a Scalable Toolkit for an Open Community Supporting Near Real-time High Resolution Coastal Modeling

Hartmut Kaiser[1], Joannes Westerink[2], Rick Luettich[3], Clint Dawson[4]

[1]Louisiana State University, [2]University of Notre Dame, [3]University of North Carolina, [4]University of Texas at Austin

Motivation:

ADCIRC, a multi-scale, multi-physics coastal circulation model, is used to predict the effects of large storms approaching the coast. Under development for twenty years, the software has a large community of users including the US Army Corps of Engineers, NOAA, and FEMA.

With the recent availability of petascale compute resources and the introduction of new architectures, the **ADCIRC** community has recognized the need to revamp the underlying parallelization paradigms to take full advantage of the growing and quickly changing resource landscape.

By leveraging the scalability harnessed by **HPX**, an open source C++ runtime system, and improving the algorithms which provide the foundation of the model, the researchers will update the code base to be faster, more flexible, and sustainable for years to come.

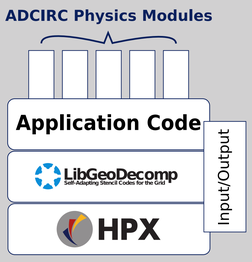
Our Goals:

We aim to create a **sustainable software infrastructure** that will allow us to:

• Scale to at least 256k compute cores on modern HPC systems by utilizing **HPX**, a next-generation parallel runtime system

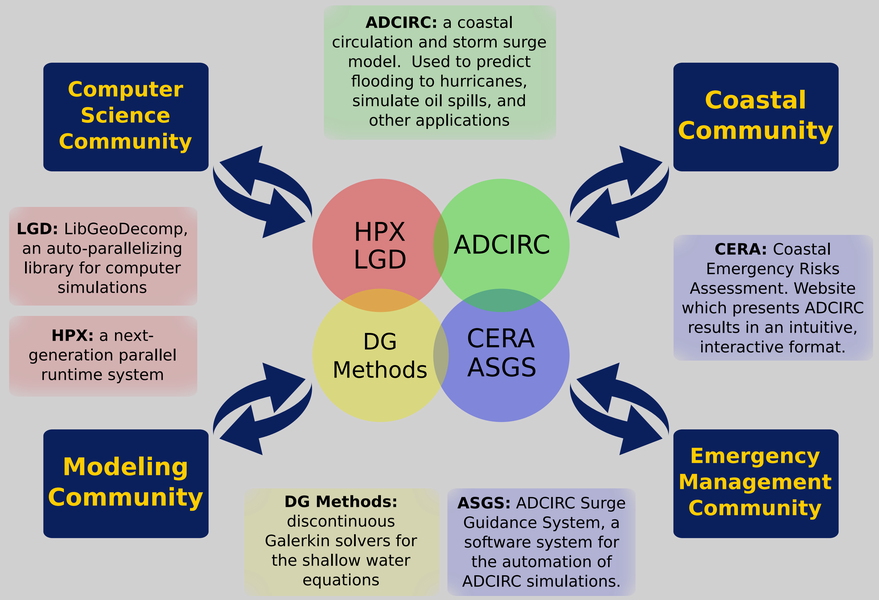
•Separate the tasks for load balancing, boundary value exchange, and IO from the scientific computations by using **LibGeoDecomp**

• Use multiple solution algorithms, such as **discontinuous Galerkin methods**, which promise to increase accuracy and fidelity in ADCIRC simulations.



ADCIRC/HPX software stack

Community Engagement:



Broader Impacts:

STORM will have a large impact on the communities that it comes in contact with:

•The fundamental research in **discontinuous Galerkin methods** will be dispersed to the broader unstructured mesh and coastal modeling communities.

•In addition, other scientific communities which consume the hydrodynamic output of **ADCIRC**, such as **biologists**, **ecologists**, and **coastal engineers**, stand to benefit from the improved fidelity and resolution that these new methods can bring.

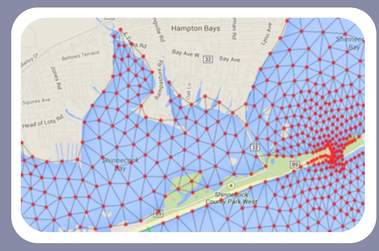
•This project also increases ADCIRC's presence in Louisiana, as daily runs of ADCIRC are planned as part of the model's ongoing development. Data from these runs will be made available to **emergency managers** and others working in the coastal zone including **local fishermen** and **wetlands researchers**.

Work so far:

•**Modularization of ADCIRC subroutines:**
We have begun the process of refactoring the ADCIRC physics subroutines to facilitate their use of HPX and LGD.

•**Game of Life proxy code:**
We have created a "proxy code" built on top of LGD and HPX. It is written in C++ but implements a simple FORTRAN kernel. It reads in a decomposed ADCIRC computational mesh and uses the same communication patterns that parallel ADCIRC currently uses.

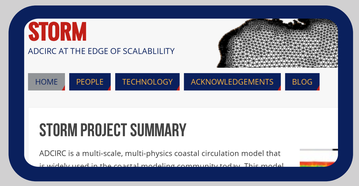
Scan to Watch!
www.youtube.com/watch?v=kTNm3mFhAnk



Outreach:

•STORM Website
•Supercomputing 2014 Presentation Nov. 19, 2014
•SCALA (Scientific Computing around Louisiana) Presentation, March 2015
•HPX and LGD are both open source and available online (GitHub and Bitbucket, respectively)
•Planning to co-schedule a workshop for early dissemination of our goals and result with the AMS workshop January 2016

STORM
Website:
storm.stellar-group.org



LSU Center for Computation & Technology
Interdisciplinary | Innovative | Inventive

UNIVERSITY OF NOTRE DAME

THE UNIVERSITY of NORTH CAROLINA at CHAPEL HILL

TEXAS
The University of Texas at Austin

Sea Grant LOUISIANA

NSF