



# OPAL **Climate** Survey

## Workbook and recording sheets

Please read this workbook before starting the survey



## Introduction

In the OPAL Climate Survey we aim to study aspects of the way human activities affect climate, and the way in which climate change may affect us. The activities in this Workbook involve us measuring the weather. But what is the difference between weather and climate? Weather is the condition of the atmosphere at any particular time: temperature or rainfall, for example. Climate is an average of weather conditions (usually for a given month) over a 30 year period, including its variability and extremes.

### Activity 1



## Are aircraft making clouds?

### What are contrails?

Contrails are the tracks that high-flying planes leave behind in the sky. Activity 1 asks you to look for these and report what type you see.

### How do they form?

When we breathe out on a cold day, the water vapour in our breath mixes with cold air and condenses into a mini cloud of water droplets – we say we can ‘see our breath’. In the same way, when fuel is burnt in an aircraft’s engine, the water vapour which is formed mixes with the very cold air at high altitudes and condenses. The air is so cold that **ice crystals** are formed. The line of ice crystals left behind is called a condensation trail or ‘**contrail**’.



### How cold does it need to be?

The temperature needs to be below about  $-40^{\circ}\text{C}$  for a contrail to form, so aircraft have to be above about 10km (about 30 000ft), the altitude at which most airliners cruise. If the atmosphere is fairly ‘dry’ (has a low relative humidity, meaning it contains little water vapour) then no contrail will form, or if it does form it will evaporate quickly and disappear. If the atmosphere is ‘moist’ (has a high relative humidity, having lots of water vapour) then contrails can last for a long time, and even spread out.

### Why do contrails matter?

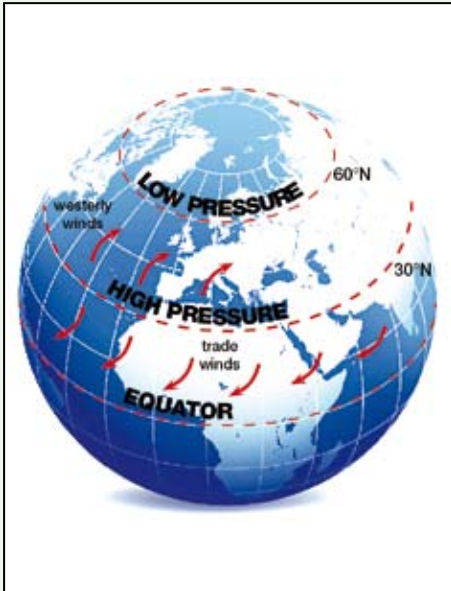
High clouds stop some invisible infrared (heat) radiation leaving the earth, in the same way as greenhouse gases do. They have a warming effect on climate. Spreading contrails act in the same way. Their warming effect is very uncertain, although much less than that from man-made carbon dioxide.

### Can contrails be seen everywhere?

Aircraft use different routes in the sky and so contrails may be very common in some places, and quite rare in others – reporting ‘no contrails’ is a useful result.



In Activities 2 and 3 we will be measuring wind, the invisible movement of air. There are great benefits in doing Activities 2 and 3 together, and then going on to do Activity 4 as it uses wind information from Activity 3.



### Why do winds blow?

Polar regions get much less energy from the sun than tropical regions, but on a global scale winds are the main way that this difference is evened out. The picture alongside shows pressure and winds averaged out over many years. The winds near the UK generally come from the west and south, but on a particular day can be from any direction.

### What does wind direction tell us?

The wind direction is the direction the air is blowing from, so this tells us something about the type of weather we can expect. For example, winds from the south ('southerlies') will have come from southern Europe or Africa and so are generally dry and warm. They can cause heatwaves in summer. Winds from the north ('northerlies') will have come from the Arctic and travelled over vast areas of sea where they pick up water vapour. They will be cold and wet and can give snow in winter.

### How do winds blow?

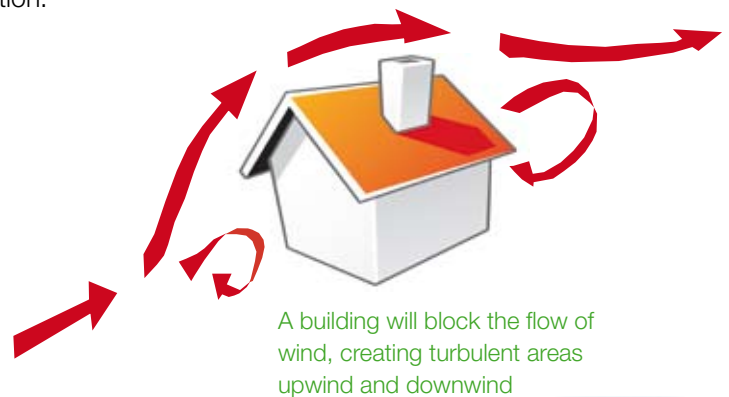
Winds blow freely at the height of clouds, but nearer the ground the general effect of lots of trees, buildings, hills etc. slows them down and changes their direction. So the 'free' wind direction you measure in Activity 2 (at cloud height) may be different from the wind direction you measure at person height in Activity 3.

### Following the wind

Something moved by the wind (such as a leaf or some litter) doesn't simply follow a straight line. Instead, it changes direction as it moves from place to place. In the Bubble Chase experiment, each bubble will follow a different path, but using 10 bubbles will give an average wind direction.

### Turbulence

Wind can be greatly affected by buildings. As wind cannot pass through them, it blows around them. This creates areas where wind speed and direction are highly variable; they change from place to place and from second to second. This is turbulence.



If the wind around you is turbulent, then getting measurements in Activity 3 might be difficult. If this happens, write T in the boxes under 'wind direction' (for the Bubble Chase) and 'speed' (for the Bubble Race).

## How to use a compass

- Place the compass on a **flat** and **level** surface.
- Make sure there are no objects nearby that could interfere with the compass (e.g. laptops, mobile phones, any metal or electronic devices).
- The needle will rotate until the red half points towards north.
- Turn the compass so that the N (north) on the compass is aligned with the red point of the needle. The needle should point in the same direction whichever way you turn the compass.
- N, E, S, W on the compass will now point in the correct directions.



### Activity 3 **How do winds blow at person height?**

#### **Where can I get bubbles and a blower from?**

The easiest (and best) way is to buy a simple party bubbles kit, available at toy shops, stationers, etc. Alternatively you can make bubble solution by diluting washing-up liquid with 4 parts of water. To blow the bubbles, you can use a 'bubble cone' made from a sheet of paper as described on the website.



### Activity 4 **How hot or cold do you feel?**

One way in which climate influences us as individuals is our perception of how hot or cold we feel, or **thermal comfort**. The temperature at which one person is comfortable may differ widely from others, but in general people from hot climates are less comfortable at lower temperatures than people from colder climates.

Our bodies generate heat by converting food into energy. To maintain a constant body temperature this heat must be released to the environment. If we lose too much heat we will feel cold, but if we lose too little heat we will feel hot. A decrease or increase of as little as 1°C in the core body temperature can be associated with hypothermia (dangerously cold) or heat-stroke (dangerously hot), but the human body is very good at helping to maintain this precise balance.

#### **Environmental factors affecting thermal comfort**

- **Weather.** Not only the temperature, but also how windy, sunny, humid, dry or rainy it is.
- **Climate.** Perceptions of personal warmth reflect the local climate that people are used to. For example, people from Finland are generally comfortable at lower temperatures than people from Spain.
- **Local Environment.** For example in the centre of a big city we might be shaded from the sun by tall buildings, but will be exposed to heat emitted by buildings, traffic and other people. Your observations of local environment and person-height winds from Activity 3 will be useful here.

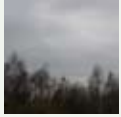




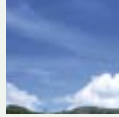
# Activity 1 **Are aircraft making clouds?**

## Results for Activity 1

Please do this short activity any time of the day on as many days as possible. Decide on what type of contrail (if any) you can see. You can report **O** (for overcast), **A**, **B**, **C** or **D**.



**O** Overcast



**A** No contrails



**B** Short-lived contrails – disappearing soon after they are formed



**C** Long contrails stretching out across most of the sky, but not spreading much



**D** Long-lived contrails spreading out to form cirrus-like clouds

Report your observation by using the form or going online.

- To report **online**, go to [www.OPALexplore.org/contrails](http://www.OPALexplore.org/contrails) and just follow the steps shown.
- Using the **form** below, please record the time and date, then the first part of the postcode where you are observing from, and finally the contrail type(s). At the end of the survey, post the form to the address at the bottom. If you run out of space, please make photocopies, or just make up your own form.

Time	Date		First part of postcode	Contrail type(s)
	day	month		
0930	03	04	GU42	O
1430	23	05	SW1	B C

Time	Date		First part of postcode	Contrail type(s)
	day	month		

Post the completed recording sheets to: **Freepost RSCH-CKYJ-HYYC, OPAL, Centre for Environmental Policy, Imperial College London, London SW7 2AZ**

If you can take a photograph of the sky and any contrails while you are doing the activity, please send it to us at [climate@OPALexplore.org](mailto:climate@OPALexplore.org) with a note of what contrail type you recorded it as (i.e. A, B, C or D). Selected photographs will be used on the website.



## Results for Activities 2, 3 and 4

Before doing Activities 2, 3 or 4, please answer the questions below.

1. Date of survey \_\_\_\_\_

2. Time of survey \_\_\_\_\_

✓ Tick the appropriate boxes

3. How did you participate in the survey today?  school  volunteer group  family or friends

4. Record your location (postcode / OS map reference / GPS reading)  
\_\_\_\_\_

Help about location is available on the OPAL website

5. Which type of environment are you in?



a Dense high-rise



b Dense mid-rise



c Dense low-rise



d Spaced high-rise



e Spaced mid-rise



f Spaced low-rise



g Sparsely built



h Open field



i Spaced trees



j Woodland

### Activity 2

## Which way do winds blow the clouds?

Record your measured wind direction to the nearest of the 8 points (e.g. N, SW).

Wind direction (example)	S
Wind direction (your result)	

If you are confident enough to report the direction in degrees, then please enter the data in the box on the website

**Remember:**  
wind direction is the direction wind is coming from

So if a cloud is moving towards the north east, wind direction is from the south west

### Activity 3

## How do winds blow at person height?

### (a) The Bubble Chase

Record your measured wind direction to the nearest of the 8 points (e.g. N, SW).

- If there is too much turbulence to follow any bubbles, write T.

Wind direction (compass point)
SE

If you are confident enough to report the direction in degrees, or you are using a map instead of a compass, then please enter the data in the box on the website



## (b) The Bubble Race

For each bubble you follow, write down

- The distance you used for your Bubble Race – normally 10 metres.
- The time it took the bubble to move from start to finish.

Do the bubble race 10 times (or as often as possible) and note below each of the times taken. You can calculate the speed of each bubble in the last column

Trial number	Distance (metres)	Time (seconds)	Speed (metres per second)
example	10	4	$10 \div 4 = 2.5$
1	10		
2	10		
3	10		
4	10		
5	10		
6	10		
7	10		
8	10		
9	10		
10	10		
<b>Total</b>	100		
<b>Average speed (metres per second)</b>			

Now you can calculate average wind speed (although the OPAL website will do this for you)

$$\text{Average speed} = \frac{\text{Total distance}}{\text{Total time}}$$



## Activity 4 How hot or cold do you feel?

### (a) At the moment do you find your location is...

very cold   
  cool   
  neither cool nor warm   
  warm   
  very hot

✓ Tick one box only

The **very cold** and **very hot** categories mean that you would not want to feel like this for a long period of time.

### (b) For my own personal warmth, compared to right now, I would prefer the weather to be...

<input type="checkbox"/> Cooler	<input type="checkbox"/> Same as now	<input type="checkbox"/> Warmer
<input type="checkbox"/> Sunnier	<input type="checkbox"/> Same as now	<input type="checkbox"/> Cloudier
<input type="checkbox"/> Windier	<input type="checkbox"/> Same as now	<input type="checkbox"/> Less wind
<input type="checkbox"/> More humid	<input type="checkbox"/> Same as now	<input type="checkbox"/> Less humid



✓ Tick one box from each row



### (c) Temperature

If you have an OPAL thermometer card, or your own thermometer, record the air temperature.

Temperature (°C)	
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### (d) Clothing

✓ **Tick one box only** This section is about your clothes, so that we can estimate how much insulation they provide you with. Tick the box that best matches what you are wearing. This should be possible for both western and non-western styles.

**a**



**Summer wear**

- Short sleeve top or vest
- Shorts or short skirt


**b**



**Warmer weather wear**

- Short or long sleeve top
- Trousers or skirt
- Shalwar kameez
- Dress
- School uniform (no jumper / blazer)

**c**



**Everyday wear**

- Category **b** plus jumper or jacket
- Business suit
- School uniform with jumper / blazer
- Daraa and abaya

**d**



**Everyday outdoor wear**

Category **c** plus jacket or coat

**e**



**Cooler weather wear**

Category **d** plus

- **either** hat / gloves / scarf or thermal underwear
- **or** substantial overcoat

**f**



**Winter wear**

Category **e** plus substantial winter overcoat

- **and** hat / gloves / scarf
- Thermal underwear / vest

### (e) Information about you

✓ **Tick the appropriate boxes** *These questions are optional* but will help us to work out any patterns there might be for particular age groups or by gender. The residence question will help us to understand if local residents feel differently from those from further afield.

Age  Under 12  12-17  18-24  25-34  35-44  45-54  55-64  Over 64

Gender  Male  Female

**Residence** If you normally live in the UK, write the first part of your postcode (e.g. GU46) or if you normally live outside the UK, state the country where you live

### Complete your survey

Enter your results on the OPAL website [www.OPALexplorenature.org](http://www.OPALexplorenature.org)

Or post the completed recording sheets to: **Freepost RSCH-CKYJ-HYYC, OPAL, Centre for Environmental Policy, Imperial College London, London SW7 2AZ**



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