Originals:

4.2 Differentiating Between Drifting and Precipitating Curtains140 As mentioned in the introduction, AC6 lacks pitch angle resolution that would al-  
141 low it to easy differentiate between drifting and precipitating curtain electrons. Fortu-  
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manuscript submitted to JGR: Space Physics142 nately we can use the South Atlantic Anomaly (SAA) and AC6’s location in LEO to dif-  
143 ferentiate between the two possibilities.  
144 Earth’s magnetic field is spatially shifted towards Singapore which creates a region  
145 of weaker magnetic field in the South Atlantic Ocean called the South Atlantic Anomaly.  
146 Most particles observed in LEO are barely-trapped: they bounce and drift around the  
147 Earth until they reach the SAA. In the SAA the weaker magnetic field strength lowers  
148 the electron’s mirror point altitude into the atmosphere where collisions with the atmo-  
149 sphere are more numerous and the particle is lost. Particles that drift and are lost in the  
150 SAA have pitch angles in the drift loss cone. Particles with smaller pitch angles that are  
151 lost in the atmosphere within one bounce are in the bounce loss cone. Traditionally, we  
152 define a particle with a mirror point altitude at or below 100 km to be in the BLC.  
153 Without pitch angle resolution AC6 can not easily differentiate between trapped,  
154 drift loss cone, and bounce loss cone electrons. In the SAA, AC6 observes a combina-  
155 tion of trapped, drift loss cone, and bounce loss cone electrons. In the region magnet-  
156 ically conjugate to the SAA in the North Atlantic, AC6 only observes particles in the  
157 BLC. Too much hand holding or appropriate? If an electron makes it to AC6’s al-  
158 titude, it can be in the local loss cone and precipitate in the local hemisphere. Alterna-  
159 tively, the electron will mirror at or below AC6 and gyrate to the conjugate mirror point  
160 in the SAA where the mirror point is deep in the atmosphere or below sea level. There-  
161 fore, any precipitation observed in the BLC region in the North Atlantic must rapidly  
162 precipitate. Lastly, outside of the SAA and its conjugate point, AC6 will observe elec-  
163 trons in both the drift and bounce loss cones.  
164 We estimated the BLC region for locally-mirroring electrons in the North Atlantic  
165 Ocean using the IRBEM-Lib magnetic field library and the Olson-Pfitzer magnetic field  
166 model (Boscher et al., 2012; Olson & Pfitzer, 1982). We defined a latitude-longitude grid  
167 spanning the North Atlantic, at 700 kilometer altitude that is typical for AC6, and es-  
168 timated the local magnetic field strength. For each latitude-longitude point we traced  
169 the magnetic field line to the SAA and found the conjugate mirror point altitude. If the  
170 conjugate mirror point is at or below 100 kilometers, the latitude-longitude grid point  
171 is in the bounce loss cone and the particle is likely lost. Furthermore, a more rigorous  
172 bounce loss cone criterion is if the conjugate mirror point altitude is below sea level. In  
173 this case the electron is definitely lost. Since we are considering locally-mirroring elec-  
174 trons at AC6’s altitude in the North Atlantic, this estimate is the upper bound mirror  
175 point altitude. The BLC region estimated here closely matches the BLC region shown  
176 in Comess et al. (2013, Figure 1) and Dietrich et al. (2010, Figure 3). Furthermore, we  
177 repeated the same analysis using the Tsyganenko 1989 model (Tsyganenko, 1989) which  
178 yielded similar boundaries.

**5.3 Local Atmospheric Precipitation**218 Figure 5a shows a map of the BLC region in the North Atlantic. The solid blue  
219 line is the northern boundary where a locally-mirrorring electron observed at 700 kilo-  
220 meters will mirror at 100 kilometers in the SAA. Immediately south of the solid blue line  
221 the SAA mirror altitude rapidly decreases towards, and below, sea level. The dashed blue  
222 line is the boundary where the SAA mirror point altitude is at sea level. For reference,  
223 AC6 takes about 30 seconds to move between the solid and dashed blue curves. The two  
224 dotted black curves in Fig. 5a bound the outer radiation belt, defined between L shells  
225 of 4 and 8.  
226 We found 36 curtains that were observed inside the BLC region. Figure 5b-e shows  
227 the shifted time series plots for 4 examples with the AC6 in-track lag, L and MLT dur-  
228 ing the observations annotated. The AC6 locations where these curtains were observed  
229 are shown in Fig. 5a with red stars and the corresponding panel labels. Move the rest  
230 of the P to the discussion? The curtains shown in Fig. 5c and e were observed near the  
231 sea level SAA mirror altitude curve thus they were not drifting and were precipitating  
232 as much as 6 seconds as shown in Fig. 5e. The curtain precipitation persisted for mul-  
233 tiple *≈* 1*:*5 second bounce periods of 30 keV electrons in this region.

Comments and rewrites

As mentioned in the introduction, AC6 lacks pitch angle resolution that would al low it to easy differentiate between drifting and precipitating curtain electrons. To differentiate between these two possibilities we use a region of the earth’s magnetic field known as the South Atlantic Anomaly (SAA).

Earth’s magnetic field is spatially shifted towards Singapore which creates a region of weaker magnetic field in the South Atlantic Ocean called the South Atlantic Anomaly. Most particles observed in LEO are barely trapped: they bounce and drift around the Earth until they reach the SAA. In the SAA the weaker magnetic field strength lowers the electron’s mirror point altitude. If the mirror point altitude is lowered into the atmosphere it will likely collide with atmospheric particles and be lost. Particles that drift and are lost in the SAA have pitch angles in the drift loss cone. Particles with smaller pitch angles that are lost in the atmosphere within one bounce are in the bounce loss cone. Traditionally, we define a particle with a mirror point altitude at or below 100 km to be in the BLC.

Without pitch angle resolution AC6 cannot easily differentiate between trapped, drift loss cone, and bounce loss cone electrons. In the SAA AC6 observes a combination of trapped, drift loss cone, and bounce loss cone electrons. In the region magnetically conjugate to the SAA in the North Atlantic, AC6 only observes particles in the BLC. Too much hand holding or appropriate? If an electron makes it to AC6’s altitude it might be in the local loss cone and precipitate in the local hemisphere. Alternatively, the electron will mirror at or below AC6 and gyrate to the conjugate mirror point in the SAA where the mirror point is deep in the atmosphere or below sea level. Therefore, any precipitation observed in the BLC region in the North Atlantic must rapidly precipitate. Outside of the SAA and its conjugate point AC6 will observe electrons in both the drift and bounce loss cones.

We estimated the BLC region for locally-mirroring electrons in the North Atlantic Ocean using the IRBEM-Lib magnetic field library and the Olson-Pfitzer magnetic field model (Boscher et al., 2012; Olson & Pfitzer, 1982). We defined a latitude-longitude grid spanning the North Atlantic at 700 kilometers altitude, typical for AC6, and estimated the local magnetic field strength. For each latitude-longitude point we traced the magnetic field line to the SAA and found the conjugate mirror point altitude. If the conjugate mirror point is at or below 100 kilometers the particle is likely lost and the grid point is considered to be in the BLC. Furthermore, a more rigorous bounce loss cone criterion is if the conjugate mirror point altitude is below sea level. In this case the electron is definitely lost. Since we are considering locally-mirroring electrons at AC6’s altitude in the North Atlantic, this estimate is the upper bound mirror point altitude. The BLC region estimated here closely matches the BLC region shown in Comess et al. (2013, Figure 1) and Dietrich et al. (2010, Figure 3). Furthermore, we repeated the same analysis using the Tsyganenko 1989 model (Tsyganenko, 1989) which yielded similar boundaries.

Figure 5a shows a map of the BLC region in the North Atlantic. The solid blue line is the northern boundary where a locally mirrorring electron observed at 700 kilometers will mirror at 100 kilometers in the SAA. Immediately south of the solid blue line the SAA mirror altitude rapidly decreases towards, and below, sea level. The dashed blue line is the boundary where the SAA mirror point altitude is at sea level. For reference, AC6 takes about 30 seconds to move between the solid and dashed blue curves. The two dotted black curves in Fig. 5a are roughly the boundary of the outer radiation belt, defined between L shells of 4 and 8.

We found 36 curtains that were observed inside the BLC region. Figure 5b-e shows the shifted time series plots for 4 examples with the AC6 in-track lag, L and MLT during the observations annotated. The AC6 locations where these curtains were observed are shown in Fig. 5a with red stars and the corresponding panel labels. Move the rest of the P to the discussion? The curtains shown in Fig. 5c and e were observed near the sea level SAA mirror altitude curve thus they were not drifting and were precipitating as much as 6 seconds as shown in Fig. 5e. The curtain precipitation persisted for multiple *≈* 1*:*5 second bounce periods of 30 keV electrons in this region.