

EDUCATION NEWS

An Ocean of Data—About Clouds

With contributions from Steve Linn, 4th grade teacher at Cottonwood Elementary, Kennewick, WA

A cruise across the Pacific from Los Angeles, California, to Honolulu, Hawaii. Ocean breezes, fluffy clouds, and lots of deck time. A whole year on the high seas. But there's a catch...

The vessel you'll sail on is actually a working 268-meter (880-foot) steam-powered container ship that makes the Los Angeles-to-Hawaii run as part of the Horizon Lines cargo fleet.

It's MAGIC

From October 2012 through September 2013, the ARM Mobile Facility (AMF2) will be deployed on the container ship *Horizon Spirit*. This yearlong cycle of trips from the mainland to Hawaii is designed to obtain data for the Marine ARM GPCI Investigation of Clouds (MAGIC) field campaign.



The GPCI portion of the acronym is comprised of the following:

- GPCI = GCSS Pacific Cross-section Intercomparison, a working group of GCSS
- GCSS = GEWEX Cloud Systems Study
- GEWEX = Global Energy/Water Cycle Experiment, a project of the World Climate Research Programme.

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About ARM

The Atmospheric Radiation Measurement (ARM) Climate Research Facility is a U.S. Department of Energy scientific user facility for the study of global climate change.

As part of its outreach program, ARM provides education resources for students, teachers, and communities.

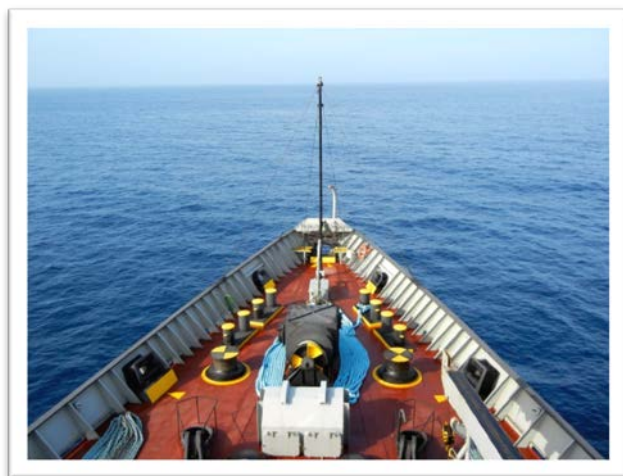
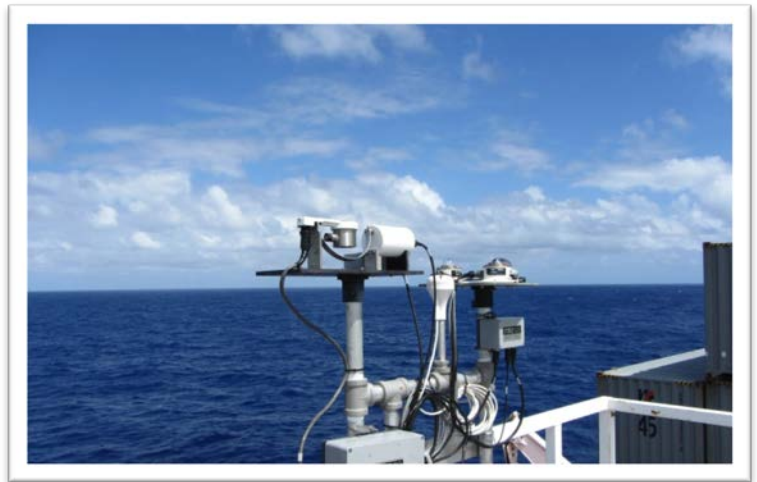
www.arm.gov

A Floating Laboratory

AMF2 is one of ARM's portable climate laboratories that travel around the world, gathering climate measurements in understudied areas. Mobile facilities have the same instrumentation as the ARM fixed sites, but they can operate from the heat of the tropics to the cold of the poles—or onboard a container ship.

During the approximately 20 round trips between Los Angeles and Honolulu, AMF2 will obtain continuous onboard measurements of clouds and

precipitation, aerosols, and atmospheric radiation; surface **meteorological and oceanographic variables**; and atmospheric profiles from **weather balloons** launched every six hours.



During two 2-week intensive observational periods in January and July 2013, additional instruments will be deployed and balloon soundings will be increased to every 3 hours. These additional data will provide a more detailed characterization of the state of the atmosphere and its daily cycle during two distinctly different seasons, winter and summer.

A Focus on Clouds

The MAGIC field campaign will study the small-scale physical processes associated with **turbulence, convection**, and radiation in two

important types of **marine boundary-layer** (MBL) clouds. **Stratocumulus** clouds persistently cover the sky over some coastal regions, like the warm ocean off the coast of California. Heading west out into the open ocean, these regions of stratocumulus clouds transition to primarily puffy shallow trade-wind **cumulus** clouds. In climate models, it is important to represent where and why this transition occurs because stratocumulus clouds cover large portions of the sky and reflect more sunlight back into space than the patches of smaller cumulus clouds. This affects the balance of energy that is gained and lost by the Earth.

However, it's difficult to predict the transition between stratocumulus and cumulus regions because the change is very sensitive to processes within clouds and interactions between the clouds and the environment around them. The MAGIC science team will use the new information collected by the AMF2 about those details to improve computer model predictions.

Definitions

- **Aerosol:** Particles in the atmosphere. There is an abundance of naturally occurring aerosols in the Earth's atmosphere. Pollution also contributes aerosols for cloud formation.
- **Atmospheric radiation:** Solar radiation is the major energy source for the Earth's biosphere and the direct driving force for atmospheric and oceanic circulations.
- **Convection:** Vertical motion within the atmosphere due to thermal instability, with important impacts on the types of cloud systems that can develop.
- **Cumulus:** Puffy white cloud belonging to a class characterized by dense individual elements in the form of puffs, mounds, or towers, with flat bases. They are usually found below 8000 feet (2400 meters).
- **Marine boundary layer:** The atmosphere between the Earth's surface and an altitude of about 1–2 kilometers. Marine boundary-layer clouds passively filter the sun, but also act as interactive systems that influence and modulate sea surface temperature and trade winds.
- **Meteorological:** Having to do with meteorology, the study of the atmosphere and atmospheric phenomena and the atmosphere's interaction with the Earth's surface, oceans, and life in general.
- **Oceanographic:** Having to do with oceanography, the branch of science dealing with the physical, chemical, geological, and biological features of the oceans and ocean basins.
- **Precipitation:** All liquid or solid phase aqueous particles that originate in the atmosphere and fall to the Earth's surface.
- **Stratocumulus:** A cloud belonging to a class characterized by large, dark, rounded masses, usually in groups, lines, or waves, usually found below 8000 feet (2400 meters).
- **Turbulence:** An irregular motion of the atmosphere, indicated by gusts and lulls in the wind.
- **Variables:** Conditions of the atmosphere that change with time and can be observed, measured, and recorded. Examples of weather variables are temperature, air pressure, relative humidity, dew point, precipitation, wind speed, wind direction, and cloud cover.
- **Weather balloon:** A balloon that carries instruments into the sky to send back information on atmospheric pressure, temperature, humidity and wind speed.

Did you know?

Weather balloons are launched every day from ARM's fixed sites in Oklahoma, Alaska, and the Tropical Western Pacific. But launching weather balloons from the deck of a ship is a different challenge! MAGIC researchers launched several test balloons before the start of the field campaign, with vegetables like potatoes and turnips attached. These vegetables weighed roughly the same as the sensors that are usually attached, enabling the researchers to find the best spot for balloon launches without wasting any sensors.



Related Activity: Common Covering Clouds

Grade Level: K–2

Approximate Time: 1.5 hours, or two 45-minute segments

Objective: The student will investigate and demonstrate understanding of common clouds as evidenced by completion of the activity.

Materials: 5x7 pictures of each of the eight clouds, butcher paper or poster board, cotton balls, gray marker or gray paint and brush, blue or white construction paper, glue, crayons or colored pencils, Student Record Sheet.

Procedure:

1. Before beginning the lesson, ask students the following questions and have a class discussion.
 - o What are clouds?
 - o What does it mean when we see different types of clouds outside?
 - o How would you describe the clouds you have seen outside?
2. Bring students to the floor by the poster board. On the poster board, tape up pictures of each cloud one at a time. Ask students to describe each cloud as you show them the pictures. Below each cloud, write the name of the cloud and a description. Leave this poster up throughout the lesson.
3. Each student should now have a piece of construction paper, glue, cotton balls, and gray marker or gray paint and paint brush at their desk. Guide them or allow them to independently make their own representation of each cloud on the construction paper. Students take the cotton balls, spread them apart to make thin wispy clouds or clump them together to make thick clouds and blue them on their paper to represent the different clouds. Use a marker or paint to lightly color the cotton balls to look like gray or hazy weather. Underneath each cloud, have the students write the name of the cloud and a description of the cloud.
4. Take the students outside to look at the weather and complete the Student Record Sheet together.

For the full lesson plan, visit:

<http://education.arm.gov/teachers/outline/lessons/Common-Covering-Clouds-Gr-K-2.pdf>

ABOUT ARM EDUCATIONAL OUTREACH

The goal of ARM Educational Outreach is to develop basic science awareness and increase critical thinking skills focusing on environmental science and climate change for K-12 students.

Resources for students and teachers are available at: education.arm.gov

Try our social media channels!

