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Interactive comment on "Parallel algorithms for planar and spherical Delaunay construction with an application to centroidal Voronoi tessellations" *by* D. W. Jacobsen et al.

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The paper "Parallel algorithms for planar and spherical Delaunay construction with an application to centroidal Voronoi tessellations" presents a process for constructing 2D Delaunay triangulations in parallel of a set of points (generators) on the sphere. The focus of the method is the construction of a centroidal Voronoi tessellation. The approach is to create overlapping subdomains (specifically circles), in which two regions are identified: a) a region whose local Delaunay triangulation is also globally Delaunay, b) a region where the global Delaunay property is not guaranteed, but it is covered by the regions a) of the neighboring subdomains. While the approach is very interesting, the presentation has some major gaps and my recommendation is to be reconsidered after major revisions.

The core of the algorithm lies on decomposing the domain (the sphere surface) into overlapping circles. The generators included in the circles are projected to the plane where Triangle is used for creating the triangulation. The set of triangles T whose circumcircle is inside the subdomain circle is also globally Delaunay, while the rest triangles are discarded from the triangulation. The basic requirement for the correctness of the algorithm is:

1. The union of T gives the global Delaunay triangulation.

Other considerations that should be taken into account (but are not requirements) are:

2. The overlapping areas should be minimum in order to avoid unnecessary cost.

3. The decomposition should be reasonably balanced.

The authors propose the radious of the circles to be the max distance of the center to the neighbor's centers (page 1444, 3-5), but they do not provide any formal proof of the 1. condition. The size of the subdomains, as well as the size of the overlapping areas, depend on the local size of the Delaunay triangle radius. Especially for non-uniform tessellations this maybe challenging. One needs not to cover all cases, reasonable assumptions on the nature of the grid and the density function can be used, such as smoothness. The convergence properties of CVT construction can also be of help. The approach of utilizing an initial Voronoi diagram as basis for constructing the decomposition is a good start. The derived bounds of the sizes may help also for reducing the overlapping areas, which currently triple the triangulation load (if my counting is correct). It can also provide some clues for better load balancing. While degenerate cases can be safely ignored, some discussion on cases where the method may not work should be included.

The experimental results also need some clarification. In Table 1 performance results in comparison with STRIPACK for constructing a single Delaunay triangulation are given. It appears that the proposed method is significantly slower, while Triangle (which is used as far as I understand by MPI-SCVT) is probably the fastest 2D Delaunay triangulator. In page 1448, lines 1-2, the authors indicate that the merge step is the one that is costly, but it is not clear to me where this cost comes from (especially for an algorithm designed to minimize the merge cost). It may also be a matter of implementation. Again, in Table 4, STRIPACK triangulation outperforms MPI-SCVT (on one processor) by a factor of 10, but the total iteration is almost 10 times slower. Is there a reason for the Loyd iteration to be so much slower when using STRIPACK? Or is there another part that slows it? In page 1443, line 21, a cluster with "6176 cores per node" is cited; is this correct? Finally, if the software is publicly available, it would be useful to cite it in the paper.

Interactive comment on Geosci. Model Dev. Discuss., 6, 1427, 2013.