In this project, I aimed to use the satellite imagery data to conduct an analysis about flooding.

**Situation:**

In January of 1997, Northern California witnessed a historical flooding which submerged a large part of Northern California in flood. Its is considered one of the largest recorded El Nino events in the history. To have a close look at the effect of this flooding, we conduct an analysis to calculate the flooding extent which inundates a large area (including urban area and agriculture area) with water.

**Hypothesis:** after the heavy rain, there would be a large area inundated with water, which caused hazard for the agriculture and urban area.

**Process:**

Step 1: Collect imagery data from Landsat 5 under Landsat L4-5 TM in USGS Earth Explorer website. Location is path 44 row 33, in two days: 10/10/1996 (clear sky before flood came) and 14/1/1997 when the area is inundated with water. We downloaded band 1 (blue), 2 (green), 3 (red) which are necessary for compositing layers into the useful image.

Step 2: Using ‘Composite Bands’ to merge TIFF files together, set band 1 to blue, band 2 to green and band 3 to red.

Step 3: After having two good images (before and after flood) ready, we performed maximum likelihood classification for each image. First, we collect samples including water, vegetation, bare land and others (including clouds or urban area). We gather at least 10 samples for each class (see the screenshot). The result includes two raster layers, which have discrete values standing for water/land/vegetation/others. We match the proper color for each class. After that, we apply ‘reclassify’ tool to change the name of classes same between two image. Which 1 is water, 2 is land, 3 is veggies, and 4 is others. These two reclassified rasters are use as input for model which will be built in step 4.

Step 4: Building model: The model including 8 steps:

4-1: extract water component out of the rasters resulted from step 3. We have two rasters with only water class for before and after flooding. This step we used ‘raster calculator’ too, which set value = 1. The two layers are similar which have two value 1 and 0. 1 is water and 0 is non-water.

4-2: we merge these two rasters together by perform raster calculator , which set value = raster\_after\_flood \* 10 + raster\_before\_flood. This result to a raster with 4 value 11, 10, 1, 0. Value 11 is the intersection between two raster, which is the original water (river/lake); value 10 is the flood extent which result in inundated areas. Our purpose is analysing this component. Value 1 is ‘uncertainty’ one, because the water is disappear in the after\_flood\_raster, which does not make sense here. Value 0 is the area without inundated (out of hazard).

4-3: We continue to perform raster calculator, which set value = 10. This result in a raster with 2 values 1 and 0. 1 is the flood extent, and 0 is non-flood extent.

4-4: To make it easier to visualise, we use ‘set null’ tool to set 0 value to null. The raster maintain only value 1 which is the flood extent.

4-5: We calculate the unit area for each pixel in the raster which is 30x30 = 900 m2. We using ‘raster calculator’ again. Value is 900 instead of 1, which is the value of area of that pixel.

4-6: we use ‘Zonal Statistics as Table’ tool to convert the raster layer to table, and aggregate SUM which means we calculating the area of flood extent.

4-7: in this step, we ‘create field’ area\_km2, and the default value is Null

4-8: in this step, we calculate value for area\_km2 by multiplying the SUM field by 0.000001 to convert area in squared meter to squared kilometre. The result is 1598.7 km2 area are inundated with water. We done the analysis part.

Step 5: visualising the analysis on map. We insert into the current map 3 more dataframe, one is for the location reference, one is for the satellite image before flooding, and one is for the image when flooding happening. The map then be completed with title, description, legend, arrow, and scale bar.

**Conclusion:**

The Analysis is finished. There was an area of 1598.7 km2 submerged under flood after the historical raining in 14/1/1997.