

# Remote Sensing with OpTIS

Measuring the adoption of sustainable farming practices



## WHAT IS OPTIS?

OpTIS, or Operational Tillage Information System, uses remote sensing (satellite-based) data to measure the adoption of cover crops and specific tillage systems that impact environmental sustainability. These practices affect greenhouse gas emissions and soil carbon sequestration and improve soil health and water quality outcomes.

OpTIS helps scientists, farm advisors, conservationists and others assess the progress of sustainable practice adoption.



### HOW DOES IT WORK?

OpTIS algorithms utilize MODIS, Landsat and Sentinel satellite imagery to determine tillage and cover crop adoption. Information on practices such as the presence and quality of cover crops and crop residue levels, are determined by performing time series analysis of publicly available remote sensing data. Information is processed at the field level, but released only on a larger geographic scale to protect grower privacy.

The satellites used in OpTIS pass each land area every 3-5 days, ensuring that data is always up to date.

# HOW DO WE USE IT?

OpTIS data is utilized across many Regrow products, including Sustainability Insights and our MRV platform (which powers measurement, reporting and verification for ecosystem markets).

Data on sustainable practice adoption is aggregated for Sustainability Insights, empowering users to identify opportunities for new investments in sustainable farming.

Regrow's MRV platform uses OpTIS products to simplify workflow and verify practices in several stages of the carbon credit development process. On the grower's side, we use OpTIS to pre-fill growers' historical farm management data (in combination with the information from the producer's Farm Management System), making data collection simple for growers embarking on a carbon farming project.

In credit verification, OpTIS data may be used by verification bodies and standards wishing to crosscheck the information provided by growers.

Here's an example of OpTIS capabilities in a carbon farming project, for which our MRV Platform is used:





## MODEL ACCURACY

Studies that compared OpTIS results with 5,000 road-side observations report that OpTIS has been able to make a determination of tillage practice or cover crop with 85-90% accuracy in the area that has been analyzed to date.

## MEASURING ACCURACY THROUGH SUSTAINABILITY WATCH

At Regrow, we are continuously improving our models through efforts like the Sustainability Watch Program. This program utilizes agronomists across the United States to help monitor changes in the adoption of conservation practices. Agronomists collect on-the-ground data regarding farms in a specific region, and data will be compared with OpTIS observations to determine the tool's accuracy.

The Sustainability Watch Project is part of public-private partnerships between Regrow, The Nature Conservancy, the Conservation Technology Information Center and the Foundation for Food and Agriculture Research.

Regrow also provides OpTIS results to the public at crop reporting district and HUC8 watershed scales, making this data accessible at a broad scale.



To learn more, watch this webinar hosted by The Nature Conservancy.





# SCALABILITY

OpTIS offers a scalable alternative to on-the-ground data collection, reducing the costs and manual labor associated with this level of data.

The accuracy and timeliness of the data provided ensures that OpTIS will be scalable as sustainable practice adoption increases, and as adoption trends spread over broader geographic regions and farming systems.



Visit <u>www.regrow.ag</u>



# DNDC Soil Carbon Model

Setting the Bar for Global Soil Carbon Modeling



# THE PREMIER DATA MODEL FOR SOIL NUTRIENT ANALYSIS, USED EXCLUSIVELY BY REGROW.

The Denitrification- Decomposition (DNDC) model is a scientific model that helps us estimate nutrient cycling in the soil, including how much carbon is stored in agricultural soil as a result of soil management practices. DNDC is calibrated and validated locally, using data specific to the location. This allows the model to be both global and flexible, and enables it to be quite accurate to its location. As the dataset grows, DNDC will become more accurate over time.

Regrow has exclusive commercial rights to this model, which was developed at the University of New Hampshire. DNDC has been reviewed in over 500 publications, and is utilized across the globe. DNDC powers all our solutions, including our Sustainability Insights Tool and our Measurement, Reporting and Verification (MRV) platform for ecosystem markets.

Global brands like Cargill, General Mills and the Ecosystem Services Market Consortium (ESMC) recognize the value of this tool, and are currently using it to implement and evaluate regenerative agriculture programs. In fact, ESMC convened an independent panel to review a suite of scientific models, and chose DNDC as the preferred model among those reviewed.



# A RELIABLE CHOICE FOR INDUSTRY LEADERS

Organizations that set the standards for ecosystem markets, including influential bodies like the Ecosystem Services Market Consortium (ESMC), have chosen DNDC as a reliable soil carbon model for ecosystem markets.

We have also submitted reports to CAR and Verra, and expect approval for use of DNDC model and Regrow MRV platform within these markets within 2022.

### WHAT IS DNDC?

The Denitrification- Decomposition (DNDC) model is a biogeochemical model used to simulate carbon and nitrogen soil dynamics in row crops, and to show how those dynamics change with the adoption of new farming practices.

The model predicts greenhouse gas emissions and other environmental effects of crop production, such as crop growth and yield, based on a series of environmental drivers (crop management, weather, and soil data, cultivar etc.)

The data that feeds DNDC is updated continuously. Our remote sensing model, OpTIS analyzes images that are acquired every 3-4 days, and those insights about practices implementation drive DNDC. We have logged historical practices back to 2009 through OpTIS, and this enabled us to establish a strong GHG baseline to measure against.

# **DNDC: HOW IT WORKS**

A computer simulation model estimates the influence of agricultural management practices on carbon and nitrogen cycling in soils.



#### Inputs

Climate, soil properties, & management practices. Grower input and publicly available data.



#### Simulation

Algorithms that simulate soil processes use model inputs to digitally recreate the effects of farming practices on soil health.



#### Prediction

Carbon sequestration and greenhouse gas emissions are predicted based on simulated in-field denitrification and decomposition rates.

#### Validation

Model predictions are verified using field level measurements and peer reviewed studies.



### MODEL CALIBRATION

Model calibration is the process of adjusting the DNDC model parameters to ensure that it accurately predicts measured data, like soil carbon sequestration and GHG emissions. During this process, we adjust several model inputs to better match the field-level observations.

Observation data used in the calibration process is not used in the validation of the DNDC model — a process described below.

#### MODEL VALIDATION

Model validation is the process of understanding how well DNDC predicts newly measured data. DNDC is validated with location-specific data collected from farms across the globe. In this process, on-farm data from soil testing is combined with data from academic studies and used to test the performance of the model. This is done with CalVin software, which Regrow built to perform this process in a scalable, efficient way. DNDC becomes increasingly accurate as data is collected and more varied scenarios are added to the system.

DNDC relies on varied and comprehensive input data. While DNDC requires more data inputs than other models, Regrow has established seamless pipelines to supply these data requirements, including farm management system integrations and public datasets. In cases where this data isn't available (and if a grower neglects to provide the data), Regrow has developed a system of substitute values to ensure adequate model performance.

While DNDC has been tested and validated globally with over 500 peer-reviewed publications, Regrow is systematically validating the latest commercial version of the model globally for the majority of annual and perennial cropping systems. We have compiled the data from over 1500 independent field studies of seasonal and/or annual GHG emissions and soil carbon stock changes. This dataset enables Regrow to extensively validate the model and quantify accuracy, which positions Regrow customers perfectly to meet rigourous market demands.

# MODEL ACCURACY

## CONFIDENCE AND ACCURACY

Our validation of DNDC indicates that our model estimates of soil carbon change are within 0.05 tons of Carbon per acre (+/-) of measured soil carbon changed, at 95% confidence level for a project with 100 fields. While this uncertainty will vary with project size, these numbers indicate a high degree of accuracy.

DNDC is able to report results within a specific degree of scientific accuracy — that is, we can establish an acceptable margin of error and report results within that margin. This level of scientific rigor ensures that the model will be viable as climate tech, agrifood tech, and ESG regulations shift.

# STANDARDS & APPROVALS

We are working with industry standards and regulators CAR and Verra for approval of our model in measurement, reporting and verification methods for carbon markets. We are also part of the GoldStandard/SUSTAIN Value Change Initiative for regulations and standards related to model use in carbon markets.



**RESULTS WITHIN** 

0.05

TONS

CARBON/ACRE

95%

CONFIDENCE

LEVEL

# MODEL SCALABILITY



## CAN DNDC SCALE ACROSS CROPS AND REGIONS?

DNDC is built to be implemented on a large scale. This is primarily due to the model's calibration and validation system, which allows it to maintain accuracy as it scales. The model is scalable for both crop and livestock operations.

DNDC is unique in its dynamic calibration process. The model takes into account all relevant location-specific data available and is calibrated using that data. Model performance is also tested against field trials and academic studies, ensuring a high level of scientific rigor. Other models are typically only calibrated once.



#### DNDC: USED EXCLUSIVELY BY REGROW

Regrow holds exclusive commercial rights to use DNDC. However, the model is still being used in the academic realm, meaning it's consistently reviewed, questioned, and validated across the globe. Internally, Regrow continues to improve the model and provide access to updated versions to the academic community.