MADALGO
CENTER FOR MASSIVE DATA ALGORITHMICS


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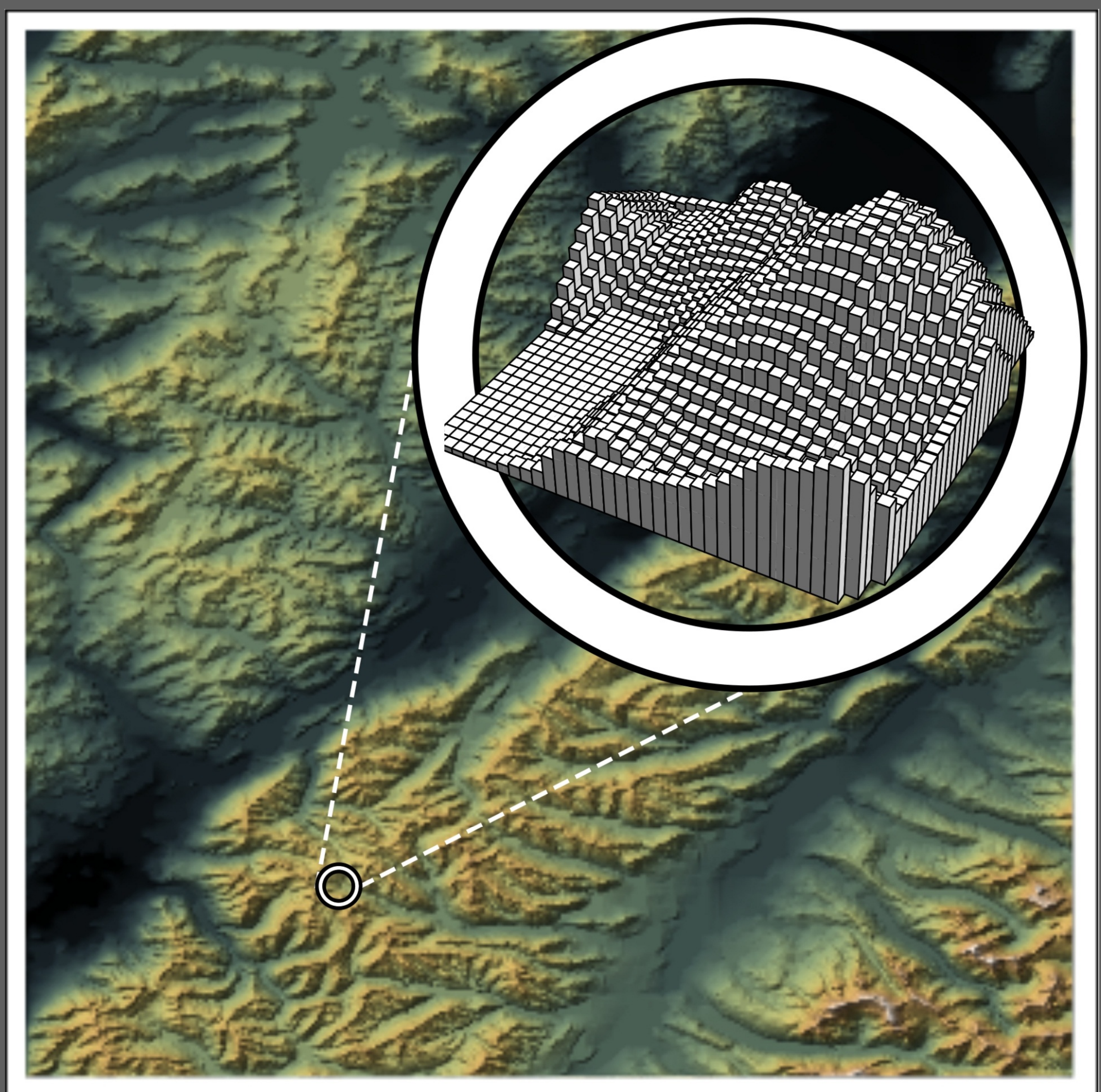
Estimating River Floods on Massive Terrains

The Problem

Severe river floods have lead to some of the most serious natural catastrophes of the modern years. Predicting the part of a landscape that will be covered by water in case of a river flood is a well-studied problem in the fields of Hydrology and Geographic Information Science.

The Challenge: Predictions Based on Massive Digital Terrains

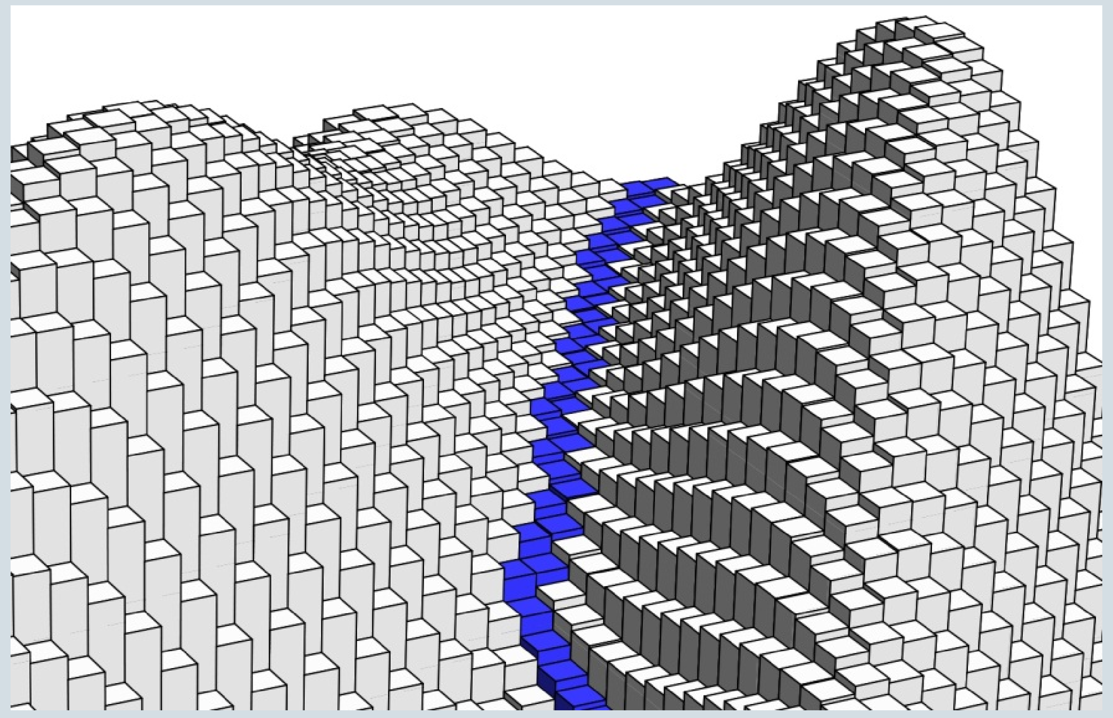


Today it is possible to represent landscapes, and therefore to simulate water flow on their surface, using digital terrains. During the last years, the resolution of available digital terrains has increased radically; this has lead to huge datasets of hundreds of Gigabytes that do not fit in the memory of a normal computer. Therefore such datasets cannot be processed by standard algorithmic methods. For this reason, it becomes critical to develop a method for simulating river floods and which works efficiently on huge data sets.

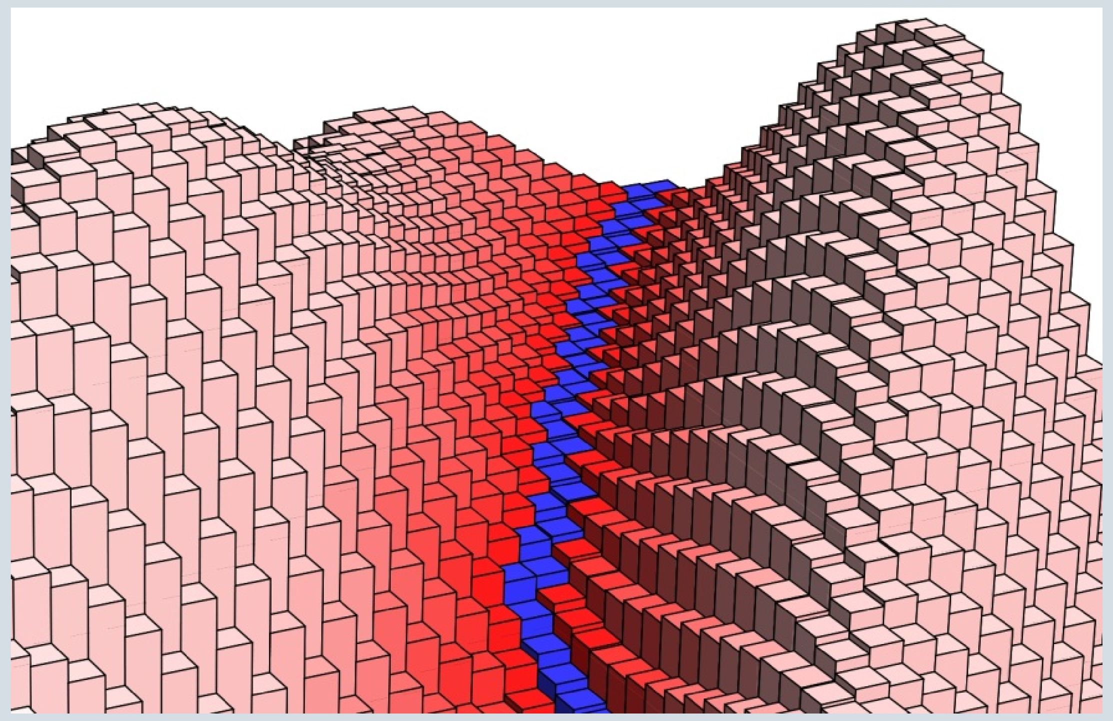
Main Strategy

The key idea behind the methods that we study is to assign to each location on the terrain a value that indicates the risk of getting flooded by a potential rise of the river stream level.

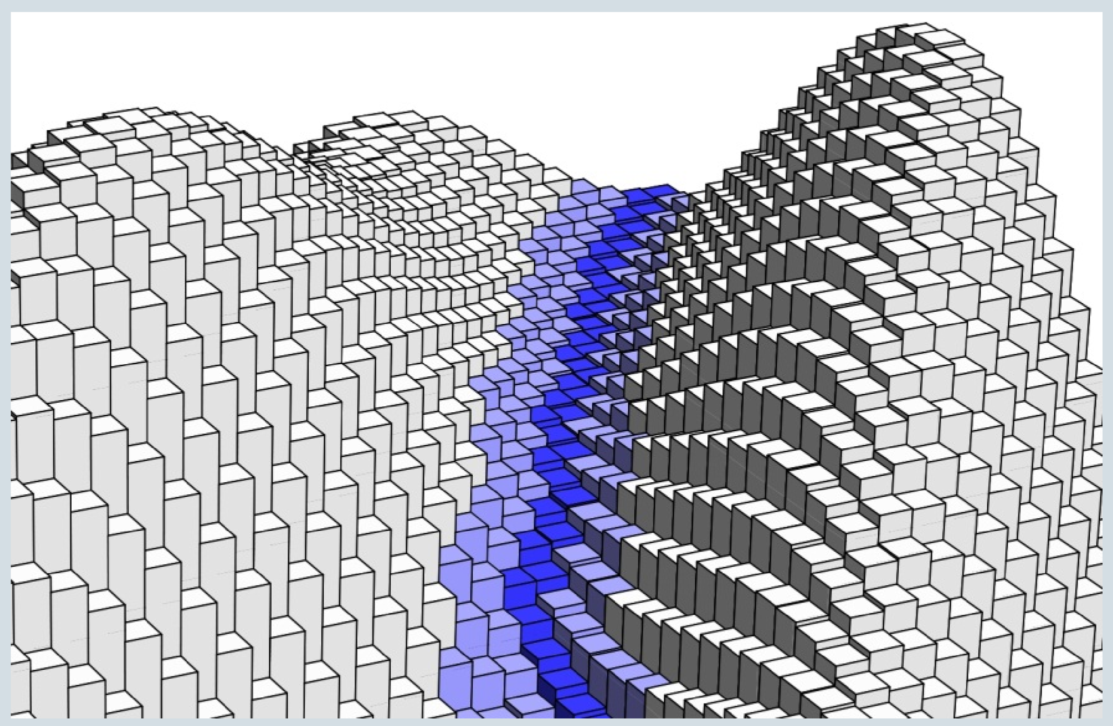
Step 1: Identify the main river stream



Step 2: Compute a risk value for each location



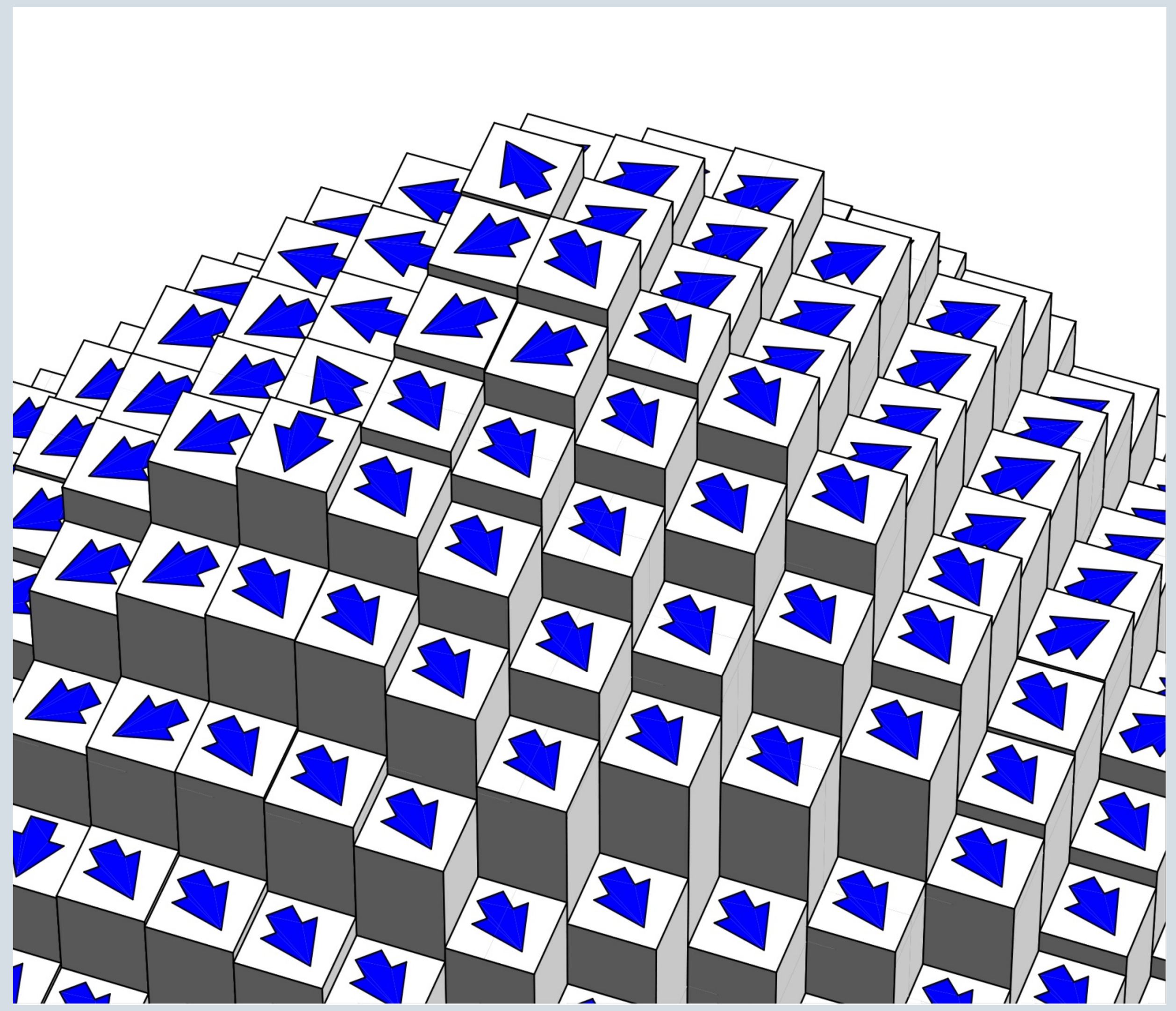
Step 3: Use a threshold to outline the region covered by water



Two Different Approaches

We implemented two different methods for assigning risk values to locations on the terrain.

- The first method uses the slope of the terrain to model the paths through which water flows into the river. In case of flood, these paths are tracked backwards, simulating the phenomenon of water level rise.



- The second method is based on a existing algorithm that calculates the risk of flooding according to Euclidean distance from the original river stream. We have developed an I/O-efficient implementation of this method, so that it can process terrain datasets that are too large to fit in the main memory of a standard computer.

References

[1] C. Alexander, L. Arge, P. Klith Bøcher, M. Revsbæk, B. Sandel, J.C. Svenning, C. Tsirogiannis and J. Yang. Work in progress.