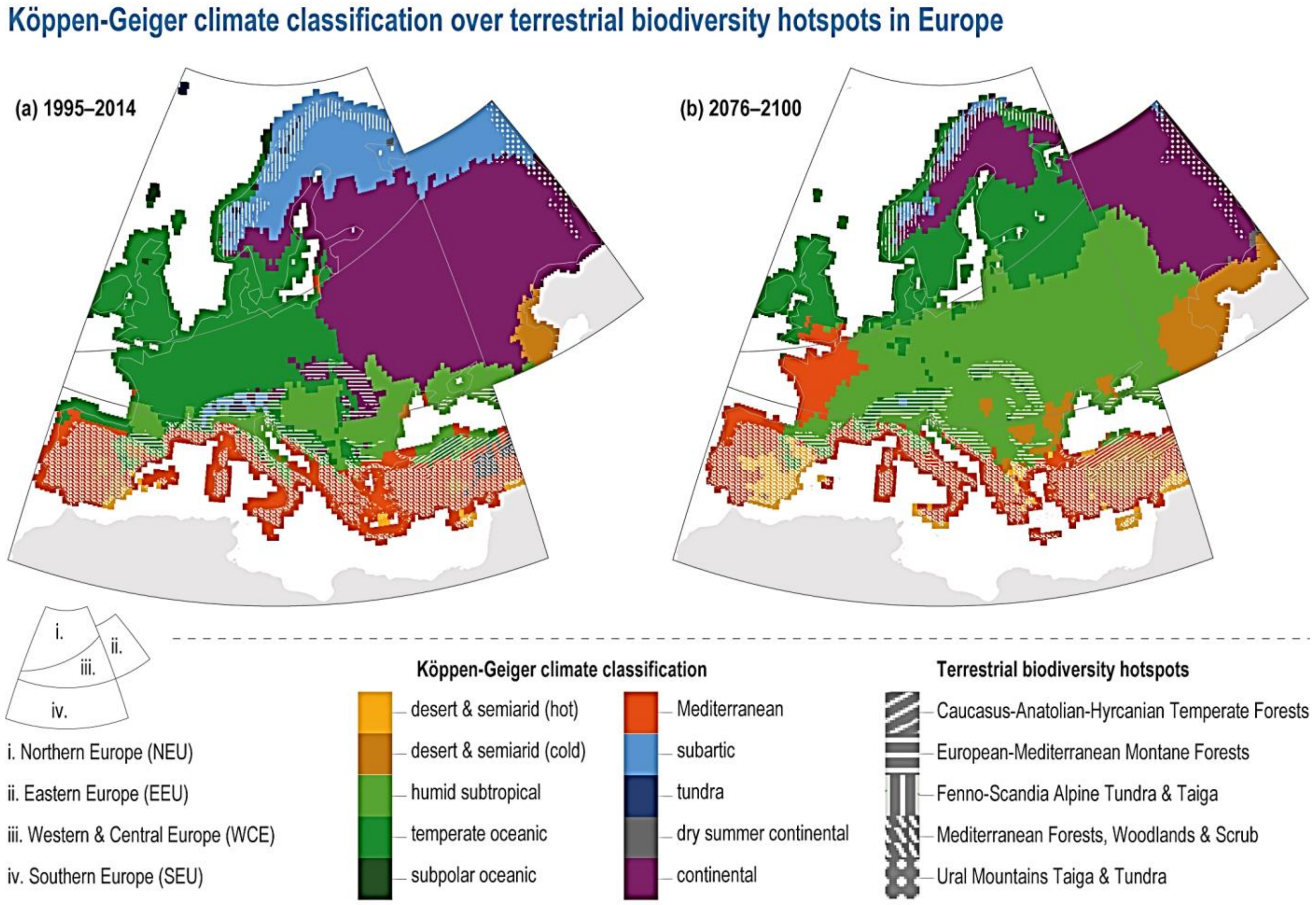
ADAPTATION OF AGRICULTURAL PRACTICES TO GLOBAL WARMING.

In the 6th assessment report (2022), the IPCC Group 2 presents numerous maps taking into account the different warming scenarios.

The document below summarises the evolution of climates in Europe by the end of the century.



Köppen-Geiger climate classification and biodiversity hotspots in Europe. Boundaries of the (a) Northern (NEU), (b) Western-Central (WCE), (c) Southern (SEU), and (d) Eastern (EEU) European regions for 1985-2014 (left) and 2076-2100 (right, A1FI scenario, ~4°C GWL), based on Rubel and Kottek (2010)

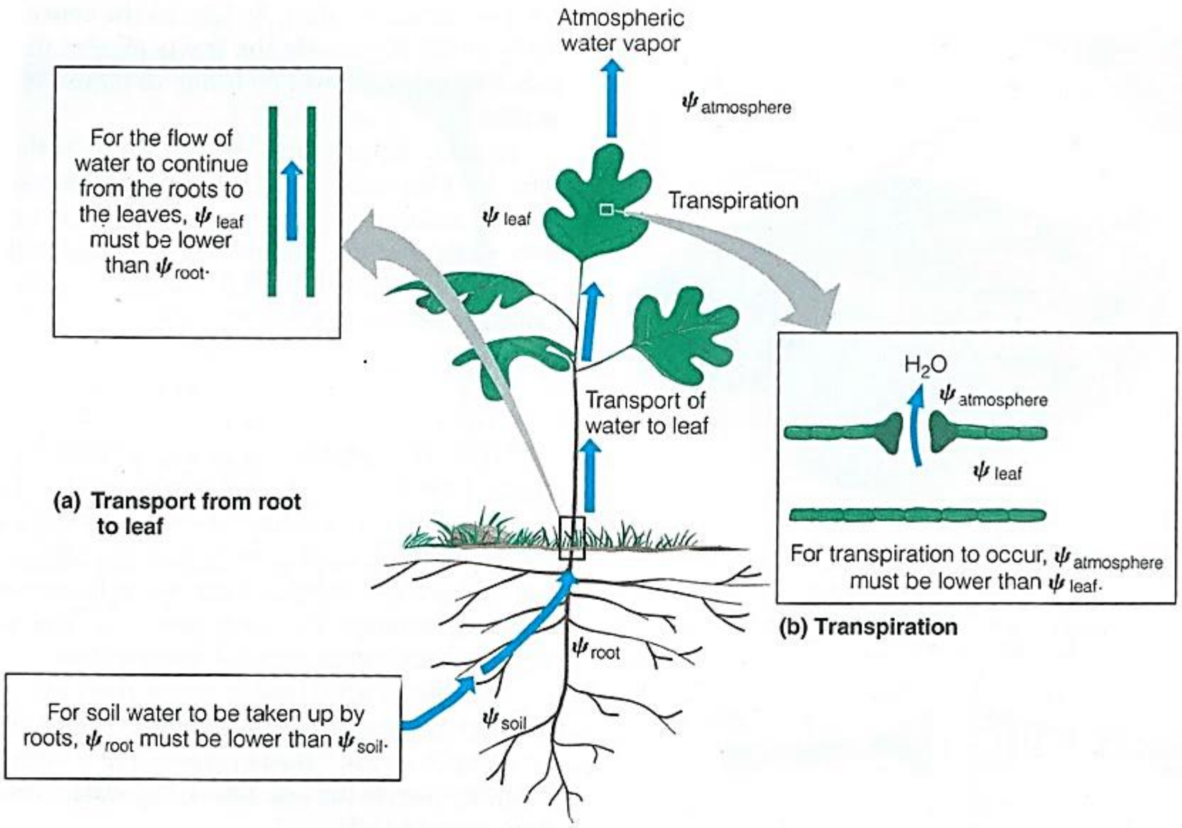
The consequences of climate change are countless and will have an increasing impact on every aspect of our daily lives. Agriculture is an essential sector that must already deal with climate change.

Among the five major risks, the IPCC identifies two that are typically agricultural: water and heat stress on crops, and water scarcity.

Throughout the 21st century, substantial losses in agricultural production throughout Europe are envisaged, without the gains in production in Northern Europe being able to compensate for them. While irrigation may be considered to limit the impact of global warming on agricultural crops, the decrease in water availability makes this option of little relevance.

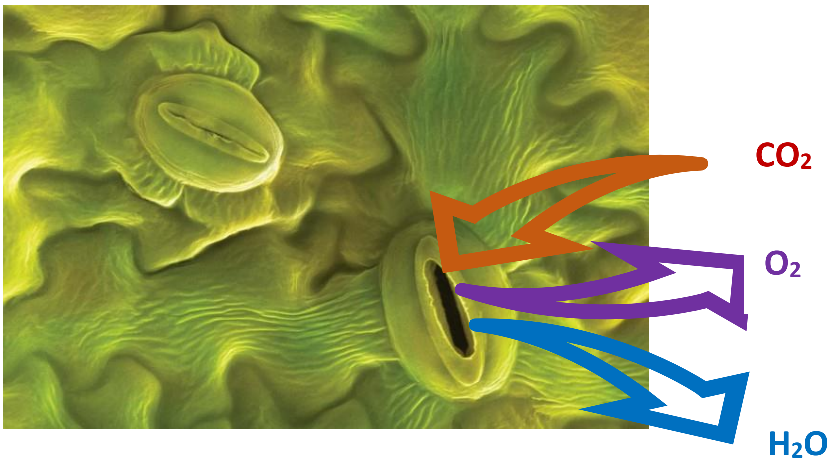
European agriculture must therefore adapt through changes in agricultural practices.

A quick presentation of the water balance at the level of an agricultural plant allows us to see the flow of water through it during a day.



It is of course the roots that draw from the soil most of the water needed for the plant's development. The capacity of the soil to make water available is therefore a central element of agricultural crops.

The leaf surface is the site of the evapotranspiration phenomenon, which allows the plant both to ensure root absorption and to regulate its temperature. Water vapour escapes from the plant through the stomata. Stomata are cellular structures that act like doors that can open and close to allow gases to flow through. During photosynthesis, CO2 enters the plant, while oxygen and water vapour escape.



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Although plants have mechanisms that allow them to adapt to situations of water stress, this is generally at the expense of their growth and therefore of biomass production.

Thus, to limit water loss through evapotranspiration, the plant can close its stomata. CO2 absorption is then reduced, as will be photosynthesis, which requires this compound for the synthesis of carbonaceous molecules such as sugars (for cereals), fatty acids (for oilseeds) and proteins (for legumes). In addition, the reduction of evapotranspiration leads to an increase in the temperature of the plant, which can be highly detrimental to it.

It is easy to understand that agriculture cannot afford such reactions if it aims to produce enough. The selection of agricultural species must therefore take into account their resistance to water stress without negative repercussions on the expected yield.

The table below gives an idea of the tolerance of some agricultural species to water stress.

	Risque climatique, esquive / évitement			Efficience de l'eau		Tolérance		Global
Espèce	Cycle cultural	Système racinaire	Degré de esquive / évitement	Efficience climatique	Efficience intrinsèque	Robustesse système végétatif	Robustesse système reproducteur	Appréciation, "réputation"
Colza	automne-printemps	profond	++++	+++	+	+	+	++++
Luzerne	pérenne	très profond	+++	++	+	+	+	++++
Vigne	pérenne	très profond	++++	+	++	+	+	++++
Blé	hiver-printemps	profond	+++	+++	+	++	++	+++
Tournesol	printemps-été	profond	+	+	-	++	+++	++
Orge	printemps-été	moyen	++	+	+	++	+++	+++
Sorgho	été	moyen	+	-	+++	++	+++	+++
Pois	printemps-été	faible	-	+	+	+	+	-
Maïs	été	moyen	+	-	+++	++	-	-

To interpret this table it is important to keep in mind that under similar climatic conditions, water requirements are roughly equivalent from one crop to another. For example, the water requirements of wheat and corn are similar (about 500 L/m²/year). However, depending on the length and phases of the growth cycle, the climatic risk is different:

Corn carries out most of its cycle in summer when the water deficit is highest. Wheat has a much longer cycle and starts at times when the water deficit is limited (autumn, spring).

Secondly, the degree of dodging or avoidance of the crop must be considered. This mainly corresponds to the ability of the plant to draw water from the deep layers of the soil. Alfalfa (Medicago sativa) has an extremely well-developed and deep root system, while peas (Pisum sativum), although belonging to the same family of Fabaceae, have shallow roots, making their cultivation hardly resistant to water stress.

Finally, the metabolism of certain plants makes them naturally resistant to drought. This is the case for plants with C4 photosynthesis such as Sorghum (Sorghum bicolor) and Corn (Zea maize). This very particular metabolism allows efficient photosynthesis to take place despite low CO2 availability caused by the closure of the stomata. However, these two species differ in their tolerance to water stress. While the entire vegetative and reproductive systems of sorghum are adapted to water stress, the highly developed reproductive system of corn is particularly sensitive to drought.

In conclusion, the adaptation of agricultural practices and crop types is a vital necessity. Climatic conditions, mainly water availability, but also soil erosion and the presence of pesticides make the status quo impossible. This metamorphosis of this economic sector must be accompanied by a complete rethink of the uses of agricultural land.

Is it reasonable to continue growing corn in a dry Mediterranean climate when we know its irrigation needs, that more than 70% of European production is intended for livestock feed and that an ever-increasing percentage is dedicated to the production of biofuel?