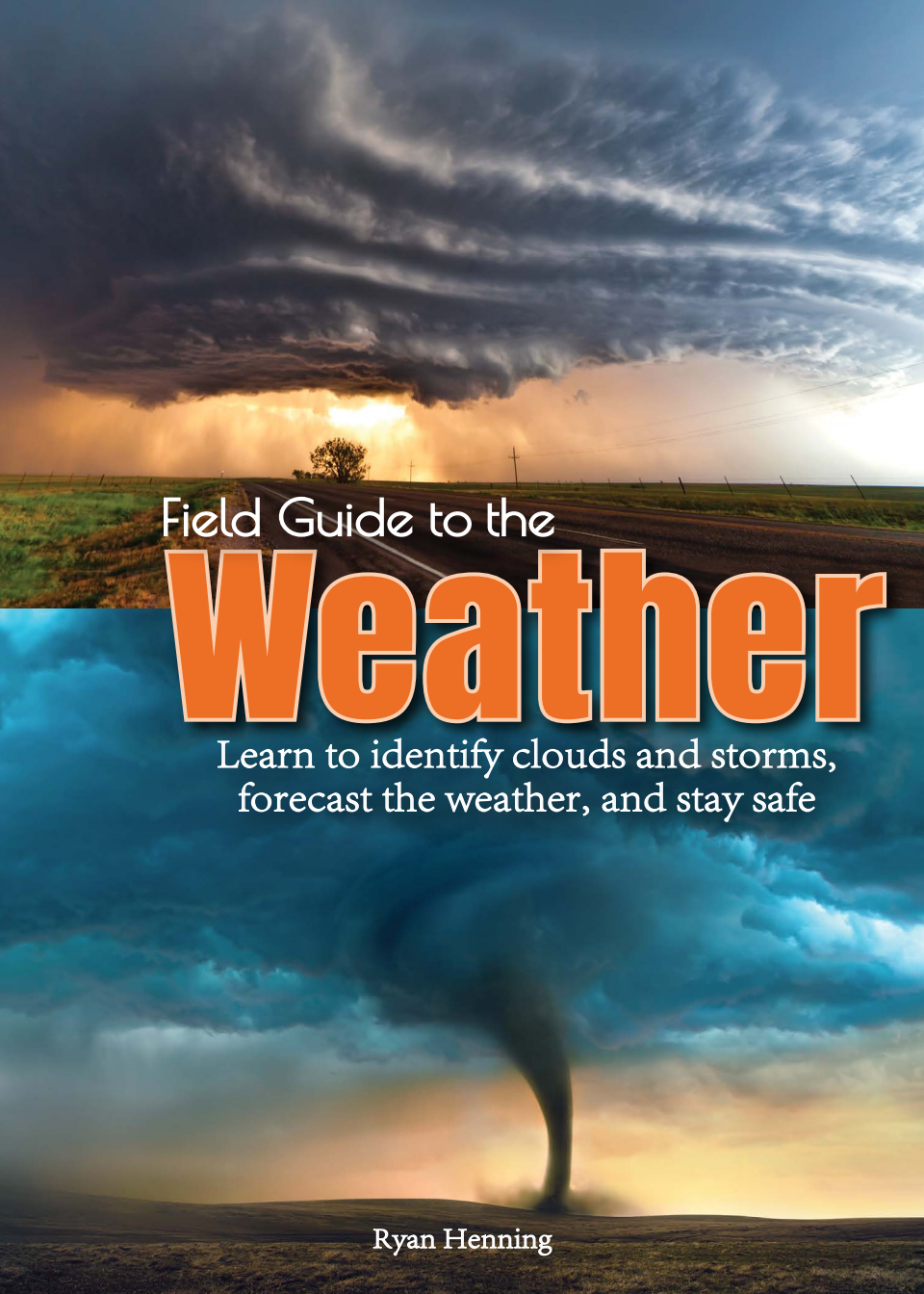
Field Guide to the
Weather
Learn to identify clouds and storms, forecast the weather, and stay safe
Ryan Henning

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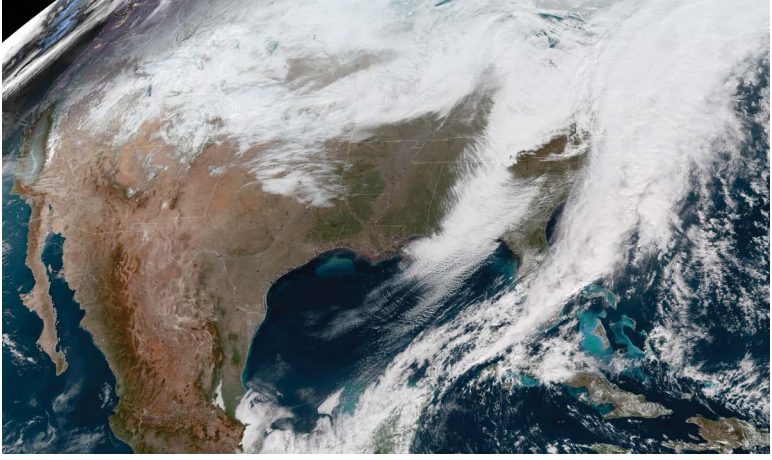


NOAA/GOES EAST, taken January 24, 2019

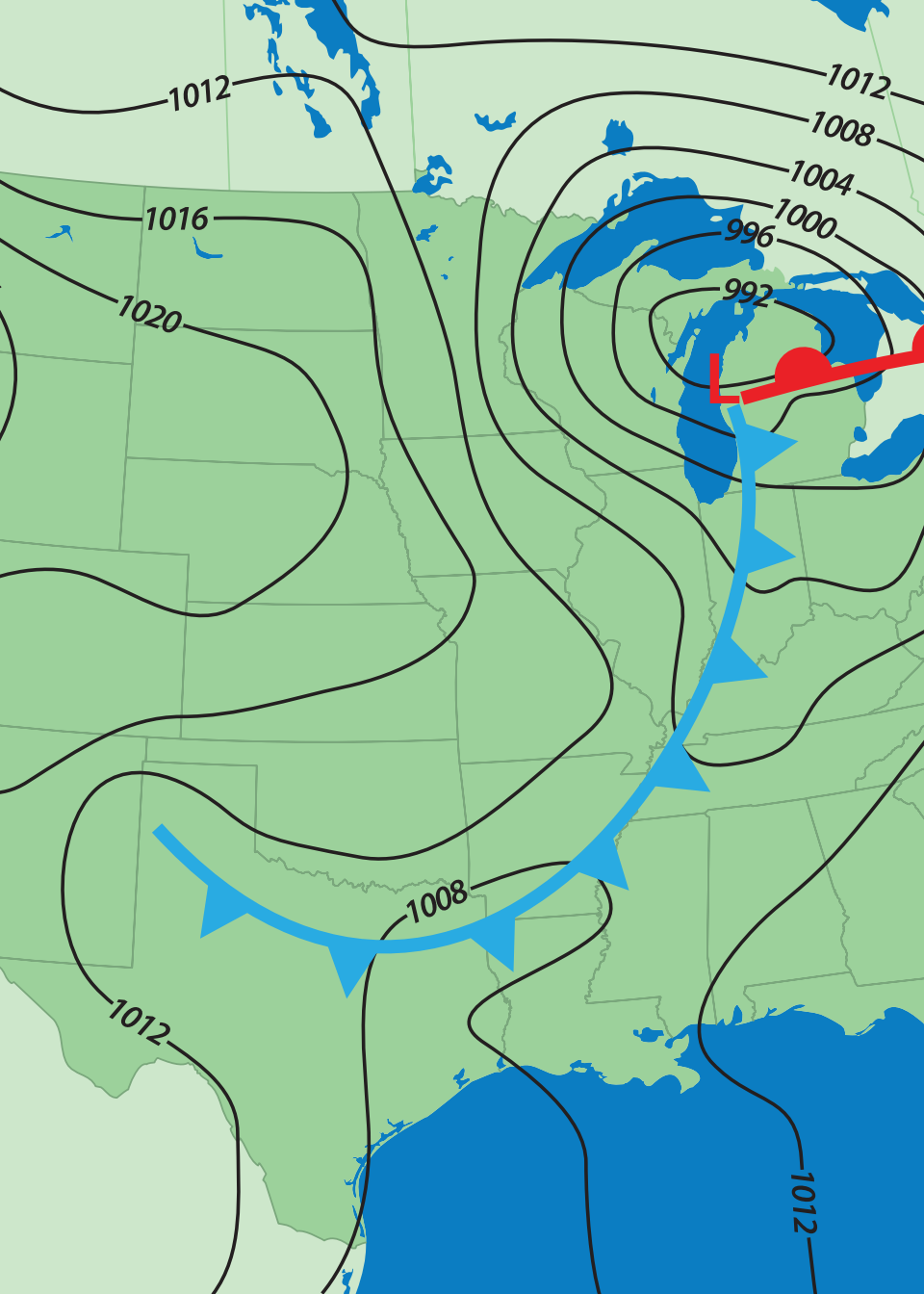
What Is Meteorology?

Defined simply, meteorology is the study of the processes and phenomena of the atmosphere. To a meteorologist, it is a bit more complicated than that. While most people are interested in the day's forecast, if you want to learn how the weather works, it's helpful to start with a top-down look from the perspective of a professional meteorologist.

At its rawest and most basic level, meteorology is one big math problem. The atmosphere is essentially a big basin full of fluids, such as water vapor and gases (which are considered fluids in physics). These fluids follow all the basic rules of physics, so in theory, the daily forecast is a solvable problem, if it weren't for two issues.

1. Too many calculations are required to solve this equation, and the calculations are too complicated to be solved by the world's fastest computers in time for the forecasts to be usable.

2. There are several equations, called primitive equations, that feed into all of the atmospheric models that meteorologists use for their forecasting, but there aren't enough equations to calculate for the variables in question.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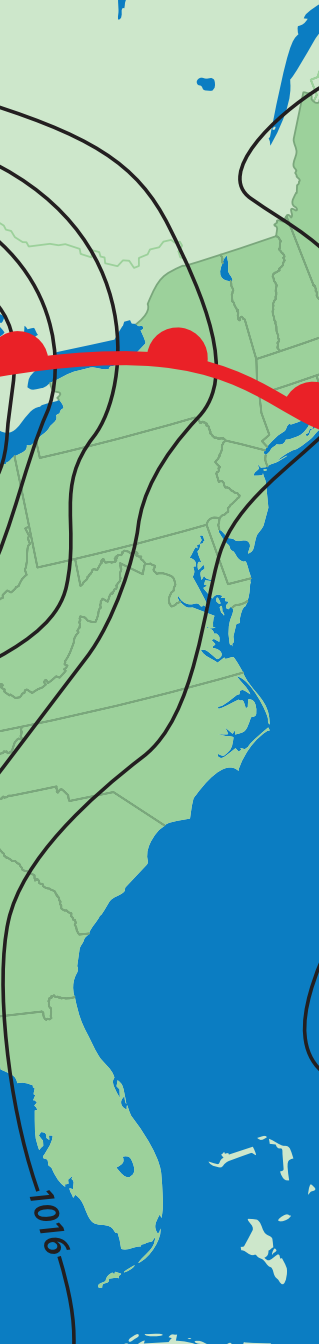


How to Read a Weather Map

The black lines on a weather map represent "isobars." The prefix "iso-" means "equal" and bars or millibars are the measure of atmospheric pressure. An isobar is therefore a line of equal pressure. Lower numbers represent lower pressure and higher numbers reflect higher pressure.

The blue line with triangles on it is a cold front, with the triangles pointing in the direction in which the front is moving. The red line with half circles is a warm front, with those half circles pointing in the direction in which the front is moving. Note that the fronts lie in areas where the otherwise circular rings around the center of low pressure are contorted. Other distensions in these concentric circles represent troughs and are likely areas of precipitation.

Though not used in this example, other common features on surface maps are stationary fronts, represented by an alternating line of blue triangles and red half circles pointed in opposite directions; occluded fronts, which are purple lines with half circles and triangles all pointing in the same direction; and brown or purple dashed lines, which are catchall symbols, either for surface troughs or dry lines.

A strong tornado

SEVERE WEATHER PHENOMENA

Some weather phenomena only occur during storms or severe weather events. Lightning and tornadoes are obvious examples, but flash floods, blizzards, and heat waves can also pose dangers to both people and property. Here's how to recognize such conditions and stay safe in them. Of course, the best preparation is staying informed; for information on weather watches, warnings, what they mean, and how to find out about severe weather in your area, see page 108.

Lightning

Lightning

You couldn't have thunderstorms without lightning, which is a byproduct of the aggressive updrafts within nimbus clouds. Thunderclouds form as warm air rises very quickly (upwards of 60 miles per hour); as the air rises, warm air condenses out, and the resulting water droplets brush past each other, producing static electricity. Electricity, much like air pressure, seeks an equilibrium or balance, so all that electricity eventually needs to find an outlet, either as a lightning bolt that connects with another cloud, or as a bolt that strikes the ground.

Lightning takes the path of least resistance to connect positive and negative poles, which usually means that lightning stays within clouds, but when bolts reach down to the surface, they often like to find the most exposed, highest-reaching object on the ground, either the tallest tree in a forest, the tallest point of a building, or a lonesome boat in the middle of a lake. Often, of course, doesn't mean always. While the storms may be vast, lightning bolts are quite narrow, which means that the course a bolt takes to reach the surface might not include the absolute highest

A 22-degree halo, sun dogs, and more

CLEAR-SKY PHENOMENA

Not all meteorological phenomena pertain to clouds or are associated with thunderstorms or severe weather. In fact, there are many meteorological features you might see even when the sky is relatively clear. These are known as clear-sky phenomena.

Most things that we see in the sky are a product of the interplay between the sun and the various forms of water or ice in the atmosphere; the amount of water/ice present, and the altitude that it occurs at, are the main variables in determining what phenomena we see. Let's take a look at some of the most notable phenomena that you might see if the skies *aren't* gray.

A rainbow

Rainbows

Rainbows are perhaps the most famous clear-sky phenomena. Famous for their beauty and ubiquitous in culture, they occur when light is reflected and refracted through water in the sky. They also serve as one of the best tools to explain how sunlight and the visible light spectrum work.

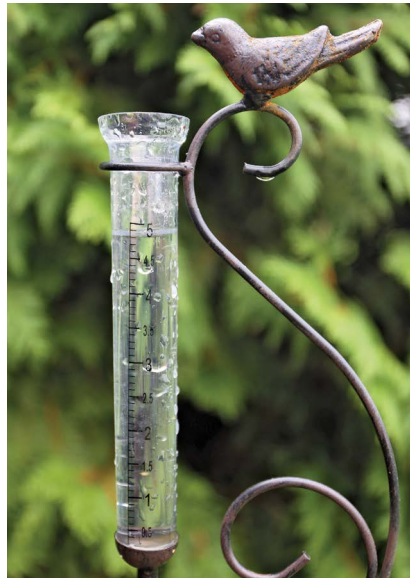
When we see the sun, it looks yellow, red, or orange. But when seen from space, the sun looks white. White light is a combination of all the different colors (wavelengths) on the visible light spectrum; to see that spectrum, you need a prism, which helps separate out the various wavelengths of white light. Organized by wavelength from longest to shortest, the visible light spectrum is ordered: red, orange, yellow, green, blue, indigo, and violet. (It should be no surprise that the next waves on the wave spectrum from visible light are infrared and ultraviolet, longer and shorter wavelengths respectively).

Setting Up a Home Weather Station

One of the easiest ways to get involved with the weather is to set up your own weather station. A weather station manufactured by AcuRite is pictured here, but there are many other whole stations or components that you can buy and set up. The model seen at left is associated with an electronic display that is kept indoors, though there are many weather monitoring devices that you can see from a distance and that won't tax your wireless network when collecting observations. Most weather stations collect much of the same types of data.

Rain Gauges

Most people start out in backyard meteorology by simply putting out a basic rain gauge. Low-tech models consist of a cylinder held upright with measurements clearly marked on the outside; these need to be emptied after rain events so you can keep an accurate record of the next rainfall event. More-sophisticated systems include a pass-through rain gauge, which allows rain water to move past a sensor that keeps tabs on the amount of water, and there's no need to empty it.



An ornamental rain gauge

Your Guide to Watching Clouds and Understanding the Weather

From the soothing sound of rain to the shrill whistle of a blizzard, from the house-shaking rumble of thunder to the violent fury of a hurricane, weather is a fascinating part of our lives. Professional meteorologist Ryan Henning demystifies meteorology, helping you to understand how weather works, identify the phenomena you're seeing, and even predict what's coming next.

Inside You'll Find

- Simple introduction to the basics of meteorology
- Guide to individual weather topics—from clouds to tornadoes
- Details you need to read weather maps, radar, and more
- Essential information about weather watches, warnings, and weather-safety tips
- Recommendations for building a home weather station

Learn to better recognize weather patterns and prepare for what's ahead with the expertise of a professional meteorologist!

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