A GIS add-in for automated measurement of sand dune migration using multi-temporal and high-resolution digital elevation models

User's Guide

Please send comments/suggestions to:

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1. Downloading and Installing Dune Migration Add-in

The Dune Migration ArcGIS add-in was developed using the Python programming language for ArcGIS 10.2.2 and later versions. The add-in, test data, and user's guide can be downloaded from http://geography.unt.edu/~pdong/software/dune/ (Figure 1).

Figure 1.

Once the three files in Figure 1 are downloaded, users can unzip the test data zip file which contains two sample LiDAR-derived 1-meter resolution digital elevation models (DEM) in TIFF format, acquired on January 24, 2009 and June 6, 2010 for an area of 401 m by 802 m in the White Sands Dune Field (WSDF) in New Mexico, USA. The steps for installing the add-in are listed below:

Step 1: Double click the downloaded file "DuneMigration.esriaddin". You can see the Add-in Installation Utility window (Figure 2). Click the "Install Add-in" button, and you should see a pop-up message: "Installation Succeded."

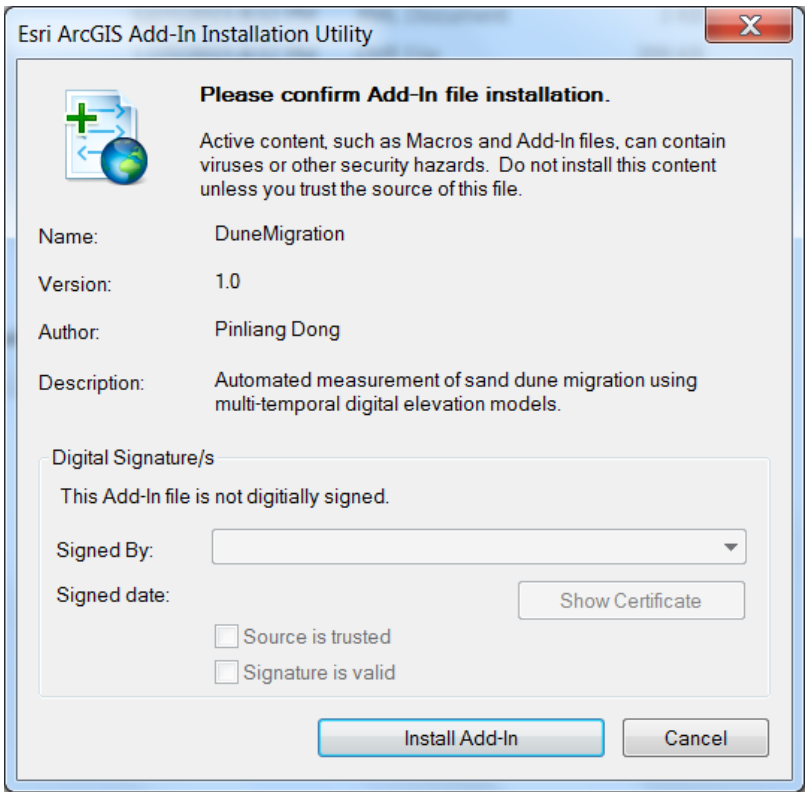

Figure 2.

Step 2: Open ArcMap, select menu "Customize → Add-in Manager…". Then select the "DuneMigration" add-in and click "Customize…" (Figure 3).

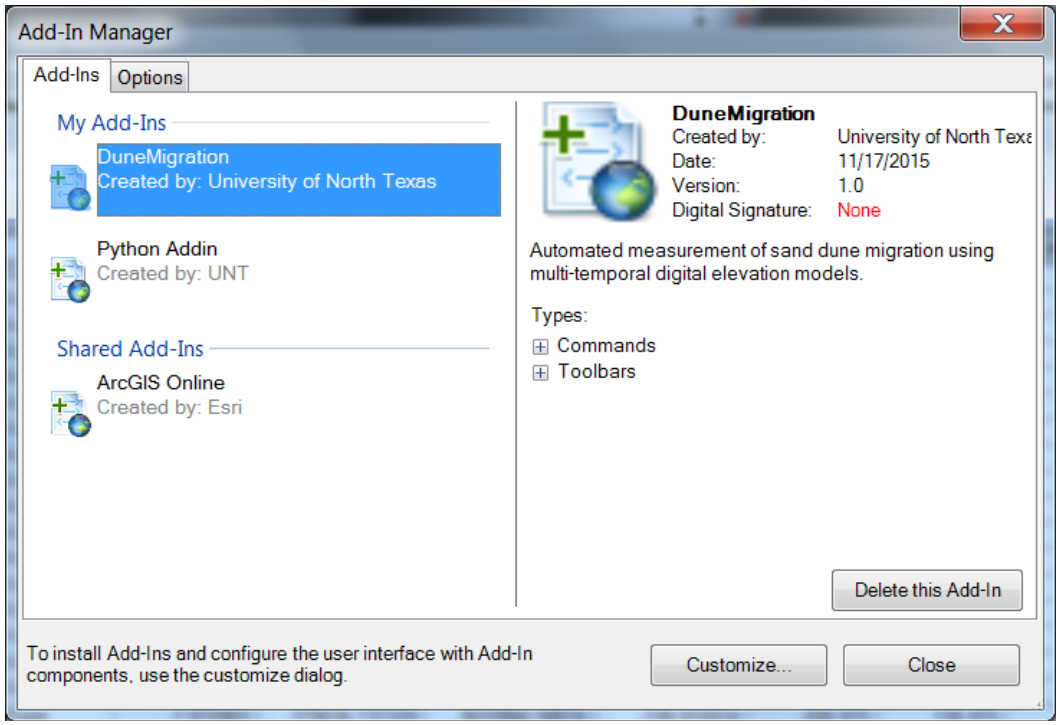

Figure 3.

Step 3. In the Customize window, check the Dune Migration toolbar, then click "Close" (Figure 4). The Dune Migration toolbar should appear (Figure 5).

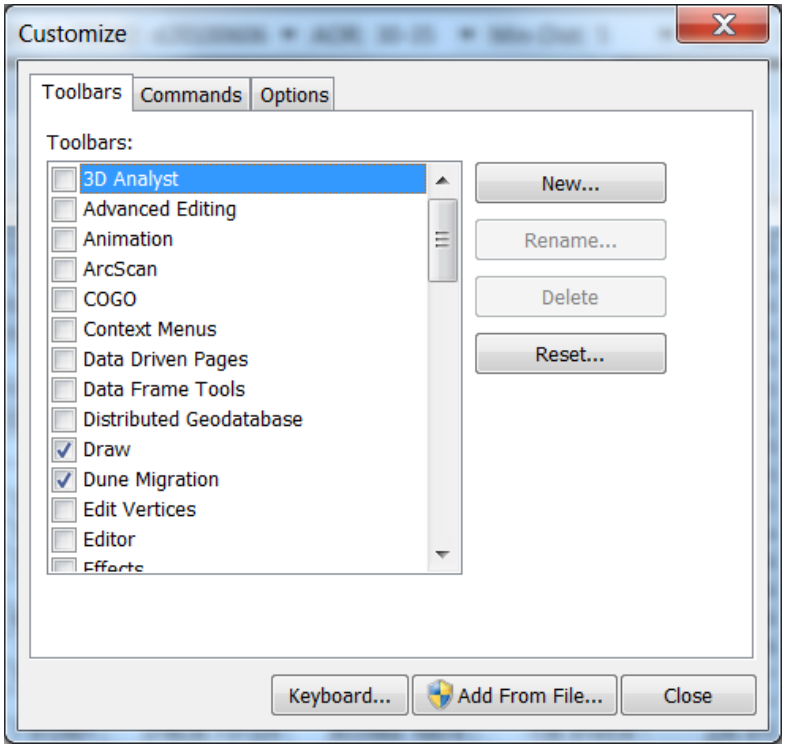

Figure 4.

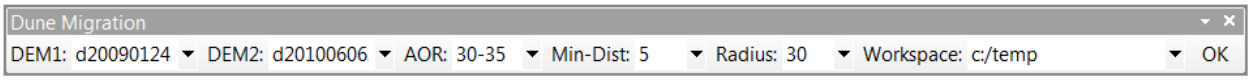

Figure 5.

2. Application Demonstration

Add the two DEMs (TIFF files) to ArcMap, and start using the toolbar. The items on the toolbar are described below:

(1) DEM1: The first DEM raster which can be created from LiDAR data or other data sources. The data acquisition date is contained in the DEM layer name in the format of YYYYMMDD, and the YYYYMMDD string can be any where in the DEM name as long as it is the first eight numbers, for example, A20090124DEM1. The DEM layer name can be changed by the user in ArcMap, and can be different from the actual file name.

(2) DEM2: The second DEM raster (similar to DEM1). The dates for DEM1 and DEM2 are used for calculating the time interval (number of days) between DEM1 and DEM2, which will be used to convert dune migration distance into migration rate at each sampling point.

(3) AOR: Angle of repose for sand dune slip faces. AOR is usually around 34°, depending on the sand grain size, shape and moisture content. Users can select/input a range, such as 30-35, as AOR values.

(4) Min-Dist: The minimum distance between two random points. The unit of distance is the same as the linear unit of the DEM layers.

(5) Radius: The search radius used to identify the nearest source point around a random target point. The unit of radius is the same as the linear unit of the DEM layers.

(6) Workspace: The folder for output rasters and shapefile. To ensure the geoprocessing steps are not affected by any existing files, there should be no existing files or folders in the workspace before a users clicks the OK button; otherwise a warning message will pop up.

(7) OK: Click OK to run the program. If there are any errors in the parameters on the toolbar, error messages will pop up.

Results from the test data are shown in the following figures.

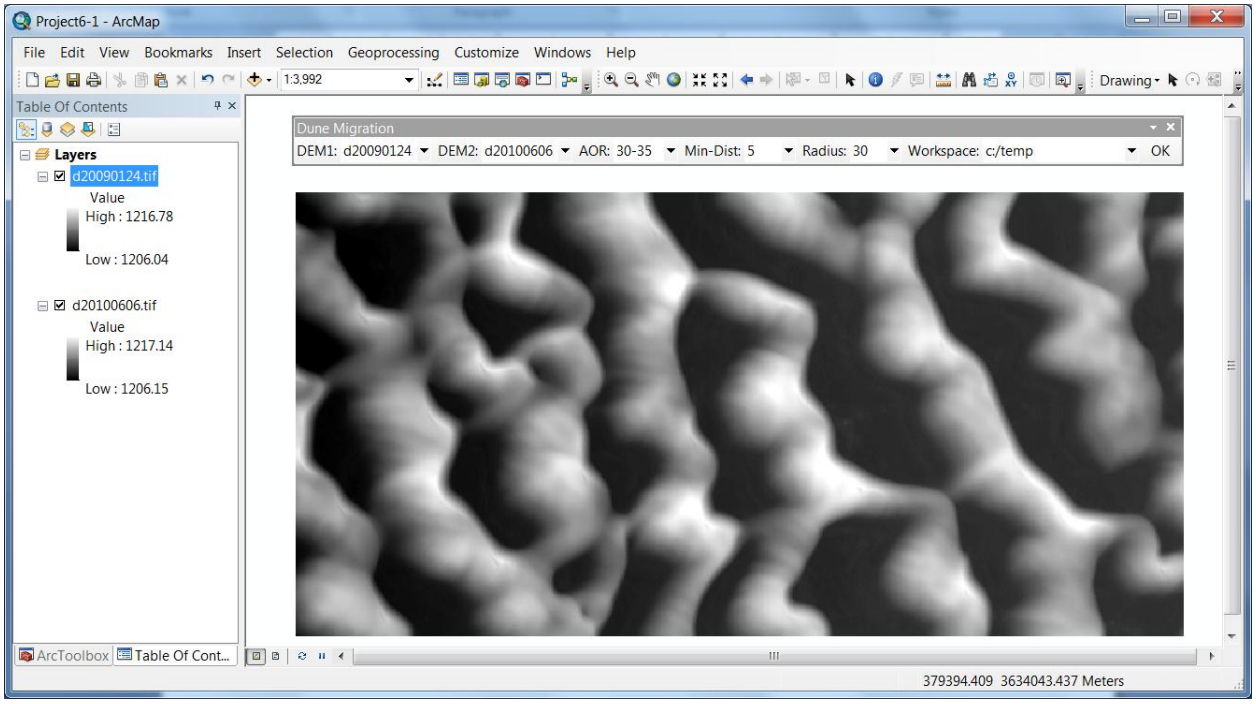

Figure 6. LiDAR-derived DEM (1-m resolution) of January 24, 2009 for the 401 m by 802 m test area.

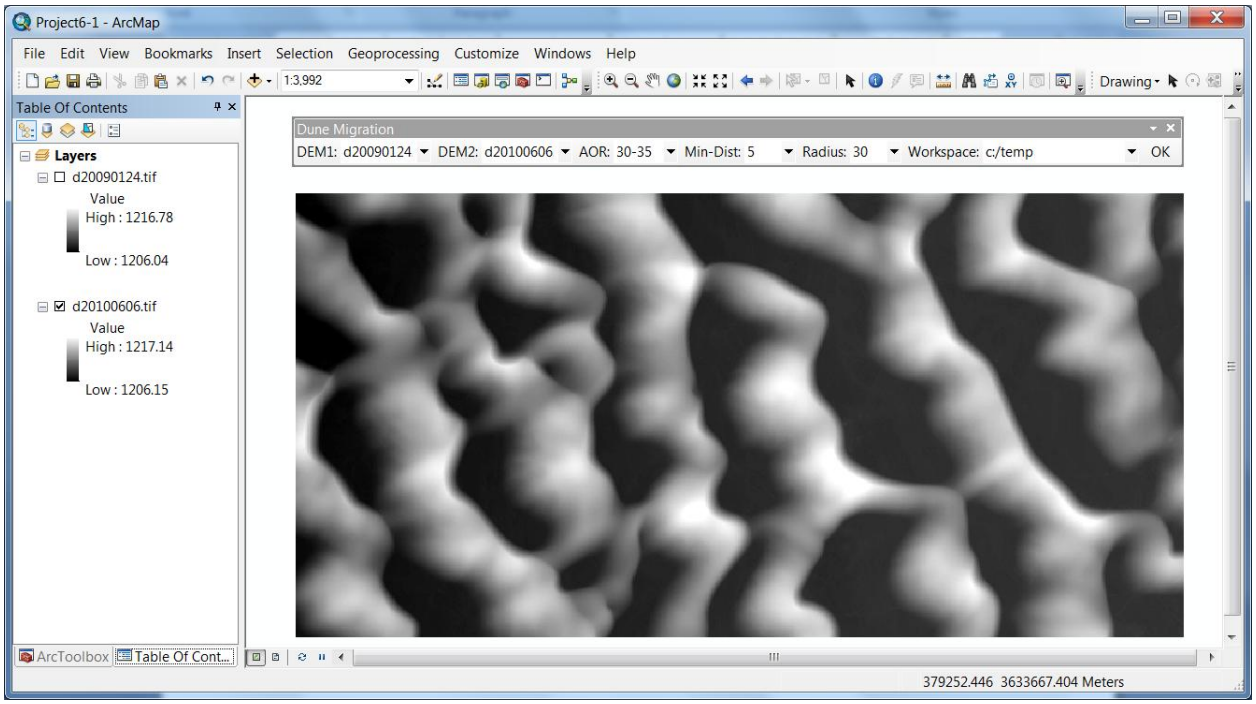

Figure 7. LiDAR-derived DEM (1-m resolution) of June 6, 2010 for the 401 m by 802 m test area.

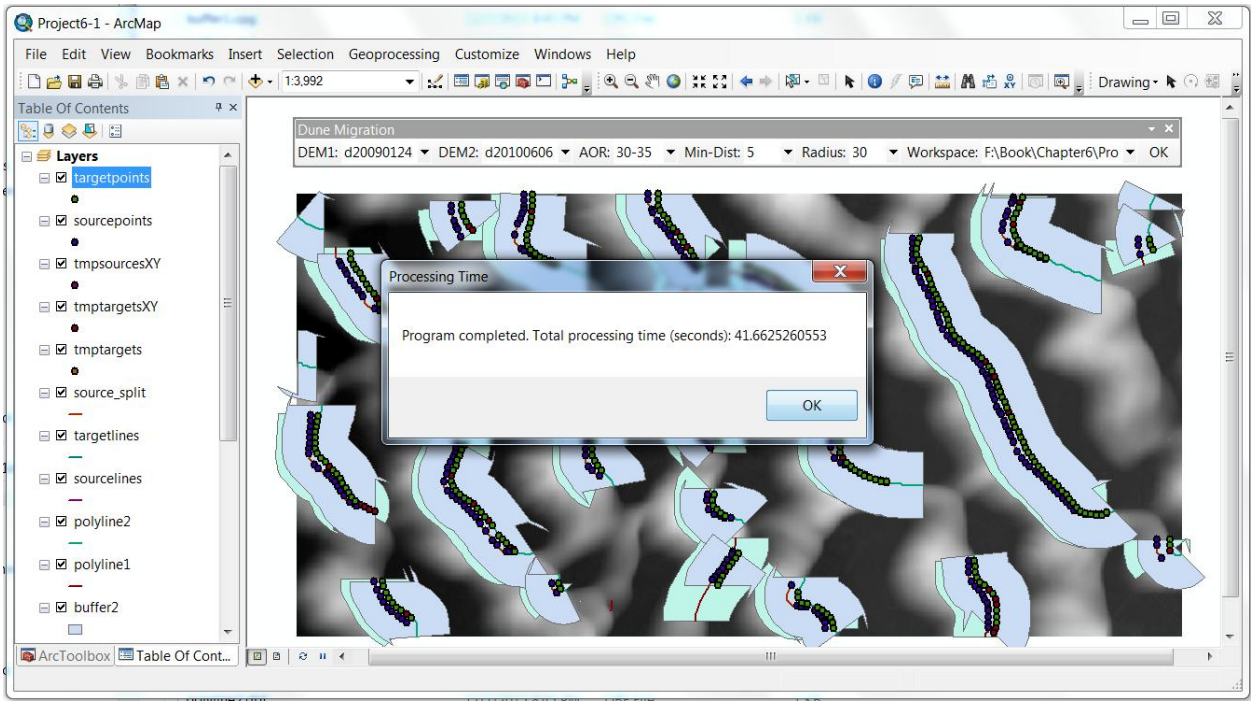

Figure 8. The test datasets were processed in less than 42 seconds.

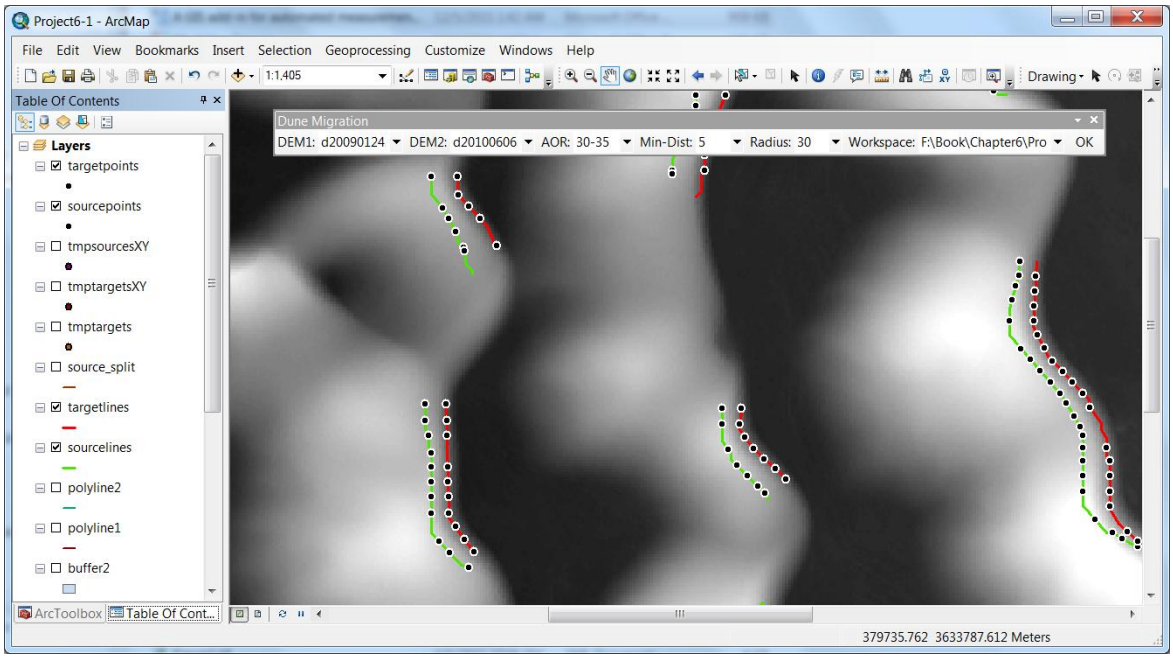

Figure 9. Target points on target lines (red, for June 6, 2010), and source points for source lines (Green, for January 24, 2009).

Table

targetpoints

FID	Shape *	NEAR_DIST	NEAR_X	NEAR_Y	NEAR_ANGLE	Azimuth0	Azimuth1	Diff_Azi	m_Rate
0	Point	10.045656	379426.9799	3634010.15506	-174.289407	264.289	174.289	90	7.36278
1	Point	9.590955	379427.487759	3634005.07647	-174.289407	264.289	174.289	90	7.02952
2	Point	10.108606	379429.487476	3633996.87115	-155.556045	245.556	155.556	90	7.40892
3	Point	10.168364	379431.583568	3633992.25974	-155.556045	245.556	155.556	90	7.45272
4	Point	10	380049.975701	3633979.95514	180	270	0	270	7.32932
5	Point	11.455775	380049.975701	3633975.2855	180	270	0	270	8.3963
6	Point	12.587863	380051.840124	3633966.60378	-161.565051	251.565	161.565	90	9.22604
7	Point	9	379605.975701	3634021.16765	180	270	0	270	6.59639
8	Point	9	379605.975701	3634015.97633	180	270	0	270	6.59639
9	Point	7.111591	379608.801112	3634007.25258	-150.255119	240.255	150.255	90	5.21231
10	Point	7.025692	379610.143614	3634004.5254	-165.963757	255.964	165.964	90	5.14935
11	Point	7.781547	379614.339523	3633997.31572	-139.085617	229.086	139.086	90	5.70334
12	Point	7.65866	379617.628123	3633993.52118	-139.085617	229.086	139.086	90	5.61328
13	Point	6.019416	379620.667891	3633990.01376	-139.085617	229.086	139.086	90	4.41182
14	Point	6.37817	379623.957318	3633986.21826	-139.085617	229.086	139.086	90	4.67476
15	Point	7.602758	379629.069294	3633977.41599	-140.710593	230.711	140.711	90	5.5723
16	Point	7.08949	379632.384508	3633973.36407	-140.710593	230.711	140.711	90	5.19611
17	Point	7.972901	379638.737329	3633964.16674	-136.974934	226.975	136.975	90	5.84359
18	Point	6.66975	379642.188065	3633960.46952	-136.974934	226.975	136.975	90	4.88847
19	Point	5.233663	379645.504543	3633956.91615	-136.974934	226.975	136.975	90	3.83592

0 (0 out of 282 Selected)

targetpoints

Figure 10. Attributes of target points. NEAR_DIST – migration distance, Azimuth0 – source direction, and m_Rate – migration rate (meters/year).

Recommended Citation:

Dong, P., 2015. Automated measurement of sand dune migration using multi-temporal LiDAR data and GIS. *International Journal of Remote Sensing* 36: 5526–5547.