

Expanding Aviation Applications for the Geostationary Lightning Mapper

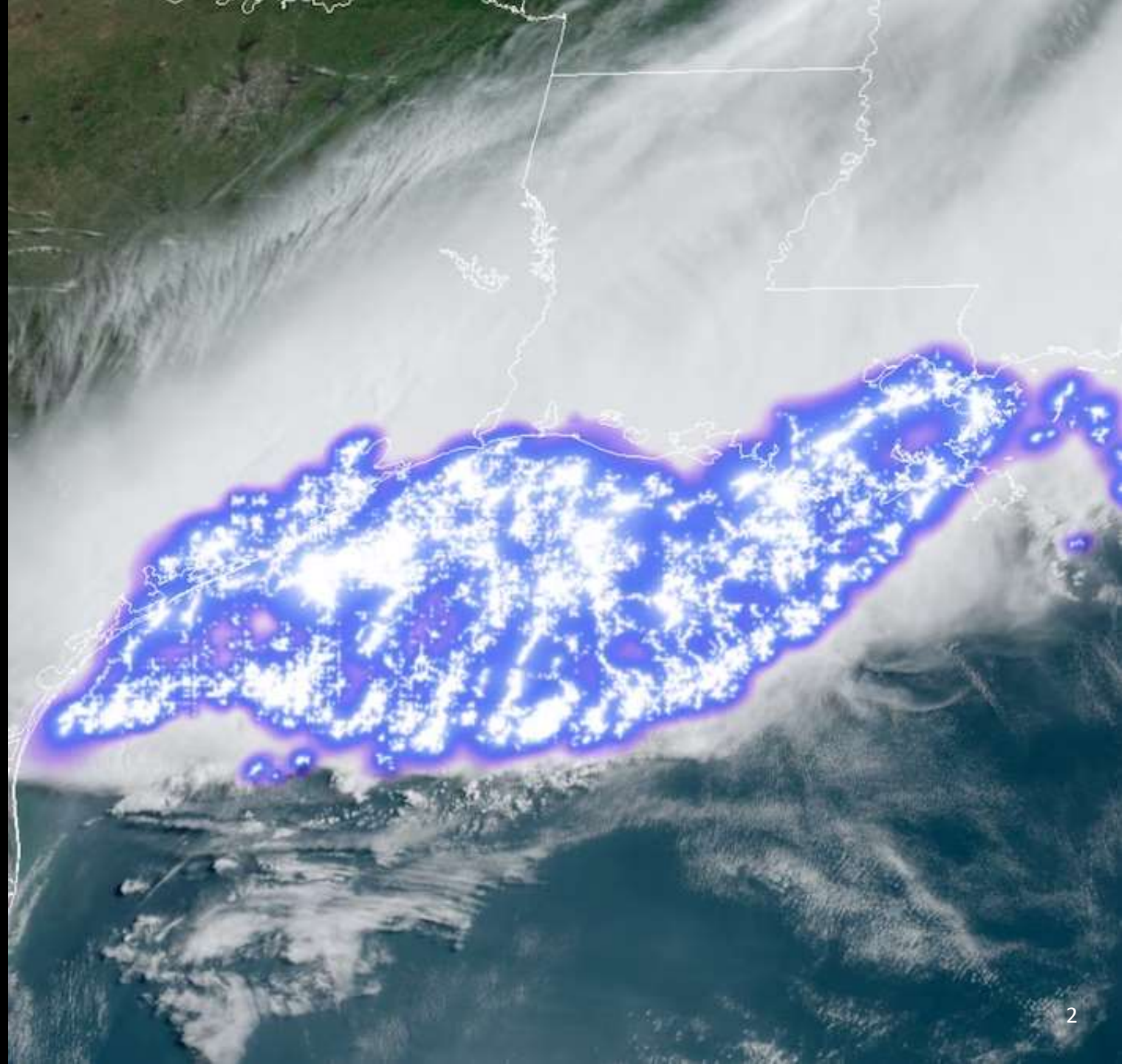
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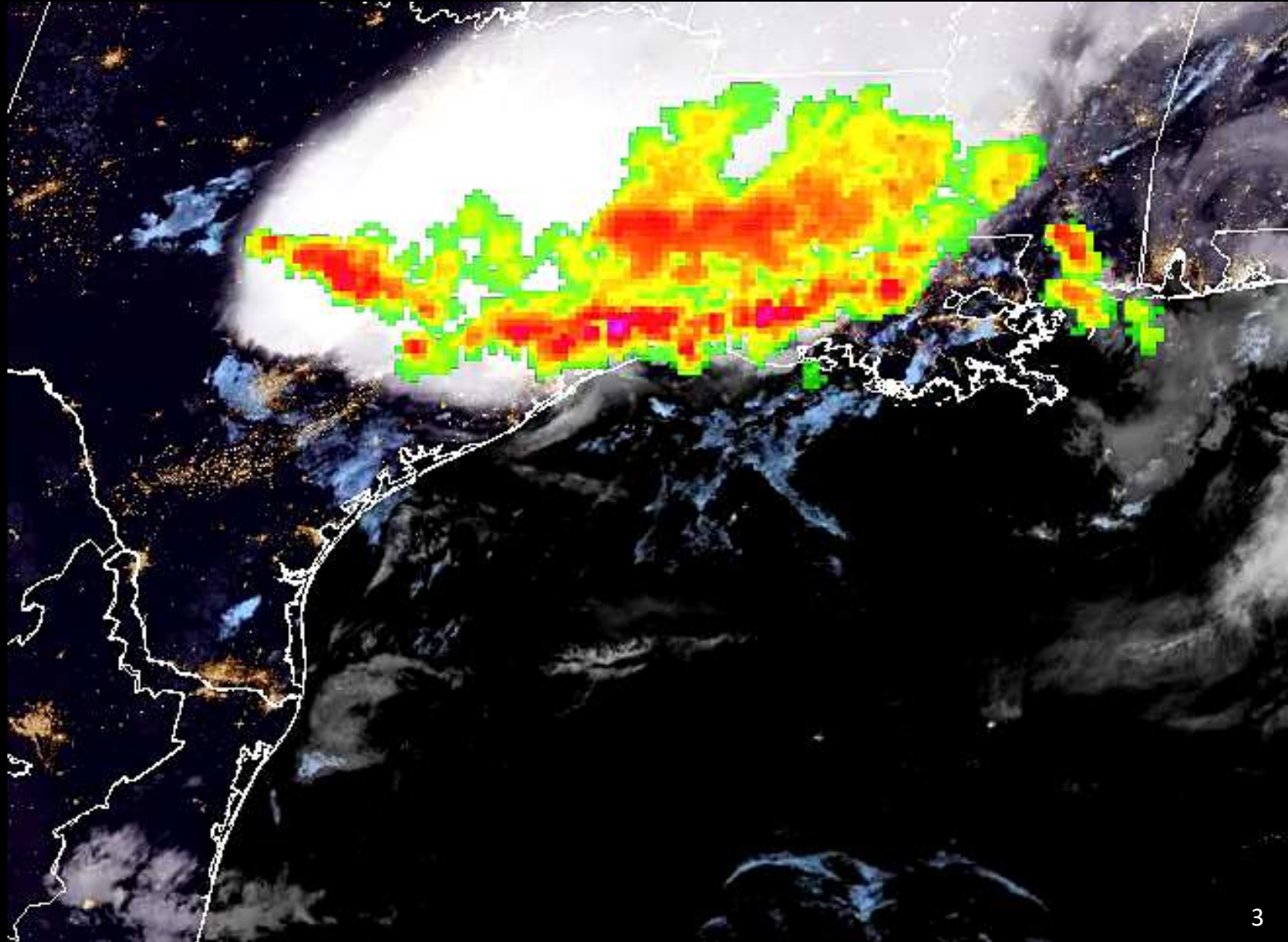
GOES-R GLM

- Geostationary Lightning Mapper (GLM) captures lightning at a near hemispheric view with a high frame rate
- Optical lightning observations differ from ground-based lightning detection networks
- Lightning provides a key indicator for determining storm intensity
- Access to GLM observations has a great potential to promote aviation safety and efficiency



Composite ABI GLM Imagery

- GLM Flash Extent Density (FED) overlaid onto GeoColor imagery from the Advanced Baseline Imager (ABI)
- GLM FED reveals both the convective intensity along the leading line and the spatial extent in the trailing stratiform region
- Longest Lightning Flash Ever?
<https://www.noaa.gov/stories/worlds-longest-lightning-flash-on-record-captured-by-noaa-satellites>



Lightning Skeleton



Geostationary Lightning Mapper (GLM) rapid sampling reveals continuous progression of this individual flash. Imagery provided by Michael Peterson

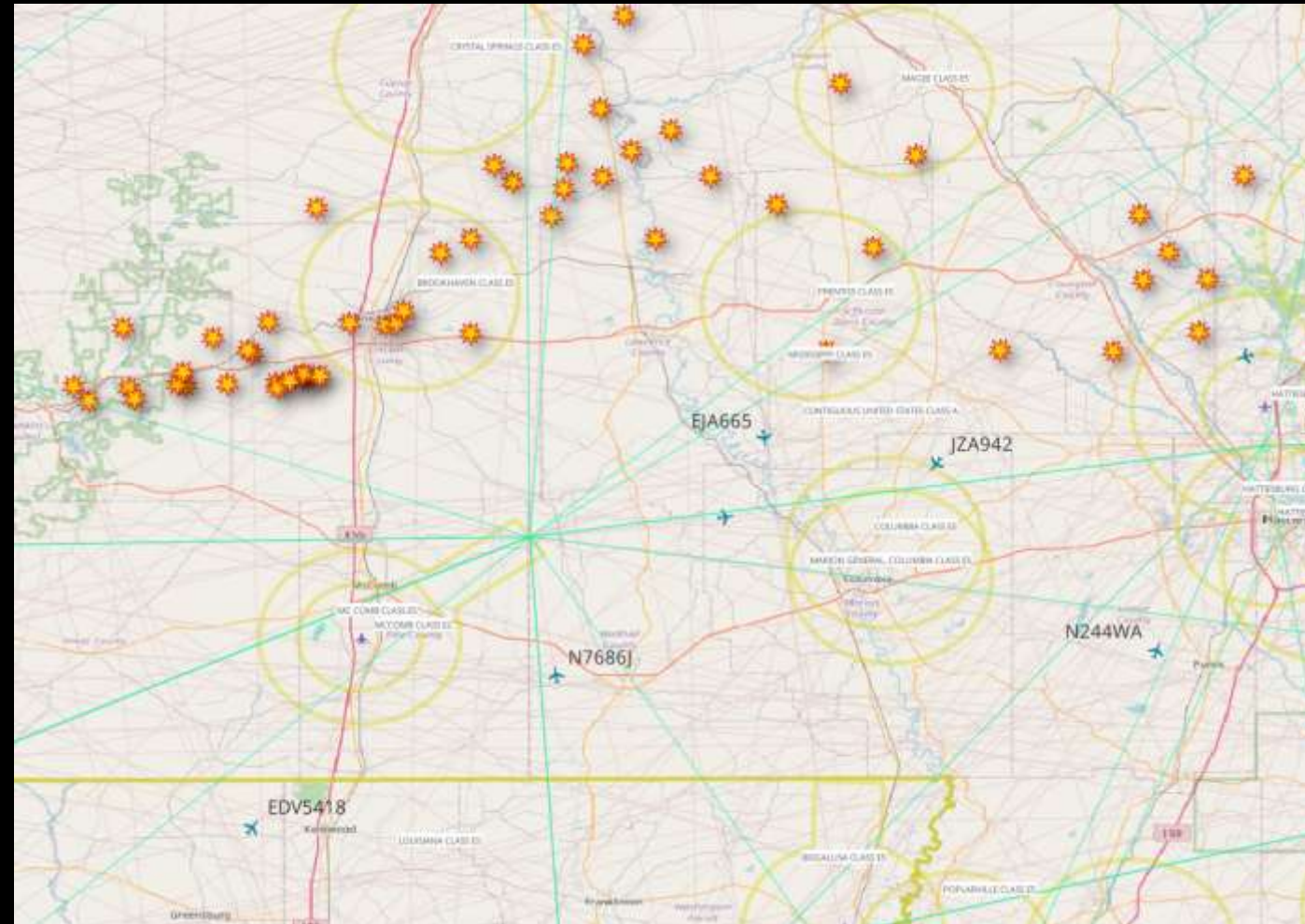
Motivation

- Safety is the number one priority in aviation
- Increased flight efficiency saves time and fuel
- Improved storm predictions aid pilots, air traffic controllers, and airport managers
- Pilots require access to more weather resources and tools to predict and avoid hazardous storms
- Aircraft are most vulnerable during ascent and descent due to limited deviation options
- Reduce the potential for flash induced temporary pilot blindness
- Research required to better understand the optimal combination of weather data and tools that provide accessible, easily interpreted, and actionable information to pilots



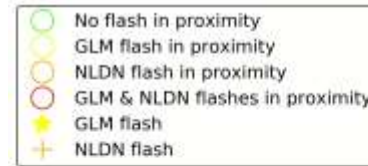
Project Overview

- Goal: Display a map with air traffic, airspaces, GLM lightning observations, and proximity indicators to airports and aircraft
- Example image illustrates:
 - GLM lightning with the flash intensity
 - Flight paths for the time frame (pink lines)
 - Air Traffic Service (ATS) routes (green lines)
 - Airspace rings (yellow lines)
 - Flight traffic with transponder information
 - Turbulence detection in progress
- Create a tool for pilots, ATC, researchers, and weather briefers to use to expand the knowledge of storms effects on aviation

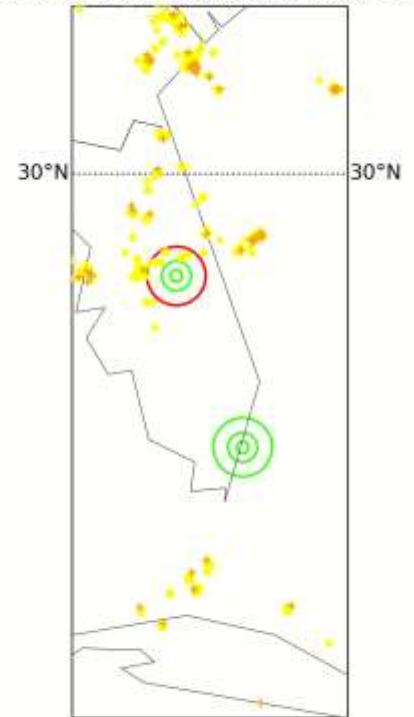


Project Specifics

- Use python and Linux to receive and visualize data
- Process flight data from the community-based OpenSky network
- Identify lightning in vicinity of airspaces, flight paths, and ATS routes using GLM data
- Investigate possible turbulence detection by differencing data fields
- Collect flight data in the vicinity of thunderstorm



2019-06-09 00:00:00-00:05:00 UTC



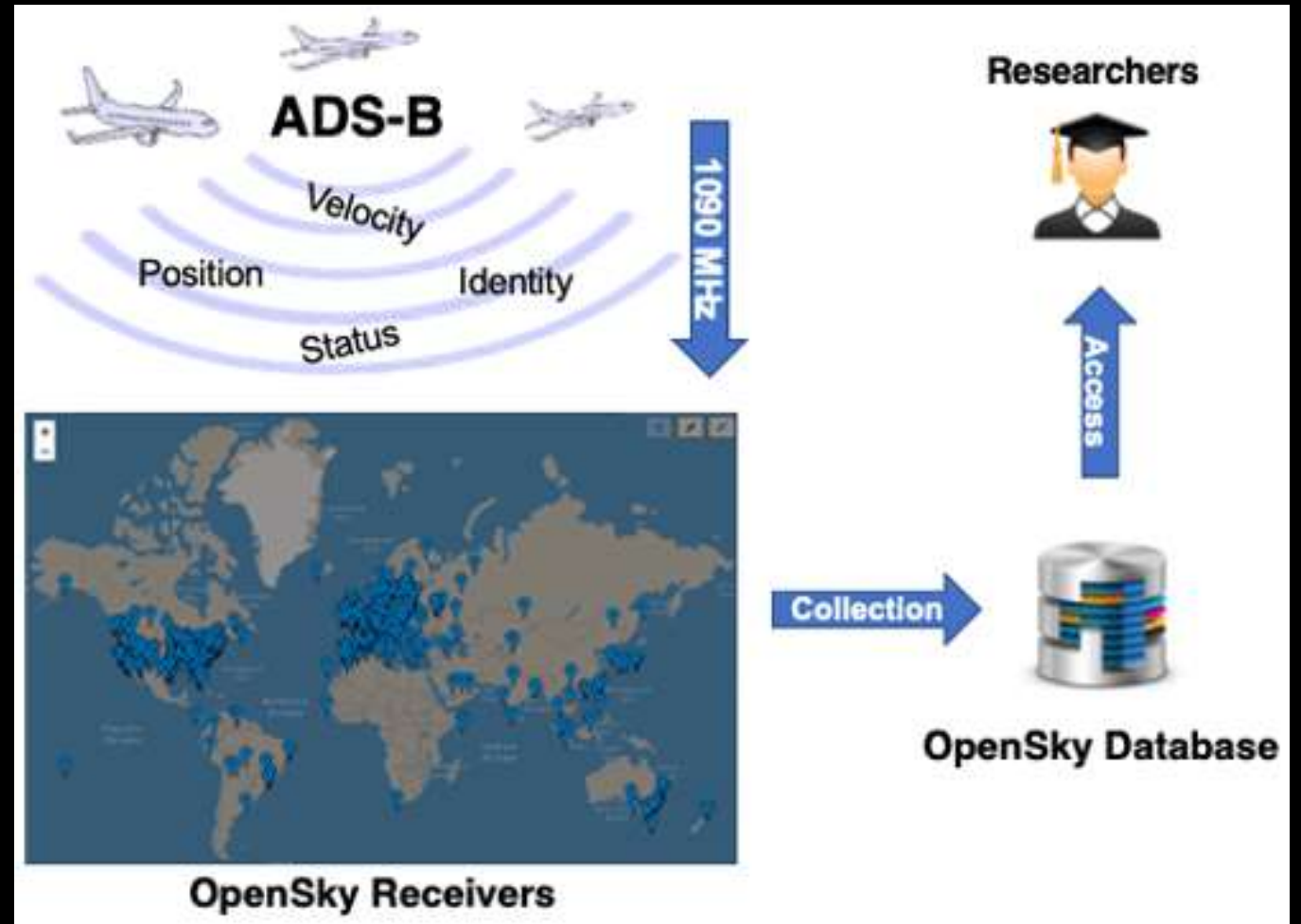
OpenSky Network

- Community-based receiver network that continuously collects and redistributes raw air traffic surveillance data
- Limited live data can be retrieved by using python
- Installing an automatic detection service broadcast (ADS-B) receiver allows for more credits and broader data access
- Live traffic is updated every 10 seconds for non-members or every 5 seconds for members
- Requested and was granted access to previously collected datasets



OpenSky Opportunities

- OpenSky allows researchers to select an area and a time to get a specific dataset
- Some aircraft hosts ModeS transponders which can be useful for turbulence detection and quantification
- Flight path information can be used to determine if aircraft were rerouted, analyzing which aircraft fly through storms, the intensity of those storms, and the limitations and capabilities of these aircraft



Integrating Pilots Requirements

- Incorporating lightning data into familiar tablet displays would allow the pilot to more easily incorporate this new information into their workflow
- Pilots require weather briefings prior to takeoff, the weather briefers can help relay lightning observations and forecasts to pilots
- Pilots must understand their aircraft capabilities, motivating our analysis of aircraft traffic and performance near thunderstorms
- This knowledge can aid pilot judgement by knowing what to expect from the storm



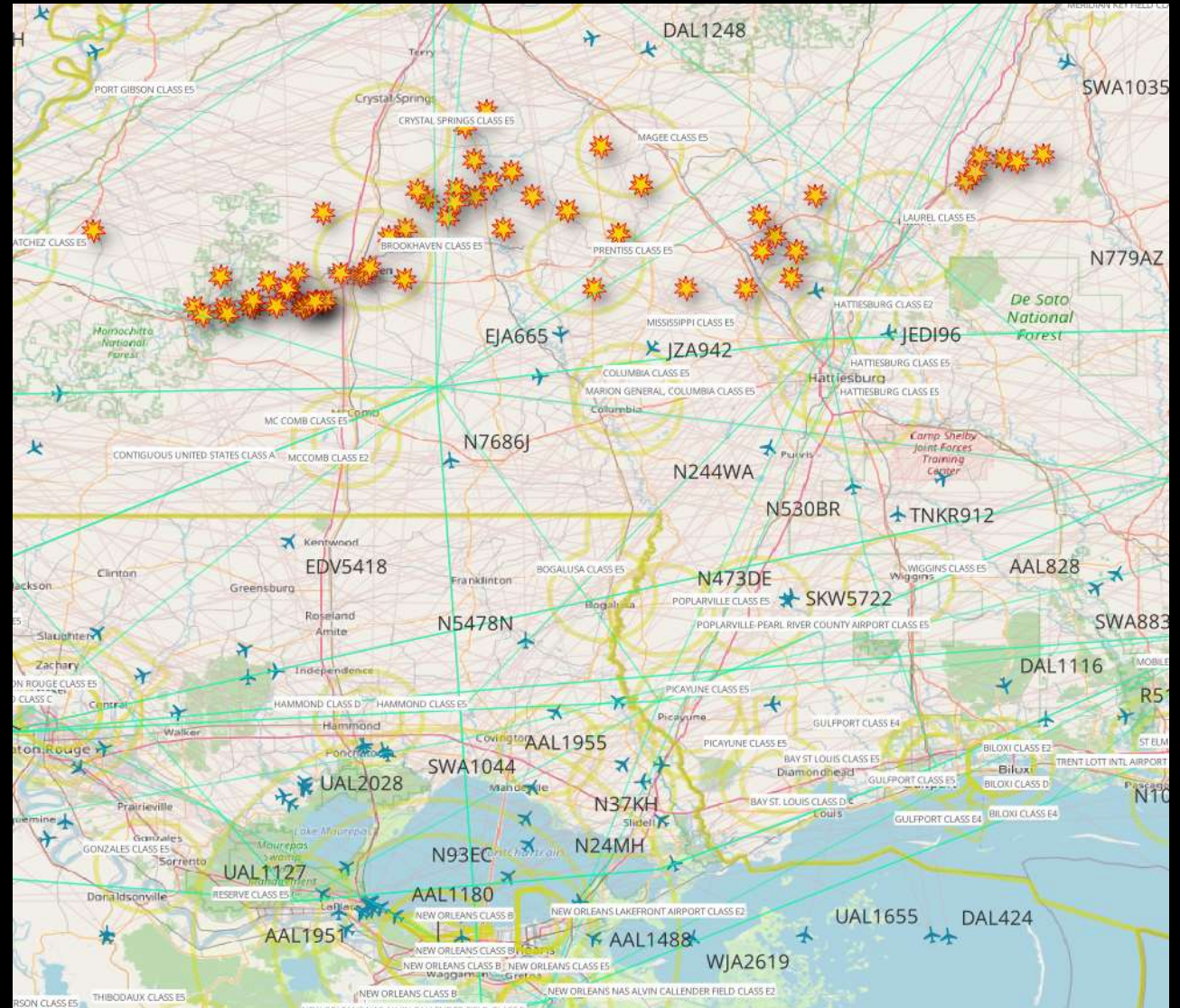
Visualization Components

- Pilot access to tablets provides great opportunities for accessing weather information in flight
- Adding Air Traffic Service routes to aid in rerouting
- Highlight busier airspaces to indicate potential deviation limitations
- Incorporating lightning information to assist pilot decision making
- Planning to integrate GLM data into existing Garmin or Foreflight software



Prototype Display

- Before incorporating the lightning data in an app similar to Garmin or Foreflight, a prototype with limited features can help determine the level of detail to provide
- Ground testing is required prior to displaying lightning data inflight, this will be done by incorporating the information into weather briefings, and by conducting flight simulator demonstrations
- The prototype will allow researchers to study aircraft interactions with storms of many different intensity levels



Summary and Future Work

- Training pilots, air traffic controllers, and ground workers to integrate GLM information can increase aviation safety and efficiency
- Incorporating the information into familiar tools will reduce the chances of being overwhelmed and allow for an easier transition
- Lightning data can be used to better understand the limitations and capabilities of both the aircraft and pilots



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