

6 Ship's Meteorological Station

6.1 Meteorological Conditions During Leg M 45/1

(L. Kaufeld, W. Th. Ochsenhirt)

After having left the harbour of Malaga at 19 May at about 10.00 hours, the wind blew from southwest with increasing forces 5 to 6 bft. The well known funneling effects caused the wind to freshen up in the Strait of Gibraltar. There it reached 7 bft from westerly direction despite of only weak pressure differences between the Gulf of Cadiz and the Alboran Sea. Due to the short fetch, the wind sea was not adapted to this wind force.

The next few days with scientific measurements in the Gulf of Cadiz, a northerly breeze blew with force 4 associated with a bright sky. During the two days passage to Lanzarote northerly winds with 5 bft were observed.

From 25 to 31 May during the research work north of the Canary Islands, only weak winds occurred from northerly directions. The visibility was good to excellent: Sometimes the northeastern part of Teneriffa could be seen and once even the volcano Pico de Teide in a distance of 120 km. In the morning of 31 May, an old depression which had penetrated the subtropical ridge and had reached the region north of Madeira caused some showers in the ships vicinity.

By the change of the months, a weak depression moved northeastward away from the Portuguese coast and a strong anticyclonic ridge extended eastward from the Azores high. Since the heat depression over Northwest Africa remained stationary, the pressure differences around the Canary Islands intensified. This weather development was well forecast several days in advance by the numerical model of *Deutscher Wetterdienst*. On the cruise leg to Lissabon the northnortheasterly wind increased to 6 bft during the night to 4 June and shortly reached 7 bft.

The last four days of this cruise, METEOR gradually "sailed" into the regime of the anticyclonic ridge with weakening winds from northerly directions. For a short time they freshed up a little before entering the mouth of the Tejo river.

In the morning of 8 June, this voyage ended in Lissabon with bright sunshine.

6.2 Meteorological Conditions During Leg M 45/2

(G. Kahl)

When METEOR left Lisbon on 11 June 1999, the subtropical anticyclone was centered just west of the Bay of Biscay, its central pressure being 1032 hPa. Over the Iberian Peninsula, however, low pressure was prevailing, so that the vessel had to deal with headwinds up to Beaufort 7 while on her way to the position where oceanographic work began on 10 June 1999. While on her way to the CGFZ, the Charlie Gibbs Fracture Zone, the research vessel experienced moderate southwesterly winds most of the time. On 19 June, however, the wind force rose to 8 Bft during passage of a front. The general circulation consisted of fast moving waves that passed between a gale center west of Iceland and the aforementioned Azores High. The gale force winds thus did not last very long. While work was going on over the CGFZ, METEOR experienced light to moderate winds from westerly directions.

Meanwhile however, some intensification of the General Circulation was taking place over the Northwest Passage, a well developed low of under 990 hPa central pressure reaching Davis Strait on 23 June 1999. In due course, a flat low over Cape Walloe, Southeastern Greenland, started intensifying during 24 June 1999 to lie southwest of Iceland on 25 June 1999 as a gale center of under 985 hPa central pressure.

As the gale center continued eastward Bft 8 was observed on METEOR from Southwest, veering West later. Gale force winds of 8 Bft from the northeast were blowing on 26 June 1999 while the gale center stalled south of Iceland and finally began filling. The seas that had developed in the region hampered operations only to a little effect by reducing the ship's speed. Winds abated and were light only in the days to follow when the research vessel probed the Reykjanes Ridge.

When METEOR finally began heading for her next port of call on 2 July 1999, the general circulation had adopted a more southerly route, a gale center with a central pressure of under 985 Pa moving east north of the Azores before stalling and filling just west of Ireland. Thus, moderate northeasterly winds were observed, veering southeast during 3 July 1999 and finally southwest during 4 July 1999 before abating. The low had been detected during 2 July 1999 west of the Great Lakes as it moved eastward quickly, passing the Strait of Belle Isle on 3 July 1999 with of central pressure of under 990 hPa, but then turning north and even northwest, thereby starting to fill. secondary depressions followed on a more southerly course so as not to influence METEOR as she proceeded on her way, reaching St. John's, Newfoundland, on 8 July 1999.

6.3 Meteorological Conditions During Leg M45/3

(G. Kahl)

When METEOR left St. John's, Nfld, on 11.07.1999, a gale center over the southern part of Baffin Island was governing the general synoptic situation. In ist reign, a flat low had just passed Newfoundland and another was due to follow. This resultet in light easterly winds while the vessel began her way northward into the Labrador Sea. Winds turned to westerly directions soon, however, and a secondary low formed over Hudson Bay during 15.07.. It developed into a gale center when still over the continent, passing the Strait of Belle Isle during 17.07. and moving away eastwards later. The METEOR was left unmolested because her work had carried her far enough northward. Meanwhile, however, another low had been travelling east from the region well west of the Great Lakes, developing into a gale center when passing Hudson Bay during 18.07. and Goose Bay, Labrador, during 20.07. when southeasterly winds of 6 Bft, backing northeast, were observed. The light winds that followed were of short duration because the low over Baffin Island was still active. So, the next secondary low was formed over Hudson Bay during 21.07., southeasterly winds of 6 Bft being felt by 22.07.. When the research vessel finished probing the Labrador Sea region and headed south to the southeastern rim of th Grand Banks, a low approaching from the Great Plains had developed into a storm center at the western tip of Hudson Bay, and a high had formed over the Maritimes. In consequence, light northerly winds accompanied our ship up to the 26.07. Meanwhile a low had formed near Cape Cod, Mass., moving northeast and developing but slightly. It passed along the south coast of Newfoundland on 28.07. while strong southeasterly winds, veering southwest, were felt on the southeastern Grand Banks. These tapered off soon, and winds remained light during the last days of July. The low in the upper atmosphere over Baffin Island had moved south somewhat to lie over northern Quebec. A secondary low had formed over the St. Lawrence Seaway during 31.07., moving northeast and developing into a gale center east of Hudson Strait during 01.08., then swinging northwest into Baffin Island as a storm center by 02.08.. At METEOR's position, southwesterly winds up to 6 Bft were observed, veering northwest on 03.08.. Light winds then accompanied the research vessel on her way to the Flemish Cap. During 04.08., a low had formed off the coast of South Carolina and had moved slowly along the eastern seaboard, thereby developing into a gale center so that southeasterly gales of 7 to 8 Bft were observed on 07.08.. Winds were light again on 08.08. while the METEOR began heading

for St. John's, Nfld., but by that day still another low had migrated east from a position southwest of the Great Lakes, thereby developing into a gale center. In the morning of 09.08., the gale center had reached Nova Scotia, swinging northeast to Belle Isle Strait and deepening further, strong to gale force southwesterlies ensuing during the last day of the voyage. Saint John's was reached by 10.08.1999.

6.4 Meteorological Conditions During Leg M45/4

(G. Kahl)

When METEOR left St. John's, Nfld, on 13.08.1999, a migrating high had just passed the city, heading away northeastwards. A trough of low pressure extended from the Foxe Basin over North Quebec to New Brunswick. In consequence, light southerly winds were accompanying the research vessel out to sea. Another flat low, situated over the Great Lakes, was moving east, thereby developing into a gale center by 14.08. when over the Gulf of St. Lawrence. It turned northward and moved up the west coast of Greenland. Its secondary low, however, continued to move east. During 16.08., it was a gale center near Southeastern Greenland. The air masses north of the gale center moved against the mountainous coast and were diverted to the south where METEOR was experiencing northeasterly gales of 9 Bft and storm force gusts up to 11 Bft. These conditions reduced her speed severely. Half a day was lost before the position where work was to begin was reached on 17.08., winds being light and variable by then. Conditions kept being favorable while a high was building east of Greenland and the next low moved due east from Newfoundland. By 20.08. another low had been swinging northeast from Labrador, its movements being influenced by a trough in the upper air that had reached eastern Greenland. As it made its way into Denmark Strait, southerly winds 7 Bft were felt shortly on the ship's position. Winds continued to be blowing from southerly directions, speeds being light to 5 Bft, in the days to follow so that oceanographic work was not impeded. On 26.08., however, a low in the upper atmosphere had moved to southeastern Greenland, a gale center denoting its position at surface level. As METEOR began heading for the Pentland firth, southeasterly gales 8 Bft hampered her for a few hours. The last days of the voyage continued to be under the influence of the upper air low migrating east as our ship was proceeding in the same direction. In consequence, several lows and their associated frontal troughs made themselves being felt by strong southerly winds up to 7 Bft. Winds abated in the North Sea so that Rendsburg was reached by 31.08.1999.

6.5 Meteorological Conditions During Leg M45/5

(G. Kahl)

When METEOR began her voyage from Bremen on the first of October, 1999, a gale center on the south coast of Iceland was governing the North Sea. So she was greeted by strong Westerlies of 7 Bft and gale force thundersqualls even as she ventured into German Bight. Going north along the coast of Jutland, these calmed down on 02.10. and 03.10. while on METEOR scientific work was done on the Skaw. Meanwhile, the gale center had moved away to the Norwegian Sea, but a secondary low had formed and reached western Norway. In its wake strong to gale force Northwesterlies accompanied the ship on her way to the Silver Pit where winds calmed down a bit. By 5 October, a High had formed over the British Isles and Ireland, and when the ship headed for the Straits of Dover, there were light northerly winds only.

Passing the Bay of Biscay, METEOR was lucky in being met by the subtropical high being situated north of the Acores, extending a wedge into the area. So only moderate northwesterlies of 4 Bft were observed, and on her way on to the first probing position just north of the Acores, conditions were sometimes calm.

When METEOR went further south past the Azores reaching the vicinity of the Great METEOR Bank she was continually under the influence of high pressure so that only light winds were felt. The last mentioned position was probed on 14 October when course was changed to the east.

On her way to Cape Ghir the ship continued to be under the influence of subtropical high pressure so that light northerly winds were observed and scientific work was unhampered. When near the coast of Morocco, there were moderate Northerlies of 3 to 5 Bft.

METEOR called at Las Palmas de Gran Canaria from 20 October to 22 October, 1999. During the time that the ship was working in the Cape Ghir region and was calling at Las Palmas, a tropical storm called IRENE had developed east of the Lesser Antilles, made her way past the Bahamas and near the Eastern Seaboard of the U.S.A.. There, IRENE successfully transformed into a storm of the temperate latitudes, and when METEOR put out to sea again on 22 October, Ex-IRENE was south of Greenland, its central pressure being estimated as 945 hPa. Thus, she was a very prominent feature of the synoptic chart indeed. The General Circulation was greatly intensified, and as a result a cold front passed METEOR while working on the DOMEST position just north of Tenerife on 24 October. Mean winds were of the order of 5 Bft before and after the frontal passage, veering from west to northwest and later abating again. So there were no strong winds, but in the wake of Ex-IRENE swell up to 5 m height was observed while the ship stayed at the DOMEST position until 27 October.

In fact, the outbreak of cold air masses was such that a Low over and to the north of the Canary Islands was formed, central pressure being 1008 hPa before it slowly filled during the next few days. METEOR was in the center of the Low and experienced light winds only as she headed to the Cape Ghir Region again, probing it intensively up to the end of October. Light to moderate northerly winds were observed there. During 01 November the DOMEST position was visited again. Meanwhile, in the General Circulation, which had been intensified again by storm force remnants of a tropical storm called JOSÉ, a storm center of 960 hPa was near the Faroeer Islands on 31 October, moving north and filling but slowly. A secondary low had formed on its cold front just east of the Azores on 01 November, moving to Cape Finisterre and further on to the northeast. Its cold front reached the Canary Islands during 01 November. Northeasterlies were strong in and just behind the frontal passage, 6 Bft being observed for some hours before winds abated again.

METEOR called at Las Palmas on 03 November 1999.