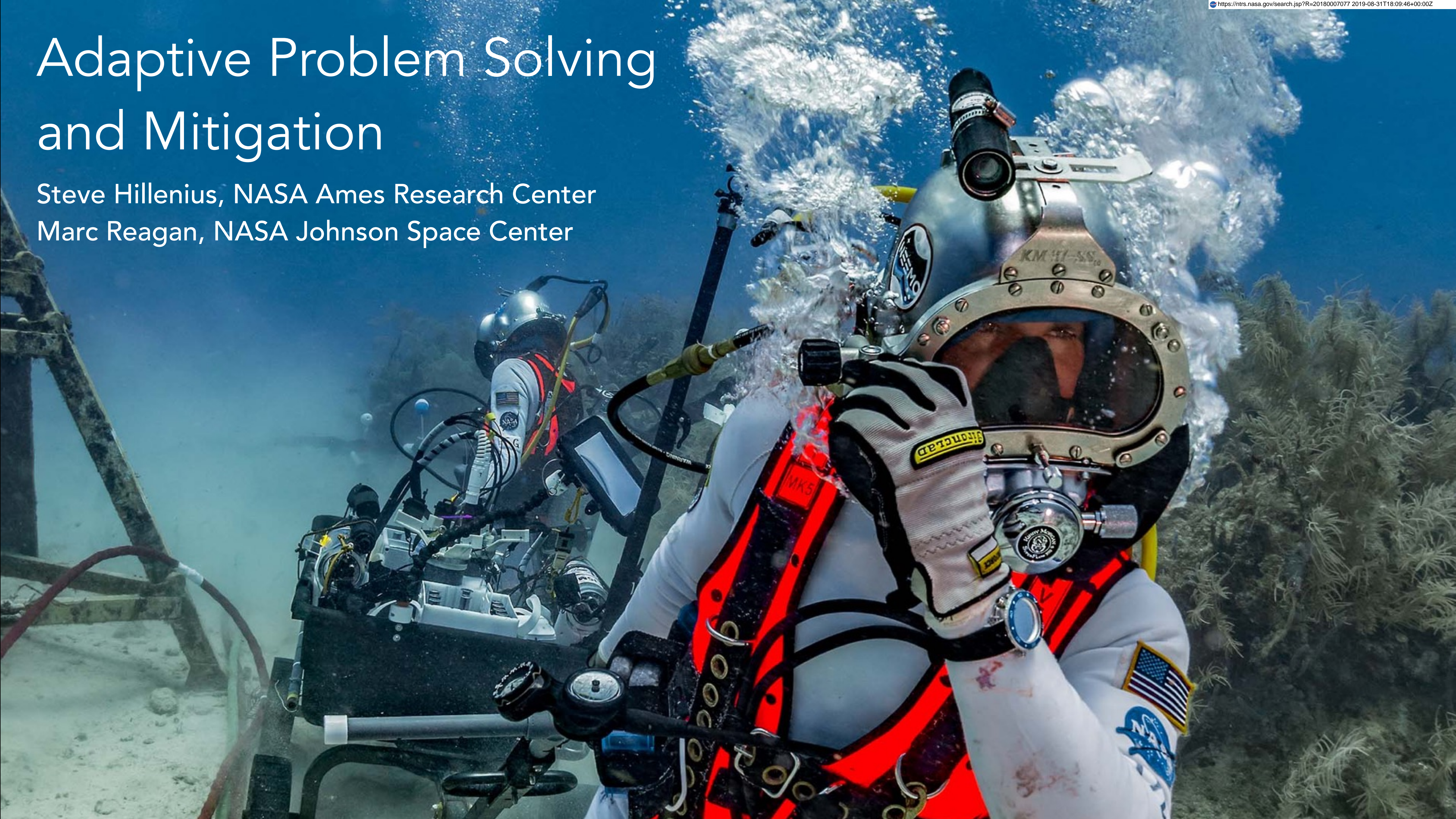


# Adaptive Problem Solving and Mitigation

Steve Hillenius, NASA Ames Research Center

Marc Reagan, NASA Johnson Space Center



# NEEMO Overview

*aquarius habitat*



# NEEMO Overview

*LSB (life support buoy)*



# NEEMO Overview

## *aquarius interior*



# NEEMO Overview

## MCC interior



# Methods of Communication/ Information Transmission



*Voice Comm*

*VCOM*

*Voxer*

*Playbook Mission Log*

*Playbook Timeline*

*ML Videos and Photos*

*Video (one-way, no audio)*

*Daily Plan Review*

*Daily Planning Conf.*

*Procedures*

*Crew Notes*

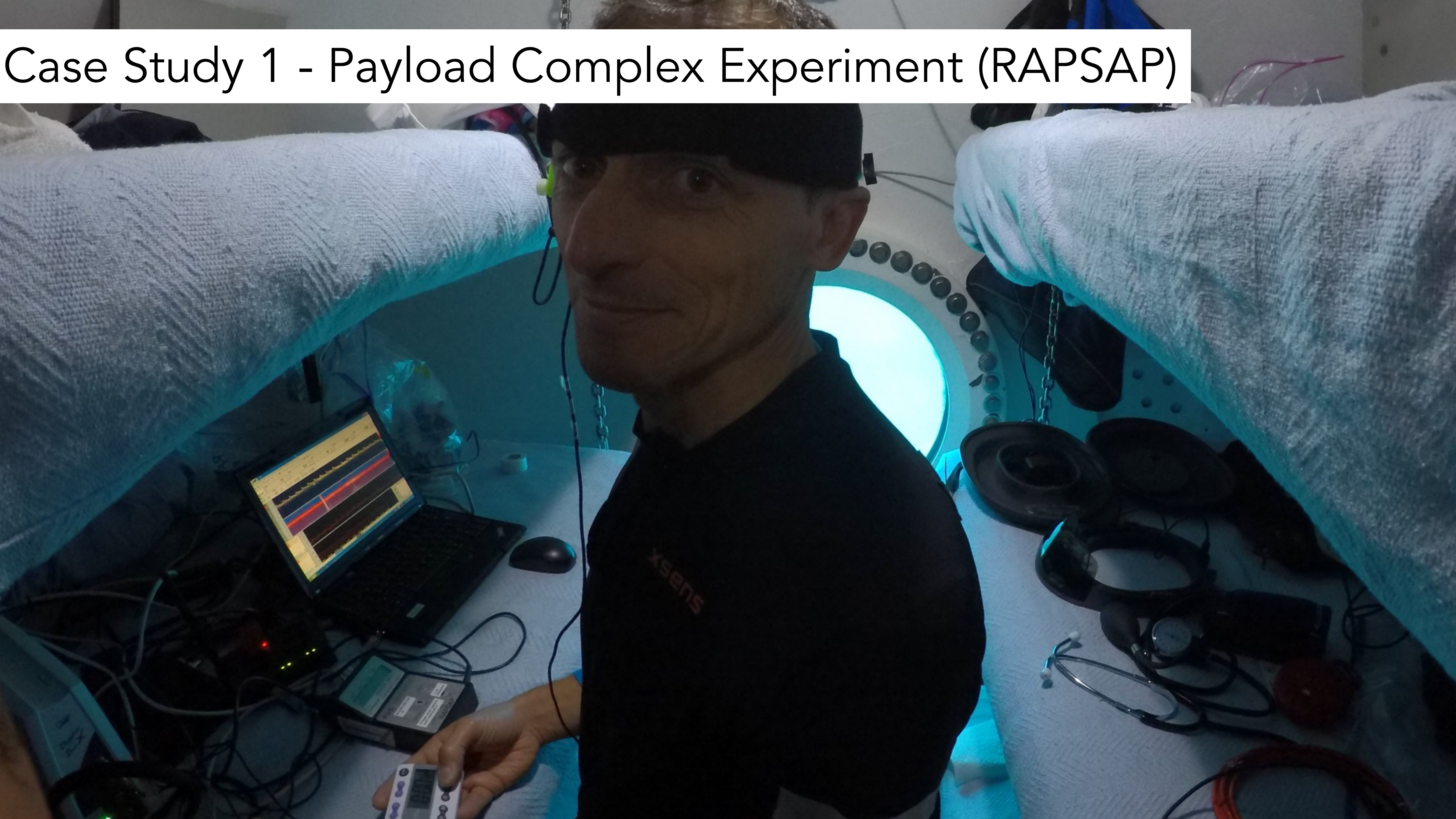
# Methods of Communication/ Information Transmission



Types of unexpected problem solving seen  
on the NEEMO 22 Mission



# Case Study 1 - Payload Complex Experiment (RAPSAP)



# Case Study 2 - Payload Hardware Troubleshooting (miniDNA)



# Case Study 3 - Weather Related EVA Replan

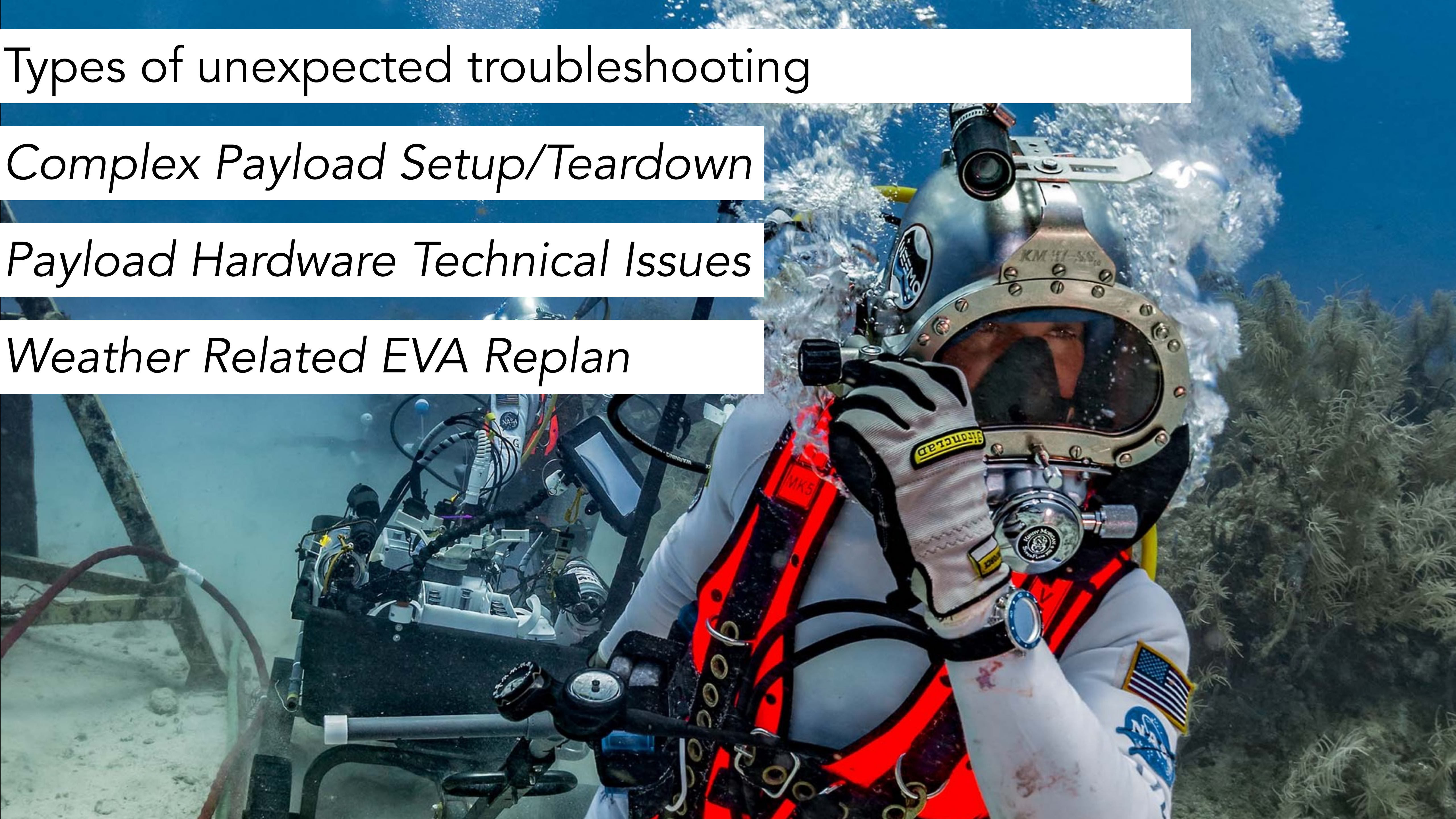


Types of unexpected troubleshooting

*Complex Payload Setup/Teardown*

*Payload Hardware Technical Issues*

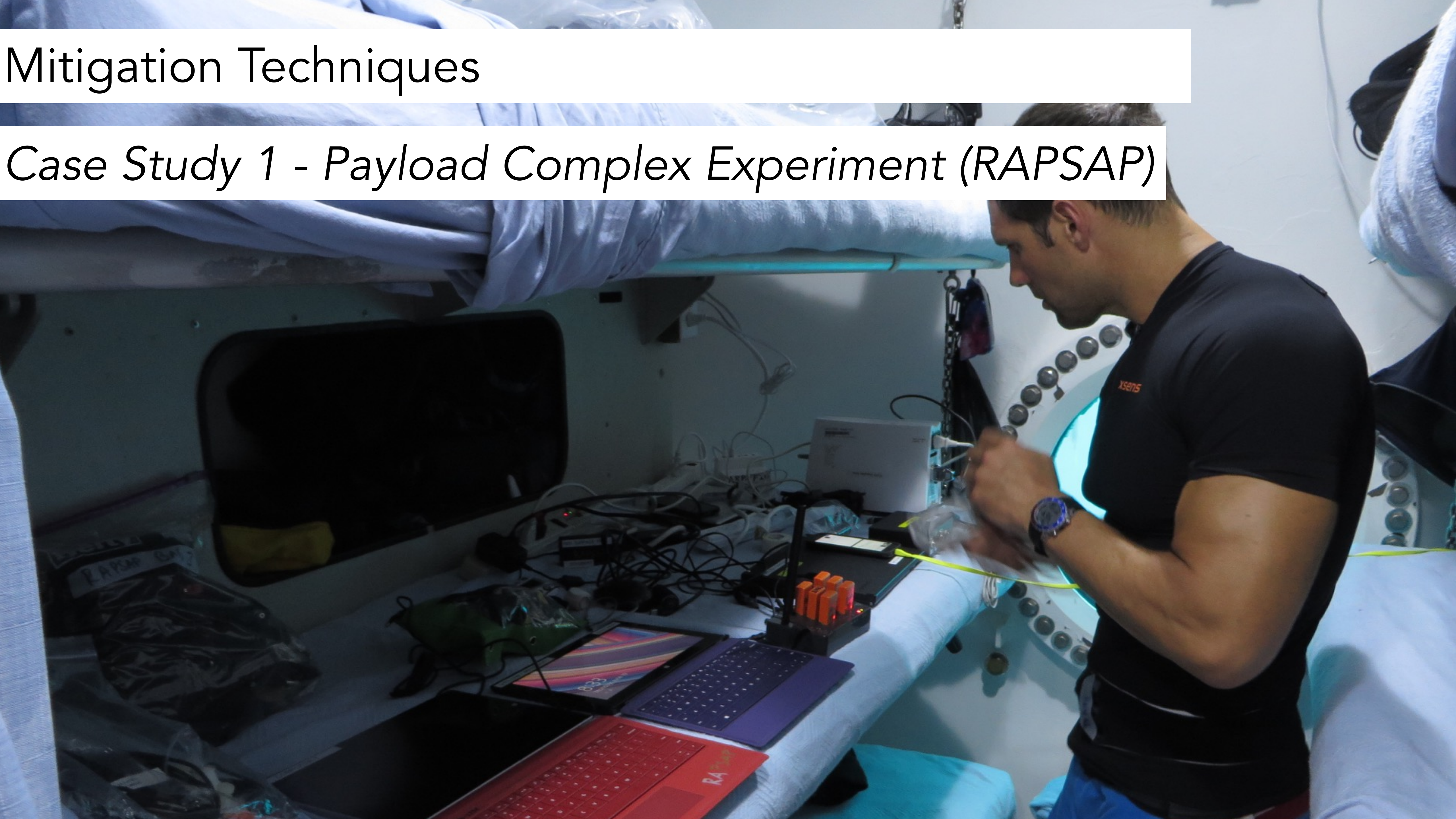
*Weather Related EVA Replan*



# Mitigation Techniques

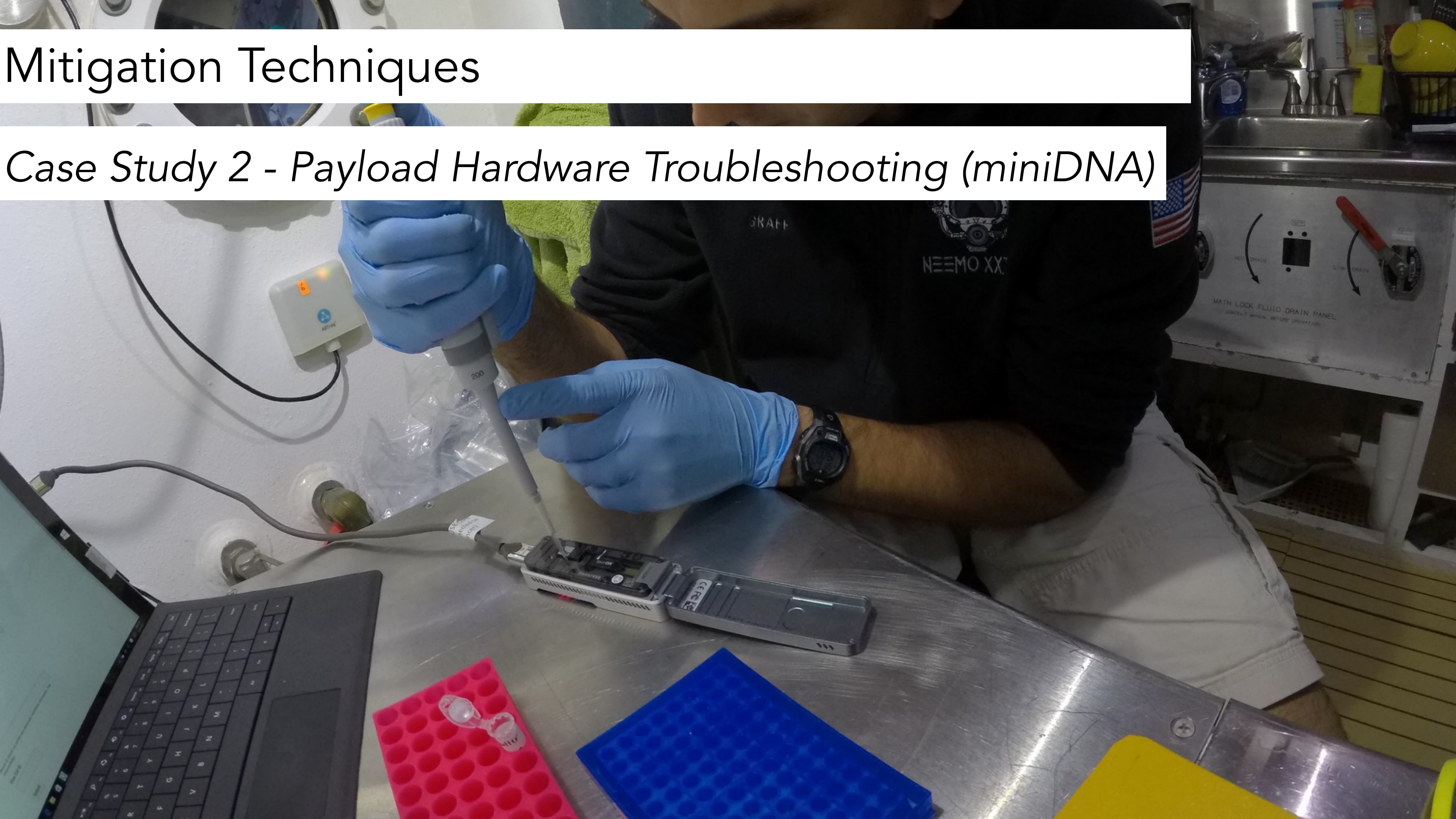
# Mitigation Techniques

## *Case Study 1 - Payload Complex Experiment (RAPSAP)*



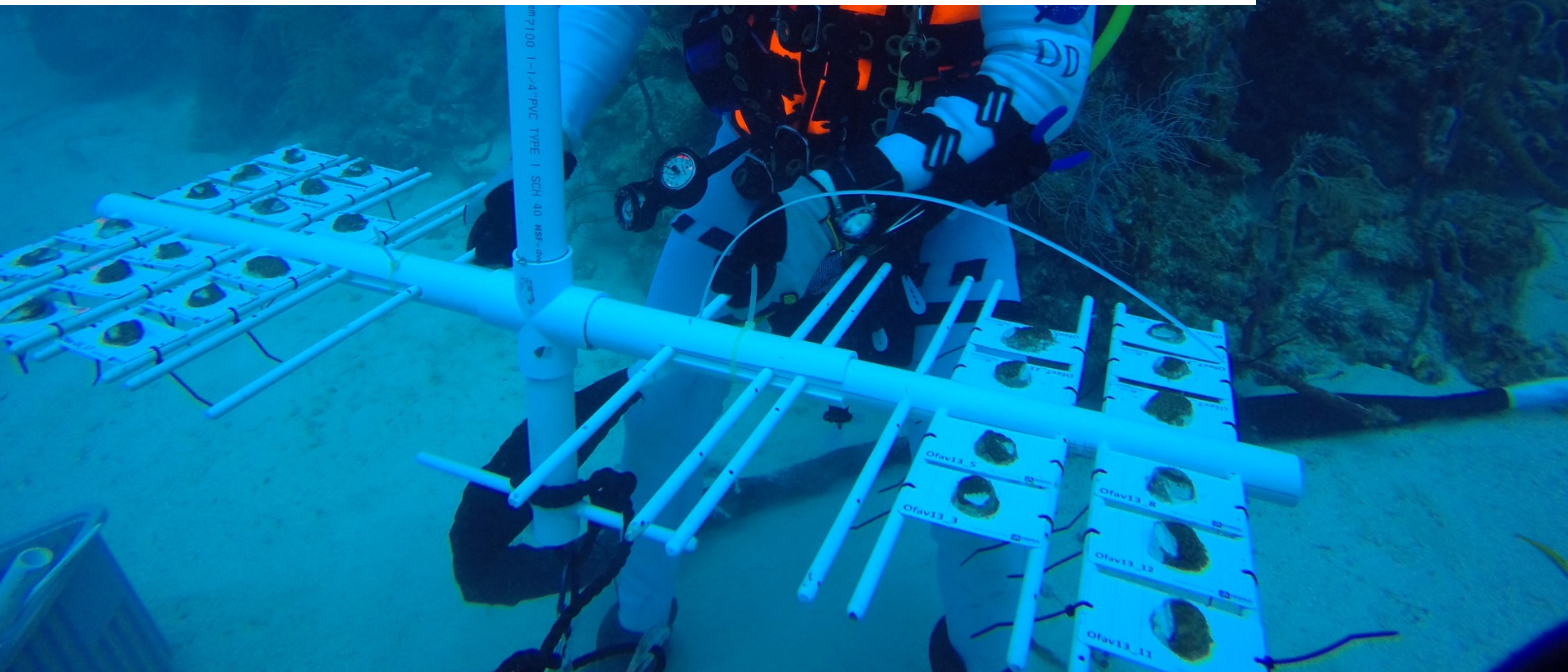
# Mitigation Techniques

## Case Study 2 - Payload Hardware Troubleshooting (miniDNA)



# Mitigation Techniques

## *Case Study 3 - Weather Related EVA Replan*





How this can relate back to guidelines for automation

What Machine Learning Can Do  
(Brynjolfsson and Mitchell)

# Suitability of Machine Learning (SML Scores)

*Case Study 1 - Payload Complex Experiment (RAPSAP) 2.62*

*Case Study 2 - Payload Hardware Troubleshooting (miniDNA) 3.52*

*Case Study 3 - Weather Related EVA Replan 1.86*

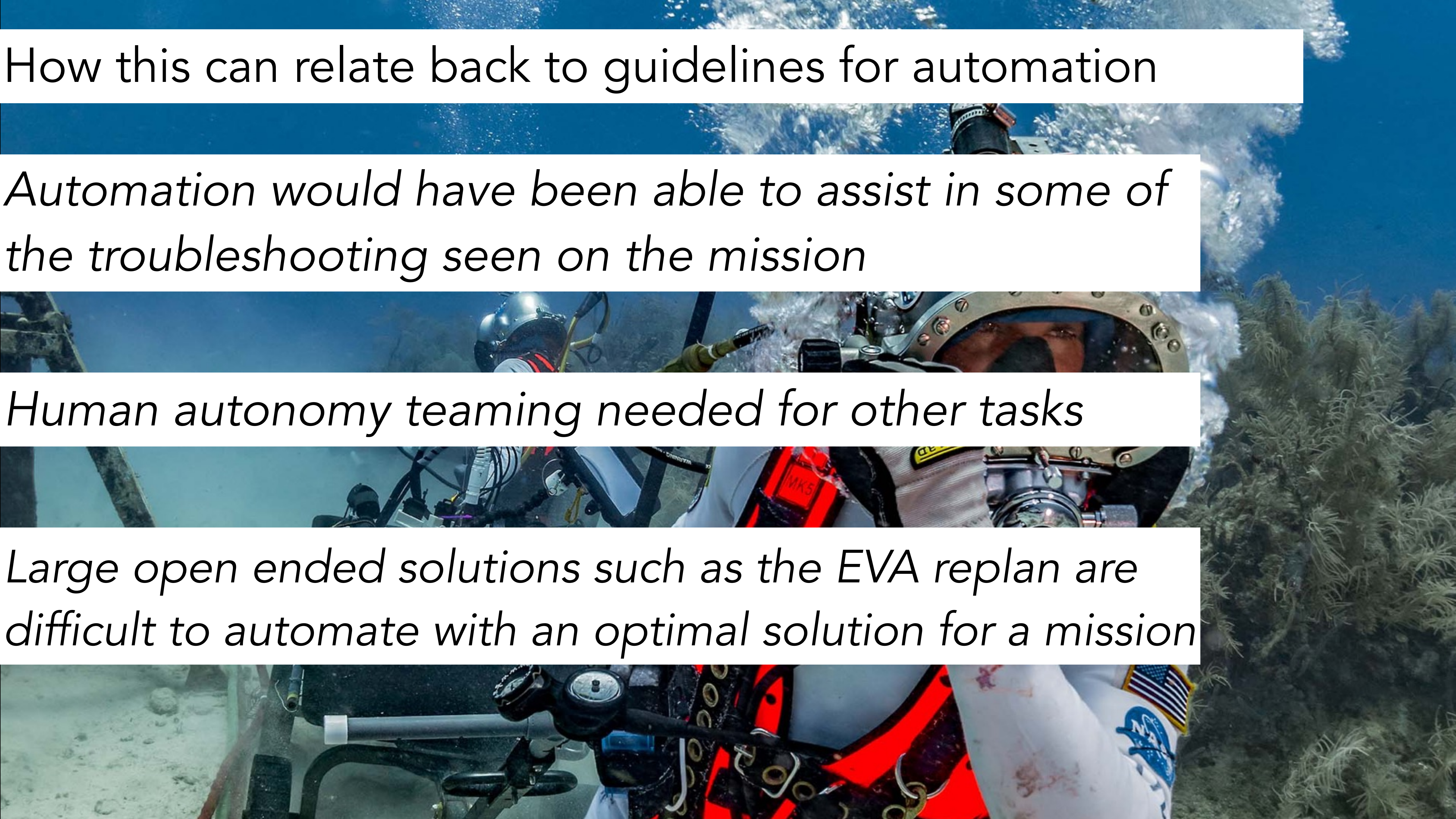
*On a scale from 1.0 to 5.0, where 1.0 is least suitable and 5.0 is most suitable for machine learning (Brynjolfsson and Mitchell)*

How this can relate back to guidelines for automation

*Automation would have been able to assist in some of the troubleshooting seen on the mission*

*Human autonomy teaming needed for other tasks*

*Large open ended solutions such as the EVA replan are difficult to automate with an optimal solution for a mission*



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