

## **Alaska: A Bird's Eye View**

(The narrator of this story is a Canada Goose named Tutangiaq, unless specified otherwise)

### **Chapter 1. Introduction**

Hi! My name is Tutangiaq (Too-tang-geye-ack), but math lovers can call me 2T. I am a Canada Goose, or *Branta canadensis* for the scientists out there.

Each summer I travel across Alaska. Some people think that Alaska is part of Canada but that's not true (more information 1.1). I love Alaska and the people that live there. In fact, they gave me my name!

I hatched on the Yukon-Kuskokwim Delta in southwestern Alaska, and was given the name "Tutangiaq." It means "Cackling" in Central Yupiq (more information 1.2). I have no idea why they gave me this name.

I have flown across Alaska so many times, and, being high up in the sky, I have gotten a unique perspective. Come join me to explore this remote state! (Satellite image mosaic of Alaska – more information 1.3)

### **More information in Chapter 1**

#### More information 1.1:

The truth about Alaska is out there ....

- Alaskans do not live in igloos.
- Dog mushing is primarily a sport now and not a method of transportation.
- In central and northern Alaska, the winter days are dark, while summer days can be continually light.
- Alaska is by far the largest state in the Union. It is more than twice the size of Texas.
- Alaska is the northernmost, the westernmost, and the easternmost state (the Aleutian Islands stretch across the International Date Line).
- The record low temperature in Alaska is  $-80^{\circ}\text{F}$  ( $-62^{\circ}\text{C}$ ), and the record high temperature is  $100^{\circ}\text{F}$  ( $38^{\circ}\text{C}$ ).

#### More information 1.2:

(Map of Alaska showing the spatial distribution of native Alaskan languages) Native Alaskan languages vary all over the state from Inupiaq on the North Slope and Seward Peninsula to Tlingit along the southeastern panhandle.

#### More information 1.3:

Satellite image mosaic of Alaska. This picture of Alaska is not just one snap shot taken from space. It is in fact a mosaic of hundreds of smaller scenes. Each individual scene is

about 183 km by 170 km. The scene is acquired by the 'Enhanced Thematic Mapper' (ETM) sensors. These sensors are onboard a NASA Earth Observation satellite called Landsat. (Check out the Landsat website for more information.)

The ETM has sensors that operate in different wavelength bands. These sensors record energy that is reflected from the Earth's surface. Different objects on the Earth's surface reflect different amounts of energy. Consequently, the information recorded by the sensors reveals the type of materials on the Earth's surface. This image mosaic was generated by the Earthsat Company. The image uses a combination of the six reflective bands. This provides a pleasing natural color for the surface.

## **Chapter 2. The Last Frontier**

First owned by Russia, Alaska was purchased by the United States of America in 1867 for \$7.2 million. This equates to, roughly, two cents an acre, where an acre is about half the size of a football field. Originally, many considered the purchase to be a "folly" (a reckless act), but it has proved to be a wise investment because of the state's rich resources. Alaska became the 49th state in 1959, and it adopted the nickname "The Last Frontier" for its rugged environment and its isolation from the "Lower 48" states. (Graphic showing Russia, Alaska, Canada Goose, hand shake and the original purchase check – more information 2.1).

Alaska has a population of fewer than 650,000 people. The state has a population density of just over one person per square mile.

Click on a red dot to learn more about an important location in the state. (red dot 1, red dot 2, red dot 3, red dot 4, red dot 5, red dot 6) You will see a color composite image made from data acquired by the Landsat satellite. (more information 2.2)

Alaska is such a huge state! If you were to imagine it positioned over the Lower 48, Alaska would stretch from the Atlantic Ocean across the continent to the Pacific Ocean. Try comparing Alaska to individual states! (Interactivity 2.1)

Normally my family and distant relatives fly from several parts of the lower 48 states and nest in various parts of Canada and Alaska. I will take a scenic route to show you my favorite state!

### **More information and interactivity in Chapter 2**

#### More information 2.1:

On August 1, 1868 this check was issued to Edouard de Stoeckl, Russian Minister to the United States. For \$7.2 million the United States acquired the Alaska territory. (Source: U.S. National Archives & Records Administration)

#### More information 2.2:

Remote sensing color composite images.

Remote sensing images can be very colorful. Some color images look natural and are called natural color composites. On such images, trees look green, clouds look white and shadows look black.

On other images, the colors of objects can be made to look completely different from what they are in real life. Such images are called false color composites. In remote sensing, a very commonly used false color composite is one in which healthy green trees look red. This is called a standard false color composite.

False color composites are used to highlight different Earth materials and are therefore very useful for remote sensing studies.

#### Red dot 1: Barrow

Barrow is located on the northernmost point in the United States. This city is 340 miles north of the Arctic Circle. In Barrow, the sun doesn't set for 84 days in the summer. The sun doesn't rise for 64 days in the winter!

(Satellite image of Barrow). Barrow is surrounded by the Arctic Ocean and many lakes. This makes the North Slope (the northern part of Alaska) look like Swiss cheese. Some of the lakes and the Arctic Ocean are partially frozen appearing as bright whitish blue colors. Point Barrow, the northernmost point in Alaska, can be clearly seen where the spit juts out into the ocean.

#### Red dot 2: Prudhoe Bay

Prudhoe Bay (Proo-dough Bay) is located on the North Slope of Alaska. This city is primarily an industrial town. Prudhoe Bay marks the end of the Dalton Highway and the beginning of the 800-mile Trans-Alaska Pipeline.

(Satellite image of Prudhoe Bay). This is a satellite image of Prudhoe Bay and the surrounding area. On the image you can see small scattered rectangular structures in bright cream and black colors. These are oil pumping stations with gravel pads and drilling platforms. The bright lines with angular bends are roads connecting the stations. Around the Prudhoe Bay area are many black patches, which are lakes. Some of the lakes are partially frozen appearing as blue spots. It is interesting to note that these lakes change their boundary and shape with time. Two neighboring lakes may grow and merge. Lakes close to the ocean may also have their sea edge eroded away forming a new bay.

#### Red dot 3: Fairbanks

The state's second largest city, Fairbanks is located 150 miles below the Arctic Circle and was founded during the gold rush days in interior Alaska.

(Satellite image of Fairbanks). This image is of the Fairbanks city and its surroundings. Buildings and other structures show up in shades of mauve (pinkish-purple), while vegetation is green. The large river at the bottom of the image is the famous Tanana river. The smaller winding river passing through the city is the Chena River.

#### Red dot 4: Denali National Park & Preserve

Originally established in 1917 as a wildlife refuge, Denali is the fourth largest national park in the nation and home to North America's tallest mountain, Mt. McKinley.

(Satellite image of Denali National Park and Preserve). This satellite image of the Denali National Park area was taken in August 2000. Glaciers appear in shades of blue. Mt. McKinley is in the upper middle part of this image. North America's tallest peak, Mt. McKinley measures 20,320 feet. Of America's 20 tallest mountains, 17 are in Alaska, and of America's 10 largest parks, 9 are in Alaska. (a photograph of Mt. McKinley is included).

#### Red dot 5: Anchorage

Anchorage is, by far, the largest city in Alaska. It has 41.5% of the state's total population, or slightly more than 260,000 people.

(Satellite image of Anchorage). This is a 'false color' image of Anchorage. The colors are called "false" because surface features appear very different than we usually observe in reality. On the image, vegetation (trees, grass, shrubs, etc.) appears in different shades of red. Man-made objects (buildings and roads) appear in cyan-blue shades. The rectangular buildings arranged in systematic rows along roads give a typical checkered pattern to the image, which is characteristic of any big city.

#### Red dot 6: Juneau

The state capital, Juneau (Joo-no) is situated on Alaska's pan-handle. Although it is Alaska's third largest city, Juneau lacks road access like many other remote areas in the state.

(Satellite image of Juneau). On this satellite image of Juneau and its surroundings, the city's historical center appears in the bottom right corner of the image. More buildings and developed areas appear around the center of the image. Bodies of water appear as dark blue or black, while the mountains are colored purple. The fluffy patches of white/cream are clouds that were present when the image was taken. The dark spots next to them are their shadows. Clouds, such as the ones in this image, hide parts of the surface, which can be a challenge for scientists.

#### Interactivity 2.1

Comparison of the size of Alaska with contiguous US states and each individual state (comparison based on total state area, land and water).

A drop down menu lets the user select a state of their choice. A graphics showing that particular state overlaid on the State of Alaska appears, which shows the relative sizes of the two states. A numeric comparative relation also appears. This comparison is based on total state area (including land and water). This relationship for Alaska and the various US states is as follows:

5 times Alaska = Lower 48 states

Alaska = 12.5 times Alabama  
Alaska = 5.8 times Arizona  
Alaska = 12.3 times Arkansas  
Alaska = 4.0 times California  
Alaska = 6.3 times Colorado  
Alaska = 118.4 times Connecticut  
Alaska = 263.7 times Delaware  
Alaska = 10.0 times Florida  
Alaska = 11.0 times Georgia  
Alaska = 60.0 times Hawaii  
Alaska = 7.9 times Idaho  
Alaska = 11.3 times Illinois  
Alaska = 18.0 times Indiana  
Alaska = 11.7 times Iowa  
Alaska = 8.0 times Kansas  
Alaska = 16.2 times Kentucky  
Alaska = 12.7 times Louisiana  
Alaska = 18.5 times Maine  
Alaska = 52.9 times Maryland  
Alaska = 62.2 times Massachusetts  
Alaska = 6.8 times Michigan  
Alaska = 7.6 times Minnesota  
Alaska = 13.6 times Mississippi  
Alaska = 9.4 times Missouri  
Alaska = 4.5 times Montana  
Alaska = 8.5 times Nebraska  
Alaska = 5.9 times Nevada  
Alaska = 70.2 times New Hampshire  
Alaska = 75.3 times New Jersey  
Alaska = 5.4 times New Mexico  
Alaska = 12.1 times New York  
Alaska = 12.2 times North Carolina  
Alaska = 9.3 times North Dakota  
Alaska = 14.6 times Ohio  
Alaska = 9.4 times Oklahoma  
Alaska = 6.7 times Oregon  
Alaska = 14.3 times Pennsylvania  
Alaska = 424.9 times Rhode Island  
Alaska = 20.5 times South Carolina  
Alaska = 8.5 times South Dakota  
Alaska = 15.6 times Tennessee  
Alaska = 2.4 times Texas  
Alaska = 7.7 times Utah  
Alaska = 68.3 times Vermont  
Alaska = 15.3 times Virginia  
Alaska = 9.2 times Washington

Alaska = 27.1 times West Virginia  
Alaska = 10.0 times Wisconsin  
Alaska = 6.7 times Wyoming

### **Chapter 3. Ring of Fire**

My relatives who nest along the Aleutian Islands tell me that they live on the "ring of fire," an area surrounding the Pacific Ocean that is home to 75 percent of the world's volcanoes.

Alaska alone is home to 8 percent of the world's active volcanoes, and about 80 percent of all active volcanoes within the United States. More than 100 volcanoes and volcano fields have been active here within the past 1.5 million years, although only 40 have been active during recorded time. With so many volcanoes, you must be wondering how scientists keep track of them without visiting every single one.

You humans have sent up satellites into orbit that look back at Earth from much higher up than I could ever fly! From my perspective, I can usually see only one volcano at a time. The new Landsat satellites orbit the Earth at 705 kilometers (interactivity 3.1) and can look at a 183 kilometers wide area in one pass.

Objects that are hot emit a lot of energy, which a satellite's infrared sensors can detect and record. The hotter the object the brighter it appears on the image. Before a volcano erupts it usually has increased thermal activity which appears as elevated surface temperatures (hot spots) around the volcano's crater. Early detection of a "hot spot" and monitoring is a key factor in predicting possible volcanic eruptions. Take a look at this infrared satellite image. Can you find and click on the hottest spot? (interactivity 3.2)

A dormant volcano may look like a beautiful mountain. Do you want to see what it looks like when it erupts? (interactivity 3.3)

This is a 2001 satellite image of Mt. Cleveland erupting out in the Aleutian Islands. Look at all that ash! Did you know that ash is a serious hazard for the aviation industry? (more information 3.1). It can seriously damage planes and cause engines to temporarily fail, possibly leading to a disastrous crash.

Scientists carry out numerical modeling to predict the movement and spread of ash plumes. To see a sample animation for a plume from Mt. Cleveland, Click here (interactivity 3.4). This analysis was made using a program named "PUFF." The yellow stars represent airplanes. Once they have observed or been affected by the ash plume, they turn red. Based on predictions from models such as PUFF, scientists can warn the aviation industry. That's a good thing to do!

Oh it's hot! Let's move on to a cooler place!

## **More information and interactivity in Chapter 3.**

More information 3.1: Aviation safety.

(Picture showing the air traffic routes above the Aleutian islands, location of volcanoes and historic eruptions). The airspace above the Aleutian Islands is one of the heaviest traveled in the world, with more than 50,000 large aircraft per year and 10,000 passengers per day traveling between Asia and North America and Europe. (Source: Alaska Volcano Observatory)

On December 15, 1989, KLM Flight 867 from Amsterdam was descending into Anchorage International Airport when it flew through a thick cloud of ash from Mt. Redoubt. All four engines stalled and the standby electrical system failed. After descending more than 14,000 feet, the crew was finally able to restart the engines and safely land the plane. In this case the ash caused more than \$80 million in damage to the plane, but fortunately no lives were lost. (Source: US Geological Survey)

### Interactivity 3.1

Conversion calculator – kilometers to miles and reverse. One can enter any numeric digit and the calculator converts on the click of a button.

### Interactivity 3.2

Hot spot detection. A grey scale AVHRR image of Mt. Cleveland and surrounding area is presented. The brightest (white) region on this image is the hot spot due to eruption of Cleveland Volcano. Clicking on the white hot spot, the Canada goose standing close by animates "Awesome". Clicking on any other part of the image the same bird shakes head in an animation with the message "Try again".

### Interactivity 3.3

Volcanic Eruption: On clicking the 'click here' tab, the whole screen shakes, the picture on the left showing a peaceful volcano changes to a picture of an erupting volcano, and Tutangiaq, the Canada goose that was earlier looking at the volcano runs to the right away from the volcano.

### Interactivity 3.4

Puff modeling results: Clicking on the "Click here" tab displays the results of a "PUFF" model simulation of the eruption of the Cleveland volcano. The plume from the volcano is shown to be splitting up and traveling a long distance reaching unto the western US states.

## Chapter 4. Moving Ice Edge

When I fly far enough north I often encounter vast stretches of Arctic sea ice, where the water has literally frozen from the extended cold weather.

During the summer months, the sea ice covers an average of 7,000,000 sq km, but grows to around 14,000,000 sq km during the winter. By comparison, the entire United States is just over 9,000,000 sq km. (interactivity 4.1)

Over the years the thickness and extent of seasonal ice cover has decreased. Scientists predict that increased melting of ice will result in a rapid warm-up of the polar regions. I wonder how this Arctic warming is affecting my pinniped friends, especially walrus.

(Walrus narrates). You're right Tutangiaq. We walrus use sea ice as an important place to rest, breed, and molt. The ice breakup has been occurring earlier in the year and its edge receding further now than even a decade ago. Look at these satellite images which preserve a record of how the sea ice edge has changed over the years. Of course, we need data for many more years to establish a reliable trend. (interactivity 4.2)

(Walrus narrates). Did you ever wonder how these satellite images reveal changes in sea ice? Even though water and ice have the same chemical formula (H<sub>2</sub>O) they have a different chemical structure and physical properties. Ice has a crystalline structure that reflects most of the visible energy that falls on it, making ice appear bright in satellite images from the visible spectrum. Clear water on the other hand tends to absorb most of the visible energy that strikes it, making water appear relatively darker than ice on the same image. This contrast in the behavior of water and ice can be seen as variations in tone (gray shades) on a satellite image.

(Walrus narrates). As you may know, we pinnipeds are adapted for an aquatic environment and are most vulnerable to predators out of the water. For us, sea ice is the safest ground with minimum risks. From there we like to dive down to the continental shelf where we feed. (more information 4.1). The farther the ice edge recedes from the continental shelf in the summer and the longer that lasts, the farther we have to travel to eat. Some scientists believe that the sea ice edge could be receding because of gradual global warming.

That's terrible to hear! I know that scientists are working hard to study the global environment. Some believe that we are seeing global warming. Hopefully, we can all together to preserve our environment and ensure that we do not contribute to global warming.

Oh now I am too cold! Maybe it's time for me to rejoin my migrating family.



## **More information and interactivity in Chapter 4**

### More information 4.1:

Regions of the Ocean: The ocean can be divided into several regions. (Figure showing the sea with sea ice. Also shown are the coast, which extends to the continental shelf, continental slope, continental rise and the deep sea bed).

### Interactivity 4.1:

Seasonal variation in the extent of Arctic Sea Ice: Graphics showing Arctic Sea Ice. The graphic has 4 tabs on top. Clicking on these tabs, the main graphic changes to show the Arctic sea ice extent in March 1985, June 1985, September 1985, and December 1985.

### Interactivity 4.2:

Variation in the extent of Arctic Sea Ice from 1972 through 1993: Graphics showing Arctic Sea Ice. The graphic has 8 tabs on the left. Clicking on these tabs, the main graphic changes to show the Arctic sea ice extent in the third week of September for the years 1972, 1975, 1978, 1981, 1984, 1987, 1990 and 1993.

## **Chapter 5. The Golden Heart City**

Located in interior Alaska, the city of Fairbanks was founded in 1903 as a trading post after gold was found in the area. Today, nicknamed the Golden Heart of Alaska, Fairbanks and the surrounding area are home to more than 80,000 people with numerous species of migratory birds passing through or stopping every year.

Fairbanks sits along the winding Chena River just north of the much larger Tanana River. Whenever my family is passing through town, we always stop at the University of Alaska Fairbanks. Do you think they might be there now?

The UAF campus is located West of Downtown Fairbanks and North of the Fairbanks International Airport, just across the Chena River. The Airport can be identified by its long straight runway and adjacent float pond. Can you help me by clicking on the campus? Use this city map for more clues. (interactivity and more information 5.1)

The University of Alaska Fairbanks is Alaska's premier research and educational institution. At the Geophysical Institute in particular, studies are conducted related to natural processes that control the planet, especially those both occurring in and affecting Alaska. (interactivity 5.2)

I don't see my family here. Let's look elsewhere.

Perhaps they are in Creamer's Field, an old dairy that has been turned into a refuge for migratory birds. Can you click on it and help me find my family?

The refuge is North of the Chena River and Downtown Fairbanks, and off of College Road. (interactivity 5.3)

Oh! Oh! There is my family! You found them! They are about to head north though, so I'll see you later. Thank you for all your help. I hope you love Alaska now as much as I do! Goodbye and maybe I'll see you around here again!

(Last page) – Picture of the Canada Geese flying in a 'V' formation over an Alaskan field. An animation shows the lead bird flying off the screen to right.

The End.

### **Interactivity and more information in Chapter 5.**

#### Interactivity and more information 5.1:

Find University of Alaska Fairbanks (UAF) on a satellite image. Directions for locating UAF are provided in the text. The more information button opens a map of West Fairbanks that provides additional clues to locate UAF. The map clearly shows the Fairbanks International Airport, the Winding Chena River and the location of the campus.

On correctly identifying the UAF and clicking on it, the next screen comes up. On clicking some other 'wrong' spots on the image a pop up window appears telling what the particular feature is and asking the user to try again. Only on identifying the UAF can one go to the next screen. Else the continue button is disabled.

#### Interactivity 5.2:

A small subset of the satellite image of Fairbanks, showing the UAF area is shown. The user can toggle between a road overlay on/off link. 'On' overlays the prominent roads in the campus in red color, on the satellite image. 'Off' removes this road overlay.

#### Interactivity and more information 5.3:

Find Creamer's Field: This interactivity is very similar to interactivity 5.1. The image of Fairbanks is provided again. Directions for locating the Creamer's field are provided in the text. The more information button opens a map of a part of Fairbanks that provides additional clues to locate Creamer's field. The map clearly shows the UAF, the Chena River, College Road and downtown Fairbanks.

On correctly identifying the Creamer's field and clicking on it, the next screen comes up. On clicking some other 'wrong' spots on the image a pop up window appears telling what the particular feature is and asking the user to try again. Only on identifying the Creamer's Field can one go to the next screen. Else the continue button is disabled.