Syllabus and homework for InVEST training sessions

Important resource:
Training resource shared Google drive - contains recordings, syllabus, model data, etc.

Pre-training homework, due April 11

1. Download and install the latest InVEST Workbench (version 3.14.1).
2. Make sure your GIS software is up to date and working properly, either ArcGIS or QGIS.
3. Review two chapters in the InVEST User Guide: Getting Started and SDR: Sediment Delivery Ratio.
4. Download the SDR sample input data and sample output data that we prepared for Luzon onto your computer. If they were zipped for downloading, unzip them. You may save them wherever you like, but we recommend using a local hard drive (not a folder in the cloud), and don't relocate any of the individual files, leave them in the folders they are packaged in.
5. Load the sample input and output data layers into your GIS and explore them. If you are using the latest ArcGIS Pro, there is a .lyrx file that you can use to symbolize specifically the land use/land

cover (LULC) raster. If this doesn't work, that's ok, just symbolize the LULC layer in a way that is intuitive to you.

Session 1: April 11 (U.S.) / 12 (Philippines), 2024

Link to recording of this session

Link to slides from this session

Agenda

- Welcome and introductions (10 minutes)
- Overview of InVEST software (5 minutes)
- InVEST Sediment Delivery Ratio (SDR) model (25 minutes)
- Quick walkthrough of InVEST Workbench (10 minutes)
- Hands-on model input and output in GIS (20 minutes)
- Brief introduction to calibration (10 minutes)
- Homework and housekeeping (10 minutes)

Homework for April 11 (U.S.) / 12 (Philippines), due April 23/24

1/ Use InVEST Workbench to run the SDR sample data on your own. Bring the results into GIS, zoom around, and consider whether or not the patterns make sense to you and why.

2/ Look for better/higher-resolution/more local data for all of the SDR inputs.

> a/ Create a list of the new SDR data sources that you find in this Data Needs spreadsheet. Go to the tab "Sediment - SDR" and fill in information for the columns "Updated data source" and "Why did you choose this new data source?"
>
> b/ Come to the next class prepared to discuss the process of finding new SDR data, and consider together how to process these layers to be used in the model.
>
> *Extra credit*: Prepare these new inputs as needed, and run SDR with them. Look at the results closely, do they make sense? How do they compare with the results from coarser global data? The SDR Methods document might be helpful for preparing the layers.

3/ Look for sources of observed gauge data in the Santo Tomas watershed in Zambales Province and the Palawig watershed in Cagayan Province, to be used in calibration later. These may take a while to find, so we should start looking early.

a/ If observed data exist, obtain the available daily records related to nutrient, sediment, and water flow for at least 10 years (preferably longer, up to 30 years).

b/ Also check if these data have already been processed into monthly or annual average values for sediment loading, nutrient loading, and water flow.

c/ Come to the next class prepared to report back on the status of this observed data.

4/ Download the NDR sample input data and sample output data that we prepared for Luzon onto your computer. If they were zipped for downloading, unzip them. You may save them wherever you like, but we recommend using a local hard drive (not a folder in the cloud), and don't relocate any of the individual files, leave them in the folders they are packaged in. Load the sample input and output data layers into your GIS and explore them. If you are using the latest ArcGIS Pro, there is a .lyrx file that you can use to symbolize specifically the land use/land cover (LULC) raster. If this doesn't work, that's ok, just symbolize the LULC layer in a way that is intuitive to you. We will go over these together in the next session.

Session 2: April 23/24, 2024

Link to recording of this session

Link to slides from this session

Agenda

- Review homework from last week (~30 minutes?)
- InVEST Nutrient Delivery Ratio (NDR) model (20 minutes)
- Hands-on model input and output in GIS (20 minutes)
- Very brief overview of calibration (10 minutes)
- Next homework and housekeeping (5 minutes)

Homework for April 23 (U.S.) / 24 (Philippines), due May 8/9

1/ Look for better/higher-resolution/more local data for the NDR inputs. Note that many of these are the same as are used in SDR.

a/ Create a list of the new NDR data sources that you find in this Data Needs spreadsheet. Go to the tab "Nutrient - NDR" and fill in information for the columns "Updated data source" and "Why did you choose this new data source?" (Note that we transferred over some of these updates from SDR, since many of the datasets are the same.)

- A reminder that it is strongly recommended to do a literature search (and/or expert consultation) to improve the land use/land cover parameters in the NDR biophysical table.

b/ Prepare these new inputs as needed, and run NDR with them. Look at the results closely, do they make sense? How do they compare with the results from coarser global data? The NDR Methods document might be helpful for preparing the layers. Come to the next class prepared to talk about this.

2/ Also run SDR with your updated data sources. Critique the results, and compare them with the sample data results to see how they're different. Come to the next class prepared to talk about this.

- A reminder that it is strongly recommended to do a literature search (and/or expert consultation) to improve the land use/land cover parameters in the SDR biophysical table.

3/ Download the Seasonal Water Yield sample input data and sample output data that we prepared for Luzon onto your computer. If they were zipped for downloading, unzip them. You may save them wherever you like, but we recommend using a local hard drive (not a folder in the cloud), and don't relocate any of the individual files, leave them in the folders they are packaged in. Load the sample input and output data layers into your GIS, symbolize them as you like, and explore them.

4/ Read the Seasonal Water Yield User Guide chapter.

5/ Keep looking for sources of observed gauge data in the Santo Tomas watershed in Zambales Province and the Palawig watershed in Cagayan Province. ***By this class we at least need to know if observed data exist and obtain them***. As a reminder:

a/ If observed data exist, obtain the available daily records related to nutrient, sediment, and water flow for at least 10 years (preferably longer, up to 30 years).

b/ Also check if these data have already been processed into monthly or annual average values for sediment loading, nutrient loading, and water flow.

c/ Come to the next class prepared to report back on the status of these observed data.

Session 3: May 8/9, 2024

Link to the recording of this session

Link to slides from this session

Agenda

- Review homework from last week (30 minutes)
- InVEST Seasonal Water Yield model (25 minutes)

- Hands-on model input and output in GIS (25 minutes)
- Next homework and housekeeping (10 minutes)

Homework for May 8 (U.S.) / 9 (Philippines), due May 22/23

1/ Look for better/higher-resolution/more local data for the Seasonal Water Yield inputs. A few of them are the same as are used in SDR and NDR.

> a/ Create a list of the new SWY data sources that you find in this Data Needs spreadsheet. Go to the tab "Water Yield - SWY" and fill in information for the columns "Updated data source" and "Why did you choose this new data source?"
>
> b/ Prepare these new inputs as needed, and run SWY with them. Look at the results closely, do they make sense? How do they compare with the results from coarser global data? The SWY Methods document might be helpful for preparing the layers. Come to the next class prepared to talk about this.

2/ Continue obtaining observed data for the watersheds of interest or nearby reference watersheds. Describe the dataset from the reference watershed if obtained.

3/ Critically evaluate the stream networks created with the new DEM used in NDR and compare it with a real-world stream network. Do the modeled networks for DEMs of different resolutions resemble reality or not? Try different TFA values. Please come to the next class prepared to talk about this.

4/ As was done with the parameters from Thailand for NDR, update the biophysical table with more local values for SDR too.

Session 4: May 22/23, 2024

Link to recording of this session

Link to slides from this session

Agenda

- Review homework from last week (35 minutes)
- Introduction to beneficiaries (25 minutes)
- Getting started with calibration (20 minutes)
- Next homework and housekeeping (10 minutes)

Homework for May 22 (U.S.) / 23 (Philippines), due May 29 / 30

1/ Carefully *READ* the Supplementary Information for, and review the draft manuscript of Mandle et al..
2/ Review Hamel et al. 2015, especially section 3.2.1.: "*Absolute predictions and model calibration*".

Homework due June 20 (Philippines)

1/ Upload results of your InVEST model runs to the "Updated_data" folder in our shared folder on Google Drive and update the first three tabs (SDR, NDR, SWY) in the Data Needs Philippines watershed models spreadsheet with the sources of your updated data.

2/ Read the 'DelineateIt' tool section of the InVEST User Guide

3/ Explore running DelineateIt (a tool found in the InVEST Workbench alongside the models) in the watersheds of interest, a reference watershed, and/or the InVEST sample data.

a/ Use the same DEM you plan to use for all models (which creates a stream network that best resembles reality).

b/ Create and use points approximating the locations of the gauge stations from where the observed data you will use in calibration will come.

c/ Experiment with different Threshold Flow Accumulation (TFA) values and snapping distances

d/ Critically evaluate results and come prepared to talk about them. The goal is to create service-sheds that are as realistic as possible.

Session 5: May 29/30, 2024

Link to recording of this session

Agenda

Guest lecture by Héctor Angarita, Natural Capital Project - Natural Capital Assessment and Accounting in Colombia

Reminder of Homework due June 20 (Philippines)

1/ Upload results of your InVEST model runs to the "Updated_data" folder in our shared folder on Google Drive and update the first three tabs (SDR, NDR, SWY) in the Data Needs Philippines watershed models spreadsheet with the sources of your updated data.

2/ Remember to work on updating the biophysical table parameters for all models. This involves a literature search, which is time-consuming, but worthwhile, since the models are generally quite sensitive to these values, and it's best to look for more local values. As two sources of data, look through our NatCap publications and User-contributed publications to see if there are studies using these specific models that seem relevant, as they may list their biophysical table parameters and sources. Upload the updated tables to the related model folder in the Updated_data Gfolder.

3/ Read the 'DelineateIt' tool section of the InVEST User Guide

4/ Explore running DelineateIt (a tool found in the InVEST Workbench alongside the models) in the Santo Tomas watershed. You can use the resulting watershed to summarize modeling results to compare with observed data.

a/ Use the same DEM you plan to use for all models (which creates a stream network that best resembles reality).

b/ Create and use points approximating the locations of the gauge stations from where the observed data you will use in calibration will come.

c/ Experiment with different Threshold Flow Accumulation (TFA) values and snapping distances

d/ Critically evaluate results and come prepared to talk about them. The goal is to create servicesheds that are as realistic as possible.

Session 6: June 19/20, 2024

Link to recording of this session
Slides were not involved with this session, so none to share

Agenda

- Review homework from last week (30 minutes)
- Calibrating SDR
  - Service-sheds and model input data preparation (10 minutes)
  - InVEST Python package (30 minutes)
    - writing scripts
    - running scripts
  - Data management (10 minutes)
    - storage and access
    - version control and filenames
- Next homework and housekeeping (10 minutes)

Homework due July 4 (Philippines)

1/ ***Update the baseline biophysical tables for all models***. This involves a literature search, which is time-consuming, but worthwhile, since the models are generally quite sensitive to these values, and it's best to look for more local values. As two sources of data, look through our NatCap publications and User-contributed publications to see if there are studies using these specific models that seem relevant, as they may list their biophysical table parameters and sources. *Be sure to document the sources you use!*

Upload the updated tables to the related model folder in the Updated_data Gfolder, and come prepared to talk about your experience with updating, and the sources you decided to use.

2/ Calibrate the SDR model for the Santo Tomas watershed, following the guidance in the methods document. Find model inputs and parameters for a model run that produces about 50% of the example baseline annual sediment for the Santo Tomas watershed

- Aim for ~30,000 annual tons of sediment export for Santo Tomas watershed

Upload the script and results of your calibrated model to our Calibration_Gfolder. Add any new or modified data inputs to the SDR_Updated_inputs_Gfolder.

Session 7: July 3/4, 2024

Link to recording of this session
Slides were not involved with this session, so none to share

Agenda

- Review homework from last week (30 minutes)
- Revisit calibrating SDR (50 minutes)
    - Service-sheds and model input data preparation
    - Data management
    - InVEST Python package
        - writing scripts
        - running scripts
- Next homework and housekeeping (10 minutes)