The

CIX

VFR Club

WEATHER

for

VFR PILOTS

NOT TO BE USED FOR REAL WORLD AVIATION

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Document History

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The author, Peter Dodds, is CEO and CFI of the Cix VFR Club, and a VATSIM P1, P2 & P3 Rated pilot, and S2 rated Controller.

1 GENERAL INFORMATION

The manual is designed to provide weather information for virtual pilots which is similar to and parallels the weather considerations for real world pilots of light aircraft. Where the Flight Simulator or VATSIM situation differs from real world situations, such differences are highlighted. This to help Virtual Pilots perform as realistically as possible, which is one of the things which makes the hobby so enjoyable.

2 WEATHER IN FLIGHT SIMULATOR

The knowledge of the weather required in real world private flying is quite detailed. It includes how weather is created and what makes it change; what those changes mean for flight planning and for the en route aircraft, Some of these topics really do not affect Flight Simulator Pilots.

In Flight Simulator, the weather does not change realistically. It can be programmed to be fixed or to change with time, or to use real weather data. If real weather data is used, FS downloads the data from an international source and interprets it reasonably correctly. When flying on VATSIM or IVAO, FS is set to “User Defined Weather”, and the pilot client software passes real world weather information to FS, which it then interprets and displays. So far so good.

The problem arises when the aircraft is flown near to another weather station and the pilot client software updates the weather with this new data. One of two things can happen.

a) The weather suddenly changes to that of the new station. Cloud levels and cover can change, precipitation can start or cease and a new atmospheric pressure may abruptly change the altimeter reading.
b) The weather can suddenly clear to infinite visibility and no cloud, (no weather information) and then a few minutes later suddenly change again back to the real weather from the new weather station.

This is something we don't have to live with, fortunately for the purists among us. There is at least one very realistic weather addon for Flight Simulator which provides a much better "weather engine" for flying. The clouds look a bit more realistic too, but there is a cost, performance as well as financial, as creating and displaying cloud is quite an processor intensive process.

3 WEATHER INFORMATION IN CODE

Aviation weather forecasts come in three types:

Terminal Area Forecasts, abbreviated to TAFs

Meteorological ActualReports, abbreviated to METARs

Special reports, abbreviated to SPECI

4 METARS

This section explains how to decode a UK METAR. US METARs have a slightly different set of abbreviations.

Below is an example of a typical METAR code

110930Z 24012G25KT 210V280 8000 R271900 +SHRA SCT09 BKN15CB 10/08 Q1014 TEMPO 09301230 25016G35KT

METAR code is made up of several sections. Sometimes some sections are not included, for instance if the weather is very stable during high pressure conditions, typically.

EGBJ	Airport Code to which the TAF applies: Gloucestershire in this case.
110930Z	This is the date and time of the report - in this case the 11th of the month at 0930 UTC (formerly Greenwich Mean Time). The Z suffix means UTC and is recognised world wide.
24012G25KT	The first 3 digits give the wind direction in degrees from north - in this example 240 degrees, or broadly from the south west. If 000 is shown it means nil wind i.e. calm. If VRB is shown it means the wind direction variable. The next 2 digits give the wind speed in knots - in the example this is 12 knots. If the windy is gusty, this is shown with a 'G' followed by the maximum gust velocity recorded in the previous 2 hours. Other units are MPS (metres per second).

210V280	The first 3 digits give the wind direction in degrees from north - in this example 240 degrees, or broadly from the south west. If 000 is shown it means nil wind i.e. calm. If VRB is shown it means the wind direction variable. The next 2 digits give the wind speed in knots - in the example this is 12 knots. If the windy is gusty, this is shown with a 'G' followed by the maximum gust velocity recorded in the previous 2 hours. Other units are MPS (metres per second).
8000	This is the visibility in metres. 9999 = 10kilometres or more, 0000 = Less than 50 metres. Other units are Statute Miles, mainly in the USA, in which case the digits have SM on the end.
R271900	This is the Runway Visual Range (RVR) and is usually only given if the visibility is 2000m or less. In this case the RVR for unway 27 is 1900 metres. Rarely, the visibility may be prefixed with P, which means "more than" e.g. (P1000 = More than 1000m). An RVR can be variable and the format then similar to the variable wind; 0600V900 (varying between 600m and 900m)
+SHRA	This is the current weather. A number of 2-letter codes may be used in combination. These letter codes are listed in section **Error! Reference source not found.** below.
SCT09 .	There may be up to three cloud layers reported. This code means "scattered, with a base level of 900 feet above the aerodrome",
BKN15CB	This one means Broken with a base of 1500ft and thunderstorms.
10/08	This is the Temperature and Dew Point in degrees Celcius. The temperature is the first 2 figures and the second two figures are the Dew Point (the temperature at which the air is saturated - cannot hold any more moisture Minus temperatures are prefixed by an M, e.g. M01 = - 1°C. If the temperature and the dewpoint are close together, then expect carburettor icing in conventionally aspirated aircraft engines - yes even in Flight Simulator
Q1014	This is the barometric pressure at sea level, for which the code QNH is used in the UK and some other countries, expressed in hectopascals.

TEMPO 09301230 25016G35KT	This is the trend forecast for the next two hours (09:30 to 11:30). Options are: - BECMG = Becoming, TEMPO = Temporarily, NOSIG = No Significant Change. So TEMPO 09301230 26016G35KT. means: Temporarily, between 0930 and 1230, the wind will be more westerly, stronger and with stronger gusts than the general forecast wind.

4.1 Atmospheric Pressure

Atmospheric Pressure used to be measured in millibars, which have the same numerical value as hectopascals. 1000 millibars is 1 bar, or 14.2 lb/sq in. In the US and some other countries, the barometric pressure is measured in inches (of mercury - 30 inches of mercury being equivalent to 1 bar or 14.2 lbs/sq. in

In general, the numerical value is only of interest for correctly setting the altimeter, but as a general rule low QNH values less than 1015 approximately mean poorer weather, whereas higher QNH values signify better flying weather.

4.2 Cloud

Cloud definitions require further explanation. The amount of sky covered by cloud and the height of the base of that cloud layer are reported. The first three letters are the cloud cover of the layer. Cloud cover used to be reported numerically as octas, 8 octas being overcast. However, cloud cover descriptions have changed in recent years. The current definitions are as follows: -

SKC = sky clear;

FEW = Up to 25% cloud cover;

SCT = From 26% - 50% cloud cover

BKN = From 51% to 90% cloud cover;

OVC = Overcast (91% to 100% cloud cover);

/// = “State of sky obscured” (figures after the /// will give forecast vertical visibility in hundreds of feet).

NSC = no significant cloud (none below 5,000 feet and no CB). CB will be the only cloud type specified

CAVOK means “Cloud and visibility OK”. More specifically it means “No cloud below 5,000ft, visibility 10 kilometres or more, no Cumulonimbus (thunderclouds) and no towering cumulus, and none forecast”. Where appropriate, it replaces visibility and cloud groups in TAFS and METARS.

CB means "Cumulonimbus". Cumulonimbus clouds are nasty. They are known by pilots as “Ceebees”. They aren’t well simulated in FS, but in the real world a light aircraft can be sucked up or forced down by vertical air currents way beyond its ability to be controlled. They can be turned upside down or even break up in extreme thunderclouds. Real world pilots give CBs a wide berth. The recommended flight distance from a CB cell is no less than 10 nautical miles.

Towering cumulus is a cloud formation which is likely to turn into a CB. It will certainly be very turbulent if you get inside it.

The three figures following the letter code are the height of the cloud base, in hundreds of feet above the ground at the reporting station. 000 = Below 100ft, 001 = 100ft, 002 = 200ft etc.. Be careful with this value, as it is easy to be confused and think that 250 is two hundred and fifty feet, not twenty five thousand feet, (which won't affect anyone, unless it is a thunder cloud.)

If CB follows the cloud layer and height, it means the cloud is Cumulonimbus cloud (one or more thunderstorm cells). If TCU follows it means Towering Cumulus. Light aircraft must avoid flying within 10 nautical miles of thunderstorm cells otherwise they can become uncontrollable in the turbulence within a storm cell. In the real world, if CB activity is widespread, light aircraft pilots stay on the ground!

5 TAFS

The code for TAF's is quite similar to that for METARs. Being a forecast, there are a number of estimates made in regard to wind, weather (precipitation) and temperature, mainly. The code PROB30 or PROB40 is therefore often seen. It means "There is a 30% (40%) probability that the following item will occur. Among real world pilots with long experience, it is translated PROB30 probably won't happen; PROB40 and above probably will! It is unlikely you will see PROBs less than 30.

Here is an example TAF.

EGKK 121703Z 1218/1324 33007KT 9999 FEW025 BECMG 1302/1305 7000 PROB30 TEMPO 1305/1309 3000 BR BECMG 1309/1311 9999 BECMG 1320/1323 22012KT PROB30 TEMPO 1322/1324 7000 RA

This is a fairly complex one, but it looks more frightening than it is. Each group of characters can be expanded, and some in a way that almost reads like plain English! -

EGKK	Airport Code to which the TAF applies: Gatwick in this case.
121703Z	The time of issuing the forecast.

1218/1324	The period for which it is valid. This is an "18 hour TAF" (there are also "9 hour TAFs"), this one from the 12th at 18:00Z to the 13th at 24:00Z (midnight).
33007KT	The forecast wind: from 330° at 7 knots.
9999	9999 is a special code (also found in METARs, which means "10 kilometres or more", and describes the horizontal visibility.
FEW025	This is the same code as for METARs again - this snippet being "Few clouds with a base at 2500ft".
BECMG 1302/1305	Becoming, sometime between 02:00 and 05:00 on 13th...
7000	... 7000 metres visibility - i.e. the visibility is forecast to reduce from 10 kilometres or more to 7000 metres in the early hours of 13th...
PROB30	A 30% probability exists that...
TEMPO 1305/1309	... temporarily, between 05:00 and 09:00 on the 13th...
3000 BR	... the visibility will reduce to 3000 metres in mist. (BR for mist is an odd code, some say it stands for Baby Rain, but the truth is that it is an abbreviation for the French Brume, meaning mist.) How do we know that 3000 means visibility in metres and not 3000 feet cloud ceiling? Because cloud ceiling is measured in 100s of feet with the trailing zeros omitted. So the clue is in the size of the number.
BECMG 1309/1311	Becoming, sometime between 09:00 and 11:00 on 13th...
9999	Nice and clear again! (More than 10 Km of course, technically).
BECMG 1320/1323	Then, between 20:00 and 23:00 on 13th...
22012KT	the wind will "back" from 330° to 220° and freshen a little to 12 knots. The term "veer" for wind is familiar, and means that the direction it is coming from moves round clockwise. "Back is less familiar, and means that the direction it is coming from moves round anticlockwise. Similarly, "freshen" means go a bit faster.
PROB30	A 30% probability exists that...

TEMPO 1322/1324	...temporarily between 22:00 and 24:00 on 13th...
7000 RA	...it will rain, and the visibility while it is raining will be 7000 metres. 7000 RA are often coupled together, because that is the normal approximate visibility whenever it is raining.

So - when, if at all, will it be a good day to fly a light aircraft on a short cross-country trip or perhaps a night flight? The answer is that sometime between 09:00 and 11:00 on 13th, there will be light wind and good visibility, though the wind will back and freshen later, but still within limits for a light aircraft, and this "weather window" will last until about 22:00 or midnight, when it may start to rain.

Note that BECMG is more certain than PROB, and TEMPO can last all day, even though it is supposed to be only "temporarily".

It is really quite simple once you get used to it! It is just that weather is not a certainty in the UK; it's a gamble.

6 WEATHER CODES

DZ= DRIZZLE

RA= RAIN

SN= SNOW

GS= SMALL OR SOFT HAIL

GR= HAIL

PE= ICE PELLETS

IC= ICE CRYSTALS

TS= THUNDERSTORM

HZ= HAZE

BR= MIST

FG= FOG

FU= SMOKE

SS= SANDSTORM

DS= DUSTSTORM

PO= DUST DEVILS

DU= DUST

SA= SAND

SQ= SQUALL

FC= FUNNEL CLOUD (Tornado or Waterspout or similar)

UP= UNKNOWN PRECIPITATION

The following can only be put before one of the above codes. They can't be used on their own.

- = LIGHT

+ = HEAVY

RE= RECENT

FZ= FREEZING

BL= BLOWING

DR= DRIFTING

They can be combined, or used individually, e.g.

+SHRA= HEAVY SHOWERS of RAIN

RERA= RECENT RAIN

RASN= SLEET (RAIN & SNOW)

TSGR= THUNDERSTORM WITH HAIL

BLSN= BLOWING SNOW

+-FZRA= LIGHT FREEZING RAIN

RADZ= RAIN & DRIZZLE

7 THE STANDARD ATMOSPHERE

The International Standard Atmosphere (ISA) is defined as a weather condition where the temperature is 15° Celcius, and the atmospheric pressure is 29.92 inches of mercury or 1013.2 hectopascals at sea level. It is more complicated than that, but it's principal use in aviation is in providing a base set of conditions against which aircraft performance can be measured and compared.

In flight simulator, it isn't actually terribly important, but it is included here, because you will come across the term ISA, and the above is what it means.

8 VISUAL FLIGHT RULES AND WEATHER

8.1 General Principles

Visual flight is permitted when the visual meteorological conditions (VMC) are suitable. The rules which define "suitable" are included within the Visual Flight Rules (VFR) under which the great majority of light aircraft flights are conducted.

The first visual flight rule defines visual flight: -

An aircraft being flown under Visual Flight Rules must be flown clear of cloud and in sight of the surface.

The pilot is solely responsible for maintaining the aircraft clear of cloud and in sight of the surface and for maintaining visual separation from terrain and other aircraft. This is usually known simply as "See and avoid".

When the pilot cannot fulfill these criteria then the flight must be conducted under Instrument Flight Rules (IFR) and the weather conditions are known as Instrument Meteorological Conditions (IMC).

The boundary between IMC and VMC is defined by certain visibility values known as the VMC minima.

- Horizontal visibility
- Clearance from cloud both horizontally and vertically
- Cloud ceilings for take offs and landings

In the UK VFR flight is not permitted in Class A airspace. Until 2012, night flight was always classed as IFR, but from September 15th 2012, VFR at night is now permitted, with certain provisions.

1) Above 3,000 feet above mean sea level, an aircraft must remain at least 1000ft above the highest obstacle within 5 nautical miles either side of track.
2) At or below 3000 feet above mean sea level the aircraft must be flown clear of cloud and with the surface in sight in a flight visibility of 5 km.
3) At or below 3000 feet above mean sea level, if the aicraft is flying at 140 knots or less, indicated airspeed, the aircraft must be flown clear of cloud and with the surface in sight in a flight visibility of 1.5 km.

For full details, see
http://www.caa.co.uk/docs/33/InformationNotice2012145Corrected.pdf.

There is no Class B airspace in the UK.

8.2 UK Defined Weather Minima for VFR Flight

Within Controlled Airspace (Classes C to E)		
At and above FL 100	**Below FL100**	**At or Below 3000ft**
• 8 km flight visibility • 1500m horizontally from cloud • 1000ft vertically from cloud	• 5 km flight visibility • 1500m horizontally from cloud • 1000ft vertically from cloud	Fixed wing aircraft at more than 140 knots: - • 5 km flight visibility • 1500m horizontally from cloud • 1000ft vertically from cloud Fixed wing aircraft at 140 knots or less: - • 5 km flight visibility • Clear of cloud • In sight of the surface

Helicopters inside controlled airspace: - Clear of cloud and in sight of surface

Outside Controlled Airspace (Classes F and G)		
At and above FL 100	**Below FL100**	**At or Below 3000ft**
• 8 km flight visibility • 1500m horizontally from cloud • 1000ft vertically from cloud	• 5 km flight visibility • 1500m horizontally from cloud • 1000ft vertically from cloud	Fixed wing aircraft at more than 140 knots: - • 5 km flight visibility • Clear of cloud • In sight of the surface Fixed wing aircraft at 140 knots or less: - • 1500m flight visibility • Clear of cloud • In sight of the surface

Helicopters may operate at a speed which, having regard to the visibility, is reasonable: Clear of cloud and in sight of the surface

8.3 US Weather minima for VFR flight

Within Controlled Airspace (Classes C and D)	
At and above 10,000ft AMSL	**Below 10,000ft AMSL**
• 8 statute miles flight visibility • 1 mile horizontally from cloud • 1000ft above and below cloud	• 3 statute miles flight visibility • 2000ft horizontally from cloud • 1000ft above or 500ft below cloud

Outside Controlled Airspace (Class E)	
At and above 10,000ft AMSL	**Below 10,000ft AMSL**
• 5 statute miles flight visibility • 1 mile horizontally from cloud • 1000ft above and below cloud	• 3 statute miles flight visibility • 2000ft horizontally from cloud • 1000ft above or 500ft below cloud