# Contrails Segmentation Policy

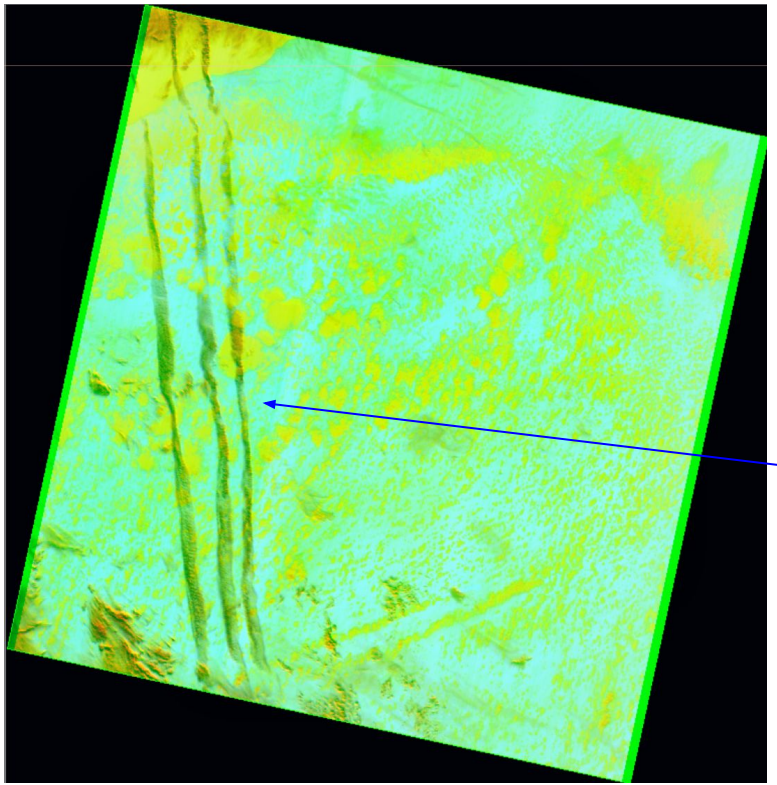
# Goal: Contrails identification

The goal of this task is to identify and segment contrails from Landsat satellite imagery.

All visible instances of contrails must be covered with a polygon drawn by the operator. The boundary of the object should be followed as precisely as possible.

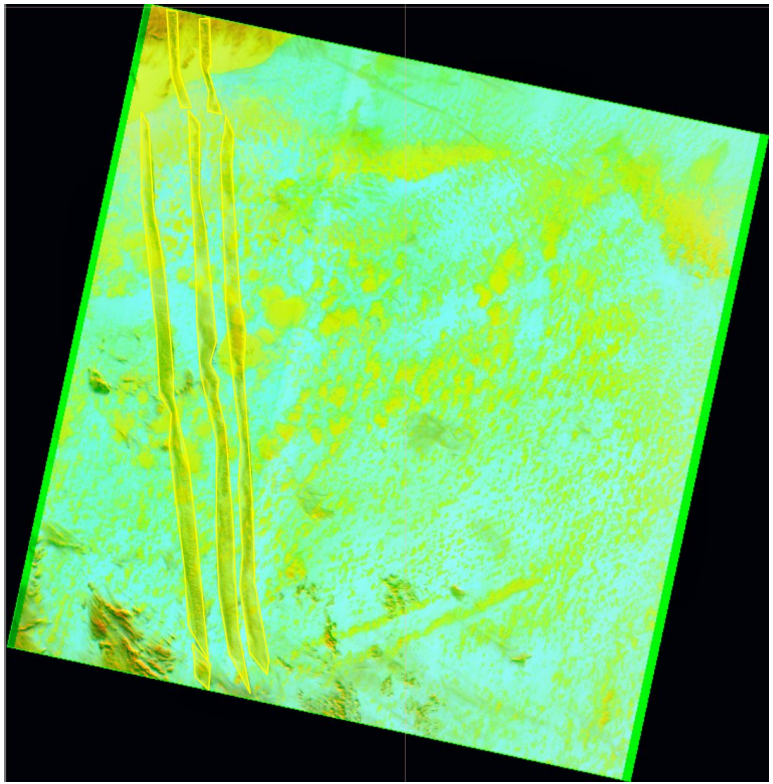
**The majority of images will not contain any contrails**. If this is the case just hit the “Submit” button without labelling anything

# Contrails - Definition




Contrails (short for "condensation trails") are line-shaped clouds produced by aircraft engines, typically at aircraft cruising altitudes several miles above the Earth's surface.

# Polygon drawing



Draw one polygon per instance of contrail in the image. The polygon must cover the entire contrail from beginning to end using the mask drawing tool, or until the last visible pixel in the image if cut.

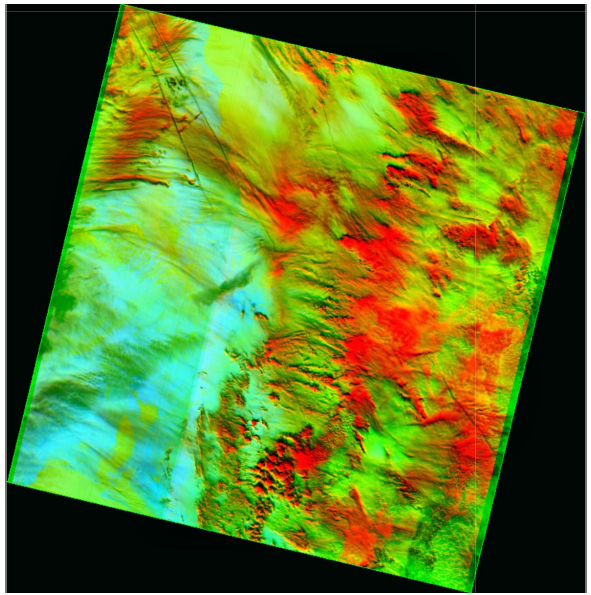
Try to follow the outline of the contrail as accurately as possible.

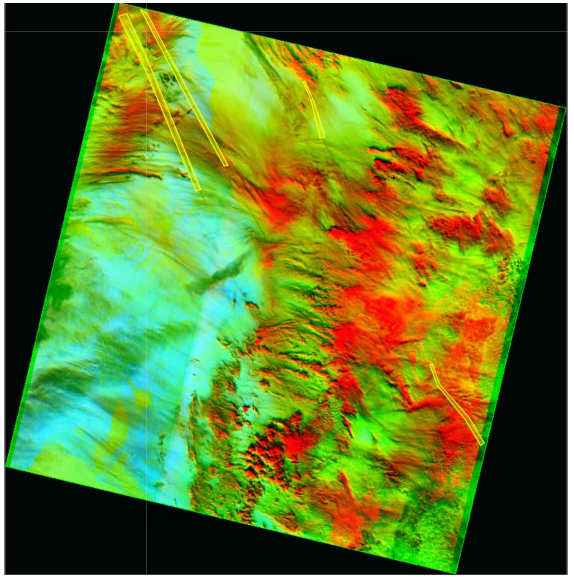
To the left is the same image as the previous slide, with appropriate polygons included.

# Contrails - Definition

Contrails start narrow and grow wider as they age. Both types of contrails should be labelled.

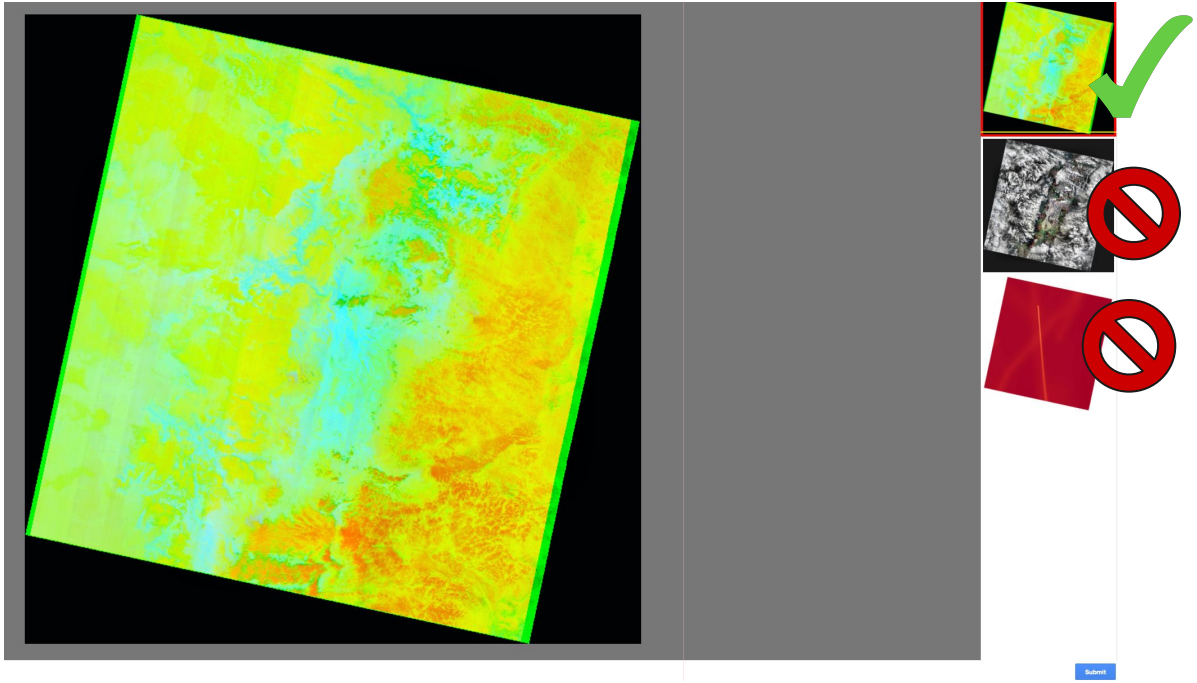
Contrast the narrow contrails on this slide with the wide ones on the previous slide.





# Auxiliary images

The UI will generally present multiple images of the same region of the sky, in different spectra. The extra images are just for additional help with visualisation. Please **only label the top image.**

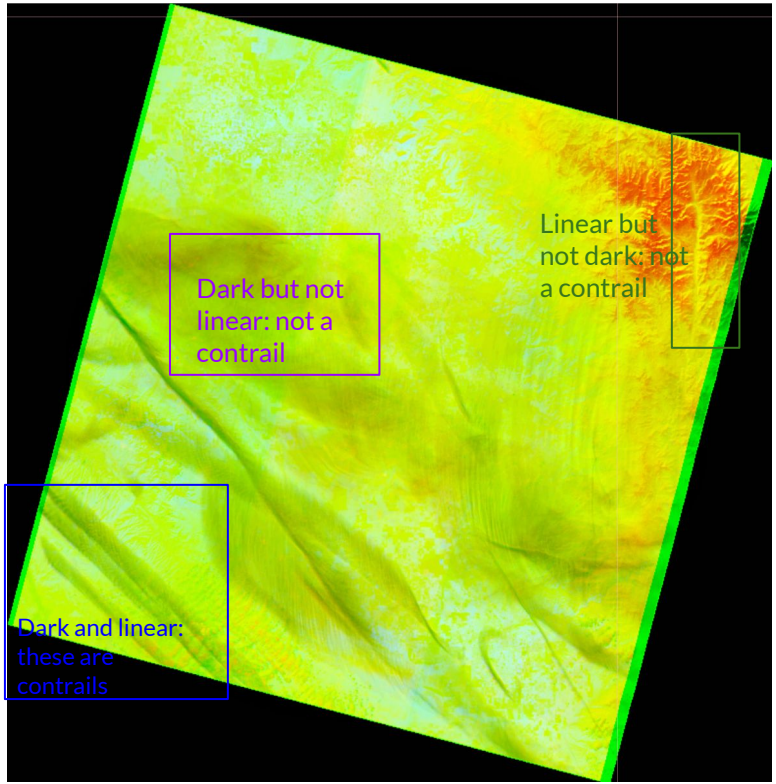




Apply labels to the top image

Extra images are just to help visualise. Don't apply labels to them.

# Top image

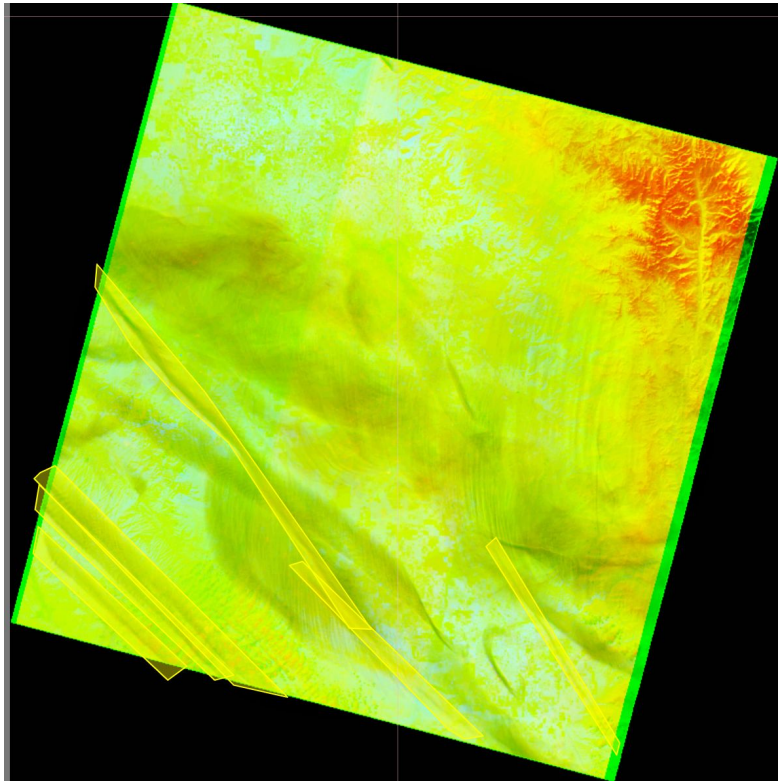



The top image is a false-color image of some infrared satellite bands.

The image is calibrated so that **contrails will appear dark in color**

An object is a contrail if it is both **line-shaped** and **darker than its surroundings**

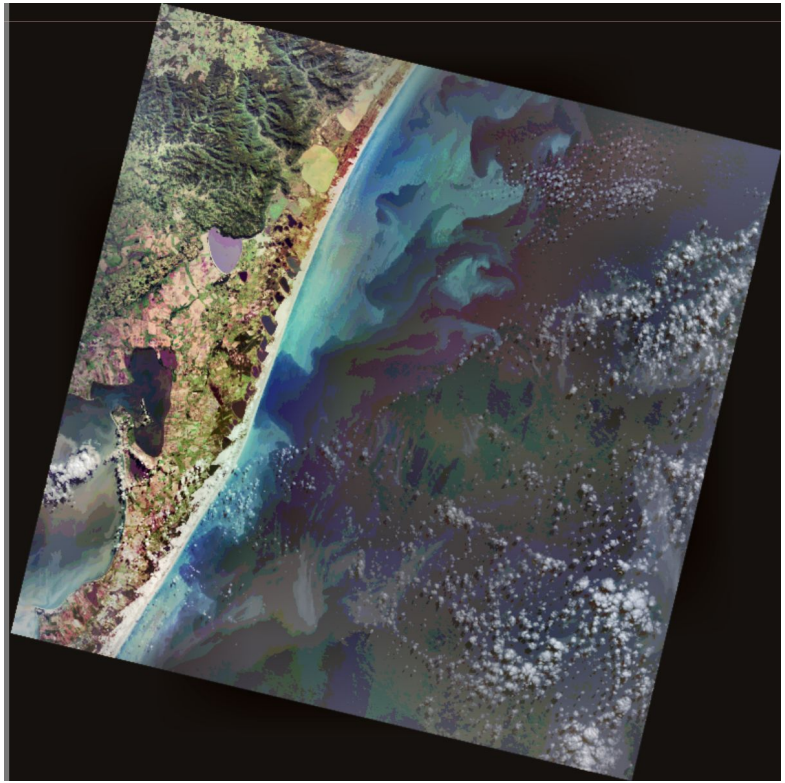
# Top image (correctly labelled)



For reference, this is the same image as the previous slide, correctly labelled

The top image is most important. You can label contrails if they appear in the top image but not in other images. But you should not label line-shaped objects in other images if they are not in the top image

# Second image: visible light



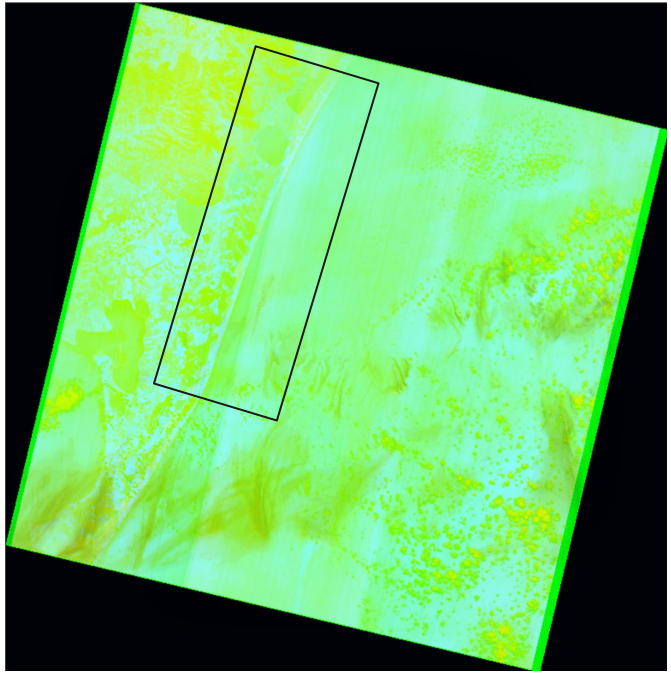
The second image is how the Earth would look to your eye

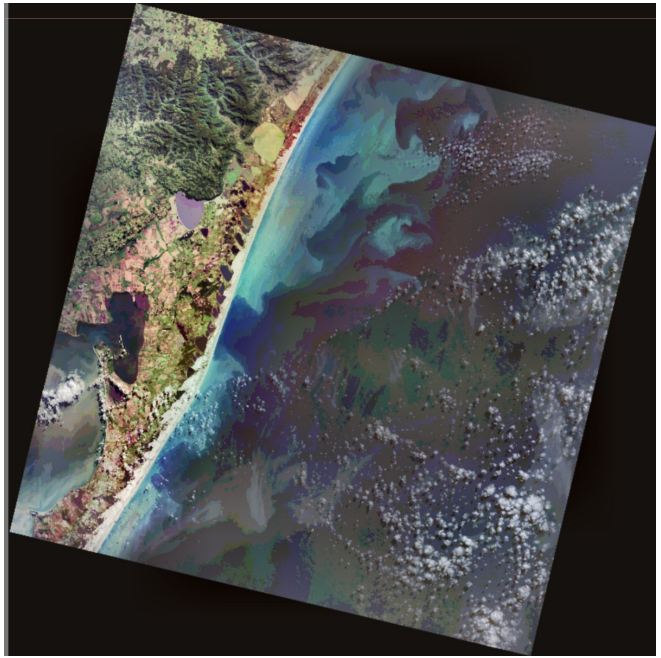
Contrails don't always show up in these images, and they also have a lot of false positives (for example, a smokestack on a windy day looks a lot like a  contrail to your eye)

These images are great for confirming that a potential contrail is a cloud, and not a linear feature on the ground. (See next slide for an example)

# Second image: example of use

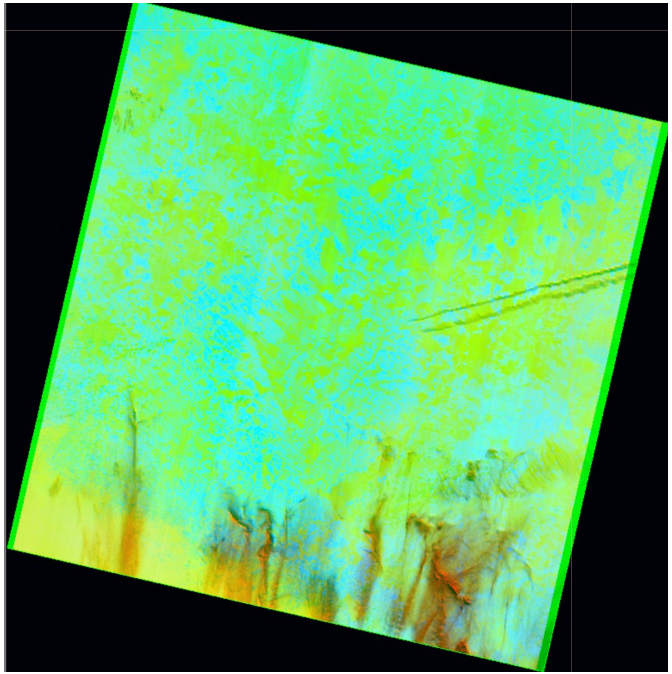
There is a linear feature in the top image. Using the visible image, we can see that it is in fact a coastline

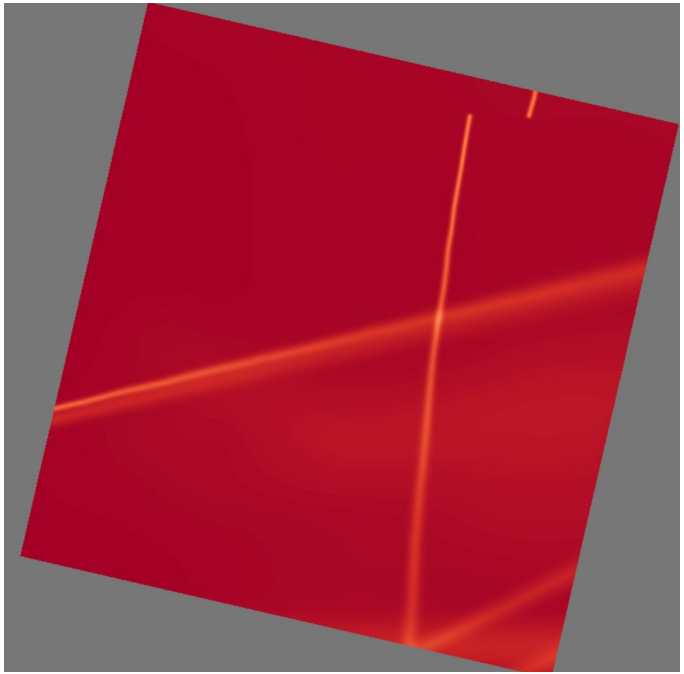




# Third image: flight paths

The third image is the estimated path airplanes took through the image. Contrails should line up with these paths





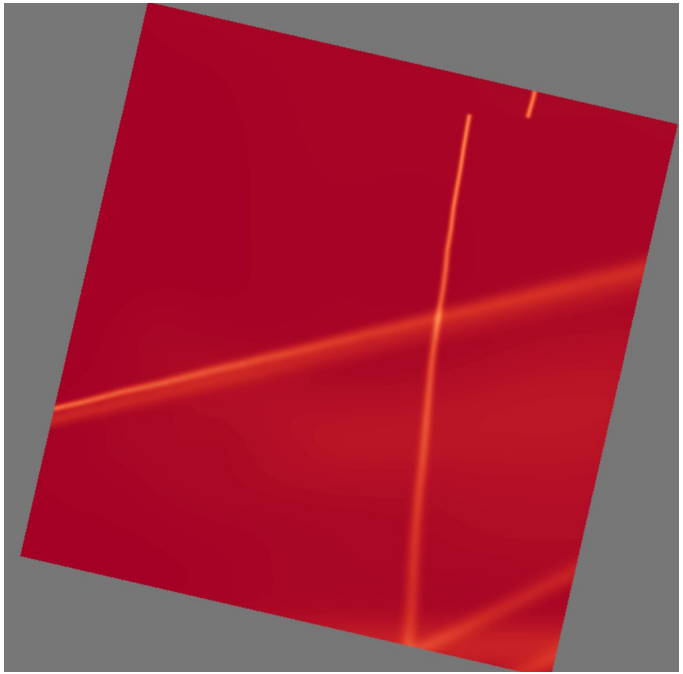
Not every flight path will make a contrail

It's also possible (though unlikely) that a flight path is missing from the image.

If no flight path is found, you should be very (>90%) sure something is a contrail before labelling

If a flight path is found, you only need to be 60% sure

# Third image: flight paths

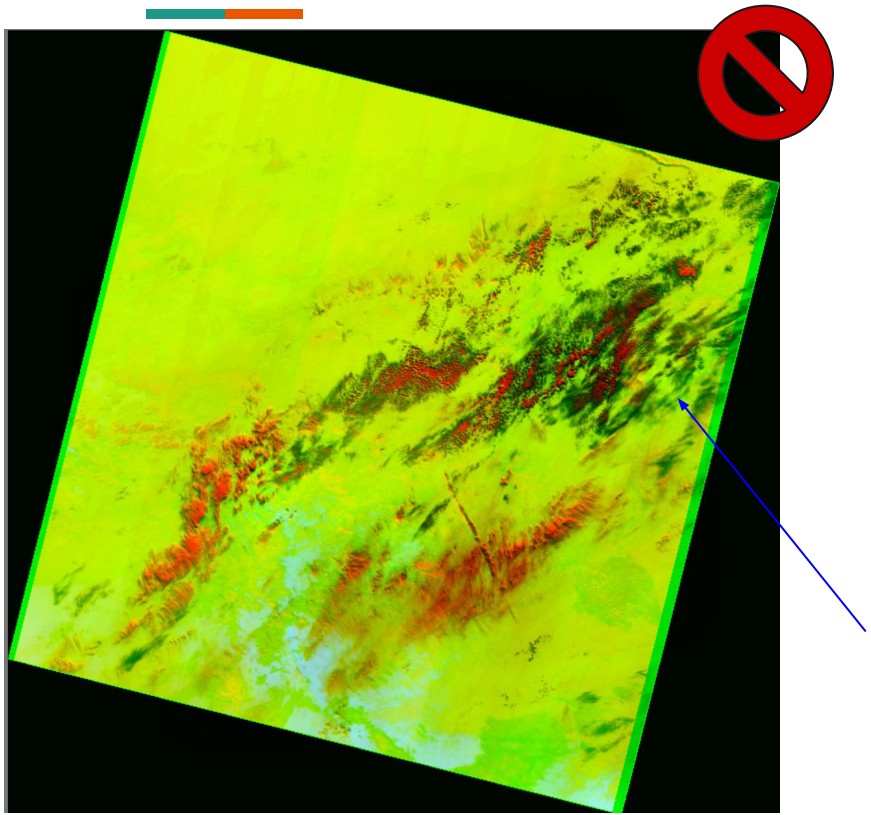


Fuzzier flight paths means we are less sure exactly where the flight flew

A completely red image means we do not think that any flights few through the image

# Some tricky cases

# Not a Contrail: Cirrus



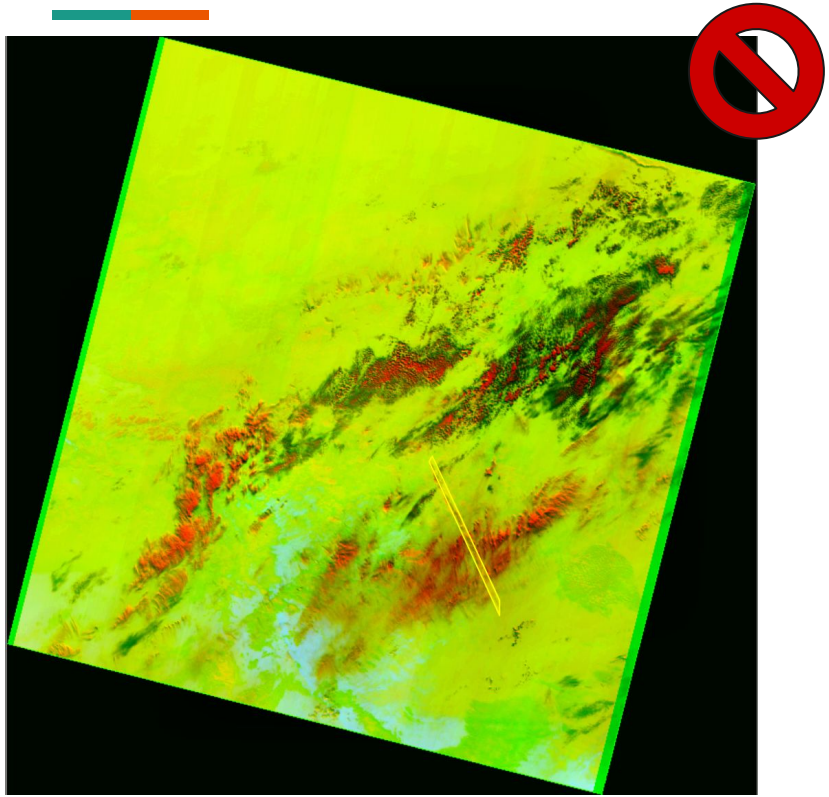
Cirrus are a type of cold, thin clouds than look similar to contrails. These should **not** be labeled.

Some signs that these are not a contrail:

- They are part of (and roughly parallel to) a larger cloud system
- They are not as linear as a contrail

These dark patches are cirrus clouds and should not be labelled

# Not a Contrail: Cirrus (labelled example)



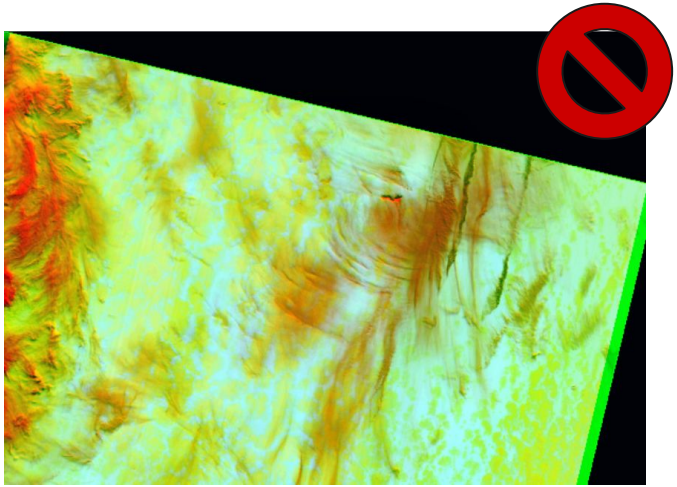
The image on the left shows how the image from the previous slide should be labelled

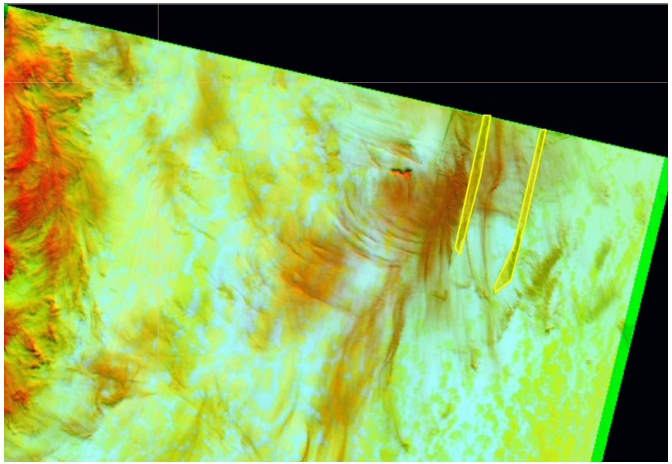
Contrails are labelled with polygons, but cirrus clouds are not

# Not a Contrail: Cirrus

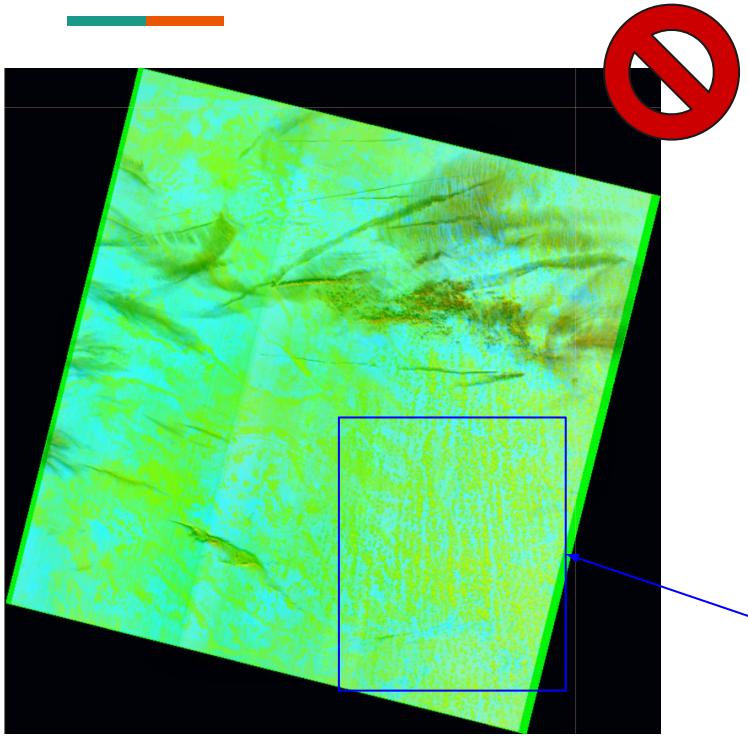
Here is another example. There are a number of linear looking clouds in the image. Some are contrails, some are cirrus.

The contrails are darker, and the lines are longer and straighter





# Not a Contrail: Cloud Streets



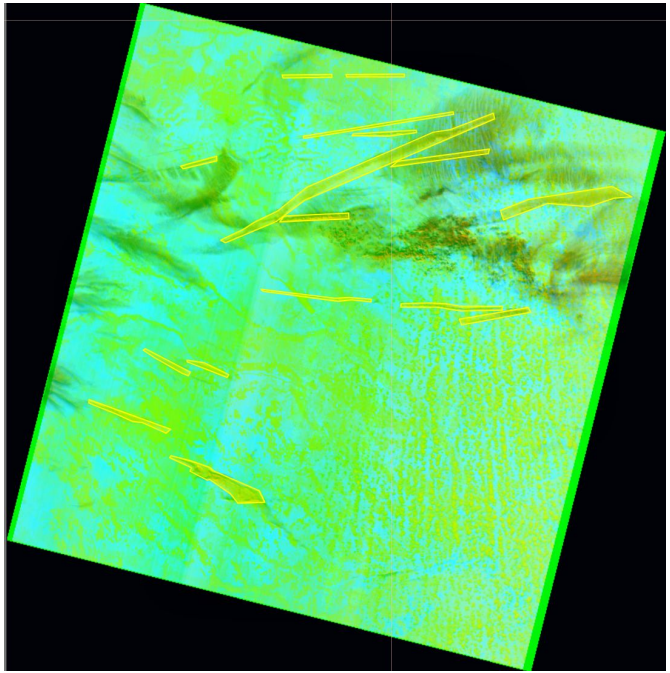
Cloud streets are a particular weather condition that causes large numbers of linear parallel clouds.

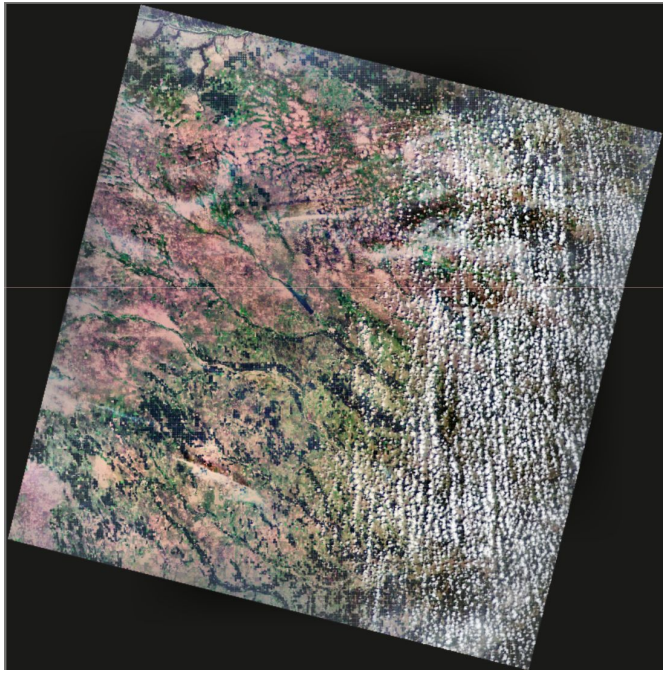
Compared to contrails, these tend to cover a large area with mostly-parallel clouds. They also tend to be brighter and fluffier

This is an area of cloud streets

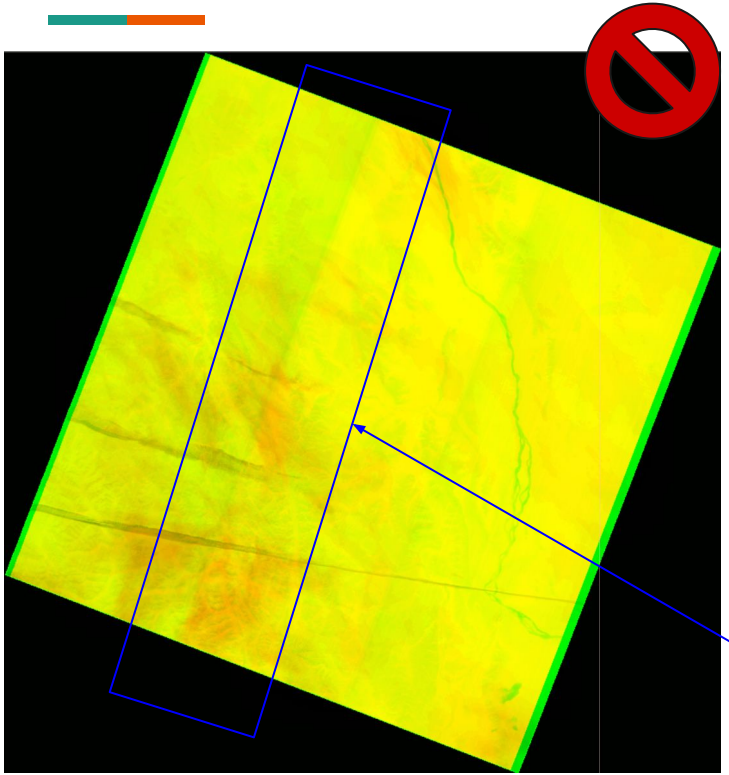
# Cloud streets

Cloud streets are often easy distinguish in the true-color image (right) The left image is correct labels





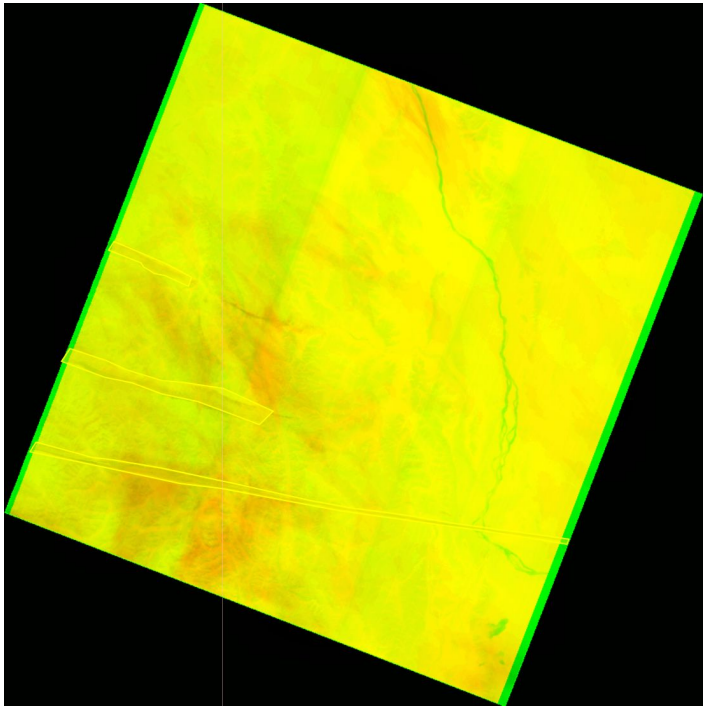
# Not a Contrail: Rolling shutter effect




Satellite imagery are being captured by scanning the area from left to right. This sometimes creates straight lines parallel to the frame.

Those are not contrails and should not be labeled. You can recognize them as being parallel to the frame, oftentimes clustered together. They are also often not the same color along the line but just a variation of the local surroundings.

# Not a Contrail: Rolling shutter effect

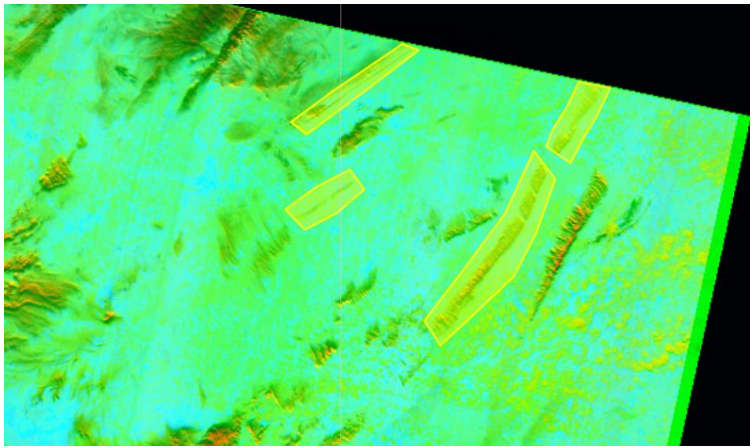


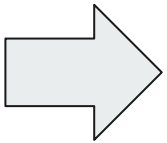
Here is the previous image, correctly labelled

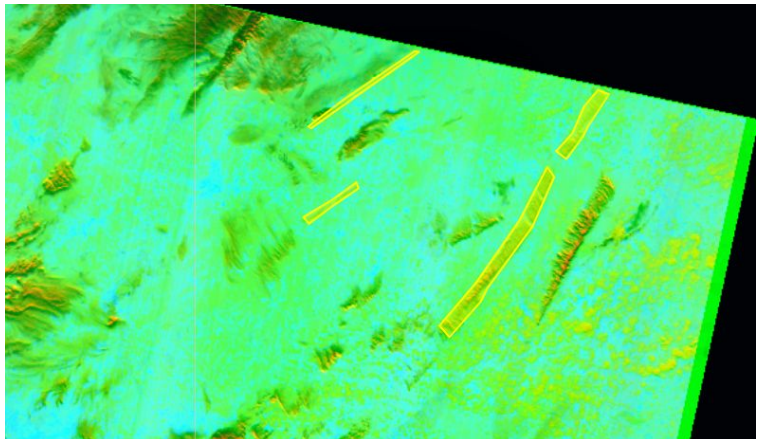
# Training exercise

Before you start actually labelling contrails you will be given a number of images in which the contrails have been labelled correctly, but the labels are not precise

Your task is to refine the labels to closely match the contrails



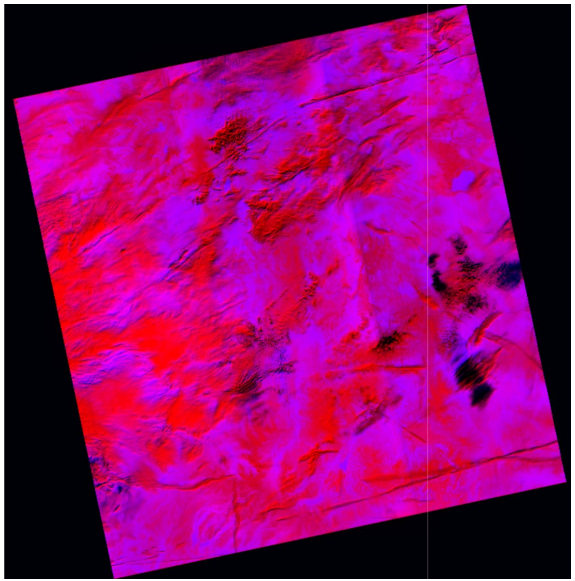


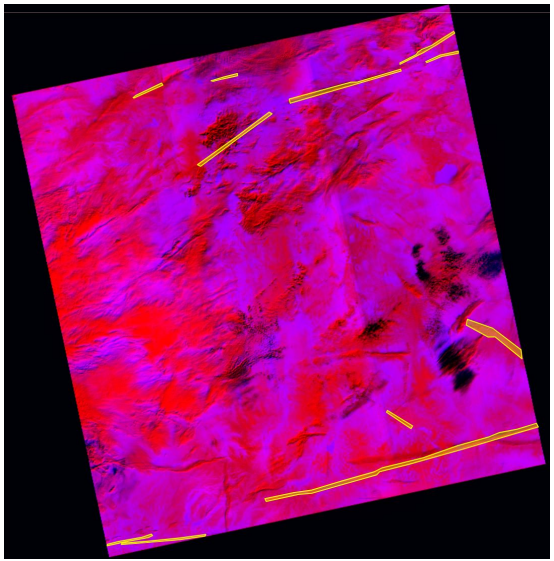


# Nighttime images

Some images are taken at night. These will not have any visible light image, and the top image will seem to have a different color scheme

Your task is still to label contrails, which will still be showing up as dark, linear objects





# Reference

- Evolution of a contrail