Development of a GIS-Based Input Creator for the Quick Environmental Simulation (QES) System

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INTRODUCTION

- The Quick Environmental Simulation (QES) System is a fast-response (low-computational-cost) framework designed to compute high-resolution 3D environmental scalars in complex atmospheric boundary layer environments.
- QES-Winds is a 3D diagnostic wind model with applications to modeling wildfires, pathogen transport in vineyards, smoke exposure for grapes, or pollution propagation and dispersion in cities.
- Previously, using QES-Winds would require the user to have expertise in using GIS-based packages to manually trim input raster data.
- The input creator for the QES system is a code that enhances user experience while working with QES-Winds by reducing interaction time with GIS-based packages.
- It will Increase efficiency by streamlining the process of trimming the Digital Elevation Models (DEM) and other raster data and ensure better data consistency and accuracy.

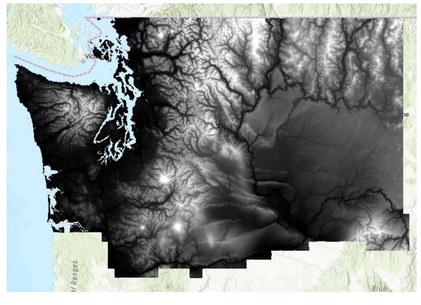
METHODS

- The code was scripted in Python and utilized the following packages for its functionalities:
  - ArcPY – Enables the geoprocessing functions used for trimming data (Windows)
  - GDAL – Enables the geoprocessing functions used for trimming data (Windows, MacOS & Linux).
  - Tkinter – Enables the user to interact with a graphical user interface (GUI) for file selection.
  - OS – Enables Python to interact with the operating system.

PROCEDURES

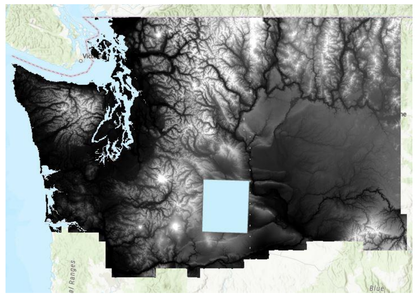
(The following steps outline how code operates)

1. The user will be prompted to select the input coordinates of their target domain, a parent DEM or other raster data, and UTM zone.



PROCEDURES CONT.

2. The code will automatically create a polygon vector layer of the user's target domain.

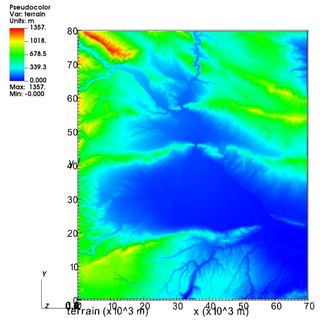


3. Then it will use the polygon vector layer to make a new DEM with the target domain area clipped out of the original parent DEM.

4. After this step, the clipped DEM or other raster data is prepared to be processed by QES-Winds.

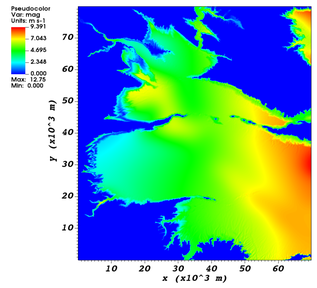
RESULTS

After being processed by QES-Winds, we were able to use data visualization software (Visit) to make the following plots:

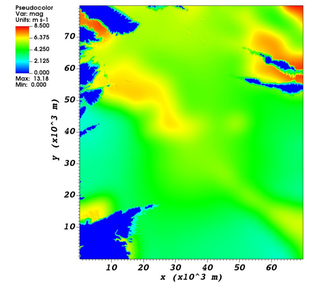


- This plot models the elevation data of the target area using the terrain data outputted by QES-Winds.

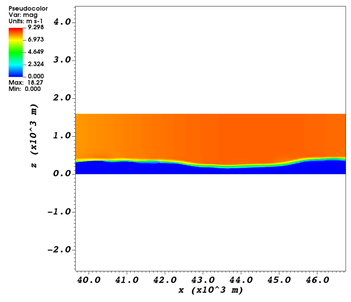
RESULTS CONT.



- Horizontal (x-y) variations in wind speed at a height of 400 m.
- Wind speeds decrease as elevation of the topography increases



- Horizontal (x-y) variations in wind speed at a height of 800 m.
- High wind speeds through valleys



- Vertical (z) variations in wind speed at 45000 m
- Wind speed profile contours to the given topography

CONCLUSIONS

- The automatic input creator code can automate the process of trimming DEM's and other raster data.
- This code makes the QES system more accessible and reduces required previous experience to use it.
- Significantly reduces the time required to trim data for QES and improves the consistency and accuracy of output data.

NEXT STEPS

- Use the code to create an application program interface (API) connection to online geodatabases to further improve usability and efficiency.
- Keep developing towards a unified GUI for QES.

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