

Geocomputation & Machine Learning course

Quick recap

This meeting was a LSA session focused on geocomputation and hydrological modeling using GRASS GIS and related tools. Giuseppe led a detailed presentation on hydrological modeling techniques, demonstrating how to process global digital elevation models at 90-meter resolution to identify stream networks and basins using commands like `r.watershed`, `r.stream.extract`, and `r.upstream.basin`. He explained the challenges of working with large datasets that require tiling and discussed memory limitations when processing global datasets. The session covered practical aspects including data type management, mask alignment, and handling computational constraints through strategic tiling approaches. Students shared their current projects, with Abdul working on upstream/downstream water calculations, Shiva analyzing wind turbine visual impact, and others discussing applications in hydrology and environmental modeling. Giuseppe emphasized the importance of building stackable layers and scripting procedures that can be easily modified as new data becomes available.

Next steps

Abdul

- Try running the GRASS tutorial/scripting procedure over the upcoming weekend.

Andrea

- Switch the basin intersection strategy from vector-based to raster-based in GRASS to handle the larger dataset.

Leanda

- Combine survey data with existing wind turbine and nature reserve datasets, and determine an appropriate resolution for the analysis.

Shiva

- Retry the visual impact analysis of wind turbines using the GRASS-based approach discussed.

Collaboration

- All students: Prepare a study case for the next week's session, focusing on implementing a geocomputation workflow (GDAL, GRASS, PK tools) and having a stack of layers ready for machine learning.

Summary

GRASS Hydrological Modeling Discussion

Giuseppe led a discussion on using GRASS for hydrological modeling, focusing on a specific study case involving global digital elevation models at 90-meter resolution. He explained the importance of upstream contribution areas in stream network delineation and noted that the current procedure uses a fixed 0.05 km² area for starting streams, which is a simplification of the original 5 km² approach. Giuseppe also discussed the challenges of processing the full globe in one shot, requiring tiling procedures to ensure complete basins are included within each tile.

Basin Delineation and Stream Network

Giuseppe explained the process of basin delineation and stream network identification using digital elevation models and R watershed commands. He detailed the steps involved in tiling the globe, computing flow accumulation and direction, and extracting stream networks, emphasizing the importance of aligning masks and considering computational constraints. Giuseppe also highlighted the use of area rasters for weighted accumulation and discussed the role of depression files in improving watershed computations. The discussion included practical considerations for handling large datasets and the complexity of hydrological modeling compared to other types of environmental modeling.

Hydrological Modeling with GRASS GIS

Giuseppe explained a hydrological modeling approach using GRASS GIS, demonstrating how to handle flow accumulation and stream extraction across tiles while addressing boundary issues between tiles. He showed a specific technique for masking invalid basins and merging results from multiple tiles to create seamless flow accumulation data. Shiva shared her experience using GRASS for wind turbine visual impact analysis, noting challenges with defining areas due to the large number of installation locations, and expressed interest in potentially retrying the approach with her existing dataset.

GRASS Hydrological Modeling Discussion

Francesco discussed his previous work using GRASS to detect lens flow prone areas by combining different layers including DTM, slopes, aspect, and precipitation data. Sun inquired about using GRASS for delineation and calculating residence time, with Giuseppe explaining that while residence time calculation is possible in GRASS, it requires making assumptions about coefficients and is typically a proxy rather than a direct measurement. Giuseppe demonstrated a technique for removing incomplete basins along tile borders by identifying and setting border pixels to null values, and explained the reasoning behind using specific tile dimensions despite working with smaller areas. When asked about the benefits of using GRASS over White Box Tools, Giuseppe acknowledged that both tools are effective for hydrological modeling, noting that White Box Tools might have additional functionality specific to hydrological applications.

Flow Accumulation Algorithms Discussion

Giuseppe explained the differences between flow accumulation algorithms in different software and recommended using White Box for the study case, particularly highlighting new R-flow accumulation tools developed recently. He advised Sebastián to start with a simple project and focus on building a scripting procedure with data layers, as the next meeting would be freestyle and focus on implementation rather than theory. Giuseppe emphasized that Sebastián should prepare the data stack by next week to begin machine learning work, suggesting that even if not all data layers are available yet, building the scripting procedure would be beneficial.

GIS Computational Strategies Discussion

Giuseppe discussed computational strategies for GIS operations, particularly recommending the use of raster environments over vector environments for faster processing of intersection

calculations. Andrea confirmed that switching to a raster-based approach would be necessary due to performance issues with larger datasets. Leanda shared her work on perceived wind farm impacts using survey data and discussed challenges in balancing data resolution and computational feasibility. Giuseppe concluded by reviewing the week's topics, including BASH commands, GDAL tools, and GRASS functionality, and announced the next session would continue the following week at the usual time.