Dynamically Coupling INTEL and METOC to Predict the Risk of Pirate Attack

An Idealized example

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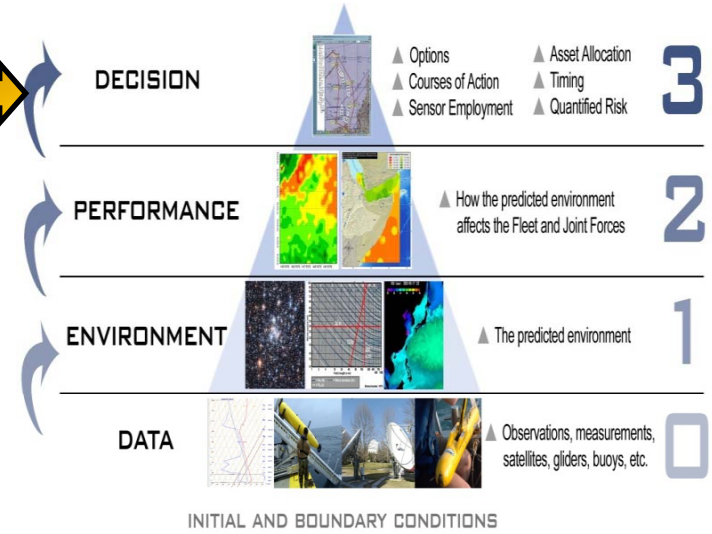
Motivation

- The Navy METOC community often struggles to play a proactive role in mission planning.
  - Typically, plans are developed and then forecasters are asked about METOC impacts.
  - In strike groups, the METOC officer does very little METOC. Instead attempts to integrate with ship operations.
  - Some METOC groups have integrated themselves with planners through personality and/or good fortune.

- The aim of this project is to provide the METOC community with frameworks, tools, and training that will enable them to better impact the planning process.

- Piracy as an example.



Objectives

- Demonstrate that in the case of piracy, INTEL and METOC must be dynamically coupled to produce relevant risk estimates.

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Dynamically coupling INTEL and METOC Framework

- A method to predict the probability of pirates operating in an area, taking into account:
  - Pirate CONOPS
    - Tactics, capabilities
  - METOC
    - Thresholds, drift
  - INTEL
    - Bases, numbers, commercial shipping
  - Spatial-temporal correlations

Approach

- Write a model of pirate behavior that produces a trajectory of pirate location as a function of time.
- Account for as many factors as possible (e.g. METOC, operating thresholds, commercial shipping, recent behavior).
- Run the model a large number of times over the same forecast period, sampling from known sources of uncertainty.
- Interpret the collection of trajectories probabilistically.
- Modify the trajectories - and hence the probabilities - as new information becomes available (e.g. METOC, INTEL, confirmed pirate activity).

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Input information

- Probability of land base locations as a function of lat/lon.
- Probability of sea base locations as a function of lat/lon.
- Likely number of pirate groups acting at a particular time.
- Distribution of those groups between land and sea bases.
- METOC forecasts (probabilistic form).
- Degree to which pirates have access to and act on METOC forecasts.
- Degree to which pirates have access to and act on sea lane traffic information.
- Pirate tactics while at sea.
- How winds and currents thresholds impact pirate behavior.
- How winds and currents impact pirate skiff drift.
- Probability of a Navy ship identifying a pirate during routine operations.

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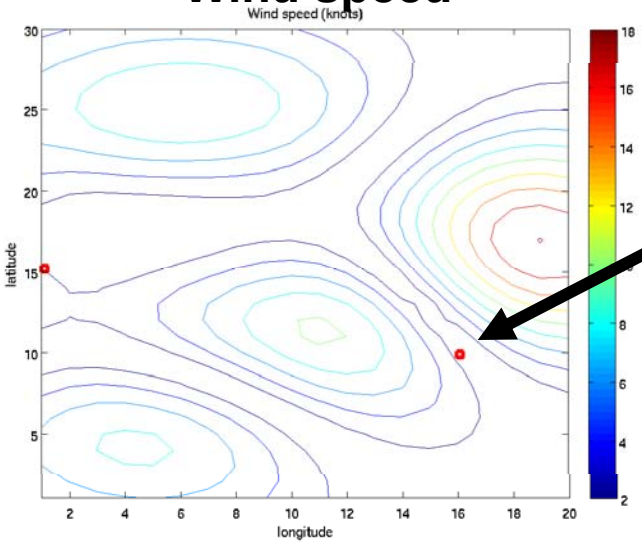
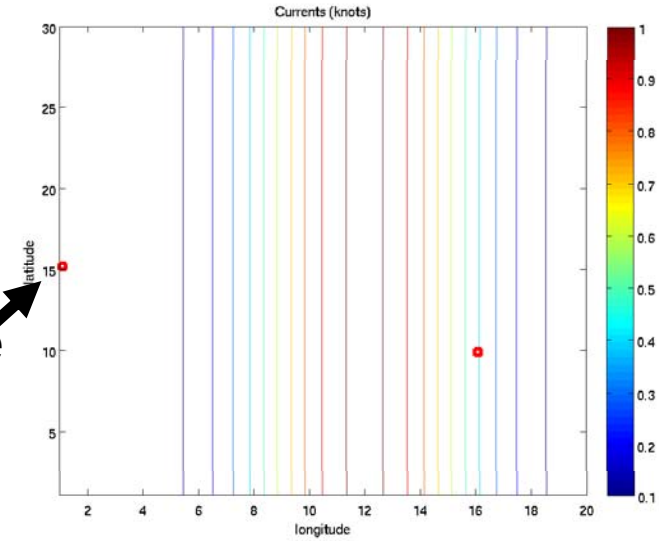
Idealized Situation

Wind speed



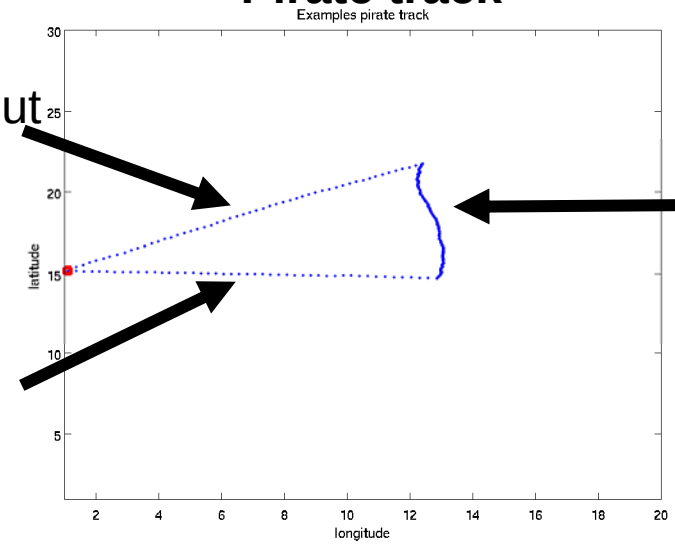
Center of distribution of possible sea bases

Currents



Land base

Pirate track



Motor out

Motor in

Drift with winds and currents

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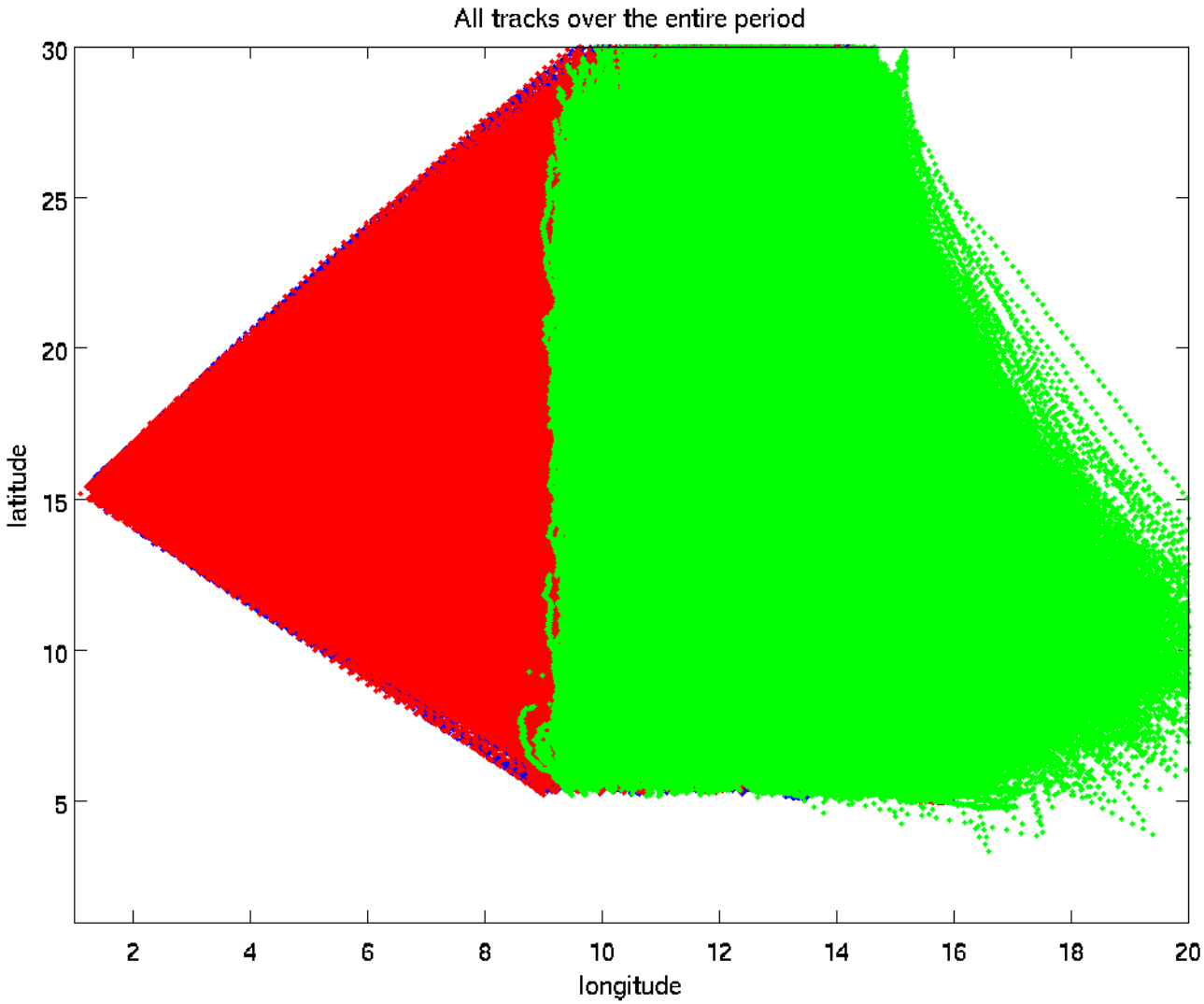
10,000 trajectories, 3 million locations

Assumes three pirate groups, two based on land and one at sea.

72 hour period.



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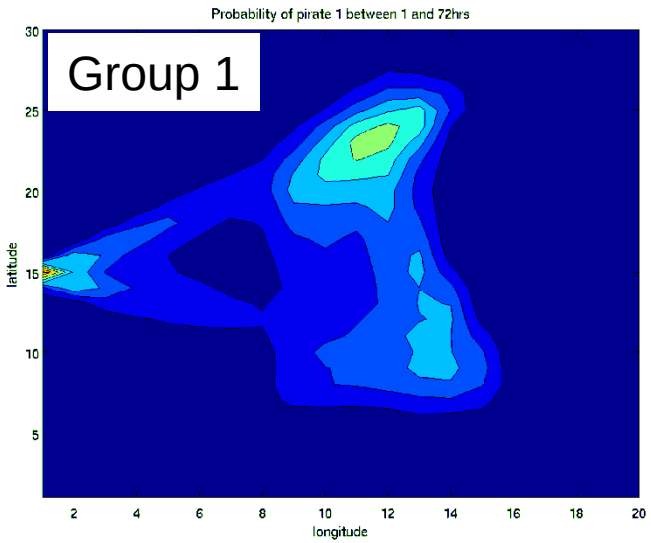
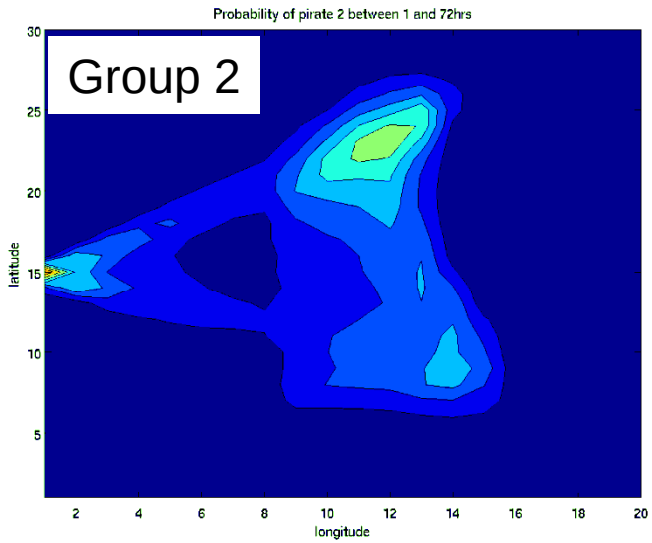
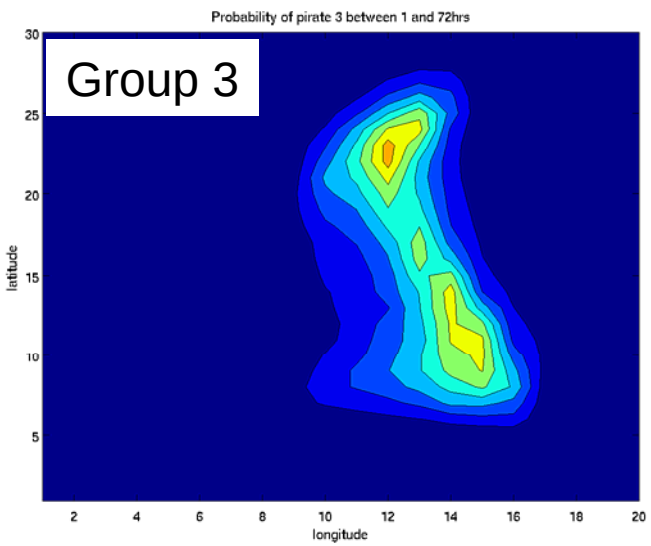
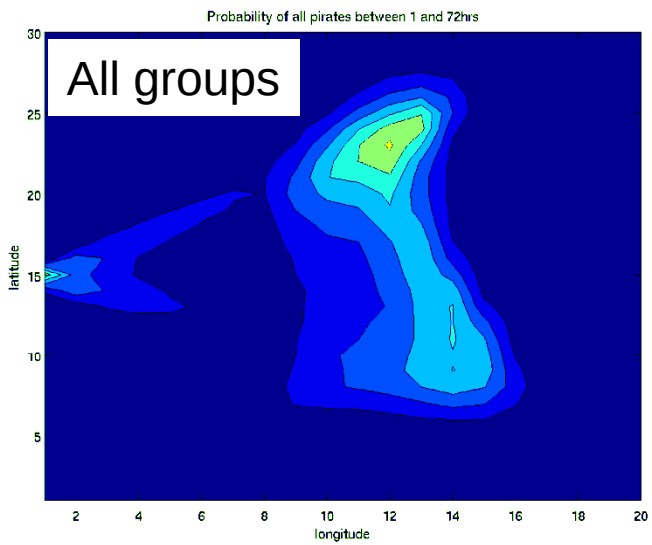
Pirate probabilities, 1-72hrs

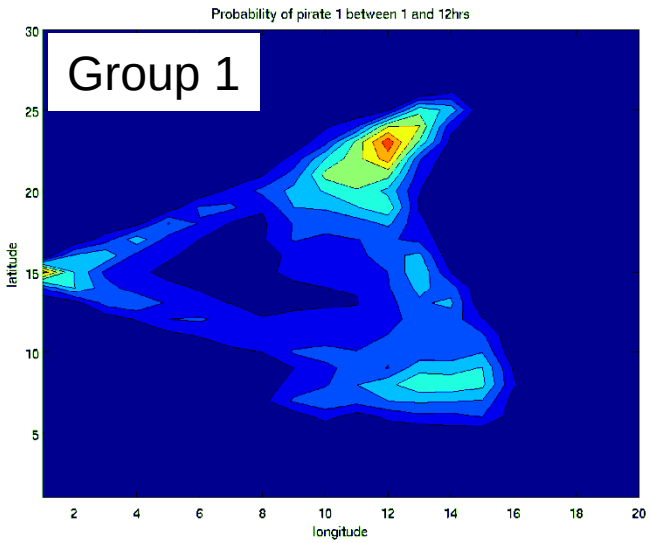


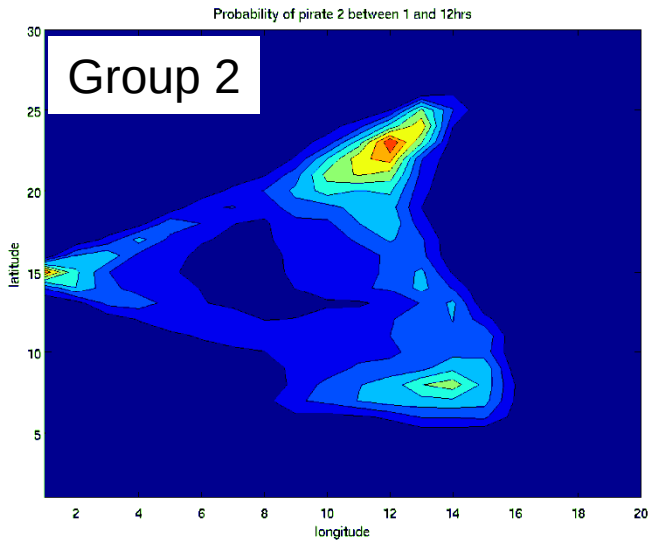


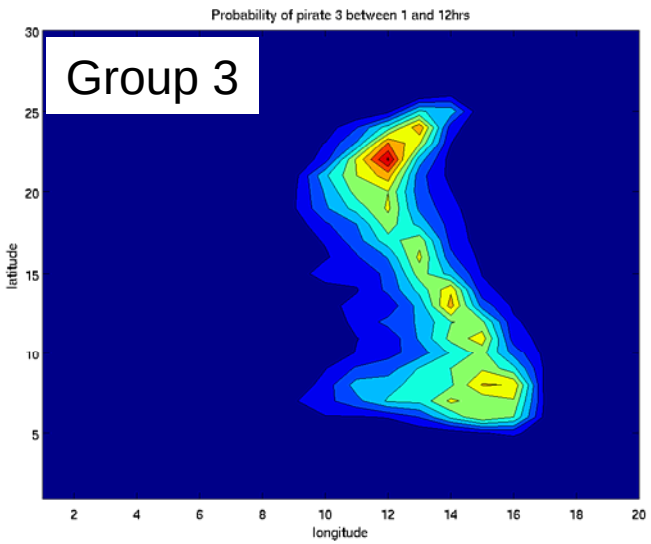


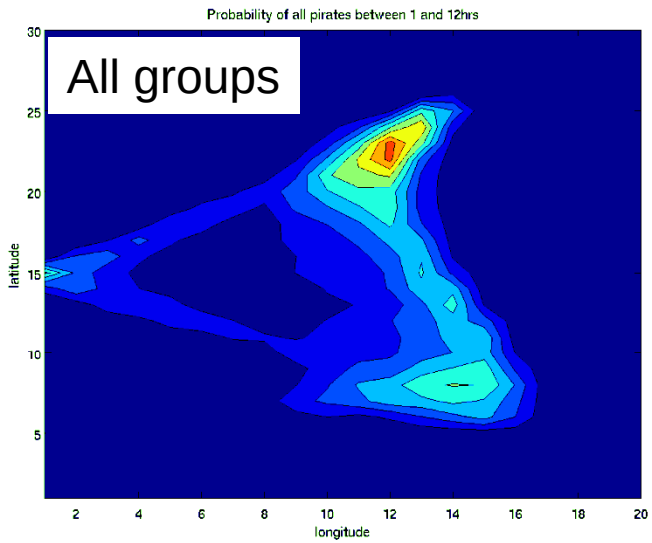


Pirate probabilities, 1-12hrs

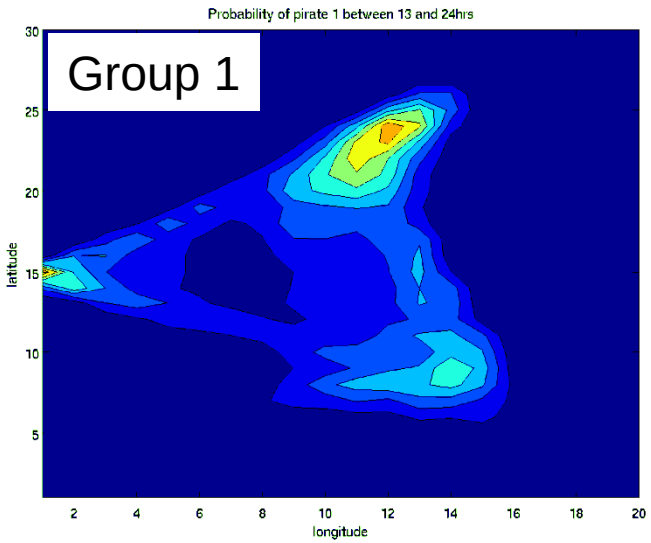


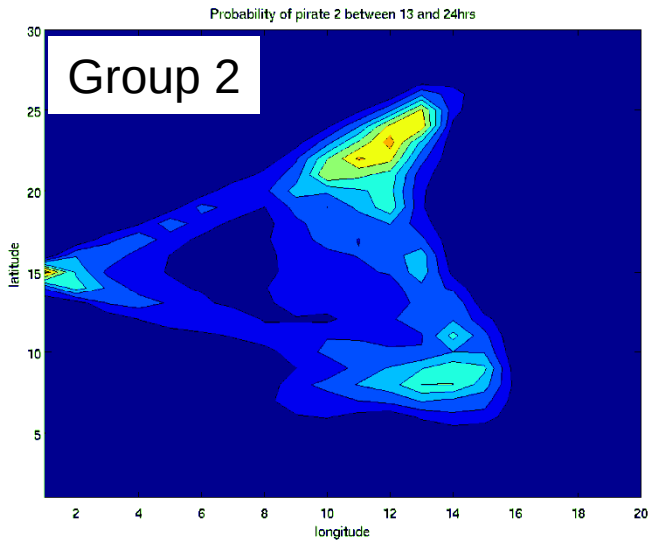


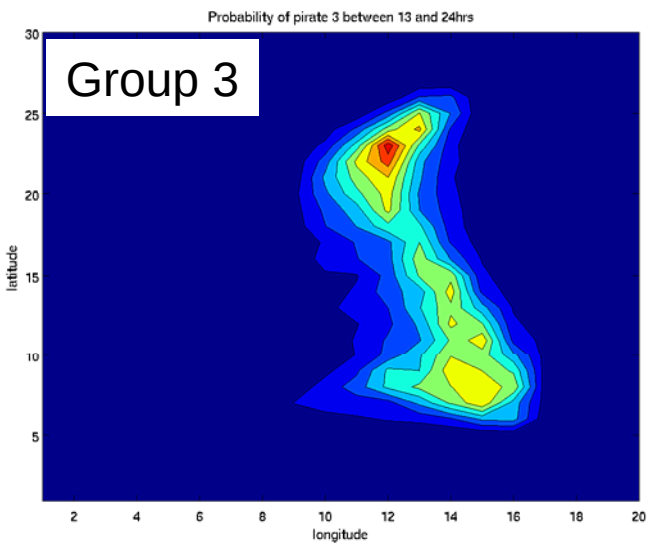


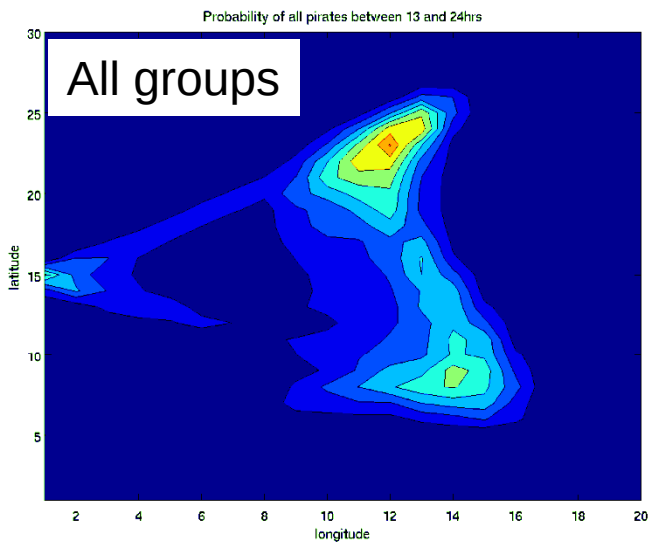


Pirate probabilities, 13-24hrs

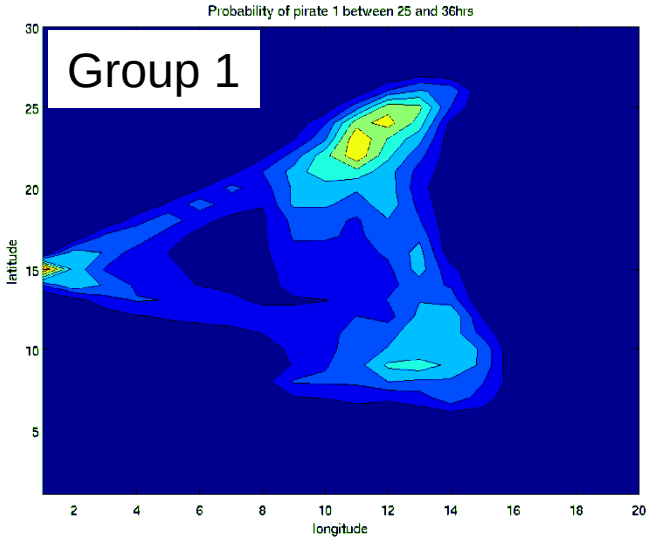


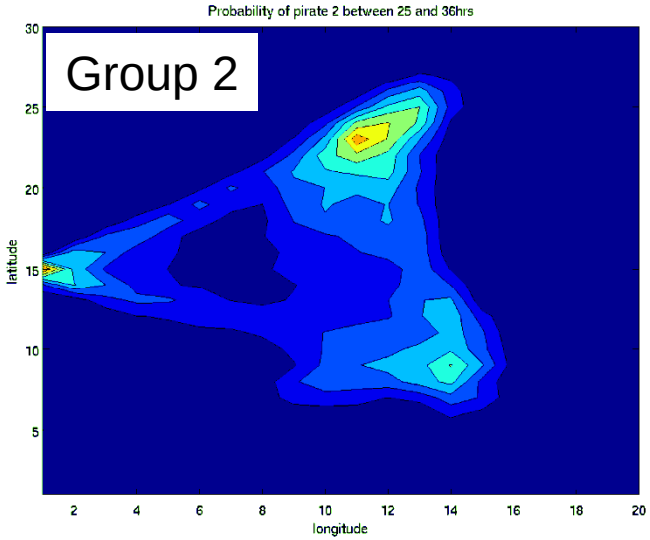


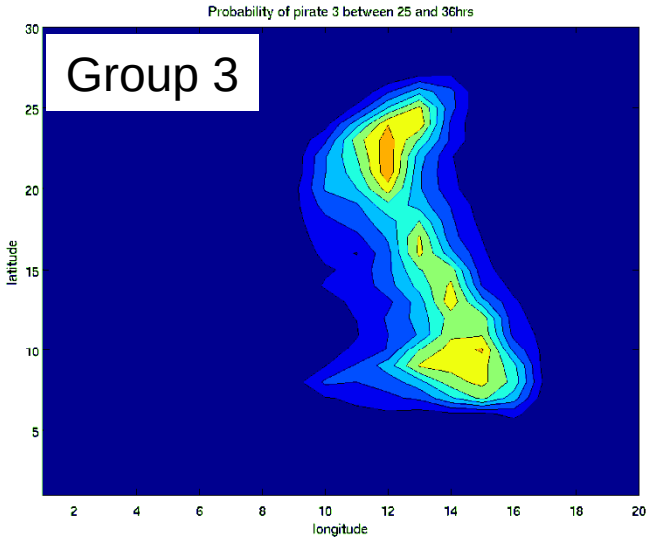


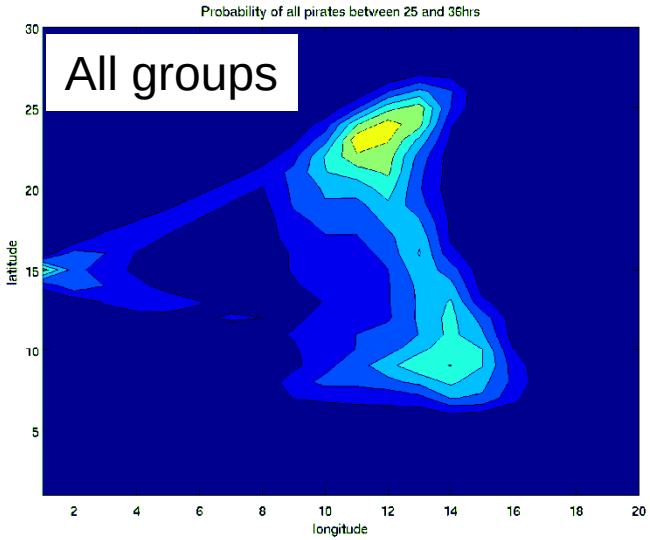


Pirate probabilities, 25-36hrs

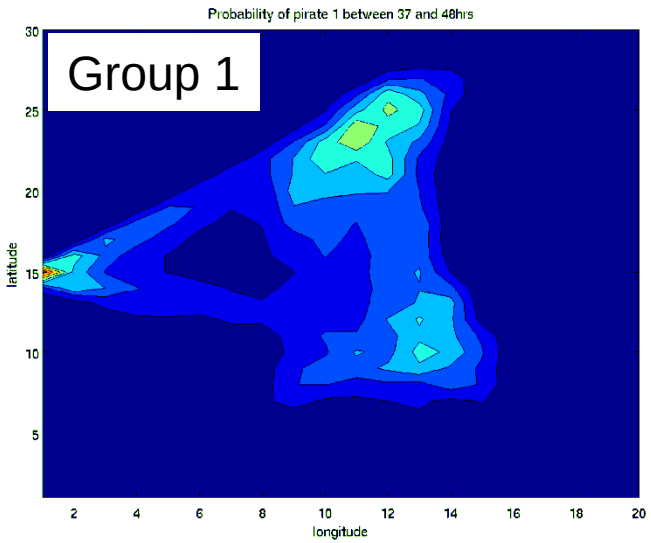


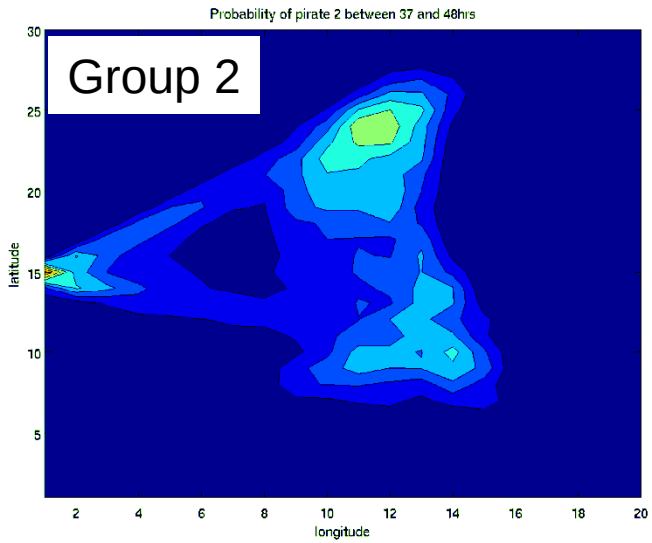


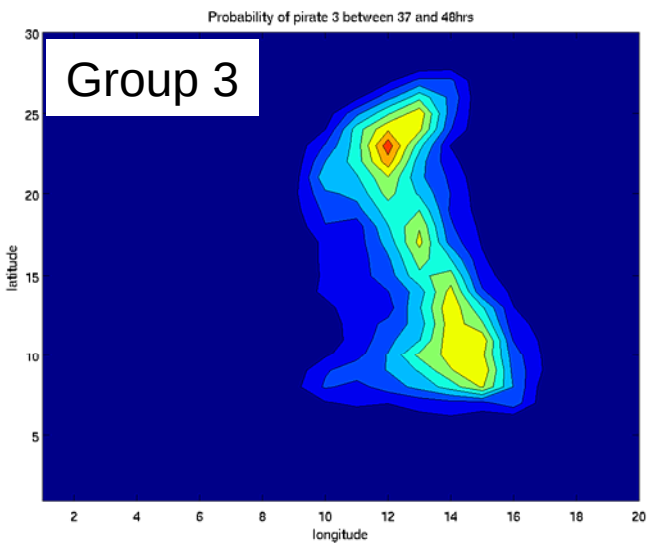


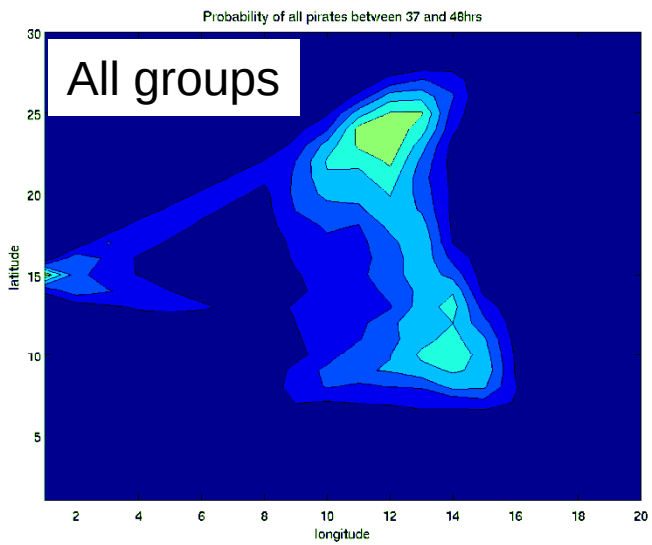


Pirate probabilities, 37-48hrs

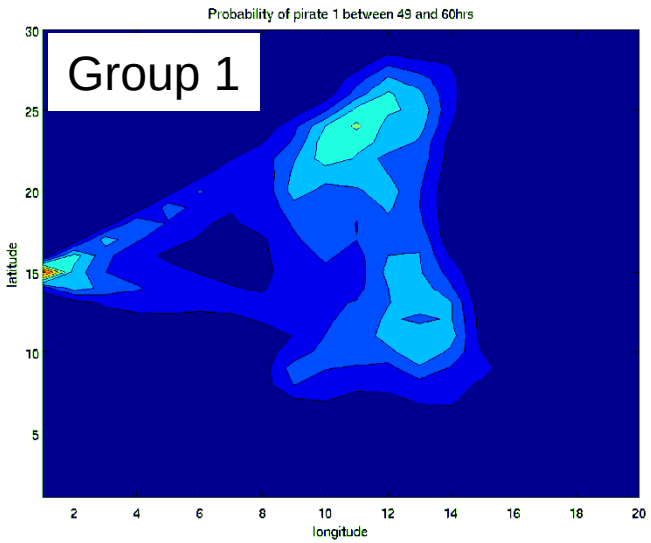


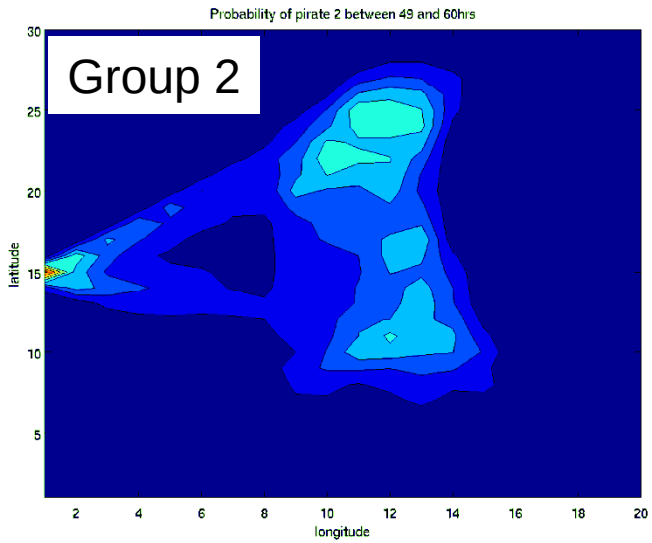


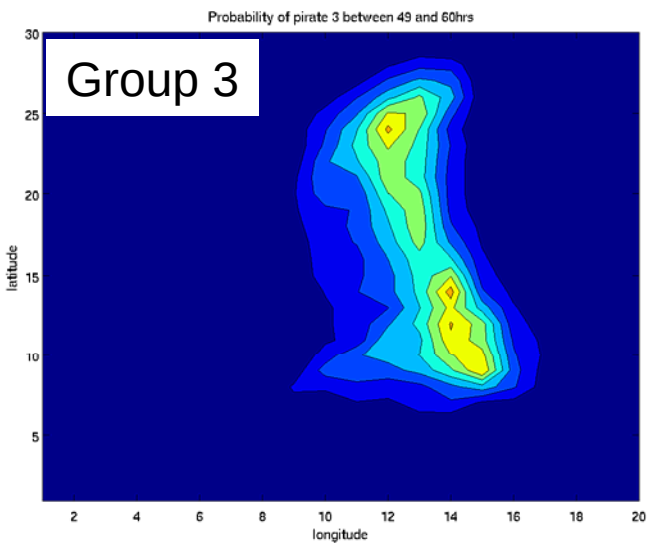


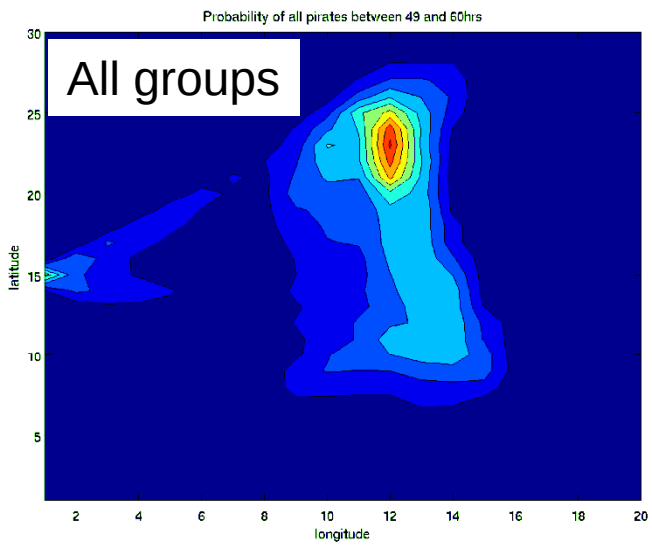


Pirate probabilities, 49-60hrs

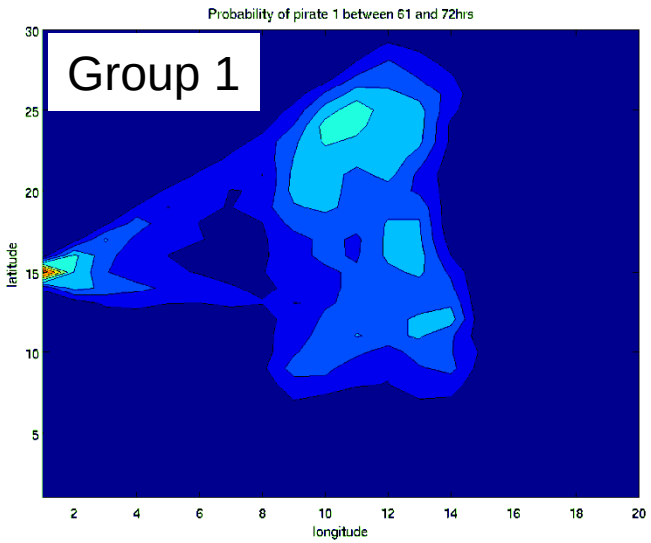


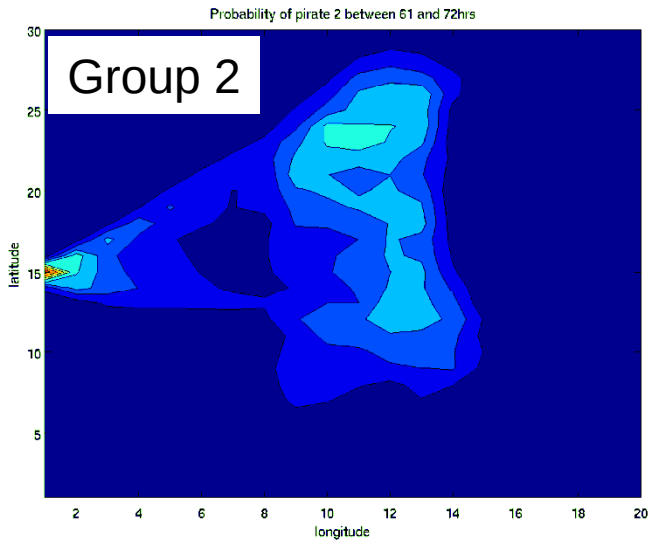


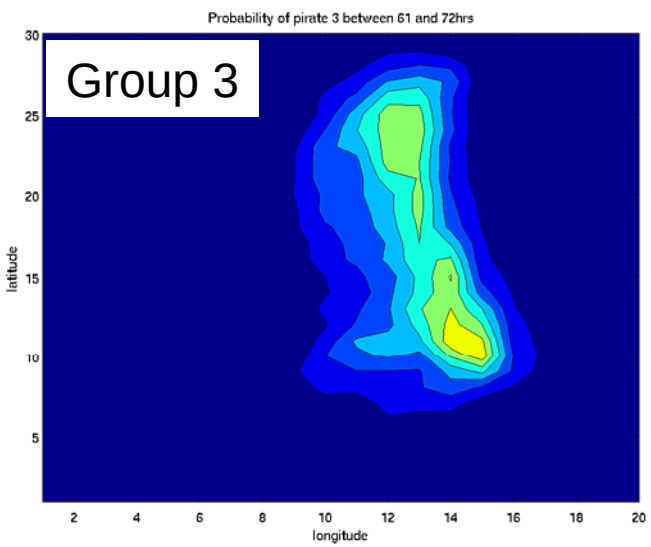


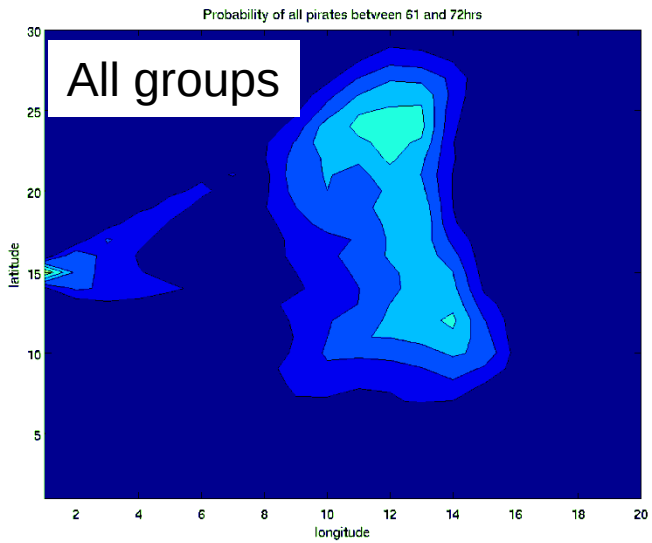


Pirate probabilities, 61-72hrs





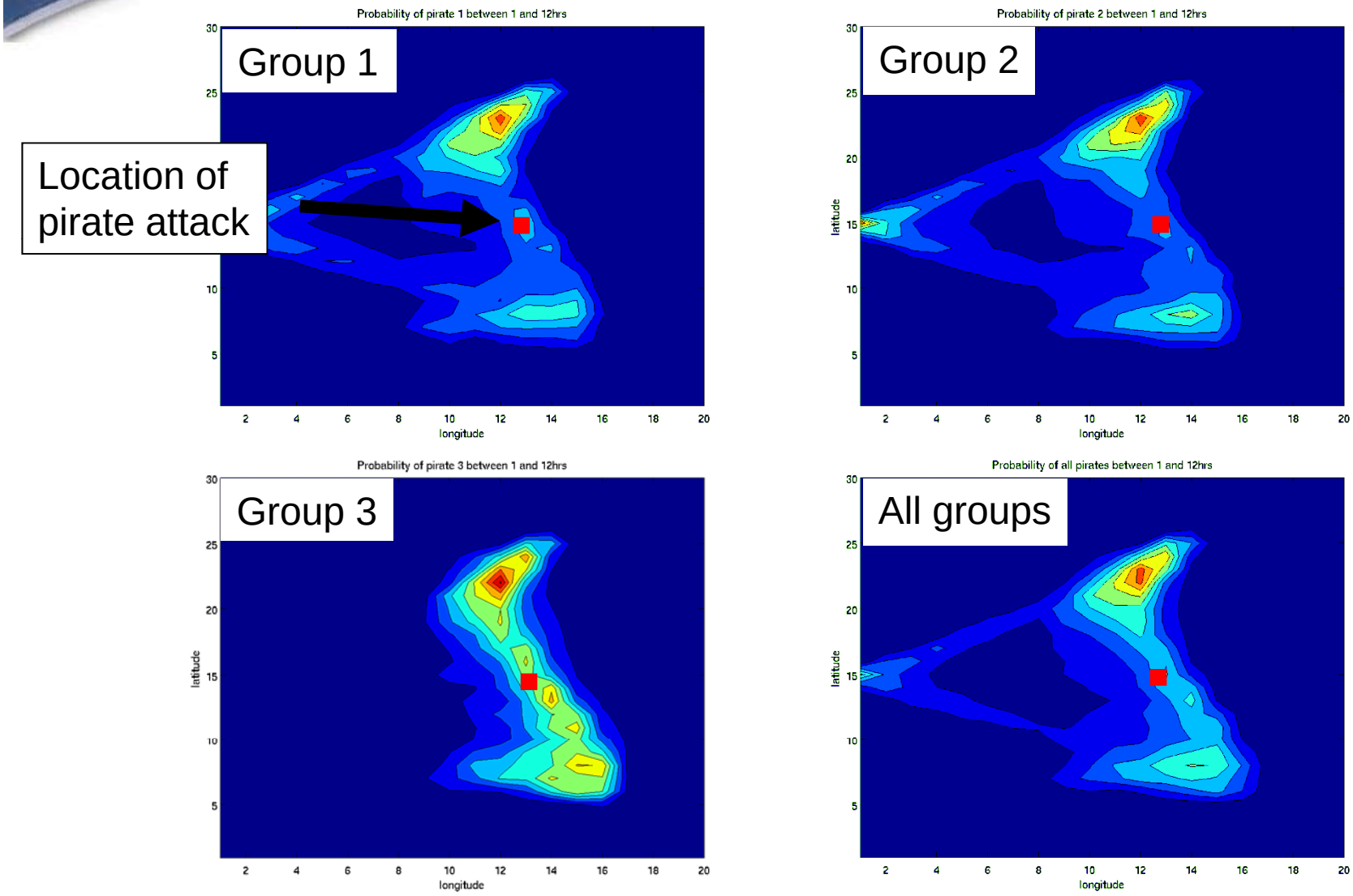




Probability updating

- Probabilities can be immediately updated as new INTEL becomes available.
  - Example: Unsuccessful pirate attack

Pirate probabilities, 1-12hrs



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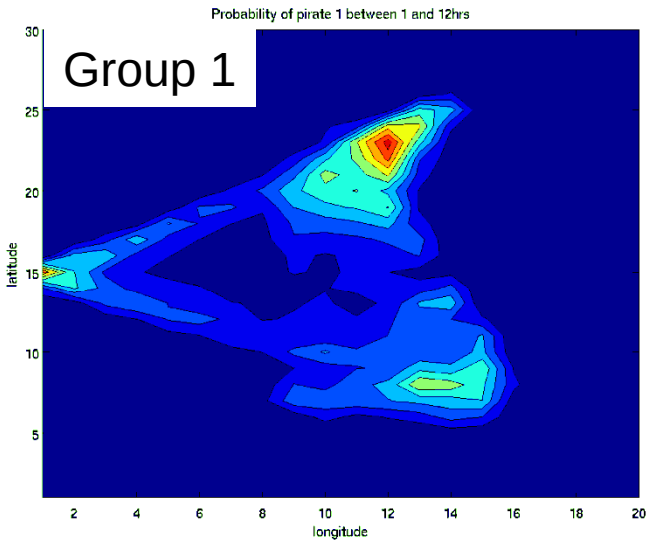
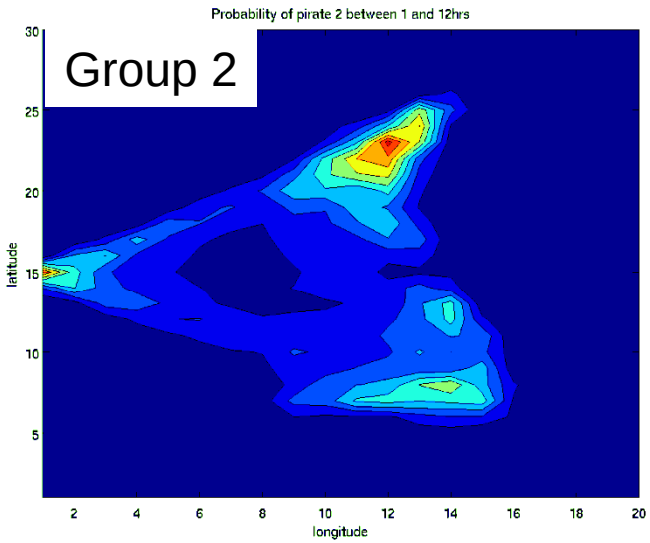
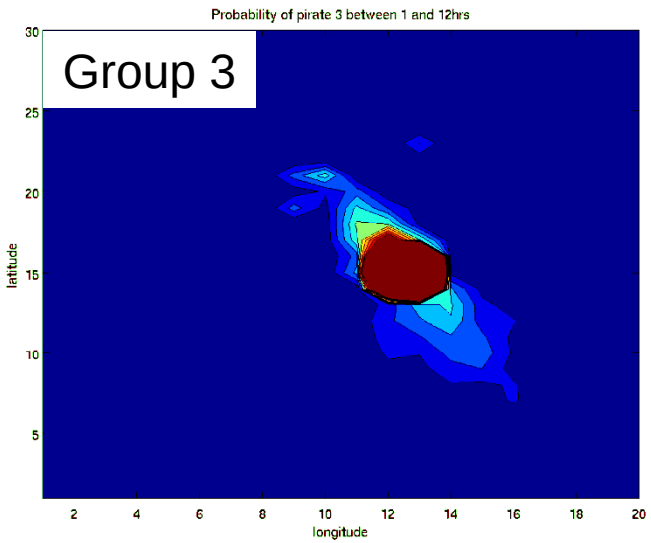
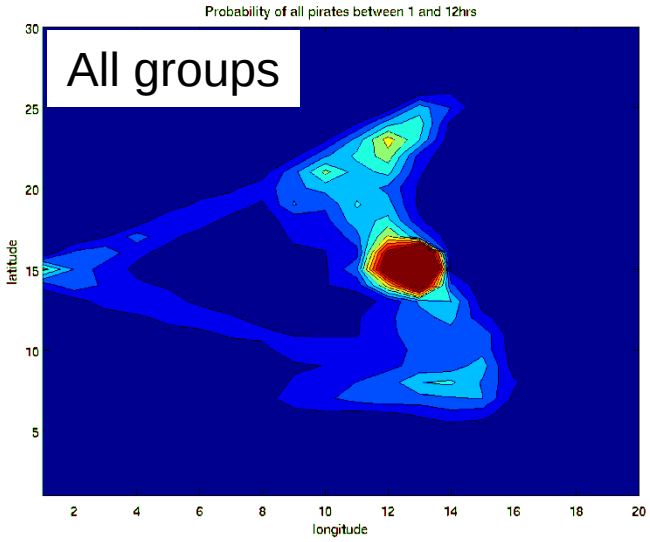
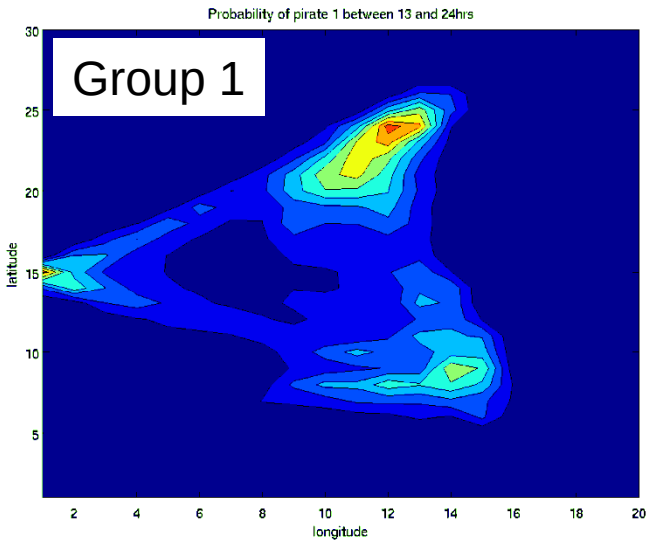


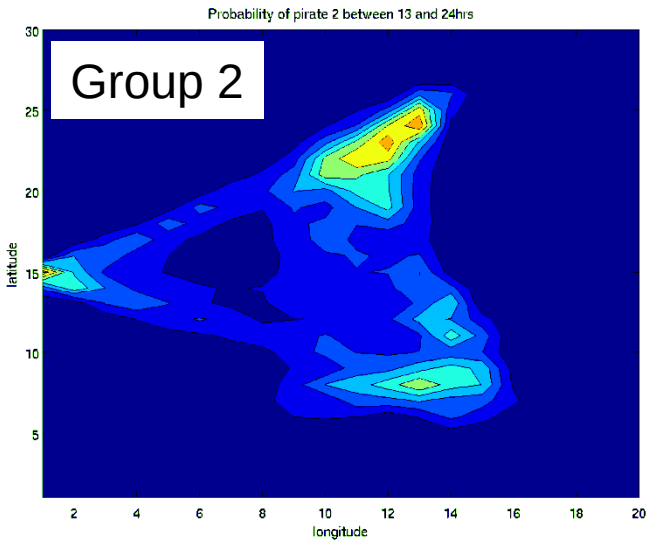


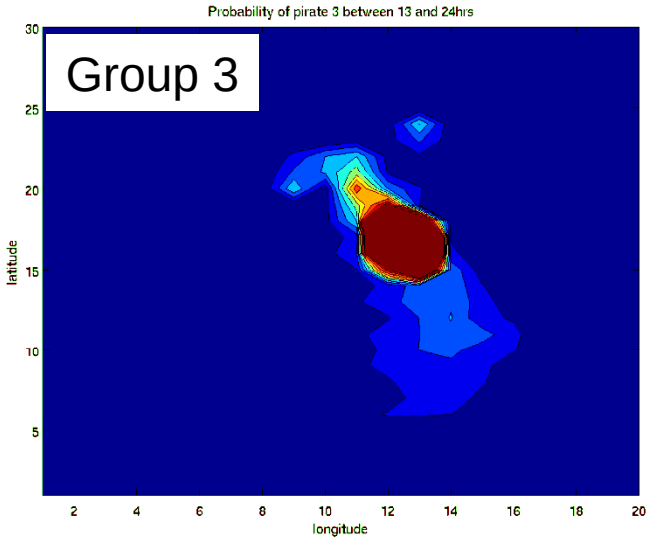


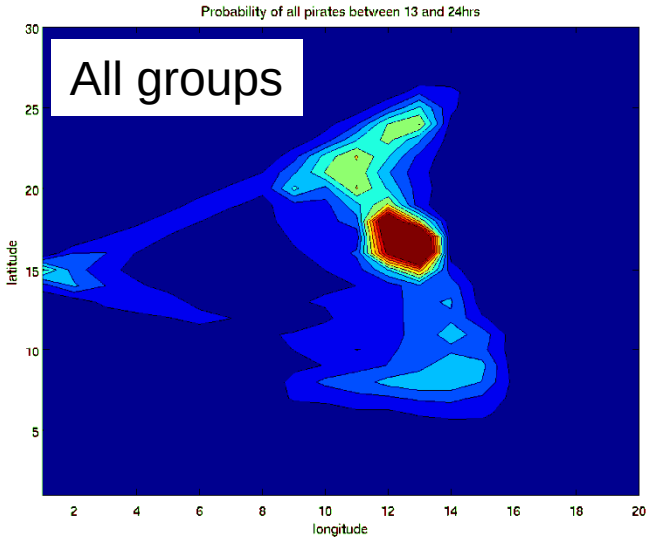


Pirate probabilities, 13-24hrs









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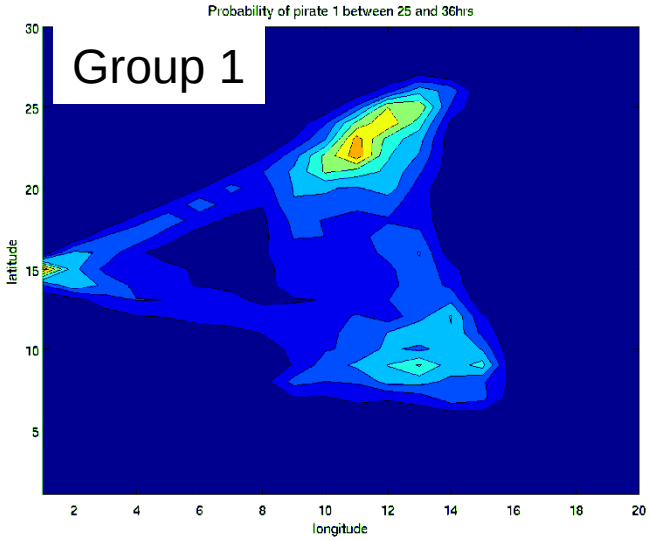
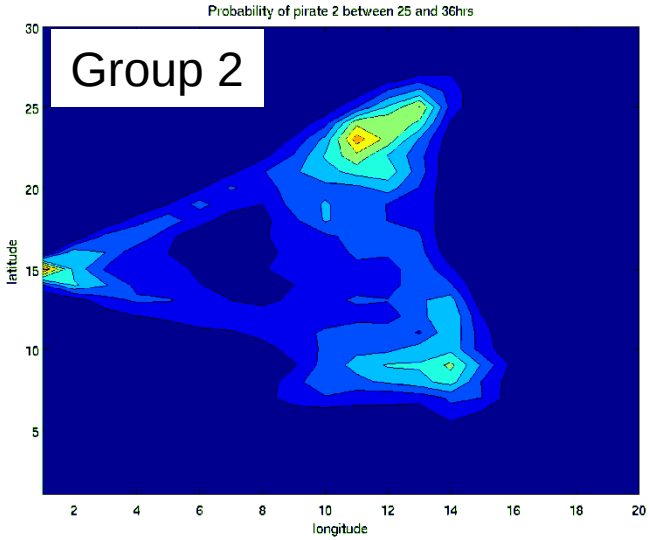
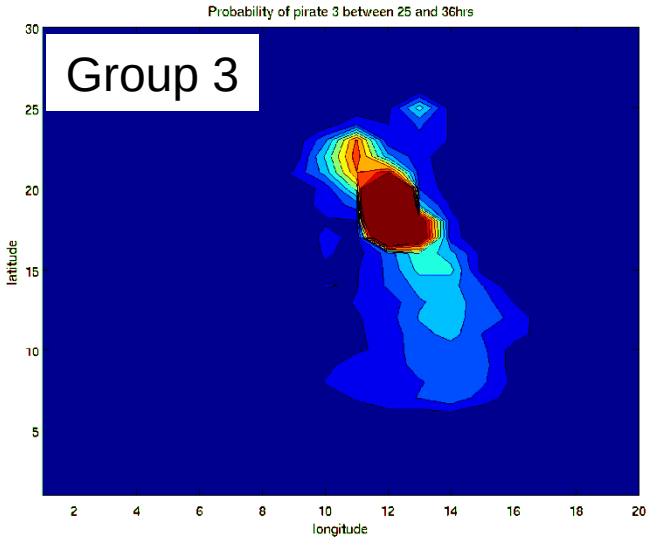
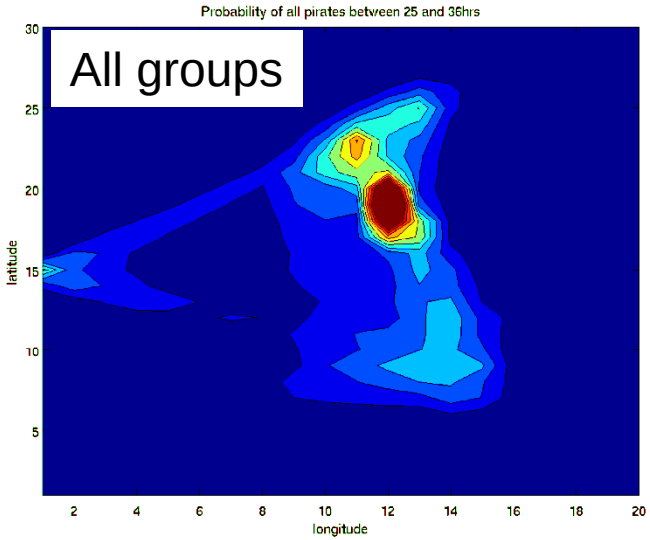
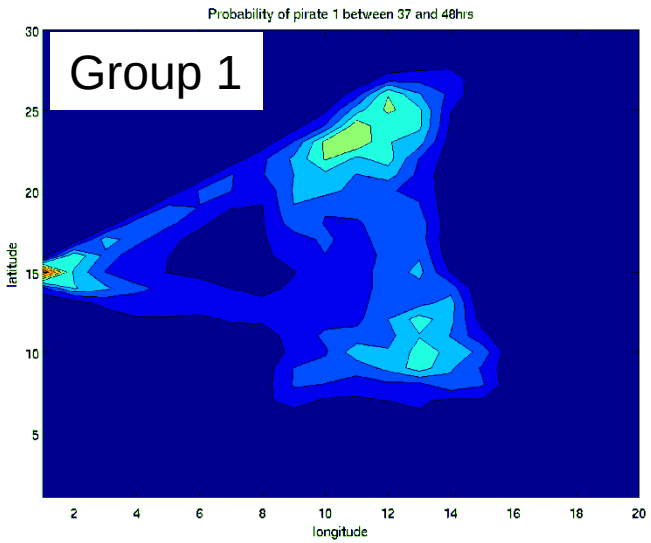


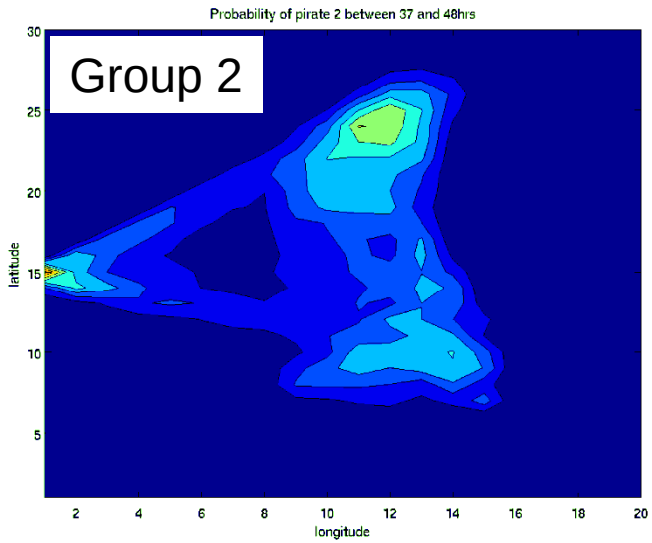


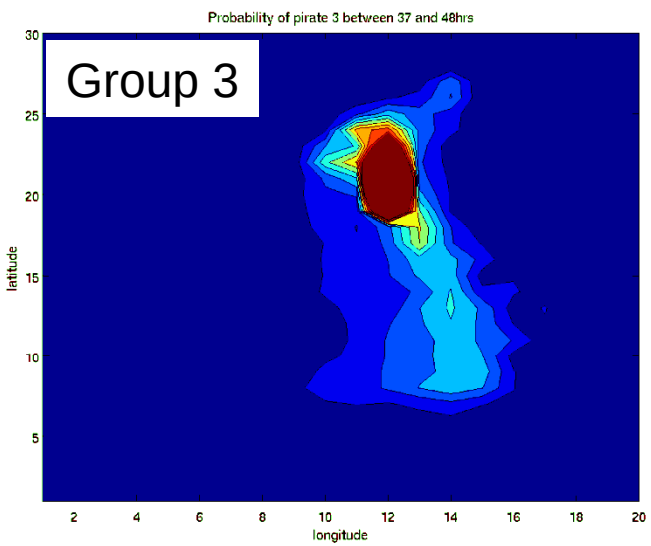


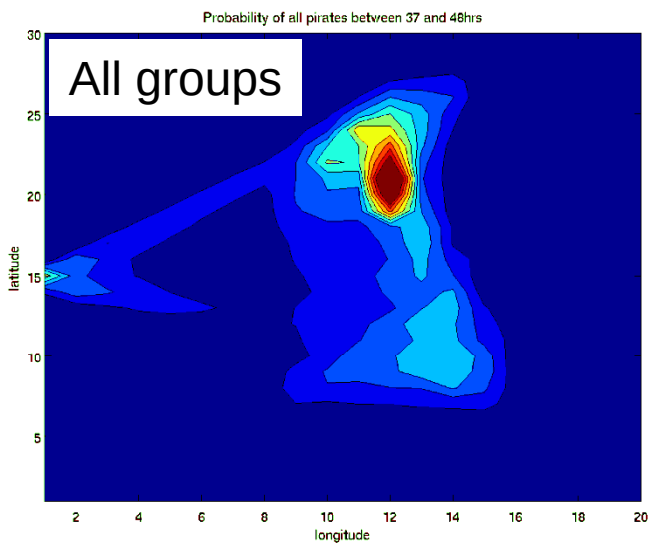


Pirate probabilities, 37-48hrs









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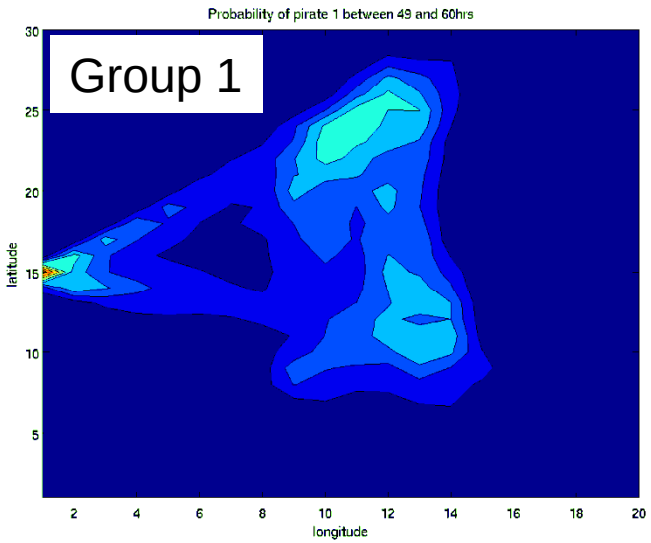
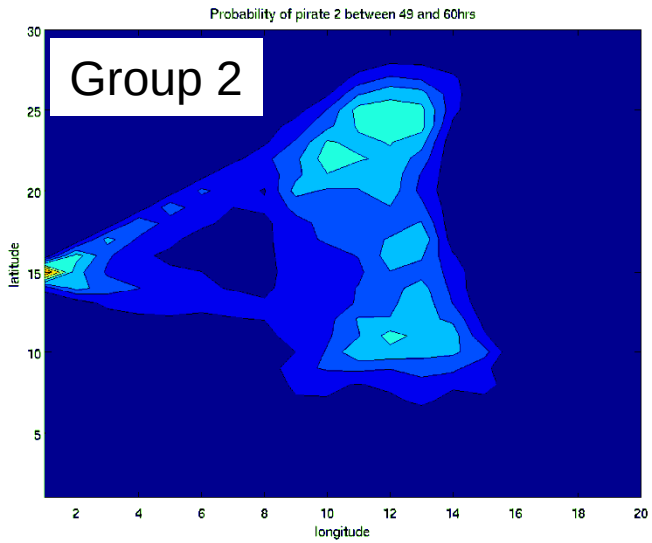
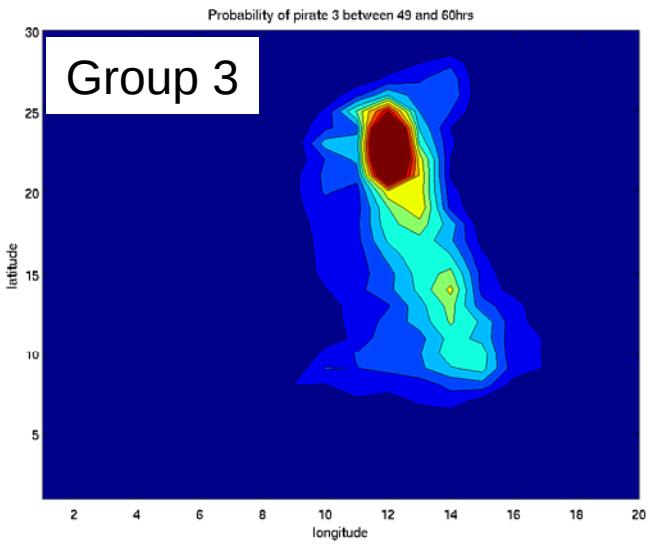
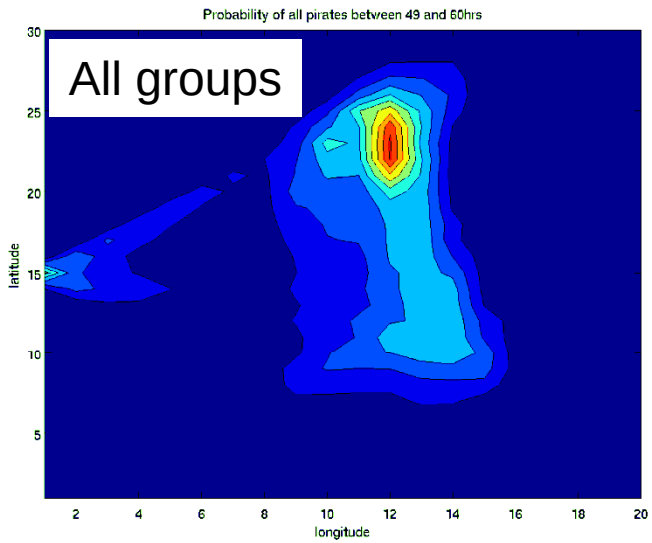
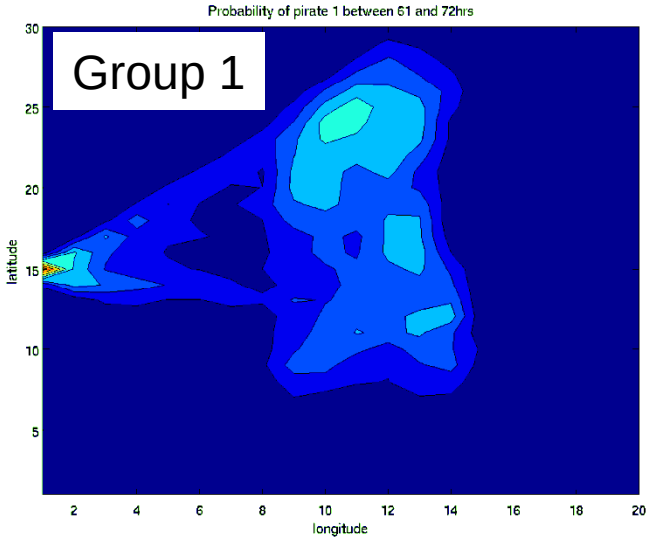


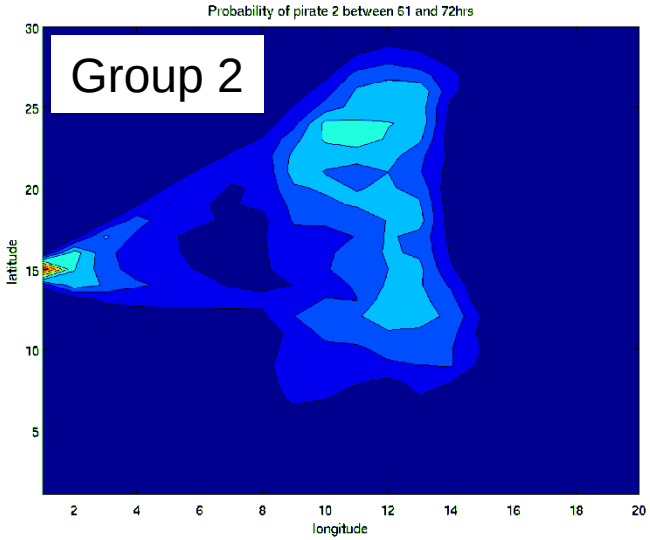


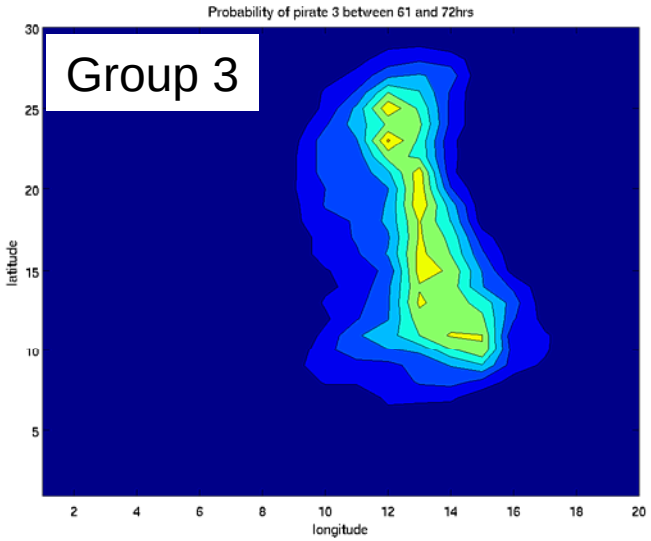


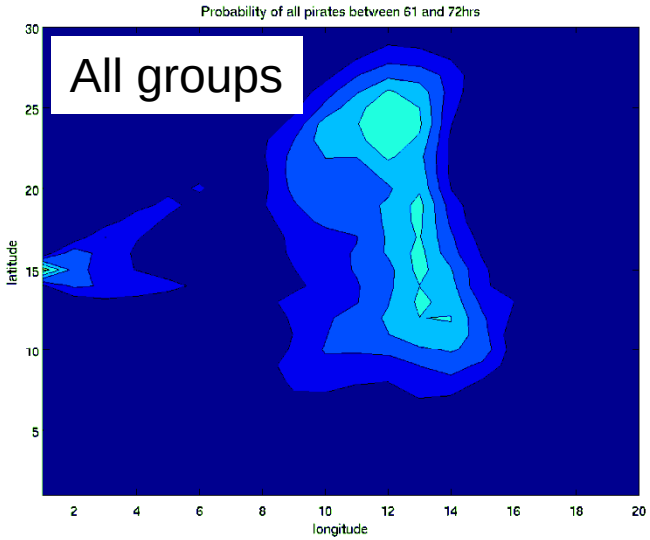


Pirate probabilities, 61-72hrs









Climbing the BOND pyramid

- Interdiction agents don't care about pirate probability – they care about the risk of pirate attack.

- Probability of pirate attack is obtained by combining pirate probability and commercial shipping probability (and perhaps information about interdiction forces).

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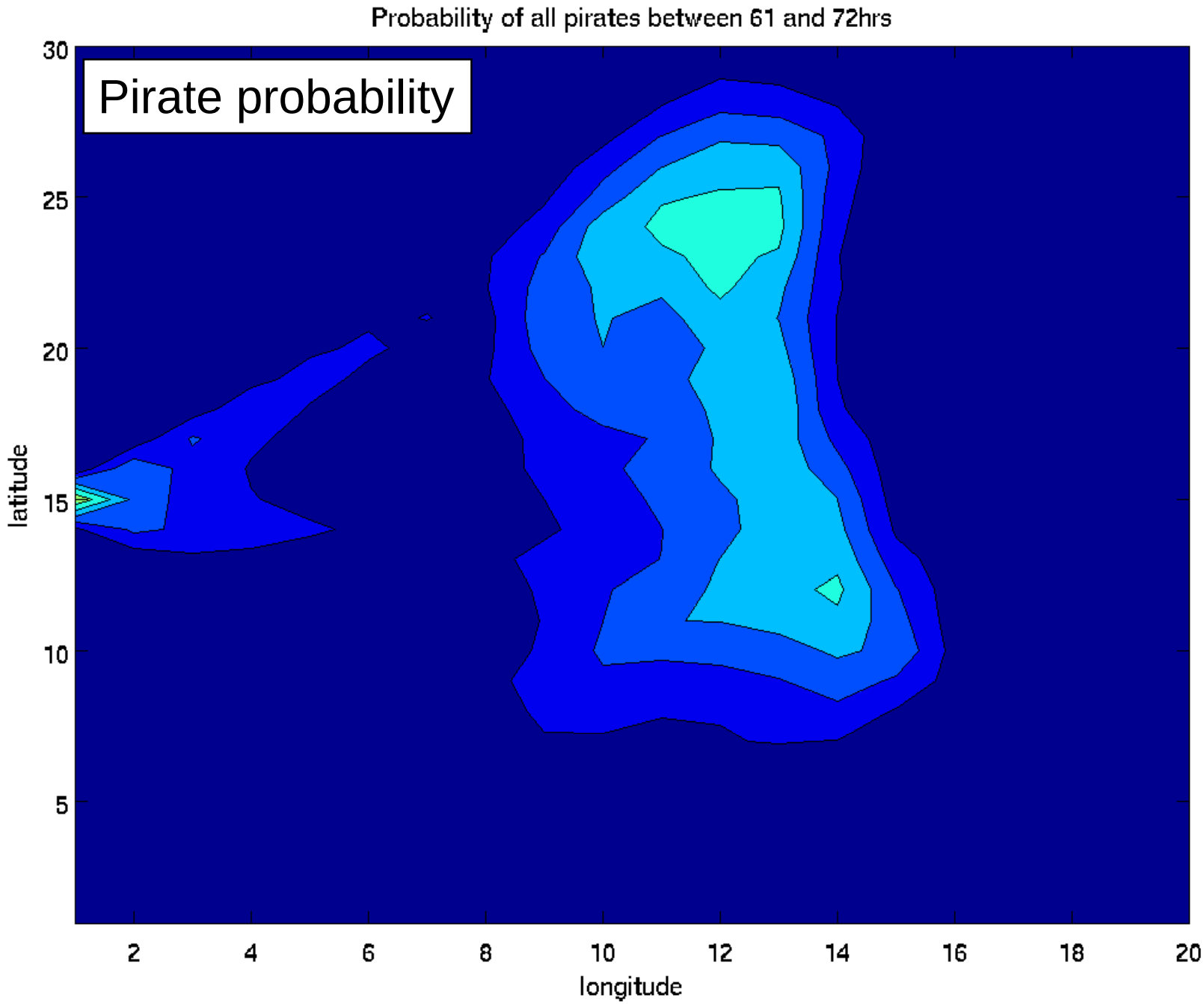

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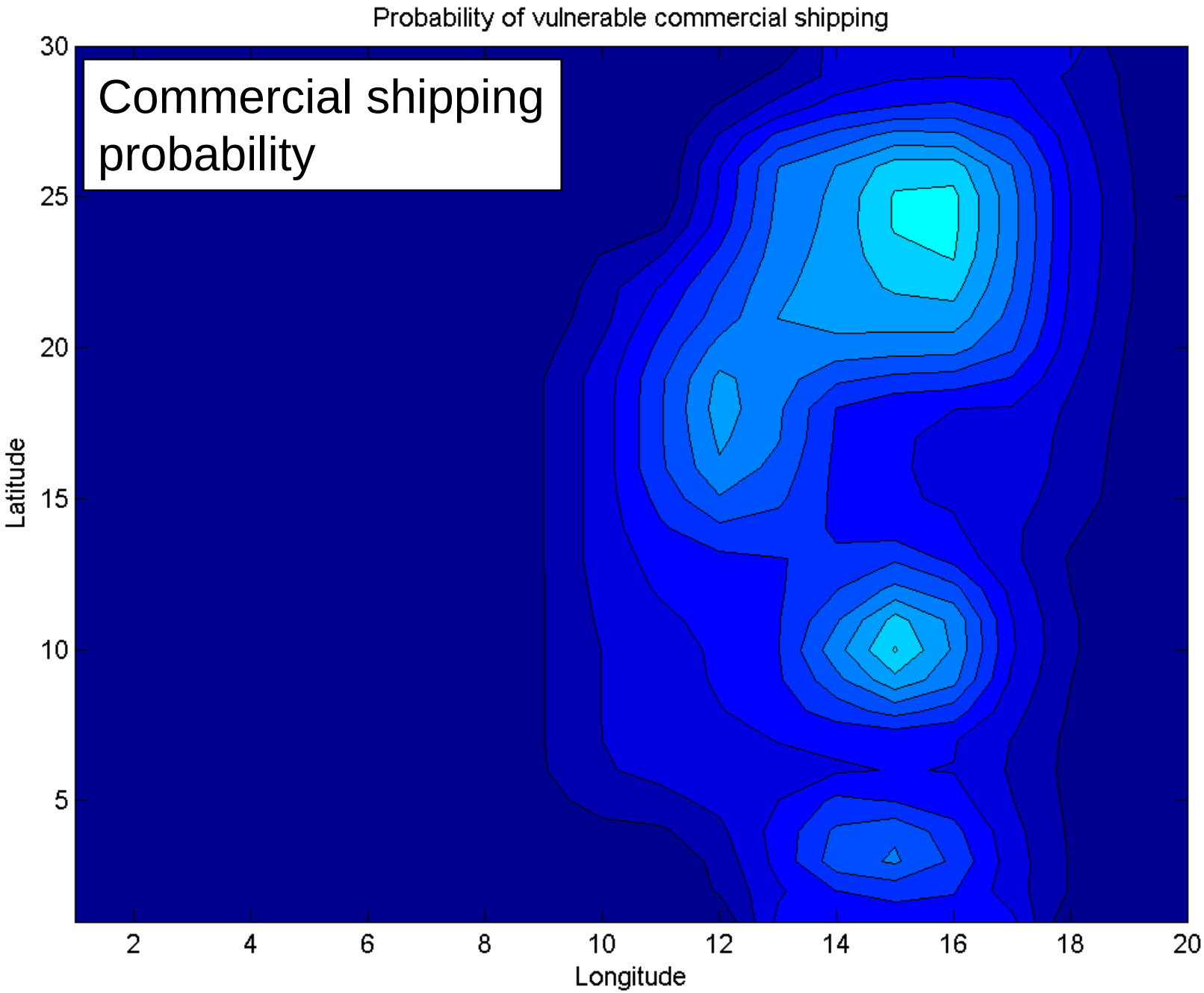

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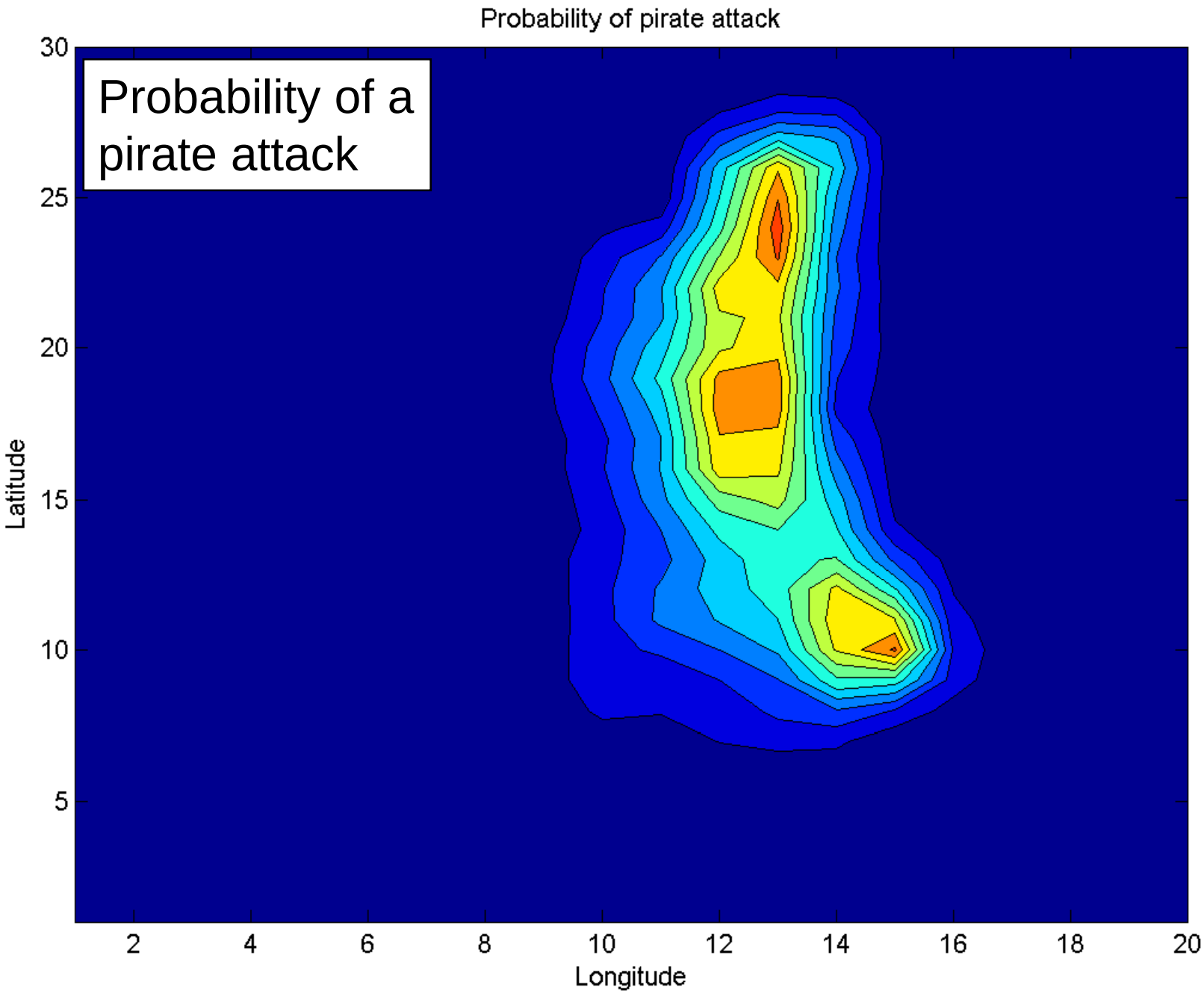

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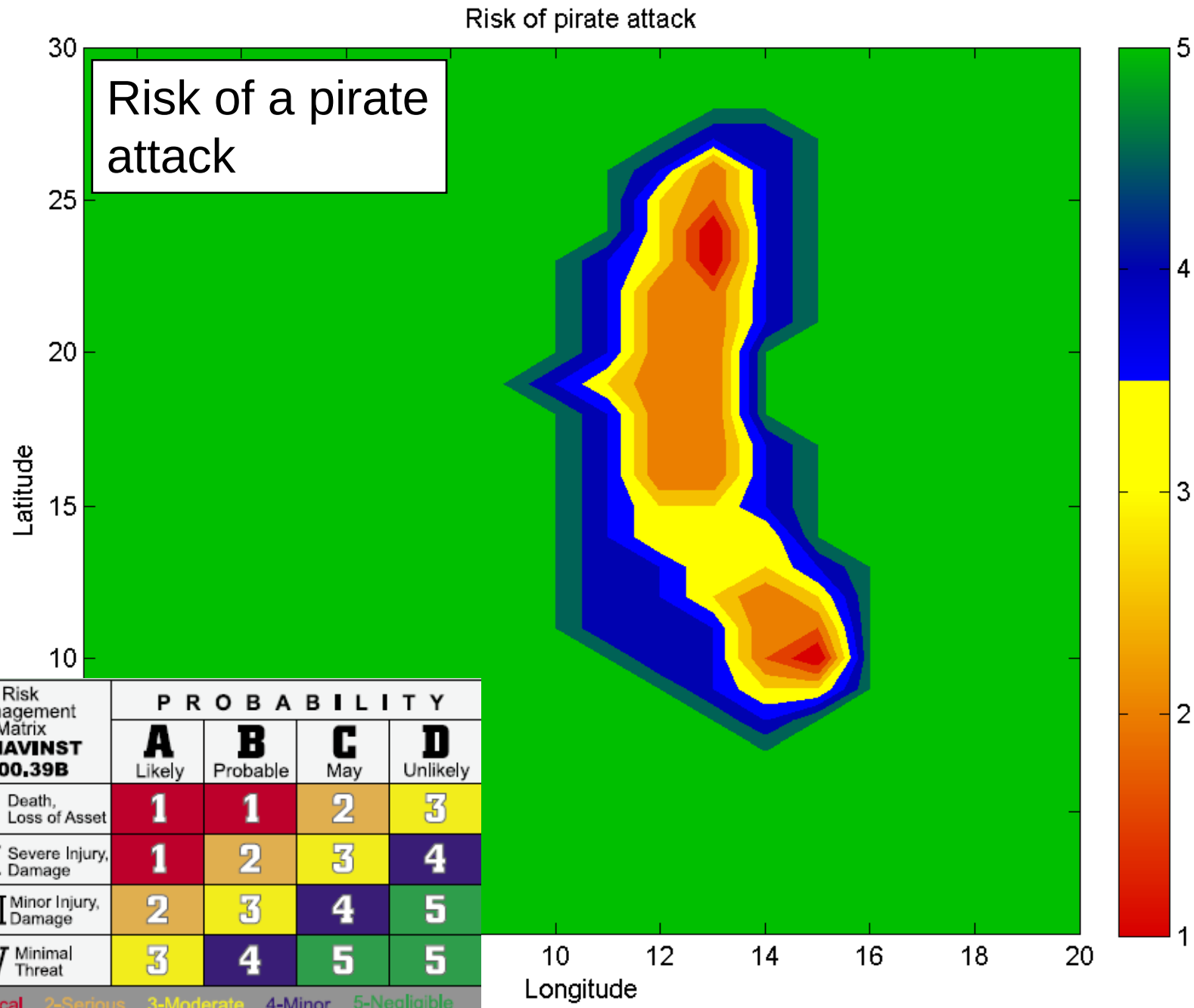

Risk Management Matrix OPNAVINST 3500.39B		PROBABILITY			
		A Likely	B Probable	C May	D Unlikely
SEVERITY	I Death, Loss of Asset	1	1	2	3
	II Severe Injury, Damage	1	2	3	4
	III Minor Injury, Damage	2	3	4	5
	IV Minimal Threat	3	4	5	5

1-Critical 2-Serious 3-Moderate 4-Minor 5-Negligible

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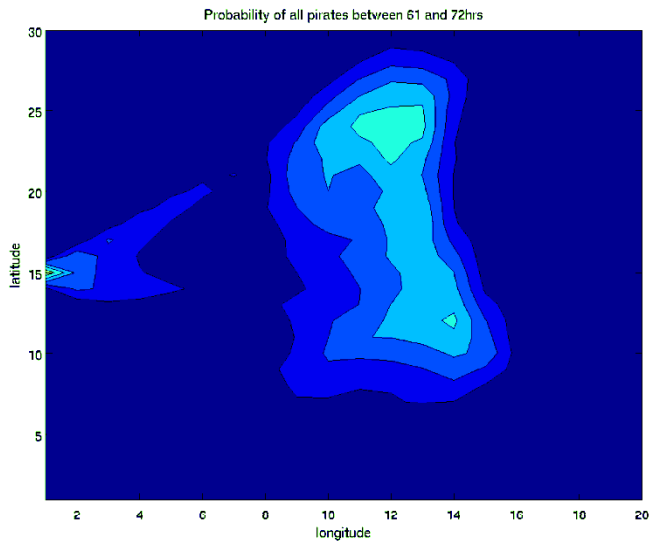
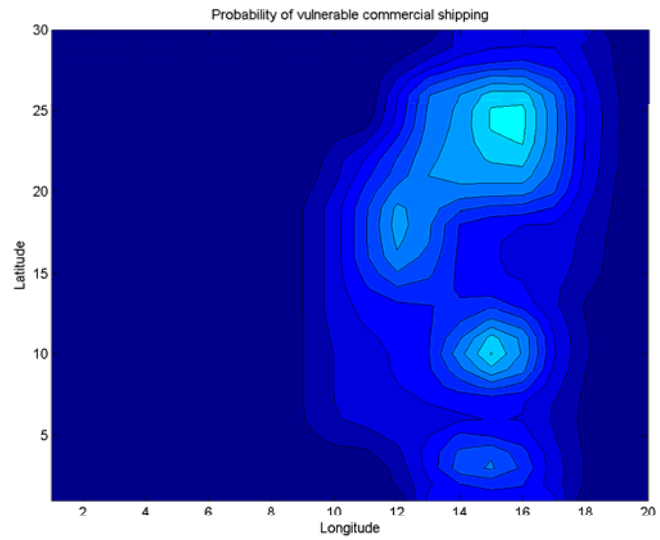
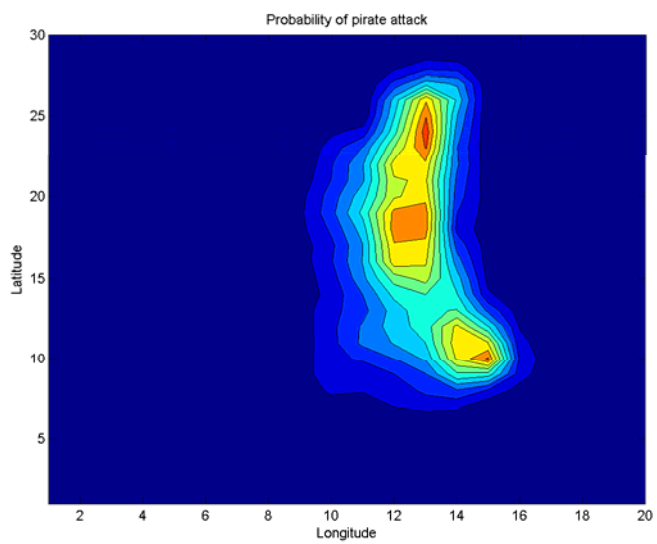
Pirate probability

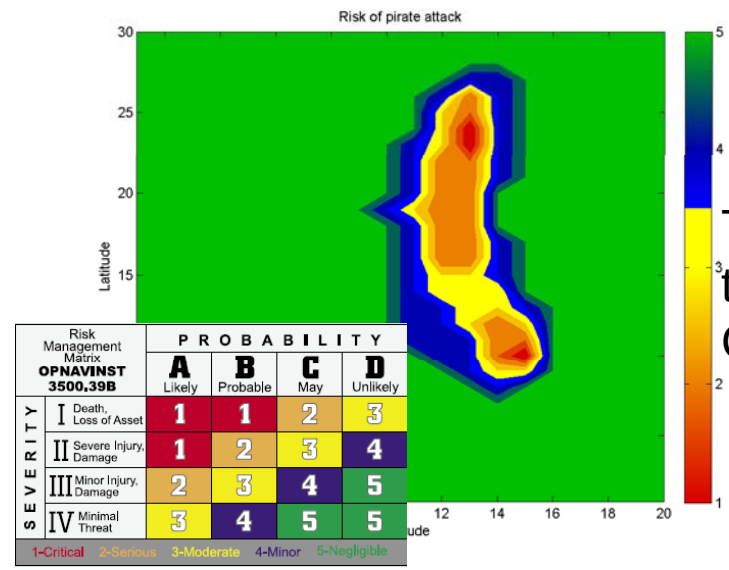




Shipping Lane Probability

Probability of a pirate attack





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Translating to Risk Category

Summary

- Risk provides a framework for METOC to impact mission planning and decision making.
- Objective uncertainty forecasts can be communicated in terms of mission risk.
- Mission risk due to METOC cannot always be treated independently of other sources of information. Product is consistent with the Intel's knowledge.
- Piracy provides an example where it is necessary to dynamically couple INTEL and METOC.
  - Pirate probability product will be operationalized at NAVOCEANO this fiscal year.
  - Early sensitivity studies indicate that METOC is the primary driver of distribution structure.

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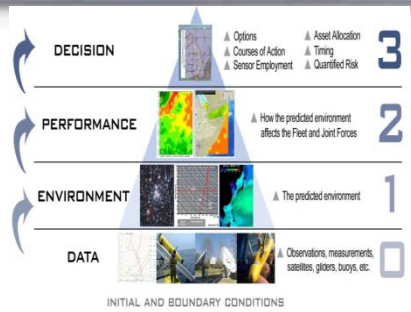
Current/Future Work



- Operationalize this product, including more weighted Intel info
- Dynamic coupling between sea state and probability of Attack
- Pirate behavior attributes/probability – Inversion Technique
- Working with Decision Science to analyze Sensitivity of Intel information (which one has more weights?)
- Incorporating Intelligent Agent Model

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