THUNDERSTORM - AVOIDANCE

In the following work a new approach to understanding some hidden facts about the Turbulence associated with CB & Cumulus clouds and methods to avoid it so as to promote comfortable flights have been explained in a scientific & more practical manner. There have been incidents where a/c have been subjected to undesirable severe turbulence during circumnavigation in-spite of having modern airborne Weather Radar. My theory is based upon experience-oriented exercise with a back up of nature, science and simple logic.

THE INVISIBLE TURBULENCE IN VICINITY OF CB / CUMULUS CELL

CB is well known for its turbulent characteristics and is easily identified by its towering appearance with an anvil on top during the day and by its associated lightning during night. The modern airborne radar can identify the CBs & other large cumulus cells and display it on the screen to help pilots circumnavigate the turbulent areas. No pilot likes to fly through turbulence but such undesirable incidents only happen during the detour course. So the solution to the problems associated with turbulence is ***how to select the deviation / detour course ?***

1. *STRUCTURE OF A CB / CUMULUS CELL (large)* ***:***

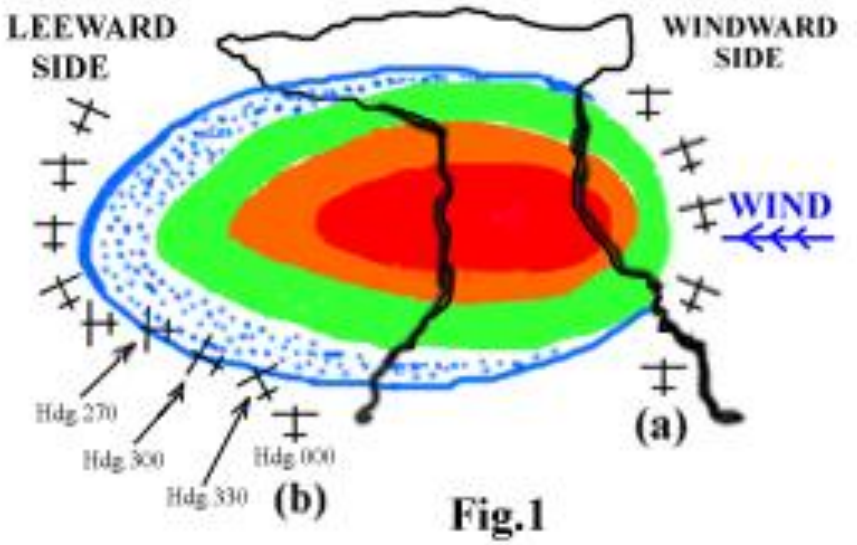


Fig.1

The CB cell's frontal view as seen by a pilot approaching the cell has been sketched with a dark outline of the cell.

An enlarged cross-sectional plan-view of its associated turbulent regions within and around the CB cell has been superimposed upon the sketch of the CB.

2. TURBULENT LEVELS ASSOCIATED WITH CB / CUMULUS CELLS :

(i) The innermost **red** area contains the most severe to moderate turbulence.

(ii) The **amber** portion around the red contains turbulence up to moderate levels.

(iii) The **green** lobe/area of low turbulence level is safe and navigable by a/c but there exists a probability for this area to be associated with turbulence, at times.

(iv) The outer-most 'HIDDEN' layer/area outlined by a **blue-dotted** lobe/area is the envelope that surrounds the green zone, as shown. This area contains less or no moisture hence it always remains undetected by the airborne weather radar.

The Wx.Radar detection capability is based upon the reflection of its transmitted energy caused by a reflecting media such as moisture, rain, water or hail so as to create an image on the radar screen whereas CAT in close proximity to the CB/Cumulus cell remains undetected by the radar due to lack of a reflecting media.

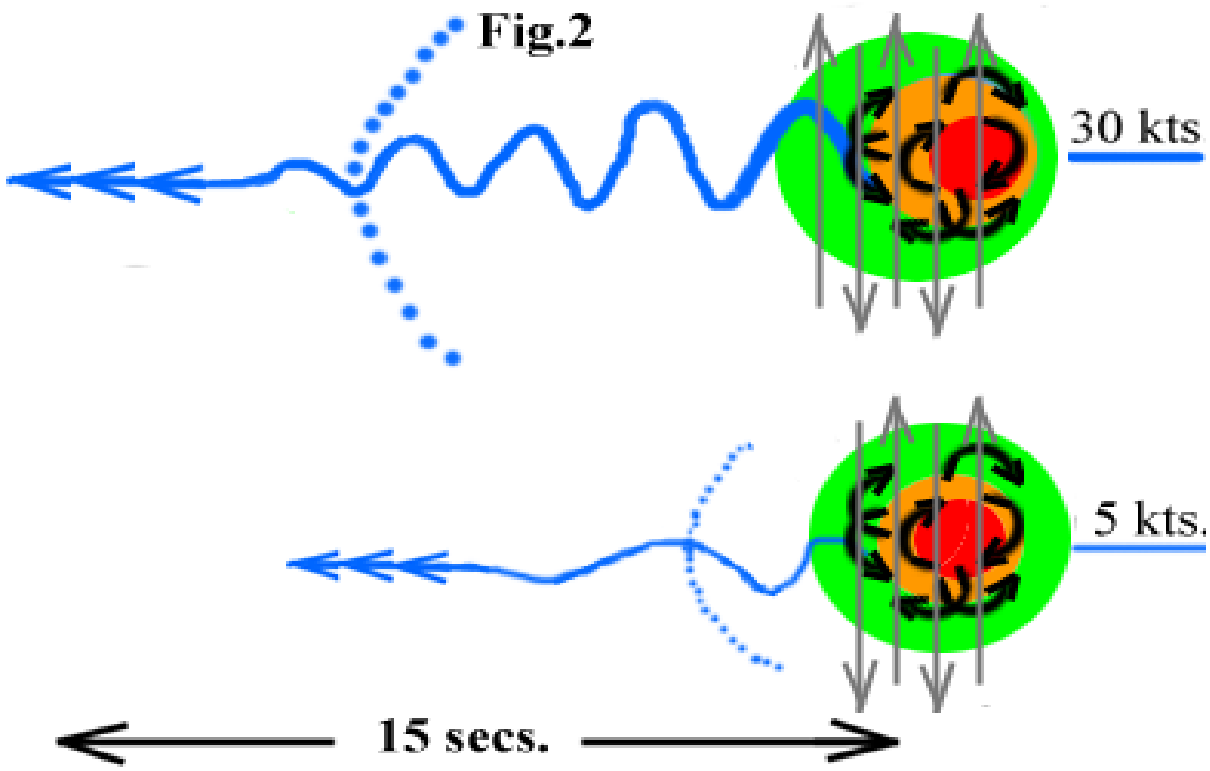
3. EFFECT OF WIND UPON TURBULENCE

The prevailing winds around a cell contributes towards the shape and extent of the area covered by the turbulence around the cell:

(i) **With little or nil winds,** all the activity of the turbulence associated with the cell remains confined within the red, amber & green area / lobes which adopts a more or less rugged / irregular circular or oblong shape embracing the cell without the presence of the fourth blue-dotted area/lobe.

(ii) With winds flowing at about 20 kts. and above the resultant effect upon the red, amber and green zones is to take a somewhat parabolic shape, as shown in fig.1 where these three lobes are stretched more away towards the leeward side as indicated. The amount of the stretch varies directly with the magnitude of the wind.

A 'Hidden' turbulent area also persists in this case which is so caused due to the presence of wind flowing around & across a CB cell. Hence the formation of a fourth area /lobe takes place which does not contain much moisture but the airflow within this blue-dotted area is turbulent due to an induced effect upon it after having traveled past the cell's disturbed area i.e. the up & down drafts, eddies, turmoil within & around the cell.



(iii) As seen in fig. 2, the activity / turmoil inside the CB cell is shown by the grey up & down arrows to represent the up & down drafts and the curved black arrows denote the turmoil/rotors/eddies which are viciously active inside a CB / large cumulus cell. The prevailing winds adjacent to the CB as shown by the blue line, pass through & around the turbulent region of the cell. This wind is traveling from right to left, before entry into the cell it has a normal horizontal orderly flow which gets disrupted and is subjected to random irregular violent changes in both the vertical and horizontal planes caused due to the turmoil within & around the cell. The amplitude of these upsets to the normal flow of the wind is proportional to the amount of activity within the cell, the wind-speed blowing across and the density of the surrounding air-mass, as shown. The upper portion of fig.1 shows an air mass of winds at about 30 kts. which passes through the cell. It travels a certain distance X in say 15 secs. before the effect of its induced-turbulence fades /dies away. The lower portion of the illustration shows a wind of about 5 kts which also passes through & around the cell and is also subjected to upset but it travels a distance less than X due to its lower speed in a time period of 15 secs hence

it can be seen to affect a smaller area of hidden turbulence. Therefore it can be established that the winds at a speed of 30 kts. will create a larger blue-dotted turbulent lobe towards the leeward side than the wind traveling at a speed of 5 kts. i.e. more the wind-speed more is the blue-dotted lobe area stretched as seen in fig.1

4. HOW TO SELECT THE DEVIATION / DETOUR COURSE ?

SITUATION / EXAMPLE: As seen in fig.1, wind flowing from right to left, an aircraft is approaching a CB, the pilot has two options available i.e. whether to deviate **left** or to the **right.**

CASE I : TOWARDS THE WINDWARD SIDE (Right):

Here as seen by the a/c (a), the pilot decides to make a deviation to the right side of the CB cell i.e. towards the windward side. This is a better way because it is on the windward side, here the turbulent area / lobes cover a lesser region since the wind is blowing into the cell and the wind currents are not flowing in from a disturbed source as in the case of the leeward side. Hence this way the pilot would have to make a lesser deviation and could be assured of least chances of turbulence encounter. This side could only be subjected to some turbulence caused due to the turmoil effect within the CB and a detour of about 10 nm. is sufficient to cater for a comfortable flight.

CASE II *DEVIATION TOWARDS THE LEEWARD SIDE (Left) :*

An a/c approaching the CB can make a deviation to the left but here the pilot shall have to make a larger / wider detour because the lobes of the turbulent air-mass covers a greater area since this deviation track is on the leeward side and the wind carries along with it the effect of the turmoil i.e., the up & down currents + eddies etc. so created by the CB cell to cause turbulence.

How to negotiate? : TRIAL & EXPERIENCE METHOD :

(i) As you approach the blue lobe, upon first encounter with slight turbulence, turn left by 30^{o} as shown by a/c (b) and fly for about 15 secs / about 2 nm. Now see the effect, if the turbulence level decreases or remains the same which is acceptable then maintain this offset heading of 30degrees.

(ii) But if the turbulence increases, turn left another 30^{o} i.e. hdg.300^{o} , for another about 15-20 secs. if the turbulence further increases, turn left another 30^{o} as shown to remain away from the blue area / lobe. This blue area is the misleading / nuisance area within which the Wx. radar does not detect turbulence due lack of a reflecting media for the radar beam but the area is turbulent

The intensity of the turbulence within this blue dotted area depends mainly upon the characteristic of the CB i.e. stage of the storm cell and the wind speed / direction, and other mentioned factors.

5. HOW MUCH TO DEVIATE WHEN DETOUR IS TO THE LEFT ?

As described in case I, a pilot can sought to deviate by the trial & experience method by the 30°/15secs. By the illustration in fig.2 it is very clear to understand the scientific theory associated behind the turbulence in the blue-dotted area as shown in fig.1. Notice the upper portion in fig.2 where the wind is blowing at about 30 kts. which after passing through & around the cell is subjected to turbulence resulting in to areas of larger 'turbulent oscillations' extending more distance in a specific time whereas the lower illustration shows the wind of a lesser strength which correspondingly subjects to a lesser distance in the same specific period. Experience has resolved a thumb rule which may be found very effective => if wind speed is > 25kts. a detour of about 25nm to the left from the edge of the amber lobe would be required to cater for the worst possible case.

Hence a more positive approach would be to couple this assumption along with the 30°/15secs trial & experience method by which there would be absolutely no reason as to why an aircraft be subjected to severe turbulence or at the same time why should a pilot make very large detour to avoid a cell.

6. LUNAR EFFECT ON TURBULENCE

Just as science & experience has made us aware of the fact that the phase of the moon has an effect on the ACTIVITY LEVEL of the tidal waves and the human-mind, the truth is that similarly the phase of the moon also has an effect on the amount of turbulence in the atmosphere (cosmic).

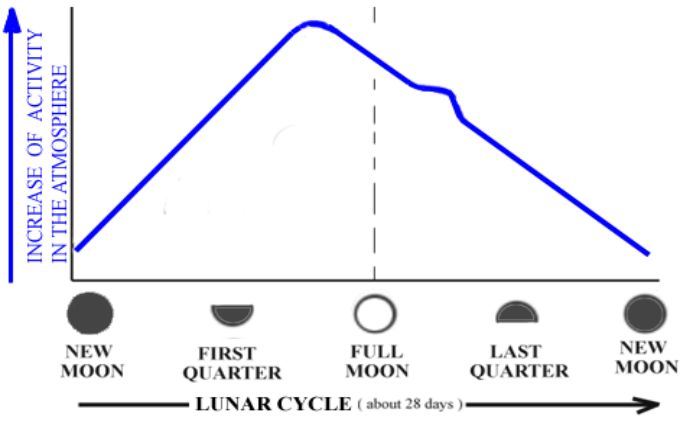


Fig.3

As seen from fig.3, the turbulence generated by the natural source increases its activity from a period of about 2 days after New Moon to achieve its peak activity level at about 3 days prior to Full Moon. Thereafter it declines back to its minimal

value as seen. This diurnal change in the moon's phase has a direct relation to affect the amount of activity within tidal waves in the sea /ocean & also the turbulence associated in the atmosphere, a pilot's awareness on this aspect would also be helpful.

*One must try to ponder: after all what is that invisible force / vitality in the atmosphere which is the cause of the activity leading to the formation of turbulence, if a CB generates turbulence, what is the source which gives the form to a CB? **

TIPS ON CBs & Turbulence :

(i) The anvil of a CB normally points towards the direction in which the mean wind prevailing at the anvil & tower / mid-portion level of the CB and its associated air mass is moving but when ambient winds have low speeds, the direction of the CB movement may change with the anvil still pointing in the previous direction. Hence the best way to find out the direction of a CB travel whilst selecting a detour towards the windward side is to notice the spot-winds on the ND (aircraft instrument for spot-wind detection) when close to the CB because it is the wind at your level that is going to effect turbulence to your a/c.

(ii) A CB may or may not have an anvil depending upon its stage so the appearance could be of a towering cumulus so expect same amount of turbulence and use the same detour method whilst circumnavigating.

(iii) Large cumulus patches at high altitudes are at times as violent as the CBs so adhere to avoidance procedures most respectfully.

(iv) Higher the CB or a cumulus cloud more will be the activity inside the cell hence more vicious is its associated turbulence. Height of a CB could be up to about 40,000 ft.

(v) If you happen to subject the a/c through an encounter with severe turbulence do report the same for a thorough maintenance check for broken rivets and bent / broken structures so as to play safe for its next flight.

** Read the [H S-s] file of www.Divinekripa.in : to get every answer! i.e to find how the spiritual forces in this world work, also how it can be controlled. Spirituality is the very basic of our existence; one should try and get closer to this reality and make best use of this elite wisdom which governs the entire cosmos. The colossal cosmic entity is a result of manifested Energy; out of the Power source, called the Creator / God /Nature who has unlimited intelligence and is omni-present to guide the seeker.*