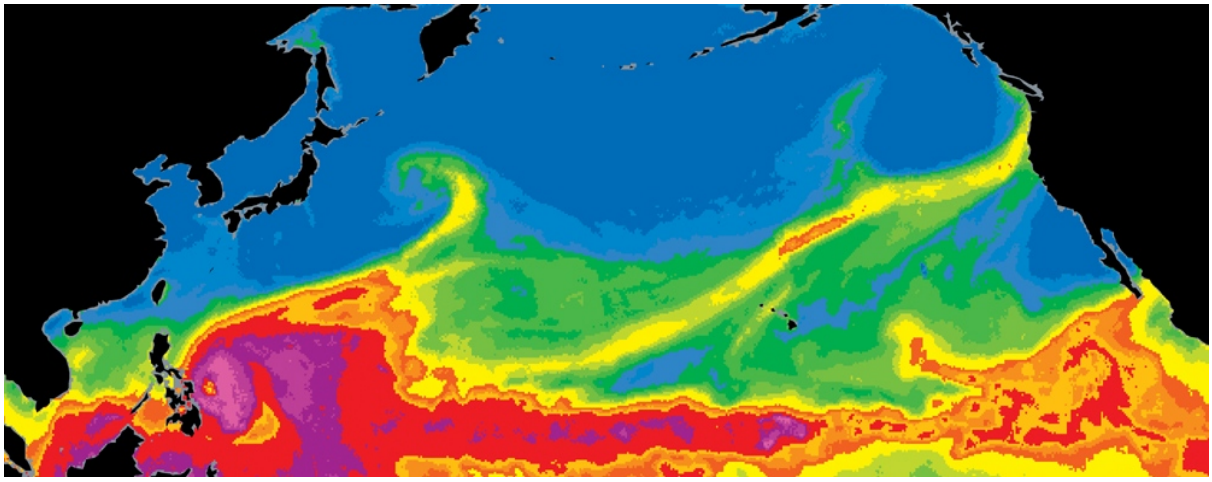
IEAGHG Information Paper 2015-06; Rivers in the Sky? No, it's not science fiction.

A recent article in Nature News (Nature 517, 424–425, 22nd January 2015) published new research on airborne jets that bring both floods and drought relief.



The above picture (courtesy of NOAA) is a satellite image showing water-vapour concentration and it reveals an atmospheric river (yellow) streaming northeast across the Pacific Ocean

In California this phenomenon is known as the Pineapple Express: a weather pattern that zips across the Pacific Ocean from Hawaii, delivering buckets of rain and snow (not fruit).

In meteorological terms, the Pineapple Express is an atmospheric river, a narrow band of air that carries huge amounts of moisture. These atmospheric rivers get their start over warm tropical waters; they then flow eastwards and towards the poles a kilometre or two above the ocean surface. They may stretch for thousands of kilometres, but are only a few hundred kilometres wide. When they hit land, they start to drop their moisture in torrential downpours or blizzards.

"When we have too many atmospheric rivers, floods can occur, and when we don't have enough we gradually fall into drought," says Marty Ralph, a meteorologist at the Scripps Institution of Oceanography in La Jolla, California, and a leader of the field campaign.

In Europe, atmospheric rivers affect mostly the western part of the continent, but they can be felt as far inland as Poland. In North America, the entire west coast is affected, and parts of the central and eastern United States occasionally feel the effects of atmospheric rivers that develop over the Gulf of Mexico. The moisture is often welcome, bringing up to half of the year's water supply in affected areas. A 2013 study found that as many as three-quarters of all droughts in the Pacific Northwest between 1950 and 2010 had been brought to an end by atmospheric-river storms. California has been stricken by drought for years, but last month, an atmospheric river dropped enough rain to erase one-third of the water deficit of one major reservoir in just two days.

Climate change may bring stronger and more frequent atmospheric rivers, because the warmer the atmosphere is, the more water it can hold, says David Lavers, a meteorologist at Scripps who is not involved in the project. "The more you know about how the atmosphere behaves," he says, "the better position you're in to prepare for extreme events."

The current US$10-million field campaign, called CalWater 2015, is a massive push to capture the physics of atmospheric rivers as they make landfall. One major goal is to work out how aerosols affect atmospheric rivers.

CalWater 2015 will measure how aerosol particles interact with atmospheric rivers, both offshore and when they reach the coast. Supercomputer simulations will then be used to examine how airborne dust affects the amount and type of precipitation that eventually falls.

That information should help water managers to predict what atmospheric rivers may bring. Reservoir engineers in northern California typically release precious water from their reservoirs in the winter, so as to have enough space behind the dam to cope with the threat of flooding. With better knowledge of when atmospheric rivers might arrive and how much water they might carry, engineers should be able to manage that winter release more effectively.

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