

Development of a Predictive Bayesian Data-Derived Multi-Modal Gaussian Maximum-Likelihood Model of Sunken Oil Mass

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Investigative Approach

- Empirical sampling and likelihood-based fate/transport model
- Locate sunken oil w/o bottom current data
- Superimposed predictive Bayesian Gaussian
 - Unconditional probabilities of oil particle locations
 - Based on spill location/time, and field data at later time
 - Riemann integration over 23-D parameter space



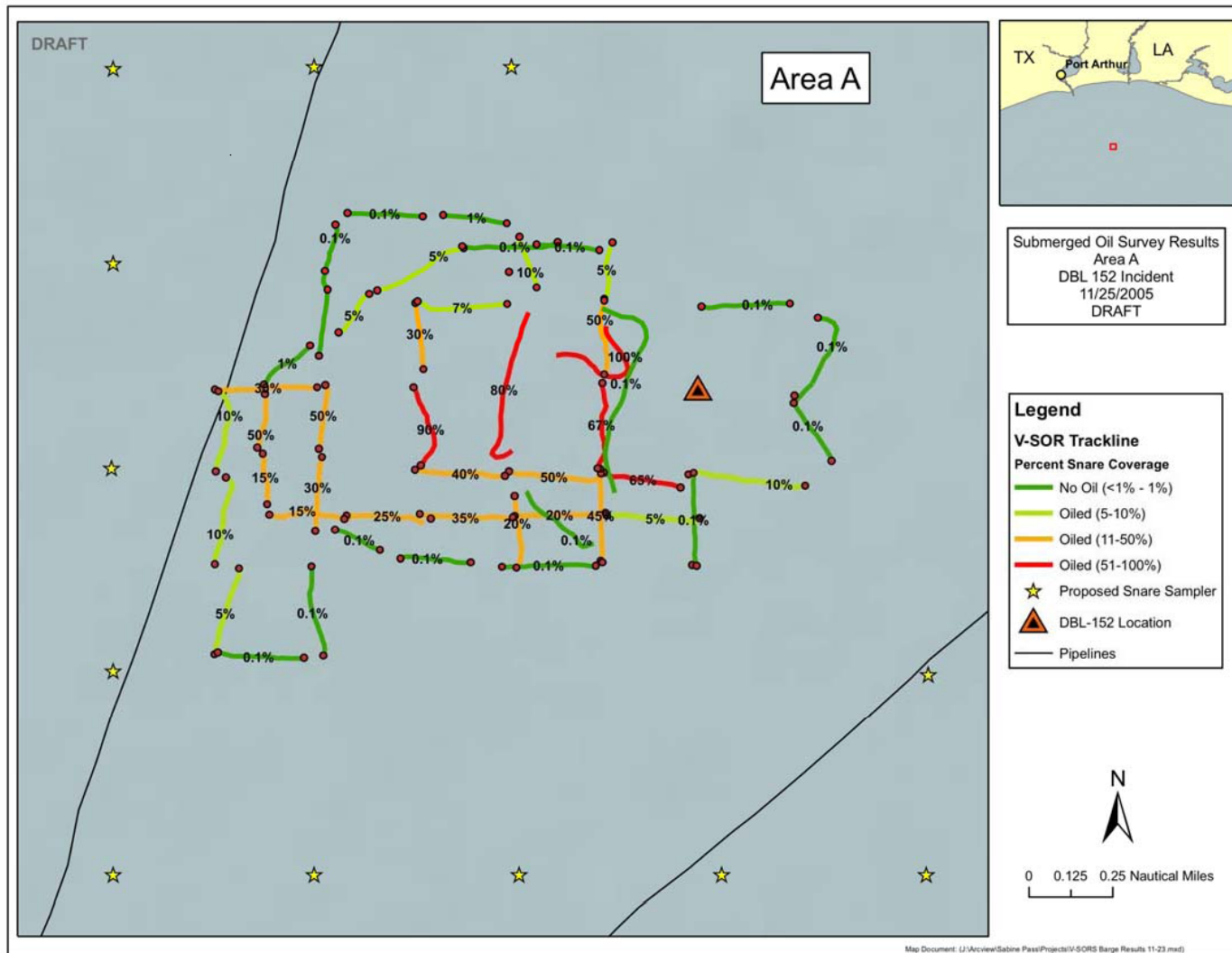
Investigative Approach (cont.)

- Required input:
 - Spill coordinates and time
 - Subjective relative conc. data and sampling times
 - Desired prediction dates and time



- Optional Input:
 - Spatial scale, interactive (or automated based on data)
 - Desired resolution

Example Input Data: DBL 152



Investigative Approach (cont.)

- Internal:
 - ~20 existing and 3 developed interacting Python packages (interactive graphical input, model, output mapping)
 - Basic world geographic metadata in WGS
 - Maximum entropy-distributed data error
- Output:
 - Maps of relative concentration (unconditional probability) at desired times
 - Optional: Revised maps based on subsequent data (new sampled area)
 - Optional: Contiguous maps (partial re-run)



Status

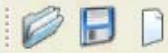
- Stand-alone 2-D predictive model
- Python programming language (open source)
- Multimodal: 4-puff superposition
- Data: up to 10 sampling campaigns
- Subjective relative conc. at irregular WGS points
- Resolution and modeling area: user-defined
- 6-node boundary: innovative image theoretic
- Graphical User Interface (GUI) with interactive graphics



Results to Date: GUI

1. Quick demo
2. Results from synthetic spill in a bay





SPILL INFORMATION

Spill Name:

Spill Time:

Longitude: E W

Latitude: N S

SAMPLING CAMPAIGN(S)

Sampling Campaign Number:

Started at:

MODELING AREA AND GRID

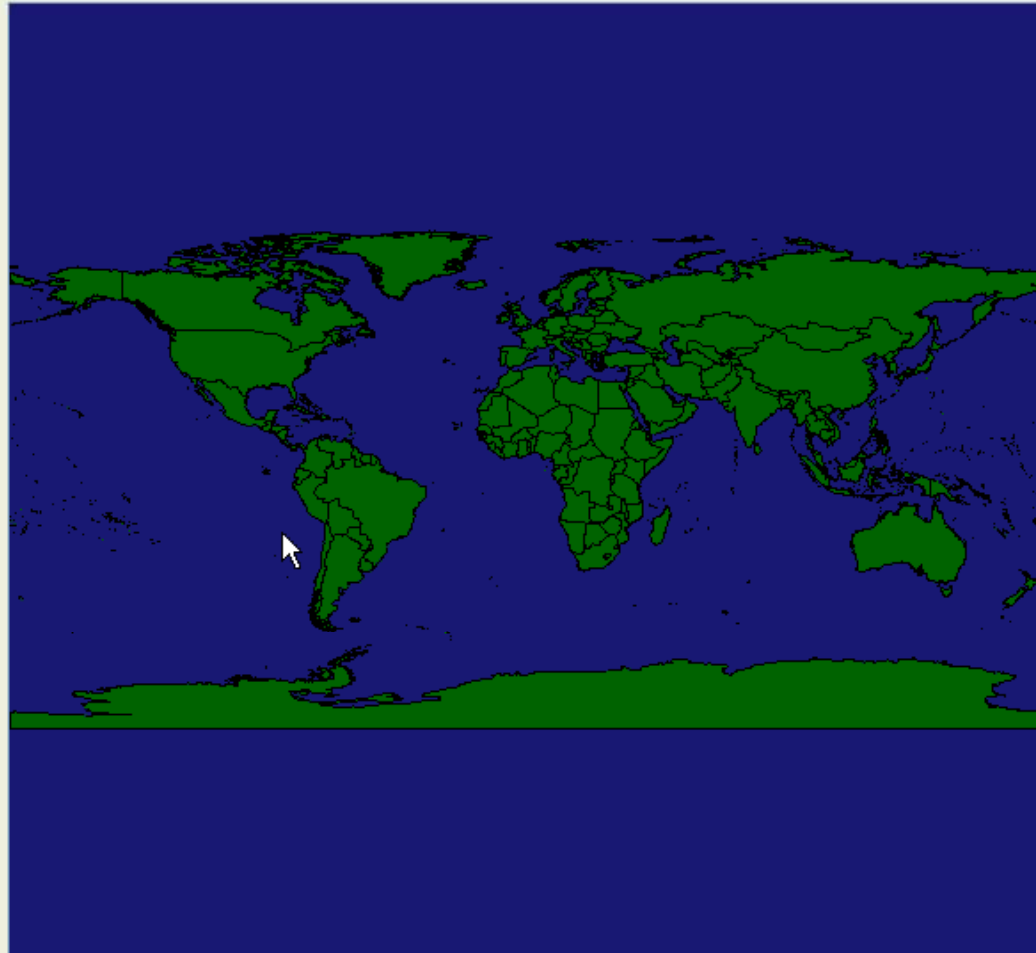
Number of grid nodes:
 Default, or select: x: y:

LAND BOUNDARIES

CALCULATION TIMES

Time Number

Time/Date



TIME VIEW

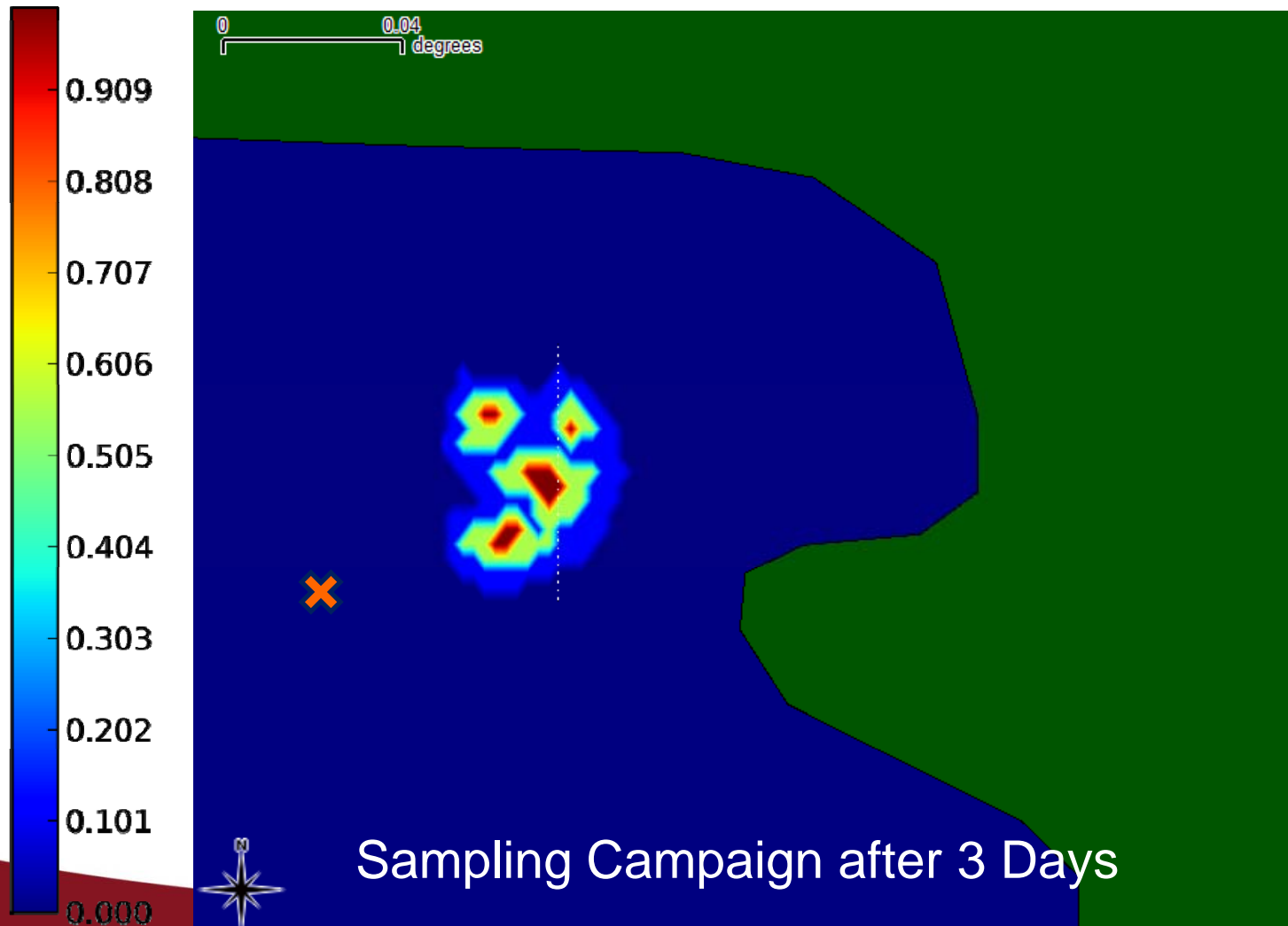
PAN

W N E S

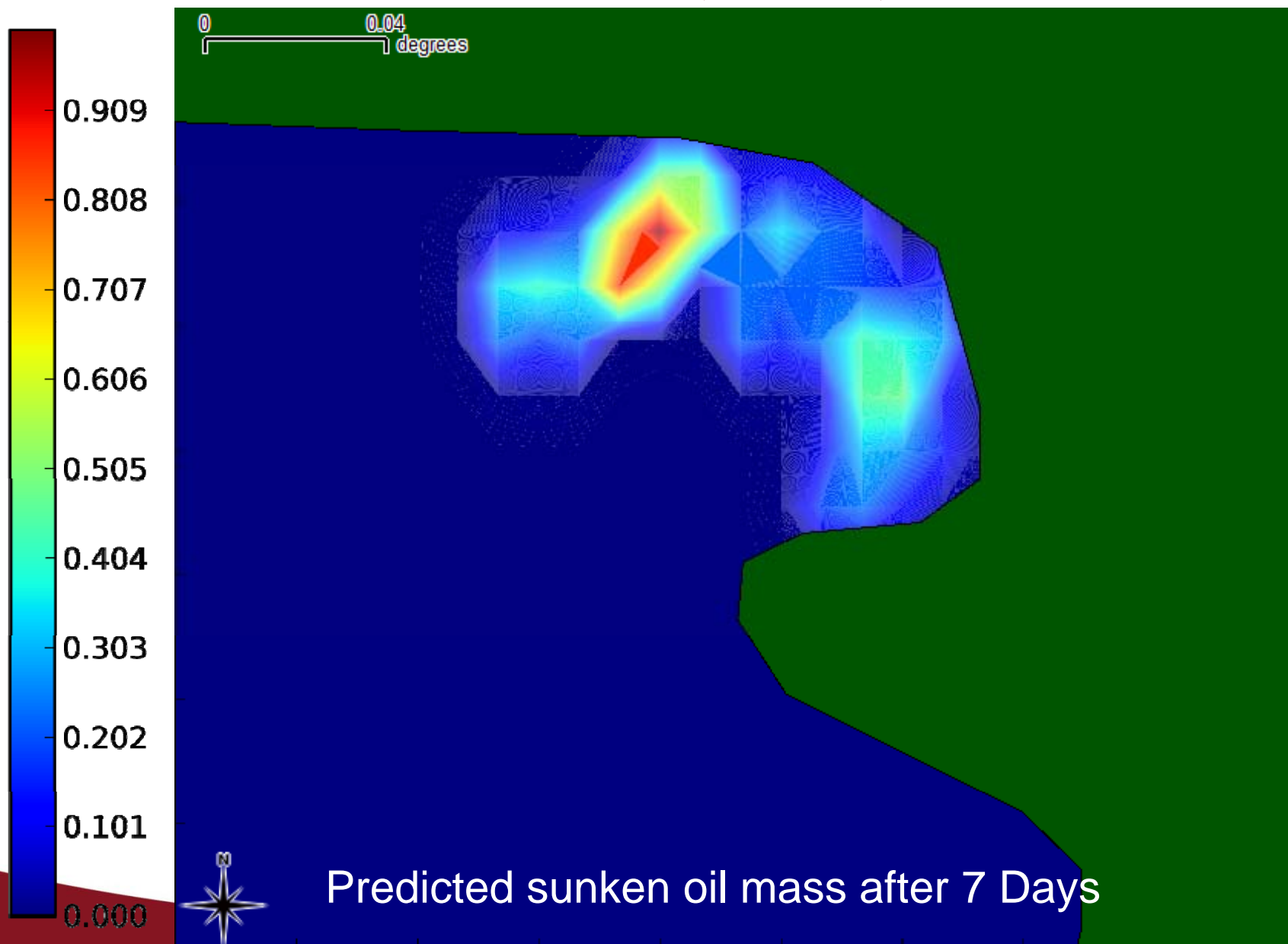
Prediction in progress...  10%

Results to Date (cont.)

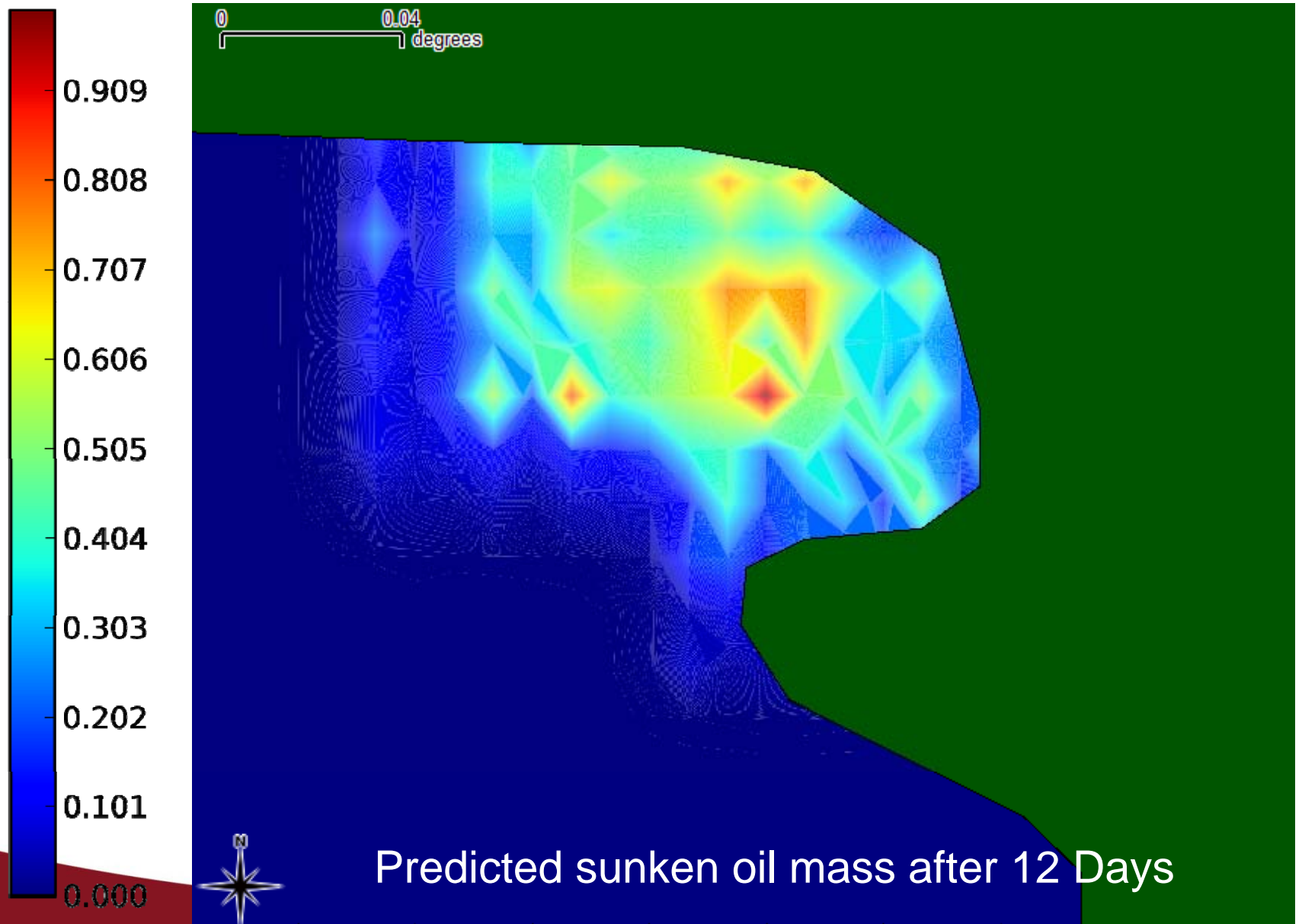
- Synthetic data: 3 days after spill
 - Spill at 82.95° W; $29^{\circ}05'$ N (Gulf of Mexico, FL)



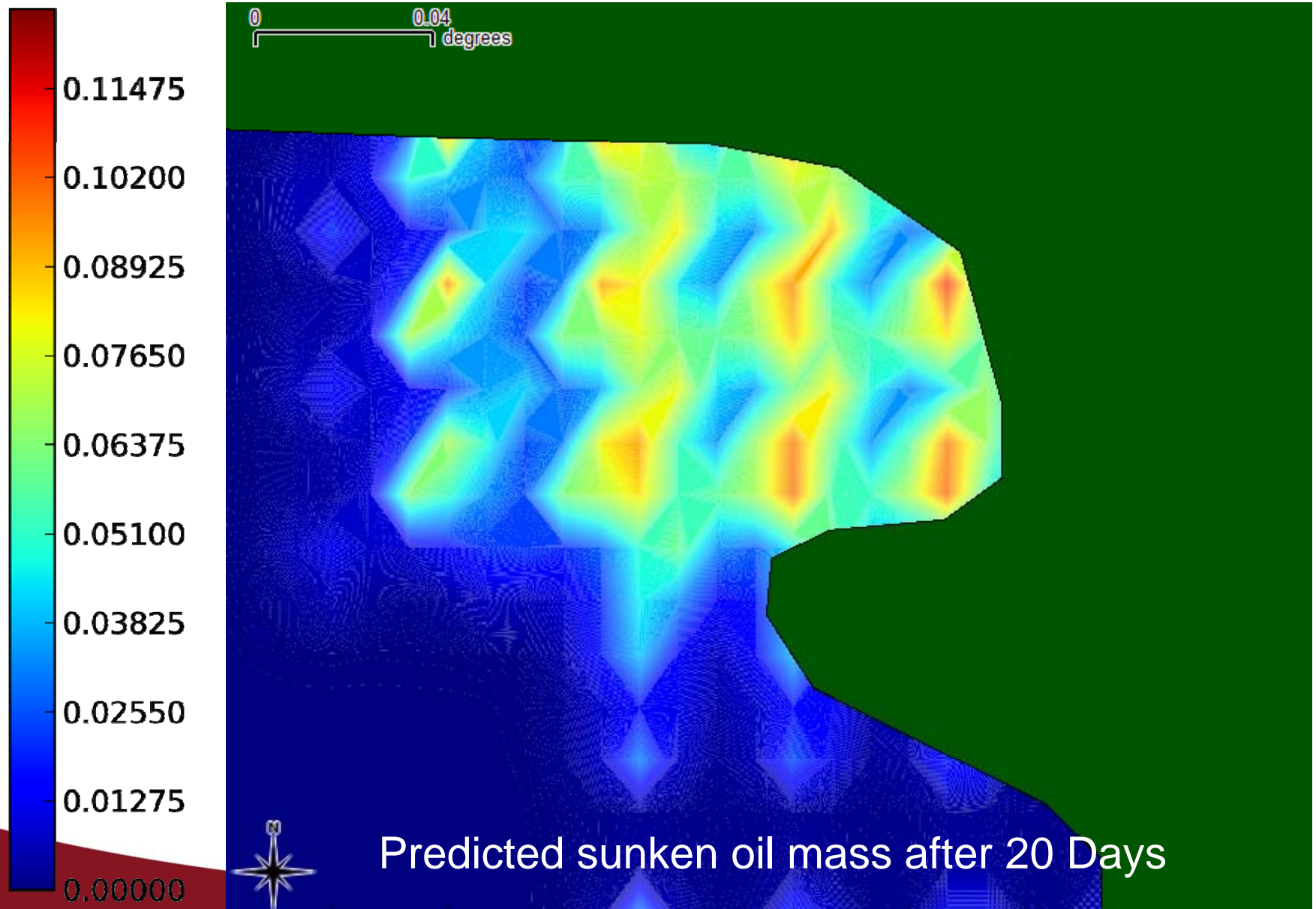
Results to Date (cont.)



Results to Date (cont.)



Results to Date (cont.)



Current Activities

- Verification versus:
 - Approximation of DBL 152 spill graphical data
 - Synthetic multi-modal data
- Optimization: integration precision v. run time
- Mapping and GUI amenities
- Draft final report



Application/Implication

- Unconditional relative probabilities of oil mass, considering uncertainty
- Bottom current data not required
- Emergency response
- Relatively flat-bottomed bays
- Convex/concave shoreline geometries
- Multiple field-sampling campaigns (area/time)



Recommended Further Development

- Input capabilities:
 - Bathymetry-based prior information
 - Bottom current-based prior information
- Application to restoration



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