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Comparison of the Meteorological Conditions between the Two Sites around Saroma-ko Lagoon*, **

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Abstract: Long term meteorological data have been collected at two sites crossing Saroma-ko Lagoon. One site is at Wakka near the second inlet, and another is at Kimuaneppu on a cape just south of Wakka station across Saroma-ko Lagoon. Time series of air temperature, wind direction, wind speed, relative humidity and global radiation are shown. Wind rose and wind direction are discussed to understand the dependency of air temperature and the difference of air temperature for the two sites. Further, the climatic sensibility is discussed along with the seasonal change in surface condition of Saroma-ko Lagoon.

要旨：サロマ湖の北と南の岸に位置するワッカとキムアネップの気象データを示し、風向別にそれらがどのような関係にあるかを調べ、サロマ湖の表面状態(結氷、開水等)の季節変化との関係を報告する。

Key words : Meteorological variables, Saroma-ko Lagoon, wind rose
キーワード :気象要素、サロマ湖、風系図

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I . Introduction

Lakes and oceans has an ability to modify the climate over the surrounding land due to its high specific heat capacity. However, if they once freeze up, the effect will become smaller due to the smaller specific heat capacity of ice. Further, since snow fallen over the ice also has the smaller specific heat capacity and high heat insulation ability, the heat stored in the water of lake and ocean would not transfer to atmosphere. In order to clarify these effects of Saroma-ko Lagoon to the climate of surrounding land, a meteorological tower was constructed at Wakka and the meteorological data from the tower was compared with the data from the meteorological tower set up by Saroma Research Center of Aquaculture at Kimuaneppu. The Wakka site is located just north of Kimuaneppu site across the Lagoon. The comparison of the meteorological parameters at both sites would show the effect of water in Saroma-ko Lagoon and the Okhotsk Sea.

II . Observation

The Wakka site is located near the second inlet of Saroma-ko Lagoon on the sandbank between Saroma-ko Lagoon and Okhotsk Sea (Fig. 1). The Kimuaneppu site is located just 4.5km south of Wakka site across the Saroma-ko Lagoon. The meteorological tower at the Wakka site was set up on the temporarily-built watch hut. The height of the hut's roof is 3 m and the height of the tower from the ground was about 5.5m. The height of wind vane is at 5.5 m from the ground, and the height of hygrothermometer is at 5 m from the ground. The observation system and the data taken are reported by Shirasawa et al. (1997). The observation at Wakka site started since January 1995 and it is currently in operation. The data used in this analysis is from January 1995 to November 1998. The data of the same period was used for Kimuaneppu site.

III. Results

The hourly data was used for this analysis except that the 10-minute interval data was used for Kimuaneppu in Figs. 2 and 6. The missing data were shown as blank.

III-1. Annual variation of meteorological parameters

Time series of daily mean air temperature, daily prevailing wind direction, daily mean wind speed, daily mean relative humidity (only for Wakka) and daily integrated global radiation (only for Kimuaneppu) from 1995 to 1998 are shown in Fig. 2 for Wakka (left) and Kimuaneppu (right). Air temperatures at the both sites were fluctuated almost in the same manner. The minimum air temperature of about −15℃ occurred at the end of February and the maximum temperature at the end of July except in 1998, which was at the end of August. The inter-annual difference is small. In autumn, wind blows most frequently from south, in winter from south and northwest, and in spring and summer from south, northwest and northeast. Wind speed is larger in winter and smaller in summer. Relative humidity at Wakka from May to August is higher when compared to other months. Global radiation at Kimuaneppu is the largest at the end of June and the smallest at the end of December, and it is relatively smaller on some days in August and September.

III-2. Monthly wind rose

Monthly frequency distribution for wind direction is shown in Figs. 3 for Wakka (left) and Kimuaneppu (right). The data are integrated for the period from 1995 to 1998 and missing January 1996 at Wakka. Northwest is the most prevailing wind direction and South is the second from November to March. From April to July, northeasterly wind is added as the thirdly frequent wind direction. From August to November, southerly wind is prevailing.

III-3. Monthly mean air temperature with wind direction

Mean air temperature for each wind direction is shown monthly averaged for the period from 1995 to 1998 in Fig. 4. The data are missing from December 1995 to June 1996 for Wakka and from February to March 1997 for Kimuaneppu. Note that the number of the data averaged for obtaining the mean air temperature for each wind direction are different and the reliability of the "mean" is different. From December to February, northerly wind is warmer than the other wind directions for both site. It might be due to the warmer water temperature of the ice-free Okhotsk Sea than the land. From March to August, air temperature is lower for northerly wind and higher for southerly wind than the other wind directions for both sites. No apparent difference was found from September to November.

III-4. Monthly air temperature difference with wind direction

The difference in air temperature between the two sites is shown monthly as a function of wind direction in Fig. 5. The one case is shown in frequency (%) as Wakka is warmer than Kimuaneppu; another is as Kimuaneppu is warmer than Wakka. For example, in January for southeasterly wind, 5% of the total number of air temperature compared was warmer at Kimuaneppu than at Wakka, and 3% was warmer at Wakka than at Kimuaneppu. Wind direction at Wakka was used for this analysis. The data is missing from December 1995 to June 1996 and from February 1997 to March 1997.

From November to January, Kimuaneppu is much frequently warmer than Wakka for westerly winds, and Wakka is much frequently warmer than Kimuaneppu for southeasterly winds. In February and March, for northwesterly winds, the frequency is equivalent for both sites, but for southeasterly winds, much frequently warmer at

Kimuaneppu. From April to June, Kimuaneppu is much frequently warmer than Wakka for all wind directions. In July, there is no big difference with wind direction, and from August to October, Wakka is much frequently warmer than Kimuaneppu for southeasterly winds.

III-5. Time series of climatic sensitivity

Figure 6 shows the time series of climatic sensitivity at Wakka (solid line) and Kimuaneppu (broken line). The data is shown as 10-day running mean. The climatic sensitivity is defined as the ratio of daily air temperature amplitude to the clearness index. The clearness index is defined as the ratio of daily sum of global radiation observed at Kimuaneppu to the daily sum of extraterrestrial radiation. If the weather is clear for all day long, the clearness index is about 0.8, depending on the turbidity of the atmosphere, and for cloudy day, it is closed to 0. The climatic sensitivity defined here indicates how much air temperature rises for a unit increase of clearness index. Since a rise of air temperature depends on the surface temperature increase, the seasonal change in surface condition of Saroma-ko Lagoon, i.e. open water or ice-cover, would affect the climatic sensitivity surround the Lagoon.

We can find from Fig. 6 that the climatic sensitivity at Kimuaneppu is larger than Wakka. It would be suggested that the air temperature at the Kimuaneppu site is affected mainly by the lagoon water while the air temperature at Wakka is substantially influenced by both lagoon and Okhotsk Sea waters, where is located on the sandbank between the lagoon and Okhotsk Sea. In March and April, the climatic sensitivity for both sites is smaller when compared with other months. This is due to the snowmelt in these months when the snow surface temperature is kept to 0℃.

IV. Summary

The meteorological parameters at two sites around Saroma-ko Lagoon were compared in order to clarify the influence of the lagoon to the surrounding climatic conditions. We could find the dependency of air temperature and air temperature difference in wind direction between Wakka and Kimuaneppu sites, which would be influenced by the water and ice (and snow) of Saroma-ko Lagoon. The climatic sensitivity was higher at Kimuaneppu than at Wakka, which showed that the Wakka site was influenced by both lagoon and Okhotsk Sea waters.

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References

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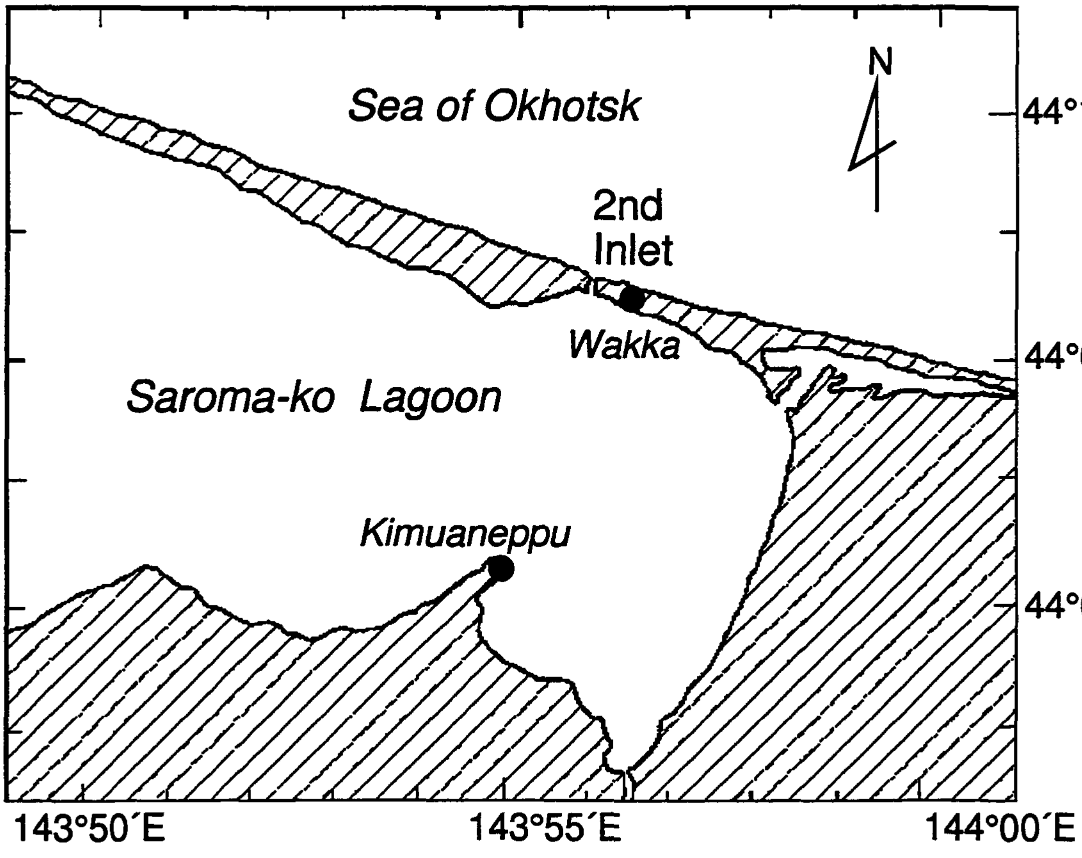


Fig. 1 Observational site around Saroma-ko Lagoon.

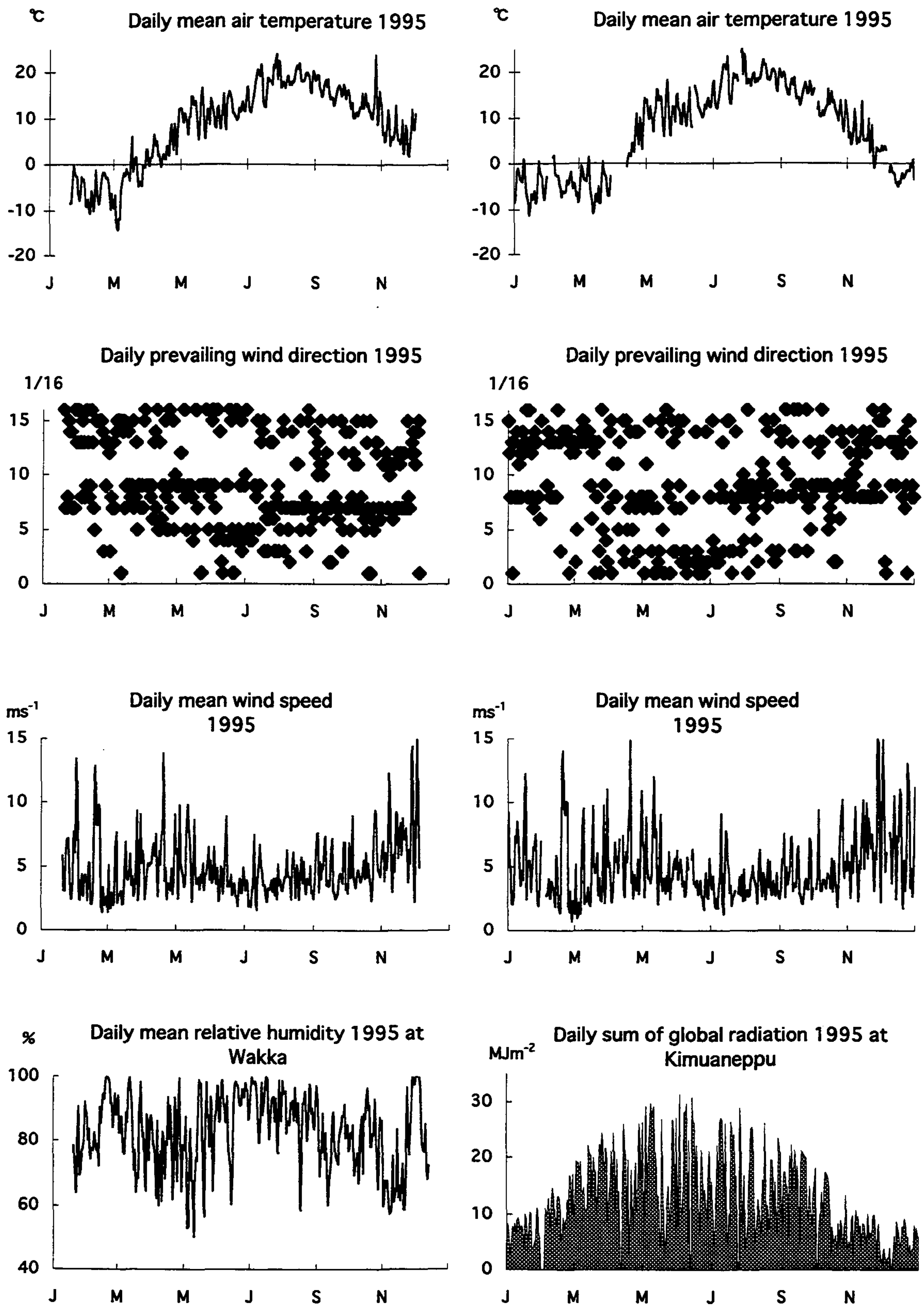
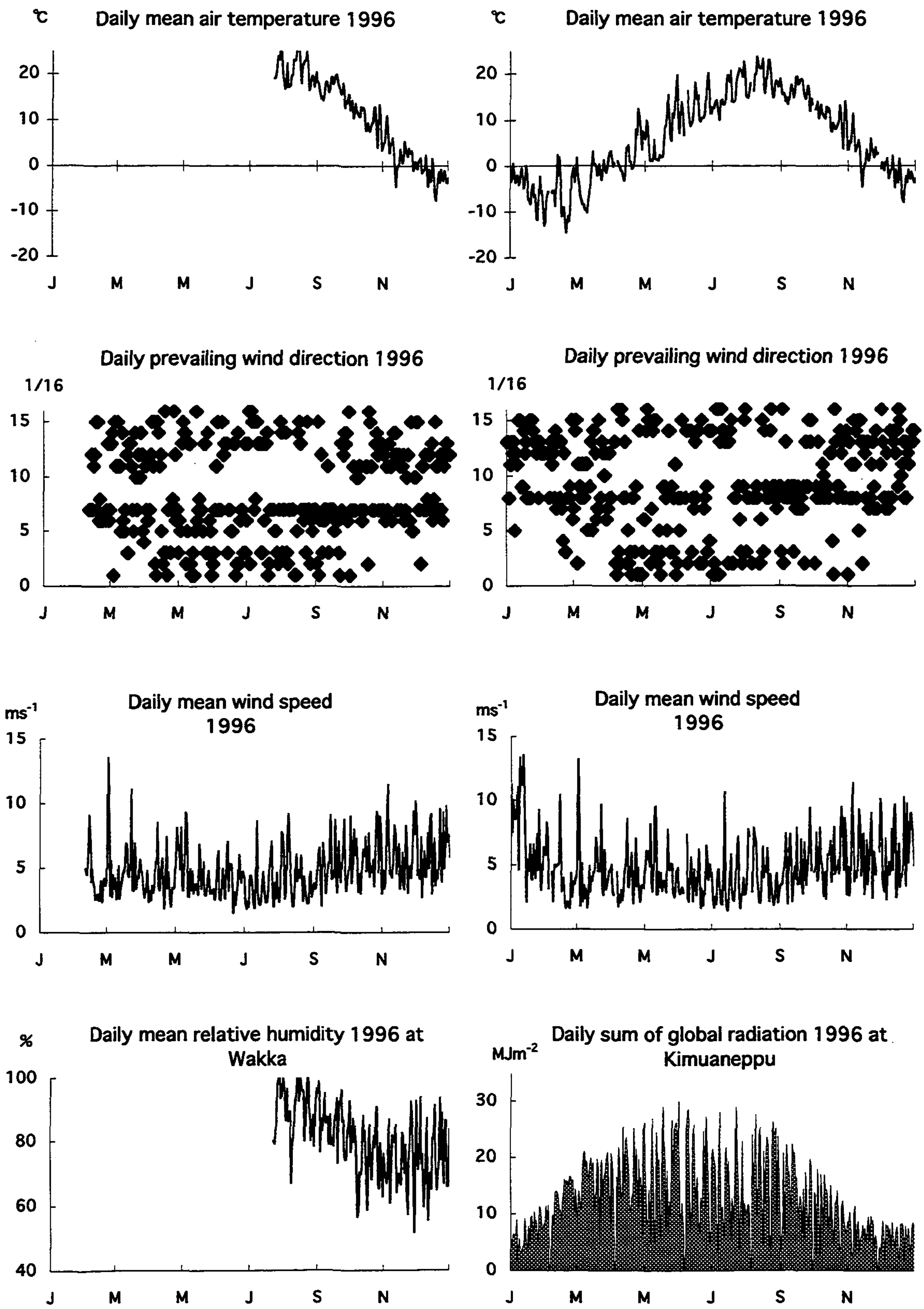


Fig. 2 Time series of air temperature, wind direction, wind speed, relative humidity (only for Wakka) and global radiation (only for Kimuaneppu) obtained at Wakka station (left) and Kimuaneppu (right) for the period from 1995 to 1998.


℃
Daily mean air temperature 1996
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J M M J S N
℃
Daily mean air temperature 1996
20
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0
-10
-20
J M M J S N
Daily prevailing wind direction 1996
1/16
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5
0
J M M J S N
Daily prevailing wind direction 1996
1/16
15
10
5
0
J M M J S N
ms-1
Daily mean wind speed 1996
15
10
5
0
J M M J S N
ms-1
Daily mean wind speed 1996
15
10
5
0
J M M J S N
%
Daily mean relative humidity 1996 at Wakka
100
80
60
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Daily sum of global radiation 1996 at Kimuaneppu
30
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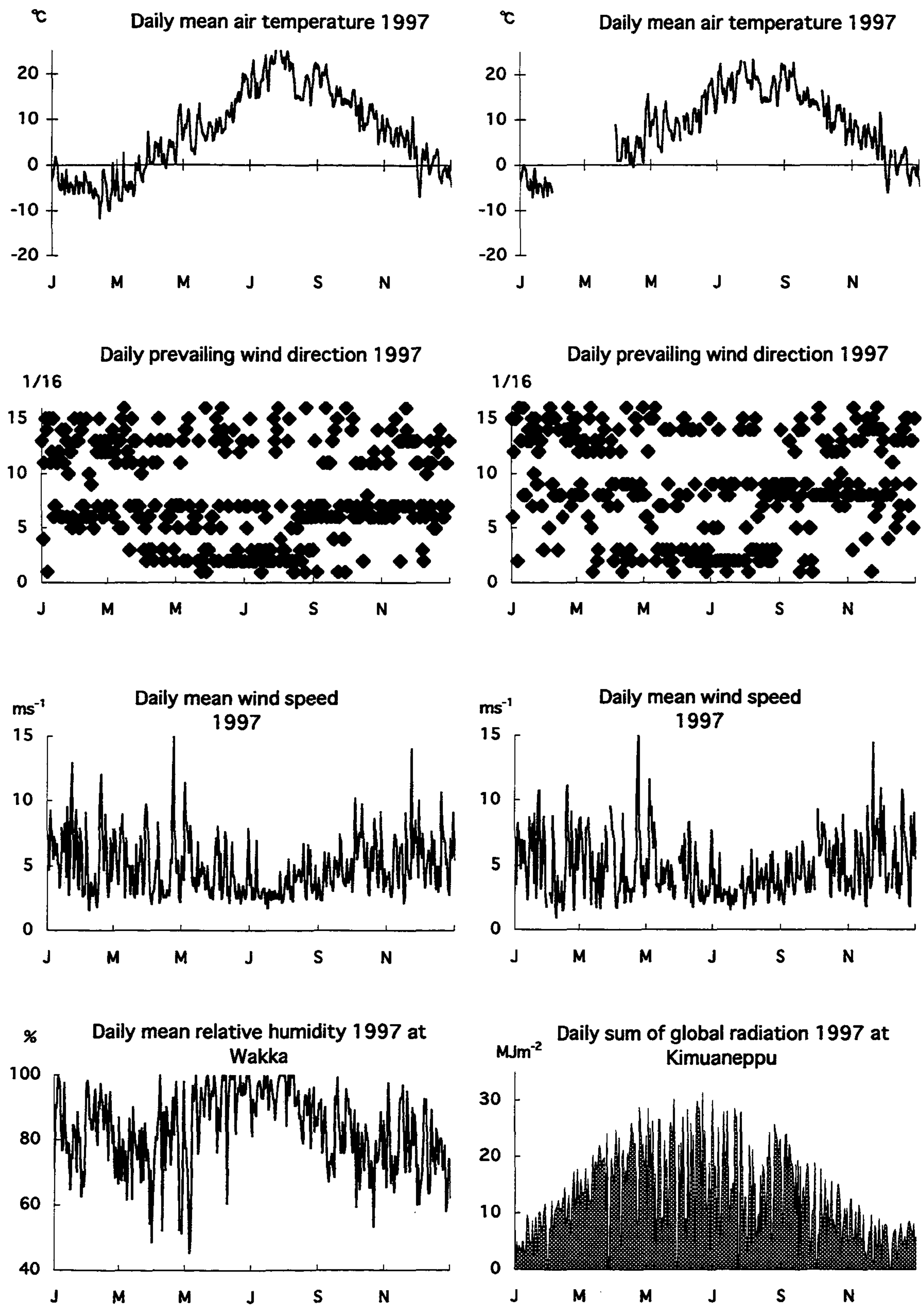
J M M J S N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Daily mean air temperature 1997
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Daily mean air temperature 1997
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J M M J S N
Daily prevailing wind direction 1997
1/16
15
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J M M J S N
Daily prevailing wind direction 1997
1/16
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0
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Daily mean wind speed 1997
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Daily mean wind speed 1997
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Daily mean relative humidity 1997 at Wakka
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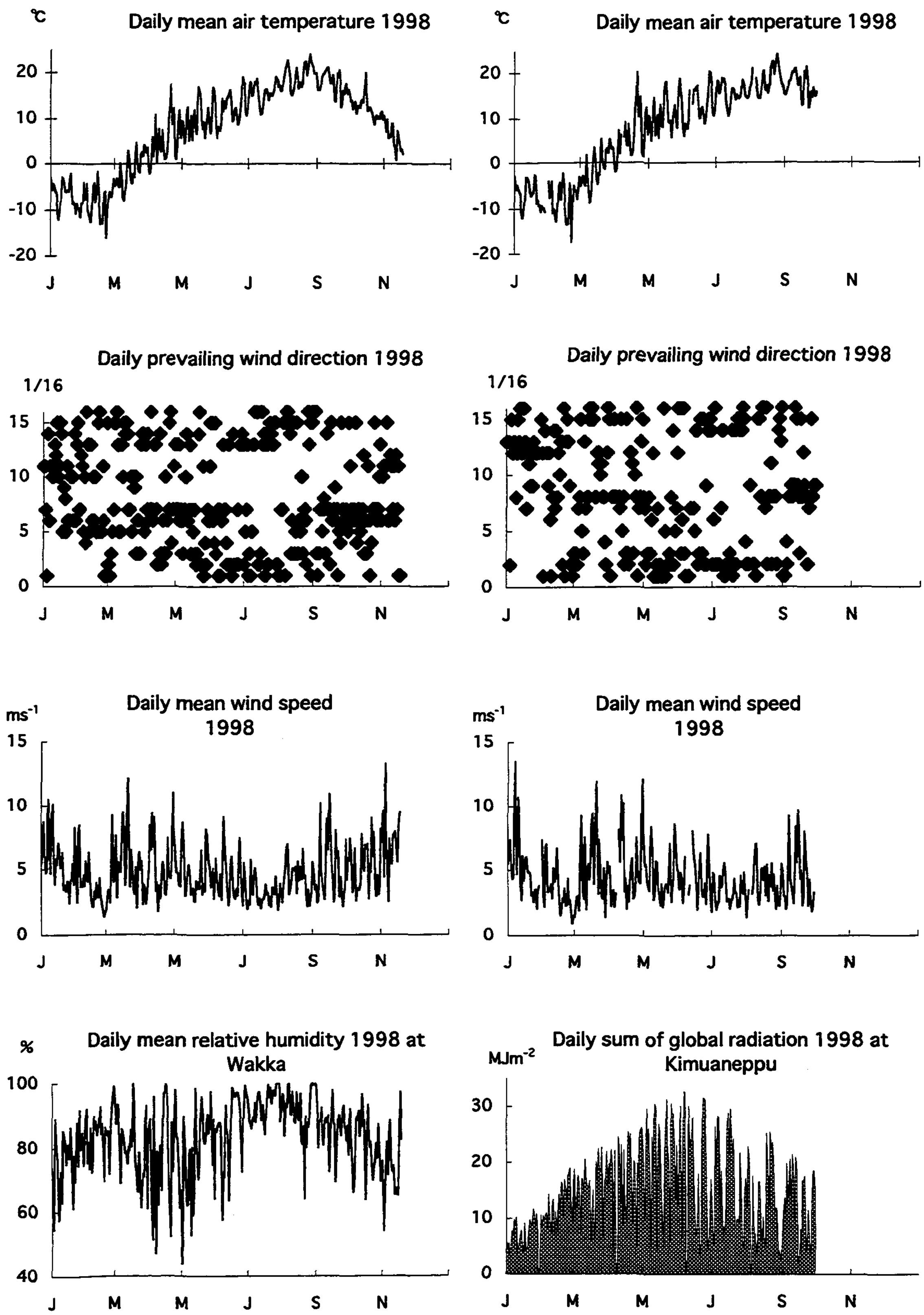
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Daily prevailing wind direction 1998
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Daily mean wind speed 1998
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Daily mean relative humidity 1998 at Wakka
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Daily sum of global radiation 1998 at Kimuaneppu
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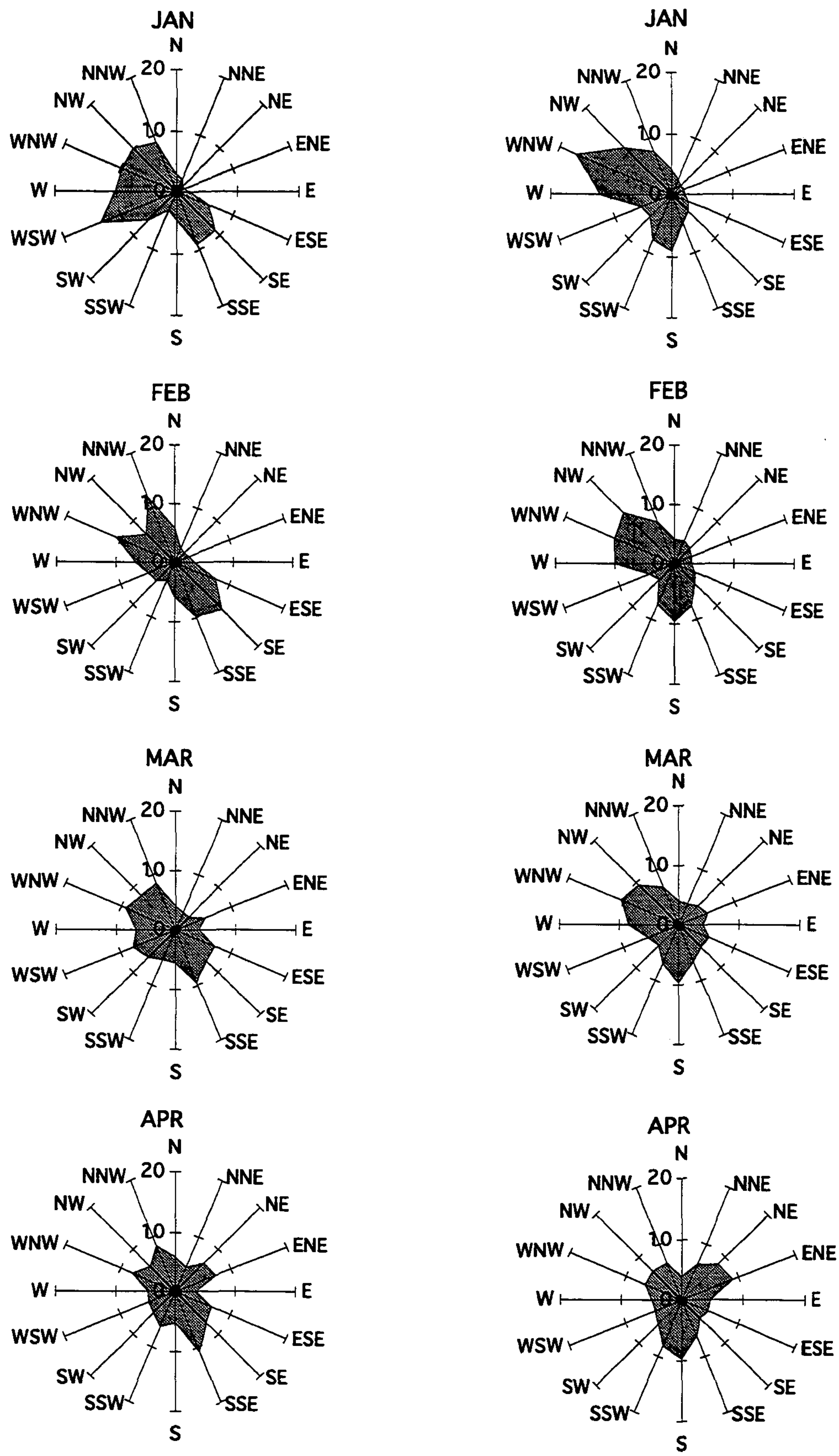
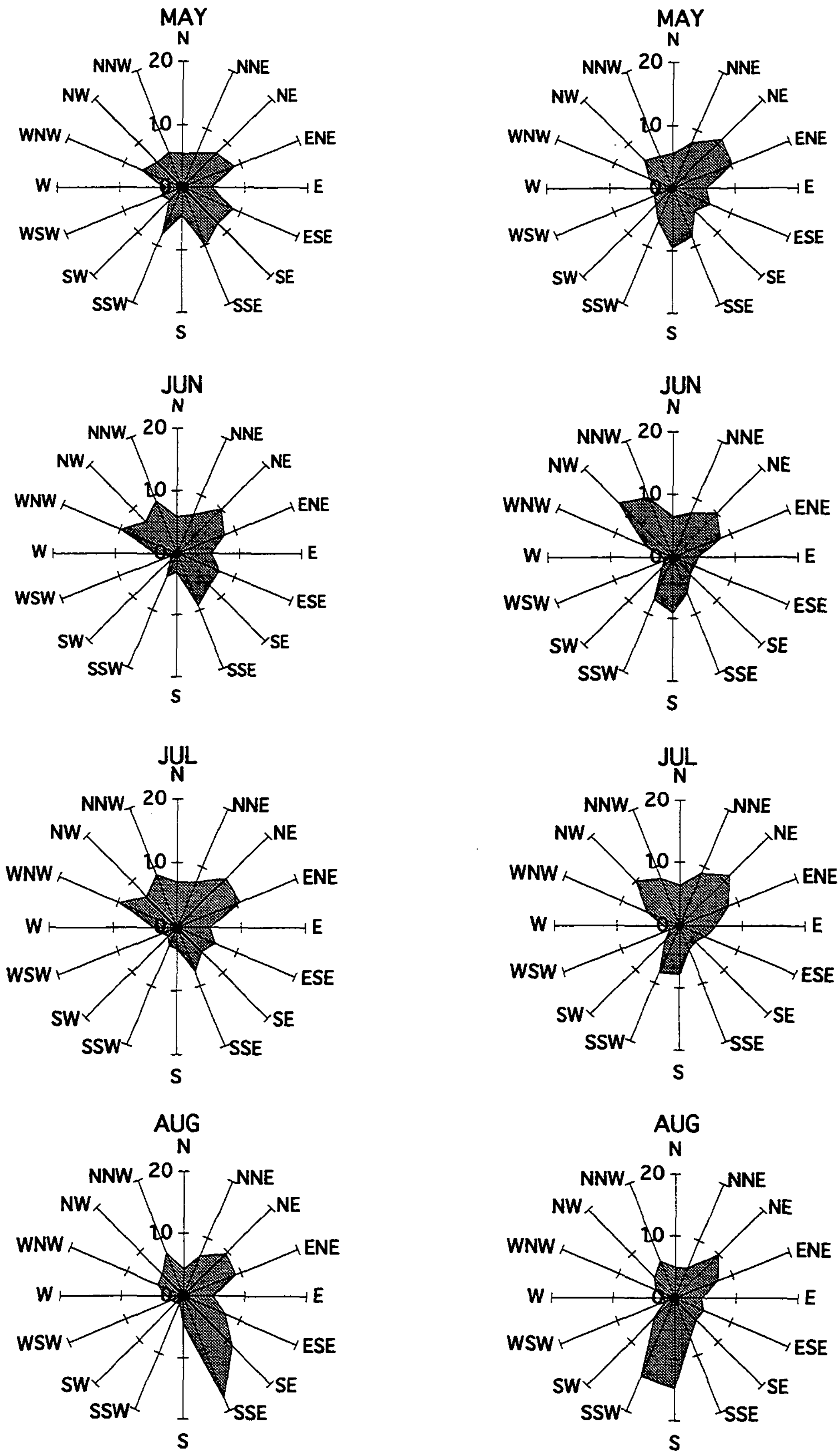


Fig. 3 Monthly wind rose (%) at Wakka (left) and Kimuaneppu (right) integrated for the period from 1995 to 1998.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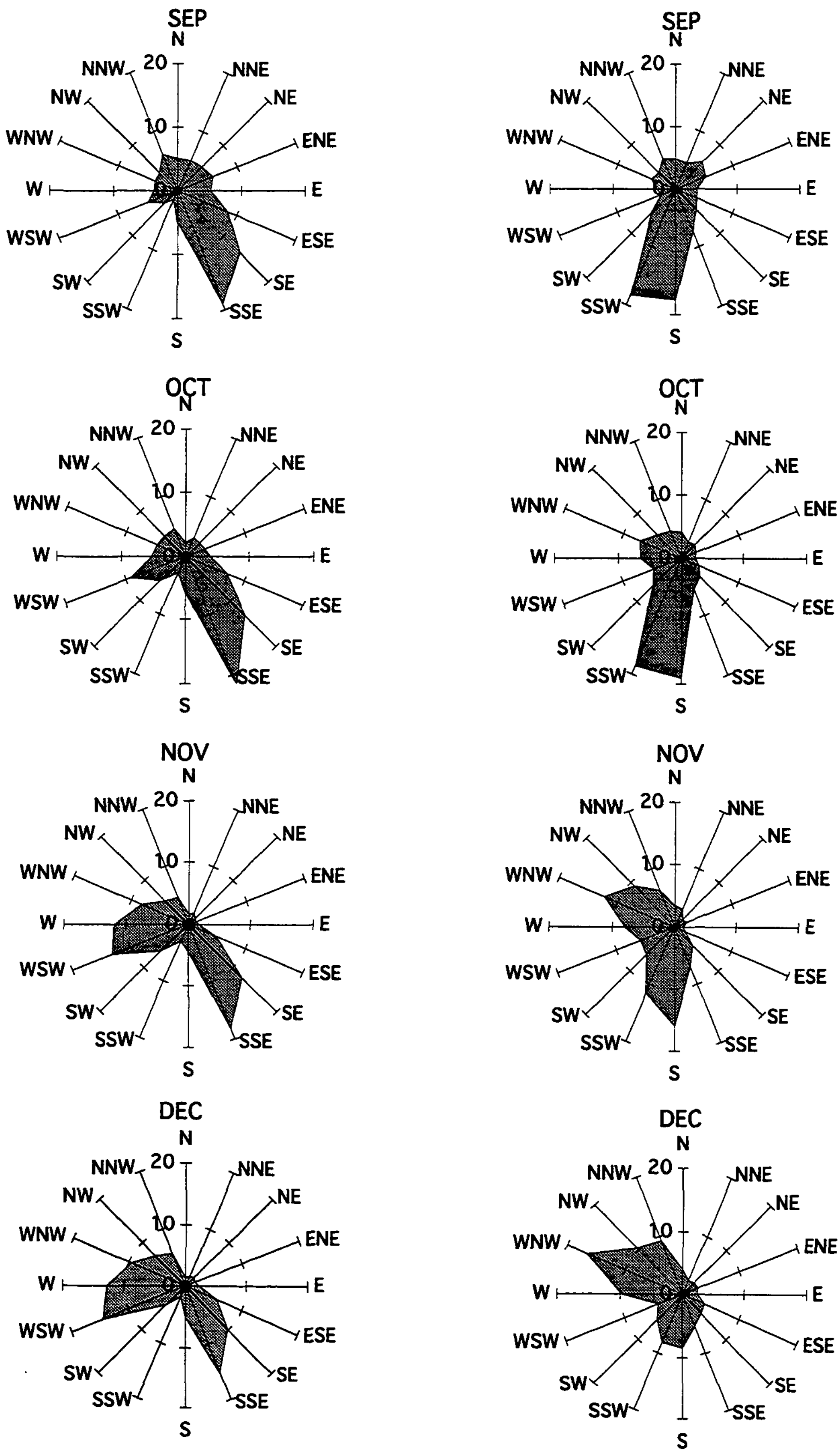
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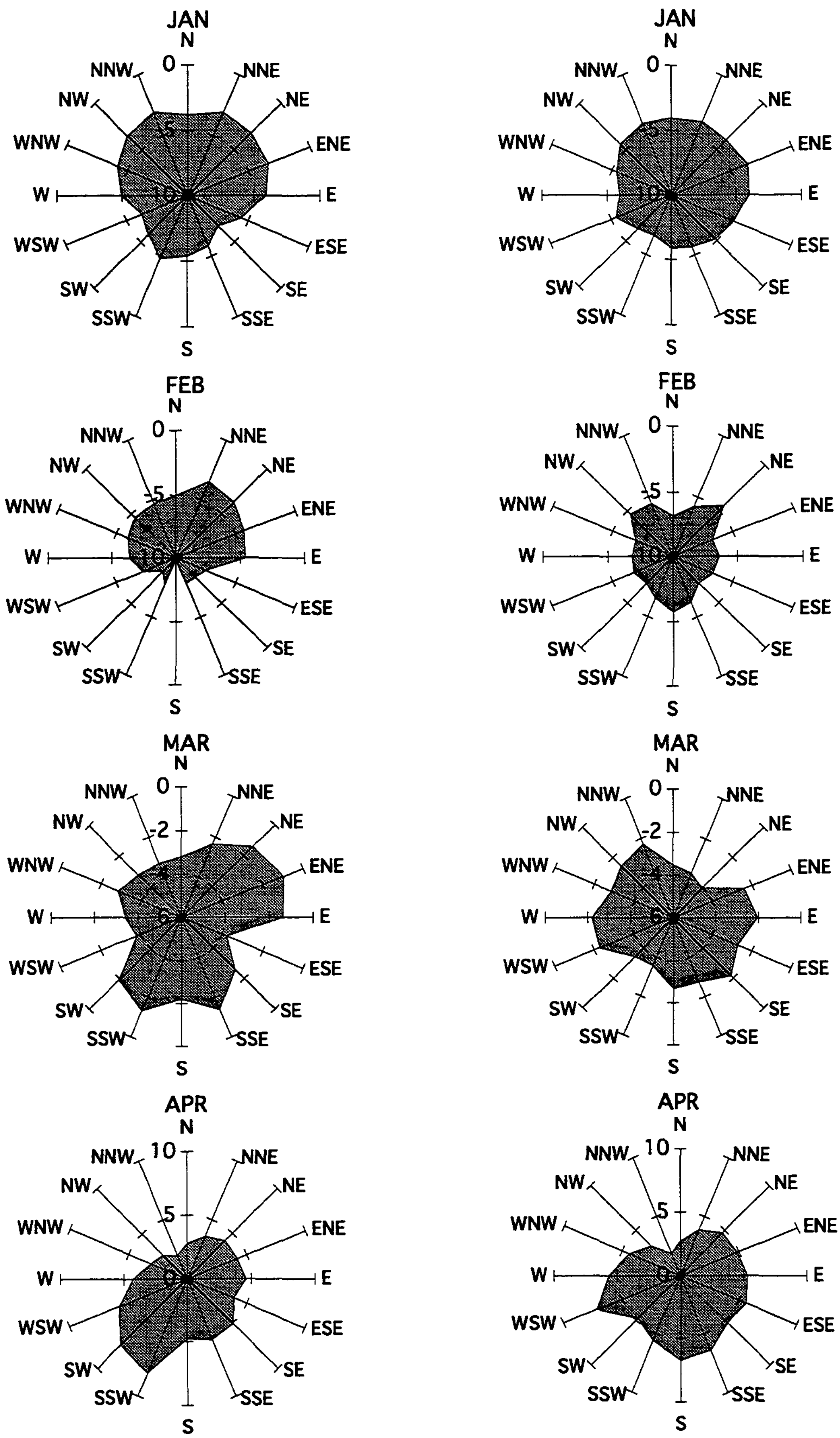
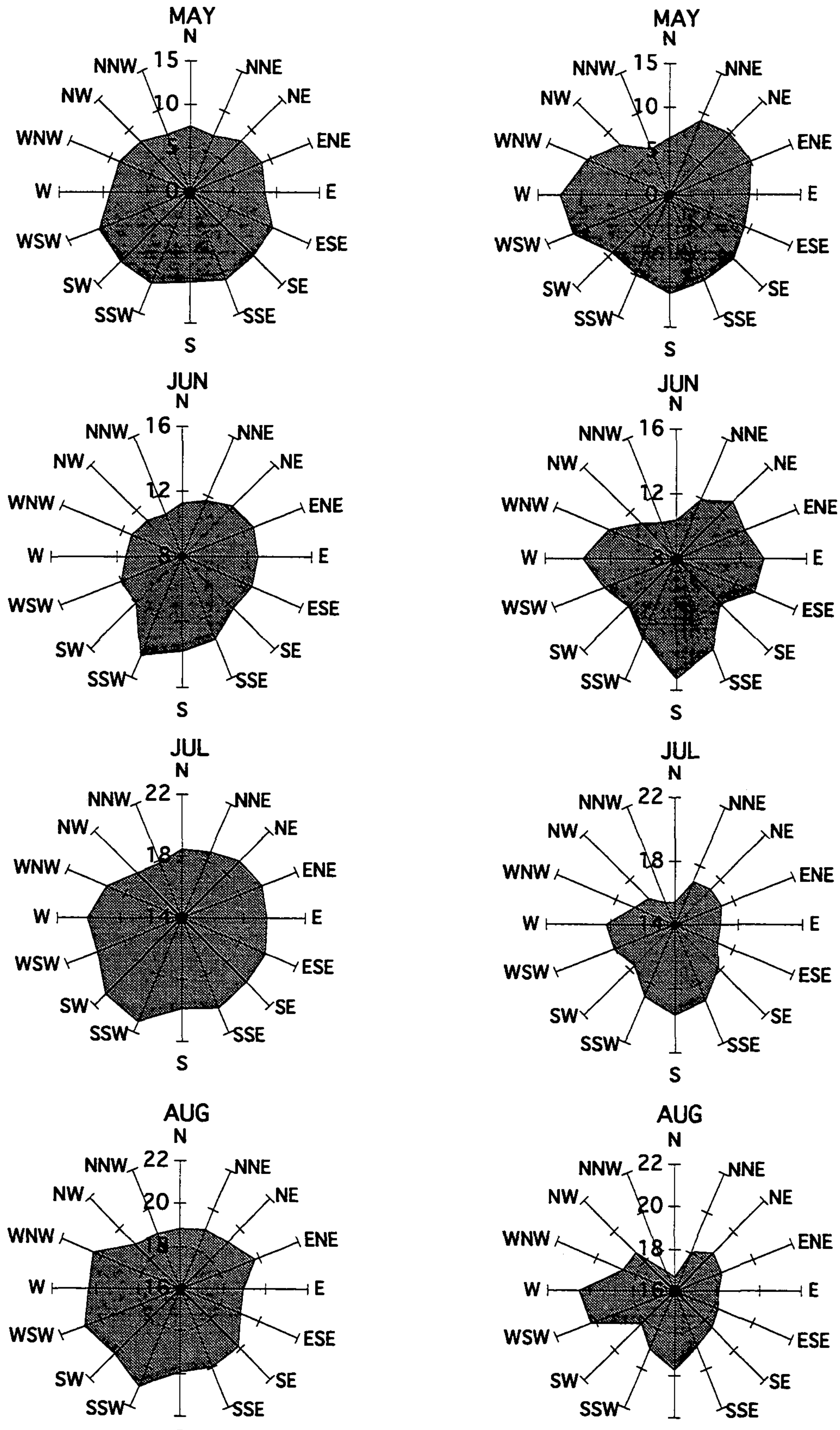


Fig. 4 Monthly wind direction dependency of air temperature (℃) at Wakka (left) and Kimuaneppu (right) averaged for the period from 1995-1998.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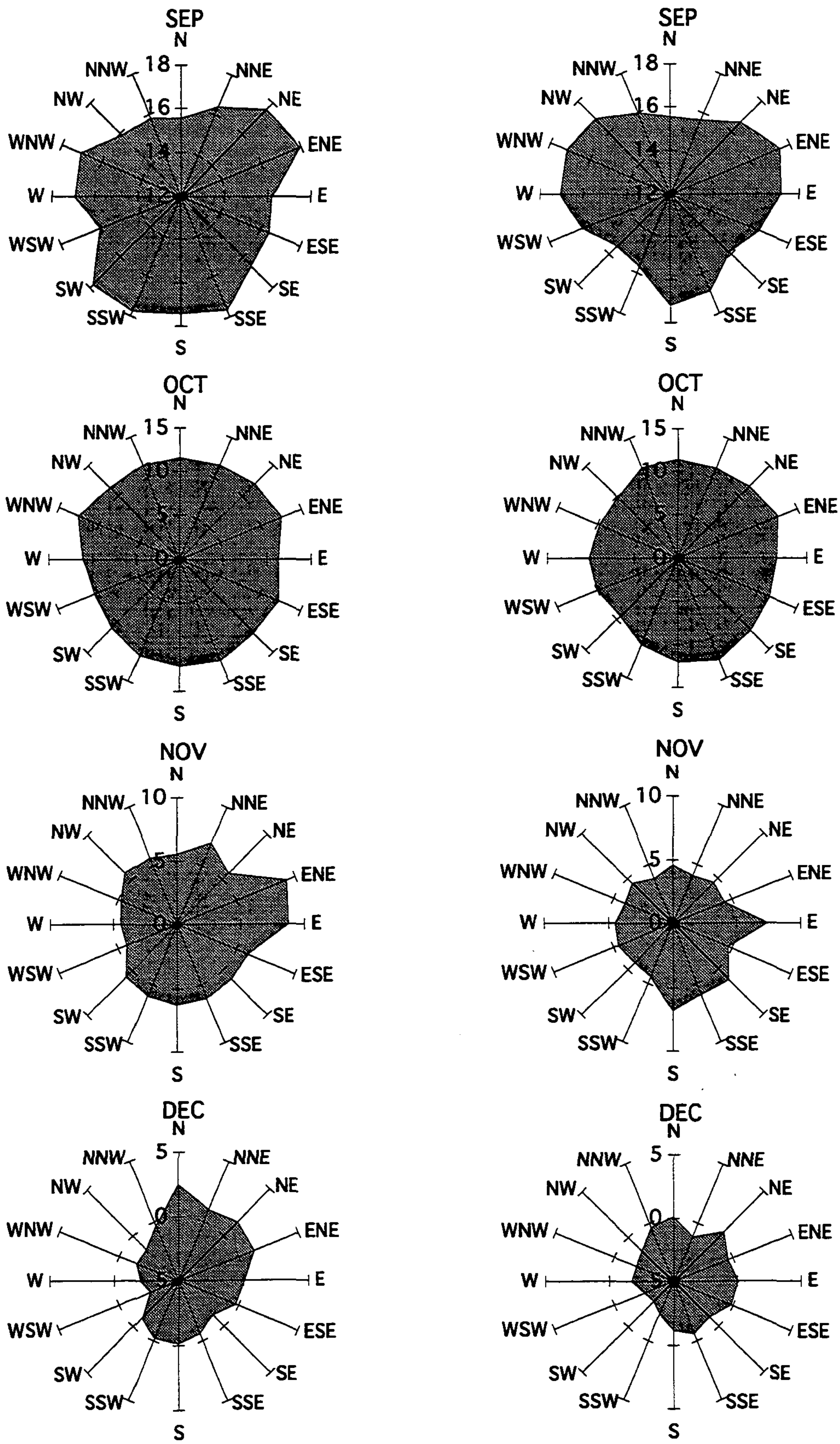
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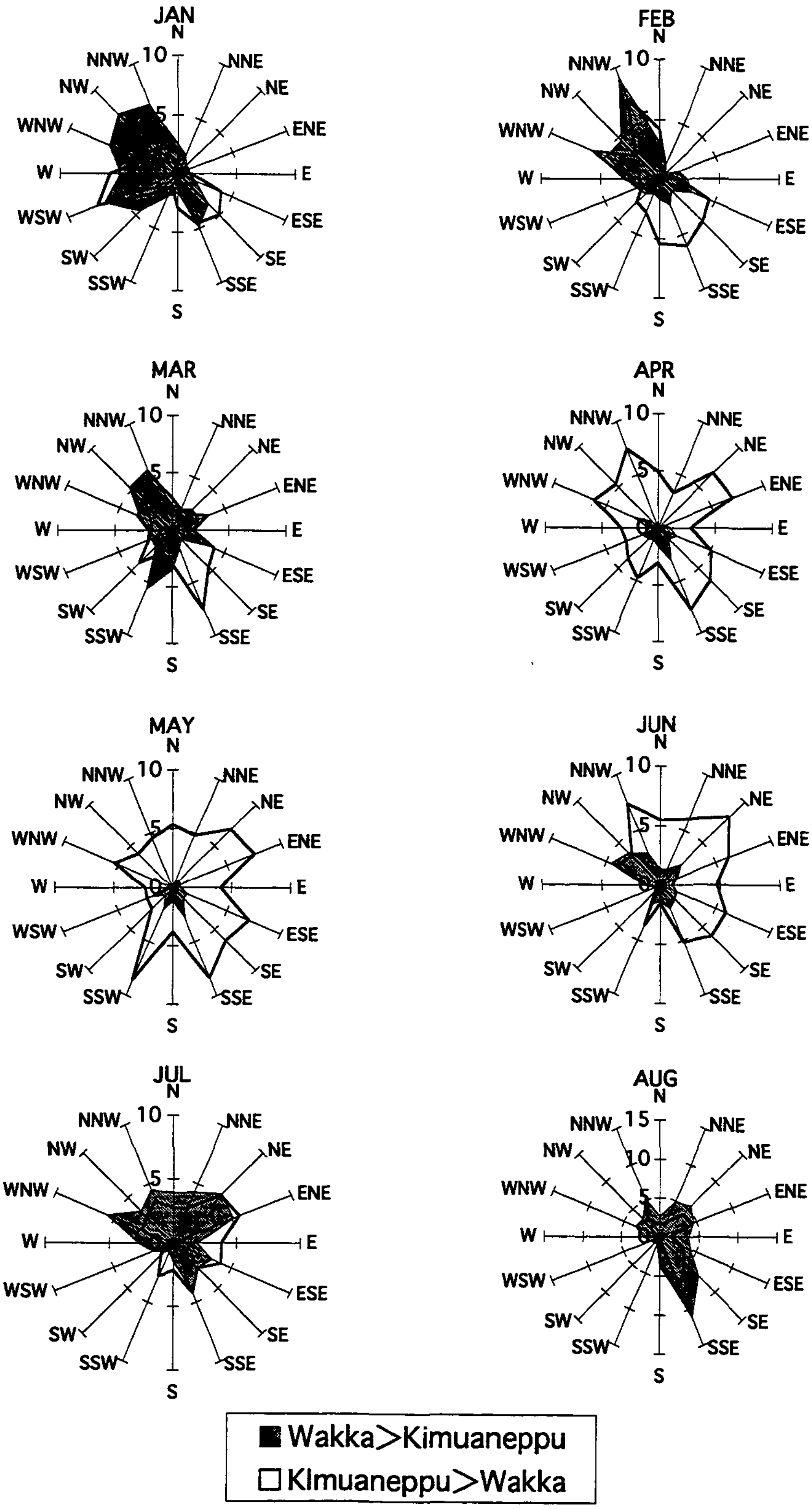
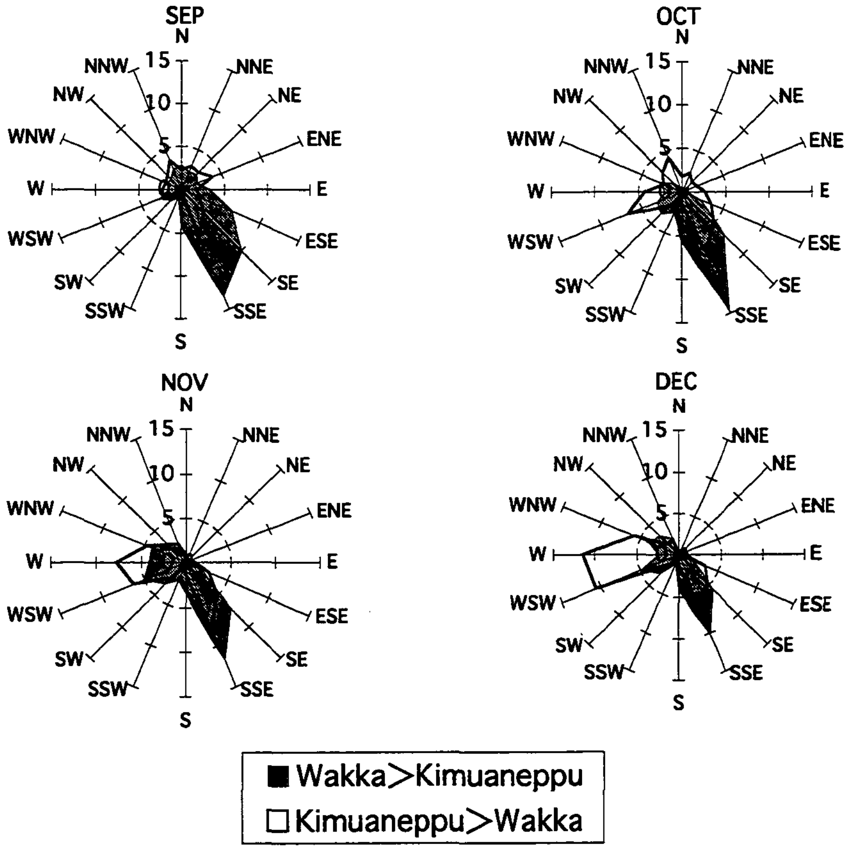


Fig. 5 Monthly wind direction dependency of frequency of the higher air temperature at Wakka (solid line) and the higher air temperature at Kimuaneppu (broken line) integrated for the period from 1995 to1998. The wind direction is the one observed at Wakka.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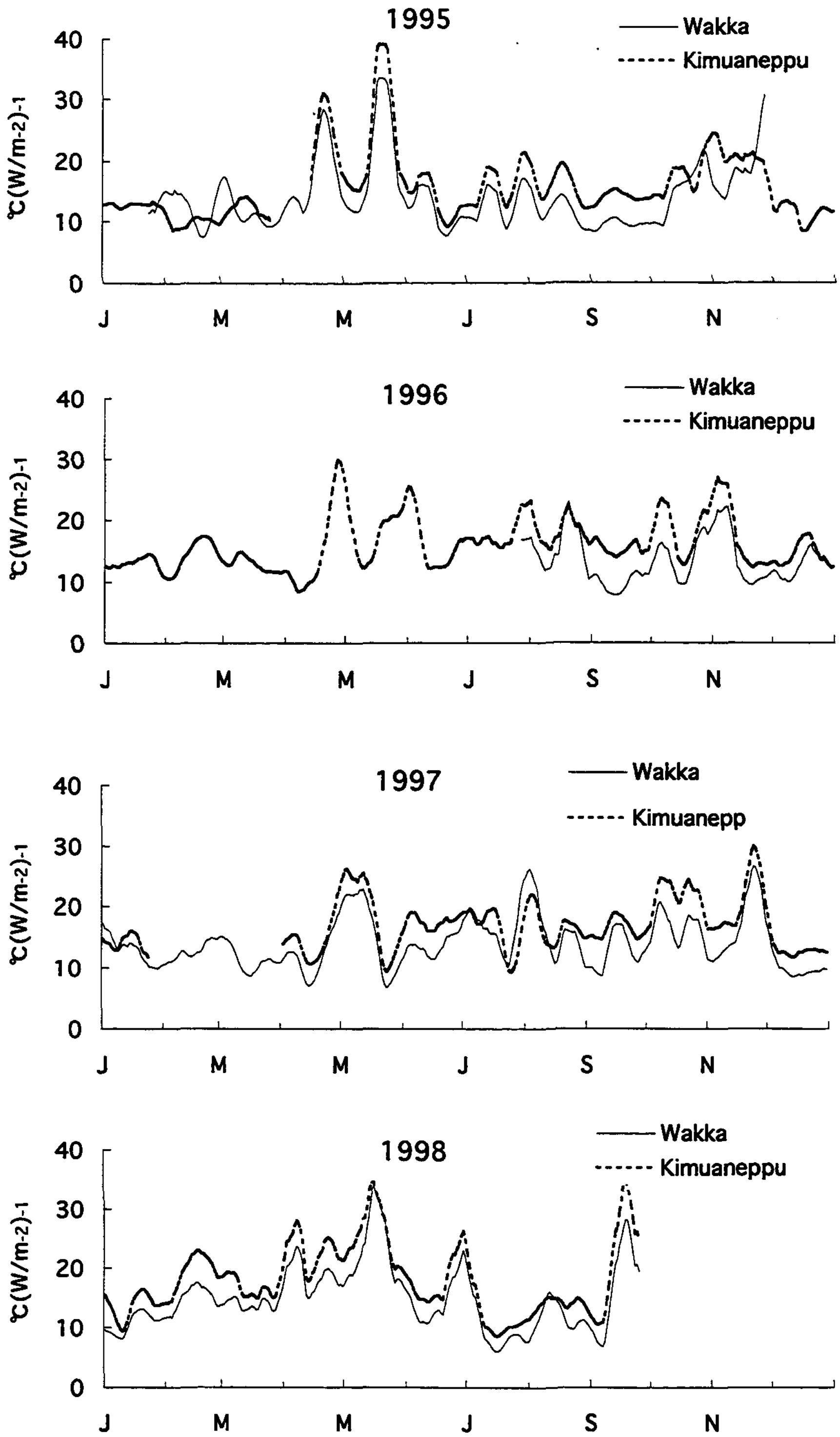

Fig. 6 Time series climatic sensitivity of at Wakka (solid line) and Kimuaneppu (broken line) for the years from 1995 to 1998.

(Climatic sensitivity; the ratio of daily air temperature amplitude to the clearness index. The clearness index is the ratio of the daily global radiation to the extraterrestrial radiation.