

Influence of Growing-Season Meteorology on X/Q Values for Carbon-14 Dose Assessment

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Reason for Concern

- Atmospheric dispersion X/Q factors are typically calculated using long-term, 24-hr/year-round meteorology... Regulatory Guide 1.111, NUREG-0133, etc.
- The primary exposure pathways for Carbon-14 involve incorporation of C-14 dioxide into vegetation via photosynthesis
- Most photosynthesis occurs during daytime hours during the primary growing season
- Inclusion of off-season and nighttime meteorology may result in erroneous X/Q values used to calculate C-14 vegetation concentrations and resulting dose



Method of Analysis

- Utilize XQQDOQ software package developed for NRC
- Utilize two-year data set (2010,2011) for analysis
- Calculate X/Q values using all data, growing-season data, daytime data, and daytime/growing-season datasets
- Apply terrain height corrections



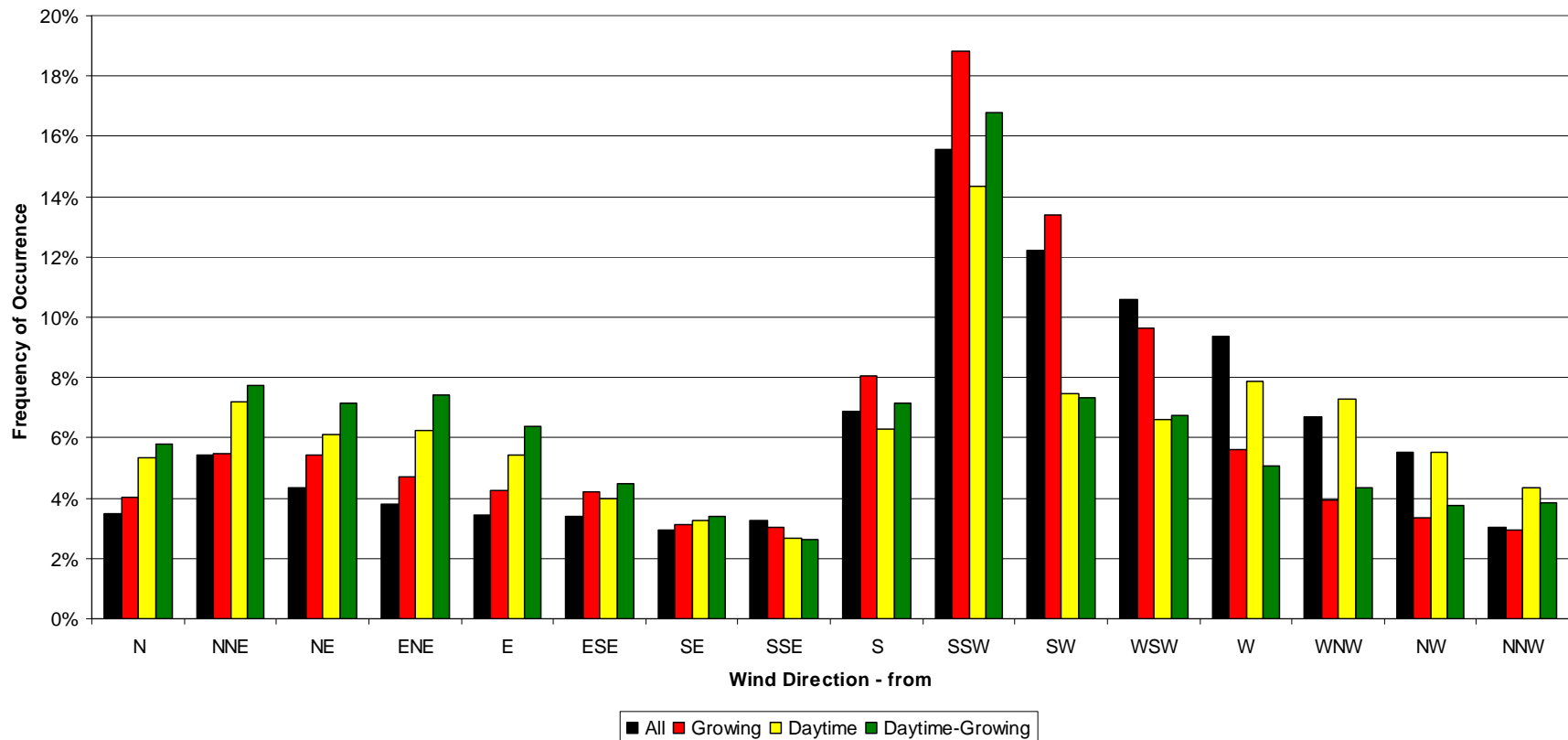


Meteorological Data Sets

- All dataset
 - 17,330 hourly-average records
- Growing-season dataset
 - Growing season assumed to be from 16-Apr through 15-Oct
 - 8,784 hourly-average records
- Daytime dataset
 - Daytime assumed to contain records from 1-hour after sunrise through 1-hour before sunset; facilitate solar warming
 - 8,806 hourly-average records
- Daytime/growing-season dataset
 - Daytime dataset trimmed to 16-Apr through 15-Oct
 - 4,416 hourly-average records

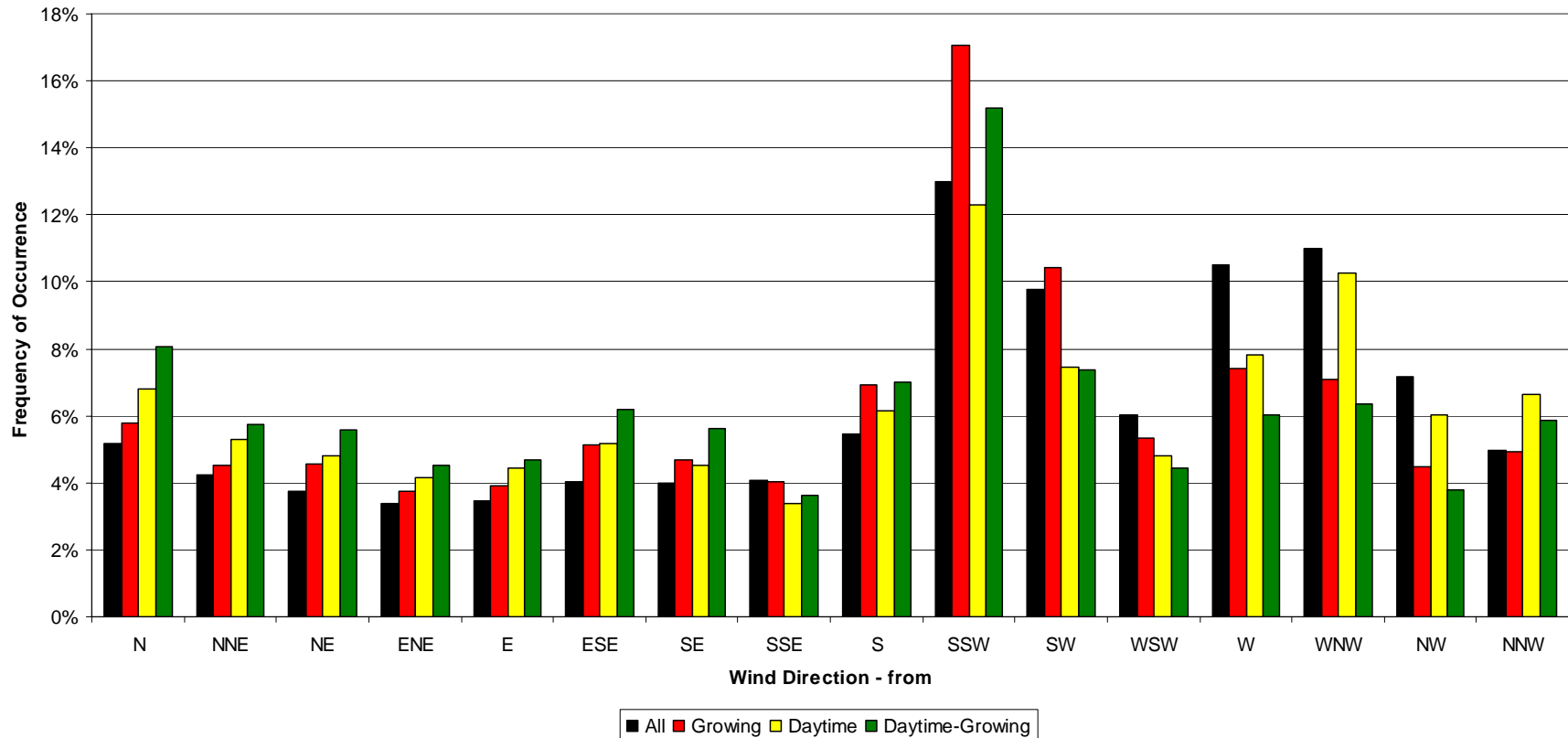
Difference in Meteorology: Wind Direction, 10-meter elevation

Wind Direction Distribution by Meteorology Type
10-meter Sensor Level



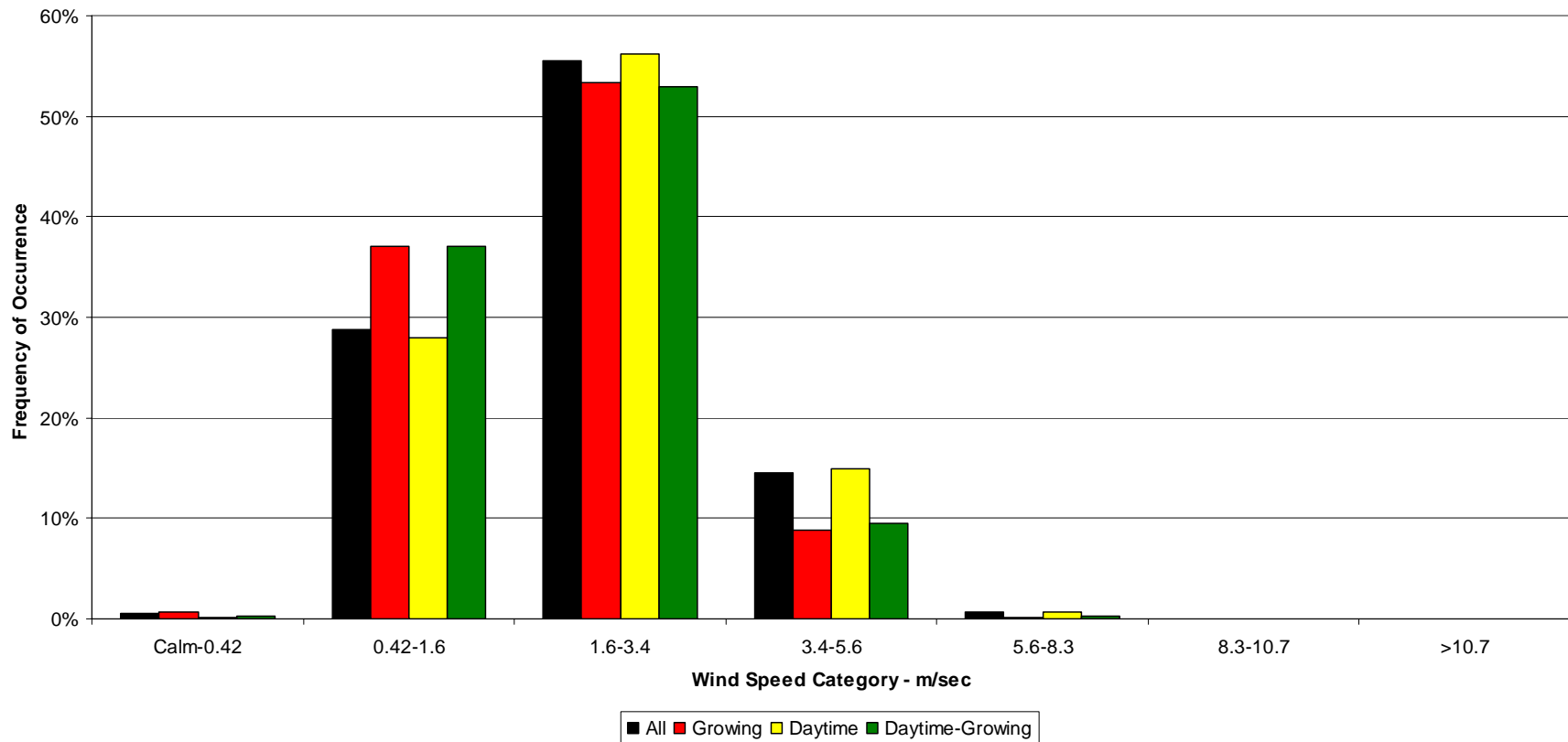
Difference in Meteorology: Wind Direction, 67-meter elevation

Wind Direction Distribution by Meteorology Type
67-meter Sensor Level



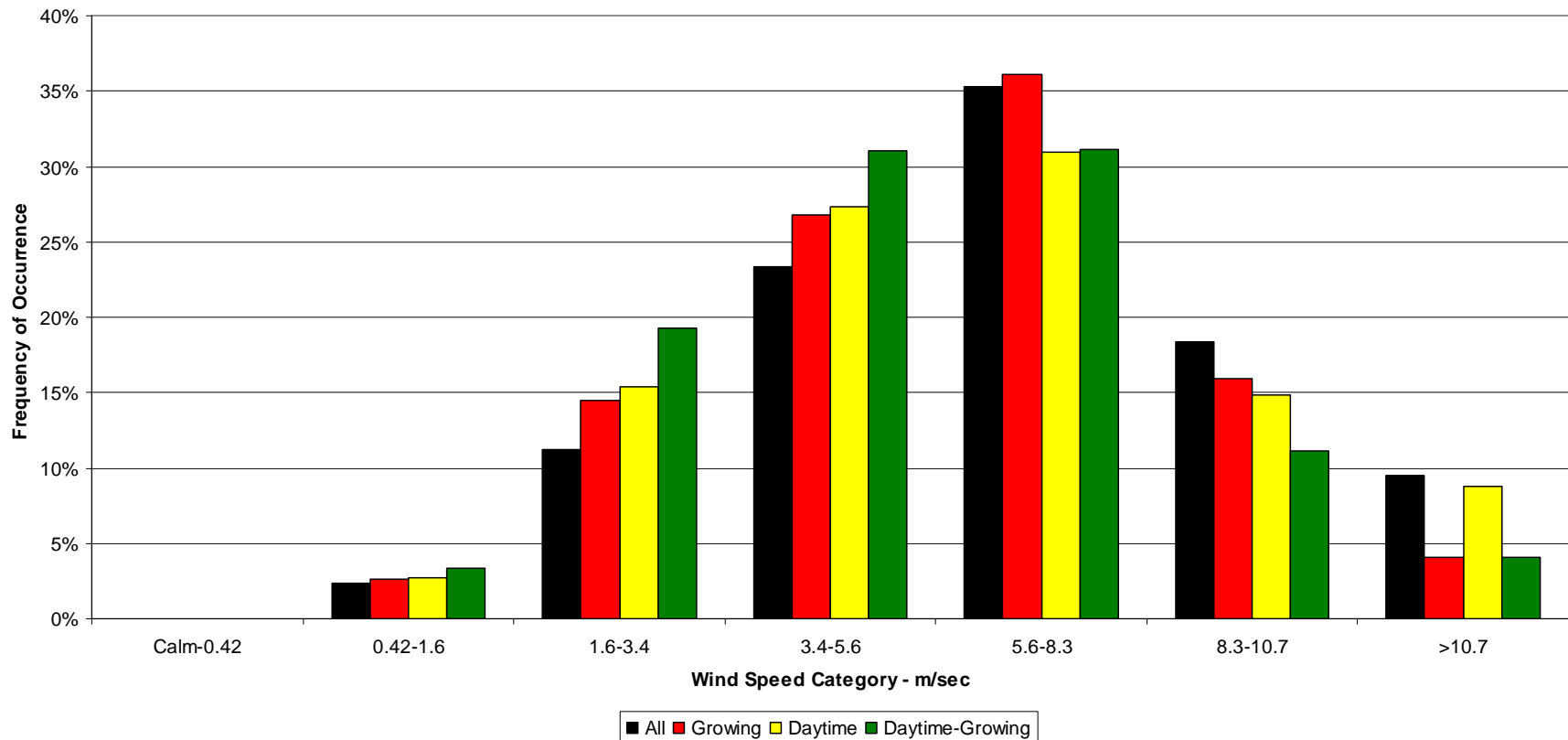
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10-meter Sensor Level



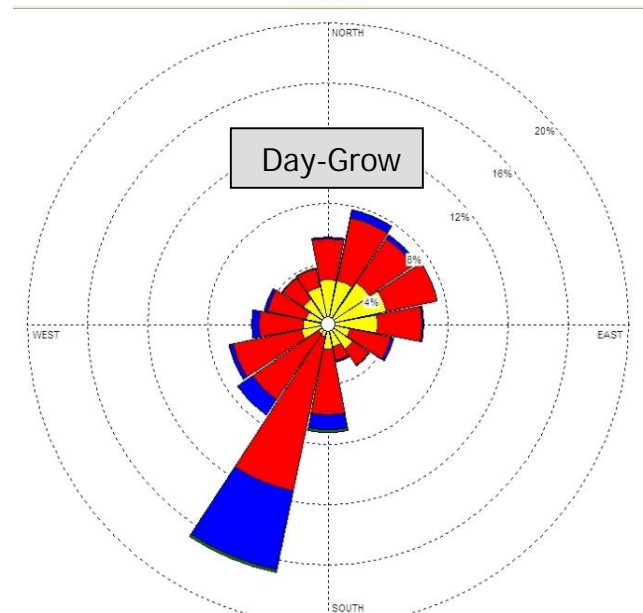
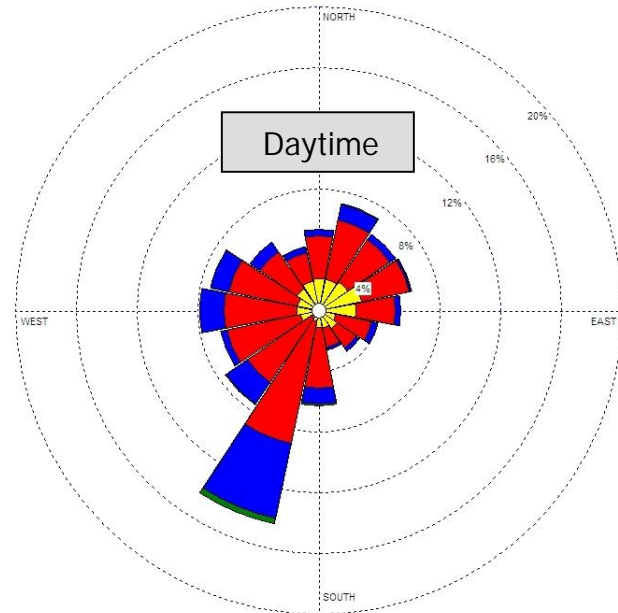
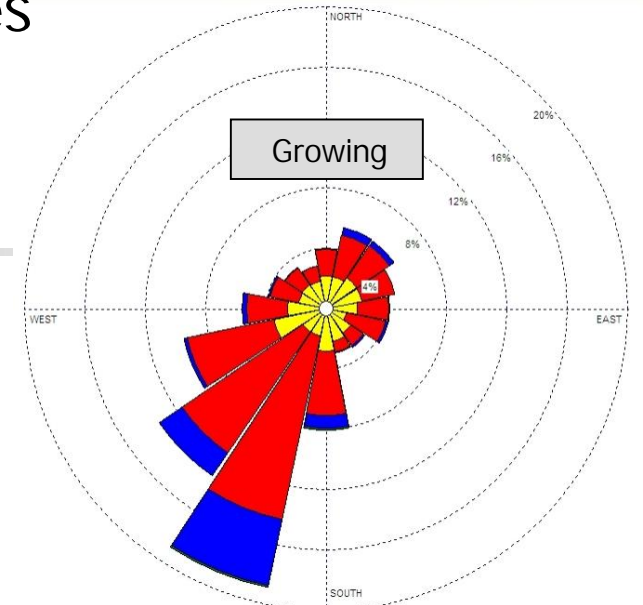
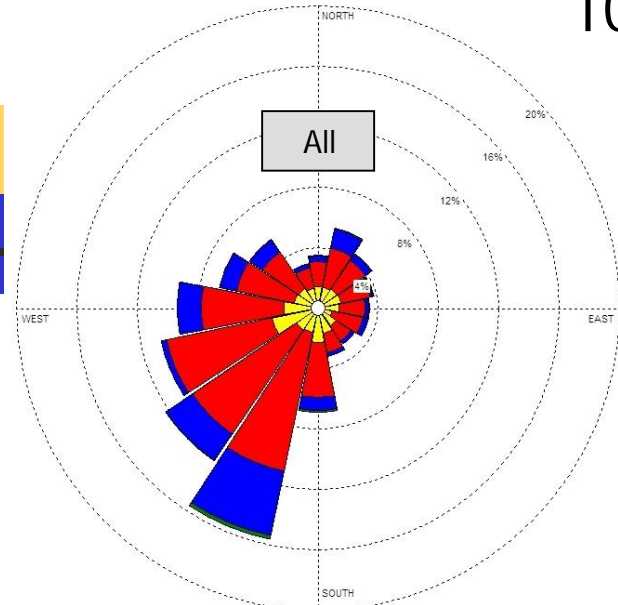
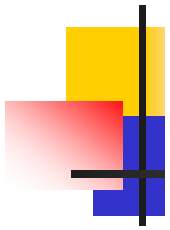
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67-meter Sensor Level

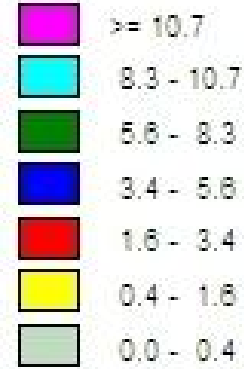


10-m Wind Roses

Direction from



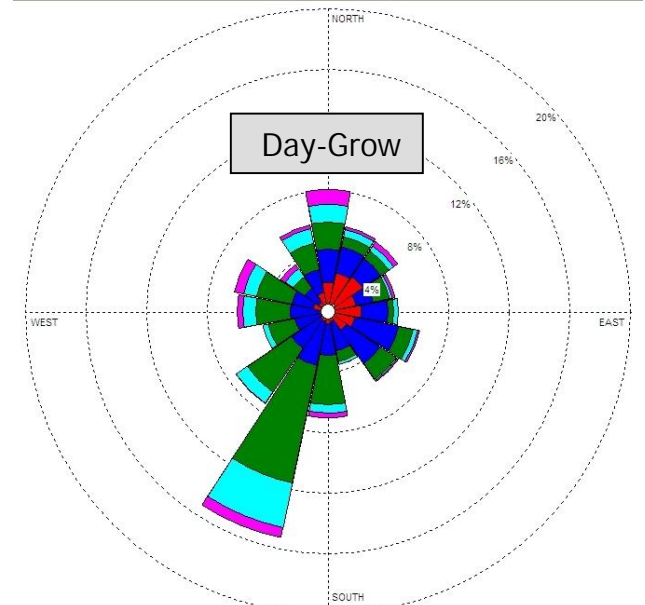
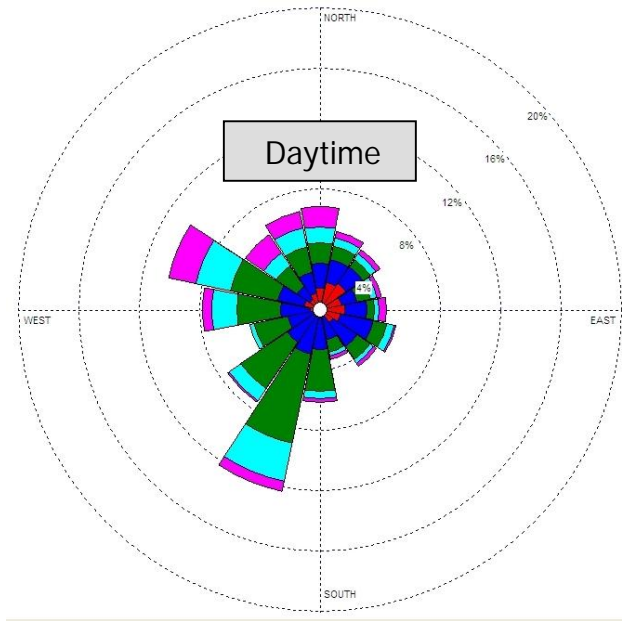
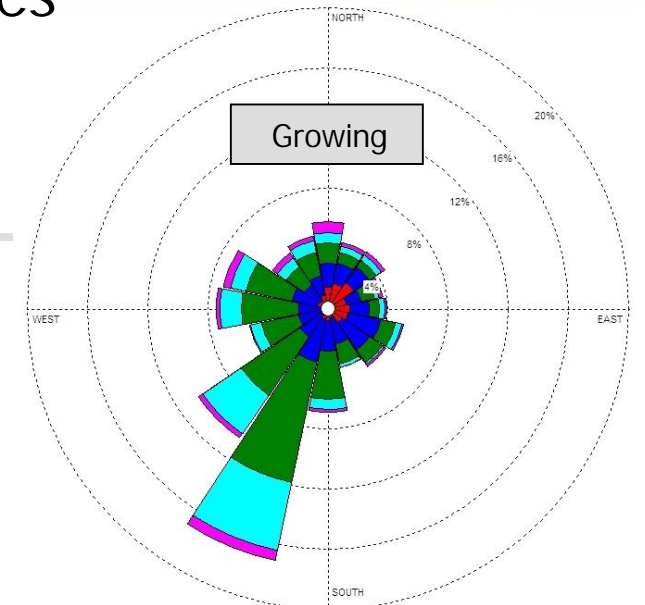
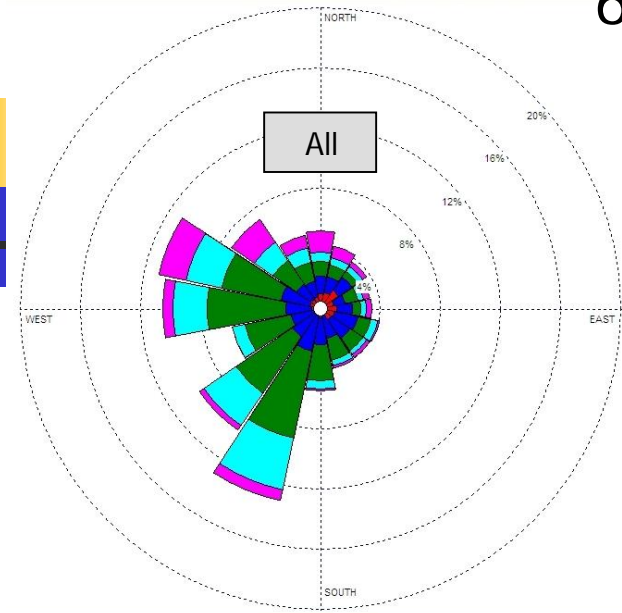
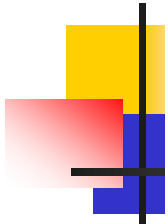
WIND SPEED
(m/s)



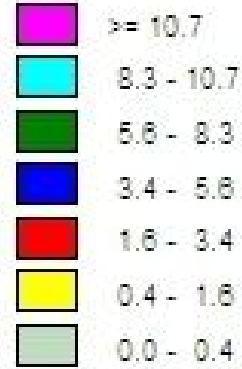
Calms: 0.00%

67-m Wind Roses

Direction from



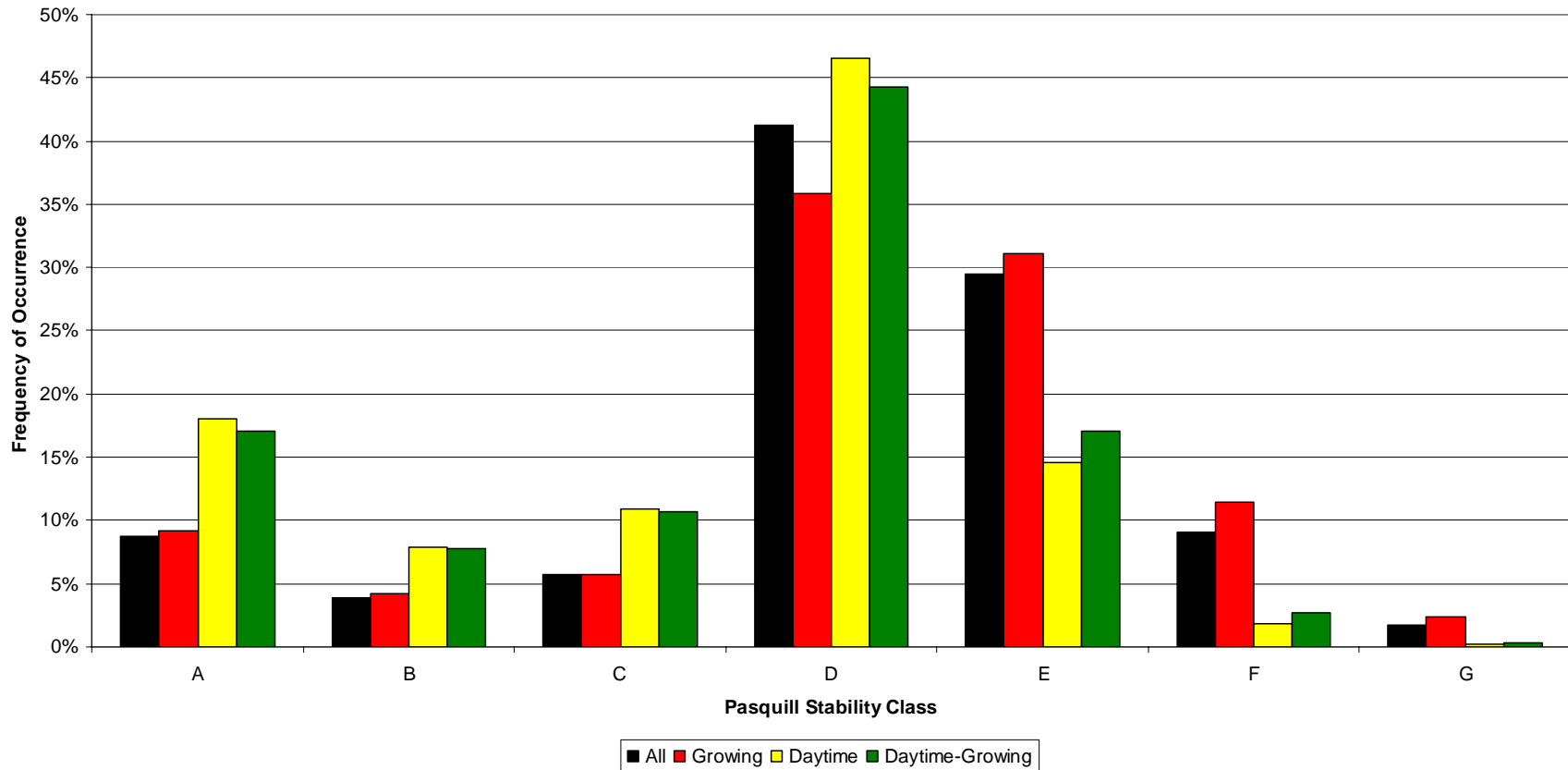
WIND SPEED
(m/s)



Calms: 0.00%

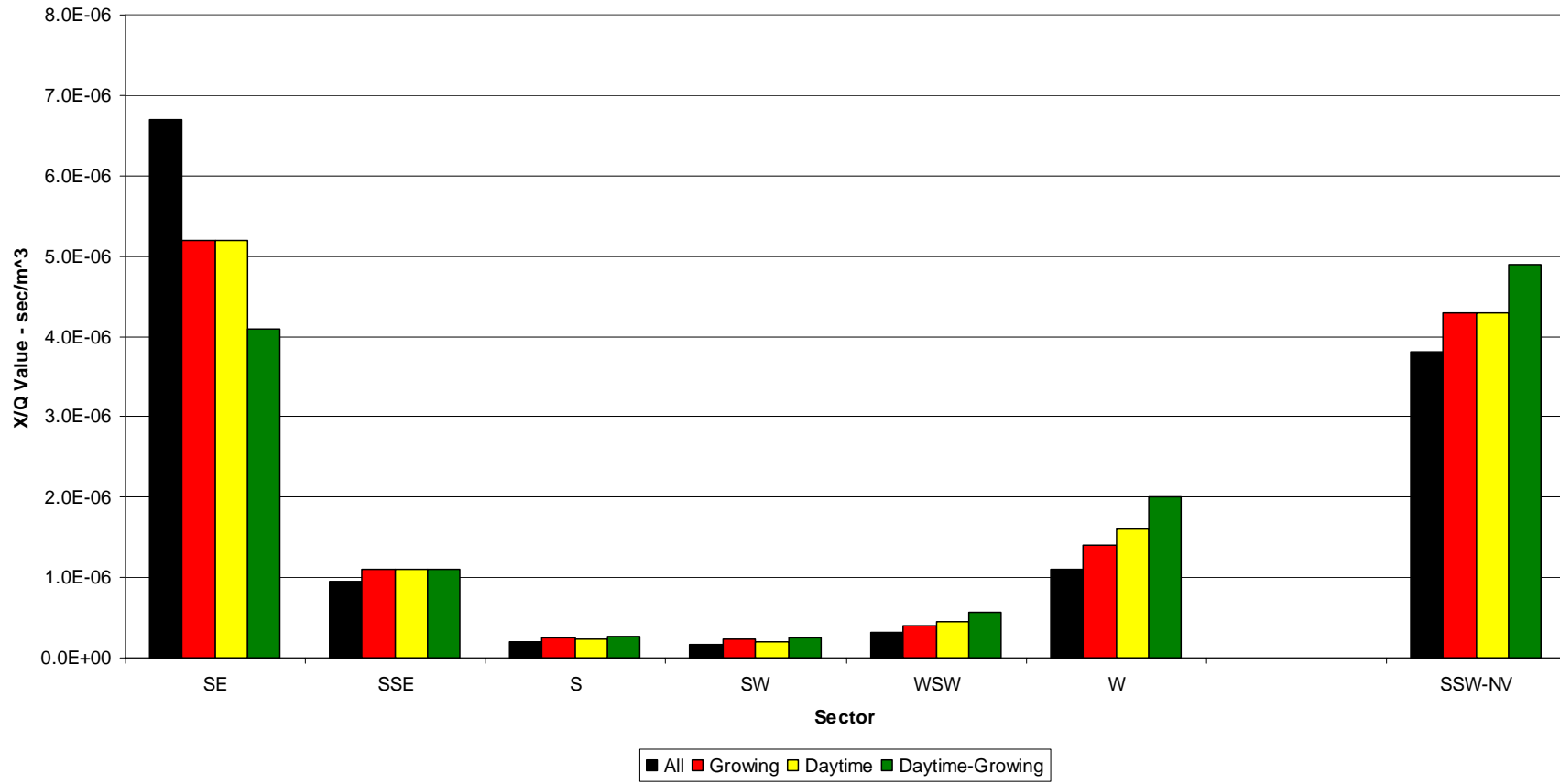
Difference in Meteorology: Pasquill Stability Class

Stability Class Distribution by Meteorology Type



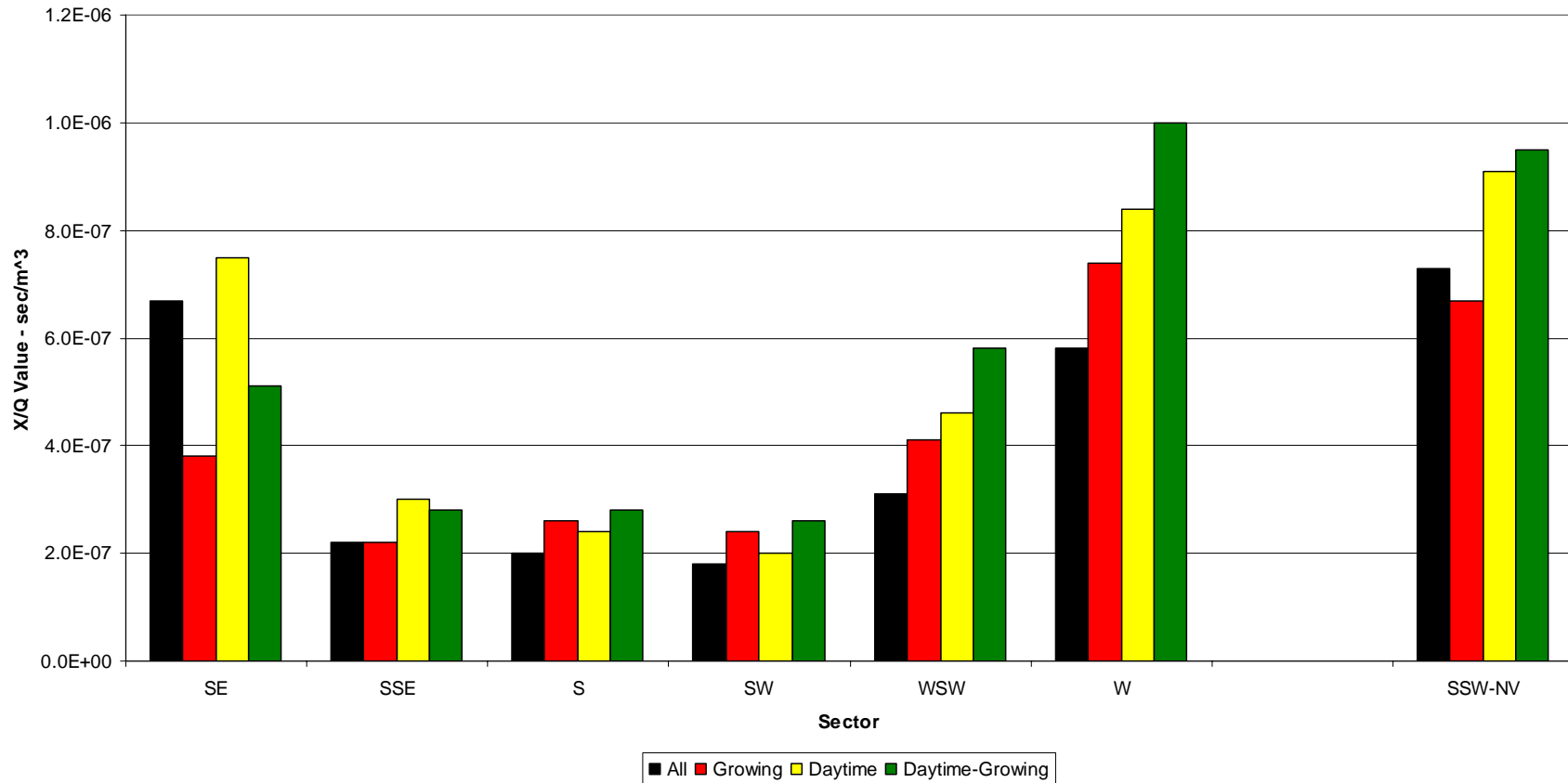
Impact on Dispersion Factor: Ground-level Release – Garden X/Q

Ground-Level Release Garden X/Q



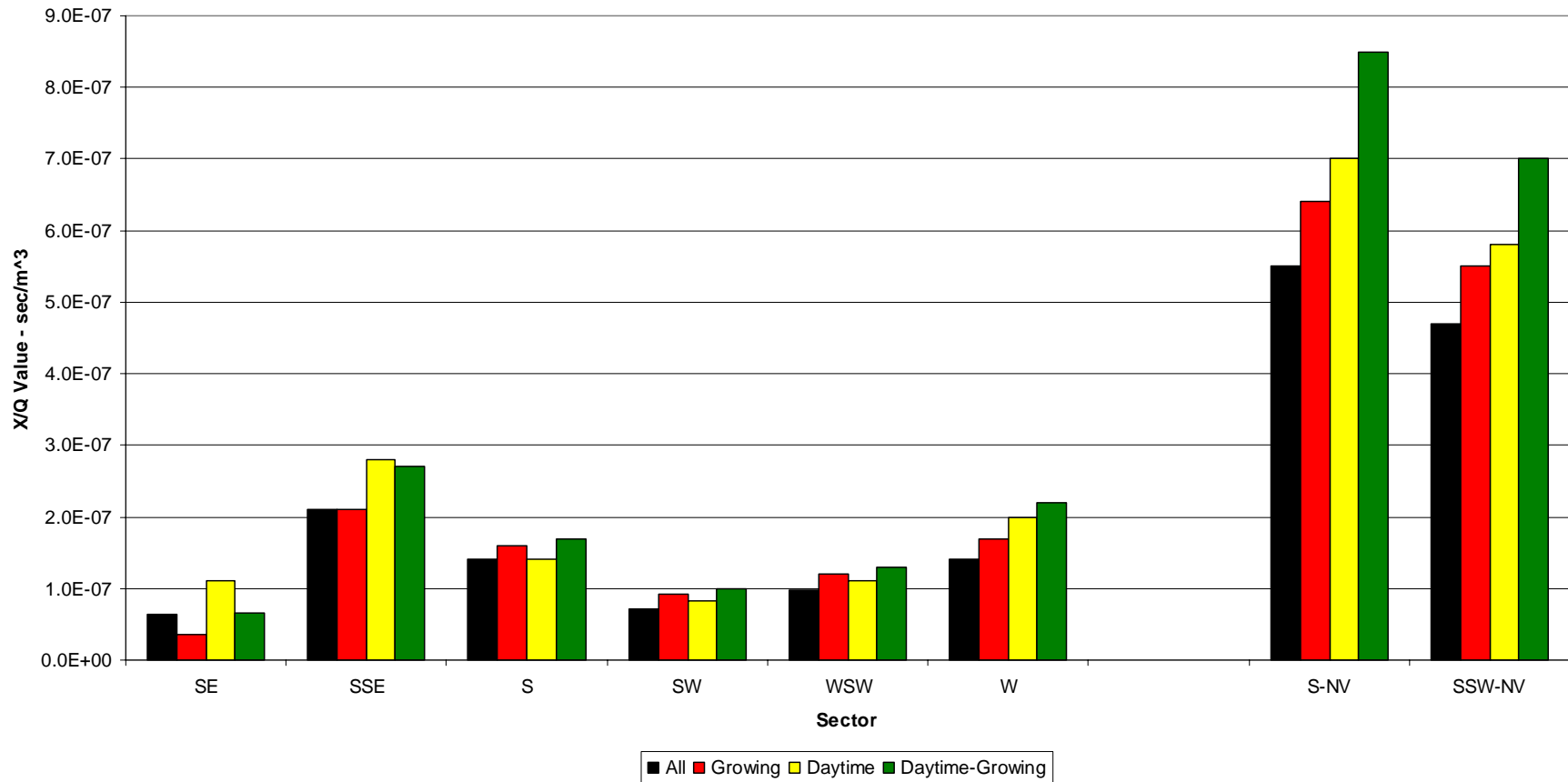
Impact on Dispersion Factor: Mixed-Mode Release – Garden X/Q

Mixed-Mode Release Garden X/Q



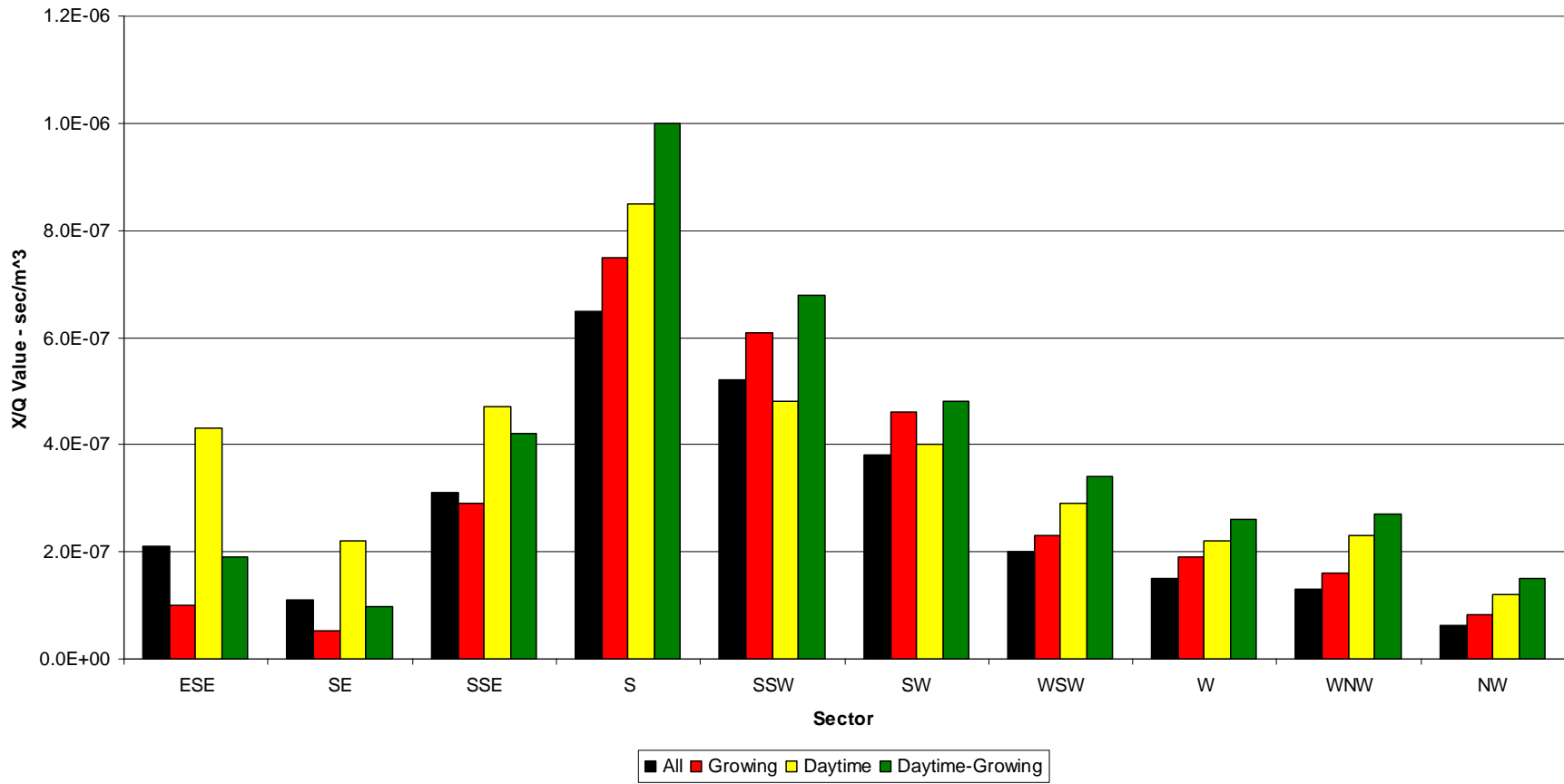
Impact on Dispersion Factor: Elevated Release – Garden X/Q

Elevated Release Garden X/Q



Impact on Dispersion Factor: Elevated Release – Sector Maximum X/Q

Elevated Release Sector Maximum X/Q





Summary

- Use of daytime/growing-season meteorology results in changes in parameters affecting atmospheric dispersion; complex interplay of parameters
 - Slight shifts in frequencies of onshore vs. offshore direction
 - Increase in frequency of lower-speed winds, resulting in less dispersion
 - Shift in frequency of Pasquill stability class to more unstable classes, resulting in greater dispersion



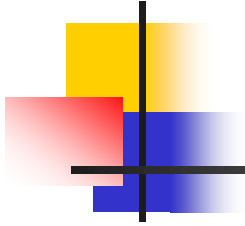
Summary (continued)

- No “one size fits all” approach... have to evaluate X/Q influence on a site-by-site basis
- Daytime effects only applicable to C-14 due to daytime photosynthesis; would not affect particulate activity deposited on vegetation
- Seasonal affects may have some limited impact on particulate activity deposition



Conclusion

- Differences in daytime and seasonal meteorology can result in significant changes (increase or decrease) in X/Q factors used to estimate C-14 concentrations in vegetation... possible significant impact on dose



Questions?