GES4090 - Image Processing - In-Class Exercise

1. **Creating a NDVI image using Landsat Band 3 (red) and Band 4 (near-infrared)**
2. **Unsupervised classification of land cover**
3. **Distinguishing snow from clouds using Landsat Band 2 (green), 4 (near-infrared), and 5 (shortwave infrared)**

Exercise Introduction: Using the Las Vegas Landsat imagery from last week (Path 39, Row 35), a new set of imagery of the Colorado Springs area (Path 33, Row 33), or any old Landsat scene you like (such as one of my favorites; the western San Juan Mountain region, Path 35, Row 34) you will perform various common and very relevant image processing tasks. You will start by creating simple normalized difference vegetation indices (NDVI) for two regions. Next, you will use unsupervised classification techniques to (automatically) distinguish land cover in the two or more regions. Last, you will use Landsat imagery of the Pikes Peak Region that contains ground-obscuring cloud cover to distinguish snow on the ground from clouds.

Landsat Reference Table: Landsat 7 ETM contains the following bands (all are 8 bit)

Band	Spectral wavelengths(µm)	Description	Ground res.
Band 1	.415-.515	Blue	30m
Band 2	.525-.605	Green	30m
Band 3	.63-.690	Red	30m
Band 4	.75-.90	Near ir	30m
Band 5	1.55-1.75	Shortwave ir	30m
Band 61	10.40-12.5 (low gain TIR)	Thermal ir	60m
Band 62	10.40-12.5 (high gain TIR)	Thermal ir	60m
Band 7	2.09-2.35	Shortwave ir	30m
Band 8	.52-.90	Panchromatic band	15m


*** REMEMBER - TO USE LANDSAT IMAGERY IN TAIGA, YOU MUST FIRST CONVERT TO AN IDRISI *.RST FORMAT (SEE LAST WEEK'S EXERCISE) ***
*** DURING THE CONVERSION PROCESS, YOU MAY NEED TO SPECIFY THE BAND # IN THE OUTPUT .RST FIELD ***

## Task #1: Creating a NDVI image using Landsat Band 3 (red) and Band 4 (near-infrared)

1. IDRISI Taiga offers a canned (built-in) program called "VEGINDEX" that calculates 19 variations of vegetation indices. We will practice with a very common index, the NDVI.
2. Open IDRISI Taiga.
3. Start VEGINDEX from the main menu (Go: Image Processing > Transformation > VEGINDEX)
4. Select the radio button for NDVI

5. Click on the browse button and navigate to your Las Vegas imagery folder (NOTE: first copy the imagery from Brandon's outbox to your desktop).
6. REMEMBER: These files are .tifs that need to be converted to .rst files (see Task #3 below or last week's in-class exercise for help)!
7. Input the red band (Band 3) and the infrared band (Band 4)
8. Set the Output image path
9. Click OK to generate and display the image. Do you see the golf courses?
10. WAIT! We are not done. We need to adjust the display properties so that our DN range falls between +1 (verdant vegetation) and -1 (no vegetation).
11. In the little "Composer window" in IDRISI, click on the Layer properties button.
12. Change the values in the "Display Min" text box to -1 and change the values in the "Display Max" text box to 1.
13. Click Apply and then Save (you should see an image like the one below)
14. **Repeat NDVI for Colorado Springs (Path 33, Row 33) or for the western San Juan Mountains (Path 35, Row 34) .** Use the GLOVIS site to download Level 1 imagery. *I recommend using Landsat 7 SLC-on (1999 - 2003). I would pick a spring or early summer month - May 12, 2001 is a good imagery set for Colorado Springs - with only 4% cloud cover! Also, if you chose to use San Juan imagery, May 16, 2003 has only 3% cloud cover!*
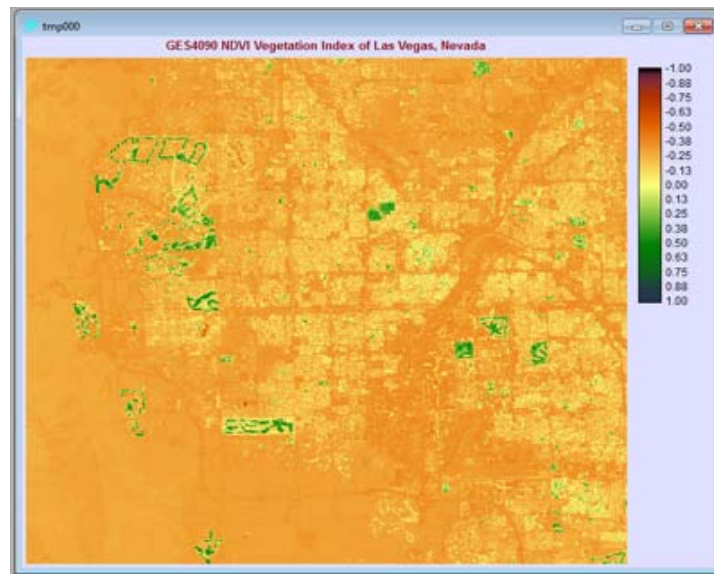

Task #2: Unsupervised classification of land cover

1. First, talk with your neighbor about differences between supervised and unsupervised classification.
2. Pick a set of Landsat imagery to work with. I processed the San Juan imagery.
3. First, create a false color composite (TM Bands 3, 4, 5 will be assigned blue, green, and red). This image will help with the interpretation of the land cover types.
4. Open Taiga. Go: Display > COMPOSITE
5. Using the 'pick list', specify blue as Band 3, green as Band 4, and red as Band 5. Give the image a name like "composite". The resulting image will look like this.
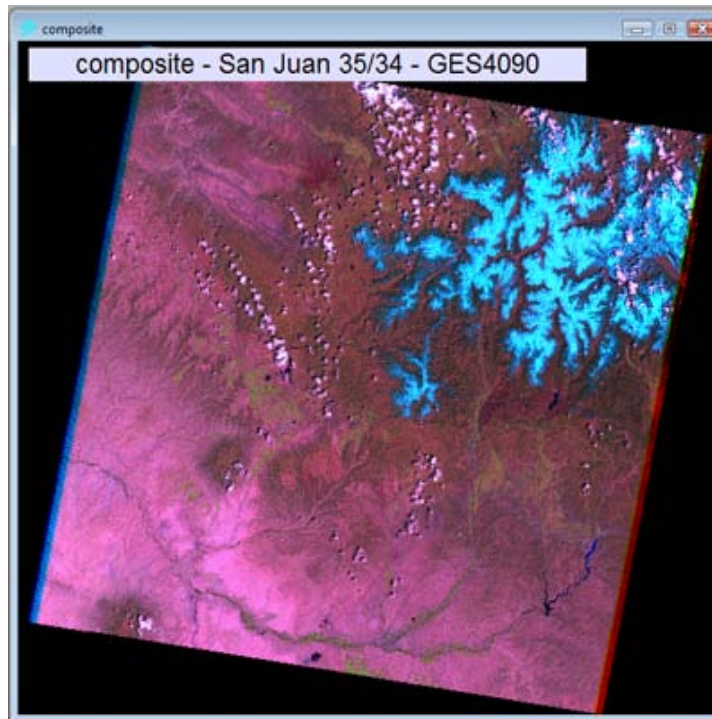
6. Next, create a 'file collection' in IDRISI. This essentially makes one group file to work with (instead of always having to work with many separate Bands/files).
7. In IDRISI, go: File > IDRISI EXPLORER. Click on the tab for files. Navigate to your imagery directory (with the .rst files). Select (while holding down the "CTRL" key) Bands 1, 2, 3, 4, 5, and 7 (six total).
8. Right-click on the selection and scroll down to "Create" and then select "Raster Group File". You have just created a file (not an image you can view) named 'Raster Group.rgf".
9. Finally, it's time to CLASSIFY! This process is called 'ISOCLUST' in Taiga.
10. In IDRISI, go: Image processing > Hard classifiers > ISOCLUST. The window below will pop up.
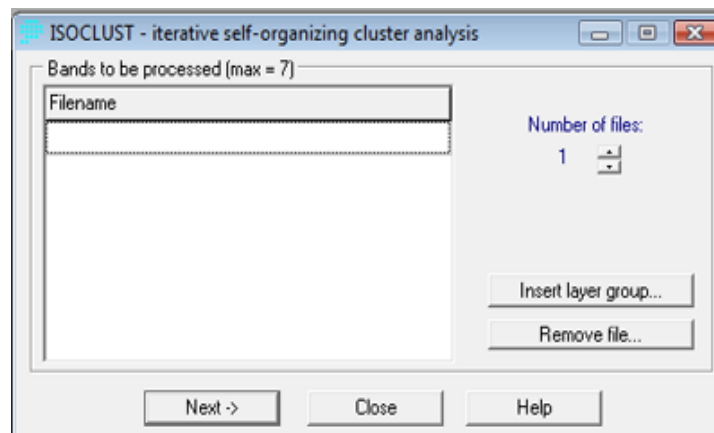
11. Click on 'Insert layer group' and navigate to the "Raster Group.rgf" that you created earlier.

12. Click on "Next" (The processing here will take some time......)

13. When finished processing, two windows will open. In the ISOCLUST window, add "10" in the "Number of clusters desired" cell (this is a good number because it represents where the histogram begins to flatten out. Set the other two specifications to match those in the image below:
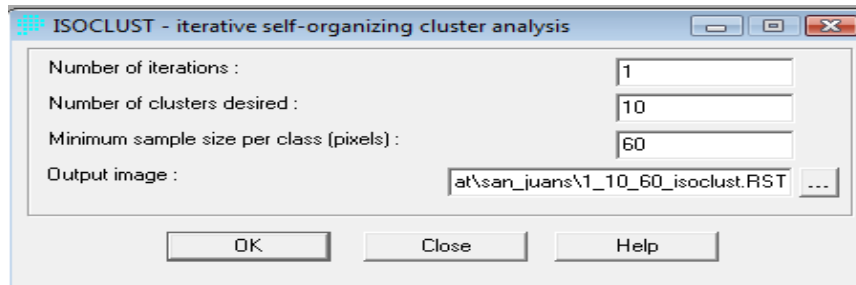

14. Specify the "Output image" name as 'isoclust10' and click OK. (*This will take A LOT of time to process....... probably a few to 10 or more minutes*). When finished processing, you are left with an unsupervised classification raster like such:
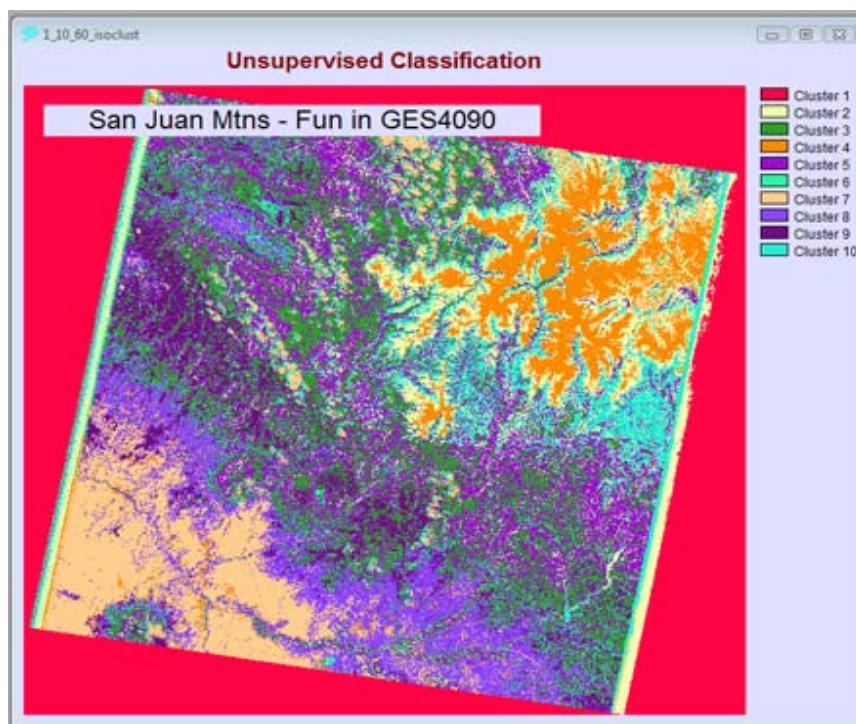

15. To customize the palette (setting classes to distinctive colors and names) ask Brandon for pages 187 - 197 from last semester's Beginner's Guide.

# Task #3: Distinguishing snow from clouds

1. For this task, use the set of SLC-on Landsat 7 ETM+ imagery (Path 33, Row 33) collected on April 10, 2001. This Pikes Peak area scene contains 49% cloud cover. The data are immediately available from the GLOVIS site.
2. The image below shows the specs for the imagery you'll download:
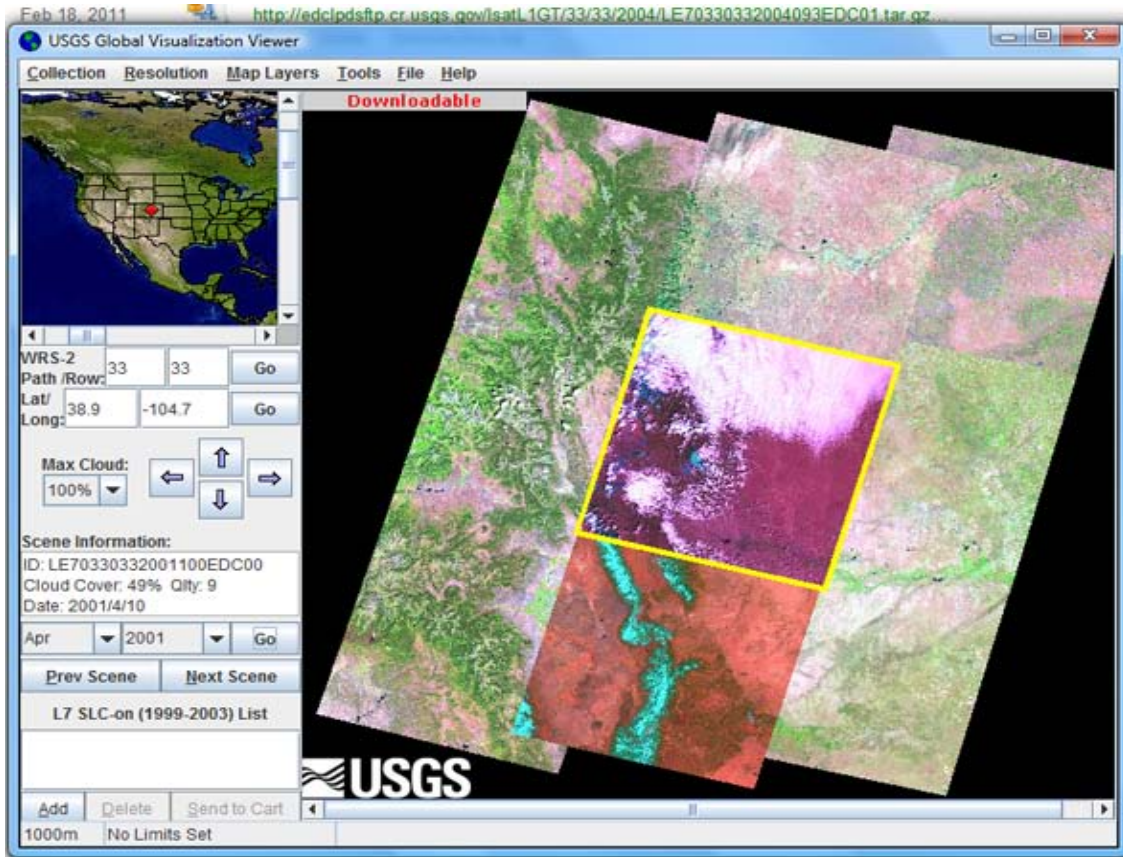
3. Use the import tool you used last week - the Landsat ETM data to IDRISI tool (see the screen shot below).
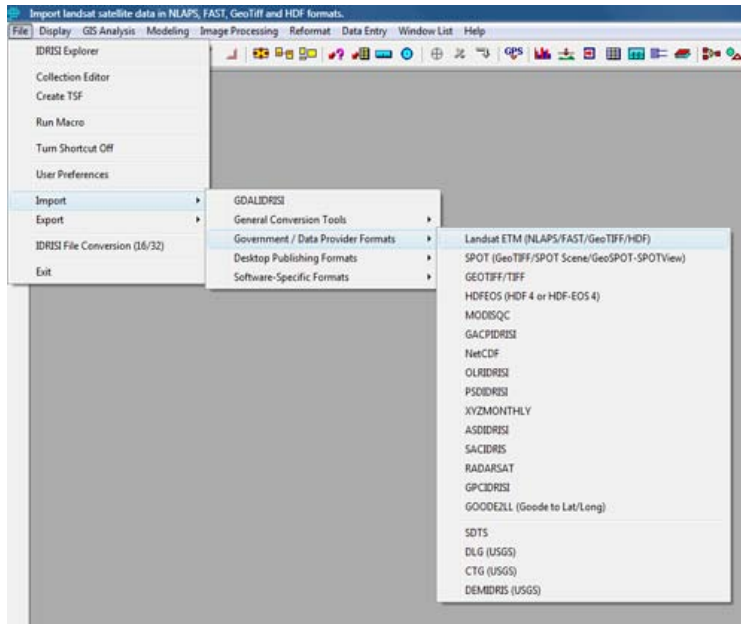
4. Make sure to select the "GEOTiff" button. Add all of the bands in the correct cells and click OK. Make SURE you know where (on your PC) the new files will be created!
5. Let's make a false color composite substituting B, G, R with Band 2, 4, and 5 (respectively).
6. In Taiga, go Display > Composite. Add Bands 2, 4, and 5 (R, G, B).
7. Name the output image something like "snow_composite"
8. You can give the Output image a Title if you wish. Use all other defaults in the composite window
9. You should see an image like the one below (hard to tell clouds from snow, eh?)
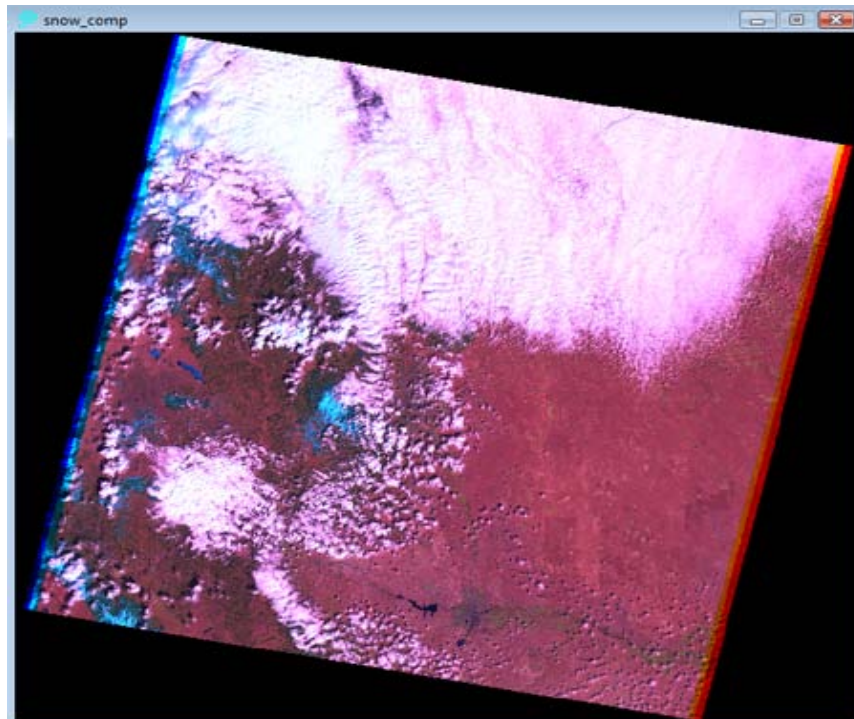
10. Next, let's use a ratio to better discriminate snow. One ratio is (Band 2 - Band 5) / (Band 2 + Band 5). Let's use the OVERLAY program to implement this ratio so we can see snow from clouds.
11. In IDRISI, Go: GIS Analysis > Mathematical Operators > Overlay
12. Set the specs like this:
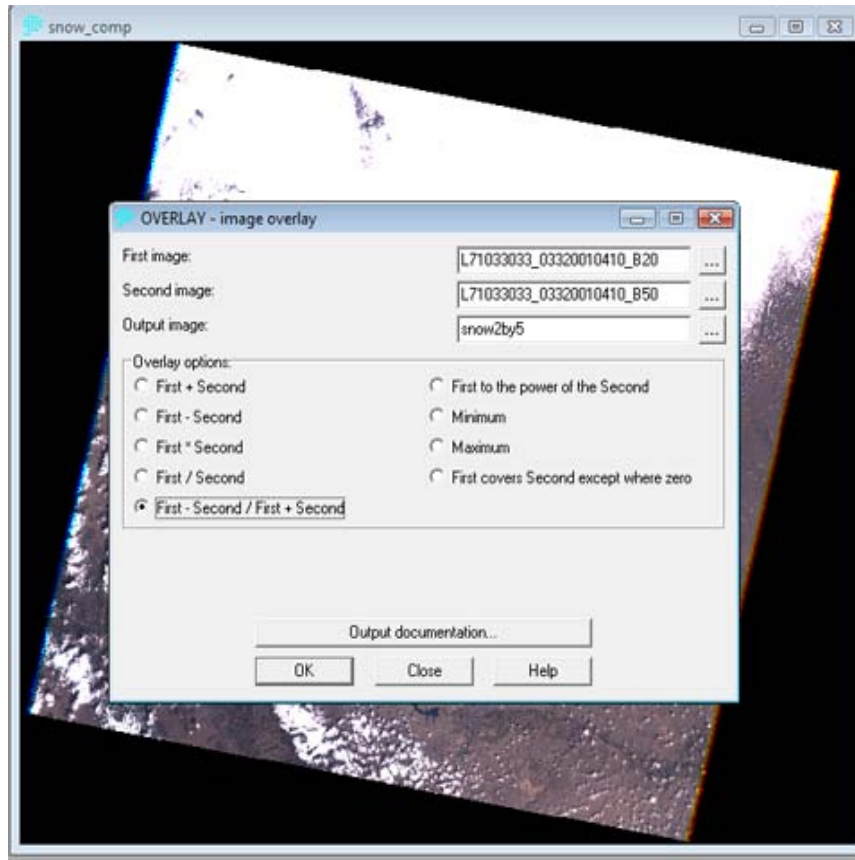
13. Click OK. Your image should look like this.
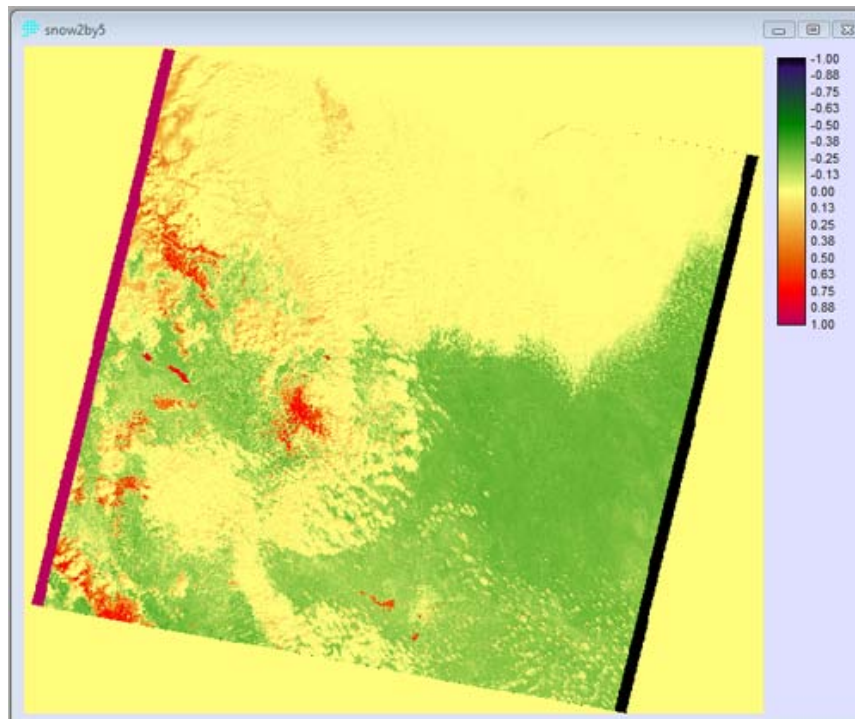
14. Higher ratio values are red (snow). Why does Pueblo Reservoir show as snow? Could it be frozen this time of year?
15. Note: if you want to reclassify the image to map ONLY snow, see pages 135-136 of the Beginner's Guide (if you were not in Remote Sensing last semester, ask Brandon or a group member to provide a copy of Chapter 5).
16. Want more practice? Get imagery from other places in Colorado or elsewhere taken in the winter or early spring. Look for snow using this approach.