A GRASS GIS module for 2D superficial flow simulations

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Proper flood modelling in urban areas is critical

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- Integration of superficial and drainage flows [Hsu et al., 2000]

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- Flow damping and 2D friction

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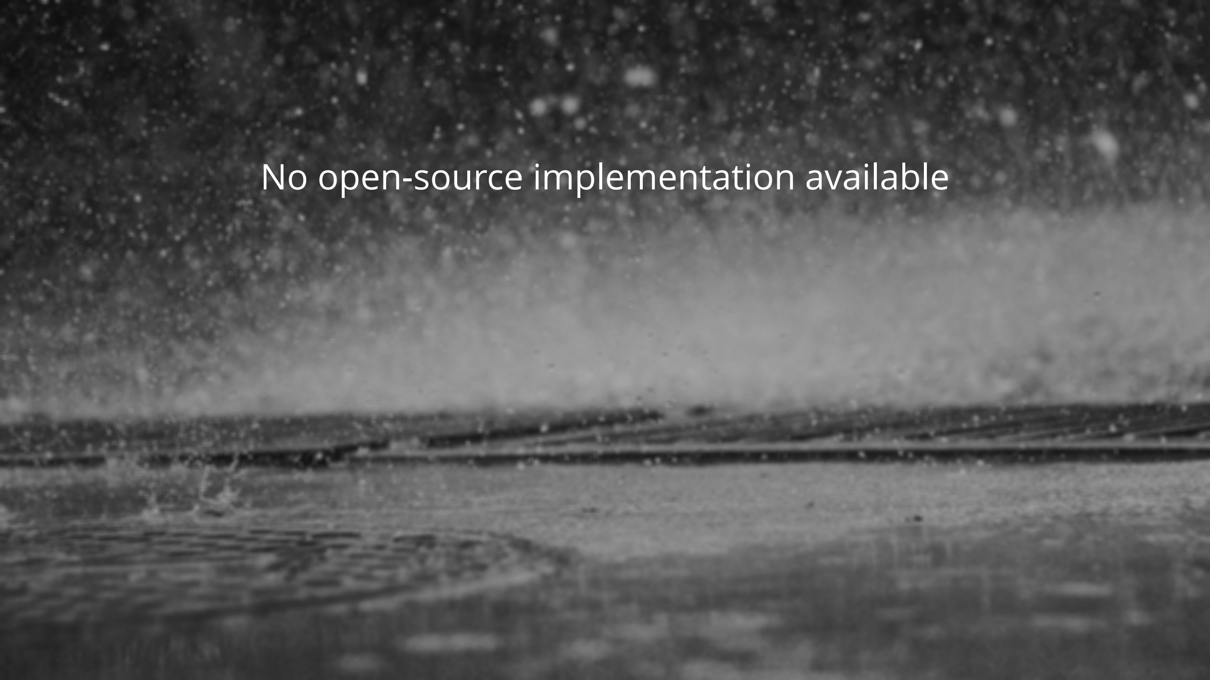
- Diffusive wave: slow at high resolutions [Hunter et al., 2008]
- Partial inertia: unstable at low frictions [Bates et al., 2010]
- Flow damping and 2D friction: no drainage coupling [De Almeida and Bates, 2013]

Objective:

Couple a damped partial inertia superficial model with a drainage model, in a GIS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→ Development of new model *from scratch* in Python:

Itzï

GRASS GIS + Itzï

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- Complete open-source GIS

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- Easy selection of study area
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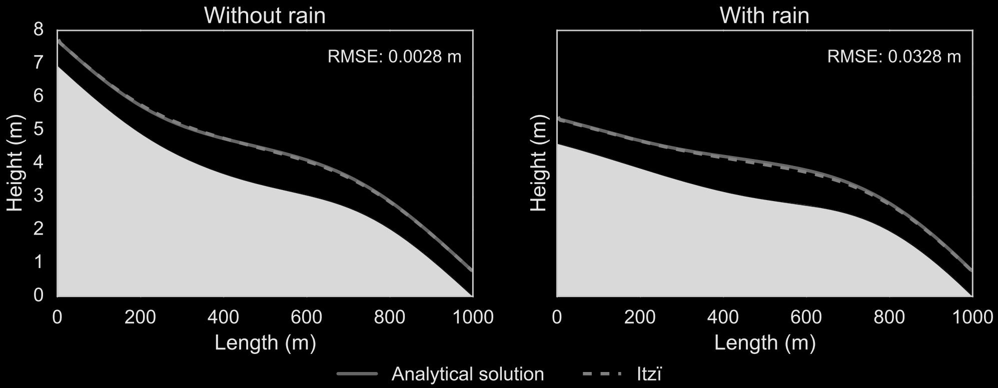
- Parallelized using OpenMP

Model testing and validation

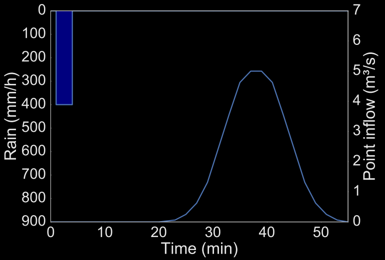
- Superficial model
  - Analytic cases
  - EA test 8a, synthetic
  - Hull (UK), real-life
- Bidirectional drainage coupling
  - EA test 8b

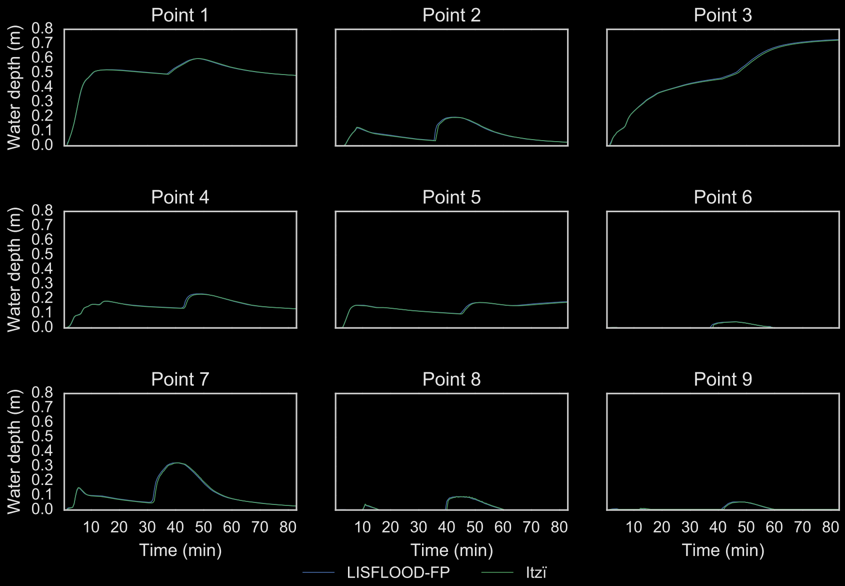
Comparison with analytic solution of SWE [MacDonald et al., 1997]



Comparison with LISFLOOD-FP (EA test 8a)

[Néelz and Pender, 2013]



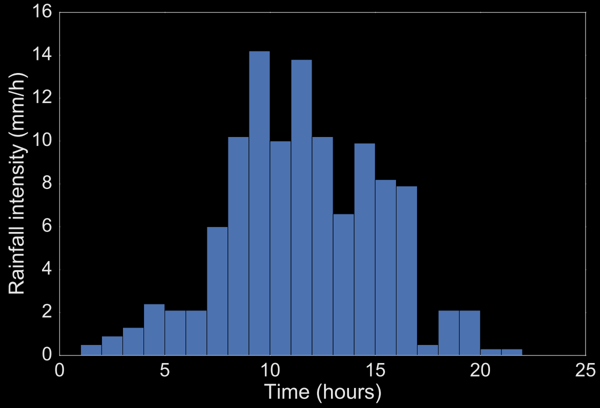

Point 1
Point 2
Point 3
Point 4
Point 5
Point 6
Point 7
Point 8
Point 9
Water depth (m)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
10 20 30 40 50 60 70 80
Time (min)
LISFLOOD-FP
Itzï

Flooding of Hull (UK), 25th June 2007

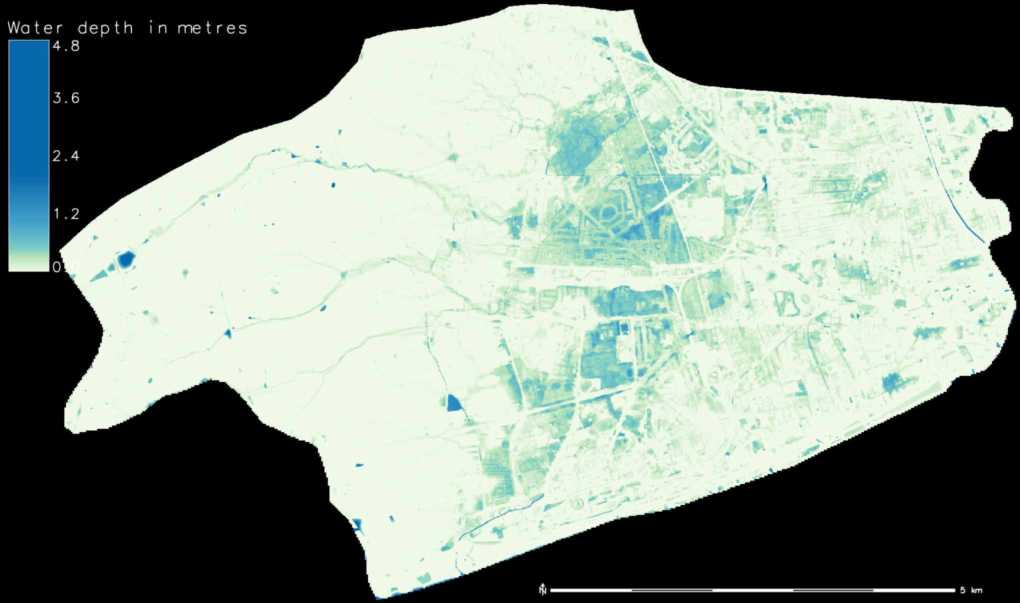
[Yu and Coulthard, 2015]

- LiDAR 5m
- 3.5M cells
- Drainage represented as a constant loss (no network)
- 24h event
- Computed in 3h on a desktop computer

Rainfall at Hull university



Flooded areas


Water depth in metres
4.8
3.6
2.4
1.2
0.0
N
5 km

Bidirectional drainage coupling: EA test 8b (video)

- Inflow upstream of drainage network
- Overflow at manhole only (no rainfall)
- 2m LiDAR
- Buildings represented as increased elevation

Conclusions

- New open-source computer model
- Being used for Mexican flood risk atlas in 20 cities
- Bidirectionally coupled with SWMM (in progress)
- Upcoming modeling of Kolkata drainage system

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Thank you

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