# Mean Spring and Fall Upwelling Transition Dates off the Oregon and Washington Coasts

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Pacific Fisheries Environmental Laboratory publishes indices of the intensity of large-scale, wind-induced coastal upwelling and alongshore transport at standard locations on a monthly basis. The CBR Mean method uses data from 1967 to the present for three locations along the Pacific Northwest coast:

1. 42N125W West of OR/CA border,
2. 45N125W West of Siletz Bay Lincoln, OR,
3. 48N125W West of La Push, WA.

For all years, the CBR Mean method takes each day's upwelling deviations from the site-specific mean offshore transport. The upwelling deviation was used to account for long term trends at each site. Then the daily deviations were averaged from the three sites. The average upwelling deviation indices are then smoothed using a 15 day central mean calculation. The use of a central mean avoids the trailing nature of a running mean. The smoothed cumulative upwelling deviation indices are then examined for spring minima and fall maxima through the entire series. The julian day of these extremes are listed as the CBR Spring and Fall Transition Dates (Table 1).

In addition to spring transitions to upwelling and the fall transitions to downwelling, the averaged and smoothed upwelling indices show additional patterns. There is a date of maximum summer upwelling, approximating the inflection point between spring and fall transition dates (Figure 1). The winter minimum for cumulative upwelling is very difficult to pinpoint due to the volatility of the index during the winter months (Figure 2).

There is seasonality in the alongshore transport indices as well; although, it is not as consistent as the upwelling index. There is a summer maximum in southward flow and a fall minimum in southward flow (Figure 3) with a summer transition to northward flow and a fall transition to southward flow. Similar to upwelling, alongshore transport shows a seasonal variation in volatility (Figure 4).

Besides the spring and fall transition dates, there are other useful numbers to characterize the nature of the ocean near the mouth of the Columbia. The difference in cumulative upwelling between the fall and spring transition dates gives a measure of the upwelling volume. One can also note the days at peak cumulative southward transport in the summer and peak cumulative northward transport in the fall. The difference in cumulative alongshore transport between the summer and fall alongshore transitions gives a measure of the volume of northward transport. These numbers are summarized in Table 1.

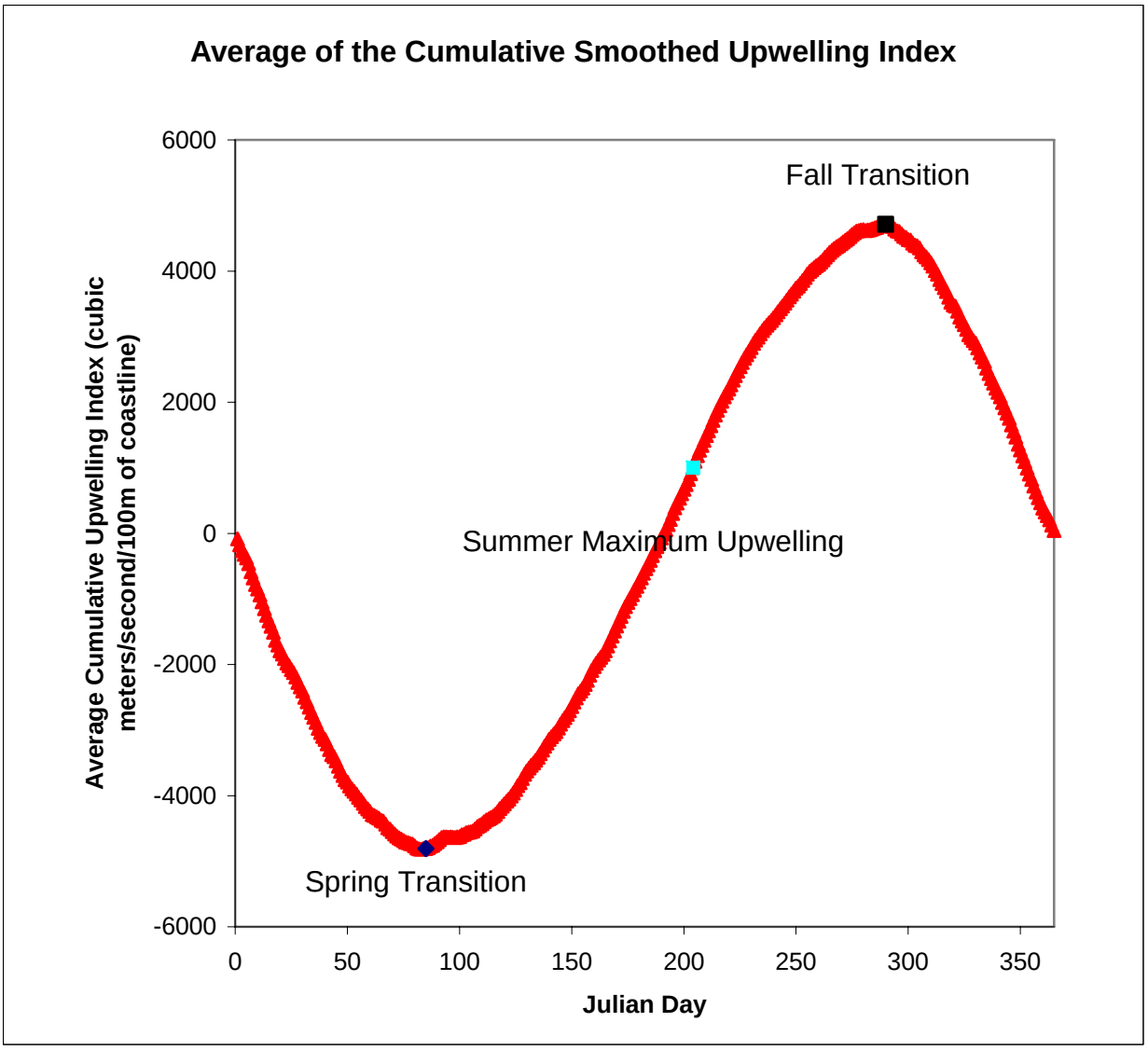


**Figure 1 Averaged cumulative upwelling index (cubic meters/second/100m of coastline) for the three PNW locations, 1967-2006.**

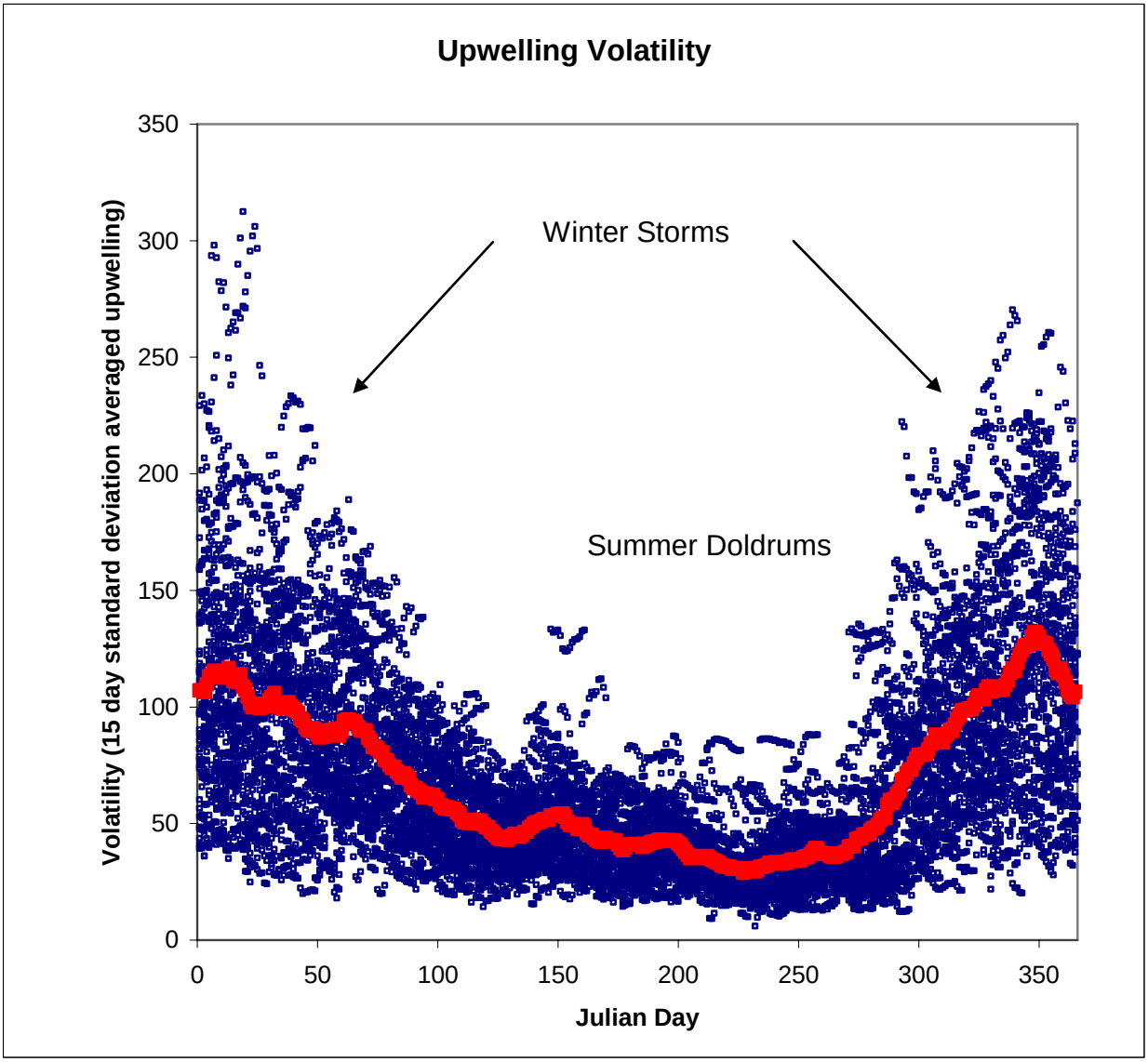


**Figure 2 Seasonal volatility in upwelling, 1967-2006.**

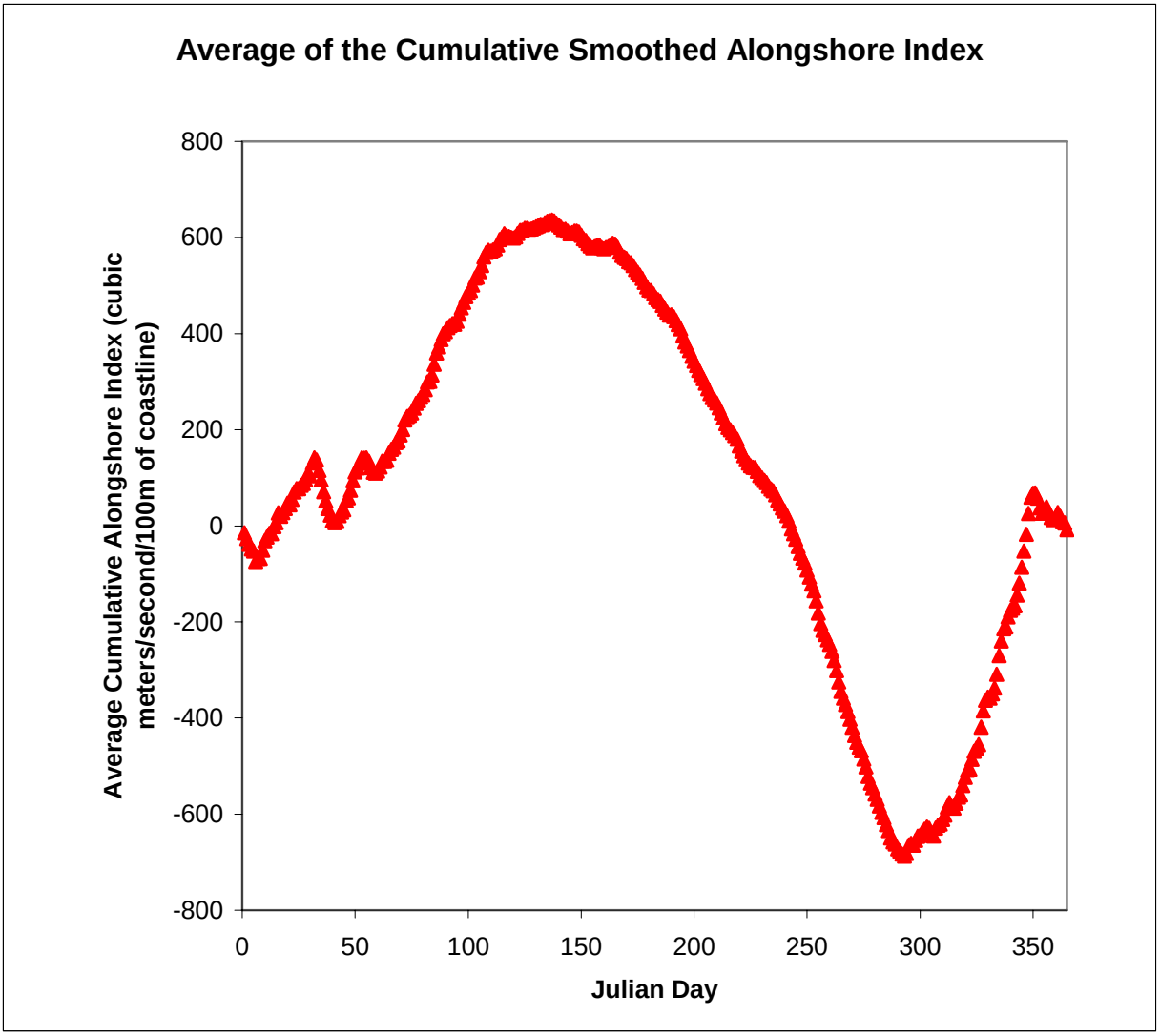


**Figure 3 Averaged cumulative alongshore transport, 1967-2006. Positive values are southward.**

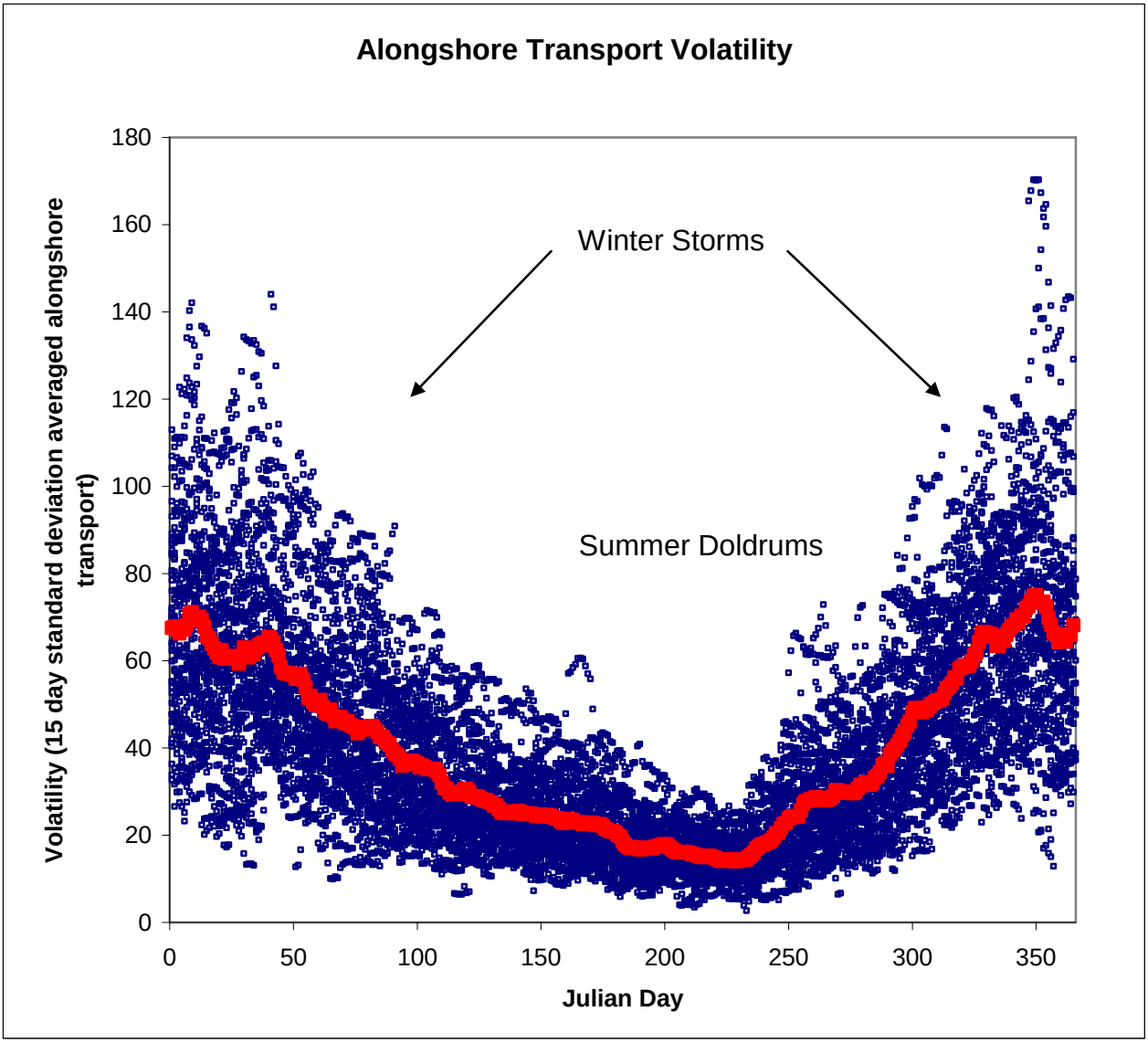


**Figure 4 Seasonal volatility in alongshore transport, 1967-2006.**

**Table 1 Summer Upwelling volume index, Late Summer northward flow volume index, Summer transition day from southward to northward flow, Fall transition day ending northward flow, and Spring Transition and Fall Transition days. Note that northward transition day may be in the following year (gray shading).**

| Year | Volume Index | | Alongshore Transition Days | | Upwelling Index | |
|---|---|---|---|---|---|---|
| | Summer Upwelling | Late Summer Northward Flow | Summer End Southward Flow | Fall End Northward Flow | Spring Transition Day | Fall Transition Day |
| 1967 | 11806 | 838 | 177 | 271 | 82 | 271 |
| 1968 | 11796 | 570 | 236 | 276 | 84 | 282 |
| 1969 | 9361 | 2252 | 122 | 382 | 116 | 258 |
| 1970 | 12888 | 1670 | 130 | 326 | 74 | 287 |
| 1971 | 9052 | 1344 | 176 | 290 | 103 | 290 |
| 1972 | 10480 | 3096 | 119 | 350 | 102 | 304 |
| 1973 | 12242 | 827 | 168 | 295 | 64 | 287 |
| 1974 | 10922 | 1944 | 178 | 320 | 98 | 306 |
| 1975 | 12067 | 1188 | 143 | 274 | 80 | 273 |
| 1976 | 8499 | 3987 | 115 | 400 | 100 | 296 |
| 1977 | 10739 | 1561 | 147 | 400 | 70 | 292 |
| 1978 | 9299 | 4502 | 95 | 398 | 66 | 317 |
| 1979 | 9643 | 3440 | 129 | 396 | 65 | 289 |
| 1980 | 10907 | 2483 | 154 | 400 | 76 | 295 |
| 1981 | 8274 | 972 | 173 | 297 | 83 | 262 |
| 1982 | 9627 | 2397 | 107 | 330 | 104 | 276 |
| 1983 | 8406 | 3185 | 92 | 400 | 91 | 288 |
| 1984 | 8245 | 2161 | 146 | 400 | 109 | 276 |
| 1985 | 10066 | 3765 | 133 | 369 | 45 | 290 |
| 1986 | 8567 | 2310 | 141 | 318 | 86 | 292 |
| 1987 | 9582 | 2653 | 108 | 323 | 72 | 309 |
| 1988 | 7937 | 2403 | 157 | 302 | 85 | 301 |
| 1989 | 9351 | 1981 | 96 | 364 | 94 | 288 |
| 1990 | 9377 | 1754 | 77 | 283 | 76 | 289 |
| 1991 | 11450 | 2366 | 150 | 314 | 62 | 304 |
| 1992 | 9982 | 3947 | 65 | 400 | 64 | 289 |
| 1993 | 8507 | 3519 | 128 | 400 | 116 | 327 |
| 1994 | 9351 | 1360 | 176 | 285 | 82 | 294 |
| 1995 | 8583 | 1630 | 171 | 307 | 100 | 309 |
| 1996 | 10569 | 1430 | 117 | 283 | 116 | 311 |
| 1997 | 6038 | 1568 | 126 | 347 | 78 | 255 |
| 1998 | 11722 | 1799 | 72 | 315 | 71 | 277 |
| 1999 | 13426 | 1826 | 138 | 295 | 88 | 294 |
| 2000 | 10917 | 3581 | 79 | 393 | 78 | 288 |
| 2001 | 13837 | 1841 | 121 | 293 | 64 | 296 |
| 2002 | 14166 | 3925 | 126 | 386 | 81 | 302 |
| 2003 | 12483 | 2735 | 136 | 386 | 105 | 278 |
| 2004 | 8862 | 1844 | 90 | 381 | 89 | 338 |
| 2005 | 8846 | 1332 | 107 | 270 | 106 | 284 |
| 2006 | 14158 | 2270 | 110 | 305 | 108 | 304 |