TAO IMPLEMENTATION PANEL

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variability. However, one might expect progress towards a well developed international GOOS program in the near future to be slow, knowing the financial difficulties of the developed countries which are taking the lead in this program.

Strategy for the cooperative western Pacific salinity monitoring project, originally supported by ORSTOM/Noumea, NOAA/PMEL, and the University of Hawaii was reviewed. With the loss of two heavily instrumented TAO moorings and a significant loss of SEACATs, emphasis will shift away from moorings with vertical arrays of SEACATs to primarily measurements of surface salinity. Also, due to the need of SEACATs for other programs, the University of Hawaii has decided to begin a phased withdrawal from this cooperative effort. However, effort will be continued by NOAA/PMEL and ORSTOM/Noumea, with three meridians instrumented in the western and central Pacific (156°E, 165°E, and 180°). A TAO salinity data bank will be maintained under the direction of Paul Freitag at NOAA/PMEL.

French scientists are regularly using TAO data for multiple purposes. ERS-1 winds were validated by the Space Oceanography Group at IFREMER/Brest. TAO winds were also used to improve tropical wind products produced jointly by NASA/GSFC and ORSTOM/Noumea. Output of the LODYC/Paris tropical Pacific ocean general circulation model has been compared to TAO current and temperature measurements. At ORSTOM/Noumea, TOPEX/POSEIDON sea level and derived surface currents are being validated with TAO data. Current measurements from the TAO moorings along the equator have been merged with circulation drifter data to construct a tropical Pacific near-surface velocity field for the period 1987–93. Studies of the importance of zonal currents in advecting the eastern edge of the warm pool during El Niño and La Niña episodes spanning 1986 to 1994 are also being conducted using velocity fields inferred from GEOSAT, TOPEX/POSEIDON, drifter data, and TAO near-surface current measurements. During the TOGA-COARE Enhanced Monitoring Phase, temperature measurements in the upper 20 m from about 30 French drifters were calibrated with the closest TAO moorings. Also during TOGA-COARE, sea surface salinity variations were studied from a combination of merchant ship and TAO measurements.

5. BRAZILIAN OCEAN-CLIMATE PROGRAMS

5.1 Seasonal Climate Prediction at CPTEC/INPE (P. Nobre, INPE, Brazil)

5.1.1 Ocean-atmosphere interactions over the tropical Atlantic: Interannual climate variability over the tropical Atlantic is dominated by anomalous meridional migrations of the intertropical convergence zone (ITCZ). It is shown that modulation of ITCZ migrations are related to modulations of meridional gradients of anomalous SST over the tropical Atlantic. Also, it is shown that rainfall anomalies that affect Nordeste (Northeast Brazil) are large scale phenomenon, encompassing the whole equatorial Atlantic and eastern Amazon region. Observational evidence supports the conjecture that atmospheric dynamics, linked to the occurrence of teleconnnection patterns originating from the equatorial central Pacific modulate the formation of anomalous SST patterns over northern tropical Atlantic. It is suggested that an ocean-atmosphere observing system over the tropical Atlantic must go beyond the equatorial band to be useful for seasonal rainfall forecasting over Brazil.

5.1.2 Seasonal Climate forecasting at CPTEC: The numerical seasonal rainfall forecast experiment done at CPTEC for the March–April–May (MAM) 1995 rainy season over northeast Brazil (Nordeste) is described. The model used is COLA/CPTEC's AGCM (T62 L28). Four member ensembles with varying initial conditions are used to obtain the seasonal forecasts. For each initial condition the AGCM is integrated for six months for both climatological and forecasted SSTs. Persisted SST anomalies are used to simulate forecasted SSTs. The runs which used persisted December 1994 SST anomalies (while ENSO conditions still dominated over the equatorial Pacific), forecasted MAM negative rainfall anomalies over Nordeste, in disagreement with the observed positive anomalies. The next runs, which used January, February, and March persisted SST anomalies respectively, showed progressively better forecasts, as the monthly SST fields approached more and more the actual MAM SST. The differences between the December and January forecasts (with the latter showing closer-to-observed values), are attributed in large part to the more favorable SST conditions over the southern tropical Atlantic in January, since not much change occurred over the equatorial Pacific during that period. These results highlight the importance of forecasting tropical Atlantic SST for the seasonal rainfall numerical predictions over the Nordeste, the equatorial Atlantic, and the Amazon regions. A March 1995 persisted SST anomaly run generated MAM rainfall forecast that resembled closely the observed rainfall distribution (Figure 5). It is concluded that atmospheric general circulation modeling is capable of predicting seasonal rainfall anomalies over Nordeste, provided accurate SST fields are prescribed. For the December 1994–March 1995 period, persisting SST anomalies was shown to be a poor method of forecasting SSTs over the tropical Atlantic and equatorial Pacific.

5.2 Atlantic Ocean Processes, Ocean Observing Systems and the Predictability of Fluctuations in Climate and Fisheries Yields at Seasonal to Interdecadal Scales (M. Vianna, INPE, Brazil)

We review here some basic and distinct features of the large-scale air-sea interaction and ocean circulation in the Atlantic tropics and subtropics, which have to be monitored in order to support to the development of realistic coupled circulation models that may be used for regional climate prediction at several scales. This is done to give insight into the formulation of criteria to prioritize the siting of elements of an Atlantic TAO Ocean Observing System in certain key regions. Among the distinct features, we will concentrate on our studies of the Atlantic high-resolution SSTA (SST anomaly) dynamics (Vianna and Kampel, 1995), which seem to imply Rossby wave-driven westward spread of SSTA's, and the following:

5.2.1 Recent studies indicate that although tropical and extra-tropical SSTA variability in the Indian Ocean is largely correlated to the Pacific, Atlantic SSTA fields (Figure 6) exhibit largely independent variance modes (Kawamura, 1994; Tourre and White, 1995). On the other hand, ENSO-induced intensification and subsequent relaxation of the Western Equatorial Atlantic (WEA) zonal wind stresses may generate a strong subsurface signal which causes the flattening of the Atlantic thermocline a few months later (Delecluse et al., 1994). However, amplitude and phases of the observed signal are not explained by the OGCM simulation. Although linear equatorial ocean dynamics seem to partly explain the evolution of the eastern tropical SST fields, the phase relationships between SST, mixed layer depth and thermocline depth are space-time dependent (Houghton, 1991). This is due to the fact that in the southwestern tropical Atlantic, heat fluxes are generally dominated by horizontal advection and wind stress, which requires the routine observation of the complex patterns of thin (100 km across) surface and subsurface currents (Molinari, 1982) for a long period of time before a realistic coupled model can be developed.

MAM 1995 RAINFALL ANOMALIES (mm/day)

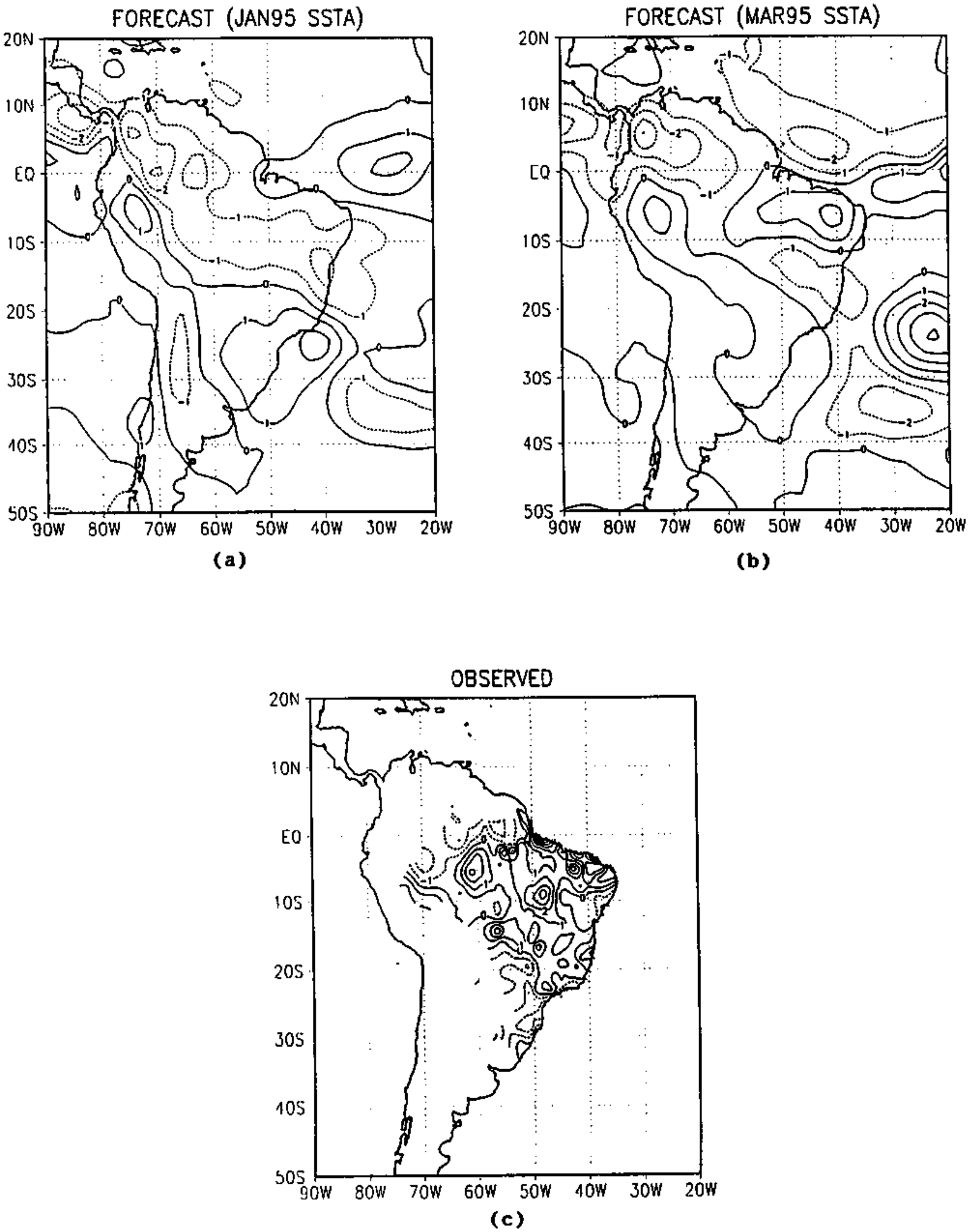

Figure 5 (see Section 5.1.2)

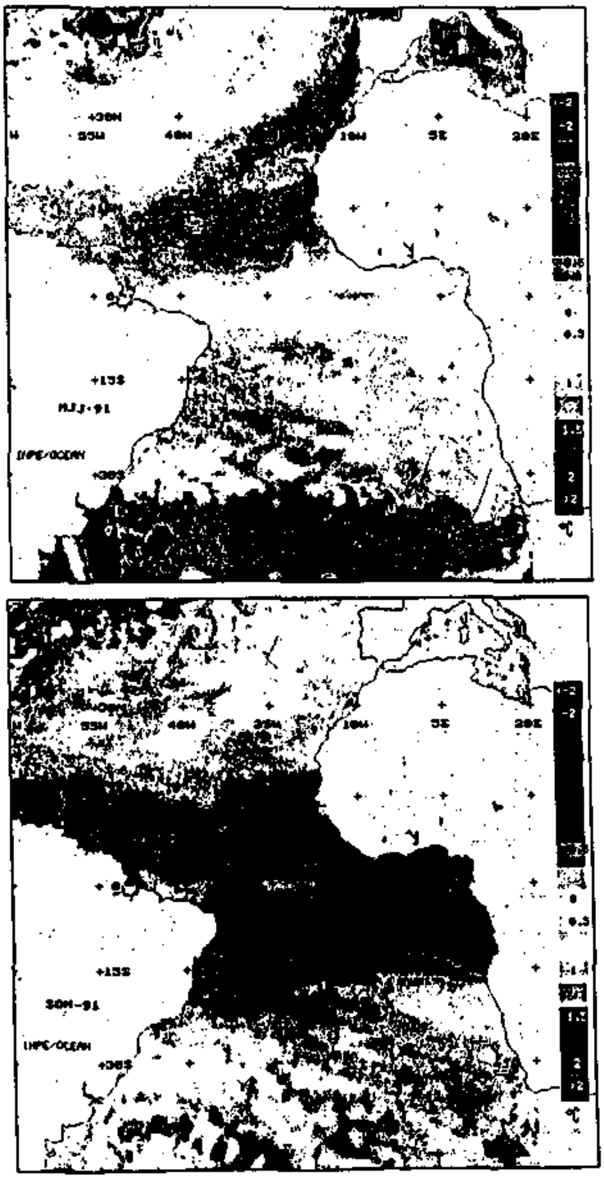

Figure 6 Satellite-derived seasonal (MJJ 91, upper panel; SON 91, lower panel) SSTA map at the onset of the 1991-1992 Atlantic Cold Event. Based on the 18 km x18 km weekly data set (MCSST) distributed by JPL. Notice the eastward propagating equatorial warm signal, followed by a cold westward Rossby wave scattering pattern extending to the Brazilian coast. (see Section 5.2.1)