Do you like cloudy days?

Akira Yamada (Department of Earth and Planetary Science)

Clouds floating across the sky capture our imagination. The white clouds change their shapes over time, which makes us enjoy a wide variety of forms. However, clouds are not just beautiful. Do you know that clouds play an important role in global warming? Do you even know that we have not yet discovered the whole image of clouds, which leads to an uncertainty in climate prediction? Now, I will tell you about how these problems are related to our life and what inspired me to do research on this topic.

First, how do clouds affect climate? Clouds are white, so some of them reflect the sunlight and cool the Earth. To put it simply, an increase in cloud cover will drop the rate of temperature rise, while fewer clouds contribute to warming. Therefore, it is important to expect precisely how much cloud quantity will change. Understanding the process of cloud formation, maintenance, and dissipation is crucial, but we still do not know much about it.

One of the reasons is the lack of observation data. Clouds are floating in the sky, and it is extremely difficult to grasp them directly. We use satellites and radars or observe data related to clouds such as rainfall on the ground. These are both indirect ways to analyze clouds. You might wonder here that there are some direct ways like flying into clouds on a plane or using observation balloons. Of course these methods are also used, but they are classified as a type of single-shot observation, so we cannot apply them when we need continuous time series or horizontal 2D data. In my laboratory, we are trying to observe small particles called aerosols. They will behave as nucleus of cloud particles in the sky, and cloud particles are usually unable to form without aerosols. We can observe them continuously on the ground, so I believe this will help us

understand the cloud mechanisms more clearly. However, it is still challenging to observe clouds directly, which is a major barrier to accurate climate prediction.

Then, why am I working on this issue? The first time I got interested in meteorology is when I was a high school student. I found physics and earth science interesting, and meteorology was the best field to easily find out how both are applied to. Meteorology, or weather, is very close to our daily lives. I was surprised that physics can explain how wind blows and temperature changes, and even forecast weather.

Actually, at first I rather liked fluid dynamics and was not so interested in cloud physics. The reason was simple: I did not know much about cloud physics. There were a lot of basic books to meteorology, but most of them focused little on cloud physics. In my senior year of undergraduate school, every student in my faculty needed to choose some laboratories and experience research. I wanted to jump into some part of meteorology I did not know very well, so I decided to work on cloud physics. Through this program, I realized that a lot of phenomena or processes are still remained unknown in the field of earth science even though just watching them is simple and easy. For example, I was surprised that a certain cloud is well understood in subtropical area, but not in mid-latitudes including Japan. This exciting gap made me proceed to this field. My long-term ultimate goal now is to find out the whole mechanism to explain the system of clouds. I think it is extremely difficult to achieve this, but I want to get closer to the goal step by step through observations and theories.

You may now want to know how this research is related to our life. Again, clouds are the most uncertain part in climate prediction. In other words, understanding the behavior of clouds will provide us with more specific image of the future climate. From a broad perspective, we will be able to take more clear and effective measures to tackle global warming. The uncertainty will become smaller, so we will be able to prepare for a certain sea level rise for example. This is a social point of view, but it will also affect individuals. In recent years, we have more and more really hot days in summer. It is believed that this is one of the major outcomes of global warming. If climate prediction gets more accurate and more effective measures are taken, the frequency of such hot days will perhaps turn to decrease one day. This is a little like a world of fantasy because microscopic direct observation in the sky is almost impossible now, but a breakthrough in technology might overcome this problem in the future.

This research focuses on clouds that everyone knows. It is inspiring and motivating that a lot of mysteries remain close at hand. I hope that many people feel familiar to science around themselves which might be a treasure box of groundbreaking discoveries. It will change the way

you observe your surroundings and make your life more vivid and enjoyable. After you get interested in this research, you might be looking forward to a cloudy day more than a sunny day.

Acknowledgment:

I used ChatGPT for some ideas of phrases, and Irasutoya for the image. I would also like to thank Professor Kate Harris and Kota Aikyo for their helpful feedback for my first draft.