

Flooding in Dar es Salaam



During heavy rains Housing, Transport, Electricity and Water systems are heavily affected and all utilities are in limited supply.

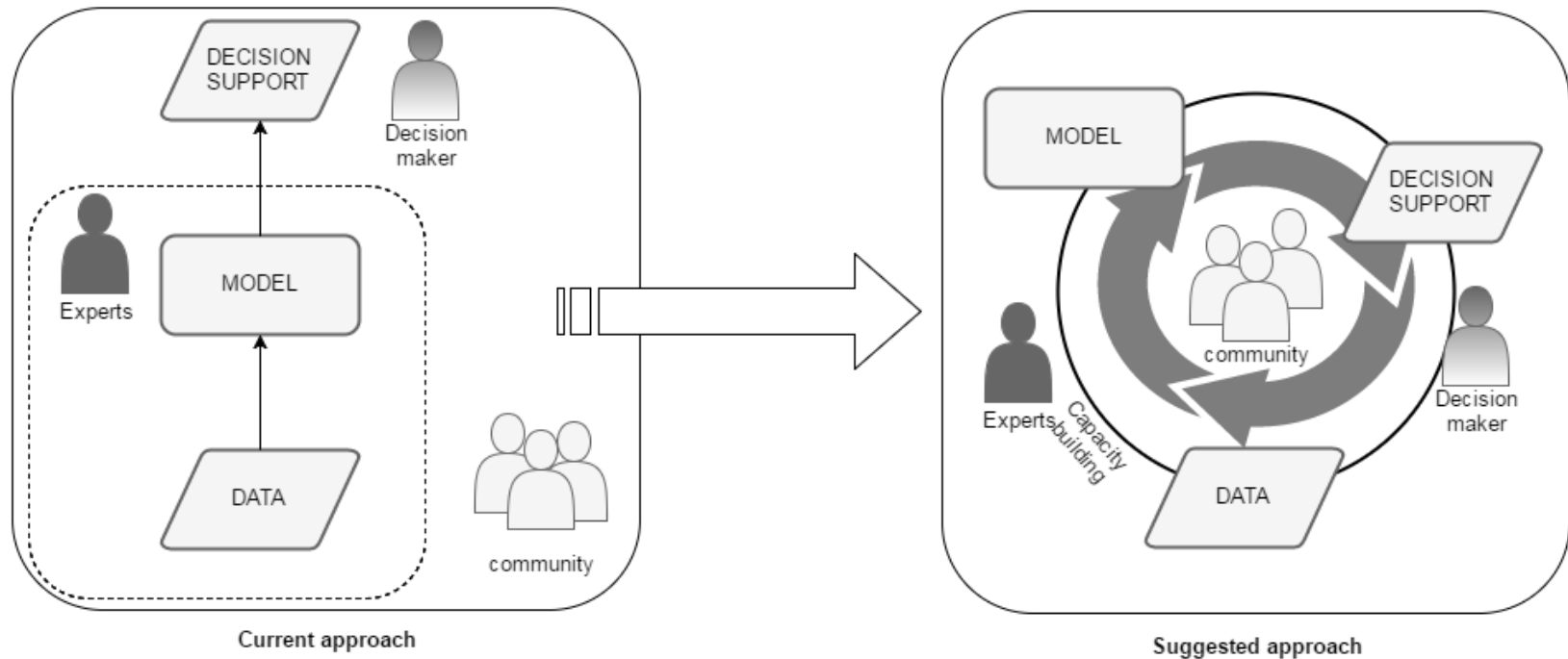
Total closure of some health facilities, schools and industries.

Soaring food prices.

DATA ?

Mobilizing your data – and improve!

Collaborative modeling approach



If data is not there, **collect** it!

If data is there, **enrich** and **organise** it

If data is organised, **mobilize** it for mapping water

What is Ramani Huria?

Ramani Huria – Swahili for “Open Map” started in March 2015 –

over 300 people have been trained in mapping. A collaboration with the Red Cross has trained 100 community volunteer disaster responders, across Dar es Salaam.

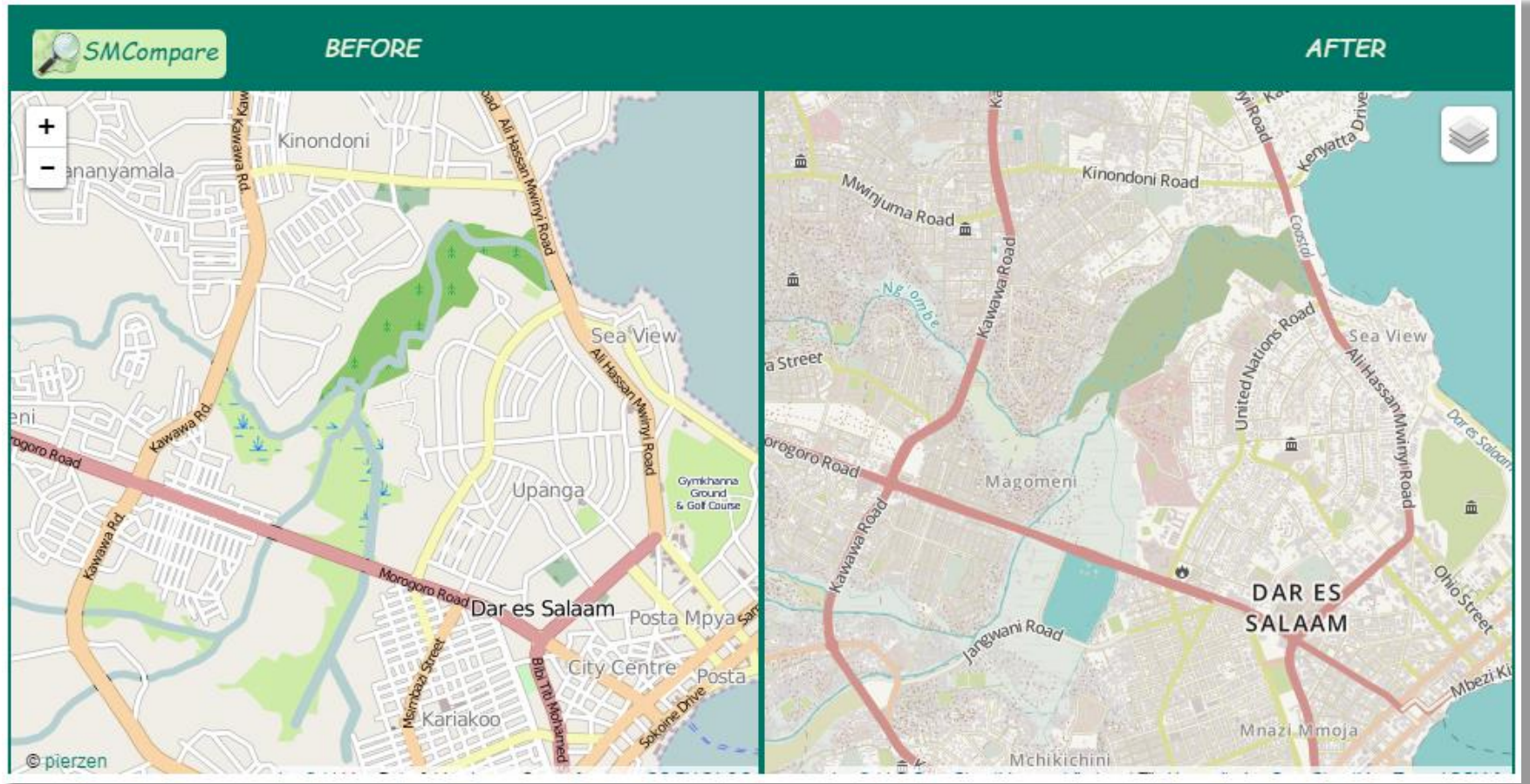
Ramani Huria is a participatory mapping project that empowers residents to understand how their communities can become more flood resilient

Ramani Huria: A decision making tool for Urban planners

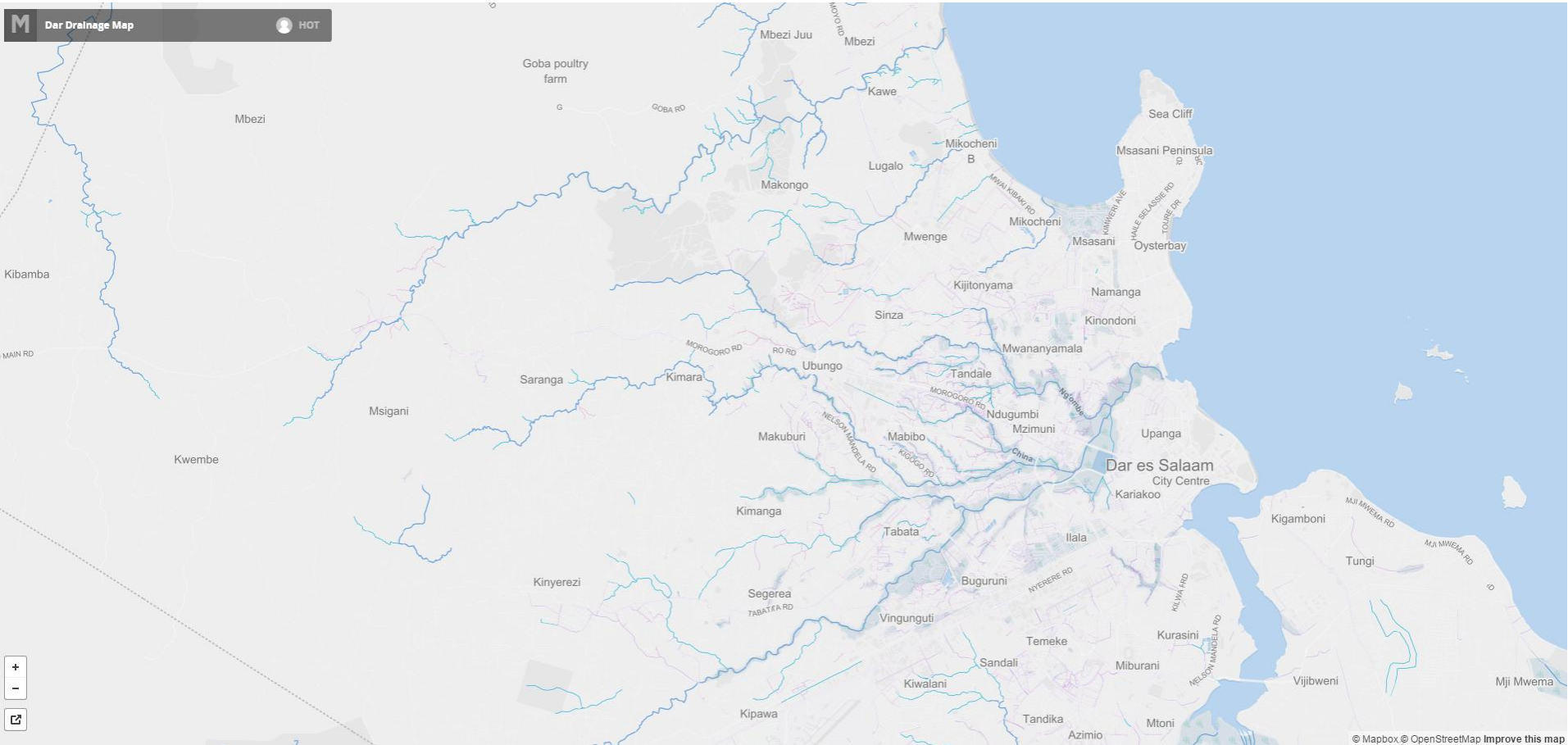
New innovations meant to progress understanding
in disaster risk

- Available data and tools
- From information to insight
- Beyond insight to changes in behaviour

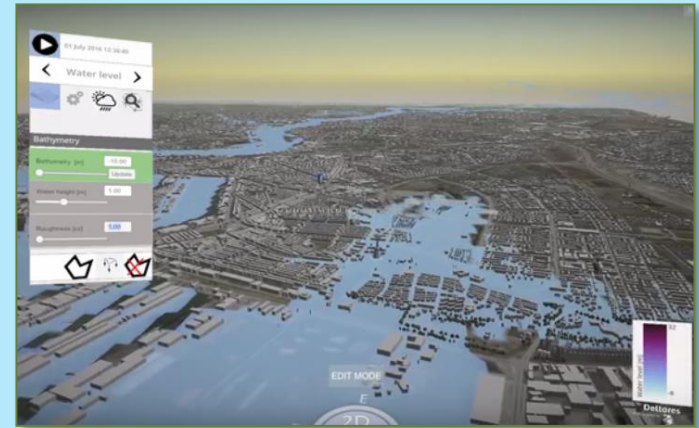
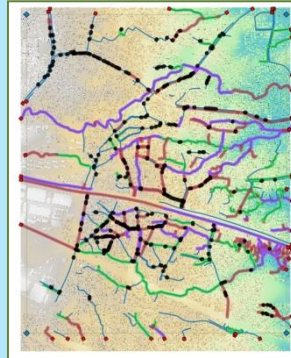
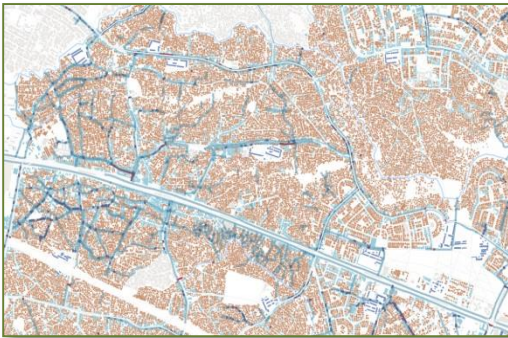
Ramani Huria: community engagement



Drainage features



what can you do with open data?



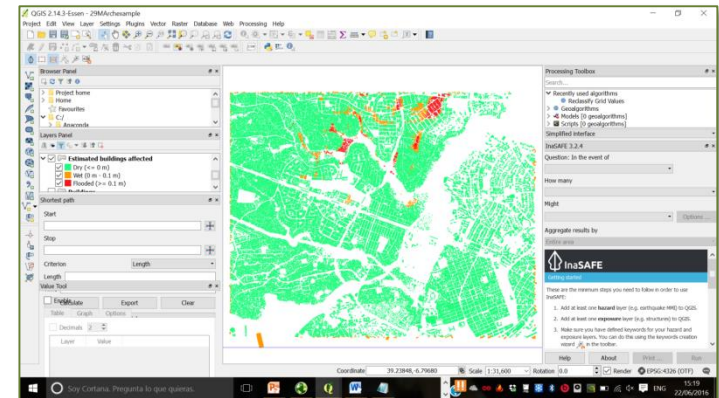
Ramani Huria Data

GIS layers of
elevation, channels
culverts and boundary
conditions

Flood inundation
model

Scenarios
- Rainfall
- Discharge
- infra blockage
- new infrastructure)

Flood impacts (e.g.
with InaSAFE)



Urban flood modelling

- 1D modelling
- 2D modelling
- Rainfall and rainfall-runoff (effects of paved/unpaved surfaces)

One dimensional De Saint Venant equations

Change in system storage

Net in- or outflow

Lateral sources

Continuity

$$\frac{\partial A_f}{\partial t} + \frac{\partial Q}{\partial x} = q_{lat}$$

Momentum

$$\frac{\partial Q}{\partial t} + \frac{\partial}{\partial x} \left(\frac{Q^2}{A_f} \right) + gA_f \frac{\partial h}{\partial x} + \frac{gQ|Q|}{C^2 R A_f} - w_f \frac{\tau_{wind}}{\rho_w} = 0$$

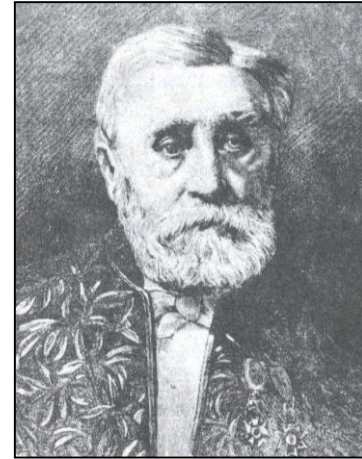
Inertia

Gravitation

Wind friction

Advection

Hydraulic Roughness



*Jean-Claude Barre
de Saint-Venant
1797 - 1886*

Flow formula of *de Chézy*:

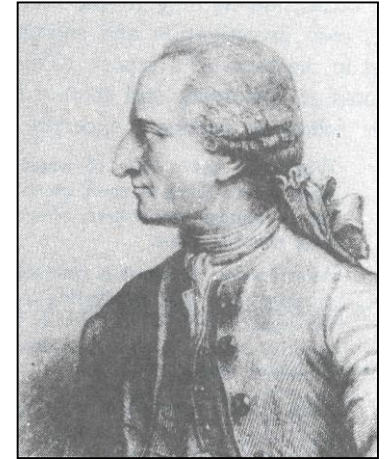
$$u = C \sqrt{r_{hy} I_f}$$

Restrictions to this formula:

Valid only for hydraulic rough behaviour, exponent n (here 2.0) is in nature smaller (1.7 - 2.0)

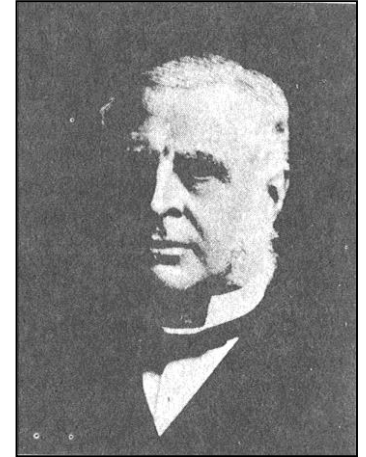
The viscosity („internal friction“) of the water is not taken into account

The form of the cross section of the channel (i.e. the real flow velocity distribution) remains unstudied



Antoine Chezy
1718 - 1798

$$C = \frac{1}{n} r_{hy}^{1/6} = k_{St} r_{hy}^{1/6}$$



Robert Manning
1816 - 1897

The flow formulas according to Manning, Strickler are empirical !!

The flow formula and the roughness should be chosen with respect to the local situation and practical experience

1D modelling

- Example:

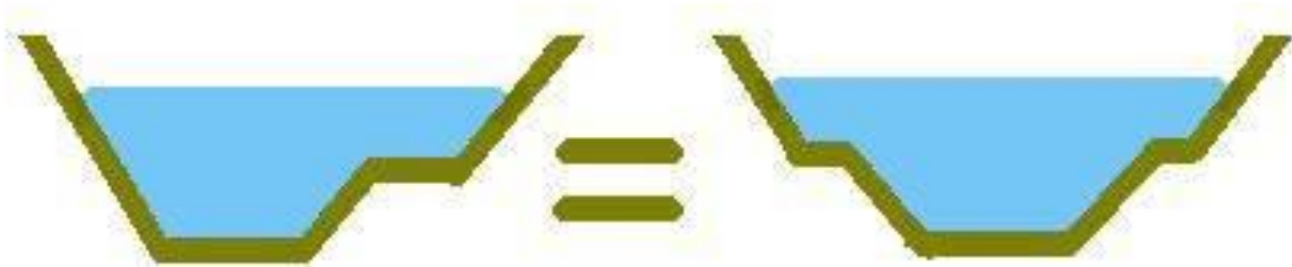
For a 1D hydrodynamic model

- water depth (z-dimension) and

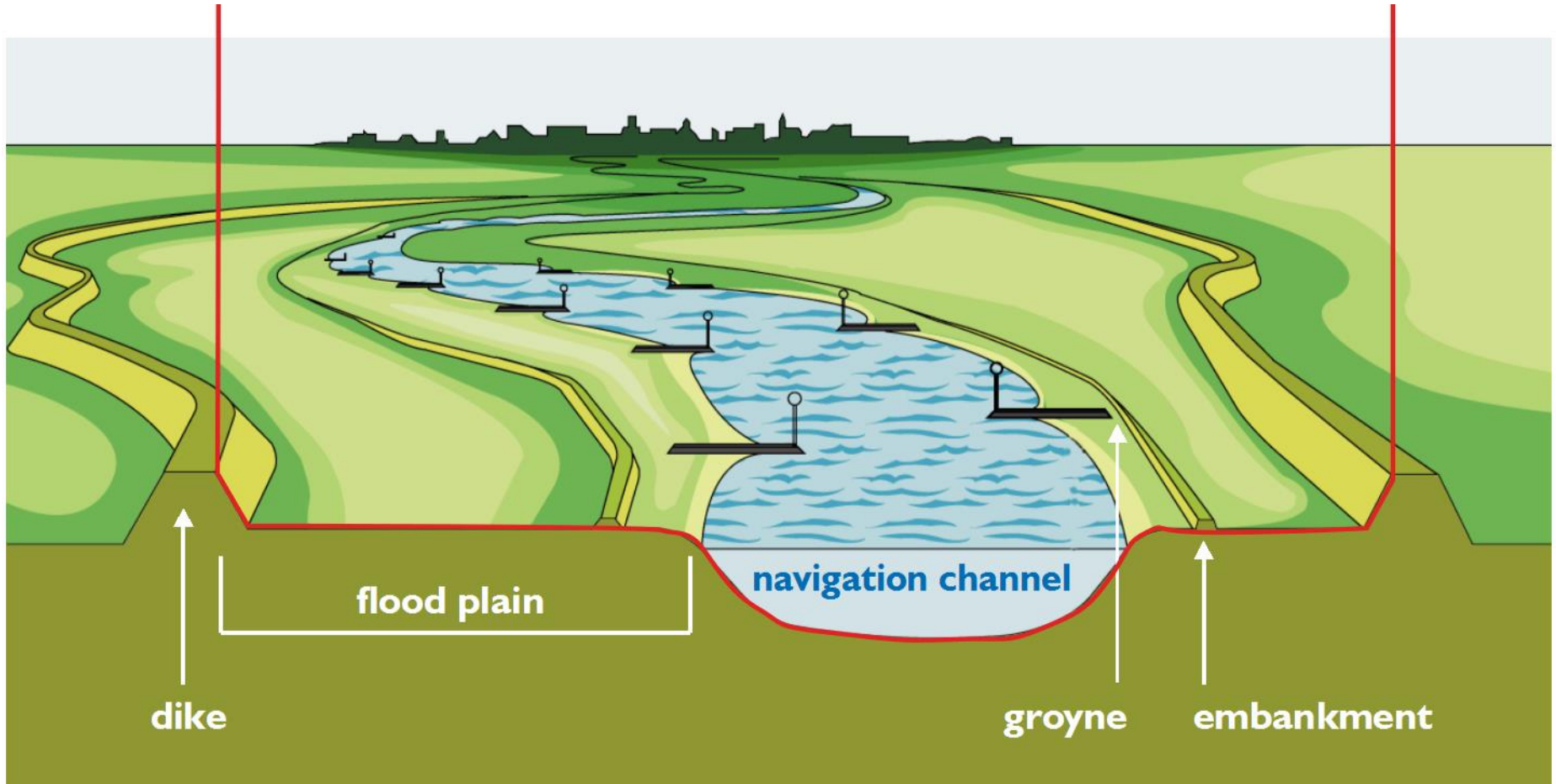
- river width (y-dimension)

are put in two parameters: “wetted surface”
and “wetted perimeter”

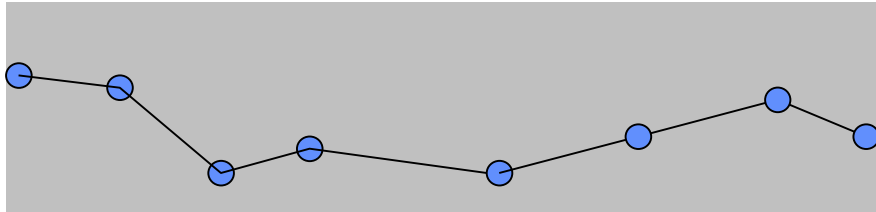
Thus:



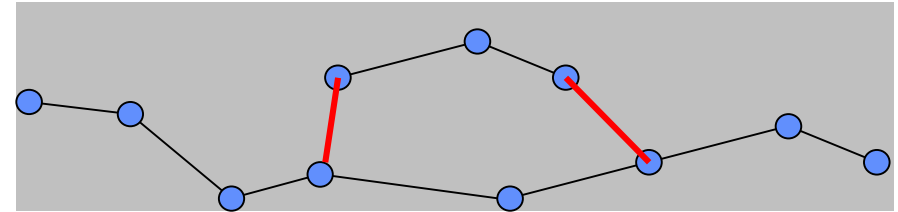
1D modelling concept



Hydraulic Models for Flood Mapping: 1D, 2D, 1D2D

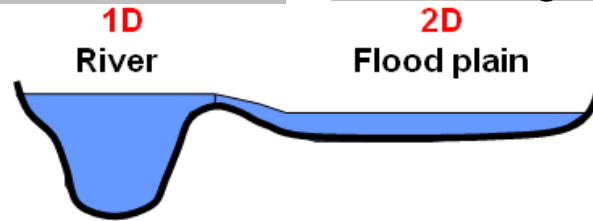


Fully 1D

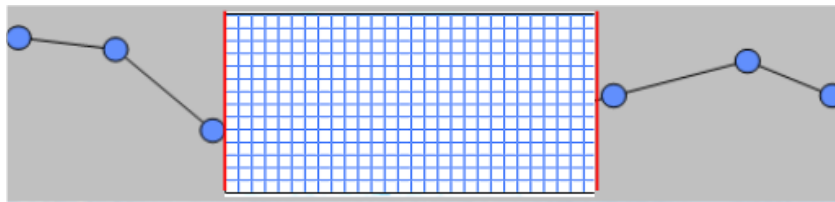


2D
Flood plain

Quasi-2D

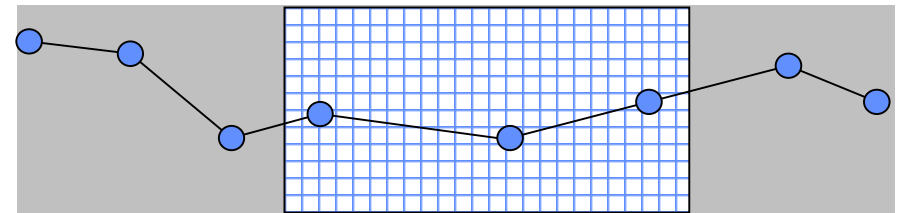


1D
River

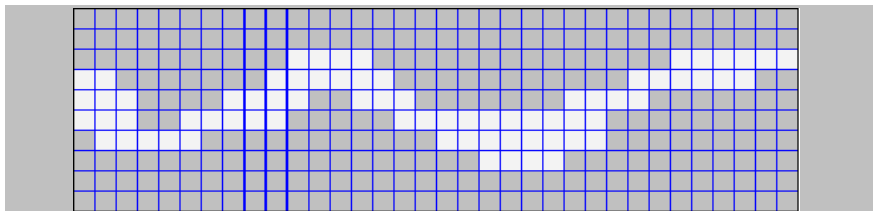


— Line 1D2D Internal boundary

Horizontally 1D/2D connection



Vertically 1D/2D connection



Fully 2D model

Application for 1D2D Urban Flood Modelling

simulation of inundation of flood plains and dike rings due to high sea-levels, river discharges

inundation - risk analysis

damage modelling

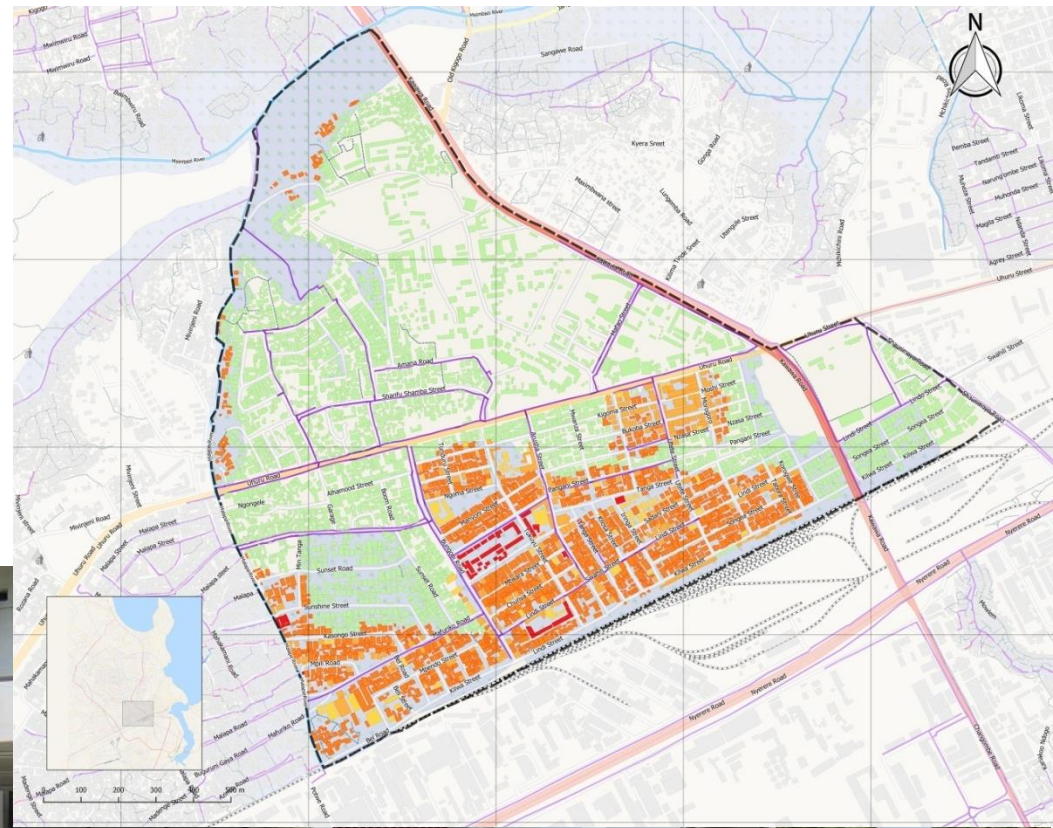
evacuation plans / disaster scenarios

modelling of wetland areas



Inundation Modelling

Training Staff and Students with Open Source: InaSafe



This allows us to see the priorities for actions in our city. Identify the most flood prone infrastructure (Orange) and make decisions accordingly!

Other Applications

- construction of drainage systems and other Infrastructures
- Property tax
- Investment decision
- Relocation
- at Individual level

AHSANTENI

Thank you

Merci

Спасибо

Gracias

شكرا

谢谢