

Spot the difference... on the surface
of Mars!

Mars in Motion: Overview and early results

Citizen science for training and verification of
automated data mining for change detection

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With more than a little help from:

Robert Houghton, James Sprinks, Steven Bamford, Jeremy Morley, Panagiotis
Sidiropoulos, the Zooniverse team and X volunteers.



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Mars in Motion: The Images

3364

Image pairs in which the algorithm found change.



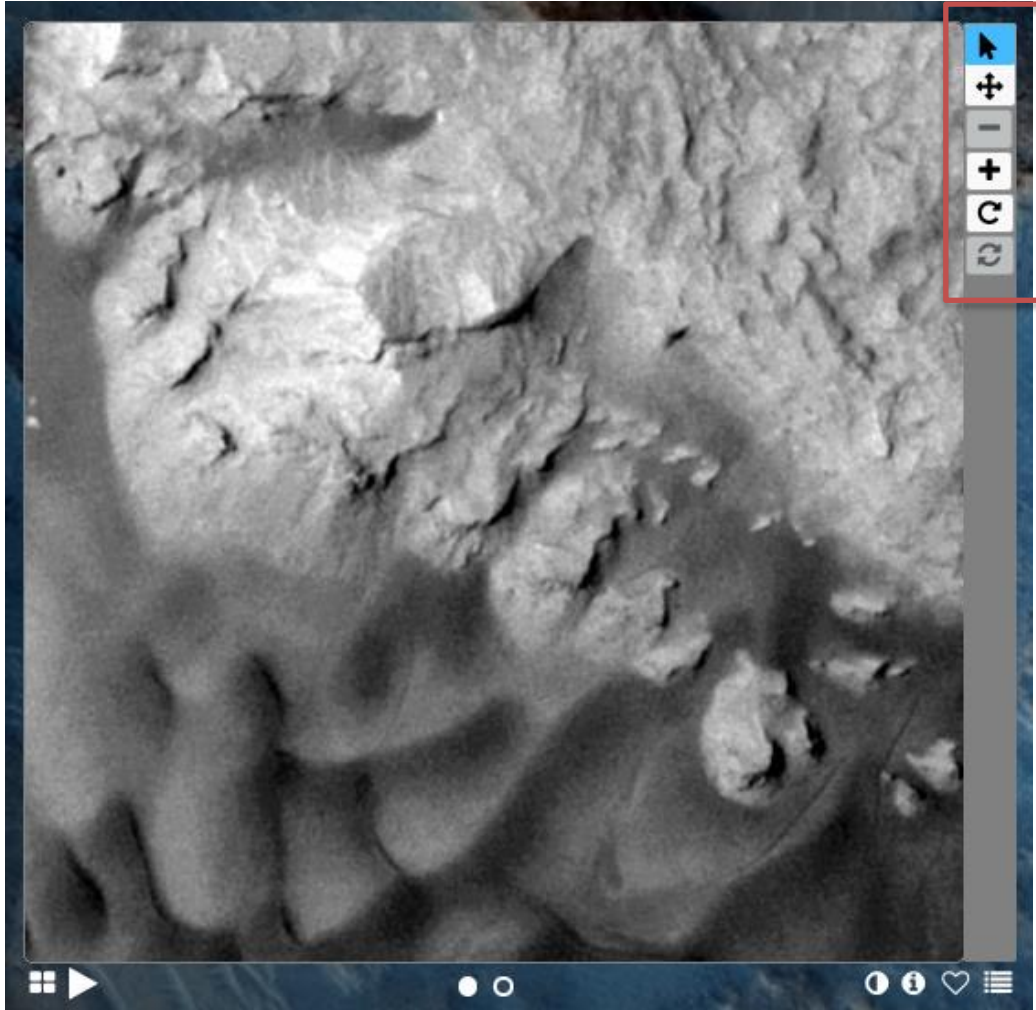
CONTROL: manually checked

465

270 true positives

195 false positives

Mars in Motion: The Task



Annotation

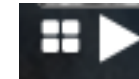
Pan

Zoom Out

Zoom In

Rotate

Reset

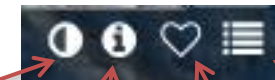


Side-by-side/Play



Switch image

Invert image

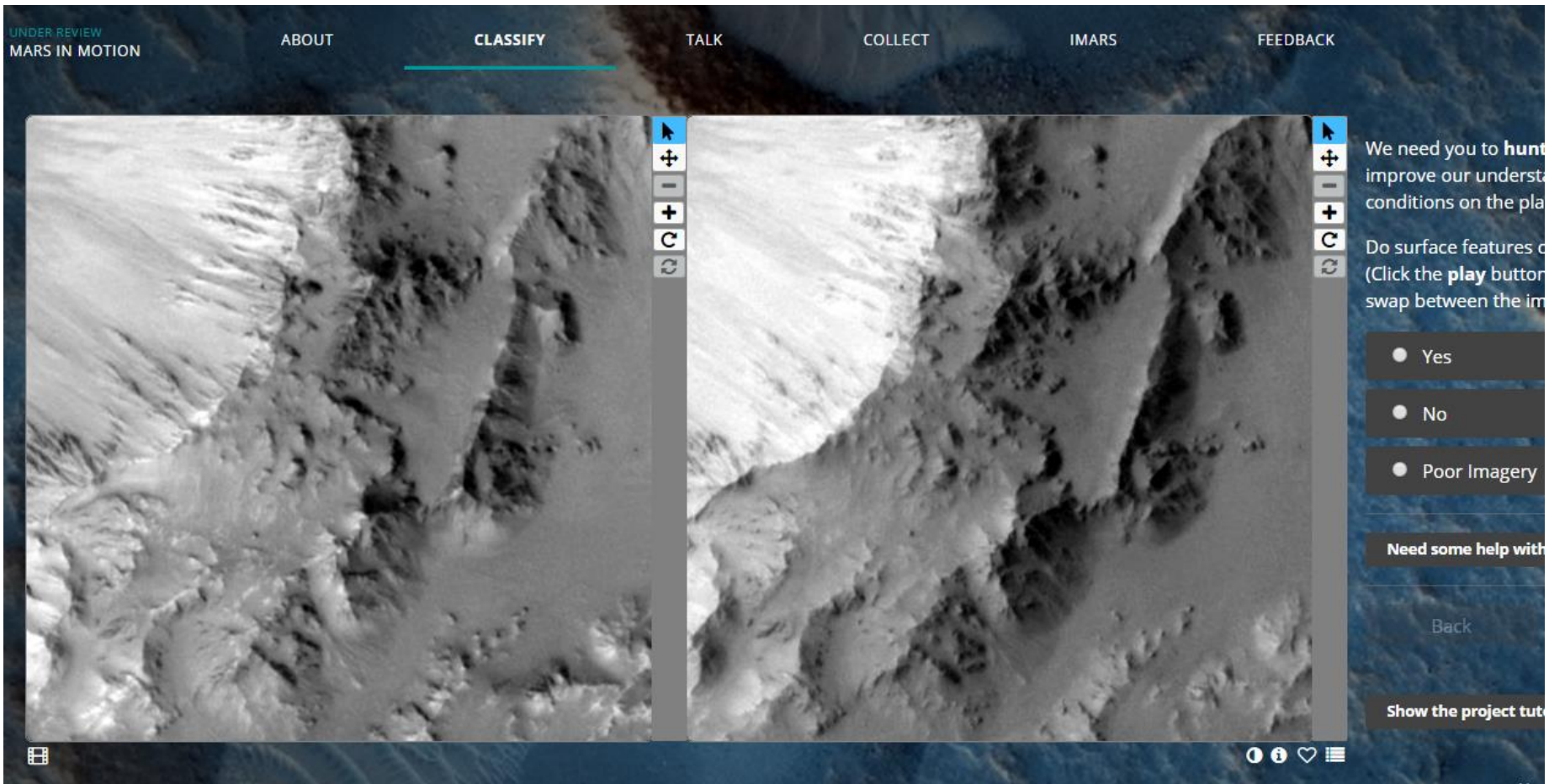


Metadata

Favourite

Collect

Side by Side



Mars in Motion: The Task

We need you to **hunt** for and **Identify** changes in surface features to improve our understanding of atmospheric and environmental conditions on the planet. Firstly:

Do surface features change between the two images?
(Click the **play** button - bottom left or the **switches** - bottom centre to swap between the images)

☐ Yes

☐ No

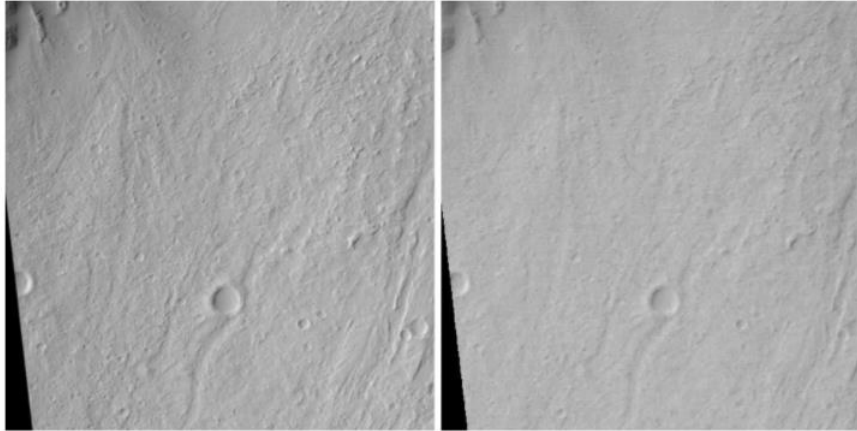
☐ Poor Imagery

FIELD GUIDE

Need some help with this task?

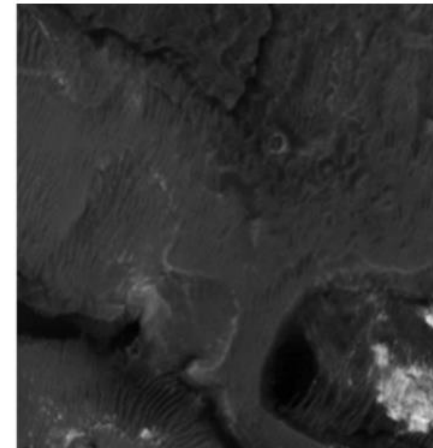
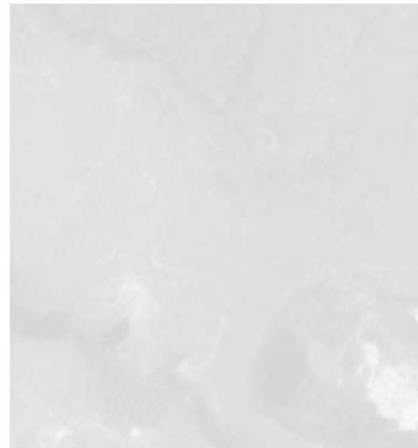
Need some help with this task?

The changes we are looking for are physical changes on the surface, and **NOT** changes in contrast, lighting conditions or resolution.



Whilst the image on the left is clearly a higher resolution, and a slightly darker contrast (depending on your screen setup) - there are no physical changes on the surface, so in this case you would select the answer **No** and click done.

Some of the imagery might be poor in quality, making detecting change hard to do. This could be due to over exposure (causing a 'whited out' image - see below), noise, or poor co-registration (the two images are badly aligned). In the case that it is so poor you cannot make out features, select the 'Poor Imagery' option.



Field Guide



Impact crater



Gullies



Dune



Slope streaks/RSLs



Dust devil tracks



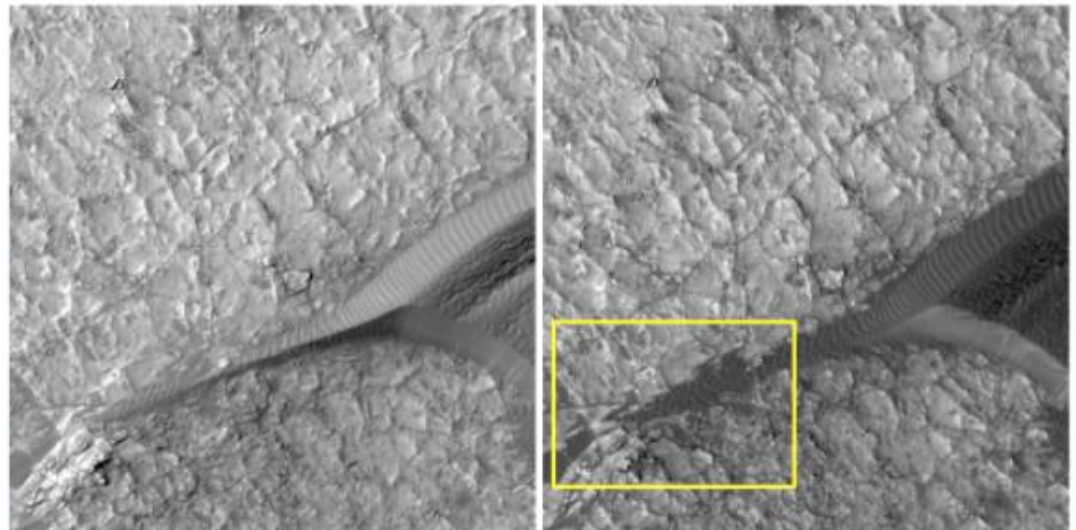
Seasonal fans



Dune

for and identify changes in surface features. Understanding of atmospheric and environmental conditions is needed. Firstly:

Like dunes found on Earth, Martian dunes are a hill of sand and occur in different shapes and sizes. They have been known to slowly migrate across the surface, at a rate of fractions of a metre to several metres per Martian year (see yellow box).



Answer: YES

Use the tool below to mark the area(s) of the image in which you see surface features change. Click "Done" when you have finished.

Area of change

0 drawn

(Click the **play** button - bottom left or the **switches** - bottom centre to swap between the images)

☒ Yes

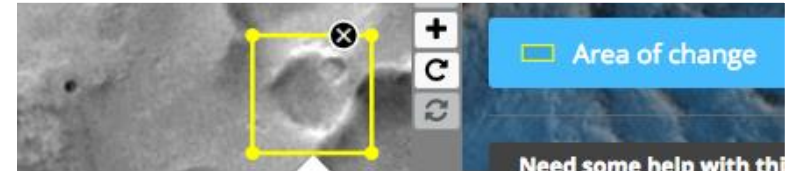
☐ No

☐ Poor Imagery

Need some help with this task?

START

FINISH



What surface feature have you marked?

☐ Impact crater

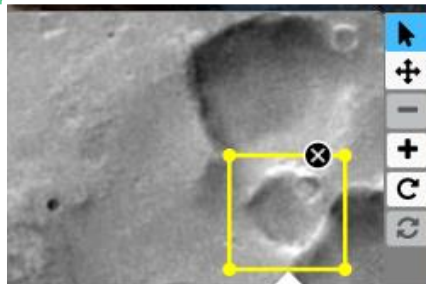
☐ Gully

☐ Dune

☐ Slope streak/RSL

☐ Dust devil track

☐ Seasonal fan



Use the tool below to mark the area(s) of the image in which you see surface features change. Click "Done" when you have finished.

Area of change

1 drawn

Need some help with this task?

What surface feature have you marked?

☒ Impact crater

Done

Confirmation

Thanks!

Your classification:

We need you to **hunt** for and **Identify** changes in surface features to improve our understanding of atmospheric and environmental conditions on the planet. Firstly:

Do surface features change between the two images?
(Click the **play** button - bottom left or the **switches** - bottom centre to swap between the images)

☒ **Yes**

[More](#)

Use the tool below to mark the area(s) of the image in which you see surface features change. Click "**Done**" when you have finished.

Area of change (1 rectangle marked)

[More](#)

[Talk](#)

[Next](#)



'No' and 'Poor Imagery'

We need you to **hunt** for and **identify** changes in surface features to improve our understanding of atmospheric and environmental conditions on the planet. Firstly:

Do surface features change between the two images?
(Click the **play** button - bottom left or the **switches** - bottom centre to swap between the images)

☐ Yes

☒ No

☐ Poor Imagery

Thanks!

Your classification:

We need you to **hunt** for and **identify** changes in surface features to improve our understanding of atmospheric and environmental conditions on the planet. Firstly:

Do surface features change between the two images?
(Click the **play** button - bottom left or the **switches** - bottom centre to swap between the images)

☒ No

[More](#)

Talk

Next



We need you to **hunt** for and **identify** changes in surface features to improve our understanding of atmospheric and environmental conditions on the planet. Firstly:

Do surface features change between the two images?
(Click the **play** button - bottom left or the **switches** - bottom centre to swap between the images)

☐ Yes

☐ No

☒ Poor Imagery

Thanks!

Your classification:

We need you to **hunt** for and **identify** changes in surface features to improve our understanding of atmospheric and environmental conditions on the planet. Firstly:

Do surface features change between the two images?
(Click the **play** button - bottom left or the **switches** - bottom centre to swap between the images)

☒ Poor Imagery

[More](#)

Talk

Next



Classification data

L2														fx [{"task":"T0","task_label":"Do surface features change between the two images?","value":"No"}]	
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	
	classification_id	user_name	user_id	user_ip	workflow_id	workflow_name	workflow_version	created_at	gold_standard	expert	metadata	annotations	subject_data	subject_ids	
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3	12938014	iMarsNottingham	1495428	4be43a07b0df601188de	1980	Spot the differen	18.37	2016-06-02 11:15:45 UTC			{"session":"0"}	[{"task":"T0"}	[{"2080574":{"r	2080574	
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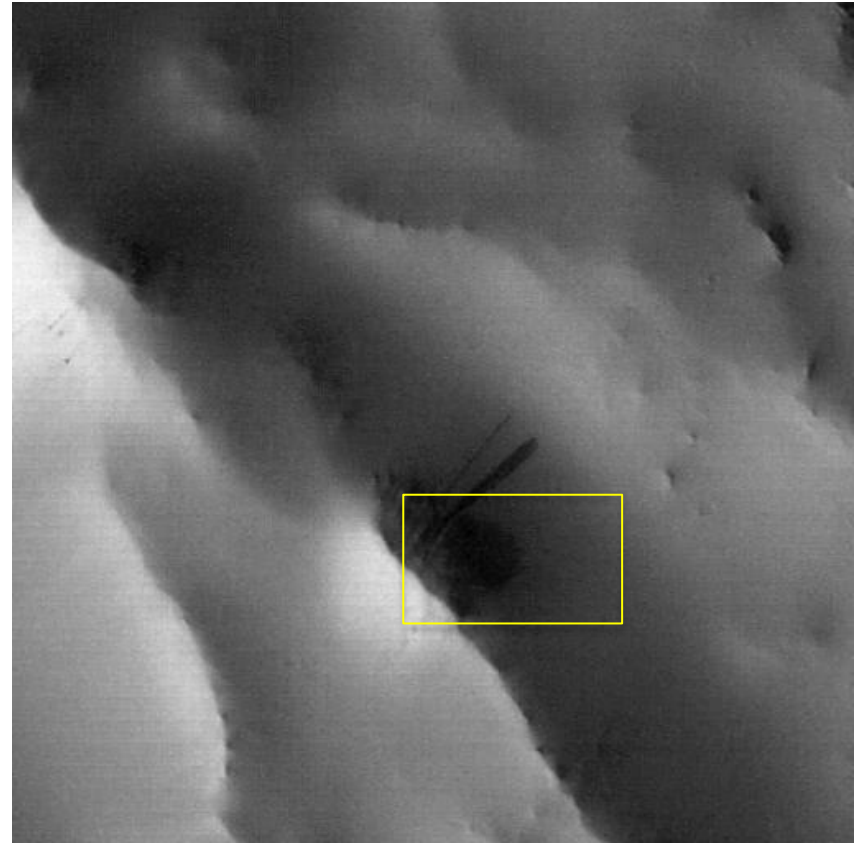
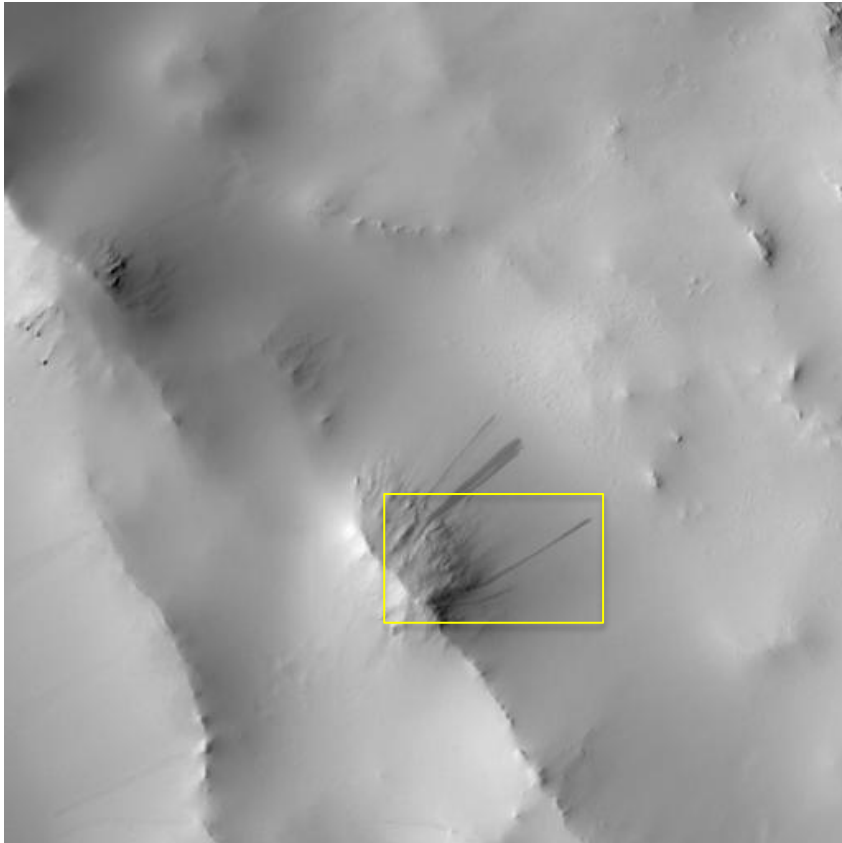
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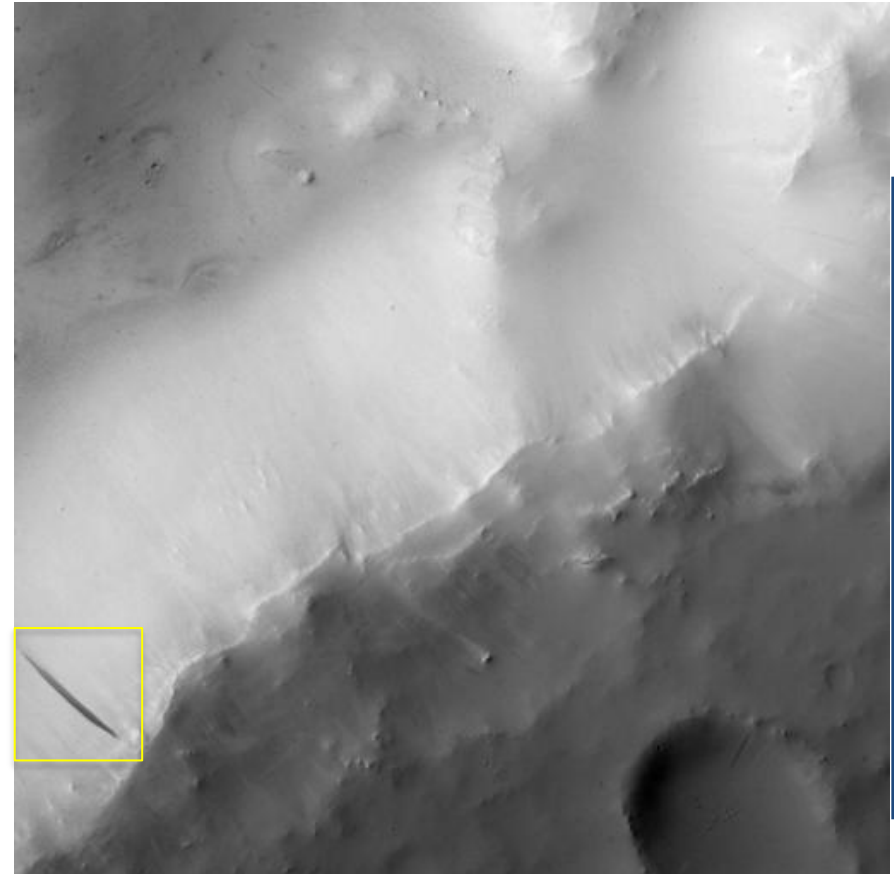
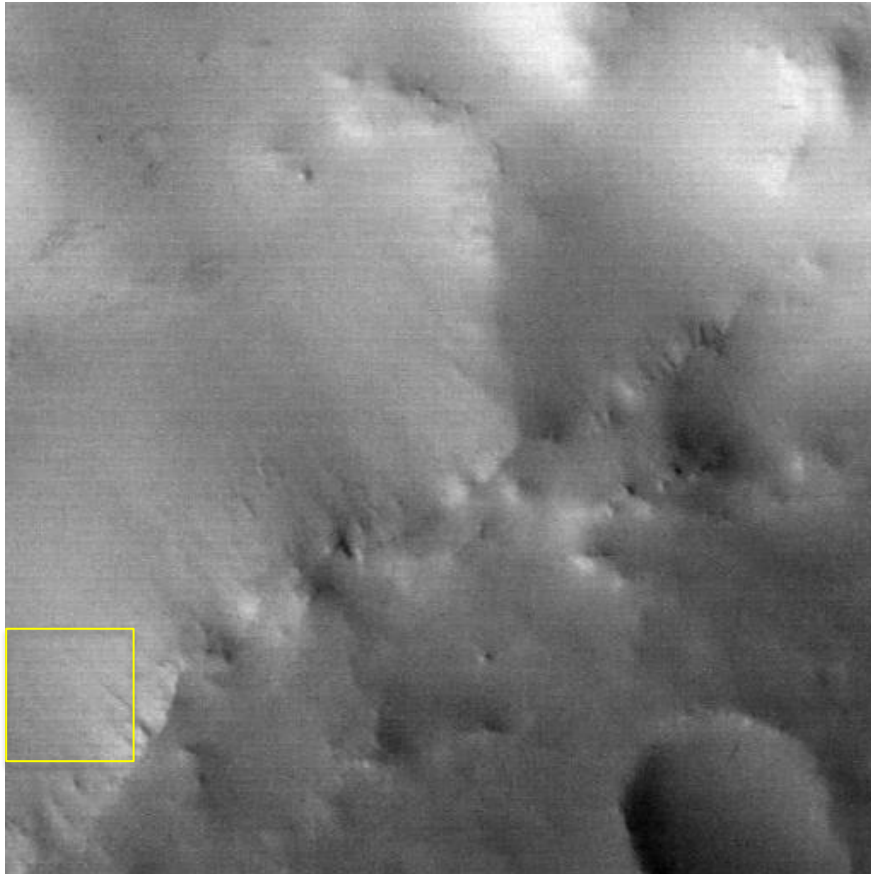
[{"task":"T0","task_label":"We need you to ****hunt**** for and ****identify**** changes in surface features to improve our understanding of atmospheric and environmental conditions on the planet. Firstly:\n\nDo surface features change between the two images?\n\n(Click the ****play**** button - bottom left or the ****switches**** - bottom centre to swap between the images), "**value**":"**Yes**"}, {"task":"T1","task_label":"Use the tool below to mark the area(s) of the image in which you see surface features change. ****Click \"Done\"**** when you have finished.", "value":{"x":1.796875,"y":367,"tool":0,"frame":0,"width":72,"height":77,"details":{"**value**":"**3**"}, "tool_label":"Area of change"}}]

Early results



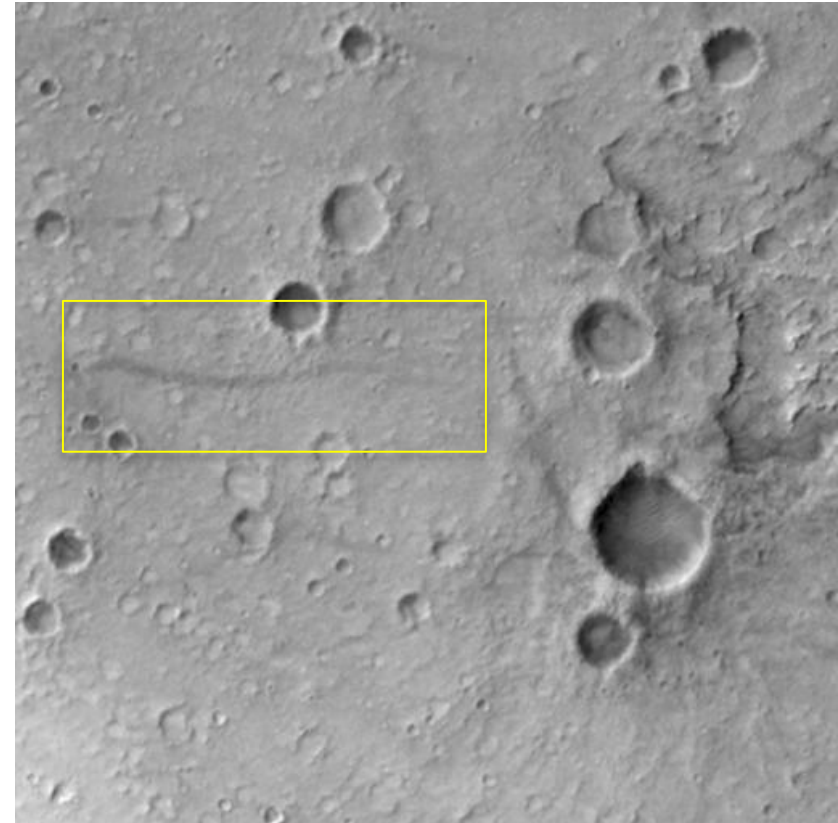
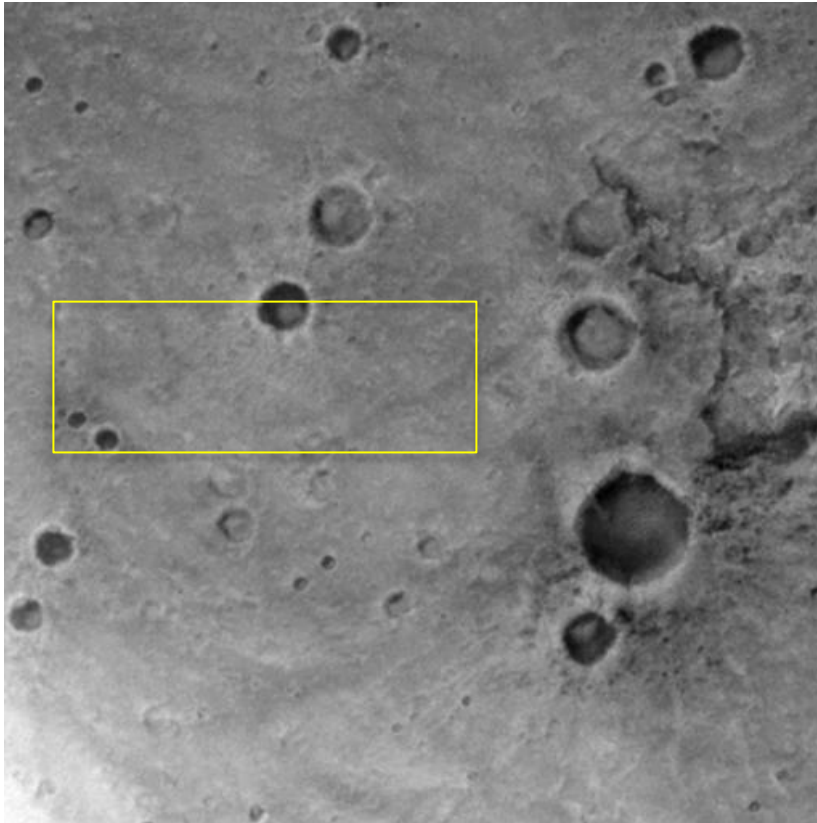
Slope Streaks

Early Results



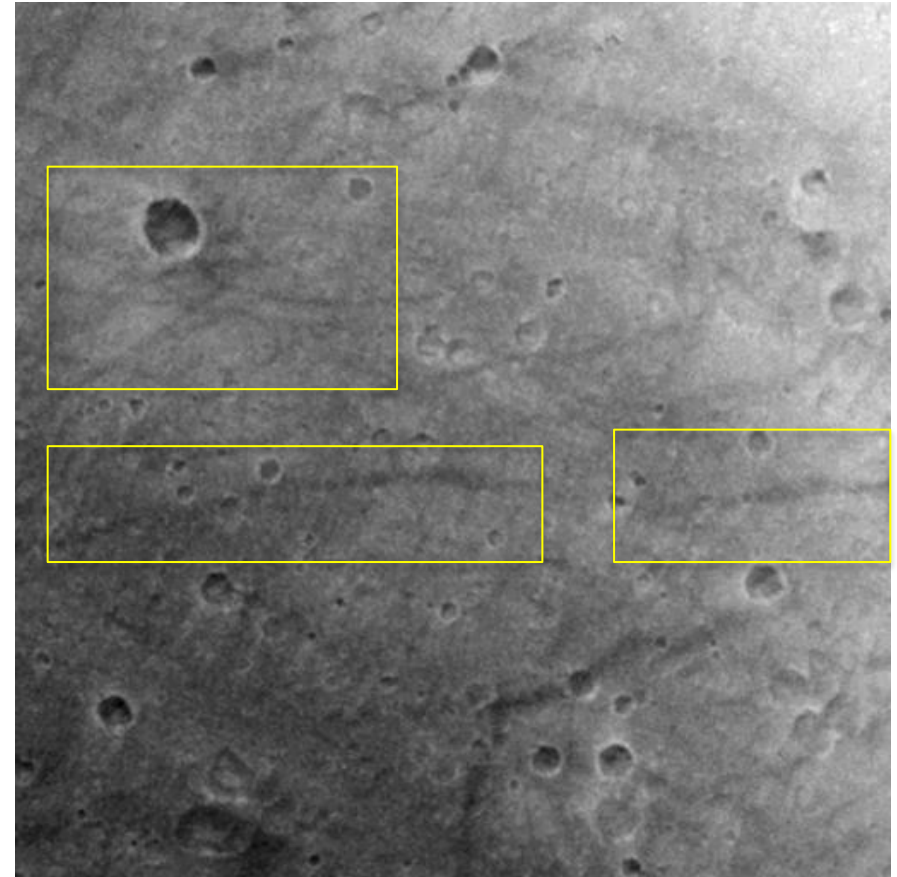
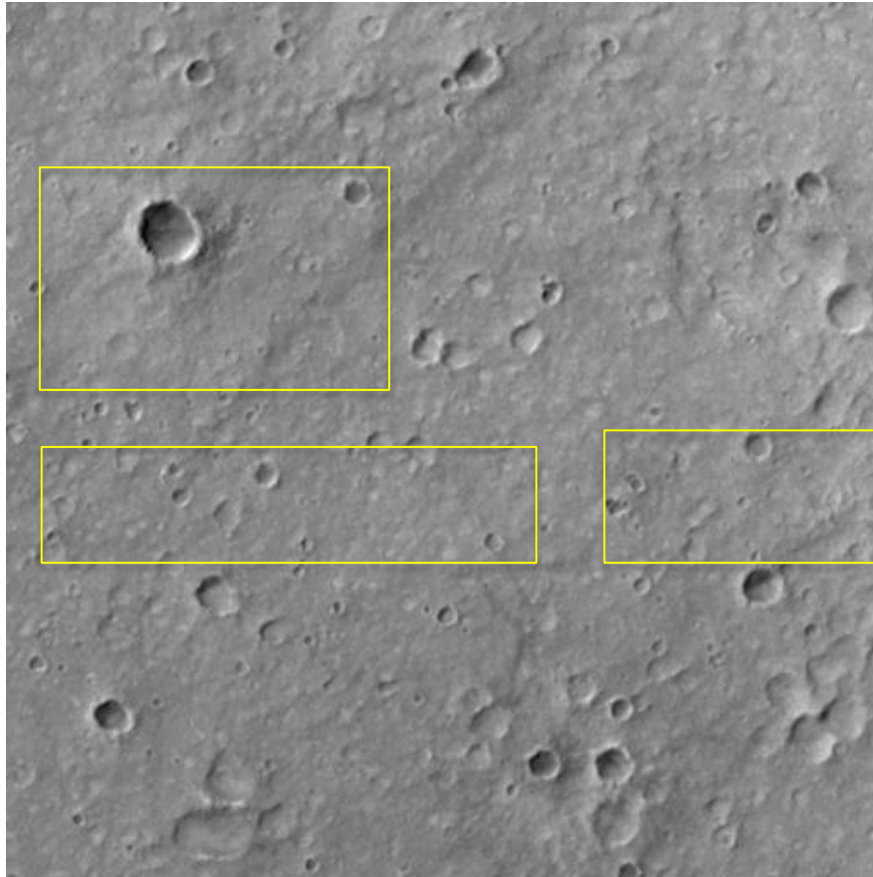
Slope Streaks

Early Results



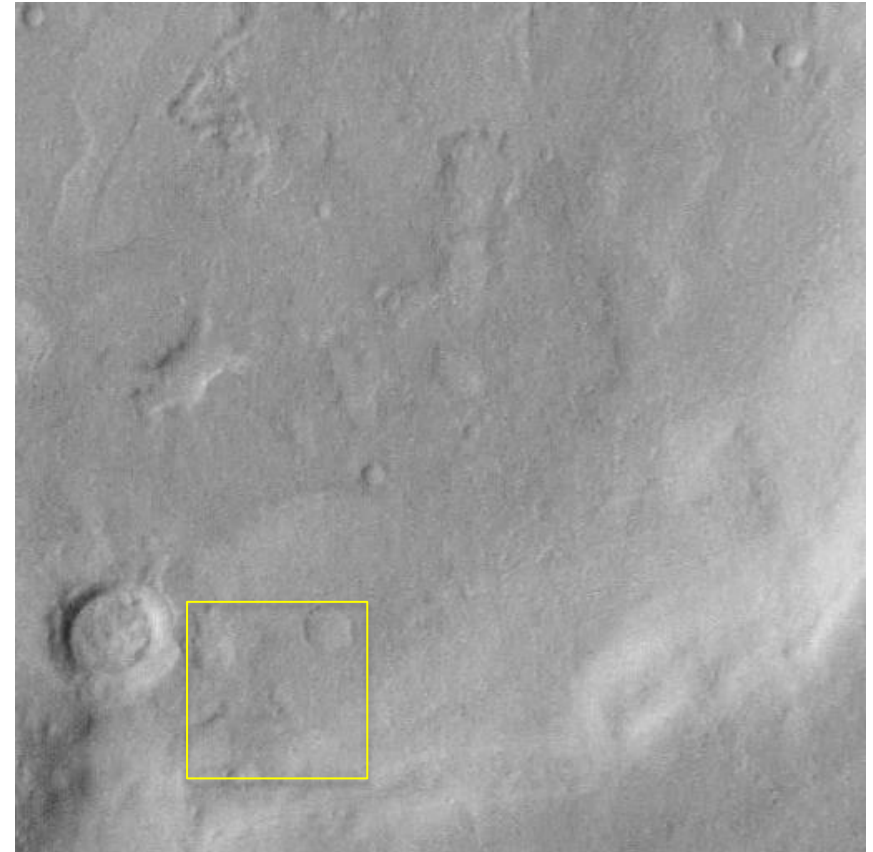
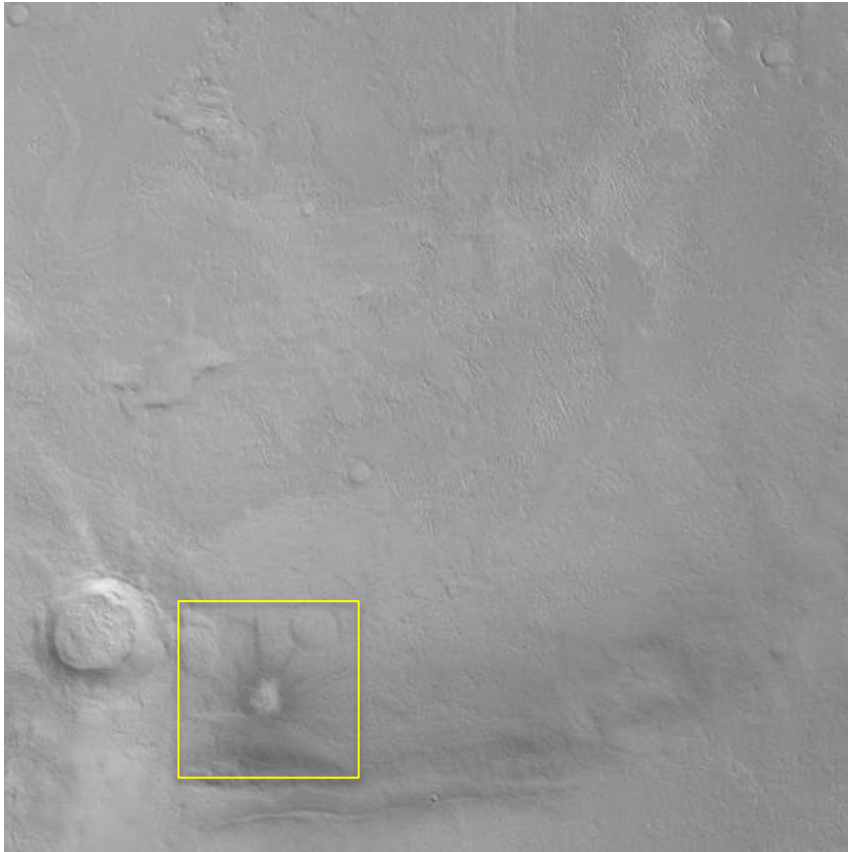
Dust Devil Tracks

Early Results



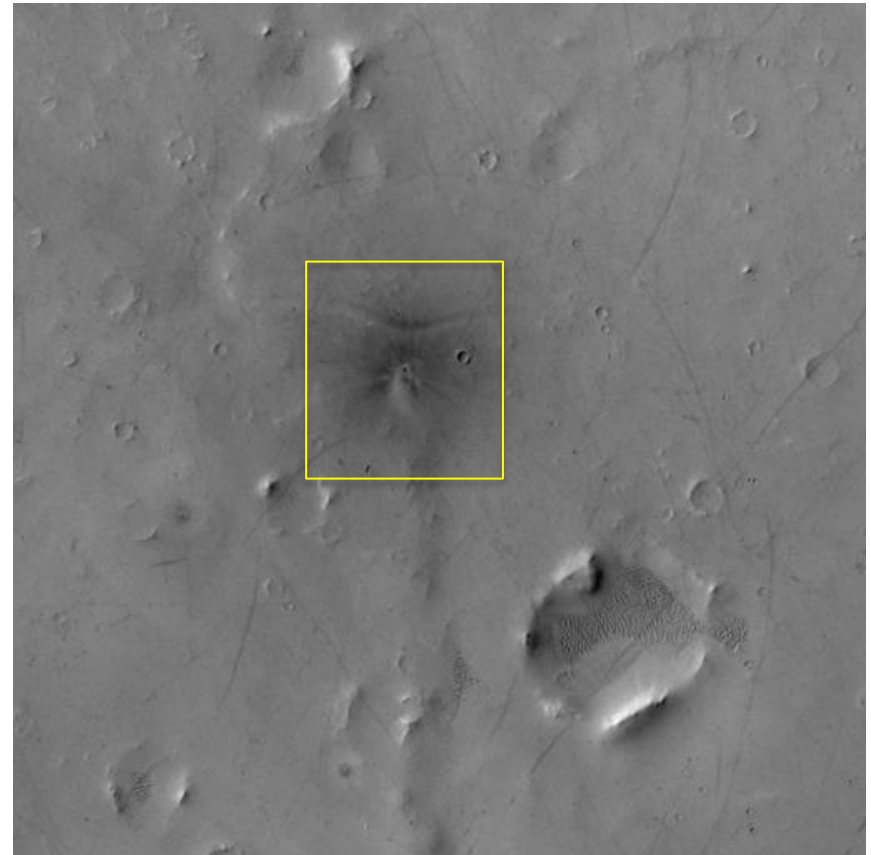
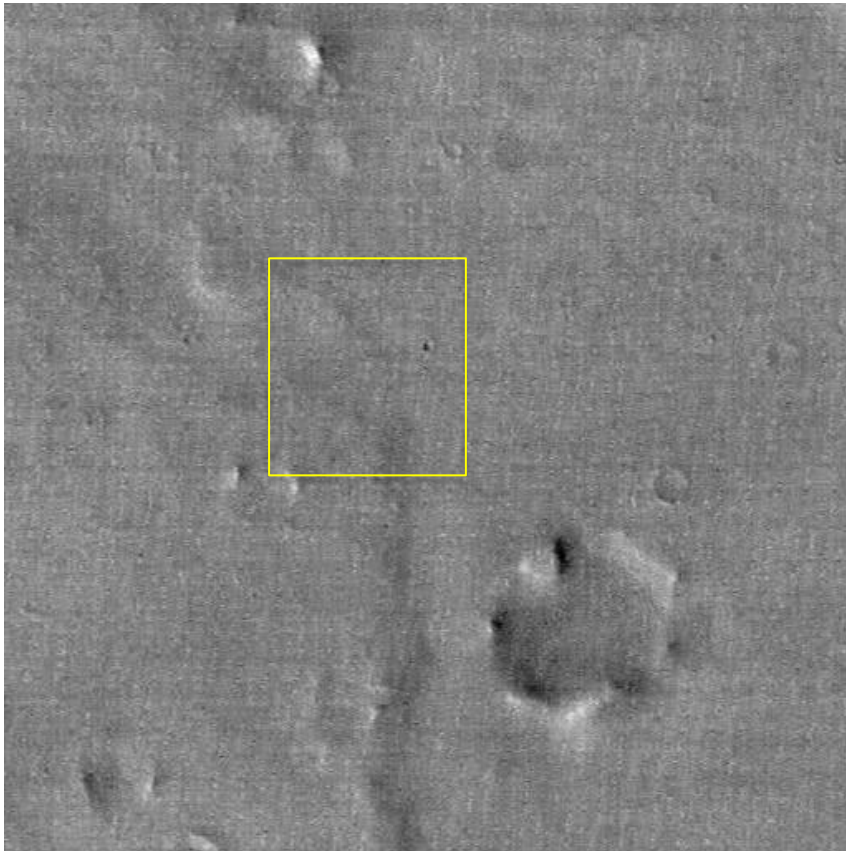
Dust Devil Tracks

Early results



New Impact

Volunteers...Making an Impact



Craters