

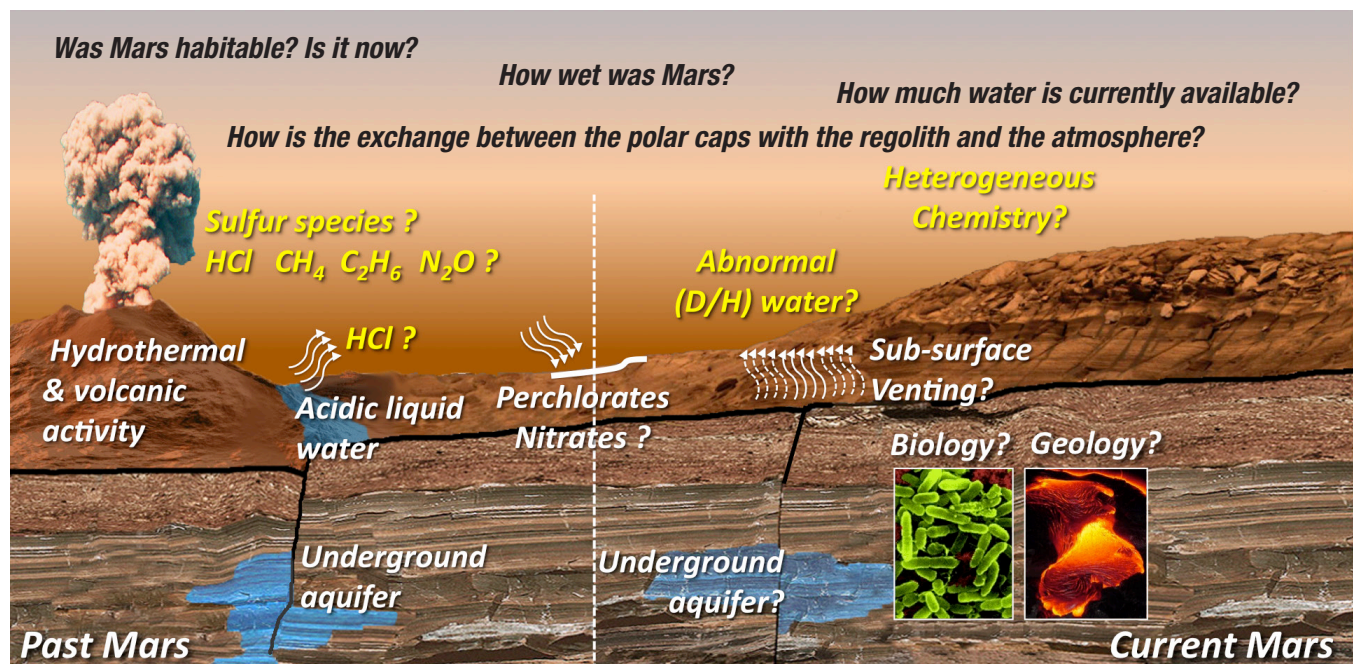
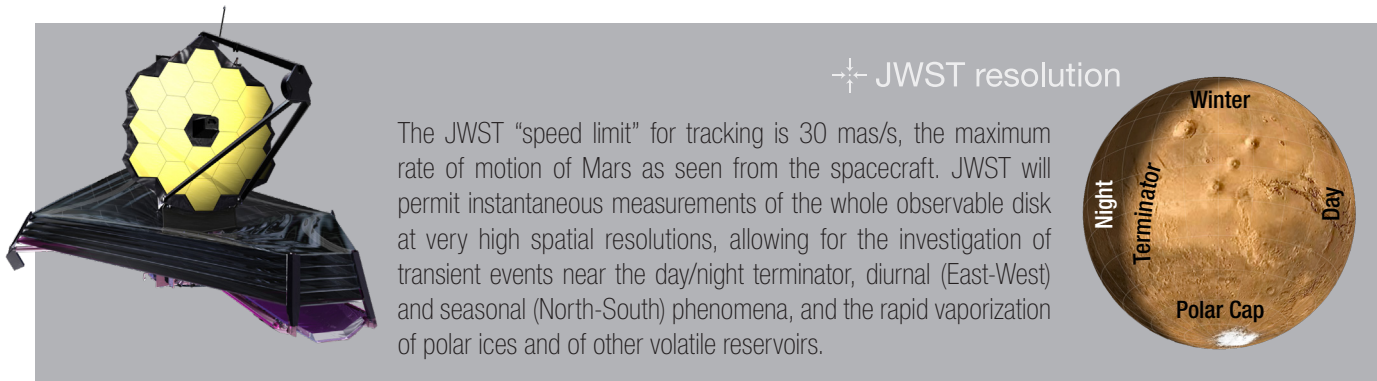
# NASA's James Webb Space Telescope:

## Observations of Mars

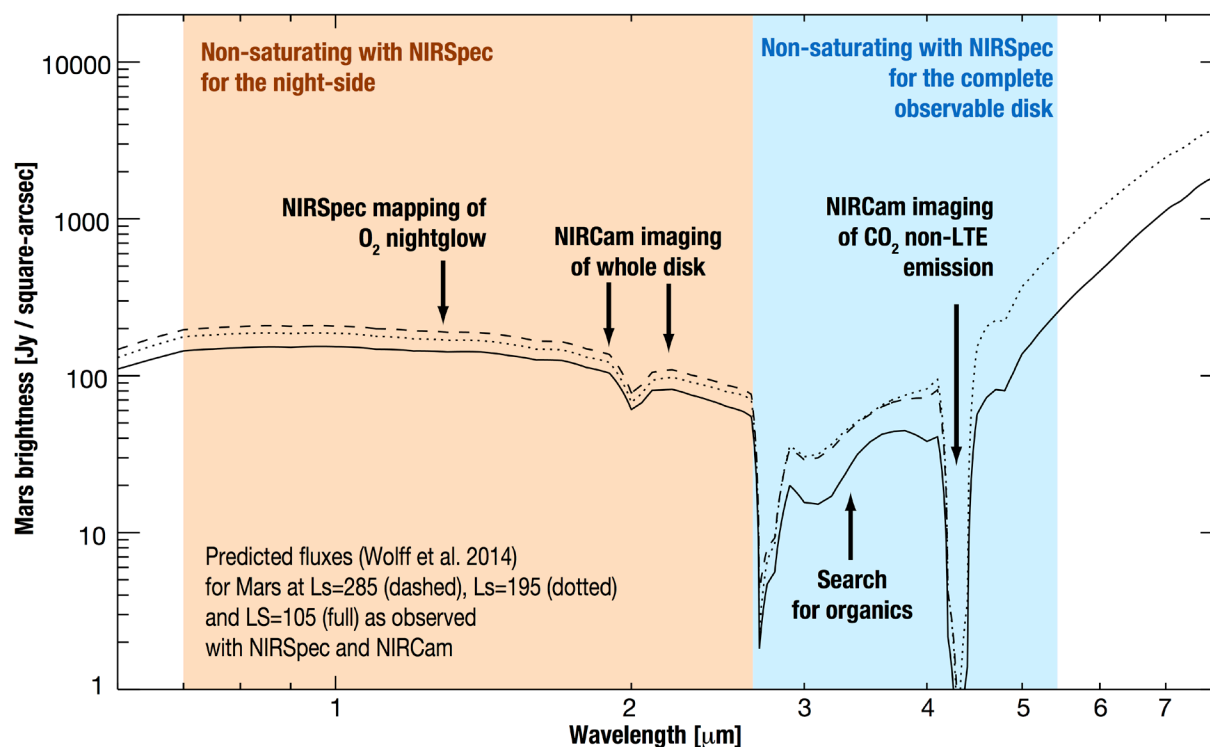
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**Does the atmosphere of Mars reveal a more habitable past? Are there unidentified sources of water on Mars? What processes alter the chemical stability of its atmosphere?** These are some of the questions that JWST can address by performing isotopic studies of molecular species (e.g., HDO/H<sub>2</sub>O), and by investigating the role of trace species in the atmospheric photochemical cycles. The atmosphere acts as a buffer between the main reservoirs of H, C and O (e.g., regolith, polar caps, rocks) and the exosphere, consequently atmospheric isotopic/abundance ratios and their variability provide key diagnostics quantifying the exchange between these environments.

Characterization of these processes require high-spatial resolution, global coverage, superb spectroscopy and unprecedented time cadences, all qualities provided by the James Webb Space Telescope (JWST), due to its unique vantage point at the second Sun-Earth Lagrange point (L2) and its powerful suite of instruments. The broad spectral coverage provided by JWST will permit the characterization of the formation and evolution of global dust storms and cloud systems over volcanoes, while its spectral resolution allows the search for trace photochemical species and isotopic compounds.



# Spectroscopy and Imaging of Mars



JWST will permit observations of Mars at infrared wavelengths with NIRSpec and NIRCam—predicted fluxes are shown for three seasons/aerocentric longitudes (Ls). Specifically, NIRSpec observations are feasible with sub-array readouts in the 2.7 to 5.2  $\mu\text{m}$  spectral region for the complete observable disk, and from 0.7 to 5.2  $\mu\text{m}$  in the night regions. Observations with NIRCam are accessible with two narrow filters near 2  $\mu\text{m}$  for the complete disk, and with several filters from 0.5 to 2  $\mu\text{m}$  across the night regions. Mapping of CO<sub>2</sub> non-LTE emission at 4.3  $\mu\text{m}$  will be also possible with NIRCam's F430M filter.

## Near-Infrared Spectrograph (NIRSpec)

- Narrow slit spectroscopy
- ~100 km resolution at equatorial latitudes
- Moderate spectral resolution ( $\lambda/\delta\lambda \sim 2700$ )
- 0.7 to 5.2  $\mu\text{m}$  accessible with sub-array readouts
- Measurements of D/H, O<sub>2</sub> nightglow, dust and clouds, CO<sub>2</sub> non-LTE emission and sensitive searches for trace species such as organic compounds

## Near-Infrared Camera (NIRCam)

- Full disk accessible at 2  $\mu\text{m}$
- O<sub>2</sub> nightglow mapping at 1.3  $\mu\text{m}$
- CO<sub>2</sub> non-LTE mapping at 4.3  $\mu\text{m}$
- Mapping of the night-side hemisphere

*Mars is too bright to be observed with MIRI.*

## Mars viewing geometry

- Two visibility windows occur ~6 months apart every ~2 years and last ~75–100 days
- Most windows will sample the southern cap; polar caps only observed when illuminated
- Most of the observable disk will be in daytime (84–93%)
- When approaching, the evening terminator will be sampled, while the morning terminator will be sampled when receding



Link to arXiv manuscript

See more at [jwst.stsci.edu](http://jwst.stsci.edu) and [jwst-docs.stsci.edu](http://jwst-docs.stsci.edu)

