

# Monitoring the land with Collect Earth

*Free, innovative, open access,  
multi-purpose software*

by Kamel ALOUI

## Introduction

Open Foris is a collection of free, open access applications developed by the FAO's Department of Forests and designed to be a flexible and efficient way of gathering, analysing and communicating data.

Collect Earth is a tool within Open Foris and was developed in collaboration with Google Earth Outreach. Collect Earth communicates with Google EarthEngine to facilitate access to the satellite images freely available from EarthEngine; the application can also link up with other services such as Bing Maps. By submitting pre-programmed scripts to Google Earth Engine Playground, Collect Earth can visualise, on the basis of the remote sensing images from Landsat and MODIS, reflectance values as well as other variables such as the Normalized Difference Vegetation Index, the Normalized Difference Water Index and the Enhanced Vegetation Index. Collect Earth enables operators to visually assess the previously-established sampling plots or sectors and to incorporate the results into a database by filling in a data collection form on a screen.

The data collection form is drawn up in such a way that it acts as a guide for operators throughout the entire survey process, starting with the identification and quantification of simple elements related to the land (e.g. trees and shrubs) and the identification of the main classes of land use. This approach enables operators to alert others whenever impacts or disturbances affecting the plots or sampling areas during the reference period have been detected.

## Methodology

Assessment is based on the data acquired from a number of sampling plots or sectors, depending on the area studied. Each such plot measures 70 m x 70 m (i.e. roughly 0.5 ha), which is the size corresponding to the minimum laid down by the FAO in its Assessment of Global Forestry Resources for an area to be qualified as a forest: "Forested land is an area of more than 0.5 ha covered over by more than 10% in trees that have reached more than 5 m high, or with trees capable of attaining these thresholds actually on site." Collect Earth represents each sampling plot as a frame containing a grid with 49 monitoring points, thus enabling the user to make an accurate assessment of the proportion of trees, shrubs and bushes and other terrestrial elements. Visual interpretation is based on each expert's knowledge of the terrain and on the information obtained from satellite remote sensing.

A large number of features for every sampling plot are collected and recorded in order to assess land cover and use at the most recent date for which high-resolution satellite imagery is available. The variables monitored permit the determination of the land cover, the utilisation of the land, changes in land use as well as other significant dynamic features that affect the land (for example, desertification or greening over), disturbances that impact forest stands (such as wildfire) and, also, bio-physical indicators.

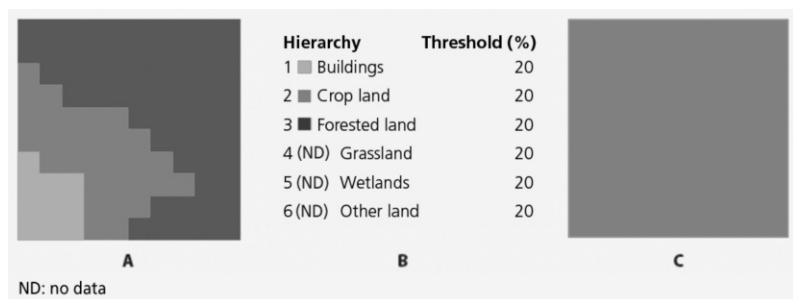
It is not always easy to identify the main use of the land on a given sampling plot or

sector in accordance with the categories of the Intergovernmental Panel on Climate Change (IPCC); thus the same plot can sometimes be put into several different categories. In every Collect Earth project, a rule of hierarchy prevails in such cases in accordance with the United Nations' Framework Convention on Climate Change. A synthesis of this rule appears below while MARTINEZ and MOLLICONE (2012) provide a more detailed account. To determine the main utilisation of a plot whose land is involved in several (A in Fig. 1), the various categories of use are ranked in a pre-established order (B): given that buildings are situated at the top of the hierarchy, if this use covers more than 20% of the plot it is considered as predominant whatever the other uses present. If buildings occupy less than 20%, then crop land, second on the list, is viewed in the same way: it is considered predominant if it occupies more than 20% of the plot. If not, forested land, third on the list, is treated in the same way, and so on. In Fig.1, buildings do not represent 20% as opposed to crop land. Thus, crop land should be considered as the main use even if 50% of the plot is covered by grassland.

For each Collect Earth project, a grid is drawn up on which all the sampling plots are localised; the grid is further subdivided, each sub-division grouping up to 800-1,000 plots. The ensemble of sub-divisions is distributed to the operators or experts involved in the assessment and each one works on an independent computer not connected to a mainframe nor to an internal network of other operators (this is one of the advantages of the software). For each sampled plot, the expert in charge locally logs the data directly into an electronic database. The visual interpretation of the extremely high-resolution spatial images is done using the database of images available via Google Earth and Microsoft Bing Map and complemented by the analysis of medium-resolution images via Google Earth Engine. All the data are generated and geo-synchronised automatically for each plot. When each assessment is finished, all the subdivisions of the grid are regrouped on one computer for an analysis of the collected data.

The software used for carrying out the data analysis is Saiku Analytics, an online application which enables the user to visualise and analyse the data thanks to a simple interface using the "slide and paste"

**Figure 1:**  
Rule of Hierarchy  
in determining  
predominant land use.



method. Saiku makes it possible to export the digital results and graphs using Excel, CSV, PDF, JPG, PNG...

## The Tunisian experience

Tunisia began its experience with Collect Earth in 2014 in the framework of the Nation Forest Surveillance System of the Tunisian National Forests Service (NFS) for a real and transparent REDD+ process in collaboration with the FAO's Department of Forests and financed by the International Initiative for Climate (IKI) of the German Ministry for the Environment (BMUB). Some twenty people, representing the Tunisian National Forests Service, public bodies under both the Ministries of Agriculture and the Environment, research institutes and the universities, benefited from training in the use of Collect Earth.

Data collection was carried out by a team from the NFS. It involved 8,000 plots spread throughout Tunisia with the aim of assessing land use and changes in such use between 2000 and 2014. The form for data collection was designed to permit the classification of each plot in one of the IPCC's six categories of land use (Buildings, Crop land, Forested land, Grassland, Wetlands, Other land) and their possible sub-divisions, all easily identifiable on the satellite imagery provided by Google Earth.

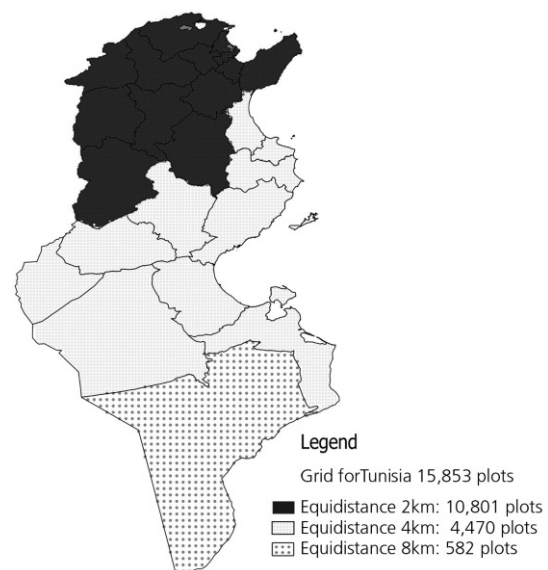
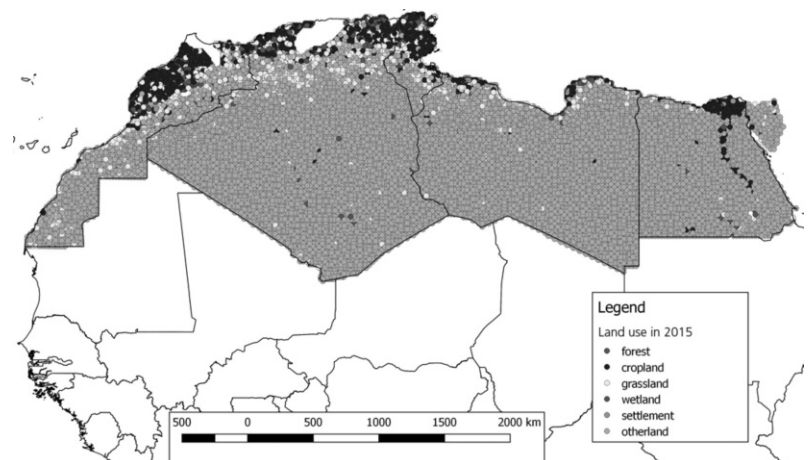
In 2015, in the light of the quality of the work done, and within the framework of the FAO's assessment of arid regions across the planet done via Collect Earth (213,795 sampling plots located worldwide), data collection for the arid areas of North Africa was put in the hands of Tunisia's NFS, focusing on the assessment of 15,077 plots (Fig. 2). The resulting data formed the basis for the publication in 2017 of the world's first assessment on the subject, "Trees, forests and land use in arid zones" along with the mapping of degraded ecosystems which are the object of restoration in the areas of Africa's "Green Barrage".

In 2016, the drawing up of a new Collect Earth project (CE-Tunisia-2016) was undertaken in collaboration with the Collect Earth team of the FAO. The objective of the project was to assess land use and any changes in Tunisia over the period 2000-2016 but this

time on the basis of 16,000 sampling plots having different densities (Fig. 3). Equidistant at 2 km from each other, 10,800 plots were selected throughout the country's wooded and forested areas (north and west-central). The steppe grazing land (centre, south-east and south-west) was covered by 4,470 plots equidistant at 4 km while the desert areas in the south were covered by 580 plots equidistant at 8 km from each other. The number of plots was increased in order to make possible the analyses of the data at the different levels of regional subdivisions prevailing in the country (governorships, delegations, sectors) and to provide more reliable information on land use and its changes, even for the sub-categories of the six classes of the IPCC. The data gathered will serve as the basis for the conception of restoration projects in degraded forest and

**Fig. 2 (below):** Spread of plots depending on land use, in North Africa in 2015.

**Fig. 3 (bottom):** Spread of sampling plots in Tunisia, 2016.



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grazing ecosystems, for improving the inventory of greenhouse gases in Tunisia and for enriching the report of the 2020 worldwide forest assessment (FRA 2020).

**K.A.**

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## Summary

### Monitoring land via Collect Earth: free, innovative, open-access, multi-purpose software

Collect Earth is a free, open-access “Open Foris” tool. It enables data to be gathered from images from Google Earth and Google Earth Engine with no need to download satellite images or conduct field visits. Data collection is based on a systematic sampling in which each plot covers 0.5 ha in reference to the FAO’s minimum area for a forest used in its Assessment of Global Forestry Resources. An analysis of the collected data enables an idea to be obtained about the utilisation of the land and changes in use over a given period of time. Tunisia has used this tool for assessing land use and changes to it in the arid regions of North Africa, sampling 15,077 plots during the period 2001-2015, and, in Tunisia, 15,850 plots in the period 2000-2016.

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## Résumé

### Surveillance des terres via Collect Earth - Logiciel innovant, libre, gratuit et multi-usage

Collect Earth est un outil «Open Foris», libre et gratuit. Il permet la collecte des données à partir des images Google Earth et Google Earth Engine sans recours au téléchargement des images satellitaires et sans recours aux visites de terrains. La collecte des données s’appuie sur un échantillonnage systématique où chaque placette couvre 0,5 ha faisant référence à la taille minimale que peut occuper une forêt selon la définition utilisée pour l’Évaluation des ressources forestières mondiales de la FAO. L’analyse des données collectées permet d’avoir une idée sur l’utilisation des terres et le changement d’affectation des terres durant une période donnée. La Tunisie a utilisé cet outil pour l’évaluation de l’utilisation des terres et le changement d’affectation des terres des régions arides de l’Afrique du nord à partir de 15077 placettes durant la période 2001-2015 et pour la Tunisie à partir de 15850 placettes durant la période 2000-2016.

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## Resumen

Collect Earth es una herramienta de la iniciativa “Open Foris”, libre y gratuita. Permite la recolección de datos a partir de imágenes de Google Earth y Google Earth Engine sin necesidad de descargar imágenes de satélite y sin recurrir a las visitas de terreno. La recopilación de datos se basa en un muestreo sistemático en el que cada parcela cubre 0,5 ha como referencia al tamaño mínimo que puede tener un bosque según la definición de la “Evaluación de los recursos forestales mundiales” de la FAO. El análisis de los datos recogidos permite tener una idea de los usos y los cambios de uso del suelo durante un período de tiempo. Túnez ha utilizado esta herramienta para evaluar los usos y el cambio de usos del suelo en las regiones áridas de África del Norte a partir de 15.077 parcelas en el período 2001-2015 en Túnez a partir de 15.850 parcelas en el período 2000-2016.