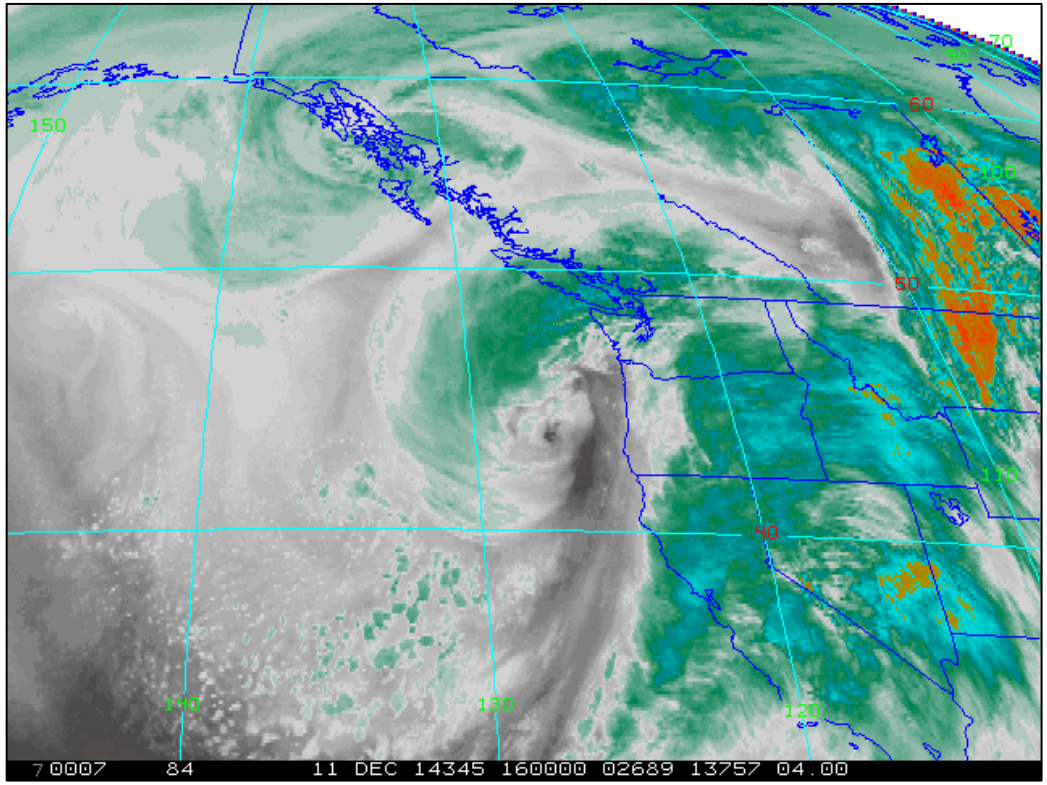
Preliminary Climatological Analysis of the 11 Dec 2014 Classic Windstorm



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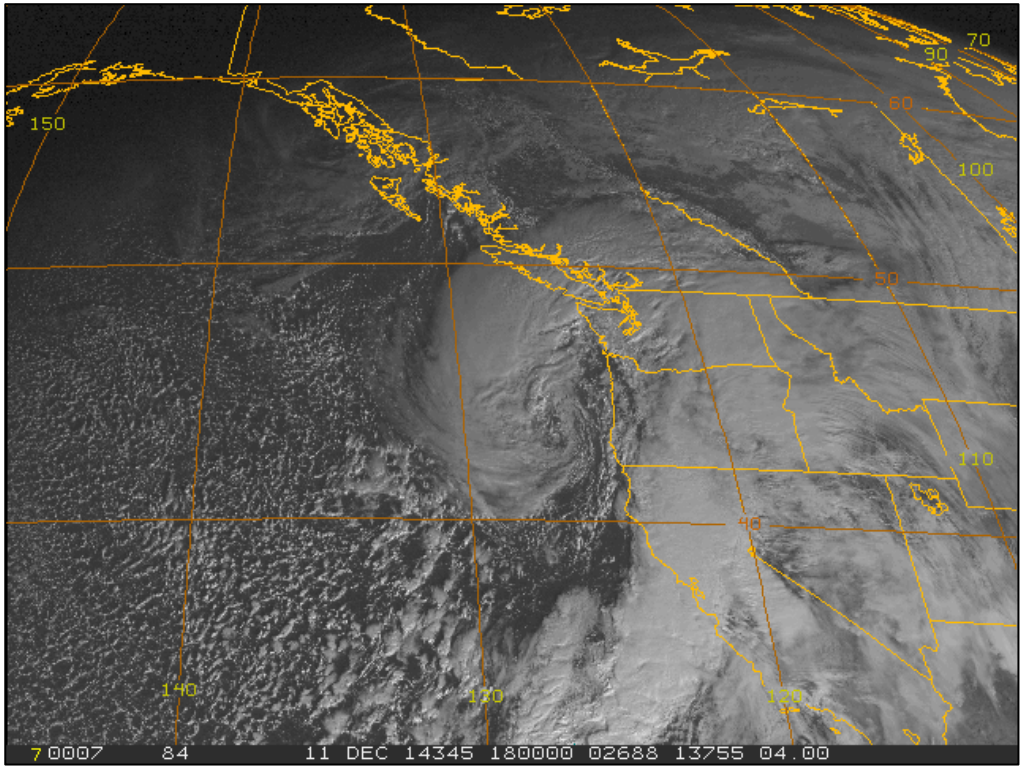
Outline

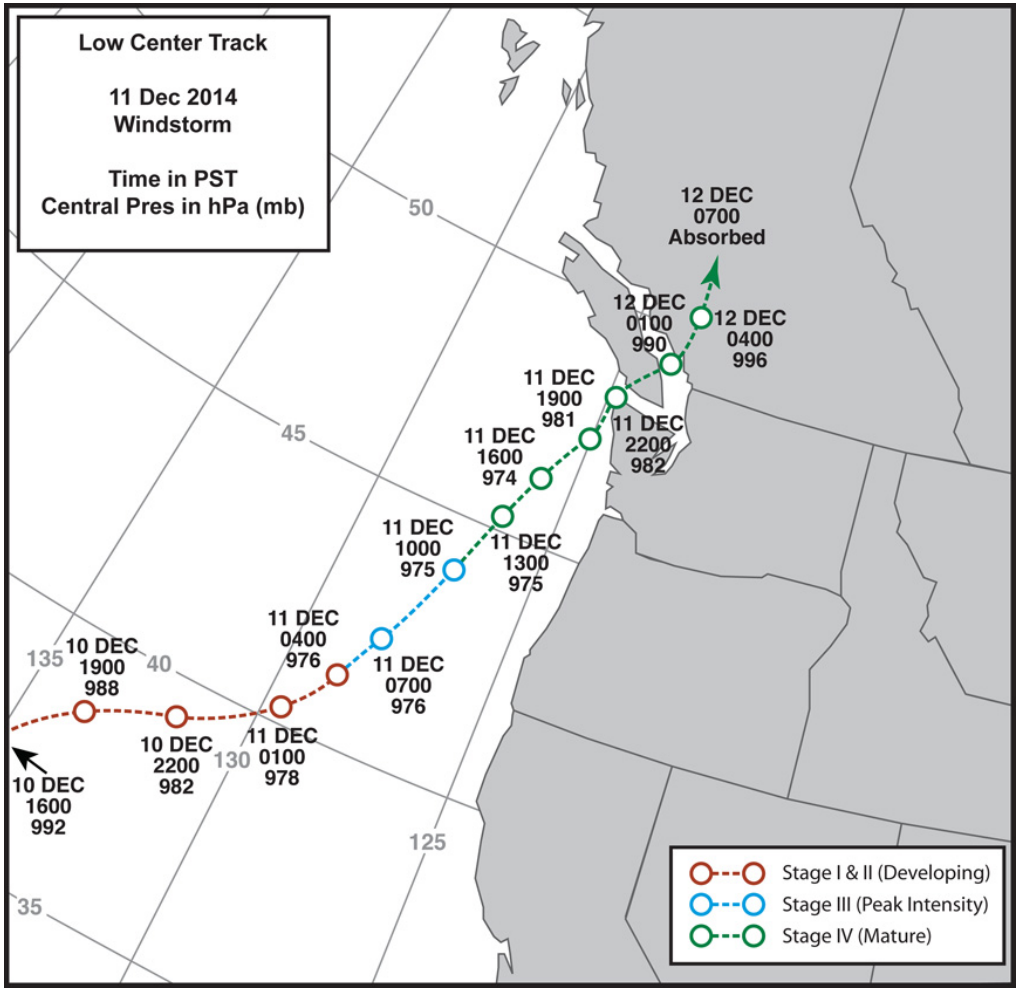
- Track for the 11 Dec 2014 windstorm
- Intercomparison with historic tracks
- Peak gusts
- Intercomparison with historic windstorms



The extratropical cyclone at near peak intensity off the Southwest Oregon coast at 1000 PST on 11 Dec 2014.

Storm Track

- The extratropical cyclone (ETC) rapidly deepened late on 10 Dec 2014
- Deepening rates of 1-2 hPa h^{-1} for nearly 9 h
- For a time, the ETC met the requirements for explosive cyclogenesis
  - This was not sustained for 24 h, however

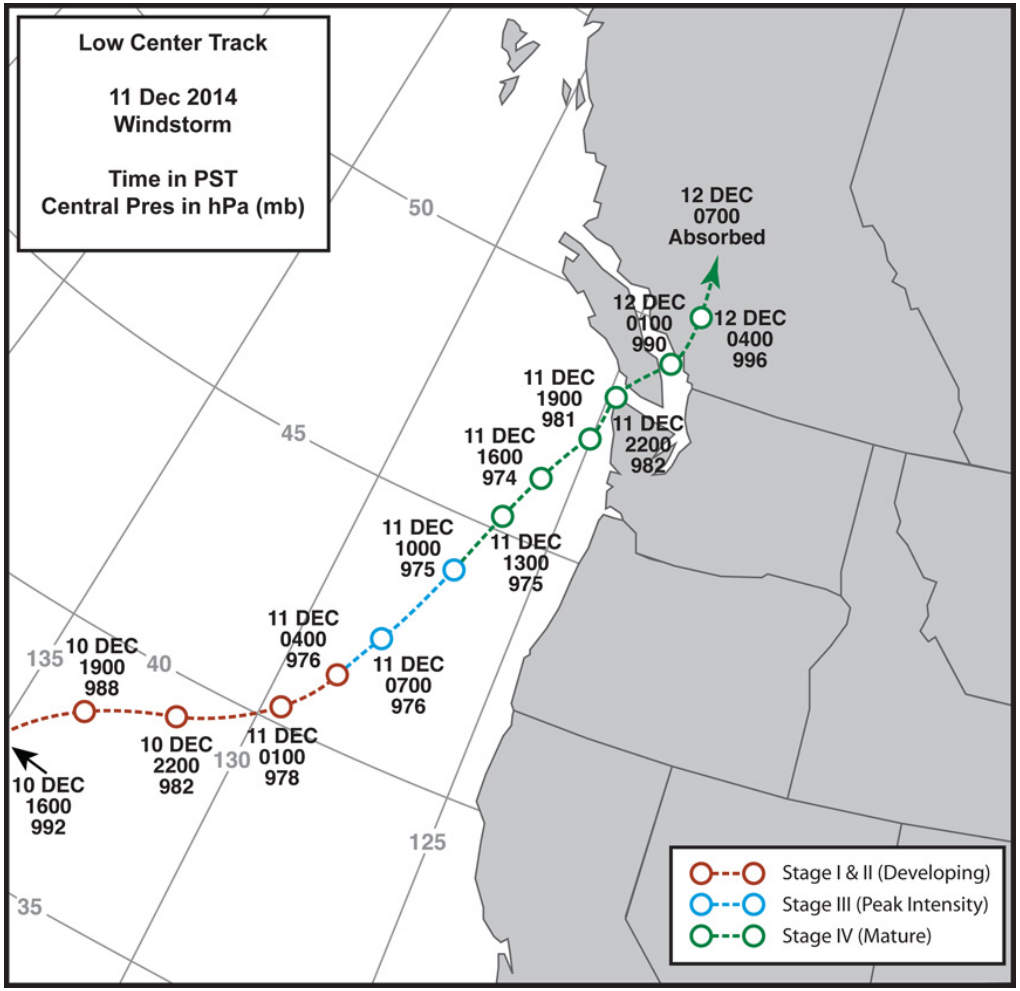


Storm track is based on the NOAA Weather Prediction Center 3-hourly surface analyses.

Storm Track

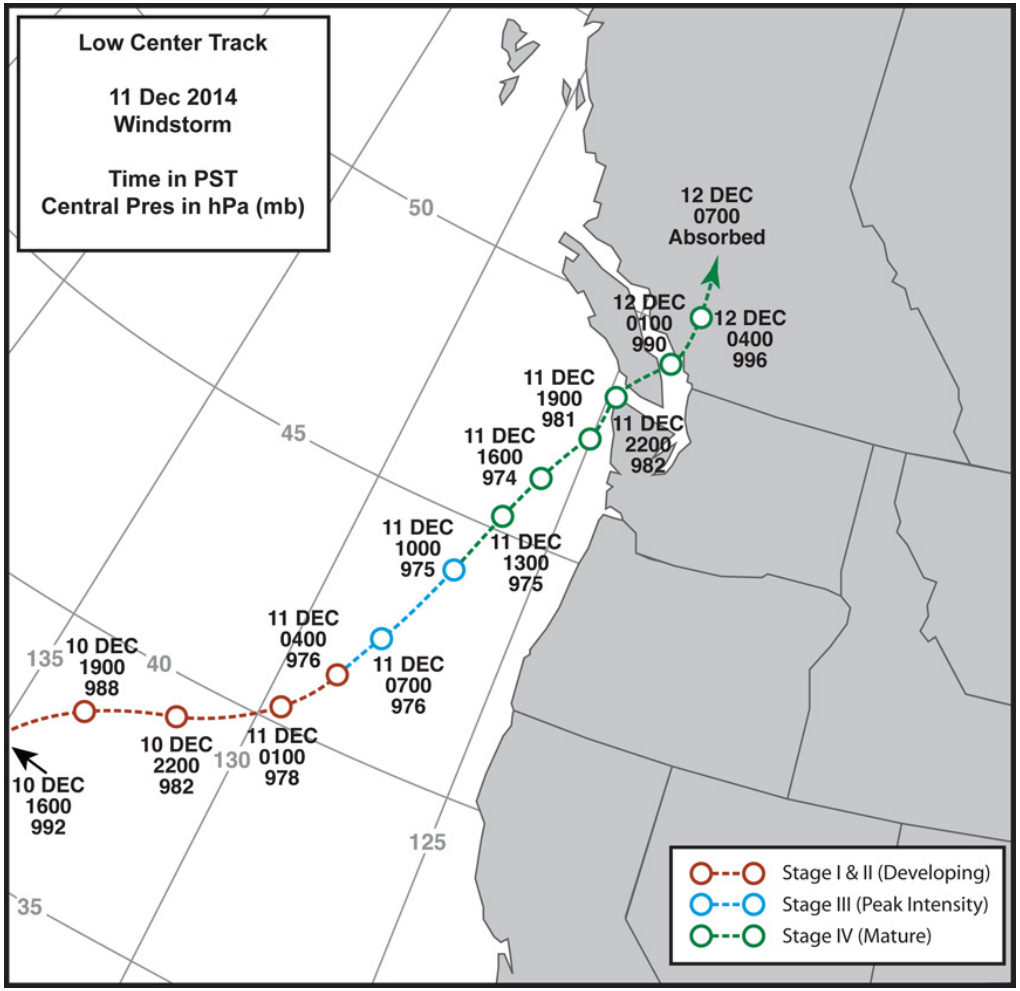
- Low tracked ENE and then “recurved” to the NNE off of the north California coast

- This is the classic path, notorious for being associated with some of the region’s biggest windstorms



Storm Track

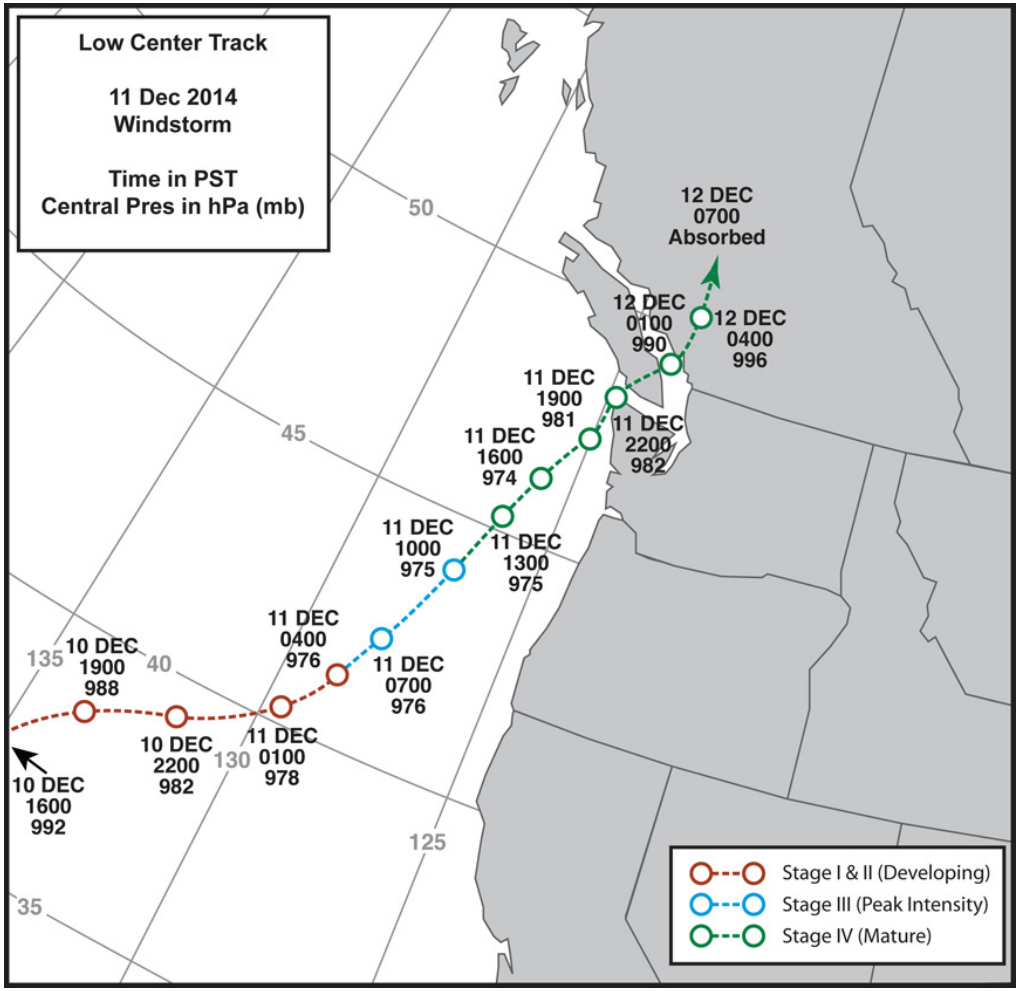
- The cyclone development stages are based on Shapiro and Keyser (1990)
- I used satellite interpretation in tandem with central pressure tendencies
  - The method is imperfect, but probably reasonably close



Shapiro, M. A. and D. Keyser, 1990: Fronts, jet streams, and the tropopause. Extratropical Cyclones, The Erik Palmén Memorial Volume, C. W. Newton and E. Holopainen, Eds., Amer. Meteor. Soc. 167-191.

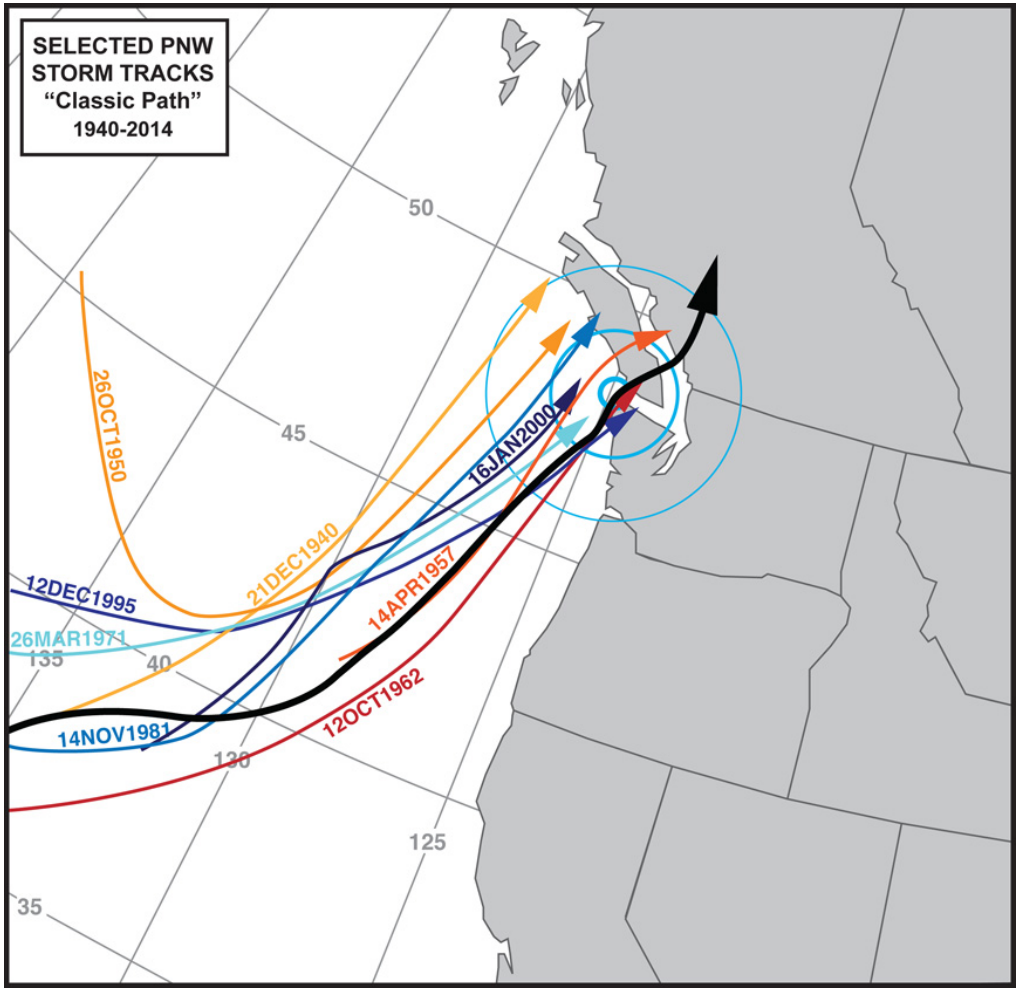
Storm Track

- The ETC reached peak intensity as it reached the latitude of Southwest Oregon
- Reached the mature "warm-core seclusion" stage as it tracked north of Newport



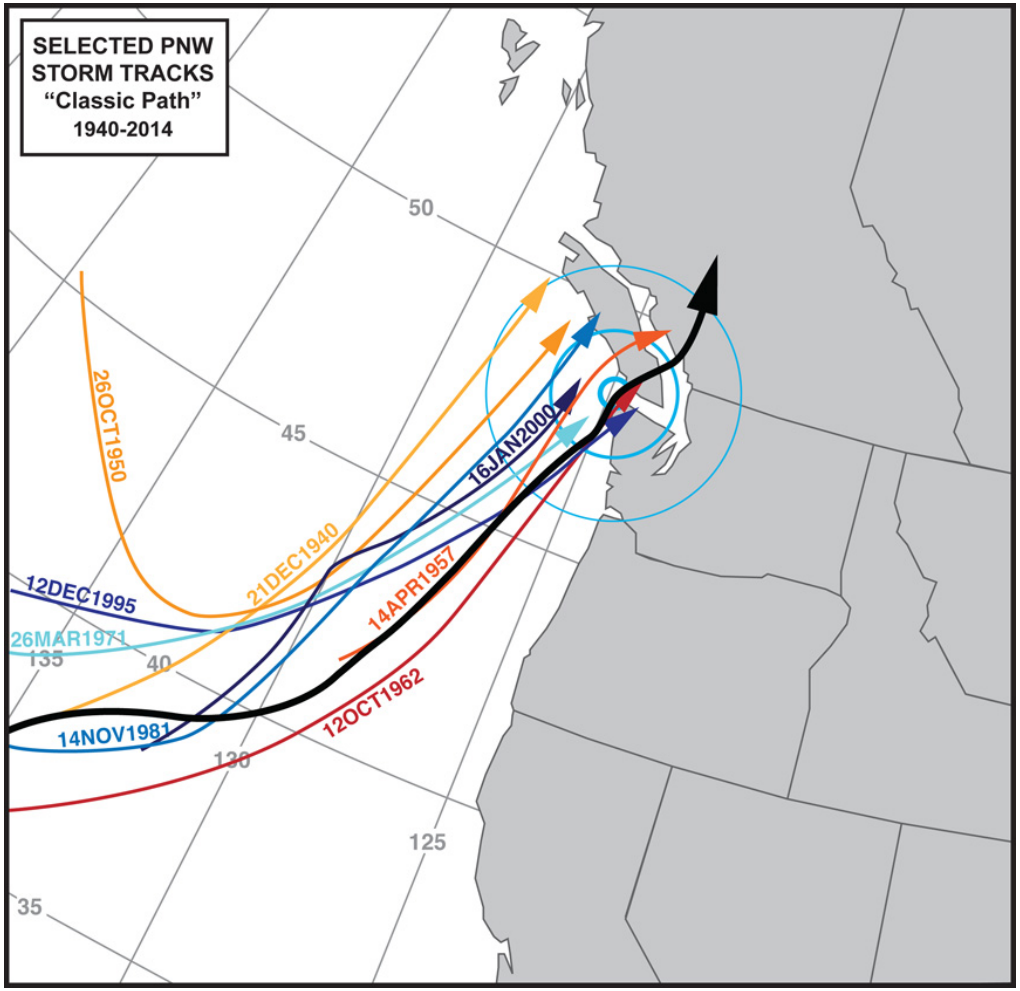
Storm Track

- The 11 Dec 2014 ETC is depicted by the heavy black line
- The blue circles denote the “sweet spot” where many high-wind generating ETCs track



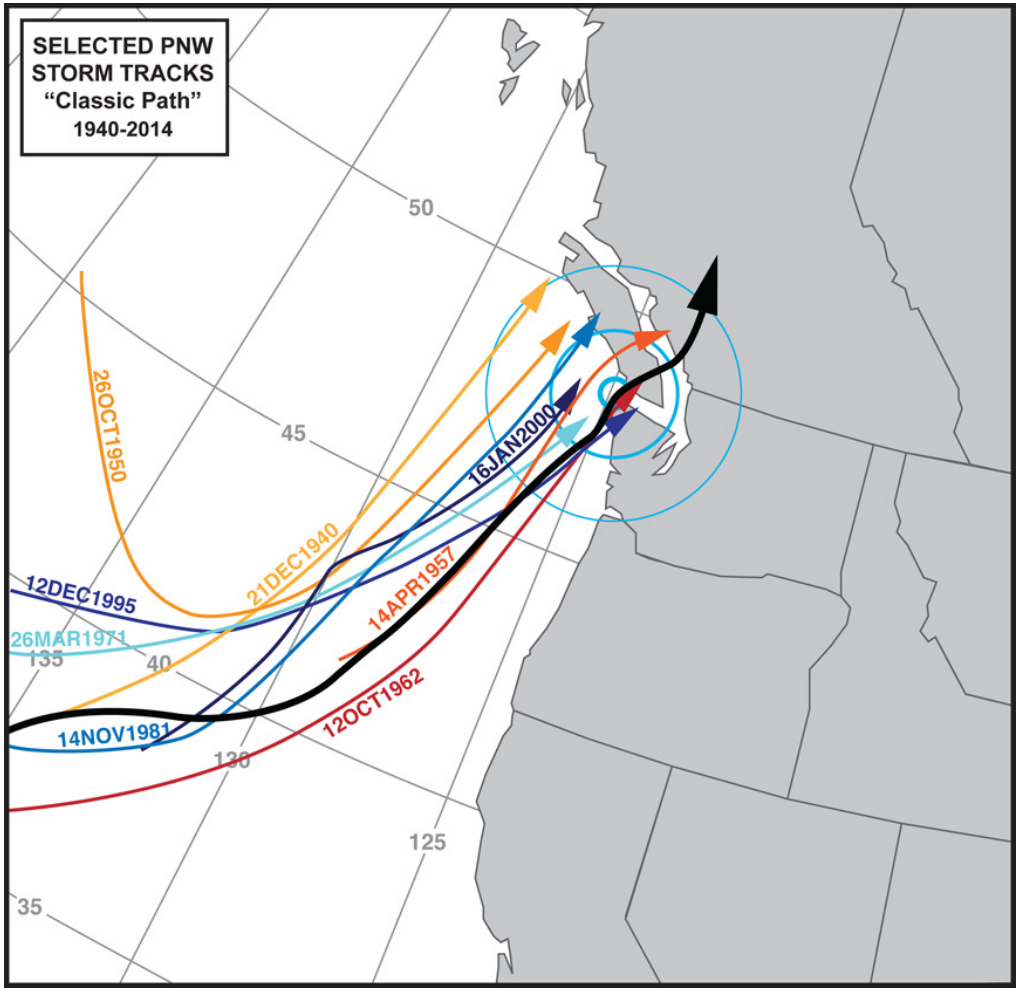
Storm Track

- The low began on the track of 21 Dec 1940
- Then shifted over to the 14 Apr 1957 path
- And finally ended up on the 12 Oct 1962 track
  - Thus hitting the bullseye



Storm Track

- The 11 Dec 2014 windstorm was not too far off the infamous 12 Oct 1962 tempest
- The closest we have experienced in decades
- Neither 14 Nov 1981 or 12 Dec 1995 were as close
  - Though these two ETCs had much deeper central pressures at their peak depth, perhaps accounting in part for the difference in impact

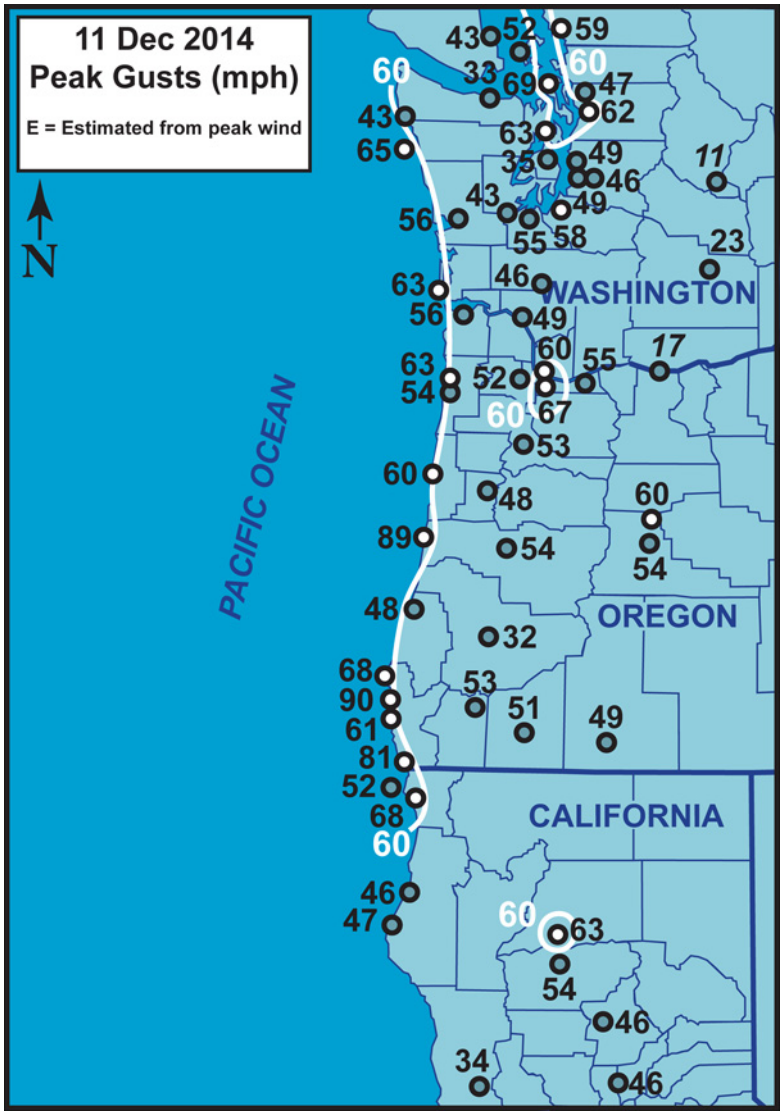


Peak Gusts

- For the interior, the strongest peak gusts occurred in pockets, with concentrations in the:
  - Northern Sacramento Valley, CA
  - Deschutes Valley, OR
  - Northern Willamette Valley, OR
  - Northwest Interior, WA

  (White-filled circles = high-wind criteria)

- The South Puget lowlands also had a fairly strong showing

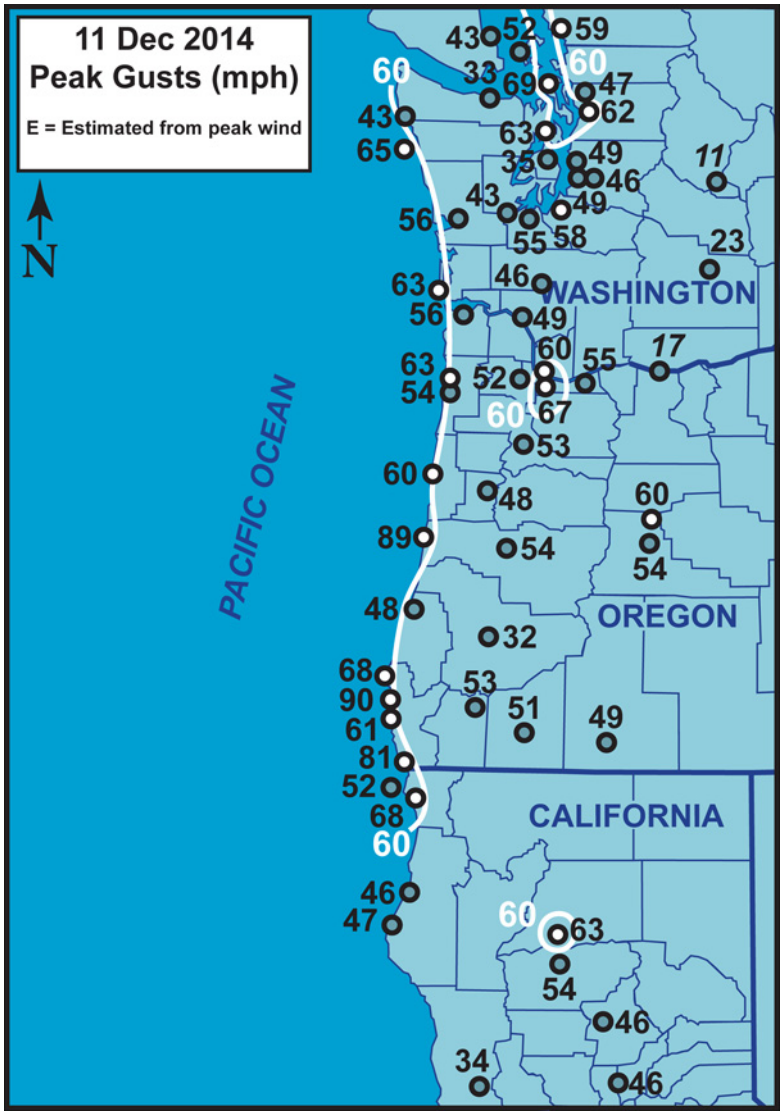


Peak gusts are from hourly and special observations obtained from the NOAA National Data Buoy Center, Aviation Digital Data Service and the National Climatic Data Center Storm Events Archive.

Peak Gusts

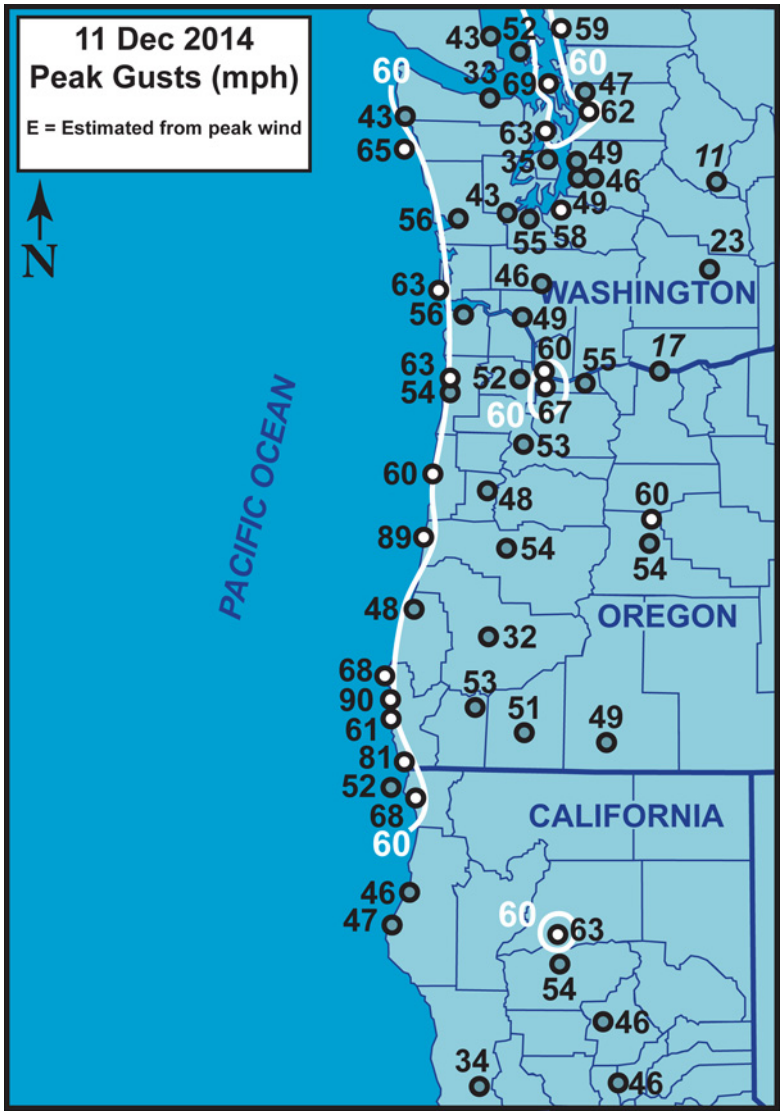
- On the coast, extreme Northwest California and Southwest Oregon appear to have received the highest winds

- Interestingly, the stretch from Newport, OR, northward generally did not receive gusts any higher than interior portions



Peak Gusts

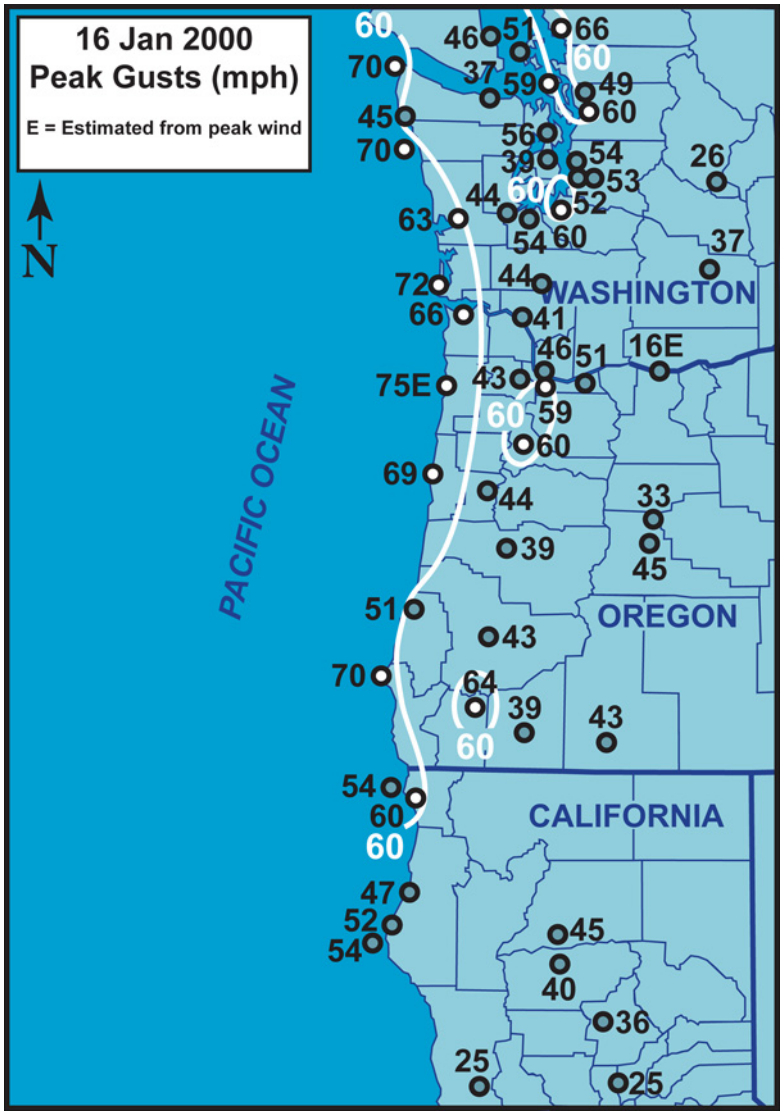
- The 67 mph peak gust at Portland is the strongest since a 74 mph instant gust was recorded during the 12 Dec 1995 windstorm
- The 16 Jan 2000 windstorm may have also produced a comparable gust
- Speaking of which…



Peak Gusts

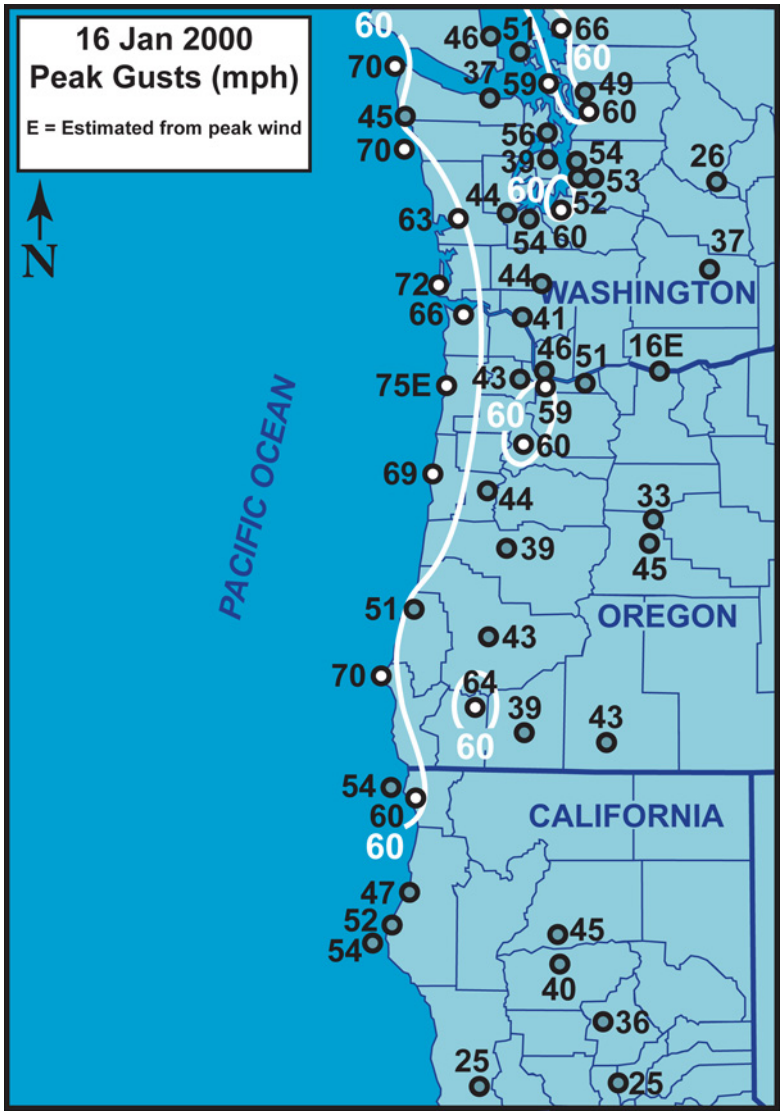
- The first classic event that came to mind after a review of the peak gust distributions was 16 Jan 2000

- Key similarities include:
  - Strongest winds concentrated in pockets in the North Willamette Valley, South Puget Lowlands and Northwest Interior



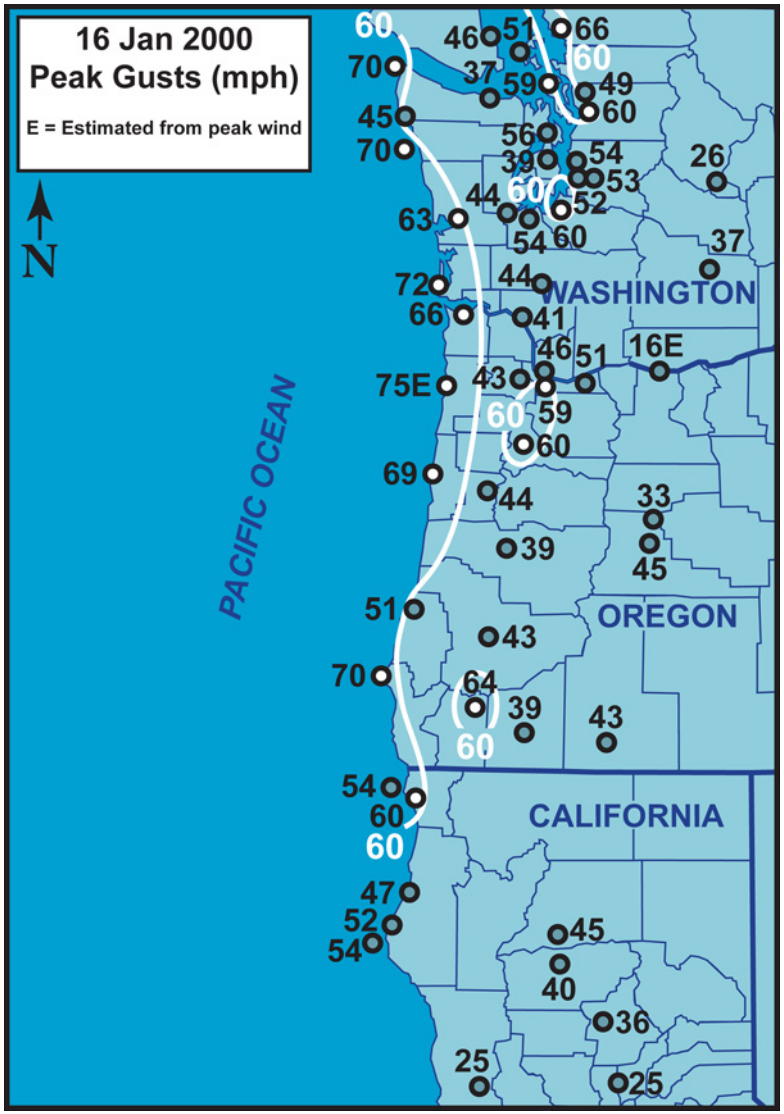
Peak Gusts

- Key differences include:
  - Weaker response in the Sacramento and Deschutes Valleys
  - Stronger response on the coast



Peak Gusts

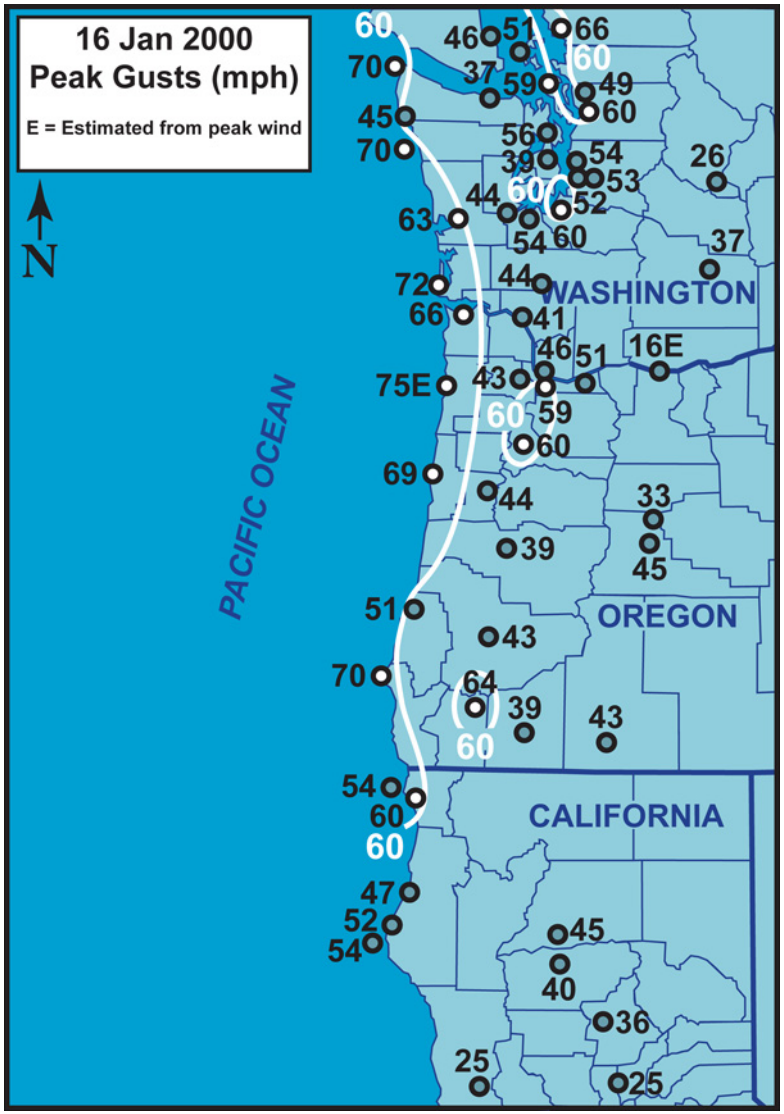
- Coastal sections took a real beating in 2000
- Take Astoria, for instance:
  - Peak gust of 66 mph in 2000 vs. 56 mph in 2014
  - In 2000, gust was a 5-second block average on cup-based anemometers
  - In 2014, gust was a 3-second moving average on a sonic anemometer
- Based on instrumentation, a higher gust was favored in 2014



Peak Gusts

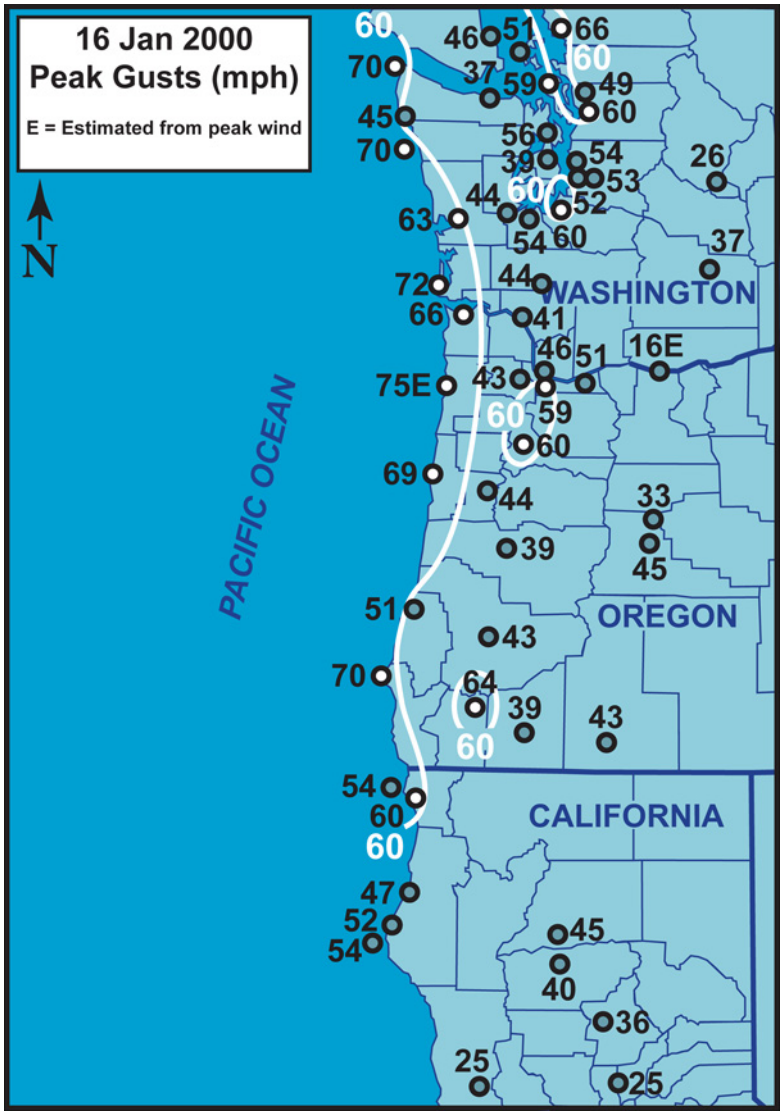
- Indeed, using the most conservative conversion factor (1.065), that 66 mph 5-second gust was probably more like 70 mph

- Keeping the instrumentation difference in mind, we see that Newport and North Bend also had markedly higher gusts in 2000 than during the 2014 storm



Peak Gusts

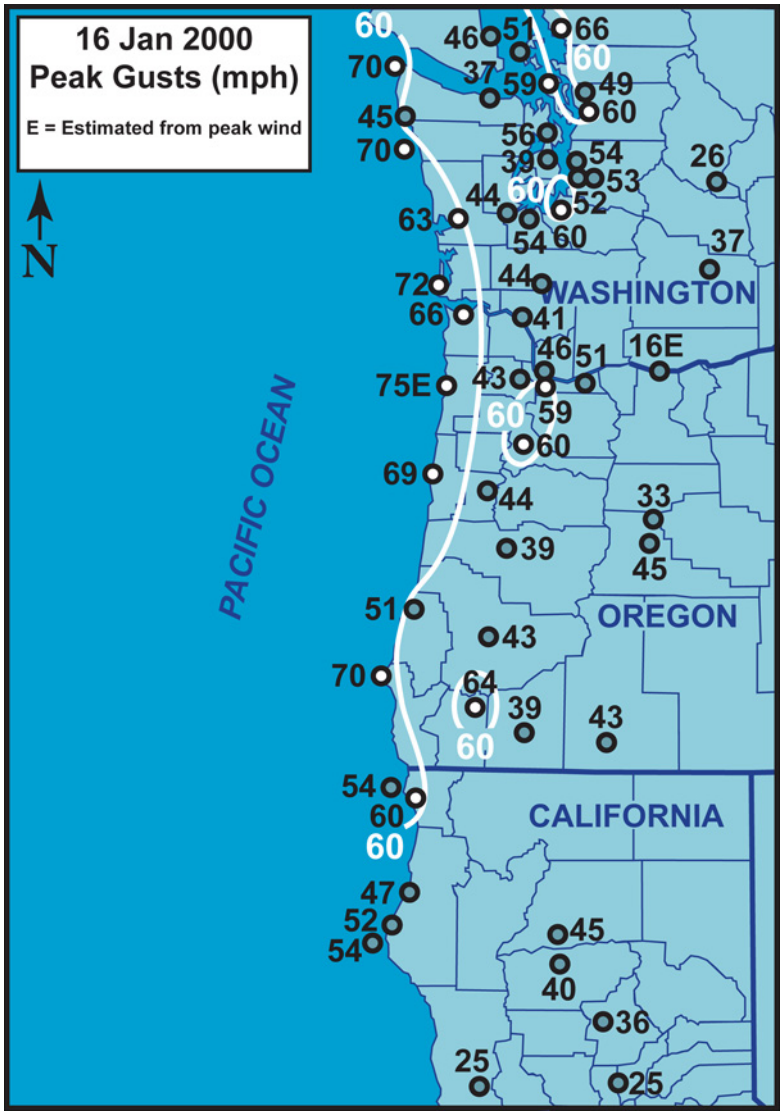
- In the interior, Salem and much of the Puget Lowlands had stronger gusts in 2000
- Portland's 59 mph 5-sec gust in 2000 converts to at least 63 mph for 3-sec, and could have approached 70 based on other estimations
  - Thus, at Portland, the two storms appear to have had a fairly similar response



Peak Gusts

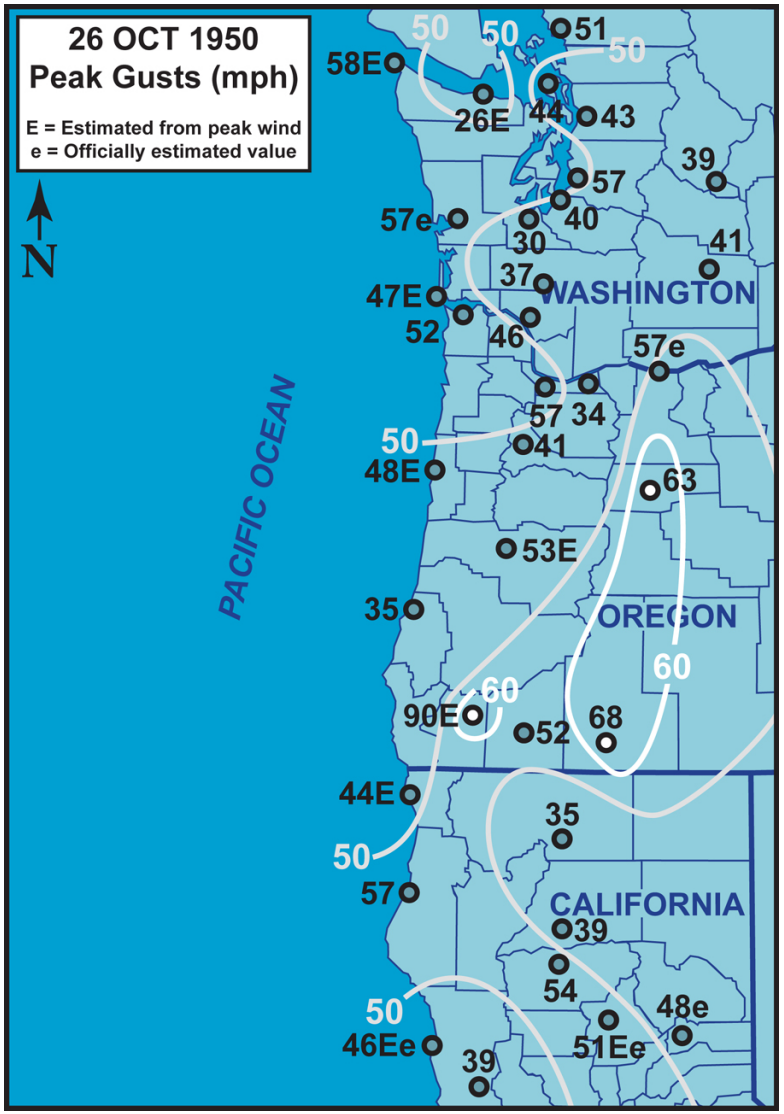
- Overall, the average peak gust using 37 stations in the region was:
  - 16 Jan 2000: 49.3 mph
  - 11 Dec 2014: 47.8 mph
  - Without adjusting for instrumentation differences

- Interestingly, the 2000 storm had a stronger impact despite:
  - A higher minimum central pressure (980 hPa vs. 973 hPa)
  - A track further offshore (130º-127º W vs. 128º-125º W when off the OR and WA coasts)



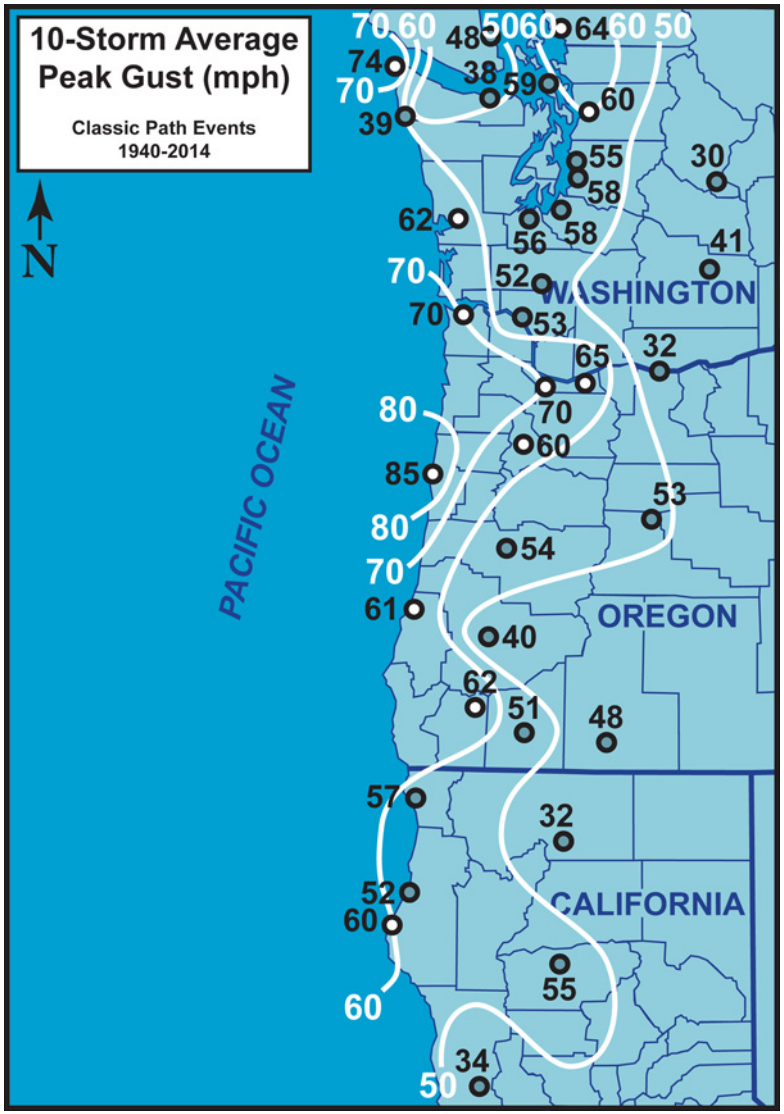
Peak Gusts

- There is also some similarity with the 26 Oct 1950 windstorm
- Especially in regard to:
  - The high winds east of the Cascades
  - Relatively weak winds on the coast



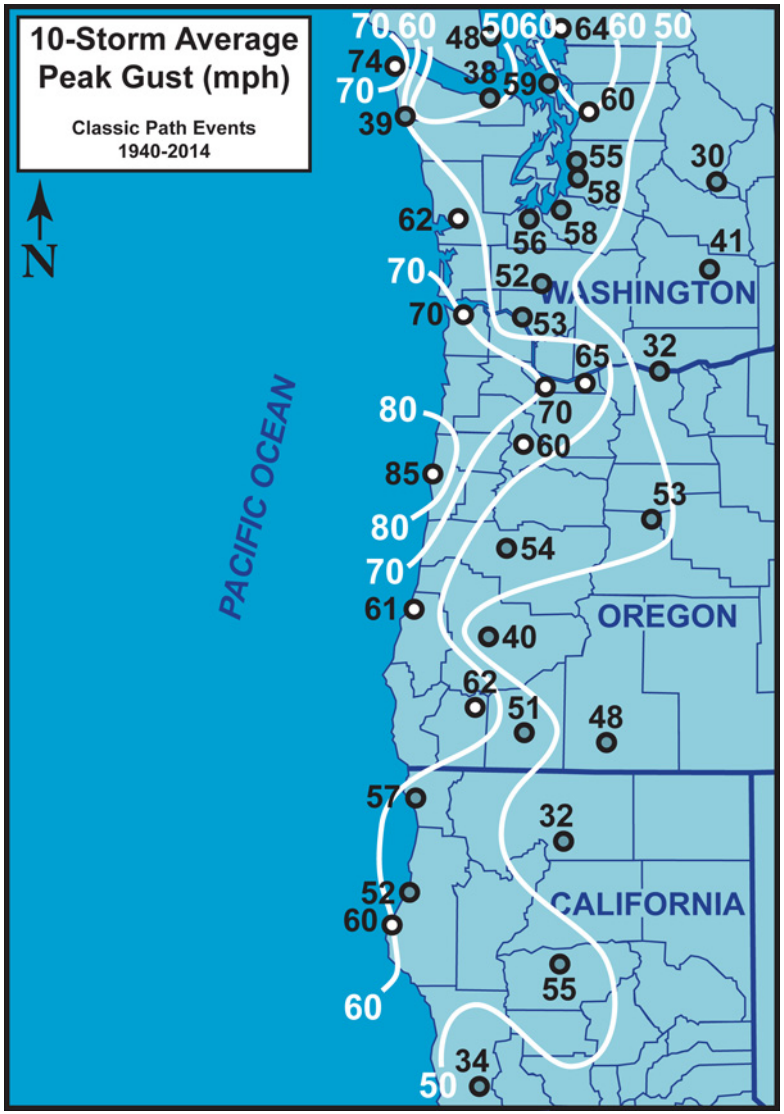
Peak Gusts

- Average peak gust for all 10 classic windstorms 1940-2014
- The 11 Dec 2014 windstorm generally followed the pattern, save perhaps for having the strongest winds hit the south Oregon coast as opposed to north
  - Note that spotty wind records on the south Oregon coast leaves a data void
- The more southerly focus of the highest winds fits with the ETC reaching peak intensity off of the Southwest Oregon coast



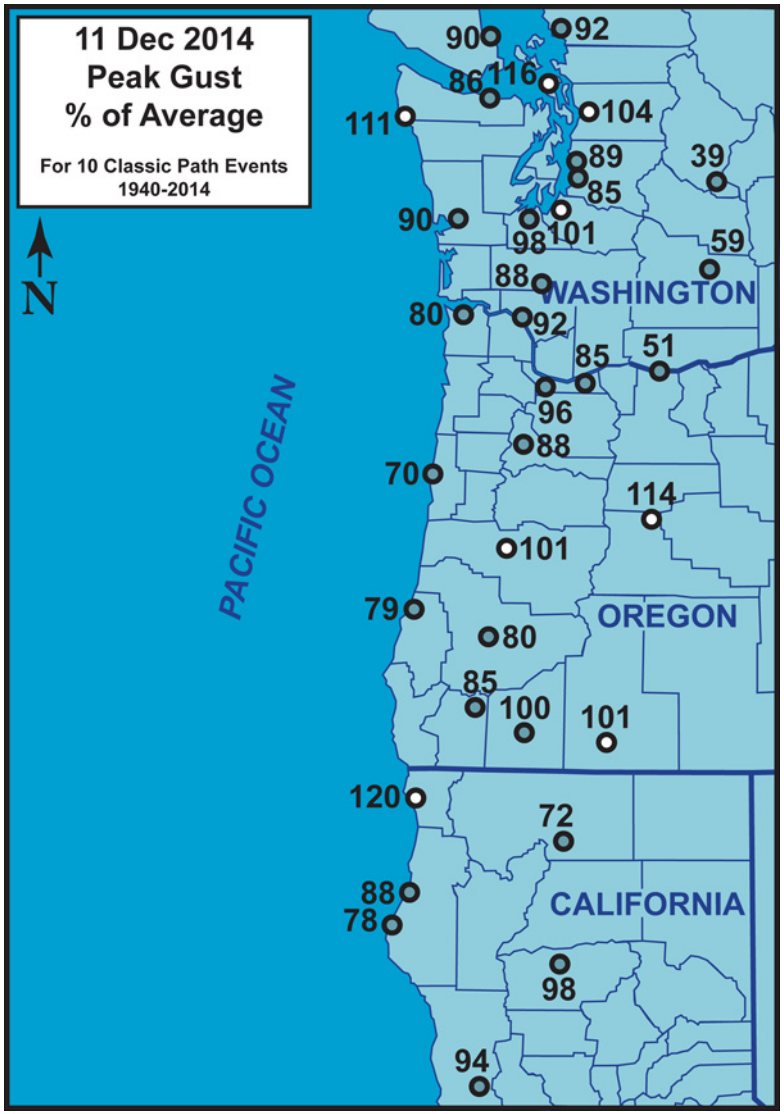
Peak Gusts

- Some key patterns of interest:
  - The gradient in peak gust speed from Eugene to Portland in the Willamette Valley
  - The gradient from Seattle to Bellingham
  - Concentration of highest gusts on the central and north Oregon coast
- Portland appears very prone to strong gusts during this class of windstorm
  - Out of all the interior stations, Portland has the highest average
  - 11 Dec 2014 fit the pattern



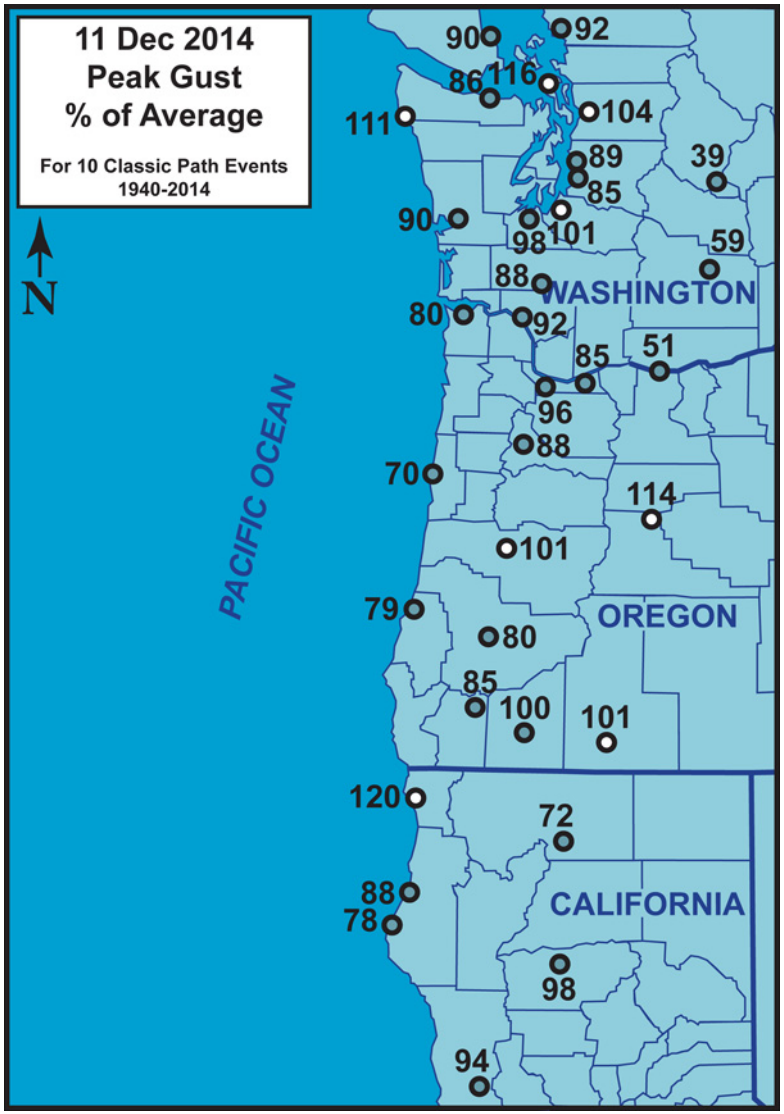
Peak Gusts

- Peak gusts in terms of percent of average for the 11 Dec 2014 windstorm
- Only a few stations had an above average response (white-filled circles), with Crescent City having the strongest showing
- Portland had an intense 67 mph gust, but it was somewhat below the average for this class of windstorm



Peak Gusts

- Overall, 11 Dec 2014 peak gusts averaged about 88% of the average classic windstorm
  - So, somewhat below average for this kind of event
- For comparison, peak gusts during the 1962 Columbus Day Storm were 140% of average
- This suggests that the surface pressure gradient difference between the 2014 and 1962 storms was probably about a factor of 2
  - This awaits further analysis



Thank You

- Questions and Comments