Subject: triangulating over undefined space in irregular grids
Posted by bjelley on Wed, 26 Mar 2008 15:45:33 GMT
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Hi folks. Longtime lurker, but now I have a challenging (to myself anyway) problem to post.

I have a need for some more details about triangulate than I can seem to find.

The setup: I am trying to contour plot a number of variables for a storm surge grid that has up to 10 km resolution in the open Atlantic, yet has 8 meter resolution in New Orleans area waterways. The grid obviously includes most anything at or below sea level for the Northwest Atlantic domain, but also includes many (200k or so) land-based grid points (or it would be useless as a storm surge model). I mention the land-based nodes to express that a coastline mask will not fix the problem.

The problem: When plotting the results using the triangles returned, the result includes vast areas that are outside of the model domain. For example, the plot shows data in trangles running from central Louisiana to New England, yet the grid does not include any land with an elevation greater than 20 meters. So the grid does include some land for a range of distances from the coast, from ~5 to ~100 km inland based on elevation.

For example, when plotting the wind field from a hurricane, the magnitude plot ends up with streaks from higher wind speeds near the storm stretched out along the triangles towards areas not impacted...such as New England during Katrina. Clearly not acceptible.

More about the grid: Areas of Florida are excluded and should be null, but of course with a peninsula like that the triangles cover it. Cuba and the Yucatan landmasses are not included in the grid. Most of the land based nodes are along the Northern Gulf of Mexico. And I must reiterate, it is not that the triangles are including data where the data is null, but that the triangles are extrapolating data where the grid is undefined.

Also of importance is that the grid is numbered and ordered in a counter-clockwise fashion, not in any order of south to north and the like. This is native to the model which uses a finite element method for calculations allowing us to successfully resolve conservation of momentum, velocity, etc at very high resolutions in areas of interest while maintaining the ability to carry out computation at lower resolutions over larger areas where mass conservation is required...such as the Gulf of Mexico. Could I reorder for purposes of

plotting? Sure, but do I need to and where would it get me?

I have been through Dr. Bowman's book, Liam Gumley's book, David Fanning's site, the astro site, the online help, and the German library of IDL routines with no light shed on the solution.

I have fiddled with the tolerance variable passed to triangulate which has not changed anything until I make it too large at which time...
% TRIANGULATE: Points are co-linear, no solution.
Trial and error isn't fun as the wind file for this is 18 GB and the spherical method for 700,000 highly irregular points takes a very long time (hours) on top flight equipment (3.0GHz Xeons) and I have yet to get good results from it.

Can anyone help with a successful determination of what tolerance should be set to? Or is that not the answer?

Any other ways to plot a very irregular grid? Especially interested in one much faster than spherical triangulation. Regular triangulation is fast enough, but...see above.

Any pointers would be very welcome and appreciated at this point.

Cheers,
-Ben

Subject: Re: triangulating over undefined space in irregular grids
Posted by bjelley on Thu, 27 Mar 2008 22:27:50 GMT
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>>>> The inputs are all double precision and the data in the files are
>>>> carried out to enough places to avoid round off errors.
>>>> Example definition for node 1:" 1 -90.2350725000 30.4780242000
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>>>> [node long lat bathymetry]
>>>> Of course this is far beyond the precision of any measuring system,
>>>> but that does not matter at the moment.
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>>>> (above) are defined in the grid file. I am going to try using that to
>>>> look for any side of a triangle that is not repeated, which means it
>>>> is on a boundary, and classify the nodes on either end of the line
>>>> (side of triangle) as a memebr of an array descibing FAULT_POLYGONS
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>>>> I'll share how that goes.
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>>> Hi,
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>>> can be calculated once and then saved for reuse just like the
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Posted by bjelley on Fri, 28 Mar 2008 18:49:46 GMT
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Well here is my latest: http://www.worldwindsinc.com/uploads/wind_polygons.PNG

I have used any unique line between grid points, meaning that it is along a boundary, as part of the polygon and followed along those points to classify a mainland polygon, disallowing the use of any point more than once. I had to force the addition of the mapping extents at the end of the polygon array to give a good fill area in polyfill.

Next, I will do the same for the islands with some minimum distance requirements for the next nearest point to classify as part of a polygon. If I do not go with a minimum distance, multiple islands will appear in a single polygon.

I am confident that the color contour data presented via triangulate does well represent the data within the defined grid area (especially when considering the density of the data points).

This runs in about 90 seconds on my system, a desirable time compared to 1 hour+ for any griddata routine attemped to date. So...problem solved :-)

Cheers and thanks for all you guys could offer on this one,
-Ben

Subject: Re: triangulating over undefined space in irregular grids
Posted by bjelley on Fri, 28 Mar 2008 20:24:29 GMT
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See final (almost) product here: http://www.worldwindsinc.com/uploads/72hour_wind.PNG
