CONTINUUM

DESIGN SPECIFICATION

SPONSOR

NASA JPL

MHCID

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CONTENTS

INTRODUCTION

NASA has a strong history of thoroughly planned flyby missions, yet responding to new data and challenges in flight requires flexibility and coordination among multiple cross-disciplinary teams, a balance which takes a great deal of time and resources to maintain. The Europa Clipper mission, currently in planning phases, is taking significant steps to improve the efficiency of operations so that planning takes much less time and fewer resources. Continuum, an integrated interface for planning and scheduling, is part of that effort. It allows instrument scientists to geospatially construct plans for spacecraft activity, visualize the effects of their plans on other teams and the spacecraft, and be aware of conflicts at all times.

Continuum is informed by in-depth interviews, collaborative design activities, concept testing, and usability testing with 21 NASA scientists, engineers, researchers, and designers. Every part of the UI responds to our findings or assumptions based on themes and insights generated during synthesis, especially its main functionalities - geospatial editing, computer-supported planning, and dynamic conflict resolution.

Continuum integrates crucial science planning functionality across JPL standard tools. It also allows scientists from different teams to import their own data and flight rules into the system for improved planning and computer support, reducing the need to switch back and forth between team-specific tools.
By supporting all teams with a unified interface, Continuum ensures better cross-team communication and more collaborative planning and scheduling.

Integration with the mission team's flight rules and spacecraft activity constraints ensures conflicts at the planning and scheduling level are discovered in real time, reducing the number of potentially harmful requests made. Whenever the computer provides support, either by providing results when searching for science opportunities or when suggesting courses of action for resolving conflict, the user makes the call. Computer-generated results are explained clearly and succinctly so the user knows how to respond.

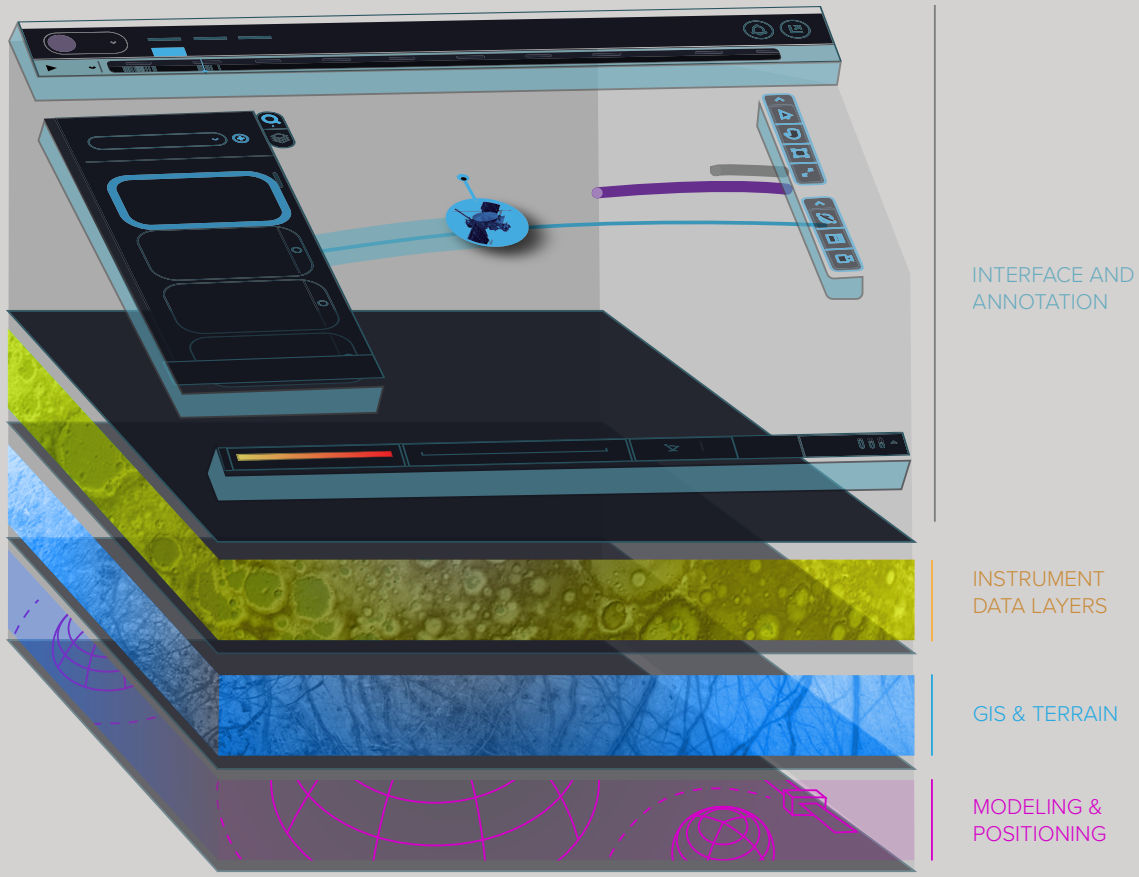
ARCHITECTURE

Documents the overall structure of the product by explaining its information hierarchy and interaction flow

LAYERED VIEW

Spatial View

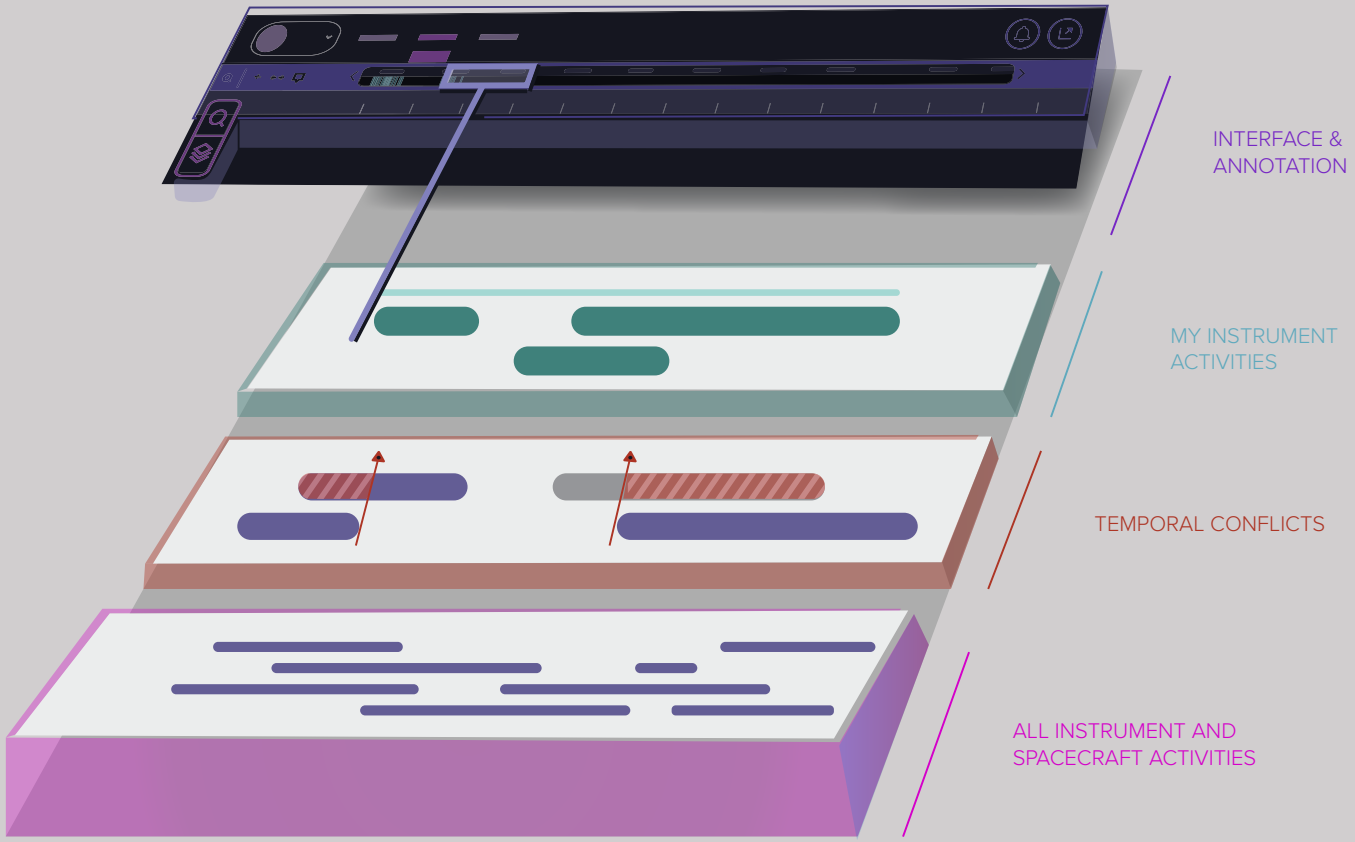
The spatial screen is reliant on layered data, with each layer being built upon the one beneath. The bottom layer is the skeleton with a layer of camera imagery mapped on top, this gives all instrument scientist an understanding of actual geographical features for reference. Layered above the camera data is the actual instrument data layered on top, the team can set different opacity levels to see their data overlaid on the moon's surface. Finally a level of interaction controls and interface elements manipulate each layer and view below.



LAYERED VIEW

Timeline View

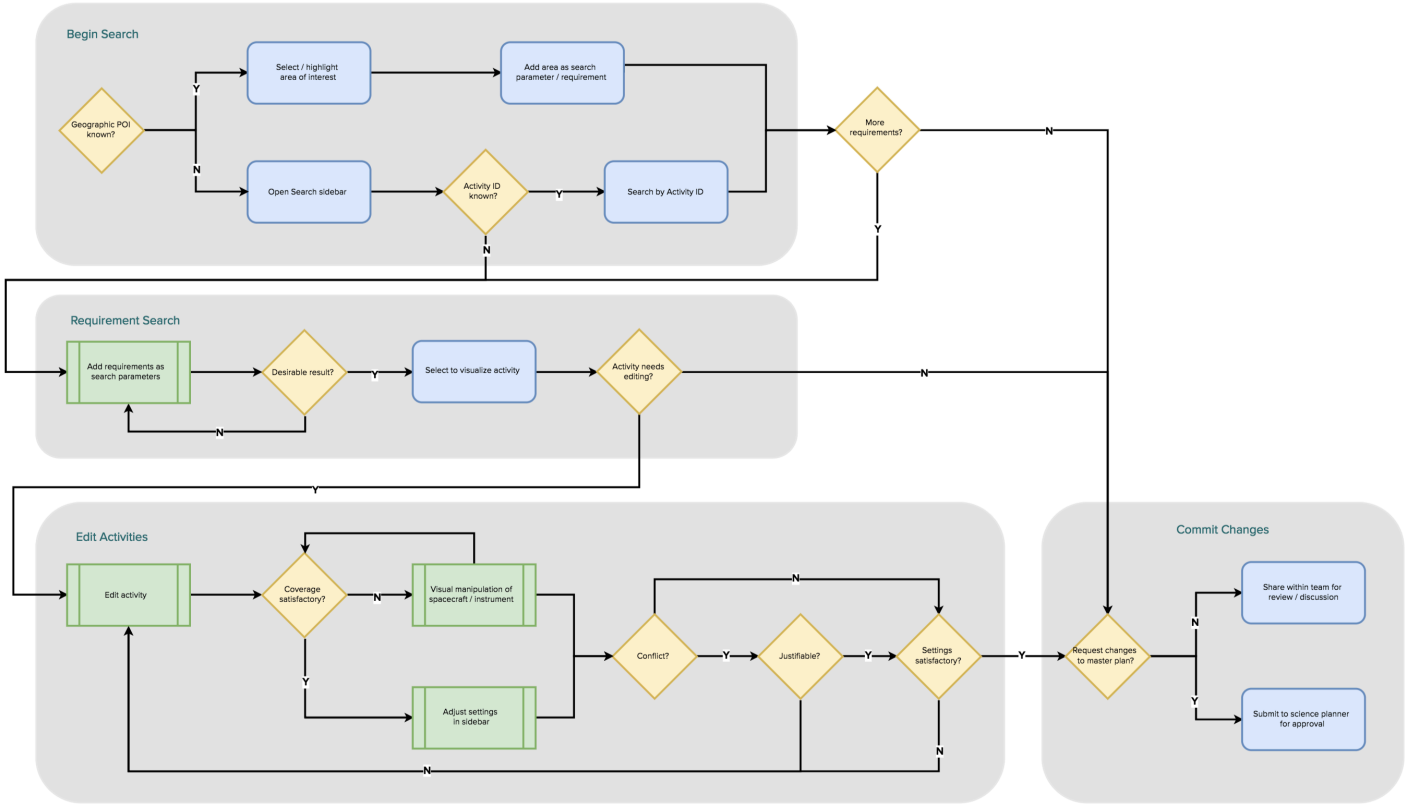
The timeline view is layered to make relevant activities grouped for easy access and comparison. The bottom layer is all instrument team activities with minimal annotations. Above that is everything conflicting with your current selections. Most prominently is your team's activities broken into minute detail. A layer of interface and UI wraps above every temporal layer allowing users to explore and resolve scheduling conflicts as they arrive.



INTERACTION FLOW

Searching for Opportunities

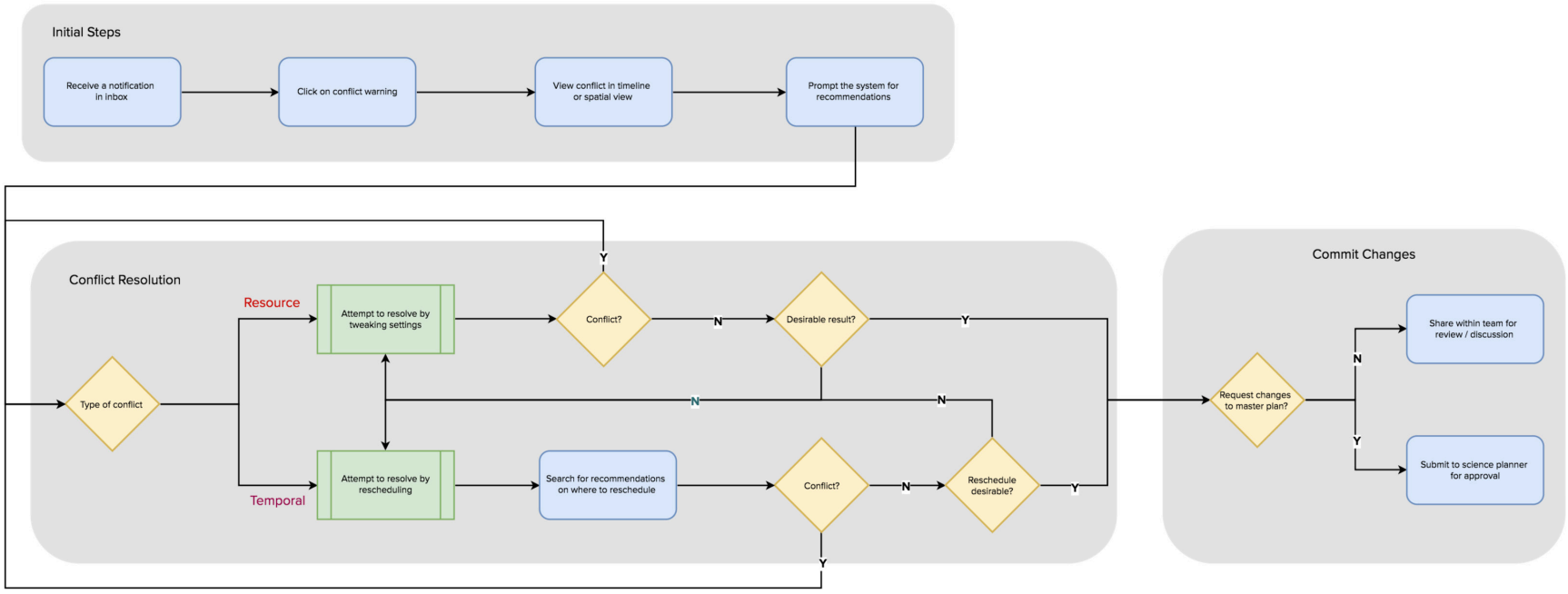
The following interaction flows detail Continuum's main functionalities: visual planning and conflict resolution. The first follows an instrument scientist's path from searching for opportunities to tweaking results to fit their desired results.



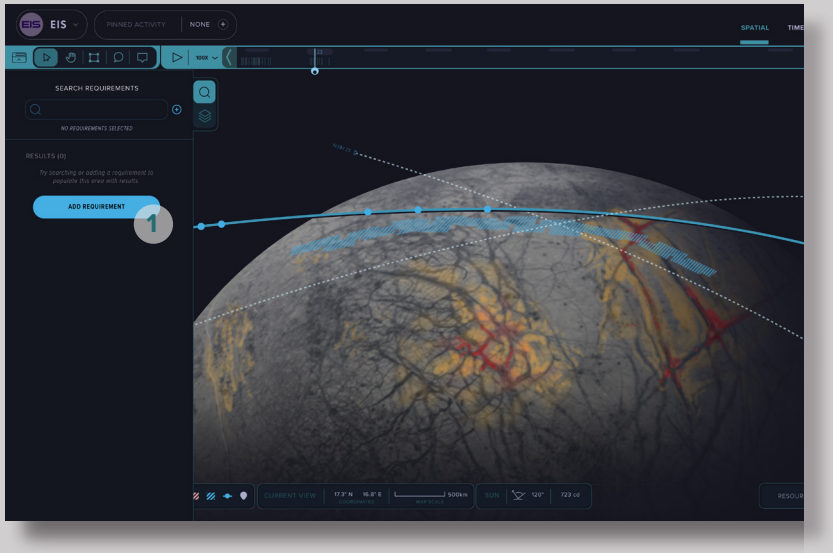
INTERACTION FLOW

Resolving Conflicts

The second follows an instrument scientist receiving a notification of a conflict with their instrument through possible courses of resolving that conflict.

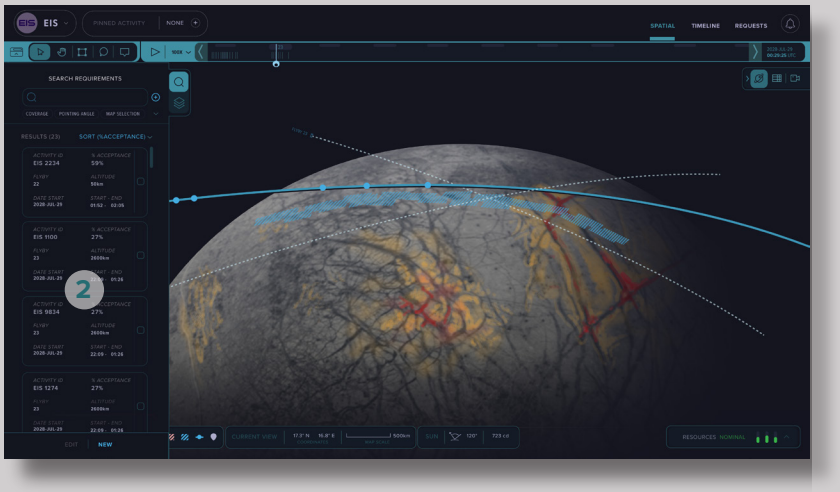


MAJOR INTERACTIONS



1.

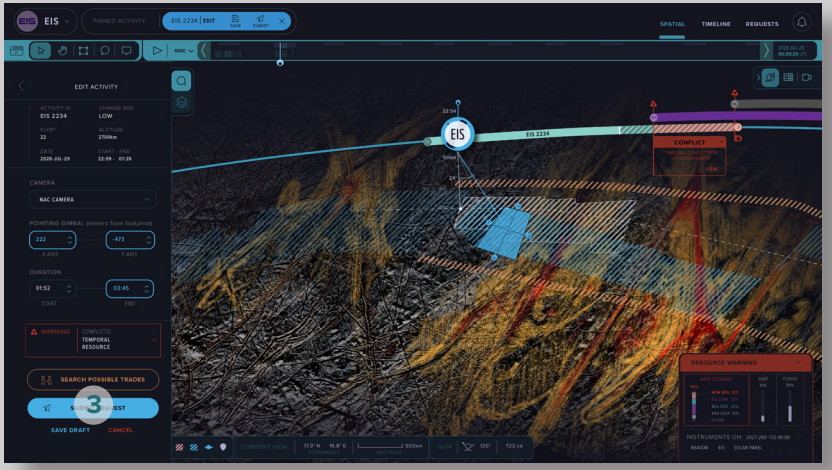
Users search for science opportunities by adding their own requirement



2.

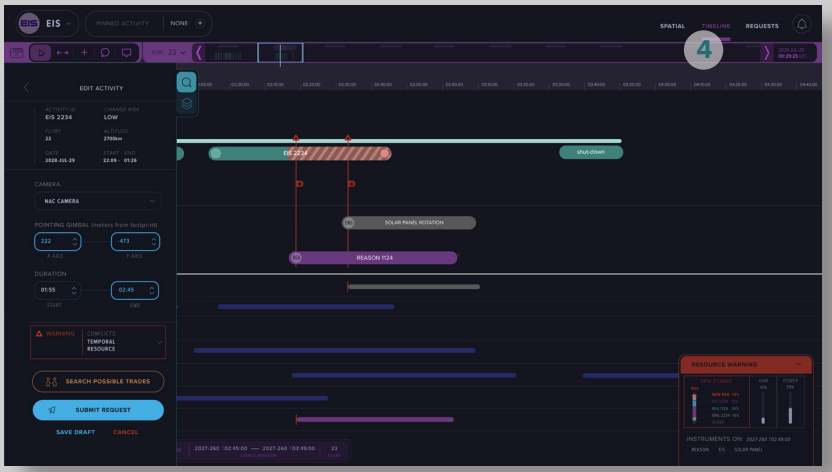
The system offers a list of suggested science activities that meet their requirement.

MAJOR INTERACTIONS



3.

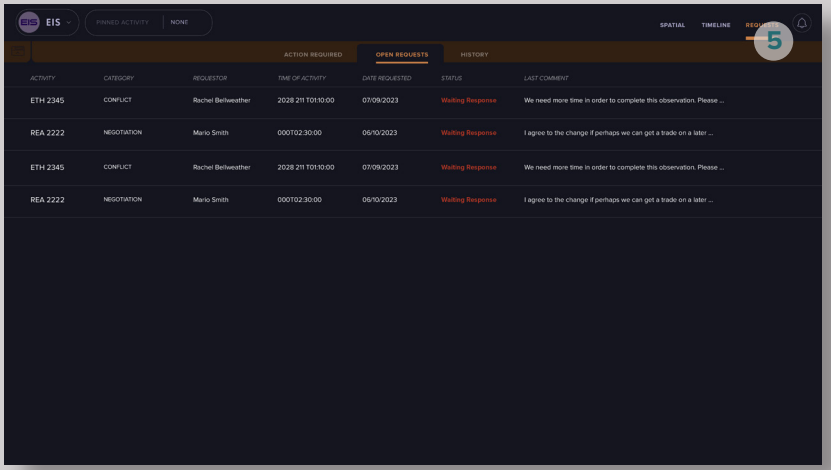
After the suggested activity is selected, users could change the parameter to further meet their science requirements. Conflicts will popup both textually and geographically when new adjustments violate safety rule or conflict with other teams' activities. Users could submit request to the one conflicted with for negotation.



4.

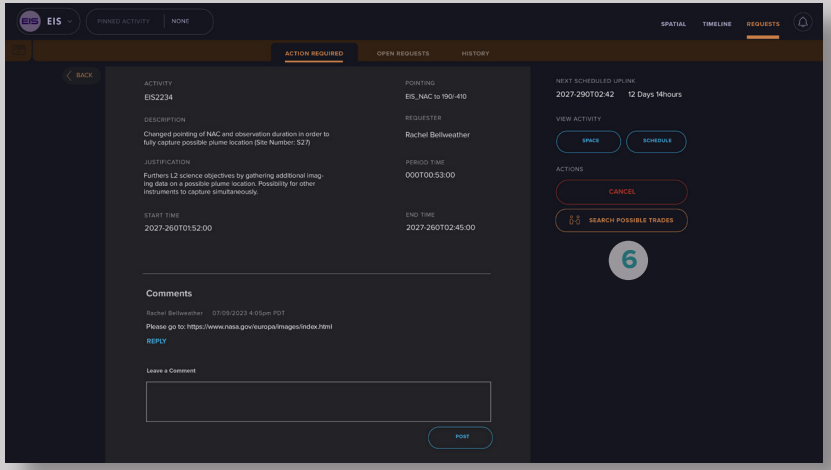
Switch to timeline view too see how selected activity conflict with other activities temporally.

MAJOR INTERACTIONS



5.

Switch to request view to see a list of requests from other science teams.



6.

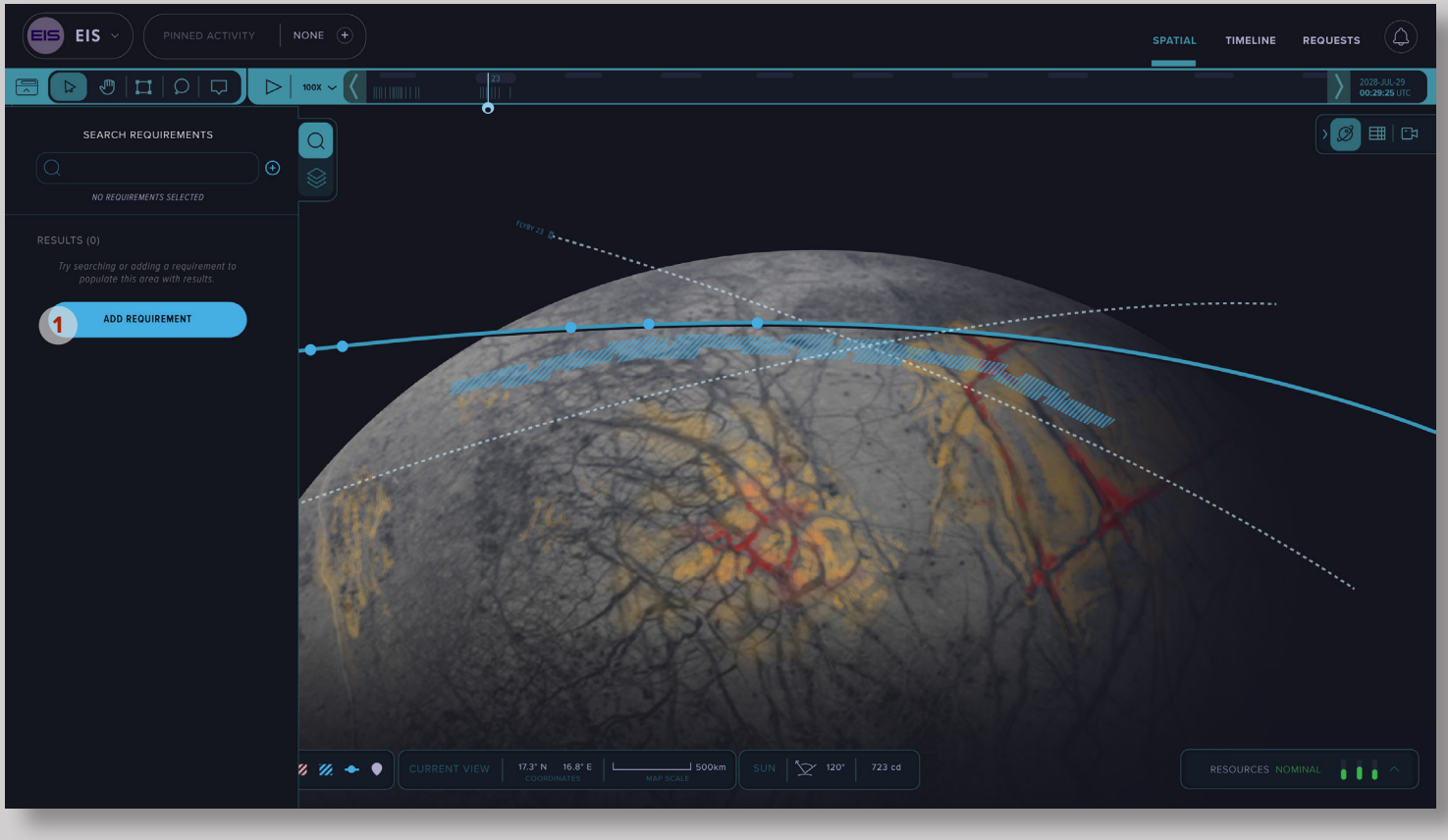
Users can see all details of request. They can view the negotiated activity both in timeline view and geographical view.

HERO FLOW

Shows the primary use cases of the product and explains interactions step by step for achieving certain goals. It further details common use cases outlined in our interaction flows.

HERO FLOW

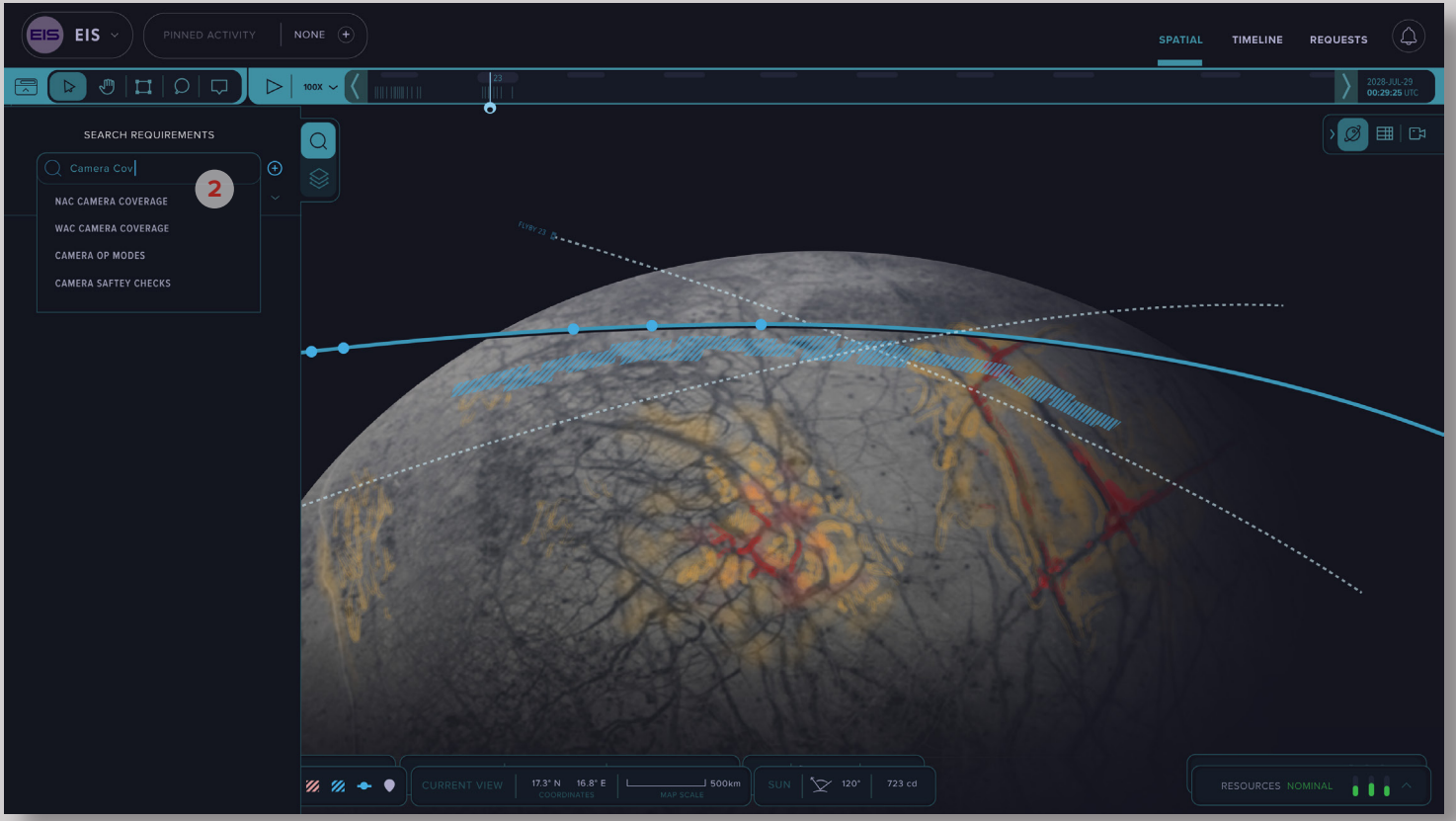
1.1 Opportunity Searching



Helen, a scientist on EIS, Europa Clipper's camera team, has received notification of exciting new data and wants to see if EIS has an opportunity to image it. She starts by adding a requirement or parameter to her search.

HERO FLOW

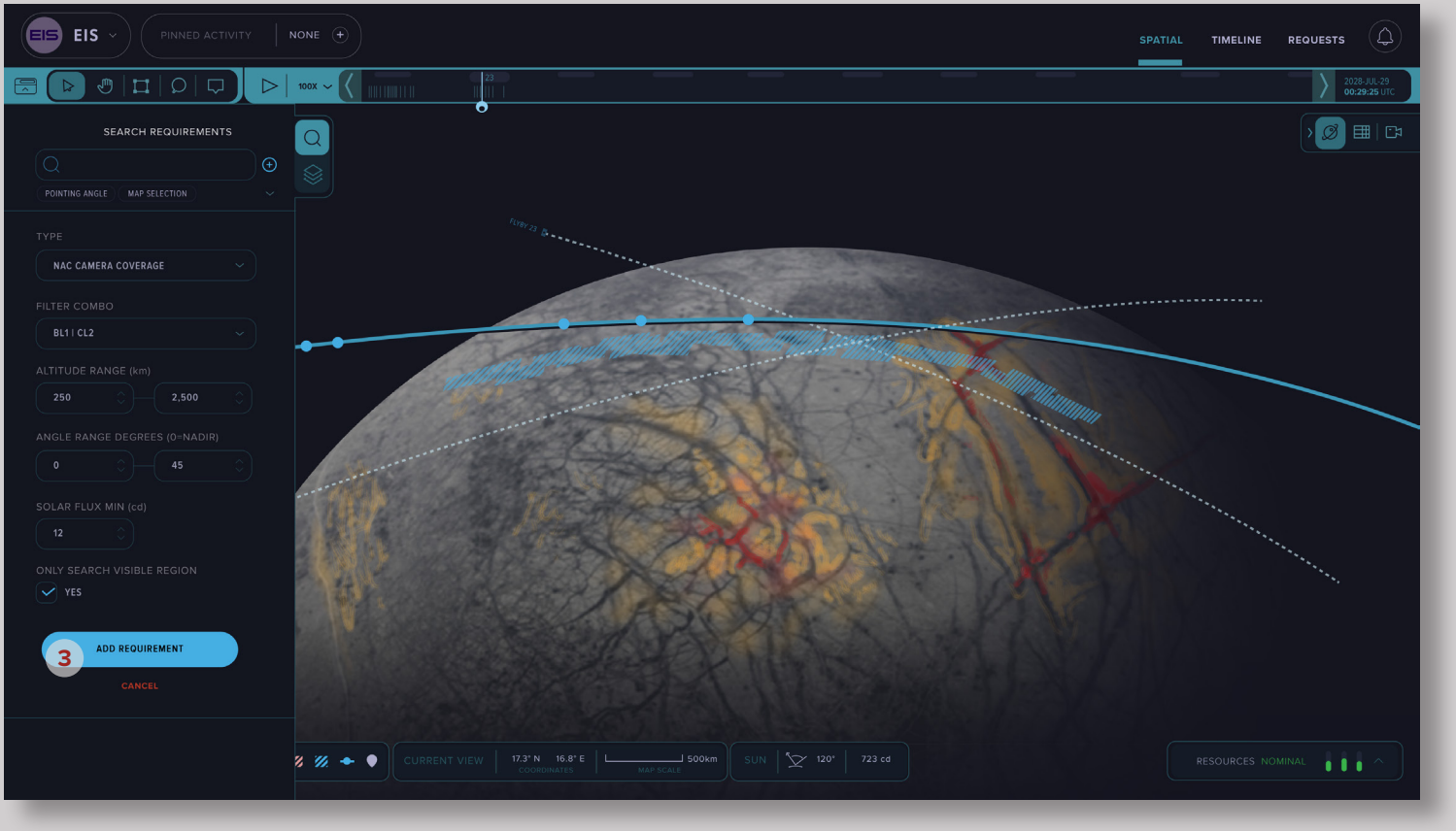
1.2 Planning



Clicking on “Add Requirement” allows her to search for opportunities by defining parameters.

HERO FLOW

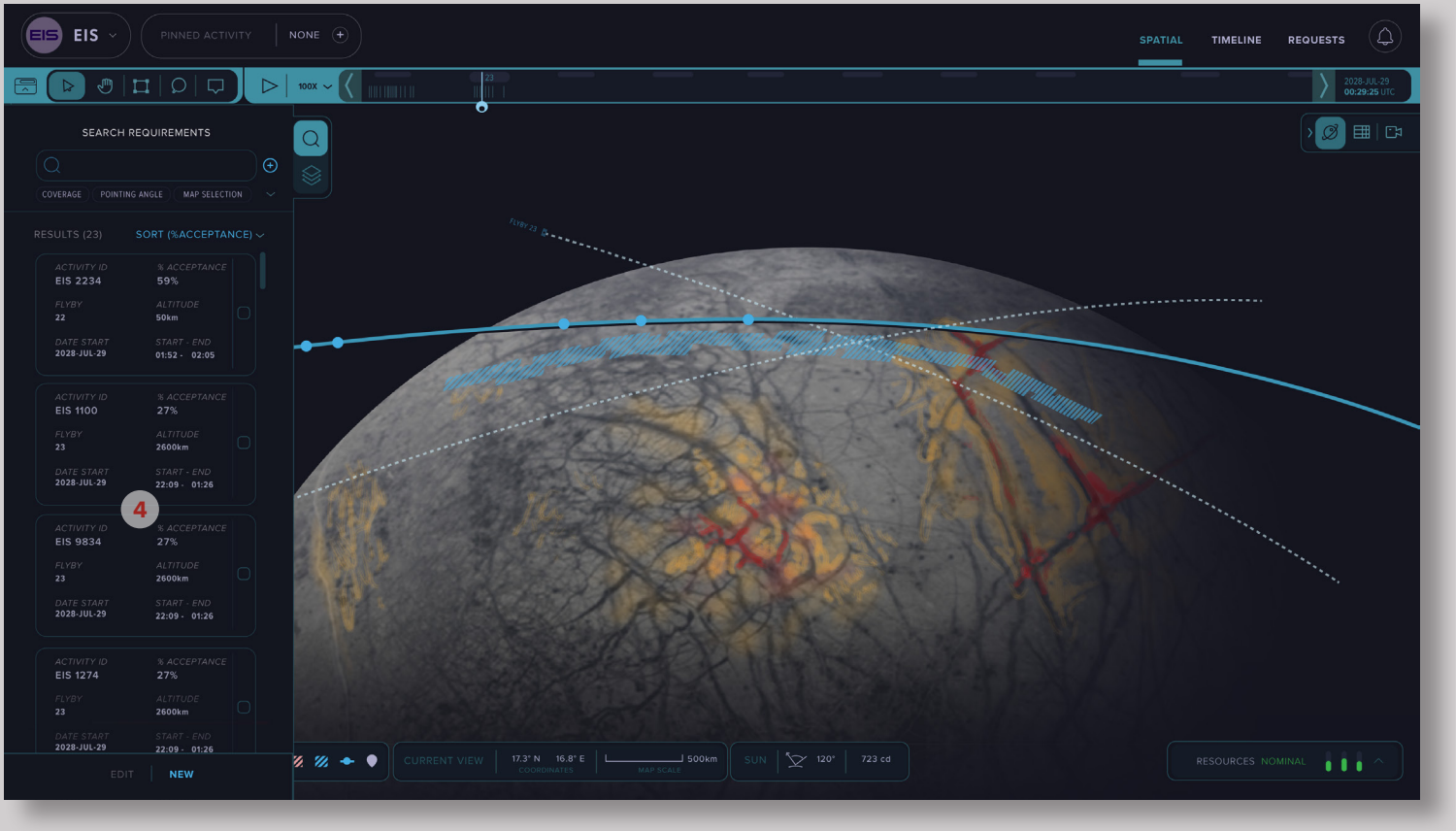
1.3 Planning



The search sidebar allows Helen to define parameters on her search based on instrument settings. She can tell the system she only wants to look at opportunities within a certain altitude range because she knows that range is optimal for the type of observation she'd like to make. Then she hits "ADD REQUIREMENT".

HERO FLOW

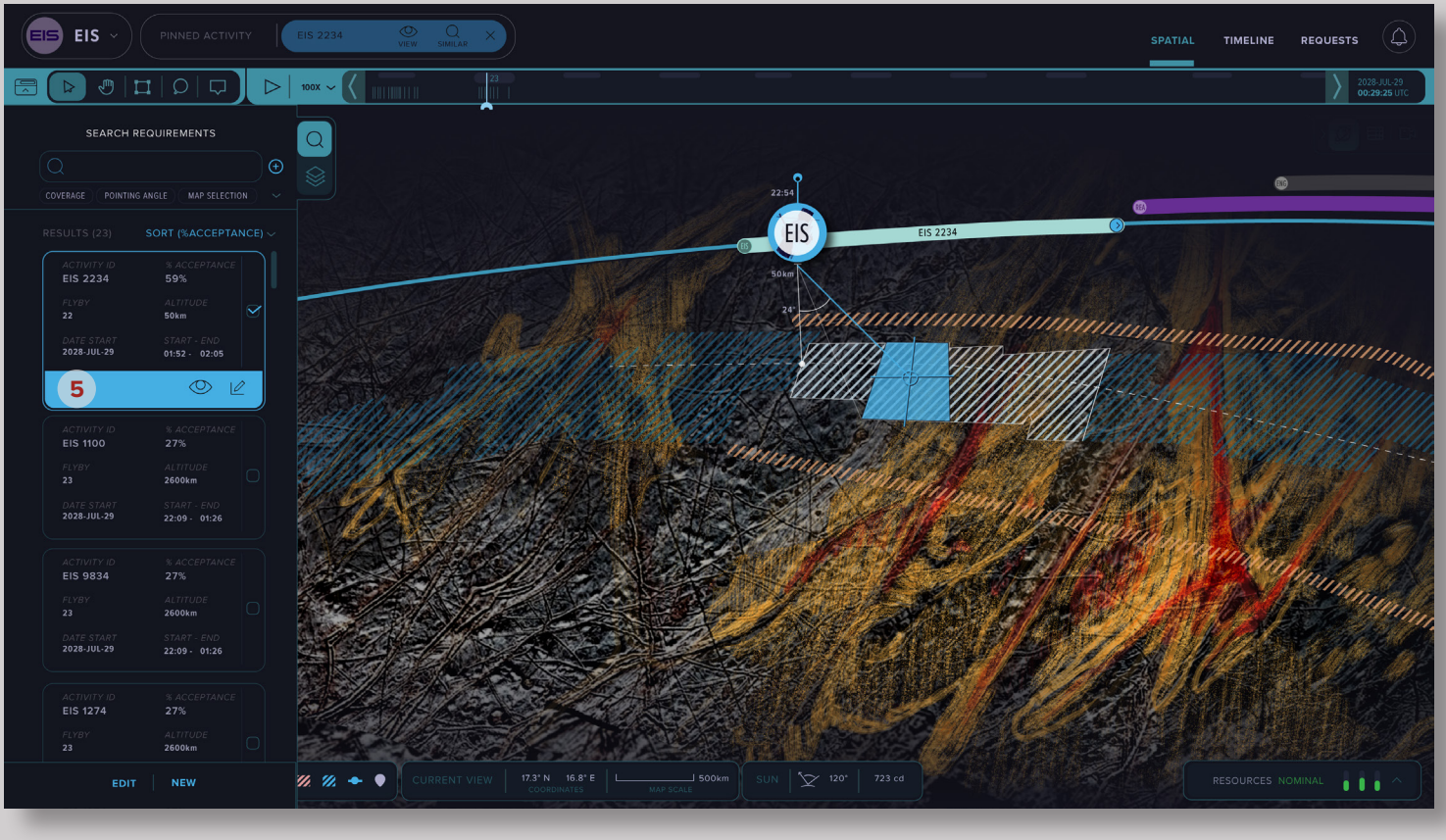
1.4 Planning



Once she has entered her requirements, the system returns a list of already-scheduled observation opportunities that match her search requirements to varying degrees. “% acceptance” tells her how close the observation comes to her requirements.

HERO FLOW

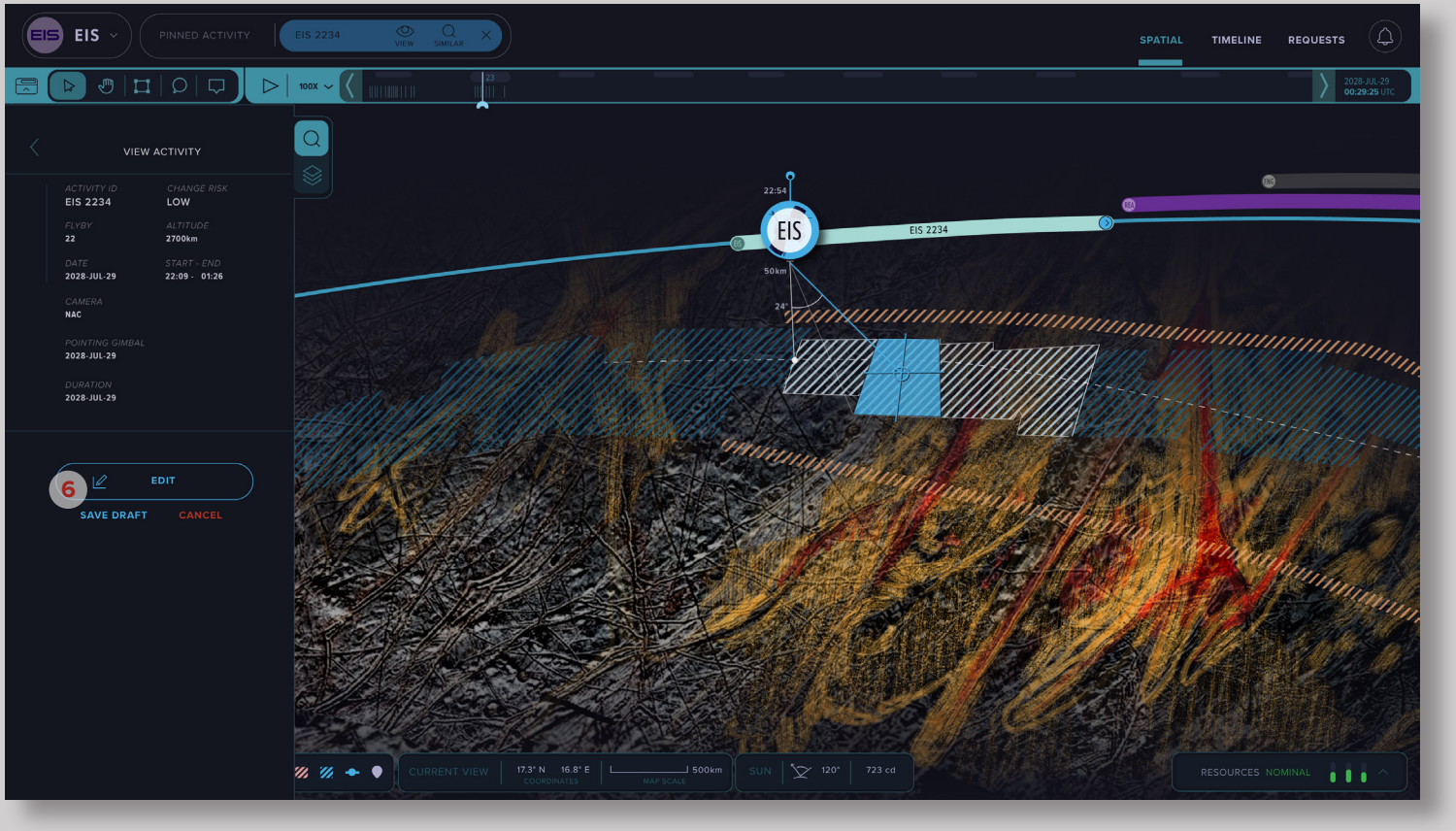
1.5 Planning



Helen clicks through the search results to see visualizations of each spacecraft activity, like where in the flight plan they occur and what she can observe with them.

HERO FLOW

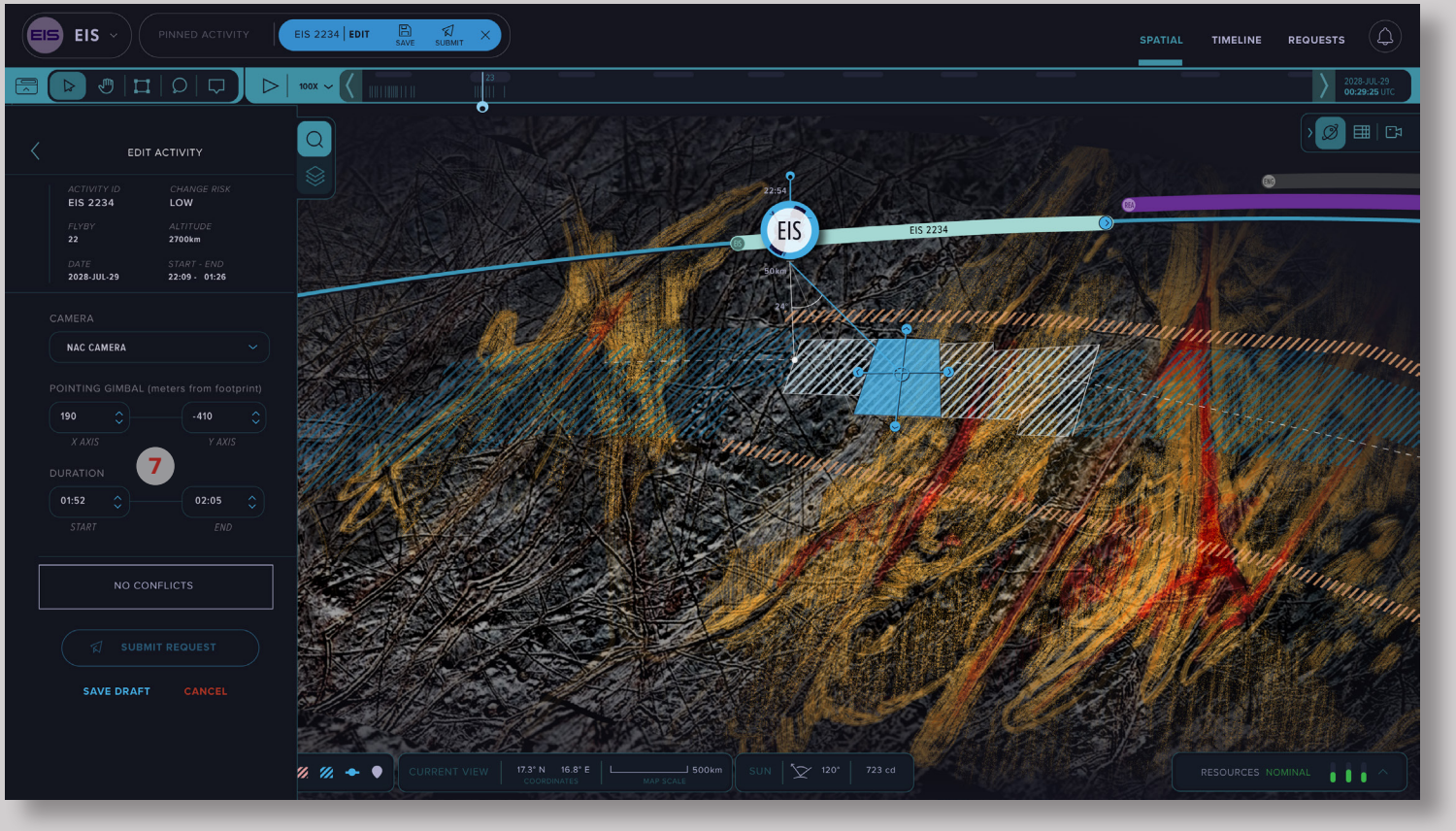
1.6 Planning



She finds an activity that comes close to her requirements for this particular observation, but it doesn't cover the whole area she wants to image. She pushes Edit button to edit the activity.

HERO FLOW

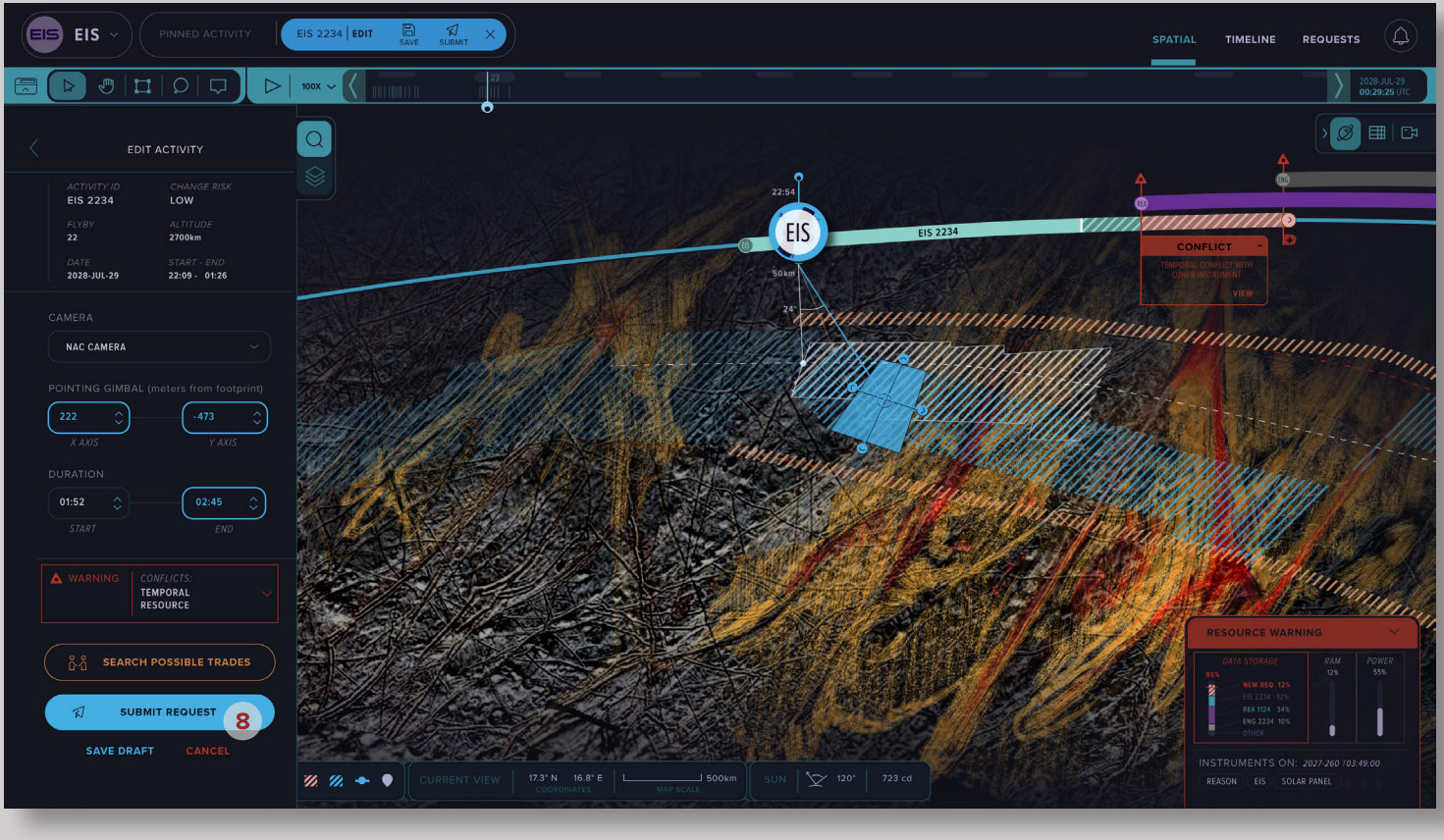
1.7 Planning



Entering edit mode, Helen tweaks the activity and the visualization shows her the effect her changes have on the spacecraft and what she can observe.

HERO FLOW

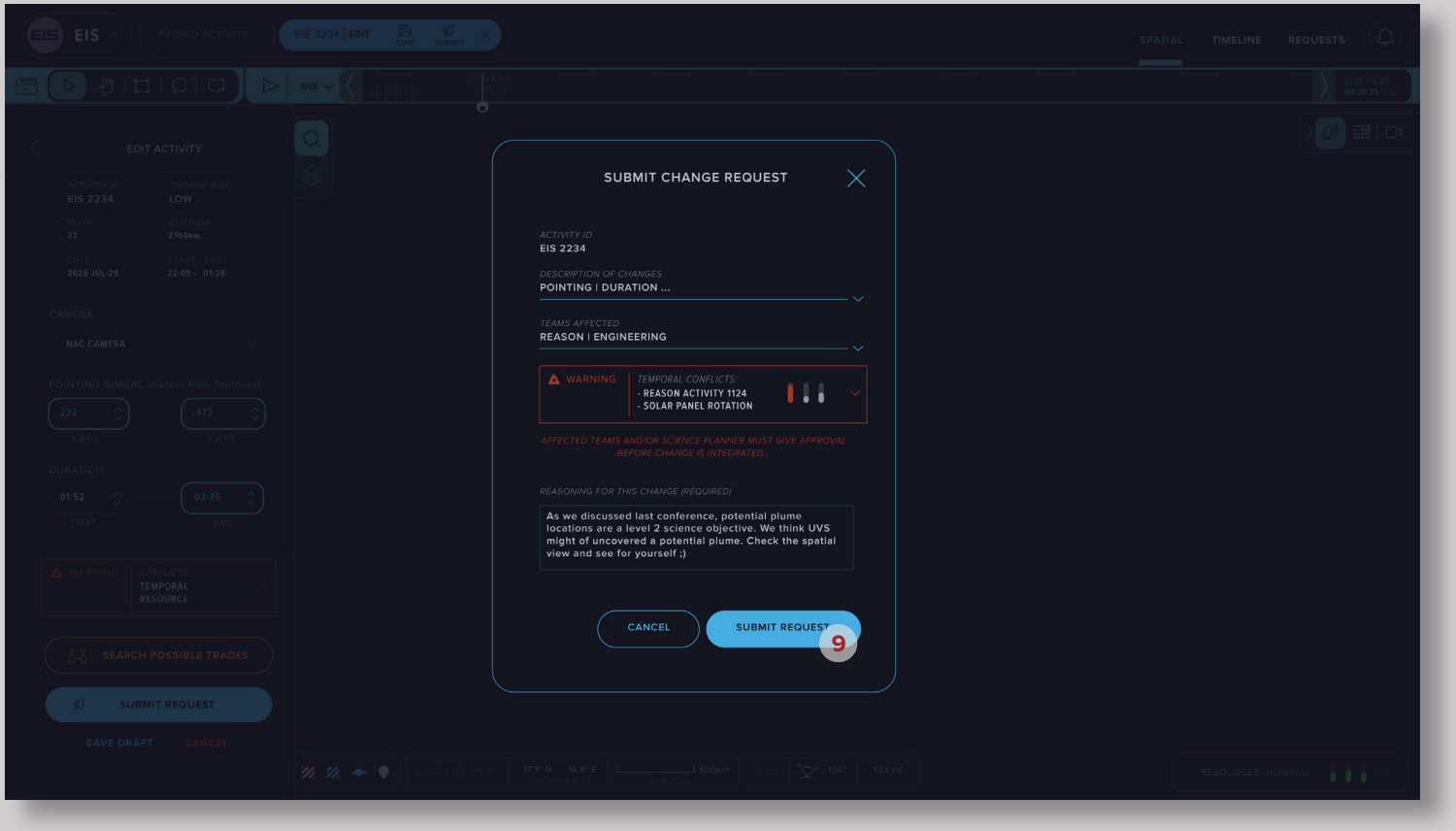
1.8 Planning



Every time Helen makes a change that breaks a flight rule or affects another team, the system warns her and clearly and succinctly explains the problem. In this case, she has extended the duration of her observation to capture the entirety of the desired area, which takes time and resources away from other teams. She decides to submit a request for the changes anyway because this observation is high priority for her team.

HERO FLOW

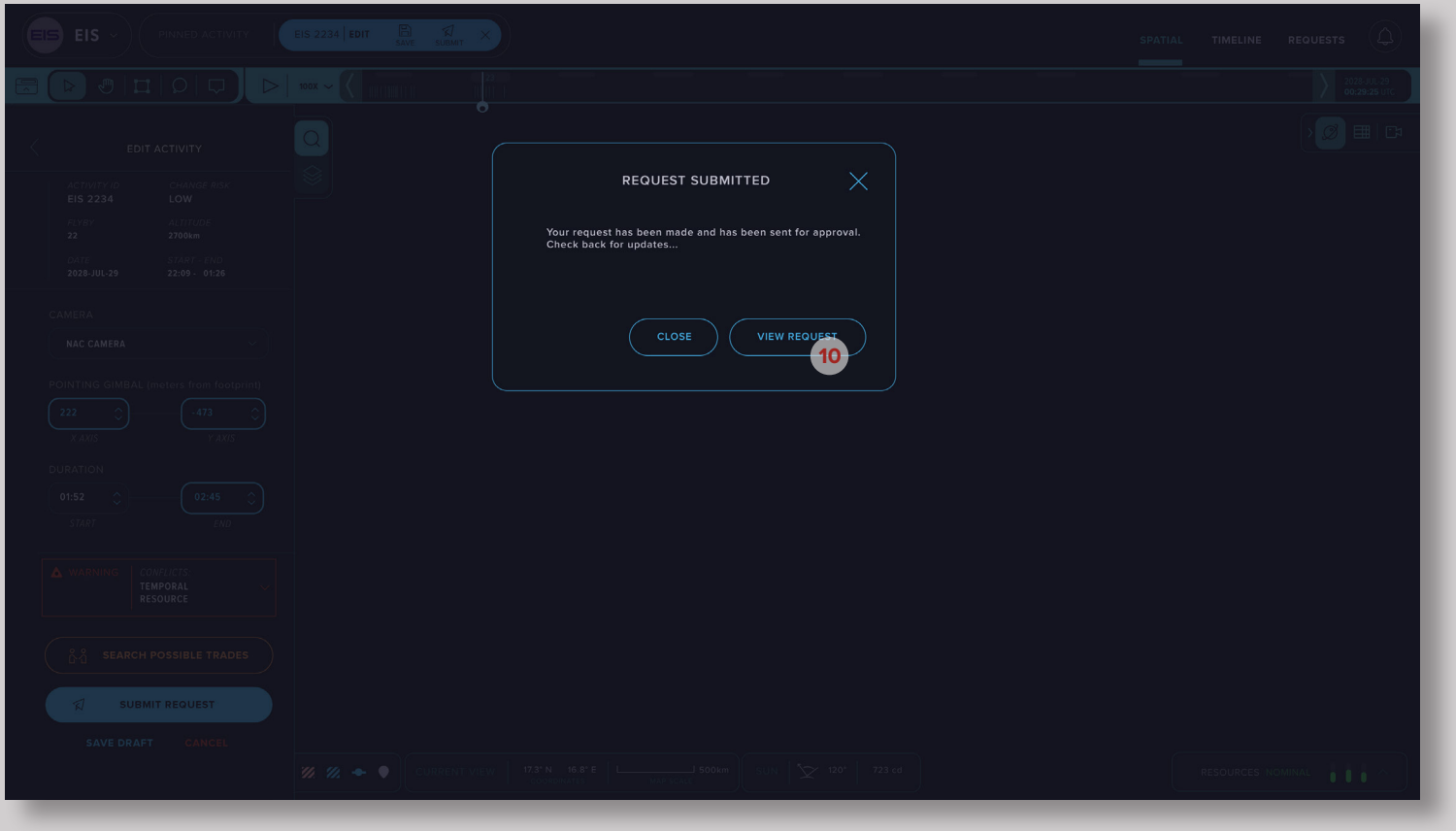
1.9 Planning



When Helen submits her change request form, a warning once again reminds her of potential conflicts. The system requires her to write a justification for her changes so that other teams and science planners know she has good reason for making conflicting changes.

HERO FLOW

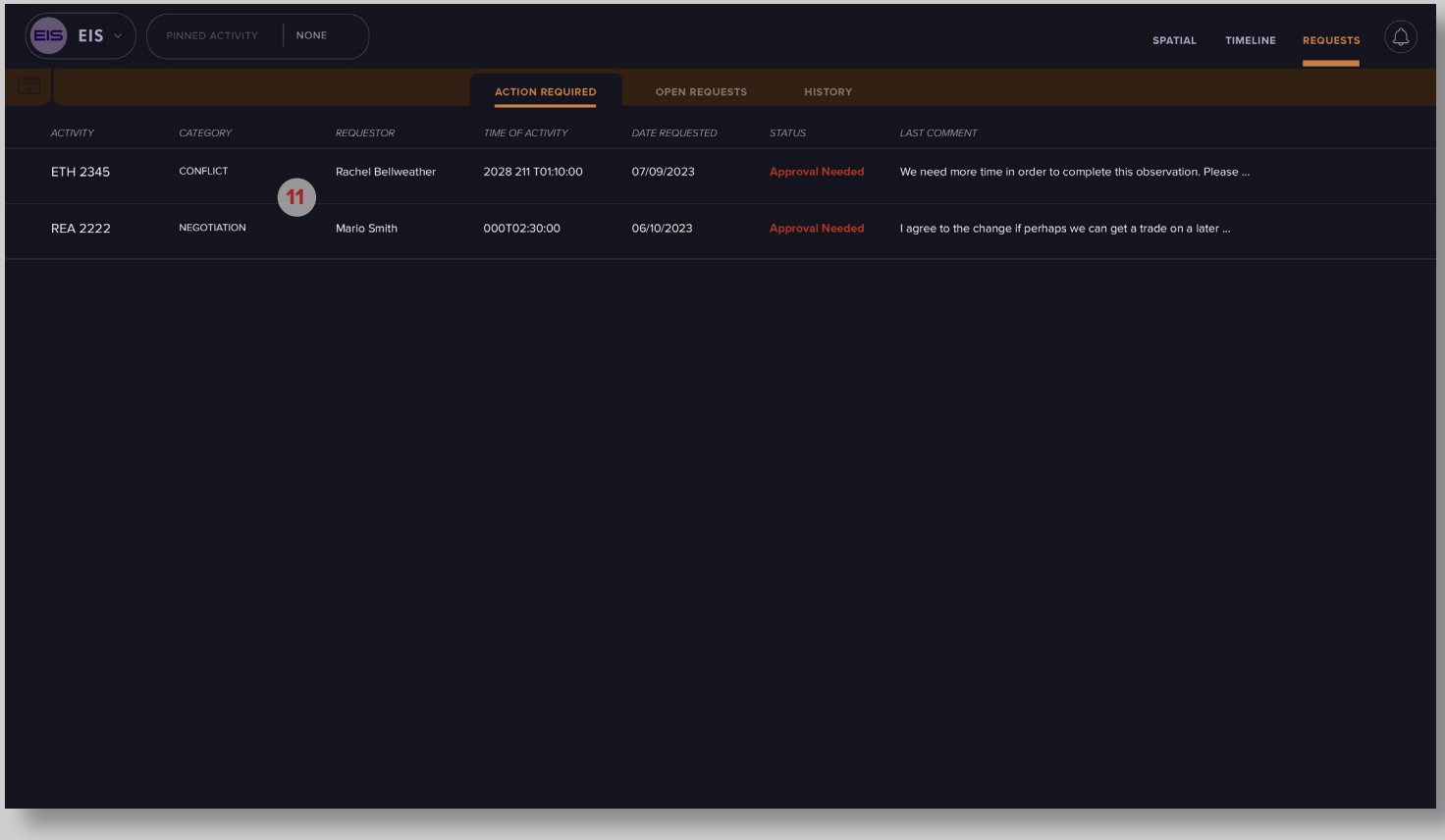
1.10 Planning



After hitting “Submit,” Helen can view the details and status of her request.

HERO FLOW

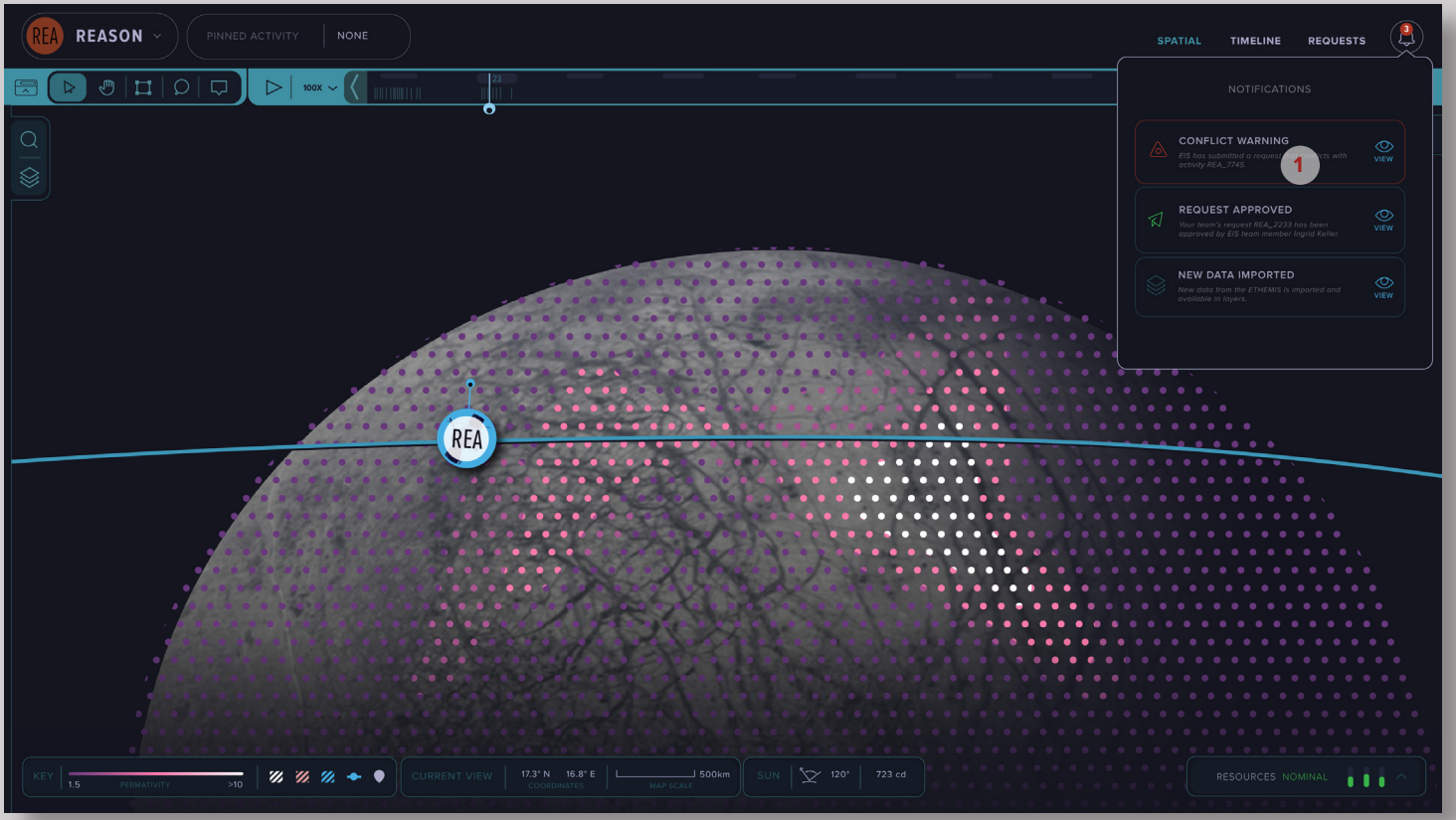
1.11 Planning



This allows her to track it through negotiation and eventual approval or rejection from a science planner. The status and comments are updated dynamically as they are reviewed and/or fulfilled.

HERO FLOW

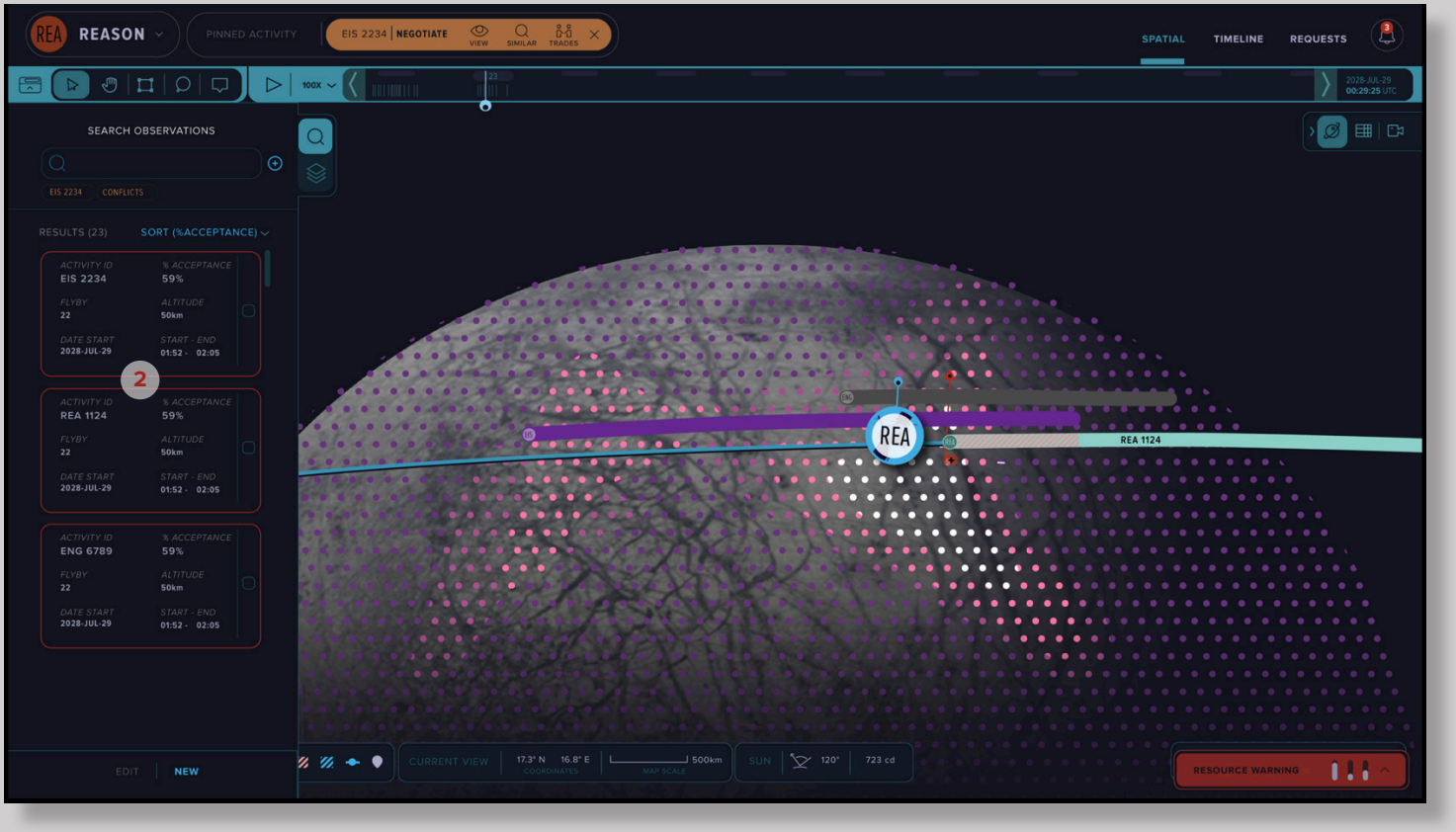
2.1 Conflict Resolution



Mary, a REASON intrument scientist, get notified immediately that there's been a request submitted that conflicts with one of their observations.

HERO FLOW

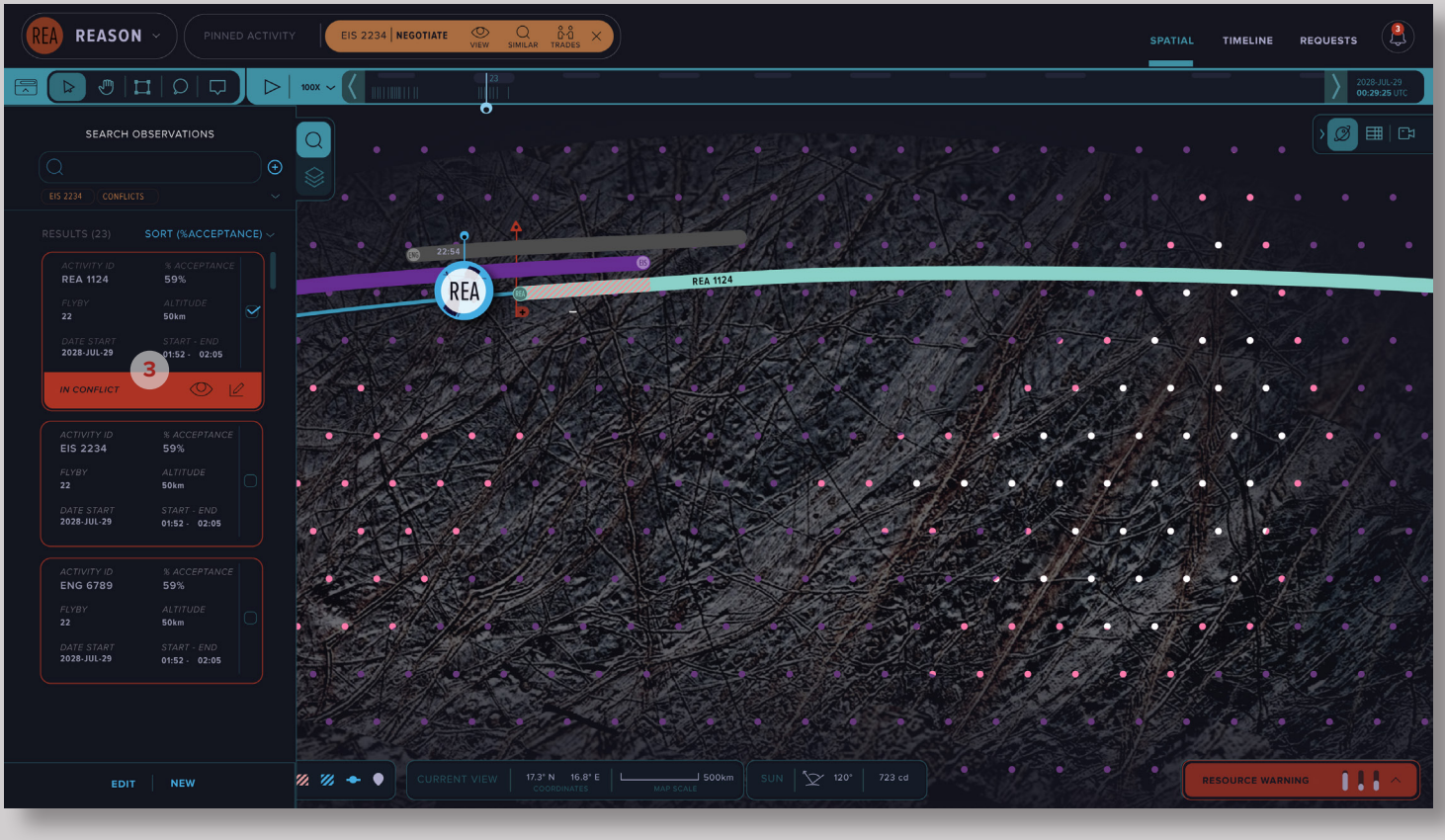
2.2 Conflict Resolution



Clicking on that conflict notification allows Mary to visualize all the conflicting activities via the search sidebar.

HERO FLOW

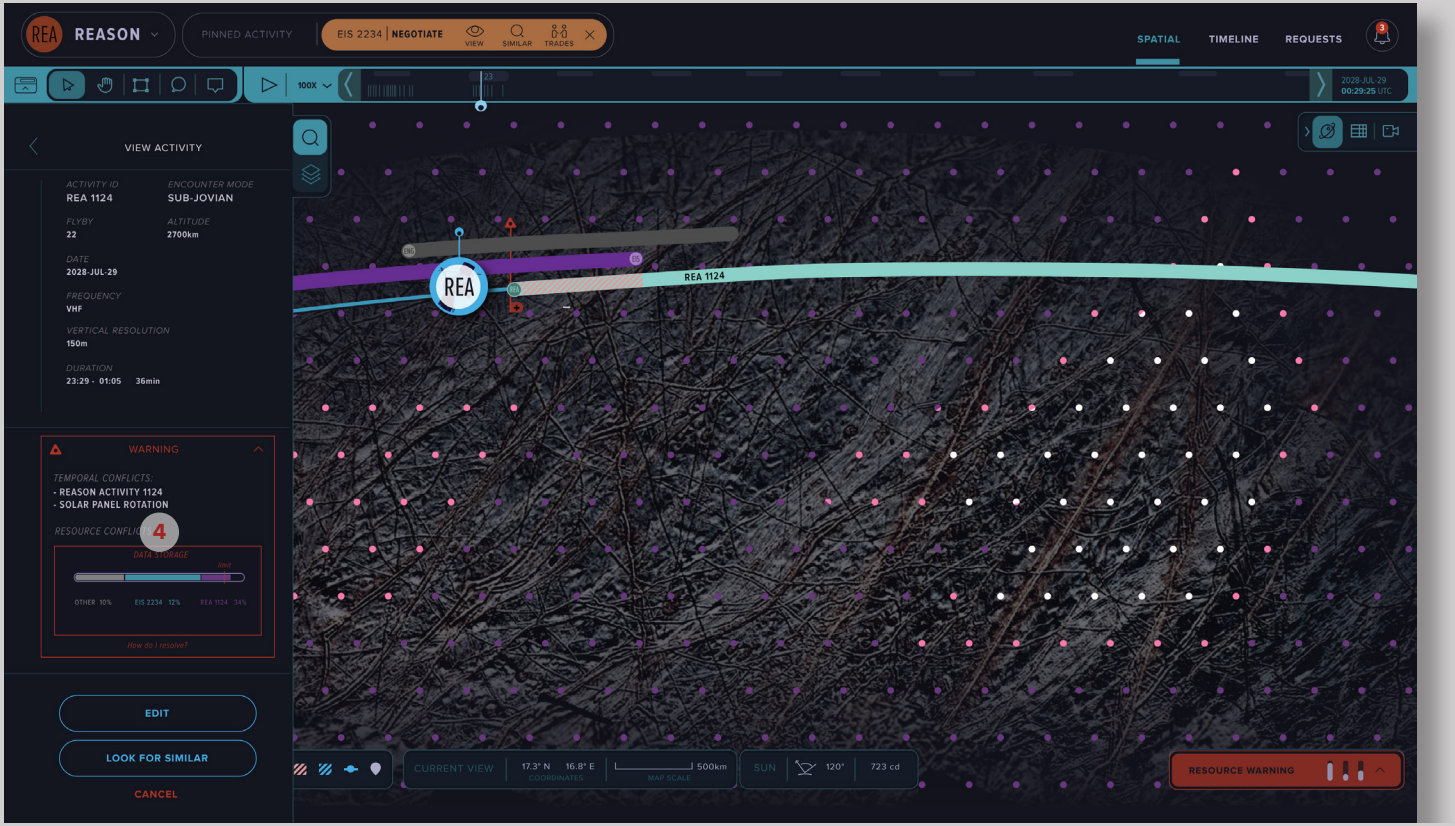
2.3 Conflict Resolution



She can view them all at once or individually. Clicking on one shows a simulation of the activity or observation .

HERO FLOW

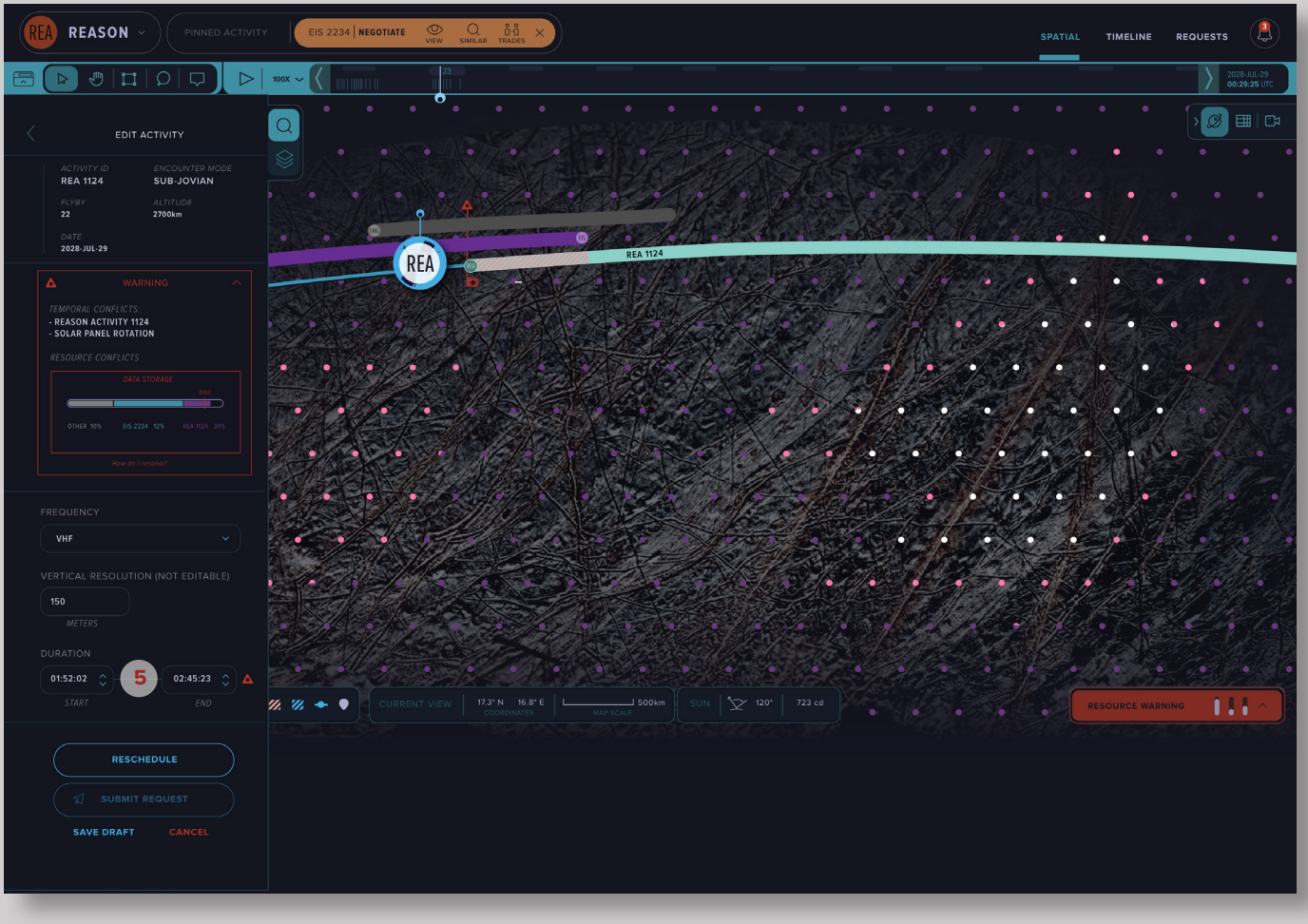
2.4 Conflict Resolution



The system gives the user details on the conflicts, explaining succinctly what has caused them and suggesting possible courses of action.

HERO FLOW

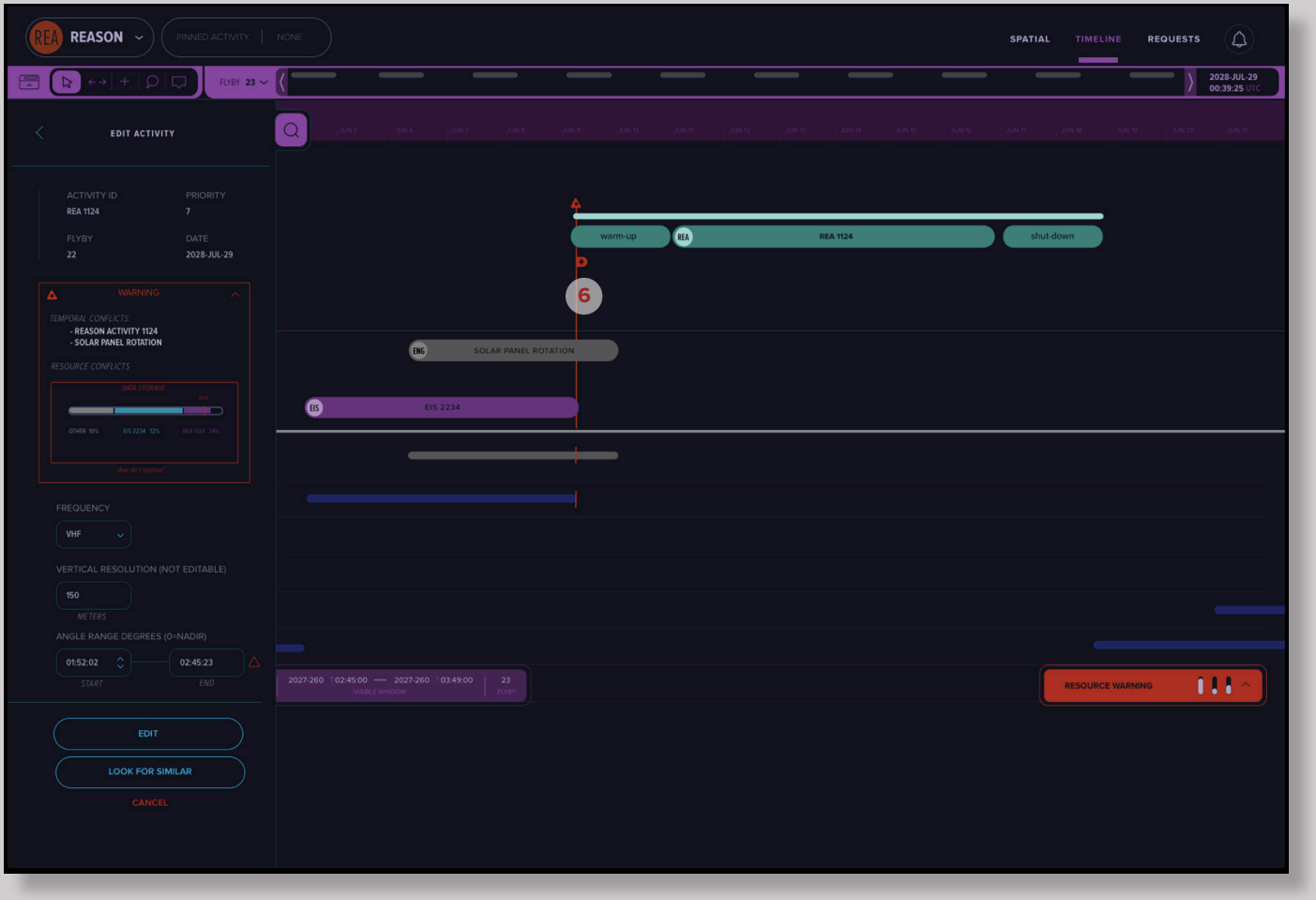
2.5 Conflict Resolution



She decides to try to edit her observation to deconflict with EIS, because she knows EIS's observation is high priority, by tweaking observation setting in editing mode.

HERO FLOW

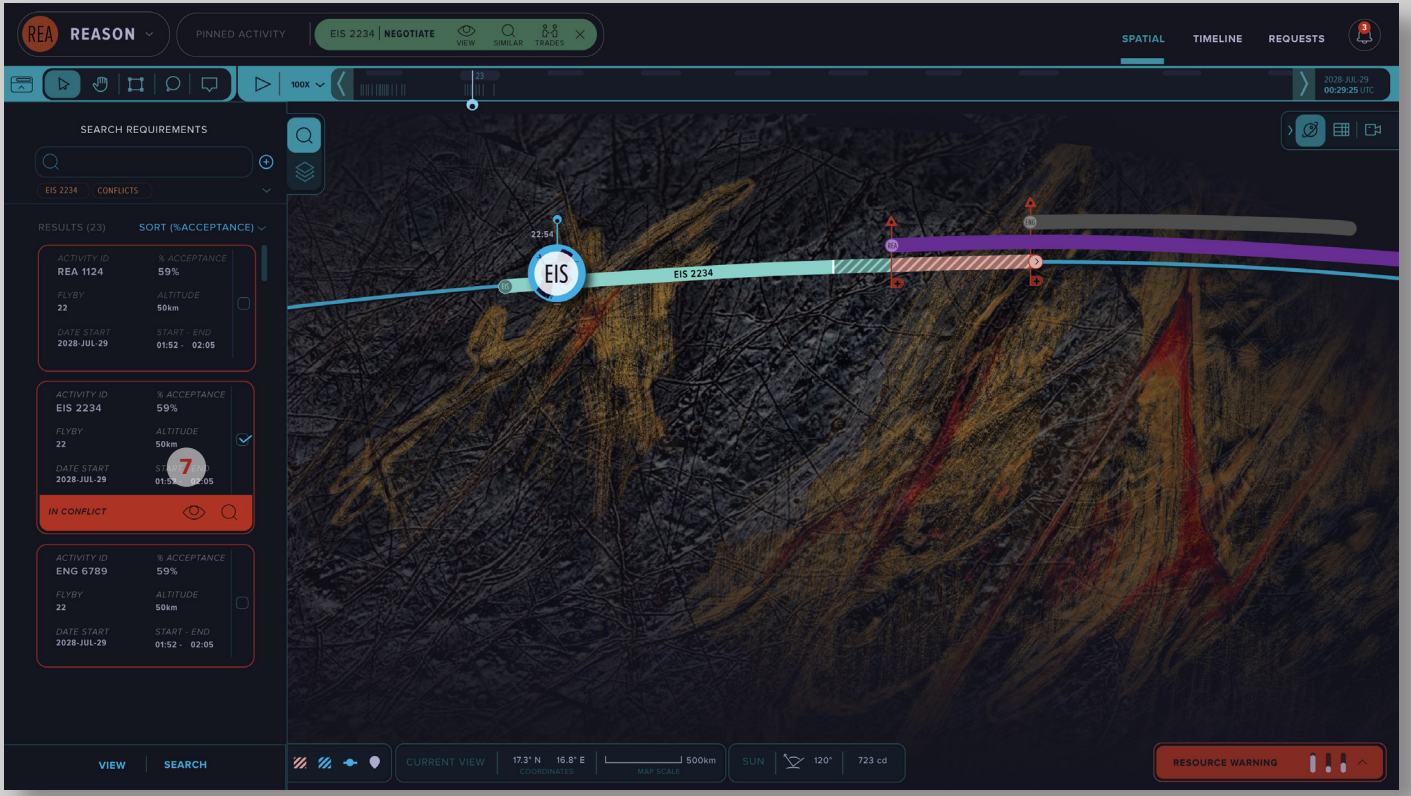
2.6 Conflict Resolution



She can always check the timeline view for a clearer view of the temporal conflicts. She finds that change is not desirable to her or her team unless the spacecraft is passing by this area again on a future flyby. She decides to check.

HERO FLOW

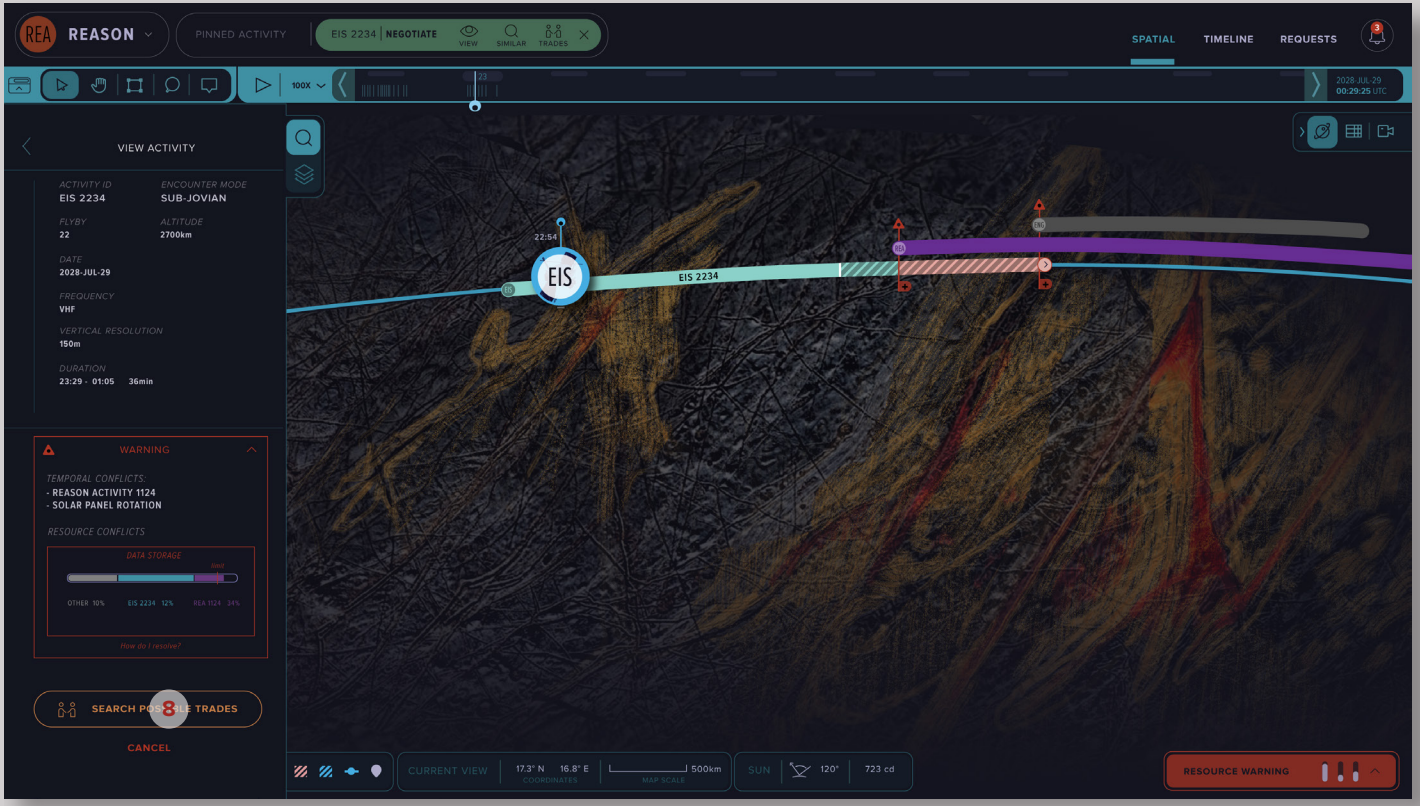
2.7 Conflict Resolution



Going back to the conflicting view, she tries another option to mediate the conflict: searching for opportunities to negotiate with EIS. She starts by selecting the conflicting EIS observation.

HERO FLOW

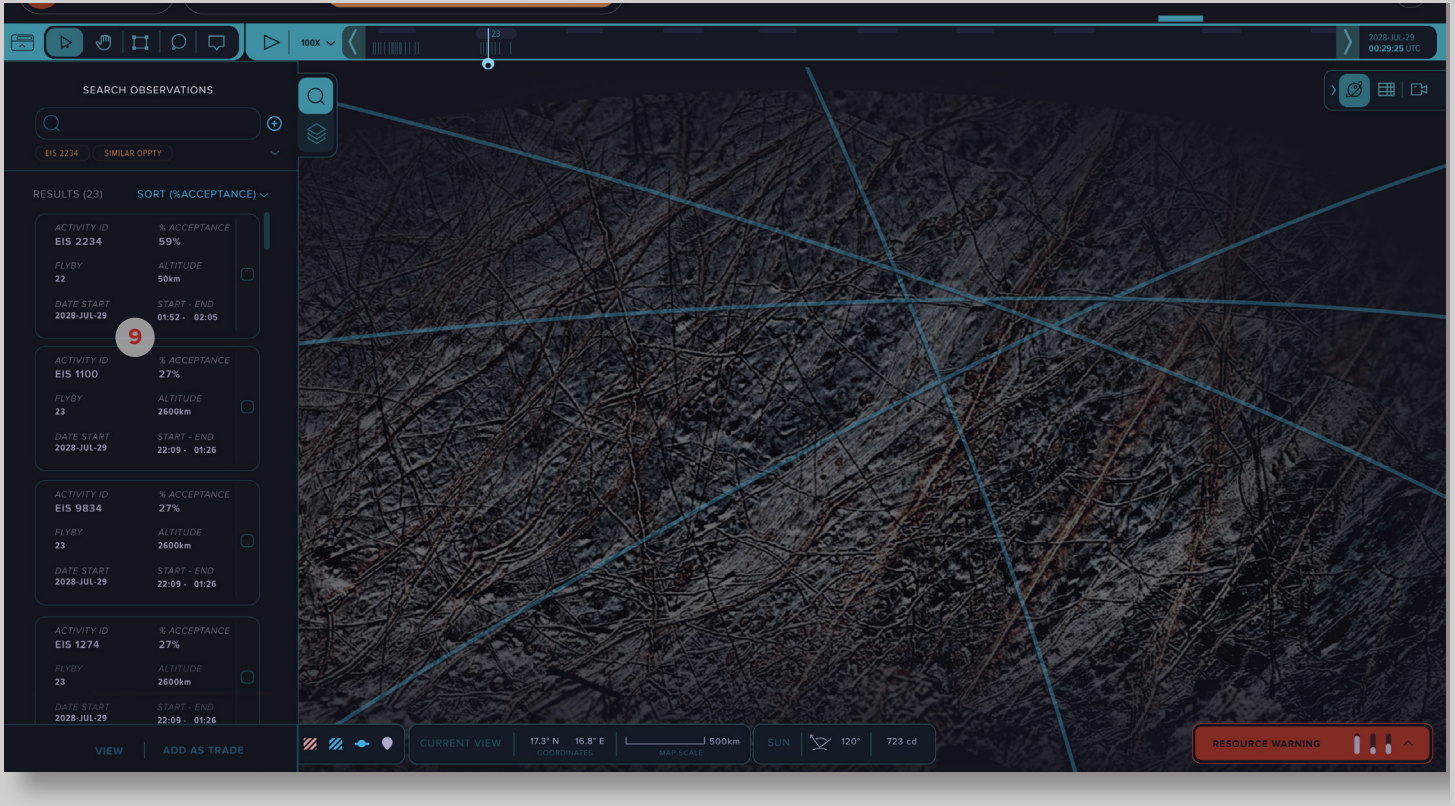
2.8 Conflict Resolution



From here she can see the details of the EIS activity and a new button shows up that allows her to search for places in the flight plan where she might be able to negotiate a trade with EIS.

HERO FLOW

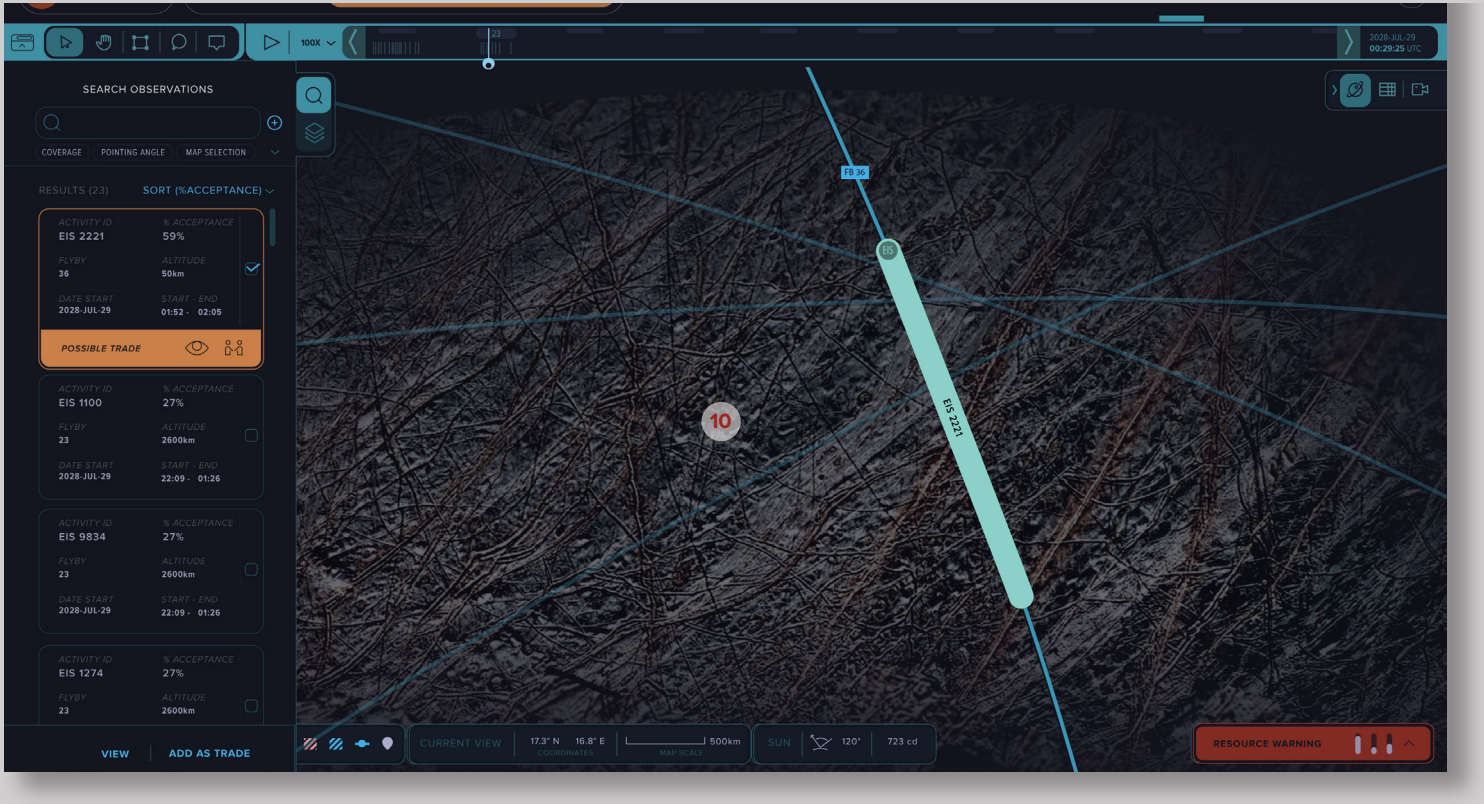
2.9 Conflict Resolution



The system searches for EIS activities for which REASON might possibly be able to negotiate a trade.

HERO FLOW

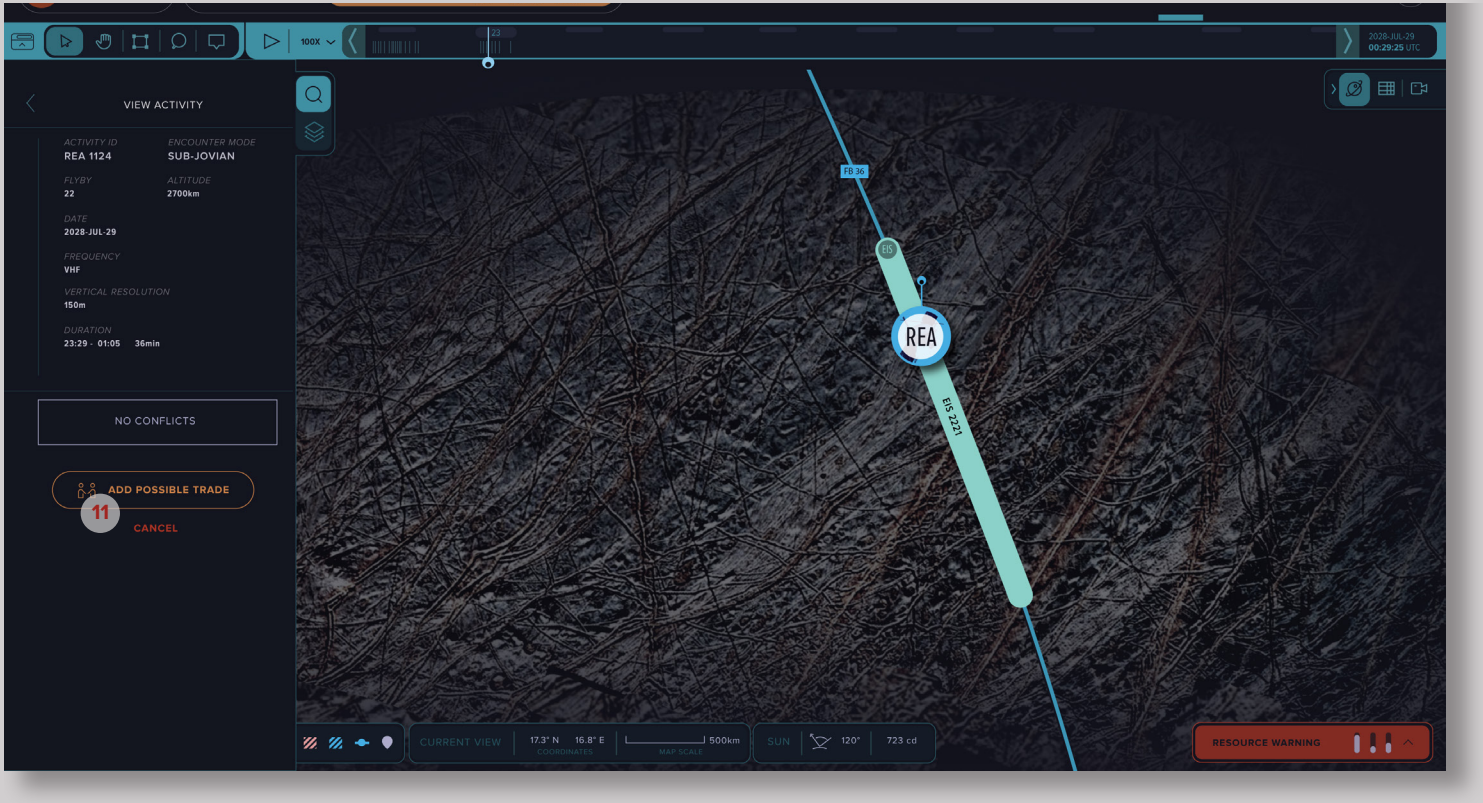
2.10 Conflict Resolution



She can view a simulation of each search result.

HERO FLOW

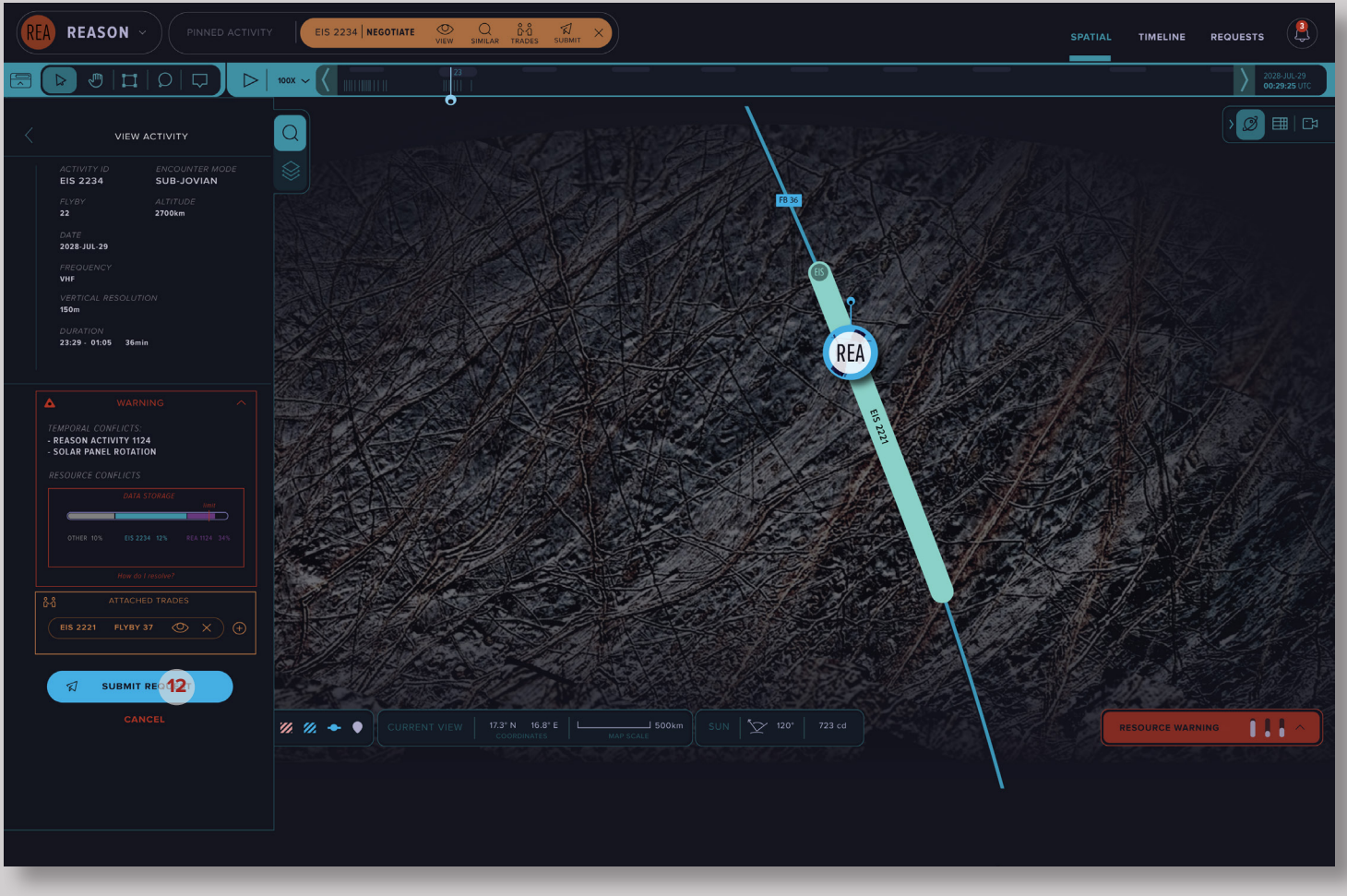
2.11 Conflict Resolution



The first search result would be ideal for Mary to make up for the observation time lost on that previous flyby. She adds this activity to her request as a possible trade.

HERO FLOW

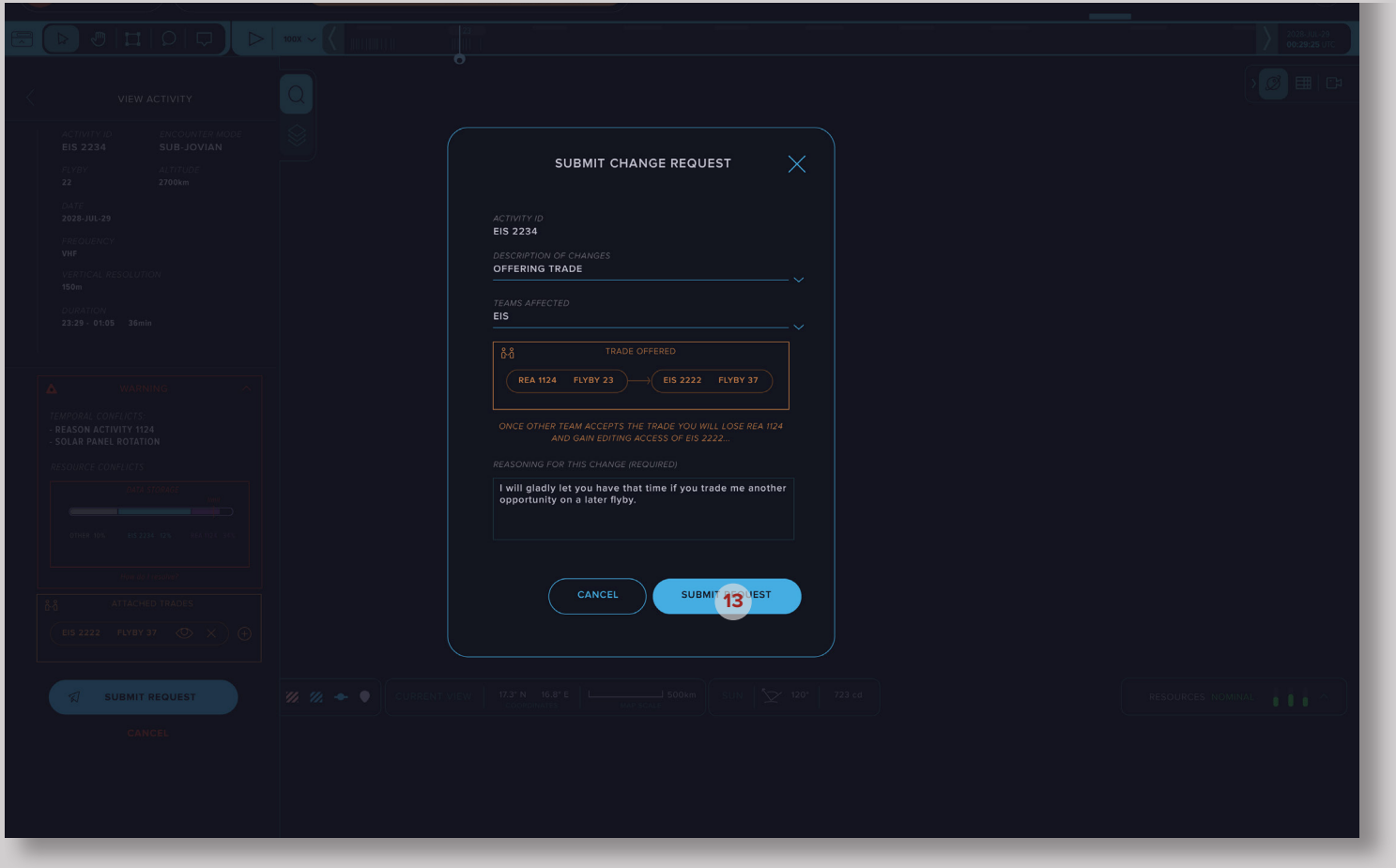
2.12Conflict Resolution



She then submits a request as if she were submitting a change to the plan,

HERO FLOW

2.13Conflict Resolution



She specifies justification for wanting to make the trade and submits.

VISUAL SYSTEM

High-level details of system grids, UI components and relation between color typeface and interaction elements.

COLOR

Our interface uses a dark color scheme with secondary color highlights. While this has adapted over many iterations we were originally inspired by the classic car colors of the 1950's and 1960's. During our research interviews we also became enamoured with some of the pop culture references that participant mentioned, there are elements of color use that were pulled from the touch interfaces in Star Trek the Next Generation.

PRIMARY

20212d

7f81bd

SECONDARY

404730

428060

B6CB8A

a7d8d3

232c66

673c7d

ab3627

46abe2

ICONOGRAPHY

Utilizing a good amount of space between elements and rounding many of the corners of interface elements we provide an interface that both looks easy to navigate and provides enough information for scientists to complete their work. In the same spirit of our design we also looked toward the organic shapes found in classic cars and in Star Trek curvilinear interfaces.

Top Bar

Notifications

Toolbar

Search | Minimize top bar | Direct selection | Pan | Regional selection | Zoom | Comment

Play simulation | Add activity | Move

Main View

3D GIS | 2D GIS | Instrument FOV | Instrument Data Layers | Solar Incidence Angle

TYPOGRAPHY

NASA has a rich history that has influenced the very culture of what it means to be American. Our choice of typefaces borrows from the excitement of the 1960's space race while remaining functional and easy to read. Proxima Nova is a more contemporary font based on geometric typefaces with more modern proportions. The use of each weight and color selection is meant to aid users to find data above text descriptions, making it ideal for pro users who do not need as much help with supportive text.

Proxima Nova Bold

Proxima Nova Medium

Proxima Nova Regular

Proxima Nova Light Italic

Proxima Nova Condensed Bold

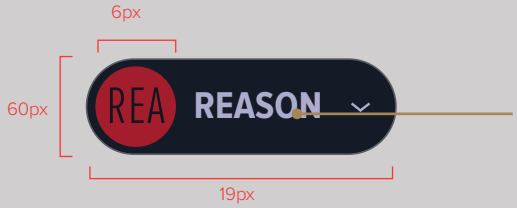
Proxima Nova Condensed Semibold

Proxima Nova Condensed Regular

Proxima Nova Condensed Light

COMPONENTS

Topbar



Font

Proxima Nova Condense Bold 24

Description

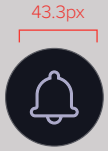
User Profile

Font

Proxima Nova Regular 14

Description

Pined Activities



Description

Inbox button to check incoming messages

COMPONENTS

Toolbar/Spatial View

Description

Toolbar to manipulate 3D view

Font

Proxima Nova Condensed

Bold 12

Description

Progress bar for science

activities

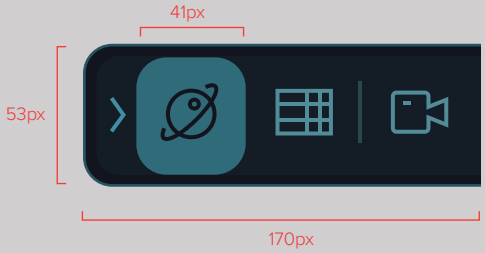
Font

Proxima Nova Condensed

Bold/Light 12

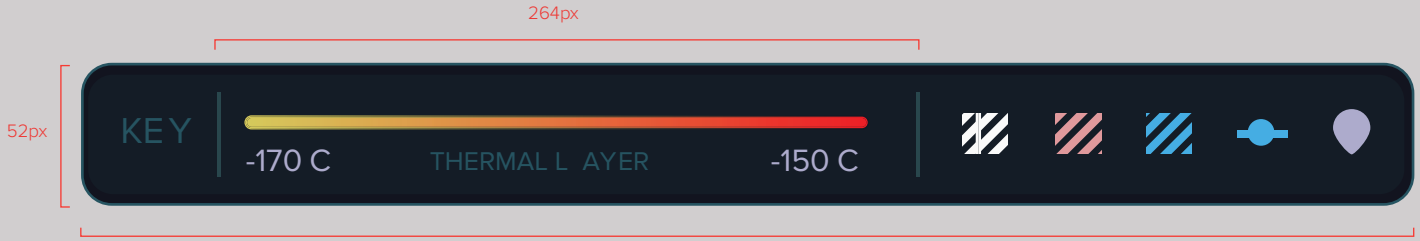
COMPONENTS

Controls/Spatial View



Description

Switch to alternative spatial view

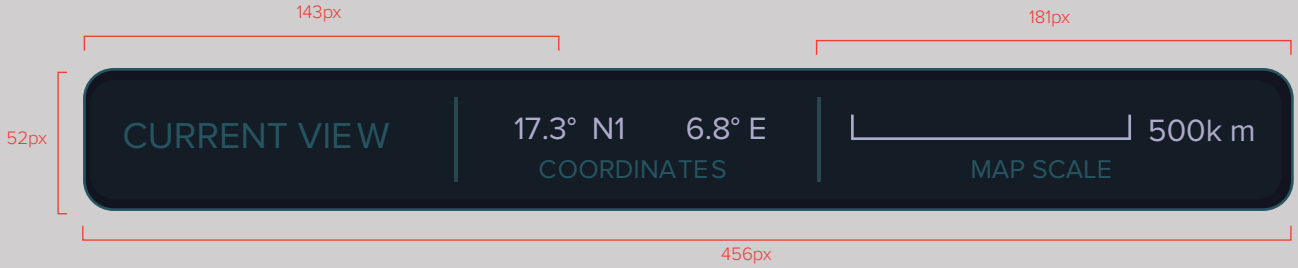


Description

Key to visualization in spatial view

Font

Proxima Nova Regular 12, 14



Description

Gepgraphical information of spatial view

Font

Proxima Nova Regular 10, 12

COMPONENTS

Controls/Spatial View

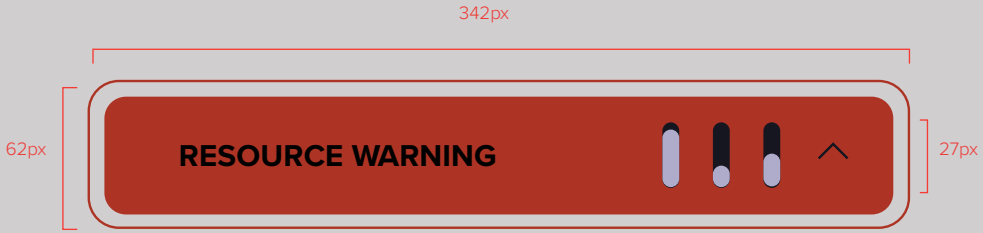
Font

Proxima Nova Regular

12, 14

Description

Sun-related info panel



Font

Proxima Nova Bold

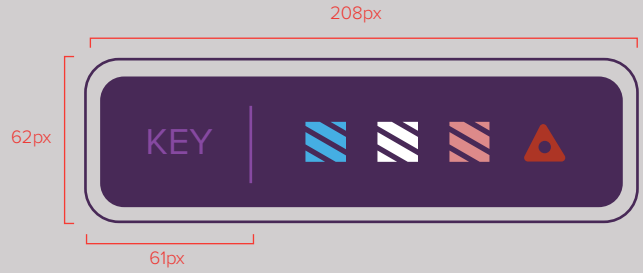
14

Description

Resource visualization

COMPONENTS

Controls/Timeline View

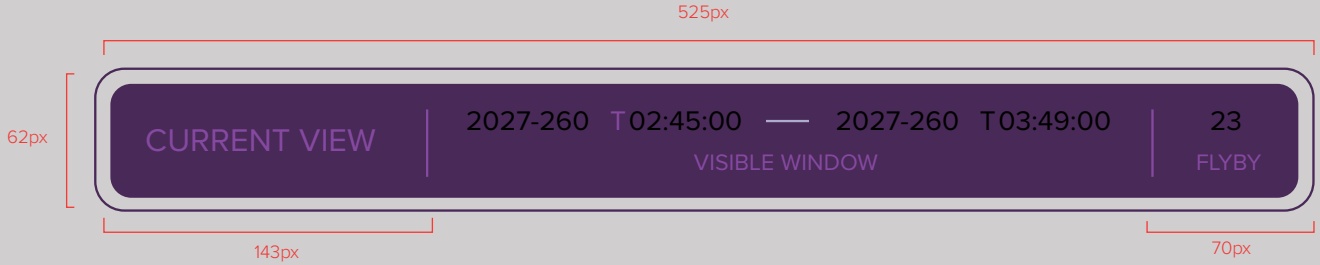


Font

Proxima Nova Regular 14

Description

Key to timeline view



Font

Proxima Nova Regular 10, 12 14

Description

visualization on current/

selected science activity

COMPONENTS

SideBar

Description

Suggested already-scheduled science activities based on typed-in requirement

Font

ProximaNovaCond Light 14

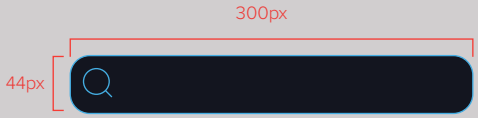
ProximaNovaCond Regular 14

ProximaNovaCond Bold 12, 14

ProximaNova Regular 14

Description

Suggested activity

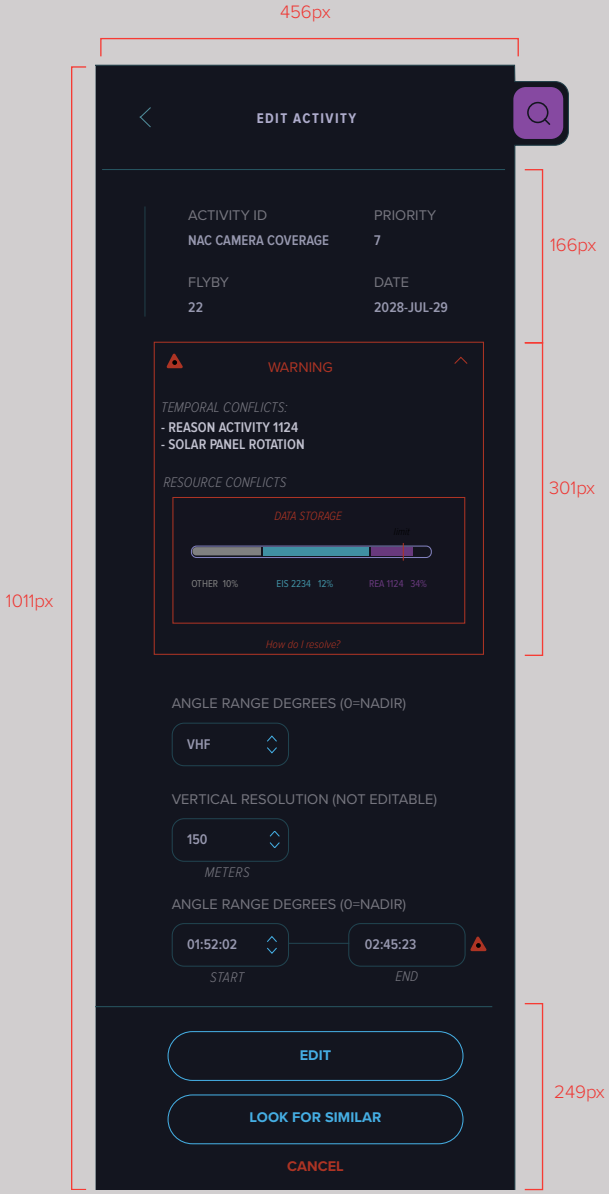


Description

place to type in requirement

COMPONENTS

SideBar



Description

Editing on suggested activities by adjusting its parameters. Warnings show up when conflicts happen.

Font

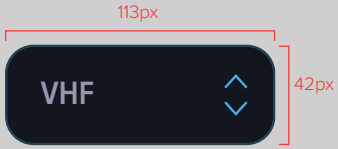
ProximaNovaCond Bold 14

ProximaNovaCond SemiBold 14

ProximaNovaCond Regular 14

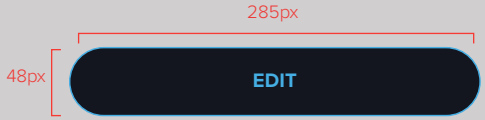
ProximaNovaCond LightIt 14

ProximaNova Regular 14



Description

Input box to change parameter



Description

Button