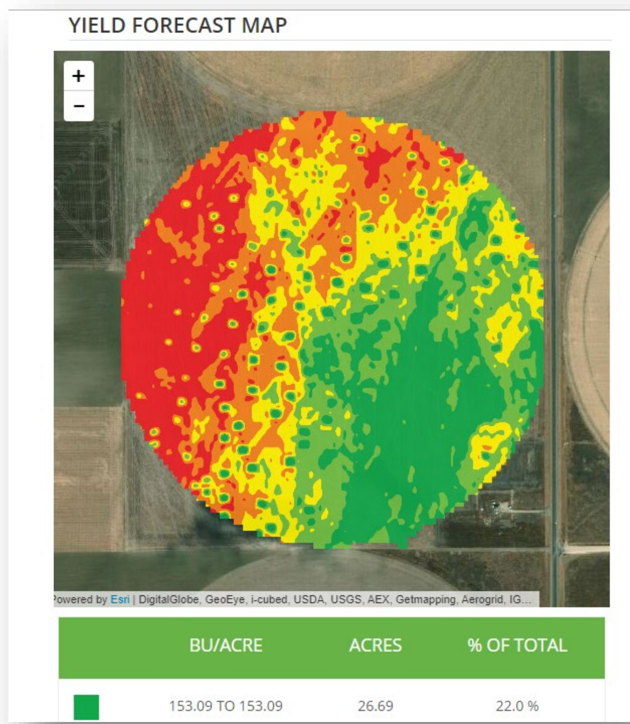
# YIELD FORECAST BETA

*API Documentation*
*2020*

## Service Overview

The Ag-Analytics® Yield Forecast API uses Artificial Intelligence algorithms to forecast the yield on a given field, based on geospatial data. The Yield Model API provides service by considering various factors like soil, vegetation index, location of the field, planting varieties to forecast the yield for a given field.




Crop yield is a function of a large set of parameters, many of which are outside the control of the farmer. The forces of nature are unpredictable and can make or break a growing season, while chemical applications can be rendered ineffective by new weeds or pests.

The current version of the yield model is relatively simple as compared to the number of factors that actually influence yield, however, it still provides insight and predictive power. Current yield model factors are location, crop season, seeding characteristics, planting date, application characteristics, soil characteristics, past growing history, weather data, and satellite imagery.

# Technical Details

The current model requires only six inputs to predict the yield for a given field. This may seem like a small amount, but a large amount of external data is collected based on these input values. The inputs are the bare minimum information that is required, and is information that would be impossible to obtain otherwise. Below are listed the types of data that inform the model and their origins, along with how the inputs help obtain the external data.

1. Location: the location of the field plays a role in the predicted yield due to the geospatial influence on growing season, type of climate, and possible farming practices. The SHAPE parameter provides latitude and longitude coordinates that can be used to find these patterns.
2. Season: for back-filling applications (i.e., determining what the yield was in the past for unknown fields), crop season plays a big role in keying the model in to factors such as adverse weather or unusual conditions specific to that year.
3. Weather conditions: the crop season also helps us find the weather data for that particular growing season. Without it, it would be impossible to know what weather patterns to apply to predict the yield. In future models, the user will be able to select different weather scenarios in order to see the effect of average or extreme conditions.
4. Soil characteristics: soil characteristics are obtained from both the SSURGO and POLARIS public soil datasets. The model uses the location of the field and the Soil API to find its specific soil properties.
5. Past growing history: past growing history is obtained from the Cropland Data Layer (CDL) database. The influence of crop rotation practices or lack thereof can factor in to how well the current crop performs.
6. Weather data: weather data is obtained through the PRISM dataset provisioned by Oregon State University. This requires the location and crop season for the field.
7. Satellite imagery: satellite imagery can illuminate the growing pattern of a crop throughout the growing season. Using multispectral bands over a period of many weeks throughout the year can help the model determine whether a crop is thriving.

# POST Request

## Header Parameters

Execute Type: POST

content-type: "application/json”

## Request Parameters

| Parameter | Data Type | Required? | Default | Options | Description |
|---|---|---|---|---|---|
| **MODELNAME** | Text | Yes | - | “NN” | The type of AI Model to be used. Ex. “NN” corresponds to Neural Network |
| **SHAPE** | Text | Yes | - | GeoJSON | The shape of the desired area-of-interest. See Fig. 1 for example. |
| **ScalarVariables** | Text | Yes | - | - | The constants for the given Shape – **includes all parameters below**. |
| **CropSeason** | Text | Yes | - | 2013 to 2019 | Growing season year for prediction. Ex. “2018” |
| **PlantingDay1** | Text | Yes | - | “mm-dd-yyyy” | Date when planting occurred for crop of interest. Ex. “05/20/2018” |
| **SeedingDensity** | Integer | Yes | - | Any number | The number of seeds planted per acre. Ex. 10,000 |
| **HarvestDay** | Integer | Yes | - | “mm-dd-yyyy” | Date when harvest is expected. Ex. “10/20/2018” |

## Response Parameters

| Parameter | Type | Description |
|---|---|---|
| **raster_filename** | - | URL to download result raster (.tif) file. |
| **rasterinfo.attributes.CellSize** | Resolution | Resolution of result Geotiff file in meters. |
| **rasterinfo.attributes.CoordinateSystem** | - | Information about the projection of the raster. |
| **rasterinfo.attributes.Extent** | - | Extents of the result raster. Specifies the bottom left and top right corners of the field raster in degrees. |
| **rasterinfo.attributes.Legend** | List | Legend gives the following details for each range of values:<br>I. **Area**: Area covered in percentage.<br>II. **Count**: # of pixels from the result raster in that range<br>III. **CountAllPixels**: Total # of pixels in the result raster<br>IV. **Max**: Max value in the range<br>V. **Min**: Minimum value in the range<br>VI. **Mean**: Mean value in the range<br>VII. **Color**: Hex color used for the range of values |

Ag-Analytics



| | | |
|---|---|---|
| **rasterinfo.attributes.Matrix** | List | Row and columns, containing attributes below. |
| **rasterinfo.attributes.Max** | Number | Maximum value from the result raster. |
| **rasterinfo.attributes.Min** | Number | Minimum value from the result raster. |
| **rasterinfo.attributes.Mean** | Number | Average value from the result raster. |
| **rasterinfo.attributes.Percentile5** | Number | $5^{th}$ percentile value from the result raster. |
| **rasterinfo.attributes.Percentile95** | Number | $95^{th}$ percentile value from the result raster. |
| **rasterinfo.attributes.pngb64** | Link | base64png image of the result raster with legend entries. |

# GET Request

Header Parameters
Execute Type: GET
content-type: "URL"

## Request Parameters

| Parameter | Data Type | Required | Default | Options | Description |
|---|---|---|---|---|---|
| **Filename** | Text | Yes | - | .tif file | Filename that is returned by the initial POST request. Ex: "result_tillageraster_20191126_175158_3291.tif" |

## Response Parameters

| Parameter | Data Type | Description |
|---|---|---|
| **File** | .tif | Tiff file will be download to the computer of the caller with the name that was used to call the API. |

# Appendix



## Figure 1.

*Shape Example - GeoJSON*


```
"{\"type\":\"Feature\",\"geometry\":{\"type\":\"Polygon\",\"coordinates\":[[[-89.199
484,40.972729],[-89.199773,40.97258],[-89.200135,40.972415],[-89.20034,40.972318],[-
89.200445,40.972177],[-89.200439,40.972001],[-89.200404,40.971815],[-89.200245,40.97
1599],[-89.20004,40.971397],[-89.199869,40.971233],[-89.199865,40.971097],[-89.19995
2,40.970952],[-89.200264,40.97078],[-89.200517,40.970664],[-89.200903,40.970471],[-8
9.201168,40.970345],[-89.201324,40.970277],[-89.201407,40.970174],[-89.201428,40.970
042],[-89.20271,40.970005],[-89.202738,40.970421],[-89.202844,40.970431],[-89.202851
,40.970648],[-89.203123,40.970666],[-89.203216,40.973626],[-89.20332,40.973635],[-89
.203281,40.972154],[-89.203277,40.972049],[-89.203227,40.970607],[-89.204645,40.9705
5],[-89.204639,40.970427],[-89.205456,40.970446],[-89.205638,40.970467],[-89.206002,
40.970527],[-89.206306,40.97059],[-89.206516,40.970642],[-89.206711,40.97061],[-89.2
0688,40.970542],[-89.207086,40.970492],[-89.207267,40.970414],[-89.207449,40.970364]
,[-89.207667,40.970286],[-89.207849,40.970255],[-89.208057,40.970251],[-89.208287,40
.970328],[-89.208494,40.970369],[-89.208672,40.970421],[-89.208866,40.970506],[-89.2
08972,40.970511],[-89.209009,40.970595],[-89.20893,40.970671],[-89.208736,40.970787]
,[-89.208535,40.970909],[-89.208325,40.971052],[-89.207907,40.971306],[-89.207633,40
.971478],[-89.207313,40.971574],[-89.207065,40.971645],[-89.206566,40.971699],[-89.2
06246,40.971784],[-89.205998,40.971878],[-89.205548,40.972042],[-89.205013,40.97232]
,[-89.20468,40.972494],[-89.204246,40.972725],[-89.203988,40.972931],[-89.203819,40.
973168],[-89.203666,40.973428],[-89.203616,40.973685],[-89.203552,40.973966],[-89.20
3548,40.9743],[-89.203411,40.974615],[-89.203284,40.974906],[-89.202723,40.975587],[
-89.20283,40.975719],[-89.203383,40.975106],[-89.203522,40.974847],[-89.203658,40.97
4521],[-89.203723,40.974241],[-89.20381,40.97376],[-89.203891,40.973546],[-89.20407,
40.973197],[-89.204197,40.973016],[-89.204369,40.972868],[-89.204686,40.972672],[-89
.205018,40.972499],[-89.205351,40.972314],[-89.205742,40.972139],[-89.206047,40.9719
99],[-89.206367,40.971904],[-89.206907,40.971771],[-89.207303,40.971719],[-89.207551
,40.971658],[-89.207846,40.971535],[-89.207938,40.971481],[-89.208059,40.971448],[-8
9.208267,40.971295],[-89.208534,40.971115],[-89.209089,40.970762],[-89.209108,40.971
493],[-89.209143,40.972829],[-89.209176,40.974108],[-89.209236,40.977186],[-89.20442
,40.977285],[-89.199613,40.977383],[-89.199533,40.974593],[-89.199484,40.972729]]]},
\"properties\":{\"OBJECTID\":5102679,\"CALCACRES\":145.08999634,\"CALCACRES2\":null}
,\"id\":5102679}"
```

## Figure 2

*POST Request Example – application/json*


```
{
"MODELNAME": "NN",
"SHAPE": "{\"type\":\"Feature\",\"geometry\":{\"type\":\"Polygon\",\"coordinates\":[[[-89.199484,4
  0.972729],[-89.199773,40.97258],[-89.200135,40.972415],[-89.20034,40.972318],[-89.200445,40.9721
  77],[-89.200439,40.972001],[-89.200404,40.971815],[-89.200245,40.971599],[-89.20004,40.971397],[
  -89.199869,40.971233],[-89.199865,40.971097],[-89.199952,40.970952],[-89.200264,40.97078],[-89.2
  00517,40.970664],[-89.200903,40.970471],[-89.201168,40.970345],[-89.201324,40.970277],[-89.20140
  7,40.970174],[-89.201428,40.970042],[-89.20271,40.970005],[-89.202738,40.970421],[-89.202844,40.
  970431],[-89.202851,40.970648],[-89.203123,40.970666],[-89.203216,40.973626],[-89.20332,40.97363
  5],[-89.203281,40.972154],[-89.203277,40.972049],[-89.203227,40.970607],[-89.204645,40.97055],[-
  89.204639,40.970427],[-89.205456,40.970446],[-89.205638,40.970467],[-89.206002,40.970527],[-89.2
  06306,40.97059],[-89.206516,40.970642],[-89.206711,40.97061],[-89.20688,40.970542],[-89.207086,4
  0.970492],[-89.207267,40.970414],[-89.207449,40.970364],[-89.207667,40.970286],[-89.207849,40.97
  0255],[-89.208057,40.970251],[-89.208287,40.970328],[-89.208494,40.970369],[-89.208672,40.970421
  ],[-89.208866,40.970506],[-89.208972,40.970511],[-89.209009,40.970595],[-89.20893,40.970671],[-8
  9.208736,40.970787],[-89.208535,40.970909],[-89.208325,40.971052],[-89.207907,40.971306],[-89.20
  7633,40.971478],[-89.207313,40.971574],[-89.207065,40.971645],[-89.206566,40.971699],[-89.206246
  ,40.971784],[-89.205998,40.971878],[-89.205548,40.972042],[-89.205013,40.97232],[-89.20468,40.97
  2494],[-89.204246,40.972725],[-89.203988,40.972931],[-89.203819,40.973168],[-89.203666,40.973428
  ],[-89.203616,40.973685],[-89.203552,40.973966],[-89.203548,40.9743],[-89.203411,40.974615],[-89
  .203284,40.974906],[-89.202723,40.975587],[-89.20283,40.975719],[-89.203383,40.975106],[-89.2035
  22,40.974847],[-89.203658,40.974521],[-89.203723,40.974241],[-89.20381,40.97376],[-89.203891,40.
  973546],[-89.20407,40.973197],[-89.204197,40.973016],[-89.204369,40.972868],[-89.204686,40.97267
  2],[-89.205018,40.972499],[-89.205351,40.972314],[-89.205742,40.972139],[-89.206047,40.971999],[
  -89.206367,40.971904],[-89.206907,40.971771],[-89.207303,40.971719],[-89.207551,40.971658],[-89.
  207846,40.971535],[-89.207938,40.971481],[-89.208059,40.971448],[-89.208267,40.971295],[-89.2085
  34,40.971115],[-89.209089,40.970762],[-89.209108,40.971493],[-89.209143,40.972829],[-89.209176,4
  0.974108],[-89.209236,40.977186],[-89.20442,40.977285],[-89.199613,40.977383],[-89.199533,40.974
  593],[-89.199484,40.972729]]]},\"properties\":{\"OBJECTID\":5102679,\"CALCACRES\":145.08999634,\
  "CALCACRES2\":null},\"id\":5102679}",
"ScalarVariables": {
"CropSeason": "2018",
"PlantingDay1": "05/20/2018",
"SeedingDensity": "30000",
"HarvestDay": "10/20/2018"
}
}
```

# Figure 3

*POST Response – application/json*


```
{
  "raster_filename": "result_tillageraster_20191121_222140_9894.tif",
  "rasterinfo": [
    {
      "attributes": {
        "CellSize": [
          0.0001,
          -0.0001
        ],
        "CoordinateSystem": "GEOGCS[\"WGS 84\",DATUM[\"WGS_1984\",SPHEROID[\"WGS
84\",6378137,298.257223563,AUTHORITY[\"EPSG\",\"7030\"]],AUTHORITY[\"EPSG\",\"6326\"]],PRIMEM[\"Greenwic
h\",0],UNIT[\"degree\",0.0174532925199433],AUTHORITY[\"EPSG\",\"4326\"]]",
        "Extent": "-89.209236, 40.969983000000006, -89.19953600000001, 40.977383",
        "Legend": [
          {
            "Area": "100.0 %",
            "Count": 6511,
            "CountAllPixels": 6511,
            "Value": 1.0,
            "Variety": "Variety 1.0",
            "color": "#6e9a9e"
          }
        ],
        "Matrix": [
          74,
          97
        ],
        "Max": 1.0,
        "Mean": 1.0,
        "Min": 1.0,
        "OID": 0,
        "Percentile5": 1.0,
        "Percentile95": 1.0,
        "Variety": "Variety",
        "pngb64": "data:image/png;base64,
iVBORw0KGgoAAAANSUhEUgAAAGEAAABKCAYAAACrbTpWAAAB6klEQVR4nO2ZMZKDMAxFP5lcgQtSUOYwlFvsBfcS26xnMl4bDDHwJf1X
ZZIikp6QwAwwzOvr++fuGD5lmafx6SER6zzuDkBIAgWSQIAkECAJBEgCAZJAgCQQIAkESAIBkkCAJBAgCQRIAgGSQIAkEBBawjJP490x
AIElLPM0srxVDCuBRQAQWAITkkBAKAksizgnjASmRZwTRgKrACCIBNYxlAghgZ0QEphHERBAAvsoAgJIYL8KgAASLCAJBLiWYGEfAI4l
WBEAOJZgCUkgQBIIcCkh7QMLzwiAUwlWip9wKYH53UEJlxKs4U6CtasAcCbBogDAmQSLAgAnEiwdUZQwL8HqCHrHrARrD2RrmJPgqfgp
lwGwkZCHsZPId5gZCR6o3UA8rw4kIlt3b3Q7wfrtZk5LPjQSPC3cvdBIiFj8xOUSvI2bLVqa63QJedEjdvxWzt0k1Do8YtFLrNWhmwQV
e5tajWgWcxRKInZJiLZUr6JZgqezGzaaJUjAeaxK0Pi5hqIEz0cIjI2lo+yLKTXBY+1H0Y9lnsZajYf0QVfDObQ09yUvde46P9oqwJlx
7JksQ/5Fr8COjLc9/91jfJ4h4Uhc/yQkjgRoda/0kPFJ7lUJObVArRb+nU8k9Mi/WYJnjkrw0IDij18vdrpMAEXhUgAAAABJRU5ErkJg
gg=="
      }
    }
  ]
}
```

Figure 4.

*GET Request Example - URL*

```
https://ag-analytics.azure-api.net/Tillage_Model?filename=result_tillageraster_20191126_175158_3291.tif
```

## Citation

**Spatial Reference Information:**

Universal Transverse Mercator (UTM) Dominant Zone, North American Datum 1983

Please contact **support@analytics.ag**, **josh@ag-analytics.org**, or **woodardjoshua@gmail.com** with any comments or questions.