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Department of Mathematics

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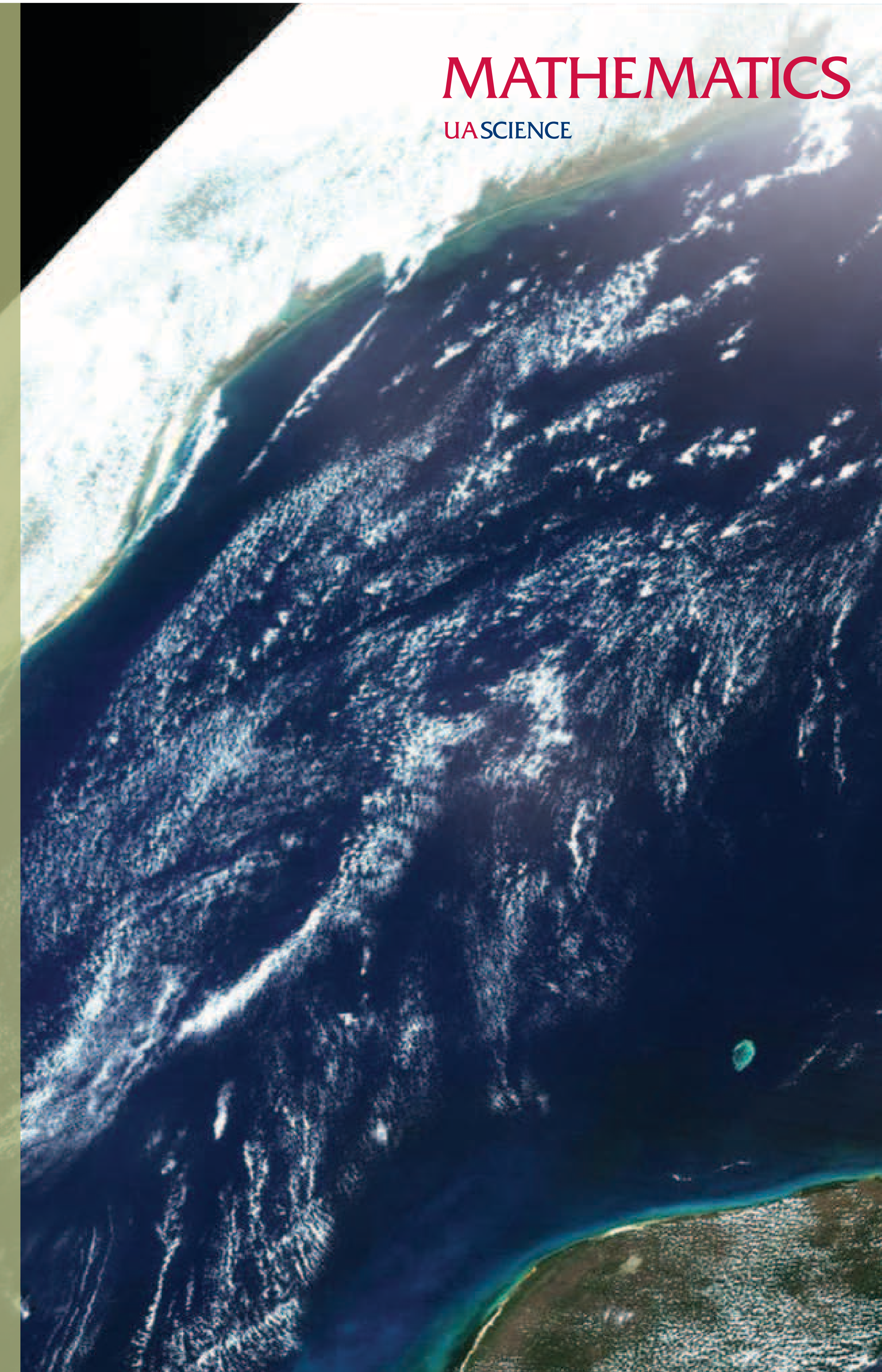
Associate Professor Bruce Bayly and son Devin outside Arts for All, at 2520 North Oracle Road. The bench memorializes Math Grad Student Daniel Bartlett. To find out more about Arts for All, please go to their website at **http://www.artsforallinc.org**.

MATHEMATICS

UA SCIENCE



In this Issue

Fall 2010
Volume X, Issue 1

A View from the Chair

WILLIAM G. MCCALLUM, DEPARTMENT HEAD AND UNIVERSITY DISTINGUISHED PROFESSOR OF MATHEMATICS

I returned last week from an exhilarating 10 days at the International Congress of Mathematicians (ICM) in Hyderabad, India, where the recipients of the quadrennial Fields Medals were announced. I am proud to say that the research areas of the Fields Medalists are well represented in our department, and Dinesh Thakur has organized a series of talks by Lennie Friedlander, David Savitt, and Janek Wehr to explain their work. We hope to feature these talks in our spring newsletter.

Our department is also a leader in collaboration between mathematicians and mathematics educators, so I was heartened to see that the ICM had a number of presentations on this topic (including a panel I served on with the rather mysterious title *Relations between the Discipline and School Mathematics*). One of the founding fathers of mathematics education in Arizona, Fred Stevenson, retired this year. Fred has been passionate about teachers and teacher education for as long as I have known him. His most recent success in setting up the Center for Recruitment and Retention, garnering the financial support of local school districts and philanthropists in tough times, is just one in a long string of achievements in a distinguished career.

We had a spectacularly successful hiring season in 2010. Two new assistant professors, Matt Felton in mathematics education and Leo Tzou in partial differential equations, will join us this year and two more faculty members, Bryden Case in number theory and Helen Zhang in statistics, will join us next year. We also hired Hanno Rund Assistant Professor Alan Lindsay and five teaching postdocs who bring an astonishing diversity of energy and interests to the department. Bios of these and other new employees are featured beginning on page 7.

This newsletter also contains a profile of Marianne Cooke Johnsen, whose endowment has established an award for female undergraduate math majors.

Left to Right: Front Row – Cassie Gribble, Samantha Klein. L to R: Back Row – Jill Bond, James Henry, Liliana Munoz, Donna Rishor, Dr. Daniel Madden, Dr. William McCallum, Katherine Temple, Christina Grossman. (Photo by Donna Rishor)

Arizona Teacher Initiative's Cohort 1 Graduation

BY DONNA RISHOR, ATI GRADUATE

Graduation! It was an exciting day for Cohort 1 of The Arizona Teacher Initiative. The ATI, funded by a grant from the National Science Foundation to the Institute for Mathematics and Education, is a program designed to enhance the mathematical and pedagogical knowledge of already outstanding elementary certified mathematics teachers. Cohort 1 completed the part-time masters program in Middle School Mathematics Teaching and Leadership in three years. The program is directed by Associate Professor Daniel Madden and by University Distinguished Professor and Department Head, William McCallum. Cohort 1 graduates will be utilizing their new skills to increase student achievement and mathematics leadership at the middle school level. Keep an eye on these movers and shakers of the middle school math world.

For more information about ATI, please go to http://ime.math.arizona.edu/ATI/certificate.html

Our cover shows a photograph of the Gulf of Mexico, where ocean dynamics, the subject of Juan Restrepo's feature article, played a big role this summer. Juan's work on climate variability and uncertainty quantification demonstrates the centrality of mathematics in establishing inferences about complex systems with incomplete information. I encourage you to read his fascinating article.

Multiscale Ocean Dynamics, Climate Variability, and Uncertainty Quantification

BY JUAN M. RESTREPO, PROFESSOR OF MATHEMATICS

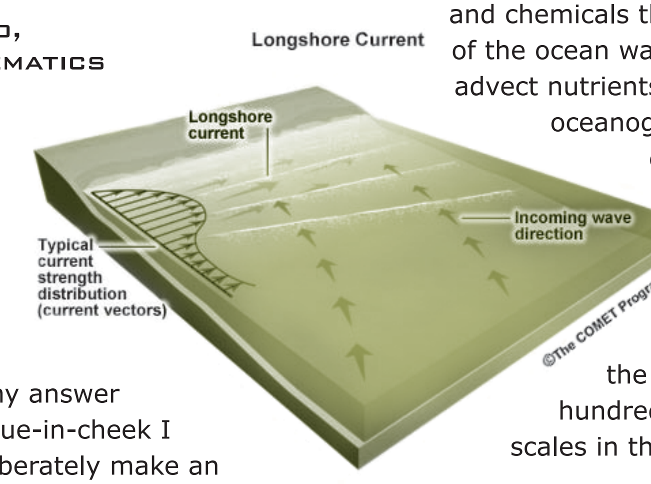


Fig. 1 Schematic representation of nearshore currents and waves.

People often ask me why I work on oceans, given that I live in the desert. My answer is well appreciated by any theorist: "Reality can ruin a good theory." Should there be any doubt that my answer is nothing more than tongue-in-cheek I should mention that I deliberately make an effort to publish my work in geoscience journals: Acceptance of my work in these journals shows that my mathematical work is geophysically relevant and current in geosciences. I do, nevertheless, have a more thoughtful answer to the question, but first I will describe some of my work.

Wave/Current Interactions

Waves and currents are ubiquitous geophysical manifestations of flows in the ocean and in the atmosphere. Though a great many things are known about waves and currents, in isolation, their interactions are less well understood. One of my research interests is in developing a general theory for the interactions of waves and currents. At oceanic shelf scales currents advect sand, affect critical nearshore environments (see Figure 1), and also interact with freshwater flows. Some of the most expensive property worldwide happens to be coastal. During my leave 2009-2010 at the Institute of Mathematics and Its Applications I have been working on a model for waves, currents, and transport of oil slicks, such as the Gulf of Mexico disaster of Spring of 2010.

Written and Edited by: Christa King
Designed by: Roma Krebs, AHSC BioCommunications
The Department of Mathematics Newsletter Fall 2010, Volume X, Issue 1, is published twice yearly by the University of Arizona Department of Mathematics, PO Box 210089, Tucson, AZ 85721-0089.

At oceanic scales, currents are a key component of the Earth's climate, advecting heat, and chemicals that affect the buoyancy of the ocean water. These currents also advect nutrients and chemicals that affect oceanographic biology as well as organisms (phytoplankton, for example, is a crucial component of the World's carbon cycle.

Gravity waves, of scales in the order of tens of meters to hundreds of kilometers, and time scales in the order of seconds to days, are small and fast compared to the larger currents, the latter with scales of kilometers to basin dimensions and time scales of days to hundreds of years. Traditional climatology ignores wave effects. In 1999 Jim McWilliams (the University of California, Los Angeles) and I formulated a wave-driven circulation theory, which describes how waves persist at scales much larger than themselves, and shows the extent to which they are important in climate. What we found is that the non-zero residual flow due to the waves coupled to the overall vorticity in the flow forms a "vortex force" in the momentum equation. There is also a pressure gradient adjustment as well as significant modifications of the traditional boundary conditions due to the waves.

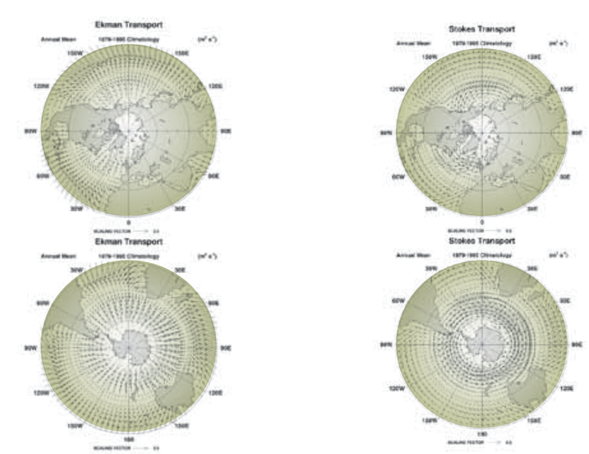


Fig. 2 Total transport, due to the Ekman wind-driven circulation, (b) wave-contribution to transport, Stokes drift circulation.

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With Dr. Emily Lane, a former Applied Mathematics student with the University of Arizona, we developed a more comprehensive theory. The theory is now capable of capturing waves and currents, from shelf to global scales. The model, or variants of it, are now a basis for practical simulation-scale circulation models being implemented for practical forecasting.

Emily and I used the model to understand the role played by waves and currents in the formation and maintenance of shore-connected sand bars. These are seen in shallow waters off the coast of Florida, say, and up the middle Atlantic Bite (see Figure 3). Their unusual feature is that they line up at a nearly 12 degree angle with respect to the shore-normal direction. With an overall southerly flow for the currents, the appearance of bars at an angle had been a mystery. What we and others found was that the bars result when the flow, which runs parallel to the shore, destabilizes due to convergences and divergences of a tilted topography. The bars are thus manifestations of instabilities of the erodible bed equations due to convergences and divergences of the flow. The resulting angle matched, and so did the overall size of the bars as well as their migration rates.

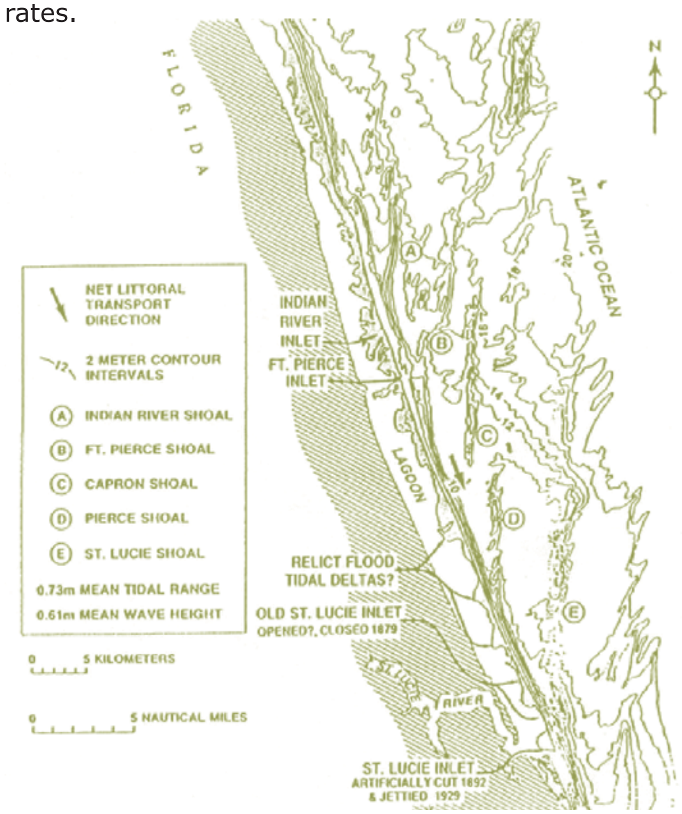

Fig. 3 Shore-connected sand ridges off of the coast of Florida. Bar predictions from our model, in a stylized version of the physical setting. Under proper rescaling these predicted bars have the same extent, and bar separation as their physical counterparts.

Brad Weir, a PhD student in Math finishing in summer 2010, along with myself, and some UCLA folks, are also studying the role played by the vortex force in the destabilization of longshore currents as well as in the formation of rip currents in the nearshore. Brad, along with Dr. Jared Barber, another recent Applied Math PhD, and I are also trying to explain the formation of rip surges in shallow water flows, potentially a new oceanic phenomenology, whereby vorticity builds up and gets advected toward the shore. When this vorticity builds enough potential energy it then washes back toward the deeper ocean as narrow currents.

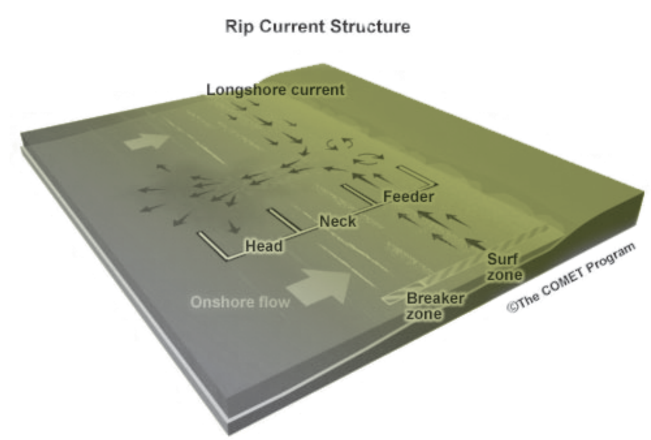

Fig. 4 Schematic view of the nearshore environment in which rip currents take place. Vorticity calculations, produced by our wave/current model, that capture the evolution of the rip currents.

Recently I've turned to incorporating wave breaking in the wave/current interaction model. Strong evidence points to its crucial role in momentum transfers between waves and currents, along with the enhancement of mixing and oxygenation of the oceans near its surface. My approach deemphasizes analyses, favoring instead modeling the phenomenon in a statistically consistent way. The key mathematical strategy that lead to a wave/current interaction model was used, with a stochastic twist: in the Lagrangian frame, where the distinction between wave and currents loses significance, breaking can be thought of as collective uncertainties in the path motions, with inherent statistical characteristics. Conceptually this approach is akin to how a connection was made between random microscopic motion mechanics and diffusion processes; this would be the wave-motion counterpart. In collaboration with Jorgé Ramírez, a UA Math Dept Pierce post-doc, Jim McWilliams, and Mike Banner (U. New South Wales), we

developed further this idea leading to a full wave/current interaction model which describes how wave breaking contributes to the Reynold stresses of the currents and dissipates wave motion. Jorge, Mike and I are presently discussing how this model could be compared to experimental results in a wave tank.

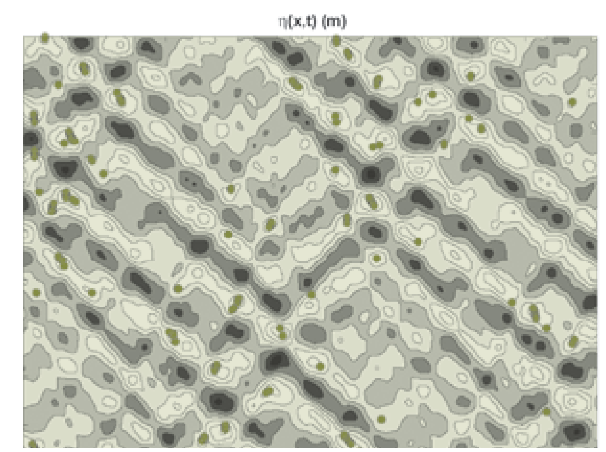

Fig. 5 Stochastic wave groups. These have a tendency to steepen and focus considerable energy and momentum, a situation that can persist for a period of time. These focusing spots thus form random tracks which have a Poisson distribution in space/time. When the focusing energy exceeds a certain field-derived threshold the waves white-cap (break). These events are shown here, at a given time, as red dots.

Yes, experiments. As a graduate student I did water wave experiments. With my former Applied Math student, Dr. Sam Schofield, we did computational and experimental work on fluid jets. With Dr. Derek Moulton, a Rund Post-doc, and Dr. Hermann Uys, PhD UA Physics, we have done experiments on sand ripples.

Climate Variability

Are the trends in warming temperature, a well-documented variability, natural or anthropogenic? (See Figure 6). Climate, on the Earth, is the name given to the large-scale geophysical fluid dynamics forced upon a rotating Earth by the Sun. The fluid consists of an atmosphere and an ocean, domains in which thermodynamics, chemistry, and transport cannot be ignored. (The smaller-scale counterpart of climate is what we call "meteorology," what's important physically in climate and weather tend to be different).

I have been pursuing questions related to climate variability, mostly focusing on the role played by the oceans in climate, or on general questions related to quantifying uncertainty in climate predictions.

In addition to the scientific challenges posed by the sheer complexity of the problem, an additional challenge in climate is the generally poor data with which to make progress on understanding such things as global warming, abrupt climate change, glacial/interglacial events, El Nińo/La Nińa events, the Northern Atlantic Oscillation, and other climatic manifestations. In order to ameliorate the spotty and ill-constrained data, we use climate models. The models, however, also have significant uncertainties, e.g., poorly understood or non-present physics, under-resolution, poorly constrained, noise, etc.

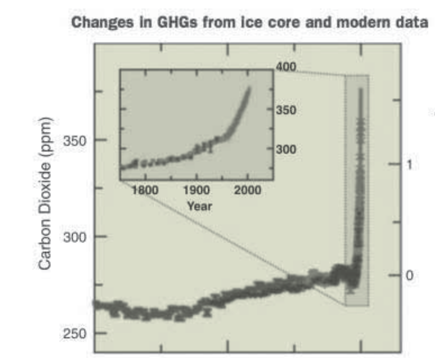

Fig. 6 The carbon dioxide/radiative forcing "hockey stick", indicating increases in global temperatures that coincide with the industrial revolution.

The sun has been delivering over 10^{17} watts of energy to the Earth, for about 4 billion years. The oceans have not boiled into oblivion because heat escapes and because the oceans (primarily) transport heat around the world. Emily Lane, Dr. Synte Peacock (now at the National Center for Atmospheric Research), and I set out to determine whether glacial/interglacial fluctuations of carbon dioxide (pCO_2) in the atmosphere, which were in the order of 80 parts per million, could be captured with an ocean-only climate model: It had been achieved, with models that amounted to direct assertions of this outcome, or with highly tuned, large-scale, ocean-general circulation models; the latter involves a computer code that is extremely complex and riddled with tunable parameters. Instead of millions of lines of code, we captured the carbon dioxide signal with 37 ordinary differential equations; the ultimate benefit was to have a model that confirmed the computational outcomes and that we could analytically understand. The strategy I proposed was to use asymptotic methods to capture the low-frequency/large-scale flow. But rather than use standard perturbation methods I proposed that the higher order corrections be incorporated using fluid topological kinematics and a knowledge of the

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approximate structure of the eigenfunctions of the zonally-averaged large-scale computer calculations.

With Doug Kurtze, now at St. Joseph University in Philadelphia, I took on the question of whether transport can create abrupt and large-scale variability in the ocean circulation. To do so we looked at the thermohaline circulation equations, which describe the slow-time evolution of oceanic waters; the same equations used in the glacial/interglacial problem above. Doug had a simple yet easy way to proceed: use delays as models for transport effects. The outcome was a simple model that we could fully analyze mathematically and create a description of the circumstances in which thermohaline circulation flows could switch due to advective (transport) effects. This strategy, by the way, is now adopted in many tropical climate problems in which waves are important and the interaction of tropical and extra-tropical dynamics cannot be ignored. With Doug and Jason Dittmann, an honors UA physics and astronomy student here at the University of Arizona, we are also trying to get to the bottom of a problem that dogged climatologists running large scale ocean models in the 90s: They discovered that decadal variability evident in their calculations was actually an artifice of their computer codes, rather than the outcome of a natural event.

The Uncertainty Quantification in Climate
In the last 10 years I have been working on one of the most important and challenging aspects of climate, and climate change in particular: quantifying the uncertainty on predictions and outcomes of climate models and data.. It is clearly crucial to developing plans that address global warming. It is in fact an area where mathematics and statistics can provide valuable guidance.

I have been working on various aspects of what in climate and meteorology is called "data assimilation". Roughly speaking, it is the mathematical procedure used to combine dynamic weather and climate models of oceans, atmospheres, and other systems critical to climate and observations, in order to make better predictions or retrodictions. The process is challenging because the models are imperfect and the data are full of errors and sparse with regard to spatio-temporal coverage. The errors in the model come from unresolved processes, poorly understood yet critical physics, poorly constrained parameters, and numerical errors inherent in the computation. The errors in the data come from the measurement devices, from uncertainties in the use of proxies, etc. Data assimilation or filtering is a procedure largely responsible for a significant increase in the ability of forecasters to predict the weather (at least when nothing too out of the ordinary happens!). Some of my work has been "technological": for example, developing computational methods for computing very large gradients of functions without making any approximations (these resulting matrices, for a typical weather model, can be of order tens of millions per time step of computing). My present focus is on the nonlinear/non-Gaussian situations, the ones that lead to those extraordinary (and not so extraordinary) conditions that lead to poor predictions. They are challenging computationally, statistically, mathematically, and even ambiguous when one tries to define what is meant by a prediction. With Dr. Paul Krause, a former UA post-doc, I have been working on developing his and my methodologies for the assimilation in nonlinear/non-Gaussian problems. The focus problem is oceanic: data assimilation of data obtained by buoys, and models of oceanic flows. There is a worldwide effort to use this data and models to infer ocean weather and climate, yet the existing assimilation technology is poor. Paul and I were able to demonstrate that our methods work in situations where traditional methods fail. (See Figure 7)

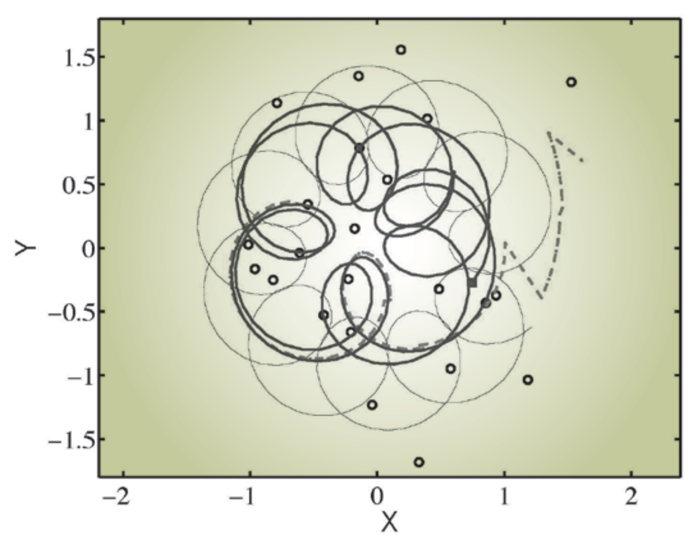

Fig. 7 Comparison of our Diffusion Kernel Filter, a benchmark calculation (both of these are shown in blue), and extended Kalman Filter (in red). The dots represent the position of the buoy at the time it produces data. These are estimated buoy tracks. Our methods agree with the benchmark, the extended Kalman filter, which is the state of the art in this field, is shown to fail.

The Future and the Uncertainty Quantification Group
The Uncertainty Quantification Group is a group I formed, with Shankar Venkataramani, Kevin Lin, both with the UA Department of Mathematics and Kobus Barnard with UA Computer Science. We have graduate and undergraduate students from math, physics, and computer science. The faculty comes from Math, Statistics, Computer Science, Hydrology, Physics, and Atmospheric Sciences. We run tutorials, workshops, and a reading group in topics related to computer vision, stochastic aspects of hydrology, and climate variability. The group's Web site is at www.physics.arizona.edu/~tolwinski. We receive support from the National Science Foundation.

The focus research themes are climate, hydrology, computer vision; all very complex (in the sense of being composed of many parts that interact in very complicated ways). More importantly, these are problems in which progress will not come exclusively from data or from models, but rather, from a combination of both.

Dr. Arthur Mariano from RSMAS at U. Miami, Prof. Shankar Venkataramani, my colleague in Mathematics here at the UA, and I are working on contour dynamics, which is a dynamic estimation process that exploits Lagrangian information to improve upon the blending of data sets of the same phenomena but which come with different resolutions, error characteristics, and spatio-temporal coverage. In hydrology, for example, Darin Comeau, a graduate student in Applied Math, together with Shlomo Neuman from Hydrology at UA, and I are working on multiscale framework for computing hydrogeological dynamics in heterogeneous media. Prof. Kevin Lin is working with computer scientists to improve sampling techniques and complex searchers through high-dimensional parameter space.

Uncertainty quantification in the sense discussed above is not a traditional mathematical discipline, yet it is appreciated and encouraged in our Mathematics Department. Thinking outside of the box has been the hallmark of many of our faculty and our department. This is why I work here, and this is really why I do oceanography in the desert.

New Employees — Mathematics

Chandrani Banerjee
Chandrani Banerjee, Adjunct Instructor, Department of Mathematics, UA, is originally from Kolkata, India. She completed her MSc in Applied Mathematics from Jadavpur University, Kolkata in December 2002. She decided to pursue higher studies in the United States and completed her MS in Applied Mathematics from Texas Tech University in December 2007. Her research area was in Mathematical modeling of biological systems. She joined the Department of Mathematics and Statistics, Texas Tech University, where she taught a variety of courses in Algebra, Trigonometry, Analytical Geometry, Calculus, Business Calculus and Statistics until December 2009. She likes to teach a culturally diverse body of students and enjoys interacting with students from different countries and communities. In her spare time she enjoys travelling and reading.

Ming Beckwith was hired in February as an Administrative Assistant working with David Gonzalez in the Grants & Contracts office. She graduated from Indiana University in 2004 with a BA in Psychology, then worked briefly as a Clinical Research Coordinator in Indianapolis, Indiana. After moving to Tucson five years ago, Ming began working in the Department of Ecology and Evolutionary Biology where she was the Program Coordinator for an NSF funded interdepartmental graduate training program. When she is not here, Ming is a full time student studying Graphic Design and Illustration at Pima Community College. Besides art and design, her main interests are food and travel. She has visited over 20 countries since graduating from college and spent most of her time on those trips happily sampling local cuisine.

Jason Dyer is a Mathematics Specialist at the University of Arizona. He has degrees in Mathematics and Fine Arts Studies and has taught for five years with the Tucson Unified School District, most recently at Pueblo Magnet High School. His interests are in the

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psychology of mathematical cognition and the use of multimedia in education. His previous projects include Off-Road Algebra, a series of videos designed to teach algebra to grades 7-9 through motocross racing.

Mathew Felton-Koestler, a tenure-track Assistant Professor, is from Madison, WI. He completed his PhD in Curriculum and Instruction with a focus on Mathematics Education at the University of Wisconsin–Madison in August 2010. His research is on mathematics teacher education, with a recent focus on supporting pre-service K-8 teachers in understanding the social and political dimensions of mathematics teaching and learning. He has taught mathematics courses for pre-service teachers and collaborated extensively with mathematics specialists and teachers from the Madison Metropolitan School District to improve his own teaching and to provide support in professional development settings. He is looking forward to building relationships with his new colleagues within the university and the surrounding school districts. In his spare time he enjoys playing board games.

Brie Finegold – After teaching high school for a brief period of time, Brie recently earned her PhD at the University of California at Santa Barbara and she continues to follow and expand her mathematical interests in geometric group theory and low dimensional topology. At UCSB, Brie co-founded a student seminar and is looking forward to participating in seminars at the University of Arizona in her role as a Teaching Postdoc. Outside of research, Brie has found that writing about mathematics for the general public and working with pre-service teachers were also rewarding experiences. She practices yoga and enjoys folding origami, swing dancing, swimming, and hiking. A good cup of iced coffee and some quiet time with a paper and pencil or with her computer makes Brie happy.

Ning Hao is originally from China. After graduation from Peking University, he came to the United States and received his PhD in mathematics from the State University of New York at Stony Brook in 2009. He spent one year at the Statistics Lab in Princeton University before joining the University of Arizona.

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Biography of Marianne Cooke Johnsen*

During and after the Great Depression, Marianne Cooke Johnsen's father was Business Manager for the Tucson Water Department and her mother a nurse. Marianne earned her Bachelor's degree in Psychology from the University of Arizona in 1948, but it was her love of mathematics and teaching that inspired many students over her 30 year career.

After a move to the San Francisco Bay area with her family, Marianne began working as an elementary school teacher in the Palo Alto school district. She was chosen to develop, implement and manage a successful program for gifted students. Cooke Johnsen went on to become a mathematics consultant for the district of 17,000 students. During this time, she authored five mathematics text books used by the district, primarily for children from 3rd to 6th grades.

During summers, she worked in the real estate field and after her retirement from teaching, sold real estate until she was 75. Her love of life and curiosity led her to travel in Europe, Australia, New Zealand, the United States and Canada. She also maintained an active life and played tennis each week until her death in 2009.

To contribute to this endowment, please make checks payable to the UA Foundation's Marianne Cooke Johnsen Endowment and send to David Gonzalez, Department of Mathematics, 617 N Santa Rita Ave., Tucson, AZ 85721.

**11/14/2009 Johnsen Family Newsletter*

Marianne Cooke Johnsen Endowment

Supports Women in Mathematics

Late in 2009, the Department of Mathematics received notification of a new endowment for a scholarship in Mathematics. The Marianne Cooke Johnsen Endowment was created by Melissa Johnsen and Randy Johnsen in honor of their mother.

Marianne Cooke Johnson and Melissa, Cathy and Eric Johnsen.

Students interested in applying for this scholarship must be entering their Junior year (submission of application should occur at the conclusion of the Sophomore year), a declared Mathematics or Mathematics Education Major, female, and have a minimum 3.0 GPA. In addition, applicants are asked to submit an essay along with their application.

The essay, of 500 words or less, should address:

1. Why I chose to be a Mathematics or Mathematics Education Major
2. How I will use my degree upon graduation from the University of Arizona

Teachers and friends of Marianne Cooke Johnsen.

The essay, which should focus on how the applicant wants to positively impact society, will be reviewed by the Undergraduate Committee or by a Scholarship Committee designated by the Department Head. They will also be included in the annual Johnsen Family newsletter and will be distributed to donors and friends of the Marianne Cooke Johnsen Endowment in Mathematics.

For additional information about the scholarship application, please contact Laurie Varecka, Undergraduate Program Coordinator (varecka@math.arizona.edu) or see http://math.arizona.edu/ugprogram/awards/departmental.html

His research interests on the mathematical side are geometry and topology including secondary geometric invariants, Cheeger-Simons invariants and Deligne Cohomology. His interests on the statistical side focus on high dimensional statistical learning. He likes swimming, hiking and many other sports.

Jennifer Hardy, originally from Colorado, moved to Tucson to attend the University of Arizona. While in school she worked for American Airlines as a shift coordinator. In 2001, after earning her B. A. in Communication, Jennifer worked as a concierge for Loews Ventana Canyon Resort. She arranged small dinner events and tours, and soon discovered that planning events was her passion. In 2003 Jennifer joined Miller, Michael & Associates/MM&A Productions as an Event Manager of large scale music concerts, halftime performances, opening acts, and fan appreciation events for the NBA & NFL. After 3 years on the road, she returned to her home base in Tucson and accepted the position as Operations Manager at Loews Ventana Canyon Resort where she managed the resort's entertainment and décor for the restaurants, bars, brunches, holiday events and the occasional wedding. She also managed off property events (dining in the desert events, cattle drives, firework displays, and rodeos…just to name a few) for conference clients of the resort. In 2007 Jennifer accepted a position with Kellen Company as a Conference Manager where she created and managed continuing education conferences for associations in the medical and trade fields. Jennifer joined the Mathematics department in March of 2010 as the Recruitment and Events Coordinator. She is a snowboard enthusiast and an avid runner. If you find yourself at a local race, you will be guaranteed to see her there. She lives with her fiancé, Chris, one dog and 2 cats.

Ronald Hopley, an ATI Math Specialist for 2010-2011, has taught high school math in Tucson for over 29 years. He earned both his bachelor's and master's degrees from the University of Arizona. He has been active throughout his career, participating in UA outreach programs such as the PRISM and Co-op programs and presenting at NCTM regional and national conferences. Although his brief claim to fame was an article on geometry published in the NCTM's Mathematics Teacher, he has spent the past ten years teaching Intermediate Algebra and Precalculus. Along with his wife, he is kept busy raising two teenage sons.

Margaret (Maggie) Janecki, one of this year's ATI Math Specialists, is an Arizona native. She graduated from the University of Arizona in 1997 with a Bachelors of Health Science in Physiology with a minor in Mathematics. After graduation she worked in the field of physical therapy as an aquatic specialist in local rehabilitation facilities. She then moved into education, working for the past 10 years as a junior high and high school mathematics teacher. Maggie has been the mathematics department chairperson at both Emily Gray Junior High and Tanque Verde High School in the Tanque Verde Unified School District. She has played an integral role in the development of the district at both the site and district level participating in textbook adoption and curriculum alignment. She has designed and facilitated professional development activities and was the district presenter for the new Arizona Math Standards. Maggie founded the TVHS swim team four years ago and has been coaching and developing the team ever since. In her spare time Maggie enjoys swimming, hiking, camping, working in her garden, and spending time with her friends and her dog, West.

Pamela Keane is a Project Coordinator for the Secondary Mathematics Education Program. She attended the University of Arizona as an undergraduate before moving to New Mexico, where she obtained her B.S. in Applied Mathematics (1990) and her M.A. in Secondary Education (1992). For approximately ten years, Pam taught mathematics, working in three different states, in various positions from private tutor to substitute teacher, to many years as a full-time high school teacher, as well as an adjunct instructor at The University of Arizona. For the past ten years,

Pam has been traveling and raising three young boys with her husband, Sean. Pam enjoys reading and writing and, of course, 'rithmetic.

Alan Lindsay, the Hanno Rund Postdoctoral Fellow, is originally from Glasgow, Scotland. A graduate of the University of Edinburgh, he decided to continue his studies in Canada and received his PhD in Applied Mathematics from the University of British Columbia in July 2010. His research area is Applied Mathematics with a particular focus on the application of singular perturbation techniques to real world problems.

Erin Militzer – Born and raised in Kalamazoo, MI with three brothers and one sister, I attended Central Michigan University and graduated with a B.S. in Mathematics and minor in Chemistry. In May 2010, I received my PhD from University of Kentucky under the advisement of James Brennan. My current research is in the field of Complex Analysis, utilizing both real and functional analysis. My thesis involved making a connection between L^p bounded point evaluations for the polynomials and uniform rational approximation. Complex anaylsis is my first math love but I am always interested in exploring new areas to expand my mathematical reach. I was recently married (Matthew) and we have a young cat, Derby. Matthew and I enjoy meeting new people and going out for a night on the town. In my spare time I run, read, bike, watch movies/TV and someday I plan on becoming an excellent cook! While I am in Arizona, I hope to travel and explore the southwest as much as possible.

Cody L. Patterson, an ATI Teaching Postdoctoral Fellow, grew up in Weatherford, Texas. He earned his B.S. and M.S. in mathematics at Texas A&M University, and completed his PhD in mathematics at The University of Texas at Austin in May 2010. Cody's area of research is geometric group theory and topology; his current work is on fixed-point-free actions of Coxeter groups on nonpositively curved three-dimensional cell complexes. Cody has taught a number of different courses in mathematics, including precalculus, calculus, and mathematics for preservice elementary teachers. He is particularly interested in inquiry-based and workshop-based models of learning and has developed materials for several courses based on these models. One of his current projects is developing a course in problem solving for middle school students. In his spare time, Cody enjoys reading novels, solving and creating puzzles, and playing racquetball.

Penny Ridgdill received her B.S. in mathematics and computer science from the University of Georgia in 2004. She then went to the University of Massachusetts for her PhD which she obtained in May 2010. Her research is in arithmetic geometry, particularly in elliptic curves and their Galois representations. She plans to continue pursuing arithmetic geometry, but she is also interested in combinatorics, computer science, and math education. In addition to her research, she is very passionate about teaching. She taught recitations for one year and then ran her own lectures for five years at UMass. She was the director of the undergraduate Math Club for three years as well.

In her personal time, Penny enjoys a broad variety of music, and continues to work obsessively on her record collection. She has a ferret named Cleo that she adores (when she isn't stealing her office supplies), and is looking forward to getting a dog-friend. She also loves cycling and rock climbing. She is a dedicated environmentalist and is frequently consumed by politics. Also, if you are in the mood for a mean southern supper, you need look no further, as Penny loves to cook and feed her friends.

Silvia Saccon, a Teaching Postdoctoral Fellow, is originally from Venice, Italy. A graduate of the University of Padova (Italy), she decided to continue her studies in the United States and received her PhD in mathematics from the University of Nebraska--Lincoln

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in August 2010. Her research area is in commutative algebra, and she is currently studying the direct-sum behavior of a class of modules over certain commutative rings. She has participated in a variety of teaching environments, and enjoys discussing and learning different teaching methods. She has also been involved in several mentoring and outreach programs, including a summer program for students starting graduate school in the fall. In her spare time, she enjoys reading and hiking.

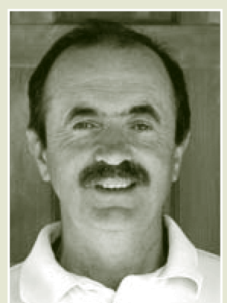
Leo Tzou spent his undergraduate years at the University of British Columbia in Canada and the Universita' degli Studi dell'Aquila in Italy. After obtaining his bachelor's in applied mathematics he went on to complete a PhD in mathematics at the University of Washington under the supervision of Gunther Uhlmann. Prior to coming to UA he held the position of visiting researcher at the Helsingin Yliopisto in Finland and Szego Assistant Professor at Stanford University in California. He currently focuses on the interplay between geometry and partial differential equations. Leo will join the Department in January of 2011.

Esther Widiasih, a Teaching Postdoctoral Fellow, came to the United States as a high school student in bucolic Vermont from the hectic city of Yogyakarta, Indonesia. She received her PhD in Mathematics from the University of Minnesota-Twin Cities in June 2010. Her research area is Dynamical Systems, with focus on climate studies. She is currently studying the dynamics of energy balance models with ice albedo feedback. Esther adores teaching and inspired by the many teachers in her life, she aspires to forge an international network of people with that same passion. Outside of school, she enjoys music, yoga, food, wine, cooking and dinners with friends.

Awards and Grants

Moloney Leads $7.5 M Laser Research Project

"The University of Arizona is among a small group of institutions nationwide to receive a competitive, multi-million dollar federal grant to investigate the effects of highly specialized lasers on the atmosphere," explains La Monica Everett-Haynes, University Communications.



Arizona Center for Mathematical Sciences (ACMS) Director Jerome V. Moloney will lead a team to investigate lasers with practical implications, such as generating terahertz waves for use in airport scanners or in creating detection systems that could be used over long distances. Generated by lab-based scientific researchers, multi-terawatt femtosecond laser pulses deliver extreme power densities in incredibly short bursts, creating havoc as they pass through the atmosphere.

Principle Investigator on the new five-year U.S. Department of Defense grant, Moloney says, "we need a more profound, fundamental understanding."

The UA-led project will involve researchers from the University of Colorado, Colorado School of Mines, Cornell University, Temple University and the University of Central Florida. He will also assemble a core group of applied mathematicians and theoretical and experimental physicists at the UA's ACMS to anchor the project.

For additional information, please see **http://acms.math.arizona.edu.**

Vélez receives two honors

The Victoria Foundation will present the Dr. Alfredo G. de los Santos, Jr., Outstanding Latino/a Faculty Service/

Teaching in Higher Education Award to University Distinguished Professor of Mathematics, William Yslas Vélez. The presentation takes place at a banquet in Phoenix on September 23, 2010.

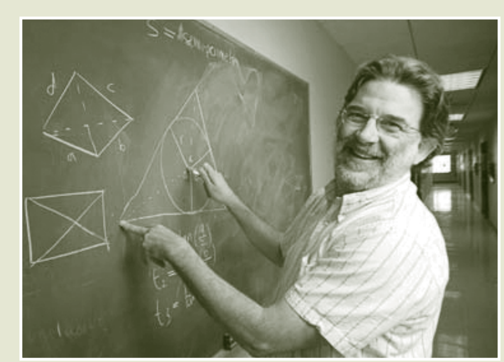
Vélez is Founding Member of the Society for the Advancement of Chicanos and Native Americans in Science (SACNAS) and served as its president from 1994-96. In his position as president of SACNAS he obtained funding to initiate the web-based SACNAS biography project, an effort that resulted in the publication of approximately 100 biographies of Chicano/Latino scientists aimed at middle school and high school students. SACNAS is now recognized as one of the premier minority scientific organizations in the country.

Associate Head for the Undergraduate Program at the UA, Vélez has also been named the Dr. Martin Luther King Jr. Visiting Professor of Mathematics at the Massachusetts Institute of Technology for the Spring semester. Dr. Martin Luther King, Jr. Visiting Professors "are expected to be deeply engaged in the life of the Institute through teaching, research and other scholarly interactions with the MIT community. Their presence gives them the opportunity to make a significant impact on the growth and awareness of undergraduate and graduate students, and the community as a whole."

Both awards honor Bill's exceptional contributions in promoting careers in math and science for minority and women students.

In a related story, please see the Math Major Orientation on page 15.

McCallum named 2010 Leitzel Lecturer



William G. McCallum, University Distinguished Professor and Mathematics Department Head, has been named the 2010 James R. C. Leitzel Lecturer by the Mathematics Association of America. This lecture was established by the Board of Governors in 1998. It provides a forum for the presentation and discussion of "issues or innovations in mathematical sciences education at the undergraduate or graduate level," and, in so doing, honors the many contributions of James R.C. Leitzel to the improvement of mathematical sciences education. McCallum spoke at MathFest 2010 on "Exploring High School Mathematics with Felix Klein."

Civil and McGraw receive grant from NSF's Robert Noyce Teacher Scholarship Program

"A new UA program to train 'master teachers' is built on the premise that Arizona not only needs strong math teachers at the elementary level, but that those educators must also be leaders in their schools and districts," reports La Monica Everett-Haynes of University Communications.

Marta Civil (left), will head up the program that is funded to train 20 "master teachers" over a period of 4.5 years. Rebecca McGraw (below), co-principal investigator from the Department of Mathematics

and Erin Turner and Marcy Wood, from the College of Education, will collaborate on the newly funded NSF grant. The project is an interdisciplinary, graduate-level program and slated to launch in the spring of 2011 with a cohort of 20 elementary school teachers.

"This program is not about taking teachers out of the classroom but is about building leadership capabilities within schools and working with teachers to develop coaching and mentoring skills," said McGraw. Each fellow will receive an annual stipend of $10,000 while being trained in leadership, coaching and mentoring strategies while also learning about equity issues, mathematics instruction and student learning. The application process will begin in late fall 2010.

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UA will work with the Tucson Unified School District, Sunnyside School District, Pima County Regional Support Center and the Arizona K-12 Center.

AZ-MTM Program Manager, Mary Bouley explains "the demand for mathematics-focused master teachers is steep...there are not as many programs in a position to support elementary school teachers."

HHMI Grant Funding

On September 1st, the University of Arizona began its sixth 4-year grant from the Howard Hughes Medical Institute. This grant is best known for its support of the Undergraduate Biology Research Program (UBRP). With the growing recognition of the need for quantitative training for life science students, the 2006 HHMI grant funded projects to revamp an integrated integral calculus and differential equations course and to develop a new calculus-based statistics course.

For this round of activities, the grant will add several new opportunities: an evidence-based medicine course and an algebra-based introductory biology course. The grant will also support BioMath Circles, a monthly seminar connecting faculty members, postdoctoral trainees and graduate students to discuss the integration of biology and mathematics. In addition, the University of Arizona will host the 2012 national conference entitled Making BioMath Happen.

In Mathematics, we are seeing a great response from students. 26 of the 98 new UBRP students are either math minors or majors and three of the four Goldwater Scholars are jointly studying mathematics and life science. For additional information please visit: **http://math.arizona.edu/~hhmi/**

Assistant Professor Ana-Maria Castravet's Mori Dream Spaces and Rational Curves project funded by NSF

This project aims at understanding different aspects of the geometry of algebraic varieties and their moduli. The broader context of the project is the area of algebraic geometry, which is the study of algebraic varieties, or geometric objects defined by the zeros of systems of polynomial equations. The variation of algebraic varieties is captured by the so-called moduli spaces, which are themselves varieties with a very rich structure. The project aims to reveal the intriguing structure of various moduli spaces of curves (fundamental in many areas of mathematics and in theoretical physics). The project impacts arithmetic and computational algebraic geometry — areas which have increasing applications in coding theory and robotics.

Math major Sean Howe is recipient of College of Science Award

Sean Howe, who received the College of Science's Award for Excellence in Undergraduate Research, worked with the following:

- UA Associate Professor Robert Indik on an inverse problem from optics
- University of Washington Professor Sara Billey on a problem in reflection groups
- Sergei Tabachnikov of Penn State University on a problem in bicycle curves and contact geometry
- Frank Morgan of Williams College on isoperimetric problems in manifolds with density
- UA Associate Professor Kirti Joshi on the conductors of elliptic curves

Howe feels that undergraduate research "gives you a much deeper insight into the inner workings of math and science than you can obtain from coursework." He also advises that "getting involved early on opens all sorts of doors."

Shiffler and Soto Accept Raytheon Scholarships

Stacy Shiffler, majoring in Applied Math and Physics and Robert Soto, majoring in Mathematics and Chemistry, received Raytheon scholarships of $5,000 each for the academic year 2010-2011. The scholarships are part of the new (2010) Raytheon Scholars Program, supporting four Raytheon scholars from the UA: two from the College of Science and two from Engineering. In addition, during the summer of 2011, these scholars will be eligible to receive a Raytheon paid summer internship.

Professor Joseph Watkins in a discussion with several undergrad math majors

Math Major Orientation

By Laurie Varecka, Undergraduate Program Coordinator

The Department of Mathematics Undergraduate Program held this year's Undergrad Math Major Orientation on Saturday August 21, 2010. Verizon grant funding helped to provide a light breakfast and a buffet lunch for the 12 faculty and 68 students in attendance.

Incoming students were welcomed by Dr. William Y. Vélez, Associate Head for the Undergraduate Program (please see related story on page 12), who encouraged each student to contact him personally via email (velez@math.arizona.edu).

Continuing math majors spoke to the students about opportunities available to them, including the MathCats math club, faculty-led research projects and teaching assistantships.

Eight faculty members spoke to the students about the math major itself, courses involved, and additional opportunities to work with faculty and other students.

Professor Klaus Lux and Kurt Mohty

When asked why he participates in this orientation, Professor William Faris said, "It is fun to participate... because the students are eager to begin... I give them content. Instead of talking about probability and statistics as bureaucratic options, I try (in five minutes) to explain the distinction between the two subjects. With luck, there is even time for them to participate in a small probability experiment. Will it come out the way I expect? I never know for sure. One pleasure... is that you can follow their careers up to graduation. Then they go on to do the most amazing variety of things."

Professor William Faris and Cody Franz

During lunch, faculty members each hosted an individual table where they were able to interact with students in smaller groups. Some students sought out faculty members to discuss their specific research areas in more depth.

Each year, this orientation provides an amazing opportunity for new students to learn that math professors are approachable and take a real interest in them and in their success.

Funding support was supplied by a grant from the Office of Student Affairs and from Verizon.

Associate Professor Ted Laetsch and a group of Undergrad Math Majors