TOWER of POWER - Power Challenges for Remote iUTAH EPSCoR Weather Stations

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Overview

- A major part of the iUTAH EPSCoR project includes GAMUT, which describes instrumentation for measurements made through a Gradient Along Mountain to Urban Transitions.
- Powering remotely located weather stations from solar energy calls for understanding of instrument power requirements and limiting weather conditions.
- Appropriately sizing batteries and solar panels ensures system integrity and long-term data collection.
- Terrestrial stations for GAMUT will be installed during 2013-14 in the three watersheds.

Methodology

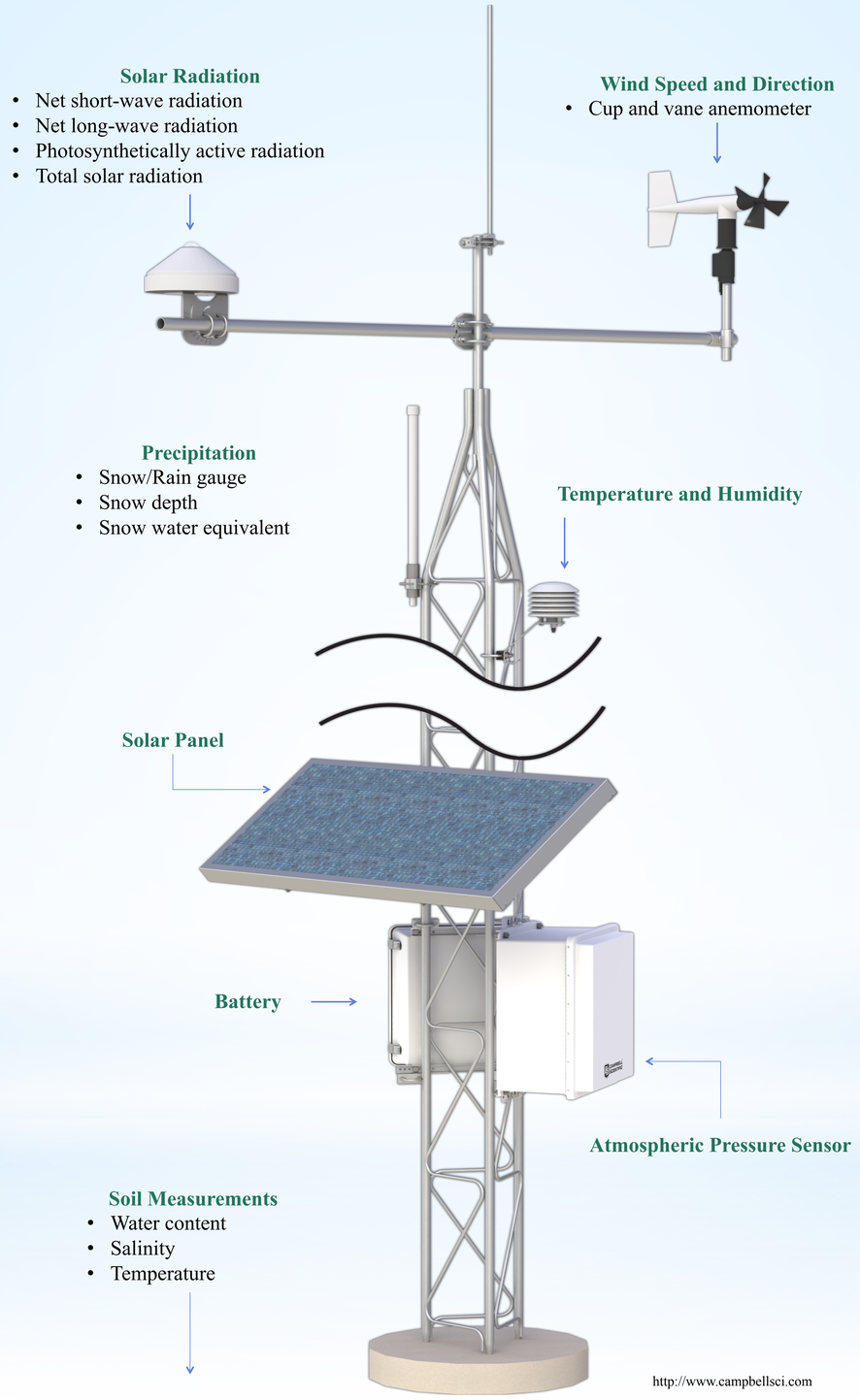
Identify
- Identify sensing and instrumentation measurement needs to satisfy scientific objectives

Calculate
- Calculate weather station power requirements by summing individual sensor power demand
- Calculate the available sunlight at the site

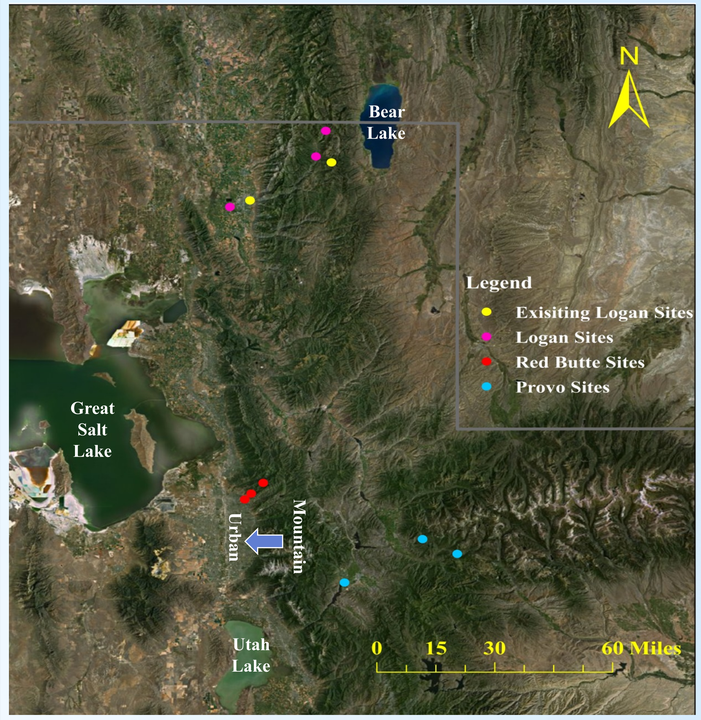
Select
- Select battery and solar panel size according to calculations and worst-case weather scenario

Challenges of Solar Power

- Solar panels have low efficiency of 11-15%. As an example, under ideal conditions a solar panel of 1m^2 area with an efficiency of 15% will produce 150 W of power from 1000 W of sunlight.
- Winter sunlight and cloudy days are limiting conditions.
- Accumulation of dust, snow and other particles reduces solar panel output.
- A dust layer of one-seventh of an ounce per square yard decreases solar power conversion by 40 percent.
- Sun tracking systems can improve panel output efficiency but are very costly.
- The performance of solar panels and batteries degrade with time.

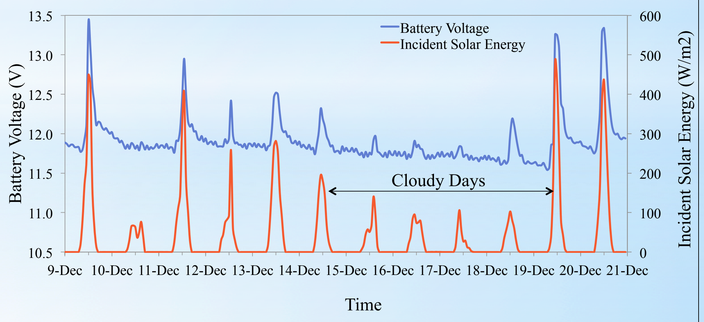


GAMUT Terrestrial Stations



Power Management

- The plot below shows the incident solar energy and resulting battery voltage over 11 winter days.
- Daylight charging significantly increases battery voltage except under cloudy conditions.
- Improperly sized batteries or solar panels may lead to critically low battery levels resulting in data loss.



- Power budget calculations provide estimates of sensor demand coupled with battery capacity and solar panel sizing resulting in sustainable power supply and reliable operation of terrestrial weather stations.

iUTAH EPSCoR Graduate Research Fellowship Program

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