PHD SYMPOSIUM

FIELD
Energy Meteorology

KEYWORDS
Solar Resource Assessment and Forecasting, Data Fusion, Cloud Characterization

COUNTRY
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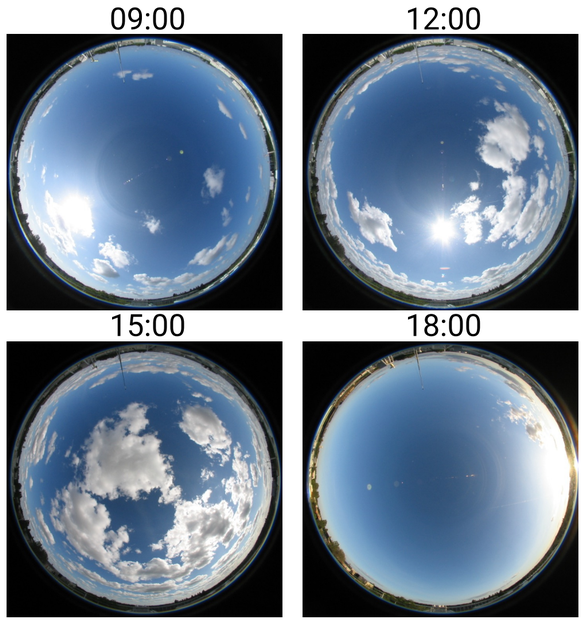
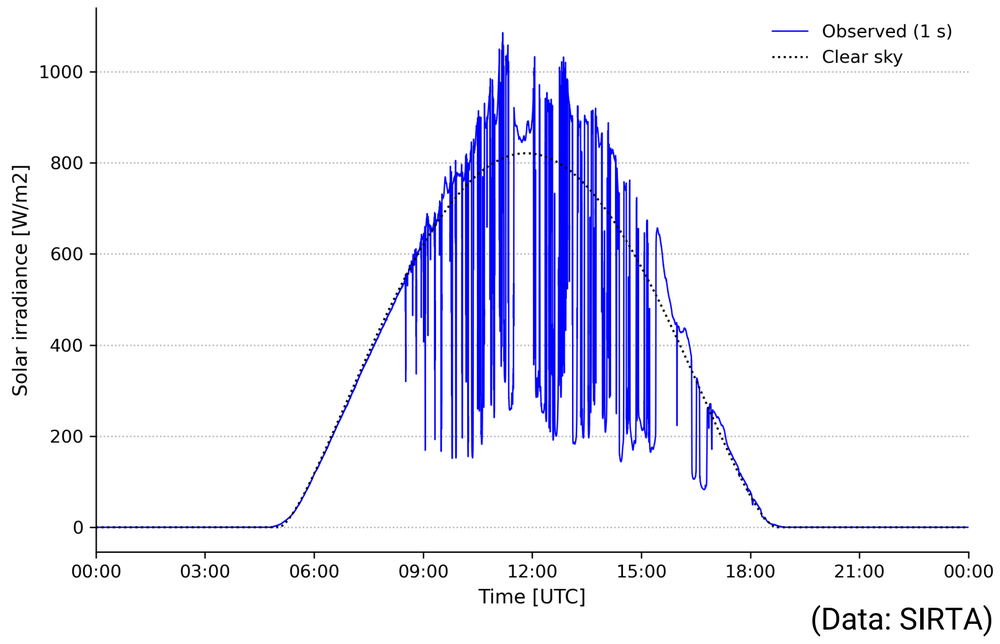
Mitigating Uncertainty in Solar Power Generation via Cloud Characterization

Context

- Clouds strongly modulate ground level solar irradiance on seconds to hours.
- This variability drives the power output of photovoltaic power plants.

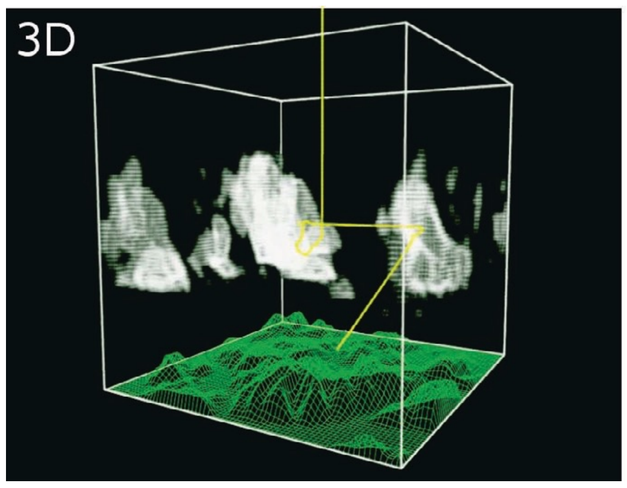


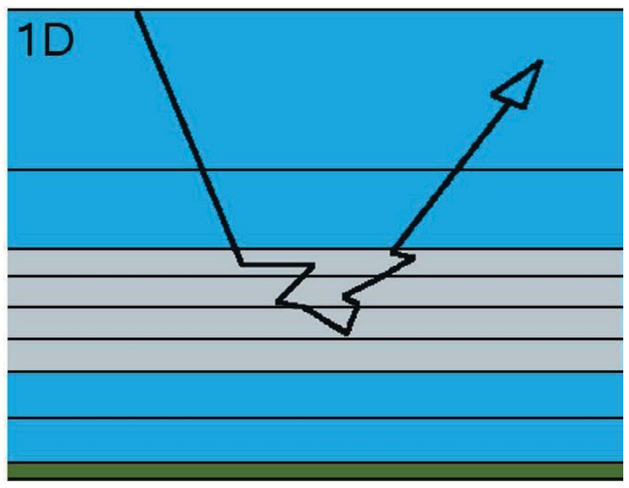


(Data: SIRTA)

Research Problem

- Operational irradiance retrieval models rely on 1D radiative transfer.
- This simplification ignores 3D cloud geometry and introduces large errors during broken cloud scenes.
- High resolution 3D cloud characterization in real time is required to reduce this uncertainty.



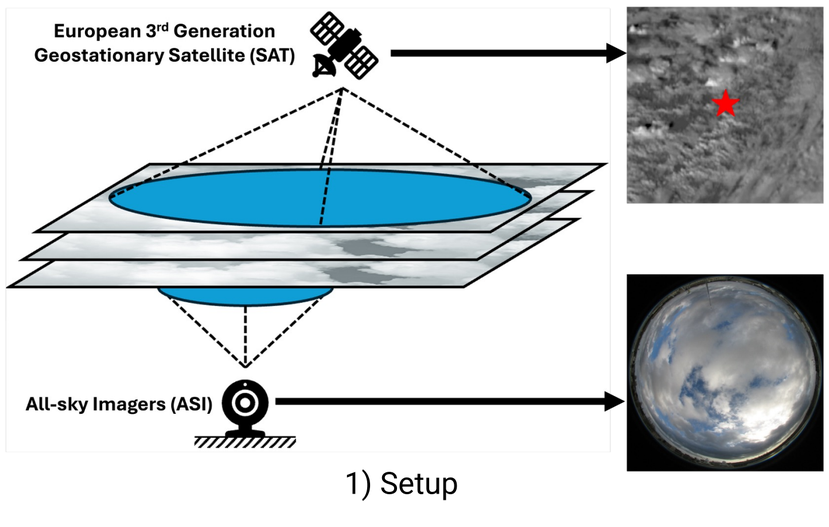


(Source: Mayer, 2009)

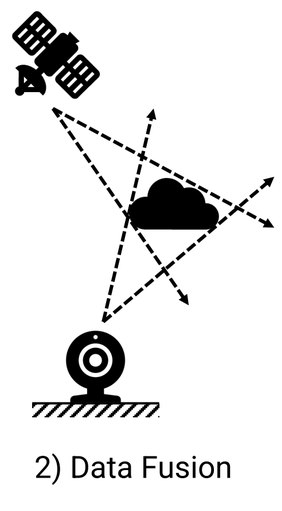
Contribution: real time reconstruction of a 3D cloud field at ~100 m resolution from combined satellite and all-sky imagery.

Our Approach

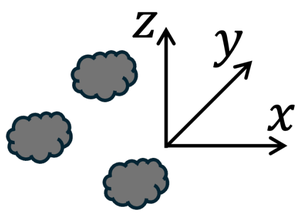
- Combine geostationary satellite images with a ground based all-sky imager.
- Develop data and image fusion methods to reconstruct a 3D cloud field.
- Support 3D radiative transfer for more accurate surface irradiance.



1) Setup



2) Data Fusion

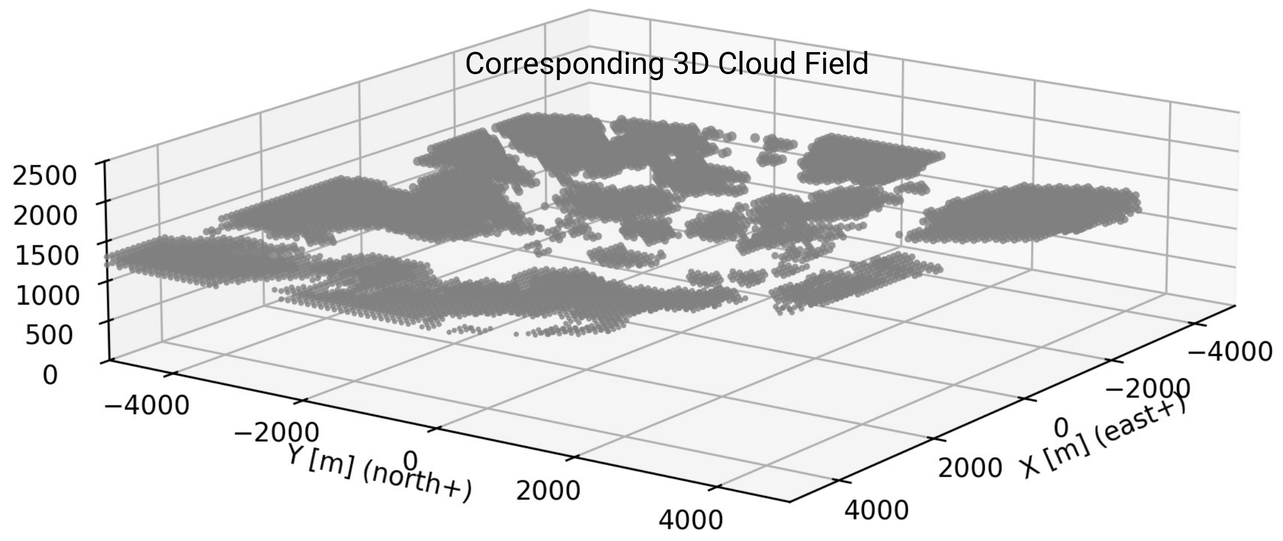


3) 3D Cloud Field

Result

- Algorithm reconstructs high resolution (≈100 m) 3D cloud fields in real time.
- Reconstructed fields are validated against atmospheric measurements.
- Surface solar irradiance is estimated from the 3D fields.

All-sky imager view



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