

Impact of Wind on the Spatio-Temporal Variation in Concentration of Suspended Solids in Tonle Sap Lake, Cambodia

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Inverse distance weighted (IDW)

IDW interpolation implements a basic law of geography; i.e. things that are close to one another are more alike than things that are far apart. To predict a value for any unmeasured location, IDW uses the measured values surrounding the predicted location. As the distance approaches zero, the relative weight approaches one. This method basically depends on estimating the height of the unknown points "Z(x, y)" by computing the distances from this point to the other known points, as it mathematically clarified by the following;

$$Z(x, y) = \frac{\sum_{i=1}^n \left[\frac{Z_i}{d_i^p} \right]}{\sum_{i=1}^n \left[\frac{1}{d_i^p} \right]} \quad (1.1)$$

$$Z(x, y) = \sum \lambda_i \times Z_i \text{ where } \sum \lambda_i = 1 \quad (1.2)$$

Appendix 1 – Methodology for wind data interpolation

$$d_i = \sqrt{(x_i - x)^2 + (y_i - y)^2} \quad (1.3)$$

where: " $Z(x, y)$ " is the predicted value at the ensample location x, y , " i " is the number of measured sample points within the neighborhood defined, " Z_i " is the observed value at location " i ", d_i is the distance between the predicted location x, y and the measured location " i ", λ_i is the distance-dependent weight associated with each sample point; and " p " is the power parameter that defines the rate of reduction of the weight as distance increases. Based on previous research, the IDW interpolation is proved successful over other adopted interpolation methods (Ali et al., 2012).

Vectorized average

The average of wind speed and direction was calculated by converting rectangular coordinates to polar coordinates as shown in eq. (3.4). Finally, the averaged values were returned to the values of rectangular coordinates for each observation data.

$$(W, \theta) \rightarrow (W \cos \theta, W \sin \theta) \quad (1.4)$$

Inverse of ratio of distance

Vector synthesis of polar coordinates of wind speed and direction from three observation points was done by considering the effect of distance between interpolated and observed points. The distance between the interpolated and each observation point was calculated by eq. 1.5, and the inverse value was calculated by eq. 1.6.

Appendix 1 – Methodology for wind data interpolation

$$\left(\frac{d_1}{d_1 + d_2 + d_3}, \frac{d_2}{d_1 + d_2 + d_3}, \frac{d_3}{d_1 + d_2 + d_3} \right) \xrightarrow{\text{Inverse}} \left(\frac{d_1 + d_2 + d_3}{d_1}, \frac{d_1 + d_2 + d_3}{d_2}, \frac{d_1 + d_2 + d_3}{d_3} \right) \quad (1.5)$$

$$\mathbf{W} = \left(\frac{d_1 + d_2 + d_3}{d_1} \right) \times \mathbf{W}_1 + \left(\frac{d_1 + d_2 + d_3}{d_2} \right) \times \mathbf{W}_2 + \left(\frac{d_1 + d_2 + d_3}{d_3} \right) \times \mathbf{W}_3 \quad (1.6)$$

where d_1, d_2, d_3 are the distance between the interpolated and observed points, and \mathbf{W} is the vectorized polar coordinate value. Thereafter, the parameters were proportioned and added to the vectorized polar coordinate values to determine the polar coordinate values at each point. The values were returned to the rectangular coordinate values to calculate the wind speed and direction.

The accuracy of interpolation was assessed by correlation coefficient and standard deviation at the observation points, Pursat in 2008, 2009 and 2010 and Battam-Bang in 2010, as shown in Table

A1.1

Table A1.1. Comparison of interpolated wind speed (m/s) and direction (degree) at Pursat in 2008 and 2009

| Date | NCDC | | Method1: IDW | | Method2: Vectorized average | | Method3: Inverse of ratio of distance | |
|------------|-----------|-------|--------------|-------|-----------------------------|-------|---------------------------------------|-------|
| | Direction | Speed | Direction | Speed | Direction | Speed | Direction | Speed |
| Pursat | | | | | | | | |
| 2008/01/13 | 230 | 2 | 119 | 1.68 | 150 | 0.560 | 81 | 1.48 |
| 2008/03/27 | 140 | 1 | 160 | 2.34 | 140 | 1.85 | 80 | 1.03 |
| 2008/05/03 | 90 | 1 | 131 | 2.39 | 212 | 2.21 | 87 | 1.09 |
| 2008/08/07 | 230 | 21 | 120 | 3.76 | 224 | 4.19 | 93 | 2.82 |
| 2008/08/11 | 180 | 1 | 131 | 2.32 | 226 | 1.29 | 94 | 1.42 |
| 2008/08/24 | 270 | 1 | 158 | 1.52 | 207 | 1.34 | 101 | 0.593 |
| 2008/09/04 | 230 | 1 | 114 | 1.95 | 313 | 0.313 | 91 | 0.825 |
| 2008/09/09 | 230 | 1 | 51 | 1.94 | 315 | 1.67 | 96 | 1.42 |
| 2008/09/10 | 230 | 1 | 79 | 2.08 | 269 | 1.08 | 90 | 2.16 |
| 2008/09/21 | 230 | 1 | 79 | 2.96 | 265 | 2.33 | 90 | 2.90 |
| 2008/10/01 | 230 | 1 | 91 | 1.51 | 187 | 0.701 | 68 | 0.756 |
| | | | | | | | | |
| 2009/01/02 | 50 | 1 | 69 | 2.91 | 2 | 3.63 | 87 | 3.00 |
| 2009/01/12 | 230 | 1 | 18 | 2.13 | 1 | 2.58 | 97 | 0.502 |

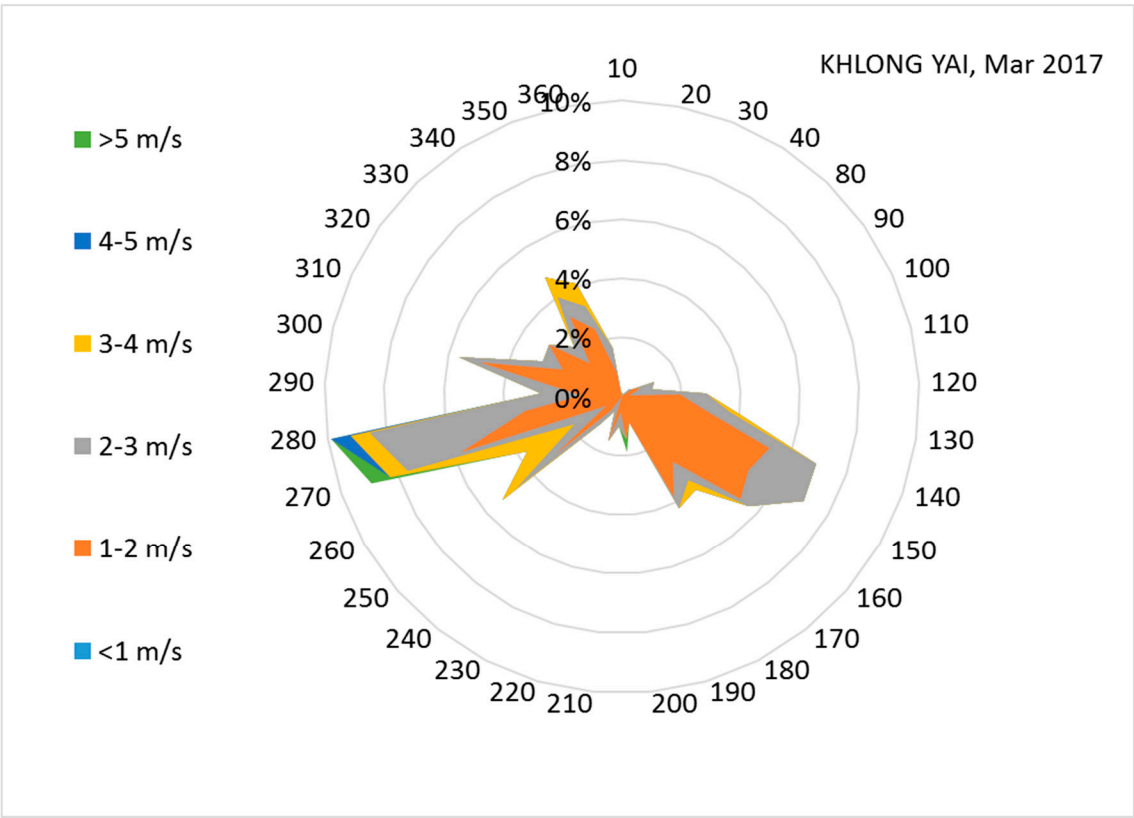
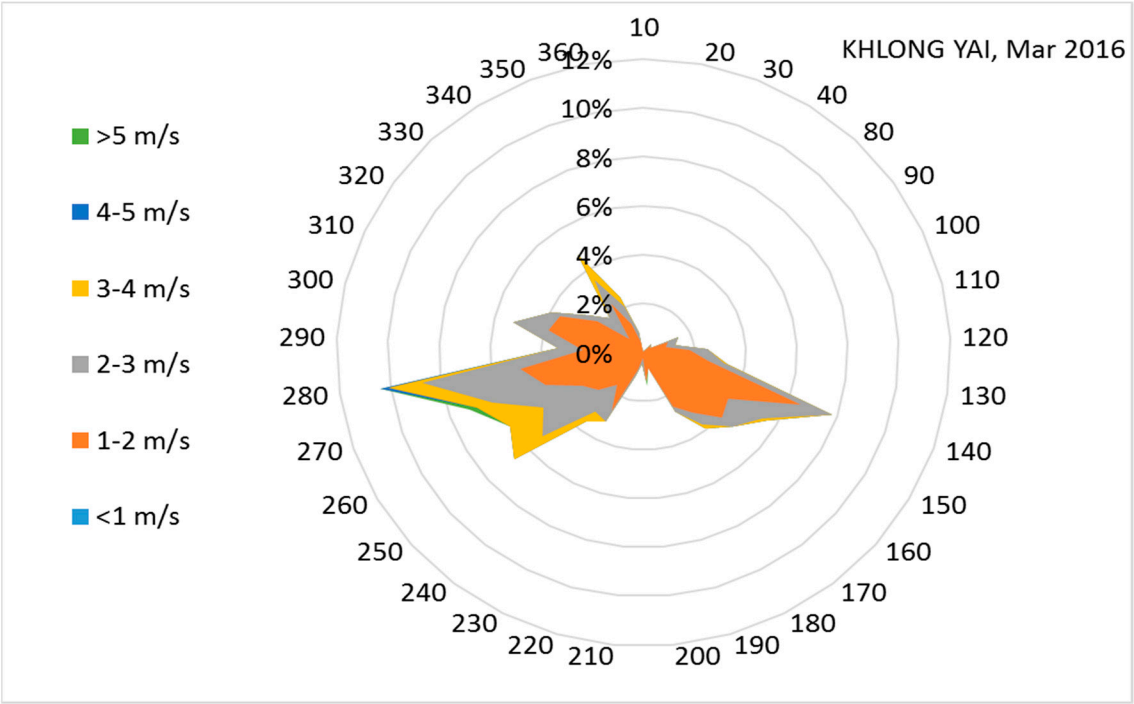
Appendix 1 – Methodology for wind data interpolation

| Date | NCDC | | Method1: IDW | | Method2: Vectorized average | | Method3: Inverse of ratio of distance | |
|----------------|-----------|-------|--------------|-------|--------------------------------|--------|---|-------|
| | Direction | Speed | Direction | Speed | Direction | Speed | Direction | Speed |
| 2009/01/13 | 270 | 2 | 29 | 3.22 | 10 | 3.42 | 101 | 1.18 |
| 2009/01/29 | 230 | 1 | 121 | 1.80 | 215 | 0.0986 | 66 | 0.798 |
| 2009/02/03 | 90 | 1 | 114 | 1.95 | 2 | 0.672 | 65 | 0.715 |
| 2009/02/06 | 90 | 1 | 113 | 2.06 | 74 | 0.50 | 99 | 1.07 |
| 2009/02/09 | 270 | 1 | 102 | 2.72 | 38 | 0.820 | 81 | 0.815 |
| 2009/02/10 | 270 | 2 | 84 | 2.00 | 353 | 0.673 | 95 | 1.54 |
| 2009/02/14 | 90 | 1 | 129 | 1.89 | 154 | 1.34 | 78 | 1.33 |
| 2009/03/14 | 50 | 2 | 38 | 3.53 | 16 | 3.09 | 74 | 1.63 |
| | | | | | | | | |
| 2010/06/14 | 230 | 1 | 129 | 2.36 | 197 | 1.26 | 99 | 1.60 |
| 2010/06/15 | 300 | 2 | 111 | 2.57 | 231 | 1.68 | 86 | 2.05 |
| 2010/06/18 | 180 | 1 | 132 | 2.56 | 229 | 2.32 | 97 | 1.94 |
| 2010/06/19 | 140 | 1 | 104 | 2.48 | 258 | 1.65 | 81 | 2.02 |
| 2010/07/05 | 360 | 1 | 151 | 1.85 | 146 | 1.16 | 93 | 0.914 |
| 2010/07/14 | 320 | 1 | 156 | 2.25 | 190 | 1.90 | 85 | 0.561 |
| 2010/07/29 | 140 | 1 | 109 | 2.98 | 219 | 3.15 | 86 | 1.37 |
| 2010/07/30 | 180 | 1 | 99 | 2.21 | 217 | 1.97 | 82 | 1.73 |
| 2010/08/03 | 140 | 2 | 96 | 2.55 | 240 | 2.38 | 89 | 2.30 |
| 2010/08/12 | 90 | 1 | 129 | 2.19 | 213 | 0.990 | 89 | 1.71 |
| 2010/08/15 | 180 | 1 | 134 | 1.60 | 168 | 0.789 | 97 | 0.985 |
| | | | | | | | | |
| | | | | | | | | |
| Battam Bang | | | | | | | | |
| 2010/07/17 | 270 | 2 | 155 | 2.48 | 200 | 2.11 | 132 | 0.484 |
| 2010/07/18 | 140 | 1 | 157 | 2.70 | 170 | 2.44 | 81 | 0.915 |
| 2010/07/30 | 330 | 1 | 102 | 2.22 | 222 | 1.82 | 82 | 1.79 |
| 2010/07/31 | 270 | 1 | 77 | 1.88 | 257 | 2.10 | 87 | 2.84 |
| 2010/08/01 | 90 | 1 | 121 | 1.99 | 198 | 1.63 | 99 | 1.74 |
| 2010/08/08 | 270 | 2 | 105 | 3.71 | 226 | 1.32 | 81 | 3.43 |
| 2010/08/11 | 230 | 1 | 133 | 2.37 | 243 | 3.43 | 80 | 1.43 |
| 2010/08/19 | 320 | 1 | 75 | 2.35 | 177 | 2.65 | 85 | 1.70 |
| 2010/08/27 | 270 | 2 | 78 | 3.09 | 68 | 0.739 | 85 | 2.62 |
| 2010/08/28 | 320 | 3 | 61 | 2.42 | 250 | 3.14 | 89 | 1.55 |
| 2010/09/19 | 50 | 2 | 158 | 1.89 | 266 | 0.757 | 127 | 0.312 |
| | | | | | | | | |

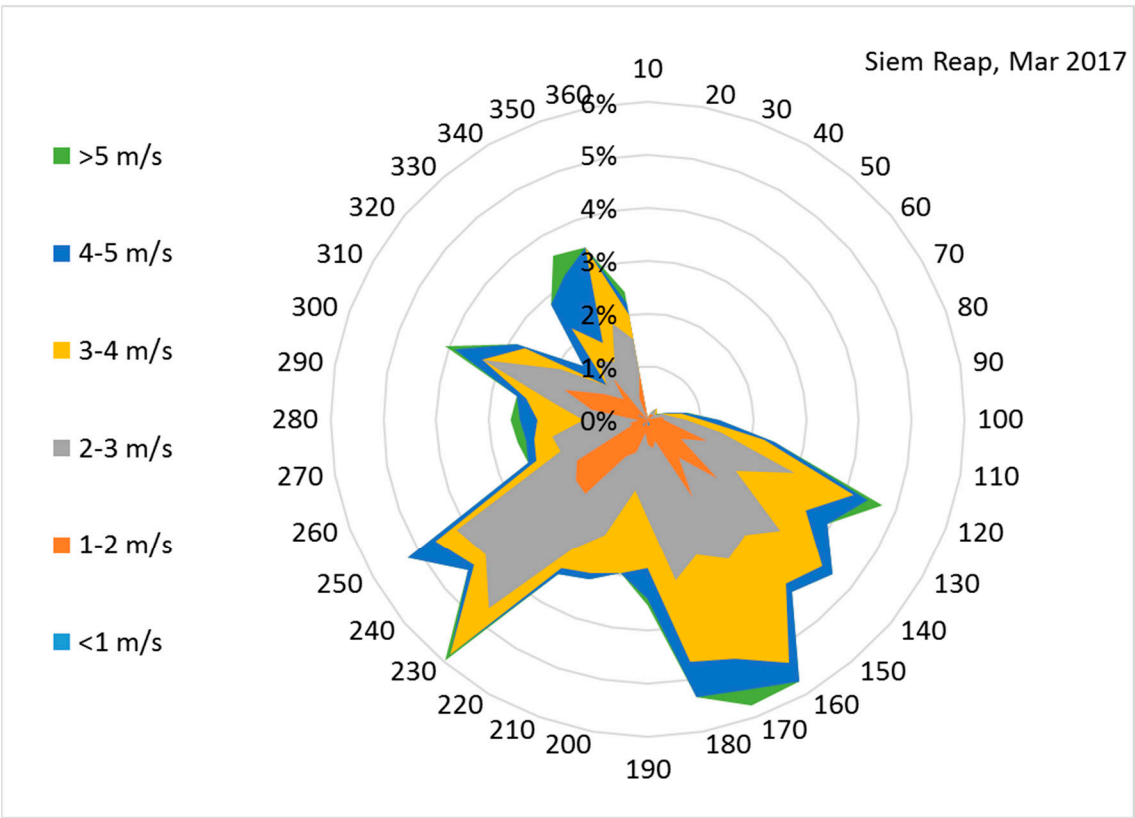
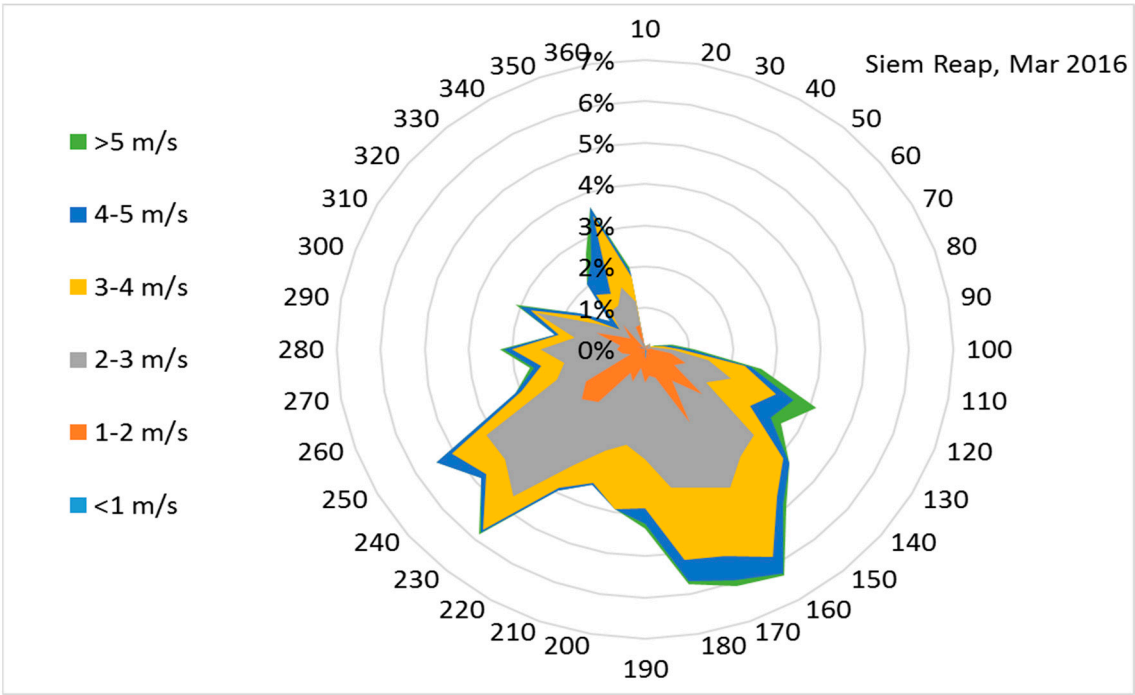
References

Ali, S. M., Mahdi, A. S., & Shaban, A. H. (2012). Wind speed estimation for Iraq using several spatial interpolation methods. Environmental protection, 1, 2.

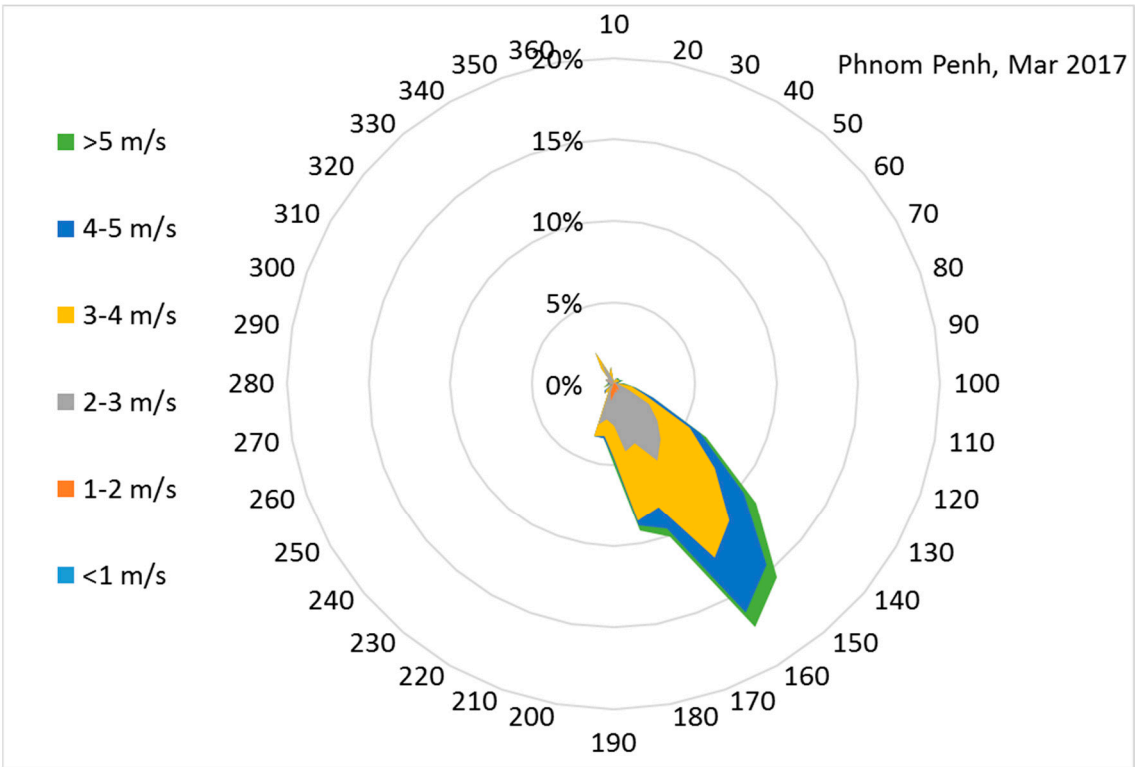
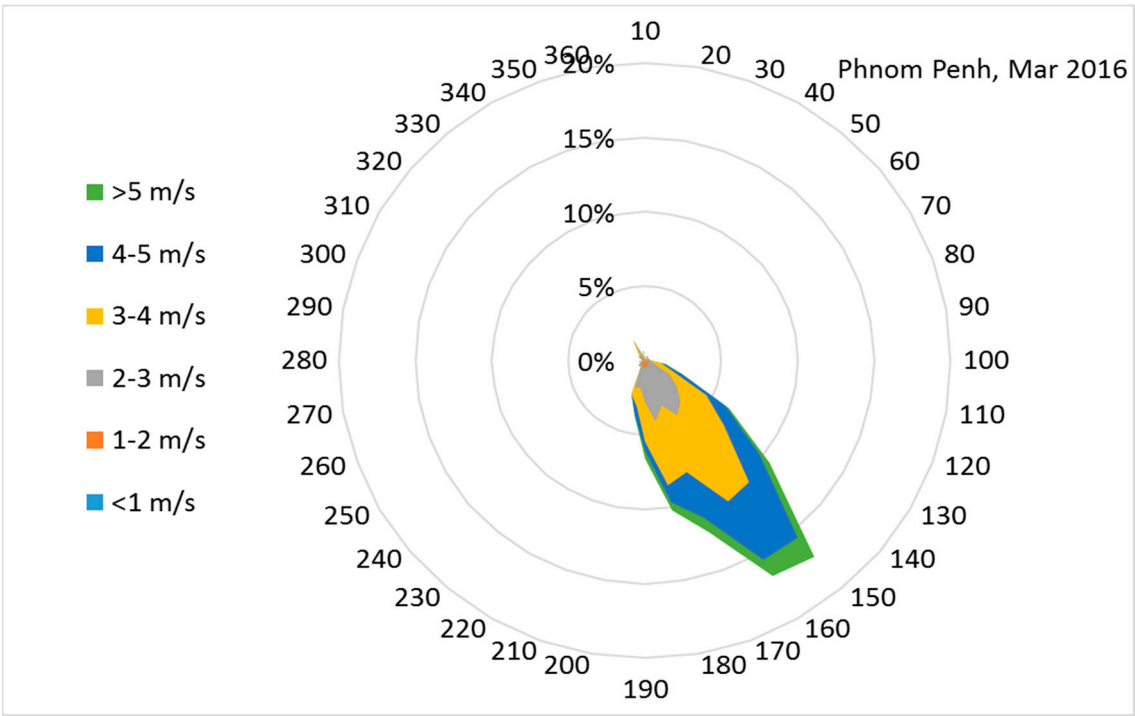
Appendix 1 cont...
Wind Rose diagram at Khilong Yai, Siem Reap and Phnom Penh



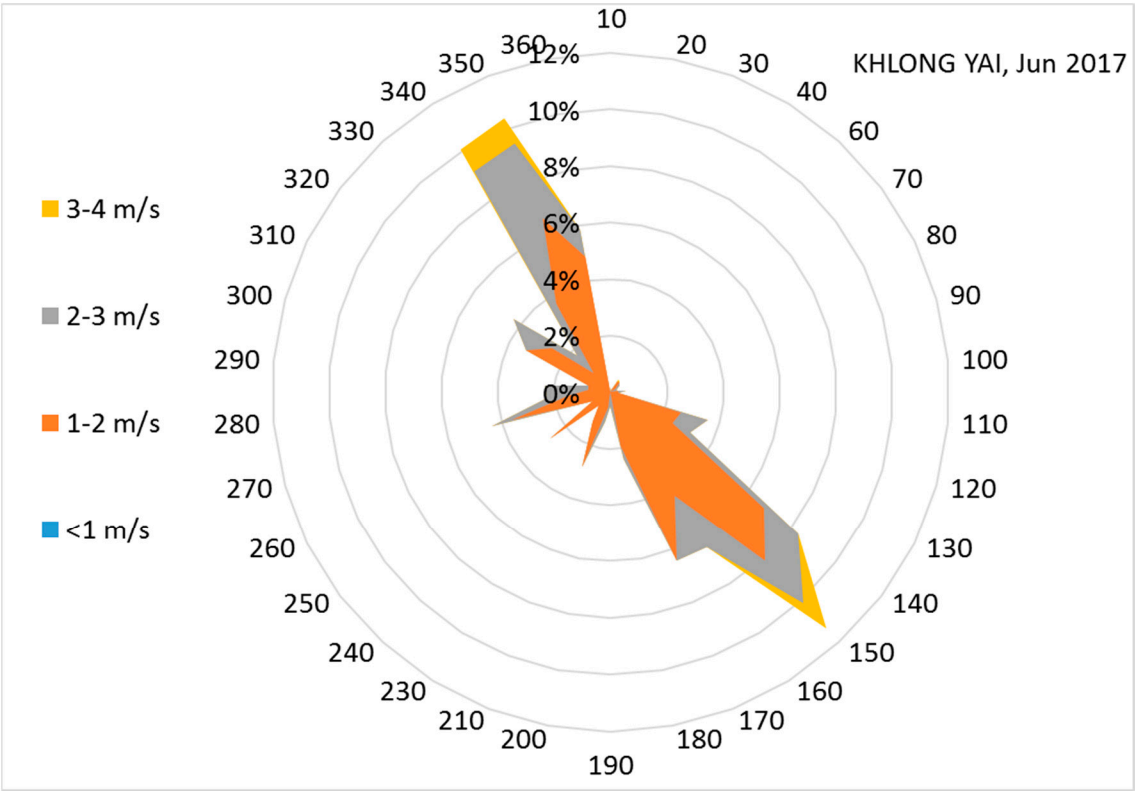
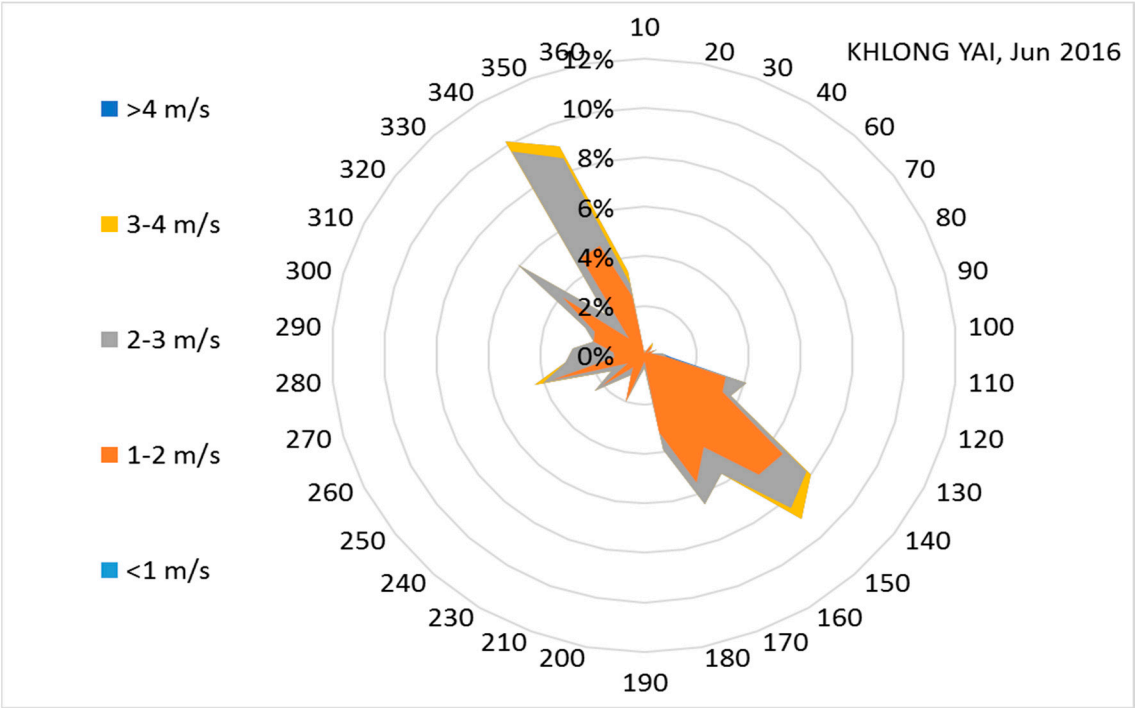
Appendix 1 cont...
Wind Rose diagram at Khilong Yai, Siem Reap and Phnom Penh



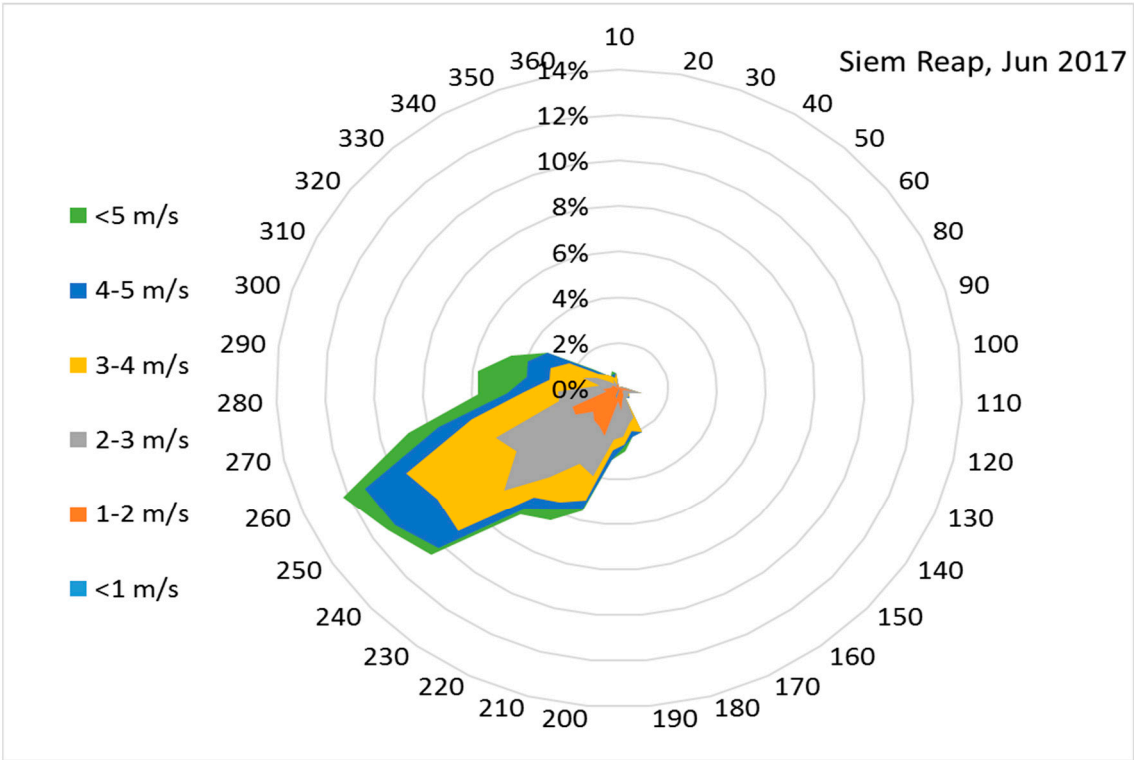
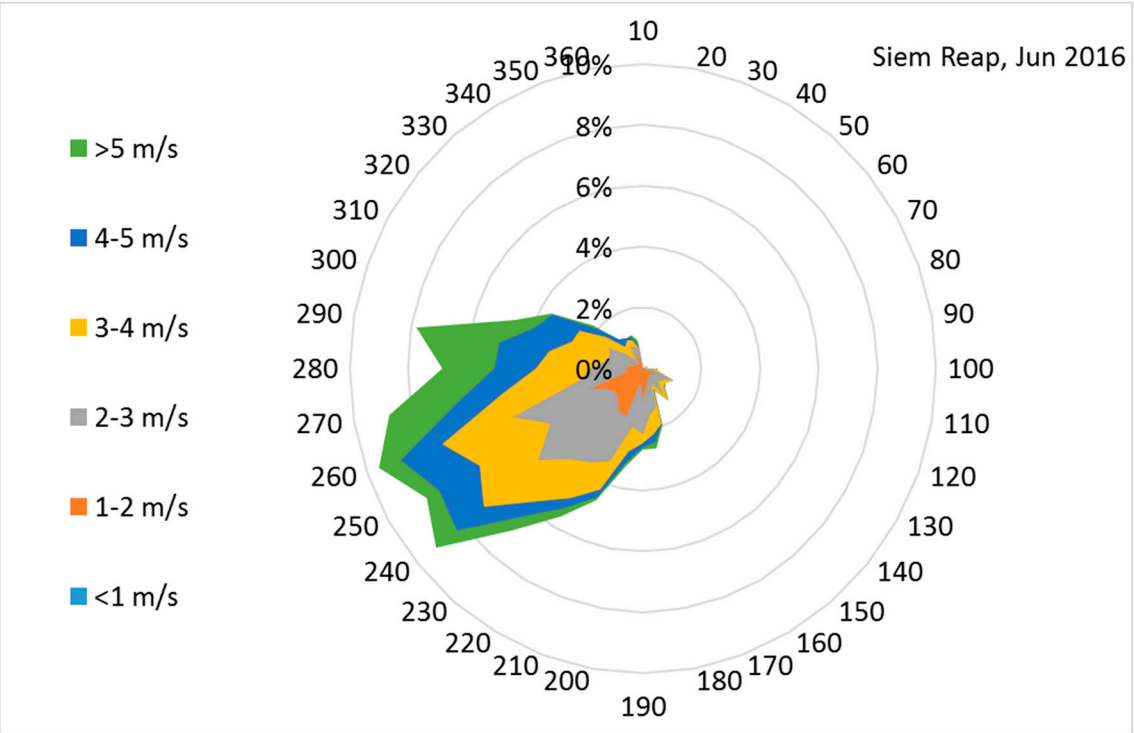
Appendix 1 cont...
Wind Rose diagram at Khilong Yai, Siem Reap and Phnom Penh



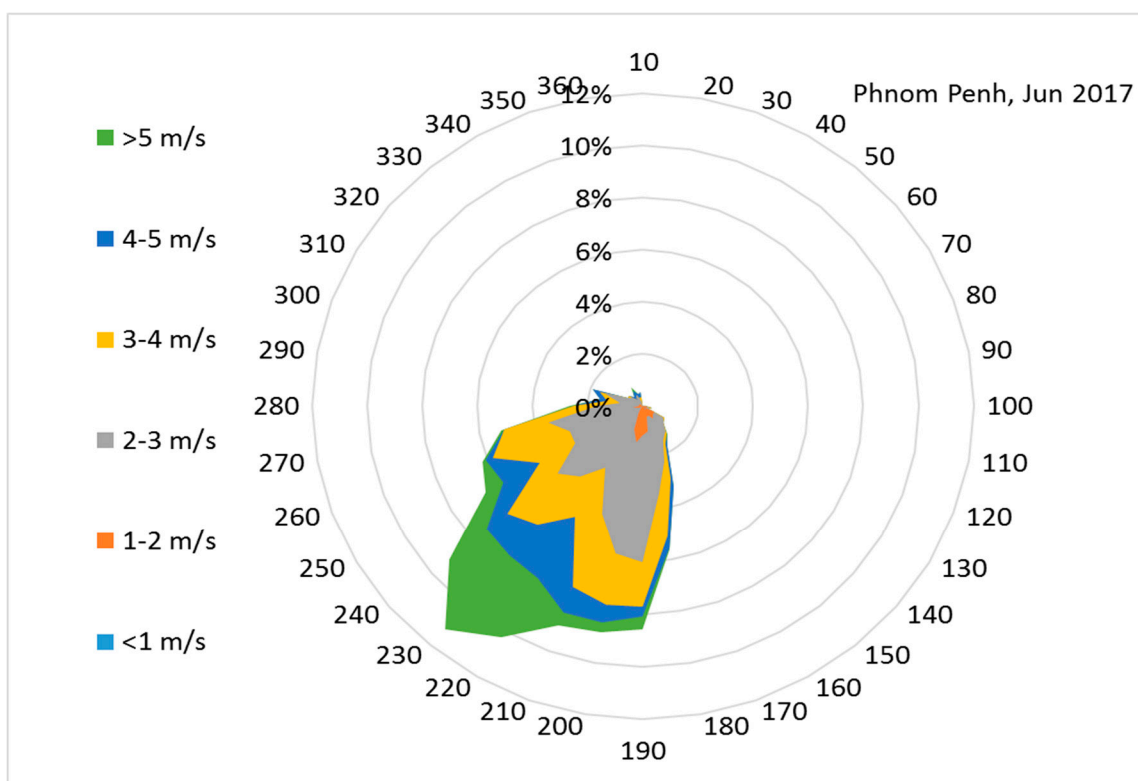
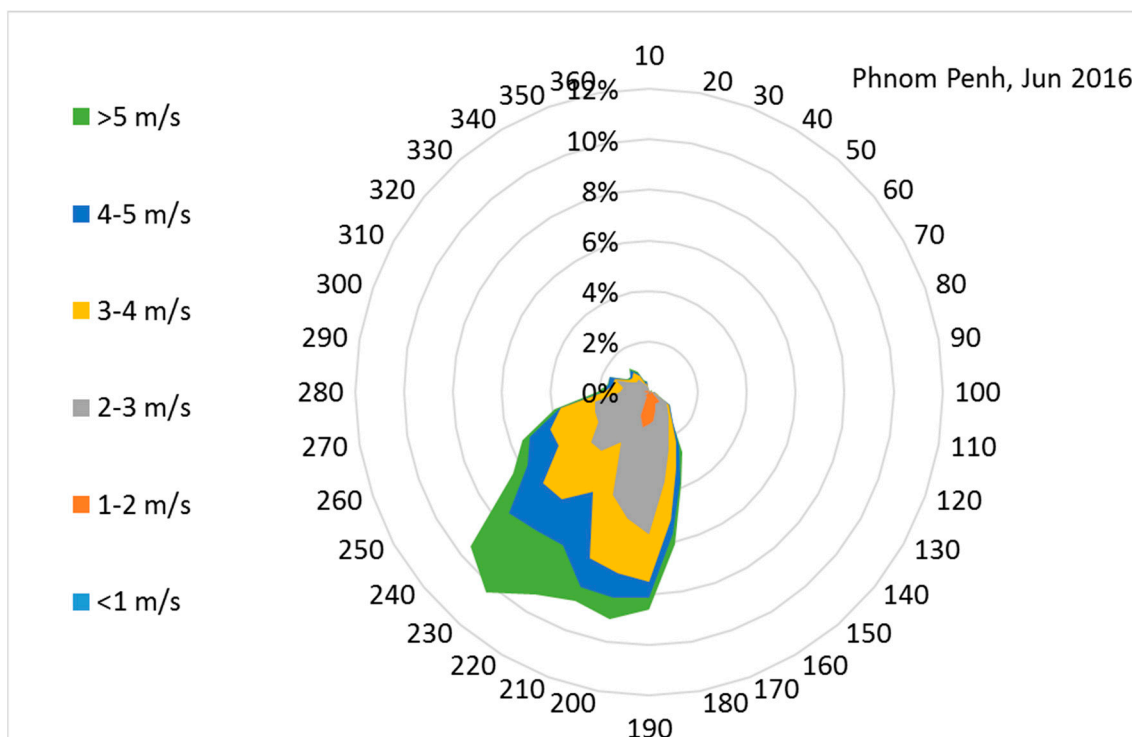
Appendix 1 cont...
Wind Rose diagram at Khilong Yai, Siem Reap and Phnom Penh



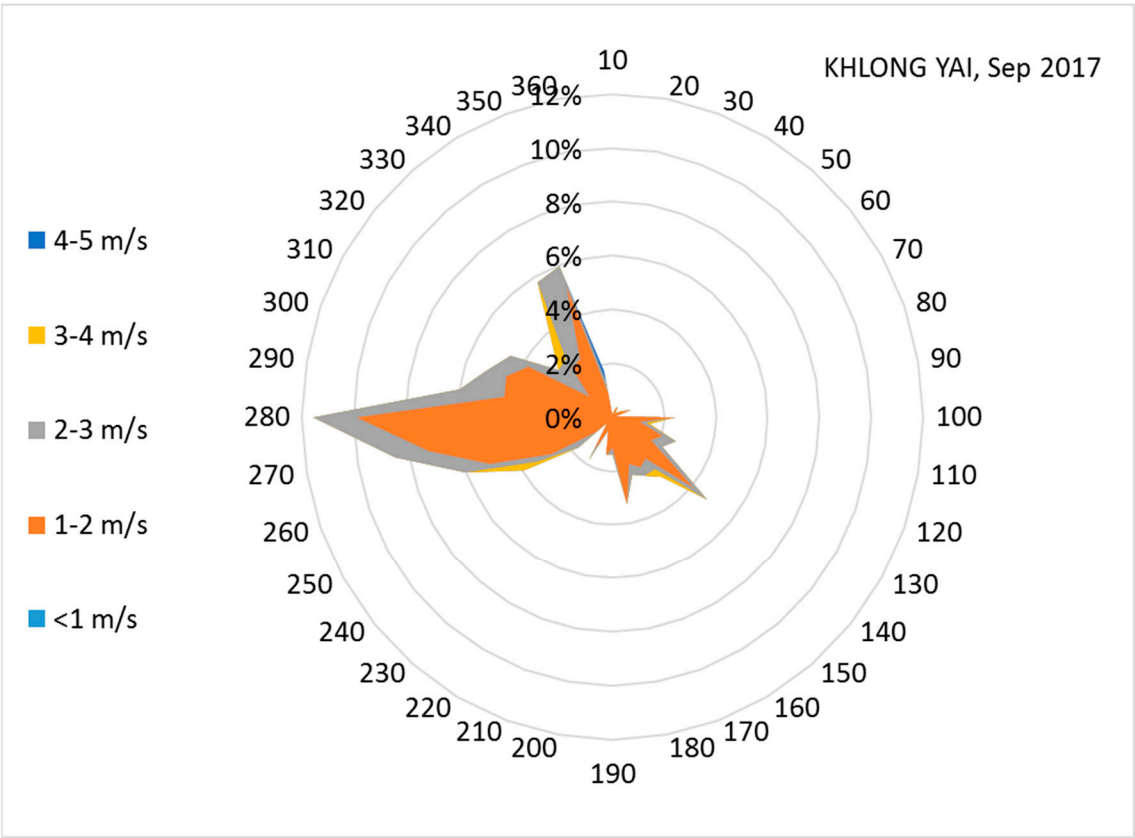
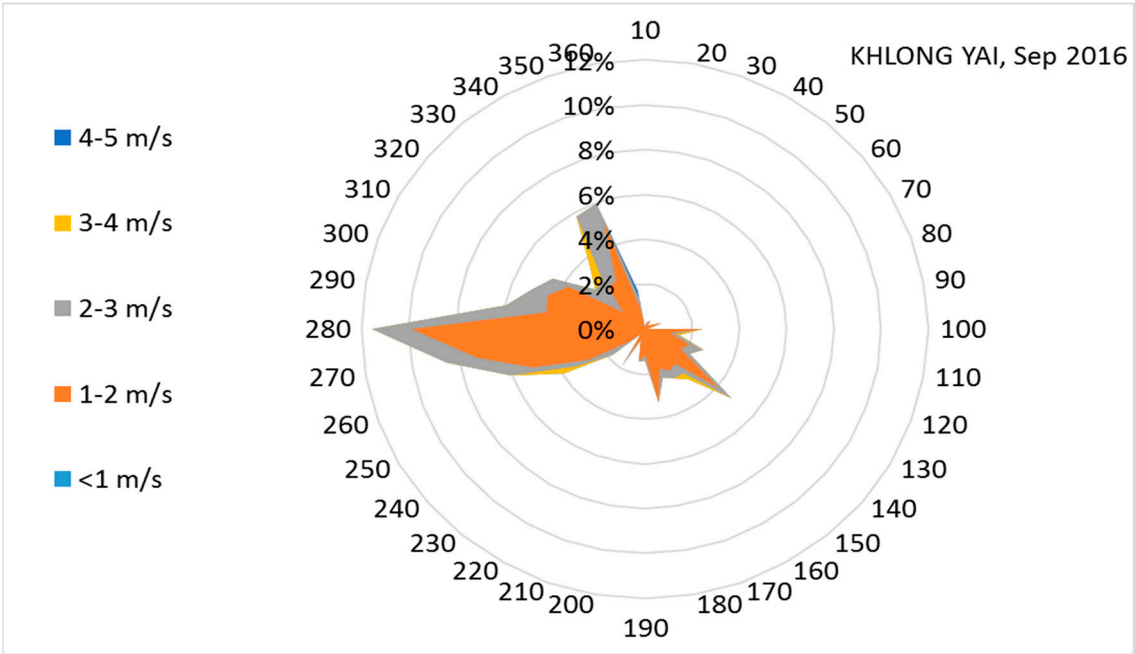
Appendix 1 cont...
Wind Rose diagram at Khilong Yai, Siem Reap and Phnom Penh



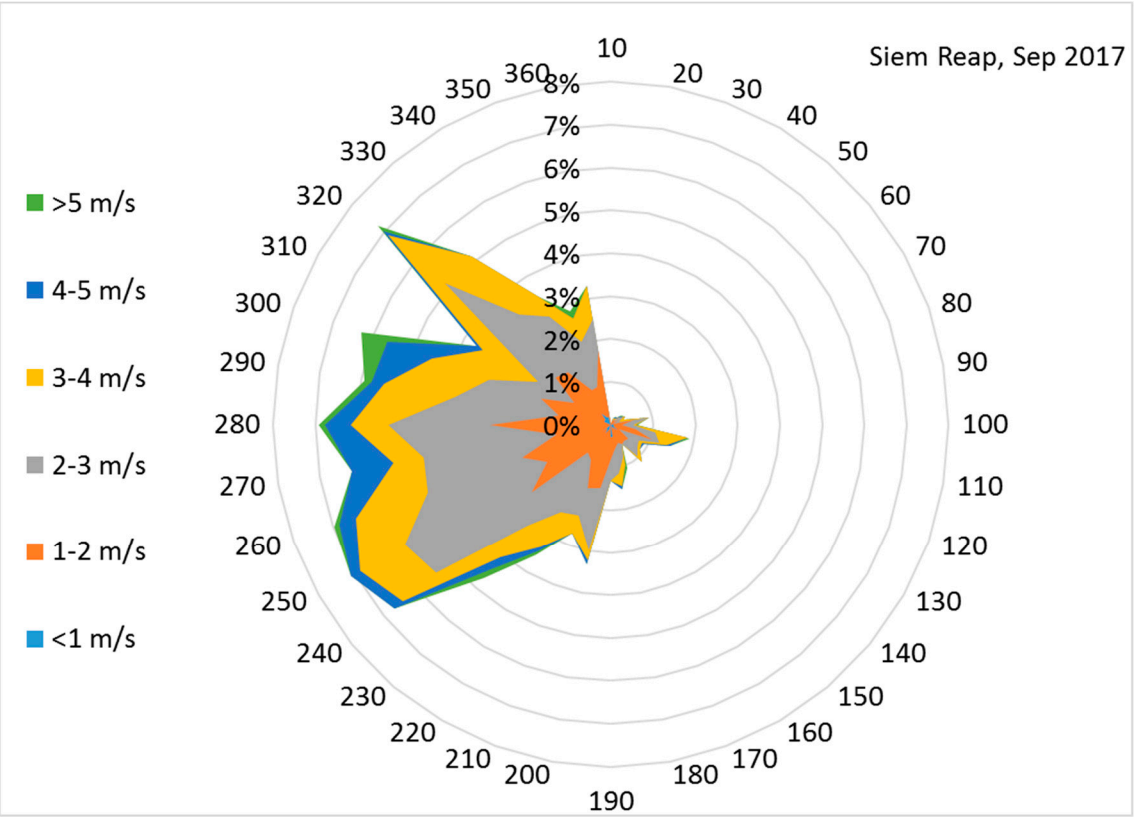
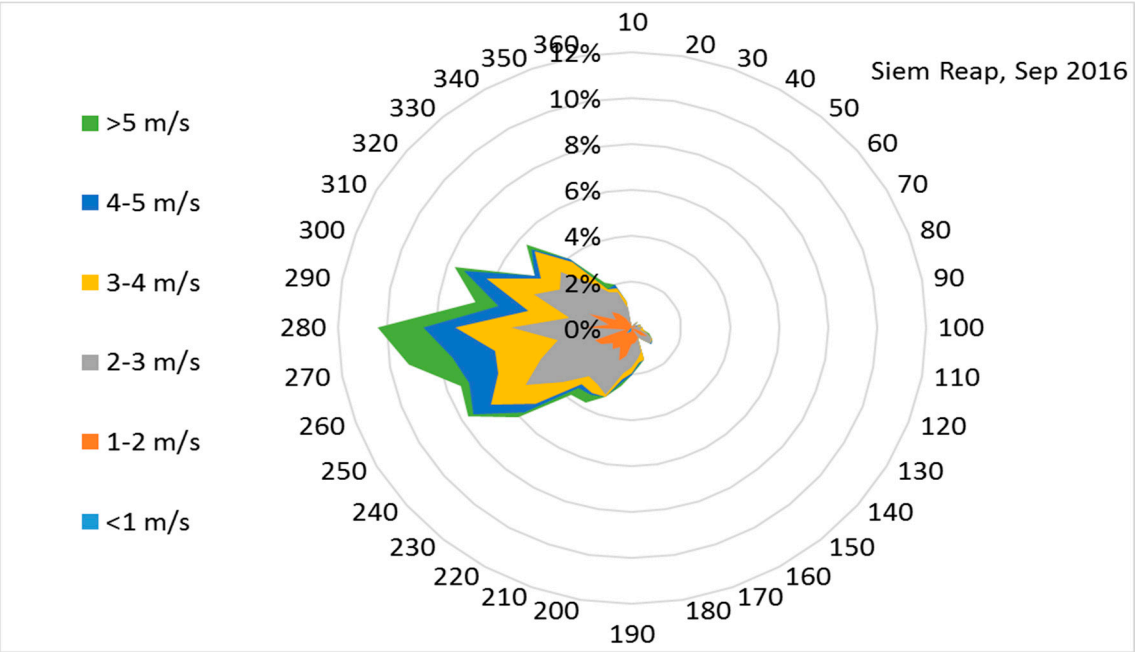
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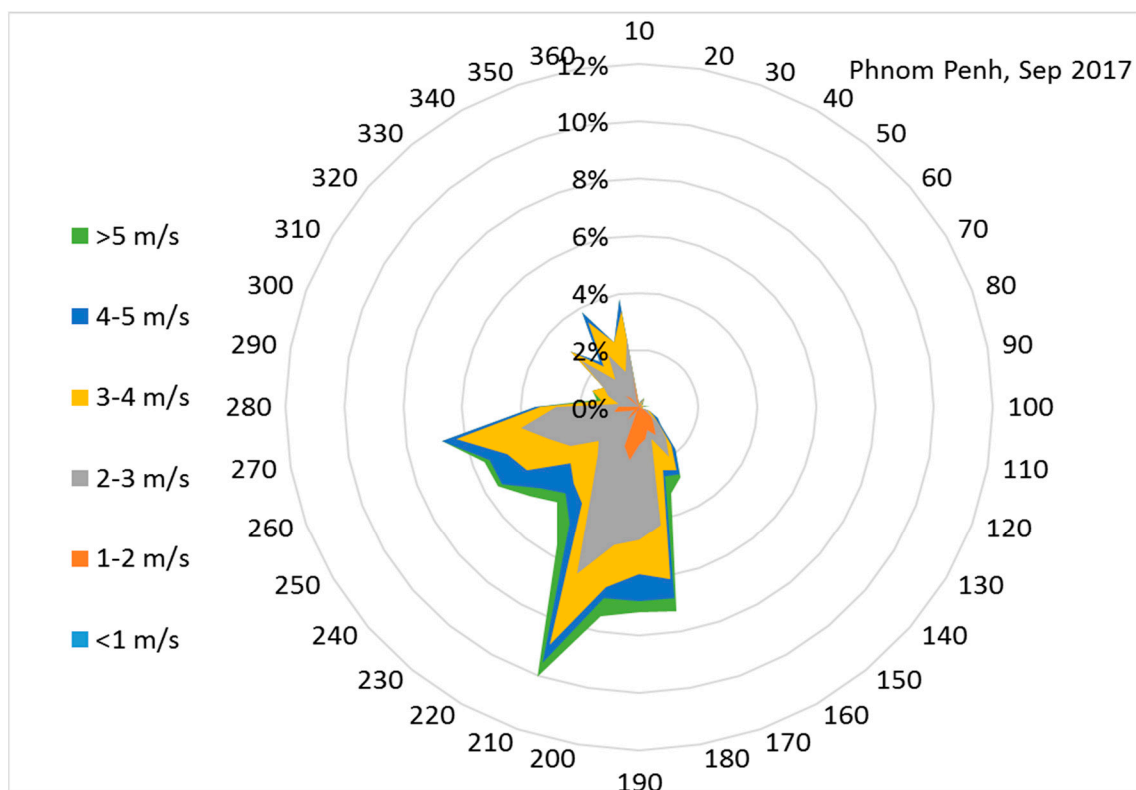
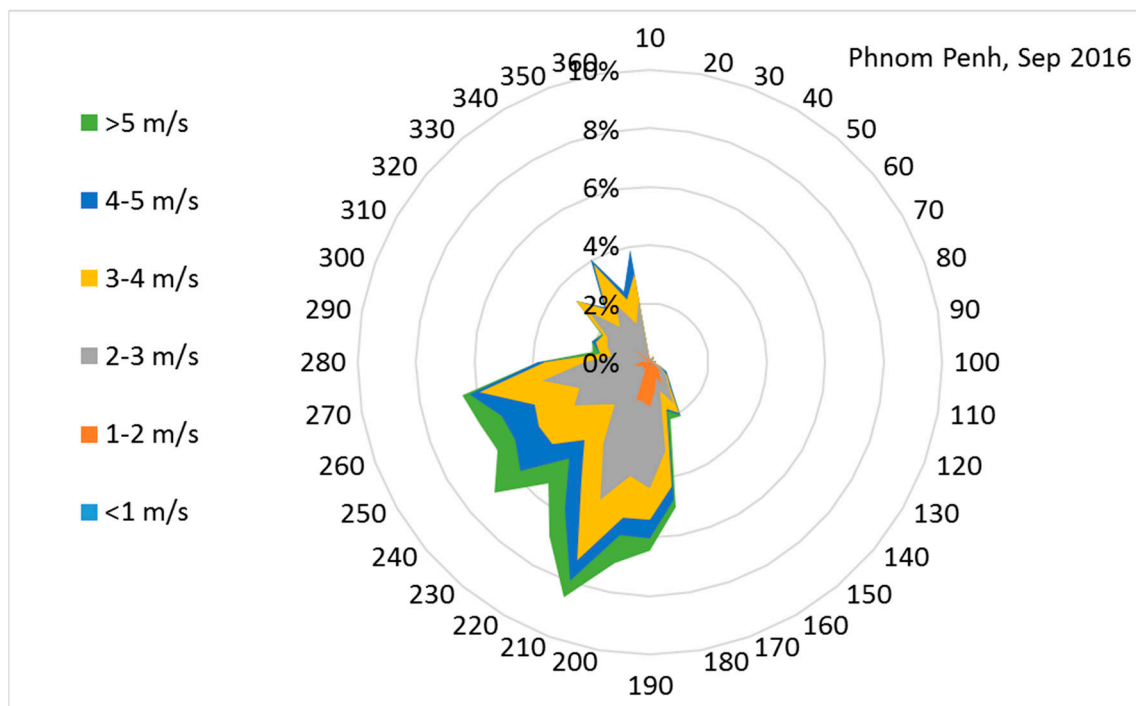
Appendix 1 cont...
Wind Rose diagram at Khilong Yai, Siem Reap and Phnom Penh



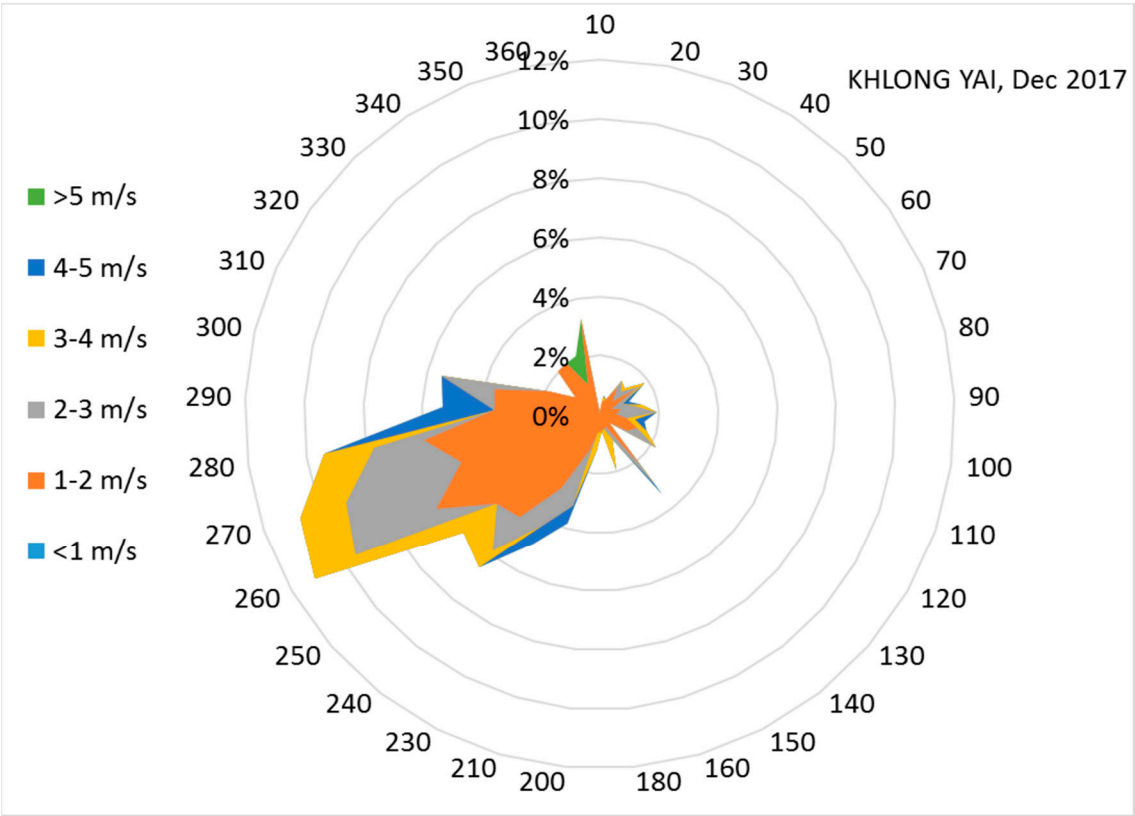
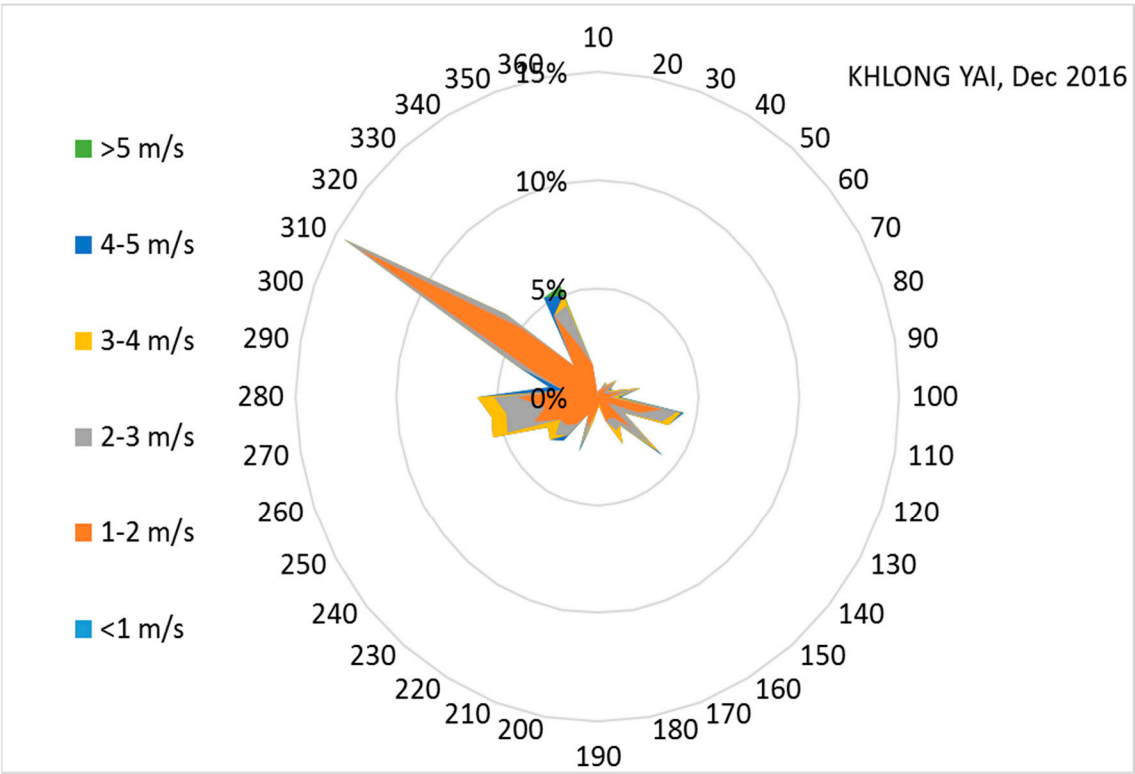
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Wind Rose diagram at Khilong Yai, Siem Reap and Phnom Penh



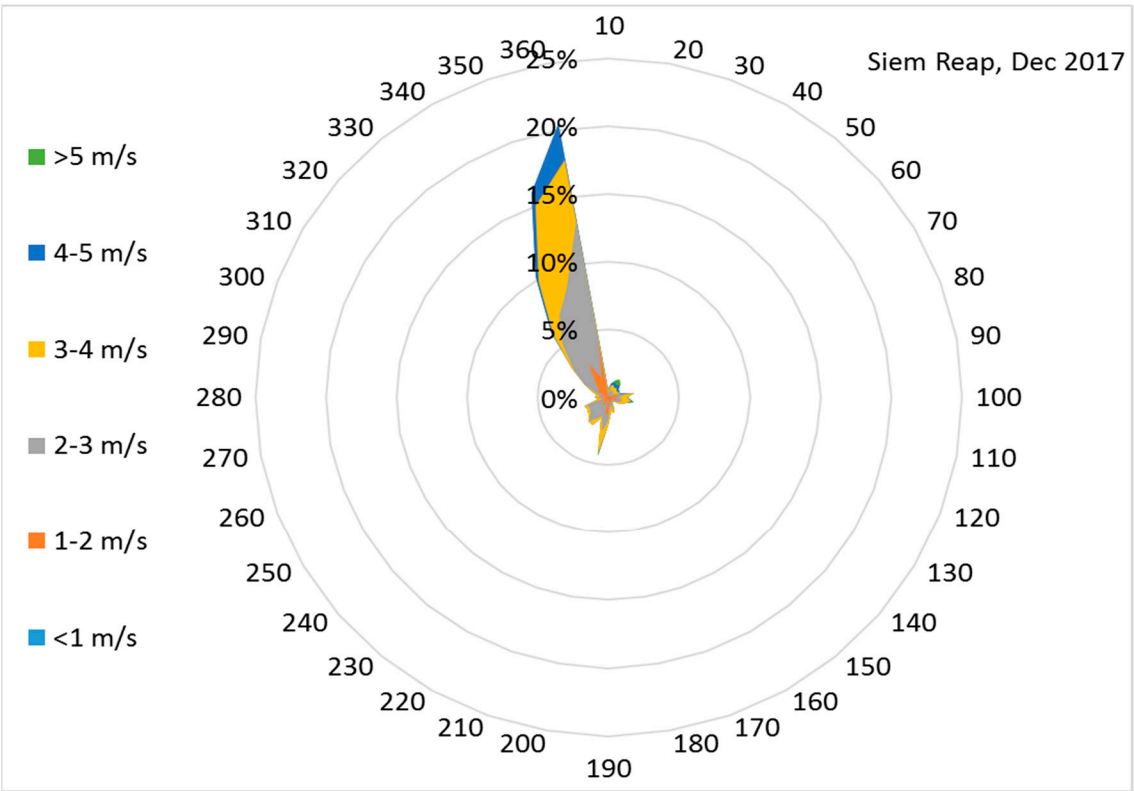
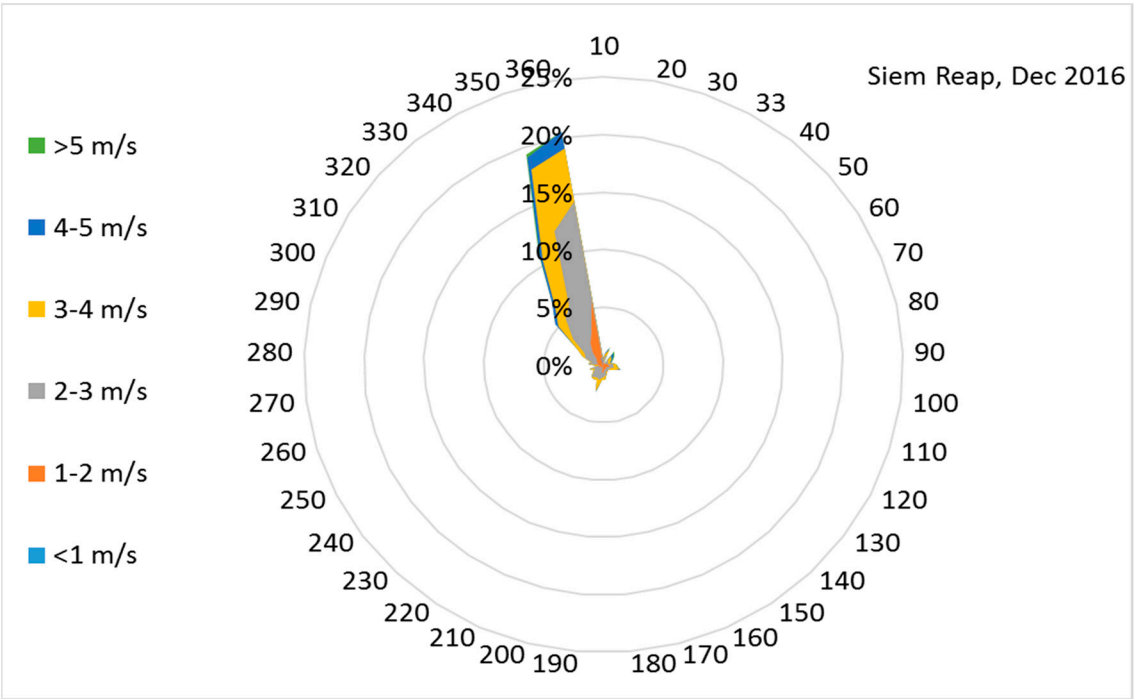
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Appendix 1 cont...
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