WHICH WAY TO STEER?

FLIGHT SIMULATOR: WINDS, COURSES, AND HEADINGS

OBJECTIVE

Experience the effects of wind on an airplane's heading, course, and groundspeed during a simulated cross-country flight.

MATERIALS (Per Group)

- Computer with flight simulation software or flight simulator
- Joystick or yoke
- Optional: Throttle quadrant, rudder pedals, additional monitors

INSTRUCTOR PREPARATION

This simulator activity can be performed using any airports at the teacher's discretion or of the students' choosing. The following scenario uses specific airports as an example and for clarity.

ASSEMBLY AND PREPARATION

Configure the simulator to fly between two airports at approximately 6,000 feet altitude in a general aviation aircraft (a Cessna 172 for example). Configure a display to allow the students to see the plotted true course between their origin and destination, as well as the actual aircraft heading and groundspeed. Have the students set the power of the aircraft to fly approximately 110 knots indicated airspeed.

For this exercise, assume no compass deviation.

QUESTIONS

Using a sectional or SkyVector, have students plot a course from Portland, Oregon (KPDX) to Seattle, Washington (KSEA). The True Course should be 350 degrees. With Magnetic Variation of 16 degrees East, the Magnetic Heading should be 334 degrees

Have the students fly their planned magnetic heading in the simulator (with no wind).

1. How do the airspeed and groundspeed compare? How do the ground track and heading compare?

   In a no-wind condition, the airspeed should equal the groundspeed, and the magnetic course and magnetic heading should be equal.

Add a significant headwind (approximately 30 knots).

2. How does your groundspeed compare with the reading on the airspeed indicator? What impact does the change in groundspeed have on the flight time and fuel consumption?

   The groundspeed should now be 30 knots lower than the airspeed. This reduced groundspeed will increase the total flight time, which will also increase the total fuel used on the flight.

Change the wind to a significant tailwind (approximately 30 knots).

3. How do the airspeed and groundspeed compare? What impact does the change in groundspeed have on the planned flight's flight time and fuel consumption?

   The groundspeed should now be 30 knots higher than the airspeed. This increased groundspeed will decrease the total flight time, which will also decrease the total fuel used on the flight.

Change the wind to a significant wind (approximately 30 knots) from 90 degrees off the plotted course. Without using a wind triangle, try to determine the heading required to maintain your plotted course. This is done in flight through "bracketing."

- Choose a heading into the wind, and fly that heading (you may want to write down the heading you selected). Monitor the ground track to see if your selected heading holds the desired track or causes a deviation into the wind or away from the wind.
- If the heading is too great of a wind correction, reduce the correction angle and note the new heading; if the heading is insufficient and the aircraft is being blown off course, increase the angle and note the new heading.
- Continue this analysis, noting the heading and making progressively smaller corrections until the heading converges on one that allows you to maintain your desired track. If time allows, repeat this exercise with smaller winds (10 knots) and much larger winds (90 knots) to observe the effect on the aircraft flight path.

4. How does this nearly pure crosswind affect groundspeed?

   Even though a pure crosswind technically has no headwind component, a pure crosswind will still reduce the overall groundspeed because the aircraft has to expend some of its speed by turning into the wind to prevent downwind drift. Thus, the component of the speed that is along the intended flight path is lower, reducing the overall groundspeed.

Zero out the wind to allow the students to stabilize their flightpath, and then, without informing the student flying which way the wind is coming from, add a significant quartering headwind (approximately 40 knots, in this example, from approximately 020 deg).

5. Use bracketing to correct for the wind and analyze the groundspeed. Where is the wind coming from? How does this affect the flight time and fuel burn?

   Once stabilized, the students should observe that the nose generally moves toward the side of the aircraft the wind is coming from. If the wind is coming from the left, then the nose points slightly left of the desired track. If the wind is coming from the right, then the nose points slightly right of the desired track.

   The change in groundspeed can indicate whether the wind is from the front or rear (higher GS = tailwind, lower GS = headwind). The flight time and fuel burn are affected by the change in groundspeed caused by the necessary wind correction. Higher GS = shorter time, less fuel; lower GS = longer time, more fuel.

Zero out the wind to allow the students to stabilize their flightpath, and then, without informing the flying student which way the wind is coming from, add a significant quartering tailwind (approximately 40 knots, 200 degrees).

6. Use bracketing to correct for the wind and analyze the groundspeed. Where is the wind coming from? How does this affect the flight time and fuel burn?

   Once stabilized, the students should observe that the nose generally moves toward the side of the aircraft the wind is coming from. If the wind is coming from the left, then the nose points slightly left of the desired track. If the wind is coming from the right, then the nose points slightly right of the desired track.

   The change in groundspeed can indicate whether the wind is from the front or rear (higher GS = tailwind, lower GS = headwind). The flight time and fuel burn are affected by the change in groundspeed caused by the necessary wind correction. Higher GS = shorter time, less fuel; lower GS = longer time, more fuel.

With the quartering winds from the prior exercise, overfly your destination and then turn to another airport 90 to 120 degrees off course. Without changing the winds, turn on the new course to the next airport and compensate for the new wind effects on their new course.

7. How did the aircraft respond to the crosswinds? What did you do to compensate for the winds?

   Aircraft tend to drift downwind when experiencing winds from the left or right. To compensate, pilots have to turn slightly into the wind to negate the drift.

8. Can a pilot compensate for headwinds or tailwinds? What might happen if a pilot planned for a tailwind, but instead experienced a headwind?

   Pilots can only compensate for headwinds and tailwinds by changing their airspeed, and it may or may not make sense to do so. For example, with a tailwind, a pilot could choose to fly a slower airspeed than planned to obtain the planned groundspeed. This would require less power from the engine, which would probably reduce the amount of fuel used while still arriving at the destination at the intended time. Airliners with a tailwind sometimes use this technique. It not only saves fuel but also helps avoid arriving at an airport too early (as their gate may be blocked by another airplane if they arrive too soon). A pilot could compensate for a headwind by flying a faster airspeed, but this would use more fuel. The aircraft may not be able to carry enough fuel for this adjustment.

   If a pilot planned for a tailwind and either did not have it or experienced a headwind instead, the pilot would need to conduct some flight re-planning to ensure they could reach their destination with the available fuel. A diversion to another airport might be necessary to refuel.