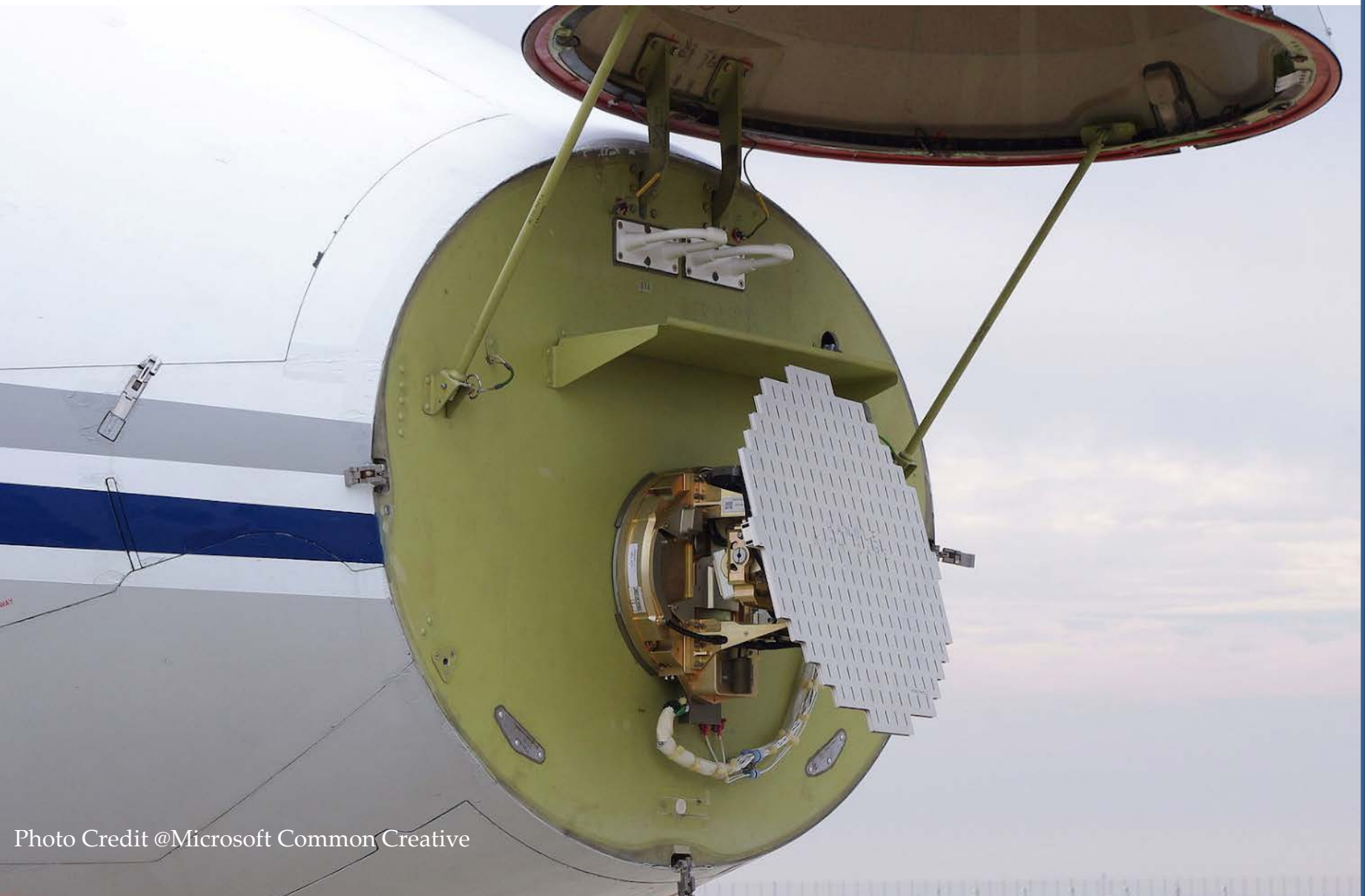


Photo Credit @Microsoft Common Creative

Practical Use of Onboard WX Radar

Greeting

Presenting by Facilitator: Capt. Edward Kan / Eddy Qin秦艾德

- Professional Credential expertise
  - Pilot : Type rated on A319/320/321/330/340/MD11/B742/744
  - Flight Engineer / 747-200
  - Flight Attendant / 737/A300/747-200/747-400/MD-11
  - Investigator In Charge (IIC) of Aircraft Accident / FAA
  - En-route Inspector / FAA
  - Electric Technician Third Class Licensed / Taiwan, Chnia
  - Radiation Inspection Technician certified / Atomic Energy Council Taiwan, China
- Educational Background
  - Aviation Business Administration / MBA / RMIT University, Australia
  - Juris Doctor (J.D./LLM) / Soochow University (东吴大学法学院), Taiwan
  - Electronic and Computer Engineering (BS) / Long Hua Univ. of Tech.

欢迎

Presenting by Facilitator: Capt. Edward Kan / Eddy Qin秦艾德

职业经历及专业

飞行员：机型签注A319/320/321/330/340/MD11/744

- 飞航机械员 / 747-200
- 乘务员 / 737/A300/747-200/747-400/MD-11
- 航空器事故调查员-飞机 / FAA
- 航线检查员 / FAA

工业电子技术士 / 中国台湾

辐射侦检技术士 / 台湾原子能委员会(中国台湾)

教育背景

- 航空管理硕士 MBA / 澳大利亚墨尔本 RMIT 大学

法学硕士（Juris Doctor/LLM) /台湾东吴大学法学院

- 电子工程/计算机工程本科 / 台湾龙华科技大学

机载气象雷达型号

THE VERSIONS OF ROCKWELL COLLINS WX RADAR

MultiScan V1
WXR-2100

RECOMMENDED OPERATING MODE

The recommended operating mode for MultiScan V1 is AUTO, CAL Gain, and WX+T (Weather Plus Turbulence) in all phases of flight.

Figure 3-12 Recommended Operating Mode

TPO7945_01

MultiScan *ThreatTrack*
WRT-2100

Figure 6-1 Airbus MultiScan ThreatTrack Control Panel

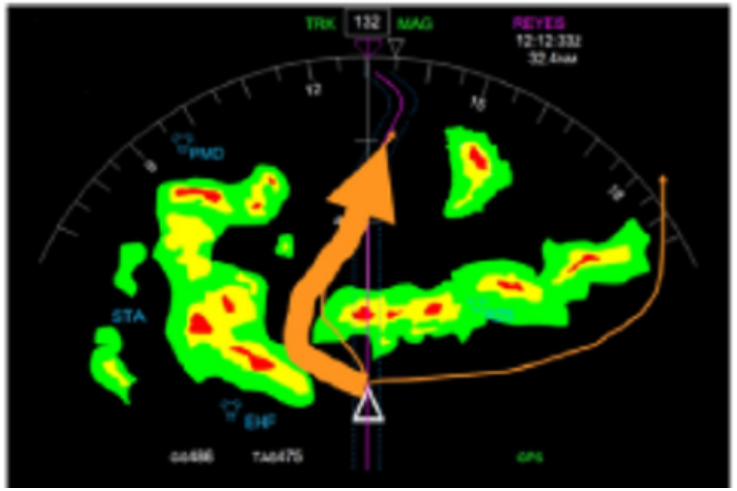
TPO7944_01

真有厂家说的那么神，他们承担所有责任吗?

WHO IS LIABLE IF CREW FOLLOW MANUFACTURER RECOMMENDATIONS

The Quiet, Dark Cockpit philosophy means that, when the radar is used in AUTO, only threat weather is displayed. Weather that is beneath the aircraft altitude is not displayed. A recent OEM Human Machine Interface (HMI) study shows the operational efficiencies achieved through this philosophy. Note that in the lab when the pilot sample was presented with a MultiScan like HMI, very efficient flight operations were achieved. Almost all pilots navigated the weather in the safest manner and did so in a way that saved the most time and fuel.

Figure 2-1 MultiScan Quiet Dark Cockpit Efficient Deviation



AUTO (+T or +T+HZD) mode is recommended for all phases of flight?

Q1. Is Rockwell Collins willing to bear the liability?

Q2. Do you believe what they claimed?

NOTE

When MultiScan ThreatTrack software is installed, Turbulence (TURB) Mode on the control panel is replaced by Weather+Turbulence+Hazard (WX+T+HZD). Weather (WX) and Weather+Turbulence (WX+T) Modes operate the standard MultiScan V1 software. ThreatTrack functions are activated when WX+T+HZD is selected.

TIP

AUTO and WX+T are recommended during all phases of flight for V1. AUTO and WX+T+HZD are recommended during all phases of flight for V2.

墨菲定律-机组完全遵照厂家建议就能免责?

MURPHY'S LAW – WILL CREW IMMUNE FROM LIABILITY?

齐）航班，北京起飞爬升至高度3000 米左右，机组看到飞机右部有闪光，检查飞机各参数正常，继续飞行，乌鲁木齐落地后机务检查发现右侧雷达罩后部遭雷击，经波音评估后用金属胶带做临时性修复，继续开始航班运行。

●事件分析：
1· 左座设置气象雷达方式为自动、增益+1 模式，右座设置气象雷达方式为自动方式，ND 距离范围 40 海里；
2· 飞机起飞以后连续爬升，1500 米后进入云中飞行，机组依靠雷达显示来绕飞天气。

●事件分析：
1· 左座设置气象雷达方式为自动、增益+1 模式，右座设置气象雷达方式为自动方式，ND 距离范围 40 海里；
2· 飞机起飞以后连续爬升，1500 米后进入云中飞行，机组依靠雷达显示来绕飞天气。
3· 根据柯林斯公司提供的雷达技术资料显示：只有天气系统威胁到飞行航径安全时才会在 ND 上显示。
4. 机务按照波音公司的方案对雷击损伤部位进行打磨，并做 NDT 探伤，经波音公司评估后用金属胶带做临时性修复，继续开始航班运行。新疆维修基地已制定了临时性修复的定期检查方案，并按照波音公司的规定在 400 个飞行循环内完成永久性修复。

Crew saw flashing on the right hand side of AC after TO from ZBAA around 3000 M, all parameters were normal the flight was continued and found lightening strikes on rear side of radom….. patched with high speed tape……

● Event analysis
1. LH set Wx radar in AUTO, Gain +1 mode, RH set Wx radar in AUTO mode, ND range 40 NM;
2. AC were in the IMC after TO climbing to 1500 M and circumnavigating based on Wx radar.
3. According to technical info provided by Rockwell Collins only threats will display on ND
4. Mechanic has grinded the damage of lightening strike and carried out NDT probe, patched with high speed tape….

空客如是说

WHAT AIRBUS HAS TO SAY

Different Types of Radars

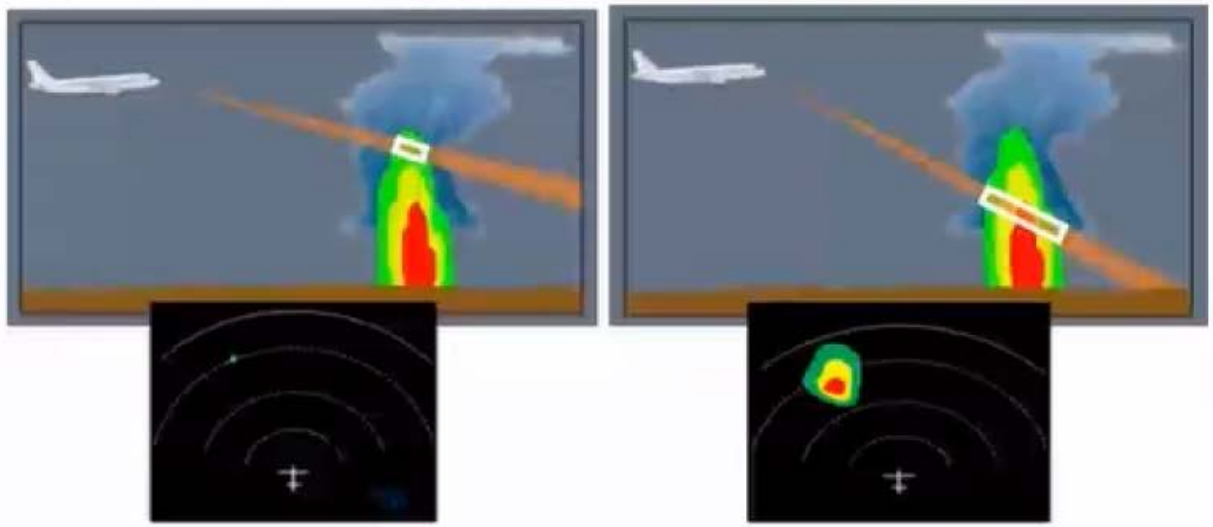
Auto-Tilt Radars

A320 A330 A340

TILT AUTO mode is the default mode…

… However, manual tilt is still necessary:

+ For further storm cells analysis
+ Regularly, to enhance weather awareness



Manual and Auto-Tilt Radars are very similar in terms of operation

FCTM Aircraft Systems/Weather Radar

空客跟柯林斯的差别- 听谁的?

WHAT IS THE DIFFERENCE BETWEEN AIRBUS AND ROCKWELL COLLINS

To whom that you will follow? Airbus or RC?

Why they talk differently?	Airbus	Rockwell Collins
NATURE OF PRODUCTS **产品本质**	Commercial & Public safety 商业利益及公共安全	Commercial 商业利益
LIABILITY **产品瑕疵担保产品瑕疵损害担保**	Huge and unlimited (Product and liability incurred by the product) **产品瑕疵损害担保几乎无上限**	Little and limited (Product itself) 轻微或有限
BURDEN OF PROOF **举证责任**	Heavy 沉重	Nil or light 无或极轻

空客对使用气象雷达的建议

NEW RADAR OPERATIONAL RECOMMENDATIONS

Common Recommendations

A320 A330 A340 A350 A380

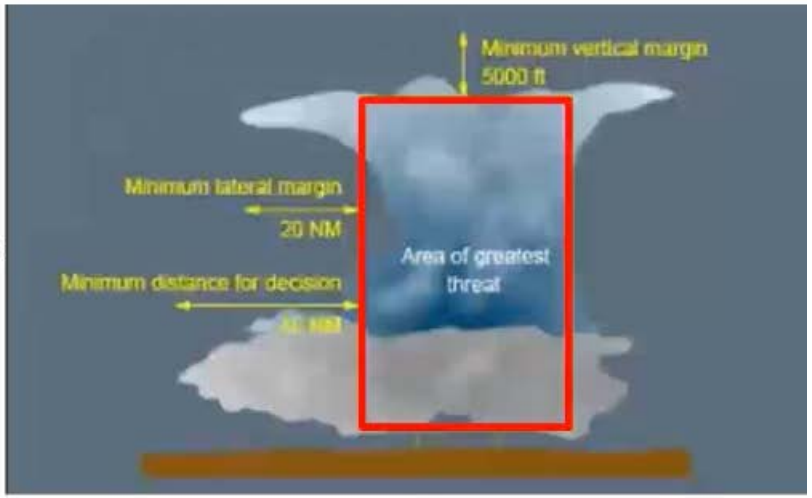
New Operational Recommendations in FCTM

Avoidance Decision:

+ No longer linked to the height of cells
+ Does not rely only on colors
+ "Area of greatest threat" based on:
  - Location and shape of the strongest weather radar echoes
  - Meteorological knowledge of the flight crew

⇒ Zone where the flight crew estimates that the weather conditions are too dangerous to fly in

⇒ Empowers crew's expertise



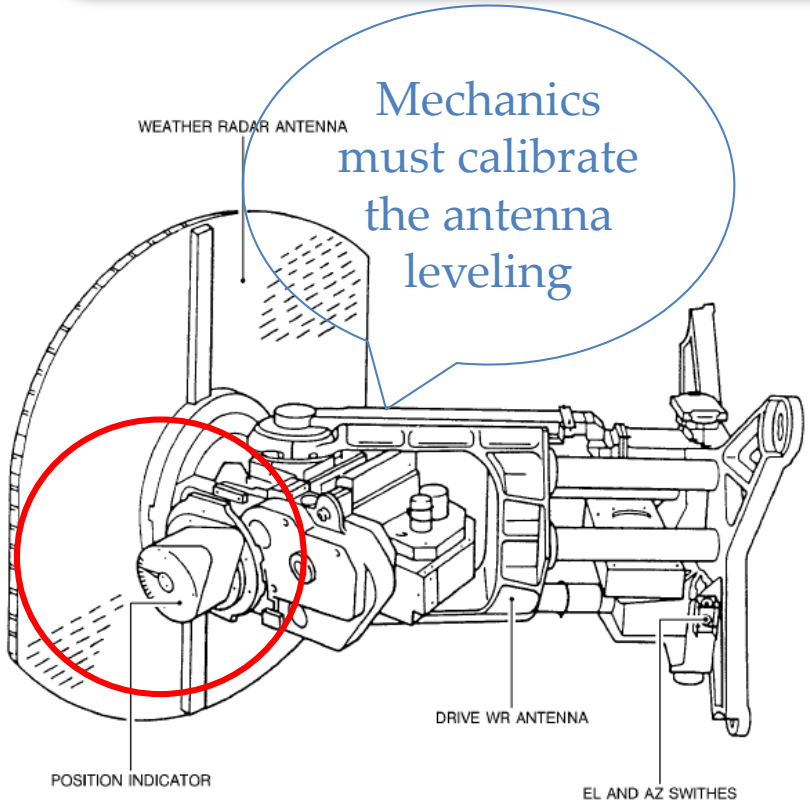
AIRBUS

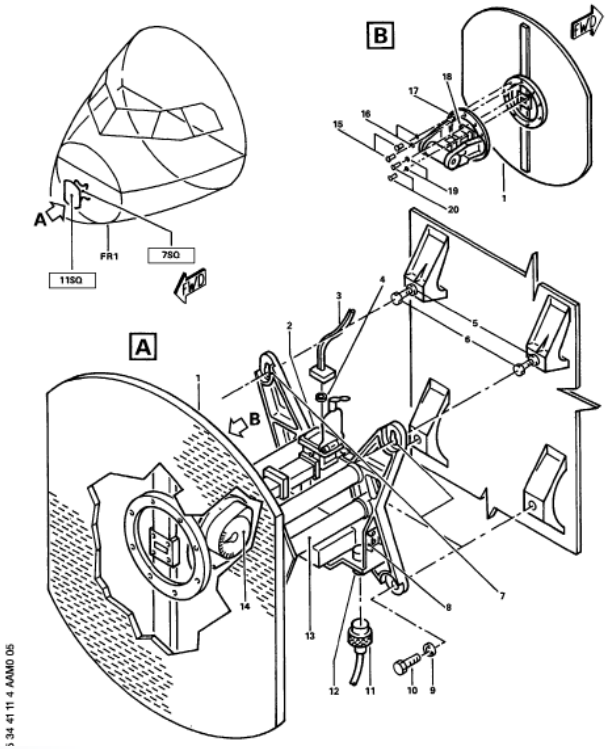
- The beam of radar, 雷达波的波束
- Manual tilts are still necessary
- Multi Scan
- On path /Off path
- Use of radar/ Recommendation; 3 N, No longer linked to the height of CB, Not rely on the colors, No shooting on the shadow
- Avoidance technique
- Gain control
- Tilt control 1/60 rules
- Lightening : "Observation"
- Impact of ice crystal
- Conclusion

机载雷达天线模组

THE RADAR ANTENNA AND MOUNT

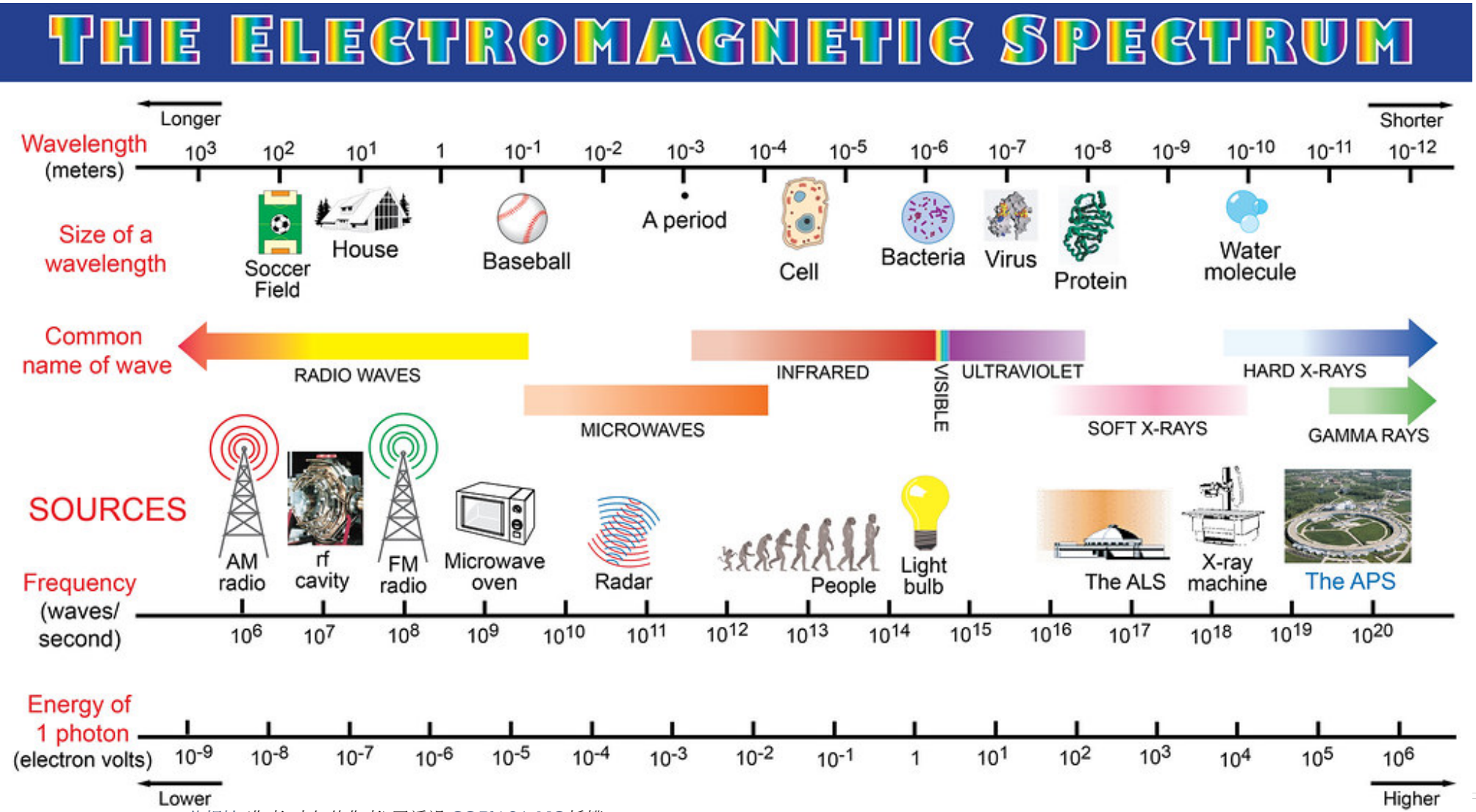
One antenna can only shoot one beam at a time, there is no “two antenna beams”; Multi-Scan does not shoot two beams simultaneously, it sweep upper and lower beam alternatively then store in the memory for computer to compose the images together, just like “MRI” scan image, two sweeps takes 8 seconds / 2 NM distance coverage





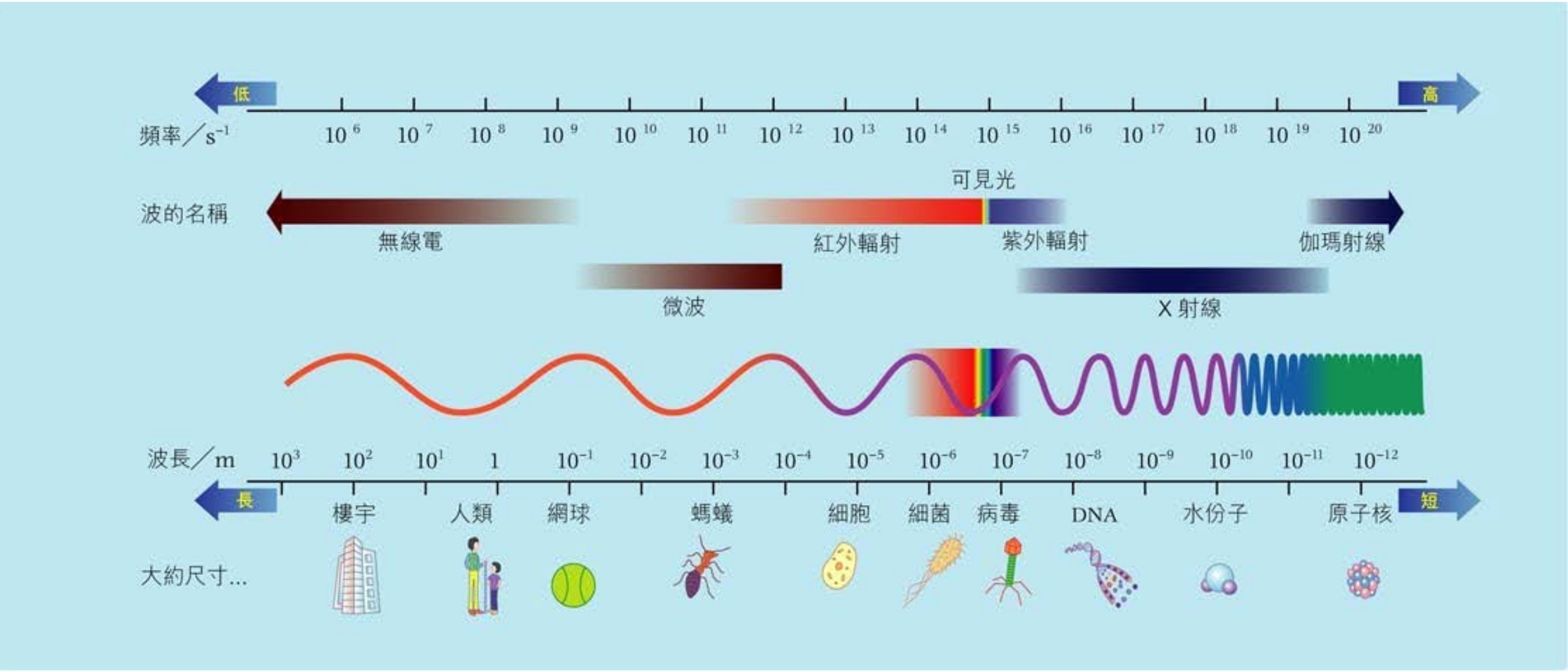
电波辐射在现代的生活中无所不在

THE ELECTROMAGNETIC RADIATION IS EVERYWHERE



电波辐射在现代的生活中无所不在

THE ELECTROMAGNETIC RADIATION IS EVERYWHERE



环境电磁波容许辐射强度分级标准

MAXIMUM EXPOSURE OF ENVIRONMENTAL ELECTROMAGNETIC RADIATION

波长Wave length	单位Unit	一级(安全区) 容许场强 First level exposure	二级(中间区) 容许场强 Second level exposure
长、中、短波 Long, Medium, Short	V／m	〈10	〈25
超短波 Ultra short	V／m	〈5	〈12
微波 Microwave	μW／cm2	〈10	〈40
混合 Mixed	V／m	按主要波段场强；若各波段场分散，则按复合场强加权确定	

Note: μ=1x10 $^{-6}$;mentioned in μ W/cm ^{2} . The gauge shown on next 2 slide is measuring in μ W /m ^{2}

电场与磁场-风档加温才是祸首...但是

ELECTRO AND MAGNETIC FILES – WINDSHIELD HEATER IS THE WORSE BUT....

这锅我不背-雷达 I am not the one, don't blame me- Radar

The strongest electromagnetic radiation is coming wind shield heating / intermittent heating based on preset temperature

No variation of reading regardless the Radar circuitry is turned on or off

机载雷达的微波运行时对机组有害？

IS WX RADAR EMITTING THE HARMFUL RADIATION ?

RF radiation are everywhere these days, but it has nothing to do with Wx Radar !

Radar “on” as soon as you start taxi no later than before take off may save you a day!!

理解雷达波束的结构

THE ANTONYMY OF RADAR BEAM(S)

Beam width can be calculated by means of geometry in relation to the angles and distance
But…… Is the radar beam exactly 3.5 º sharp, for precise calculation?

BEAM WIDTH AND CELL HEIGHT RESOLUTION

The MultiScan radar utilizes a 3.5 degree beam. Although this is pretty narrow, by 80 NM it is already 28 0(picture). As a result, height estimati more coarse the further the distance occasion, weather that is initially visi display as it approaches the aircraft the cell height.

Figure 4-21 3.5 Degree Radar Beam Width

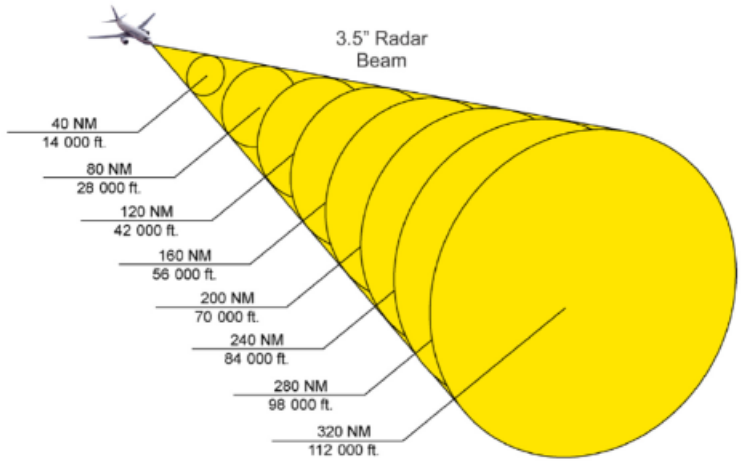


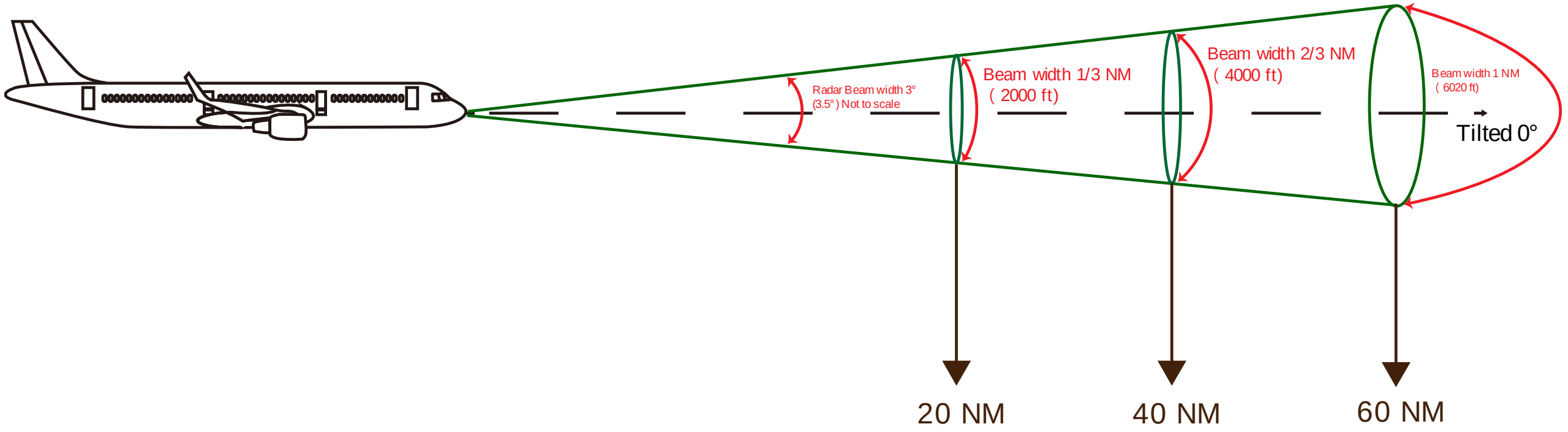
Figure 7-3 Flight Path Hazards — Flashlight Beam

Objects may be detected outside the center of a flashlight beam. Similarly, radar side lobes may also pick up returns outside the normal 3.5º beam width.

TPO5443_03

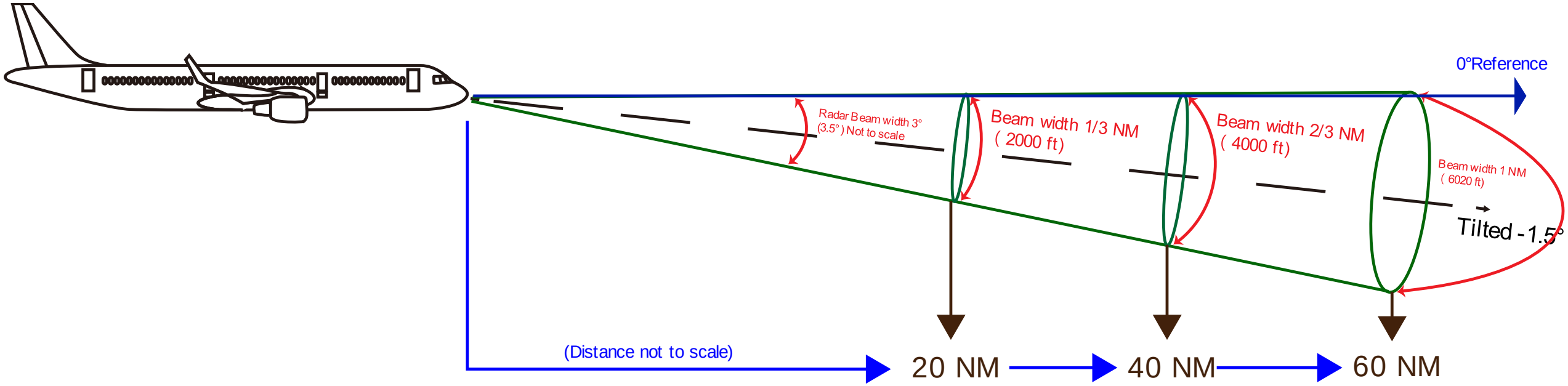
理解雷达波束的结构

PRACTICAL USE OF WXR 2100 RADAR- UNDERSTAND THE TILT



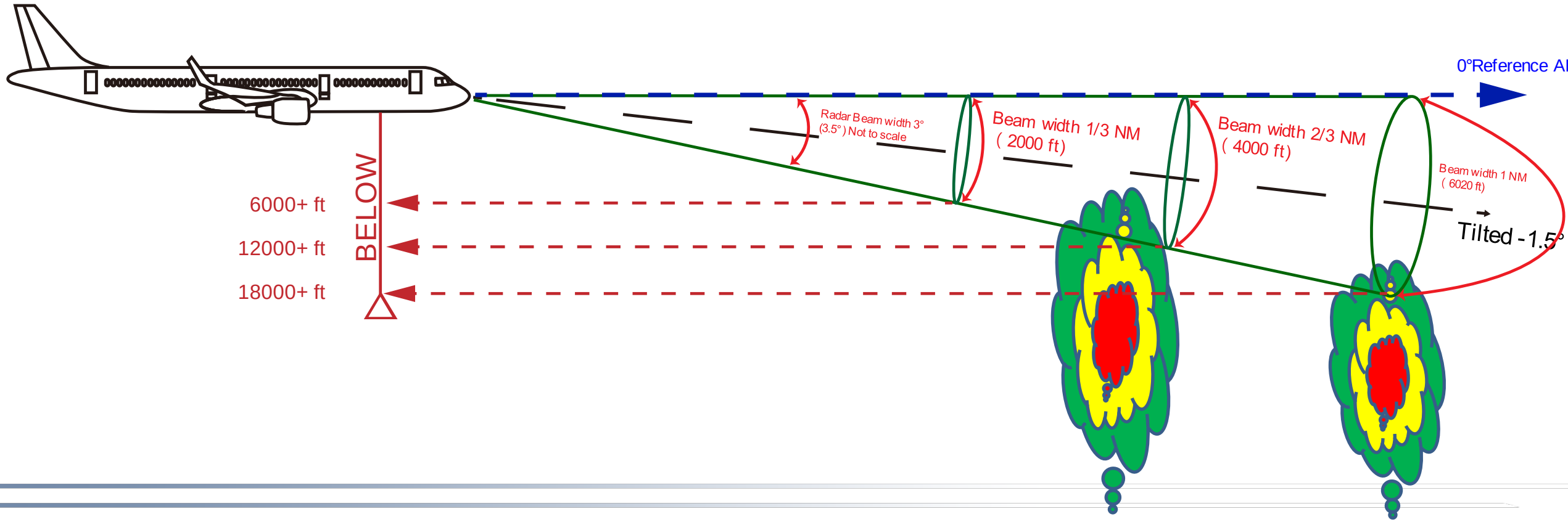
理解雷达波束的结构

PRACTICAL USE OF WXR 2100 RADAR- UNDERSTAND THE TILT



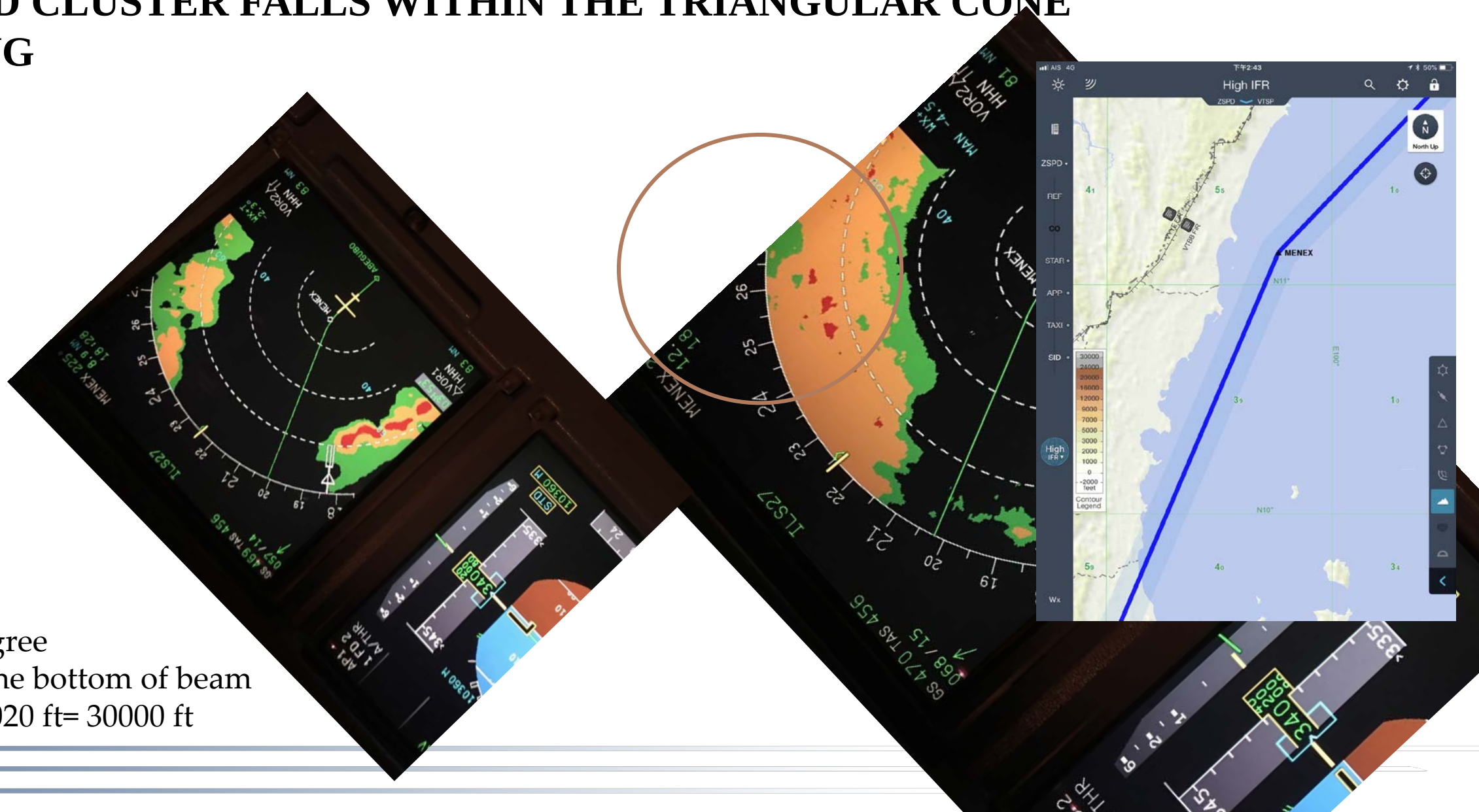
理解雷达波束的结构-距离与高度

PRACTICAL USE OF WXR 2100 RADAR- UNDERSTAND THE TILT



理解雷达波束的结构-距离与高度

GROUND CLUSTER FALLS WITHIN THE TRIANGULAR CONE MAPPING



Tilt -4.5 degree
At FL 340 the bottom of beam
(4.5+1.5)x5020 ft= 30000 ft

增益GAIN的理解与使用

THE GAIN CONTROL

circuitry associates these different amounts of moisture (or rainfall rates) with a particular color level on a weather radar display (see figure 6-7). For instance, green represents a weak rainfall rate of 0.03 to 0.15 inches/hour (in/hr), while red represents a rainfall rate that is greater than 0.5 in/hr. Note that **black** is also a color level. Black on a weather radar display does not mean that weather is not present (although this may be the case), it simply means that the rainfall rate is less than 0.03 in/hr.

Also note that each color level represents a change of 10 dBz (green is 20 dBz, yellow is 30 dBz, and red is 40 dBz or greater). Therefore, changing the gain by 10 dBz above or below the **CAL** setting will change the display by one color level.

Magenta represents turbulent airflow that, in essence, represents variations in raindrop movement of greater than 5 meters/second. Doppler turbulence detection is described in detail later in this section (♦page 6-32).

Figure 6-7 Calibrated Gain Color Scheme

增益GAIN的理解与使用

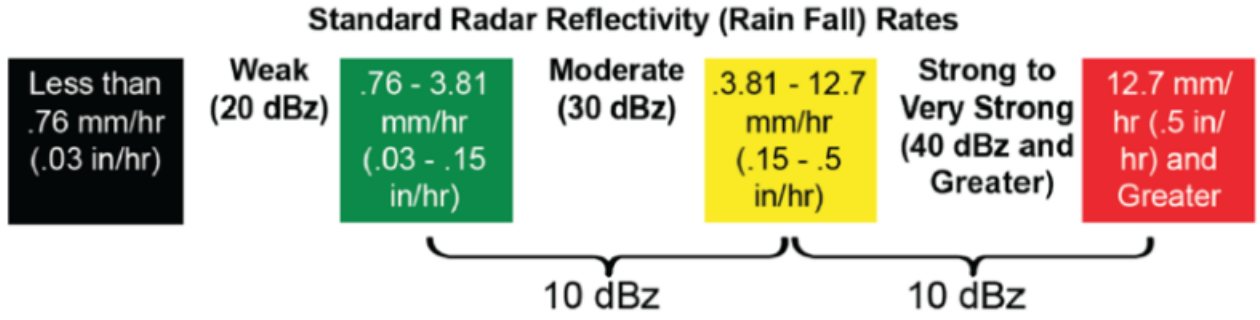
THE GAIN CONTROL

The basic principals of radar has never been changed for almost 50 years (fours colors + later Doppler effect)

GAIN — STANDARD RADAR COLORS/ REFLECTIVITY RATES

In MAN CAL Gain, the radar paints the standard reflectivity rates (representing rain fall rates) for red, yellow, green and black. Weather that is present in the black region is not reflective enough to meet the green threshold display criteria. Notice that an increase or decrease o 10 dB of sensitivity represents a change of one color level.

Figure 4-1 Standard Radar Reflectivity (Rain Fall) Rates



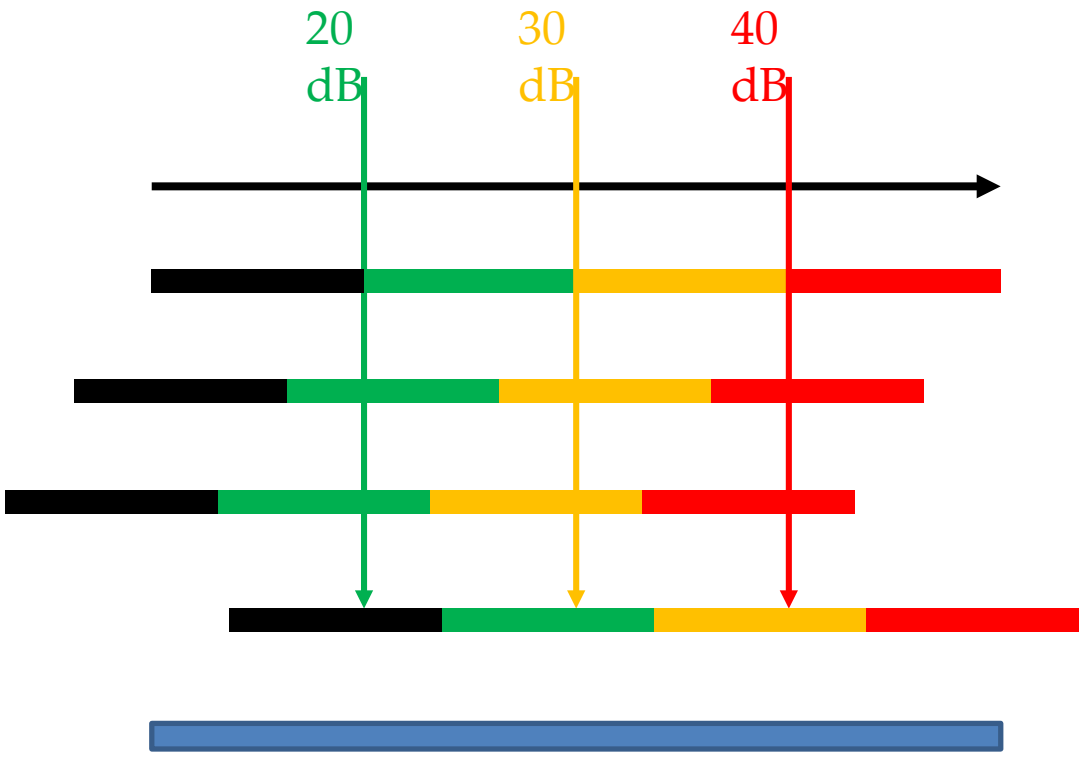
During MAN operation radar colors are determined by rainfall rates (note: dBz is an engineering term for reflectivity).
Note that there is 10 dB of gain between each color level.

TPO5414_01

增益GAIN的理解与使用

THE GAIN CONTROL

Figure 6-7 Calibrated Gain Color Scheme



COLOR SCHEME

- **Black** (Less Than .76 mm/hr [.03 in/hr])
- **Green: Weak** (.76 - 3.81 mm/hr [.03-.15 in/hr] - 20 dBz)
- **Yellow: Moderate** (3.81 - 12.7 mm/hr [.15-.5 in/hr] - 30 dBz)
- **Red: Strong to Very Strong** (12.7 mm/hr [.5 in/hr] and Greater - 40 dBz and greater)
- **Magenta: Turbulence** (Greater than 5 meters/second wind velocity)

Gain has nothing to do with echo (rainfall) intensity, it merely changes the way how that electronic signal is going to display colors

e.g. 16 dB will display black, but if you turn gain control to + 4 dB, then it starts to display green

增益GAIN的使用-使用不当不理解 – 自己吓自己?

SELF CREATED THREATS – IMPROPER USE OF RADAR

1. Precaution (Auto)

2. Check how high is the wet top, my alt and above (Manual)

3. Check intensity 12000ft below my alt at 120 NM

4. Check relative intensity 12000ft below my alt FL 301

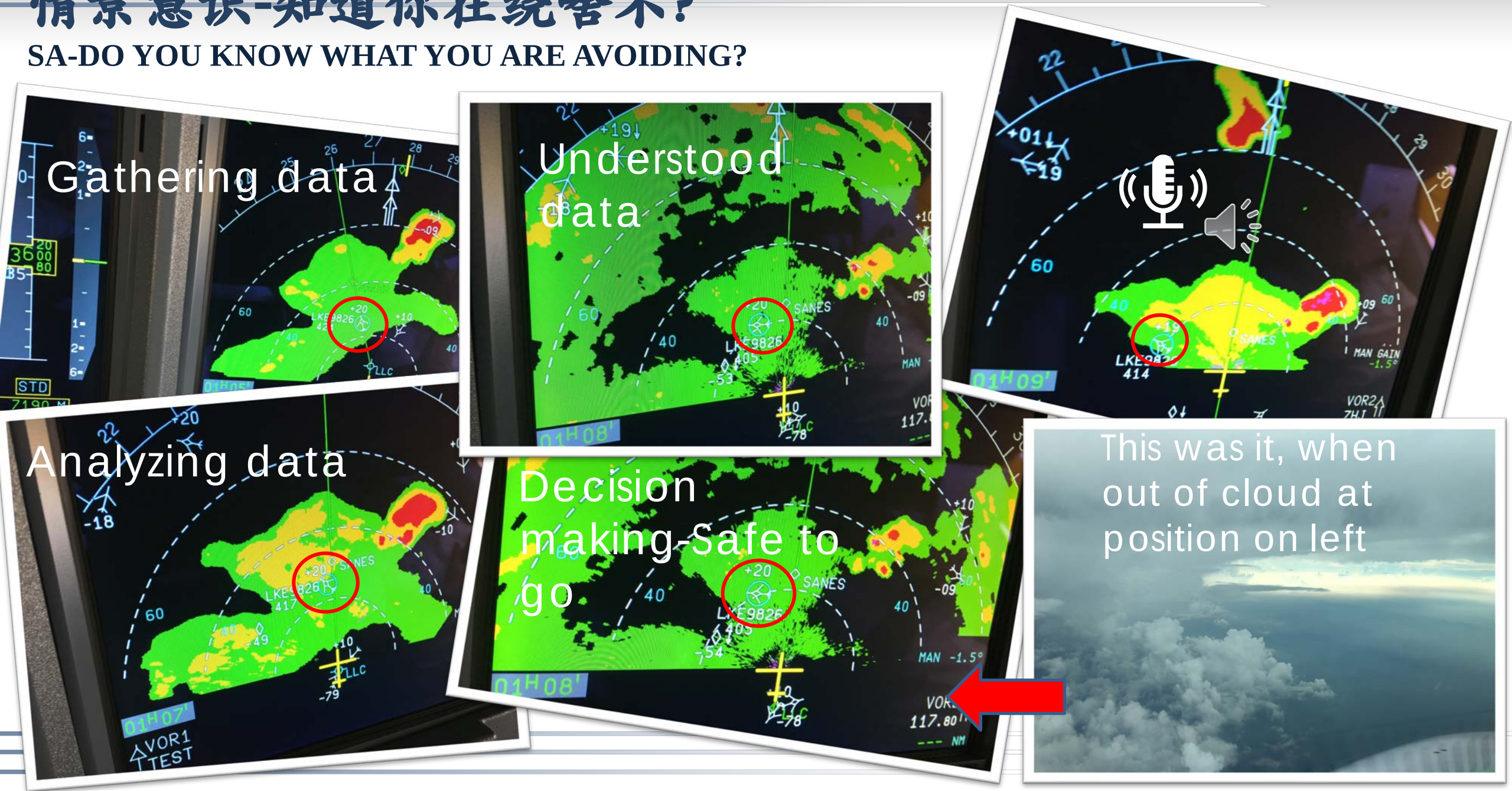
5. Confirm it is safe stay on route

6. This was what everyone else is avoiding, AUTO Gain +8

Self created ghost "threat"

情景意识-知道你在绕啥不?

SA-DO YOU KNOW WHAT YOU ARE AVOIDING?



自动模式下的增益与人工模式大不同

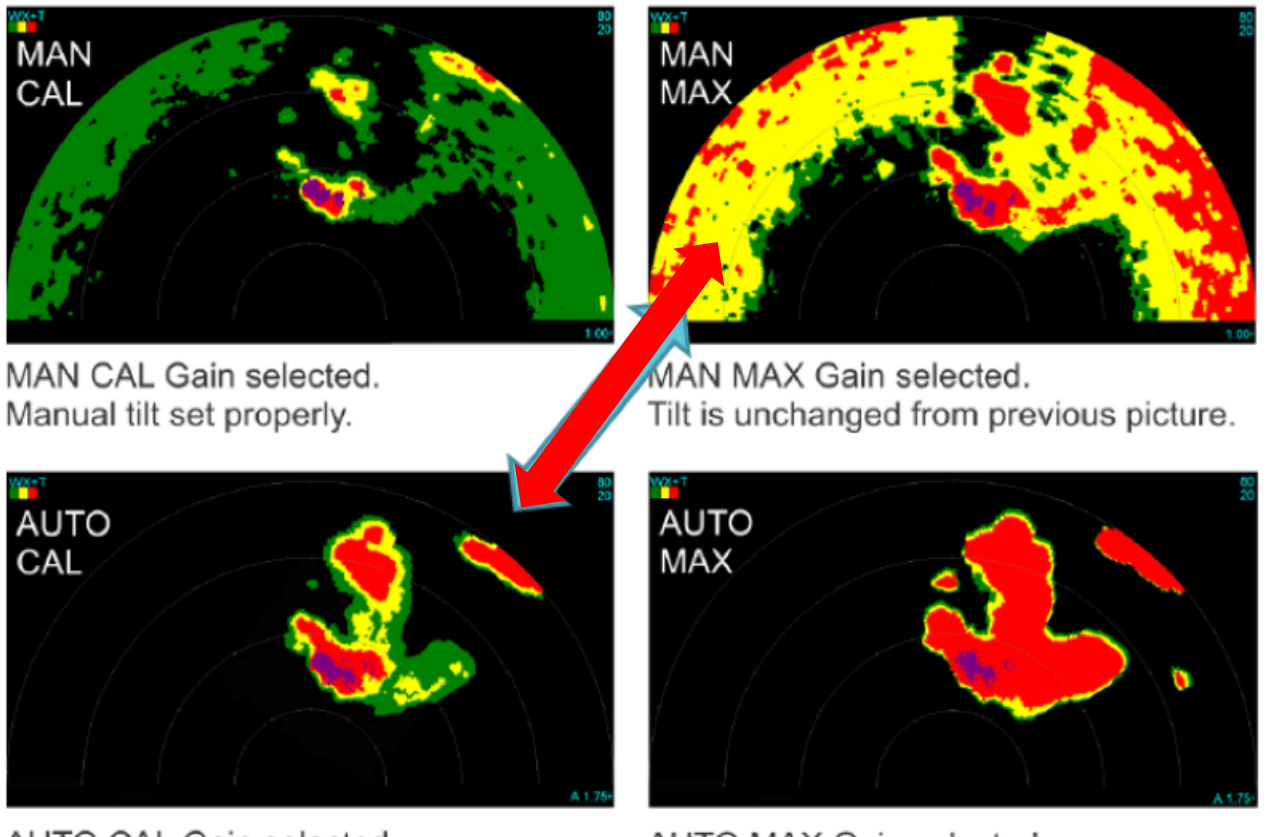
GAINS ARE NOT THE SAME

TIP

At cruise altitudes, MAN Max gain and AUTO CAL gain are essentially equivalent. In AUTO, further increasing the gain above the CAL position may result in over warning and unnecessary deviations.

Understand the system logics when use AUTO functions !!

Figure 4-7 Automatic Temperature Based Gain



MAN CAL Gain selected.
Manual tilt set properly.

MAN MAX Gain selected.
Tilt is unchanged from previous picture.

AUTO CAL Gain selected.
Note that AUTO CAL Gain and MAN MAX Gain display essentially the same level of cell intensity.

AUTO MAX Gain selected.
Full Gain control above CAL is available in AUTO but will over represent the threat.

TPO5329_01

自动模式下的增益与人工模式大不同

GAINS ARE NOT THE SAME

By examine the real flight condition, the reflectivity of precipitation level, It is the case that the gain control in

AUTO mode gain set to CAL at cruise level

=

MAN mode gain set to MAX

SO WHAT ABOUT AT LOW ALT?

AT HIGH CRUISE LEVEL

AUTO / GAIN=CAL

MAN / GAIN=MAX

自动模式下的增益与人工模式大不同

GAINS ARE NOT THE SAME

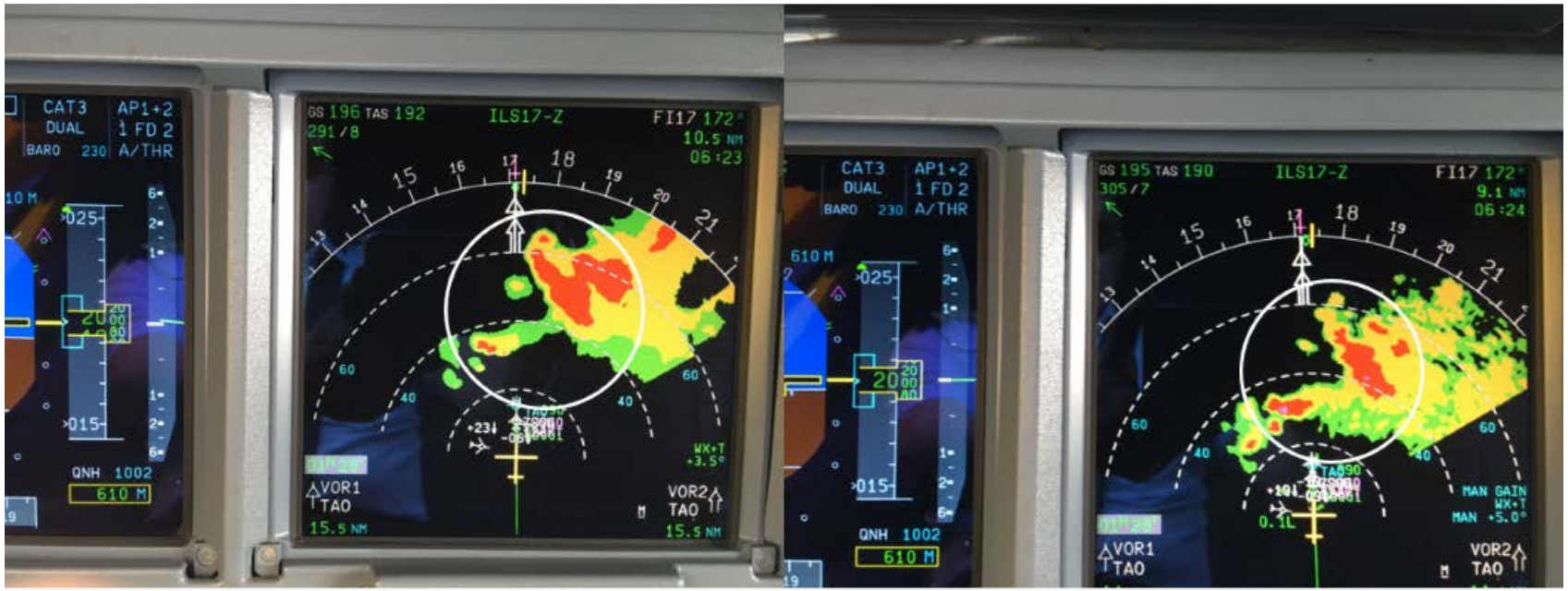
It does not seem much of difference by comparing the High Cruise Level and Low Approach ALT !!

USE AUTO MODE WISELY !!
Fool-proof radar won't proof fools

AT LOW APPROACH ALTITUDE

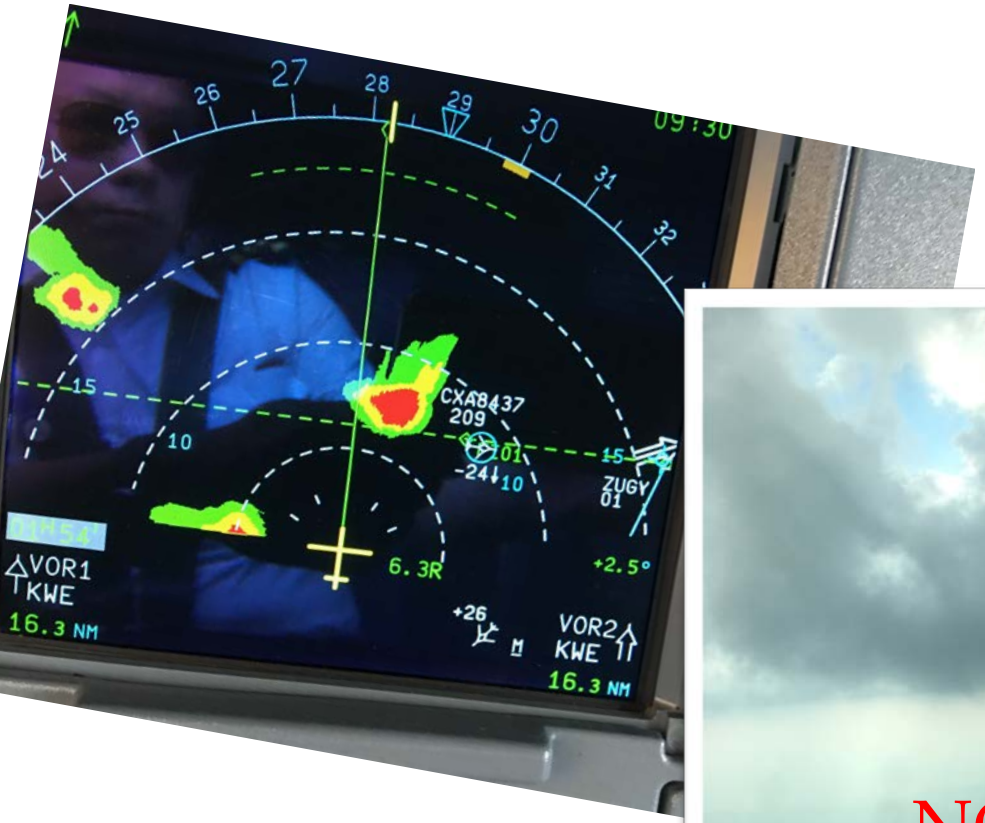
AUTO / GAIN=CAL

MAN / GAIN=MAX



增益GAIN的使用-使用不当不理解 – 自己吓自己

AVOID GREATEST THREAT OR AVOID BASED ON COLORS?



Low altitude

Known precipitation

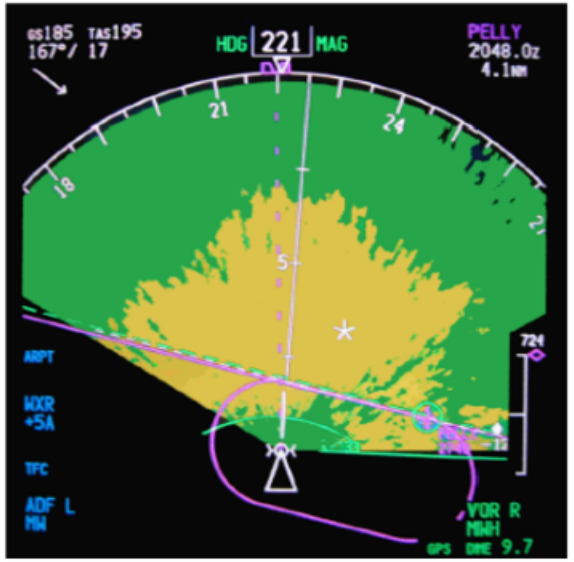
No Doppler effect with precipitation

季节或地域性垂直降水叠加回波

BRIGHT BAND / MONSOON RAIN EFFECT

Colors are not the only identification of THREAT, it could be merely a result of nature phenomenon and man made machine

Figure 5-8 Bright Band/Monsoon — CAL Gain

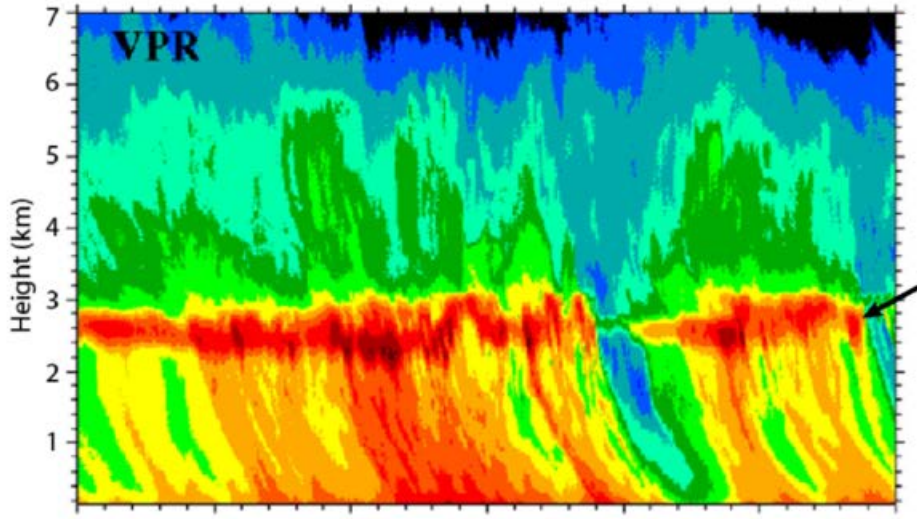


Bright Band has caused much of the display to turn yellow. At longer ranges the display turns green due to the fact that the radar beam is pointed up out of the Bright Band region.

TPO5339_01

A similar situation sometimes occurs during monsoon rains where heavy rain fall rates produce very strong reflectivity. In the case of monsoon rains, it is not unusual for the entire display to turn red. Should flight crews encounter a red out situation, gain can be temporarily reduced by –9, or about one color level (See page 4-1 and page 5-26), to better determine if embedded cells are hidden by the stratiform rain.

Figure 5-7 Ground Based Vertical Weather Radar Presentation



Bright Band produces very strong radar returns that can turn the entire display yellow or red.

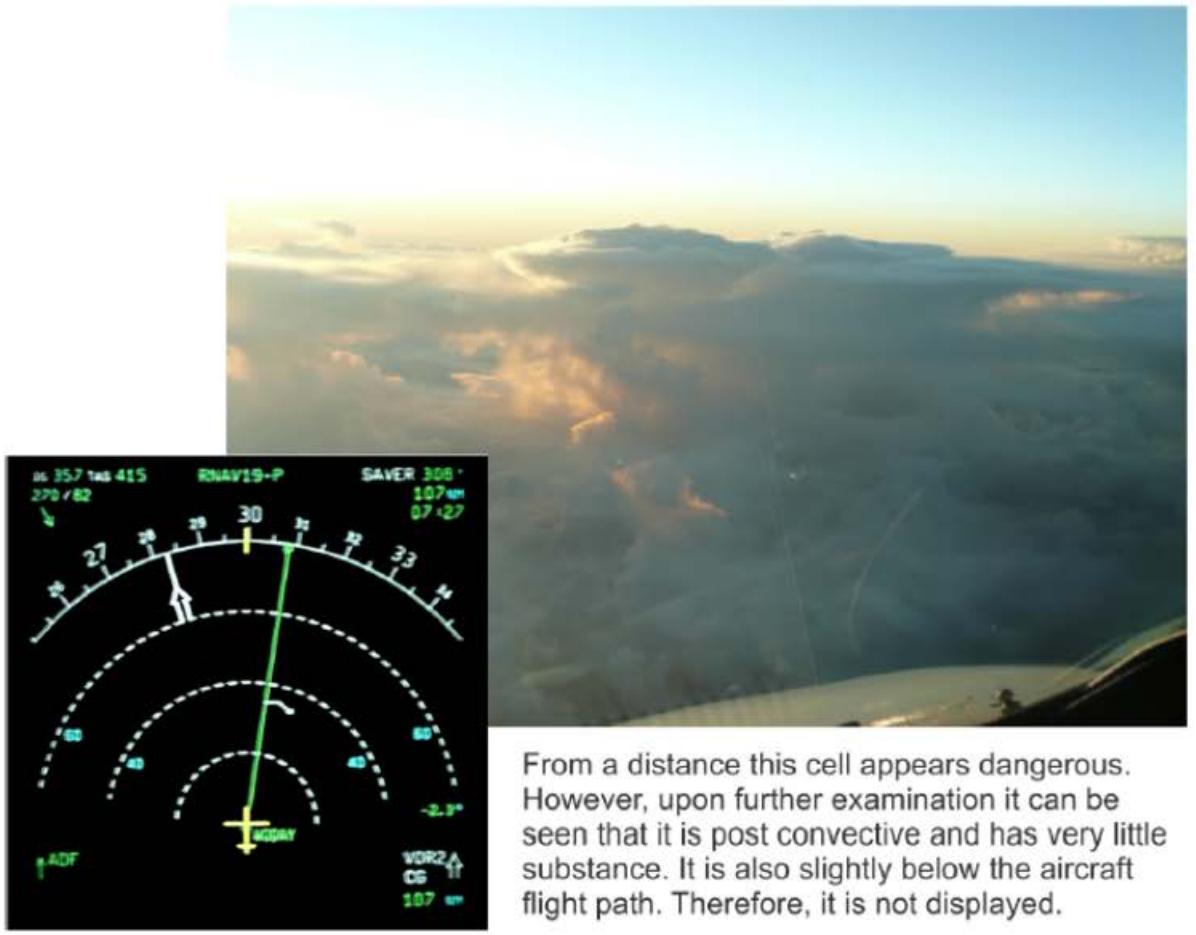
TPO5391_01

不能单从云系的外观判断影响-无害云系

EXAMPLE OF NON THREAT WX

It may not look as bad as it is !!

Figure 4-10 Non-Threat Weather



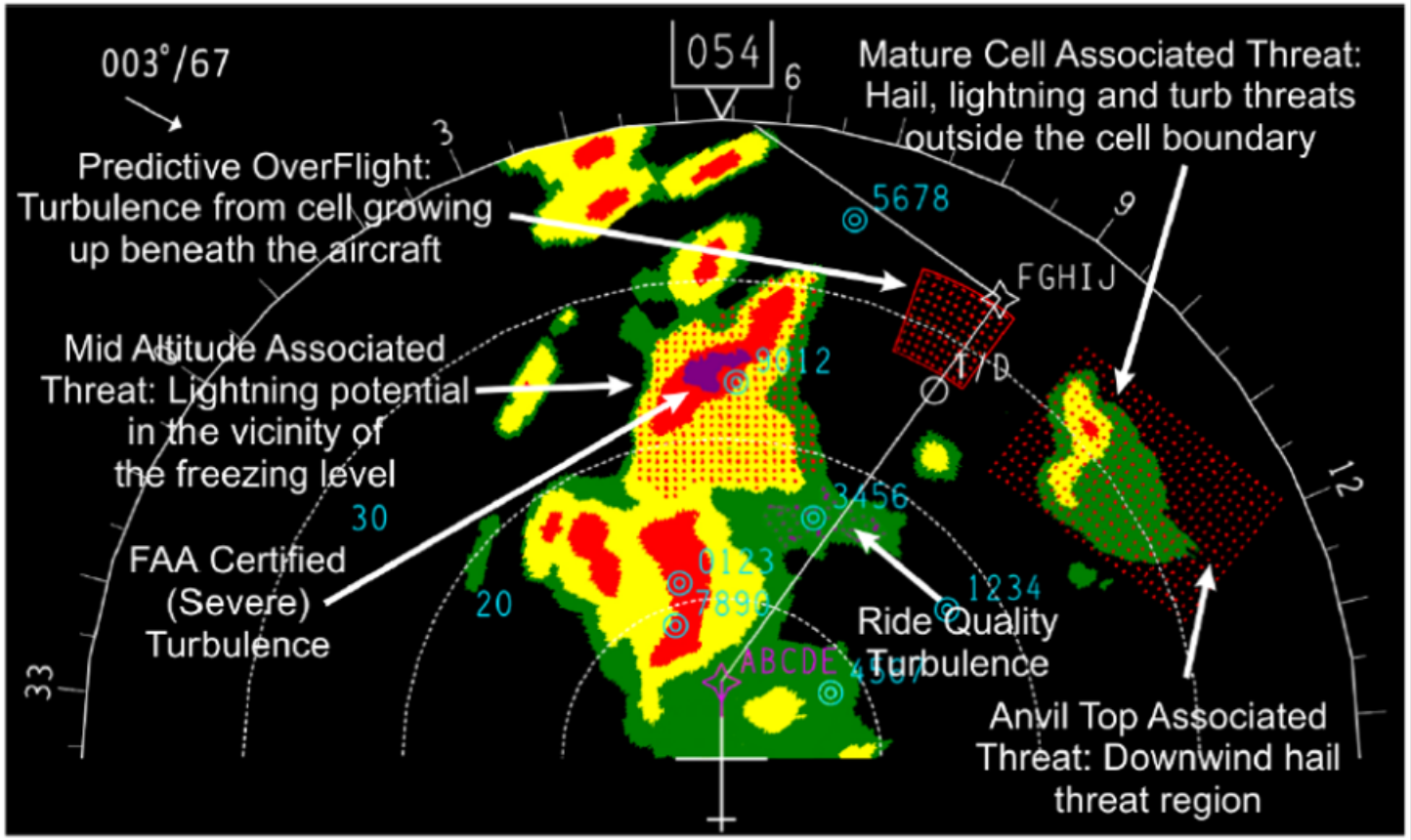
From a distance this cell appears dangerous. However, upon further examination it can be seen that it is post convective and has very little substance. It is also slightly below the aircraft flight path. Therefore, it is not displayed.

TPO5383_01

V2 *Threat track* 危迹功能系统逻辑

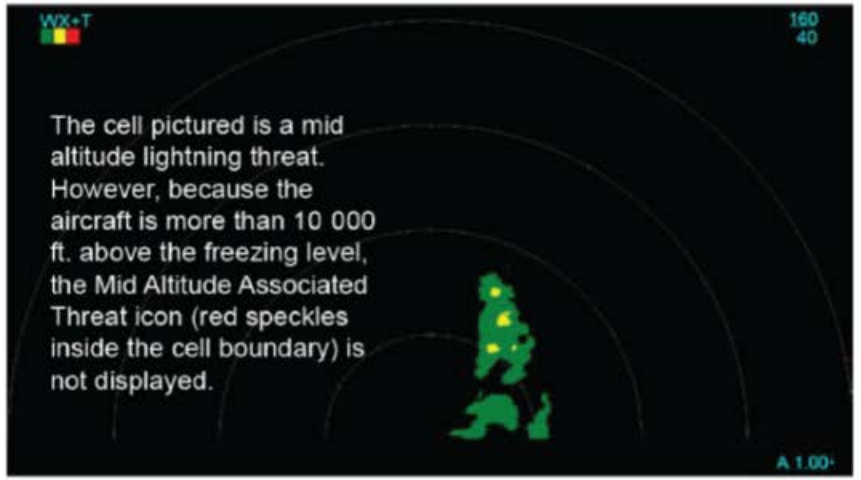
THREAT TRACK LOGICS

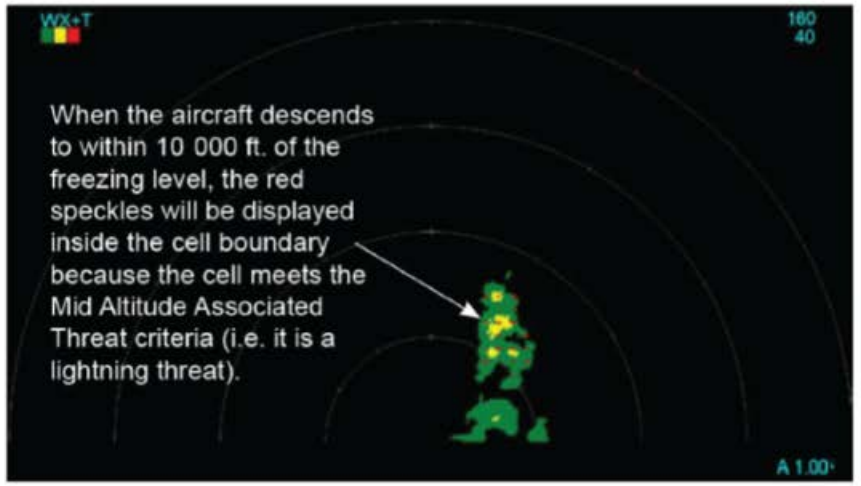
Figure 2-8 MultiScan ThreatTrack Radar Display Icons



MultiScan ThreatTrack provides analysis tools that facilitate the best possible decision making when transiting severe weather.

Figure 6-11 Mid Altitude Associated Threat Criteria

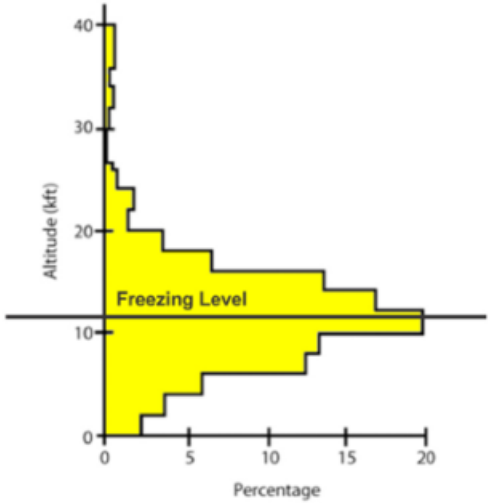




V2 *Threat track* 危迹功能系统逻辑

THREAT TRACK LOGICS

Figure 6-10 Lightning Strike vs. Freezing Level



The majority of lightning strikes occur within the vicinity of the freezing level.

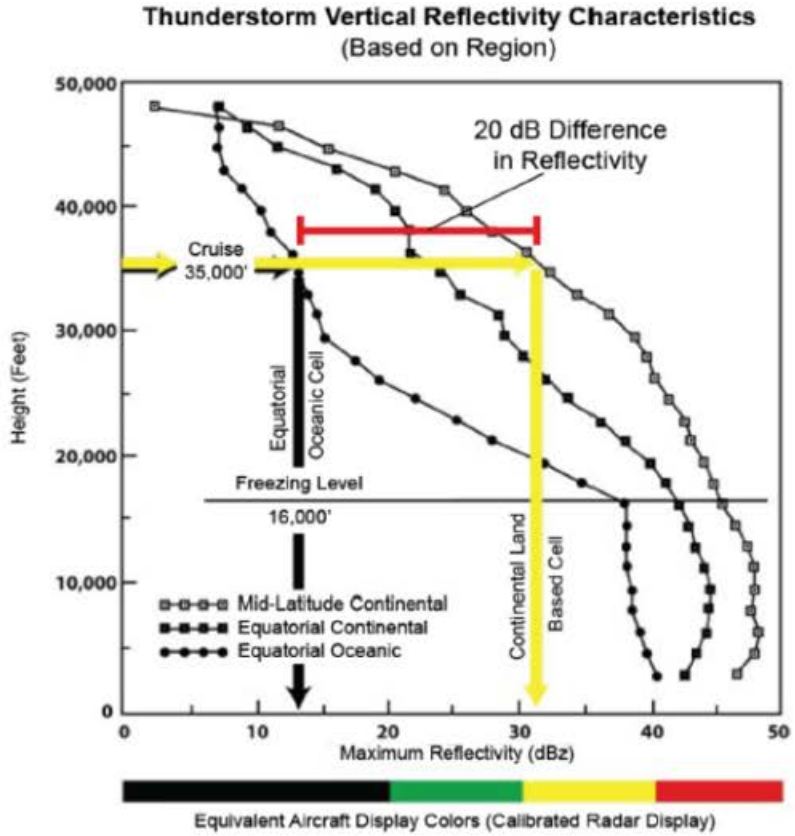
TIP

When possible, minimize time in the vicinity of the freezing level to reduce the potential for lightning strikes.

NOTE

Later stage cumulus cells are not a significant lightning threat at cruise altitude. Therefore, the mid altitude associated threat icon is no longer displayed once the aircraft climbs more than 10 000 ft. above the freezing level.

Figure 7-13 Thunderstorm Vertical Reflectivity Characteristics (Based on Region)

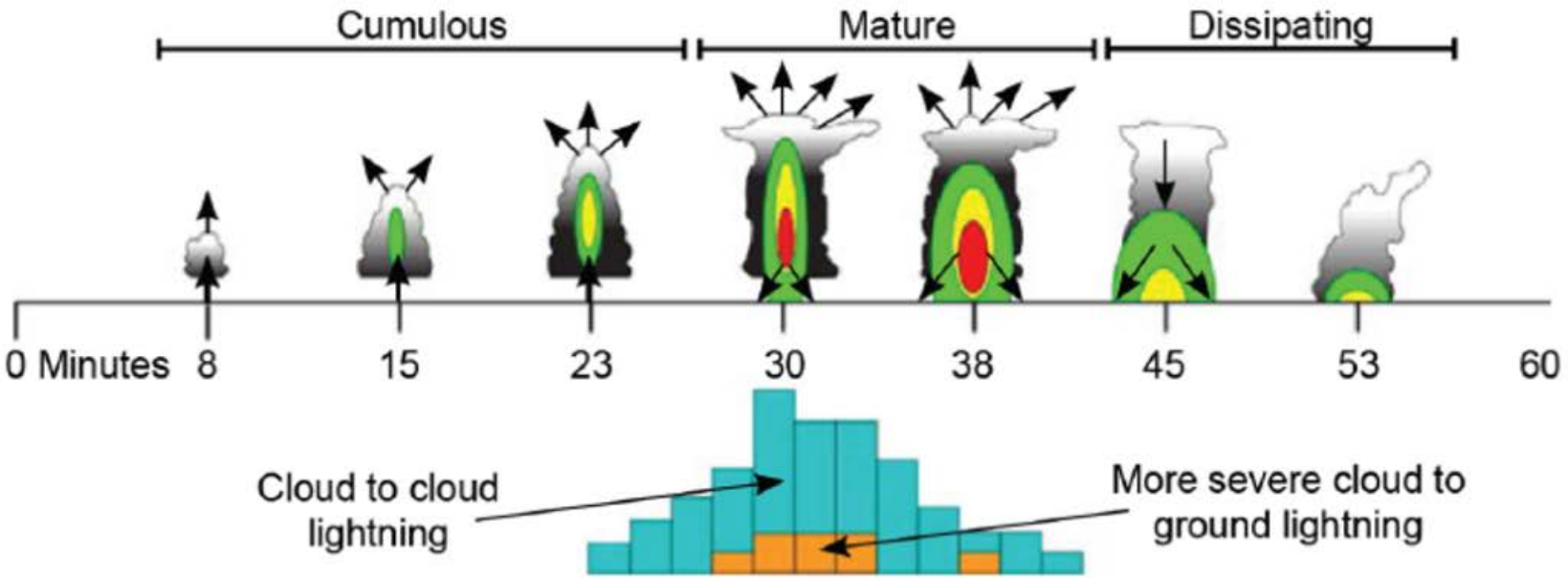


Land masses cause differential heating that produces strong updrafts. Thus moisture is carried to high altitudes and increases the reflectivity of land based cells. Oceanic regions, however, act as a heat sink (constant temperature) resulting in only moderate updrafts and less moisture/reflectivity at higher altitudes.

雷暴的一生剖析

AUTONOMY OF THUNDER STORM CELL

Figure 6-8 Cell Life Cycle



Lightning potential exists during the latter cumulous stage and the mature stage of thunderstorm development. During the Mature stage additional threats include hail and severe turbulence which may extend outside the cell boundaries.

TPO5424_01

回波信号衰减

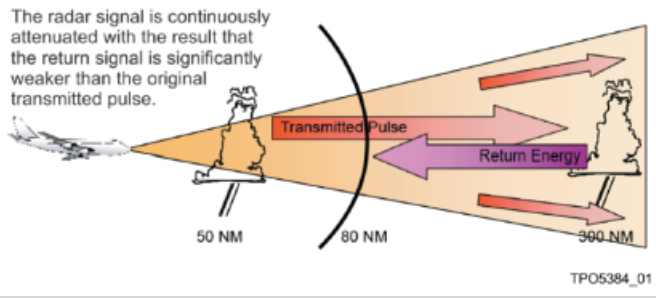
ATTENUATIONS

1. Coulomb's law $F=kQ1.Q2/r^2$ ($k=1/4\pi\varepsilon0$) 库伦定律：电波强度与距离平方成反比
2. Low reflectivity of body of precipitation in nature

ATTENUATION

Significant attenuation of the radar signal due to absorption and scattering occurs as the transmitted pulse moves to its furthest range and again during transit back to the receiver from a radar target. In addition, beyond 80 NM a normal thunderstorm (defined as a 3 NM sphere of water) no longer fills the radar beam. As a consequence, significant amounts of radar energy bypass the target entirely. Thus, for weather targets detected at extended ranges, the signal received back at the aircraft is significantly weaker than the original radar pulse.

Figure 4-11 Range Attenuation

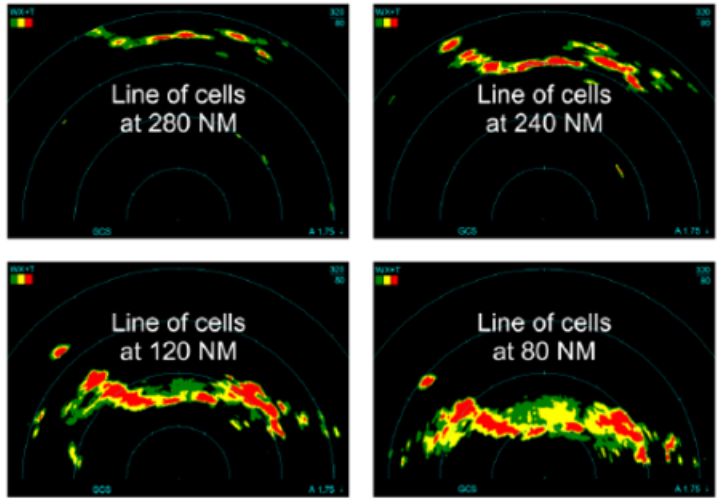


ATTENUATION AND THE DISPLAY OF LONG RANGE WEATHER

At longer ranges, due to attenuation, the radar will only be able to see very strong weather such as thunderstorm cores. As these storms approach the aircraft, more of the cell becomes visible. In the pictures on the following page, first note the line of cells at 300 NM. As the cells approach the aircraft, attenuation is lessened and the cells appear to grow. Within 80 NM the full extent of the storms becomes visible to the radar.

Figure 4-12 Line of Cells

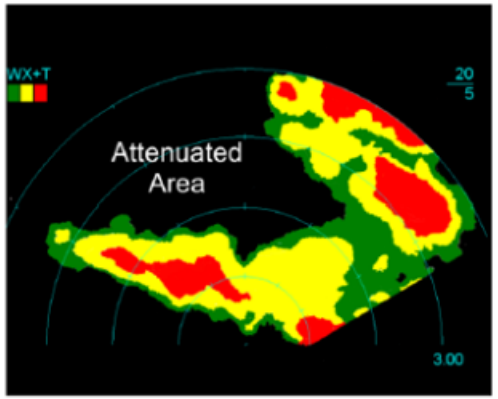
Due to attenuation the radar can only see thunderstorm cores at 320 NM. As cells near the aircraft they will appear to grow. In actuality, attenuation is decreasing and the radar is better able to see the full extent of the cells.



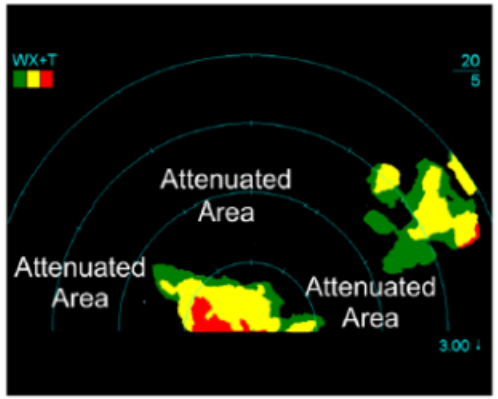
回波信号衰减及警告

ATTENUATION AND WARNING

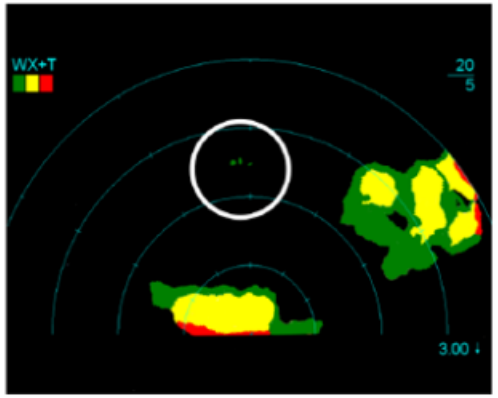
Figure 4-16 Radar Attenuation Sequence



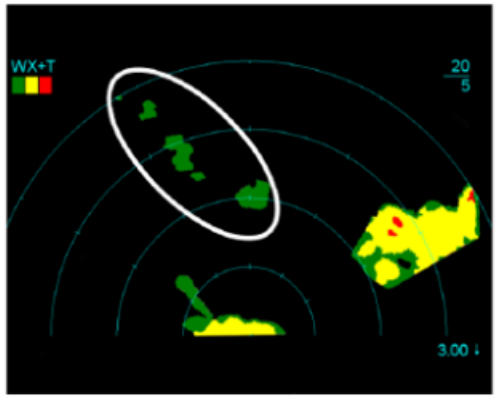
1. Due to attenuation the cells at 5 NM are masking significant weather behind them.



2. Upon penetration attenuation increases Previously visible weather is masked.



3. At the mid point of the penetration a small weather return is visible behind the storm.



4. Near the trailing edge of the initial storm cell several additional returns become visible.

Figure 4-17 PAC Alert — Attenuated Regions (Radar Shadow)

The yellow PAC Alert bar warns flight crews of attenuated regions, (sometimes called a radar shadow) while maintaining the Quiet, Dark Cockpit philosophy.

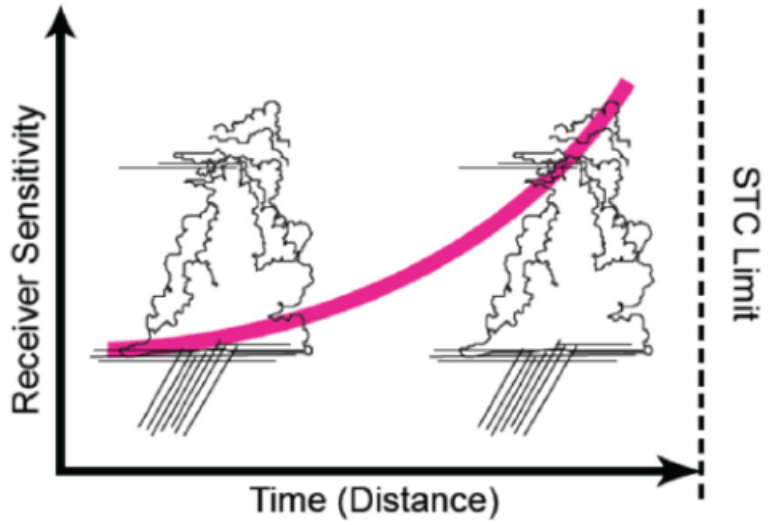
回波灵敏度补偿回路-库伦定律：电波强度与距离平方成反比

SENSITIVITY CONTROL STC - COULOMB'S LAW $F=kQ1.Q2/r^2$（$k=1/4\pi E0$)

SENSITIVITY TIME CONTROL (STC)

Sensitivity Time Control (STC) is designed to compensate for beam attenuation of the radar by increasing receiver sensitivity over time so that more distant thunderstorm cells have more energy on the target than do cells closer to the aircraft.

Figure 4-13 Sensitivity Time Control Graph



Sensitivity time control (STC) increases receiver sensitivity over time. As a consequence distant thunderstorm cells have more energy on target than do close in cells.

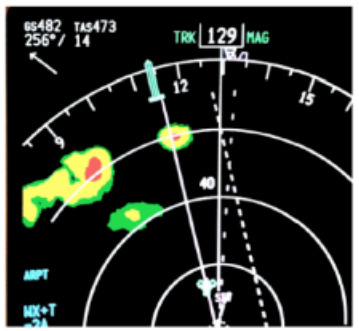
TPO5385_01

As cells approach the aircraft, STC decreases sensitivity to prevent the cells from growing in intensity. However, due to the use of increased gain in AUTO (see page 4-4), it is not unusual for green returns to appear at 40-50 NM. Green in this case represents very low reflectivity returns (two color levels below the normal green threshold). The green areas can be transited, and light to moderate chop can be expected. As an example, the following pictures depict a transit corridor between two cells at 50 NM. However, green returns become visible between the cells at 40 NM. Essentially, at 40 NM the radar is displaying the haze layer that is between the two cells (see page 5-1, Radar Interpretation for additional information on "What Does Green Mean?").

TIP

It should be considered normal radar operation when green appears on the display at around 40-50 NM. In this case, green represents navigable weather and light to moderate chop would be expected.

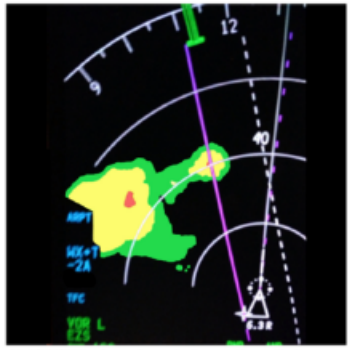
Figure 4-14 Sensitivity Time Control on ND — 50 NM



At 50 NM a potential transit corridor can be seen between the cells at the top left of the ND.

TPO5386_01

Figure 4-15 Sensitivity Time Control on ND — 40 NM



At 40 NM the haze layer between the cells is displayed. Light to moderate chop can be expected.

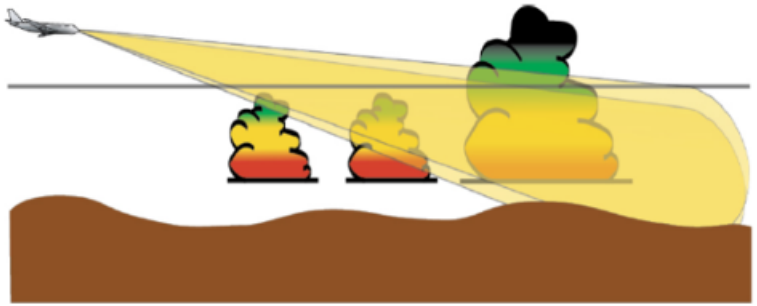
自动模式不是万灵丹

AUTO MODE WON'T SAVE YOU A DAY

MULTISCAN V1

MultiScan V1 software was incorporated into the radar in 2008. MultiScan V1 introduced the Quiet, Dark Cockpit concept (i.e., only threat weather is displayed). Using the Beam to Beam Power Comparison technology developed for MultiScan, the radar draws a line 6000 ft. beneath the aircraft at cruise altitudes. Non-threat weather that is below the line (approximately 6000 ft. beneath the aircraft) is not shown. Threat weather above the line is displayed on the Navigation Display (ND).

Figure 2-4 Quiet, Dark Cockpit Concept (6000 ft Line)

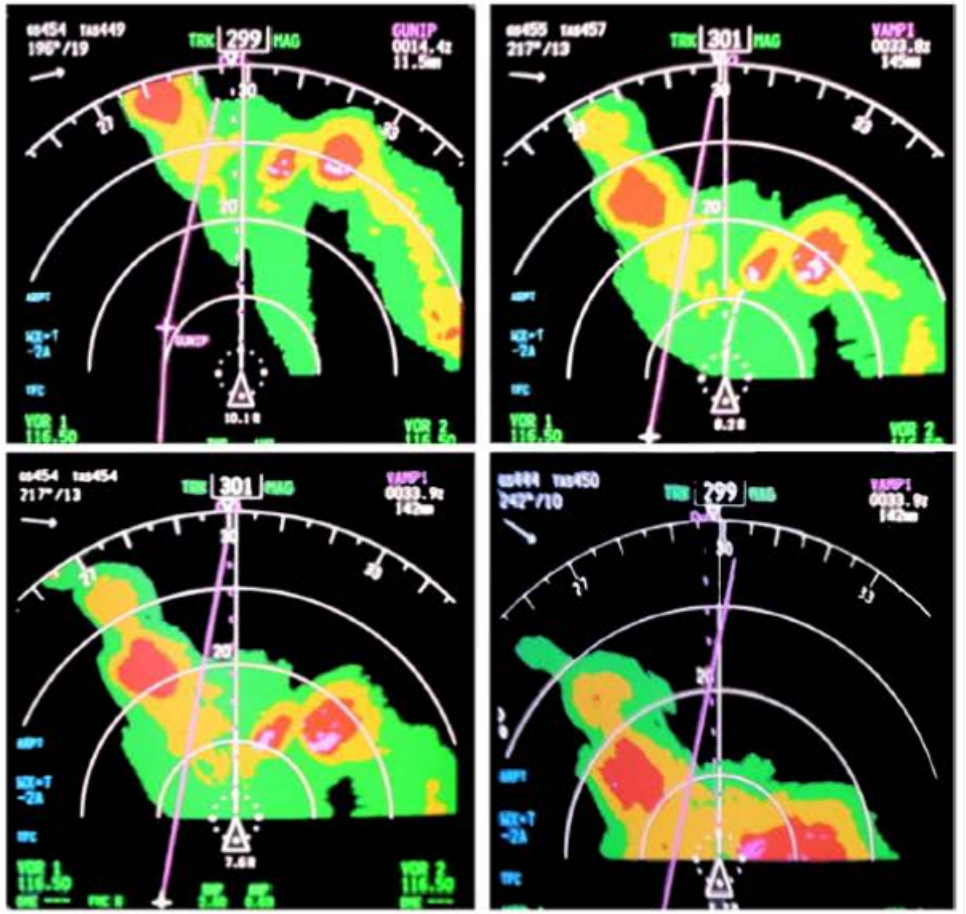


A line is drawn six thousand feet beneath the aircraft altitude. A beam to beam power comparison is then performed and only weather above the line is displayed.

TPO5369_01

If the Wx 6000 ft below is insignificant, why BLOOMING becomes an issue?

Figure 5-36 Blooming



In this sequence of photos the crew made the decision to deviate through the green path between two cells. In the second picture yellow blooming is beginning directly ahead of the aircraft at 10 NM. Blooming continues until the entire area within 10 NM of the aircraft has turned yellow. Blooming over represents the threat. Only light chop was encountered.

TPO5407_01

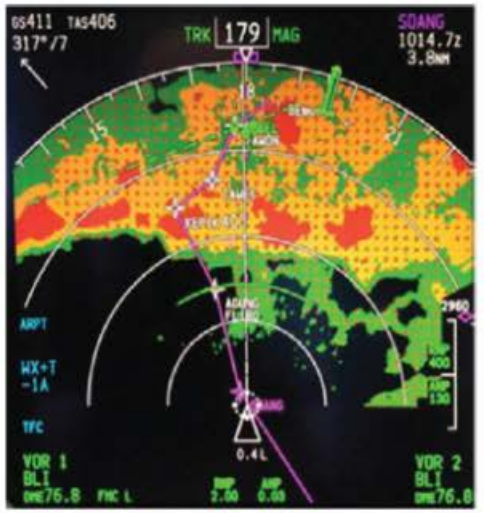
理解并有效使用自动模式-勿盲目自动

DO NOT BLINDFOLD AUTOMATICALLY

Monkey pushes the buttons, human push the brain !!

Figure 6-3 MultiScan Weather Returns

MultiScan V1 Weather Returns



MultiScan ThreatTrack Weather Returns

TPO5421_01

Note that the ThreatTrack software is operating properly in the second picture (i.e., this is not really an over sensitive condition). The Core Threat Analysis feature has determined that the cells are more convective than they actually appear. Therefore, the radar has increased the returns to better convey the actual threat. And the fact that the red speckles are inside the cell boundaries indicates that these cells are moderate (not severe), but create an increased probability of a lightning strike (see page 6-9). In this case, yellow really does mean caution.

The best way to navigate these cells is to turn the gain down to reduce the intensity of the returns by about one color level (see page 4-1).

自动模式下可能威胁预警

AUTO PRECAUTIONS

Real flight Example 1-1

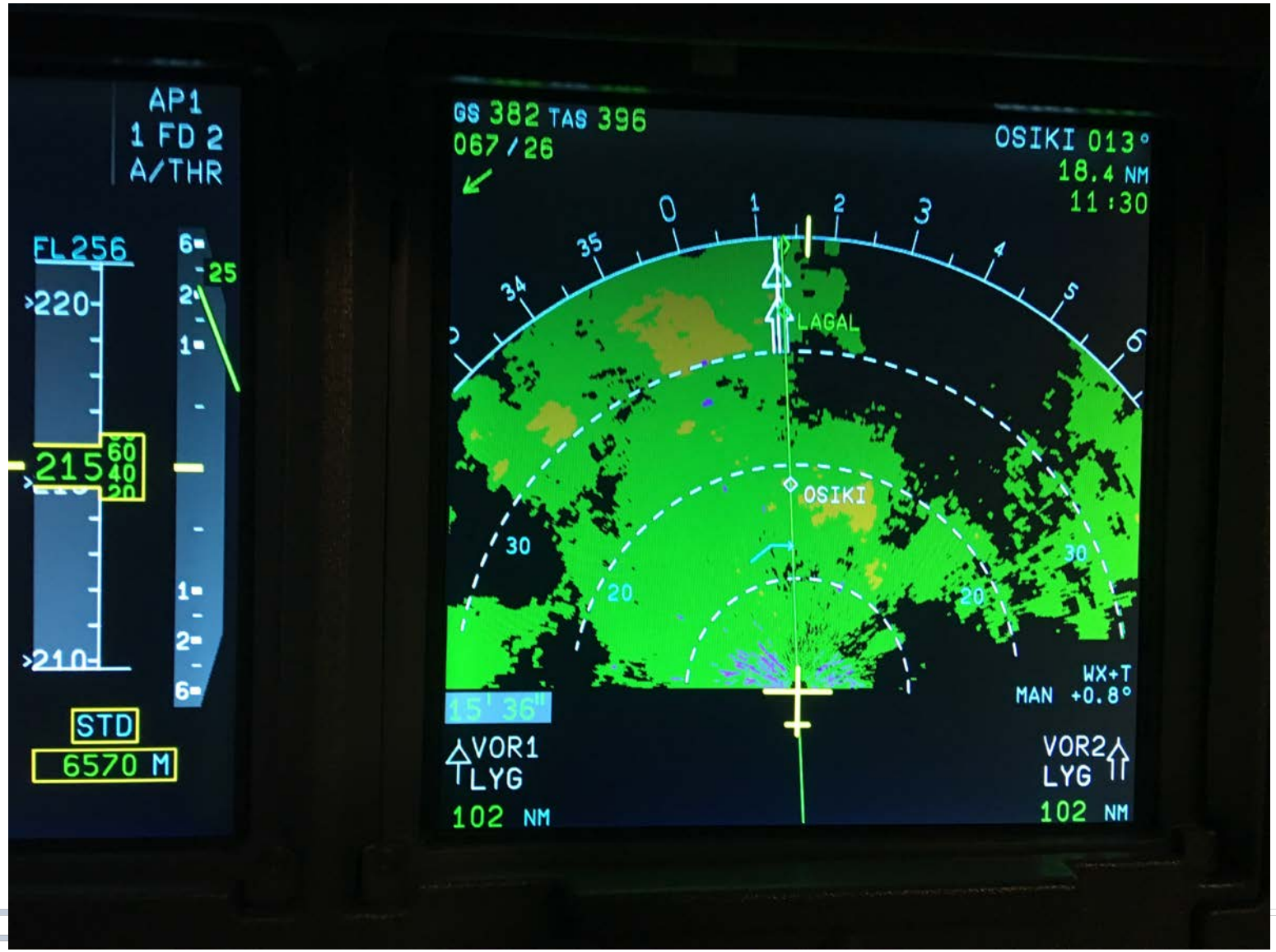
Spot the potential threat for further analysis

转换人工模式确认

MANUAL CONFIRMATION

Real flight Example 1-2

Concur threats for avoidance path



自动模式提供信息可能不完整

AUTO MODE MIGHT TRAP YOU

Real flight Example 2-1

Shortly after take off

AUTO indicated only precipitation at 030-040 bearing / 20NM range

人工模式逐步确认

AUTO MODE MIGHT TRAP YOU

Real flight Example 2-2

Revert to manual mode

And tilted up +2 at 030-040 bearing / 20NM range

确认威胁-回避

AUTO MODE MIGHT TRAP YOU

Real flight Example 2-3

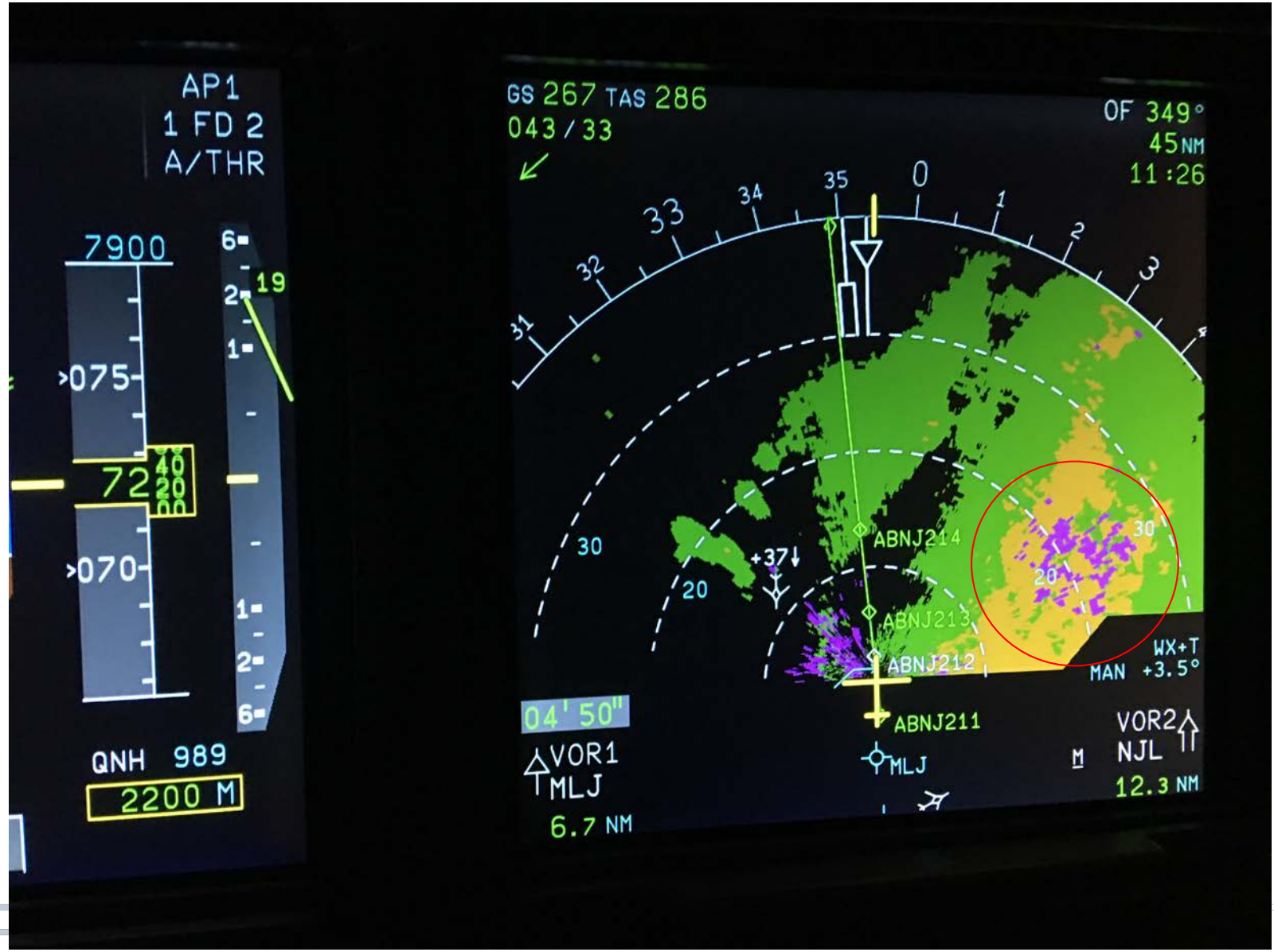
Revert to manual mode

And tilted up +3.5 at 030-040

bearing / 20NM range

indicates cumulous stage TS

at high ALT hidden by AUTO

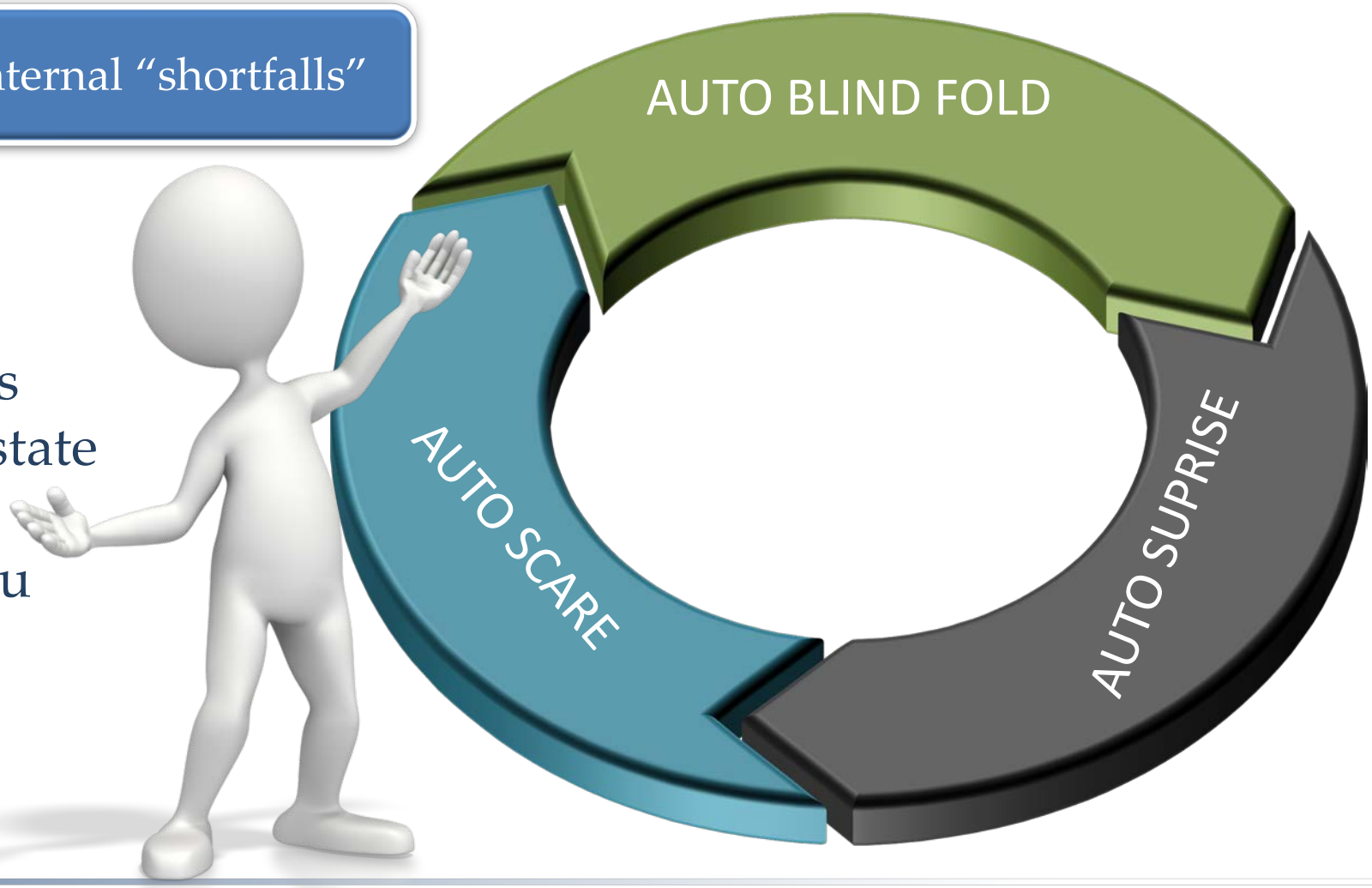


总结 – 正确合理地理解并使用机载气象雷达

SUMMARY – UNDERSTAND THE RADAR CORRECTLY& USE WISELY

Be advised of internal “shortfalls”

Some functions may have the state of art in mind….but you are a pro pilot



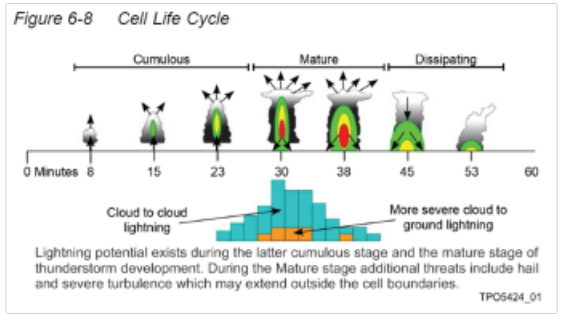
正确理解威胁性天气

CORRECTLY UNDERSTAND THE WX THREATS

Torrential Rain

Lightening Strikes

Low Visibility



Turbulence

Hail Strikes

You need to know how Wx are formed and how will they affect you

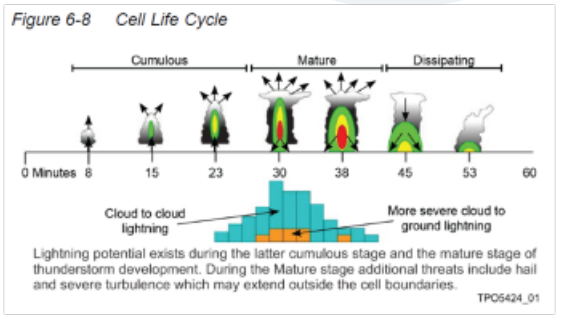
30000 ft

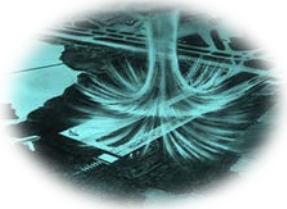
20000

10000

5000

GND





Low VSBY LL WS +RA Turb TS Lightening Strike Hail

绕飞决断听谁的

TO WHOM THAT YOU WILL FOLLOW

AUTO Mode may impair your SA

Auto Mode may lead you to inconsistent judgement

Auto Mode may give you false warning

You are the pilot, you call the shot, not Airbus nor Rockwell Collins

总结 – 正确合理地使用机载气象雷达

SUMMARY OF PROPER USE OF ON BOARD WX RADAR

Disclaimers:

1. The statements herein are based on weather radar manufacture's user manuals (WXR2100/WRT2100) and Airbus recommendation of how to use the weather radar; in addition to author's experience, operational practice and validation of proclaimed functions by the user's manual in real flight.
2. It is based on the campaign of Airbus RDPM (Recognition Primed Decision Making) principal in which way the experience counts.
3. These statements are by no means official nor intended to replace airlines policies and procedures, if airlines only require pilots to use recitation, i.e. 1 notch, 2 notch, instead of understand the system logic about what is the functions behind the "notch", then all reference herein has no reference value in all circumstance.
4. These statements are not indented for recite & apply, these are not procedures but the means to understand the system logics of Wx radar and the structure of Wx threat therefore understand the interaction in between mother nature and man-made machine to archive both safe and efficient operation in regard to decision making for "threat" avoidance in flight, author will not be held liable in any way whatsoever, reader's discretion is advised.

总结 – 正确合理地使用机载气象雷达

SUMMARY OF PROPER USE OF ON BOARD WX RADAR

免责宣告:

1. 本文论述系参照雷达制造商所发布雷达使用手册(WXR2100/WRT2100)以及空中客车公司对于机载雷达的使用建议，并基于多年经验，根据雷达使用手册所宣称的功能在实际航班运行所综整得出结果。
2. 决断的思路的实践系根据空中客车公司所倡议的「全方位认知决断模式」RDPM (Recognition Primed Decision Making)，经验是决断的核心依据。
3. 本文的论述非属任何官方文件或经官方认可的文件，更不是用来取代个别航司的天气绕飞政策或既有的程序，如果个别个人或航司规定系以死记硬背式的操作，例如增益加一档、两档等等，而非加一档为增加4dbz 的意义为何？对系统功能产生的效果为何，则本文对其并不适用。
4. 本文的论述以及附表总结出的结论，目的在于透过概括性的快速判断，帮助飞行员短时内能做出合理绕飞天气威胁的路径，并非可供强记并直接套用的程序，还必须透过对机载雷达工作原理的认识及对威胁天气的形成理论，交叉验证、实践获取经验跟信心，达到实现高效、安全的运行，珍惜有限的空域资源，请自行判断采用并承担责任。

总结 – 正确合理地理解并使用机载气象雷达

SUMMARY – UNDERSTAND THE RADAR CORRECTLY& USE WISELY

SETTING OF NAVIGATION DISPLAY

320 NM 海里	160 NM 海里	80 NM 海里	40 NM 海里
General overview	Strategical planning	Circumnavigation Decision making	Threats avoidance
总览	绕飞策略预案拟定	绕飞决断	回避危险天气
AUTO	AUTO+MAN+AUTO	MAN+AUTO+MAN	MAN+AUTO+MAN+MAN

总结 – 天气绕飞敬畏指数

Summary – Wx Avoidance Respect Index

Wx Avoidance Respect Index 天气绕飞敬畏指数							
Doppler Effect Turbulence 杜普勒效应颠簸反应			Aircraft Altitude 飞机高度	Radar Echo 雷达回波			
Magenta 洋红			(Radar Echo ±10000 ft)	Black 黑	Green 绿	Amber 橙黄	Red 红
RANDOM /LIGHT / SCATTER AND PATCHY	显示不定/色淡/分散不集中(注1)	0	-5000 ft	0	0	1	2
STEADY LIGHT / SMALL AREA / PATCHY	持续显示色淡/小范围 / 分散	1	5000 ft -10000 ft	0	0	1	2
STEADY BRIGHT / SMALL AREA	持续显示色浓/小范围	2	15000ft -20000 ft	0	0	1	3
STEADY BRIGHT / LARGE AREA	持续显示色浓/大范围	3	20000 ft - 25000	0	1	2	5
注1(note 1)：possible nuisance 有可能是假信号 *"area" is relative term, refers to relative to the area of precipitation echo "小范围"是相对而言，相对于所在回波范围而言。 ***Wet top is identified by MAN tilt and effective gain setting, CAL as basis no more than +4 dB**			25000 ft +	0	2	4	5

@ Respect index敬畏指数= Magenta 洋红 （index） + Radar Echo 雷达回波(index)

❺= Threat Avoid 威胁，果断绕飞

❹= Threat Avoid威胁，果断绕飞

❸= Consider a threat Avoid，seat belt sign on PA everyone be seated if not 考虑绕飞，若不绕飞，系安全带灯开/广播全员就座

❷= Not a threat 非威胁

❶= Not a threat非威胁

*This a supplement only to a professional pilot, not a procedure for recited and repeat; Airmanship and professional knowledge shall prevail.

*本表仅供实际飞行中印证理论知识的补充参照，并非可供死记硬背照的程序，职业素养的体现与专业知识才是最终的决断依据

延误的锅该谁背？

WHO IS RESPONSIBLE FOR AIR TRAFFIC CONGESTION AND DELAYS ?

Professional pilots exercise their professional knowledge, CRM principal and Aeronautical Decision Making with critical thinking.

Amateur pilots make decision based on senseless speculations and wrongful belief without logical thinking.

99.999999 % of the time is not critically related to safety in term of CRM decision making . *(.....safe and efficient flight,FAA)*

Thank You