Simulating the CIPS Instrument

[1]Anthony DiNorscia, [2]John McNabb, [2]John Blalock, [3]Mackenzie Devilbiss

[1]Millersville University of Pennsylvania
[2]Hampton University Center for Atmospheric Sciences
[3]American University

Background

- Polar mesospheric clouds (PMCs) are mysterious clouds that form around 80-85 km above the poles.
- They occur over the summer hemisphere.
- The Aeronomy of Ice in the Mesosphere (AIM) satellite was created to investigate PMCs.
- The AIM satellite contains three instruments: SOFIE, CDE, and CIPS.
- The focus for this research is the CIPS instrument.
- The CIPS instrument produces level 1, 2, and 3 data.

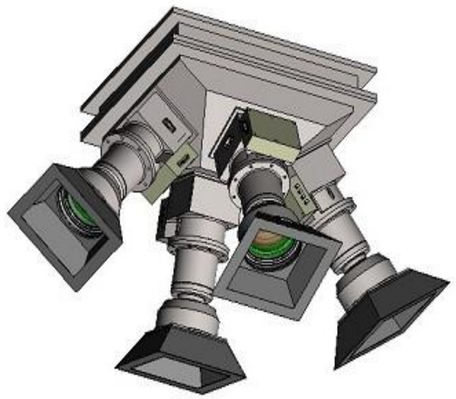


Figure 1: A design of the CIPS Instrument.

Methodology

First part of algorithm

- Find the projection of the CIPS camera images on the Earth's surface or a cloud surface.
  - This consists of the angular resolution and the line of sight.
- Convert the coordinate system into Cartesian coordinates.
- Create a quadratic formula using satellite's position and directional components to solve for the intersection point.
- Once the intersection point is calculated, calculate the coordinates of the intersection.
- Convert back into latitude, longitude, and altitude.

Second part of algorithm

- Use simulation with a cloud field created by Mackenzie Devilbiss.
- Extract latitude, longitude, and albedo from cloud field.
- Rebin cloud data into the simulation's coordinates.
- Match the cloud's albedo to the closest simulated latitude and longitude.
- Plot the simulated clouds.

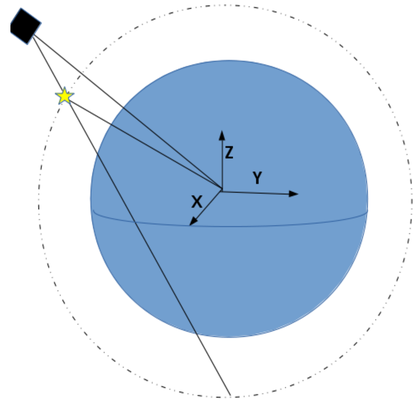


Figure 2: The conversion from polar coordinates to Cartesian coordinates.

Motivation

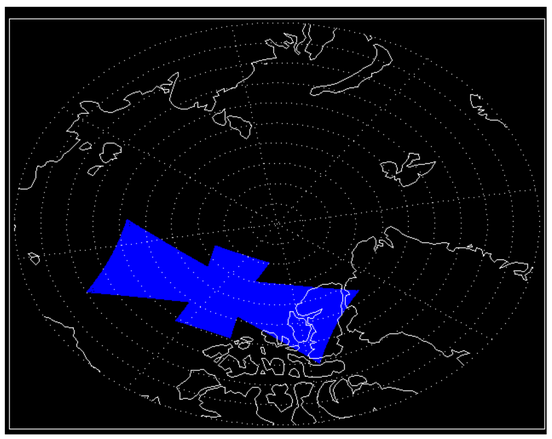
- A simulation is important to have before a satellite is launched.
- The CIPS instrument did not have a simulation before it was launched.
- A simulation can help simulate what the instrument will see with the changing behavior of the CIPS instrument.
- One major change to the instrument is the orbit is changing.
- This simulation will help find the sources of error, if the data is worth keeping, if the data can be used for another reason, or if the data is not able to be used at all.

Future Work

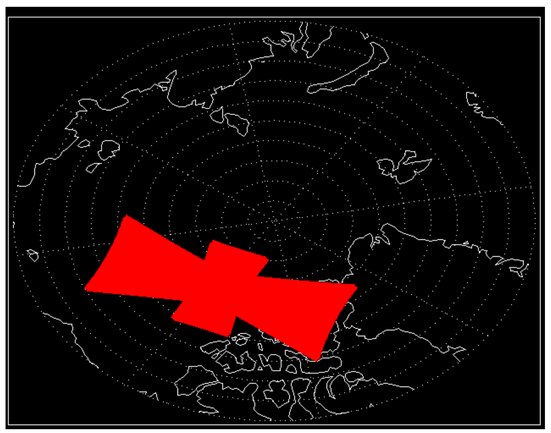
- Adding the sun angle, calculating the scattering angle, and including the phase function.
- Adding in other orbits.
- Creating this simulation for other instruments and satellites.

Results

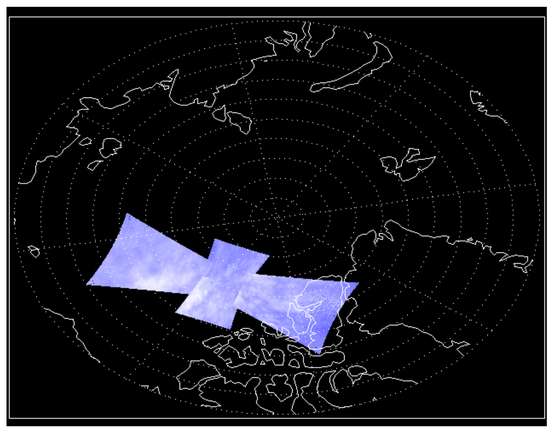
- Plot of the real level 1 data.



- Plot of the simulated level 1 data overlapping the real data.



- Plot of the simulated data using created cloud field.



Conclusions

- It is possible to simulate the CIPS instrument.
- The results conclude that the algorithm works.
- This simulation is important because it can help determine what data will look like if an instrument changes behavior.
- With the AIM satellite changing orbit, this algorithm can help NASA with what the satellite is seeing and how the data will look.

Acknowledgments

A special thanks to NOAA CREST, Hampton University, and the Center of Atmospheric Science for the funding and the continuous help throughout this research.