# MID-LATITUDE ALL-SKY-IMAGER NETWORK FOR GEOPHYSICAL OBSERVATION (MANGO)

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WPI
SRI International

# Overview

- Sponsor Description
- SRI Project
- Problem Statement
- Design

# Sponsor Description: SRI International

**1955**

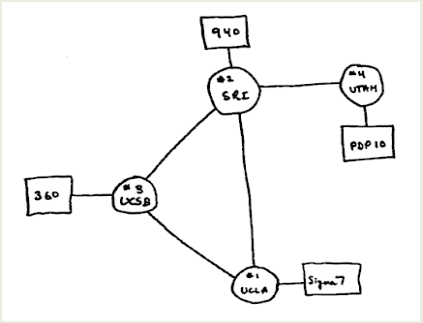
Electronic Recording Machine

**1968**

The Mouse

**1969**

The Internet




**1977**

Wireless Comm.

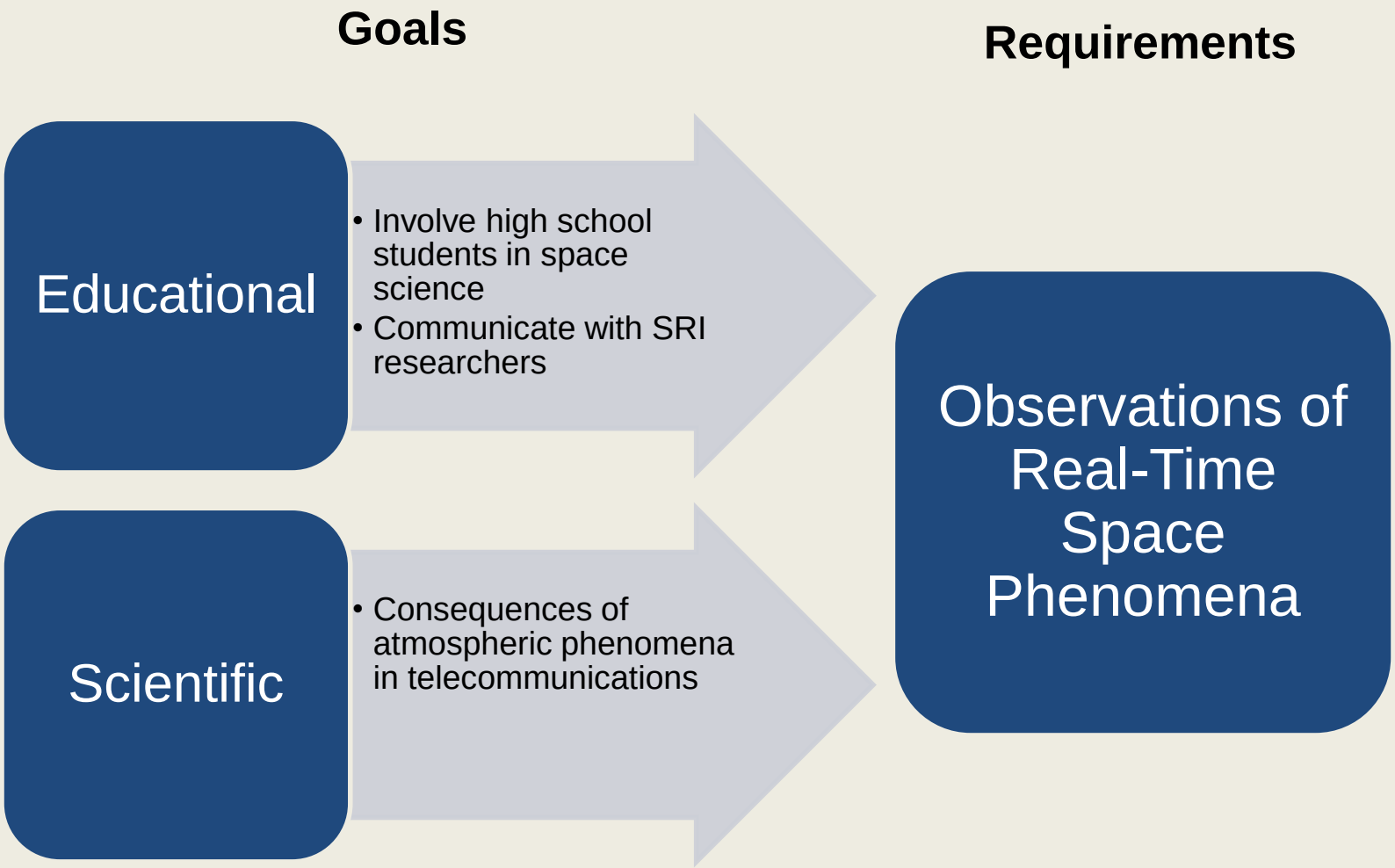
**1980**

Ultrasound

**2007**

AI for Mobile Devices

# SRI MANGO Project



# Project Goal

To architect and formulate a system which allows researchers and students to observe mid-latitude airglow and auroras from multiple sites in the United States.

# Airglow

- Recombination of photoionized particles
- Emission of photons
- Night sky never completely dark

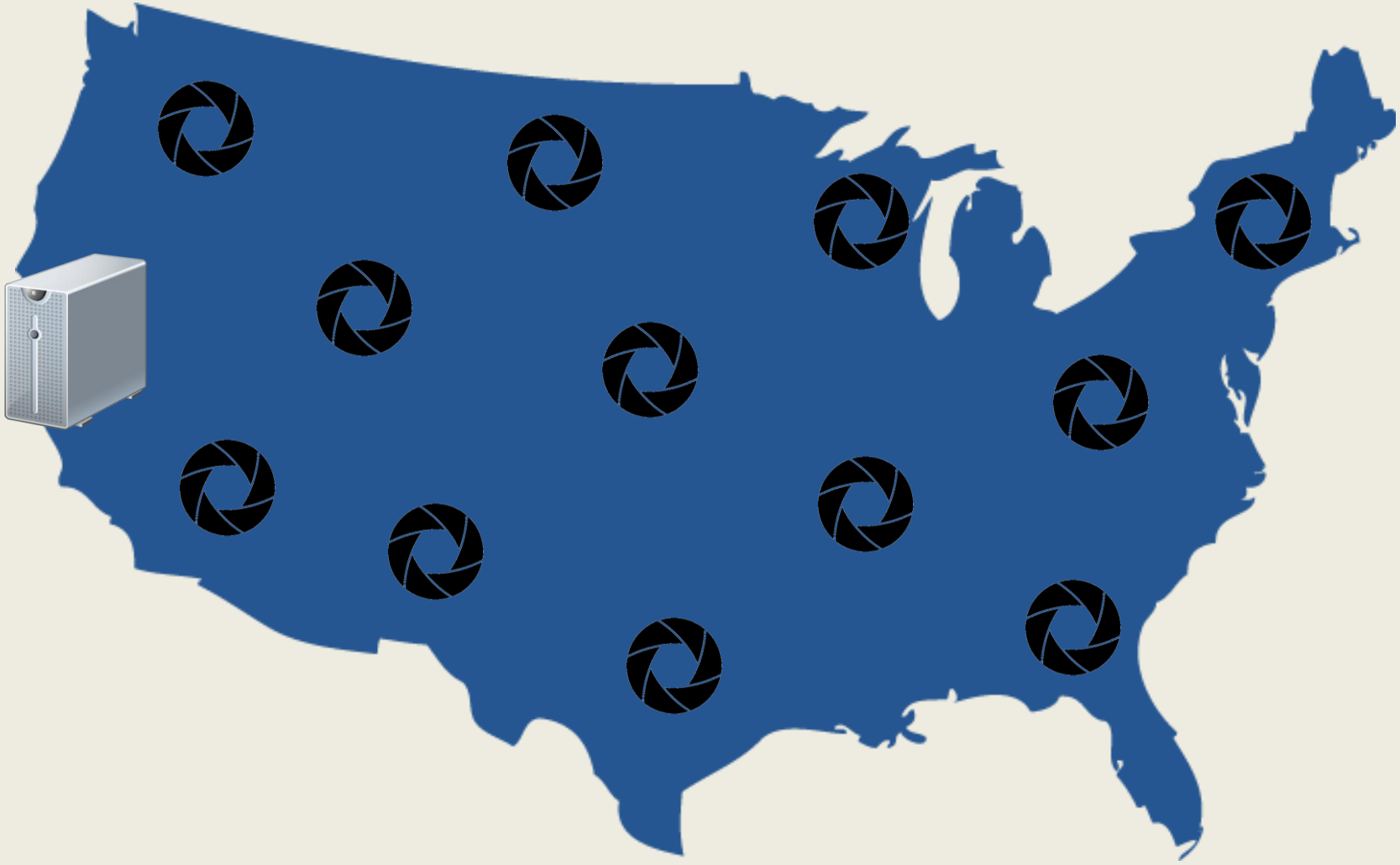
(Source: The Blaze, 2012)

# Auroras

- Collision of charged particles with atoms in the atmosphere
- Emissions of photons
- May not be visible to naked eyes

(Source: Wikipedia, 2012)

# Imager Network



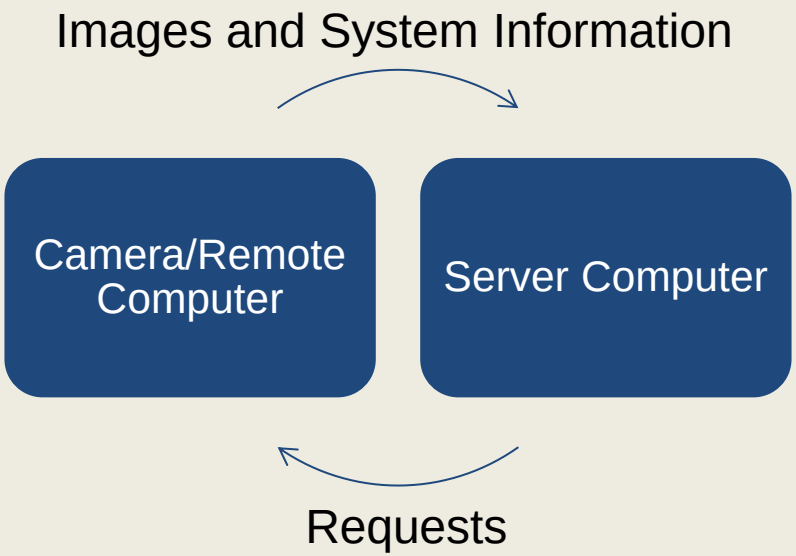
# Fisheye Lens

**Wide-angle field of view causes noticeable distortion**

# Project Objectives

- Data Acquisition
- Image Processing
- Visualization

# Data Acquisition




**Aim:** To create an automated method to acquire real-time camera data and transfer to a computer for processing

python™

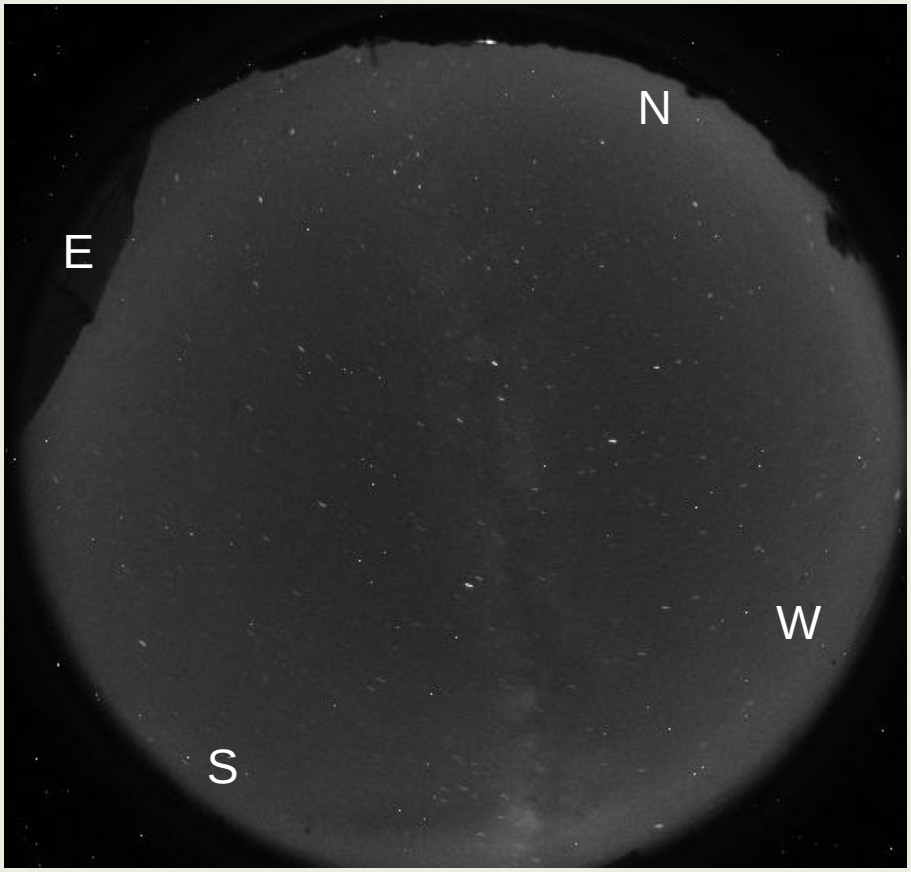
# Image Processing Tasks

- All-Sky Spatial Calibration
- Star Removal
- Brightness Normalization
- From Hemispherical to Rectilinear

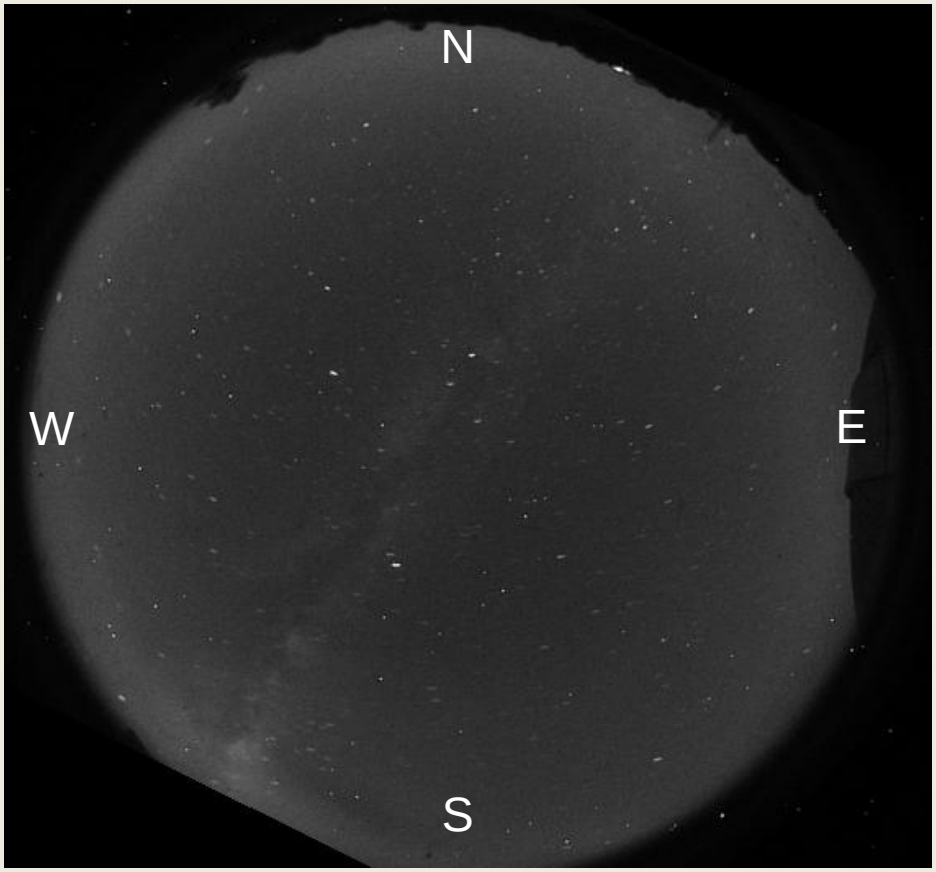
**Aim:** Mapping pixels to geographical coordinates

# All-Sky Spatial Calibration

**Before**

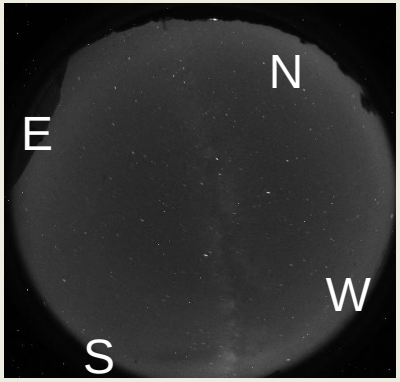



**After**

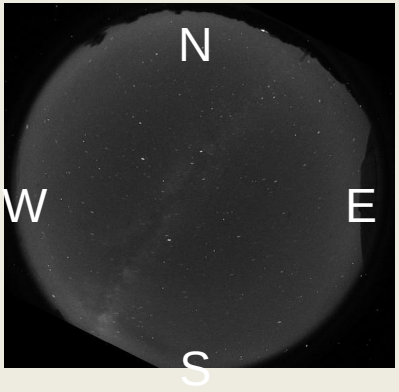


# All-Sky Spatial Calibration

**Before**




**After**




## What is it?

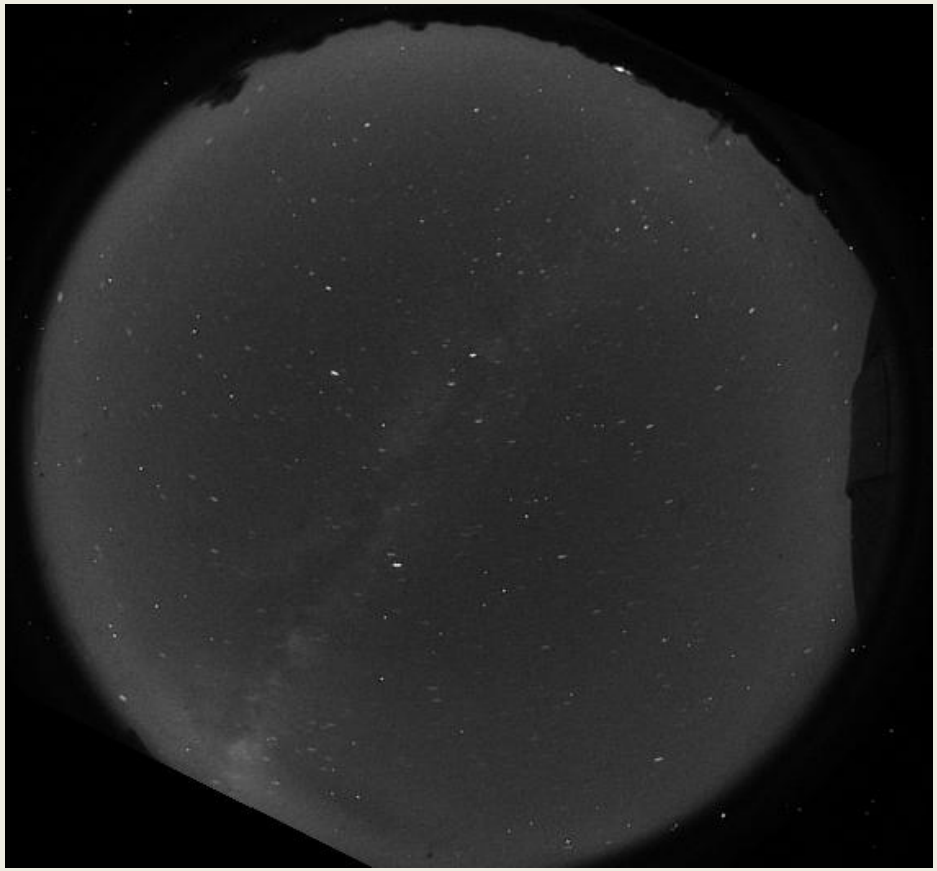
- Rotation of image using stars
- Flipping image left-right
- Scaling *x*- and *y*-axis

## Why is it done?

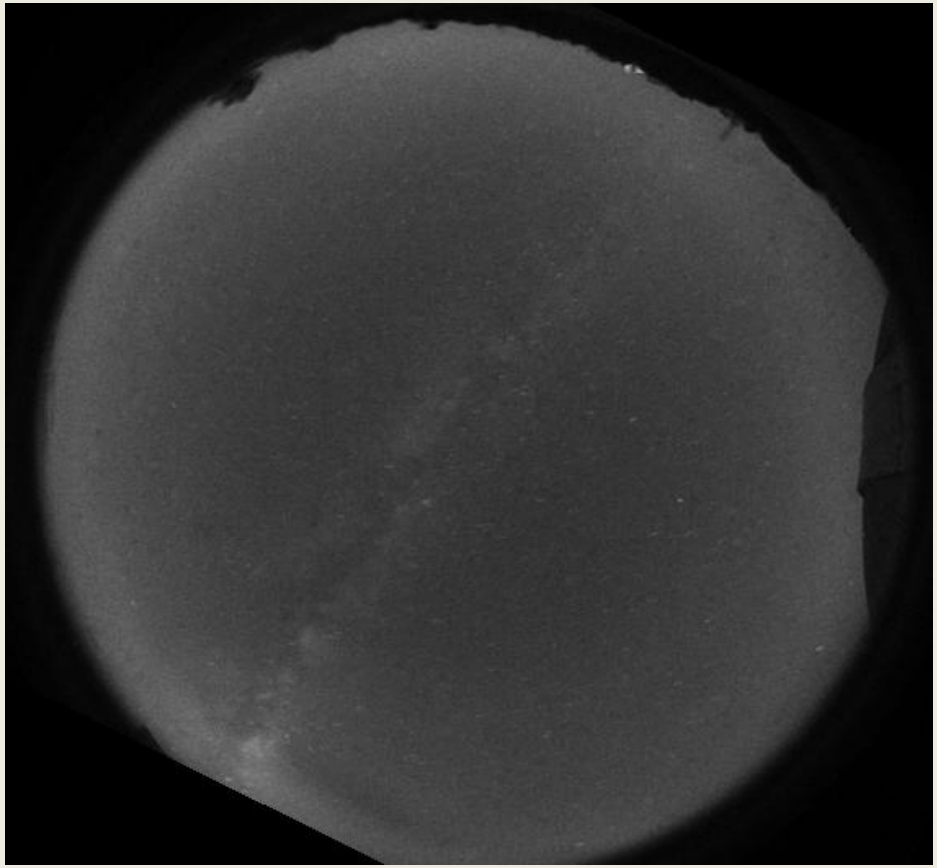
- To align true north with top
- To project it top-down
- To account for elliptical image

# Star Removal

**Before**

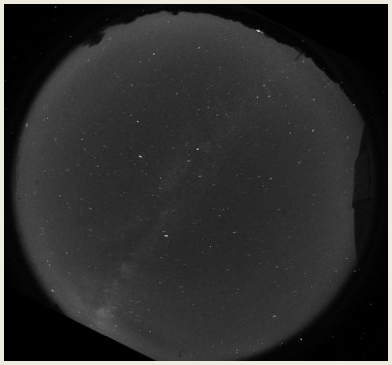


**After**

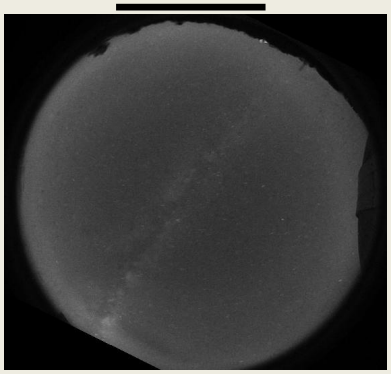


# Star Removal

**Before**



**After**



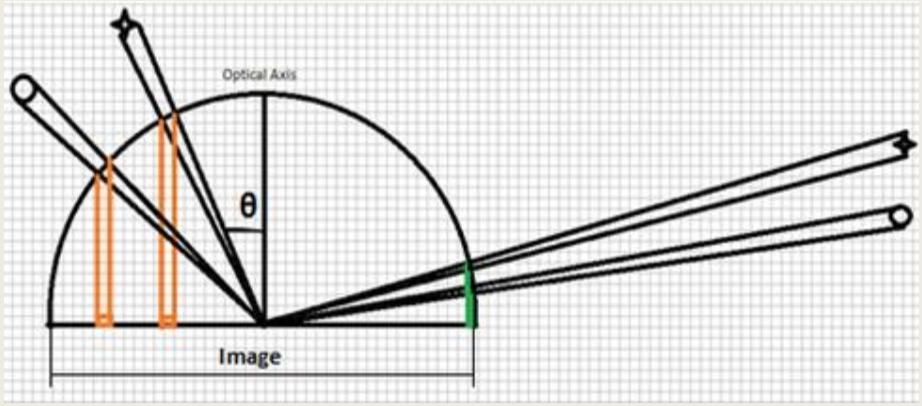
## Why is it done?

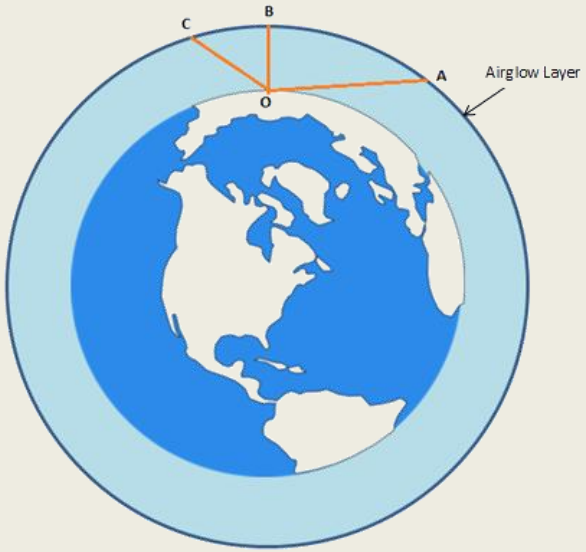
- Stars represent noise, not aurora/airglow
- They cause streaking in Rectilinear projection

## What is it?

- Removal of stars from calibrated images
- Uses statistical properties of pixels values to identify local peaks
- Interpolation over these pixels

# Brightness Normalization

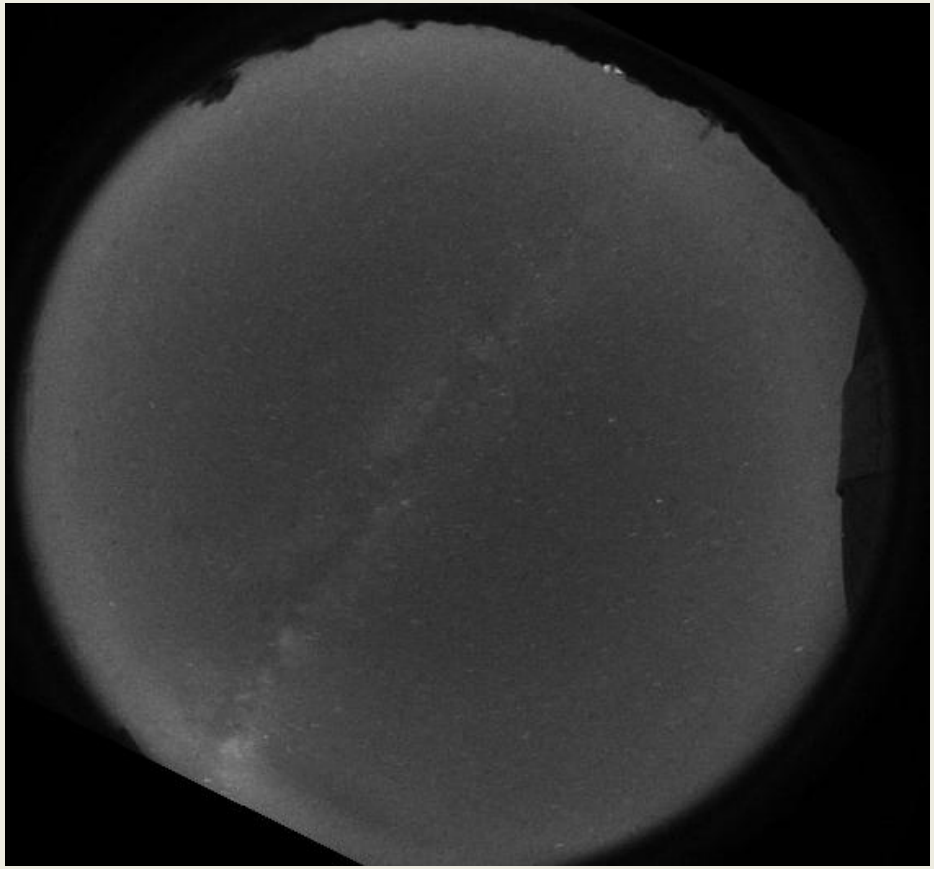


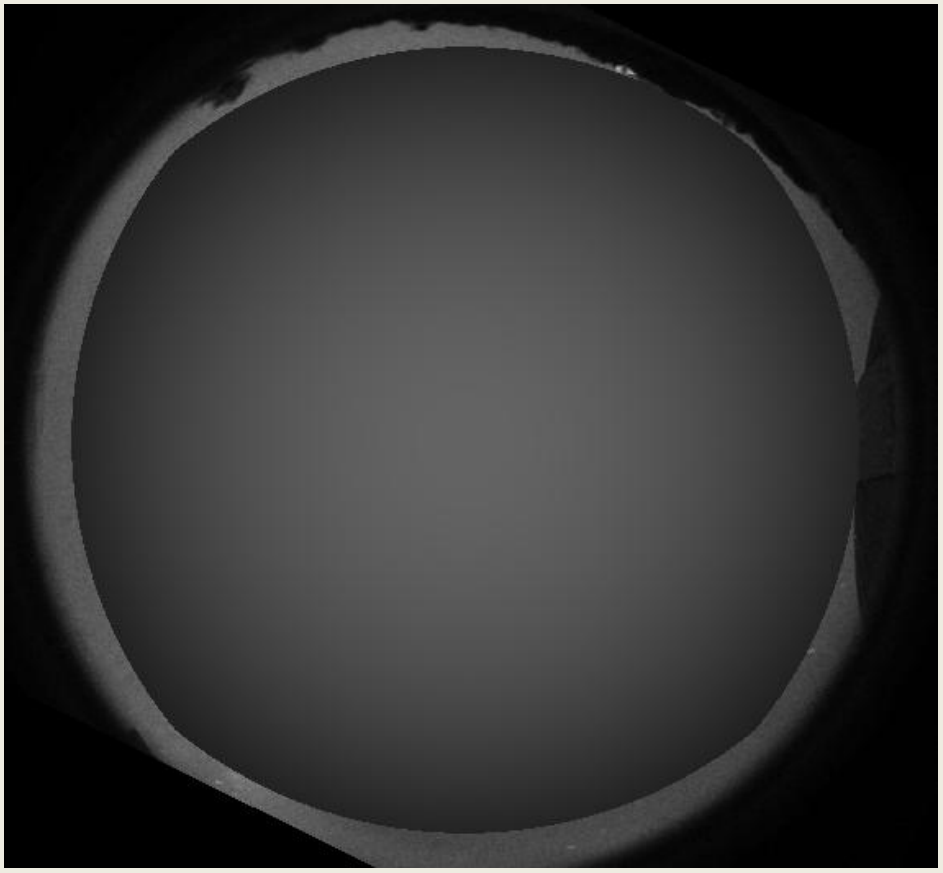

- Van Rhijn effect
  - Outer pixels are brighter for astronomical objects at low elevations
- Atmospheric extinction
  - Dust and gases reduce emissions from astronomical objects at low elevations

# Brightness Normalization

**With Van Rhijn Effect and Atmospheric Extinction**

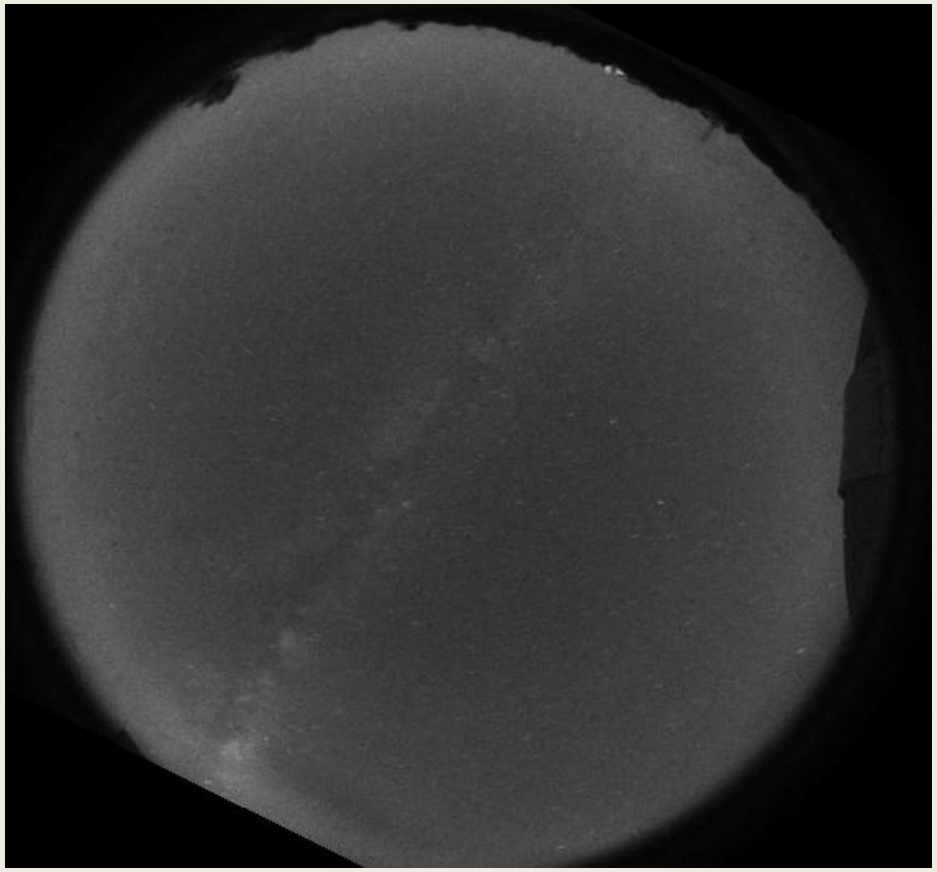


**Correction Filter**

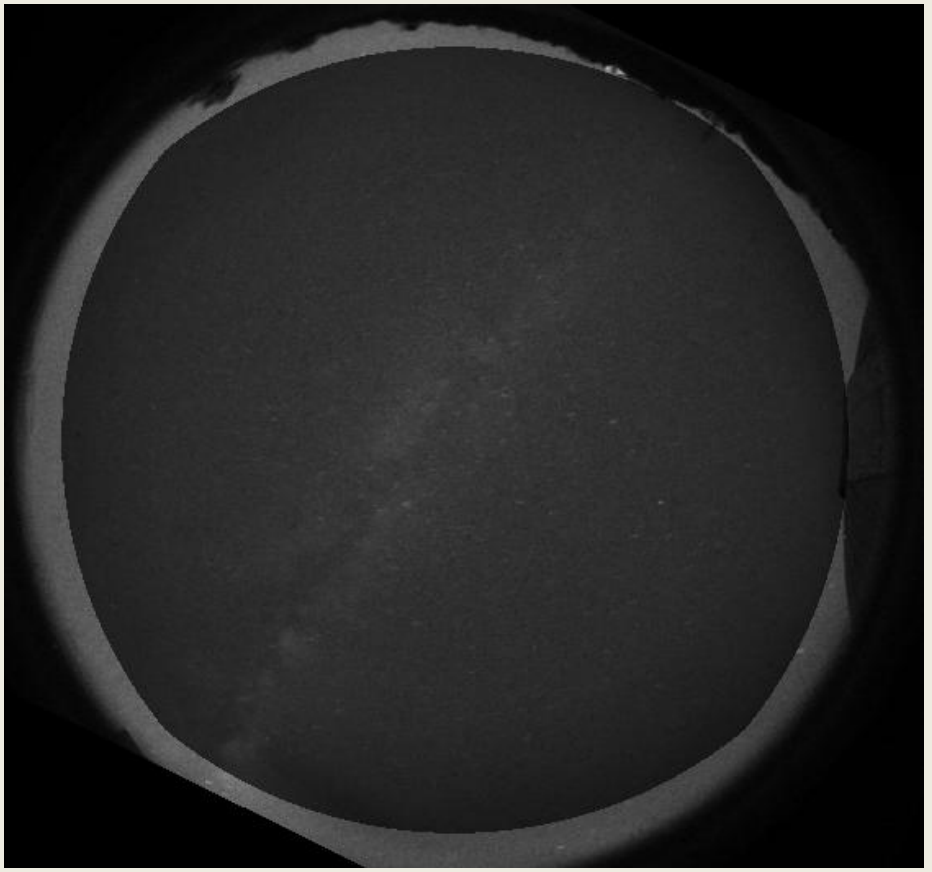


# Brightness Normalization

**Before**

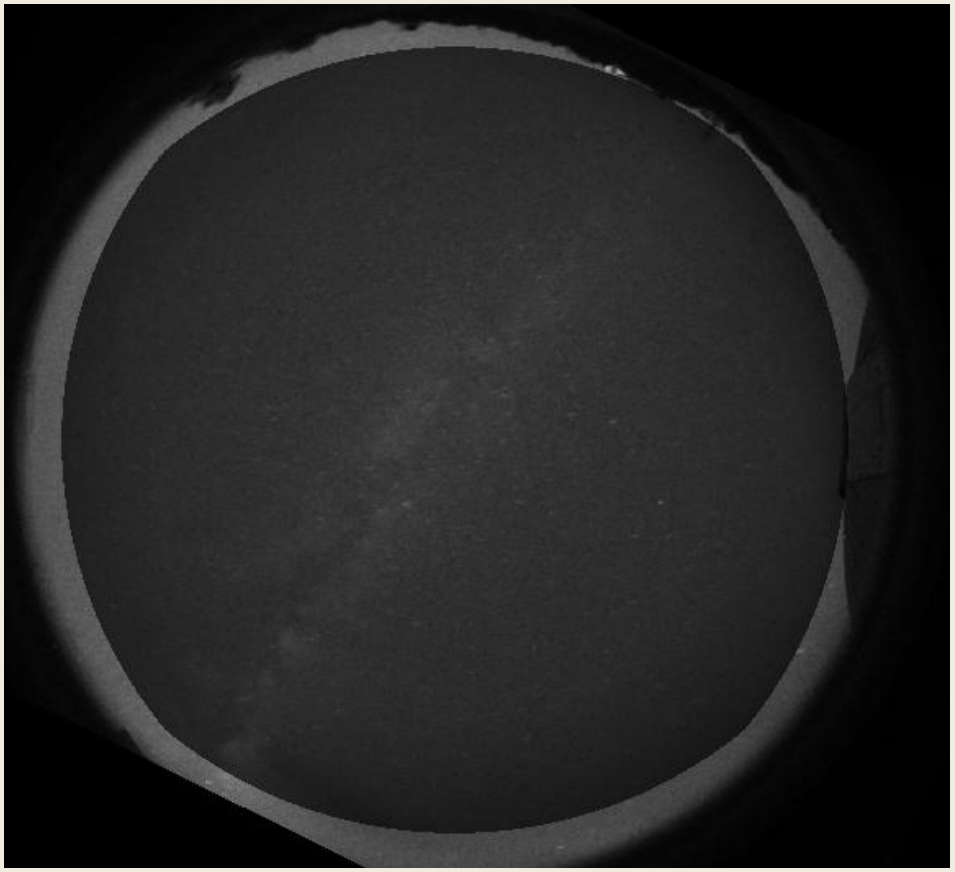


**After**

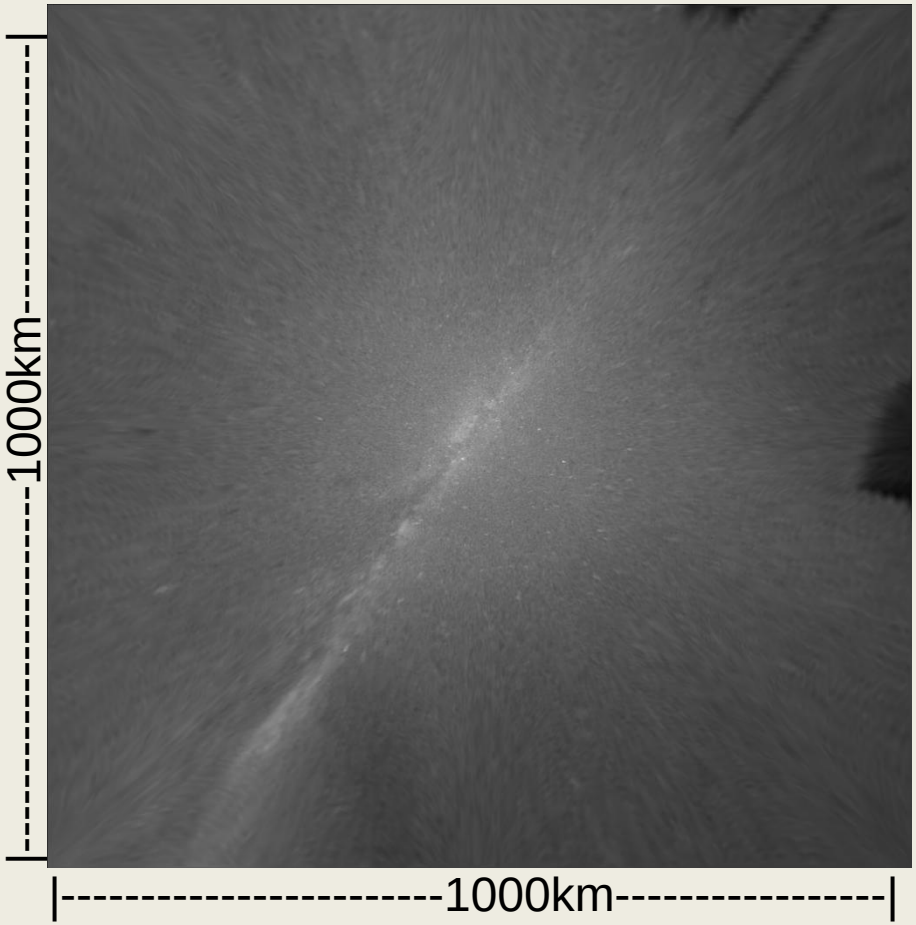


# Hemispherical to Rectilinear

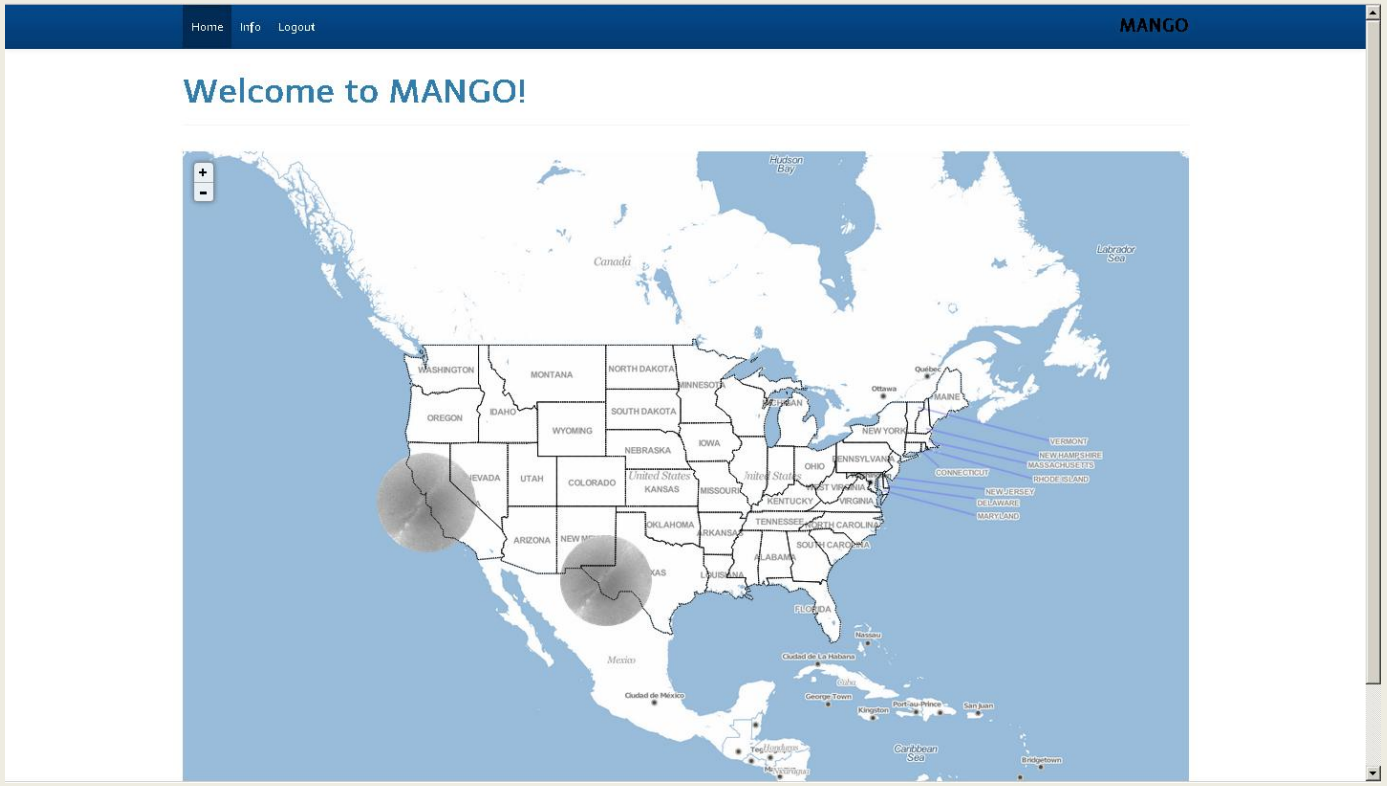
**Before**



**After**



# Visualization

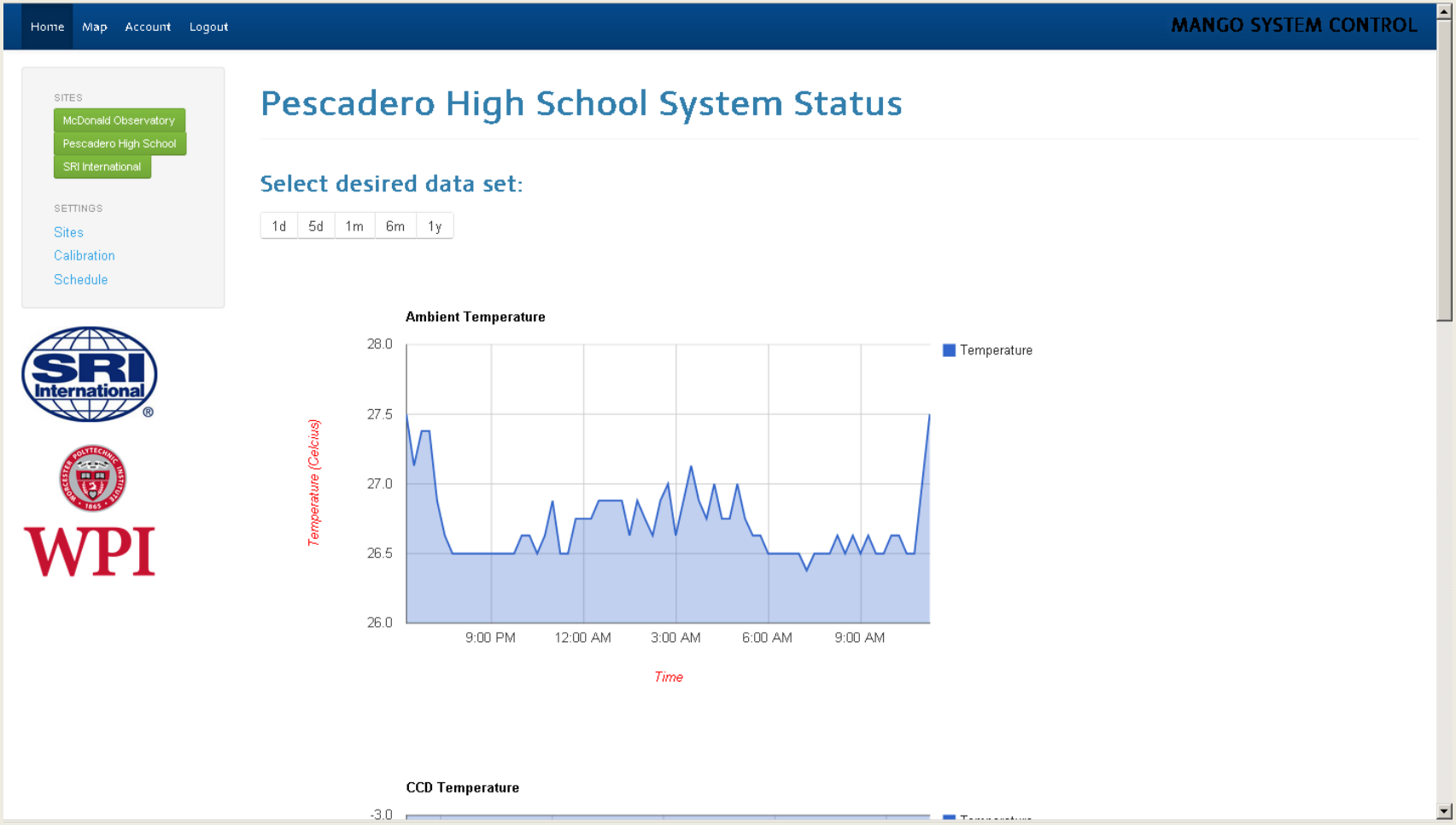



Map Overlay

Website

Flask
web development,
one drop at a time

# Visualization



# Acknowledgements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- Bob Marshall
- Jeffrey Baumgardner
- Curtis Carlson
- …many others!

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