CLIMATE CHANGE

supPlant
More produce. Less water.

Climate Change? What is it? There seems to always be a large debate about what it is exactly and how it affects agriculture. How bad is it? How is it measured? Is it happening already, or will it occur in the future? We will answer those questions, providing facts and discussing what SupPlant, a company working with farmers for water optimization and yield sustainability, is doing to minimize the climate change concern to our customers.

Climate Change is defined as a long-term change in the earth's climate, especially a change due to an increase in the average atmospheric temperature. Long-term changes to the temperature. That seems simple enough?

It shouldn't be too hard to measure that? Well, there is some disagreement on how bad climate change really is. NASA says that Earth's global surface temperatures in 2017 ranked as the second warmest since 1880. Separately, scientists at the National Oceanic and Atmospheric Administration (NOAA) concluded that 2017 was the third-warmest year in their record.

Continuing the planet's long-term warming trend, globally averaged temperatures in 2017 was 0.90 degrees Celsius warmer than the 20th-century average. While a one-degree change may not be felt by us, it can have a huge impact on agriculture. Climate models are built to predict how major changes in the earth's atmosphere affect patterns. Each model differs in their assumptions, and as a result, there is significant variation in the projected results of different models.

Characteristics of Selected Climate Models Under a Doubling of CO2

GCM	Change in Global Mean Temperature (°C)	Change in Global Precipitation (percent)*
GISS	+4.2	+11.0
GFDL-R30	+4.0	+8.3
UKMO	+5.2	+15.0
OSU	+2.8	+7.8

* Estimates at regional levels vary considerably across seasons and regions and are much less certain. In some cases, estimates show reduced regional precipitation. Source: U.S. Country Studies Program

According to these models, the impact on crops will have wide variances. Corn in Brazil would have a -2% to -25% impact while in Argentina it would be -17% to -36% and the United States with -15% to -30%

(Source: IPCC).

Agriculture is highly dependent on the weather. Climate change causes more accurances of severe weather. Extreme conditions, such as floods, droughts, heavy rainfall, snow events, and heat waves can have substantial impacts on crops and challenge farmers. Torrential hurricanes, devastating droughts, crippling ice storms, and raging heat waves can have long-term effects on ecosystems.

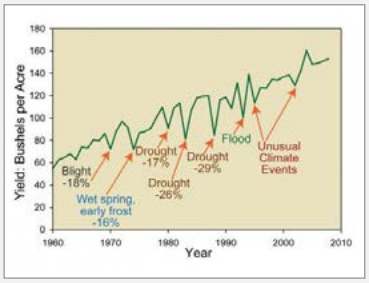
How often these extreme events occur will have major impacts on agriculture.

When long-term changes occur, effects on normal weather patterns occur. National Geographic put together *a lovely illustration* showing the amounts of climate-related events, many of which turned into disasters, that have been increasingly occurring.

These extreme occurrences, therefore, have large impacts on crop growth and yields. How and why? With punishing storms and severe droughts, the plants are put in excessive stress, which is not always good for a plant. The type of stress can be detrimental during its vegetative and productive stages, depending on crop types.

The changing climate affects the length and quality of the growing season and farmers could experience increasing damage to their crops, caused by a rising intensity of extreme climate events.

Below you can see how the EPA monitored events that have affected crop yields in the United States since 1970. The slight upward trend, from technological improvements that increase yields, is impacted through extreme events causing significant reductions.



We can see that climate change also causes unknown and unusual weather events more often.

Source: USGCRP (2009)

At SupPlant we are able to monitor how these events affect the plants, and we act accordingly to protect and nuture the crops. When working with growers, we start with a weather station, measuring temperature, wind speed & direction, precipitation as well as many more variables. These variables are the basis to doing our analysis. We then monitor how the plant is doing, connecting to the soil of its roots to the expansion of its leaves. Maintaining an optimal moisture in the soil for the plants is just one of the many tasks we perform daily. We see all the changes and when an extreme event occurs, are made aware of how that is affecting the stress of the plant. Our automated closed-loop system then acts on sophisticated algorithms designed based on years of agronomical experience and including machine learning and other prevalent models. Our systems quantify stress through plant growth patterns and then minimize it through extremely precise irrigation, by calculating the correlation between the stress levels of the plant and the water content in the soil.

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Water is critical to agriculture. Too little or too much at the wrong time can affect the overall health and growth potential. Without it, we couldn't provide sustenance to nurture and propagate plants. Climate changes may impact water more than any other element. We do know that if global temperatures would increase, more water would evaporate from the land from higher temperatures. Changes in amounts of rainfall as well as weather patterns will affect irrigation sources; river and aquifers. With more intense weather patterns coming from an increase in water vapor concentration, these more intense rainstorms could cause flooding and soil damage. Dealing with drought is challenging enough. Combined with rising summer temperatures, soils can become drier, requiring more water to irrigate.

Climate change could reduce the availability or reliability of water supplies in many places already subject to water scarcity. Cape Town, for example, is experiencing the worst water shortage, as two consecutive years of drought were followed by one of the driest years in 2017. Water supplies are being significantly reduced and worst yet could be completely stopped.

As agriculture is responsible for 70% of freshwater withdrawal globally, these impacts must be considered in the bigger picture of water scarcity and agricultural development. With access and water sources being harder to acquire, we may be leaving less water available for irrigation when more is needed.

Changes in temperature and increases in atmospheric carbon dioxide (CO2) could have significant impacts on crop yields. While an increase in temperature could help many crops in certain regions, if the temperature exceeds a crop's optimum temperature, yields will decline.

Weather and temperature are how climate change affects Agriculture growth. We know that climate changes that have caused disruptions to agricultural production and occurrences are becoming more common. For example, in 2010 and 2012, high temperatures at night negatively affected corn yields across the U.S. Corn Belt. Premature budding from warm winter in 2012 caused $220 million in losses to Michigan cherry growers. Additionally, this past year over 80% of Georgia peaches were lost from the warm winter.

Overall, climate change could make it more difficult to grow crops in the same ways and same places as we have done in the past.

The future course of global food production will depend on how well we can adapt to such climatic changes utilizing technological advancements that allow farmers to be on the winning side of climate changes. Adapting to these changes SupPlant provides a technology that assists in the unknown. We monitor the needs of the plants in order to ensure a sustainable yield.

The Paris Agreement, which in 2015 established many climate change protocols and Sustainable Development Goals (SDGs), provides an international framework for increasing actions and effective efforts to sustainable development. According to the FAO, in order to contribute to these goals the following intertwined challenges must be tackled:

- Sustainably increasing agricultural productivity and incomes
- Building resilience to the impacts of climate change
- Contributing to climate change mitigation where possible

By lowering water usage while maintaining or increasing yields assists, SupPlant provides savings to farmer's income. Our unique GBI technology monitors the plant's health to ensure consistency during the growth cycles. Our technology is based upon agronomical knowledge to keep the plant at its optimal potential during the phenological stages.

There are many options for climate change adaptation and will vary according to the specific types of stress the system is facing, the farmers' coping and adaptive mechanisms, and the degree to which each climate factor affects yields. SupPlant systems monitor the stress the plants feel and how climate changes are affecting them. Working with farmers, a livelihood of 1/3 of the world's population, we provide access to a deep well of knowledge through technological awareness, helping them manage crops better, not work harder.

The last and most crucial aspect of climate change is the loss of farming know-how. For decades farmers have learned how to grow in certain climatic conditions, becoming more professional in the technological and agronomical aspects. The extreme climate shifts make many practices irrelevant, requiring a technology that can adapt in real time to the climatic. Our system does exactly that. SupPlant's closed-loop autonomous irrigation technology irrigates according to real-time conditions.

We will constantly thrive to challenge the ag-tech frontiers to facilitate the growth of farmers feeding the world whatever obstacles come our way.