

Collaborative Coastal Modeling with SIMULOCEAN

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Introduction

SIMULOCEAN Science Gateway

SIMULOCEAN - <http://xsede.simulocean.org>

SIMULOCEAN

Home Software Tutorials About Contact

00 Coastal model 00 Regional model

Manage and Deploy Scientific Applications with SIMULOCEAN

[Get Started](#)

Community

We believe that the open science is better science and community efforts are crucial to the success of almost all open science projects. To encourage community involvement, SIMULOCEAN provides an open platform for not only academia, but also industry and general public to contribute and share scientific applications, computing resources, and expertise.

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LSU XSEDE

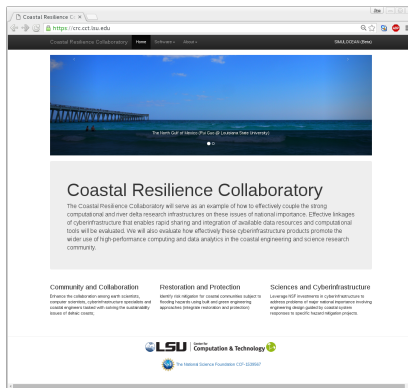
NG-CHC Project - PI: Michael Khonsari

Northern Gulf Coastal Hazards Collaboratory - <http://ngchc.org>
(NSF Award: EPS-1010640, \$2,166,000.00,
10/1/2010-09/13/2013)

The screenshot shows the Northern Gulf Coastal Hazards Collaboratory (NGCHC) website. The header includes navigation links: Home, About, Highlights, and Contact. Below the header is a search bar and a 'Log in' link. The main content area features a large diagram titled 'The Collaboratory framework' which illustrates the integration of various data sources and models. Below this diagram is a section titled 'CI Strategy 2: Community modeling framework' which describes a shared, distributed functional 'reference implementation' of models, data & tools. To the right of the diagram is a 'USERS TAGS' section listing various users and their associated tags. Below that is a 'RELATED TOOLS TAGS' section listing various tools and their associated tags. At the bottom of the page is an 'ARCHIVE' section listing various archived documents. The website is designed with a clean, professional layout and uses a color scheme of blues, greys, and oranges.

CRC Project - PI: Q. Jim Chen

Coastal Resilience Collaboratory - <http://crc.cct.lsu.edu>
(NSF Award: CCF-1539567, \$1,199,154.00,
10/1/2015-9/30/2019)



Our Vision

We envision SIMULOCEAN as

A Computational Platform

We aim to create a computational platform for coastal modeling applications with our competitiveness and expertise on high performance computing technology and coastal applications.

and

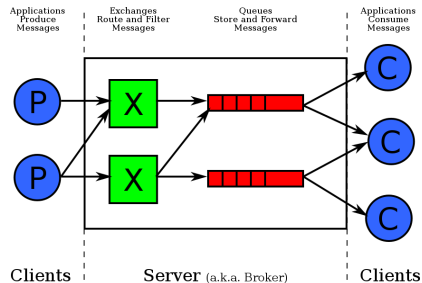
A Collaborative and Educational Environment

We aim to advance research, enrich training, inspire collaboration, and inform decision making through highly available innovation-enabling cyberinfrastructure.

Web Programming Technologies

Advanced Message Queuing Protocol

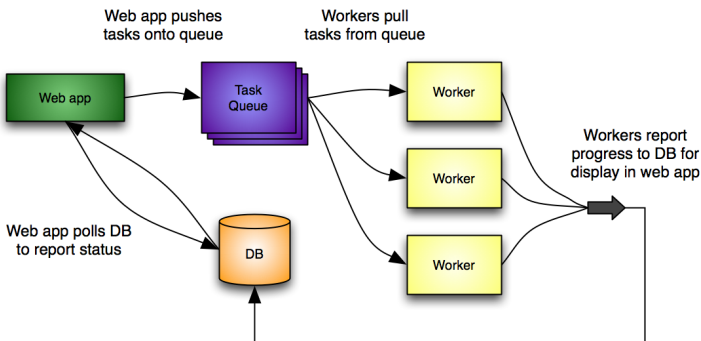
The Advanced Message Queuing Protocol (AMQP) is an open standard application layer protocol for message-oriented middleware (<http://www.amqp.org/>). **RabbitMQ** is one of several open source message broker software packages that implement AMQP (<https://www.rabbitmq.com/>).



(image credit: <https://www.wikipedia.org/>)

Celery - Distributed Task Queue

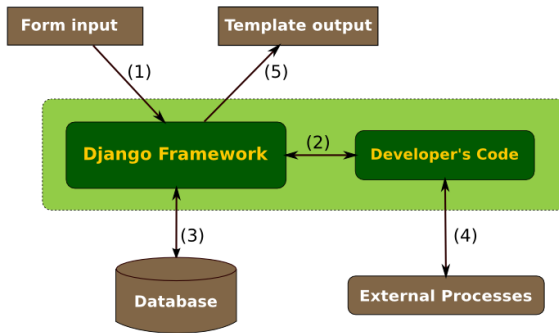
Celery is an asynchronous task/job queue based on distributed message passing (<http://www.celeryproject.org/>). It supports RabbitMQ and other message brokers.



(image credit: <http://digitheadslabnotebook.blogspot.com/>)

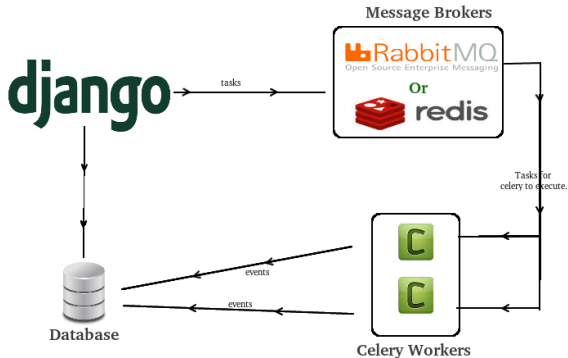
Django Web Framework

Django is a high-level Python Web framework that encourages rapid development and clean, pragmatic design. It supports **MariaDB** and other many other database backends.



(image credit: <https://www.djangoproject.com/>)

Put All the Blocks Together



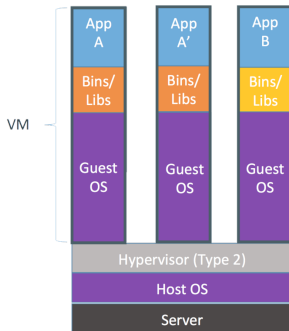
(image credit: <http://my-django-python.blogspot.com/>)

Containerization with Docker

Container v.s. Virtual Machine

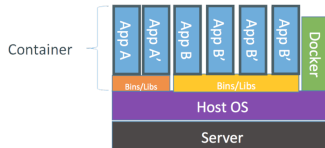
“Containerization is a lightweight alternative to full machine virtualization that involves encapsulating an application in a container with its own operating environment.”

— <http://www.webopedia.com/>



Containers are isolated,
but share OS and, where
appropriate, bins/libraries

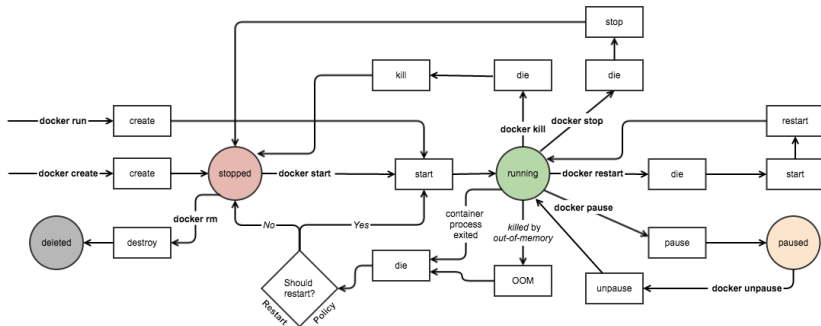
...result is significantly faster deployment,
much less overhead, easier migration,
faster restart



(image credit: <https://www.docker.com/>)

Docker

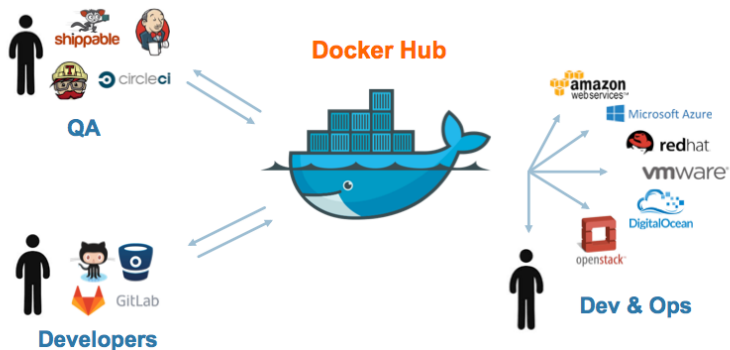
Docker - <https://www.docker.com/> is an open platform for distributed applications for developers and sysadmins. It provides an additional layer of abstraction and automation of operating-system-level virtualization on Linux.



(image credit: <https://www.docker.com/>)

Docker Hub

The Docker Hub - <https://hub.docker.com/> is a public registry maintained by Docker, Inc.

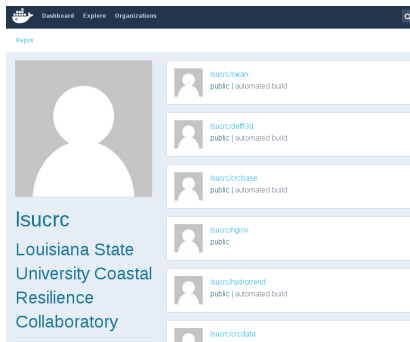


(image credit: <https://www.docker.com/>)

Coastal Model Repository & SIMULOCEAN

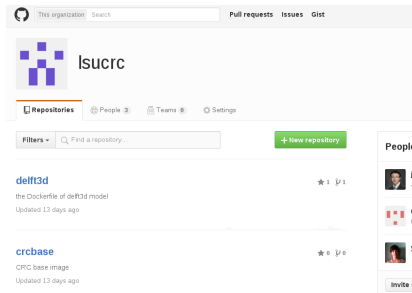
LSU CRC Docker Hub Repo

The Coastal Model Repository is currently hosted on Docker Hub as a public platform for sharing and exchanging open source models. All images hosted at Docker Hub are automatically built and tested.



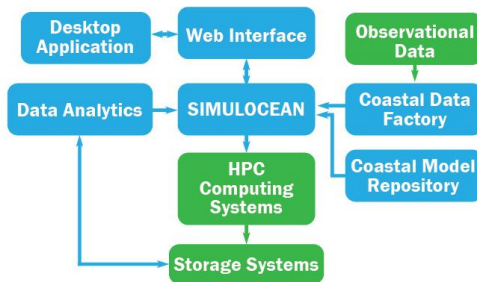
LSU CRC Github Repo

The LSU CRC Github repositories host the Docker files that are linked with the Docker images on Docker Hub.



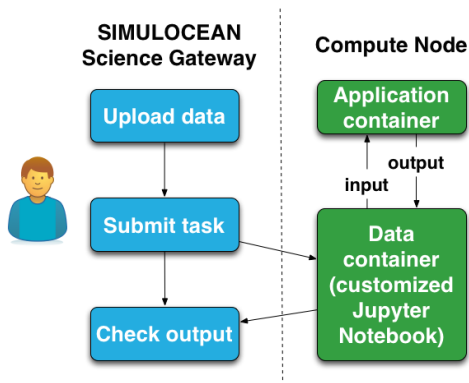
SIMULOCEAN Architecture

A platform for managing and deploying containerized coastal models and other scientific applications on cloud-ready computing systems.



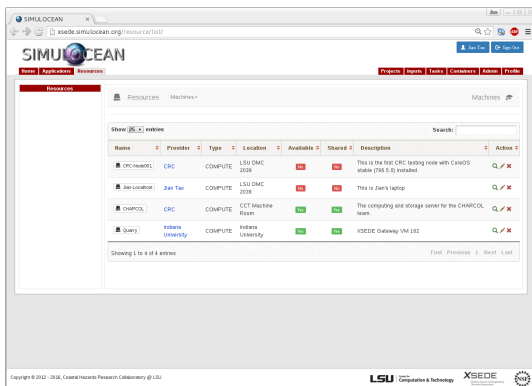
Workflow in SIMULOCEAN

A quick tutorial can be found at
<http://xsede.simulocean.org/about/tutorials>



Computing Resources

SIMULOCEAN gets access to computing resources via remote SSH (an encrypted network protocol) execution.



The screenshot displays the SIMULOCEAN web application interface. The main content area shows a table of computing resources. The table has columns for Name, Provider, Type, Location, Available, Shared, Description, and Actions. There are four entries listed:

Name	Provider	Type	Location	Available	Shared	Description	Actions
CRC-head01	CRC	COMPUTE	LSU DMC 2039	Yes	Yes	This is the first CRC testing node with CentOS stable (766 5.6) installed.	Q / X
Jian-Localhost	Jian Tao	COMPUTE	LSU DMC 2039	Yes	Yes	This is Jian's laptop	Q / X
CHARCOL	CRC	COMPUTE	CCT Machine Room	No	No	The computing and storage server for the CHARCOL team.	Q / X
Quary	Indiana University	COMPUTE	Indiana University	No	No	XSEDE Gateway VM 182	Q / X

Below the table, it says "Showing 1 to 4 of 4 entries". At the bottom of the page, there is a copyright notice: "Copyright © 2012 - 2016, Coastal Hazards Research Collaboratory @ LSU". Logos for LSU, XSEDE, and UNCF are also present.

Coastal Models

SIMULOCEAN provides an interface for managing models hosted at Coastal Model Repository.

The screenshot displays the SIMULOCEAN web application interface. The browser address bar shows the URL `xsede.simulocean.org/application/istd/`. The application has a navigation bar with links: Home, Applications, Resources, Projects, Ingers, Tools, Containers, Admin, Profile. The main content area is titled "Application List" and shows a table of applications. The table has columns: Application, Version, Docker Repository, Time Created, Available, Shared, Description, and Action. Three applications are listed: SWAN, Delf3D, and HydroTrend. Each application entry includes a brief description and a "Q" icon for details.

Application	Version	Docker Repository	Time Created	Available	Shared	Description	Action
SWAN	41.01	lsu/swan	Dec. 31, 2015, 3:13 A.M.	Yes	Yes	SWAN is a third generation wave model that computes random, short-crested wind generated waves in coastal regions and inland waters. SWAN accounts for the following physics: Wave propagation in time and space, refraction, refraction due to current and depth, frequency shifting due ...	Q / X
Delf3D	5.81.00.2183	lsu/delf3d	Dec. 14, 2015, 4:38 P.M.	Yes	Yes	Delf3D is a flexible integrated modeling suite, which simulates two-dimensional (in either the horizontal or a vertical plane) and three-dimensional flow, sediment transport and morphology, waves, water quality and ecology is capable of handling the interactions between these processes. The ...	Q / X
HydroTrend	3.0	lsu/hydrotrend	March 4, 2016, 2:53 P.M.	Yes	Yes	HydroTrend is an ANSI-standard C numerical model that creates synthetic river discharge and sediment load time series as a function of climate trends and basin morphology and has been used to study the sediment flux to a basin for basin ...	Q / X

Showing 1 to 3 of 3 entries

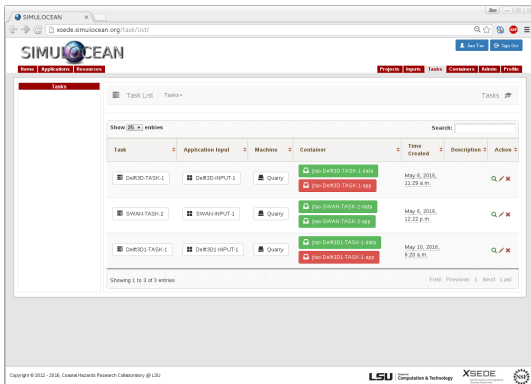
First Previous 1 Next Last

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LSU Computation & Technology XSEDE UNIVERSITY OF TEXAS AT AUSTIN

Task/Container Management

SIMULOCEAN launches and monitors Docker containers on computing systems.



The screenshot displays the SIMULOCEAN web application interface. The top navigation bar includes links for Home, Applications, Resources, Projects, Inputs, Tasks, Containers, Admin, and Profile. The main content area is titled 'Task List' and shows a table of tasks. The table has columns for Task, Application Input, Machine, Container, Time Created, Description, and Action. There are three tasks listed, each with a 'Query' button and a 'Container' button. The tasks are: Der3D-TASK-1, SWAN-TASK-2, and Der3D-TASK-1. The interface also includes a search bar, a 'Show 3 entries' indicator, and pagination controls at the bottom.

Task	Application Input	Machine	Container	Time Created	Description	Action
Der3D-TASK-1	Der3D-INPUT-1	Query	Der3D-TASK-1-440	May 6, 2016, 11:29 a.m.		Query / Delete
SWAN-TASK-2	SWAN-INPUT-1	Query	SWAN-TASK-2-002	May 6, 2016, 12:22 p.m.		Query / Delete
Der3D-TASK-1	Der3D-INPUT-1	Query	Der3D-TASK-1-440	May 10, 2016, 6:20 a.m.		Query / Delete

Showing 1 to 3 of 3 entries

First Previous Next Last

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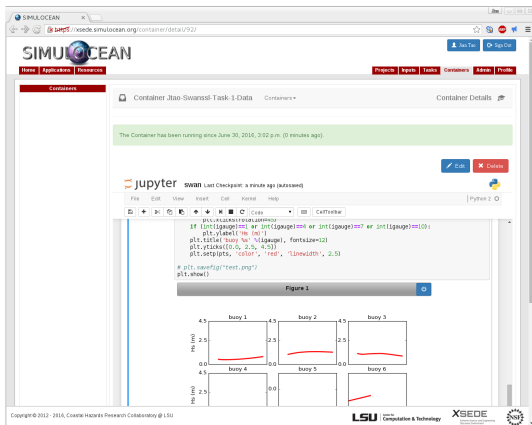
LSU Louisiana State University
Computation & Technology

XSEDE
Extreme Scale Environment

UNY

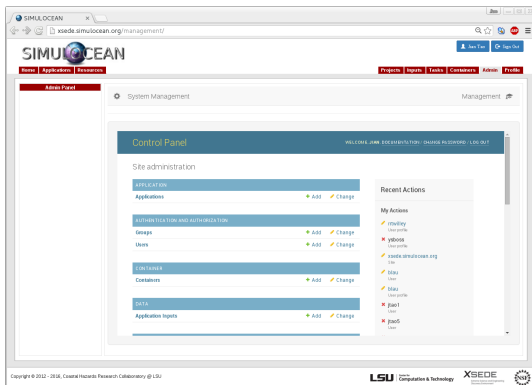
Data Container

For each task, a data container that runs a Jupyter server will be launched to serve data back to users and enable interactive data analysis and visualization.



System Administration

SIMULOCEAN uses Django (<https://www.djangoproject.com/>) to build the web-based interface and RESTful APIs for serving mobile and desktop applications.



Future Plans

Science Gateway on NSF Cloud

SIMULOCEAN was supported by XSEDE ECSS program. Past ECSS experts include: Stu Martin and Eric Blau (Globus Team), Mona Wong and Andrea Zonca (SDSC Team). We are in the process to test out singularity on Bridges and Comet.

The screenshot shows the XSEDE website interface. The header features the XSEDE logo and the tagline "Extreme Science and Engineering Discovery Environment". Below the header is a navigation bar with links: HOME, GATEWAYS WIKI, SCIENTIFIC WORKFLOWS, and GATEWAYS COOKBOOK. The main content area displays the breadcrumb trail: XSEDE > Gateways > Gateways Cookbook > Welcome > Simulocean Gateway Recipe. Below this is a search bar with a "SEARCH" button. The title "Simulocean Gateway Recipe" is prominently displayed. Underneath the title, there is a list of links: Portal URL - <http://simulocean.org> and Primary Discipline: Coastal modeling. The section "Assistance" includes links for Licensing: LGPL and Primary Funding: National Science Foundation. The section "How its Made:" is also visible.

Commercial Cloud Platforms

We will look into Amazon AWS and other commercial cloud platforms to seek opportunities to offer services to more users.



Acknowledgments

Acknowledgments

My thanks go to

- SIMULOCEAN team members: Shuai Yuan, Du Jin, Kelin Hu, Q. Jim Chen, and Honggao Liu.
- CHARCOAL group members and our collaborators in NG-CHC and CRC projects
- NSF (Awards EPS-1010640 and CCF-1539567)
- LSU HPC, CCT, LONI, HPRC, TEES, and XSEDE for the computing resources.
- CSDMS Integration Facility and XSEDE Extended Collaborative Support Service (ECSS) program for their support and help