UNIT 5
Environmental threats

Operational topics	Types of weather phenomena; Pilot reports; METAR, ATIS, TAF; Effects of weather on flight paths; Handling environmental phenomena; Weather radar and safety strategies; Wind shear; Dealing with icing; Volcanic ash
Communication functions	Communicating weather information; Asking about the weather; Communicating orally from coded and numerical data sources; Communication errors: expectation bias; Correcting; Describing a flight path; Reading back and confirming; Clarifying and rephrasing; Saying why unable
Language content	Environmental vocabulary; Stressed syllables; Modal verbs; Interrogative expressions; Synonyms; Pronouncing word pairs and whole transmissions; Giving advice; *result in* and *prevent*; Changing conditions; Parts of speech

Unit 5 Teacher's brief

Meteorological and other environmental phenomena not related to weather (e.g. **volcanic ash**, bird strikes, wake turbulence) have immediate, fast-changing and very significant effects on flight. As a result, they are a prime example of unexpected circumstances which may require communication in plain language, not only to transmit information, but also to manage the sometimes complex effects on air traffic.

Pilots have several sources of weather and environmental information:

- **ATIS** (Automatic/Automated Terminal Information Service): A regularly updated, pre-recorded message providing pilots with information about the conditions at a given airport at a given time. The report is identified by a sequence of letters (Kilo, Lima, Mike, etc.). See exercise 7a.
- **METAR** (Meteorological Airport Reports): A METAR is a weather report from an airport or weather station often used by pilots as a print-out during the pre-flight briefing. It can be obtained for any location in the world and is usually updated hourly. See exercise 5b.
- **TAF** (Terminal Aerodrome Forecasts): TAFs use a similar format and coding to METARs, but provide weather forecast information (rather than current weather reports) for a five-mile radius around a given point. See exercise 5b.
- **PIREP** (pilot reports): Weather information from official sources is complemented by live updates from pilots about weather conditions they encounter en-route, or during approach and landing.
- **Live ATC inputs**: Controllers may relay weather reports orally to flight crews, especially in cases of fast-changing weather conditions, or reports sent in from other flight crews. See exercise 6a.
- **On-board weather radar returns**: Aircraft are fitted with weather radar systems using a radar antenna in the radome, covering a range of up to several hundred miles. Crews use the colour-coded displays provided by this system to detect the presence of weather systems (cumulonimbus clouds, thunderstorms and resulting turbulence) in order to request a change of flight path if necessary. See exercise 8a.

Weather information is transmitted in a pre-established sequence: location; time; wind velocity, i.e. direction and speed; any gusting; horizontal visibility in kilometres or metres (except in the US where miles and feet are used); cloud cover at different altitudes in feet; temperature; dew point; altimeter setting; and sometimes duration of validity. It is usually transmitted orally, but also textually using a set of international symbols, see exercise 5a.

Environmental phenomena may have the following effects on aircraft movements:

- the **ability to land and take off** (poor horizontal and vertical visibility), see Unit 4
- the **choice of the runway**(s) in use for departures and arrivals (wind velocity)
- challenging approaches and **hard touchdowns** (crosswinds, gusting and windshear), see exercises 1, 15, 16
- **change of flight path**, deviations, flying to alternates (cumulonimbus, thunderstorms), see exercises 11, 12
- **aquaplaning** and increased landing distances (wet, icy or snow-covered runways), see Unit 3
- increased aircraft weight, **impaired flight control movements** (freezing conditions), see exercises 19, 20
- **damage** to the windshield, radome, leading edges (hailstorms)

- structural damage and effect on electrical components (lightning)
- damage to the engines, **engine failure** (bird ingestion), see Unit 7
- damage to the engines, engine stall (volcanic ash), see exercises 22, 23
- longer flight times (headwinds)
- shorter flight times (tailwinds)

In Unit 5, we will be looking at most of these conditions, their effects on operations and how to communicate in plain language in order to manage the resulting situations.

Unit 5 Sources

- Airbus Flight Operations Briefing Notes: *Adverse Weather Operations* (Exercises 10a–d; 11a–b)
- Airbus: *Getting to grips with Cold Weather Operations* (Exercises 21a–b)
- ALPA/Boeing: *Volcanic ash hazard DVD* (Exercises 29a–34c)
- Aviation Safety Network: *Convair 580-ZK-KEU*, 3 October 2003 (ice build-up) (Exercises 21a–b)
- Boeing: *Aero*, issue 9 (volcanic ash) (Exercises 24a–b)
- http://www.flyingineurope.be/ METAR, TAF (Exercises 5a–c; 7a)
- ICAO Circular 323: *Guidelines for aviation English training programmes, 3.8.3*
- ICAO Doc. 9835: *Manual on the implementation of ICAO Language Proficiency Requirements*, 2nd edition 2010, Appendix A–14
- Lacagnina, M.: *Escape from a microburst, AeroSafety World*, April 2010 (Unit lead-in; Exercise 16)
- Qantas B744 at Sydney on Apr 15th 2007, *Microburst at 100 feet AGL* (Exercises 17a–b)
- UK CAA: *Airworthiness Communication on volcanic ash*, 23 April 2010
- http://www.ukweather.freeserve.co.uk METAR, TAF (Exercises 5a–c; 7a)
- http://weather.noaa.gov/weather/
- Withington, T.: *Clearing the air*, *AeroSafety World*, November 2010

Lead-in

The lead-in quotation gives a very physical and detailed description of the sensations and effects of a microburst during landing, and the way in which the crew responds. All pilots will have experienced similar situations and should have stories to tell. ATCOs, many of whom are also private pilots, will be very aware of the importance of wind phenomena especially during approach and landing. Reporting actual incidents of all sorts is something which pilots have to do in debriefing sessions, and controllers do when they report to their supervisor. In addition, many aviation language proficiency tests include an oral reporting task. Therefore, students should be encouraged to make reports on various subjects throughout the course whether it is, like here, informally during a lead-in, or during exercise scenarios.

Quote: **Discuss with the class the meaning of environmental threats and elicit some examples. Note that examples are given in exercise 2a. Students then read the quote and the information about its source to find out what the environmental threat was, what happened, and what the outcome was.**

Answers:
- Environmental threats are threats (dangers) to air traffic caused by natural factors, especially the weather, other natural phenomena (e.g. volcanic eruptions) and wildlife (e.g. bird strikes). See exercise 2a for some examples of environmental threats.
- The threats in this case were the sudden changes in wind velocity (direction and speed), which were the result of windshear and the downdraught, which characterises a microburst.
- In the end, the plane landed with a hard landing but safely.

Background notes:

- A *microburst* is a very localised, descending wind which hits the ground and spreads out. It is extremely dangerous for landing aircraft as it causes an increase in airspeed as the aircraft enters it, followed immediately by a decrease in airspeed as the aircraft exits the microburst. They are severe cases of downdraught.
- A *downdraught* is a sudden vertical descending movement of a mass of air.

1a **Students discuss the questions in pairs and then feed back to the class.**

Suggested answers:
1 final approach and touchdown
2 *Flare* is the final nose-up pitch movement of a landing airplane; *pitch attitude* is the angle between the aircraft's longitudinal axis and the horizontal plane; the *sink rate* is the rate of descent of a body in free fall.
3 See *Teacher's brief* for a list of information contained in weather reports.
4 See *Teacher's brief* for a list of sources of weather information.

b **Students make lists in pairs and then compare their lists with another pair before feeding back to the class. You may need to check the meaning of *precipitation* (= moisture released from the atmosphere and falling as rain, etc.) and *obscuration* (decreased visibility caused by fog, etc.).**

Suggested answers:
1 rain, snow, hail (= ice pellets), sleet (= snowy rain), drizzle (= light rain)
2 crosswind, tailwind, downdraught, microburst, headwind, gusts, windshear
3 fog, mist, smoke, sandstorm, snow, fumes, rain
4 bird strikes, volcanic ash clouds, wake turbulence, black hole phenomenon (spatial disorientation and erroneous perception of altitude caused by a dark approach area and bright lights beyond the active runway), snow blindness

Extension activity:

1 Discuss with the class the differences between similar terms, e.g. *fog* and *mist*, *sleet* and *hail*, *fumes* and *smoke*, *snow* and *slush* etc.
2 Discuss with the class which threats are minor inconveniences, which are serious causes for caution and which are serious enough to cancel flights.

Suggested answers:
Minor inconveniences: mist, rain, drizzle

Serious causes for caution: ice, wake turbulence, hail, gusting wind, bird activity, windshear

Serious enough to cancel flights: volcanic ash clouds, thunderstorms, sandstorms

Background notes:

- *Drizzle* is very light but constant rain.
- *Haze* is fine dust or vapour causing a lack of transparency in the air.
- *Wake turbulence* is a downdraught caused by the movement of a large aircraft through the air. For this reason, ATC usually provides additional horizontal separation after the passage of particularly large aircraft.

Environmental phenomena

Communicative and operational issues:

In the first section, students perform several communication tasks which they have to be able to perform in working situations:

- describing the environmental phenomena they recognise (exercises 2a, 3b)
- describing the effects and precautionary or avoidance measures (exercise 2b)
- visualising weather phenomena from oral descriptions (exercise 3a)
- reporting phenomena and incidents related to environmental phenomena (exercise 4)

2a **Students work alone to match the phenomena with the correct pictures. They then check in pairs before feeding back to the class.**

Answers:

a fog	b bird strike
c lightning strike	d ice build-up
e wake turbulence	f cumulonimbus
g volcanic ash	h crosswind
i rain	j standing water

Extension activity:

Students test each other in pairs by pointing to a picture to elicit the name of the threat from their partner.

b **You may need to provide some useful phrases for speculating about results (X *could/might lead to / result in / cause* Y). Encourage students to think about each flight phase in their discussions (taxiing, take-off, climb, cruise, descent, landing). Students then discuss the question in pairs and then feed back to the class.**

Suggested answers:
Many of the dangers of environmental phenomena are listed in the *Teacher's Brief*. The golden rule for dealing with bad weather is to avoid it.

- **Thunderstorms** can often be avoided by flying around them.
- **Icing conditions** in clouds may be avoided by requesting a higher flight level and flying above the clouds.
- **Volcanic ash** can be avoided by flying outside contaminated airspace.
- **Ice and snow on the ground** can be removed from the aircraft by de-icing.
- **Ice in flight** can be removed or prevented by the aircraft's de-icing and anti-icing systems.
- **Bird strikes** and bird ingestions can be made less likely by airports using audio bird scares and birds of prey to deter birds.
- The effects of **runways contaminated by ice and snow** can be reduced by snow removal using snow ploughs, and by pilots planning for longer landing distances.
- The effects of **poor visibility** can be attenuated by the use of ILS approaches and ground movement radar.
- **Changing or threatening wind conditions** require ATC to provide flight crews with up-to-date wind velocity reports and any pilot reports of windshear.

3a **2.01 Go through the conditions in the box to elicit what they mean. Then play the recording for students to identify the conditions. They discuss their answers in pairs, including as much as they remember about each transmission, before feeding back to the class.**

Answers:

1 gusts	5 glare
2 low ceiling	6 hail
3 windshear	7 smoke
4 drifting snow	8 drizzle

Background notes:

- *Drifting snow* is snow that has been blown by the wind to form a deep deposit.
- *Glare* is bright reflected or refracted light.
- A *gust* is a sudden rush of wind. If wind ***gusts***, it blows in gusts / accelerates momentarily.
- *Hail* is precipitation in the form of compacted ice and snow.
- A *low ceiling* refers to the height of the first layer of cloud cover.
- *Windshear* is a large dangerous local wind gradient and change in wind direction characterised by a sudden downward gust causing the aircraft to lose airspeed and altitude.
- In transmission 2, *two kilometres* refers to the horizontal distance it is possible to see. *400 feet* refers to the height of the cloud cover.
- When it is *overcast (OVC)* there is *0.9+* (i.e. over 90 per cent) cloud cover.
- A *radome* is a conical protective cover over the weather radar antenna and forming the nose of the aircraft.
- A *shift* is a change of wind direction.
- *Fumes* are chemical or industrial gases.

Extension activity:

Write the following numbers and notes on the board:
1 170 / 12 / 18
2 2 / 400
3 incoming / sudden / last mile
4 NE / runway surface / markings
5 snow / sun / visibility
6 737 / damaged / descent
7 shift / approach path / fumes / SW
8 light rain / final descent

Students work in pairs to reconstruct the transmissions, word for word. Elicit the reconstructions from the class and play the recording to check. Pay particular attention to the use of tenses (e.g. present perfect continuous, transmission 3), pronunciation (e.g. downdraught, descent), *have something done* ('*had its windshield damaged*', transmission 6), etc.

Language note:

In Unit 3, the structure *have something done* was presented as a way of describing things that people arrange for others to do (e.g. *I'll have the wheels looked at*). In transmission 6, the same structure is used, in the past simple, to describe a problem that somebody suffered. Another example of this meaning would be '*I had my car stolen*'.

b **Students work alone to choose the correct adjectives and then compare their answers with a partner.**

Answers:

1 thick smoke	6 bright glare
2 scattered cloud	7 poor visibility
3 heavy rain	8 strong wind
4 severe turbulence	9 scattered showers
5 deep standing water	10 thick fog

Background notes:

- *Scattered (SCT) showers* or *clouds* are distributed irregularly.
- For information about pilot reports (PIREPs), see:
  www.weather.aero
  www.maps.avnwx.com
- The seriousness of weather is generally reported using the following terms: *smooth to light*; *light to moderate*; *moderate to severe*; and *extreme*.

c **2.02 Play the recording for students to check. Then play the recording again, pausing after each phrase for students to repeat, either individually or as a whole class.**

Extension activity:

Students could test each other by reading an adjective to elicit from their partner the best noun(s), or vice versa.

4 **Go through the example with the class, focusing especially on the phrase '*reporting …*' (for pilots) and '*Be advised …*' (for ATCOs), and on the use of present perfect in the ATCO's transmission. Students then work in pairs to prepare and deliver reports and transmissions. Afterwards, elicit example transmissions for each phenomenon from the class.**

Note that the Students' Book recommends that students prepare four transmissions each, but, in fact, they could prepare all ten, or they could swap roles after four or five transmissions.

Possible answers:

Pilot: Lufthansa 3675 reporting strong gusting crosswinds during flare and touchdown on Runway 31 Left.

ATCO: Be advised that incoming flights have experienced strong gusting crosswinds near the threshold of Runway 31 Left.

Pilot: Qantas 209 reporting moderate bird activity 200 metres to the left of the far end of Runway 17 Left. I believe we may have suffered a bird strike on our wing leading edge.

ATCO: Be advised that a departing flight has observed moderate bird activity 200 metres to the left of the far end of Runway 17 Left.

Pilot: Regional 27, reporting severe ice build-up on our leading edges between 1,500 and 7,000 feet after departing from Runway 05 Right.

ATCO: All departures from Runway 05 Right, be advised of severe ice build-up between 1,500 and 7,000 feet.

Pilot: Tower, Singapore 384 reporting moderate standing water towards the mid-point of Runway 28 Left during roll-out. As a result, we missed our Bravo 2 turn-off.

ATCO: Be advised that the previous flight has reported the presence of moderate standing water near the mid-point of Runway 28 Left and that your stopping distance may be increased.

…

If you have an odd number of students you will need to have a group of three, where each student prepares three (or more) transmissions. The third student can choose whether to be a pilot or an ATCO.

Background notes:

- A full pilot report (PIREP) may take something like this form:

  This is a Routine Upper Air (UA) PIREP. The aircraft observation was 20 nautical miles west of the Buffalo-Niagara (BUF) VOR/DME (270 due west 020 miles) at 23:20 UTC. The aircraft was at 6,000 feet (FL 060) and is a Boeing 737 (TP B737). The clouds were broken at 2,000 feet AMSL with tops at 4,000 feet and an overcast layer at 11,000 feet AMSL. The temperature is –14 Celsius and the winds are from the NE at 45 knots. (030 @45) There is moderate clear air turbulence (MDT CAT) between 6,000 feet and 8,000 feet. There is light rime icing between 2,000 feet and 4,000 feet. (This would indicate that the icing is picked up in the cloud.) The remarks section says that light freezing rain was encountered in the cloud. (RM LGT FZRA)

  In coded form this would be transmitted as follows:

  UA / OV BUF 270020 / TM 2320 / FL 060 / TP B737 / SK 020BKN040 1100VC / TA –14 / WV 030045 / TB MDT CAT 060-080 / IC LGT RIME 020-040 / RM LGT FZRA INC

- *rime icing* is the most common form of icing. Rime ice forms when small supercooled drops of water freeze on contact with a sub-zero surface. The ice deposit is rough and crystalline. Rime ice forms on the leading edges and can affect aerodynamic characteristics of wings and engine air intakes; it also considerably increases the weight of the aircraft.

Communicating weather information: METAR, TAF and ATIS

Communicative and operational issues:

In exercises 5 and 6, students have practice interpreting international weather abbreviations, listening to METAR, TAF and ATIS reports, giving weather reports and asking and answering questions about changes in the weather.

While the weather abbreviations are only used in print-outs, pilots and controllers need to be able to say the corresponding conditions in full in order to communicate them. Most of the abbreviations or contractions are quite easy to understand, but some are derived from French, from a time before World War II when, with Clément Ader, Santos Dumont, Blériot, Guynemer, Mermoz, Saint Exupéry and the Aéropostale, France was the cradle of aviation and French was its predominant language. A fuller list of abbreviations can be found at: http://www.dixwx.com/abbreviations.htm. And a more exhaustive treatment of METARs and TAFs at:
http://en.allmetsat.com
http://skylinkweather.com
http://stoivane.iki.fi/metar/
http://www.nws.noaa.gov
http://www.ukweather.freeserve.co.uk

5a **Elicit the difference between METAR and TAF reports (see *Teacher's brief*). Students work alone to match the abbreviations with the words and then check in pairs. Go through the answers with the class, making sure all students fully understand the 18 terms.**

Answers:

1 RA	rain	10 VA	volcanic ash
2 DU	dust	11 TS	thunderstorm
3 DZ	drizzle	12 FU	smoke
4 SN	snow	13 SCT	scattered
5 HZ	haze	14 BCFG	fog patches
6 BR	mist	15 DRSN	drifting snow
7 GR	hail	16 FZRA	freezing rain
8 SQ	squall	17 RASH	rain showers
9 IC	ice	18 MIBR	shallow mist

Background notes:

- A *squall* is a sudden, violent wind often with rain.
- *Shallow mist* is a thin layer of mist near the ground, above which the aircraft climbs quickly.
- The order in which some information is given may vary slightly, e.g. in the US they may say '2,500 feet overcast', whereas in the rest of the world 'Overcast 2,500 feet' is more usual.

Extension activity:

Students test each other in pairs by saying a symbol to elicit the correct word, or vice versa.

b **2.03** Before the students listen, go through the reports with the class to discuss what the symbols mean (see *Background notes* below) and what type of information is missing. With experienced pilots and ATCOs, this will be fairly easy, but inexperienced pilots and ATCOs will struggle and need plenty of support. Then play the recording for students to complete the reports. Students check in pairs and then listen again to check. Finally, go through the answers with the class, and deal with any problems with understanding.

Answers:
1
METAR KBUF (Buffalo Niagara International) 12**1755**Z AUTO **210**16G**24**KT **180**V240 1SM R**11**/P**6000**ft – **RA** BR BKN**015** OVC025 **06**/04 A**2990**
2
METAR EPKK (Krakow) 06**1800Z** 120**6KT** 1400 R**12**/P**1500**N +SN **BKN**017 M04/**M07** Q**1020** NOSIG
3
TAF SBRF (**Recife**) 070801Z 210**12**KT 9999 BKN010 – RA **BKN**008 TEMPO 0712/0718 **SCT**015=

Background notes:

	Report 1	Report 2	Report 3	Notes
Type of report	METAR	METAR	TAF	
Airport code	KBUF	EPKK	SBRF	
Date	12	06	07	
Time	17:55Z	18:00Z	08:01Z	Z = *zulu*, *GMT/UTC*
Wind direction	AUTO 210	120	210	AUTO = *information provided automatically*
Wind speed	16G24KT	6KT	12KT	G = *gusting* KT = *knots*
Direction of gusts	180V240			V = *varying between … and …*
Visibility	1SM	1400	9999	1 SM = *1 statute mile* (see page 94) 9999 means *effectively unlimited visibility* (see page 94)
RVR information for specific runways	R11/ P6000ft	R12/ P1500N		RVR = *runway visual range* R = *runway number* P = *in excess of* (see below) ft = *feet* N = *to the north*
Ground-level weather	– RA BR	+ SN		– = *light* + = *heavy*
Level of lowest clouds	BKN015	BKN017	BKN010	BKN = *broken* (see page 94) (numbers in hundreds of feet)
Weather at higher level	OVC025		–RA BKN008	OVC = *overcast*, i.e. complete cloud cover
Time of weather condition			TEMPO 0712/0718	TEMPO = *temporary* 0712 = *12:00 UTC on 7th*
Weather at higher level			SCT015=	SCT = *scattered clouds* The equals sign (=) shows that this is the end of the message.
Temperature and dew point	06/04	M04/M07		M = *minus*
Pressure	A2990	Q1020		A = *altimeter* Q = *QNH*
Change		NOSIG		NOSIG = *no significant change*

Background notes:

Weather reports follow the same sequence, as explained in the *Teacher's brief*. The first METAR comes from Buffalo airport in the north-eastern United States. Visibility is given in statute miles and feet rather than kilometres and metres and the altimeter setting (29.90) is given in inches of mercury rather than hectoPascal (1012 hPa). The second METAR is from Krakow, Poland and the TAF is from Recife, Brazil.

The three reports from exercise 5b are explained, step by step, in the table.

- *broken (BKN)* = cloud cover of between 0.5 and 0.9 (i.e. 50 per cent and 90 per cent) of the sky
- *clear (CLR)* = no cloud cover
- *9999* = horizontal visibility of more than ten kilometres
- *P* = greater than highest reportable sensor
- *scattered (SCT)* = intermittent or irregular cloud cover or precipitation
- *statute mile (SM)* = 1,609.34 metres, land mile as opposed to nautical mile (1,853.18 metres)
- *VV* = vertical visibility, indefinite ceiling
- The IATA and ICAO airport codes are:
  Bordeaux, France: BOD - LFBD
  Karachi, Jinnah International Airport, Pakistan: KHI - OPKC
  Seoul, Incheon International Airport, South Korea: ICN - RKSI
  Fujairah, United Arab Emirates: FJR - OMFJ
  Maastricht, Holland: MST - EHBK
  Dubai, United Arab Emirates: DXB - EGLC
  London City, UK: LCY - EGLC
- Report 6 includes the term *becoming*. This is shown in weather reports as *BECMG*.
- In report 7, '*probability 30 per cent*' is written as *PROB30*.

c **2.04 Tell students to listen first to take notes. If they are not familiar with such reports, it might be useful to use a table format (as above) for students to organise their notes. You could write the seven airport codes (see below) on the board to help them. Make sure they realise that there are eight reports, so they will need to listen and concentrate for a long time. Afterwards, students compare their notes in pairs to identify any discrepancies. They then listen again to check their notes. When they are confident that their notes are accurate, they take turns to make weather reports, using their notes. Finally, ask a volunteer to deliver each report, which you can check using audioscript 2.04 on page 180.**

Extension activity:

Elicit from the class a written form of each report from exercise 5c, and write it up on the board. You could do this before students have to make their spoken reports. The objective of this exercise is not technical accuracy; any combination of coded and plain language would be quite acceptable.

Answers:
1 METAR LFBD 070850Z 21012KT 9999 BKN023 20/14 Q1017=
2 METAR OPKC 081225Z 18006KTS 8000 SCT030 SCT100 34/24 Q1002 TEMPO NE 30KTS TSRA FEW025CB=
3 METAR RKSI 071200Z 20011KT 9999 BKN037 17/13 Q1022=
4 METAR OMFJ 081200Z 10009KT 040V130 6000 FEW025 34/25 Q1001 A2955=
5 METAR EHBK 071350Z 21008KT 160V250 9999 BKN008 17/14 Q1019=
6 TAF OMDB 081056Z 0812/0918 34012KT 8000 NSC BECMG 0815/0817 10007KT BECMG 0908/0910 35012KT BECMG 0915/0917 11008KT=
7 TAF EGLC 070800Z EGPA 070805Z 0709/0718 18010KT 9999 FEW030 BECMG 0709/0712 19020G32KT PROB30 TEMPO 0712/0718 8000 SHRA

6a **Students work alone to prepare their weather forecasts. Make sure they realise to use plain English. Note that in plain English, it is usual to use *will*, not *going to*, to make predictions in weather forecasts.**

b **Students read their reports for their partners to make notes and ask for clarification. Again, remind them to use plain English.**

Extension activity:

Students use the notes they made in exercise 6b to give a METAR or TAF-style weather report to their partners.

7a **2.05 Go through the tables with the class, eliciting the type of information missing from each box. Then play the recording for students to complete the tables. They check their notes with a partner and listen again to check, if necessary. Finally, go through the answers with the class.**

Answers:
ATIS 1

Airport	NZCH Christchurch	Visibility	5,000 m
Information	G	Cloud	SCT 3,000 ft BKN 11,000 ft

Time	2200Z	Temperature	12°
Departure RWY	20	Dew point	10°
Wind velocity	110° / 20 kts	QNH	1001 hPa

ATIS 2

Airport	Prague	Visibility	10 km or more
Information	L	Precipitation	light rain showers
Time	10:59	Ceiling	Few 500 ft; few CB 1,500 ft; BKN 4,000 ft
ILS RWY	24	Temperature	15°
RWY condition	wet	Dew point	14°
Transition level	50	QNH	1019 hPa
Runways closed	13/31	Special instructions	NOSIG
Wind velocity	340°/ 14 kts		

Background notes:

- The first ATIS comes from Christchurch in the South Island of New Zealand. It contains just the basic weather information. The second is from Prague in the Czech Republic; in addition to the weather information, it also provides information about the state of the runways, the transition level and precipitation.
- The *transition level* is the flight level at which flight crews reset their altimeters from local atmospheric pressure (QNH or QFE) to standard atmospheric pressure at sea level (1013 hPa). Below this point *altitude* rather than *level* is used by pilots and controllers.
- *Few* = 0.25 or less of the sky covered by clouds.

b **Discuss the questions with the class.**

Suggested answers:

- The order in which information is given is generally that used in the examples, but regional variations exist. The first example contains the essential mandatory transmission and weather information: location; information identification (India, Juliet, Kilo …); Zulu time (UTC); runway; wind velocity; visibility; ceilings; temperature; dew point and altimeter setting.
- Additional information may be given in case of rapidly changing or hazardous weather conditions, or modifications to the runways etc.
- The information in the ATIS is absolutely critical for flight, especially for take-off and landing. It determines the runway(s) in use, any special precautions (de-icing, aircraft anti-icing, runway length required), the conditions of climb-out, IFR (instrument) or VFR (visual) flight and expectations about the way the aircraft will respond.

c **Students work in pairs to give their ATIS reports and to make notes. Point out that there is a table in the Pairwork section for them to take notes in.**

If you have an odd number of students you will need to have one group of three, where Student C listens and takes notes from both reports. Student C then reads back both reports in exercise d below.

d **Students use their notes to repeat the weather reports, while their partners check.**

Language focus: Changing conditions

Tell students to close their books. Ask questions to elicit the information from the *Language focus* box (e.g. *How can we describe positive/negative changes in wind strength/direction?*, etc.). Write the elicited phrases on the board. Then allow students to check in their books to see if they have missed any phrases (or found some that are not in the book). Draw attention to the form of present continuous to describe changes. You may need to check the spelling and pronunciation of *strengthening* /ˈstreŋθənɪŋ/ and *deteriorating* /dɪˈtɪərɪəreɪtɪŋ/.

Extension activity:

Students test each other in pairs by reading the beginning of a sentence from the *Language focus* box (e.g. *The wind is …*) to elicit a suitable ending from their partner, whose book is closed. They could use body language (e.g. pointing upwards or downwards) to encourage their partner to use a positive or negative word to complete the sentence.

8 **This pairwork exercise develops the students' ability to talk about changing weather conditions using the appropriate language seen in the *Language focus* box, and to use the present continuous in a naturally suitable context. It also develops the students' ability to produce language from a combination of oral and symbolic inputs, which is something they have to do frequently in their operational environment where they respond to oral questions while referring to information on their displays. Go through the examples with the class to draw attention to the types of questions and responses. Students then work in**

pairs to ask and answer about changing weather conditions. Afterwards, ask volunteers to act out their dialogues for the class.

If you have an odd number of students you will need to have one group of three, where Student C takes the first two reports from Student A and the last report from Student B.

Communication errors: Expectation bias

Communicative and operational issues:

Expectation bias, which is the subject of this section, is, of course, not restricted to environmental issues, but changes in flight plan or the times at which clearances are given may well be affected by the state of the weather. In commercial aviation, where there is a lot of routine and procedures indeed constitute safety measures, pilots and controllers may sometimes understand not what they hear, but what they expect to hear. When routings, changes of level, runways and taxiways, radials and altitudes are always the same or always given at the same time or in the same conditions, it may happen that a change in information may be overlooked. In such a case, readback is the immediate safety net.

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Elicit from the class what is meant by expectation bias [**Answer:** see *Communicative and operational issues* above]. Students then read the quote to identify the two pieces of information that are confused in the example. Students discuss the two questions in pairs and then feed back to the class.

Possible answers:

- In the example a heading of 280° is confused with Flight Level 280.
- Information which may be confused in transmissions includes: active runways (28R/28L); FL 100 / FL 110 (one zero zero / one one zero); a clearance and information to expect (climb to Flight Level 260 / expect Flight Level 260 at 35); navaid identifiers (ALD/ADL); call signs (Fedex 2835 / Fedex 2385); 5 and 9 if not said correctly as *fife* and *niner*; squawk transponder identifiers (3645/3465); *taxi into position and hold / taxi to holding position*; altimeter settings (1003 hPa / 1013 hPa) etc.

9 **This exercise is especially designed to improve students' skill in recognising discrepancies between an instruction and its readback and being able to correct the misunderstanding fluently. Go through the example with the class, drawing attention to the mistake that the pilot makes. Point out that each student has input cues and readback cues. Students then work in pairs to make dialogues. Afterwards, ask volunteers to act out their dialogues for the class.**

Suggested answers:

Student A initiating

1

ATCO: White Eagle 268, expect joining clearance at time 55. Time is 45.
Pilot: Expect joining clearance time 45, White Eagle 268.
ATCO: White Eagle 268, negative. Expect joining clearance at time 55.

2

ATCO: Gulf Air 395, recent rain showers, standing water at midpoint Runway 34 Left, braking action medium.
Pilot: Heavy rain, braking action poor (on) Runway 34 Left, Gulfair 395.
ATCO: Gulfair 395, negative. I say again standing water at midpoint of Runway 34 Left. Braking action medium.

3

ATCO: Broken 2,500 feet; overcast 5,000 feet; temperature minus four degrees; dew point minus six degrees, QNH 979 hectoPascal.
Pilot: Broken 2,500 feet; overcast 5,000 feet; temperature minus four degrees; dew point minus six; QNH 997 hectoPascal.
ATCO: Negative. I say again, QNH 979 hectoPascal.

…

Student B initiating

1

ATCO: Lufthansa 3165, caution: there is a thunderstorm 200 miles ahead of you and ten miles to the south-east of your projected flight path, moving north-west.
Pilot: Roger. Confirm thunderstorm 200 miles ahead and ten miles north-west of our flight path.
ATCO: Negative. The thunderstorm is ten miles south-east of your projected flight path and moving north-west.

2

ATCO: Aeroflot 3587, climb and maintain FL 190.
Pilot: Maintaining heading 190, Aeroflot 3587.
ATCO: Aeroflot 3587, negative. I say again, climb and maintain Flight Level 190.

3

ATCO: Kyrmal 591, maintain FL 310, expect descent after Minsk.
Pilot: Maintaining Flight Level 310, expect descent after Minsk, Kyrmal 391.
ATCO: Kyrmal 391, negative. That transmission was not intended for you.

…

If you have an odd number of students you will need to have a group of three students, where Student C takes the first two input and readback cues from Student A and the last two from Student B.

Background notes:

- *Controlled airspace* is airspace of defined dimensions within which ATC service is provided.
- *Delaying action* involves holding or orbiting to slow down the progress of a flight.
- *Joining clearance* is authorisation to join a circuit prior to approach and landing.
- In *IFR* (Instrument Flight Rules), *straight-in* means an instrument approach in which the final approach is begun without a prior procedure turn. In *VFR* (Visual Flight Rules), *straight-in* means the entry of a traffic pattern by interception of extended runway centreline without executing any portion of a traffic pattern.

Extension activity:

Discuss with the class what can be done to minimise the risk of expectation bias.

Suggested answer: The simplest technique is simply to be aware that it exists and that it can be extremely dangerous. Pilots and ATCOs should be constantly alert not only for instances when they themselves fall into this trap, but also for their colleagues and the people they are communicating with. As mentioned above, readback and hearback are the most important safety nets. Applying good crew resource management by discussing decisions, verbalising actions, crosschecking different sources of data, using common sense, breaking out of tunnel vision, are also effective barriers against expectation bias.

The effect of the weather on a flight path

Communicative and operational issues:

This section explores changes to the projected flight path due to encountering a weather system first through using two Airbus weather radar displays and then listening to an authentic example of a flight in the vicinity of a thunderstorm in Florida.

The Airbus example is taken from the Airbus Flight Operations Briefing Notes (FOBN) on Adverse Weather Operations. These FOBNs are an invaluable source of genuine professional expertise in an accessible form.

Quote: **Students read the text to identify what the numbers 40, 160 and 80 refer to. [Answers: The flight crew needs to make decisions while 40 nm away from a storm; the pilot non-flying range is 160 nm and below; the pilot flying range is 80 nm and below]. You may need to check the meaning and pronunciation of *adverse* /ædˈvɜːs/ (= likely to cause problems).**

10 a, b, c, d **Students discuss the four questions in pairs and then feed back to the class.**

Suggested answers:

- Given the speed at which the aircraft moves, it is necessary to take any avoiding action while 40 nautical miles (nm) away from a thunderstorm. This is why the weather radar is especially useful in IMC (Instrument Meteorological Conditions) or at night. The two pilots will have their displays set at different ranges covering a 90° arc, for instance, in this example, 40 and 80 nm ahead of the aircraft. This enables the crew to have advanced warning of a storm and see what change of heading they need to make to avoid it effectively, while having a more detailed view on the shorter range display.
- The airborne weather radar usually displayed on each pilot's Navigation Display uses Doppler technology to give information about cloud formation, not the presence of other aircraft. On most controllers' radar screens, weather returns are suppressed in favour of the identification and position of aircraft under their control.
- En-route or arriving traffic taking avoidance measures will result in a concentration of flights and increase ATC workload by requiring additional communication, unexpected flow management, possible conflict resolution and possible deviations to alternates.
- In cruise, weather avoidance is usually fairly simple and localised: a temporary change of heading and then return on course after circumventing the obstacle; a possible climbing to a higher flight level to avoid icing conditions or turbulence. During approach, more traffic is concentrated in a smaller airspace. Thunderstorms in the vicinity of the airport may make approaches to the glide path more complicated and cause holding traffic to build up, generating further delays. Very bad weather (storms, poor visibility) at the airport itself may make it impossible for some flights to land if conditions are below their minima in terms of decision height, visibility or CAT III capability. This in turn will mean that flights have to be re-routed to alternate airports.

Background notes:

- The *range* is the distance that can be covered by an aircraft without refuelling, or the distance that can be covered by a radar / radio / navigation aid signal or an instrument.

- The terms *pilot flying* (*PF*) and *pilot non-flying* (*PNF*) are used to designate the pilot who is actually doing the hands-on flying of the aircraft at a given moment and the pilot who is monitoring the PF, entering data, communicating with ATC etc. Captain and First Officer take these roles in turn.
- *Avoidance* is the action of distancing oneself from an obstacle, danger etc.
- *Doppler technology* is used in radar and consists in reflecting beams off objects, in this case cloud formations, to sense their density and velocity. Pulse Dopplers are used to detect precipitation particles, e.g. rain, ice, hail.

11a **Students discuss the four questions in pairs and feed back to the class.**

Answer:
The two screens show simultaneous views of the same area ahead of the aircraft but with different ranges. On the more detailed, shorter range left-hand display, one has the impression that it is possible to avoid the two storm formations by flying a heading of 343° between them. The longer range right-hand display shows that after flying between the two cloud formations at just under 40 nm, one will encounter a much larger one straight ahead, 60 nm from the aircraft's present position. In other words, a heading of 315° is a better avoidance manoeuvre.

b **Discuss the question with the class.**

Answer:
Green indicates weather of moderate intensity; yellow of heavy intensity and red of extreme intensity. Some displays have gradations of colour such as light green, dark green, pale yellow, dark yellow, orange and red and allow the identification of different types of weather.

12a **Students role play the situation in pairs.**

If you have an odd number of students you will need to have one group of three students, where there are two PNFs (pilots non-flying).

b **In the same pairs, students plan what they will say to ATC. Then ask volunteers from several groups to act out their communications. Then discuss and agree on the best course of action as a class.**

Suggested answers:
Basically, they need to obtain authorisation to enter a new course and follow a different heading from their next waypoint in just under 20 nm from their present position (small yellow aircraft symbol), by flying a heading of 315° or 294° instead of 343°.

13a **2.06 In this recording, while flying south off the Florida coast to land at Daytona International Airport, a Comair commuter flight (Comair 580) is unable to pursue its approach by turning west towards the airport because a tornado centred near the airport causes a power cut which makes all the controllers' equipment momentarily unserviceable. The flight crew pursue their flight south before turning north to make a new approach.**

Tell students to read the report to get a general idea of what happened and to start thinking about the order of events. They discuss their ideas in pairs. Then play the recording for them to put the events in order and write the correct times. Allow them to discuss their answers in pairs before listening again to check if necessary. Finally, go through the answers with the class.

Answers:

1 e	3 a	5 c	7 b
2 g	4 h	6 f	8 d

Background notes:

- If an aircraft is *nearing* something, it is approaching it.
- A *landing sequence* is the series of manoeuvres (outbound track, base turn, inbound track) prior to landing.

b **Volunteers re-tell the story to the class.**

Extension activity:

Use the following questions to generate a class discussion based on the story, eliciting students' own similar experiences where possible. Note that the discussion here is more important than the correct answers.

- Why do you think the airport lost power? [**Possible answer:** There was a severe storm, which may have brought down power lines, caused overvoltages or caused short circuits.]
- Is this a common problem? [**Possible answer:** It is fairly rare.]
- What can be done to avoid such situations? [**Possible answer:** ATC needs to have contingency plans, i.e. use of a back-up generator.]
- How long was the plane out of contact with the airport? [**Answer:** Around three minutes.]
- What should a pilot do if he loses contact with the airport? [**Possible answer:** Climb to the Minimum Safe Altitude, perform a circuit and attempt to contact ATC on the previous frequency used.]
- Do you think the tornado was a complete surprise? [**Possible answer:** In this case, it seems to have been unexpected, as planes were still arriving just before the tornado struck.]

- Is it possible to predict where a tornado will hit? [**Possible answer:** Not precisely, but it is possible to make judgements based on worsening weather conditions. In this case there seems to have been a failure to interpret the weather conditions properly, although it should be remembered that the airport had no power at the critical time.]
- Did anyone make mistakes on the day of the event? [**Possible answer:** Possibly the weather forecasters and planners, who failed to predict the tornado, but the exact location of a tornado is almost impossible to predict.]
- What should have been done to avoid such situations? [**Possible answers:** There should have been a back-up electricity supply to prevent such power cuts. There should have been a more effective weather forecasting system.]

14a **2.07 Go through the example with the class. Then play the recording, pausing after each transmission for volunteers to confirm or read back. Discuss the most suitable responses with the class. Afterwards, students can test each other in pairs using audioscript 2.07 on page 180.**

Suggested answers:
1 Freezing rain is expected at destination.
2 Strong windshear on approach.
3 Current ceiling is 3,000 feet.
4 Solid cloud from 1,000 to 6,000 feet.
5 Moderate to severe icing in clouds.
6 Gusty winds reported on (the) approach path.
7 Wind 150 degrees, 18 knots, gusting to 23 knots.
8 Thunderstorms (in the) vicinity (of) Kuala Lumpur.
9 50-mile volcanic cloud moving south west from Iceland.
10 Snow flurries at destination.

Background notes:

- The *ceiling* is the bottom of the lowest level of clouds.
- *Snow flurries* are sudden rapid falls of snow.

b **2.07 Go through the examples with the class. Then play the recording, pausing after each transmission for volunteers to suggest a course of action or give an instruction. Make sure they know to use a modal verb in their responses. Elicit a range of possible responses from the class and then discuss and decide on the most suitable responses. Afterwards, students can test each other in pairs using audioscript 2.07 on page 180.**

Suggested answers:
1
Pilot: We must set the probe heat, window heat and wing and nacelle anti-icing on. We should prepare for a longer landing distance.
ATCO: Up-to-date advisories should be transmitted as required. The longer runway must be used.
2
Pilot: We should be ready to go around. You must call out airspeed during approach. We should ask ATC for the latest update.
ATCO: We must be prepared for flights to go around. You must monitor the incoming flights carefully.
3
Pilot: You should ask ATC if the vertical visibility is increasing or decreasing. We may have to go around if we are below minima / if the ceiling drops below our minima.
ATCO: You must advise incoming flights if the ceiling decreases any more.
4
Pilot: We will need wing ant-icing during climb-out. We must climb out of the cloud as soon as possible. There may be some turbulence during the initial climb / first segment. We will be in IMC.
ATCO: You should advise flight crews of icing conditions. All flights will be in IMC.
5 (See 4, above)
6
Pilot: We may experience some turbulence during our approach. We will decrab just before touch-down.
ATCO: We must update incoming flights on any changes to wind velocity.
…

Background notes:

- In the first example, the phrasal verb *set … on* means *turn … on*.
- The *probe heat* is the electrical anti-icing of the air data probes (pitot probe, static ports, angle of attack sensors, outside air temperature probes) which are located on the outside of the forward fuselage. The failure of the probe heat system on the A330 is suspected as being a contributory factor to the loss of Air France Flight 447 over the South Atlantic in June 2009. If the probes become obstructed with ice, the flight crew can lose all altitude, airspeed and angle of attack information and the computers which receive this information will generate erroneous outputs.

- *Minima* (answer 3 above) are the lower limits of visibility for a given aircraft depending on its onboard equipment.
- If a pilot *decrabs* (answer 6 above), he/she aligns the aircraft with the runway centreline just prior to touchdown in crosswind conditions. *Crabbing* refers to flying with drift due to crosswind.

15 **Go through the example with the class. Students then work in pairs to ask and answer questions. Note that they should swap roles when they have finished. Afterwards, ask volunteers to act out their dialogues for the class, and discuss the best ways of phrasing the responses.**

If you have an odd number of students you will need to have a group of three, where Student C answers questions 1 to 3 from Student A and questions 8 to 10 from Student B.

Suggested answers:

To Student A questions

1 We are still in icing conditions at 8,000 feet. / We left icing conditions at 11,000 feet.
2 We have some moderate weather activity showing 70 miles ahead and ten miles to the right of our flight path.
3 Affirm, but there is a CB formation maybe some 20 miles to the south-west.
4 We experienced some moderate clear air turbulence over Irkutsk.
5 We are at Flight Level 290 with a 45-knot tail wind and occasional mild turbulence.
6 Temperatures were negative from 1,200 feet.
…

To Student B questions

1 At 9,000 feet we are still in IMC with severe ice build-up despite our anti-icing being on High.
2 We experienced moderate wake turbulence at 1,600 feet as we turned right off the extended runway centreline.
3 Our flight conditions are smooth/bumpy.
4 Affirm. Snow has accumulated on our wings.
5 Our weather radar is not displaying any weather activity after HMG 20 miles ahead.
6 It is severe with a very high frequency. It is making the instruments quite difficult to read.
…

Background notes:

- *Extend* has two meanings. If a pilot *extends* flaps, slats or landing gear, he deploys them or moves them down. If clouds *extend* over a given area or height, they cover it.
- If clouds have *smooth tops*, it means there are no sudden variations, movements or irregularities.
- *CB* or *cumulonimbus* is a type of cloud which is high, dense and generates storm activity; it is the type of cloud that represents the greatest threat for aviation and which crews try to avoid.
- The *freezing level* is the altitude at which the temperature in the atmosphere drops to 0° Celsius.
- A *build-up* is an accumulation.
- *Wake turbulence* is a severe disturbance of the air caused by the passage of an aircraft through a mass of air. The wake turbulence caused by a B747 or A380 can upset a smaller aircraft. Consequently, ATC creates about three minutes' separation between aircraft on the same trajectory during climb when aircraft are using full thrust.
- *Ride* is jargon for flight.
- *Buffeting* refers to the effects of being knocked around by turbulence or the rapid oscillation of flight control surfaces.
- A *weather return* is the coloured patterns or outlines which are shown on the weather radar display.
- *Overhead* can be used as a preposition (*overhead the field*), meaning *immediately above*.

Windshear

Communicative and operational issues:

Windshear (a large dangerous local wind gradient and change in wind direction characterised by a sudden downward gust causing the aircraft to lose airspeed and altitude) represents a considerable hazard for aircraft during final approach and touchdown as there can be dramatic variations in wind speed which can thrust the aircraft violently downwards. To mitigate this danger, ATC must provide incoming aircraft with up-to-date information about any changes in the reported weather conditions.

Quote: **Elicit from the class what *overshoot windshear* is and what causes it. They then read the quote to check their answers.**

Background notes:

- *Overshoot windshear* is characterised by an increase in aircraft airspeed. It contrasts with *undershoot windshear*, characterised by a decrease in aircraft airspeed.
- A *head wind* is a wind blowing in a direction opposite to the direction of travel of the aircraft, while a *tail wind* is blowing in the same direction as the direction of travel of the aircraft.
- *Indicated airspeed* (*IAS*) is the relative velocity between the aircraft and the surrounding air.

16 **Students discuss the questions in pairs and then feed back to the class.**

Suggested answers:
Windshear is particularly dangerous during final approach and touchdown because the effect on the aircraft's airspeed, rate of descent and vertical movement can be so sudden and unexpected at a phase of flight when the aircraft is using reduced engine power, it is close to the ground and its flight control surfaces have less effect. Windshear can result in the aircraft suddenly: losing height and airspeed, and so touching down short of the runway, or making a hard landing; gaining height and airspeed and touching down late on the runway; or being blown away from its flight path on the runway centreline. Given the aircraft's built-in inertia and the response time of the engines and flight controls, the pilot's remedial action may not prevent the aircraft from touching down even if he/she wishes to go around.

The controller's main contribution at this phase of flight is to provide the pilots with the most up-to-date weather information, including reports sent in by pilots who have just landed.

17a **2.08 The story in this exercise highlights the importance of up-to-date weather information in windy and windshear conditions. The crew did not receive the latest ATIS, and so was less prepared for conditions near the ground. Seeing the conditions, the crew disconnected the autopilot to have direct control of the flight controls. The rapid changes in wind velocity during the last couple of minutes before landing demonstrate how unpredictable conditions can be. The aircraft's airspeed increased to 159 knots then decreased to 131 knots, which was 13 knots below the aircraft's reference speed. This caused a rapid descent (sink rate) over the last few feet with 2.34g. In theory, aircraft should touch down at 1g.**

Go through the table with the class to check what sort of information is needed for each gap. Then play the recording for students to complete the table individually. They check their answers with a partner and then listen again to check if necessary.

Answers:

1 B747-400	10 20 kts tailwind
2 Singapore	11 continuous wind data call-outs
3 Sydney	12 15 kts headwind
4 030°; 17 kts	13 right crosswind
5 18 nm SW of airport	14 131 kts
6 different frequency	15 820 ft/min
7 3 nm from runway	16 go around
8 16R	
9 180°; 22 kts	

Background notes:

- *CAS* stands for *calibrated airspeed*, i.e. the indicated airspeed corrected for airspeed indicator errors.
- The *pilot-in-command* is the pilot flying (PF), i.e. the pilot in control of the aircraft.
- An *approach control frequency* is the frequency used by the Approach controllers at a given airport, as distinct from the Tower or Ground frequencies.
- A *reference speed* (*Vref*) is the speed at which the aircraft should be flying in a given configuration.
- *Surface wind* is measured near ground level.
- A *readout* is data which is displayed or played audibly.
- *Autopilot* (*AP*) is an airborne electronic system which automatically stabilises the aircraft about its three axes.
- *Autothrottle* is an automatic engine power control system.
- A *call-out* is spoken data read out by a member of the flight crew.
- If you *advance* a thrust/throttle lever, you move it forward to increase engine thrust.
- Note that the pilot decided to *go around* after touching down. In other words, the aircraft took off again immediately because it was not properly controlled.

b **Students work in pairs or small groups to ask and answer questions about the information they noted down. Note that the aim here is to practise question forms as well as to discuss the events in the story.**

Suggested answers:
1 What type of aircraft was involved in this incident?
2 Where was the aircraft flying from?
3 Where was the aircraft flying to?
4 What were the wind conditions like at 18:30?
5 Where exactly was the thunderstorm?
…

c **Students write their crew briefings or reports as homework.**

Suggested answer:
A Qantas B747-400 was enroute from Singapore to Sydney. Just before descent, the crew requested the latest weather report. The METAR reported fairly strong winds (17 knots) and thunderstorms moving towards the airport. The aircraft was on an approach frequency and did not receive the windshear warnings on the latest ATIS. Three miles from touchdown on Runway 16 Right, the crew learnt of a change in wind velocity. At 1,000 feet, the crew were experiencing a tailwind. The crew disconnected the autopilot and autothrottle. At 500 feet, the wind changed to a crosswind. At 120 feet, the airspeed increased from 146 to 159 knots, then decreased to 131 knots on touchdown; the reference touchdown speed was 144 knots. The aircraft made a very hard landing, but the pilot flying decided to go around in compliance with company standard operating procedures.

Language focus: The same word used differently

Tell students to close their books. Write the following words on the board:

control *go around* *call out* *clear*

Elicit from the class two meanings of each word, with examples. Elicit also, the rules about hyphenation of go-around and call-out. Then tell students to check in their books.

18a **2.09 Go through the ten pairs of words first to make sure students know which word is a noun (i.e. the first in each pair) and which is a verb (i.e. the second in each pair). Then play the recording for students to mark the correct word. They check in pairs and listen again to check if necessary. Then go through the answers with the class. Elicit what happens to the stress pattern of phrasal verbs when they are turned into verbs and as nouns/adjectives (See *Language note* below).**

Answers:

1 b	3 b	5 b	7 b
2 b	4 a	6 a	8 a

Language note:

Phrasal verbs are usually stressed on the second word (e.g. *Can you read it OUT?*). When they are transformed into nouns or adjectives, the stress moves to the first word (e.g. *They have requested a READout*).

Background notes:

- *Rollout* is an aircraft's ground roll after landing, i.e. its movement along the runway after touchdown while it is decelerating.
- *V1* refers to the decision speed, i.e. the speed at which the pilot must decide to continue or abandon take-off.
- A *synthetic voice* is an automatic recording triggered in certain configurations, especially during approach and landing, e.g. '*pull up, pull up*'.
- *Go-around thrust* is take-off/go-around thrust (TOGA on Airbus); this is the maximum engine power setting.

b **2.10 Play the recording, pausing after each pair of words for students to repeat the words, either individually or as a class.**

Extension activity:

Students can repeat the pronunciation work in exercise 18a in pairs, by reading one word from a pair for their partner to work out which word it is.

19a **Go through the tables with the class to elicit what type of information needs to go in each gap. Note that *PF* refers to the pilot flying, so the information should be the Captain or First Officer. The type of circuit could be, e.g. *holding*, *diversion*, or *vectors for a new approach*. In the box marked *ATC instructions*, students should write abbreviated ATCO instructions.**

Students then work alone to fill in the details in their tables, using their imaginations. Both pilots and controllers should be able to find roughly suitable data, but the accuracy of the data is not the purpose of the exercise and indeed any disagreement could generate further discussion between partners. They then work in pairs to ask and answer questions about the information in their partners' tables. See exercise 17b for examples of questions to ask.

If you have an odd number of students you will need to have a group of three, where Student A asks about Student B's flight, Student B asks about Student C's flight and Student C asks about Student A's flight.

b **Students take turns to describe their partners' flights using their notes.**

Dealing with icing

Communicative and operational issues:

Icing, like wind, is another meteorological condition which can have severe consequences both in flight and on the ground. Ice formation (build-up) on the wings, stabilisers and flight control surfaces increases the weight of the aircraft, changes the centre of gravity, may alter or invalidate airspeed and attitude data by blocking the probes, and reduces

the efficiency, or even prevents the movement of the flight controls. It can result in aircraft stall, i.e. the aircraft losing lift and entering an uncontrollable dive, as in the New Zealand example in exercise 20, or in a crash after take-off like Air Florida Flight 90, which ended in the Potomac River in Washington in 1982.

Aircraft are equipped with anti-icing and de-icing systems, which are electrical for the cockpit windows and air data probes; and pneumatic (hot bleed air) for the wing and engine cowl leading edges or using deformable rubber boots on some turboprop aircraft. Usually, turboprop aircraft cannot generate enough spare hot air to de-ice the wing leading edges, so they use another system which consists in inflating and deflating a rubber chamber running along the wing leading edges in order to detach any ice which has built up on it.

On the ground, aircraft are often de-iced by de-icing vehicles or gantries (see Unit 3) in freezing and snowy conditions. When freezing conditions are forecast in dense cloud, flight crews select aircraft anti-icing before take-off. Whenever possible, aircraft fly above freezing conditions, i.e. above cloud.

ATC provide flight crews with up-to-the-minute weather briefings in addition to regular ATIS recordings and have to take into account delays caused by aircraft going through a ground de-icing cycle.

The report in exercise 20 is about the flight of a turboprop aircraft which leaves Christchurch in New Zealand's South Island at night to fly to Palmerston in the North Island. They climb to FL 210 before being cleared by ATC Wellington to descend to FL 130 and then 11,000 feet. As they descended they were cleared to 7,000 feet. The aircraft then disappeared from the controller's radar screen as the aircraft was beginning a left turn. Ice build-up could have obstructed the transponder as it could have made the aircraft air data probes unserviceable.

The accident report said that an ice-induced tail stall likely caused the aircraft to enter a nose-down pitch attitude of about 70 degrees and descend rapidly in a spiral dive. The aircraft was descending through 9,000 feet at about 345 knots when the Cockpit Voice Recorder recorded a terrain awareness and warning system '*Bank angle, bank angle*', indicating that the aircraft was banked more than 50 degrees.

Since 2004, New Zealand's transition altitude is 13,000 feet, where pilots switch from local field to standard pressure settings, and the transition level is FL 150.

See http://www.skybrary.aero/index.php/In-Flight_Icing

Quote: **Tell students to close their books. Elicit from the class what a pilot should do if he/she encounters icing conditions in flight, and write their ideas on the board. Students then compare their ideas with those in the quote.**

Background notes:

- The *accretion rate* refers to the speed at which ice is accumulating; it is also referred to as the *accumulation rate* or *build-up rate*.
- Types of cloud include: cirrus, cirrocumulus and cirrostratus (above 20,000 ft); altocumulus, altostratus (between 6,500 and 20,000 ft); stratocumulus and altostratus (up to 6,500 ft) and nimbostratus and cumulus (up to 10,000 ft). Cumulonimbus are vertically developing clouds which generate severe thunderstorms and may rise to as high as 40,000 feet. Icing is especially associated with cumuliform clouds, or more locally with stratiform clouds.
- A *stratiform cloud* is a stratified or layered cloud, whereas a cumuliform cloud is made of a large aggregate or mass of cloud.

See:
http://eo.ucar.edu
http://www.stuffintheair.com

20 a, b, c, d **Students discuss the questions in pairs and then feed back to the class.**

Answers:

a Flights usually encounter icing at relatively low altitudes (from ground level up to 10,000–13,000 feet), i.e. when flying in cloud in freezing conditions. Once they are above dense cloud formations, there is little humidity in the air although temperatures are often as low as –50°C.

b In flight, pneumatic de-icing is used to remove any ice that has formed on the wing leading edges, which could affect the aircraft's aerodynamic characteristics, and on the engine air intakes, where ice ingested into the engine could damage the engine blades. The cockpit windshield and air data probes are protected electrically from ice formation. On the ground, the aircraft will be sprayed with de-icing fluid from vehicles or a gantry.

d ATC can help flight crews by providing up-to-date weather forecasts for the areas around the departure and destination airports and by providing them with information about the altitudes and the locations where they may expect freezing conditions. In flight, ATC may also help by clearing aircraft to, usually higher, altitudes at which they will not encounter icing.

21a **2.11 Go through the statements with the class to make sure everyone understands them. Play the recording for students to complete the exercise individually. They then discuss their answers in pairs.**

Background notes:

- A *Digital Flight Data Recorder* (*FDR / DFDR*) is a device for automatically recording information on aircraft operation (altitude, airspeed, vertical acceleration, heading, elapsed time, attitude, flight control surface position and engine speed). Such recorders are designed to survive crash accelerations, impacts, crushing and fire and often carry underwater transponders or beacons.
- A *Cockpit Voice Recorder* (*CVR*) is an automatic recycling recorder storing all crew radio and intercom traffic, including crew speech and background noise.
- If the captain was *pilot flying*, it means that it was the captain who was at the controls, while the First Officer monitored the instruments and was in charge of the radio.
- *PAR* is the abbreviation for Palmerston North, an airport and Navaid in New Zealand.
- An aircraft's *primary radar target* is its blip (symbol) displayed on a controller's radar screen.
- A *transponder* is a radio device, which when triggered sends out a pre-coded reply on the same wavelength.
- A *transition altitude* is the altitude at which the altimeter setting is changed from local atmospheric pressure to 1013 hPa and vice versa, while a *transition level* is the flight level at which this change is made.

b **2.11 Play the recording for students to check their answers. Then go through the answers with the class.**

Answers:

1 F – 20:32	6 T
2 T	7 T
3 T	8 T
4 F – 1,500 fpm	
5 F – only the route instructions	

c **Go through the example with the class. Make sure students realise that they need to remember the answers to the statements in exercise 21a. If necessary, they could refer to audioscript 2.11 on page 181 to check. Afterwards, go through the questions and answers with the class to make sure the questions were formed correctly.**

If you have an odd number of students you will need to have a group of three, where Student C takes questions 1 to 3 from Student A and questions 6 to 8 from Student B.

Suggested answers:
A1 Did the aircraft depart on time? → Yes
B1 Where was it flying from? → Christchurch
A2 Who was at the controls? → the captain
B2 When did the co-pilot request to fly directly to PAR? → At 21:08
A3 To which altitude did ATC instruct the plane to descend? → 11,000 feet
B3 What was the aircraft's rate of descent? → 1,500 feet per minute
…

Extension activity:

Discuss the story with the class: how common are such problems?; what went wrong?; and what could have been done to avoid them?

22 **In this exercise, students will deliberately use their cues to make statements in slightly unusual or idiomatic language. Their partner will ask for clarification or explanation using either the phraseology *Say again*, or plain English expressions such as *I'm sorry, I didn't understand*, or *What do you mean exactly?* etc. Elicit some of these phrases for requesting clarification onto the board. Then go through the example with the class. Point out that each cue is the beginning of a new dialogue, making 24 in total. Students then work in pairs to make dialogues. Basically, the responding student says *Say again* or a plain language equivalent (*Can you repeat that?*, *What did you say?* etc.) each time. Afterwards, discuss the dialogues with the class, and agree on the best answers. You may wish to highlight and discuss those words for which it is easy to find satisfactory synonyms and those which do not have any (e.g. snow, flight plan, wings, braking, water, ash cloud, runway lights, turbulence, mountain, climb, hold, ice, radar, squawk).**

If you have an odd number of students you will need to have a group of three, where Student C takes cues 2, 6, 10 and 14 from Student A and cues 4, 8 and 12 from Student B.

Suggested answers:
Pilot
1 We are going around.
2 Request a change in our flight plan. / Will you modify our flight plan?
3 Our weather radar return is displaying a weather formation 40 miles in front of us.
4 Snow is accumulating on our wings.
5 We expect to reach / arrive at / overfly Lima at 18 minutes past the hour / at 17:18.
6 Request a longer circuit.
…

ATCO
1 Can you see the runway lights? / Are you visual?
2 There is a possibility of wake turbulence after the A380.
3 There may be turbulence over the Carpathians.
4 Traffic is climbing to Flight Level 290; he is now at Flight Level 210.
5 We will make sure / verify that.
6 You are heading 045 degrees on our radar.
…

Background notes:

- A *missed approach* is a discontinued approach followed by a go-around.
- A *braking coefficient* is a measurement of braking efficiency based on the friction coefficient of the runway, i.e. if the runway surface is wet or icy, it will be slippery, there will be less friction and the braking coefficient will be lower.
- *Mountain wave effects* are the result of a large body of rotating air just after an aircraft has crossed a mountain range.
- *Light chop* refers to mild turbulence
- The *stack* is a superimposed series of holding patterns at assigned flight levels.
- A *radar return* is the reflection of the beam off the 'target' (the aircraft) which causes a 'blip' or display on the controller's screen.

Volcanic ash

Communicative and operational issues:

This short section is devoted to another environmental phenomenon which periodically causes a lot of disruption to aviation: ash clouds from erupting volcanoes. The clouds rise to high altitudes, are carried long distances by prevailing winds and contain abrasive materials and moisture in the form of ice which, when ingested by jet engines, damages the leading edges of the blades and obstructs the airflow resulting in engine malfunction or shutdown. In addition, the dust may enter the air conditioning system distributing toxic gases and reducing visibility inside the cockpit and cabin. Flight crews need to communicate with ATC to avoid or escape from ash clouds by deviating from their flight plan and to manage any aircraft malfunctions caused by the ash.

The content in this section is based on recommendations from Boeing about how flight crews should react to volcanic ash. The full recorded version of the recommendations contains some vocabulary (e.g. *deploy*, *don*, *exceed*, *exit*, *idle*, *recovery*, *shutdown*, *SOP*, *surge*, *thrust*) which can be useful when describing different types of environmental or technical problems.

Quote: **Read the quote aloud. Elicit from the class what happened during the volcanic ash shutdown of Europe, and whether/why the shutdown was necessary.**

Background note:

The volcanic ash shutdown of Europe refers to the events of April 2010, when ash from the erupting Eyjafjallajökull volcano in southern Iceland caused major disruption to flights across Europe. See *Clearing the Air*, in Flight Safety Foundation *AeroSafety* World November 2010.

23 **Students discuss the questions in pairs and feed back to the class.**

Suggested answers:
1 The photos illustrate a volcanic eruption and the effect on passengers of flights cancelled or delayed by the volcanic ash cloud.
2 The shutdown was painful for the many passengers who were stranded or delayed in uncomfortable conditions (e.g. sleeping at airports), and also painful for the airlines and airports who lost a lot of revenue.

24a **2.12 Students work alone to match the beginnings of the sentences with the endings, and then compare their answers in pairs. Then play the recording for students to check their answers. Finally, go through the answers with the class.**

Answers:

1 d	3 b	5 c
2 a	4 f	6 e

Background notes:

- An *Auxiliary Power Unit* (*APU*) is an airborne power generation system usually located in the aircraft tail, used to provide electrical and pneumatic power and engine start when the aircraft is on the ground or during an in-flight emergency.
- *Idle* describes the minimum smooth engine operating speed.
- If oxygen masks *deploy*, they extend or drop down from the PSUs (Passenger Service Units) above the passengers' heads.
- If you *don* a mask or life vest, you put it on.
- If a plane *exits* a cloud, it goes outside it.
- *Molten debris* is matter melted or fused with heat.
- *Hot-section components* are the combustion chamber, high and low pressure turbines and exhaust.
- *Bleed air* is hot air taken from the engine compressor for air conditioning and anti-icing etc.

- A *surge* is a breakdown of airflow over the engine airfoils (blades and vanes) resulting from compressor stall (i.e. a sudden loss of compressor efficiency) and often accompanied by a muffled bang and an increase in turbine temperature. A *surge margin* is the difference between the current operating rpm and the rpm at which the compressor blades will stall at any altitude in the event of a sudden acceleration.
- A *stall* is a sudden breakdown of fluid flow around an aerofoil (wing) or in an engine. An *engine stall margin* is the difference between the gas turbine operating line and the stall line.
- *Recovery* is the completion of a flight manoeuvre and return to straight and level flight or return to normal operation, or restarting of the engine.
- An *air conditioning pack* is a large unit comprising an air cycle machine and pre-cooler which regulates bleed air from the engine compressor for use in the cabin.
- *Shutdown* involves reducing engine power to zero; stopping engine operation.
- *Standard operating procedures* (*SOP*) are specific procedures defined by an airline to respond to all contingencies.

b 2.12 **Make sure students know which points to take notes on and what type of information to record. Then play the recording for students to take notes.**

If you have an odd number of students you will need to have a group of three students, where one student makes notes on points 1 and 4, one on points 2 and 5 and one on points 3 and 6.

c **Students exchange information with their partners and discuss the most important actions. Then open up the discussion to include the whole class.**

d **Discuss the question with the class.**

Suggested answer:
Area Control should keep flight crews informed of any developments in the location, extent and direction of movement of volcanic ash clouds and relay any information received from other flights. They must also coordinate any changes to flight plans resulting from avoidance manoeuvres or deviations to alternates caused by serious damage or engine failure.

Extension activity:

Students look back at the sentences in exercise 24a and audioscript 2.12 to underline different ways of describing cause and effect (including prevention).

Suggested answers:
- X could/will result in Y (as a result of Z)
- X prevents/will prevent Y (from happening)
- By doing X, Y may happen
- X allows Y to happen
- X improves the chances of Y happening
- X can cause Y

Putting it together: Handling environmental problems

Communicative and operational issues:

Putting it together is an opportunity to review many of the environmental threats looked at in Unit 5. It is also an opportunity to develop students' ability to say why they are unable to do something, or comply with instructions or requests (exercise 25), as well as prepare and play out scenarios related to environmental problems (exercise 26).

The quotation in the ICAO focus, from ICAO Circular 323, *Guidelines for aviation English training programmes*, summarizes succinctly the relationship between standard phraseology and plain language and defines the aviation English which is targeted in *Flightpath*. Indeed, difficult weather or environmental conditions are one of the circumstances in which plain language will often be required. The other circumstances are addressed in other units.

Like the second edition of ICAO Doc. 9835 (2010), Circular 323 (2009) should be required reading for all aviation English teachers and their contents and principles fully assimilated. In the *Flightpath* Teacher's Book we have tried to comply with, but not to simply repeat, what is explained in these two ICAO documents. The Teacher's Book aims at expanding and giving practical examples and applications of the principles they contain.

Preparation

25 **Students work alone to match the problems with the consequences. They then check in pairs. Afterwards, go through the answers with the class. You may need to check the meaning of some words, e.g. *blurred* (= not in focus).**

Answers:

1 f	3 a	5 c	7 d
2 h	4 g	6 b	8 e

Background notes:

- *Clear air turbulence (CAT)* is significant turbulence where no clouds are present, normally at high altitude near a jetstream.
- *Aquaplaning* is when an aircraft's wheels are partially supported by standing water on the runway and not fully in contact with the runway surface so that braking and steering are inefficient.
- A *blade* is an aerofoil designed to rotate about an axis.
- A *flame-out* is a loss of combustion in a gas turbine engine.

Extension activity:

Students could test each other in pairs by reading the first half of a sentence to elicit from their partner the correct ending.

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Students read the quote to find adjectives to describe: standard phraseology [**Answers:** clear, concise, internationally recognised, formulaic]; and non-standard situations [**Answers:** non-routine, abnormal, emergency]. Students then discuss the task and question in pairs and feed back to the class. Note that the issue of when to use standard and non-standard phraseology may generate some strong opinions and a lot of discussion.

Possible answers:
Environmental conditions such as volcanic ash, lightning strikes, ice build-up, bird strikes, thunderstorms, hailstorms, fog and other sorts of obscuration, severe turbulence, windshear, runways contaminated by ice, snow, slush or water etc. will all result in increased communications between the flight crew and ATC. This is due to: 1) the fact that the aircraft may be damaged or its aerodynamic performance modified; 2) there may be a need for an unscheduled and sudden change of flight level or heading; 3) the crew may need to divert to an alternate destination or even declare an emergency; 4) the type of approach may be affected; 5) runway conditions, and so landing and braking, may not be as expected; 6) the crew may require information about a change of routeing or an alternate; 7) the crew may require assistance on arrival. All these factors will generate a lot of communication which cannot be handled by standard phraseology and so which will require plain language.

26 **Go through the example with the class. Point out that each student has eight inputs and eight responses. Make sure they realise to swap roles after they are satisfied with their eight dialogues. Students then work in pairs to create dialogues. Finally, ask some pairs to act out their dialogues for the class. Discuss the appropriacy of each dialogue.**

Suggested answers:
Pilot responses
1 Negative. Unable. The ILS display seems unreliable; it is fluctuating following a lightning strike.
2 Negative. We are still in thick/dense cloud.
3 Negative. We have not got enough fuel to perform another pattern.
4 Negative. We have only intermittent transmission; we have problems with our receiver. We suspect the antenna was damaged in the hailstorm.
…
ATCO responses
1 Unable due traffic. Expect lower in five minutes.
2 Negative. A Dash 7 has declared an emergency due (to a) bird strike. It is on short final to Runway 07.
3 Unable due traffic restrictions. There are military exercises in the Yaounde area.
4 Unable. Runway 31 Left is closed due (to) flooding near (the) threshold.
…

If you have an odd number of students you will need to have a group of three, where Student C takes inputs and responses 1 to 3 from Student A and inputs and responses 6 to 8 from Student B.

Background notes:

- *CB* stands for cumulonimbus.
- A *tight circuit* has a short radius.
- A *level change* involves climbing or descending. It might be preferable to orbiting because it avoids icing conditions.
- '*Are you visual?*' means '*Have you got the runway in sight?*'
- When the ATCO asks '*Did you read my previous transmission?*' (Student B, Input 4), *read* means hear and understand.
- '*You #3*' means the aircraft has two other aircraft ahead which will land first.
- *Below minimums* means that the vertical and horizontal visibility is less than that for which the airport, aircraft and crew are certificated.

Communication

27a **Make sure students realise they are only planning at this stage, and that they will need to invent most of the information for their dialogues. They should make notes, but should not actually script their dialogues.**

If you have an odd number of students you will need to have a group of three students, where the third student could be a co-pilot.

Background notes:

- a) The *cracked windshield* will cause problems of visibility for the flight crew which are particularly critical during approach and landing. In some cases the crack may also result in a distracting noise. If the crack worsened, it might result in the windshield breaking possibly injuring the pilots, causing a cabin depressurization and a risk of the crew being sucked towards the open window. Therefore, the crew will need to reduce their airspeed and request descent to reduce pressure on the windshield.
- b) The effects of *volcanic ash clouds* have been seen in some detail in the previous section through the Boeing recommendations. It will be necessary to manage a diversion.
- c) A *bird strike* can either crack or shatter the windshield, with results similar to those in the first scenario, or if there is ingestion of a large bird in the engine(s) result in engine stall or loss. Normally, bird strikes/ingestions are at fairly low altitudes just after take-off, or less often during approach. In any case, a pan-pan urgency call and precautionary landing will be necessary.
- d) *Heavy rain during approach and landing* obviously affect visibility through the windshield and cause the approach and runway lights to be blurred. If the rain is very heavy, it may be accompanied by squalls and windshear which make the approach more difficult. It is also likely that the rain water will not be entirely drained from the runway resulting in standing water. This makes aquaplaning possible and in any case reduces the runway friction coefficient and braking efficiency and so increases the distance required to come to a standstill. In these conditions, there is a greater probability of a runway excursion, like that which occurred with the Air France A340-300 at Toronto, Canada, in August 2005. The crew will need to be ready to perform a missed approach, especially if they touch down too far from the runway threshold.
- e) *Turbulence*, especially clear air turbulence for which there is no warning, may cause passengers moving in the cabin to be thrown around and injured: concussion, broken ribs and bruising are quite common in this case. If the injuries are serious, the flight crew will have to request a diversion to the nearest suitable alternate so that the injured passengers can be cared for. The crew will need to describe the nature, extent and seriousness of the injuries. Cabin attendants will provide first aid.
- f) *Cumulonimbus storm cloud formations* will often cause the crew to change heading momentarily in order to avoid them by 20 or 30 miles, before resuming their route. These dense clouds are often the sign of intense electrical storm activity and violent up and downdraughts which can destabilise the aircraft and damage its electronic equipment.

b, c **Pairs take turns to role play their dialogues for the class. Give and elicit feedback on each dialogue, focusing not only on accurate and effective language but also the success of the communication and ways it could have been improved.**

Extension activity:

As a homework task, students could write out their dialogues as a script and act them out in the next lesson. Alternatively, they could write a short report on the incident and present it to the class in the next lesson.

Debriefing

28 **Students discuss their dialogues and how they could have been improved with the class.**

Progress check

Students work alone to complete the progress check and then discuss their notes with a partner. Then discuss with the class what students still feel uncomfortable with, and how they can overcome these problems.

DVD: *Volcanic ash hazard*

Communicative and operational issues:

The clip in Unit 5 is the simulation of an actual United Airlines Boeing 747 flight (United 869) off the coast of Alaska en route to Japan at night. The crew are unaware of any erupting volcanoes. The first sign of volcanic ash is their detecting a slight smell, which they interpret as an electrical overheat or fire. As a precautionary measure, the Captain instructs the First Officer to don his oxygen mask. The Captain realises that if it is volcanic ash, they might lose their sense of smell and be unaware of it in the flight

deck. The crew then notice the presence of dust and call United Airlines Dispatch to know whether there have been any reports of volcanic activity.

The Captain also dons his mask and calls for the '*Smoke, Odour, Fumes*' QRC. Then the crew lose engines 4 and 1 (the outboard engines) followed by engines 2 and 3. They shut down the engines, declare an emergency ('*Mayday*' call) and perform a 180° turn in order to exit the cloud. The Captain then calls for the Indicated Airspeed Disagree / Airspeed Mach Unreliable checklist as the crew have undoubtedly noticed discrepancies in their airspeed indications caused by the Captain and First Officer probes being obstructed to different extents. Airspeed (and attitude) is one of the essential items of situational awareness required to fly the plane.

Two of the four engines relight, presumably once they have flown out of the ash cloud. ATC advise them of reports of volcanic activity near their present position and Dispatch look for a suitable alternate airfield for the crew to divert to (the weather is OK and the runway long enough for a B747 with a heavy load of fuel). ATC also liaise with the airport staff for them to provide the necessary support (engineering, catering, accommodation etc.). Flight 869 lands successfully at Petropavlovsk-Kamchatskiy airport in the far east of Russia.

29a **Brainstorm a list of effects on the board.**

b **Students watch Part 1 to answer the three questions. You could play the clip again to highlight the useful vocabulary from this part: *en route* /ɒn ˈruːt/ (= on the way to); *a whiff* (= a slight, almost undetectable odour); *to don an oxygen mask*; *a sense of smell*; and *desensitised* (= no longer sensitive to a sensation).**

Answers:
1 at FL 330 over the North Pacific between the United States (Alaska) and Japan
2 a whiff, a faint smell which does not last long
3 the First Officer dons his oxygen mask

30a **Discuss the questions with the class but avoid confirming or rejecting students' suggestions.**

Suggested answers:
- The captain will probably contact the Area Control Centre for the Flight Information Region in which he is flying and/or his own company's Dispatch.
- The captain will probably report his position, the phenomena he has encountered, the status of the aircraft, the action he has taken and ask for information about making a diversion.

b **Play Part 2 for students to answer the questions. Go through the answers quickly with the class. You could play the clip a second time to focus on the important vocabulary (see *Background notes*).**

Answers:
1 United Airlines Dispatch
2 The Captain checks with Dispatch whether they have any reports of volcanic activity and suggests that the First Officer dons his oxygen mask as a precaution.

Background notes:

- *Dispatch* is an airline's operations department in radio contact with all the fleet.
- '*Copy all that*' means I understand and will comply with those instructions, requests, etc.
- A *QRC* (Quick Reference Checklist) is a concise document listing actions to be performed in abnormal situations.
- *Indicated Airspeed Disagree / Airspeed Mach Unreliable checklist* is a checklist performed if the crew suspect that the information provided by their air data probes is incorrect.
- The obstruction of the air data probes by ice or volcanic ash, for example, is extremely serious since these probes are the only source of airspeed, altitude and attitude information for the pilots' instruments which comprise an essential part of their situational awareness. See Air France flight 447, which disappeared over the South Atlantic in June 2009.

31a **Discuss the question with the class.**

Suggested answer:
The systems which are most immediately affected by a volcanic ash cloud are the engines, air data probes and air conditioning which could all be blocked and damaged.

b **Play Part 3 for students to answer the questions. Afterwards, go through the answers quickly with the class.**

Answers:
1 First, Engine 4 (the outer right-hand engine) fails and then the indications of Engine 1 approach the operating limits.
2 The captain calls for the Engine 4 Failure checklist, then shuts down Engine 1 (outer left-hand engine) and calls for the Engine Surge/Stall Quick Reference Handbook checklist.

32a **Discuss the question with the class.**

Suggested answer:
The captain needs to exit the volcanic ash cloud as soon as possible by performing a 180° turn.

b **Play Part 4 for students to answer the four questions. Students discuss the answers in pairs before feeding back to the class. Elicit from the class which two checklists the pilot called for in this clip [Answers: the Indicated Airspeed Disagree / Airspeed Mach Unreliable checklist and the Multiple Engine Flame-out checklist]. You could also check the meaning of some of the useful words: *inadvertently* (= accidentally); *relit* (= past form of *relight*, i.e. started again), and play the clip a second time for students to check how these words were used.**

Answers:
1 The captain makes a 180° turn, declares an emergency and calls for the Indicated Airspeed Disagree / Airspeed Mach Unreliable checklist.
2 The captain contacts both ATC (to declare an emergency) and his company Dispatch.
3 All four engines had failed initially; now two engines have been re-started successfully.
4 You see the various technicians working in the airline Dispatch department and the air traffic controllers.

33a **Discuss the question with the class.**

Suggested answer:
ATC should inform the flight crew of the reported location and altitude of the volcanic ash cloud and its direction of movement. They should provide the flight crew with a new route to avoid the area. They will also alert other aircraft in the area.

b **Play Part 5 of the DVD for students to answer the four questions. They discuss their answers in pairs before feeding back to the class.**

Answers:
1 ATC receives reports of volcanic eruptions in the area.
2 Dispatch looks for the most suitable diversionary airport in the vicinity, collects weather and routeing information and informs the flight crew and the airport authorities.
3 The weather is good, the runway is 11,155 feet (3,400 metres) long and the name of the airport is Petropavlovsk-Kamchatskiy (in the Russian Far East).
4 The aircraft lands successfully and safely at Petropavlovsk-Kamchatskiy airport.

Background notes:

- A *sweeping weather check* is a check for weather, which covers a wide area using weather reports from various sources and weather centres.
- The *arrival weather* is a forecast of weather conditions at the time the aircraft is expected to arrive at a destination.

34 a, b, c **Allow about five minutes for students to plan their reports in pairs. Then play all five clips again for students to check their information. They then write up their reports, either in class or as homework.**

Possible answer:
United Airlines flight 869, a Boeing 747, was flying over the North Pacific en route to Japan at night at Flight Level 330 when the crew encountered the first signs of a volcanic ash cloud: a slight smell in the cockpit. The captain instructed the First Officer to don his oxygen mask and contacted United Airlines Dispatch to check whether there had been any reports of volcanic activity in the region. Dust then appeared in the cockpit, the Captain donned his mask and they performed the 'Smoke, Odour, Fumes' checklist.

…