... four-year $5,000 scholarship for students pursuing marine and ... science.

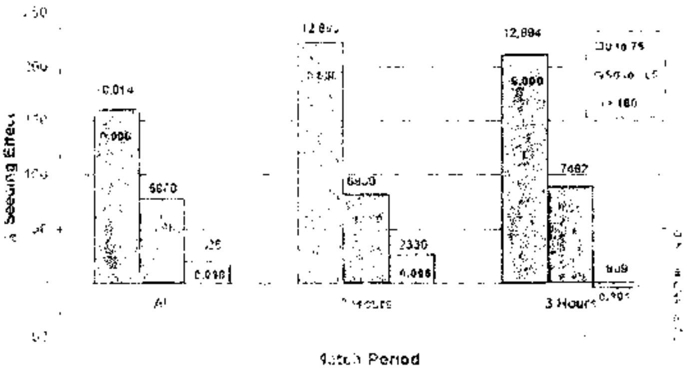
Backing up the teams are more than 400 scientists, researchers, teachers and marine science experts who are volunteering their time to support the next generation of marine scientists, educators and policy makers.

NOSB questions cover ocean biology, chemistry, geology, physics, navigation, geography, and related history, literature, and public policy. Questions are presented in "buzzer" rounds (rapid-fire multiple-choice or short-answer) and the "team challenge," which gives students an opportunity to apply their critical thinking skills to questions involving real-time data and cutting edge research ... policy issues.

For a sample of the kinds of questions included in the competition, go to the NOSB Web site (www. ... Dev2Go.web?/anchor ... home_page) and click on "Test Your Ocean Knowledge."

New Method to Evaluate Cloud Seeding

A new method for the objective evaluation of short-term nonrandomized operational convective cloud seeding projects on a floating-target analysis basis was used to evaluate seeding effects in the Texas High Plains (HP) and Edwards Aquifer (EA) programs during 1999-2000 ... Specifically, seeded and nonseeded matching control units were defined in accordance with ... definitions in previous randomized seeding experiments in Texas and Thailand. The units were defined and selected by a computerized automatic algorithm, which is not subject to human bias.



Apparent seeding effect, [(S/NS)–1]100(%), as a function of pretreatment age at initial treatment and match period (number of hours since first treatment) for matches made outside the operational target for the High Plains Program in 1999 and 2000. The average rain change (acre-ft) per unit is shown above each bar. The corresponding P-values are shown within each bar.

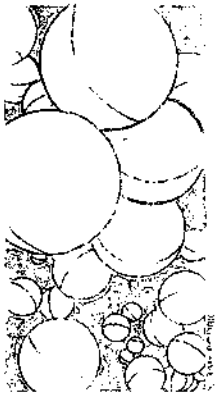
The computer-based method made use of NEXRAD mosaic radar data to define fields of circular 25-km radius floating-target analysis units with lifetimes from first echo to the disappearance of all echoes and then superimposed the track and seeding actions of the project seeder aircraft onto the unit fields to define seeded and nonseeded analysis units. Objective criteria were used to identify "control" matches for each of the seeded units from the archive of nonseeded units. To minimize potential contamination by seeding, no matching was allowed for any control unit if its perimeter came within 25 km of the perimeter of a seeded unit during its lifetime.

The matches were selected from within and outside each operational target within ±6 h and ±2 h of the time on a given day that seeding of a particular unit took place. These were done to determine whether selection biases and the diurnal convective cycle confounded the results. This analysis effort is consistent with the recommendations from the National Research Council report, "Critical Issues in Weather Modification Research."

Although the results of all analyses were subjected to statistical testing, in the absence of a priori treatment randomization, P-values cannot be used as probabilities for the effects having occurred by chance, but merely to determine the relative strength of the various findings. The apparent effect of seeding in both programs was large, even after determining the effect of selection biases and the diurnal convective cycle. The most conservative estimates of seeding effects were obtained from

...matches drawn from outside the operational target within ... of the time that each unit was ...ly seeded. Under these circumstances, the percentage increase exceeded 50% and the volumetric increment was greater than 400 acre-ft (3700 kilotons) per ... with strong, *P*-value support ... 0.0001) in both the *t*-*P* and ...-*p* programs. This is in good agreement with the apparent percentage effects of seeding for the randomized Texas and Thai cloud-seeding programs, which were ... and 48% to 92%, respectively. ...seeded within 75 min of their ... appearance on radar showed ... largest apparent seeding effects ... Although these results ... a strong case for enhanced ... by the operational seeding ...rams, such programs must ... viewed as substitutes for ...mized seeding efforts that ...nducted in conjunction with ... physics measurements and ...ic cloud modeling. Such ac... are not normally the pur... of operational programs, and ... current funding climate we ...ey should be undertaken by ...ership between the research ... operational sectors.—WILLIAM ... (Colorado Weather ...) AND DANIEL ROSEN... *The Development and Testing ... an Method to Evaluate the ...tional Cloud-Seeding Pro... in Texas," in the February* ... of Applied Meteorology.

A PING-PONG BALL'S CHANCE . . .



A single ping-pong ball may seem pretty harmless, but 550,000 of them hurtling down a mountain would most certainly be cause for alarm. Scientists studying the physics of avalanches recently found this to be true by using that number of balls to mimic a powder snow avalanche, in which the snow is light enough so that it becomes airborne while coming down the mountain. Jim McElwaine of Cambridge University and Kouichi Nishimura of Hokkaido University sent the balls down a Japanese ski jump in order to devise a mathematical model of the tendencies of this particular type of avalanche, which moves much more erratically than those with heavier snow, and is therefore more dangerous. In the experiment, cameras and air-pressure sensors situated along the slope recorded the movement and speed of individual balls and showed occurrences of turbulent eddies in the "ball-alanche." The resulting model was surprisingly uncomplicated. However, more research will be required to determine just how accurate the model is in replicating an actual avalanche's movement.

PULSED LIDAR FOR AIRCRAFT WAKE CHARACTERIZATION

...pulsed Doppler lidar, ... successfully used for wind ... turbulence measurements, has ... modified for long range ... characterization of wake vortices ... aircraft. This mainly con... the opto-mechanical ar... rangement and the scanning device on the hardware side, and the four-stage data-processing algorithm being developed to achieve precise profiles of tangential velocities from which the vortex parameters like trajectories, core separation, tilt angle, and circulation can be derived. During an extended field trial during summer 2002 at the airfield of Toulouse, France, the potential of the pulsed lidar for wake-vortex characterization in the atmospheric environment could be demonstrated.

The main advantage of the pulsed lidar is the long-range capability of several kilometers, allowing the observation over long periods from the moment of wake generation to a progressed state of vortex decay. The flexible scanning device makes it possible to investigate the vortex behavior not only near the ground, but also outside the ground influence, by pointing the scanning area steeper in an upward direction. The operation onboard an aircraft for characterization of wake vortices generated by a preceding aircraft is under consideration.—FRIEDRICH KÖPP (DLR, INSTITUTE OF ATMOSPHERIC PHYSICS), STEPHAN RAHM, AND IGOR SMALIKHO. *"Characterization of Aircraft Wake Vortices by 2 μm Pulsed Doppler Lidar," in the* ...uary Journal of Atmospheric and Oceanic Technology.

CONVECTIVE SYSTEM EXPANSION AS PREDICTOR

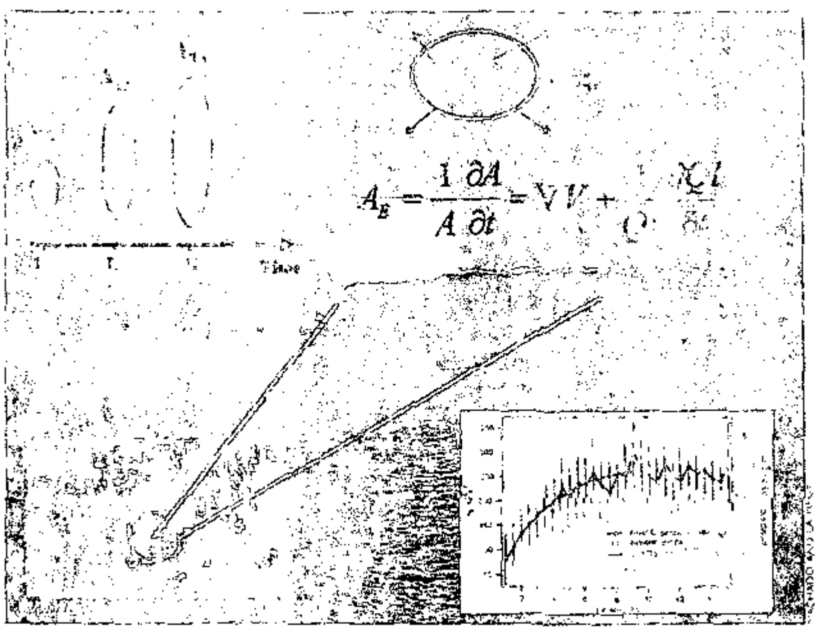
...s possible to estimate the prob... the lifetime of a convective system, within a certain error bar, consider... only its initial area expansion.

...e analyzed the relationship... between the initial area expansion rate of tropical convective systems and their total life duration using an objective tracking of convective systems during their life cycle. We

also investigated the hypothesis that the area expansion, and hence the convective activity, impact the high-level wind divergence.

The WETAMC/LBA experiment over tropical south America makes possible dynamic and thermodynamic analysis of convective systems and their associated precipitation from the combination of satellite images, meteorological radars and rain gauges, and radiosonde data. We used the full resolution GOES-8 satellite images to detect and track the convective systems during their life cycle. This objective tracking was performed for 48 days during the WETAMC/LBA over Rondônia, covering tropical south America. The high-level wind and divergence have been estimated using objective satellite wind observations.

Initial area expansion not only predicts the life cycle of the convective systems but also appears to be a good indicator of convective precipitation. The analysis of the area expansion showed that this initial area expansion parameter could be very useful for short range forecasts, convection diagnostics, and maybe to help improve the precipitation estimation from geostationary meteorological satellites. Also, the area expansion can be used to determine the convective system life stage and to supply information about the condensation processes and the upper level divergence. It is shown that the area increase in the initial stage is mainly due to the condensation process; then, afterward, in the mature stage, the upper air wind divergence increases. —LUIZ AUGUSTO T. MACHADO, DANIEL ALEJANDRO VILA, AND HENRI LAURENT, "The Convective System Area Expansion over Amazonia and Its Relationship with Convective System Life Duration and High-Level Wind Divergence: Part II." Monthly Weather Review

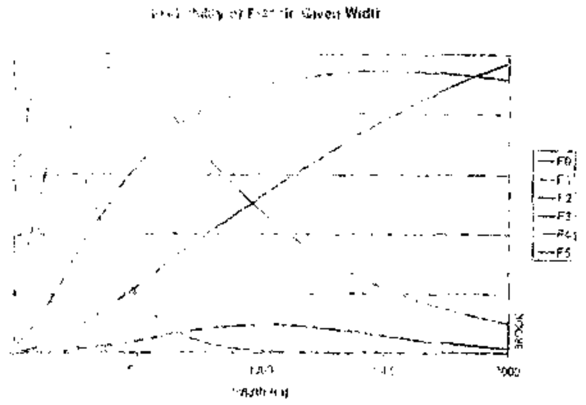


Schematic diagram of the convective system detection and size evolution. The figure also shows the equation relating A_E, the normalized area time rate of expansion, with the upper-level wind divergence and the condensation/evaporation rate (Ql is the liquid water content). On the right side, the figure shows A_E at the initiation stage, as a function of the convective system lifetime.

Tornado Strength and Path Relationship

Tornado path length and widths are reported in discrete values. For many purposes, such as developing statistical models of hazards, it is desirable to have continuous functions. This is accomplished by modeling reported path length and widths of tornadoes using Weibull distributions for different values of the Fujita damage scale ("F" scale). Weibull distributions are frequently used to model variations in wind speeds, being both continuous, nonnegative, and with a curve trailing off toward higher values. The fits are good over a wide range of lengths and widths. Path length and width tend to increase with increasing F-scale, although the changes over time in the data for some aspects are large enough that caution must be exercised in interpretation of short periods of record. For example, the mean reported width of F3 tornadoes shows a slow increase beginning in early 1970s, when it was a little less than 200 m, to the mid-1990s, when the mean reported width was over 500 m, followed by a rapid decrease in the late 1990s and early 2000s. These changes appear independent of changes in NWS policy concerning whether the mean path width or maximum path width should be reported.

The statistical distributions demonstrate that, as the length or width increases, the most likely F scale value associated with the length or width tends to increase (see figure, next page). Nevertheless, even for long or wide tornadoes, there is a significant probability of a range of possible F values, so that simple ob-



Probability of the Fujita damage scale rating given the reported width of a tornado. Damage intensity increases from F0 to F5. Thin lines associated with F0–F2 and thick lines with F3–F5. Colors go from green to red to black within each group of three.

...data on the length or width is insufficient to make an accurate estimate of the F scale. Tornadoes above F5 are rare enough, however, that they are never the most likely damage rating for any length or width. —HAROLD E. BROOKS (NOAA/NATIONAL SEVERE STORMS LABORATORY), *On the Relationship of Tornado Path Length and Width to Intensity*, in the April Weather and Forecasting

OUTBREAKS OF TORNADOES IN HURRICANES

Although midlevel dry intrusions have been mentioned as a possible factor in tornado outbreaks with landfalling tropical cyclones for more than three decades, a systematic analysis of the historical outbreaks has been lacking. Analysis of rawinsonde observations shows that of the 13 Atlantic basin tropical cyclones producing tornado outbreaks (20 or more tornadoes) in mainland North America between 1960 and 1999, 11 were found to have evidence of a midlevel dry intrusion near or over the area of the outbreak.

The "positive" outbreak cases occurred when the favored area for tornadogenesis (i.e., the right front or northeast quadrant of the tropical cyclone) coincided with a pronounced midlevel relative humidity gradient as determined from relative humidity at 850, 700, and 500 mb relative-humidity data. A review of all tropical cyclone landfall events since 1960 revealed only three cases with clear evidence of similar midlevel dry intrusions that failed to produce an outbreak of 20 tornadoes or more. However, each of those cases did produce a significant number of tornadoes.

The analysis showed no correlation between landfall intensity and outbreak potential in the 13 cases, but did detect a strong diurnal signal. Almost two-thirds of the tornadoes in the 11 positive cases occurred between 1500 and 2400 UTC (daylight hours in the region examined). The horizontal distribution of midlevel dry air varied from case to case, but two basic patterns were identified: in one, a mass of dry air impinged on much of the northern or northwestern semicircle of the storm's outer circulation and gradually divided into two separate areas (to the northwest and to the northeast) as the storm advanced poleward; the other involved apparent ingestion of a lobe of dry air from a reservoir most often located in the eastern semicircle of the storm.

Subsequent research is planned into the origin of the midlevel dry air reservoirs. Surface baroclinic boundaries appear to have been involved in at least two of the cases and additional research is warranted with respect to that issue, as well.—LON CURTIS (KWTX-TV) *Midlevel Dry Intrusions as a Factor in Tornado Outbreaks Associated with Landfalling Tropical Cyclones from the Atlantic and Gulf of Mexico*, in the April Weather and Forecasting

ECHOES

"Preventative plans on a larger scale are needed."

—JOHN SCHELLNHUBER, head of a group of climate scientists at the Tyndall Centre for Climate Change Research in the United Kingdom, speaking after a meeting in Britain of leading European and American climatologists in January that produced some imaginative ideas for dealing with climate change. Among the "larger-scale" proposals were various methods to deflect the Sun's rays, including sending billions of tiny balloons into the stratosphere or utilizing gigantic mirrors in space, as well as ideas to use giant reservoirs filled with saline water to offset rising sea levels and algae farms to absorb greenhouse gases. Critics say the unusual suggestions indicate governments and some scientists are out of touch with ways to sensibly deal with the problem of climate change.