Gliding Australia Training Manual

Pilot Guide

Unit 33

Thermal Source and Structure

WHAT THIS UNIT IS ABOUT

To develop your knowledge and skills related to thermal sources, thermal structure, and thermal lifecycle.

WHAT ARE THE PRE-REQUISITES FOR THIS UNIT?

- GPC Unit 31 Thermal Entry

COMPLEMENTARY UNITS

This unit should be read in conjunction with:

- GPC Unit 38 Meteorology and flight planning
- GPC Unit 40 Cruising, speed to fly, height bands and thermal selection

KEY MESSAGES

- Thermals are rising buoyant air from a thermal source.
- The ground is a thermal source when it is heated by the sun. Darker and hotter surfaces generate better thermals.
- Thermals have a lifecycle and may have a bubble structure.
- There may not be a thermal at the ‘perfect’ location relative to sources and triggers since you need to be at the right point of the cycle (the bubble may be below or above).
- Thermalling at low level increases the risk of a spin – maintain safe speed near the ground and have a clear break-off point at a safe height for a circuit and landing

PILOT GUIDE FOR THIS UNIT

Understanding what a thermal is, potential sources of a thermal, thermal triggers, and the vertical structure of thermals is important for maximising the chance of finding a thermal, and for making decisions on thermal selection.

Thermals are rising air caused by buoyancy of the air relative to the surrounding air. This buoyancy is normally due to differential (higher) surface temperature generating hotter less dense air but can also be due to increased humidity since humid air is also less dense.

The sun heats the ground, not the air, and will heat darker and drier areas more than lighter moister areas – rock, townships and dark areas are good early in the day; green grassy areas, forests and swamps are not. However once they have warmed up, moist areas produce good thermals late in the day. It may help to think of walking barefoot on the ground – the warmer areas underfoot are likely to produce thermals.

The ground heats a pool of air which is then more buoyant than the surrounding air but is held near the ground by surface tension. It will need a trigger to break away from the ground – triggers are features such as machinery, lines of trees, and upwind edge of lakes. Once triggered the pool of air will ascend until the pool of buoyant air is exhausted – this may be a few minutes or tens of minutes. The area then needs to heat to regenerate the buoyant air and the cycle repeats.

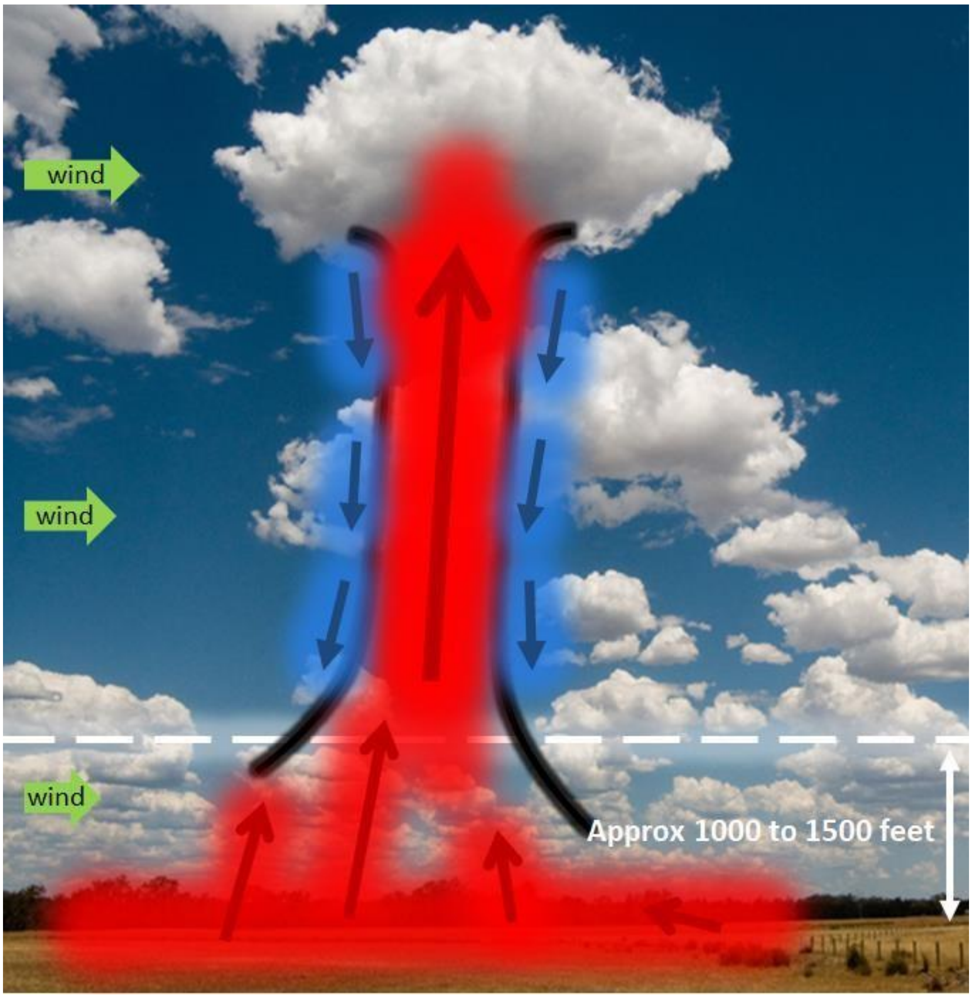
The source area feeding a thermal is large (1 square kilometre or more) but the triggers can be small.

Thermals may be columns of air that rise continuously from the ground for a period of time or may be a bubble that continues to rise but is no longer fed by the thermal source.

Further detail on the impact of wind will be discussed in the advance training syllabus.

The diagram below illustrates a column thermal. The red area shows warmer air, which rises due to buoyancy. There's a pool of warmer air near the ground that typically breaks away in multiple narrow and turbulent cores before eventually coalescing into a single core. In this example the core rises into a cumulus cloud (where the water vapour in the air forms water droplets) until eventually the air temperature in the thermal is roughly the same as the surrounding air. At that point the air stops rising and spreads out. Around the outside of the thermal is a ring of sinking air, depicted in blue.

Higher convection (the height of thermals) normally generates stronger thermals, with a longer cycle fed by a larger pool of buoyant air – this means that the thermals will also be further apart. A rough rule of thumb is that thermals will be the same number of kilometres apart as the convection height in thousands of feet.



FLIGHT EXERCISES FOR THIS UNIT

You will have an opportunity to sample many possible thermal sources and triggers while navigating on a short cross country flight. You'll find the discussion on the terrain that you fly over useful. Think about the air blowing across the ground in the wind. What areas will be good thermal sources and what features will it flow over that are likely to trigger a thermal?

Don't be frustrated if the thermals aren't there when you get to a good location. You may have made a good choice but arrived too late or early for the thermal to be there – remember thermals typically cycle and often have bubble behaviour.

THINGS YOU MIGHT HAVE DIFFICULTY WITH

COMMON PROBLEMS	
Problem	**Probable Cause**
• Confusing sources with triggers	• Thermal source areas are large • Triggers are small • Only a small amount of experience with which to judge – take the time to watch and learn.

HOW DO YOU DEMONSTRATE COMPETENCE?

- Describe:
  - The difference between thermal sources and triggers
  - The vertical thermal structure
  - How thermals cycle and variations with terrain and time of day
- Identify potential thermal sources and triggers taking into consideration sun, wind, terrain, vegetation, time of day, cloud cover
- Demonstrate navigation to relevant thermal sources and triggers in a search for thermals

RESOURCES & REFERENCES

- G Dale, 'The Soaring Engine – Volume 1', Chapter: Thermal soaring – Thermal formation; When thermals start to rise & Appendix

SELF-CHECK QUESTIONS

Use these questions to test your knowledge of the unit.

1. Does the sun heat the air?
2. What is the difference between a thermal source and thermal trigger?
3. Would a road make a good thermal source?
4. Why might a thermal not be there when you arrive in the 'perfect' spot for a thermal?