

Simulation of Mirror Augmented Solar Irradiance using Meteorological Data

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Project Objective: Design an algorithm (software package) that computes solar output from meteorological data (TMY3) and reflector-collector geometries.

Motivation:

- Explore the potential from using inexpensive reflectors to boost solar collector output.
- Observe the uneven distribution found in collectors with reflectors.
- Provide useful information about how climatological regions and geometries affect performance of a system.
- Be able to simulate non-conventional configurations for financial studies without actually running experimental tests.

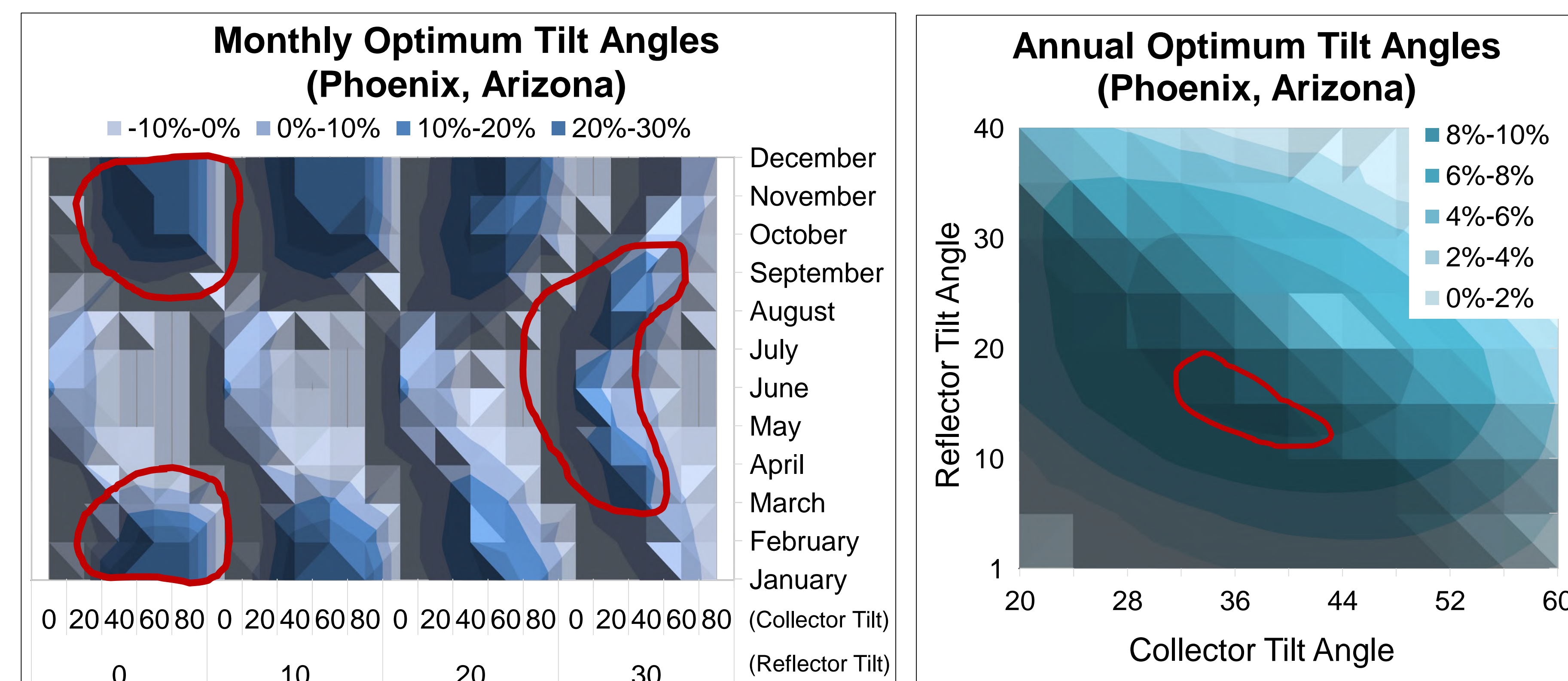
Methodology:

- Simulation consists of 8760 hour by hour calculation of sun position and its irradiance incident and reflection from reflector. Parametric simulations with different collector and reflector tilt angles were done to find optimum annual and monthly output.

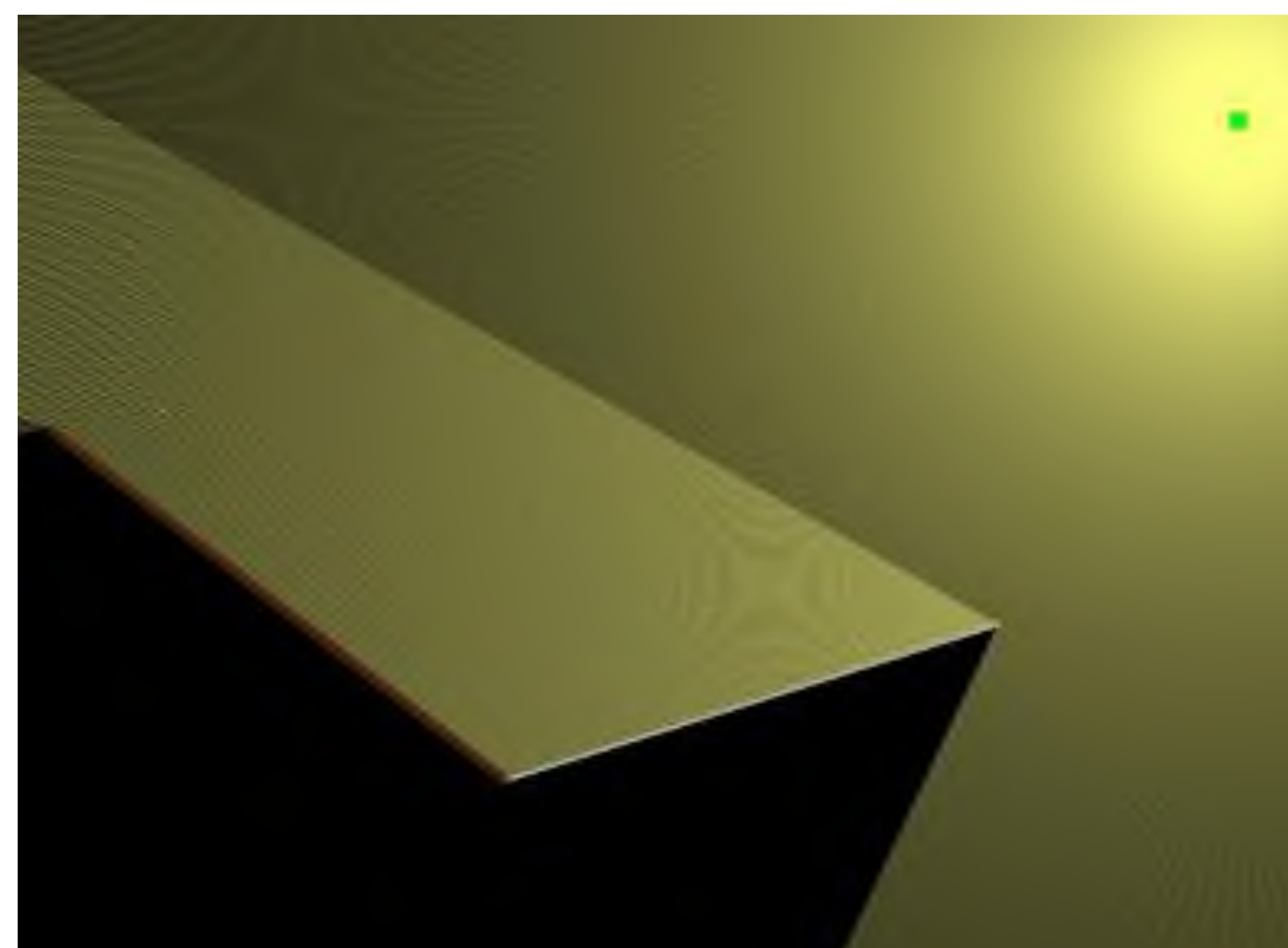
Conclusions:

- Simulation shows correlation with experimental results (*Bradish and Bodhanker, 2016*) with increased annual radiation of up to 10%.
- Results show that reflectors does not have much impact on annual overall energy increase output; but, rather fills a specialized seasonal niche, such as increasing seasonal peak demand power.
- Geometry affects the uneven distribution greatly when the reflector's tilt angle is increased.

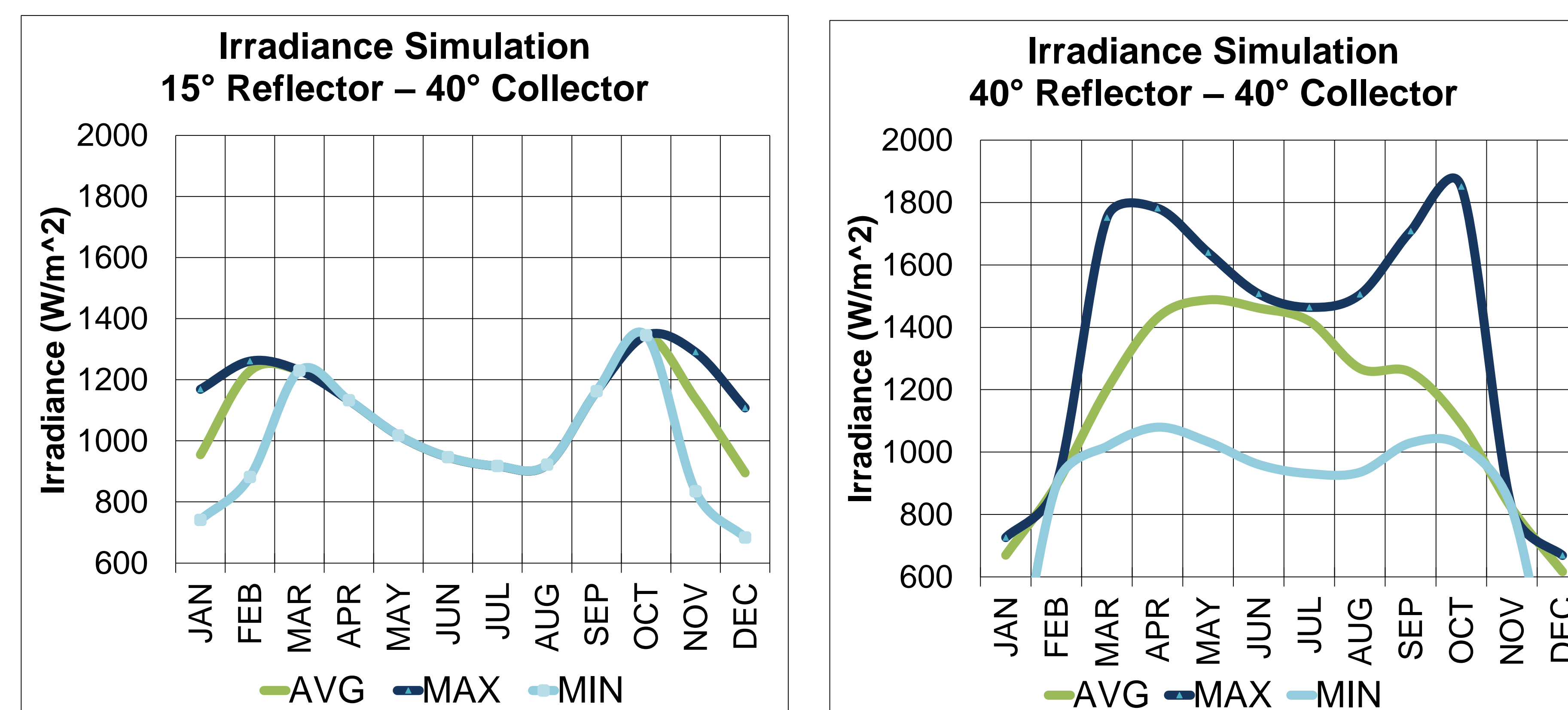
Results:



Result of simulation for various configurations on Monthly or Annual basis



Ray Optics Simulation (Rick Tu, 2016)



Results of simulation for day 10th day of each month. Min-Max gap shows the magnitude of uneven distribution.

Recommendations

- Explore other configurations of collector-reflector geometry following the algorithm proposed.
- Run financial models to obtain feasibility results on demand-driven systems.