**The Effect of Climate Change on Our White Christmas**

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# Summary

### The problem

#### At the end of 2019, it gathered questions from the 2020 IVSS research. Among the various opinions, the theme that gained the sympathy of many friends was "Why? White Christmas doesn't come?"

#### Hasn't it ever been a real white Christmas? If white Christmas does not happen often, why? Are these phenomena related to the global environment? If so, what efforts should be made to make us and our descendants see 'White Christmas'?

### Research Questions

#### How many times has it snowed in our village this winter?

#### Have you ever had snow on Christmas in our country?

#### (Global issues)Doesn't it snow on Christmas in other countries, too?

### Objectives set

#### Perform GLOBE Protocol and use data from Data Entry to identify the state of the atmosphere and find records of snowing in Korea and other countries.

#### The results of the study can be found by referring to the national meteorological agency observations, news and newspaper articles.

#### White Christmas can be seen again by presenting and implementing climate change response measures.

### Conclusions

#### In order to make it snow again at Christmas, we all need to practice climate change response. GHG emissions and energy use should be reduced. Practice pulling unused socket-outlets, turning off unused lights, and not using disposable products at home. We're going to get everyone to do it together through our campaign activities. So We suggest a few things.

#### First, let's take part in a time campaign for Earth. On Saturday, March 28, 2020, at 20:30 p.m., let's all get together and turn off everything that uses electricity, and have a warm time with candles.

#### Second, I will do GLOBE activities with my school friends for 'climate change response behavior Let's be concerned about the global environment, and let's be protective.

#### Third, I will do environmental exhibition and campaign activities at flea market in our village. From children to adults, we will ask for efforts to protect the environment and protect the Earth.

#### We hope that children like us and their descendants will be able to breathe and play freely. Let's all be together.

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# Research Questions

### How many times has it snowed in our village this winter?

### Have you ever had snow on Christmas in our country?

### (Global issues)Doesn't it snow on Christmas in other countries, too?

# Introduction

### Our school's GLOBE students collect data about the atmosphere. It mainly measures cloud observation, temperature and humidity, and air pressure. At the end of 2019, it gathered questions from the 2020 IVSS research. Among the various opinions, the theme that gained the sympathy of many friends was "Why? White Christmas doesn't come?"

### Hasn't it ever been a real white Christmas? If white Christmas does not happen often, why? Are these phenomena related to the global environment? If so, what efforts should be made to make us and our descendants see 'White Christmas'?

### We wondered about all these things. The number of snow in our town has really decreased dramatically, and it hasn't come a few times this year.

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# Research Methods

### Study sites setting

#### Study Site

#### Our School location: [Hyunhwa Elementary School](https://www.globe.gov/web/hyunhwa-elementary-school)(80, Anhyeon-ro seo 7-gil, Anjung-eup, Pyeongtaek-si, Gyeonggi-do, Republic of Korea)

#### A major area: The Korean Peninsula, Pyeongtaek, Seoul, Suwon, Cheonan, Seosan

#### Comparative area: Worldwide GLOBE Study Sites

#### The Climate Characteristics and Land Surface Condition of the Korean Peninsula The Korean Peninsula is located in the mid - latitudes of the Northern Hemisphere, with distinct seasons, mild climates, hot and rainy in summer, cold and dry in winter. Spring(March~May), Summer(June~August), Fall(September~November), Winter(December ~ February). Average annual average temperature is 13.2 degrees Celsius. Most of the annual precipitation is concentrated in summer. Most people live in the plains, and most of the observation points in GLOBE schools are on the plains.교육부 공식 블로그(https://if-blog.tistory.com/5579)

### Data Collection method

#### Perform GLOBE Protocol and use Data Entry

#### Atmosphere\_Cloud protocol

#### Atmosphere\_Temperature protocol

#### Atmosphere\_Precipitation protocol

#### Atmosphere\_Relative Humidity protocol

#### Atmosphere\_Surface Temperature protocol

#### Use data of the national meteorological agency

#### News and newspaper articles

### The relationship between data and research questions

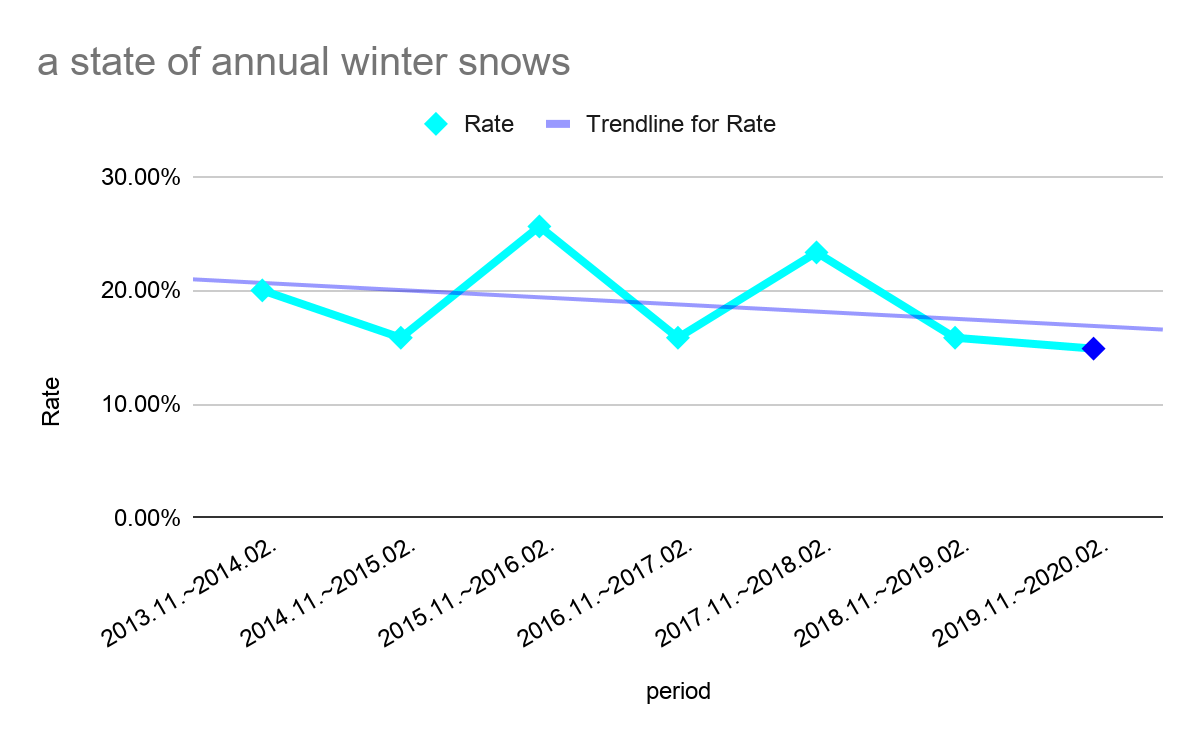
|  |  |
| --- | --- |
| Research Questions | Data Set |
| Q1. How many times has it snowed in our village this winter? | GLOBE\_Precipitation protocolUse data of the national meteorological agency |
| Q2. Have you ever had snow on Christmas in our country? | Use data of the national meteorological agencyNews and newspaper articles |
| Q3. Doesn't it snow on Christmas in other countries, too? | GLOBE\_Cloud protocolGLOBE\_Precipitation protocolGLOBE\_Surface Temperature protocol |

# Results

### Q1. How many times has it snowed in our village this winter?

#### Snow fell six times in our village from November 2019 to February 2020. Unfortunately, there was no Christmas among them. Adults say it's 'dry winter.' Snow falls less frequently than before(Source: Past Observations for Integrated Atmosphere (1-Day))Total Snow(cm) vs. date

#### Using data from the National Weather Service, we compared the snowy days from winter 2013 to winter 2019. As we see, the number of snow falls has decreased. There is a change every year, and we expect it to continue.



### Q2. Have you ever had snow on Christmas in our country?

#### We looked into the records of Christmas snow in our country. National meteorological agency data and news articles were utilized. In the 40 years from 1980 to 2019, there were 13 Christmas snows in Seoul, the capital of Korea. On average, it was white Christmas about three times a decade. The latest white Christmas was snowing at midnight in 2015.

### White Christmas in Korea(Source: Korea Meteorological Agency)

### Q3. Doesn't it snow on Christmas in other countries, too?

#### We wondered if it was our country's own or global problem that no snow was coming at Christmas. So we used GLOBE data to explore the situation in other countries. From 2015 to 2019, data from GLOBE schools, which measure snowfall, were collected.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Measurement of Christmas snow in other countries (Source: GLOBE data)** | | | | | | | |
| Year | Date,Time | Snow Depth(mm) | Cloud cover | Cloud type | Country(State) | GLOBE School | Site\_id |
| 2019 | 12.25.11:55 | -9 | Overcast | Stratus | Lithuania | Zemynos pro-gimnazium | 33425 |
| 2019 | 12.25.02:36 | -9 | Overcast | - | Saudi Arabia | The 2nd Secondary Girls School at Makkah Al-Mukarramah | 33736 |
| 2019 | 12.25.12:36 | 0.5 | None | - | Saudi Arabia | Bin Baz Secondary Scool At-Riyadh | 147583 |
| 2019 | 12.25.12:22 | 0.5 | None | - | Saudi Arabia | Rowad AL-Omaraa secondery Scool At Riyadh | 144858 |
| 2019 | 12.25.12:06 | 0.5 | None | - | Saudi Arabia | Yamama Secondary School at Riyadh | 13092 |
| 2018 | 12.25.11:38 | 0.5 | None | - | Saudi Arabia | The 19th Secondary Girls School at Al-Madinah Al-Monawarah | 101090 |
| 2018 | 12.25.12:06 | 0.5 | Clear | Cirrus | Saudi Arabia | Yamama Secondary School at Riyadh | 13092 |
| 2018 | 12.25.04:29 | **94** | Overcast | Stratus | **Lithuania** | Akmenes gimnazija | 8633 |
| 2018 | 12.25.11:55 | **150** | Overcast | Stratus | **Lithuania** | Zemynos pro-gimnazium | 34998 |
| 2018 | 12.25.11:29 | **40** | Overcast | Stratus | **Latvia** | Dundaga Secondary School | 8828 |
| 2018 | 12.25.11:59 | **100** | Overcast | AltoStratus | **Estonia** | Kilingi-Nomme Gymnasium | 3363 |
| 2018 | 12.25.11:45 | **200** | Overcast | StratoCumulus | **Estonia** | Palupera Primary School | 3415 |
| 2018 | 12.25.12:05 | **50** | None | - | **Croatia** | OS Eugena Kumicica | 6183 |
| 2017 | 12.25.12:08 | -9 | Overcast | Cirrus,CirroStratus,AltoCumulus | Saudi Arabia | The 19th Secondary Girls School at Al-Madinah Al-Monawarah | 101090 |
| 2017 | 12.25.11:38 | -9 | None | - | Saudi Arabia | The 25th Secondary Girls School at Al-Madinah Al-Monawarah | 12509 |
| 2017 | 12.25.12:06 | 0.5 | Clear | Cirrus | Saudi Arabia | Yamama Secondary School at Riyadh | 13092 |
| 2017 | 12.25.12:28 | **43** | Overcast | CirroStratus,AltoStratus | **Estonia** | Kaapa Comprehensive School | 3462 |
| 2017 | 12.25.11:59 | 7 | Broken | AltoStratus | Estonia | Kilingi-Nomme Gymnasium | 3363 |
| 2017 | 12.25.11:45 | **53** | Clear | CirroStratus | **Estonia** | Palupera Primary School | 3415 |
| 2017 | 12.25.11:55 | -9 | Overcast | Stratus | Lithuania | Zemynos pro-gimnazium | 34998 |
| 2017 | 12.25.11:50 | **104** | - | - | **USA(Michigan)** | Shumate Middle School | 102676 |
| 2017 | 12.25.11:43 | **76** | - | - | **USA(NewYork)** | State University of New York at Fredonia | 104611 |
| 2017 | 12.25.11:45 | -9 | Overcast | AltoStratus | Finland | Utajarven Ylaaste | 4594 |
| 2016 | 12.25.11:59 | 7 | Overcast | Stratus,NimboStratus | Poland | Complex of Secondary Schools no 1 Jana Pawła II in Przysucha | 10470 |
| 2016 | 12.25.11:57 | **89** | Broken | StratoCumulus | **Poland** | Stanislaw Dambski Primary School in Rudna Wielka | 11215 |
| 2016 | 12.25.11:15 | -9 | None | - | Saudi Arabia | Moamar Bin Rashed Intermediate School at Riyadh | 33549 |
| 2016 | 12.25.11:37 | -9 | Broken | Cumulus | Saudi Arabia | The 25th Secondary Girls School at Al-Madinah Al-Monawarah | 12509 |
| 2016 | 12.25.12:06 | 0.5 | Clear | Cirrus | Saudi Arabia | Yamama Secondary School at Riyadh | 13092 |
| 2016 | 12.25.11:55 | -9 | Overcast | Stratus | Lithuania | Zemynos pro-gimnazium | 34998 |
| 2015 | 12.25.12:20 | -9 | Clear | Cumulus | Saudi Arabia | Al-Khaleej Secondary School at Dammam | 12809 |
| 2015 | 12.25.12:06 | 0.5 | Overcast | Stratus | Saudi Arabia | Yamama Secondary School at Riyadh | 13092 |
| 2015 | 12.25.12:09 | -9 | None | - | Croatia | Gimnazija Petra Preradovica | 6208 |
| 2015 | 12.25.12:38 | -9 | Scattered | Stratus | Poland | XI Liceum St. Konarskiego in Wrocław | 11646 |
| 2015 | 12.25.11:55 | -9 | Overcast | Stratus | Lithuania | Zemynos pro-gimnazium | 34998 |
| 2015 | 12.25.11:36 | -9 | Overcast | Stratus | Germany | Alexander von Humboldt Gymnasium | 2329 |

#### What we learned from the research is that many GLOBE schools are measuring snow levels. They also say that Saudi Arabia suffered an untimely snowfall this winter (January 15, 2020), and that in 2018, heavy snow and heat waves in various parts of the world put many people in a difficult situation.

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# Conclusion

### Is no snow on Christmas related to global warming and climate change?

### The reason why we can't see white Christmas is because of El Nino. According to the National Oceanic and Atmospheric Administration's announcement, the El Nino phenomenon causes abnormal weather conditions on Earth and is difficult to predict. The thermal equilibrium of the earth has collapsed. According to an interview with Professor Jeon Jong-gap of Seoul National University, if carbon dioxide continues to increase, the Korean Peninsula will become even hotter in 100 years and be in a terrible state.

### Not only Our Country, but also the global Santa village has lost winter snow due to global warming. Some Santa villages suffer from floods, and reindeer can't run around in the snow. As a result, many countries around the world are taking action against climate change.

### What efforts should be put into practice to have snow on Christmas?

### We must take 'climate change response' to have a happy Christmas with friends from all over the world. Efforts to reduce greenhouse gas emissions and energy use should be implemented.

### The use of fossil fuels should be reduced, such as pulling out unused socket-outlets, turning off unused lights, and reducing the use of disposable products at home. The country should come up with policies to reduce carbon dioxide emissions. And we all have to practice 'climate change response'. We ask you to join us from the March 28, 2020 'Earth Hour' campaign.

### (Planning later) Study how to predict 'White Christmas' by observing the clouds on Christmas Day.

### It would be a 'white Christmas' if our efforts brought the Earth back to normal. When you look at the clouds in the morning of December 25, you can predict whether they are 'white Christmas' or not. Looking at the GLOBE data, the snow-falling clouds were "Cumulonimbus", "Nimbostratus", "StratoCumulus" and "Stratus". Among them, it will definitely be a "white Christmas" if you see "Cumulonimbus", "NimboStratus" and "StratoCumulus" which contain a lot of water vapor.

### Our club will carry out a project to use AI (machine learning) to identify clouds. I want to make it easy for anyone to sort clouds. I want to share the joy of Christmas with people.

# 

# References/Bibliography

### List of GLOBE data used

#### Clouds Noons protocol(2015-12-24~2019-12-25)

#### Clouds protocol(2015-12-24~2019-12-25)

#### Precipitation protocol(Snow pack)(2015-12-24~2019-12-25)

#### Surface Temperature Noons protocol(2015-12-24~2019-12-25)

#### Surface Temperature protocol(2015-12-24~2019-12-25)

### GLOBE Materials listed

#### Cloud Chart(Korean Ver.3)

#### Digital thermometer

#### Snowboard

#### Handheld Infrared Thermometer(IRT)

### The Meteorological Administration Observation Data

#### 기상청 날씨누리: <http://www.weather.go.kr/weather/main.jsp>

#### 기상청 기상자료개방포털: <https://data.kma.go.kr/cmmn/main.do>

### Article

#### climate change response : <http://kfem.or.kr/?p=203803>

#### El Nino: <http://www.sjournal.kr/news/articleView.html?idxno=401>

#### Lost Christmas: <http://www.segye.com/newsView/20181225001454?fbclid=IwAR2nZZnoWRvdvxDSxc0Sc_xHa6FZtBww7aNwwQOWeQfmlaKrxUJmKzLsn1Q>

### Instagram

#### #Saudisnow: <https://www.instagram.com/p/B7eE0YiHx-M/>

### Interview

#### Professor Jeon Jong-gap: <http://gmcl.pusan.ac.kr/?ca=board&page=notice_view&auto_idx=213&page_num=5>

# 

# (Optional) Badge Descriptions/Justifications:

### Be a Collaborator

|  |  |  |
| --- | --- | --- |
| **Student** | **GLOBE Protocol** | **Role in IVSS** |
| Kim Soyul | Cloud, Precipitation, AirTemp, RelativeHumidity, SurfaceTemp | Article Collector, To review the conclusions, Plan our campaign |
| Jeong hayun | Cloud, Precipitation, AirTemp, RelativeHumidity, Aerosol | Data Collector, To analyze the results, Ai-Programming |

### Be a data Scientist

|  |  |  |
| --- | --- | --- |
| **Type** | **Content(period)** | **the number of cases** |
| GLOBE Data | Precipitation(2019-11-01~2020-02-29) | 6 |
| Precipitation\_SnowDepth(2015-12-25~2019-12-25) | 35 |
| Cloud\_Photo(2016~2020) | 100 |
| The Meteorological Administration Observation Data | Snowfall(2013-11-01~2020-02-29) | 158 |
| White Christma(1980~2019) | 13 |
| SNS(Instagram) | #Saudisnow | 16 |
| Article | White Christmas, Heavy Snow(in 2018), Climate change, Global warming, Climate Change Response Action | 15 |

### Make a Impact

* + Participating in “Earth Hour” Campaign(2020-03-28, 20:30)
  + Join GLOBE activities with friends to respond to climate change(in 2020)
  + Environmental Exhibition and Campaign in the Village flea Market  
    (Link to Regional Sustainable Development Committee)