Simulated Twilight Solar System Survey with Rubin

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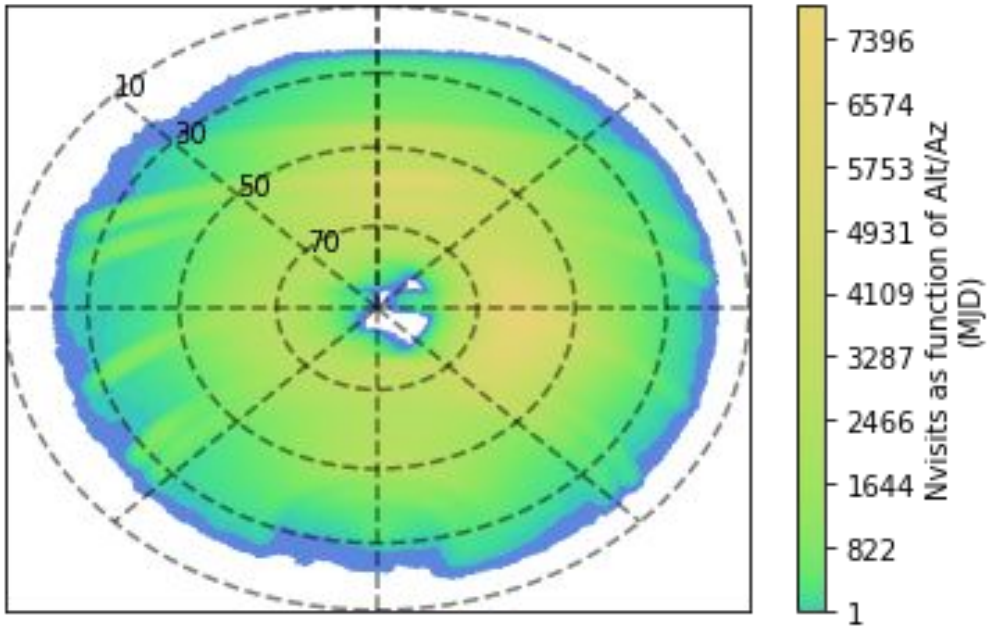
In earlier simulations (v1.7, v2.0), we tried taking 1s exposures in twilight pointing in the direction of the sun

- Didn’t seem to work well
- Very negative impact on the rest of the survey science
- Camera team suggesting we can’t move the shutter than often and maintain thermal control anyway

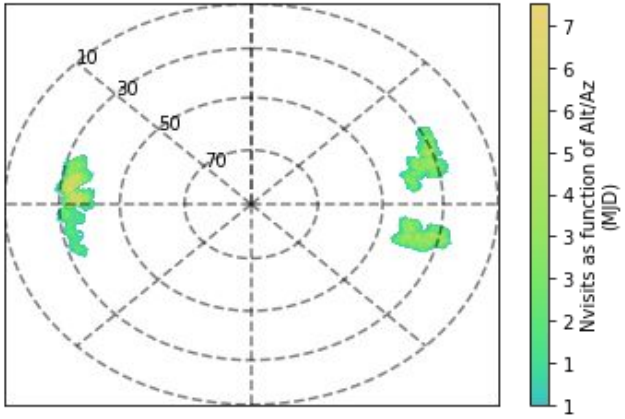
New v2.2 twilight observations
Observing at both evening and morning twilight (sun > -17 deg altitude)

- 15s exposures (1-snap visits)
- High airmass, in direction of sun
- Select a contiguous area
  - Observe 3x or 4x
  - Using z, one of iz, or one of riz filters in a twilight period
  - Observe 25%-100% of nights with varying patterns (three nights on/three off, etc)

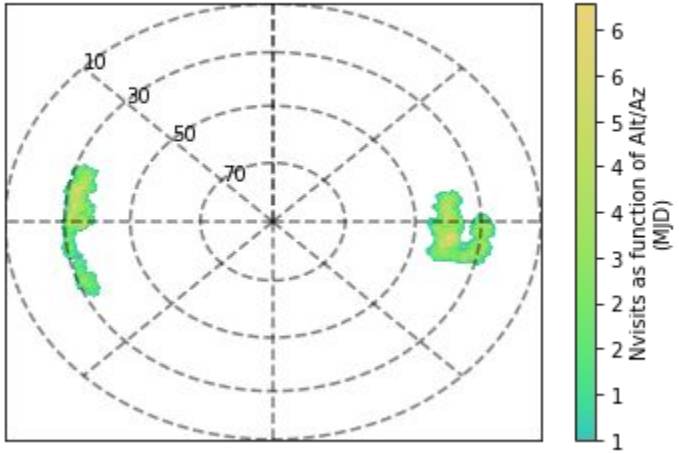
Alt/az distribution of regular survey observations



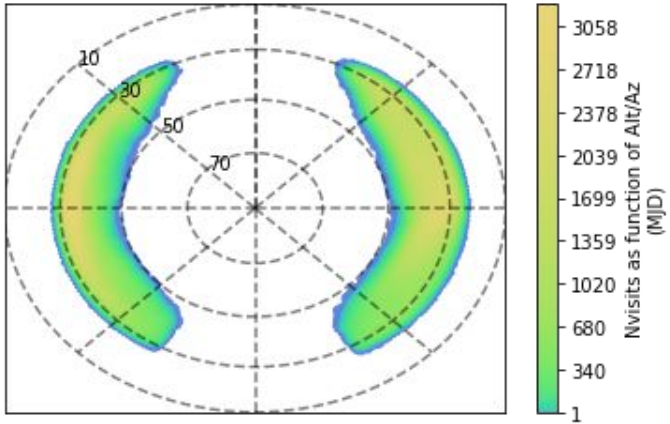
twi_neo_repeat3_iz_np1_v2.2 notetwilight_neo and night10: Nvisits as function of Alt/Az



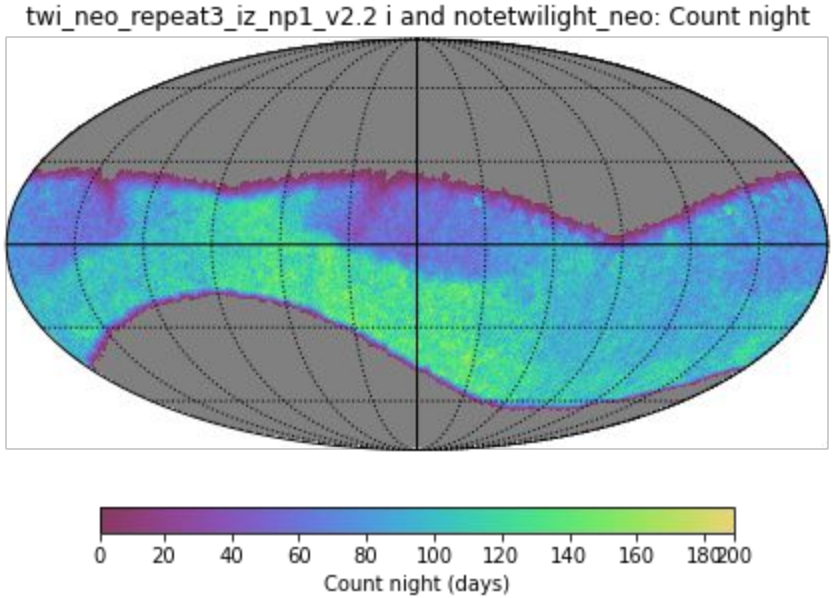
twi_neo_repeat3_iz_np1_v2.2 notetwilight_neo and night11: Nvisits as function of Alt/Az

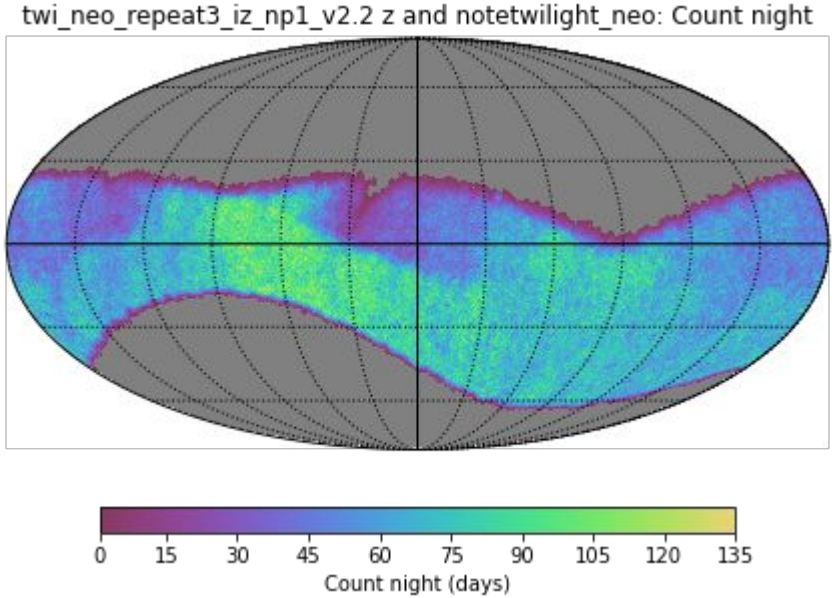


twi_neo_repeat3_iz_np1_v2.2 notetwilight_neo: Nvisits as function of Alt/Az



Alt/az distribution of twilight NEO observations. Select nights and full survey.

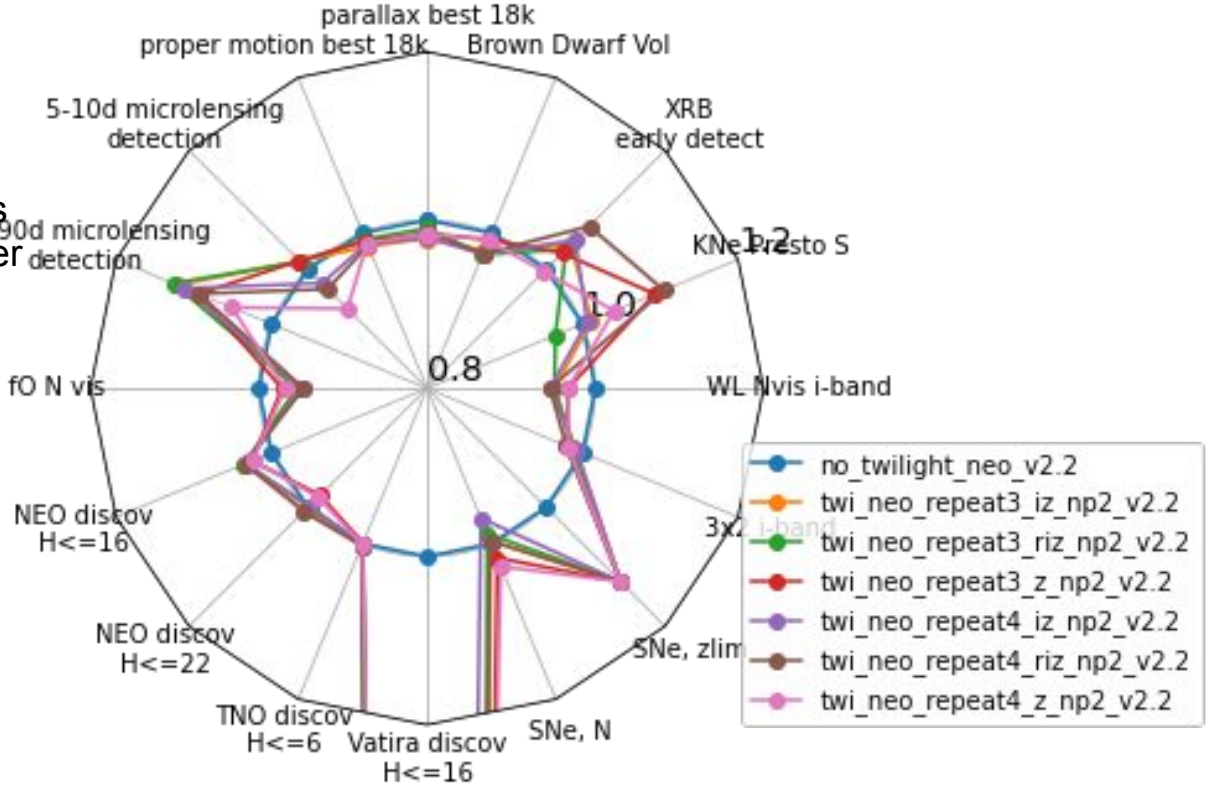




What twilight observations look like in RA,Dec space
300k visits = ~7.5% of the total time if observing every night

Science impact observing 50% of nights
Details of the science metrics in
https://smtn-017.lsst.io/

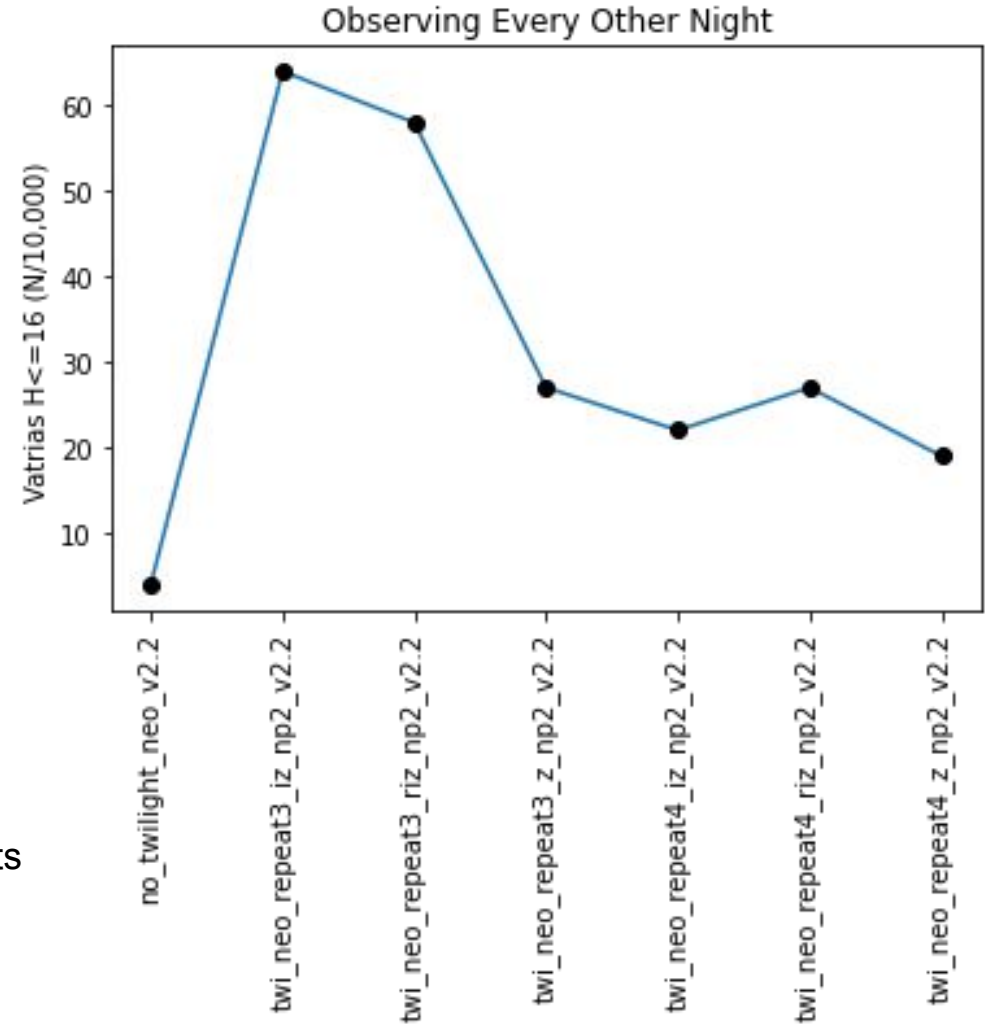
- Helps some transient science (XRB, long microlensing, SNe Ia)
- Small negative impact on some cosmology and astrometric metrics
- Huge boost in the expected number of Vatira detections



Different strategies observing every-other night

Better if we can get by with observing triples rather than quads. Looks like the bluer filters are slightly better.

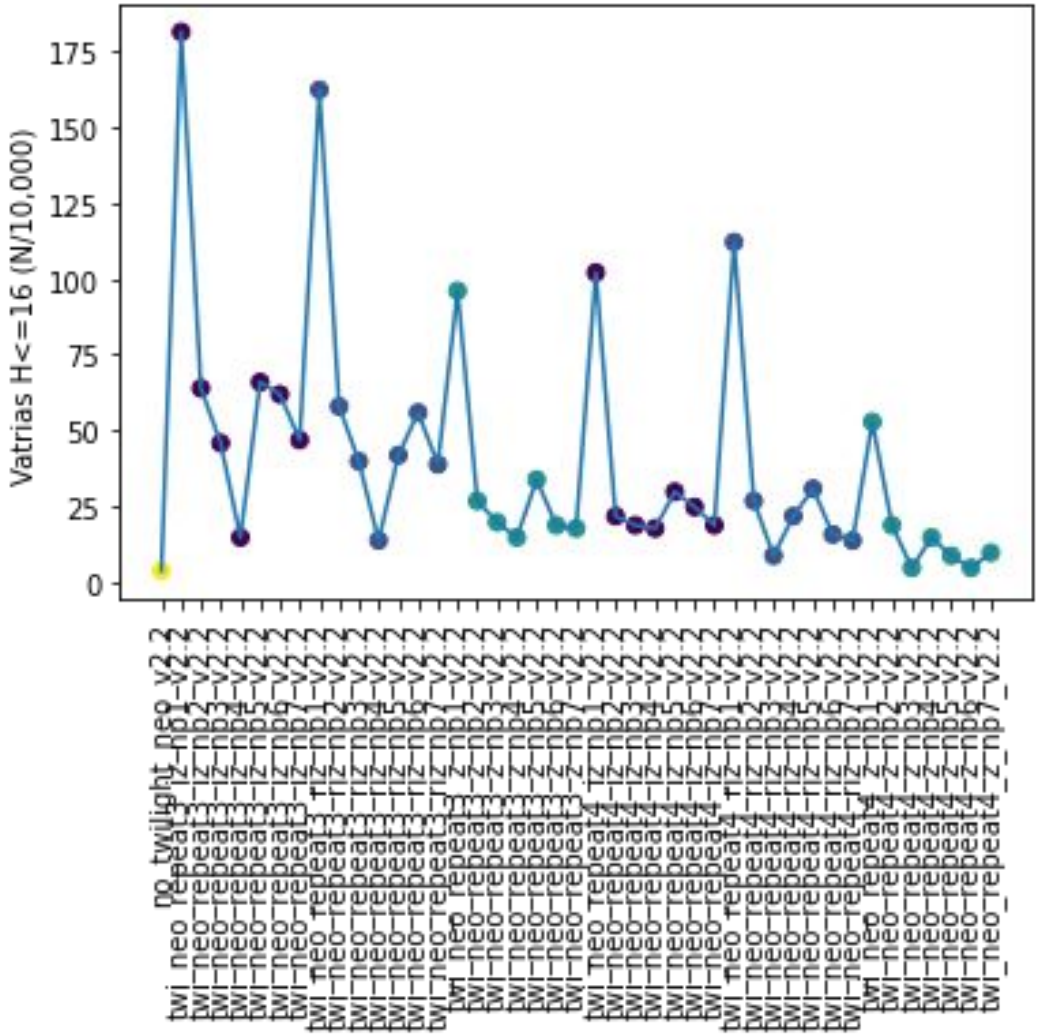
Factor of 5-15 increase in detections over no dedicated twilight survey



In case folks want to check, I'm looking at the:
CumulativeCompleteness H <= 16.000000
Discovery_N_Chances Vatira 3 pairs in 15 nights
detection loss MoObjSlicer
Metric output

All the runs

Observing every night gives a big boost, but then we start having >10% decreases in other metrics

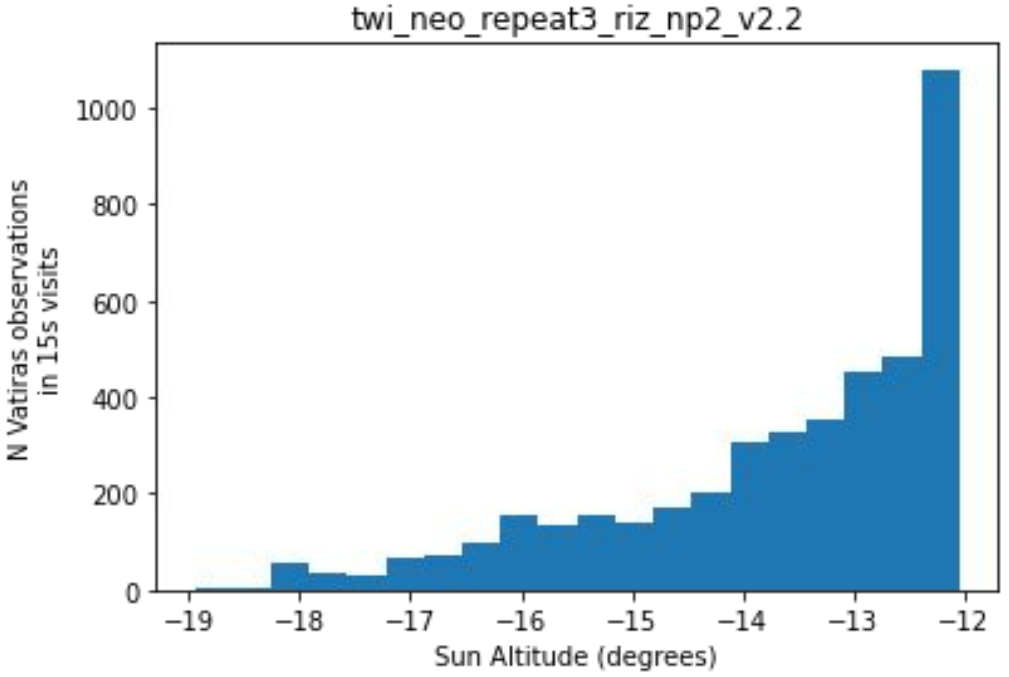
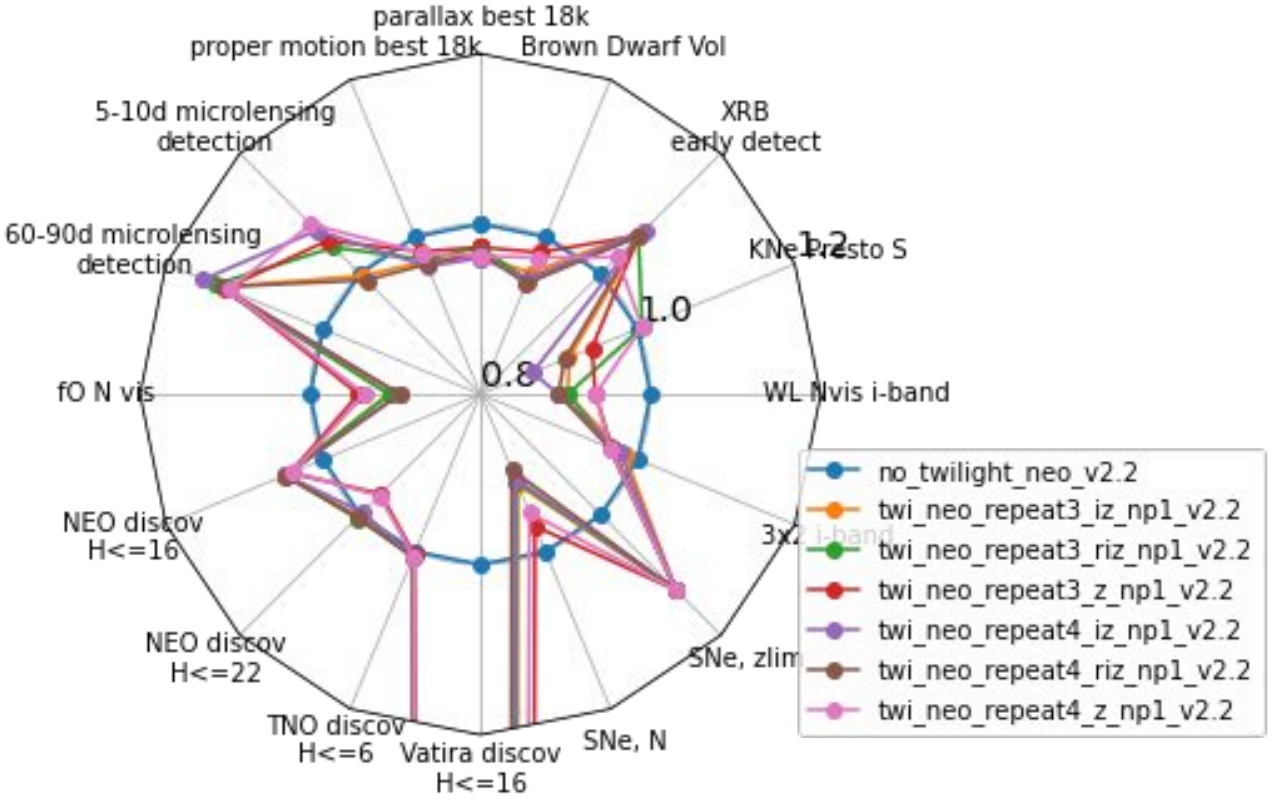


Conclusions

- Looks like it works now, we detect many more Vatira objects, minimal impact on the other science metrics

Next steps

- Can we go down to even less twilight time? sun alt > -15? Do we have to close at -12 degree twilight, or can we push a little farther?
- Think more deeply about filter selection
- Do we need 3 or 4 observations in a night?



Observing twilight program every night. Start to see large impacts on other science metrics