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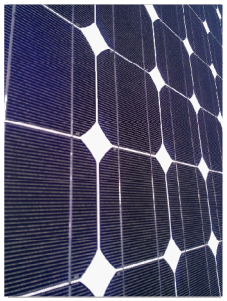

Adapting Renewable Energy Systems for a Changing Climate in Remote Tribal Communities– Navajo Nation, Arizona

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Abstract

The intent of this research paper is to help bring awareness that changing climates such as, desert drought conditions may require renewable energy technology to be adapted.

More specifically this research addresses the relationships between lack of precipitation, drought, desertification, temperature fluctuations, lightning, photovoltaic systems, and soil resistivity. With the notion that the extreme/severe drought on the Navajo Nation, Arizona has created high soil resistivity that inhibits the effectiveness of a residential off-grid photovoltaic grounding system.

In order to install a grounding rod, the dry soil needs water, thus, requiring the implementation of a greywater system to be used to water the soil to install the grounding rod.

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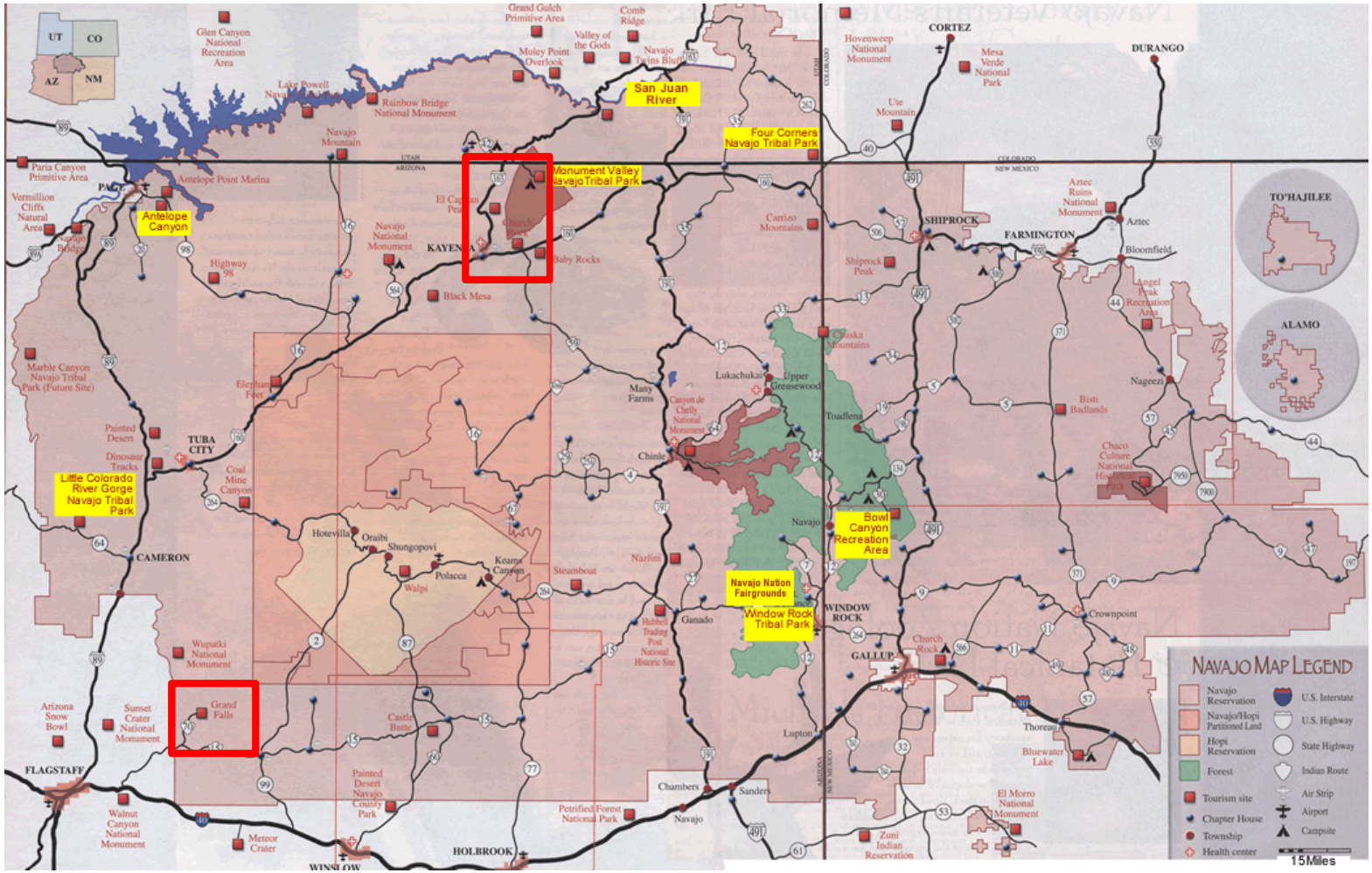
Navajo Nation



Source: http://www.navajonationparks.org/parks.htm

Changing landscapes

Monument Valley, Utah

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Kayenta, Arizona

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- Longer droughts
- Below average precipitation
- Increased erosion
- Formation of sand dunes increased
- Dust Storms
- Dry Lightning Storms

Applications of Renewable Energy

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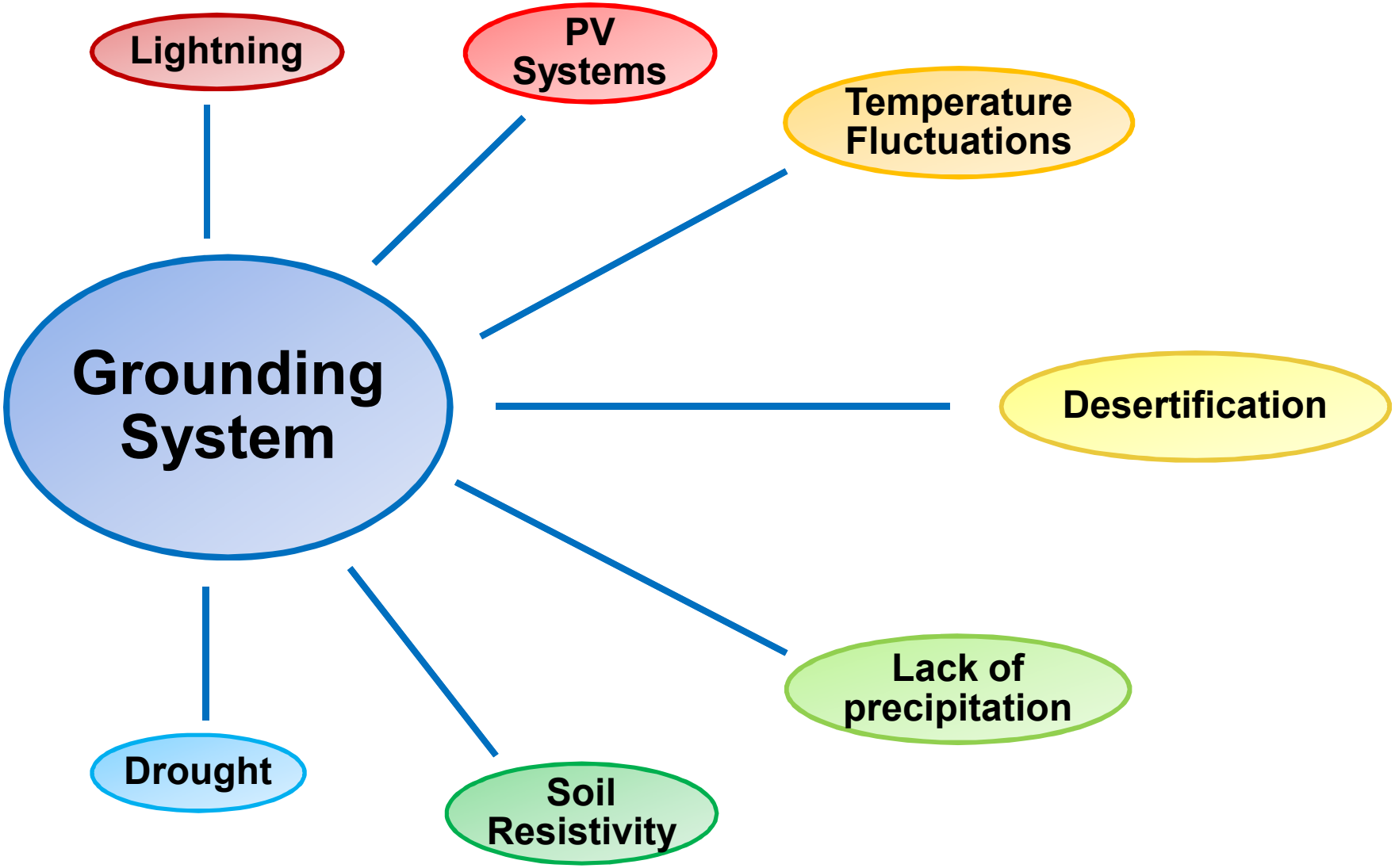
- 18,000 Residents without electricity
- 1,000s living without running water
- Remote communities
- Rugged roads
- Limited transportation
- Far from transmission lines

Inhibitors of Effectiveness



Climate influences on PV systems

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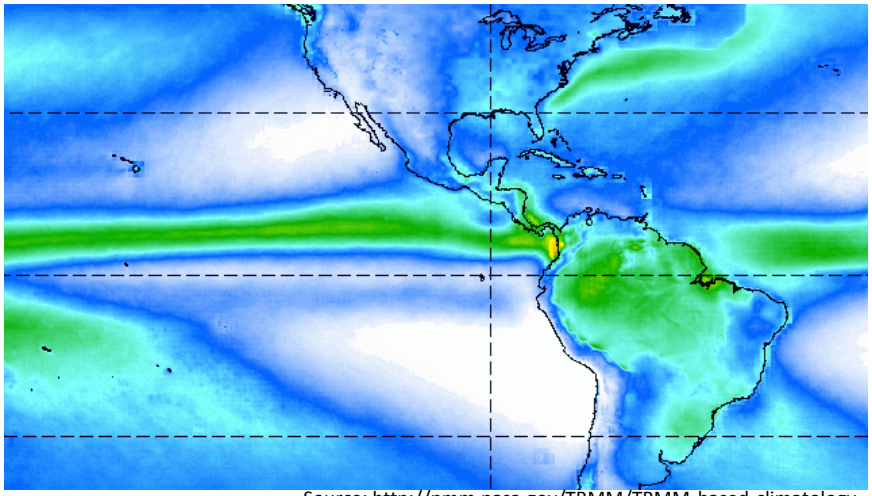
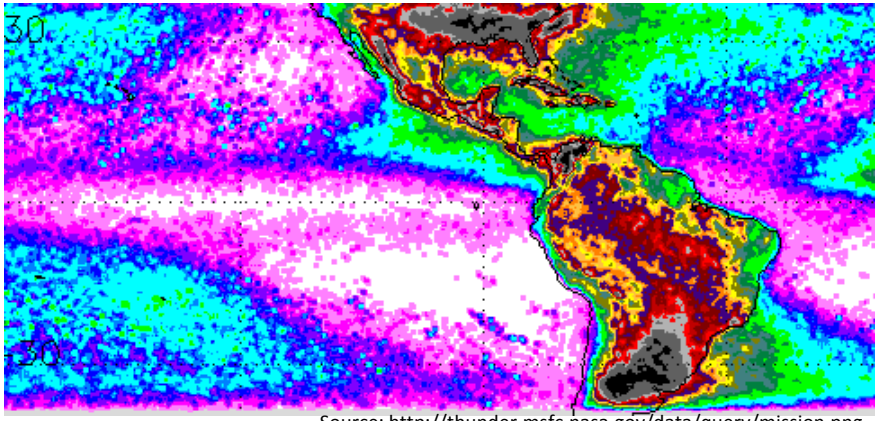
- Sand entering inverter box
- Erosion
- Temperature extremes
- Leveling distortion
- Soil resistivity

Precipitation and Lightning



Source: http://pmm.nasa.gov/TRMM/TRMM-based-climatology



Source: http://thunder.msfc.nasa.gov/data/query/mission.png

- Global precipitation and lightning average taken from 1988-2012
- Less precipitation and more lightning activity
- Below average precipitation in northern Arizona causes greater soil resistivity
- Increased dry lightning occurrences during drought conditions creates greater hazards
- Varying climate change factors in northern Arizona reduce the effectiveness of PV grounding systems

Grounding Rods

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- Protect people from electrical shock and safeguards electrical equipment
- Provides electrical connection to the ground (earth) to direct current away from a circuit in the occurrence of an electrical surge

Greywater Systems

Source: Black Falls Safe Drinking Water Project, Forgotten People

- 1,000s of Navajo families continue to live without running water
- There is a need to set up systems of using greywater both *mechanically* and through *education* to ensure lightning protection safety for tribal members
- In the state of Arizona greywater systems are allowed to exist without a permit when 400 gallons or less is used

Future Work

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- Establish a process to monitor ohm readings for several months at different locations
- Establish study sites at different areas with varying geology
- Monitor PV system lightning incidents
- Create a PV grounding system as a control that uses a greywater system to help with soil resistivity
- Develop a group of tribal members with PV systems to participate in implementing greywater systems

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