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A flexible Python script for stratified random site selection

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Random Site Selection is important

- The design of a sampling network is very important when trying to answer a question
- Removing as much bias as possible is critical to the usefulness of sampling results

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USGS random sampling tool

COMPUTERIZED STRATIFIED RANDOM SITE-SELECTION APPROACHES

FOR DESIGN OF A GROUND-WATER-QUALITY SAMPLING NETWORK

by Jonathon C. Scott

U.S. GEOLOGICAL SURVEY

Water-Resources Investigations Report 90-4101

pubs.er.usgs.gov/publication/wri904101

Oklahoma City, Oklahoma

1990

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USGS random sampling tool

- Designed for a national water-quality assessment
- Used for many national, regional, and local USGS ground-water studies
- Three random sampling methods

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Three methods

1. Simple random selection

   (without replacement)
2. Random selection within cells
3. Random selection with iterating grids

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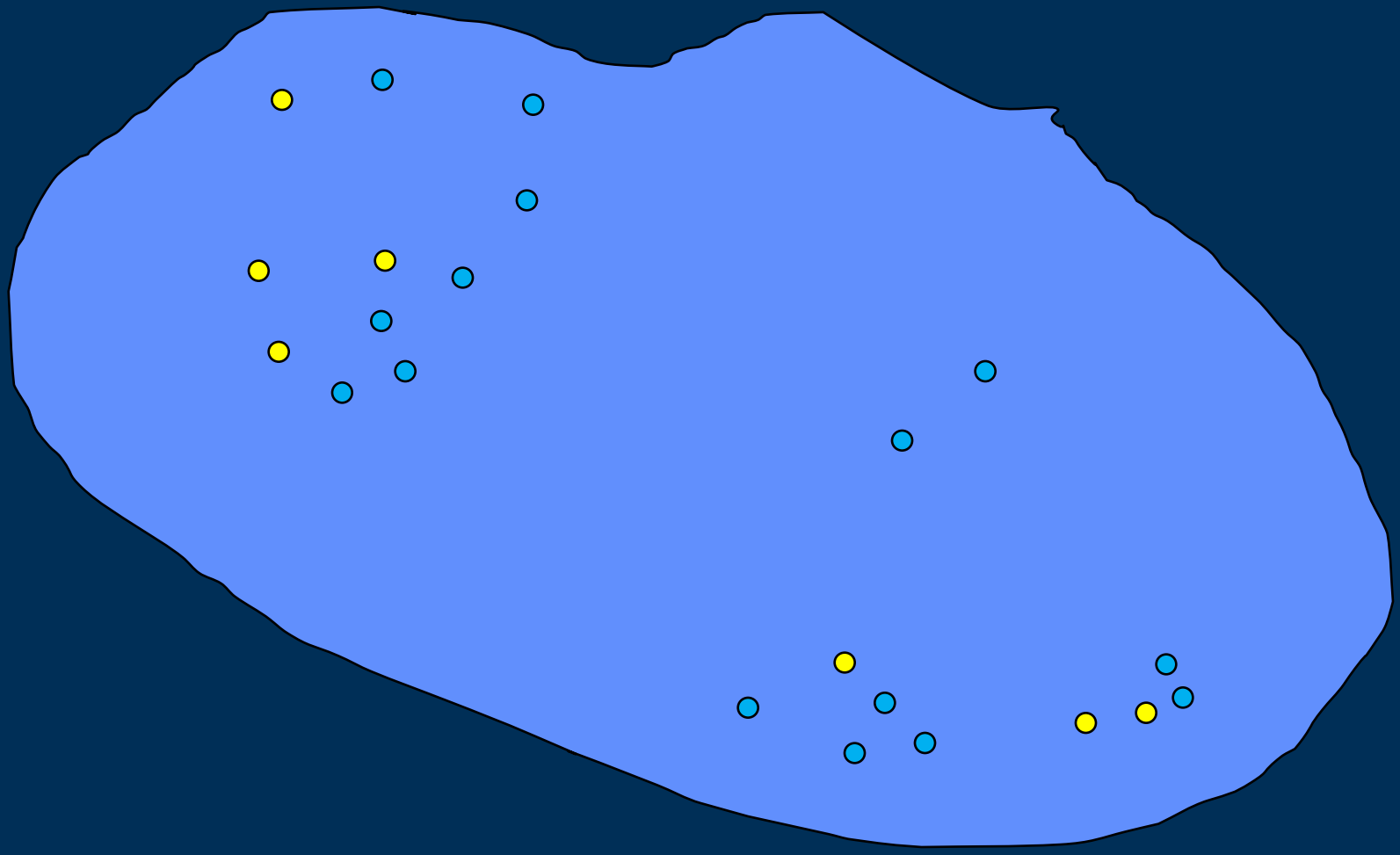
Simple random selection



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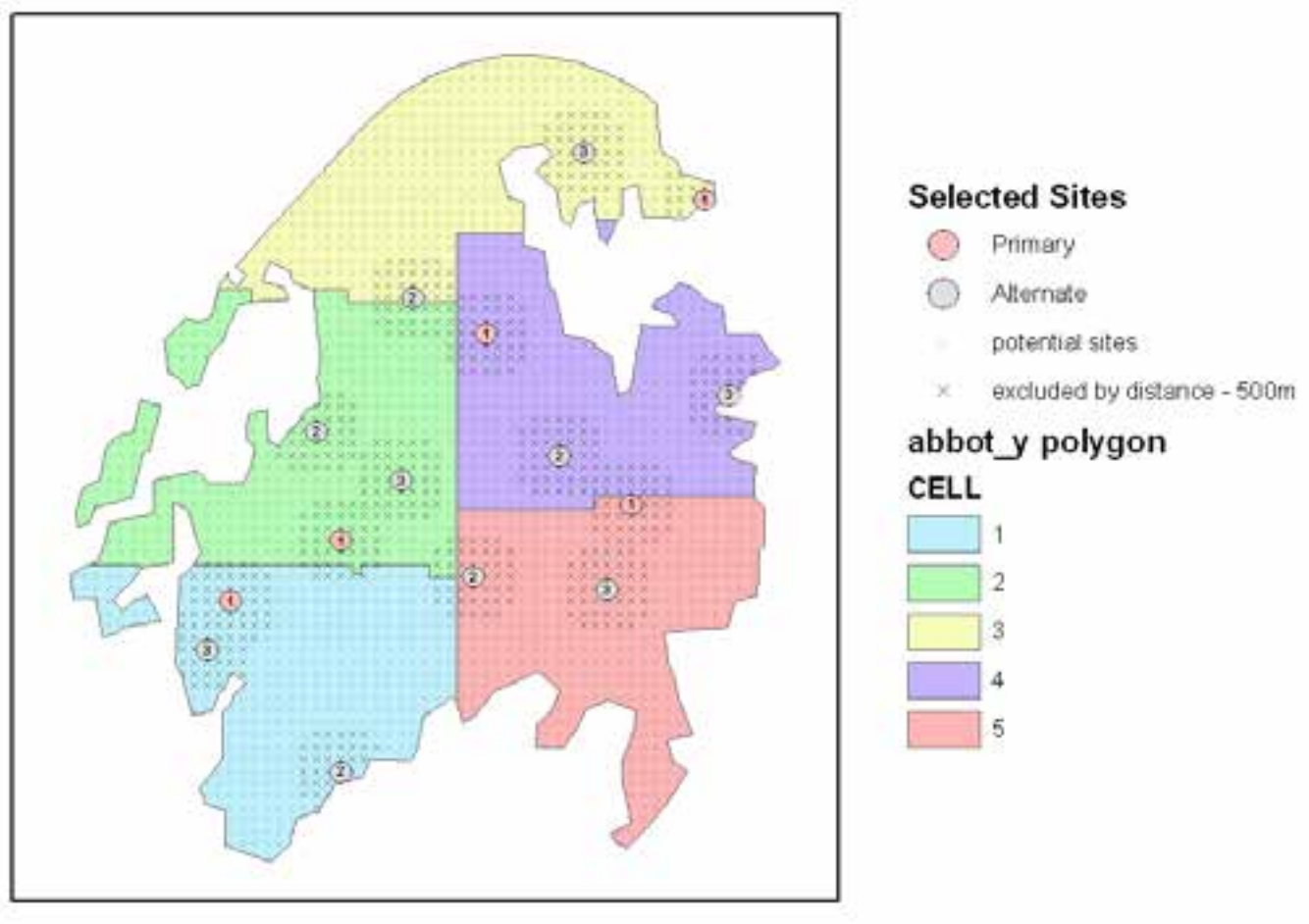
Random selection within cells



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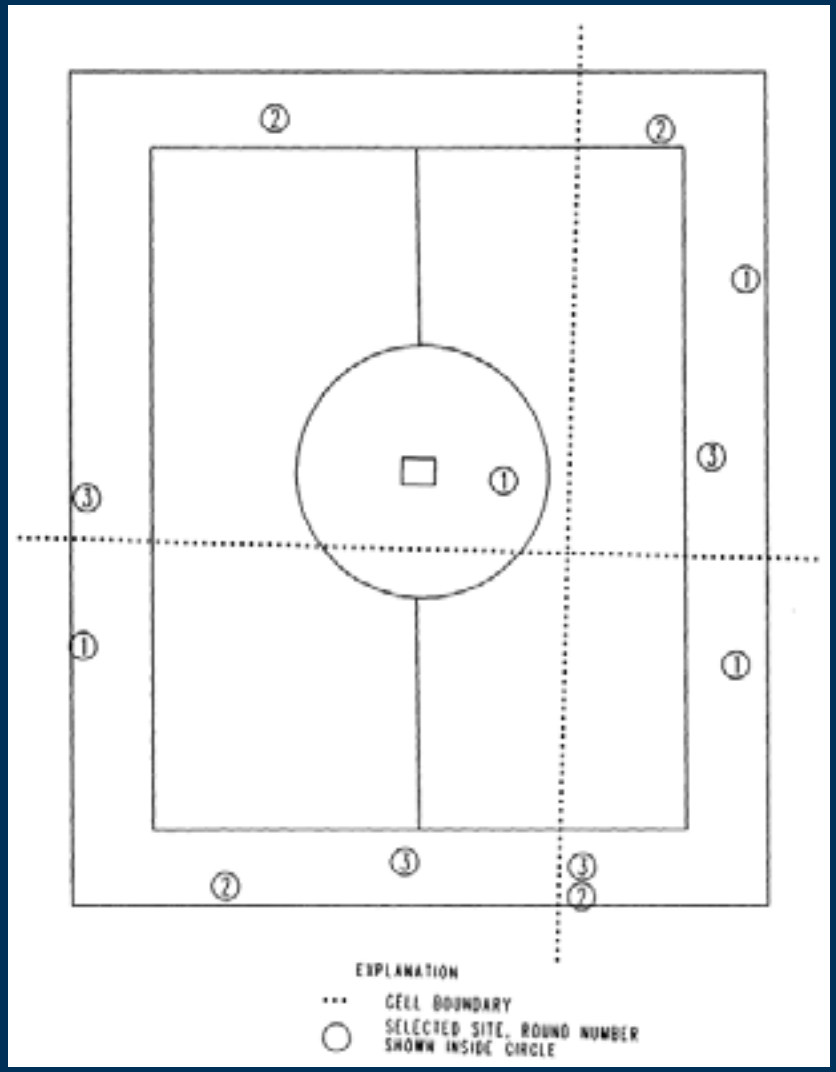
Random selection with iterating grids



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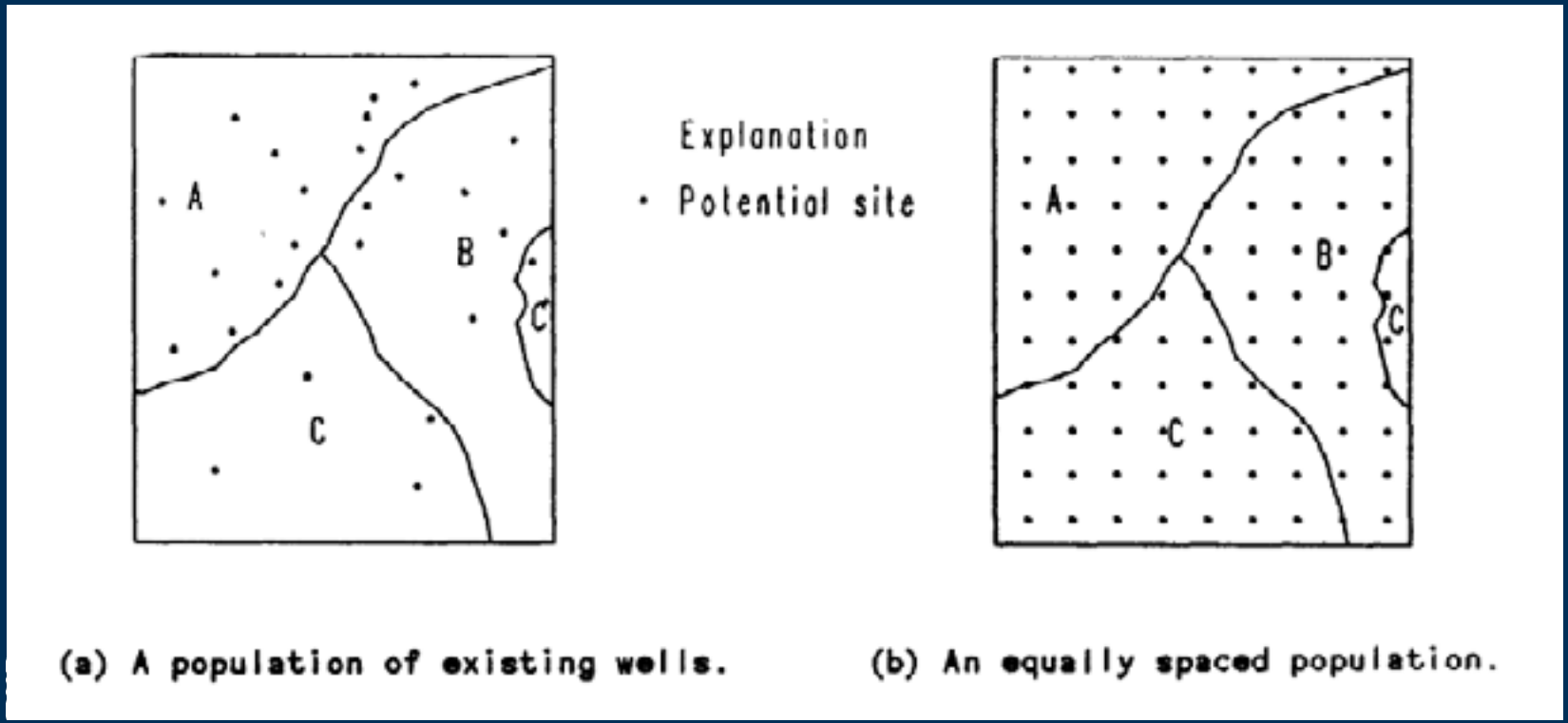
Source points

- All three methods accept existing points or build a lattice of candidate points from a provided study area



(a) A population of existing wells.

(b) An equally spaced population.

Original implemenation

- Developed using
  - ArcInfo Workstation AML
  - ArcSDL FORTRAN (later versions modified to remove ArcSDL libraries)
- GIS polygon overlay is used to delineate and process sample areas
- Command-line interface, user is guided through a series of prompts to complete the analysis

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SAMPLE.AML user interface

```
Arc: &R SAMPLE

Site selection may be performed using one of three methods:

   Code     Method

      1     Simple random selection
      2     Random selection with equal-area distribution
      3     Random selection with iterating grids

Enter method code: 2
Enter name of areal-subset coverage: LUSE
Enter name of category variable: CATEGORY

Checking areal-subset coverage specifications
Submitting command RESUME NAWSOFT>SAMP>FINAL>ITEXST.RUN
Directory of INFO data base is NAWSOFT>SAMP>FINAL>INFO
INFO user name is ARC
INFO file name is LUSE.PAT
```

Sample – arcpy implementation

- Functionality has been preserved as much as possible
- Implemented using raster approach for speed (using NumPy arrays)
- Runs with ArcGIS Basic license
- ArcGIS script tool interface
- Parameter validation code is used to simplify and enhance the user experience

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Sample tool user interface

- ArcGIS tool interface
- All three methods in one tool interface – with many (17!) parameters
- User experience simplified using
  - Parameter defaults
  - Parameter validation to set defaults based on inputs and disable unneeded parameters
  - Parameter categories to ‘hide’ parameters

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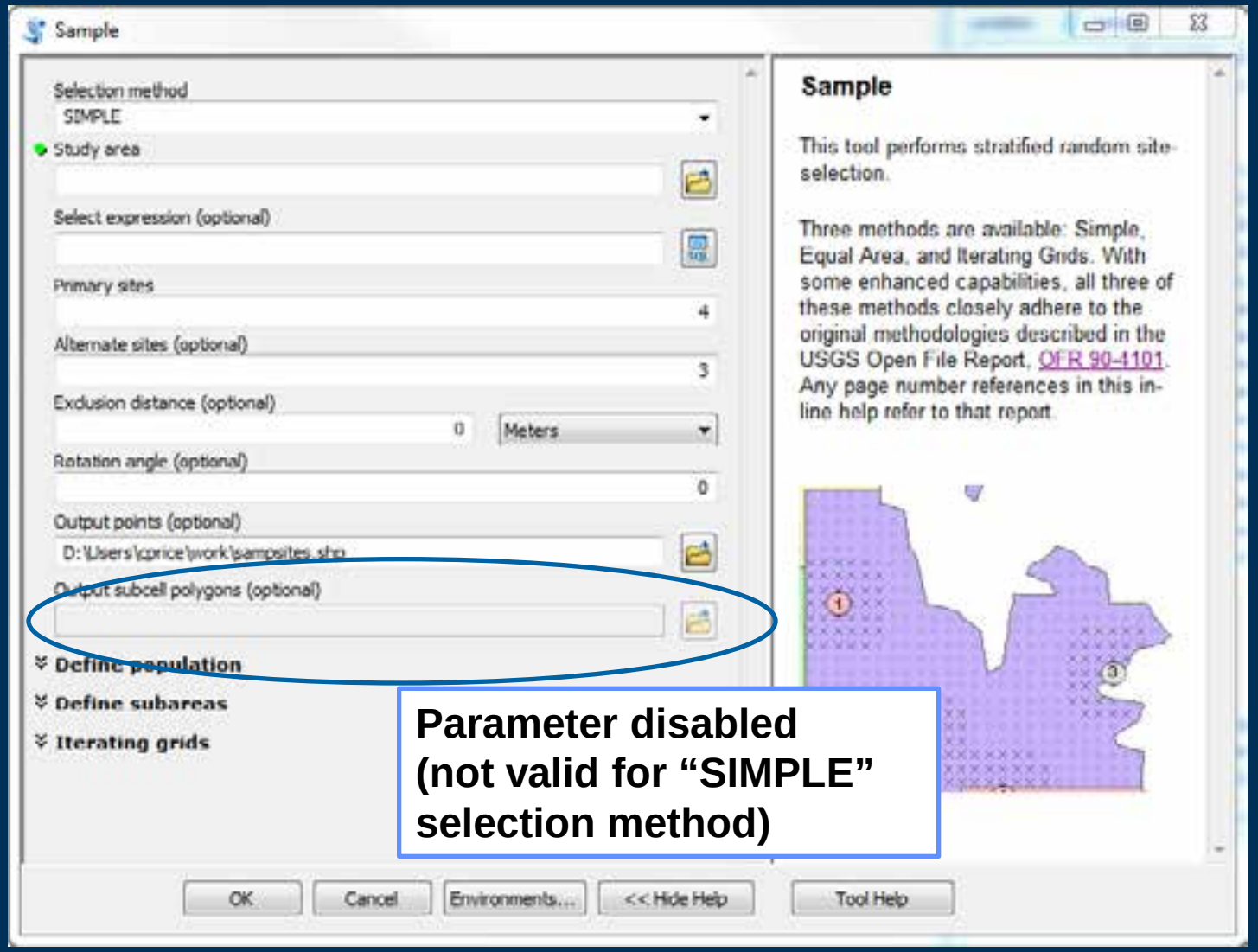
Parameter validation



Parameter disabled (not valid for "SIMPLE" selection method)

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Parameter validation code

```
# determine method
meth = self.params[0].value
# ...
if m_simple:
  # SIMPLE method:
  #   no rotation
  #   no sample cell output
  #   no subarea parameters
  for p in [8, 12, 13, 14, 15, 16]:
    self.params[p].value = None
    self.params[p].enabled = False
```

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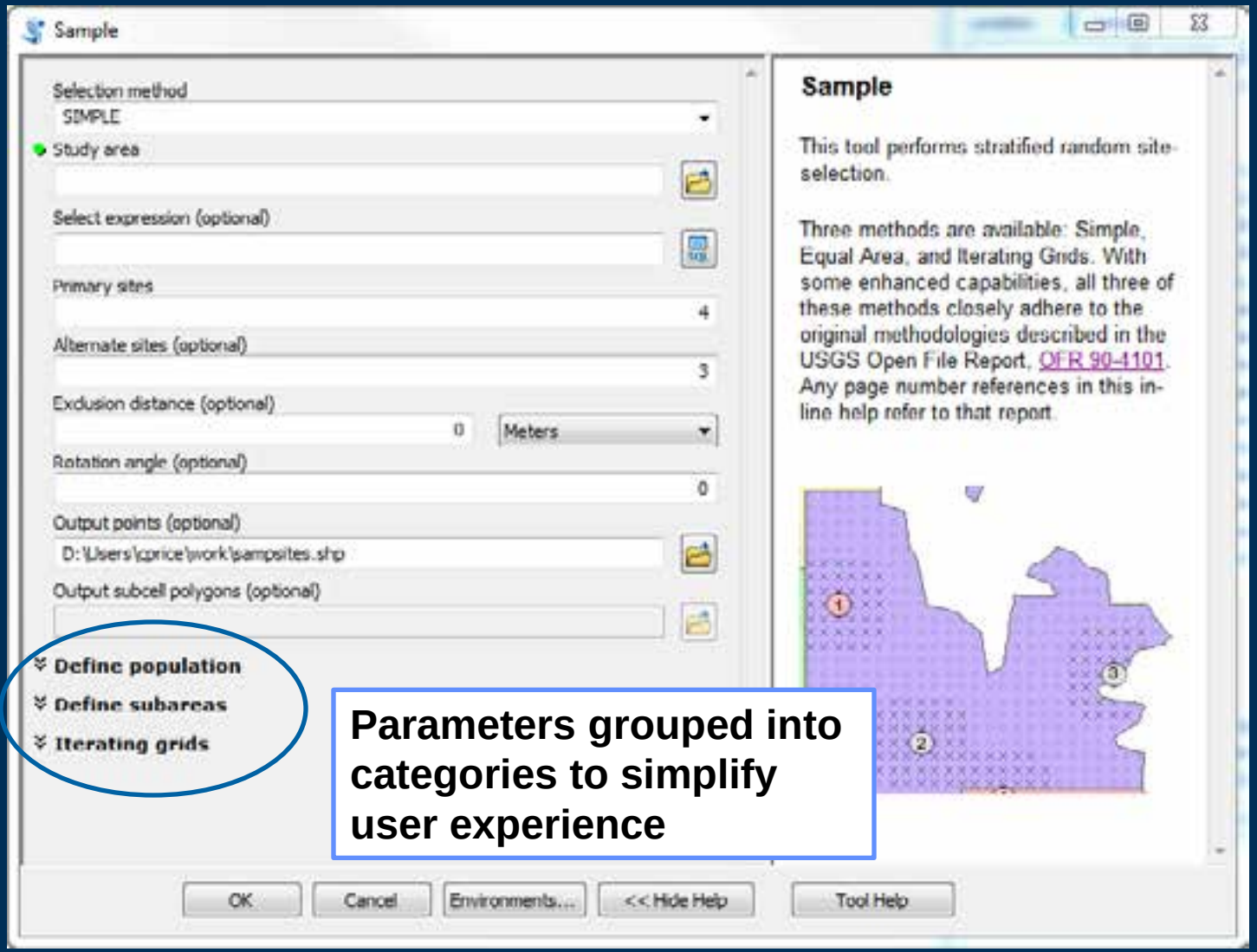
Parameter categories



Parameters grouped into categories to simplify user experience

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Parameter categories

- Tool validation code:

```
def initializeParameters(self):
  for p in [9, 10, 11]:
    self.params[p].category = \
       "Define population"
```

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Using NumPy arrays

- RasterToNumPyArray, NumPyArrayToRaster

```
numpyNoData = 0
numpyData = 1
R = arcpy.RasterToNumPyArray(procRas,
                nodata_to_value=numpyNoData)
R = R.astype('int32') # force integer type
J = len(R)      # number of rows in studyarea raster
I = len(R[0])   # number of cols in studyarea raster
```

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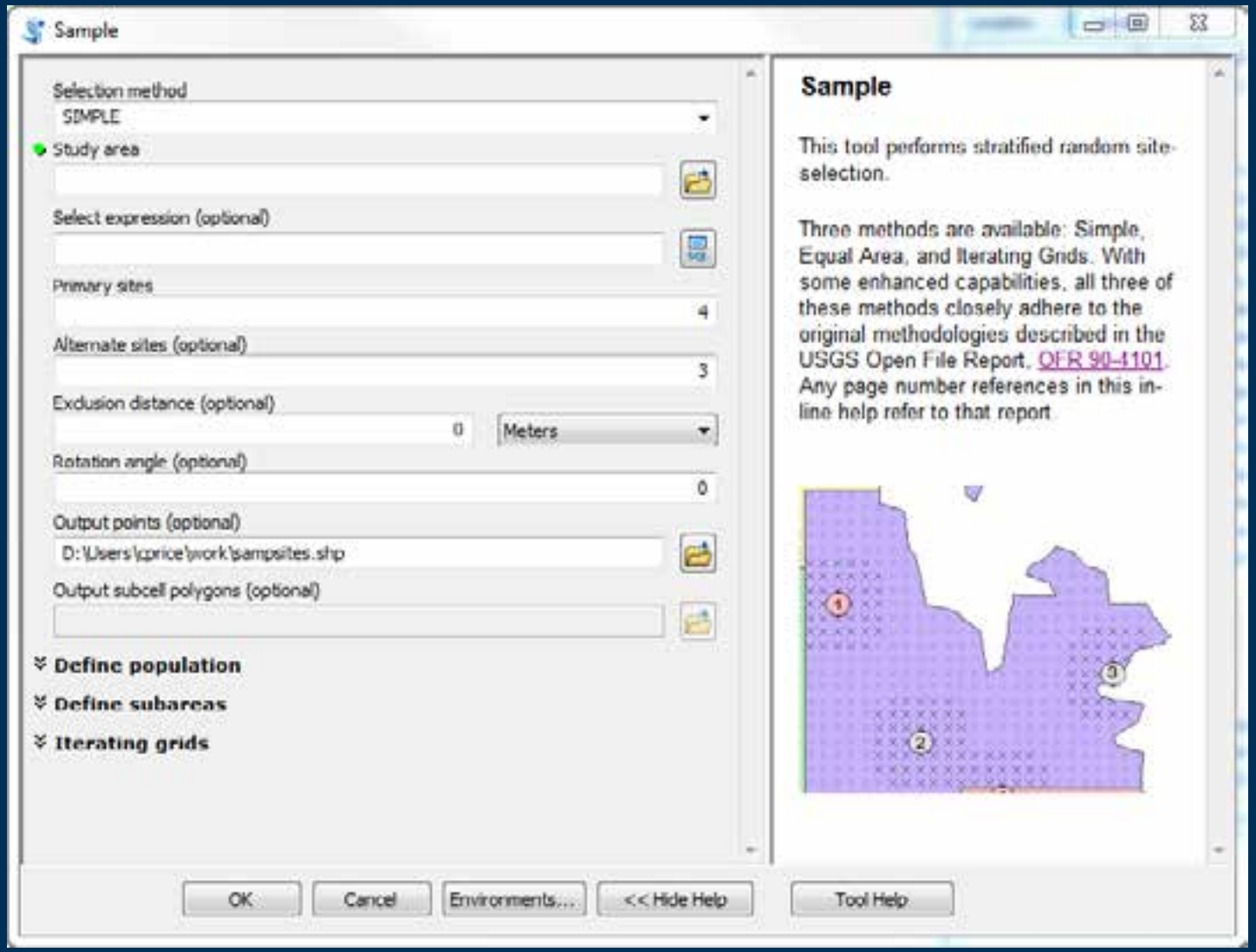
Sample tool demonstration



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Questions?

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