Developing a Solar Resource Map for a Stored Solar Cooker

Emily Floess, Matthew Alonso, Keilin Jahnke, Samantha Lindgren, Joe Bradley
Madhu Viswanathan, Bruce Elliott-Litchfield, Tami C. Bond
College of Engineering, University of Illinois Urbana-Champaign
http://sustainability.illinois.edu/research/energy-transitions/stored-solar-stove-project/

ISEE

SCI SOLAR COOKERS INTERNATIONAL

6th SCI World Conference 2017

ILLINOIS

Cooking Indoors with Solid Fuels

University of Chicago Magazine, Indoor Air Pollution

- Approximately 3 billion people cook on solid fuels daily
- 4.3 million people globally die prematurely each year from the effects of indoor air pollution

Storing the Energy to Cook

Vessel filled with salt

Parabolic Dish concentrates sunlight onto vessel

Image Courtesy of Matthew Alonso.

- Charges in 2 ½ Hours
- Stores thermal energy at 300-400C

Heat Loss from the Storage Vessel

Radiative & convective losses from exposed part used for charging & cooking

Conductive heat loss through insulation

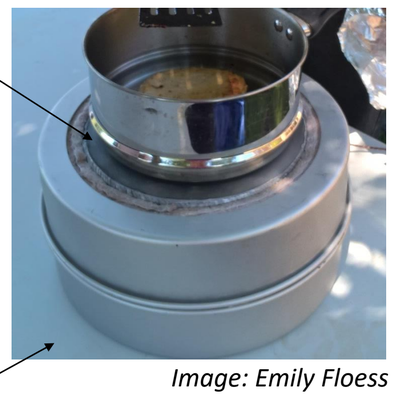
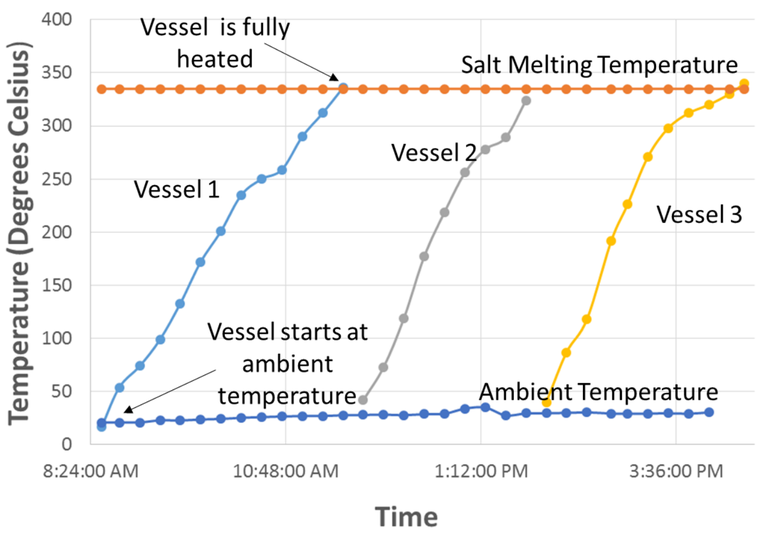
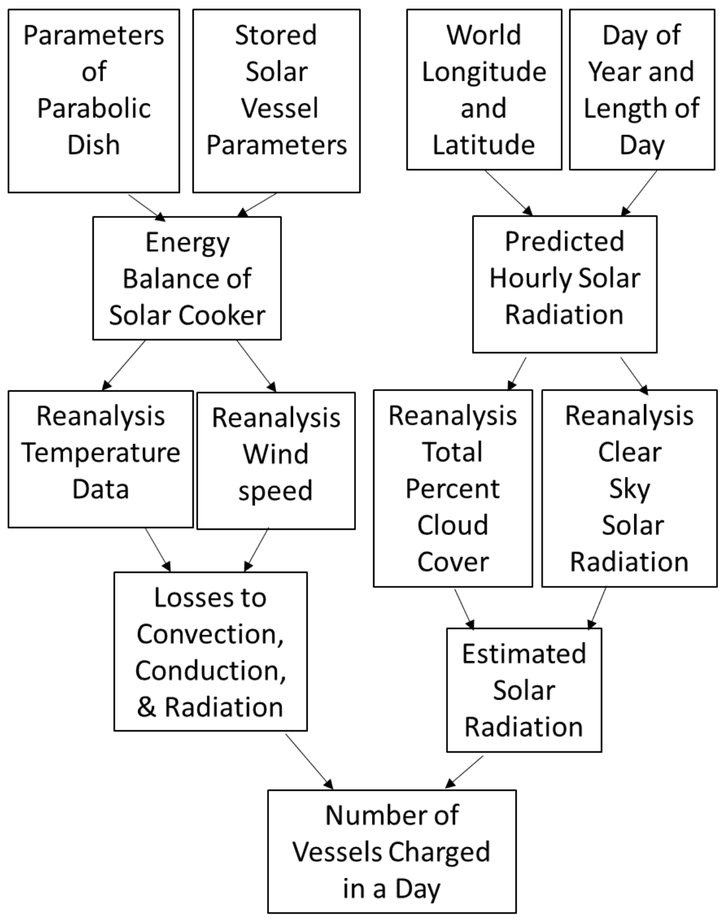


Image: Emily Floess

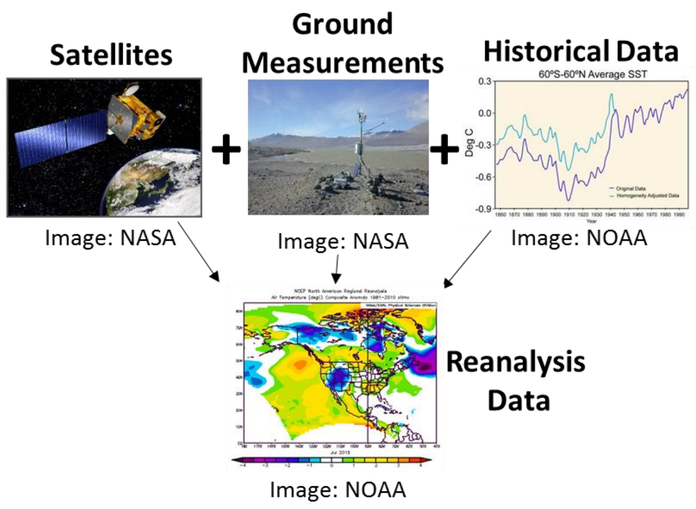
Charging Multiple Vessels on an Ideal Day



Determining where in the world a Stored Solar Cooker is useful



Reanalysis Data



NOAA Reanalysis Data Used in the Energy Balance

Energy into the Vessel

Cloud Clover

Image: NOAA

Solar Radiation

Image: NASA

Losses from Conduction, Convection, and Radiation

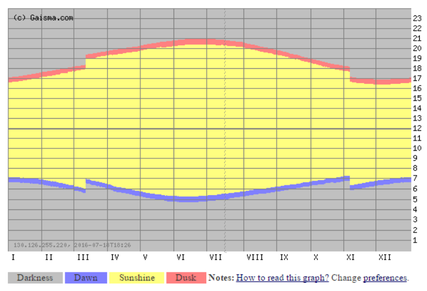
Air Temperature

https://cimss.ssec.wisc.edu/satmet/modules/1_intro/intro-1.html

Wind Speed

https://www.e-education.psu.edu/meteo300/node/719

Ideal Daily Solar Radiation



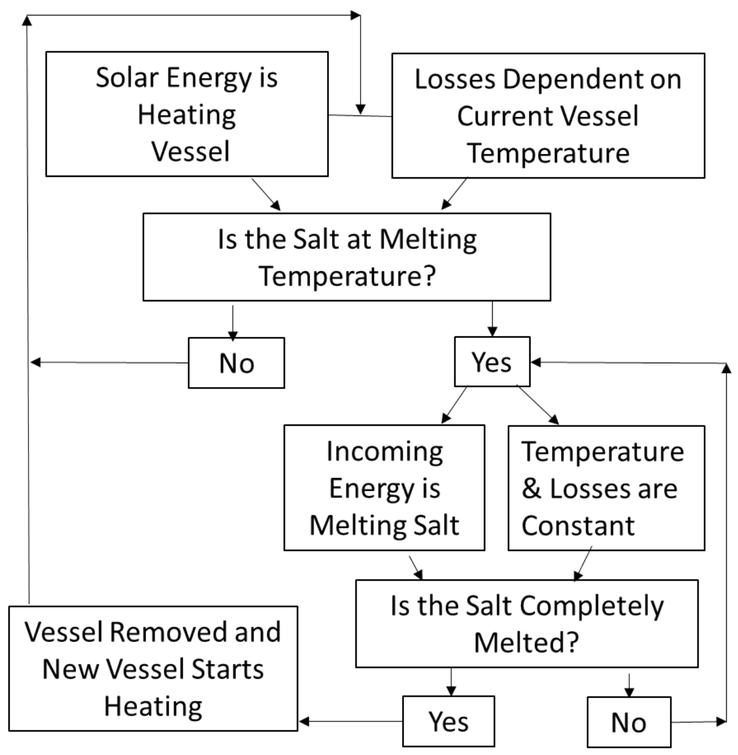
Calculated from longitude, latitude, and day of year

Percent Total Cloud Cover

Estimated Clear Sky Solar radiation is compared with Reanalysis Solar Radiation

Direct Normal Solar Radiation = Clear Sky Solar radiation*(1-Total Percent Cloud Cover)

Charged Vessels



Next Steps

A global map of the Stored Solar Cooker's potential to serve cooking needs.

References

Kalnay, Eugenia, et al. "The NCEP/NCAR 40-year reanalysis project."*Bulletin of the American meteorological Society* 77.3 (1996): 437-471.

Twidell, J., & Weir, T. (2015). *Renewable energy resources*. Routledge.

Acknowledgements

- Funding from the Institute for Sustainability, Energy and the Environment, UIUC
- UIUC Civil and Environmental Engineering Fellowship