Air Resources Board

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FROM: Vernon Hughes, Manager
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DATE: June 12, 2006

SUBJECT: AIR QUALITY MODELING OF EMISSIONS FROM COMPOSITE WOOD PRODUCTS

Per a request from the Stationary Source Division (SSD), we have completed air quality simulations of the impacts from composite wood emissions using the ISCST3 dispersion model. Details of this work are described below. If you have questions on the analysis, please call me at (916) 324-4069 or call Steve Zelinka of my staff at (916) 445-2199.

Modeling Approach

An analysis was requested to estimate outdoor formaldehyde air concentrations from composite wood products. Composite wood products such as particle board, fiberboard, and plywood can contribute to formaldehyde emissions. These products are sometimes stored in bundles in warehouse-size home repair stores with exposure to outside air through large roll-up doors, or entirely outside in pole barns. Based on this, two scenarios were modeled for which source characteristics were provided by SSD:

- Scenario 1: a warehouse-sized home repair store which houses bundles of wood products and has a large roll-up door to the outside; and
- Scenario 2: a pole barn with a roof but no side walls.

Per SSD direction, specific source characteristics required for modeling were taken from an SSD contract with Battelle, *Determination of Formaldehyde and Tuolene Diisocyanate Emissions from Indoor residential Sources* (1996).

Each source was modeled as a volume source with flagpole receptors 30 meters from the source at heights of 1 meter. A polar receptor grid was used to capture the concentrations 30 meters from the source regardless of wind direction.

Each scenario was run using meteorological data from five historical data sets: Burbank, Fresno, Oakland, San Diego, and Pasadena. These stations were chosen for their representativeness of the diverse land characteristics of California and due to the availability of five years of consecutive data, as recommended by the U.S. EPA Guideline on Air Pollution Models. In the case of Pasadena, only one year of consecutive data was used. The Pasadena 1981 dataset is used frequently by the South Coast Air Quality Management District for modeling purposes; therefore it was included in this analysis.

A screening run had already been performed by SSD staff and was used as a basis of comparison, against which the ISCST3 runs for each scenario and meteorological dataset were compared.

Scenario 1 – Warehouse

The first scenario is a warehouse-size home repair store with a large roll-up door opening to the outside. Per SSD, the door has a height of 4 meters and a width of 7 meters. This results in an initial lateral dimension, for direct input into the ISCST3 model, of:

$$\sigma_{Y0} = 7m / 4.3 = 1.63m$$

and an initial vertical dimension of:

$$\sigma_{Z0} = 4m / 2.15 = 1.86m$$

The release height was 2 meters and the emission rate was 139,159 µg/hr as defined in Battelle 1996. Since emissions to the outside only occur when the door is open during business hours, emissions were only modeled during the hours of 6:00 am and 9:00 pm.

Table 1 shows a summary of meteorological values for the modeled time period at each station. Wind roses are available in Appendix A at the end of this document.

Meteorological Data Summary (6AM to 9PM)			
	Years	Ave	Calms
Burbank	1958-62	2.79 m/s	8.9%
Fresno	1985-89	2.74 m/s	11.6%
Oakland	1960-64	4.54 m/s	7.2%
San Diego	1985-89	3.87 m/s	3.3%
Pasadena	1981	1.52 m/s	13.9%

Table 1. Meteorological summary for all sites between 6am and 9pm

Results for the model runs for each meteorological dataset for the warehouse scenario are summarized in Table 2. The 1-hr maximum value as well as the annual average concentration is listed for each run. Additionally, the screening case results are listed for comparison.

Scenario 1 - Warehouse				
	Years	1-Hr Max	Annual Ave	Units
SCREEN	--	0.53	0.042	ug/m**3
Burbank	1958-62	0.5297	0.0196	ug/m**3
Fresno	1985-89	0.5143	0.0160	ug/m**3
Oakland	1960-64	0.5143	0.0119	ug/m**3
San Diego	1985-89	0.3432	0.0151	ug/m**3
Pasadena	1981	0.5297	0.0225	ug/m**3

Table 2. Results for the warehouse scenario model runs

As seen in Table 2, the 1-hr maximum values at all sites except San Diego approach the worst case value from the screening run. Pasadena had the highest annual average concentration at 0.0225 µg/m^3.

Scenario 2 – Pole Barn

The second scenario is a pole barn, which is a pole-supported roof without any walls. Per SSD, the bundle of wood products from which emissions are emanating has dimensions 7.3 meters laterally and 2.4 meters vertically. This results in an initial lateral dimension of:

$$\sigma_{Y0} = 7.3m / 4.3 = 1.7m$$

and an initial vertical dimension of:

$$\sigma_{Z0} = 2.4m / 2.15 = 1.1m$$

Also, per SSD, the release height was 1.2 meters and the emission rate was 131,472 µg/hr as defined in Battelle 1996. Since the wood bundles are housed outside, emissions were modeled for all 24 hours of the day.

Table 3 shows a summary of meteorological values for the modeled time period at each station. Wind roses are available in Appendix A at the end of this document.

Meteorological Data Summary (All Hours)			
	Years	Ave	Calms
Burbank	1958-62	2.44 m/s	13.2%
Fresno	1985-89	2.64 m/s	14.3%
Oakland	1960-64	4.03 m/s	10.6%
San Diego	1985-89	3.34 m/s	6.1%
Pasadena	1981	1.27 m/s	21.9%

Table 3. Meteorological summary for all sites for all hours

Results for the model runs for each meteorological dataset for the pole barn scenario are summarized in Table 4. The 1-hr maximum value as well as the annual average concentration is listed for each run. Additionally, the screening case is listed for comparison.

Scenario 2 - Pole Barn				
	Years	1-Hr Max	Annual Ave	Units
SCREEN	--	0.62	0.05	ug/m**3
Burbank	1958-62	0.6234	0.0337	ug/m**3
Fresno	1985-89	0.6234	0.0385	ug/m**3
Oakland	1960-64	0.6234	0.0199	ug/m**3
San Diego	1985-89	0.6234	0.0268	ug/m**3
Pasadena	1981	0.6234	0.0426	ug/m**3

Table 4. Results for the pole barn scenario model runs

As seen in Table 4, the 1-hr maximum values at all sites reach the worst case value from the screening run. This scenario also produces higher concentrations than the warehouse. Pasadena had the highest annual average concentration at 0.0426 µg/m^3.

Summary

The impacts of formaldehyde emissions from composite wood products were evaluated using the U.S. EPA air dispersion model ISCST3 v02035. SSD provided specific

definitions of source and receptor configurations. Two scenarios were analyzed, each with receptors 30 meters downwind from the source.

The first scenario is a warehouse-sized home repair store containing composite wood products. The warehouse has a large roll-up door open to the outside from 6am to 9pm. Five cases were run using meteorological data from a diverse range of areas representative to California. Most of these runs resulted in maximum 1-hour concentrations near the worst case screening value of 0.53 $\mu g/m^3$. The highest annual average concentration was 0.0225 $\mu g/m^3$ for Pasadena.

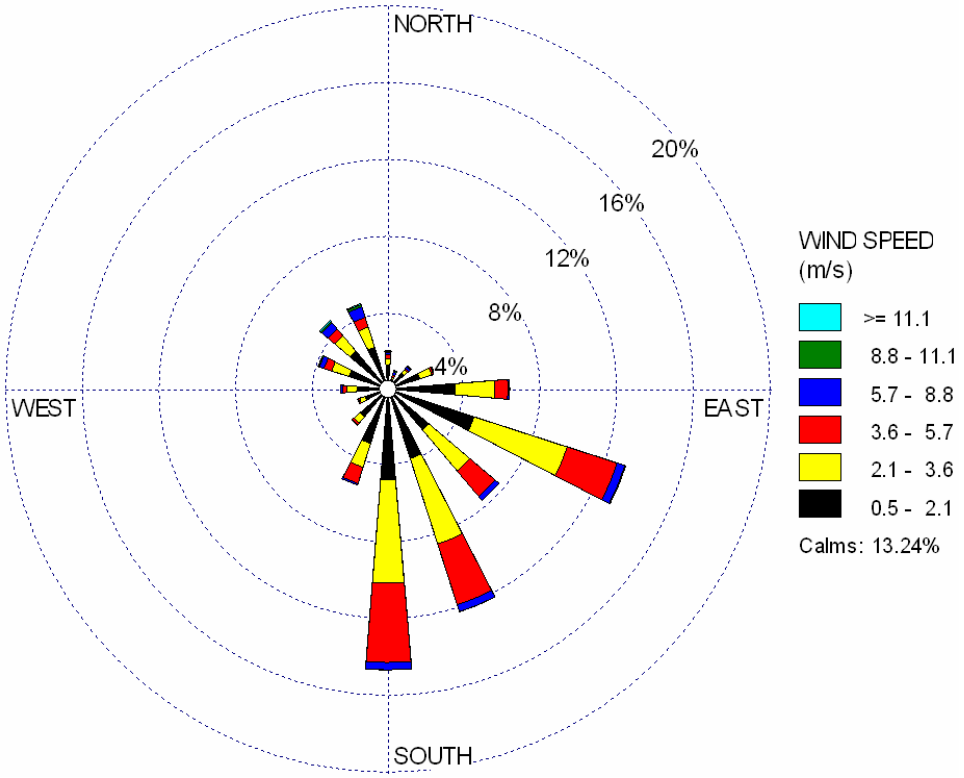
The second scenario is an outdoor pole barn that has a roof but is open on all sides and contains bundles of particleboard. In this case, emissions occurred 24 hours a day. All of the runs resulted in maximum 1-hour concentrations near the worst case screening value of 0.62 $\mu g/m^3$. The highest annual average concentration was 0.0426 $\mu g/m^3$ for Pasadena.

References

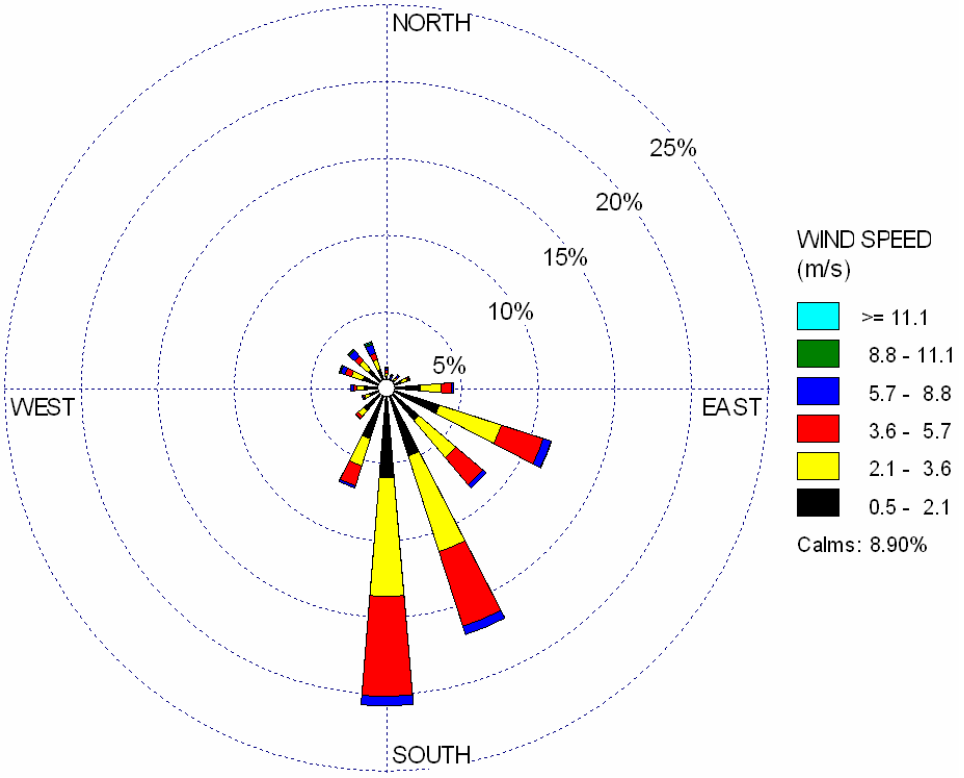
Determination of Formaldehyde and Toluene Diisocyanate Emissions from Indoor Residential Sources, Battelle, Columbus, Ohio, prepared for CARB under contract number 93-315, Nov. 1996.

CC: John DaMassa, PTSD
Steve Zelinka, PTSD
Tony Servin, PTSD

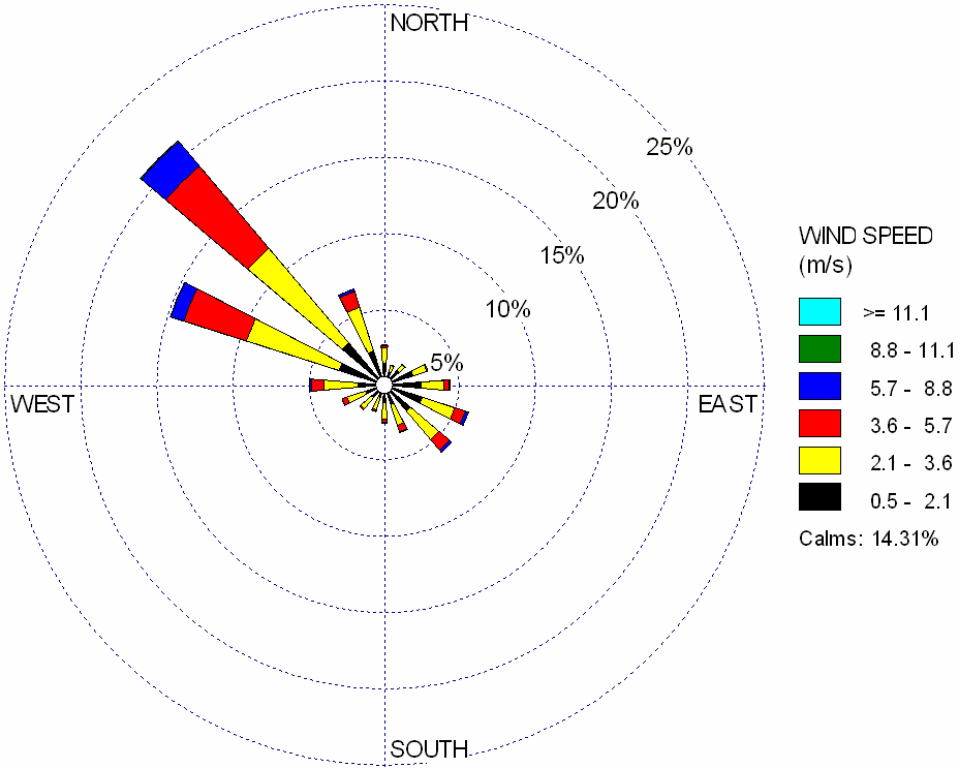
Burbank, CA Wind Rose 1958-62 (All Hours)



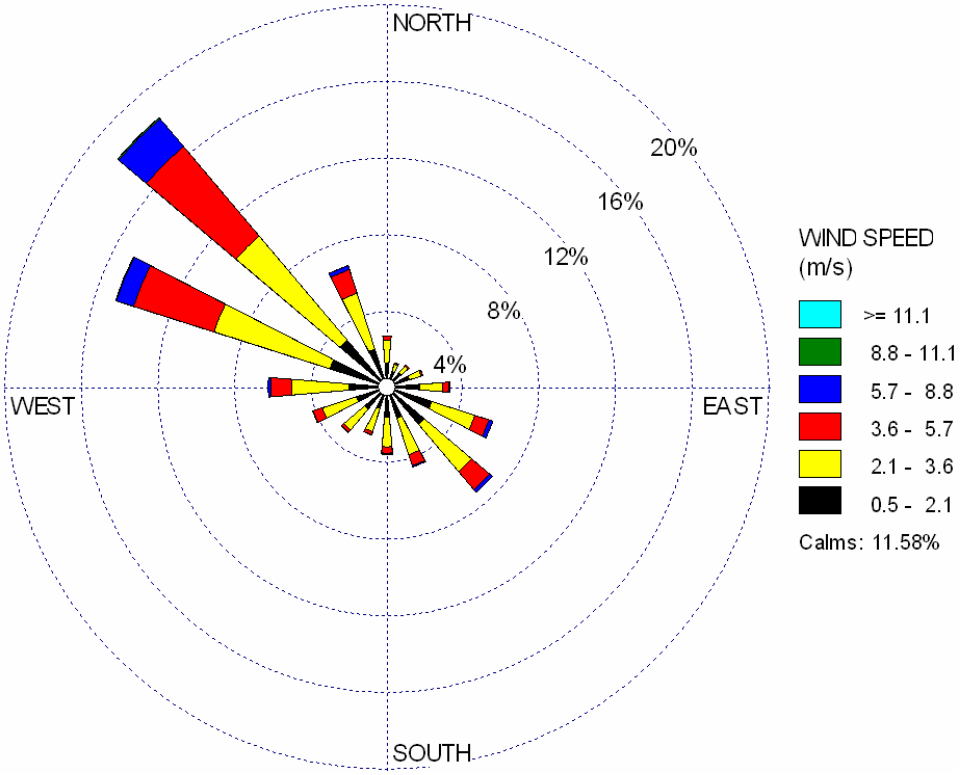
Burbank, CA Wind Rose 1958-62 (6am – 9pm)



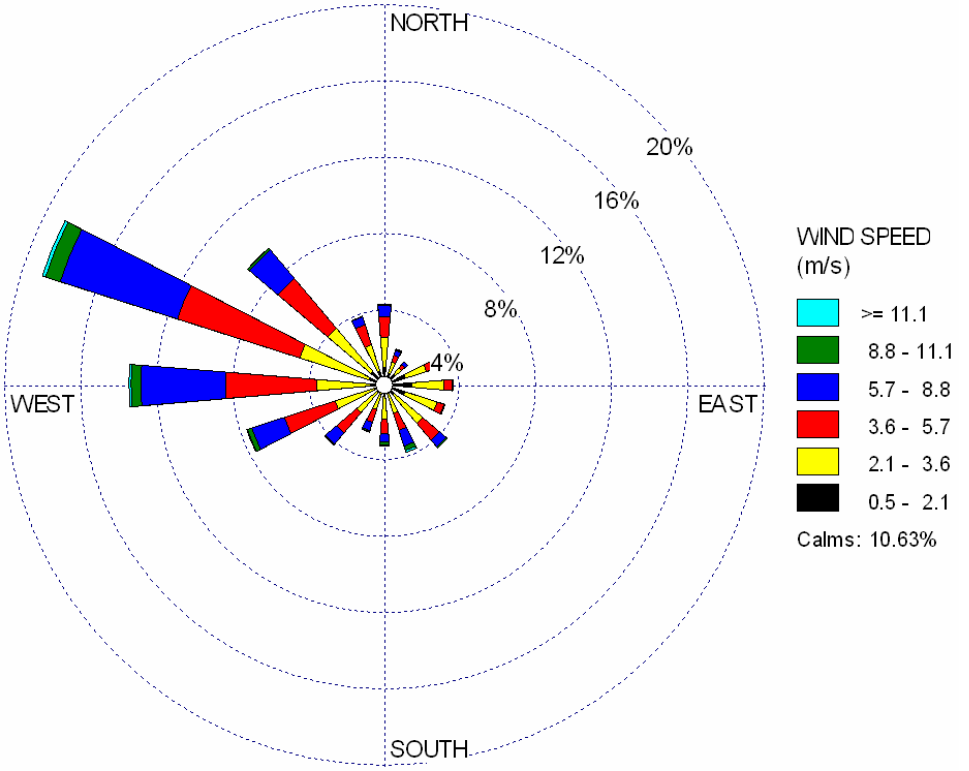
Fresno, CA Wind Rose 1985-89 (All Hours)



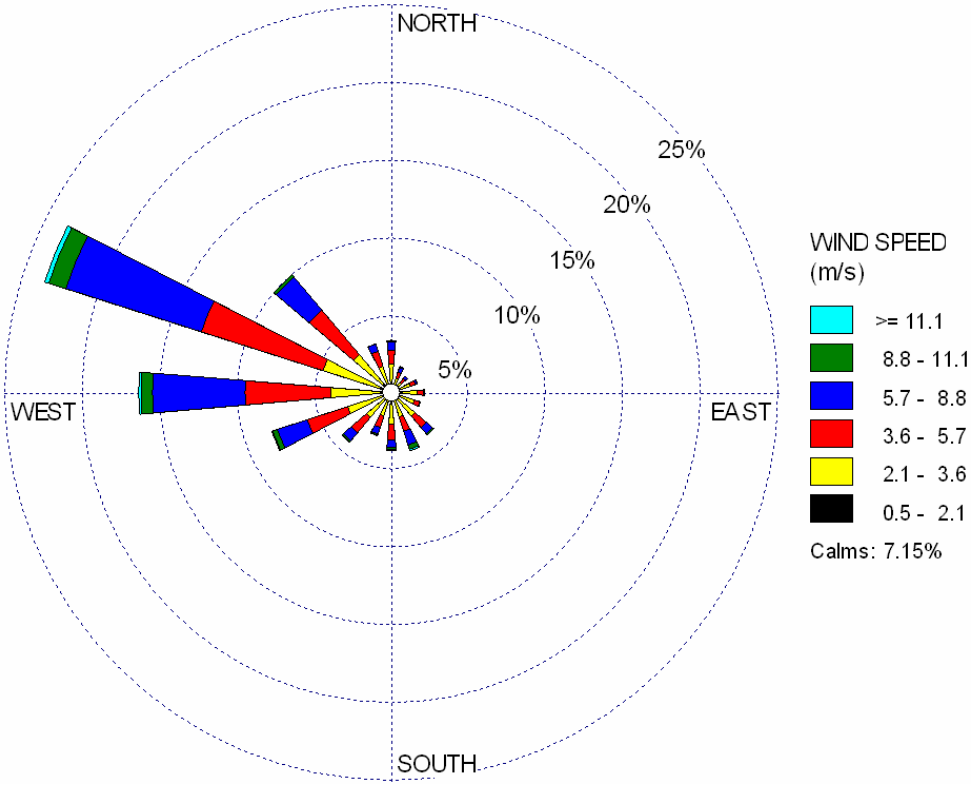
Fresno, CA Wind Rose 1985-89 (6am – 9pm)



Oakland, CA Wind Rose 1960-64 (All Hours)

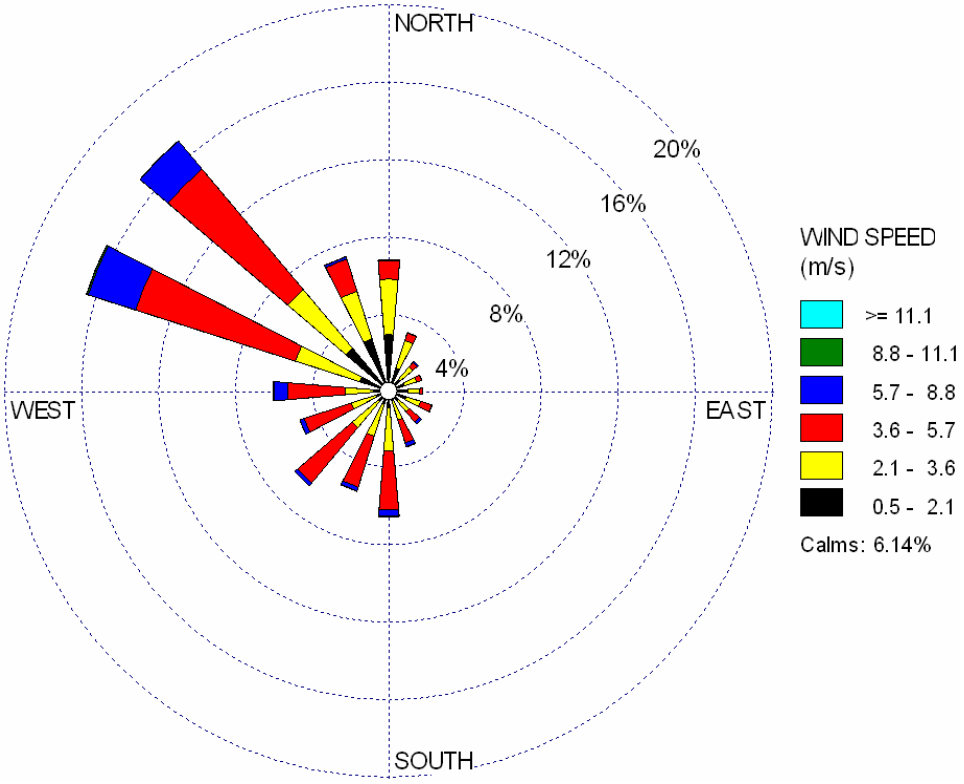


Oakland, CA Wind Rose 1960-64 (6am – 9pm)

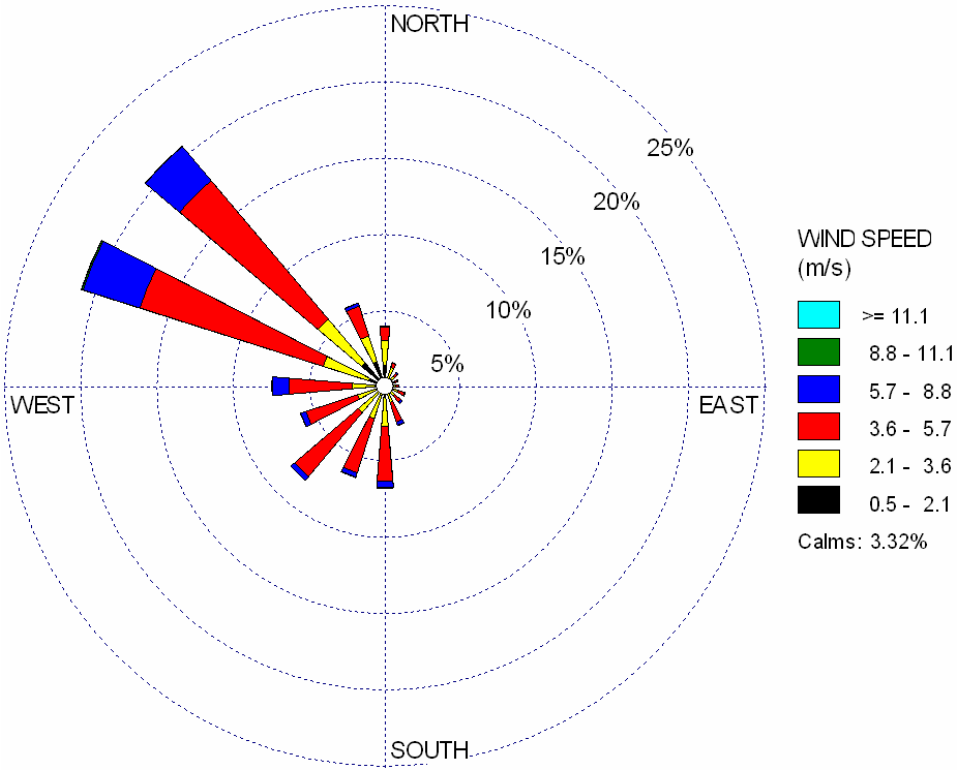


San Diego, CA Wind Rose 1985-89 (All Hours)

Appendix A

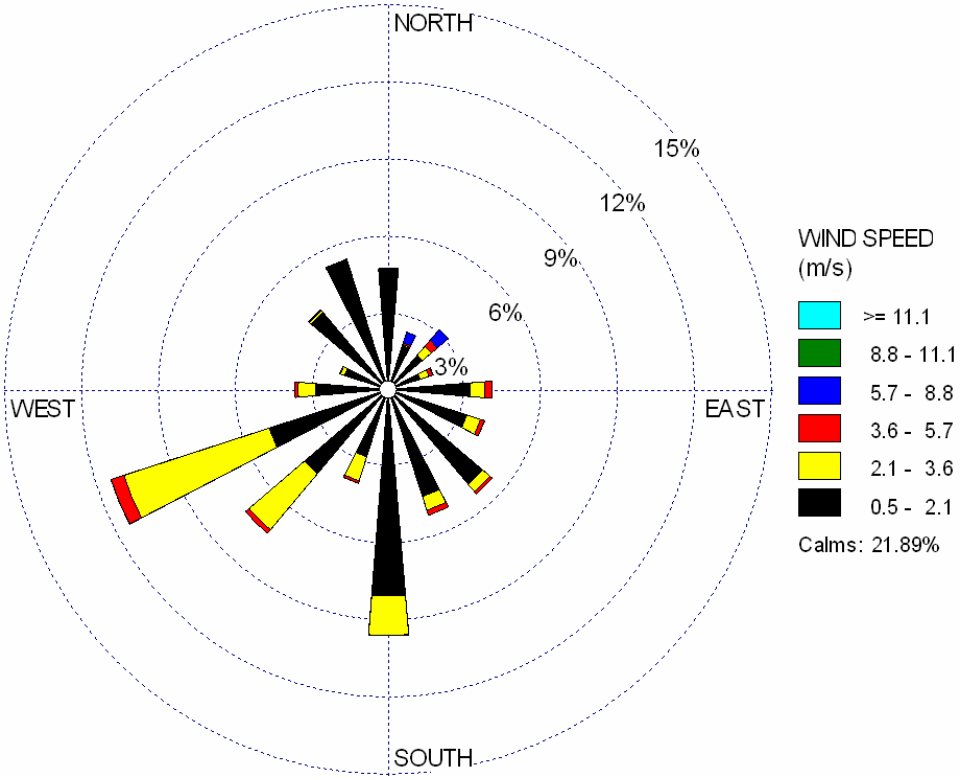


San Diego, CA Wind Rose 1985-89 (6am – 9pm)



Pasadena, CA Wind Rose 1981 (All Hours)

Appendix A



Pasadena, CA Wind Rose 1981 (6am – 9pm)