ARCTIC FRONTIER:
FRAGILITY OF THE MONUMENT, POWER OF THE ENVIRONMENT.

EMILY AQUILINA
Research Question:

*What is the role of architecture in territorial space-power relations found in the extreme environment of the Arctic?*
RESOURCES EXTRACTION
MODES OF PRODUCTION
CLIMATE CHANGE

- shifting global trends
- environmental crisis

Buckminster Fuller’s world projection
Dymaxion map

Arctic Region
rapid increase in the melting of the ice within the polar regions

new found interest in the unclaimed territory
new uncharted territory

30% untapped gas and oil resources

international shipping trade routes
current claims made by arctic nations
who owns the Arctic?
CARTOGRAPHY  
tool of mapping  
analysis  
comparison  

DECONSTRUCTION  
architecture  
power  
territory  

TERRAFORMATION  
project-ion
Williem Barentsz, 1598
Het Nuiewe Land
After the discovery of Svalbard (1596)

Gerard Mercator, 1595
Septentrionalium Terrarum descriptio, 2
First projection of the arctic circle

TOOL OF POWER
“THE ARCTIC WAS AN AREA OF INTENSE INTEREST TO EUROPEANS IN THE EARLY MODERN PERIOD. THE ARCTIC WAS ASSUMED TO CONTAIN A PASSAGE TO THE PACIFIC, AND THEREFORE CHINA.”

AN OCEAN FULL OF WEALTHY RESOURCES; WHALES, SEALS, MAMMALS, NEW LANDS AND GRAND SHIPPING EXPEDITIONS

MAPPING VALUES OF THE TIME
Arctic // Antarctica

Svalbard
Antarctica landmass

Legend
- United States
- Canada
- Norway
- Denmark
- Russia
- Arctic Circle
- Unclaimed Territory

Legend
- Arctic ocean
- Continent surrounded by ocean
- Ocean surrounded by continents
Antarctic claims frozen and have resulted in a peace agreement.

Arctic claims are being considered with some already approved (Norway).
Antarctica

- permanent base
- scientific research station
- expedition
- treaty

Svalbard

- mining
- scientific research
- whaling, hunting, trapping
- tourism
- settlement establishment

1596
1600
1760
1850
1900
1905
1944
1959
2020
2025
"...peaceful purposes only."

Resources
―Antarctica shall continue forever to be used exclusively for peaceful purposes and shall not become the scene or object of international discord‖ (Intro)

cooperation / research
No government

The Antarctica Treaty
1959

"...never be used for warlike purposes."

Resources
―shall enjoy equally the rights of fishing and hunting in the territories‖ (Art. II)

exploitation / extraction
Norway sovereignty

The Svalbard Treaty
1920
RULES OF THE 'EXCEPTIONAL'

TERRA NULLIUS:
NO MANS LAND
DEGREE OF ENVIRONMENTAL EXTREMITY

0 100

Arctic Antarctica
ARCHITECTURE

INTER-SECTION

POWER

TERRITORY

DIVISION OF SPACE

LAND

CONTROL

RELATION

HISTORY OF CONCEPTS
Scientists shocked by Arctic permafrost thawing 70 years sooner than predicted

- Ice blocks frozen solid for thousands of years destabilized
- ‘The climate is now warmer than at any time in last 5,000 years’

Chinese Oil Drillers Are Back in Russian Arctic

This is the third year in a row when the Chinese Nanhai-8 drilling rig has arrived in Russia’s Murmansk for drilling in Arctic waters.

Russian Arctic shipping boost with support from Dubai

The developers of the Northern Sea Route team up with DP World, the global port operator based in the Arab gulf state. Container shipping is among the priorities.

The U.S. Military Wants to Build a Strategic Port in the Melting Arctic

A military spending bill has asked for a brand new Arctic port to face "future great power competition."
The end of the Arctic as we know it

Less oxygen and ice, more acid and heat. Jonathan Watts joins an expedition studying what this means for the planet.

The demise of an entire ocean is almost too enormous to grasp, but as the expedition sails deeper into the Arctic, the colossal processes of breakdown are increasingly evident.

The first fragment of ice appears off the starboard bow a few miles before the 79th parallel in the Fram strait, which lies between Greenland and the Norwegian archipelago of Svalbard. The solitary floe is soon followed by another, then another, then clusters, then swarms, then entire fields of white crazy paving that stretch to the horizon.
through architecture can we construct alternative realities to the existing modes of production and extraction.

the creation of new paths of movement

can we work together with earth forces and ecological processes to create alternative ways of valuing the Arctic and its critic yet fragile environment?
a proposal presented by

THE STATE OF THE ARCTIC

The People of the Arctic Treaty
instating value into the Arctic environment,
just like the approach towards Antarctica.
1. PRODUCTIVE
constructing alternative modes of production, rather than extracting, can we harvest
earth forces and work together with them?

2. MONUMENTAL
Can architecture be used as a tool to represent and make visible the powerful yet fragile
ecosystems that are crucial for our environment?
ARCTIC LANDSCAPE

environmental extremity

Intrinsic Environmental

human impact

Extrinsic Architecture
Extrinsic Architecture

Intrinsic Environmental

ARCTIC LANDSCAPE

environmental extremity

human impact

TOOLS OF MEASUREMENT

human impact

environmental extremity

Intrinsic Environmental

Extrinsic Architecture
PROCESS
architectural response

conflict mapping

conditions

environmental process

'conflict' mapping - analysis of disruptive forces

micro-climate condition

architectural manifestation

conflict mapping conditions

global system

macro / local

micro climate
Legend

Arctic Circle
Unclaimed Territory
Magnetic Pole
North Pole
Pole of Impossibility

Greenland
Norway
Svalbard
Russia
Canada
Alaska

Arctic circle
Arctic Ocean
North Pole
Svalbard
Greenland
Norway
Russia
Canada
Alaska

micro climate
macro / local
global system
shifting magnetic pole
MARINE INVASION PATHWAYS

sea ice extent
MARINE INVASION PATHWAYS

- sea ice extent
- shipping trade routes

Legend:
- Transpolar Sea Passage
- Northern Sea Passage
- North-West Passage

Arctic Circle
Unclaimed Territory

Ice sheet
Main Shipping Routes
Main Harbours

- Greenland
- Norway
- Svalbard
- Russia
- Canada
- Alaska
- Alaska
MARINE INVASION PATHWAYS

- sea ice extent
- shipping trade routes
- main industrial harbours
MARINE INVASION PATHWAYS

- sea ice extent
- shipping trade routes
- main industrial harbours
- human activity zone
  (tourism, extraction, fisheries)
INDUSTRIAL ACTIVITY

mining sites

Legend

main oil + gas pipeline
projected oil + gas pipeline
major route
mining sites
Arctic Circle
Unclaimed Territory
Probability of undiscovered gas and oil
major oil spills <50,000
prospective areas for oil
oil production
gas production
area of exploration drilling
Greenland
Norway
Svalbard
Russia
Canada
Alaska
Arctic circle
major oil spill
INDUSTRIAL ACTIVITY

- mining sites
- gas and oil production

Legend:
- Main oil + gas pipeline
- Projected oil + gas pipeline
- Major route
- Mining sites
- Arctic Circle
- Unclaimed Territory
- Probability of undiscovered gas and oil
- Major oil spills <50,000
- Prospective areas for oil production and gas production
- Area of exploration drilling

Countries and regions:
- Greenland
- Svalbard
- Alaska
- Russia
- Norway
- Canada
INDUSTRIAL ACTIVITY

- mining sites
- gas and oil production
- exploration drilling and routes
- main pipeline
INDUSTRIAL ACTIVITY

- Main industrial activity
- Gas and oil production
- Exploration drilling and routes
- Main pipeline
- Prospective drilling
- Prospective pipeline
INDUSTRIAL ACTIVITY

main industrial activity
gas and oil production
exploration drilling and routes
main pipeline
prospective drilling
prospective pipeline
probability of undiscovered gas and oil
MIGATORY PATHS

bird migration

Legend

Main migratory routes for marine mammals
- Cetaceans: bowhead and grey whale
- Pinnipeds: walrus, northern fur seal, and bearded seal

Commercial fishing activity in summer and autumn

Main migratory routes for birds
- Rivers where fish migrate

Basins:
- Makarov Basin
- Nansen Basin
- Amundsen Basin
- Fram Strait
- Bering Strait
- Davis Strait
- Foxe Basin
- Baffin Bay
- Chukchi Sea
- Laptev Sea
- East Siberian Sea
- Greenland Sea
- Kara Sea
- Barents Sea
- Greenland
- Norway
- Svalbard
- Russia

Arctic circle
MIGATORY PATHS

bird migration
fish and sea mammals
MIGATORY PATHS

- bird migration
- fish and sea mammals
- seasonal commercial fishing
OCEAN ACIDIFICATION MAPPING

sea currents
OCEAN ACIDIFICATION MAPPING

sea currents
fresh water input
OCEAN ACIDIFICATION MAPPING

- sea currents
- fresh water input
- pH decrease

Legend

Warm

Cold

Arctic Circle

Unclaimed Territory

Aragonite undersaturated sea area (CaCO3) according to the RCP8.5 scenario (MPI/uni2010 ESM/uni2010 LR) of the IPCC

Main deep seawater current

River Discharge

Surface Current

Atlantic Current

Area where the pH is expected to significantly decrease (period 1986-2005 and 2066-2085)

Glacier/Greenland Ice Sheet

Bering Strait

Sea-ice meltwater

Arctic Ocean

Barents Sea

Norwegian Sea

Bering Sea

Iceland

Scandinavias

Greenland

Beaufort Sea

Nares Strait

Nares Sound
FEEDBACK LOOPS AND
GLOBAL SYSTEMS
KEY CONFLICTS

ATMOSPHERIC CO₂
OCEAN ACIDIFICATION
ALBEDO EFFECT
SHIFTING MAGNETIC POLE
MIGATORY PATHWAYS
INDUSTRIAL ACTIVITY
C02 emissions
biosphere carbon store
permafrost C02 release

fresh water input

higher C02 = lower pH reduces size and abundance of shellfish

reduction in harvest

decrease in harvest

critical food source for indigenous communities

calcium carbonate undersaturated water (atlantic and pacific)

marine life food chain

decrease in harvest

reduction in nutrients, size and amount for consumption

atmosphere carbon store

OCEAN C02
INDUSTRIAL ACTIVITY
OCEAN ACIDIFICATION
WHAT
Increased vegetation growth → polar region warming → heated atmosphere → decreased albedo (sun reflection) → increased sun → decreased albedo (sun reflection) → less sea ice → polar region warming → increased vegetation growth
The fabricated reflective element creates a white layer and reduces sun absorption. Bouys are activated through sensor monitoring as the ice sheet melts away. How dormant winter mode changes to active summer mode. Radiation heat temperature type ecology border-zone or 'site' along edge of the ice sheet extents.
particles from the sun / solar wind
pass through atmosphere
excite oxygen + nitrogen atoms
deflect
causing atoms to light up

reverse attraction - Magnetic North Pole
reverse attraction - Magnetic South Pole
the flow between the surface magnets and wind begins to harvest the energy. The intersection between the surface energy flow and the wind mirrors the aurora borealis effect, lighting up the arctic sky.

Magnetic parachutes use the extreme wind conditions to counteract the force and pull towards the earth's inner core.

How/scenario one

Change/continuous
dynamic

Elements/magnetic field
wind

Conduction/pressure?

Type/production
energy

Border-zone or 'site'/shifts/follows the magnetic north pole/path

Atmosphere

Ocean

Agent

Atmosphere

Agents

Magnetic field lines

Water

Level

Earth's inner core
GATEWAY TO THE ARCTIC
FLOWS
MOVEMENT

RESEARCH/SITE VISIT
the arctic and its shifting, dynamic, environment
Meteorological Conditions

- Dominant polar easterlies winds / secondary sub-polar mid-latitude westerlies
- Prevailing wind direction: East-North-East
- Monthly average wind speed: 18 km/h
- Average atmospheric pressure: 1010 hPa
- Summer surface air temperature mean 2018: 3°C
- Precipitation: accumulation depending on snowdrift
- Sea Ice Coverage: Northern most ice free area
- Midnight sun: 134 days / Days without sun: 155 days

Position: 81°49'N 7°20'E, situated on the Yermak Plateau, north of the Fram Strait - the passage between Greenland and Svalbard - sitting on the cusp of the Arctic Ocean marking the entry point from the southern Greenland Sea and Atlantic Ocean.

Distance to:
- 1482km Magnetic North
- 935km North Pole
- 398km Longyearbyen, Svalbard
- 307km mainland Greenland
- 247km Molloy Hole (deepest part of Arctic 5607m)
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**Sea Ice Coverage**
- Northern most ice free area

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materialisation of ecological processes
ALTERNATIVE FORMS OF CONSTRUCTING ENVIRONMENTS
AN ARCHITECTURAL MANIFESTATION
FOUR FORCES

ECOLOGY  PROTEIN  ENERGY  HUMAN
ALTERNATIVE FORMS OF CONSTRUCTING ENVIRONMENTS
AN ARCHITECTURAL MANIFESTATION

ECOLOGY

PROTEIN

ENERGY

HUMAN

BIRD SANCTUARY

MARINE PERMACULTURE

ENERGY HARVEST

RESEARCH CENTRE
RELATIONS
Meteorological Conditions

Dominant polar easterlies winds / secondary sub-polar mid latitude westerlies

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1A. BIRD SANCTUARY
1B. WATER FLOW
Meteorological Conditions
Dominant polar easterlies winds / secondary sub-polar mid latitude westerlies
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81.50°

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1. BIRD SANCTUARY
2. RESEARCH CENTRE
3. ENERGY HARVEST
4. MARINE PERMACULTURE
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EARTH FORCES AND TECHNOLOGY
1. BIRD SANCTUARY
2. RESEARCH CENTRE
3. ENERGY HARVEST
4. MARINE PERMACULTURE
1. PRODUCTIVE
Constructing alternative modes of production, rather than extracting, can we harvest earth forces and work together with them?

2. MONUMENTAL
Can architecture be used as a tool to represent and make visible the powerful yet fragile ecosystems that are crucial for our environment?
Vortex Induced Vibration (VIV) resonant wind generator
Vortex Bladeless Design

Vortex Induced Vibration (VIV) based hydro-kinetic energy harvesting system
1 Diffuser pipes
2 Kelp forest
3 Heat exchanger
4 Surface buoy
5 Steel cable
6 deep water pipe
7 deep pipe

Natural Pressure
pumps water up
Deep, cold, nutrient rich water

Wave buffer
dampening wave energy

Shifting fish
migratory paths

25m

1. BIRD SANCTUARY
2. RESEARCH CENTRE
3. ENERGY HARVEST
4. MARINE PERMACULTURE
4. MARINE PERMACULTURE

3. ENERGY HARVEST

2. RESEARCH CENTRE

1. BIRD SANCTUARY

Kelp forest

Marine permaculture
The climate foundation
1. BIRD SANCTUARY
2. RESEARCH CENTRE
3. ENERGY HARVEST
4. MARINE PERMACULTURE

1. Observation tower
2. Research centre
3. Arrival deck
4. Single strength deck
5. Stability column
6. Transverse strength truss
7. Longitudinal pontoon
8. Tension leg steel tendon
9. Seabed piles
1. BIRD SANCTUARY
2. RESEARCH CENTRE
3. ENERGY HARVEST
4. MARINE PERMACULTURE

Princess Elizabeth Antarctic research station
WBArchitectures

Halley VI - Antarctica research station
Hugh Broughton Architects
Axonometric Structure

Research centre
Modular system

1. Longitudinal pontoon
2. Transverse strength
3a. Exterior column
3b. Interior Column
4. Single Strength Deck
5. Floor bracing
6. Columns
7. Utilities
8. Diamond Structure
9. Support Beams
10. Flooring Panel

Detail 1:100
Research centre
Semi submersible structure (TLP)
Early transverse strength truss

1. Steel triangular cross braced tubular column
   Ø 200mm
2. Single strength deck; low carbon 50mm steel arctic
   D: tensile strength 435-510 ; 90/10 cupronickel, welded
3. Low carbon 50mm steel stability column, 90/10 cupronickel, welded
4. Cupronickel, welded
5. Low carbon 40mm steel grade D steel transverse strength truss, 90/10 cupronickel, welded
tension leg platform; tendon 40mm steel porch,
6. 20mm prestressed steel tendon tension cable
2000mm x 3500mm x 750mm composite
7. Concrete foundation template
10. Seabed piles
1. BIRD SANCTUARY
2. RESEARCH CENTRE
3. ENERGY HARVEST
4. MARINE PERMACULTURE

CIRCULATION

circulation - human experience of the research centre

OBSERVATION
Ground floor plan
1a. Entry
1b. Central staircase
2. Bar
3. Water storage tank

4. MARINE
PERMACULTURE

3. ENERGY
HARVEST

2. RESEARCH
CENTRE

1. BIRD
SANCTUARY
Ground floor plan
4. Energy storage room

1. Bird Sanctuary
2. Research Centre
3. Energy Harvest
4. Marine Permaculture

ECOLOGY/WATER STORAGE

RESEARCH

SLEEP

ENERGY/CONTROL ROOM
First floor plan
5. Seaweed cultivation
6. Restaurant
7. Dining
1. PRODUCTIVE

Constructing alternative modes of production, rather than extracting, can we harvest
earth forces and work together with them?

2. MONUMENTAL

Can architecture be used as a tool to represent and make visible the powerful yet fragile
ecosystems that are crucial for our environment?
1. BIRD SANCTUARY
2. RESEARCH CENTRE
3. ENERGY HARVEST
4. MARINE PERMACULTURE

1. Stability columns
2. Cross bracing
3. Drainage
4. Hall
5. Ballast
1. BIRD SANCTUARY

2. RESEARCH CENTRE

3. ENERGY HARVEST

4. MARINE PERMACULTURE

Hallgrímskirkja Hallgrims Church
Iceland

Arctic bird colonies on Svalbard’s bird cliff
Alkefjellet
1. BIRD SANCTUARY

2. RESEARCH CENTRE

3. ENERGY HARVEST

4. MARINE PERMACULTURE

HEIGHT

80m

45m
1. BIRD SANCTUARY

2. RESEARCH CENTRE

3. ENERGY HARVEST

4. MARINE PERMACULTURE

regularity       irregular

naunce          standard
Axonometric Structure

Bird Sanctuary
Pre-fabricated steel and concrete system

1. Columns
2. Cross Bracing
3. Hull Platform
4. Drainage Vents
5. Ballast

Welding Strategy

Center Column

1. Welded to base
2. Center welded to neighbour columns

Detail 1:100

Bird Sanctuary

Concrete Casing 300mm; Pre-fabricated Steel hexagonal columns welded 100mm; 20mm waterproofing membrane 10mm; 20mm Steel channel

Stainless steel plate 300mm; waterproofing membrane; insulation 20mm; water proofing membrane 10mm; carbon fibre hull, pipe cavity 1980mm; carbon fibre hull; Stainless steel plate 300mm; concrete spacer 500mm

Stainless Steel lined water drainage; Diameter 1450mm

Canvas water hose 1400mm; water drawined to research center
REFLECTION
Meteorological Conditions
Dominant polar easterlies winds / secondary sub-polar mid latitude westerlies
Prevailing wind direction: East-North-East
Monthly average wind speed: 18 km/h
Average atmospheric pressure: 1010 hPa
Summer surface air temperature mean 2018: 3°C
Precipitation: accumulation depending on snowdrift
Sea Ice Coverage: Northern most ice free area
Midnight sun: 134 days / Days without sun: 155 days

Position: 81°49'N 7°20'E, situated on the Yermak Plateau, north of the Fram Strait - the passage between Greenland and Svalbard - sitting on the cusp of the Arctic Ocean marking the entry point from the southern Greenland Sea and Atlantic Ocean.

Distance to:
- 1482km 2018 Magnetic North
- 935km North Pole
- 398km Longyearbyen, Svalbard
- 307km mainland Greenland
- 247km Molloy Hole (deepest part of Arctic 5607m)

Yermak Plateau

+ ENE prevailing winds polar easterlies
+ WSW winds sub-polar westerlies

Marine mammals
- African eurasian

Atlantic fish
- Arctic fish

Bird flyway
- Worm

Surface water current
- Cold saline deep water current

Transpolar sea shipping route
NEW CARTOGRAPHY
Meteorological Conditions

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