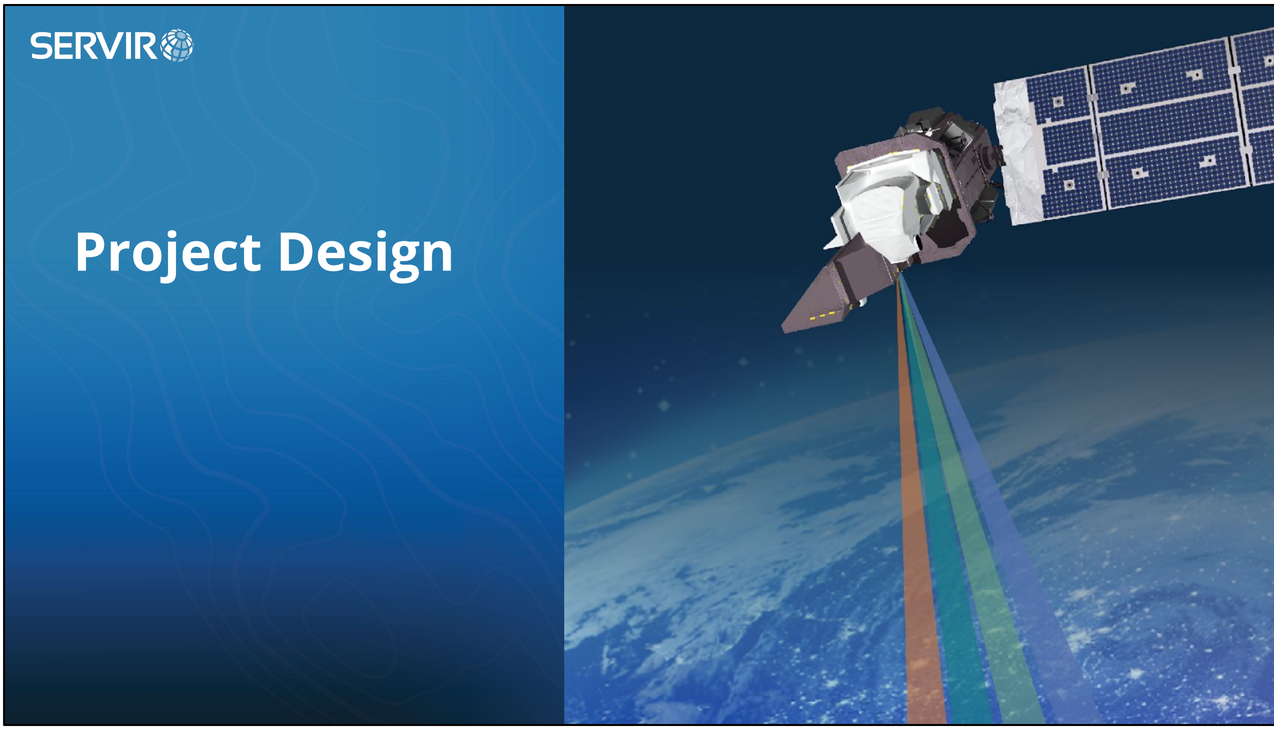
Best practices → design & interpretation → source

Now that you are more familiar with Collect Earth Online, let's take a look at some of the best practices to keep in mind when using this tool. We'll start by covering the best practices when designing your project, as well as the best practices when interpreting the image and collecting the data. These best practices were created from the Collect Earth Online official documentation, as well as best practices documented by the SERVIR team after countless projects using Collect Earth Online.



To begin, let's look at what you should keep in mind when planning your project before creating it in Collect Earth Online.

Planning Your Project

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- Define Objectives
- Define End Product
- Delineate Classification Schema
- Imagery

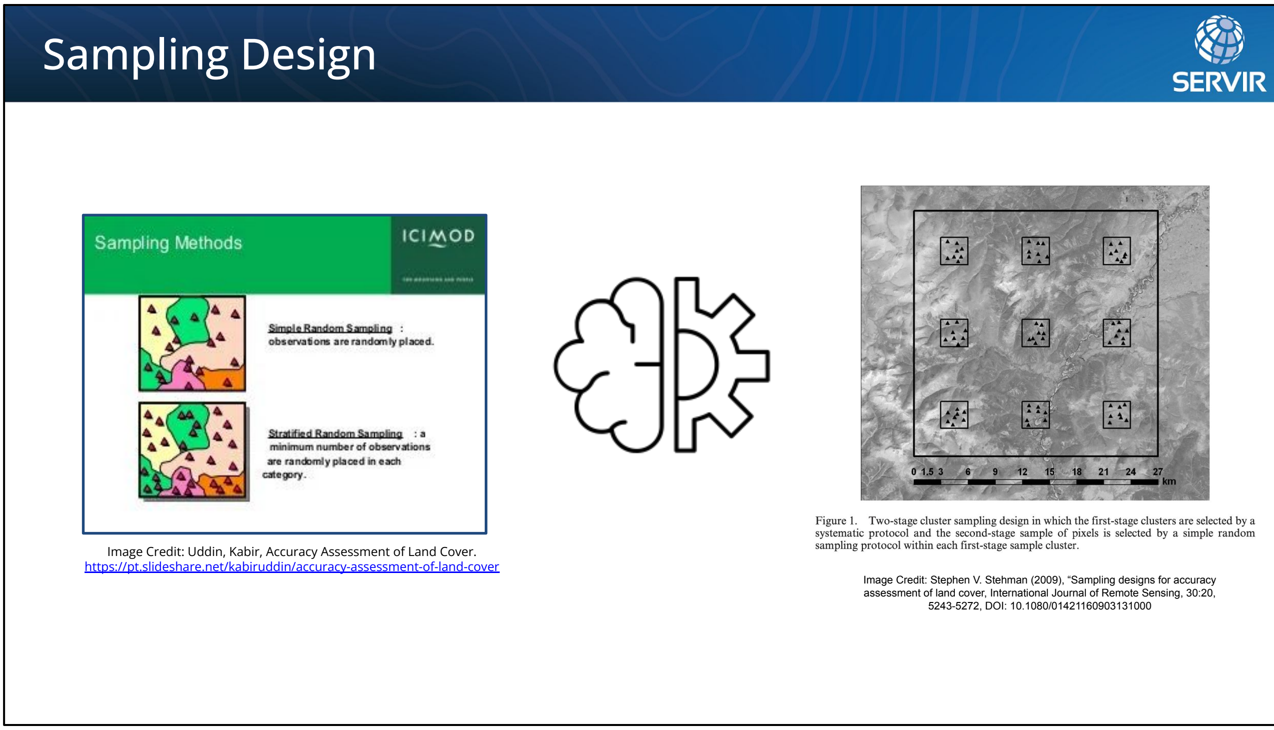
	Classes	Description
i.	Urban Built-Up Areas/Open/Transitional Areas	Residential, commercial and services, industrial, transportation, communication and utilities. Open or Transitional areas are bare-lands which are exposed areas and quarries
ii.	Agricultural/Grass/Secondary Growth and Riparian Vegetation	Cropland, coffee plantations, horticultural farms, greenhouses, other agricultural crops, well – kept grass as well as the riparian vegetation
iii.	Forests	Evergreen forests, mixed forests with higher density of trees, little or no under storey vegetation
iv.	Rangeland and Shrubs	Sparsely distributed scrub species. Ground layer covered by grass. Species include *Acacia mellifera* and *Lawsonia inermis.* The shrubs constitutes perennial grass under storey, trees rarely above 5m, impoverished woodlands near the forests. Other dichotomy entails very sparsely distributed, low-lying scrub species. Usually less than 1m, typical species include *A. reficiens, Salvadora dendroides*, ground usually bare or covered by annual grasses.
v.	Water Bodies	Rivers, natural dams, reservoirs and waste water lagoons

Source: (Modified from Anderson *et al.*, 1976)

First steps → objectives → end product → class schema → imagery → ML logo → foreground & background classes → all data to model given to collector

So what are the first steps when designing an image interpretation project? Your first order of business is defining the objectives your project hopes to achieve. Next, you will outline the end product you aim to create – which could be a land cover map, or a statistical analysis of land cover based on your survey. Then, you will develop a classification schema, which you can see an example of on the right hand side of the screen. A classification schema includes the land cover or land use classes you will identify in your project, as well as the descriptions of those classes. Oftentimes, you don't have to generate a classification schema yourself, but can use one already created by government organizations in your region of interest.

After generating your classification schema, think about what imagery you will need to be able to discern the different classes you have created. Will the default imagery in Collect Earth Online be substantial in distinguishing your classes of interest? Or will you have to import additional imagery? We’re going to see this logo pop up several times throughout this presentation, and when it does, you’re about to hear a best practice for projects that collect training data for a machine learning algorithm, which SERVIR often does. If your end product is going to be a machine learning generated land cover map trained with CEO data, it is recommended that you include the classes you are interested in mapping as separate classes in your schema, and combine the other land cover classes into a background class if they are (1) rare and (2) not of interest. Another best practice for machine learning models is that all of the data that is provided to the model should be provided to the collector, and vice versa. So if your model uses Landsat data, you want to include Landsat data in your image interpretation project.

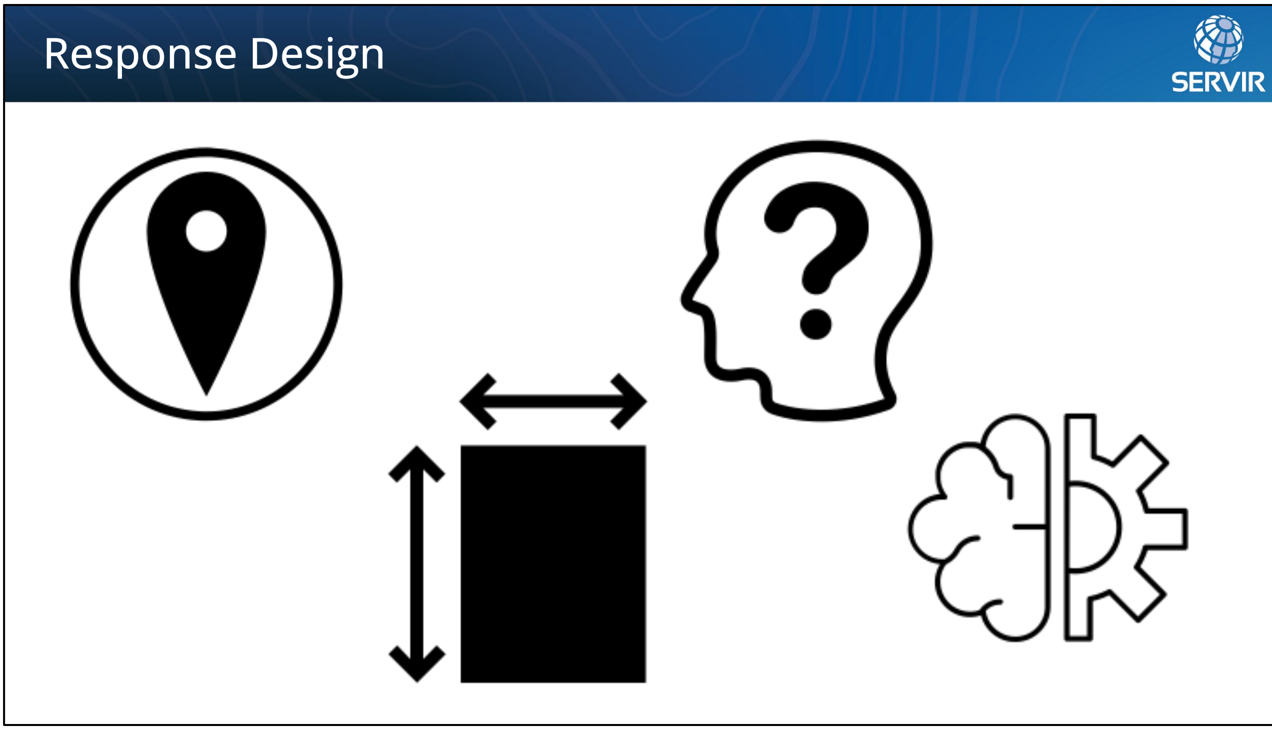


transition → SD definition → AU definition → Clusters → Cluster definition → Strata → Strata design → Selection protocol → hard negatives → hard negatives example in Bhutan

Once you have your objectives, identified an end product, and developed a classification schema, your next step is to develop your sampling design. The term sampling design refers to how you will geographically place your assessment units. Assessment units are the locations at which you will interpret the imagery, and collect data about which land cover or land use types occur in that location.

Your first step when planning out your sampling design is choosing whether or not to incorporate clusters in your design. Clusters, shown on the right hand side, group your samples together, and can reduce the costs associated with a large scale image interpretation project. Next, you must decide whether or not to incorporate strata in your design. Strata are groups of pixels that are exhaustive and exclusive. This just means all pixels in your study region can be assigned to one and only one strata. Land cover class is often used as a strata using a pre-existing land cover product. This helps you to obtain a sample with all land cover classes present. You can see an example of what a stratified sample looks like on the left hand side. Now, you must determine your selection protocol, which is a fancy way of saying, will you distribute your pixels randomly, uniformly, or in some other way within your study area (or strata, if applicable). Finally, you must determine your sample size.

ML Best Practices: intentionally sample hard negatives. Hard negatives are land cover classes that could be incorrectly interpreted by the machine learning model. For example, a SERVIR project I worked on aimed to map rice extent in the country of Bhutan. However, we found that our model confused rice with riverbanks and glaciers due to similar backscatter reflectance in the synthetic aperture radar signal. Thus, in future iterations of the study, our sampling design for the training data will specifically seek out these land cover classes to improve the model’s accuracy.

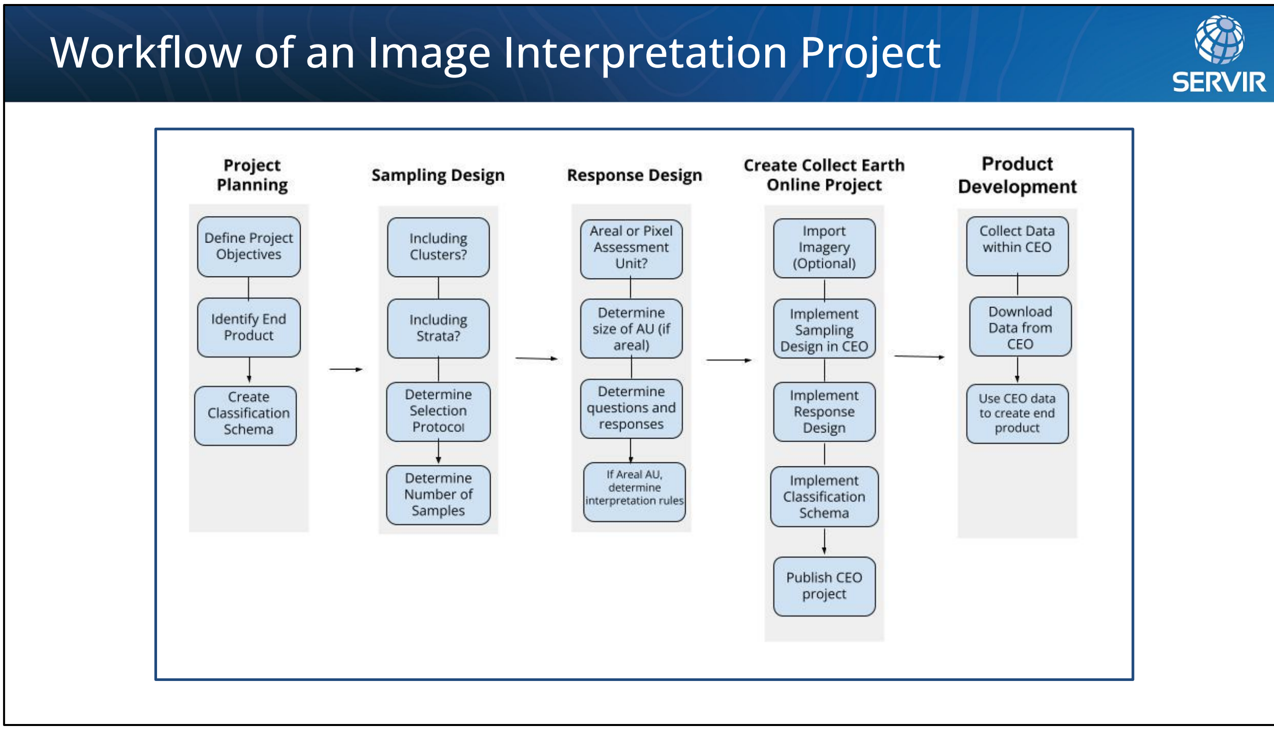


Define Response design → pixel or areal → consult CS → determine size of AU → determine questions and responses (give example) → Classification methodology

Next you will develop your response design, which refers to the protocol you will undergo when interpreting the imagery and classifying your assessment unit.

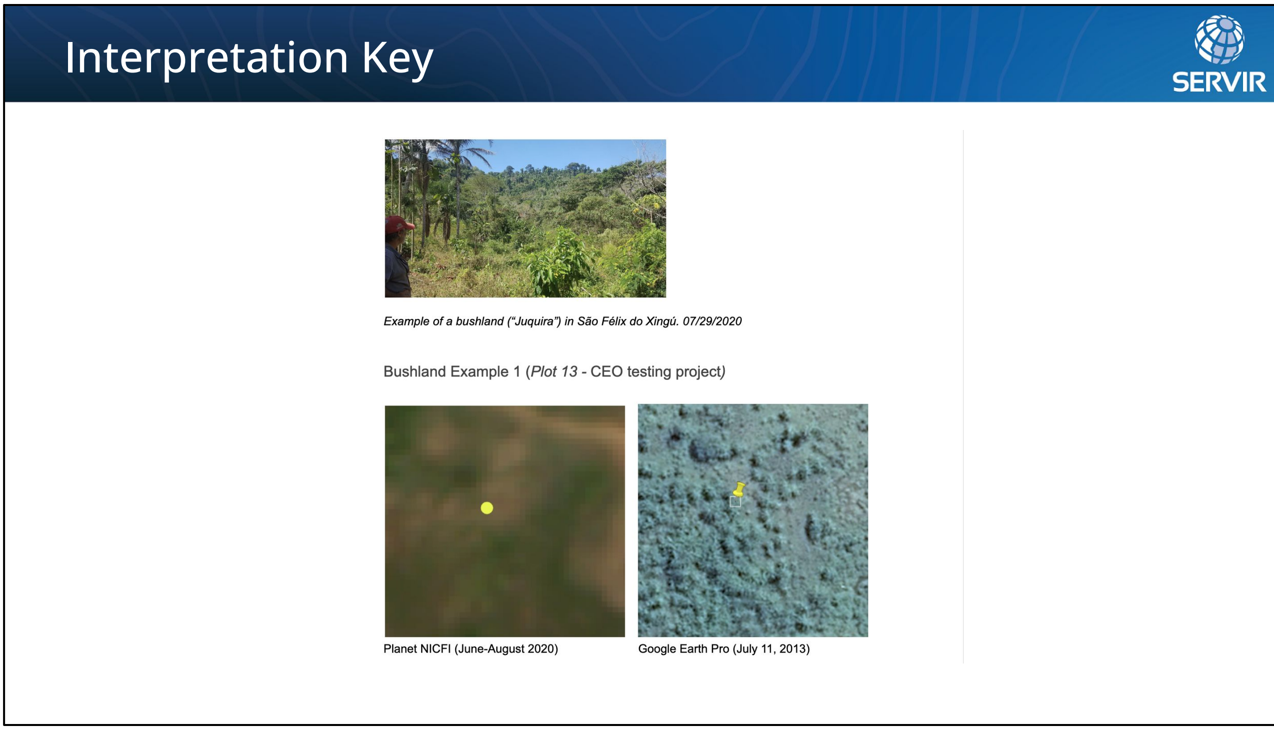
First, decide whether you will be using an areal-based or pixel-based assessment unit. A pixel-based assessment unit means that you will classify only a point as a land cover class, whereas an areal-based assessment unit means you will interpret a larger area. Consult your classification schema when making this decision, because certain classification schema require an areal assessment unit. For example, definitions of forest often will say something like “50% of the land is trees”. Next, determine the size of AU you need.

Then, determine the questions and responses you will include in your study. If you are performing a land cover change assessment between 2015 and 2020, your questions may be “What is the land cover type in 2015” and “What is the land cover type in 2020” and your responses will be your different land cover classes in your classification schema. Finally, a large component of your response design concerns coming up with a set of rules for interpreting an areal assessment unit. For example, what if your AU is 60% of one class and 40% of another class. In the Bhutan project, we determined that if the pixel was over 50% one land cover class, the entire assessment unit would be classified as that class. However, after an audit, we learned that it is a best practice to only feed the model assessment units where the entire assessment unit is rice.



This image represents a typical workflow of an image interpretation project using Collect Earth Online. Starting on the left, we have the project planning phase. Then, as we discussed, you draft your sampling design and response design. Then, you go about implementing your project in Collect Earth Online, before collecting data and creating your final product

Now that you know what it takes to plan out a project in Collect Earth Online, let’s take a look at some best practices for interpreting a satellite image.



Subjective → resolution → interpretation key → why use an IK

The reason that these best practices are provided is because image interpretation is extremely subjective, it's not an exact science. Two different people can interpret the same image two different ways. This subjectivity is compounded by spatial resolution making images grainy, cloud cover, etc. Because of this subjectivity, those conducting an image interpretation project will often create a document called an interpretation key. Interpretation keys show what the different land cover classes look like from the ground level versus the satellite imagery. They help for larger interpretation projects where you have multiple data collectors and need a strict set of rules to minimize the chances of two people classifying the same land cover type differently.

Example of an Interpretation Key

Tone & Color

Image Credit: Patterson, M.S.; McCallum, Kimberly. Collect Earth Online Project Development Manual. https://www.collect.earth/wp-content/uploads/2022/11/CEO_Theoretical_Manual.pdf

Humans typically use seven image characteristics to classify images, the first of which is tone. Tone is used to refer to the differences in brightness in a black and white image, while color refers to the different hues of color that appear. This effect can be enhanced by using false color imagery, where wavelengths of light the human eye cannot detect are assigned to a color. You can see an example of a false color image on the right.

Shape

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Image Credit: Patterson, M.S.; McCallum, Kimberly. Collect Earth Online Project Development Manual. https://www.collect.earth/wp-content/uploads/2022/11/CEO_Theoretical_Manual.pdf

Another useful image characteristic is shape, which is useful in identifying man-made objects due to the uniform and linear shapes buildings tend to display. This criteria is more important when you are trying to map very specific land cover types, for example different species of trees.

Size

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Image Credit: Patterson, M.S.; McCallum, Kimberly. Collect Earth Online Project Development Manual. https://www.collect.earth/wp-content/uploads/2022/11/CEO_Theoretical_Manual.pdf

You can usually assess the size of objects by viewing objects the interpreter is familiar with and comparing their relative size to less familiar objects. Relative size of objects is useful in helping distinguish between things with otherwise similar structures, such as trees and shrubs.

Texture

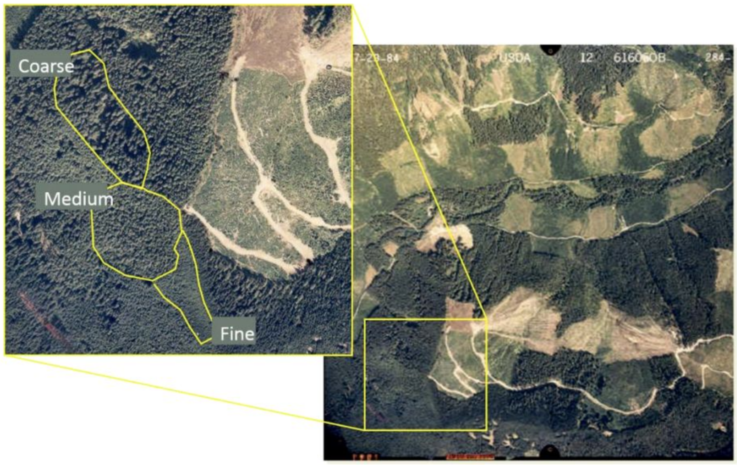
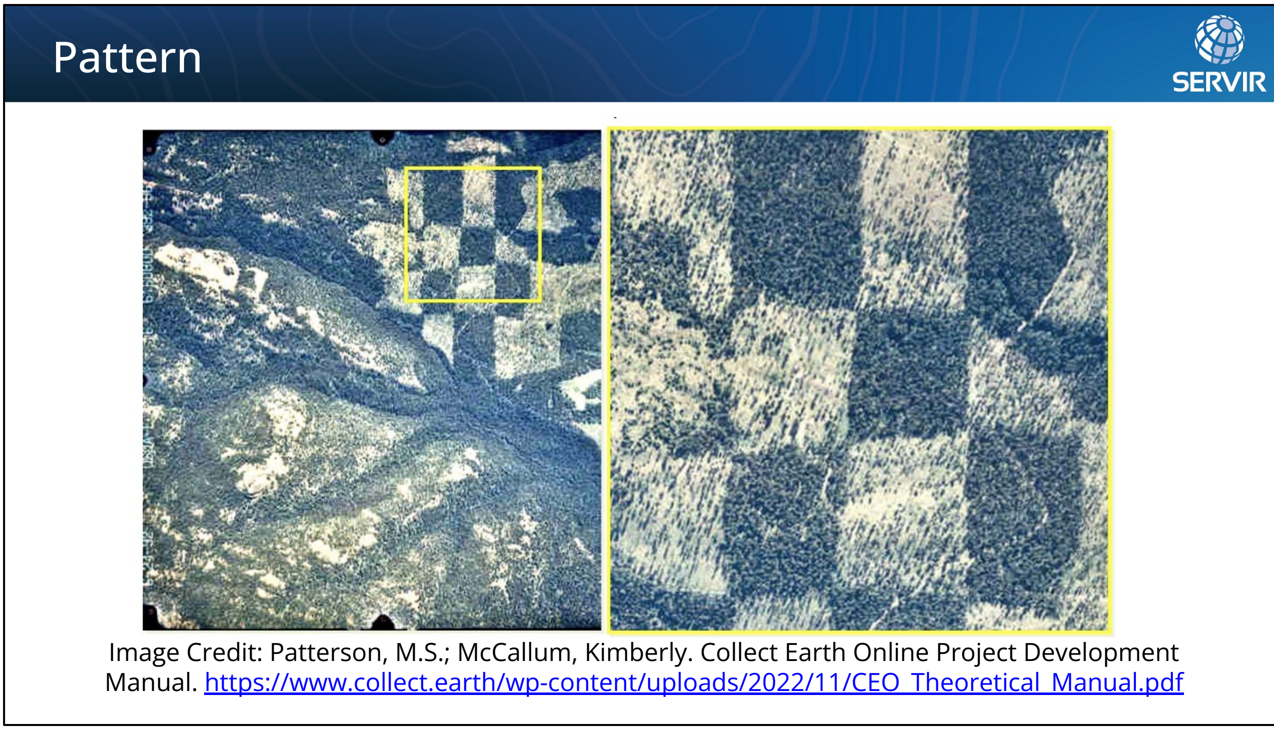


Image Credit: Patterson, M.S.; McCallum, Kimberly. Collect Earth Online Project Development Manual. https://www.collect.earth/wp-content/uploads/2022/11/CEO_Theoretical_Manual.pdf

Texture refers to the apparent roughness of an image, and can be especially helpful when distinguishing tree species or crop types from one another.



Pattern refers to the arrangement of individual objects into recurring forms. Here we can see a checkerboard pattern, indicating that the forest is being clear-cut along boundaries.

Shadows

Image Credit: Patterson, M.S.; McCallum, Kimberly. Collect Earth Online Project Development Manual. https://www.collect.earth/wp-content/uploads/2022/11/CEO_Theoretical_Manual.pdf

Shadows can be helpful in interpreting the relative heights of objects in the image.

Association

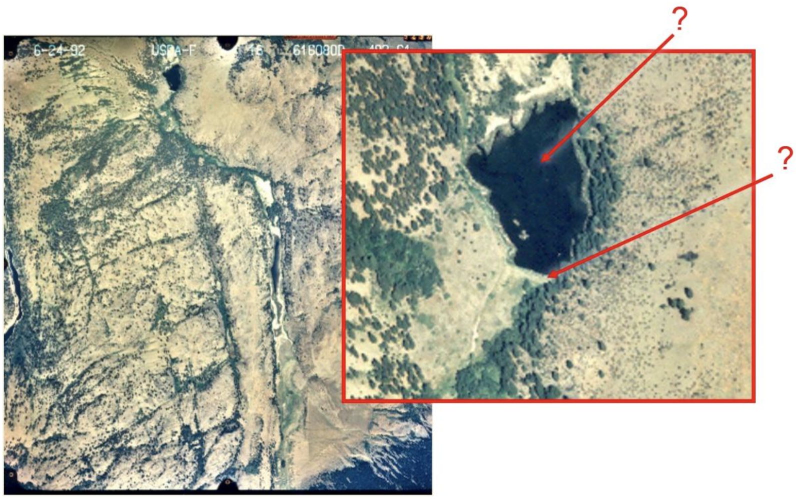
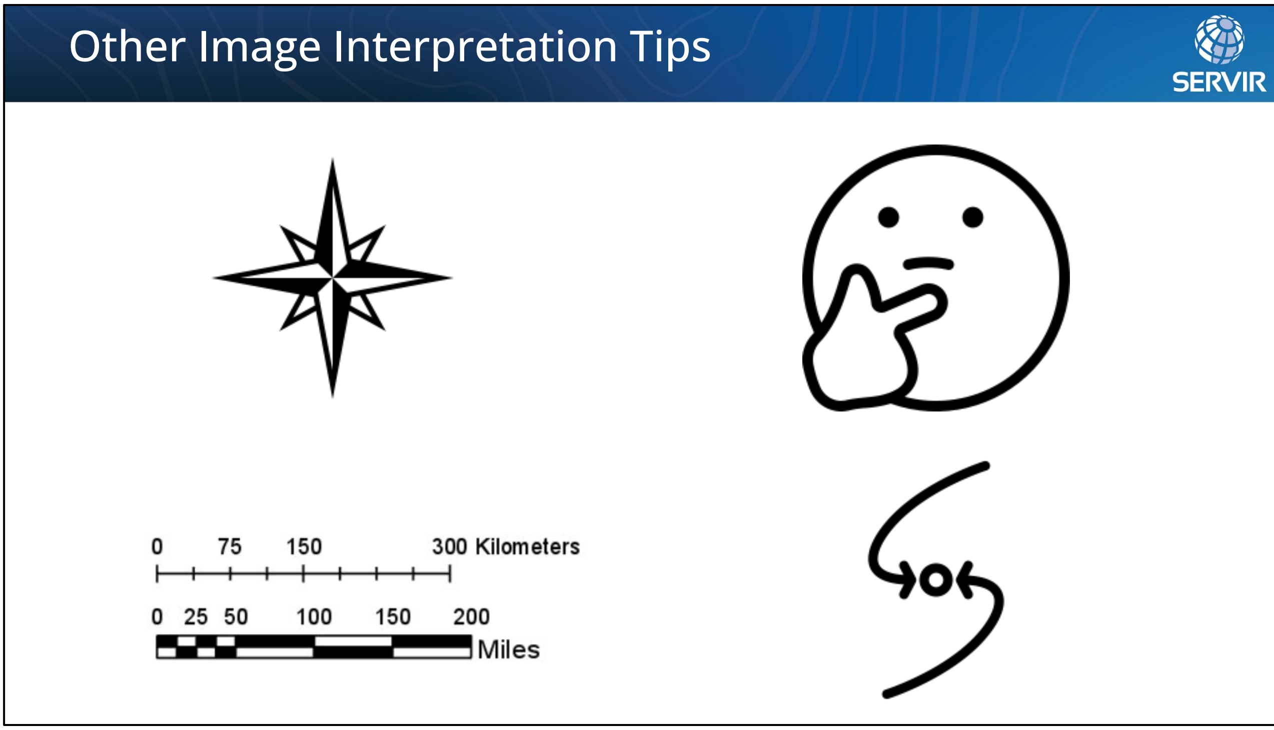


Image Credit: Patterson, M.S.; McCallum, Kimberly. Collect Earth Online Project Development Manual. https://www.collect.earth/wp-content/uploads/2022/11/CEO_Theoretical_Manual.pdf

By observing how objects are related to their surroundings, you can better ascertain what that object is. For example, the straight line in the lower border of the lake in this image tells you that this is a reservoir and not a natural lake.



Orient → Scale → Prior Knowledge → Convergence

Beyond these seven image characteristics, there are other tips that can help you to interpret an image. These include orienting yourself by finding North in the image, and looking for a scale, which is easy in Collect Earth Online because the scale bar will be in the lower left corner. Also, consider your prior knowledge. What do you know about this area? What do you know about land cover types like this? Do they exist in association with other things. Finally, most images are interpreted using a convergence of evidence, meaning that multiple observations allow you to draw a conclusion that may not have been reached from just one of those observations.

- https://earthobservatory.nasa.gov/features/ColorImage

Syllabus → Office Hours → Set up a time → Module 1 → Thanks

So I will now put the link to the syllabus I have created in the chat. The syllabus contains links to all of the curriculum materials I have created, as well as my contact information. I have also included a Google Meets Link for “office hours” and will be available after 3:00 p.m. Monday through Friday to meet with you. So you can text or email me to set up a time to meet on that Google Meets link and show me how you are working with ClimateSERV, or ask any questions you may have. So with the remaining time, we can start to work through Module 1 individually and put any questions you may have in the chat. And thank you everyone for allowing myself and SERVIR to be a part of your learning experience.

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Review of the material was also conducted by Bart Krol and Laura Cray of ITC (The Faculty of Geo-information Science and Earth Observation at the University of Twente). The course and unit banner images were created by Gianluca Ambrosi of ITC.

Sources

- Development Team: https://sams.servirglobal.net/detail/7
- All other info: https://www.collect.earth/about/