

Modeling and Analysis of CF Logistics Distribution for Northern Operations

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Outline

1. Airships for Military Logistics Heavy Lift

- A performance Assessment Analysis

2. Northern Support Hubs

- Performance Analysis
- Location Problem
- Resources Allocation

Airships for Military Logistics Heavy Lift

Aim

The objective of this study is to analyze the effectiveness and responsiveness of using airships for logistics heavy lift in support of Canadian Forces operations in the North.

Methodology

1. Modeling and Simulation:

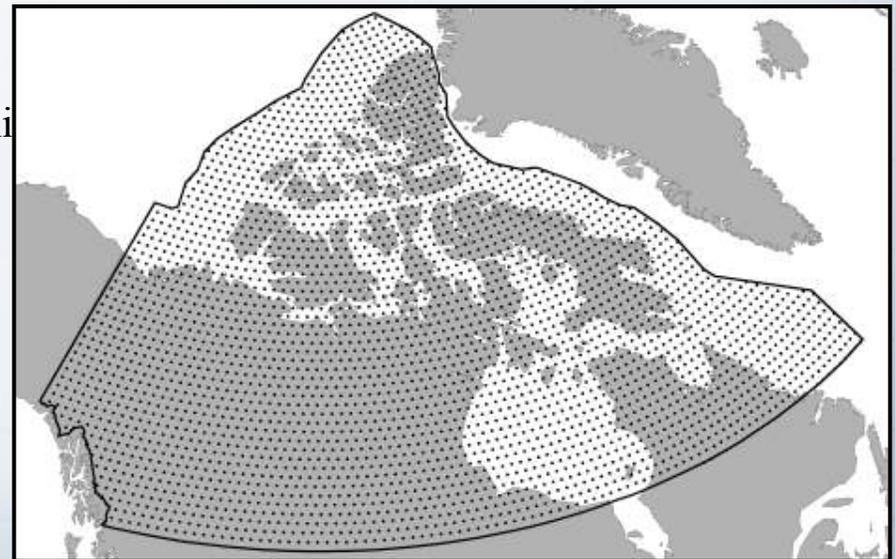
Performance measures (cost, time, carbon emissions)

2. Data:

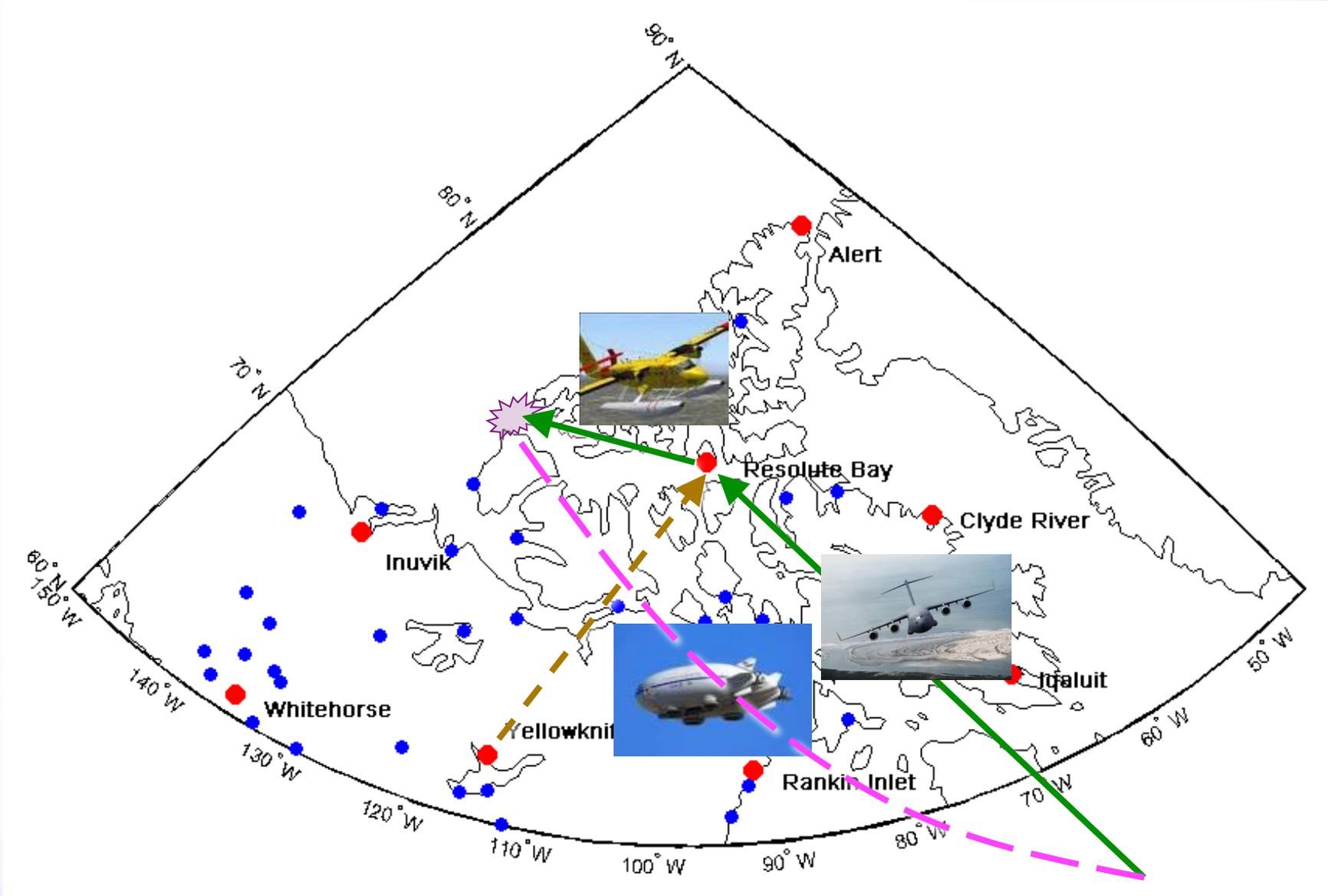
Historical military exercises and operations

3. Logistics Transport:

Current CF assets (C177, C130, C138)
airships



Scenario



Performance Metrics

1. Cost avoidance

The transportation cost that could potentially be avoided if airships are used for sustainment lift instead of the current transportation approach.

2. Response time

The total time required for the movement of supplies from their origins to their destinations.

3. Carbon emission avoidance

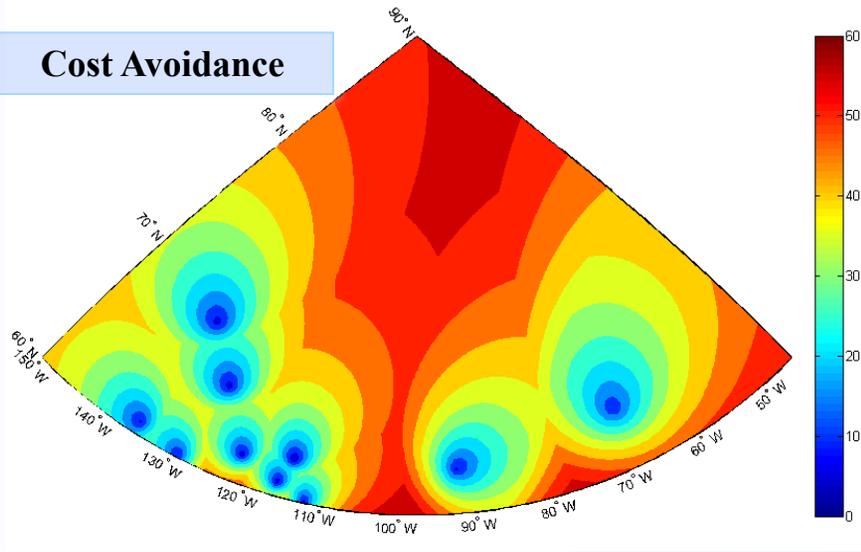
The quantity of greenhouse gas emissions that could potentially be avoided if airships are used for the sustainment lift instead of the current transportation approach.

Generic Transportation Data

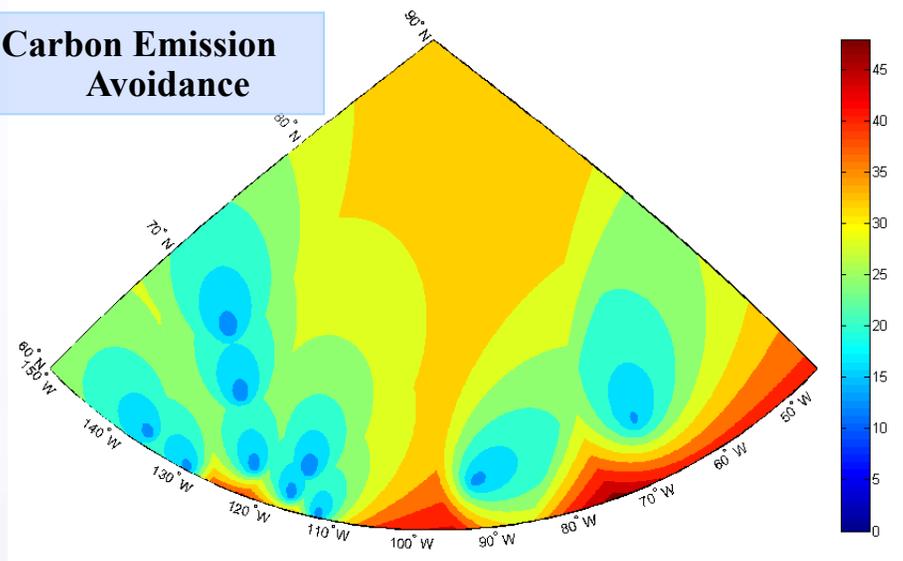
	CC 177	CC 130	CC 138	Airship
Payload (tonne)	76	18	3	50
Capacity (pallet)	18	6	1	-
Loading time (h)	2	1.5	0.5	1
Unloading time (h)	2	1.5	0.5	1
Cruise Speed (km/h)	700	500	265	180
Lift Cost Rate (\$/h)	20,000	8,000	1,200	5,000
Fuel Consumption Rate (kg/h)	8,000	2,500	260	1,800

Performance Analysis

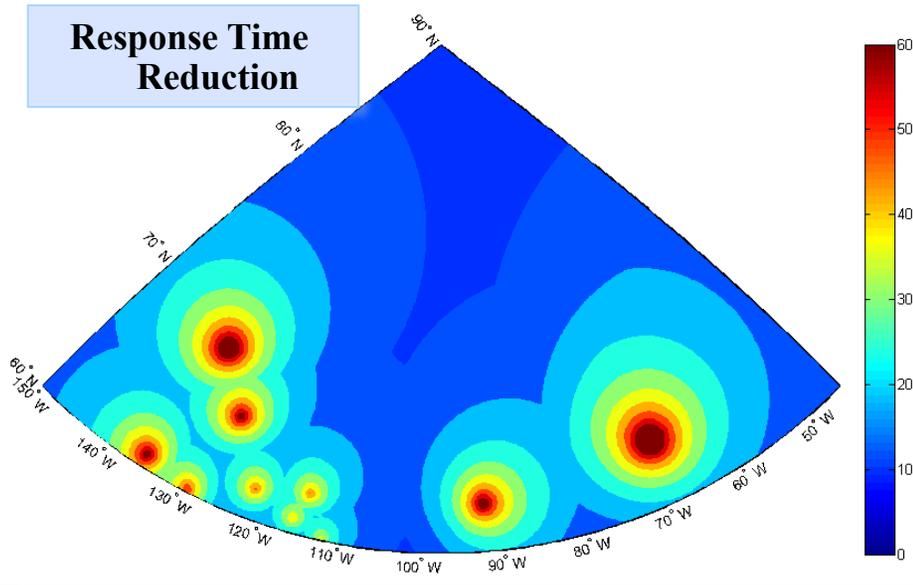
Cost Avoidance



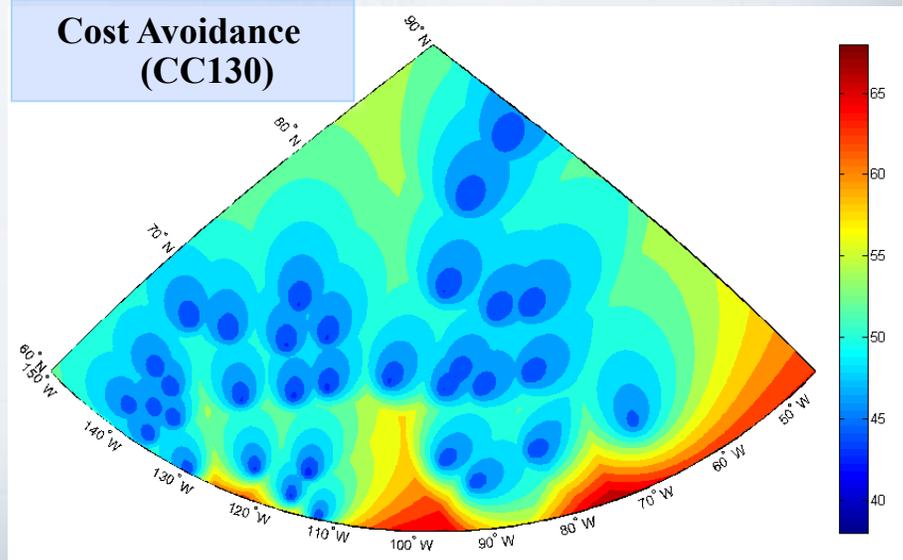
Carbon Emission Avoidance



Response Time Reduction



Cost Avoidance (CC130)



Northern Support Hub – Location Analysis

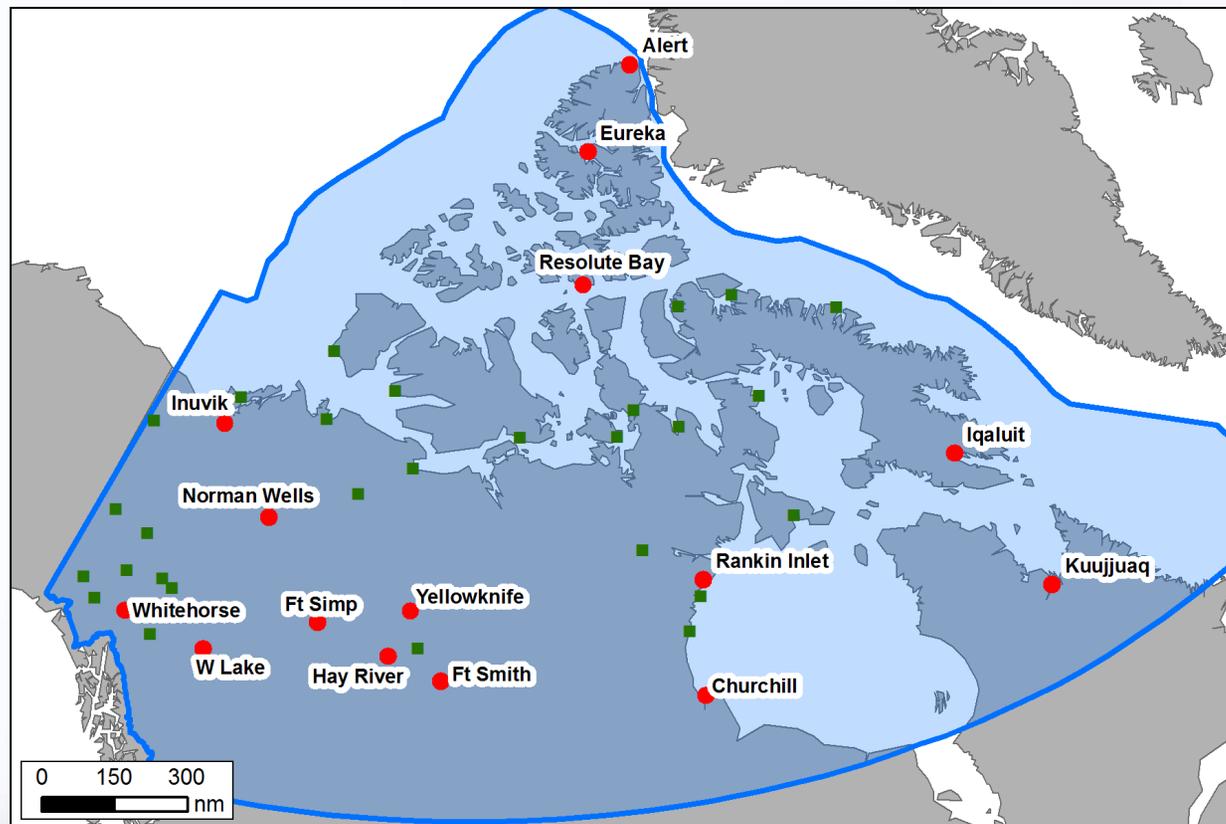
Aim

1. Analyze the Operational Support hub concept for the CF Northern operations
2. Assess the impact of the number of Northern hubs on operational effectiveness
3. Identify promising hub locations and combinations, taking into account various employment and support factors

Overall goal is not to recommend one specific hub combination, but to provide analysis in support of the planning and decision process.

Potential Northern Hub Locations

- **Key assumption:** strategic hubs not to be built from scratch. Candidate locations must already have existing capability for CC-177 landing and take-off.
- 15 possible locations retained.
- Smaller airfields (in green) also considered as potential forward support bases.



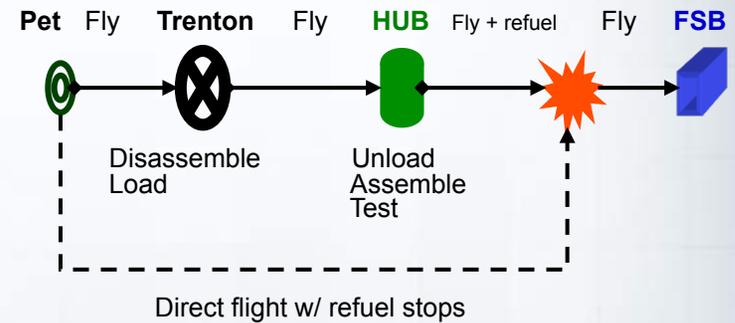
Criteria Considered

Category	Criteria
<p>1. Operational Employment Effectiveness</p>	1.1 Utility for Major Air Disaster (MAJAID) response
	1.2 Utility for Major Maritime Disaster (MAJMAR) response
	1.3 Utility for major natural disaster (floods, fires, earthquakes) response
	1.4 Coverage (Utility for contingency airlift <i>anywhere</i> in the North)
	1.5 Utility for SAR basing
	1.6 Serviceability (weather)
<p>2. Operational Support Capabilities</p>	2.1 Runway condition
	2.2 Fuel capacity and availability
	2.3 Infrastructure capability and capacity
	2.4 Maintenance and contracting capability
	2.5 Sustainment capability and capacity

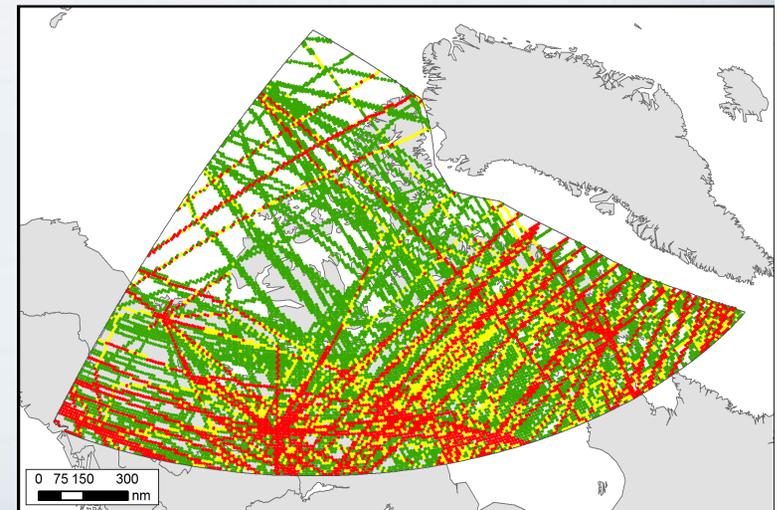
Criterion 1.1

Utility for MAJAID Initial Response

- Metric used for ranking hub combinations:
 - Initial response time to a MAJAID incident



- Potential MAJAID locations distributed according to historical flight paths

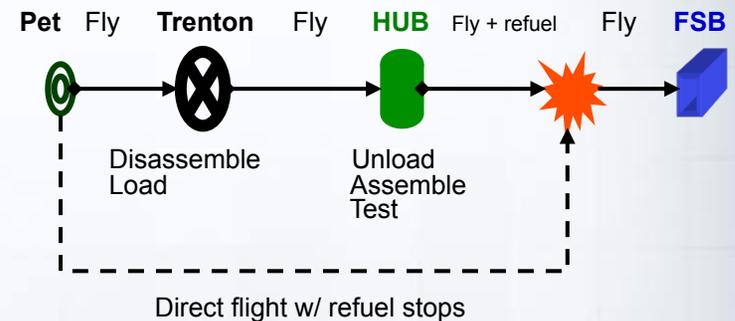


Historical flight paths for 2005/2006
(Source: NAV Canada)

Criterion 1.2

Utility for MAJMAR Initial Response

- Metric used for ranking hub combinations:
 - Initial response time to a MAJMAR incident
- Potential MAJMAR locations distributed according to historical locations of significant marine incidents (collisions, grounding, ice damage, etc.)

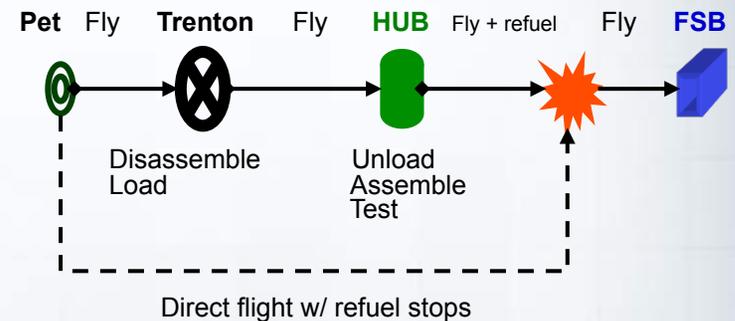


Historical marine accidents for 1995-2006
 (Source: Arctic Marine Shipping Assessment –
 Accidents/Incident Database)

Criterion 1.3

Utility for Major Natural Disaster Initial Response

- Metric used for ranking hub combinations:
 - Initial response time to a major natural disaster
- Disaster locations distributed according to “significant disasters” that have occurred over last 100+ years
- Includes floods, fires, earthquakes with:
 - 10 or more people killed; or
 - 100 or more people affected, injured, evacuated or homeless; or
 - An appeal for natl/intl assistance; or
 - Damage such that affected community cannot recover on its own



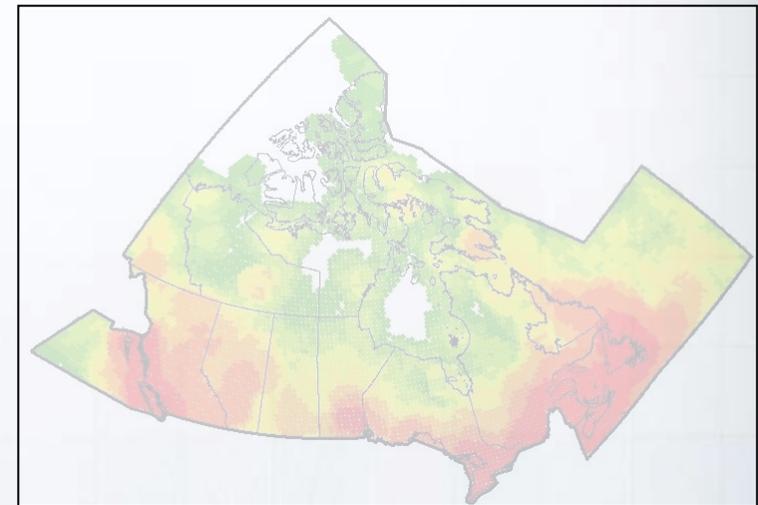
Significant natural disasters (24) from 1925-2010

(source: Public Safety Disaster Database)

Criterion 1.5

Utility for Search and Rescue (SAR) Basing

- Metric used for ranking hub locations:
 - Location that maximizes the number of incidents falling within SAR aircraft range (600nm), while minimizing response time to these incidents and overlap with existing SAR coverage
- Model used: CAS SAR basing model
- Assumes one of the strategic hubs could be eventually used as an additional fixed-wing SAR base
- Other assumptions/data identical to latest SAR Basing Study produced for CAS (2010)



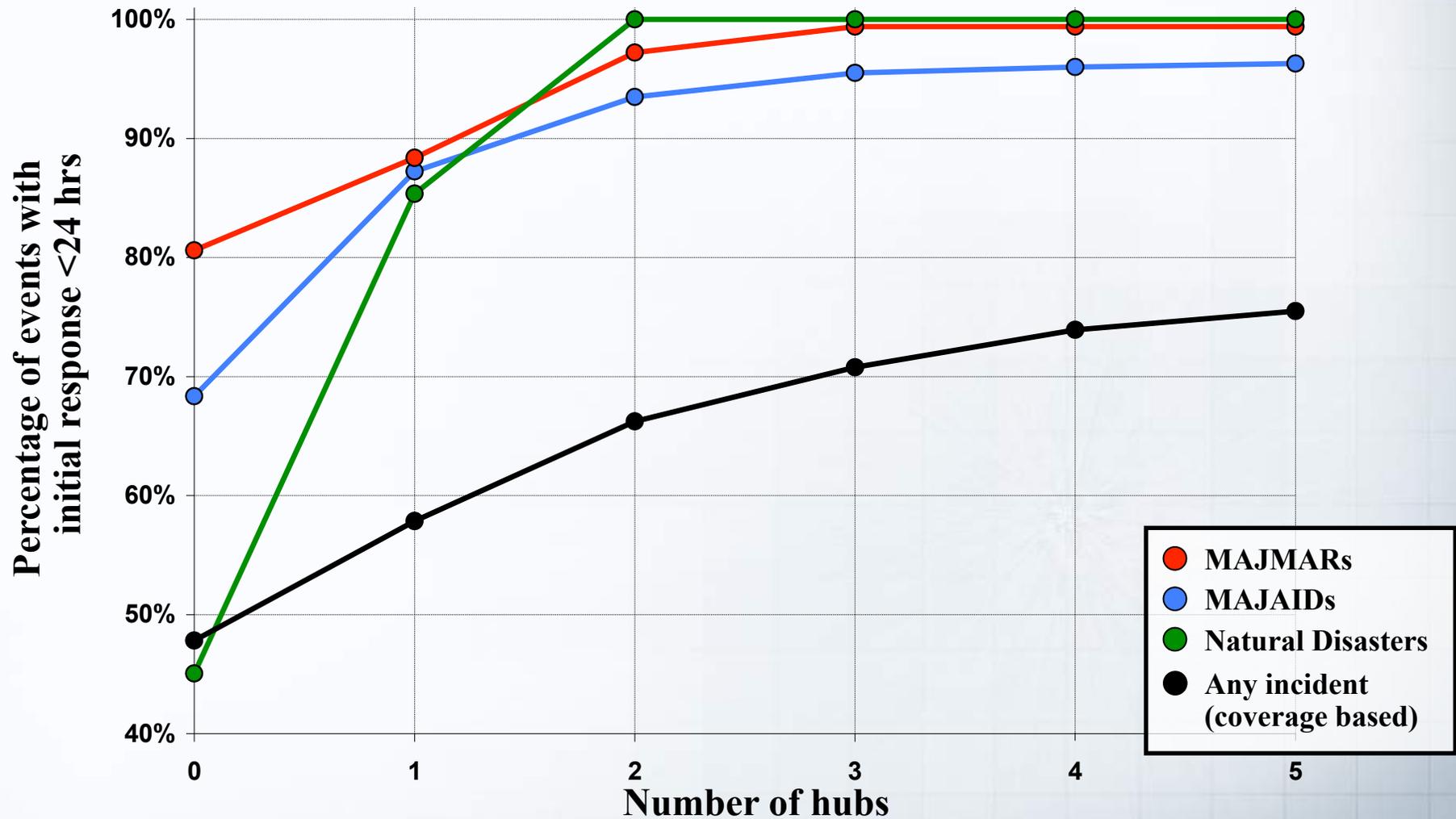
SAR Event Distribution (2000-2004)

Operational Support Criteria

- 2.1 Runway condition:** Quality of the airfield based on runway condition
- 2.2 Fuel capacity and availability:** Capacity to store/supply fuel and make it readily available for various CF aircraft requirements
- 2.3 Infrastructure capability and capacity:** Quality of the infrastructure at location/community, taking into account ramp, warehousing capacity, airfield services (e.g., air control, de-icing, unloading, fuelers, stairs), C2 and communication capability, lodging facilities, hangars, etc.
- 2.4 Maintenance and contracting capability:** Potential for maintenance/contractor support at location/community. This includes the availability of contractual support, mechanical support, infrastructure support, food support, firefighting support, etc.
- 2.5 Sustainment capability and capacity:** Quality and capacity of the location/community to sustain routine ops involving maritime, land, or air assets. This considers factors such as proximity to a port facility, a rail facility, the quality of the road network, and the proximity to areas where routine missions frequently take place.

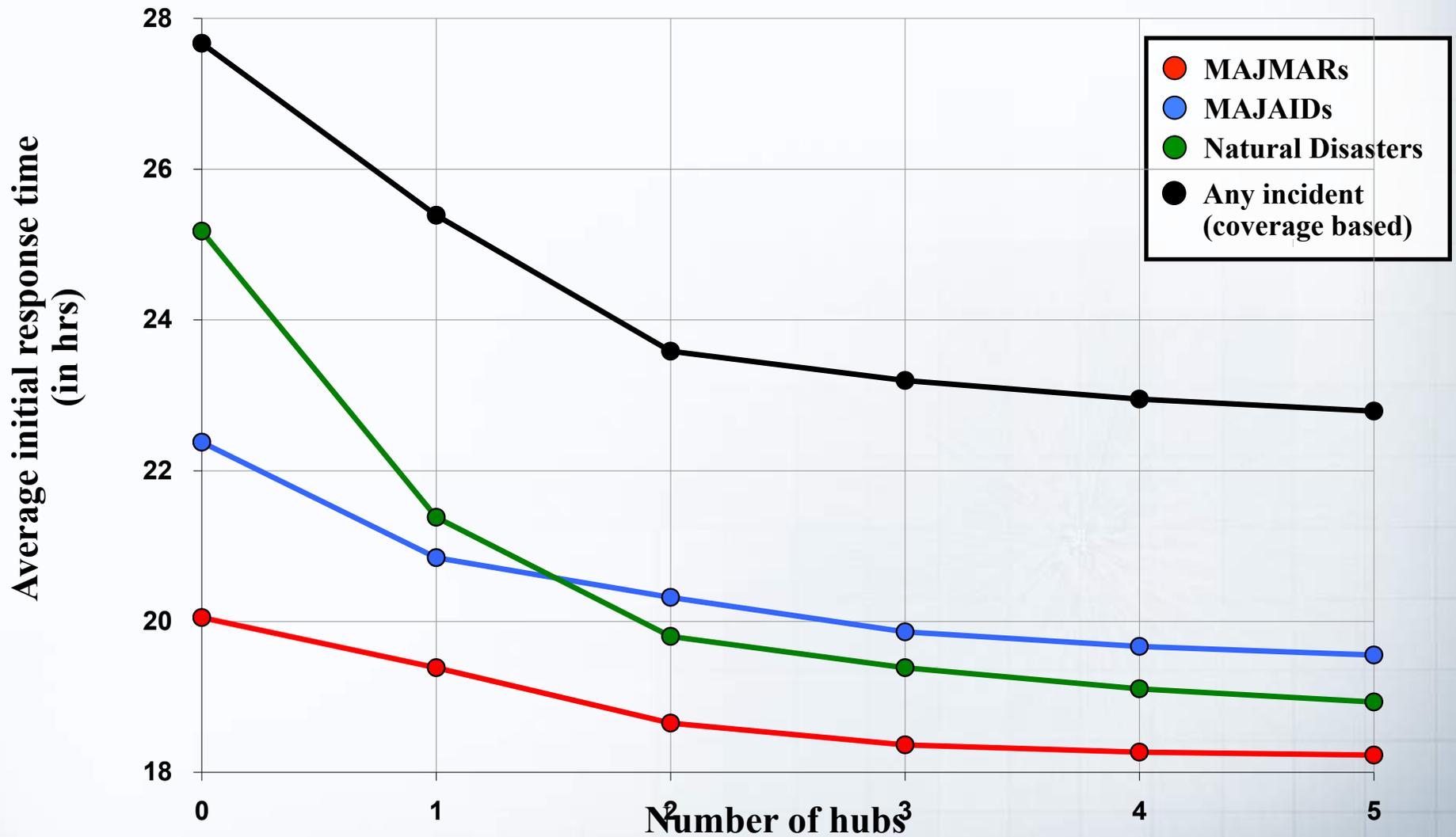
Results

Operational effectiveness vs. number of hubs



Results

Operational effectiveness vs. number of hubs



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