

Everything *wind*

WIND SCIENCE & ENGINEERING RESEARCH CENTER

TEXAS TECH UNIVERSITY | SUMMER 2009





TEXAS TECH UNIVERSITY

Wind Science and Engineering Research Center

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Everything Wind is a publication of the Wind Science and Engineering Research Center at Texas Tech University. The brochure features current information about academia and research and is sent to alumni and friends of the program.

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Send comments and news to:
Liz Inskip-Paulk at elizabeth.paulk@ttu.edu



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Mission Statement

The Wind Science and Engineering (WISE) Research Center at Texas Tech University distinguishes itself as an internationally recognized leader in research, education, and knowledge transfer on the effects of wind on people and the built environment.

Vision

The WISE Research Center will continue to perform advanced and innovative multidisciplinary research to mitigate the deleterious effects of windstorms on the built environment, people and their quality of life, and to utilize the beneficial effects of wind. Through research, we provide educational experiences that prepare students for technical and leadership roles in private practice, industry, government and academia. We will be the place of choice for interested students, professionals and industry on wind-related research and education.

Director's Message



The Wind Science and Engineering (WISE) Research Center at Texas Tech University is proud of its accomplishments and owes its success to the vision, dedication, hard work and collaborative spirit of our faculty affiliates, professional staff, and former and current students. WISE maintains a national and international reputation for expertise in wind-related research, exploiting the beneficial effects for wind energy, and mitigating the detrimental effects of windstorms, such as hurricanes and tornadoes.

The WISE Research Center offers the only Wind Science and Engineering Ph.D. de-

gree program in the nation with opportunities for multidisciplinary research and academic pursuit with its unparalleled infrastructure. WISE facilities include the Reese Technology Center that provides both an open and unobstructed environment with state of the art instrumentation for field research and a vast indoor laboratory space. The Texas Tech University campus hosts the Center's administrative offices and library facilities adjacent to the Civil Engineering Department.

The WISE Research Center is strongly multidisciplinary with 27 faculty affiliates from 11 academic departments with offices located on the main campus and at the Reese Technology Center. These individuals represent the disciplines of Architecture, Atmospheric Science, Business, Civil, Electrical, Industrial and Mechanical Engineering, Economics, Engineering Technology, Geospatial Technology, and Mathematics. Total annual research expenditures are between three and four million dollars.

We are very proud of our faculty, staff and students, and especially our alumni for what they have accomplished. Please feel free to come and visit us.

A. Swift

Andrew Swift, Sc.D., P.E.
Director

Current Faculty Associates

Architecture

Saif Haq, Ph.D.
Glenn Hill, M. Arch.

Atmospheric Science

Sukanta Basu, Ph.D.
Richard Peterson, Ph.D.
John Schroeder, Ph.D.
Christopher Weiss, Ph.D.

Business

Bradley Ewing, Ph.D.

Civil Engineering

Xinzhong Chen, Dr. Eng.
Ernst Kiesling, Ph.D.
Kishor Mehta, Ph.D.
Douglas A. Smith, Ph.D.
Andrew Swift, Sc.D.
J. Arn Womble, Ph.D.
Delong Zuo, Ph.D.

Economics

Dakshina De Silva, Ph.D.
Robert McComb, Ph.D.

Electrical Engineering

Michael Giesselmann, Ph.D.
Brian Nutter, Ph.D.

Engineering Technology

Daan Liang, Ph.D.

Geospatial Technology

Kevin Mulligan, Ph.D.

Industrial Engineering

Mario Beruvides, Ph.D.
Milton Smith, Ph.D.

Mathematics

Kathleen Gilliam, Ph.D.

Mechanical Engineering

Darryl James, Ph.D.
Siva Parameswaran, Ph.D.

Research Faculty

Jamie Chapman, Ph.D.
Jerry Guynes, P.E.



Donald R. Haragan, Ph.D.



H. Scott Norville, P.E., Ph.D.



Jim McDonald, Ph.D.



Richard E. Peterson, Ph.D.

WISE FOUNDERS' CIRCLE



Kishor C. Mehta, Ph.D.



Joseph E. Minor, P.E.



Ernst W. Kiesling, Ph.D.



WISE Faculty.
From left to right:
Mehta, Weiss, Peterson,
Swift, Smith, Kiesling,
Schroeder, Liang.



Research Highlights & Specific Accomplishments

- **Design of residential and community shelters for tornadoes;** design information disseminated by FEMA (1-800-621-3362).
- **Archive of damage documentation** of over 130 windstorm events.
- **Contribution to National Weather Service advisories** regarding not opening windows during tornadoes.
- **Contributions to development of national wind load standards.**
- **Establishment of the Wind Engineering Research Field Laboratory.**
- **Development of missile launcher for debris impact.**
- **Development of tornado design standard and guide** for Department of Energy facilities.
- **Presentation of more than 100 professional seminars** and short courses for professional practitioners and educators.
- **Establishment of Wind Research Database** to disseminate literature and information; www.wind.ttu.edu.
- **Development of prescriptive standard for windstorm resistant construction** for use on Texas Gulf Coast.

The EF-Scale

The **Enhanced Fujita Scale** still rates tornadoes from zero to five, but should provide more accurate ranges of wind speed to assess damage. It takes into account additional variables indicating a tornado's strength. The original F-Scale was developed in 1971 by the late Dr. T. Theodore Fujita, University of Chicago, to rate tornadoes and estimate associated wind speed based on the damage they cause.

The EF-Scale refines and improves the original scale. Limitations of the F-Scale have led to inconsistent ratings, including possible overestimates of wind speeds. **Drs. Kishor Mehta and Jim McDonald** of Texas Tech led a group representing Fujita Scale users – including nationally renowned meteorologists and wind engineers – that began working in 2001 to revise the scale. The wind speed ratings were revised based on 30 years of damage assessment data collected by Texas Tech from tornado sites across the nation.

Facilities

VorTECH Simulator

A large-scale tornado simulator 'VorTECH' has been developed to generate tornado-like vortices of varying types for the purpose of obtaining a fundamental understanding of how tornadoes damage and destroy structures. Reducing the loss of life and damage mitigation is possible if we have a better understanding of fluid-structure interaction and the associated transport of the debris that can be used to design improved structures and lead to improved engineering codes.

TTUKa Mobile Doppler Radars

Texas Tech University has developed two state-of-the-art mobile Ka-band Doppler radars (TTUKa) that will allow pioneering measurements of boundary-layer flow at a resolution and sensitivity previously unseen. The higher frequency of the systems allows for a very narrow beamwidth resulting in highly accurate wind velocity measurements. State-of-the-art hardware and a novel non-linear frequency modulation pulse compression technique make the TTUKa radars powerful tools for boundary-layer flow visualization. The mobility of the system allows for site- or event-specific implementation.



Stick-Net

Students and faculty at Texas Tech University have developed a versatile, rapid-deployment, 2.5 meters meteorological observing station. Affectionately dubbed “Stick-Net” for its resemblance to a stick figure, the Stick-Nets collect high-resolution meteorological data. The two-dozen platforms are designed to be deployed in a short period of time (three minutes or less), and by a small number of people. The probes are extremely versatile and can be used for numerous field studies.

WEMITE

The Wind Engineering Mobile Instrument Tower Experiment (WEMITE) became operational in time for the 1999 Atlantic hurricane season; it also collects high-wind data associated with thunderstorm outflow boundaries. This single mast tower can record wind speed and direction data at 3, 5, 7, and 10 meters. It also collects temperature, relative humidity, and barometric pressure.

Wind Engineering Research Field Laboratory (WERFL)

An instrumented 30 x 45 x 13 ft building and signal light structures are located at the field site. These and other structures with an associated data acquisition system permit measurements of wind-induced pressures and responses in natural wind.

Integrated Wind-Water Desalination Test Facility

This research technology is part of the Desalination Project co-sponsored by TTU's Water Resource Center and WISE. The project uses reverse osmosis to help develop mathematical equations needed to desalinate brackish water from underground aquifers using wind energy.

Debris Impact Facility

A pneumatic cannon, capable of producing simulated wind speeds over 250 mph, can launch different types of simulated wind-borne debris in a controlled environment to provide valuable impact resistance data.

Wind Library

The WISE Research Center preserves one of the largest collections of wind-related material in the world. This collection includes Dr. Ted Fujita's papers, and documentation of over 130 windstorm events from throughout the United States and overseas.

200-Meter Tower

A 200-meter data acquisition tower measures and records atmospheric conditions at ten levels with a variety of instruments, including sonic and u-v-w anemometers.

West Texas Mesonet

A network of fifty-six atmospheric stations located in more than 38 counties in West Texas and eastern New Mexico provides a network to monitor and record regional mesoscale weather conditions. This web-based system receives over 30,000 hits per day.

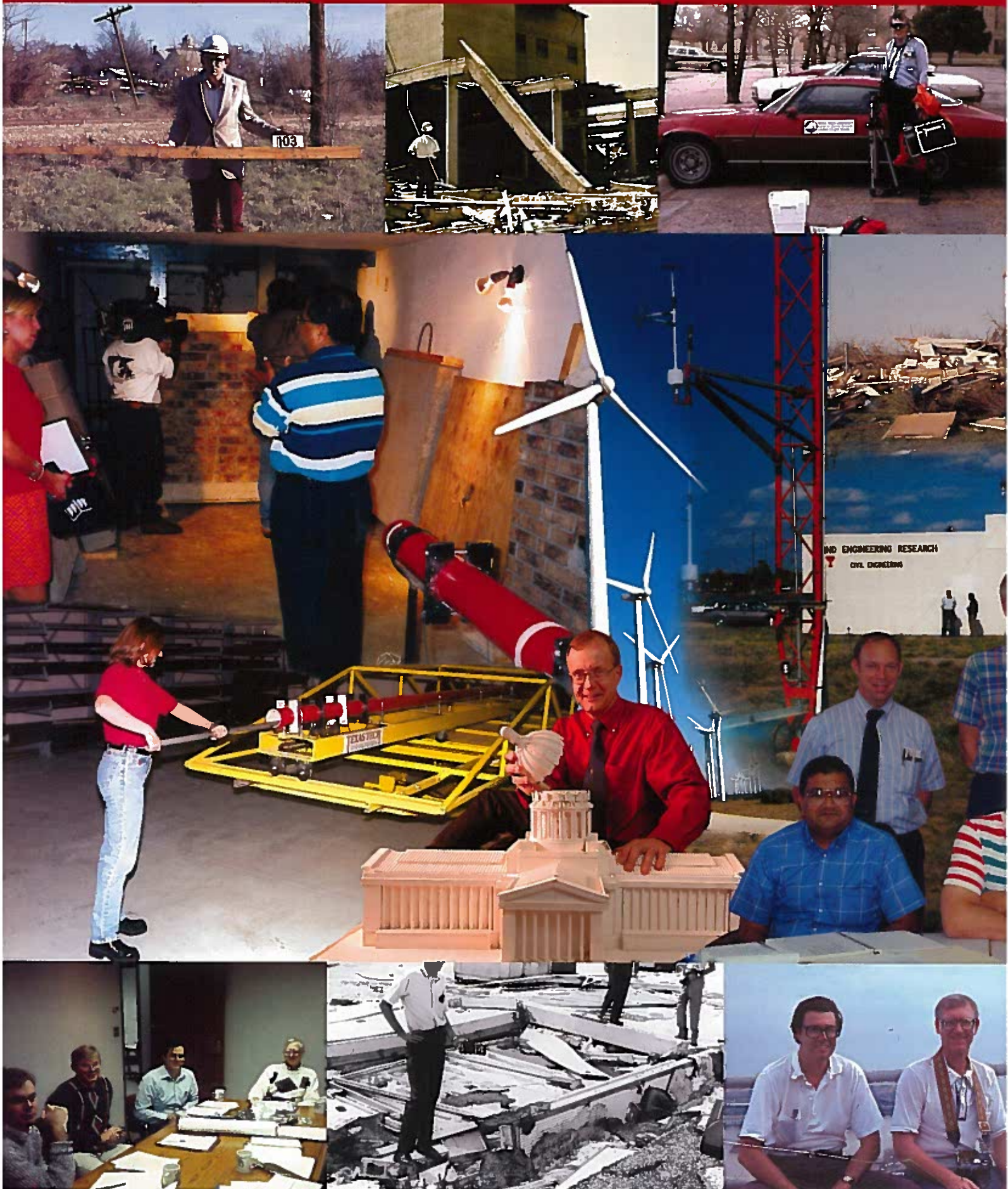
Low Level Profiler

This vertical atmospheric radar provides a detailed analysis of the lower boundary layer and is linked with the West Texas Mesonet.

Mobile Instrumentation

The windstorm and hurricane deployment teams record real-time storm data using two specially designed 10-meter mobile towers, an array of 2-meter towers, and a small fleet of specially instrumented automobiles.

Through the years of the Wind Science & Engineering Research Center







On-going Projects

Listed below are some of the Center's research projects; some are long-term and some are short-term projects.

Great Plains Wind Power Test Facility

Sponsored by: Department of Energy

Award Amount: \$1.96 million

Investigators: Andy Swift, Ken Rainwater, Jamie Chapman, Bob McComb

The objectives of the project are to continue development of a nationally-recognized facility for the testing, characterization and improvement of grid-connected wind turbines and integrated wind-water desalination systems, and to provide education and outreach on these topics.

Wind Education In Texas Schools

Sponsored by: Texas State Energy Conservation Office

Award Amount: \$50,000

Investigators: Jamie Chapman, Andy Swift, Lianfa Song

This project provides basic instruction to students and teachers of Shallowater and Crosbyton schools in the operation of wind turbines and the economics of wind energy.

Windstorm Damage Assessment Using Satellites

Sponsored by: National Science Foundation

Award Amount: \$160,000

Investigators: Daan Liang, Brian Nutter, Kishor Mehta

This project investigates the capability of hyperspectral imaging technology recorded by satellite to provide quick assessment of building damages. The results will be used by risk modelers, insurers, and public agencies.

Billboard Sign Tests

Sponsored by: International Sign Association and Outdoor Advertising Association of America

Award Amount: \$61,258

Investigators: Doug Smith, Delong Zuo, Kishor Mehta

This research conducts field and wind tunnel tests to determine forces on solid signs and compare them with the values given in ASCE 7-05.

Bridge Safety

Sponsored by: National Science Foundation

Award Amount: \$149,934

Investigator: Xinzhong Chen

This project will develop advanced methods to assess bridge performance to damaging winds and achieve reliability-based risk-consistent design of long span bridges.

NSF-CAREER Award

Sponsored by: National Science Foundation

Award Amount: \$505,000

Investigator: Sukanta Basu

One of the National Science Foundation's most prestigious awards, the NSF-CAREER award for young researchers, was granted to Dr. Sukanta Basu, Assistant Professor, to conduct research in the areas of low-level jets, mesoscale modeling, and wind energy. It will also allow the development of a new graduate course on wind power meteorology, forge the collaboration with a local K-12 school, and provide support for a post-doctoral associate and a Ph.D. student.

Rotation in Tornadoes (VORTEX2)

Sponsored by: National Science Foundation

Award Amount: \$645,000

Investigator: Christopher Weiss

Titled 'Verification of the Origin of Rotation in Tornadoes' (VORTEX2), this project's principal objective is to identify the thermodynamic and kinematic controls on low-level mesocyclogenesis by making numerous in-situ samples of the storm scale near the principal thunderstorm updraft.



Wind Science & Engineering Alumni

1970 - 79

Antoine Abiassi
Philip Harris
Kanajett Hathaitham
Patrick Lea
Robert Minor
Joseph Minor
Ramakrishna
Narayanaswami
Chok-Tat Tan
Travis Waldrip
Raymond Thompson

1980 - 84

Barry Allen
Abdulhamid Al-Tayyib
W. Lynn Beason
Richard Behr
Gary Boubel
Alfred Farwagi
Diboro Kanabolo
Kenneth Lagreca
Magnus Linden
Tim Marshall
Erik Rasmussen
Tillat Sattar
David Spears
Shuay-Ren Twu
Bob Wang
Ren-Tseng Young

1985 - 89

James Bailey
Yuan-Bin Chen
Gee Chou
Nirmal Das
Sheng-Yung Hsu
Yuh-Shing Hwang
Radhakrishna Kadaba
Sridhar Kamineni
V. Reddy Kancharla
Jaynool Khayrattee
Chee Lai
Basilio Lakas
Gee Lim
Yak Lim
Ah Lo
Dudley McFarquhar
Dan Millsaps
Sesha Nagalla
Chris Neufeld
Howard Ng

Himansu Pal
Rathinam Selvam
Jayaraman Sivakumar
Charles Stone
Juifeng Wang
Brad White
June Willcott
Rick Hissem
Eric Pani
Jeffrey Sites

1990 - 94

Satyasai Bhavaraju
Kevin Coughlin
Marc Levitan
Chun-Min Lin
Lei Liu
Subrahmaniam Mudda
N. Blair Nevins
Manjunatha
Ramasamudra
Lynda Rios
David Ritchie
Nina Sahni
Ajay Shanker
Darrel Sheridan
Udai Singh
Douglas Smith
W. T. Straughan
Scott Wagaman
Wendong Wang
Byron Yeatts
Yuming Zhang
Teresa Bals-Elsholz
George Mathews
David Spector

1995 - 99

Vinu Abraham
Shawn Balcar
Mark Bird
Scott Bole
Paul Bove
Russell Carter
Joe Charlton
Shannon Francoeur
Himanshu Gupta
Dennis Haar
Hui Jiang
Rohit Kaul
Kim King
Shrinivas Kola

Devanand Kondur
Surachet Laophulsuk
Dingyuan Lu
Yongqing Lu
Siwei Luo
John McNulty
Vanna Oberholz
Susheela
Palaniswamy
Narendra Pulipaka
Bryan Robertson
Praveen Sandri
John Schroeder
Rajesh Shimpi
Jason Swofford
George Thomas
Tyson Thompson
Christian Unanwa
Jianming Yin
Zhongshan Zhao
Chris Machuca
Kevin Simmons

2000 - 04

Kamalesh Agarwalla
Ryan Alexander
Erik Allen
Yahya Al-Menyawi
Shannon Baker
Jacob Bice
Bin Cai
Kevin Chappell
Niaz Chowdary
Justin Davidson
Satya Dutta
Rebecca Fagan
Anna Gardner
Mandar Ghosalkar
Ameri Gurley
Andrew Ickert
Ryan Jackson
Shikha Jain
Urmilla Jokhu-Sowell
Tarek Kewaisy
Lani Lin
Fei Long
Christopher Lubke
Tyler Mackay
Sundarrajan Mani
Mark Martinez
Mohammed Masud
Stephen Morse

Staci Pruitt
Robert Pruitt
Long Qiao
Prasanna Rachakatla
Jennifer Ray
Jennifer Rice
David Rivera
Roberto Rodriguez
Anthony Rodriguez
Steven Samuels
Anindya Sengupta
Sanad Shamsan
Spandana Tummuri
Selim Turkyilmaz
Keyi Wang
Mona Whitworth
Fuqiang Wu
Seth Nagle
Brian Pierce
Gary Skwira

2005 -

William Anderson
Anjing Bi
Eugene Bowles
Lizhong Chen
Dejiang Chen
Chelsea Cohen
Apoorv Dabral
Jonathan Edwards
Navin Galani
Hua He
Ning Lin
Bryan McElrath
Thanh Ngo
Matthew Richter
Anson Thompson
Jennifer Ward
Brian Wiese
Arn Womble
Nan Zhou
Hongchao Zhu
Tanveerul Islam
Maribel Martinez
Becca Paulsen-Edwards
Dennis Noll
Hector Crusado
Andrea Gamret-Jackman
Brandon Storm
Kevin Walter
Rolando Vega
Guoqing Huang

Ph.D. Program

The Wind Science and Engineering Research Center at Texas Tech University is pleased to offer the first doctoral degree program in Wind Science and Engineering in the country. The educational objectives of the program are to provide graduates with the broad education necessary to pursue studies and solve problems related to the detrimental effects of windstorms (hurricanes, tornadoes, thunderstorms, and others) and to take advantage of the beneficial effects of wind power, natural ventilation, pollution dispersion, etc. We are focused on education and committed to producing quality graduates who improve everyday lives of the public.

Graduate Certificate Program

The Graduate School has approved a certificate program in wind energy available to degreed personnel working in that industry. This program requires five graduate level courses of which two courses are in wind power systems. Other optional courses can be selected from wind energy meteorology, sustainable energy, alternative energy markets, and others. There are two tracks in the program: a technical track and a managerial track. Most of the courses in this program will be available through distance education by 2012.

Bachelor's Program

The undergraduate academic courses in wind energy are under development. The goal is to produce graduates who have a Bachelor of Science degree with a minor in wind energy. The degree will be a B.S. in University Studies which permits students to combine specialties from different colleges. Next to wind energy courses, students will focus on two areas from disciplines such as energy commerce, atmospheric science, electrical-electronic technology, construction technology, natural resource management, or others.

Recent Addition of Wind Energy

The Texas Wind Energy Institute (TWEI)

Texas Tech University received a \$1 million Workforce Investment Act Statewide Activity Fund grant from the Texas Workforce Commission (TWC) to support the creation of the Texas Wind Energy Institute (TWEI). The grant will be used to develop curriculum and prepare students to meet the workforce needs of the rapidly growing wind power industry in Texas. TWEI is a partnership between Texas Tech and Texas State Technical College in collaboration with American Wind Energy Association, Utility Wind Interest Group, Institute of Electrical and Electronic Engineers and other energy-related organizations. The vision of the Institute is to position Texas as the leader in technical, managerial and professional education for the wind power industry. The Institute's initial focus will include the development of safety courses currently needed by the wind power industry.



Christmas photo-op of 2008 KA-Band radar truck with faculty, staff and students taken at the American Wind Power Museum.



Occasion of recent check donation of \$30,000 to WISE by State Farm Insurance Company



TEXAS TECH UNIVERSITY
**Wind Science and Engineering
 Research Center**

Box 41023 | Lubbock, TX | 79409-1023 | 888.946.3287 | F 806.742.3446

Wind WISE Friends (WWF)

Thank you for taking the time to read through this update on the WISE program at Texas Tech. As part of our 40 year reunion, on May 7-8 2010, we will be seeking contributions for graduate student scholarships, fellowships, and WISE research. The goal is to raise \$5 million by 2012 which will provide resources to attract highly qualified students from across the country and around the world.

As you know from your own experience, graduate studies are often funded by scholarships. The WISE Research Center depends on contributions that will allow us to continue to support our graduate students.

This letter is strictly for informational purposes only and we will follow-up with more information and donor opportunities at the end of the summer.

We would appreciate you taking the time to consider making a contribution or pledge for the scheduled mail out in a couple of months. We will need your assistance to meet our endowment objective by 2012.

Here are our current endowment.

You may want to consider a similar one with level of support:

- McDonald-Mehta Endowments for Excellence (Research)
- Kishor C. & Mary Ann Mehta Endowment for Graduate Student Fellowship/Scholarship
- Ernst W. Kiesling Endowment (Matador Society)
- Kishor C. Mehta Endowment (Matador Society)
- Founder's Fellowship Endowment
- _____ Endowment – opportunity for you to establish your own scholarship

**Matador Society reflects planned gifts that will establish these endowments*

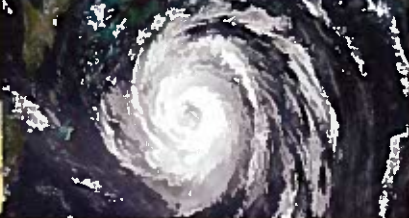
Level of Contributions and Pledges

Platinum WWF	\$250,000
Gold WWF	\$100,000
Silver WWF	\$50,000
Bronze WWF	\$10,000
Loyal WWF	\$5,000

Please look for our forthcoming letter and we hope you will be a part of our graduate fundraising efforts!



TORNADOES



HURRICANES



WIND DAMAGE



WIND ENERGY



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