

# Understanding Multiple Hazards and Risk from Climate Change on Interdependent Infrastructure: a Serious Game Approach



## Infrastructure & climate change

- climate change (CC) can impact magnitude, frequency, and type of weather-related natural hazards
- infrastructure is vulnerable to these hazards, but essential to society, and thus a key mitigation target
- complex interdependencies between different infrastructure types & shared responsibilities require coordinated cooperation

### Use a serious game approach to

- engage stakeholders and facilitate cooperation
- identify CC risks on interdependending infrastructure
- inform the focus of future CC research

## From climate model projections

- from the Met Office Hadley Centre's regional climate model (1)
- assume a medium-emission scenario

## ...to extreme weather events

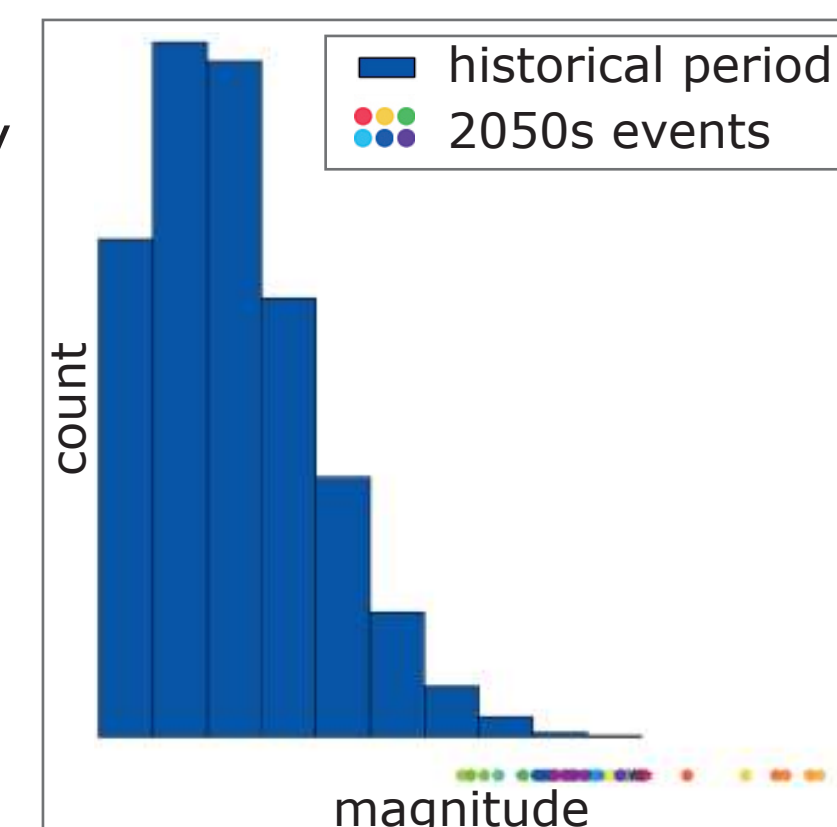
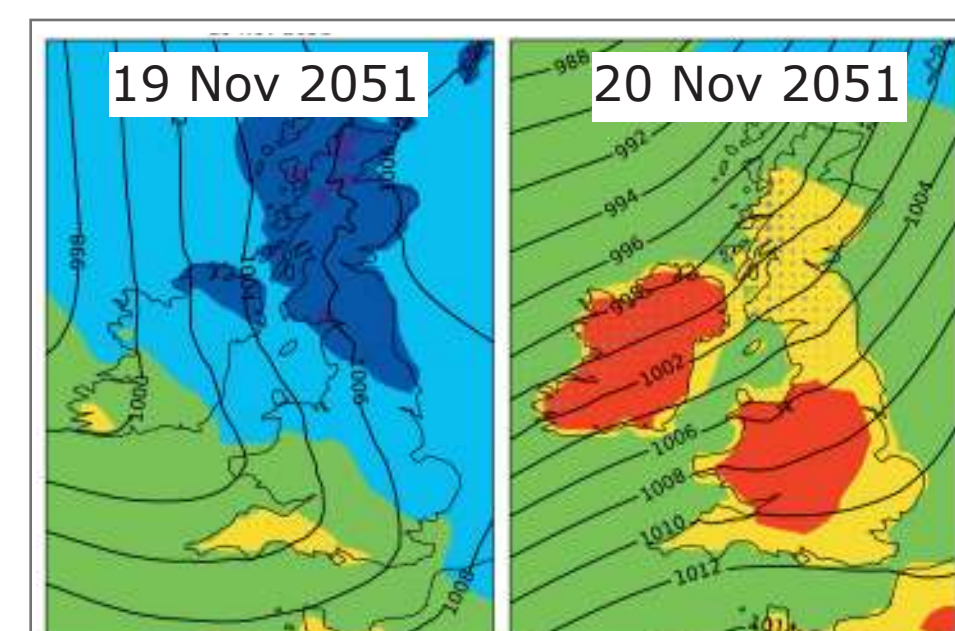
- in the 2050s over the UK
- use 1950-2000 baseline to define extremeness e.g. for rainfall
- use observations to correct for model temperature bias (2)

## ...to hazard events

- heat waves; cold spells; snow; surface, river, & coastal flooding; droughts
- use definitions used by local authorities and infrastructure providers (3) as well as flood maps from SEPA (4)

## ...to game rounds 1 - 9

- describe each event in terms of meteorological conditions & rarity



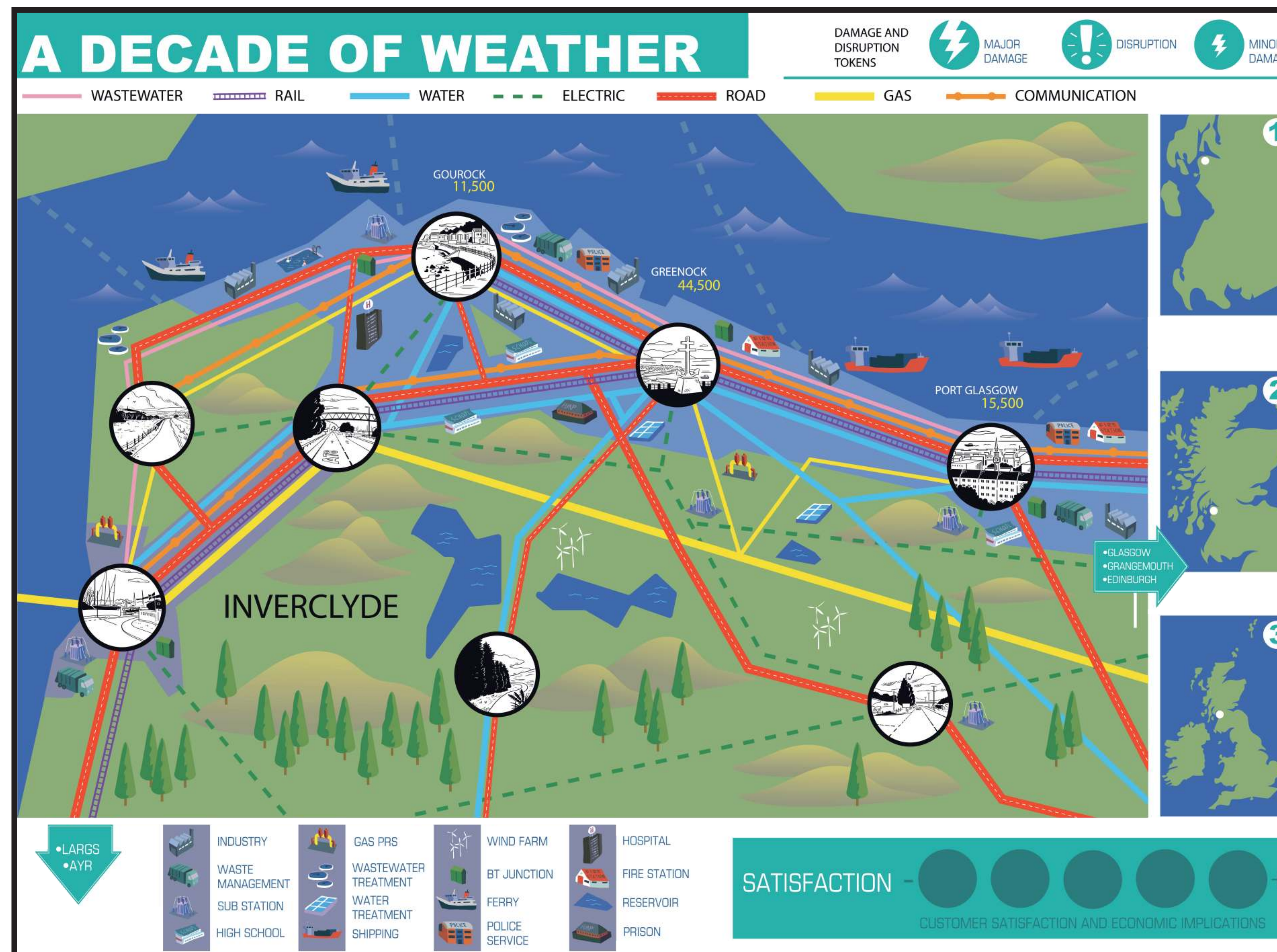
- select the model run with the most interesting series of events
- simplify the event descriptions and add illustrations

## Game scenario

Time has leaped to 2050, but only the climate has changed, with weather events occurring as plausible for the 2050s. We provide infrastructure services to Inverclyde, at the Scottish coast west of Glasgow. Our common goal is to keep satisfaction levels up.

## Game setup

- the game board is a simplified map of the Inverclyde area with representations of key infrastructure elements, created with input from the infrastructure providers (4)
- each player is responsible for a type of infrastructure or for public services and is assumed to know their vulnerability to weather hazards



## Game development issues

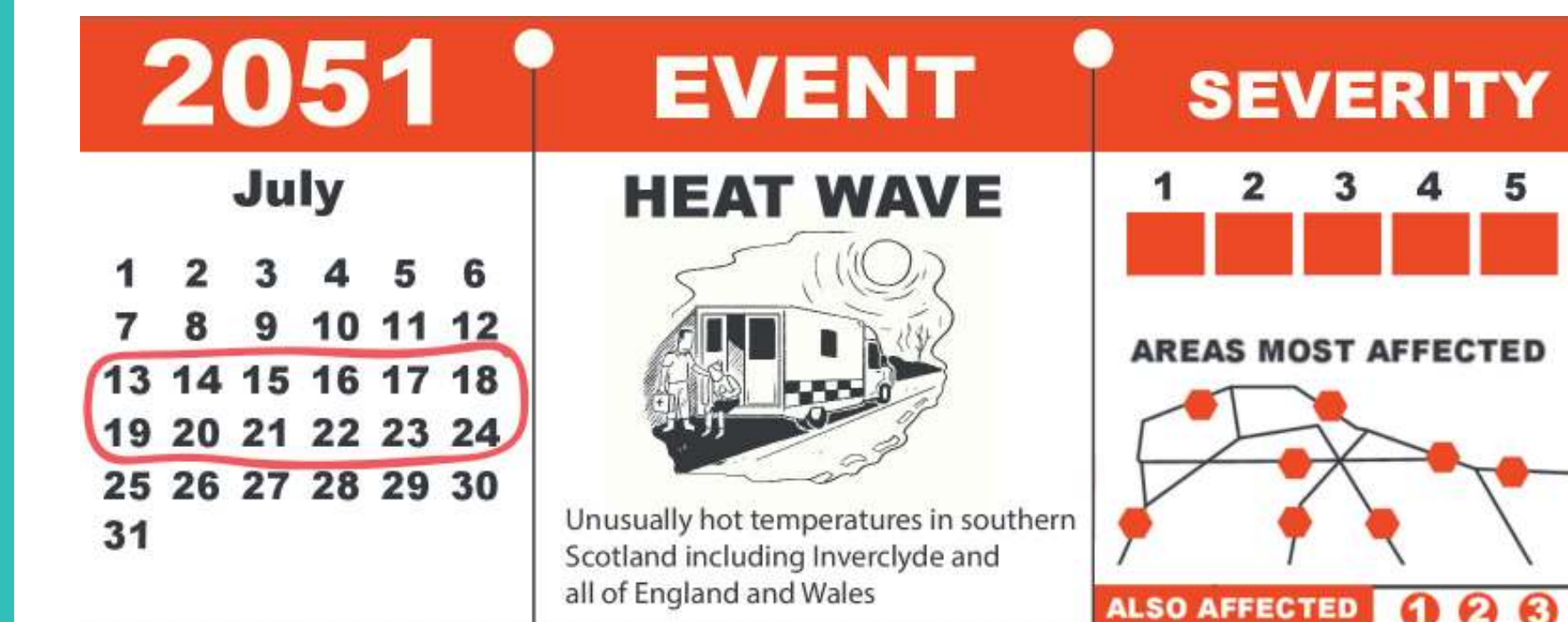
- necessity to simplify
  - infrastructure network for the game board
  - translation of climate model output to flood events
- anticipation of outcomes necessary for game creation?
- degree of gameplay necessary for game to be a game
- confidentiality of information

## Preliminary conclusions & feedback

- productive cooperation between university across disciplines, SEPA, visualisation experts, and the infrastructure providers
- enthusiastic engagement by infrastructure partners
- stimulating discussions on infrastructure interdependencies
- positive feedback on the game approach
- trial games promising on cascading hazard impacts information

In each round, the players

## 1. Understand the hazard event



## 2. decide on damage

on their infrastructure elements both from the event itself and from disruptions of other infrastructure types by placing major/minor damage and disruption tokens on the game board



## 3. discuss impacts

on infrastructure and public services, decide on customer satisfaction, and note thoughts and learning

## A recovery phase

card after each event round describes the time until the next event. The players recover damage and disruptions appropriately, take notes, and assess customer satisfaction.

## Socio-economic changes

potentially having taken place by 2050 are considered at the end of the game in discussions on how the experienced disruptions and damages would then have been different, stimulated by cards describing scenarios like 'growing population pressure', 'lagging infrastructure investment', or 'technological breakthroughs'.

- 1) Perturbed physics ensemble (HadRM3-PPE) simulations from the Met Office Hadley Centre's regional climate model, which form part of the UK Climate Projections 2009. Murphy, J. et al, Met Office Hadley Centre Tech. Rep., 2010.
- 2) European gridded observational dataset E-OBS. Haylock, M. et al., J. Geophys. Res., 2008.
- 3) We thank Adaptation Scotland, Climate Ready Clyde, Inverclyde Council, Scottish Water, SEPA, SGN, SP Energy Networks, and Transport Scotland for their cooperation.
- 4) Scottish Environmental Protection Agency (SEPA).

