Wave Meteorology and Soaring

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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
~30,000 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, Bill Harris
Nov 17 1983: 30,000 feet
Nov 17, 1983: 29,000 feet
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 RAZSACK 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 HALAECY 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

\[ \lambda = \text{Wave length} = 0.6 \ U^{-3} \]

-where \( U \) is wind speed at the mountain top in meters per second

- wavelength is in kilometers

- Probably the reason for the maximum wave lift leaning into the wind at high altitudes

- 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 <150knots)
• Height of the surfaced based inversion in relation to mountain peaks is a key
• Braking waves must be understood and forecasted better
QUESTIONS?

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