SUPPLEMENTARY MATERIALS

Table S1. Metadata for all utilized Landsat 8 images.

#	Landsat ID	SENSING_TIME	CLOUD COVER
1	LC08_L1TP_006068_20180420_20180502_01_T1	2018-04-20T15:04:01.8192279Z	60.91
2	LC08_L1TP_006068_20180607_20180615_01_T1	2018-06-07T15:03:34.2646420Z	6.31
3	LC08_L1TP_006068_20180522_20180605_01_T1	2018-05-22T15:03:41.4989700Z	61.43
4	LC08_L1TP_006068_20180623_20180704_01_T1	2018-06-23T15:03:45.3609760Z	13.25
5	LC08_L1TP_006069_20180215_20180307_01_T1	2018-02-15T15:04:58.5739070Z	69.51
6	LC08_L1TP_006069_20180303_20180319_01_T1	2018-03-03T15:04:51.1744390Z	70.66
7	LC08_L1TP_006069_20180319_20180403_01_T1	2018-03-19T15:04:42.5190170Z	67.81
8	LC08_L1TP_006069_20180404_20180417_01_T1	2018-04-04T15:04:35.3721250Z	60.34
9	LC08_L1TP_006069_20180420_20180502_01_T1	2018-04-20T15:04:25.7441549Z	43.82
10	LC08_L1TP_006069_20180506_20180517_01_T1	2018-05-06T15:04:16.9971200Z	62.56
11	LC08_L1TP_006069_20180522_20180605_01_T1	2018-05-22T15:04:05.4281330Z	5.07
12	LC08_L1TP_006069_20180607_20180615_01_T1	2018-06-07T15:03:58.1980410Z	0.46
13	LC08_L1TP_006069_20180623_20180704_01_T1	2018-06-23T15:04:09.2943749Z	2.88
14	LC08_L1TP_007068_20180206_20180221_01_T1	2018-02-06T15:10:48.3417380Z	54.45
15	LC08_L1TP_007068_20180222_20180308_01_T1	2018-02-22T15:10:42.5544200Z	21.55
16	LC08_L1TP_007068_20180310_20180320_01_T1	2018-03-10T15:10:33.9663839Z	57.87
17	LC08_L1TP_007068_20180326_20180404_01_T1	2018-03-26T15:10:26.6158150Z	53.31
18	LC08_L1TP_007068_20180411_20180417_01_T1	2018-04-11T15:10:18.3002330Z	29.19
19	LC08_L1TP_007068_20180427_20180502_01_T1	2018-04-27T15:10:09.1340430Z	21.29
20	LC08_L1TP_007068_20180513_20180517_01_T1	2018-05-13T15:09:59.2049570Z	7.75
21	LC08_L1TP_007068_20180529_20180605_01_T1	2018-05-29T15:09:46.4205769Z	7.56
22	LC08_L1TP_007068_20180614_20180703_01_T1	2018-06-14T15:09:50.2510530Z	32.36
23	LC08_L1TP_007069_20180206_20180221_01_T1	2018-02-06T15:11:12.2709010Z	21.24
24	LC08_L1TP_007069_20180222_20180308_01_T1	2018-02-22T15:11:06.4835820Z	24.39
25	LC08_L1TP_007069_20180310_20180320_01_T1	2018-03-10T15:10:57.8913109Z	17.96
26	LC08_L1TP_007069_20180326_20180404_01_T1	2018-03-26T15:10:50.5449780Z	9.19
27	LC08_L1TP_007069_20180411_20180417_01_T1	2018-04-11T15:10:42.2293960Z	2.64
28	LC08_L1TP_007069_20180427_20180502_01_T1	2018-04-27T15:10:33.0632060Z	15.31
29	LC08_L1TP_007069_20180513_20180517_01_T1	2018-05-13T15:10:23.1256480Z	39.07
30	LC08_L1TP_007069_20180529_20180605_01_T1	2018-05-29T15:10:10.3497400Z	55.19
31	LC08_L1TP_007069_20180614_20180703_01_T1	2018-06-14T15:10:14.1886880Z	69.6

Code S1. Google Earth Engine code

```
var rois = ee.FeatureCollection(train_p1);
var rois2 = ee.FeatureCollection(testing_p1);
var ALOSDSMDEM = ee.Image('JAXA/ALOS/AW3D30_V1_1');
var ALOSDM = ALOSDSMDEM.select('AVE').toDouble().clip (puna).rename("ELEVACION");
var SLOPE_F = ee.Terrain.slope(ALOSDM).toDouble().clip (puna).rename("PENDIENTE");
var ASPECT_F = ee.Terrain.aspect(ALOSDM).toDouble().rename("ASPECTO");
var SIN_ASPECT =
ASPECT_F.divide(180).multiply(Math.PI).sin().toDouble().rename("ASPECTO");
var IMGLandsat8= ee.ImageCollection ('LANDSAT/LC08/C01/T1_SR')
  .filterDate ('2018-01-31', '2018-06-30') //fechas disponibles ('2013-04-11' - actualidad)
  .filterBounds (puna);
function maskLXsr(image){
  var cloudShadowBitMask = ee.Number(2).pow(3).int();
  var cloudsBitMask = ee.Number(2).pow(5).int();
  var qa = image.select('pixel_qa');
  var mask = qa.bitwiseAnd(cloudShadowBitMask).eq(0)
      .and(qa.bitwiseAnd(cloudsBitMask).eq(0));
  return image.updateMask(mask).divide(10000).clamp(1e-6, 1)
            .copyProperties(image, ["system:time_start"]);
}
var lXmask = IMGLandsat8.map(maskLXsr);
var Landsat8_NRG1 = ee.Image(lXmask.median());
var Landsat8a = Landsat8_NRG1.clip (puna)
              .select(['B2', 'B3', 'B4', 'B5', 'B6', 'B7'])
              .rename(['blue','green','red','nir','swir1','swir2'])
              .toDouble();
var Landsat8 = (Landsat8a.select('blue','green','red','nir','swir1','swir2')
              .divide((Landsat8a.select('blue','green','red','nir','swir1','swir2')
                      .reduce(ee.Reducer.sum()))).divide(ee.Number(6))))
                      .multiply(ee.Number(100));

//NDVI
var addNDVI=function(imagen){
    var NIR='nir';
    var RED='red';
  var ndvi= imagen.normalizedDifference([NIR, RED]).rename('NDVI');
  return imagen.addBands(ndvi).select('NDVI')};
var ndvi = addNDVI(Landsat8).select('NDVI').toDouble().rename("NDVI");
var NDVI_FIN = ndvi.clamp(-1, 1);
//print(NDVI_FIN,"NDVI_FIN")
//Map.addLayer(NDVI_FIN,{min: 0,  max: 1},"ndvi");

// Normalized Difference Builtup Index (NDBI)  NDBI = (SWIR1 – NIR) / (SWIR1 + NIR)
var addNDBI=function(imagen){
    var NIR='nir';
    var SWIR1='swir1';
  var ndbi= imagen.normalizedDifference([SWIR1,NIR]).rename('NDBI');
  return imagen.addBands(ndbi).select('NDBI')};
var NDBI = addNDBI(Landsat8).select('NDBI').toDouble().rename("NDBI");
```

```
var NDBI_FIN = NDBI.clamp(-1, 1);
//print(NDBI_FIN,"NDBI_FIN")
//Map.addLayer(NDBI_FIN,{min: 0,  max: 1},"NDBI");

//Normalized BURN RATIO "(NIR - SWIR1) / (NIR + SWIR1)"
var addNBR=function(imagen){
    var NIR='nir';
    var SWIR1='swir1';
  var nbr= imagen.normalizedDifference([NIR, SWIR1]).rename('NBR');
  return imagen.addBands(nbr).select('NBR')};
var NBR = addNBR(Landsat8).select('NBR').toDouble().rename("NBR");
var NBR_FIN = NBR.clamp(-1, 1);
//print(NBR_FIN,"NBR_FIN")
//Map.addLayer(NBR_FIN,{min: 0,  max: 1},"NBR");

// Normalized Difference Water Index (NDWI) NDWI = (Green – NIR) / (Green + NIR)
var addNDWI=function(imagen){
    var NIR='nir';
    var GREEN='green';
  var ndwi= imagen.normalizedDifference([GREEN, NIR]).rename('NDWI');
  return imagen.addBands(ndwi).select('NDWI')};
var NDWI = addNDWI(Landsat8).select('NDWI').toDouble().rename("NDWI");
var NDWI_FIN = NDWI.clamp(-1, 1);
//print(NDWI_FIN,"NDWI_FIN")
//Map.addLayer(NDWI_FIN,{min: 0,  max: 1},"NDWI");

// Modified Normalized Difference Water Index (mNDWI) or Normalized Difference Snow Index
(NDSI)
// A common index for detecting water (mNDWI) or snow (NDSI), where mNDWI = NDSI = (Green
– SWIR1) / (Green + SWIR1).
var addNDSI=function(imagen){
    var GREEN='green';
    var SWIR1='swir1';
  var ndsi= imagen.normalizedDifference([GREEN, SWIR1]).rename('NDSI');
  return imagen.addBands(ndsi).select('NDSI')};
var NDSI = addNDSI(Landsat8).select('NDSI').toDouble().rename("NDSI");
var NDSI_FIN = NDSI.clamp(-1, 1);
//print(NDSI_FIN,"NDSI_FIN")
//Map.addLayer(NDSI_FIN,{min: 0,  max: 1},"NDSI");

// MSAVI
var MSAVI = Landsat8.select('nir').multiply(2).add(1)
  .subtract(Landsat8.select('nir').multiply(2).add(1).pow(2)
    .subtract(Landsat8.select('nir').subtract(Landsat8.select('red')).multiply(8)).sqrt()
  ).divide(2)
var MSAVI_FIN = MSAVI.toDouble().rename("MSAVI");
//print(MSAVI_FIN,"MSAVI_FIN")
//Map.addLayer(MSAVI_FIN,{min: 0,  max: 0.5},"MSAVI_FIN");
```

```
// Enhanced Vegetation Index (EVI)
//An "optimized" vegetation index designed to enhance the vegetation signal with improved
sensitivity
//in high biomass regions. Landsat EVI = 2.5 * (NIR – Red) / ( NIR + 6*Red – 7.5*Blue + 1).
var EVI1 = ((Landsat8.select('nir').subtract(Landsat8.select('red')))
        .divide(Landsat8.select('nir').add(((Landsat8.select('red').multiply(6))
        .subtract(Landsat8.select('blue').multiply(7.5))).add(1)))).multiply(2.5)
var EVI = EVI1.toDouble().rename("EVI");
//print (EVI, 'EVI')
//Map.addLayer(EVI, {min: -1, max: 1}, 'EVI');

// Spectral Variability Vegetation Index (SVVI)
var SVV1a = Landsat8.select('blue','green','red','nir','swir1','swir2').reduce(ee.Reducer.stdDev());
var SVV1b = Landsat8.select('nir','swir1','swir2').reduce(ee.Reducer.stdDev());
var SVVI = SVV1a.subtract(SVV1b).rename("SVVI");

//var bands = ['blue','green','red','nir','swir1','swir2']
//var bands = ['NDVI','NDBI','NBR', 'NDWI','NDSI','MSAVI','EVI','SVVI'];
//var bands = ['blue','green','red','nir','swir1','swir2', 'NDVI','NDBI','NBR',
'NDWI','NDSI','MSAVI','EVI','SVVI']
//var bands = ['blue','green','red','nir','swir1','swir2','ELEVACION', 'PENDIENTE', 'ASPECTO'];
//var bands = ['NDVI','NDBI','NBR', 'NDWI','NDSI','MSAVI','EVI','SVVI', 'ELEVACION',
'PENDIENTE', 'ASPECTO'];
//var bands = ['blue','green','red','nir','swir1','swir2','NDVI','NDBI','NBR',
'NDWI','NDSI','MSAVI','EVI','SVVI','ELEVACION', 'PENDIENTE', 'ASPECTO'];
var predictors_base = Landsat8.addBands(NDVI_FIN).addBands(NDBI_FIN).addBands(NBR_FIN)
            .addBands(NDWI_FIN).addBands(NDSI_FIN).addBands(MSAVI_FIN)
             .addBands(EVI).addBands(SVVI)
            .addBands(ALOSDM).addBands(SLOPE_F).addBands(SIN_ASPECT);
var predictors = predictors_base.select(bands);
var trainingPartition = predictors.sampleRegions({
        collection: rois,
        properties: ['Clave'],
        scale: 30
});
var testingPartition = predictors.sampleRegions({
        collection: rois2,
        properties: ['Clave'],
        scale: 30
});
var classifiers = [ee.Classifier.libsvm(),
                   ee.Classifier.minimumDistance(),
                   ee.Classifier.smileCart(),
                   ee.Classifier.smileGradientTreeBoost(100),
                   ee.Classifier.smileNaiveBayes(),
                   ee.Classifier.smileRandomForest(100)];

var classifier = ee.Classifier.smileRandomForest({numberOfTrees: 100,}).train({
  features: trainingPartition,
  classProperty: 'Clave',
  inputProperties: bands
```

```
});

var dict = classifier.explain();
var variable_importance = ee.Feature(null, ee.Dictionary(dict).get('importance'));
 var chart =
ui.Chart.feature.byProperty(variable_importance)
.setChartType('ColumnChart')
.setOptions({
title: 'Random Forest Variable Importance',
legend: {position: 'none'},
hAxis: {title: 'Bands'},
vAxis: {title: 'Importance'}
});

var votes = ee.Image().clip(puna);
for(var i in classifiers) {
  votes = votes.addBands(predictors.classify(classifiers[i].train(trainingPartition,"Clave")))}
print(votes, "votes");
var votes1 = votes.select('classification_4').toDouble()
print(votes1, 'vot1')

*Export.image.toDrive({
  image: votes.select('classification','classification_1',
                      'classification_2', 'classification_3',
                      'classification_4', 'classification_5'),
  description: 'C1',
  scale: 30,
  folder : 'COVER_NYC',
  maxPixels: 8000000000,
  region: puna});
```