College of Engineering, Forestry, and Natural Sciences
Dept. of Mechanical Engineering

Solar Irradiance Measuring Device

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Overview

- Introduction
- Problem Statement
- Tripod Acquisition
- Sensor Mount
- Data Transfer
- Data Analysis
- Timeline
- Resources

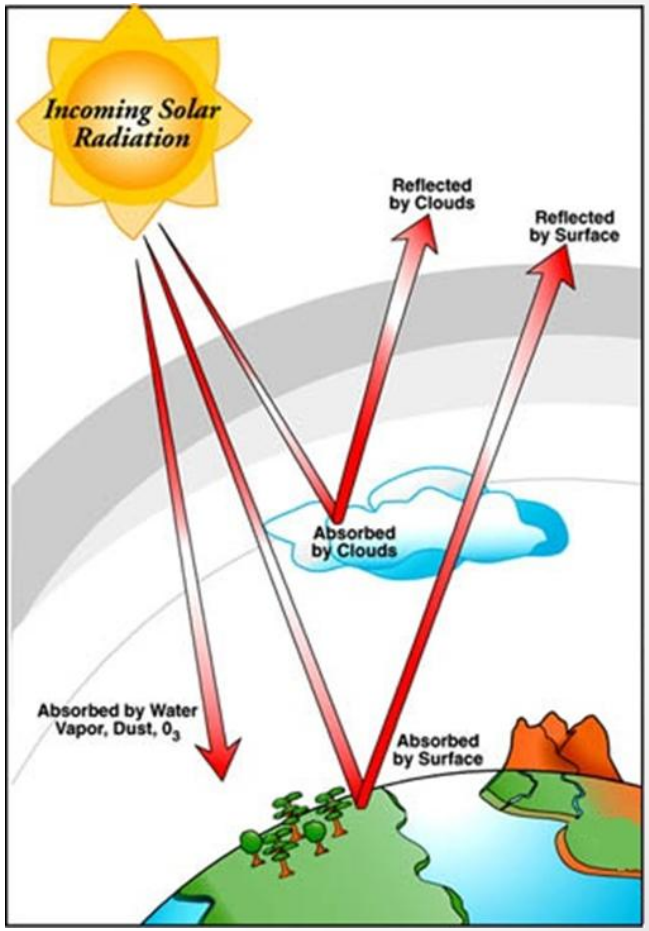
Problem Restatement

Problems with current site

- Covers to much surface area
- Data collection errors
- High cost

Goal:

Design a relatively small, portable solar irradiance measuring system that can accurately quantify variance in solar irradiance over a larger area.



Tripod Options

- **Acculine Pro Tripod**
  - Lightweight, durable
  - Feet have sharp metal points
- **Manfrotto Aluminum Tripod**
  - Leg angles: 25°, 46°, 66°, 88°
- **Vanguard MT-23 Metal Tripod**
  - Supports 8.8 lb
  - Spiked feet
- **Slik Sprint Pro Tripod**
  - 18.5 inches when folded

	Acculine Pro	Manfrotto	Vanguard MT-23	Slik Sprint Pro
Cost $	99.95	112.73	44.95	89.95

Auto Leveling Mount

- Auto levels as soon as tripod is placed
- Stays level with changing ground conditions

Li-Cor 2003S Fixture

- Off-the-shelf product
- Don't know price of fixture

Model LI2003S (c) 2001 Campbell Scientific (Canada) Corp.

Data Transfer

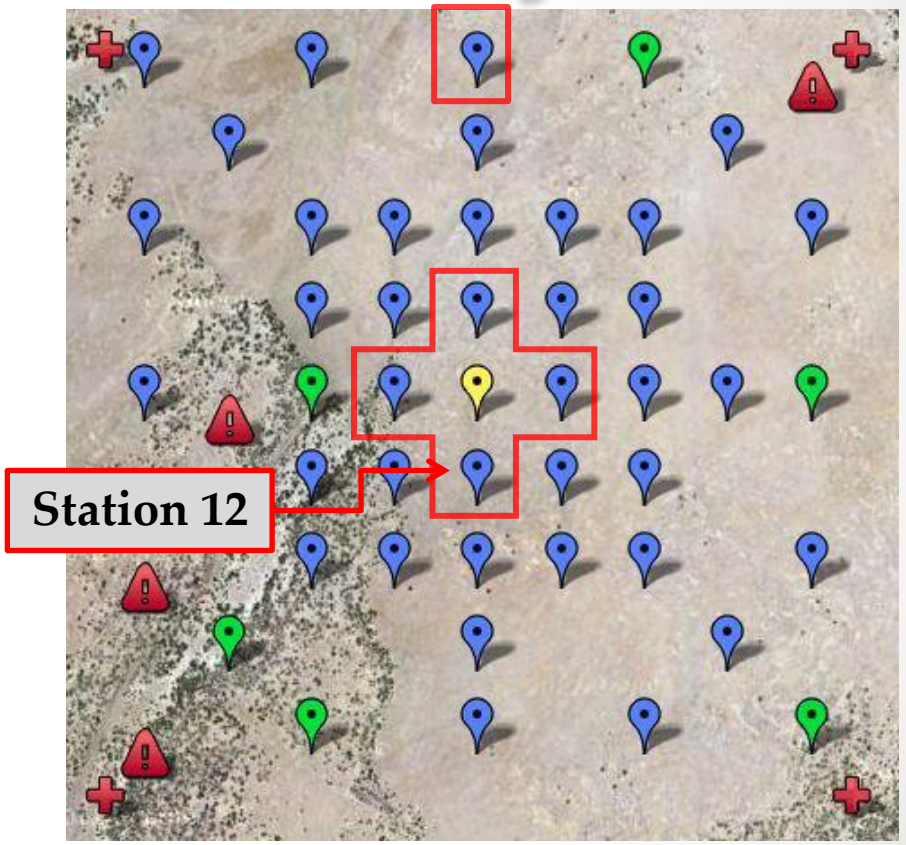
- **Wireless:**
  - Electrical engineering component difficult
  - High cost
  - Low reliability
- **Wired:**
  - Simple setup
  - Sensors come with 50 foot cable
  - Negligible voltage drop

Data Transfer

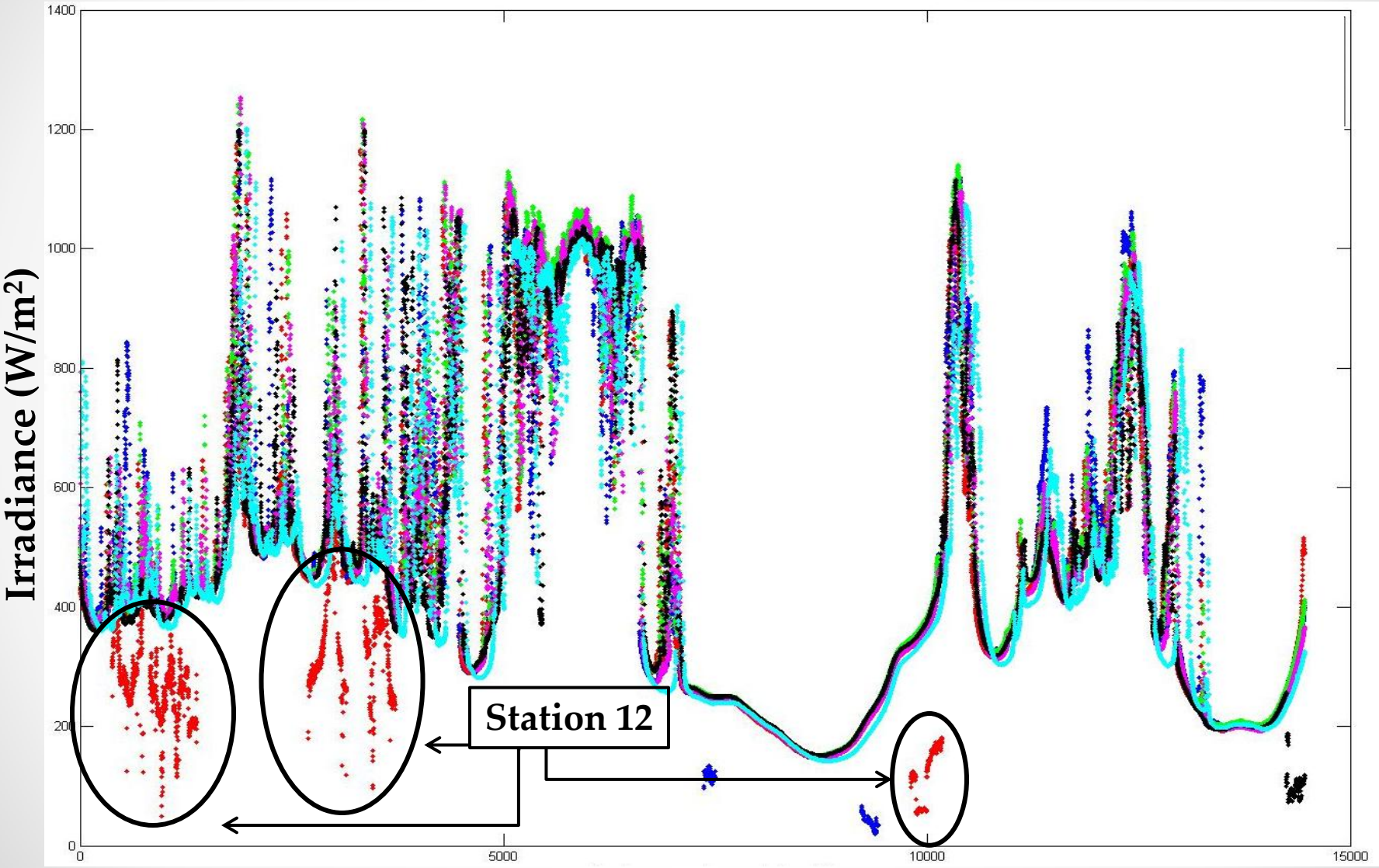
- Wires will be housed in flexible conduit
- Protects wires from
  - Cows
  - Rodents (ie. Field mice)
  - Ultra violet rays
  - Water

Current Data Analysis

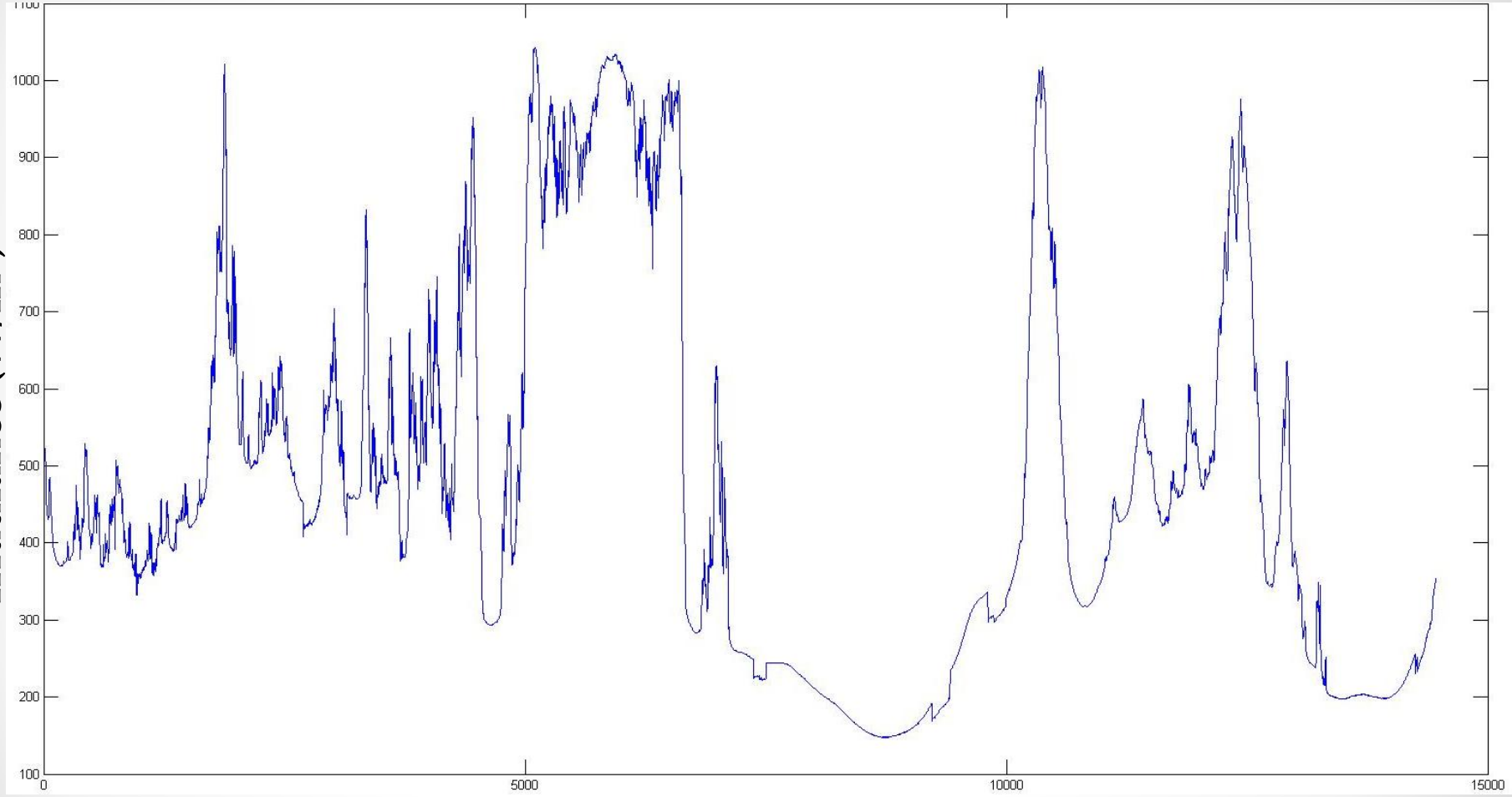
- Statistical analysis to guide future data processing
- Compare this smaller grid to the larger site



Irradiance Vs. Time



Average Irradiance Vs. Time



Natural Variance of Irradiance

- Developed by David Willy

$$NVI = \frac{\sigma_{\Delta G}}{\overline{G}}$$

- Provides a non dimensional number that compares the change of irradiance over time to the total average irradiance

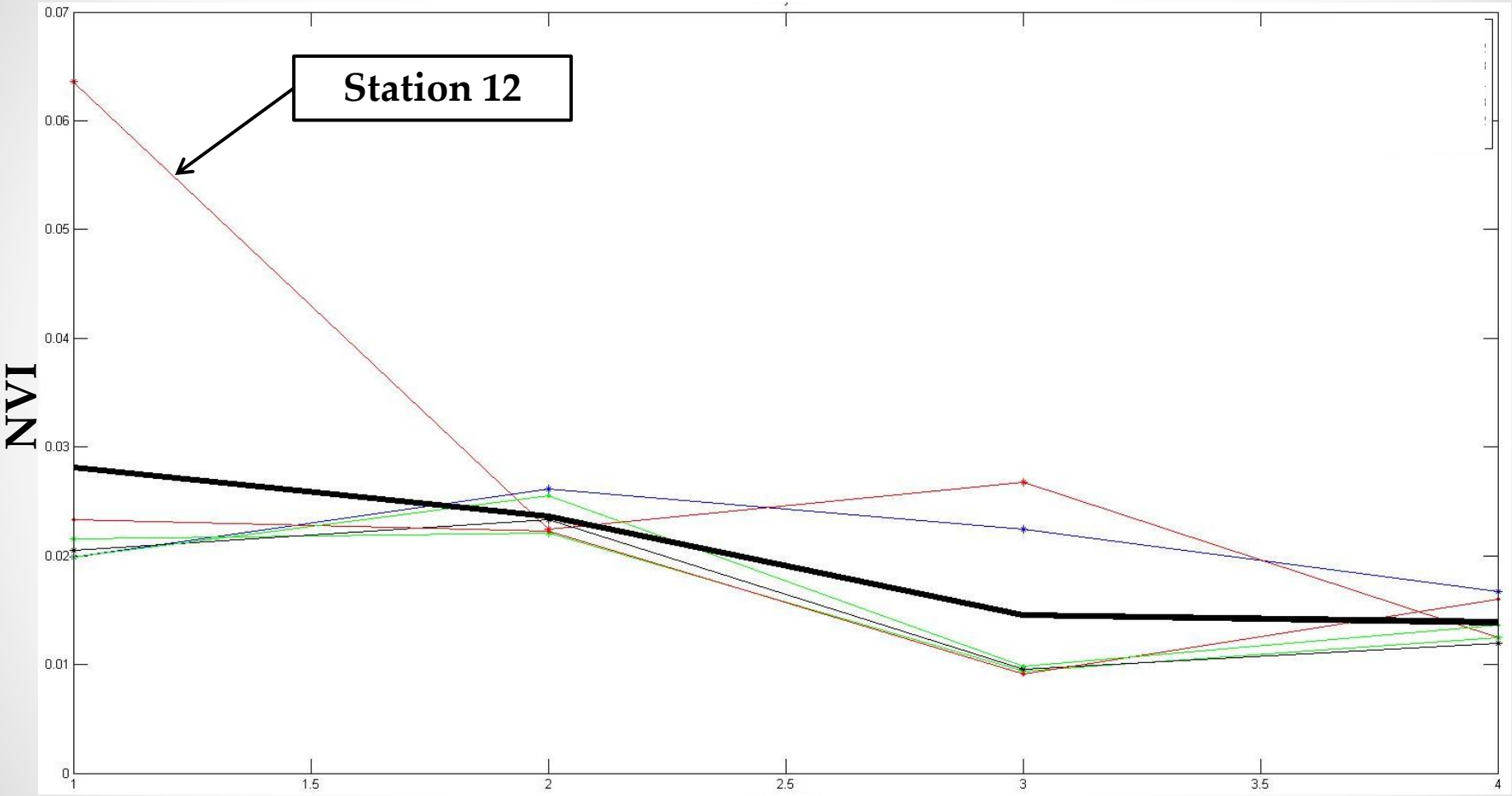
Daily NVI

Notes

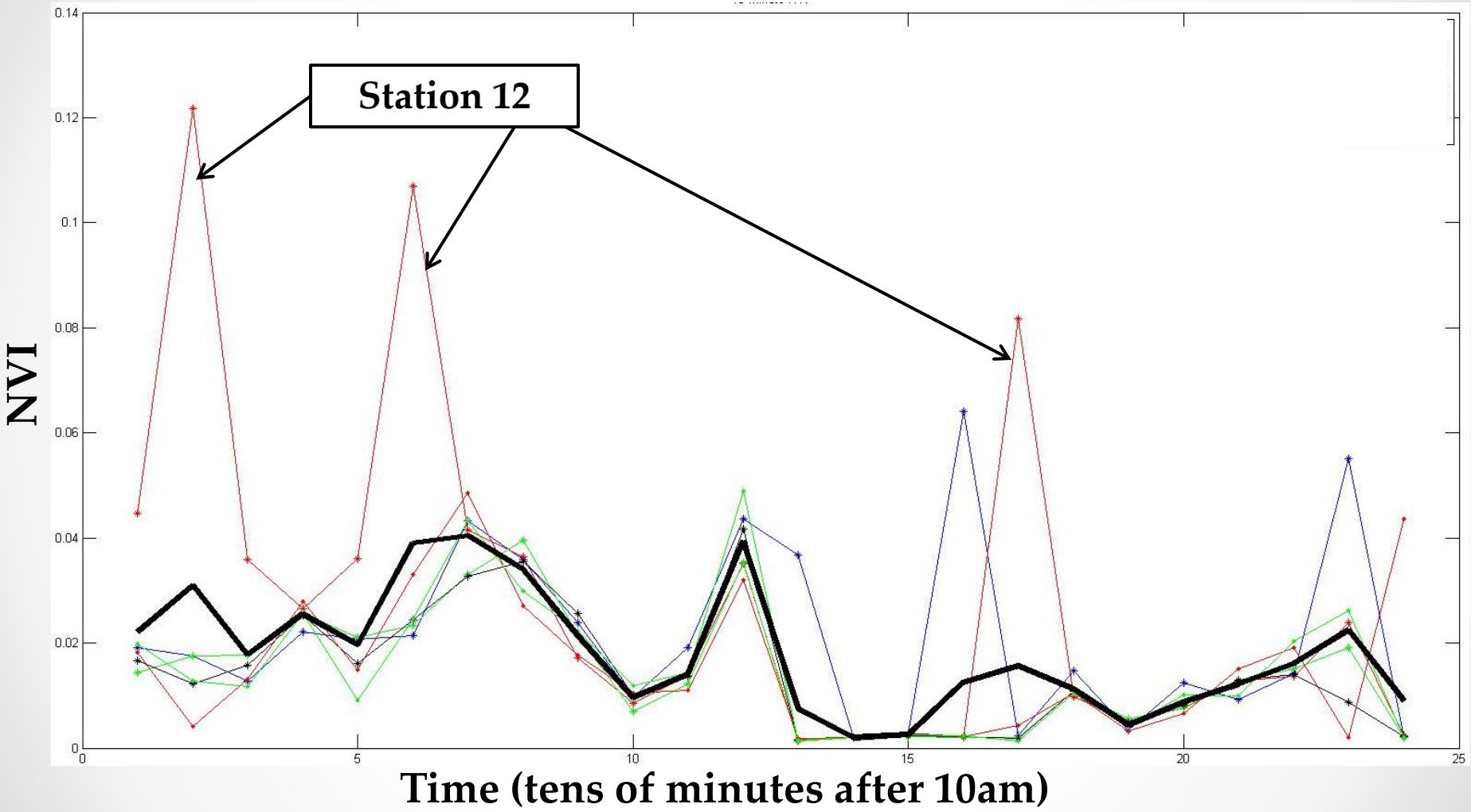
- Most stations exhibit similar NVI values
- Station 12 still an outlier

Station	NVI
8	0.02369
12	0.03642
13	0.02054
14	0.02093
18	0.02174
42	0.02213
Average	0.02424

Hourly NVI

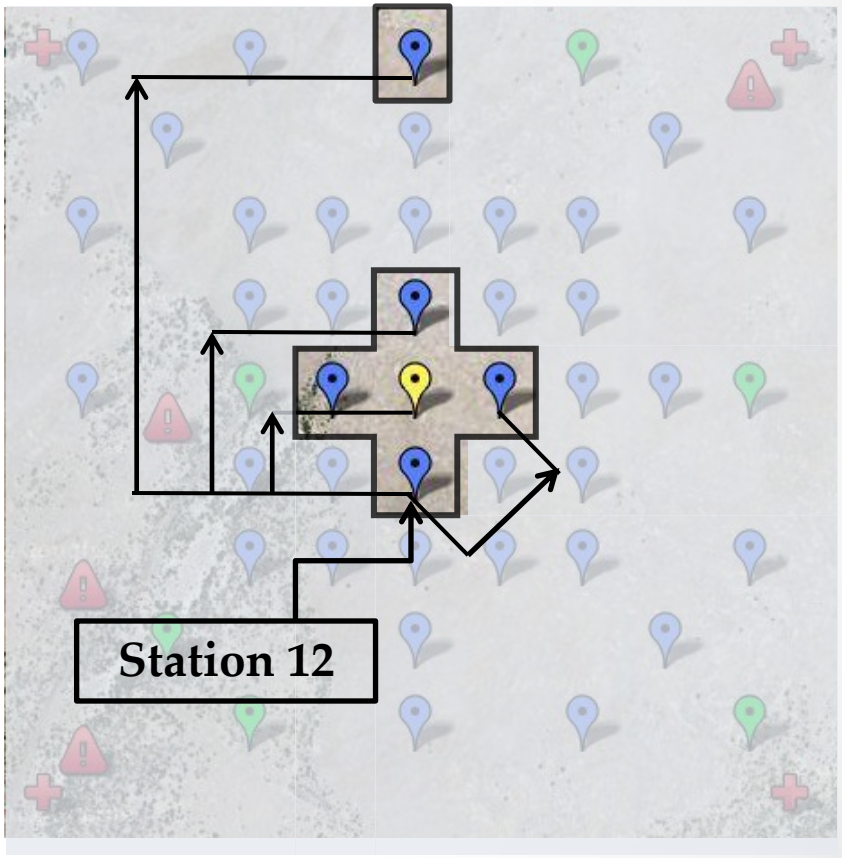

Station 12
NVI
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
1
1.5
2
2.5
3
3.5
4
Time (hours after 10am)

10 Minute NVI

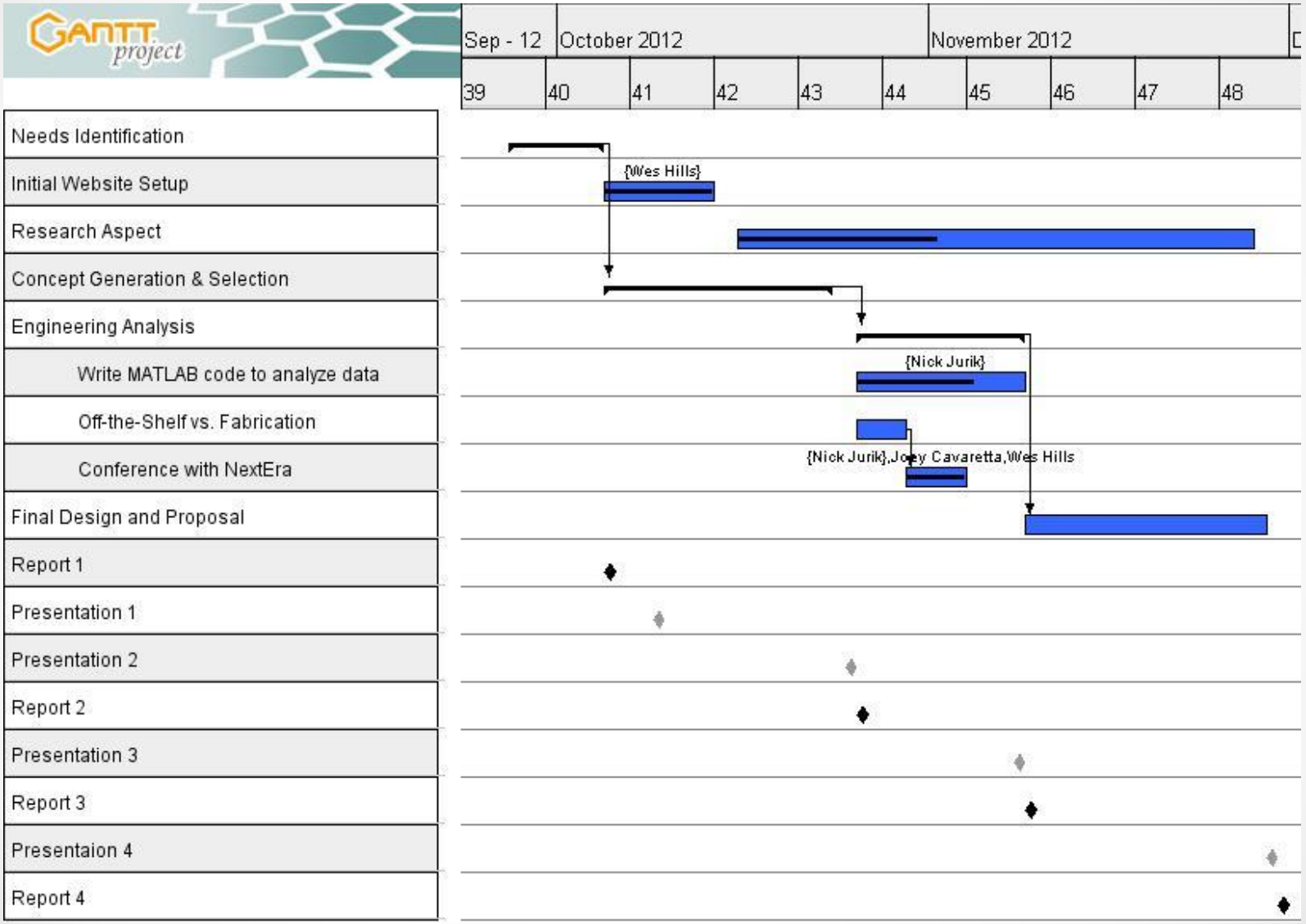


Where to go from Here?

- Determine irradiance as a function of time and separation distance
- Try to model cloud movement
- Investigate data from station 12



Timeline


GANTT project
Sep - 12
October 2012
November 2012
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Needs Identification
Initial Website Setup
Research Aspect
Concept Generation & Selection
Engineering Analysis
Write MATLAB code to analyze data
Off-the-Shelf vs. Fabrication
Conference with NextEra
Final Design and Proposal
Report 1
Presentation 1
Presentation 2
Report 2
Presentation 3
Report 3
Presentaion 4
Report 4
{Wes Hills}
{Nick Jurik}
{Nick Jurik},Joey Cavaretta,Wes Hills

References

- "Prevailing Wind Direction." *Http://www.wrcc.dri.edu/*. N.p., n.d. Web. 03 Nov. 2012. <http://www.wrcc.dri.edu/htmlfiles/westwinddir.html>
- Flood, Ronald K., Dr. Tom Acker, and David Willy. *Prescott Airport Solar Facility Solar Variability Study*. Tech. N.p.: n.p., n.d. Print.

Questions?