

Remotely judging the weather on MK

“How does Gemini do it?”

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What is weather?

- ➔ 1.) Astronomical 'weather'
- ➔ 2.) Telescope 'weather'

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➔ 1.) Astronomical 'weather'

- Cloud Cover (CC)
- Seeing (IQ)
- Water vapour (WV)
- Background (BG)

➔ 2.) Telescope 'weather'

What is weather?

➔ 1.) Astronomical 'weather'

- Cloud Cover (CC)
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➔ 2.) Telescope 'weather'

- Humidity/fog/valley clouds
- Low/rain clouds (above or maybe close to dome)
- Ice, snow, sleet, ...
- Dust
- Wind

Our approach in going remote?

- ⇒ replace any 'going outside' with new tools
- ⇒ our goal: new tools are as good or better as before
- ⇒ not goal: upgrade all of our old tools

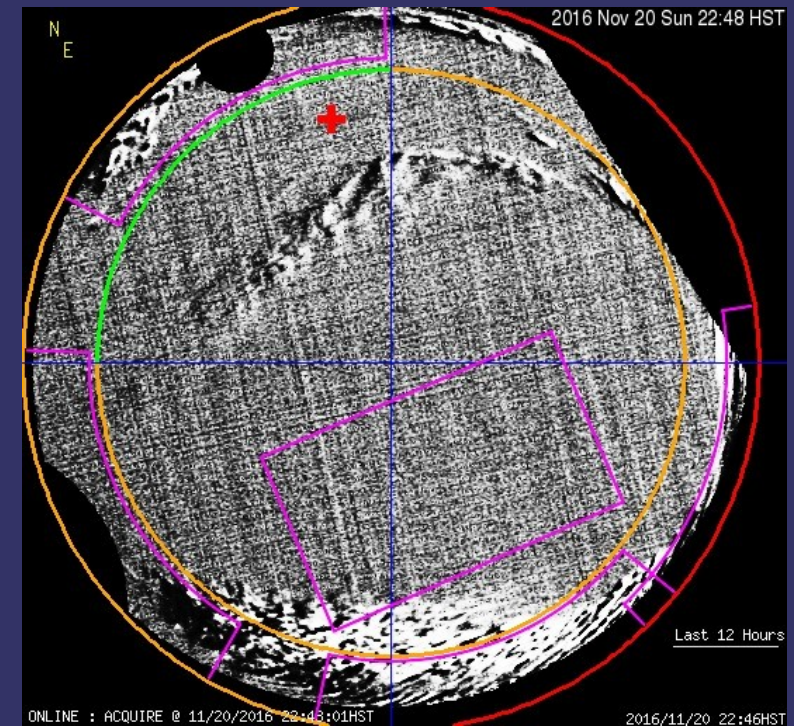
How do we sense it?

⇒ Cloud Cover:

- Ext. tools:
 - CFHTs ASIVA, skyprobe, cloudCam, Kecks cosmic camera
- Our old tools:
 - guide counts
 - only rough estimate unless clear patch in between
 - need to disentangle seeing effects
 - quick analysis pipeline (QAP) for GMOS img → not fully comm.
 - check outside: eye → takes time to adapt
NVG → thin, slow moving clouds hard to spot



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▶ CloudCam movies are even better than being outside

How do we sense it?

⇒ Image Quality:

- Ext. tools:
 - CFHTs tower DIMM
 - ask around (phone, Slack)
- Our old tools:
 - calibrated guider (Altair)
 - uncalibrated guiders → rough idea + trend
 - measurements (e.g. QAP) on images/spectra → delivered IQ
- Our new tools:
 - none
 - should we put our measurements on webpage?

How do we sense it?

⇒ Water Vapour:

- Ext. tools:
 - CSO 225 GHz corrected
 - if CSO down, we use JCMT
- Our old tools:
 - none
- Our new tools:
 - none

How do we sense it?

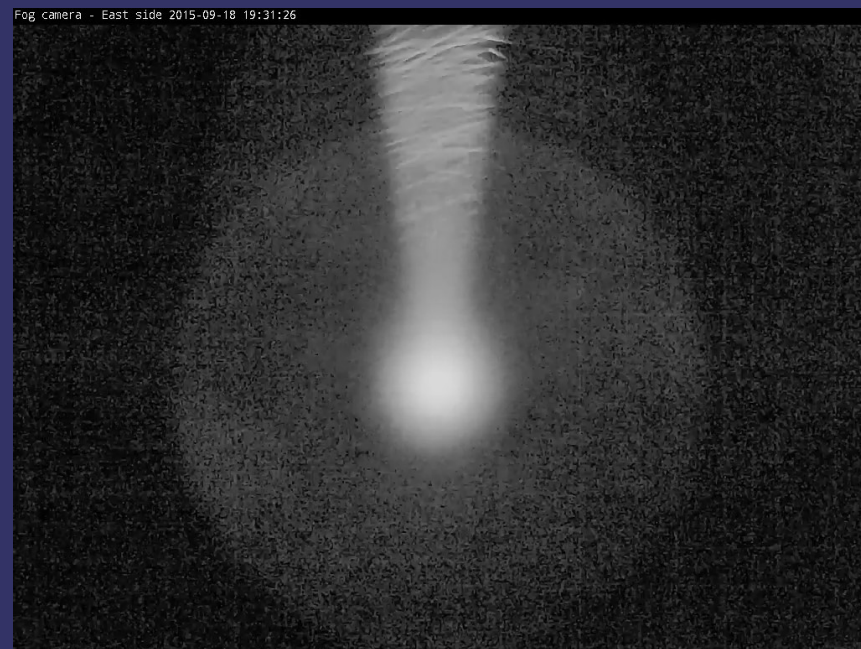
⇒ Background:

- Ext. tools:
 - none
- Our old tools:
 - calculated from model (sun, moon, target)
 - quick analysis pipeline (QAP) for GMOS img → not fully comm.
- Our new tools:
 - none

How do we sense it?

⇒ Humidity/fog/valley clouds:

- Ext. tools:
 - rel. humidity measurements of other telescopes (CFHT/UKIRT)
- Our old tools:
 - check outside: touch metal → very easy to spot condensation
flashlight → very efficient to spot fog
 - check in dome: touch metal



- Our old tools:
 - ~~check outside: touch metal → very easy to spot condensation~~
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- Our new tools:
 - 2 new humidity sensors to E/W of our support building
 - East cloudCam is actually HiloCam → rolling in clouds easily seen
 - fogCamera plus flashlight (East) → still able to spot East fog

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▶ East fog covered pretty well, but humidity (condensation) not so

How do we sense it?

⇒ Low/rain clouds:

- Ext. tools:
 - humidity sensor on top of CFHT dome
 - ask around (phone, Slack)
- Our old tools:
 - check outside: twilight → easy to look for mammatus clouds
flashlight → very hard to spot clouds above dome
 - twilight: roofCam

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- Our new tools:
 - 4 precipitation sensors on our support building
 - twilight: fogCam, UH88Cam, CFHTCam
 - night: 5 cloudCams

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▶ rare; warning less good, but start even better detected

How do we sense it?

⇒ Ice, snow, sleet ...:

- Ext. tools:
 - ice road monitor at UKIRT
 - ask around (phone, Slack)
- Our old tools:
 - check outside: ice on railing (~3mm) → linked to ice on dome
 - check outside: ice on road → decision to evacuate
 - dayCrew inspects dome → only M-F and start of night
 - twilight: roofCam

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 - snow and ice sensor on our support building
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UH88Cam + fogCam flashlight



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UH88Cam + fogCam flashlight

▶ harder to spot, so more conservative, but crew safe

How do we sense it?

⇒ Dust:

- Ext. tools:
 - none
- Our old tools:
 - particle sensor → only inside, uncalibrated (see Sunny's talk)
 - check outside: particles (thick) in flashlight
 - check outside: 'dust in mouth' → time to close
 - check in dome: flashlight, wiped CDROM



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 - (domeCams + light)

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▶ not very well at summit, worse from down here

How do we sense it?

⇒ Wind:

- Ext. tools:
 - CFHT weather tower, UKIRT windspeed
- Our old tools:
 - anemometer inside dome (at M1/M2)
- Our new tools:
 - none

Conclusions

- ➔ No need to be at summit (as the others proved well before)
- ➔ CloudCam movies beats being up there
- ➔ CloudCam movies show ASIVA not 100% but ~98%
- ➔ Need to be more conservative
 - more downtime, less pushing limits
 - but, most timeloss is bad weather data anyway
- ➔ Dust monitoring is weakest link
- ➔ Leaky shutter plus run-off requires tricky remote dome drain