Watching water dry

New satellite data and sophisticated computer models are transforming our understanding of the water cycle. Eleanor Blyth explains how insights into evaporation could improve our ability to predict the climate of the future.

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Sometimes environmental science involves things that are so everyday and normal that you can forget how important they are. For example, the way a puddle dries out might seem rather boring at first sight, like watching paint dry. But, if you consider all the areas over the world that are wet at any one time, you might believe me when I say that the way water evaporates from a damp surface has a huge effect on the climate and weather.

The problem is that it's very hard to estimate how much water is evaporating in remote parts of the world. Most of our efforts to quantify evaporation, whether by measuring it directly, diagnosing it indirectly from things we can measure from space, or modelling it, fail to capture the process completely.

Evaporation from wet surfaces is an important part of the overall amount of evaporation from the surface of the land worldwide, and is particularly important in the tropical rainforests of South America and Africa. Other processes that contribute to the land's total evaporation are soils drying out and water loss through the leaves of plants.

Across the world, the fraction of rain that evaporates back into the atmosphere varies from around 15 to 85 per cent. This variation, combined with the changing amount of heat coming from the oceans, is the driving force behind much of the world's weather. As well as being important for the climate, it also defines how much water is left over in rivers and groundwater stores – and this is the water that people rely on to live.

To predict how the climate and the distribution of water will change in the future, we need to build computer models of evaporation and to test these models against observations. But until now, the only observations we have had were detailed data from a handful of places around the world. That was until researchers started to use information from satellites to estimate evaporation.

A group of us at the Centre for Ecology & Hydrology (CEH) in Wallingford have spent the last 20 years working with detailed data on evaporation at specific sites and have developed models of how the process works. We decided it was time to bring together the scientists from around the world who are developing these new methods of measuring evaporation with satellites, to see what they had all come up with. So we held a two-day International Symposium on Global Land-surface Evaporation and Climate in July 2009 at Wallingford.

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The symposium brought together experts in modelling, researchers working on measuring evaporation *in situ* and the scientists who specialise in estimating it from satellite measurements. After several presentations from these experts and plenty of discussion, it became clear that new data and new ideas are beginning to come together to solve this problem.

At the meeting we decided that the combined estimates of evaporation using the satellite data would provide a very useful benchmark dataset for the models. If we combine the satellite products with data from on-site measurements and models we will begin to have a fuller idea of the global water cycle, including all-important but hard-to-monitor areas like the tropics.

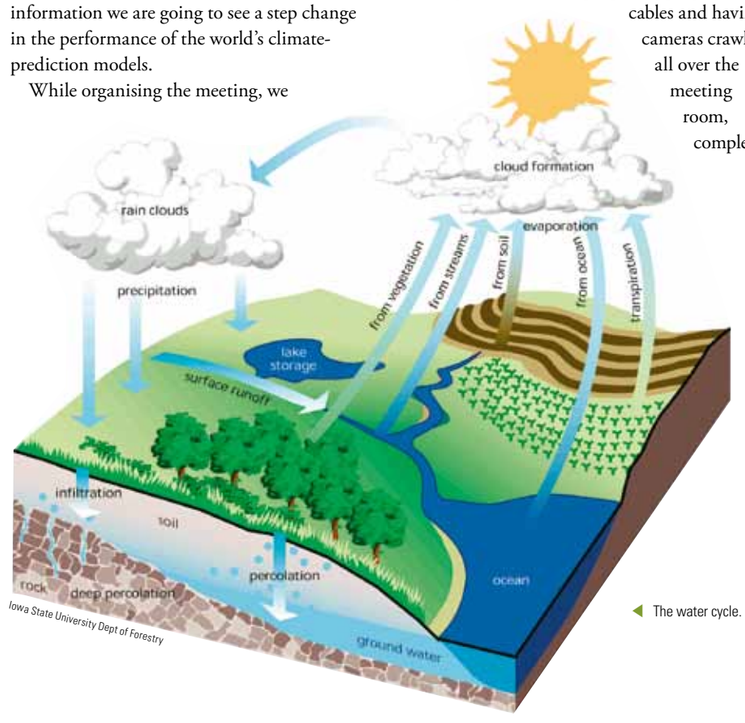
Evaporation on film

But what will we do with the data? It goes back 30 years, and the main way we'll be using it is to check whether we are modelling evaporation around the whole planet correctly. We can combine this data with other information we have on vegetation growth patterns around the world, as well as our datasets on river flows and atmospheric carbon dioxide concentrations.

With this combination we will be able to understand how the land works at the global scale: where and why plants thrive or die, whether they are stunted through lack of nutrients or water. In areas like Africa, where there is very little infrastructure to support a dense network of *in situ* measuring devices to gather data, and where the vegetation is very responsive to the availability of water, this satellite data will give us new information about how ecosystems function. I think with this new information we are going to see a step change in the performance of the world's climate-prediction models.

While organising the meeting, we realised that it might be a little bit special. It might be the first of its kind, and we might want to refer back to ideas that were formed during the meeting. So, as an experiment, we decided to explore a new way of communicating its results: to capture the workshop on film.

As the day arrived I was severely regretting agreeing to this film; it added to the stress of organising the meeting. I even had a dream the night before about people tripping up over cables and having cameras crawling all over the meeting room, completely disturbing the meeting's intellectual ambience and confidentiality. However, as the camera crew predicted, after about an hour, the scientists all forgot about the cameras and happily fell back into their comfort zone of discussing the physics of evaporation. I think the only person who tripped over the camera wires was a member of the camera crew.



The water cycle.

One of the benefits of having a film made and distributed was that many senior scientists could give personal opinions of the state of the science and comment on the meeting. This type of wisdom and expertise can often be lost unless you manage to go to the meeting. The film lets us share such an overview across the whole scientific community. We have yet to see whether this technology will help us communicate and build international communities without the need to travel around the world to meet up – but at least we can say we tried.

The film is available for viewing at www.eu-watch.org (see Events and Project Events). Watching it, you get a taste of the excitement of the world's leading hydrological scientists that such a new perspective of the science is emerging, and that it may help take the field to a new level of understanding. It feels far from everyday!

MORE INFORMATION
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