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PHARMACEUTICALS IN MONTANA'S WATER

Article by The Montana Water Center Website: http://water.montana.edu/mwnewsletter/archives/newsletter_08_03sp.htm

This week's investigative report by the Associated Press has brought us questions about pharmaceuticals in the waters of Montana. Has anyone looked for them? Where are they? Where do they come from? Should we be concerned? What can we do about them? This summary report addresses these basic questions. The report contains 'hot links' to the experts whose work we describe, so you can follow up with them if you have specific questions.

Sources

Pharmaceutical compounds are used by humans and in veterinary applications, including livestock rearing. They're not completely broken down within people or animals, and so they can potentially be found in any waters influenced by human or animal waste. Treated and untreated human wastewaters (septic system leachate, sewer pipe leakage and wastewater treatment plant effluent) and the effluent from concentrated animal feeding operations are the chief sources.

Montana Studies

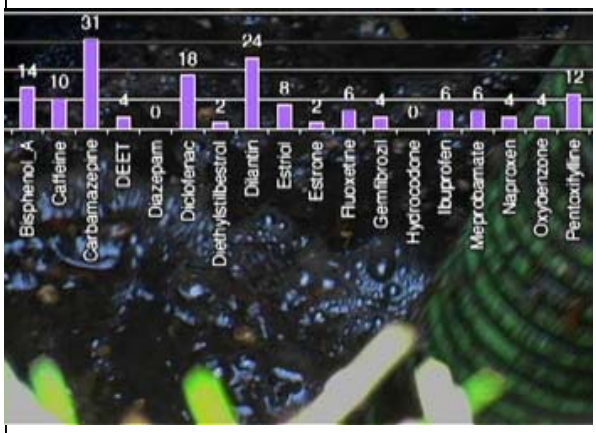
In 2003 a University of Montana team led by Bill Woessner looked for 22 common pharmaceuticals in leachate from the Frenchtown High School septic system, and in shallow wells in and near Missoula that could have been influenced by leachate from residential septic systems or by leakage from city sewer lines. Three pharmaceutical compounds were found to have entered the shallow subsurface at Frenchtown, and five compounds were found in Missoula ground water.

Kate Miller of the Montana Bureau of Mines & Geology (MBMG) and Joe Meek of the Montana Department of Environmental Quality surveyed ground water beneath the Helena Valley on two

INRA's efforts in the management of the Subsurface Science Research Institute and the Water Research Consortium are supported by DOE contracts DE-FG07-02ID14277 and DE-FG02-05ER64132.

occasions in 2005. They tested 35 domestic water supplies, and found 22 compounds classified as "pharmaceuticals or personal-care products." These included antibiotics, pain-killers, anti-inflammatory and seizure-control drugs, anti-depressants, estrogens and androgens, caffeine, plasticizers, insect repellent and an herbicide.

In fall 2007 the MBMG and the Gallatin Local Water Quality District sampled ground and surface water and streambed sediment several places in the rural parts of the Gallatin Valley. Preliminary results did not show contamination by pharmaceutical products; independent confirmatory samples have not yet been analyzed.



Steve Sando of the US Geological Survey recently collaborated with the Lewis & Clark Local Water Quality District and the Helena Wastewater Treatment Plant to test the water of Prickly Pear Creek above and below the mouth of the plant's discharge canal. Some pharmaceutical residues were detected upstream of the discharge; many more were found downstream of the discharge.

Gary Icopini of the MBMG is leading a statewide study funded by the USDA Natural Resources Conservation Service to look for veterinary pharmaceuticals in a set of wells regularly monitored by MBMG across the state. These wells are in areas with land uses ranging from crop production to concentrated animal agriculture to rural subdivisions. Preliminary results from 2007 show pharmaceutical contamination ranging from none at all to concentrations that are known to act on animal organs and systems.

In summary, at this point we can say that:

- A number of studies have examined Montana waters for pharmaceuticals and other compounds that are biologically active at very low levels
- Contamination has been found in both surface and ground water, but it's far from universal
- The observed contamination probably arises from both domestic wastewater and animal wastes
- The concentrations found in any specific sample are highly dependent on local conditions, especially the characteristics of the soil and aquifer, and proximity to sources Environmental concentrations differ greatly among compounds. Some compounds are much more mobile in the environment and more resistant to breakdown than others.

Significance for Montanans

Biologists know that living in water containing pharmaceuticals is unhealthy for fish, amphibians and reptiles. But would people suffer harm if we drank water containing these compounds every day? Unfortunately, unless the concentrations are relatively high – actual therapeutic dosages – no one can say. Pharmaceutical research using low, sub-therapeutic doses is very difficult, and little such research has been carried out. There are no drinking water standards for these compounds, and so no guidelines for safe levels in water.

Should individuals who are concerned send a sample of their water to a laboratory for testing? Perhaps, with caution. Because the concentrations of concern are extremely low – parts per trillion, sometimes less – few labs around the country are qualified to conduct these tests. The tests are complex and expensive, and the results are often ambiguous. The only laboratory in Montana that has tested for pharmaceuticals in water is the Agricultural Experiment Station Analytical Laboratory at MSU-Bozeman.

Montanans who are concerned about their drinking water can install treatment units at their kitchen taps. Activated carbon filters are good and reverse osmosis units are better at removing the compounds of concern. But - no treatment device works forever without maintenance – these units **must** be operated and kept up according to their specifications, or they'll cease to be effective. Unless it's been treated by reverse osmosis, bottled water is not necessarily free of pharmaceutical compounds.

For further information, consult these websites:

Environmental Protection Agency Safewater at http://www.epa.gov/safewater/
National Ground Water Association at http://www.ngwa.org/public/awarenessweek/index.aspx
MSU Extension Water Quality Program at http://waterquality.montana.edu/

Research Improves Detection of Harmful Pathogens

Courtesy of WSU Website: http://researchnews.wsu.edu/environment, By Prashanta Dutta, Assistant Professor, School of Mechanical and Materials Engineering, 509/335-7989, prashanta@wsu.edu, Contact: Tina Hilding, Communications Coordinator, College of Engineering and Architecture, 509/335-5095, thilding@wsu.edu

PULLMAN, Wash. -- A group of Washington State University researchers have developed a method that greatly improves and speeds up the detection of harmful pathogens in the environment.

In a paper published this month in the Journal of Micromechanics and Microengineering, the researchers, including Prashanta Dutta, assistant professor in the School of Mechanical and Materials Engineering, and colleagues from the University of Akron, present an improved and more effective Coulter device, used for the detection of the tiny microbes.

The existing technique, which uses micro- or nano-pores to detect and separate particles, can only detect tiny volumes of material at a time in a single channel, limiting its effectiveness for detecting particles rapidly in large volumes. To detect harmful pathogens, samples currently have to be sent to a lab facility, and results take several hours.

The researchers, including graduate students in the WSU School of Mechanical and Materials Engineering Isaac Sprague and Talukdare Jubery, have been working on micro- and nano-scale bioparticle sensors that avoid the contamination of samples that has traditionally plagued the tiny detectors, allowing the use of multiple channels to do separations for the first time. The channels on the tiny microchip are only 50 microns wide and can detect particles, ranging from a single molecule to a single cell, within a large sample (up to five milliliters of liquid, for instance). In particular, the research team was able to use the 4-channel system to detect tiny particles of pollen and polymethacrylate (PMA).

The device is made of plastic in a clean room, using techniques similar to those used in the production of computer microchips.

The researchers are continuing work to increase the number of sensing channels in their micro-chip for significant improvements in the detection of the harmful bioparticles. They hope that the new system could someday allow detection of dangerous pathogens in food or the air, ranging from E. coli to anthrax, in minutes with a portable device. Because it can be mass produced, the detection device could also be significantly less expensive than devices that are currently used.

Purchase of Key Instrument Provides Strong Boost to Boise State's Research Prospects

Boise State University Website: www.bsu.edu

A key building block of Boise State University's advancement as a metropolitan research university of distinction could be in place and operational as soon as the fall semester. The recent purchase of a new nuclear magnetic resonance (NMR) spectrometer and accompanying cryoprobe, as well as related liquids and solids probes, significantly advances research potential in several academic disciplines at Boise State and several key areas of the regional economy, including technology and agriculture.

"Very few universities in the Pacific Northwest, including research universities, have an instrument comparable to this one," said Mark Rudin, Boise State's vice president for research. "We're very excited about how this core piece of equipment will elevate our ability to conduct high level research across a wide range of disciplines. And a number of our partners in government, private industry and academia are quite interested in what it may be able to do for them." Delivery and installation of the 600-megahertz spectrometer is expected during the late summer months.

NMR is a technique used to determine how atoms are arranged in molecules. The NMR spectrometer uses a magnet to align atomic nuclei and then identifies their tell-tale responses to irradiation with a radio frequency field. The cyroprobe amplifies the spectrometer's signal, providing results similar to that of 800- or 900-megahertz instruments without the prohibitive costs associated with them.

Uses include the real-time examination of how medication affects cells and the molecules they produce, the study of body fluid components, the interactions between therapeutic drugs and their molecular targets to aid rational drug design, component analysis of biphasic systems for pesticide or heavy metal remediation, understanding the mechanisms behind chemical reactions and the characterization of new materials, among others.

Boise State's new NMR opens the door for research needed in the development of a new master's degree in chemistry and anticipated doctorate programs in biomolecular science and materials science and engineering. The research of at least 13 Boise State faculty members in five departments (biology, chemistry, physics, materials science and engineering, and electrical and computer engineering) will be improved with the purchase.

The new instrumentation is particularly exciting to members of Boise State's chemistry department, where the equipment will be housed. The equipment provides critical infrastructure for the development of advanced degrees in chemistry, including a new master's program that could be offered as early as this fall. Currently, Boise State only offers undergraduate chemistry programs.

"This equipment puts our department on par with colleges and universities that offer a doctorate in chemistry," said Don Warner, an assistant professor of chemistry who did much of the legwork to secure funding for the new equipment. "This will be a cornerstone for the development of our master's curriculum and eventually our own Ph.D."

The more than $900,000 in funding for the equipment and installation came from a $500,000 National Science Foundation grant and another $400,000 in funding from various departments at Boise State. The acquisition also means an existing 300-megahertz NMR spectrometer will be dedicated primarily to undergraduate coursework, increasing the hands-on exposure of undergraduate students to state-of-the-art instrumentation and strengthening their research experience and professional training at Boise State.

In addition to being a boon to Boise State research, Owen McDougal, an assistant chemistry professor, said the technology and agriculture sectors, environmental oversight agencies, health care providers and area colleges and universities could all stand to benefit from the new equipment. .
"Our local, national and international partners will sit up and take notice of this," McDougal said.

Media Contact: Mike Journee, University Communications, (208) 426-1517, mikejournee@boisestate.edu

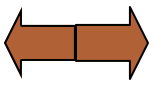


Photo courtesy of Richard Collins, UAF Geophysical Institute

Noctilucent clouds shine in the dark portion of the sky in this image taken from the Poker Flat Research Range in 2005.

Scientists: Polar Ice Clouds May Be Climate Change Symptom

University of Alaska Website: www.uaf.edu

As the late summer sun sets in the Arctic, bands of wispy, luminescent clouds shine against the deep blue of the northern sky.

To the casual observer, they may simply be a curiosity, dismissed as the waning light of the midnight sun. But to scientists, these noctilucent ice clouds could be an upper-atmospheric symptom of a changing climate.

“The question which everyone in Alaska is dealing with is what are the symptoms of climate change and, as in medicine, how do these symptoms reflect the underlying processes,” said Richard Collins, a researcher at the Geophysical Institute at the University of Alaska Fairbanks. “It is believed that [these clouds] are an indicator of climate change.”

Dozens of scientists from several countries will gather at the University of Alaska Fairbanks Aug. 20-23 to discuss the latest findings on noctilucent clouds and other phenomena of the earth’s upper atmosphere during the Eighth International Workshop on Layered Phenomena in the Mesopause Region. Sessions will include information on the latest ground-based and satellite data on the mesopause region, an area of the atmosphere 50 miles above Earth’s surface and the site of the coldest atmospheric temperatures.

Noctilucent clouds form under conditions that counter common logic. They only form in the summer, when solar radiation is most intense, Collins said. That solar heating, rather than warming the mesopause, causes cooling, he said. “The mesopause region is colder in summer under perpetual daylight than it is in winter under perpetual darkness.”
The reason lies in the movement of air within the atmosphere, Collins said. Solar radiation heats the lower atmosphere, causing a rising cell of air over the summer pole, he said. “As the air rises it cools and that beats out the radiative heating.” Those cold temperatures allow the ice clouds to form in the mesopause. The clouds could serve as an indicator of climate change because an increase in carbon dioxide, which causes heating in the lower atmosphere, causes cooling in the upper atmosphere.

Collins said the noctilucent clouds are a relatively new phenomenon. History indicates that humans first recorded their presence in the 19th century, he said. Satellite and ground-based data has been limited, he said, but it appears that the clouds have become more prevalent over time. A new satellite, Aeronomy of Ice in the Mesosphere, or AIM, was launched in April 2007 to observe clouds and their environment in the mesopause, Collins said scientists are looking forward to having more reliable data, which could contribute to a broader understanding of the upper atmosphere, noctilucent clouds and how both fit into the climate system.

CONTACT: Richard Collins, associate professor of atmospheric science, at (907) 474-7607 or via e-mail at rlc@gi.alaska.edu.

New Extension guide on strategies to best estimate soil nutrient levels and variability

Montana State University Website/MSU News Service: www.montana.edu

A new Montana State University Extension Service publication is available to identify optimal soil sampling strategies to best characterize soil nutrient levels.

Also, for producers who want to apply different nutrient rates across a field to optimize yield and fertilizer use, this guide discusses how to divide a field into management zones.

"The main goal of soil sampling is to characterize the nutrient status of a field as accurately and inexpensively as possible," said Clain Jones, Extension soil fertility specialist in MSU's Department of Land Resources and Environmental Sciences.

"If soils were uniform, this would be easy, however, nutrient levels are generally quite variable across a field," Jones said. For example, phosphorus levels have been observed to vary more than any other nutrient within a field. In addition, different soil sampling strategies can account for this variability better than others.

Unfortunately, collecting a soil sample representative of an entire field is not a simple task. "Having a better understanding of several different soil sampling strategies should help producers achieve their goals," said Jones. The new MontGuide describes optimal soil sampling strategies to obtain representative soil samples and the number of soil samples to collect per field for a desired accuracy level.

The guide assists in determining which soil sampling strategy is best for a field.

For copies of the MontGuide, please refer to the Web at http://msuextension.org/publications/agandnaturalresources/mt200803AG.pdf . To order printed copies, please refer to the Web at http://www.montana.edu/wwwpb/com_serv/$order.html or call Extension Publications at (406) 994-3273. Contact your local MSU Extension agent (http://extn.msu.montana.edu/localoffices.asp) or crop adviser for help interpreting your soil test results and for specific fertilizer decisions.

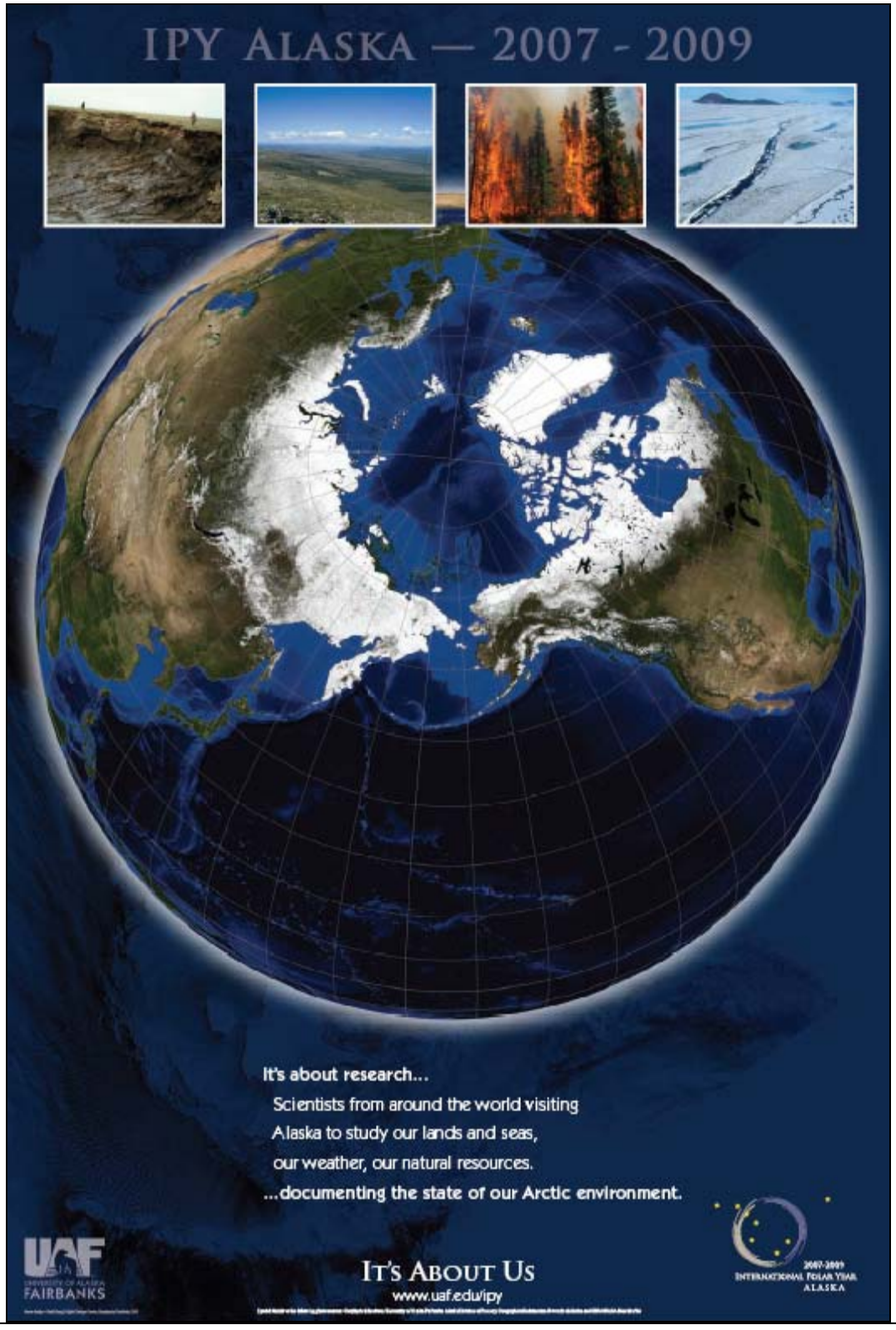
Contact: Clain Jones (406) 994-6076 or clainj@montana.edu

INRA INSTITUTE
IS PLEASED TO ANNOUNCE

THE INTERNATIONAL POLAR YEAR SYMPOSIUM,
TO BE HOSTED BY THE
UNIVERSITY OF ALASKA FAIRBANKS
IN SPRING 2009

MORE INFORMATION WILL BE AVAILABLE ON OUR WEBSITE SOON.

VISIT WWW.UAF.EDU



INTERNATIONAL POLAR YEAR 2007—2009

The International Polar Year (IPY) is a two-year event, beginning in March 2007, which will be focusing the attention of the international research community on the Earth's polar regions. This focus is encouraging scientists from across the globe to collaborate to find new ways to address the impacts of climate change and development in the polar regions and to share their findings with the public.

The work of the scientist, as with earlier IPYs, will leave a legacy of new knowledge and understanding and greater public awareness of the polar regions and the importance of polar research. It will also contribute to a lasting research and educational infrastructure.

The University of Alaska Fairbanks (UAF) is ideally situated to participate in IPY research, education and outreach. For years, UAF researchers have been recognized as leaders in polar research. From climate change to arctic indigenous peoples, UAF researchers in a wide range of disciplines offer a wealth of expertise on the northern latitudes that lie just outside their front door.

More than 300 institutions from dozens of countries are participating in IPY. UAF researchers have leadership roles in many of the hundreds of projects endorsed by the IPY International Programme Office. In addition, UAF is planning a variety of professional conferences, opportunities for undergraduate, graduate and postdoctoral research, public outreach events, and K-12 educational materials and programs that promise to not only further enhance our arctic focus, but also to engage the people of our state, nation and world in the fascinating fields of polar science.

INRA would like to thank CH2M –WG Idaho, LLC and Decagon Devices for their symposium sponsorships for the 2007 year.

If you or your agency is interested in being a symposium sponsor, please contact Fred Sica, Director of Business and Research Development for Inland Northwest Research Alliance. He can be reached via email at fsica@inra.org or by phone at (208) 524-4800.

INRA Announces NEW Website: www.inra.org

Inland Northwest Research Alliance is pleased to announce our newly designed website at www.inra.org. This newly designed website has many new beneficial features such as our growing researcher database. The website links to the eight INRA Universities and our research initiatives, and provides information on events and direct registration for our INRA Institute.

INRA INLAND NORTHWEST RESEARCH ALLIANCE

The Inland Northwest Research Alliance (INRA) is a non-profit scientific and educational organization consisting of eight Western research universities (Boise State University, Idaho State University, Montana State University, University of Alaska Fairbanks, University of Idaho, University of Montana, Utah State University and Washington State University). The total research and development budget for these universities in FY 2005 was nearly $744 million, which could collectively rank these institutions as the fifth largest institution of higher education in the country in terms of research funding. INRA was created to promote new opportunities for research and education that will benefit the region and the nation in a variety of technical disciplines.

The INRA mission is to develop multi-institutional university research programs on behalf of its members, and apply these programs to complex problems of regional importance and national significance. This extramurally funded research-driven agenda will strengthen the collaborative research ties between INRA members, offer potential opportunities to develop innovative graduate-level education programs that contribute to the research agenda, bring positive attention to the consortium, and advance individual and joint science and research funding opportunities for the members.