

**Supplementary Table 2. Core OGH functions introduced in use-case 1 through 4**

Use case	Function name	Inputs	Purpose/output
1. Map watershed centroids	reprojShapefile	sourcepath: (dir) the path to the .shp file	Convert a shapefile into a new projection
		newprojdictionary: (dict) new projection definitions	
		outputpath: (dir) the output path for the new shapefile	
	TreatGeoSelf	shapefile: (dir) study site ESRI shapefile	Identify gridded cell centroids that intersect the study site
		NAmer: (dir) 1/16th-degree gridded cell centroids ESRI shapefile	
		mappingfile: (str) name of the output file	
		buffer_distance: (float64) multiplier to increase the boundary	
	multiSiteVisual	listOfShapefiles: (list of dir) list of ESRI shapefile paths	Generate a visual map of multiple watershed study sites
		listOfNames: (list of str) list of study site labels (in order of shapefile)	
		multishape: (dir) output shapefile with each study site shape	
		singleshape: (dir) output shapefile with each study site shape combined	
		fileoutputpath: (dir) output file path for figure	
		projection: (str) Basemap notation for projection schema e.g. 'merc'	
		epsg: (int) EPSG code for regional projection	
		polygon_color: (str) matplotlib color notation to color the study sites	
		margin: (float64) figure margin multiplier from study site shape	
		scale_x_dist: (float64) reference scale, x degrees from lower left	
		scale_y_dist: (float64) reference scale y degrees from lower left	
		scale_ref_length: (float) reference length	
		scale_yoffset: (float64) reference scale height	
		text_x_dist: (float64) label position, x degrees from study site centroid	
		text_y_dist: (float64) label position, y degrees from study site centroid	
		annotate: (logic) display study site labels	

**Supplementary Table 2 cont. Core OGH functions introduced in use-case 1 through 4**

Use case	Function name	Inputs	Purpose/output
1. Map watershed centroids	griddedCellGradient	mappingfile: (dir) mapping file source path	Generate a visual map of the gridded cell in a study site
		shapefile: (dir) study site ESRI shapefile	
		outfilepath: (dir) the output path for the new shapefile	
		plottitle: (str) title of figure	
		colorbar_label: (str) colorbar label	
		spatial_resolution: (float) grid cell spatial resolution in LatLong degrees	
		margin: (float64) figure margin multiplier from study site shape	
		epsg: (int) EPSG regional projection code	
		basemap_image: (str) code for arcgis basemap	
		cmap: (str) reference color gradient for colorbar	
		column: (str) column label in mapping file	
2. Data download	getDailyMET_livneh2013	homedir: (dir) directory to create subdirectories mappingfile: (dir) mapping file source path	downloads datafiles from Livneh et al., 2013 MET web services
	getDailyMET_bcLivneh2013		downloads datafiles from Livneh et al., 2013 bias corrected MET web services
	getDailyMET_livneh2015		downloads datafiles from Livneh et al., 2015 MET web services
	getDailyVIC_livneh2013		downloads datafiles from Livneh et al., 2013 VIC web services
	getDailyVIC_livneh2015		downloads datafiles from Livneh et al., 2015 VIC web services
	getDailyWRF_salathe2014		downloads datafiles from Salathe et al., 2014 raw WRF web services
	getDailyWRF_bcsalathe2014		downloads datafiles from Salathe et al., 2014 bias corrected WRF web services
	mappingfileSummary	listofmappingfiles: (list) list of mapping file paths	Summarize cataloged datafiles by watershed and gridded data product
		listofwatershednames: (list) list of study site labels	
		meta_file: (dict) dictionary of metadata annotations	

**Supplementary Table 2 cont. Core OGH functions introduced in use-case 1 through 4**

Use case	Function name	Inputs	Purpose/output
3. Summarize monthly Meteorology (continued on next page)	findCentroidCode	mappingfile: (dir) mapping file path	generate a list of gridded cell codes (FID, LAT, LONG) that meet a specified criteria
		colvar: (string) a column name in mappingfile	
		colvalue: (value) a value that corresponds to the colvar column	
	overlappingDates	date_set1: tuple of start and end date	generates a tuple for the overlapping start and end dates
		date_set2: tuple of start and end date	
	gridclim_dict	mappingfile: (dir) mapping file path	generates 8 spatial-temporal data processing outputs to an output dictionary object.
		dataset: (str) gridded data product shortname as suffix	
		gridclimname: (str) user-defined suffix	
		metadata: (dict) dictionary of metadata annotations	
		variable_list: (list - optional) list of variables to read in	
		min_elev: (float64 - optional) min. elevation criteria	
		max_elev: (float64 - optional) max. elevation criteria	
		file_start_date: (date - optional) time-series start date	
		file_end_date: (date - optional) time-series end date	
		file_time_step: (str) pandas notation for time-increment	
		file_colnames: (list) column names from left to right	
		file_delimiter: (str) character to parse columns	
		subset_start_date: (date) startdate of analysis	
		subset_end_date: (date) enddate of analysis	
		df_dict: (dict - optional) existing output dictionary object	
		colvar: (str - optional) gridded data product short name for complete file reading	

**Supplementary Table 2 cont. Core OGH functions introduced in use-case 1 through 4**

Use case	Function name	Inputs	Purpose/output
3. Summarize monthly Meteorology (Continued from previous page).	aggregate_space_time_sum	df_dict: a variable dataframe of daily dates (rows) and gridded cells (columns).	generates 10 spatial and temporal summary dataframes for the time period of interest.
		suffix: the gridded data product short name	
		start_date: start date of the period of interest.	
		end_date: end date of the period of interest.	
	valueRange	listOfDf: (list) a list of dataframes and arrays	generate a tuple representing the minimum and maximum value among the matrices provided
	saveDictOfDf	outfilepath: (dir) the path to the output json file	Save a JSON file with the pickle'd python dictionary-of-dataframes
		dictionaryObject: (dict) the python dictionary object	
	renderValueInBoxplot	vardf: (dataframe) dataframe of values	Renders boxplots for the distribution of values across gridded cells
		outfilepath: (dir) output file path	
		plottitle: (str) title of figure	
		time_steps: (month or year) x-axis time-scale	
		value_name: (str) y-axis label	
		cmap: (str) reference color gradient for colorbar	
		wateryear: (logic) organize months using wateryear	
		vmin: (float64 - optional) colorbar minimum	
		vmax:(float64 - optional) colorbar maximum	
		figsize: (tuple) figure height and width in inches	
		reference_lines: (list - optional) list of gridded cells to identify as reference lines	
		ref_legend: (logic) display reference line legend	
		ref_legend_loc: (int) matplotlib code for the legend location	

**Supplementary Table 2 cont. Core OGH functions introduced in use-case 1 through 4**

Use case	Function name	Inputs	Purpose/output
3. Summarize monthly Meteorology (Continued from previous page).	renderValueInBoxplot (cont.)	obs_datavector: (vector) a vector of values to display as dashed lines	Renders boxplots for the distribution of values across gridded cells (cont.)
		obs_datalabel: (str) the name of the vector	
		obs_legend: (logic) display the observation data legend	
		obs_legend_loc: (int) matplotlib code for the legend location	
		vardf: (dataframe) dataframe of values	Renders visual map with the spatial distribution of gridded cell values
		vardf_dateindex (str) row-index	
		shapefile: (dir) study site ESRI shapefile path	
		outfilepath: (dir) figure output file path	
		plottitle: (str) title of figure	
		colorbar_label: (str) colorbar label	
		vmin: (float64 - optional) colorbar minimum	
		vmax: (float64 - optional) colorbar maximum	
		spatial_resolution: (float) grid cell spatial resolution in LatLong degrees	
		margin: (float64) figure margin multiplier from study site shape	
		epsg: (int) EPSG regional projection code	
		basemap_image: (str) code for arcgis basemap	
		cmap: (str) reference color gradient for colorbar	

**Supplementary Table 2 cont. Core OGH functions introduced in use-case 1 through 4**

Use case	Function name	Inputs	Purpose/output
4. Compute exceedance probabilities	monthlyExceedence_mmday	df_dict: (dict) source dictionary of dataframes	Generates a dataframe for monthly monthly (rows) exceedance probability thresholds for each gridded cell (columns)
		daily_streamflow_dfname: (str) dataframe of interest	
		exceedance: (float64) exceedance percentage	
	computeSurfaceArea	shapefile: (dir) the path to the study site shapefile for selecting the UTM boundary	Data-driven computation of surface area using a watershed shapefile
	cfs_to_mmday	cfs: (float) flow rate in cubic feet per second	Convert a volumetric rate to a linear rate over a surface area
		SA_sq_ft: (float) surface area in square feet	