the shallow bottom and the water containing regenerated CO2 as well as directly dissolved CO2 is mixed into the deeper subsurface layer of the open sea by isopycnal diffusion and advection. The isopycnal mixing still continue under the pycnocline, even in the warming season. In the high latitudes, the formation of sea ice amplifies the pump activity. In the low latitudes, the evaporation of water from the surface also performs as a starter.

The CSP is functioning more strongly in Funka Bay in the northern Japan (Nakayama et al. 2000) and in the Okhotsk Sea (Tsunogai et al., 2001). Here we present the results obtained in the Japan Sea.

In the last 50 years, dissolved oxygen contents decreased year by year and it is considered that its deep water was not formed. The Japan Sea is connected to the Pacific and the Okhotsk Sea through 4 straits, but their sill depths are shallower than 140 m. Thus, its deep and bottom waters are produced within the sea. We studied their formation process using CFCs. The observations were carried out twice in 2000 and 2001 and obtained interesting results.

In 2000, the CFC-11 concentrations decreased almost exponentially with depth from 6 pmol/kg at 500 m depth to 0.3 pmol/kg or less at the bottom, 3500 m depth at 3 stations (40 – 41 E<N, 132 – 133 E<E) a few hundred km off Vladivostok. In 2001, they first decreased similarly to the year 2000, but they increased up to 2 pmol/kg in the bottom water. The concentrations of dissolved oxygen also increased in the bottom water in 2001. On the other hand, at a station (42.0 E<N, 136.5 E<E) apart about 500 km to the ENE, we did not find the increase in the bottom water in 2001. Furthermore, the increase in the layer between 500 – 1500 m layer varied widely from station to station. This variation may be due to the spatially different cooling and the different topography in the shelf and slope zones.

OS12O-12 1640h

Could China's Development Lead to Bottom Water Formation in the Japan/East Sea?

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Using hydrographic data and box models and a comparison between the cooling of the Mediterranean and the Japan/East Sea, it is shown that the presently discussed diversion of rivers such as the Yellow or the Yangtze for agricultural use is likely to cause the renewal of Bottom Water formation in the Sea of Japan. Such formation was common (near the Siberian coast) in the 1930s, 40s and 50s but subsided since that time due to a warming trend (accompanied by a decreased salinity due to the melting of ice). Since a diversion of fresh water is analogous to evaporation, a (diversion-induced) increase of salinity is expected and the increase is large enough to allow Bottom Water formation even at the present-day cooling rates. Even a modest diversion of merely 3000 cubic meters per second (which is 10 percent of the total fresh water flux) will probably cause Bottom Water formation at a rate of roughly 750,000 cubic meters per second. This is the first known case where anthropogenic effects can easily reverse an existing vertical structure.

OS12P HC: 316 B Monday 1330h

The North Atlantic Ocean and Its Changing Climate II

Presiding: **B Dickson,** CFEAS, The Laboratory**; T M Joyce,** Woods Hole Oceanographic Institution

OS12P-01 1330h INVITED

Tracking Hydrographic Change Through the Deep Western Boundary Current System

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In recent decades, a notable infusion of fresh water in the Northern North Atlantic and an extreme fluctuation of surface wind patterns together precipitated major shifts in the character and production of deep waters in the Nordic Seas and Labrador Basin – the headwaters of the global thermohaline circulation (THC). The consequences of this high latitude THC variability are now recognizable downstream in the subtropical and tropical deep circulation as conspicuous shifts in temperature-salinity characteristics, atmospheric tracer gas concentrations, and vertical density structure in the deep western boundary current (DWBC). Hydrographic changes are quite prominent near the two principle cores of DWBC flow– the Upper and Lower North Atlantic Deep Water – directly reflecting recent freshening and ventilation history at their respective sources. The DWBC velocity structure is exhibiting attendant modifications: a weakening of the deeper core of Overflow Waters and an apparent strengthening of the upper core of Labrador Sea Water (LSW). In the 1990's, these signals moved progressively through the subtropical circulation and have now entered the tropics enroute to the equator. By year 2000, just 10-12 years following dramatic events in the Labrador Sea, a plume of anomalously cold, fresh, dense, and highly ventilated LSW had advanced down the boundary to 10°N. Its strength and continuity along the tropical DWBC signify a thermohaline anomaly that is building in intensity and transiting large distances without being mixed away by eddies or diffusion into the adjacent interior. Simultaneous alterations of the DWBC vertical density structure, including the development of a potential vorticity anomaly, suggest a tropical expression that has dynamical implications for the deep circulation. These anomalous signatures are providing an opportunity to directly measure the speed with which ocean signals propagate from the high latitudes to the tropics and beyond via the DWBC, and to assess the dynamical response of the deep limb of the THC to high latitude climate fluctuations.

OS12P-02 1345h

Rapid Freshening of the Deep North Atlantic Over the Past Four Decades.

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The overflow and descent of cold dense water from the sills of the Denmark Strait and Faroe-Shetland Channel is the principal means by which the deep ocean is ventilated and so is a key element of the global thermohaline circulation (THC). Most projections of greenhouse gas induced climate change anticipate a weakening of the THC in the North Atlantic in response to increased freshening and warming in the subpolar seas and the supposition is that this climate signal will be transferred to the deep ocean via the two overflows. Nevertheless, these simulations do not yet deal adequately with many of the mechanisms believed to control the THC, and our observations cannot yet detect whether the rate of the oceans overturning circulation is changing. Here, complementing recent evidence that overflow transport may be slackening, we show that the entire system of overflow and entrainment that ventilates the deep Atlantic has steadily changed in character over the past four decades, resulting in a sustained freshening of the deep and abyssal waters of the Northern North Atlantic — the headwaters of the global thermohaline circulation.

OS12P-03 1400h

^{129}I Ventilation Ages for Denmark Strait Overflow Water in the Labrador Sea

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^{129}I (half-life = 16 million y) discharged from nuclear facilities in France and the UK is transported through the North Sea into the Norwegian/Greenland Seas in 1-2 years. Deep mixing and convection in the Greenland Sea injects tracer ^{129}I into intermediate waters that overflow the sills between Greenland, Iceland and Scotland and ventilate the deep North Atlantic. ^{129}I is well suited to determining ventilation ages for North Atlantic Deep Water (NADW), because it has a direct pathway for injection into NADW source regions and provides an excellent comparison with ventilation tracers such as CFCs. An ^{129}I section measured across the Labrador Sea in 1997 showed decreasing levels with increasing water depth in Labrador Sea Water, with the lowest values (3-4 x 10^7 atoms/l) measured at 1800 m, close to the deepest historical extent of convection. The highest ^{129}I levels (> 15 x 10^7 atoms/l) were measured in Denmark Strait Overflow Water (DSOW), below 3000 m. From a comparison of ^{129}I/CFC ratios measured in DSOW with the Greenland Sea input function, a ventilation age of 2-3 y was estimated for DSOW. An ^{129}I section measured in 1999 showed that the ^{129}I concentration in DSOW increased by about 50% between 1997 and 1999. This is consistent with a predicted 50% increase in the Greenland Sea ^{129}I input function between 1995-1997 and a 2-3 year transit time to the Labrador Sea.

OS12P-04 1415h

FISHES 2001 and Vivaldi 1996; Two Recent Surveys of the Subpolar Northeast Atlantic

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Many detailed surveys have been made in the subpolar North Atlantic during the past decade. However, descriptions of the circulation vary in their pattern and magnitude. Satellite studies and eddy resolving ocean models indicate that eddies may dominate mean currents in some regions, effectively aliasing traditional basin scale ocean observations. However the region is important climatically and biologically. It is an area of cooling and deep winter mixing. Zooplankton distributions (specifically Calanus finmarchicus) are heavily constrained by the circulation. Thus it is an important area to understand dynamically.

Surveys made in the subpolar North Atlantic in 1996 and 2001 were designed to investigate the pathways of the North Atlantic Current and distinguish areas of eddy activity, particularly in the region between Iceland and Scotland. An upper ocean SeaSoar survey (0-400 m) with scattered full depth CTD casts was made in Oct - Nov 1996 (Vivaldi'96). Extending from west of Ireland and Scotland to East Greenland it showed clear current paths of warm stratified water flowing into the region and deep winter mixed subpolar mode water to the east and in the north Iceland Basin. However the vertical extent of mode water was greater than the SeaSoar could survey. Thus a second survey using full depth CTD casts was made in May-June 2001 to investigate the end of winter distribution of mode water. FISHES 2001 (Faroe - Iceland - Scotland Hydrographic and Environmental Survey) concentrated on the region between Iceland, the Faroes and Scotland. Results showed a large area of weakly stratified water extending 500-600 m vertically and spreading westwards from the Scottish shelf edge between the Rockall - Hatton and Faroe Plateaux out into the Iceland Basin. Circulation was weak and no clear current paths were apparent, but topography clearly influenced the distribution of mode water. Here we will discuss the circulation observed in the two surveys five years apart, contrast the distribution of mode water and investigate the factors affecting them.

OS12P-05 1430h

First Direct Thickness Observations of the Denmark Strait Overflow

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The overflows of cold dense water which cross the Greenland-Scotland Ridge through the Denmark Strait and Faroe-Bank Channel are the principal means of ventilating the deep water of the North Atlantic. In doing so, these overflows and their entrained watermasses are also instrumental in transferring the effects of climate variations over the Nordic Seas and North Atlantic to the deep ocean south of the Ridge. The issue of variability in the speed and transport of these overflows has been addressed by numerous studies, using a variety of direct and proxy methods, and we briefly review these before describing some new direct evidence from the Denmark Strait overflow, downstream from the sill.

A near-bottom current meter array has been maintained across the core of the deepening overflow off Angmassalik, SE Greenland since 1986 by CEFAS with Finnish and German co-workers. The overflow plume passing through this array exhibits a large-amplitude variation in speed on timescales of a few days, but so far there is little evidence of significant variability at longer timescales (seasonal-interannual). However, transport variability will reflect changes in the thickness as well as the speed of the plume, and moorings of a few current meters are not well suited to describing the time varying thickness component. As part of the EC-MAST-III VEINS programme, two bottom-mounted inverted echo sounders (IES) at 10–12 kHz were added to the array to give the first direct measure of the thickness of the overflow layer and its changes. A total of 5 years of IES data have now been successfully collected, of which 1.5 years (the 1997 deployment) featured thickness measurements at two positions on the array.

The IES located in the core of the overflow at the near the 2000 m contour (mooring UK1) showed a mean thickness of 232 m (maximum 276 m, minimum 220 m) and standard deviation of 8.2 m. Further downslope at 2200 m (mooring G1), the mean thickness is 398 m, range 382–434 m and standard deviation of 7.6 m. The plume thickness at both sites is shown to vary with the along–Slope current speed, but is not correlated with the temperature of the overflow. Full depth hydrography is only available at the start and end of each array deployment but these CTD profiles show differing water column characteristics above the two IES. The water column at G1 shows distinct ISOW (S maximum) and LSW (S minimum) layers above the DSOW, whilst at UK1 the water column overlying the DSOW layer consists of mixtures of the main water masses without salinity extrema.

OS12P-06 1505h

Response of North Atlantic Heat Transport and Overturning to Changes in the Properties of DSOW

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The response of the large-scale circulation of the North Atlantic to prescribed changes in Denmark Straits Overflow Water is examined in an eddy-permitting GCM. Results from the reference experiment are compared to synoptic observations and indicate reasonable properties of the model's bottom boundary layer parameterization. In a series of process studies, it is demonstrated that the meridional overturning and heat transport are sensitive both to the density of the overflow and to the lateral mixing parameterization of the model. While the change in throughflow in the Denmark Strait agrees with estimates from hydraulic theory, after the descent of the plume the response is amplified by entrainment. - The ocean model is part of FLAME (Family of Linked Atlantic Model Experiments), a PE-model based on the GFDL-MOM code. Horizontal resolution is 1/3 degree * cos(latitude), with 45 levels in the vertical.

OS12P-07 1520h

Exchange processes over the Greenland Scotland Ridge

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The outflow of dense water from the GIN Sea into the subpolar North Atlantic plays a fundamental role in NADW formation. In a numerical model with 1/6th degree horizontal resolution we investigate processes which influence the volume and heat transport across the Greenland-Scotland Ridge system. The focus is on the reaction of the subpolar gyre circulation of the North Atlantic to surface wind stress and buoyancy forcing on seasonal to inter-annual time scales. The sensitivity of the cross-ridge exchange to wind stress and density contrast between the basins is studied in a series of idealized experiments. The general relation between heatflux changes and the overturning transport of source water established in the idealized cases is confirmed in a realistic experiment including 6 years full forcing with surface fluxes estimated in an ocean estimation procedure to be consistent with ocean data. The full model shows a steady decrease in the strength of the cyclonic gyre with according decrease in heat transport. On seasonal time scales there is a clear correlation of heat flux and wind stress curl variability.

OS12P-08 1535h

Warm and Intermediate Water Circulation Around the Reykjanes Ridge

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In mid-basin in the northern North Atlantic the North Atlantic Current delivers warm subtropical waters to the eastern basin, part of which branches northward into the eastern subpolar gyre. It undergoes progressive transformation driven by air–sea fluxes as it flows northward along pathways in the Iceland Basin, and over the Rockall Plateau and Trough. Perhaps half of this transforming warm water is delivered to the Norwegian Sea, transformed to dense waters and ultimately returned south as dense overflows. Additionally, part of the warm water is entrained into the dense overflows of the Wyville–Thompson Ridge, Faroe Bank Channel and Iceland Faroe Ridge, warming the overflow plumes, and returning southward as an admixture to the regional deep and bottom water. But a significant part of the warm water delivered to the eastern subpolar gyre makes its westward across the Reykjanes Ridge into the Irminger Basin — and from there to the Labrador basin, with the continuing transformation yielding Labrador Sea Water, an intermediate water delivered to the subtropics.

The large international effort in the subpolar North Atlantic in WOCE provides a large diverse data set for examining this flow. We focus on the pathways and circulation intensities of flow elements at mid-basin: How does the warm water traverse the Reykjanes Ridge? We address this question using a combination of high-resolution hydrographic sections along and across the Ridge and simultaneous shipboard and lowered acoustic Doppler current profiles. The interpretation will additionally utilize velocity data from surface drifters, PALACE float displacements and RAFOS float trajectories, all part of this large community effort during WOCE.

OS12P-09 1550h

Direct Lagrangian Measurements of the Circulation of Labrador Sea Water in the Northern and Eastern Atlantic, North of 38N

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As part of the U.S. WOCE Atlantic Climate Change Experiment (ACCE), the European EUROFLOAT experiment, the German SFB Subpolar program and the French ARCANE experiment, several groups collaborated in a major initiative to determine the absolute velocity field in the northeast Atlantic using acoustically tracked, eddy-resolving RAFOS and MARVOR floats. Floats were deployed on two levels. In this paper we focus on the waters at 1500-1750 m, the depth range of the main body of Labrador Sea Water (LSW). The float trajectories indicate a) pathways and advection rates from the LSW source region into the eastern Atlantic, and the role played by the MAR and its fracture zones in governing these, b) the pathways and influence of the overflows from the Nordic seas, c) the broad southward flow over the Iberian Abyssal plain, and d) a concentrated flow around the eastern flank of the Azores plateau. The LSW in the NE basin is ventilated on a 5 year time scale, much faster than traditional deep circulation time scales. A broad southward flow carries LSW around the Azores Plateau, and a few trajectories suggest a pathway back into the western basin through the Oceanographer Fracture Zone.

Whereas the mean flow patterns at this depth differ in significant ways from the circulation in the main thermocline, the eddy kinetic energy distributions mimic those on the shallower surface with a conspicuous maximum in the center of the Iceland Basin and minima on the eastern slope of the Reykjanes ridge and over the mid-Atlantic ridge south of the fracture zones. The eddy kinetic energy (EKE) levels over the deep waters west of Europe are low.

Thanks to the Lagrangian approach to the measurement of the velocity field we are able to see a closer connection between pathways of fluid motion and the underlying topography. These maps of the mean circulation and EKEs will be valuable for quantitative studies of mass-and heat transport. They will also help the interpretation of data from the rapidly growing Argo array.

OS12P-10 1605h

Surface Salinity Variability in the Northern North Atlantic During Recent Decades

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The sea surface salinity (SSS) variability in the North Atlantic is investigated using numerical model simulations for the last 50 years based on atmospheric forcing variability from the Comprehensive Atmosphere Ocean Data Set (COADS) and National Center for Environmental Prediction/ National Center for Atmospheric Research (NCEP/NCAR) Reanalysis. The SSS variability in the subpolar region is discussed. The seasonality of the subpolar surface salinity variability is prominent with the maximum standard deviation occurring in the summer/fall period so that the amplitude of the summer SSS anomalies far exceed those of the wintertime. The interannual SSS variability in the subpolar gyre can be attributed mainly to excess ice melt, while the longer term (decadal) variability is associated with deep mixing and meridional overturning variability. In this hindcast, the deep mixing (which drives overturning changes) is forced by heat flux variability so that weak subpolar heat loss, and subsequent weak overturning, are usually manifested in fresh surface conditions in the subpolar gyre within two years. This is because the role of deep convection is to mix down the net fresh water input received by the high-latitudes. Significant freshening periods of the early 1970s and mid 1980s are reproduced in the model. Also, according to the model and based on observational evidence, a significant freshening occurred in the mid 1990s.

OS12P-11 1620h

Response experiments with NAO related forcing

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Many aspects of the high latitude North Atlantic circulation and seaice are apparently related to the NAO (North Atlantic Oscillation). To identify the mechanisms of long term NAO-related variability response experiments are carried out with a coupled ocean-sea ice model of the North Atlantic.

We concentrate on the effect of long term changes in the forcing on the large scale oceanic circulation in the periods before and after 1970, especially on the sudden drop and the following recovery of the NAO index in the mid-nineties.

Experiments with "NAO+" and "NAO-" forcing show a clear response in the Arctic Ocean and the subpolar North Atlantic. There is a direct connection between the wind stress forcing and the sea ice cover and a subsequent reaction of the SSS and SST fields. To distinguish the influence of NAO-related wind stress and temperature changes, we vary each forcing component individually.

OS12Q HC: 316 A Monday 1330h

Coral Reef Habitats: New Insights From Integrated Coastal Science II

Presiding: **M Field,** University of California, Santa Cruz**; P Jokiel,** University of Hawaii at Manoa

OS12Q-01 1330h

Advective Linking of Shelf and Back Reef Ecosystems by Wind-influenced Tidal Transport

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Surface drogue trajectories in a tidal channel in the Exuma Cays, Bahamas, are combined with tidal predictions and wind stress calculations to describe the physical linking of shelf waters of Exuma Sound with back reef environments on Great Bahama Bank. Five flood-tide excursions under varying tide and wind conditions are used in a multiple linear regression analysis to obtain an empirical equation that estimates 705 wind-influenced flood-tide excursions over a one-year time period. Results define back reef regions that are chronically hypersaline due to their isolation from the regular arrival of shelf water. The regression equation suggests that tidal forcing alone produces flood-tide excursions of 3-9 km. Predominantly landward wind stress is more effective in extending flood-tide excursions than in shortening them. Wind forcing has the greatest influence on the flood-tide excursion when the wind direction is 10^o counterclockwise of a directly across-shelf heading. Correlation is highest (r = 0.868) when wind stress is vector-averaged from one hour before the flood through the end of the flood tide. With both tidal and wind forcing, 90% of the flood-tide excursions are longer than 5.6 km, but only 10% are longer than 9.1 km. Juvenile queen conch are absent from otherwise suitable seagrass habitat beyond approximately 6 km from the mouth of the tidal channel. This provides evidence that the infrequent arrival of shelf water impacts the back reef ecosystem by making regions beyond the normal reach of Exuma Sound water hydrographically distinct.

OS12Q-02 1345h

Mapping Bathymetry and Percent Living Coral with Multi-spectral Data; Kailua Bay, Oahu, Hawaii

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The purpose of this study was to determine how effective a tool airborne multi-spectral sensor data was for mapping and studying coral reef geology and ecology. We successfully predicted depth and bottom-type using a simple formula based on the difference in radiance measured in two multi-spectral bands. Our study area was in Kailua Bay, Oahu, Hawaii, which is a typical fringing reef marine environment. The airborne multi-spectral data used was collected when weather and ocean conditions were calm.

Two of the three visible wavelengths measured in this study were suitable to work with. These wavelengths were at 488 nm and 551 nm with a 10 nm full width half maximum. Our results indicate that our two-band method can improve the predictive results (accuracy and detail) when applied to multiple two-band combinations with hyperspectral sensors. Furthermore, we will be able to map change in bathymetry and percent living coral cover by applying these methods to data collected at different times.

We achieved 77% accuracy for seven 'percent living coral' categories derived by unsupervised classification of our multi-spectral predicted bottom-type map. Forty-four 30 m line-intercept transects (Harney, 2000) were used as ground truth and provided detail of the make-up of each percent living coral category. Furthermore, the area covered by each percent living coral category was calculated.

From our multi-spectral depth predictions (80% accuracy), we generated a map of slope for Kailua Bay and found the relationship among slope and the percent living coral categories. With the smallest slopes found in the greatest and the least percent living coral habitats and the greatest slopes in the middle percent living coral categories, we present two hypotheses for this observed relationship. The first hypothesis is that slope is the inhibiting factor to coral growth. In the second hypothesis, the observed relationship results from the topography generated by the various extents of coral cover.

OS12Q-03 1400h

Reefal carbonate facies off Dubai, Arabian Gulf: remote-sensing with Ikonos satellite images and ground-truthing by vessel-based video survey

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Satellite-based remote-sensing is a rapid and cost-efficient way to obtain large-scale data of seafloor types or organismal assemblages. Misclassifications can reduce accuracy and rigorous ground-truthing is necessary. We compared results from a vessel-based video-survey recording footage along parallel survey lines from the surface (Riegl et al., 2001, Bull. Mar. Sci. 68) and classification from an Ikonos image with 1m pixel resolution - two data-sets with 100 percent space cover. Video data were obtained in 1995/6, the Ikonos image in 2001. Facies distribution was not expected to be identical since in the five intervening years a coral mass mortality had killed most of the corals and breakdown of the skeletons had started. Also seagrass and algae beds exhibit high spatial dynamics and were not expected to be identical in the two surveys. The remotely-sensed distribution of habitats nevertheless was highly compatible with that observed by the video survey. Some differences were found in the distribution of algae and seagrass beds, but these could largely be attributed to the five-year time-lag between the surveys. The classification obtained from the satellite image suggests that the video-survey missed some areas of coral-growth. Conversely, some areas mapped as having corals in the video survey did not show in the image classification which suggests breakdown after the 1996 mass mortality. Several small coral areas surrounded by seagrass areas and dense areas of algal growth were only picked-up by the video-survey - since most dead corals were covered by algae, their pixel values on the satellite image were similar to those of algae. Also, in depths greater 10m the spectral values did not allow clear classification. Overall, for areas in less than 10m depth, the results of the satellite-remote sensing and the vessel-based video-survey compared very well. Images courtesy NASA Scientific Data Purchasing Program and F. Muller-Karger at USF.

OS12Q-04 1415h

Drowned Reefs and antecedent Karst Topography, Au'au Channel, S.E. Hawaiian Islands

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During the last glacial maximum *LGM*, about 21,000 years ago, the Hawaiian Islands of Maui, Lanai and Molokai were inter-connected by limestone bridges creating a super-island known as Maui-Nui. Approximately 120 meters of sea-level rise during the Holocene Transgression flooded, and then drowned, these bridges separating the islands by inter-island channels. A new multibeam high-resolution bathymetric survey of the channels between the islands, coupled with observations and video-transects utilizing DeepWorker-2000 submersibles, have revealed the existence of numerous drowned reef features including concentric solution basins, solution ridges (rims), sand and sediment plains, and conical shaped reef pinnacles. The concentric basins contain flat lagoon-like bottoms that are rimmed by steep sided limestone walls. Undercut notches rim the basins at several depths marking either sea-level still stands or paleo-lake levels. All of the solution basins shallower than 120 m were sub-aerial at the LGM, and at one stage or another, may have been shallow shoreline lakes. Today, about 70 drowned reef pinnacles are scattered across the Maui-Lanai underwater bridge and all are situated in wave-sheltered positions. Most drowned during the interval between 14-10,000 years ago when sea-level rise averaged 15 mm/yr. Virtually all of the surficial topography in the Auau Channel today is a product of karst processes accentuated by marginal reef growth during the Holocene. Both the submerged basins and the drowned reefs represent an archive of sea-level and climate history in Hawaii during the late Quaternary.

Key words: Drowned reefs, Holocene Transgression, sea level, karst topography, reef growth, Hawaii

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Large Scale Assessments of Reef Condition in the Atlantic Province, a Role Model for Other Reef Areas

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Large-scale surveys of reefs throughout the Western Atlantic Province provide a regional context for understanding spatial patterns in reef health. By examining multiple indicators of reef condition (corals, fishes, and algae), across multiple spatial scales, it is possible to develop norms for each indicator. These norms allow for comparative analysis of reef condition. It is also possible to infer potential causes (local versus regional) and processes (herbivory, mortality, recruitment), which allow for a more complete understanding of the present states and future trajectories of these complex systems.

During the past 3 years, scientists and managers from throughout the region have applied a standardized rapid assessment methodology to over 500 reef sites in 23 countries as part of the Atlantic and Gulf Rapid Reef Assessment (AGRRA) Program. This baseline dataset establishes the present state of the region's reefs and lays the foundation for future repetitive assessments. Highlights of the AGRRA Program, to be discussed include: 1.Development of a practicable method for rapidly assessing key indicators of reef condition with small teams of divers. 2.Establishment of a sampling approach for characterizing large areas (hundreds to thousands of km). 3.Applying the method to a large number of reef areas, particularly remote areas not previously examined. 4.Establishment of scales for various indicators of reef condition (e.g. partial mortality, biomass of target fishes, abundance of fleshy algae). 5.Distinguishing large-scale vs. local impacts to reefs.

URL: http://coral.aoml.noaa.gov/agra/