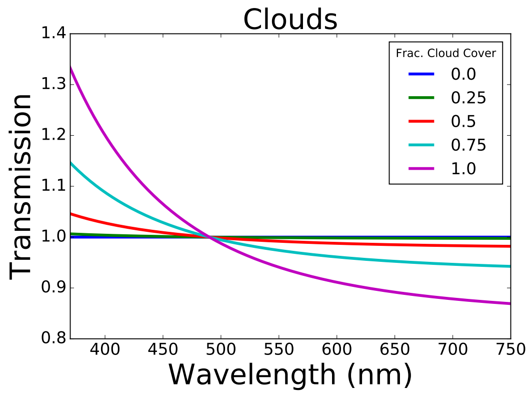
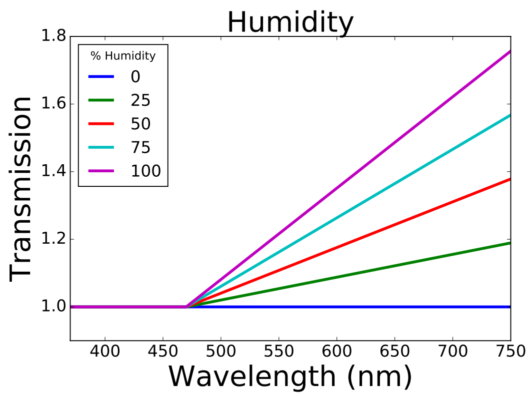
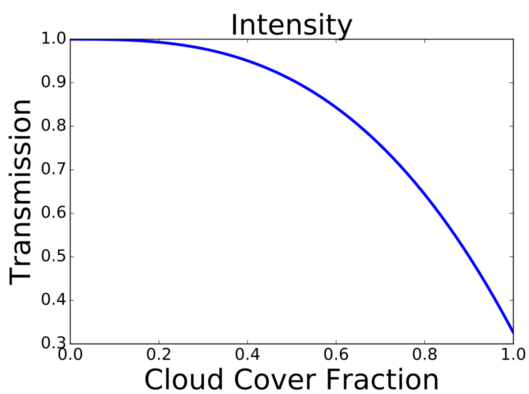


(a)



(b)



(c)

FIG. 1: Atmospheric conditions have a small impact on the spectrum of downwelling irradiance and a large impact on the intensity of such light. (a) shows the factor by which the irradiance at a given wavelength is reduced or increased at varying cloud cover, relative to the transmission at 490 nm, according to the model from [1]. In (b) we apply a bilinear fit to data from [2] to model the transmission of light as a function of wavelength at varying percent humidity, relative to transmission at 490 nm. In (c) we plot a relation between cloud cover fraction and total light transmission across the visible spectrum, as reported in [1]

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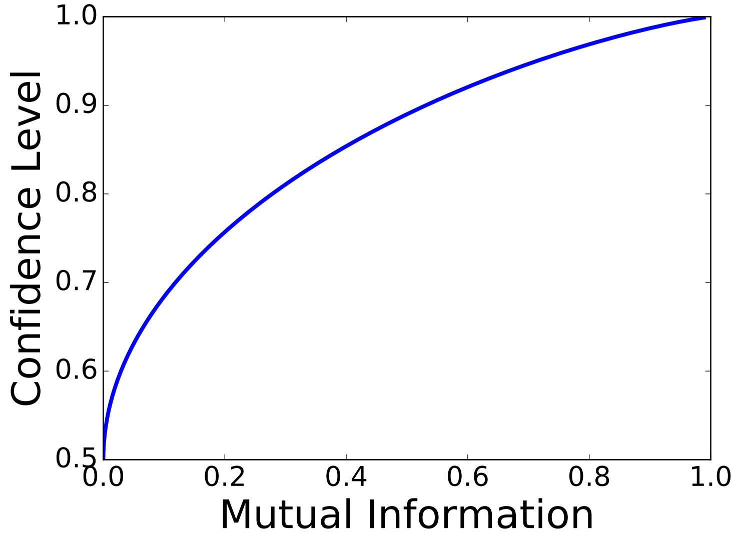

FIG. 2: Mutual information in bits is a measure of the confidence level in distinguishing two days of the lunar cycle based on the received spectrum or intensity of skylight. 1 bit of information corresponds to a perfectly ability to distinguishing two days of the lunar cycle. 0 bits corresponds to a confidence level of 0.5, i.e., a $50-50$ chance of infering the correct day from light. $MI(p) = 1 + p\log_2(p) + (1-p)\log_2(1-p)$ where p is the confidence level.

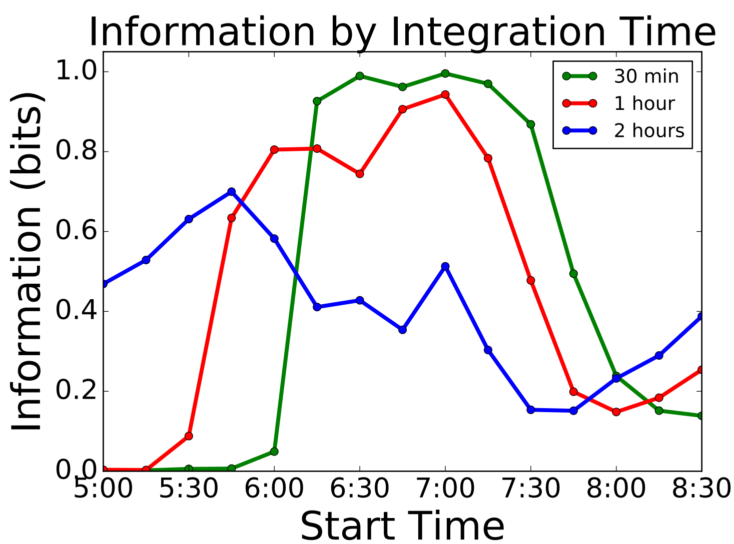

FIG. 3: Information in twilight spectrum to distinguish days 0 and 2 for varying integration periods. We assume two opsins, peaked at 440 nm and 550 nm. Start and stop times are drawn from a Gaussian distribution with standard deviation $t/6$ for a given integration time t. Solar and lunar elevations and lunar phases are drawn from the Great Barrier Reef in July 2015.

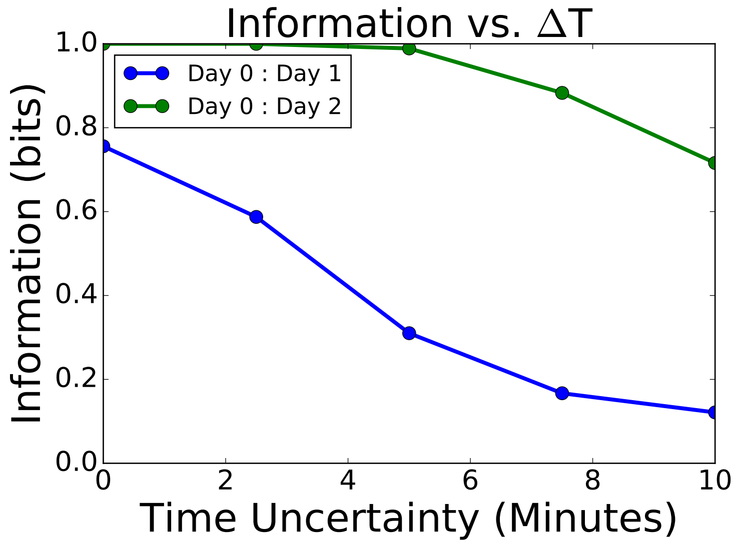

FIG. 4: Uncertainty in integration time reduces information since skylight spectrum has a rapidly time-varying profile over twilight hours. Information in irradiance spectra to distinguish days 0 vs 1 (blue) and day 0 vs 2 (green) as a function of variance in starting and stopping of integration times. We assume two opsins peaked at 440 nm and 550 nm respectively that integrate the photon catch over between 6:30 pm to 7:30 pm but with uncertainty in these start and stop times. Solar and lunar elevations and lunar phases are drawn from the Great Barrier Reef in July 2015.

[1] Jasmine S Bartlett, Áurea M Ciotti, Richard F Davis, and John J Cullen. The spectral effects of clouds on solar irradiance. *J. Geophys. Res.*, 103(C13):31017–31031, December 1998.

[2] A R Bioleau. Some spectral sky radiances with different relative humidities. 1960.