Solutions: Assignment for Senior Software Engineer - Geospatial

Question 7:

A. Inspect the metadata using any python library and provide the output print out.

Once you run `sentinel_2_processor.py` locally on your PC. The following metadata will be printed out for the input file: **`S2B_MSIL2A_20221127T075159_N0400_R135_T36NXF_20221127T100500.SAFE.zip`**


```
{'AOT_QUANTIFICATION_VALUE': '1000.0',
 'AOT_QUANTIFICATION_VALUE_UNIT': 'none',
 'AOT_RETRIEVAL_ACCURACY': '0.0',
 'AOT_RETRIEVAL_METHOD': 'SEN2COR_DDV',
 'BOA_QUANTIFICATION_VALUE': '10000',
 'BOA_QUANTIFICATION_VALUE_UNIT': 'none',
 'CLOUDY_PIXEL_OVER_LAND_PERCENTAGE': '67.150432',
 'CLOUD_COVERAGE_ASSESSMENT': '67.681426',
 'CLOUD_SHADOW_PERCENTAGE': '1.00211',
 'DARK_FEATURES_PERCENTAGE': '7.0E-4',
 'DATATAKE_1_DATATAKE_SENSING_START':
'2022-11-27T07:51:59.024Z',
 'DATATAKE_1_DATATAKE_TYPE': 'INS-NOBS',
 'DATATAKE_1_ID': 'GS2B_20221127T075159_029905_N04.00',
 'DATATAKE_1_SENSING_ORBIT_DIRECTION': 'DESCENDING',
 'DATATAKE_1_SENSING_ORBIT_NUMBER': '135',
 'DATATAKE_1_SPACECRAFT_NAME': 'Sentinel-2B',
 'DEGRADED_ANC_DATA_PERCENTAGE': '0.0',
 'DEGRADED_MSI_DATA_PERCENTAGE': '0',
 'FOOTPRINT': 'POLYGON((33.898748981595126 0.904799502316074,
'
              '34.885310549700094 0.904418497286558,
34.88507939165355 '
              '-0.08843451908062, 33.898638724445924
-0.088471771010446, '
              '33.898748981595126 0.904799502316074))',
 'FORMAT_CORRECTNESS': 'PASSED',
 'GENERAL_QUALITY': 'PASSED',
 'GENERATION_TIME': '2022-11-27T10:05:00.000000Z',
 'GEOMETRIC_QUALITY': 'PASSED',
 'GRANULE_MEAN_AOT': '0.106666',
 'GRANULE_MEAN_WV': '2.047634',
 'HIGH_PROBA_CLOUDS_PERCENTAGE': '32.283592',
```

```
 'L2A_QUALITY': 'PASSED',
 'MEDIUM_PROBA_CLOUDS_PERCENTAGE': '27.29553',
 'NODATA_PIXEL_PERCENTAGE': '0.0',
 'NOT_VEGETATED_PERCENTAGE': '1.10709',
 'OZONE_SOURCE': 'AUX_ECMWFT',
 'OZONE_VALUE': '273.613039',
 'PREVIEW_GEO_INFO': 'Not applicable',
 'PREVIEW_IMAGE_URL': 'Not applicable',
 'PROCESSING_BASELINE': '04.00',
 'PROCESSING_LEVEL': 'Level-2A',
 'PRODUCT_DOI': 'https://doi.org/10.5270/S2_-znk9xsj',
 'PRODUCT_START_TIME': '2022-11-27T07:51:59.024Z',
 'PRODUCT_STOP_TIME': '2022-11-27T07:51:59.024Z',
 'PRODUCT_TYPE': 'S2MSI2A',
 'PRODUCT_URI':
'S2B_MSIL2A_20221127T075159_N0400_R135_T36NXF_20221127T100500
.SAFE',
 'RADIATIVE_TRANSFER_ACCURACY': '0.0',
 'RADIOMETRIC_QUALITY': 'PASSED',
 'REFERENCE_BAND': 'B4',
 'REFLECTANCE_CONVERSION_U': '1.0259047172003',
 'SATURATED_DEFECTIVE_PIXEL_PERCENTAGE': '0.0',
 'SENSOR_QUALITY': 'PASSED',
 'SNOW_ICE_PERCENTAGE': '0.0',
 'SPECIAL_VALUE_NODATA': '0',
 'SPECIAL_VALUE_SATURATED': '65535',
 'THIN_CIRRUS_PERCENTAGE': '8.102305',
 'UNCLASSIFIED_PERCENTAGE': '1.276555',
 'VEGETATION_PERCENTAGE': '28.335902',
 'WATER_PERCENTAGE': '0.596216',
 'WATER_VAPOUR_RETRIEVAL_ACCURACY': '0.0',
 'WVP_QUANTIFICATION_VALUE': '1000.0',
 'WVP_QUANTIFICATION_VALUE_UNIT': 'cm'}
```

B. Only keep the extent of the image covered by the region and add a metadata tag called “region” that should have the value “test roi”.

A snippet of subset file - **test_roi.tif** showing added metadata:

```
……..
  RADIOMETRIC_QUALITY=PASSED
  REFERENCE_BAND=B4
  REFLECTANCE_CONVERSION_U=1.0259047172003
  region=test roi
  SATURATED_DEFECTIVE_PIXEL_PERCENTAGE=0.0
  SENSOR_QUALITY=PASSED
……..
```

C. Calculate the Min, Max, Mean, Median and Standard Deviation of the spectral index mentioned in Question 1 and any OTHER two indices - what can you infer from the spectral index outputs and the statistics?

NDVI, NDWI and EVI zonal statistics for Min, Max, Mean, Median and Standard Deviation.

```
zonal_statistics_db=> SELECT * FROM test_roi_tbl;
```

image_date	min	max	mean	median	std_dev
2024-03-15	-0.05908976495265961	0.6738551259040833	0.4945444133424539	0.5072463750839233	0.06412473830772163
2024-03-15	-0.6188784837722778	0.06144971027970314	-0.42755065074164744	-0.4367622137069702	0.06276932215864407
2024-03-15	-17620	15060	4.053278536039713	4.182857513427734	172.1729614260082

```
(3 rows)
```

D. Using PostgreSQL, create a database called zonal_statistics_db then in python, create a table called test_roi_tbl and columns should be image_date, min, max, mean, median, std_dev . Update the values of the Question 4 c. above to the table and print out the values to make sure they were saved correctly.

The **zonal_statistics_db** and the the **test_roi_tbl** created and zonal statistics results for the NDVI, NDWI and EVI indices successfully inserted:

```
zonal_statistics_db=> SELECT * FROM test_roi_tbl;
```

image_date	min	max	mean	median	std_dev
2024-03-15	-0.05908976495265961	0.6738551259040833	0.4945444133424539	0.5072463750839233	0.06412473830772163
2024-03-15	-0.6188784837722778	0.06144971027970314	-0.42755065074164744	-0.4367622137069702	0.06276932215864407
2024-03-15	-17620	15060	4.053278536039713	4.182857513427734	172.1729614260082

```
(3 rows)
```

On success, inserted values are printed:

```
Values {'min': -0.05908976495265961, 'max':
0.6738551259040833, 'mean': 0.4945444133424539, 'std':
0.06412473830772163, 'median': 0.5072463750839233} inserted
successfully.

Values {'min': -0.6188784837722778, 'max':
0.06144971027970314, 'mean': -0.42755065074164744, 'std':
0.06276932215864407, 'median': -0.4367622137069702} inserted
successfully.

Values {'min': -17620.0, 'max': 15060.0, 'mean':
4.053278536039713, 'std': 172.1729614260082, 'median':
4.182857513427734} inserted successfully.
```