

# Smoke and vertical visibility

Thick smoke conditions can be a major hazard to aviation traffic in Australia, particularly due to reductions in visibility.

## Introduction

The bushfire season in Australia during the summer months of 2019–2020 was particularly severe and caused a significant hazard to aircraft operating in the fire affected areas. Thick smoke can cause reductions in visibility and obscure the ground below.

## Detection and monitoring of smoke layers

If human observers are present at a location, they provide direct reports of smoke. Where there are no observers, automatic weather stations (AWS) or remote sensing (such as satellite) are used.

However, smoke can be difficult to detect using automated equipment. Ceilometers and visibility sensors may not report smoke accurately in AUTO METAR/SPECI.

In Australia, AUTO METAR/SPECI do not code smoke (weather code FU). Where a reduction in visibility is detected by the visibility sensor, an AUTO METAR/SPECI may code this as haze (HZ) or dust (DU).

In thick smoke conditions, where there is no cloud present, the ceilometer may detect the smoke and confuse it for cloud. In this situation, smoke may be



Pyrocumulus cloud formed from the severe 2020 Australian bushfires. Credit: Kris Paine

reported as a cloud layer in automated weather reports (AUTO METAR/SPECI) and Centralised Aerodrome Weather Information Service (C-AWIS). The ‘cloud’ height reported may not be indicative of the height of the smoke.

Meteorologists use a range of sources to infer the presence of smoke. Satellite observations may show smoke, especially in thick or widespread smoke situations, though it can sometimes be difficult to discern smoke amongst other cloud. AIREPS and pilot reports, where available, are also critical in these situations.

## Vertical visibility

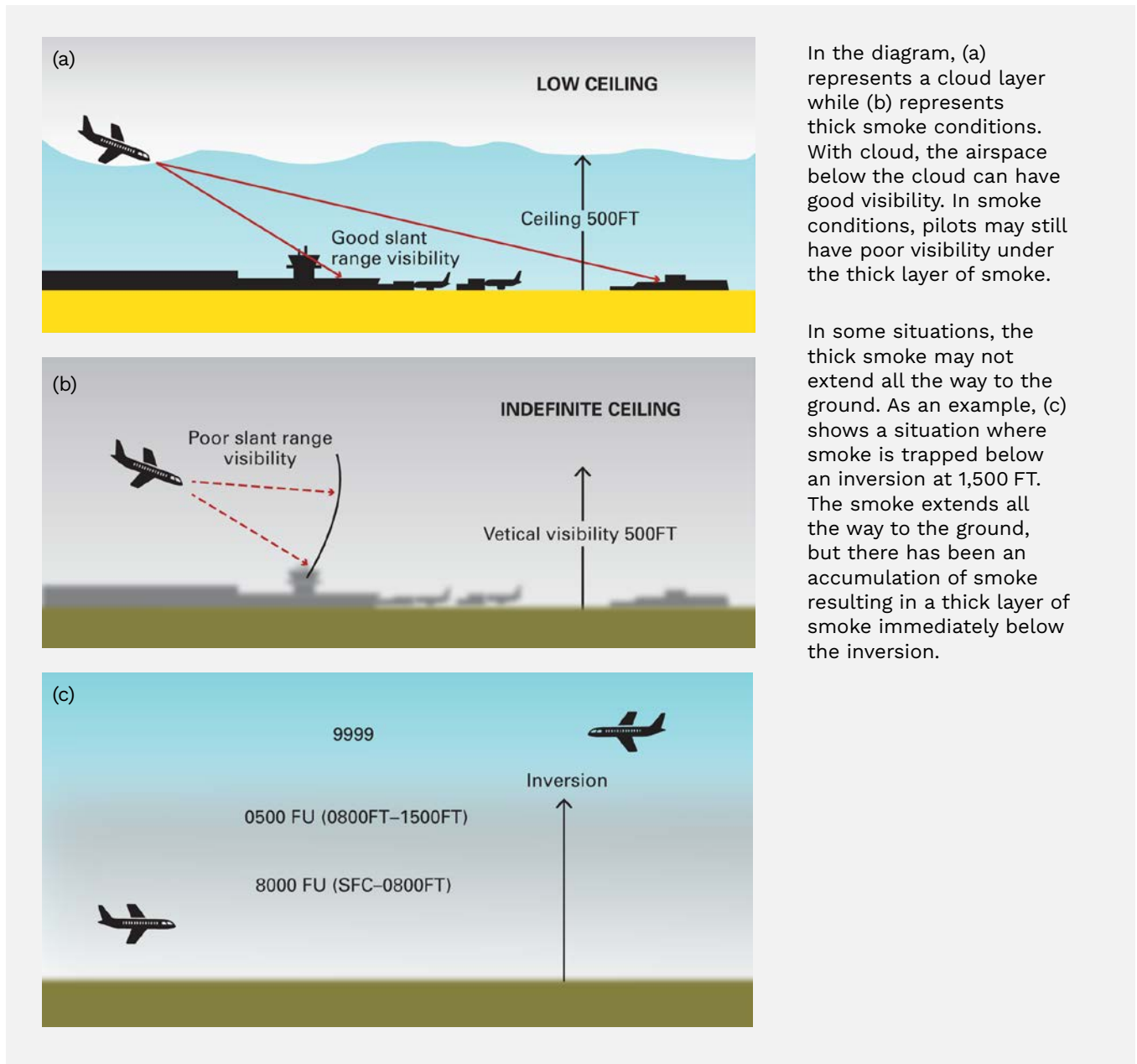
Vertical visibility (VV) can be used to describe a meteorological obscuration (such as smoke or dust). Vertical visibility describes the vertical distance through a meteorological obscuration (e.g. a layer of smoke) that an observer can identify an object. The vertical visibility height is considered a ceiling height. Automated equipment (ceilometers) can report an estimate of the vertical visibility, though this should be used with caution.

In Australia, VV is only used to describe conditions when the sky is obscured by smoke.

Forecast VV is given in TAF and in GAF (for critical locations). Aerodrome weather reports (METAR/SPECI) can include VV only at locations with a human observer. VV is not included in AUTO METAR/SPECI.



Bushfire smoke above Botany Bay, 21 Dec 2019. Sydney Airport is barely visible, but still operating. Credit: iStock



In the diagram, (a) represents a cloud layer while (b) represents thick smoke conditions. With cloud, the airspace below the cloud can have good visibility. In smoke conditions, pilots may still have poor visibility under the thick layer of smoke.

In some situations, the thick smoke may not extend all the way to the ground. As an example, (c) shows a situation where smoke is trapped below an inversion at 1,500 FT. The smoke extends all the way to the ground, but there has been an accumulation of smoke resulting in a thick layer of smoke immediately below the inversion.

## Operational impacts for aviation

Where vertical visibility is forecast, there is a risk of a pilot not becoming ‘visual’ during an approach or not remaining in Visual Meteorological Conditions (VMC). Operationally, the vertical visibility height is equivalent to an overcast cloud layer at that same height; that is, it is equivalent to ceiling height of overcast cloud (OVC).

However, an obscured ceiling differs from a cloud ceiling. Once a pilot descends through a cloud layer, they can normally see the ground and runway. However, with an obscured ceiling, the obscuring phenomena can restrict visibility between the aircraft’s altitude and the ground, and pilots can have restricted slant visibility.

In order to maintain the appropriate level of aviation safety during circumstances when vertical visibility is forecast in lieu of cloud heights, pilots and operators are to treat the vertical visibility height as equivalent to ‘more than SCT cloud’ when determining whether to depart, or continue a flight under the VFR, or plan

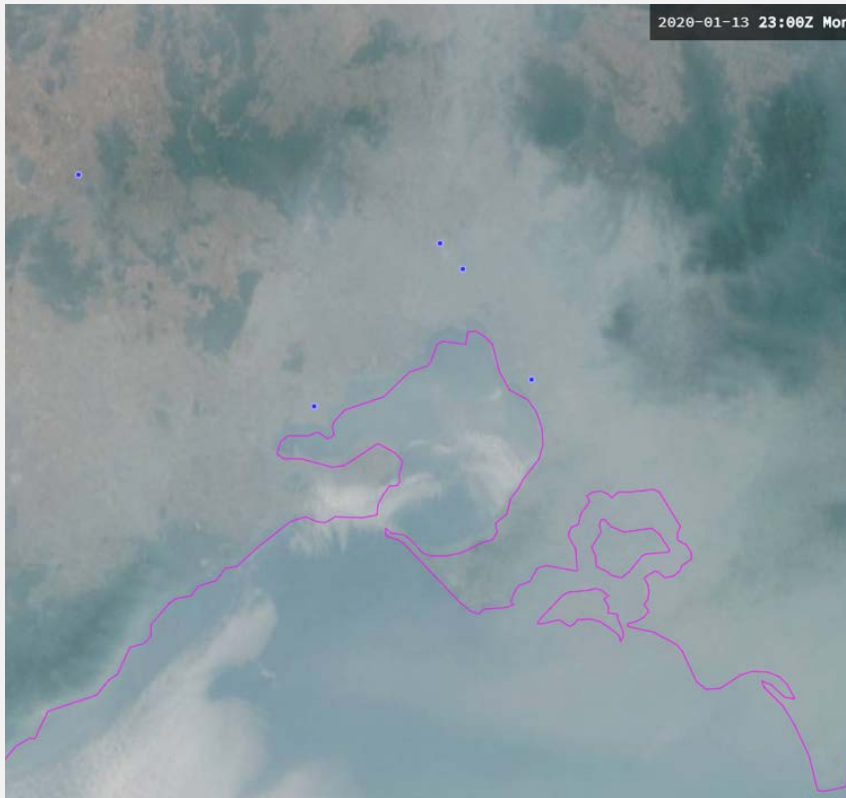
for an alternate aerodrome. Note that these options are subject to the other alternate aerodrome rules and exceptions outlined in AIP, or the subject of individual operator authorisations.

VV allows for information about the height of the thick smoke layer to be communicated, rather than just the surface visibility. With VV, this situation illustrated in diagram (c) should be described in the TAF as 8000 FU VV008 (where the VV is forecast in hundreds of feet using 3 figures). This indicates that the surface visibility is 8000 metres, but there is a thick layer of smoke aloft at 800 feet.

## Forecasts and warnings

Information on Vertical Visibility (VV) is provided in Aerodrome Forecasts (TAF) and Critical Location forecasts within the Graphical Area Forecast (GAF) in lieu of cloud information when smoke is obscuring the sky. Aviation warnings are not issued for smoke.

## A case study: smoke over Melbourne airport



The image shows a visual satellite image over Melbourne at 2300UTC on 13 January 2020. There is smoke over the area, varying in thickness. (You can see the surface in some areas of smoke).

This was represented in aviation products in the following ways.

Note: The Melbourne TAF shown here predates the introduction of the TAF3 service.

```
TAF AMD YMML 132024Z 1320/1500
19006KT 1500 FU VV010
BECMG 1403/1405 15012KT 4000 FU VV015
BECMG 1410/1412 36006KT 7000 FU NSC
FM142000 36018G28KT 9999 FU NSC
PROB30 1320/1403 1000 FU VV010
PROB30 1403/1418 4000 FU VV010
RMK FM141800 MOD TURB BLW 5000FT
T 17 23 30 32 Q 1015 1016 1014 1012
```

VIC GAF, Remarks section:

GAF REMARKS:

CRITICAL LOCATIONS [HEIGHT AMSL]:

KMG [ELEV 1200FT]: 1000M FU NSC, BECMG 1303/1305 9000M FU VV010

**THICK LAYER OF SMOKE WITH ESTIMATED VISIBILITY OF 0500M BETWEEN 0500/2000FT**

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