

## WISEly Watching the Earth Breathe

Contributed by Jim Parker

In a recent survey of over 2,200 peer reviewed articles on climate change, authored by over 9,000 scientists and published from November 2012 to December 2013, only one article, by a single author, denied man-made global warming. Though many of the nation's industrial leaders now accept the scientific consensus of man-made warming, one of the nation's major political parties sides with the one outlier study, as do some corporate entities, hence any national action to relieve global peril is at a standstill.

At a WISE (Woman in Science and Engineering) meeting in the Oviatt Library's Ferman Presentation Room near the end of last year, about a hundred of the group's members listened to some of the more damning scientific evidence that rational people cannot but accept. The meeting began with a video detailing the purpose of WISE: to encourage women in science and engineering to become role models and mentors that students can look up to and so be inspired to follow in those careers.

Jennifer Coronado briefly spoke of the need to help young women "to fulfill their dreams..." and emphasized that mentors must "start at an early age to get more women in these fields..." Coronado is an Industrial Engineering graduate of CSUN, now working with Nestle to implement a human development module. She noted that the Oviatt Library supports WISE through the purchase of new books, scholarships, the dedication of study spaces, and in many other ways (rattling them off quicker than this non-professional note taker could handle).

Dean Mark Stover noted that the Oviatt Library is the cultivator and the shepherd of the WISE Endowment at CSUN, started in 2009 with funds provided by Bonnie Campbell, the first tenured female professor in the University's College of Engineering. Campbell wanted her legacy to live on by encouraging young women to go into the 'STEM' (science, technology, engineering, and math) fields. "The more education we provide, and the more encouragement," noted Dean Stover, "the more successful we will be in getting women into STEM careers."

CSUN's WISE Board is composed of ten professionals who meet once a month to plan logistics for the program. After Coronado's and Stover's introductory remarks, the Board's chairperson, Marilee Wheaton, divided the audience into two groups. One was sent directly to the planetarium to view a star show given by Jan Dobias, the planetarium Program Director, while the other listened to the featured speaker. Later the two groups switched places.

The presentation that followed was entitled: *The OCO-2 Mission; Watching the Earth Breathe*. In her talk Karen Yuen, the Science Data Applications Lead for the Orbiting Carbon Observatory

of the Jet Propulsion Laboratory's NASA Center, provided a wealth of information, and laid out the challenges we earthlings face on a living, breathing planet. The challenge is sustainability, that is, keeping the 'breathing' of the earth in a CO<sub>2</sub>/Oxygen balance that makes animal and human life possible.



Karen Yuen

OCO-2, we learned, was a NASA satellite, the Orbiting Carbon Observatory (appended with the number '2' because the first was lost at launch....making the CO-2 part of the name doubly meaningful, as its purpose is to monitor carbon dioxide emissions around the globe). Yuen has been working on the project for 13 years; she likened it to "delivering a child." The project, long dormant after the first loss, was resurrected and refunded last year. On July 2, 2014, the day of the launch, the fog was so thick no one could see the satellite. It was "like looking at pitch black; so thick, in fact that the scientists all got wet."

The purpose of the project is to "identify regional scale emissions (CO<sub>2</sub> sources) and collectors (CO<sub>2</sub> sinks)." In the last 150 years, Yuen warned, "something is really off...the concentration of CO<sub>2</sub> has been rising, and we need to know where it is coming from." We proceeded to view an animated video on CO<sub>2</sub>, and learned that oceans, forests and atmosphere are both sources and sinks. Lately, however, humans have tipped the scales by having many more sources, but not enough sinks. OCO-2 will look at seasonal changes with the intent of learning "where are the carbon sinks, what controls the process?"

Yuen, a polished speaker who made complex scientific notions very easy to understand, explained her use of the video: "I am a child of Saturday morning cartoons"....notably the "Schoolhouse Rock" program—so she knew the importance of animation.

She then delivered what seemed like the nail in her argument's coffin: it was, at the very least, the key point she wanted to impart. Last May, she told us, was the first time in human history we reached 400 parts per million of CO<sub>2</sub> in the part of the atmosphere we breathe (recorded at the Mauna Loa observatory in Hawaii). "Why do we care about 400 parts per million (ppm)?" she asked. "It's a round number that says we've grown ... exponentially [in a globally short time]...With deforestation we are having a great effect on the planet.....we need to know where the carbon is going (sinks), so we can get the facts out there to those making the decisions..." At

Mauna Loa, she noted, we recorded a CO<sub>2</sub> level of about 310 ppm in 1955, and it is now 400 ppm. Thirteen years ago, when Yuen started, it was also much lower than now, between 376 and 380 ppm.



Featured Speaker Karen Yuen during her presentation. Full video of the event is available at <https://youtu.be/5xErLkLwng>

We then viewed a film noir cartoon: *Where is the Carbon going?* "There was a problem," the film's protagonist said in a 1940's detective voice, "but the numbers just weren't making sense...." Then looking down at his Dick Tracy wristwatch, he noted: "I need more DATA! Let's get to the bottom of this Missing Carbon Mystery." [And so, the need to build an Orbiting Carbon Observatory.]

Back to the podium, Yuen noted that there is "an [atmospheric] blanket that protects us...but the blanket is changing, affected by the changing balance of CO<sub>2</sub>....Water and carbon dioxide are related....if plants don't have enough water, photosynthesis shuts down....if due to drought, the number of plants diminish and there is less of a carbon sink. Surface temperature has been on the rise, sea levels are going up.... The Antarctic, Arctic, and Greenland ice masses are going down...what is going on with the planet?...what can we do to be part of the solution?"

There are 100,000 measurements a day of CO<sub>2</sub> by the OCO-2 satellite. CO<sub>2</sub> measurements before this satellite were mostly ground measurements of limited earth areas. A limited CO<sub>2</sub> map had been made by a Japanese GOSAT satellite. "Now with OCO-2 we have much greater coverage of CO<sub>2</sub> measurements globally. We can now see photosynthesis [and] we can see photons released by plants. We are not [specifically] mapping photosynthesis worldwide. Previously [with GOSAT] we could see color change of plants [which reveals photosynthesis], but this needed one week to show [color] differences.... Now [using OCO-2] photosynthesis can be measured globally and daily."

Yuen concluded her prepared talk—presented in a manner that even legislators could understand, even if those who resist the irresistible conclusions drawn—and then took questions, many of which were as interesting as her presentation:

Q: Can you build CO<sub>2</sub> sinks?

A: Yes, but how big would it need to be? And it would it be labor and energy intensive...

Q: How long will the OCO-2 satellite be operative?

A: Two years we are expecting, but hoping for 5-10 years.

Q: Are droughts cyclical? Or because we live in a desert?

A: Not sure if there is a relation between CO<sub>2</sub> and drought cycles.

She finished her time at the dais by giving a promo for NASA, which after her talk made one want to donate money right away. Bringing her message home, she noted that her dad in Minnesota brags about her working at NASA to farmers there...."they say congratulations, but what has NASA done for us? Landed on the moon and those Mars things [rovers]? But what has it done to help us?" NASA, she explained, is doing things besides moon and Mars landings...We [today] have cell phones, direct TV because of satellites, [we have] weather satellites.." All are the direct outgrowth of space exploration and the technology it has spawned.

The final speaker of the day was Dr. Helen Cox, Director of the Institute for Sustainability and Professor of Geography at CSUN. Dr. Cox spoke on the topic of "Climate Change: Disaster or Opportunity," and gave a fascinating (and optimistic) presentation that encouraged the audience to focus on "cleaner energy, cleaner transport, and better-designed cities" as the ultimate solution for the problems that face us with climate change.

My conclusion after hearing all this? Given even a single ppm of political will by those in Washington to address the problems that NASA and other scientists have revealed, it might be that NASA will enable us to continue to breathe and live.