NASA's Habitable Worlds Observatory

From Science to Engineering

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HWO Pre-Formulation Scientist (interim) & Pre-Formulation Architect

HWO Special Session – Winter AAS Meeting

January 15, 2025

HABITABLE WORLDS OBSERVATORY

High-level summary of current activities

Explore the science, engineering, & technology trade space

Develop Technology Maturation Plan

Get everything ready to make good decisions rapidly in Phase A

Great Progress in the Last Year

Credit: M. Ansdell / J. Ziemer

MILESTONES

GOMAP Established (June 2023)	START & TAG Formed (Oct 2023)	Initial Working Groups Formed (Jan 2024)	Technology Maturation Project Office Formed (Aug 2024)	Science Cases and Sensitivity Studies (July 2025)	Concept Maturity Level 3

WE ARE HERE

Goal: August 2025

ACTIVITIES

Begin Decadal Survey implementation	*Investigate potential science cases & identify mission drivers*	Science and Engineering Trade Space Exploration Synthesis
Solicit & select initial START & TAG members	*Develop analytic science & engineering codes & models*	
Develop precursor science & technology calls	*Assess technology gaps & aerospace landscape*	
Communicate GOMAP approach with HWO	*Develop technology maturation roadmaps*	

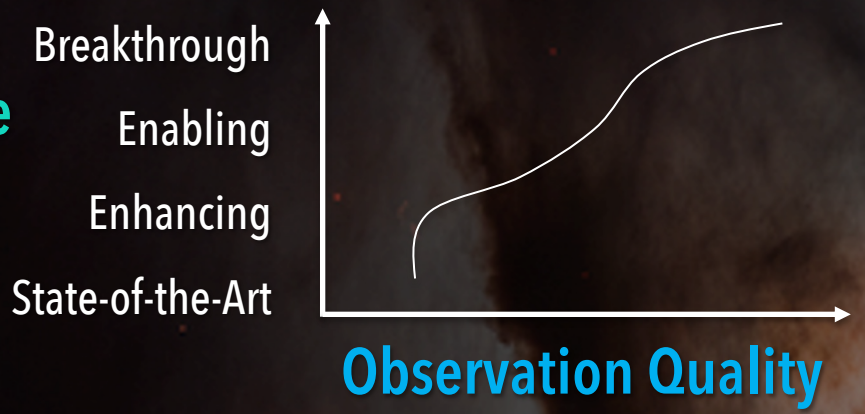
Planning [2023✓] → ***Exploring the Trade Space [2024-2025]*** →

Reviewed and determined not to contain CUI

EXPLORING THE TRADE SPACE

Credit: John Ziemer

1



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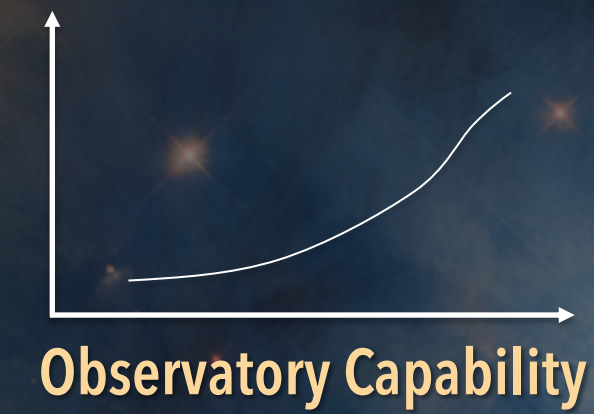

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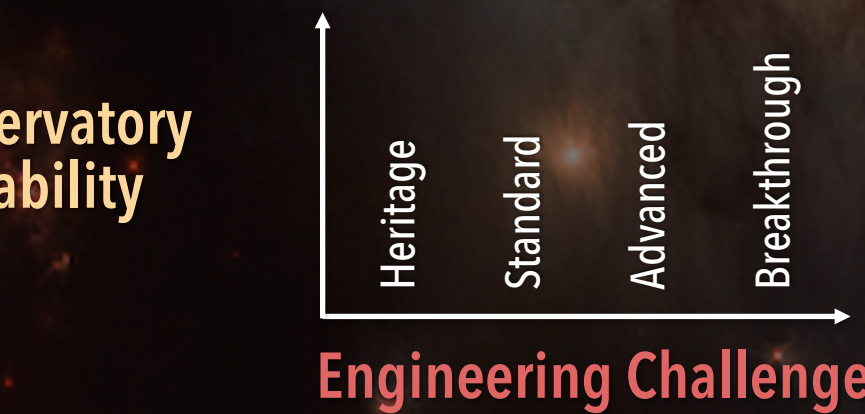

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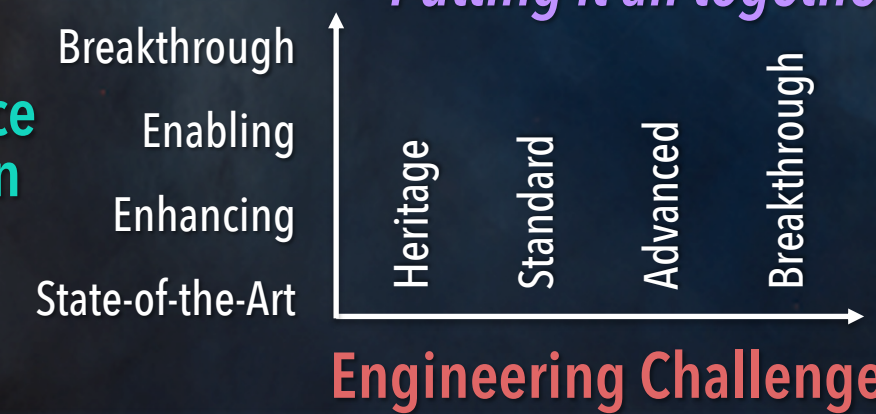
Putting it all together



Improved tools to explore the trade space

Dynamic Integrated Science Return Analysis (DISRA)

- Enable rapid analysis of total science returns from a mission architecture
- Integrate multiple science case code modules provided by community scientists
- Draw from consistent set of astrophysical & observatory parameters for all science cases
- Determine sensitivities of science returns to changing astrophysical & observatory parameters, and correlations between them
- Identify driving hardware performance parameters to guide technology development

DISRA STRUCTURE

Layer 1 – Science Case Modules

Explore science metrics & needed observations (python notebooks)

Layer 2 – Exposure Time Calculators (ETCs)

Link the observations to the observatory

Layer 3 – Science / Engineering Interface

Hold unified set of astrophysical parameters & telescope / instrument parameters

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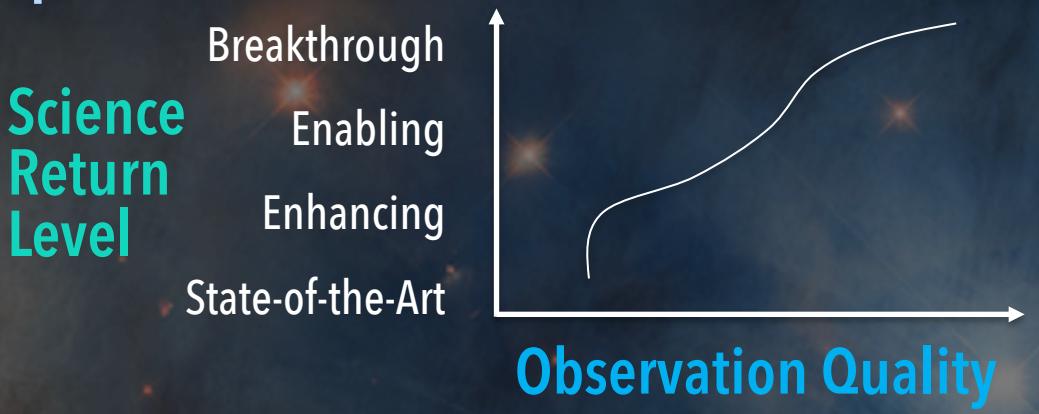

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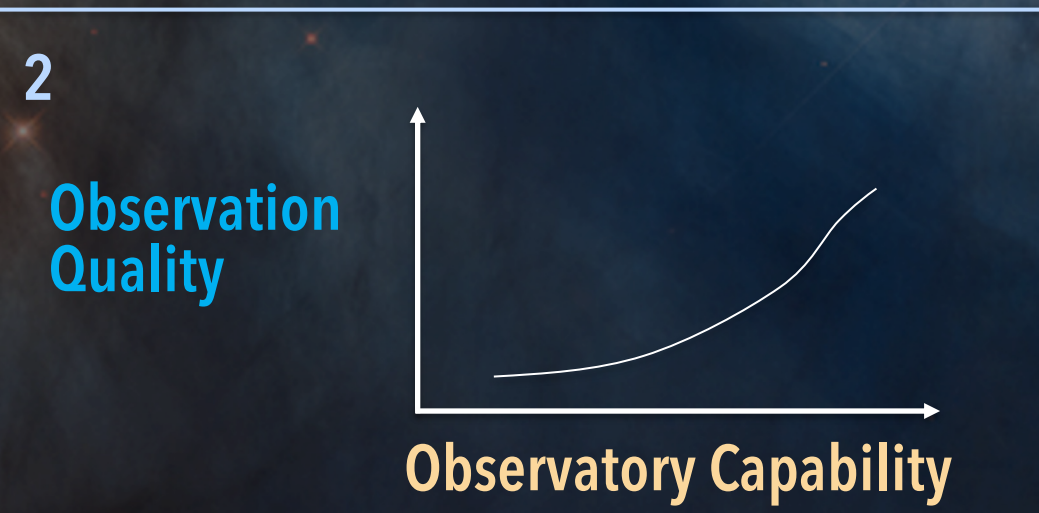


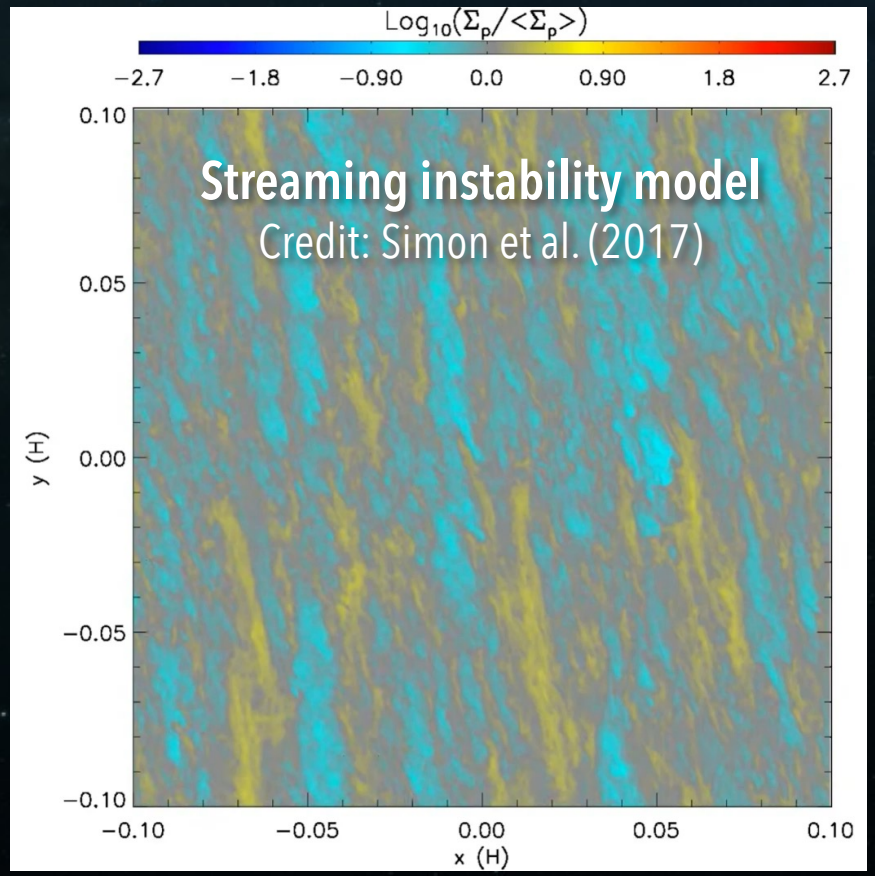
Example science case

Goal: How did the seeds of Solar System planets first come together?

Major uncertainties in planet formation's first steps – the growth of planetesimals

The planet formation process is robust, but our models of it are not

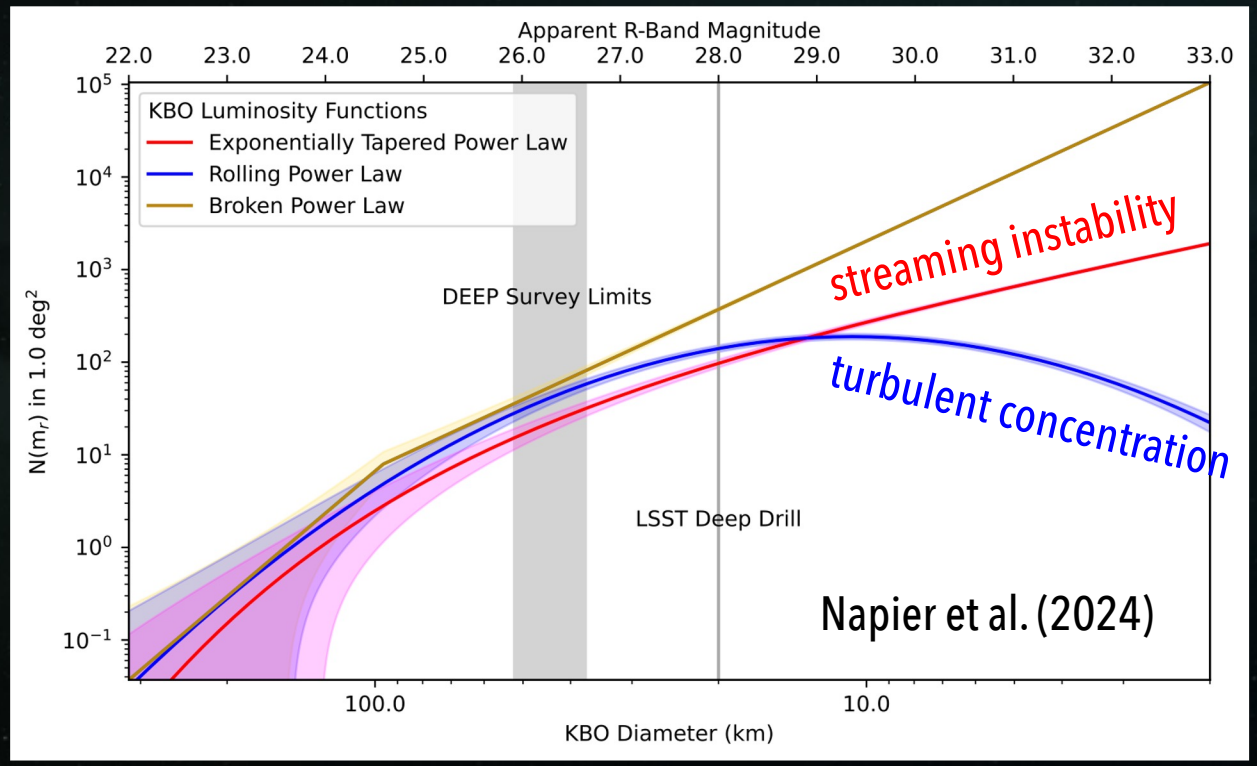
Objective: Discover primordial KBOs in the outer Solar System to distinguish between planetesimal formation models



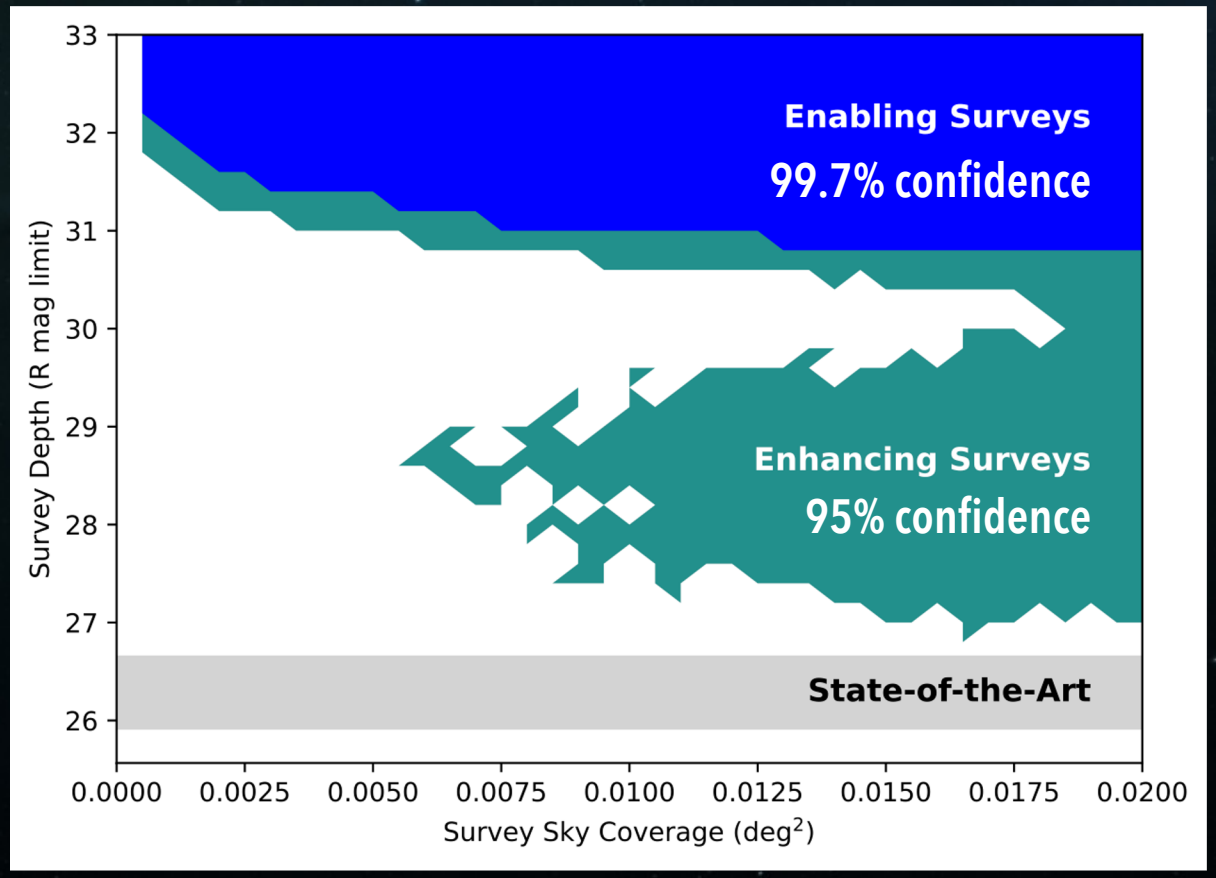
Streaming instability model
Credit: Simon et al. (2017)

SCIENCE RETURN LEVELS VS. OBSERVATIONS

Best-fit KBO luminosity functions from DEEP Survey (current state-of-the art)



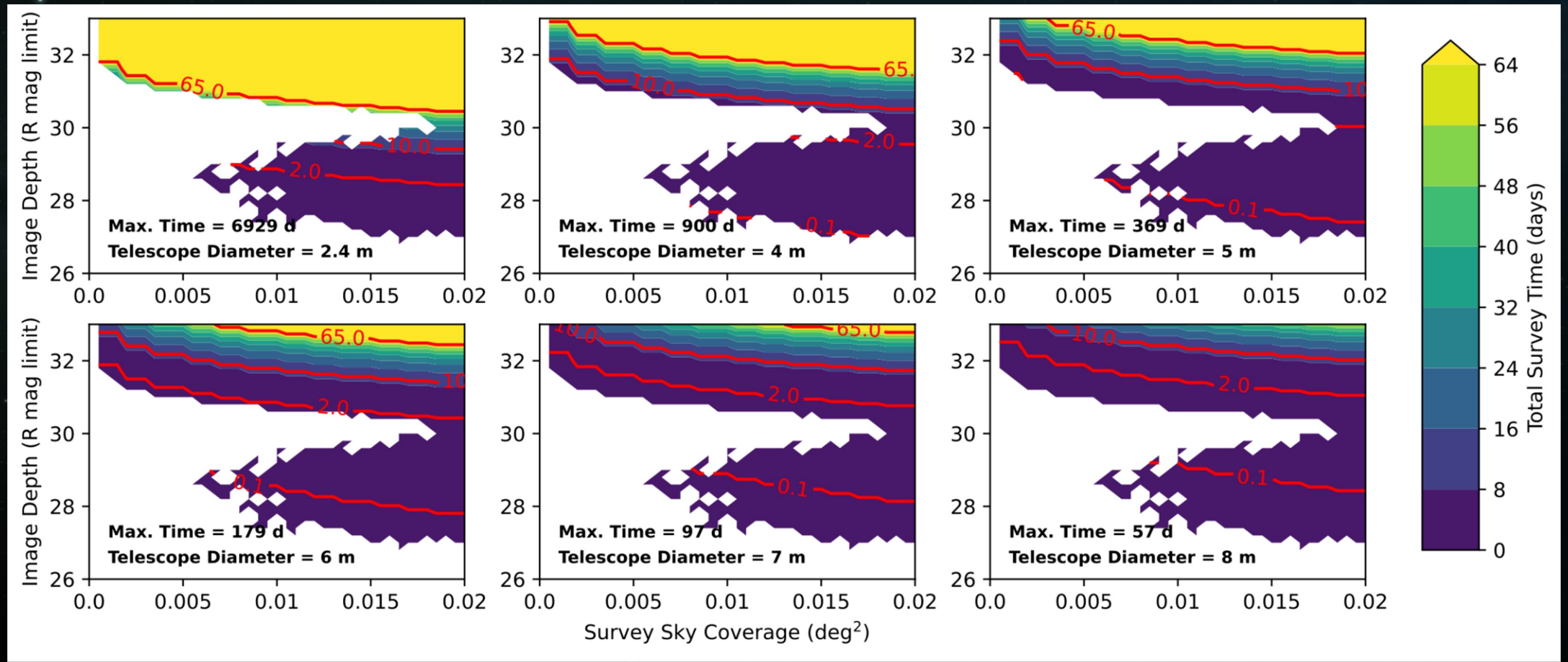
Ability of R band imaging surveys to distinguish between models (Panel 1)



OBSERVATIONS VS. OBSERVATORY CAPABILITY

Enabling survey with Hubble would take ~65 days (~six Ultra-Deep Fields)

Same survey with 6-m HWO would take ~2 days (~1 small proposal)



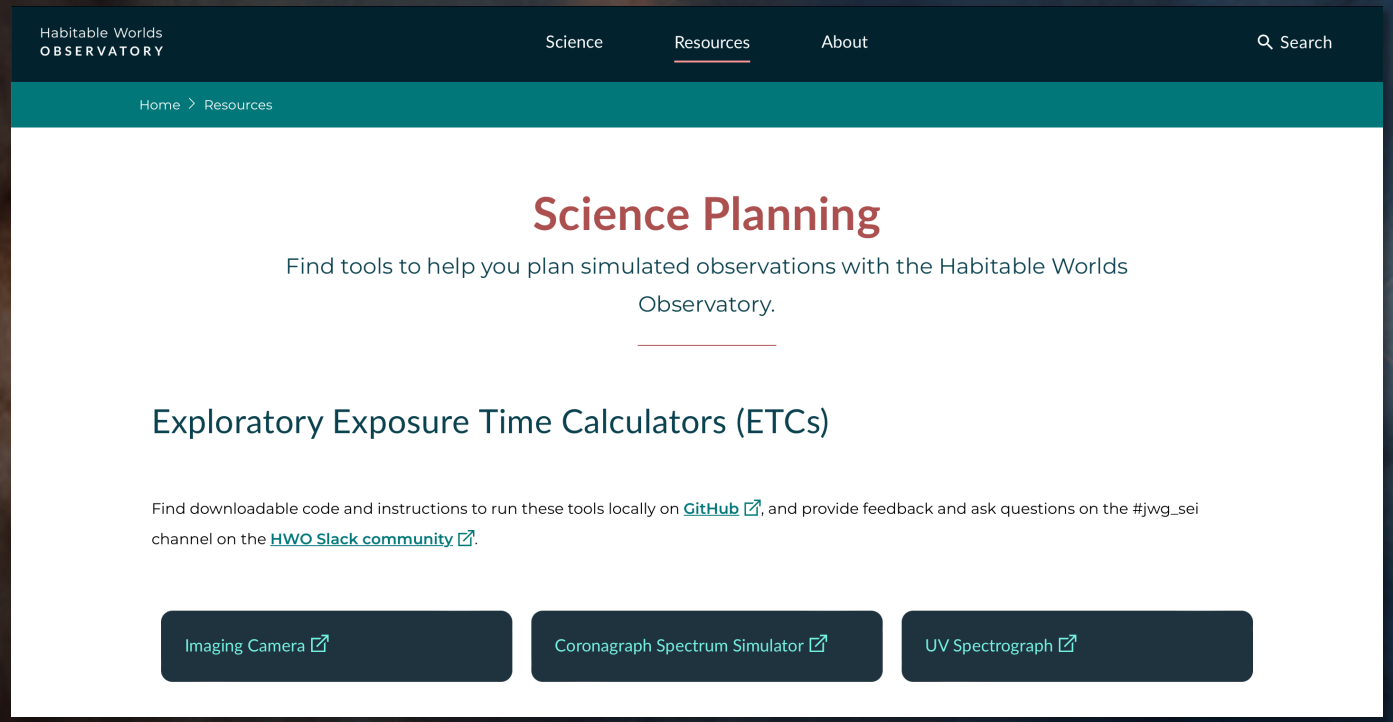
Onward

Working Groups and Project Science Team collaborating to turn more science cases into DISRA modules

HWO exposure time calculators are maturing

- ETCs also available via web interface for quick calculations

Higher fidelity simulations in the works



https://habitableworldsobservatory.org/resources/science-planning

Our goal is to empower YOU to create your own DISRA modules