VEÐURSTOFA ÍSLANDS

Report
03045

Guðmundur Hafsteinsson

Report on weather conditions related to an aircraft accident 6 March 2001

Report prepared for Aircraft Accident Investigation Board

VÍ-ÞJ06
Reykjavík
Desember 2003

Report - Greinargerð
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Introduction

An USA-registrated aircraft, N272BB, of the type Aero Commander (two engines, seven seats) left Keflavík airport (BIKF) 6 March 2001 at 8:19 UTC, heading for Prestwick, Scotland. At 8:57 the pilots reported to ATC that they had reached 15000 feet which was the planned cruising altitude. The position was some 4 Nm WNW of Þrídrangar and 8 Nm off the coast of Iceland (appr. 63:30,1N 20:39,4W, see Fig 1). At 8:59 the plane disappeared from the radar screen and any attempts to contact it were unsuccessful. Wreckage from the plane found near this place indicates that the plane broke up in flight and that the two pilots were killed immediately.

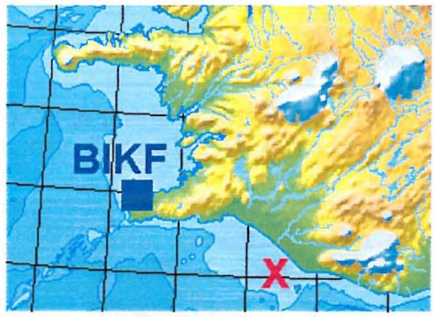

Fig 1 - The position of the accident is marked with a red **X**

General synopsis

A surface analysis at 6 UTC is shown in Fig 2. The main features are a high pressure area, 1025 hPa, over Greenland and an extensive 957 hPa low some 1300 km SSW of Iceland. To the west of The British Isles there was a strong advection of warm air towards Iceland. A warm front was generated where the warm air suppressed the much colder air associated with the high over Greenland.

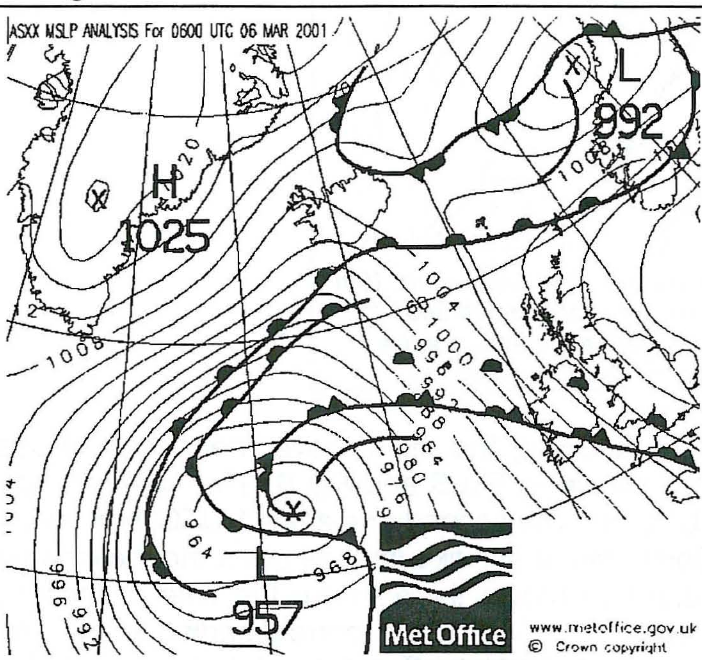

Fig 2 - Surface analysis 6 UTC 6 March 2001. The map is published by UK Met Office and the map shown here is a part of the original map

On Fig 3 the approximate position of the surface front is shown together with synoptic observations from stations in SW-Iceland. Fig 4 shows a numerical forecast map of mean sea level pressure, 10 m wind, 2 m temperature and accumulated precipitation. The strong temperature gradient and warm advection associated with the front appears clearly.

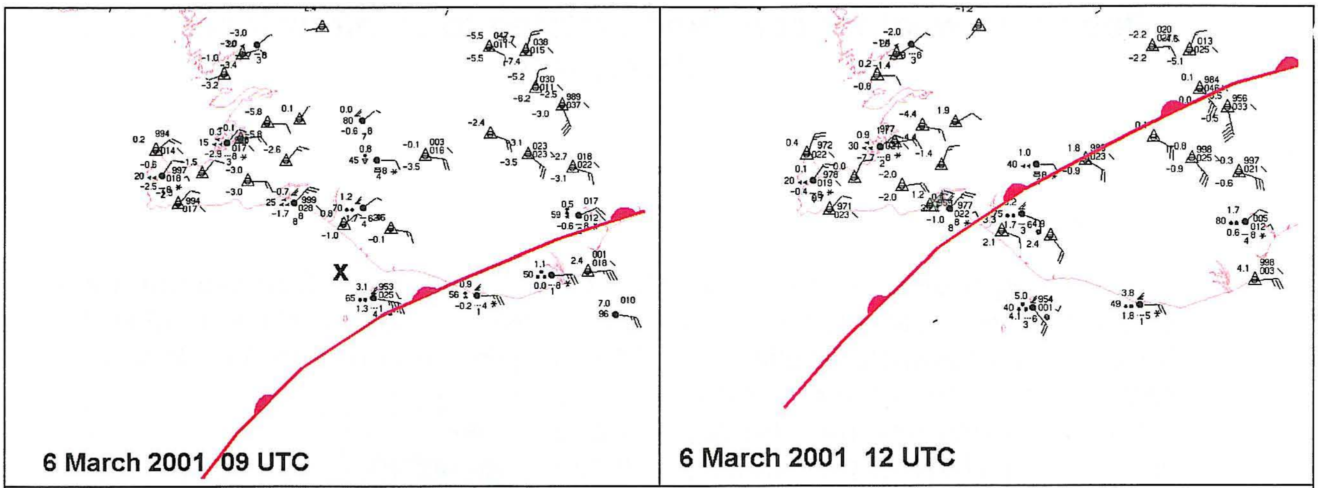

Fig 3 - Surface observations and approximate position of the warm front over the south coast of Iceland 6 March 2001. Left: 9 UTC. The approximate position of the accident is marked with **x**. *Right: 12 UTC*

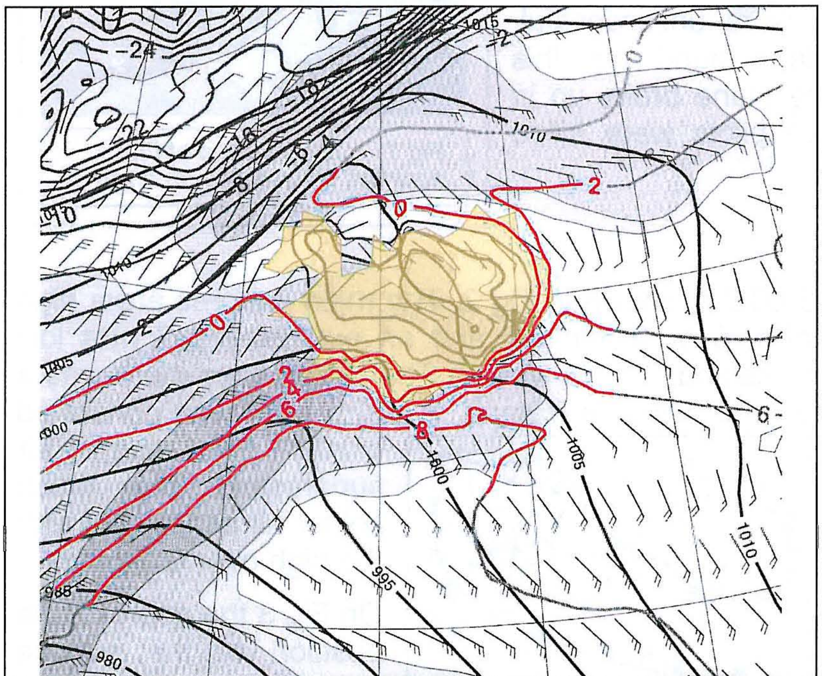

Fig 4 - Forecast mean sea level pressure, 2m temperature, 10m wind and 6 hours accumulated precipitation at 6 March 2001 12 UTC. A part of the isotherms are coloured red to enhance the marked warm front off SW-Iceland and the warm advection.

Low resolution satellite images showing the cloud cover near Iceland this morning are available and are shown in Fig 5 and Fig 6. The first one was taken at approximately 7:04 UTC and the second one at 8:41 UTC, very close to the time of the accident. Comparing these two images gives the feeling that the cloud cover off SW-Iceland has grown thicker from the time of the first image to the second one. An area of thicker clouds, corresponding to the area of strongest temperature gradient and most accumulated precipitation according to the numerical forecast shown in Fig 4, has built up. It is reasonable to guess that within this area, where the warm air was ascending over the frontal surface, the cloud deck has been rather solid and without dry layers inbetween.

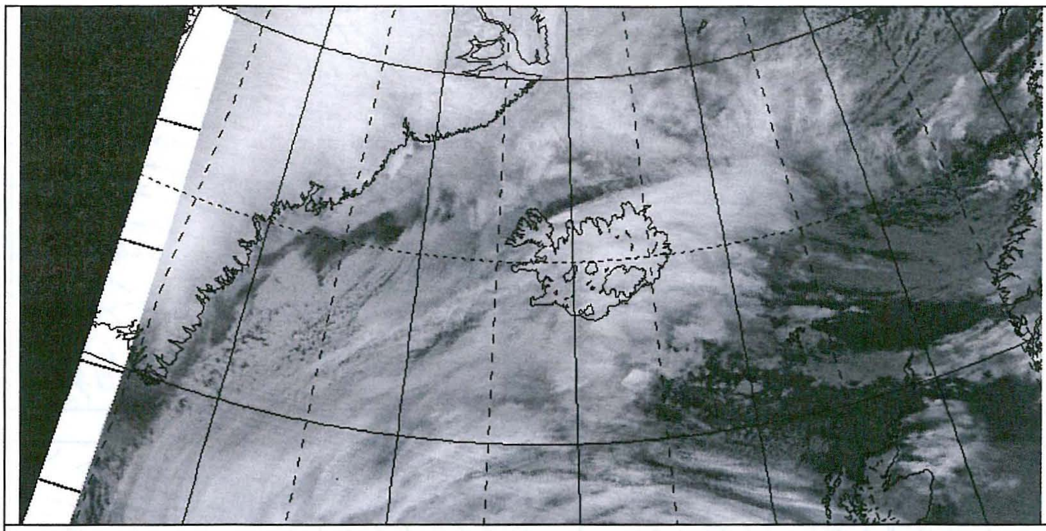

Fig 5 - Infrared satellite image (NOAA14, low resolution) 6 March 2001 7:04 UTC

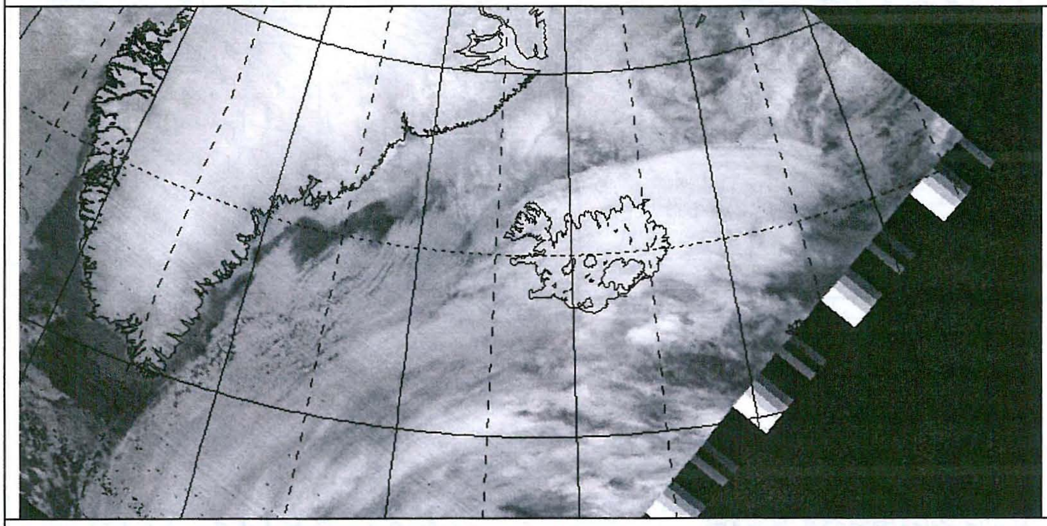

Fig 6 - Infrared satellite image (NOAA14, low resolution) 6 March 2001 8:41 UTC

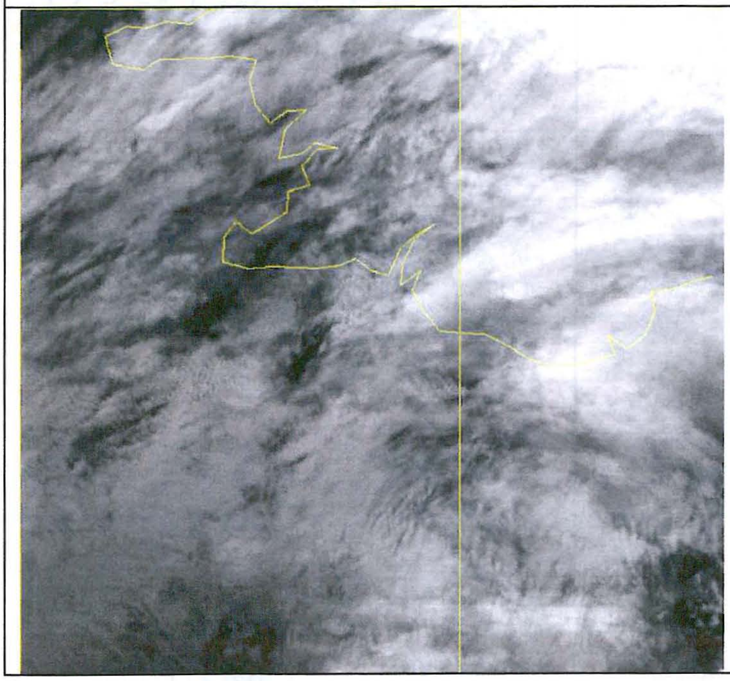

Fig 7 - High resolution infrared satellite image (NOAA14, AVHRR) 6 March 2001 7:04 UTC. Courtesy of Dundee Satellite Receiving Station, Dundee University, Scotland.

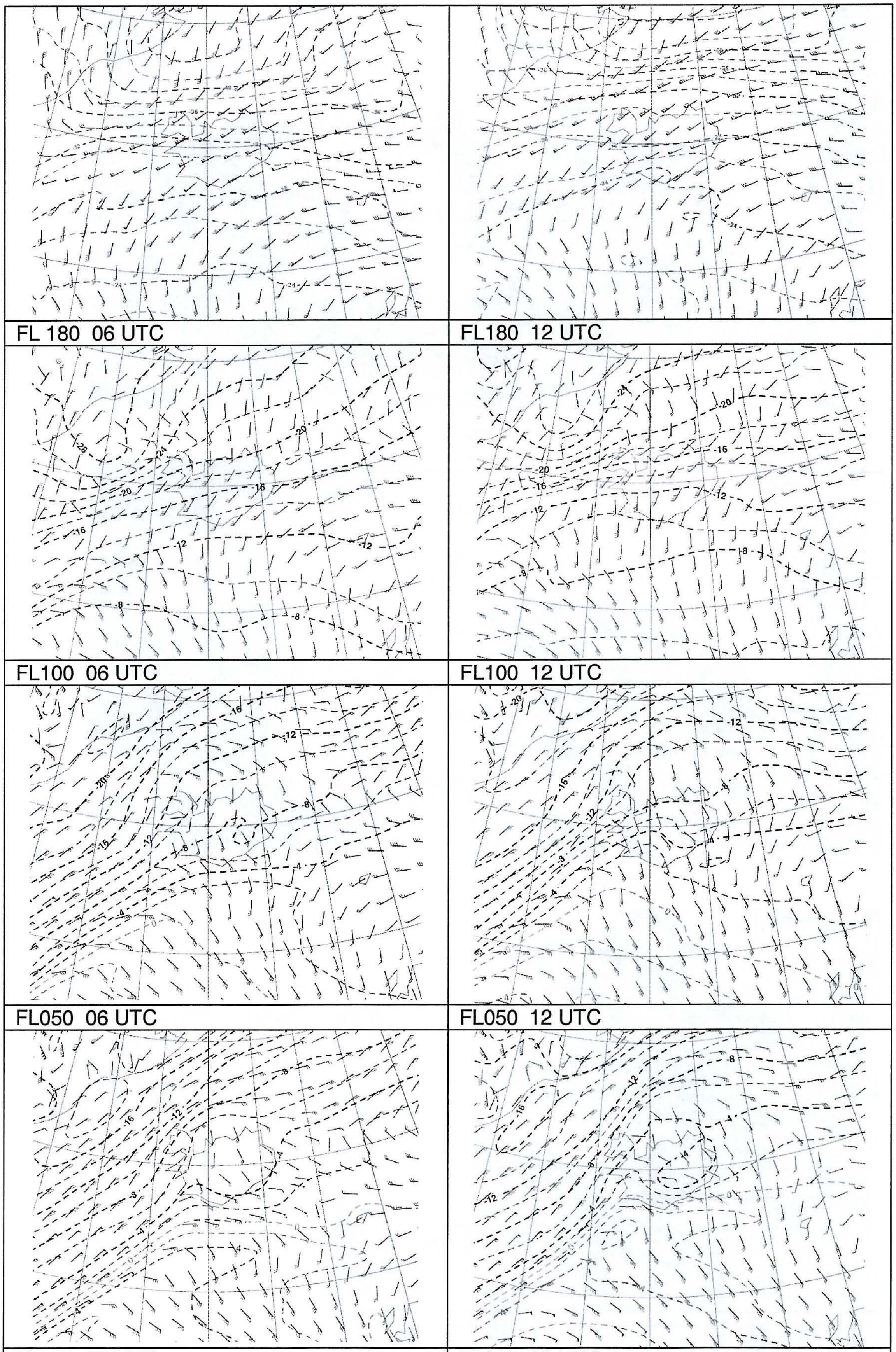

Fig 8 - Upper winds and temperature fields calculated by the HIRLAM G45 model. To the left: VT. 6 March 2001 06 UTC. To the right: VT. 6 March 2001 12 UTC.

The resolution of these images (APT, 4 km resolution) is not high enough to distinguish clearly any mesoscale features with in the warm front shield. In Fig 7 a high resolution image (AVHRR, 1.1 km resolution) from the first of the two passes is shown. This image was provided by Dundee Satellite Receiving Station in Scotland. AVHRR-images from the latter pass were not available there. On this image the cloud cover does not seem to be very uniform but rather built up of mesoscale bands of thick clouds with thinner clouds inbetween.

Radar images from the exact time of the accident are not available but simple pseudo-cappi images scanned between 10:00 UTC and 11:00 UTC can be shown. On the image from 10:00 (Fig 9) one can see that the precipitation in and ahead of the front was rather continuous and uniform. The main exception, apart from some local influence from the orography of Iceland, is a band of increased precipitation which was moving slowly towards NW and was approaching BIKF by 10:00 UTC. The possible nature of this precipitation band will be discussed later.

Upper winds and temperatures as calculated by the HIRLAM G45 numerical model may be seen on Fig 8. The model run is based on data from midnight (00 UTC) and 6 hours and 12 hours forecasts are shown. The sharp frontal zone off SW-Iceland is very marked in the lower levels (FL025 and FL050) and the warm advection seems to have extended at least up to FL180.

The weather at BIKF

An area with continuous frontal precipitation reached BIKF by 6:30 UTC. In the beginning the snowfall was light and the visibility was rather good but by 8 UTC the visibility had detoriated to 4 km. The temperature was slightly below zero. By 9:30 UTC the visibility was down to 1.5 km and the temperature was reported zero.

On Fig 9 one can see how the precipitation was detected by the weather radar near Keflavik Airport at 10:00 UTC. The precipitation seems to have been rather uniform but a band with higher intensity was approaching the radar site from the southeast. There is also an indication of more intense precipitation over the southwest coast, not far from the site of the accident.

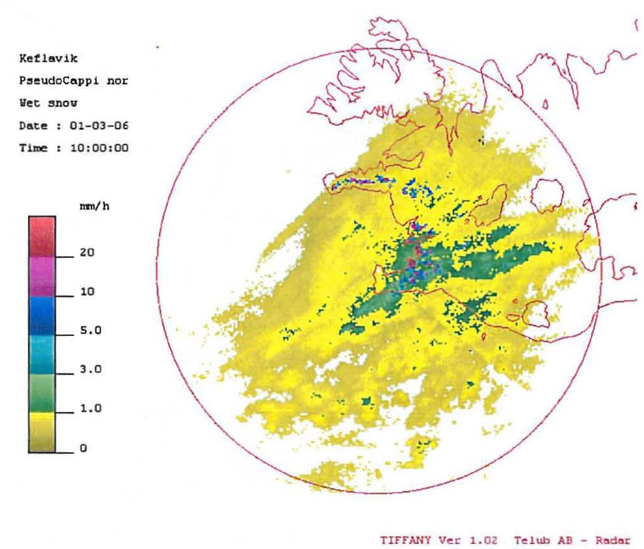

Fig 9 - Image from a weather radar at Keflavik airport 6 March 2001 10:00 UTC

All the time from the beginning of the snowfall until several hours after departure the form of the precipitation was reported as snow. From the upper air observation at Keflavik Airport at 12 UTC (Fig 10) one can see that the temperature was just below zero in a 4000 feet thick layer. It is not impossible but still not very likely and can not be confirmed that some precipitation has fallen as freezing rain somewhere near the airport in the approximately 3000 feet thick layer beneath the frontal surface. If that is the case there is a slight possibility that the plane encountered icing in form of freezing rain, eventually mixed with snow, during take-off or the first phase of the climb.

The weather conditions during the flight

From upper air observations (Fig 10) and surface maps it can be estimated that the slope of the frontal surface was of the order of 1:150. By the time of departure the frontal surface would then have been in an altitude of approximately 3000 feet over BIKF, descending towards the SE. The plane has therefore penetrated the frontal surface already after less than 10 minutes flight and after that it has been climbing in the relatively warm and moist air ascending over and behind the front. Under such conditions it is likely that a solid cloud cover will have built up and the upper air observation from 12 UTC (Fig 10) does not indicate any dry layers below 24000 feet. This means that considerable icing may be expected anywhere during the climb from the surface up to a considerable height.

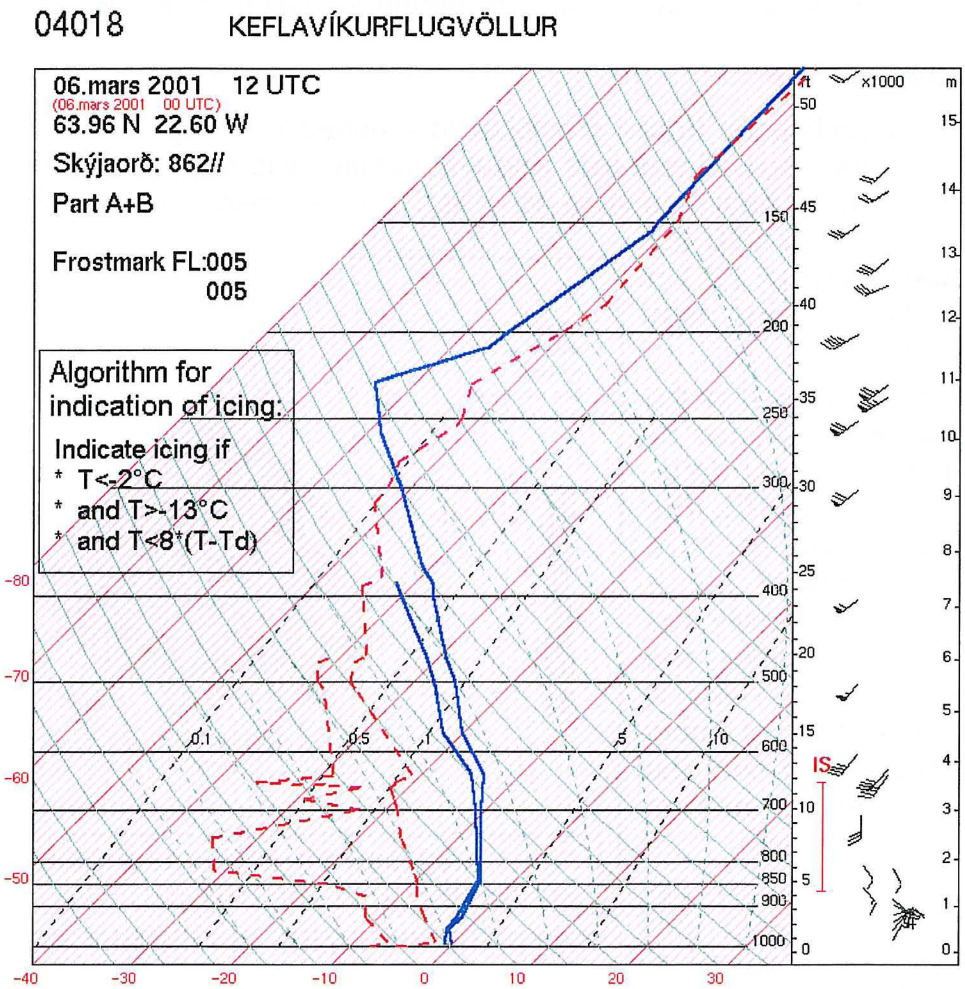

Fig 10 - Upper air observation made at Keflavik airport 6 March 2001 at 12 UTC. The observation from 00 UTC is also shown with a dotted red line.

On the diagram shown in Fig 10 the most typical layer for icing is indicated automatically by an algorithm based on temperature and moisture (difference between temperature and dewpoint). In this case the layer between 4000 and 12000 feet is indicated.

Above this layer one can see a layer with reduced static stability where the lapse rate is close to the wet-adiabatic. Within this layer, which goes up to 16000 feet, one could expect the formation of enhanced precipitation bands associated with instability rolls embedded in the massive warm front cloud. Fig 11 shows the likely position of such rolls relative to the warm front and the warm conveyor belt ascending along the frontal surface.

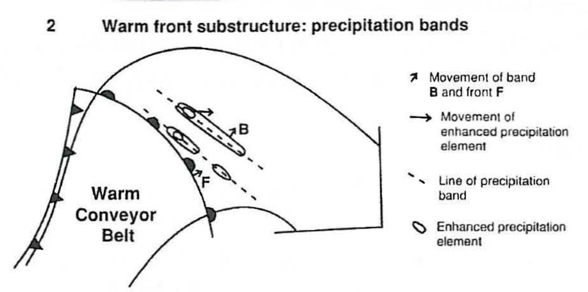

Fig 11 - Warm front precipitation bands. The image is taken from "Improvement of nowcasting techniques", COST Action 78 Final report, EUR 19544, 2001

It has been suggested that within such lines of convection the vertical motion may be five or even ten times stronger than generally within the frontal system. These convection lines are good candidates for spots where one could expect icing much more severe than in other parts of the frontal cloud.

Fig 12 is based on radar images from 10:00 UTC and 11:00 UTC. The echo shown is taken from the image at 11:00 UTC and the position of a rain band, which could very well be of the type mentioned above, is indicated with a dark blue line. The position of the same rain band at 10:00 is also indicated (see Fig 9) and a likely position at 8:30 is found by subjective extrapolation one and a half hour back in time. If this assumption is right the plane will have passed through the convection line shortly before the accident.

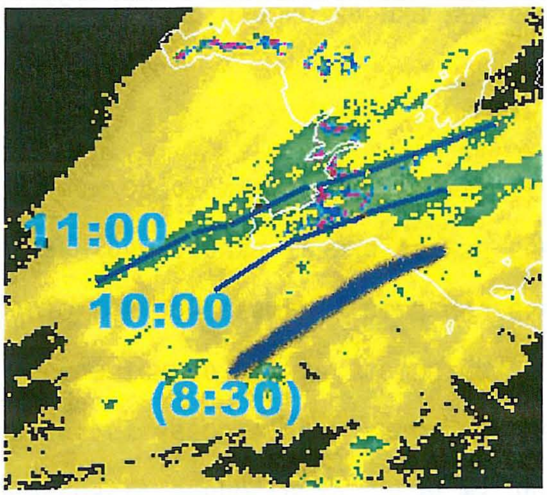

Fig 12 - Estimated position of enhanced precipitation bands, based on radar images.

Most of the deliberations above on the weather conditions during the flight are based on the sounding made at Keflavik airport at 12UTC. Even if it is three hours after the accident it is probably a good indication on the actual conditions at the time and place of the accident since during these three hours the front has been approaching the airport. The distance from Keflavik airport to the front at 12 UTC is not far from the distance from the place of the accident to the front at 9 UTC.

Aerodrome observations

The following aerodrome weather reports were submitted from the three aerodromes closest to the accident site (BIKF, BIRK, BIVM).

BIKF

BIKF	6.3.2001 06:00	**METAR** 08007KT 9999 FEW027 SCT048 BKN060 M01/M06 Q1001 11490064=
BIKF	6.3.2001 06:30	**METAR** 07010KT 9999 -SN SCT027 BKN042 OVC060 M01/M06 Q1001 11490064=
BIKF	6.3.2001 07:00	**METAR** 06010KT 8000 -SN SCT025 BKN038 OVC060 M01/M04 Q1000 11490064=
BIKF	6.3.2001 07:30	**METAR** 06011KT 8000 -SN SCT025 BKN038 OVC060 M01/M04 Q1000 11490064=
BIKF	6.3.2001 08:00	**METAR** 06011KT 4000 -SN SCT025 BKN038 OVC060 M01/M04 Q1000 11450064=
BIKF	6.3.2001 08:30	**METAR** 04010KT 4000 -SN FEW003 BKN014 OVC050 M01/M04 Q0999 11450064=
BIKF	6.3.2001 09:00	**METAR** 04011KT 2000 -SN SCT003 BKN009 OVC025 M01/M03 Q0999 11450064=
BIKF	6.3.2001 09:30	**METAR** 02011KT 1500 -SN BKN003 OVC008 00/M02 Q0999=
BIKF	6.3.2001 10:00	**METAR** 02010KT 1500 -SN BKN003 OVC006 00/M02 Q0999 RMK RVR N/A=
BIKF	6.3.2001 10:30	**METAR** 02013KT 1800 -SN BKN003 OVC007 00/M01 Q0998=
BIKF	6.3.2001 11:00	**METAR** 36013KT 1800 -SN BKN003 OVC006 M01/M02 Q0998 11750033=
BIKF	6.3.2001 11:30	**METAR** 36012KT 2000 -SN BKN003 OVC006 00/M01 Q0998 11750033=
BIKF	6.3.2001 12:00	**METAR** 36013KT 2000 -SN BKN002 OVC006 00/M01 Q0997 11750033=
BIKF	6.3.2001 12:30	**METAR** 35014KT 2000 -SN BKN002 OVC006 00/M01 Q0997=
BIKF	6.3.2001 13:00	**METAR** 35017KT 2500 -SN BKN002 OVC018 00/M01 Q0996=

BIRK

BIRK	6.3.2001 06:00	**METAR** 10013KT 9999 FEW018 BKN038 BKN050 00/M07 Q1001=
BIRK	6.3.2001 07:00	**METAR** 06008KT 9999 FEW018 BKN032 BKN050 M00/M06 Q1000=
BIRK	6.3.2001 08:00	**METAR** 05006KT 9999 -SN SCT018 BKN035 M00/M03 Q1000=
BIRK	6.3.2001 09:00	**METAR** 02006KT 1500 SN SCT007 BKN011 00/M01 Q0999 13490095=
BIRK	6.3.2001 10:00	**METAR** 01008KT 0900 SN VV002 M00/00 Q0999 13490328=
BIRK	6.3.2001 11:00	**METAR** 04009KT 0800 SN VV002 01/01 Q0998 13590334=
BIRK	6.3.2001 12:00	**METAR** 04009KT 3000 SN SCT004 BKN070 01/00 Q0997 13590330=
BIRK	6.3.2001 13:00	**METAR** 04008KT 7000 SNRA FEW005 SCT015 BKN023 01/01 Q0996 13590352=

BIVM

BIVM	6.3.2001 07:00	**MET REPORT** 08030G40KT 9999 VCSH FEW015 BKN030 02/M00 Q0998=
BIVM	6.3.2001 08:00	**MET REPORT** 08035G45KT 9999 RA FEW007 BKN015 BKN030 02/M00 Q0998=
BIVM	6.3.2001 09:00	**MET REPORT** 08035G45KT 7000 RA FEW007 BKN015 OVC030 03/01 Q0997=
BIVM	6.3.2001 10:00	**MET REPORT** 08030G40KT 7000 RA FEW007 BKN015 OVC030 03/01 Q0996=
BIVM	6.3.2001 10:47	**MET REPORT** 08035G45KT 5000 RA BKN005 OVC015 03/02 Q0995=
BIVM	6.3.2001 12:00	**MET REPORT** 15030G40KT 080V180 3200 RA OVC003 05/05 Q0995 RMK MISVINDA=
BIVM	6.3.2001 13:00	**MET REPORT** 15025G35KT 080V180 7000 RA OVC003 07/05 Q0995 RMK MISVINDA=

Aerodrome forecasts

BIKF	6.3.2001 04:05	TAF	6	6	06010KT 9999 SN SCT015 BKN040 BECMG 0810 03025G35KT 4000 RASN BKN008 OVC015 BECMG 1012 9000 RA SCT010 OVC020 BECMG 1618 12015KT 7000 RA BKN008 OVC015 BECMG 2124 06020KT 9999 SCT015 BKN025 TEMPO 2106 5000 DZ OVC010=
BIKF	6.3.2001 10:08	TAF	12	12	06015KT 2000 SN SCT003 BKN010 OVC020 BECMG 1214 4000 RASN BKN015 OVC025 BECMG 1416 7000 RA SCT010 OVC025 BECMG 2124 06020G30KT 9999 SCT015 BKN025 TEMPO 2112 7000 RA OVC015=
BIKF	6.3.2001 04:22	TAF	6	15	06010KT 9999 SN SCT015 BKN040 BECMG 0810 03025G35KT 4000 RASN BKN008 OVC015 BECMG 1012 9000 RA SCT010 OVC020=
BIKF	6.3.2001 07:11	TAF	9	18	06010KT 8000 SN BKN015 OVC040 BECMG 0910 03025G35KT 4000 RASN BKN008 OVC015 BECMG 1012 9000 RA SCT010 OVC020 BECMG 1618 09015KT 7000 RA BKN008 OVC015=
BIKF	6.3.2001 10:11	TAF	12	21	06015KT 2000 SN SCT003 BKN010 OVC020 BECMG 1214 4000 RASN BKN015 OVC025 BECMG 1416 7000 RA SCT010 OVC025=
BIVM	6.3.2001 07:33	TAF	8	17	08030G40KT 5000 RASN SCT004 BKN010 OVC020 BECMG 0810 7000 RA BECMG 1213 11020G30KT 8000 DZRA SCT005 BKN015 OVC025=

Flight documentation

Some of the forecast charts of winds and temperature aloft and significant weather available at departure are shown in Fig 13-15.

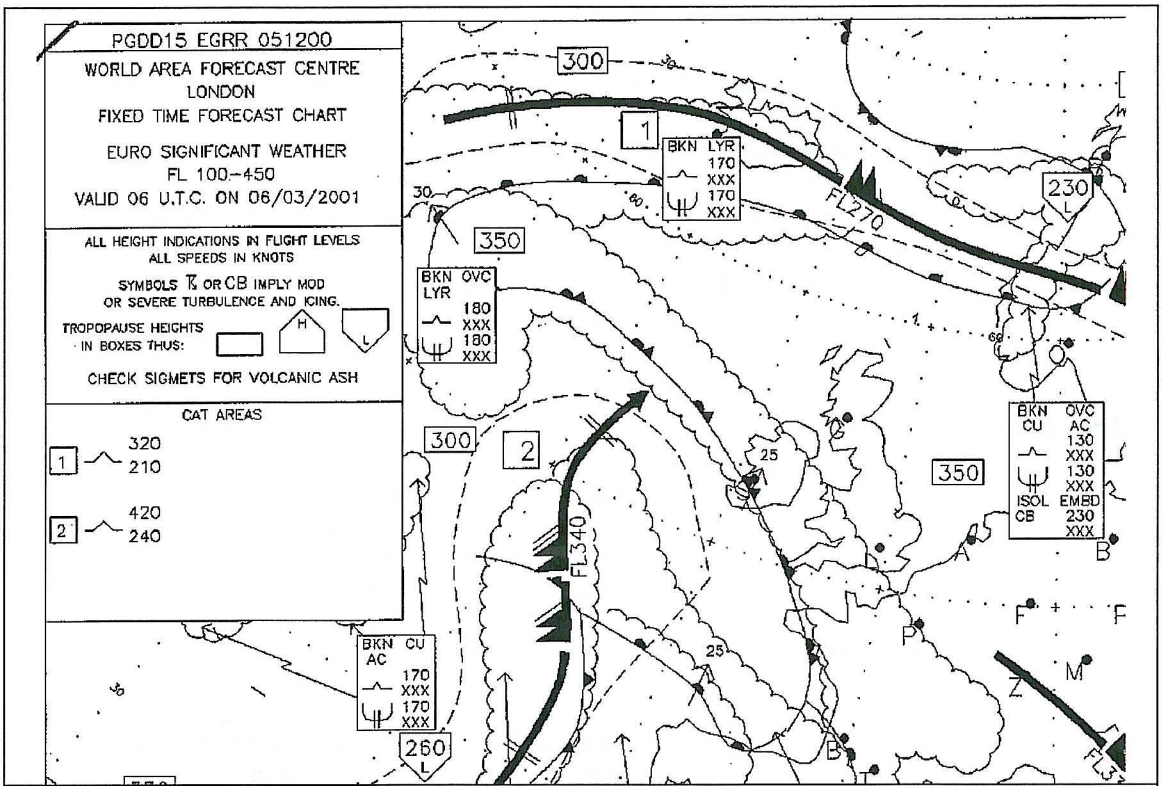

Fig 13 - Significant weather forecast chart from WAFC London, VT 6 March 2001 06 UTC.

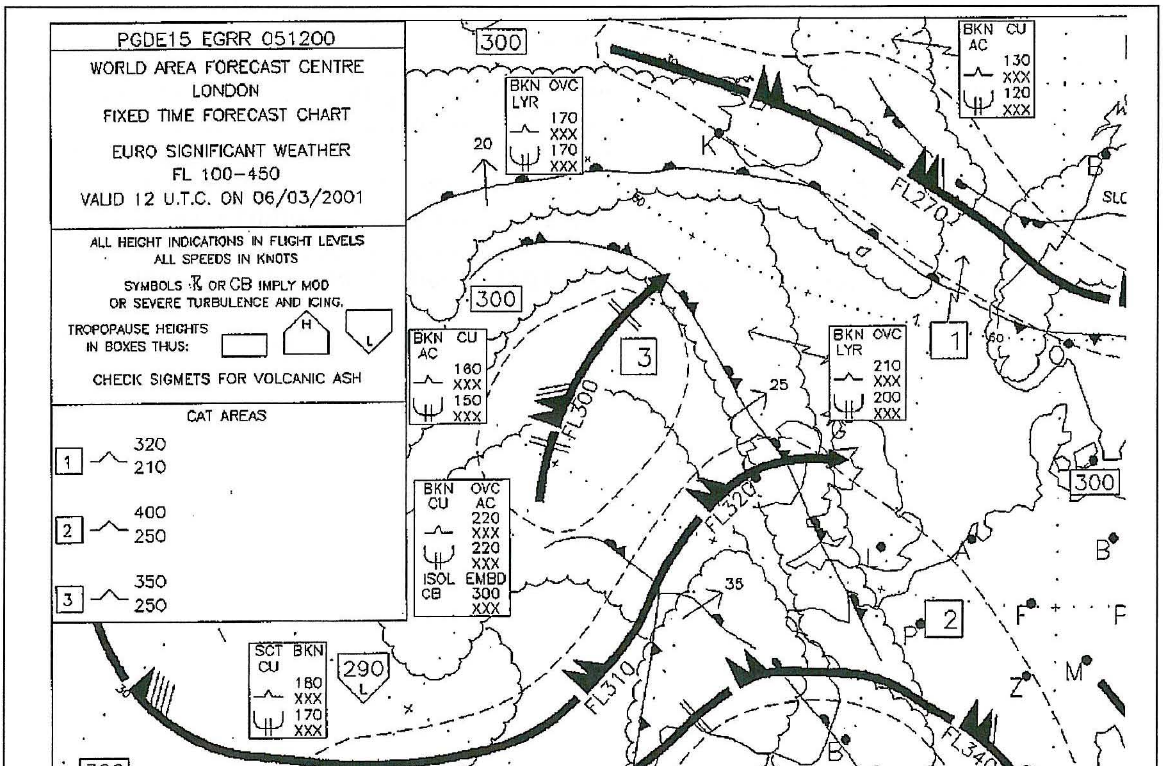

Fig 14 - Significant weather forecast chart from WAFC London, VT 6 March 2001 12 UTC.

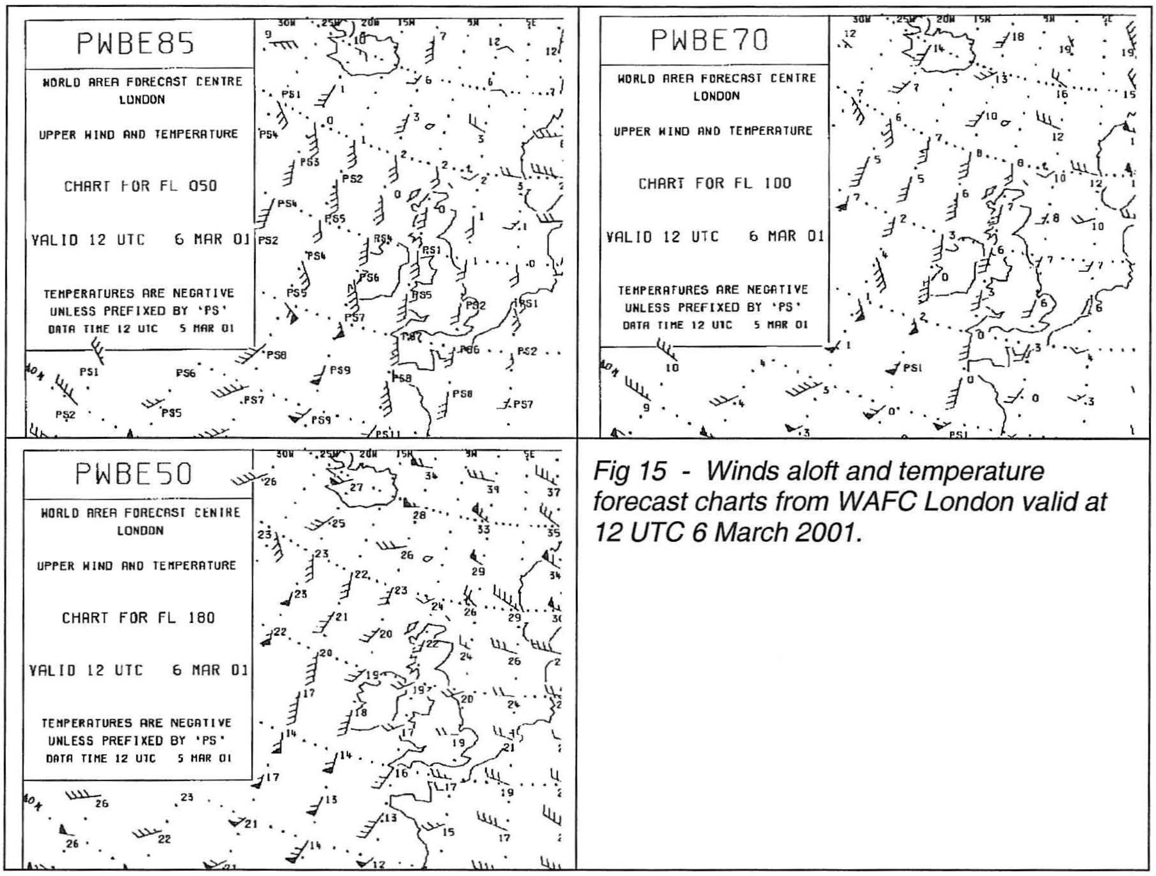

Fig 15 - Winds aloft and temperature forecast charts from WAFC London valid at 12 UTC 6 March 2001.

Reykjavík, 18 June 2001

Guðmundur Hafsteinsson