Winter Flying

GAP
GOOD AVIATION PRACTICE

CAA
CIVIL AVIATION AUTHORITY OF NEW ZEALAND
Te Mana Rererangi Tūmatanui o Aotearoa

CONTENTS

Winter Flying

Winter in New Zealand brings an altered operating environment.

New Zealand does not get the extremes of weather that other parts of the world do, but the temperature does regularly drop below zero. Whether you operate from these areas or are just planning to visit, the following advice is equally relevant to both fixed-wing and rotary-wing VFR operations.

Cover photo: Mount Cook Skiplanes

Photo: Air Safaris

Preparation

Before the onset of winter, review the aircraft Flight Manual, particularly the sections relating to winterisation of the aircraft and its systems. Check to see if you need a different grade of oil for winter operations.

Any outside activity in extremely cold conditions will be uncomfortable, and tasks will be difficult. Your pre-flight check is likely to be less thorough. Slips, falls and minor injuries while working around aircraft are also more common in winter.

Heating and Defrosting Systems

Have the heating and defrosting systems checked. This is particularly important if you have a combustion heater. It is good practice to check the carbon monoxide (CO) emissions regularly. Standard tests will not reveal the condition of all parts in a heating system. They need to be inspected.

One of the cheapest insurance policies is a CO detector. They are a small sensitive spot that will darken when CO is present. They should be attached somewhere in view and away from direct sunlight. Replace at the interval recommended by the manufacturer.

If you are wet, your body, especially your feet, can become very cold when you climb to altitude. Not only can this cause hypothermia, but also it will have a detrimental effect on your ability to fly the aircraft and make a safe landing. There have been cases where people with very cold feet failed to land safely because they were suffering from the early stages of hypothermia.

Remove wet clothing if possible and try to keep your feet dry, especially if your heater does not work. Consider keeping some dry clothing inside the aircraft.

Most importantly, keep a cloth handy for demisting the cabin windows in case the defrosting system does not work properly. Fogged-up windscreens have caused a number of incidents in the past.

Water Accumulation

The expansion that takes place when water freezes may cause considerable damage to internal structures of wings, control surfaces, or fuselage bulkheads. Even small quantities of water accumulation may create a static imbalance that could seriously impair control of the aircraft.

Check the drain holes in the wings, stabiliser, flight control surfaces, fuselage, tailplanes, and air scoops to make sure they are unobstructed and capable of working. Aircraft that are left outside for any length of time in rain and frost conditions will tend to accumulate water in all of these places. It is easy for drain holes to freeze over, keeping the water and ice in.

Aircraft systems should be checked for water. A small amount of ice can prevent the proper operation of fuel pumps, selector valves and carburettors. Pitot-static systems should also be checked, as water freezing in these could render the altimeter, airspeed indicator and vertical speed indicator unserviceable.

Water in the Fuel

In winter there is a greater risk of water condensing in fuel tanks; completely full tanks will help minimise this. Fuel tanks should be checked for contamination by draining some fuel into a tester. Check that all fuel vents are unblocked. A blockage could cause an engine to stop or a tank to collapse.

Fuel checks should be carried out after fuel has had sufficient time to settle after refueling.

Photo: Air Safaris

Batteries

A fully charged battery is essential for winter operations and is less susceptible to freezing. Low temperatures mean harder starting, and this imposes high loads on the battery and electrical system. In extremely cold weather, the battery can be removed from the aircraft when not in use and stored at room temperature. The application of a high charge to a frozen battery may cause it to explode sulphuric acid.

Mud and Slush

Wheel spats and fairings pick up mud and slush, which adversely affects the operation of the aircraft. If mud is allowed to accumulate in the spats, it can add considerable weight and create a braking effect on the wheels. The accumulation of compressed mud may eventually break the spats if they are not cleaned out regularly.

Ice build-up inside wheel spats tends to break up into blocks, which have the potential to jam between the wheel and the spat. Check spats, fairings and undercarriage bays for ice accumulation and mud. Clear out regularly. If you regularly operate from a muddy aerodrome, consider having the spats removed seasonally.

Cleaning

Operating from muddy aerodromes in winter requires aircraft to be washed frequently. Mud adds to the weight of an aircraft, as well as degrading the efficiency of the flying surfaces.

Beware of washing the protective agents and lubricants out of hinges in the flying controls and trim mechanisms. This could allow water to enter and freeze at altitude. Replace the protection by either re-greasing or spraying on a suitable water displacing lubricant.

High-pressure hoses should not be directed at the aircraft from behind the wing and tail section, or around the undercarriage

– as water could become trapped in control mechanisms and then freeze. This may cause problems with brakes and wheel bearings.

Ensure that water drains away before you expose the aircraft to freezing temperatures.

If your aircraft has a retractable under-carriage, check the system, including wheel wells, for contamination by mud and slush.

Cover

Hangarage is the best winter protection for an aircraft but, if this is not available, consider having wing and engine covers made if the aircraft is to be picketed outside. These covers can save a lot of time and hard work when preparing for flight after frost or heavy snowfalls.

Photo: Air Safaris

Tiedowns

Good tiedowns and pickets should always be carried when overnighting away from base. This is particularly important in winter, when frontal weather systems are more frequent and harsh. Don't forget to remove all tiedowns and pickets before flying.

For more information on tiedown procedures, refer to the *Secure Your Aircraft* GAP booklet.

Personal Preparation

Warm clothing should be worn on winter flights, and good footwear is a must. In the event of a forced landing it may be the one thing that ensures your survival.

Survival Kit

A compact survival kit has all-year-round value. A kit comprising a hunting knife, freeze-dried food, lighter or matches, flares, fishing line, and a survival blanket, can be packed into a lightweight container that takes up little space.

Ensure the survival kit is adequate for the number of people on board. Consider carrying emergency clothing made of wool, which is reasonably light weight and fire resistant. The survival kit should also include an information book on survival techniques and use of the equipment in the kit.

Ice Protection Systems

A knowledge of ice protection systems could be useful to the VFR pilot should they inadvertently find themselves in icing conditions in an aircraft so equipped. A brief description of the most common ice protection systems follows.

For more information refer to the CAA *Aircraft Icing Handbook* available on the CAA web site, www.caa.govt.nz.

Pneumatic Boots

Pneumatic boots are rubber tubes attached to the leading edge of wings, tailplane and vertical fin. They work by inflating and cracking off the ice. They must be operated by the pilot and are time-critical in that they may not work if too much ice has been allowed to build up. If too little ice has collected before they are operated, then ice may form around the boot while it is extended.

Nevertheless, pneumatic boots are still the most popular device used to remove inflight icing.

Inflight De-icing Fluids

De-icing fluids are oozed through perforations or porous portions on the leading edges. This system, although very effective, is still rare because of the costs involved.

Propeller De-icing

Alcohol de-icing systems for propellers are simple and require minimal care. Tubes emit liquid from the propeller hub and rubber aprons direct it along the blade.

Many propellers have electric de-icing systems that heat the blade, causing the ice to shed.

Windscreen De-icing

Windscreen de-icers heat either the windscreen or a portion of the windscreen. They can be embedded in the windscreen or attached as an additional plate.

Rotor-blade Anti-icing Equipment

Rotor-blade anti-icing equipment is usually an electrical matrix that covers part of the leading edge along the entire length of the blade. Heat is phased into this matrix in different sectors to avoid large chunks of ice shedding from the blades.

Preflight

Before any flight, a thorough weather briefing is essential, especially in winter. Carefully consider the following.

Departure weather – would you be happy to return if you had to? What about an alternative aerodrome that has better forecast weather? You may be better advised to go there than to return to base.

Enroute weather – consider the effects on your flight of visibility, cloud base, freezing level, potential induction icing, and various forms of precipitation. Don't overlook current pilot reports of weather hazards.

Destination weather – check ceiling, visibility and precipitation, not only for your destination, but also for suitable alternatives. Fog is much more common in winter and can be very widespread, potentially covering the whole of either coast of the South Island. Because fog occurs under an anticyclone, it is tempting to assume that the weather will be clear and fine. It is important to obtain regular weather updates and augment these reports with information from local operators.

Night flights are even more limited by available alternatives.

Other things to consider in winter are the surface condition of the destination airfield and the amount of daylight remaining when you arrive. Remember that the daylight becomes even shorter when bad weather sets in. For VFR operations, plan to arrive at your destination at least 30 minutes before end of Evening Civil Twilight. This will give a safety margin for unexpected delays en route.

Possible diversions around weather can considerably add to flight time and increase your fuel needs. The use of carburettor heat will probably be more frequent, and this also will increase your fuel consumption.

Anywhere snow is falling should be avoided. Snow will transform reasonable visibility in rain to virtually zero in heavy snow.

Coverings of Snow, Ice, or Frost

Coverings of snow, ice, or frost must be **entirely removed** before flight. It is especially important to remove snow before it turns into ice. A tactile inspection for ice should be conducted by moving a bare hand or a thinly gloved hand over critical surfaces. Any covering of frost is unpredictable in its effect and could adversely affect the lifting capabilities of an aeroplane wing.

Photo: Air Safaris

For small aircraft, hand brushing will clear what is not stuck to the surface. However, hard ice will not be removed by brushing. Patches of solid ice can then be removed by 'sawing' with a length of material or hemp rope backwards and forwards over the surface. Hard-edged tools must not be used. Hot-air blowers are sometimes helpful, but take care that the run-off is not allowed to pool and freeze unseen over drainage holes or around hinges. Warm water mixed with de-icing fluid can also be used. Plastic cards are particularly good for windscreens.

Snow, ice and frost should be completely removed from helicopters. Even a small amount of ice remaining on a portion of the rotor blades could set up a vibration that leads to loss of control.

Pitot-Static systems

Before flight, ensure that the pitot and static sources are clear of contaminants, the pitot cover is removed, and the pitot head is securely attached and free of damage.

Starting

Some aircraft Flight Manuals recommend pulling the propeller through several times with the magneto and master switches off before starting. This is intended to relieve any possible component stress caused by cold-thickened lubricants during start. This should not be done if the manual does not recommend it. The additional wear on engine components rubbing without lubrication could be harmful.

Heating pads that attach to the bottom of the oil sump work by warming the oil before start, and they are a reasonably cheap way of raising the oil temperature. In extreme conditions it may be necessary to remove the oil and warm it. In this case, ensure that the oil does not become contaminated before it is returned to the engine.

In winter, starting requires more priming in both fuel-injected and carburetted engines. Carburetted engines can be particularly hard to start. There is an increased chance of additional fuel igniting during the start. Be ready to take appropriate action. Consult the aircraft Flight Manual for fire-during-start procedures.

In winter the importance of cylinder-head and oil temperatures as well as carburettor air heat cannot be over-emphasised. Warming the engine before takeoff and allowing the engine to cool down before shut down pays dividends, especially at overhaul time.

Taxiing

Associated with winter are the problems created by ice, snow and heavy rain on runways and taxiways. Taxi on snow and ice as though you have neither brakes nor ability to steer. Stay out of ruts, puddles and mud patches, and watch out for heavy frost or ice on sealed areas.

It may be necessary to plan to taxi and take off very early in the morning before the ice or frost melts and turns the aerodrome into a bog.

Freezing fog is not uncommon in inland areas on winter mornings. Running up and taxiing in freezing fog can lead to large buildups of ice on propellers. Better to shut down and try again later when the fog has lifted than to attempt a departure in this situation.

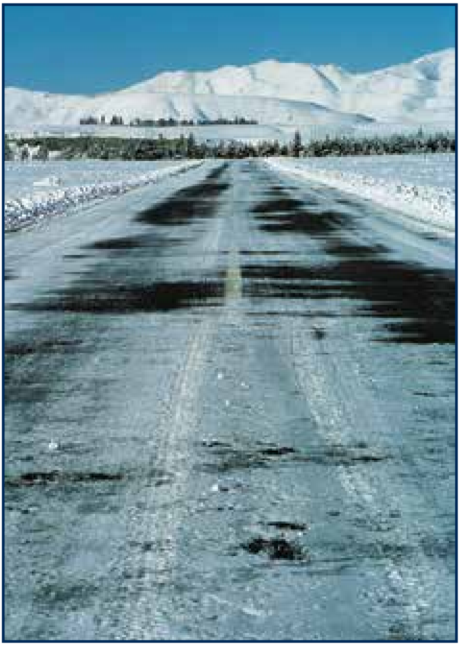


Photo: Air Safaris

Tekapo runway newly cleared after an overnight snowfall.

Windscreen Misting

Sudden misting on the inside of the windscreen is a hazard that can easily catch people out. Misting can be accentuated when warm bodies in damp clothing are on board. If your demister doesn't work well, make sure you have a clean rag or chamois available, and that's all it's ever used for.

Takeoff

Snow, slush, mud, and wet grass will lengthen the takeoff roll and may contaminate undercarriage doors and wheel wells. This could cause damage to the undercarriage on retraction and could increase the likelihood of jamming gear and damaging structures.

It is recommended not to take off on runways contaminated with snow and ice unless you are properly trained to do so. It may be impossible to maintain directional control - especially in gusty or crosswind conditions.

Snow or ice on the upper wing surface substantially reduces lift and increases weight. The shape of the aerofoil is altered, and it becomes much less efficient.

Frost is more subtle than snow or ice buildups. The added roughness on the wing upper surface increases skin friction and reduces the kinetic energy of the boundary layer. Flow separation occurs at an angle of attack lower than that of a smooth wing.

Whether snow, ice or frost, the stall speed is increased, and taking off without removing **all** the snow or ice should not be attempted. The belief that propeller slipstream or airflow over the wings will blow the surfaces clean is incorrect.

Take off on the driest part of the runway. If you find the takeoff performance poor, preferably abort early enough to enable you to stop in the distance remaining. Calculate a 'decision point' which will allow sufficient runway to stop or facilitate a safe takeoff. Even if that is not possible, it is still better to go through the fence at the end of the strip than to continue with a takeoff that can not be completed.

In Flight

Induction Icing

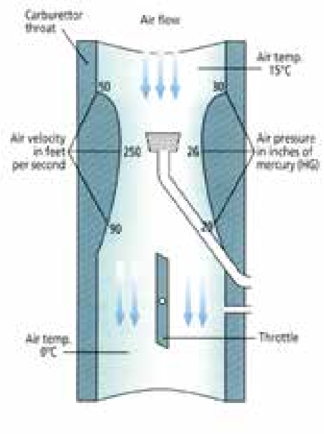
Induction icing can occur at any time of the year. Carburettor heat or alternate air are the best defence against it. These systems should have been checked before takeoff to ensure that they were functioning correctly. In the case of carburettor heat, it should be confirmed that its application gave an rpm or manifold pressure drop. (Most fuel-injected engines have an alternate air system fitted, which, when selected by the pilot, ducts warm air from within the engine cowling, thus by-passing the normal filtered air source.)

Photo: Mount Cook Skiplanes

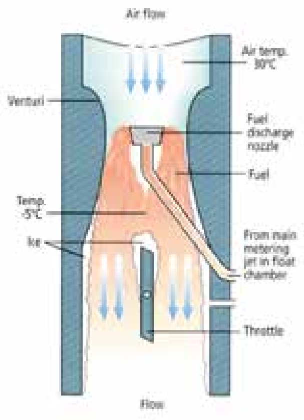
The engine instruments should be monitored in flight for loss of rpm (fixed-pitch propellers) or loss of manifold pressure (constant-speed units). Any such loss, or rough running in general, could indicate the formation of ice in the induction system.

For aircraft with carburetted engines, apply full carburettor heat periodically during the cruise to avoid ice accumulating, ensuring that the selection is long enough to take effect (ie, 20 seconds or more). **If induction icing is present, the engine may continue to run roughly for a short time as the ice melts and is ingested.** Full carburettor heat should be applied prior to, and during, reduced-power descents to prevent venturi icing caused by the reduced throttle butterfly settings involved. The engine should also be warmed periodically with gradual applications of power if the descent is to be a prolonged one.

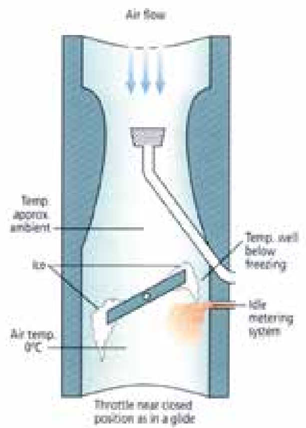
For aircraft with fuel-injected engines, select alternate air ON if impact icing is suspected (such as may be encountered during descent through an area of precipitation above the freezing level).



Simplified views of a venturi showing changes in air velocity and temperature. These vary in relation to changes in throttle opening and engine rpm.

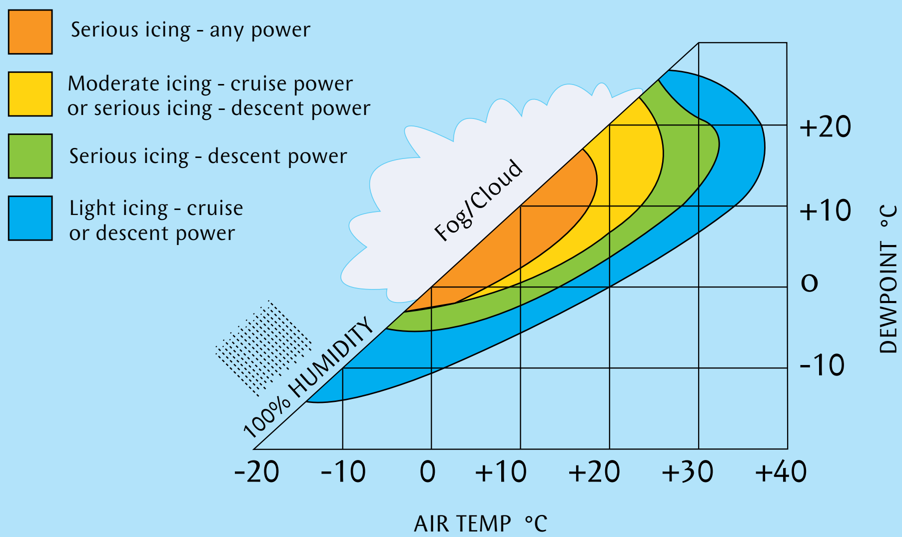


Float-type carburettors have a fuel discharge nozzle located in the venturi. Venturi action plus cooling effect of fuel vaporisation can reduce mixture temperatures markedly.



The risk of serious carburettor icing is greatest at lower or idle power settings. When carrying out prolonged glides, the engine must be warmed regularly to provide sufficient exhaust heat to the hot-air heat exchanger.

Carburettor Icing Chart



Alternate air should be selected until the aircraft descends into warmer air and the accumulated impact ice melts away from the engine air intake(s).

Induction icing is also a major problem in piston-engine helicopters. Unlike aeroplanes, which have a propeller that keeps the engine running if it hesitates or coughs, helicopters have a freewheeling unit or one-way drive. There is no inertia to keep the engine running. Detecting the onset of icing is made more difficult by the nature of helicopter flying, where the numerous small changes in power and rotor rpm mask the usual signs of carburettor icing. Carburettor heat is usually effective and should be used when icing conditions are likely to be encountered. Check the aircraft Flight Manual for specific instructions on carburettor heat application.

Photo: Air Safaris

Helicopter Loss of Visibility

Flying a helicopter with obscured visibility because of fog, snow, a low ceiling or on a dark night can be fatal. Helicopters have no inherent stability, and they roll and pitch at much faster rates than aeroplanes. Loss of outside visual references, even for a moment, can result in disorientation and incorrect control inputs. This type of accident tends to be fatal because of the high impact velocities involved.

It is easy to realise too late that visibility has been lost. Any attempt to turn without visual reference is likely to lead to a complete loss of control. Remain ahead of your aircraft, and avoid areas where the visibility is obscured.

Unlike the aeroplane, the helicopter allows you greater opportunity to land and use alternative transport in bad weather. Use your good judgement and willpower to make the decision early.

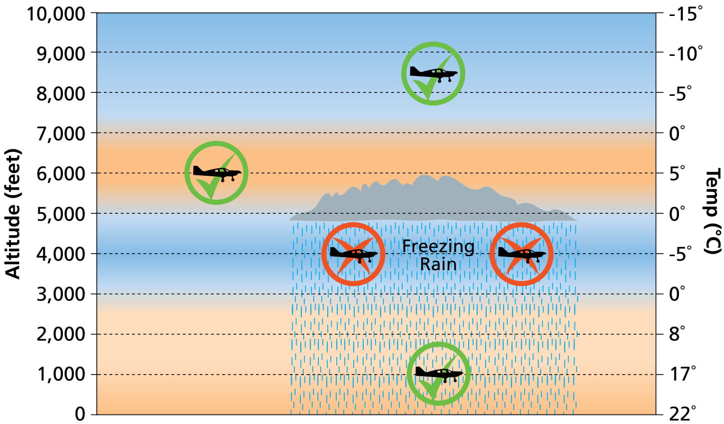
Freezing Rain

If you encounter any form of icing (the most likely being freezing rain) when flying below cloud, vacate the area by changing either altitude or heading.

Freezing rain occurs when rain from a warm layer of cloud falls into an air mass that has a temperature below zero. If you happen to be flying through this area it is likely that your aircraft will be quickly enveloped in ice (usually clear ice) from the freezing rain.

Freezing rain is normally associated with the cold sector directly under the slope of

Freezing rain associated with a frontal system inversion layer



This shows how a temperature inversion at altitude can produce conditions conducive to freezing rain.

a warm front, or in the cold sector just behind a cold front. Sometimes it can occur where there is a strong temperature inversion and rain falls from warmer air at altitude into cooler air just above the freezing level.

Snowfall

Snow masks familiar landmarks, making navigation difficult. Rain can turn to snow very quickly, causing a sudden loss of visibility. Remain alert to the overall weather development around you so that you can react to the potential hazard, rather than getting caught out.

Whiteout

Whiteout can occur when snow-covered featureless terrain blends into an overcast (especially high overcast) sky. The horizon disappears and disorientation can quickly set in.

Maintain good visual contact with well-defined objects. Proceed on the basis of what you can see, not what you can not. If you do become unable to distinguish terrain from sky, transfer to instruments and turn at rate one through 180 degrees without delay.

Landing

Fog

Fog can be very deceptive from the air. As you fly over it you may well be able to see down through it, because it is generally only a few hundred feet thick. But once you start an approach towards the ground you will no longer be able to see horizontally through it any further than a few hundred metres.

Some fog patches may be impossible to see against an overcast day.

Wet Surfaces

Any wet landing surface will increase the distance of the landing run. It is, therefore, important to land at the minimum speed suitable for the conditions, to minimise the landing distance. Maximum braking effect will be achieved if the wheels are not locked, so intermittent brake application is more effective than applying full pressure and holding it (this does not apply to anti-skid braking systems).

Landings on Snow

Landing on snow or ice is extremely hazardous and should be avoided unless you are properly trained to do so. It increases the distance required markedly, and the heavier the aircraft the greater the increase. In these conditions plan the landing as if you will be unable to brake. Touch down at the slowest practical speed, never land downhill, and during the landing run keep straight with rudder – try to stay off the brakes.

Heavy wet snow of even a shallow depth can increase the drag considerably. This can increase the chance of overturning a tailwheel aircraft.

Extreme caution should be exercised when landing helicopters on snow, particularly at an unfamiliar site. There may be doubt about the depth of snow and the condition of the underlying ground. The weight of the aircraft should be transmitted to the landing gear carefully and gradually, testing the site's ability to take all the weight. Be ready to lift off immediately there is any doubt.

Soft powder snow will whip up in the rotor wash and destroy visibility. Approach snow very carefully, especially in powder conditions.

Snow Ingestion

Snow ingestion into helicopter turbine engines can cause a flameout. A particle separator can prevent this but is also subject to icing and becoming blocked.

The amount of snow ingestion can be controlled to some extent by careful flying. Hovering over loose snow should be avoided wherever possible. In these conditions a positive rate of climb and forward speed should be attained immediately after liftoff. A normal approach for landing on snow should be one continuous operation to the ground, without hovering.

Apart from the possibility of a flameout, unnecessary hovering can also cause spatial disorientation. During the approach, if the landing area or reference point starts to become obscure, an immediate go-around should be made rather than any attempt to hover and reorient yourself.

Parking

Top up the fuel tanks after flight to minimise the risk of condensation forming. If the aircraft is to be parked outside, use control locks, and tie it down securely to good pickets. If covers are used for engines, air-conditioning system intakes, pitot and static system openings, or ram-air inlets, make sure they are highly visible so that you don't forget to remove them before the next flight.

When parking overnight in areas where there is snow falling, be prepared to sweep the wing and tail surfaces at regular intervals. This is to avoid excessive weight on the wing and tailplane (some snow can be very wet and heavy). Take care in where you place your pickets – a heavy snowfall could cause the aeroplane to sit on its tail and potentially its picket!

Conclusion

Winter flying can be a spectacular experience, especially in the snow-covered Southern Alps. In order to keep it safe think ahead, and be fully prepared before venturing out into the winter weather.

GOOD AVIATION PRACTICE

CIVIL AVIATION AUTHORITY OF NEW ZEALAND
Te Mana Rererangi Tūmatanui o Aotearoa

PO Box 3555
Wellington 6140
Tel: +64 4 560 9400
Fax: +64 4 569 2024
Email: info@caa.govt.nz

Winter Flying was reprinted in April 2014.
See our web site, www.caa.govt.nz, for details of more CAA safety publications.

New Zealand Government