



MINISTÉRIO DA CIÊNCIA E TECNOLOGIA
INSTITUTO NACIONAL DE PESQUISAS ESPACIAIS

Image Generation and Visualization System for Ionosphere Dynamics

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Agenda

- The ionosphere model
- Proposed data interpolation approach
- Comparison with different methods
- Maps visualization using Google Earth
- Conclusion



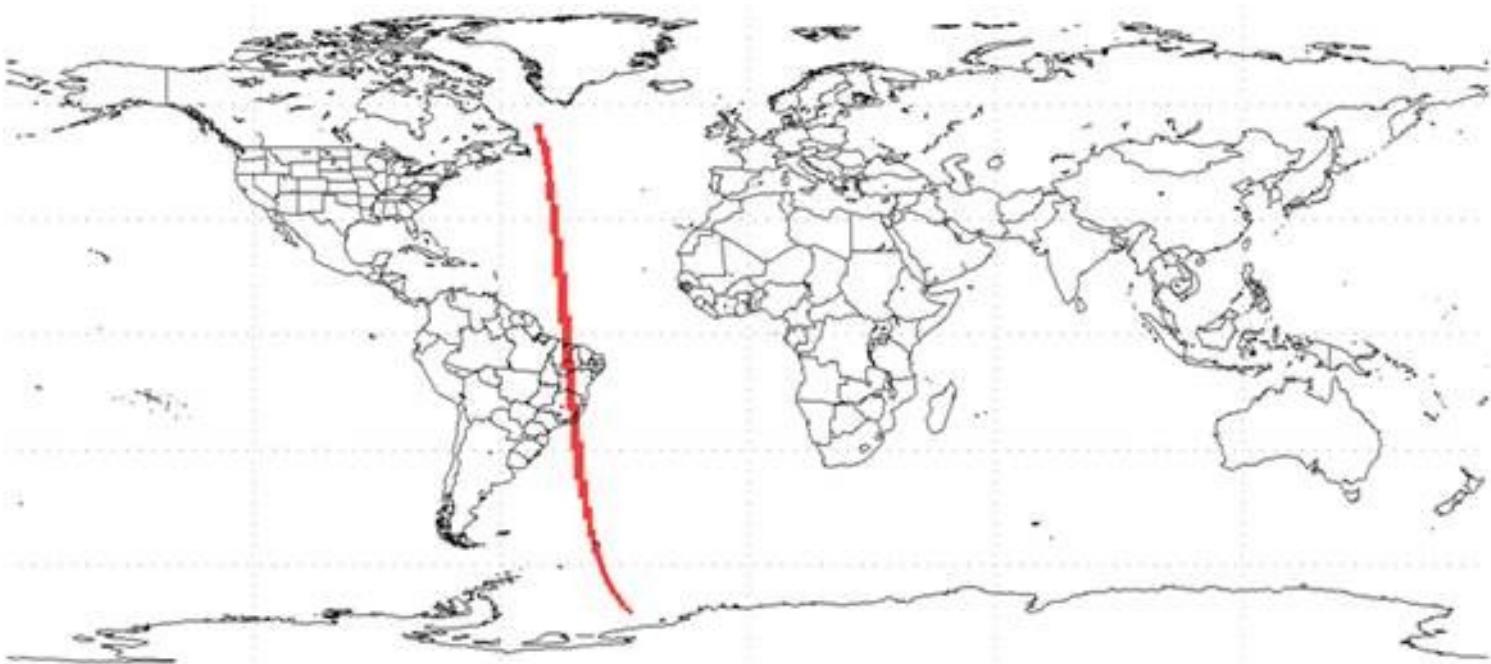
The ionosphere model

- The Sheffield University Plasmasphere-Ionosphere Model (SUPIM)
- Solves coupled time-dependent equations of continuity, momentum and energy balance along magnetic field lines for six different ions (O^+ , H^+ , He^+ , N_2^+ , O_2^+ and NO^+) and the electrons
- Outputs are basically the ion and electron densities, temperatures, and field-aligned fluxes in a 2-dimensional plane aligned with Earth magnetic field lines



The ionosphere model

- Outputs



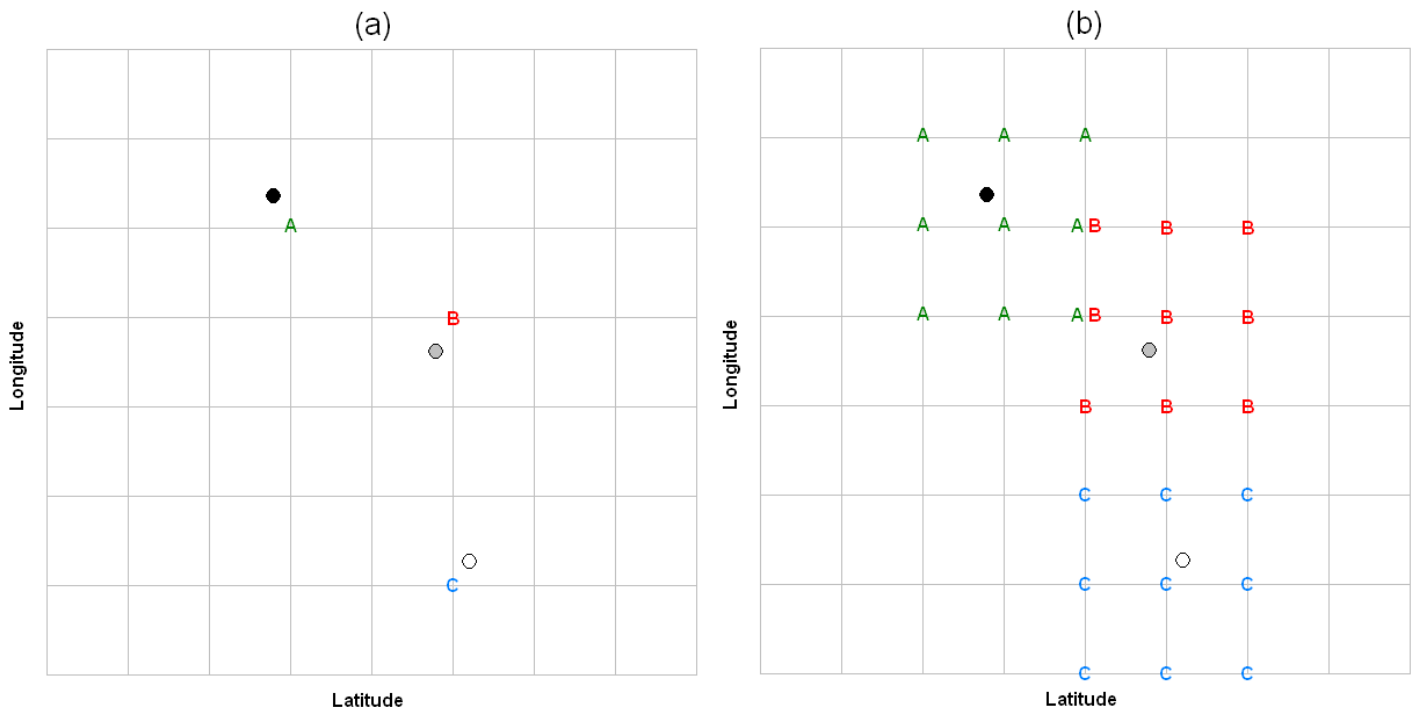


Proposed data interpolation approach

- Several SUPIM runs on different ground station longitudes
- Simulation points are neither geographically aligned nor homogeneously spaced
- Final result could be presented in a grid, with interpolated points equally spaced
- Reasonable processing time

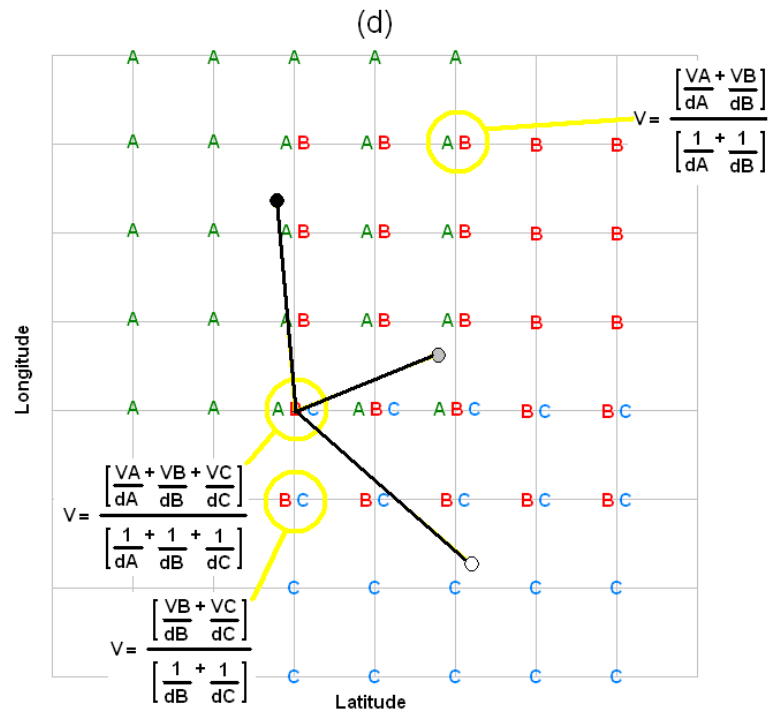
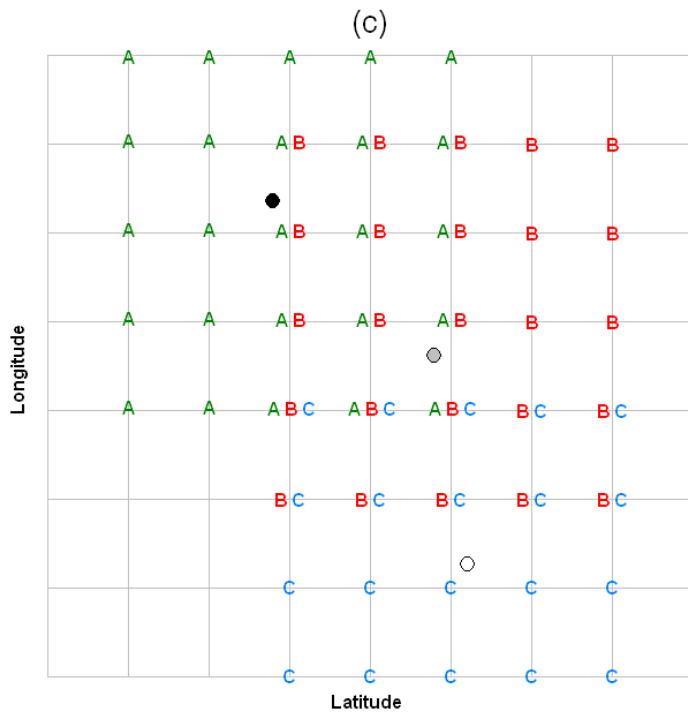


Proposed data interpolation approach



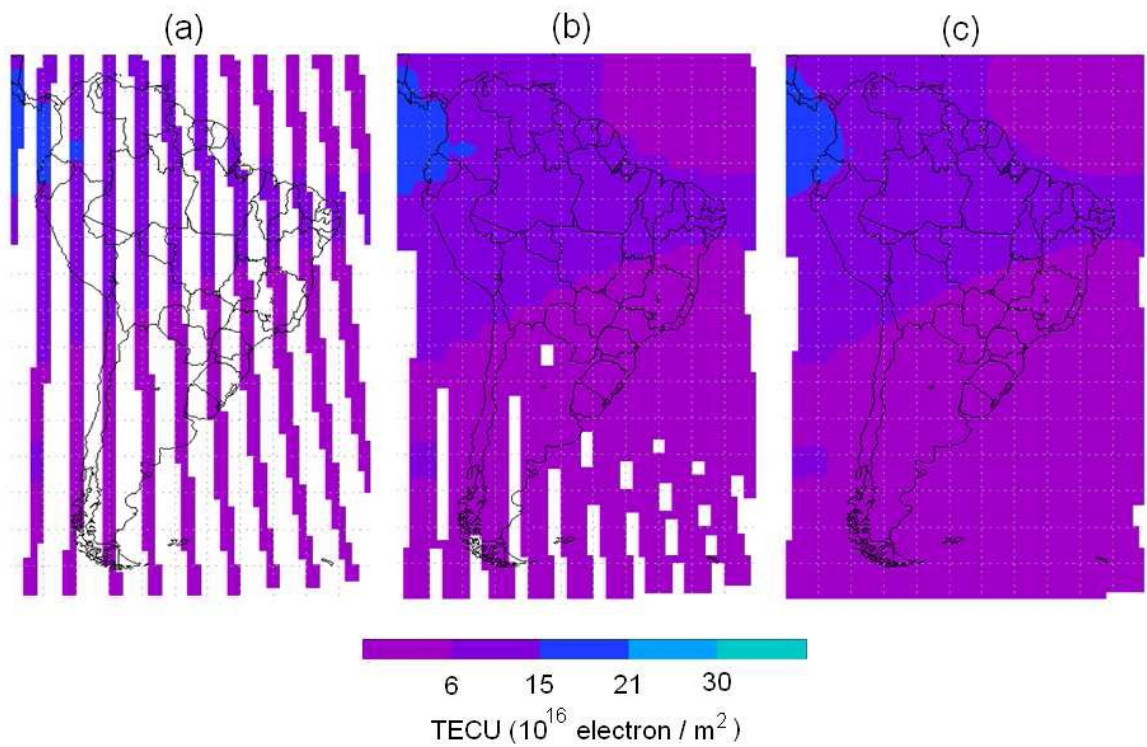


Proposed data interpolation approach





Proposed data interpolation approach



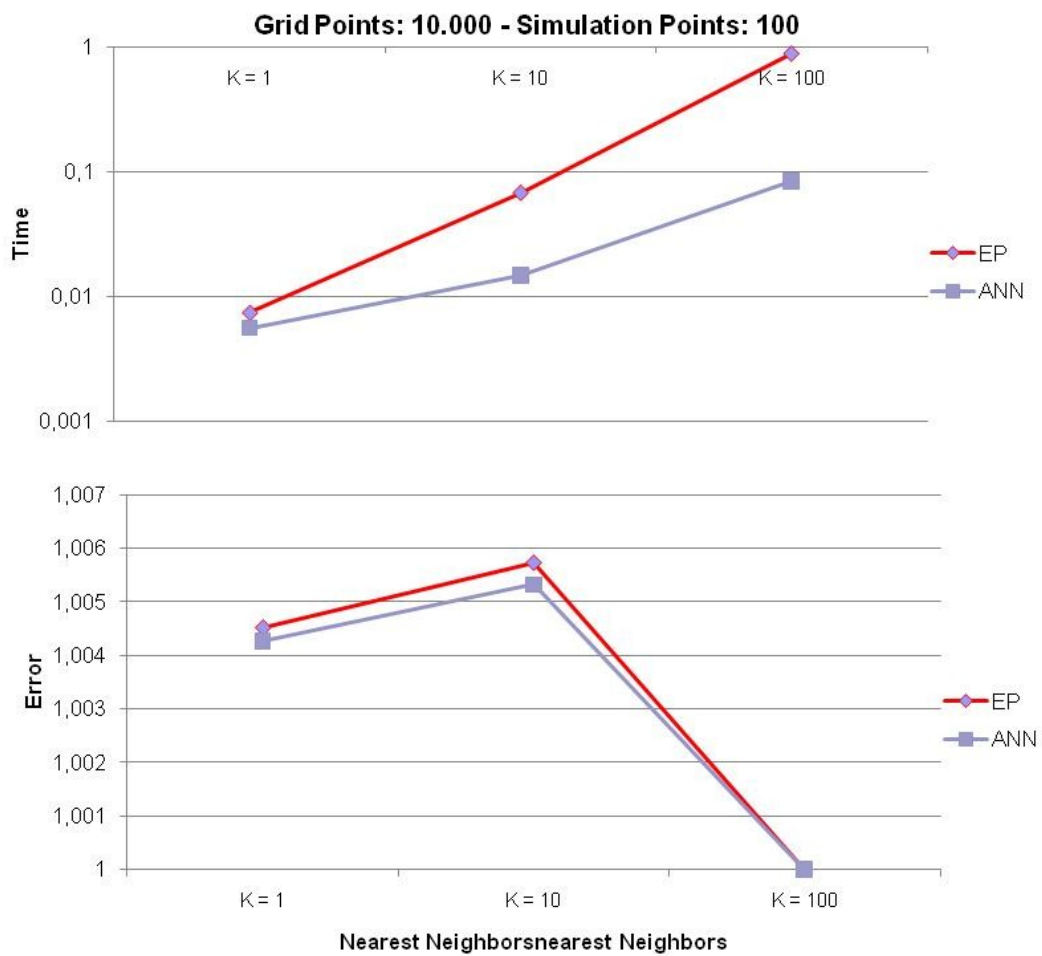


Proposed data interpolation approach

- Not all, but “K” closest points can be used to estimate a grid point (reduce memory requirements)
- Interpolation technique used may vary (IDW, AIDW, kriging, etc)
- “Explosion” order can be increased to cover all grid points
- Alternative to the Optimal Algorithm for Approximate Nearest Neighbor Searching (ANN)

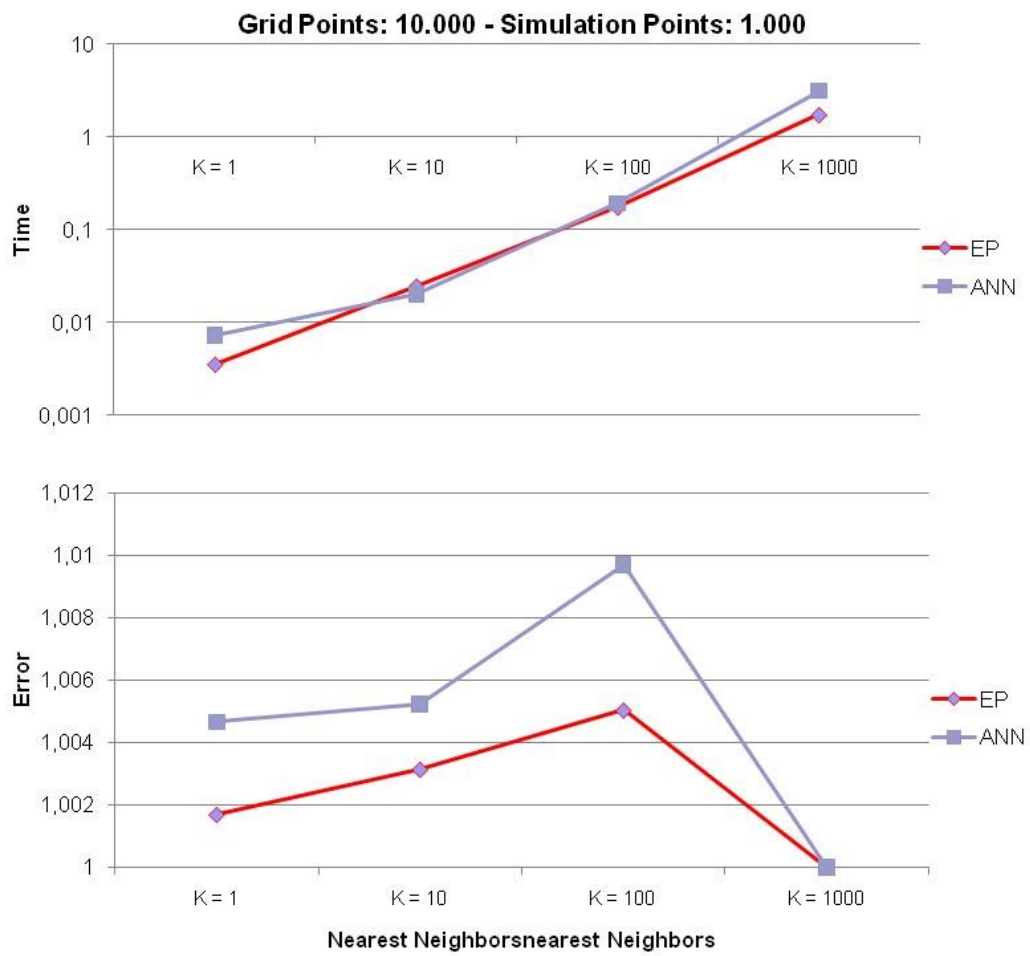


Comparison with different methods



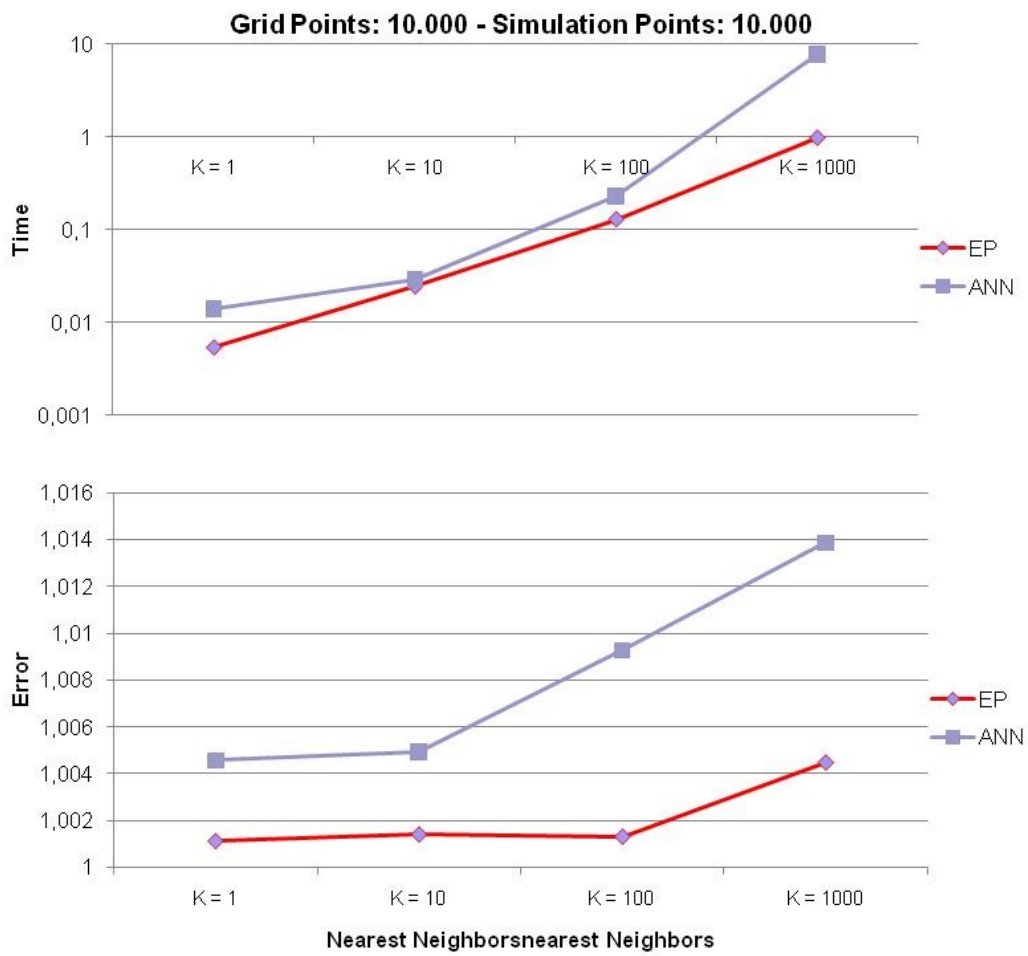


Comparison with different methods



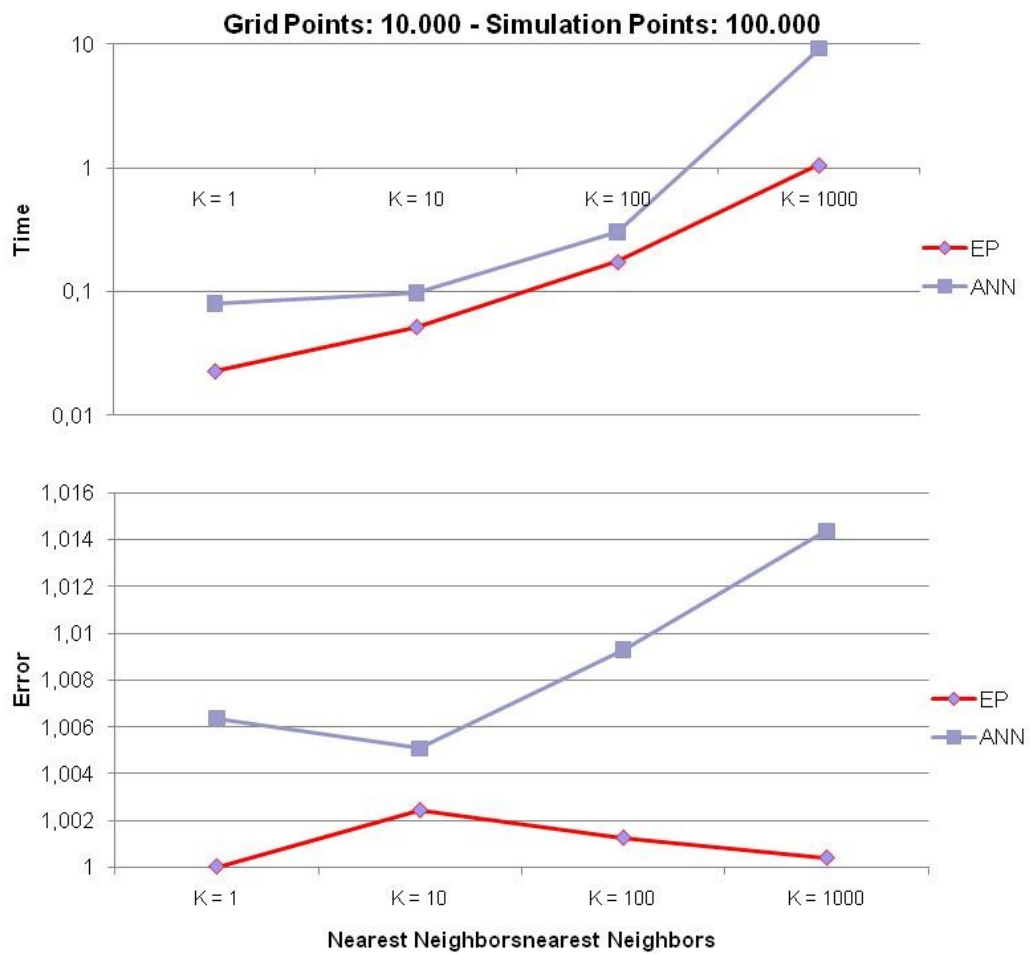


Comparison with different methods



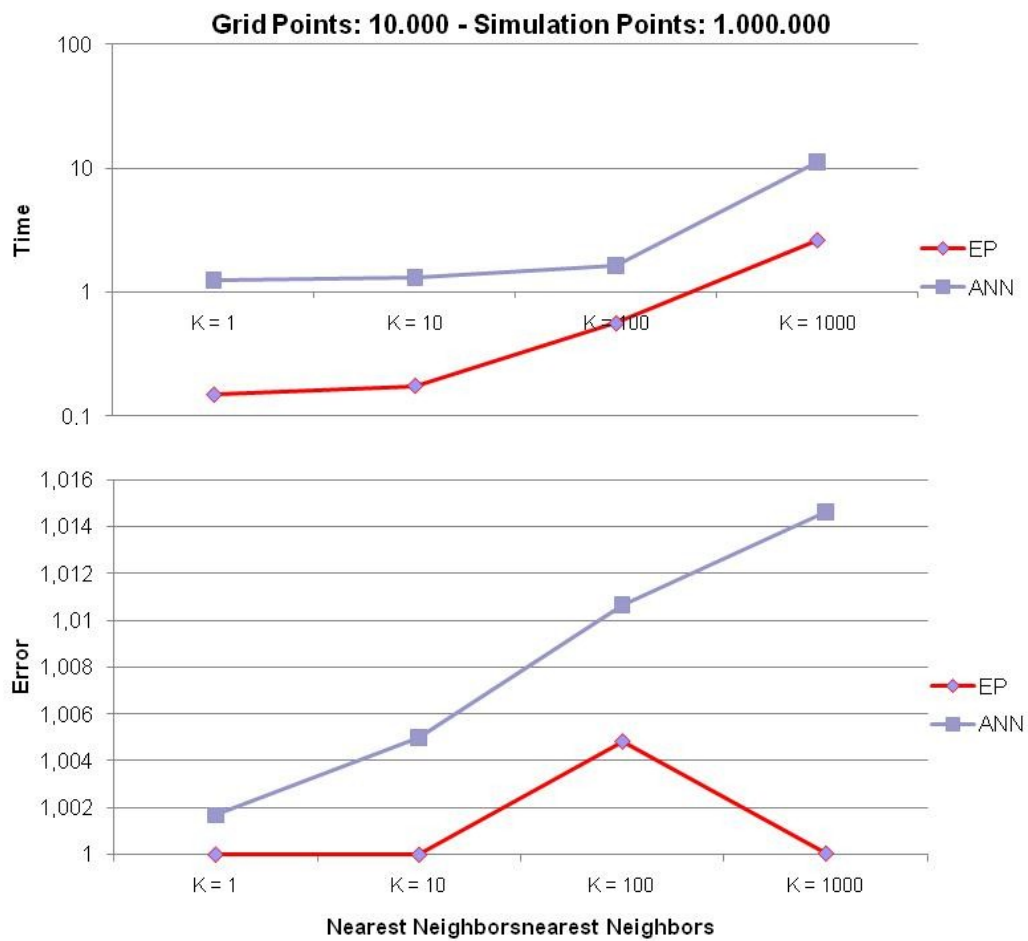


Comparison with different methods





Comparison with different methods





Comparison with different methods

- Time processing was notably better than ANN in almost all cases
- When the ratio between sample points and grid points increases, our approach reaches even better performance
- The quality of approximate nearest neighbors compared to exact nearest neighbor shown the proposed approach outperformed ANN at the same conditions
- Our algorithm is much more easy to understand and implement, and is trivially parallelized.



Maps visualization using Google Earth

- Gridded Data Sets format for data file writing, and GrADS software for file loading and map generation

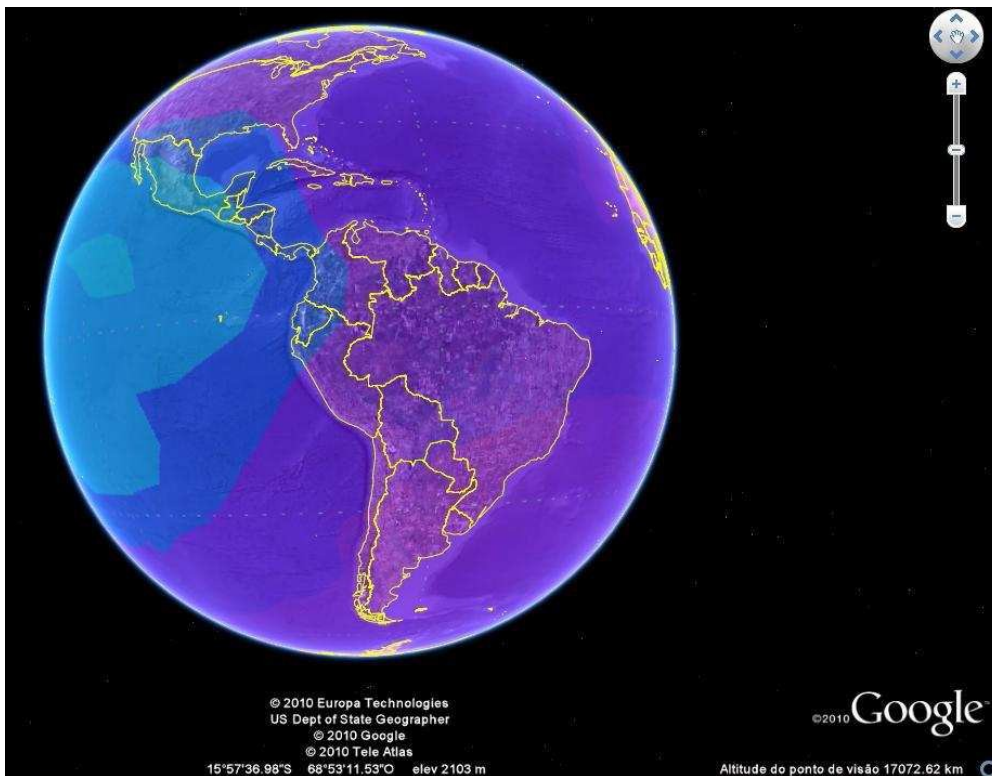
- Keyhole Markup Language (KML) to display the images on Google Earth platform

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Maps visualization using Google Earth

■ Demonstration





Conclusion

- It was shown an approach to interpolate several SUPIM data in grids
- Our approach outperformed the Optimal Algorithm for Approximate Nearest Neighbor Searching in almost all cases tested, considering time processing and error
- From the interpolated data GrADS was used to generate the images
- KML was applied to visualize the images on Google Earth



Thank you

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