

En introduktion till

Vågflygning

Robert Danewid

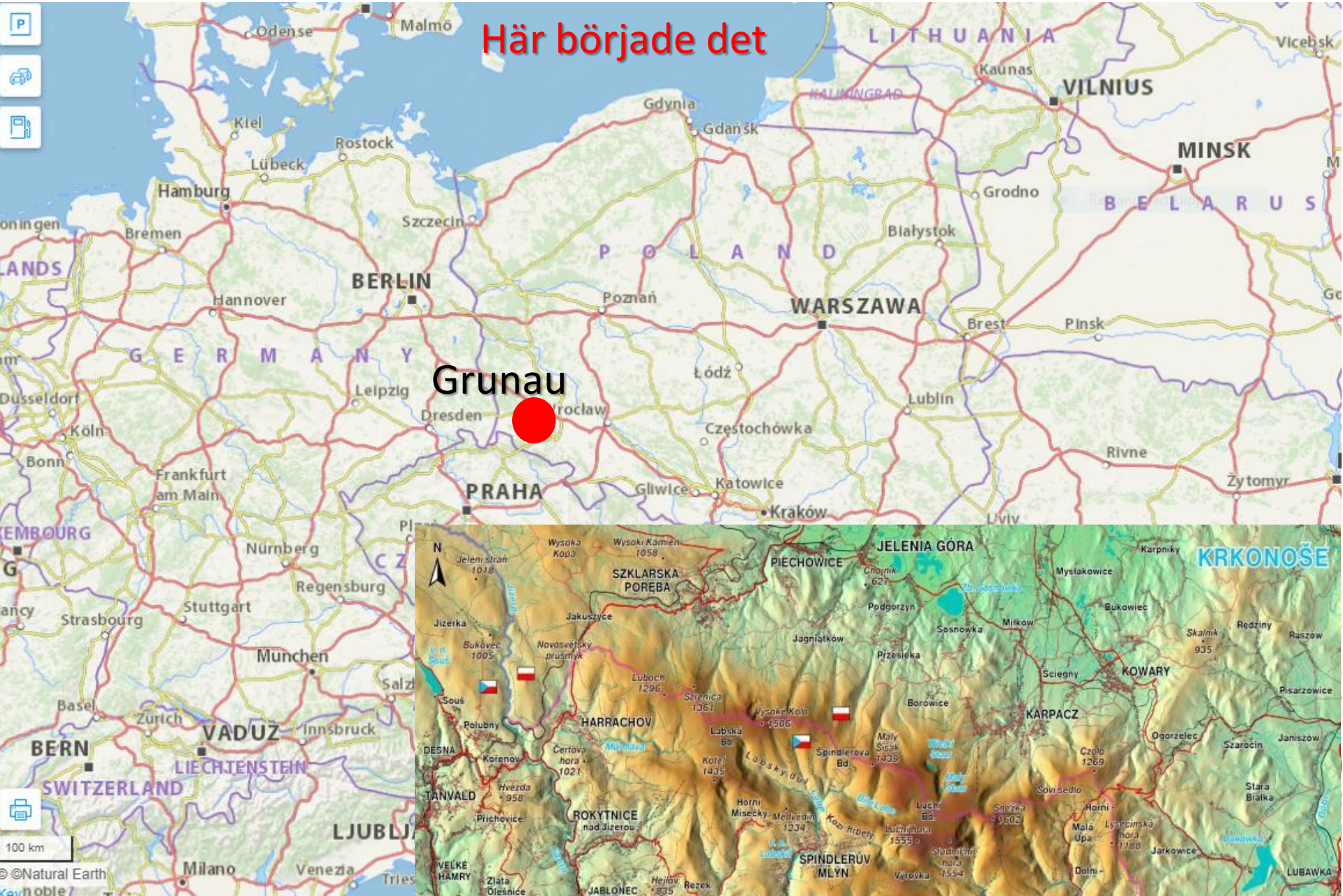
SEGELFLYGET


A white sailplane is shown in flight, banking to the left. The aircraft has a long, slender fuselage and a high-wing configuration. The registration 'D-IBFQ' is clearly visible on the side of the fuselage. The background is a lush green landscape with a winding river and patches of forest.

Lite vågad historik

Vad är detta?

SEGEFLYGET



Här började det

Grunau

KRKONOŠE

Riesengebirge



Grunau



Wolf Hirth 1933



Jezów Sudecki (f d Grunau)



Gottlieb Motz ("der Moatza Gottl")



Moazagotl molnet över Riesengebirge. Fotot taget den 11 december 1936 mot söder. Notera "fönmuren" och rotormolnen (cumulus fracti)

Joachim Küttner (1909-2011)



Rhönbussard

September 1937 nådde Küttner 7 000 m över Riesengebirge

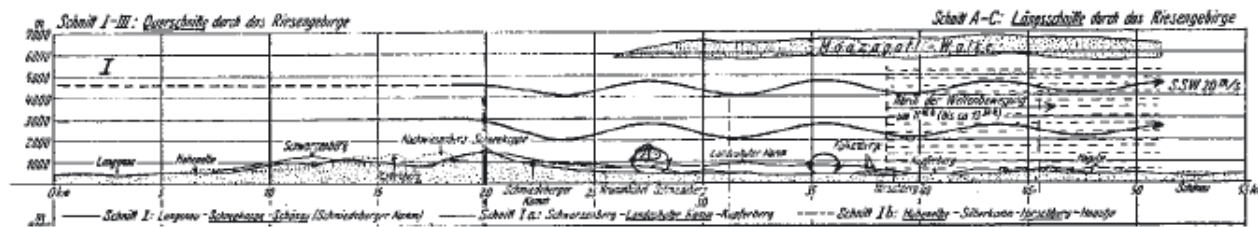


Fig. 32. Grundriß zu Fig. 31, 21. Mai 1937, vormittags.

Pluszeichen: Gebiete aufsteigender Luftbewegung. Minuszeichen: Gebiete absteigender Luftbewegung.

Küttners (andra)
doktorsavhandling
1939:
"Zur Entstehung
der Föhnwelle"

Figur ur Küttners uppsats
"Moazagotl und
Föhnwelle" 1938. Bilden
visar resultat från
flygningar med 22
segelflygplan samtidigt i
våg över Riesengebirge
den 21 maj 1937. Vinden
är SSW 20 m/s.

Stig Fägerblad



Karl-Erik Övgård

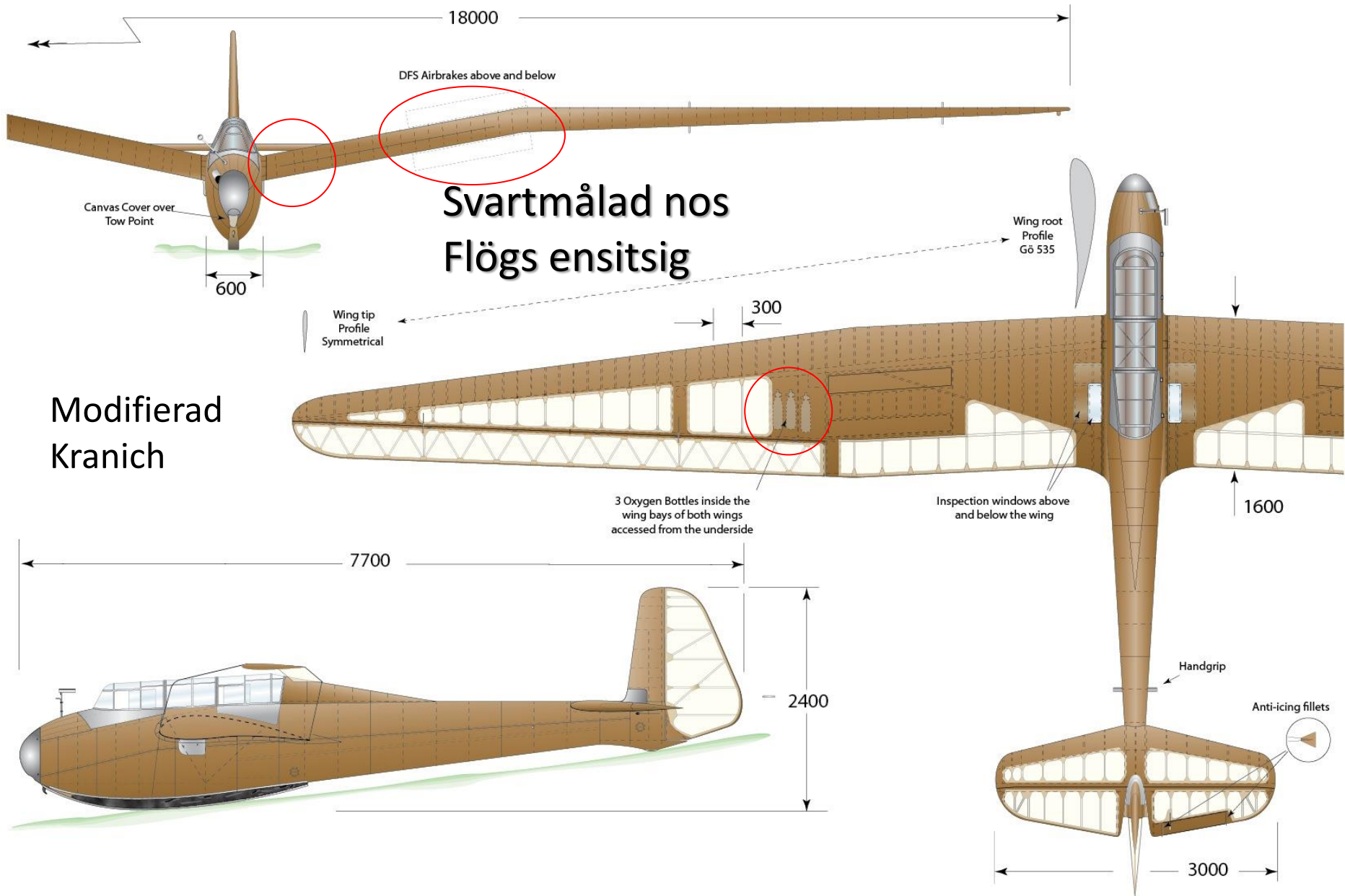


Grunau 1938

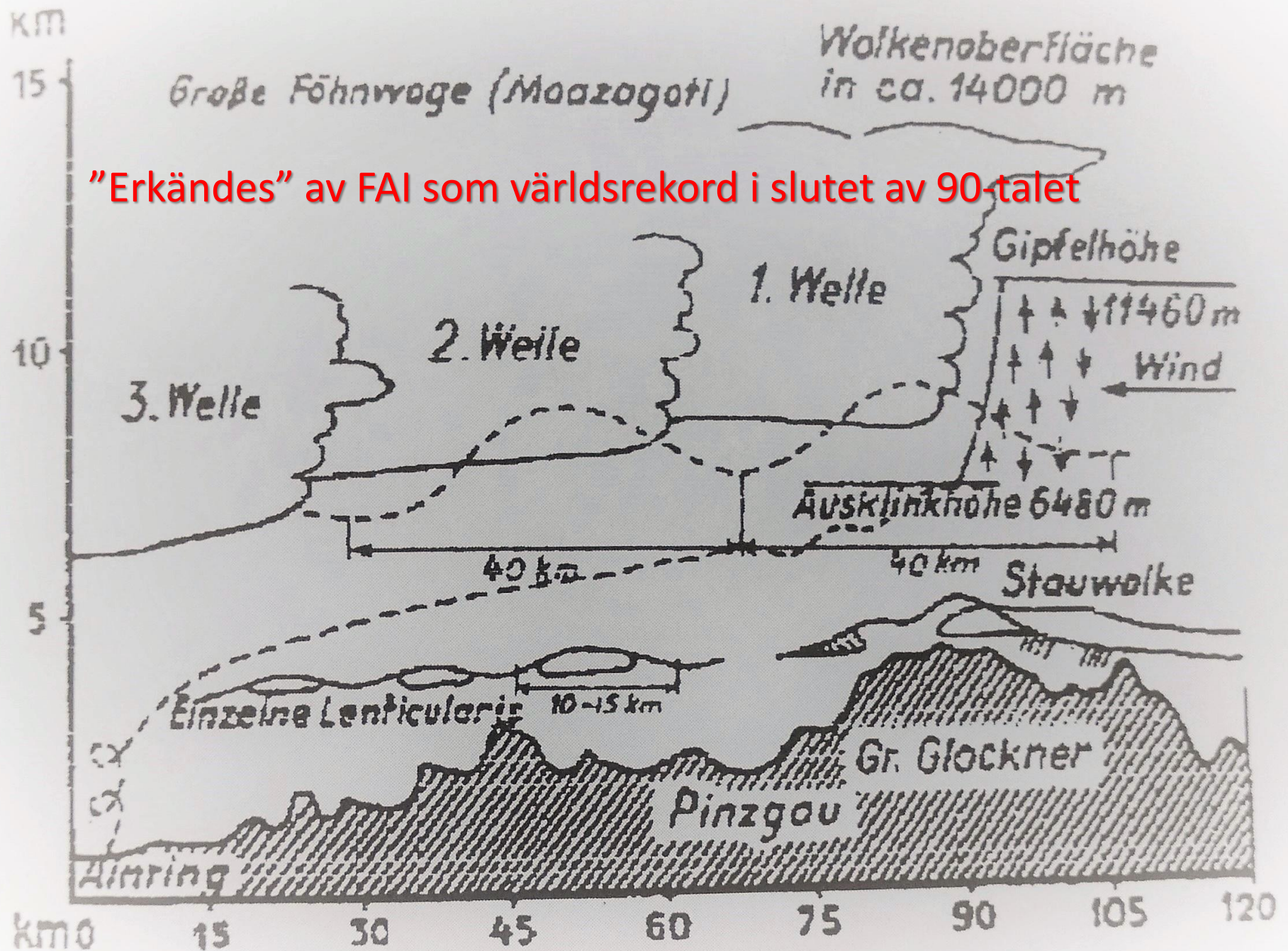


Erich Klöckner (1913-2003)
Först i stratosfären – 11 640 m
11 oktober 1940
Kranich W





Kranich W eller Wolken Kranich



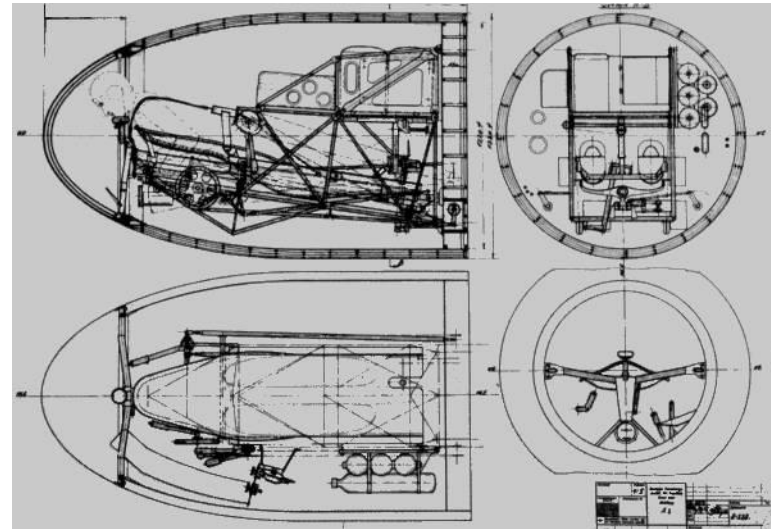


Han bar aldrig uniform





DFS 228 (DFS 54)



tryckkabin



Alcor

Perlan II

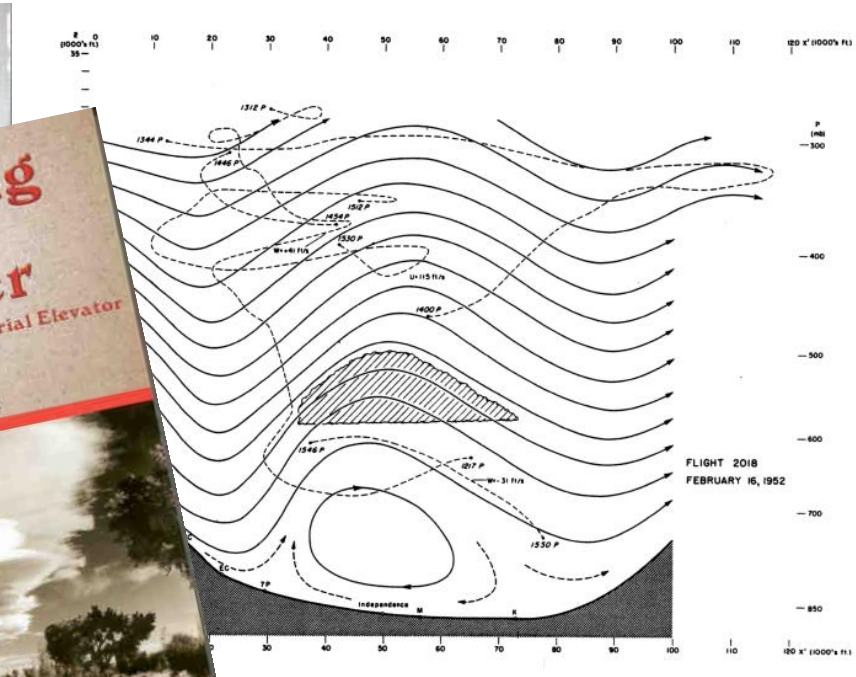




Sierra Wave Project

Bishop, California

Exploring the Monster
Mountain Lee Waves: the Aerodynamic Challenge
By Robert F. Whelan

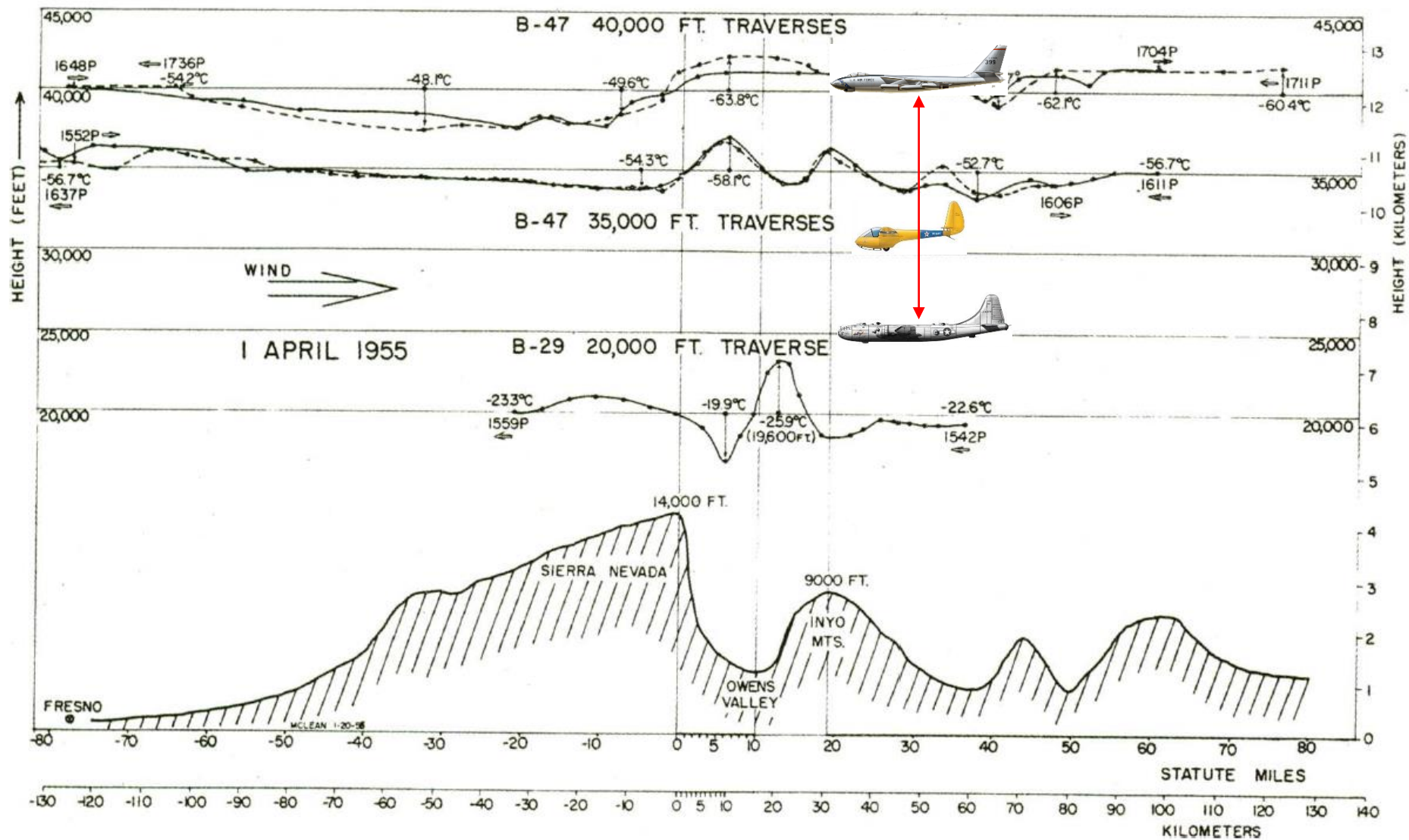


1951-52
1955



A black and white photograph of four men in flight suits standing in front of an aircraft. The man on the far right is identified as Kuttner. The aircraft has "EXPERIMENTAL" written on its side.



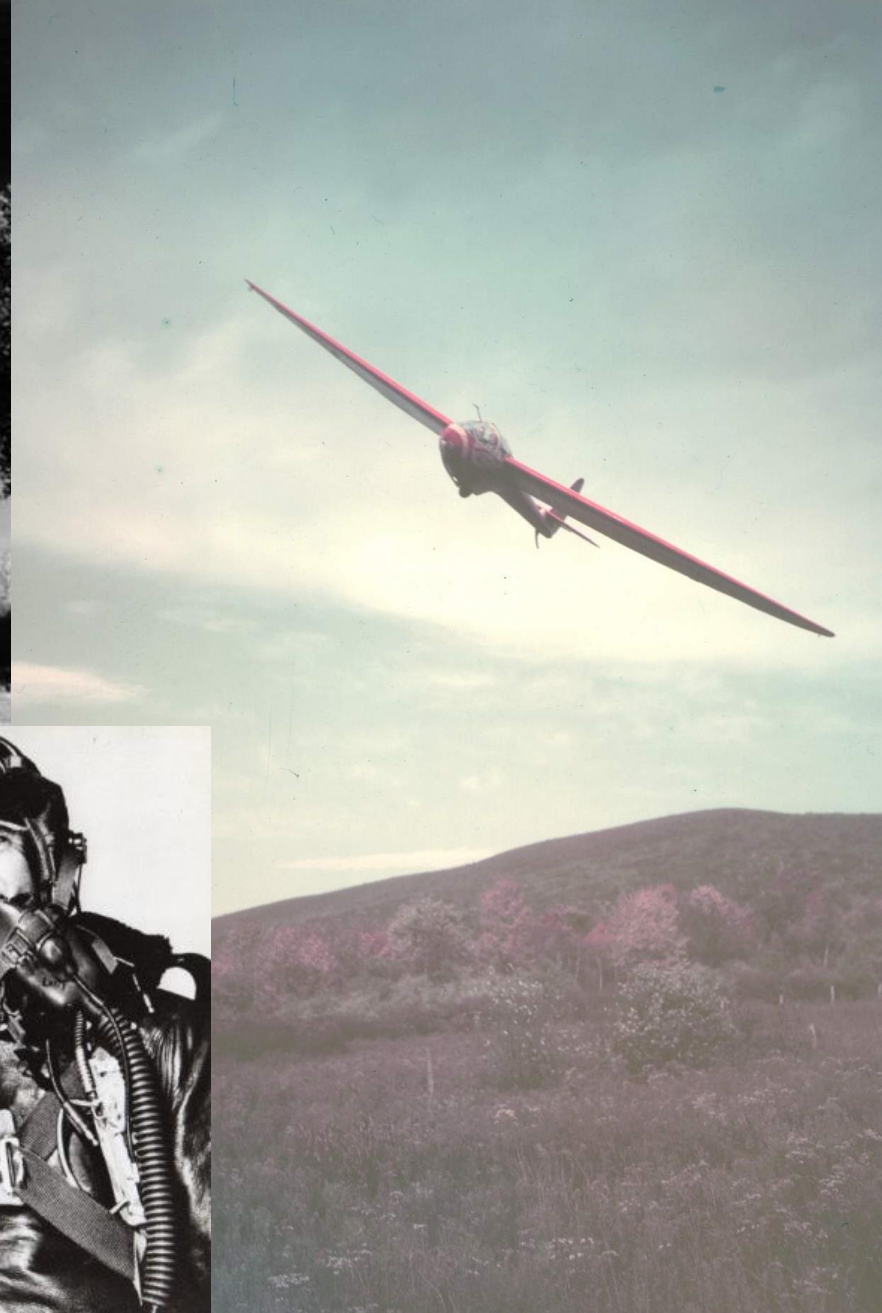


1955 Sierra Jet-Stream Wave Project

*"A loser in war, a
winner in peacetime"*



projekten



Mars 1952
13 489 m världsrekord
Larry Edgar & Harold G. Gatty

Stod sig i 54 år



<https://nordicgliding.com/de-banade-vag-for-perlan/>

Svensk vågentusiast #1

Karl-Erik Övgård

(1915-1951)

Gymnastikdirektör

Var i Grunau 1938

Instruktör på Ålleberg

Svenska uthållighetsrekordet –

22 tim (västhaget Ålleberg)

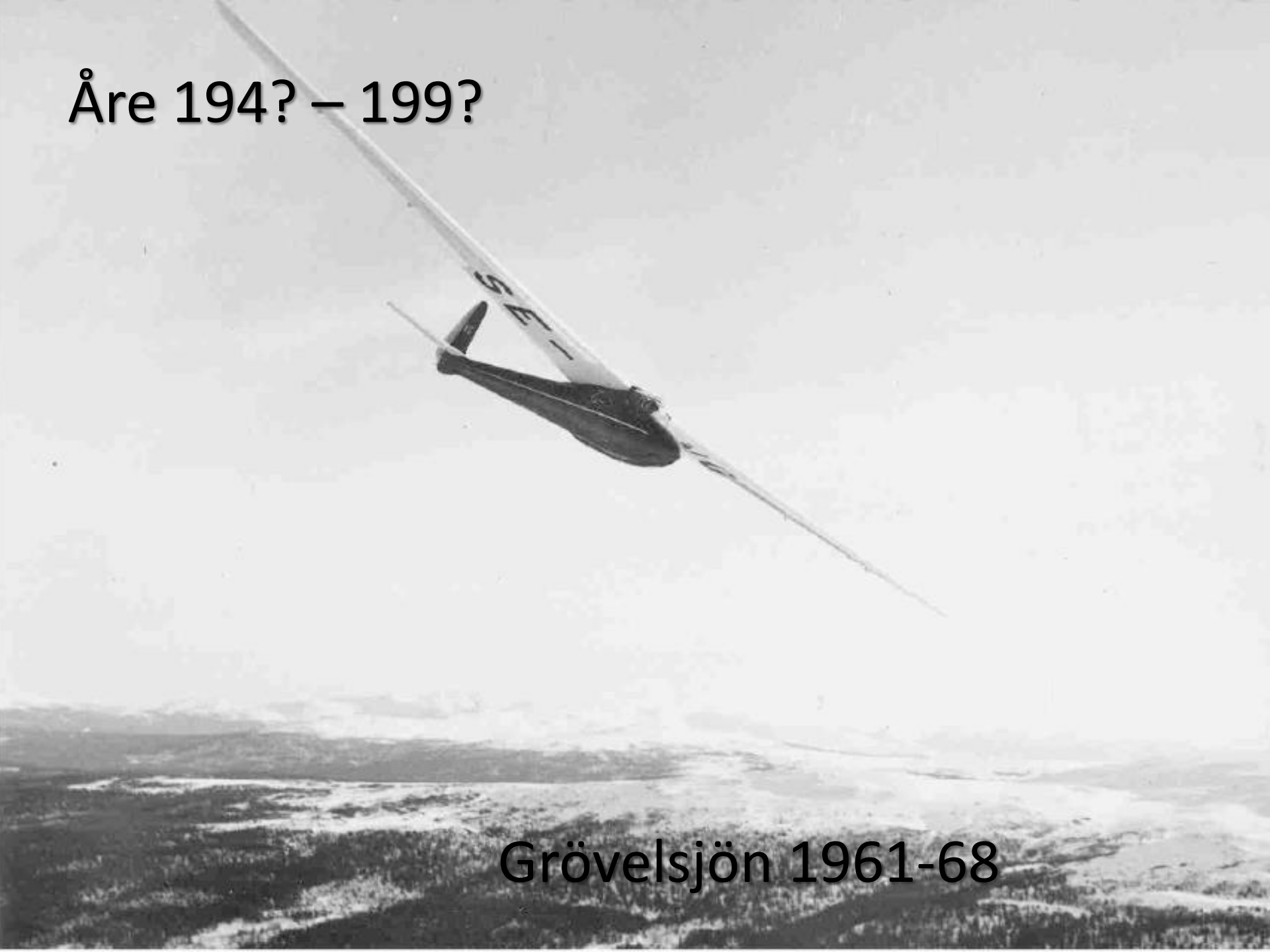
1947 Hohe Tatra

Omkom i Sierra vågen 1951

Gröndalen 1944 – första
svenska vågexpeditionen

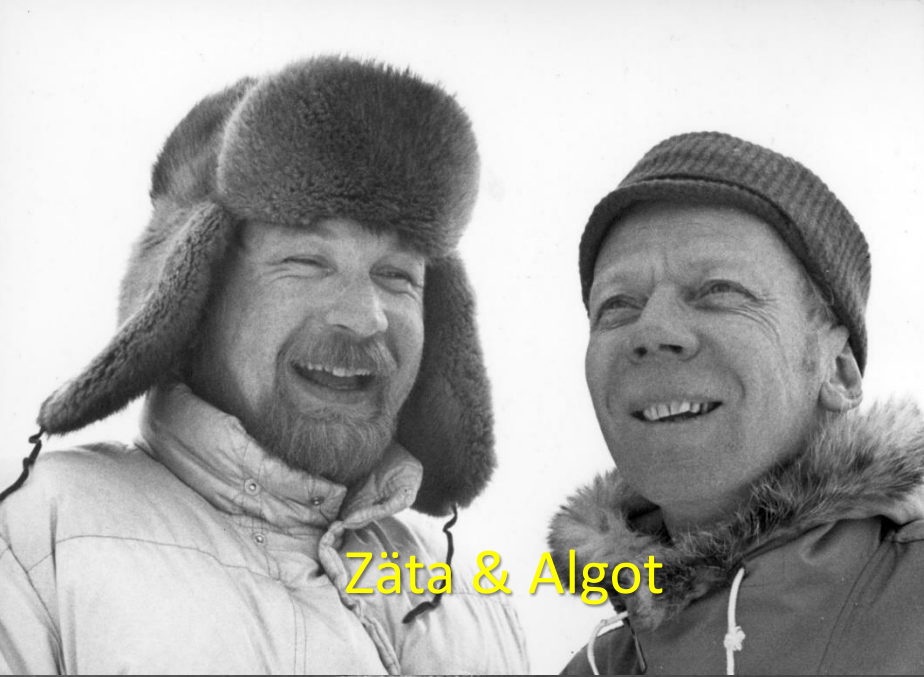


Åre 194? – 199?



Grövelsjön 1961-68

Ottsjö 1961



Kebne-lägrät 1962



"Kebne-lägrät" i Pirttivuopio 1969

Hemavan (även höstläger)



Vågå
1989



SEGELFLYGET

Höstläger

Hedlanda

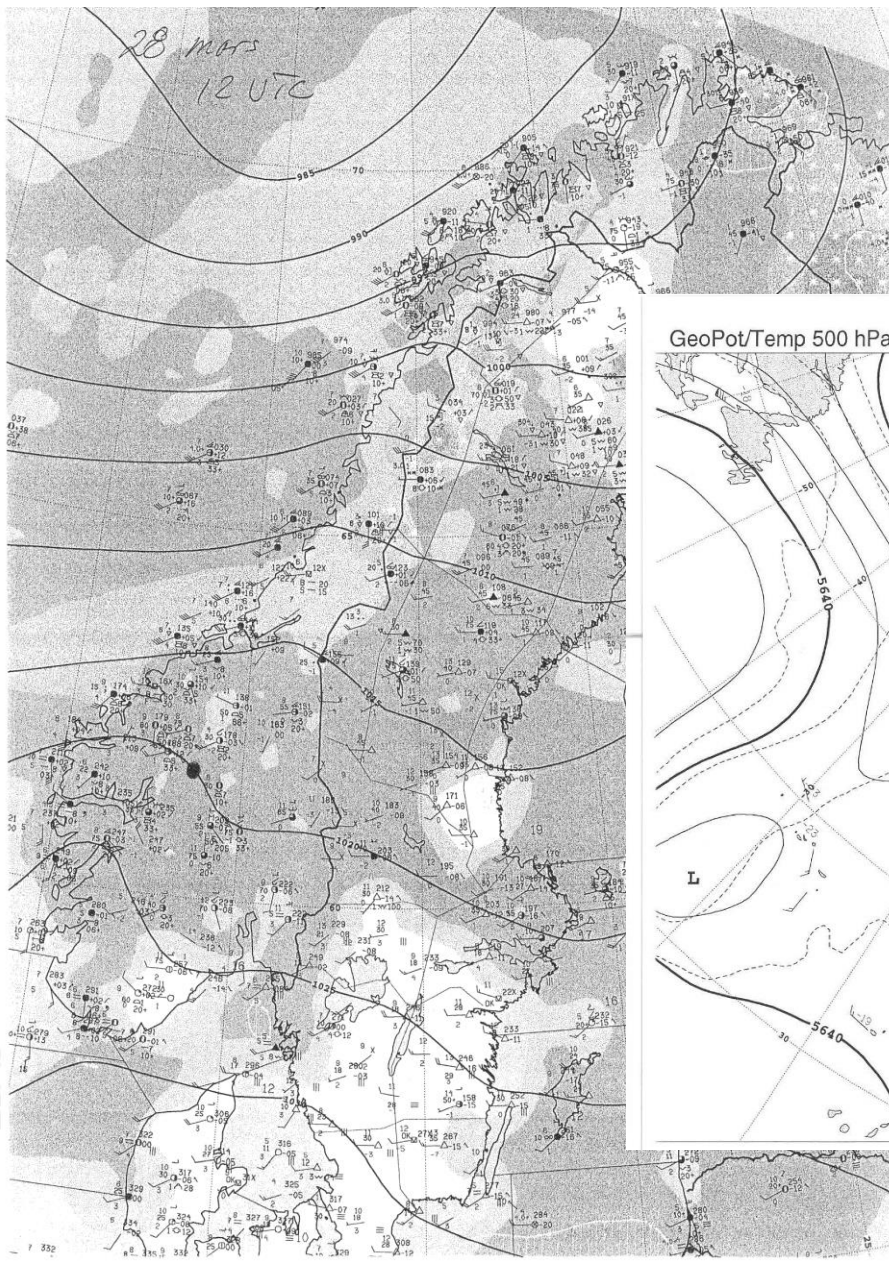


Frya



Bjorli

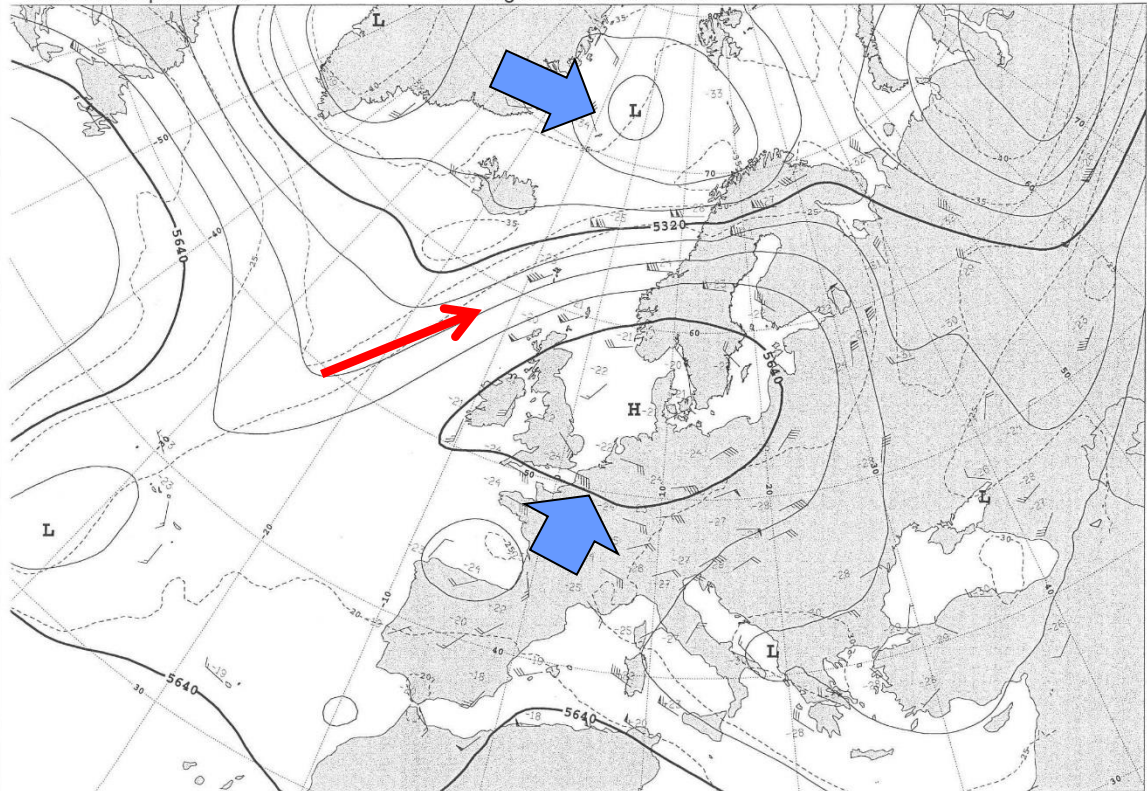




Väderläget vi vill ha

GeoPot/Temp 500 hPa

Torsdag 28 mars 2002 12UTC



På tal om väder.....



"Bergen skolan" – den moderna
meteorologin

Onödigt vetande

Vilhelm Bjerknes (1862-1951)

Geofysisk institut sedan 1917



ON THE STRUCTURE OF MOVING CYCLONES

BY

J. BJERKNES, BERGEN

Manuscript received 5. November 1918.

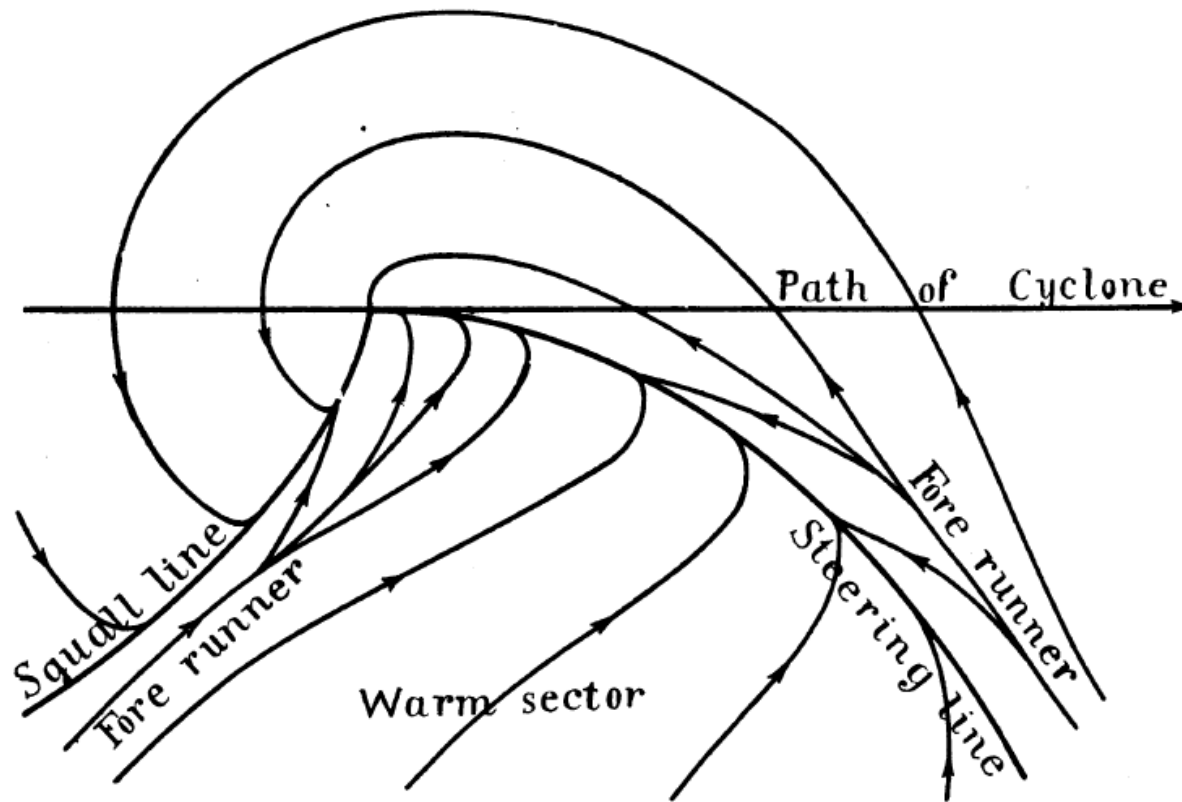


Fig. 1. Lines of flow in moving cyclones.

Life Cycle of Cyclones and the Polar Front Theory of Atmospheric Circulation

by
J. Bjerknes and H. Solberg.

(Manuscript received May 27th, 1922).

In previous papers¹ we have described the ideal type of moving cyclones represented by Fig. 1. Its principal features may here be briefly recapitulated.

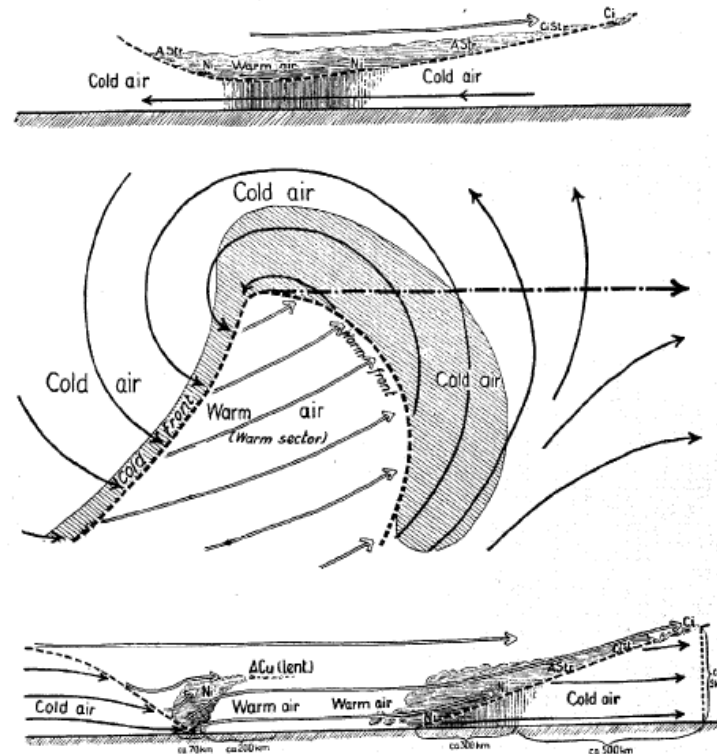


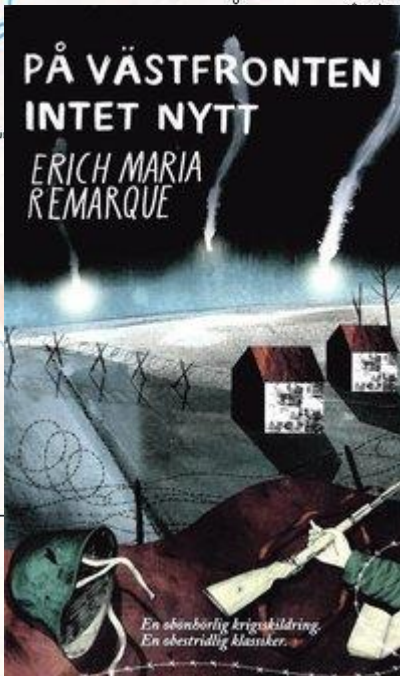
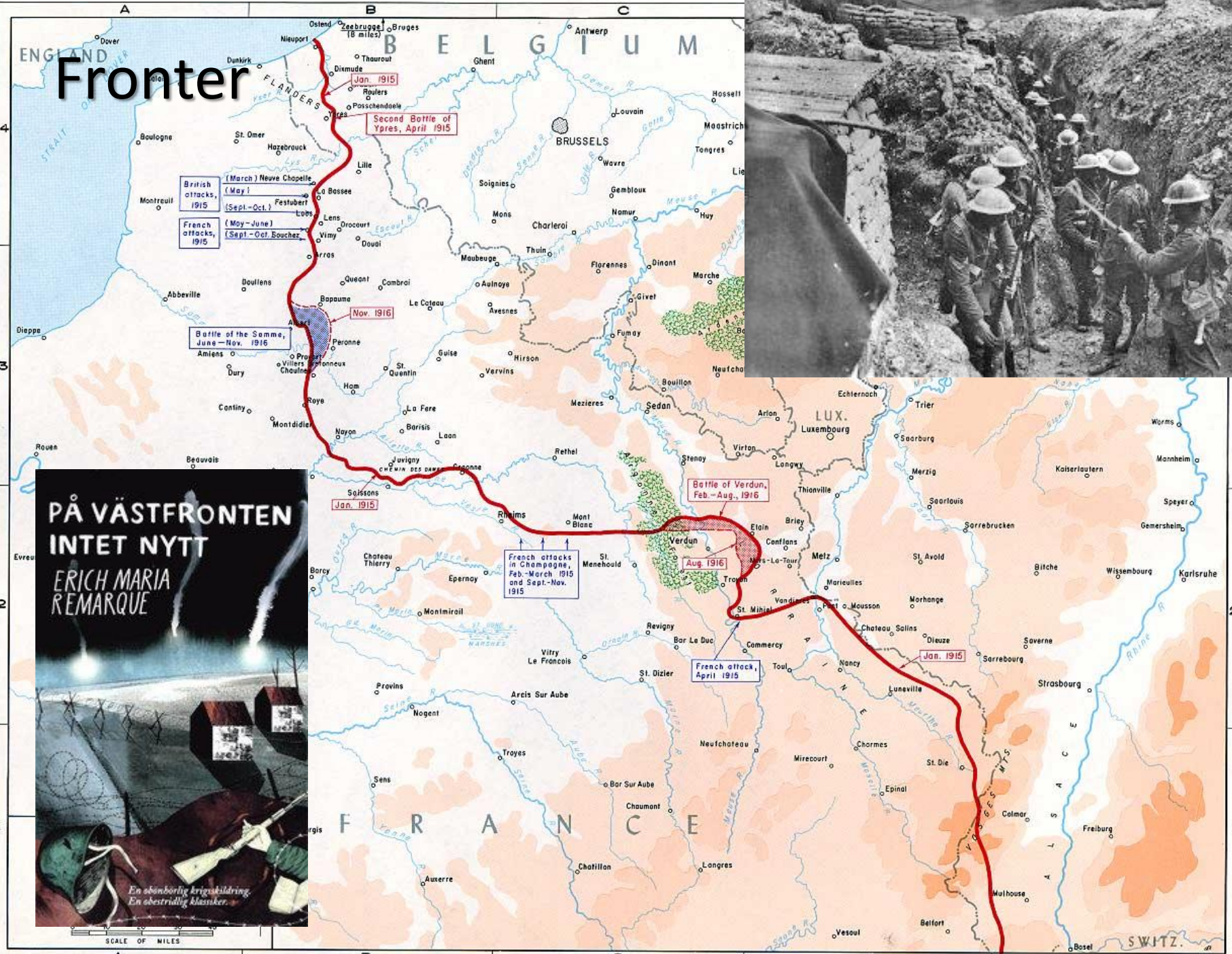
Fig. 1.
Idealized cyclone.

¹ J. Bjerknes, »On the Structure of Moving Cyclones«, *Geofysiske Publikationer*, Vol. I, Nr. 2.
J. Bjerknes and H. Solberg, »Meteorological Conditions for the Formation of Rain«, *Geofysiske Publikationer*, Vol. II, No. 3.

Deltog i Sierra
Wave som expert

Bjerknes and Solberg (1922)

Fronten



Dagens innehavare av professuren

Thomas Spengler

I am a meteorologist focusing on the combination of theory, observations, and modelling. I have specialized on a variety of scales ranging from meso, synoptic, to large-scale flow and participated in several field campaigns addressing meso-scale atmospheric flow and atmosphere-ocean interactions. Since 2015, I am the director of the NFR funded Norwegian Research School on Changing Climates in the Coupled Earth System (CHESS). I was coordinator and head of the field campaign ALLGEX and part of the organizational team of FLOHOF. My specific research interests are devoted to interaction processes between different space and time scales, addressing wave mean flow interactions and the dynamical impact of smaller scale processes. I am currently leading research focusing on high impact weather in the Arctic, e.g., Polar lows and topographically initiated wind events with an increasing interest on atmosphere-ocean-ice interactions. In 2012 I was elected as a member of the International Commission for Dynamic Meteorology and lead the organization of an international workshop on atmosphere-ocean-ice interaction, which was held in Norway in 2015. I was awarded the prize for best lecturer of the academic year 2012/2013 at the Faculty for Mathematics and Natural Sciences at the University of Bergen and nominated for the IAMAS early career scientist medal in 2013. Since 2015 I am elected as chair of the Atmospheric Working Group of the International Arctic Science Committee (IASC). Personal UiB website: <http://www.uib.no/en/persons/Thomas.Spengler>

Professor

Geofvsk institutt. UiB/Geophysical institute. UiB



E-mail: thomas.spengler@uib.no

Phone: 55589846

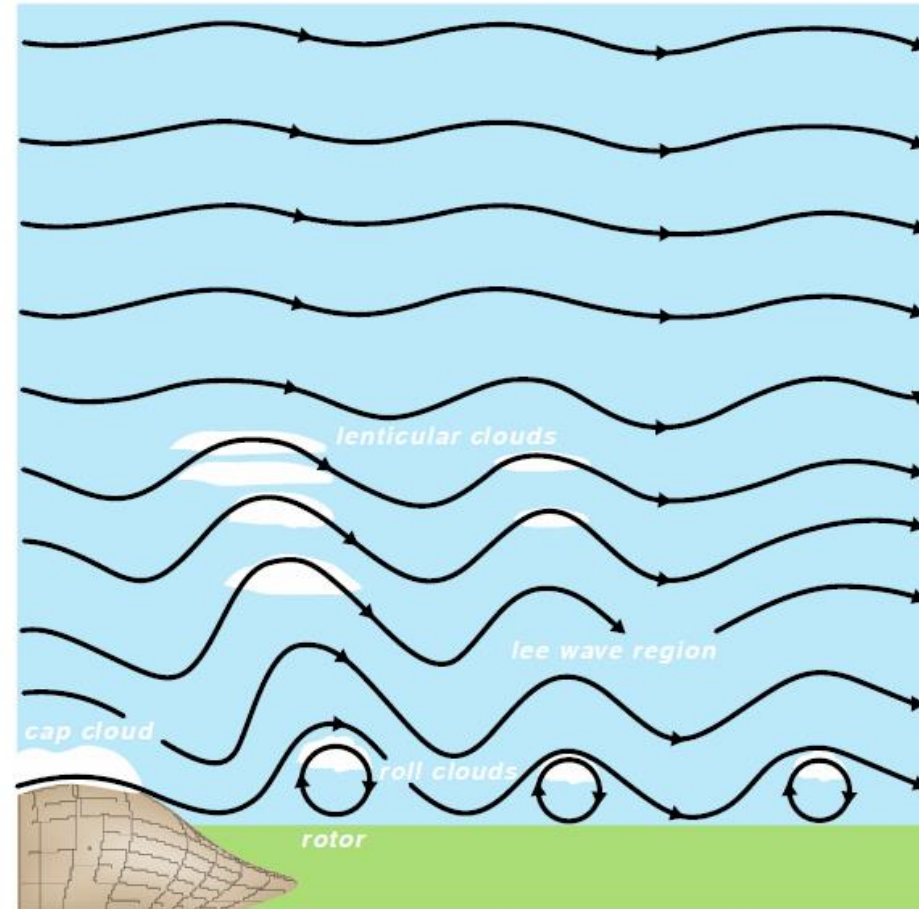
Givetvis segelflygare!

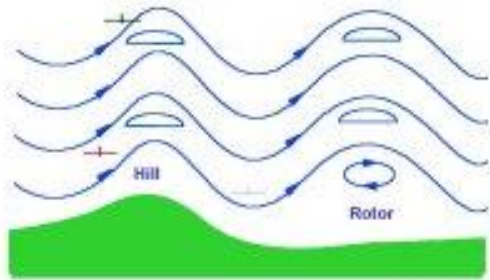
Orographic Gravity Waves

Internal gravity waves forced by two-dimensional terrain

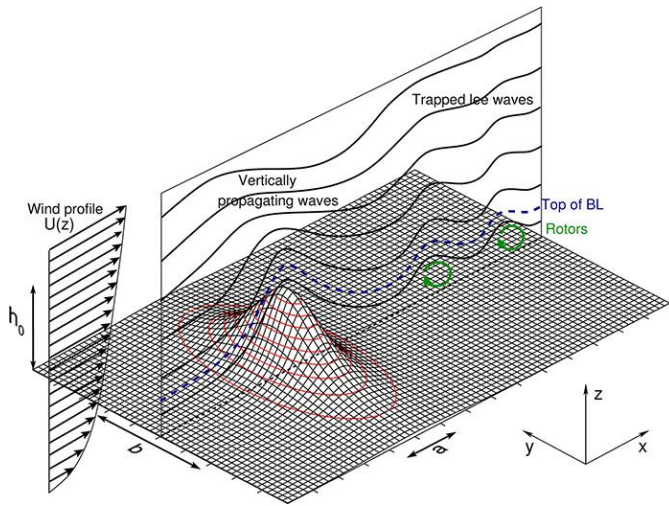
Taylor-Goldstein equation

$$w_{zz} + \left(\frac{N^2}{\bar{u}} - k^2 \right) \hat{w} = 0$$





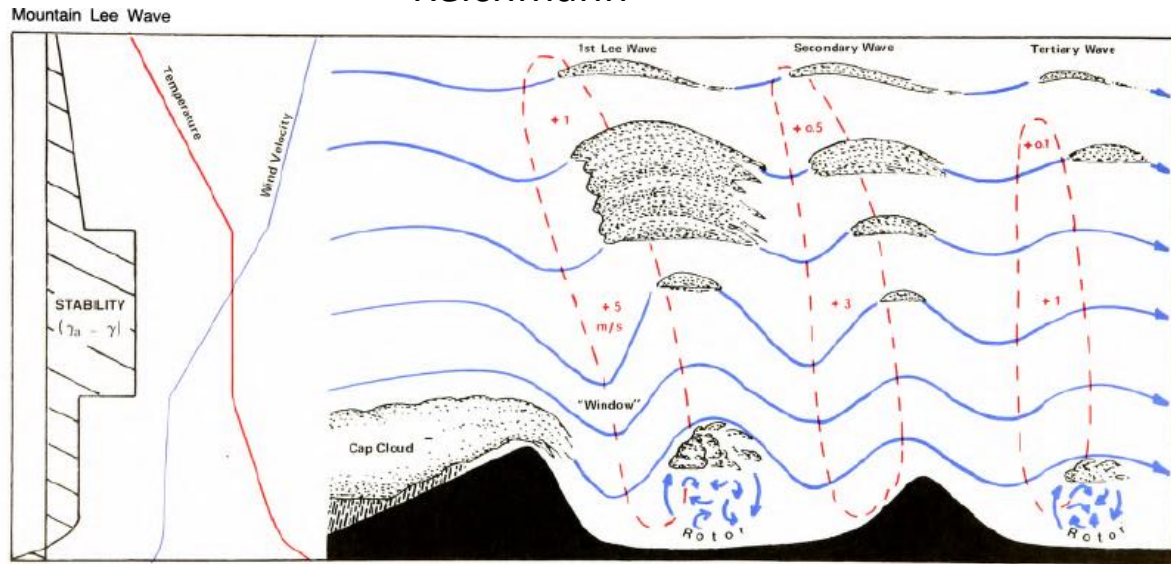
Reichmann



$$h(x, y) = \int_{-\infty}^{+\infty} \int_{-\infty}^{+\infty} \hat{h}(k, l) e^{i(kx + ly)} dk dl,$$

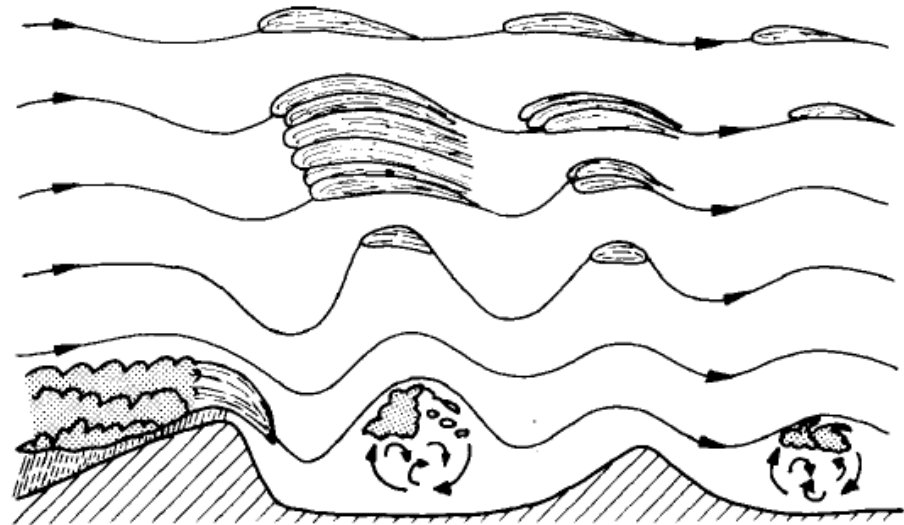
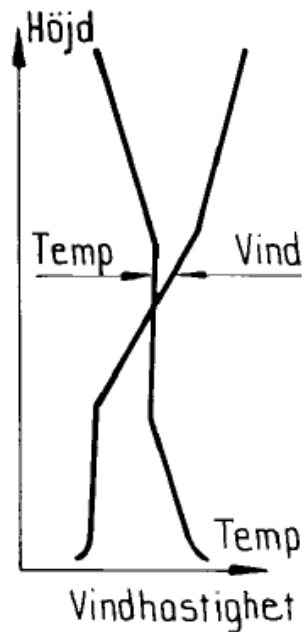
$$w(x, y, z) = \int_{-\infty}^{+\infty} \int_{-\infty}^{+\infty} \hat{w}(k, l, z) e^{i(kx + ly)} dk dl,$$

$$p(x, y, z) = \int_{-\infty}^{+\infty} \int_{-\infty}^{+\infty} \hat{p}(k, l, z) e^{i(kx + ly)} dk dl,$$

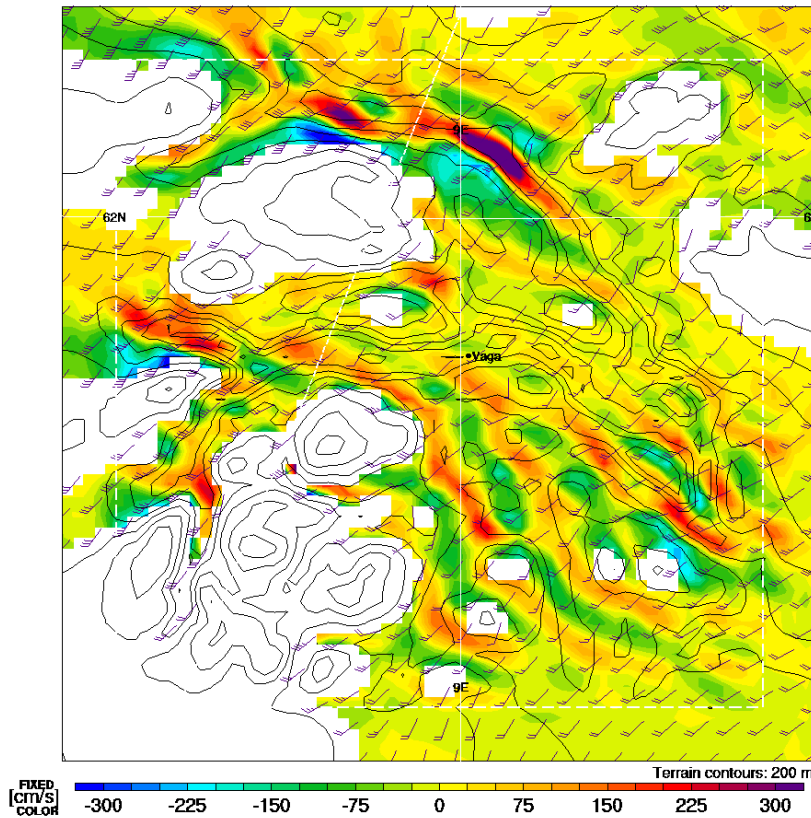


Bernt O, teoriboken

Vågor
påverkar
klimatet och
jetströmmar



Vertical Velocity & Wind [kt] at 850mb
Valid 1500 CET (1300Z) Mon 13 Mar 2017 [%shrFcst@%sz]
box Wmax=244@61.74,8.59,7045m

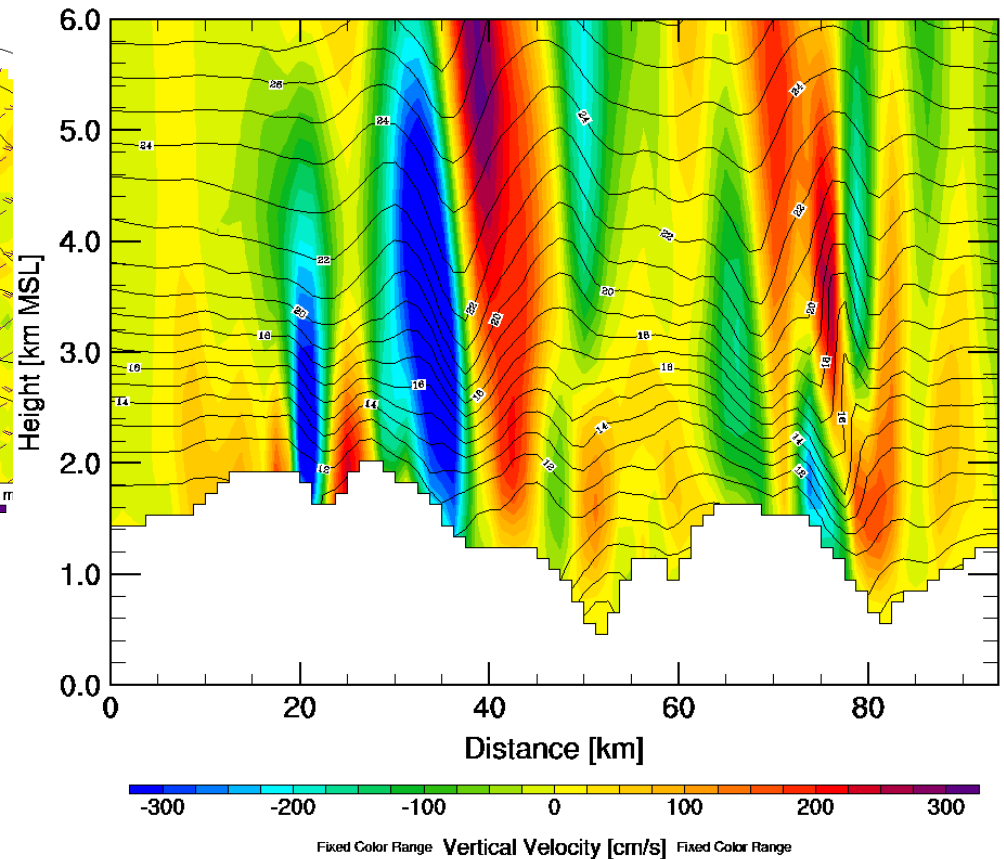


"RASP"

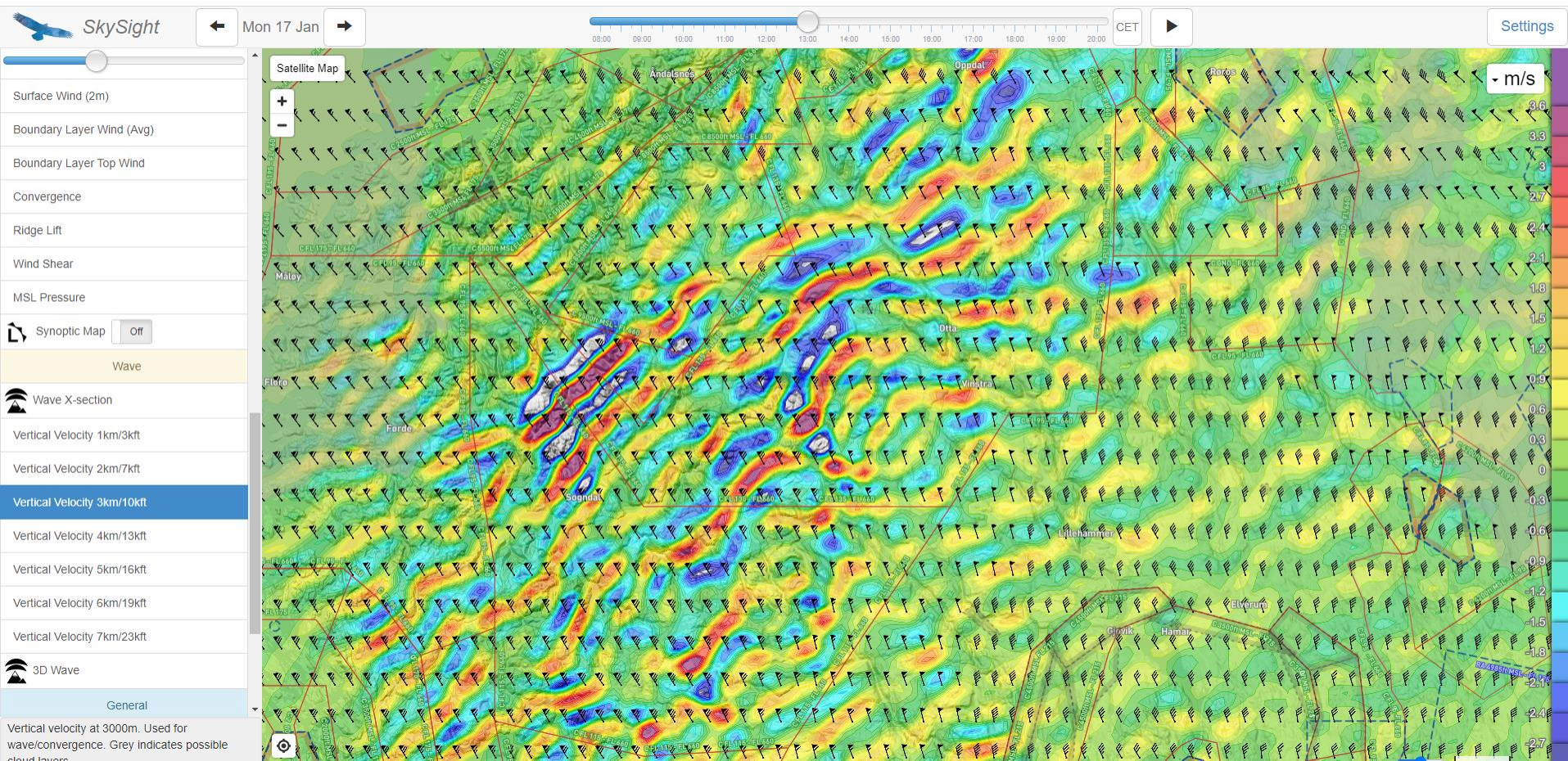
Stefan Löfgren

Vågprognoser

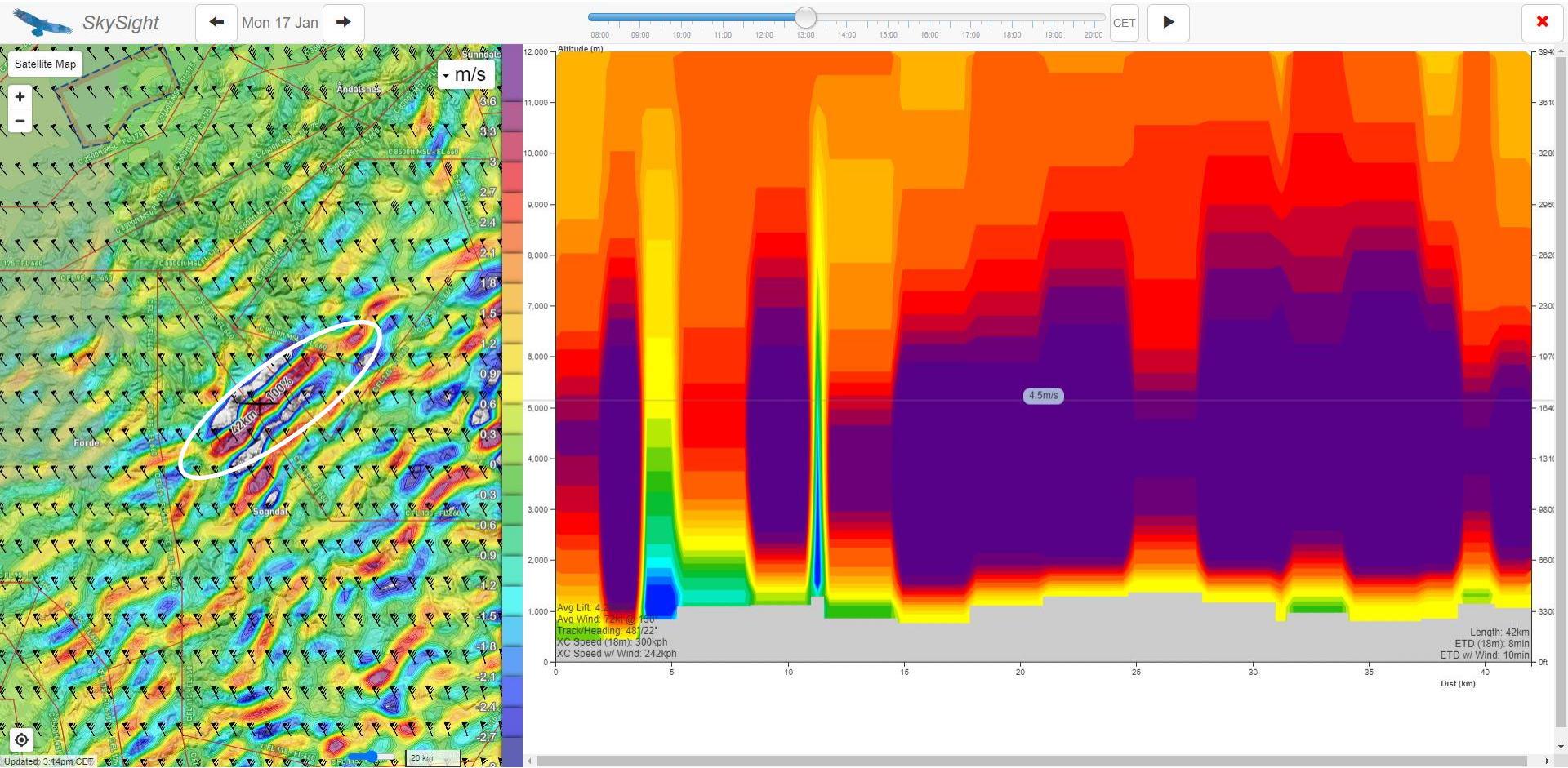
Wind-Parallel Section at Max W: Vertical Velocity & Pot.Temp. (c)
Valid 1500 CET (1300Z) Mon 13 Mar 2017 [%shrFcst@%sz]
box Wmax=244@61.74,8.59,7045m



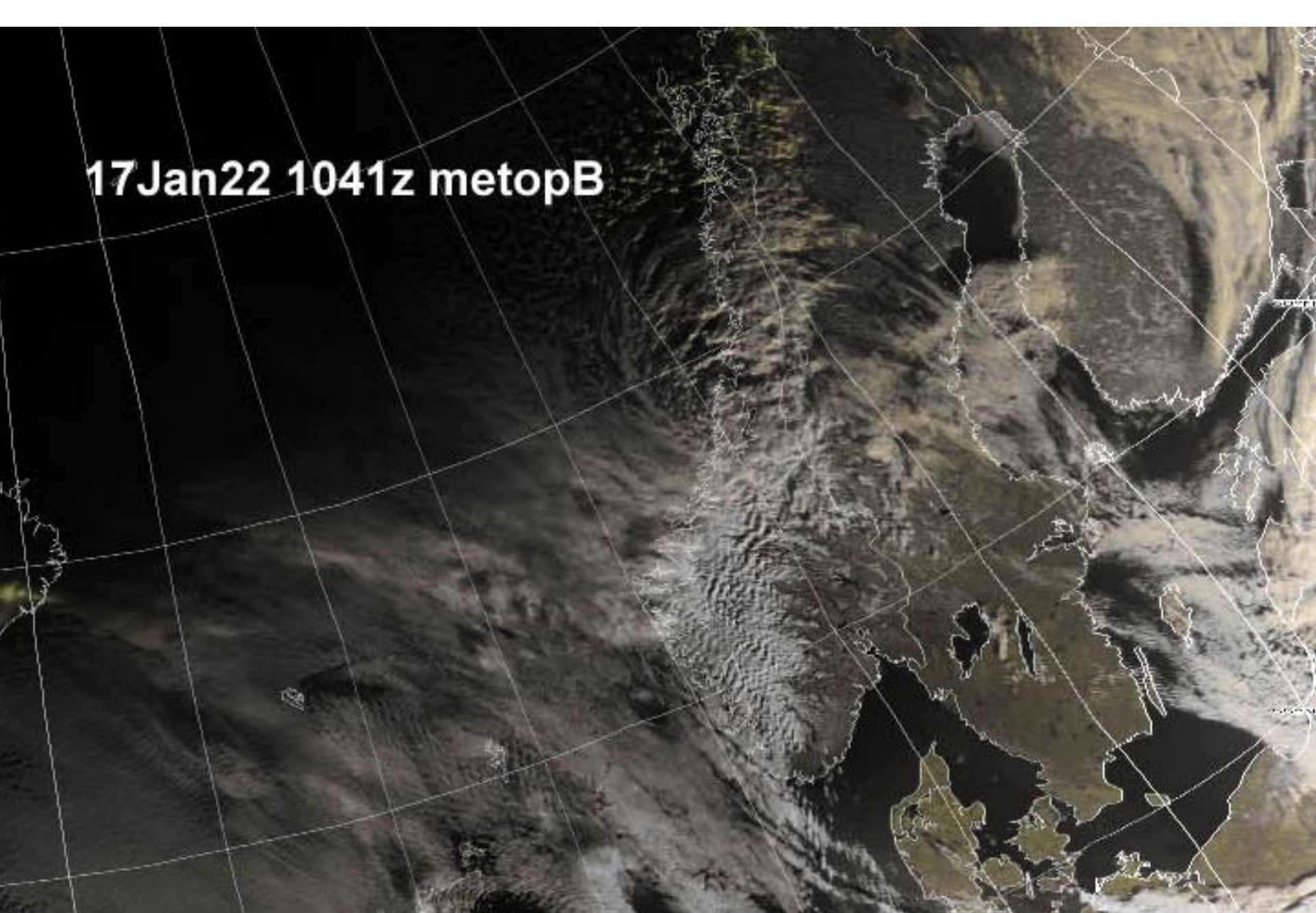
Skysight



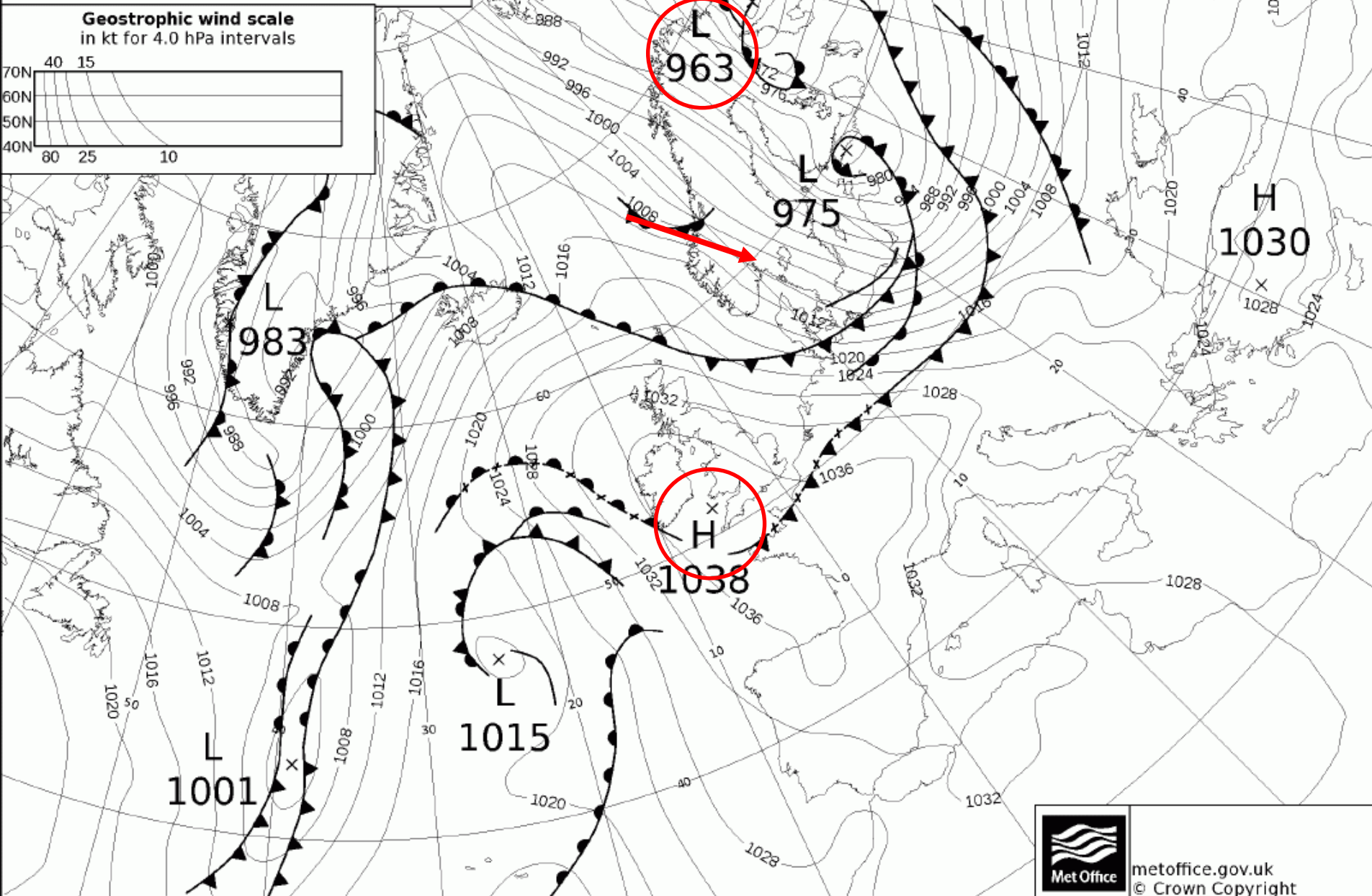
Skitbra!

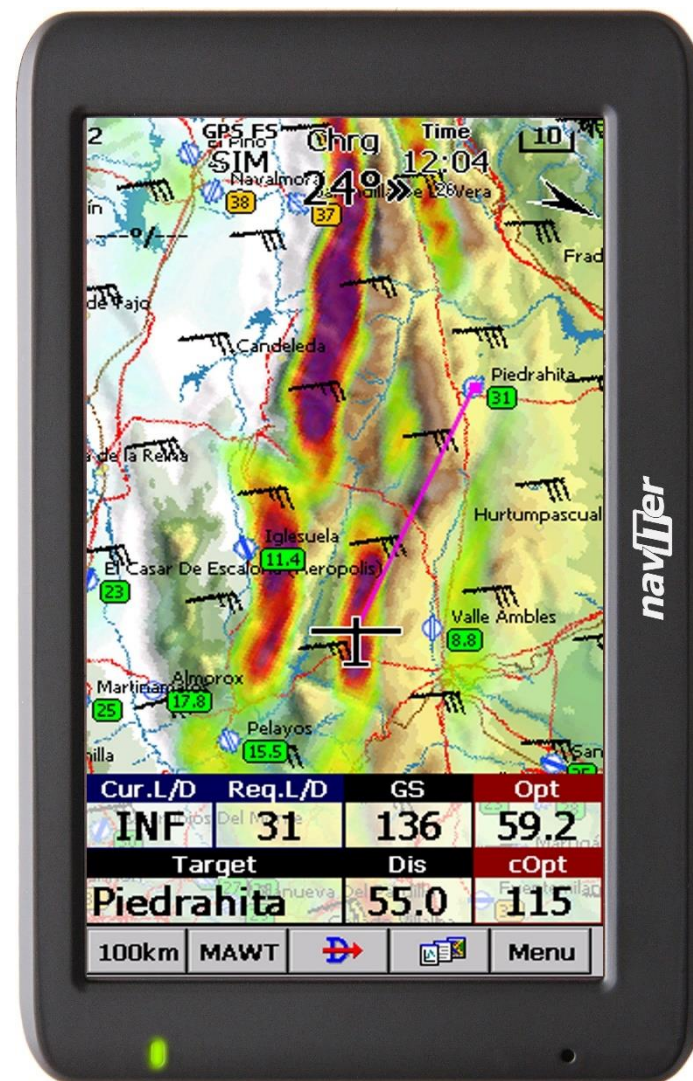


17Jan22 1041z metopB



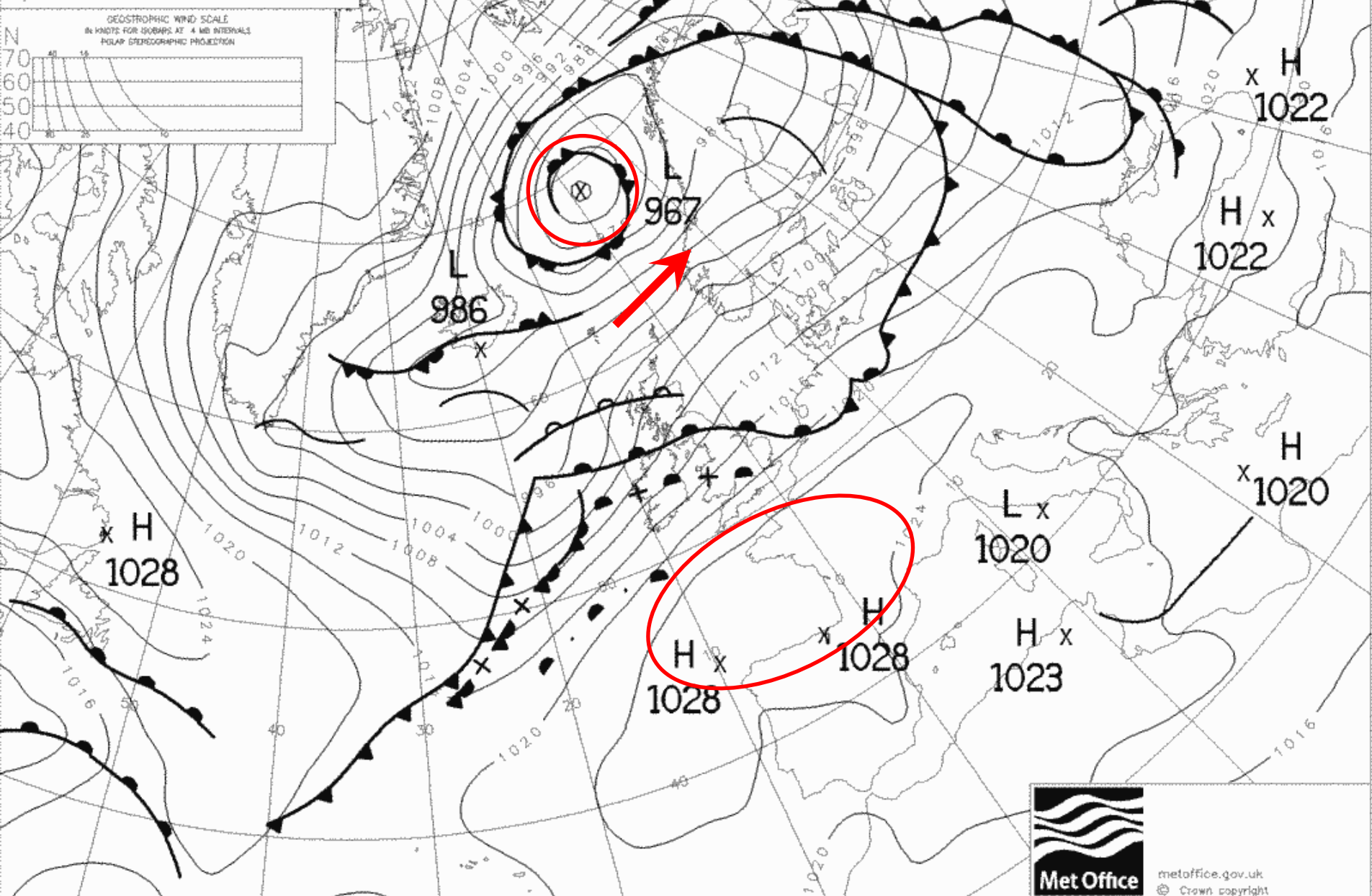
Analysis chart valid 06 UTC MON 17 JAN 2022





Vågprognos i cockpit
(Skysight)

Analysis chart valid 00 UTC WED 05 OCT 2011



05Oct11 1203z noaa19

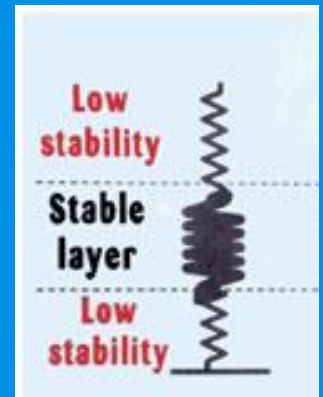
”Böljor e ju så vackra....”



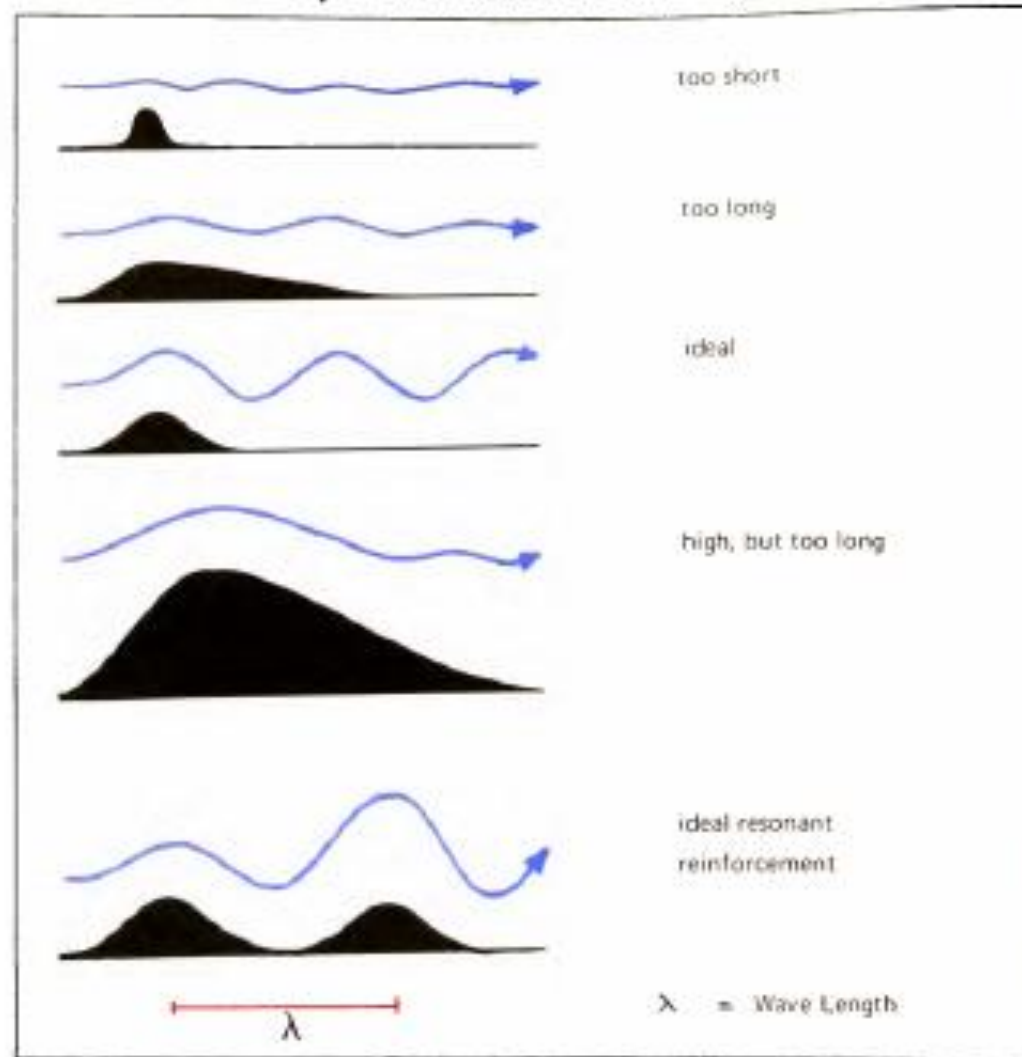
Enligt **Wallington** (*Meteorology for Glider Pilots*, 1977)
finns det 5 gynsamma kriterier för våg

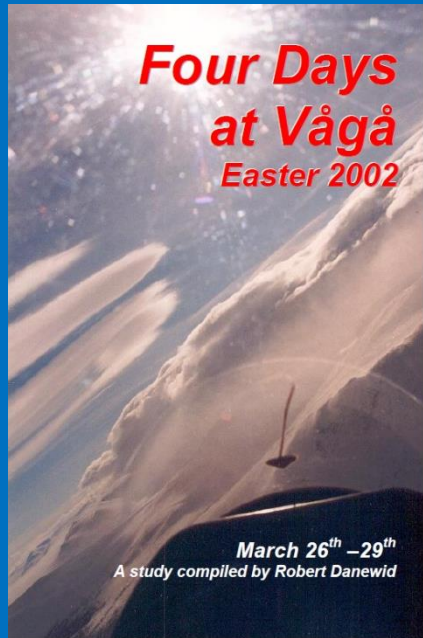
- 1) A layer of low stability at low levels
- 2) A stable layer above the lower layer
- 3) An upper layer of low stability in the troposphere
- 4) A wind of about 30 km/h (15 kts) or more across the mountain ridges
- 5) An increase of wind speed with height without much change of wind direction

fjäderanalogin

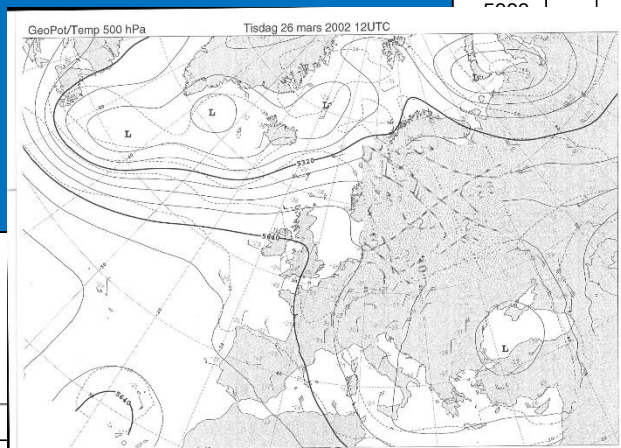


Influence of shape of Wave Obstacle (after Wallington)

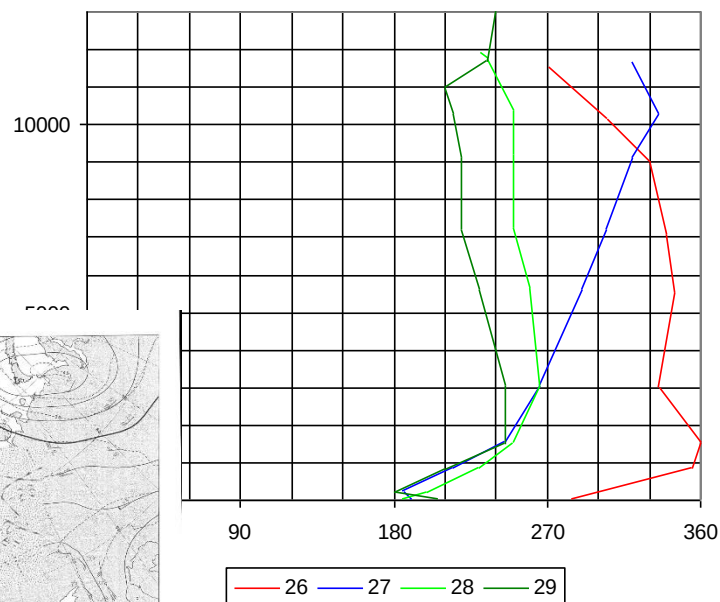




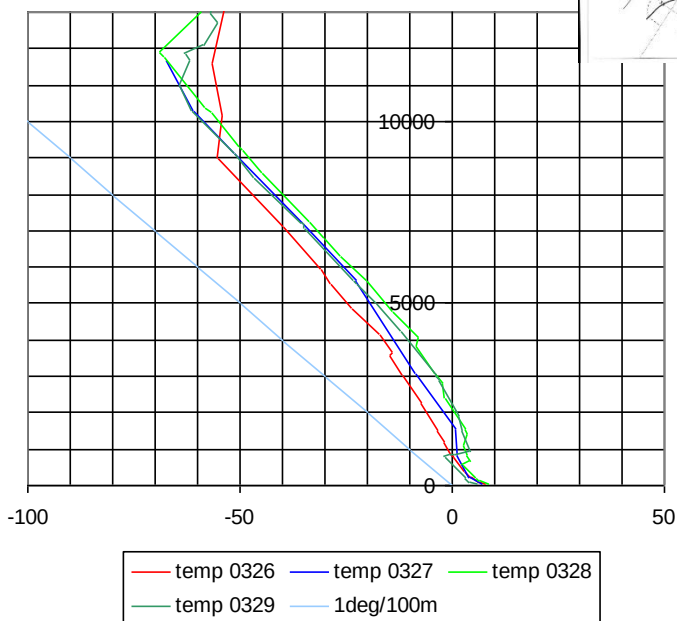
Tack till Gordon
Carlsson, SMHI



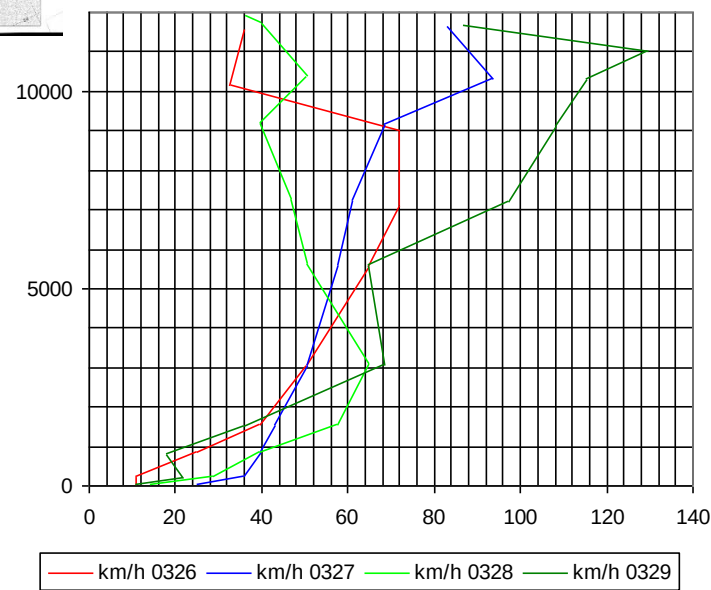
Summary of wind directions



Summary of tempogram



Summary of Wind Speed



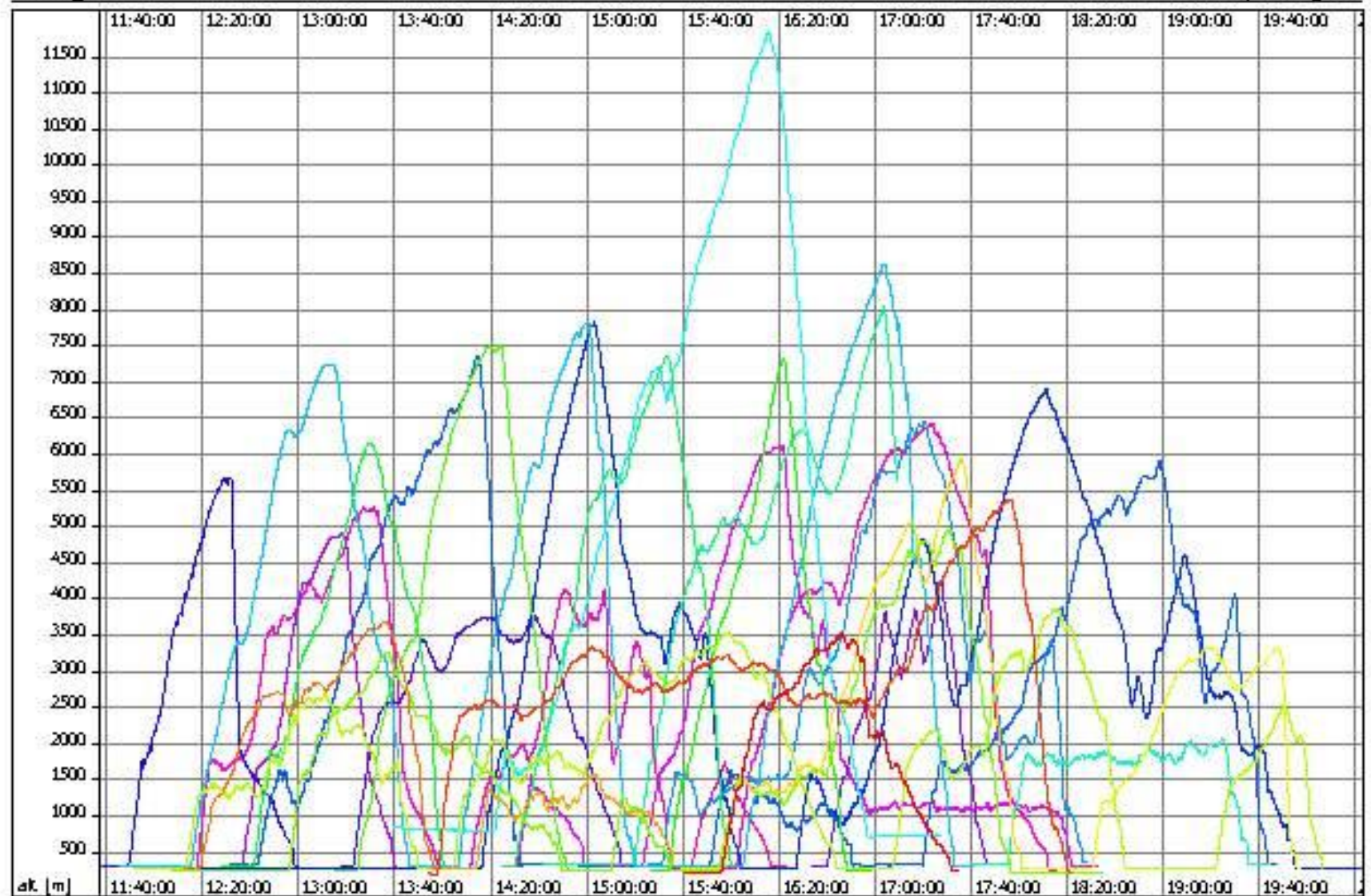
Wallingtons kriterier

Date	26th	27th	28th	29th
max altitude	7 000 m	8 500 m	11 000 m	7 000 m
no of Diamonds	4	33	23	2
no of Golds	10	34	26	18
A layer of low stability (high lapse rate) at low levels	X	X	X	X
A stable layer (e g isothermal layer or inversion) above the lower layer	-	X	X	X
An upper layer of low stability in the troposphere	-	-	-	-
A wind of about 30 km/h or more across the mountain ridges	X	X	X	X
An increase of wind speed with height without much change of wind direction	X	-	-	X

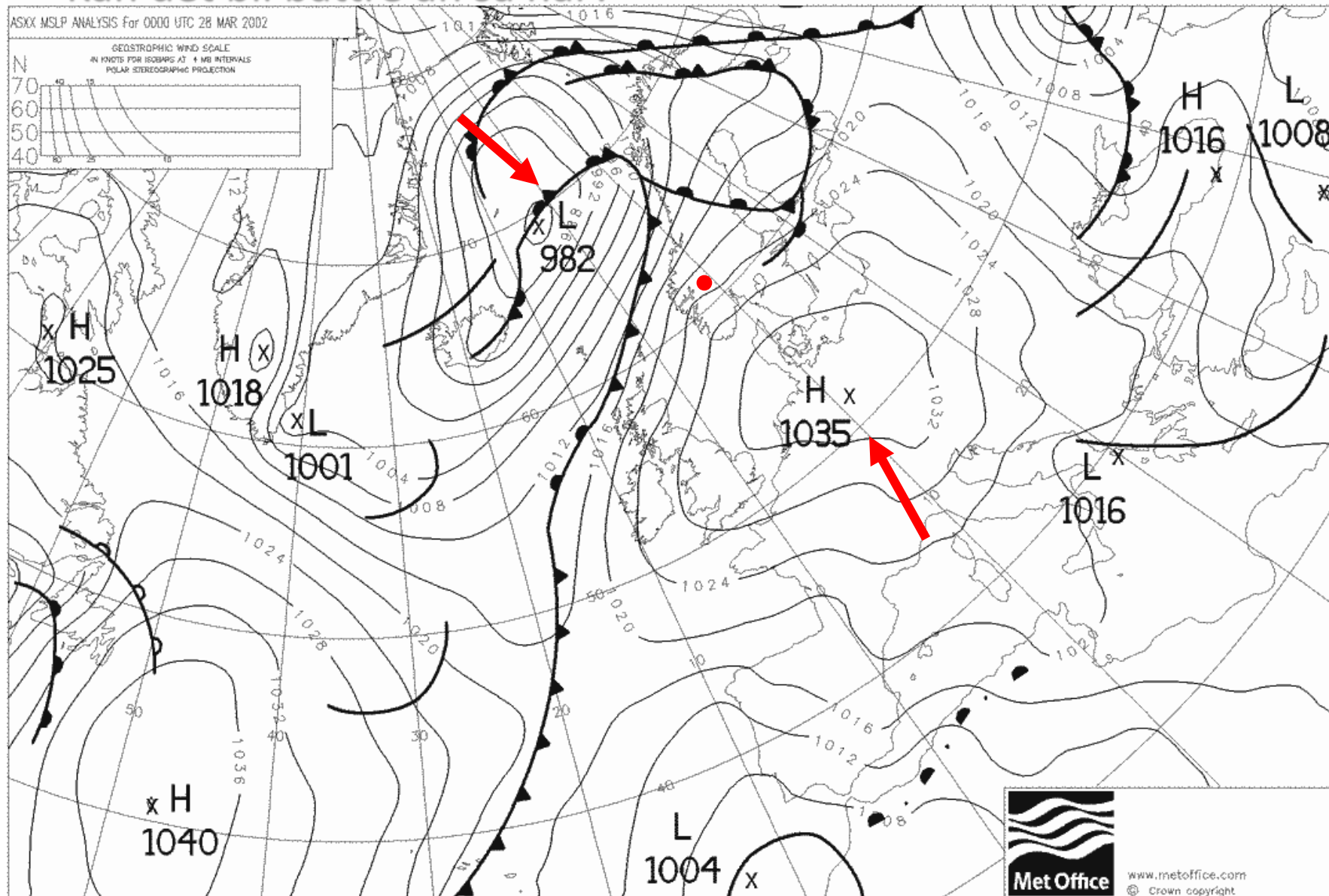
Tidpunkten på dagen?

Barogram

Multiple flights

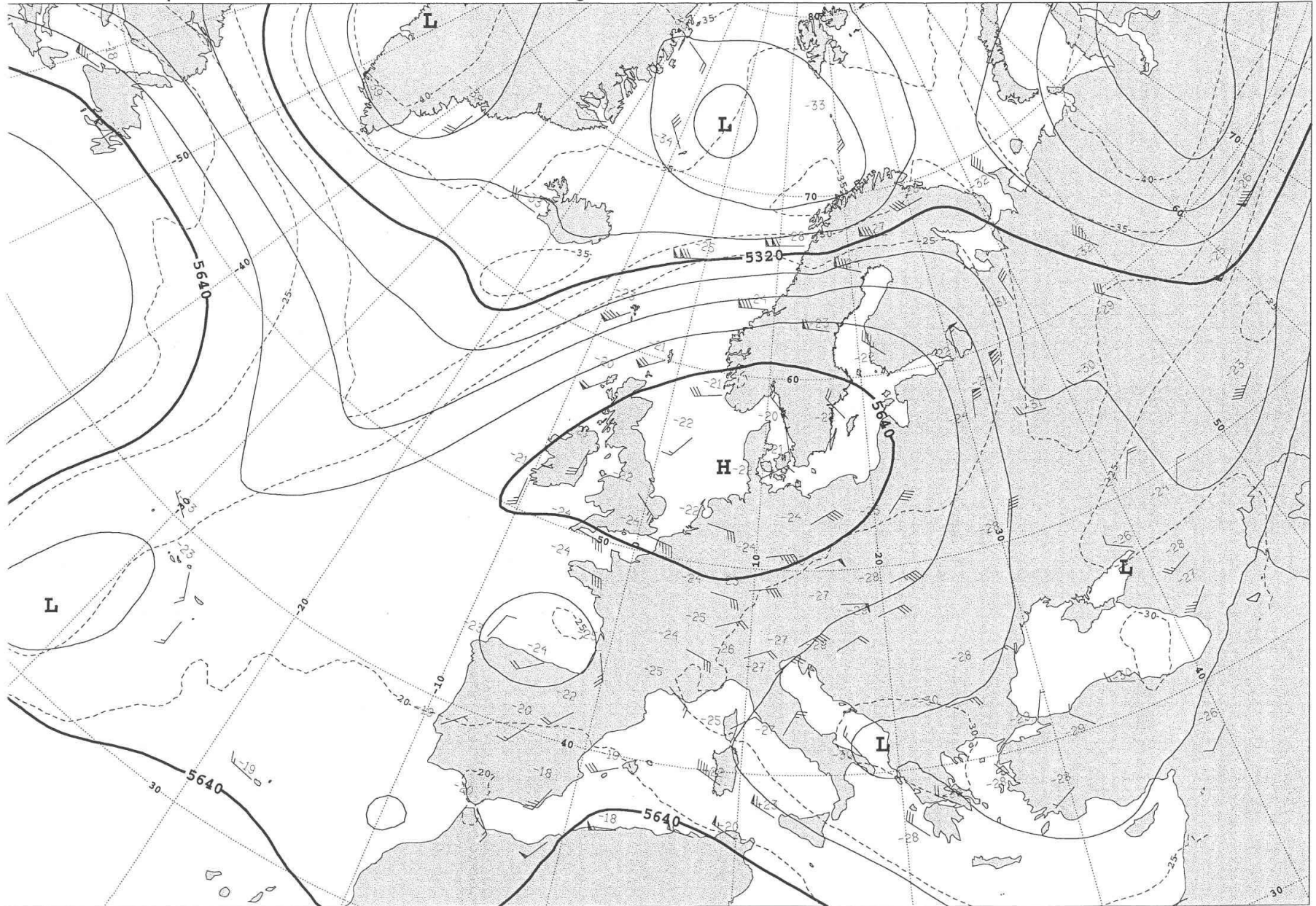


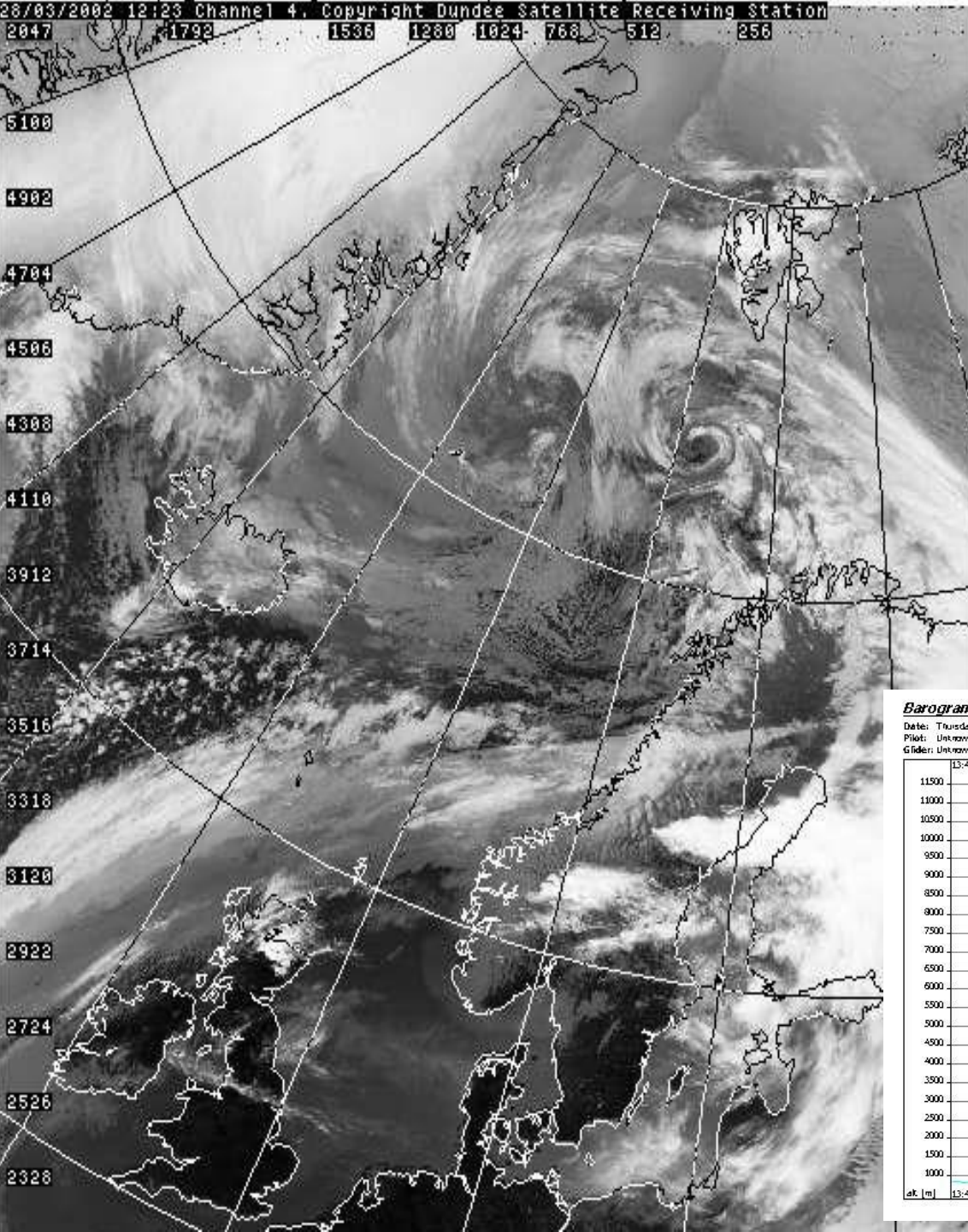
Kan det bli bättre än så här?



GeoPot/Temp 500 hPa

Torsdag 28 mars 2002 12UTC

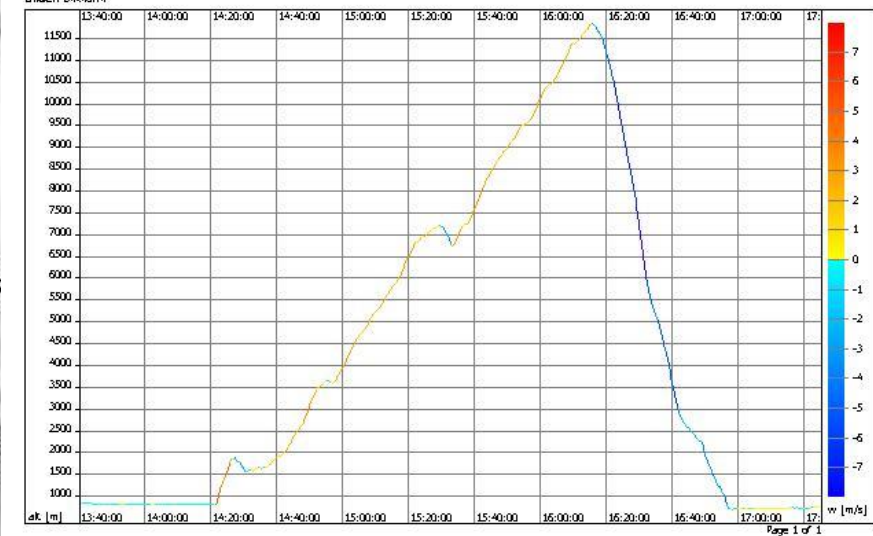




Barogram

Date: Thursday, March 28, 2002
Pilot: Unknown
Glider: Unknown

23se2ee2.jgc



Men.....

O2 haveri!

Föreskrifter för höjdflygning med segelflygplan

Följande föreskrifter gäller vid höjdflygning för såväl moln- som vågflygning.

Under 3000 m

Under 3000 m krävs ingen syrgas. Vid långvarig flygning mellan 2000 m och 3000 m rekommenderas dock att då och då ta några andetag syrgas.

Intervallet 3000 - 4000 m

En flygtid upp till 30 minuter utan syrgas kan accepteras i detta höjdsikt.

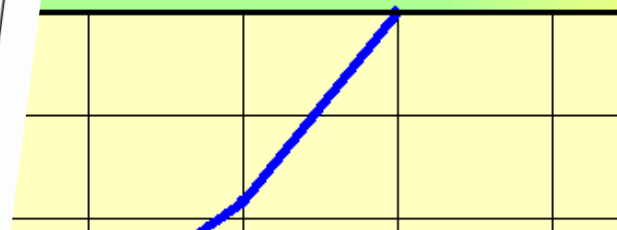
Intervallet 4000 - 7000 m

I detta höjdsikt krävs syrgasandning. Syrgasandningen skall helst påbörjas vid marknivå och absolut lägst vid 3000 m. Under förutsättning att flygningen över 3000 m ej varar längre än en timme accepteras personlig eller fast installerad utrustning. Funktionskontroll av utrustningen skall utföras före varje flygning. Övrig periodiskt underhåll av utrustningen fordras ej.

Vid längre flygning över 3000 m än en timme fordras utrustning och kunskap enligt förutsättningarna i avsnittet "Flygning över 7000 m".

Flygning över 7000 m

Vid flygning över 7000 m fordras godkänd och enligt gällande föreskrifter underhållen flygplansfast utrustning. Utrustningen skall vara godkänd av tillverkaren för användning upp till aktuell flyghöjd. Syrgasmasken skall vara underhållen och täthetsprovad för aktuell pilot. Reservsyrgasutrustning skall också finnas. Föraren bör ha genomgått s.k. undertryckskammarprov för att känna sina personliga reaktioner på syrebrist. Föraren skall också vara väl insatt i syrgasproblematiken på hög höjd. Flygningen skall planeras så att det finns syrgas för minst 30 minuters förbrukning kvar när 3000 m passerats på nervägen.



BESTEMMELSER FOR HØYDEFLYGNING MED SEILFLY

1.0 Innledning

Høydeflygning med seilfly medfører høyere risiko for fly og pilot. En bestemmelse for høydeflygning kan ikke ta for seg alle farene med høydeflygningen. Bestemmelsene kan kun sette noen rammebetingelser som må være oppfylt for å opprettholde en akseptabel risiko. Seilflygeren må ha gode kunnskaper om høydeflygning slik at han/hun tar de rette valgene under flygningen ut i fra de aktuelle forholdene.

2.0 Teorikrav ved flygning over 3500m QNH

Deltatt på et SVEDANOR kurs i fjellflygning eller tilsvarende.

Aktuelle læreverker:

Kompedium fjellflygning
Bølgeflygning

Teorikurs i fjellflygning av Robert Danewid
Presentasjon laget for opplæring i klubbene
(Tilsvare SVEDANOR kurset sammen med teoripsumet)
Bok om hang og bølgeflygning av Jean-Marie Clément

3.0 Oksygen og oksygenutstyr

Oksygenutstyret skal være godkjent av produsenten for bruk opp til aktuell flyhøyde. Utstyret skal være vedlikeholdt etter fabrikantens vedlikeholdsinstruks. Alle batterier skal være fulladet før turen starter. Oksygenutstyret skal være tilpasset og testet for den aktuelle pilot. Funktions-test av oksygenutstyret skal utføres før flygningen. Tilgjengelig oksygen for flyturen skal beregnes. Flygningen skal planlegges slik at det er oksygen for minst 30 minutters forbruk når 3000 m passerers på vei ned.

3.1 Oksygen og oksygenutstyr under 3500 m QNH

Piloten skal ha kunnskaper om oksygenmangel ved lavere høyder enn 3500m QNH. Ved flygning under 3500 meter kreves det ikke oksygen. Det anbefales likevel at det tilføres litt oksygen ved flygning mellom 1500 og 3500 meter for å opprettholde oksygenmetningen i blodet.

3.2 Oksygen og oksygenutstyr mellom 3500 m og 7000 m QNH

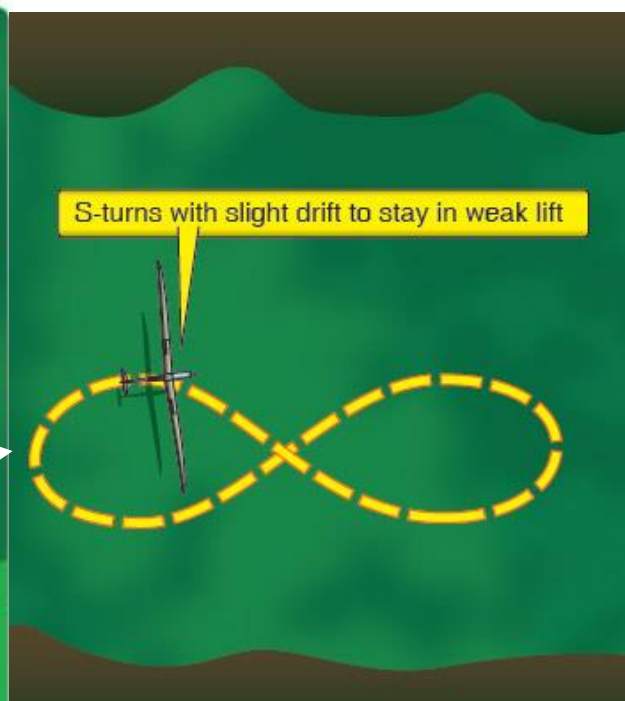
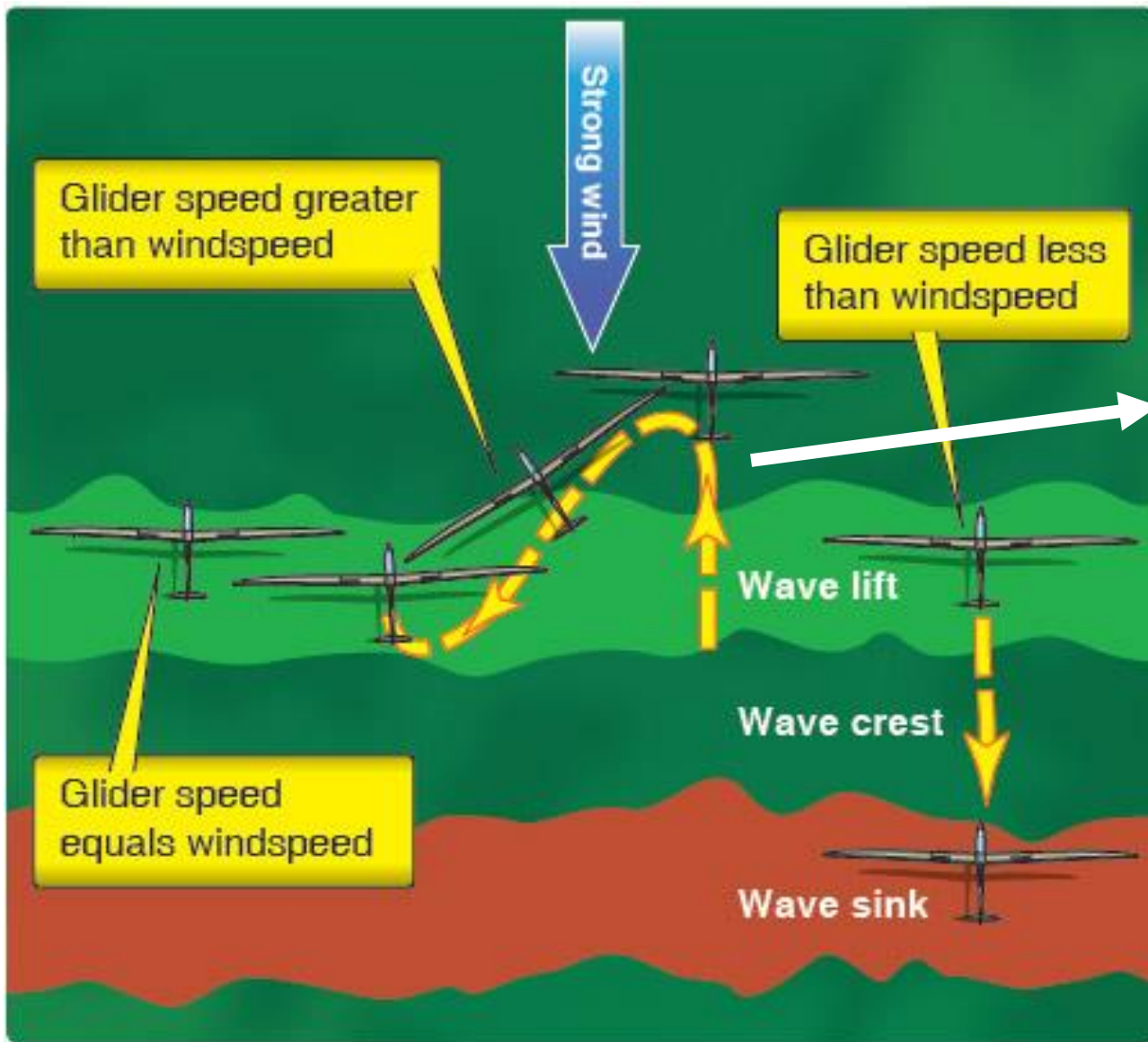
Det er krav til bruk av oksygenutstyr. Pusting av oksygen bør påbegynnes ved bakkenivå og senest ved 1500 m. Alle om bord skal ha grundige kunnskaper om oksygenmangel og trykkløshet, og kjenne de fysiologiske begrensningene for flygning i store høyder.

3.3 Oksygen og oksygenutstyr over 7000m QNH

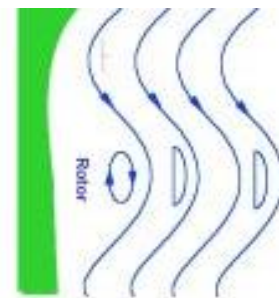
Det skal brukes et dobbelt oksygensystem som er fastmontert. Svikter det ene systemet skal det andre kunne ta over automatisk. Pusting av oksygen skal påbegynnes ved bakkenivå og avsluttes ved bakkenivå. Alle om bord skal ha grundige kunnskaper om oksygenmangel og trykkløshet, og kjenne de fysiologiske begrensningene for flygning i store høyder. Alle om bord skal ha gjennomgått trening i lavtrykkskammer for å kjenne sine personlige reaksjoner på oksygenmangel.

Idé Sakka

Flygteknik

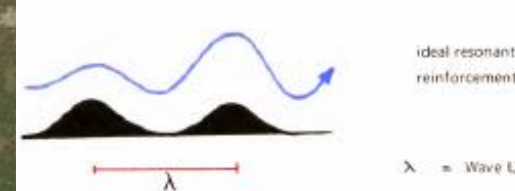


Alltid sväng
upp i vind



Vågen är geostationär, driver ej med vinden

Exempel



Lom

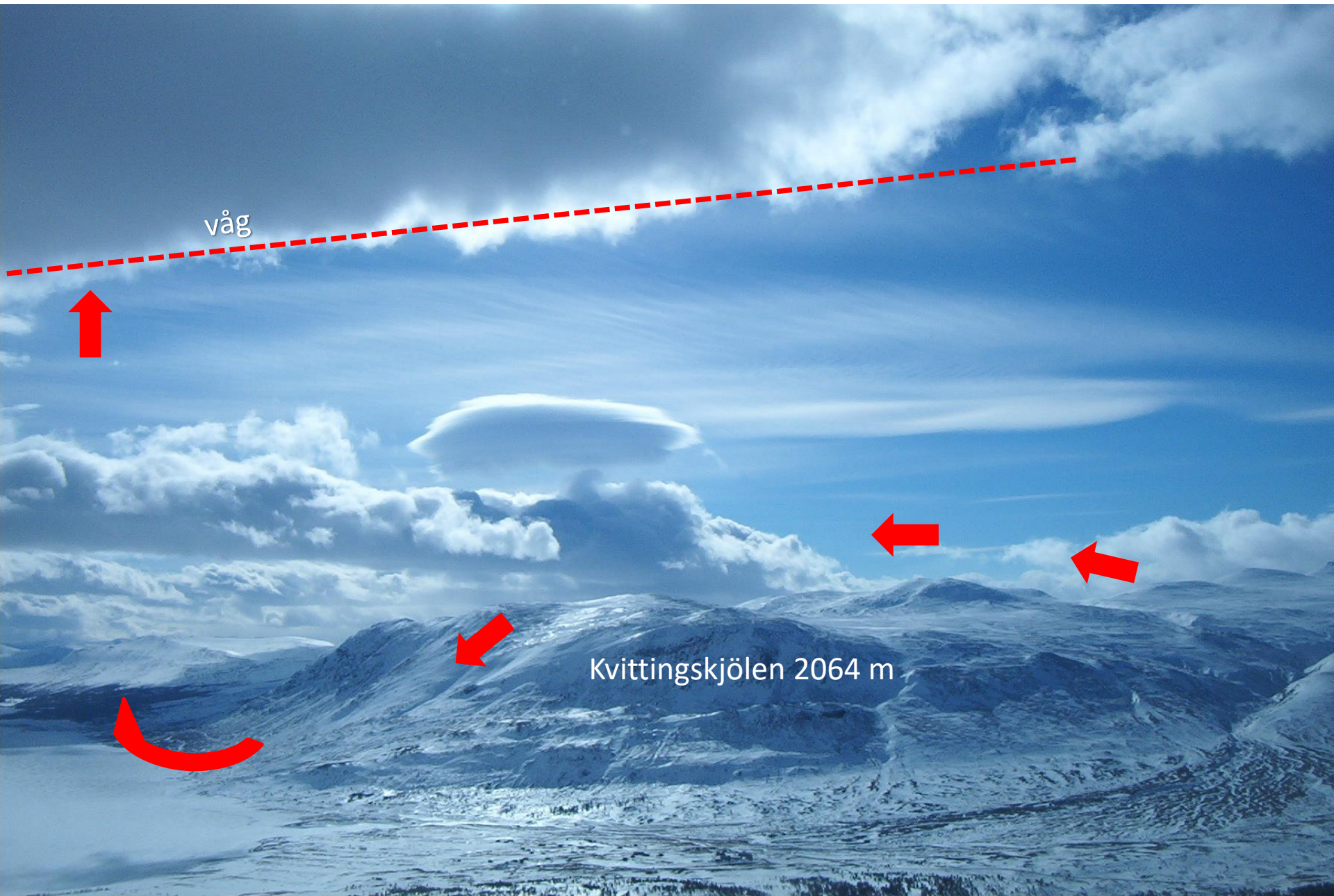
Randen

VAGA IS

Kvittingskjölen 2064 m



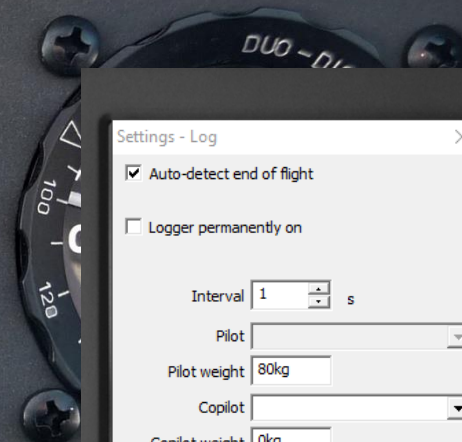
*"Tesse-
bölgen"*



våg

Kvittingskjölen 2064 m

Loggern kan stanna!



LN-GAO

Altitude		V _{NE} (IAS)		
m	ft	km/h	kt	mph
0-2000	0-6562	262,8	142	163
3000	9843	253	137	157
4000	13123	241	130	150
5000	16404	228	123	142
6000	19685	215	116	134

Settings - Log

☒ Auto-detect end of flight

☐ Logger permanently on

Interval 1 s

Pilot

Pilot weight 80kg

Copilot

Copilot weight 0kg

Glider Default

Registration

Comp. ID

Class

Launch type Tow or wind

OK

Cancel

Page

Keyb

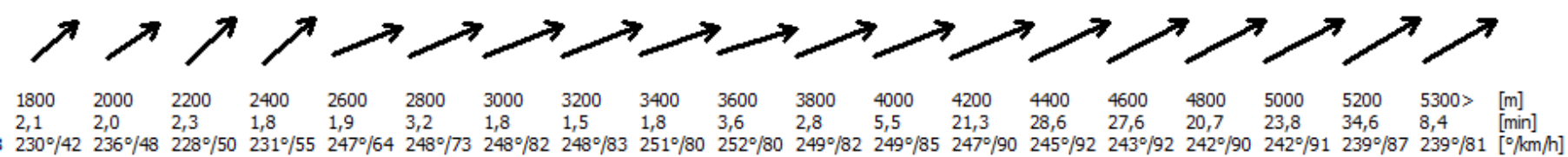
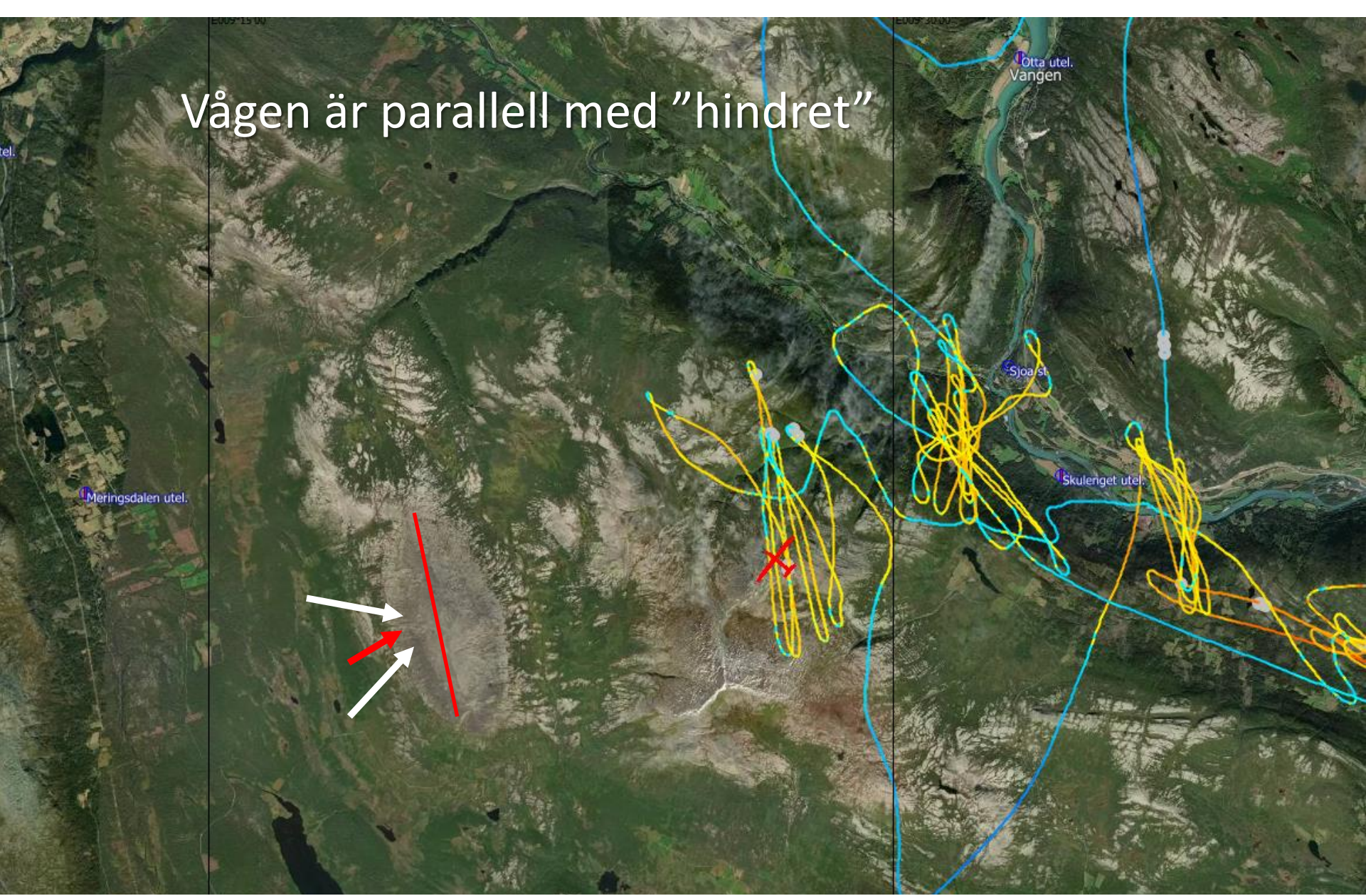
navTijer

Max Speed Limit for high altitude

Altitude m (ft)	V _{NE} IAS (km/h)
0 - 5000	270
< 6000	258
< 7000	242
< 8000	228
< 9000	218
< 10000	202



Vågen är parallell med "hindret"





Svårt att "fånga"
vinden vid vågflygning



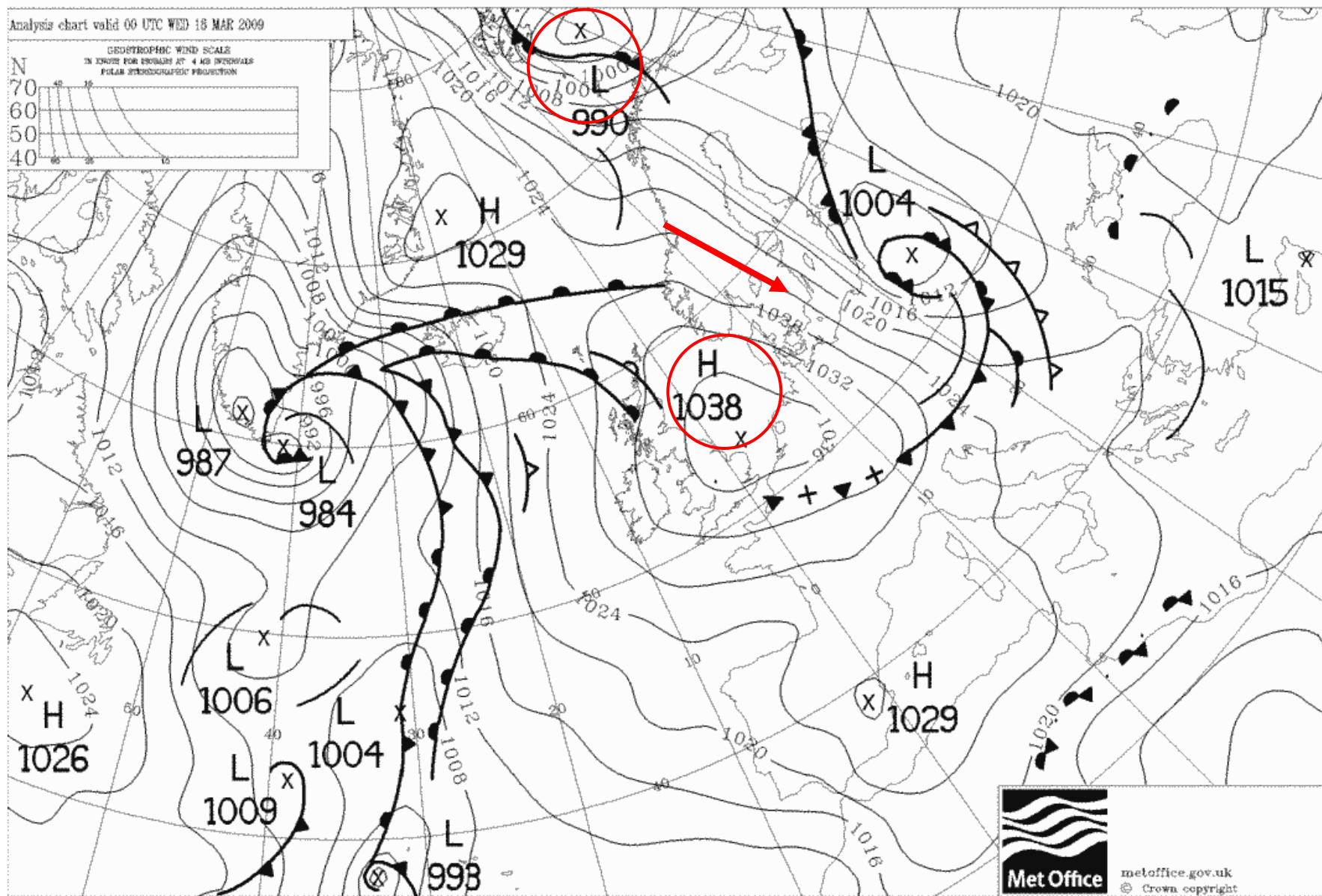
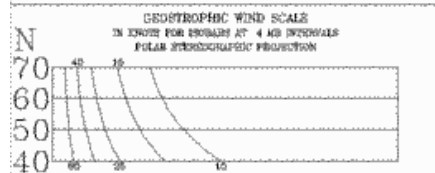
En vågflygning

(aptitretare)

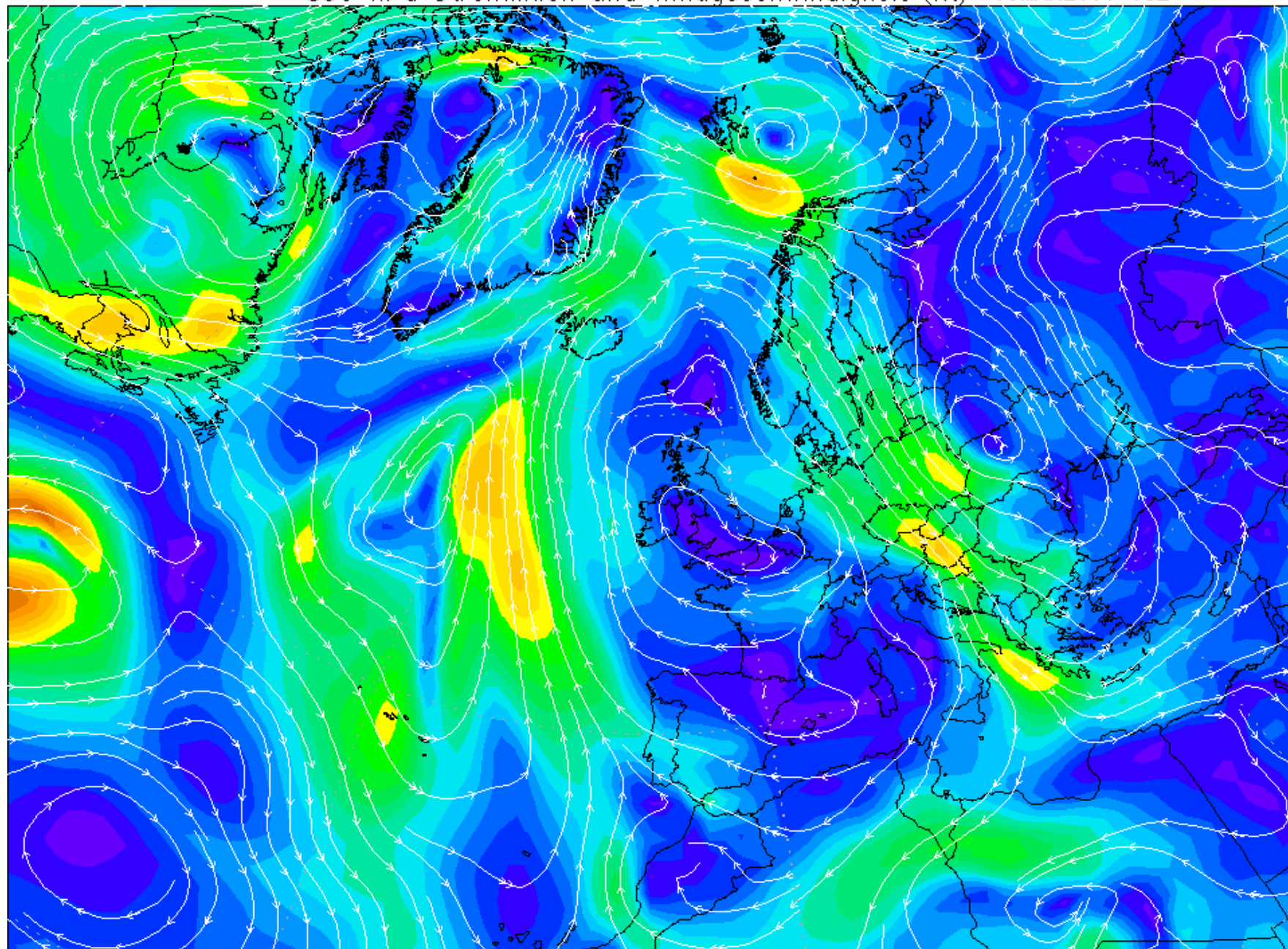
”Vågå International”
Världens största flygfält,
2 x 25 km



Analysis chart valid 00 UTC WED 18 MAR 2009



metoffice.gov.uk
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Data: NOAA reanalysis 1.000°

(C) Wetterzentrale

www.wetterzentrale.de

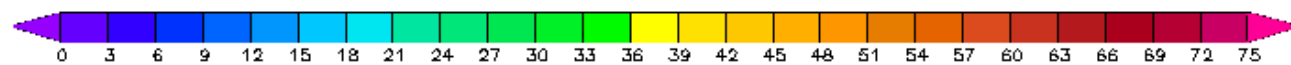
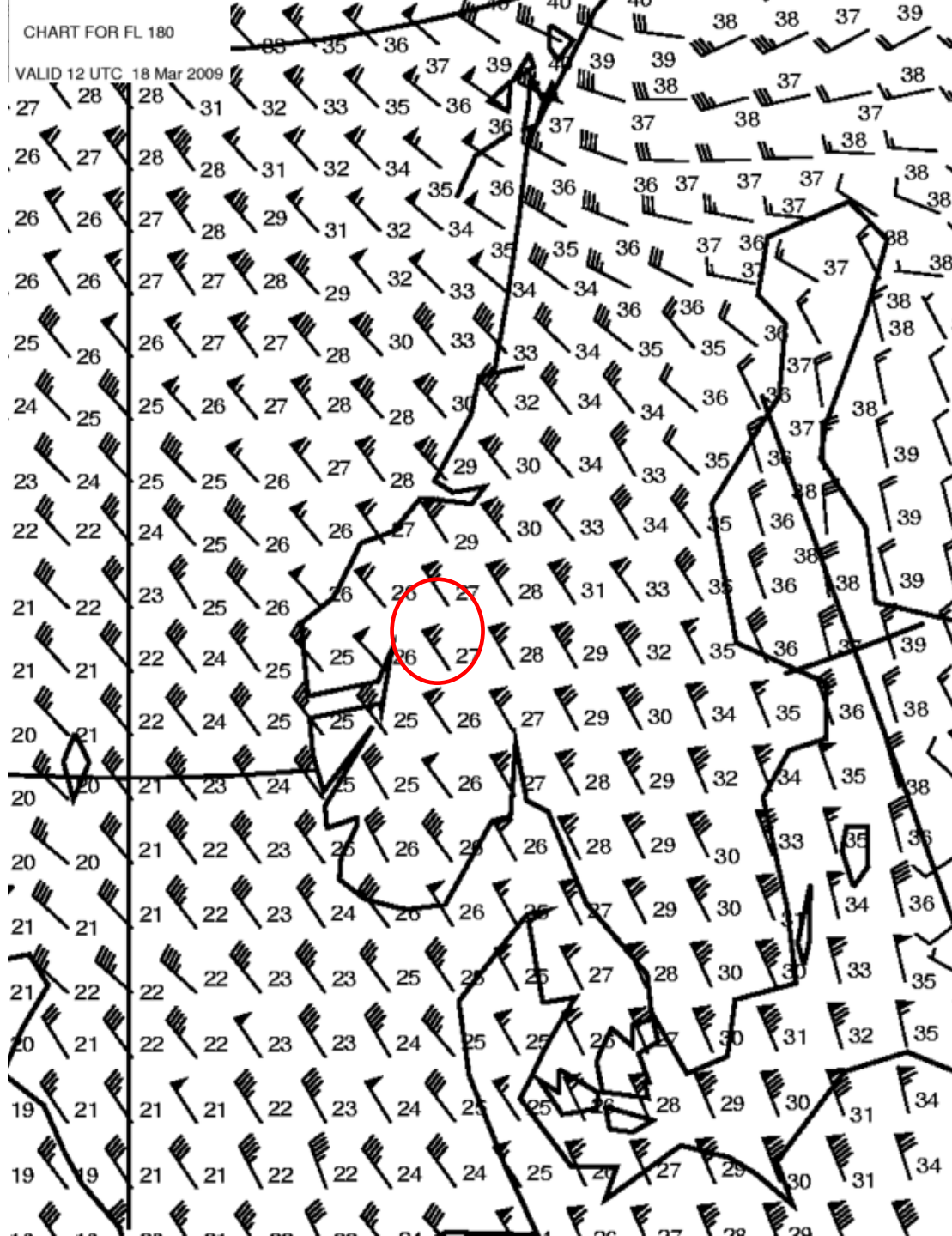
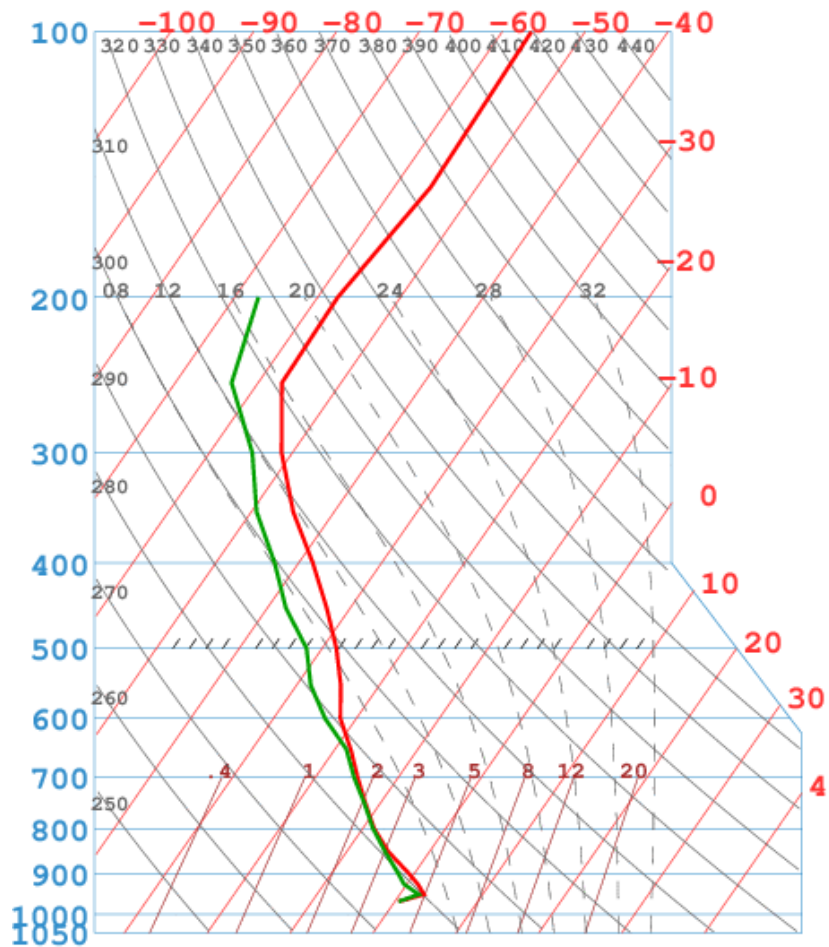


CHART FOR FL 180

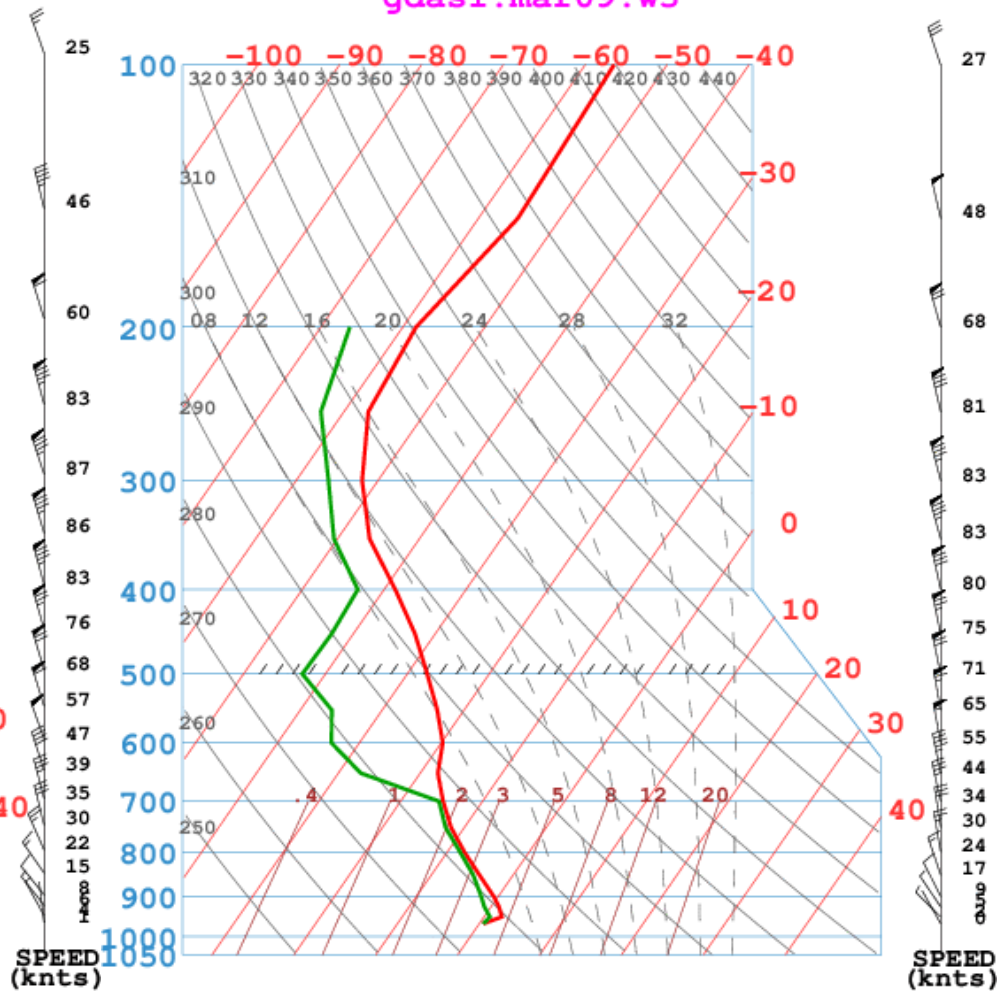
VALID 12 UTC 18 Mar 2009



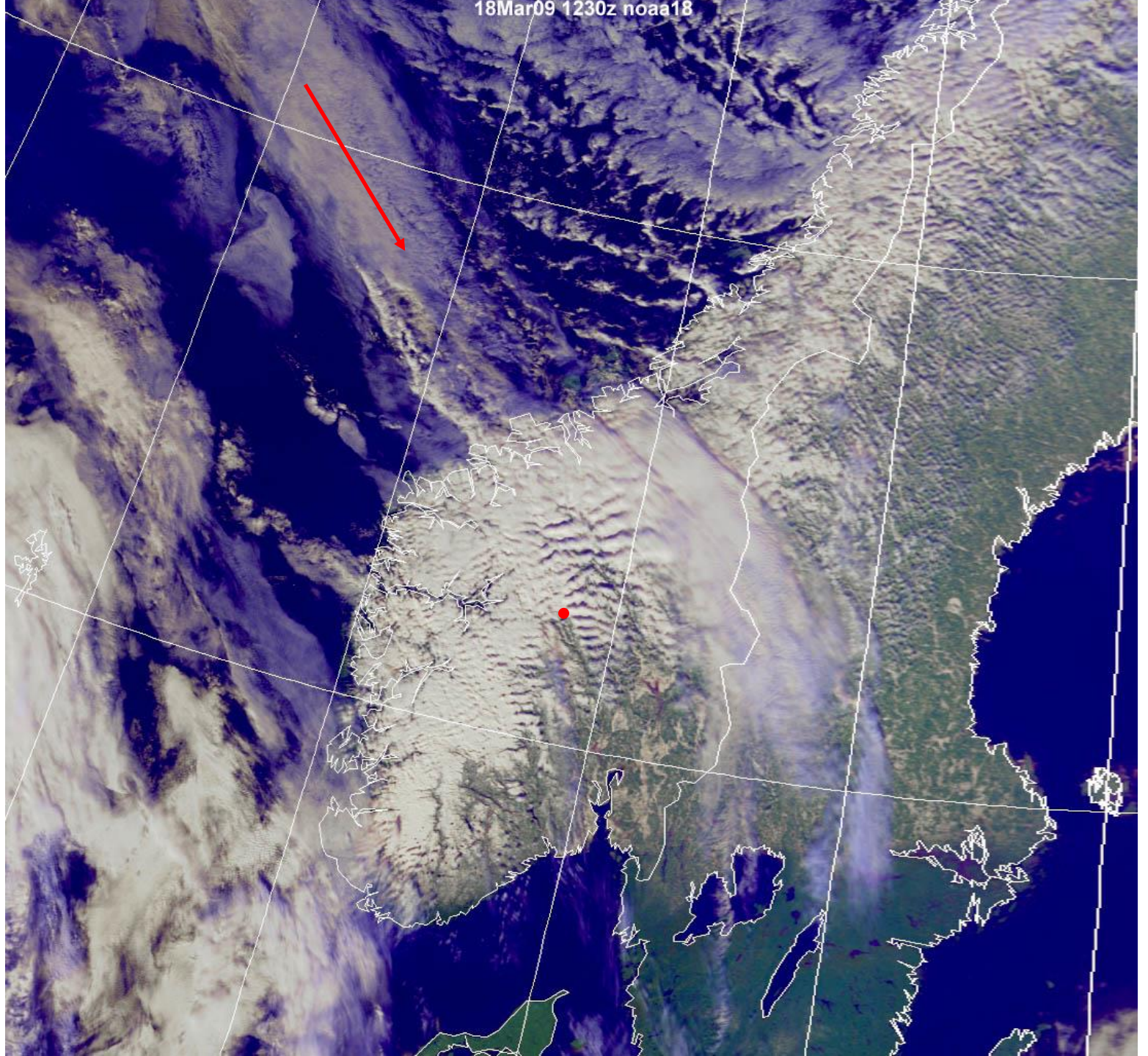
gdas1.mar09.w3

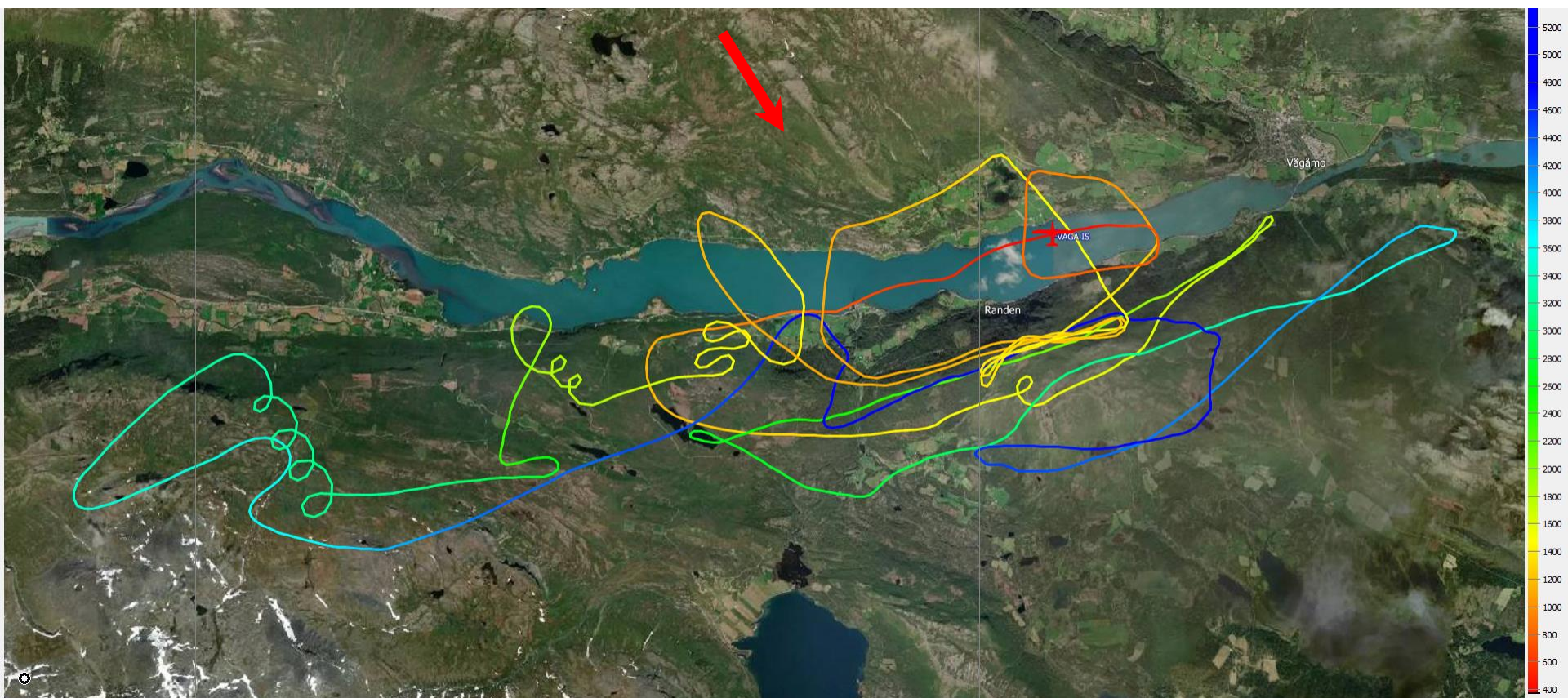


gdas1.mar09.w3

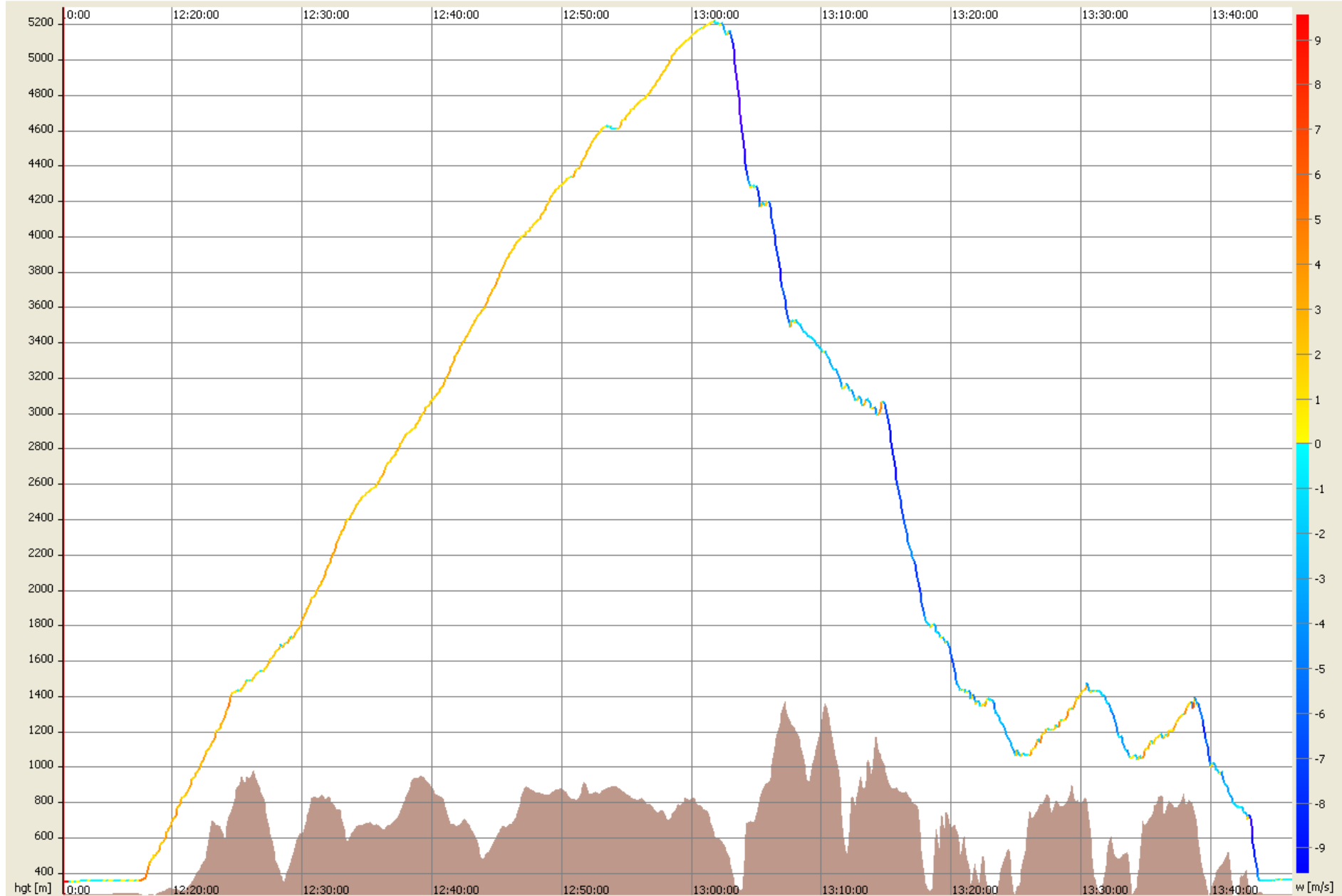


18Mar09 1230z noaa18



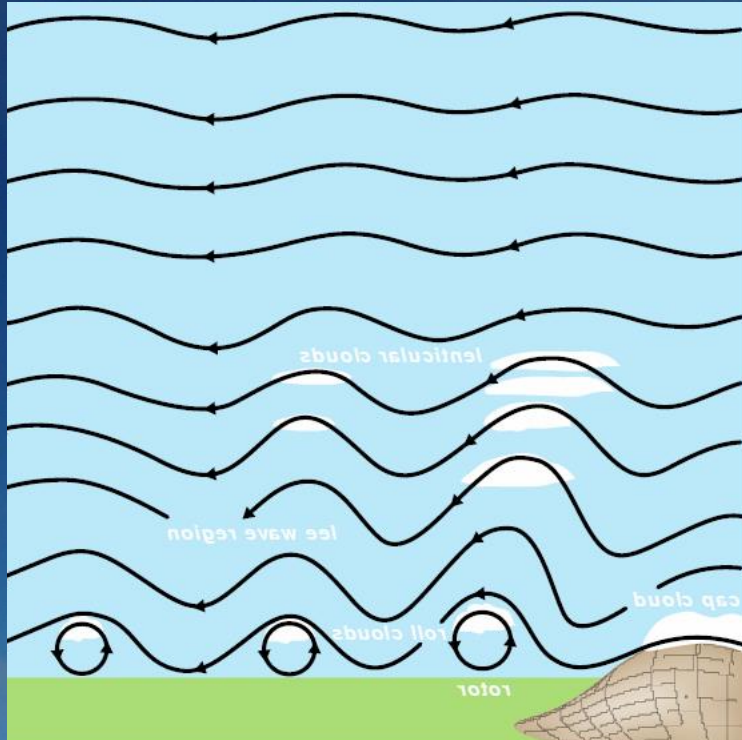


Dagens uppgift: träna hangflygning



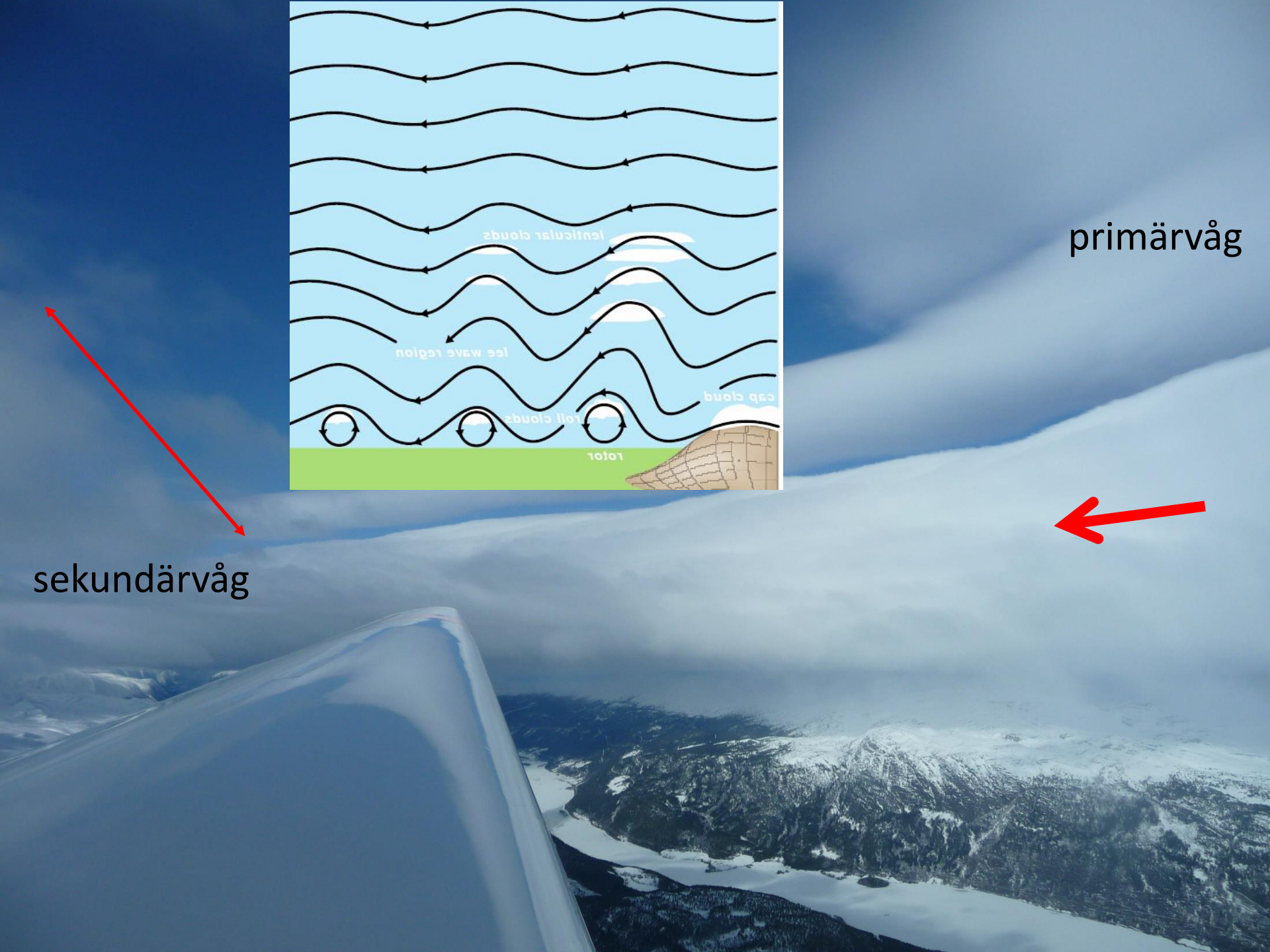


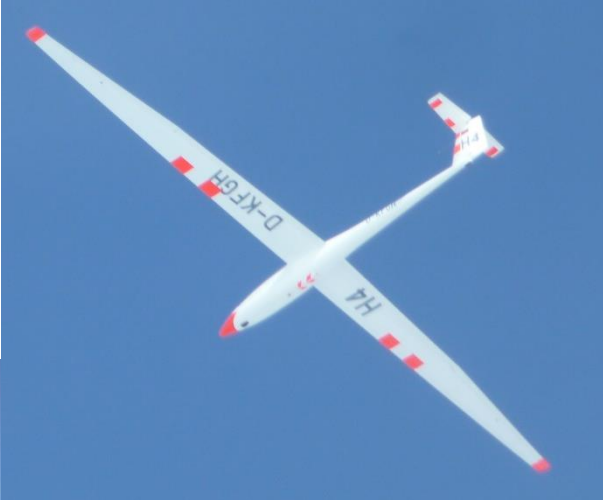




primärvåg

sekundärvåg









Visst är det vackert?



Kallt...???

Det är friskt,
men ack så
vackert!







Fjällflygkurser i Ottsjö och Vågå -
rekommenderas

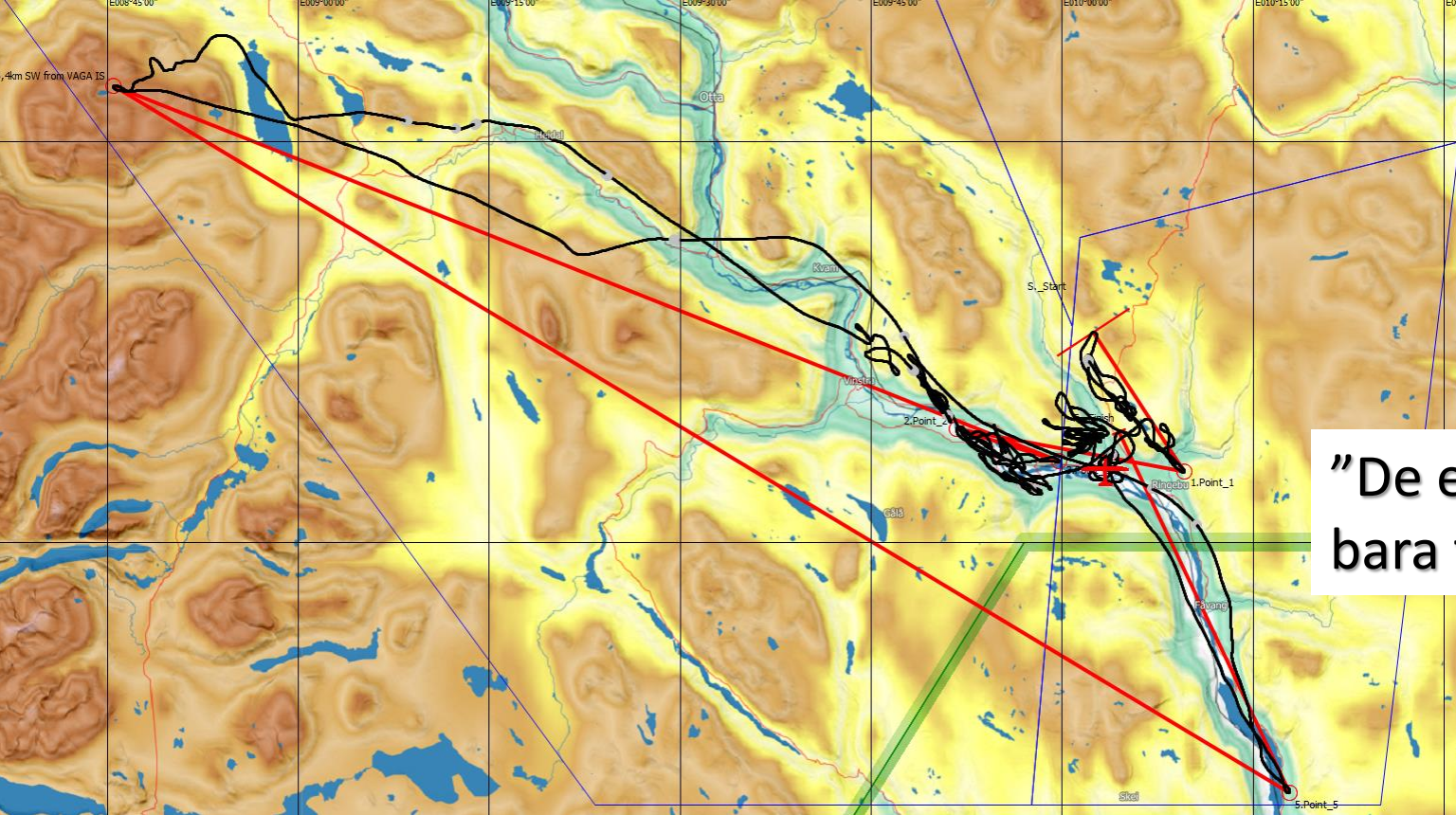
Filosofiskt

Varför flyger vi så lite
sträcka i våg?



På vårvintern
ingenstans att landa

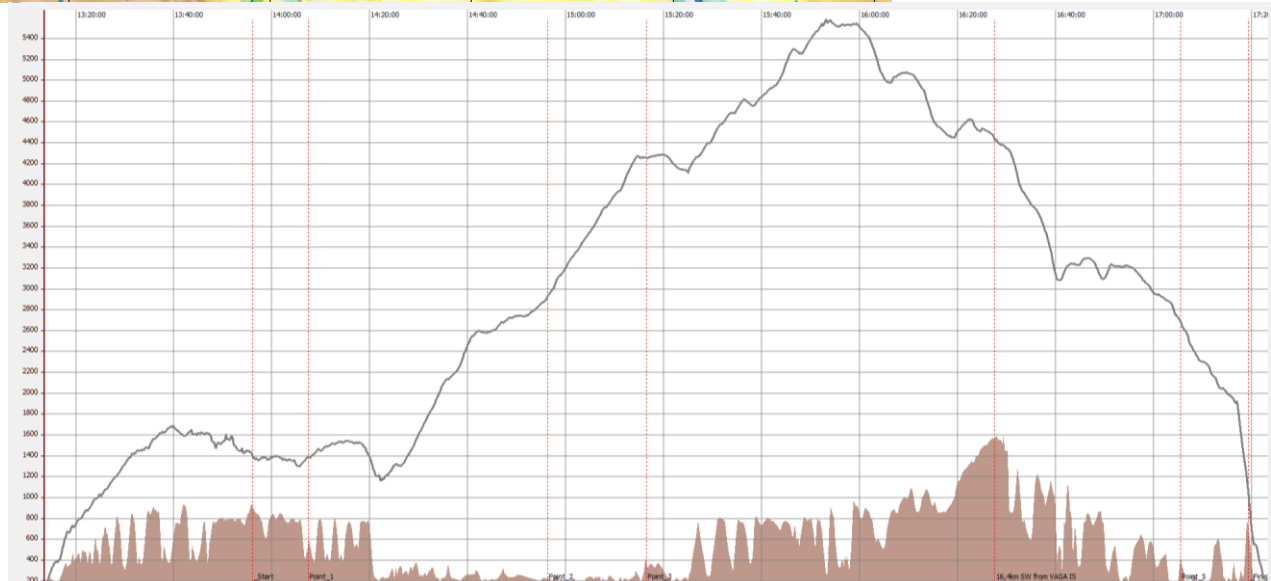




Ca 25 mil

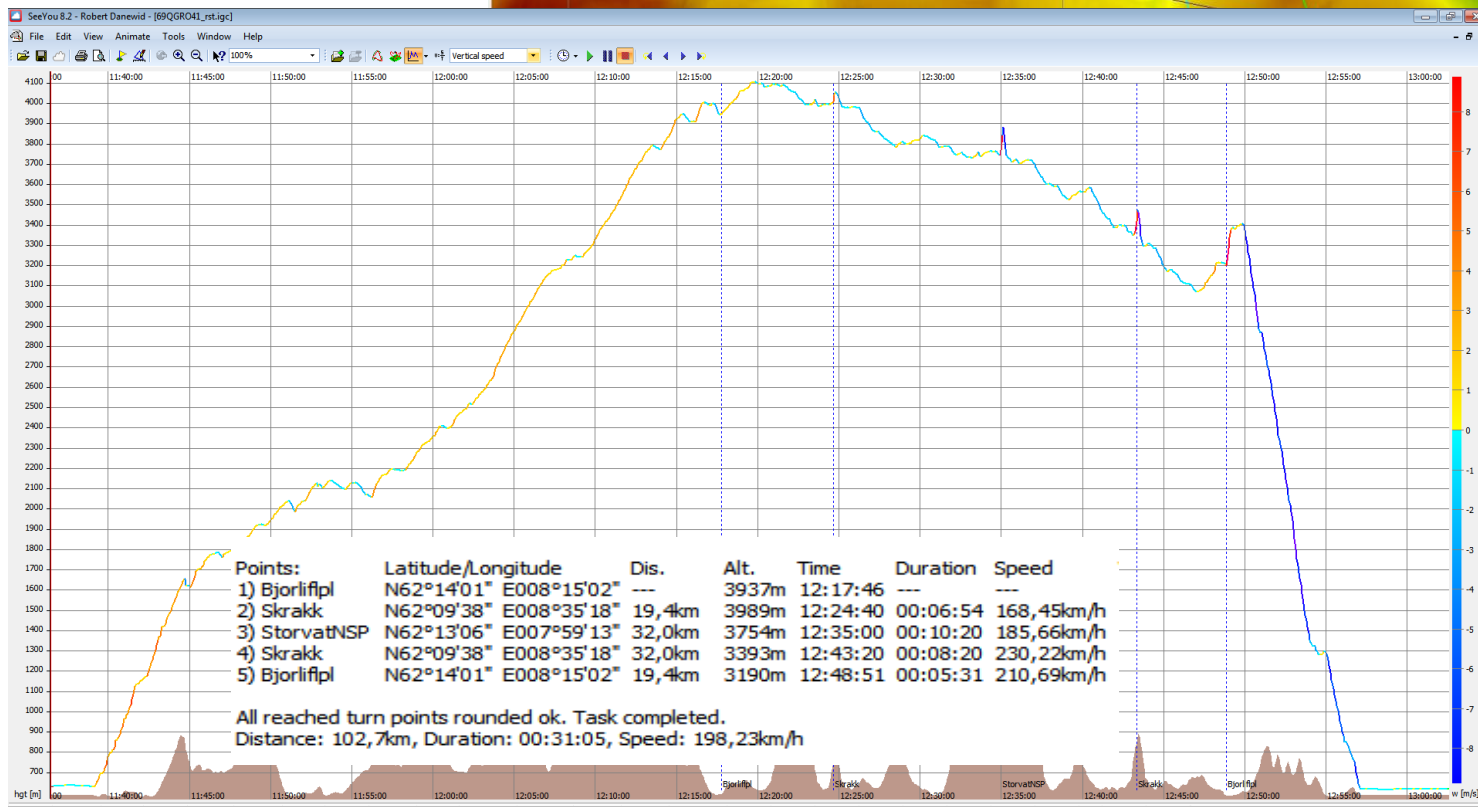
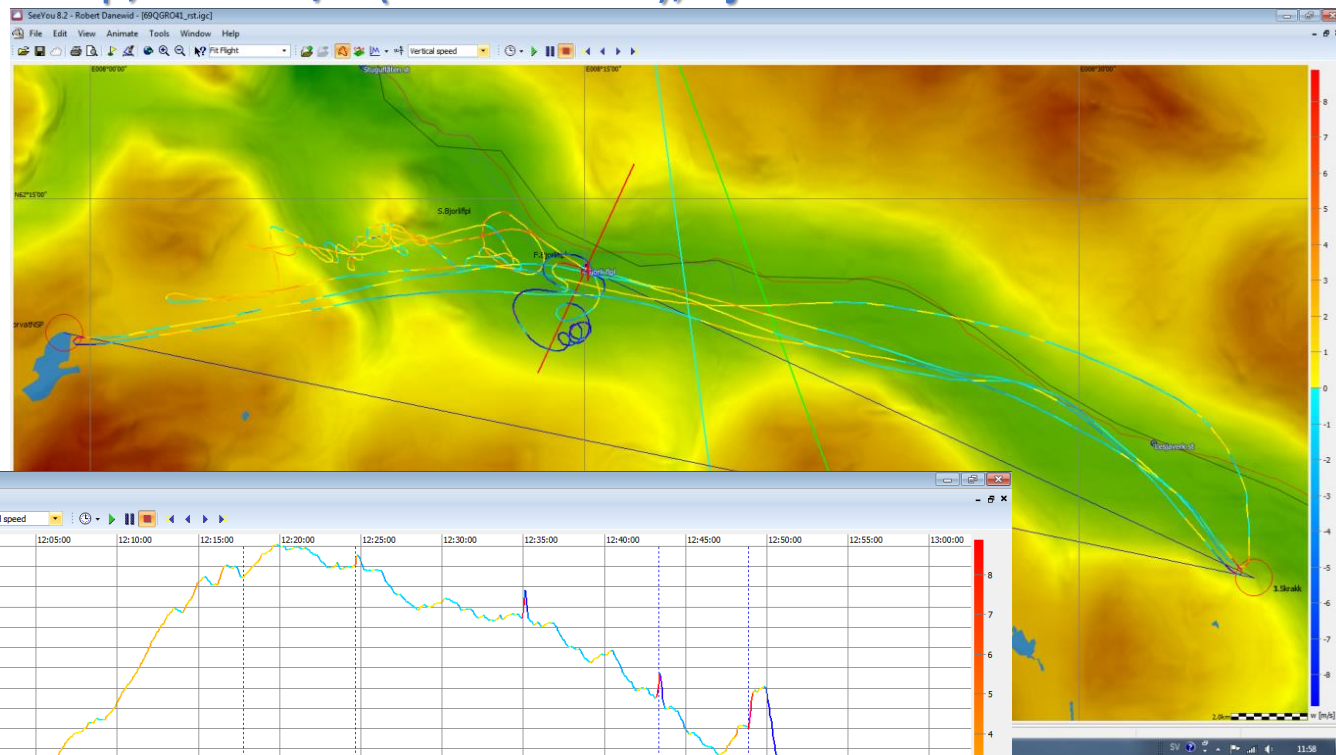
"De e' gött å
bara flyga bölja"

På hösten blir det
bara så

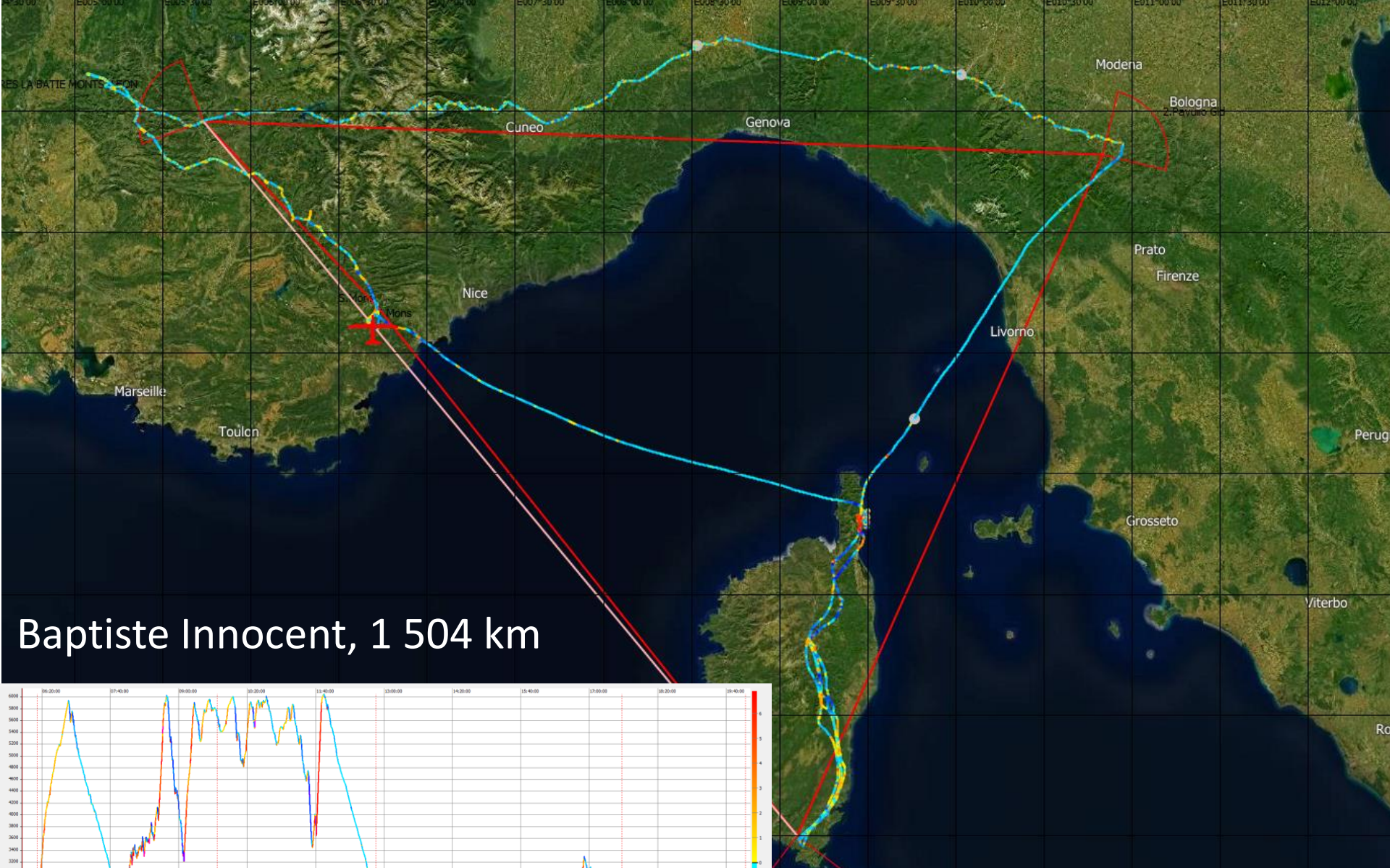


Årets snabbaste flygning 2016

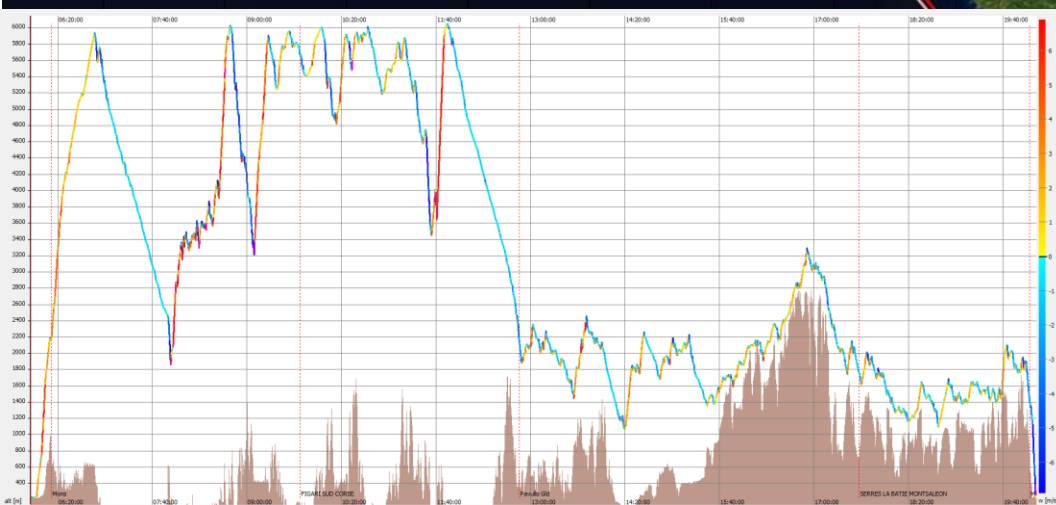
Lars-Göran Uhr, 26 sep, 198 km/h (102.7 km FB), Bjorli



SEGEFLYGET



Baptiste Innocent, 1 504 km





General information

Date of flight: 2002-06-19
File integrity: Unknown?

Pilot name: Helmut J. Rohs + Robert Fe Ler
Glider type: NIMBUS 3DM
Competition class: OFFEN
Registration: D-KTTT
Competition number: AS

Takeoff: 12:03:54 at 216m (Sunrise: 03:37)
Soaring begin: 12:10:32 at 880m
Soaring end: 10:52:12 at 935m
Landing: 12:01:33 at 166m (Sunset: 22:51)
Duration: 23:57:39
Engine time: 00:29:07

Declared Task - Polygon with 5 points

Declaration is NOT VALID!
Date/Time: 2022-01-26 20:13:29
Type: Polygon with 5 points
Task distance: 1355,0km

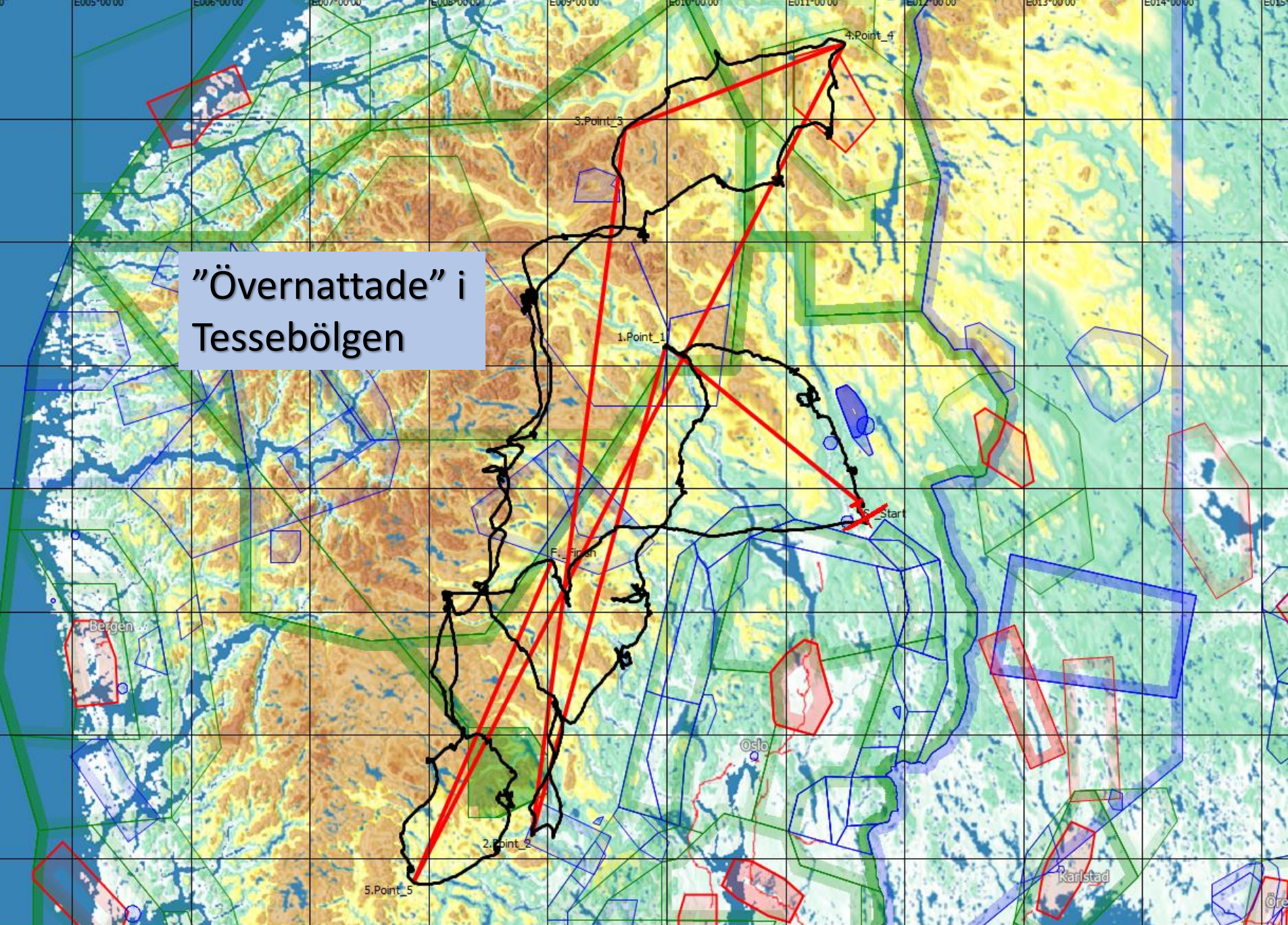
Points:	Latitude/Longitude	Dis.	Alt.	Time	Duration	Speed	Wind	WindComp
1) _Start	N60°55'54" E011°39'20"	---	1521m	12:18:02	---	---		
2) Point_1	N61°34'59" E009°59'43"	114,9km	2033m	14:46:20	02:28:18	46,50km/h		
3) Point_2	N59°35'40" E008°51'47"	230,1km	4445m	19:04:06	04:17:46	53,56km/h		
4) Point_3	N62°27'33" E009°38'55"	322,0km	4786m	22:05:33	03:01:27	106,49km/h		
5) Point_4	N62°48'32" E011°29'27"	102,2km	3996m	22:51:28	00:45:55	133,58km/h		
6) Point_5	N59°24'19" E007°52'04"	426,5km	3251m	07:24:47	08:33:19	49,85km/h		
7) _Finish	N60°42'36" E009°02'07"	159,3km	1611m	10:26:39	03:01:52	52,54km/h		

All reached turn points rounded ok. Task completed.
Distance: 1355,0km, Duration: 22:08:37, Speed: 61,19km/h



Norge, Elverum
1355 km @ 61 km/h
Flygtid **23 tim 57 min**

"Övernattade" i Tessebølgen





Perlan II



För proffs!

härligt, härligt
men
farligt, farligt

**BE
CAREFUL**

THIS GLIDER HAS NO BRAIN
USE YOUR OWN