Charting the Arctic Risk Map

Use of ArcGIS Server to portray risks in the Arctic

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ESRI UC 2014, San Diego CA

Facing harsh conditions

Jeanne d'Arc Basin outside St. Johns, New Foundland:

"There is a potential for superstructure icing to occur between November and May with the highest potential for freezing spray being in February due to colder temperatures, and high wind and wave conditions.
In spring, icebergs are a common occurrence.

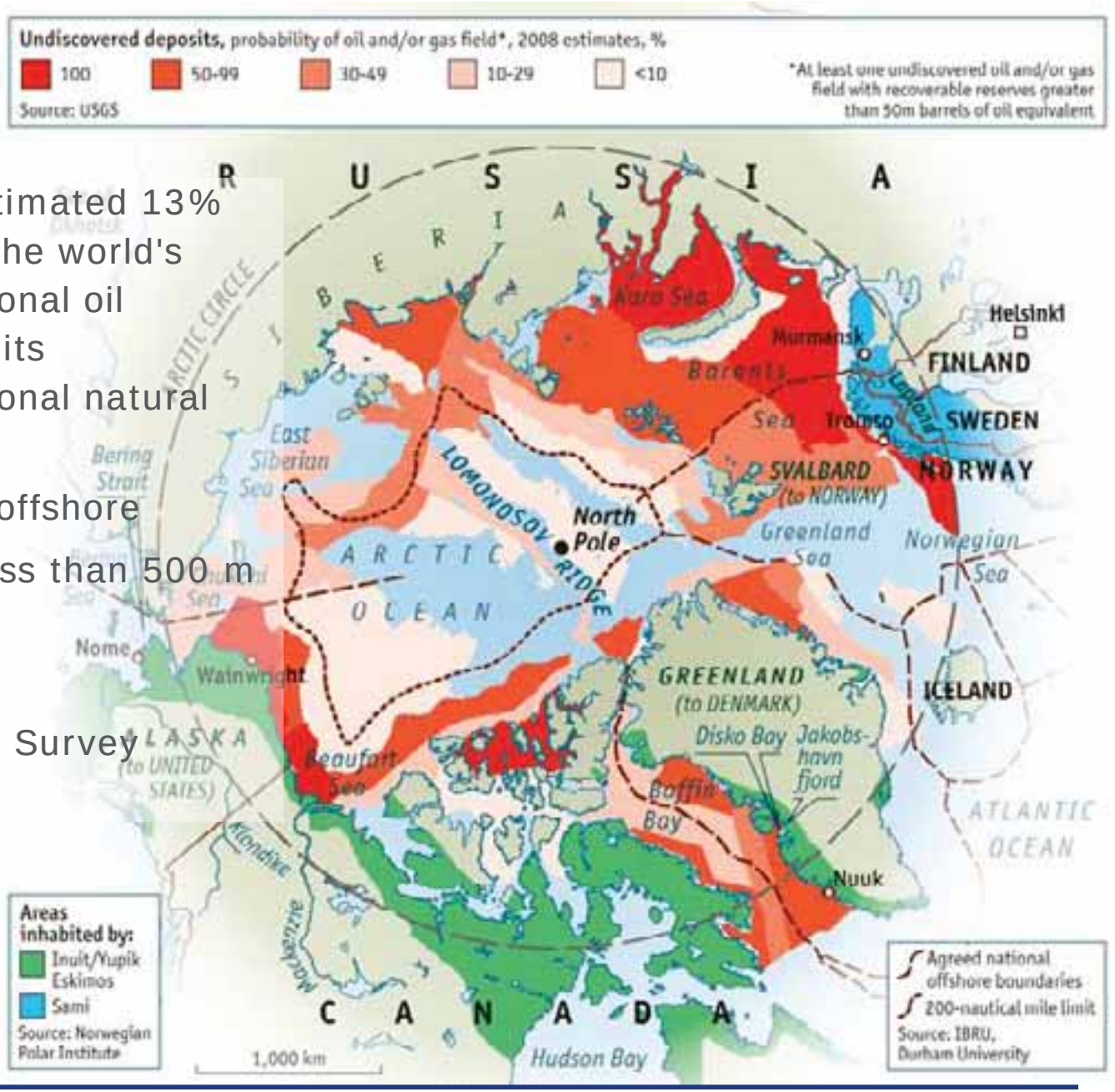
Icebergs originate from the glaciers in Greenland and Ellesmere Island and drift south through the White Rose area with the Labrador Current. Icebergs up to 5,900,000 tons have been observed in the area. The number of icebergs that drift through the White Rose area is variable from year-to-year. From 1974 to 2009, the mean number of sightings has been 60 while the maximum number was 215 in a 1°-grid centered on White Rose. Iceberg scours up to 1.5 to 2.0 m deep have been measured on the seafloor in the White Rose area."

Excerpt from the official White Rose Project Extension project description

Moving North

- The Arctic holds an estimated 13% (90 billion barrels) of the world's undiscovered conventional oil resources and 30% of its undiscovered conventional natural gas resources
- 84% of resources are offshore
- Accessible in waters less than 500 m deep

Source: U.S. Geological Survey (USGS)



Arctic – A region of opportunity, but also challenges

- Harm to the environment
- Climate change
- Safety for those working in the arctic
- Interference with other activities

- Local job creation
- Economic growth
- Increased knowledge about the arctic
- Energy security

- Disturbance of natives
- Conflicts between countries
- Lacking regulations
- High investment costs

- Development of infrastructure
- Technological advancements
- Increased regional cooperation

Navigating ice covered waters

- Trans-Arctic shipping along NSR – a new reality?
- Passage requires escorte from tugboats and icebreakers
- 71 vessels sailed the Northern Sea Route in 2013
- Most of which were high capacity tankers carrying hydrocarbons
- Transit time Rotterdam–Shanghai cut by 28% compared to Suez (10.800 nm vs. 7.600 nm)

Source: Northern Sea Route Information Office

Towing icebergs at the White Rose Field outside New Foundland

Operating in ice infested waters

Environmental factors contributing to elevated risk

- Daylight - Polar nights and midnight sun
- Extreme temperatures
- Ice coverage
- Wind chill
- Reduced visibility (fog and ceiling)
- Superstructure icing
- Polar lows

Is risk a matter of perception, and how is it conceived?

- Among different stakeholders
  - The industry (Oil & Gas, Fishing, Mining, Shipping)
  - The government
  - Policy makers and legislators
  - Indigenous communities
  - Environmental organizations (IPCC, UNEP, WWF, CAFF)
  - Tourists

- In order to provide a transparent and unbiased basis on which to communicate risk, DNV GL created the Arctic Risk Map

Risk Indices – Ecological significance

Environmental vulnerability index - Vulnerability towards oil

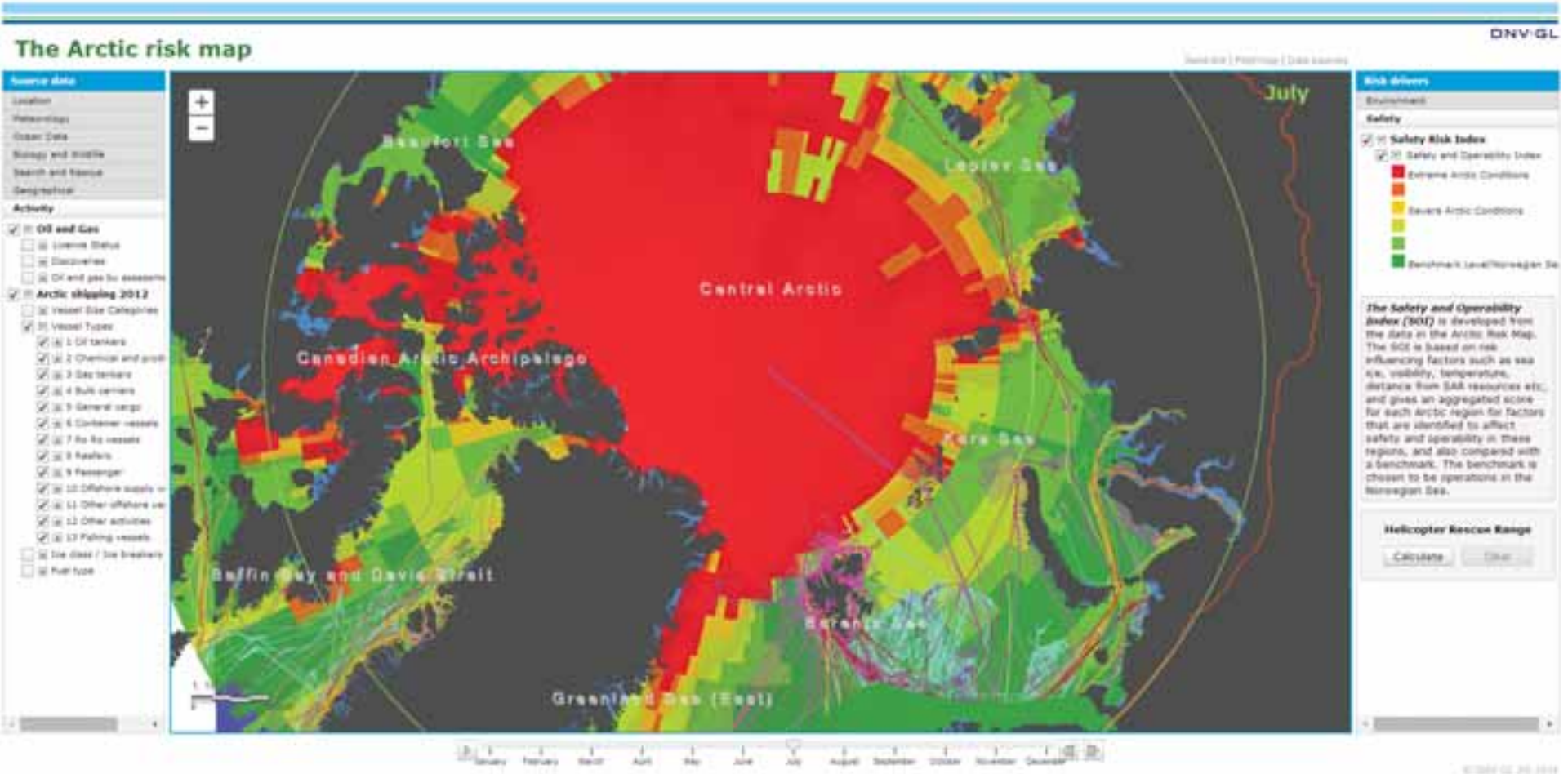
Calculated score for each area to reflect:

- Species distribution
- Population size and ratio
- Red List status (IUCN)
- Habitat preference and specificity
- Ecosystem significance
- Activity/occupation
- Season

Safety and operability index

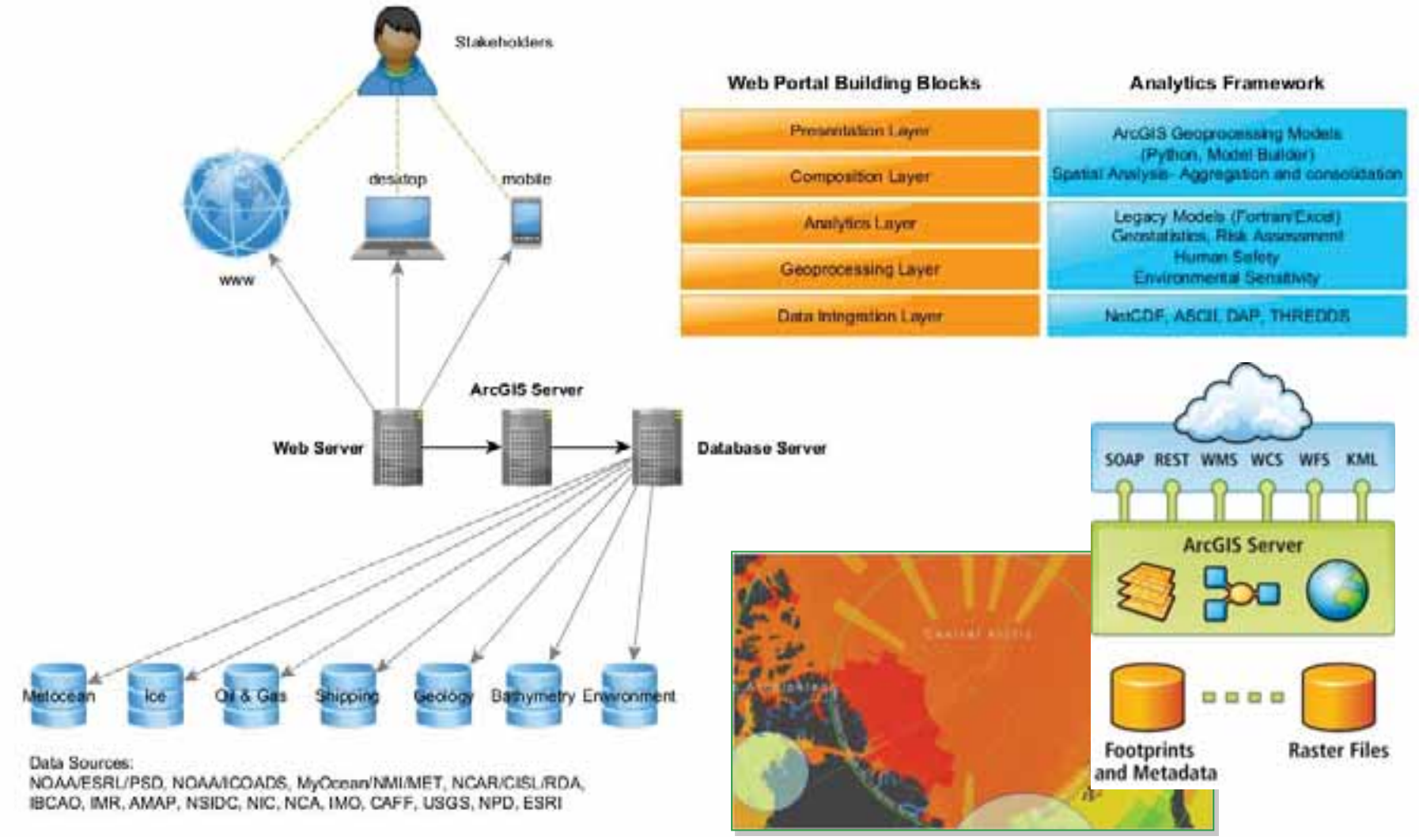
- The SOI is based on risk influencing factors such as sea ice, visibility, temperature, distance from SAR resources, etc.
- Expressed as an aggregated score for each Arctic region by Month
- The principal factors are known to affect safety and operability in these regions
- Benchmarked against recognized standards [NORSOK] and risk-level of operations in the Norwegian Sea

The Arctic Risk Map



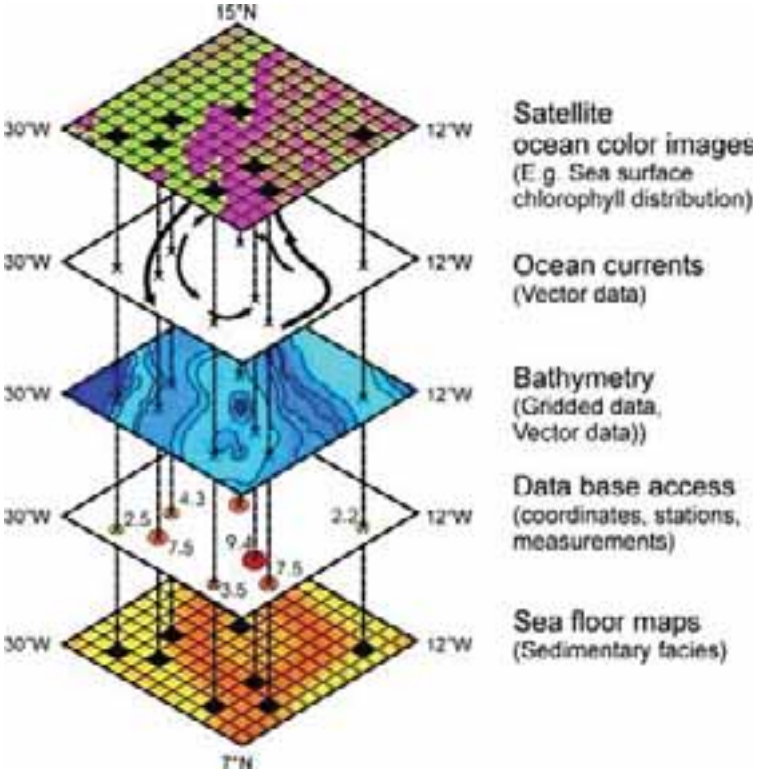
Source: [The Arctic Risk Map]

Arctic Risk Map – System Design



Use of GIS in modelling risk

- GIS allows for a multivariate approach
- GIS captures the influence of geography, topography, and topology
- Statistics on phenomena and their covariation can be readily inferred
- Capture spatial and temporal variation
- Location specific risk analysis
- Situational risk analysis



Questions?

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