We assessed and processed the Landsat Mosaics through the Google Earth Enginge (GEE). We used the surface reflectance collections of Landsat 5, 7 and 8 which are corrected for atmospheric effects using the LEDAPS and LaSRC algorithms, respectively (USGS Landsat Surface Reflectance Tier 1). For each image between 06-01 and 09-30 of each year we masked clouds, cloud shadows and snow as identified by the CFMASK algorithm and calculated the NDVI based on the Red and Near Infrared band. For the Landsat 8 data we applied an intercept and offset as provided by Roy et al. 2016, which compensates for the different bandwidths between Landsat 5/7 and Landsat 8. Subsequently, we produced annual NDVI mosaics using the median of the NDVI tiles and exported the results to a local drive.

Roy, D. P., Kovalskyy, V., Zhang, H. K., Vermote, E. F., Yan, L., Kumar, S. S., & Egorov, A. (2016). Characterization of Landsat-7 to Landsat-8 reflective wavelength and normalized difference vegetation index continuity. Remote Sensing of Environment, 185, 57-70.

Code:

//#####################################################################################

// Generation of annual Landsat Surface reflectance mosaics

//#####################################################################################

//load AOI

//#####################################################################################

// feature collections can be uploaded at: https://fusiontables.google.com/DataSource?dsrcid=implicit

var AOI = ee.FeatureCollection('ft:1q9QA9q-Mc-YR7yIQfvJdoOpo--Gj6CYMDecs0BPC');

var AOI = AOI.filter(ee.Filter.eq("system:index", '13')); // ID + 1 !!!!

//Map.centerObject(AOI);

Map.addLayer(AOI, {color: '00FF00'}, 'AOI extent', true);

// cloud masking functions:

//#####################################################################################

var getQABits = function(image, start, end, newName) {

// Compute the bits .

var pattern = 0;

for (var i = start; i <= end; i++) {

pattern += Math.pow(2, i);

}

// Return a single band image of the extracted QA bits, giving the band a new name.

return image.select([0], [newName])

.bitwiseAnd(pattern)

.rightShift(start);

};

// A function to mask out cloudy pixels.

var cloud\_shadows = function(image) {

// Select the QA band.

var QA = image.select(['pixel\_qa']);

// Get the internal\_cloud\_algorithm\_flag bit.

return getQABits(QA, 3,3, 'Cloud\_shadows').eq(0);

// Return an image masking out cloudy areas.

};

// A function to mask out cloudy pixels.

var clouds = function(image) {

// Select the QA band.

var QA = image.select(['pixel\_qa']);

// Get the internal\_cloud\_algorithm\_flag bit.

return getQABits(QA, 5,5, 'Cloud').eq(0);

// Return an image masking out cloudy areas.

};

// A function to mask out snow pixels.

var snow = function(image) {

// Select the QA band.

var QA = image.select(['pixel\_qa']);

// Get the internal\_cloud\_algorithm\_flag bit.

return getQABits(QA, 4,4, 'Snow').eq(0);

// Return an image masking out cloudy areas.

};

var maskClouds = function(image) {

var s = snow(image);

var cs = cloud\_shadows(image);

var c = clouds(image);

image = image.updateMask(s);

image = image.updateMask(cs);

return image.updateMask(c);

};

// Load SR image collections and calculate NDVI:

//#####################################################################################

var collectionL5 = ee.ImageCollection('LANDSAT/LT05/C01/T1\_SR').filterBounds(AOI)

.map(function (image) {

return (

maskClouds(image).select('B4').subtract(maskClouds(image).select('B3'))

.divide(maskClouds(image).select('B4').add(maskClouds(image).select('B3'))).rename('nd').set({"system:time\_start":image.get("system:time\_start")})

)

});

var collectionL7 = ee.ImageCollection('LANDSAT/LE07/C01/T1\_SR').filterBounds(AOI)

.map(function (image) {

return (

maskClouds(image).select('B4').subtract(maskClouds(image).select('B3'))

.divide(maskClouds(image).select('B4').add(maskClouds(image).select('B3'))).rename('nd').set({"system:time\_start":image.get("system:time\_start")})

)

});

//Landsat 8 ndvi is adjusted based on the offset and intercept by Roy et al./2016/RSE to compensate for deviating bandwidths

var collectionL8 = ee.ImageCollection('LANDSAT/LC08/C01/T1\_SR').filterBounds(AOI)

.map(function (image) {

return (

maskClouds(image).select('B5').subtract(maskClouds(image).select('B4'))

.divide(maskClouds(image).select('B5').add(maskClouds(image).select('B4'))).multiply(0.9589).add(0.0029).rename('nd').set({"system:time\_start":image.get("system:time\_start")})

)

});

// Merge Landsat collection

var collectionL = ee.ImageCollection(collectionL5.merge(collectionL7).merge(collectionL8));

//Extend of test polygon (centered rectangle), required for visulization of time series

var point=(ee.Geometry.Rectangle(Map.getBounds()).centroid()).getInfo().coordinates;

print(point);

var CX=point[0];

var CY=point[1];

var DELTAx=0.02; //AOI size

var DELTAy=0.01; //AOI size

var AOI2 =ee.Geometry.Polygon([[

[CX-DELTAx, CY-DELTAy],[CX+DELTAx,CY-DELTAy],[CX+DELTAx,CY+DELTAy],[CX+DELTAx,CY+DELTAy],[CX-DELTAx, CY+DELTAy]

]]);

Map.addLayer(AOI2,{},"AOI4STATS",true);

//print charts of the time series within the rectangle (AOI2)

var bands5 = Chart.image.seriesByRegion(collectionL5,AOI2, ee.Reducer.mean(),'nd',30)

.setOptions({

title: 'LS5',

vAxis: {title: 'NDVI'},

lineWidth: 0.5,

pointSize: 4,

series: {

0: {color: 'FF0000'}

}

});

print(bands5);

var bands7 = Chart.image.seriesByRegion(collectionL7,AOI2, ee.Reducer.mean(),'nd',30)

.setOptions({

title: 'LS7',

vAxis: {title: 'NDVI'},

lineWidth: 0.5,

pointSize: 4,

series: {

0: {color: 'FF0000'}

}

});

print(bands7);

var bands8 = Chart.image.seriesByRegion(collectionL8,AOI2, ee.Reducer.mean(),'nd',30)

.setOptions({

title: 'LS8',

vAxis: {title: 'NDVI'},

lineWidth: 0.5,

pointSize: 4,

series: {

0: {color: 'FF0000'}

}

});

print(bands8);

var bandsall = Chart.image.seriesByRegion(collectionL,AOI2, ee.Reducer.mean(),'nd',30)

.setOptions({

title: 'LSall',

vAxis: {title: 'NDVI'},

lineWidth: 0.5,

pointSize: 4,

series: {

0: {color: 'FF0000'}

}

});

print(bandsall);

//define time period used to filter the image collection for suitable imagery

var L\_1984 = collectionL.filterDate('1984-06-01','1984-09-30');

var L\_1985 = collectionL.filterDate('1985-06-01','1985-09-30');

var L\_1986 = collectionL.filterDate('1986-06-01','1987-09-30');

var L\_1987 = collectionL.filterDate('1987-06-01','1987-09-30');

var L\_1988 = collectionL.filterDate('1988-06-01','1988-09-30');

var L\_1989 = collectionL.filterDate('1989-06-01','1989-09-30');

var L\_1990 = collectionL.filterDate('1990-06-01','1990-09-30');

var L\_1991 = collectionL.filterDate('1991-06-01','1991-09-30');

var L\_1992 = collectionL.filterDate('1992-06-01','1992-09-30');

var L\_1993 = collectionL.filterDate('1993-06-01','1993-09-30');

var L\_1994 = collectionL.filterDate('1994-06-01','1994-09-30');

var L\_1995 = collectionL.filterDate('1995-06-01','1995-09-30');

var L\_1996 = collectionL.filterDate('1996-06-01','1996-09-30');

var L\_1997 = collectionL.filterDate('1997-06-01','1997-09-30');

var L\_1998 = collectionL.filterDate('1998-06-01','1998-09-30');

var L\_1999 = collectionL.filterDate('1999-06-01','1999-09-30');

var L\_2000 = collectionL.filterDate('2000-06-01','2000-09-30');

var L\_2001 = collectionL.filterDate('2001-06-01','2001-09-30');

var L\_2002 = collectionL.filterDate('2002-06-01','2002-09-30');

var L\_2003 = collectionL.filterDate('2003-06-01','2003-09-30');

var L\_2004 = collectionL.filterDate('2004-06-01','2004-09-30');

var L\_2005 = collectionL.filterDate('2005-06-01','2005-09-30');

var L\_2006 = collectionL.filterDate('2006-06-01','2006-09-30');

var L\_2007 = collectionL.filterDate('2007-06-01','2007-09-30');

var L\_2008 = collectionL.filterDate('2008-06-01','2008-09-30');

var L\_2009 = collectionL.filterDate('2009-06-01','2009-09-30');

var L\_2010 = collectionL.filterDate('2010-06-01','2010-09-30');

var L\_2011 = collectionL.filterDate('2011-06-01','2011-09-30');

var L\_2012 = collectionL.filterDate('2012-06-01','2012-09-30');

var L\_2013 = collectionL.filterDate('2013-06-01','2013-09-30');

var L\_2014 = collectionL.filterDate('2014-06-01','2014-09-30');

var L\_2015 = collectionL.filterDate('2015-06-01','2015-09-30');

var L\_2016 = collectionL.filterDate('2016-06-01','2016-09-30');

//produce median mosaic

var med\_L\_1984 = L\_1984.reduce(ee.Reducer.median());

var med\_L\_1985 = L\_1985.reduce(ee.Reducer.median());

var med\_L\_1986 = L\_1986.reduce(ee.Reducer.median());

var med\_L\_1987 = L\_1987.reduce(ee.Reducer.median());

var med\_L\_1988 = L\_1988.reduce(ee.Reducer.median());

var med\_L\_1989 = L\_1989.reduce(ee.Reducer.median());

var med\_L\_1990 = L\_1990.reduce(ee.Reducer.median());

var med\_L\_1991 = L\_1991.reduce(ee.Reducer.median());

var med\_L\_1992 = L\_1992.reduce(ee.Reducer.median());

var med\_L\_1993 = L\_1993.reduce(ee.Reducer.median());

var med\_L\_1994 = L\_1994.reduce(ee.Reducer.median());

var med\_L\_1995 = L\_1995.reduce(ee.Reducer.median());

var med\_L\_1996 = L\_1996.reduce(ee.Reducer.median());

var med\_L\_1997 = L\_1997.reduce(ee.Reducer.median());

var med\_L\_1998 = L\_1998.reduce(ee.Reducer.median());

var med\_L\_1999 = L\_1999.reduce(ee.Reducer.median());

var med\_L\_2000 = L\_2000.reduce(ee.Reducer.median());

var med\_L\_2001 = L\_2001.reduce(ee.Reducer.median());

var med\_L\_2002 = L\_2002.reduce(ee.Reducer.median());

var med\_L\_2003 = L\_2003.reduce(ee.Reducer.median());

var med\_L\_2004 = L\_2004.reduce(ee.Reducer.median());

var med\_L\_2005 = L\_2005.reduce(ee.Reducer.median());

var med\_L\_2006 = L\_2006.reduce(ee.Reducer.median());

var med\_L\_2007 = L\_2007.reduce(ee.Reducer.median());

var med\_L\_2008 = L\_2008.reduce(ee.Reducer.median());

var med\_L\_2009 = L\_2009.reduce(ee.Reducer.median());

var med\_L\_2010 = L\_2010.reduce(ee.Reducer.median());

var med\_L\_2011 = L\_2011.reduce(ee.Reducer.median());

var med\_L\_2012 = L\_2012.reduce(ee.Reducer.median());

var med\_L\_2013 = L\_2013.reduce(ee.Reducer.median());

var med\_L\_2014 = L\_2014.reduce(ee.Reducer.median());

var med\_L\_2015 = L\_2015.reduce(ee.Reducer.median());

var med\_L\_2016 = L\_2016.reduce(ee.Reducer.median());

//clip extent to previously defined area of interest (AOI)

var med\_L\_1984 = med\_L\_1984.clip(AOI);

var med\_L\_1985 = med\_L\_1985.clip(AOI);

var med\_L\_1986 = med\_L\_1986.clip(AOI);

var med\_L\_1987 = med\_L\_1987.clip(AOI);

var med\_L\_1988 = med\_L\_1988.clip(AOI);

var med\_L\_1989 = med\_L\_1989.clip(AOI);

var med\_L\_1990 = med\_L\_1990.clip(AOI);

var med\_L\_1991 = med\_L\_1991.clip(AOI);

var med\_L\_1992 = med\_L\_1992.clip(AOI);

var med\_L\_1993 = med\_L\_1993.clip(AOI);

var med\_L\_1994 = med\_L\_1994.clip(AOI);

var med\_L\_1995 = med\_L\_1995.clip(AOI);

var med\_L\_1996 = med\_L\_1996.clip(AOI);

var med\_L\_1997 = med\_L\_1997.clip(AOI);

var med\_L\_1998 = med\_L\_1998.clip(AOI);

var med\_L\_1999 = med\_L\_1999.clip(AOI);

var med\_L\_2000 = med\_L\_2000.clip(AOI);

var med\_L\_2001 = med\_L\_2001.clip(AOI);

var med\_L\_2002 = med\_L\_2002.clip(AOI);

var med\_L\_2003 = med\_L\_2003.clip(AOI);

var med\_L\_2004 = med\_L\_2004.clip(AOI);

var med\_L\_2005 = med\_L\_2005.clip(AOI);

var med\_L\_2006 = med\_L\_2006.clip(AOI);

var med\_L\_2007 = med\_L\_2007.clip(AOI);

var med\_L\_2008 = med\_L\_2008.clip(AOI);

var med\_L\_2009 = med\_L\_2009.clip(AOI);

var med\_L\_2010 = med\_L\_2010.clip(AOI);

var med\_L\_2011 = med\_L\_2011.clip(AOI);

var med\_L\_2012 = med\_L\_2012.clip(AOI);

var med\_L\_2013 = med\_L\_2013.clip(AOI);

var med\_L\_2014 = med\_L\_2014.clip(AOI);

var med\_L\_2015 = med\_L\_2015.clip(AOI);

var med\_L\_2016 = med\_L\_2016.clip(AOI);

//visulization and settings

var differenceViz = {min: 0, max: 1, palette: ['999966', '996633', 'ff9900', '99ff33', '009933']};

Map.addLayer(med\_L\_1984,differenceViz, 'med\_L5\_1984', false);

Map.addLayer(med\_L\_1985,differenceViz, 'med\_L5\_1985', false);

Map.addLayer(med\_L\_1986,differenceViz, 'med\_L5\_1986', false);

Map.addLayer(med\_L\_1987,differenceViz, 'med\_L5\_1987', false);

Map.addLayer(med\_L\_1988,differenceViz, 'med\_L5\_1988', false);

Map.addLayer(med\_L\_1989,differenceViz, 'med\_L5\_1989', false);

Map.addLayer(med\_L\_1990,differenceViz, 'med\_L5\_1990', false);

Map.addLayer(med\_L\_1991,differenceViz, 'med\_L5\_1991', false);

Map.addLayer(med\_L\_1992,differenceViz, 'med\_L5\_1992', false);

Map.addLayer(med\_L\_1993,differenceViz, 'med\_L5\_1993', false);

Map.addLayer(med\_L\_1994,differenceViz, 'med\_L5\_1994', false);

Map.addLayer(med\_L\_1995,differenceViz, 'med\_L5\_1995', false);

Map.addLayer(med\_L\_1996,differenceViz, 'med\_L5\_1996', false);

Map.addLayer(med\_L\_1997,differenceViz, 'med\_L5\_1997', false);

Map.addLayer(med\_L\_1998,differenceViz, 'med\_L5\_1998', false);

Map.addLayer(med\_L\_1999,differenceViz, 'med\_L5\_1999', false);

Map.addLayer(med\_L\_2000,differenceViz, 'med\_L5\_2000', false);

Map.addLayer(med\_L\_2001,differenceViz, 'med\_L5\_2001', false);

Map.addLayer(med\_L\_2002,differenceViz, 'med\_L5\_2002', false);

Map.addLayer(med\_L\_2003,differenceViz, 'med\_L5\_2003', false);

Map.addLayer(med\_L\_2004,differenceViz, 'med\_L5\_2004', false);

Map.addLayer(med\_L\_2005,differenceViz, 'med\_L5\_2005', false);

Map.addLayer(med\_L\_2006,differenceViz, 'med\_L5\_2006', false);

Map.addLayer(med\_L\_2007,differenceViz, 'med\_L5\_2007', false);

Map.addLayer(med\_L\_2008,differenceViz, 'med\_L5\_2008', false);

Map.addLayer(med\_L\_2009,differenceViz, 'med\_L5\_2009', false);

Map.addLayer(med\_L\_2010,differenceViz, 'med\_L5\_2010', false);

Map.addLayer(med\_L\_2011,differenceViz, 'med\_L5\_2011', false);

Map.addLayer(med\_L\_2012,differenceViz, 'med\_L7\_2012', false);

Map.addLayer(med\_L\_2013,differenceViz, 'med\_L7\_2013', false);

Map.addLayer(med\_L\_2014.clamp(-1,1),differenceViz, 'med\_L8\_2014', false);

Map.addLayer(med\_L\_2015.clamp(-1,1),differenceViz, 'med\_L8\_2015', false);

Map.addLayer(med\_L\_2016.clamp(-1,1),differenceViz, 'med\_L8\_2016', false);

//export rasters for each year

Export.image.toDrive({

image: med\_L\_1984,

description: 'med\_L\_1984\_poly\_12',

folder: 'data\_earth\_engine',

scale: 30,

region: AOI,

maxPixels: 95830873570

});

Export.image.toDrive({

image: med\_L\_1985,

description: 'med\_L\_1985\_poly\_12',

folder: 'data\_earth\_engine',

scale: 30,

region: AOI,

maxPixels: 95830873570

});

Export.image.toDrive({

image: med\_L\_1986,

description: 'med\_L\_1986\_poly\_12',

folder: 'data\_earth\_engine',

scale: 30,

region: AOI,

maxPixels: 95830873570

});

Export.image.toDrive({

image: med\_L\_1987,

description: 'med\_L\_1987\_poly\_12',

folder: 'data\_earth\_engine',

scale: 30,

region: AOI,

maxPixels: 95830873570

});

Export.image.toDrive({

image: med\_L\_1988,

description: 'med\_L\_1988\_poly\_12',

folder: 'data\_earth\_engine',

scale: 30,

region: AOI,

maxPixels: 95830873570

});

Export.image.toDrive({

image: med\_L\_1989,

description: 'med\_L\_1989\_poly\_12',

folder: 'data\_earth\_engine',

scale: 30,

region: AOI,

maxPixels: 95830873570

});

Export.image.toDrive({

image: med\_L\_1990,

description: 'med\_L\_1990\_poly\_12',

folder: 'data\_earth\_engine',

scale: 30,

region: AOI,

maxPixels: 95830873570

});

Export.image.toDrive({

image: med\_L\_1991,

description: 'med\_L\_1991\_poly\_12',

folder: 'data\_earth\_engine',

scale: 30,

region: AOI,

maxPixels: 95830873570

});

Export.image.toDrive({

image: med\_L\_1992,

description: 'med\_L\_1992\_poly\_12',

folder: 'data\_earth\_engine',

scale: 30,

region: AOI,

maxPixels: 95830873570

});

Export.image.toDrive({

image: med\_L\_1993,

description: 'med\_L\_1993\_poly\_12',

folder: 'data\_earth\_engine',

scale: 30,

region: AOI,

maxPixels: 95830873570

});

Export.image.toDrive({

image: med\_L\_1994,

description: 'med\_L\_1994\_poly\_12',

folder: 'data\_earth\_engine',

scale: 30,

region: AOI,

maxPixels: 95830873570

});

Export.image.toDrive({

image: med\_L\_1995,

description: 'med\_L\_1995\_poly\_12',

folder: 'data\_earth\_engine',

scale: 30,

region: AOI,

maxPixels: 95830873570

});

Export.image.toDrive({

image: med\_L\_1996,

description: 'med\_L\_1996\_poly\_12',

folder: 'data\_earth\_engine',

scale: 30,

region: AOI,

maxPixels: 95830873570

});

Export.image.toDrive({

image: med\_L\_1997,

description: 'med\_L\_1997\_poly\_12',

folder: 'data\_earth\_engine',

scale: 30,

region: AOI,

maxPixels: 95830873570

});

Export.image.toDrive({

image: med\_L\_1998,

description: 'med\_L\_1998\_poly\_12',

folder: 'data\_earth\_engine',

scale: 30,

region: AOI,

maxPixels: 95830873570

});

Export.image.toDrive({

image: med\_L\_1999,

description: 'med\_L\_1999\_poly\_12',

folder: 'data\_earth\_engine',

scale: 30,

region: AOI,

maxPixels: 95830873570

});

Export.image.toDrive({

image: med\_L\_2000,

description: 'med\_L\_2000\_poly\_12',

folder: 'data\_earth\_engine',

scale: 30,

region: AOI,

maxPixels: 95830873570

});

Export.image.toDrive({

image: med\_L\_2001,

description: 'med\_L\_2001\_poly\_12',

folder: 'data\_earth\_engine',

scale: 30,

region: AOI,

maxPixels: 95830873570

});

Export.image.toDrive({

image: med\_L\_2002,

description: 'med\_L\_2002\_poly\_12',

folder: 'data\_earth\_engine',

scale: 30,

region: AOI,

maxPixels: 95830873570

});

Export.image.toDrive({

image: med\_L\_2003,

description: 'med\_L\_2003\_poly\_12',

folder: 'data\_earth\_engine',

scale: 30,

region: AOI,

maxPixels: 95830873570

});

Export.image.toDrive({

image: med\_L\_2004,

description: 'med\_L\_2004\_poly\_12',

folder: 'data\_earth\_engine',

scale: 30,

region: AOI,

maxPixels: 95830873570

});

Export.image.toDrive({

image: med\_L\_2005,

description: 'med\_L\_2005\_poly\_12',

folder: 'data\_earth\_engine',

scale: 30,

region: AOI,

maxPixels: 95830873570

});

Export.image.toDrive({

image: med\_L\_2006,

description: 'med\_L\_2006\_poly\_12',

folder: 'data\_earth\_engine',

scale: 30,

region: AOI,

maxPixels: 95830873570

});

Export.image.toDrive({

image: med\_L\_2007,

description: 'med\_L\_2007\_poly\_12',

folder: 'data\_earth\_engine',

scale: 30,

region: AOI,

maxPixels: 95830873570

});

Export.image.toDrive({

image: med\_L\_2008,

description: 'med\_L\_2008\_poly\_12',

folder: 'data\_earth\_engine',

scale: 30,

region: AOI,

maxPixels: 95830873570

});

Export.image.toDrive({

image: med\_L\_2009,

description: 'med\_L\_2009\_poly\_12',

folder: 'data\_earth\_engine',

scale: 30,

region: AOI,

maxPixels: 95830873570

});

Export.image.toDrive({

image: med\_L\_2010,

description: 'med\_L\_2010\_poly\_12',

folder: 'data\_earth\_engine',

scale: 30,

region: AOI,

maxPixels: 95830873570

});

Export.image.toDrive({

image: med\_L\_2011,

description: 'med\_L\_2011\_poly\_12',

folder: 'data\_earth\_engine',

scale: 30,

region: AOI,

maxPixels: 95830873570

});

Export.image.toDrive({

image: med\_L\_2012,

description: 'med\_L\_2012\_poly\_12',

folder: 'data\_earth\_engine',

scale: 30,

region: AOI,

maxPixels: 95830873570

});

Export.image.toDrive({

image: med\_L\_2013,

description: 'med\_L\_2013\_poly\_12',

folder: 'data\_earth\_engine',

scale: 30,

region: AOI,

maxPixels: 95830873570

});

Export.image.toDrive({

image: med\_L\_2014,

description: 'med\_L\_2014\_poly\_12',

folder: 'data\_earth\_engine',

scale: 30,

region: AOI,

maxPixels: 95830873570

});

Export.image.toDrive({

image: med\_L\_2015,

description: 'med\_L\_2015\_poly\_12',

folder: 'data\_earth\_engine',

scale: 30,

region: AOI,

maxPixels: 95830873570

});

Export.image.toDrive({

image: med\_L\_2016,

description: 'med\_L\_2016\_poly\_12',

folder: 'data\_earth\_engine',

scale: 30,

region: AOI,

maxPixels: 95830873570

});