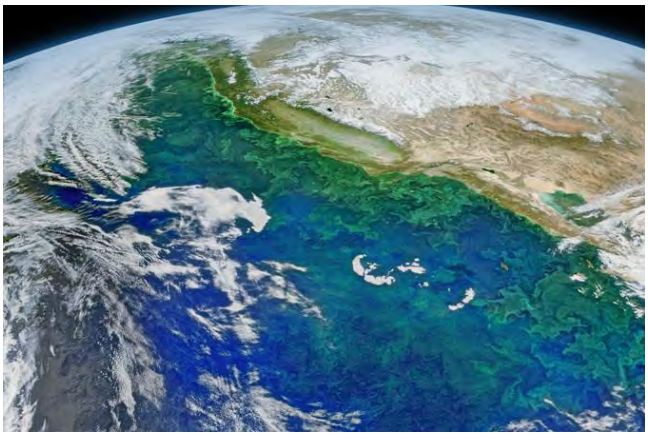
Making Sense of Images



Earth Observatory, NASA

Images can be much more than a snapshot—they are often evidence of choices made, of a culture's impact on the land, and of the natural systems acting upon a place. Images can dramatically document changes over time: coastal weather hazards can be predicted, slow-moving geological processes can become visible, connections between biological communities can be seen. In a fast changing world of many environmental problems, image analysts provide insight into past choices, current conditions, and possible future scenarios that may be used to make sensible choices. Images do more than document problems—they often point the way to solutions.

Thinking Tools for Image Analysis

Coastal image analysts look for evidence relevant to specific questions they are seeking to answer or for a phenomenon they are seeking to explain. Analysts may start by looking for evidence of the following big ideas:

- Patterns
- Cause and effect mechanisms
- Scale
- Natural systems and boundaries/ intersections with other systems
- Structure and function
- Stability and change
- Energy flows and cycles

Observed **patterns** are the foundation of many scientific questions. Consider, for example, the patterns inscribed in beach sand by human activity or on water by wind.

Cause and effect relationships are often the focus of an image analysis. Once a pattern is noticed, the hunt for an explanation can begin. For example, you may have noticed the impact of a holiday on a beach or park. Overflowing garbage cans, plastic bags pinned in the bushes by wind, and footprints covering the beaches are all evidence of heavy human traffic the day before.

Scale and placement within **natural systems** is vital to image analysis. Before interpreting an image, it's helpful to know the general location and a reference for the size of the objects in the image. Considerations of scale, place, and their conceptual boundaries inform how an analyst will model a system. For example, the small beach shown above is on Lake Tahoe, a relatively closed system with an alpine climate. This makes the dynamics different from a beach on the temperate and energetic Pacific shore.

The concept of **structure and function** explores how the form or shape of an object or living thing is related to or depends upon its function, and vice versa. For example, coastal armoring structures (such as seawalls) are sometimes built to function as protection for homes that are too close to eroding bluffs and beaches. Natural rates of erosion within a beach system, angles of surf and currents, and the height of projected sea level rise must be understood to make informed choices as to how and whether to build on the coast or to install coastal armoring to protect existing structures.

Determining the degree of **stability and change** within the beach system is how engineers place parameters around these decisions. When looking at the photo on the right, two questions might be: how is the Pacific Ocean's level changing over time at the location, and what other factors (sand starvation, storms, el Niño) might be destabilizing the beach?

Finally, **energy**, energy flows, and the consequences of moving energy are a frequent focus of image analysis investigations of the natural systems in coastal zones. The moon, the atmosphere, the ocean, and adjacent land areas all impart energy to beaches. Energy is conserved, meaning that energy can't be created or destroyed, so typically the task of the image analysis becomes describing how the energy is flowing within a given place or natural system. Have you ever stood on a beach as a powerful wave breaks upon the shore, sending both vibrations into the sand and sound into the atmosphere?

These seven thinking tools may be used independently or woven together to reflect the complicated nature of natural systems. Your choice of tools will be governed by your purpose. For example, engineers planning to build a power plant will want to know if an area is geologically stable. A policy maker working on enhancing access to a beach would seek images that offer insights into transportation routes. Where to locate bathroom facilities or build low impact trails is another question answered using image analysis. Beach users seek shelter from the wind, so a bathroom could logically be sited near but not in these relatively rare spots. Beach users have historically created damaging informal trails, sometimes visible in aerial photographs. Placing low impact trails and boardwalks along these routes could make access easier and protect vulnerable plant and animal communities. This pathway in Palos Verdes protects sensitive coastal scrub habitat.

Interpretation of Aerial Photographs

The following elaborates on the Guiding Questions for Image Analysis worksheet.

Absolute Location: In what coastal region was this image created?

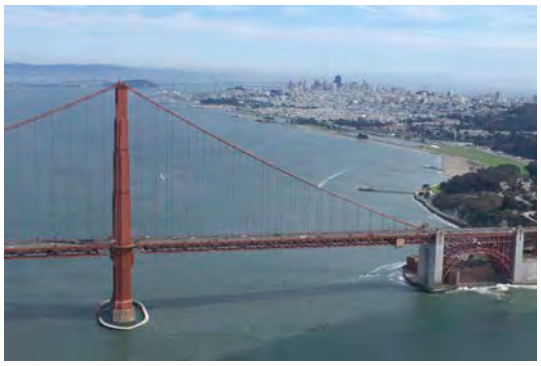
Use clues like plant communities or size of rivers to place the image in either the North, Central, or South Coast regions. Recognizable human-built landmarks can help. Distinctive types of trees (redwoods for example), or distinctively contoured points of land are the most common starting point for an analysis. For example, if the coast has large, impressive trees on both sides of a coastal point, the location is likely in a northern region; by contrast, if only low scrubby plants are visible then a location further south in the coastal scrub biome may be inferred initially. Be careful in your conclusions, as a location completely exposed to the North Coast's incessant winds will also have only low, ground-hugging plants. Piles of large logs on the beach will, however, be a reasonably definitive clue to North Coast beaches.

Place: What would a person in this place see, hear, and feel?

Determine what direction is north. Subsequently, think about the prevailing wind, direction that hills and cliffs face, evidence of precipitation, and plant community.

Normally, you should begin by looking for a reference object to give you a sense of scale. If buildings are present, find a home, school, or road. This will help you develop a good picture of things combined with your prior knowledge.

Human/Environment Interaction: How do humans depend upon and/or influence (positive or negative) the coastal environment in this place? What ecosystem services can you identify? Examples of some of the many ecosystem services include natural shoreline protection, water filtration, food production, carbon sequestration, and recreation.



Movement and Access: How are people accessing this place and how could access be improved? This may be considered from perspectives inside or outside of the study site but keep your purpose in mind. Increasing and enhancing access is one purpose, protecting and enhancing habitat is another. They might or might not be mutually exclusive.

Bio-Region: How and why is one area in this place similar to another? Can you identify any natural geographic boundaries?

Photos courtesy of the California Coastal Records Project.

Guiding Questions for Image Analysis

Place this handout in your project notebook for repeated reference.

Absolute Location: In what coastal region was this image created? What is your evidence?

Place: What would a person in this place see, hear, and/or feel? What is your evidence?

Human/Environment Interaction: How do humans depend upon and/or influence (positive or negative) the coastal environment in this place? What ecosystem services can you identify? What is your evidence?

Movement and Access: How are people accessing this place and how could access be improved? This should be considered from perspectives inside or outside of the study site, but be sure to use remote sensing tools to build your perspective.

Bio-Region: What natural factors influence the biological community found in this place? Be sure to consider climate, geology, geography, and vegetation distribution.

It's More Than A Place

A person's notion of a place may be cultural, physical, ecological, and sometimes even legal, so communicating about place might include art, science, or anything in between. A Yurok tribal member paddling along the North Coast's wooded shores may have one approach to thinking about place even as the GPS on her phone provides her with additional information. A vacationing hiker making her way down the nearby California Coastal Trail may have her own perspective based on her first-hand experience of ecological relationships. Let's start with how a scientist identifies a place, even as we acknowledge other ways of knowing.

A place can be identified by its latitude and longitude, and perhaps with a street address. For example, the Ford House Museum is at latitude/longitude 39.304685, -123.799587, and at 45035 Main Street in Mendocino, California. These are two examples of an absolute location for the Ford House. The Ford House could also be described as being across the street from the water tower, or next to the bluffs in Mendocino Headlands State Park, or 0.4 miles west of the Shoreline Highway. When a location is described in relation to something else it is called a relative location.

Places exist on a vertical plane as well as a horizontal plane. The town of Mendocino can be described as being at an elevation of 154 feet (or 47 meters), or 54 feet higher than the town of Fort Bragg, which is 10.3 miles to the north.

When describing places in California, you can choose to frame them in relation to major geologic features. The state is divided up into 11 geomorphic provinces as described by the California Department of Conservation, each with unique, defining features. Mendocino is part of the Coast Range geomorphic province, having a coastline that is uplifted, terraced, and wave-cut. You might also describe a place in terms of its vegetation type, annual rainfall, soil type, watershed, or animal migration routes.

You might wish to describe a place in terms of the people that live there; for example, in 2010, the population of Mendocino was counted at 894 residents, which is 201 more than Shelter Cove, in adjacent Humboldt County. You might include in your description statistics on languages spoken, household income, or median age. You might include details on historic and current American Indian tribes, and patterns of human migration into and out of the place. You might include major industries or crops, transit access, or percentage of the land that is covered by roads and buildings.

There are almost as many ways to describe a place as there are places. And even more ways to combine and layer different data on a map to tell a story and answer your questions. Traditional knowledge, first-hand experience, and remote sensing technology all offer valuable information. The key is to make conscious choices and to frame your investigation of place in a manner relevant to your purpose. How will you describe your place?

Mendocino Coast. Photo: Karen Ganschow