GAP
Good Aviation Practice

Winter flying

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

Contents

Whether winter conditions are present because it is winter, or because you're flying at higher altitude, you can encounter 'winter flying' at any time of the year in New Zealand. Whether flying fixed-wing or rotary VFR operations, your preparation may be all that stands between you and harm. This GAP booklet provides a brief introduction, or maybe a refresher, on good safety practices for colder conditions.

Photo courtesy of Wanaka Helicopters

Cover photo: Courtesy of Air Safaris
A Grand Caravan EX over Tasman Glacier.

Our thanks to Wanaka Helicopters (particularly Brian Paavo) and Air Safaris (particularly Richard Rayward) for their valuable and much appreciated contributions to the revision of this GAP booklet.

See the CAA website for civil aviation rules, advisory circulars, airworthiness directives, forms, and more safety publications. Visit aviation.govt.nz.

Every effort is made to ensure the information in this booklet is accurate and up-to-date at the time of publishing, but numerous changes can occur with time, especially in regard to airspace and legislation. Readers are reminded to obtain appropriate up-to-date information.

Preparation

The pilot

Flying activities in winter conditions can be dangerous, but there are steps you can take before flying to keep yourself, and others, safe. These include:

- preventing slips and falls on the apron by spreading a modern de-icer on the ground as opposed to salt – modern de-icers act faster, last longer, and are less corrosive
- keeping your feet dry, or if they do get wet, changing into appropriate dry footwear
- storing some dry, warm clothing inside the aircraft that you can put on before take-off
- using the I'M SAFE checklist to ensure you're in a fit and healthy state to fly safely. Go to aviation.govt.nz/education for I'M SAFE posters. You can also ask for copies of publications from your aviation safety advisor.

If you have passengers, make sure they're prepared for the winter conditions too. Advise your passengers to wear warm layers of clothing and make sure they know where your survival and first aid kits are in the aircraft.

In an emergency, your survival kit needs to adequately cover the needs of the number of passengers you're carrying. The contents of the kit will be determined by the region you're flying in, and should include an appropriate shelter, food, and water. If you're incapacitated, written instructions for passengers explaining how to use the ELT, radio, VHF radio, tracker, transponder, NRRC numbers for mobile phones, and signal mirrors will also be helpful.

As an extra precaution, check to see if your local flying school or aero club runs refresher training on how to prepare for winter flying conditions.

Photo courtesy of Wanaka Helicopters

The aircraft

Winter can change the way you use and maintain your aircraft. Check your flight manual to see if there's anything specific you need to do differently in winter conditions, such as changing your grade of oil.

The following sections provide information on how to prepare your aircraft to fly safely in winter conditions.

Airframe - water contamination

Even small amounts of water getting into control linkages, between panels, or under fasteners can cause control problems or structural damage when you climb into colder air. As the temperature drops, water freezes, expands, and can pry and push with considerable force. Make sure the drain holes aren't clogged up, and carefully inspect them after every wash or when the aircraft has been sitting outside for a long time. Be aware that removing ice and snow from linkages can also remove essential lubricants.

Batteries

Consider storing your batteries, fully charged, indoors during winter. A frozen battery can cause a costly and dangerous internal short. Having a fully charged battery is essential for winter operations, because low temperatures mean harder engine starts, imposing higher loads on the battery. Slower chemical reactions in cold batteries and higher use of accessories may mean your electrical loading is higher when your systems are least able to cope.

During winter starting procedures, if your master has a split switch, consider conducting the start using the battery side to use the strongest charge available, and reduce electrical loading. Only bring the alternator side on once the engine has started.

Heating and windscreen demisting systems

Since you'll rely on them more during winter, make sure you've had your heating and defrosting systems checked, as routine maintenance may not reveal flaws in all parts of the heating system. Inspections should include the carbon monoxide (CO) sensor,

and emissions testing. Chemical CO detectors are older technology, but are still fitted to many GA aircraft, so consider replacing them with a modern version. It's also important that all vents work easily – usually the outside air is dryer than inside air, meaning vents help demisting systems work. Keep a dedicated, suitably absorbent cloth in the cabin to wipe a misted windscreen.

Ice protection systems

Before taking out a new or unfamiliar aircraft for a flight, ask a qualified person to give you a specific briefing on its winter protection systems. Your safety equipment is going to be effective only if it's in proper condition, and you have practised using it in non-emergency situations. Consider the following:

- **Pitot heat:** Is your pitot heat working? Do you know where the circuit breaker is? If you're sceptical about your indicated airspeed in winter, consider whether a blocked pitot may be the problem.
- **Pneumatic boots:** Timing is everything in making pneumatic boots work for you and not against you. Ice buildup on your leading edge can quickly result in airflow separation. Boots don't protect against all forms of icing, and can only be effectively activated once there's sufficient buildup. Otherwise you may end up expanding the deformation. Seek specialty training on the correct use of pneumatic boots.
- **De-icing fluids:** Although very effective, forcing de-icing fluids out of your wing's leading edges is possible only if the reservoir is full, the pump is working, and you know how to use it appropriately in flight before you need it. Propeller de-icing systems are more common. If electric, where is the breaker? How does its use affect your electrical load? If fluid-based, is the reservoir filled and have you confirmed the system is visibly working prior to flight?

Snow clearing around hangars.

Storage and cleaning

Completely clear your flight surfaces of ice and snow. Patches of frost, ice, or snow cause immediate aerodynamic problems and may encourage faster, more severe icing later in flight. Repeated cycles of freezing and melting will prematurely age your aircraft, increasing the likelihood of failures and decreasing its value. Under the best of conditions, any frost or ice will increase your stall speed and drag, as well as result in control surface restrictions, airflow separation and stalls, or destructive vibrations on blades and props. Just before departure, clear all leading edges and other critical surfaces with your bare or thinly gloved hand to make sure the surface is clear of frost and ice.

Clear light snow not stuck to surfaces with a brush. Ice and adhered hoar frost won't brush off, but don't resort to hard-edged tools that will damage your carefully engineered surfaces. Plastic ice scrapers can easily scratch your windscreen. If the outside temperature is close to zero, using cold water to clear your screen may be

Photo courtesy of Air Safaris

appropriate. However, once the surface is below freezing temperature, this technique can damage the screen. In this case, covers or defrosting the screen, once the engine is running, is a better option.

Winter flying requires more frequent and careful cleaning than in summer. Be especially cautious with high-pressure sprayers, and avoid directing water from behind wings or up into undercarriages, as this may force water into narrow, load-bearing spaces. Be wary of washing lubricants out of hinges and linkages, and consider using an appropriate water-displacing lubricant. Allow the aircraft to drain and dry before climbing into freezing levels.

Wheel spats and fairings pick up mud and slush during winter, so consider removing spats seasonally. Accumulated frozen mud adds weight, and could impede wheel rotation. A frozen block of mud jamming between the wheel and the spat can lead to the landing gear malfunctioning, breakage of spats, or tyre rupture.

Helicopters parked in muddy areas during winter may be at increased risk of dynamic rollover due to a stuck skid, or hooking up on frozen, uneven surfaces. Slick surfaces, like concrete pads with ice on top, present slip hazards to pilots and passengers alike – before the flight even begins.

Hangaring your aircraft is the best option, but if this isn't possible, covers can save you a lot of time, maintenance cost, and in-flight risks.

Wing and windscreen covers, blade tie-downs, prop covers, cowling plugs, and pitot sleeves all save a lot of time and work preparing for a flight, after a frosty or snowy night.

Tanks

Sometimes fuel pumps or tanker nozzles can get excessively wet with rain, snow, or ice. Inspect them and give them a shake, so you don't add water into your tanks when filling up. Completely filling tanks overnight reduces the risk of water condensing from the air above the fuel onto your tank walls, and then running into your fuel. Check that all fuel vents are unblocked, as a blockage could cause an engine to stop or a tank to collapse. Carry out drain checks after fuel has had sufficient time to settle. If any water exists in the lowest points of the fuel system, and temperatures are low enough, the water can freeze and a fuel sample won't be achieved. You will need to thaw this water before sampling the fuel.

Flight planning

Flight preparation and planning are even more important during winter conditions when shorter daylight hours, reduced hours of operation for flight services, and other factors can catch pilots by surprise.

Low sun is a significant consideration in terrain such as valley sides in deep shade, or flying into the sun towards a ridgeline, where detail in the distance is harder to define.

Particularly in early morning and late evening, sun strike, compromising forward visibility, needs to be anticipated and considered for various stages of flight, especially on or after take-off, and on landing approach. Consider the landing ground orientation relative to the position of a low sun.

Weather

A comprehensive and conservative weather brief is a must for winter flights. Consider how the conditions differ from what you've experienced before, and look at whether the weather trends are improving or degrading. Take a worst-case scenario approach and plan for a successful and safe day, especially as conditions can change. Use the support systems you have available such as air traffic control or a flight following team, or file a flight plan.

Weather on departure

Consider the following points:

- Are you comfortable returning to your departure point if necessary?
- What's your alternative plan, should your departure point close out?
- Is the runway clear of ice and snow, and is it dry? Unless you're specifically trained for it, a safe take-off may not be possible on a patchy or icy runway in a crosswind, that would be perfectly acceptable with a dry runway.
- Remember to check your NOTAMs and AIP Supplements before you set off.

Photo courtesy of Wanaka Helicopters

Weather en route

Freezing levels and cloud bases are generally lower in winter. Do they affect your safety margins for crossing that pass? Plan conservative vertical margins, and monitor these throughout the flight.

Observations and forecasts are both valuable to your understanding of the weather situation, but think critically. What are the challenges related to precipitation, visibility, and lighting?

Weather at your destination

Mission blindness is a real risk for pilots. Acknowledge that your final destination may not be your intended destination, due to local winter weather conditions.

Check ceiling, visibility, precipitation, runway conditions, and services available at your intended and alternate destinations. Does a minor alteration in your flight path give you more landing options?

What is the temperature and dew point split along your route and at your destination? How might you time your flight to give yourself the clearest visibility?

Take fog into consideration, as it's more common in winter and spreads more widely. Pilots often think of anticyclones as clear weather, but in winter they can fog out both South Island coasts which may affect your landing.

Webcams and local operators can be critical resources – make use of them when you're working out whether your planned destination is a safe place to land.

Because daily temperatures often fluctuate over a greater range in winter, cloud bases can thicken and lower dramatically, especially at higher-elevation aerodromes. This is particularly true from mid-afternoon, when temperatures drop and moisture content becomes high.

Whatever margin you usually use to arrive before ECT (Evening Civil Twilight), add at least an additional 30 minutes to allow for overcast skies and lower sun angles which make it darker than you might expect at other seasons, especially if delays en route extend your flight time.

Photo courtesy of Air Safaris

Slushy snow may contaminate undercarriage doors and wheel wells.

Start, taxi, take-off

Start

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 cause damage.

Heating pads that attach to the bottom of the oil sump work by warming the oil before start, and they're a reasonably inexpensive way of raising the oil temperature. In extreme conditions it may be necessary to remove the oil and warm it. In this case, ensure the oil does not become contaminated before it's 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. Be ready to take appropriate action when the additional fuel ignites. Consult your aircraft flight manual for fire-during-start procedure.

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

Taxi

Aeroplanes: Icy, even patchy, runways present multiple problems when taxiing. Any crosswinds will change an aeroplane's steering authority, and almost certainly your roll-out will be longer than you might expect for a given load. Any uncleared frost lingering from a hurried preflight decreases your lift, lengthening your roll-out and your required stopping distance at the same time.

When taxiing an aeroplane, use a speed and path that works even if you don't have any brakes or wheel steering, just rudder. That way, you won't be caught out by a patch of ice. Stay out of ruts, puddles, and mud patches. Consider flying earlier in the day when the ground is hard, rather than a muddy bog.

Helicopters: When hover-taxiing in snowy conditions, be aware of the possibility that you could become suddenly blinded by blowing snow. If there's a light freezing fog present, blade icing is a danger, just as prop or wing icing is a problem for aeroplanes. It's better to delay your flight until the fog lifts instead of assuming you'll be clear before a problem develops. Snow may cover familiar aerodrome markings, making it easy to go the wrong way. Be on the lookout for off-taxiway obstructions such as irrigation guns or fences.

Take-off

Aeroplanes: It's not recommended to take off on runways contaminated with snow and ice unless you're properly trained to do so. Snow, slush, mud, and wet grass will lengthen the take-off 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 may be impossible to maintain directional control – especially in gusty or crosswind conditions.

Freezing fog on the prop during ground running.

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 build-ups. 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. Propeller slipstream or airflow over the wings will not blow the surfaces clean.

Take off on the driest part of the runway. If you find the take-off performance poor, abort early enough to allow you to stop in the distance remaining. Calculate a 'decision point' which will allow sufficient runway to stop or facilitate a safe take-off.

Helicopters: While surface conditions don't matter much aerodynamically to helicopters with forward speed, the take-off path and lighting conditions can be critical.

Bright sun can create high-contrast illusions with dark runways, as well as unusually dark shadows from surface snow contours. These can confuse a pilot's estimates of speed and height above ground. When overcast skies merge with white fields of snow into the

distance, a sudden lack of contrast can be disorienting. These flat light conditions not only affect your senses of speed and height, but also your horizon perception.

Loss of visual ground reference can happen in moments during take-off or landing phases. Any attempt to manoeuvre without a set of suitably separated visual references may lead to a loss of control with no time to correct. Think ahead of your aircraft, and avoid areas where visibility is obscured, sufficient references are lacking, or references are not positively identified.

Taking off from slippery surfaces requires you to adapt. When becoming light on your skids, you may find the aircraft shifting at a lower collective setting than you're used to on dry surfaces. With power applied, lateral movements on uneven ground make dynamic roll-over more likely, which requires a quick reduction in power.

Lifting from soft-snow sites poses several hazards. Knowing the wind direction and your exit flight path is essential before lifting. A little attention to site reconnaissance can help, but you must anticipate possible blowing snow and disorientation before gaining sufficient speed and height. Many factors can result in one skid pulling free of snow before the other and you must guard against dynamic roll-over.

The biggest safety feature of any helicopter is its ability to land almost anywhere. Before you take off on a winter's day, make the decision that if you encounter marginal conditions, you would rather land and spend a night or get alternative transportation, than continue.

In flight

Carburettor heat and alternate air sources

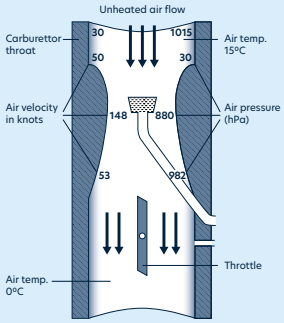
Induction icing is a year-round problem that is more likely to occur in winter conditions.

Applying carburettor heat to incoming air is your most effective defence against induction icing. All piston helicopters and some aeroplanes have a carburettor air temperature gauge. While many pilots may be used to using carburettor heat only in low-power situations such as descent, you should use it as required to remain outside the icing range.

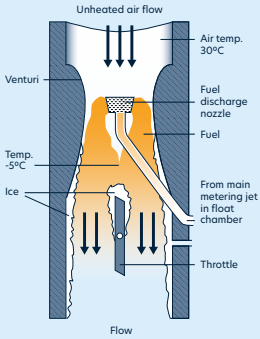
Rarely, in extremely cold temperatures where the indicated temperature is below the icing range, you should not apply carburettor heat and enter the danger range. If your aircraft is not fitted with a carburettor temperature gauge, pay attention to RPM (fixed-pitch propellers) or manifold pressure drops (constant-speed units). They might precede the rough-running characteristic of ice forming. If icing is suspected, apply carburettor heat fully and give it time to work – at least 20 seconds or more. The engine may suddenly cough and run more roughly with heat applied as the engine ingests and removes ice. Leave the carburettor heat on until the engine runs smoothly again.

Fuel-injected engines may also have alternate air sources. Rerouting intake air from around the engine performs a similar function to carburettor heat. This air may be filtered or unfiltered in your aircraft, so consider other ingestion problems. Make sure you understand your equipment so that you can take appropriate action for the conditions.

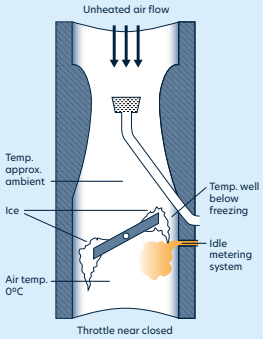
Icing in the carburettor



Temperatures drop in a venturi in relation to throttle position.

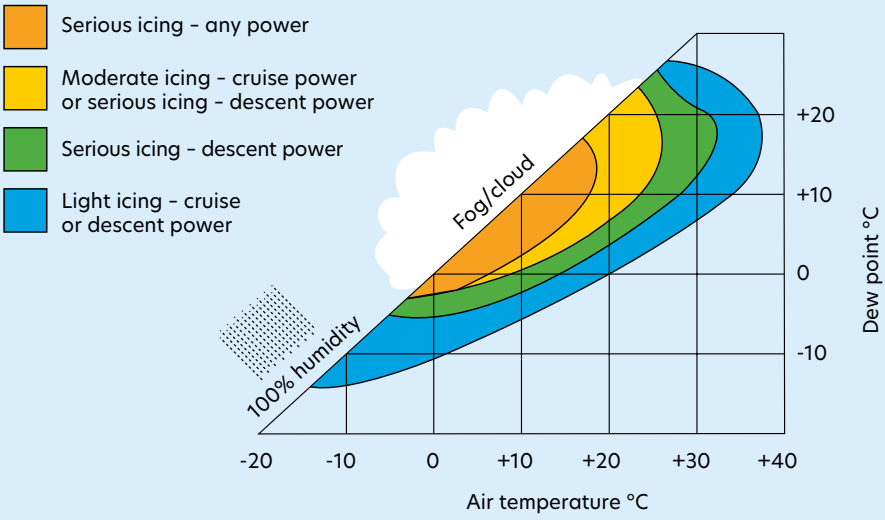


Evaporating fuel has an additional cooling effect.



A closed throttle creates a secondary venturi when the idling engine is most vulnerable to stopping.

Carburettor icing conditions

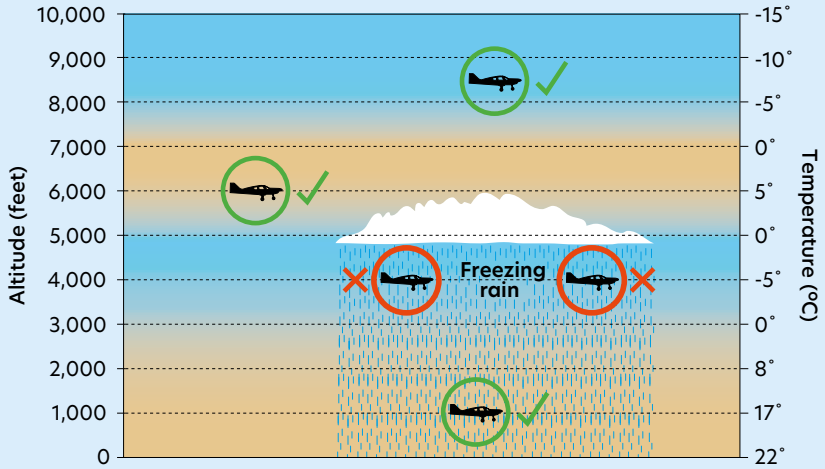


Visible moisture and freezing rain

Your preflight planning should consider freezing level forecasts, but maintain your situational awareness by checking your outside air temperature (OAT) frequently. Be aware that some aircraft OAT readings may be affected by the sensor's position. Do the forecasts match your enroute observations? If the OAT is approaching 0°C, give a wider separation from any visible moisture than you might do in summer. Failure to do so may invite engine and aerodynamic icing problems.

When an inversion is present, it's possible for rain from a warmer, higher air mass to fall into a freezing, lower air mass. If this happens, your aircraft could quickly become enveloped in ice and suddenly become uncontrollable. It's important that you can recognise the dangers of frontal systems and inversions, and avoid them by rerouting or flying in an air mass well below freezing temperatures (as terrain permits).

Freezing rain associated with a frontal system inversion layer



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

Navigation and attitude

Even familiar routes can suddenly appear strange in winter. Snow makes familiar landmarks change or disappear, railway tracks can vanish, streams can disappear or appear larger than usual, secondary roads and tracks can have big gaps, peaks change their shapes, snow-packs can change skylines or visual reporting points, and vegetation changes can change your perceptions. Navigation on unfamiliar routes therefore poses even greater ground-to-chart challenges.

To keep yourself as safe as possible, consider the following actions:

- Build contingency into your flight plans, and take extra care with them.
- Simplify and shorten your legs.
- Improve your situational awareness with up-to-date and reliable navigation tools.
- Ask a friend to be your safety pilot to reduce your winter flying workload.

While carrying and properly using GNSS equipment can greatly improve your situational awareness, it shouldn't extend your operational limits. Similarly your turn coordinator, inclinometer, artificial horizon, and compass or direction indicator can be crucial assets, or unsafe distractions, unless you've recently trained using them to maintain coordinated flight. If you suddenly become disoriented due to a lost horizon or visibility, transfer your attention to instruments and turn at rate one through 180 degrees without hesitation.

Photo courtesy of Wanaka Helicopters

Landing

Fog

Fog can be very deceptive from the air. As you fly over it you may be able to see down through it because it's often only a few hundred feet thick and the light is above you. Once you start an approach, however, you'll no longer be able to see horizontally through it any further than a few hundred metres, and contrast is reduced. In a valley fog you also suddenly find yourself in IMC due to wall shadowing.

Helicopter pilots might be tempted to descend rapidly to regain visual contact with the ground, but if the temperature is cold, sudden icing conditions can result in accidents.

Wet, icy, and snowy landing conditions

Any wet landing surface increases the landing distance required for aeroplanes. Where possible, get a surface condition report prior to a landing commitment, and back up with your own reconnaissance. When the surface is clearly wet, land at a low speed to minimise your distance, and anticipate wheel-steering and brake failures. Land uphill if wind permits, keep your landing-run straight with rudder, and try to stay off the brakes. Intermittent braking is more effective than steady or full pressure, unless your aircraft has an anti-skid system. Landing on snow or ice is extremely hazardous, and should be avoided unless you're properly trained to do so. Many bushplane pilots have executed a successful landing, only to find they can't safely take off again due to snow slowing them down.

Helicopter pilots may be tempted to land in beautiful, snowy spots to get out and appreciate the landscape. Whiteout, glare, flat light, and a disappearing horizon can pose difficulties in this situation. Ground conditions and objects may be hidden by snow cover. Snowshoes on your skids may help, but pilots need to settle directly onto snowy surfaces while being aware of how far and how evenly their skids are sinking in. Conditions dictate the choice of a zero-

Flat light can pose difficulties when landing.

speed landing versus a prolonged hover and cautious settling. During such a high workload landing, it's difficult to detect slight depressions and mounds in the all-white surface. Settling into deep, soft snow can damage radio antennae, mirrors, and cargo hooks.

Once safely landed, there are still dangers to consider. Hazardous crevasses and uncertain footing can be dangerous for any disembarking passengers. After enjoying the scenery, passengers may be unaware of potentially reduced clearance between the ground and the spinning blades on slopes, or where the walking surface is mounded, and they can walk right into danger. If landing at a snowy site was challenging, the take-off may be as well. It isn't worth the risk to land on snowy or icy remote sites unless your knowledge of the site, and your training, is comprehensive and current.

Photo courtesy of Air Safaris

Photo courtesy of Wanaka Helicopters

Parking

When you don't have a hangar to park your aircraft overnight, make sure to carry good picketing straps and anchors, or blade tie-downs.

Winter frontal systems are more frequent and harsher than in other seasons, so park into the predicted wind, set the control locks, and use the ties according to your pilot operating handbook, so you don't overstress prop/blade straps. Top up the tanks and use your take-off checklist in reverse to reapply all covers, plugs, and sleeves.

If heavy snow is falling, be prepared to periodically sweep off buildup, or at least ensure that accumulation on the tail doesn't damage your plane if it settles in a new position.

Conclusion

Winter flying, especially in our snow-covered Southern Alps, can be a spectacular experience.

With good preparation and a slow, steady expansion of your own personal experience limits, you can safely venture out into winter conditions and take in more of what makes New Zealand a special place to fly.

Photo courtesy of Wanaka Helicopters

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See the CAA website for civil aviation rules, advisory circulars, airworthiness directives, forms, and more safety publications.

To order publications such as GAPs and posters, go to aviation.govt.nz/education.

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