Traditional agricultural research is mostly conducted at specific locations. It’s a challenge to interpret results and upscale them to larger spatial scales. TEDs classify sites based on key climate and soil factors that govern crop yield. Concept was developed in the context of the Global Yield Gap Atlas project. TEDs have been developed for the United States (US) and sub-Saharan Africa and an online interactive tool is available for the TEDs in central & eastern US.
• **If you are a farmer:**
  View results of product trials to see if trials were conducted in regions with similar climate and soils to yours.

• **If you conduct ag research:**
  You might want to consider conducting research in a variety of TEDs to capture varying climate and soil conditions and represent well the main crop producing areas and/or those where your product is expected to deliver the largest impact.
Access TED interactive tool via GYGA

From GYGA Homepage, click on GYGA data -> Technology extrapolation domain

Click on the link that will direct to TED tool
TED interactive tool

Selected TEDs cover 70.3% (60790465 acres) of corn area in central/eastern U.S.

Select TEDs with corn area

Additional selection by TED climate-soil attributes:
- Soil water storage
- Growing degree days
- Arability index
- Temperature seasonality

<table>
<thead>
<tr>
<th>TED</th>
<th>Corn area (ac)</th>
<th>% of corn area</th>
</tr>
</thead>
<tbody>
<tr>
<td>504063</td>
<td>554078</td>
<td>6.2%</td>
</tr>
<tr>
<td>604063</td>
<td>51436072</td>
<td>6.0%</td>
</tr>
<tr>
<td>603963</td>
<td>4212234</td>
<td>4.9%</td>
</tr>
<tr>
<td>604063</td>
<td>3672964</td>
<td>4.3%</td>
</tr>
<tr>
<td>603763</td>
<td>3676909</td>
<td>3.6%</td>
</tr>
<tr>
<td>603363</td>
<td>2897719</td>
<td>3.4%</td>
</tr>
<tr>
<td>604363</td>
<td>2743666</td>
<td>3.2%</td>
</tr>
<tr>
<td>504063</td>
<td>2055125</td>
<td>3.0%</td>
</tr>
<tr>
<td>404063</td>
<td>2542499</td>
<td>2.9%</td>
</tr>
<tr>
<td>303763</td>
<td>1836078</td>
<td>2.1%</td>
</tr>
<tr>
<td>403763</td>
<td>1813673</td>
<td>2.1%</td>
</tr>
</tbody>
</table>
Components of TEDs

Unique TED = CZ + RZWHC

Climate Zones (CZ)
- Growing degree days (GDD)
- Aridity index (AI)
- Temperature seasonality (TS)

Soil water storage capacity
- Root-zone water holding capacity (RZWHC)

Source: van Wart et al. (2013)
Source: gSSURGO, USDA-NRCS
TED = CZ + RZWHC

Example TED value: 604803
- RZWHC = 600000
- CZ:
  - GDD [Growing degree days] = 4000
  - AI [Aridity index] = 800
  - TS [Temperature seasonality] = 03
List of TEDs within the TED tool
Corn area (and % of corn area) represented by each TED was shown.
Users can select areas to display based on:
i. Target corn area
ii. Actual corn production (corn mask)
iii. State
iv. User-defined rectangle
v. Specific sites (GPS coordinates)
vi. TED climate-soil attributes
i. Target corn area

Selected TEDs cover 70.3% (80,703,456 acres) of corn area in central/eastern US.

Default target corn area once tool opens is 70%

TEDs highlighted in yellow were the selected TEDs based on the performed selection.
• When the tool first loads, you see only the TEDs that cover the top 70% of corn producing area in the US
• You can choose to view any % of corn area up to 100% - but the tool performs less efficiently at 100% scale, and includes even areas with very small % of corn area (see next slide)
• The pre-filter of 70% was chosen to increase efficiency and speed of loading
Target corn area: 100%
Checking “apply corn mask” further filters areas where corn is produced.

Corn mask is based on 2015 USDA-NASS crop area data map.
Each color corresponds to TED. In case of Iowa, production area were categorized into seven TEDs. Zooming out, the TED tool will show other areas where the same seven TEDs are found (see next slide).
Example: user selected Iowa

TEDs in Iowa extends to other states

Each color corresponds to TED. In case of Iowa, production area were categorized into seven TEDs.
User selected an area including 70% of TEDs within the rectangle that was represented by **five TEDs**
v. Specific sites (GPS coordinates)

Users can upload any coordinates of specific area of interest and check the corresponding TEDs. **Note: the tool will list all TEDs within 1-mile buffer of the specified site and their associated area coverage.**
vi. TED climate-soil attributes
Select by attributes combination
User can download the TED information associated with the selected area of interest by clicking on the excel icon.
### TED download in csv-format

Thank you for your interest in GYGA TEDs. In case the download doesn’t start please click [here](#).

Here is a sample of the data in CSV format:

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
</tr>
</thead>
<tbody>
<tr>
<td>number</td>
<td>corn area in acres</td>
<td>percentage of corn area in US</td>
<td>soil water storage in mm</td>
<td>growing degree days</td>
<td>aridity index</td>
<td>temperature seasonality</td>
</tr>
<tr>
<td>1</td>
<td>504803</td>
<td>5340078</td>
<td>6.183 200 - 250 mm</td>
<td>3792 - 4829 A°C.day</td>
<td>10182 - 12876</td>
<td>High</td>
</tr>
<tr>
<td>2</td>
<td>604803</td>
<td>5143672</td>
<td>5.96 250 - 300 mm</td>
<td>3792 - 4829 A°C.day</td>
<td>10182 - 12876</td>
<td>High</td>
</tr>
<tr>
<td>3</td>
<td>603603</td>
<td>4212234</td>
<td>4.881 250 - 300 mm</td>
<td>3170 - 3791 A°C.day</td>
<td>7786 - 8685</td>
<td>High</td>
</tr>
<tr>
<td>4</td>
<td>604603</td>
<td>3072984</td>
<td>4.256 250 - 300 mm</td>
<td>3792 - 4829 A°C.day</td>
<td>7786 - 8685</td>
<td>High</td>
</tr>
<tr>
<td>5</td>
<td>603703</td>
<td>3076809</td>
<td>3.565 250 - 300 mm</td>
<td>3170 - 3791 A°C.day</td>
<td>8686 - 10181</td>
<td>High</td>
</tr>
<tr>
<td>6</td>
<td>603503</td>
<td>2897719</td>
<td>3.358 250 - 300 mm</td>
<td>3170 - 3791 A°C.day</td>
<td>8589 - 7785</td>
<td>High</td>
</tr>
<tr>
<td>7</td>
<td>603403</td>
<td>2713556</td>
<td>3.179 250 - 300 mm</td>
<td>3170 - 3791 A°C.day</td>
<td>5690 - 6583</td>
<td>High</td>
</tr>
<tr>
<td>8</td>
<td>304803</td>
<td>2555125</td>
<td>2.961 100 - 150 mm</td>
<td>3792 - 4829 A°C.day</td>
<td>10182 - 12876</td>
<td>High</td>
</tr>
<tr>
<td>9</td>
<td>404803</td>
<td>2542469</td>
<td>2.946 150 - 200 mm</td>
<td>3792 - 4829 A°C.day</td>
<td>10182 - 12876</td>
<td>High</td>
</tr>
<tr>
<td>10</td>
<td>403703</td>
<td>1838078</td>
<td>2.13 100 - 150 mm</td>
<td>3792 - 4829 A°C.day</td>
<td>8686 - 10181</td>
<td>High</td>
</tr>
<tr>
<td>11</td>
<td>403603</td>
<td>1813672</td>
<td>2.101 150 - 200 mm</td>
<td>3792 - 4829 A°C.day</td>
<td>8686 - 10181</td>
<td>High</td>
</tr>
<tr>
<td>12</td>
<td>404403</td>
<td>1771844</td>
<td>2.053 250 - 300 mm</td>
<td>3792 - 4829 A°C.day</td>
<td>5690 - 6583</td>
<td>High</td>
</tr>
<tr>
<td>13</td>
<td>704803</td>
<td>1734547</td>
<td>2.01 &gt; 300 mm</td>
<td>3792 - 4829 A°C.day</td>
<td>10182 - 12876</td>
<td>High</td>
</tr>
<tr>
<td>14</td>
<td>603303</td>
<td>1717041</td>
<td>1.99 250 - 300 mm</td>
<td>3170 - 3791 A°C.day</td>
<td>4792 - 5689</td>
<td>High</td>
</tr>
<tr>
<td>15</td>
<td>704503</td>
<td>1556922</td>
<td>1.804 &gt; 300 mm</td>
<td>3792 - 4829 A°C.day</td>
<td>7786 - 8685</td>
<td>High</td>
</tr>
</tbody>
</table>
Access to TEDs

- TEDs can be accessed via the Global Yield Atlas (GYGA):
  https://www.yieldgap.org/web/guest/technology-extrapolation-domains

- The TEDs can be requested for free in the case of non-profit organizations.

- In the case of for-profit organizations, there are two ways to have access to the TEDs:
  1. By purchasing a GYGA sponsorship or commercial license, which provides access to all the data included in the GYGA website: https://www.yieldgap.org/licensing-and-sponsorship
  2. By purchasing a license ONLY for accessing the TEDs via NUtech ventures:
     - TEDs for the entire United States: https://marketplace.unl.edu/nutechmarketplace/nutech-teds.html
     - TEDs for Sub-Saharan Africa: https://marketplace.unl.edu/nutechmarketplace/nutech-teds-ssa.html

- If you want to discuss extensions and/or applications of TEDs for other geographic areas or uses, feel free to contact us at: pgrassini2@unl.edu (Dr Patricio Grassini).