The Christmas Day Storm of 2011 in Western Washington and Southwest British Columbia

A Synoptic Analysis

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Outline

- Forecast winds vs. actual
- Synoptic analysis
- Mesoscale surface analysis
- High-wind distribution
## Forecast Winds and the Outcome

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This is admittedly a very basic examination, ignoring wind direction and timing.
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The forecast worked well for these locations
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Oops! These areas had much stronger winds than expected.

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High-wind criteria gust in the Seattle Area
Forecast Winds and the Outcome

Wind gusts at or very close to high-wind criteria:

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<th>Maximum Gust</th>
<th>Time (PST)</th>
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<td>Burien (Public)</td>
<td>28 m s⁻¹ (55 kts)</td>
<td>1122</td>
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<tr>
<td>Everett (KPAE)</td>
<td>25 m s⁻¹ (49 kts)</td>
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<td>Bellingham (KBLI)</td>
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Data Courtesy of NOAA ADDS and NWS Seattle

No high wind watch or warning for interior areas that received high wind criteria gusts

No wind advisory issued for interior sections
Synoptic Analysis
1200 UTC (0400 PST) 25 Dec 2011

Map courtesy of NOAA NCEP
Synoptic Analysis
1200 UTC (0400 PST) 25 Dec 2011

Fading Haida Gwaii low

Map courtesy of NOAA NCEP
Synoptic Analysis
1200 UTC (0400 PST) 25 Dec 2011

Position of Frontal System

Map courtesy of NOAA NCEP
Synoptic Analysis

1200 UTC (0400 PST) 25 Dec 2011

Front in a well-defined baroclinic region

Map courtesy of NOAA NCEP
Synoptic Analysis
1200 UTC (0400 PST) 25 Dec 2011

Front also on the east side of a strong upper-level trough

Map courtesy of NOAA NCEP
Synoptic Analysis
1200 UTC (0400 PST) 25 Dec 2011

Front is also under a jet maximum with diffuence aloft

Map courtesy of NOAA NWS Storm Prediction Center
Synoptic Analysis
1200 UTC (0400 PST) 25 Dec 2011
All these ingredients point to a case of “attempted” cyclogenesis

Map courtesy of NOAA NWS Storm Prediction Center
Surface Analysis
25 Dec 2011 Windstorm
Remnants of warm sector from a storm system that moved to the north 24 h previous.
Surface Analysis
25 Dec 2011 Windstorm

As SE winds build ahead of incoming cold front, relatively warm air in place begins migrating north as a mesoscale warm front in the NW Interior.
Surface Analysis
25 Dec 2011 Windstorm

Strong preferential pressure falls along cold front enhance gradient along boundary.
In fact a closed 100.7 kPa isobar is justifiable, another indication of attempted cyclogenesis.
Surface Analysis

25 Dec 2011 Windstorm
Surface Analysis
25 Dec 2011 Windstorm

Strong preferential pressure falls along front force an E to ESE pressure slope over the Lower Mainland and Georgia Strait and SE over Puget Lowlands.
Winds accelerate at SE-wind-prone locations in response to strengthening SE pressure slope over the NW Interior.
On the coast, fastest winds arrive with cold front, where the strongest pressure gradient exists.
Surface Analysis
25 Dec 2011 Windstorm
Surface Analysis
25 Dec 2011 Windstorm

As front moves inland, strong preferential pressure falls relax south of Nanaimo, altering pressure slopes.
Surface Analysis

25 Dec 2011 Windstorm

Pressure slope becomes more S over the NW Interior and Puget Lowlands, supporting strong winds
Surface Analysis

25 Dec 2011 Windstorm

As warm sector reached Abbotsford and pressure slope became more favorable, strong SSE to S winds strike the area.
Vancouver and Victoria both seem to have missed the strongest pressure gradient, and were not visited by the warm sector, factors reducing high-wind potential.
Strong SW pressure slope supports a gale through the Strait of Juan de Fuca
Surface Analysis
25 Dec 2011 Windstorm
Surface Analysis
25 Dec 2011 Windstorm
Surface Analysis

25 Dec 2011 Windstorm
Peak Gusts
25 Dec 2011 Windstorm
Peak Gusts
25 Dec 2011 Windstorm

High winds mostly restricted to a small area where strongest gradients occurred

S or W (depending on pre- or post-cold front)
Peak Gusts
25 Dec 2011 Windstorm

Areas prone to post-frontal W to WNW winds during a SW pressure slope also received high-wind gusts
Thank You

Wolf Read
wolfread@me.com

Funding:
- BC Hydro
- NSERC
• Slides that follow were removed from the original presentation
What is this?

A feature racing ahead of the front causes an initial dip in pressure at many stations and appears to be associated with the onset of precipitation in some areas.
Detailed Windstorm Analyses 1994-2011

25 Dec 2011 Windstorm

What is this?
The feature is analyzed as an upper trough here, but could it be an upper front instead?

In any event, the feature is unusual.
Detailed Windstorm Analyses 1994-2011

25 Dec 2011 Windstorm

Classic Olympic Mountain lee low with weak cyclonic circulation indicated at several stations in the vicinity: Southerly upper-air flow supports this feature.
Detailed Windstorm Analyses 1994-2011

25 Dec 2011 Windstorm

Unusual upper feature has moved well inland by this time

Surface Map
1800 UTC 25 Dec 2011
Temperature & Dew Point °C
Pressure kPa
Wind 2.5 m/s per half-barb
Forecast Winds and the Outcome

• From the 0920 PST AFD:
  “THE SYSTEM LOOKS WEAK ON SATELLITE IMAGERY
  BUT PRETTY VIGOROUS ON THE COASTAL RADAR...”

• Perhaps the radar offered a hint that could
  have aided in a more accurate wind forecast?