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Observations for climate: Satellite observations for climate studies

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Climate research greatly benefits from satellite observations as a critical tool to assess variability and change, to fill the observational gaps with high-quality, up-to-date and synoptic products. As a component of the Global Climate Observing System (GCOS), satellite observations are part of the Global Earth Observation System of Systems (GEOSS). Sea surface temperature (SST), sea height anomaly (SHA), and ocean currents have been identified by GCOS as essential climate variables for the ocean. These and other satellite-derived products, such as surface currents and tropical cyclone heat potential fields, are used to analyze and monitor the state of the ocean system, to identify the underlying climate processes, and to apply to climate and weather studies. The data used to derive these products come from a wide array of observing platforms, and include datasets such as temperature profiles from Argo floats and expendable bathythermographs (XBTs), and surface currents from drifters. Some of these products and analyses are shown at: www.aoml.noaa.gov/phod/satprod, and key results are presented here. In the South Atlantic, the Brazil Current, the southwest component of the South Atlantic subtropical gyre, is the main conduit of upper ocean waters in the region. The observed low-frequency variability of the Brazil Current front (BCF) using SHA and SST observations during the period 1993-2008 indicates a southward shift of approximately 1.5o of the separation of this current from the continental shelf break. Simulations using synthetic drifters are consistent with the observed southward shift of the BCF. Trends of eddy kinetic energy, SHA, SST and wind stress curl are also in agreement with this variability. Wavelet transform analysis reveals that the separation of the BCF from the continental shelf break also changed from annual to bi-annual during 2003, which could be an indication of an abrupt change in the transport of the Brazil and Malvinas currents or of the local or remote wind field. In the Tropical Atlantic, the North Brazil Current (NBC) plays an important role in the Atlantic Meridional Overturning Circulation (AMOC) by periodically shedding rings which transfer water of southern hemisphere origin to the northern hemisphere. In 2010, the NBC demonstrated extremely anomalous conditions with a constant shedding of large rings. Anomalies of this magnitude have not been seen previously in the altimeter time period (1993--present). The interannual variability of the NBC ring shedding deserves further study, particularly how it interacts with the dominant modes of tropical climate variability. In the North Atlantic, the Gulf Stream (GS) plays an important role in the climate system in both dynamic and thermodynamic aspects. As the northward return flow of the upper limb of the AMOC, the GS transports a vast amount of heat from low to high latitudes. Changes in the GS transport have been linked to its meridional shift and meandering state. The GS path also influences storm tracks over the northwest Atlantic. GS properties estimated from satellite SHA have shown strong changes in position and meandering intensity. These and other results reveal the benefits of combining and integrating satellite and in-situ data for climate studies, particularly from those sensors providing longer time series (~30 yr for SST, >18 yr SHA) which are more adequate to detect and study climate signals.