



**Figure S5:** Assessment of potential systematic biases on retrievals. **a)** Basin-desert dP (retrieved – a priori surface pressure, Pa) vs. basin-desert  $X_{CO_2}$  enhancement. **b)** Basin-desert signal\_o2 (A-band spectral radiance,  $W\ cm^{-2}\ sr^{-1}\ (cm^{-1})^{-1} * 10^7$ ) vs. basin-desert  $X_{CO_2}$  enhancement. **c)** Basin-desert aod (aerosol optical depth) vs. basin-desert  $X_{CO_2}$  enhancement. **d)** Basin-desert blended\_albedo vs. basin-desert  $X_{CO_2}$  enhancement. The lack of correlation indicates none of these parameters are responsible for the observed basin enhancement.