Real-Time Terrain Correction of Satellite Imagery-Based Solar Irradiance Maps Using Precomputed Data and Memory Optimization

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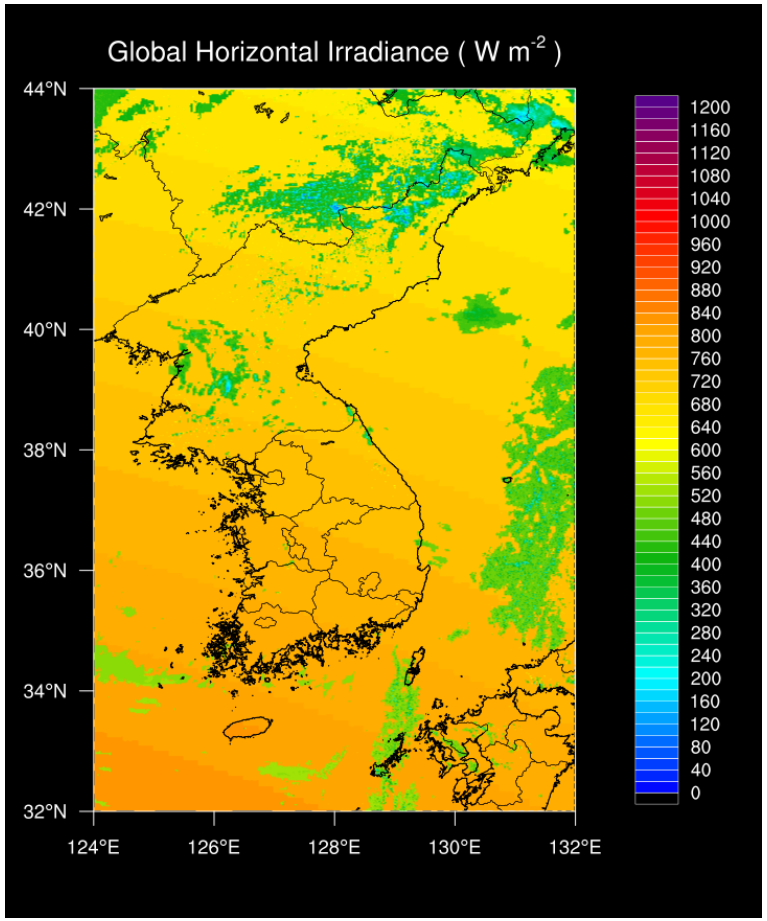
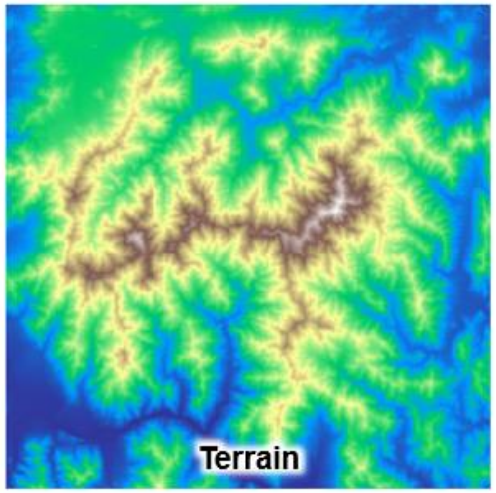
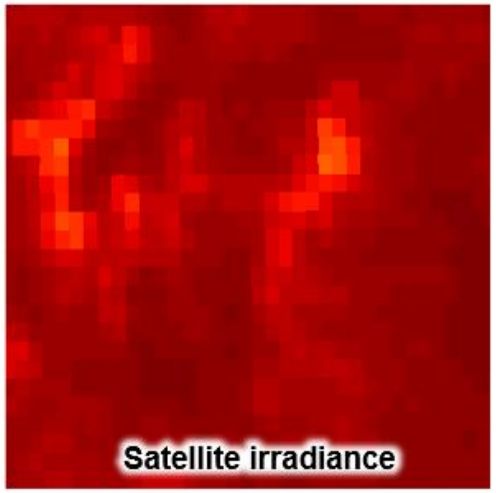
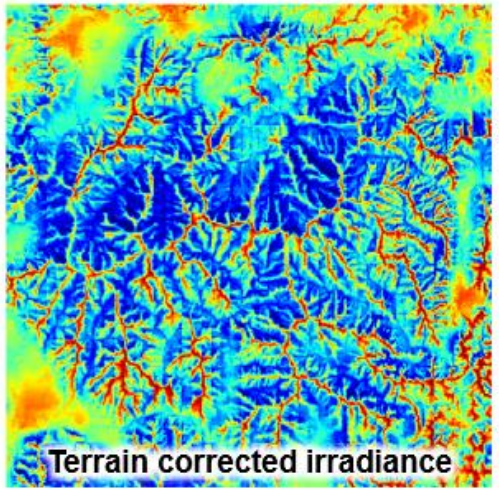


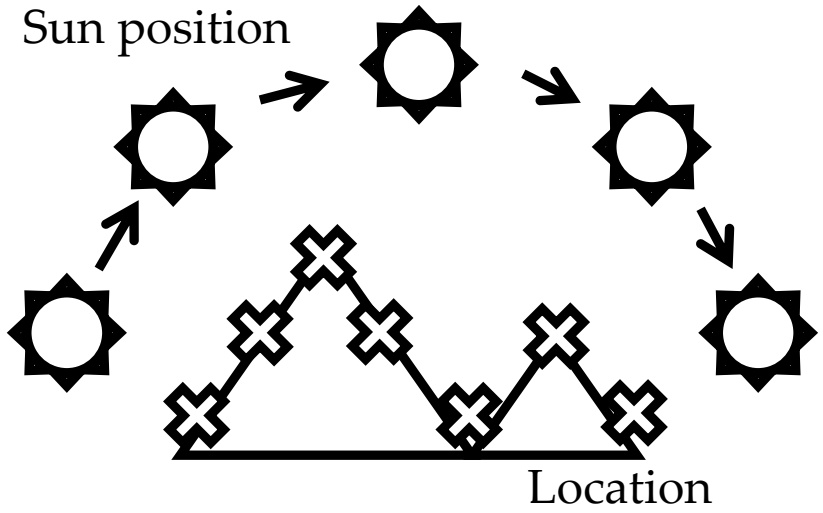
The animated satellite imagery-based solar maps can be downloaded from the website linked below (https://kier-solar.org/user/map/map_solar.do)





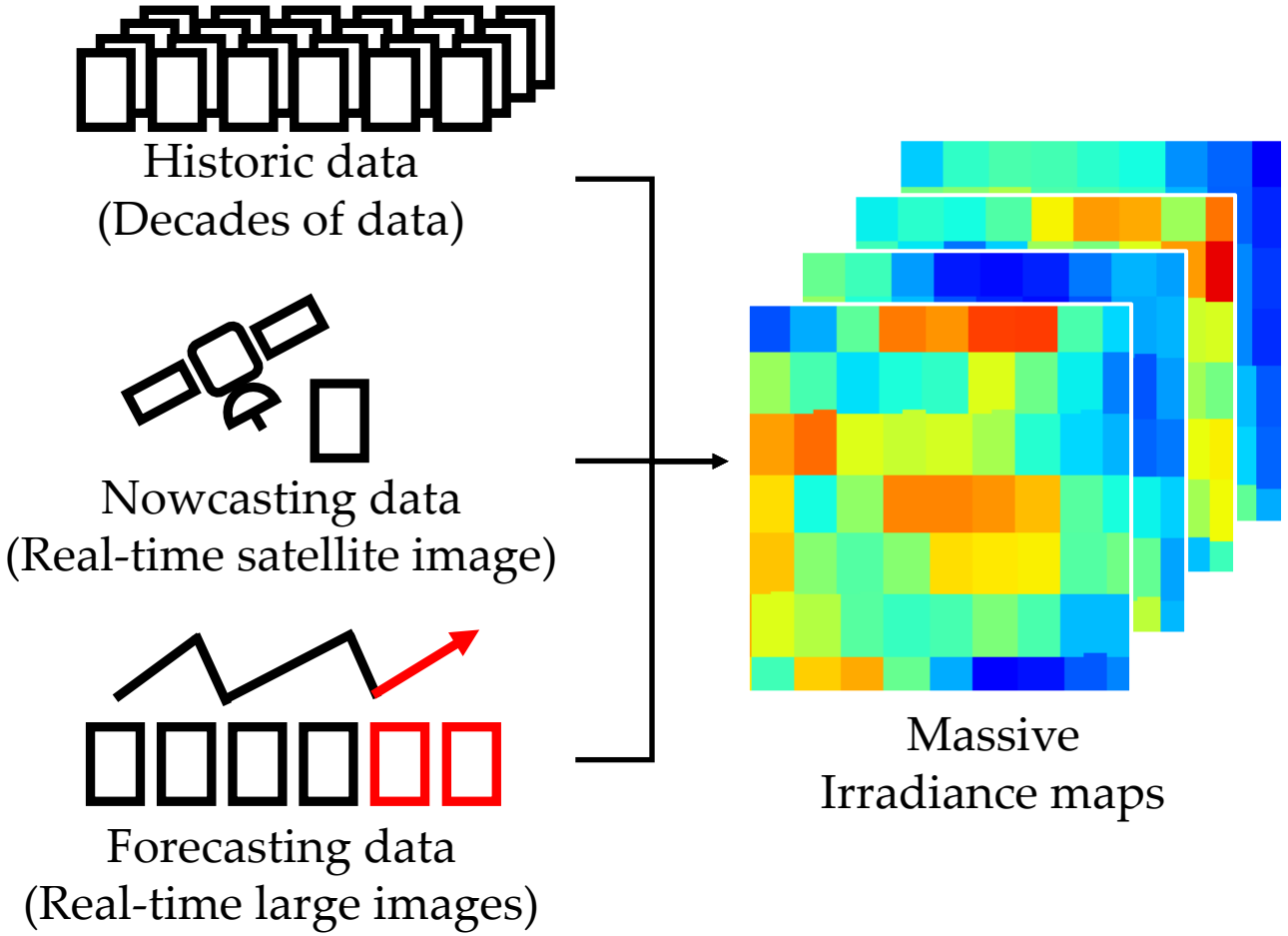


Slide 1: Satellite imagery-based solar irradiance mapping studies are essential for large-scale solar energy assessments but are limited in their spatial resolution and accuracy.



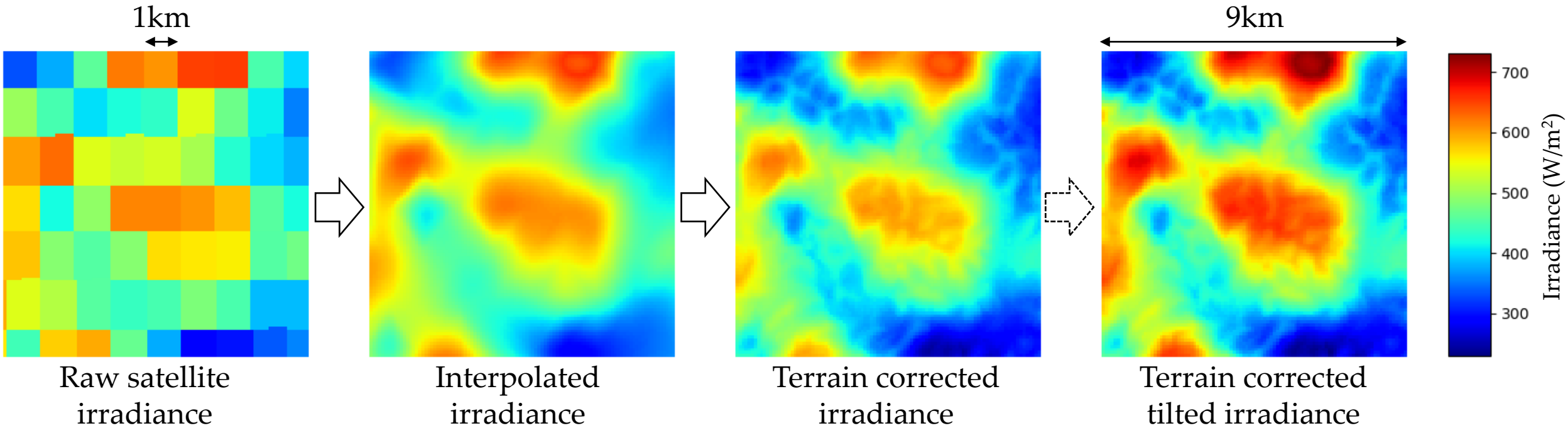
Repetitive shadows calculations for all time and space

Slide 2: Despite efforts to increase the map resolution by correcting inaccuracies caused by shadows on the terrain, the computational time of these models and the massive volume of generated data still pose challenges.

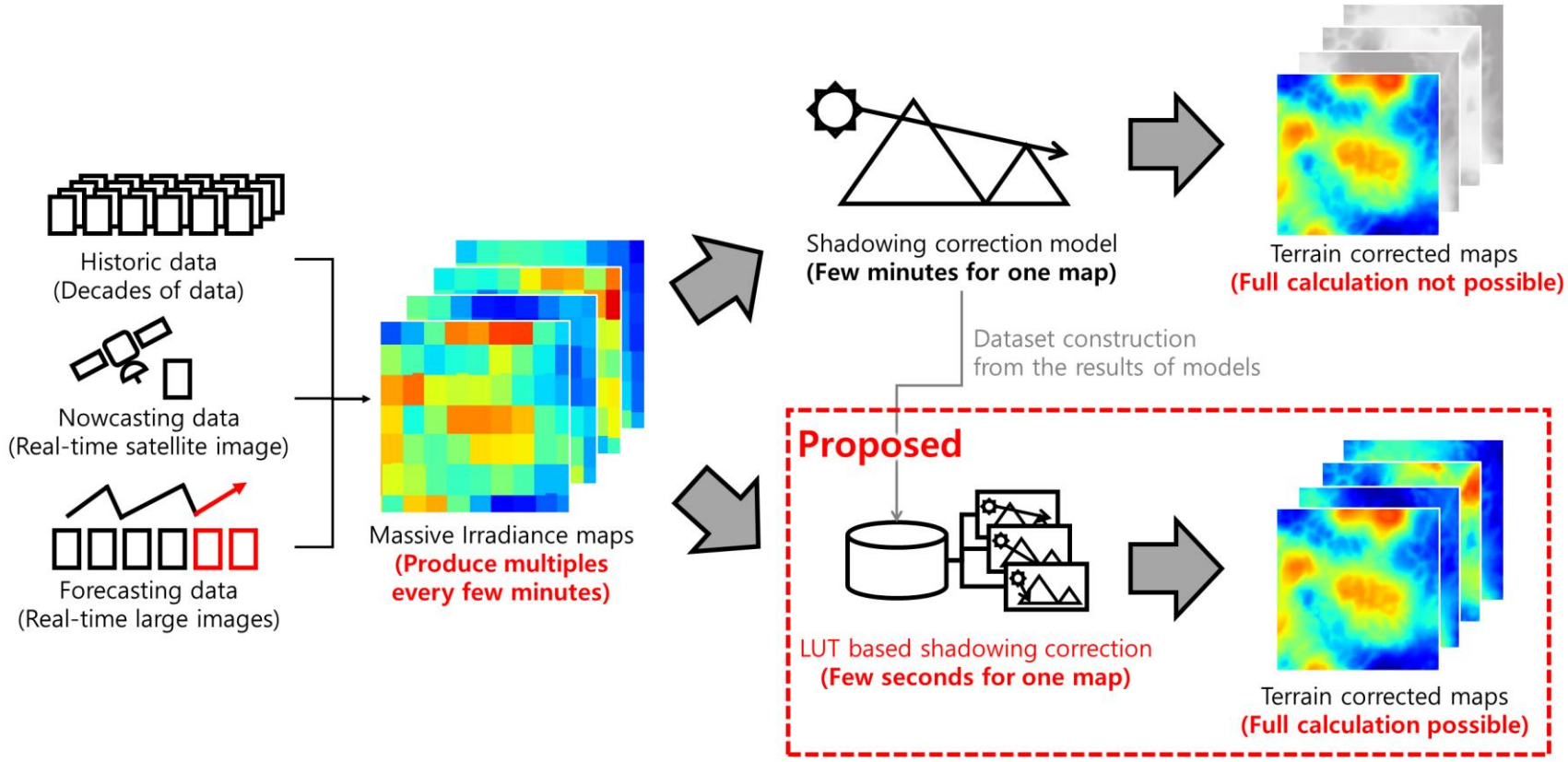


Slide 3: In particular, forecasting generates large amounts of time series data, and the data production rate is faster than the computational speed of traditional terrain correction.

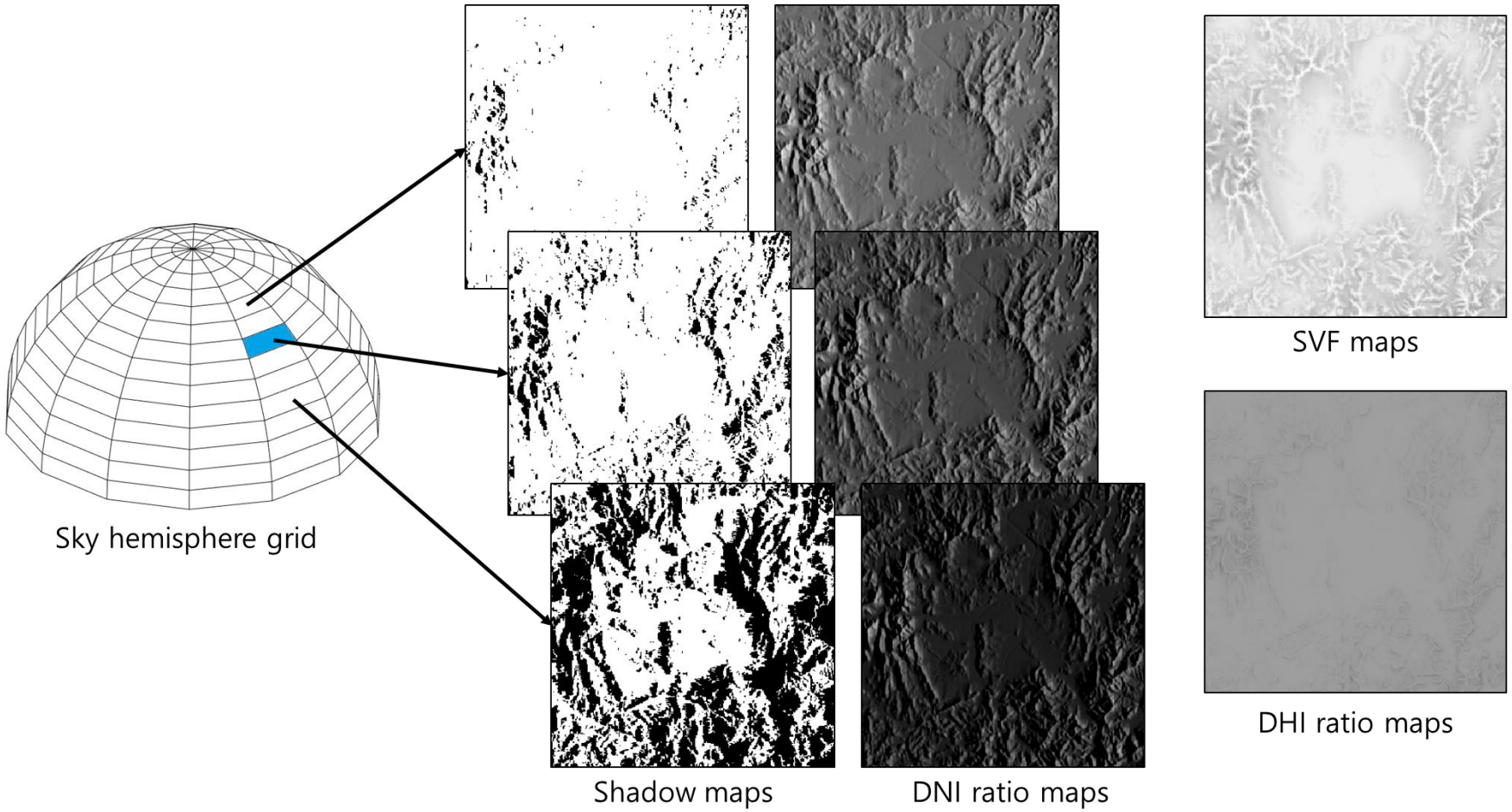
Moreover, while previous research has been conducted to expedite computations, a novel and innovative technology in terrain correction is still required.



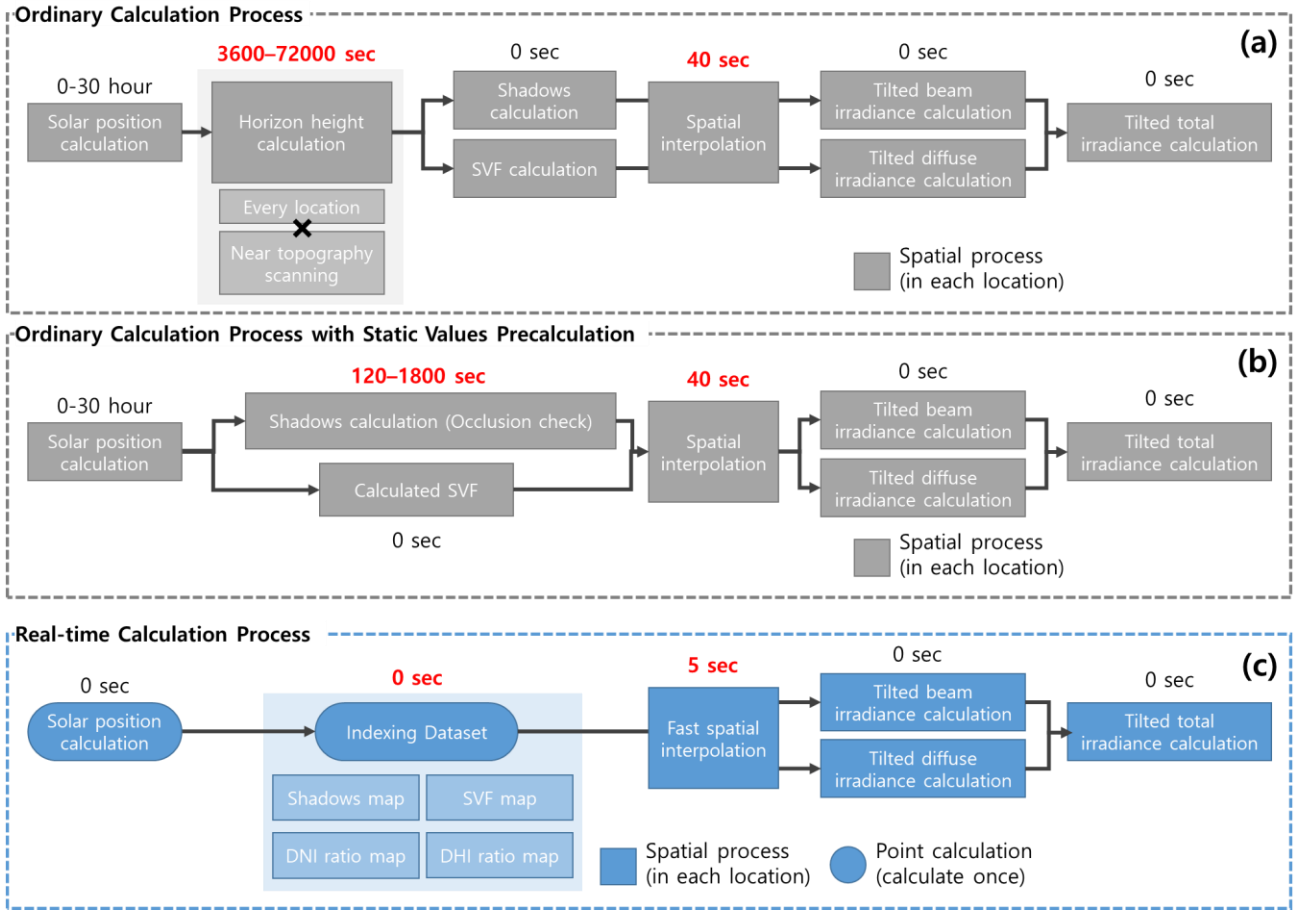
Slide 4: However, this terrain correction must be performed in terms of accuracy and shadows.



Slide 5: Therefore, we propose a new correction method that can bypass complex calculations and process enormous amounts of data within seconds.



Slide 6: This model extends the lookup table concept, optimizes the results of many shadow operations, and stores them in memory for use.

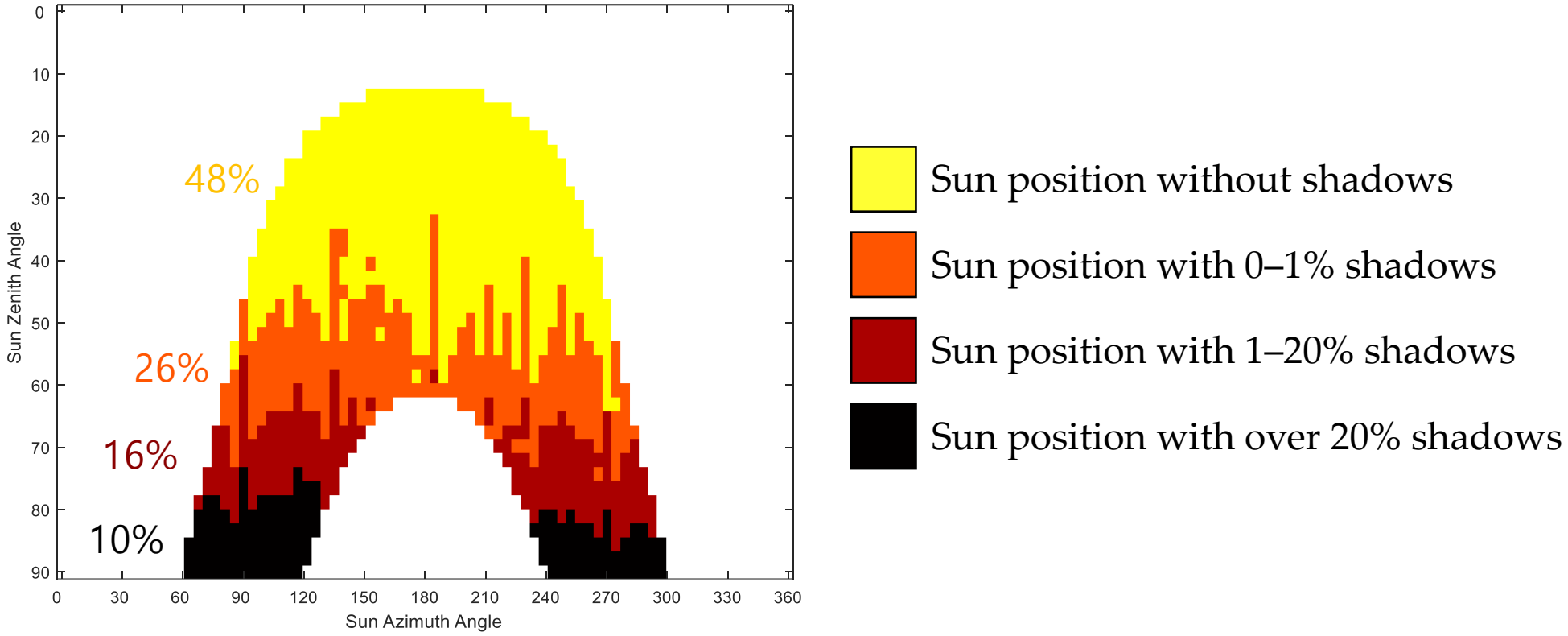


Existing methods: 120-3600 sec for each 7000×5000 map

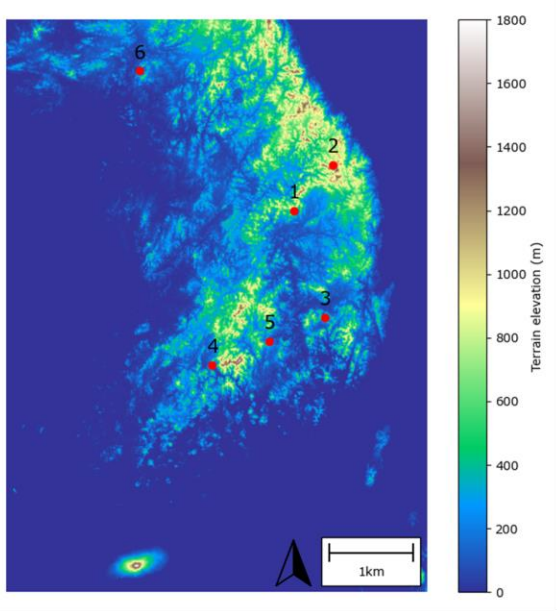
Ours: 6 sec for each 7000×5000 map

Slide 7: The model enabled 90 m scale computations across Korea within seconds on a local desktop computer.

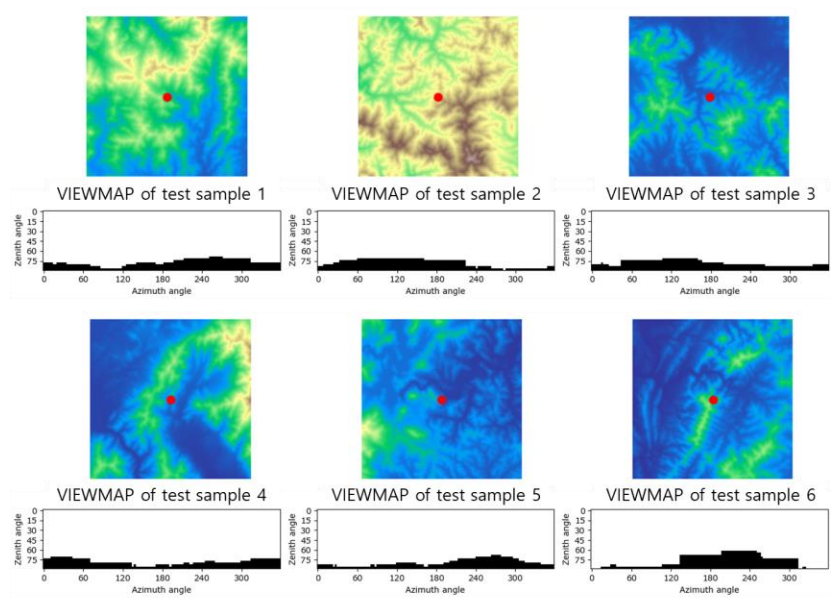
A quantitative analysis of computation time was also conducted, revealing a previously overlooked computational bottleneck.



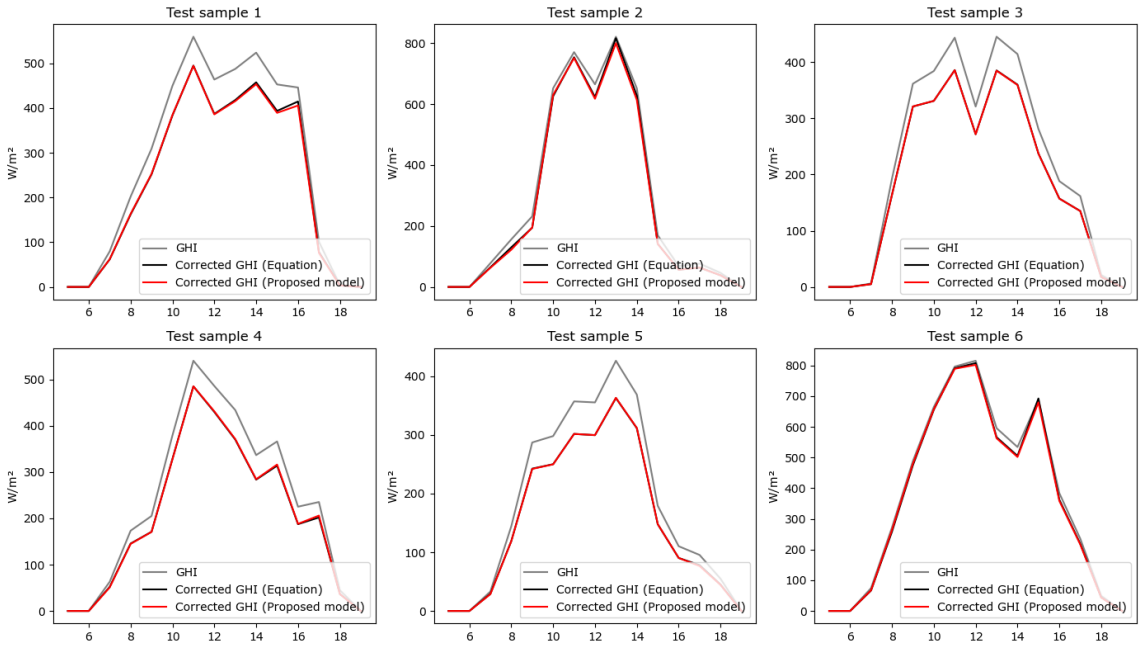
Slide 8: Optimization based on domain knowledge was performed to reduce the memory required to a realistic level.



(a)

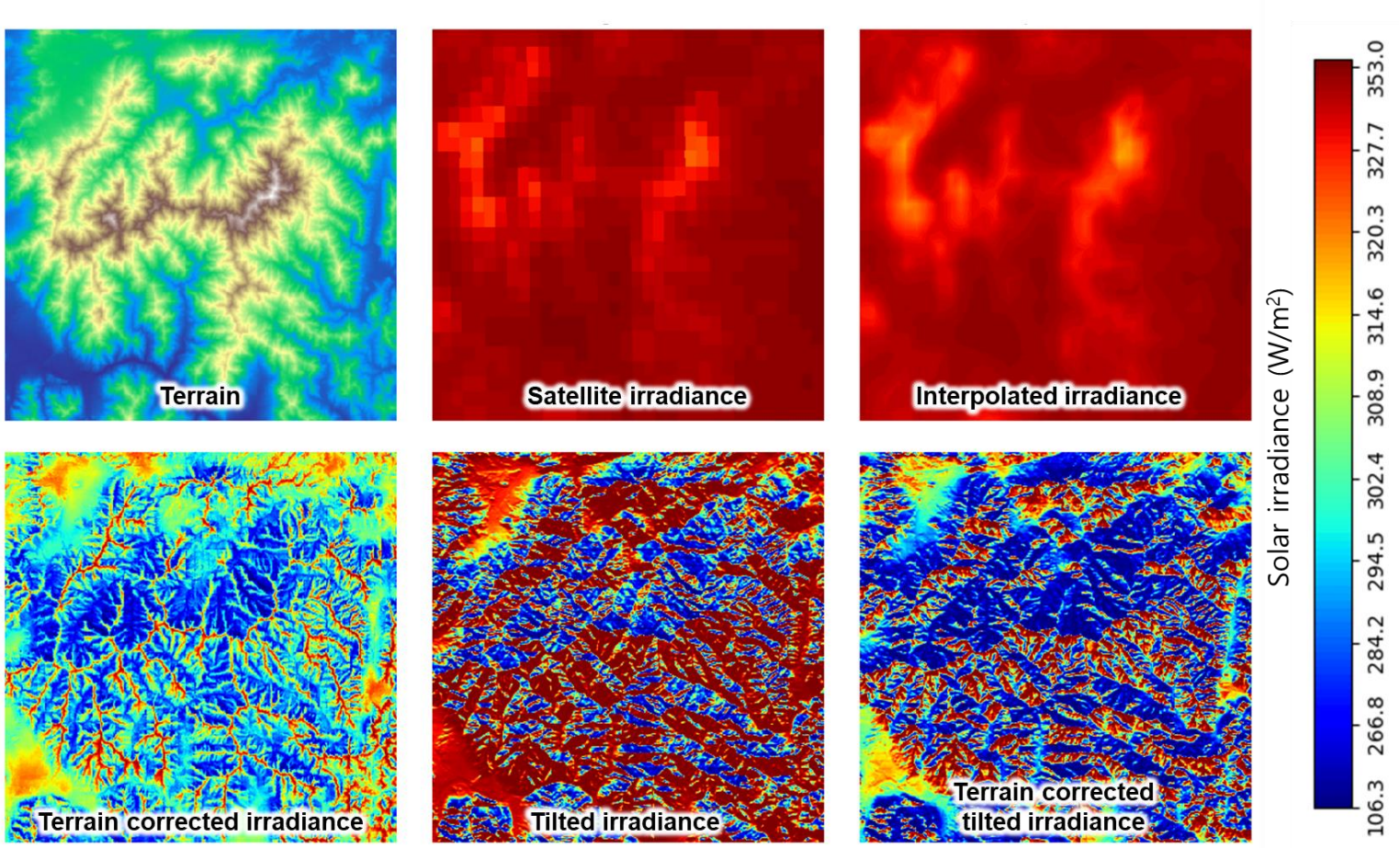


(b)



Slide 9: Validation of the model was also performed for selected sites.

The results show little difference from the existing method.



Slide 10: In conclusion, the developed model enables real-time terrain correction and subsequent processing of massive amounts of data.