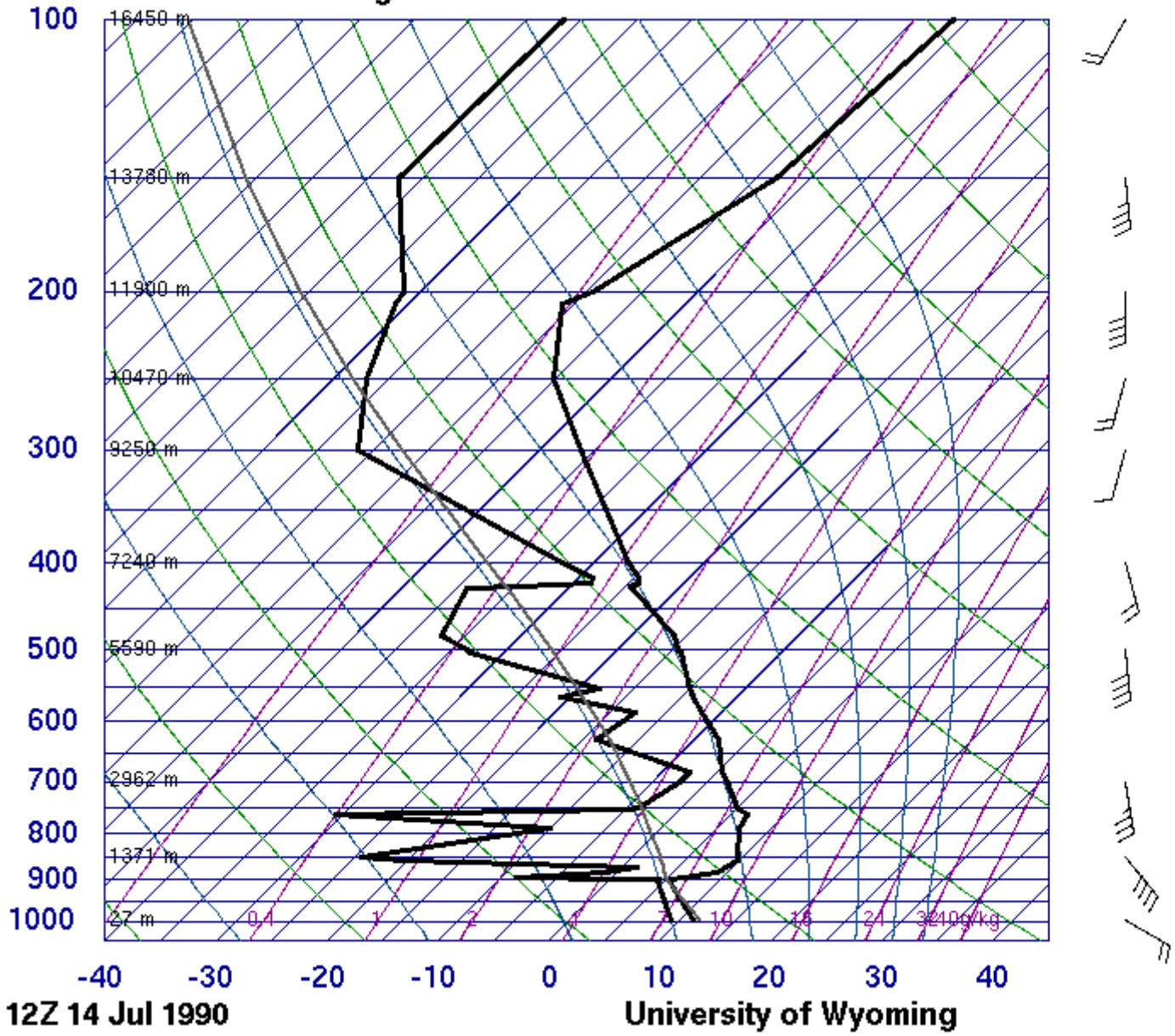
- Haraldur Ólafsson, Hálfdán Ágústsson, Guðrún Nína Petersen, Andréa Massad, Ólafur Rögnvaldsson, Marius O. Jonassen, Birta Líf Kristinsdóttir, Andreas Dörnbrack, Jón Egill Kristjánsson, Mel Shapiro, Idar Barstad, Sigurður Jónsson

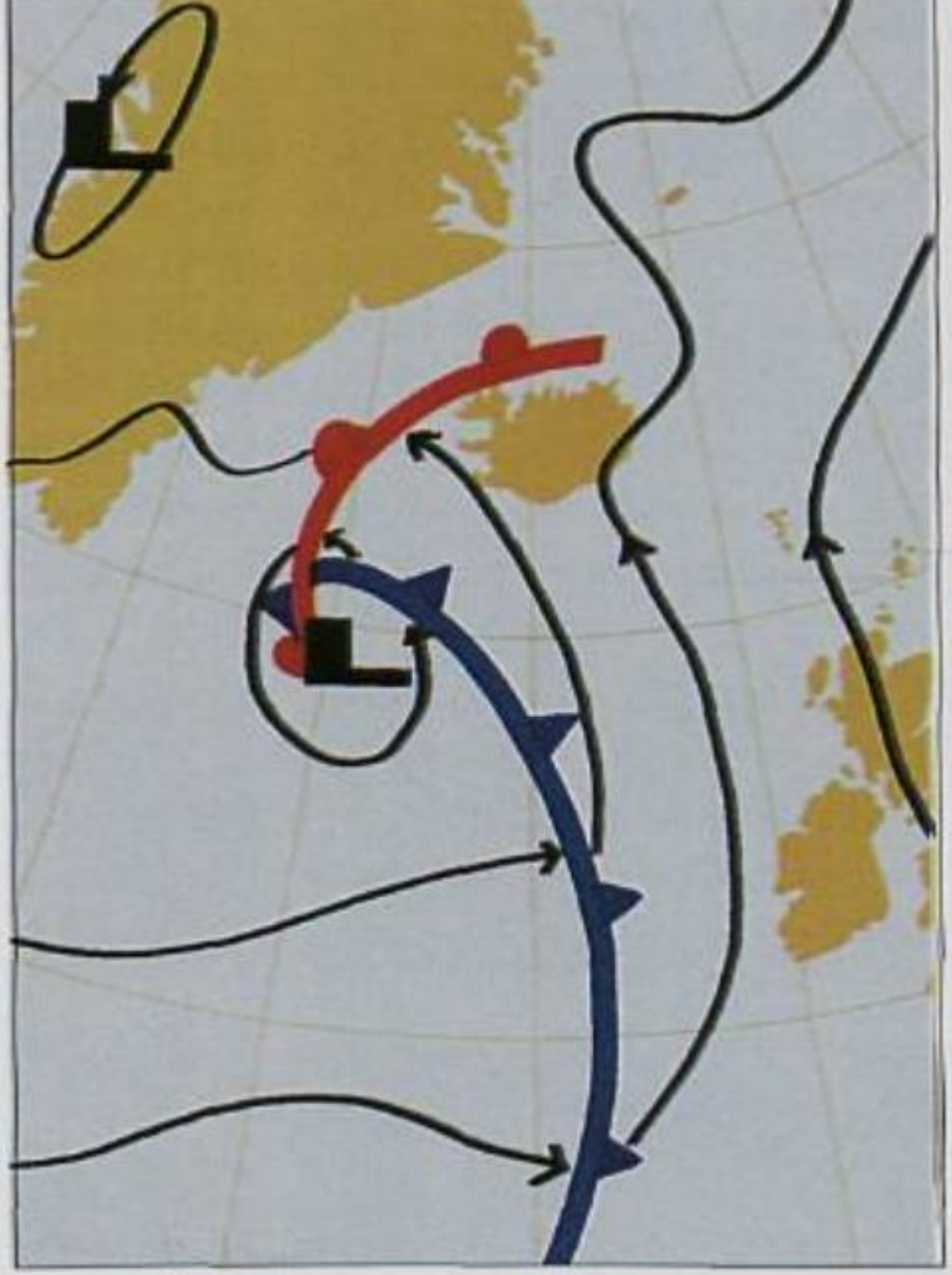
Hitahvörf

Photo: Olafur Sigurjonsson

04018 BIKF Keflavikurflugvollur



SLAT	63.95
SLON	-22.60
SELV	54.00
SHOW	15.67
LIFT	11.35
LFTV	11.28
SWET	113.9
KINX	-4.60
CTOT	-9.90
VTOT	24.10
TOTL	14.20
CAPE	0.00
CAPV	0.00
CINS	0.00
CINV	0.00
EQLV	-9999
EQTV	-9999
LFCT	-9999
LFCV	-9999
BRCH	0.00
BRCV	0.00
LCLT	280.6
LCLP	945.5
MLTH	285.1
MLMR	6.93
THCK	5563.
PWAT	17.70



9. mynd. Veðurkort frá hádegi 14. júlí 1990. Hitaskil eru rauð og kuldaskil blá.

HARALDUR ÓLAFSSON

VINDSTRENGIR OG SKJÓL VIÐ FJÖLL

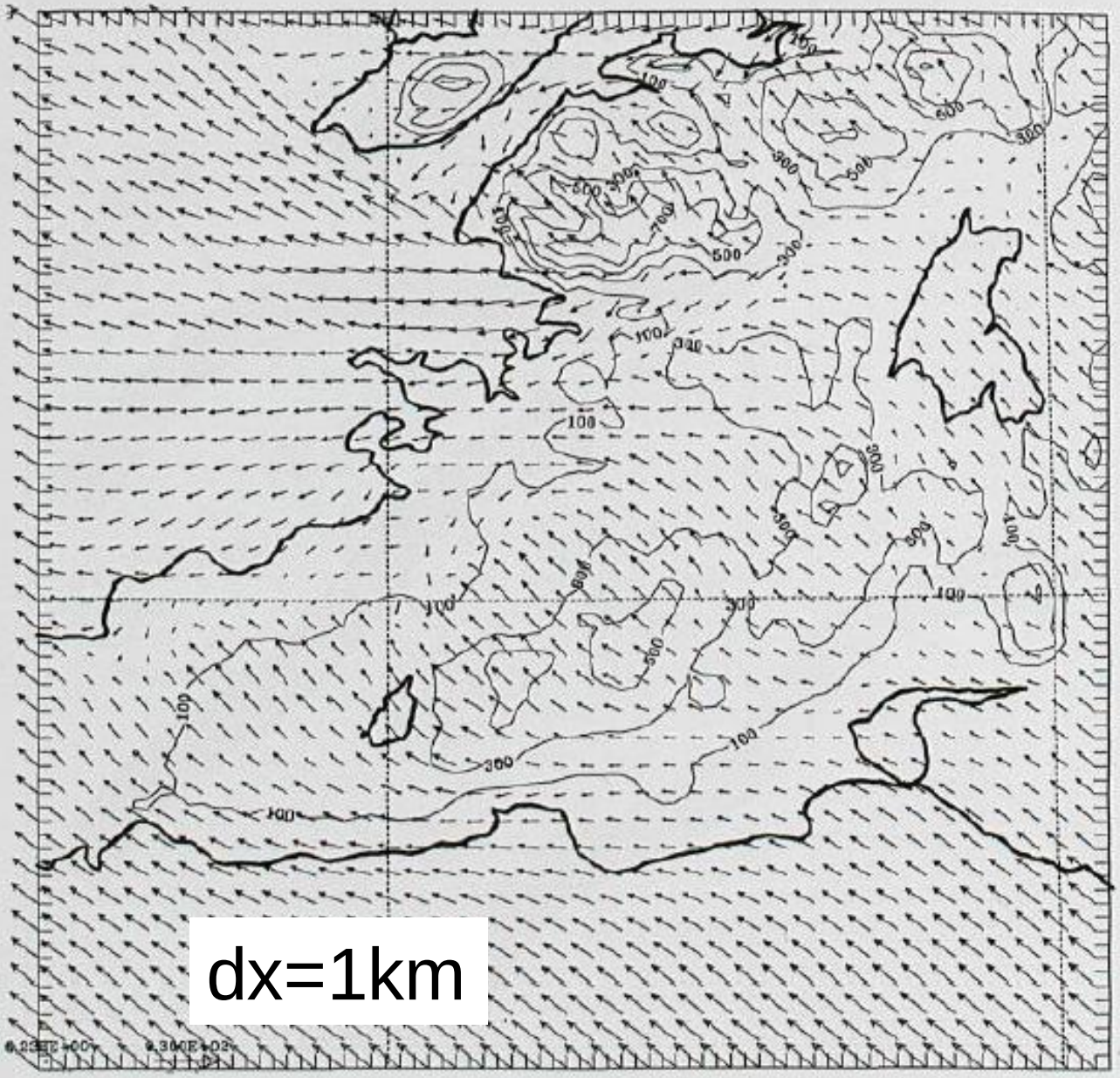
Ungmennafélagsveðrið 14. júlí 1990

Með aðstoð reiknilíkans er gerð grein fyrir vindstreng sem myndaðist sunnan og suðvestan undir Esju þann 14. júlí 1990. Veðrinu er lýst og er það tengt fjalllendi sem suðaustanáttin gat ekki klifið sökum lítils hitafalls með hæð. Þess í stað myndaðist vindstrengur þar sem loftið leitaði framhjá fyrirstöðunni. Ólíkt óveðri í Kverkfjöllum, sem lýst er í 3.–4. hefti 66. árg. Náttúrufræðingsins, myndast þessi vindstrengur þar sem vindur blæs samsíða fjallgarði. Tilurð vindstrengja af þeirri gerð, sem og skjóls, er útskýrð m.a. með tilvísun í straum loftmassa sem lesa má úr veðurkortum. Í framhaldi af reiknitilrauninni er meðalvindhraði í ýmsum áttum á Þingvöllum borinn saman við meðalvindhraða á öðrum veðurstöðvum suðvestanlands. Raunverulegt veður á Íslandi hefur ekki áður verið reiknað með þeirri nákvæmni sem hér er viðhöfð.

ÓVEÐRIÐ

Hinn 14. júlí 1990 héldu ungmennafélögin landsmót í Mosfellsbæ (1. mynd). Um hádegi er kaldi af suðaustri, léttskýjað og fremur hlýtt í veðri. Er líður á daginn vex vindur og sandur og mold rjúka upp í hviðum. Um fimmleytið hvessir fremur snögglega og er þá ekki lengur stætt. Tjöld taka að fjúka og tjaldvagnar takast á loft og berast með vindi. Með kvöldinu lægir svo

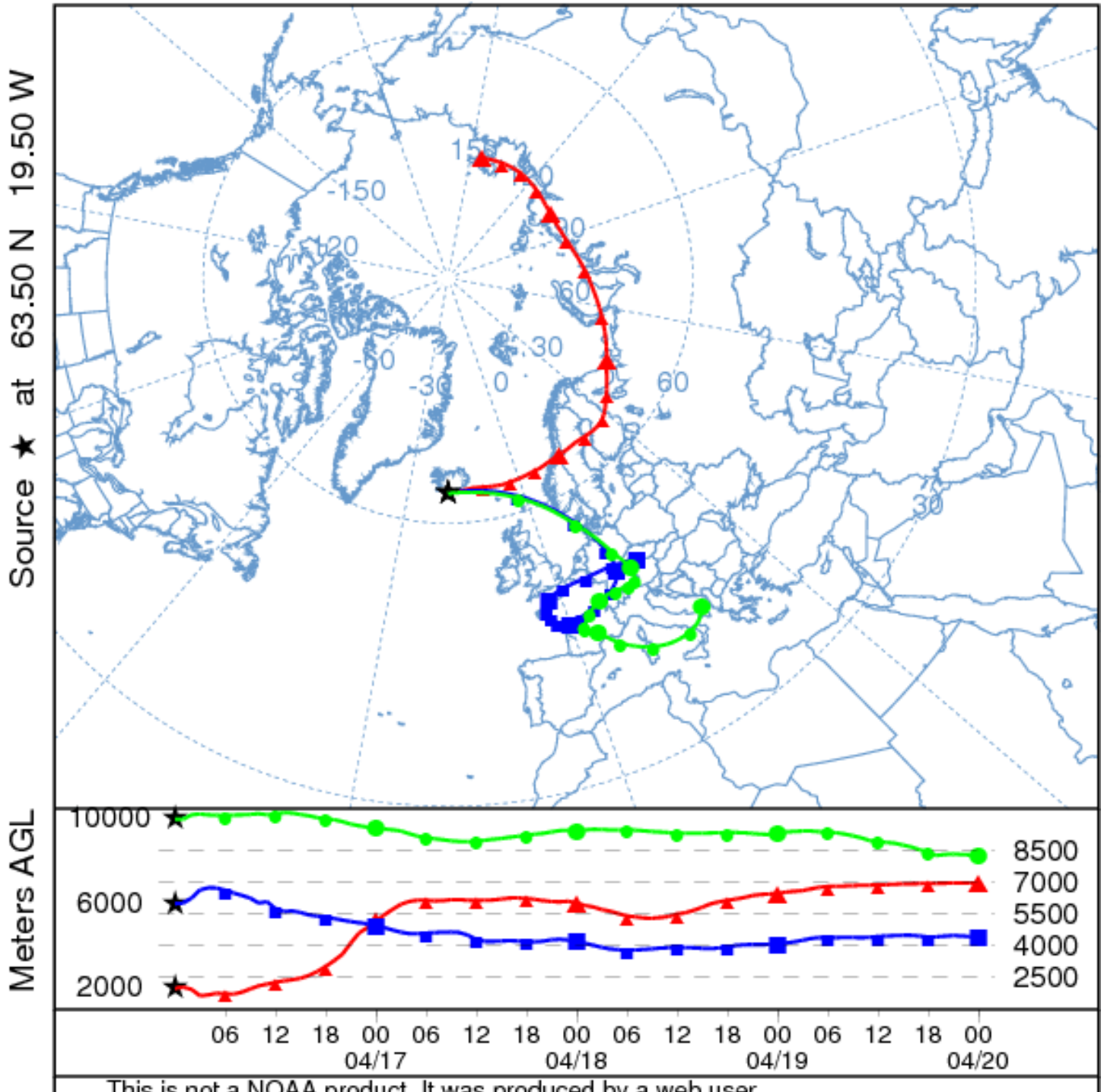
Þetta sama síðdegi hvessti víðar við Kollafjörð. Við Veðurstofuna í Reykjavík mældust mest 9 vindstig og á Skrauthólum á Kjalarnesi mældust 8 vindstig. Mesta vindhviða í Reykjavík var 31 m/s (61 hnútur). Ekki er venja að að mæla vindhviður á þann vindstigakvarða sem notaður er fyrir meðalhraða vinds í 10 mínútur, en 31 m/s jafngildir 11 vindstigum ef um 10 mínútna meðalvind væri að ræða. Á Skrauthólum var mesta hviða 27 m/s (52



3. mynd. Reiknaður vindhraði og vindátt við yfirborð jarðar síðdegis 14. júlí 1990. – The simulated surface wind speed based on observations at 1200 UTC on 14 July 1990.

Spyr þá lesandinn sig hvernig hann geti sjálfur ráðið í líkur á að vindstrengir myndist, séu hitamælingar í háloftunum ekki til taks. Má þá fyrst nefna að veðurathugunum á fjöllum hefur fjölgað mjög á síðustu árum. **Auk þess sem lesið er í útvarp er ýmsar upplýsingar að finna í textavarpi, á alneti og í svarsímum Vegagerðar og Veðurstofu.**

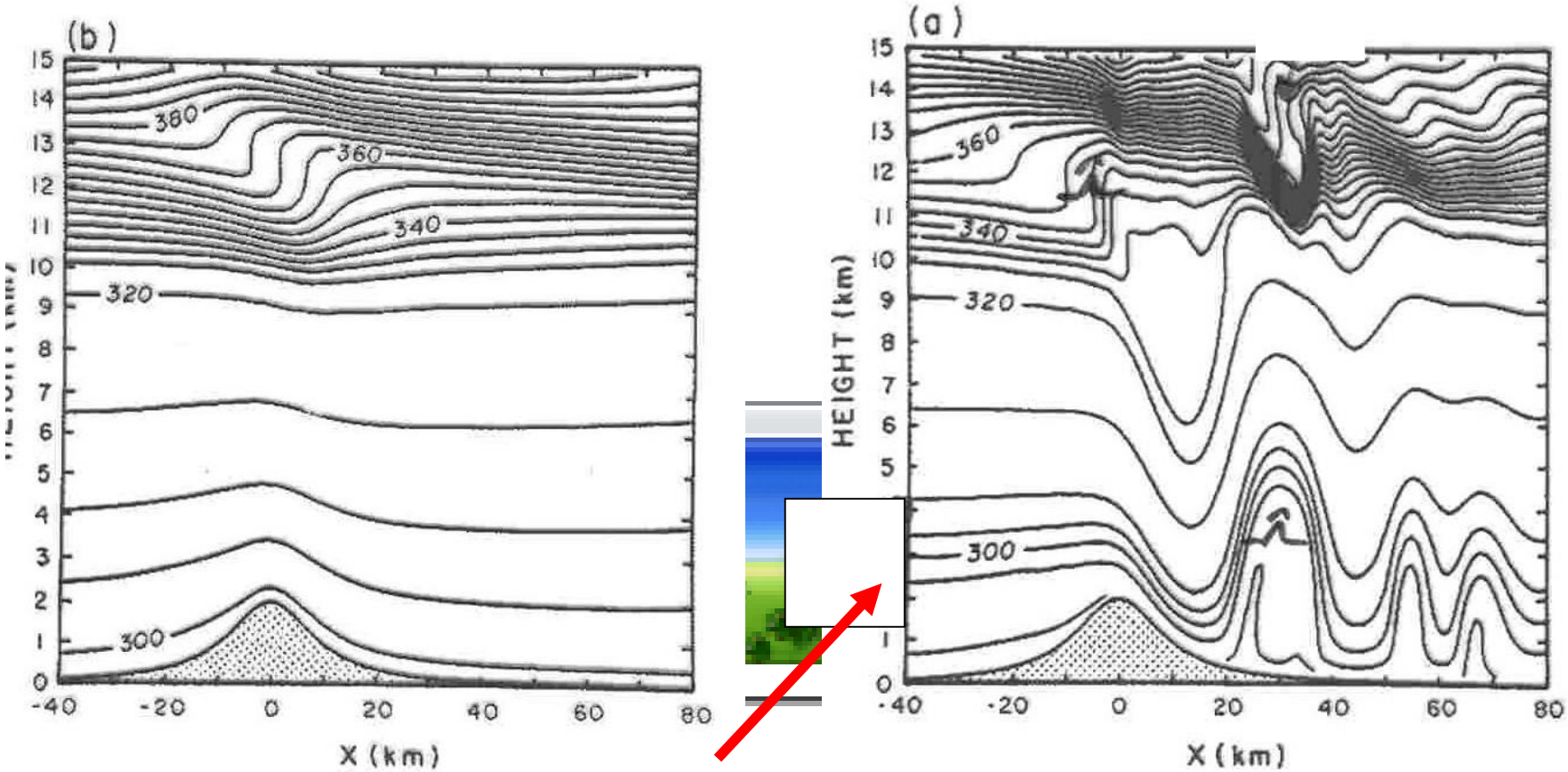
Photo: Olafur Sigurjonsson


Source ★ at 63.50 N 19.50 W
-150
-120
-90
-30
0
30
60
Meters AGL
10000
6000
2000
8500
7000
5500
4000
2500
06 12 18 00 06 12 18 00 06 12 18 00 06 12 18 00
04/17
04/18
04/19
04/20
This is not a NOAA product. It was produced by a web user.

Isentropes in two numerical simulations (K)

Little wave activity in the troposphere

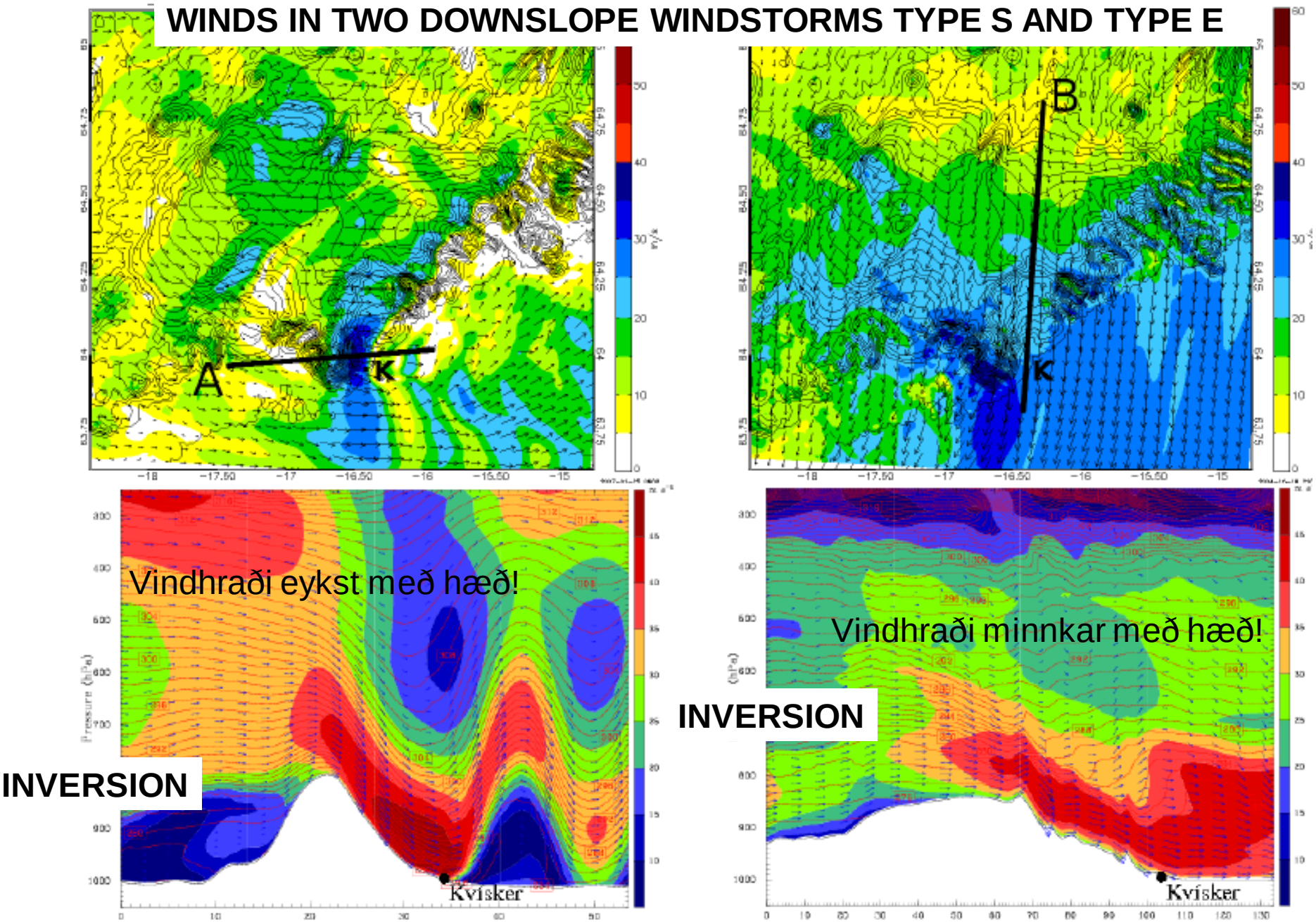
Very amplified waves



A stable layer

Durran, 1990

WINDS IN TWO DOWNSLOPE WINDSTORMS TYPE S AND TYPE E



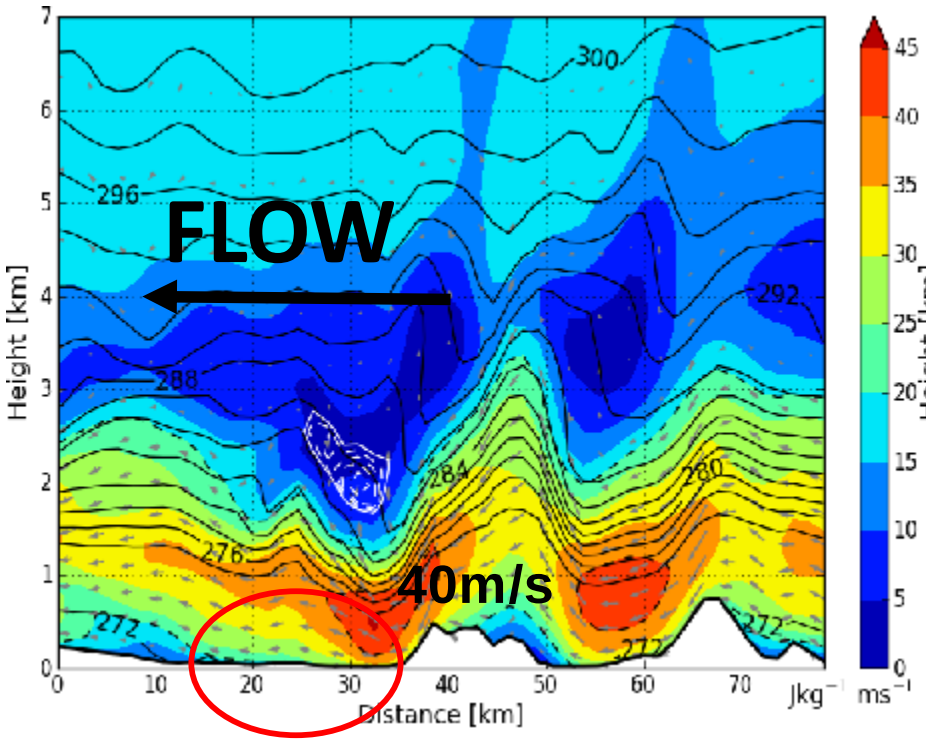
Á&Ó, MAP, 2010

EME
et. al

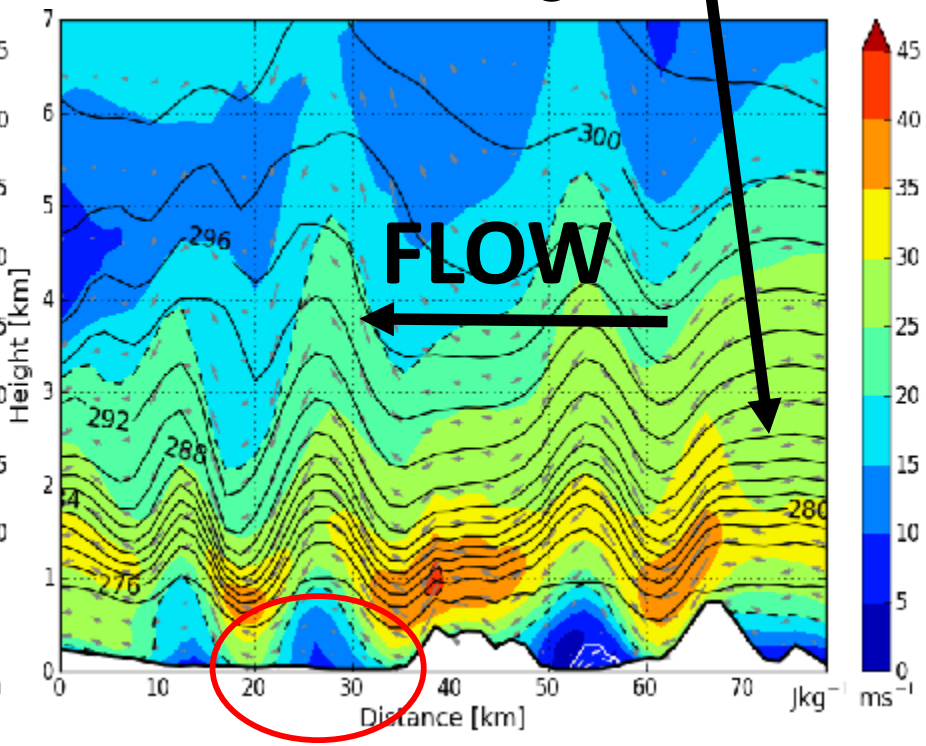
A change in the stability profile

Höfðatúnsveðrið

NOON



Evening



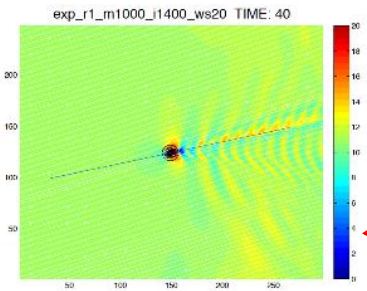
Reykjavík 10-35 m/s

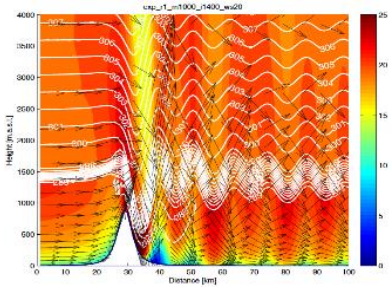
Reykjavík 5-30 m/s, but in totally different locations

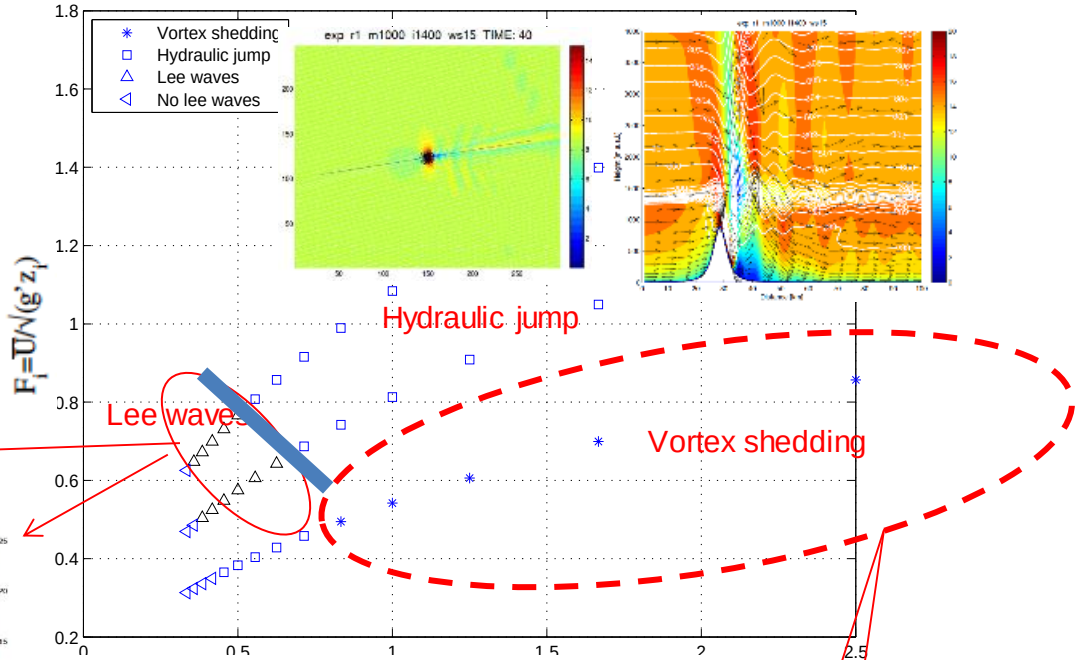
Idealized flow past a circular mountain

Marius Opsanger Jonassen[2,4], Haraldur Ólafsson[1,3] , Hálfdán Ágústsson[1,2],
[1] Háskóli Íslands (University of Iceland), [2] Reiknistofa í veðurfræði (Institute for Meteorological Research), Iceland, [3]Veðurstofa Íslands (Icelandic Meteorological Office), [4]University of Svalbard, Spitzbergen

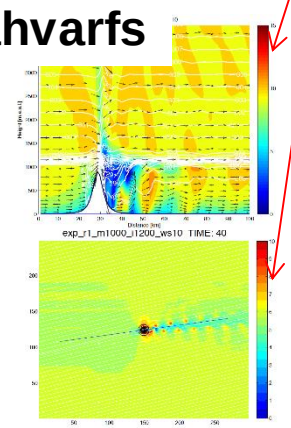
Vindhraði / Styrkur hitahvarfs





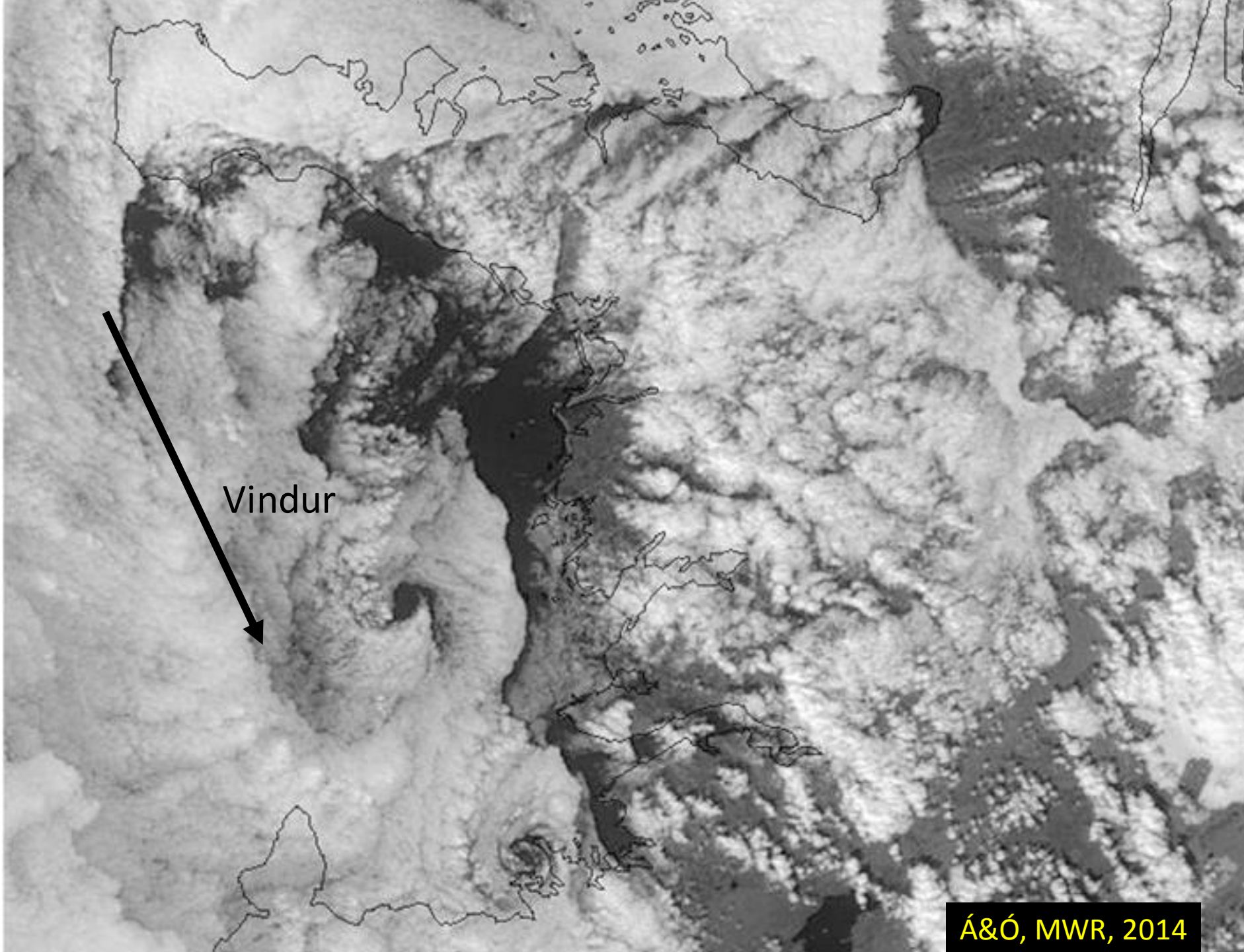


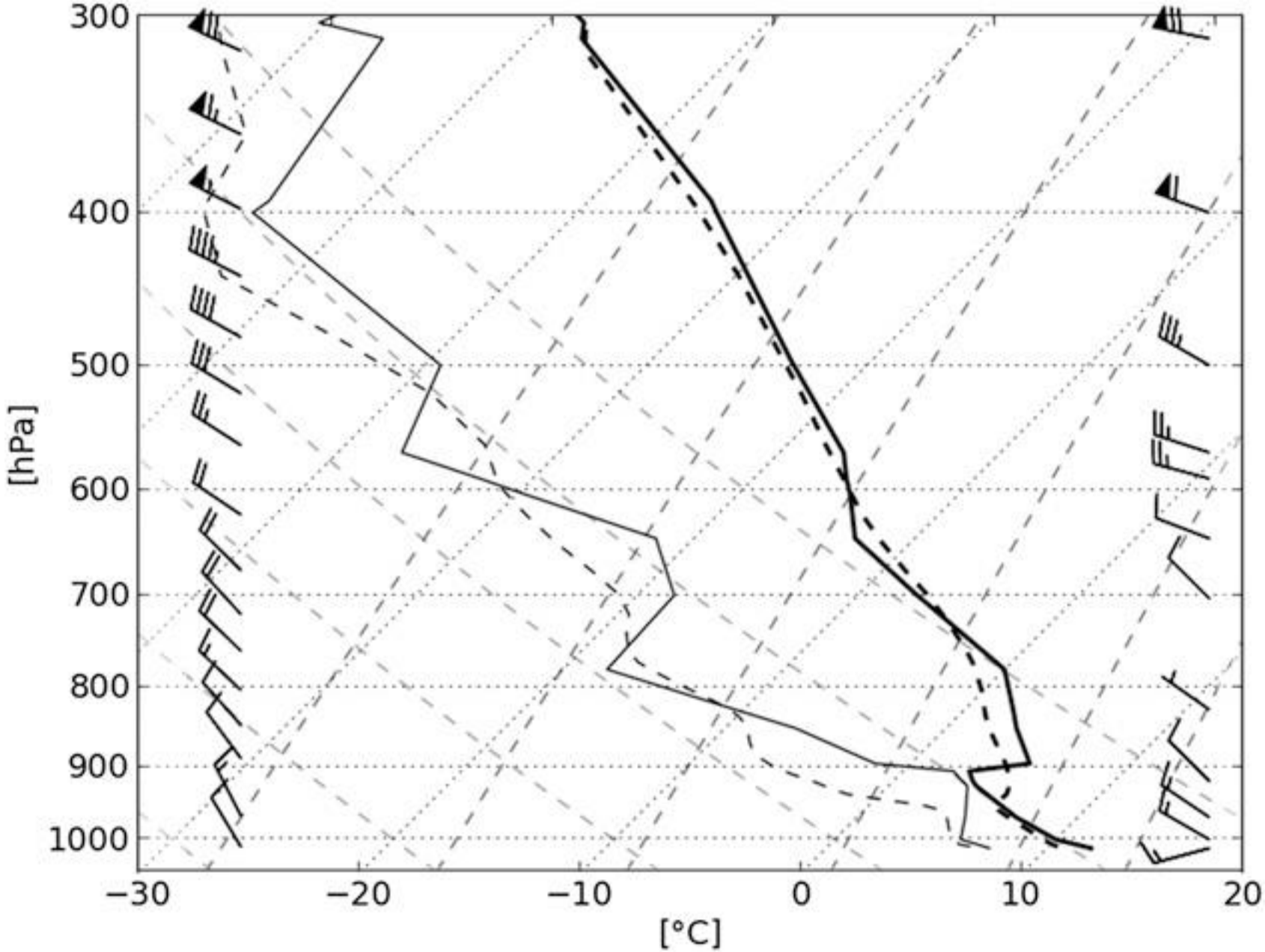
Hæð fjalls / hæð hitahvarfs

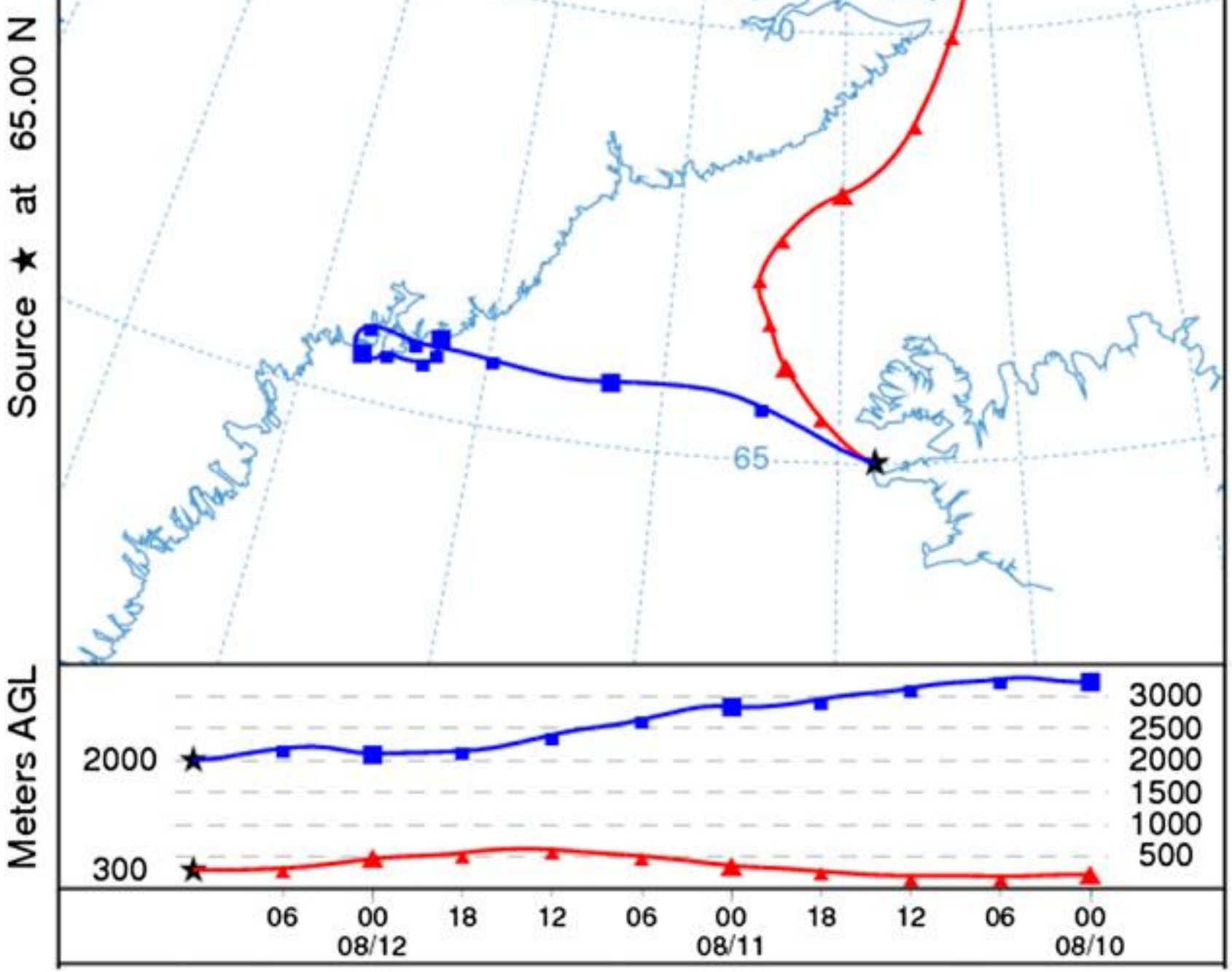


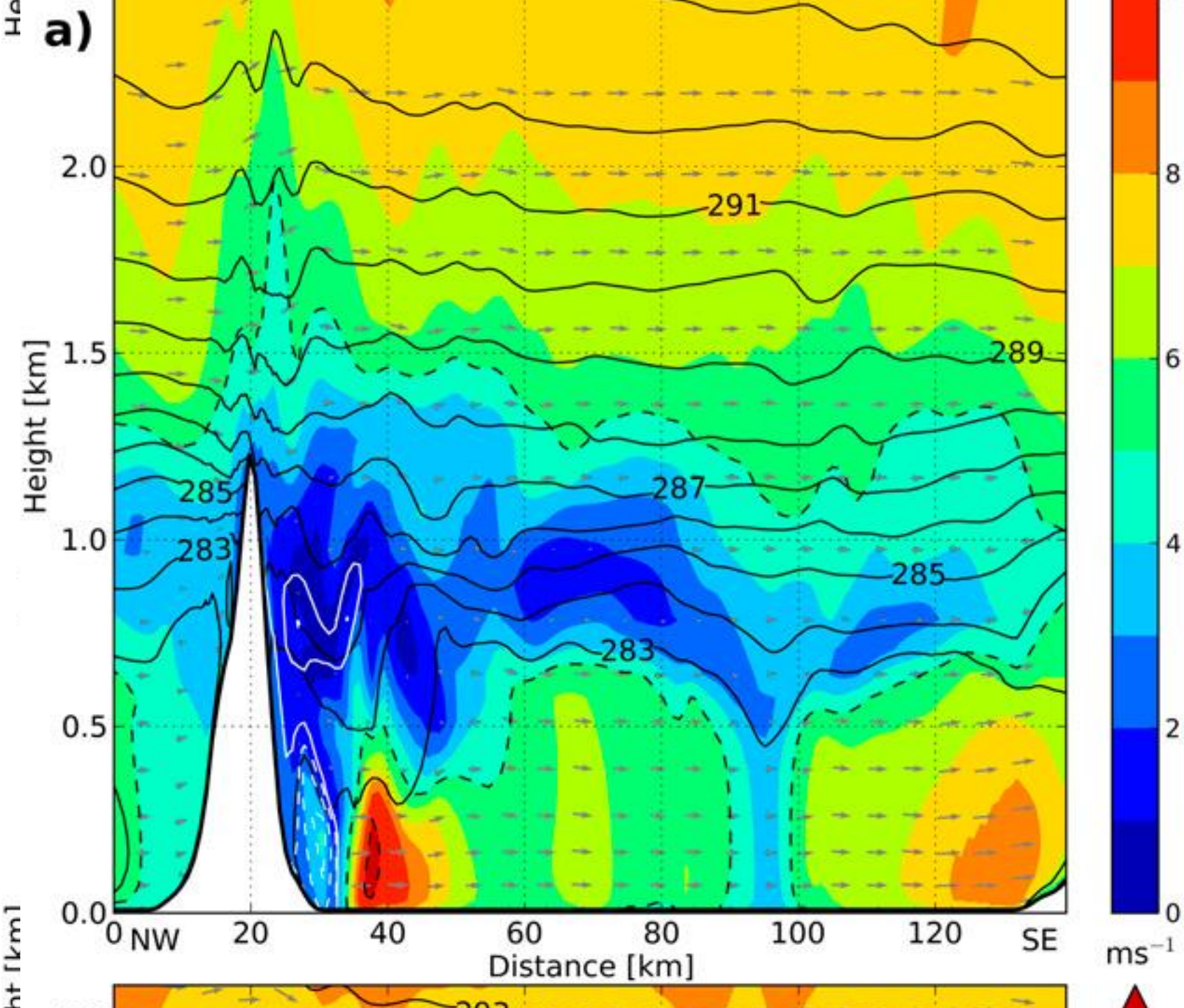
Motivated by the need to relate some key features of atmospheric flow over mountains to the elevation of the inversion and wind speed, many numerical experiments are made in order to create a diagramme a la Vosper (2004). The simulations are carried out with the WRF model and stationary boundary-conditions. A neutral boundary-layer is capped by a 10K inversion, of which the height varies. The mountain is 1 km high and the incoming winds are 10,15 or 20 m/s. The surface has zo=0.1m.

MOP, HÓ, HÁ 201x


Vindur
Á&Ó, MWR, 2014

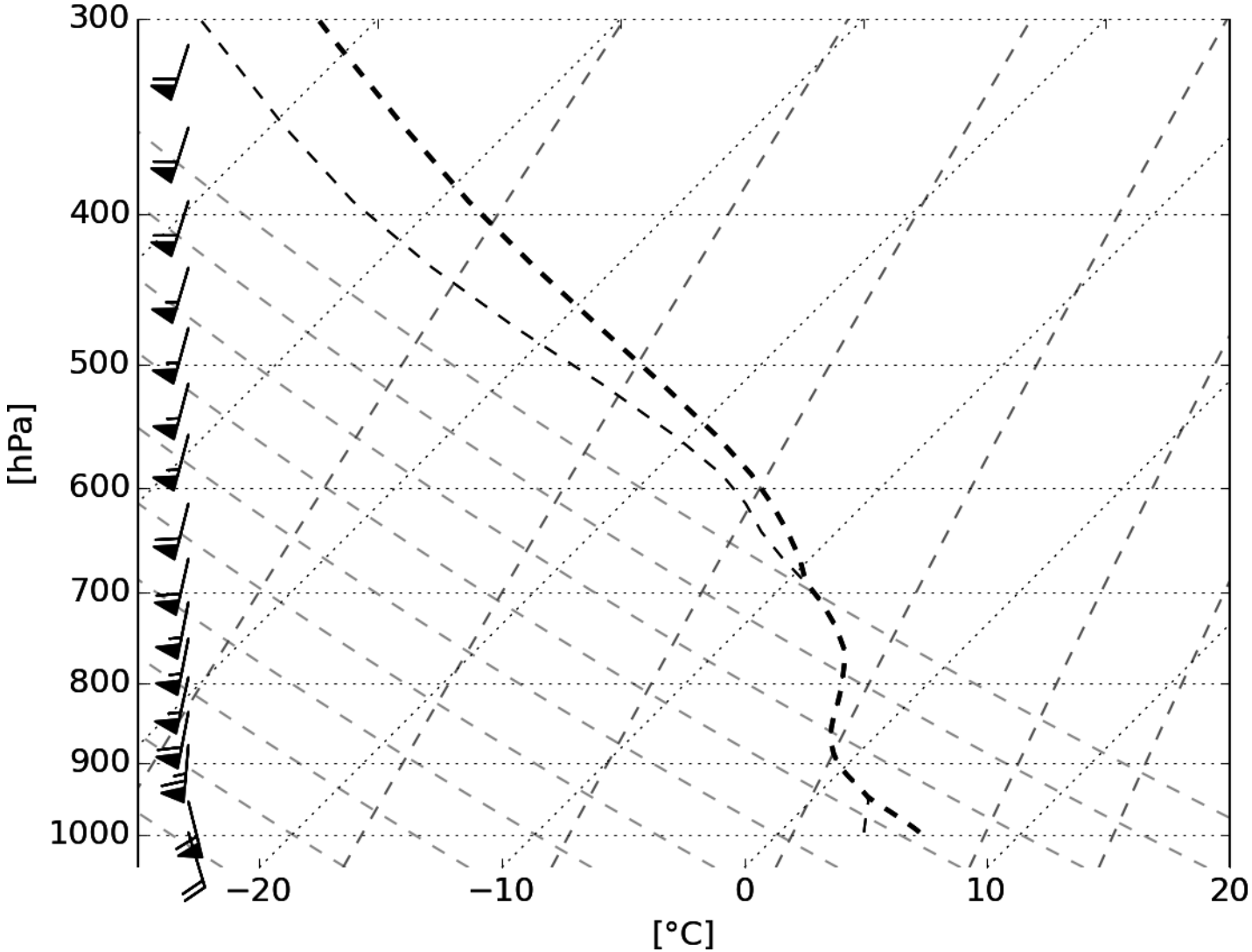

300
400
500
600
700
800
900
1000
[hPa]
−30
−20
−10
0
10
20
[°C]

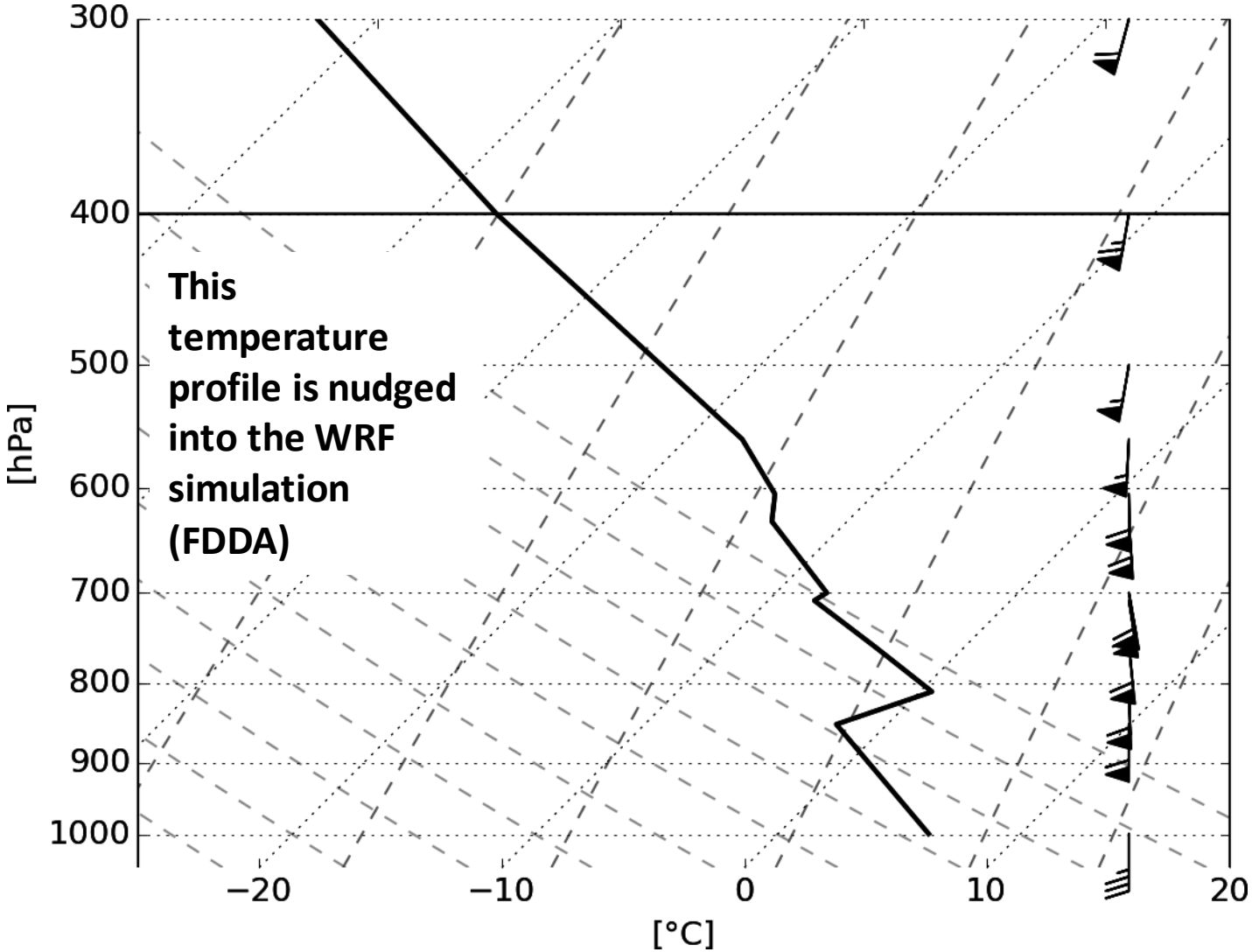

Source ★ at 65.00 N
65
Meters AGL
2000
300
3000
2500
2000
1500
1000
500
06
00
08/12
18
12
06
00
08/11
18
12
06
00
08/10


a)
Height [km]
2.0
1.5
1.0
0.5
0.0
291
289
287
285
283
285
283
0
NW
20
40
60
80
100
120
SE
Distance [km]
8
6
4
2
0
ms^{-1}

Hvalfjordur rotor in 1974
ICELANDAIR
TF-FIK
https://www.flickr.com/photos/88821481@N00/1646657933/lightbox/#

BLK, 2014

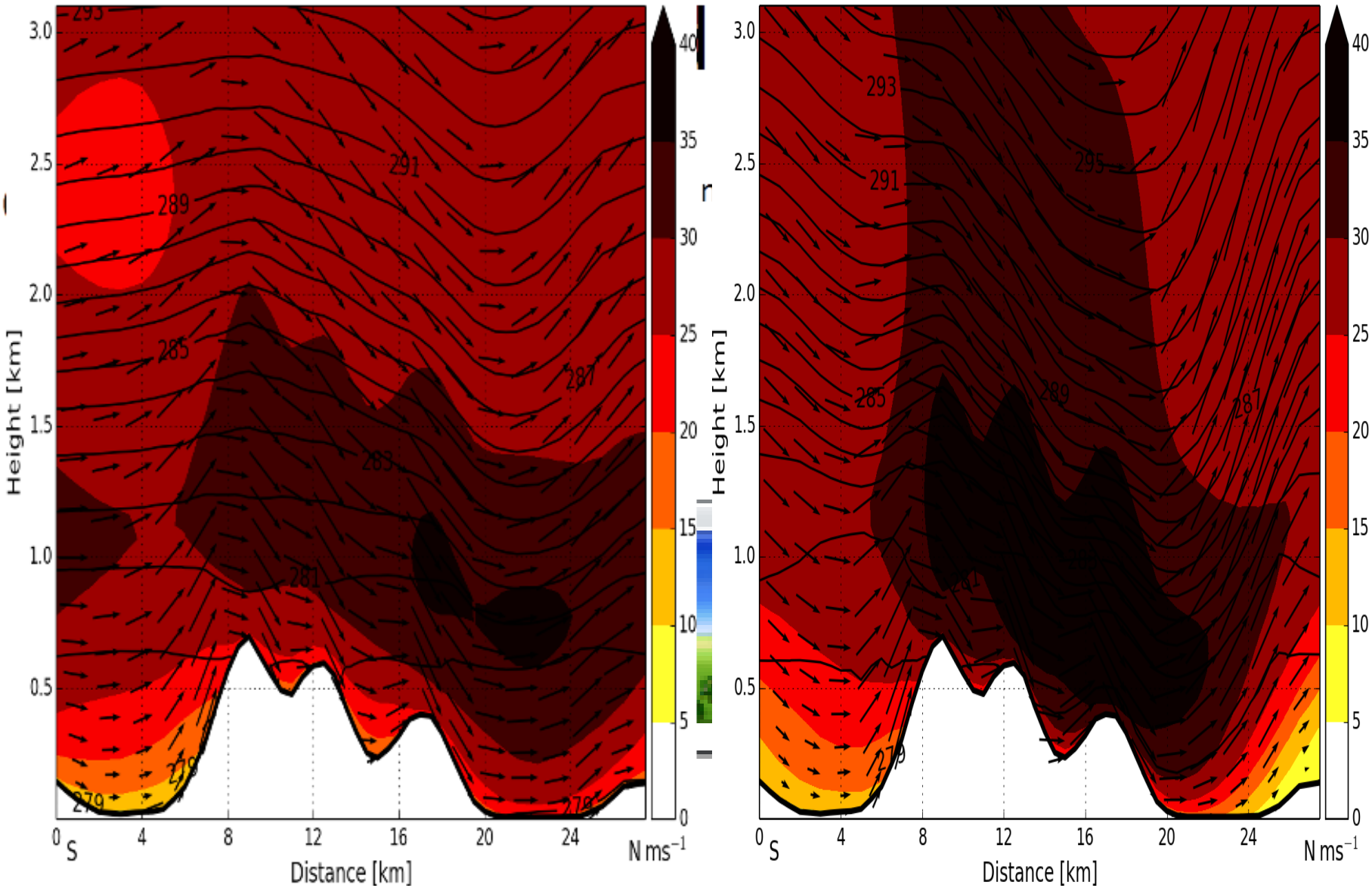

300
400
500
600
700
800
900
1000
[hPa]
−20
−10
0
10
20
[°C]

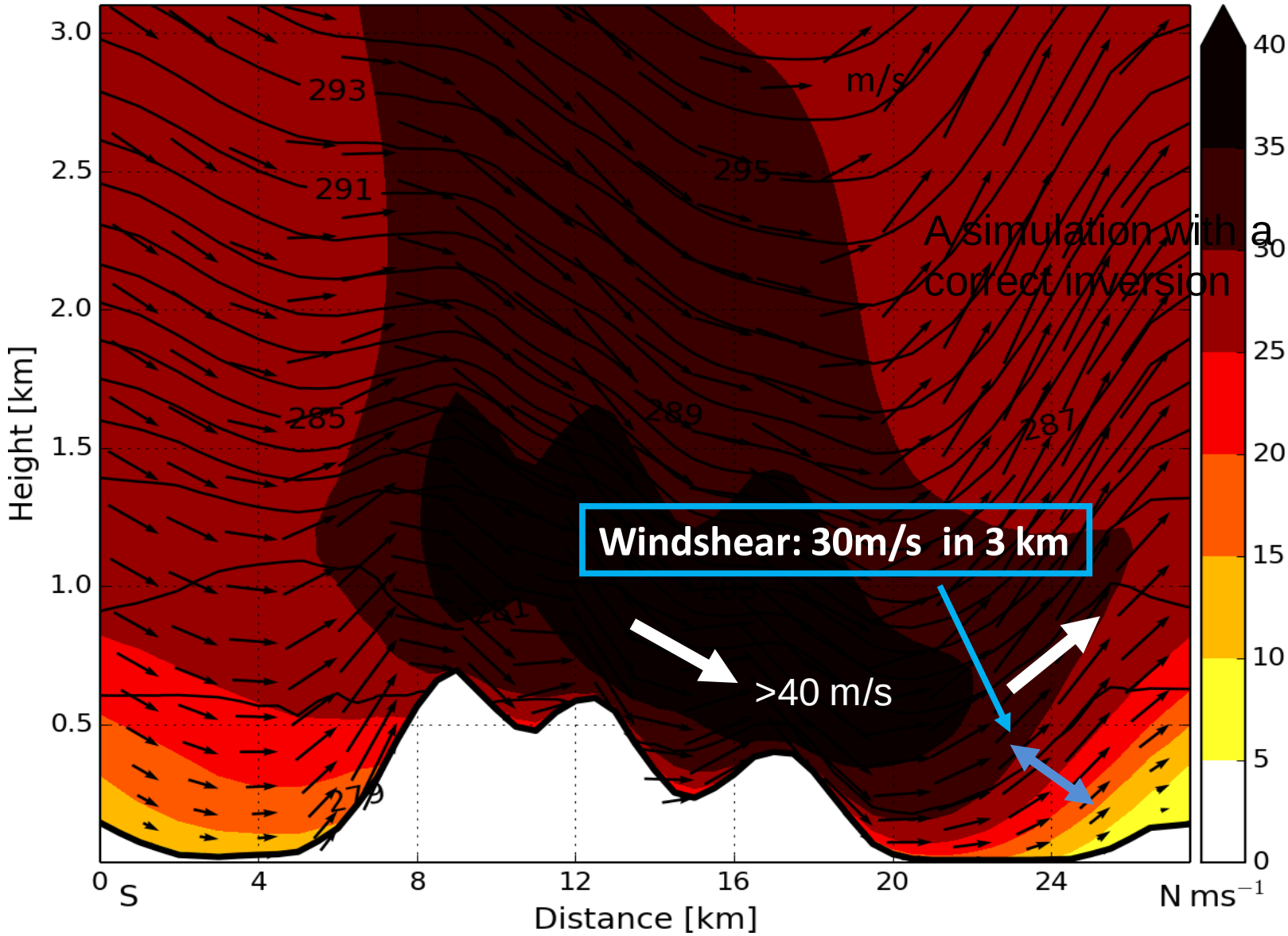

This temperature profile is nudged into the WRF simulation (FDDA)
300
400
500
600
700
800
900
1000
[hPa]
−20
−10
0
10
20
[°C]

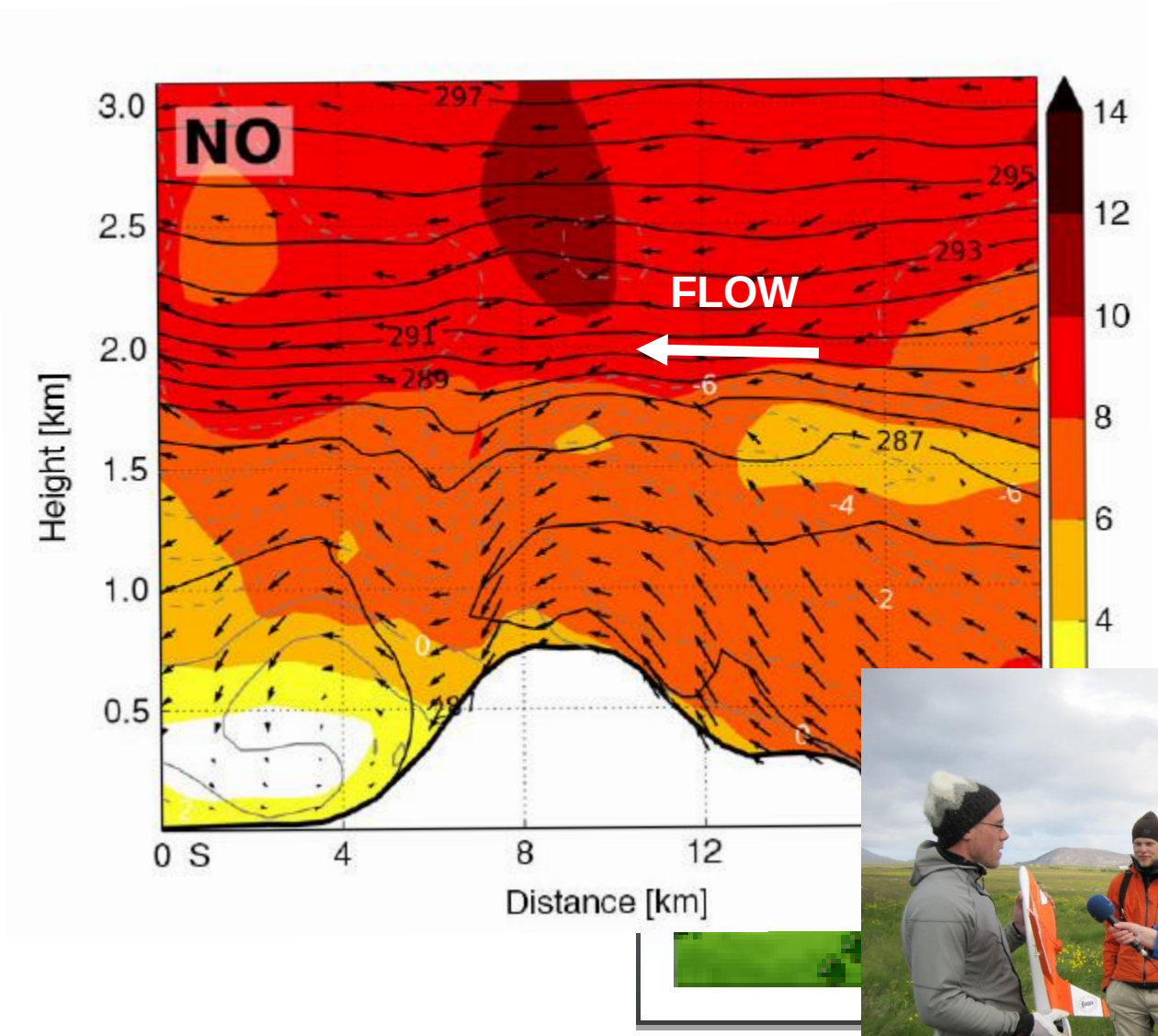
Án

m/s

Með hitahvarfi

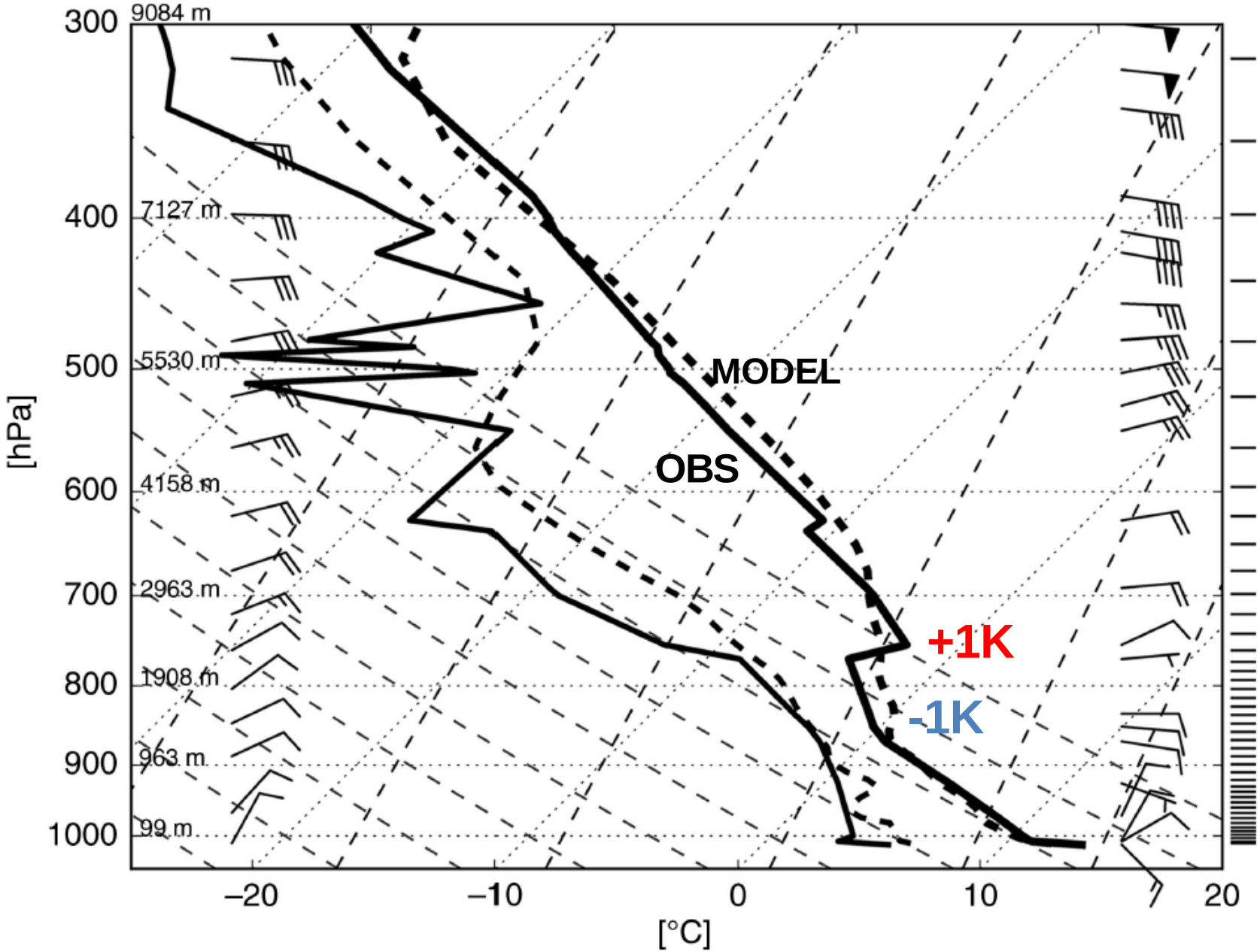


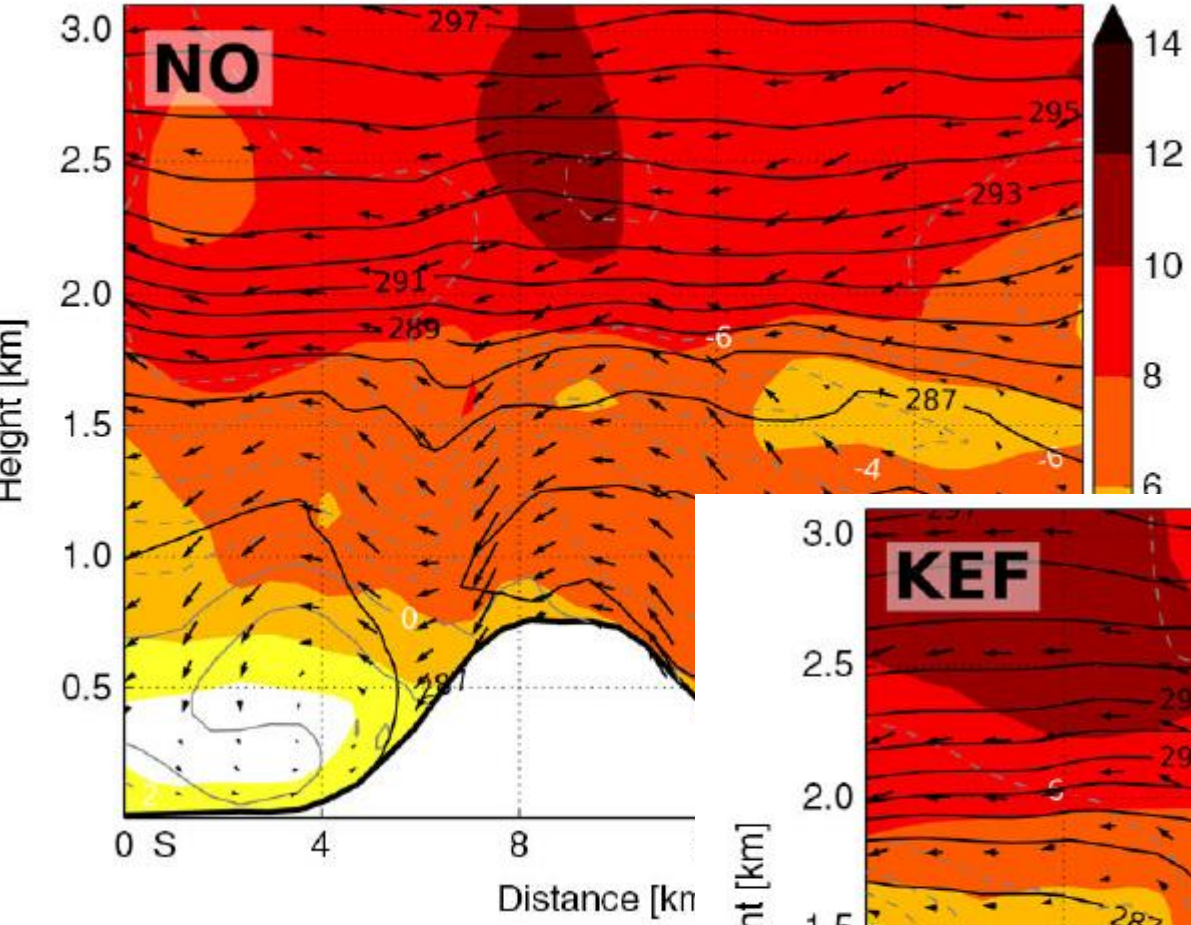

A simulation with a correct inversion
Windshear: 30m/s in 3 km
>40 m/s
m/s
293
291
295
285
289
287
281
279
Height [km]
Distance [km]
S
N
ms^{-1}
0
4
8
12
16
20
24
0.5
1.0
1.5
2.0
2.5
3.0
5
10
15
20
25
30
35
40

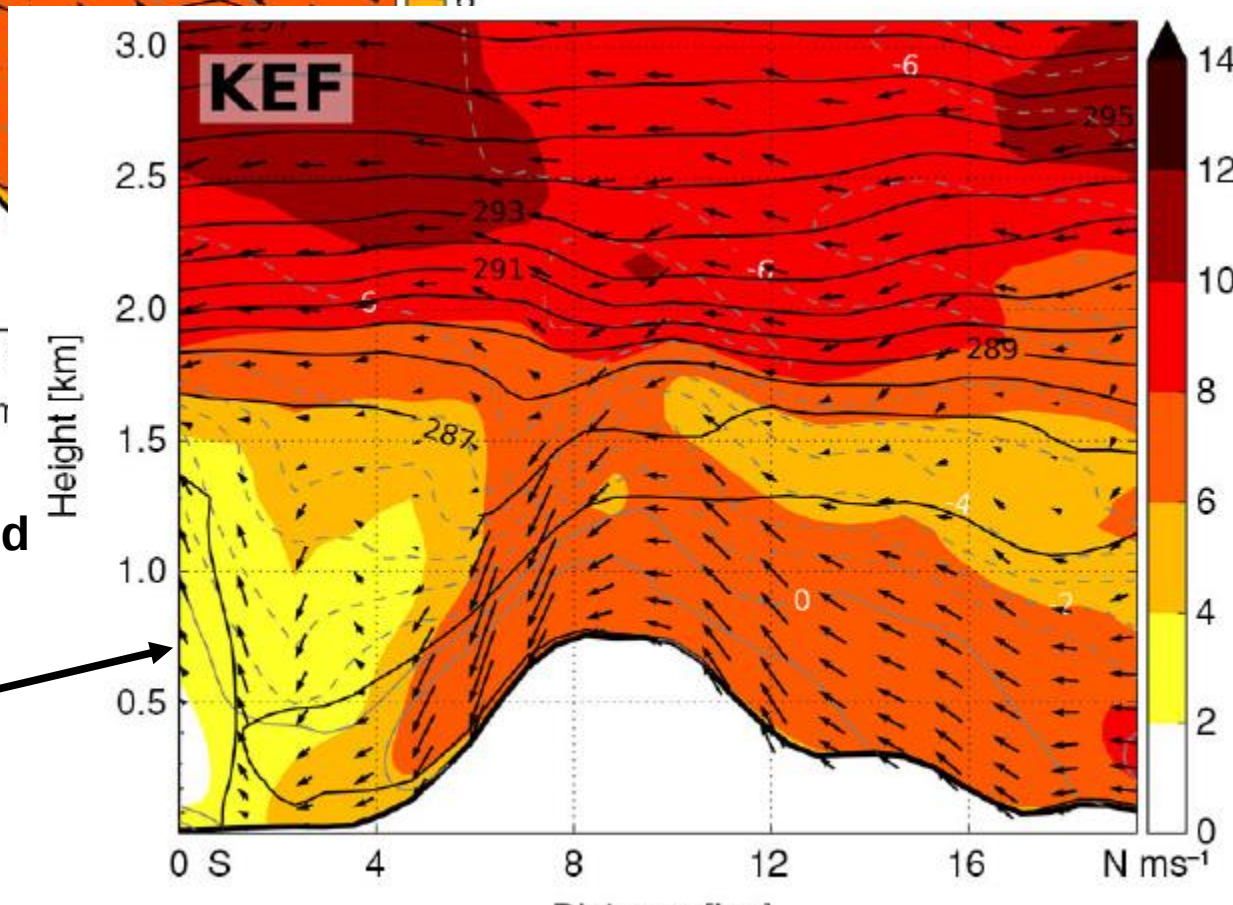


The MOSO experiment

Agustsson, Olafsson, Jonassen, Rognvaldsson, Tellus, 2014


9084 m
7127 m
5530 m
4158 m
2963 m
1908 m
963 m
99 m
300
400
500
600
700
800
900
1000
[hPa]
–20
–10
0
10
20
[°C]
MODEL
OBS
+1K
-1K

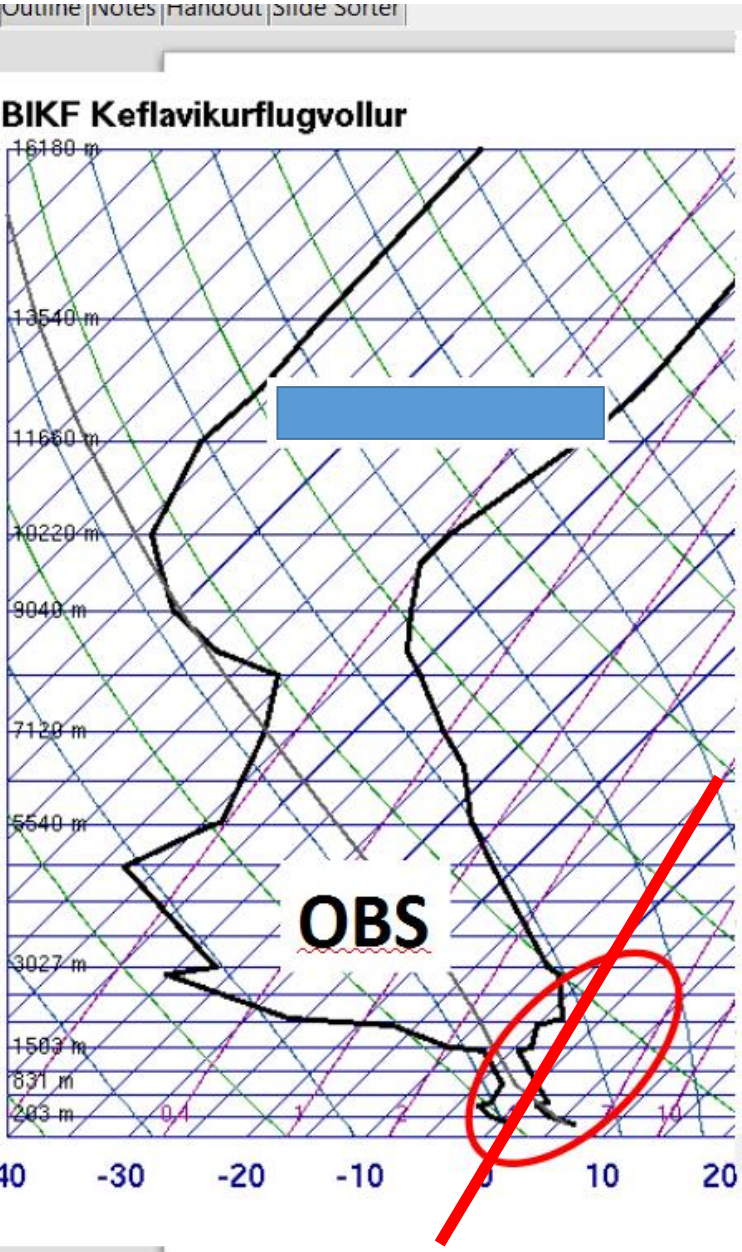


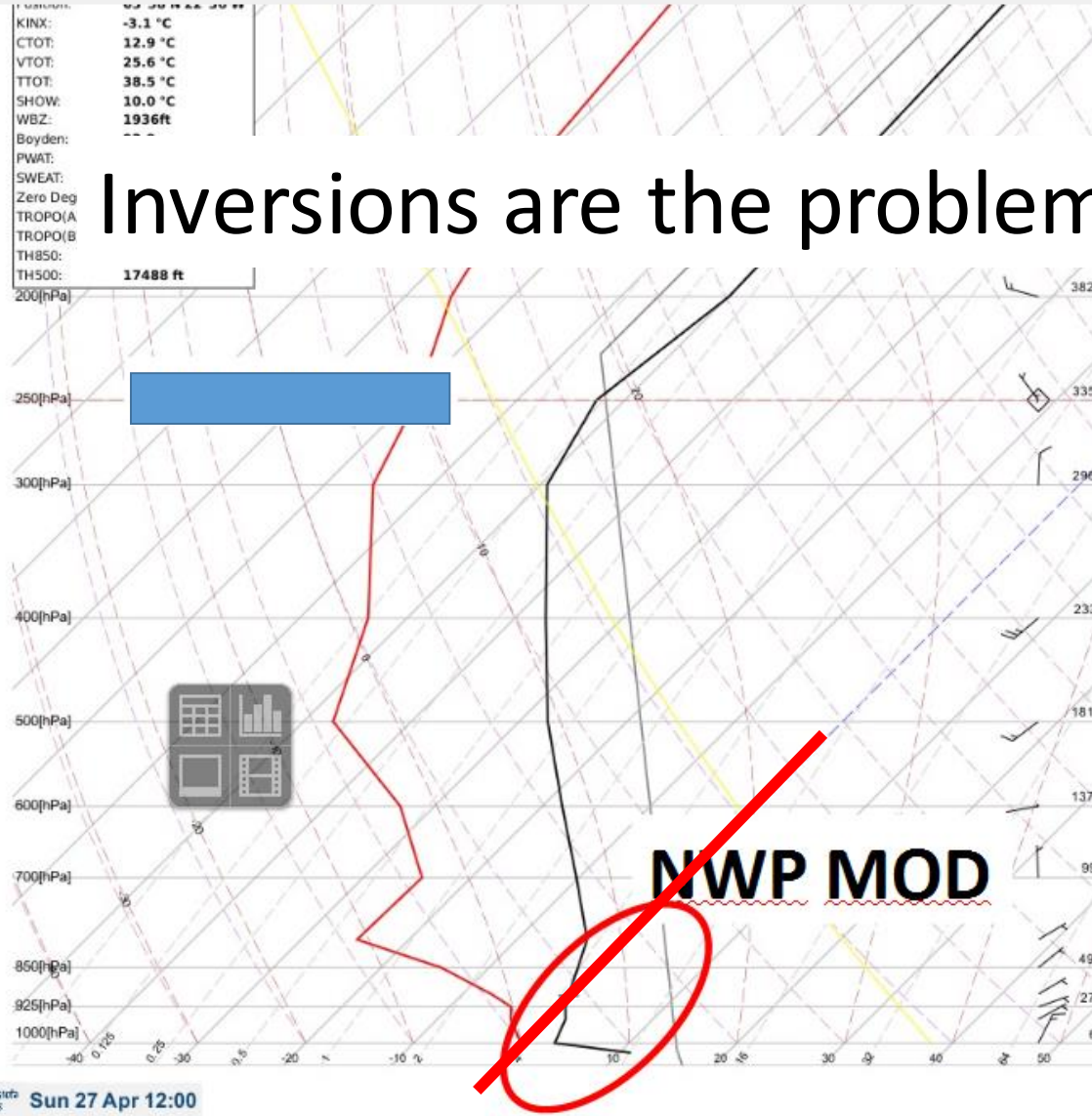


Simulation with the observed sounding (with the sharp invesion) „forced“ upon the flow (nudged)

Correct downslope flow

Inversions are the problem

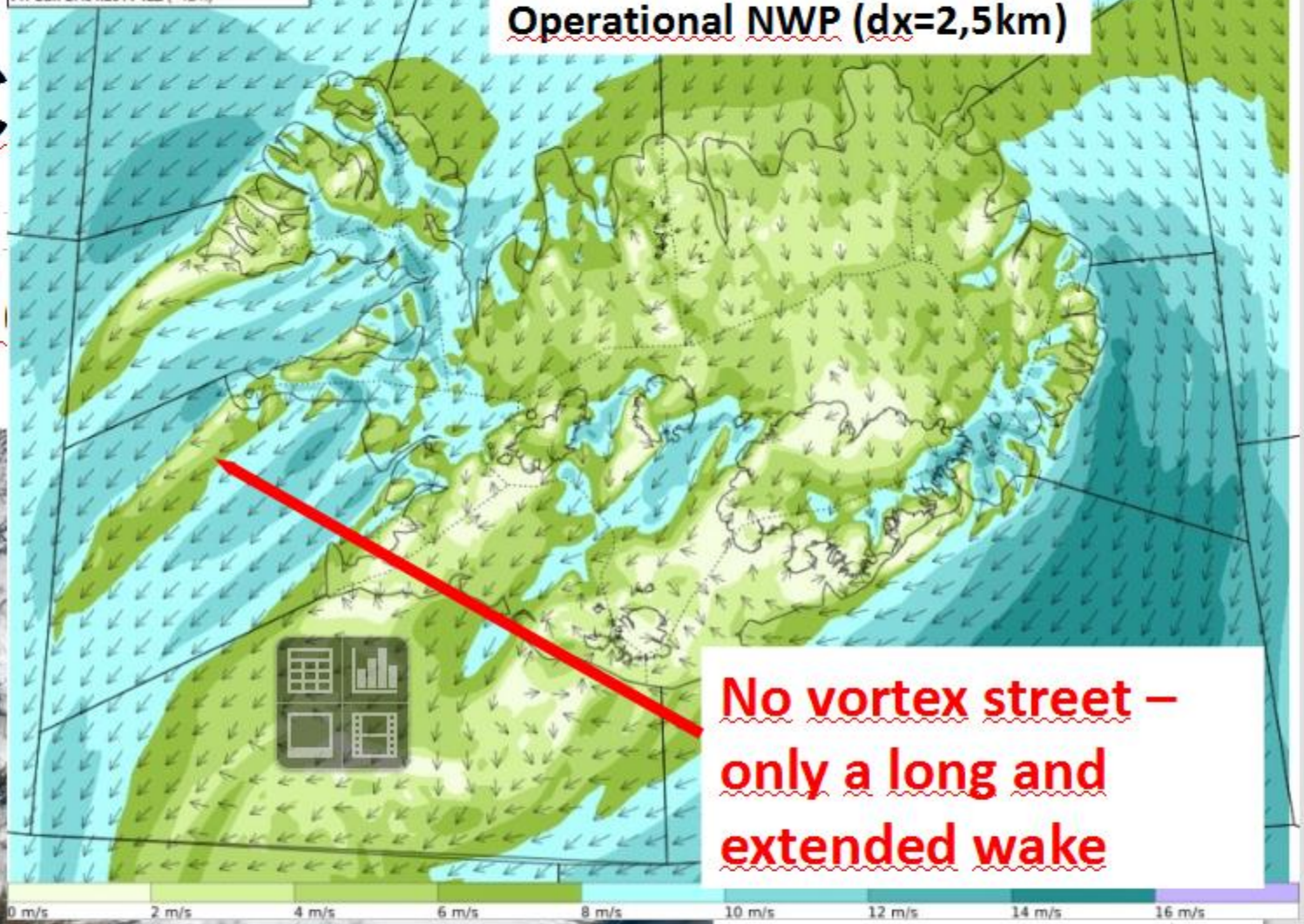




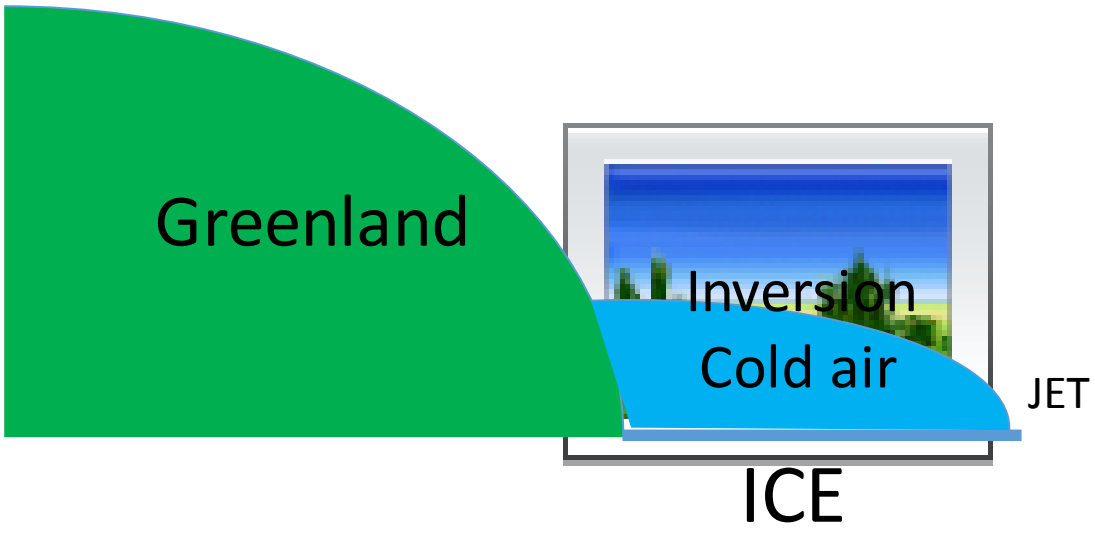
Very different low-level vertical temperature profiles

C

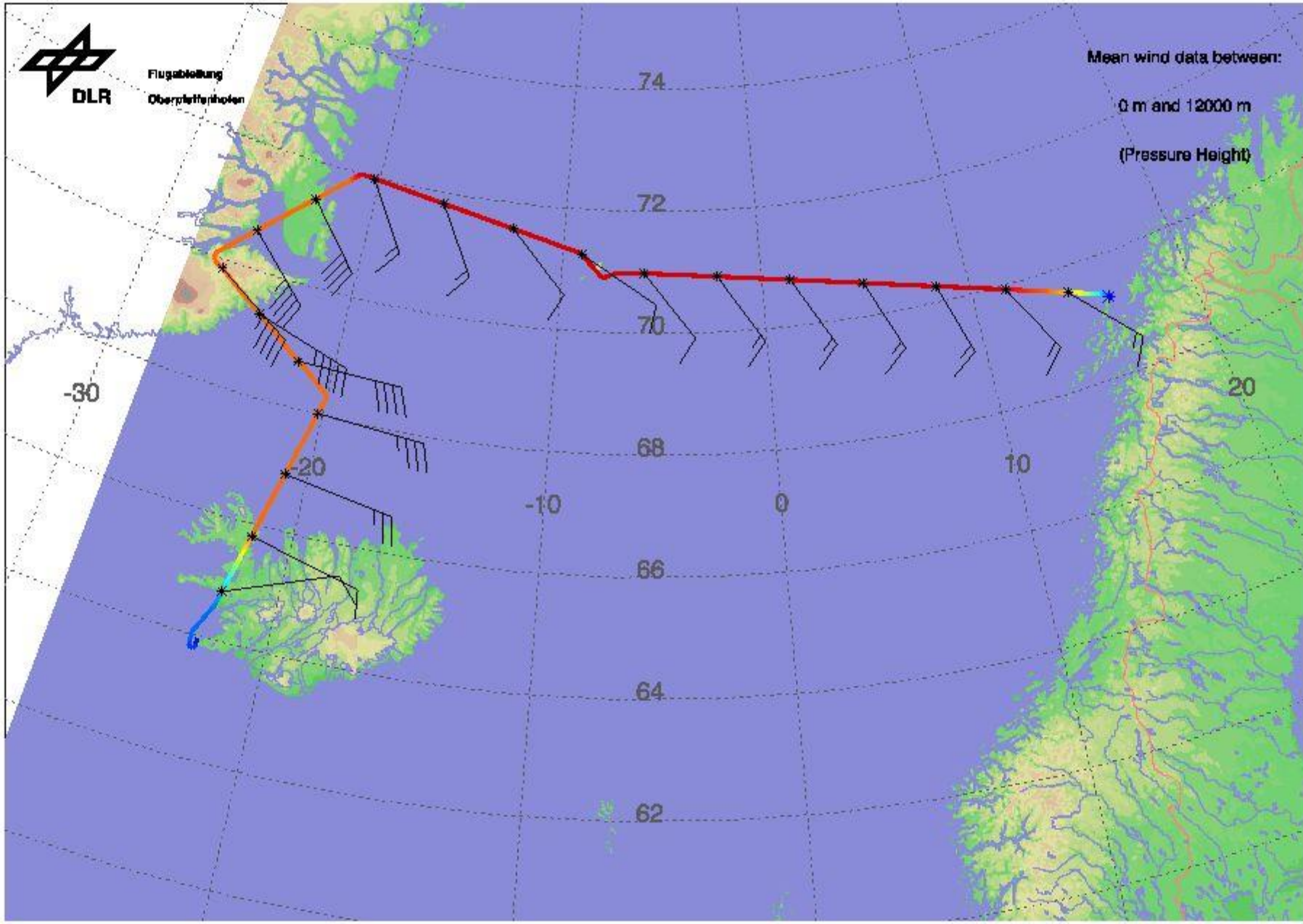
Click to ad


Operational NWP (dx=2,5km)
No vortex street – only a long and extended wake
0 m/s
2 m/s
4 m/s
6 m/s
8 m/s
10 m/s
12 m/s
14 m/s
16 m/s

Where do the inversions come from?

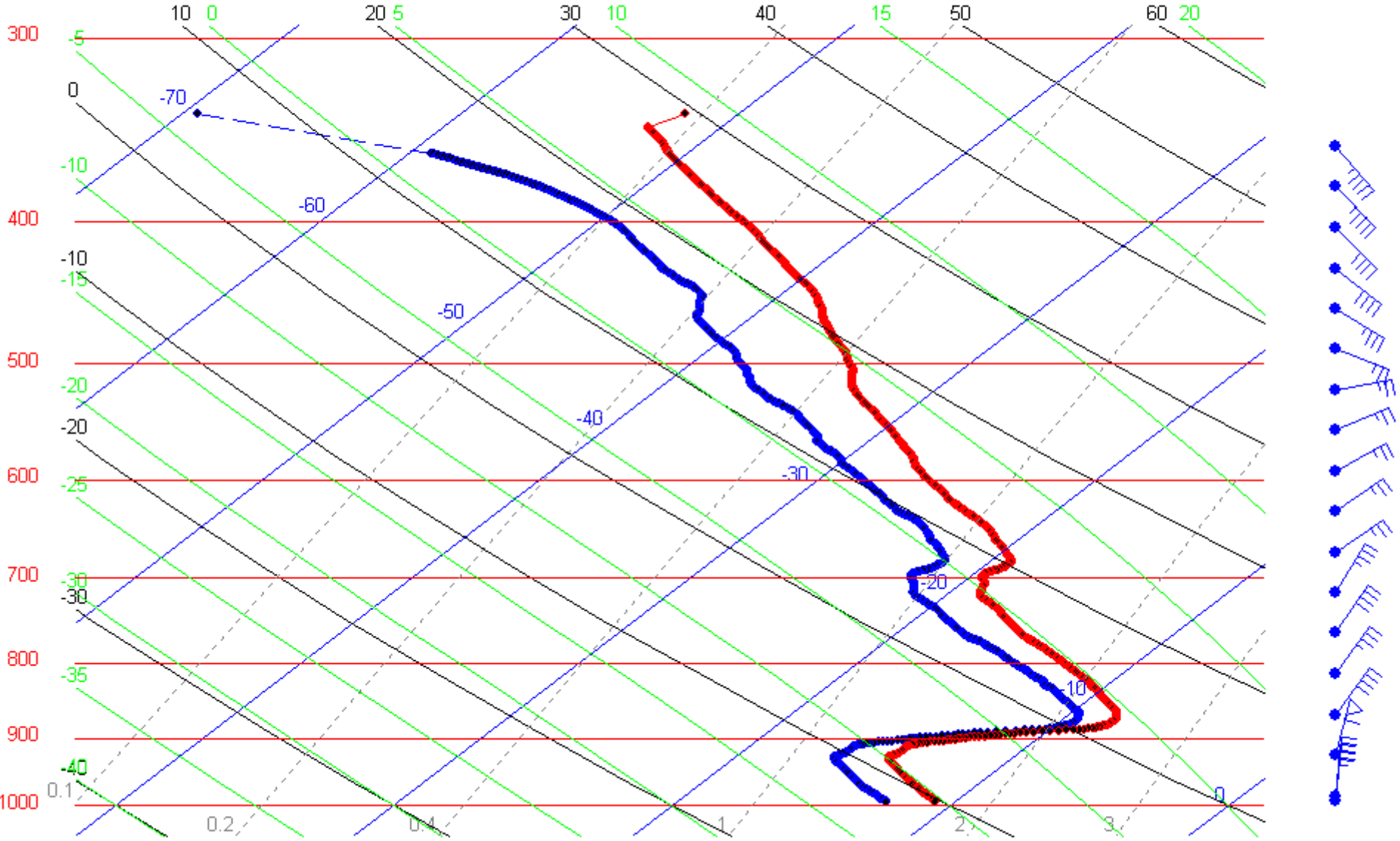


IPY - THORPEX #10 09/03/2008



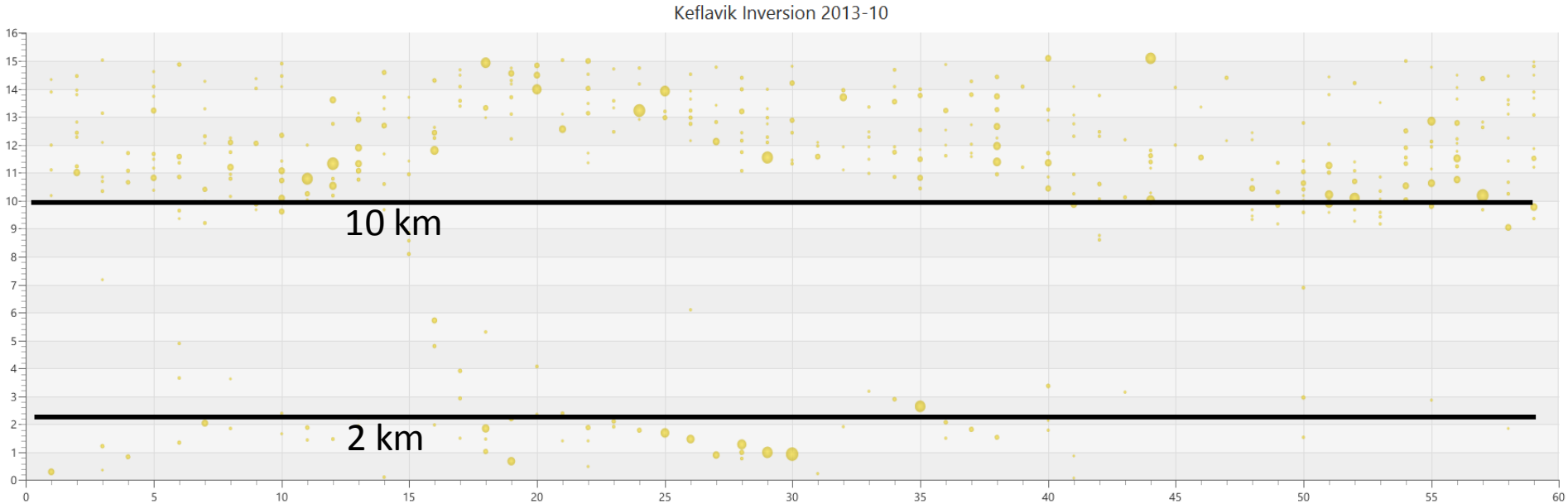
Flight Time: 12:11:27 to 15:51:15 System Time from DAQ SCALE=1:1.00000e+007

D20080309_140608.1 073029015 THORPEX, Thorpex_2008_03_09a Falcon 20, D-CMET



Aspen V2.7.2.1, 09 Mar 2008 14:18 UTC

Inversions (dots) over SW-Iceland in October 2013



1 OCT

31 OCT

SJ

Some of what we know:

- Inversions are important for the mountain flow, particularly the wind field downstream

- We have some ideas on where to place them to obtain certain flow patterns for given

- The orographic flow pattern can be very sensitive to the position and the strength of the inversion

It would be nice to know more about

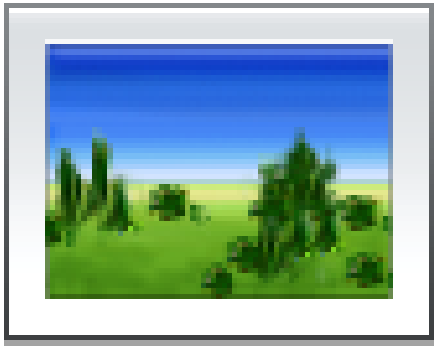
- how they are created

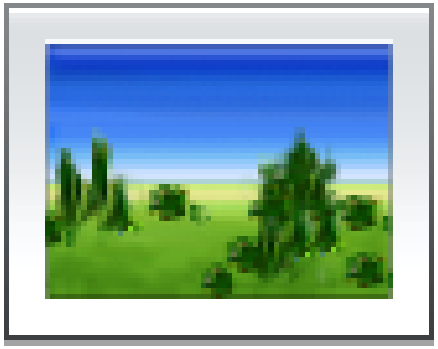
- their life cycle

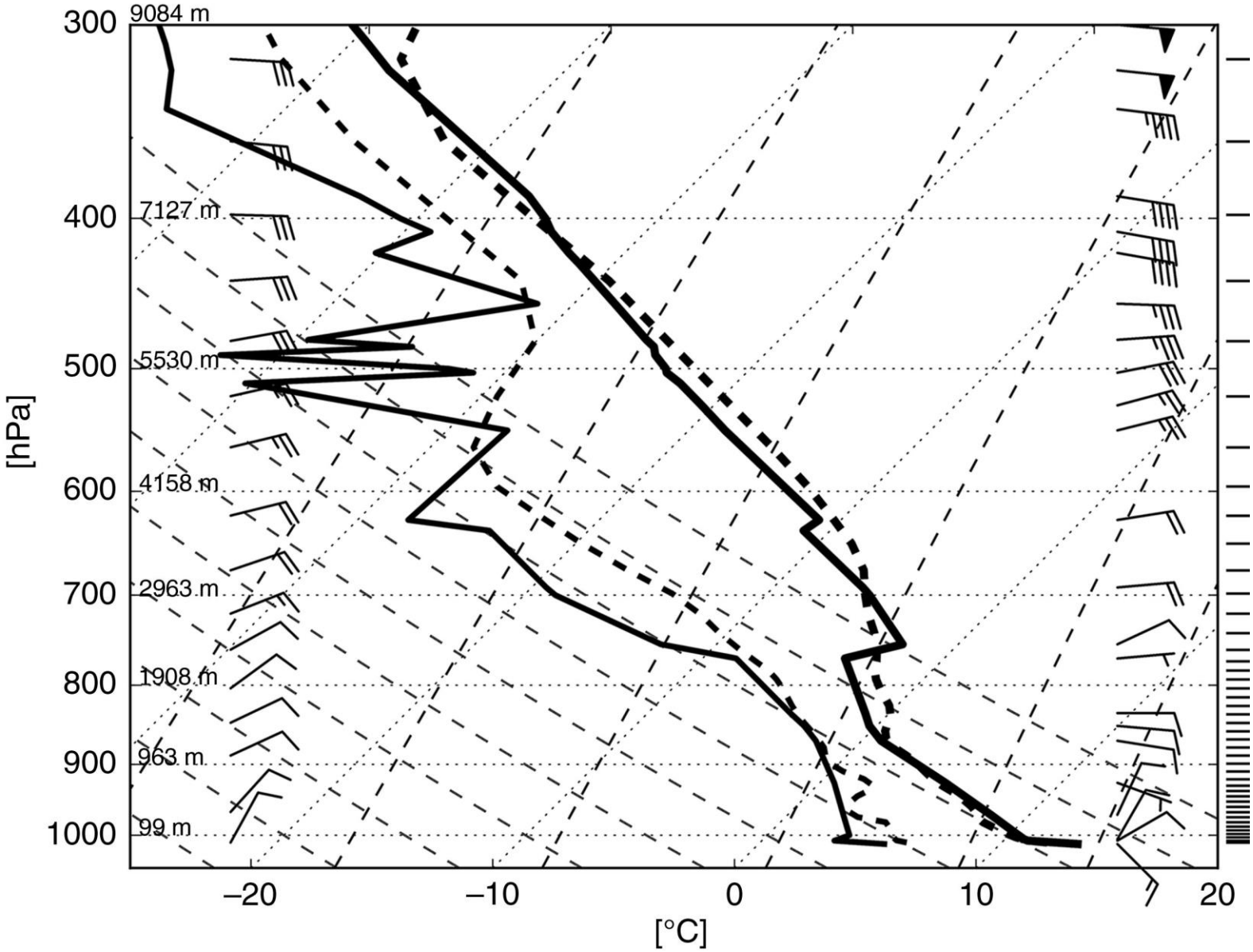
- what processes are important for their sharpness and destruction

- if it is feasable to have an adaptive observation system for short term weather prediction?

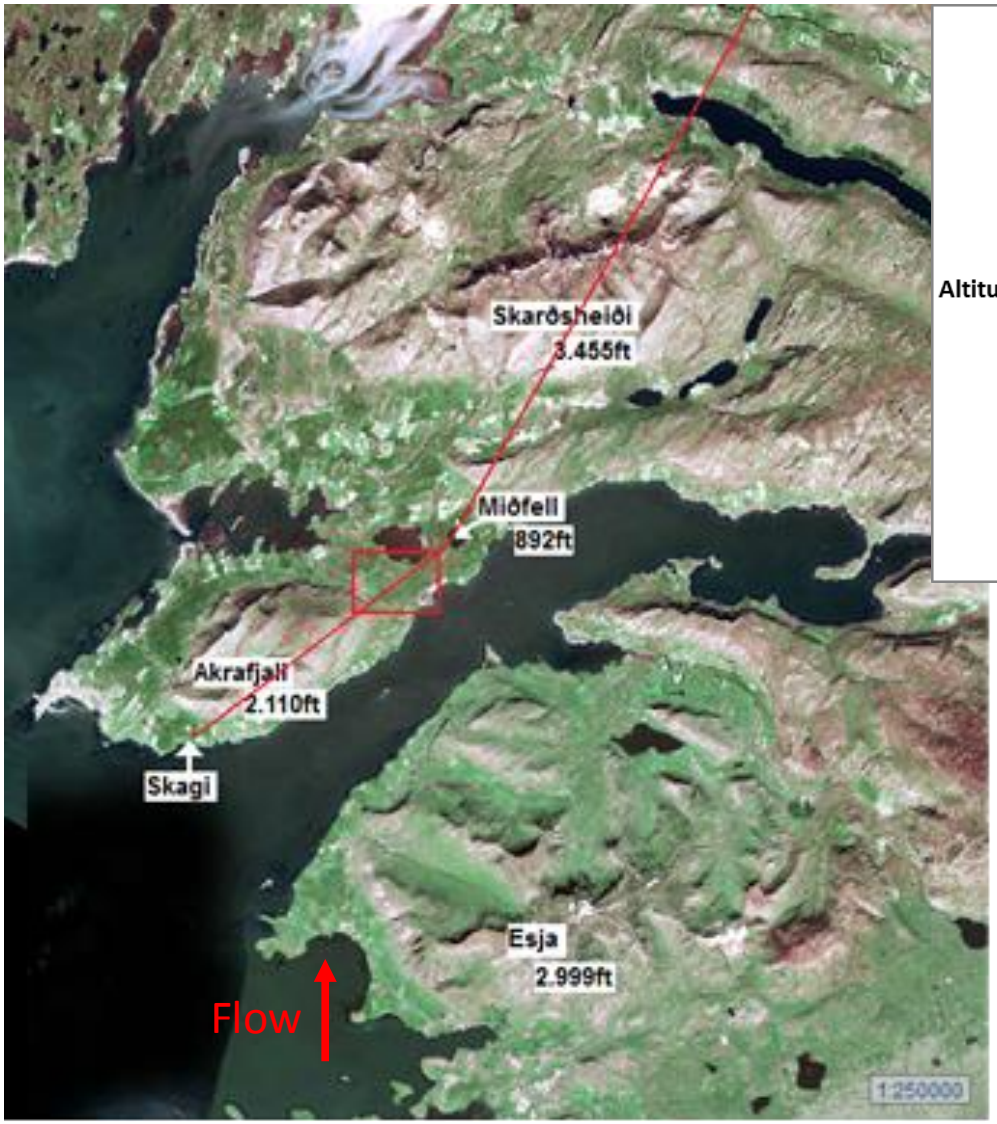
Þökk fyrir áheyrnina

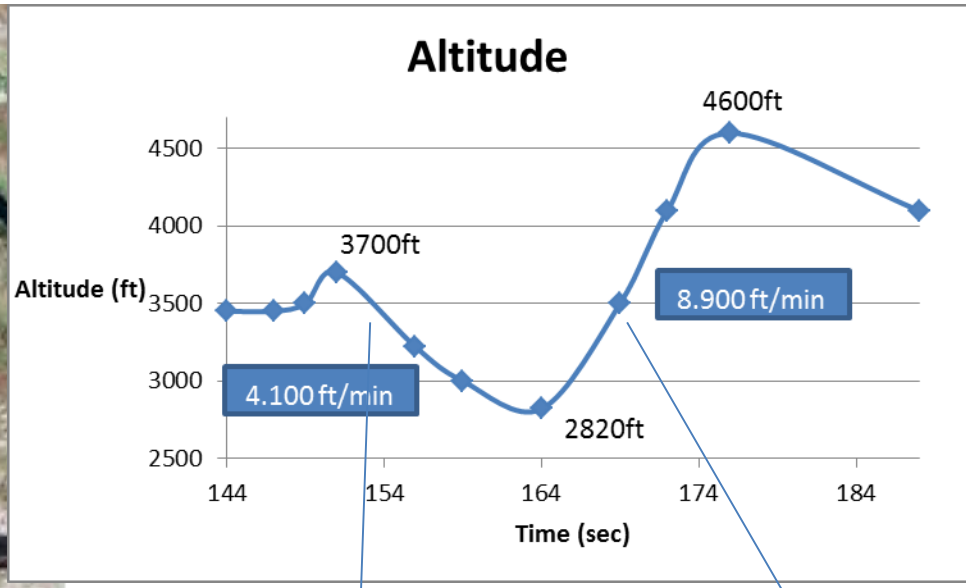





9084 m
7127 m
5530 m
4158 m
2963 m
1908 m
963 m
99 m
300
400
500
600
700
800
900
1000
[hPa]
–20
–10
0
10
20
[°C]

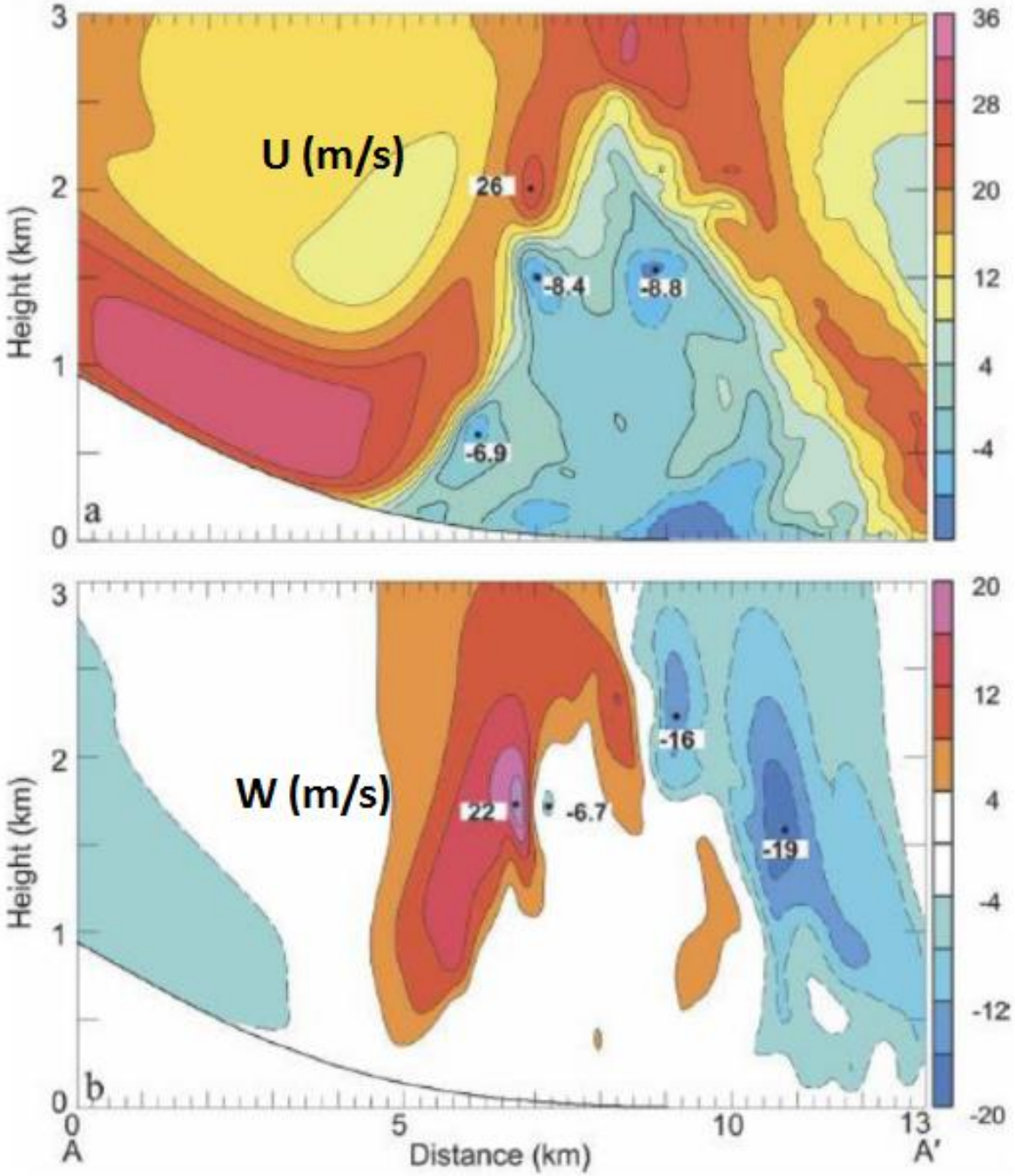
Extreme vertical velocities





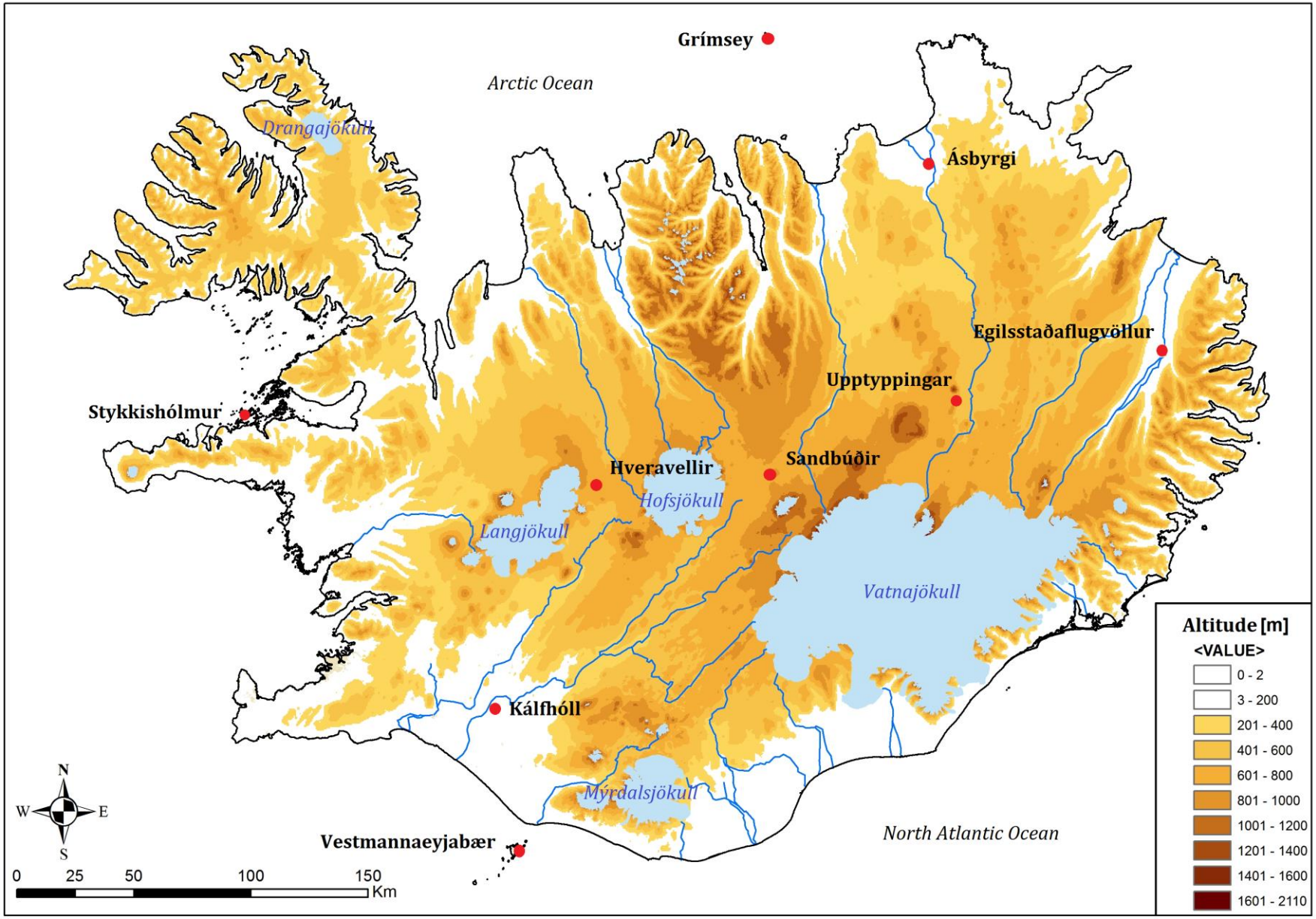
w=45 m/s

w=-20,8 m/s

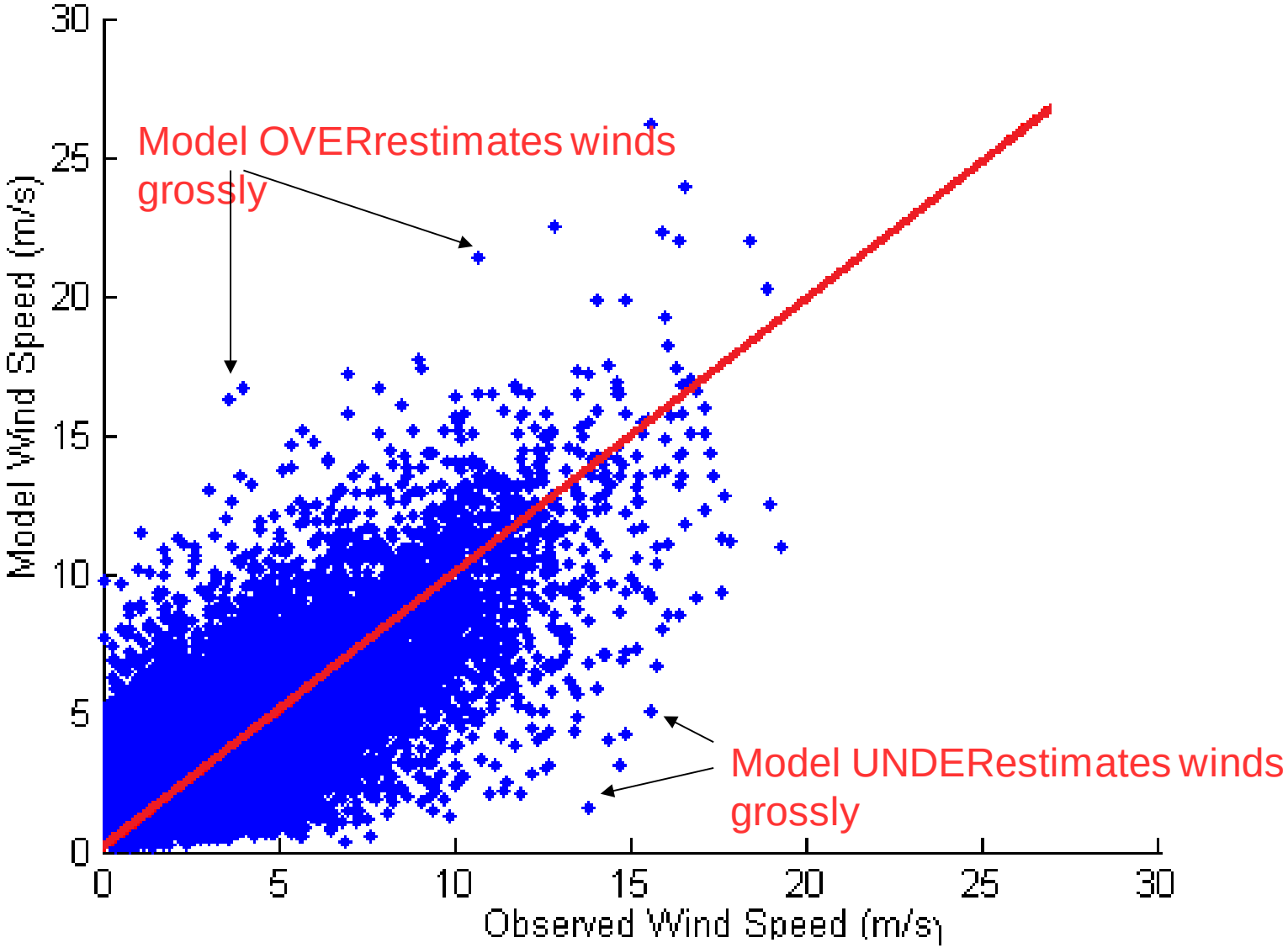


Doyle & Durran (2007)

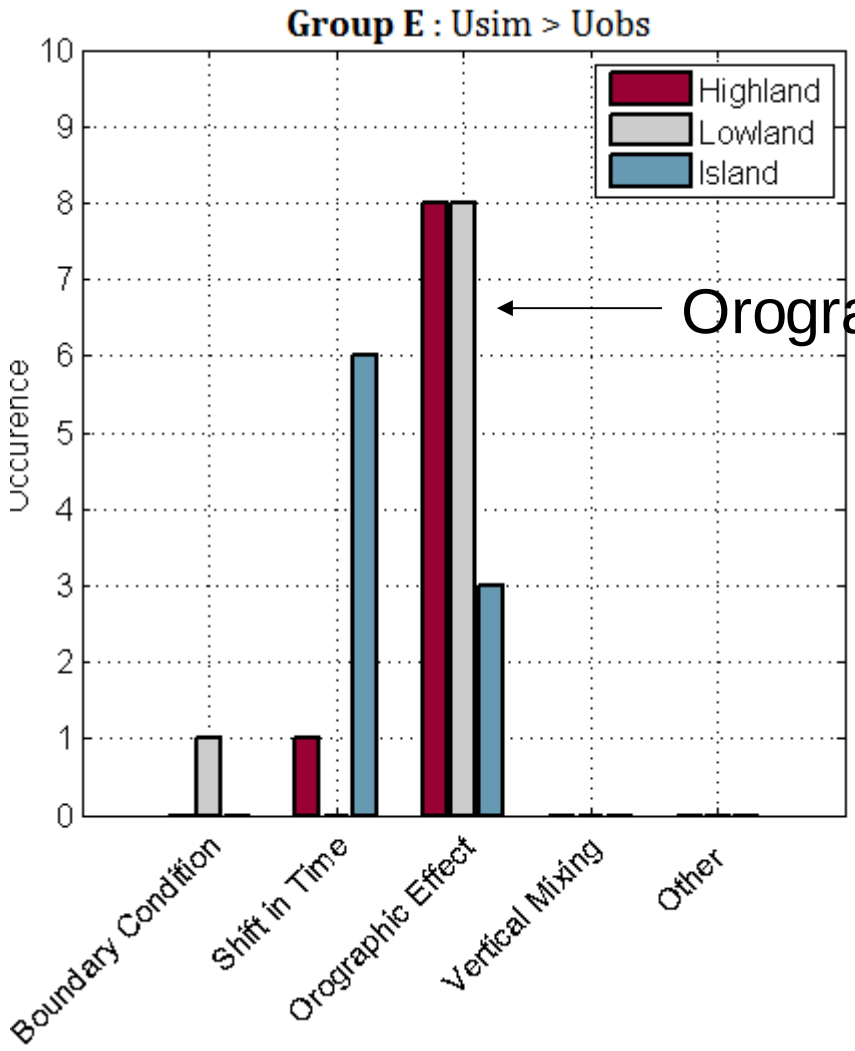
Dynamic downscaling of winds over Iceland (ECMWF, WRF dx=3km)



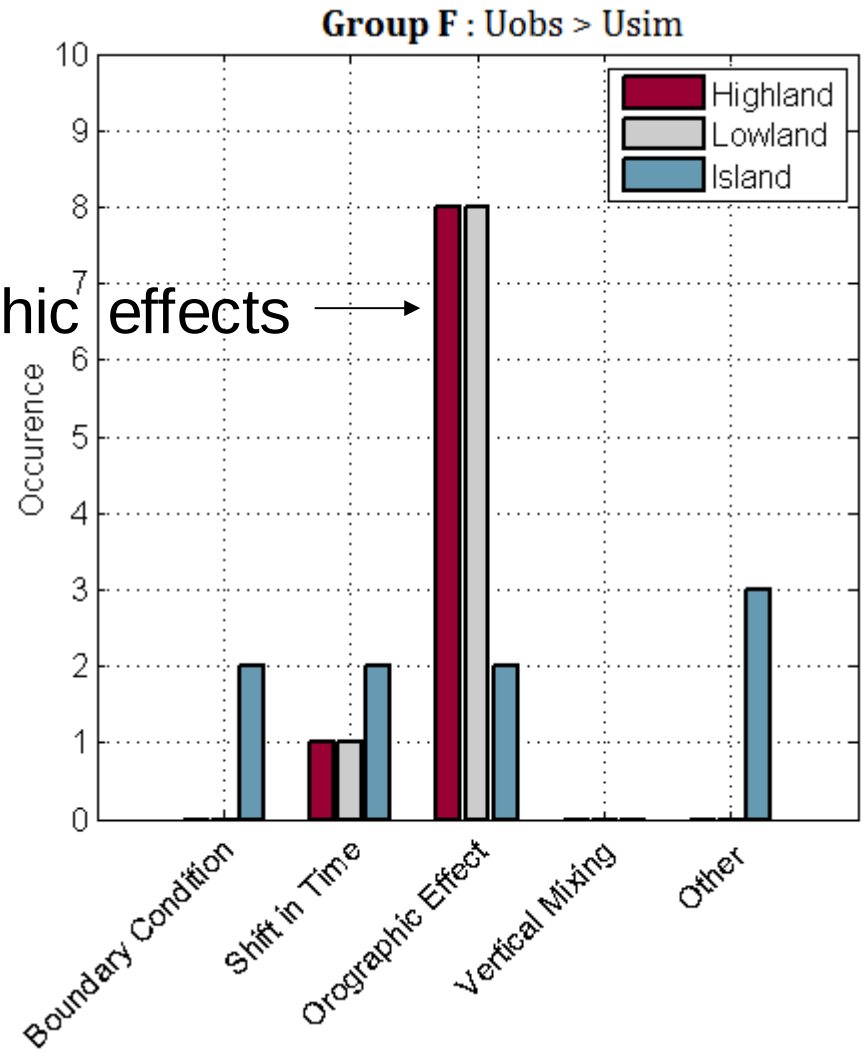
Winds in a dynamic downscaling (ECMWF/WRF dx=3km)

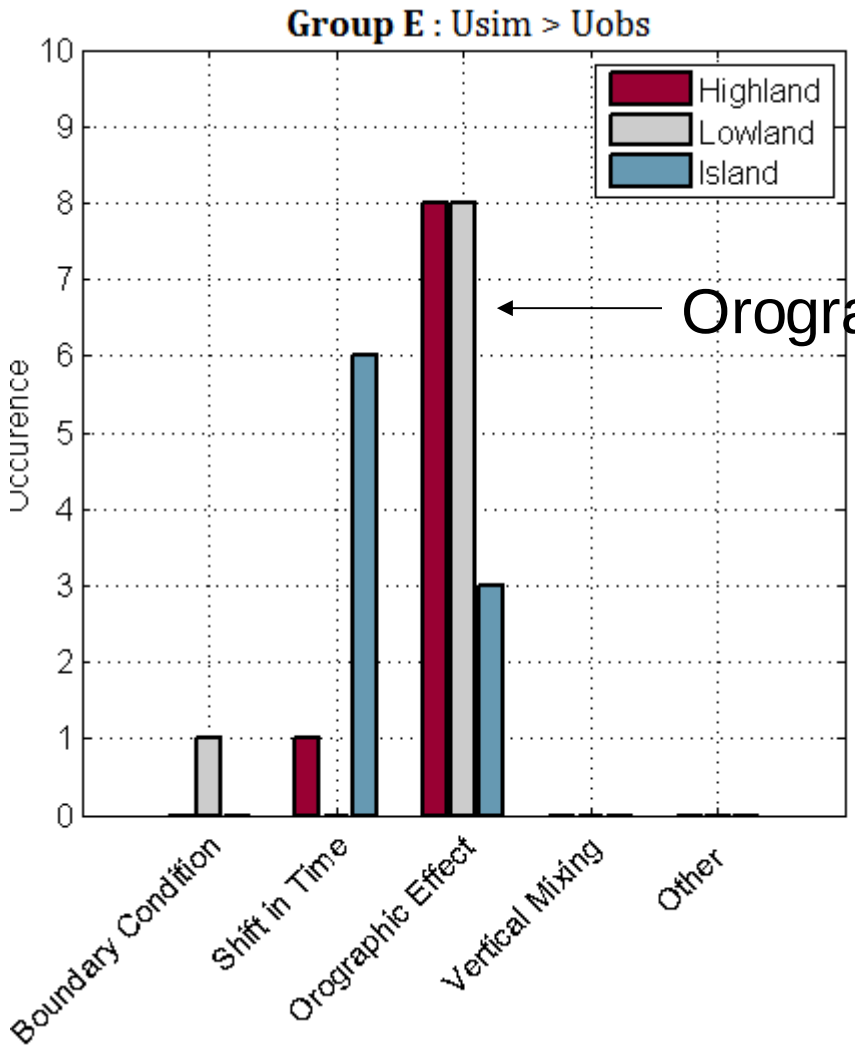


Massad, Olafsson, Petersen, Rognvaldsson, Agustsson

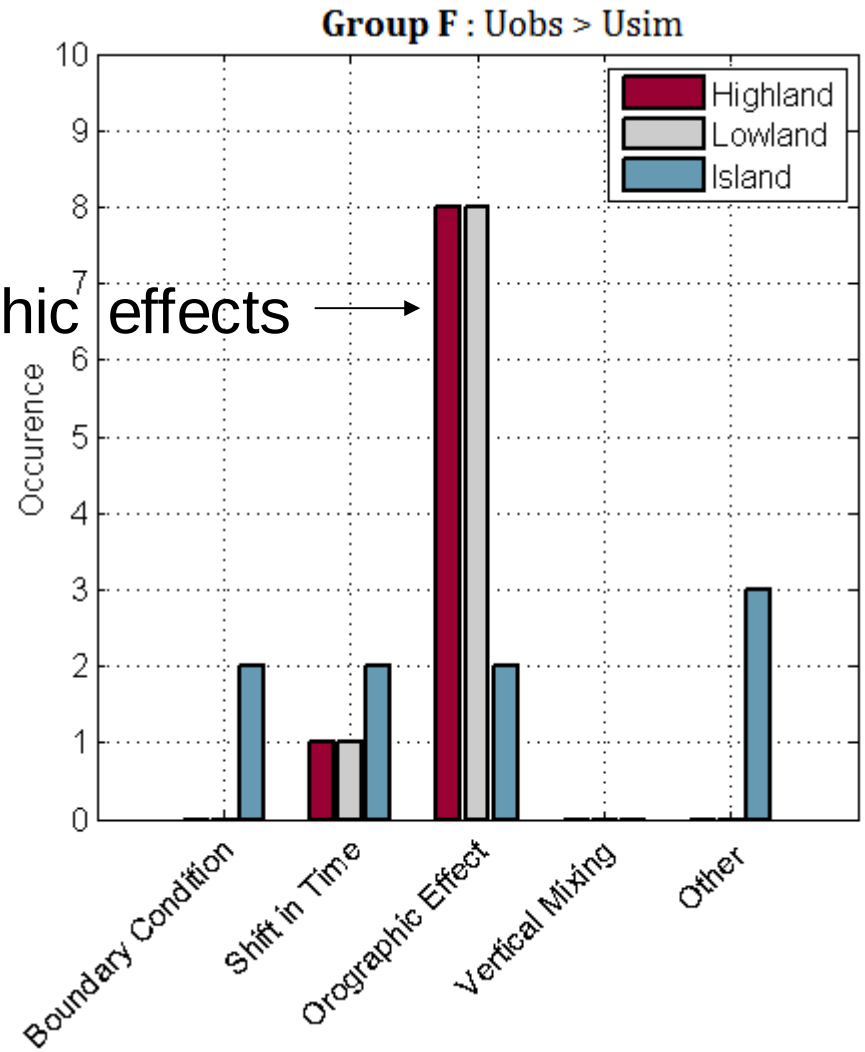


Orographic effects





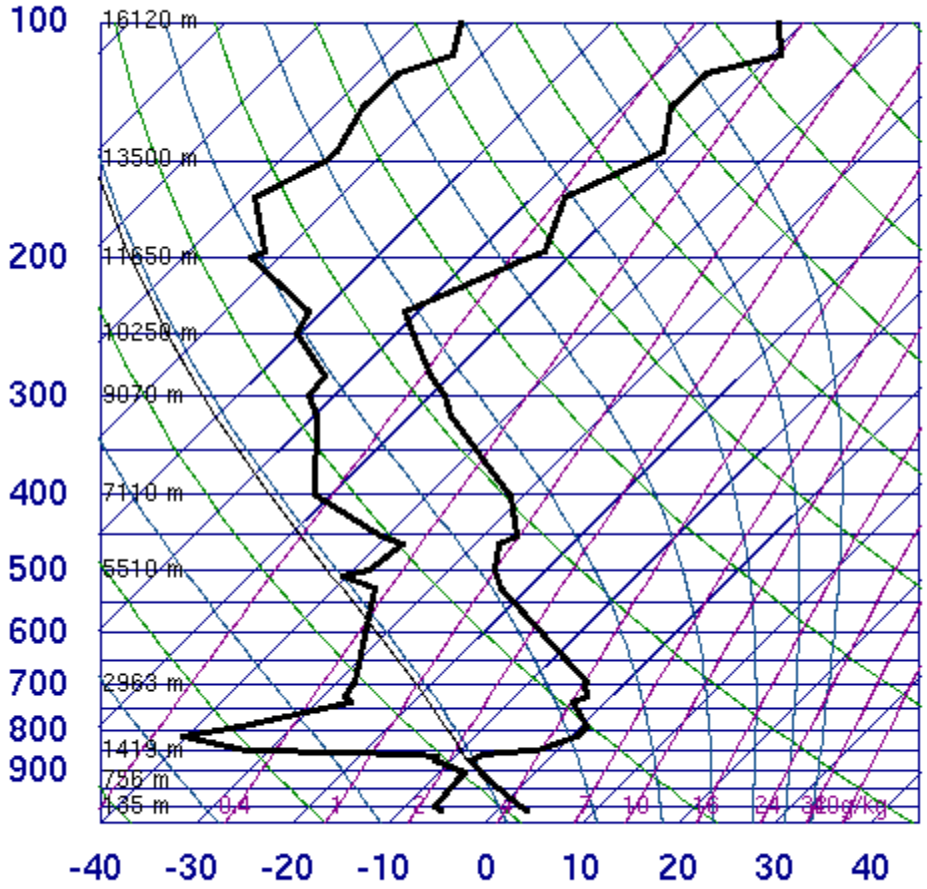
Orographic effects

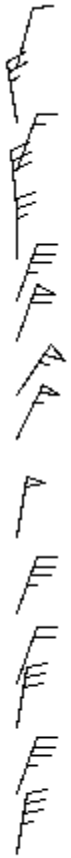


Must be non-resolved orography (??)

25/09/2014 13:28

04018 BIKF Keflavikurflugvollur





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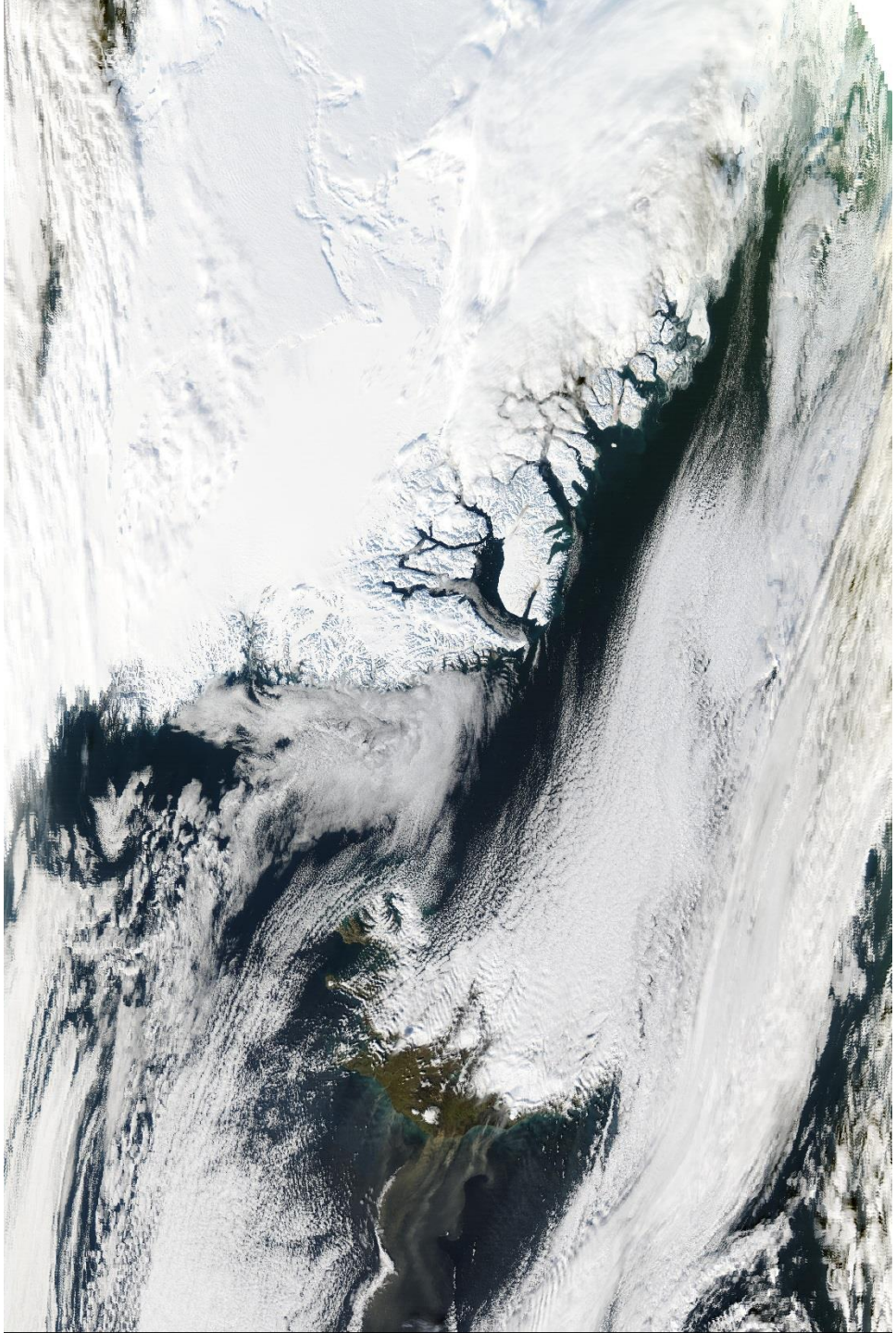
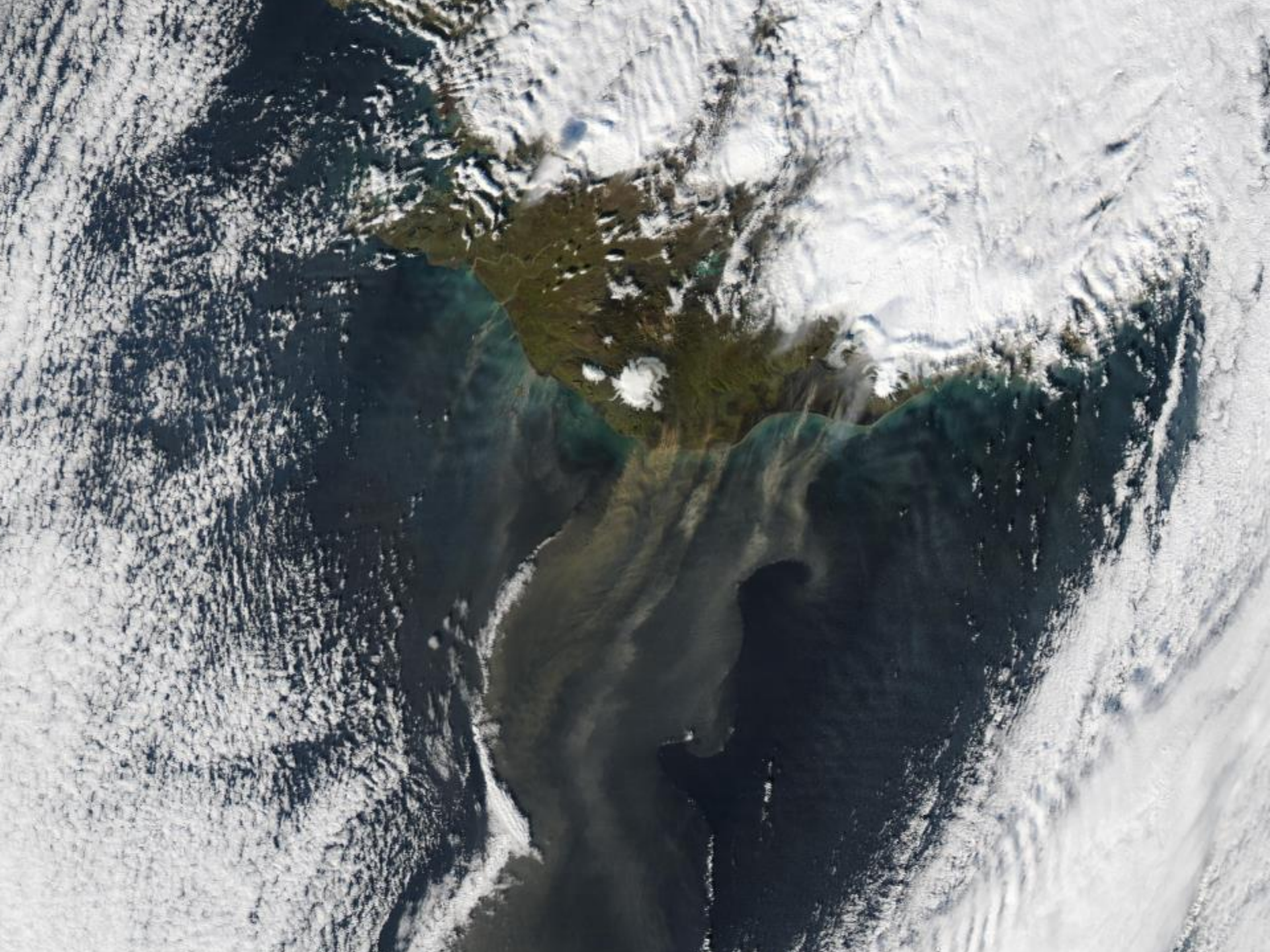
SLON	-22.6
SELV	54.00
SHOW	15.30
LIFT	17.25
LFTV	17.26
SWET	109.0
KINX	-32.5
CTOT	-5.60
VTOT	22.40
TOTL	16.80
CAPE	0.00
CAPV	0.00
CINS	0.00
CINV	0.00
EQLV	-9999
EQTV	-9999
LFCT	-9999
LFCV	-9999
BRCH	0.00
BRCV	0.00
LCLT	264.5
LCLP	872.1
MLTH	275.1
MLMR	2.31
THCK	5375.
PWAT	5.30

12Z 05 Oct 2004

University of Wyoming



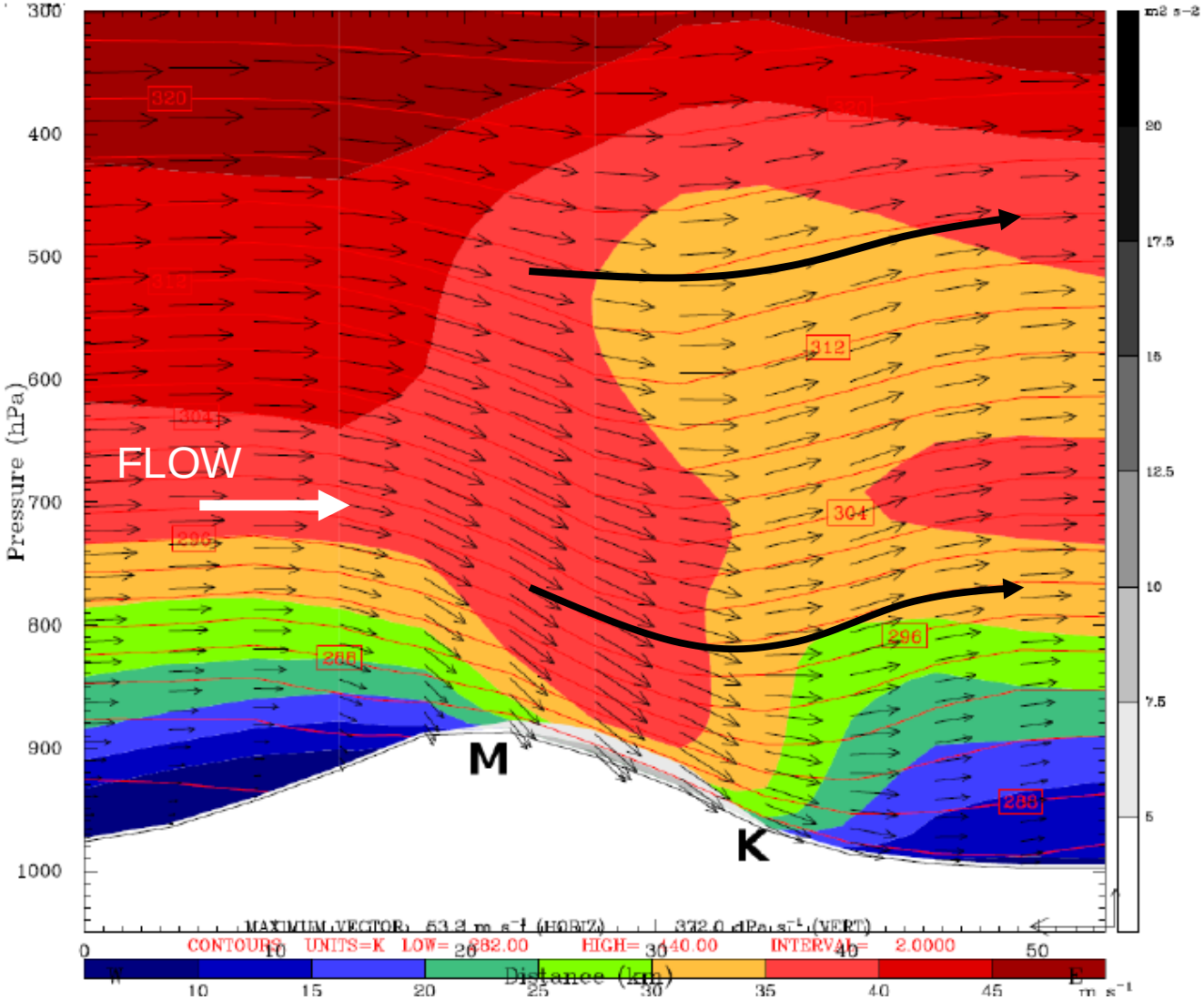


ICAM 2017?

The Mt. Eyjafjallajökull ash plume on 1 May 2010. (Photo: Bernadett Weinzierl)

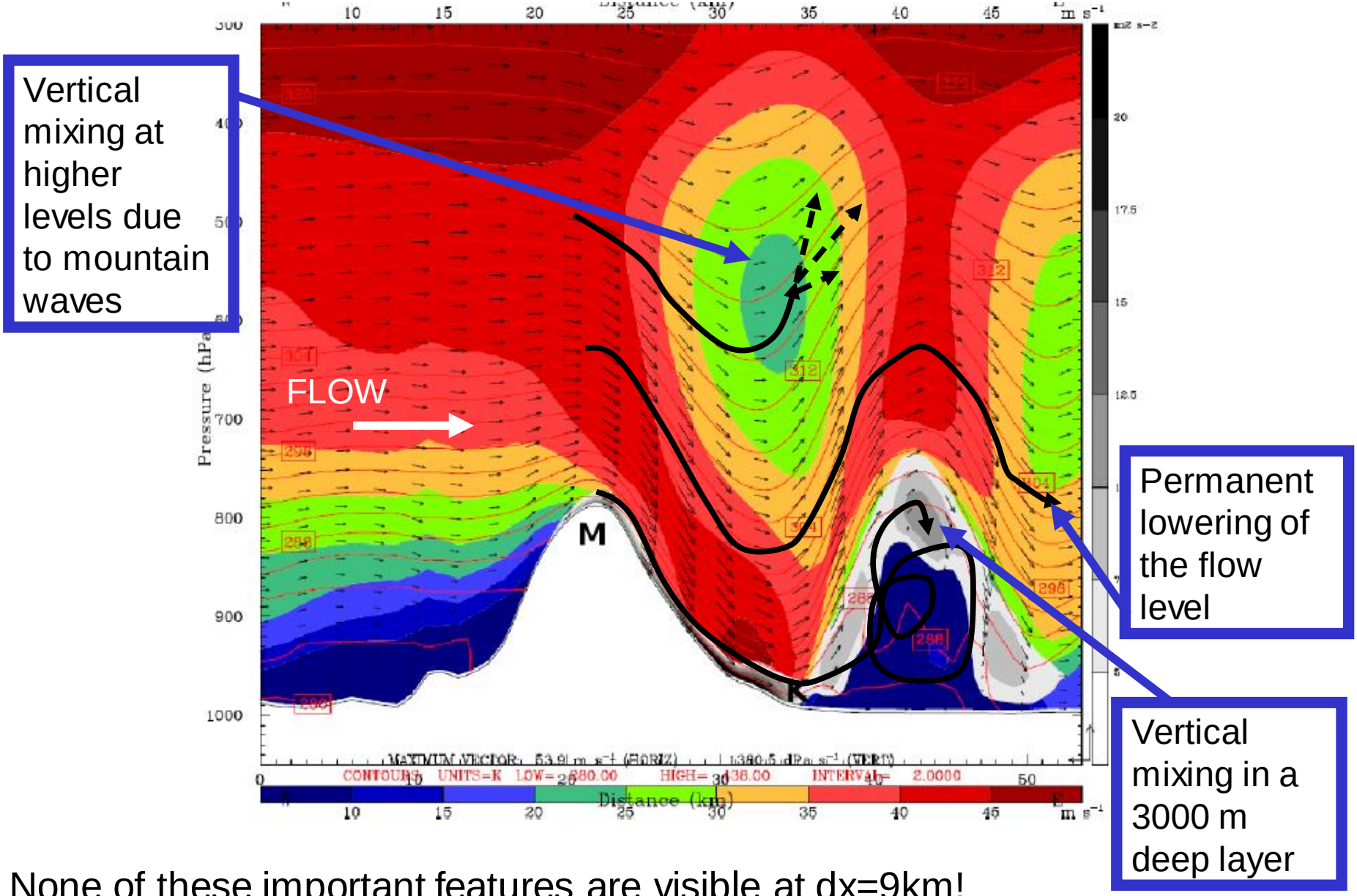
Thank you

Numerical simulation (model) with horizontal resolution of 9 km



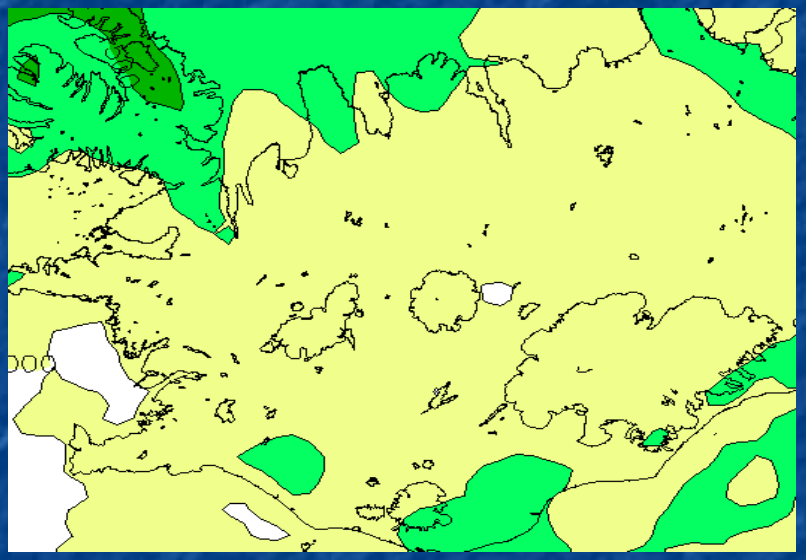
Ágústsson & Ólafsson, 2010

Numerical simulation (model) with horizontal resolution of 1 km

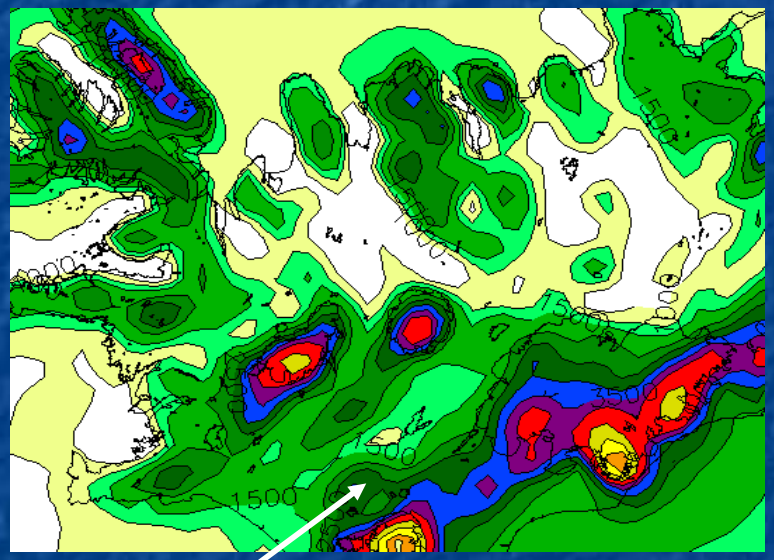


None of these important features are visible at dx=9km!

One year simulated precipitation (dx=8km)



Flat

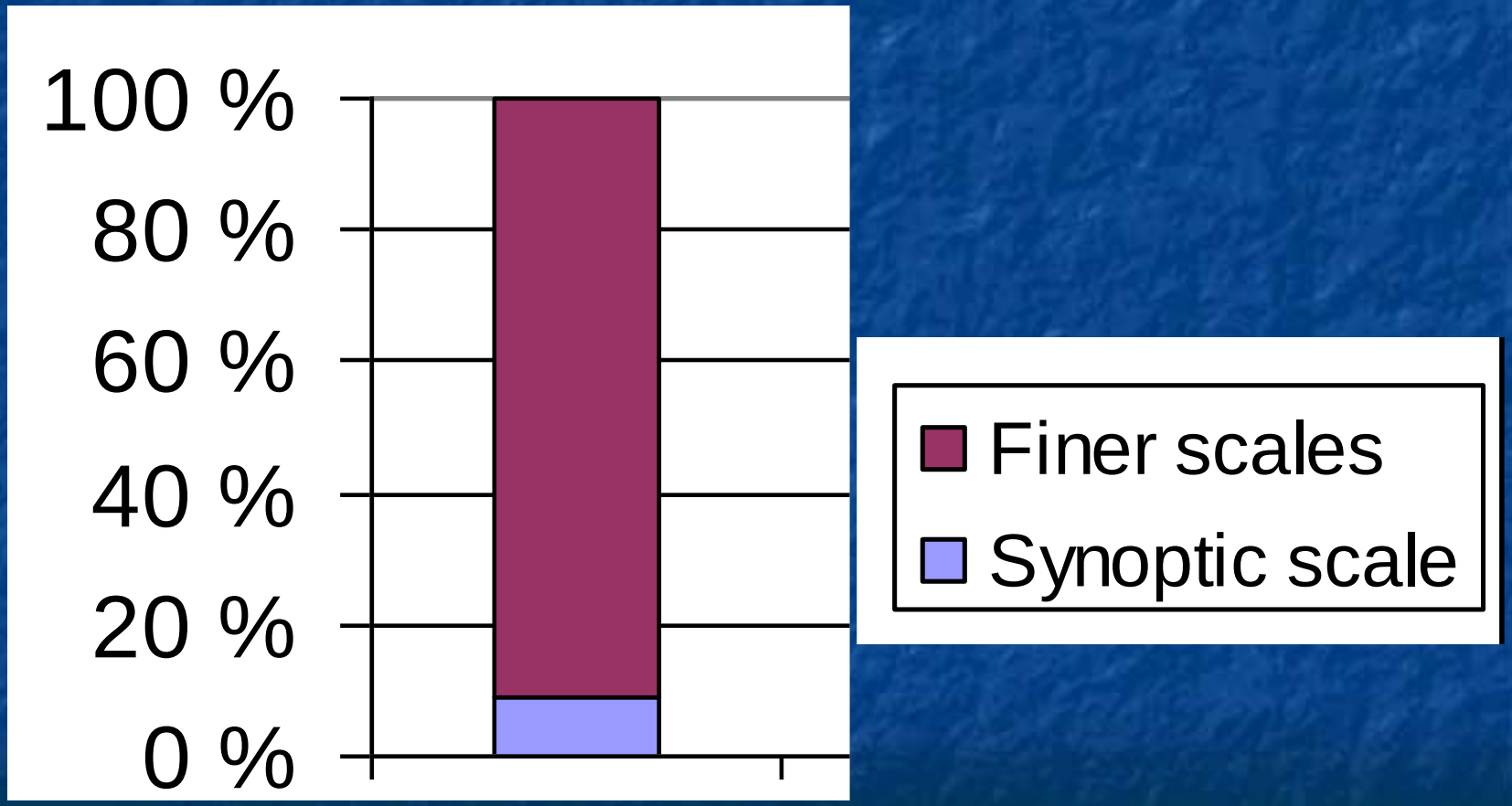


Mountains

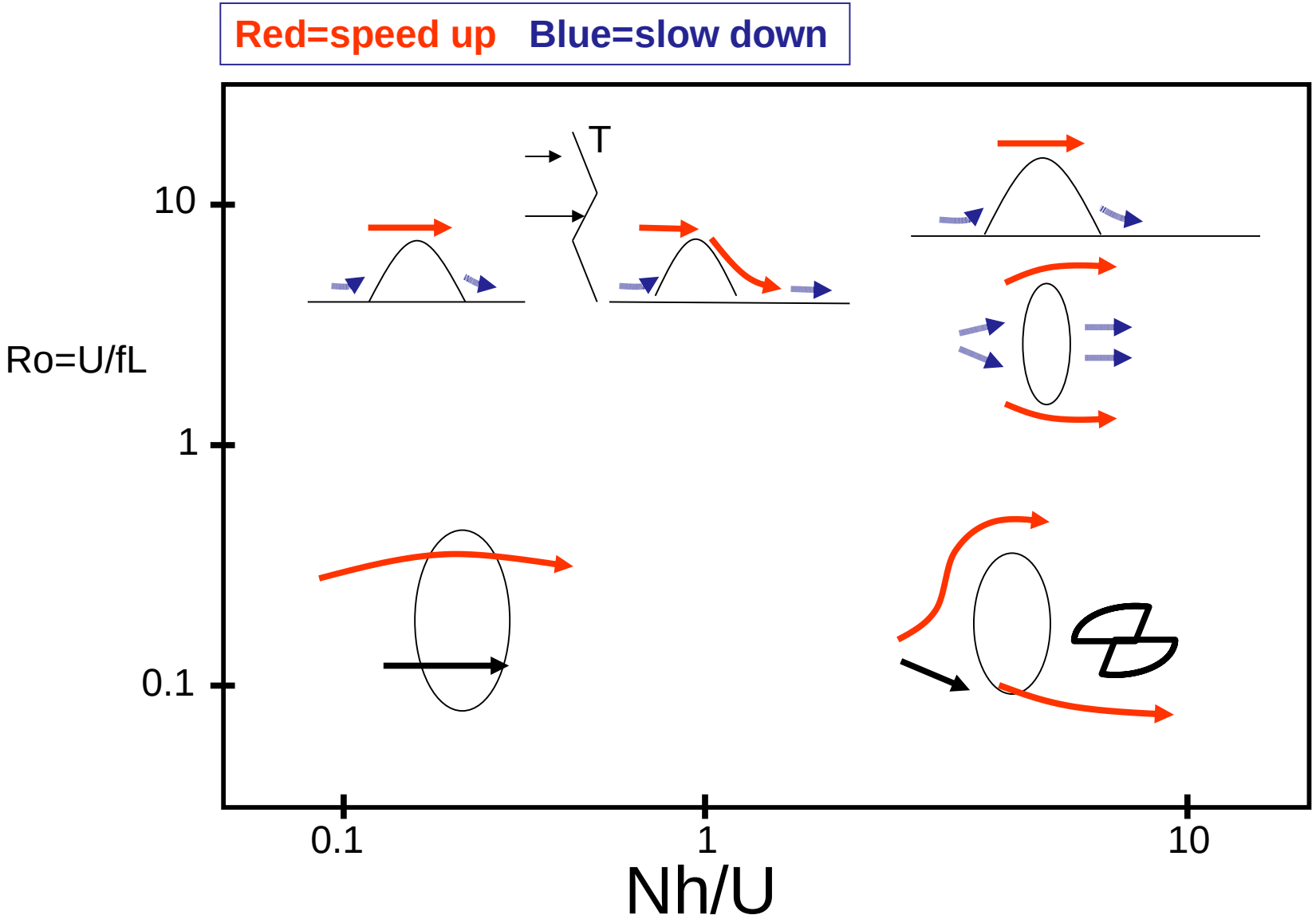
>7000 mm

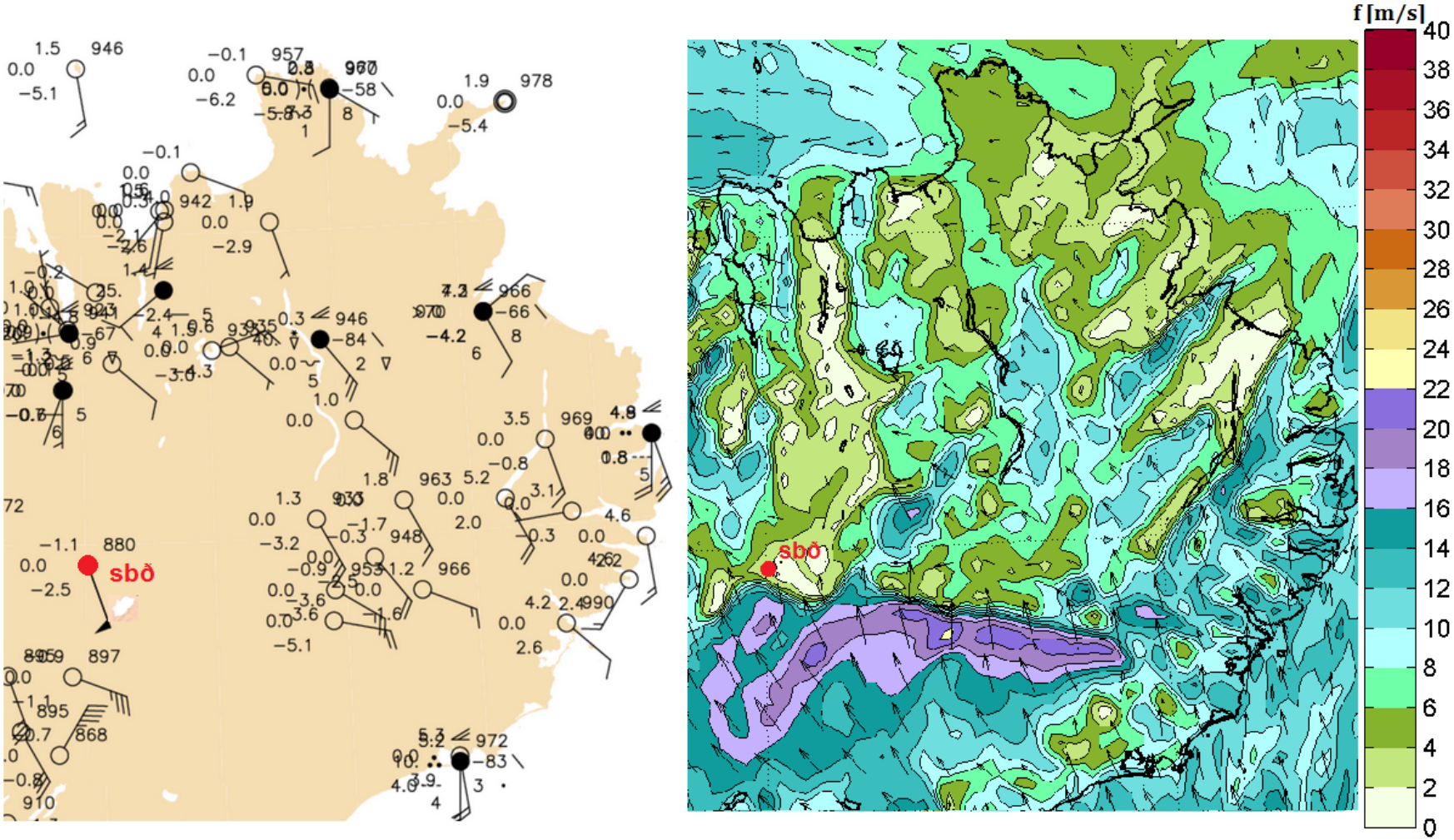
Rögnvaldsson, Jónsdóttir and Ólafsson,Met Z. 2007

Annual precipitation in Öræfajökull (2110 m), SE-Iceland

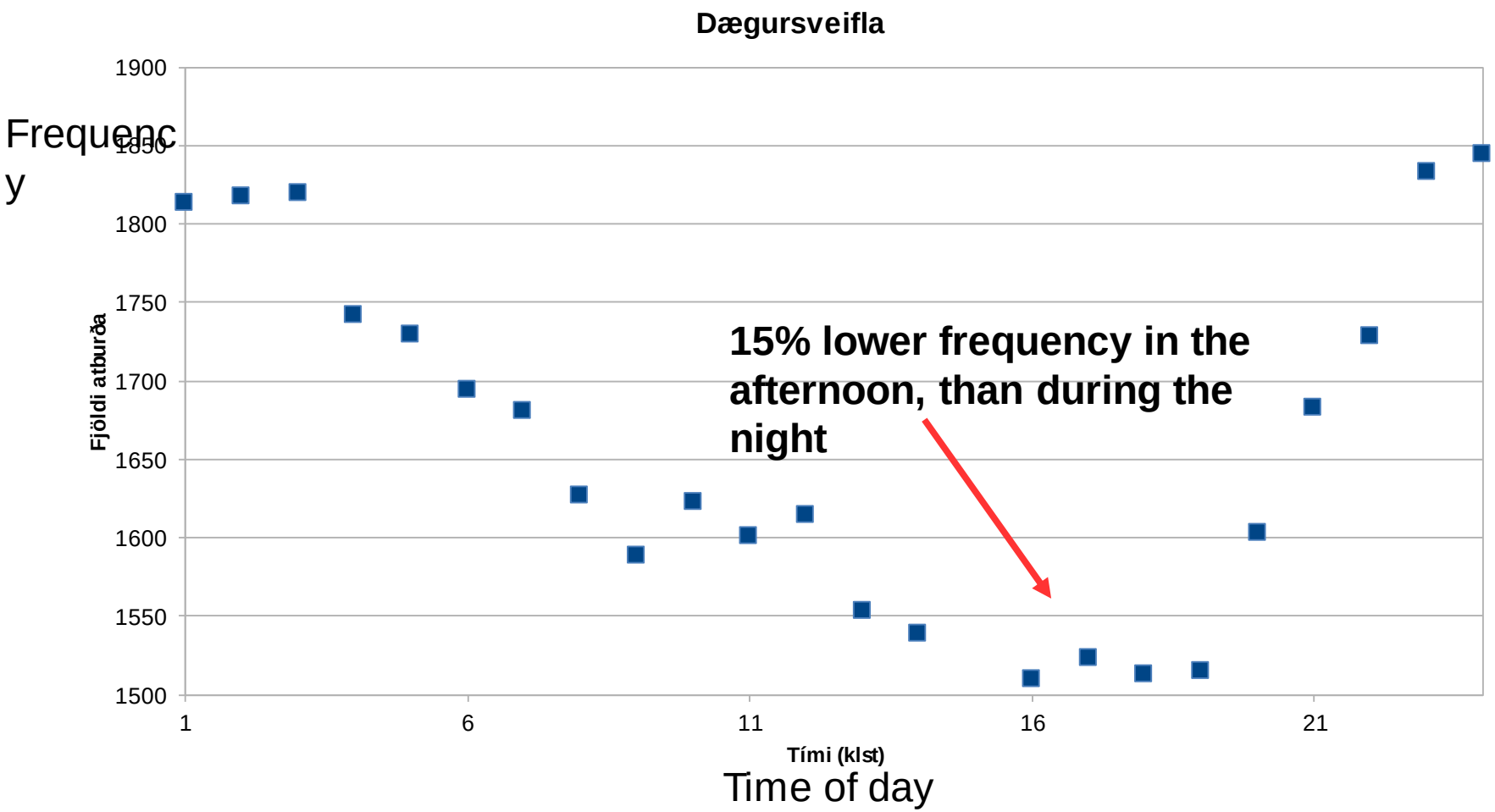


The mountain wind forecasting diagram




sbö
sbö
f [m/s]
40
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0

Diurnal variability of the frequency of windstorms in the vicinity of comlex terrain



Kristjansdottir & Olafsson

Inversions are still a problem

12Z 27 APR 2014

12Z 27 APR 2014

OBS

NWP MOD

Very different low-level vertical temperature profiles

Operational NWP (dx=2,5km)

No vortex street – only a long and extended wake

Atmospheric Research 116 (2012) 105–115

Contents lists available at SciVerse ScienceDirect

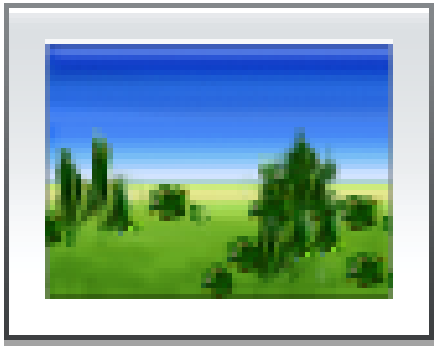
Atmospheric Research

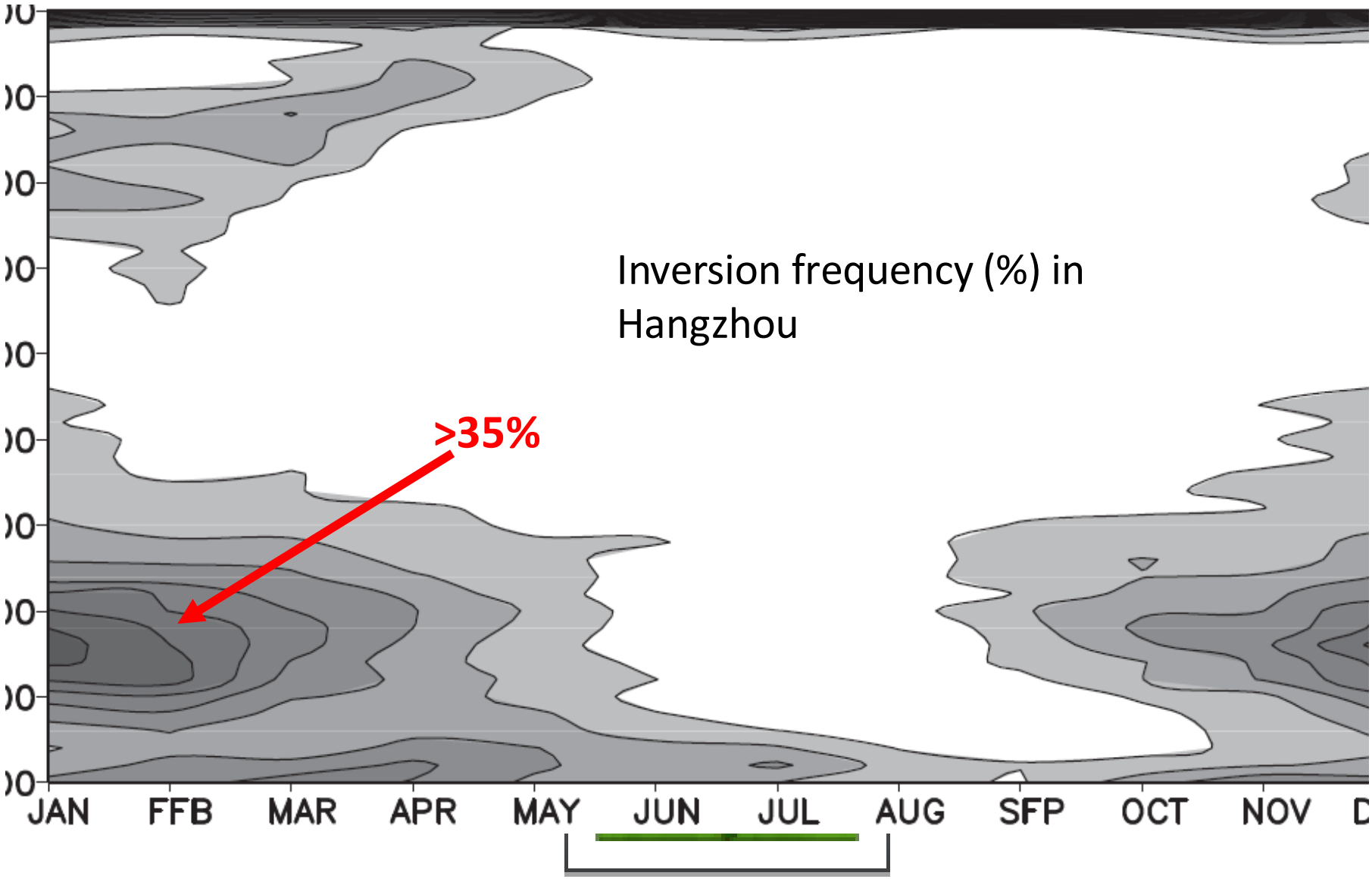
journal homepage: www.elsevier.com/locate/atmos

ropospheric temperature inversion over central China

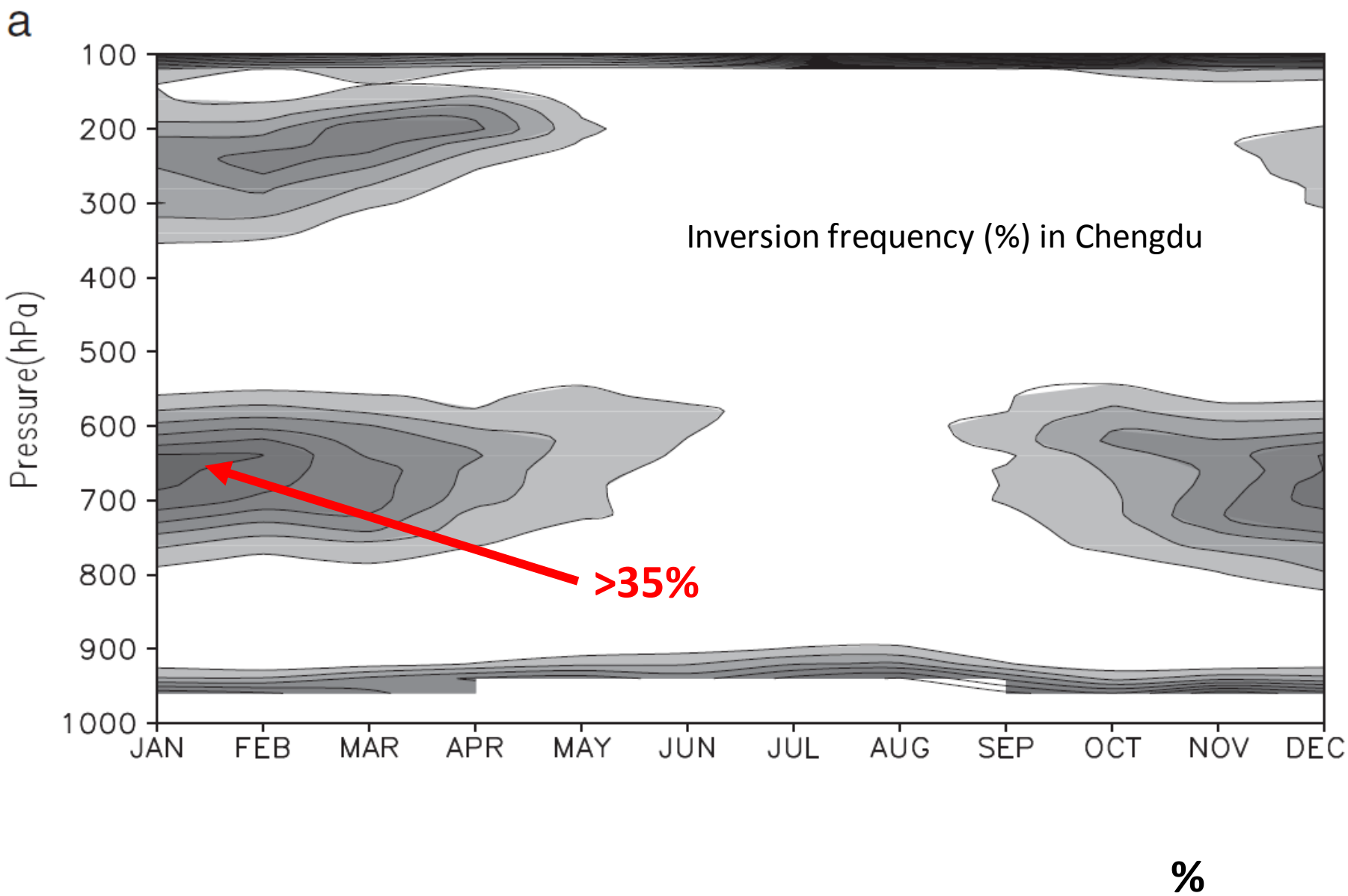
nying Li *, Jiping Yan, Xingbin Sui

tute of Meteorology, PLA University of Science and Technology, Nanjing 211101, China



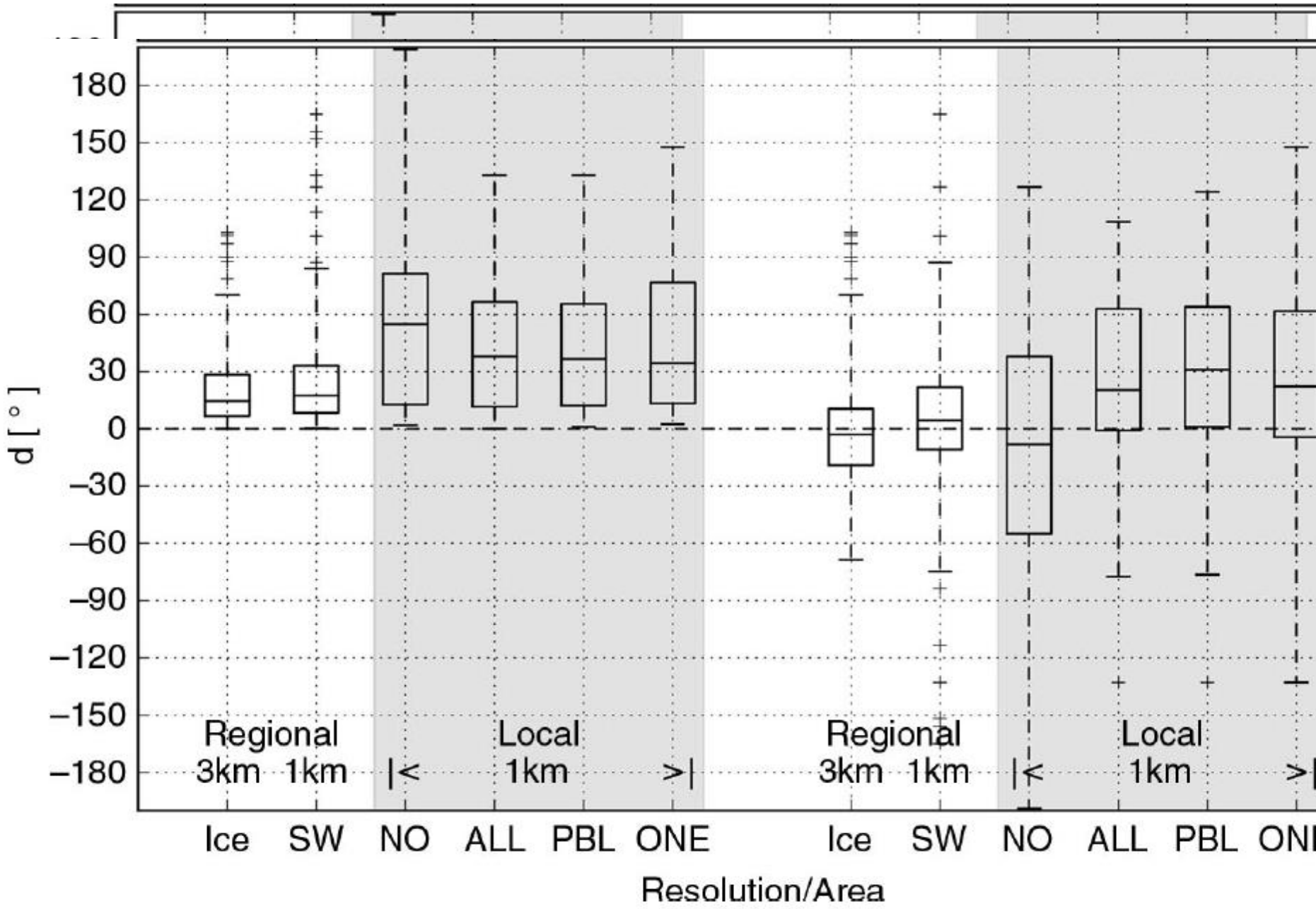


Li, Yan & Sui, 2012



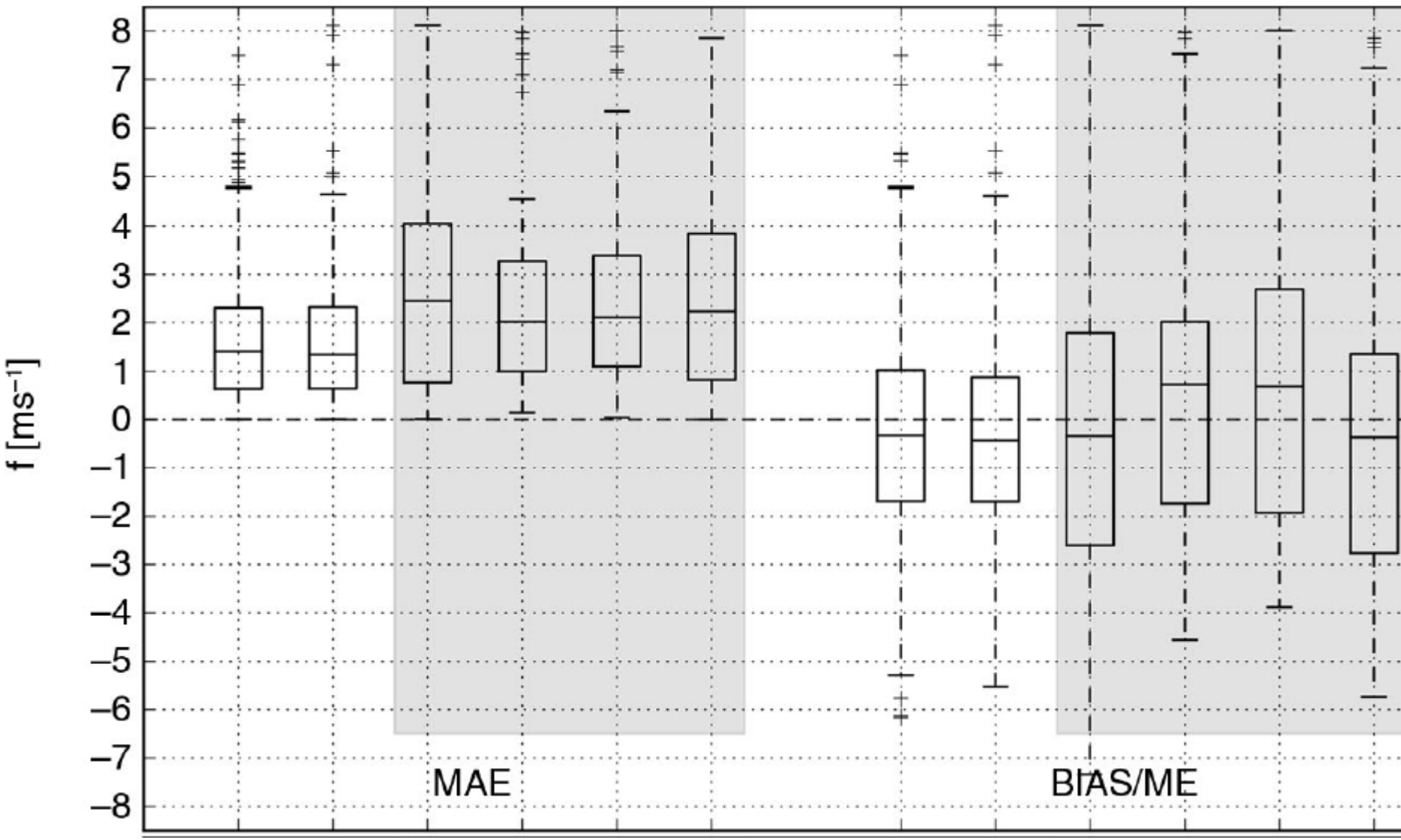
Li, Yan & Sui, 2012

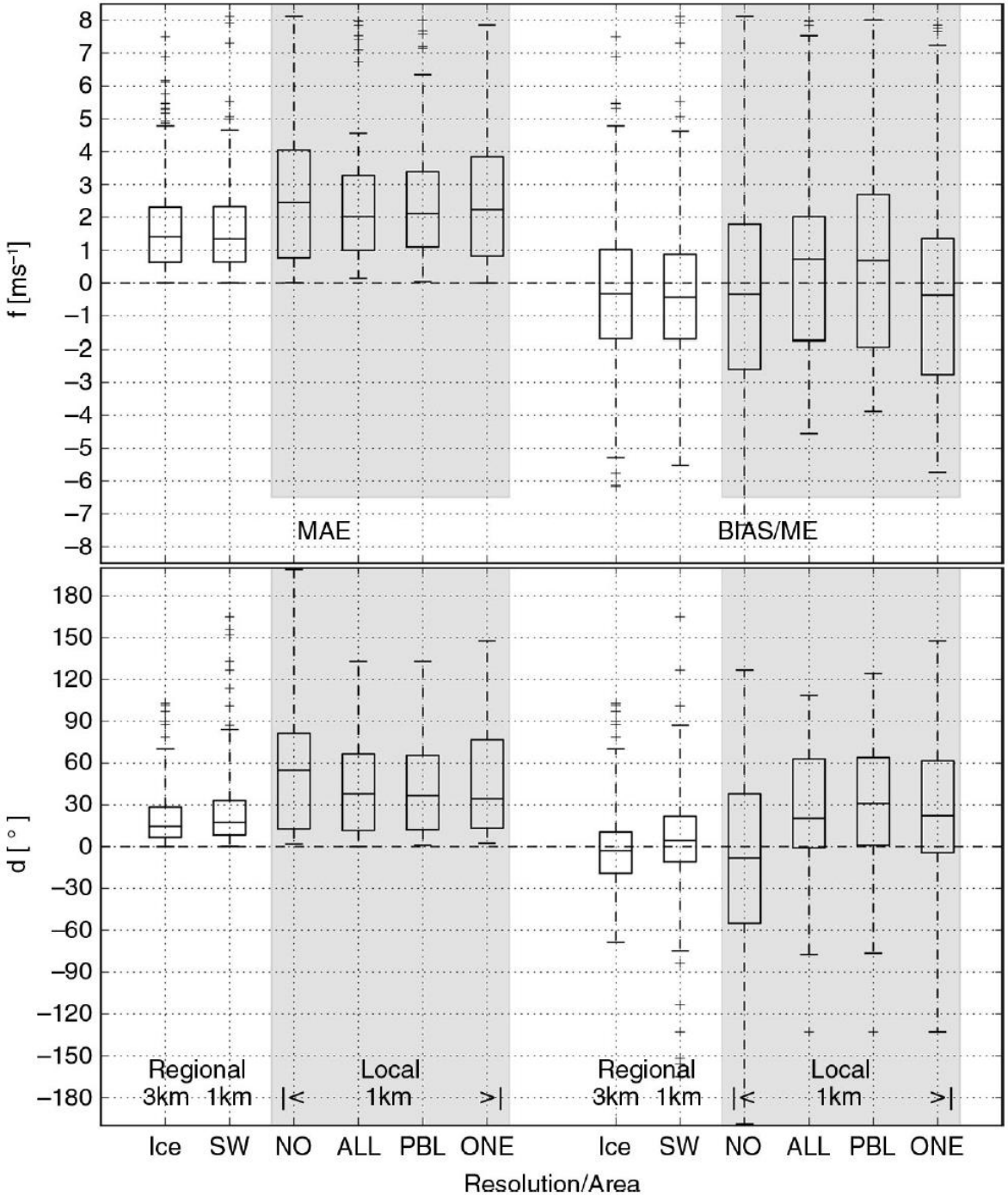
The 4 March 1974 case


180
150
120
90
60
30
0
−30
−60
−90
−120
−150
−180
d [°]
Regional
3km 1km
Local
1km
|<
>|
Regional
3km 1km
Local
1km
|<
>|
Ice
SW
NO
ALL
PBL
ONE
Ice
SW
NO
ALL
PBL
ONE
Resolution/Area

The China Inversions

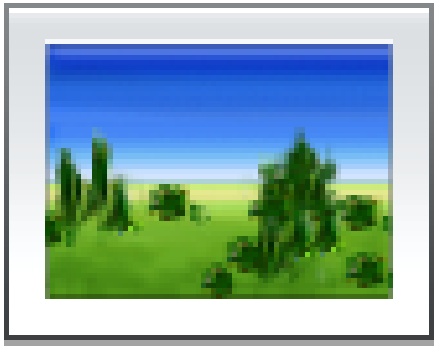
Why are they there? (microphysics, advection, subsidence, radiation....)
Do the models see them (and understand what made them)?
How important are they?


f [ms⁻¹]
8
7
6
5
4
3
2
1
0
−1
−2
−3
−4
−5
−6
−7
−8
MAE
BIAS/ME


f [ms⁻¹]
MAE
BIAS/ME
d [°]
Regional
3km 1km
Local
1km
|<
>|
Ice SW NO ALL PBL ONE
Ice SW NO ALL PBL ONE
Resolution/Area

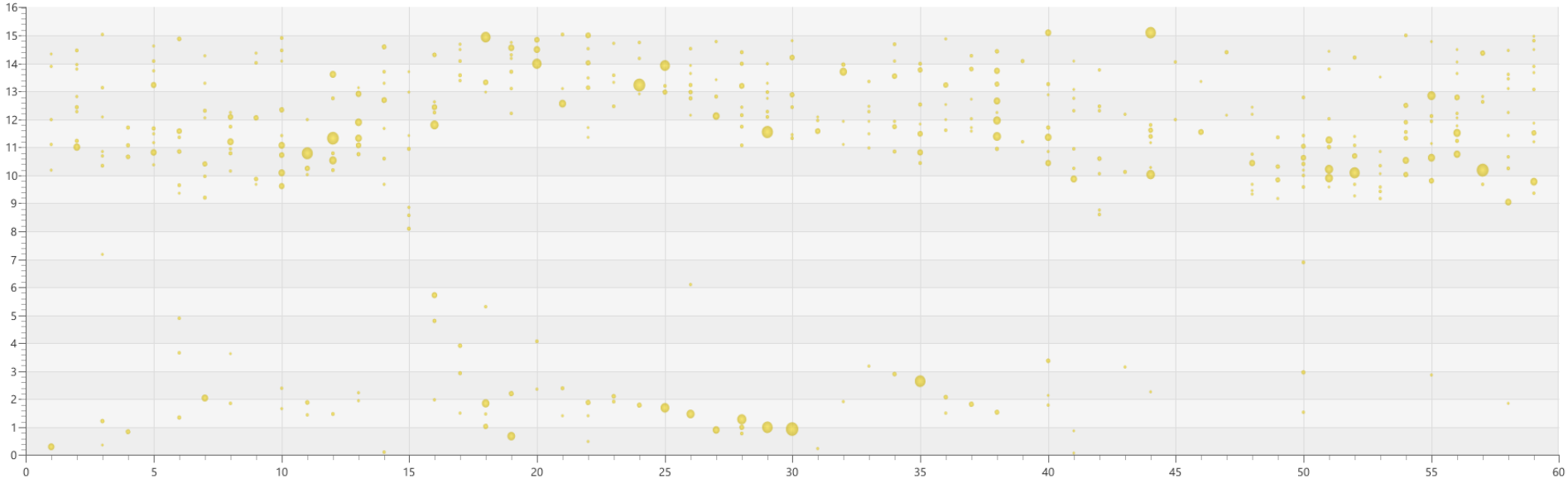
U (m/s)

W (m/s)



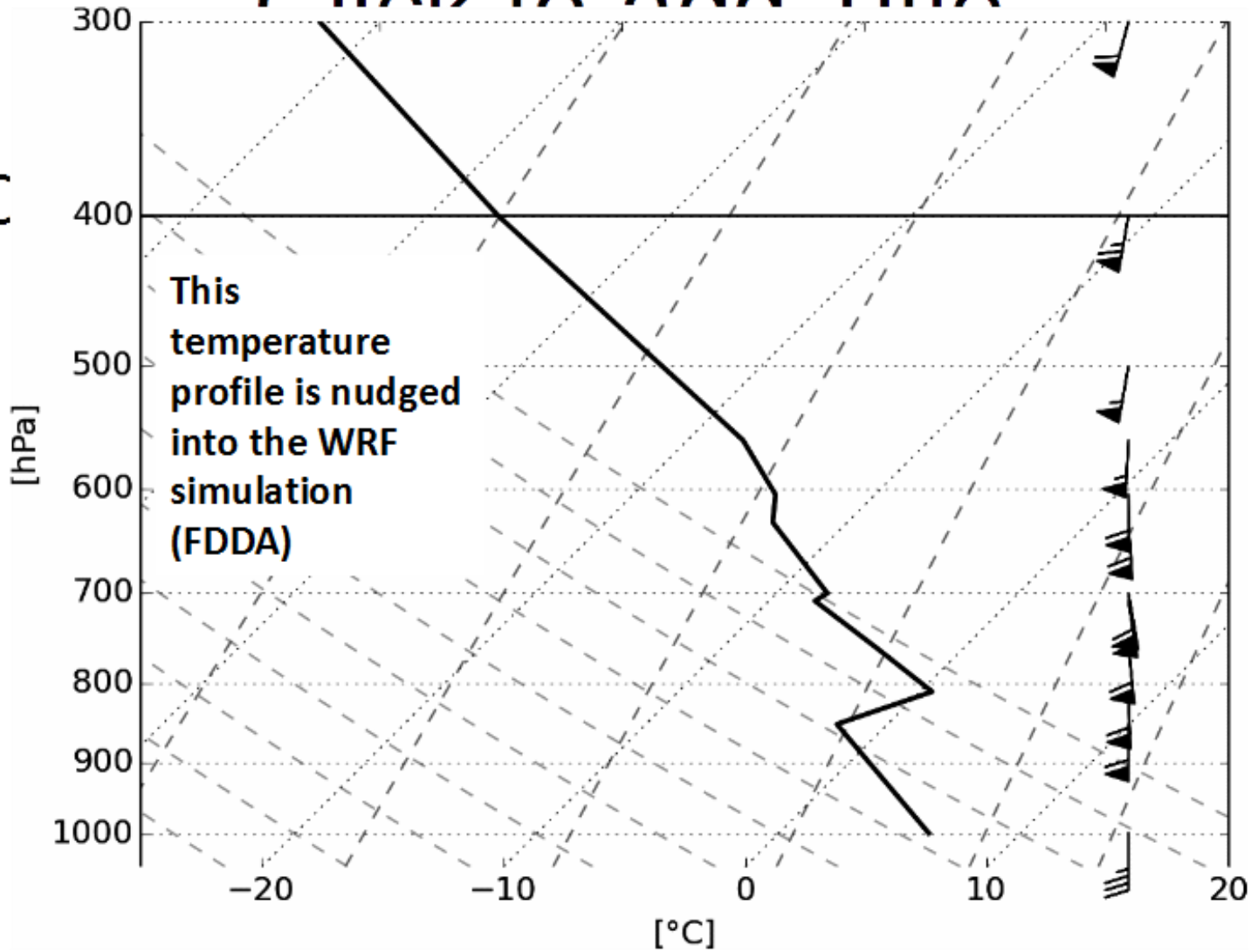
Doyle & Durran (2007)

Keflavik Inversion 2013-10



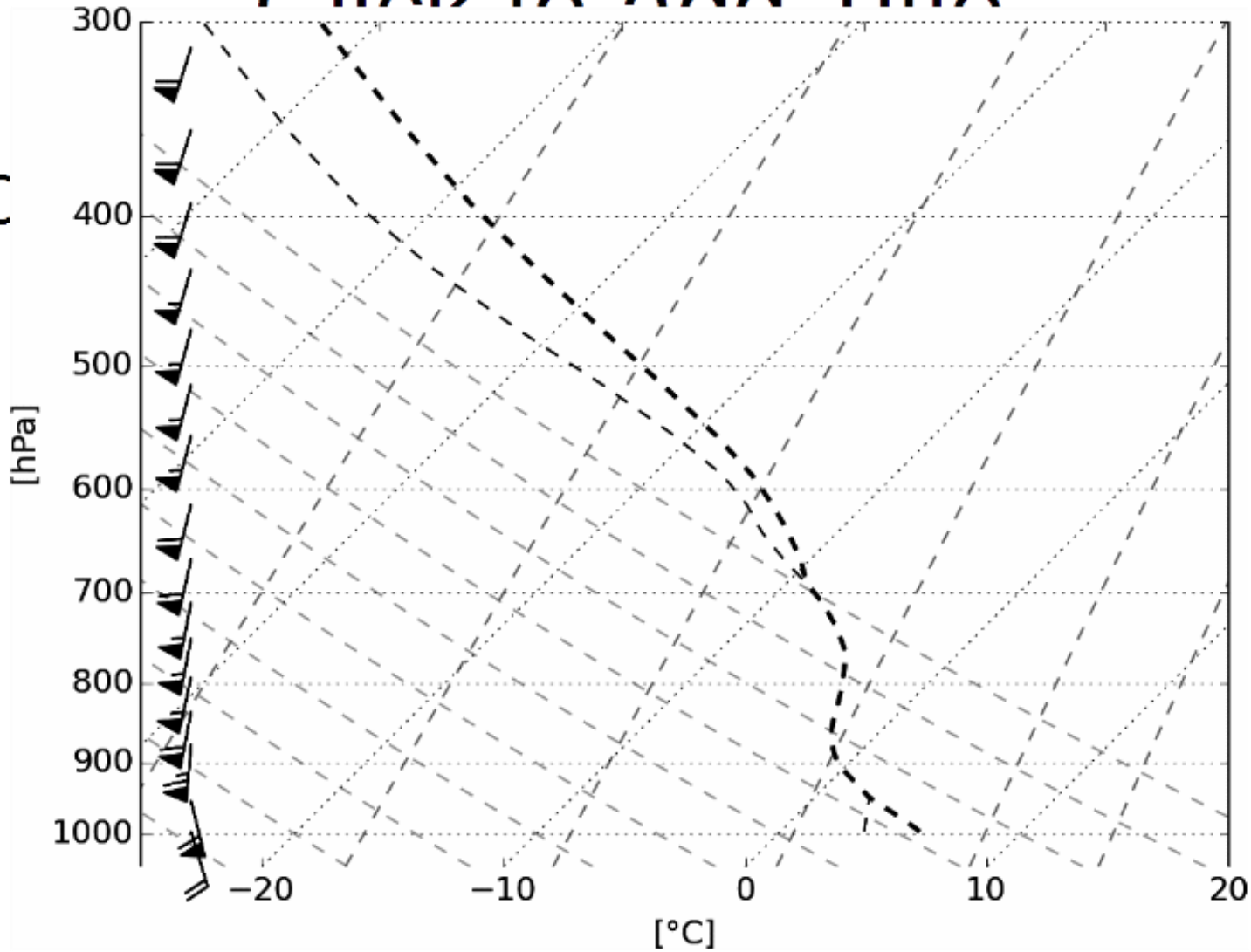
Click to add Title

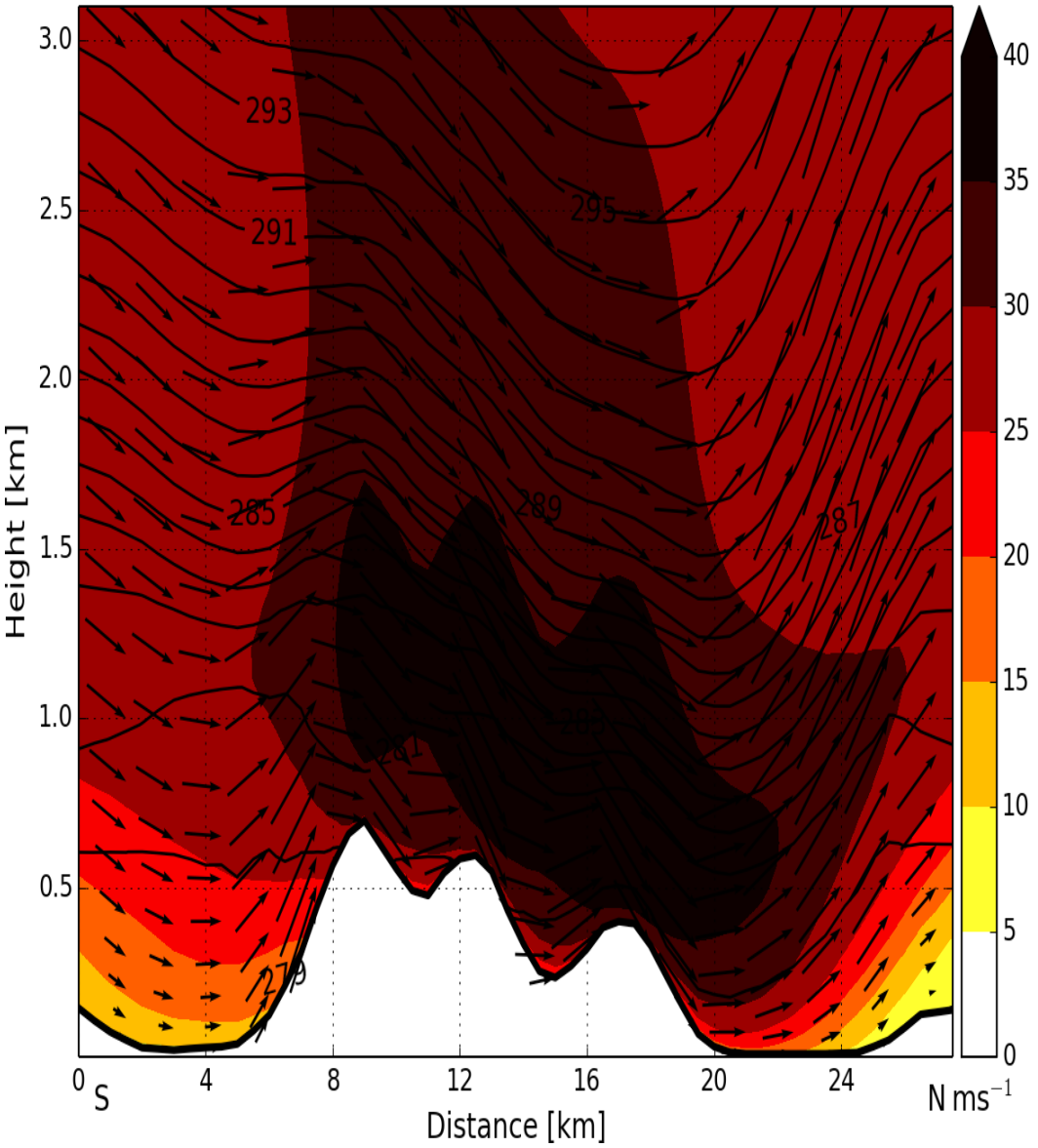
- C



Click to add Title

- C

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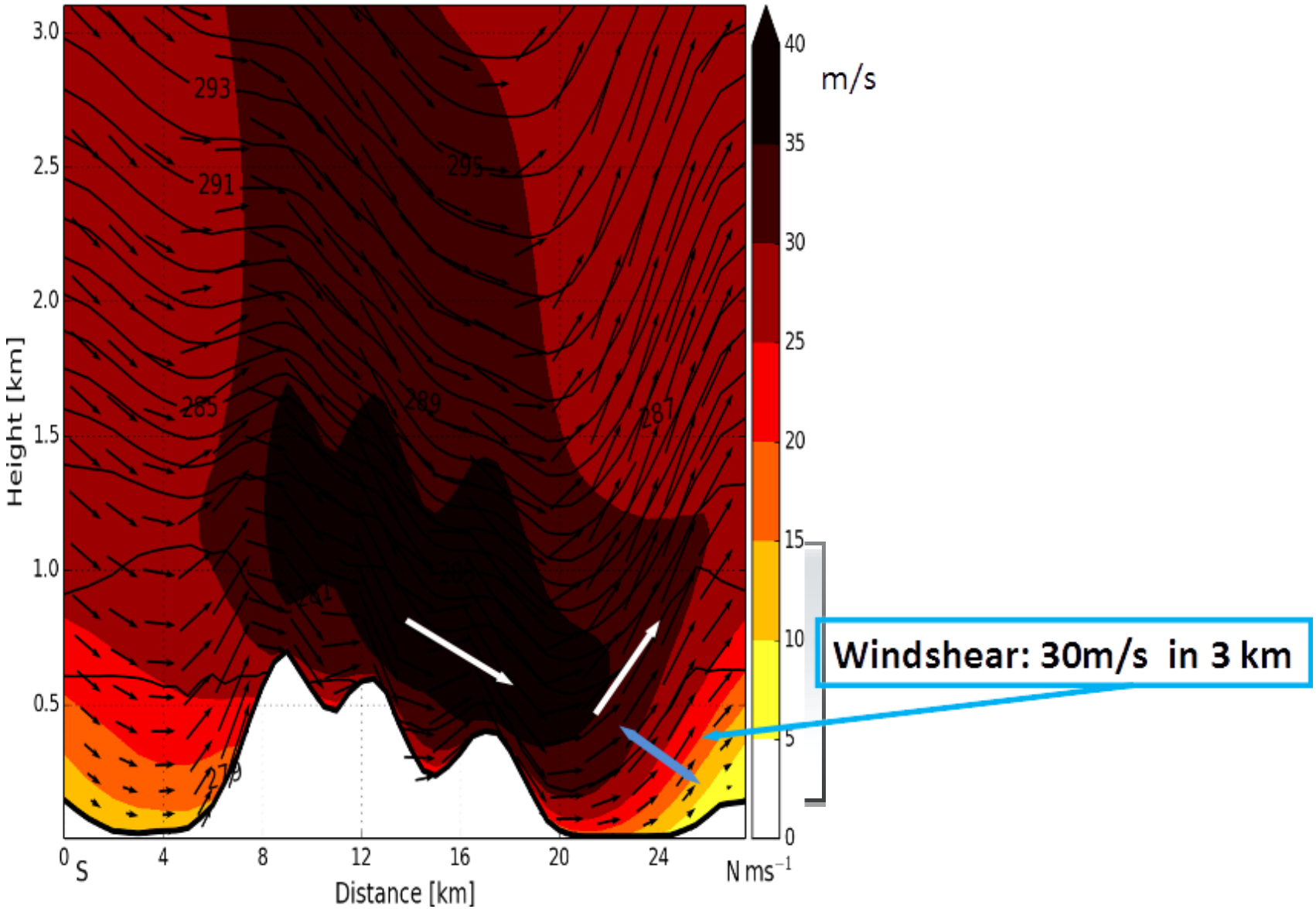
2.5
2.0
1.5
1.0
0.5
0
4
8
12
16
20
24
S
N
Distance [km]
293
291
295
285
289
287
281
283
279
40
35
30
25
20
15
10
5
0
N ms^{-1}


Height [km]
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2.5
2.0
1.5
1.0
0.5
0
S
4
8
12
16
20
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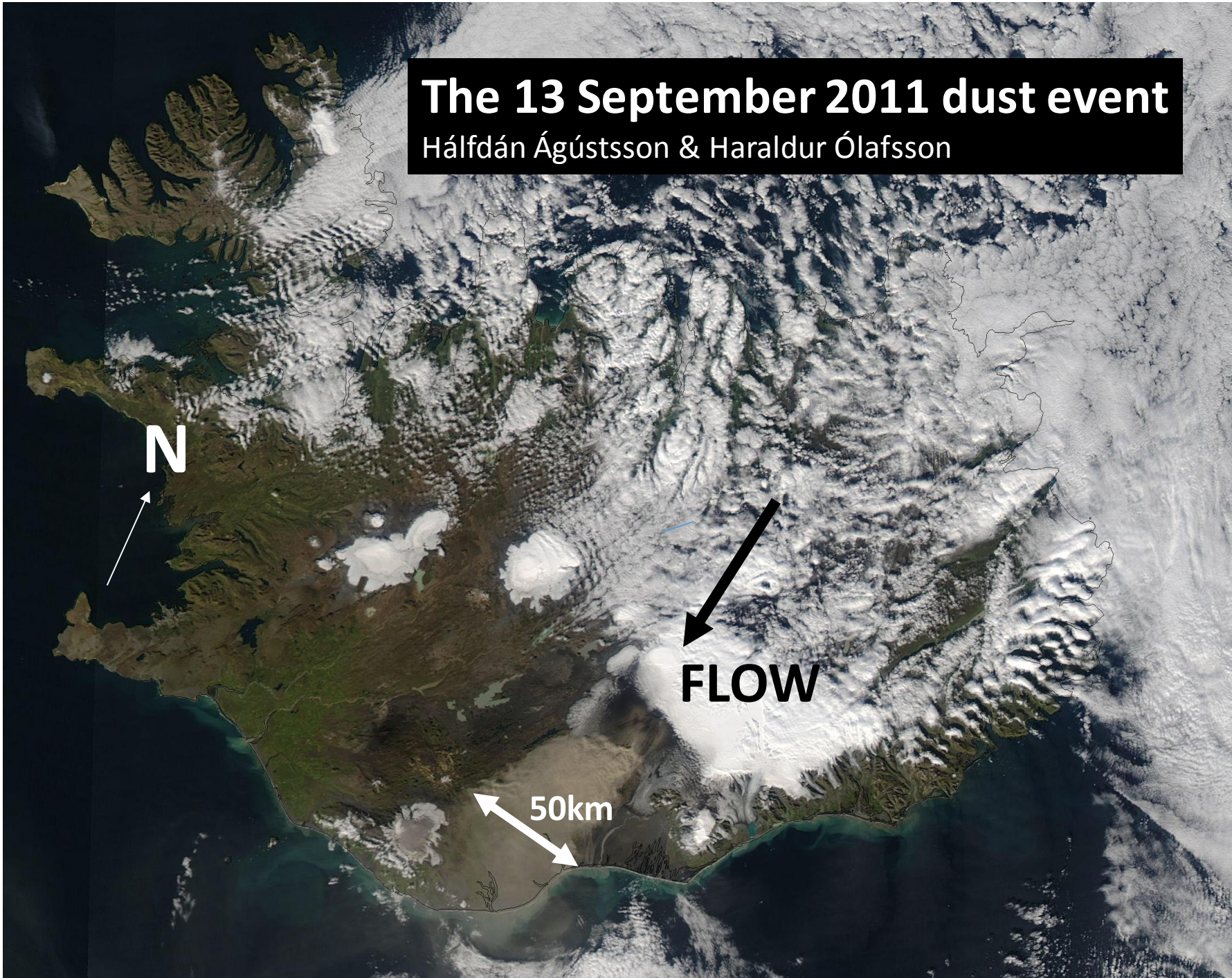
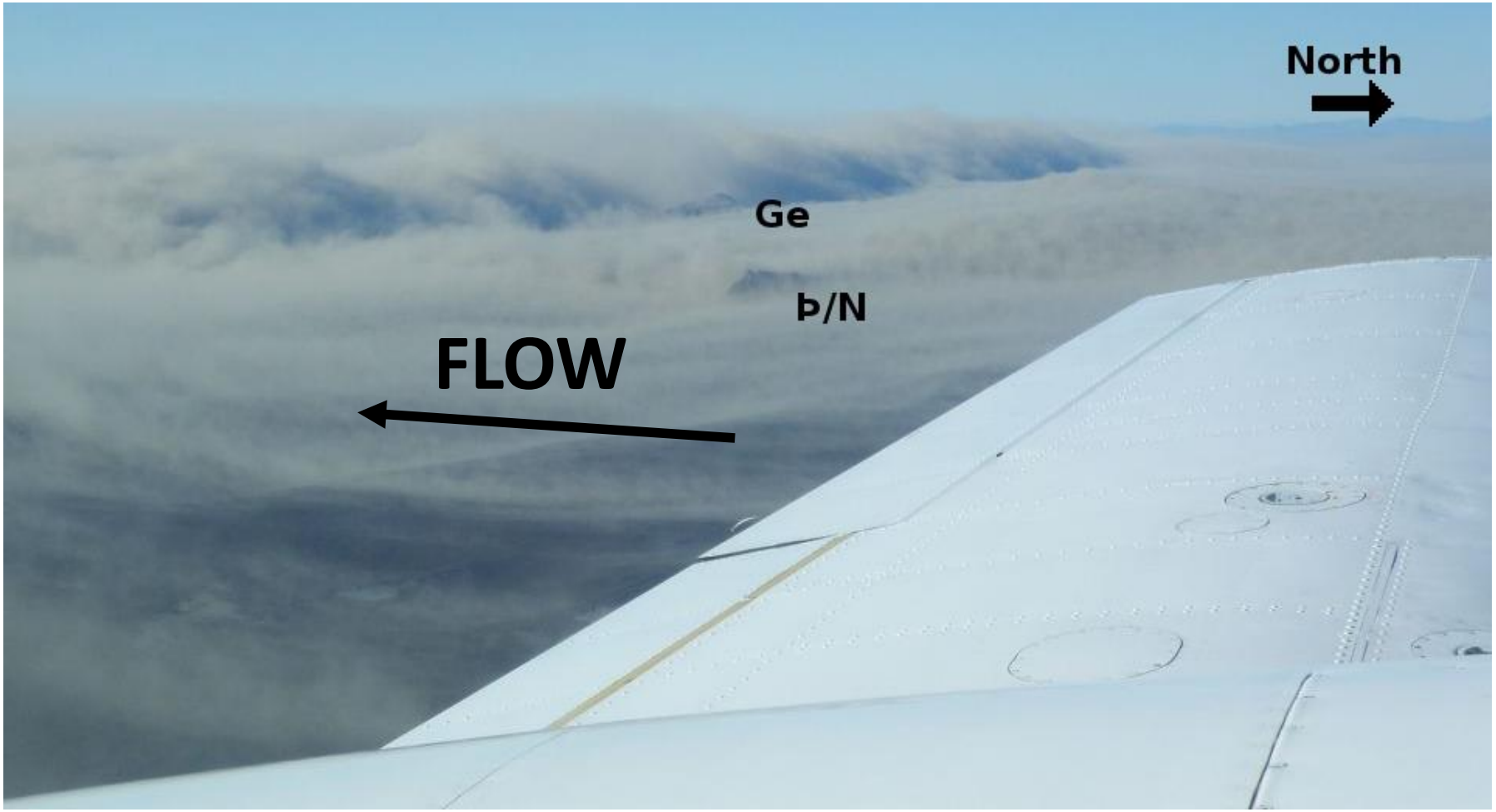
N
Distance [km]
293
291
295
285
289
287
281
283
279
40
35
30
25
20
15
10
5
0
m/s
ms⁻¹
Windshear: 30m/s in 3 km

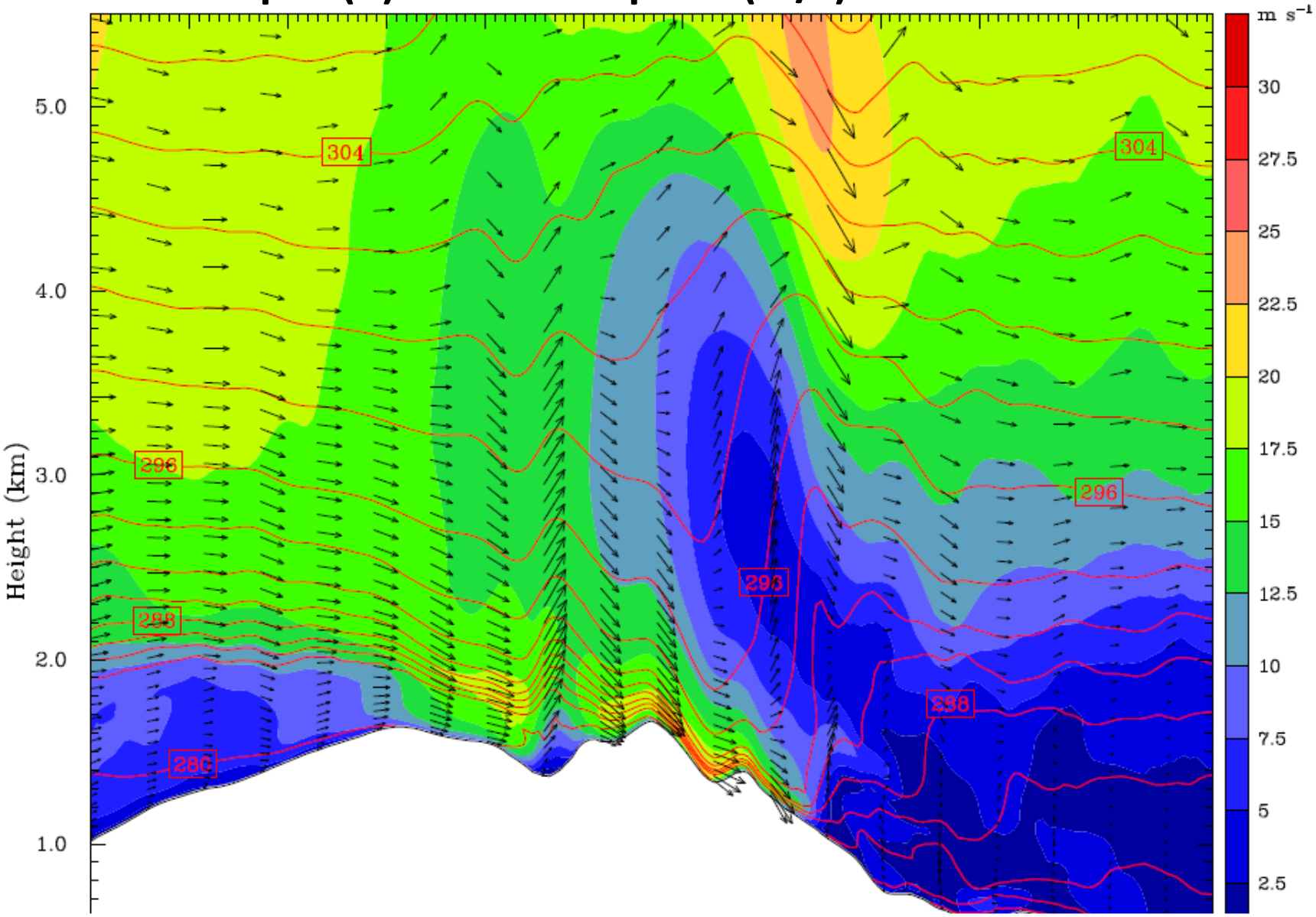
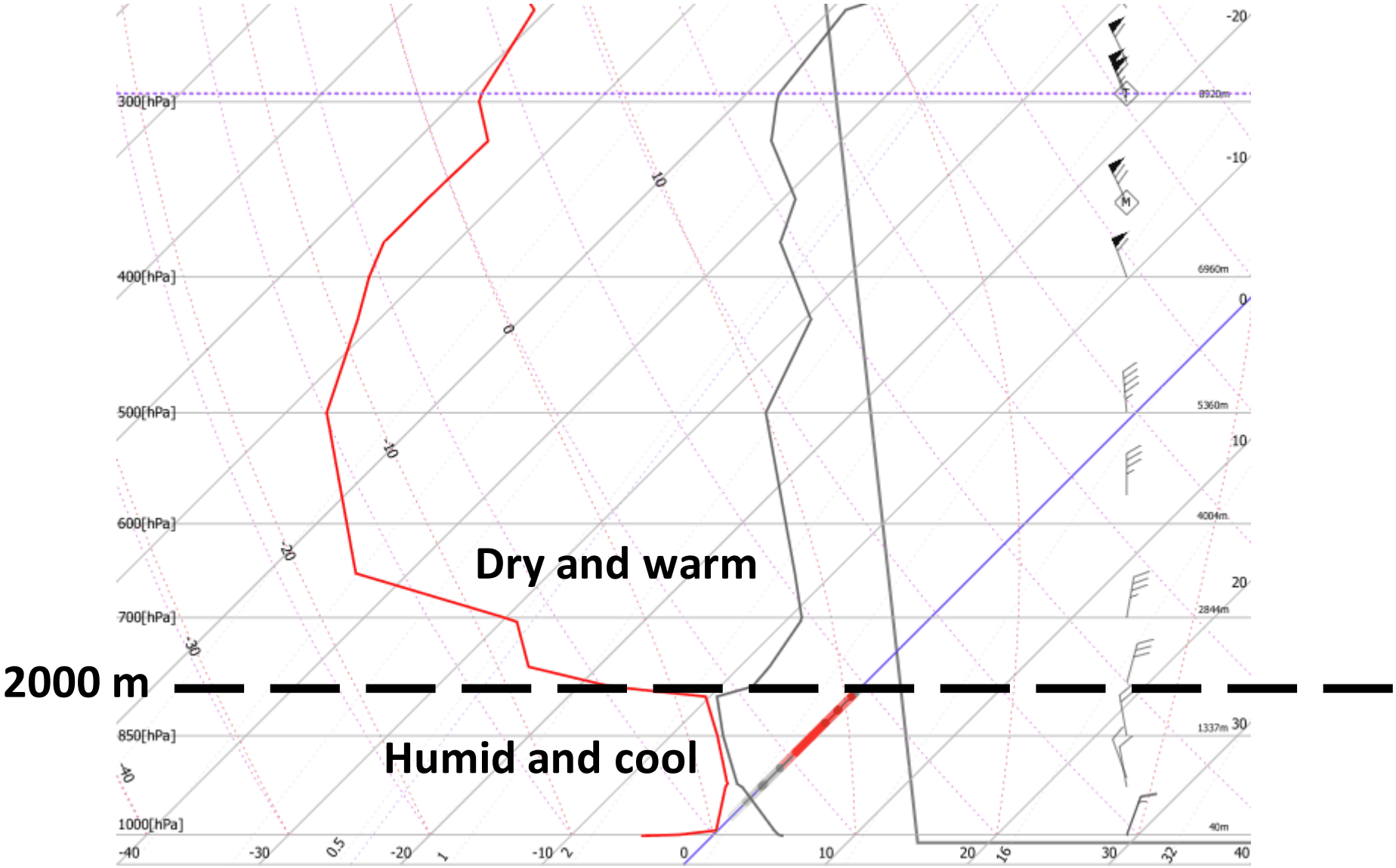
The 13 September 2011 dust event

Hálfdán Ágústsson & Haraldur Ólafsson




North
Ge
Þ/N
FLOW

Isentropes (K) and wind speed (m/s)



Observed upstream profile of the atmosphere