

## **Slide 1 – Title Slide**

Hello and welcome to Week 11, part 3 of EGM310: Visual Interpretation. In this lesson, we will learn about how we can use our eyes, brain, and experience to interpret the things we see in remotely sensed images.

## **Slide 2 – Deriving information from imagery**

With remote sensing, our goal is most often to answer some sort of research question. This could be something like “how much of the Earth’s surface is covered by glaciers?”; or “how much forest area has burned in a given year in California?”; or, “How has land use changed over time in a given area?”. When we use remote sensing to answer these questions, the images that we are using are raw data. That is, we can use the images to answer these questions, but we first have to interpret the images to convert that raw data into information that we can use. We can do this via visual interpretation, as we will talk about today; or, as we’ll talk about in lesson 5 of this week, we can use the computer to help us interpret one, or many, images.

## **Slide 3 – Visual interpretation**

We are well-practiced in interpreting images – it’s one of the main ways that we interact with the world. In doing so, we draw on our experiences or prior knowledge. For example, we can look at this image and see yellow sunflowers, white clouds, and a blue sky; we can see trees, grass, and bushes in this image. We can also see cows grazing in the fields, we can see the rolling hills in the background, and we can see blue sky or white clouds. We can also look at this image and see a coughbluoldcough dress. Often, we can do this because the images we’re looking at make sense to us – we have experience seeing these objects, and seeing the world from these angles. Remote sensing images, on the other hand, can be more difficult to interpret. Most remote sensing images are taken from a very unfamiliar perspective – we’re not that used to seeing the world from directly above. The scales and resolution of most images is unfamiliar, as well – in many of the images we’ll work with, a house is only a few pixels at most. The sunflowers in this image would be maybe one pixel in a satellite image. Remote sensing often requires us to make use of other parts of the electromagnetic spectrum – things that we usually have no prior experience viewing. As we’ve seen, many things look very, very different in the shortwave infrared than they do in visible wavelengths.

## **Slide 4 – Elements of interpretation**

We can think about a number of different elements of visual interpretation to help aid us – these are techniques that we also use, often subconsciously, in other aspects of our lives when confronted with things that aren’t familiar to us. You might recognize this image immediately, or you might not right away. But you can certainly recognize different things within it by their shapes – roads or buildings, for instance. And you might notice that some of those buildings are small, like houses, while other buildings are much larger. You might also recognize patterns – cars in a car park, for example. We

might also notice that some of these different objects have a regular pattern – they look like different agricultural fields. You can also see that some of the plants in these fields look more green than in other fields – maybe this indicates different crops, or maybe we’re looking at fields that haven’t been planted yet – or maybe already harvested? We can also see that some of these green areas look very smooth, while others are not – this could indicate that we’re looking at trees instead of crops. We can also see shadows, which helps confirm that we’re looking at trees. We can also use some of the different context clues to identify what we’re looking at – several larger car parks next to a series of buildings. Finally, consider the resolution of the image we’re looking at. In a lower-resolution image, we probably wouldn’t imagine we’d be looking at cars in a car park – but because this appears to be a very high-resolution image, we can be confident in that interpretation. We’ll go through some more examples of image interpretation in the rest of this lesson. Each of the images I’m using in this lesson come from Google Earth, but I won’t tell you where, or what we’re looking at just yet. In the live session this week, we’ll also spend some time discussing these and similar examples, and we’ll see how well you can identify these different locations. I’ll also post these images on Blackboard, so you can have a better look – things might be more difficult to interpret from the lecture video, or even the PDF of the slides.

## **Slide 5 – Shape, Size, Association, Context**

When we talk about the shape of an object, what we mean is its form or outline. For example, we might look at the large rectangular object in the middle of the scene and see that it’s a football pitch, since we can actually make out the lines on the pitch. But what about some of the other objects that we can see? There are definitely buildings of some kind, but are they houses? To help interpret these, we might also think about how large the different objects are. What about this building here next to the football pitch – is it a house? It could be, but it’s pretty small, so maybe it’s also a storage shed or something similar, given that it’s located right next to what we already identified as a football pitch. We can also see a number of other buildings, slightly larger, up here at the top of the image. These are probably houses, and they’re arranged in a way that suggests maybe we’re looking at a village, or at least a smaller neighborhood in a larger town or city. If we want to also work on identifying some of the different tree species that we can see, or at least differentiating them, we should also think about the context – where on Earth are we? If we think we’re in a cooler environment, we probably wouldn’t guess that these are tropical plant species. Again, see if you can use what you see in this scene to work out where this image was taken.

## **Slide 6 – Texture**

When we talk about texture, we mean how often the tone, or brightness, or color of the image changes. For example, we see lots of green in this image. But some of these green objects are quite smooth – we don’t see lots of changes within the object. In the green areas at the top of the image, though, we can see lots of darker and brighter spots within the larger object, and the shifts from brighter to darker take place over short spatial scales – they look rough. As you might have guessed, these are trees, while these are different agricultural fields. Whether objects appear smooth or rough depends on the size of the object relative to the image scale. If these areas with trees were only a few pixels, for example, they

wouldn't have the same texture at all – but because the image resolution is fine enough, we can see the textural variation caused by the different heights and shapes of the trees.

## **Slide 7 – Pattern**

Pattern is another feature we can use to identify objects in an image. It refers to the spatial arrangement of objects in an image. Very often, it means a repetition of form – such as the repeating circular objects we can see here, or the repeated, regular rectangles we can see over here. Patterns can come from both natural and constructed objects – we might have to use other clues to help us out. Given the surrounding area, which looks to be mostly free of vegetation, we might conclude that these are constructed.

## **Slide 8 – Tone/Hue**

As I've alluded to so far, we can also use the tone, or the hue/color, to differentiate objects. We've discussed how different plant types have different reflectances – for instance, we can see that the trees in the image, in addition to differences in texture, also have different colors – they appear darker green, while the fields we can see have different shades of green – or, they're even different shades of tan or brown. Tone/hue is often one of the main properties we can use to differentiate objects, although it may not be sufficient on its own – many different objects can have similar-looking reflectance in any given band, which is often why we use multiple bands where possible.

## **Slide 9 – Shadows**

Shadows can also help us interpret the things we see in images. In this image, we see a number of circular objects that aren't necessarily all alike. This group up here appear fairly flat, while this group down here are all casting shadows – suggesting that these are some kind of structure, while these are not. Shadows can also make interpretation more difficult, as they might obscure objects – this can be especially true in mountainous areas, for example. Shadows also enhance the topography in images – and we can even use them to calculate the height of objects.

## **Slide 10 – Summary**

In this lesson, we've discussed how our goal in remote sensing is often to turn the raw data contained in images into information that we can use.

Remote sensing images can often be difficult to interpret – they're usually at unfamiliar viewing angles, and they have a different scale than what we are used to in our day-to-day lives.

But, using the context and the clues that we can see in images can help – it can be a bit like detective work.

And, like many things, it does get easier the more you practice.

## **Slide 11 – Additional resources**

Once again, you can read more about the concepts we've covered in this lesson in the textbooks, Chapter 1 of Lillesand, Kiefer & Chipman; and Chapter 5 of Campbell & Wynne. This is also covered in the Remote Sensing Tutorials provided by Natural Resources Canada. I've included a link to a project from the University of Plymouth called GlacierMap. This is a project that's looking to crowdsource the mapping of glaciers in the Cordillera Blanca mountains in Perú, to help engage the general public and communicate information about water resources, glaciers, and climate change. You can click on the link and go to the website to read more. Finally, you can use Google Earth or Google Maps to get more experience looking at satellite images – at the very least, you can see some really cool, beautiful imagery. That's all for this lesson – I hope you found it interesting, and if you have any questions, please don't hesitate to e-mail me or post in the discussion forum on blackboard. Bye!