ANTARCTIC

Penguin Population Analysis

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THE PENGWINGS TEAM:

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Our Research Goal

Climate change is highly prevalent in current culture, and the Antarctic continent's animals are an often overlooked casualty.

Develop an interactive model to show how the population of Antarctic penguins has been, and will be, affected by various stressors on their environment.

The Data - Stressors

CLIMATE CHANGE:
Land-Air and Sea surface temps (1880 - 2017)
National Oceanic and Atmospheric Administration (NOAA)
National Aeronautics and Space Administration (NASA)

ANTARCTIC SEA ICE:
Sea Ice Extent/Area (1978 - 2012)
National Snow and Ice Data Center

HUMAN ACTIVITY:
Monthly fisheries of Antarctic Krill
Commission for the Conservation of Antarctic Marine Living Resources

KRILL POPULATION STATISTICS:
Location, growth rate, uropod size, and standard length (1992 - 2003)
Australian Government public datasets

ANTARCTIC SILVERFISH:
Population statistics for silverfish in breeding areas of Emperor Penguins
Australian fishing boats and include statistics of location, weight, and standard length.

All data sets were in different formats, with some scraping required to obtain all of the required relevant data from the various sources.

SQL:
All data was collected and mapped to individual tables to allow joins.
Data was scrubbed to remove extraneous information.

The Animals

There are 4 species of penguin that only reside in Antarctica:

- Emperor
- Adele
- Gentoo
- Chinstrap

Focused only on these four species to minimize impacts from non-Antarctic dwellers

Data scraped from: MAPPPD (Mapping Application for Penguin Populations and Projected Dynamics)

The Model

Intuition: Climate change affects the Antarctic penguin population

Python was utilized to implement a time series model of ARMA for prediction of penguin population.

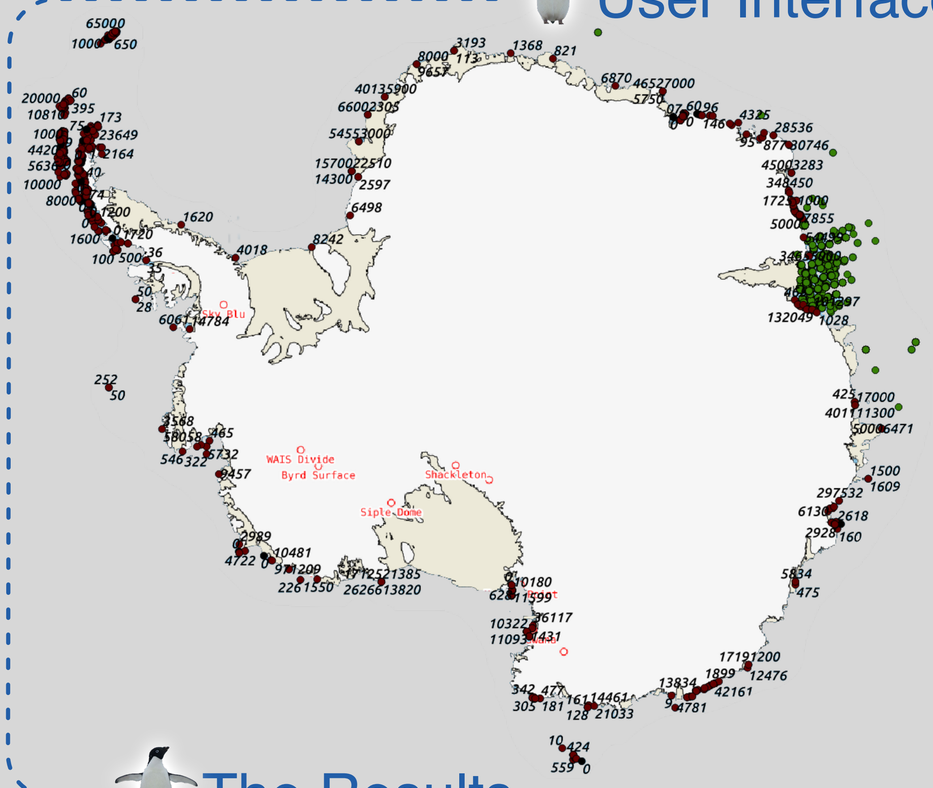
Penguin Population: averaged and grouped by year.
Note: breeding season is in summer (Jan-March), and harsh winter conditions decrease population size.

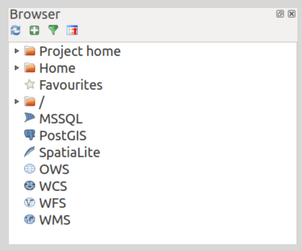
16 possible stressors:
- Annual global temperature in summer/winter
- Annual Temperature in the Antarctic region
- Ice Area and Ice Extent in summer/winter
  (observed areas are Indian Ocean, Western Pacific Ocean, Weddell Sea, Ross Sea, Bellingshausen Sea, Amundsen Sea, and the whole Antarctic region)
- Human activity (through krill fishing)

Calculation:
Pearson Correlation Squared of each stressor
The top 10 are returned and plotted

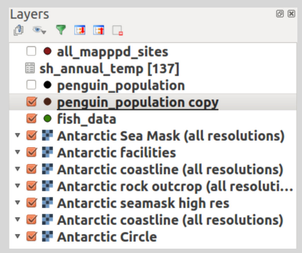
Data Fitting: (Linear Regression)
Features chosen are based on Pearson Correlation results
This shows a linear correlation coefficient
The 3 'best' features were picked for fitting to each penguin species population, and combined for a single result
Note: For all four species Ice Area and/or Ice Extent was one of the top 3 stressors

User Interface





Data Source:
Users have the ability to select the data source they want to see. QGIS can connect to online databases



Layer Selector:
Users have the ability to select the layers and subsequent data they want to see.

Penguin Population with Tags
Food Source Data

The Results

Pearson Correlation by species, and Contributing Top Stressors

Emperor: 0.479
Ice Area of Ross Sea, Ice Extent Ross Sea, Annual Krill Fishery

Adele: 0.492
Ice Area of Antarctica, Ice Extent of Antarctica, Annual Krill Fishery

Gentoo: 0.432
Ice Area of Ross Sea, Global Winter Temp, Annual Krill Fishery

Chinstrap: 0.380
Ice Area Weddell Sea, Ice Extent Weddell Sea, Ice Area Pacific Ocean

Primary Insights

This is the first model that provides a quantifiable link between multiple climate stressors and penguin populations in Antarctica.

The Antarctic penguin populations are directly affected by the state of ice, and this is a second order effect of rising global temperatures.

Antarctica is a very inhospitable place, with multiple countries claiming regions, and as a result there is very little consistent data on penguins their population, and the stressors that they face.