Cellular approach and accurate large scale environment simulation

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CONTEXT

Needs to understand climate change effects: flood, fire, insect swarms... and evolving environment: sea level, weather patterns, ecosystems.

Methods:
- To monitor changes and mitigate consequences together using sensor networks, aerial pictures, physical modeling and computer simulation.
- Test applications are needed such as Harmful Algal Blooms monitoring.
- Measure from sensor fields, simulate with cellular systems [1], and adjust theoretical model behaviour.
- Elaborate prediction software.

Problems:
- Characterization of “complex terrains”: mountains, hills, rivers, shores are disrupting behaviour. Other parameters too: population density, soil composition, people activity.
- Modeling large areas will induce partitioning based on these characteristics.

DATA ANALYSIS

Cellular automata example: rain

Data space is divided into tiles, zone character, elevation,... processed step by step, independently, with a management of margin dependencies.

Transition Rules:
- The water quantity of each central cell distributed to its neighbors at each time step based on Equation 1, 2.
- A minimization algorithm based principle of a dynamic system has proposed to minimize the height margin of cells [6].

SYSTEM MODEL

Fig 8. Workflow for simulation system

Challenges/Perspectives
- Multiple targets computing solution: CPU, GPU, MPI.
- Real world applications.
- Parallel load distribution related to data complexity/requirements.
- Data diversity and Open Data [5] access from cells.
- Integrating of remote detection and ground sensor.
- Modeling of fluid dynamics and computing methods for Biosystems applied to water management and monitoring in system model.

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References