

User Guide

Vector Difference Analysis in Google Earth Engine

Shiqi Tao, Arman Bajracharya

Summary

The Vector Difference Analysis application in Google Earth Engine (GEE) focuses on quantifying the differences between two sets of wind vectors, in terms of magnitude and direction. The application computes the Mean Deviation (MD) and the Mean Absolute Deviation (MAD). The MAD is further broken down into the Quantity Component (QC) and the Allocation Component (AC). These metrics are shown as a stacked bar chart, which can be exported as CSV, SVG, and PNG formats. The calculations of the abovementioned metrics are based on equations from *Metrics that Make a Difference* by Dr. Robert Gilmore Pontius.

View the app through <https://taoshiqi.users.earthengine.app/view/wind-vector-comparison>

Data

The input wind vectors are from ECMWF Reanalysis 5th (ERA5) Monthly aggregate data. ERA5 represents u and v components of wind as magnitudes along the horizontal and vertical axes respectively. The GEE app converts u and v components to the direction and magnitude for each pixel.

Please find more details on u and v components from ERA5 through the links below:

Data documentation:

<https://confluence.ecmwf.int/display/CKB/ERA5%3A+data+documentation>

Parameter details (u): <https://apps.ecmwf.int/codes/grib/param-db?id=165>

Parameter details (v): <https://apps.ecmwf.int/codes/grib/param-db?id=166>

How ERA5 calculates u and v component:

<https://confluence.ecmwf.int/pages/viewpage.action?pageId=133262398>

Application functions

The functions included in the source code for the application are designed to accomplish the following tasks:

1. Convert u and v components to magnitude and direction
2. Display the magnitude and direction using predefined color palettes
3. Calculate MD, MAD, QC, and AC for magnitude and direction
4. Display the results using a stacked bar chart
5. Export chart to a local computer

User Interface:

There are two steps to obtain the results, following the manual in the left panel (Fig. 1). First, input the dates of the wind data. Since the wind data is the monthly average, the input format should follow year-month as YYYY-MM. The display button is designed to visualize the data, which is not a necessary step to do the calculations. Second, draw a region for comparison (Fig. 2).

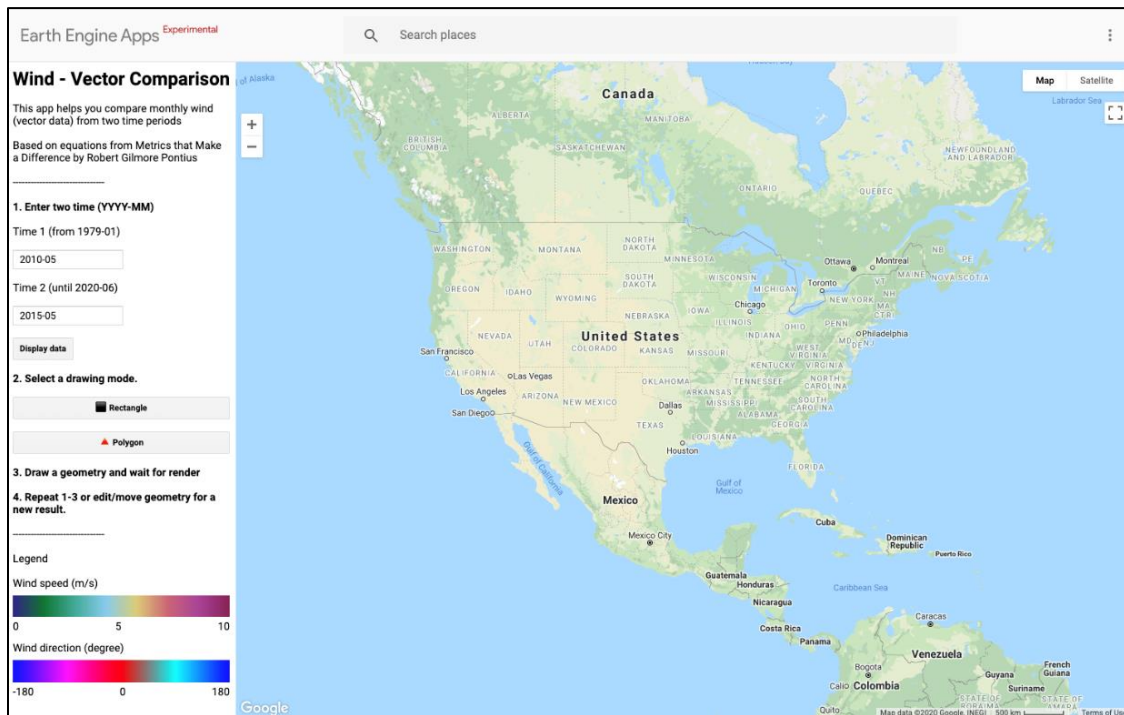


Figure 1. The application allows the user to select two time points for comparison. The area selection provides users two options (rectangle or polygon) to draw on the interactive map panel.

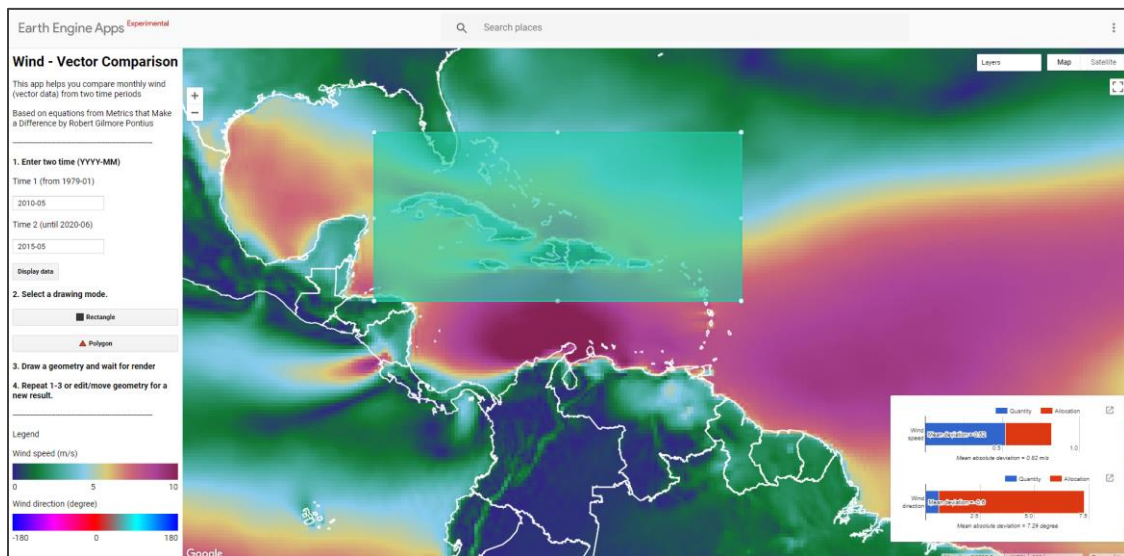


Figure 2. The application displays the wind data as raster from the selected time-points showing the magnitude and direction. Following the selection of a region, the stacked bar graph to the bottom-right displays the results.

Additional information:

1. The book METRICS THAT MAKE A DIFFERENCE gives equations that apply to a flat plane or to geographic projections that preserve direction.
2. The book METRICS THAT MAKE A DIFFERENCE gives equations where vector X has a positive component e when X points east and a positive component n when X points north. Other conventions portray wind as the direction from which the wind comes, in which case wind has a positive component u when the wind blows from east to west and a positive component v when the wind blows from north to south.