

Frequently Asked Questions

Activity 1: are aircraft making clouds?

Questions about taking part:

Why do you ask us to try for Tuesdays and Thursdays – is that when you expect most contrails to form?

No, there is nothing special about those two days of the week. Although it would be great if everyone in the survey was able to send in contrail observations every day, most people won't be able to do this. Rather than have smaller numbers of observations every day, we would like to have some days with lots of observations. To try and get this, we have arbitrarily chosen Tuesday and Thursday as days when we hope you will be able to report every week – this gives us a better chance of getting lots of observations on those days to compare with the model.

Why should I try to spot contrails preferably between 9am and 4pm?

Our predictions of where contrails should (and shouldn't) occur comes from a weather model that analyses the atmosphere at 12 noon every day (GMT, so 1pm BST). Ideally we would like observations as close as possible to this time, but most people will have to fit in surveying the skies between all the other things they do in the day. However, the conditions needed for contrails to form do not usually vary much over the few hours either side of noon, so your reports are welcome at any time of the day. Within 3 or 4 hours of noon they will be even closer to what the model analysis time, so that is why we have suggested you observe in that period if possible. It also coincides with the school day, and we hope lots of schools will take part.

Do times refer to BST or GMT?

They refer to the time usually used, so GMT in the winter and BST in the summer. Because (as we said in question 2) conditions high in the atmosphere don't change very quickly, it doesn't matter if the time is wrong by an hour anyway.

How short is a short contrail? How long is a long contrail?

If the contrail evaporates a short distance behind the aircraft – lasting at most 10 or 20 seconds after the aircraft has passed – then we call it a short contrail (Type B). If it reaches out across the sky, then it's a long contrail (Type C). But please don't agonise too much!

How spread is a spread contrail?

As a rough guide, hold a finger at arm's length. If your finger can't cover the contrail, then it's a spreading contrail (Type D). If your finger covers the contrail, then it's not a spreading one, it's a Type C.

I am going to text in my reports; why do I need to do this soon after I have made my observations?

The text messaging service which collects all your text reports also shows the time you sent in your text. We assume this is the time you actually made your observation, so that saves you texting in the observation time as well. Sending the text soon after the observation also minimises the chances of you forgetting it!

Why can I see short and long contrails at the same time?

Aircraft fly at different heights. On a particular day, an aircraft at 12km (40 000ft) may be in air that is very dry, so its contrail evaporate soon after it is formed (Contrail type B). But, at the same time, an aircraft at 9km (30 000ft) may be in very moist air, so will form a contrail that persists for a long time (Contrail type C). Please report both B and C.

I can see an aircraft, but it's not making a contrail. Why not?

There could be two reasons for this. If the aircraft is high up, the most likely explanation is that the air is too dry for contrails to form or persist – if the humidity is below 100% then the contrail may form but evaporate quickly. Or the aircraft may be too low, where the air is never cold enough (below about minus 40C) for contrails to form.

Why can't I report clouds?

For the purposes of this survey, we aren't too interested in clouds – they simply get in the way of us spotting contrails! However, if you are interested in keeping a record of weather observations in general, then the amount and type of cloud is very important. So we have provided you with a cloud chart to allow you to identify the 10 basic types of clouds – low, medium or high.

Why can I never see any contrails, even in clear weather?

Contrails can only form where there are aircraft to provide the water vapour! Commercial aircraft at the “right” height for contrails to form fly in air lanes (like motorways in the sky) over most of the country. There are some regions where there are generally few high-flying airliners; these include parts of East Anglia, the West Midlands and Yorkshire – although there may be military aircraft there. In other areas (such as around London and Manchester) hundreds of high-flying pass overhead every day. Fortunately (for OPAL) the most heavily populated areas of England are underneath air lanes – although some are busier than others and some are only used in particular wind directions. Your observations are useful to us even if you don't see contrails.

I can see a high-flying aircraft; how can I tell what height it is at?

If you can see an aircraft producing contrails over you, and you want to know what height it is at, then you can find out using websites such as www.flightradar24.com or www.radarvirtuel.com. On these sites you can add a filter to show all aircraft above 9000m, ie the ones which could be making contrails. If you click on the plane symbol, it also tells you the speed, airliner and airline, and where it has come from and is going to. This information can also be seen using an app for Android or iPhone.

Questions on the science behind the contrails activity:

What is a model?

In Activities 1 and 3 we mention comparing your results with weather or climate models – but what are they? To forecast weather for the next few days, or predict how climate will change over the next few decades, we use models. They are massive computer programmes, run on super-computers, representing what goes on in the atmosphere, oceans and on land, and calculate how they evolve over time. Models used for weather forecasting over the next weeks or so are somewhat different to those used for longer term climate change projections over many decades, but the basic representations of processes in the atmosphere, etc, are the same.

Why is model validation so important?

It is important because it will show how good the model is. If a model cannot do a good job of representing what the atmosphere looks like today, that would lessen our confidence in its weather forecasts for tomorrow, or its climate predictions for 50 years time.

What is the difference between weather and climate?

Weather is the condition of the atmosphere at any particular time – temperature or rainfall, for example – at a certain place. Climate is an average of weather conditions at that place (usually for a given month) over a 30 year period, including its variability and extremes.

What is humidity?

Air is mainly made up of nitrogen and oxygen, but it also contains variable amounts of water vapour. Humidity is the amount of water vapour in the air. When the air contains a lot of water vapour, we say it is moist. When it doesn't contain much, we call it dry.

Relative humidity is the amount of water vapour that the air contains, as a percentage of that required to saturate it, so that it couldn't hold any more. So air which has a relative humidity of 50% has half the amount of air needed to saturate it. The amount of water vapour needed to saturate air depends upon its temperature – warm air can hold more than cold air.

In the contrails activity, the relative humidity refers to that measured in the presence of ice rather than water, because we are concerned with the evaporation or persistence of the ice crystals which make up contrails.

How can the air have a relative humidity above 100%?

When air is saturated with water vapour it needs small particles to condense on to. At ground level, this isn't a problem, as the air has hundreds of particles from dust, sea spray, pollution etc – so fog (water droplets suspended in the air) will always form. High in the atmosphere, the air is much cleaner. If there are no small particles for the water vapour to condense onto, then the humidity can rise above 100%. We say the air is supersaturated. But an aircraft emits not just water vapour but also small particles from its engine, so there will be plenty of these for the water vapour to condense on to and form contrails of ice crystals.

Are planes damaging to the environment?

When aircraft engines burn fuel, they emit carbon dioxide, water vapour, other gases and small particles. Everything that burns fossil fuels adds CO₂ to the atmosphere, and this (together with other greenhouse gases) is very likely to be the main cause of the rise in global temperatures over the past few decades. But aircraft aren't the major culprits; they only account for a few percent of all carbon dioxide emissions, although aviation is growing fast.

But aircraft also sometimes form contrails. When these linger a long time and spread out, they will trap some of the invisible infra-red (heat) radiation from the earth's surface that would normally escape to outer space and cool the planet. So they act as a blanket (in the same way as greenhouse gases do) and keep the surface warmer than it would otherwise be. The amount of warming due to contrails and the clouds they make is very difficult to calculate and hence very uncertain. The best estimate we have is that it is about one percent of that due to all greenhouse gases.

What does it mean if I see lots of contrails where I live - is this bad?

No, it simply shows that there are lots of planes flying high over you, and the air where they are flying is moist. As mentioned in an earlier question, the cumulative effect of lots of spreading contrails could be having a warming effect on the planet, although much smaller than that due to man-made greenhouse gases

What's the point of this activity?

OPAL will collect all observations on particular days during the climate survey period (March – June 2011) and show on a map the areas where contrails are seen and not seen. We will also show a map of where contrails might (or might not) be expected – based on temperature and humidity high in the atmosphere from a weather forecasting model.

The model and observations data will be available for a more scientific study, where we can “test” the weather forecasting model against contrail observations, and see how good the model is at simulating the right conditions for contrails to form.

Have we always had contrails in the sky?

We have had contrails ever since aircraft were able to fly up to the sort of altitudes needed for them to form – above about 9km (30 000ft) or so. In World War 2, contrails from high-flying aircraft such as Spitfires were a common sight. You can search the web to see some amazing photographs of contrails over St Paul's Cathedral during the Battle of Britain. In fact, the Met Office did a lot of research at the time so that it could tell pilots where to fly, and not to fly, to avoid making contrails which could give away their presence. And now, 70 years later, research is again looking at the possibility of reducing the environmental effect of jet airliners by routing them into areas where they wouldn't make contrails.