Project_Study_1

A New Generation Hurricane Storm Surge Model for Southern Louisiana

1. Paper review

Department of Mathematics
Gyeongsang National University
Youngmin Shin

1. Subject

MATHEMATICAL MOMENTS

폭풍 해일 예측하기

때로는 폭풍 해일이 태풍에서 가장 파괴적입니다. 해일을 예측하는 수학적 모형은 해안 해양 및 인접한 범람원의 기하학적 구조 및 지형과 함께 바람, 기압, 조수, 파도, 강의 흐름의 영향들을 결합시켜야 합니다. 유체역학의 방정식들이 물의 움직임을 기술하지만, 잠재적 홍수 발생 지점을 더욱 정확하게 예측하려면 거의 대부분 겨대한 연립방정식을 수치해석으로 풀어야 합니다.

해안이나 그 근처의 자세한 기하학적 구조와 지형을 모형화하는 데는 매우 높은 정확성이 필요하지만, 섬해의 넓게 트인 지역 등은 대개 비교적 낮은 해상도로도 가능합니다. 따라서 모든 지역에 동일한 척도를 사용하면 너무 정보가 많아 비실용적이거나, 너무 정보가 적어 가장 중요한 문제인 해안 범람원을 잘 예측하지 못함을 의미합니다. 연구자들은 대양에서 해안과 내륙까지 정보를 결합할 수 있고, 관련 지역에 따라 가변적인 **비정형 격자**를 사용하여 문제를 해결합니다. 이렇게 만든 모형을 남부 루이지애나에서 일어난 과거 폭풍에 적용했을 때 매우 정확하였으며 그 지역에서 더 효율적이고 안전한 방파제를 디자인하는 데에 사용되고 있고 모든 해안 지역의 안전을 평가하는 데 사용하고 있습니다.

더 알아보기: "A New Generation Hurricane Storm Surge Model for Southern Louisiana", by Joannes Westerink et al.

Translation courtesy of volunteer members of the Korean Mathematical Society.

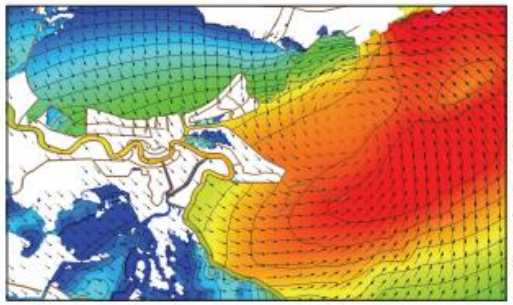

Image: Water surface elevation (blue is low, red is high) in the New Orleans area 9:00 a.m. 8/29/05 (arrows indicate wind velocity). Courtesy of Joannes J. Westerink.

AMS American Mathematical Society

Mathematical Moments 프로그램은 과학, 자연, 기술, 그리고 인간의 문화에서 수학이 하는 역할에 대한 올바른 평가와 이해를 촉진합니다.

www.ams.org/mathmoments

<Figure 1>

8/27/2004 10:04 AM

A New Generation
Hurricane Storm Surge Model
for Southern Louisiana

Joannes J. Westerink[1*], Jesse C. Feyen[1], John H. Atkinson[2], Richard A. Luettich[3], Clint N. Dawson[4], Mark D. Powell[5], Jason P. Dunion[6], Hugh J. Roberts[1], Ethan J. Kubatko[1], Hasan Pourtaheri[7]

[1] Department of Civil Engineering and Geological Sciences
University of Notre Dame
Notre Dame, IN 46556

[2] School of Civil Engineering and Environmental Science
University of Oklahoma
202 W. Boyd St., Room 334
Norman, OK 73019

[3] Institute of Marine Sciences
University of North Carolina at Chapel Hill
3431 Arendell Street
Morehead City, NC 28557

[4] Institute for Computational Engineering and Sciences
The University of Texas at Austin
Austin, TX 78712

[5] Hurricane Research Division
National Oceanic and Atmospheric Administration
4301 Rickenbacker Cswy.
Miami, FL 33149

[6] University of Miami-NOAA Cooperative Institute for Marine and Atmospheric Studies
National Oceanic and Atmospheric Administration
4301 Rickenbacker Cswy.
Miami, FL 33149

[7] U.S. Army Corps of Engineers, Wilmington District
69 Darlington Ave.
Wilmington, NC 28402-1890

*Corresponding author

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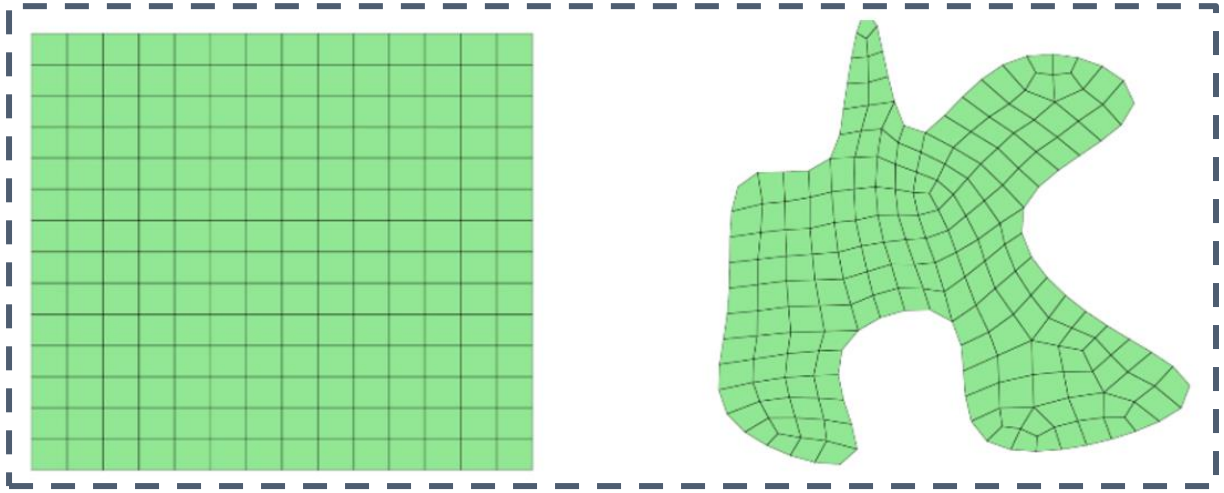
<Figure 2>

1. Summary & Abstract

This paper talks about developing molecular scale, unstructured grid, and high-resolution hydrodynamic models to calculate dynamically accurate storm surges in complex coastal floodplains.



Structured grid Unstructured grid

<Figure 3>

1. Summary & Abstract

Floods caused by storm surges have a large loss of life and enormous environmental and economic damage.

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Louisiana, in particular, is more vulnerable to damage due to its geographical features.

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Modeling capabilities

1. Summary & Abstract

Southern Louisiana is difficult to model due to the complexity of domains, the scope of space size, and long-term changes in physical systems.

1. Summary & Abstract

Traditional storm surge models

-structured grid

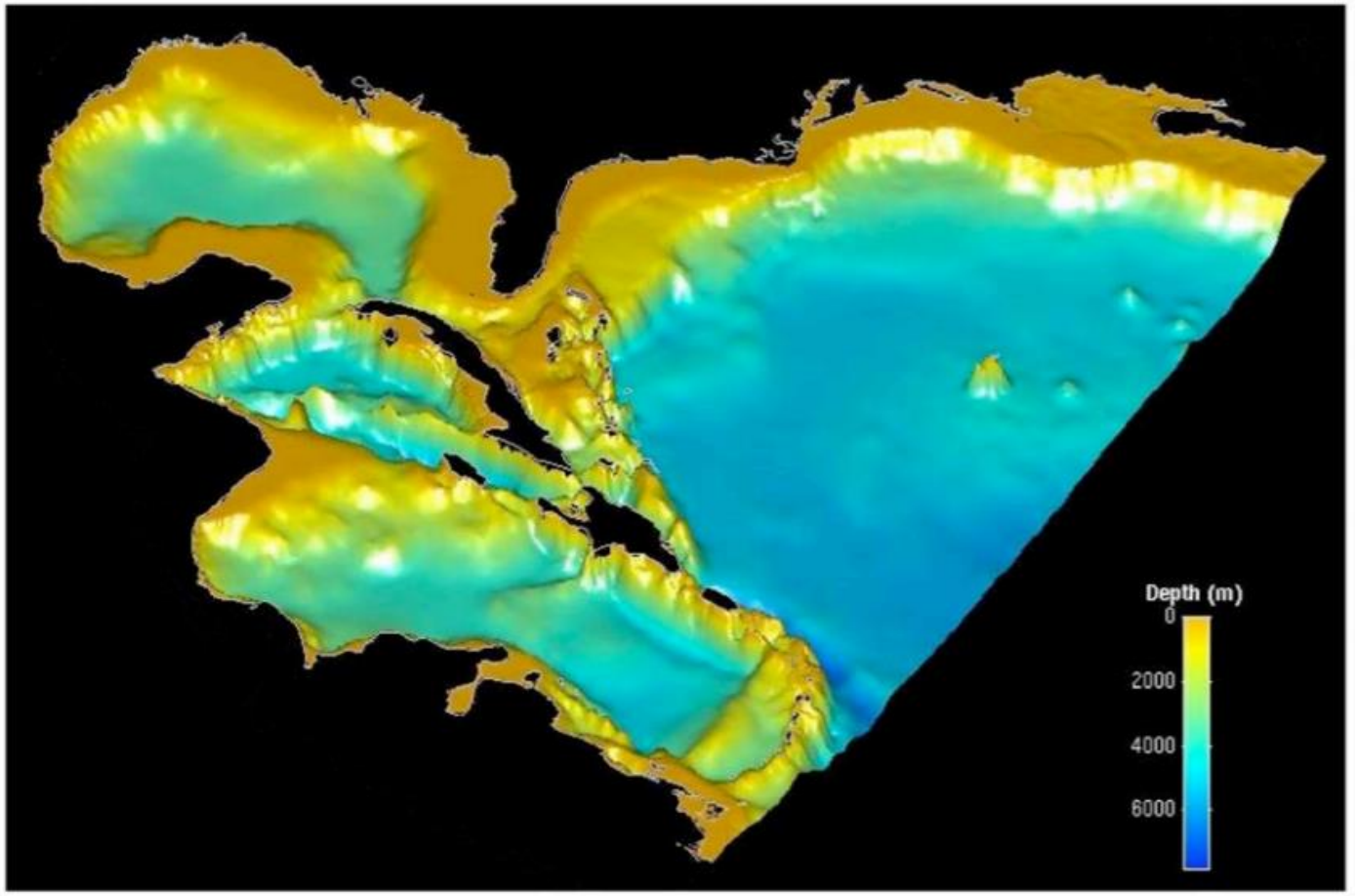
-coarse grid

What changes

-unstructured grid

-Fine-grained discretization

2. Large domain-localized grid resolution strategy



<Figure 4>

2. Large domain-localized grid resolution strategy

Shallow Water Equations(SWE)

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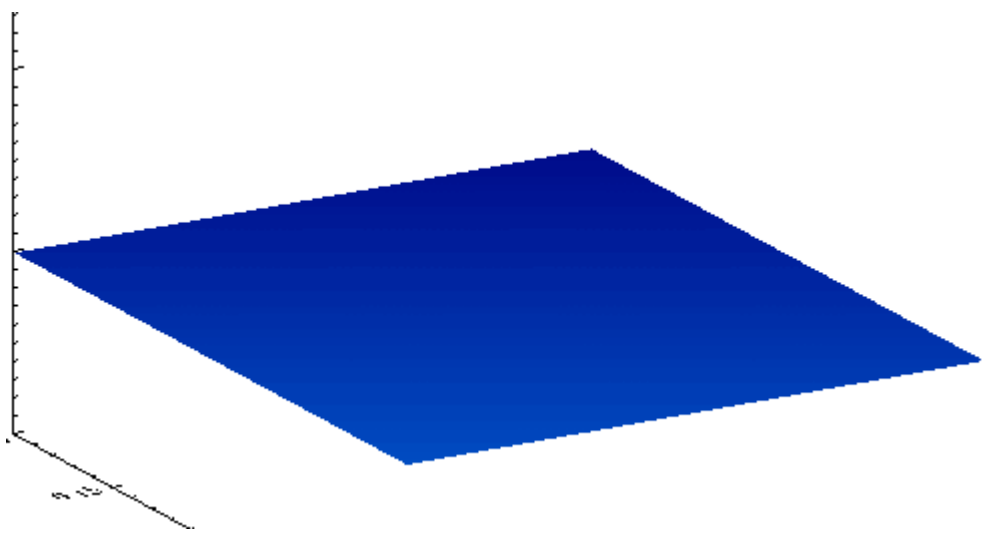
Local Tide System



2. Large domain-localized grid resolution strategy

Exact boundary conditions (X)

Simultaneous Resolution System

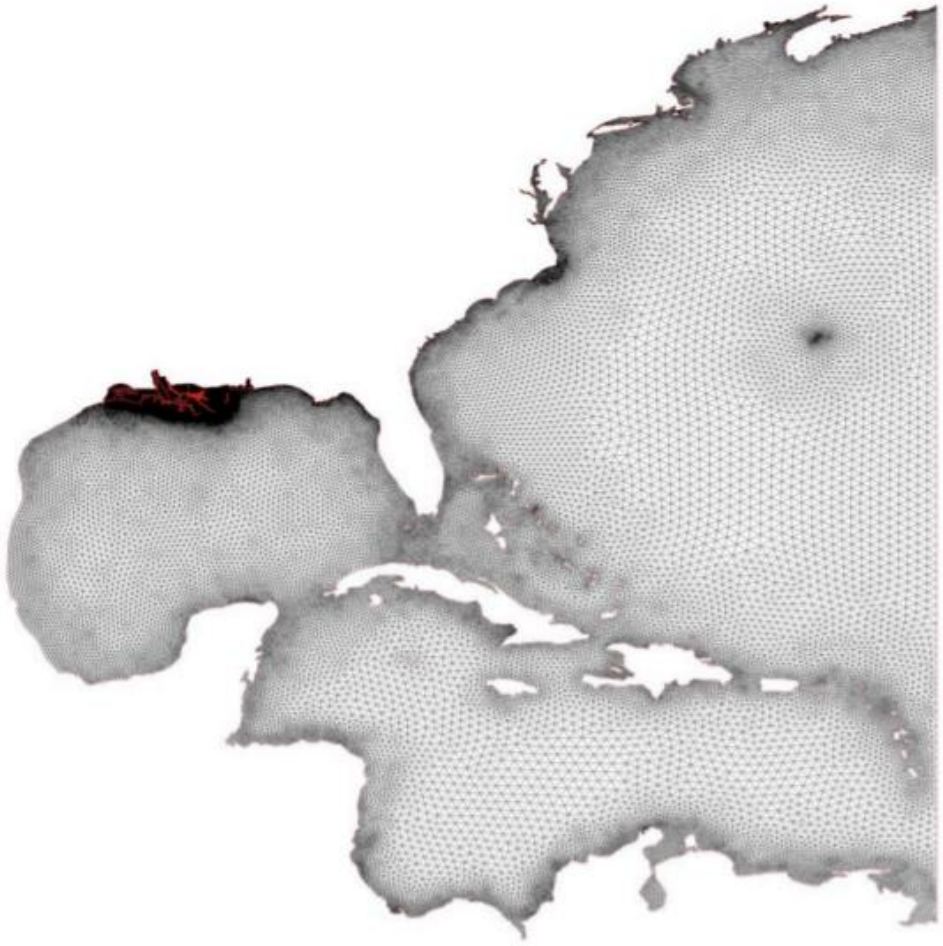
Simple & Accurate

2. Large domain-localized grid resolution strategy

Accurate kinetic energy scale

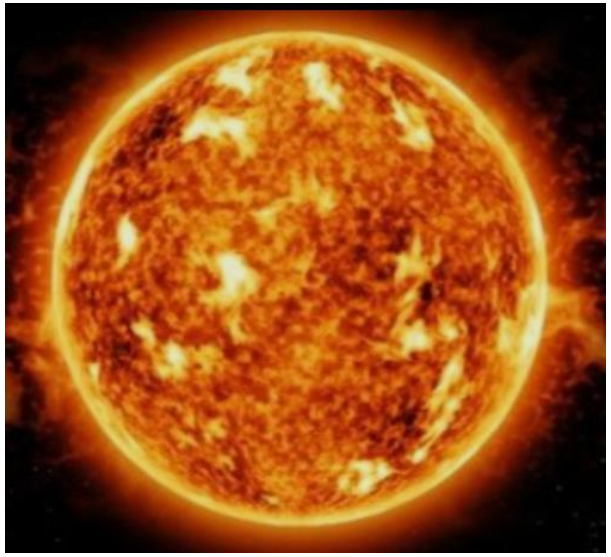
Accurate Calculation Model

2. Large domain-localized grid resolution strategy



2. Large domain-localized grid resolution strategy

It dynamically adjusts the gravity of the moon and the shaking of the earth.



2. Large domain-localized grid resolution strategy

Unstructured grid & SWE & Finite Element Method

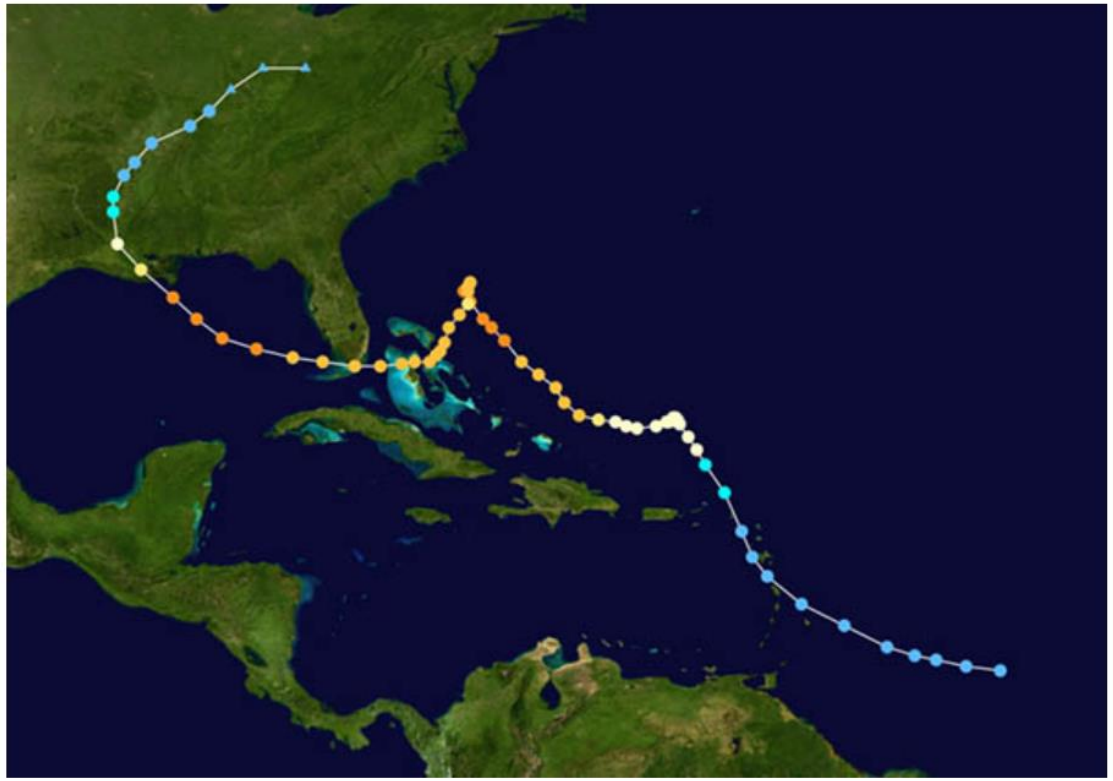
Simulation

2. Large domain-localized grid resolution strategy

Unstructured grid & SWE & Finite Element Method

Simulation

2. Hindcasting Hurricane Betsy



Hurricane Betsy

2. Conclusion

-Detailed physical features

-Unstructured grid

→ Accurately solve control equations

→ Complete dynamic coupling between terrain

Figure 1. kms

Figure 2. A New Generation Hurricane Storm Surge Model for Southern Louisiana

Figure 3. https://onscale.com/blog/meshing-in-fea-structured-vs-unstructured-meshes/