m
1. NE Atlantic ~5km
2. Cork Harbour 90m

MODEL OUTPUTS

(a) Current MSL (H10)
(b) MRFS MSL (M4)
(c) HEFS MSL (H4)

Maximum water depths under high-end surge conditions for (a) current, (b) medium-range, and (c) high-end sea levels

(a) Current MSL (H10)
(b) MRFS MSL (M4)
(c) HEFS MSL (H4)

Maximum water velocities under high-end surge conditions for (a) current, (b) medium-range, and (c) high-end sea levels

Hazard polygons for (a) children, and (b) adults under high-end surge conditions on current and future sea levels

CONCLUSIONS

Climate-driven increases in both coastal and fluvial mechanisms have the potential to cause an extensive inundation across the Cork City domain and create a significant threat to the populace across the majority of the city.