



Decadal-scale Changes in Large-Scale Temperature, Salinity, and Circulation in the N. Pacific Observed from Argo Floats

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The WOCE hydrographic program, active during the 1980s and 1990s, was a highly accurate, one-time survey of the water mass properties and circulation of the world's oceans, setting a baseline to which later studies could be compared. Beginning in the late 1990s, profiling floats began to be deployed in large numbers throughout the world ocean, and as of 2005 well over 1500 floats are active throughout the world ocean as part of the international Argo program. At depths above 1000 m the floats provide temperature and salinity observations with sufficient accuracy, precision, and long-term stability that these data can be compared to the WOCE baseline. Furthermore, since the Argo array also provides absolute velocity observations at a quasi-standard deep level, it is possible to estimate the absolute geostrophic circulation over larger expanses of the world ocean than has previously been feasible. These developments have permitted a detailed examination of the changes in hydrographic properties of the waters above 1000 m in the N. Pacific between the late 1980s and the early part of the 21st century and some estimate of the circulation that might lead to these changes. Here we concentrate on changes in salinity above 1000 m in the N. Pacific over the past one or two decades. Taken together, the Argo and WOCE results show an upper ocean signal in salinity associated with the Pacific Decadal Oscillation that has previously been reported in other studies, although this result, a marked freshening in the subarctic gyre, is confined mainly to the eastern N. Pacific. The salinity of the western subarctic N. Pacific appears to have increased markedly at all depths between the sea surface and 1000 m since the mid-1980s, perhaps partially related to PDO but also possibly caused by changes in the nearby N. Pacific marginal seas. At thermocline depths, where no direct ventilation by the atmosphere occurs over most of the N. Pa-

cific, there appears to be a marked increase in salinity over much of the western N. Pacific from the Equator to the subarctic. These changes include changes in the large-scale properties of the North Pacific Intermediate Water as well as water masses closer to the Equator. Using the geostrophic circulation inferred from Argo floats, it is speculated that this large-scale change in salinity is related to changes in the low-latitude circulation of the western Pacific.