Nightlights-Based Assessment of Global Electricity Infrastructure and Future Emissions to Meet Growing Demand

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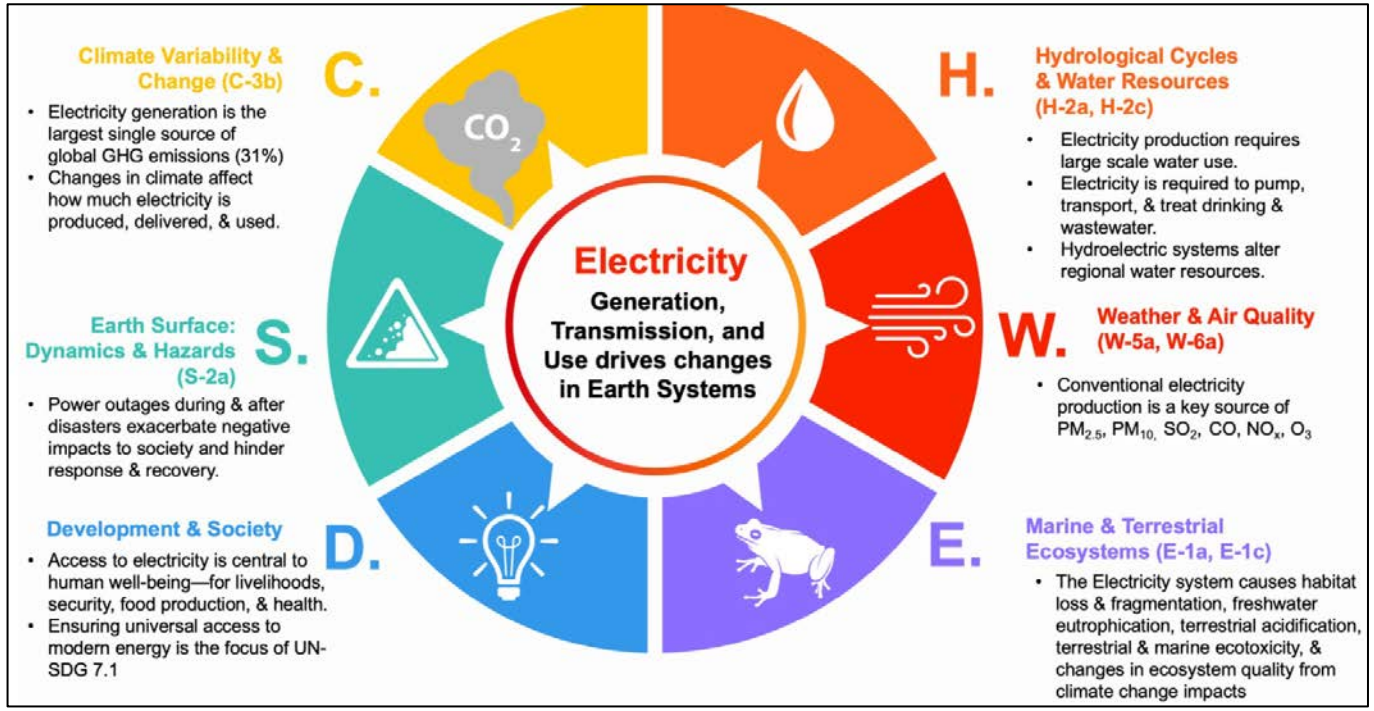
Nightlights-Based Assessment of Global Electricity Infrastructure and Future Emissions to Meet Growing Demand

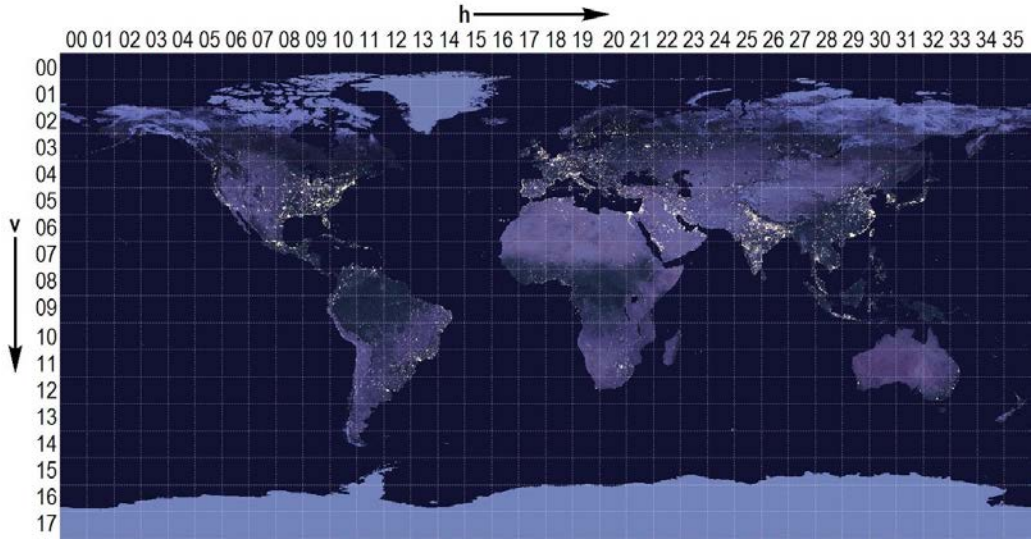
Impact of electricity infrastructure development and use across different earth system components



U.S. Decadal Survey for Earth Science and Applications from Space (ESAS), E Stokes

Assess the spatial distribution and degree of electricity access deficits and explore how future electricity supply— to close those deficits and meet growing demand— will impact emissions.

Proposed Research

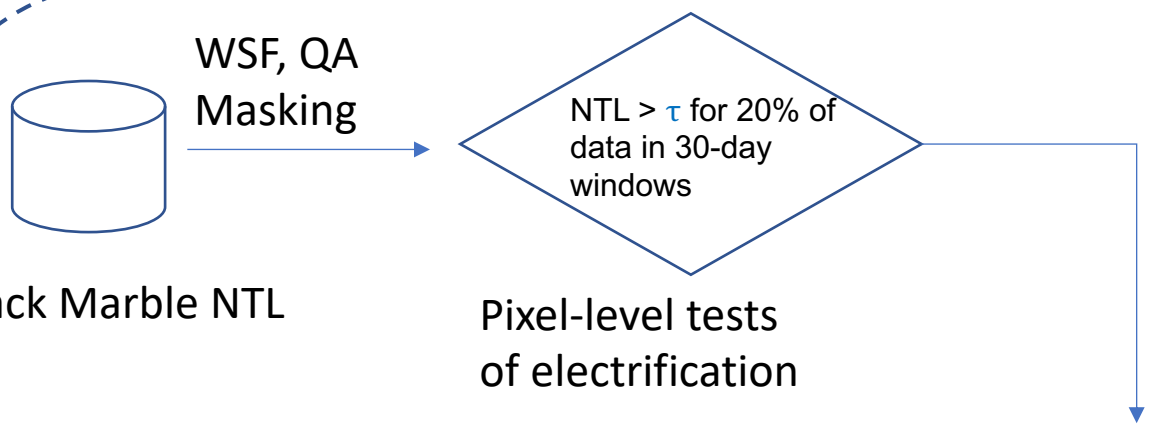


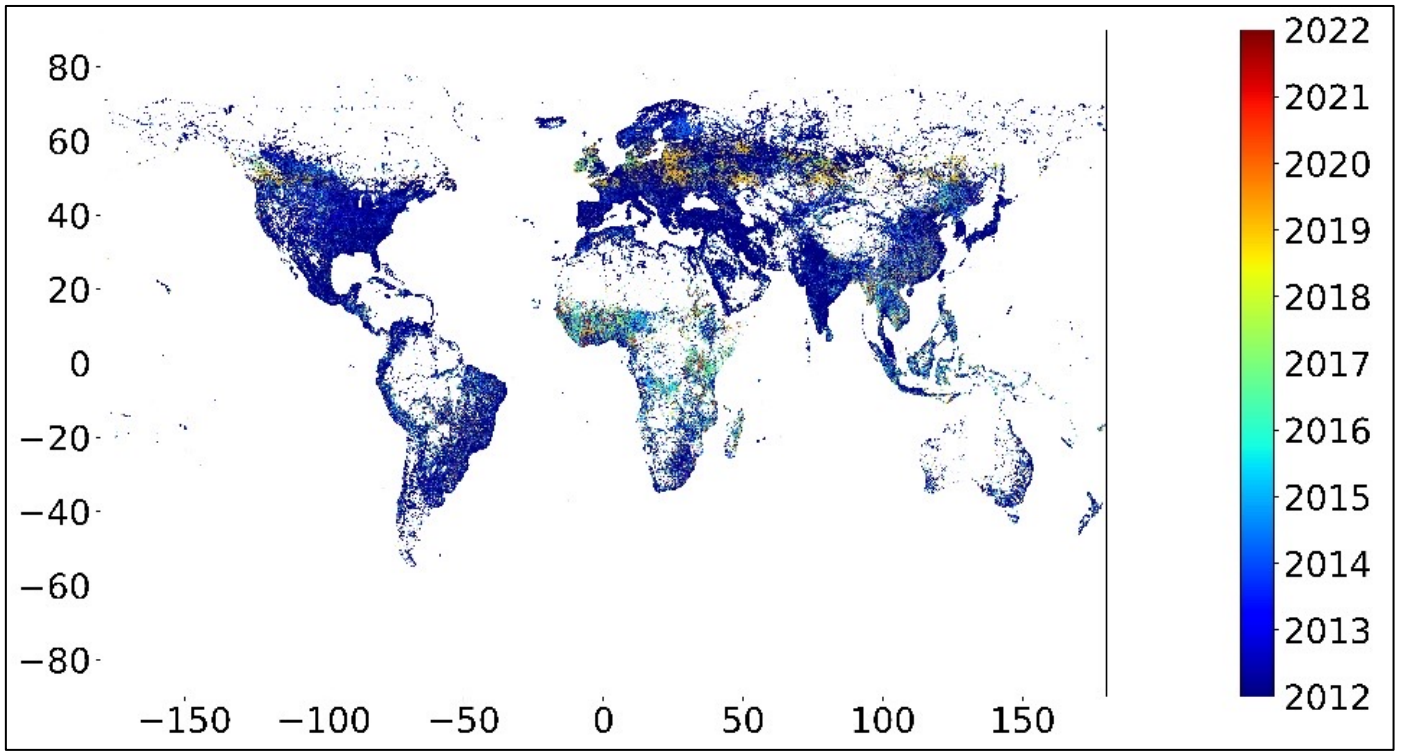
Black Marble Nighttime Lights, M. O. Román

Objective:

- Assess electricity access and reliability
- Assess unmet demand in low access areas
- Assess how future demand over these areas will evolve under different socioeconomic and climate futures

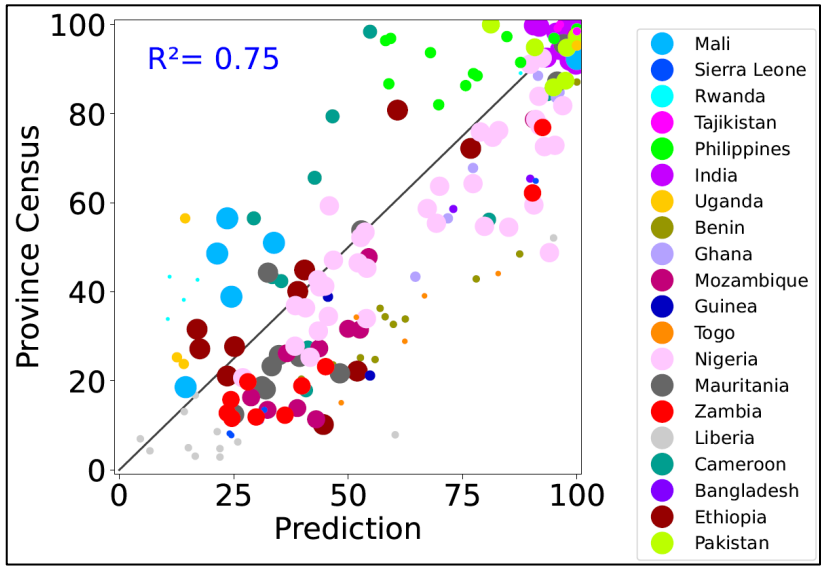
Global Electrification Estimates from Black Marble Nighttime Lights





O. Alexander

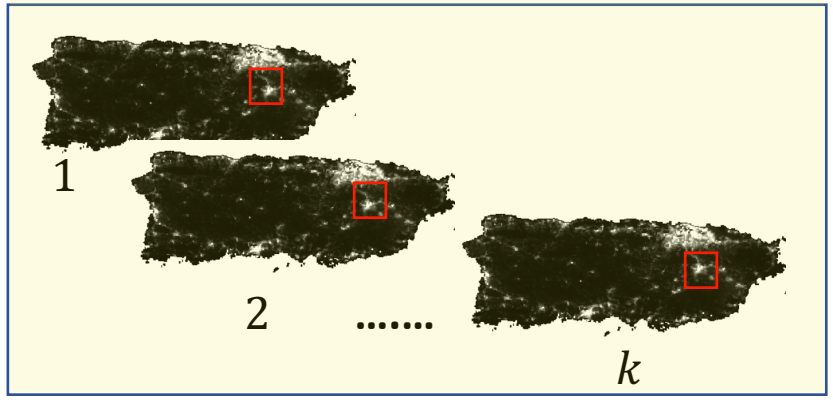
Comparison of % of population (LandScan) with electricity access to Census Estimates (USAID/DHS Program STAT-compiler)



O. Alexander

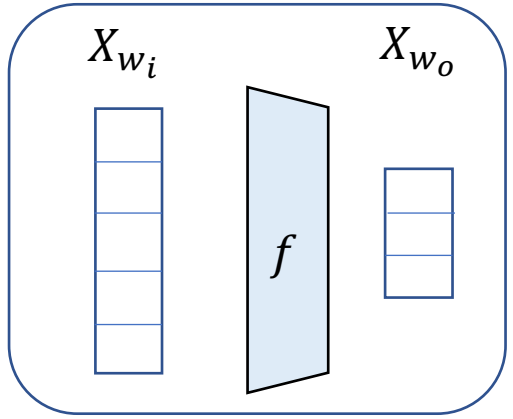
Towards Global Electrification reliability from Black Marble Nighttime Lights and Machine learning

Training temporal dependence in NTL



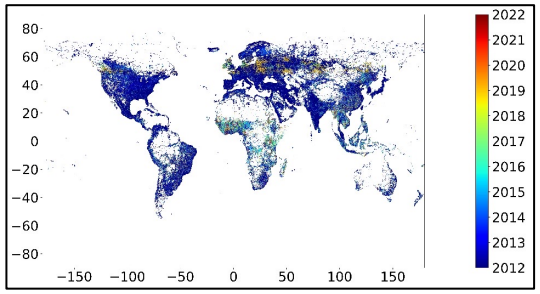
X_t: NTL of a pixel t

Training over sliding windows



Trained forecasting model

X_{w_o}: output window X_{w_i}: input window



Similarity between NTL prediction and observation

High similarity:
- no change/ reliable

Low similarity:
- Likely change point/ unreliable

Next Steps/ Outcome:
- Global per-pixel estimates of electricity reliability,
- power access frequency and consistency

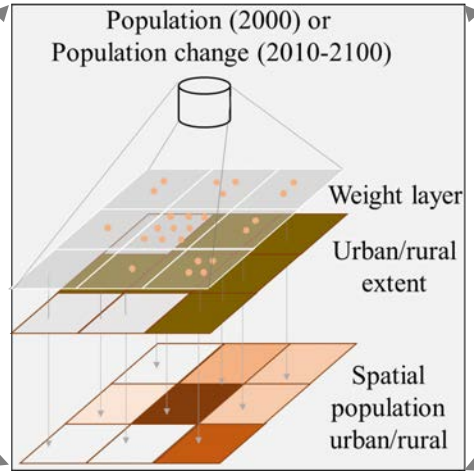
Building Energy Modeling- Global Population distribution from 2000 to 2100

Urbanization
Climate change
→ Urban heat island
→ **(1) Population distribution**
→ (2) Population-weighted HDD/CDD
→ Per capita building floorspace
→ Building energy use

❖ **Population distribution 2000**

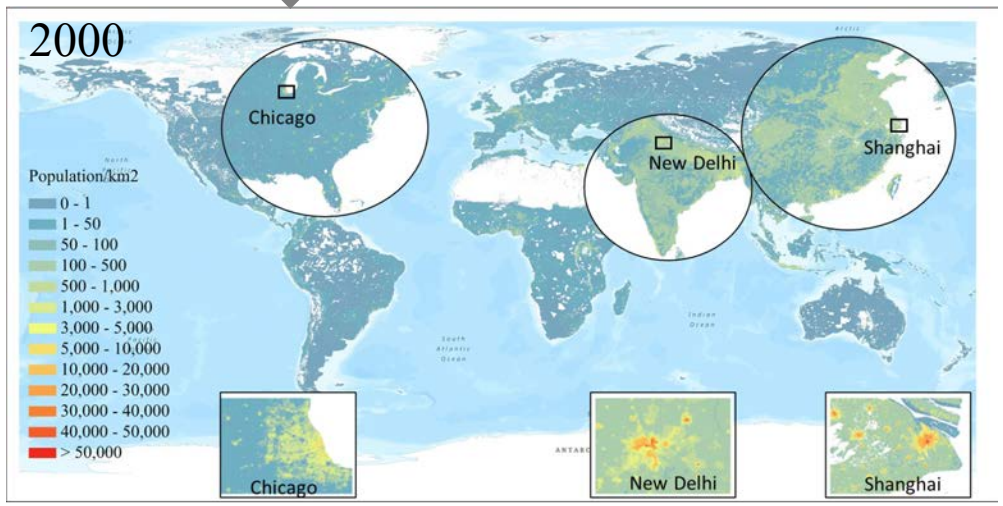
❖ **Population distribution 2010-2100**

Random forest based dasymetric model

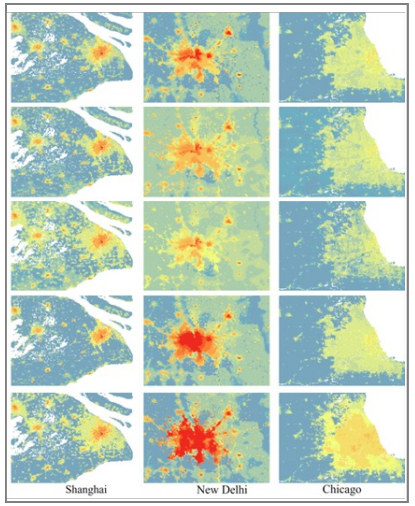


Gravity based population redistribution model

Dynamic urban boundary



Base year



Next Steps:

- Quantify annual electricity demand that was consumed, considering intermittency from NTL Reliability.
- How electricity demand for low and no access areas evolve, given different socioeconomic and climate futures?

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