Lighting Dark Places

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Introduction

Light pollution (LP), as defined by the International Dark Sky Association, is "any adverse effect of artificial light". Caused by unshielded, overly bright, and continuously lit residential/commercial lights, LP causes sleep disorders/anxiety, instigates diabetes, and halts the production of melatonin. Melatonin regulates wake and sleep cycles. Preliminary research has found melatonin can improve the immune system, as well as, prevent the onset and side effects of breast/prostate cancer.

The goal of my research at the NOAO was to inter-compare these LP measurement systems: Globe at Night (GaN), Dark Sky Meter (DSM), Loss of the Night (LoN), Digital Single-Lens Reflex (DSLR), and Sky Quality Meter with Lens (SQM-L).
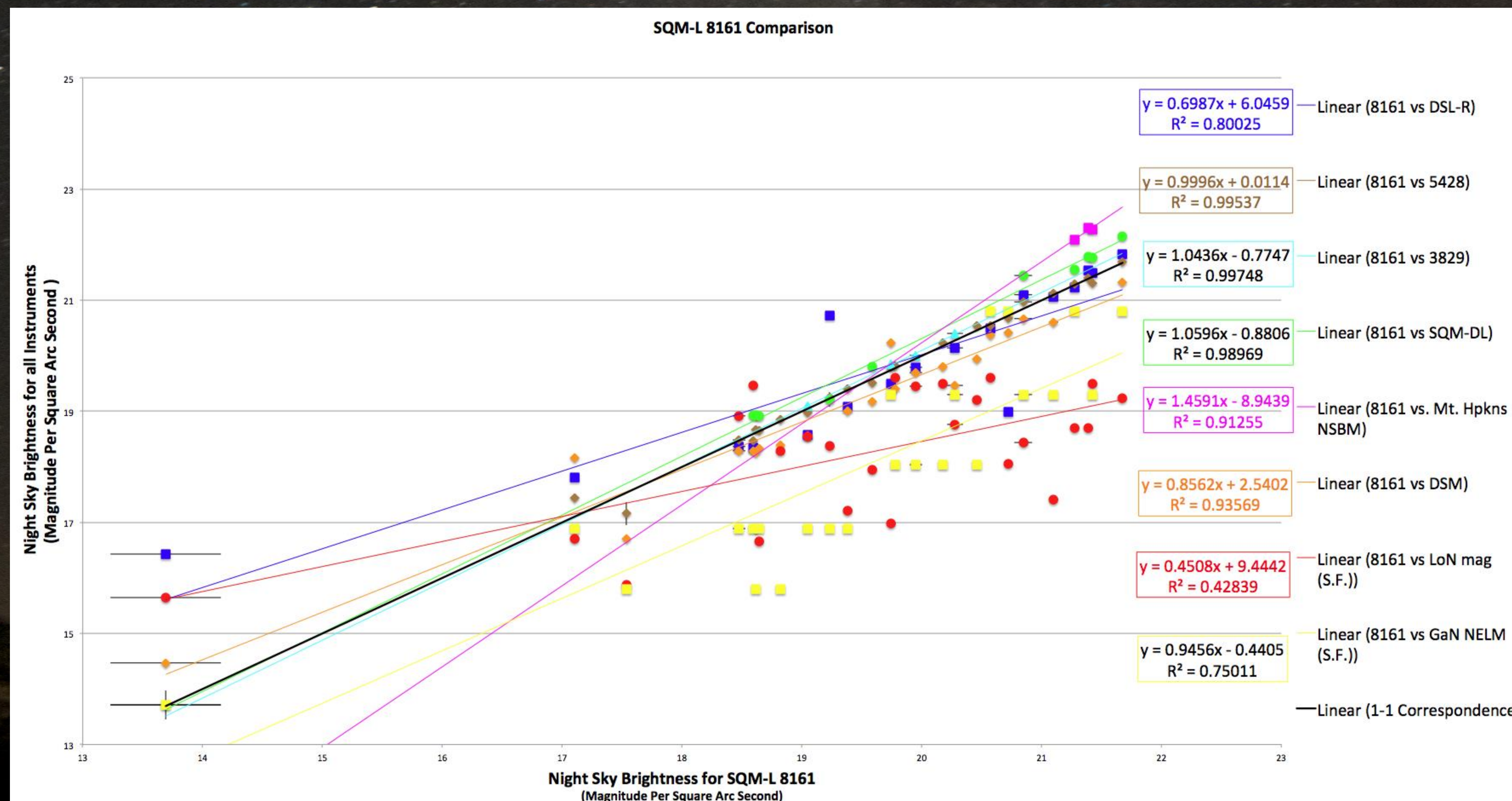
Visual Analysis
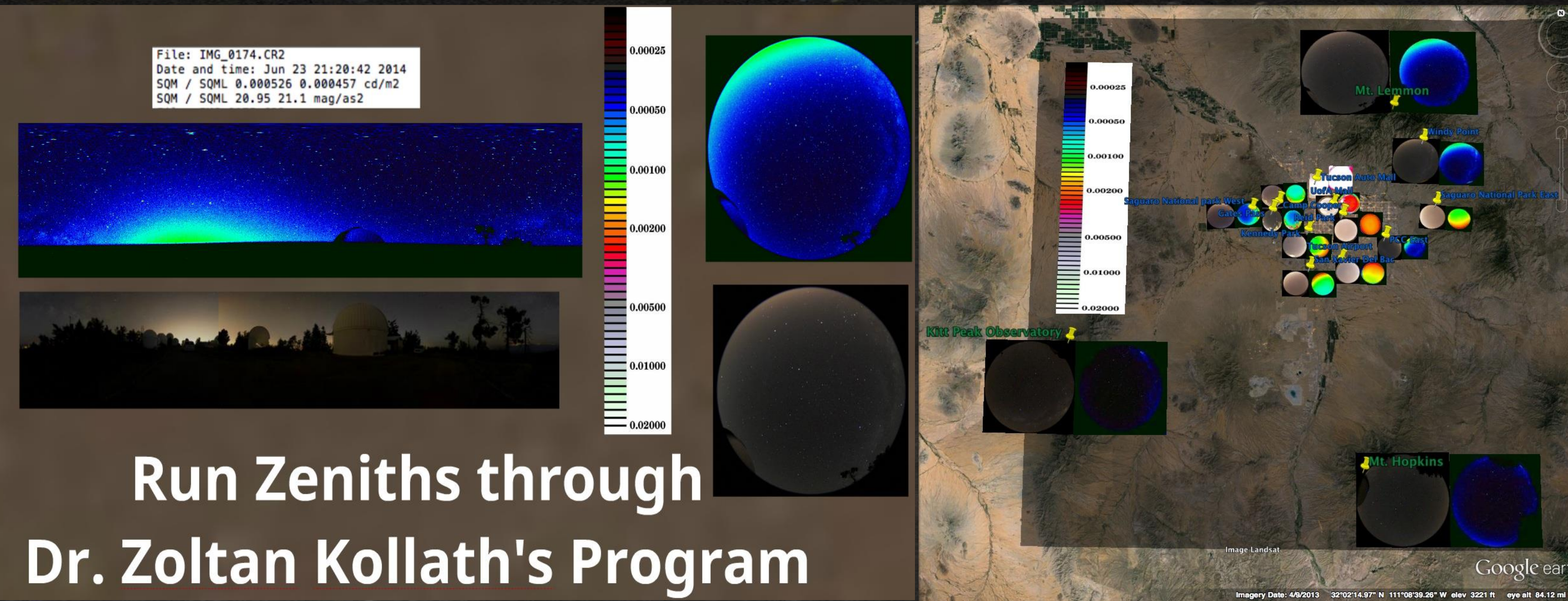
Run Zeniths through Dr. Zoltan Kollath's Program

Results

Focusing on the linear equations of the form y=Mx+b, the M-value depicts the correlation of that LP measurement device to the SQM-L 8161. M=1 and b=0 demonstrates a perfect correlation (1-1 Correspondence). The closer M is to one, the better the correlation. Therefore, GaN is the highest correlated cell phone application with M=.9456.

Data Acquisition

Step One: Panoramas

Step Two: Zeniths

Step Three:

Step Four: Loss of the Night Android Application

Step Five:

Step Six: SQM-L

Step Seven:

Conclusion

All three cell phone applications offer Dark Sky conservationists a window into an extraordinary future. With students, teachers, and community members recording LP data internationally, more sites can be identified as either: Dark Sky certified or in need of night sky conservation/education/legislation.

Next Steps for Research

Take more inter-city data to help strengthen the correlations and fill in the gap between 13 and 17 Magnitude Per Square Arc Second
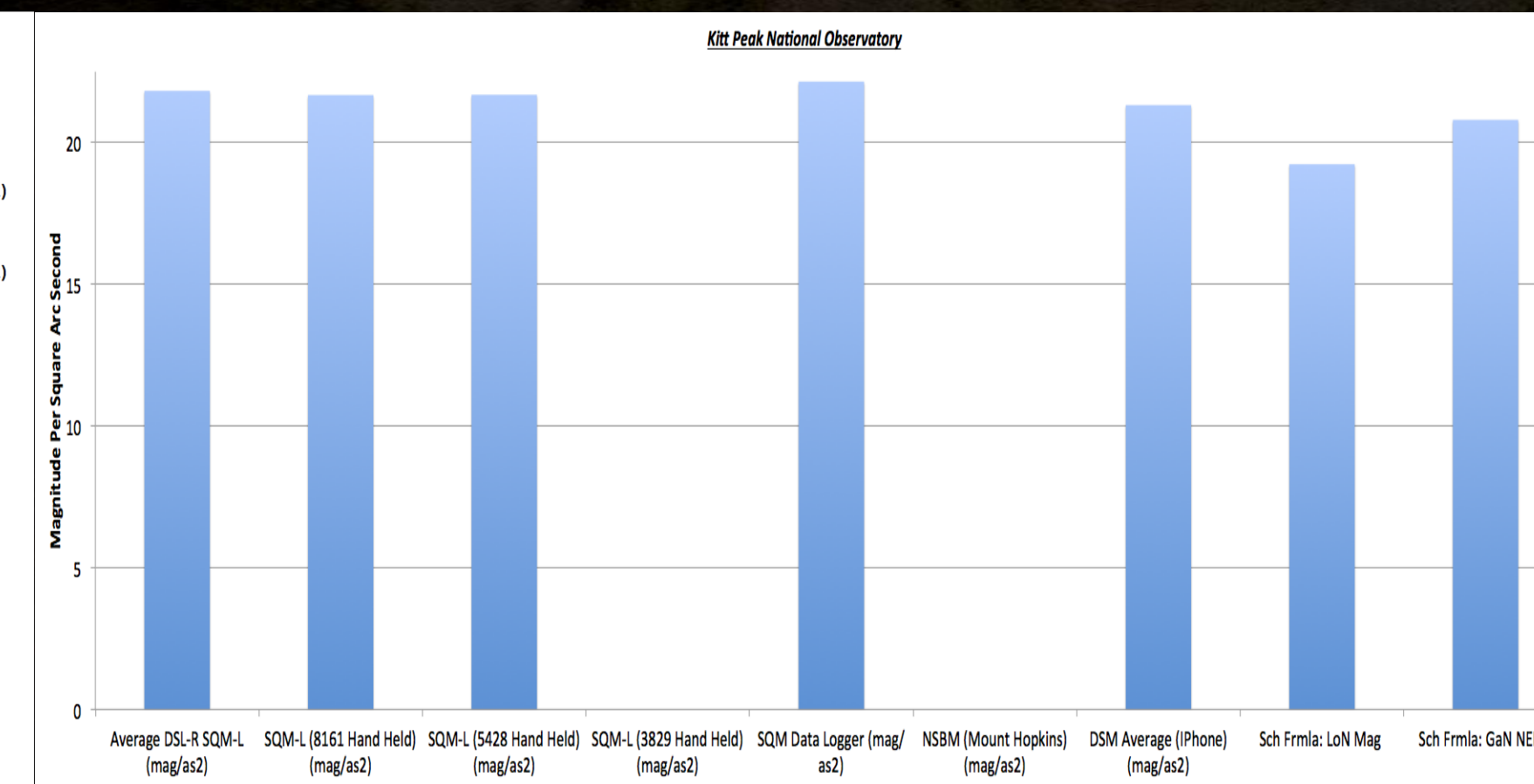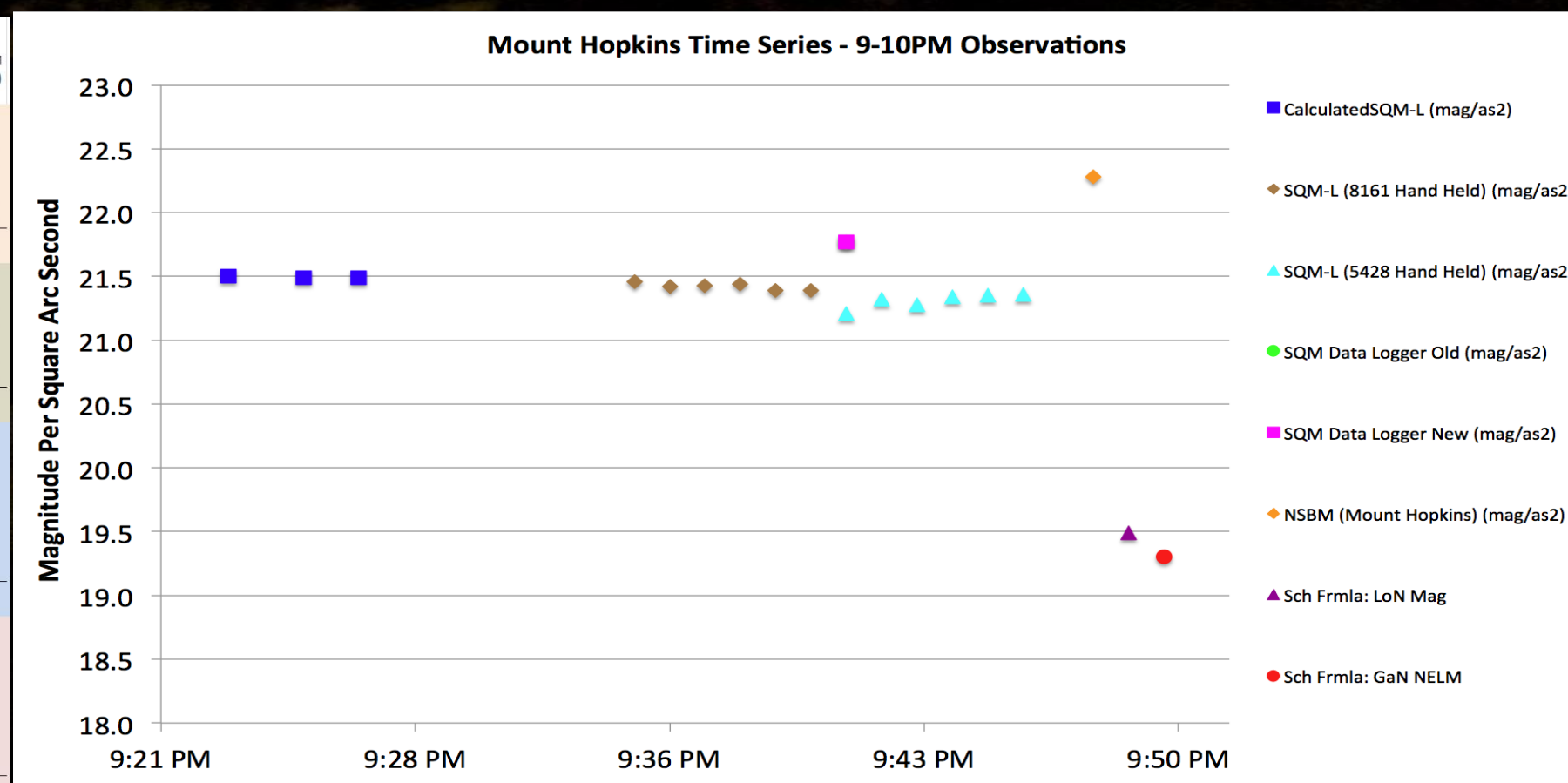
Take more Loss of the Night data to better constrain the correlation line of best fit

Conduct Tohono O'odham Nation Research

Create a Light Pollution Curriculum aligned with the United States of America Common Core and the Next Generation Science Standards

SQM-L 8161 Comparison

$y = 0.6987x + 6.0459$
$R^2 = 0.80025$ — Linear (8161 vs DSL-R)

$y = 0.9996x + 0.0114$
$R^2 = 0.99537$ — Linear (8161 vs 5428)

$y = 1.0436x - 0.7747$
$R^2 = 0.99748$ — Linear (8161 vs 3829)

$y = 1.0596x - 0.8806$
$R^2 = 0.98969$ — Linear (8161 vs SQM-DL)

$y = 1.4591x - 8.9439$
$R^2 = 0.91255$ — Linear (8161 vs. Mt. Hpkns NSBM)

$y = 0.8562x + 2.5402$
$R^2 = 0.93569$ — Linear (8161 vs DSM)

$y = 0.4508x + 9.4442$
$R^2 = 0.42839$ — Linear (8161 vs LoN mag (S.F.))

$y = 0.9456x - 0.4405$
$R^2 = 0.75011$ — Linear (8161 vs GaN NELM (S.F.))

— Linear (1-1 Correspondence)

Night Sky Brightness for all Instruments (Magnitude Per Square Arc Second)

Night Sky Brightness for SQM-L 8161 (Magnitude Per Square Arc Second)

Mount Hopkins Time Series - 9-10PM Observations

Kitt Peak National Observatory