Wave Meteorology and Soaring

Scott Wiley
Meteorologist, Tybrin, Inc
NASA Dryden Flight Research Center
This and the next 15 photos are courtesy of and copyrighted by Bob Harris on February 17, 1986. Record Soaring Wave Conditions.
~7,000 feet on tow
~9,000 feet
~10,000 feet
~14,000 feet
~15,000 feet
~16,000 feet
~25,000 feet
~20,000 feet
~35,000 feet
~49,009 feet
Inyokern, Feb 17, 1986

Scott,
This picture was taken at Inyokern Feb 17, 1986, 4:30 PST.
It was a good wave day!!

Regards, Biff Harris
Dec 22, 83 FL350
Nov 17 1983: 30,000 feet
Nov 17, 1983: 29,000 feet
Mar 27, 1985: 34,000
Mojave: Mar 27, 1985: 19,000 SE
Trapped mountain waves
“Never fly downwind in a mountain wave” Paul Bickle

- Einar Enevoldson and Steve Fossett moved downwind to get 50,699 feet in the Andes mountains (Aug 29, 2006)
- Bob Harris used S Sierras for 49,009 feet (Feb, 17, 1986)
- Joach Kuettner’s downwind dash is still doable but has not been realized YET! (3 very high climbs and dash)
- Trapped mountain waves may be a factor in the downwind dash with a higher workload
- Night launches, ATC cooperation, faster, strong sailplanes will all play a role wherever in the world the next record in mountain wave is set
WUA018 LG148 L LLU097 DLPD
TDLPWS WASHINGTON DC14 246A PST
PAULF BIKLE JR, DO NOT FWD
44926 NORTH RAJSACK AVE LANCASTER CALIF
YOUR RECORD BREAKING FLIGHT IN A SINGLE-PLACE GLIDER -- 45,000 FEET -- IS A NOTEWORTHY ADDITION TO THE ANNALS OF AVIATION PROGRESS. CONGRATULATIONS AND BEST WISHES ON YOUR ACHIEVEMENT.
N E HALEY ADMINISTRATOR FAA.
1058A PST MAR 14 61
Clips from Argentina, Gliding in the 5th Dimension, 3000 km in a glider

- Have asked for permission to use this DVD but have not received the permission yet. This slide will be removed if permission is not received prior to release and presentation.

- Following 8 slides are also from this DVD and will be removed if permission is not granted as well.
The Wave Project wave strength forecast
6-8am
“No two wave days are the same”
Jim Payne-JP
λ-Mountain Wave Wavelengths

λ = Wave length = 0.6 U\(^{-3}\)
λ -where U is wind speed at the mountain top in meters per second
λ -wavelength is in kilometers
λ Probably the reason for the maximum wave lift leaning into the wind at high altitudes
λ If lift is lost move upwind when windspeeds decrease or go downwind to the secondary wave crest
Long mountain waves: long flights

- Ten Longest Mountain Ranges
  - Andes: 4,500 miles
  - Rocky Mountains: 3,000 miles
  - Himalayas: 2,400 miles
  - Great Dividing Range: 2,250 miles
  - Transantarctic Mountains: 2,200 miles
  - Brazilian Coastal Range: 1,900 miles
  - Sumatra-Java Range: 1,800 miles
  - Aleutian Range: 1,650 miles
  - Tien Shan: 1,400 miles
  - New Guinea Range: 1,250 miles

- Canadian and US Sierras?
Mountain wave rotor damage

Boeing B-52H 'Stratofortress'
©USAF Museum Photo Archives
Jet lands minus engine, wing tip

EMERGENCY LANDING: The damaged DC-8 cargo jet landed safely at Stapleton Airport yesterday morning.
MOUNTAIN WAVE TURBULENCE OPERATIONAL HAZARDS TURBINE POWERED

• REDUCE SPEED TO BELOW $V_a$
• TURN ON IGNIGHTERS BEFORE TURBULENCE PENETRATION
  – TO ASSIST IF THE TURBULENCE DISRUPTS THE AIRFLOW TO THE ENGINES AND ASSIST IF RESTART IS NECESSARY
  – SEVERE TURBULENCE COULD CAUSE ENGINE FLAMEOUT
Record soaring flights in MTN WV

- Combination of polar and subtropical Jets
- Speed tasks do not require upper level support
- Altitude records require a very high Tropopause
- Years of study, preparation and a great deal of knowledge of meteorology and weather support required
- A broad spectrum of mountain waves can be used to obtain world records
- Good soaring techniques are required but with determination and planning, even lower time pilots can become record setters
FURTHER STUDIES

• Get igc flight files and map record flights to the terrain and flight winds in See you
• Velocity limits for good wave on Polar and Subtropical jetstream flow (usually < 150 knots)
• Height of the surfaced based inversion in relation to mountain peaks is a key
• Braking waves must be understood and forecasted better
QUESTIONS?

• scott.wiley@nasa.gov
• 661-276-3970