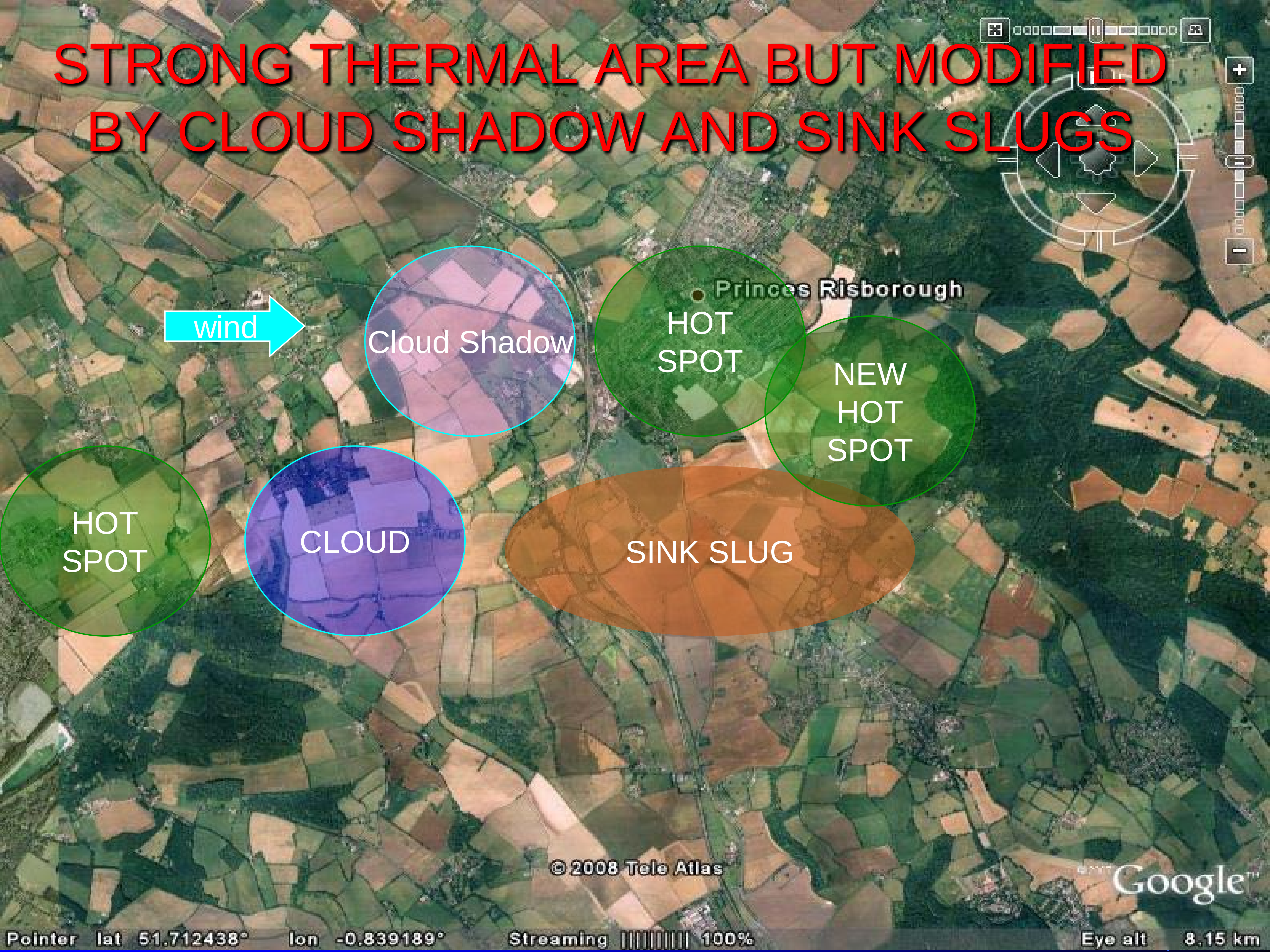
ROUTE PLANNING

Careful what you wish for!

STRONG THERMAL AREA BUT MODIFIED BY CLOUD SHADOW AND SINK SLUGS



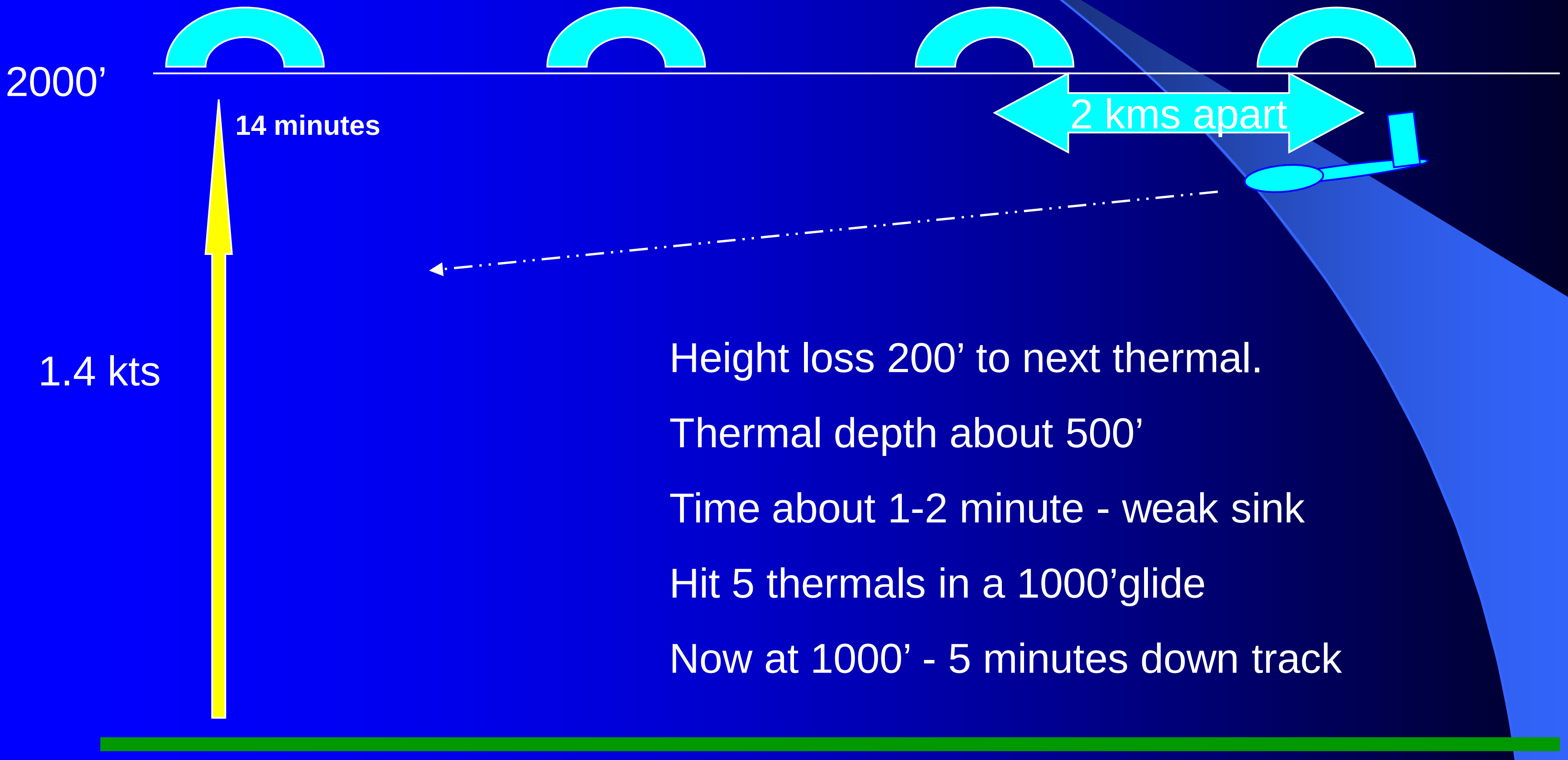
Daily Changes

- Look at the sky at mid day. Just before you go off on a racing task!
- What you see is what you get and it will stay that way until about
- 1500 in August,
- 1600 in May and July,
- and 1700 in June (light winds).
- As the angle of the sun changes, casting shadows in significantly different ground areas, then the structure will start to change.
- Easy to become ‘out of phase’.

Time from Ground to Cloud Base (Be careful what you wish for)

- Semi revision
- 2000' cloud base gives
- 2000' x 1.2 = 2 x 1.2 = 2.4 – 1 = 1.4 knot
- Ground source to cloud base takes 14 minutes
- 3600' cloud base gives
- 3600' x 1.2 = 3.6 x 1.2 =4.3 – 1= 3.3 knot
- Takes 11 minutes and not too far away!
- 5000' cloud base gives
- 5000' x 1.2 = 5 x 1.2 = 6 – 1 = 5 knots
- Takes 10 minutes but thermal cycle will be faster and longer cruise in sink before you get there!
- For a cruising cross country hold between cloud base and half way to the ground and use the clouds. Below this height you will need to start using ground features to assist in finding your next thermal.

Cloud Base 2000’



Height loss 200’ to next thermal.

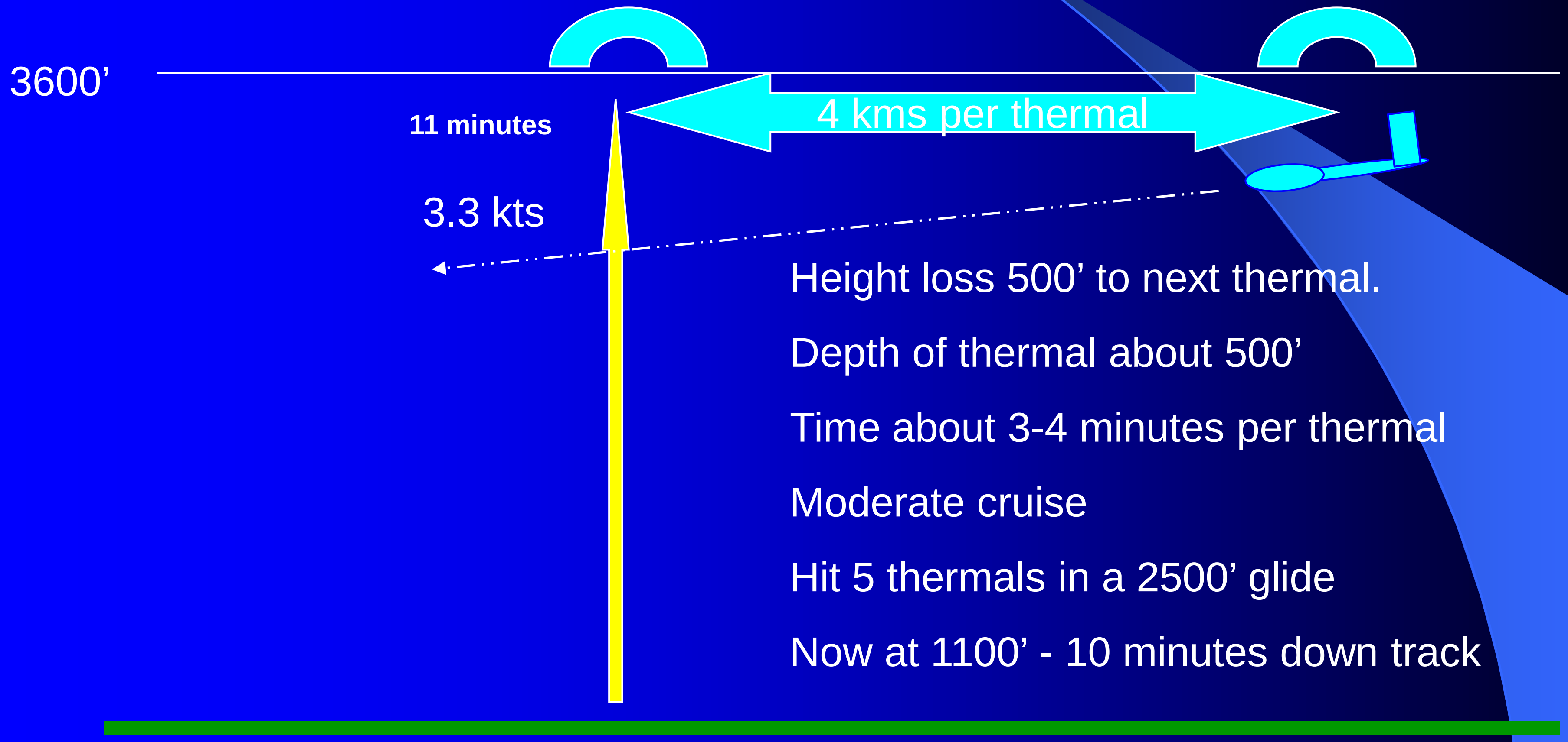
Thermal depth about 500’

Time about 1-2 minute - weak sink

Hit 5 thermals in a 1000’glide

Now at 1000’ - 5 minutes down track

Cloud Base 3600’



Height loss 500’ to next thermal.

Depth of thermal about 500’

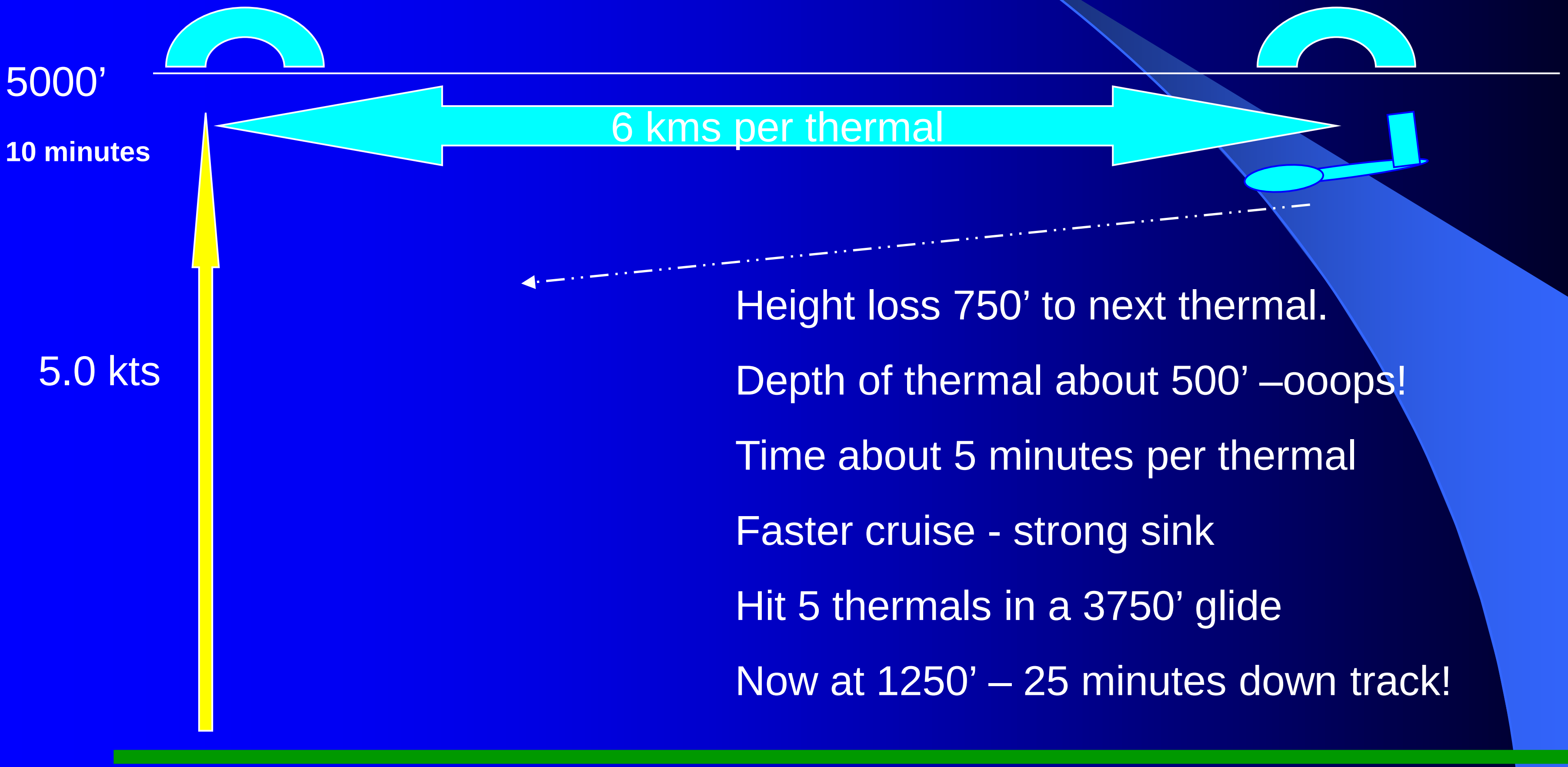
Time about 3-4 minutes per thermal

Moderate cruise

Hit 5 thermals in a 2500’ glide

Now at 1100’ - 10 minutes down track

Cloud Base 5000’



Height loss 750’ to next thermal.

Depth of thermal about 500’ –ooops!

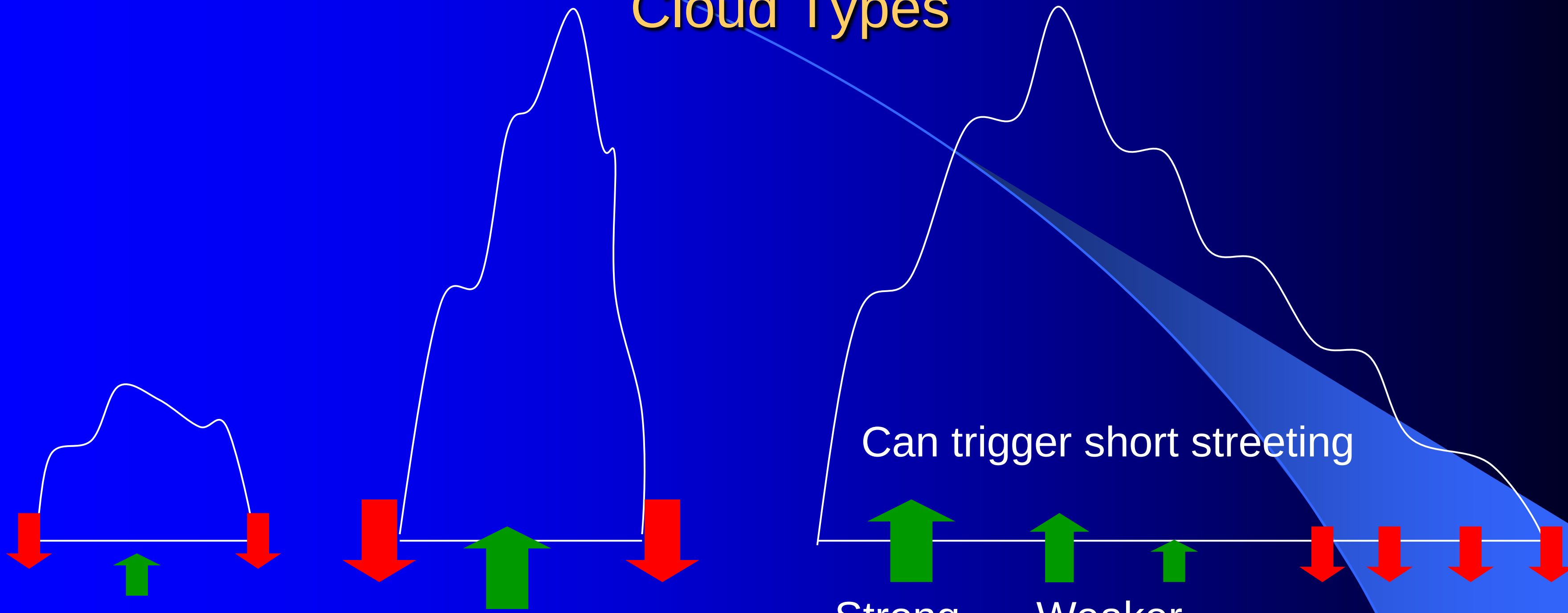
Time about 5 minutes per thermal

Faster cruise - strong sink

Hit 5 thermals in a 3750’ glide

Now at 1250’ – 25 minutes down track!

Cloud Types



Normal single cell

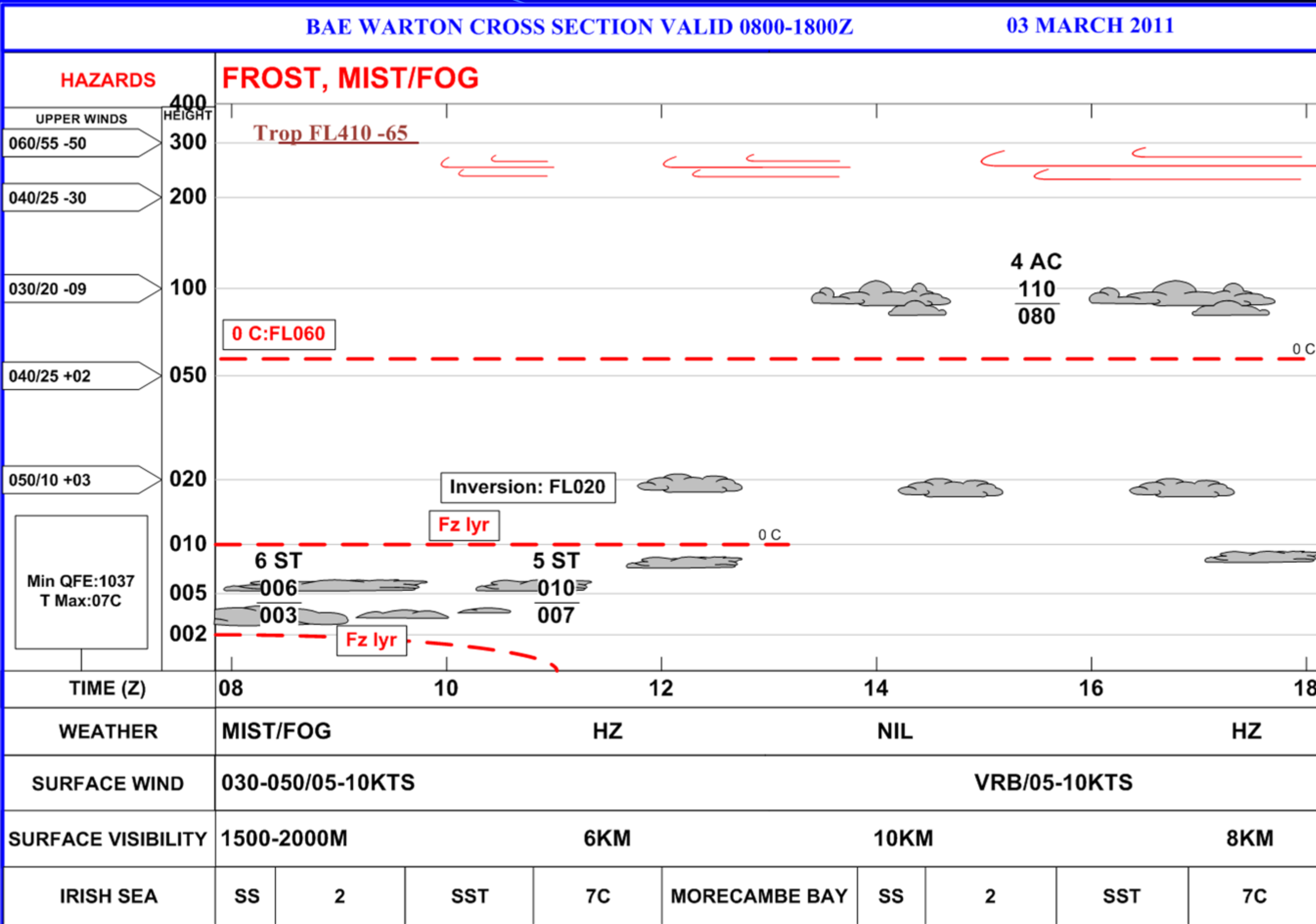
Strong cells

Plus cloud suck

Strong cells

Weaker cells

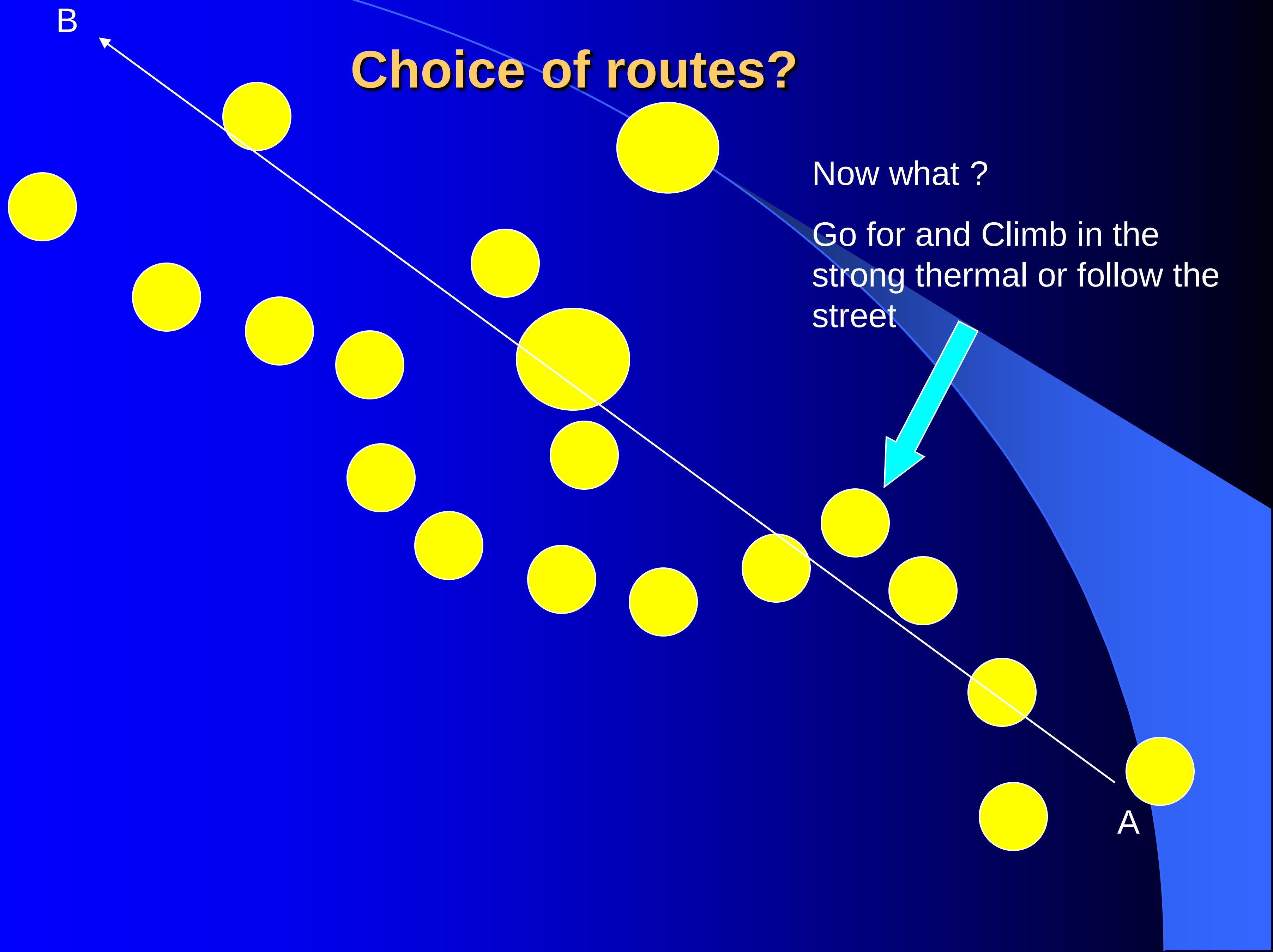
Temperature does not always reduce with height



To go faster!

- There is a commonly held view that the person who climbs only in the strongest thermals is the fastest.
- Well that is only part of the story.
- If you can make considerably efficient glides making good speed but losing less height than the polar curve suggests, and therefore spending less time climbing, then you have less climbing to do, hence the need to understand streeting, and linking the energy together. It is often called straight line flying - but actually involves a lot of weaving and not that much straight line flying.

Choice of routes?

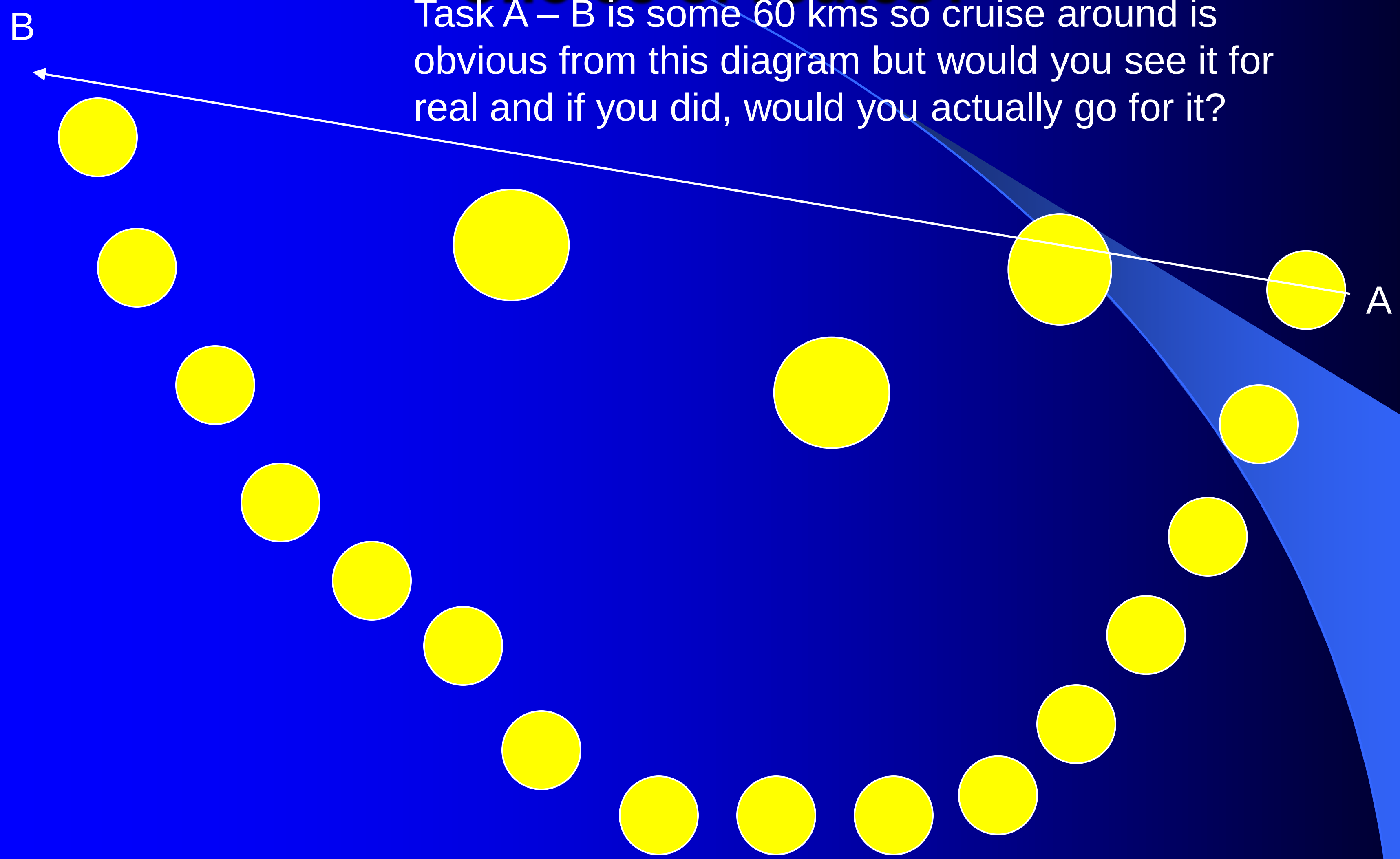


Now what ?

Go for and Climb in the strong thermal or follow the street

Choice of routes?

Task A – B is some 60 kms so cruise around is obvious from this diagram but would you see it for real and if you did, would you actually go for it?



Streeting

You need some wind and normally an Inversion

Power Station Streeting

Classic/Common Inversion Induced Streeting

Blue Day Streeting

Wave induced Streeting

Cloud Shadow Streeting

‘Hill Streeting’

Sea breeze Streeting

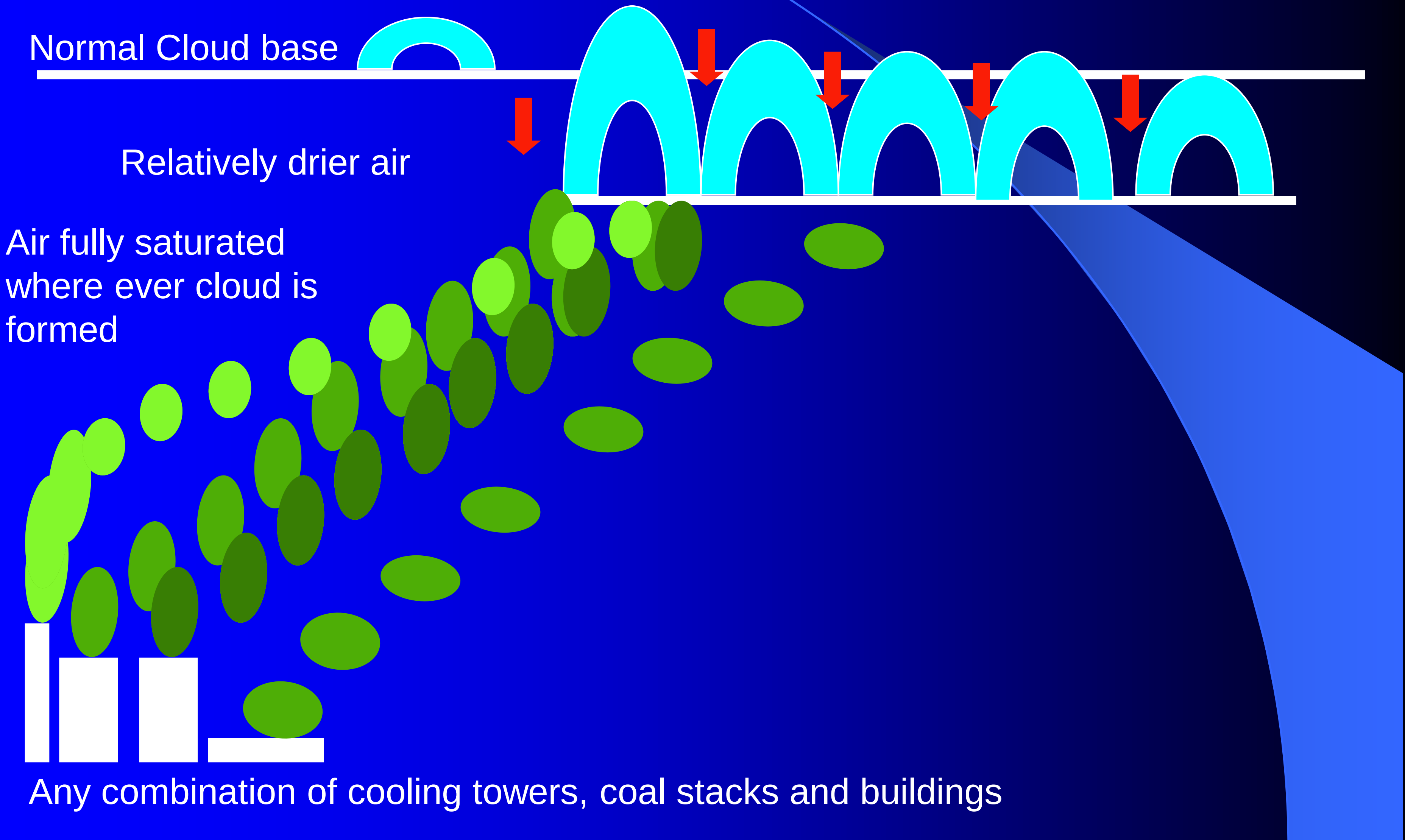
Power Station Streeting

- Natural streeting compared to the streeting caused by power stations are significantly different. The great news is, however, that power station streeting is clearly visible from the thermal source, its progress up to cloud base and the cloud street development allow a useful starting point to get to grips with the structure of both a thermal and a street.
- The fundamental differences are twofold.
- 1. The main heat sources of a power station are not associated with the sun, cloud shadow or sink slugs.
- 2. The humidity of the air is artificially increased, whilst the thermals may be stronger on low humidity days, cloud base will be lower.

Size Matters

- Drax Power Station
- The top of the boiler chimney contains 4 exhausts less than 2 metres across.
- Despite the temperature being around 300 degrees C, this only gives the potential of 14,400 cubic metres of air at one degree hotter.
- The main cooling towers are around 20 metres across at 45 degrees C. Area is 1200 square metres therefore potential of 54,000 cubic metres of air at one degree hotter. This equates to a field warmed by one degree, 230 metres by 230 metres. Fields, however, are normally bigger and several degrees warmer! At 4 degrees hotter equals a field 116 metres square.
- So despite the appearance, power stations are not quite as good as they appear, but are better on dry days due to increased humidity, if they are working. Coal stacks possibly a better heat source.
- The streeting can be useful.

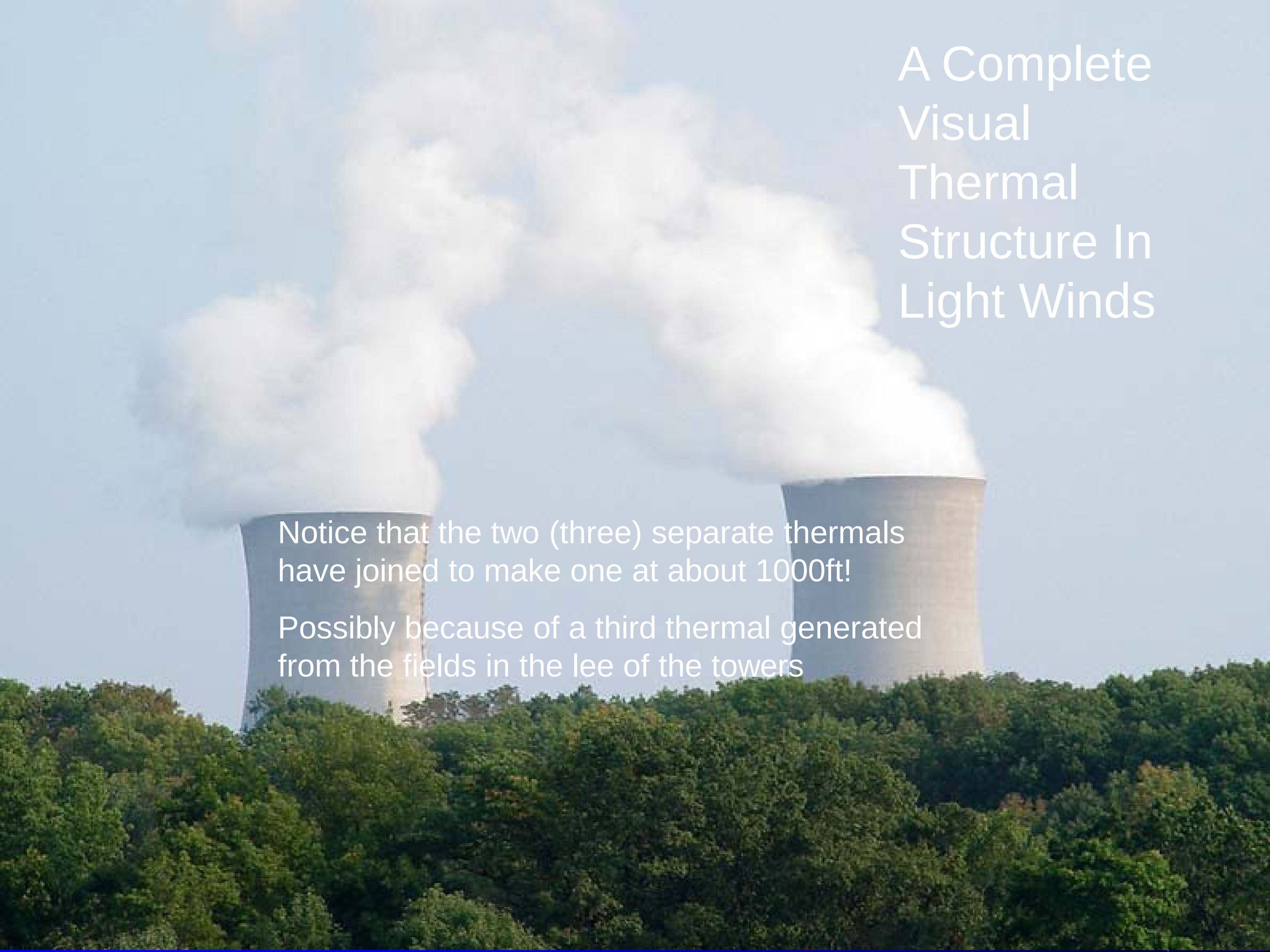
Power Station Streeting (simplistic diagram)



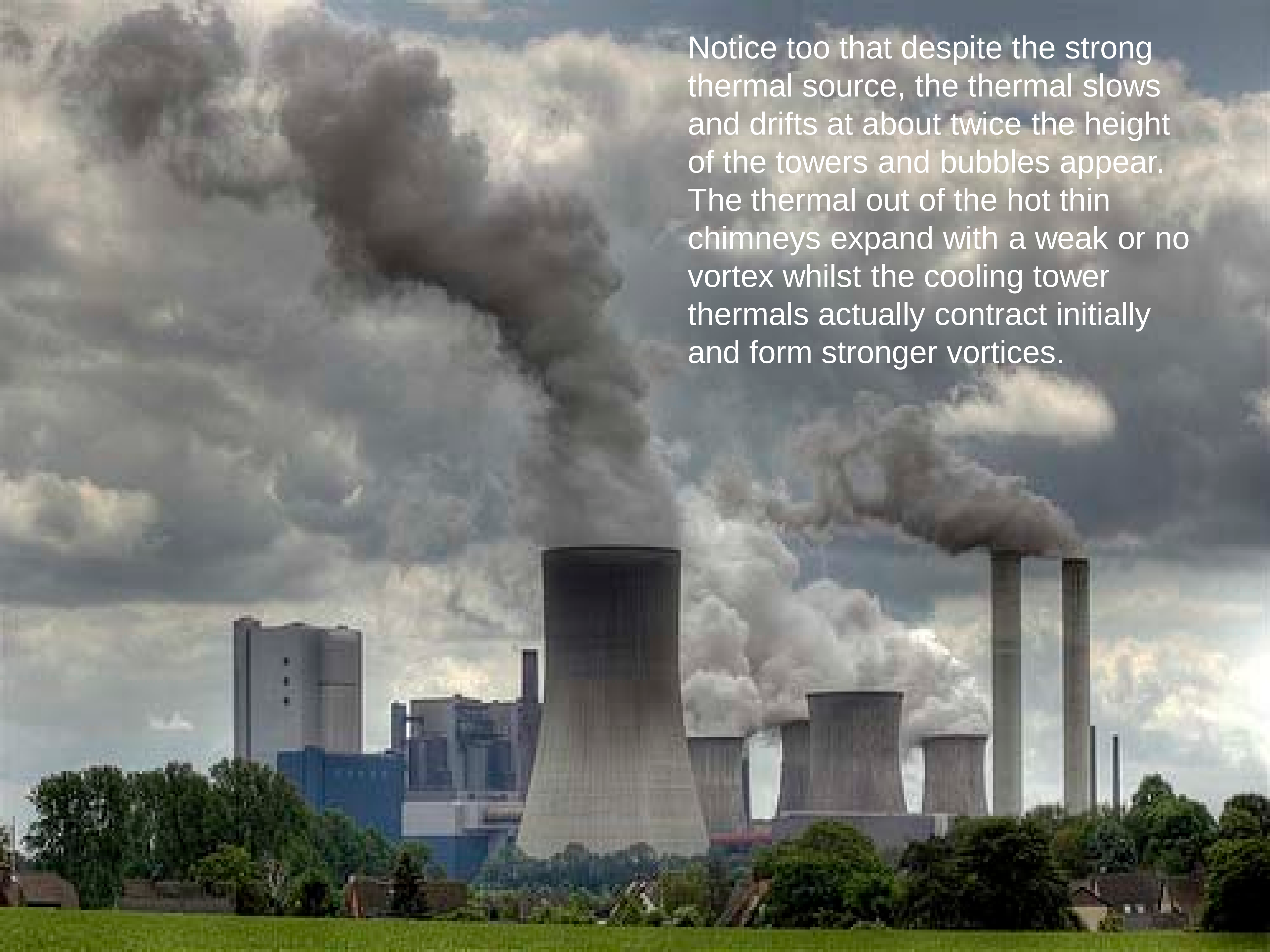
A Complete Visual Thermal Structure In Light Winds

Notice that the two (three) separate thermals have joined to make one at about 1000ft!

Possibly because of a third thermal generated from the fields in the lee of the towers



This too has joined up to make one huge thermal. Also notice that despite the constant heat source the air still **does break into bubbles** as it rises. This photo taken early in the morning and a sharp inversion obvious with failure of the cloud to extend vertically (streeting and spread out) and a marked change of wind with height



Notice too that despite the strong thermal source, the thermal slows and drifts at about twice the height of the towers and bubbles appear. The thermal out of the hot thin chimneys expand with a weak or no vortex whilst the cooling tower thermals actually contract initially and form stronger vortices.

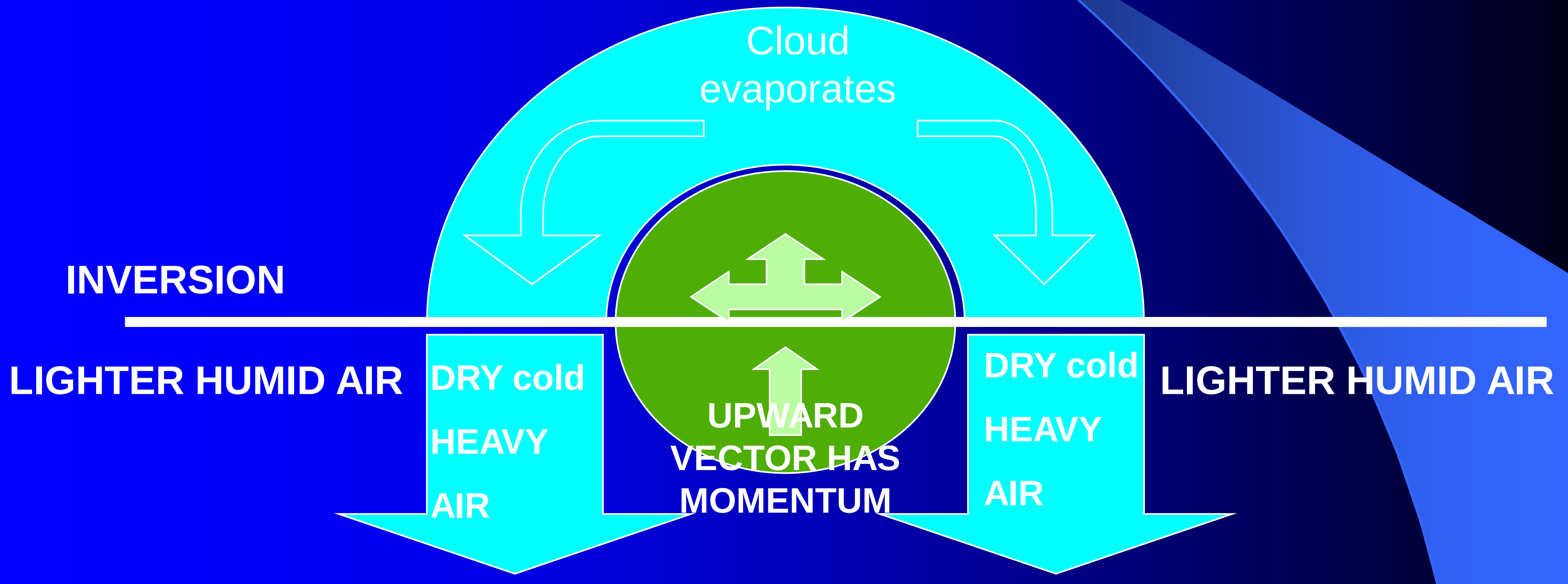
WIND

- And along came the wind and changed everything!
- The wind is best imagined as a river flowing over rocks. The eddy currents will be the same but only effect the lowest levels, where thermals are generated. At higher heights the misleading gusts reduce.
- Rule of thumb, 1 knot per 100 feet. Therefore a 10 knot wind will not effect the thermal structure above 1000 feet; and a 20 knot wind will not effect the thermal structure above 2000 feet. Above 20 knots though wave comes into play. Important if you are looking at gusts to centre on a thermal. To avoid confusion 1 knot per 100 feet then becomes the good height not to go below if searching for solid vortex thermals!

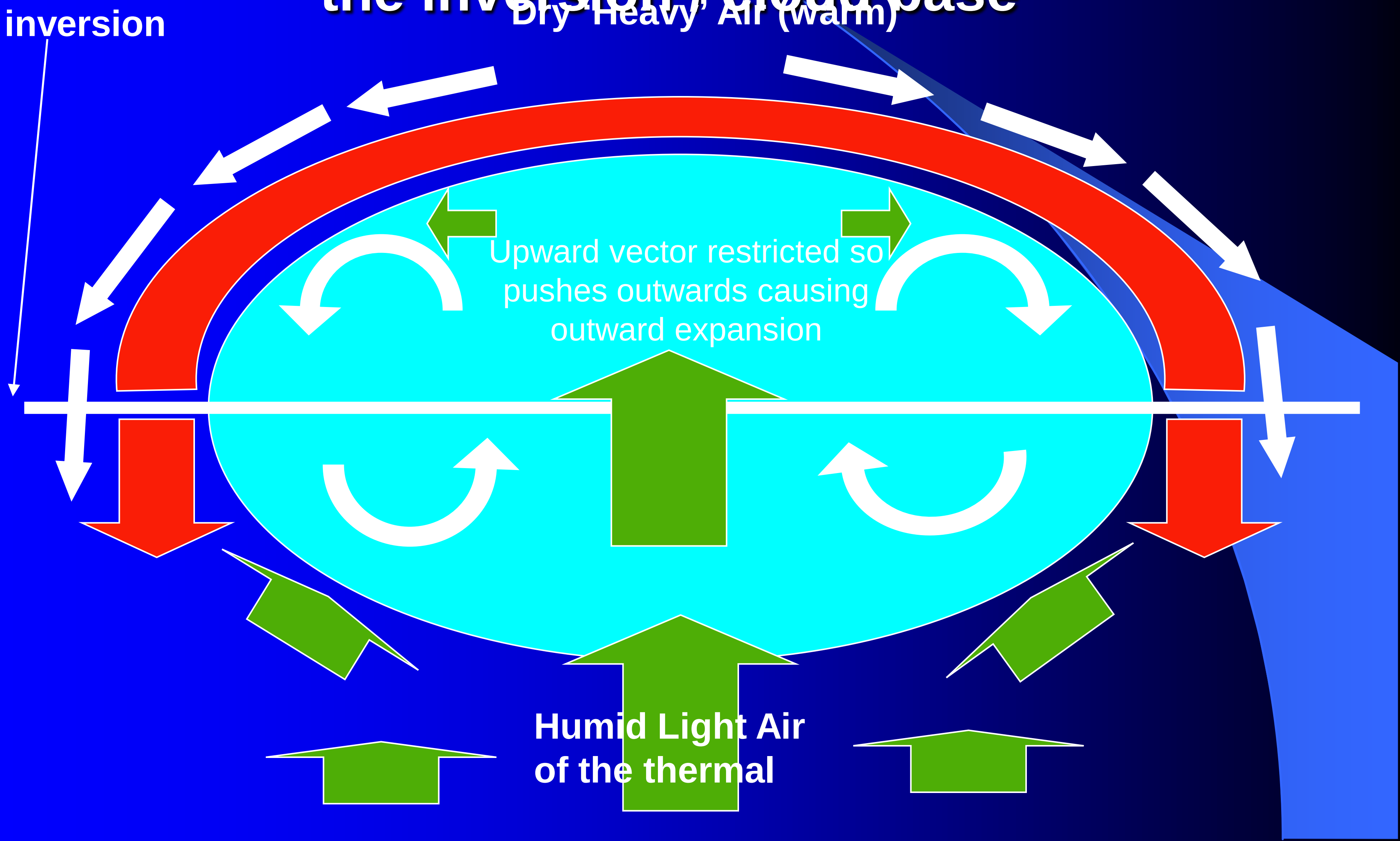
Cloud Streets

The most favourable conditions for the formation of cloud streets occur when the lower most layer of air is unstable, but is capped by an inversion of stable air. This often occurs when the air is subsiding, (all descending) such as under anti cyclonic conditions (high pressure). Convection occurs below the inversion, with a line of rising air in thermals below the clouds and sinking in the air between the streets. The upper wind usually determines the streeting direction which will then break down if the day develops hot enough to break the inversion. Whilst they are usually straight lines and favour a 10 to 20 knot wind, they can make a paisley pattern when the wind driving the street encounters an obstacle. These cloud patterns are known as von Karman vortex streets.

Vortex Ring Formation
Into Wind View
at the top of the thermal, at the inversion



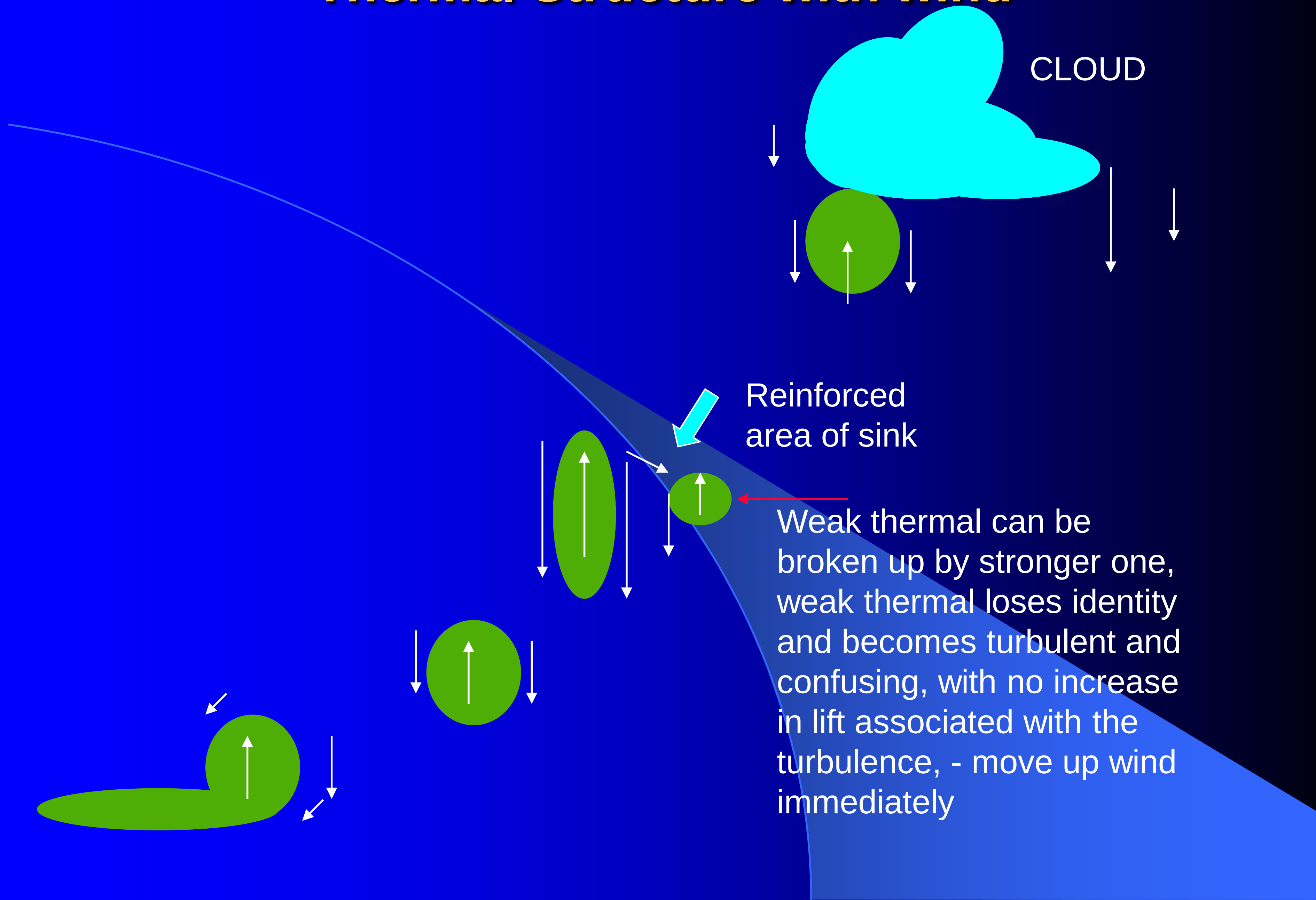
Vortex Ring Formation
Into Wind View The Smoke Ring analogy at the inversion / cloud base



Effect of wind

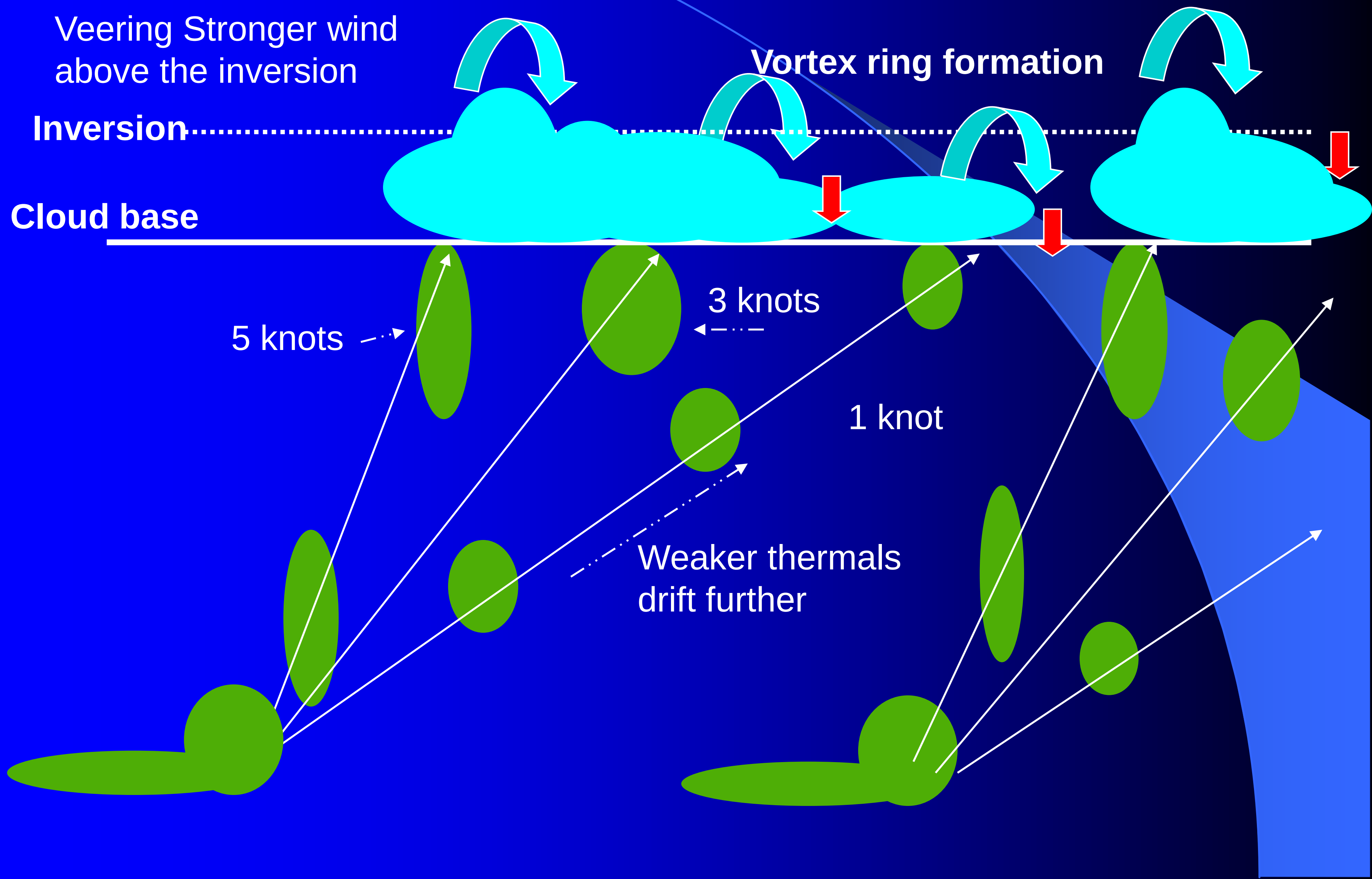
- The effect of wind slants the thermal line relative to the ground which normally causes a string of bubbles and **never** a column
- or with an inversion - streeting.

Thermal Structure with wind



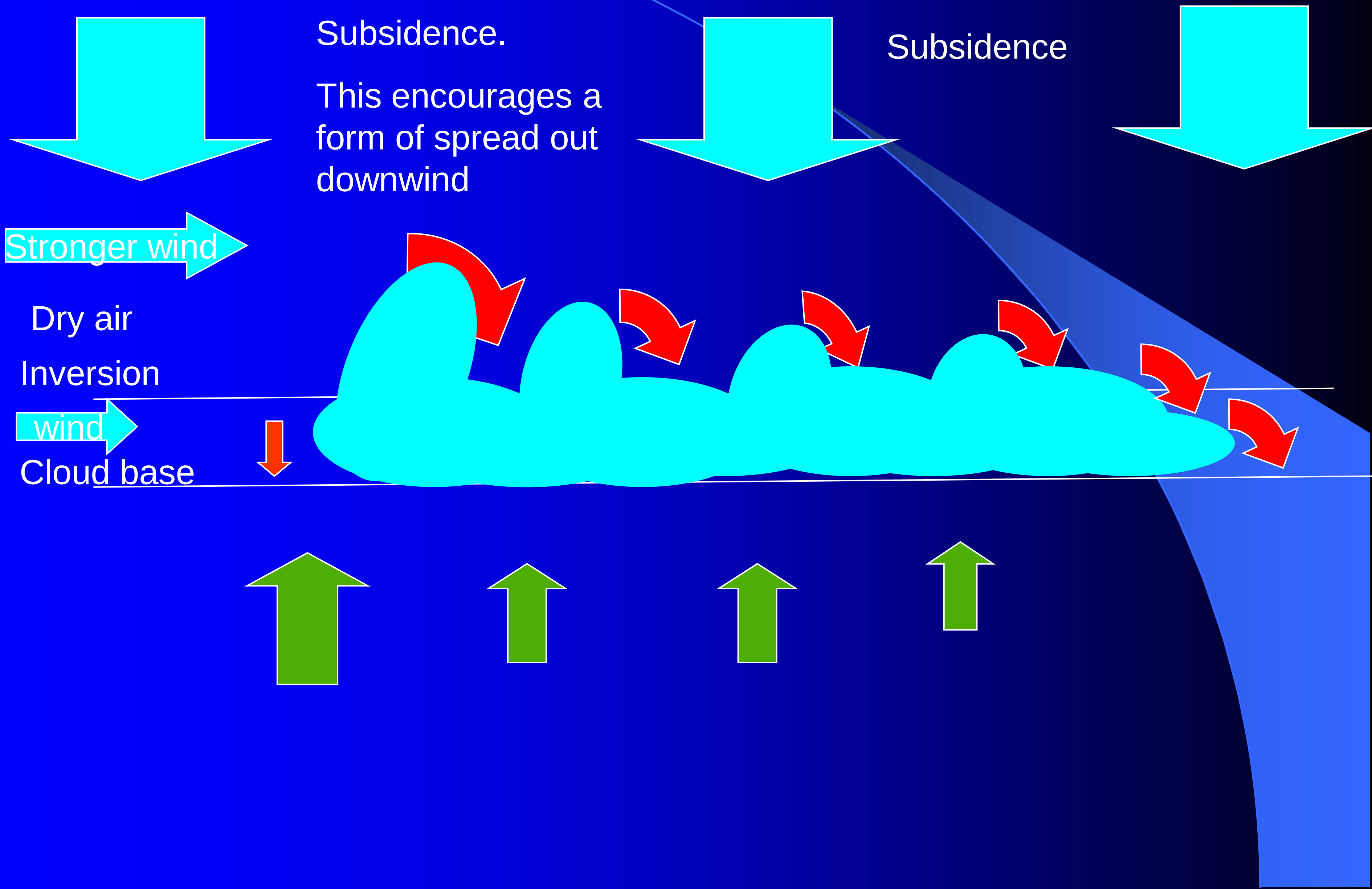
Weak thermal can be broken up by stronger one, weak thermal loses identity and becomes turbulent and confusing, with no increase in lift associated with the turbulence, - move up wind immediately

Streeting side view - a concept picture



Thermal Structure Streeting

Cross wind view improved concept

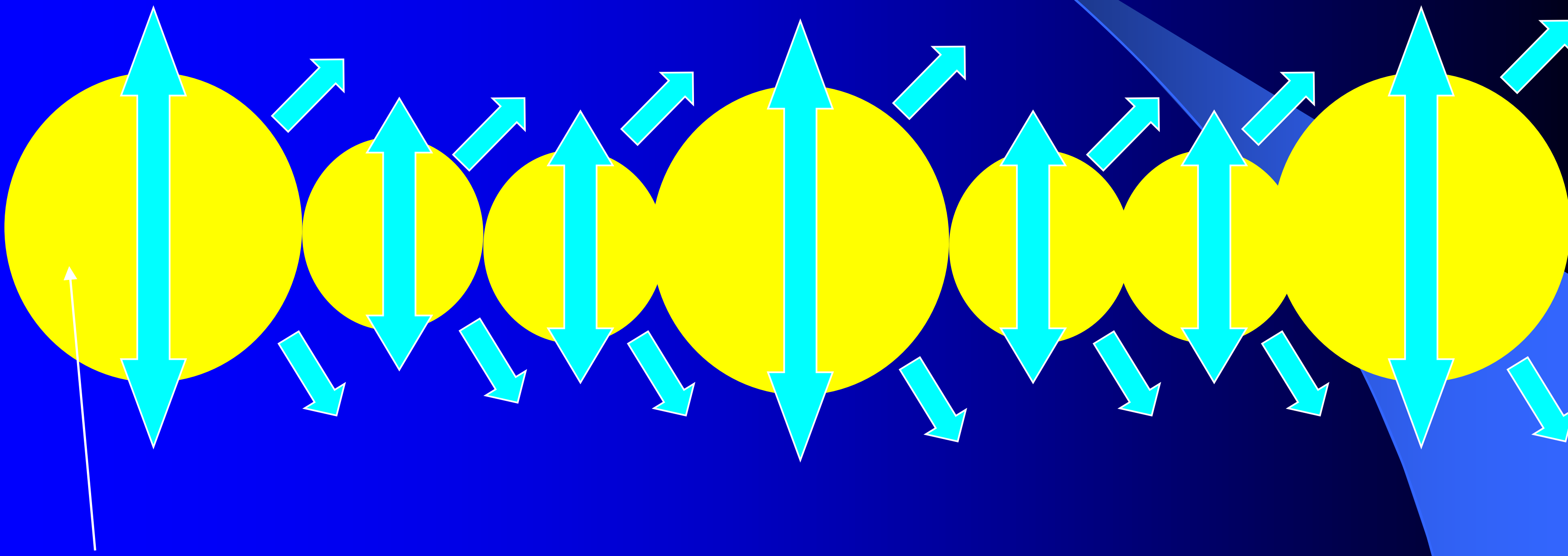


Vortex Streeting top view

WIND near cloud tops ⇨

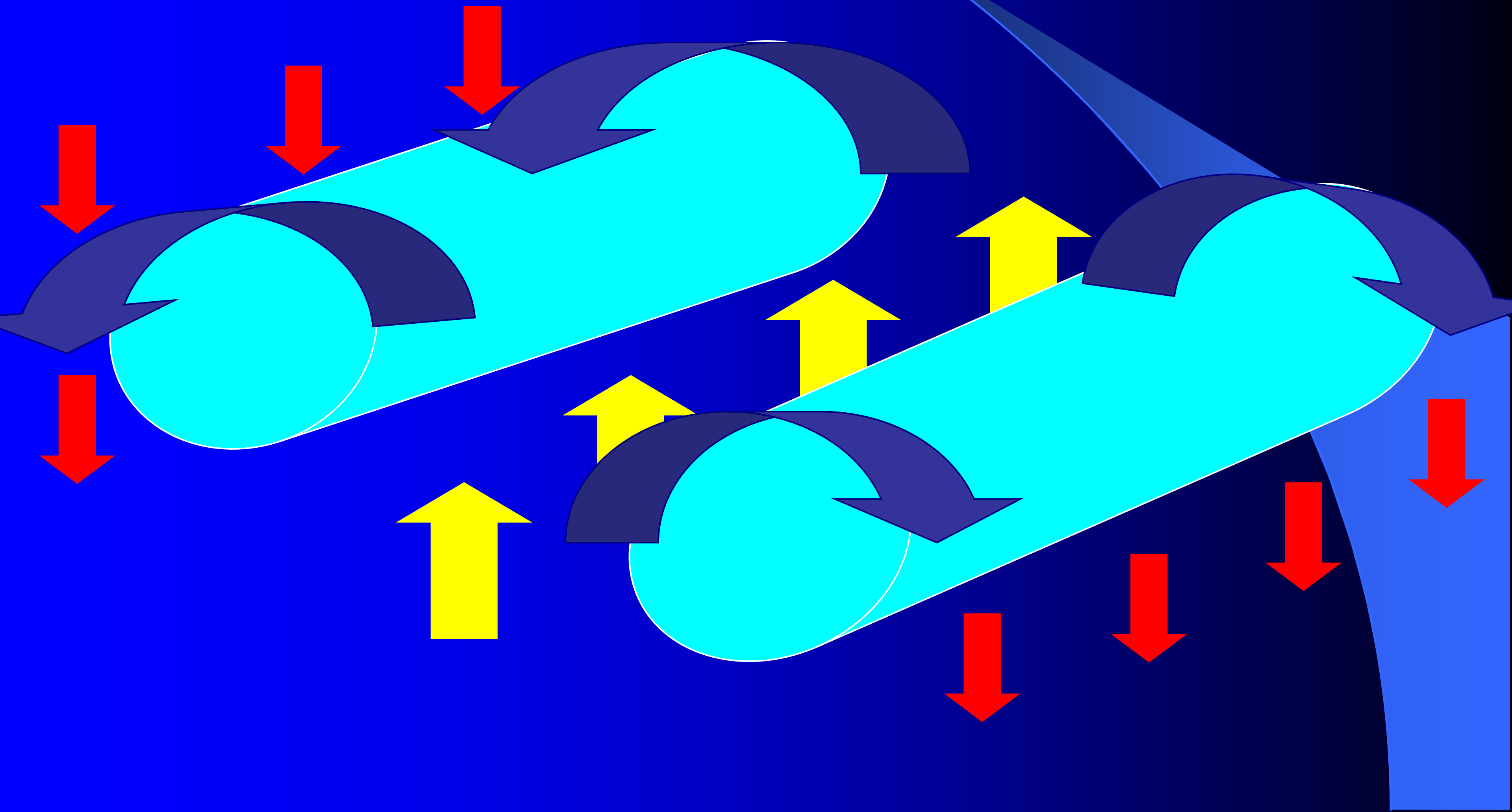
WIND at Cloud Base ⇨

Vortex ring formation, more sausage roll shaped and self perpetuating!



The leading strong thermal punches highest and prevents the downdraft up wind coupled with any significant increase and change in direction of the wind above the inversion

Vortex Streeting 3D



Cloud Shadow Streeting

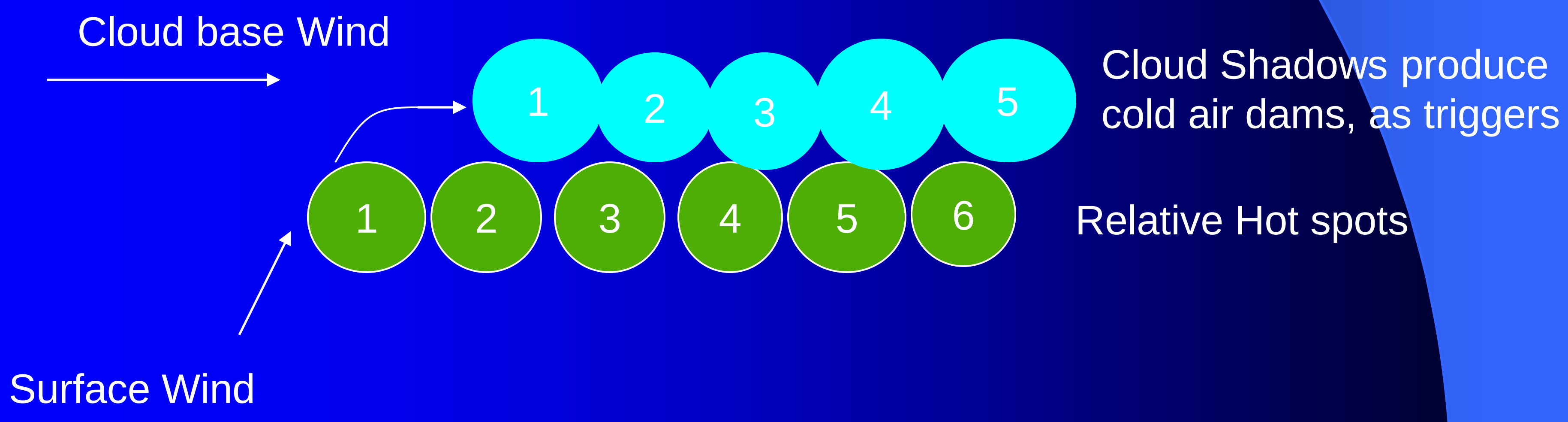
Just when you thought that you were getting on top of it all, along comes cloud shadow to ruin everything. Actually it improves the situation for two reasons. The first is obvious, you can see where the thermals are or were. More importantly it provides structure to the sky and allows long glides to be made linking the energy. Usually needs a change in wind direction with height before cloud base.

The sun heats the primary source and the thermal generated forms a cloud. The cloud makes a shadow near the original thermal source which generates differential heating and triggers another thermal and cloud.

The process is repeated many times.

This example shows a veering wind with height (usual).

Note the cloud street appears angled well off the surface wind direction



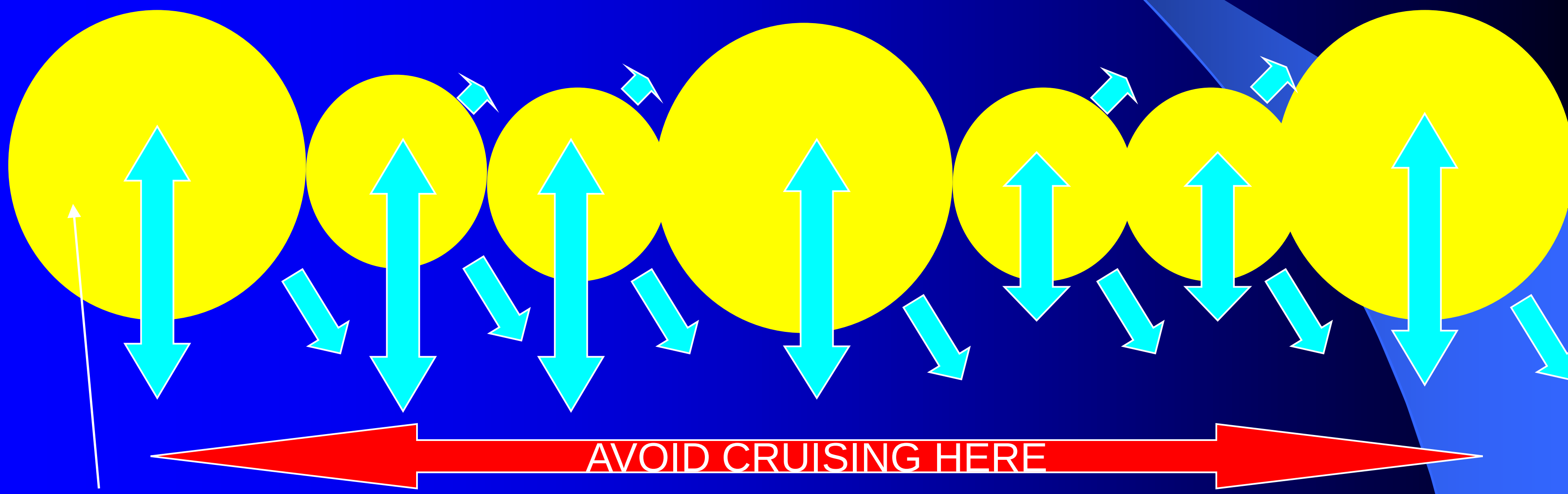
Vortex Streeting top view

WIND near cloud tops

Vortex ring formation

Note: Wind veers and increases with height

WIND at Cloud Base



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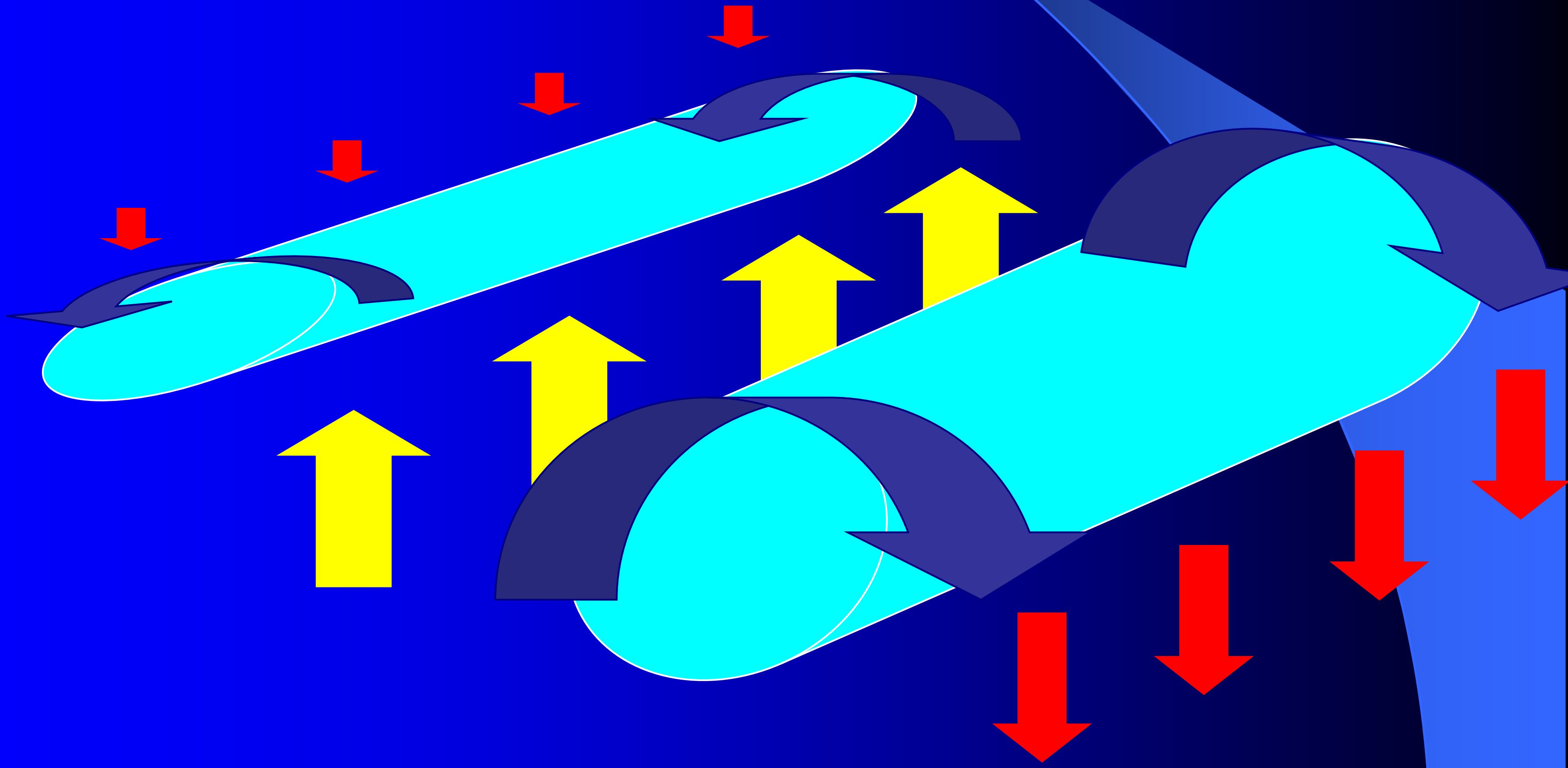
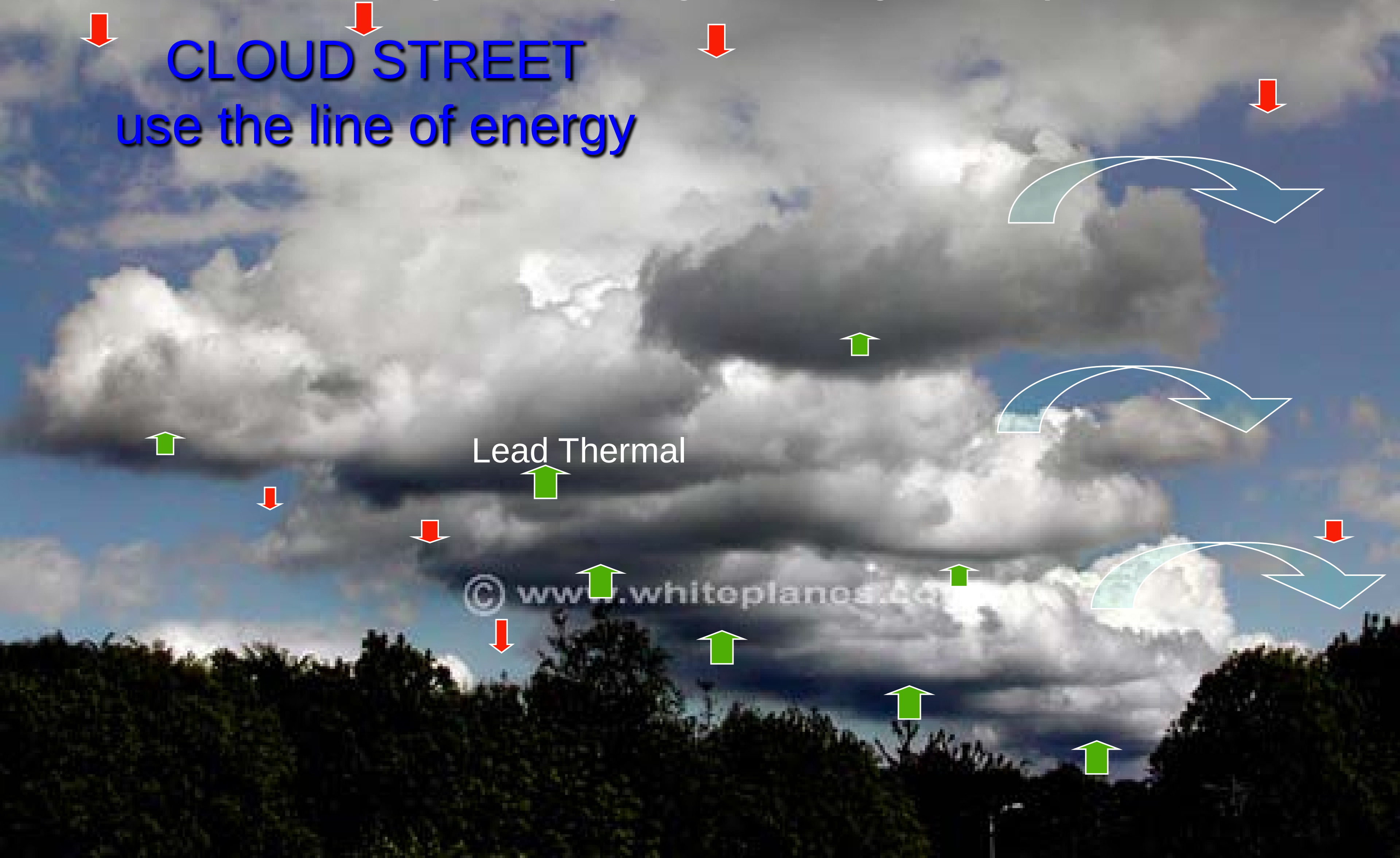
Vortex Streeting 3D

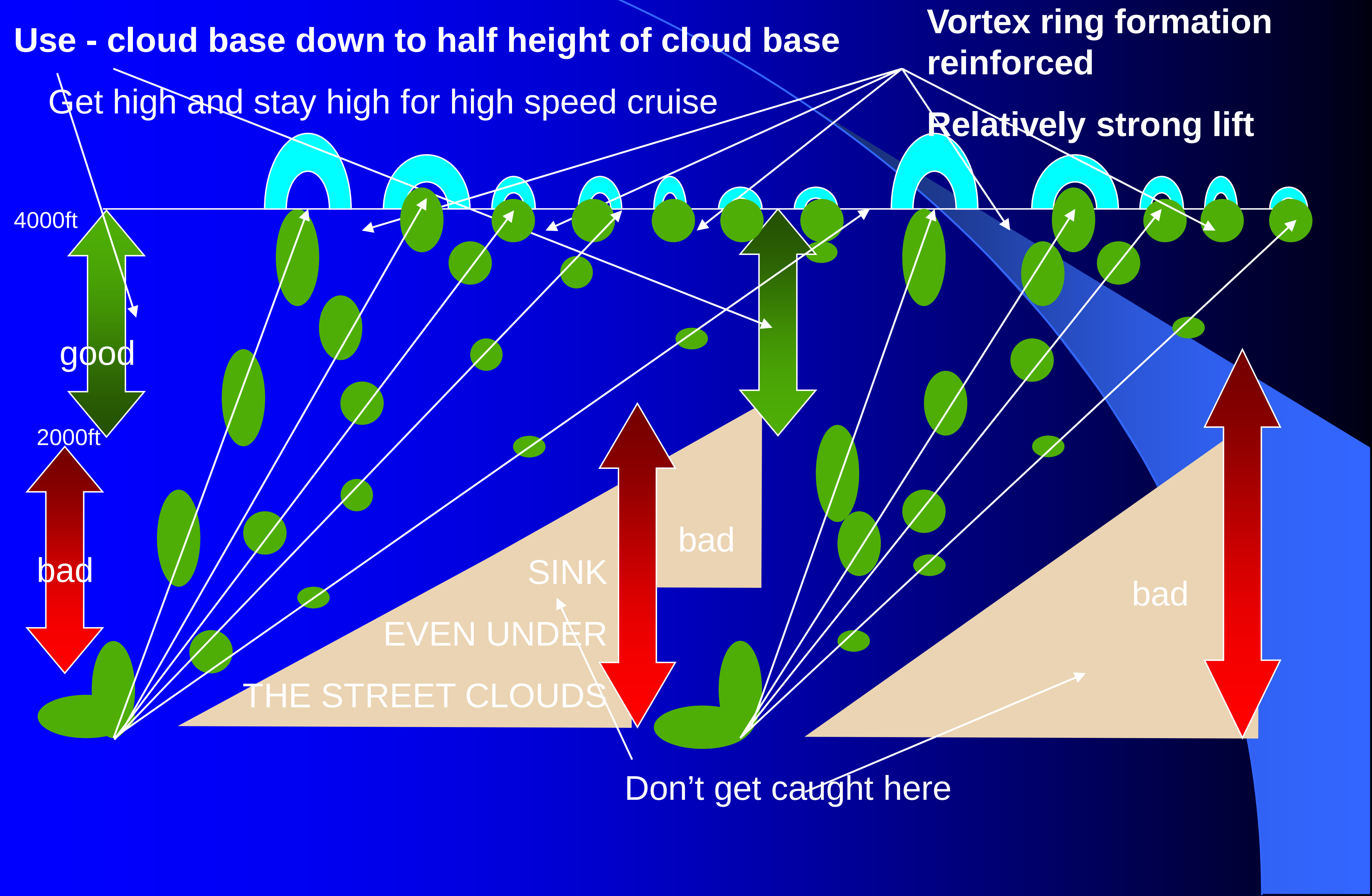


How do you anticipate the strong thermal. When streeting, it is the widest cloud (cross wind) or if jumping across street to street, the one where the cloud has climbed the highest. Wind increases and veers with height. The sink line – Tracking West keep Right, Tracking East keep Left.



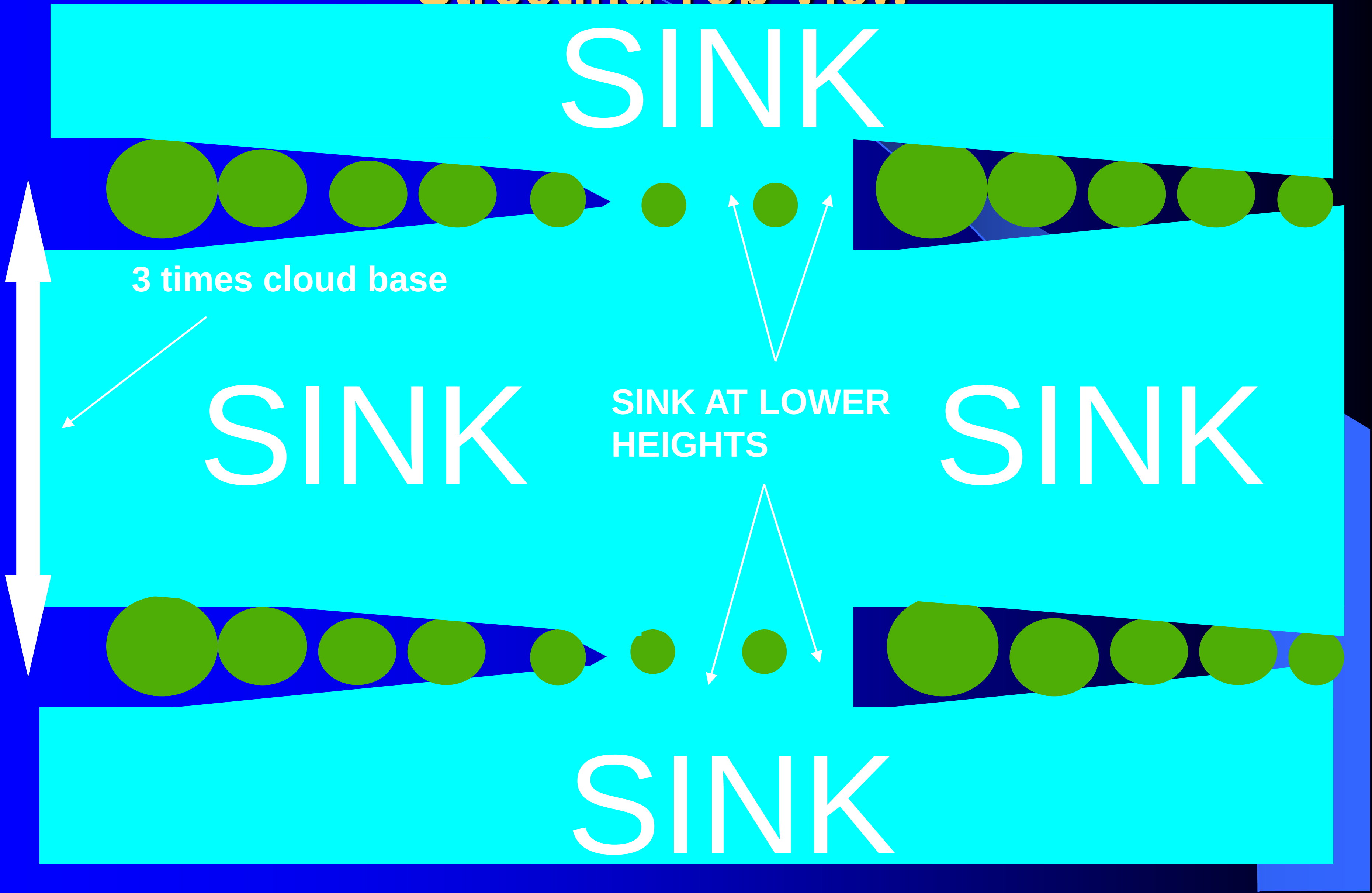
Streeting side view

Climb in strong thermals and cruise to next strong thermal. High MacCready value




Broad Streeting, Inversion not far above Cloud base

Streeting Top View



Street Surge

- Often whilst on a street ‘cruise’ we encounter a larger surge and despite which ever way we turn we encounter considerable sink,- frustrating! Where is that strong thermal?
- Always try to remember that despite the desire to turn – don’t. Instead pull up hard and ride it whilst you can. Perhaps surprisingly, you can anticipate it!
- The question is where does this unusually strong ‘thermal’ come from?

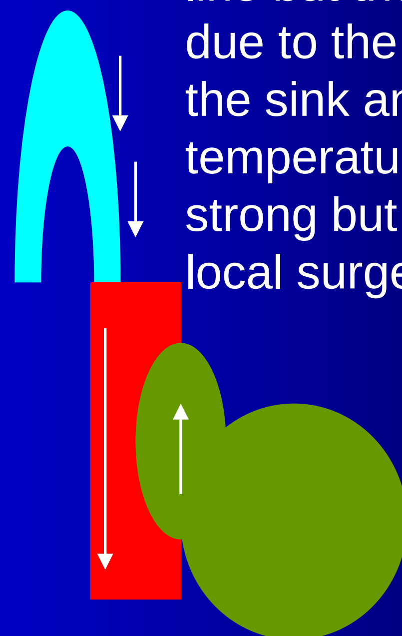
Street Surge

- It comes from the modification of a sink hole clashing with a strong thermal hitting it. The sink is pushed out to become horse shoe shaped, remember that sink does not form a vortex. But it does reinforce the thermal vortex at that point. You will not experience any strong sink before the surge. The cloud structure above can give you the clue. Always, you have to look for it! Whilst it does give us a surge because it energizes the vortex motion and the vortex will turn in on itself faster, it does not increase the overall thermic rate of rise of the bubble, so it only goes up as far as that vortex bubble physically goes. (And you can not thermal in it because you can not turn tight enough.

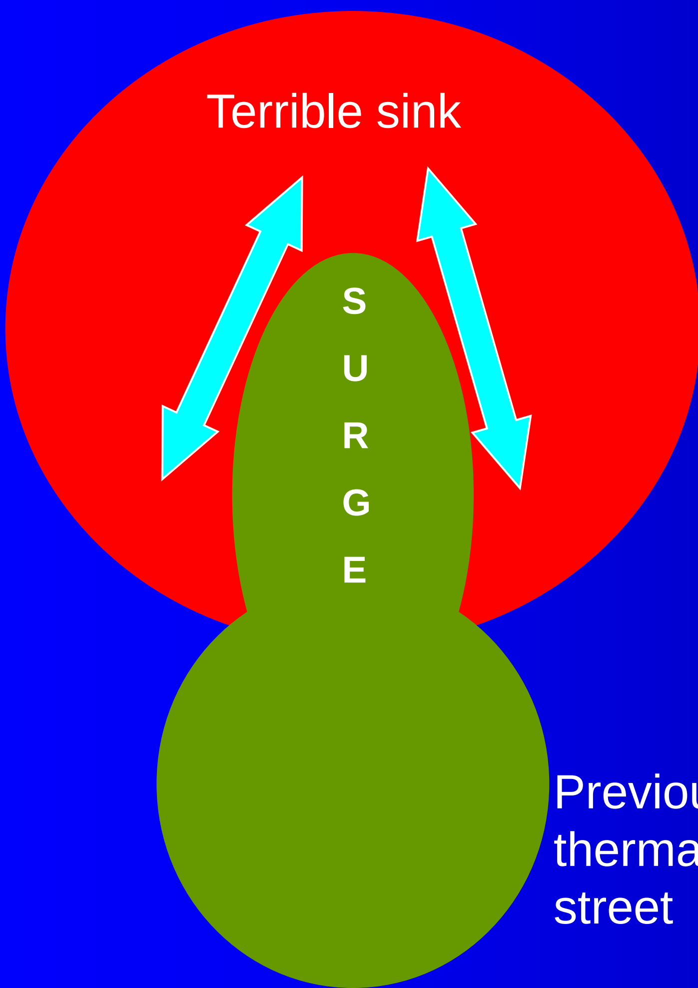
Street Surge

Side View

Taller decaying cloud on the street causing strong sink hole on street line but the thermal is not destroyed due to the vortex motion but distorts the sink and reinforced by the strong temperature difference gives a strong but rarely usable (to turn) local surge

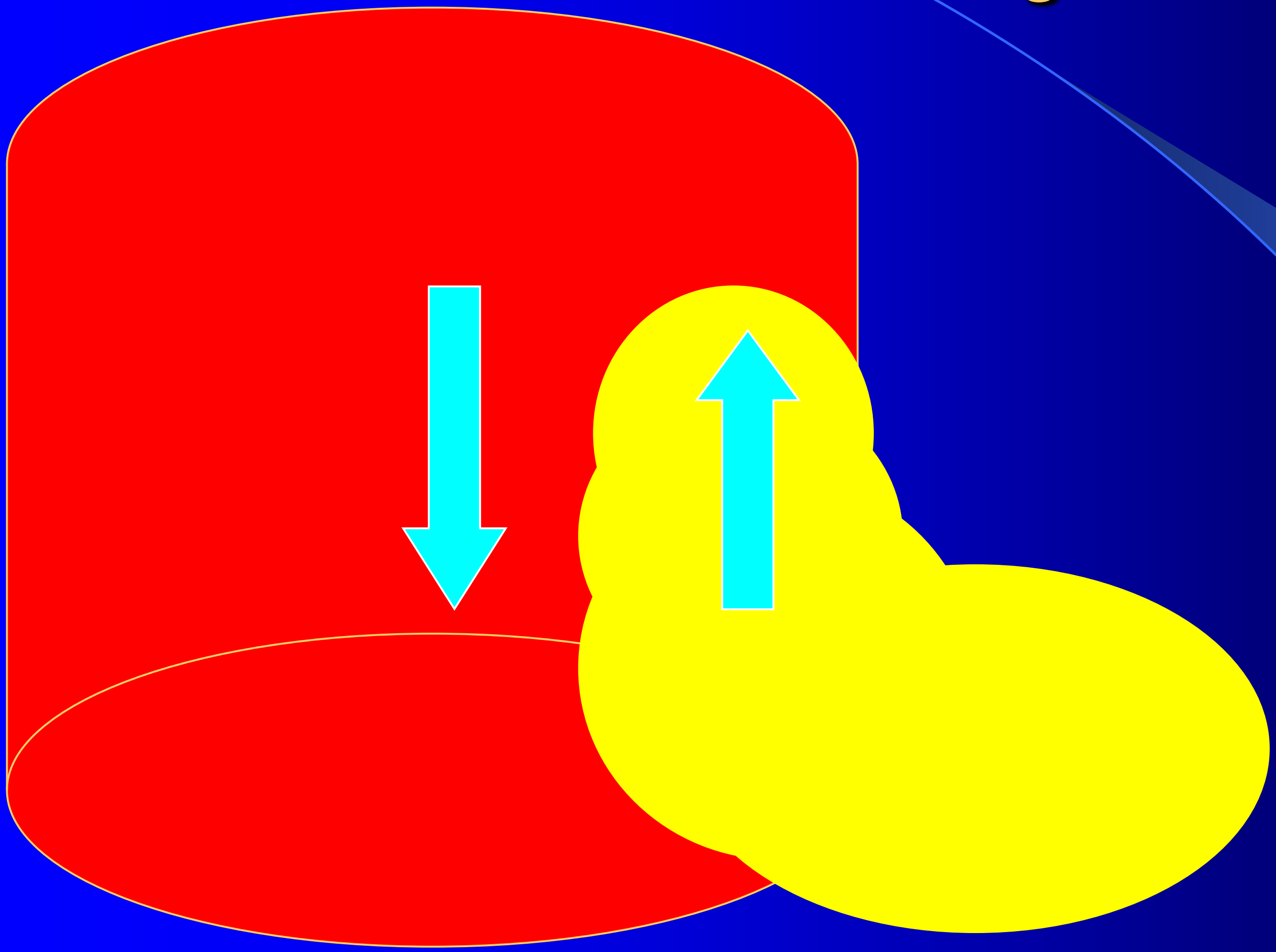


Top View

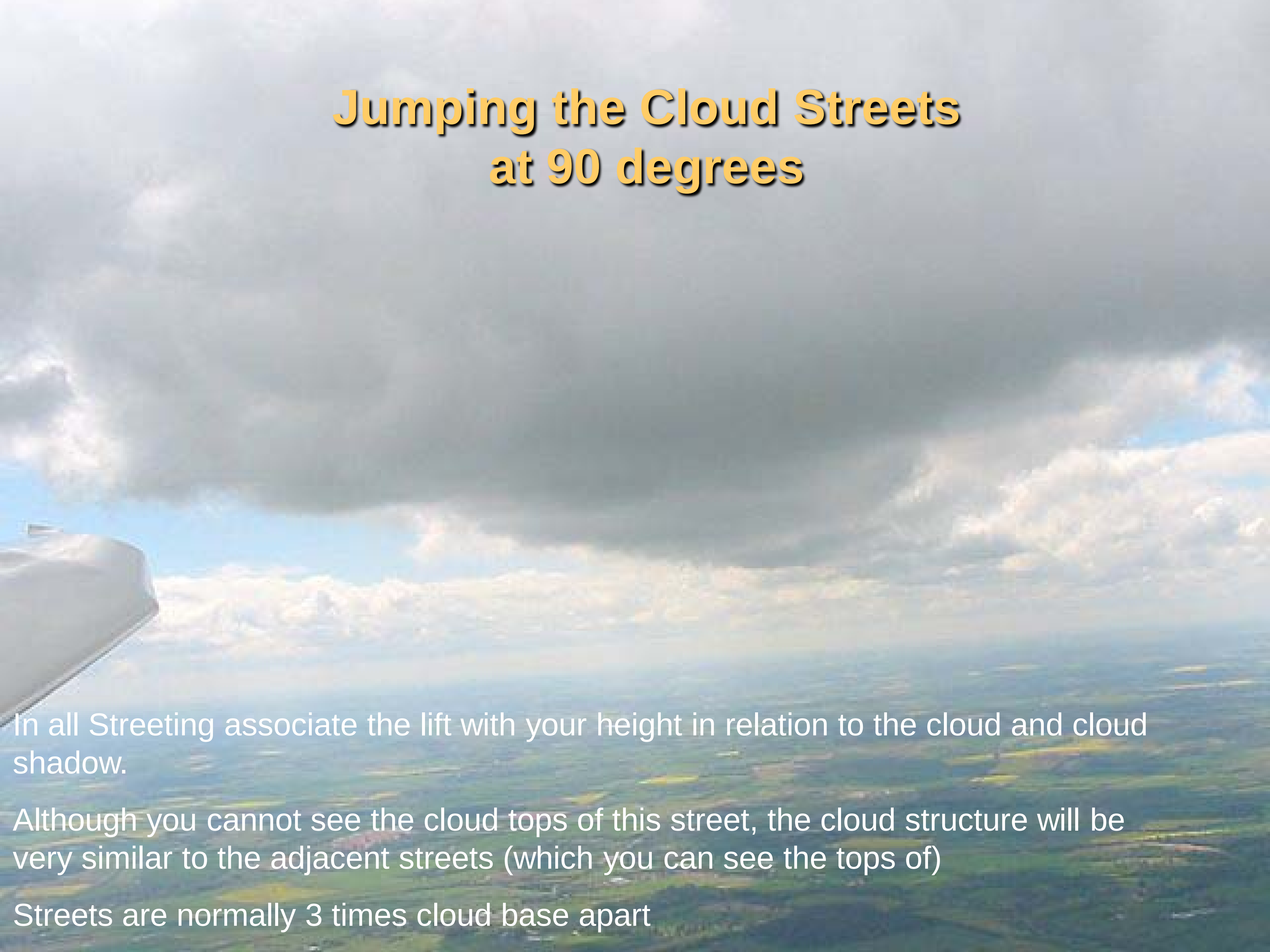


Previous normal thermal bubble in street

Street Surge



Jumping the Cloud Streets at 90 degrees



In all Streeting associate the lift with your height in relation to the cloud and cloud shadow.

Although you cannot see the cloud tops of this street, the cloud structure will be very similar to the adjacent streets (which you can see the tops of)

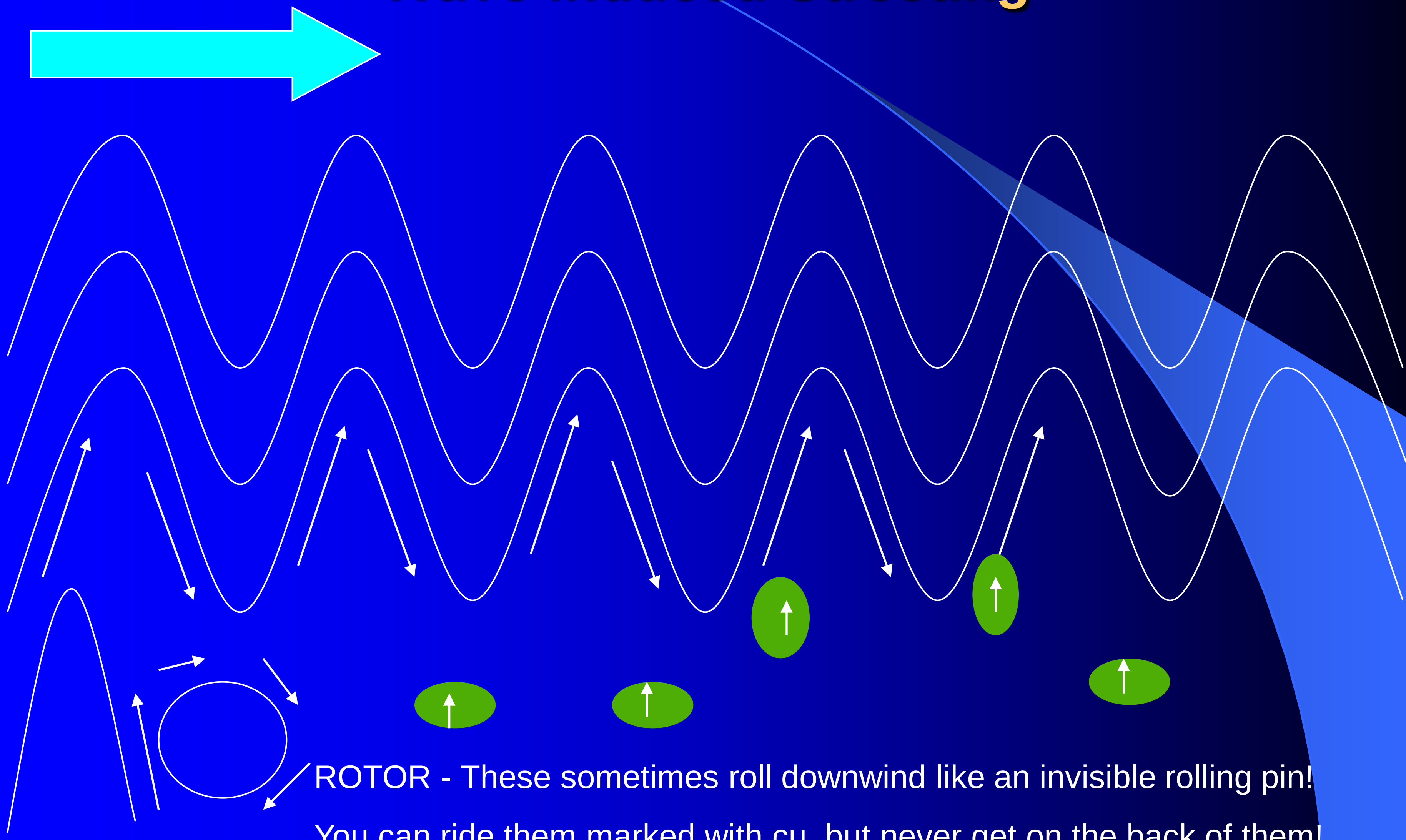
Streets are normally 3 times cloud base apart

Blue Day Streeting

- Having grasped the basic concept of streeting then you should now have an understanding of the thermal structure on a blue day with 15 knots of wind. Given half a chance, it will always street on a windy blue day, because the biggest thermals dominate the sky structure, although you can't see it. It keeps rotating as it drifts downwind at the inversion.
- The good news is that thermals will be triggered from the same obvious sources. Recognizing ground features for thermal sources now becomes extremely important. You will find many of them on a map!
- However it is not quite that simple (did I hear it never is!) The thermals weaken with height as the thermal enters relatively warm air and stops ascending. However there is no cloud formation (shadow) nor evaporating cloud sink so the inertia of the vortex can continue to exist for some time as it drifts downwind.
- This gives weak thermals at height but may be strong low down. Decision is how long to stay in a high band in weak thermals dumping the water or how low you are prepared to push on carrying the water and rejecting the thermals as they become weaker in the climb!


Nearly a blue day Streeting
Inversion just above cloud base
The lack of cloud depth reduces the sink slugs

Wave Induced Streeting

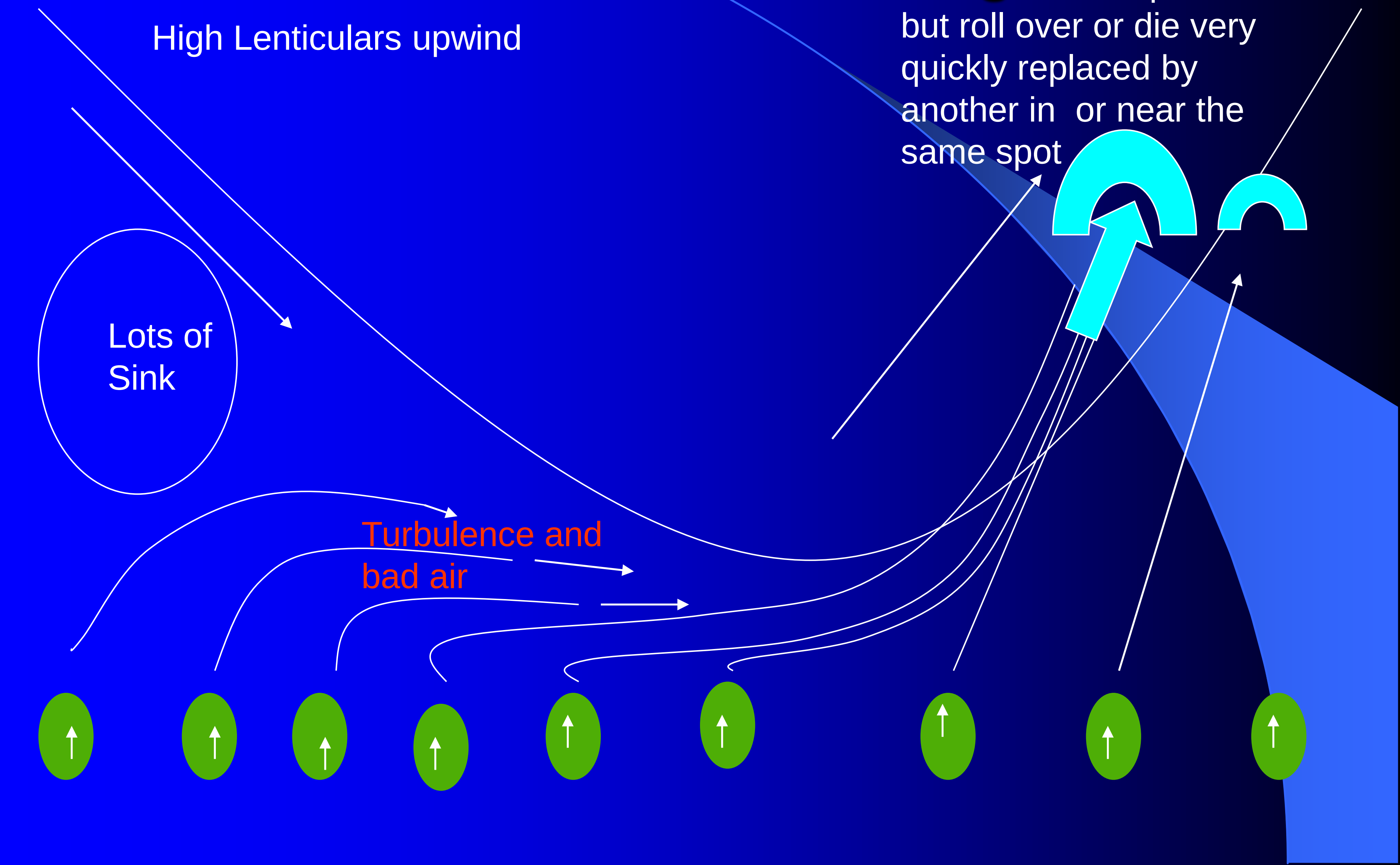


ROTOR - These sometimes roll downwind like an invisible rolling pin!

You can ride them marked with cu, but never get on the back of them!

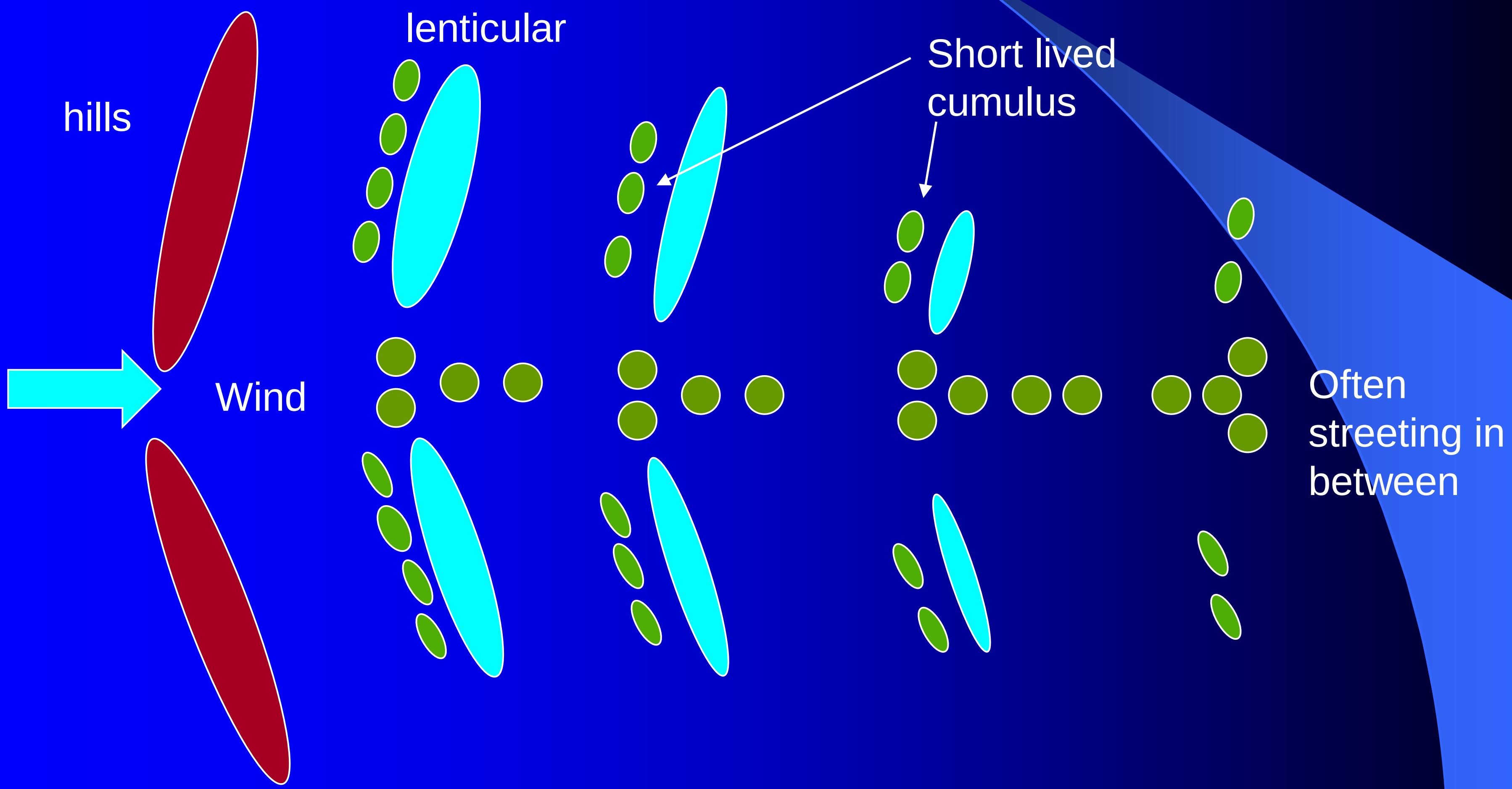
You'll be flattened!

Wave Induced Streeting



Wave Induced Streeting

The street is parallel to the wave, which is parallel to the hills, not the wind



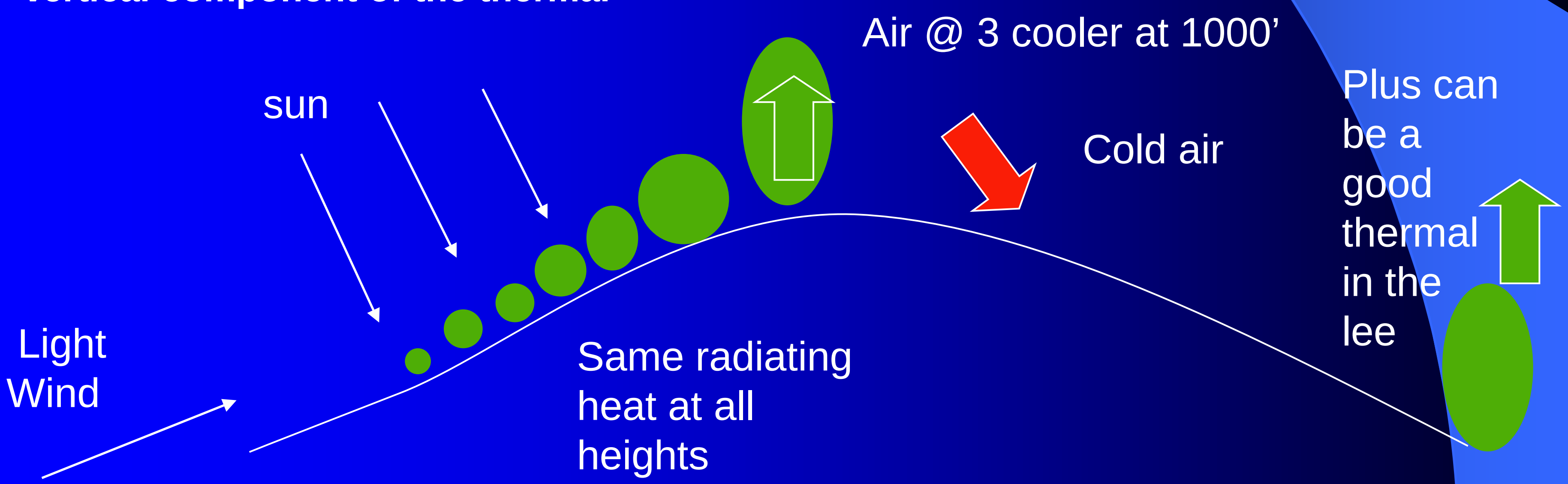
Hill Streeting

Hill Streeting is simply a term I use to understand the lift pattern associated with hills.

In the right conditions, if there is a long line of hills or a ridge then a line of thermals may develop

3 things are important to understand.

1. The heating of the same type of ground surface at height is the same as at lower levels but because the air at height is cooler the effect of warming the air is more effective. Therefore thermals are likely to come off the hill tops, not valleys.
2. The better perpendicular angle of the sun with the ground surface giving more heat
3. The wind blowing up the slope along with the hot air generated provides a flow into the vertical component of the thermal




Note the change in visibility


Hill Streeting
WIND


Strong thermal area due to Hills
Bollington
Rainow
Macclesfield
N
© 2008 Europa Technologies
© 2008 Tele Atlas
Google™
Pointer lat 53.256831° lon -2.020083° Streaming |||||||||| 100% Eye alt 12.38 km

Cloud Shadow again

Of course cloud shadow simply prevents those nice areas which would otherwise get hot on a blue day from doing so, so avoid flying under large cloud shadow areas.

If completely overcast I.e. a day of spread out, then it is back to using the obvious hot spots as on a blue day, with or without streeting.

The leading edge of cloud tracking downwind can produce some very good thermals because it is the leading edge of cold air undercutting the warm air and triggering a stream of thermals.

See next picture!

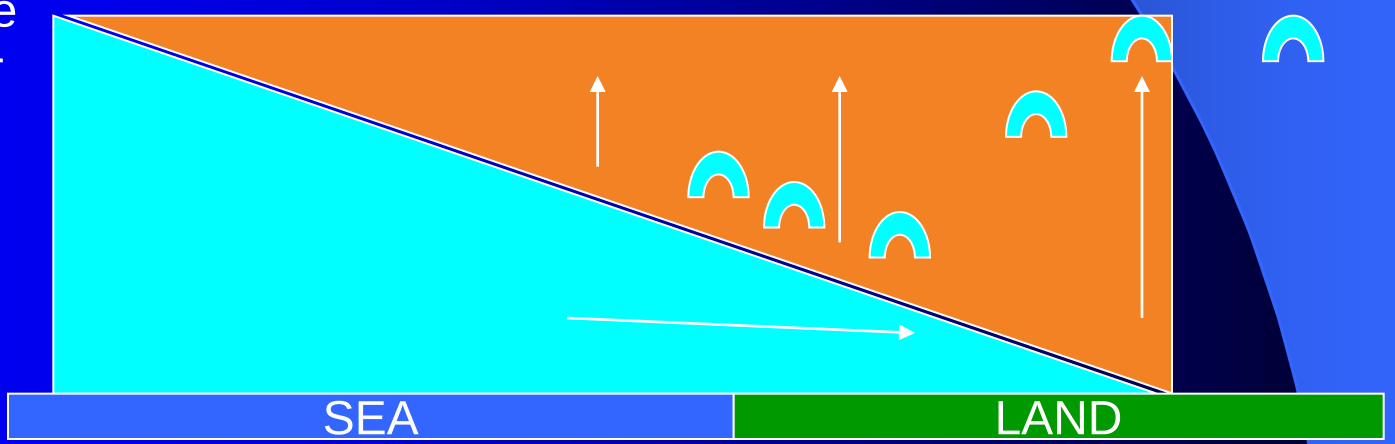

Bad area!
GOOD AREA
Princes Risborough
© 2008 Tele Atlas
Google
lat 51.712438° lon -0.839189°
Streaming 100%
Eye alt 8.15 km

Classic Convergence
Sea Breeze

Warm lighter air rises and cools forming clouds.

High humidity (lower dew points) underneath therefore lower cloud bases towards the coast.

Cold heavy dense air pushing under warm air



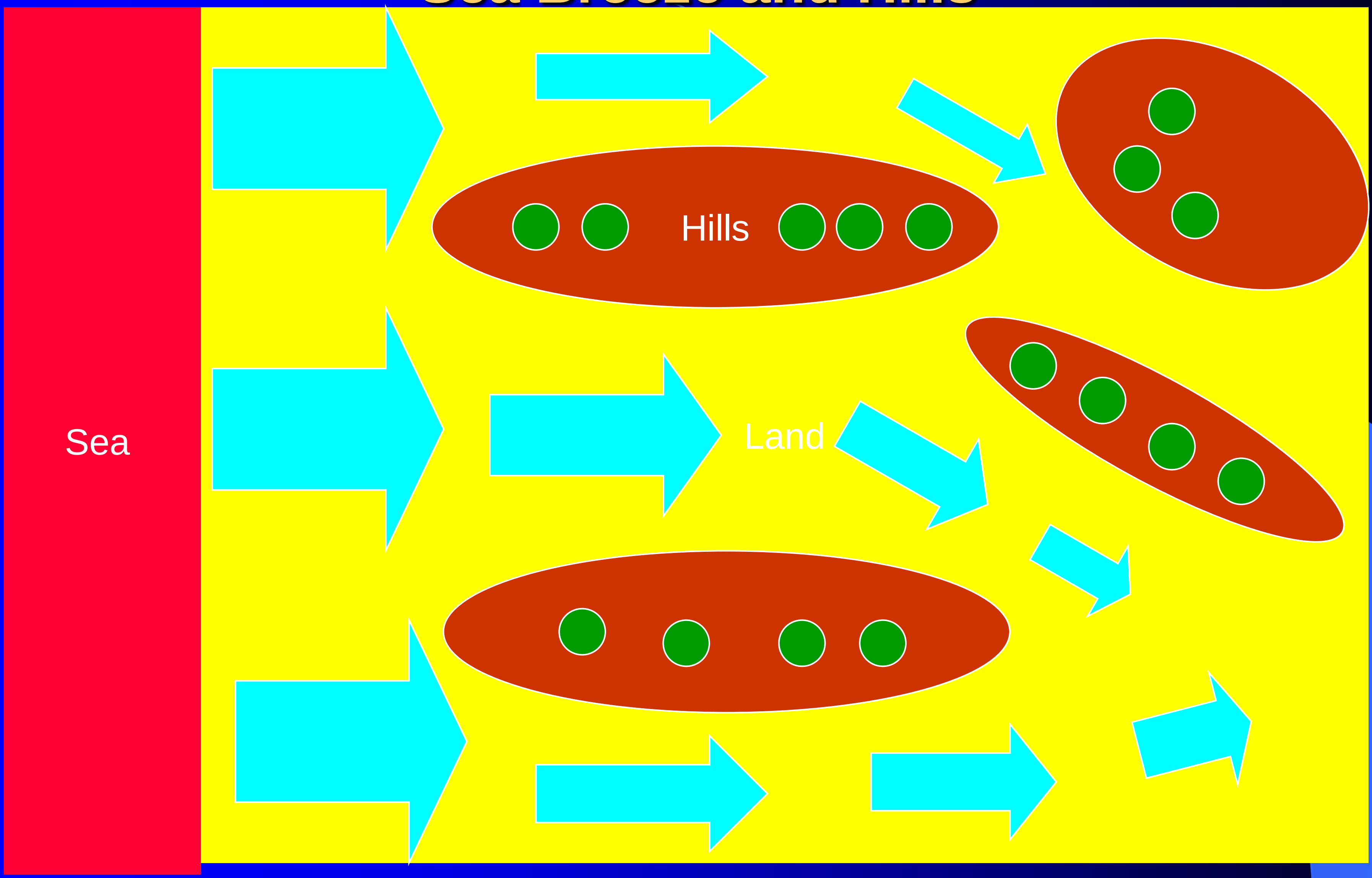
wind


STRONG Sea Breeze convergence
on the Isle of White
And a great glider!

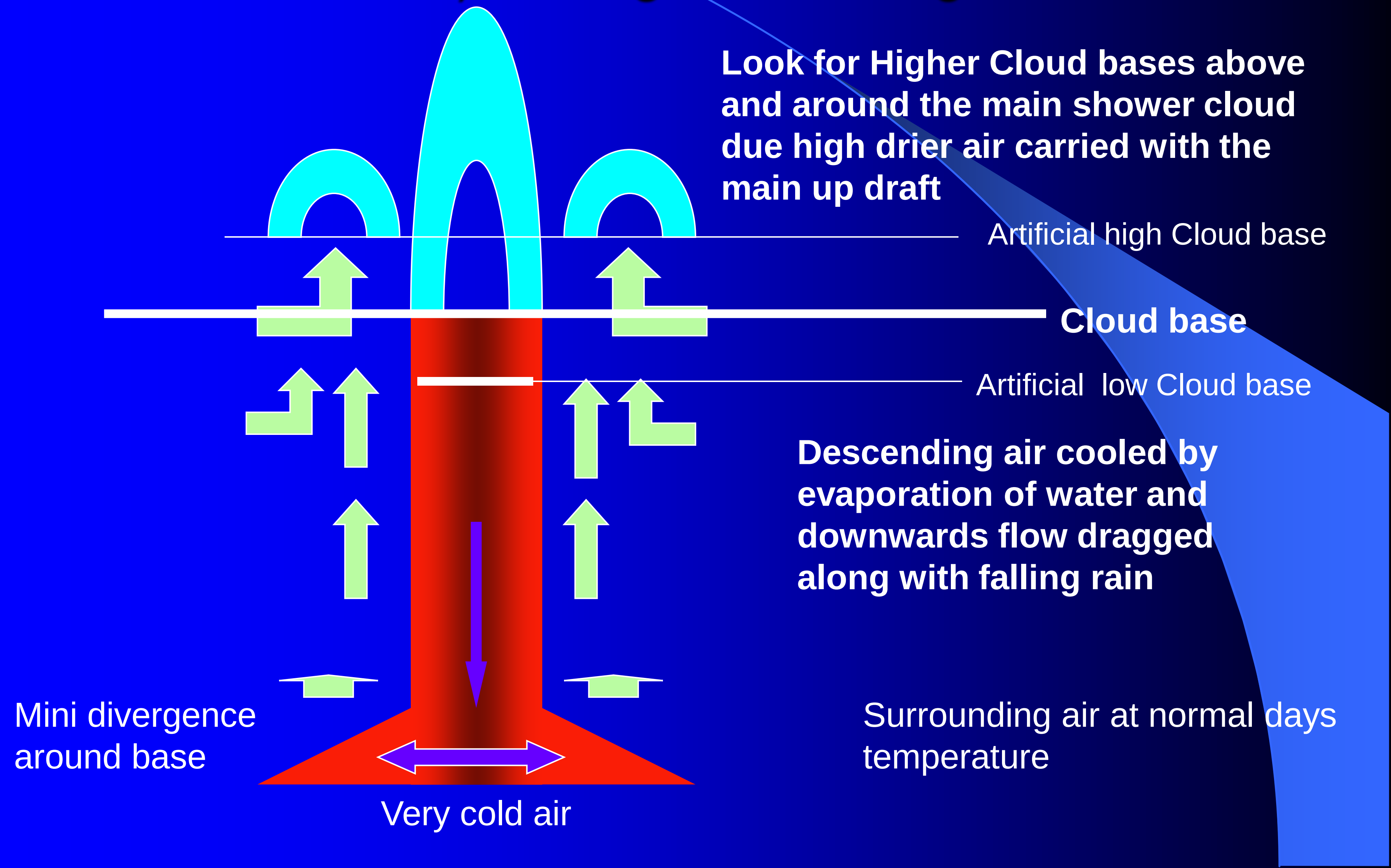
Sea Breeze Streeting

- Sea breezes cause 2 types of streeting
- 1. Parallel to the coast with lower cloud bases.
- 2. Down wind streets caused by the pooling of the cold air in the valleys and the streeting starting from the high ground.
- 3. The streeting continues in land for as far as the hills and sea breeze can influence it.
- The direction of the streeting is dependant on the strength of the wind (sea breeze against the gradient wind and direction).

Sea Breeze and Hills



A Reverse Thermal: Theory; Heavy Shower (Rain, hail, snow.) Local ground divergence



Do thermals rotate?
Any evidence?

- Do birds always turn in the same direction?
- Low pressures, tornadoes, tropical rotating storms and dust devils all rotate.
- Stubble fires in certain conditions have shown rotation and even leaves driven around in mini whirl winds indicate the possibility.
- Evidence suggests that thermals might on occasion rotate but they do not extend to any great height as clouds ‘never’ rotate. The highest likely hood of experiencing rotating thermals will be low in the hills.
- The best visual example of rotation in thermals is provided by dust devils. Dust, though, is not a significant component, it just makes it visual!

Just 4 more little bits about thermals!
Column Thermals

It is important to recognize that column thermals can form in very light winds and if the cloud base is high and the clouds are tall then they dominate the sky, grow very large (outwards and upwards) and kill off weaker thermals out to many miles, rather like a shower effects the general area. Big gaps between usable thermals. Also the sinking air does not descend on to its own thermal source so it keeps stoking up.

Notice the cloud shadows indicating streeting to left/right.

Town with strongest thermal, cloud shadow trigger.

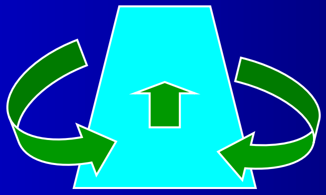
PLUS Sea Breeze

Highest cloud is strongest thermal – if you can get there in time!

Convergence Thermals

Another ‘trigger’ action for thermals can be downwind of a hill, caused by the wind going around the hill and then meeting up on the downwind side with a slight collision vector.

This kind of action is routinely seen downwind of islands and forms long streets. It is an action which occurs around any hill with varying degrees of success in producing a thermal depending on many things, but mainly the surrounding topography.



Understandably any time one wind is on a collision with another an updraft will result. Happens a lot in the hills and sea breezes.

Thermal Strength, Size and Shape

If the thermal you are in is giving 2 knots but then accelerates / develops into 4 knots there are several considerations.

The drag of the bubble is proportional to the square of the speed so if the speed is doubled the thermal must have 4 times as much buoyancy to maintain the new speed.

Clearly if the original thermal ascends simply because it is 2 degrees hotter then it would now have to be 8 degrees hotter and this increase cannot just come from the relative temperature difference between the thermal and the air it is rising in. Quite simply because we would feel the temperature difference!

However, Drag is also proportional to cross sectional area (form drag) so a reduction in radius would cause a reduction in drag. (Streamlining!) If the thermal reduces its cross sectional area (reduce it by 75%) then the drag at its doubled speed is now the same as the drag of the original ascent.

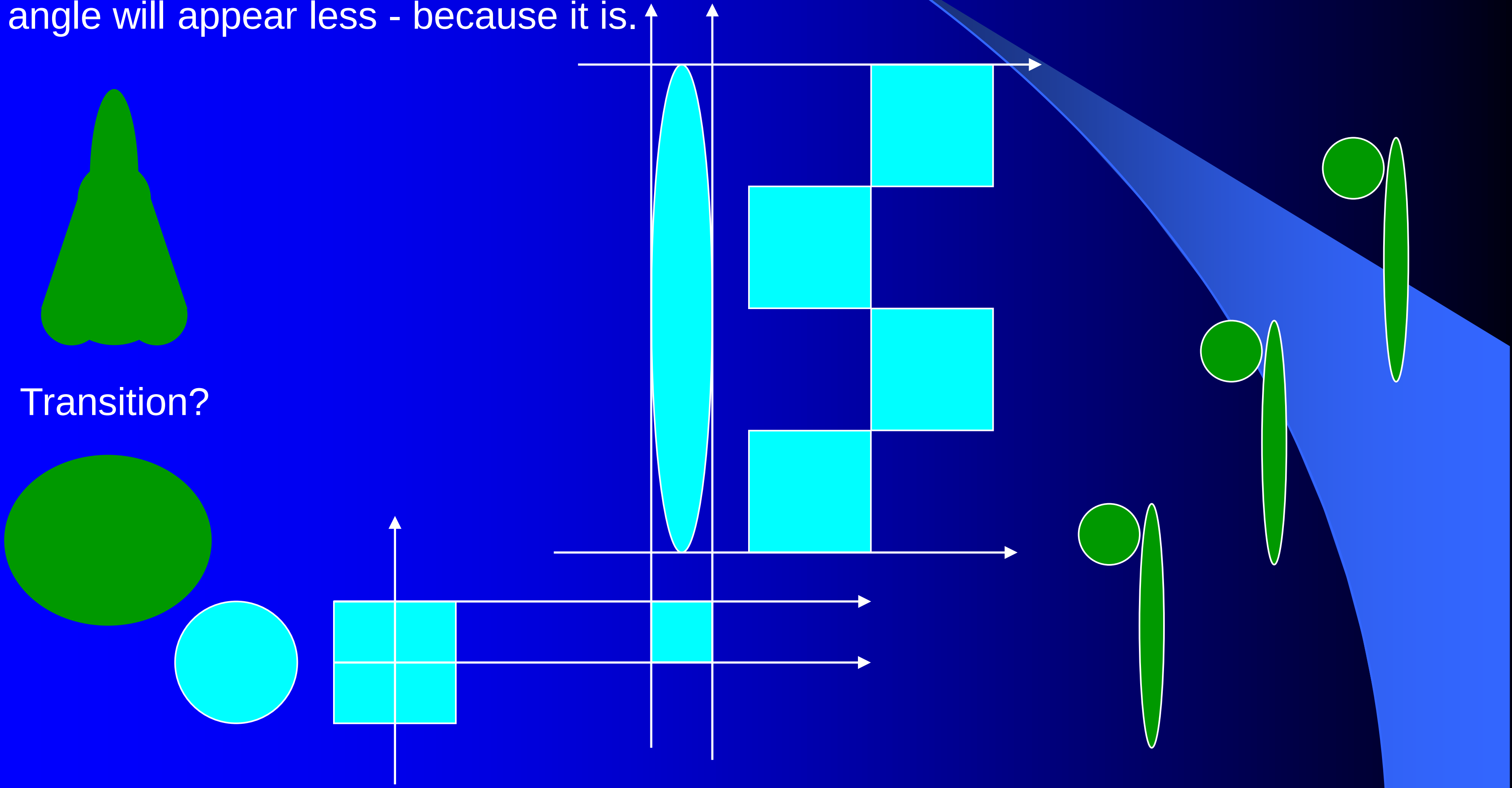
As we cannot destroy the mass of the air in the thermal then the thermal must change shape and become vertically more bullet / sausage shaped and also therefore potentially more stream lined. Stronger thermals are tighter!

Further then for the street gust. My understanding is that the surge is exactly that and the vortex becomes much distorted as the air rushes up into a bullet shape. The surge is too narrow to turn within, it has seemingly huge associated sink on three sides and the considerable reduction in profile drag allows for the significant increase in speed.

Thermal Strength, Size and Shape

So why is the shape of normal or strong thermal important?

If the thermal reduces in diameter by half then it must be 4 times taller so that you can join a strong thermal well below another glider in the same bubble and the drift angle will appear less - because it is.



Reinforced Thermals

When a thermal hits the updraft of a wave bar it will go up faster relative to the earth, but it does not go up any faster relative to the air it is moving up within. As, however, it drifts into the wave bar it will distort but appear to relatively quickly revert to the classic vortex. The real indication for us is that the thermal increases for no apparent reason and becomes amazingly smooth. Easy to become confused as the ‘sink area of the thermal is simply an area of reduced climb.