Western Region Technical Attachment
No. 94-08
February 22, 1994

THE COAST PROJECT

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The Coastal Observation and Simulations with Topography (COAST) field project was staged from WSFO Seattle and the University of Washington during late November and early December, 1993. The primary objective of the project was to observe the structure of the interactions of Pacific storms with the Washington and Oregon coast. During intensive observational periods (IOPs), special soundings were taken at Quillayute (UIL), a portable radiosonde unit from the Naval Postgraduate School and a wind profiler from the Wave Propagation Laboratory in Boulder were deployed to Astoria, Oregon (AST), and the NOAA P-3 aircraft was used to collect data on the 3-D structure of the atmosphere. The Principal Investigators for this project were Jim Overland of the Environmental Research Laboratory's (ERL) Pacific Marine Environmental Laboratory (PMEL) in Seattle, Cliff Mass of the University of Washington, and Brad Colman, SOO at WSFO Seattle. Additional primary investigators included Nick Bond (PMEL), Bob Houze (University of Washington), Mel Shapiro (ERL, Boulder), and Brad Smull (National Severe Storms Laboratory, Norman, Oklahoma).

Staff members at WSFO Seattle were afforded a rare opportunity to participate in a major field study. Since the NOAA P-3 was only available for a half-dozen flights, we learned that the teamwork, cooperation, and skill of the investigative team in choosing IOPs is crucial to the degree of success of such a field project. Some of the experimental tools available at WSFO Seattle also contributed to successfully forecasting optimal IOPs. For example, beginning a few days prior to an IOP we found that high-resolution NWP model gridded data via Internet on our HP 715 workstation, running GEMPAK and NTRANS, were invaluable to the decision-making process. Use of experimental digital satellite data on a RAMMDIS/PCMcIDAS workstation played a significant role in making short-term plans.

Several of the WSFO staff were able to take advantage of the even rarer treat of flying in the NOAA P-3. The aircraft has a half-dozen workstations, each with two "computer terminals" and two seats. There is also a cloud physics workstation and a radar control workstation. Everyone on board is equipped with headsets that permit easy contact with other investigators and the highly professional NOAA crew. The workstations are extremely user-friendly, with each screen having access to any of 15 different windows via a thumb wheel. Each window contains real-time data, some in graphic format, that are being collected by this flying laboratory. For example, one window contains graphs of temperature, dewpoint, vertical wind, and liquid water. Another window contains graphs of potential temperature and equivalent potential temperature. One window contains a PPI display of conventional radar reflectivity, while another contains velocity and reflectivity from the on-board Doppler radar. An alphanumeric table provides information on latitude/longitude, aircraft track and heading, wind speed and direction, pressure altitude, sea-level pressure, true air speed, and indicated air speed. One window even shows a plot of the aircraft's current location on the carefully planned flight track.

On December 3, 1993, WSFO Seattle HMT John Dearn was aboard a marathon nine hour flight that investigated strong flow into the coast and Vancouver Island. The aircraft traversed a vigorous cold front several times. John got to experience an 85 knot low-level jet and several episodes of severe turbulence. His advice after the flight was "don't go if you have a weak stomach."

On December 7, 1993, SOO Brad Colman, forecaster Jay Albrecht, and met intern Chad Gimmestad participated in a flight that investigated a landfalling low off the Oregon coast. In addition to skirmishes with turbulence, they were treated to a period of nearly continuous lightning in the cold-air CBs accompanying the low.

On December 11, 1993, Brad Colman, met intern Treste Huse, and I participated in a flight designed to investigate the structure of the atmosphere in the lee of the Olympic Mountains prior to the formation of a Puget Sound Convergence Zone (PSCZ), the structure of a developed PSCZ, and the orographic effects of the coast and windward slopes of the Olympic Mountains. The original flight plan called for take-off at 1700 UTC, a run up the west side of the Puget Sound and out the Strait of Juan de Fuca at 300 feet AGL, several courses parallel to the Washington coast at various altitudes, back through the Strait, and then twice around the Puget Sound to capture the structure of the PSCZ. At 1500 UTC, observational data, cross-sections from new model runs, and digital satellite information all suggested that the PSCZ would not form until very late in the day. This created a real dilemma. If we departed too early, we would arrive back in the Puget Sound prior to the formation of the convergence zone. If we delayed take-off too long, it would be too dark for low-level flights over the highly congested Puget Sound late in the day. Carefully timing the flight, we were able to lift off at 1930 UTC, complete the coastal observations, and arrive back in the Puget Sound with just enough daylight for the low-level run!

The highly professional NOAA flight crew briefed us first-timers on such things as rubber suits and life rafts, the galley, and the hefty shoulder harnesses that must be used whenever flying below 500 feet AGL. We took off from Boeing Field (BFI) in light rain and low overcast. We headed west and flew up the west side of Puget Sound with sensors indicating moderate southwest winds just off the surface. As we approached Port Townsend on the east entrance to the Strait of Juan de Fuca, winds became light and variable and skies cleared, suggesting a trough in the lee of the Olympic Mountains was forming as we had hoped. I happened to be in the cockpit when we broke out of the clouds and screamed over the lighthouse at Point Wilson at 300 feet. The view was truly breathtaking.

Flying westward we encountered strong westerlies and precipitation, suggesting a surge was moving eastward through the Strait. On our first leg down the coast, the tail-mounted Doppler radar gave excellent indications of the orographic effects of the Olympics. The Doppler displays were a bit difficult to interpret at first, however, some patient tutoring from Brad Smull proved invaluable. For a description of the radar and its fore/aft scanning technique (FAST), see the November 1993 issue of *Bulletin of American Meteorology Society* and the references cited there.

We headed back east through the Strait during the mid-afternoon and found heavy precipitation in the area around Port Townsend that earlier had nearly clear skies. As we continued eastward to the foothills of the Cascade Mountains, the preliminary data suggested, to the delight of everyone, that we had indeed captured a PSCZ.

The numerous sensor readouts available on a NOAA P-3 flight, plus automatic plots that pinpoint the exact location of the aircraft at all times, combined with the meteorological knowledge of what phenomena you "should encounter" leads to an extremely educational experience. Thus, while it may be many months before the data yield new specific information on the effects of orography on the weather of the Pacific Northwest, those of us who had the privilege of flying in the NOAA P-3 feel we have already gained new insight into terrain effects and some of our toughest forecast problems.

References

Jorgensen, D.P., and B.F. Smull, 1993: Mesovortex circulations seen by airborne doppler radar within a bow-echo mesoscale convective system. *Bull. Amer. Meteor. Soc.*, **74,** 2146-2157.