

UK FAAM BAE-146 research flights during T-REX



Simon Vosper¹, Peter Sheridan¹, Phil Brown¹, Dave Kindred¹, Stephen Mobbs²,
Ralph Burton², Jim McQuaid², Barbara Brooks², Alan Woolley³ and Ruth Purvis³

¹Met Office, Exeter, UK ²School of Earth and Environment, University of Leeds, Leeds, UK
³FAAM, Cranfield University, Cranfield, Bedford, UK

Introduction

- The Terrain Induced Rotor Experiment (T-REX) special observing period took place during spring 2006.
- The UK FAAM BAE-146 research aircraft participated in T-REX for a 4 week period (13 March to 11 April 2006).
- The aircraft was based in Fresno, to the west of the Sierra Nevada and Owens Valley.
- A wide range of scientific flights were conducted. Amongst these were:
 - rotor/mountain-wave flights (IOPs 6, 8, 9, 10)
 - cold pool flights (EOPs 1 & 2)
 - dust and chemistry flights
- Preliminary results from such flights are presented here.

Instrumentation

- The aircraft was equipped with:
 - Turbulence probe, Rosemount temperature sensors, dropsonde system.
 - Chemistry instrumentation (including O₃, NO_x, CO, sample bottles).
 - ARIES (infrared interferometer), MARSS/DEIMOS (microwave radiometers).
 - Cloud droplet and precipitation particle probes, INC (ice nucleus counter), CCN (cloud condensation nuclei).

Flight tracks

- Rotor IOP flights consisted of upwind profiles (nr. Fresno) and series of stacked "racetrack" legs between 19 kft and 28 kft ASL.
- Cold pool EOP flights consisted of upwind profiles, series of stacked straight and level legs up and down the Owens Valley between 6 and 22 kft ASL and profiles within the valley.
- Dropsondes were released within the valley during IOP and EOP flights.



Fig 1: The BAE-146 as viewed from the Univ. Wyoming King Air during an intercomparison flight. **Fig 2:** Flight tracks used for rotor (IOP-6) and cold pool missions (EOP-2).

Mountain-wave measurements

- A large amplitude trapped lee wave was observed during IOP-6 on 25-26 March 2006.
- The wave event was accompanied by strong downslope winds and rotor motion within the Owens Valley.
- Measured vertical velocities exceeded 6 ms⁻¹
- The flow at 19 kft was turbulent above the Sierra Nevada range
- Comparison between northern and southern legs of the racetrack reveal significant north-south changes in the wave field

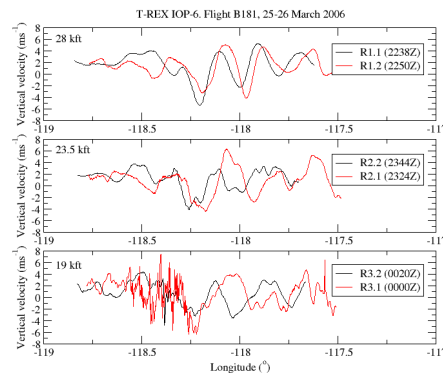


Fig 3: Vertical velocity measured during IOP-6 along the northern (black) and southern (red) legs.

- Dropsonde data shows an inversion near the mountain crest which becomes stronger towards the west and is probably connected with the downslope flow over the mountains.

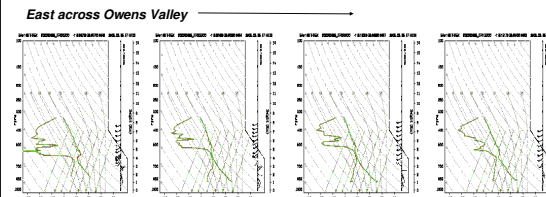


Fig 4: Dropsonde data during IOP-6 (25 March 2006). Sondes were launched close together (~30 s intervals) so as to descend into the Owens Valley.

Chemical measurements

- Chemical measurements during IOP-6 show wavy signature which is approx. 90° out of phase with the vertical velocity.
- The O₃ and CO measurements are 180° out of phase, presumably due to vertical gradients of opposing sign.

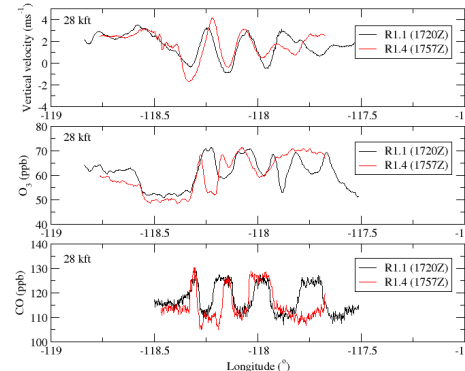


Fig 5: Vertical velocity and chemical measurements made during IOP-6. Data shown are from repeat northern legs of the racetrack.

Cold pool measurements

- Cold pool event occurred during 30 March, EOP-2.
- Strong inversion at 3.2 km observed in aircraft profiles within the Owens Valley.
- Flow beneath inversion is decoupled from that aloft.
- Increased turbulence across inversion layer.
- Inversion significantly weaker over Central Valley.

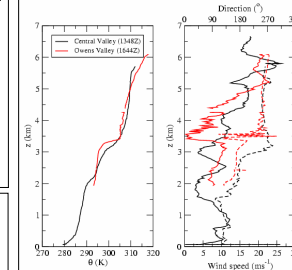


Fig 6: Aircraft profiles taken over Central and Owens Valley during am (local) of 30 March.

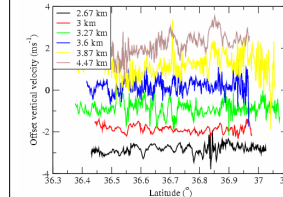


Fig 7: Vertical velocity (+ offset) along aircraft legs up and down the Owens Valley at a range of heights.

Summary

- A range of scientific flights were conducted by the FAAM aircraft during T-REX.
- The measurements, in conjunction with other observations from the comprehensive T-REX dataset, will help shed new light on mountain-wave and rotor chemistry over complex terrain.
- The data are being used for high resolution model (Met Office Unified Model) development.