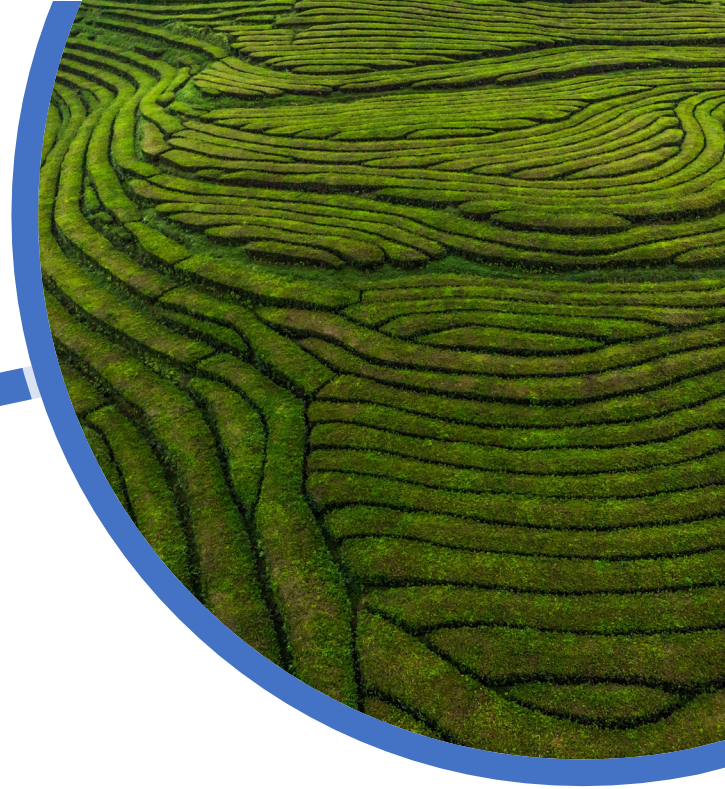

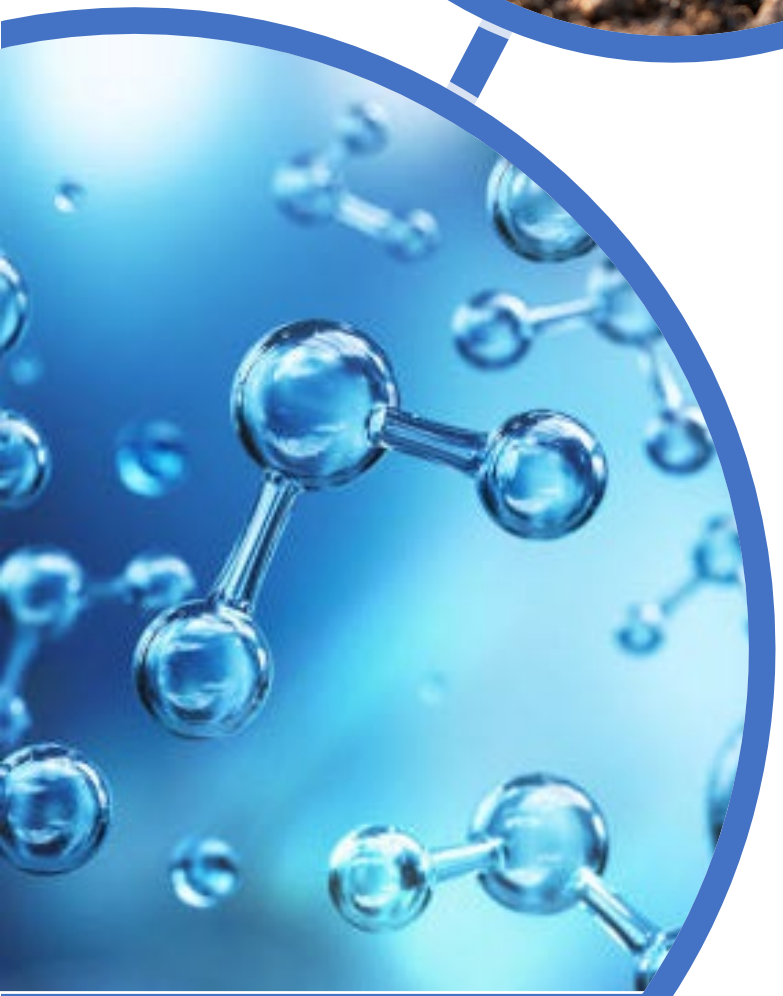

Water Isotope Data for Climate Science and Food Security

Jodie Miller *Isotope Hydrology Section, Nuclear Sciences and Applications, IAEA*

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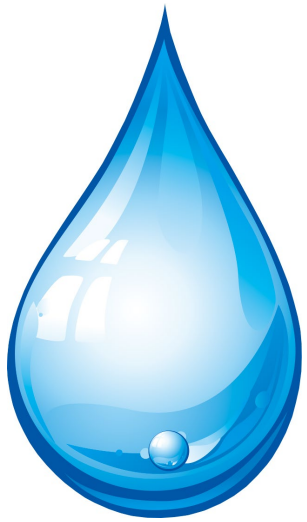
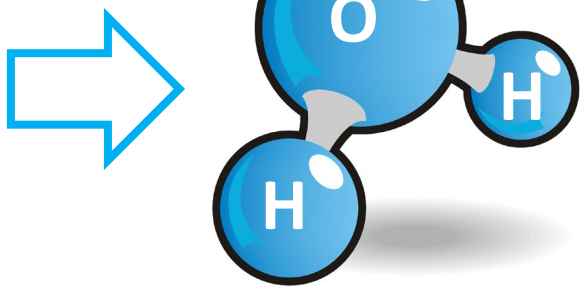
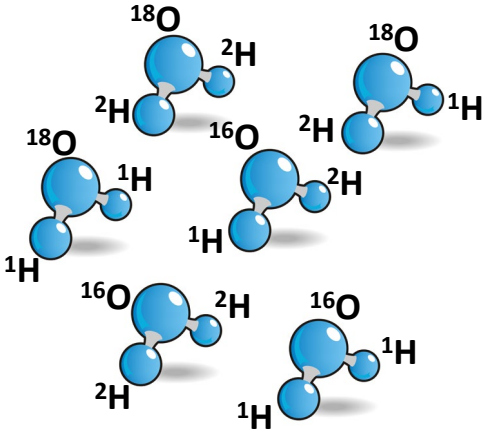
What is a water fingerprint?



Water



Water Molecule

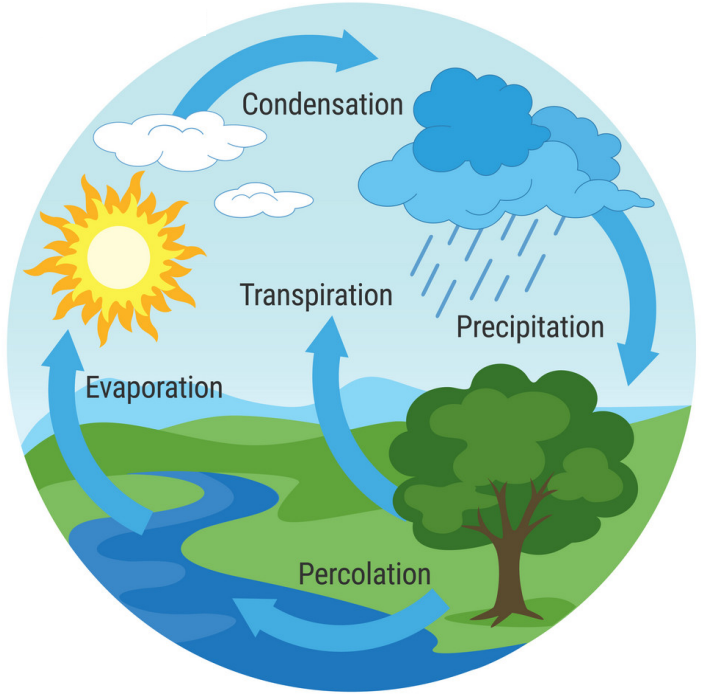


Isotopic Water Molecules

$\delta^{18}O$

How we report the water fingerprint:
A measure of the relative proportion of the heavy to the light isotopes in each water sample

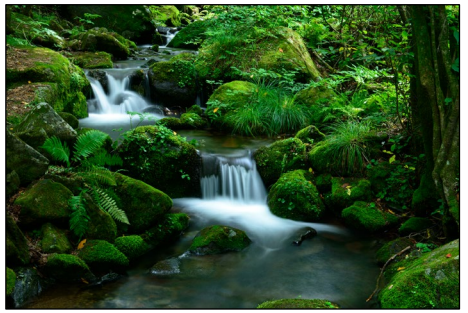
How does a water molecule get its fingerprint?



The Water Cycle









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Water isotope fingerprints and temperature

The precipitation $\delta^{18}O$ signal is particularly sensitive to fluctuations in temperature

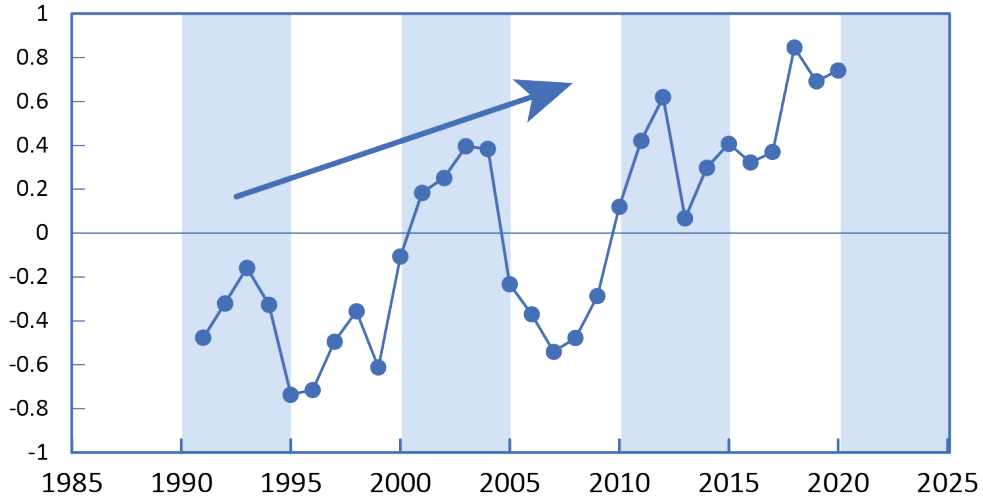
As temperature changes the relative proportions of the heavy to the light isotope changes, which yields fluctuations in the $\delta^{18}O$ value

We can use this to differentiate:

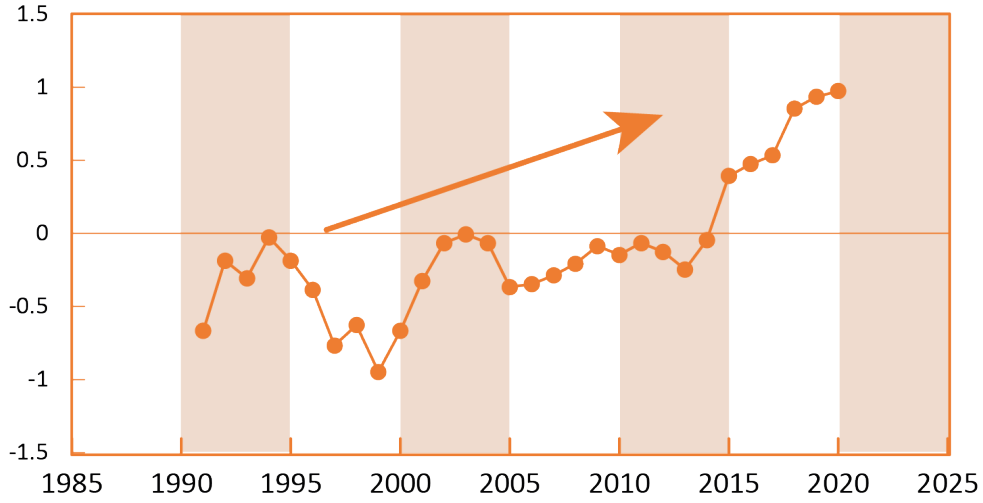
- Small scale transient fluctuations
- Larger scale cyclical oscillations
- Systematic climate change

We can do this not just for one location but across the planet if we have enough data

$\delta^{18}O$ Vienna vs. 1991-2020 mean (5yr smoothed)



Air Temperature Vienna vs. 1991-2020 mean (5yr smoothed)



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Isoscape mapping global water fingerprints

DJF = December, January, February

- Northern Hemisphere = Winter
- Southern Hemisphere = Summer
- *Grey Zones = precipitation < 10mm per year*

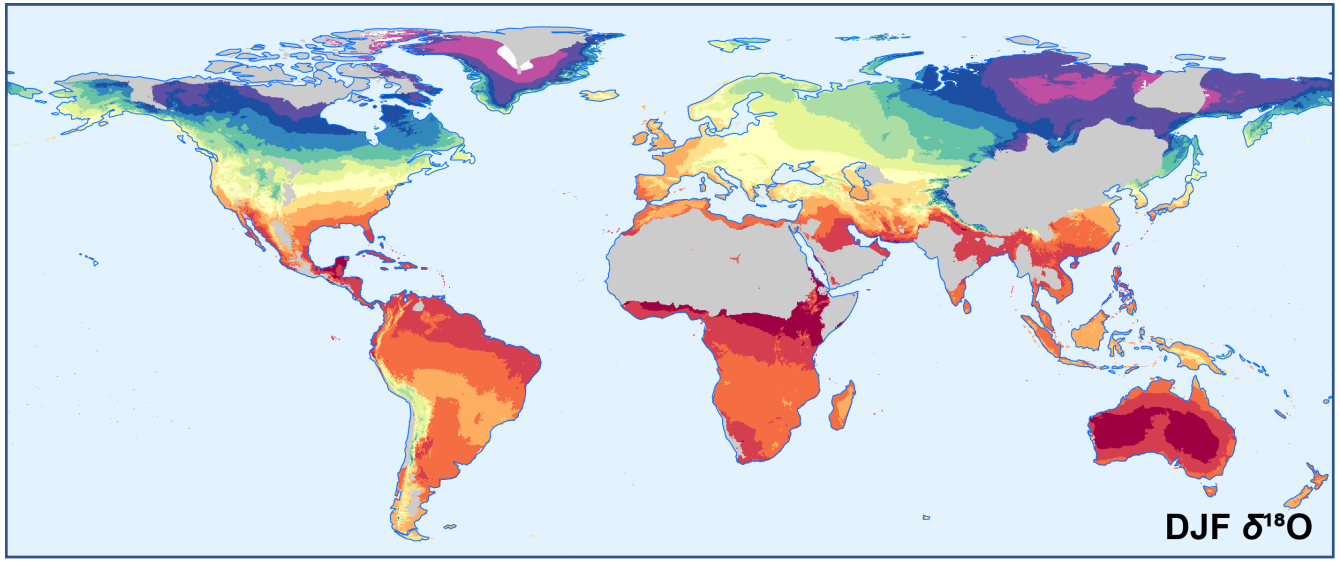
JJA = June, July, August

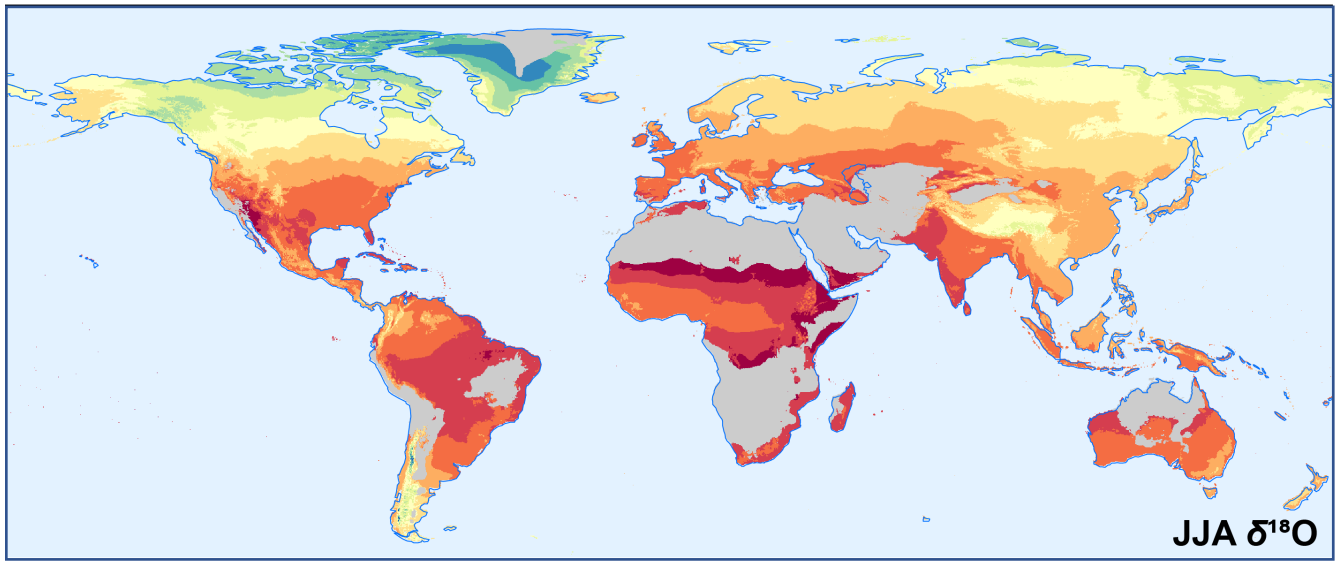
- Northern Hemisphere = Summer
- Southern Hemisphere = Winter
- *Grey Zones = precipitation < 10mm per year*

We can create these maps for each year going back several decades with the Global Network of Isotopes in Precipitation Programme. *(www.iaea.org/services/networks/gnip)*

What have we learnt from this?

Precipitation is changing…





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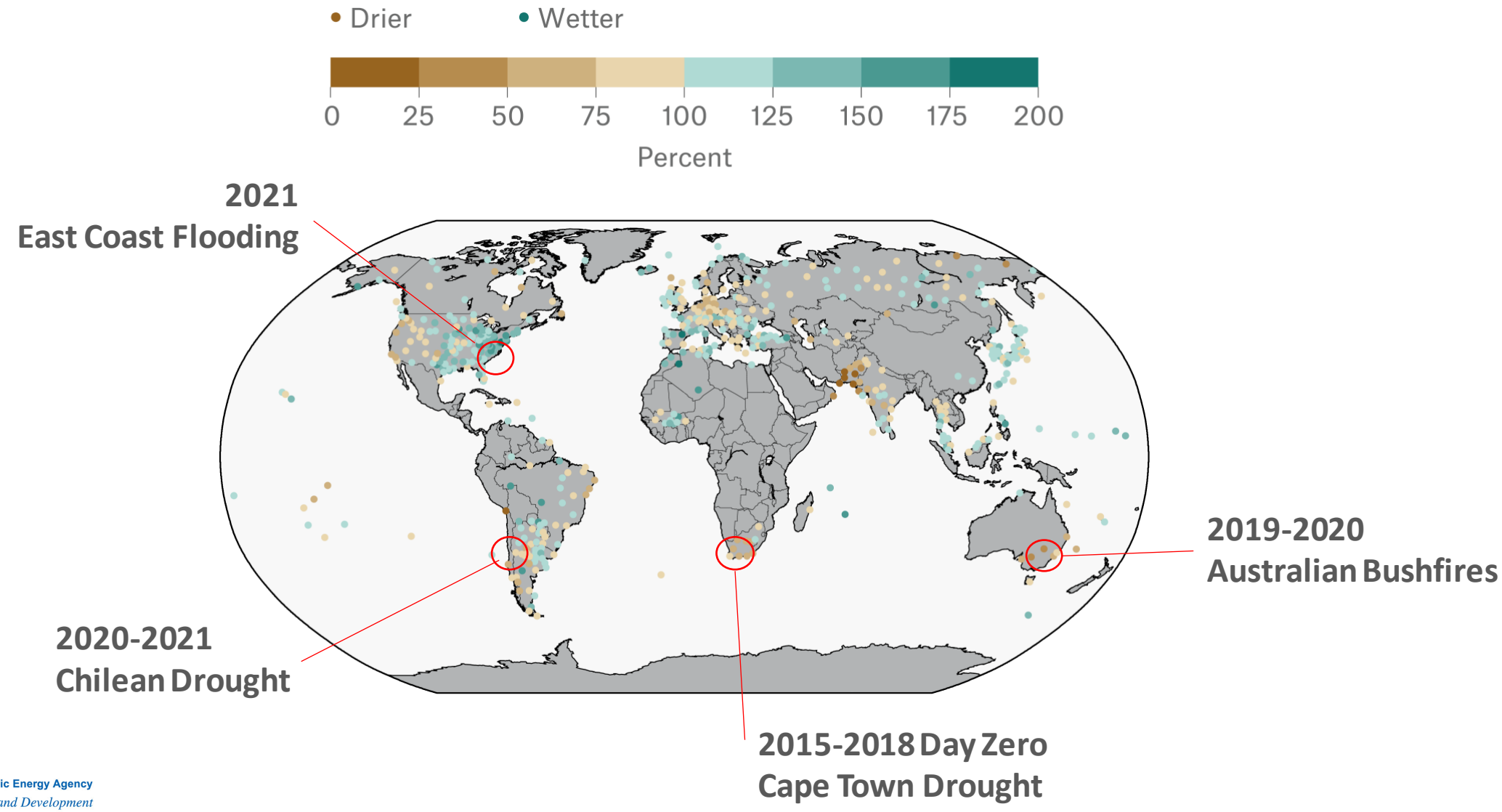
How much has precipitation changed so far?



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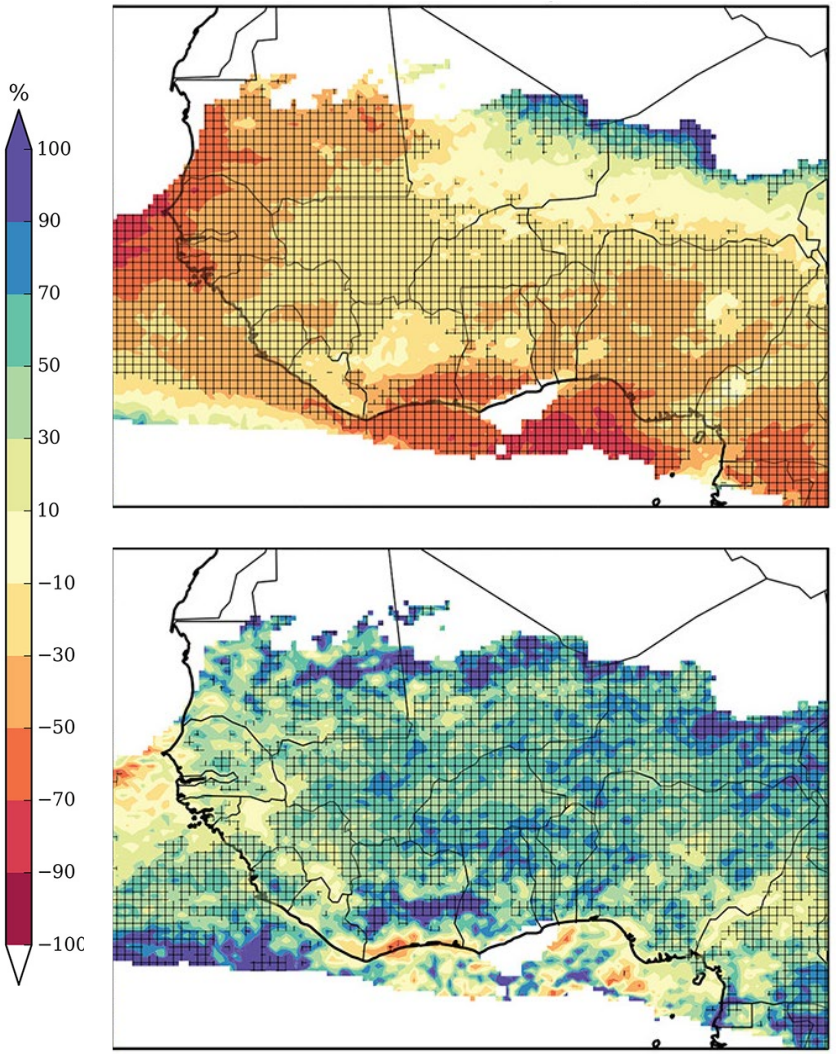
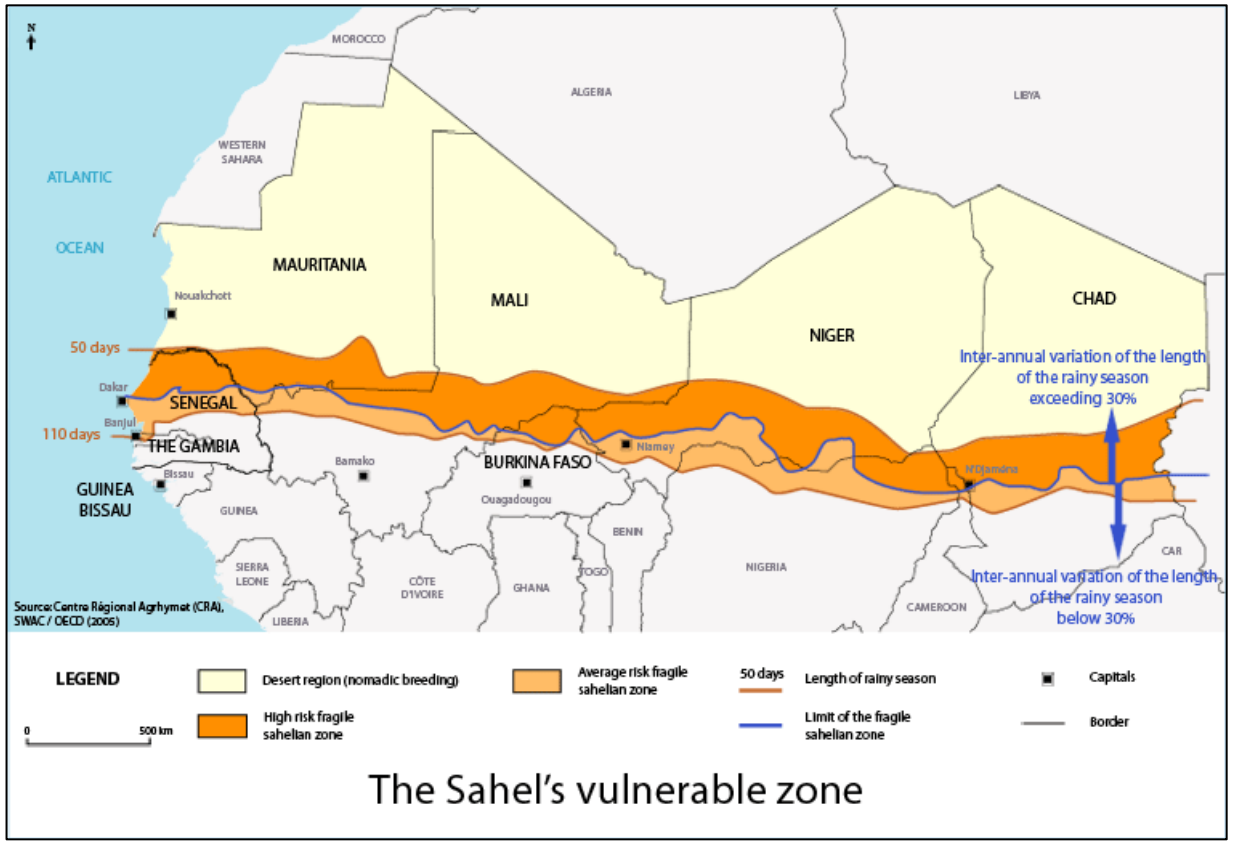
Let's Look at One Specific Example: Sahel Rainfall



Number of wet days

Intensity of rainfall



What does this mean?

1. Sustainability is about growing the right crops in the right places
2. Changes in precipitation patterns impact what crops can be grown in different locations
3. Need long term data records to validate how climate change impacts recharge to global water systems including groundwater systems that support agriculture
4. Integrating indigenous knowledge systems with nuclear sciences (isotope hydrology) can help us do this