

Searching for Life on Mars: The Contamination Paradox

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The Contamination Paradox

- As we search for life on Mars, we will be simultaneously contaminating Mars with life from Earth.
- The contamination from Earth could be mistaken for Martian life.

Consensus and Controversy

Consensus

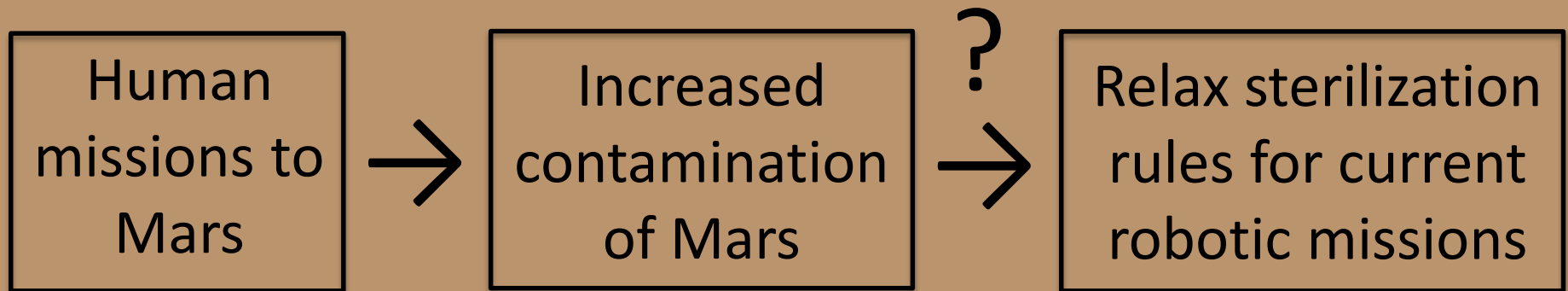
Human
missions to
Mars



Increased
contamination
of Mars

Consensus and Controversy

Controversy



Consensus and Controversy

We need data

- Consider a putative human habitat on Mars
 - i. Biological contaminants will flow out of the habitat into the Martian atmosphere
 - ii. The atmosphere will move these contaminants around
- How do we study this quantitatively?

Questions

Consider a human habitat on Mars

- Where will this contamination go?
 - i. How far will the contamination travel?
 - ii. In what directions will it travel?
 - iii. How long will the contamination be in the atmosphere?

Method

Consider a human habitat on Mars

1. We calculate a flux of biological particles per year released from the habitat into the Martian ambient environment
 - i. This flux calculation is grounded in estimates from International Space Station leak rates.

Method

Consider a human habitat on Mars

2. We model contaminants as tracers
 - i. These tracers move via transport algorithms which directly solve a mass continuity equation
 - ii. Various combinations of contaminant sizes are considered

Method

Consider a human habitat on Mars

3. We use various combinations of human habitat locations
4. We simulate the Martian atmosphere, considering aforementioned parameters, using the NASA Ames Mars Global Climate Model

Recap

- Combining the aforementioned steps, we have quantitatively simulated the atmospheric dispersion of biological contaminants sourced from a putative Mars human habitat using the NASA Ames Mars Global Climate Model.

Results

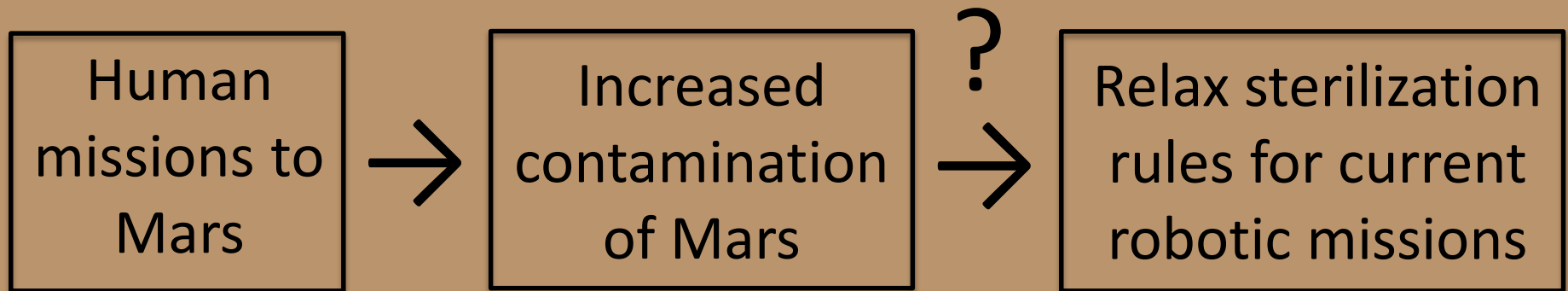
- The results from these simulations enable the creation of novel contamination heat maps showing the aerial distribution of contaminants from putative human habitats on Mars.

Why this Research is Exciting

- These results can:
 - i. Determine locations of future habitats that minimize the aerial extent subject to bio-contaminants
 - ii. Protect sites of astrobiological interest
 - iii. Constrain landing site selection of life detection missions to reduce risk of false positives

Recall: Consensus and Controversy

Now we know more about the contamination of Mars (second box). This knowledge will help inform decisions about sterilization restrictions (third box).



The End

Thanks!

Questions?