

Geospatial Center
for the Arctic and
Pacific (GCAP):
Progress on NGS
Geospatial Modeling
Grant

Chris Parrish

Oregon State University

HSRP Meeting

3/7/2024



Oregon State University, CCE Geomatics Faculty



Michael Olsen
Professor



Christopher Parrish
Professor



Yelda Turkan
Associate Professor



Jihye Park
Associate Professor



Robert Schultz
(Emeritus)



LT Matt Sharr
(Courtesy Faculty)



Ezra Che
*Assistant Professor
(Senior Research)*



Heidar Rastiveis
*Assistant Professor
(Senior Research)*



Tracy Arras
Senior Instructor



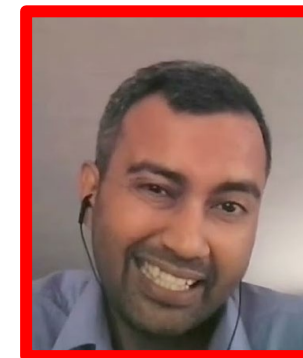
Chase Simpson
Senior Instructor



Brett Murphy
Instructor



Brian Weaver
*Assistant Professor
(Senior Research)*



Althaf Azeez
Post-doc. Scholar



Keana Kief
(FRA/Programmer)



Geomatics Grad Students 2024

Geomatics Graduate courses v 9/19/2022

Core Required: Pick two courses from both tracks

Geodetic Surveying (2)

CE568 - Least Squares Adjustments
CE663 - Geodesy
CE564 – GNSS
CE 560- Advanced GNSS
CE563 - Control Surveying

Photogrammetry\Remote Sensing (2)

CE561 - Photogrammetry
CE566 - 3D laser scanning and imaging
GEOG580 - Remote Sensing
CE560 – UAS Surveying & Mapping

Breadth Required: Pick one course from 3 tracks

Cadastral Surveying

CE565 - Oregon Survey Law
CE569 - Property Surveys

Modeling

CE560 - Advanced GIS
CE513 - GIS in Water Resources
CE562 - Digital Terrain Modeling
CE560 - Virtual Design and Construction

Hydrographic Surveying

CCE561 - Hydrographic surveying
CE567 - Coastal Remote Sensing

Programming

CE560 – Geospatial machine learning
CE660 – Advanced Point Cloud Processing
GEOG562 - GISCIENCE III: Programming for
Geospatial Analysis
CE640 - ST/Basic Matlab Env Sci & ENGR

Sensors

CE661 - Kinematic Positioning and Navigation
CCE599 – Sensors and Measurements for the
Natural and Built Environment

Other Recommended Electives

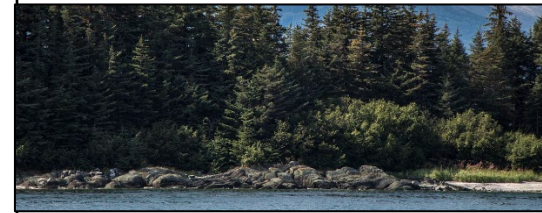
FE523 - Unmanned Aircraft System
Remote Sensing
GEOG566 - Digital Image Processing
GEOG585 - Advanced Remote
Sensing and Digital Imaging
Processing
GEOG564 – Geospatial Perspective
on Intelligence, Security and
Ethics
CS535 - Deep Learning
CS537 - Computer Vision I
CS553 – Scientific Visualization
CS559 – Digital Image Processing
CS575 - Intro to Parallel
Programming

*Many other GIS,
robotics, remote
sensing and computer
science courses
available across campus*

Geospatial Center for the Arctic and Pacific (GCAP)

- Oregon State University, University of Alaska Anchorage, the Columbia River Intertribal Fish Commission (CRITFC), and the Yurok Tribe
- Supported by Geospatial Modeling Grant from the National Geodetic Survey (NGS)
- GCAP's research supports NGS in modernizing the National Spatial Reference System (NSRS), the official system of latitude, longitude, height and gravity throughout the U.S.
- GCAP's education and outreach activities support the development of the next generation of surveyors, geodesists, and geospatial professionals

<https://gcapgeospatial.org/>



UNIVERSITY of ALASKA
ANCHORAGE



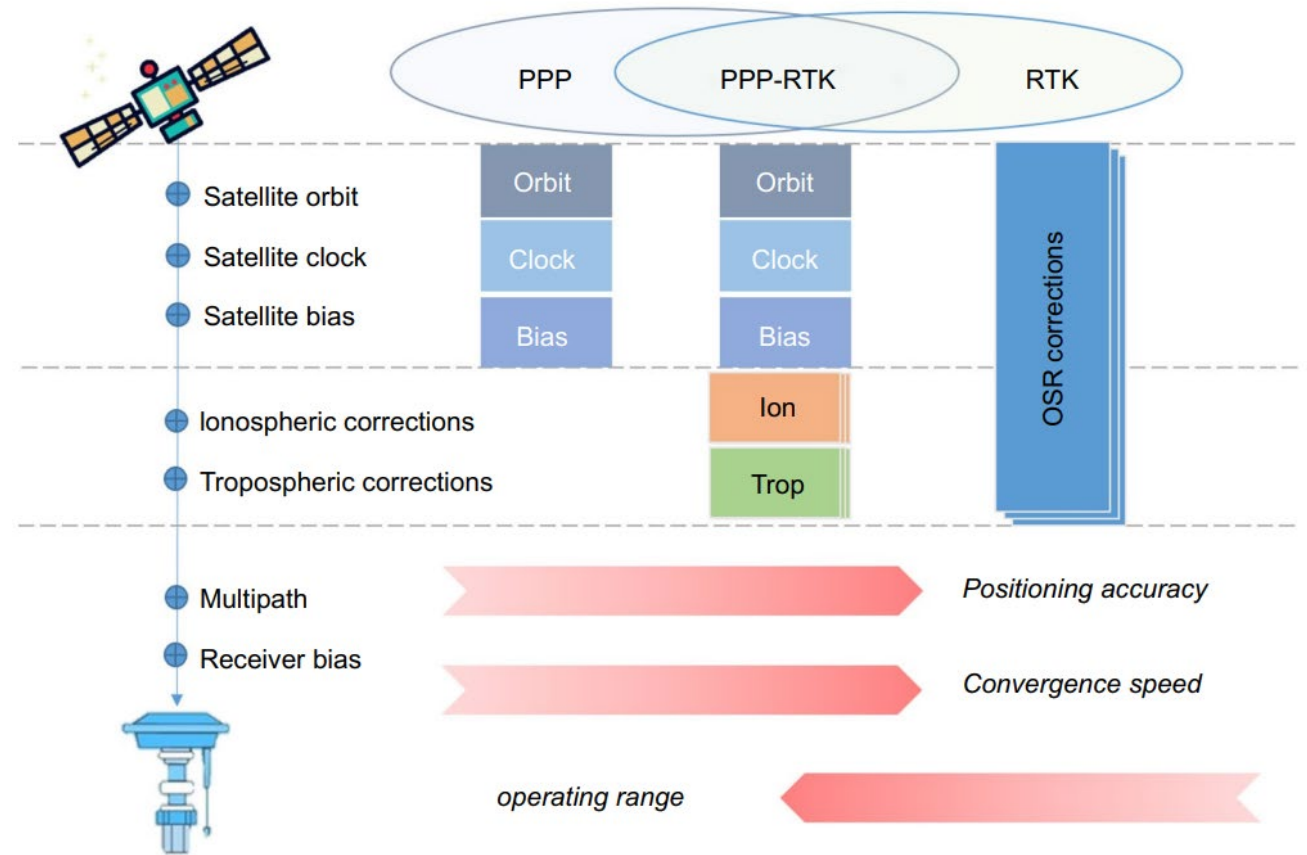
Oregon State
University

NGS Geospatial Modeling Grant

- One of 4 Grants, including Oregon State University/GCAP, Scripps Institution of Oceanography (SIO), Michigan State University, The Ohio State University
 - <https://geodesy.noaa.gov/grant-opportunities/fy23-awards.shtml>
- \$6.5M over 5-year period of performance
- 8 Tasks (each essentially being its own project), organized into 3 broad themes
 1. Geodetic Tools, Models, and Workflows
 2. Geodetic Infrastructure
 3. Partnerships, Education, and Outreach
- Each has Task Lead, Task Lead (from OSU, CRITFC, Yurok Tribe – Fisheries Dept, and UAA), Task Team, and NGS SME
- 8 PIs/Co-Is; 3-4 GRAs; 1 Project Manager, 2 FRAs, 1 Education Coordinator
- Focus on NSRS modernization and workforce development in a region that is tectonically-active, yet currently underserved by existing geodetic infrastructure, education, and outreach

Task 1: Real-Time Precise Point Positioning (PPP)

- **Objectives:** Develop Accurate and Reliable Real-Time Precise Point Positioning within the NSRS
- **Team:** Brian Weaver (Lead), Jihye Park, Chase Simpson, Muge Albayrak, Althaf Azeez
 - Josh Jones (NGS SME)
- **Current Focus Areas:**
 - Review literature and open-source PPP/PPP-AR software
 - Incremental approach, beginning with single-receiver user
 - Implement existing real-time PPP-AR products in offline mode
 - Develop/implement PPP-RTK model
 - Multi-station network
 - Single-station user

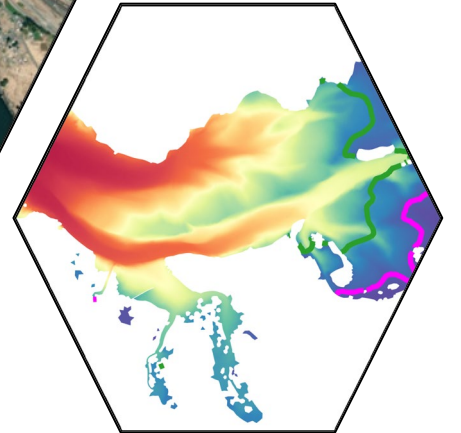
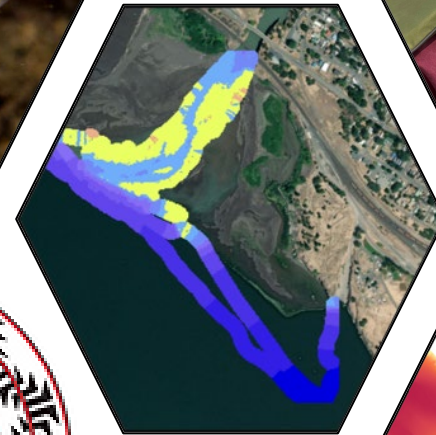
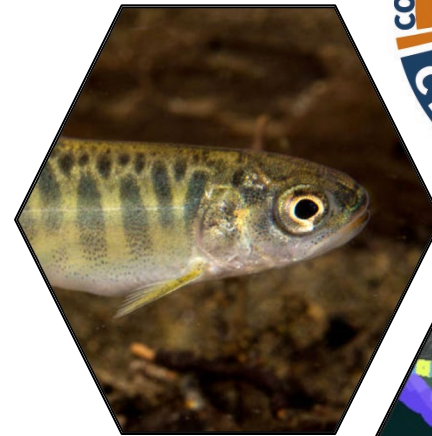


Source: Li et al. (2022)

[<https://doi.org/10.1186/s43020-022-00089-9>]

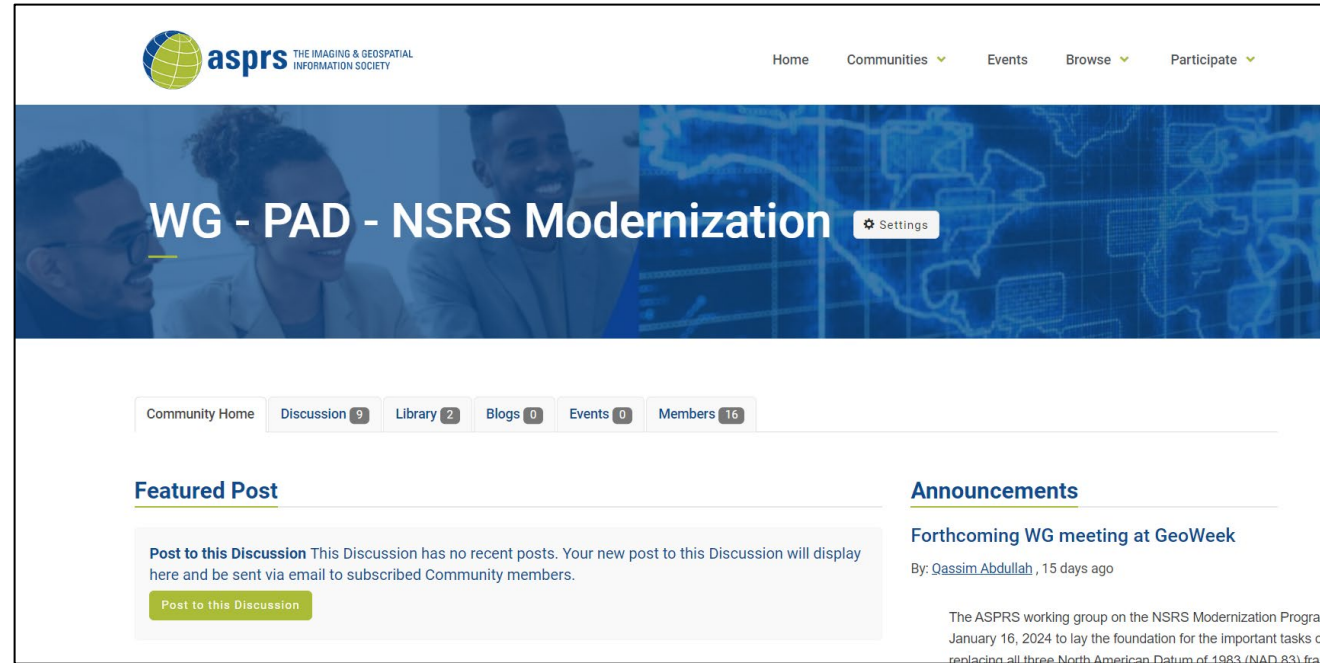
Task 2: Hydrodynamic modeling Columbia and Klamath

- **Objectives:** Conduct hydrodynamic modeling supporting salmon decision making, depending on sonar surveys, supported by and demonstrating modernized NSRS benefits.
- **Team:** Charles Seaton (CRITFC, Lead), DJ Brandowski (Yurok, Co-lead), Caixa Wang (UAA), Chris Parrish (OSU), Jihye Park (OSU), Ben Hocker (Yurok), Tom Ravens (UAA)
 - Shachak Pe'eri (NGS SME)
- **Current Focus Areas:**
 - Acquire sonar bathymetry of Columbia River tributary deltas (CRITFC) and priority areas in Klamath River (Yurok)
 - Develop and improve hydrodynamic models of priority areas
 - Investigate enhancements enabled by NSRS Modernization and RTN-NSRS alignment (Task 5)

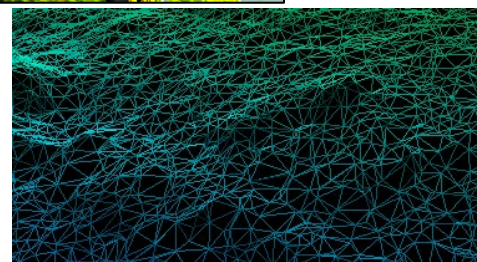
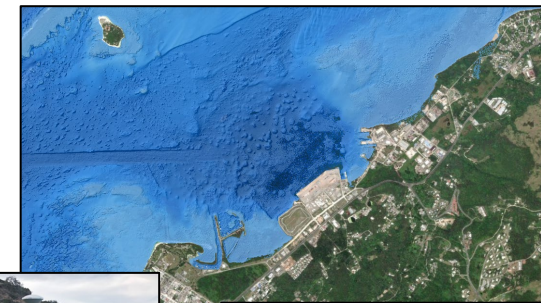


Task 3: New Datums in Geospatial Applications

- **Objectives:** Work within broad geospatial community (lidar, GIS, photogrammetry, sonar, UAS, mobile mapping, etc.) to facilitate successful transition to and use of modernized NSRS
- **Team:** Chris Parrish (OSU, Lead), Muge Albayrak (OSU), Mike Olsen (OSU), Ezra Che (OSU), Jihye Park (OSU), Charles Seaton (CRITFC)
 - Shachak Pe'eri (NGS SME)
- **Current Focus Areas:**
 - Interfacing with professional organizations, software vendors, and stakeholders on successful adoption of modernized NSRS for geospatial applications
 - Ex: address file formats that may break (e.g., due to not supporting time-dependent coordinates)
 - Case studies on use of new terrestrial reference frames & geopotential datum
 - Crowdsourced NSRS Modernization Success Stories

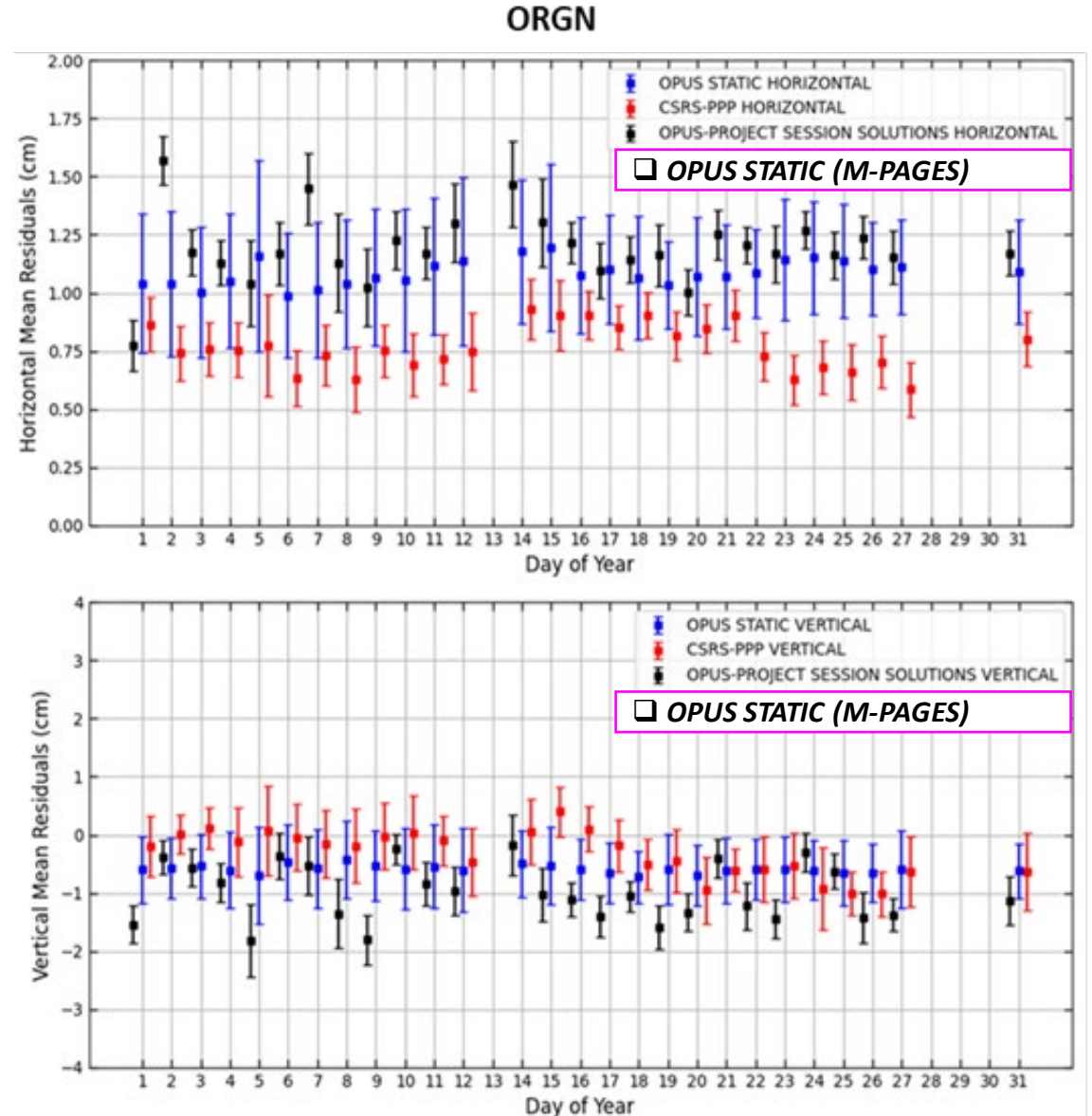


The screenshot shows the ASPRS (The Imaging & Geospatial Information Society) website. The header includes the ASPRS logo and navigation links: Home, Communities, Events, Browse, and Participate. The main banner features the title "WG - PAD - NSRS Modernization" with a "Settings" button. Below the banner, there are statistics for the community: Community Home, Discussion (9), Library (2), Blogs (0), Events (0), and Members (16). A "Featured Post" section indicates that this discussion has no recent posts and provides a "Post to this Discussion" button. An "Announcements" section mentions a "Forthcoming WG meeting at GeoWeek" by Qassim Abdullah, 15 days ago. A small text block at the bottom right of the screenshot states: "The ASPRS working group on the NSRS Modernization Program will meet on January 16, 2024 to lay the foundation for the important tasks of replacing all three North American Datum of 1983 (NAD 83) frames."



Task 4: Develop and Evaluate OPUS Utilities

- **Objectives:** Enhance access to NSRS through development and evaluation of NGS' OPUS tools
- **Team:** Brian Weaver (Lead), Chase Simpson (co-Lead), William Ohene, Ezra Che
 - Nick Forfinski-Sarkozi (NGS SME)
- **Current Focus Areas:**
 - Evaluate multi-GNSS M-PAGES software performance via OPUS-Static beta
 - Test challenging test data with known non-ideal conditions
 - Develop optimal constraints for network adjustments
 - Combined GNSS, Total Station, Leveling data
 - Collaborate with OPUS team to implement GCAP outcomes in OPUS/OPUS-Projects

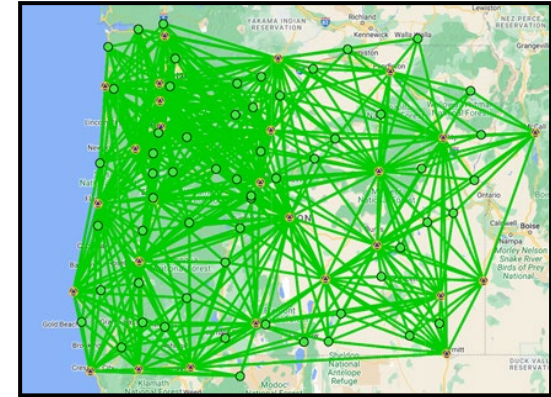
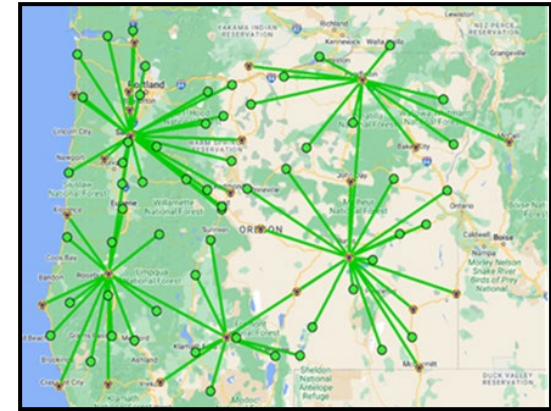
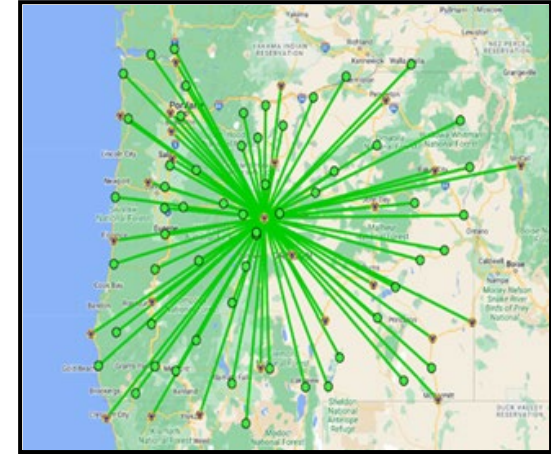
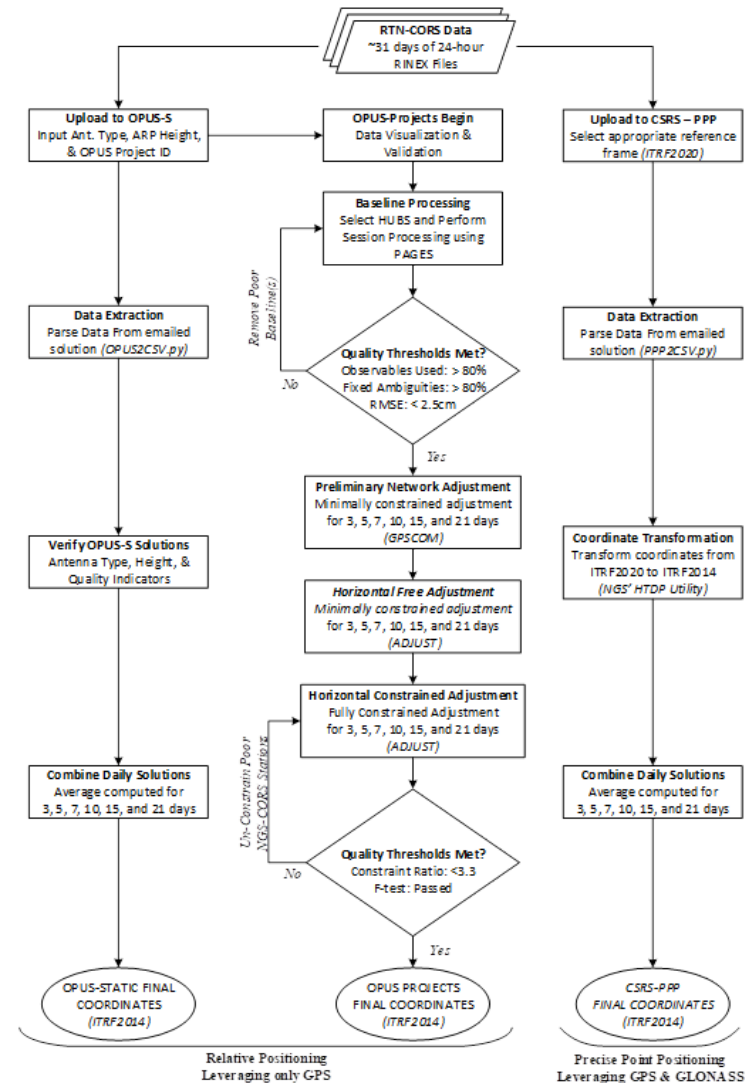


Source: Ohene (2023)

[<https://ir.library.oregonstate.edu/>]

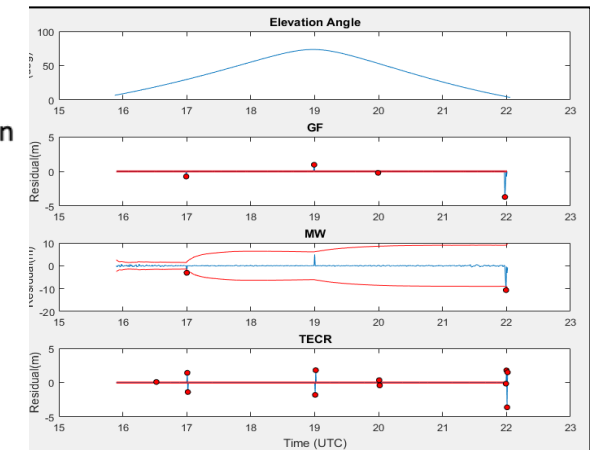
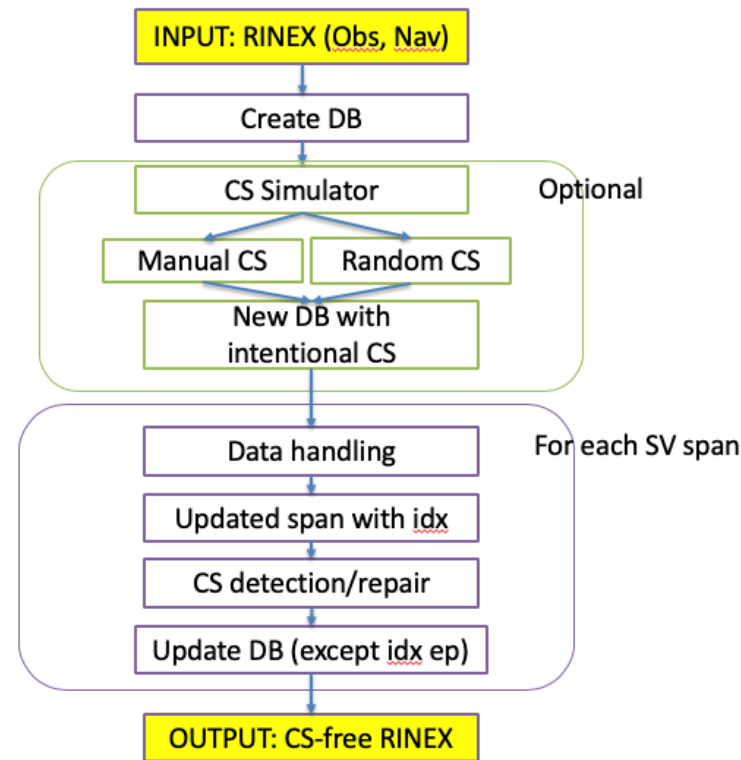
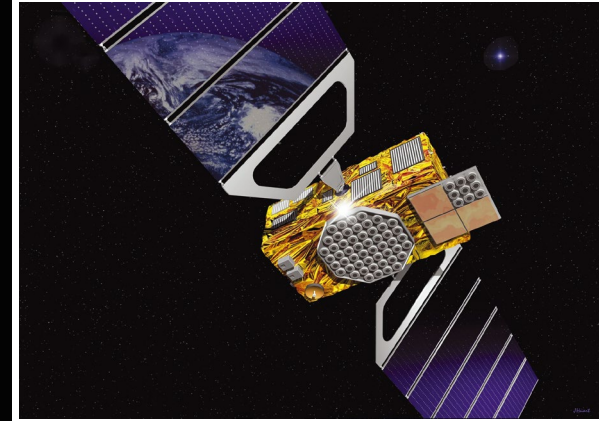
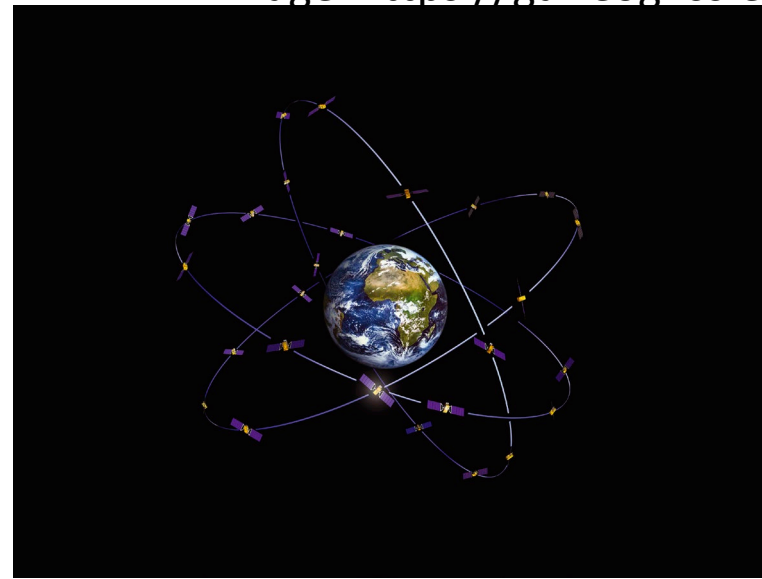
Task 5: Develop a National RTN Alignment Service

- **Objectives:** Develop a national service for all RTN operators/managers to utilize to ensure their networks are consistently aligned with the NSRS
- **Team:** Chase Simpson (OSU, Lead), Brian Weaver (OSU), Ben Hocker (Yurok), William Ohene (OSU)
 - Dan Gillins (NGS SME)
- **Current Focus Areas:**
 - Exploration of alternative methods to monitor Real-Time Network (RTN) health
 - Develop a semi-automatic workflow for aligning RTNs to the NSRS
 - Create an accessible web-based interface to empower surveying practitioners and RTN managers with real-time network alignment information



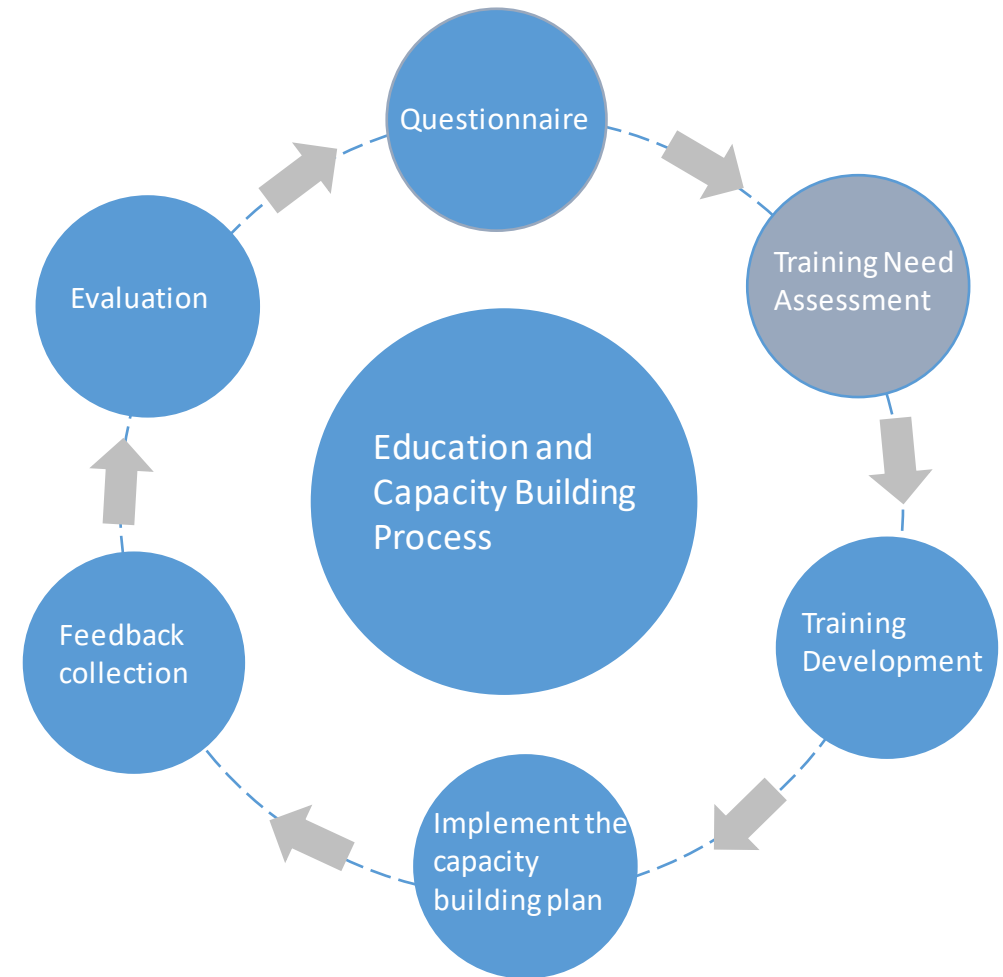
Task 6: Multi-GNSS

- **Objectives:** Assist in the Development and Testing of Multi-GNSS Processing Service
- **Team:** Jihye Park (OSU, Lead), Brian Weaver (OSU), Chase Simpson (OSU), Althaf Azeez (OSU), Mike Olsen (OSU), Muge Albayrak (OSU) Caixia Wang (UAA)
- **Current Focus Areas:**
 - Cycle Slip detection and Repair for multi-constellation, Multi-frequency GNSS observations
 - To support NGS's OPUS-Static pre-processing functionality
 - To investigate a robust CS algorithm for low sampling rate GNSS preprocessing



Task 7: Education and Capacity Building Initiatives

- **Objectives:** Develop the next generation of geodesists, surveyors, and geospatial professionals, and broaden participation in geomatics.
- **Team:** Caixia Wang (UAA, Lead), Chris Parrish (OSU), Chase Simpson (OSU), Ezra Che (OSU), DJ Bandrowski (CRITFC), Erika Little (NGS SME)
- **Current Focus Areas:**
 - Meet the needs for professional development and capacity building
 - Training topics and skillsets
 - Modality
 - Develop training material and deliver training in conjunction with professional conferences or standalone venues
 - Foster involvement and partnerships among different stakeholders, including Geomatics programs at UAA and OSU, NGS, federal/state agencies, private sectors, and community groups (e.g., ASPRS, ASPLS, AAUG)



New BSc in Geodesy, Geomatics, and Geospatial Engineering (3xGE)

- Currently in the exploratory phase
- Goal: Expand success of OSU's graduate program and undergrad minor in geomatics by adding new BSc program
- Help alleviate shortfall of geospatial professionals and geodesists in the US

Core Curriculum to include:

- Programming
- Reference Frames / Map Projections
- Geodesy
- GNSS
- Uncertainty Analysis
- Least Squares Adjustments
- Inertial Navigation and Timing

Additional Courses in:

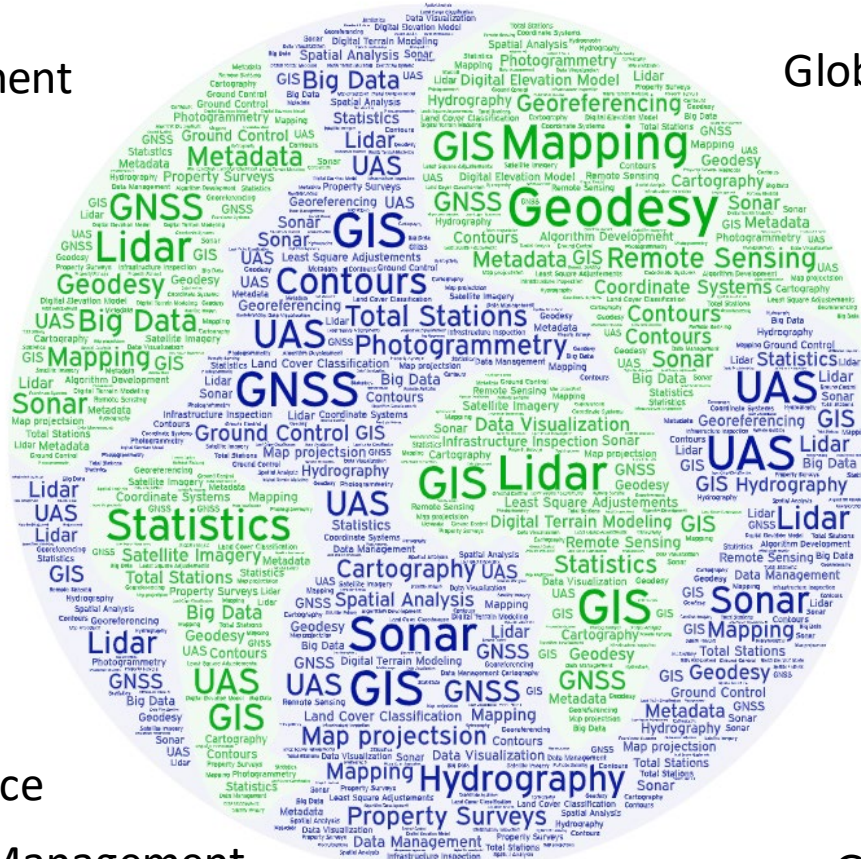
- Cadastral Surveying
- Photogrammetry
- 3D Laser Scanning / Reality Capture
- Geodetic Surveying Methods
- Hydrographic Surveying
- GIS
- Electrical & Computer Engineering
- Computer Science

3xGE

An interdisciplinary field that involves the collection, integration, management, and analysis of geospatial data

A Few Applications:

- Agriculture & Forestry Management
- Infrastructure Inspection
- Emergency Response
- Shoreline Mapping
- Cadastral Surveys
- Geodesy
- Transportation
- Hydrographic Surveying
- National Defense & Security
- Oceanography and Marine Science
- Archeology & Cultural Heritage Management



Some Tools of the Trade

- Global Navigation Satellite Systems ○
- Inertial Measurement Units ○
- 3D Laser Scanning (lidar) ○
- Web Visualizations ○
- Multibeam Sonar ○
- Satellite Imagery ○
- Differential Levels ○
- Adjustment Software ○
- Mobile Mapping Systems ○
- Uncrewed Aircraft Systems ○
- Multi/Hyperspectral Imagery ○
- Ground Penetrating Radar (GPR) ○

Task 8: Outreach

- **Objectives:** cultivate a strong talent pool of geodesists, surveyors, and geospatial professionals and broaden participation in these fields
- **Team:** Mike Olsen (OSU, Lead), Caixia Wang (UAA), Chase Simpson (OSU), Chris Parrish (OSU)
 - Nina Garfield (NGS SME)
- **Current Focus Areas:**
 - K12 Outreach (Summer Experiences in Science and EngiESEY), UAA Alaska Native Science and Engineering Program (ANSEPneering for Youth)
 - Presentations (AK Geosummit, GeoWeek, ODOT Surveyors Conference, EERI, SaGES)
 - Professional Workshops/Training
 - Committees
 - Outreach website



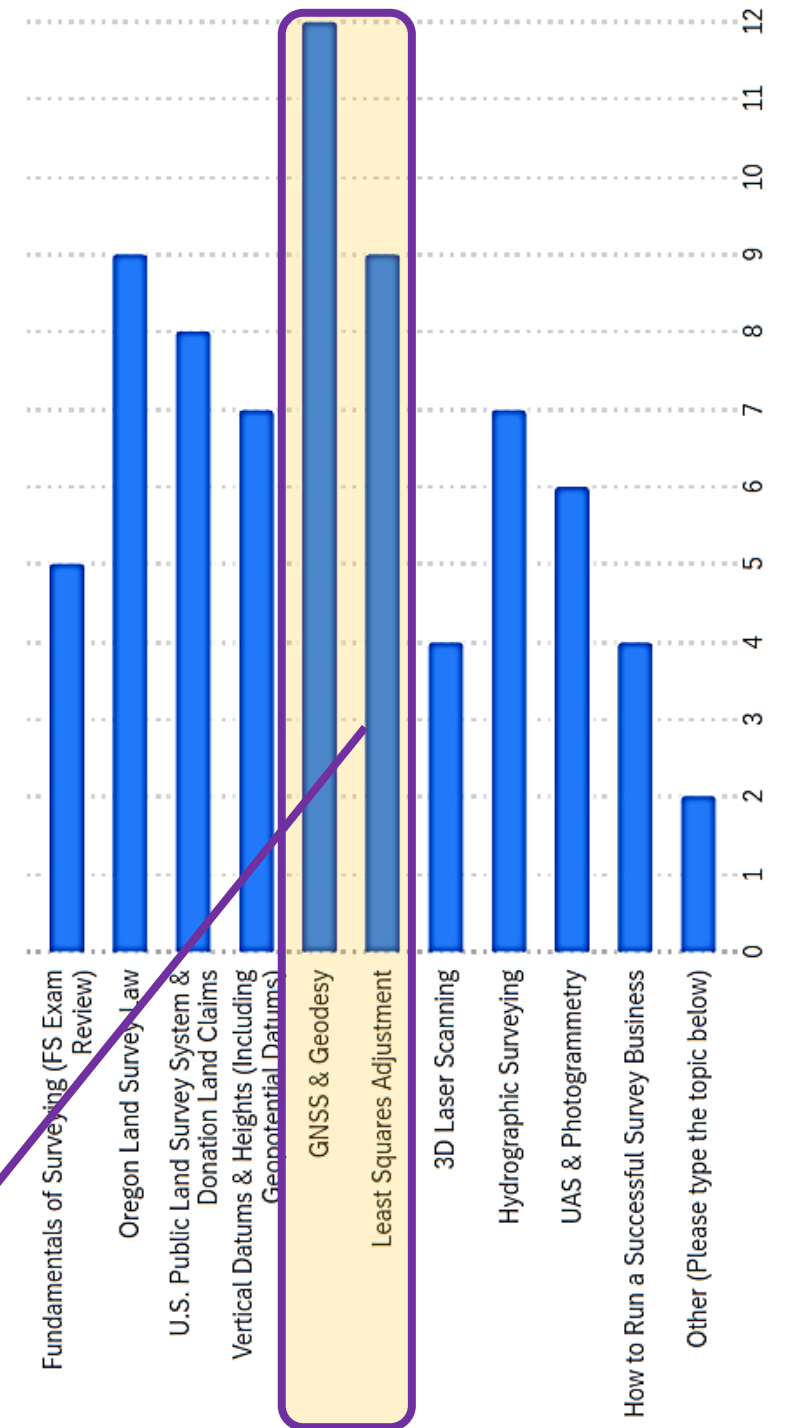
OSU Workshop Series

- Stakeholders asked
 - “What workshops would you be interested in attending?”
 - “Would you be interested in teaching or co-teaching a workshop?”
- Input provided via QR code



Top answers:

- GNSS & Geodesy
- Least Squares



GCAP & NGS Geospatial Modeling Grant in the News

- News Release:
<https://www.diwou.com/2023/11/09/oregon-state-to-receive-6-5m-for-federal-effort-to-modernize-geospatial-coordinate-system/>
- KGW TV Interview:
<https://www.youtube.com/watch?v=agXKo4A039A>
- SpatialSource article:
<https://www.spatialsource.com.au/us20m-to-help-modernise-the-us-geospatial-system/>
- OSU Barometer interview
- OPB “Live Wire”: working to schedule interview



SAVE THE DATE



Surveying & Geomatics 2024

Corvallis, Oregon | June 2-4

surveyingconference.org

Surveying: the Foundation for Geospatial Data Fusion



Oregon State
University

2024 Conference Partners



Partnered Surveying & Geomatics Conference

- At Oregon State University, June 2-4, 2024
- NGS Geospatial Modeling Grant Session: Representatives from Scripps, Michigan State University, and Ohio State University invited
- 2 NGS-led sessions
 - VDatum
 - Low Distortion Projections

<https://www.surveyingconference.org/>

Questions, Contacts & Additional Information

- Chris Parrish, GCAP Director:
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- Jenna Borberg, GCAP Project Manager:
Jenna.Borberg@oregonstate.edu
- Website: <https://gcapgeospatial.org/>

