



**25 Years** *after*  
**Hurricane Andrew** 16-28 August, 1992

A Bibliography

## 25 Years after Hurricane Andrew

Bibliography

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Compiled by Chrissy Cockrell, FIU Atmospheric Science Student, NHC Library intern, 2017.

Project supervised by Gloria Aversano, National Hurricane Center, Librarian.

The preliminary report written for Hurricane Andrew by Ed Rappaport, National Hurricane Center, Deputy Director (updated in 1993), begins with the following excerpt :

*“Andrew was a small and ferocious Cape Verde hurricane that wrought unprecedented economic devastation along a path through the northwestern Bahamas, the southern Florida peninsula, and south-central Louisiana. Damage in the United States is estimated to be near 25 billion, making Andrew the most expensive natural disaster in U.S. history<sup>1</sup>. The tropical cyclone struck southern Dade County, Florida, especially hard, with violent winds and storm surges characteristic of a category 4 hurricane (see addendum on upgrade to category 5) on the Saffir/Simpson Hurricane Scale, and with a central pressure (922 mb) that is the third lowest this century for a hurricane at landfall in the United States. In Dade County alone, the forces of Andrew resulted in 15 deaths and up to one-quarter million people left temporarily homeless.”* ([Full report at: http://www.nhc.noaa.gov/1992andrew.html](http://www.nhc.noaa.gov/1992andrew.html)):

The National Hurricane Center (NHC) Library is co-located with the Hurricane Center in Miami-Dade County. To mark this significant anniversary the following bibliography was compiled to remind readers, *it only takes one*.

Scope –

This bibliography offers 186 items starting with 145 article citations indexed in *Web of Science*, a Thomson Reuters' database and NHC Library resource. Three additional titles were collected from the *American Meteorological Society* (AMS) e-journal database. Titles were collected from both databases performing a topic search for “Hurricane Andrew” and “Hurricane Andrew 1992” limited by years, 1992 to 2017. Abstracts were reviewed and non-hurricane related articles were weeded from the results however, all subject areas were included.

Abstracts and DOI's for articles have been included when available. Topics include but are not limited to meteorological aspects such as, secondary circulations, intensity reanalysis, inner-core structures, potential vorticity diagnosis, rainbands, and influences of Saharan air layer on cyclogenesis. Other topics include human fetal distress, building regulations, tree mortality, marsh plant recovery and survival of white-tailed deer. Both NOAA and non-NOAA authors are included

Articles are followed by books and reports held at the National Hurricane Center Library. Additional items, not held at the NHC Library, are listed from NOAA Miami Regional, NOAA Central other NOAA libraries.

Last on the list are NOAA satellite and aftermath images available from the *NOAA Photo Library* online at <http://www.photolib.noaa.gov/>. This is a web-based collection available directly to all patrons. To view listed images from this resource use the ‘Weather Service’ collection – “Meteorological Monsters” – “Hurricane Andrew” album at the bottom of the screen.

These and other citations may be viewed via the NHC Library [website](#). Article citations may be viewable via the *AMS* or *E-Database>Web of Science* links. Book holdings are viewable via the *NOAAInc* online catalog, a collection of all holdings from 29 NOAA Libraries country-wide.

The National Hurricane Center Librarian is available for reference via email at [NHCLibrary@noaa.gov](mailto:NHCLibrary@noaa.gov) or phone 305.229.4406. Suggestions and comments are welcome.

I would like to acknowledge my intern, Chrissy Cockrell, for a productive collaboration.

*Gloria Aversano*  
NHC Librarian

## Web of Science Articles: (145)

2013

**Pita G. L., Pinelli J. P., Gurley K. R. and Hamid S.,** Hurricane vulnerability modeling: Development and future trends, *Journal of Wind Engineering and Industrial Aerodynamics*, 114,2013.

Abstract: "Catastrophe models help to evaluate the vulnerability of the building stock exposed to a hazard. This paper presents a history of the hurricane risk models in Florida, and discusses their relationship to the building codes. The first models were econometric, and failed to predict the insured building losses produced by hurricane Andrew. This led to a change in the loss projection paradigm and to the advent of modern catastrophe modeling. Advantages and challenges of the current methodologies are discussed, including the quality of input, validation, uncertainty, and scope of the outputs. The paper concludes with a brief overview of current and future research in vulnerability modeling. (C) 2012 Elsevier Ltd. All rights reserved." [Go to ISI://WOS:000315836600010](http://www.isinet.com/WOS:000315836600010)

**Zahran S., Peek L., Snodgrass J. G., Weiler S. and Hempel L.,** Abnormal labor outcomes as a function of maternal exposure to a catastrophic hurricane event during pregnancy, *Natural Hazards*, 66,1, 2013.

Abstract: "Hurricane Andrew, which made landfall on August 24, 1992, was one of the most destructive hurricanes in American history, causing atypically high levels of psychological and physical health impairment among the resident population and especially among vulnerable groups. This article investigates whether maternal exposure to Hurricane Andrew during pregnancy increased the risk of dystocia (or dysfunctional labor) and infant delivery by cesarean section, the standard medical response to abnormal labor progression. We analyze 297,996 birth events in Miami-Dade and Broward counties in Florida from 1992 to 1993 using propensity score methodology with stratification and nearest-neighbor matching algorithms. Results show that hurricane-exposed pregnant women were significantly more likely to experience stress-induced abnormal labor and cesarean delivery outcomes as compared to statistically matched comparison groups. The conclusion details the policy implications of our results, with particular attention to the importance of maternal prenatal care in the aftermath of disasters." [Go to ISI://WOS:000314297100006](http://www.isinet.com/WOS:000314297100006)

2012

**Mitchell C. M., Esnard A. M. and Sapat A.,** Hurricane Events, Population Displacement, and Sheltering Provision in the United States, *Natural Hazards Review*, 13,2, 2012.

Abstract: "Displacement has traditionally been conceptualized as a phenomenon that results from conflict or other disruptions in developing or unstable countries. Hurricane Katrina shattered this notion and highlighted the various dilemmas of population displacement in the United States. This paper focuses on the dilemma of post disaster sheltering and housing as experienced after Hurricanes Andrew, Katrina, and Ike. Methodology and data sources include a review of scholarly empirical research, a Lexis-Nexis search of major laws and regulations passed after the hurricanes, congressional investigations and testimonies, and newspaper articles. Evidence is found of flexible but ad hoc policy response and programmatic changes during the housing recovery process. Given the problems experienced during the recovery process and the lack of attention paid to displacement issues, recommendations are made toward integrating a process approach into current practices to: (1) recognize disaster-induced displaced persons and plan for their differential needs; (2) integrate agency programming at all scales; and (3) implement a holistic yet streamlined process to provide services to disaster-induced displaced persons. DOI: 10.1061/(ASCE)NH.1527-6996.0000064. (C) 2012 American Society of Civil Engineers." [Go to ISI://WOS:000303939200006](http://www.isinet.com/WOS:000303939200006)

2011

**Gurley K. R. and Masters F. J.,** Post-2004 Hurricane Field Survey of Residential Building Performance, *Natural Hazards Review*, 12,4, 2011.

Abstract: "This paper presents the methodology and results of a study of the performance of site-built single-family structures in Florida constructed after Andrew-related changes to the Standard Building Code. A detailed investigation of wind damage as a result of the 2004 hurricane season was conducted. The study provides a quantitative comparison of the relative performance of homes built between 1994 and 2001 with those built after the 2001 Florida Building Code replaced the Standard Building Code. DOI: 10.1061/(ASCE)NH.1527-6996.0000044. (C) 2011 American Society of Civil Engineers." [Go to ISI://WOS:000298249400005](http://www.isinet.com/WOS:000298249400005)

**Tansel B. and Sizerici B.,** Significance of Historical Hurricane Activity on Structural Damage Profile and Post hurricane Population Fluctuation in South Florida Urban Areas, *Natural Hazards Review*, 12,4, 2011.

Abstract: "The historical hurricane tracking records for the last 100 years indicate that the southeast regions of Florida have had the highest frequency of hurricane hits in the United States. Land-use characteristics and the extent of land-development activities are the major factors that contribute to vulnerability to hurricanes in high-risk coastal areas. The objectives of this study were to analyze the structural damages observed after Hurricane Andrew in relation to year of construction of the buildings to

assess the impact of historical hurricane experience on building structures and population fluctuations in South Florida, specifically in Dade County. The relatively long period of low hurricane activity from 1950 to 1992 has resulted in increased population density and coastal development in South Florida, significantly increasing the vulnerability of the region. The structural damage data compiled by the Metropolitan Dade Department of Building and Zoning after Hurricane Andrew in 1992 show that the long period of low hurricane activity in Dade County has also resulted in lower construction quality. In general, the older housing units constructed after the previous major hurricanes (in 1926, 1945, and 1950) showed less damage than the units constructed during 1970 to 1990. Although there was a decline in population immediately after Hurricane Andrew, the population increase trend was similar to the prehurricane level after 2 years. DOI: 10.1061/(ASCE)NH.1527-6996.0000045. (C) 2011 American Society of Civil Engineers." [<Go to ISI>://WOS:000298249400008](#)

2010

**Zahran S., Snodgrass J. G., Peek L. and Weiler S.,** Maternal Hurricane Exposure and Fetal Distress Risk, *Risk Analysis*, 30,10, 2010.

Abstract: "Logistic regression and spatial analytic techniques are used to model fetal distress risk as a function of maternal exposure to Hurricane Andrew. First, monthly time series compare the proportion of infants born distressed in hurricane affected and unaffected areas. Second, resident births are analyzed in Miami-Dade and Broward counties, before, during, and after Hurricane Andrew. Third, resident births are analyzed in all Florida locales with 100,000 or more persons, comparing exposed and unexposed gravid females. Fourth, resident births are analyzed along Hurricane Andrew's path from southern Florida to northeast Mississippi. Results show that fetal distress risk increases significantly with maternal exposure to Hurricane Andrew in second and third trimesters, adjusting for known risk factors. Distress risk also correlates with the destructive path of Hurricane Andrew, with higher incidences of fetal distress found in areas of highest exposure intensity. Hurricane exposed African-American mothers were more likely to birth distressed infants. The policy implications of in utero costs of natural disaster exposure are discussed." [<Go to ISI>://WOS:000282696900016](#)

2009

**Keeland B. D. and Gorham L. E.,** Delayed Tree Mortality in the Atchafalaya Basin of Southern Louisiana Following Hurricane Andrew, *Wetlands*, 29,1, 2009.

Abstract: "Hurricanes can damage trees, in forested wetlands, and the potential for mortality related to these storms exists due to the effects of tree damage over time. In August 1992, Hurricane Andrew passed through the forested wetlands of southern Louisiana with winds in excess of 225 kph. Although more than 78% of the basal area was destroyed in some areas, most trees greater than 2.5 cm dbh were alive and resprouting prolifically the following year (98.8%). Survival of most tree species was similarly high two years after the hurricane, but mortality rates of some species increased dramatically. For example, *Populus heterophylla* (swamp cottonwood) mortality increased from 7.8 to 59.2% (n = 76) and *Salix interior* (sandbar willow) mortality increased from 4.5 to 57.1% (n = 21). Stem sprouts on many uprooted hardwood trees of other species were still alive in 1998, 6 years after the hurricane. Due to the Understorey tree species composition, regeneration, and high levels of resprouting, there was little change in Species composition or perhaps a slight shift toward more shade and flood tolerant species six years following the hurricane event. *Triadica sebifera* (Chinese tallow) was found on some of the sites heavily disturbed by Hurricane Andrew, and may proliferate at the expense of native tree species." [<Go to ISI>://WOS:000265294500011](#)

2008

**Simmons K. M. and Sutter D.,** Manufactured home building regulations and the February 2, 2007 Florida tornadoes, *Natural Hazards*, 46,3, 2008.

Abstract: "The Department of Housing and Urban Development (HUD) and the state of Florida implemented new wind load and tie-down regulations for manufactured homes following Hurricane Andrew. This article examines the effect of the new regulations on the likelihood that occupants of mobile homes would survive a tornado. On February 2, 2007, three tornadoes struck central Florida, resulting in 21 deaths in Lake County, all in manufactured homes. The deaths occurred almost exclusively in homes rated as leveled by the county tax appraiser. Manufactured homes built to the new regulations, however, were significantly less likely to be leveled. Regression analysis finds that manufactured homes built to the post-Andrew requirements were 79% less likely to be leveled than homes built prior to the HUD Code in 1976, and 68% less likely to be leveled than homes built after 1976 but before the 1994 wind load regulations. Construction of all manufactured homes in the tornado paths to the wind load and tie-down requirements could have reduced fatalities by 70%." [<Go to ISI>://WOS:000257953500007](#)

2006

**Zhang D. L. and Kieu C. Q.,** Potential vorticity diagnosis of a simulated hurricane. Part II: Quasi-balanced contributions to forced secondary circulations, *Journal of the Atmospheric Sciences*, 63,11, 2006.

Abstract: "Although the forced secondary circulations (FSCs) associated with hurricane-like vortices have been previously examined, understanding is still limited to idealized, axisymmetric flows and forcing functions. In this study, the individual contributions of latent heating, frictional, and dry dynamical processes to the FSCs of a hurricane vortex are separated in order to examine how a hurricane can

intensify against the destructive action of vertical shear and how a warm-cored eye forms. This is achieved by applying a potential vorticity (PV) inversion and quasi-balanced omega equations system to a cloud-resolving simulation of Hurricane Andrew (1992) during its mature stage with the finest grid size of 6 km. It is shown that the latent heating FSC, tilting outward with height, acts to oppose the shear-forced vertical tilt of the storm, and part of the upward mass fluxes near the top of the eyewall is detrained inward, causing the convergence aloft and subsidence warming in the hurricane eye. The friction FSC is similar to that of the Ekman pumping with its peak upward motion occurring near the top of the planetary boundary layer (PBL) in the eye. About 40% of the PBL convergence is related to surface friction and the rest to latent heating in the eyewall. In contrast, the dry dynamical forcing is determined by vertical shear and system-relative flow. When an axisymmetric balanced vortex is subjected to westerly shear, a deep countershear FSC appears across the inner-core region with the rising (sinking) motion downshear (upshear) and easterly sheared horizontal flows in the vertical. The shear FSC is shown to reduce the destructive roles of the large-scale shear imposed, as much as 40%, including its forced vertical tilt. Moreover, the shear FSC intensity is near-linearly proportional to the shear magnitude, and the wavenumber-1 vertical motion asymmetry can be considered as the integrated effects of the shear FSCs from all the tropospheric layers. The shear FSC can be attributed to the Laplacian of thermal advection and the temporal and spatial variations of centrifugal force in the quasi-balanced omega equation, and confirms the previous finding of the development of wavenumber-1 cloud asymmetries in hurricanes. Hurricane eye dynamics are presented by synthesizing the latent heating FSC with previous studies. The authors propose to separate the eye formation from maintenance processes. The upper-level inward mass detrainment forces the subsidence warming (and the formation of an eye), the surface pressure fall, and increased rotation in the eyewall. This increased rotation will induce an additional vertical pressure gradient force to balance the net buoyancy generated by the subsidence warming for the maintenance of the hurricane eye. In this sense, the negative vertical shear in tangential wind in the eyewall should be considered as being forced by the subsidence warming, and maintained by the rotation in the eyewall." [Go to ISI://WOS:000242442700013](http://www.isi.edu/WOS:000242442700013)

2004

**Landsea C. W., Franklin J. L., McAdie C. J., Beven J. L., Gross J. M., Jarvinen B. R., Pasch R. J., Rappaport E. N., Dunion J. P. and Dodge P. P.,** A reanalysis of Hurricane Andrew's intensity, *Bulletin of the American Meteorological Society*, 85,11, 2004.

Abstract: "Hurricane Andrew of 1992 caused unprecedented economic devastation along its path through the Bahamas, southeastern Florida, and Louisiana. Damage in the United States was estimated to be \$26 billion (in 1992 dollars), making Andrew one of the most expensive natural disasters in U.S. history. This hurricane struck southeastern Florida with maximum 1-min surface winds estimated in a 1992 post storm analysis at 125 kt (64 m s<sup>-1</sup>). This original assessment was primarily based on an adjustment of aircraft reconnaissance flight-level winds to the surface. Based on recent advancements in the understanding of the eyewall wind structure of major hurricanes, the official intensity of Andrew was adjusted upward for five days during its track across the Atlantic Ocean and Gulf of Mexico by the National Hurricane Center Best Track Change Committee. In particular, Andrew is now assessed by the National Hurricane Center to be a Saffir-Simpson Hurricane Scale category-5 hurricane (the highest intensity category possible) at its landfall in southeastern Florida, with maximum 1-min winds of 145 kt (75 m s<sup>-1</sup>). This makes Andrew only the third category-5 hurricane to strike the United States since at least 1900. Implications for how this change impacts society's planning for such extreme events are discussed." [Go to ISI://WOS:000225557200011](http://www.isi.edu/WOS:000225557200011)

**Yau M. K., Liu Y. B., Zhang D. L. and Chen Y. S.,** A multiscale numerical study of Hurricane Andrew (1992). part VI: Small-scale inner-core structures and wind streaks, *Monthly Weather Review*, 132,6, 2004.

Abstract: "The objectives of Part VI of this series of papers are to (a) simulate the fine scale features of Hurricane Andrew (1992) using a cloud-resolving grid length of 2 km, (b) diagnose the formation of small-scale wind streaks, and (c) perform sensitivity experiments of varying surface fluxes on changes in storm inner-core structures and intensity. As compared to observations and a previous 6-km model run, the results show that a higher-resolution explicit simulation could produce significant improvements in the structures and evolution of the inner-core eyewall and spiral rainbands, and in the organization of convection. The eyewall becomes much more compact and symmetric with its width decreased by half, and the radius of maximum wind is reduced by; 10 to 20 km. A zone of deep and intense potential vorticity (PV) is formed at the edge of the eye. A ring of maximum PV is collocated in regions of maximum upward motion in the eyewall and interacts strongly with the eyewall convection. The convective cores in the eyewall are associated with small-scale wind streaks. The formation of the wind streaks is diagnosed from an azimuthal momentum budget. The results reveal small-scale Lagrangian acceleration of the azimuthal flow. It is found that at the lowest model level of 40 m, the main contributor to the Lagrangian azimuthal wind tendency is the radial advection of angular momentum per unit radius. At an altitude of 1.24 km, vertical advection of the azimuthal wind, in addition to the radial advection of angular momentum per unit radius, plays important roles. Results of a series of sensitivity tests, performed to examine the impact of several critical factors in the surface and boundary layer processes on the inner-core structures and the evolution of the hurricane intensity, are presented." [Go to ISI://WOS:000222090700007](http://www.isi.edu/WOS:000222090700007)

**Castellanos D., Perez M., Lewis J. and Shaw J. A.,** Youth suicide and Hurricane Andrew, *Journal of the American Academy of Child and Adolescent Psychiatry*, 42,2, 2003. <Go to ISI>://WOS:000180539300006

**Nufer K. E., Wilson-Ramirez G. and Crandall C. S.,** Different medical needs between hurricane and flood victims, *Wilderness & Environmental Medicine*, 14,2, 2003.

Abstract: "Objective.-Through the review of patient records seen by the New Mexico-1 Disaster Medical Assistance Team (NM-1DMAT) after various disasters, we hoped to find patterns that might help in disaster planning. Our hypothesis was that flood and hurricane victims have different medical conditions and needs. Methods.-We conducted a retrospective review of patient records for NM-1DMAT deployments to Hurricane Andrew in Florida (August 1992) and the Houston, TX flood caused by Tropical Storm Allison (June 2001). We compared age, gender, chief complaint, medical history, diagnosis, diagnostic testing, treatment rendered, triage category, and patient disposition. Results.-We found several differences between the patients presenting after Hurricane Andrew and those presenting after Tropical Storm Allison. The chief complaint, diagnosis, presence of medical history, diagnostic testing, treatment rendered, triage category, and disposition all differed between the 2 disasters. The mean ages in both groups were similar. Conclusions.-The needs of the patients differed in several areas between Hurricane Andrew and the Houston flood. This information should be tested in a future hurricane or flood and taken into account when planning for deployments." <Go to ISI>://WOS:000183680200003

**Wang X. B. and Zhang D. L.,** Potential vorticity diagnosis of a simulated hurricane. Part I: Formulation and quasi-balanced flow, *Journal of the Atmospheric Sciences*, 60,13, 2003.

Abstract: "Because of the lack of three-dimensional (3D) high-resolution data and the existence of highly nonelliptic flows, few studies have been conducted to investigate the inner-core quasi-balanced characteristics of hurricanes. In this study, a potential vorticity (PV) inversion system is developed, which includes the nonconservative processes of friction, diabatic heating, and water loading. It requires hurricane flows to be statically and inertially stable but allows for the presence of small negative PV. To facilitate the PV inversion with the nonlinear balance (NLB) equation, hurricane flows are decomposed into an axisymmetric, gradient-balanced reference state and asymmetric perturbations. Meanwhile, the nonellipticity of the NLB equation is circumvented by multiplying a small parameter epsilon and combining it with the PV equation, which effectively reduces the influence of anticyclonic vorticity. A quasi-balanced omega equation in pseudoheight coordinates is derived, which includes the effects of friction and diabatic heating as well as differential vorticity advection and the Laplacians of thermal advection by both nondivergent and divergent winds. This quasi-balanced PV - omega inversion system is tested with an explicit simulation of Hurricane Andrew (1992) with the finest grid size of 6 km. It is shown that (a) the PV - v inversion system could recover almost all typical features in a hurricane, and (b) a sizeable portion of the 3D hurricane flows are quasi-balanced, such as the intense rotational winds, organized eyewall updrafts and subsidence in the eye, cyclonic inflow in the boundary layer, and upper-level anticyclonic outflow. It is found, however, that the boundary layer cyclonic inflow and upper-level anticyclonic outflow also contain significant unbalanced components. In particular, a low-level outflow jet near the top of the boundary layer is found to be highly unbalanced (and supergradient). These findings are supported by both locally calculated momentum budgets and globally inverted winds. The results indicate that this PV inversion system could be utilized as a tool to separate the unbalanced from quasi-balanced flows for studies of balanced dynamics and propagating inertial gravity waves in hurricane vortices." <Go to ISI>://WOS:000183280900005

**Xu Y. M. and Wu R. S.,** The conservation of helicity in hurricane Andrew (1992) and the formation of the spiral rainband, *Advances in Atmospheric Sciences*, 20,6, 2003.

Abstract: "The characteristics of helicity in a hurricane are presented by calculating the MM5 model output in addition to theoretical analysis. It is found that helicity in a hurricane mainly depends on its horizontal component, whose magnitude is about 100 to 1000 times larger than its vertical component. It is also found that helicity is approximately conserved in the hurricane. Since the fluid has the intention to adjust the wind shear to satisfy the conservation of helicity, the horizontal vorticity is even larger than the vertical vorticity, and the three-dimensional vortices slant to the horizontal plane except in the inner eye. There are significant horizontal vortices and inhomogeneous helical flows in the hurricane. The formation of the spiral rainband is discussed by using the law of horizontal helical flows. It is closely related to the horizontal strong vortices and inhomogeneous helical flows." <Go to ISI>://WOS:000187229600009

**Zhang D. L. and Wang X. X.,** Dependence of hurricane intensity and structures on vertical resolution and time-step size, *Advances in Atmospheric Sciences*, 20,5, 2003.

Abstract: "In view of the growing interests in the explicit modeling of clouds and precipitation, the effects of varying vertical resolution and time-step sizes on the 72-h explicit simulation of Hurricane Andrew (1992) are studied using the Pennsylvania State University/National Center for Atmospheric Research (PSU/NCAR) mesoscale model (i.e., MM5) with the finest grid size of 6 km. It is shown that changing vertical resolution and time-step size has significant effects on hurricane intensity and inner-core cloud/precipitation, but little impact on the hurricane track. In general, increasing vertical resolution tends to produce a deeper storm with lower central pressure and stronger three-dimensional winds, and more precipitation. Similar effects, but to a less extent, occur when the time-step size is reduced. It is found that increasing the low-level vertical resolution is more efficient in intensifying a hurricane, whereas changing the upper-level vertical resolution has little impact on the hurricane intensity. Moreover, the use of a thicker surface layer tends to produce higher maximum surface winds. It is concluded that the use of higher vertical resolution, a thin surface layer, and smaller time-step sizes, along with higher horizontal resolution, is desirable to model more realistically the intensity and inner-core structures and evolution of tropical storms as well as the other convectively driven weather systems." <Go to ISI>://WOS:000185670500004

2002

Hurricane Andrew steps up, *Bulletin of the American Meteorological Society*, 83,10, 2002.  
<Go to ISI>://WOS:000178915700002

**Karyampudi V. M. and Pierce H. F.**, Synoptic-scale influence of the Saharan air layer on tropical cyclogenesis over the eastern Atlantic, *Monthly Weather Review*, 130,12, 2002.

Abstract: "The formations of Hurricane Andrew, Tropical Storm Ernesto, and Hurricane Luis, which occurred, respectively, during the 1992, 1994, and 1995 hurricane seasons over the eastern Atlantic, have been investigated by utilizing the European Centre for Medium-Range Weather Forecasts (ECMWF) gridded data analyses. These cases were selected to illustrate the contrasting influences of the Saharan air layer (SAL) on tropical cyclogenesis. Analyses results show that Tropical Storm Ernesto (1994) and Hurricane Luis (1995) formed from the merger of the low-level (925 hPa) and midlevel (700 hPa) vortices over the eastern Atlantic within the monsoon trough enhanced by surges in the trades. Midlevel vortices associated with each case appear to evolve from African wave troughs enhanced by cyclonic shear vorticity of the midtropospheric jet, which existed to the south of an SAL anticyclonic eddy as an elongated wind maximum. Vorticity budget calculations suggest that vortex stretching dominated the enhancement of low-level vortices, whereas positive vorticity advection (PVA) on the south and leading edge of the midlevel easterly jet (MLEJ) but ahead of the trough axis contributed to the enhancement of midlevel vortices for both cases. Persistent upper-level divergence associated with an anticyclonic circulation appears to have aided in the formation of Ernesto, whereas for Luis, no such prior forcing is evident. Hurricane Andrew (1992), on the other hand, appears to form from a deep African wave vortex. Vortex stretching contributed to the development of low-level vortices. Although cyclonic shear vorticity to the south of the MLEJ is present in association with a deeper and wider SAL devoid of its characteristic anticyclonic eddy (unlike in Ernesto and Luis), the midlevel contribution from PVA on the south side of the jet to the maintenance of the midlevel vortex is found to be insignificant in Andrew due to negligible cross-(vorticity) contour flow to the south and ahead of the wave trough. However, the pre-Andrew growth was dominated by PVA at upper levels associated with easterly wave perturbations to the south of an anticyclonic circulation center but to the north of an upper-level easterly jet. In at least two cases (i.e., Ernesto and Luis), the SAL directly contributed to the negative PV anomalies to the north of the MLEJ, which resulted in the sign reversal of the meridional gradient of potential vorticity (between 850- and 700-hPa levels), which satisfies the Charney and Stern criterion for barotropic and baroclinic instability across the midtropospheric jet over the eastern Atlantic. The baroclinic mechanism, proposed by Karyampudi and Carlson, is found to be valid in explaining some of the wave growth processes involved in the genesis of the same two cases. Based on these results, it is concluded that SAL had a positive influence on at least two cases [both (Ernesto and Luis) occurred in normal Sahel rainfall years], in contrast to a negative influence on Andrew, which occurred in an extremely dry year." <Go to ISI>://WOS:000179269500019

**Keen T. R. and Glenn S. M.**, Predicting bed scour on the continental shelf during Hurricane Andrew, *Journal of Waterway Port Coastal and Ocean Engineering-Asce*, 128,6, 2002.

Abstract: "A numerical sedimentation model, TRANS98, has been used to simulate storm sedimentation on Ship Shoal, a drowned barrier island on the Louisiana continental shelf. The model predicts that maximum sediment resuspension and transport occurs over a few tens of kilometers during the storm peak. Sediment transport is dominated by suspended load rather than bed load. The total resuspension and erosion depth is more than 0.02 m over Ship Shoal. A method of estimating the error in the computed wave-current shear stress is presented. The predicted shear stress during the storm peak is underpredicted by 9%. The error estimate increases to more than 16% overprediction after the eye made

landfall. The error estimates suggest that the model-predicted sediment resuspension and potential transport patterns are reasonable." <Go to ISI>://WOS:000178983400003

**Koptur S., Rodriguez M. C., Oberbauer S. F., Weekley C. and Herndon A.,** Herbivore-free time? Damage to new leaves of woody plants after Hurricane Andrew, *Biotropica*, 34,4, 2002.

Abstract: "All broadleaf woody plants of pinelands and hammocks (upland areas) in the northern parts of Everglades National Park were defoliated by the strong winds of Hurricane Andrew in August 1992.. Most plants Fe-leaved within two months of the storm, at which time we tagged newly produced leaves of eight species (five species in two hardwood hammocks and four in two pineland sites; one species was studied in both habitats), and monitored individual leaf area lost or damaged monthly for three months. We marked a second cohort of new leaves on the same individuals four months later and monitored these for three months. Herbivory rates in leaves of the first cohort were lower than observed in pre-hurricane studies on two of the species, and lower in the first cohort than in the second cohort in six of the eight species studied, indicating that most insect herbivores were virtually absent for the first few months after the storm. Additionally, most species produced significantly larger leaves in the first cohort than the second cohort, and leaves of the second cohort were not significantly different in size from pre-hurricane leaves in one species for which pre-hurricane data were available. The large disturbance of the hurricane defoliated and reduced the above-ground biomass of the plants, but apparently also eliminated most herbivores and competition for light, facilitating the recovery of the plants." <Go to ISI>://WOS:000180539800007

2001

**Baldwin A., Egnotovitch M., Ford M. and Platt W.,** Regeneration in fringe mangrove forests damaged by Hurricane Andrew, *Plant Ecology*, 157,2, 2001.

Abstract: "Mangrove forests along many tropical coastlines are frequently and severely damaged by hurricanes. The ability of mangrove forests to regenerate following hurricanes has been noted, but changes that occur in vegetation following disturbance by hurricane winds and storm tides have not been studied. We measured changes in plant community structure and environmental variables in two fringe mangrove forests in south Florida, USA that experienced high wind velocities and storm tides associated with Hurricane Andrew (August 1992). Loss of the forest canopy stimulated regeneration via seedling growth and recruitment, as well as resprouting of some trees that survived the hurricane. Initial regeneration differed among species in both forests: *Rhizophora mangle* L. regenerated primarily via growth of seedlings present at the time of the hurricane (i.e., release of advance recruits), but many trees of *Avicennia germinans* (L.) Stearn and *Laguncularia racemosa* Gaertn. f. resprouted profusely from dormant epicormic buds. In one forest, which was formerly dominated by *Laguncularia*, high densities of *Rhizophora* seedlings survived the hurricane and grew to form dense stands of saplings and small trees of *Rhizophora*. In the other forest, there were lower densities of surviving *Rhizophora* seedlings (possibly due to higher storm tide), and extensive bare areas that were colonized by *Avicennia*, *Laguncularia*, and herbaceous species. This forest, predominantly *Rhizophora* at the time of the hurricane, now contains stands of saplings and small trees of all three species, interspersed with patches dominated by herbaceous plants. These findings indicate that moderately damaged fringe forests may regenerate primarily via release of *Rhizophora* advance recruits, leading to single-species stands. In severely damaged forests, seedling recruitment may be more important and lead to mixed-species stands. Regeneration of mangrove forests following hurricanes can involve different pathways produced by complex interactions between resprouting capability, seedling survival, post-hurricane seedling recruitment, and colonization by herbaceous vegetation. These differences in relative importance of regeneration pathways, which may result in post-hurricane forests different from their pre-hurricane structure, suggest that models for regeneration of mangrove forests will be more complex than "direct regeneration" models proposed for other tropical forests where regeneration after hurricanes is dominated by resprouting." <Go to ISI>://WOS:000173513700003

**DiMarco S. F., Meza E. and Zhang J.,** Estimating wave elevation from pressure using second order nonlinear wave-wave interaction theory with applications to Hurricane Andrew, *Journal of Coastal Research*, 17,3, 2001.

Abstract: "We present a methodology to determine the nonlinear relationship between an observed dynamic pressure time series at a fixed point below the surface and the surface elevation. This method extends the formalism of previous studies where the analytical relationship between surface elevation and potential in both unidirectional and directional irregular wave trains has been derived up to second order in wave steepness. Laboratory wave tank tests show that the predicted wave elevation from the nonlinear model is more accurate than the predicted linear surface elevation of a transient irregular wave train, especially for deep troughs and high wave crests. We apply the nonlinear theory of estimate, wave elevation of a unique pressure time series recorded at a site 20 km south of Terrebonne Bay, Louisiana, during Hurricane Andrew and compare that result to the wave elevation estimated from the same time series using linear wave theory. The site was within 30 km of the storm's eye at closest approach. The

maximum significant wave height using nonlinear wave theory is reduced by 8.4% to 7.69 m. The nonlinear interaction is seen to be strongest during the six-hour period that hurricane force winds were present at the site." <Go to ISI>://WOS:000171383300014

**Robertson K. M. and Platt W. J.**, Effects of multiple disturbances (fire and hurricane) on epiphyte community dynamics in a subtropical forest, Florida, USA, *Biotropica*, 33,4, 2001.

Abstract: "We addressed the interacting effects of a natural large-scale fire and a subsequent major hurricane on relative positions of epiphytes in a subtropical forest. In Everglades National Park, subtropical hammocks (hardwood tree "islands"; burned and unburned) during the Ingraham Fire (1989) were surveyed for trees and epiphytic bromeliads (*Tillandsia* spp.) one year before, as well as one and five years after, Hurricane Andrew (1992). We measured trees (species, diameter, and status [alive/dead]) and epiphytes (species, height, host tree characteristics, substrate life status, and density). The fire decreased the height of epiphytes during the hurricane because branches and bark of trees killed by the fire were unstable epiphyte substrates in the high winds. Proportions of epiphytes on *Quercus virginiana* were equally increased after the hurricane in both unburned and burned hammocks; the large size and bark characteristics resulted in greater proportional survival of epiphytes on this species. During the five years following the hurricane, changes in the distributions of epiphytes generally were toward pre-hurricane distributions, but recovery was faster in unburned than burned hammocks. We conclude that disturbances that kill trees are likely to amplify the vertical reduction of epiphytes during a subsequent hurricane and that effects of a single disturbance on plant populations can be influenced by the disturbance history of the system, including different types of disturbances." <Go to ISI>://WOS:000173456300004

**Ross M. S., Carrington M., Flynn L. J. and Ruiz P. L.**, Forest succession in tropical hardwood hammocks of the Florida keys: Effects of direct mortality from Hurricane Andrew, *Biotropica*, 33,1, 2001.

Abstract: "A tree species replacement sequence for dry broadleaved forests (tropical hardwood hammocks) in the upper Florida Keys was inferred from species abundances in stands abandoned from agriculture or other anthropogenic activities at different times in the past. Stands were sampled soon after Hurricane Andrew, with live and hurricane-killed trees recorded separately; thus it was also possible to assess the immediate effect of Hurricane Andrew on stand successional status. We used weighted averaging regression to calculate successional age optima and tolerances for all species, based on the species composition of the pre-hurricane stands. Then we used weighted averaging calibration to calculate and compare inferred successional ages for stands based on (1) the species composition of the pre-hurricane stands and (2) the hurricane-killed species assemblages. Species characteristic of the earliest stages of post-agricultural stand development remains a significant component of the forest for many years, but are gradually replaced by taxa not present, even as seedlings, during the first few decades. This compositional sequence of a century or more is characterized by the replacement of deciduous by evergreen species, which is hypothesized to be driven by increasing moisture storage capacity in the young organic soils. Mortality from Hurricane Andrew was concentrated among early-successional species, thus tending to amplify the long-term trend in species composition." <Go to ISI>://WOS:000168959800003

**Zhang D. L., Liu Y. B. and Yau M. K.**, A multiscale numerical study of Hurricane Andrew (1992). Part IV: Unbalanced flows, *Monthly Weather Review*, 129,1, 2001.

Abstract: "Despite considerable progress in understanding the hurricane vortex using balanced models, the validity of gradient wind balance in the eyewall remains controversial in observational studies. In this paper, the structure and development of unbalanced forces and flows in hurricanes are examined, through the analyses of the radial momentum and absolute angular momentum (AAM) budgets, using a high-resolution (i.e.,  $\Delta x = 6$  km), fully explicit simulation of Hurricane Andrew (1992). It is found from the radial momentum budgets that supergradient flows and accelerations, even after temporal and azimuthal averaging, are well organized from the bottom of the eye center to the upper outflow layer in the eyewall. The gradient accelerations are on average twice greater than the local Coriolis force, and caused mainly by the excess of the centrifugal force over the pressure gradient force. It is shown by the AAM budgets that supergradient flows could occur not only in the inflow region as a result of the inward AAM transport, but also in the outflow region through the upward transport of AAM. The eyewall is dominated by radial outflow in which the upward transport of AAM overcompensates the spindown effect of the outflow during the deepening stage. The intense upper outflow layer is generated as a consequence of the continuous outward acceleration of airflows in the eyewall updrafts. In spite of the pronounced gradient tendencies, results presented here suggest that the azimuthally averaged tangential winds above the boundary layer satisfy the gradient wind balance within an error of 10%. The analyses of instantaneous fields show pronounced asymmetries and well-organized wavenumber-2 structures of the gradient flows and forces in the form of azimuthally propagating vortex-Rossby waves in the eyewall. These waves propagate cyclonically downstream with a speed half the tangential winds

near the top of the boundary layer and vertically upward. A gradient flows/forces and AAM transport in the eye are also discussed." <Go to ISI>://WOS:000166475400005

2000

**Bennetts R. E., Sparks S. A. and Jansen D.,** Factors influencing movement probabilities of Florida tree snails *Liguus fasciatus* (Muller) in big cypress national preserve following Hurricane Andrew, *Malacologia*, 42,1-2, 2000.

Abstract: "Beginning in 1993, approximately one year after Hurricane Andrew, we marked 2,547 Florida tree snails (*Liguus fasciatus*) during six sampling (mark-resighting) occasions twice per year over a three-year period. During each sampling occasion, we conducted a search for all tree snails within 16 sample plots on eight hammocks (tree islands) and for an extended radius of approximately 20 m around each plot. We individually marked all trees > 5 cm dbh within each plot and all trees within the extended radius in which a marked snail was found. Because the host tree for each marked animal was known, inter-tree movements could be directly measured as the proportion of animals found on different host trees at times  $t$  and  $t + 1$ . We observed 533 marked snails during two or more consecutive sampling occasions. Of these, 414 (77.7%) snails had moved from one host tree to another between sampling occasions. Based on a conditional logistic regression model, movement probabilities were influenced by whether or not the snail's host tree had been *Lysiloma* at time  $t$ , the diameter of the host tree at time  $t$ , and interactions among these and with year. Overall, snails had a lower probability of moving from one tree to another if their host tree had been *Lysiloma* and if they were on larger host trees. We found no evidence that movement probabilities were influenced by the snail's subspecies, age, hammock size class, or by the season. An effect of latitudinal gradient or proportion of host-trees damaged was not retained in our final model. However, a preliminary univariate analysis did indicate a difference in movement probabilities between our northernmost hammocks, which had relatively little hurricane damage, and the southern hammocks, which had extensive damage." <Go to ISI>://WOS:000089952400002

**Keen T. R. and Allen S. E.,** The generation of internal waves on the continental shelf by Hurricane Andrew, *Journal of Geophysical Research-Oceans*, 105,C11, 2000.

Abstract: "Observed currents, temperature, and salinity from moored instruments on the Louisiana continental slope and shelf reveal multiple baroclinic oscillations during Hurricane Andrew in August 1992. These measurements are supplemented by numerical models in order to identify possible internal wave generation mechanisms. The Princeton Ocean Model is run with realistic topography, stratification, and wind forcing to extend the observations to Mississippi Canyon and other areas on the shelf. A two-layer isopycnal model is used with idealized topography and spatially uniform winds to isolate internal waves generated in and around the canyon. The combination of the observations and the results from the numerical models indicates several possible mechanisms for generating long internal waves: (1) near-inertial internal waves were generated across the slope and shelf by dislocation of the thermocline by the wind stress; (2) interaction of inertial flow with topography generated internal waves along the shelf break, which bifurcated into landward and seaward propagating phases; (3) downwelling along the coast depressed the thermocline; after downwelling relaxes, an internal wave front propagates as a Kelvin wave; and (4) Poincare waves generated within Mississippi Canyon propagate seaward while being advected westward over the continental slope. These processes interact to produce a three-dimensional internal wave field, which was only partly captured by the observations." <Go to ISI>://WOS:000165351900011

**Kwit C., Platt W. J. and Slater H. H.,** Post-hurricane regeneration of pioneer plant species in south Florida subtropical hardwood hammocks, *Biotropica*, 32,2, 2000.

Abstract: "After Hurricane Andrew crossed southern Florida (U.S.A.) on 24 August 1992, native and exotic pioneer species in subtropical hardwood forests (hammocks) regenerated from seed banks. Regeneration occurred in hammocks of metropolitan Dade County and the Long Pine Key region of Everglades National park. The density of the native pioneer *Trema micrantha* was significantly higher in hammocks of Long Pine Key than in those of metropolitan Dade County. In contrast, the basal area of the exotic pioneer *Carica papaya* was greater in Dade County hammocks than Long Pine Key hammocks. Although *T. micrantha* tended to be restricted to areas of soil disturbance (tip-up pits) formed by trees uprooted during Hurricane Andrew, especially in Long Pine Key, *C. papaya* was located throughout hammocks. These results suggest differences in the regeneration niches in which the native *T. micrantha* required more specific disruptions (i.e., both canopy and soil) than *C. papaya* (only removal of canopy) for establishment. A broad regeneration niche could in part account for the capability of an exotic species with a dormant seed bank to invade native subtropical forests following natural large-scale disturbances." <Go to ISI>://WOS:000087812600006

**Lirman D.,** Fragmentation in the branching coral *Acropora palmata* (Lamarck): growth, survivorship, and reproduction of colonies and fragments, *Journal of Experimental Marine Biology and Ecology*, 251,1, 2000.

Abstract: "Acropora palmata, a branching coral abundant on shallow reef environments throughout the Caribbean, is susceptible to physical disturbance caused by storms. Accordingly, the survivorship and propagation of this species are tied to its capability to recover after fragmentation. Fragments of *A. palmata* comprised 40% of ramets within populations that had experienced recent storms. While the survivorship of *A. palmata* fragments was not directly related to the size of fragments, removal of fragments from areas where they settled was influenced by size. Survivorship of fragments was also affected by type of substratum; the greatest mortality (58% loss within the first month) was observed on sand, whereas fragments placed on top of live colonies of *A. palmata* fused to the underlying tissue and did not experience any losses. Fragments created by Hurricane Andrew on a Florida reef in August 1992 began developing new growth (proto-branches) 7 months after the storm. The number of proto-branches on fragments was dependent on size, but growth was not affected by the size of fragments. Growth-rates of proto-branches increased exponentially with time (1.7 cm year<sup>-1</sup> for 1993-1994, 2.7 cm year<sup>-1</sup> for 1994-1995, 4.2 cm year<sup>-1</sup> for 1995-1996, and 6.5 cm year<sup>-1</sup> for 1996-1997), taking over 4 years for proto-branches to achieve rates comparable to those of adult colonies on the same reef (6.9 cm year<sup>-1</sup>). In addition to the initial mortality and reduced growth-rates, fragmentation resulted in a loss of reproductive potential. Neither colonies that experienced severe fragmentation nor fragments contained gametes until 4 years after the initial damage. Although *A. palmata* may survive periodic fragmentation, the long-term effects of this process will depend ultimately on the balance between the benefits and costs of this process. (C) 2000 Elsevier Science B.V. All rights reserved." <Go to ISI>://WOS:000089284800003

**Platt W. J., Doren R. F. and Armentano T. V.,** Effects of Hurricane Andrew on stands of slash pine (*Pinus elliottii* var. *densa*) in the everglades region of south Florida (USA), *Plant Ecology*, 146,1, 2000.

Abstract: "Few hurricanes affect intact stands of subtropical pines. We examined effects of winds in the eyewalls of Hurricane Andrew, where wind speeds were > 200 km h<sup>-1</sup>, on all remaining large mainland stands of *Pinus elliottii* var. *densa* (south Florida slash pine) on limestone outcroppings (rocklands) in the everglades region of southern Florida. We measured densities and sizes of trees and assessed damage and mortality in plots in old-growth stands in the Lostman's Pines (LOP) region of Big Cypress National Preserve and in second-growth stands in the Pines West (PIW) and Long Pine Key (LPK) regions of Everglades National Park. We also examined age-size relationships using sections from trees killed by the hurricane in LOP and LPK. We used the data to predict effects of recurrent hurricanes on the structure and dynamics of the old-growth stand and to compare effects of hurricanes on old- and second-growth stands. Slash pine was resistant to hurricane winds. Most trees in stands (68-76%) were not severely damaged; mortality in the three regions averaged 17-25% shortly after the hurricane and 3-7% during the following year. Mortality was positively associated with tree size; mean tree sizes decreased and size-selective thinning occurred in all stands. Nonetheless, local mortality ranged from 3-4% to 50-60% among plots in all stands. Such local variation in mortality resulted from clustering of large trees, especially in old-growth stands, and from microbursts during the hurricane, which affected all stands. Recurrent, intense hurricanes are predicted to kill larger trees, slowly opening new patches and increasing sizes of extant patches, thus resulting in almost continual presence of openings suitable for recruitment in old-growth stands. Age-size relationships also indicated that large trees in old-growth stands may survive 2-3 centuries. The combination of frequent openings and wind resistance of large trees is predicted to result in old-growth stands that are highly uneven aged, with trees locally distributed in similar-aged patches. The extent to which such stands deviate from demographic equilibrium, as well as turnover rates within stands, are likely to increase as the frequency of recurrent, intense hurricanes increases. Damage and mortality differed in old- and second-growth stands. Large trees were more, but small trees less likely to be damaged in old- than second-growth stands. In contrast, mortality was significantly lower in old- (LOP: 16.9% +/- 3.1 [mean +/- s.e.]) than second-growth stands (PIW: 22.5% +/- 2.0; LPK: 25.2% +/- 2.7). Total hurricane-related mortality was 30-60% higher in second- than old-growth stands. Size class structure, more uneven in old- than second growth stands prior to the hurricane, diverged even more afterwards. Hurricane Andrew removed more large trees, but opened fewer patches suitable for recruitment in second- than old-growth stands. Thus, second- growth stands did not more closely resemble old-growth stands after Andrew, and size class distributions were not likely to shift towards those in old-growth stands. Moreover, rapid growth of both current large trees and small trees in the newly opened patches should result in second- growth stands being susceptible to future hurricanes. Management that shifts structure and dynamics towards old-growth stands will require changes in patch dynamics so that growth rates of trees in open patches are slowed and they become less susceptible to wind damage. High intensity prescribed fires may slow the growth of small trees, eventually resulting in second- growth stands containing larger trees more resistant to frequent, intense hurricanes." <Go to ISI>://WOS:000085307800004

**Zhang D. L., Liu Y. B. and Yau M. K.,** A multiscale numerical study of Hurricane Andrew (1992). Part III: Dynamically induced vertical motion, *Monthly Weather Review*, 128,11, 2000.

Abstract: "In this study, the vertical force balance in the inner-core region is examined, through the analysis of vertical momentum budgets, using a high-resolution, explicit simulation of Hurricane Andrew

(1992). Three-dimensional buoyancy- and dynamically induced perturbation pressures are then obtained to gain insight into the processes leading to the subsidence warming in the eye and the vertical lifting in the eyewall in the absence of positive buoyancy. It is found from the force balance budgets that vertical acceleration in the eyewall is a small difference among the perturbation pressure gradient force (PGF), buoyancy, and water loading. The azimuthally averaged eyewall convection is found to be conditionally stable but slantwise unstable with little positive buoyancy. It is the PGF that is responsible for the upward acceleration of high-theta ( $\theta$ ) air in the eyewall. It is found that the vertical motion and acceleration in the eyewall are highly asymmetric and closely related to the azimuthal distribution of radial flows in conjunction with large thermal and moisture contrasts across the eyewall. For example, the radically incoming air aloft is cool and dry and tends to suppress updrafts or induce downdrafts. On the other hand, the outgoing flows are positively buoyant and tend to ascend in the eyewall unless evaporative cooling dominates. It is also found that the water loading effect has to be included into the hydrostatic equation in estimating the pressure or height field in the eyewall. The perturbation pressure inversions show that a large portion of surface perturbation pressures is caused by the moist-adiabatic warming in the eyewall and the subsidence warming in the eye. However, the associated buoyancy-induced PGF is mostly offset by the buoyancy force, and their net effect is similar in magnitude but opposite in sign to the dynamically induced PGE. Of importance is that the dynamically induced PGF points downward in the eye to account for the maintenance of the general descent. But it points upward in the outer portion of the eyewall, particularly in the north semicircle, to facilitate the lifting of high-theta ( $\theta$ ) air in the lower troposphere. Furthermore, this dynamic force is dominated by the radial shear of tangential winds. Based on this finding, a new theoretical explanation, different from previously reported, is advanced for the relationship among the subsidence warming in the eye, and the rotation and vertical wind shear in the eyewall." <Go to ISI>://WOS:000165141300004

1999

**Benight C. C., Ironson G., Klebe K., Carver C. S., Wynings C., Burnett K., Greenwood D., Baum A. and Schneiderman N.**, Conservation of resources and coping self-efficacy predicting distress following a natural disaster: A causal model analysis where the environment meets the mind, *Anxiety Stress and Coping*, 12,2, 1999.

Abstract: "Disaster research has increasingly examined how personal characteristics mediate emotional recovery following disaster exposure. We investigated the importance of lost resources, coping self-efficacy, and coping behavior as important variables in acute disaster reaction and medium range disaster recovery following Hurricane Andrew. One hundred and eighty participants living in southern Dade county completed the initial phase of the study (1-4 months post-hurricane). with 135 individuals completing the second wave (8-12 months post-hurricane). Results confirmed that lost resources, coping self-efficacy, and coping behavior are important in understanding psychological reactivity following a natural disaster. These variables together provided the best fitted causal model for describing psychological reactions to the hurricane over time. Results are discussed in relation to how coping self-efficacy may serve as an important intrapersonal factor that mediates how lost resources are managed and how effective coping ensues. Implications for clinical interventions are also addressed." <Go to ISI>://WOS:000175299600001

**Courtemanche R. P., Hester M. W. and Mendelsohn I. A.**, Recovery of a Louisiana barrier island marsh plant community following extensive hurricane-induced overwash, *Journal of Coastal Research*, 15,4, 1999.

Abstract: "The Isles Dernieres barrier island chain provides the front line of protection for the Lower Terrebonne Estuary, Louisiana. Landfall of Hurricane Andrew on August 26, 1992 resulted in overwash of most of this island chain, thereby accelerating the erosional processes and altering the plant communities of the islands. Four zones were identified by the depth of overwash sands received (from >50 cm to <10 cm) to examine the factors affecting the colonization of vegetation following overwash. Within each, zone a permanent transect and thirty permanent plots were established and sampled four times over two years for biotic and abiotic variables. A total of 32 plant species was identified, 30 of which were located in the zone with the highest loadings of sand. Over time this zone also had the greatest increases in species richness. The most important survivor and early colonizer of the high zone overwash was *Spartina alterniflora*. However, over time *Spartina patens* became dominant. The other zones, receiving moderate to no sand deposits, differed greatly. The few species present in these zones (<7) were indicative of high salt marsh and salt pan habitats and were dominated by *Spartina alterniflora* throughout the study. Using multivariate analyses, biotic and abiotic variables were correlated. The soil variables representative of topographical elevation and soil salinity influenced plant community zonations on the Isles Dernieres. Soil fertility and herbivory were not dominant factors affecting vegetation establishment. Backbarrier marsh areas that received the greatest sand loadings are now characterized by dune and swale plant species, while areas that received low sand loadings are returning to a marsh community." <Go to ISI>://WOS:000083470300002

**Cropper W. P. and DiResta D.,** Simulation of a Biscayne Bay, Florida commercial sponge population: effects of harvesting after Hurricane Andrew. *Ecological Modelling*, 118,1, 1999.

Abstract: "The hardbottom communities of Biscayne Bay, Florida include populations of several commercial sponge species. These sponges have been subjected to harvesting, a major hurricane, trawling damage, and other stressors during the past 10 years. We developed a size-based matrix population model of the dominant commercial sponge species (*Spongia graminea*) as a tool to aid in assessing sponge population viability and potentially managing the sponge harvest. Repeated measurements of tagged sponges allowed estimation of growth, survival and fragmentation probabilities. Fecundity was estimated by solving for values of the reproductive size classes that matched the observed population growth when coupled with the observed transition probabilities. Three fecundity functions were applied to the sponge model: constant, a linear function of size class, and a function of sponge volume. All three models indicated a long-term decline in the sponge population ( $\lambda < 1$ ), attributed to poor recruitment, and significant vulnerability to harvesting. The responses were similar when either 7 or 2 size classes were assumed to be reproductively functional, and when using different methods and different assumptions of size-class distributions to fit the fecundity values. Models fit with the assumption of an open population (recruitment from outside the population) and with fecundity values increased to achieve a lambda of 1 were less sensitive to harvest, but did not match the observed population dynamics. (C) 1999 Elsevier Science B.V. All rights reserved." <Go to ISI>://WOS:000081165100001

**Keen T. R. and Glenn S. M.,** Shallow water currents during hurricane Andrew. *Journal of Geophysical Research-Oceans*, 104,C10, 1999.

Abstract: "Oceanographic measurements are used in combination with a numerical model to examine the influence of stratification on shallow water currents during the directly forced stage of a tropical cyclone (Hurricane Andrew) on the continental shelf. The following stratification-dependent coastal processes are examined: (1) turbulent mixing, (2) coastally trapped waves, (3) near-inertial oscillations, and (4) upwelling and downwelling. Turbulent mixing was strong within 1 R-w (radius of maximum winds) of the storm track, and stratification was nearly destroyed. Turbulent mixing was weak at distances greater than 2 R-w. The dominant coastal wave was a barotropic Kelvin wave generated as the storm surge relaxed after landfall. Baroclinic near-inertial oscillations were dominant at the shelf break and occurred along with a barotropic response on the middle shelf. Downwelling-favorable flow developed east of the track prior to the storm peak, and upwelling-favorable flow evolved west of the track as the eye crossed the shelf. The idealized storm flow was modified by local barotropic and baroclinic pressure gradients on the shelf. Ocean circulation during Hurricane Andrew was hindcast using both stratified and unstratified three-dimensional numerical models. For areas within 1 R-w of the storm track, the unstratified model matched the observed currents better than the stratified model, partly because of errors in the initial stratification. At distances greater than 2 R-w the influence of stratification increases, and the unstratified model does not reproduce the observed upwelling-favorable flow." <Go to ISI>://WOS:000083163500012

**Labisky R. F., Miller K. E. and Hartless C. S.,** Effect of Hurricane Andrew on survival and movements of white-tailed deer in the Everglades. *Journal of Wildlife Management*, 63,3, 1999.

Abstract: "Movements and survival of 32 radiomarked white-tailed deer (*Odocoileus virginianus seminolus*) were studied in the wet prairie of Everglades National Park (ENP) and Big Cypress National Preserve (BCNP) before and after the passage of Hurricane Andrew a storm with sustained winds of 242 km/hr that bisected the study area on 24 August 1992. All radiomarked deer survived the Hurricane. However, the hurricane, which struck during rut, appeared to reduce conception rates or fetus and fawn survival, or both, as evidenced by a 1n-fold decrease in fawn production in 1993. Home range sizes, measured during January March, did not differ ( $P > 0.05$ ) among the years 1991, 1992 (prehurricane), and 1993 (posthurricane). Strong site fidelity in the wake of Hurricane Andrew was evidenced by the lack of difference ( $P > 0.05$ ) in the distances between home range centers in prehurricane years (1991-92) and in pre- and posthurricane years (1992-93). Multiple response permutation procedure (MRPP) analyses revealed that although many deer altered ( $P < 0.05$ ) their home range use distributions between 1992 (prehurricane) and 1993 (posthurricane), these changes were consistent with those observed in the same deer between 1991 and 1992 (prehurricane years). In the absence of extraordinary or prolonged rainfall, hurricanes appear not to exert direct detrimental effects on deer populations in the interior marshes of the Everglades, but they may depress productivity for an annual cycle." <Go to ISI>://WOS:000081441500012

**Liu Y. B., Zhang D. L. and Yau M. K.,** A multiscale numerical study of Hurricane Andrew (1992). Part II: Kinematics and inner-core structures. *Monthly Weather Review*, 127,11, 1999.

Abstract: "Despite considerable research, understanding of the temporal evolution of the inner-core structures of hurricanes is very limited owing to the lack of continuous high-resolution observational data of a storm. In this study, the results of a 72-h explicit simulation of Hurricane Andrew (1992) with a grid size of 6 km are examined to explore the inner-core axisymmetric and asymmetric structures of the storm during its rapid deepening stage. Based on the simulation, a conceptual model of the axisymmetric structures of the storm is proposed. Most of the proposed structures confirm previous observations. The main ingredients include a main inflow (outflow) in the boundary layer (upper troposphere) with little radial flow in between, a divergent slantwise ascent in the eyewall, a penetrative dry downdraft at the inner edge of the eyewall, and a general weak subsiding motion in the eye with typical warming/drying above an inversion located near an altitude of about 2-3 km. The storm deepens as the axes of these features contract. It is found that the inversion divides the eye of the hurricane vertically into two parts, with a deep layer of warm/dry air above and a shallow pool of warm/moist air below. The air aloft descends at an average rate of 5 cm s<sup>-1</sup> and has a residency time of several days. In contrast, the warm/moist pool consists of air from the main inflow and penetrative downdrafts, offset somewhat by the air streaming in a returning outflow into the eyewall in the lowest 2 km; it is subject to the influence of the upward heat and moisture fluxes over the underlying warm ocean. The warm/moist pool appears to play an important role in supplying high- $\theta(e)$  air for deep convective development in the eyewall. The penetrative downdraft is dry and originates from the return inflow in the upper troposphere, and it is driven by sublimative/evaporative cooling under the influence of the (asymmetric) radial inflow of dry/cold air in the midtroposphere. It penetrates to the bottom of the eye (azimuthally downshear with a width often greater than 100 km) in a radially narrow zone along the slantwise inner edge of the eyewall. It is further shown that all the meteorological fields are highly asymmetric. Whereas the storm-scale flow features a source-sink couplet in the boundary layer and dual gyres aloft, the inner-core structures exhibit alternative radial inflow and outflow and a series of inhomogeneous updrafts and downdrafts. All the fields tilt more or less with height radially outward and azimuthally downshear. Furthermore, pronounced fluctuations of air motion are found in both the eye and the eyewall. Sometimes, a deep layer of upward motion appears at the center of the eye. All these features contribute to the trochoidal oscillation of the storm track and movement. The main steering appears to be located at the midtroposphere (similar to 4.5 km) and the deep-layer mean winds represent well the movement of the hurricane." <Go to ISI>://WOS:000083403800005

**Molinari J., Moore P. and Idone V.,** Convective structure of hurricanes as revealed by lightning locations. *Monthly Weather Review*, 127,4, 1999.

Abstract: "Cloud-to-ground lightning flash locations were examined for nine Atlantic basin hurricanes using data from the National Lightning Detection Network. A common radial distribution in ground flash density was evident: a weak maximum in the eyewall region, a clear minimum 80-100 km outside the eyewall, and a strong maximum in the vicinity of outer rainbands (210-290-km radius). These results are consistent with the authors' previous study of Hurricane Andrew. None of the storms showed this characteristic radial structure during prehurricane stages. The results support the division of precipitation in the hurricane into three distinct regimes. The eyewall is a unique phenomenon but shares some attributes with deep, weakly electrified oceanic monsoonal convection. The region outside the eyewall and under the central dense overcast has characteristics of the trailing stratiform region of mesoscale convective systems, including a relatively high fraction of positive polarity flashes. The outer bands, with mean maximum flash density at the 250-km radius, contain the vast majority of ground flashes in the storms. Eyewall lightning, defined as that within 40 km of the center, was examined for four moderate-to-strong hurricanes. Such lightning occurred episodically during hurricane stage, with 93% of hourly intervals containing no detected flashes. Eyewall lightning outbreaks over water always occurred at the beginning of or during times of intensification, but often were indicative of the imminent end of deepening. It is proposed that the existence of such inner core lightning might reveal the presence of an eyewall cycle. For the one storm with available aircraft reconnaissance data, eyewall cycles were reliably identified by the occurrence of inner core lightning, and inner core lightning appeared only during such cycles. Suggestions are made as to how eyewall flashes in existing hurricanes might be used to help predict hurricane intensity change." <Go to ISI>://WOS:000079571400006

**Norris F. H., Perilla J. L., Riad J. K., Kaniasty K. and Lavizzo E. A.,** Stability and change in stress, resources, and psychological distress following natural disaster: Findings from Hurricane Andrew. *Anxiety Stress and Coping*, 12,4, 1999.

Abstract: "The stress, resource, and symptom levels of 241 residents of southern Dade County, Florida were assessed 6 and 30 months after Hurricane Andrew. Percentages meeting study criteria for depression and PTSD did not change over time. Whereas mean levels of intrusion and arousal decreased, depressive symptoms remained stable, and avoidance numbing symptoms actually increased. Intrusion and arousal were associated more strongly with pre-disaster factors (gender, ethnicity) and within-disaster factors (injury, property loss) than with post-disaster factors (stress, resources), but the reverse was true for depression and avoidance. Changes over time in symptoms were largely explained by changes over time in stress and resources. The findings indicate that ongoing

services are needed to supplement the crisis-oriented assistance typically offered to disaster victims."  
<Go to ISI>://WOS:000175299700002

**Olson W. S., Kummerow C. D., Hong Y. and Tao W. K.,** Atmospheric latent heating distributions in the tropics derived from satellite passive microwave radiometer measurements, *Journal of Applied Meteorology*, 38,6, 1999.

Abstract: "A method for the remote sensing of three-dimensional latent heating distributions in precipitating tropical weather systems from satellite passive microwave observations is presented. In this method, cloud model simulated hydrometeor/latent heating vertical profiles that have radiative characteristics consistent with a given set of multispectral microwave radiometric observations are composited to create a best estimate of the observed profile. An estimate of the areal coverage of convective precipitation within the radiometer footprint is used as an additional constraint on the contributing model profiles. This constraint leads to more definitive retrieved profiles of precipitation and latent heating in synthetic data tests. The remote sensing method is applied to Special Sensor Microwave/Imager (SSM/I) observations of tropical systems that occurred during the TOGA COARE Intensive Observing Period, and to observations of Hurricane Andrew (1992). Although instantaneous estimates of rain rates are high-biased with respect to coincident radar rain estimates, precipitation patterns are reasonably correlated with radar patterns, and composite rain rate and latent heating profiles show respectable agreement with estimates from forecast models and heat and moisture budget calculations. Uncertainties in the remote sensing estimates of precipitation/latent heating may be partly attributed to the relatively low spatial resolution of the SSM/I and a lack of microwave sensitivity to tenuous anvil cloud, for which upper-tropospheric latent heating rates may be significant. Estimated latent heating distributions in Hurricane Andrew exhibit an upper-level heating maximum that strengthens as the storm undergoes a period of intensification." <Go to ISI>://WOS:000081006800001

**Powell M. D. and Houston S. H.,** A multiscale numerical study of hurricane Andrew (1992). Part I: explicit simulation and verification - Comments, *Monthly Weather Review*, 127,7, 1999. <Go to ISI>://WOS:000081748900021

**Zhang D. L. and Altshuler E.,** The effects of dissipative heating on hurricane intensity, *Monthly Weather Review*, 127,12, 1999.

Abstract: "The effects of dissipative heating on hurricane intensity are examined using a 72-h explicit simulation of Hurricane Andrew (1992) with a state-of-the-art, three-dimensional, nonhydrostatic mesoscale (cloud resolving) model (i.e., MM5). It is found that the inclusion of dissipative heating increases the central pressure deficit of the storm by 5-7 hPa and its maximum surface wind by about 10% prior to landfall. It is shown that dissipative heating tends to warm the surface layer, causing a decrease (increase) in sensible heat flux at the sea surface (the top of the surface layer) that acts to cool the surface layer, although the net (sensible plus dissipative) heating rates are still 30%-40% greater than the sensible heating rates in the control simulation. Finally, the potential effects of energy transfer into the ocean, sea surface temperature changes within the inner core, and evaporation of sea spray, interacting with dissipative heating, on hurricane intensity are discussed." <Go to ISI>://WOS:000084145700017

**Zhang D. L., Liu B. and Yau M. K.,** Surface winds at landfall of Hurricane Andrew (1992) - A reply, *Monthly Weather Review*, 127,7, 1999. <Go to ISI>://WOS:000081748900022

1998

**Costello N. L., Antoni M. H., Baldewicz T., Lutgendorf S., Klimas N. and Schneiderman N.,** Coping and emotional expression effects upon distress, illness burden, and cytokines in CFS patients after Hurricane Andrew, *Psychosomatic Medicine*, 60,1, 1998. <Go to ISI>://WOS:000071810000135

**Crandell J. H.,** Statistical assessment of construction characteristics and performance of homes in Hurricanes Andrew and Opal, *Journal of Wind Engineering and Industrial Aerodynamics*, 77-8,1998.

Abstract: "Construction characteristics and performance of homes in Hurricane Andrew and Opal have been documented in two damage assessment surveys using statistical sampling techniques. The surveys resulted in the documentation of a representative sample of 466 homes in Hurricane Andrew and 200 homes in Hurricane Opal. Each home was assessed for about 60 construction characteristics and about 30 damage characteristics related to various components and assemblies. The most prevalent form of structural damage in Hurricane Andrew was associated with about 64% of the homes losing one or more panels of roof sheathing. Damage to hip roofs was significantly (95% confidence level) less than comparable homes with gable roofs. Likewise, damage to two-story homes was significantly greater than the one-story counterparts. Damage to the affected housing population in Hurricane Opal was primarily

**Horvitz C. C., Pascarella J. B., McMan S., Freedman A. and Hofstetter R. H.,** Functional roles of invasive non-indigenous plants in hurricane-affected subtropical hardwood forests. *Ecological Applications*, 8,4, 1998.

Abstract: "Native forest species exhibit a well-known range of ecological roles with respect to natural disturbance regimes, from pioneer phase to mature phase, and they regenerate from a range of sources, including dormant seeds, seed rain, pre-established juveniles, and resprouts from damaged adults. In contrast, the ecological roles of invasive, non-indigenous species in forest communities after natural disturbances are not well understood. Some previous studies of invasive species have emphasized their weedy nature and their ability to colonize anthropogenic disturbances. Tropical hardwood hammock forests in southern Florida experience frequent disturbance by hurricanes. Our studies of forest regeneration during two years following a recent severe hurricane suggest that invasive non-indigenous forest species exhibit the same range of ecological roles as native forest species and compete with native species for particular kinds of regeneration opportunities. To study ecological roles of non-indigenous species in regenerating forests after Hurricane Andrew, we set up four large study areas at each of three study sites that had differing amounts of hurricane-caused canopy disturbance. There were two pairs of 30 x 60 m research plots per site, and in each pair there was one control plot and one restoration plot; restoration areas were subject to an aggressive management program, focused on reducing non-indigenous vine cover. Within these study areas we subsampled vegetation in small study plots that were regularly spaced, and conducted vegetation censuses in April (the end of the dry season) and October (the end of the rainy season) for 2 yr, beginning in April 1993. We found that the source of regeneration for forest species was dependent upon the amount of canopy disturbance, the time since disturbance, and the autecology of the constituent species. Overall, 28% of the 90 species were non-indigenous: 34% of the vines (N = 32) and 24% of other life-forms (N = 58). Non-indigenous vines seemed to have a special role; not only could they compete with native vines, but they could also negatively affect the regeneration of other natives from a diverse array of sources including pre-established juveniles and resprouts from damaged adults. Both native and non-indigenous vine cover in unmanipulated study areas increased following the hurricane. Non-indigenous vine species had higher cover than native vine species, and many species formed dense "blankets." Non-indigenous species in general (not just vines) did not differ significantly from native species in seed mass, nor were they restricted to the pioneer type of life history. Many non-indigenous species had invaded forests prior to hurricane disturbance and had their own banks of pre-established juveniles; others recruited from dormant seeds, seed rain, and/or resprouts from pre-established adults. Based on information on source of regeneration and impact on native species, we propose a classification scheme for functional roles of non-indigenous invasive species in forests. To investigate whether non-indigenous taxa had roles in other geographic regions similar to those they had in Florida, we reviewed literature for 50 taxa belonging to genera that have species known to be invasive in southern Florida. We found that these taxa were invasive or had congeners that were invasive in other geographic regions (Western Australia, the Mariana Islands, Hawaii, the Mascarene Islands, and South Africa). We propose that taxa predominantly retain their invasive, functional-role type across regions. Thus, studies of ecological roles of invasive species with respect to natural disturbance regimes in one region may help us predict invasive roles in other regions." <Go to ISI>://WOS:000077129600005

**Keen T. R. and Glenn S. M.,** Factors influencing model skill for hindcasting shallow water currents during Hurricane Andrew. *Journal of Atmospheric and Oceanic Technology*, 15,1, 1998.

Abstract: "Hurricane Andrew made landfall in the Gulf of Mexico after crossing directly over several moored current meter arrays deployed on the Louisiana-Texas shelf. The resulting three-dimensional current, temperature, and salinity time series are used in a quantitative analysis of the factors affecting the hindcast skill of ocean circulation models. This paper describes parameters for quantifying a model's skill at matching both maximum currents and time series at specific locations and depths. It then briefly discusses the following factors with respect to currents hindcast with the Princeton Ocean Model: 1) model domain size; 2) horizontal resolution, including the bathymetry and coastline; 3) vertical resolution (i.e., number of model levels); 4) the surface drag formulation; 5) the bottom drag coefficient; 6) turbulent mixing parameters and sources of turbulence; and 7) the initial temperature field. Model performance is found to be most dependent on parameters within the turbulent energy closure scheme and the initial temperature and salinity distributions. The best overall model performance is gained by adjusting one of the closure scheme coefficients (B-1,) that decreases turbulence dissipation (and increases mixing where a density gradient exists). Results incorporating wave breaking and a depth-dependent initial temperature field, however, are also reasonable, and differences between the model skill parameters are insufficient to determine which approach is preferable." <Go to ISI>://WOS:000071804700001

**Parsons M. L.,** Salt marsh sedimentary record of the landfall of Hurricane Andrew on the Louisiana coast: Diatoms and other paleoindicators. *Journal of Coastal Research*, 14,3, 1998.

Abstract: "Hurricane Andrew made landfall on the Louisiana coast on August 26, 1992, with the eye passing 40 km southwest of a salt marsh pond already under study. Storm surges ranging from 1-3 m in proximity to the pond resulted in the deposition of a mud layer, several centimeters thick, in many areas inundated by the storm surge. Analysis of pond sediment cores distinguished a hurricane mud layer characterized as a composite sediment, containing indicators of estuarine, brackish, and freshwater sources. The composite nature of the hurricane sediment is indicated by a higher diatom species diversity coupled with a more even species representation. Other distinguishing characteristics of the mud layer include lower marine diatom abundance, larger mean grain size, more poorly sorted sediment, and lower amounts of nitrogen in the sediment. Hurricane Andrew appears to have altered the geochemistry of the pond through the reduction of sulfide in the sediment allowing the proliferation of aquatic submerged flora (*Najas* sp.), resulting in a diatom assemblage shift towards epiphytic species. The submerged stand was still present two years after the hurricane landfall, and the diatom population has yet to revert to the pre-hurricane community." <Go to ISI>://WOS:000075421100019

**Pascarella J. B.**, Resiliency and response to hurricane disturbance in a tropical shrub, *Ardisia escallonioides* (Myrsinaceae), in south Florida, *American Journal of Botany*, 85,9, 1998.

Abstract: "The resiliency to hurricane disturbance and the response to posthurricane environmental conditions were examined in the tropical shrub *Ardisia escallonioides* (Myrsinaceae). Hurricane Andrew struck three of four study sites in subtropical hardwood forests in south Florida on 24 August 1992. Posthurricane understory light levels in the disturbed sites ranged from 21 to 53% of full light in 1993 and remained high in 1994; in contrast, light levels averaged only 9% in the undisturbed forest. Significant differences in mortality, damage, and defoliation were observed among the three hurricane-damaged populations. Mortality was low, but adults suffered high levels of damage and defoliation. Following the hurricane, populations in the most severely disturbed forests had more growth than populations in lightly damaged or undamaged forests. Seed germination and seedling growth were not associated with light availability. No long-term seed dormancy was observed. The observed response to posthurricane environmental conditions is consistent with understory species that show release following canopy opening, but are able to persist under periods of canopy closure. The local dominance of this species in many coastal forests in south Florida may be due to the high frequency of hurricane disturbance." <Go to ISI>://WOS:000076063900002

**Pascarella J. B.**, Hurricane disturbance, plant-animal interactions, and the reproductive success of a tropical shrub, *Biotropica*, 30,3, 1998.

Abstract: "Hurricane disturbance may have strong effects on plant-animal interactions important in plant reproductive success. Components of reproductive success (flowering, pollination, seed predation) in the tropical shrub *Ardisia escallonioides* (Myrsinaceae) were examined from 1991-1994 in four southern Florida populations. Hurricane Andrew struck three of the four populations on 24 August 1992. Hurricane Andrew delayed flowering by two months in 1992. In 1993 and 1994, the three hurricane-damaged populations had increased flowering and inflorescence production compared to 1991 and 1992, while the undamaged population had no flowering. Hurricane disturbance had different effects on generalist versus specialist plant-animal interactions. Species composition and relative abundance of the generalist pollinator community that visits *A. escallonioides* was similar before and after the hurricane, indicating little effect of the disturbance on this interaction. In contrast, populations of a specialist flower galling moth (*Periploca* sp., *Cosmopterigidae*) declined in 1992 following Hurricane Andrew. Although moth populations increased at two of the three sites in 1993, the relative impact of moth predation on seed production was low due to extensive flower production. One moth population suffered local population extirpation for two years, reestablishing itself in November 1994. Hurricane disturbance resulted in a window of opportunity for massive seed production of *Ardisia escallonioides* in south Florida. Total seed production in 1993 increased twelve to seventy-three times the 1992 levels. Total seed production declined in 1994, but remained high compared to prehurricane levels." <Go to ISI>://WOS:000076381900008

1997

**Bea R. G., Loch K. J. and Young P. L.**, Capacities of template-type platforms in the gulf of Mexico during hurricane Andrew, *Journal of Offshore Mechanics and Arctic Engineering-Transactions of the Asme*, 119,1, 1997.

Abstract: "This paper details results from nonlinear analyses of the ultimate limit state performance characteristics of four Gulf of Mexico (GOM) platforms subjected to intense loadings from hurricane Andrew. These four platforms were located to the east of the track of hurricane Andrew, and were thus in the most intense portion of the storm (Smith, 1993). The nonlinear analyses are able to replicate details of the observed behavior of the four structures. This replication is very dependent on realistic characterization of the performance characteristics of the pile foundations and on accurate information on the "as is" condition of the platforms before the storm." <Go to ISI>://WOS:A1997WK2700001

**Gibson D. J., Ely J. S. and Looney P. B.,** A Markovian approach to modeling succession on a coastal barrier island following beach nourishment, *Journal of Coastal Research*, 13,3, 1997.

Abstract: "Markov models are used to understand and predict future successional pathways of vegetation on a barrier island off the coast of northwest Florida following massive beach nourishment below mean high water (MHW) in late 1990. Discriminant Analysis and Two-Way Indicator Species Analysis were used to classify permanent plots surveyed annually in the autumn above old MHW from 1989 to 1993 into one of eight vegetation types (strand, wooded dunes, back slopes, dunes, dry swales, wet swales, marsh or empty). Annual change in the classification of individual plots was used to derive transition matrices that give the probability that a plot will be classified in a subsequent year as a different vegetation type, or remain the same. Transition matrices derived from separate years indicate that overall successional dynamics of the vegetation above old MHW did not change following deposition of the dredge spoil below old MHW. The modeling procedure allowed the potential vegetation dynamics of the barrier island to be projected so that the effects of management and natural disturbance can be assessed quantitatively. Markov model simulation of vegetation development on the dredge spoil, showed that primary succession was proceeding according to the vegetation dynamics above old MHW, but at a rate slower than predicted. It is postulated that the slow rate of primary succession on the dredge spoil was due to natural disturbances, such as flooding by the storm surge accompanying Hurricane Andrew in August 1992. Inclusion of hurricane effects (frequency, based upon historical records, and intensity) in a subsequent simulation suggests that the stable state predicted by the model is unlikely to be reached. This model provides a theoretical developmental pattern for the vegetation on the dredge spoil to be established against which future patterns may be compared. The model also allows the ecological success of the nourishment project to be judged quantitatively." <Go to ISI>://WOS:A1997XQ32600020

**Godbee D. C. and Odom J. W.,** Utilization of special forces medical assets during disaster relief: The hurricane Andrew experience, *Military Medicine*, 162,2, 1997.

Abstract: "Special Forces units and their innate assets are presented as the ideal first-response unit to natural disasters due to their breadth of skill, speed of response, and ability to work independently in remote areas. "Green Beret" soldiers are particularly suited to work under the most extreme hardships, with little or no supervision, and can demonstrate tremendous amounts of initiative and creativity in unique and changing situations. The compact, versatile, and adaptable detachments of which Special Forces Groups are composed can serve as vital resources in humanitarian and disaster relief operations as well as in combat." <Go to ISI>://WOS:A1997WG39200008

**Hardiker V.,** A global numerical weather prediction model with variable resolution, *Monthly Weather Review*, 125,1, 1997.

Abstract: "A conformal transformation suggested by F. Schmidt is followed to implement a global spectral model with variable resolution. A conformal mapping is defined from a physical sphere (like the earth) to a transformed (computational) sphere. The model equations are discretized on the computational sphere, and the conventional spectral technique is applied to march forward in time. Two types of transformations are investigated in the present study, namely the rotation and the stretching transformation. Application of the stretching transformation leads to finer resolution in the meridional direction; however, due to the spherical geometry, the resolution becomes finer in the latitudinal direction also, and furthermore, the rotation can be used to relocate the model poles. The idea is now to rotate the north pole and refine the resolution around the new north pole by applying the stretching transformation. A multilevel global spectral model is formulated from the current Florida State University global spectral model to implement the total (rotation followed by stretching) transformation. The control run in this study is a conventional T-170 resolution global spectral model. The transformed T-83 resolution global spectral model is used to study Hurricane Andrew. The performance of the transformed model is clearly seen to be improved in describing the structure, intensity, and motion of the hurricane over the conventional T-85 resolution spectral model. The computational cost for the transformed model is approximately one-half the cost for the conventional T-170 model. The conformal transformation technique can be thus used as a viable alternative to the limited-area models." <Go to ISI>://WOS:A1997WB96400004

**Ironson G., Wynings C., Schneiderman N., Baum A., Rodriguez M., Greenwood D., Benight C., Antoni M., LaPerriere A., Huang H. S., Klimas N. and Fletcher M. A.,** Posttraumatic stress symptoms, intrusive thoughts, loss, and immune function after Hurricane Andrew, *Psychosomatic Medicine*, 59,2, 1997.

Abstract: "Objective: To examine the impact of and relationship between exposure to Hurricane Andrew, a severe stressor, posttraumatic stress symptoms and immune measures. Methods: Blood draws and questionnaires were taken from community volunteer subjects living in the damaged neighborhoods between 1 and 4 months after the Hurricane. Results: The sample exhibited high levels of posttraumatic stress symptoms by questionnaire (33% overall; 76% with at least one symptom cluster), and 44%

scored in the high impact range on the impact of Events (IES) scale. A substantial proportion of variance in posttraumatic stress symptoms could be accounted for by four hurricane experience variables (damage, loss, life threat, and injury), with perceived loss being the highest correlate. Of the five immune measures studied Natural Killer Cell Cytotoxicity (NKCC) was the only measure that was meaningfully related (negatively) to both damage and psychological variables (loss, intrusive thoughts, and posttraumatic stress disorder (PTSD). White blood cell counts (WBCs) were significantly positively related with the degree of loss and PTSD experienced. Both NKCC (lower) and WBC were significantly related to retrospective self-reported increase of somatic symptoms after the hurricane. Overall, the community sample was significantly lower in NKCC, CD4 and CD8 number, and higher in NK cell number compared to laboratory controls. Finally, evidence was found for new onset of sleep problems as a mediator of the post-traumatic symptom - NKCC relationship. Conclusions: Several immune measures differed from controls after Hurricane Andrew. Negative (intrusive) thoughts and PTSD were related to lower NKCC. Loss was a key correlate of both posttraumatic symptoms and immune (NKCC, WBC) measures." <Go to ISI>://WOS:A1997WP95200003

**Leininger T. D., Wilson A. D. and Lester D. G.,** Hurricane Andrew damage in relation to wood decay fungi and insects in bottomland hardwoods of the Atchafalaya Basin, Louisiana, *Journal of Coastal Research*, 13,4, 1997.

Abstract: "Hurricane Andrew caused damage to more than 780 sq. km of bottomland hardwood and cypress-tupelo forests in the Atchafalaya Basin of Louisiana in August 1992. Trees in bottomland hardwood sites were examined, in early May 1994, for signs and symptoms of wood decay fungi, and for insect damage, ostensibly present before the hurricane, which may have predisposed trees to windthrow or breaks in the bole or top. Three sites with severe wind damage and three sites with minor wind damage were studied along the path of the hurricane. Surveying for wood decay fungi and insects on trees, and evaluating damage to crowns, stems, and roots was done on 25-m diameter point-sample plots. Evidence of wood decay fungi and insects, or the damage they cause, was rare at all sites, in part because of flooding during the evaluation, so that predisposition to wind damage by these agents was not established. Crown damage rating classes and d.b.h. classes were positively correlated for sites with severe wind damage indicating that larger diameter trees were more susceptible to wind damage than smaller diameter trees. Chinese tallow, swamp cottonwood, pumpkin ash, American sycamore, and swamp dogwood showed greater wind damage on sites with severe wind damage than other species." <Go to ISI>://WOS:A1997XZ99900031

**Lirman D. and Fong P.,** Patterns of damage to the branching coral *Acropora palmata* following Hurricane Andrew: Damage and survivorship of hurricane-generated asexual recruits, *Journal of Coastal Research*, 13,1, 1997.

Abstract: "Hurricane Andrew caused widespread damage to the *Acropora palmata* population on a patch reef on the Florida Reef Tract. After the storm, more than 50% of the *A. palmata* cover in the rubble and reef-flat zones was comprised of live fragments. Other species of coral were minimally damaged. Most fragments were distributed within or adjacent to the remaining patches of standing elkhorn colonies. Neither distribution nor mortality rate of fragments was dependent on initial fragment size. However, rate of stabilization of fragments was related to substrate type and distance from a patch of mature colonies, suggesting that standing colonies may protect regenerating fragments from removal from the reef. Differences in the substrate type (hard vs. unconsolidated rubble) where fragments landed, affected removal, total mortality, and partial mortality rates of hurricane-generated fragments. Rubble substrate favored stabilization and survival of hurricane-generated asexual recruits." <Go to ISI>://WOS:A1997WL79900009

**Liu Y. B., Zhang D. L. and Yau M. K.,** A multiscale numerical study of Hurricane Andrew (1992) . Part 1. Explicit simulation and verification, *Monthly Weather Review*, 125,12, 1997.

Abstract: "In this study, the inner-core structures of Hurricane Andrew (1992) are explicitly simulated using an improved version of the Penn State-NCAR nonhydrostatic, two-way interactive, movable, triply nested grid mesoscale model (MM5). A modified Betts-Miller cumulus parameterization scheme and an explicit microphysics scheme were used simultaneously to simulate the evolution of the larger-scale flows over the coarser-mesh domains. The intense storm itself is explicitly resolved over the finest-mesh domain using a grid size of 6 km and an explicit microphysics package containing prognostic equations for cloud water, ice, rainwater, snow, and graupel. The model is initialized with the National Centers for Environmental Prediction analysis enhanced by a modified moisture held. A model-generated tropical-storm-like vortex was also incorporated. A 72-h integration was made, which covers the stages from the storm's initial deepening to a near-category 5 hurricane intensity and the landfall over Florida. As verified against various observations and the best analysis, the model captures reasonably well the evolution and inner-core structures of the storm. In particular, the model reproduces the track, the explosive deepening rate ( $>1.5 \text{ hPa h}^{-1}$ ), the minimum surface pressure of 919 hPa preceding landfall, the strong surface wind ( $>65 \text{ m s}^{-1}$ ) near the shoreline, as well as the ring of maximum winds, the eye, the

eyewall, the spiral rainbands, and other cloud features. Of particular significance is that many simulated kinematics, thermodynamics, and precipitation structures in the core regions compare favorably to previous observations of hurricanes. The results suggest that it may be possible to predict reasonably the track, intensity, and inner-core structures of hurricanes from the tropical synoptic conditions if high grid resolution, realistic model physics, and proper initial vortices (depth, size, and intensity) in relation to their larger-scale conditions (e.g., SST, moisture content, and vertical shear in the lower troposphere) are incorporated." <Go to ISI>://WOS:A1997YJ5550002

**Pascarella J. B.**, Hurricane disturbance and the regeneration of *Lysiloma latisiliquum* (Fabaceae): A tropical tree in south Florida, *Forest Ecology and Management*, 92,1-3, 1997.

Abstract: "Large-scale catastrophic disturbances such as hurricanes may be critical events for the regeneration of late secondary canopy tree species. The impact of Hurricane Andrew, a severe Category 4 hurricane, on the tropical tree *Lysiloma latisiliquum* was examined in three south Florida subtropical forests along a gradient of hurricane disturbance (high, moderate, none). The population closest to the northern eye wall of the hurricane had the highest mortality and most severe structural damage while the population near the southern eye wall of the hurricane experienced less mortality and damage. Posthurricane reproduction was least in the disturbed sites while the undisturbed site had extensive reproduction in both 1993 and 1994. Average seed production was low due to seed predation by a bruchid beetle but some populations experienced spatial and temporal escape from this seed predator. Germination from a dormant seed bank occurred only at the most severely disturbed site in 1992. Seed germination was associated with both tip-up pits and high understory light levels. In experimental trials, fluctuating heat treatments for 5 days increased seed germination. Severe hurricane disturbance is believed to have triggered germination from a dormant seed bank through strong diurnal soil temperature fluctuations resulting from extensive canopy removal. In south Florida, the temporal and spatial dynamics of both hurricane and fire disturbance are predicted jointly to influence the population dynamics of this canopy tree species. (C) 1997 Elsevier Science B.V." <Go to ISI>://WOS:A1997XA85300010

**Ramsey E. W., Chappell D. K. and Baldwin D. G.**, AVHRR imagery used to identify hurricane damage in a forested wetland of Louisiana, *Photogrammetric Engineering and Remote Sensing*, 63,3, 1997.

Abstract: "Certain events provide a unique opportunity to test the monitoring capability of AVHRR imagery. On 26 August 1992, Hurricane Andrew passed through Louisiana, impacting a large area of forested wetlands. One response to the widespread defoliation resulting from the hurricane impact was an abnormal bloom of new leaves and new growth in the underlying vegetation between September and October. To capture this atypical phenology, a time sequence of AVHRR images was transformed into a normalized difference vegetation index, NDVI, as an indicator of vegetation changes in the forest impacted by the passage of a hurricane. Using geographic information system functions, three sites in the impacted forest were vectorized as polygons, and the inclusive pixels were extracted for subsequent graphical and univariate statistical analysis. Temporal curves of mean NDVIs for the three sites for before, during, and after the hurricane passage, and aggregate curves of the impacted forest to an undisturbed forest, were compared. These comparisons corroborated the atypical phenology of the impacted forested wetland and directly related the cause to the hurricane passage." <Go to ISI>://WOS:A1997WL69600019

**Reed D. J., DeLuca N. and Foote A. L.**, Effect of hydrologic management on marsh surface sediment deposition in coastal Louisiana, *Estuaries*, 20,2, 1997.

Abstract: "High rates of coastal land loss in Louisiana have prompted efforts to maintain or restore coastal wetland habitats, and structural management of marsh hydrology is one of a number of approaches that has been adopted. The aim of this study was to determine the effect of hydrologic management measures on marsh-surface sediment deposition in the Mississippi deltaic plain. Four impoundments, ranging in size from 50 ha to 177 ha and similarly sized control sites were included in the study. At each site, marsh-surface sediment traps were collected approximately biweekly for 3.5 yr to measure changes in sediment deposition. There was no significant difference in sediment deposition between any of the impoundment and control sites during the premanagement period. The results show no significant difference in marsh-surface sediment deposition between management year 1992-1993 and management year 1994-1995, but management year 1993-1994 had significantly lower sediment deposition than either the first or the last year of the study. Management year 1992-1993 showed the highest sediment deposition when it was assessed across all basins, areas, and sites, and this high rate of deposition is accounted for by the impact of Hurricane Andrew. For all management years there were significant differences between impoundment and control sites, with control sites showing higher rates of marsh surface sediment deposition than impoundments. No clear pattern was identified concerning the influence of various types of hydrologic management on rates of sediment deposition. This reduction in sediment deposition indicated that the areas under management in this study are receiving insufficient inorganic sediment deposition to keep pace with sea-level rise." <Go to ISI>://WOS:A1997XF14100005

**Rice M. D., Lockaby B. G., Stanturf J. A. and Keeland B. D.,** Woody debris decomposition in the Atchafalaya River basin of Louisiana following hurricane disturbance, *Soil Science Society of America Journal*, 61,4, 1997.

Abstract: "The contribution of woody debris to some biogeochemical functions of forested wetlands was examined in the Atchafalaya River Basin in Louisiana following disturbance by Hurricane Andrew, Woody debris decomposition processes were characterized in terms of mass, C, N, and P dynamics. These were compared between different diameters of debris, areas receiving different intensities of disturbance, and between different positions relative to the soil. Disturbance intensity (as defined by canopy closure) had little effect on decomposition processes when compared with soil orientation (i.e., whether in contact with or suspended above the soil). Rates of mass loss varied between 0.055 and 0.068 for suspended and ground-contact coarse woody debris, respectively. Fine woody debris rate coefficients averaged 0.060 and 0.085 for the same respective orientations. In general, woody debris displayed strong source activity for P but a greater tendency toward sink behavior for N. In terms of biogeochemical transformations, these data suggest that woody debris might act as a phosphate source during sheet flow events but could provide short-term retention of inorganic N associated with floodwaters." <Go to ISI>://WOS:A1997XN24100037

**Stone G. W., Grymes J. M., Dingler J. R. and Pepper D. A.,** Overview and significance of hurricanes on the Louisiana coast, USA, *Journal of Coastal Research*, 13,3, 1997.

Abstract: "Hurricanes have played a critical role in the transgressive evolution of Louisiana's barrier islands and may account for up to 90% of shoreline retreat measured within the historic (10(2) years) time frame. Since 1901, some 55 tropical storms or hurricanes have made landfall along the Louisiana coast showing the highest incidence in September. Fewest landfalls have been recorded along the eastern region of Louisiana with the incidence being double that along the southcentral and southwest regions of the State. Approximately half the total number of tropical cyclone landfalls occurred in a thirty year period between 1931 and 1960, bounded by two of the 'quietist' decades of the past one hundred years; 1921-1930 with two direct landfalls, and 1961-1970 with two landfalls. Review of intensities of storms making landfall along the U.S. mainland through 1992 shows that 11 of the 50 strongest storms have impacted Louisiana. Given that the foredune elevation along the Louisiana coast seldom exceeds 2m above sea level, the significance of overwash processes and inlet breaching becomes readily apparent. Episodic landward translation of the beach of near 100 m is typical during stronger hurricanes. Post-storm recovery of the barrier islands has been thwarted by a reduction of sediment supplied to the littoral zone over time, subsidence, rapid relative sea-level rise and anthropogenic activity. Consequently, Louisiana's barrier islands are predisposed towards chronic erosion and land loss. Although hurricanes have proven destructive along the open coast, they have resulted in considerable deposition on portions of Louisiana's marshes. Examples include over 70 cm of mixed organic and inorganic debris accumulating after Hurricane Audrey (1957) and up to 16 cm of vertical accretion after Hurricane Andrew (1992). However, ongoing work suggests that substrate compression during storm passage may significantly reduce, or nullify, the effect of storm deposition on the marshes' long-term net elevation gain. Areas of floating marsh undergo considerable damage during severe hurricanes. Predictions of future wave and storm surge accompanying severe hurricanes (category 5) indicate that significant wave heights between 1 and 2 m can be anticipated as far inland as New Orleans. A gradual landward shift of larger waves is predicted with time due to the disappearance of barrier islands and coastal retreat. Wave heights up to 4 m are predicted in Lake Ponchartrain, located immediately north of New Orleans, for a category 5 hurricane making landfall along the Isles Dernieres. On considering that modeled surge levels increase from around 4 m to 7 m along the lake's northern shore, a hurricane of this magnitude will likely cause severe destruction and evacuation problems for the City of New Orleans and surrounding metropolitan areas." <Go to ISI>://WOS:A1997XQ32600006

**Suhayda J. N.,** Modeling impacts of Louisiana barrier islands on wetland hydrology, *Journal of Coastal Research*, 13,3, 1997.

Abstract: "Management and restoration of natural systems requires the quantitative assessment of the impact and cost effectiveness of management alternatives. This paper provides a description of the methodology being used in Louisiana to evaluate the role of barrier islands in influencing wetland hydrology and some preliminary results. The steps that were taken to develop the methodology are reviewed. The objective of the evaluation was to determine the effect of barrier island geometry on the duration and depth of inundation of coastal wetlands under average and extreme conditions. The model selected for use was the overland flooding model developed by the Federal Emergency Management Agency to predict hurricane flood elevations for the National Flood Insurance Program. The model uses an explicit, two dimensional, spaced staggered, finite difference scheme to simulate the flow of water caused by tides and wind systems. The current size of the inlets between the islands is several times the equilibrium area based upon the tidal prisms. Slight reductions in the cross sectional areas of the inlets between the islands had only a very minor effect on reducing the depth and duration of wetland flooding.

If the barrier islands were removed from the model, the depth and duration of tidal flooding slightly increased. Under extreme conditions, the island height and inlet size did have a significant effect on the depth and duration of wetland flooding. Hurricane Andrew produced a maximum surge elevation at Cocodrie of about 2.7 m. The predicted surge elevation at Cocodrie would have been about .3 m higher if the present barrier islands were destroyed and would have been as much as 1.2 to 1.5 m lower if the barrier islands were raised and the inlets narrowed." <Go to ISI>://WOS:A1997XQ32600009

**Swiadek J. W.**, The impacts of Hurricane Andrew on mangrove coasts in southern Florida: A review, *Journal of Coastal Research*, 13,1, 1997.

Abstract: "Coastal mangroves in Southern Florida were seriously damaged when Hurricane Andrew made landfall on August 24, 1992. Damage associated with Hurricane Andrew was primarily related to high wind velocity and surge. Shoreline erosion, which was generally less than 15 m, was caused by wave action and storm surge. This erosion may continue or expand since waves and currents can reprofile unprotected subsurface and intertidal sediments uprooted by mangrove trees." <Go to ISI>://WOS:A1997WL79900030

**Walsh K.**, Objective detection of tropical cyclones in high-resolution analyses, *Monthly Weather Review*, 125,8, 1997.

Abstract: "An automated procedure is used to evaluate objective criteria for the detection of observed tropical cyclones in high-resolution (1.125 degrees) European Centre for Medium-Range Weather Forecasts analyses. Best values of the objective criteria are determined for cyclones of tropical storm and hurricane strength. It is found that intense storms are more easily detected than weaker storms. For intense storms in regions of reasonable data coverage, the detection method has some skill, but detection generally is not reliable in regions remote from land. Moreover, the numbers of vortices detected in the analyses is sensitive to relatively small variations in the values of the objective criteria used. Aspects of the structure of analyzed hurricanes in regions of good data coverage are similar to those of observed hurricanes, although the radial variation of tangential wind speeds near the center of the simulated storms differs considerably from reality. A comparison is made between the representation in the analyses of two contrasting storms: Hurricanes Hugo and Andrew. The implications of the detection method for simulations of climate change are discussed." <Go to ISI>://WOS:A1997XP30300004

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**Billington C. J. and Bolt H. M.**, Current issues and technologies for the reassessment of existing offshore installations, *Proceedings of the Institution of Mechanical Engineers Part E-Journal of Process Mechanical Engineering*, 210,E1, 1996.

Abstract: "The statutory requirement to prepare safety cases for United Kingdom offshore platforms following the Piper Alpha disaster, the extensive damage to offshore platforms in the Gulf of Mexico caused by Hurricane Andrew and the desire to extend the operational life of hydrocarbon production platforms throughout the world has led to several important industry initiatives concerning requalification and reassessment of offshore platforms. This paper describes the development of a new industry reassessment guideline document, the philosophy within the guidelines and the technologies available for reassessment. In particular, the availability of validated non-linear system ultimate strength collapse analysis computer software is revolutionizing the reassessment process by being able to take advantage of the system reserve and residual strength above the individual component design capacity level. However, there are problems in the application of these advanced techniques and there are several generic issues concerning acceptable levels of risk, the scope and methodology of reassessment and the development of international standards for reassessment. The paper draws out these issues and describes industry initiatives that are working towards their resolution." <Go to ISI>://WOS:A1996UE05600005

**Combs D. L., Parrish R. G., McNabb S. J. N. and Davis J. H.**, Deaths related to Hurricane Andrew in Florida and Louisiana, 1992, *International Journal of Epidemiology*, 25,3, 1996.

Abstract: "Background. information about circumstances leading to disaster-related deaths helps emergency response coordinators and other public health officials respond to the needs of disaster victims and develop policies for reducing the mortality and morbidity of future disasters. in this paper, we describe the decedent population, circumstances of death, and population-based mortality rates related to Hurricane Andrew, and propose recommendations for evaluating and reducing the public health impact of natural disasters. Methods. To ascertain the number and circumstances of deaths attributed to Hurricane Andrew in Florida and Louisiana, we contacted medical examiners in 11 Florida counties and coroners in 36 Louisiana parishes. Results. In Florida medical examiners attributed 44 deaths to the hurricane. The mortality rate for directly-related deaths was 4.4 per 1 000 000 population and that for

indirectly-related deaths was 9.5 per 1 000 000 population. In Louisiana, coroners attributed 11 resident deaths to the hurricane. Mortality rates were 0.6 per 1 000 000 population for deaths directly related to the storm and 2.8 for deaths indirectly related to the storm, Six additional deaths occurred among nonresidents who drowned in international waters in the Gulf of Mexico. In both Florida and Louisiana, mortality rates generally increased with age and were higher among whites and males. Conclusions, In addition to encouraging people to follow existing recommendations, we recommend emphasizing safe driving practices during evacuation and clean-up, equipping shelters with basic medical needs for the population served, and modifying zoning and housing legislation. We also recommend developing and using a standard definition for disaster-related deaths, and using population-based statistics to describe the public health effectiveness of policies intended to reduce disaster-related mortality." <Go to ISI>://WOS:A1996VC48200010

**Lew E. O. and Wetli C. V.,** Mortality from Hurricane Andrew, *Journal of Forensic Sciences*, 41,3, 1996.

Abstract: "Hurricane Andrew, a category 4 storm, made landfall in South Florida on August 24, 1992, and caused extensive structural and environmental damage. The Dade County Medical Examiner Department investigated 15 deaths directly related to the storm and another 15 natural deaths indirectly related to the storm. The aftermath of the hurricane continued to create circumstances that lead to 32 accidental deaths, five suicides, and four homicides over the next six months. Traffic fatalities due to uncontrolled intersections accounted for one-third of the post-storm accidental deaths. Dyadic deaths (homicide-suicide) doubled in rate for the six months following the storm. The limited number of direct hurricane deaths is attributed to advance storm warnings, its occurrence on a weekend, the storm's passage through less populated areas of the county, and the relatively modest amount of accompanying rainfall." <Go to ISI>://WOS:A1996UN36600017

**Major R. P., Bebout D. G. and Harris P. M.,** Recent evolution of a Bahamian ooid shoal: Effects of Hurricane Andrew, *Geological Society of America Bulletin*, 108,2, 1996.

Abstract: "Hurricane Andrew, a category 4 hurricane having wind velocities of similar to 240 km/hr, passed north of Joulter's Gays, Bahamas, in a westerly direction on August 23, 1992. We documented three sedimentary facies in a 2.7 km(2) study area dominated by mobile ooid sands before the hurricane, using aerial photographs, surface observations, and shallow coring. The shoal crest at this locality had aggrading and northward-prograding (parallel to depositional strike) washover bars composed of cross-bedded, well-sorted ooid sands. Burrowed, poorly sorted ooid sands were present seaward of the washover bars, whereas poorly sorted ooids and mud occupied a stabilized area bankward of the actively migrating shoal and local areas between washover bars on the crest of the shoal. The shoal was cross-cut by tidal channels, and older washover bars were being dissected by tidal currents. Although Hurricane Andrew profoundly changed surface features within the study area, its effects will probably be only partly preserved. The hurricane eroded washover bars and transported sediment seaward, leaving a nearly flat shoal crest overlain by a laterally continuous, decimeter-thick lens of well-sorted ooid sand that thins seaward and bankward. Post-hurricane tidal currents deposited a centimeter-thick discontinuous layer of carbonate mud over this lens of well-sorted ooid sand and transported ooids seaward off the shoal. The well-sorted ooid sand layer will most likely be reworked when an actively migrating shoal crest is reestablished, although some of this storm deposit may be preserved on the shoal crest where the ooid sand layer was deposited in areas of normally less agitated conditions. Ooids may also be preserved in finer grained sediments seaward of the shoal, as suggested by previous studies. Mud deposits on the shoal crest may be preserved where buried beneath reestablished washover bars, although some of this mud will be removed by reworking during diurnal tides." <Go to ISI>://WOS:A1996TT57900004

**McCoy E. D., Mushinsky H. R., Johnson D. and Meshaka W. E.,** Mangrove damage caused by hurricane Andrew on the southwestern coast of Florida, *Bulletin of Marine Science*, 59,1, 1996.

Abstract: "We surveyed the mangrove forest at the mouth of Lostman's River, on the southwestern coast of Florida, about 2 months after Hurricane Andrew had passed. Damage to the mangrove forest there was severe: about 60% of the trees were either uprooted or broken, about 25% of the upright, unbroken trees were dead, and only about 14% of the upright, unbroken trees were well vegetated. Larger trees were more likely to be damaged, and damaged more severely, than smaller trees. Overall, *Rhizophora mangle* (red mangrove) fared marginally better than *Avicennia germinans* (black mangrove), and both of these species fared substantially better than *Laguncularia racemosa* (white mangrove). The forest structure at our site likely will be substantially altered as a result of Hurricane Andrew for some time to come." <Go to ISI>://WOS:A1996VB34300001

**Oberbauer S. F., vonKleist K., Whelan K. R. T. and Koptur S.,** Effects of Hurricane Andrew on epiphyte communities within cypress domes of Everglades National Park. *Ecology*, 77,3, 1996. <Go to ISI>://WOS:A1996UC98500030

**Powell M. D. and Houston S. H.,** Hurricane Andrew's landfall in south Florida .2. Surface wind fields and potential real-time applications. *Weather and Forecasting*, 11,3, 1996.

Abstract: "All available wind data associated with Hurricane Andrew's passage were analyzed for periods corresponding to landfall south of Miami and emergence from southwest Florida. At landfall in southeast Florida, maximum sustained 1-min surface wind speeds V-M1 reached just over 60 m s<sup>-1</sup> in the northern eyewall over land; by the time Andrew exited the Florida peninsula, the peak value of V-M1 over land decreased to 40-45 m s<sup>-1</sup>. Radar reflectivity observations from Tampa and Melbourne could not support an obvious correlation of convective cell development with coastal convergence during landfall on the southeast coast. On the southwest coast, however, convective cell development in the southern eyewall was supported by a coastal convergence maximum. Comparison of the wind swath with two independent Fujita-scale damage maps indicated that peak swath speeds compared well with damage-derived speed equivalents in the worst damaged areas but were higher than equivalents in moderately damaged areas. Comparison of the analysis maximum wind swath with an engineering survey of damaged homes suggests that homes exposed to a wide range of wind directions while subjected to high wind speeds suffered the most damage. Potential real-time applications of wind field products include warning dissemination, emergency management, storm surge and wave forecasting, and wind engineering. Development of damage assessment models for disaster mitigation is addressed from the viewpoint of an electrical utility." <Go to ISI>://WOS:A1996VE21100004

**Powell M. D., Houston S. H. and Reinhold T. A.,** Hurricane Andrew's landfall in south Florida .1. Standardizing measurements for documentation of surface wind fields. *Weather and Forecasting*, 11,3, 1996.

Abstract: "Hurricane Andrew's landfall in south Florida left a swath of destruction, including many failed anemometer recording systems. Extreme destruction led to exaggerated claims of the range of wind speeds that caused such damage. The authors accumulated all available data from surface platforms at heights ranging from 2 to 60 m and reconnaissance aircraft at altitudes near 3 km. Several procedures were used to represent the various types of wind measurements in a common framework for exposure, measurement height, and averaging period. This set of procedures allowed documentation of Andrew's winds in a manner understandable to both meteorologists and wind engineers. The procedures are accurate to +/-10% for marine and land observing platforms, and boundary layer model adjustments of flight-level winds to the surface compare to within 20% of the nearest surface measurements. Failure to implement the adjustment procedures may lead to errors of 15%-40%. Quality control of the data is discussed, including treatment of peak wind observations and determination of the radius of maximum winds at the surface." <Go to ISI>://WOS:A1996VE21100003

**Torres A. R. and Leberg P. L.,** Initial changes in habitat and abundance of cavity-nesting birds and the Northern Parula following Hurricane Andrew. *Condor*, 98,3, 1996.

Abstract: "We examined the initial effects of Hurricane Andrew on nest site availability and abundances of seven species of cavity-nesting birds and the Northern Parula (*Parula americana*) in a large bottomland hardwood forest associated with the Atchafalaya River in Louisiana. As hurricane damage increased, so did the density of understory vegetation and the number of snags, however, the abundance of cavities did not change. None of the abundances of the individual cavity-nesting species were related to hurricane damage or the availability of cavities. Northern Parula abundance was negatively correlated with hurricane damage and density of understory vegetation. The low abundance of this species in forests heavily damaged by the hurricane may be due to loss of canopy foraging habitat or of Spanish moss (*Tillandsia usneoides*), one of its principal nesting sites." <Go to ISI>://WOS:A1996VG52500004

**Willoughby H. E. and Black P. G.,** Hurricane Andrew in Florida: Dynamics of a disaster. *Bulletin of the American Meteorological Society*, 77,3, 1996.

Abstract: "Four meteorological factors aggravated the devastation when Hurricane Andrew struck South Florida: completed replacement of the original eyewall by an outer, concentric eyewall while Andrew was still at sea; storm translation so fast that the eye crossed the populated coastline before the influence of land could weaken it appreciably; extreme wind speed, 82 m s<sup>-1</sup> winds measured by aircraft flying at 2.5 km; and formation of an intense, but nontomadic, convective vortex in the eyewall at the time of landfall. Although Andrew weakened for 12 h during the eyewall replacement, it contained vigorous convection and was reintensifying rapidly as it passed onshore. The Gulf Stream just offshore was warm enough to support a sea level pressure 20-30 hPa lower than the 922 hPa attained, but Andrew hit land before it could reach this potential. The difficult-to-predict mesoscale and vortex-scale phenomena

determined the course of events on that windy morning, not a long-term trend toward worse hurricanes." <Go to ISI>://WOS:A1996UG1760007

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**Benson R. E. and Moch I.,** REACTIVATING AFTER 11 YEARS A 3 MGD SEAWATER RO PLANT IN FLORIDA, *Desalination*, 102,1-3, 1995.

Abstract: "On January 22, 1981 the Florida Keys Aqueduct Authority commissioned a 3 mgd seawater reverse osmosis plant on the island of Key West, Florida. At the time, this plant was an interim solution to a critical water need for the lower Florida Keys. The plant was to be used until a new pipeline from the mainland Florida peninsula could be completed. The plant continuously produced potable water from seawells for 18 months and then for the next 5 years was placed in standby with each bank (total of 6) being operated two hours per day every 2 weeks. For the last 6 years, the facility has been mothballed. It became evident last year, as a result of Hurricane Andrew, that the Florida Keys needed to have available emergency potable water should a disaster strike this area. Several options were examined; the least costly appeared to be the activation of the Key West RO plant, provided the facility could be refurbished at reasonable cost. This paper discusses the very positive results obtained when this plant was brought back on-line and quality water was produced. Also included is how the facility is now being upgraded to provide a satisfactory potable water supply in case an emergency strikes the locality." <Go to ISI>://WOS:A1995TE66200021

**Bril G.,** FORECASTING HURRICANE TRACKS USING THE KALMAN FILTER, *Environmetrics*, 6,1, 1995.

Abstract: "A case study applies state space models and the Kalman filter to forecasting the path of hurricanes. The track of a hurricane is forecast by using its previous motion together with the historical record of storms which follow a similar path. Criteria are described for selecting the predictor storms, which are then incorporated into the measurement equation of the state space model. Linear and quadratic trend structural time series models are used in the transition equation of the state space model and forecasts are produced using the Kalman filter. Forecasts are obtained for hurricanes Andrew (1992), Bob (1991), Hugo (1989) and Gilbert (1988). The Kalman filter approach compares very favourably with the HURRAN and CLIPER benchmark models used by the National Hurricane Center." <Go to ISI>://WOS:A1995QF61900002

**Bronstein J. L. and Hossaertmckey M.,** HURRICANE-ANDREW AND A FLORIDA FIG POLLINATION MUTUALISM - RESILIENCE OF AN OBLIGATE INTERACTION, *Biotropica*, 27,3, 1995.

Abstract: "The obligate mutualism between figs and their species-specific pollinator wasps has been thought to be relatively fragile in the face of population fluctuations of either mutualist. Here we report on the recovery of a Florida fig pollination mutualism devastated by Hurricane Andrew in August 1992. Damage to *Ficus aurea* included loss of all leaves and fruits and many branches, as well as the presumed local extinction of its pollinator *Pegoscopus jimenezii*. Within five months, however, fig flowering phenology and fig wasp abundance (measured by the number of pollinators entering inflorescences) had recovered to near prehurricane levels. Unusual phenological traits of *F. aurea* may have aided in the rapid reestablishment of pollinator populations; in addition, the wasps may have previously underappreciated capacities for long distance movements. This study suggests that obligate interactions can be surprisingly resilient to certain population-level catastrophes." <Go to ISI>://WOS:A1995RX53600009

**Costello N. L., Antoni M., Ironson G., Klimas N., Fletcher M., Kumar M. and Schneiderman N.,** EMOTIONAL EXPRESSION, HPA AXIS AND IMMUNE FUNCTIONING IN VICTIMS OF HURRICANE-ANDREW, *Psychosomatic Medicine*, 57,1, 1995. <Go to ISI>://WOS:A1995QE07400024

**Cruess D., Ironson G., Kumar M., Wynings C., Benight C., Greenwood D., Steffen P., Baum A. and Schneiderman N.,** INTRUSIVE AND AVOIDANT THOUGHTS AND CORTISOL AT 2 TIME-POINTS AFTER HURRICANE-ANDREW, *Psychosomatic Medicine*, 57,1, 1995. <Go to ISI>://WOS:A1995QE07400074

**Davis R. A.,** GEOLOGIC IMPACT OF HURRICANE-ANDREW ON EVERGLADES COAST OF SOUTHWEST FLORIDA, *Environmental Geology*, 25,3, 1995.

Abstract: "Hurricane Andrew, one of the strongest storms of the century, crossed the southern part of the Florida peninsula on 24 August 1992. Its path crossed the Florida Everglades and exited in the national park across a mangrove-dominated coast onto the shallow, low-energy, inner shelf. The storm caused extensive breakage and defoliation in the mangrove community; full recovery will take decades. It produced no extensive sedimentation unit; only local and ephemeral ebb-surge deposits. The discontinuous shelly storm beach ridge was breached at multiple locations, and it moved landward a few meters. After seven months, there was little geologic indication that the storm had passed. It is likely that

the stratigraphic record in this area will not contain any recognizable features of the passage of Hurricane Andrew." <Go to ISI>://WOS:A1995QV74400001

**Fong P. and Lirman D.**, Hurricanes cause population expansion of the branching coral *Acropora palmata* (Scleractinia): Wound healing and growth patterns of asexual recruits, *Marine Ecology-Pubblicazioni Della Stazione Zoologica Di Napoli I*, 16,4, 1995.

Abstract: "Three mechanisms aiding recovery and expansion of a population of *Acropora palmata* on a patch reef that was directly in the path of Hurricane Andrew were documented: rapid wound healing, high rates of asexual recruitment, and rapid growth rate of the new recruits. In addition, the growth pattern of new recruits was assessed in order to quantify the initial sequence of structural changes during the transition from recruit to adult morphology. Wound healing was initially rapid (1.59 cm of linear growth per month), but slowed with time. Nine months after the storm, 72% of 218 hurricane-generated fragments of *A. palmata* had cemented to the bottom, becoming new asexual recruits. Within 18 months of the storm, the number of fragments in the same area had increased to 271, average fragment size was larger, and 94% had become recruits. Recruits showed complex patterns of branch formation, including rapid growth of solitary proto-branches, differential growth of proto-branches dependent on recruit orientation, and dominance within aggregates of proto-branches. We present a conceptual model that suggests *A. palmata* is adapted to disturbances of both low intensity and high frequency (conditions typical of reef flat zones) and episodic high intensity and low frequency events (hurricanes and tropical storms)." <Go to ISI>://WOS:A1995UQ80400004

**Friedman E.**, IN THE WAKE OF HURRICANE-ANDREW - REPLY, *Jama-Journal of the American Medical Association*, 273,23, 1995. <Go to ISI>://WOS:A1995RD11600012

**Hoit M. I., Cook R. A. and Christou P. M.**, AN INTEGRATED TECHNIQUE FOR THE ANALYSIS OF TRAFFIC LIGHTS AND SIGNS SUPPORTED BY THE DUAL CABLE SYSTEM, *Computers & Structures*, 55,6, 1995.

Abstract: "Due to failures of cable-supported traffic lights and signs under wind loading during Hurricane Andrew, a need for a comprehensive analysis method was identified. The computer program ATLAS satisfies this need and utilizes an integrated technique that consists of the extended force density method and the nonlinear direct stiffness method for large displacements. The integration of the two methods is essential for the analysis of such systems because of the numerical instabilities developed when using the direct stiffness method alone. The resulting analysis procedure proved to be stable. This paper provides a description as to how the two methods were integrated and implemented in ATLAS." <Go to ISI>://WOS:A1995QX81700004

**Lirman D. and Fong P.**, THE EFFECTS OF HURRICANE-ANDREW AND TROPICAL-STORM-GORDON ON FLORIDA REEFS, *Coral Reefs*, 14,3, 1995. <Go to ISI>://WOS:A1995RY33800008

**Lutgendorf S. K., Antoni M. H., Ironson G., Fletcher M. A., Penedo F., Baum A., Schneiderman N. and Klimas N.**, PHYSICAL SYMPTOMS OF CHRONIC FATIGUE SYNDROME ARE EXACERBATED BY THE STRESS OF HURRICANE-ANDREW, *Psychosomatic Medicine*, 57,4, 1995.

Abstract: "This study examined the effects of Hurricane Andrew on physical symptoms and functional impairments in a sample of chronic fatigue syndrome (CFS) patients residing in South Florida. In the months after Hurricane Andrew (September 15-December 31, 1992), 49 CFS patients were assessed for psychosocial and physical functioning with questionnaires, interviews, and physical examinations. This sample was made up of 25 CFS patients living in Dade county, a high impact area, and 24 patients in Broward and Palm Beach counties, areas less affected by the hurricane. Based on our model for stress-related effects on CFS, we tested the hypothesis that the patients who had the greatest exposure to this natural disaster would show the greatest exacerbation in CFS symptoms and related impairments in activities of daily living (illness burden). In support of this hypothesis, we found that the Dade county patients showed significant increases in physician-rated clinical relapses and exacerbations in frequency of several categories of self-reported CFS physical symptoms as compared to the Broward/Palm Beach county patients. Illness burden, as measured on the Sickness Impact Profile, also showed a significant increase in the Dade county patients. Although extent of disruption due to the storm was a significant factor in predicting relapse, the patient's posthurricane distress response was the single strongest predictor of the likelihood and severity of relapse and functional impairment. Additionally, optimism and social support were significantly associated with lower illness burden after the hurricane, above and beyond storm-related disruption and distress responses. These findings provide information on the impact of environmental stressors and psychosocial factors in the exacerbation of CFS symptoms." <Go to ISI>://WOS:A1995RM04400002

**McDonnell S. and Hlady W. G.**, IN THE WAKE OF HURRICANE-ANDREW, *Jama-Journal of the American Medical Association*, 273,23, 1995. <Go to ISI>://WOS:A1995RD11600013

**McNabb S. J. N., Kelso K. Y., Wilson S. A., McFarland L. and Farley T. A., HURRICANE ANDREW-RELATED INJURIES AND ILLNESSES, LOUISIANA, 1992.** *Southern Medical Journal*, 88,6, 1995.

Abstract: "To determine the extent and types of injuries and illnesses in Louisiana associated with or related to Hurricane Andrew, we gathered data from hospital emergency departments and coroner's offices on demographic variables, institution, nature and cause of the injury or illness, body part affected, location, and date and time of the event. A hurricane-related injury or illness was defined as one that occurred from noon on August 24, 1992, through midnight on September 21, 1992, as a direct or indirect result of the preparation for (preimpact), the impact of, or the clean-up after the hurricane (postimpact). Nineteen parishes in south-central Louisiana that were most affected by Hurricane Andrew provided data from patients seen in emergency departments and reports from coroner's offices. Active, advance surveillance of this type promotes and facilitates the reporting of disaster-related health outcomes. Future planning for hurricanes should take into account the high rate of cuts, lacerations, and puncture wounds, particularly during the postimpact phase." <Go to ISI>://WOS:A1995RC17200003

**Mellman T. A., David D., Kulickbell R., Hebding J. and Nolan B., SLEEP DISTURBANCE AND ITS RELATIONSHIP TO PSYCHIATRIC MORBIDITY AFTER HURRICANE-ANDREW,** *American Journal of Psychiatry*, 152,11, 1995.

Abstract: "Objective: Sleep disturbance is an important dimension of posttraumatic stress disorder (PTSD), but most of the limited available data were obtained years after the original traumatic event. This study provides information on sleep disturbance and its relationship to posttraumatic morbidity from evaluations done within a year after the trauma. Method: Sleep and psychiatric symptoms of 54 victims (12 men and 42 women) of Hurricane Andrew who had no psychiatric illness in the 6 months before the hurricane were evaluated. A subset of hurricane victims with active psychiatric morbidity (N=10) and nine comparison subjects who were unaffected by the hurricane were examined in a sleep laboratory. Results: A broad range of sleep-related complaints were rated as being greater after the hurricane, and psychiatric morbidity (which was most commonly PTSD, followed by depression) had a significant effect on most of the subjective sleep measures. In addition, subjects with active morbidity endorsed greater frequencies of "bad dreams" and general sleep disturbances before the hurricane. Polysomnographic results for the hurricane victims revealed a greater number of arousals and entries into stage 1 sleep. REM density correlated positively with both the PTSD symptom of reexperiencing trauma and global distress. Conclusions: Subjects affected by Hurricane Andrew reported sleep disturbances, particularly those subjects with psychiatric morbidity. Tendencies to experience bad dreams and interrupted sleep before a trauma appear to mark vulnerability to posttraumatic morbidity. Results of sleep laboratory evaluations suggested brief shifts toward higher arousal levels during sleep for PTSD subjects and a relationship of REM phasic activity and symptom severity." <Go to ISI>://WOS:A1995TC54300016

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Abstract: "We report on the experience of a 500-bed, long-term care facility in Miami, Fla, which provides housing and nursing care units for patients-ranging from those who are independently ambulatory to those who are acutely ill and feeble-in preparing for, during, and in the immediate aftermath of Hurricane Andrew, which struck on August 24, 1992. The problems encountered included a massive influx of evacuated elderly to the facility, facility isolation, loss of electrical power, loss of running water, special dietary needs, and limited professional staffing due to personal property losses or loss of transportation. Overwhelmed county emergency medical services, limited access to hospitals and patient care, and difficulty in procuring supplies exacerbated the already complicated situation resulting from the storm. As a result of these catastrophic conditions, a number of challenges specific to the care of the elderly were identified. In conjunction with the Florida Department of Elder Affairs, we drafted a comprehensive blueprint that could serve as a disaster plan for other long-term care facilities facing a similar threat during the hurricane season." <Go to ISI>://WOS:A1995RC17200001

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**Steffen P., Ironson G., Burnett K., Wynnings C., Greenwood D., Rodriguez M., Cruess D., Carver C., Baum A., Fletcher N. and Schneiderman N.,** HOSTILITY CORRELATES WITH DISTRESS, COPING, IMMUNE AND HEALTH MEASURES FOLLOWING HURRICANE-ANDREW. *Psychosomatic Medicine*, 57,1, 1995. <Go to ISI>://WOS:A1995QE07400154

**Tufekci S.,** AN INTEGRATED EMERGENCY MANAGEMENT DECISION-SUPPORT SYSTEM FOR HURRICANE EMERGENCIES. *Safety Science*, 20,1, 1995.

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Abstract: "Hurricane Andrew was a relatively small but intense hurricane that passed through the Bahamas, across the Florida Peninsula, and across the Gulf of Mexico between 23 and 26 August 1992. The characteristics of this hurricane primarily beyond its core are summarized using 1) marine observations from three National Data Buoy Center (NDBC) buoys and three Coastal-Marine Automated Network stations close to the storm track; 2) water levels and storm surge at 15 locations in the

Bahamas, around the coast of Florida, and along the northern coast of the Gulf of Mexico; 3) currents, temperatures, and salinities at a depth of 11 m in the northern Gulf; and 4) spatial analyses of sea surface temperature (SST) before and after the passage of Andrew. Sea level pressure, wind direction, wind speed, wind gust, air temperature, and the surface wave field were strongly influenced at locations generally within 100 km of the hurricane track. Maximum sustained winds of 75 m s<sup>-1</sup> occurred just north of the storm track near Miami (Fowey Rocks). Significant wave height increased from 1 to 6.4 m at one NDBC buoy in the Gulf of Mexico (25.9 degrees N, 85.9 degrees N). A record high water level occurred at North Miami Beach. Decreases in water level occurred along the west coast of Florida with a maximum negative surge of -1.2 m at Naples. Increases in water level occurred along the Gulf coast between the Florida panhandle and Louisiana where a storm surge of +1.2 m was observed at Bay Waveland, Mississippi. Current speeds at one shallow water location along the hurricane track in the northern Gulf (28.4 degrees N, 90.5 degrees W) increased from similar to 15 to almost 140 cm s<sup>-1</sup> at a depth of 11 m during passage of the storm. Finally, SSTs decreased by up to 3 degrees C at various locations along the hurricane track." <Go to ISI>://WOS:A1994QL5260007

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Abstract: "Study objective: To rapidly obtain population-based estimates of needs in the early aftermath of Hurricane Andrew in South Florida. Methods: We used a modified cluster-sampling method (the Expanded Programme on Immunization [EPI] method) for three surveys. We selected a systematic sample of 30 quarter-mile square clusters for each survey and, beginning from a random start, interviewed members of seven consecutive occupied households in each cluster. Two surveys were of the most affected area (1990 population, 32,672) at three and ten days after the hurricane struck; one survey was of a less affected area (1990 population, 15,576) seven days after the hurricane struck. Measurements and main results: Results were available within 24 hours of beginning each survey. Initial findings emphasized the need for restoring utilities and sanitation and helped to focus medical relief on primary care and preventive services. The second survey of the most affected area showed improvement in the availability of food, water, electricity, and sanitation (P less-than-or-equal-to .05). There was no evidence of disease outbreaks. Conclusion: For the first time, the EPI method provided population-based information to guide and evaluate relief operations after a sudden-impact natural disaster. An improvement over previous approaches, the EPI method warrants further evaluation as a needs assessment tool in acute disasters." <Go to ISI>://WOS:A1994NG6620002

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Abstract: "The massive Department of Defense deployment in support of Hurricane Andrew relief cast the military medical departments in a new role. Military medical personnel were challenged to apply the traditional principles of combat medicine to a non-combat environment, within the continental United States, within an existing health care infrastructure, in a role subordinate to local civilian health care agencies. As a medical "subject matter expert" assigned to the Joint Task Force Andrew Surgeon's staff, the author worked at the civil-military interface. The lessons learned in his role as a special staff officer should benefit any health care provider involved in disaster relief. They focus on problem areas peculiar to the disaster relief scenario." <Go to ISI>://WOS:A1994NJ9380008

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Abstract: "Hurricane Andrew rampaged across Florida and Louisiana causing businesses and homes to be lost and leaving thousands of people homeless. This storm was a category 4 on the Saffir-Simpson scale and generated winds of 145 miles per hour (65 m s<sup>-1</sup>) with gusts exceeding 175 miles per hour (78 m s<sup>-1</sup>). Billions of dollars were needed for repairs, shelters, and public utilities. Federal organizations like the National Guard and large corporations provided communities with shelter, food and clothing.

Hurricane Andrew ... a storm Americans will never forget. The National Environmental Satellite, Data, and Information Service (NESDIS) of the National Oceanic and Atmospheric Administration (NOAA) operates the nation's operational environmental satellite systems. The Polar Orbiting Environmental Satellites (POES) provide coverage to meet the needs of users in the government, public, private, and scientific communities for research and development, training, and educational purposes. A description of the POES system is given with example images of Hurricane Andrew, demonstrating the utility of polar orbiting satellites in tracking and analyzing destructive storms." <Go to ISI>://WOS:A1994PT57300002

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to a surface wind enhancement resulting in the strongest winds ever estimated (F3) for a landfall hurricane. This intense damage occurred primarily during the 'second' period of strong winds associated with the east side of the eyewall. For the first time, a well-defined circulation in the damage pattern by the second wind was documented. A superposition of radar data from Miami and Key West on top of the damage map provides the first detailed examination of the relationship between the eyewall and the surface flow field as estimated from the damage vectors." <Go to ISI>://WOS:A1994MY52800001

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Hurricane Andrew - A damage streak at Naranja Lakes These damage streaks were evident throughout the hardest hit areas Image ID: wea00552; August 1992; <http://www.photolib.noaa.gov/700s/wea00552.jpg>

Hurricane Andrew - A ground view of the devastation in Pinewoods Villa Image ID: wea00534; August 1992; <http://www.photolib.noaa.gov/700s/wea00534.jpg>

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Hurricane Andrew - A section of Pinewoods Villa Note uneven damage pattern Image ID: wea00533; August 1992; <http://www.photolib.noaa.gov/700s/wea00533.jpg>

Hurricane Andrew - An ocean-going tugboat left high and dry by storm surge. Boat is on the 174th Street side of the canal. Road in the background is old Cutler Road. A storm surge of 16.9 feet occurred a few blocks from here at the Burger King world headquarters.; Image ID: wea00530; August 1992; <http://www.photolib.noaa.gov/700s/wea00530.jpg>

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Hurricane Andrew - Close-up of 1X4 board driven through the trunk of a royal palm Image ID: wea00546; August 1992; <http://www.photolib.noaa.gov/700s/wea00546.jpg>

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Hurricane Andrew - Dadeland Mobile Home Park after passage of Andrew Needless to say, mobile homes are not safe in strong wind events Image ID: wea00566; August 1992; <http://www.photolib.noaa.gov/700s/wea00566.jpg>

Hurricane Andrew - Damage was a function of type and quality of construction Country Walk (foreground), mobile home park in center, quality housing (upper) Image ID: wea00562; August 1992; <http://www.photolib.noaa.gov/700s/wea00562.jpg>

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Hurricane Andrew - Despite the devastation folks still had time for humor; Image ID: wea00564; August 1992; <http://www.photolib.noaa.gov/700s/wea00564.jpg>

Hurricane Andrew - Even the chief executive officer wasn't spared Office of Corporate Executive Officer of Burger King World Headquarters Image ID: wea00531; August 1992; <http://www.photolib.noaa.gov/700s/wea00531.jpg>

Hurricane Andrew - F-16 in repair shop left behind at Homestead Air Force Base; Image ID: wea00560; August 1992; <http://www.photolib.noaa.gov/700s/wea00560.jpg>

Hurricane Andrew - Front view of a home in which a fatality occurred A concrete tie beam from another unit crashed through the roof of this home Image ID: wea00557; August 1992; <http://www.photolib.noaa.gov/700s/wea00557.jpg>

Hurricane Andrew - Home pushed off of foundation and well back into marsh this was several miles north of Cocodrie Damage caused by storm surge and wind acting together Image ID: wea00573; August 1992; <http://www.photolib.noaa.gov/700s/wea00573.jpg>

Hurricane Andrew - Homes in Saga Bay area Note debris from storm surge in lower left of picture Image ID: wea00537; August 1992; <http://www.photolib.noaa.gov/700s/wea00537.jpg>

Hurricane Andrew - infrared image at maximum intensity August 23, 1992 Image ID: wea00519; August 23, 1992 <http://www.photolib.noaa.gov/700s/wea00519.jpg>

Hurricane Andrew - infrared image taken by GOES 7 Andrew is crossing the Florida coast and making landfall August 24, 1992, at Dade County, Florida Image ID: wea00521; August 24, 1992; <http://www.photolib.noaa.gov/700s/wea00521.jpg>

Hurricane Andrew - Kings Bay townhomes @ \$750K each Double whammy from Andrew - upper windows blown out by winds before eye Debris in foreground result of storm surge moving through lower levels; Image ID: wea00528; August 1992; <http://www.photolib.noaa.gov/700s/wea00528.jpg>

Hurricane Andrew - Long lines waiting for ice ration following Andrew Following major disasters, refrigeration assumes a high priority Image ID: wea00559; August 1992; <http://www.photolib.noaa.gov/700s/wea00559.jpg>

Hurricane Andrew - Note contrast between neighborhoods The difference between good and best concrete block stucco construction Which would you choose?; Image ID: wea00569; August 1992; <http://www.photolib.noaa.gov/700s/wea00569.jpg>

Hurricane Andrew - Numerous gabled end roof failures in Country Image ID: wea00563; August 1992; <http://www.photolib.noaa.gov/700s/wea00563.jpg>

Hurricane Andrew - Pine trees snapped by force of wind at Pinewoods Villa Image ID: wea00536; August 1992; <http://www.photolib.noaa.gov/700s/wea00536.jpg>

Hurricane Andrew - Power line poles snapped by Andrew High profile structures are susceptible to damage in strong wind events Image ID: wea00576; August 1992; <http://www.photolib.noaa.gov/700s/wea00576.jpg>

Hurricane Andrew - Remains of a furniture warehouse west of Whispering Pines Image ID: wea00549; August 1992; <http://www.photolib.noaa.gov/700s/wea00549.jpg>

Hurricane Andrew - Roof trusses in tangled masses were common sight in area Image ID: wea00556; August 1992; <http://www.photolib.noaa.gov/700s/wea00556.jpg>

Hurricane Andrew - Shearwall of apartment building literally peeled off by winds Image ID: wea00539; August 1992; <http://www.photolib.noaa.gov/700s/wea00539.jpg>

Hurricane Andrew - Six adults crowded into interior closet of this home They all survived Image ID: wea00538; August 1992; <http://www.photolib.noaa.gov/700s/wea00538.jpg>

Hurricane Andrew - Small planes tossed about like toys at Tamiami Airport Image ID: wea00561; August 1992; <http://www.photolib.noaa.gov/700s/wea00561.jpg>

Hurricane Andrew - Storm tide data and contours in feet - green area inundated August 24, 1992 at Dade County, Florida Image ID: wea00524; August 24, 1992; <http://www.photolib.noaa.gov/700s/wea00524.jpg>

Hurricane Andrew - Streamlines of wind flow across this style of roof The resulting aerodynamic lift is displayed by the upward pointing red arrows; Image ID: wea00558; August 1992; <http://www.photolib.noaa.gov/700s/wea00558.jpg>

Hurricane Andrew - The Cocodrie Petroleum Transfer Depot south of Dulac Difficult to tell whether damage from wind or surge Either way, the results are the same Even as a Category 3 storm, Andrew still packed a mighty punch Image ID: wea00571; August 1992; <http://www.photolib.noaa.gov/700s/wea00571.jpg>

Hurricane Andrew - The frame of a mobile home with downs still anchored However, nothing is left to anchor Tie downs are not the answer to resident safety in mobile homes Evacuation remains the wisest option if warned in time to evacuate Image ID: wea00567; August 1992; <http://www.photolib.noaa.gov/700s/wea00567.jpg>

Hurricane Andrew - The marina Gables by the Sea after the storm surge Image ID: wea00527; August 1992; <http://www.photolib.noaa.gov/700s/wea00527.jpg>

Hurricane Andrew - The twisted and tangled remains of a radio tower This was north of Garden City on U.S. Highway 90 Image ID: wea00574; August 1992; <http://www.photolib.noaa.gov/700s/wea00574.jpg>

Hurricane Andrew - Tornadoes accompanied Andrew adding to terror and confusion Tornadoes hit southern Louisiana (14) and Mississippi (25) Tornado at La Place, Louisiana - 2 fatalities occurred in this town Image ID: wea00577; August 1992; <http://www.photolib.noaa.gov/700s/wea00577.jpg>

Hurricane Andrew - Trees falling damaged homes north of Avery Island Fortunately the residents had evacuated Image ID: wea00575; August 1992; <http://www.photolib.noaa.gov/700s/wea00575.jpg>

Hurricane Andrew - Two vehicles remain in garage but overturned by force of wind Image ID: wea00532; August 1992; <http://www.photolib.noaa.gov/700s/wea00532.jpg>

Hurricane Andrew - Uneven damage pattern in Lakes by the Bay development Image ID: wea00540; August 1992; <http://www.photolib.noaa.gov/700s/wea00540.jpg>

Hurricane Andrew - Vehicle picked and deposited on wall and other vehicle Vehicles belonged to CNN reporter and Hurricane Center employee Hurricane Center employee learned of damage to vehicle watching CNN Image ID: wea00547; August 1992;  
<http://www.photolib.noaa.gov/700s/wea00547.jpg>

Hurricane Andrew - visible image from METEOSAT 3 Andrew was approaching the Florida coast Image ID: wea00517; August 1992; <http://www.photolib.noaa.gov/700s/wea00517.jpg>

Hurricane Andrew - visible satellite image taken by METEOSAT 3 This picture depicts Andrew during period of maximum intensity over Bahamas Image ID: wea00520; August 23, 1992  
<http://www.photolib.noaa.gov/700s/wea00520.jpg>

Hurricane Andrew - water vapor satellite image by METEOSAT 3 August 19, 1992 image also shows upper level low to the north of Andrew Image ID: wea00518; August 19, 1992  
<http://www.photolib.noaa.gov/700s/wea00518.jpg>

Hurricane Andrew - Wind damage to a self-serve gas station in Perrine Image ID: wea00548; August 1992; <http://www.photolib.noaa.gov/700s/wea00548.jpg>

Hurricane Andrew - winds dragged this sailboat inland over marshland Image ID: wea00543; August 1992; <http://www.photolib.noaa.gov/700s/wea00543.jpg>

Hurricane Andrew - WSI radar composite of Andrew making landfall August 24, 1992, at Dade County, Florida Image ID: wea00522; August 24, 1992;  
<http://www.photolib.noaa.gov/700s/wea00522.jpg>

Hurricane Andrew - WSR-88D radar image as Andrew made landfall August 24, 1992 at Dade County, Florida Image ID: wea00523; August 24, 1992;  
<http://www.photolib.noaa.gov/700s/wea00523.jpg>

Hurricane Andrew -Sewell Park at the mouth of the Miami River Just after daybreak on August 24, 1992 Image ID: wea00526; August 24, 1992 <http://www.photolib.noaa.gov/700s/wea00526.jpg>

Hurricane Andrew -Sewell Park at the mouth of the Miami River On a normal day Image ID: wea00525; May 5, 1991; <http://www.photolib.noaa.gov/700s/wea00525.jpg>