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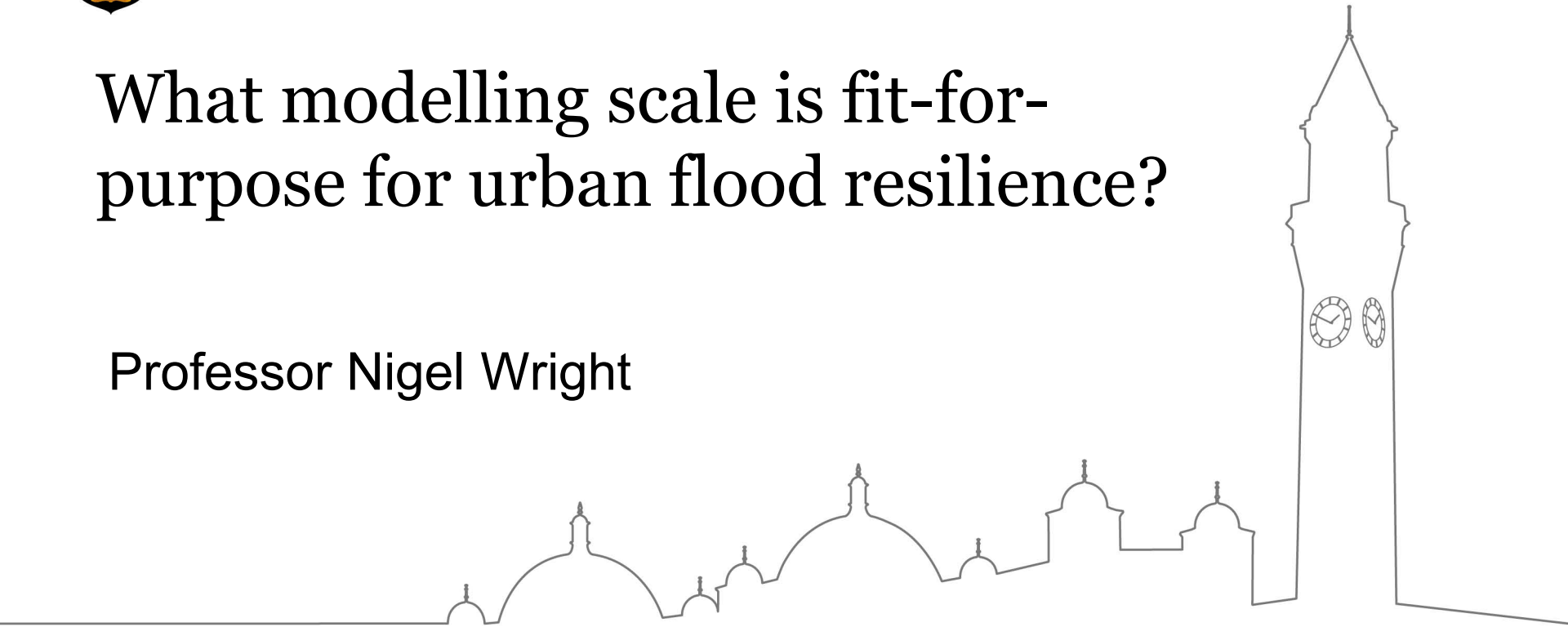
What modelling scale is fit-for-purpose for urban flood resilience?

Professor Nigel Wright



Introduction

- Part-time in the School of Engineering at the University of Birmingham
- Part-time Director at Edenvale Young Associates – a small, specialist flood modelling consultancy

- IGSNRR Collaborator

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Water-Climate-Human Nexus?

- “Nexus” is a concept, not a solution.

- Everything is connected…
- …but we cannot model everything.

- There are many sources of flooding within this nexus.

  Direct rainfall; river; coastal; groundwater.

Drivers across the nexus

- Increased Severity and Frequency:
  - Urbanisation.
  - Economic growth.
  - Climate change.

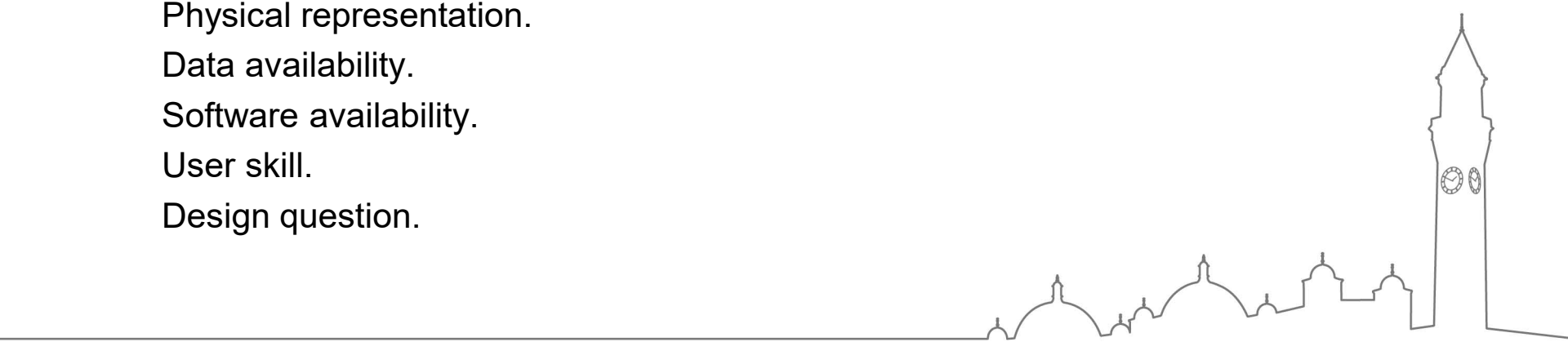
Focus on urban flood resilience

- SuDS/LID/Sponge City

- Increase infiltration.
- Enhance drainage.
- Ensure preparedness.
- Defend where necessary.

How Do We Choose Models for Resilience?

- Systems models exist for resilience.
- Focus here is on inundation prediction.
- Choice is based on:
  - Physical representation.
  - Data availability.
  - Software availability.
  - User skill.
  - Design question.

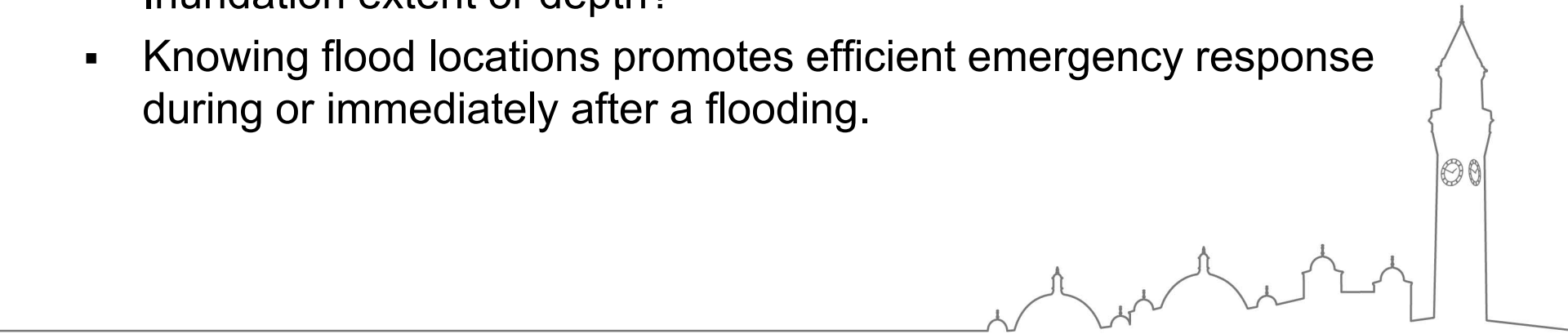


What Should an Urban Flood Model Include?

- Rainfall prediction.
- Infiltration.
- Drainage network.
- Surface water flow.
- Sediment and water quality.

What if the input data is scarce?

- Without high-quality data, standard modelling has significant uncertainties.
- What is more important for mapping an extreme flood event? Inundation extent or depth?
- Knowing flood locations promotes efficient emergency response during or immediately after a flooding.



What is best for decision-making?

- Do we want:

1. Detailed model with high uncertainty; or

2. Simpler model with less uncertainty?

Case Study: Chengdu, Sichuan, August 2020.

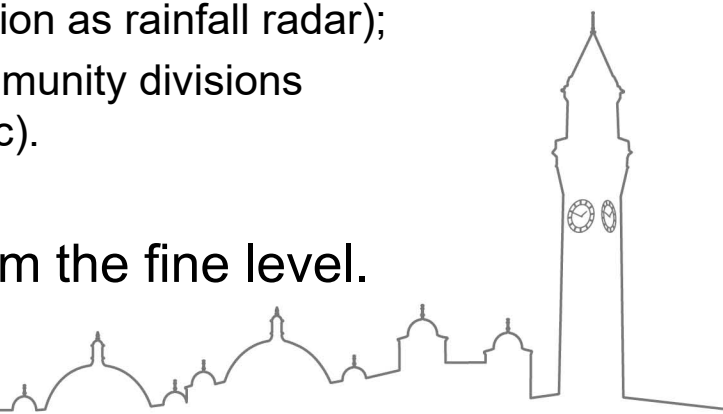
- Using crowd-sourced data.
- Considering different models:

a) grid-based hazard mapping based on fine hydrodynamic modelling with support of social media data;

b) kilometre-level hazard mapping (same spatial resolution as rainfall radar);

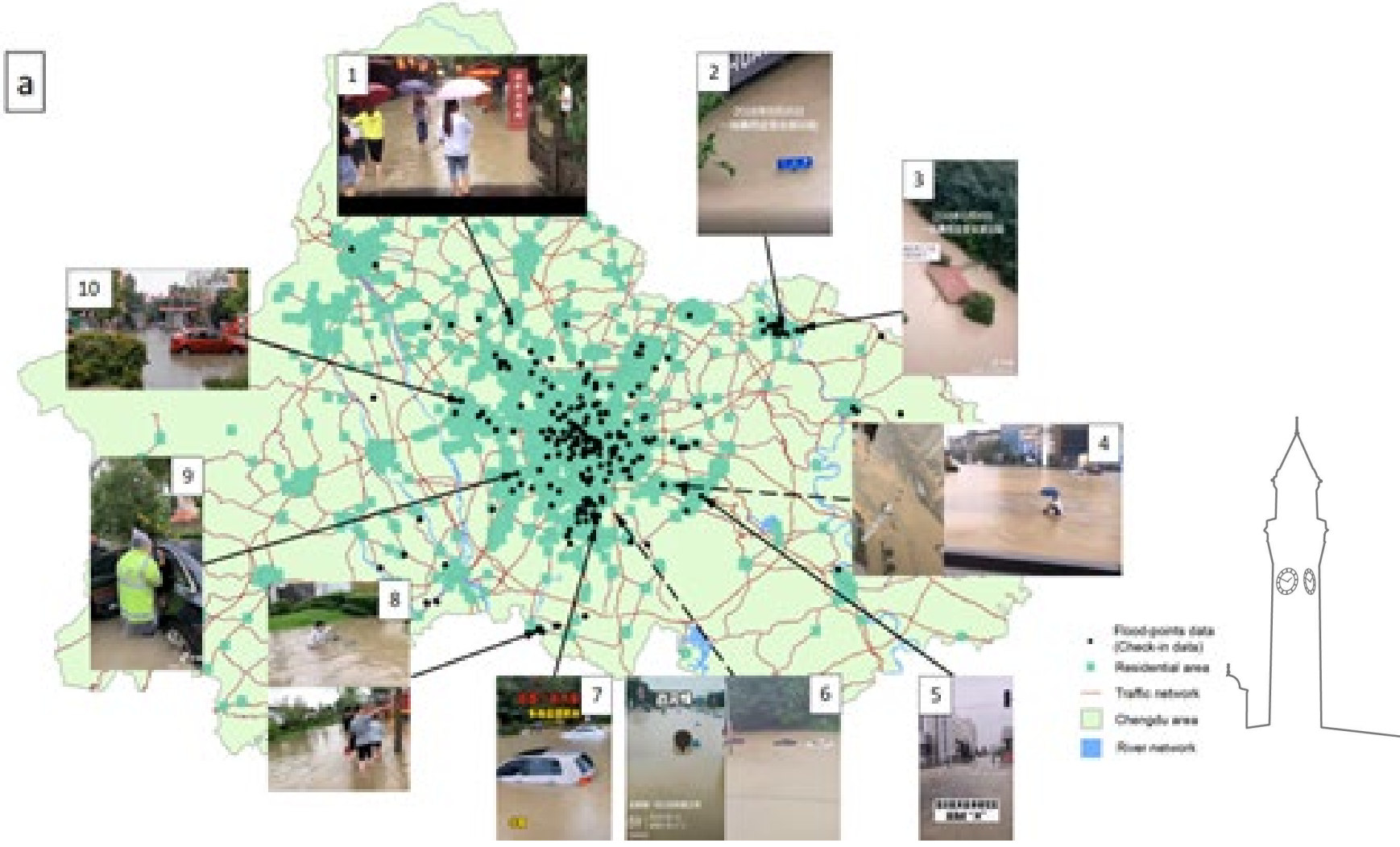
c) district-level hazard mapping based on the city's community divisions (generally the basis for communication with the public).

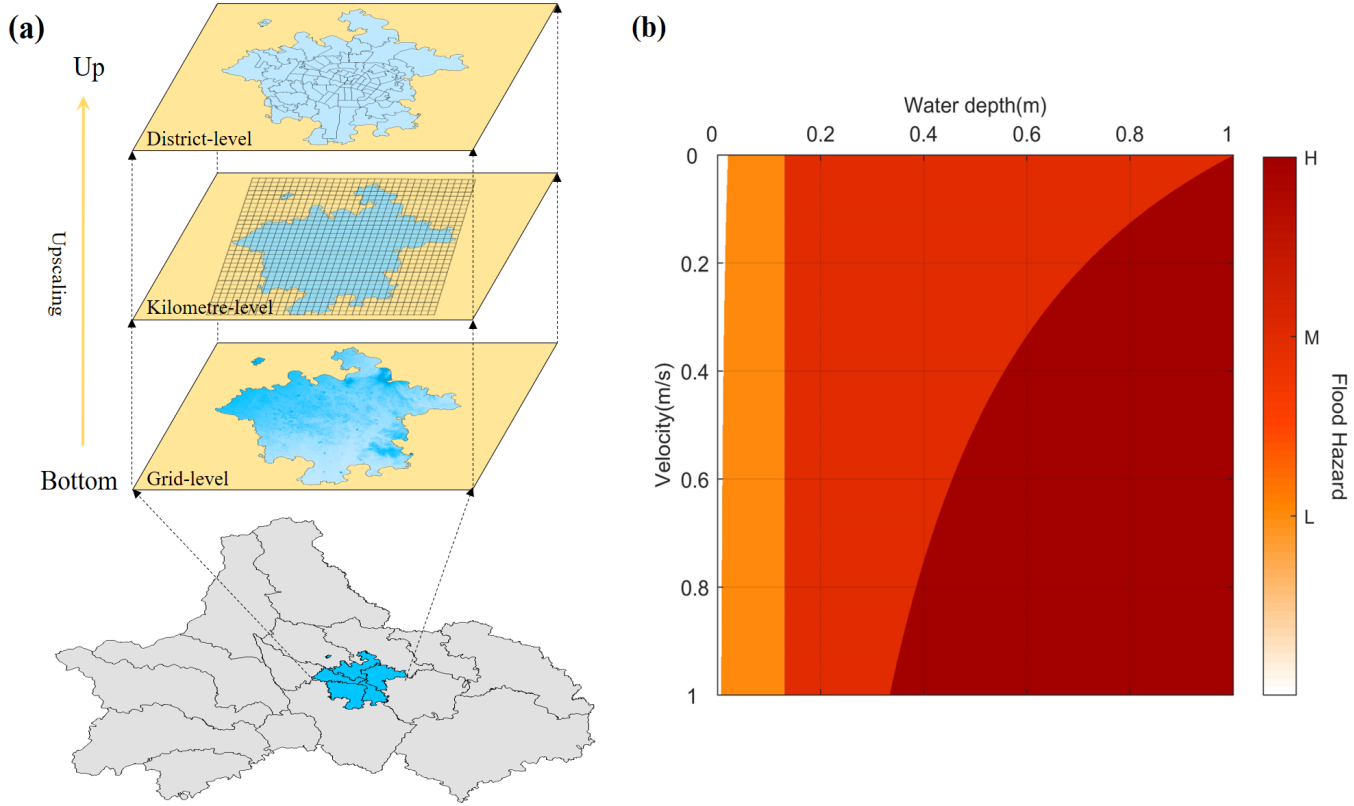
- Coarser models are based on upscaling from the fine level.
- Reduces the effect of data scarcity.



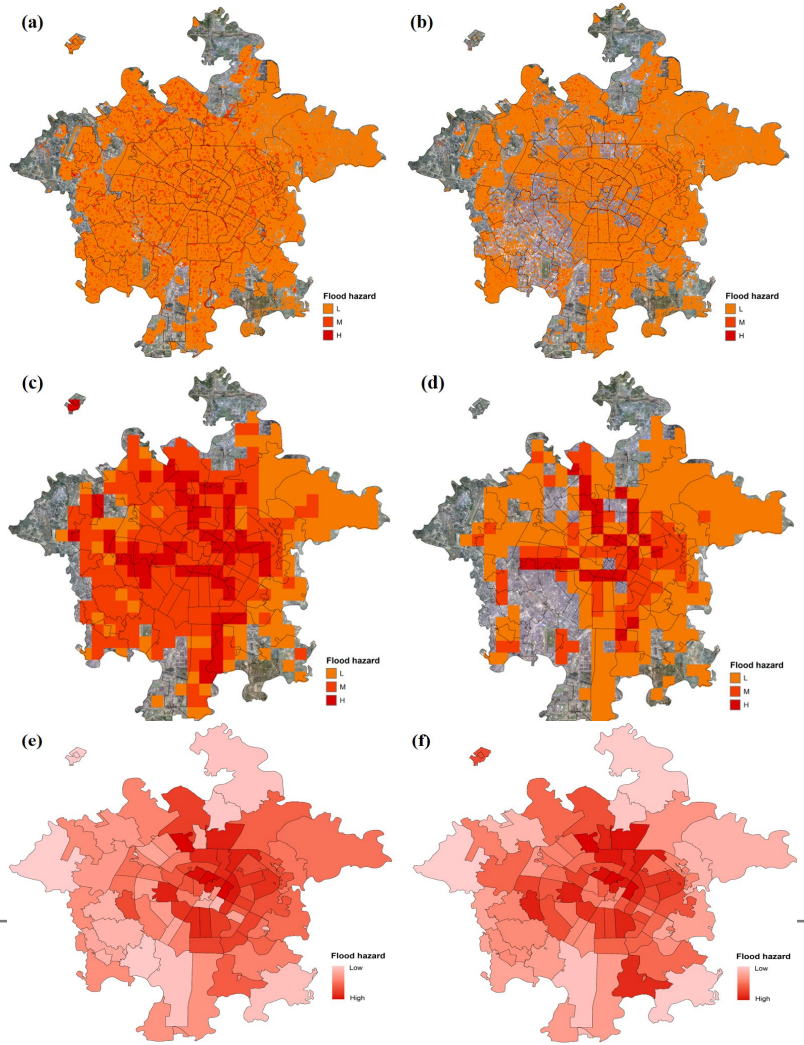
Re a
(b

(a)↵


1
2
3
4
5
6
7
8
9
10
Flood-points data (Check-in data)
Residential area
Traffic network
Chengdu area
River network


(a)
Up
Upscaling
Bottom
District-level
Kilometre-level
Grid-level

(b)
Water depth(m)
0
0.2
0.4
0.6
0.8
1
Velocity(m/s)
H
M
L
Flood Hazard



- Coarser level is most reliable and useful for emergency response.

Thank you!