Climatologies of Upper-Level Turbulence over the Continental U.S. and Oceans

Robert Sharman, Jamie Wolff, Tressa Fowler, and Barbara Brown

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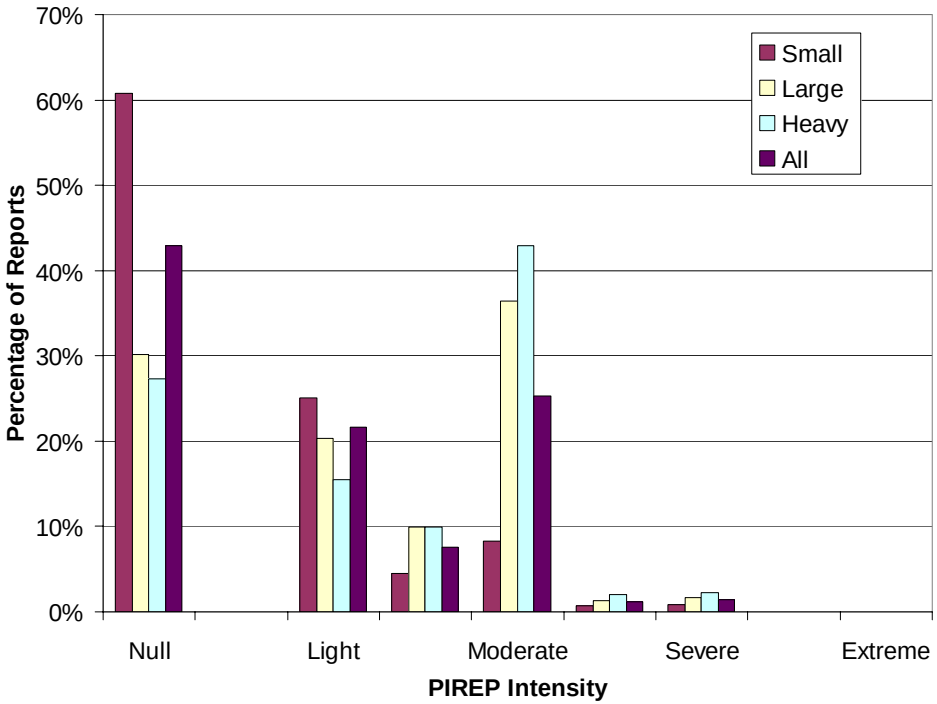
Turbulence climatologies based on pilot reports (PIREPs)

- Pilot reports of turbulence (or smooth) are recorded in NWS's Family of Services communication gateway
- PIREPs have been archived since March 1992 => 2,044,566, >20,000 ft => 551,445
- Used to develop distributions of turbulence
  - By Altitude
  - Temporally (hour,day, year)
  - Geographically (over CONUS, oceans)

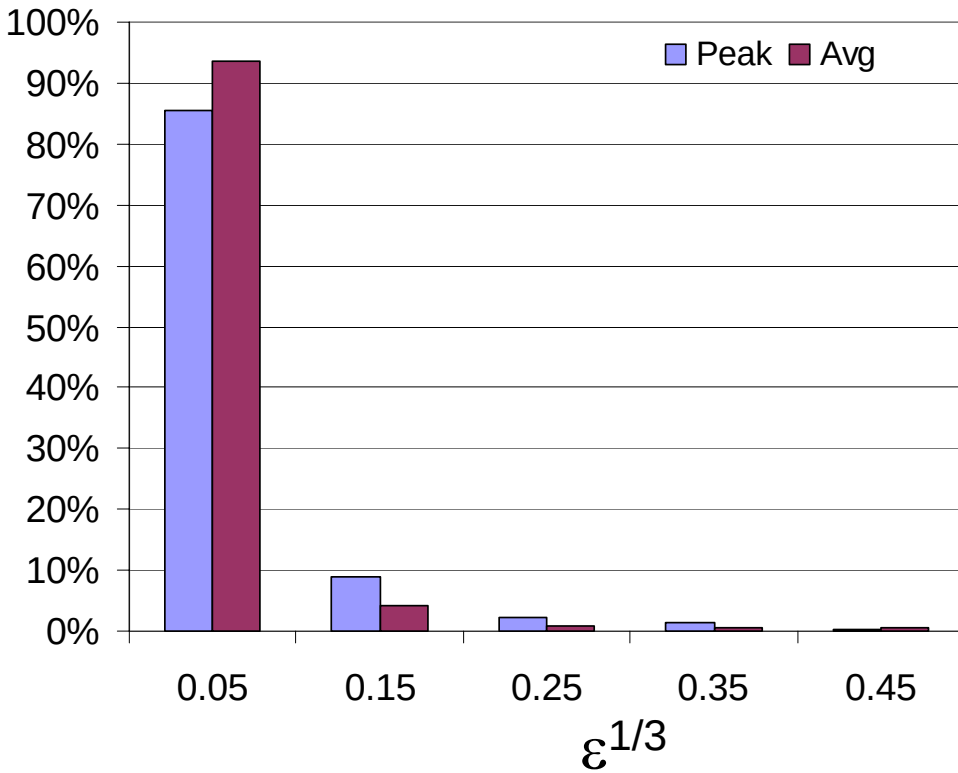
Distribution by PIREP intensities

PIREPs

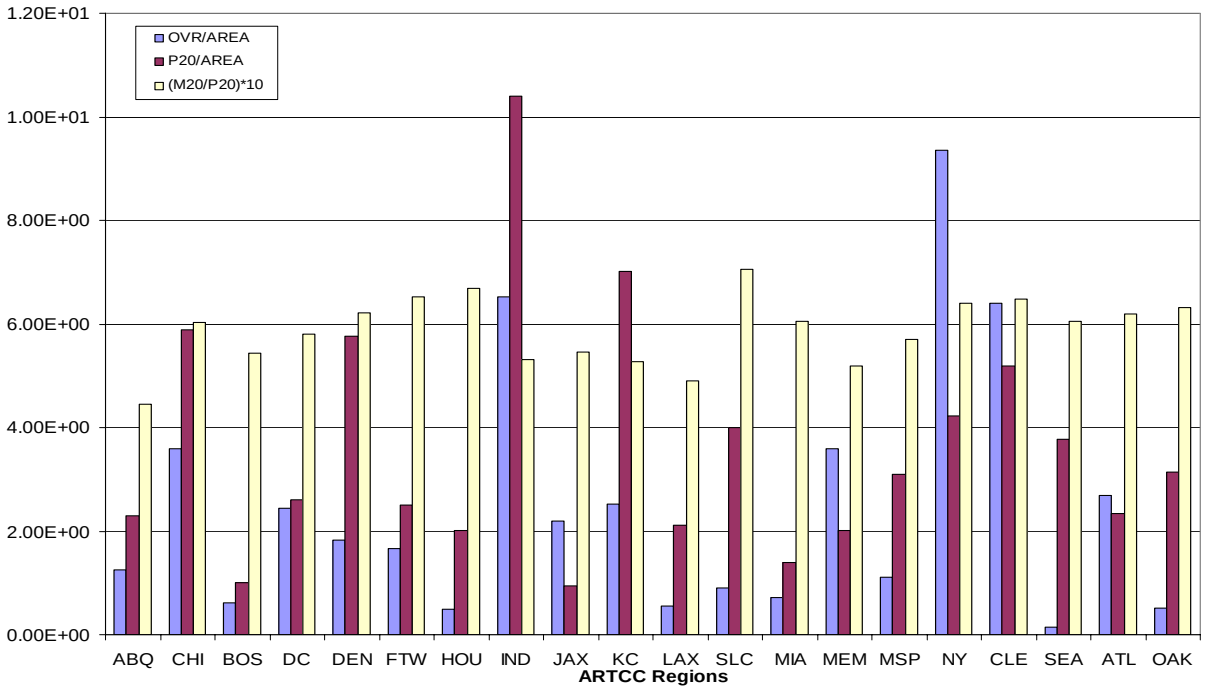


Small <41,000 lbs max, Heavy>255,000 lbs max

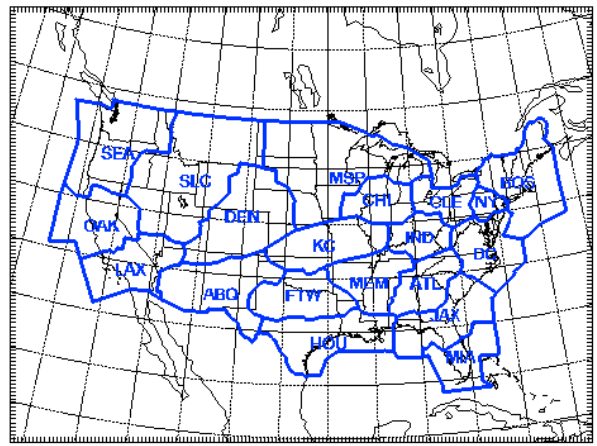
In-situ



MOG/TOTAL PIREPs ratio eliminates most air traffic biases

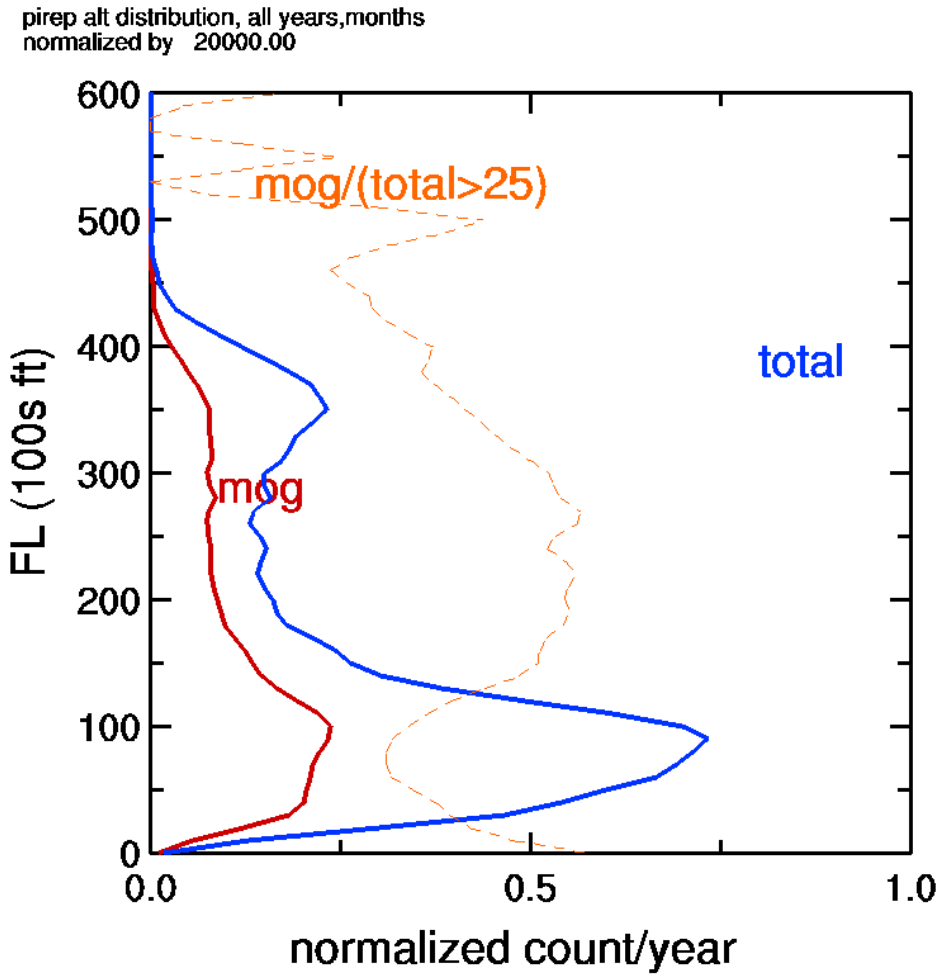


Commercial air traffic overflight density (blue), pirep density (red), and mog/total pirep ratio for each ARTCC region.

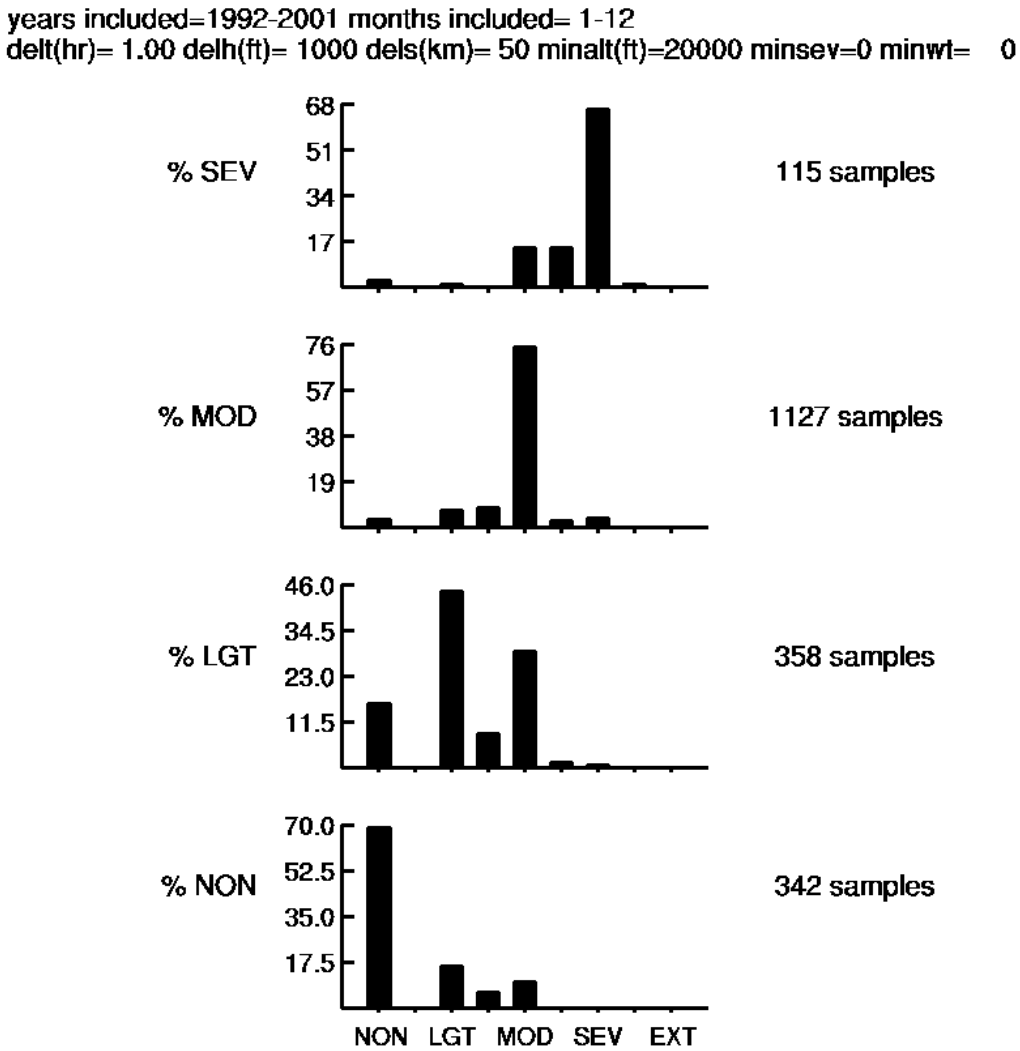


Areal plot of ARTCC regions used in assessing air traffic patterns.

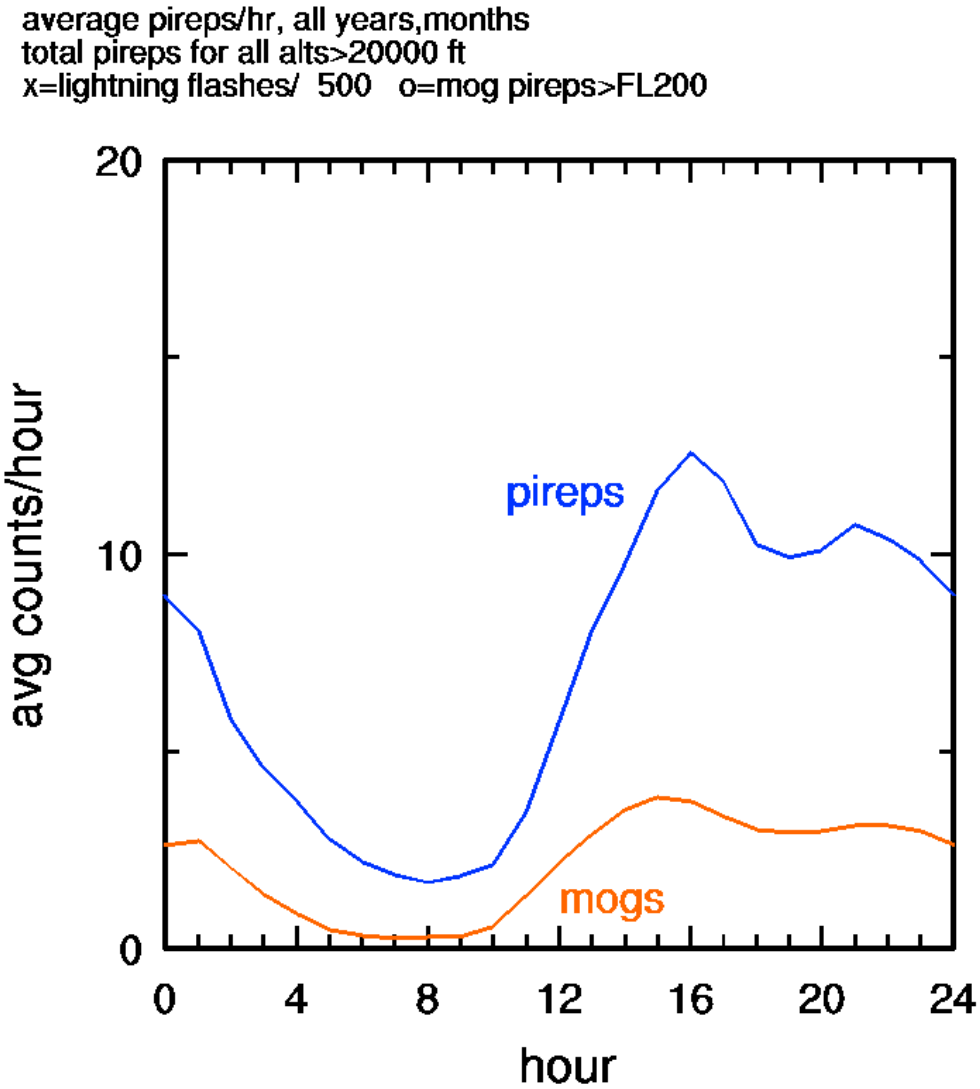
Distribution of PIREP intensities by altitude



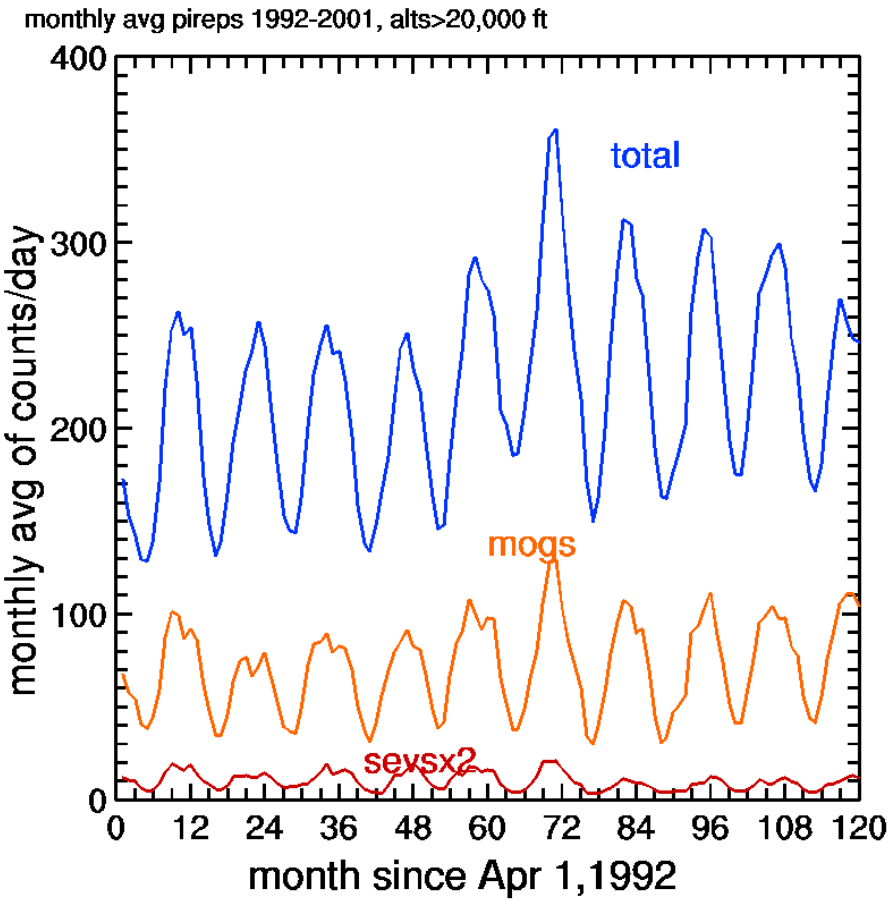
PIREP consistencies

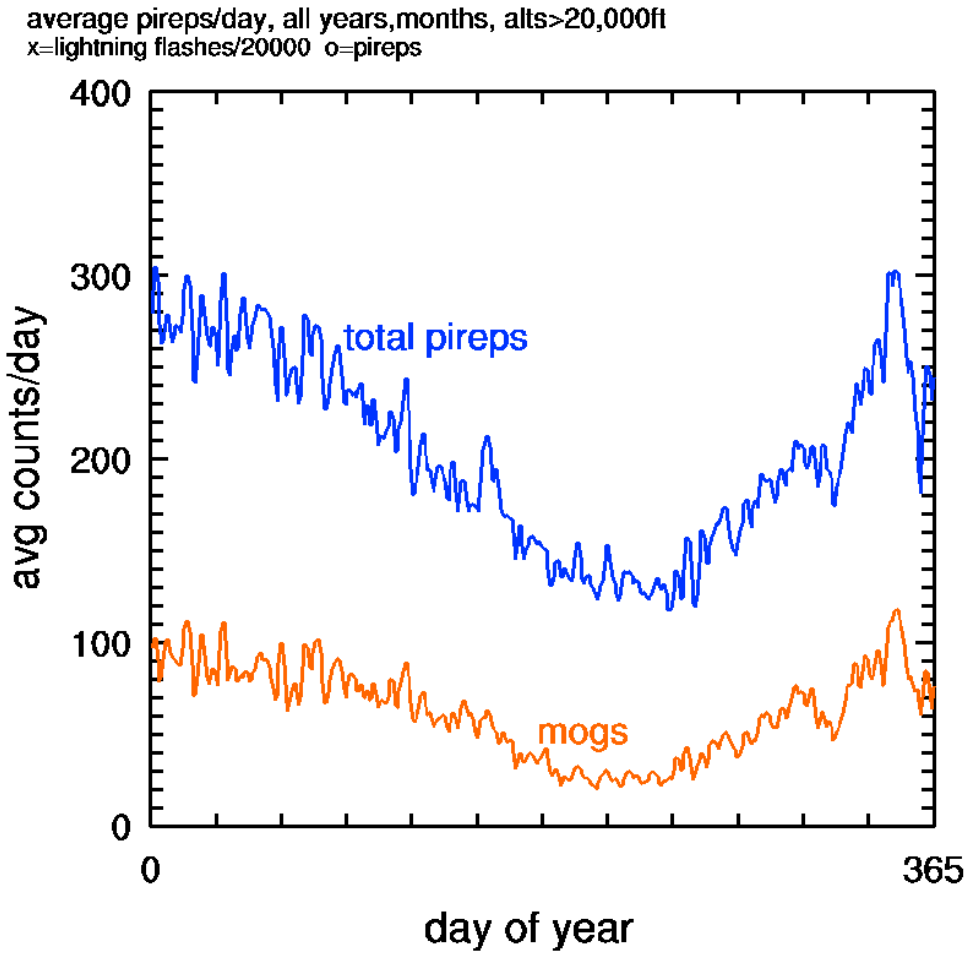


Distribution with time of day



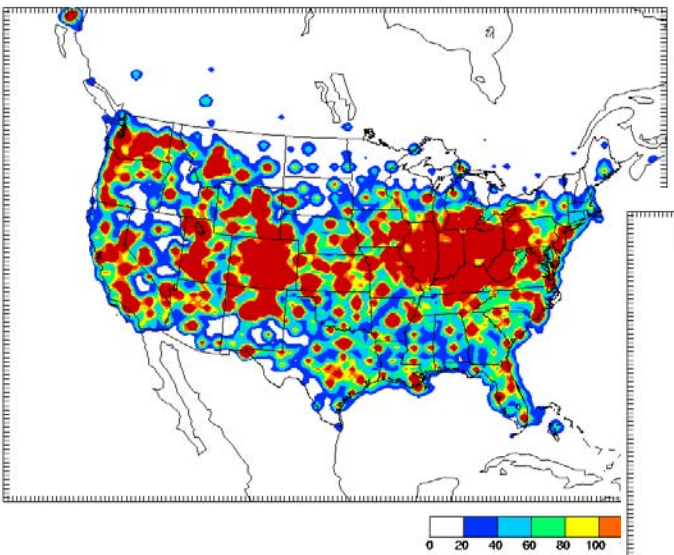
PIREP counts with time of year



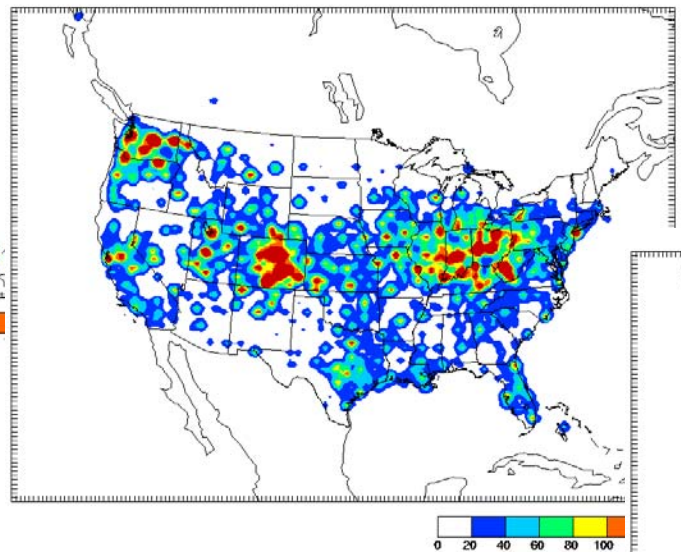


Annual geographic distribution

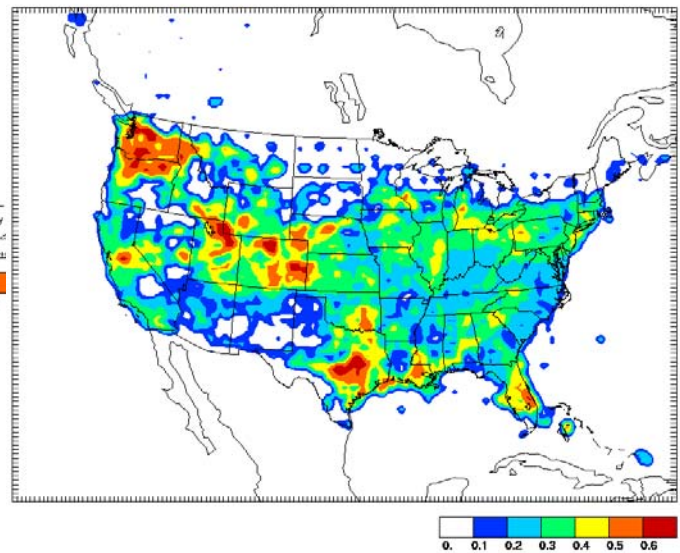
total



MOGs

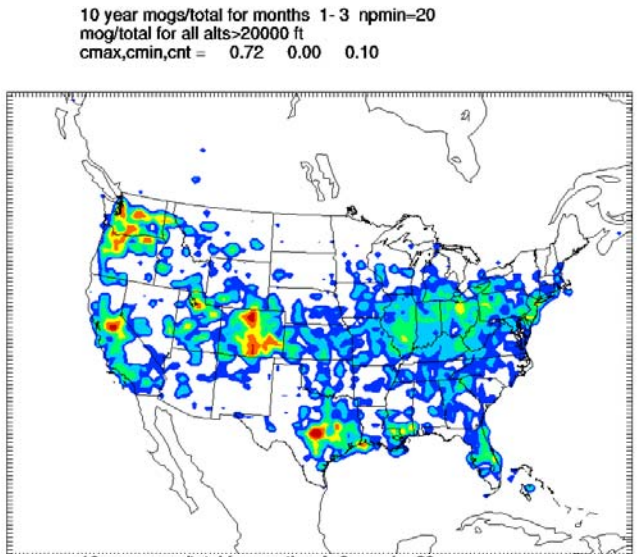


MOGs/total

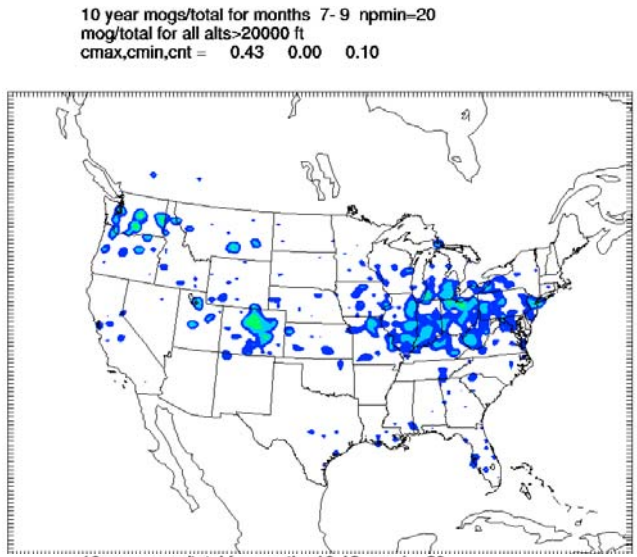


Seasonal distribution of mog/totals

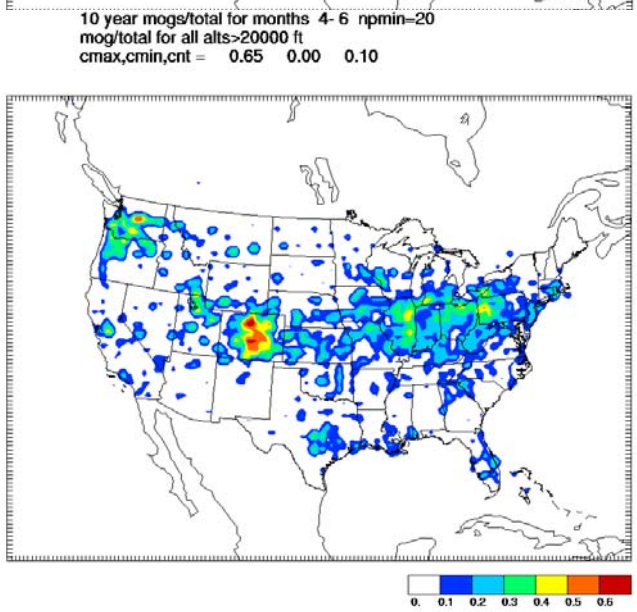
Jan-Mar



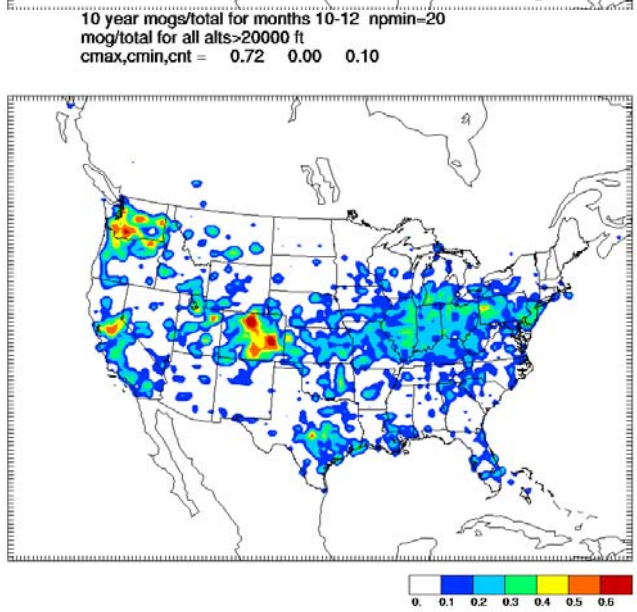
Jul-Sep



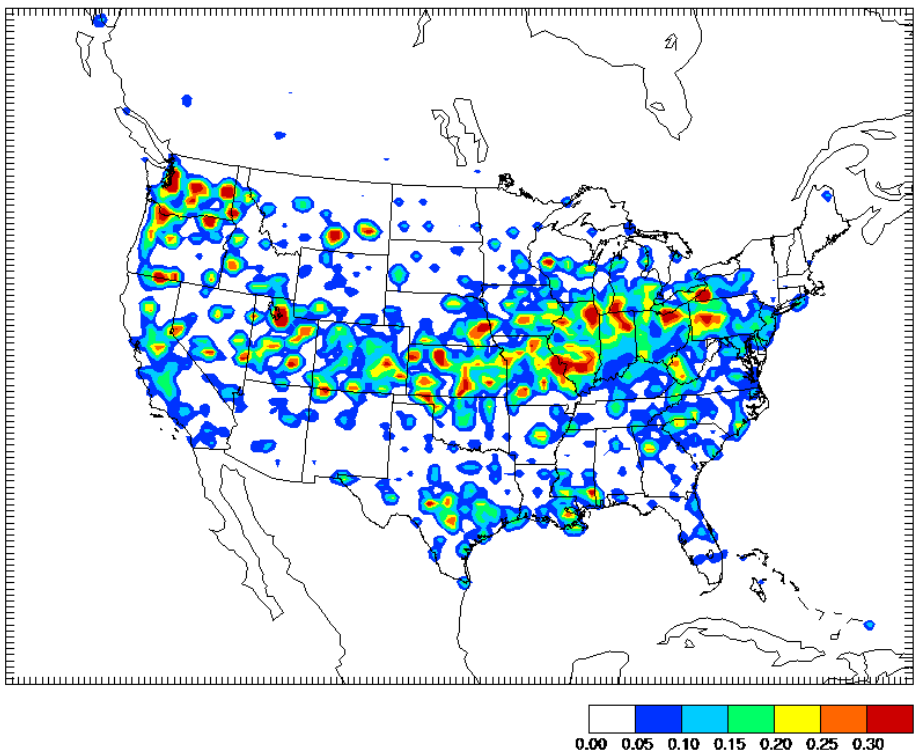
Apr-Jun



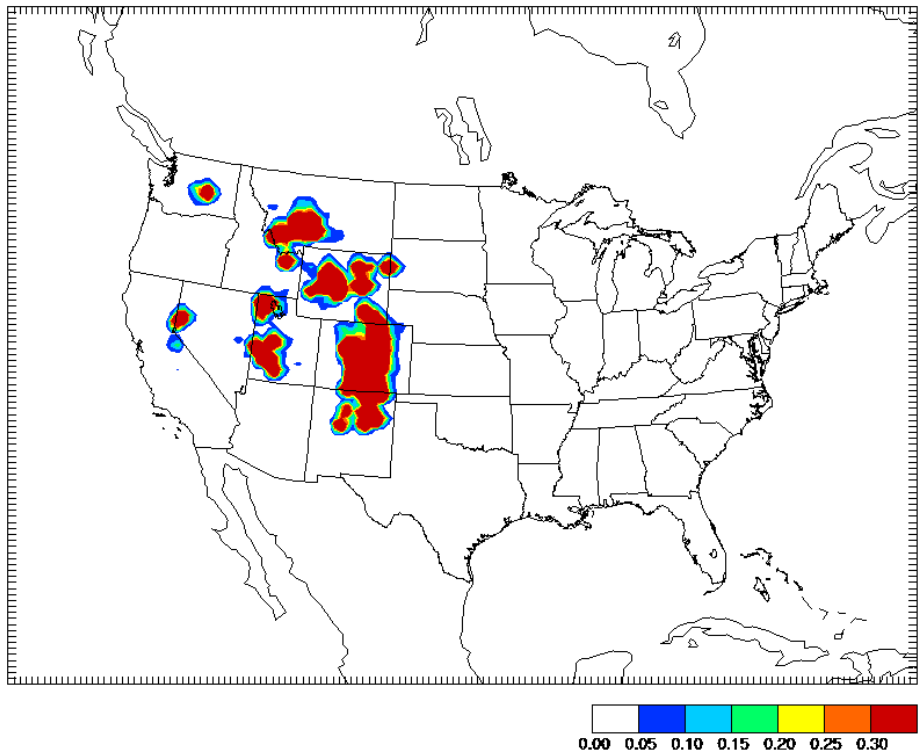
Oct-Dec



CAT, mountain wave PIREPs

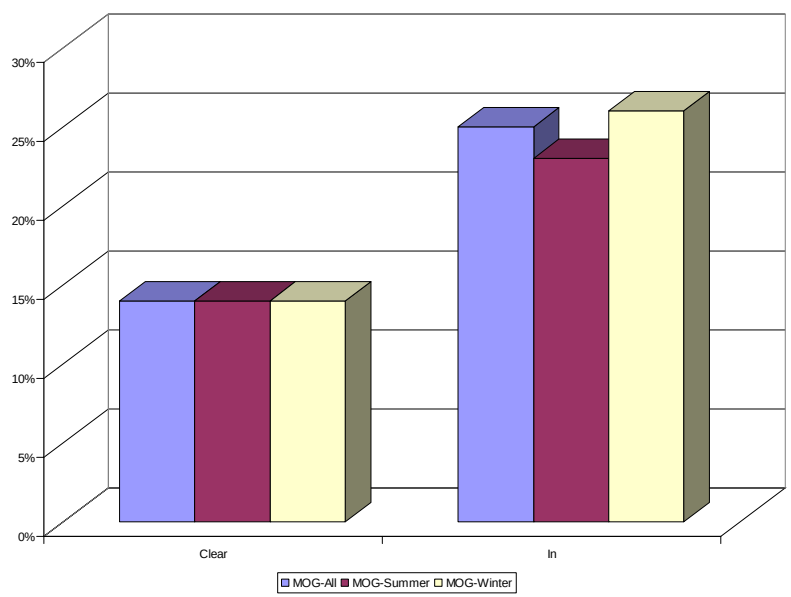


“CAT”

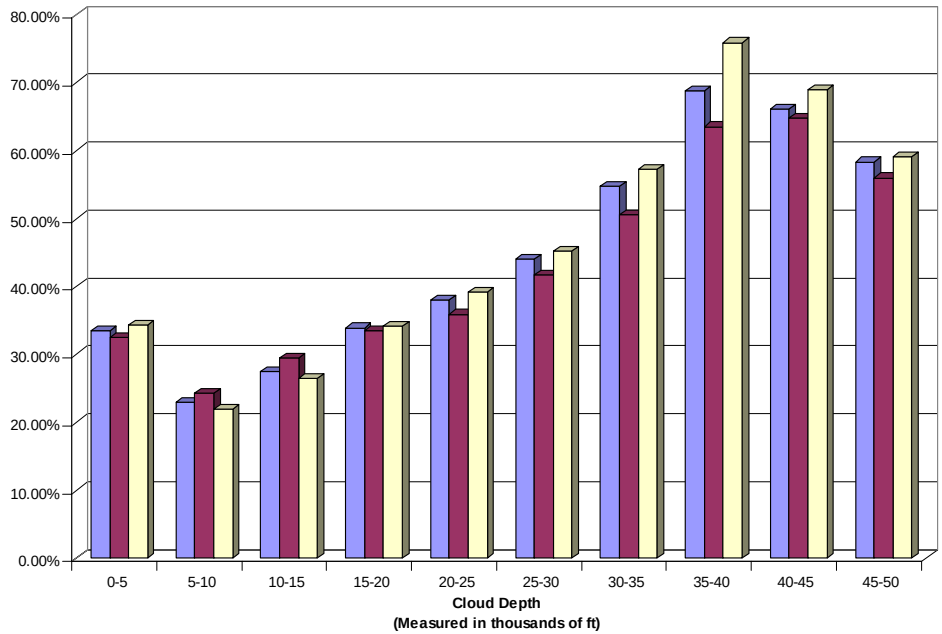


“MWT”

Relation to clouds*



Percentage of MOG PIREPs in/out cloud



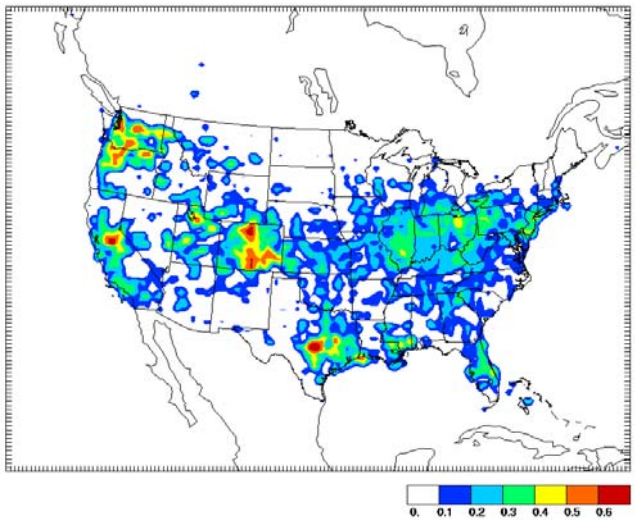
Percentage of MOG PIREPs as a function of cloud depth

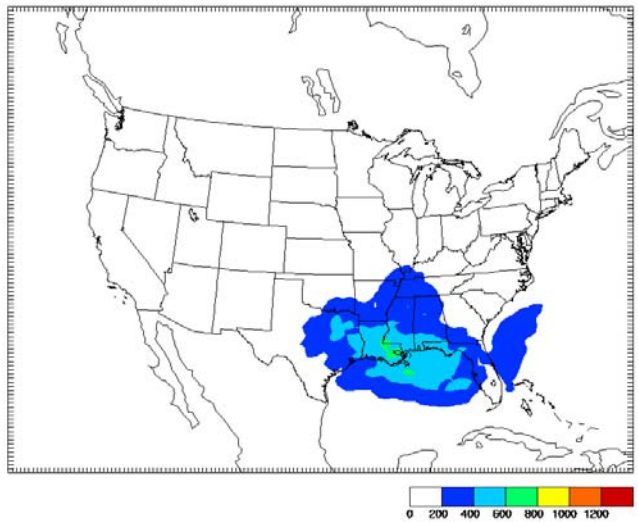
*J. Wolff, R. Sharman, B. Bernstein, “Climatology study of aircraft turbulence versus cloud cover,” JP1.18

Relation to lightning

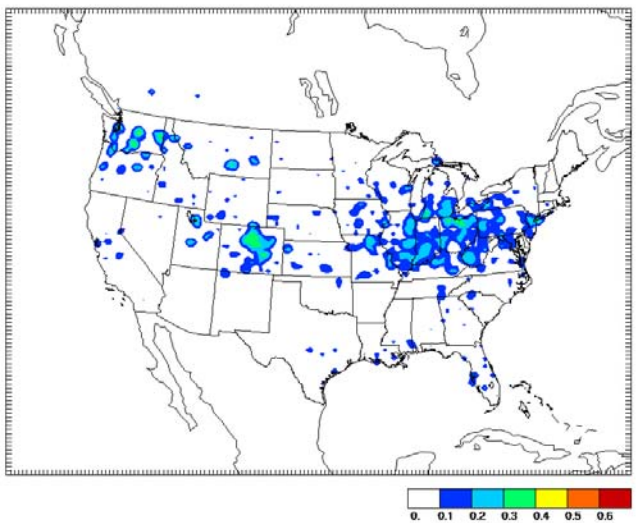
MOG/TOTAL PIREPs

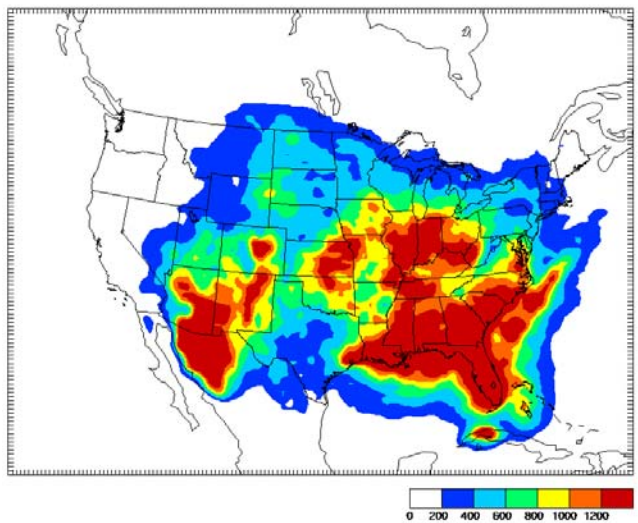
C-G lightning flash densities





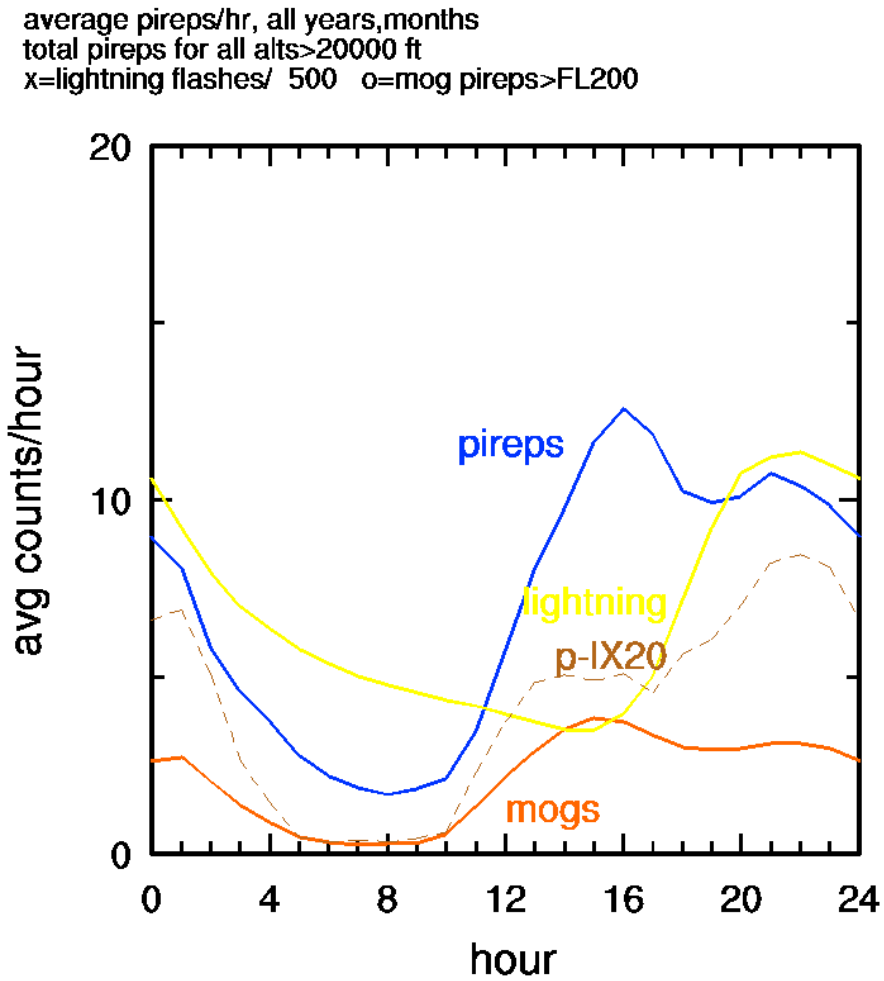
Jan-Mar

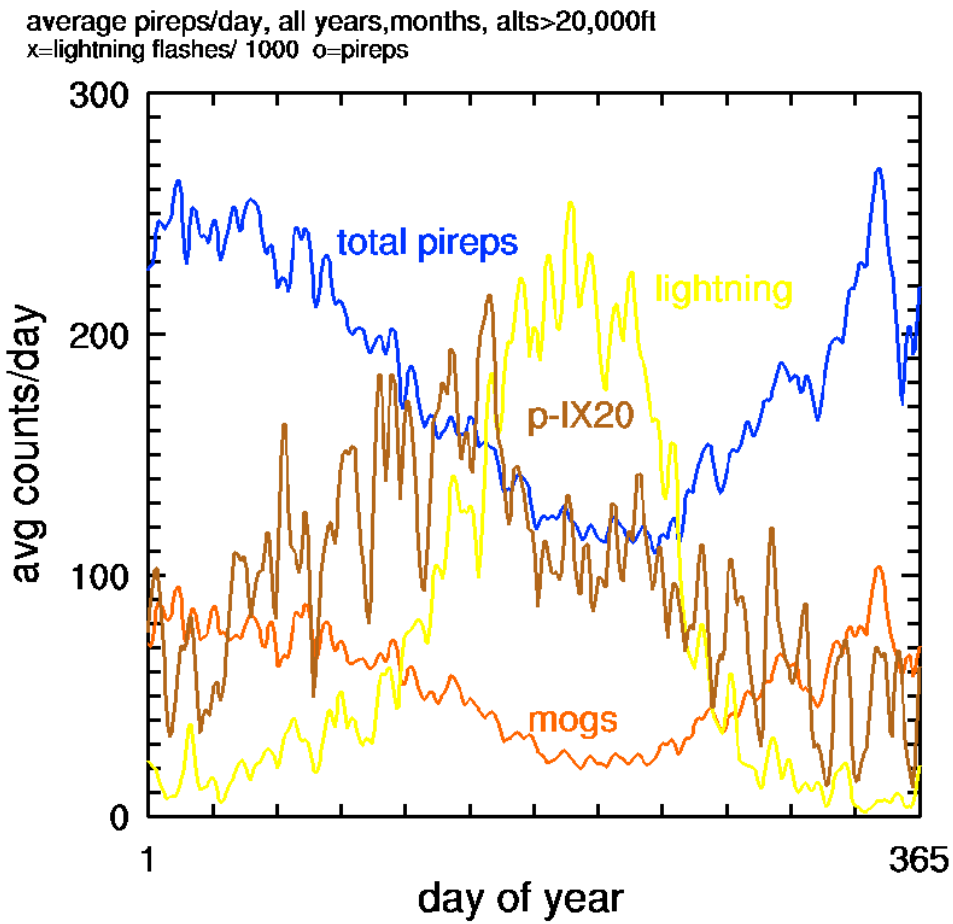




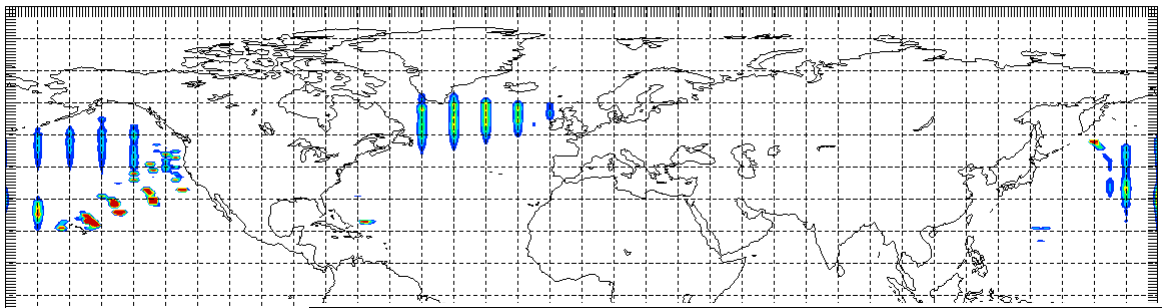
Jul-Sep

Relation to lightning (cont.)

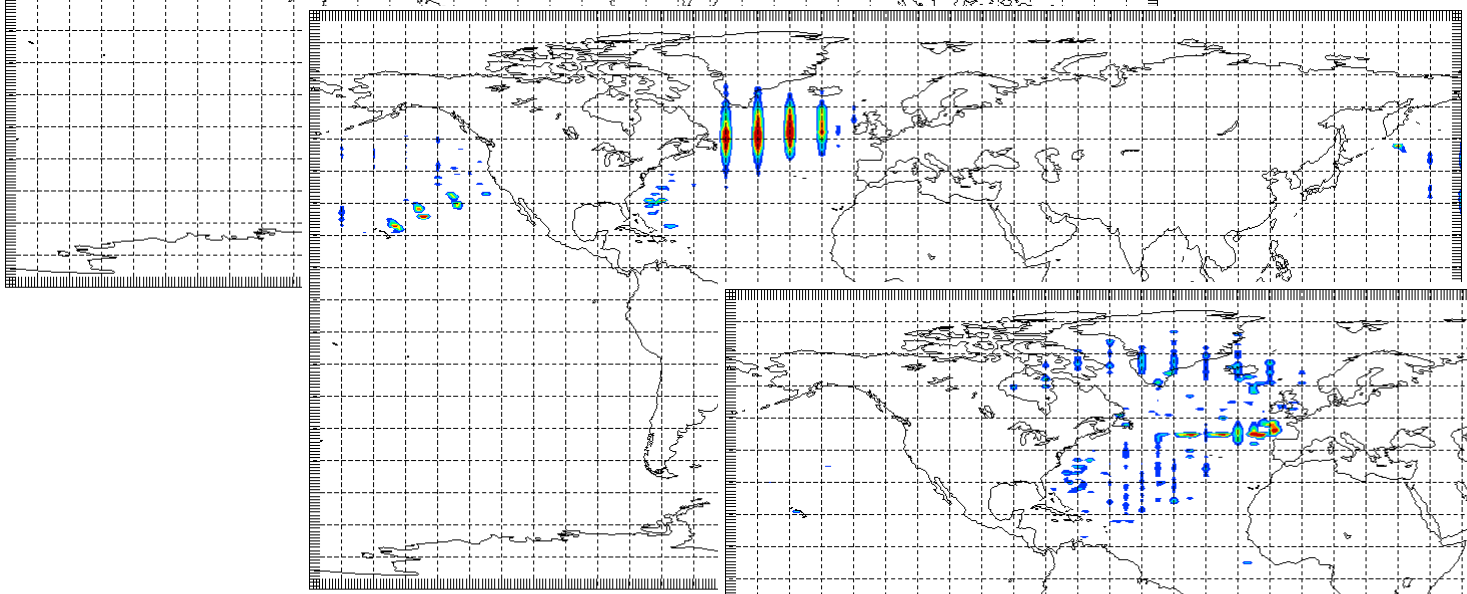




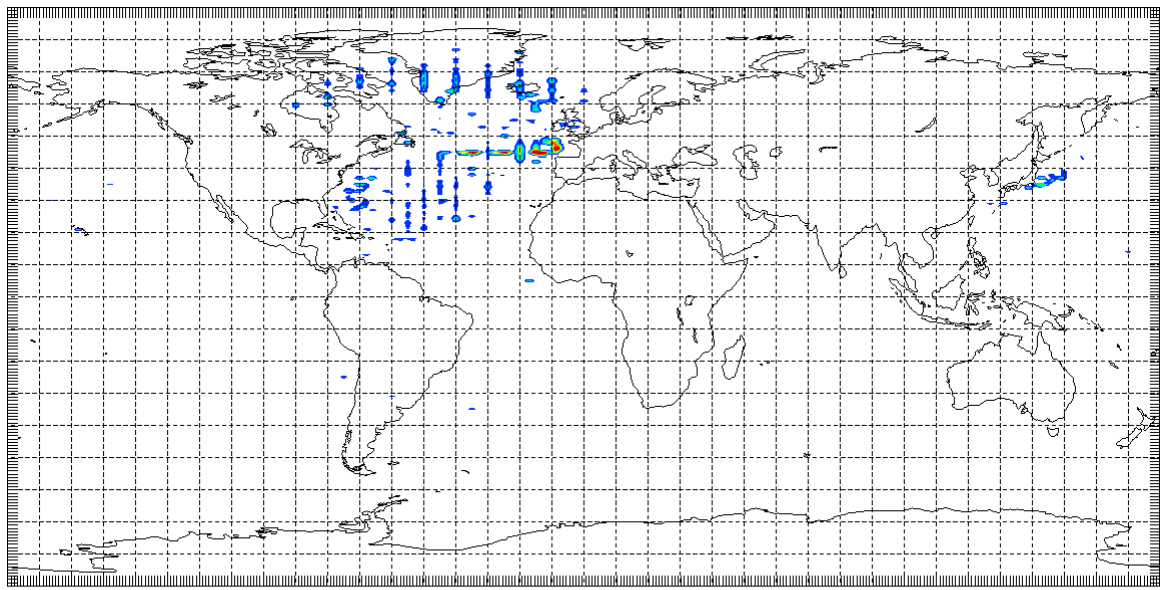
PIREPs over the oceans



total



MOGs



<u>MOGs</u>
total

Conclusions

- PIREP reported intensities are not representative of the true extent of turbulence
- PIREP reported intensities are consistent
- PIREP intensities are fairly uniform with altitude
- MOG/TOTAL PIREPs eliminates most regional air traffic biases
- Turbulence > 20,000 ft incidence is greater in winter
- Most turbulence > 20,000 ft is over western Most turbulence is associated with cloud
- Little turbulence > 20,000 ft is related to convective cloud (lightning)