

Mountain Wave Project

- Operation Mendoza -

2nd- 20th of Oct. 2006



mwp- rené heise

Introduction

OSTIV - focal point of the ongoing and planned activities of the meteorolog. section is the **Mountain Wave Project (MWP)**. Its ambitious goal is the global classification and analysis of mountain waves and their associated rotor bands

MWP- main topics are:

- detection and determination of physical processes in the atmosphere, as well as their associated synoptic characteristics, which play a dominant role in the generation and development of mountain waves
- investigation of rotor bands, determination of their location, spatial extension and classification of concomitant turbulence
- visualisation of the rotors/regions of turbulence in a graphical representation of relevant topographical features and development of forecasting tools for pilots and meteorologists

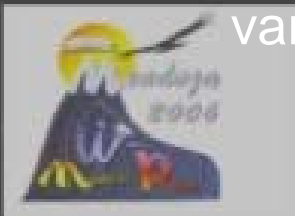


Introduction

MWP Operation „ Mendoza 2006 “

scientific objectives:

- localisation of waves and rotors with special emphasis on areas relevant to approaches into MDZ and SCL
- classification of associated turbulence
- verification of MWP's numerical turbulence prediction tools and forecasts in comparison with routine forecasts for pilots by national weather services
- 3D measurements of atmospheric parameters (temp., humidity, windfield) cross reference verification with AMDAR data obtained on commercial (LH) flights,
- radio sonde ascents, CHAMP data (GPS based soundings) and numerical modell profiles
- investigation of breaking waves and interaction of gravity waves with various atmospheric processes in the vicinity of Aconcagua



MWP- Projectteam

core - team:

- **Prof. Joerg Hacker** (flight scientist, instrument specialist)
- **René Heise** (project managment)
- **Dr. Wolf-Dietrich Herold** (documentation, analysis, communication)
- **Klaus Ohlmann** (mostly pilot, consulting for and execution of inflight measurements and record attempts)

support - team:

- **Rudolf Gaismaier** (instrumentation and oxygen systems)
- **Juergen Knueppel** (flight surgeon)
- **Prof. Alfred Helbig** (scientific co-ordination, analysis)
- **Dr. Andreas Doernbrack** (analysis, modelling)



project event- high altitude flight on the 12th of oct. 2007

Aircraft: Stemme S10 VT, D-KKOP

Crew: K Ohlmann, JM Hacker

Take-off: 10:24 LT Mendoza- Plumerillo (ARG)

Landing: 14:31 LT Mendoza- Plumerillo (ARG)

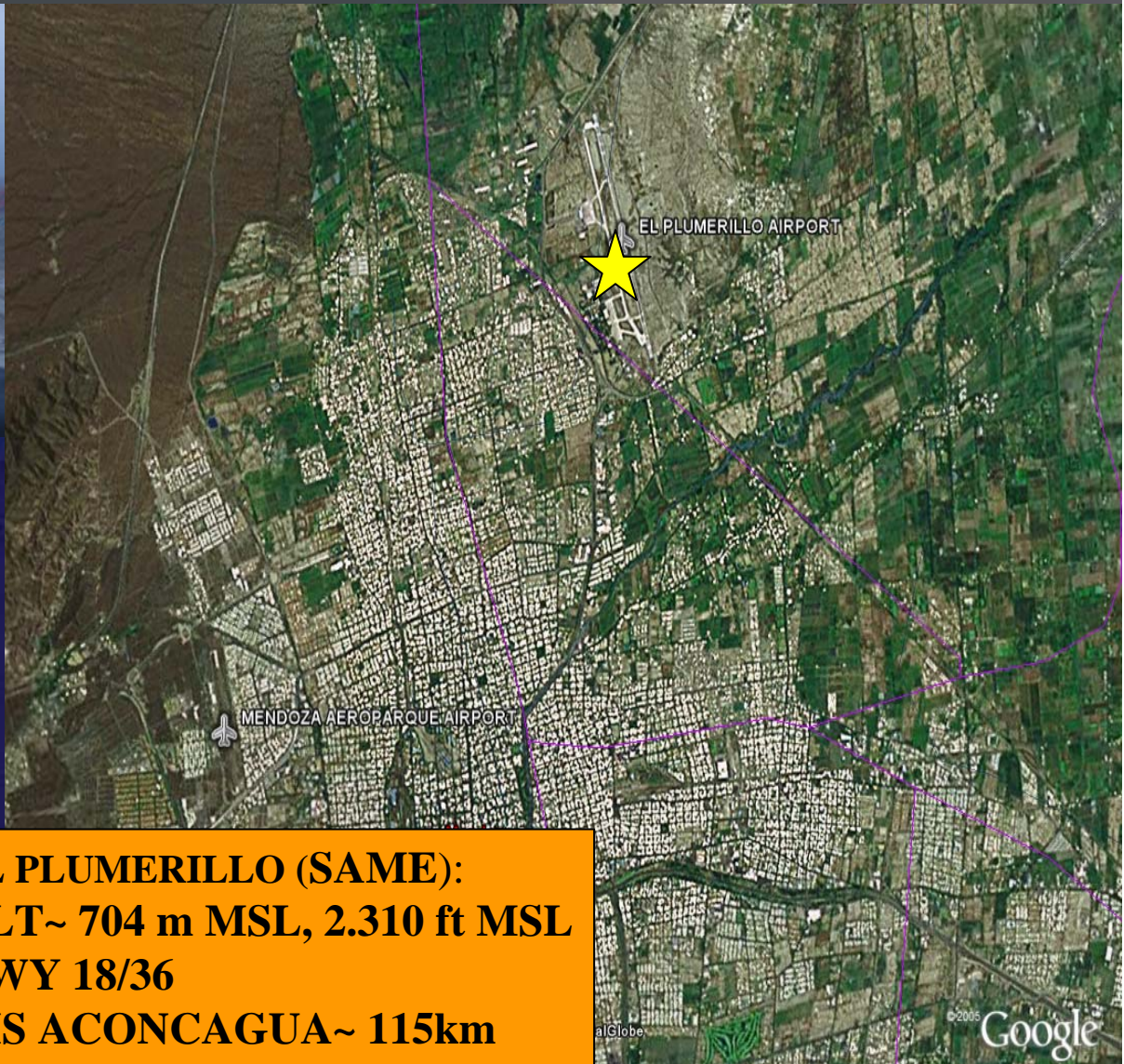
Maximum altitude reached: 12,500m AMSL



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Information about Mendoza (ARG)

- international airfield (civ./mil.) EL PLUMERILLO
(32° 50'S; 68° 47' W)



EL PLUMERILLO (SAME):
ALT~ 704 m MSL, 2.310 ft MSL
RWY 18/36
DIS ACONCAGUA~ 115km

mess equipment



High resolution measurement of humidity, temperature, 3D- wind +

ARA : BAT – „Best“ Aircraft Turbulence probe

- fast high -fidelity turbulence measurement with the 9-hole BAT pressure sphere
- sensor board contains an orthogonal array of solid state accelerometers, four pressure transducers and heating elements
- The interface board contains the electronics for three to four remotely mounted temperature sensors, the heater control and a provision for additional inputs



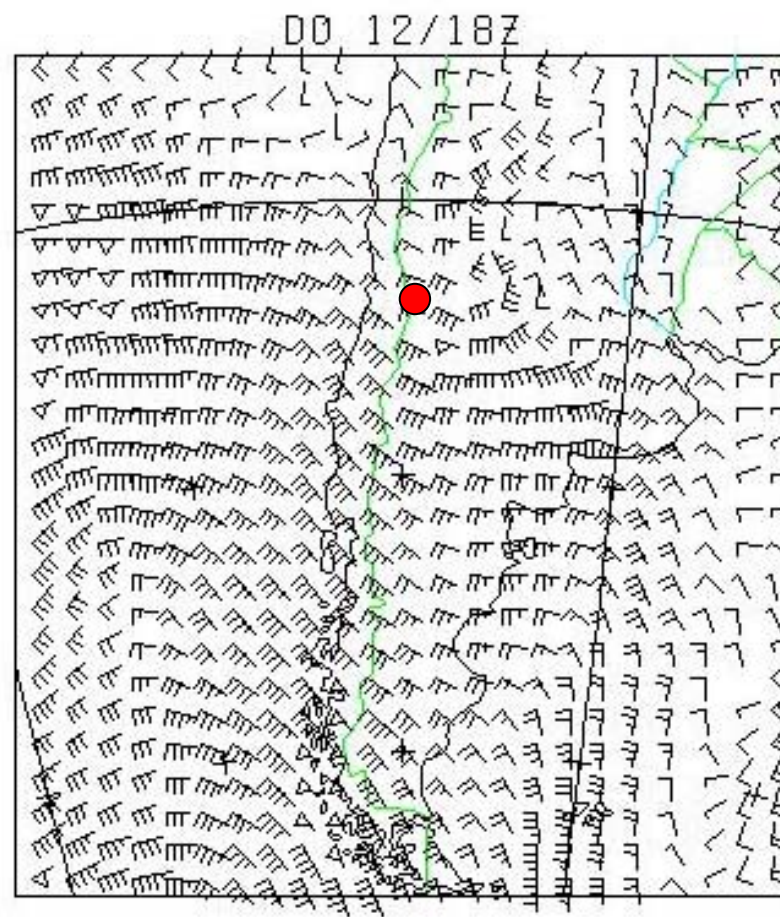
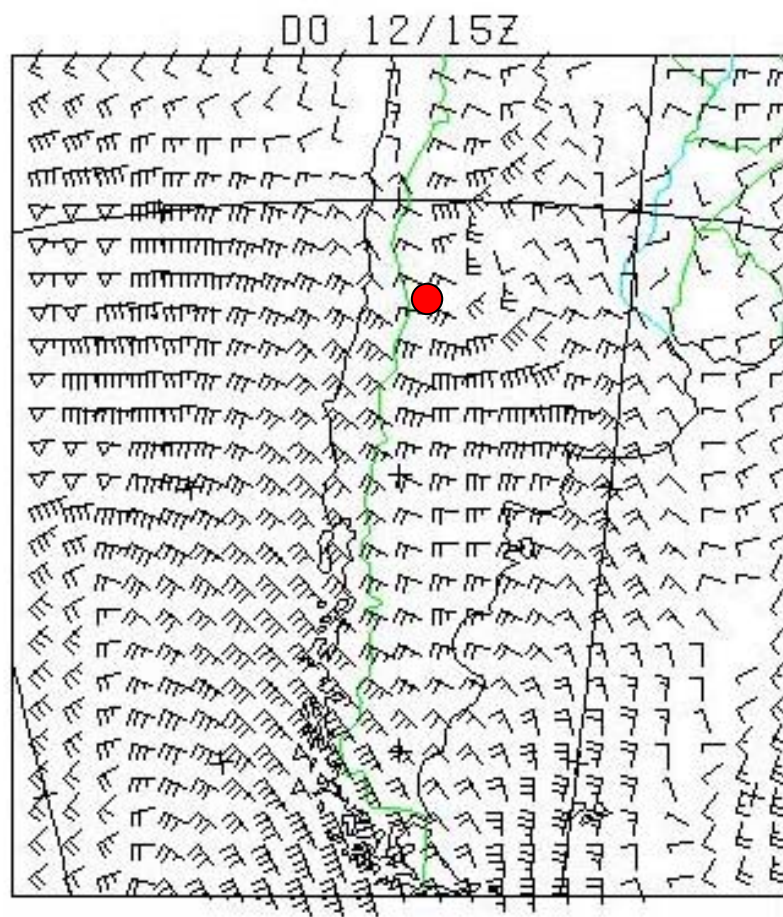
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weather situation

upcoming strong upper w'ly wind, passage of a cold front

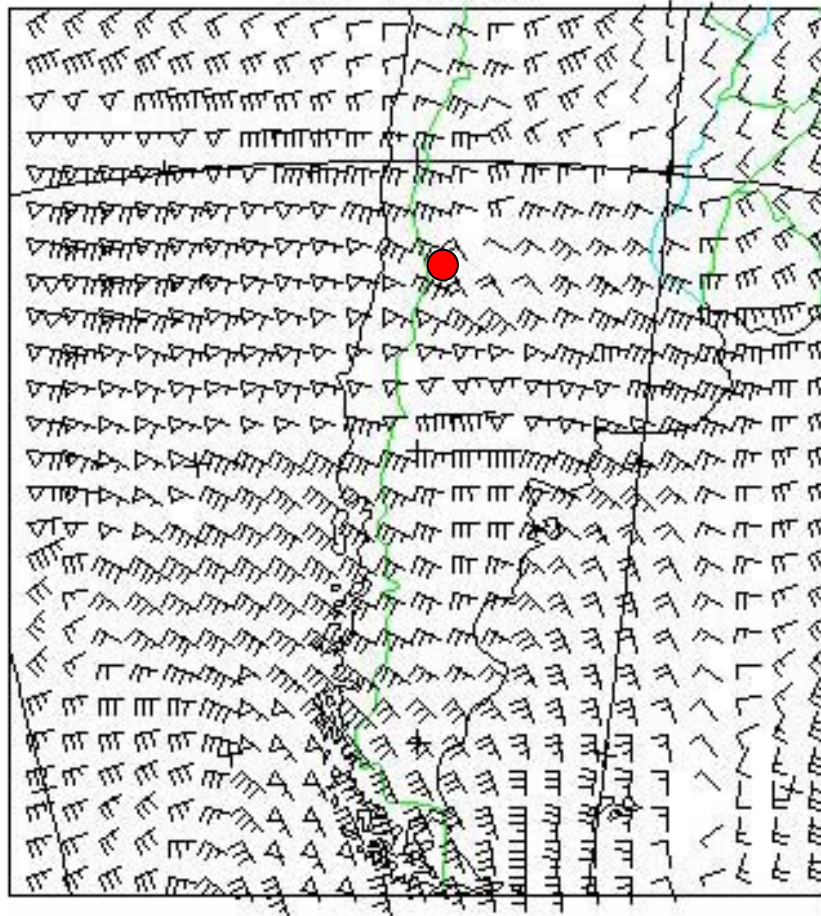
- Wind FL100



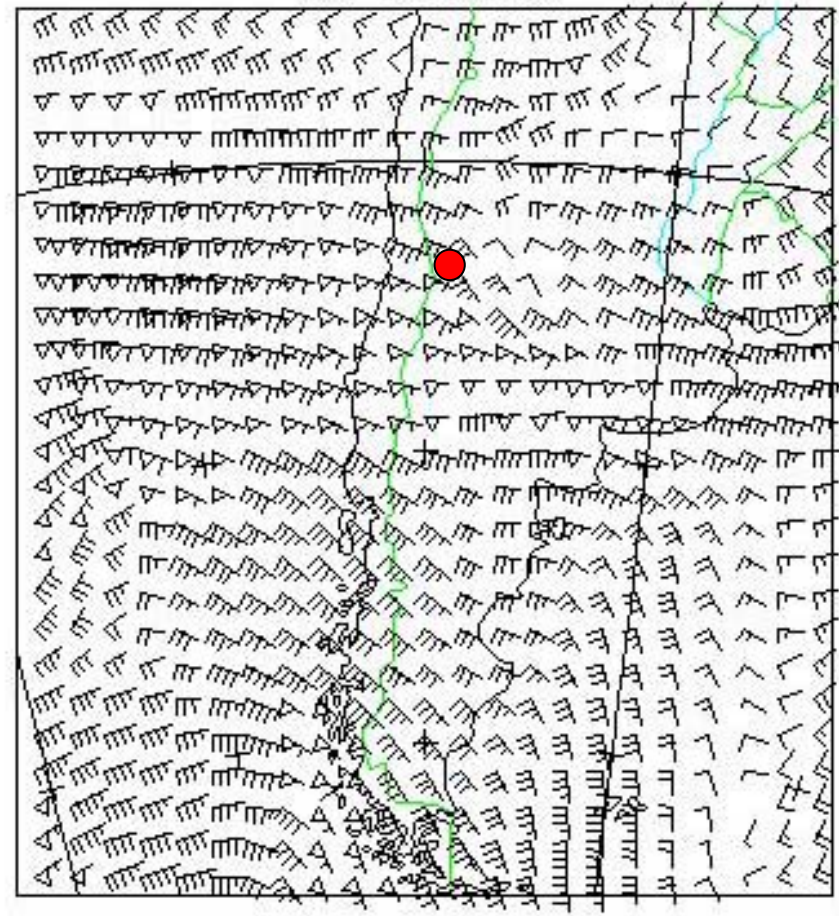
weather situation

- Wind FL170

00 12/15Z



00 12/18Z



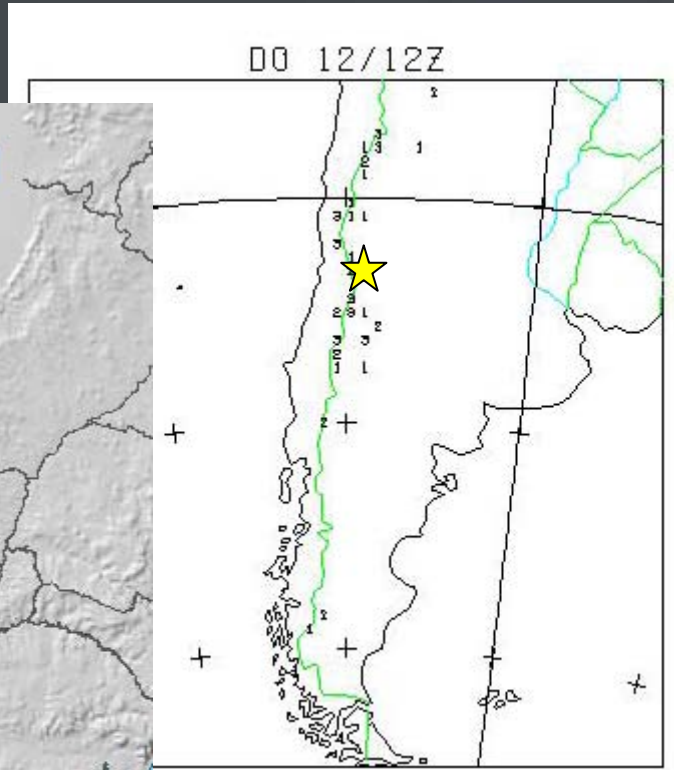
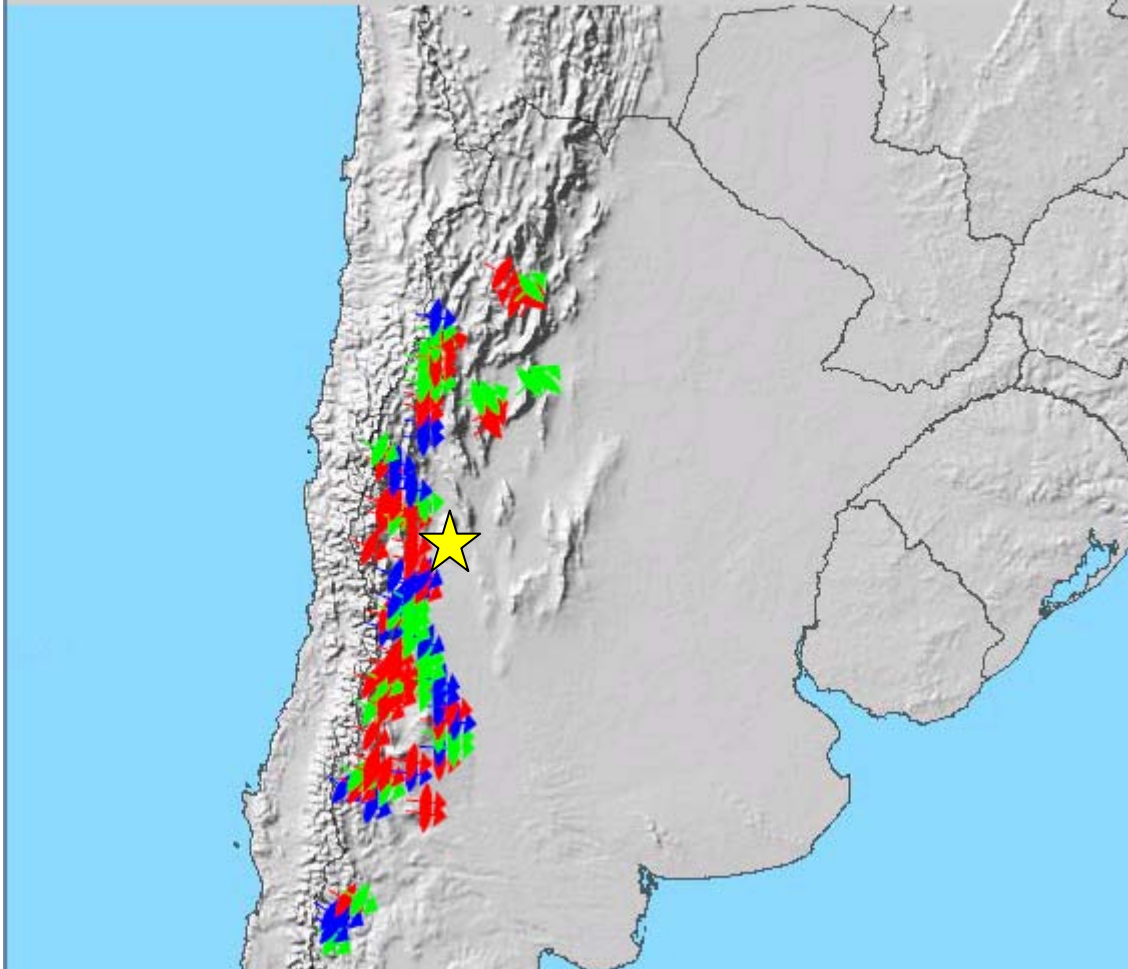
weather situation

- MWP- waveforecast

Modellauf: Thu Oct 12 00:00:00 2006

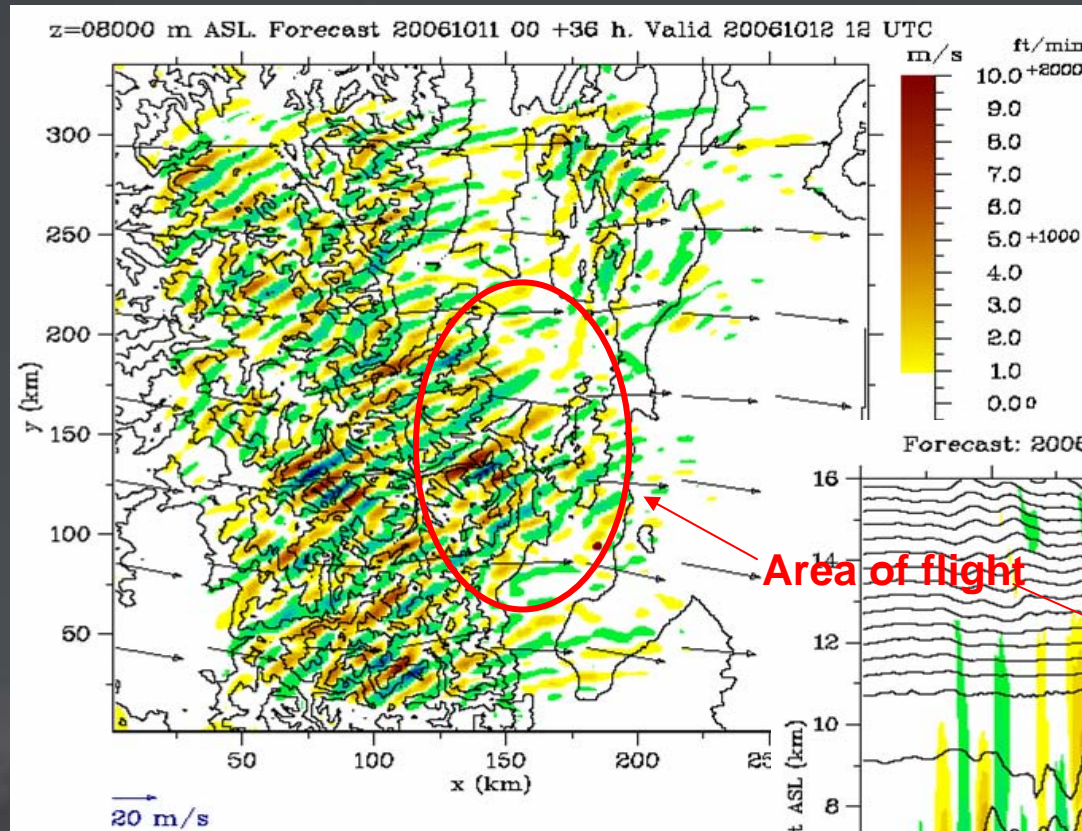
Vorhersagetermin: Thu Oct 12 18:00:00 2006

Intensität 1:  Intensität 2:  Intensität 3: 

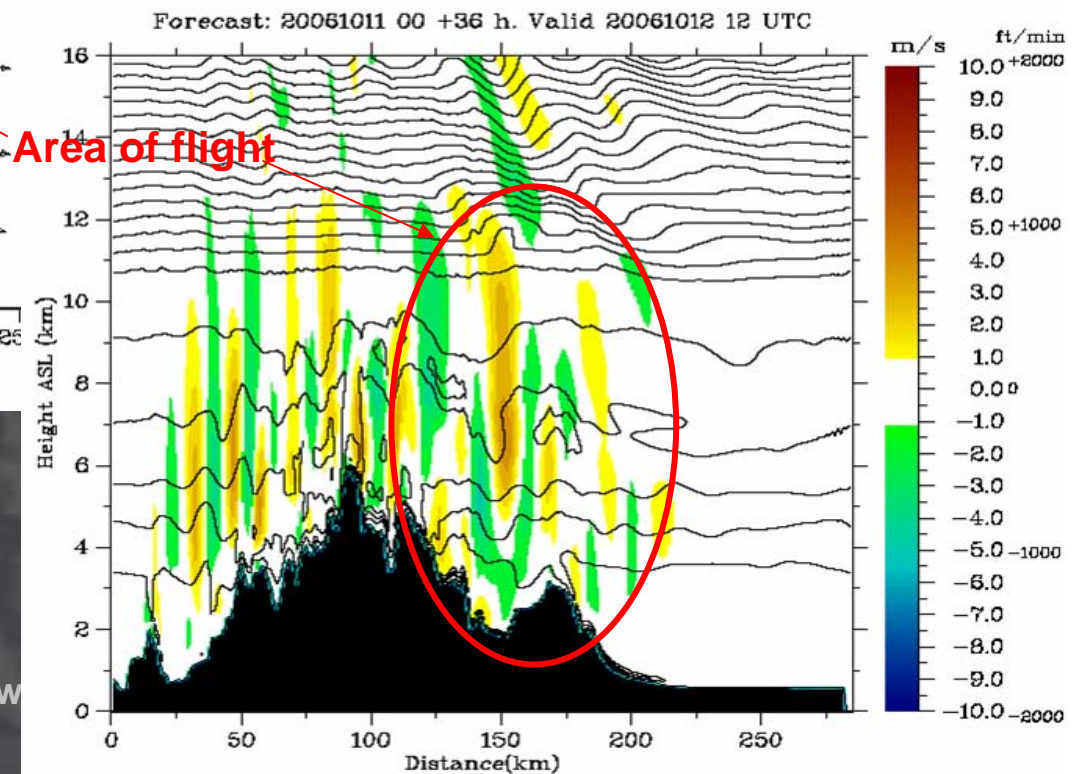


weather situation

- UK MetOffice waveforecast



for the morning of
October 12th 2006



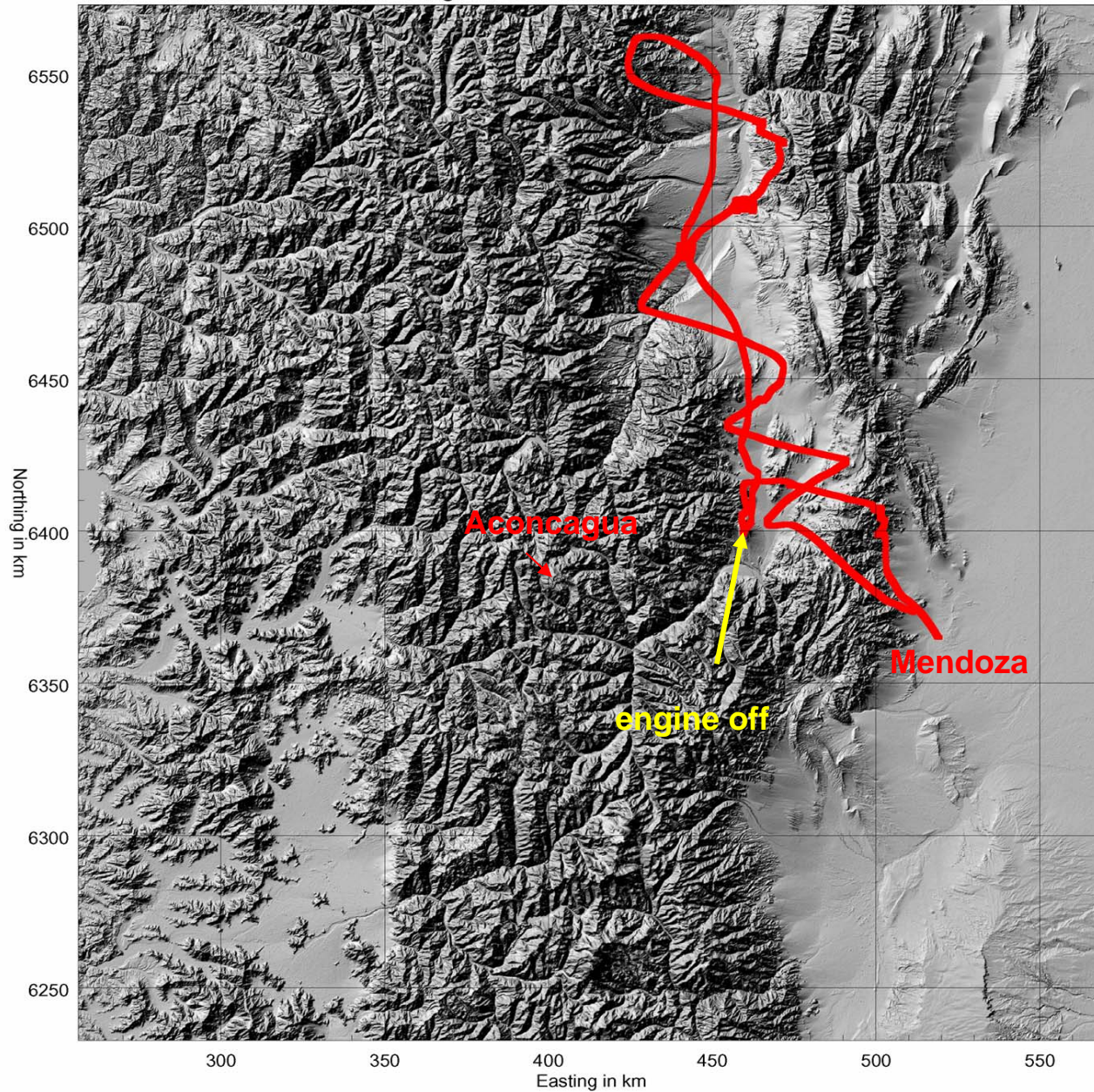
UK MetOffice Forecasts
(by Simon Vosper)



mw

pilot report from JM Hacker

MWP - Mendoza06 VH-KOP 04flgt RT3003 data 12 October 2006 10:25:45-14:19:59LT



shortened pilot report from JM Hacker



10:24: Take-off on RWY 18 (704m AMSL)

Climbing (on engine power) towards the foothills to the NW

- [IMG2584](#) (1,420m, looking N)

Encountered some thermals at ~3,200m about 44km North of Mendoza near the slope [IMG2585](#) (3,200m, looking NNW),

[IMG2586](#) (3,200m, looking N) [IMG2588](#) [2589](#) (3,200m, looking NNW),

10:50: Crossed the ridge to the West at about 3,600m (engine still running) –

[IMG2590](#) (3,700m, looking NW)



shortened pilot report from JM Hacker



11:00: Encountered some thermals over Uspallata Valley, ~21km NNE of Uspallata at ~3,800m climb to ~4,000 in rough thermal – then continued to W - [IMG2591](#) (3,900m, looking S) strong sink

11:07: turning S just E of foothills of Cordillera del Tigre (~21km NNW of Uspallata) towards some good looking rotor cloud, still in sink - [IMG2592](#) (3,700m, looking S)

11:07 – 11:14: Heading S through strong rotor turbulence ($-13 < w < +15$ m/s)

11:11: Engine off at ~4,500m in rotor ~10km NNW of Uspallata



pilot report from JM Hacker

11:14: Turning North at 5,400m ~10km NNW of Uspallata
[IMG2593](#) (5,200m, looking SW towards Punt de Vacas)
based on that view, we gave up flying further towards Aconcagua
[IMG2594](#) & [IMG2595](#) (5,600m, looking N)
based on that view, we decided to look for waves over the Northern
Uspallata Valley

11:14 – 11:28: Tracking N, paralleling the Cordillera del Tigre, climbing at
up to 5m/s, Lift ends at 7,800m ~55km N of Uspallata,

11:36: 7,600m ~62km N of Uspallata
[IMG2598](#) & [IMG2599](#) (7,600m, looking N and NNW)



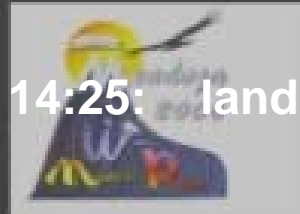
pilot report from JM Hacker

- 11:46: encountering strong lift ~100km N of Uspallata at 6,400m – turning NNE continuing in strong lift (6-8m/s) – climbing to 7,100m
- 11:49: turning E into wind upwind of large lenticular cloud – continuing to climb during several turns climbing to 9,300m in strong wave lift (up to 7m/s) [IMG2601](#), [IMG2602](#), [IMG2603](#),
- 11:59 – 12:10: tracking to the NNW, then N – not much lift, nor sink, descending gradually to 8,300m at 154km N of Uspallata
- 12:00: [IMG2609to2613](#) (9,300m, panorama looking NNW to NNE)
- 12:10: turning NW at 8,300m into wind – strong sink (up to -8m/s) – down to 6,800m



pilot report from JM Hacker

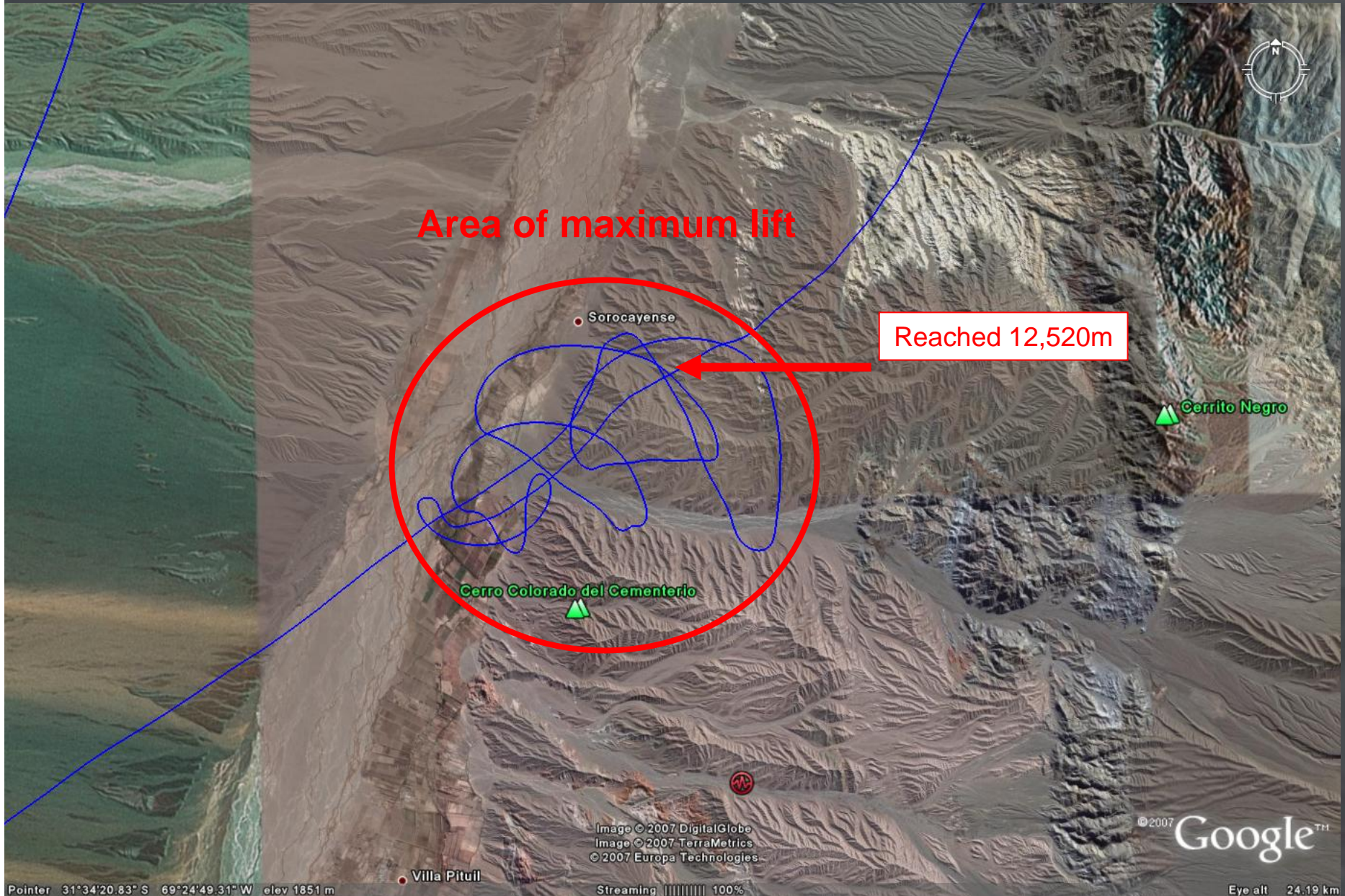
- 12:53: encountering strong lift upwind of a nice lenticular cloud at 9,200m (~115km N of Uspallata) – changing to crosswind legs – 33km from ridge on western side of valley
- 13:15: reaching maximum altitude (12,520m) 114km N of Uspallata on eastern side of valley between Sorocayense and Cerro Colorado del Cementerio
- 13:15: Decision to abandon climb due to various failures – see [IMG2618](#) (10,500m – 34,667ft)
- 13:15 – 13:30: descending towards SW across valley, down to 9,200m (88km N of Uspallata)
- 13:55 – 14:07: tracking across valley towards SW, down to 6,600m at western side of valley
- 14:09: abandoned survey pattern across valley, because oxygen low – direct track back to Mendoza



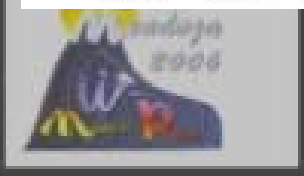
14:25: landing at Mendoza, Rwy18

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pilot report from JM Hacker



pilot report from JM Hacker



engine off

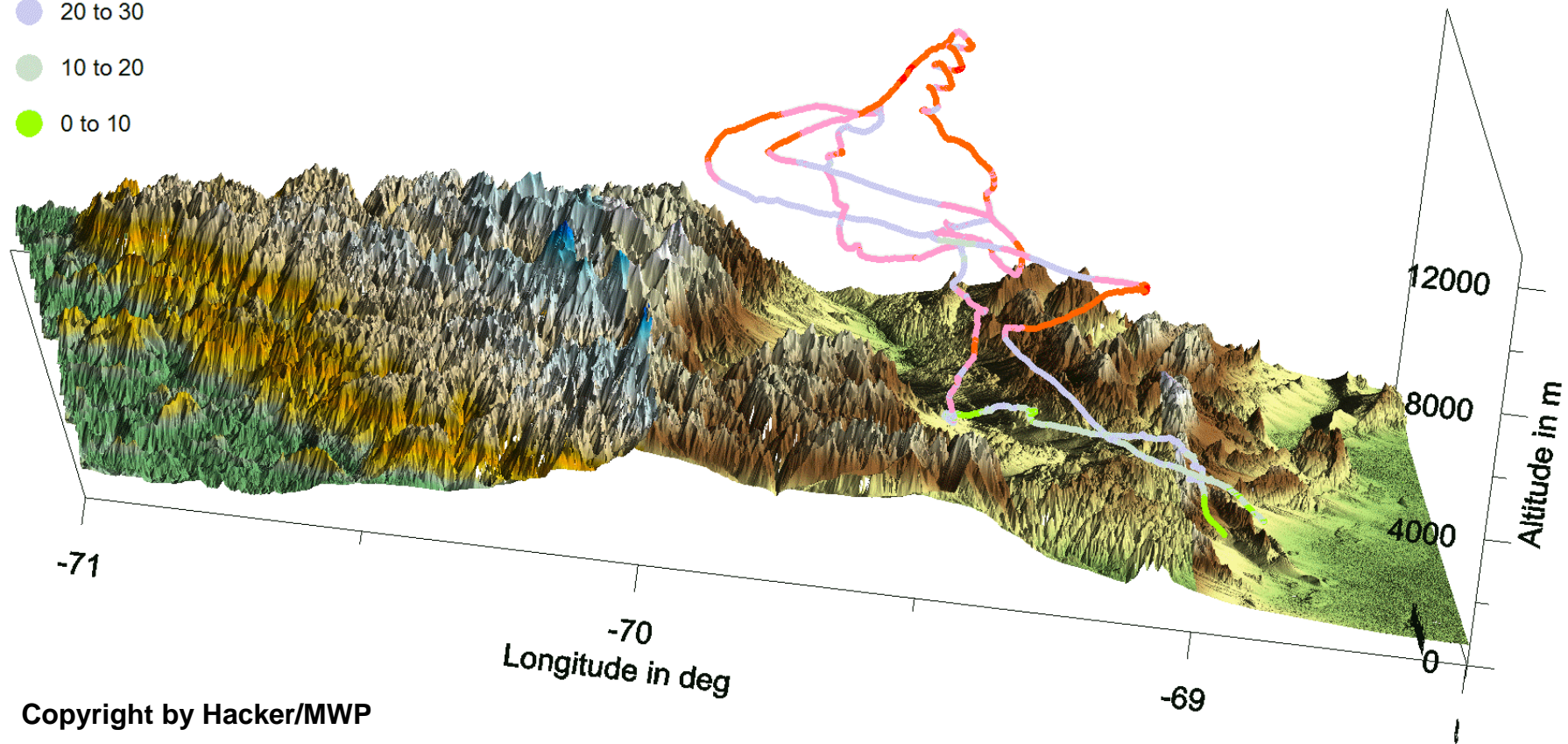
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measurement - wind speed [m/s]

Wind Speed in m/s

- 50 to 60
- 40 to 50
- 30 to 40
- 20 to 30
- 10 to 20
- 0 to 10

Mountain Wave Project Mendoza 12 Oct 2006 Flight #1

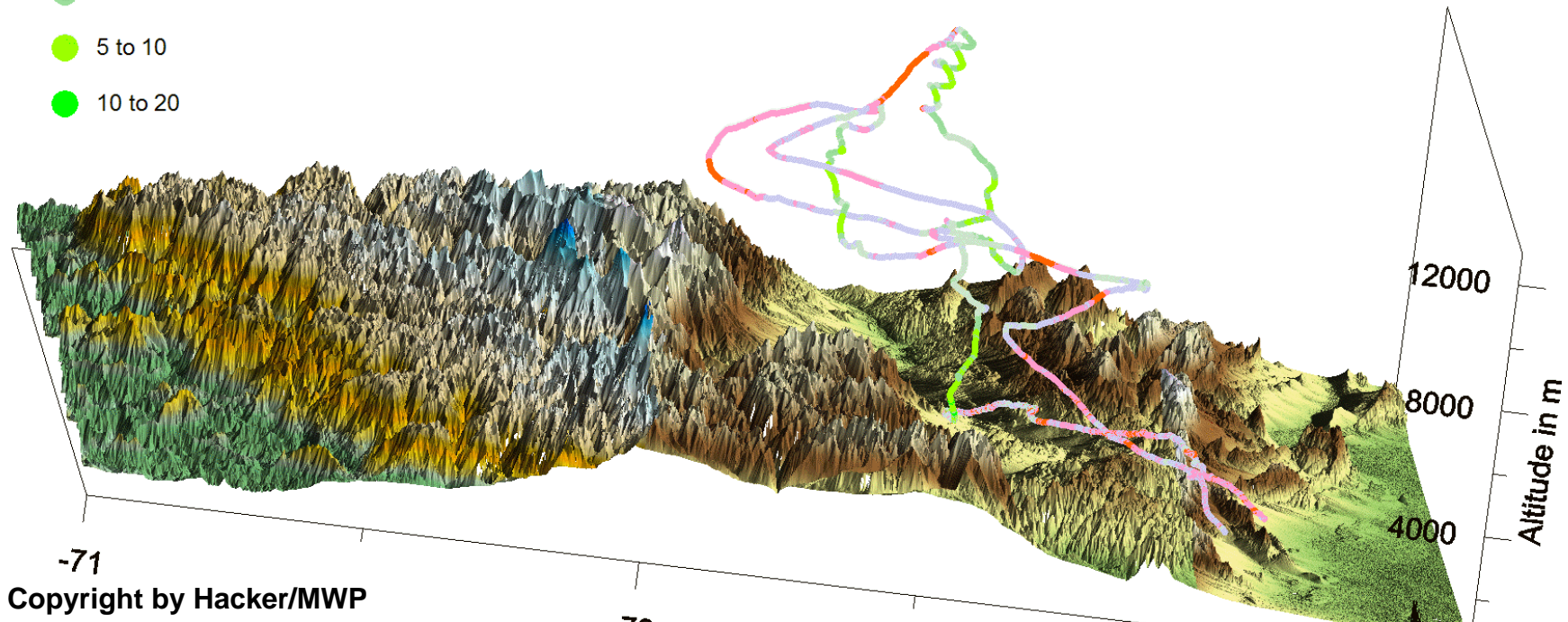


measurement - vertical wind [m/s]

Vertical Wind in m/s

- -20 to -10
- -10 to -5
- -5 to -2.5
- -2.5 to 0
- 0 to 2.5
- 2.5 to 5
- 5 to 10
- 10 to 20

Mountain Wave Project Mendoza 12 Oct 2006 Flight #1

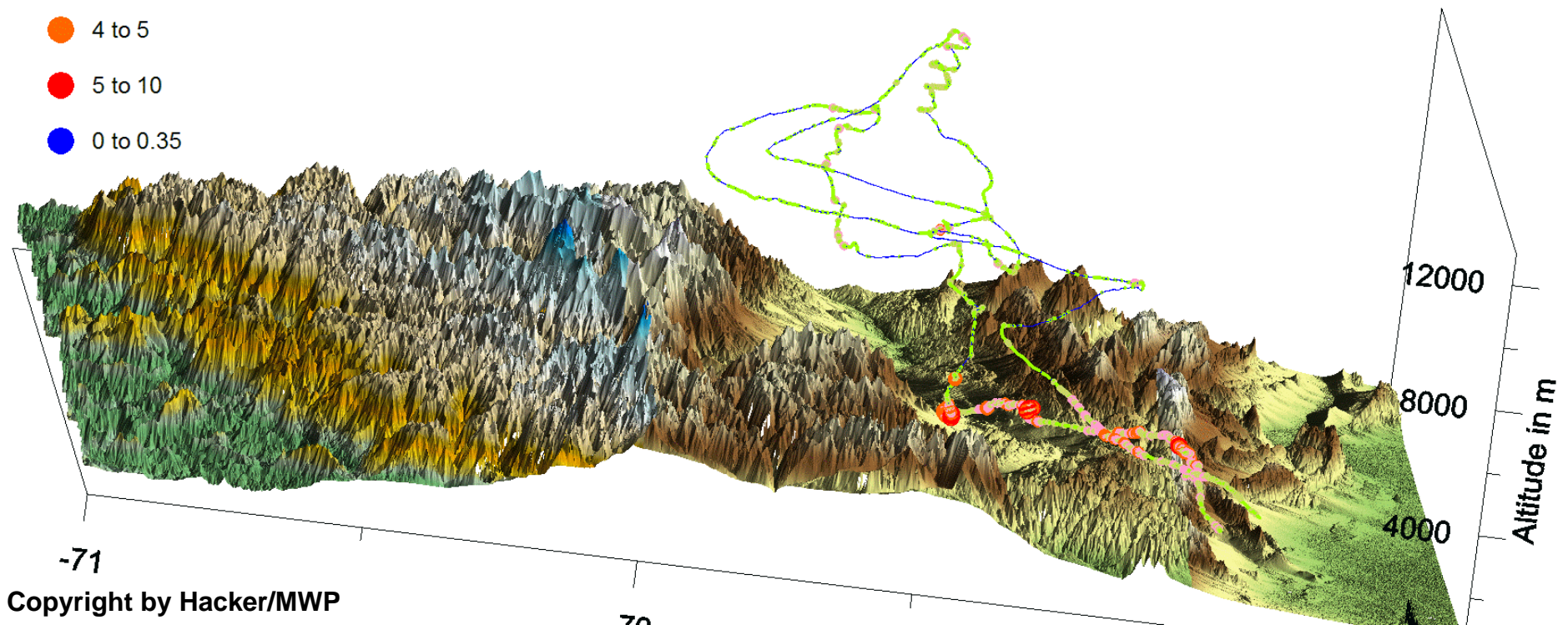


measurement - turbulence [m/s]

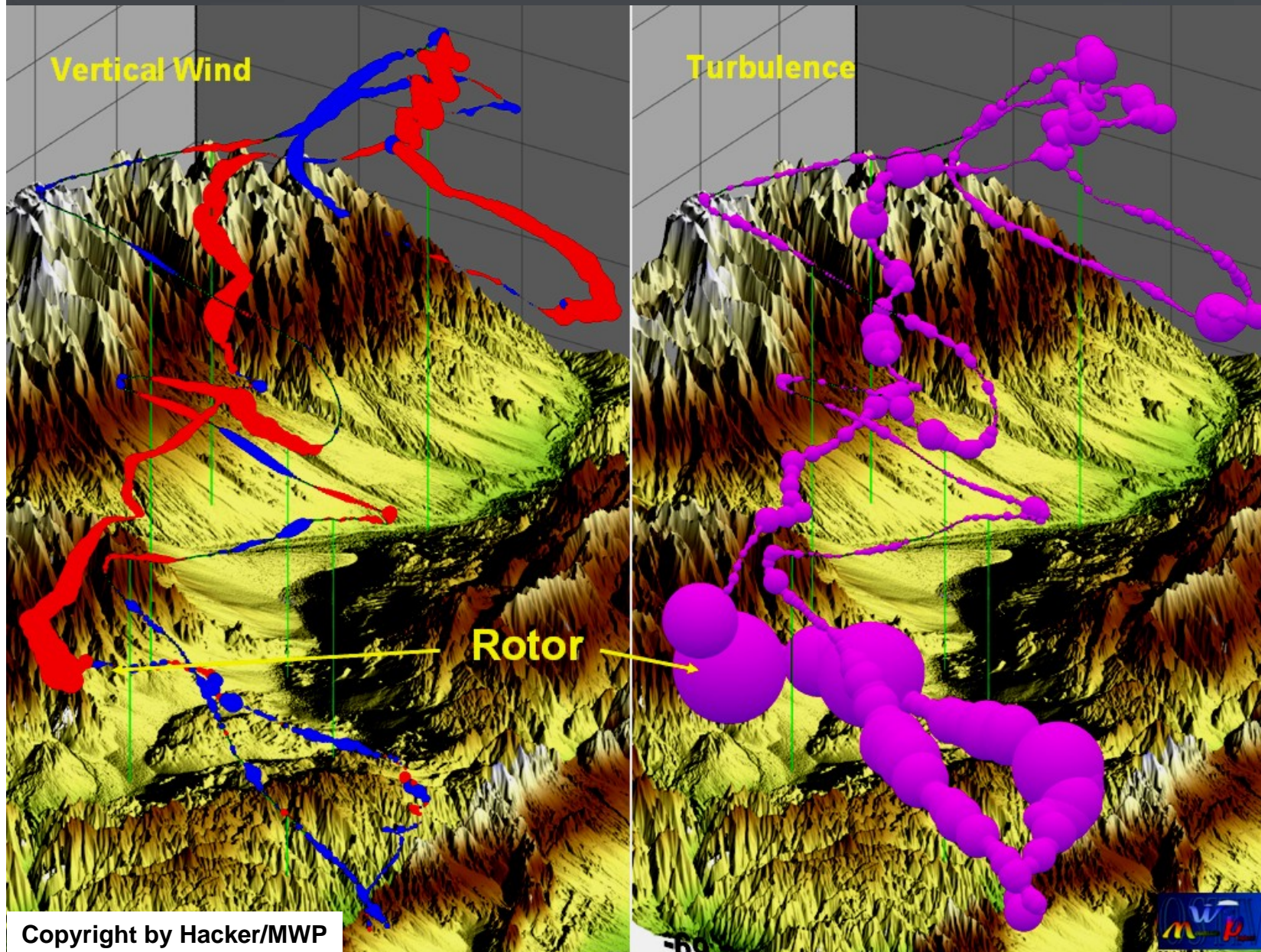
Turbulence in m/s
($\sqrt{u_{air}^2 + v_{air}^2 + w_{air}^2}$)

- 0.35 to 1
- 1 to 2
- 2 to 3
- 3 to 4
- 4 to 5
- 5 to 10
- 0 to 0.35

Mountain Wave Project Mendoza 12 Oct 2006 Flight #1



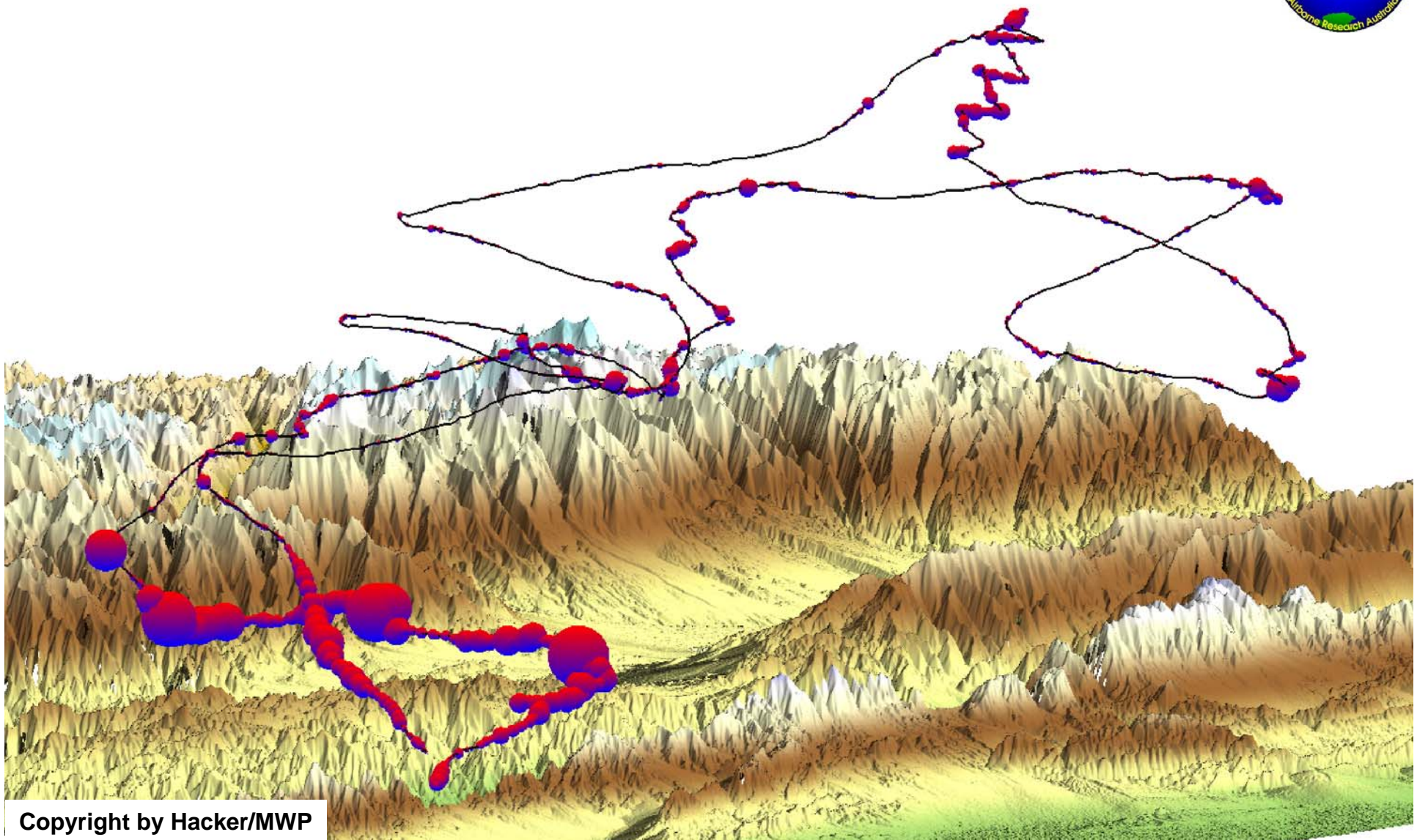
measurement - turbulence [m/s]



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measurement - turbulence

Figure: TURB (~ TKE)

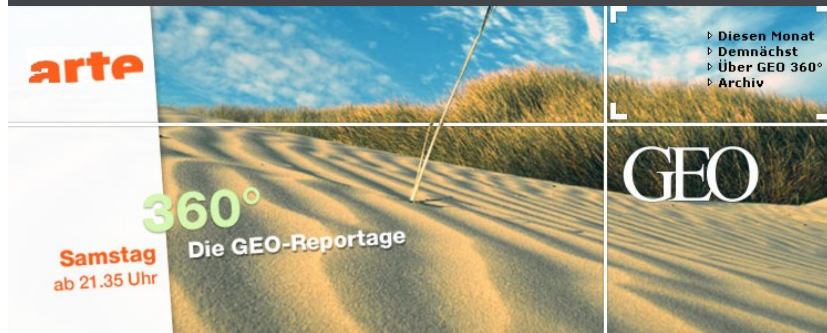


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For information request see:

www.mountain-wave-project.de



„ Wave riders of the Andes

&

Les Enragés du vol à voile“

