Saturn lightning after Cassini

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From 2004 until 2017 the Cassini spacecraft observed Saturnian lightning storms with durations of a few days up to several months. They were observed with the Cassini RPWS (Radio and Plasma Wave Science) instrument, the Cassini cameras (ISS-Imaging Science Subsystem), but also with Earth-based optical and radio telescopes. Saturnian thunderstorms rage at certain latitude bands, preferentially at the so-called storm alleys around 35° south and 35° north or around the equator. The lightning discharges in these thunderstorms are thought to originate from regions of the atmosphere where water clouds are present, at similar temperatures to terrestrial clouds, but at higher pressure levels of 8-10 bars.

There are two different classes of Saturn lightning storms: The "smaller" storms have a horizontal extent around 2000 km and a flash rate of a few flashes per minute, and there are the rare and giant "Great White Spots" (GWS) with a latitudinal diameter of 10,000 km and with a flash rate of a few flashes per second. Cassini was lucky to observe such a GWS in the years 2010 and 2011. After the GWS the lightning activity on Saturn decreased considerably, and the last small thunderstorm during the Cassini mission was observed in October 2013. The absence of lightning storms in recent years was probably caused by a convective inhibition state in the atmosphere of Saturn's northern hemisphere after the GWS.

The Cassini RPWS instrument monitored the flash rates by detecting the radio emissions from Saturn lightning discharges radiated at high frequencies (in the MHz range) above the ionospheric cutoff frequency. However, lightning is known to emit whistler waves at very low frequencies propagating along magnetic field lines from the source to the observer. We will show 3 tentative lightning whistler detections at Saturn. The scarcity of such observations can be explained by Cassini's trajectory since the storm alleys at a planetocentric latitude of 35° connect to low magnetic L-shells which were only traversed by Cassini during orbit insertion and the so-called Grand Finale orbits. With Cassini now gone, future observations of Saturnian thunderstorm will have to rely on ground-based amateur astronomers and giant radio telescopes which are able to observe Saturn's strong lightning radio bursts, which are about 10,000 times stronger than their terrestrial counterparts.