Thunder and Lightning in Iceland

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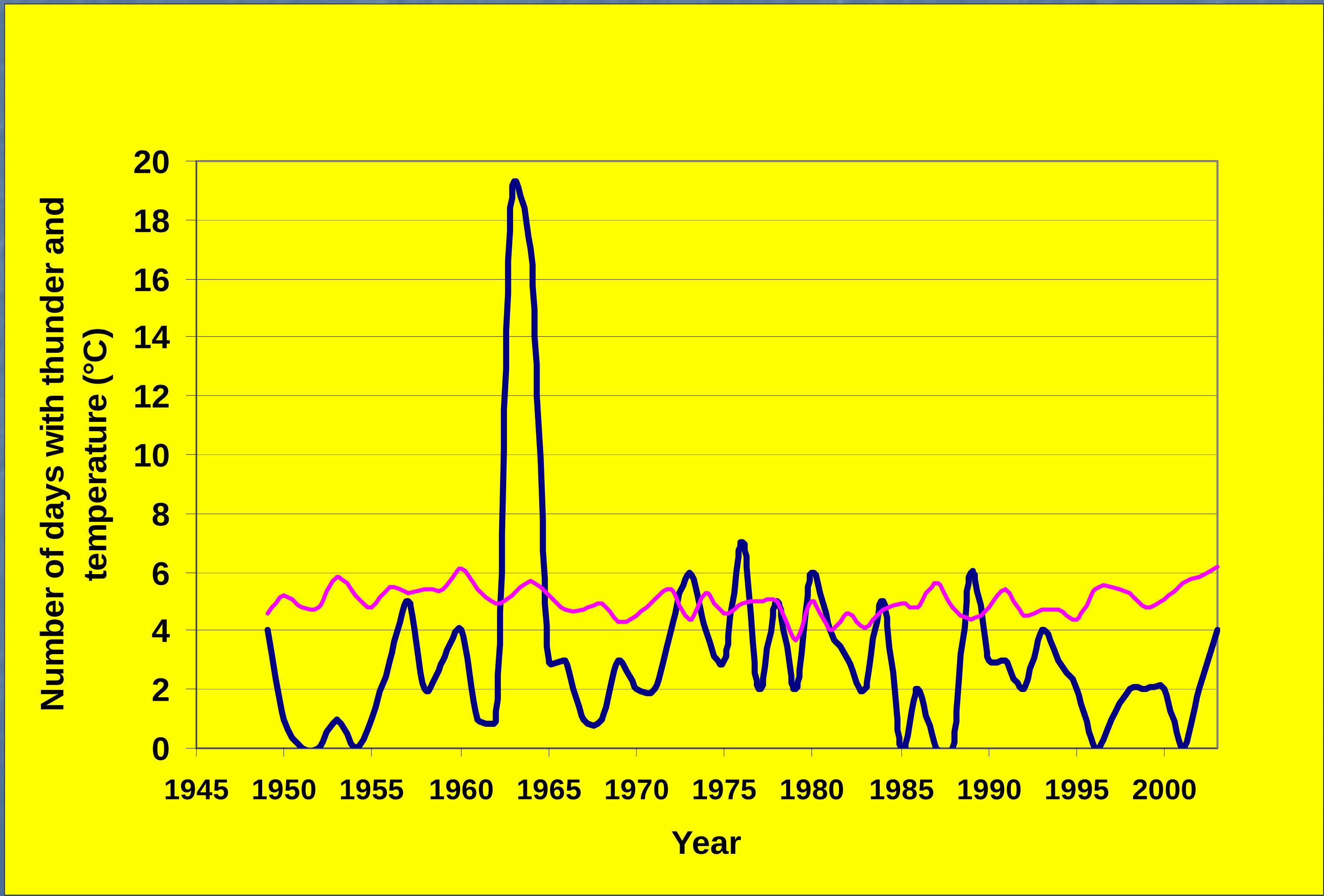
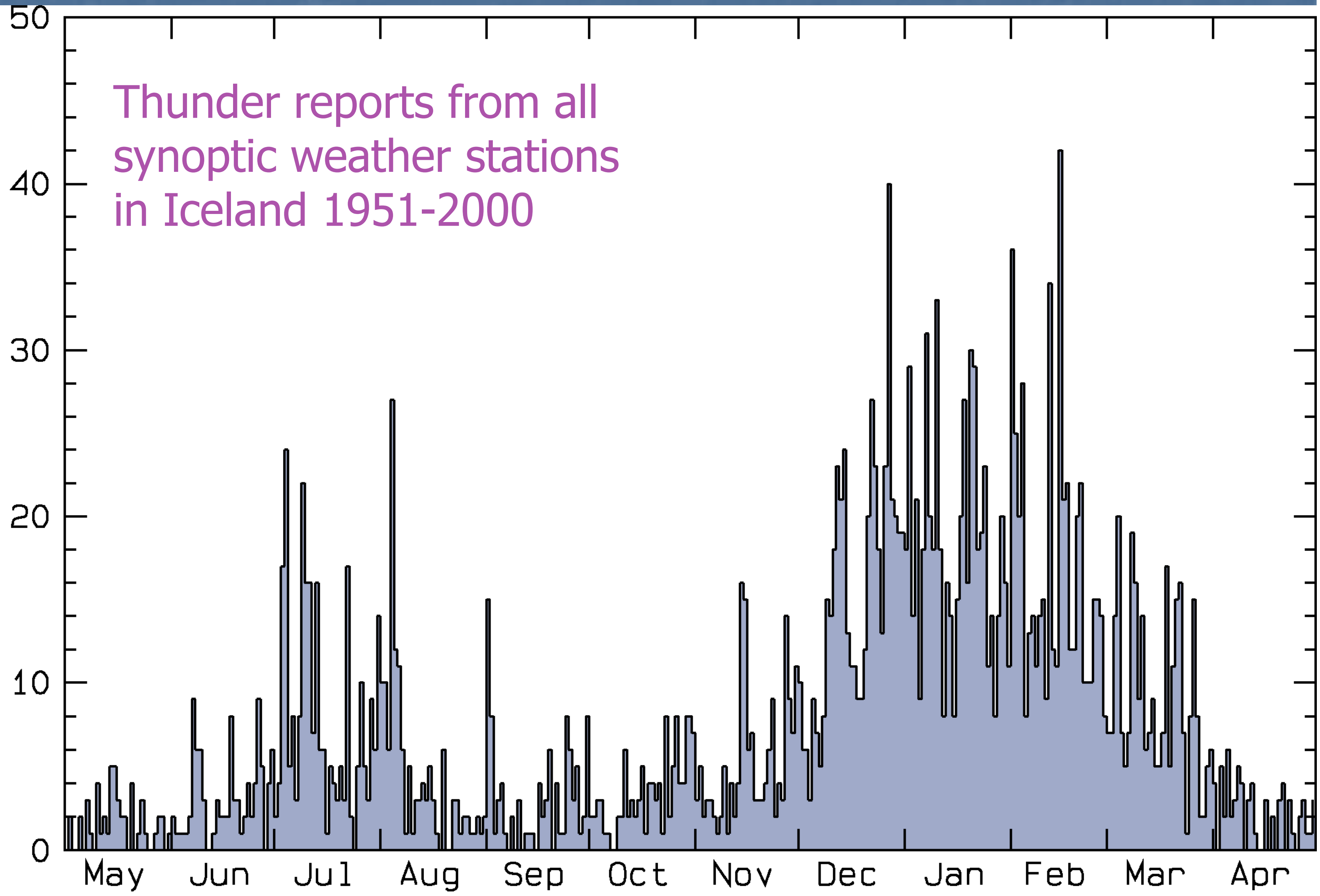
Thunder and Lightning in Iceland

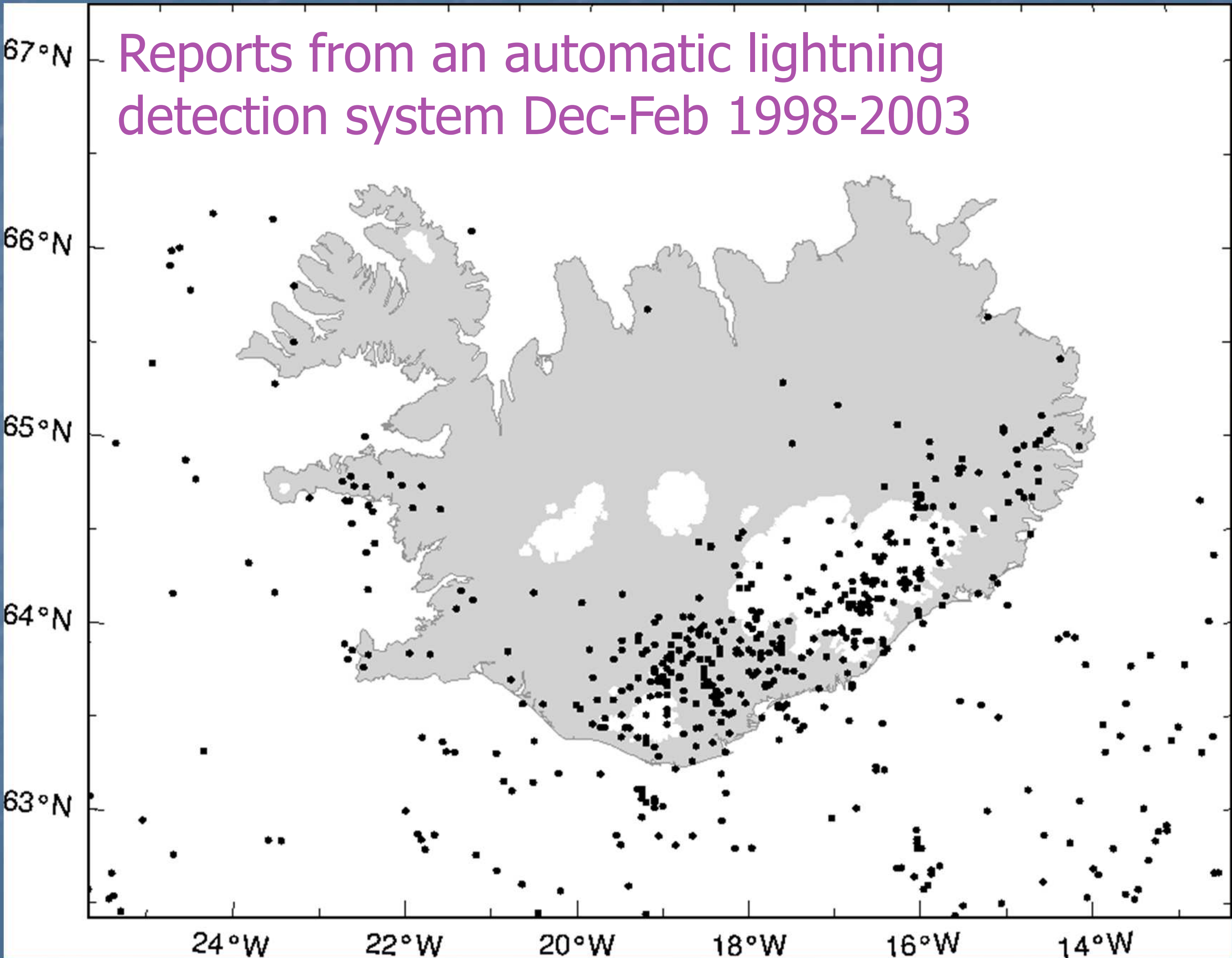
- Climatology
- Synoptic situations and origin of airmasses
- Predictability

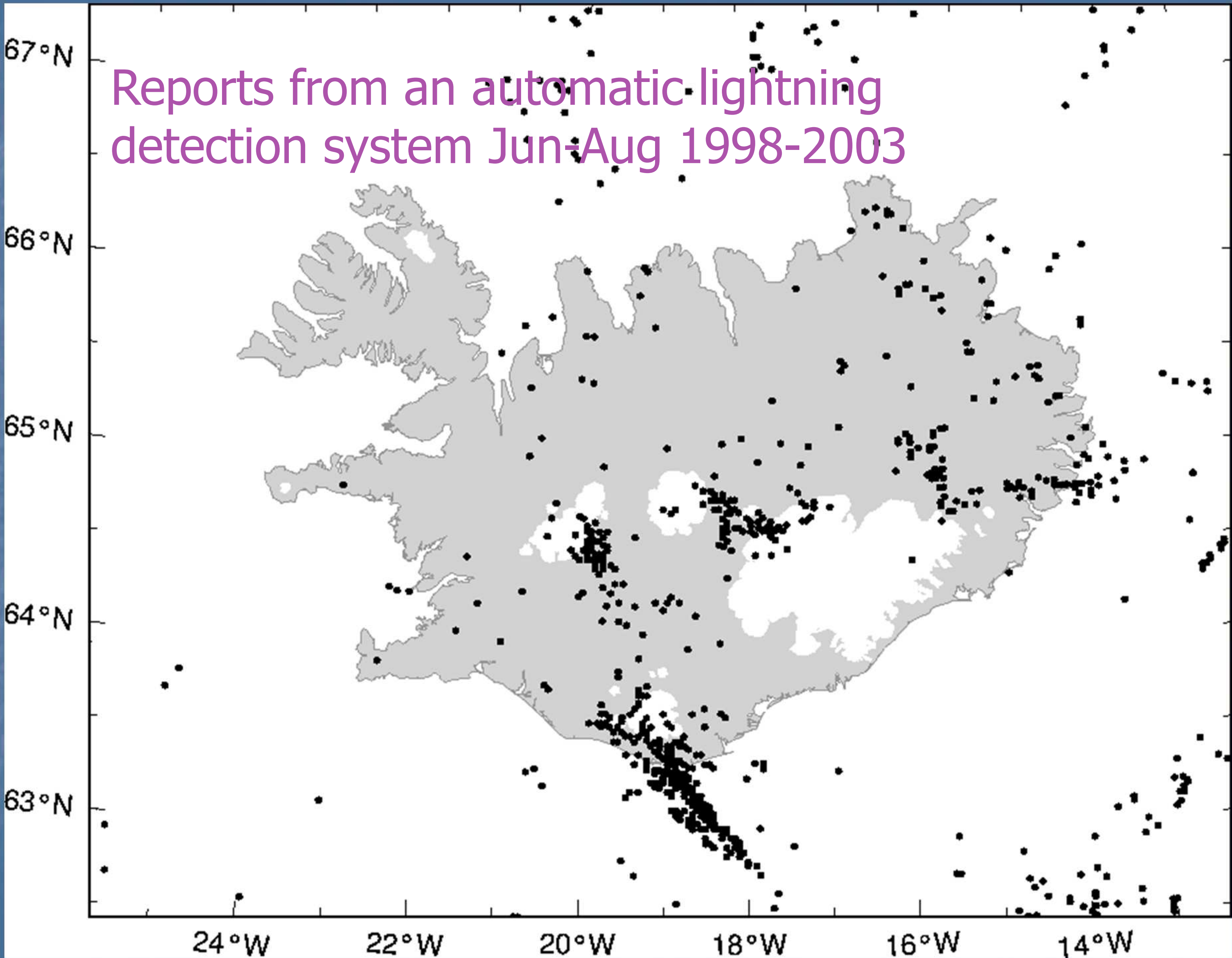
Frequency of thunder at Stórhöfði (S-coast of Iceland)




Thunder reports from all
synoptic weather stations
in Iceland 1951-2000
0
10
20
30
40
50
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr

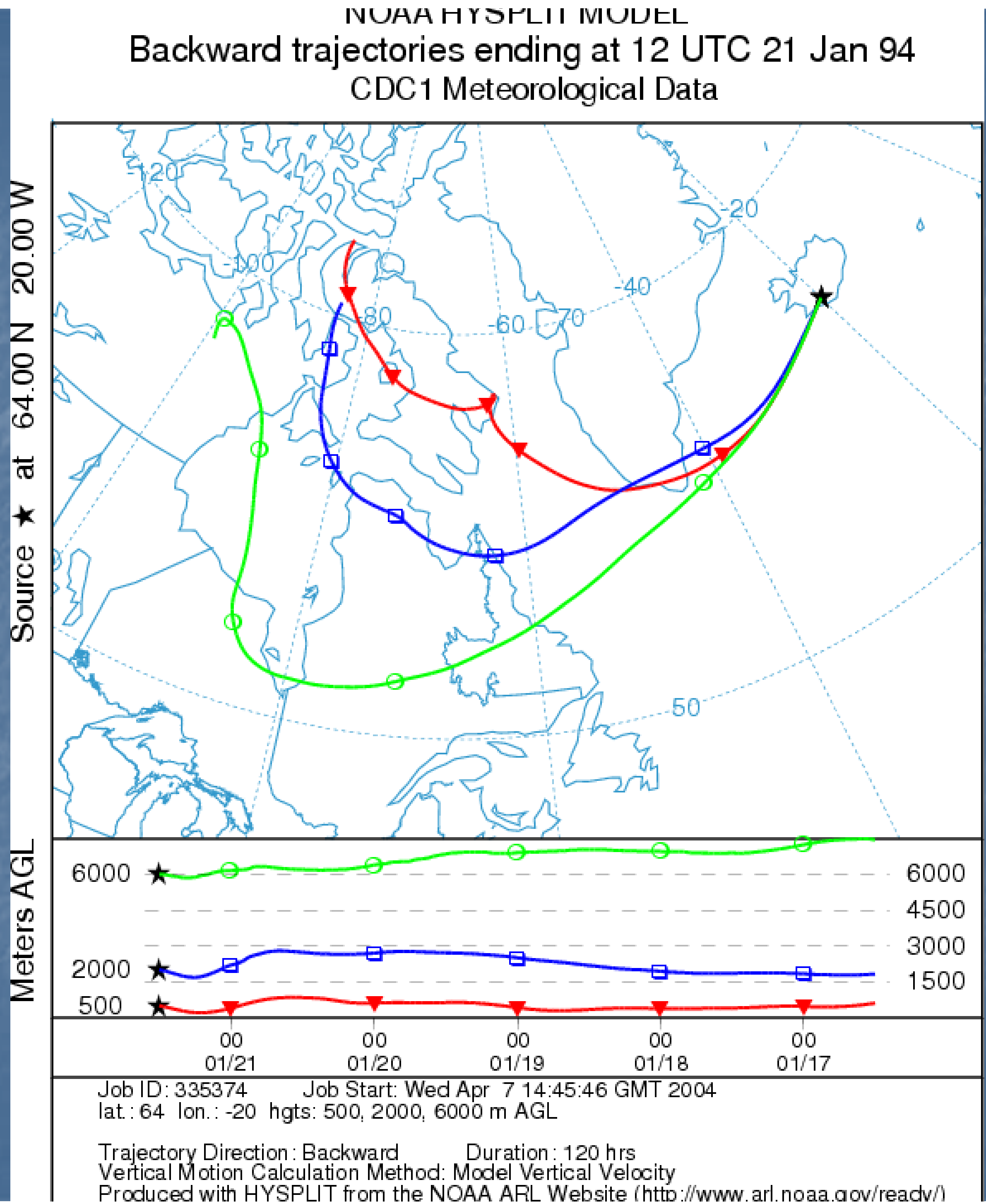
Reports from an automatic lightning detection system Dec-Feb 1998-2003

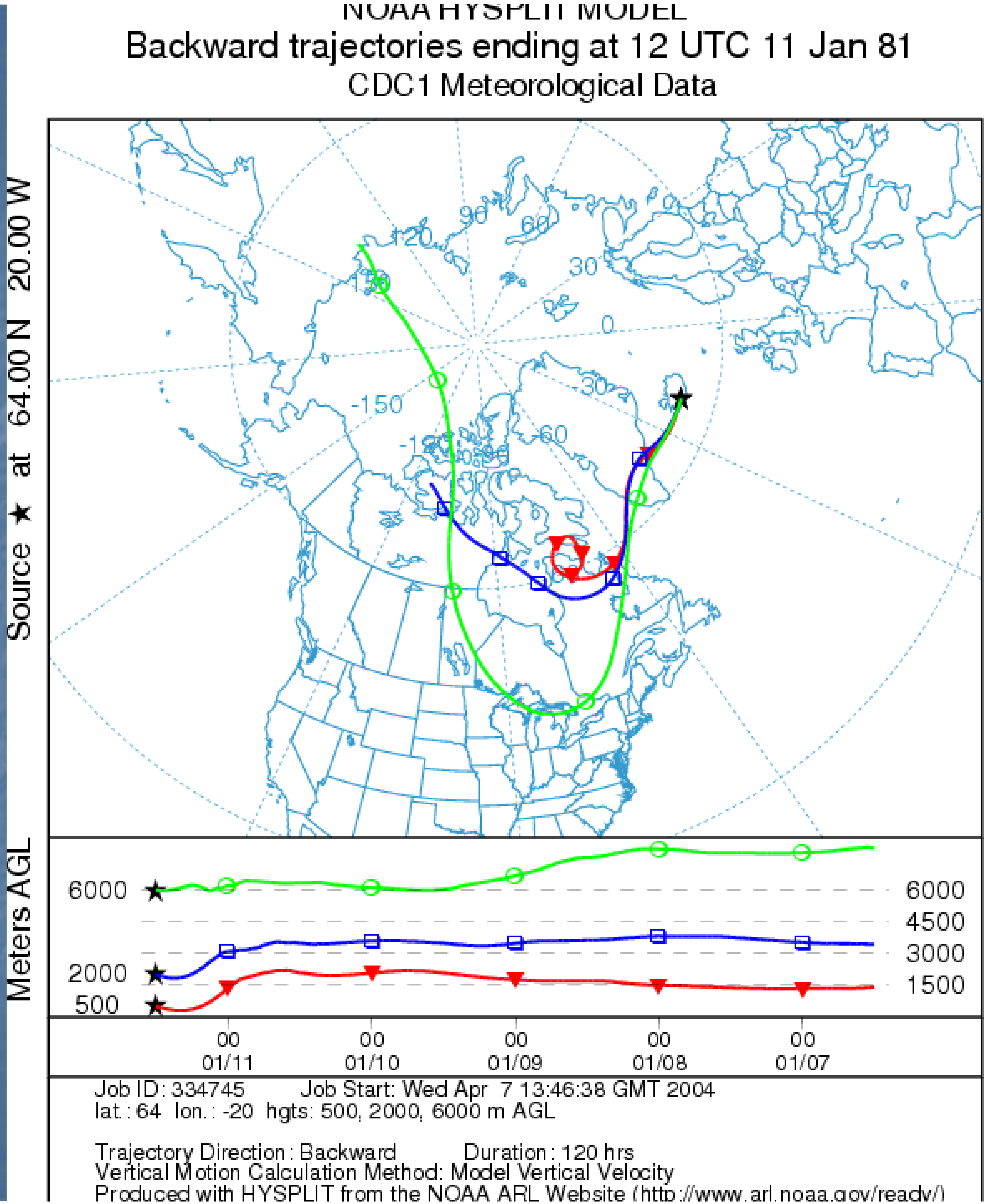


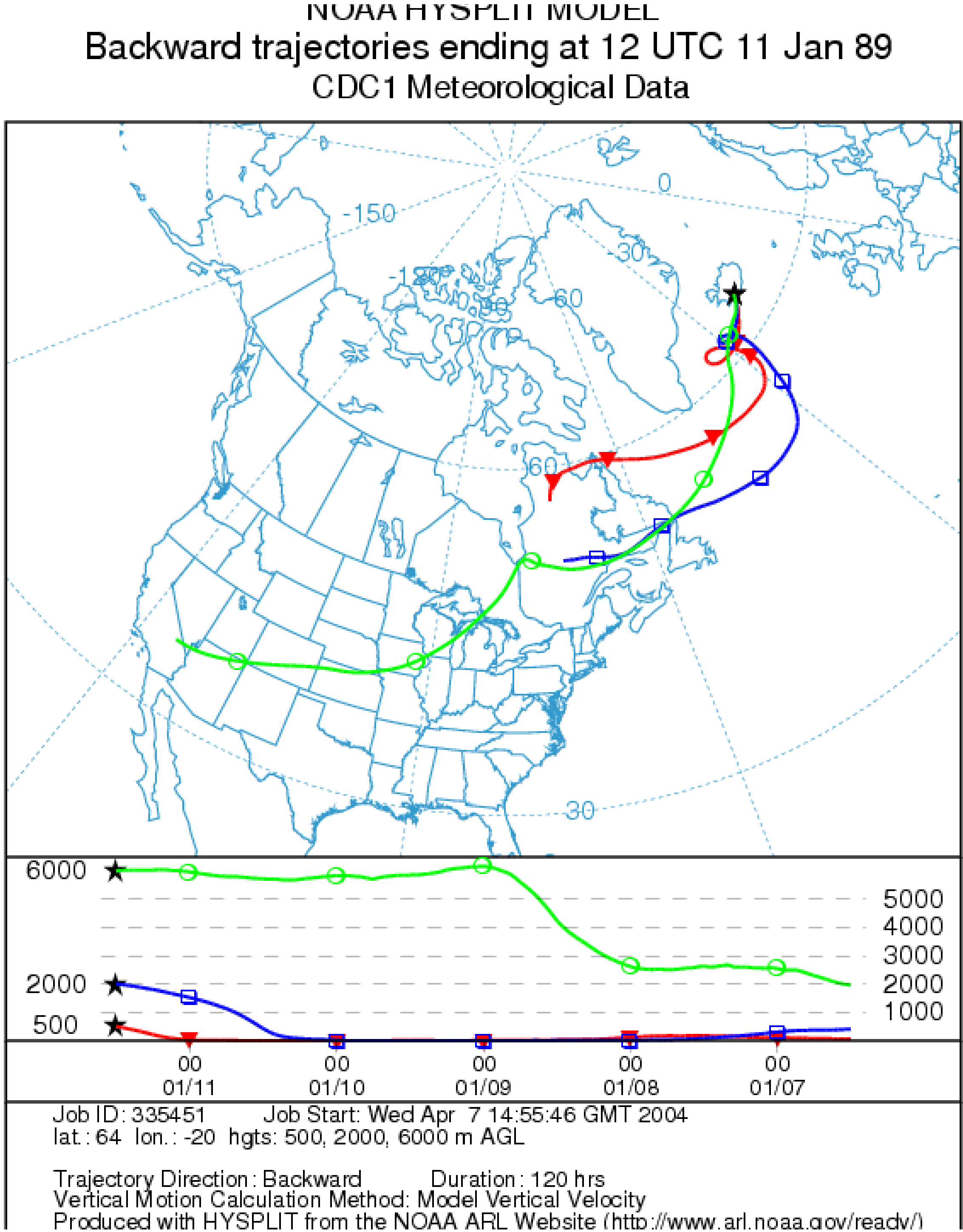

Reports from an automatic lightning detection system Jun-Aug 1998-2003
67°N
66°N
65°N
64°N
63°N
24°W
22°W
20°W
18°W
16°W
14°W

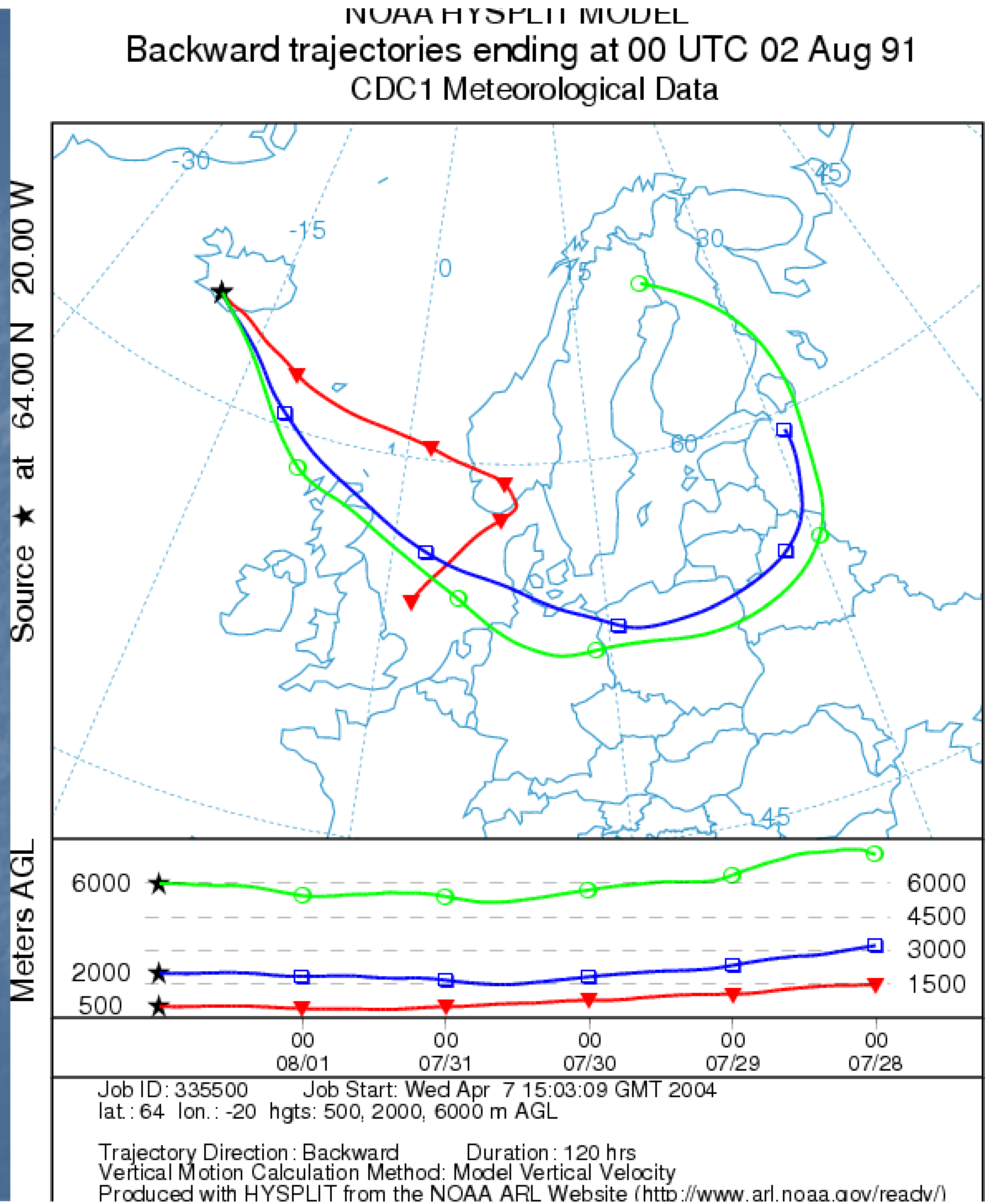
Five most intensive thunderstorms in each season 1981-2000

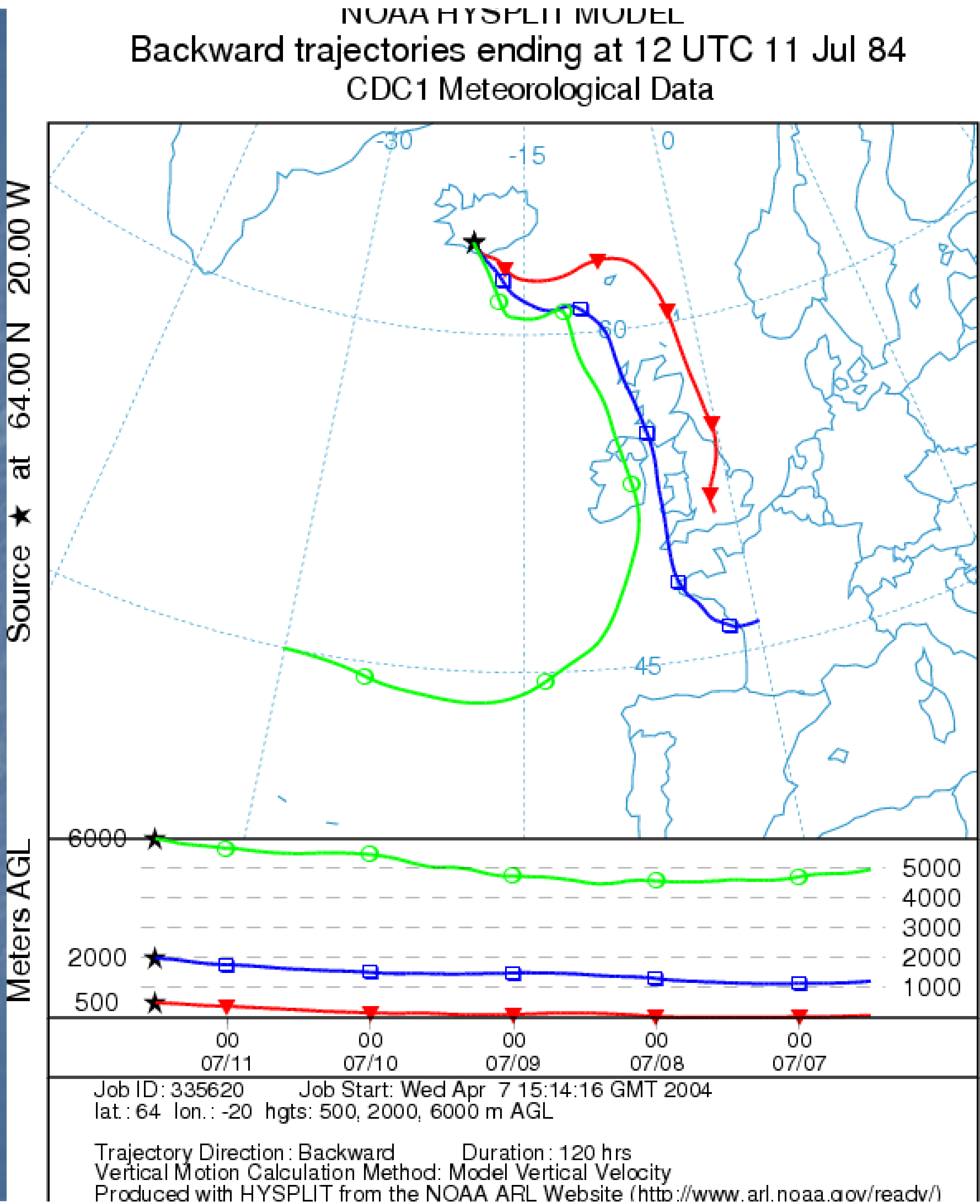
Winter	Origin of low level airmass	Wind veering	Advection
94-01-21	N-America	0°	60 m/s
93-02-12	N-America	20° (warm advection)	40 m/s
91-01-30	N-America	10° (warm advection)	40 m/s
89-01-11	N-America	0°	10 m/s
83-12-27	N-America	0°	20 m/s
Summer			
91-08-02	Britain/Cont.Europe	0°	10 m/s
91-07-08	Britain/Cont.Europe	0°	10 m/s
88-07-10	Britain/Cont.Europe	0°	10 m/s
84-07-11	Britain/Cont.Europe	10° (warm advection)	10 m/s
82-07-03	S-Ocean	80° (cold advection)	10 m/s
Interm. Season			
99-09-05	N-America	50° (cold advection)	10 m/s
97-09-27	N-America	10° (warm advection)	30 m/s
89-10-31	N-America	0°	50 m/s
81-09-01	Britain/SE-Ocean	0°	30 m/s
81-05-14	Britain/Cont. Europe	0°	20 m/s

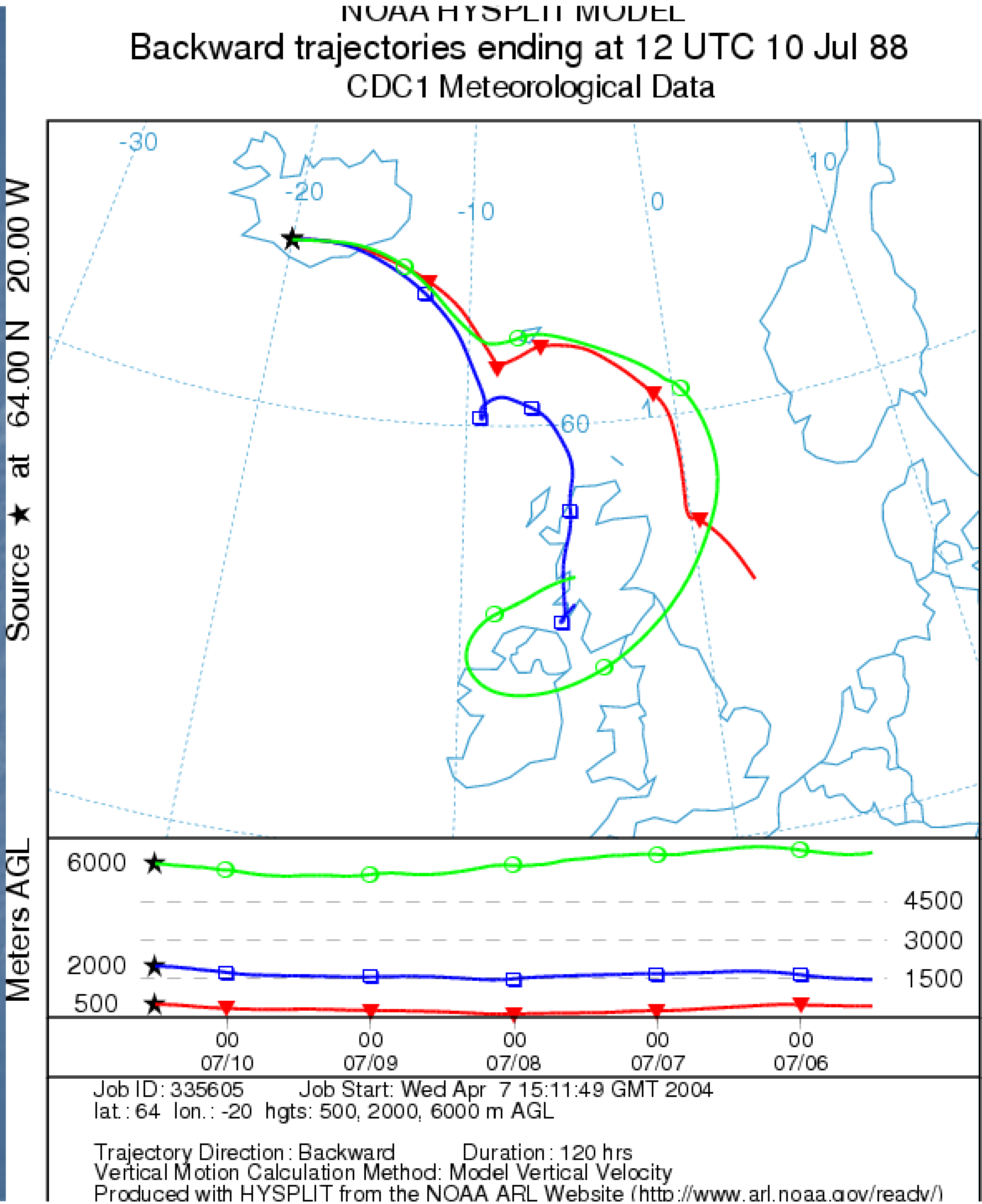

NOAA HYSPLIT MODEL
Backward trajectories ending at 12 UTC 21 Jan 94
CDC1 Meteorological Data
Source ★ at 64.00 N 20.00 W
-120
-100
-80
-60
-70
-40
-20
50
Meters AGL
6000
4500
3000
1500
6000
2000
500
00 01/21
00 01/20
00 01/19
00 01/18
00 01/17
Job ID: 335374 Job Start: Wed Apr 7 14:45:46 GMT 2004
lat.: 64 lon.: -20 hgts: 500, 2000, 6000 m AGL
Trajectory Direction: Backward Duration: 120 hrs
Vertical Motion Calculation Method: Model Vertical Velocity
Produced with HYSPLIT from the NOAA ARL Website (http://www.arl.noaa.gov/ready/)


NOAA HYSPLIT MODEL
Backward trajectories ending at 12 UTC 11 Jan 81
CDC1 Meteorological Data
Source ★ at 64.00 N 20.00 W
Meters AGL
6000
2000
500
6000
4500
3000
1500
00 01/11
00 01/10
00 01/09
00 01/08
00 01/07
Job ID: 334745 Job Start: Wed Apr 7 13:46:38 GMT 2004
lat.: 64 lon.: -20 hgts: 500, 2000, 6000 m AGL
Trajectory Direction: Backward Duration: 120 hrs
Vertical Motion Calculation Method: Model Vertical Velocity
Produced with HYSPLIT from the NOAA ARL Website (http://www.arl.noaa.gov/ready/)

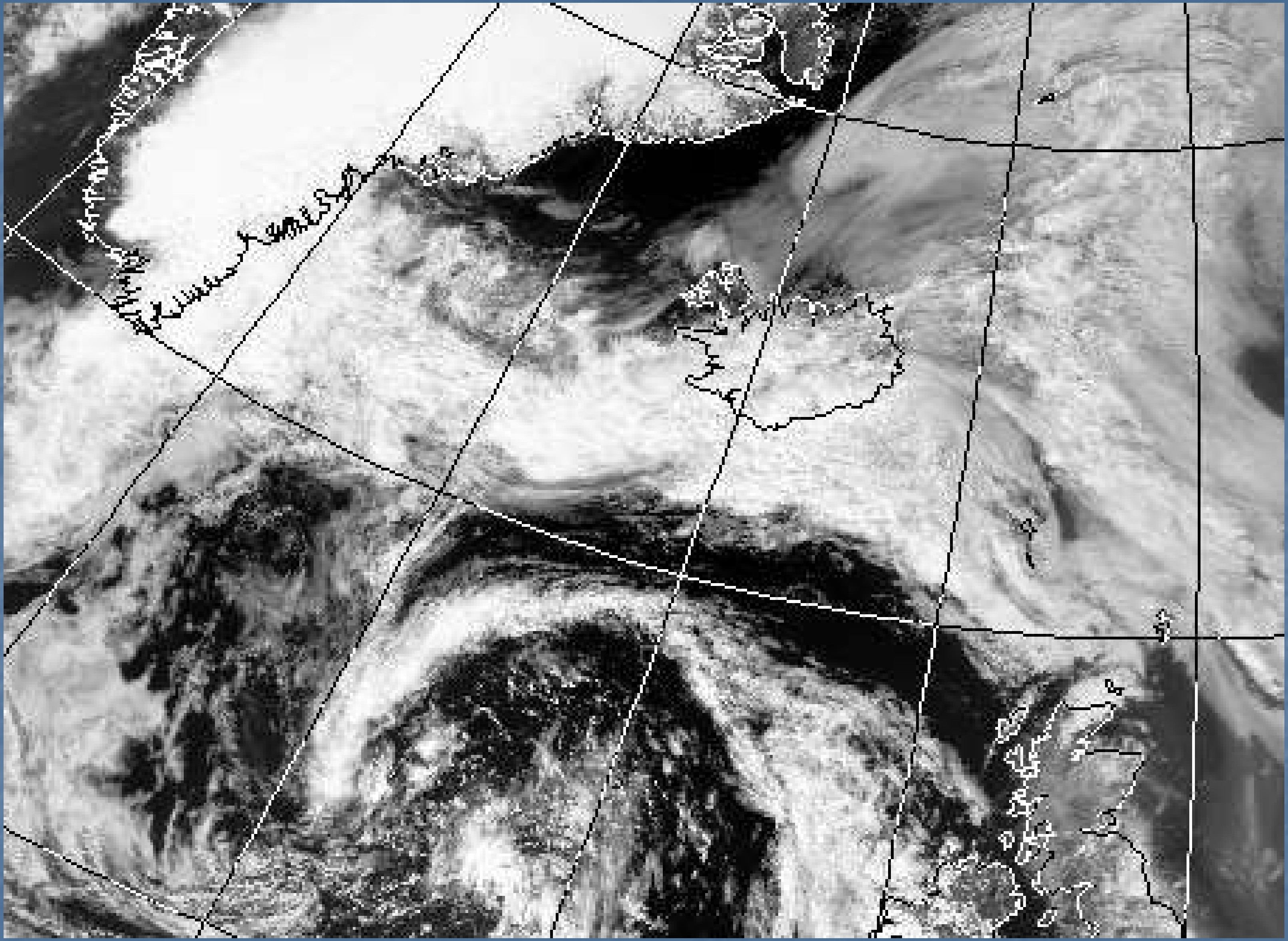

NOAA HYSPLIT MODEL
Backward trajectories ending at 12 UTC 11 Jan 89
CDC1 Meteorological Data
Source ★ at 64.00 N 20.00 W
-150
0
-30
-60
60
30
Meters AGL
6000
2000
500
5000
4000
3000
2000
1000
00 01/11
00 01/10
00 01/09
00 01/08
00 01/07
Job ID: 335451 Job Start: Wed Apr 7 14:55:46 GMT 2004
lat.: 64 lon.: -20 hgts: 500, 2000, 6000 m AGL
Trajectory Direction: Backward Duration: 120 hrs
Vertical Motion Calculation Method: Model Vertical Velocity
Produced with HYSPLIT from the NOAA ARL Website (http://www.arl.noaa.gov/ready/)


NOAA HYSPLIT MODEL
Backward trajectories ending at 00 UTC 02 Aug 91
CDC1 Meteorological Data
Source ★ at 64.00 N 20.00 W
-30
-15
0
15
30
45
60
45
Meters AGL
6000
2000
500
6000
4500
3000
1500
00 08/01
00 07/31
00 07/30
00 07/29
00 07/28
Job ID: 335500 Job Start: Wed Apr 7 15:03:09 GMT 2004
lat.: 64 lon.: -20 hgts: 500, 2000, 6000 m AGL
Trajectory Direction: Backward Duration: 120 hrs
Vertical Motion Calculation Method: Model Vertical Velocity
Produced with HYSPLIT from the NOAA ARL Website (http://www.arl.noaa.gov/ready/)


NOAA HYSPLIT MODEL
Backward trajectories ending at 12 UTC 11 Jul 84
CDC1 Meteorological Data
Source ★ at 64.00 N 20.00 W
-30
-15
0
60
45
Meters AGL
6000
2000
500
5000
4000
3000
2000
1000
00 07/11
00 07/10
00 07/09
00 07/08
00 07/07
Job ID: 335620 Job Start: Wed Apr 7 15:14:16 GMT 2004
lat.: 64 lon.: -20 hgts: 500, 2000, 6000 m AGL
Trajectory Direction: Backward Duration: 120 hrs
Vertical Motion Calculation Method: Model Vertical Velocity
Produced with HYSPLIT from the NOAA ARL Website (http://www.arl.noaa.gov/ready/)

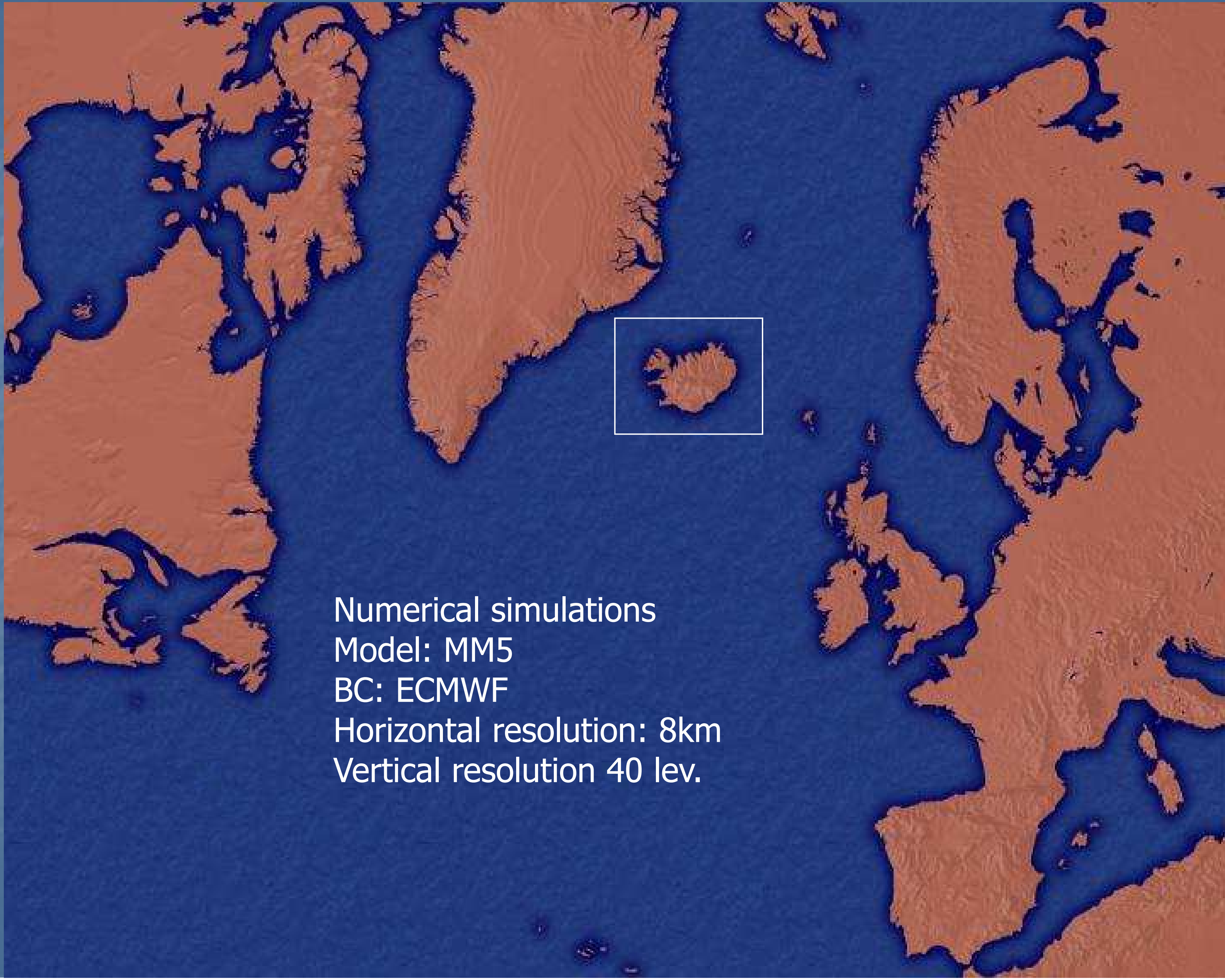

NOAA HYSPLIT MODEL
Backward trajectories ending at 12 UTC 10 Jul 88
CDC1 Meteorological Data
Source ★ at 64.00 N 20.00 W
-30
-20
-10
0
10
60
Meters AGL
6000
2000
500
4500
3000
1500
00 07/10
00 07/09
00 07/08
00 07/07
00 07/06
Job ID: 335605 Job Start: Wed Apr 7 15:11:49 GMT 2004
lat.: 64 lon.: -20 hgts: 500, 2000, 6000 m AGL
Trajectory Direction: Backward Duration: 120 hrs
Vertical Motion Calculation Method: Model Vertical Velocity
Produced with HYSPLIT from the NOAA ARL Website (http://www.arl.noaa.gov/ready/)

IR-image 21 Jan 1994



VIS-image 2 Aug 1991

Can we predict these storms?


Numerical simulations
Model: MM5
BC: ECMWF
Horizontal resolution: 8km
Vertical resolution 40 lev.

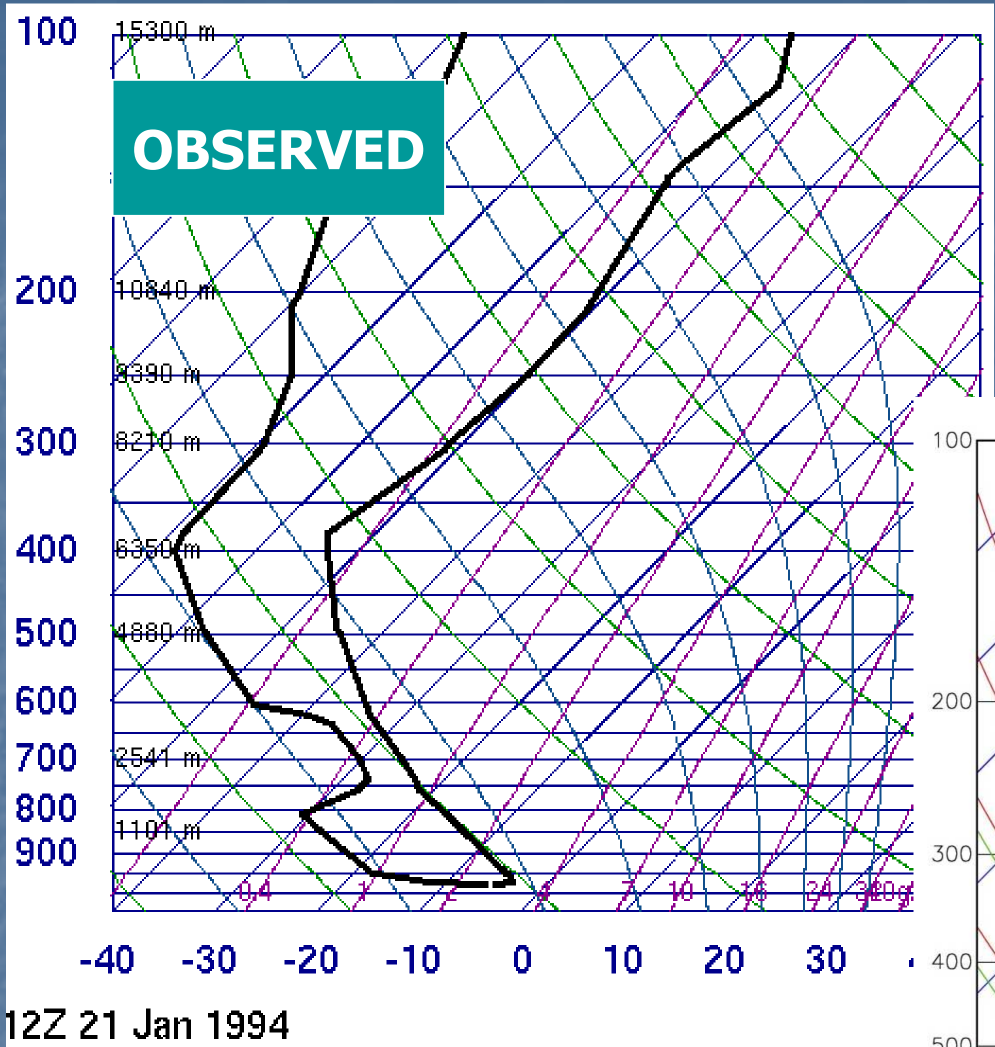
Two winter storms and two summer storms have been simulated

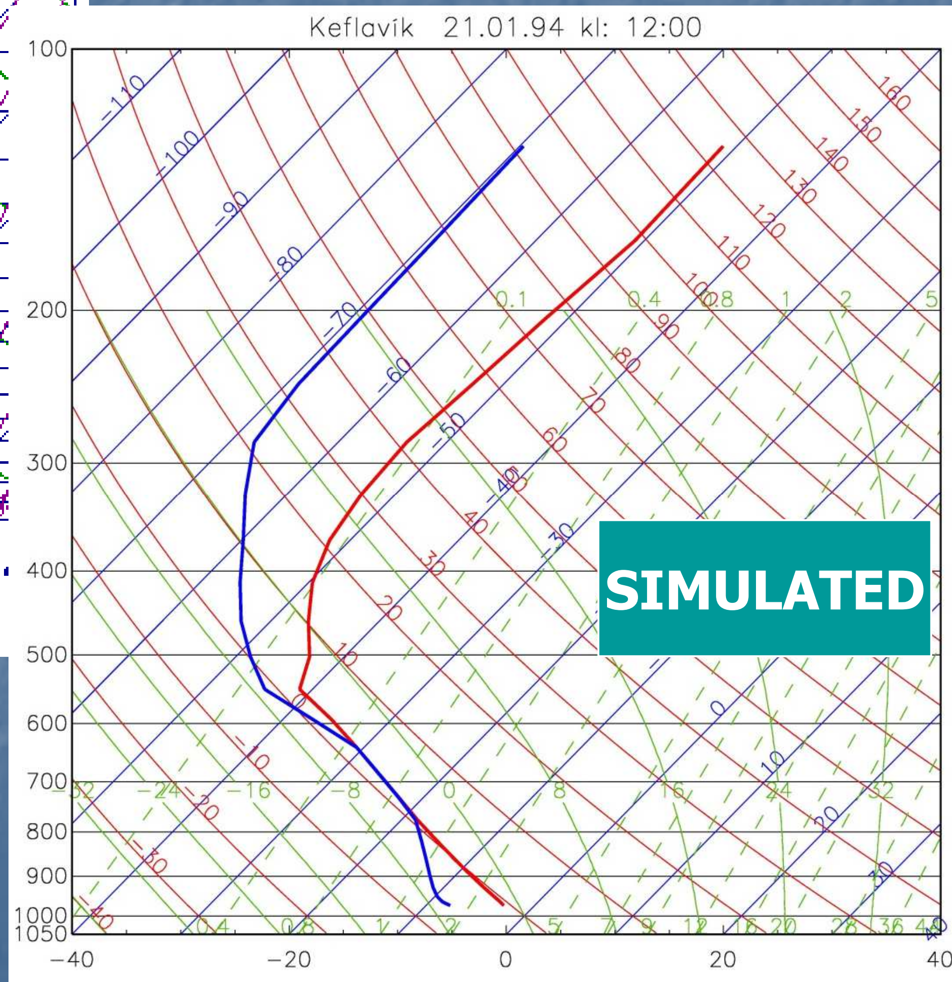
Results:

The winter storms are well reproduced

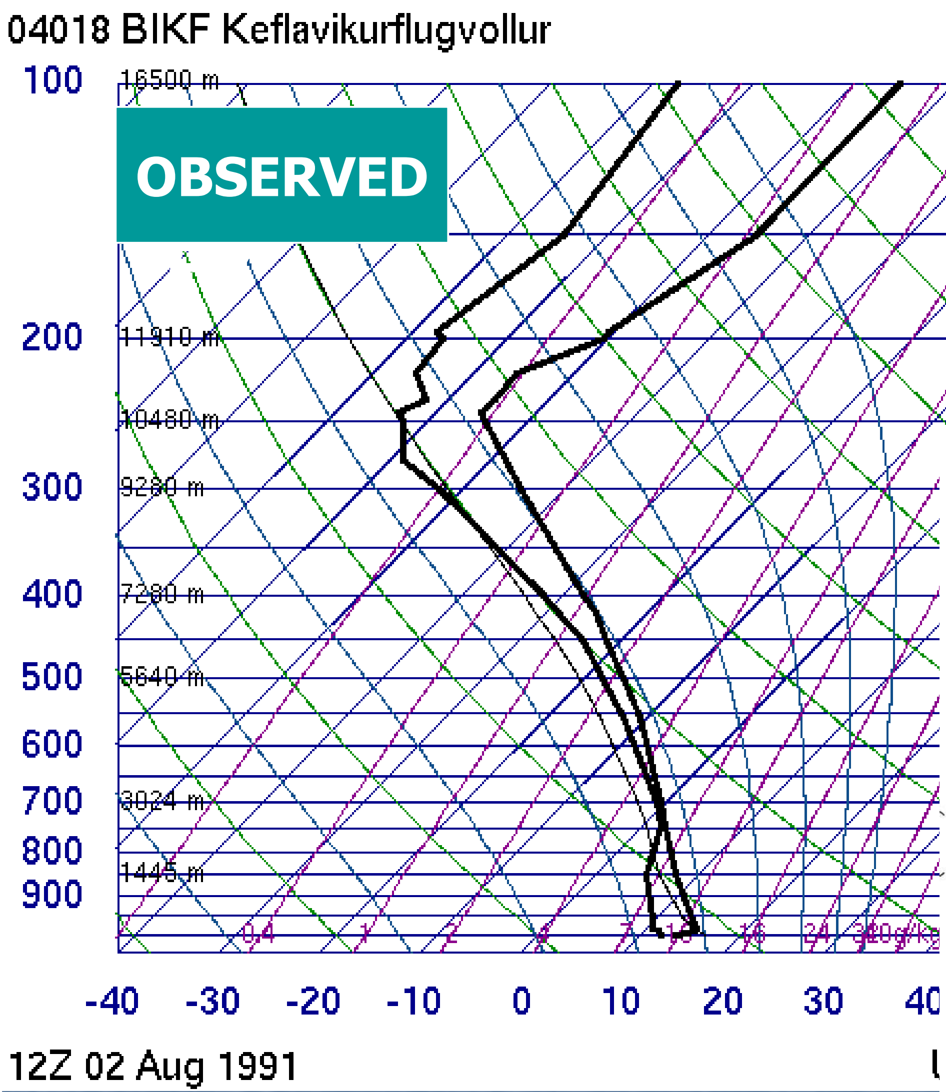
The summer storms are not as well well reproduced

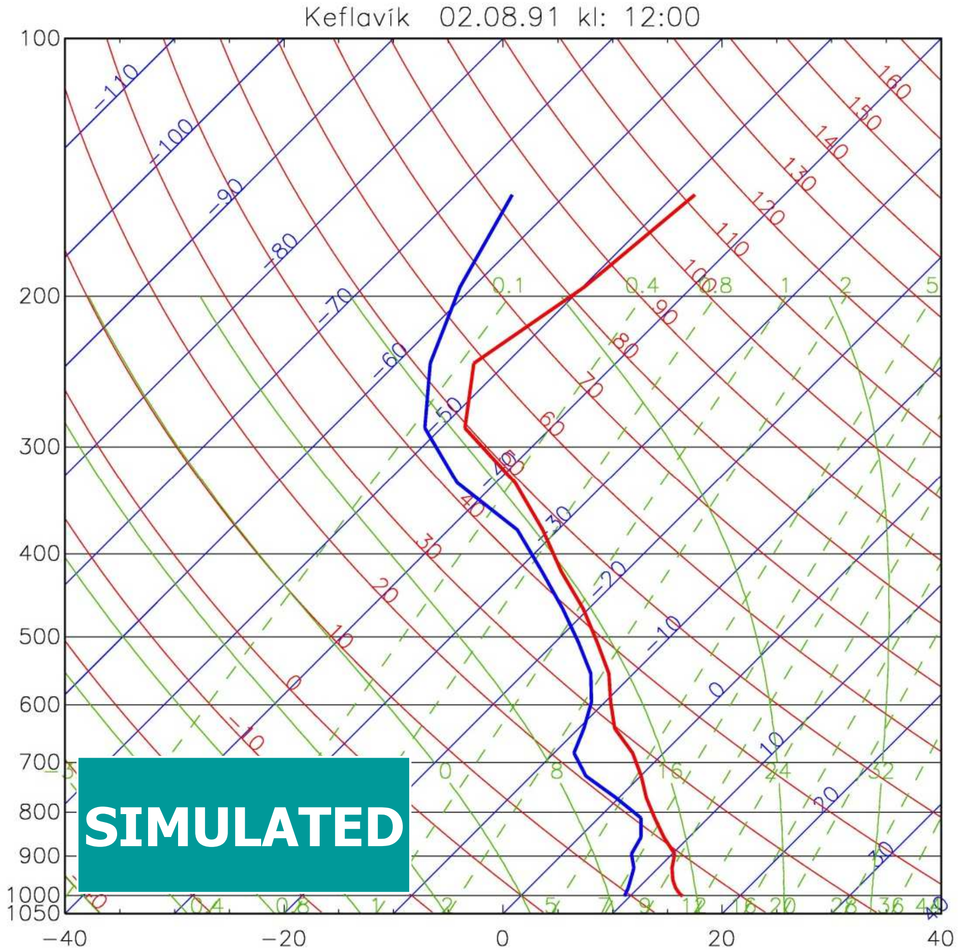
A winter case
- sucessful simulation



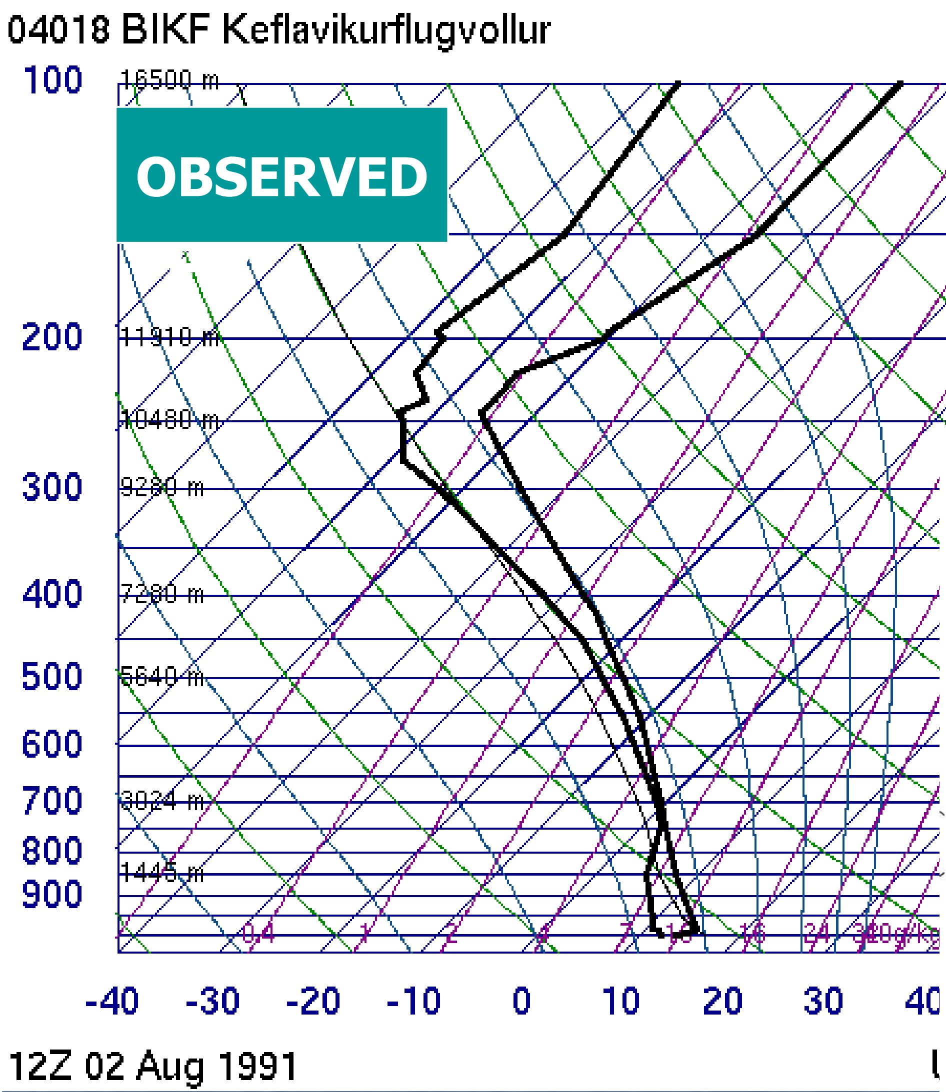


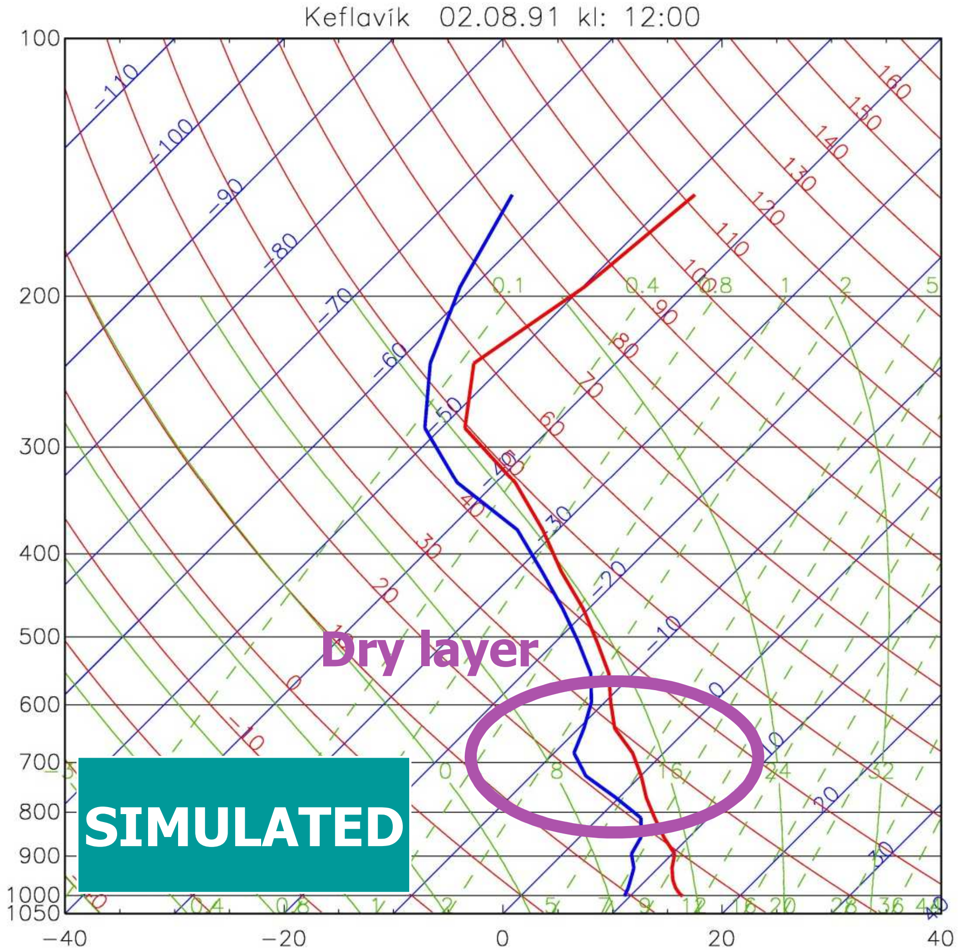
A summer case
- failure of simulation





A summer case
- failure of simulation





Conclusions on thunder in Iceland

- Main activity in mid-winter, a secondary maximum in mid-summer
- Some interannual variability, but no clear trend in long-term frequency
- Winter storms: Arctic air advected rapidly from N-America. Organized convection.
- Summer storms: Advection from SE (Britain/Cont.Europe). Front-like structures.
- Case studies indicate that the meteorological conditions in which the winter storms form may be easier to predict than those of the summer storms