Wave climate in the Baltic Sea 2009

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Key message

In the first four months of year 2009 the average wave climate in the areas covered by the measurements was calmer than usual. The highest values of significant wave heights were measured in January, 6.2 metres in the Southern part and 5.3 metres in the Northern part of the Baltic Proper. During the summer months the mean significant wave height was close to the long term mean values, except in June, when the wave climate was clearly rougher than usual in the Western Baltic Proper. An unusually high value for the season, 6.7 metres was measured in June in the Skagerak. The autumn season was characterised by a September that was rougher and a December that was calmer than usual. The highest measured significant wave height in the Baltic Sea in 2009 was 7.4 metres, measured in October in the Southern Baltic Proper.

Results and assessment

In 2009 waves were measured in nine locations in the Baltic Sea and Skagerak (Figure 1). These buoys provide real time information of the wave climate for professional and free time navigation. The wave measurements are also important for wave related research and wave model development. As waves contribute to the mixing of the surface layer and their influence can extend to the bottom (resuspension) the information about the yearly wave activity adds to the understanding of the physical environment of the Baltic Sea.

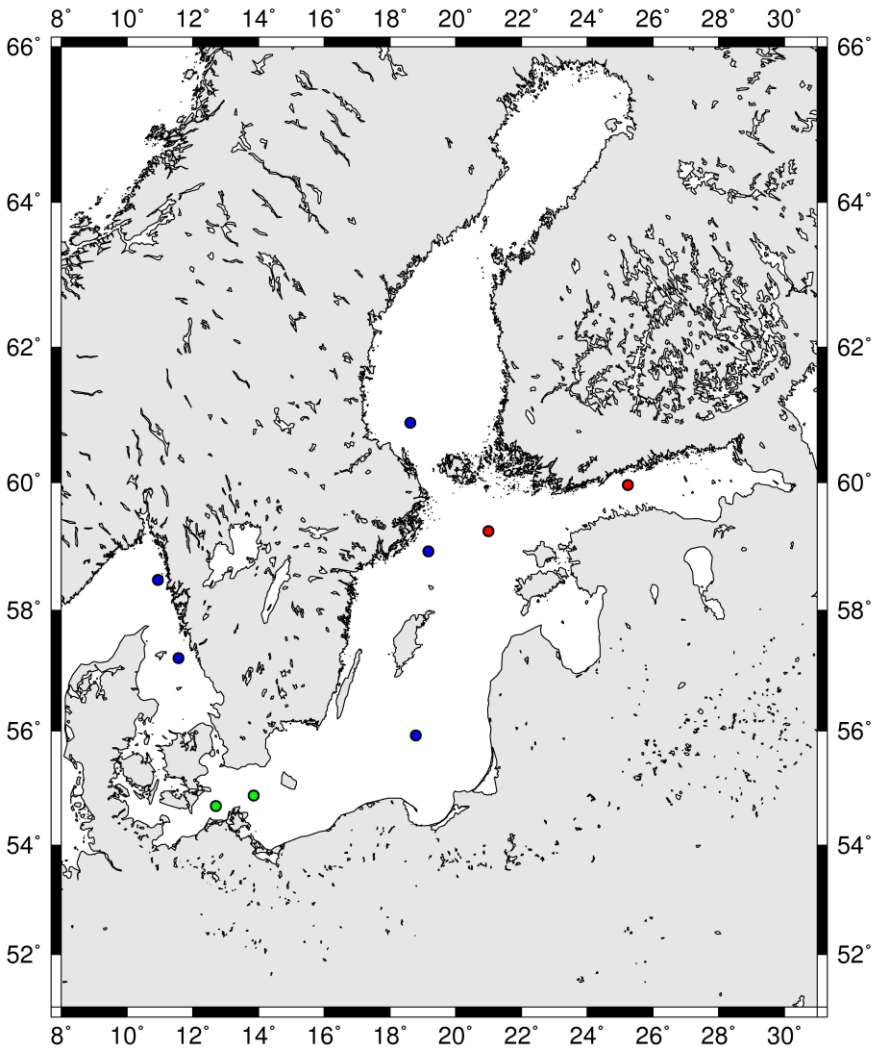

Figure 1. The position of wave measuring sites in 2009. Red dots indicate FMI buoys in the Northern Baltic Proper and in the Gulf of Finland (station Helsinki), blue dots SMHI buoys in the Southern Bothnian Sea (station Finngrundet), in the Northern Baltic Proper (station Huvudskär Ost), in the Southern Baltic Proper, in Kattegat (station Läsö Ost) and in Skagerak (station Väderöarna) and green dots the BSH and GKSS buoys off Cape Arkona and on the Darss Sill. See section Metadata for the exact positions of the buoys.

The Bothnian Bay

The Southern Bothnian Sea, station Finngrundet

The buoy at Finngrundet was operating the whole year. The highest measured significant wave height in the Southern Bothnian Sea was 3.8 metres (December 26th). Otherwise the significant wave height measured was above three metres once in January, once in July and twice in October. Although the significant wave height showed much variation monthly means, especially during the first four months, were approximately 0.30 metres lower than usual.

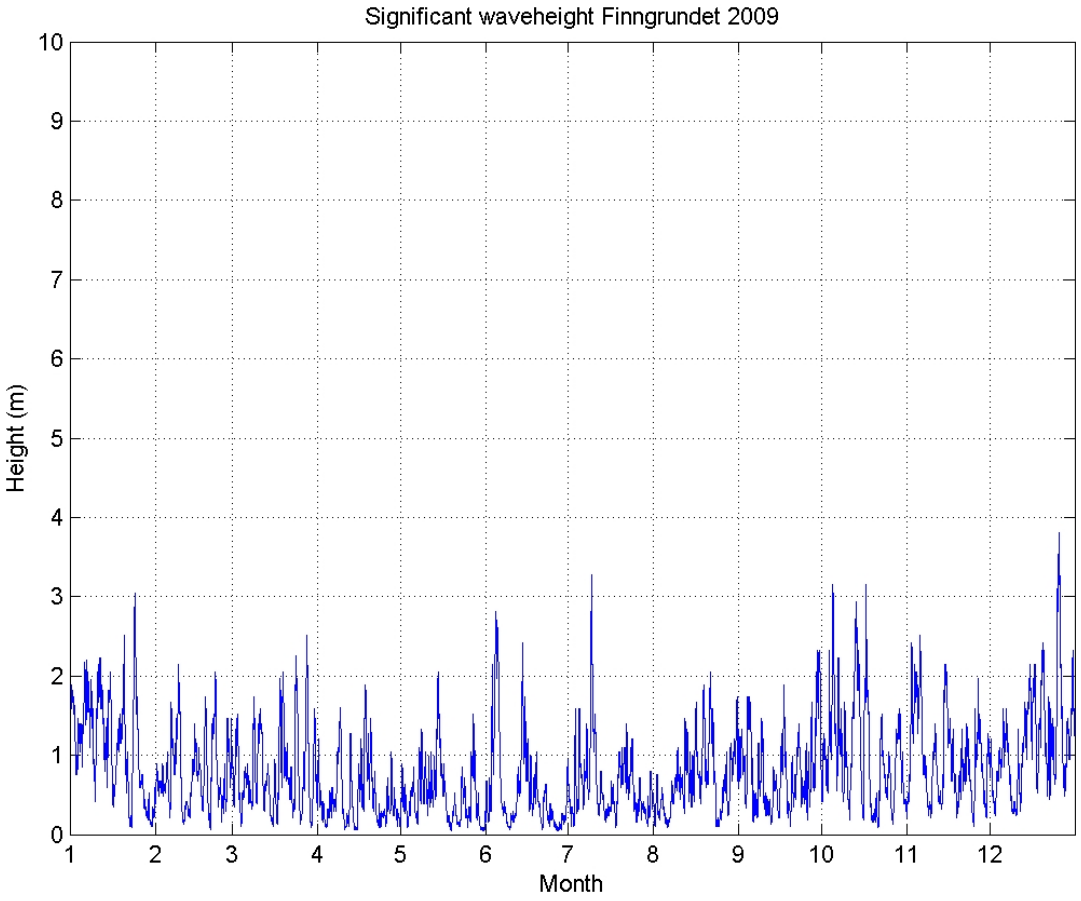

Figure 2. Time series of significant wave height at station Finngrundet.

The Gulf of Finland

The middle parts of the Gulf of Finland, station Helsinki

The period for risk of ice damage in the middle parts of the Gulf of Finland is typically from January to May. Due to instrument problems the measuring period in 2009 at station Helsinki did not start before the end of August. September and October were somewhat rougher than usual while the two last months of the year were calmer, especially in November when the significant wave height was two metres as highest (November 5th). The highest significant wave height during the measuring period of four months was 3.8 metres, measured in December 26th.

The Baltic Proper

The Northern Baltic Proper, stations Northern Baltic Proper and Huvudskär Ost

Due to the calm winter the wave measurements at the station Northern Baltic Proper could be carried out through the winter. The wave climate at this station was clearly calmer from January to April. From May to November the wave climate was typical for the season, except September, which was rougher than usual. December in turn was calmer than usual. The significant wave height exceeded five metres

four times (January 12th, October 4th and 7th and in December 26th), the highest being 5.3 metres, measured in January.

The buoy at Huvudskär is located SWW from the buoy at station Northern Baltic Proper and closer the shoreline. The highest significant wave height, four metres, was measured on March 24th. Significant wave heights above three metres were even measured twice during April and three times during October. Observe that virtually no measurements are available during the winter months (January, November and December). This was due to maintenance on the instruments during these periods.

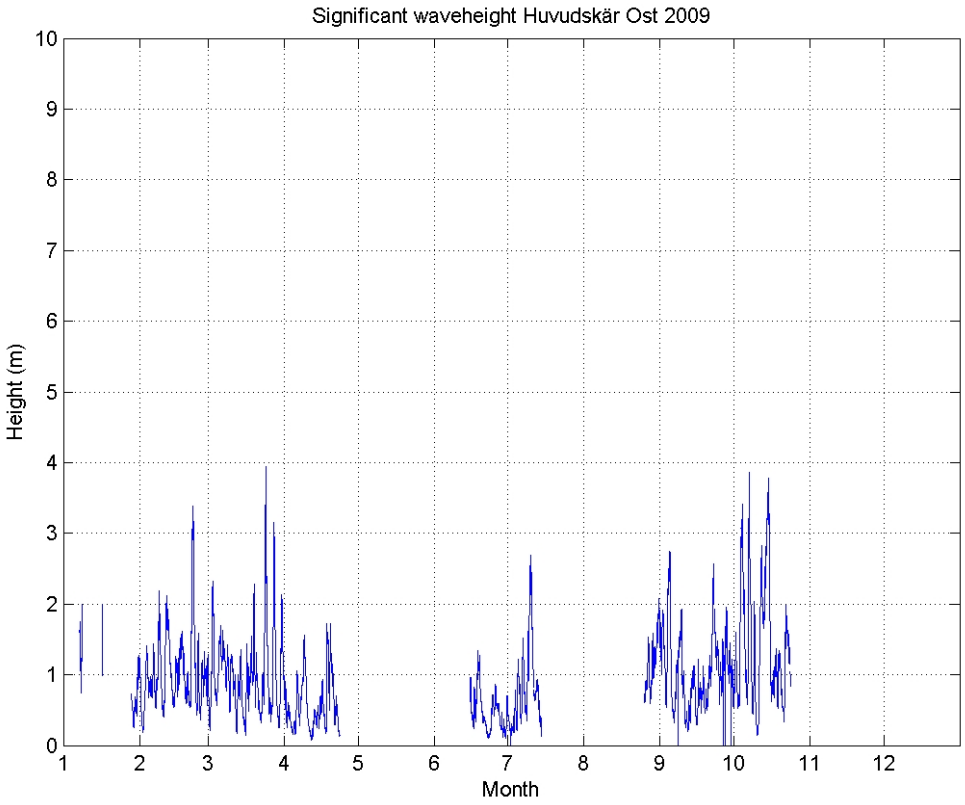

Figure 3. Time series of significant wave height at the station Huvudskär Ost.

Southern Baltic Proper, station Southern Baltic

The highest significant wave height recorded by the buoy deployed in the Southern Baltic Proper was 7.4 metres on October 14th. This is the first time that a significant wave height above seven metres was observed at this location. Between October 13th and 15th winds steadily blowing from the north resulted in 38 consecutive hours of the significant wave being four metres or more. Significant wave heights close to four metres were even registered during January, March, June, November and December. Measurements were disrupted during a short period in the beginning of October due to maintenance.

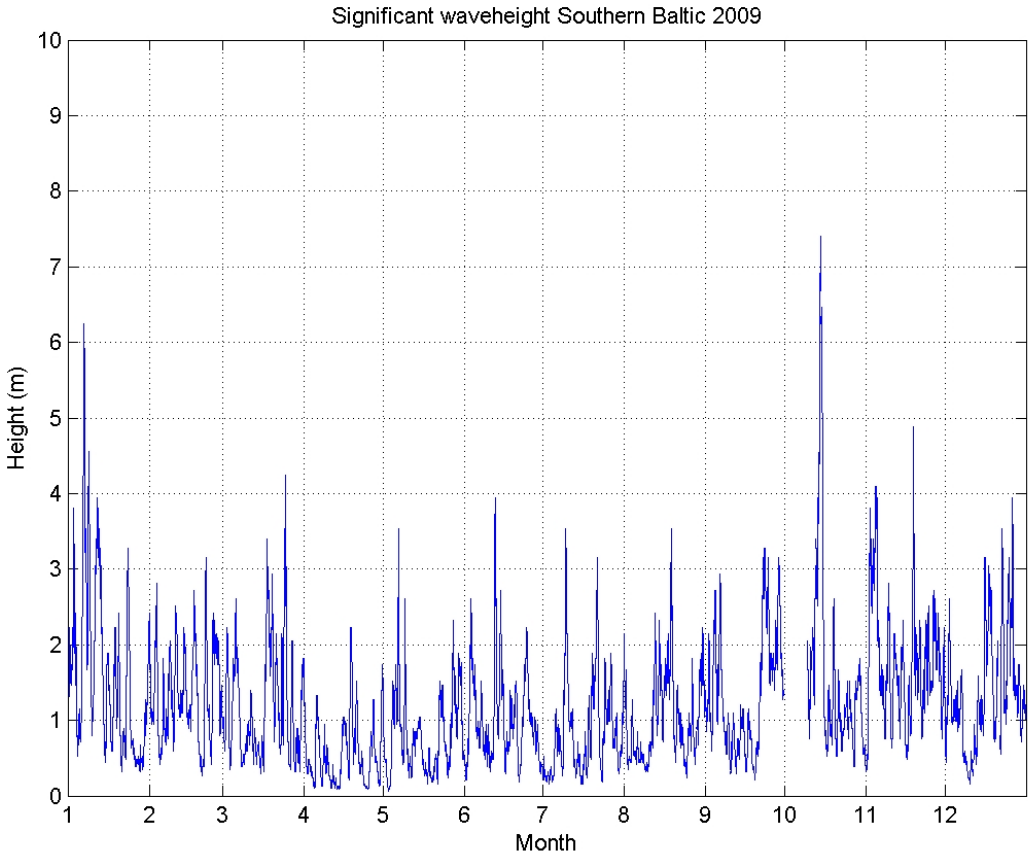

Figure 4. Time series of significant wave height at the station Southern Baltic.

Western Baltic Proper, stations Darss Sill and Arkona

In 2009 the Arkona buoy was out of operation for a prolonged period in February and the buoy at Darss Sill did not deliver data in January and October. Therefore, mean values and maxima could not be determined for these months. All measurement data referred to in the following are significant wave heights.

Mean significant wave heights in the area of Darss Sill typically are 0.6 metres in summer and 0.9 metres in winter. Wave heights at the Arkona station are slightly higher, ranging from about 0.6 to 1.2 metres. The most frequent wave direction, that roughly coincides the predominant wind direction, is west-southwest (WSW), especially during storm events. Wind fetch in this offshore direction is much longer at the Arkona Basin than at Darss Sill, i.e. waves reaching the Arkona station have more time to grow. But also with different wind and wave directions, the larger distance from the coast and deeper water at the Arkona station are important factors contributing to higher wave heights.

In 2009, the mean significant wave heights at both measuring stations did not differ significantly from the long-term means. From the beginning of the year to May, they were slightly below the mean values,

and after that they were slightly higher. June was the only month in which the mean values were exceeded clearly, by about 0.25 metres, due to a single storm event with SW wind reaching up to 20 m/s (8 Bft). This event is also reflected in the monthly maximum values of 2.6 and 3.7 metres at Darss Sill and Arkona, respectively. Maximum wave heights were three metres at Darss Sill in November, and four metres at the Arkona station in December.

Monthly maxima in 2009 generally were clearly below past extremes (although no statement is possible regarding periods with data gaps), which is due to relatively calm wind conditions. The annual mean of wind speeds, at 7.8 m/s, was slightly below the long-term mean (8.0 m/s), and the mean direction was SSW (206°) instead of the common WSW (243°). The 19 % frequency of gale-force winds of 6 Bft or more was below the mean value of 23 %. Because of low storm activity and the unusual distribution of wind directions in 2009, wave heights were lower than in average years.

Kattegat and Skagerak

Kattegat, station Läsö Ost

The buoy at Läsö Ost was only operating during a short period between January 22nd and February 14th. During this period the highest significant wave height was 2.5 metres on January 22nd. Due to the short period the buoy was operating no statistically relevant data could be obtained.

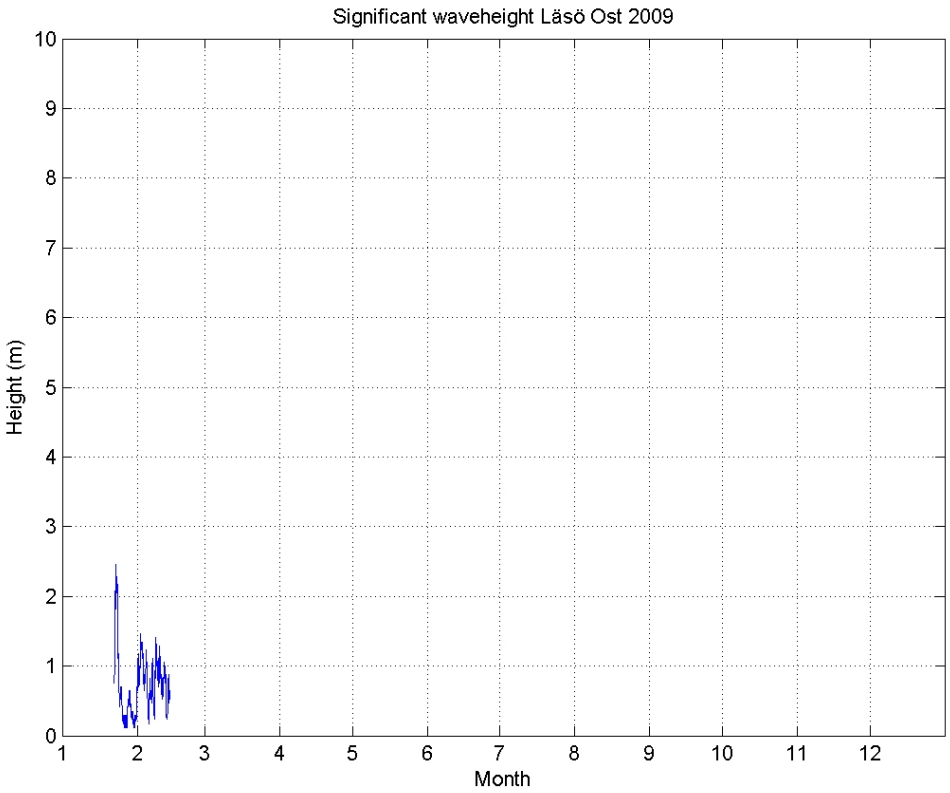

Figure 5. Time series of the significant wave height at the station Läsö Ost.

Skagerak, station Väderöarna

A summer storm blowing from the SW with mean winds around 21 m/s and gusts up to 28 m/s lead on July 31st to a significant wave height of 6.4 metres at Väderöarna. This was the highest recorded significant wave height at this location during 2009 as well as the highest significant wave height recorded on this location during summer since measurements started in 2005. The significant wave height exceeded four metres at several occasions during the year. This was the case in January, August, October and November. A high pressure system in December made that an unusually calm month. The significant wave height during this month exceeded two metres only on Christmas Eve when 3.6 metres were measured. Another calm period could be observed between the beginning of June and the end of July. During this time significant wave heights below two metres were exceeded only once, on June 18th. Generally the mean significant wave height during winter months (January, February and December) was about 0.5 metres below the climatologically mean (2005 – 2008) while during late summer and autumn (July to September) the mean significant wave height was roughly 0.2 m above the climatologically mean.

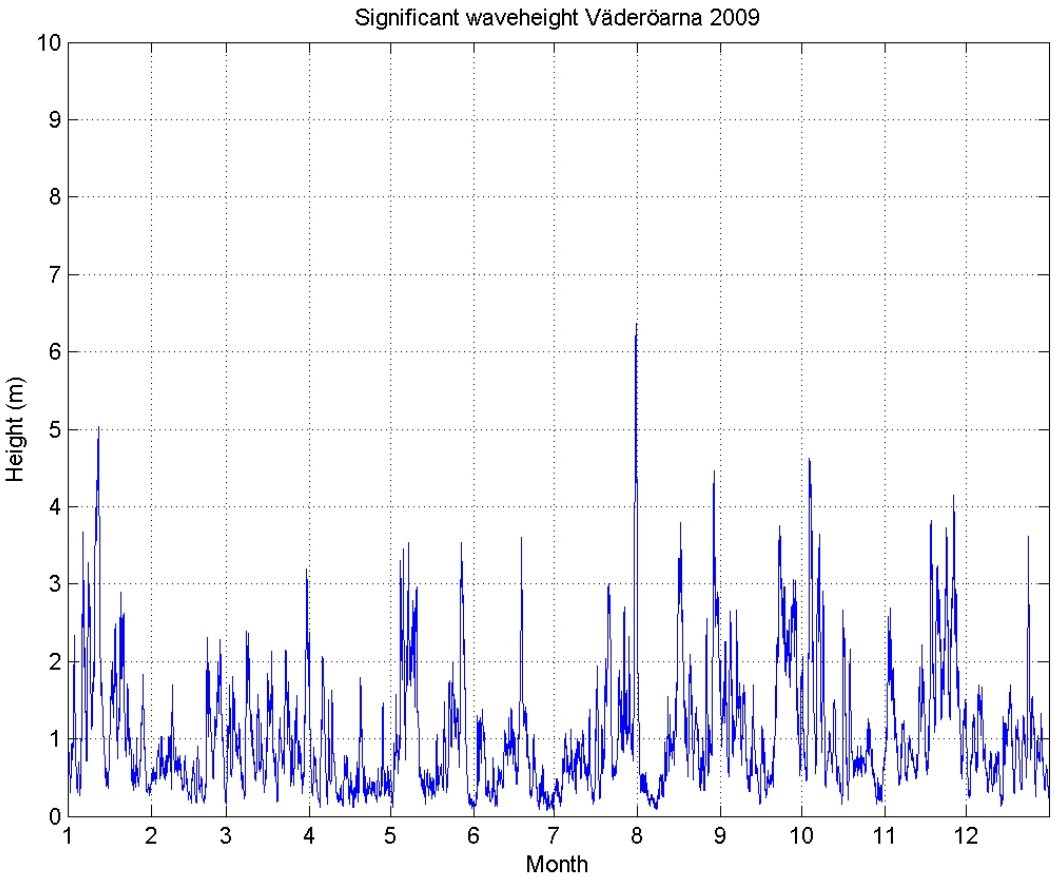

Figure 6. Time series of the significant wave height at the station Väderöarna.

Data

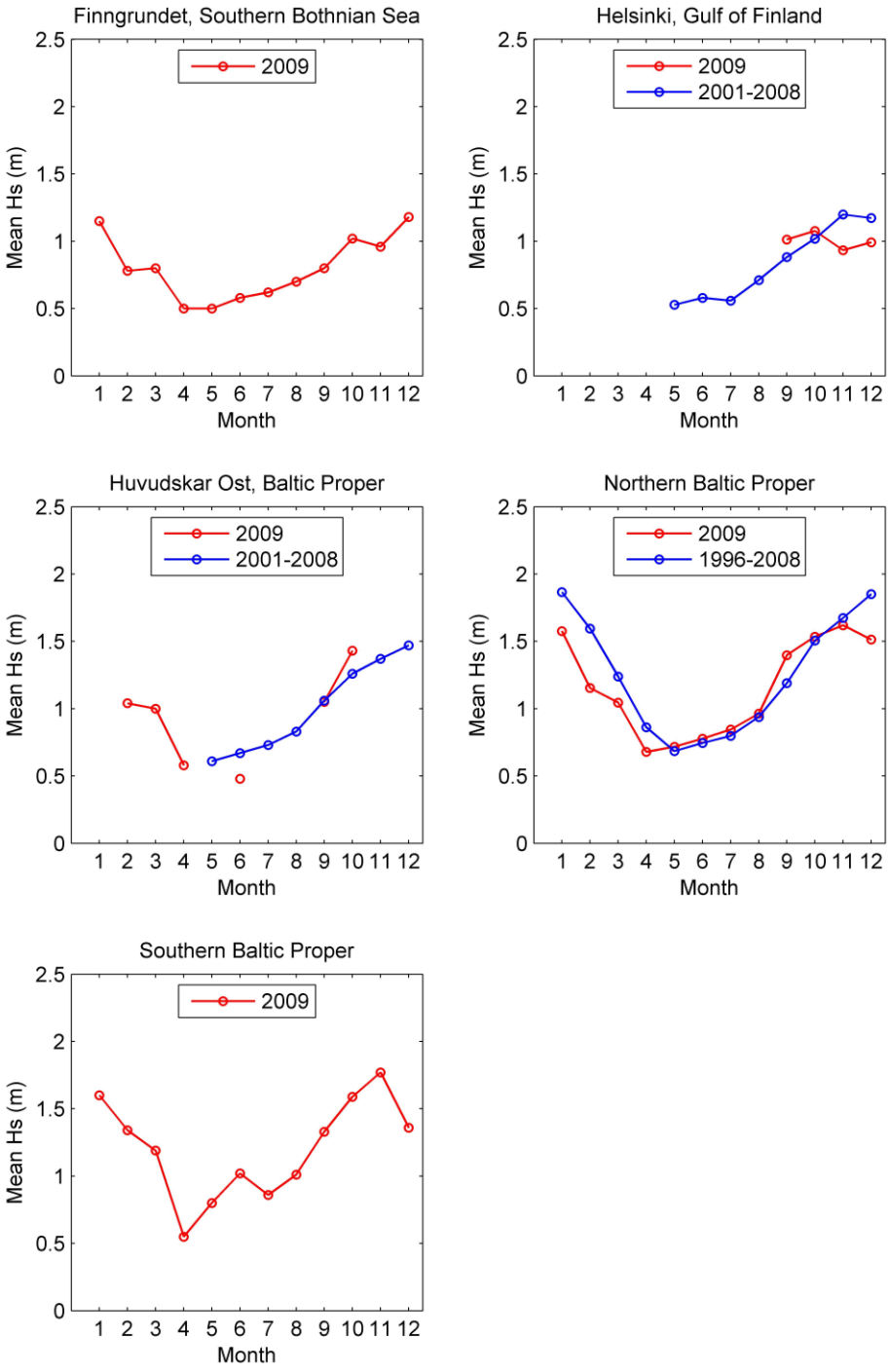

Figure 7. The monthly means of significant wave heights in the Southern Bothnian Sea, the Gulf of Finland and the Baltic Proper. In some months the long-term statistics are calculated over fewer years than indicated in the legend.

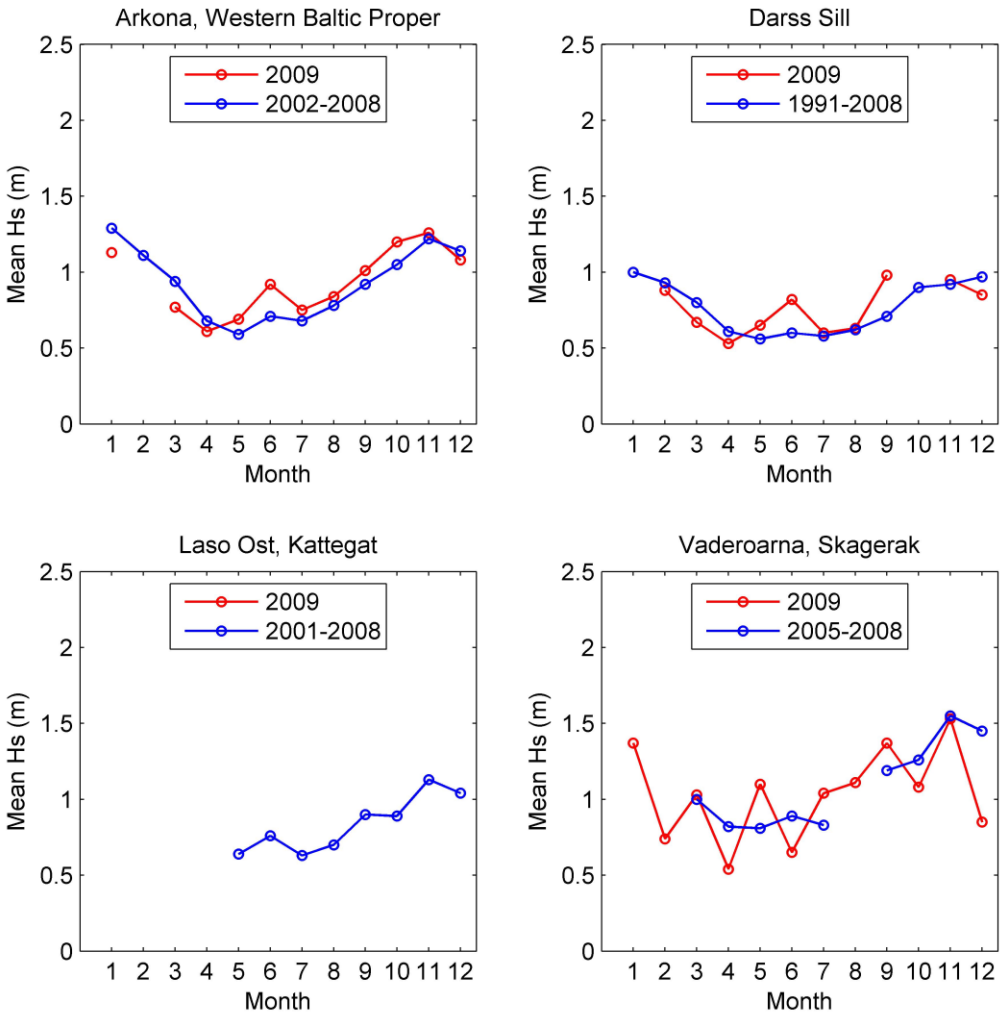

Figure 8. The monthly means of significant wave heights in the Western Baltic Proper, Kattegat and Skagerak. In some months the long-term statistics are calculated over fewer years than indicated in the legend.

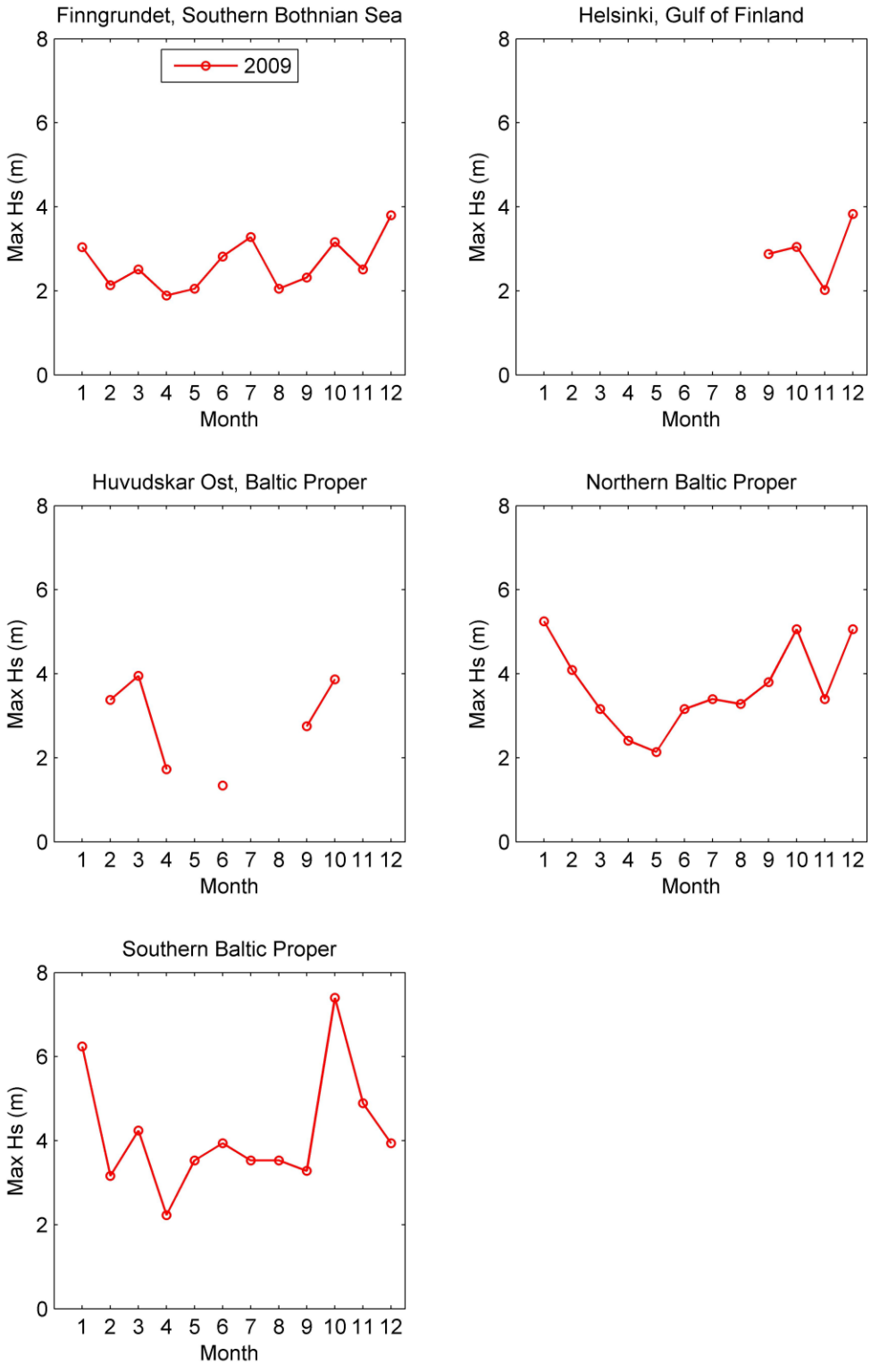

Figure 9.The monthly maxima of significant wave heights in the Southern Bothnian Sea, the Gulf of Finland and the Baltic Proper.

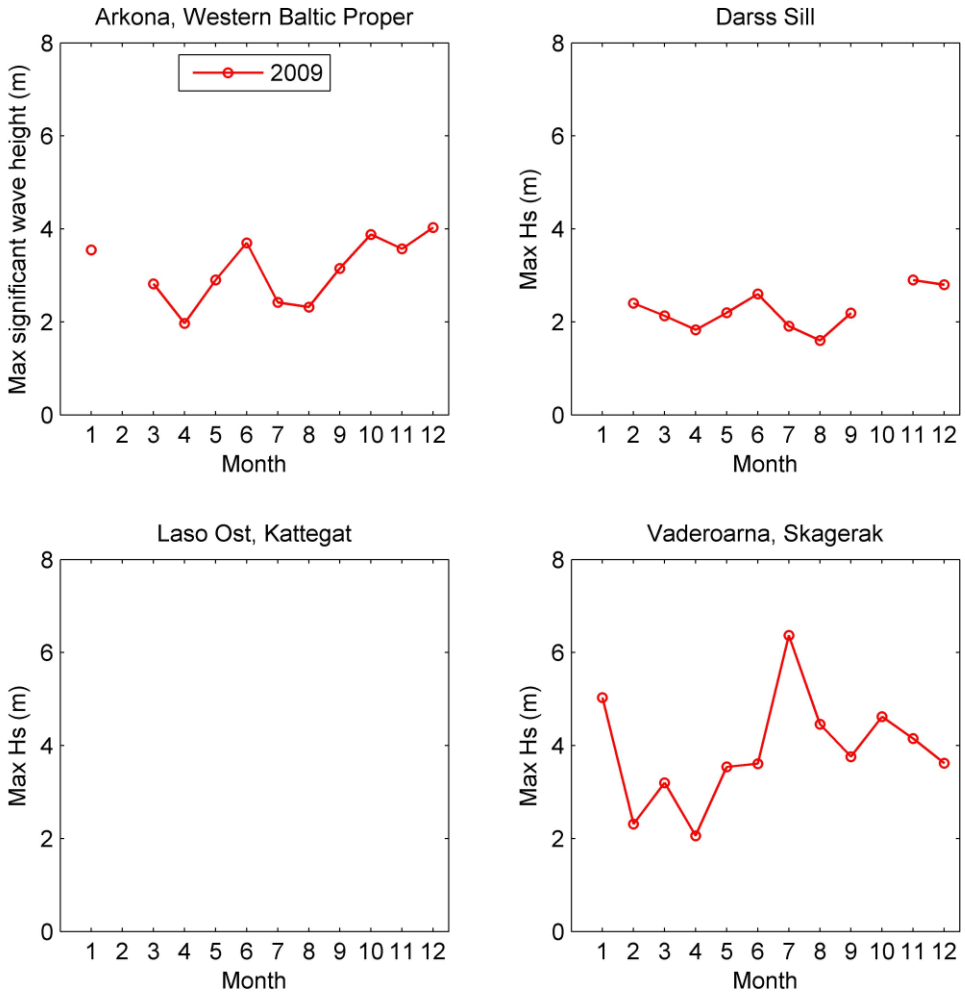

Figure 10. The monthly maxima of significant wave heights in the Western Baltic Proper, Kattegat and Skagerak.

Metadata

In 2009 Finnish Meteorological Institute (FMI) made real time wave measurements at two locations in the Baltic Sea, in the Northern Baltic Proper (station Northern Baltic Proper, 59° 15' N, 21° 00' E) and in the Gulf of Finland (station Helsinki, 59° 58' N, 25° 14' E).

The Swedish Meteorological and Hydrological Institute (SMHI) made wave measurements at five locations, in the Southern Bothnian Sea (station Finngrundet, 60° 54' N, 18° 37' E), in the Northern Baltic Proper (station Huvudskär Ost, 58° 56' N, 19° 10' E), in the Southern Baltic Proper (station Southern

Baltic, 55° 55' N, 18° 47' E), in Kattegat (station Läsö Ost, 57° 13' N, 11° 34' E) and in Skagerak (station Väderöarna, 58° 29' N, 10° 56' E).

Since 1991, wave measurements in the western Baltic Sea have been carried out at a station located at 54° 41.9'N, 12° 42.0'E in the area of Darss Sill (with GKSS Research Centre as the operator), and since 2002 at a station northwest of Cape Arkona (54° 52.9'N, 13° 51.5'E), where measurements are made by the Federal Maritime and Hydrographic Agency of Germany (BHS). Long-term climatological wave data are not yet available at the latter position. Up to now, measurement interruptions due to ice formation occurred only once, in the winter of 1995/1996, at the Darss Sill measuring station.

The waves at each station are measured with surface following buoys, Seawatch, Directional Waveriders and Waveriders. Measurements were collected app. every hour via HF link, Argos-satellite or Orbcomm system. The significant wave height is calculated onboard the buoys over 1600 s time series of surface displacement and the quality of the measurements were checked according to the routines at each of the responsible Institutes.

The lengths of the deployment periods in 2009 are indicated in the text. The length of the period at each station depends on the extent of the ice cover, maintenance and deployment logistics and possible instrument damages. As a consequence, measurements are not always available for 12 months per year for the long-term statistics. The years given in the Figures 7 and 8 indicate the start of the measurements: in some months the statistics are over fewer years but only statistics over at least four years are plotted in the Figures. Due to the variation of the length of the timeseries in statistics they should be used with caution.

For reference purposes, please cite this Baltic Sea environment fact sheet as follows:

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