NGEE Arctic Spatial Reference System Guidance -- Seward Peninsula, Alaska

Updated 2019-05-17

Phase 3

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Purpose

Define the best practices for obtaining vertical and horizontal coordinates of known precision and accuracy for sampling and measurement points and surface landscape features to meet the needs of the field sampling, landscape characterization, remote sensing, and modeling tasks of the NGEE Arctic, Phase 2 and 3.

Note the infrastructure and administrative controls to implement these best practices are not all in place. Please see the accompanying Action Plan.

Applicability

This guidance is most applicable to the Seward Peninsula, Alaska, the region of NGEE Arctic, Phase 2 and 3, field activities.

Background

Drivers for Spatial Reference System (SRS) decisions:

- Generally need a system that isn't too complex
- Visualization in Google Earth
- An accurate representation of the position for use in the data archive

Spatial Reference System Guidance

Preferred Reference Ellipsoid: World Geodetic System 1984

For primarily reasons of convenience, the WGS84 ellipsoid is preferred over the GRS80 used by the NAD83 system as it is easier to integrate directly into visualization tools and such while being nearly technically equivalent. However, using differential corrections from a well-defined control point further minimizes any error between the two systems. With that said, WGS84 is preferred and the GRS80 is included here for comparison only.

Spatial Reference System	**Name**	**Semi-major axis**	**Semi-minor axis**	**Inverse Flattening (1/f)**
Preferred	World Geodetic System 1984 (WGS84)	6,378,137	6,356,752.3142	298.257223563

For Comparison	Global Reference System 1980 (GRS80)	6,378,137	6,356,752.3141	298.257222101

Preferred Reference Geoid: National Geodetic Survey gravimetric geoid model version GEOID12B

- This reference geoid is the most recent vertical geoid product from NOAA (June 2016) and is selected for NGEE Arctic, Phase 2 and 3.
- http://www.ngs.noaa.gov/GEOID/GEOID12B/GEOID12B_TD.shtml

Horizontal Datum: North American Datum 1983 (NAD83) & World Geodetic System 1984 (WGS84) are equivalent for latitude and longitude

Vertical Datum: GEOID12B geoid model (see above Preferred Reference Geoid)

Consumer GPS or Phone

- GPS Note: If your GPS does not have the GEOID12B geoid model on it (such as a consumer GPS or phone) select the North American Vertical Datum 1988 and then plan to do additional processing later.

Preferred Projections:

- **Application specific:**
  - For surveying: UTM Zone 3N (for Seward peninsula) and Alaska Albers
  - For DEM & DSM products: these should match the surveying datum
  - For Google Earth: this is primarily a visualization tool and so it is okay to use a standard transformation (google earth is in WGS84 and I believe uses EGM96 as a geoid)
  - For points logged using consumer GPS: record the type of GPS in the metadata and these points will be surveyed later with a more precise instrument

Suggested Transformation Tools

- ArcGIS work should use the conversion tools included in the ArcToolbox.
- Users working with open source GIS applications should use the GDAL package from OSGEO for consistent transformations.
- Sometimes it will be required that you shift from a UTM coordinate system to a spherical one. Both ArcGIS and most open source GIS software have Python included.
    - The UTM package should be available in each to consistently facilitate conversions: https://pypi.python.org/pypi/utm
- A reminder: please record in your metadata/documentation what transformation tool was used and what projection the data started in.

Submitting Sampling Points

- To have newly collected sampling point coordinates added to Site Maps, contact:
    - Julian Dann: jdann@lanl.gov

Measuring Sampling Locations

- To have your sampling locations measured with a high precision RTK survey GNSS system:
    - Contact Bob Busey: rcbusey@alaska.edu
        - prior to the last trip of the season.
    - Include pictures, a site description if there is one, coordinates, and how to identify the sampling location if possible.

Ground Control Points

- Bob Busey established ground control points at the Teller, Kougarok, and Council research sites. GCP are rebar pounded 1.5-2.5 meters into the ground which are protected / marked by an orange cap. Remove the cap before doing any surveying and measure relative to the top of the rebar.

- Local would be situated within 100 meters of each study area (and multiples are ok).

- Local points will be resurveyed annually by doing a static survey and submitting the raw data to Online Positioning User Service (OPUS) for processing.

- Note that DGPS field protocols incorporate ground control points into field surveying task plans. **The ground control points can only be used with DGPS. (Sorry consumer GPS folks.)**

- As of 2017 - There is at least one local control point installed and surveyed (with OPUS processing) at each research area.
    - Find site pictures for the benchmarks, OPUS XML documents, and other complementary documents on the NGEE-Arctic Google Drive: https://drive.google.com/open?id=16IoFgf4bSUIJHVgCkLcx_NktkK4GXrOF

- Software warning:
    - Even if you do not use the primary ground control points it is a best practice to submit all base GPS data to OPUS for processing before exporting any final coordinates from the survey software you use. The NOAA CORES sites in the region have changed periodically since 2016 and there seem to be corrections made by OPUS which are done differently by the Trimble Business Center (for example). In practice this means that there is good agreement in space and time for OPUS computed positions at the ground control points but the Trimble software shows shifting on the order of tens of centimeters to meters.

UAS Flights and Ground Control Points

- Additional ground control points may be installed at sites.
    - Ideally these are surveyed during each UAS campaign relative to the GCP discussed above or at a minimum, surveyed annually.
    - Unlike the ground control installed above these additional GCPs will move up and down as the ground freezes and thaws or potentially move in all three directions as animals pick them up and move them.

Stop Signs

There are about twenty stop signs at the Teller watershed placed in 2017 that are probably present in most imagery

Red and Blue Plastic Squares
There are red and blue plastic squares that people have put out at Teller.

Metallic sheets or white corrugated plastic with rebar in the middle:
Used by LANL for surveying Teller 27 and 47 in 2017/2018

General Contacts

Contact for more information:

Bob Busey: rcbusey@alaska.edu
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Custodian for this guidance document is with the ORNL Data Team:

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Phase 3 Action Plan

Action Plan to Facilitate Implementation of NGEE Arctic Spatial Reference System Guidance -- Seward Peninsula, Alaska

Purpose:

To fully implement the spatial reference system (SRS) guidance the following tasks must be completed in 2016 and maintained in the future to ensure continued good quality spatial data.

General Tasks:

1. Establish multiple ground control points at the Teller, Kougarok, and Council research sites.

   Both local and regional ground control points are needed.

   - Local would be situated within 100 meters of each study area (and multiples are ok).
   - Local points will be resurveyed annually by doing a static survey and submitting the raw data to Online Positioning User Service (OPUS) for processing.

2. Ensure that field protocols incorporate ground control points into field surveying task plans. Ground control points can only be used with DGPS.

3. Define field protocols to ensure that surveying and point logging are reported in UTM or both UTM and latitude and longitude in decimal degrees.

4. Define field protocols to ensure that when surveying where altitude measurements are also logged, the National Vertical Datum 83 with the 2012B geoid corrections are used.

5. Ensure that Global Navigation Satellite System (GNSS) system used for the measurements is included in the metadata.

6. Ensure that surveyed points are reported to Julian Dann in a timely manner so new points can be incorporated on to maps and distributed to the Team.

Specific Actions:

Task	Responsible	Description	
Establish multiple ground control points	Bob Busey	In the spring and summer of 2016 established ground control in the Teller, Kougarok, and Council sites.	
Re-survey Annually	Bob Busey	Once per year set base GPS over top GCP and measure for 4 to 18 hours.	
Primary point of contact for current project benchmarks	Julian Dann		
Primary point of contact for background GIS documents	Julian Dann	LANL principle for reference maps	