

The lee side

An old Japanese proverb, “When the sky is blue, Fuji is angry”, had a tragic ring of truth on a fine clear day in March 1966. A Boeing 707 belonging to BOAC took off from Tokyo and crashed southeast of that famous mountain. Even if you’re not old enough to remember 707’s or what BOAC stood for, you’ve probably heard of the phenomenon that led to the demise of the aircraft and all 124 people on board. They flew into a mountain wave.

Typical preconditions for mountain waves to form include:

- A significant range, at least 1000 ft above the surrounding terrain;
- Winds greater than 20-25 knots at the mountain tops;
- Wind at right angles (or thereabouts) to the range;
- A subsidence inversion above the mountains.

An inversion will trap the air rising on the upwind side and force it to descend on the downwind (lee) side, which can give rise to very strong downdraughts and rotors. The downdraughts may be too strong for an aircraft to outclimb, and the turbulence may be enough to break an aeroplane apart, as it did to BOAC Flight 911.



Photo taken by an onlooker as BOAC Flight 911 died. The cloud is fuel escaping from the tanks.

The investigators of that accident found a passenger’s camera that had skipped two frames, and they determined that a load of at least +7.5G would have been required for that to happen. The F-14 that Maverick and Rooster nicked from under the noses of the Persians was built for that kind of load, but an airliner (or “commercial airliner” as the media would say, as though there’s another kind) is not. The 707 lost its tail surfaces, followed by the engines, and finally the section aft of the rear doors. A US Navy A-4 involved in the search for the 707 encountered the same mountain wave. The Skyhawk pilot reported that his head was banging from side to side against the canopy (thank God for helmets) and he was in and out of control. Somehow he got his aircraft pointing more up than down, got out of the turbulence and got home safely. The maximum and minimum readings on his g-meter when he landed were +9 and -4.

If there’s enough moisture to form cloud, the cloud shape at the top of a mountain wave will follow the pattern of air movement, and you may see lenticularis (lens-shaped) clouds – a good indication of danger.



Lenticular clouds

There are plenty of locations in Australia where mountain waves can form, and where lee side turbulence can be a concern. Perth Airport is internationally notorious for the lee side turbulence in the easterly winds off the Darling Range. The airport is far enough away from the hills for rotors and dangerous downdraughts to not be much of a problem, but the turbulence can make early morning landings on Runway 03 or 06 a handful.

When I worked at Moorabbin Airport I did quite a bit of aerial photography flying. On one of those days we were out to the east of town taking photos of houses in the Dandenong Ranges, which are basically the southern end of the Great Dividing Range, where it runs east-west. There was a strong northerly blowing, and at one point the photographer indicated an area south of the hills where there were some houses on his task list. We were no higher than the tops of the hills and I told him that with a northerly, the lee side turbulence would probably mean we'd be bouncing around too much to get good photos. He insisted we try – and fair enough for not giving up that easily – so we flew east until we were in the lee of the ranges. Sure enough, it was a washing machine. No control problems and no damage to the aeroplane, but the photographer agreed not to waste his time taking blurred photos from a bouncing camera.

My son and I climbed Bluff Knoll a few years ago when there was a strong southerly bringing low clouds. We were in and out of the clouds walking to the top, but the sight from the carpark, which is on the north of the mountain, was quite spectacular. The clouds were down to within a few hundred feet of the ground, and we could see them spinning in the rotors caused by the mountain waves. That was a very visible indication that flying there would have been a very bad life choice; even the birds were sensible enough to stay earthbound. But on a clear day, such as that fateful day in 1966 when the westerlies brought no moisture because they were coming off the Asian continent, those rotors won't be visible.

If you're high enough above the peaks or far enough downwind, the worst you can expect is some turbulence. But if you're planning to cross a range and you can't give the tops a good 1000 ft of clearance, for instance because of cloud, or if you're planning to fly close to the hills and below the peaks, have a look at the wind forecast. Mountain waves have only caused that one major airline crash, but they've brought plenty of light aircraft to grief, so if the conditions look good for mountain waves, it may be a good day for a Plan B.

Kevin
