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ABOUT THE RELATIONSHIP BETWEEN THUNDERSTORM GROWTH AND THE INTRACLOUD TURBULENCE CHARACTERISTICS

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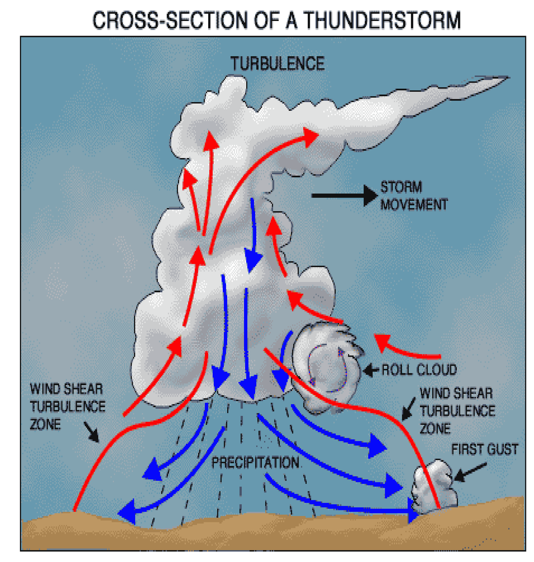


INTRODUCTION

In the resent decades a lot investigations were done in order to increase understanding of thundercloud turbulence in relation to its growth and to the precise forecasting in favor to the planning of safe flight operations in a stormy atmosphere. But it still presents some open questions about the problem.

The most of Storm Hazards Programs are focused on three factors relative to aircraft lightning strikes: electrical activity and aircraft initiated (“triggered”) lightning, altitude and ambient temperature effects, and turbulence and precipitation effects.

The lightning strikes rarely occurred in the heaviest turbulence and precipitation, and occasionally there was no lightning activity whatsoever. Most lightning strikes (approximately 80 percent) occurred in thunderstorm regions in which the crews characterized the turbulence and precipitation as negligible or light. During penetration of thunderstorms at low levels, lightning strikes were found to occur in areas of moderate or greater turbulence at the edge of and within large downdrafts. Conversely, lightning strikes experienced in the upper areas of thunderstorms and in the vicinity of decaying thunderstorms most frequently occurred under conditions of little turbulence or precipitation.

By the other side the thunderstorm growth depends on the tropopause characteristics. It influences on the turbulence inside the thunderclouds. The investigations of these interrelationships could of use to further climate predictions.

BACKGROUND

Shear-convective turbulence is studied (Tse,K.L , 2004.); using a high resolution 3D direct numerical simulation (DNS).

Limited samples of the turbulence structure in the tropopause suggest that conventional models for atmospheric turbulence may not apply through this portion of the atmosphere(Otten L.J., 2000).

Many parameters predicting thunderstorm activity have been published in the literature (e.g. Huntrieser, 1997).The results from a recenly made study(Kolev S., Tsenova B., 2007) for the behavior of the upper atmosphere parameters, above Bulgaria , has showed that the tropopause region over the country is of inportant consideration for thunderstorm growth. Te last is in a relationship with turbulence parameters inside.

Low temperatures imply the importance of condensed matter (liquid and solid clouds and aerosols) in this region, and therefore of heterogeneous and multiphase chemical reactions, as well as associated radiative effects. Finally, the tropopause temperature may control the amount of stratospheric water vapor through the freeze drying mechanism. These factors all make the tropopause region particularly crucial for such kind of studies.

The turbulence is basically a stream of air in irregular motion that normally cannot be seen and often occurs unexpectedly. It can be created by a number of different conditions. The most common encounter is flying in the vicinity of thunderstorm.

Turbulence, associated with thunderstorms, can be extremely hazardous, having the potential to cause overstressing of the aircraft or loss of control.

The thunderstorm vertical currents may be strong enough to displace an aircraft up or down vertically as much as 0.6 to 1.8 km.

The greatest turbulence occurs in the vicinity of adjacent rising and descending drafts. Maximum turbulence usually occurs near the mid-level of the storm, between 3.6 to 6 km and is most severe in clouds of the greatest vertical development.

Turbulence is important because it mixes and churns the atmosphere and causes water vapor, other substances, as well as energy, to become distributed both vertically and horizontally. In the upper part of violent thunderstorms, vertical accelerations of about three “g” have been reported.

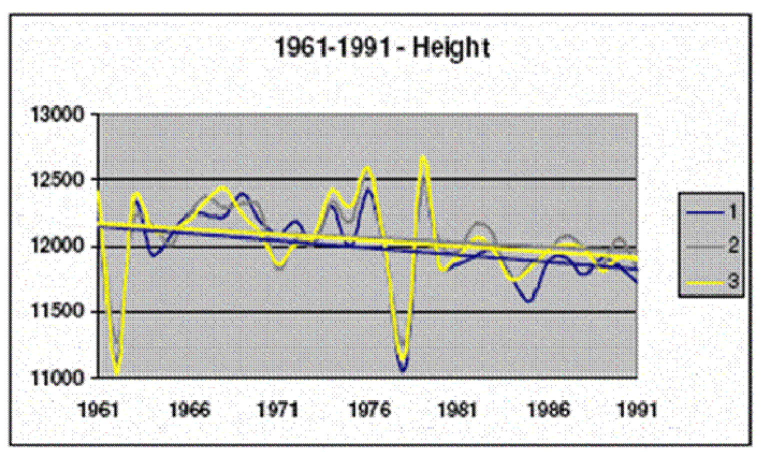
The objective of the lightning electromagnetic research was to determine the electrical parameters of the intracloud lightning environment for aircraft. The finding of these research was that lightning strikes to aircraft actually include multiple bursts of current pulses that are significantly shorter in time duration but more numerous than previously believed. The bursts are also more numerous than the more well-known strikes that occur in cloud to Earth flashes (that aircraft are also required to tolerate). This finding proved particularly important from the standpoint of devising protection of digital computers and other avionic systems against upsets which might occur in response to bursts of pulses that could be caused by lightning on new airframes and control systems.

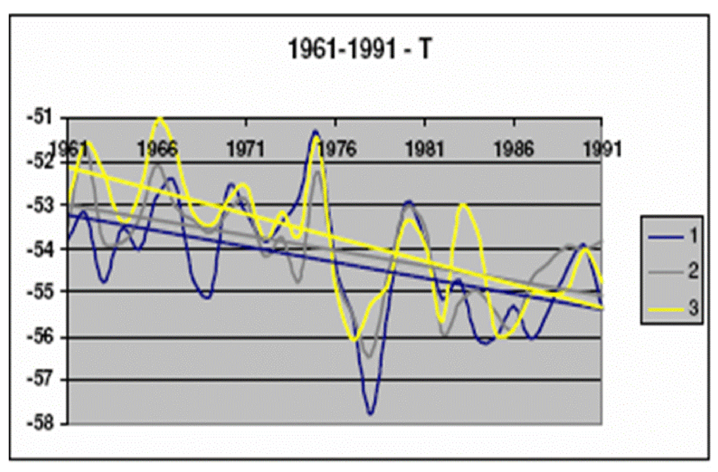
Radio noise emission from clouds had obtained by Katchurin L.G. (1991). When the electrification in a cloud builds up, faint bursts of radio energy are emitted in the VHF and UHF regions.. The characteristics of this radio noise and the distribution of its sources with the clouds have remained obscure. A portion of this radio noise might not be directly associated with overt lightning flashes, but might even precede the flashes by times long enough to be of interest for certain lightning warning applications.

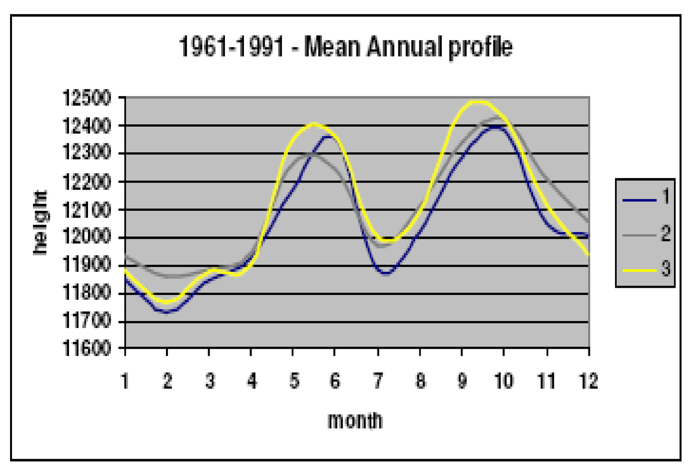
Furthermore, if this radio noise originates in small scale electrical discharges, it might well consist of a series of very short individual impulses, in which case its delectability could be enhanced by wide frequency-bandwidth signal processing.

RESULTS

The close coupling between lightning activity and storm updrafts and ice content implies that increases in lightning activity should be observed prior to severe weather, as many events such as damaging winds, tornadoes and hail are direct by-products of extreme updrafts and turbulence. The tropopause characteristics have been investigated over the Bulgaria region considering 30 years period in order to be revealed their role for the turbulence tendencies in the future thunderstorms predictions on the base of the climate change scenarios .

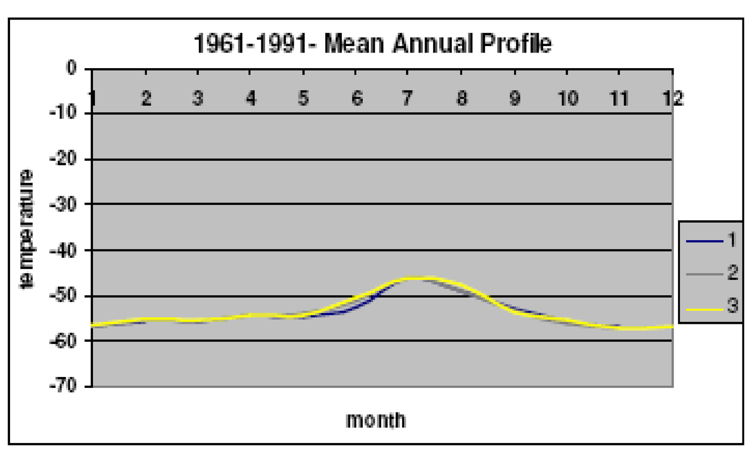


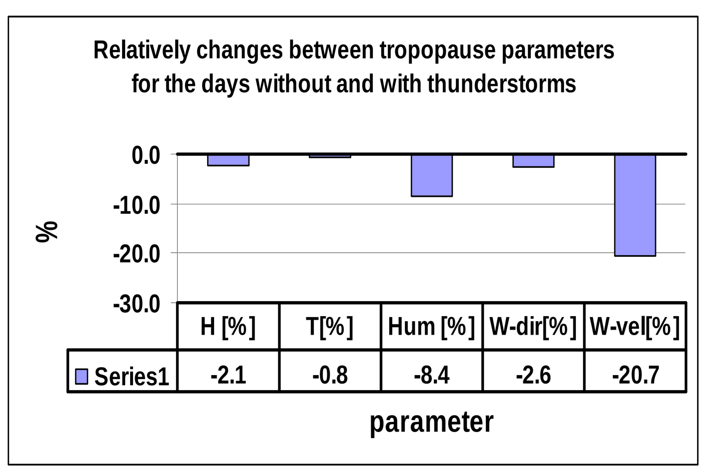




Lightning jumps associated with a variety of severe weather events were observed in Florida by Williams et al. [1999] and in Alabama Goodman, S. J. et al., 2003 .

MacGorman et al. [1991] have hypothesized that stronger updrafts will loft the main storm electric dipole to higher levels in a storm-leading to increases in total lightning rate. It allows to be proposed a method to calculated the radio noise from the motions of the “charged” domains, which to determine the level of turbulence. Intracloud lightning dominates as the updraft intensifies, which in turn stretches vorticity and increases angular momentum





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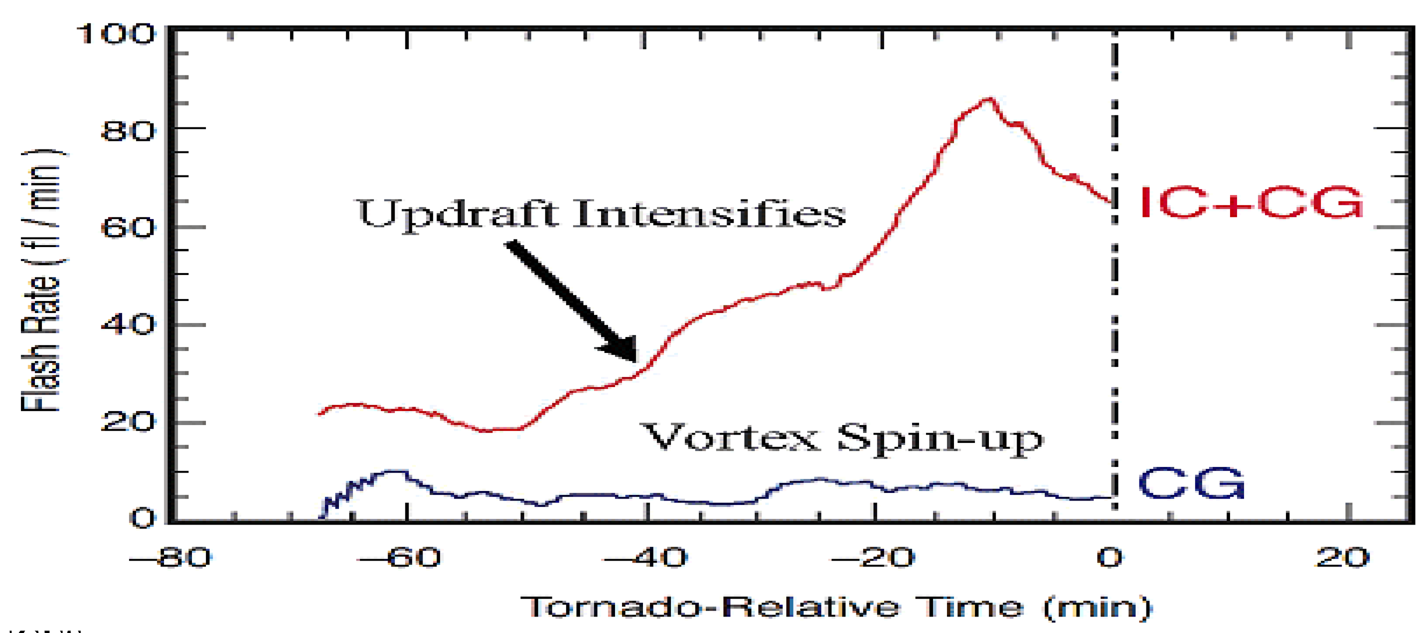

CONCLUSIONS

In can be summarized that the tropopause increases in height during the “transitional” seasons (spring and autumn) and decreases in height during the summer and the winter. As well they exhibit pronounced trends .The obtained results demonstrate relationships between the thunderstorm occurrences and the tropopause parameters , and it has to be appropriate to be utilized as a preliminary indication applicable to model simulation in climate change studies including and the turbulence.

The changes in the tropopause parameters between the days without thunderstorms and the days with thunderstorms (the time before the lightning activity) had been derived . The primary results show that the tropopause parameters in the days with thunderstorms (the time before the storms) exhibit a negatively changes .

Global atmospheric radio noise levels are calculated on the basis of global maps of thunderstorm activity derived from Ionosphere Sounding Satellite-b observations. Global distribution maps are presented for 2.5, 5.0, 10.0, and 20.0 Hz atmospheric radio noise frequencies, in Universal Time

As well the electromagnetic emissions are detected on the board of low orbiting satellites as a consequence of thunderstorm activity. The level of electromagnetic radio noises observed on satellite board strongly depends on properties of satellite environment and noises generated by payload system, as well as geophysical conditions. Most of these disturbances were observed at lower frequencies and only a few were correlated with the disturbances of HF electromagnetic emissions with a significant increase in emission intensity over some geographic areas.

Taking into account these differences and using a simple analytical model for temporal spectrum of the of the radio noise , depending from turbulence it could to be reproduced the order of magnitudes the temporal spectrum of the observed turbulence during the process ot the thunderstorm growth

The approach could be a complementary tool to the radar-measured turbulence, classified into ranges of light, moderate, and severe turbulence. From a time history of radar echoes, it was found that the 30 dBZ echo detected at the -15 deg C temperature height is the best indicator of the beginning of CG lightning activity. The observed median lag time between this lightning initiation signature and the beginning of CG lightning flashes was 15.5 minutes. In particular, it is the best appropriate time interval for experimental measuring of the turbulence related the thundercloud radio noise.

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