With the continual exacerbation of anthropogenic climate change, the potential value of geoengineering mitigation has become particularly fascinating to me. One of these geoengineering methods, which involves the injection of aerosols into the stratosphere, has shown potential throughout the literature to aid in climate change mitigation. However, research has consistently highlighted the uncertainties of this method. My main goal with this review was to generate a collection of model-produced uncertainties related to stratospheric aerosol injections (SAIs) and identify current climate model assumptions used to predict SAI outcomes; with this research, my aim was to help future researchers generate more robust assumptions and models. Despite the exhaustive goals of my review, I was able to achieve them through the utilization of advanced search methods in the library database and the targeted curation of library collections.

My first introduction to the library database came through a library workshop in my UWP102B class. Through this workshop, the librarian instructed us on how to effectively utilize advanced searches to find highly-specific research on our topics. This instruction provided me with a foundational grasp on how to navigate the vast selection of resources available in the library. The first navigation method that was introduced to me—which was crucial for my research—was the usage of library databases to find the most relevant primary research on my topic. With this in mind, I began by exploring the "Arctic and Antarctic Regions" database because I previously knew that SAIs were of interest for polar cooling applications. As I looked through this database, I identified multiple sources that emphasized the relative certainty of polar SAIs when compared to global SAIs. As a result, this database helped me recognize the value of writing a review focused on global SAI uncertainties. With this in mind, I directed my focus towards the "Agriculture and Environmental Science" database to search for broader

atmospheric research in relation to SAIs. On top of this, I made use of the "Environmental Engineering Abstracts" database to target papers which focus specifically on climate model uncertainties.

The library workshop also gave me the capacity to effectively use keywords and advanced filters when searching through library databases. This was especially important for the "Agriculture and Environmental Science" database which has millions of articles. I primarily used keywords such as "stratospheric aerosols," "climate models," and "injections" to find relevant research. Two additional methods that strengthened my search results were the utilization of truncation and phrase searching. When searching for articles which were broadly applicable throughout my review, I utilized truncation in the "stratospheric aerosol," and "injection" keywords to ensure plurals were not limiting my search results. In addition, I used advanced search features to find articles with these keywords in their titles or abstracts. When looking for more specific articles—such as climate model research—I often used phrase searching to narrow down the resulting articles. For instance, when I was looking for research on climate models, I searched for the phrase "climate model" with quotation marks around it. With these skills, I was able to navigate the various library databases I selected and produce relevant primary research for my review.

One of the biggest challenges with researching SAIs came from the relatively niche nature of the field. Because SAIs are not widely studied, certain researchers often appear cited in multiple articles related to the topic. In addition, some subtopics within the SAI field have only been studied in a few articles. As a result, I had to be diligent in ensuring that my research was not one-sided and synthesized multiple opinions with different research frames. To ensure this, I first utilized the boolean operator "NOT" in the database's advanced search to restrict the names

of researchers that were common across sources. With these unique sources, I compared results and methodologies across research to examine the validity of certain assumptions and conclusions. With this, I was able to cross-check and verify any assumptions that seemed to be repeated by researchers in multiple articles. In addition, I only utilized peer-reviewed papers when making these comparisons to ensure that researchers were not making any similar misjudgements in their methodologies.

Another challenge with my research was managing and interpreting conflicting results across papers. Although there is general consensus on the broadest implications of SAIs, there is general uncertainty about its specific consequences. To establish the validity of my review, I primarily identified the corroborated and more certain implications of SAIs. On top of this, I ensured peer-reviewed findings were the only results used within my review. For instance, I generally reviewed the climatic effects of SAIs—such as precipitation and ozone changes—but left out the more debated regional precipitation impacts. Although navigating conflicting data was challenging, it also deepened my understanding of climate model uncertainties. I utilized these conflicting results—such as different precipitation predictions—to think about what assumptions might be leading to uncertainties. For instance, I noticed that different models used vastly different values for the same variables. As a result, it helped me identify ways to potentially improve future models and increase their robusticity.

Although the literature on SAIs is not particularly extensive, I had to be strategic in my source selection because of the various research approaches used to study the effects of SAIs. When filtering through sources, I avoided primary research that solely looked at the unintended consequences of SAIs. While these are important, and were identified in my climatic effects section, I wanted to focus on research which was also critical of model assumptions and analyzed

their shortcomings. By synthesizing these sources, I was able to generate a comprehensive collection of model assumptions that produce uncertainties in models. In addition, through my analysis of these various model deficiencies, I was able to suggest some broad improvements that could be made to models in future research.

Despite the massive uncertainties of SAIs, I also wanted to review the literature on SAI injection strategies, which I had not seen in any other reviews on the topic. I looked for peer-reviewed research that identified the optimal locations and times of SAIs. The primary research I used often focused on only one aspect of injection strategies—such as targeting certain latitudes or circulations. By synthesizing these sources, I was able to produce a more comprehensive strategy and fill in the gaps of each source. This added a new dimension to the literature on SAIs that has not yet been explored by any other research. In addition, it offers a path for future research to explore assuming the certainty of SAIs increases.

Through my research process I learned—and utilized—various skills that aided me in my exploration through the library's databases. For instance, my usage of advanced search filters and keywords—which I learned through the library workshop—allowed me to find the research most pertinent to my review. With this review, I was able to highlight the major uncertainties in climate model assumptions, produce more comprehensive SAI strategies, and generate suggestions for future SAI research. These skills will remain invaluable as I continue to conduct research and will allow me to be detailed and meticulous in my source selection.