How an adaptive and flexible short term flood planning be beneficial

Mengke Ni

Supervisor: Dr. Tohid Erfani

University College London (UCL)

May 8th 2020, EGU 2020

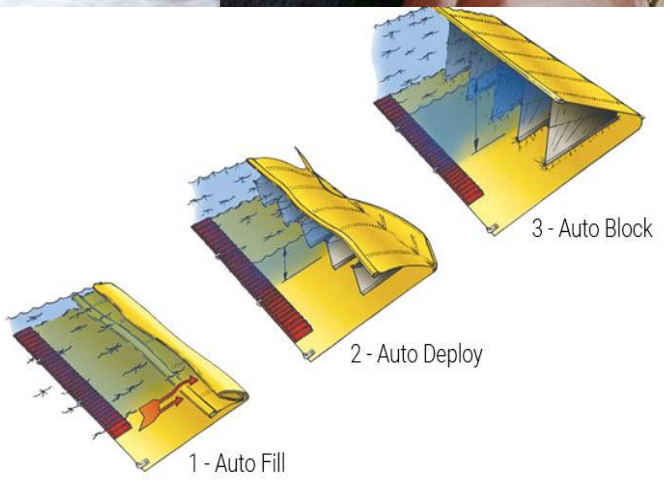
Introduction

- Flood disaster has the highest occurrence frequency among all natural disasters in UK.
- Climate change

  Rainfall is predicted to become more frequent and more intense
- Urbanization: Economic growth and development

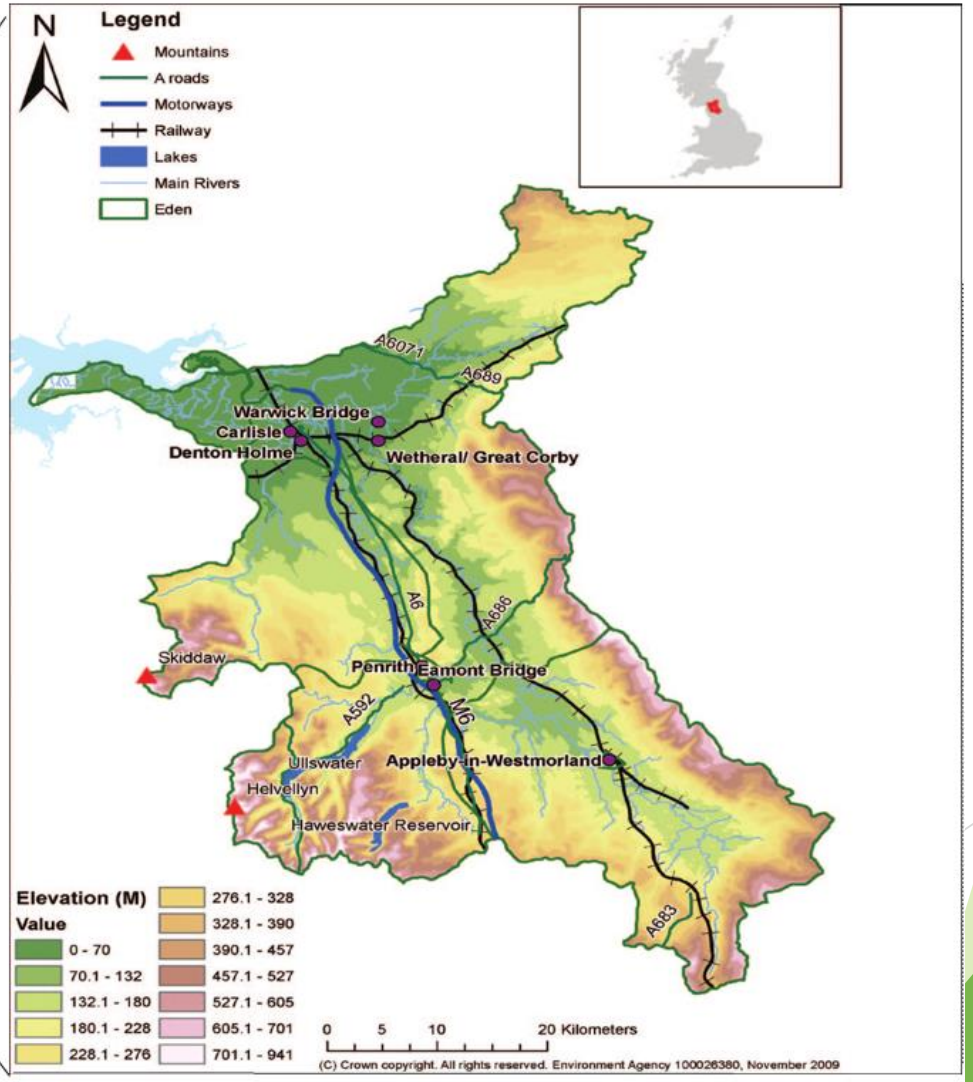
Uncertainty

Temporary flood mitigation measures



Case study


SCOTLAND
Edinburgh
UNITED KINGDOM
Newcastle upon Tyne
Belfast
Douglas
Leeds
Manchester
Dublin
IRELAND
Nottingham
ENGLAND
Birmingham
WALES
Cardiff
London
Celtic Sea


N
Legend
Mountains
A roads
Motorways
Railway
Lakes
Main Rivers
Eden
A6071
A689
Warwick Bridge
Carlisle
Denton Holme
Wetheral/ Great Corby
A6
A686
Skiddaw
Penrith
Eamont Bridge
A592
M6
Ullswater
Appleby-in-Westmorland
Helvellyn
Haweswater Reservoir
A683
Elevation (M)
Value
0 - 70
70.1 - 132
132.1 - 180
180.1 - 228
228.1 - 276
276.1 - 328
328.1 - 390
390.1 - 457
457.1 - 527
527.1 - 605
605.1 - 701
701.1 - 941
0 5 10 20 Kilometers
(C) Crown copyright. All rights reserved. Environment Agency 100026380, November 2009

Purpose of the study

- Develop a decision support framework for temporary flood interventions deployment
- Flexible and adaptable decision making in flood risk management
- Least cost mitigation planning and least damage planning

Model development

Minimize damage:

- Residential Damage f_1
- Non-residentialDamage f_2
- Agriculture Damage f_3

Minimize total cost:

- $\sum$ undiscounted Capital cost
- $\sum$ undiscounted Fixed Operational cost
- $\sum$ undiscounted Variable Operational cost

Flood damage type and methods to estimate them

Damage to Residential buildings

Structure damage

$Ds(i,j)=[FA(i,j)*EC_s(i,j)*C_s(i,j)]$

Content damage:

$Dc(i,j)=[NF(i,j)*EC_c(i,j)*C_c(i,j)]$

Outside property damage:

$Dop(i,j)=[N*EC_{op}(i,j)*C_{op}(i,j)]$

Emergency and clean up costs:

$De(i,j)=[N*EC_e(i,j)*C_e(i,j)]$

Damage to Non-residential buildings

Structure damage:

$Dp(i,j)=\sum[NW(i,j,n)*EC_p(i,j,n)*C_p(i,j)]$

Stock damage:

$Ds(i,j)=\sum[NW(i,j,n)*EC_s(i,j,n)*C_c(i,j)]$

Outside property damage:

$Dop(i,j)=\sum[NW(I,j,n)*EC_{op}(i,j,n)*C_{op}(i,j)]$

Emergency and clean up costs:

$De(i,j)=\sum[NW(I,j,n)*EC_e(i,j,n)*C_e(i,j)]$

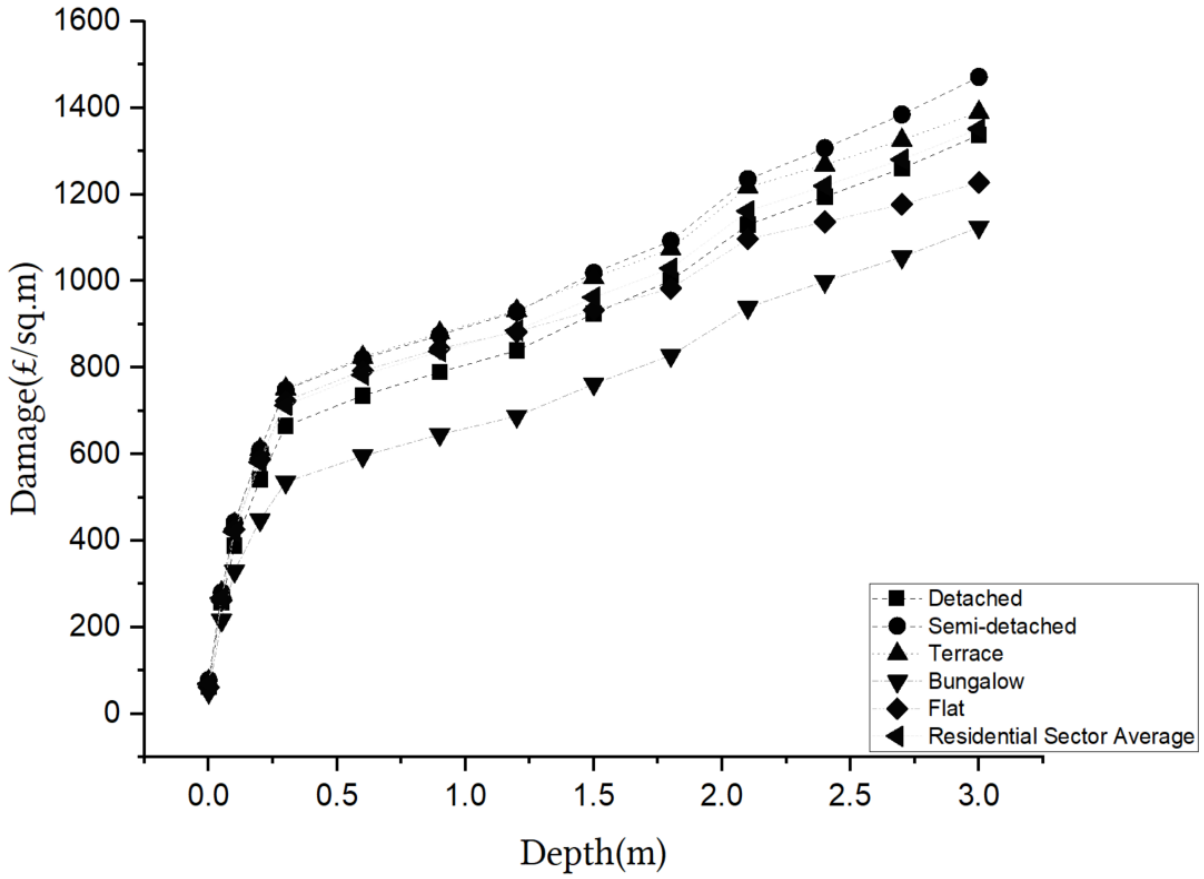
Damage to Agriculture

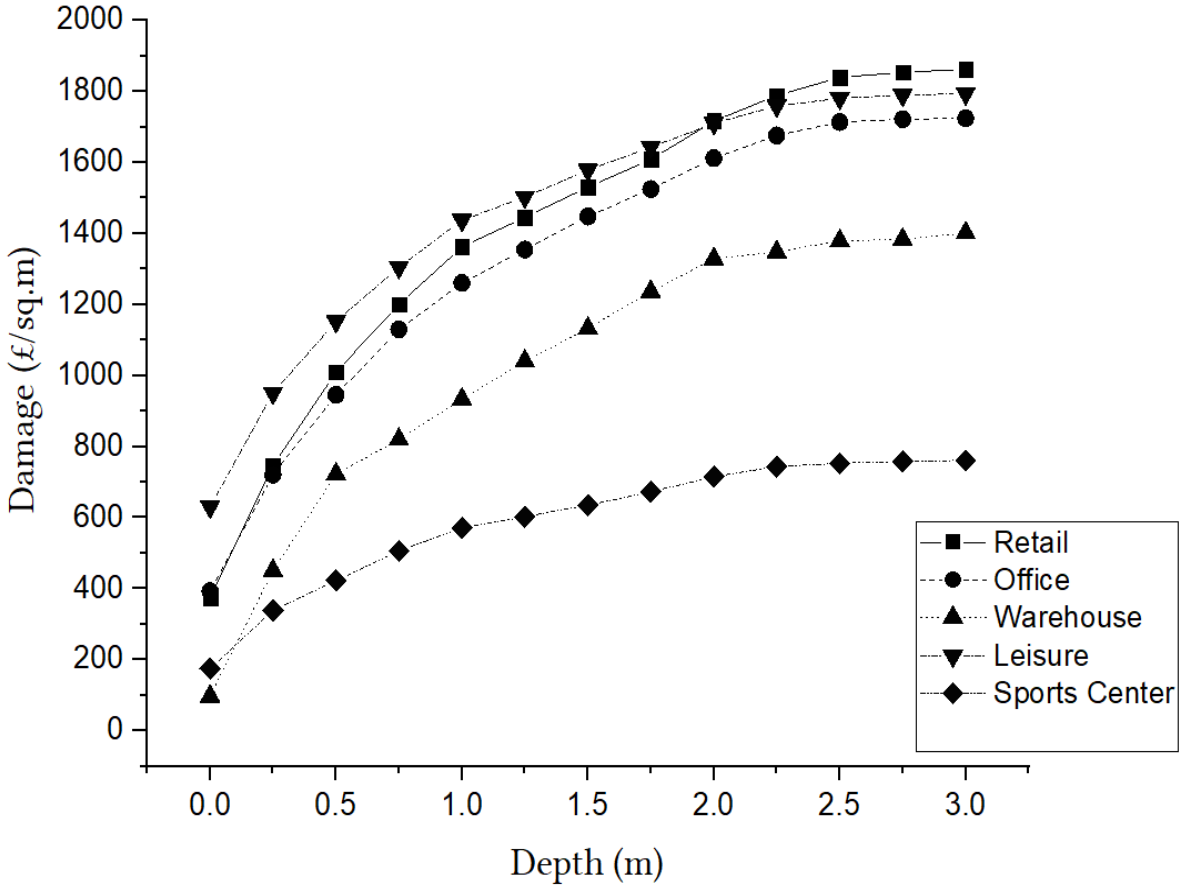
Average Damage to agriculture products in grid (i,j):

$AD(i,j)=\sum[D_m(i,j.k)*CRP_a(i,j,k)*mn(k)]$

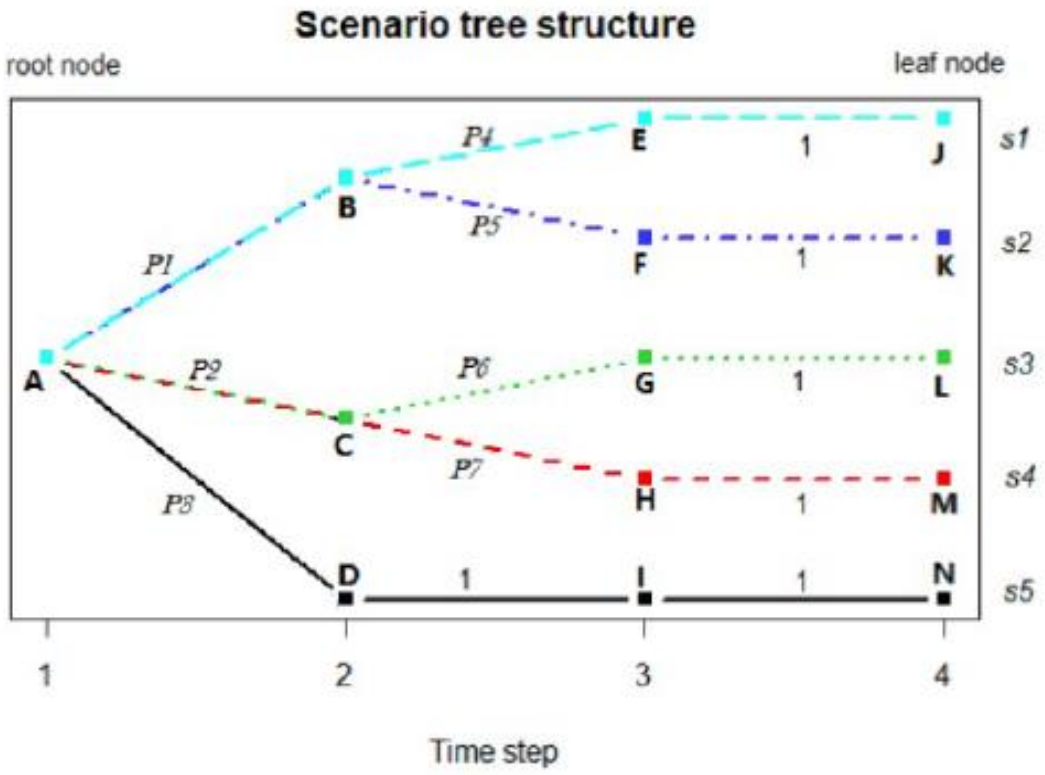
$Dm(i,j)= CP_k \times Y_k \times DC_k(i,j)$

Stage-Damage Curve



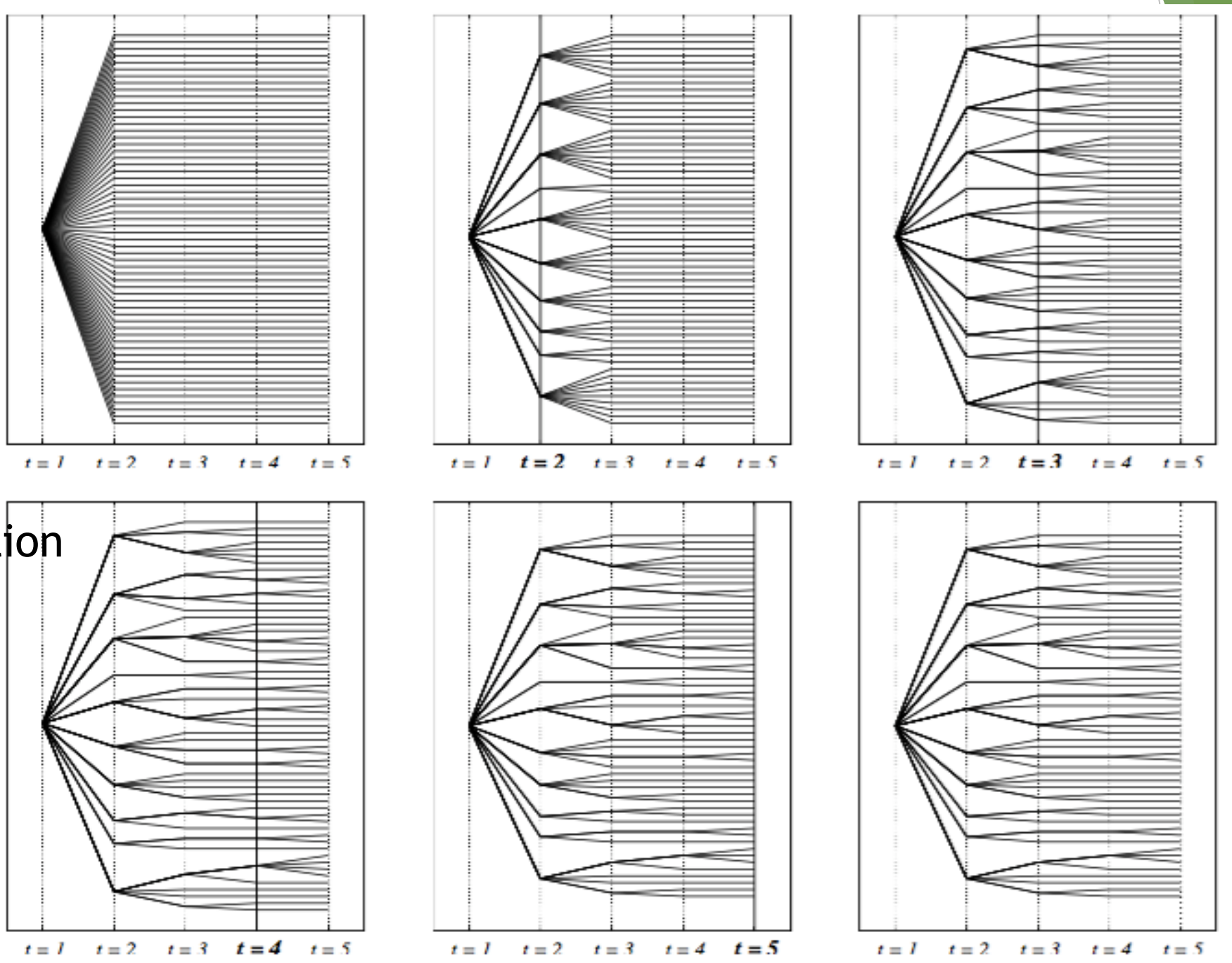


Scenario tree



- Scenario tree was generated to represent uncertain scenarios
- They show number of stages (time step) and decision process directly
- Represent the stochastic variable as much as possible
- Resulting solution show stability in and out of the sample

Forward Tree Construction



Thank you!