**Google Earth Engine Cloud Application Project**

**Predicting Climate Change of Monghafad ElQatara**

**in West Egypt based on AI Neural Network**

**Google Earth Engine Description:**

Google Earth Engine is a cloud-based geospatial analysis platform that enables users to visualize and analyze satellite images of our planet. Scientists and non-profits use Earth Engine for remote sensing research, predicting disease outbreaks, natural resource management, and more. Your students can access this information to join the discussion and become data scientists themselves.

Earth Engine provides easy, web-based access to an extensive catalog of satellite imagery and other geospatial data in an analysis-ready format. The data catalog is paired with scalable compute power backed by Google data centers and flexible APIs that let you seamlessly implement your existing geospatial workflows. This enables cutting-edge, global scale analysis and visualization.

Google Earth Engine combines a multi-petabyte catalog of satellite imagery and geospatial datasets with planetary-scale analysis capabilities. Scientists, researchers, and developers use Earth Engine to detect changes, map trends, and quantify differences on the Earth's surface. Earth Engine is available for commercial use and remains free for academic and research use.

It brings the Landsat and Sentinel-2 collections to Google Cloud Storage as part of the Google Cloud public data program. The Google Cloud collections make it much easier and more efficient to access the data directly from Cloud services. Earth Engine also provides APIs and other tools to enable the analysis of large datasets. The Earth Engine Code Editor and API do not access these Cloud collections; they use the Earth Engine data catalog directly.

Google Earth Engine brings together more than 40 years of historical and current global satellite imagery, along with the tools and computational power necessary to analyze and mine that vast data warehouse. As a planetary-scale platform for environmental data analysis, it is an invaluable tool for users to deepen their knowledge of the implications of climate change, and much more. The Timelapse project shows the power of Earth Engine by creating an interactive viewer showing cloud-free, global land coverage changes across 32 years.

**Project Study Area Description:**

يقع منخفض القطارة في محافظة مطروح، والمنخفض طوله حوالي ٣٠٠كم وعرضه حوالي ١٥٠م، والمنخفض عبارة عن مصاطب متدرجة إلى أسفل المنخفض.

A map of the qatarara depression project

Description automatically generated

**Project Problem Definition:**

مشروع منخفض القطارة وهو حفر قناة تصل بين البحر الأبيض بالمنخفض طولها حوالي ٦٠كم بهدف توليد طاقة كهربائية وملء منخفض القطارة بماء البحر.

ويقول خبراء بمركز البحوث بجانب توليد الطاقة الكهربائية سيتم إنشاء قرى سياحية ومجتمعات عمرانية ومزارع سمكية وبالتالي تشغيل أيدي عاملة وذكروا أشياء كثيرة أخرى وهم متحمسون جدا لإنشاء هذا المشروع، وفي المقابل يرى المعارضون أن المشروع كلفته كبيرة جدا لأن الحفر سيتم في أرض صخرية، وقالوا أيضا أن المياه المالحة ستؤثر على المياه الجوفية العذبة، وأن هذا سيدمر أكبر مساحات صالحة للزراعة بمصر ومستوية وممهدة، وكذلك سيدمر أكبر خزان مياه جوفية بمصر.

ونحن نريد أن نحتكم للعلم ونجيب على صحة المشروع أو ضرره أو على الأقل إنتاج بيانات يحتكم إليها المسئولين لدعم اتخاذ القرار.

**Project Requirements:**

For the four seasons of the years from 2020 to 2024, you should find, for all environmental climatic variables, the mean or average value. However, for only the precipitation it is required to get the sum or total value.

**Note:**

Winter: 1-12-#### to 29-2-####

Autumn: 1-3-#### to 31-5-####

Summer: 1-6-#### to 31-8-####

Spring: 1-9-#### to 30-11-####

**Given:**

* KML (supported by Goole earth desktop application)/shapefile (Supported by any GIS desktop application) for the study area.
* Excel file as a template for the needed data.

**Project Inputs:**

* Vegetation (NDVI)
* Elevation (DEM)
* Climatic variables:
  + Air Temperature
  + Soil Temperature
  + Precipitation
  + Evaporation
  + Evapotranspiration
  + Humidity
  + Wind Speed and Direction

**Project Outputs:**

* Maps
* Digital image as .tif file extension
* Statistics Table
* Charts

**Project Bonus:**

Design a Web App to support a user to get a temperature map for a user specific area.

**Project Programming Language:**

* Python
* Java Script

**Snippet for Vegetation (NDVI) in Java Script**

|  |
| --- |
| PA=  // ++NDVI++  // Harmonized Sentinel-2 MSI: MultiSpectral Instrument, Level-2A  // https://developers.google.com/earth-engine/datasets/catalog/COPERNICUS\_S2\_SR\_HARMONIZED  //\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*  var addNDVI = function(image)  {  var ndvi = image.expression(  '(NIR - RED)/(NIR + RED)',  {  'NIR': image.select('B8'),  'RED': image.select('B4')  })  .rename('NDVI')  .clip(region);  return image.addBands(ndvi)  };  //\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*  var withNDVI = ee.ImageCollection('COPERNICUS/S2\_SR\_HARMONIZED')  .filterDate(01-01-2023, 31-12-2023)  .select(['B8', 'B4'])  .filter(ee.Filter.bounds(region))  .filterMetadata('CLOUD\_COVERAGE\_ASSESSMENT', 'less\_than', 1)  .map(addNDVI)  .aside(print,'NDVI 2023');    var withNDVISize= ''+withNDVI.size().getInfo()+'';    var withNDVImax = withNDVI  .select('NDVI')  .max()  .gt(0.18)  .aside(print,'NDVImax 2023');    Export.table.toDrive  ({  collection: withNDVI,  description: 'CSV\_'+PA+'\_maxNDVI\_'+year+'\_10m\_CloudLessThanOne\_'+withNDVISize+'images',  folder: PA,  fileNamePrefix: 'CSV\_'+PA+'\_maxNDVI\_'+year+'\_10m\_CloudLessThanOne\_'+withNDVISize+'images',  selectors: ['system:index', 'MGRS\_TILE' , 'CLOUDY\_PIXEL\_PERCENTAGE', 'CLOUD\_COVERAGE\_ASSESSMENT', 'CLOUD\_SHADOW\_PERCENTAGE', 'HIGH\_PROBA\_CLOUDS\_PERCENTAGE', 'MEDIUM\_PROBA\_CLOUDS\_PERCENTAGE', 'NOT\_VEGETATED\_PERCENTAGE', 'VEGETATION\_PERCENTAGE', 'WATER\_PERCENTAGE', 'WATER\_VAPOUR\_RETRIEVAL\_ACCURACY'],  fileFormat: 'CSV'  })    Export.image.toDrive  ({  image: withNDVImax,  description: PA+'\_maxNDVI\_'+year+'\_10m\_CloudLessThanOne\_'+withNDVISize+'images',  folder: PA,  fileNamePrefix: PA+'\_maxNDVI\_'+year+'\_10m\_CloudLessThanOne\_'+withNDVISize+'images',  region: ee.Feature(ee.FeatureCollection(PAs).filter(ee.Filter.inList('Name\_EN', [PA])).geometry()).bounds(),  scale: 10,  fileFormat: 'GeoTIFF',  formatOptions:{cloudOptimized: true},  skipEmptyTiles: true  }); |

**Supposed Needed Applications:**

QGIS / ArcGIS / ArcGIS Pro / ERDAS Imagine

**Abbreviations:**

GIS: Geographic Information System.

RS: Remote Sensing

**References**

***Wind***

https://developers.google.com/earth-engine/datasets/catalog/NOAA\_GFS0P25#dois

S. A. Clough *et al.*, “Atmospheric radiative transfer modeling: a summary of the AER codes,” *Journal of Quantitative Spectroscopy and Radiative Transfer*, vol. 91, no. 2, pp. 233–244, Mar. 2005, doi: [10.1016/j.jqsrt.2004.05.058](https://doi.org/10.1016/j.jqsrt.2004.05.058).

***Humidity***

https://developers.google.com/earth-engine/datasets/catalog/NOAA\_GFS0P25

S. A. Clough *et al.*, “Atmospheric radiative transfer modeling: a summary of the AER codes,” *Journal of Quantitative Spectroscopy and Radiative Transfer*, vol. 91, no. 2, pp. 233–244, Mar. 2005, doi: [10.1016/j.jqsrt.2004.05.058](https://doi.org/10.1016/j.jqsrt.2004.05.058).

***Evapotranspiration***

https://developers.google.com/earth-engine/datasets/catalog/NASA\_SMAP\_SPL4SMGP\_007

R. Reichle *et al.*, “SMAP L4 Global 3-hourly 9 km EASE-Grid Surface and Root Zone Soil Moisture??Analysis Update, Version 7??” NASA National Snow and Ice Data Center Distributed Active Archive Center, 2022. doi: [10.5067/LWJ6TF5SZRG3](https://doi.org/10.5067/LWJ6TF5SZRG3).

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***Precipitation***

https://developers.google.com/earth-engine/datasets/catalog/UCSB-CHG\_CHIRPS\_DAILY#description

C. Funk *et al.*, “The climate hazards infrared precipitation with stations—a new environmental record for monitoring extremes,” *Sci Data*, vol. 2, no. 1, p. 150066, Dec. 2015, doi: [10.1038/sdata.2015.66](https://doi.org/10.1038/sdata.2015.66).

***Elevation***

https://developers.google.com/earth-engine/datasets/catalog/USGS\_SRTMGL1\_003

T. G. Farr *et al.*, “The Shuttle Radar Topography Mission,” *Reviews of Geophysics*, vol. 45, no. 2, p. 2005RG000183, Jun. 2007, doi: [10.1029/2005RG000183](https://doi.org/10.1029/2005RG000183).

***Daytime Land Surface Temperature***

https://developers.google.com/earth-engine/datasets/catalog/MODIS\_061\_MOD11A1#bands

Z. Wan, S. Hook, and G. Hulley, “MODIS/Terra Land Surface Temperature/Emissivity Daily L3 Global 1km SIN Grid V061.” NASA EOSDIS Land Processes Distributed Active Archive Center, 2021. doi: [10.5067/MODIS/MOD11A1.061](https://doi.org/10.5067/MODIS/MOD11A1.061).

***Temperature***

https://developers.google.com/earth-engine/datasets/catalog/IDAHO\_EPSCOR\_TERRACLIMATE

J. T. Abatzoglou, S. Z. Dobrowski, S. A. Parks, and K. C. Hegewisch, “TerraClimate, a high-resolution global dataset of monthly climate and climatic water balance from 1958–2015,” *Sci Data*, vol. 5, no. 1, p. 170191, Jan. 2018, doi: [10.1038/sdata.2017.191](https://doi.org/10.1038/sdata.2017.191).