PV Modules Temperature Variation and Patterns in Medium and Utility-Scale Floating PV Systems

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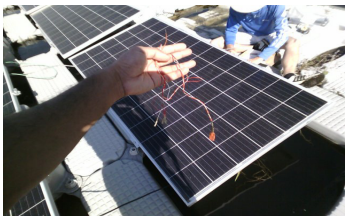
1. BACKGROUND and OVERVIEW

- No studies have been done so far to identify common characteristics among the FPVs, study the impact of FPVs on hydro-biological life, and vice-versa.
- This is a first research work assessing the performance capabilities of FPV technologies, potential environmental impacts of the technologies, and collect data for use in the subsequent development of research protocols.

2. DATA COLLECTION

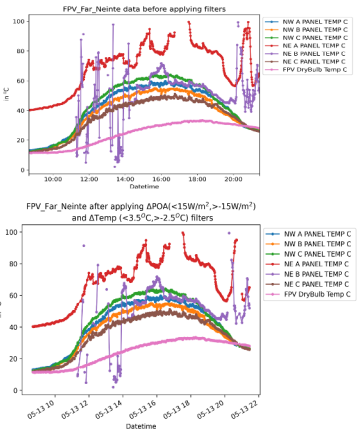
- Time-series data collection, monitoring of PV modules temperature and field surveys would be performed at four existing FPV sites, and four existing land-based photovoltaics (LPV) control sites located in Florida, and California.
- Field surveys involve the assessment of FPVs impact on water bodies, biological life, and wildlife interaction.
- Data analysis goal is identifying the common characteristics, patterns and performance improvement metrics.

3. CHALLENGES



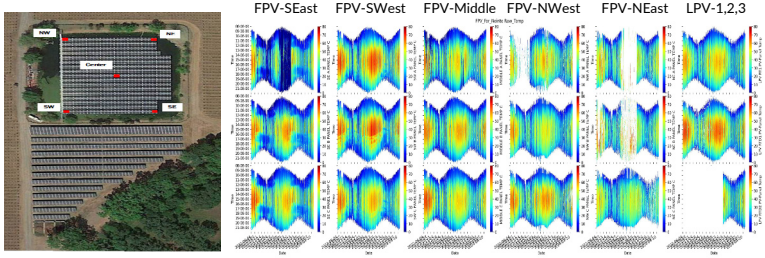
Animal activity underneath a floating PV module led to temperature sensor damage

Removing spurious spikes in the data

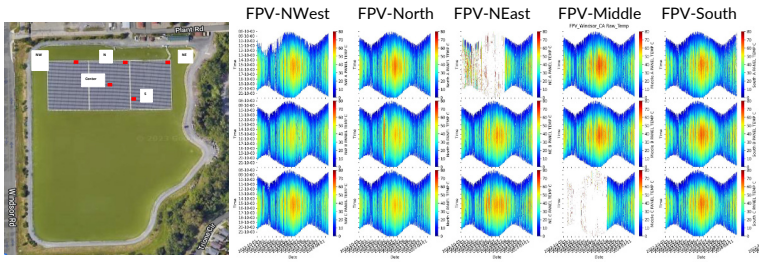


Floating PV modules operate an avg. 2.63 °C cooler compared to Land PV modules but exhibit unusual temperature differences

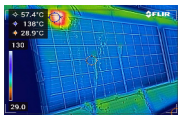
4. PV MODULE TEMPERATURE HEATMAPS



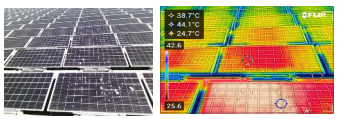
First picture: Floating and Land PV systems located at a Farm in CA. Second picture: Normalized data heatmaps of 5 FPV modules (three sensors per module) and 3 LPV modules (all subtracted by middle FPV module temperature). The five FPV modules were located at five extreme corners of the PV array as annotated in the first picture. Note: all maps scaled to one scale color bar.



First picture: Floating PV system located on a water treatment facility at Windsor, CA. Second picture: Raw data heatmaps of the five PV modules temperature (three temperature sensors per module) located at five corners of the PV array as annotated in the first picture. Note: all maps scaled to one scale color bar.

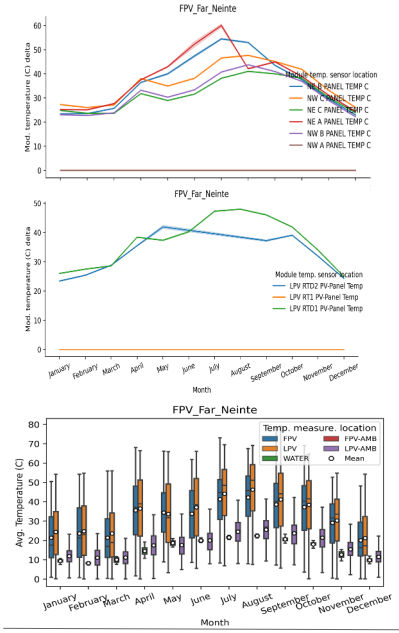


From a floating solar PV in FL: Bird dropping completely block shaded a PV cell, and the cell is operating at 138 °C.



From another floating solar PV in FL: South module at 44.1 °C, last but one row module at 38.7 °C

5. TIMESERIES DATA ANALYSIS



6. CONCLUSION

- Floating PVs operate cooler compared to land PV modules by an avg. 2.63 °C (STD 3.53 °C).
- Delta among the floating PV modules is more compared to land PV modules

References

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[2]. A. Badhoutiya, "Advancements in pv technology- floating photovoltaics," in 5th International Conference on Smart Systems and Inventive Technol-ogy (ICSSIT), pp. 382–385, 2023.

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Project contributors:

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