

# **NASA Earth Exchange (NEX) Downscaled Climate Projections of Maximum Daily Temperatures for the USA**

**October 2020**

**Peter Carter**

**Daily regional maximum actual temperatures  
for the high emissions RCP scenario RCP 8.5  
(which the world is tracking)  
correlated with the global average surface temperature increase  
from 1.5°C to 4.3°C**

**The regional daily maximum temperatures are presented here with respect to the temperature crop tolerance of 30°C.**

**There are other adverse effects of global warming, such as climate variability, increased tropospheric ozone, increased regional drought, increased weeds, increased pests and increase plant pathogens.**

**At 1.9°C the USA is at risk of losing a large area of crop production to heat intolerance.**

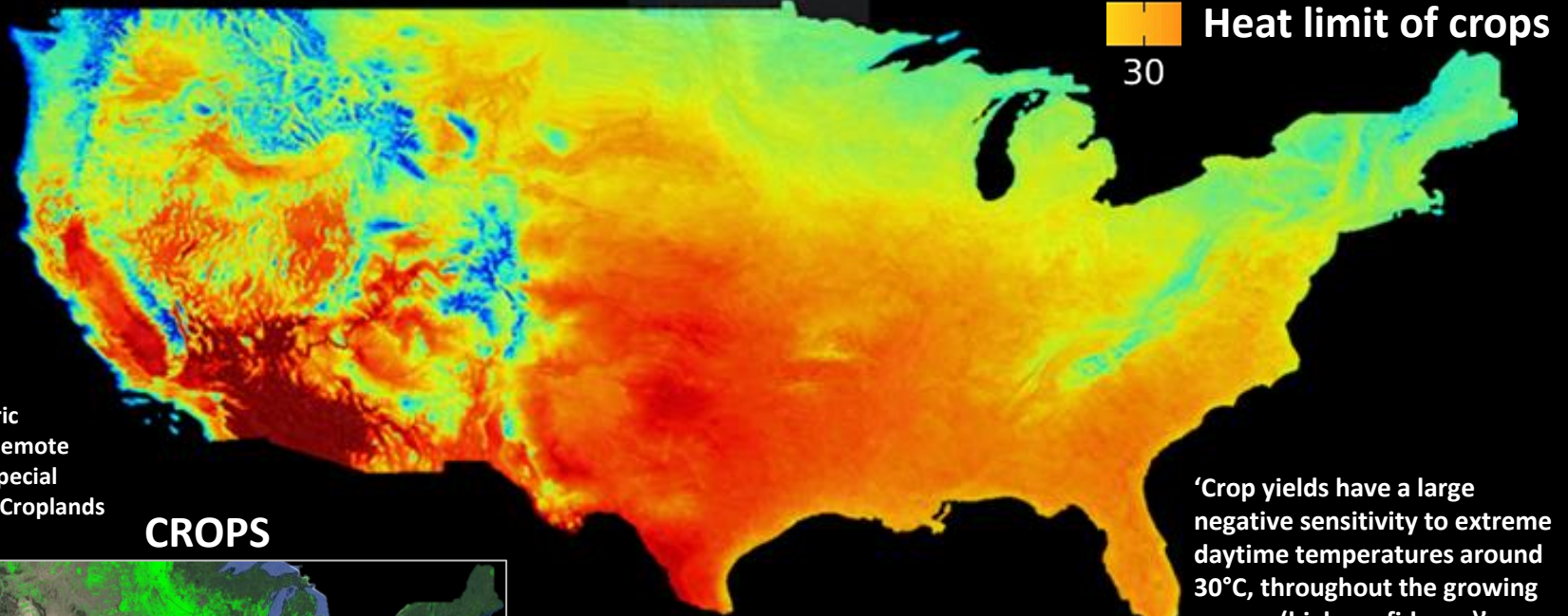


**CLIMATE EMERGENCY INSTITUTE**

**The Health and Human Rights Approach to Greenhouse Gas Pollution**

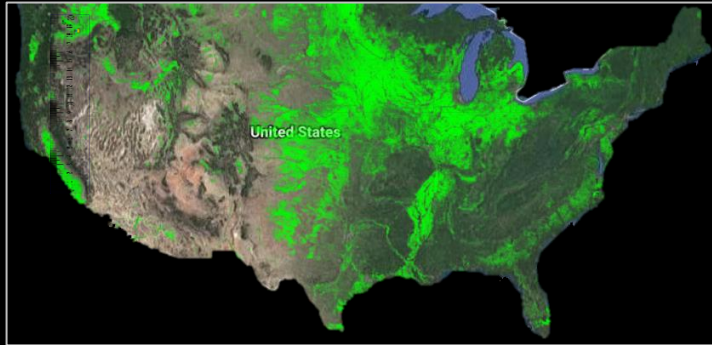
By 2030

# The USA at 1.6°C (from pre-industrial)



Photogrammetric  
Engineering & Remote  
Sensing, 2012 Special  
Issue on Global Croplands

## CROPS

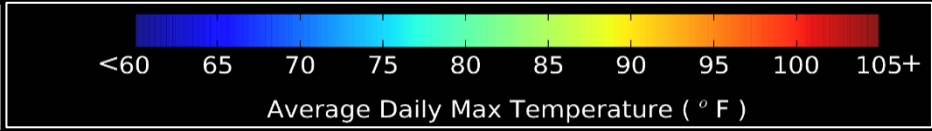
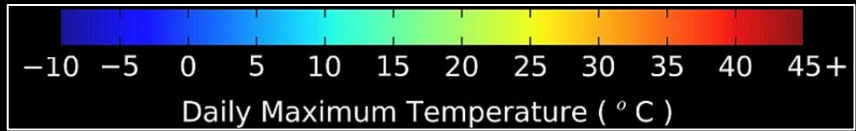


'Crop yields have a large negative sensitivity to extreme daytime temperatures around 30°C, throughout the growing season (high confidence)'.  
(IPCC AR4 WG2 TS)

July, 2030

Highest Greenhouse Gas Concentration Pathway

Possible perhaps with immediate rapid decline of global emissions from 2020



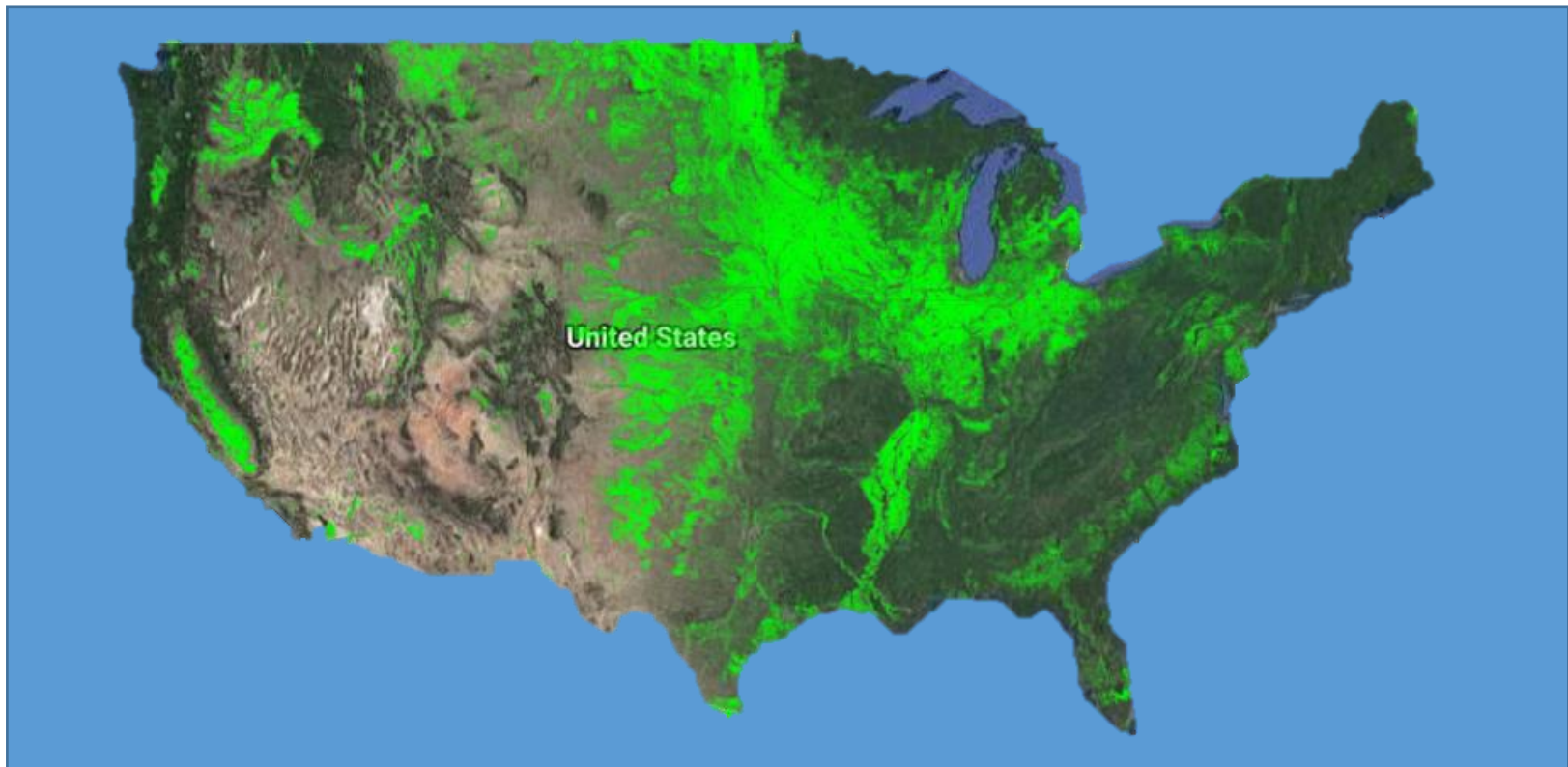
Carbon dioxide emissions and atmospheric concentrations are tracking the worst case scenario (RCP 8.5)

# United States Food Production Maps

## United States food producing land by remote sensing

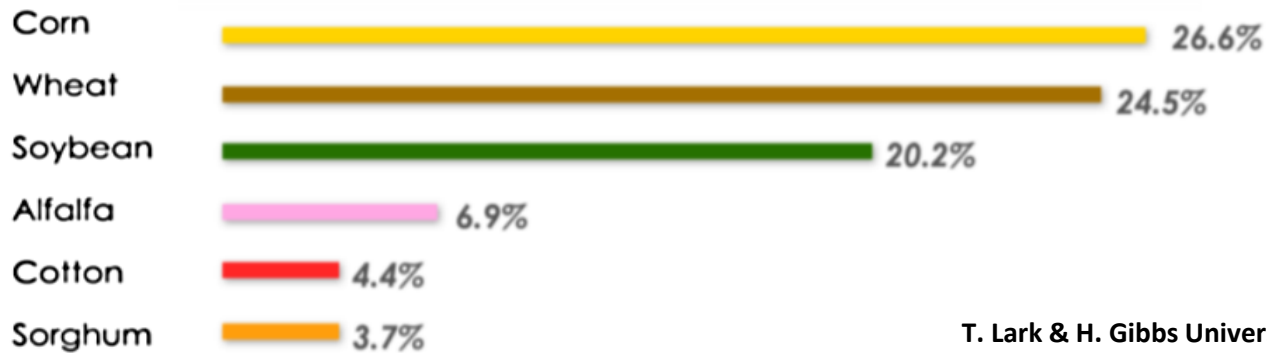
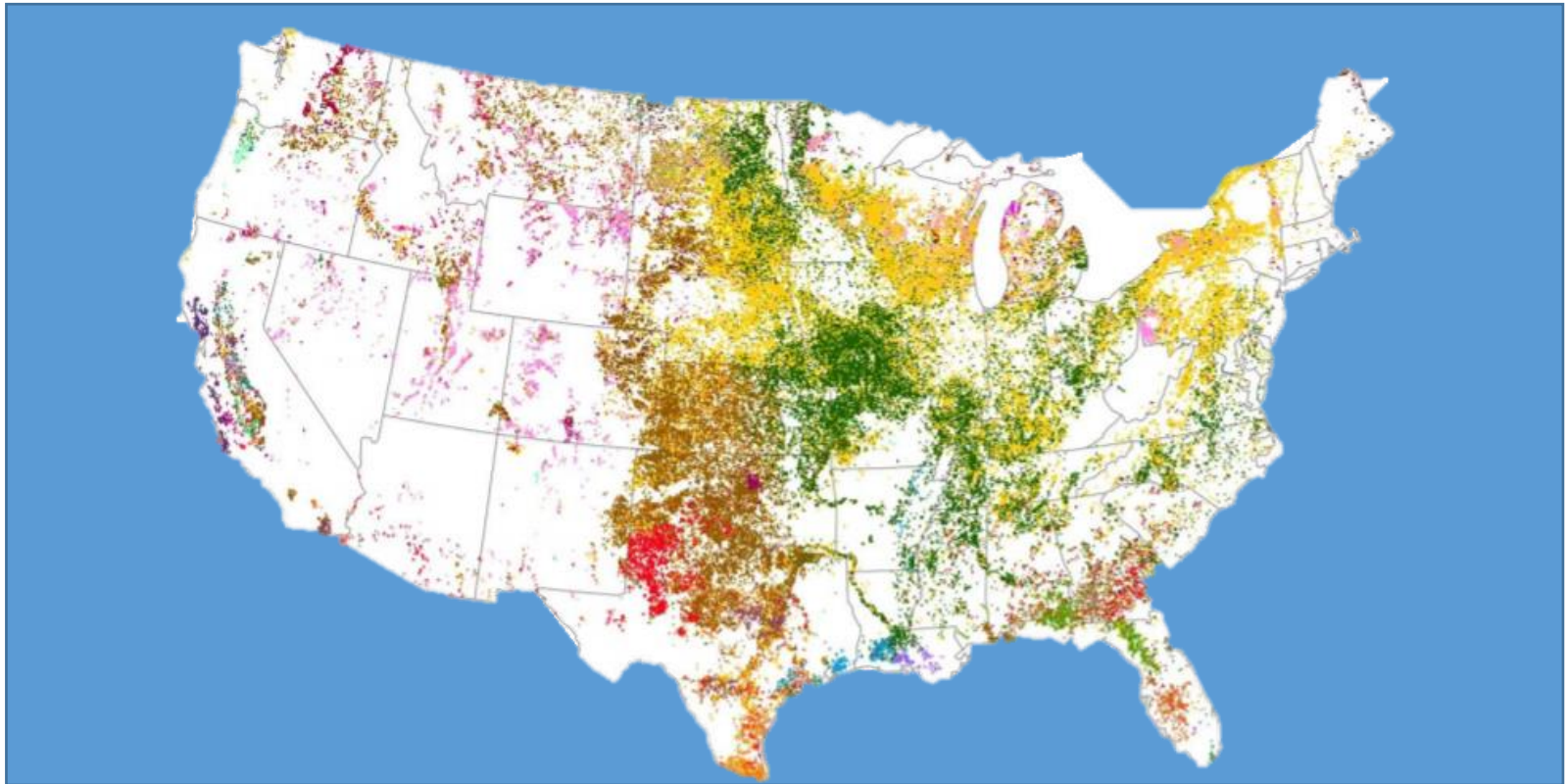
Global Food Security Analysis-Support Data at 30 Meters (GFSAD30) Project

*Photogrammetric Engineering and Remote Sensing, August 2012 Special Issue  
on Global Croplands:*



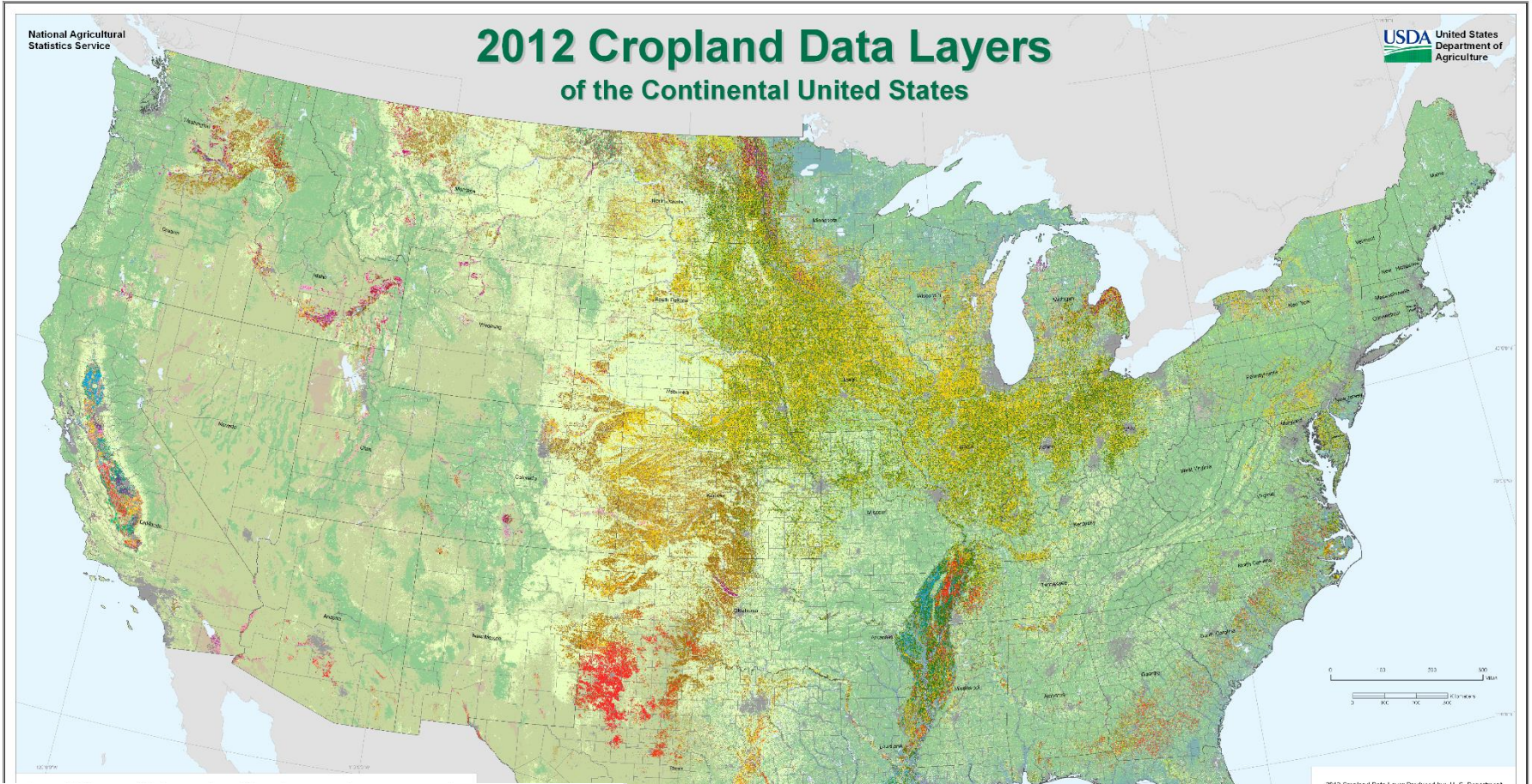
# United States Food Production Maps

## Main United States croplands





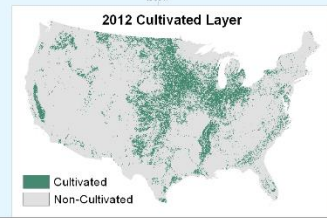
# 2012 Cropland Data Layers of the Continental United States



## Land Cover Categories (by decreasing acreage)

### Agriculture

- |                          |                       |                    |
|--------------------------|-----------------------|--------------------|
| Pasture/Grass            | Dry Beans             | Peas               |
| Corn                     | Canola                | Other Small Grains |
| Soybeans                 | Sunflower             | Millet             |
| Winter Wheat             | Peanut                | Rye                |
| Fallow/Idle Cropland     | Oats                  | App                |
| Other Hay/Non Alfalfa    | Sugarbeets            | Pec                |
| Alfalfa                  | Potatoes              | Len                |
| Cotton                   | Almonds               | Ton                |
| Spring Wheat             | Grapes                | Wal                |
| Sorghum                  | Sugarcane             | Aqu                |
| Dbl Crop WinWht/Soybeans | Oranges               | Pistachios         |
| Barley                   | Misc Veggies & Fruits | Cherries           |
| Rice                     | Other Crops           | Citrus             |
| Durum Wheat              | Sod/Grass Seed        | Blueberries        |



2012 Cropland Data Layer Produced by: U. S. Department of Agriculture, National Agricultural Statistics Service, Research and Development Division, Geospatial Information Branch, Spatial Analysis Research Section.

Cropland Data Layer CropScape Website: <http://nassgeodata.gis.usda.gov/CropScape/>

Data Sources: Landsat 5 TM, Derivatives: 1: 1K, 250M, 250M, 250M, 250M (Courtesy of USDA Foreign Agricultural Service).

Image Processing: RasterQuest See5 and ERDAS Imagine software.

Ground Truth: The Farm Service Agency Composite Land Use for crop classes, and 2008 National Land Cover Dataset (NLCD) for non-agricultural classes.

Auxiliary Data: NLCD Impervious Surface, NLCD Forest Category, National Elevation Dataset.

Disclaimer: Small area crops may be less accurate, see CropScape metadata.

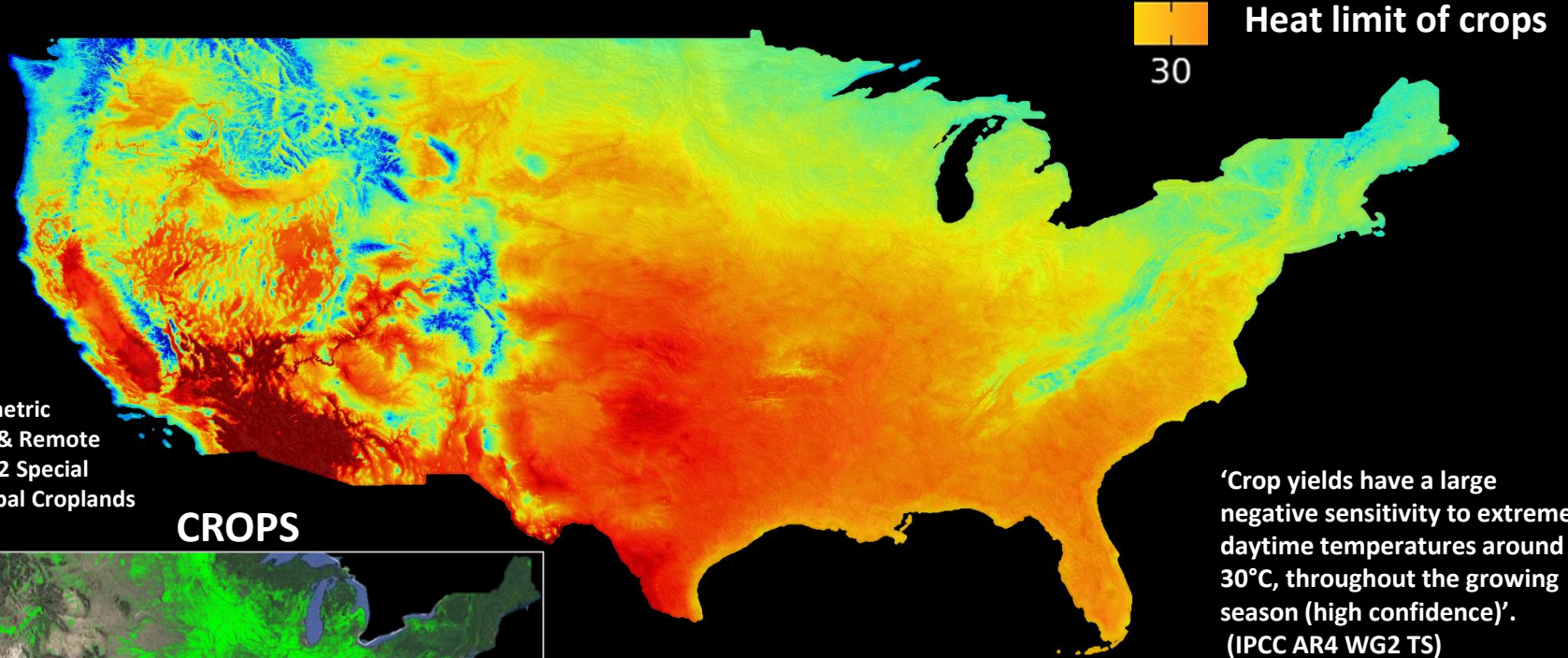
Catographic Generalization: Smaller categories are combined with larger categories.

Projection: Albers Equal Area Conic Projection, NAD 1983 datum.

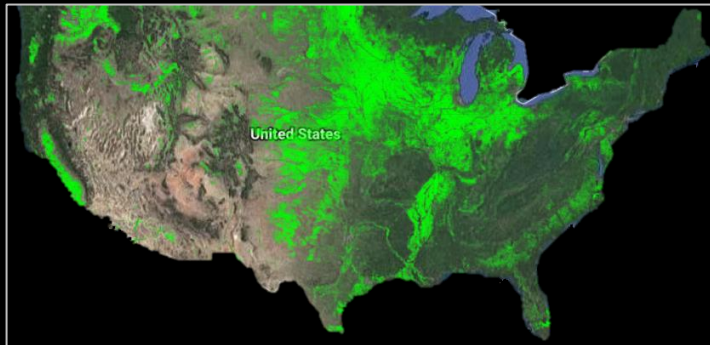
Map Production: ESRI ArcGIS 10.



# The USA at 1.6°C (from pre-industrial)



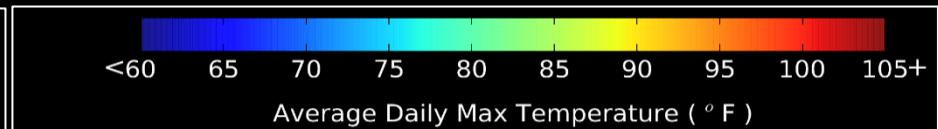
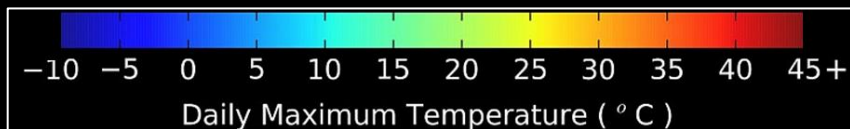
## CROPS



July, 2030

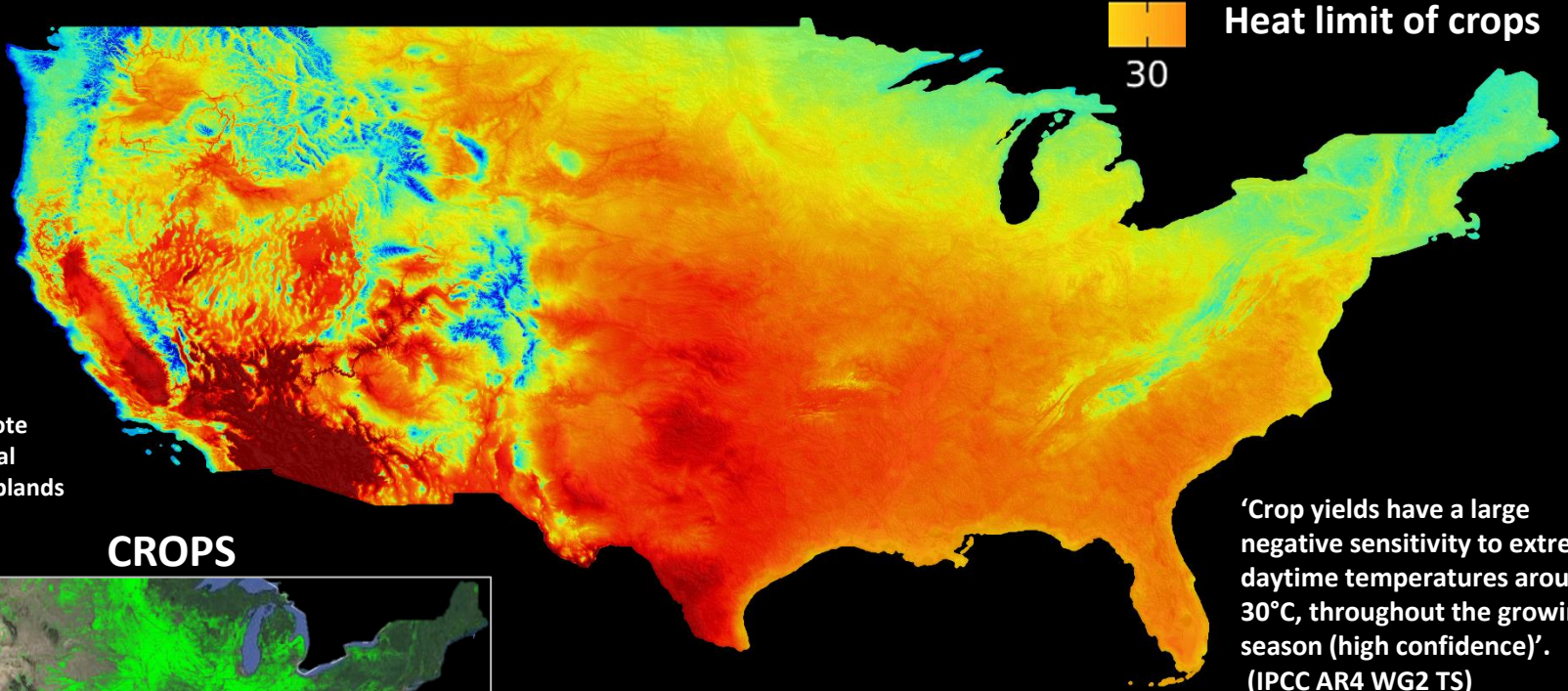
Highest Greenhouse Gas Concentration Pathway  
Average Daily Max Temperature

Possible perhaps with immediate (2020) rapid decline of global emissions (IPCC 218 1.5°C Report)



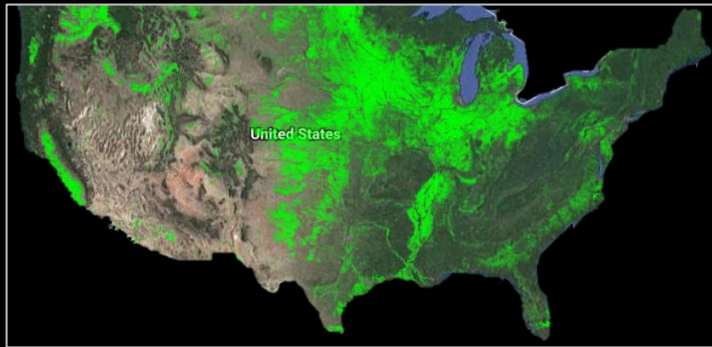
2018 carbon dioxide emissions and atmospheric concentrations are tracking the worst case scenario (RCP 8.5)

# The USA at 1.9°C (from pre-industrial)



'Crop yields have a large negative sensitivity to extreme daytime temperatures around 30°C, throughout the growing season (high confidence)'. (IPCC AR4 WG2 TS)

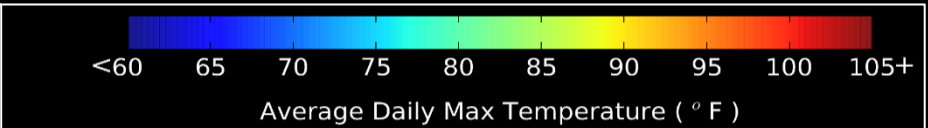
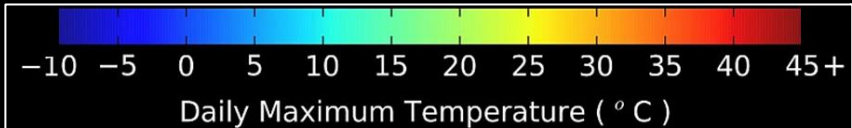
## CROPS



July, 2040

Highest Greenhouse Gas Concentration Pathway  
Average Daily Max Temperature

Locked in without immediate (2020) rapid decline of global emissions (IPCC 218 1.5°C Report)



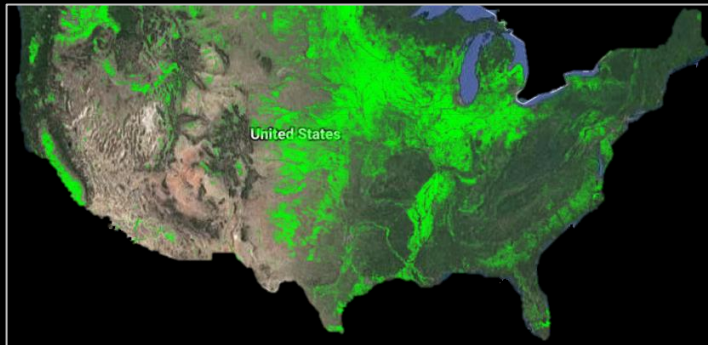
2018 carbon dioxide emissions and atmospheric concentrations are tracking the worst case scenario (RCP 8.5)



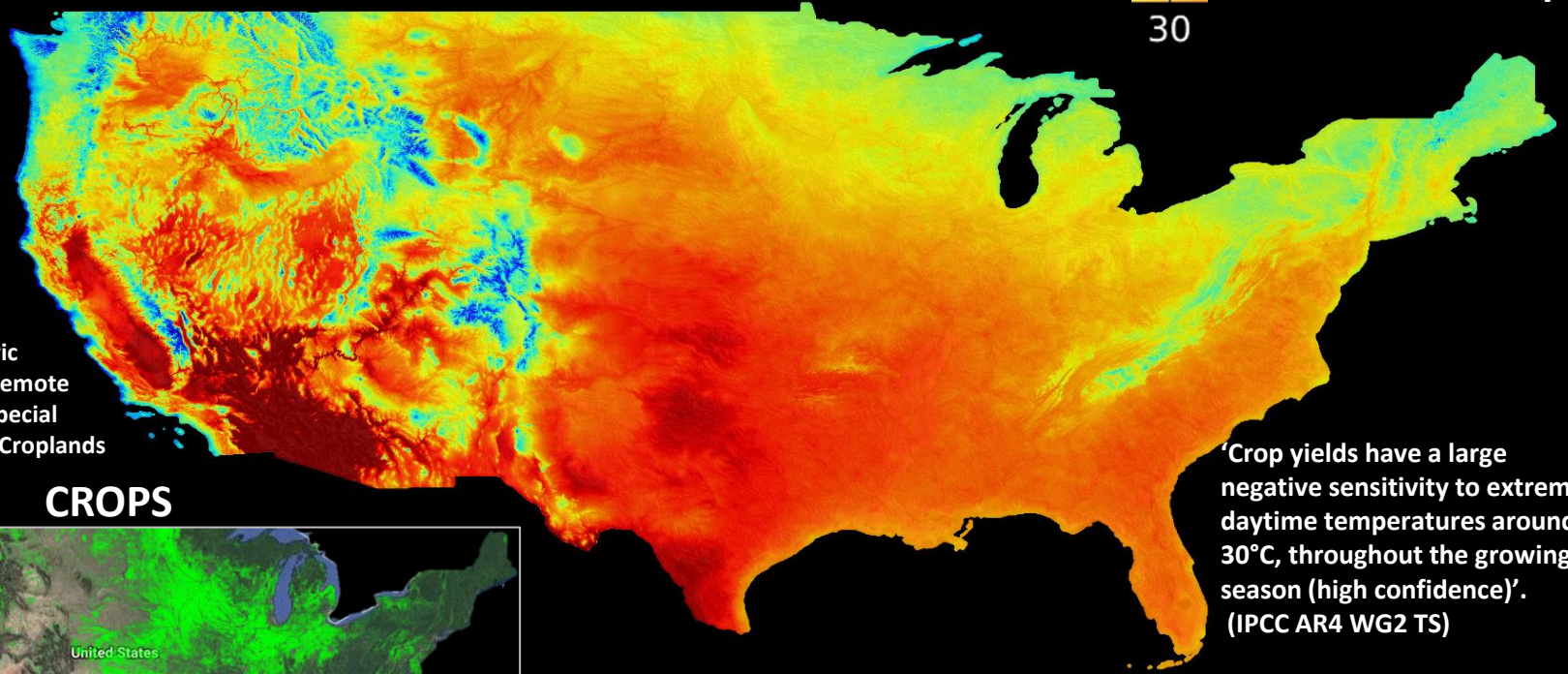
# The USA at 2.5°C (from pre-industrial)

Photogrammetric  
Engineering & Remote  
Sensing, 2012 Special  
Issue on Global Croplands

## CROPS



 Heat limit of crops  
30

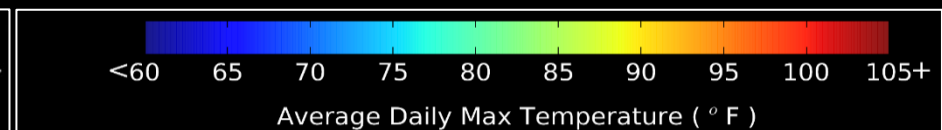
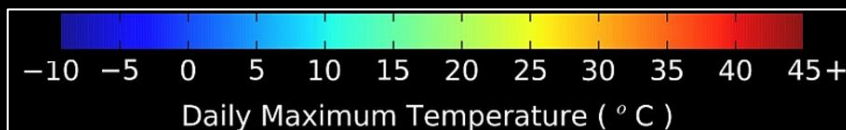


'Crop yields have a large negative sensitivity to extreme daytime temperatures around 30°C, throughout the growing season (high confidence)'.  
(IPCC AR4 WG2 TS)

July, 2050

Highest Greenhouse Gas Concentration Pathway

Average Daily Max Temperature

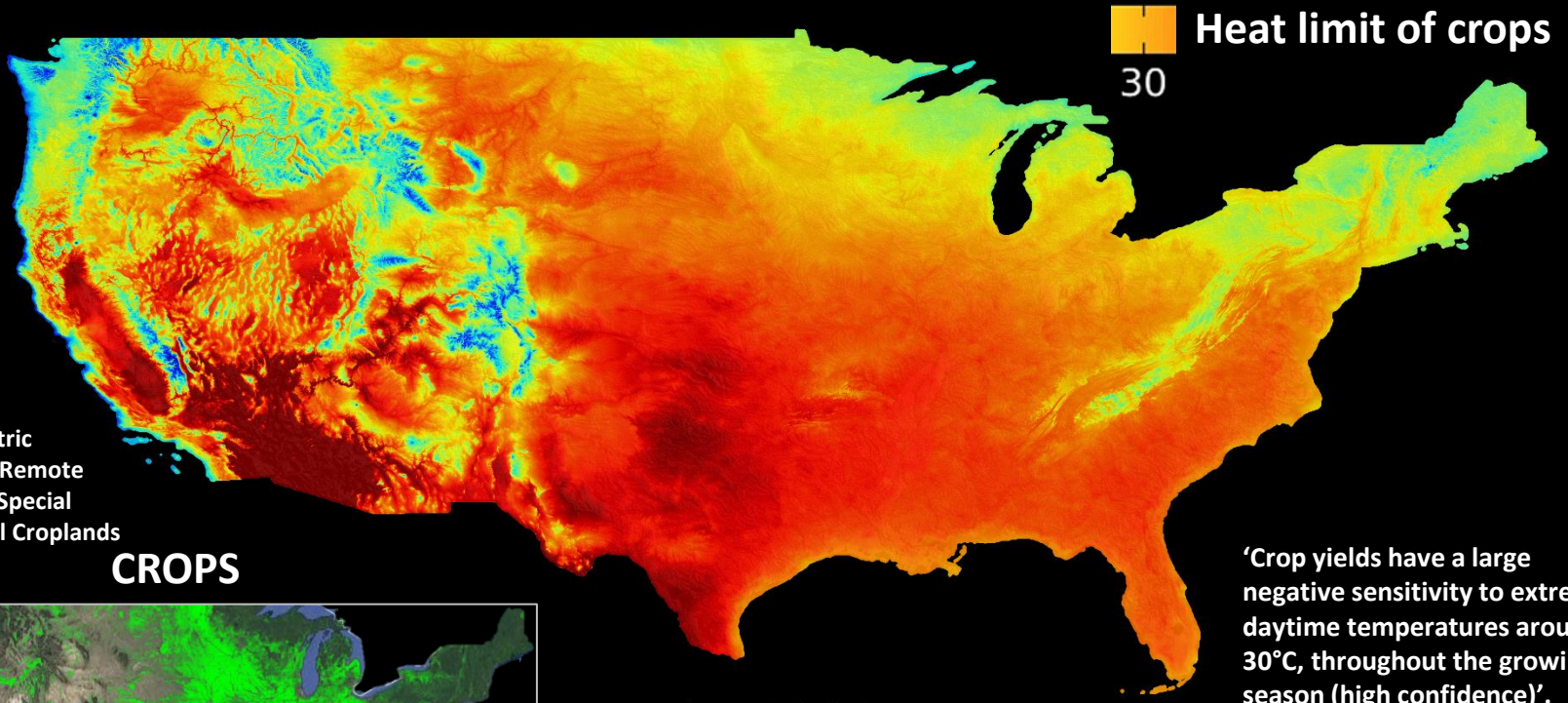


2018 Carbon dioxide emissions and atmospheric concentrations are tracking the worst case scenario (RCP 8.5)



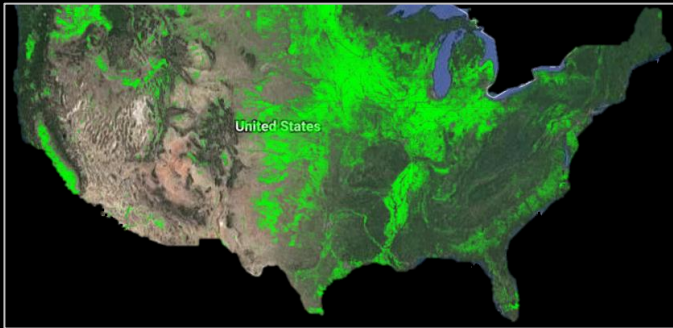
# The USA at 2.7°C

Lowest estimate Combined national emissions targets



Photogrammetric Engineering & Remote Sensing, 2012 Special Issue on Global Croplands

## CROPS

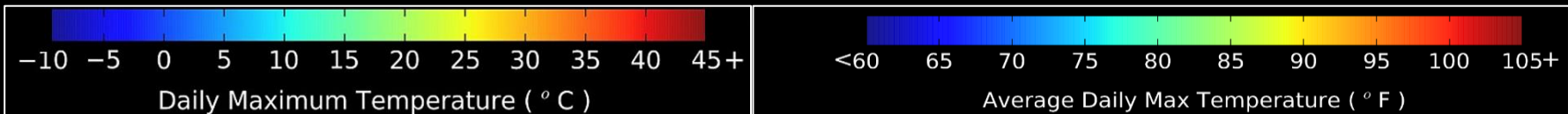


'Crop yields have a large negative sensitivity to extreme daytime temperatures around 30°C, throughout the growing season (high confidence)'. (IPCC AR4 WG2 TS)

July, 2060

Highest Greenhouse Gas Concentration Pathway

Average Daily Max Temperature



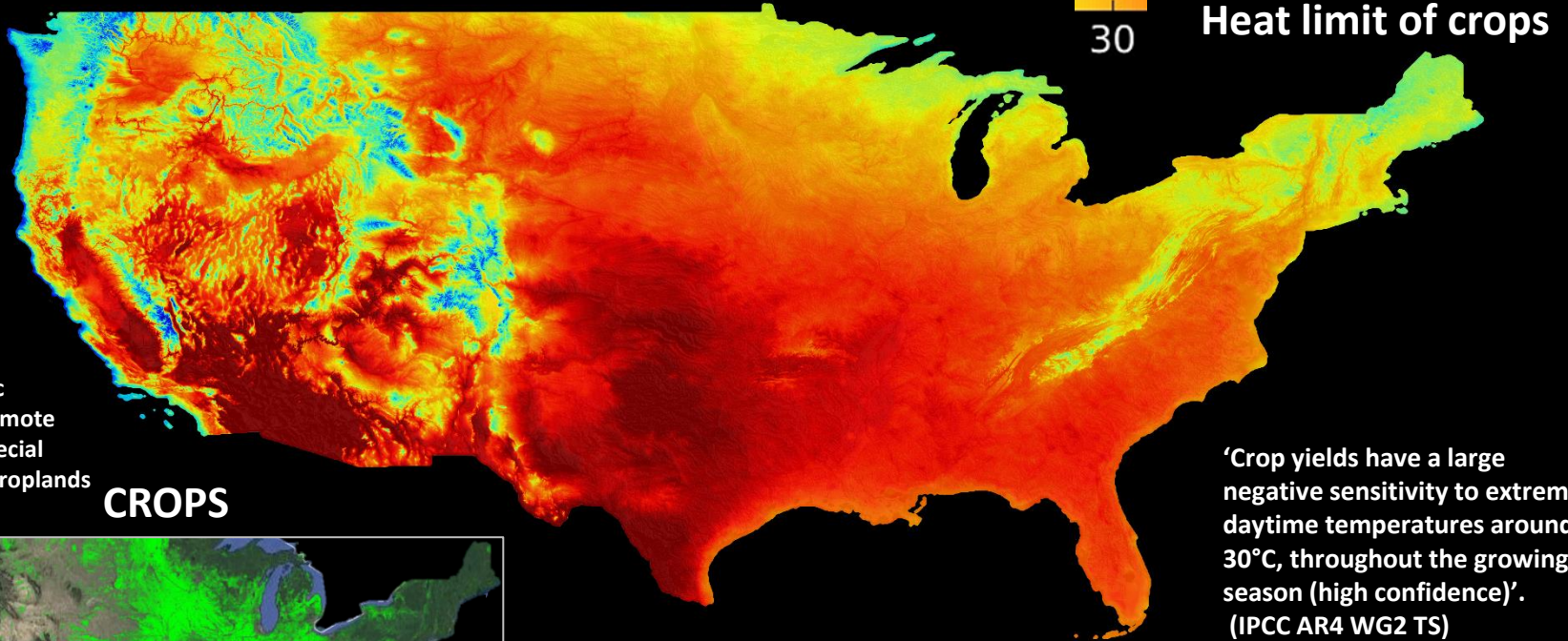
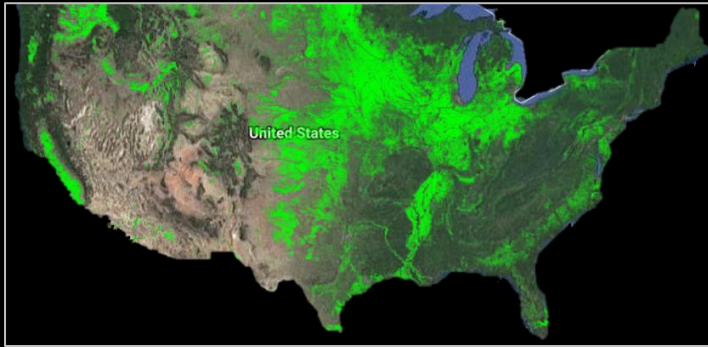
2018 carbon dioxide emissions and atmospheric concentrations are tracking the worst case scenario (RCP 8.5)

# The USA at 3.2°C

Combined national emissions targets

Photogrammetric Engineering & Remote Sensing, 2012 Special Issue on Global Croplands

## CROPS

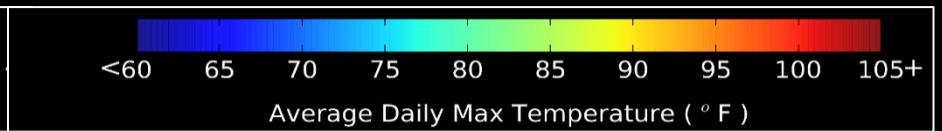
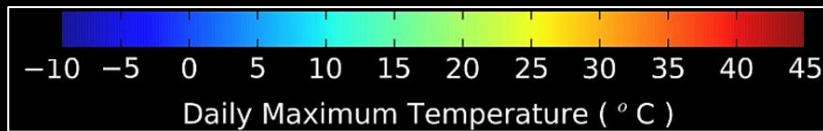


'Crop yields have a large negative sensitivity to extreme daytime temperatures around 30°C, throughout the growing season (high confidence)'. (IPCC AR4 WG2 TS)

July, 2070

Highest Greenhouse Gas Concentration Pathway

Average Daily Max Temperature

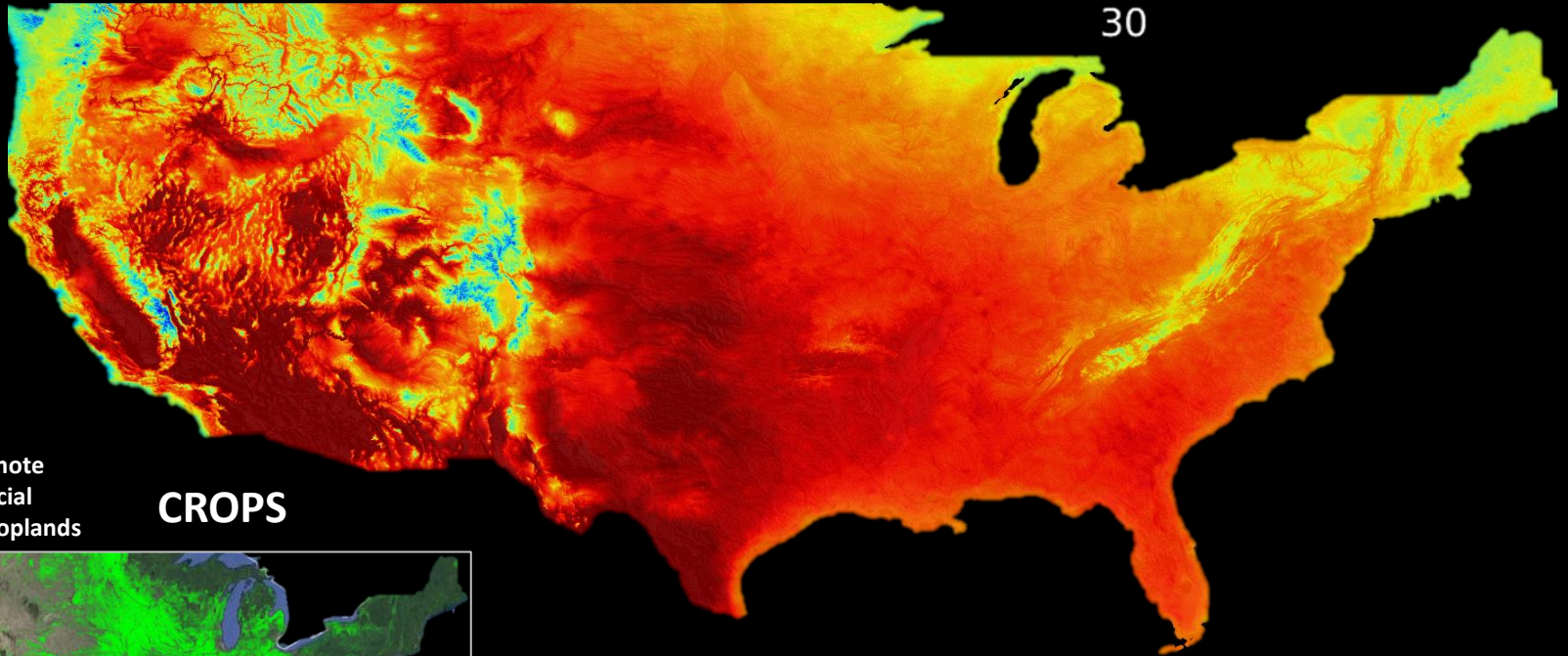


2018 carbon dioxide emissions and atmospheric concentrations are tracking the worst case scenario (RCP 8.5)



# The USA at 3.7°C (from pre-industrial)

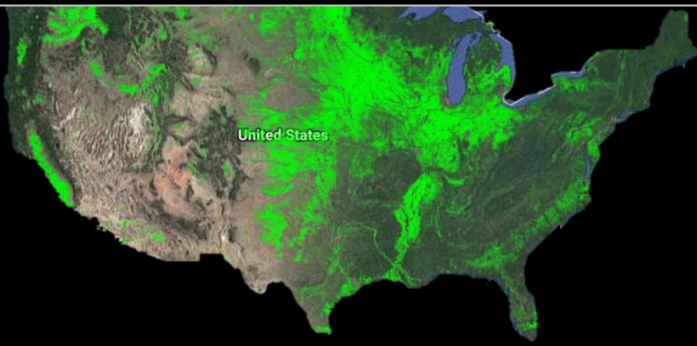
Heat limit of crops  
30



CROPS

Average Daily Max Temperature

Photogrammetric  
Engineering & Remote  
Sensing, 2012 Special  
Issue on Global Croplands



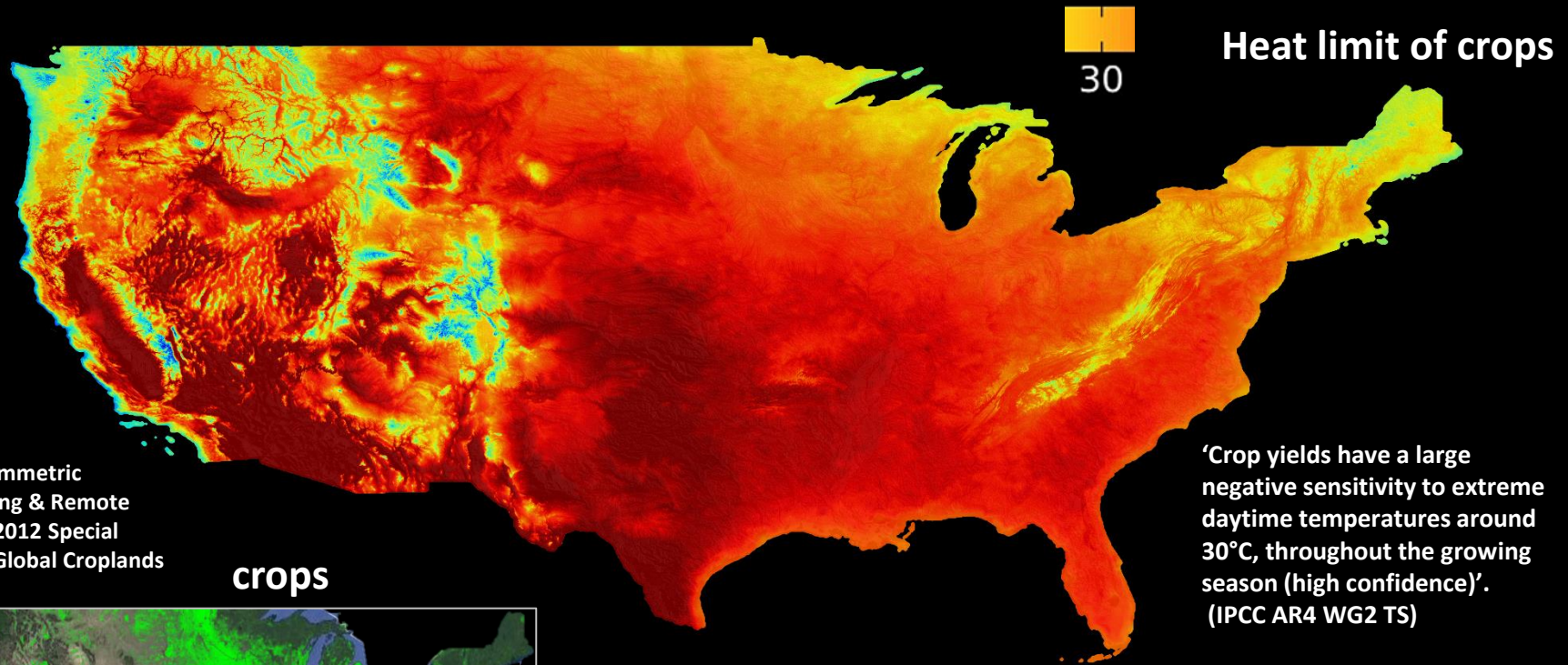
-10 -5 0 5 10 15 20 25 30 35 40 45

Daily Maximum Temperature ( ° C )

<60 65 70 75 80 85 90 95 100 105+

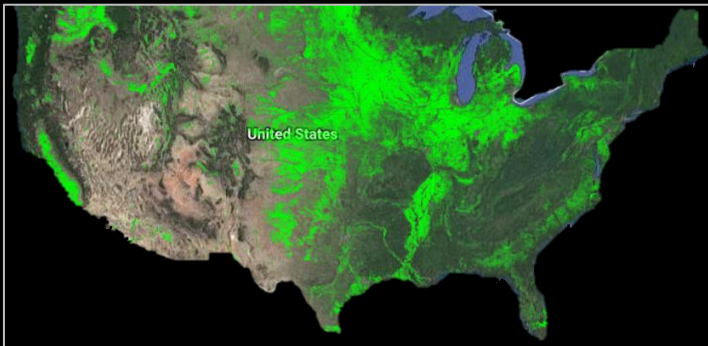
Average Daily Max Temperature ( ° F )

# The USA at 4.2°C (from pre-industrial)



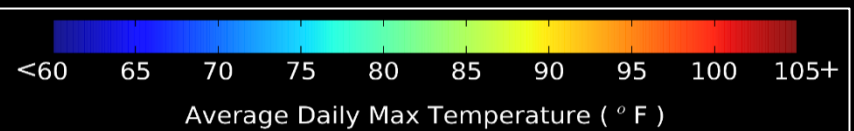
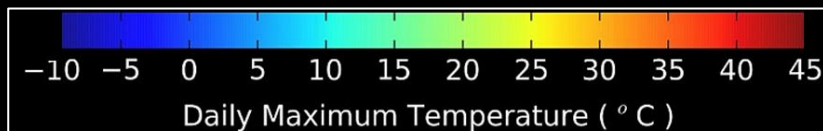
Photogrammetric  
Engineering & Remote  
Sensing, 2012 Special  
Issue on Global Croplands

**crops**



Highest Greenhouse Gas Concentration Pathway

Average Daily Max Temperature





# Derivation of global average surface average temperature increases from the IPCC AR5 highest emissions scenario RCP 8.5

IPCC AR5 RCP scenario model projections of global surface temperature increase from 1850 by 2100

