Sen’s slope LST >35°C Google Earth Engine open-source code

(developed by authors for calculating the mean day and night LST during summer for the study area)

Northeast Italian viticulture affected by heat and vegetation stress. A Satellite-Based Study from 2000 to 2024

Vincenzo Baldan, Eugenio Straffelini, Vincenzo D’Agostino, and Paolo Tarolli (2025)

// import study area boundaries

//import MODIS LST data and select “'LST\_Day\_1km”

var modisLST = ee.ImageCollection('MODIS/061/MOD11A2')

.select('LST\_Day\_1km')

.filter(ee.Filter.calendarRange(6, 8, 'month')) // Filter June-August

.map(function(image) {

var lstThreshold = image.multiply(0.02).subtract(273.15).gt(35); // Convert to °C

return lstThreshold.set('year', image.date().get('year'));

});

// Aggregate annual frequency of LST > 35°C

var years = ee.List.sequence(2000, 2024);

var yearlyFreq = ee.ImageCollection(years.map(function(y) {

var yearImages = modisLST.filter(ee.Filter.eq('year', y));

return yearImages.sum().rename('LST\_Above\_35').set('year', y);

}));

Map.addLayer(yearlyFreq, {}, 'Yearly LST > 35 Frequency');

// Compute Sen's Slope

var afterFilter = ee.Filter.lessThan({

leftField: 'year',

rightField: 'year'

});

var joined = ee.ImageCollection(ee.Join.saveAll('after').apply({

primary: yearlyFreq,

secondary: yearlyFreq,

condition: afterFilter

}));

var sign = function(i, j) {

return ee.Image(j).neq(i)

.multiply(ee.Image(j).subtract(i).clamp(-1, 1)).int();

};

var kendall = ee.ImageCollection(joined.map(function(current) {

var afterCollection = ee.ImageCollection.fromImages(current.get('after'));

return afterCollection.map(function(image) {

return ee.Image(sign(current, image)).unmask(0);

});

}).flatten()).reduce('sum', 2);

var slope = function(i, j) {

return ee.Image(j).subtract(i)

.divide(ee.Number(j.get('year')).subtract(ee.Number(i.get('year'))))

.rename('slope')

.float();

};

var slopes = ee.ImageCollection(joined.map(function(current) {

var afterCollection = ee.ImageCollection.fromImages(current.get('after'));

return afterCollection.map(function(image) {

return ee.Image(slope(current, image));

});

}).flatten());

var senSlope = slopes.reduce(ee.Reducer.median(), 2);

//clip it with the study area (table) and display the map

var senSlope\_clip = senSlope.clip(table);

Map.addLayer(senSlope\_clip, {palette: ['blue', 'white', 'red']}, 'Sen’s Slope');

//Export the results

Export.image.toDrive({

image: senSlope\_clip,

description: 'freq\_LST35\_Day\_senslope\_0024',

region: table.geometry().bounds(),

scale: 1000,

maxPixels: 1e13

});