Reading Clouds

Bill Palmer

The clouds can often tell us what the air around them and the conditions that form them are doing.

Reading the clouds is a little like reading poetry. There are some easy ones whose meaning is pretty clear:

> *I think that I shall never see*
> *A poem lovely as a tree…*
>
> Trees, JOYCE KILMER

And others that you've seen a million times, you know the words, but what does it mean? No clue.

> *I'll be the roundabout*
> *The words will make you out 'n' out*
> *I spend the day your way*
> *Call it morning driving through the sound and*
> *In and out the valley…*
>
> Roundabout, YES

Every glider pilot should be constantly asking himself, "Why does that cloud look like that?" What is it telling me about the environment that formed it? We're mostly concerned with the vertical aspect, of course, but we fly in three-dimensional space and need to imagine the flows that resulted in the cloud's formation. What is it trying to tell you? Are you listening? Sometimes it easy, sometimes it's not. Try to guess what's going on, then go try it out and see if you're right!

I won't try to provide all there is to know on the subject (as if I knew it all anyway). But here's some basics.

Cumulus Clouds

Cumulus are the granddaddy of soaring clouds. Indeed, Paul Remde named his Minnesota soaring business after them (Cumulus Soaring, Inc.) It's no wonder why. They often give away the location of a thermal.

A cumulus cloud is a convective cloud and is usually formed when moist air rises and reaches its dew point at the Lifting Condensation Level LCL (or Cooling Condensation Level CCL). At this point the water vapor in the air condenses and something else special happens: The water droplets give off a little bit of heat, since the liquid state requires less energy than the vapor state. This little bit of extra heat multiplied by a zillion water droplets helps to accelerate the upward moving air even more. Evidence of this can be seen with a nicely defined flat or concave bottom to the cloud. The updraft accelerates right under the cloud and can be so strong in larger clouds that a glider may get sucked up into it if you're not careful.

I parody a portion of the Queen song *Bicycle Race, as:*

Flat bottomed clouds, we'll be riding today
So, look out for those beauties, oh yeah…

A cumulus cloud with a softer rounded bottom may not have an updraft associated with it any longer. Perhaps the thermal that caused it is upwind, and now it's just a blob of steam drifting downwind from its birthplace. Watching the development and dissipation of them will tell you a lot about what's going on.

Nicely defined flat bottomed Cumulus Clouds at Air Sailing, NV. Translation: "you can go anywhere you want today". Indeed, I completed a 300km out and return flight that day. Photo: Author

These types of clouds form in "unstable" conditions. Meaning a bubble of lifted air tends to keep rising, since it will continue to be warmer than the air around it.

A study of a skew-T chart will allow you to tell if the conditions are unstable and supportive of these clouds and thermals in general. It will also allow you to predict at what altitude that condensation will occur and their maximum potential height.

So, now you've got a nice flat-bottomed cumulus cloud. Consider the shape of the *top* portion of the cloud. With a prevailing wind, it may be lopsided and you can imagine the thermal powering this cloud (or one side of it) slanting upwind below it. The bottom of the cloud may not be uniformly flat. One side

will be working better than the other. It's likely that the same side will be working on all of the other cumulus clouds in the area too.

Cumulus clouds come in many sizes making it difficult to tell how far away they are just by looking at the cloud. Instead, look for the shadow on the ground. You'll find that a much easier way to tell how far away it is. Note the cloud shadows in the photo below.

Cumulus Clouds leaning over, near Lake Tahoe, NV. Photo: Author

Working cumulus don't always have flat bottoms. I've had good lift under some where the wisp was forming below the cloud, right where I was thermalling. Time to move on as clouds obscure traffic, don't fly into them, even if you were there first. FAR §91.155.

Consider also the sunny side of the cloud. The sun is the source of the warmth that forms the thermal. If a cloud is shadowing the upwind ground that was the source of the thermal – goodbye thermal.

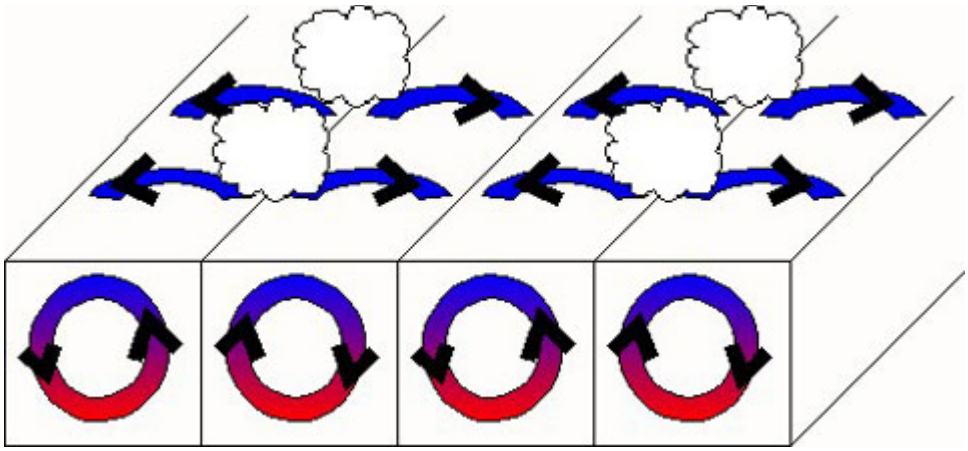
Cumulus clouds also have a lifecycle. It may be surprisingly short. Taking a time-lapse video on a cumulus day can be quite informative and surprising how quickly individual clouds form and dissipate. It's something we don't often stare at long enough to notice. A good looking cloud a few miles away may have lost its lift source by the time you get to it. Always consider what you'll do if it isn't working when you get there.

Cumulus clouds start with a wisp they also dissipate into one. So, watch them and watch for them. It is a new cloud forming or the last vestiges of an older cloud? Can you see the swirling motion caused by the updraft, or is it just sitting there getting thinner with each moment. Is its shape giving away a clue? On a low-humidity day, which we have a lot of in Southern California, you might not ever get much more than that. Flying along a convergence line, one of your best clues of where the lift is may be just the faintest wisps of cloud.

Whips of forming cumulus clouds near Warner Springs, CA. Photo: Author

Cloud Streets

Cumulus clouds also can form into lines called streets. Picture the air rising under the line of clouds and the air along side and in between the lines sinking to fill in for the rising air. That's why they're also known as *horizontal convective rolls*



Horizontal Convective Rolls. Image NOAA

Hopefully, the cloud streets are oriented in the direction you'd like to go, and return as they can run for very long distances. They're a fantastic way to make long fast cross-country flights. If there are multiple streets, you can transition from one line to another, but watch out for the sink in between.

You may be able to detect one end of the cloud street looking stronger with nice flat bottoms than the other. Perhaps the lines of clouds are drifting downwind from the thermal generator.

True life story
I was with a student getting ready to launch and pointed out the cloud streets forming near Mt Palomar and how the air would likely flow around them (rising underneath and sinking in between). Meanwhile a renter took off in the 1-36 and was back on the ground within 15 minutes. He said there was not lift, and quite a bit of sink. I asked if he was under the clouds. No, he was over the mountain ridge in the blue. Of course, though he was over what is often a good thermal spot, instead he was in the descending air alongside the cloud street. My student and I soared in the thermals under the clouds just fine.

Lenticular Clouds

Unlike Cumulus clouds which tell of unstable conditions, lenticular clouds tell of stable conditions. Like cumulus clouds they form as moist air cools to its dew point. But, their smooth nature tells a different story than the billowing cumulus. Lenticulars tell us about the presence of mountain wave. The waves form not, when the mountain pushes the air up, but when the air falls off the lee (downwind) side of the

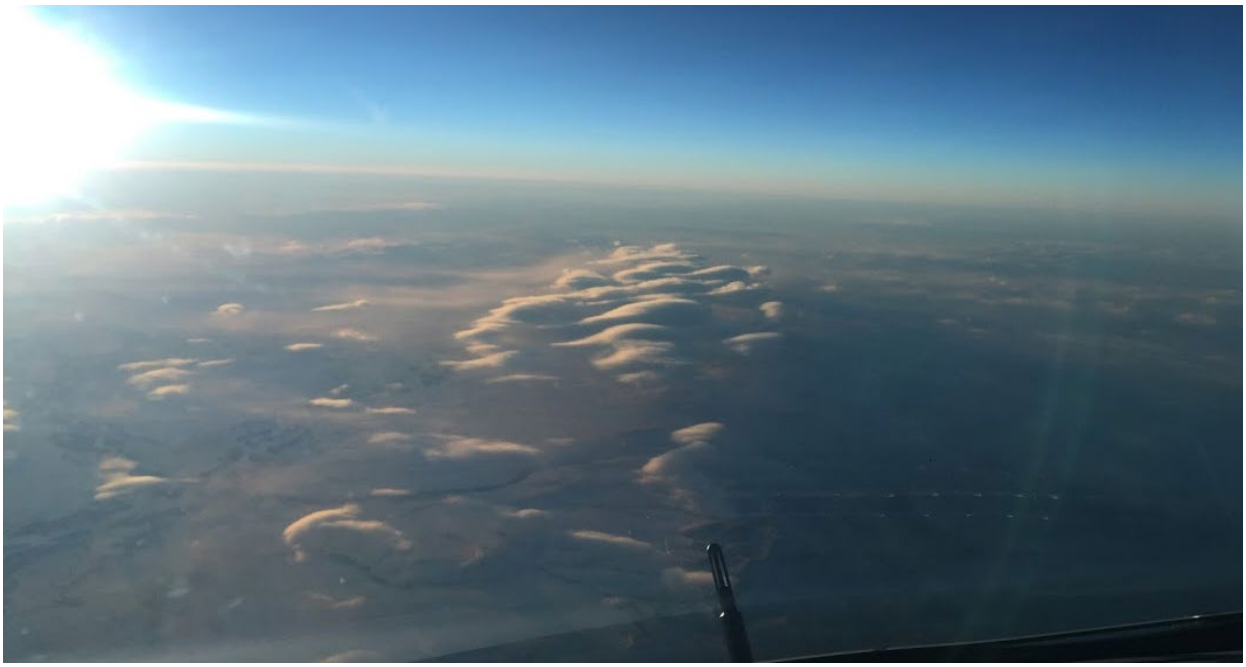
Lenticular Clouds near Julian, CA. Wind is from the right. Lift is straight ahead! Photo: Author

The same lenticular cloud as the previous image from 17,000 ft. in the opposite direction. Photo: Author

Of course, that upward motion forms a line of lift, often narrow, on the upwind side of the cloud that we can ride to great heights and long distances.

> Sailin' away on the crest of a wave
> it's like magic
> Oh,'sollin' and ridin' and slippin' and slidin'
> It's magic
> And you, and your sweet desire
> You took me, ohh, higher and higher, baby
>
> Electric Light Orchestra, Livin' Thing

Technically, they are *standing gravity waves* (quite different from the gravity waves your neighbor the astronomy buff is excited about. These don't require an interferometer to detect.) While mountains can cause them, so can other atmospheric disturbances that impart a vertical motion to a stable flow of air, like thunderstorms and jet streams. In the airliner I fly, we often encounter wave conditions up to 40,000 feet even when there are no mountains around. The clouds indicate the waves are there, but the absence of them doesn't mean they're not.



Lenticular clouds on the lee side of mountains below. We encountered the wave-generated turbulence well above them at 38,000 feet. Just slightly upwind was smooth air. Photo: Author

Rotor Clouds

Flying in the wave is usually very smooth. That's one clue that you're in it. But, below the crest of the wave lies the rotor. It is the Yin to the wave's Yang. It's an often violent, rotating horizontal shaft of air. Rising on the upwind side and slamming down on the downwind side. The small cumuliform clouds that form near the top of this rotor (cleverly, "rotor clouds") can give a clue as to its whereabouts and the hazards it brings.

Rotor Clouds, Minden, NV Photo: Author

Minden Wave Camp poster showing rotor and lenticular cloud locations

A book about the early exploration of mountain wave in the California Sierras with gliders was appropriately titled “Exploring the Monster.” It tells of the history of wave soaring and the Sierra Wave Project of the early 1950’s

Stratus Clouds

Stratus clouds may not be telling you what you want to hear, but they’re still speaking. They tell of stable conditions and little lift. They may tell of a smooth ride, in the downward direction. You’d best be close to home.

> Like stratus clouds blanketing my surroundings
> Feeling lost, deserted and weary …
>
> Like Stratus Clouds, Gigi Macabeo

A layer of stratus clouds moves in on a wave day at Warner Springs, CA. The wave motion is apparent in the clouds at center. The airport is at the right side of the photo. 20 min later it was completely overcast. Photo: Author

Cirrus Clouds

Those high-altitude ice-crystal clouds may not say much about what formed them, though they may be the opening salvo of an impending warm front and a sky soon to be filled with lots of stratus clouds. As the high cirrus fill the sky they block the sun and may bring a thermal day to a close. Best not venture far, or be heading home.

Cirrus clouds bringing an end to a thermal day. Glider at center frame. Photo: Author

With that basic introduction, I hope you'll look to the poetry in the sky, which is much better than this parting one:

Roses are red
Violets are blue
I pay attention to cloud shapes
I hope you do too.