The Effects of Commercial Airline Traffic on LSST Observing Efficiency

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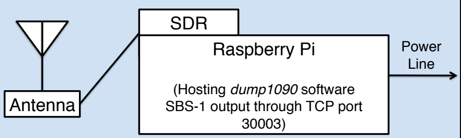
Introduction

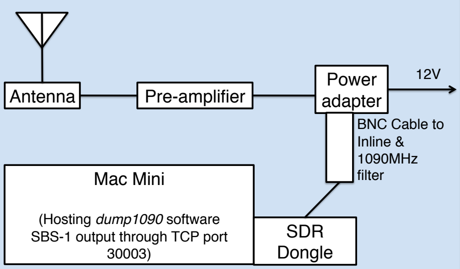
Despite LSST's remote location on Cerro Pachón in Chile, commercial aircraft fly overhead at all times of day, creating contrails that can interfere with observing. While the effect may be small, the large investment in LSST requires that every possible decrease in efficiency be examined, no matter how small.

All commercial aircraft transmit an ADS-B signal which can be received by an device tuned to 1090MHz. We used this signal to examine aircraft above the future LSST site.

Ground Stations



Tucson, AZ prototype station schematic. The entire station was located on the NOAO building and powered by a roof outlet.



Cerro Pachón ground station schematic. The antenna and pre-amp are located on top of the ALO building at the LSST site, and are connected to the power adapter indoors by a coax cable.

Abstract

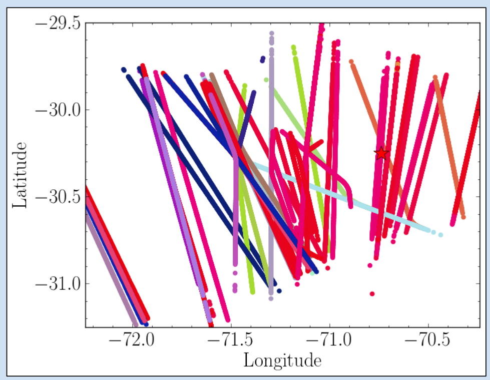
The Large Synoptic Survey Telescope (LSST) is a ten-year survey that will map the southern sky in six different filters 800 times before the end of its run. We explore the primary effect of airline traffic on scheduling the LSST observations in addition to the secondary effect of condensation trails, or contrails, created by the presence of the aircraft. The large national investment being made in LSST implies that small improvements in observing efficiency through aircraft and contrail avoidance can result in a significant improvement in the quality of survey and its science. A Software Defined Radio (SDR) received Automatic Dependent Surveillance-Broadcast (ADS-B) signals from commercial aircraft in order to monitor and record plane activity over the LSST site. We installed an ADS-B ground station on Cerro Pachón, Chile consisting of a 1090MHz antenna on the Andes Lidar Observatory feeding a RTL2832 SDR. The Python software *dump1090* converted the ADS-B telemetry into Basestation format, and we found that even during the busiest time of night there were only 4 signals being received each minute, which will have a very small direct effect, if any, on the LSST observing scheduler. Gibson and this work is supported by the NOAO/KPNO Research Experiences for Undergraduates (REU) Program which is funded by the NSF REU Program (AST-1262829) and under US DOE grant SC0007881

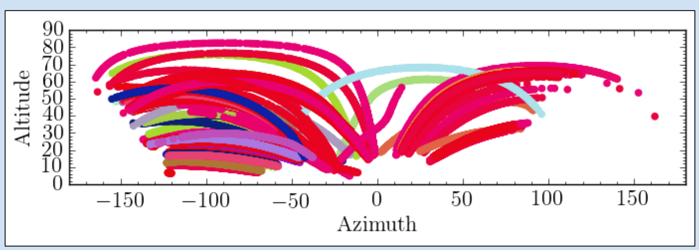
Direct Aircraft Detection

✈12 days of data collection from aircraft over Cerro Pachón

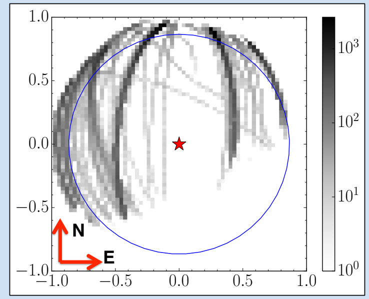
✈*dump1090* output saved to ALO computer

✈Raw Longitude and Latitude converted to Altitude and Azimuth using ADS-B elevation data and exact camera location





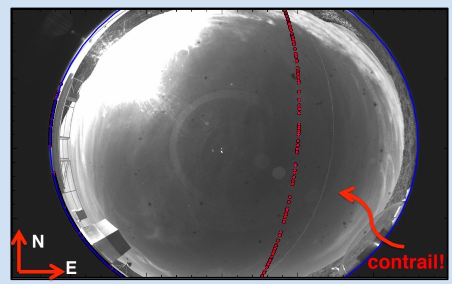
All Sky Camera & Aircraft



✈Canon 5D Mark III, 8-15mm f/4 fisheye lens; θ=r/f

✈LSST field = 47 pixels

✈Aircraft telemetry and day time images simultaneously recorded during contrail formation



Future Work

✈ Record aircraft position data and weather data in tandem

✈ Compare aircraft trails to contrails and evolution of contrails across AllSky CCD

✈ Use live telemetry of aircraft and weather services to send warning pings for incoming aircraft and contrails