Does the Aurora Differ from Year to Year ?

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Abstract

In this poster I will try and investigate if the aurora differs from year to year. I will talk about how the aurora forms, what causes the different colours of the aurora, and the dependency of the aurora on the solar cycle.

Aim

The aim of this poster is to find out how the aurora differs year to year in a way that it is easy to understand and can be presented with much ease.

Introduction

The aurora is a display of lights that form in two places, the North Pole, and the South Pole. They are normally called the Northern and Southern lights, although there is a full name of The Aurora Borealis (The Northern Lights) and Aurora Australis (The Southern Lights). If you look at figure 2 it shows how the aurora looks from space and that it is around the poles. In some mythologies when the aurora was around, it was thought of as a symbol that a war was about to happen. The aurora often form about 80 miles to 620 miles up, so very high. I will be talking about how the aurora differs year from year. I will investigate the different colours and how it is dependent on the solar cycle.

Figure 1 Here is a diagram of coronal mass ejections, it also shows how the solar flares and solar winds go to Earth with the charged ions.

Solar Cycle Dependency

The solar cycle is a magnetic cycle where once the cycle is at the maximum the Sun's poles flip. The process of minimum to maximum back to minimum, takes about 11 years. When the cycle is at the maximum it releases the most amount of matter. There are storms on the surface on the Sun which create solar flares, solar winds, and coronal mass ejection (Figure 1 shows the coronal mass ejection very well, and how it has a relationship with solar flares and winds). These storms will release the charged ions to the Earth and create the aurora. The last solar minimum was in 2020, the next solar maximum will be in 2025/26.

How does the Aurora Work?

Charged particles that come from the Sun in solar winds and solar flares, come to Earth. When the charged particles are near enough, they then hit the Earth's magnetic fields and travel down the field lines which causes currents of charged particles. Some of the charged particles are deflected around the Earth. As the particles travel along the field lines (If you look at figure 4 it will show this very well), they go to both poles thus you get the aurora at both poles. When the charged particles hit the ionosphere (which is a region at the top of the Earth's atmosphere) the charged particles hit oxygen and nitrogen, they then transfer their energy to the oxygen and nitrogen. When the oxygen and nitrogen absorbs the energy, this causes the electrons in the atoms to get 'excited' and they move from low energy to high energy orbitals. When the atoms cool and lose energy the electrons move back to their normal orbitals and they re-radiate the energy into light energy. That re-radiated light is can come in different colours dependent on the atoms. This is the aurora.

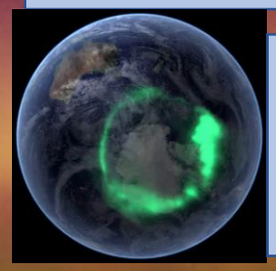

Figure 2 shows how the aurora looks from space. It shows that the Aurora is on the poles and how some areas can have higher frequencies.

Conclusion

In conclusion, yes, the Aurora does differ from year to year. The Aurora differs as each year we get closer to the solar maximum/minimum so there will be more/fewer sightings due to the solar cycle. Although each Aurora sighting looks different, the colours won't change a huge amount, as the gases in the atmosphere will stay similar. The reason that each Aurora sighting might be different would be because the charged ions would hit different molecules at different times and at different amounts.

The Different Colours

The aurora is very famous for its multiple colours. Green, blue, violet, pink, and scarlet red are the most common colours that are formed. Each different colour is from a different molecule or atom in the Earth's atmosphere. The greens are from mid to low lying oxygen in the Earth's atmosphere (meaning it is closer to the ground). Blues are from mid to high lying Nitrogen (meaning it is higher up in the Earth's atmosphere). Pink is from low lying Nitrogen (meaning it is close to the ground). Scarlet red is from high lying oxygen (meaning it further away from the ground). Figure 3 shows this well, it shows the high up reds, and the low-lying blues.

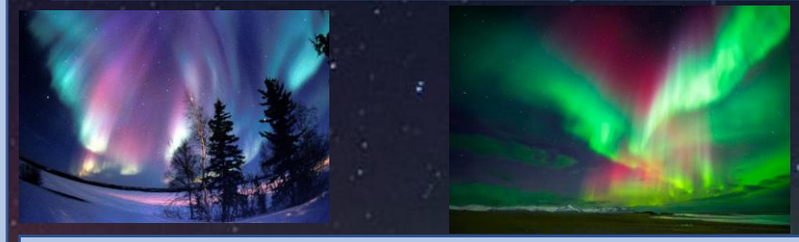

Figure 3 shows the variation of colours of the aurora and the it shows colours in layers depending on the position of the atoms.

Figure 4 shows the solar flares and solar winds releasing charged particles which travel along the magnetic field lines. It also shows how some of the ions are deflected.

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