DynaCode: A General DDDAS Framework with Coast and Environment Modeling Applications

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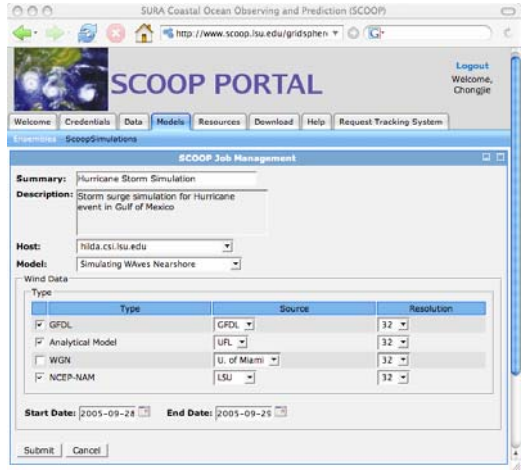
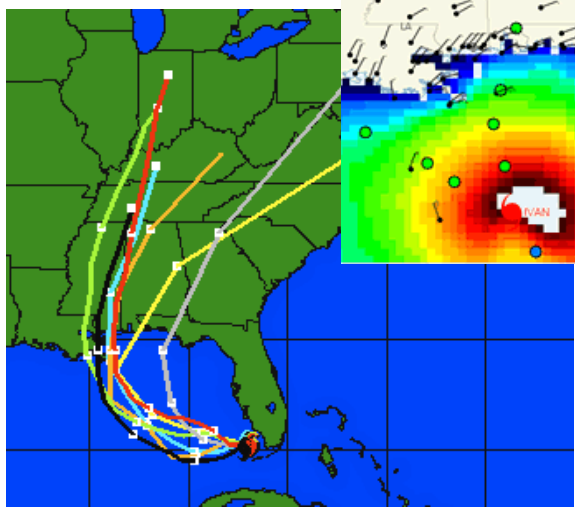
Louisiana Coastal Area

- **In US**: 25% coastal wetlands, 40% salt marshes, 30% fish catch, 17% oil, 25% natural gas, ports handle most tonnage worldwide.
- Lost: 25% (4500sqkm) wetlands in last century, future predictions dire.
- Loss of wetlands increases risk of flooding and storm surge.
- Hurricanes threaten lives & economy
- Rich dynamic environment for modeling: coupled models, multi-scale, dynamic data (sensors, satellites), physics
- **Important problems**: ecological forecasting, hurricane forecasts, restoration strategies, evacuation and emergency response strategies, predict algal blooms/salinity, etc.

SURA Coastal Ocean Observing Program (SCOOP)

- Integrating data from regional observing systems for realtime coastal forecasts in SE
- Coastal modelers working closely with computer scientists to couple models, provide data solutions, deploy ensembles of models on the Grid, assemble realtime results with GIS technologies.





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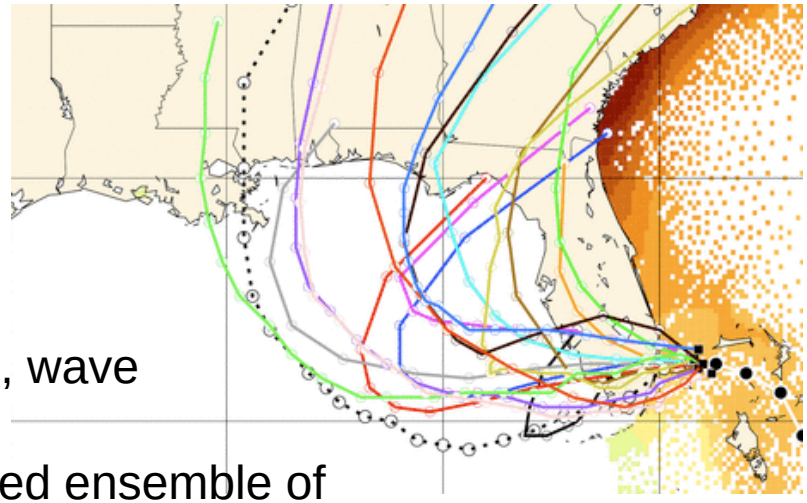
DynaCode



- Focus on scenarios:
  - Hurricane ensemble modeling
    - Coupling ocean circulation, storm surge, wave generation models for the Gulf
    - Notifications from NHC trigger customized ensemble of hurricane models (surge/wind/wave), sensors provide verification and guide dynamic ensembles
    - Event driven, dynamic component framework with algorithm selection, optimization tools, workflow, data assimilation, result validation with sensor/satellite.
  - Ecological restoration and control
    - Breton Sound diversion, control structure to allow Mississippi to flow into wetlands
    - Coupled models (hydrodynamic, salinity, geomorphic, sediment) control diversion, sensors/wind fields inject real time data.
- Enhance existing technologies
  - Cactus Framework
  - Triana Workflow, Grid Application Toolkit

Components

Infrastructure & algorithms to couple models, to each other and to external inputs from sensors, wind & databases to optimize execution of complex workflows on grids, invoking appropriate models, meshes, and algorithms, depending on current conditions.

- **Applications**: control algorithms and coupling interfaces for coastal/eco-codes
- **Maths**: Model errors for scenarios and implement basic stats toolkit in Cactus to drive ensembles
- **Systems**: Enhance dynamical capabilities of Cactus/Triana, decision making infrastructure, dynamic recomposition. Add legacy ensemble modeling to Cactus. Think about tracking data flow/data sensitivity through Cactus.
- **Measurements**: Integrate data to scenarios from existing sensors, plan out interfaces for sensor control.