Upwellings
news of the Great Lakes from **Michigan Sea Grant College Program**
Volume 19 • No. 1 • Winter 1997

Great Lakes Squall!

— by Walter J. Hoagman,
Michigan Sea Grant Extension Agent

Now it's a thing that us old-timers know,
in a sultry summer calm
There comes a blow from nowhere, and it goes off like a bomb
And a sixteen thousand tonner can be thrown upon her beam
While the gale takes all before it with a scream. . . .

—from the song *White Squall*, © Fogarty's Cove Music, 1984. Stan Rogers. Used with permission.

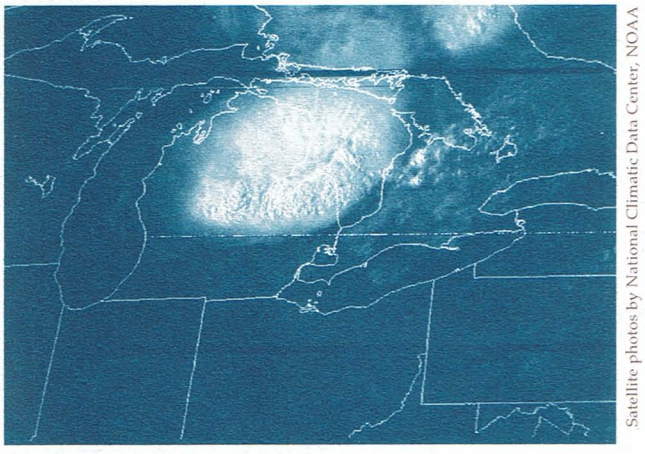
It's what sailors fear most: the storm from nowhere that turns quiet seas to rampaging white caps. The storm that comes out of mist or fog, hidden by the conditions that precede it. I experienced one firsthand, a big one.

A Near-Fatal Error

When the Great Summer Storm of July 13, 1995, hit, I was crossing Lake Huron's Saginaw Bay with my wife Athelia and our black lab Bunker in our 24-foot aluminum cabin cruiser, *Misty Blue*. Our course was Caseville (on the Thumb) to Tawas, bearing directly northwest across 30 miles of open water. Normally the trip would take about an hour and fifteen minutes of skimming the water. The conditions that day were ideal for boating, flat calm and very warm; but there was a persistent heavy haze. The horizon was invisible beyond a mile and above it the sky was white. Normally I make a weather check before any crossing, but that day I did not, much to my later regret.

The White Squall Advances

We cleared the breakwater just after 4:00, and Athelia piloted while I attended to chores. We were skipping along nicely for about 25 minutes when the small TV antenna started banging the side. We noticed the sky (haze) ahead getting darker, so I jumped up on the gunwale to secure the antenna.



Satellite photos by National Climatic Data Center, NOAA

The storm at 6 p.m. Saginaw Bay is dead center. Winds remain above 45 mph; rain and massive lightning continue. The wind veers suddenly to the northeast, causing opposing seas. Eight-to-twelve-foot waves climb into "Christmas Tree" pyramids.

Then the most unusual thing I ever witnessed in a lifetime of sailing on the Great Lakes or elsewhere happened. The sea ahead became suddenly flecked with white, as if a tremendous school of fish were thrashing the water. The white zone barreled down on us at amazing speed. Before Athelia could even throttle back, the white zone swept past us and the bow violently slewed off course despite all she could do. I was still standing on the starboard gunwale, hanging onto the cabin. The sudden swerve to port caused me to lose my footing and for an instant I dangled horizontally, hanging out in space as if I had tried to grab a moving merry-go-round.

Athelia eased off the speed, and, badly shaken, I clambered into the cockpit. I will never forget the view out the windshield. The sky had turned the deepest purple I've ever seen. With the wind accelerating from zero to frantic in five minutes, the surface of the water started to heave, the wind blowing the top off each new wave, the spray a horizontal stream of hissing water. The wind built up, howling like a locomotive. I got the *Misty Blue* headed back into the waves, and not knowing the size of the system, we decided to ride it out. We knew we couldn't outrun the storm 15 miles back to Caseville anyway.

. . .Squall!

Within 15 minutes, six-foot seas slammed our boat. Rain poured down so hard the wipers were nearly useless. It became extremely dark, but blinding lightning bolts split the gloom every 10–20 seconds. Thunder cracked and rumbled. Every now and again in life, a person has to say, "uh-oh," with just the precise inflection of fear and apprehension. We had reached that point. "What in the world did I get us into now?" I thought, and Bunker must have thought the same because he curled up in the tightest ball imaginable and never moved a hair.

Fighting the Storm

Our aluminum boat was seaworthy by the barest of margins. Keeping the *Misty Blue's* bow to the seas, we took on water, but somehow recovered from wave after wave. Being very light forward, she smacked each advancing mound with a resounding shudder, pitched crazily upward, then came down with a teeth-jarring blam, simultaneously slewing sideways as the exposed bow caught the racing wind. It took all my strength to hang on to the wheel and force her stem back around for the next one. Water poured in every possible crack and the front cabin was a shambles of mattresses, duffle bags, groceries and tableware. The bilge pumps chugged full-time. We both prayed the hull would hold, because it had been welded several times and had many rivets replaced.

The winds continued above 50 mph and raging seas built into seething whitecaps. I kept thinking, "Gads, this is one heck of a thunderstorm!" and still the rain poured down. When the wind finally slacked after about 45 minutes, I got on the radio and reported our position and situation to the Tawas Coast Guard, telling them we were all right but not out of it yet. Bunker hadn't moved a muscle.

Christmas Tree Effect

Suddenly I felt a cold blast of air from our starboard beam, flinging all the papers and charts off the dash. The compass confirmed I was maintaining my northwest course and the waves were still dead ahead, but the wind had shifted 90 degrees to the northeast. It blew violently, and soon the resulting cross-seas made a real mess of the surface. My only option was to steer into the northeast wind and hope we weren't twisted apart. Within 20 minutes the confused seas caused opposing breaking crests to climb one another and smash apart, creating the "Christmas Tree" effect described by some sailors in Great Lakes storms. These "trees" were 10 to 12 feet high, visibility was only 50 to 100 feet, and we really thought we had bought the farm this time. Both of us got extremely cold, with goose bumps making us look like plucked turkeys.

By 6:30 the storm began to ease with the wind falling below 25 mph, but seas remained at five to

continued on page 4

Anatomy of a Squall

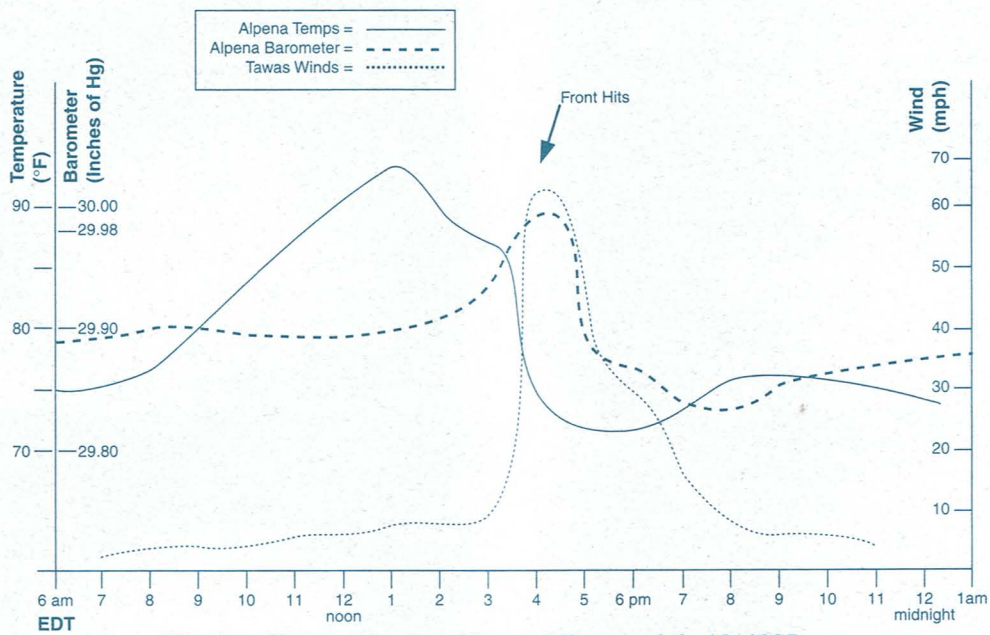
A squall is more than a severe thunderstorm; although these are bad enough. Thunderstorms are usually scattered, seldom over 5 to 20 miles across, and the violence quickly fades to moderate winds once the downburst passes. In contrast, a squall line forms from a massive atmospheric disturbance that grows as a thunderstorm does, but has a rate of advance much higher, packs hundreds of times the energy, and moves as a wall across land and sea. A squall is its own thing, and of no particular size limit. A large squall can be 30–100 miles across and move at a ground speed of 50–70 mph.

Some people doubt the existence of anything called a white squall. Over tropical oceans they are fairly common, but are very rare on the Great Lakes. Whether a storm is a white squall or not depends on the strength of the winds. A normal squall line has high winds that roil and whitecap the surface, but a white squall has hurricane force winds that foam the surface. In sea water, the effect is much more pronounced then in fresh, but the same thing happens.

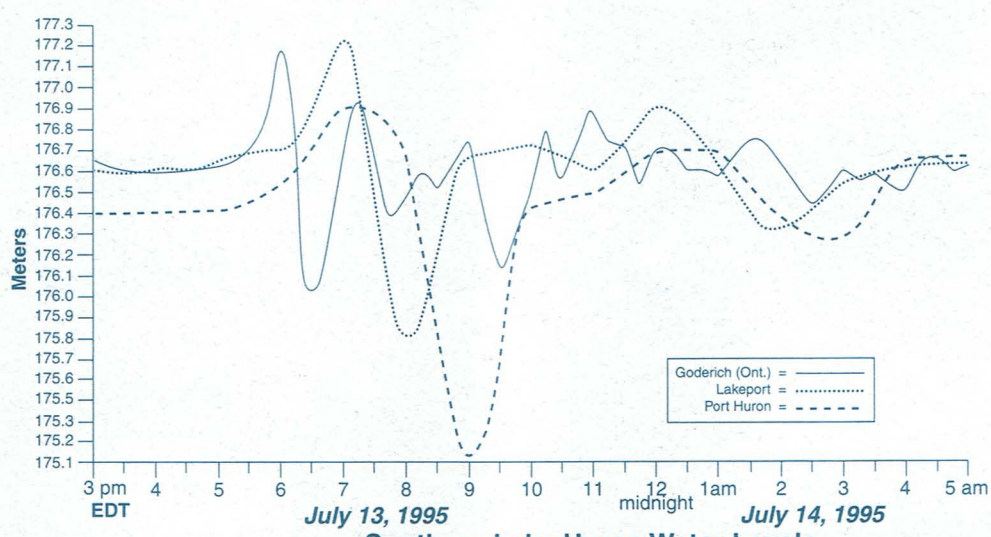
A typical severe thunderstorm travels at a rate of 20–30 miles mph, accompanied by 40–50 mph winds that quickly die to 25–40 mph. In contrast, we had traveled through an extreme line squall, advancing at 50–65 mph, with downburst winds gusting to 80 mph and sustained winds of 50–60 mph. These straight line winds are called "derechos" by meteorologists, and often spawn "gustnados," swirling funnel clouds created by extreme wind sheer patterns near the ground. These winds toppled up to half-mile tracts of forest across the Upper Peninsula and Central Michigan, the fallen trees all pointing southeast. The Coast Guard reported they had answered 183 rescue calls on the Great Lakes during the passage of the Great Storm (the most in one day ever). —WH

Air Pressure Causes Dramatic Water Level Shift

The Great Storm of 1995 caused a dramatic seiche on Lake Huron. Figure 1 shows the barometric pressure and wind speed recorded at Alpena and Tawas as the storm passed. Figure 2 shows what happened to the lake level as this pulse traveled across and down the lake. The level change was no mere wind setup, but an event driven by extreme pressure variations on the lake surface. The advancing storm caused a massive pressure wave that first elevated the water ahead of it, then pushed the water down as the front passed. The pressure then rapidly decreased below normal, allowing the lake to rock back above its static level. This massive water movement caused a difference of 45 inches at Goderich, 55 inches at Lakeport, and 64 inches at Port Huron. The rise and fall at these stations was precisely separated in time by the advance of the storm down the lake. The lake then oscillated up and down through several attenuating cycles, finally returning to "normal" after 12 hours. I finally had an explanation of the weird events on the dock at Tawas. I had missed the press-down while at sea, but caught the rebound while tying up. —WH



Weather Observations at Alpena & Tawas *July 13, 1995*



Southern Lake Huron Water Levels

seven feet. At 7:00 the sky started to clear and we spotted the Tawas lighthouse, 12 miles away. Just then, a large freighter slid across our port bow, alarmingly close, heading for open Lake Huron to the northeast. Soon the Coast Guard came out to look for us in their 44-footer, and we hailed them and gave the OK signal. Our engine was plugging along without a miss, and we were all right after a fashion. At 8:00 the sun came out, the wind died and we chugged to the Tawas dock with both pumps running.

Seiche Nearly Snatches Boat

Athelia grabbed the lines and jumped on the dock while I headed to the parking lot for the trailer. When I swung back around to the ramp, I couldn't believe my eyes. Athelia was still standing on the dock, but knee-deep in water, frantically yelling her head off to hurry. She still gripped the lines but the tugging currents and eddies were doing their darndest to snatch the boat away. I leapt out and threw the lines over the poles in a couple of clove hitches, and we waded back to the inclined cement ramp. Within minutes the water fell, exposing the dock once again. I managed the trailer under *Blue* and hauled her up. Once out, she rained bilge water from dozens of popped rivets and several cracked seams. We looked at each other in utter amazement. Driving home, we both shook nearly uncontrollably. Bunker would not move, eat, or drink for two days!

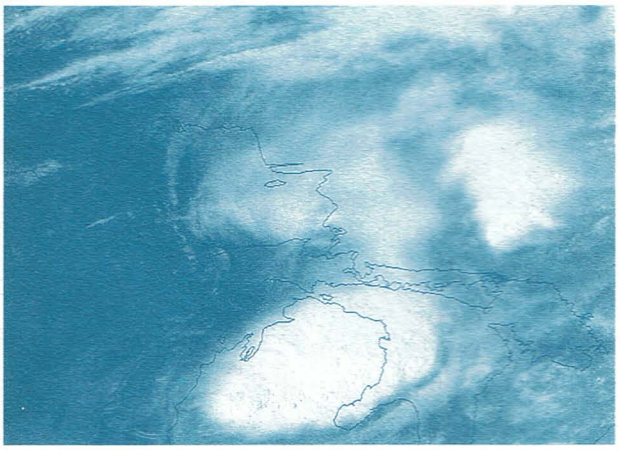
Lessons Learned

What a day and what a lesson! The most obvious lesson, as everyone is quick to remind me — why didn't I turn on my radio? They are right, I made a big mistake there, because storm warnings were broadcast for at least two hours in advance. The storm's size caught everyone by surprise, however. Its swiftness and power may prove it one of the largest summer storms in this half-century. I don't honestly know how we survived the event — dumb luck I guess. Anything could have gone wrong from a lightning bolt to a busted steering cable. But I'm still here and even though I may have used up another one of my nine lives, I hope my story gives caution to boaters of every ilk that trust their fortunes to warm sunny days on the lakes. Beware of a hot hazy day, would be my first caution; anything can happen.

Satellite photos on pages 1 and 4 are courtesy of Alex Gruman, National Climatic Data Center, NOAA, Asheville, North Carolina. The data used to create the page 3 charts was provided by the National Weather Service, NOAA, Alpena and Tawas, Michigan; Brooks Widder, Office of Ocean and Earth Science, NOAA, Silver Spring, Maryland; Bryan Smith, Ontario Climate Center, Downview, Ontario; and Rick Sandilands, Canada Hydrographic Service, Burlington, Ontario.

National Climatic Data Center, NOAA

4 p.m. *The storm has formed and is racing across Lake Michigan. The National Weather Service is broadcasting urgent severe weather watches. The storm front is 100 miles across at its widest point and moving southeast fast. Severe winds and heavy rains hit Traverse Bay and the Straits of Mackinac. The storm begins to move inland. Land elevation contributes to the rising air flow and adds to the storm's force. A lower cell begins to define itself with a squall line forming through the middle of Michigan and traveling at 50 to 60 mph. Saginaw Bay and lower Lake Huron are about to get blasted.*



National Climatic Data Center, NOAA

5 p.m. *The front crosses Saginaw Bay. The entire squall line is about 150 miles across, pushing vast quantities of moist air ahead of it as it races downslope and across open water. The sky becomes purple and winds hit with a vengeance. Within 15 minutes, winds are above 55 mph, seas running to six feet, rain and lightning everywhere.*