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# Accelerating the UMEP workflow by introducing GPU-computed continuous Sky View Factor maps

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Urban Multi-scale Environmental Predictor (UMEP) is a climate service tool focused on urban climate simulations, using meteorological, surface, and land cover data to model a variety of climate indicators. Among these, Mean Radiant Temperature (MRT) can be computed for outdoor thermal comfort analyses, by using the Solar and LongWave Environmental Irradiance Geometry (SOLWEIG) model. A critical input for SOLWEIG is a set of Sky View Factor (SVF) maps, which quantify the fraction of visible sky at each point of the urban environment under study. However, generating these SVF maps from high-resolution digital surface models is computationally expensive and represents a significant limitation in the use of UMEP for large-scale urban studies.

Thus, this study addresses the above limitation by introducing a GPU-accelerated workflow for SVF calculation, leveraging the powerful nature of NVIDIA GPUs and PyCUDA to enable parallelized ray tracing. The proposed method incorporates anisotropic SVF calculations and accounts for vegetation canopies, which are a critical factor in accurate calculations of urban climate parameters. By replacing the CPU-based SVF calculations currently integrated within UMEP, the proposed GPU-based workflow achieves a 99% reduction in processing time while maintaining accuracy and compatibility with SOLWEIG requirements.

The proposed method was applied in the Rotterdam case study, demonstrating its usability within the UMEP climate service tool. The reduction in computational time significantly accelerates pre-processing for MRT calculations, enabling the modelling of city-large areas at a 1-meter resolution. This advancement represents a step forward in optimizing urban climate modelling workflows, enhancing their scalability and usability for researchers and practitioners.