Working Session 1:

Introduction to spatial analysis for REDD+ planning at the provincial level in Viet Nam

Ha Noi, 16 – 27 June 2014

Working Session technical session plans

PART 2: Identifying potential zones for a REDD+ action – Maintaining existing forests, with a focus on natural forest (continued)

2B: Map of carbon stocks

There are three main terrestrial carbon pools: **above-ground biomass (AGB**) **carbon, below-ground biomass (BGB) carbon** and **soil organic carbon (SOC).** AGB includes all living biomass stored in the above-ground parts of vegetation, including stems, branches and understory vegetation (Gibbs and Brown 2007). BGB includes the biomass of all live roots from vegetation. SOC is the carbon stored in soil organic matter, including tissues from dead plants and animals, products produced as these decompose and the soil microbial biomass.

The carbon stored in the AGB in trees is the most directly affected by deforestation and forest degradation, and is thus the pool of largest relevance for REDD+. However, when vegetation is removed, some of the carbon stored in the soils may also be released and therefore it is useful to consider both biomass and soil carbon (see Annex 2 for further information on soil carbon mapping).

Maps and analyses should be explicit about which carbon pools are represented. The maps and underlying data for the different pools can be used separately or in combination. For example, **biomass-only maps** will be most **relevant if considering the likely carbon impacts of selective logging**; but **biomass and soil carbon** maps **give a total estimate of carbon stocks that could be vulnerable to forest conversion and ploughing[1].**

Questions / Discussion relating to support to biomass carbon mapping:-

- Viet Nam already has a process for undertaking NFI and creating above ground biomass carbon maps. Is any additional support required by FREC and other partners to support provincial staff in this activity?
- Is any help required for calculating below ground carbon?
- While provinces are waiting for NFI to be completed, can the existing National level carbon map be used?
- Is the land-cover data that was used for the National-level carbon map the same as that used in current land-cover maps at the provincial level?

[1] Noting that only a proportion of soil organic carbon will be released in such a situation and that this proportion is dependent a range of factors (e.g. climate, management, etc)

- If different, can carbon values assigned to the National-level land-cover classes be assigned to the provincial-level land-cover map to create an interim carbon map? Or is it better to use a clip from the National-level map until the proper provincial-level NFI carbon maps are produced?

Technical activity

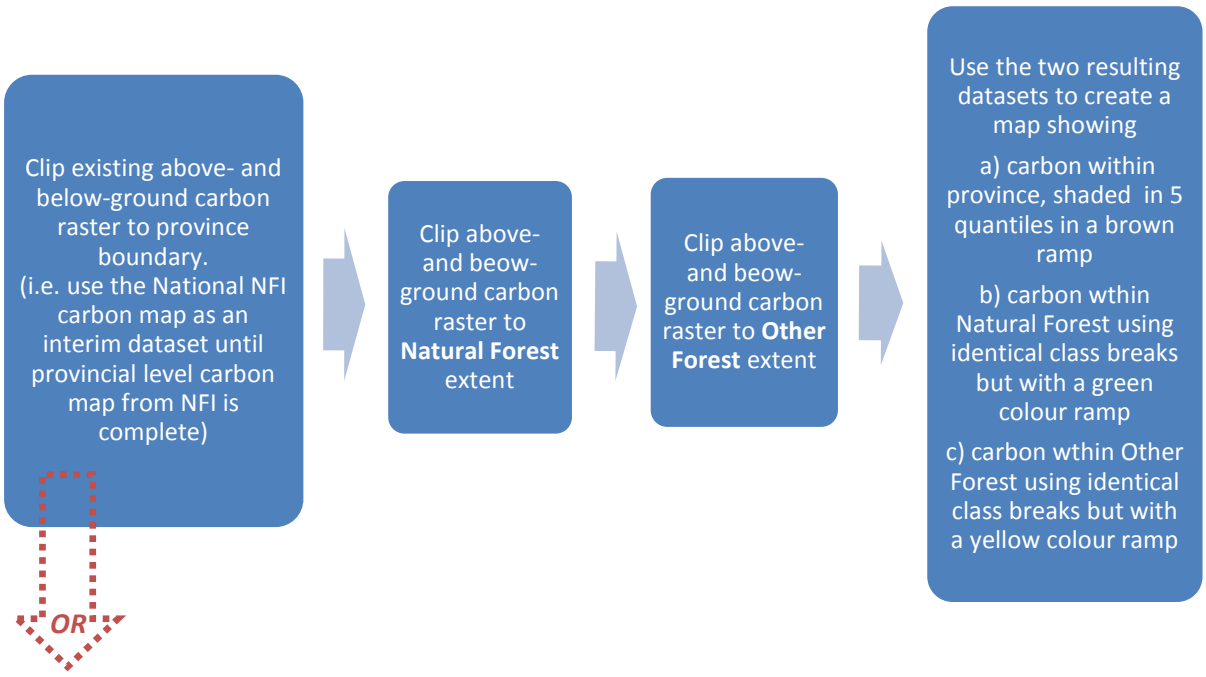
Objective: Produce a map of above- and below-ground biomass carbon within natural forest compared to other forest, according to the national forest definitions

Input datasets:
Forest/land cover for the province
Above- and below-ground biomass carbon

Analysis map projection: VN-2000 / UTM zone 48N

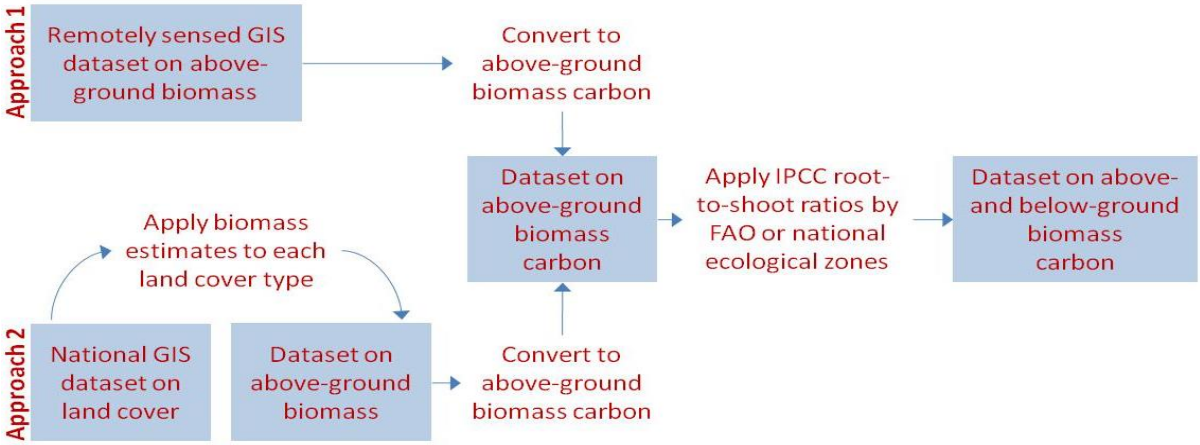
PROJCS["VN-2000 / UTM zone 48N",GEOGCS["VN-2000",DATUM["D_",SPHEROID["WGS_1984",6378137,298.257223563]],PRIMEM["Greenwich",0],UNIT["Degree",0.0174532925199433295]],PROJECTION["Transverse_Mercator"],PARAMETER["latitude_of_origin",0],PARAMETER["central_meridian",105],PARAMETER["scale_factor",0.9996],PARAMETER["false_easting",500000],PARAMETER["false_northing",0],UNIT["Meter",1]]

Step 2: Clip biomass carbon with Natural Forest to create a dataset and map of carbon stocks within natural forest areas



Depending upon outcomes of above discussion regarding what support is needed for biomass carbon mapping, some or all of the approaches below could be applied.

UNEP-WCMC has previously provided technical support to countries to produce biomass carbon maps in the following ways:-



***Note: Approach one uses an existing product that has been generated from remotely sensed information. UNEP-WCMC does not offer training in processing or classification of remotely sensed imagery. ***

(See Annex 1 for detailed GIS workflows)

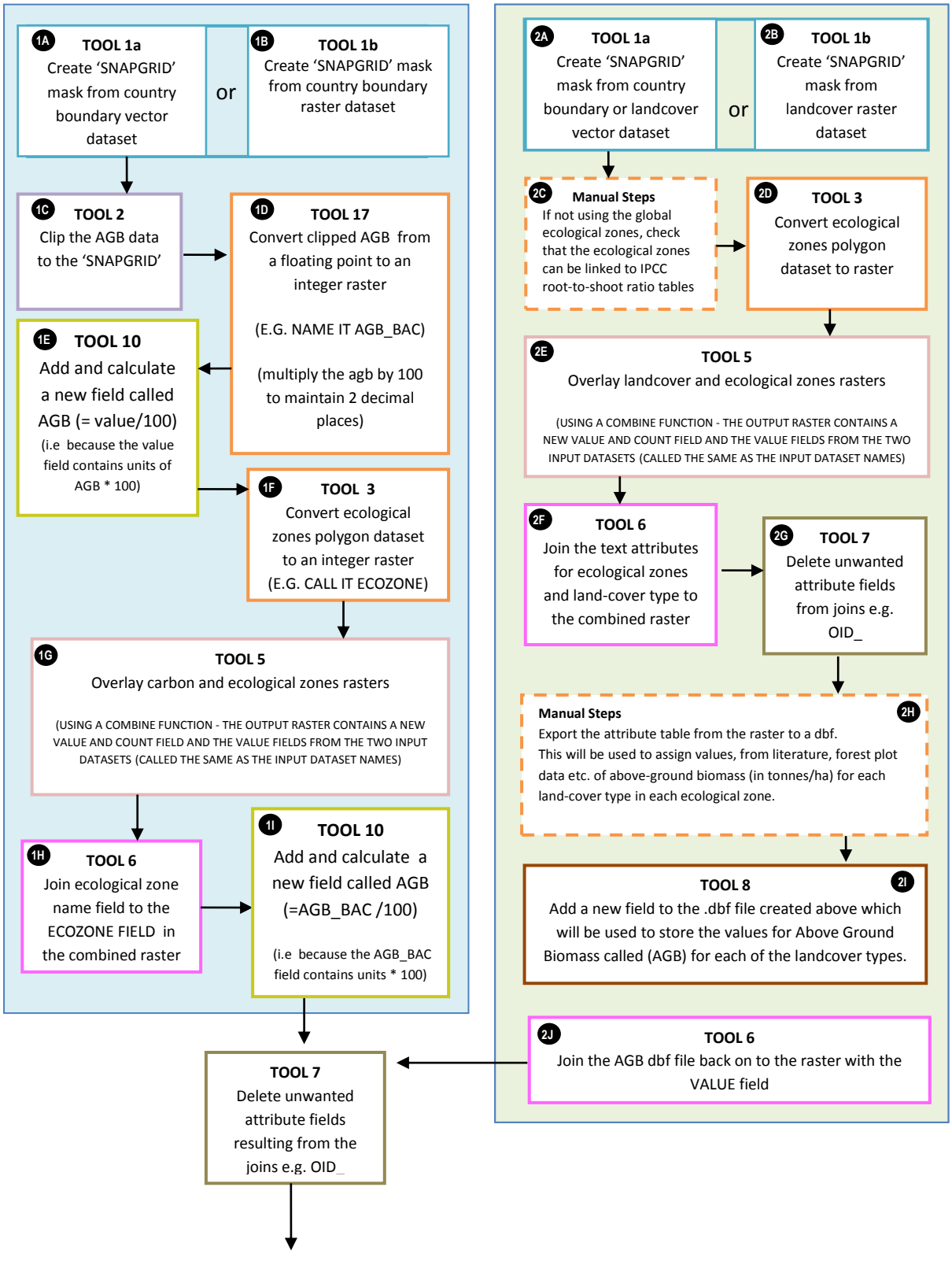
Annex 1: - Workflows (to support Step 1) for UNEP-WCMC support to carbon mapping

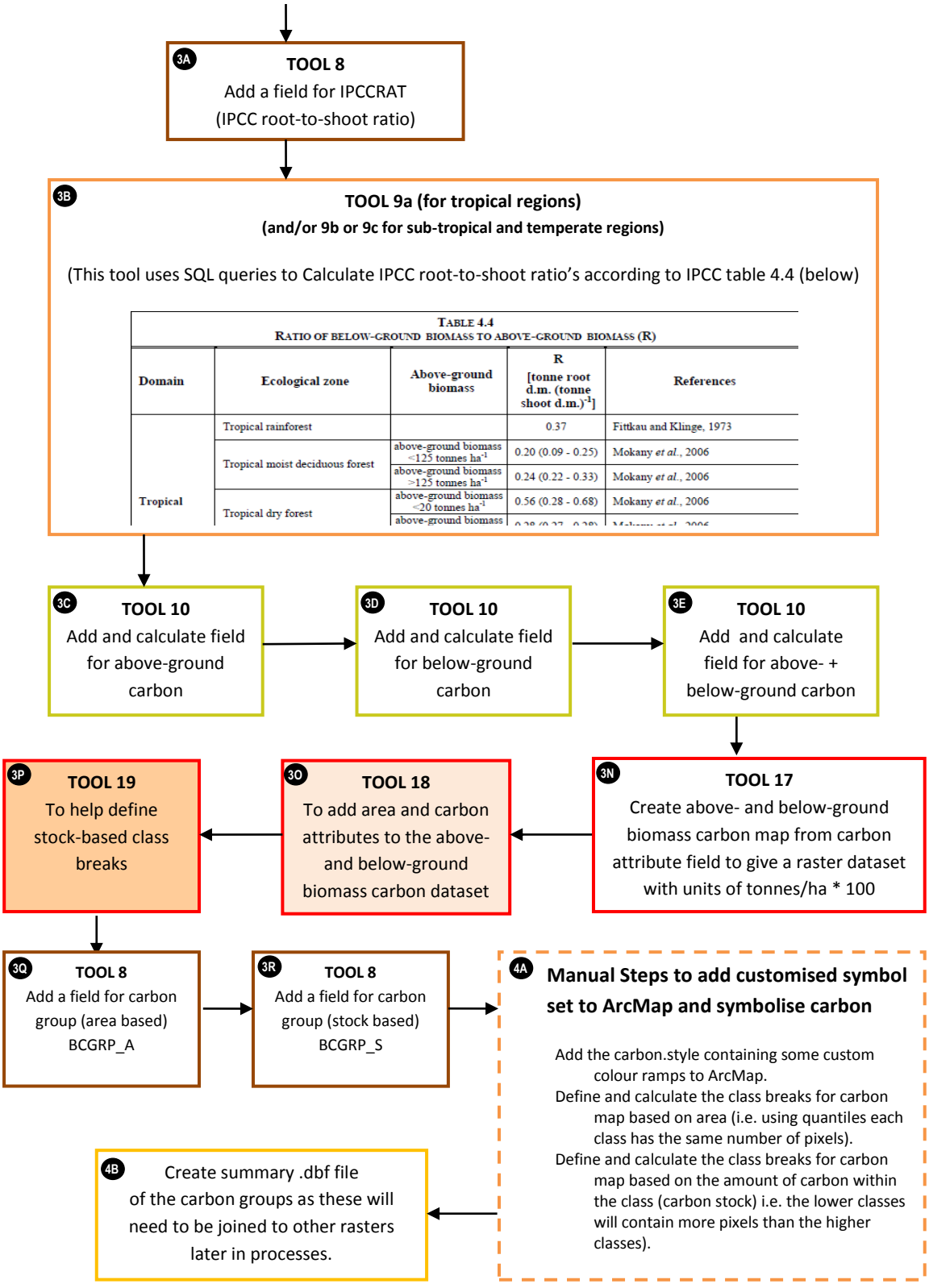
Approach 1 (e.g. starting with an above-ground biomass dataset from remotely sensed data).

Example using remotely sensed regional above-ground biomass (AGB) map from Baccini (2012)

Approach 2 (starting with a land-cover dataset and assigning carbon values to each land-cover type).

Example using a land-cover map.




3A
TOOL 8
Add a field for IPCCRAT
(IPCC root-to-shoot ratio)
3B
TOOL 9a (for tropical regions)
(and/or 9b or 9c for sub-tropical and temperate regions)
(This tool uses SQL queries to Calculate IPCC root-to-shoot ratio's according to IPCC table 4.4 (below)
TABLE 4.4
RATIO OF BELOW-GROUND BIOMASS TO ABOVE-GROUND BIOMASS (R)
Domain | Ecological zone | Above-ground biomass | R [tonne root d.m. (tonne shoot d.m.)-1] | References
Tropical | Tropical rainforest | | 0.37 | Fittkau and Klinge, 1973
Tropical | Tropical moist deciduous forest | above-ground biomass <125 tonnes ha-1 | 0.20 (0.09 - 0.25) | Mokany et al., 2006
Tropical | Tropical moist deciduous forest | above-ground biomass >125 tonnes ha-1 | 0.24 (0.22 - 0.33) | Mokany et al., 2006
Tropical | Tropical dry forest | above-ground biomass <20 tonnes ha-1 | 0.56 (0.28 - 0.68) | Mokany et al., 2006
3C
TOOL 10
Add and calculate field for above-ground carbon
3D
TOOL 10
Add and calculate field for below-ground carbon
3E
TOOL 10
Add and calculate field for above- + below-ground carbon
3N
TOOL 17
Create above- and below-ground biomass carbon map from carbon attribute field to give a raster dataset with units of tonnes/ha * 100
3O
TOOL 18
To add area and carbon attributes to the above- and below-ground biomass carbon dataset
3P
TOOL 19
To help define stock-based class breaks
3Q
TOOL 8
Add a field for carbon group (area based) BCGRP_A
3R
TOOL 8
Add a field for carbon group (stock based) BCGRP_S
4A
Manual Steps to add customised symbol set to ArcMap and symbolise carbon
Add the carbon.style containing some custom colour ramps to ArcMap.
Define and calculate the class breaks for carbon map based on area (i.e. using quantiles each class has the same number of pixels).
Define and calculate the class breaks for carbon map based on the amount of carbon within the class (carbon stock) i.e. the lower classes will contain more pixels than the higher classes).
4B
Create summary .dbf file of the carbon groups as these will need to be joined to other rasters later in processes.

Annex 2: Soil Carbon mapping

UNEP-WCMC can provide some limited advice to countries to produce soil carbon maps -

Questions relating to soil carbon mapping:-

- Are data available which could enable the creation of a soil carbon map for Viet Nam or for the province?
- Does the soil map show chemical properties of the soil?
- Are any field data available for mapping soil carbon?

The minimum information needed for creating a soil carbon map consists of (i) spatial information on the distribution of different soil types and (ii) information on the soil properties that are essential for the calculation of soil carbon content (SOC) for each soil type.

Background information on a global dataset of terrestrial soil organic carbon generated from the Harmonised World Soils Database (HWSD)

High-resolution data on carbon stored in soils are still scarce as a result of the detail with which soil types have been mapped and field data recorded. Existing datasets also rarely provide information on soil properties below 1m depth. Where data exist, they are often provided separately for topsoil (0-30cm layer of soil) and subsoil (30-100cm layer of soil). While organic matter is usually highest in the topsoil, the amount of carbon in the subsoil is still significant. It is estimated that globally there is about 1500 Gt of organic carbon (C) to a depth of 1 m and a further 900 Gt from 1-2 m (Kirschbaum 2000).

The Harmonized World Soil Database (HWSD) was the product of an initiative of the Food and Agriculture Organization of the United Nations (FAO) and the International Institute for Applied Systems Analysis (IIASA) to combine the soil information contained within the 1:5 000 000 scale FAO-UNESCO Digital Soil Map of the World with the vast volumes of subsequent regional and national updates (FAO *et al.* 2009). The HWSD consists of a spatial database of soil mapping units (SMUs) and a linked table of soil attributes. Due to the different format and resolution of the contributing datasets, data were harmonised and scaled to a notional resolution of 1km, or 30 arc seconds by 30 arc seconds (i.e. downscaled as necessary). Reliability of the data varies according to the sources, with ISRIC's Soil and Terrain (SOTER) databases being considered as the most reliable information source (FAO *et al.* 2009). The SOTER data unfortunately do not cover Viet Nam which has come from a much coarser 1: 5 million scale map.The resulting GIS raster database includes information for 16 107 unique soil mapping units (SMUs). Linked to each SMU are up to 10 soil typological units (STUs) with associated harmonized soil attribute data derived from 9 607 soil profiles in the World Inventory of Soil Emission Potential (WISE) database version 2.0.

The soil properties presented in the HWSD originate from soil profile information from numerous countries and sources. However, the global distribution of soil profile information is uneven and there are still considerable gaps in soil data (FAO *et al.* 2009). Moreover, the data do not capture natural variation or disturbance in carbon stocks. However, the HWSD often represents the only available source of soil data for a geographical area.

As every soil mapping unit can include up to 10 different soil types (or STUs) in varying proportions, soil organic carbon (SOC) needs to be calculated for each STU. Weighting these values by each STU's share in each mapping unit and adding up the results gives an estimate of total SOC in the soil mapping unit.

The following data included in the HWSD are required to convert the information into a spatial dataset of carbon stored in soils to 1m depth:

Share, i.e. proportion of soil profile unit within the mapping unit (HWSD field name SHARE, given in %)

Soil depth (HWSD field name REF_DEPTH)

Gravel content in topsoil and subsoil (HWSD field names T_GRAVEL and S_GRAVEL, given as % per volume), so that the volume of gravel can be excluded as it does not contain carbon

Organic carbon (OC) content in topsoil and subsoil (HWSD field name T_OC and S_OC, given in % of dry weight)

Bulk density of topsoil and subsoil (HWSD field name T_REF_BULK_DENSITY and S_REF_BULK_DENSITY, given as kg/dm^3, i.e. dry weight per volume)

With this information, SOC (in in g C m^{-2}) for each STU within a mapping unit can be calculated. A global dataset of terrestrial soil organic carbon has been generated from the HWSD at 1km resolution using this method and - is freely available for non-commercial use from the Joint Research Centre (JRC) at http://eusoils.jrc.ec.europa.eu/esdb_archive/octop/Global.html