Andrew Foster

Platform Engineer, Disaster Tech

COMPETITIVE DIVISION - PRACTITIONER

Automation and Runtime Improvements for the Incident-based Scenario Evacuation (ISE) Collection of Models

Industry, academic, and government partners collaborated to produce significant improvements to the Integrated Scenario-based Evacuation (ISE) Framework suite of models. These models take NOAA GEFS ensemble forecasts and generate an ensemble of hurricane scenario tracks and associated wind and flooding hazard maps ("the hazard models"). They then use a progressive hedging algorithm to recommend a decision tree of evacuation orders optimized to minimize risk in an evacuation model ("the evacuation scenarios model"). This poster demonstrates the work plan to upgrade this suite of models from a research prototype to a working prototype and the approaches for the hazard models and the evacuation scenarios model.

The hazard models are a collection of three models. Weather Research and Forecasting or WRF generates hurricane track forecasts for each scenario. Coupled Routing and Excess Storage model or CREST takes WRF's precipitation forecasts and calculates the expected downstream flooding. Near coastlines, CREST hands off to the Advanced

Circulation or ADCIRC model. The ADCIRC model calculates the additional flooding due to storm surge. In the research prototype, these models are run at different sites across the country. File transfers and other overheads are a significant

bottleneck. Further, not all hurricane scenarios are run concurrently due to resource constraints. The working prototype will run these scenarios concurrently from the same cloud-based HPC platform, significantly improving performance.

We are completely rewriting the evacuation scenarios model, and the research prototype is a collection of scripts written in five different languages (Python, R, MatLab, Java, and Mathematica). These scripts operate on Microsoft Excel files and take 36 hours to run with significant manual interaction. The new version of the code is written entirely in Python, is fully automated, and is expected to run in approximately 2.5 hours – a 24x improvement.

Presentation Theme: This presentation includes research in the fields of hazard forecasting, decision science, and behavior science. It represents a research-to-operations effort to bring this science into practice to help save lives.

Collaborators, Advisor(s) and Department(s) that assisted with this research: Researchers. All have extensive experience with hurricane evacuation research: (1) Brian Blanton, Numerical modeling of storm surge and wind-driven waves; (2) Brian Colle, High resolution atmospheric modeling, mesoscale meteorology; (3) Rachel Davidson, Hurricane risk, statistical, systems modeling; (4) Randall Kolar, Modeling fluid flow in geophysical systems; (5) Linda Nozick, Optimization, transportation; (6) Tricia Wachtendorf, human/social dynamics, community participation in decision-making.

Industry partners. Disaster Technologies (www.disastertech.com), a public benefit company, has developed a comprehensive end-to-end data science platform

providing real-time analytics and decision support for research and risk management of disasters. Offering computing expertise and long-term sustainability, they include: (1) Sean Griffin, Chief Executive Officer; (2) Andrew Foster, Senior Platform Engineer; (3) Lee DePalo, Senior Advisor; (4) Jessica Decker, VP of Product.

External evaluator: Sarah DeYoung

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