MODIS-based fire potential index

Data-collection and calculations in details

Data-collection

- Source of data: GEE (Google Earth Engine)
- How to: As there are multiple Tiff images we require for these calculations, the best way to get this data is to make a set of satellite images i.e. set of TIFF images. So here is the link for the GEE script to get the tiff images.

Calculations

- In the calculation we require two types of images 1) MODIS-NDVI and 2) TRMM

1. MODIS-NDVI: From this we can get the greenness(NDVI score) of a specific geographical point. From this we can get the LR (Live Ratio) because the dead creatures are the source of fuel hence called dead fuel. For the calculation of the dead fuel we need to take the inverse of LR because the lesser the live ratio the more dead fuel will be there for fire hence (100 – LR(%)).

2. TRMM: TRMM gives us the precipitation, 100h moisture (related to the rainfall) which is the most important factor that can cause the forest fire hence the factor which is considered in FPI. From the TRMM score we can get the MR (Moisture Ratio). The lesser the moisture the more prone to the forest fire. So we need the inverse of MR. Here we can define the moisture factor by (1 – MR).

- From the images. We can determine the two factors named LR (Live Ratio) from MODIS-NDVI images and MR (Moisture Ratio) from TRMM images. From the LR and MR we can get FPI by the equation below:

$$FPI = (1 - LR) * (1 - MR) * 100 \text{ (in \%)} \qquad \text{(eq. 1)}$$

- Here LR, MR values are from 0 to 1. These are the values calculated for each pixel.
- So we can get the pixel wise FPI by the eq. 1.

How to calculate using python:

- File: calculations
- Required packages: mentioned in requirements.txt.

To install the packages type:

pip install –r requirements.txt

or

pip3 install –r requirements.txt

(optional)For rasterio installation click here.

- This involves image processing. So using PIL(rasterio) package we can read images and get the corresponding numpy array. But we are processing multiple images so we have explicitly defined a function which is used to read a folder and give a list of numpy array of all the images.

- Equations to calculate pixel wise LR & MR are given in the reference.
- Equations for calculating pixel wise FPI is given in eq. 2, LR is given in eq. 3, MR is given in eq. 6.
- Equation for calculating pixel wise FPI is implemented as a function of addresses to the folder containing NDVI images and TRMM images named FPI_calc.
- Equation for calculating pixel wise LR(MR) is implemented as a function of address to the folder containing NDVI images(TRMM images)named LR_data(MR_data) in the calculations file.

- Other support functions are also created which are as below.
- We can save our computed list of arrays in images format with the scale and bias by arr_to_imgs function.
- Another important function is to create GIF out of given set of images for a batter representation. This function is make_gif which will take certain parameters and create a gif out of it.

Brief report on results:

- In FPI.gif we can clearly see that in August-September days there are more fire hotspots than any other days.
- We can clearly see that the areas where the forest fire happened are amongst these fire hotspots.
- These fire hotspots are increased in the areas where illegal deforestation happens in the areas of northern Bolivia ,south Amazonia state in Brazil and the actual south Amazon rainforest.

- In the beginning of October (or late September), we can clearly see that the fire hotspots are reduced. Because the rainfall starts at the same time. Hence the MR is increased by a very large value because of having rainforest. It implies that 1 – MR is close to zero hence the FPI vanishes to nearly 0. The other reason can be given as by increasing rain, the dead fuel values decreases as greenery increases hence LR increases and 1 – LR decreases hence the FPI is lowered further.
- We took the average FPI across the region and it came out to be 44.2% or 0.442 which is very close to the actual vulnerability index of the region (around 0.401). And it is in the region of all the vulnerability indices which are varying from 0.400 to 0.460. So the answers are precisely defining the actual event that is the Amazon forest fire.

Conclusion:

Amazon forest fire occurred in August,24 2019 and the good thing is that this is not the worst case where the highest forest fires were reported. The worst year is around 2007-08. There after the forest fire reports we controlled till 2016-17. But now they are increasing rapidly which is why its been a terrific concern all across the world. This time more serious. And the causes for such alarming forest fires are nothing but manmade illegal deforestation(Huge impact uponLR-Live Ratio) and global warming which causes irregularity in annual rainfall thus it has a huge impact upon the MR-Moisture Ratio. So these are the major factors for forest fires and we should always remember,

"Mother Earth Is Going to Get Mean If We Don't Go Green"