OPUS Suite Update

Montana Association of Registered Land Surveyors 2012 Conference

Mark L. Armstrong, PLS
NOAA/NGS Oregon State Advisor
mark.l.armstrong@noaa.gov

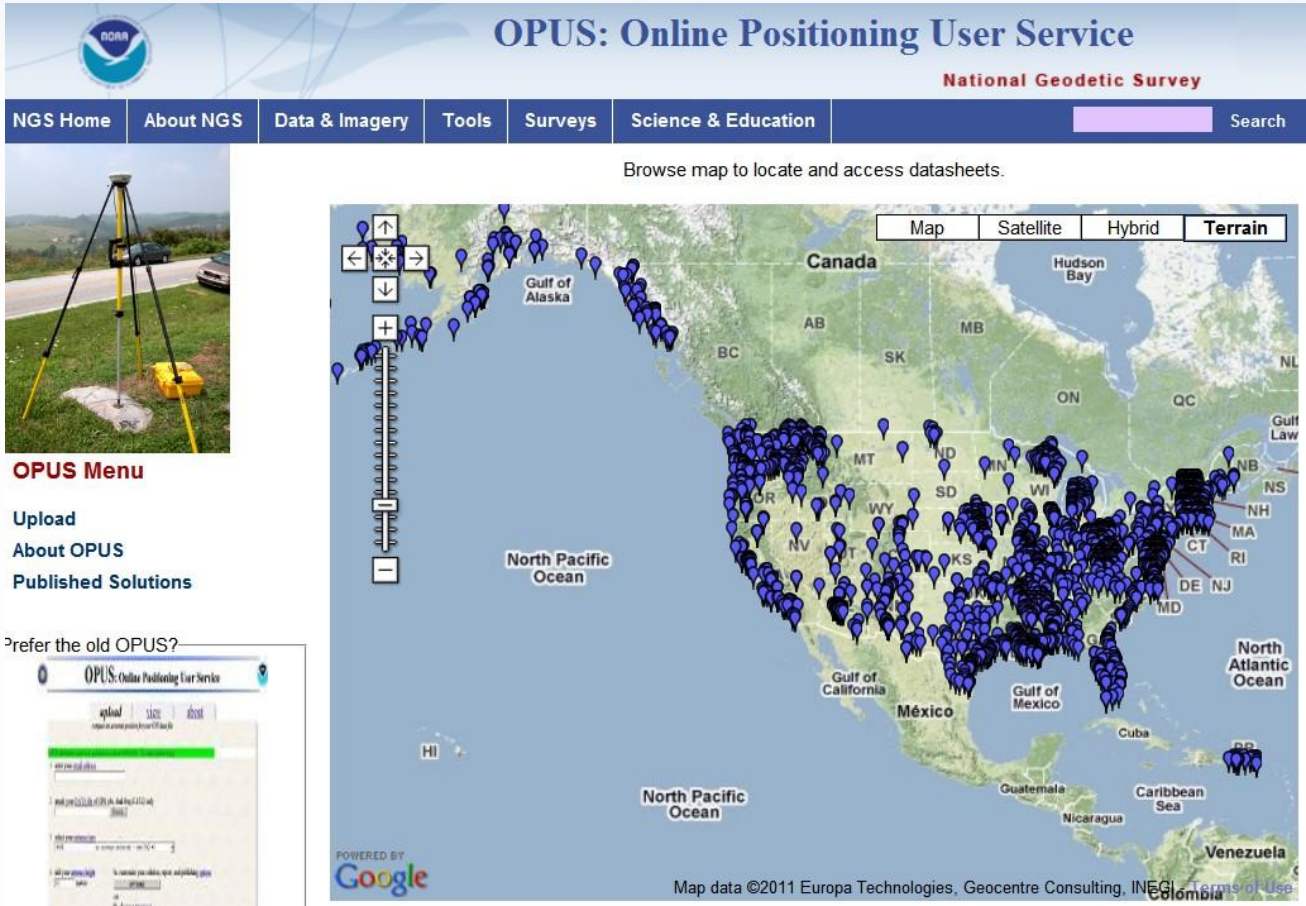
90 Slides

Topics

- **Publishing to OPUS – Make your own datasheet**
  - Adding passive mark observations to the OPUS database
  - Publishing requirements
  - The OPUS datasheet
- **Other GNSS…**
- **OPUS-Projects (OP)**
  - OPUS-Projects Manager Training
  - (OP) … network baseline processing and adjustment
- **Future OPUS changes…**
  - OPUS Net – A new engine

A Little OPUS Database History

OPUS allows users to publish their OPUS result in an on-line data base if minimum requirements for quality are met and the associated meta-data, such as photos and descriptions, are provided.



Current Minimum Field Procedures

Field Procedures

- GPS **data file** ≥ 4 hour duration
- quality **mark setting**
- experienced observer
- fixed height tripod recommended
- brace tripod legs with sandbags or chain
- verify **antenna height** and plumb
- see **HARN guidelines**

Current Minimum Publishing Requirements

High-Quality OPUS Solution

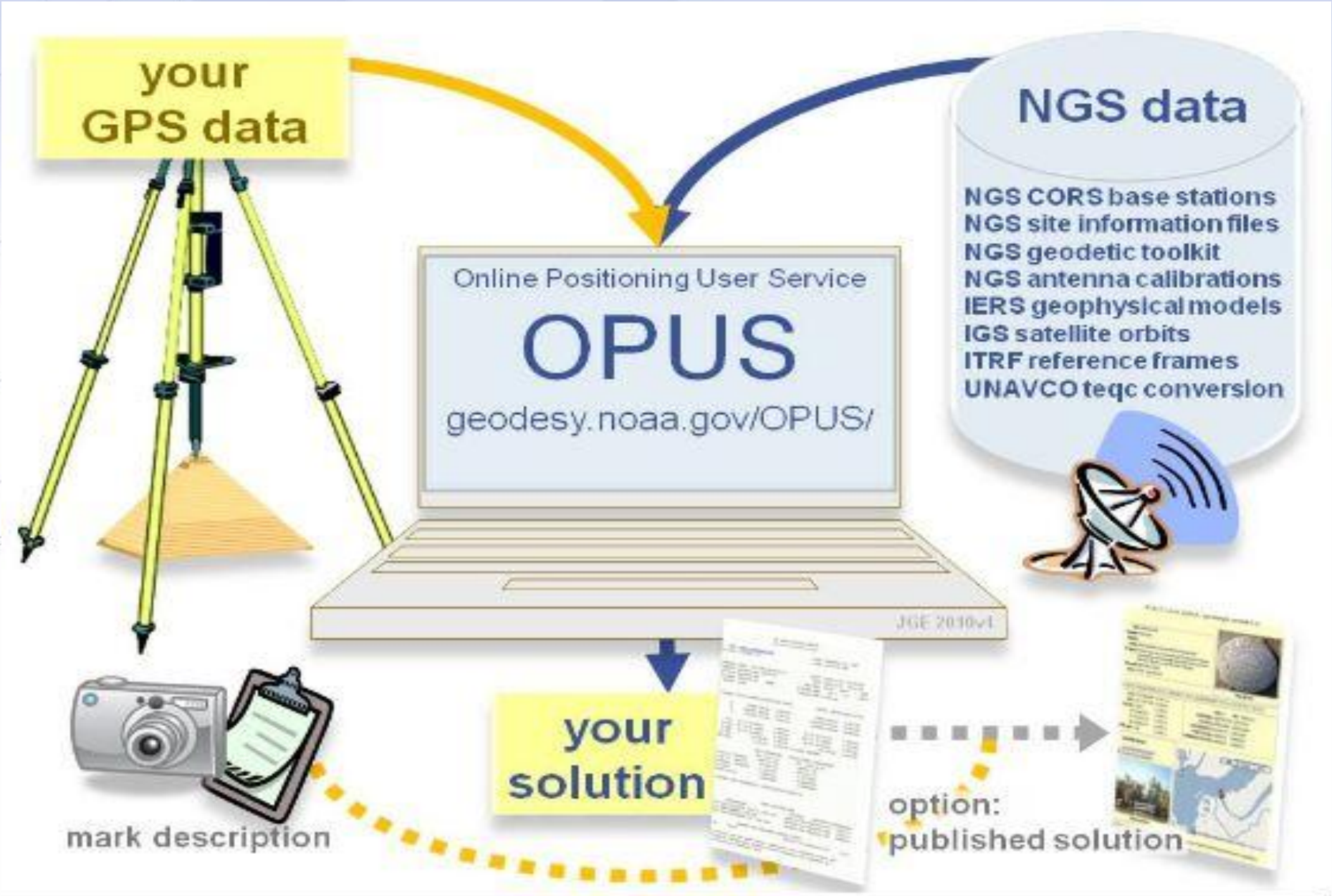
- ≥ 70% observations used
- ≥ 70% ambiguities fixed
- ≤ 3 cm RMS
- ≤ 4 cm peak-to-peaks, lat. & lon.
- ≤ 8 cm peak-to-peak, el. hgt.
- properly identify **antenna type**
- precise or rapid orbits (avail. next day)

Mark Information Needed to Publish

Mark Attributes

- photos of mark & equipment
- details (name, type, stability, etc.)
- description to aid mark recovery
- preview **mark description form** & **help file**

OPUS Publishing Work Flow



OPUS Database and the IDB

For now, OPUS datasheets and the IDB exist <u>as two separate tools</u>.

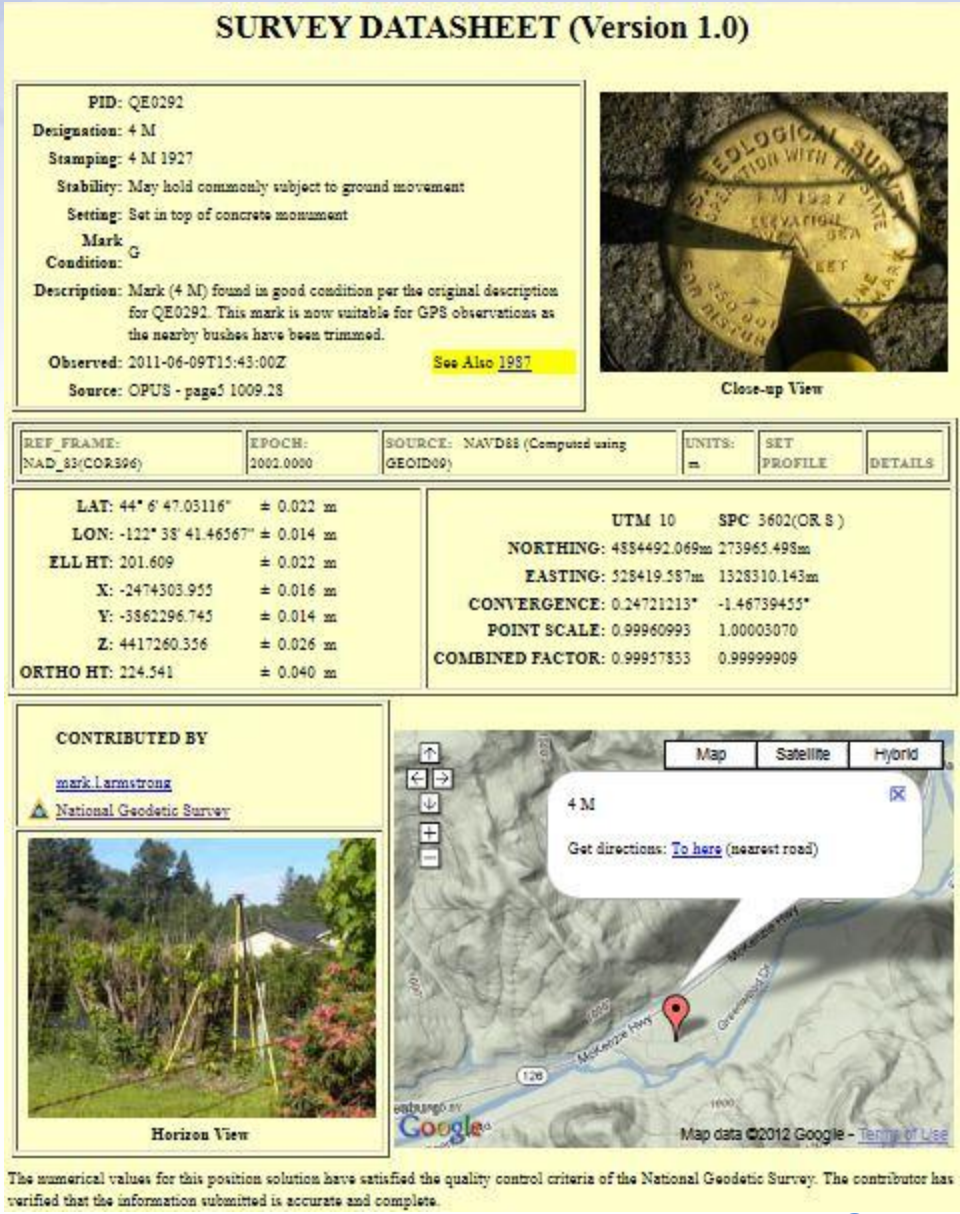
As the NGS begins to more fully understand the characteristics of the OPUS Database and the IDB will be more fully reconciled.

In the meantime, a submission to the OPUS Database may be eligible for, but not guaranteed to be included in the IDB.

OPUS Datasheet

As a last step, the user given a chance to review the submission in the form of a mock-up of the datasheet for their submission.

If the meta-data is complete, the quality control restrictions are met and the user gives the "OK", the submission is entered into the data base.



SURVEY DATASHEET (Version 1.0)

PID: QE0292
Designation: 4 M
Stamping: 4 M 1927
Stability: May hold commonly subject to ground movement
Setting: Set in top of concrete monument
Mark Condition: G
Description: Mark (4 M) found in good condition per the original description for QE0292. This mark is now suitable for GPS observations as the nearby bushes have been trimmed.
Observed: 2011-06-09T15:43:00Z
See Also 1987
Source: OPUS - page5 1009.28

Close-up View

REF_FRAME:	EPOCH:	SOURCE:	UNITS:	SET	
NAD_83(CORS96)	2002.0000	NAVD88 (Computed using GEOID09)	m	PROFILE	DETAILS

LAT:	44° 6' 47.03116"	± 0.022 m
LON:	-122° 38' 41.46567"	± 0.014 m
ELL HT:	201.609	± 0.022 m
X:	-2474303.955	± 0.016 m
Y:	-3862296.745	± 0.014 m
Z:	4417260.356	± 0.026 m
ORTHO HT:	224.541	± 0.040 m

	UTM 10	SPC 3602(OR S)
NORTHING:	4884492.069m	273965.498m
EASTING:	528419.587m	1328310.143m
CONVERGENCE:	0.24721213°	-1.46739455°
POINT SCALE:	0.99960993	1.00003070
COMBINED FACTOR:	0.99957833	0.99999909

CONTRIBUTED BY
mark.l.armstrong
National Geodetic Survey

Horizon View

Map Satellite Hybrid
4 M
Get directions: To here (nearest road)
Map data ©2012 Google - Terms of Use

The numerical values for this position solution have satisfied the quality control criteria of the National Geodetic Survey. The contributor has verified that the information submitted is accurate and complete.

OPUS Datasheet Details

Note the "See Also" highlight. This provides access to other data base and IDB entries for this mark.

PID: QE1114
Designation: C 590
Stamping: C 590 1965
Stability: May hold commonly subject to ground movement
Setting: Mat foundation or concrete slab other than pavement
Mark Condition: G
Description: The primary bench mark is a disk set in the top of the SW corner of the Oregon State University Marine Science Center cement pier, 2.13 m (7.0 ft) west of the centerline of the dock, 0.30 m (1.0 ft) north of the junction of the blacktop road and the concrete pier, and 0.30 (1.0 ft) east of the west edge of the pier.
Observed: 2006-08-11T21:16:00Z See Also 2007-09-04
Source: OPUS - page5 0908.13

Close-up View

REF_FRAME:	EPOCH:	SOURCE:	UNITS:	SET PROFILE	DETAILS
NAD_83(COR896)	2002.0000	NAVD88 (Computed using GEOID03)	m		

LAT:	44° 37' 30.96052"	± 0.008	m
LON:	-124° 2' 42.84324"	± 0.029	m
ELL HT:	-19.362	± 0.041	m
X:	-2545584.501	± 0.032	m
Y:	-3767564.728	± 0.026	m
Z:	4457792.399	± 0.023	m
ORTHO HT:	4.478	± 0.053	m

	UTM 10	SPC 3601(OR N)
NORTHING:	4941854.974m	112693.348m
EASTING:	417084.278m	2218760.816m
CONVERGENCE:	-0.73428422°	-2.51423054°
POINT SCALE:	0.99968454	0.99993927
COMBINED FACTOR:	0.99968758	0.99994231

Your Comments are Important!

upload | *view* | about

published marks

published marks | register to publish | today's marks: Static Rapid-Static

For this reason, note the "comments" link on the "view" page. This and similar links on other pages are sincere requests for your help in guiding future development.

IMPORTANT datasheet notes:

SCOPE: OPUS marks are not yet fully integrated with the NGS database (NGSIDB). Many more marks are available from the links below:

- NGSIDB: 1,000,000+ "bluebooked" marks
- NOS tidal bench marks

FORMAT: differs from traditional NGS datasheets in many ways, including:

- **POSITIONS** are individually generated from non-redundant OPUS solutions. ERRORS MAY EXIST! Users are encouraged to favor stations observed multiple times and manually compare the positions, each available from the *"See Also"* link in the datasheet header.
- **ERROR CHECKING** is the responsibility of the data publisher.
- **DATUM** for ellipsoidal coordinates may differ from NGSIDB. Orthometric heights are derived from GPS and the geoid model used by OPUS.
- **FORMAT** of coordinates differs from NGSIDB conventions

This 1st-generation datasheet is, essentially, a public OPUS solution report. We anticipate adding user-friendly features & enhanced integration with NGSIDB and our toolkit in future versions. Your comments are appreciated.

http://www.ngs.noaa.gov/OPUS/view.jsp

Alaska Marks Published to OPUS

GNSS Additions to NGS Products and Services

Unfortunately, the infrastructure must also be in place before new GNSS can be incorporated into OPUS.

- Precise ephemerides must be available in a timely manner.
- A robust and comprehensive GNSS CORS network is needed.
- Antenna models and other information must be available.
- Software must be ready and proven robust.
- The community must feel a sufficient level of comfort which is gained by reliably producing quality products.

Other GNSS

Looking at these point for GLONASS specifically:

- Precise ephemerides are available no sooner than two-weeks and there is limited global support for this product.
- The number of GLONASS enable CORS is limited but growing (approximately 12% in the U.S.).
- Antenna models and other information are being produced.
- Software development is underway at the NGS.
- The NGS has begun activities which will help develop a solid foundation for using GLONASS.

Other GNSS

What's happening now?

- Schenewerk is extending the PAGES suite to handle GLONASS and other GNSS.
- GLONASS PAGES will be able to process integer-fixed or float GPS and float GLONASS separately or together.
- The software is literally an extension of PAGES which has been proven in a variety of operational tasks.

Other GNSS

The GLONASS PAGES programming is largely complete.

- Orbit production trials should be underway by April, 2011.
- Contribution to the IGS GLONASS precise ephemeris combinations is planned by the end of the year.
- Recall that the precise ephemerides have a two-week latency, so the viability of a GLONASS rapid product (one day latency or less) will be investigated.

OPUS-Projects

- A Little OPUS-Projects History.
- What Is OPUS-Projects?
- The OPUS-Projects Interface.
- How Good Can I Do With OPUS-Projects?

A Little OPUS-Projects History

The success of OPUS clearly demonstrated the value of web-based tools for some activities. This begged the question, could a web-based utility be made for a more complex task such as an airport or height modernization survey or positioning RTNs?

In these cases, one or more survey crews would be occupying one or more marks over several hours or multiple days in a manner consistent with predefined project specifications. Each session would get baselines adjusted and then the overall network would get adjusted.

A Little OPUS-Projects History

After a hiatus, Schenewerk began development again in 2007.

Prusky and Schenewerk oversaw a second, more focus test in 2009. Again, many "pros and cons" in the original design were revealed, but a better defined set of desirable capabilities resulted.

A beta version was released via training workshops in December, 2010.

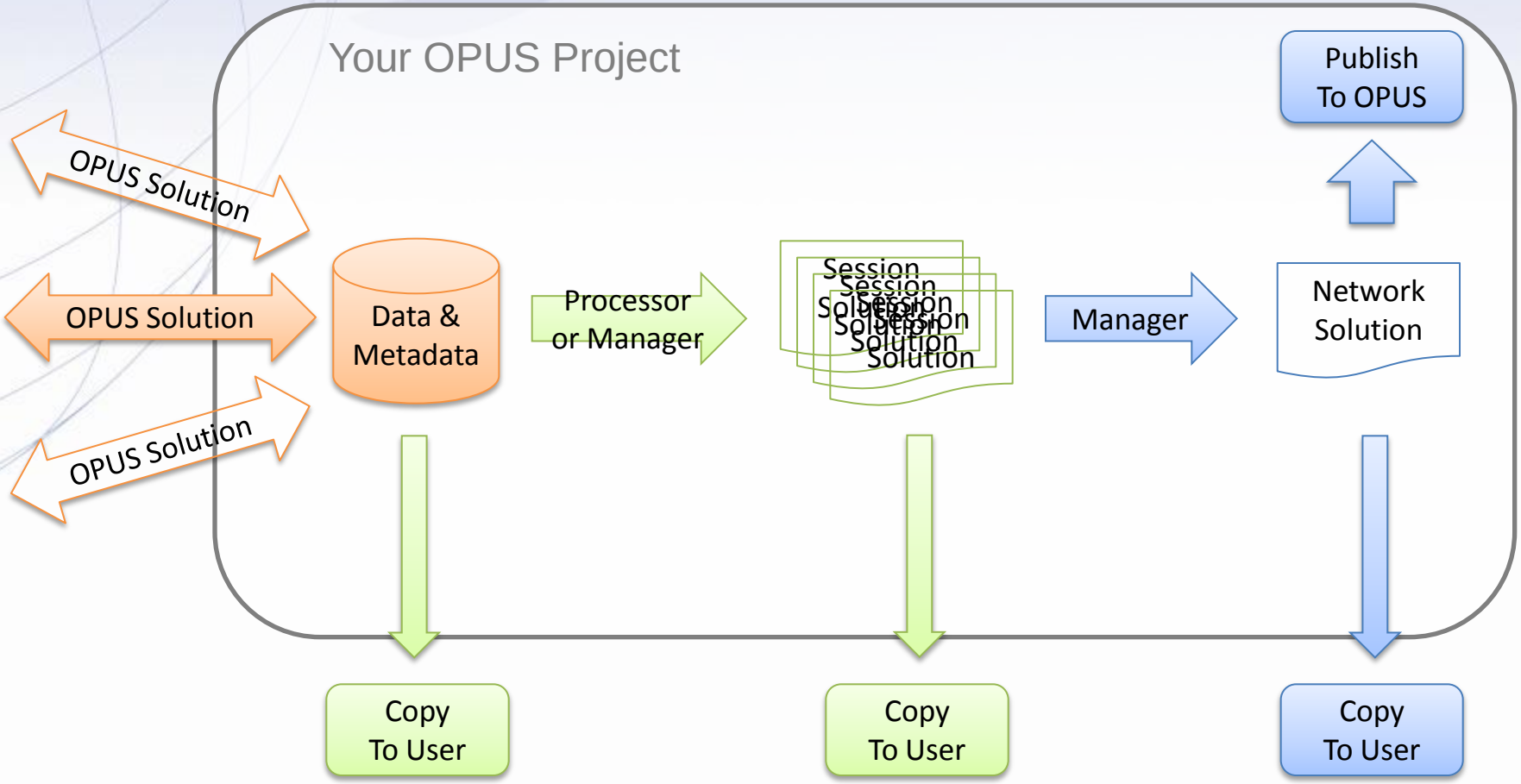
What Is OPUS-Projects?

OPUS-Projects exists in a hierarchical structure

1. Create . . . . . creates a project.
2. Upload . . . . . data submission.
3. Session . . . . . session review & processing.
4. Manage . . . . . network adjustments.
5. OPUS-Projects czar for general support.

What Is OPUS-Projects?

Graphically, this looks like:



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Upload your Data File

Tie your GPS observation to the National Spatial Reference System.
[what is OPUS?] [FAQs]

* Email address - your solution will be sent here.

Browse...

* Data file of dual-frequency GPS observations. [sample]

Antenna type - choosing wrong may degrade your accuracy.

0.0 meters above your mark.
Antenna height of your Antenna's Reference Point.

Options to customize your solution.

Upload to RAPID-STATIC — for data > 15 min. < 2 hrs.
Upload to STATIC — for data > 2 hrs. < 48 hrs.
process your solution.

- * required fields

Sample Solutions

(Note that the browser's navigation banners at the top and bottom of each page are omitted.)

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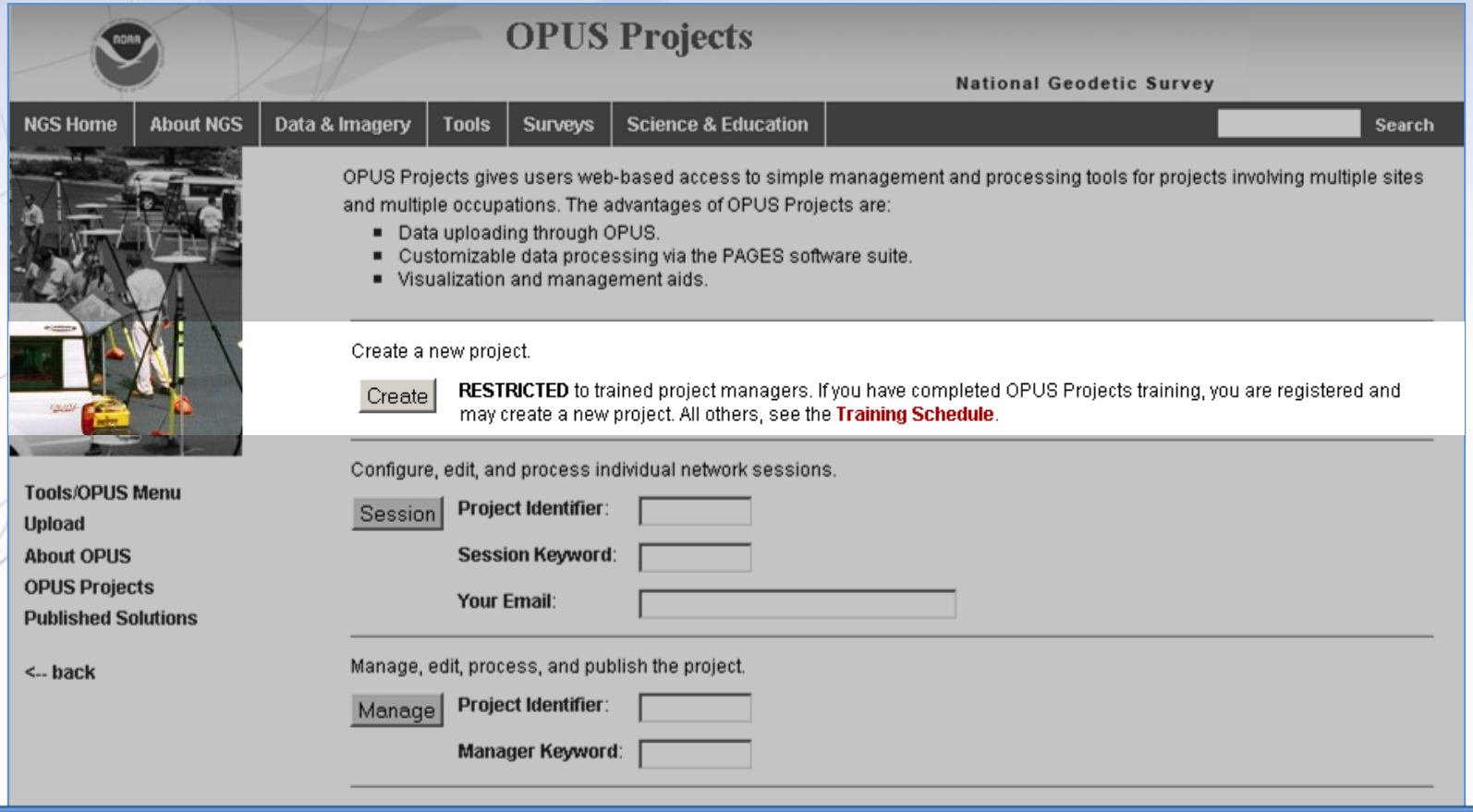
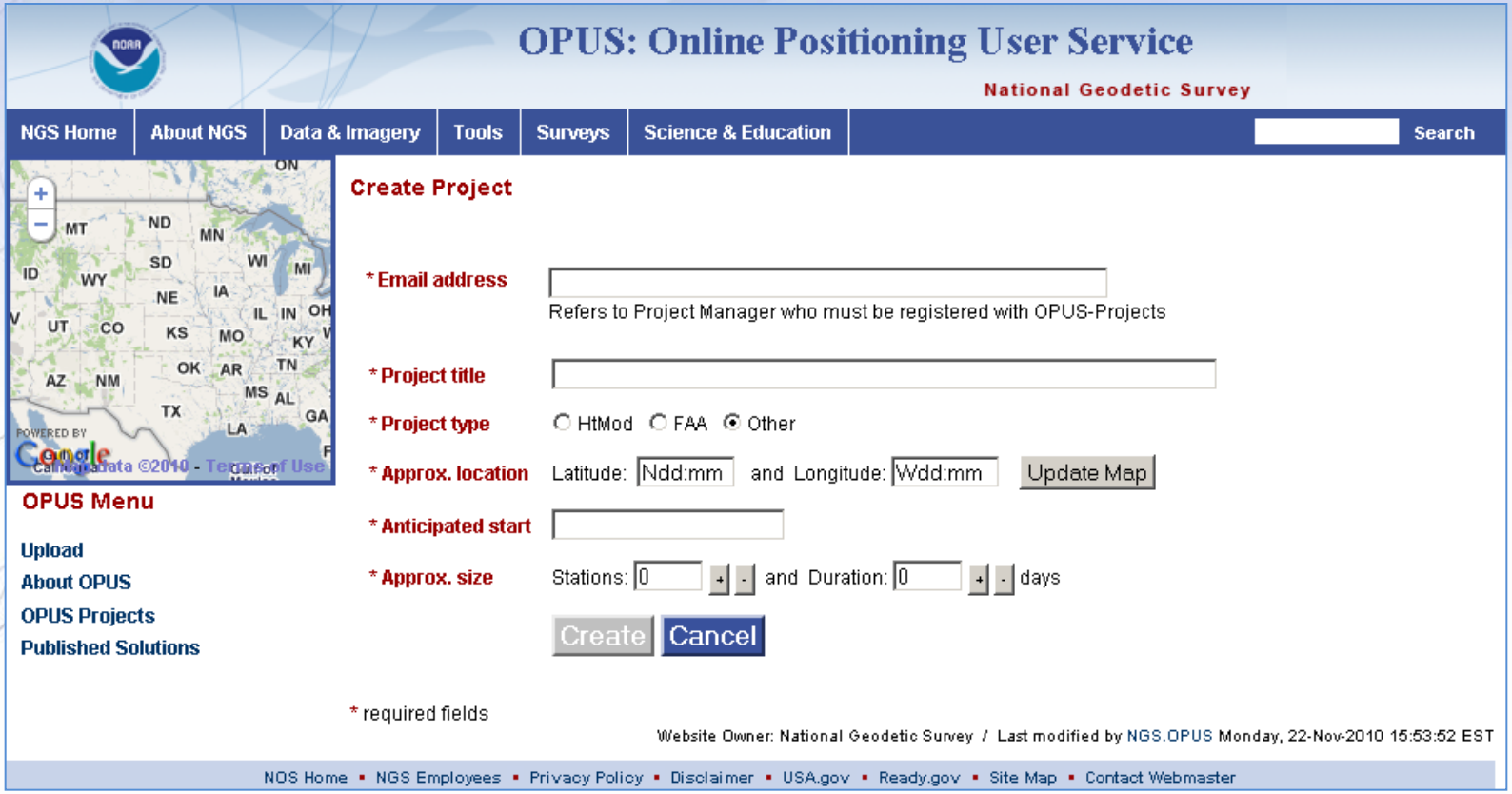
Upload to STATIC — for data > 2 hrs. < 48 hrs.
process your solution.

- * required fields
- We may use your data for internal evaluations of OPUS use, accuracy, or related research.

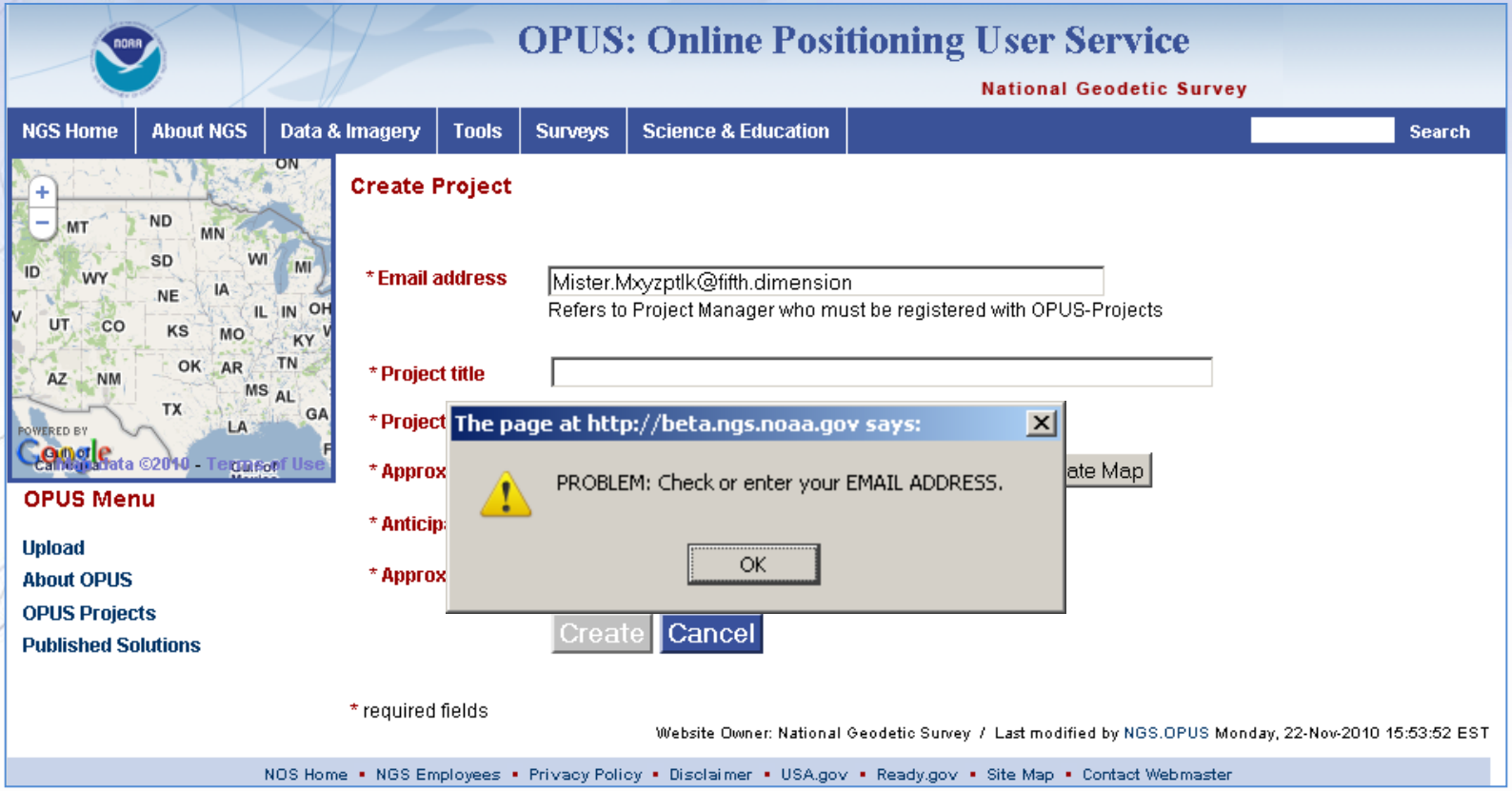
Sample Solutions



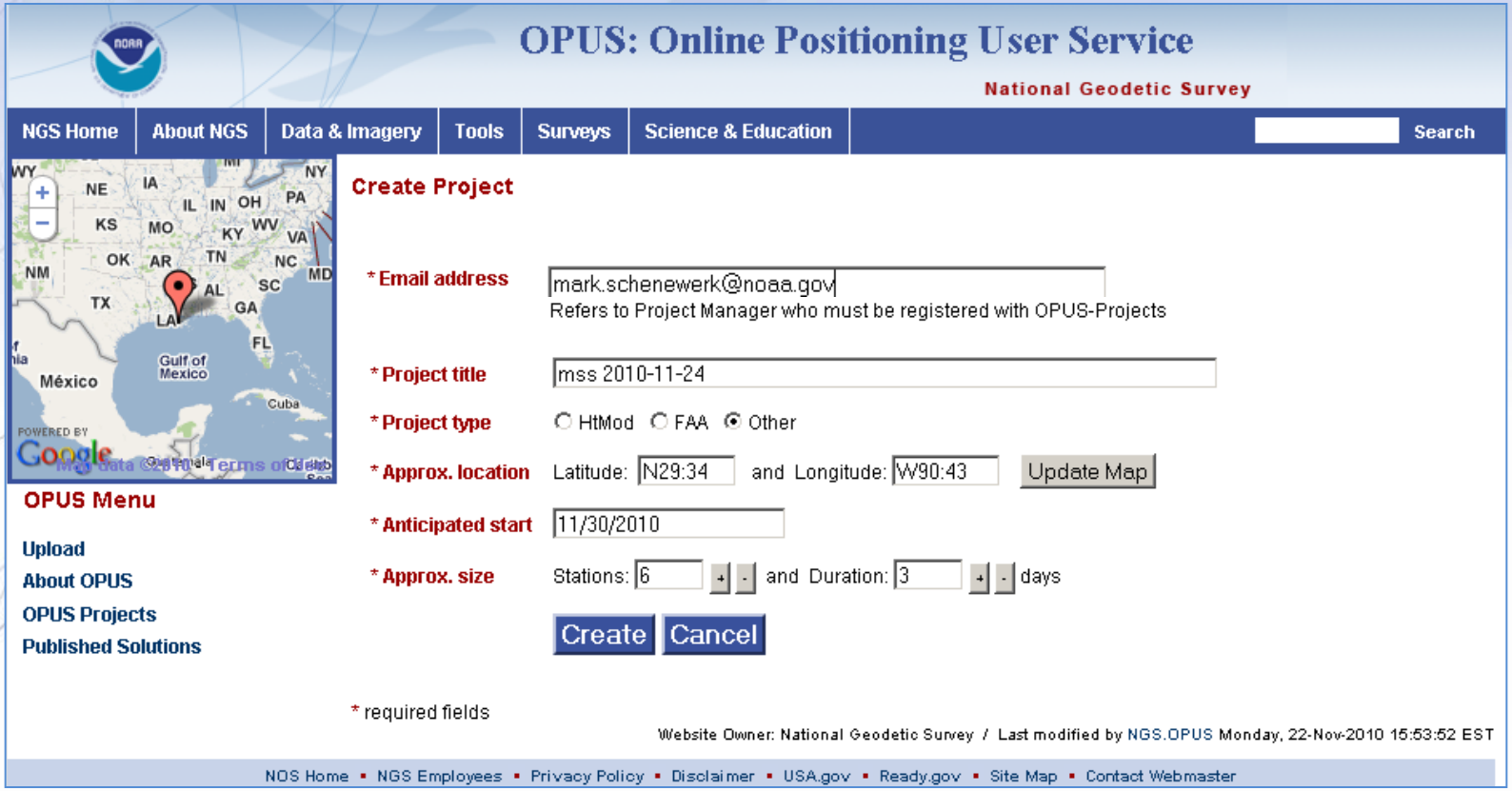
The first step is to create a project. This allocates on-line storage for the project's data and generates project keywords. Start by clicking the "Create" button.



You'll be taken to the project creation and registration page where you'll enter your email, a title for, the type of, the approximate location of, start date for and size of your project.



If you haven't completed this training, you'll be notified. Information about future training classes can be found at http://www.ngs.noaa.gov/corbin/calendar.shtml.



If you are registered, you can complete the form and click the (now enabled) Create button.

Your Project Was Successfully Created

Your New Project Was Successfully Created

Title: mss 2010-11-24

Project Manager

Email: mark.schenewerk@noaa.com

Project Keywords

Project ID: HRDB86FC

Used to submit data to this project.

Manager Keyword: FF5D3ZMU

Provides access to project management functions.

Session Keyword: D_SSVK68

Provides access to process individual project sessions.

Reminders

These keywords were also emailed to you.

Be sure to save these keywords.

Keywords may be changed at the Project **manager's page**.

Use the OPUS Projects link on the **OPUS page** to access your Project.

Website Owner: National Geodetic Survey / $Revision: 50434 $Created: 2010-11-24 13:10 UTC

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After a moment, the introduction to your newly created project is displayed. You'll also receive an email with this information.

Your Project Was Successfully Created

Your New Project Was Successfully Created

Title: mss 2010-11-24

Project Manager

Email: mark.schenewerk@noaa.com

Project Keywords

Project ID: HRDB86FC

Used to submit data to this project.

Manager Keyword: FF5D3ZMU

Provides access to project management functions.

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The Project Identifier, and the Manager and Session Keywords enable all other access to your project.

Your Project Was Successfully Created

Your New Project Was Successfully Created

Title: mss 2010-11-24

Project Manager

Email: mark.schenewerk@noaa.com

Project Keywords

Project ID: HRDB86FC

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Some find these randomly generated strings challenging, so they can be modified from the manager's page.

Your Project Was Successfully Created

Your New Project Was Successfully Created

Title: mss 2010-11-24

Project Manager

Email: mark.schenewerk@noaa.com

Project Keywords

Project ID: HRDB86FC

Used to submit data to this project.

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Your Project Identifier can be shared thereby permitting others to contribute data to your project.

Uploading Data To A Project

The second step is to "Upload" data files to your project.

At this time, this is done through OPUS-S implying the same restrictions:

- Your data must be dual frequency pseudorange and phase P1 (or C1), P2, L1 and L2.
- A minimum 2-hours data span for each submission.
- A collection rate of 1, 2, 3, 5, 10, 15 or 30 seconds.

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Upload your Data File

Tie your GPS observation to the National Spatial Reference System.
[what is OPUS?] [FAQs]

* Email address - your solution will be sent here.

Browse...

* Data file of dual-frequency GPS observations. [sample]

Antenna type - choosing wrong may degrade your accuracy.

0.0 meters above your mark.
Antenna height of your Antenna's Reference Point.

Options to customize your solution.

Upload to RAPID-STATIC — for data > 15 min. < 2 hrs.
Upload to STATIC — for data > 2 hrs. < 48 hrs.
process your solution.

- * required fields
- We may use your data for internal evaluations of OPUS use, accuracy, or related research.

Sample Solutions

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Mark.Schenewerk@noaa.gov
* **Email address** - your solution will be sent here.

C:\Documents and Settings\mark.schenewer Browse...
* **Data file** of dual-frequency GPS observations. **sample**

Sample Solutions

TRM55971.00 Zephyr GNSS Geodetic Model 2
Antenna type - choosing wrong may degrade your accuracy.

2.0 meters above your mark.
Antenna height of your antenna's reference point.

Options to **customize** your solution.

Solution formats	Add details to your report	standard solution	
Base stations	Type in site IDs for any CORS you wish to explicitly include or exclude from your solution **Sample**	**Use:** **Exclude:**	**Look up site IDs** **browse map**
State plane coordinates	Overrule your native SPCS zone	let OPUS choose	
Geoid Model	Customize your orthometric height model	GEOID09	
Contribute to a project(DRAFT) NEW	Enter the Project Identifier provided by your project manager, if any. What it means is, Project triggers 'Publish to database' option and verifies your email. If email is not registered, system will prompt you for registering email.	hrdb86fc	
My profile	Customize OPUS defaults for future solutions		
Publish my solution	Share your solutions	No, don't publish	

Upload to Rapid-Static | Upload to Static
for data > 15 min. < 2 hrs. for data > 2 hrs. < 48 hrs.

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Mark.Schenewerk@noaa.gov
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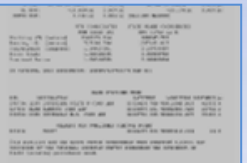
* **Data file** of dual-frequency GPS observations. **sample**



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State plane coordinates	Overrule your native SPCS zone	let OPUS choose	
Geoid Model	Customize your orthometric height model	GEOID09	
Contribute to a project(DRAFT) NEW	Enter the Project Identifier provided by your project manager, if any. What it means is, Project triggers 'Publish to database' option and verifies your email. If email is not registered, system will prompt you for registering email.	hrdb86fc	
My profile	Customize OPUS defaults for future solutions		
Publish my solution	Share your solutions	No, don't publish	

Upload to Rapid-Static — for data > 15 min. < 2 hrs.
Upload to Static — for data > 2 hrs. < 48 hrs.

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1. upload √ | **2. identify your mark** | 3. describe ... | 4. publish ...

choose one: mark has a PID | mark is NEW to NGS | skip description

mark has a PID? **Search the NGS database** to find out.

Upload successful!
You will receive an email when processing is complete.

uploaded:		Solving with:	
data file	2123275u.06o	solution format	Extended
converted to	2123275u.06o (RINEX format)	base sta. used	--
antenna type	TRM55971.00	base sta. excluded	--
antenna height	2.0 meters	state plane zone	AUTO
email address	mark.schenewerk@noaa.gov	geoid model	Geoid09
processor	static	project ID	hrdb86fc
		my profile	--
files in queue	--	publish	Publish

return to OPUS

Thank you for using OPUS!

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uploaded:		Solving with:	
data file	2123275u.06o	solution format	Extended
converted to	2123275u.06o (RINEX format)	base sta. used	--
antenna type	TRM55971.00	base sta. excluded	--
antenna height	2.0 meters	state plane zone	AUTO
email address	mark.schenewerk@noaa.gov	geoid model	Geoid09
processor	static	project ID	hrdb86fc
		my profile	--
files in queue	--	publish	Publish

return to OPUS

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Step 3 of 4: Describe new mark.

for data file: 2123275u.06o

1. upload √ | 2. identify | **3. describe your mark** | 4. publish

*** Stamping** H 179

*** Designation** H 179

*** Type** D = Disk | DD = Survey disk (other agency)

*** Setting** 31 = Pavement (street, sidewalk, curb, etc.)

Specific setting *(optional)*:

*** Description** (describe the mark, witness ties, etc., to enable future recoveries. Max. characters=500) 273

```
Take interstate I55 to State Road 442 east exit. 1
mi on SR 442, turn north on U.S. 51. After 1.5 mi
on U.S. 51, turn east on Buckles Ln. Just past the
railroad, Buckles Ln take a sharp right. Mark is
near this turn. Approximately 50 ft west, between
the road and railroad.
```

*** Close-up photo** C:\Documents and Settings\mark.schenewerk.CR Browse...

*** Horizon photo** C:\Documents and Settings\mark.schenewerk.CR Browse...

1. upload √ | 2. identify | **3. describe your mark** | 4. publish

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* **Designation** H 179
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railroad, Buckles Ln take a sharp right. Mark is
near this turn. Approximately 50 ft west, between
the road and railroad.
```

* **Close-up photo** C:\Documents and Settings\mark.schenewerk.CR Browse...
* **Horizon photo** C:\Documents and Settings\mark.schenewerk.CR Browse...

Stability Choose Vertical Stability

Magnetic Choose Magnetic Property

Application Choose Special Application

Antenna S/N 30212716 **Receiver S/N**: 30212716

Model RIMBLE NET5 **Firmware**

Upload Description | Abort

OPUS: Online Positioning User Service

National Geodetic Survey

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Description entry successful! APPROVAL PENDING

You should soon receive a normal "solution report" email from OPUS.
If successful, it and your mark description will be forwarded for approval:

- for option **"publish my solution" you are ALMOST done.**
  -- You will receive a second email with final publishing instructions.
- for option **"contribute to a project" you are done!**
  -- This second email will go to the manager for your project.

Thank you for using OPUS!

OPUS Menu

- Upload
- About OPUS
- OPUS Projects
- Published Solutions

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Subject: OPUS solution : Project hrdb86fc : 2123275a.06o 000098414
From: opus <opus@NGS.noaa.gov>
Reply-To: ngs.opus@noaa.gov
Date: 10:37 AM
To: Mark.Schenewerk@noaa.gov

```
 FILE: 2123275a.06o 000098414

                              NGS OPUS SOLUTION REPORT
                              ========================

All computed coordinate accuracies are listed as peak-to-peak values.
For additional information: http://www.ngs.noaa.gov/OPUS/about.html#accuracy

      USER: Mark.Schenewerk@noaa.gov                DATE: October 14, 2010
RINEX FILE: 2123275u.06o                            TIME: 14:37:18 UTC


  SOFTWARE: page5  1009.28 master11.pl 100910      START: 2006/10/02  20:23:00
 EPHEMERIS: igs13951.eph [precise]                  STOP: 2006/10/03  01:15:00
  NAV FILE: brdc2750.06n                        OBS USED:  9643 / 10429   :  92%
  ANT NAME: TRM55971.00     NONE              # FIXED AMB:    56 /    70   :  80%
ARP HEIGHT: 2.0                               OVERALL RMS: 0.017(m)


 REF FRAME: NAD_83(CORS96)(EPOCH:2002.0000)            ITRF00 (EPOCH:2006.7533)

         X:       -46694.800(m)   0.019(m)            -46695.467(m)   0.019(m)
         Y:     -5495064.250(m)   0.098(m)          -5495062.764(m)   0.098(m)
         Z:      3226832.866(m)   0.039(m)           3226832.676(m)   0.039(m)

       LAT:   30 35 23.59037      0.017(m)        30 35 23.60952      0.017(m)
     E LON:  269 30 47.28854      0.018(m)       269 30 47.26304      0.018(m)
     W LON:   90 29 12.71146      0.018(m)        90 29 12.73696      0.018(m)
    EL HGT:           -7.445(m)   0.104(m)                -8.816(m)   0.104(m)
 ORTHO HGT:           19.625(m)   0.177(m) [NAVD88 (Computed using GEOID09)]

                         UTM COORDINATES    STATE PLANE COORDINATES
                          UTM (Zone 15)         SPC (1702 LA S)
Northing (Y)  [meters]     3386842.995           231955.826
Easting (X)   [meters]      740977.308          1081182.812
Convergence   [degrees]     1.27952549           0.42324526
Point Scale                 1.00031642           0.99997843
Combined Factor             1.00031759           0.99997960
```

When data are submitted to a project, the OPUS-S results are "quality controlled" using *thresholds* specified by the project manager.

FLAGS

If the results from a data file exceed any of the thresholds, a warning message is sent to the email address entered when the data were submitted.

Receiving a warning message does *not* mean the data will be excluded from your project. That is the project's decision. However, the data are flagged for easy identification by the project.

Subject: Project Verification: Project hrdb86fc : 2123275a.06o 000098414
From: opus <opus@NGS.noaa.gov>
Reply-To: ngs.opus@noaa.gov
Date: 10:37 AM
To: Mark.Schenewerk@noaa.gov

```
The RINEX file listed below did not meet all the currrent threshold limits
for submission to ...

PROJECT:     hrdb86fc
RINEX FILE:  2123275u.06o
ANTENNA:     OK       TRM55971.00      NONE
ARP HGT:     OK       2.000 m

RMS:         OK       0.017 m
EPHEMERIS:   OK       igs13951.eph
OBS USED:    OK       92.5%
FIXED AMB:   OK       80.0%
LAT RANGE:   OK       0.017 m
LON RANGE:   OK       0.018 m
HGT RANGE:   WARNING 0.104 m > 0.04 m HGT peak-to-peak threshold.
```

The highlight is mine.

These preferences can be modified by the project manager.

View And Process A Session

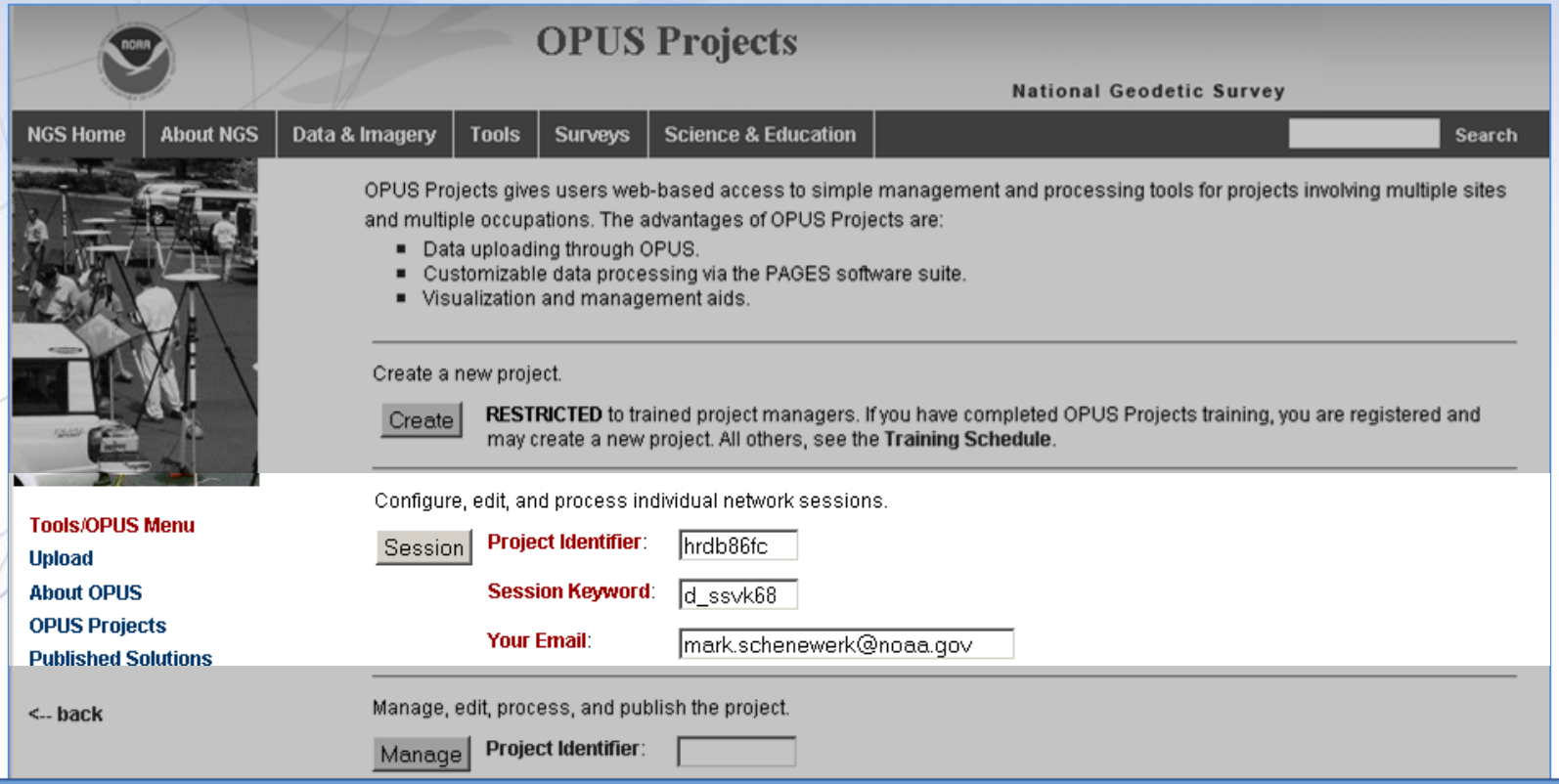
OPUS-Projects groups the data into *sessions*.

-Sessions are groups of site occupations that overlap significantly in time.

Note that;

- **a site may appear in more than one session.**
- **as new data are submitted, the definitions of the sessions may change.**

Now that some data has been submitted to the project, processing can begin.



This time we'll enter through the Session login on the OPUS-Projects gateway page.

OPUS Projects BETA - "Training data set 1"

National Geodetic Survey

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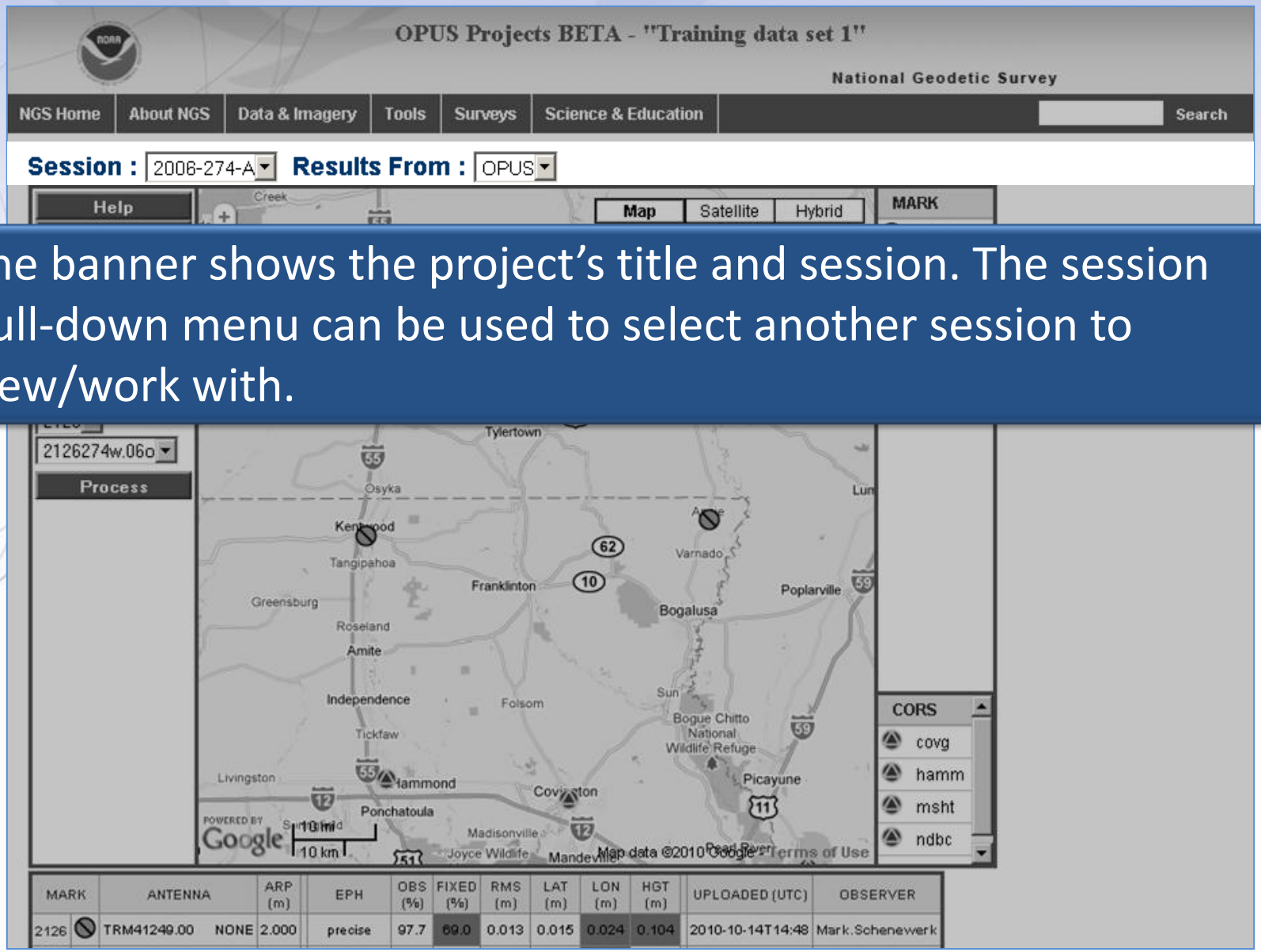
Session : 2006-274-A **Results From :** OPUS

Help
Back
Refresh
Center Project
Center All Sites
Email
Show A File
2126
2126274w.06o
Process

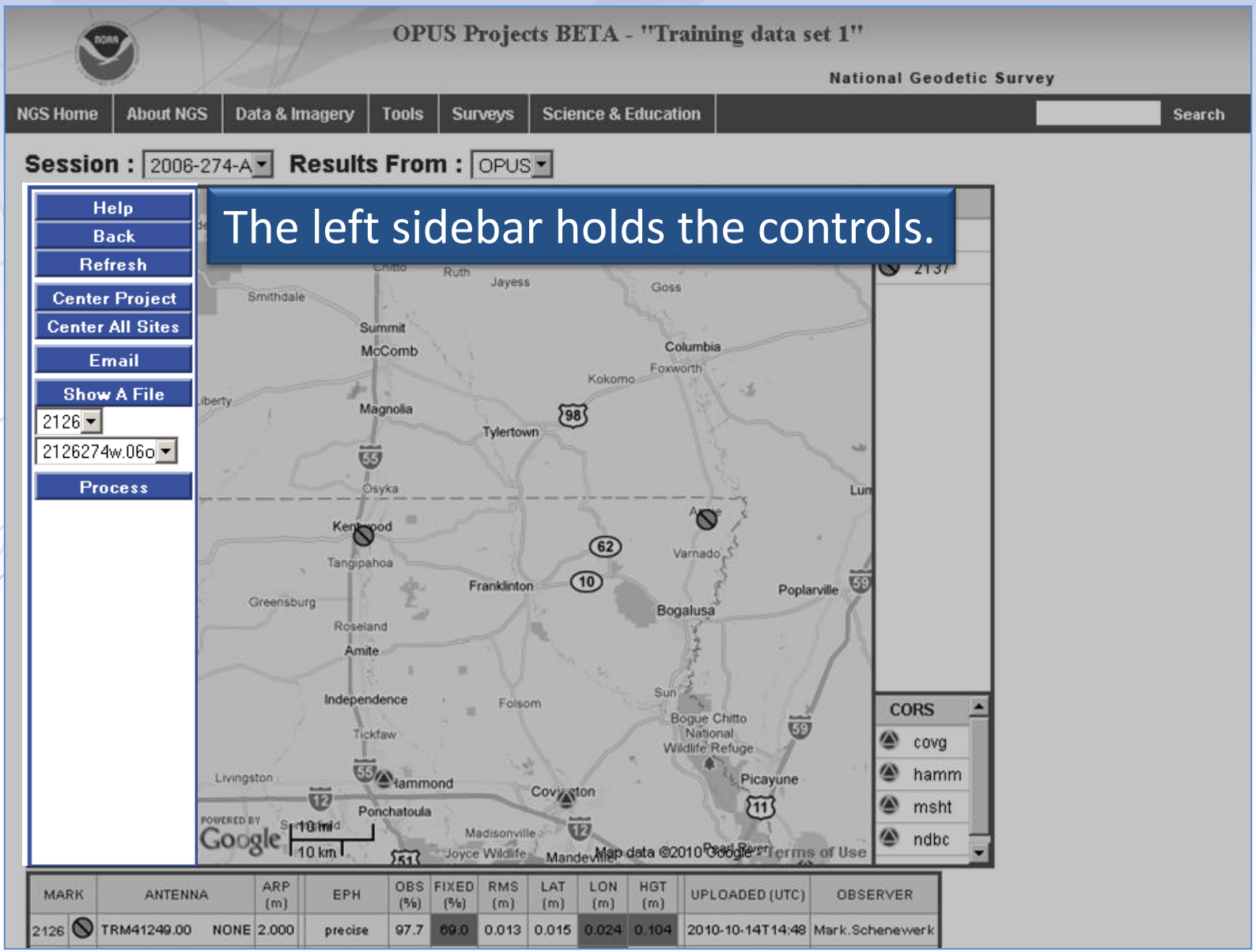
MARK
- 2126
- 2137

CORS
- covg
- hamm
- msht
- ndbc

MARK	ANTENNA		ARP (m)	EPH	OBS (%)	FIXED (%)	RMS (m)	LAT (m)	LON (m)	HGT (m)	UPLOADED (UTC)	OBSERVER
2126	TRM41249.00	NONE	2.000	precise	97.7	69.0	0.013	0.015	0.024	0.104	2010-10-14T14:48	Mark.Schenewerk



The banner shows the project's title and session. The session pull-down menu can be used to select another session to view/work with.


OPUS Projects BETA - "Training data set 1"
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Session : 2006-274-A
Results From : OPUS
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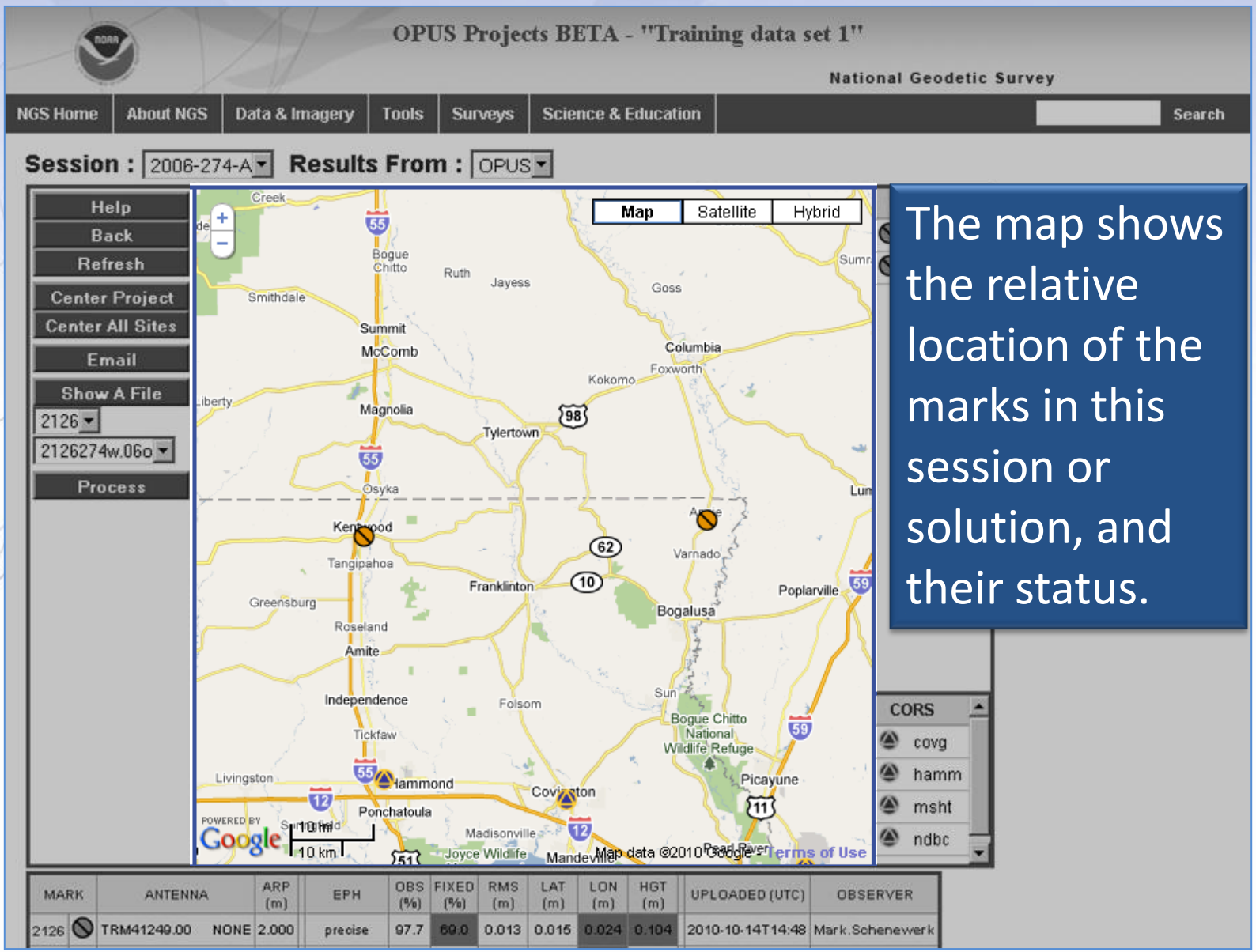
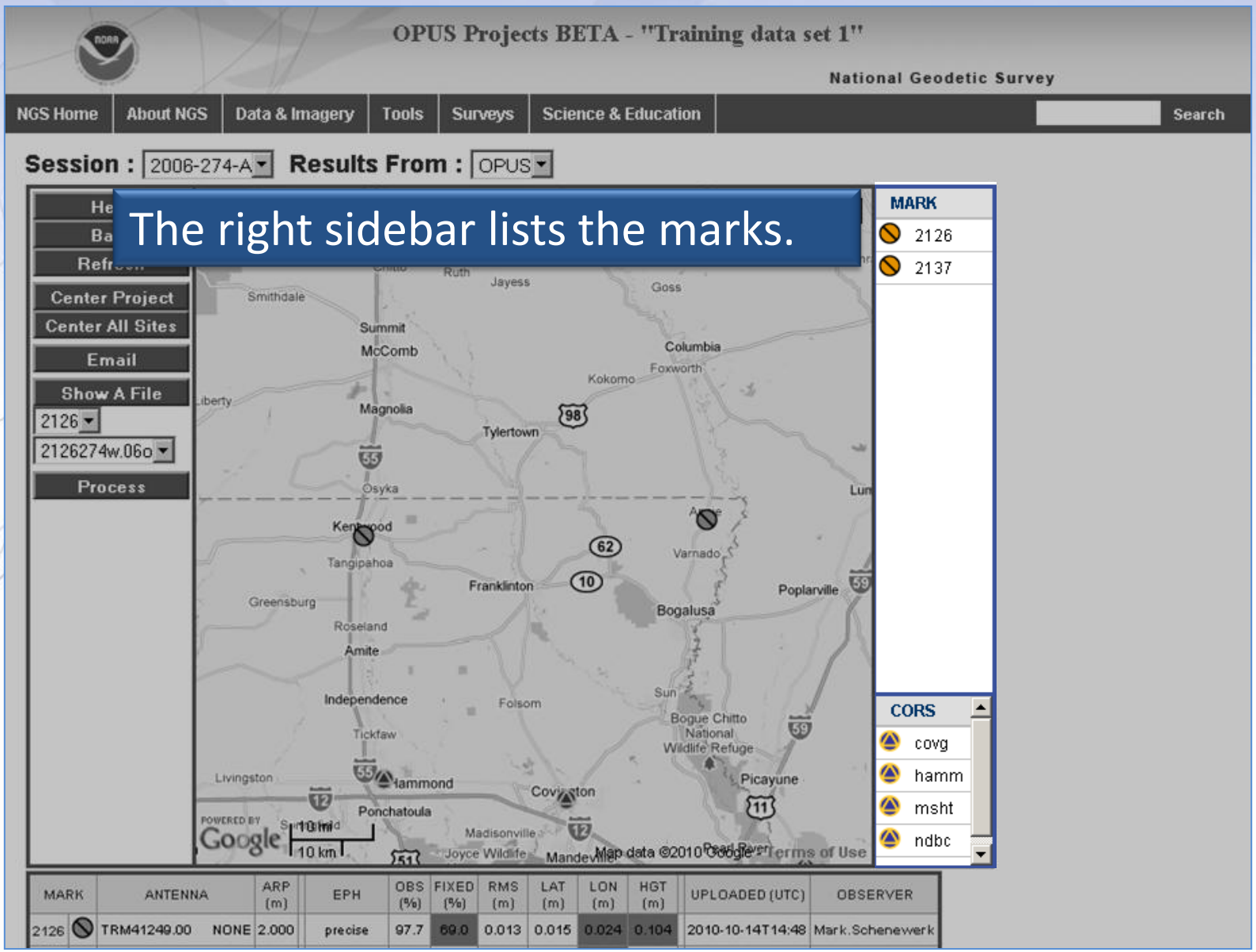
The left sidebar holds the controls.
Smithdale
Ruth
Jayess
Goss
Summit
McComb
Columbia
Foxworth
Kokomo
Magnolia
Tylertown
Osyka
Tangipahoa
Franklinton
Varnado
Bogalusa
Poplarville
Greensburg
Roseland
Amite
Independence
Folsom
Sun
Bogue Chitto National Wildlife Refuge
Tickfaw
Livingston
Picayune
Ponchatoula
Madisonville
Joyce Wildlife
Mandeville
Map data ©2010 Google
Terms of Use
CORS
covg
hamm
msht
ndbc
MARK
ANTENNA
ARP (m)
EPH
OBS (%)
FIXED (%)
RMS (m)
LAT (m)
LON (m)
HGT (m)
UPLOADED (UTC)
OBSERVER
2126
TRM41249.00 NONE
2.000
precise
97.7
69.0
0.013
0.015
0.024
0.104
2010-10-14T14:48
Mark.Schenewerk

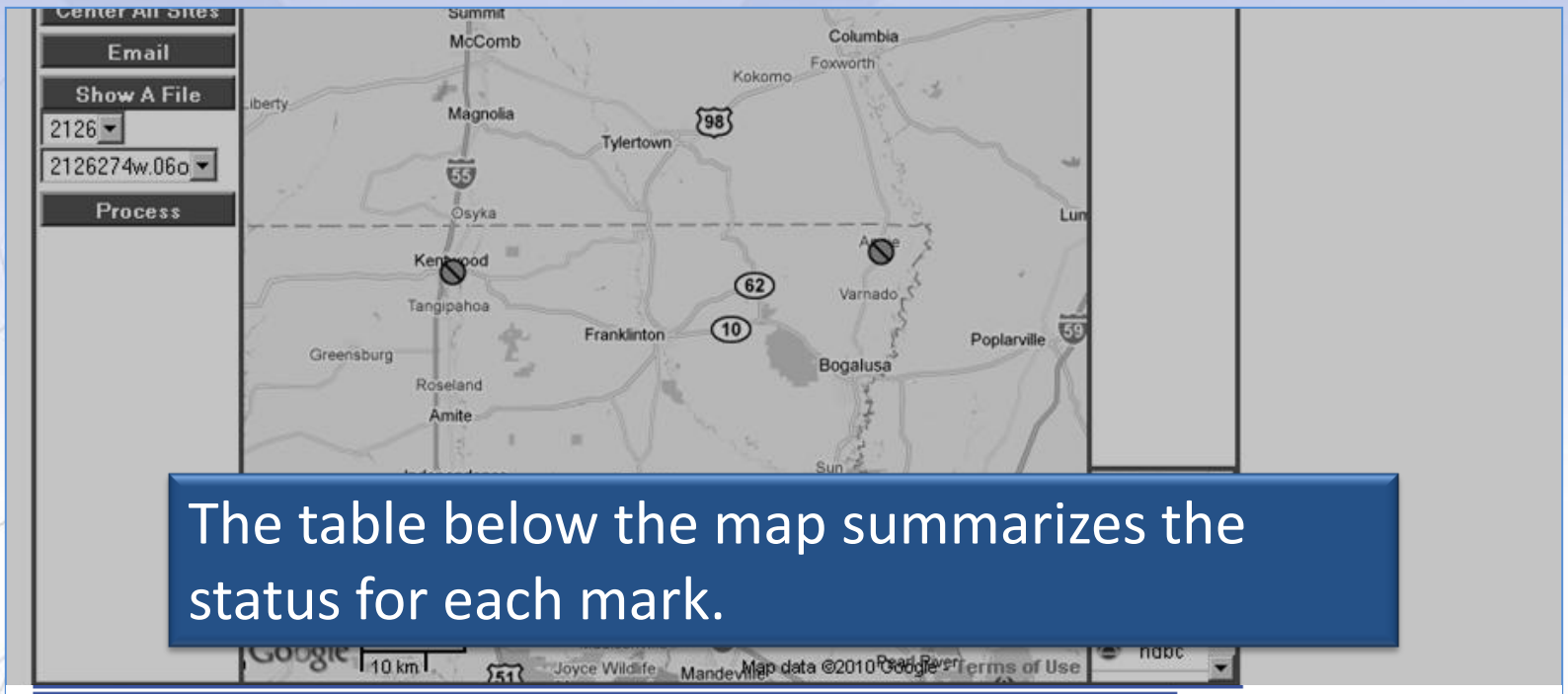


The map shows the relative location of the marks in this session or solution, and their status.



The right sidebar lists the marks.

MARK	ANTENNA		ARP (m)	EPH	OBS (%)	FIXED (%)	RMS (m)	LAT (m)	LON (m)	HGT (m)	UPLOADED (UTC)	OBSERVER
2126	TRM41249.00	NONE	2.000	precise	97.7	69.0	0.013	0.015	0.024	0.104	2010-10-14T14:48	Mark.Schenewerk



The table below the map summarizes the status for each mark.

MARK		ANTENNA		ARP (m)	EPH	OBS (%)	FIXED (%)	RMS (m)	LAT (m)	LON (m)	HGT (m)	UPLOADED (UTC)	OBSERVER
2126		TRM41249.00	NONE	2.000	precise	97.7	69.0	0.013	0.015	0.024	0.104	2010-10-14T14:48	Mark.Schenewerk
2137		TRM55971.00	NONE	2.000	precise	94.6	84.8	0.016	0.013	0.022	0.040	2010-10-14T14:52	Mark.Schenewerk
Preferences					BEST AVAILABLE	≥80.0	≥80.0	≤0.025	≤0.020	≤0.020	≤0.040	Preferences	

Data Availability Versus GPS Time

2006-10-01T20:00:00 to 2006-10-02T02:00:00 in 10 minute cells

MARK		2006-10-01																								2006-10-02											
		20							21							22							23							00							01
2126		0	0	0	0	0	0	0	0	0	0	0	0	0	7	7	8	8	8	7	8	8	8	8	7	7	7	7	7	7	8	7	7	8	8	7	0
2137		7	7	7	7	7	8	7	8	7	7	8	8	9	9	A	A	8	8	8	9	9	8	8	8	7	7	7	7	8	8	7	8	8	7	7	7

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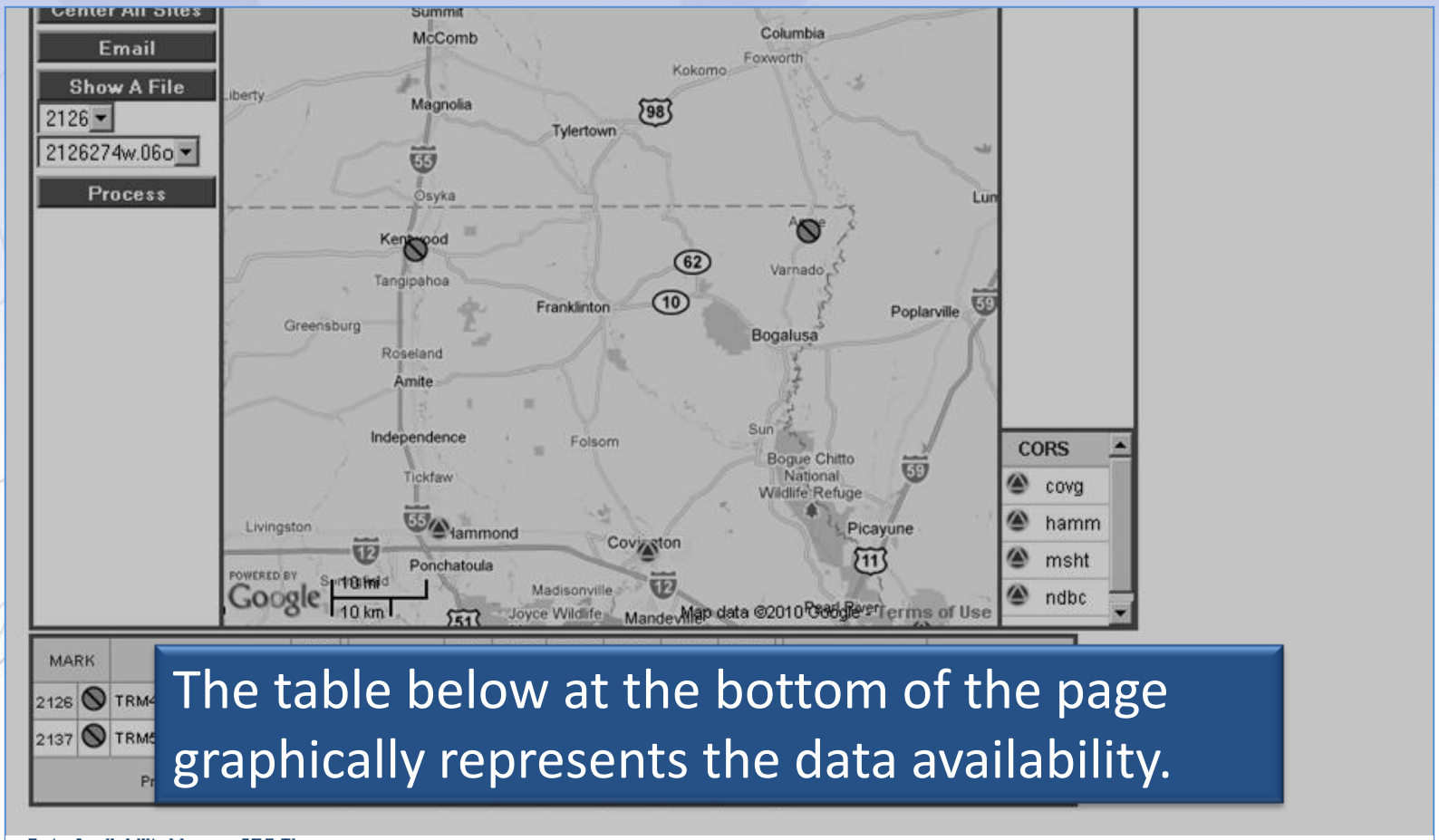

The table below at the bottom of the page graphically represents the data availability.

Data Availability Versus GPS Time

2006-10-01T20:00:00 to 2006-10-02T02:00:00 in 10 minute cells

MARK	2006-10-01																								2006-10-02					
	20						21						22						23						00					01
2126	0	0	0	0	0	0	0	0	0	0	0	0	0	7	7	8	8	8	7	8	8	8	8	7	7	7	7	7	7	8	7	7	8	8	7	0
2137	7	7	7	7	7	8	7	8	7	7	8	8	9	9	A	A	8	8	8	9	9	8	8	8	7	7	7	7	8	8	8	7	8	8	7	7

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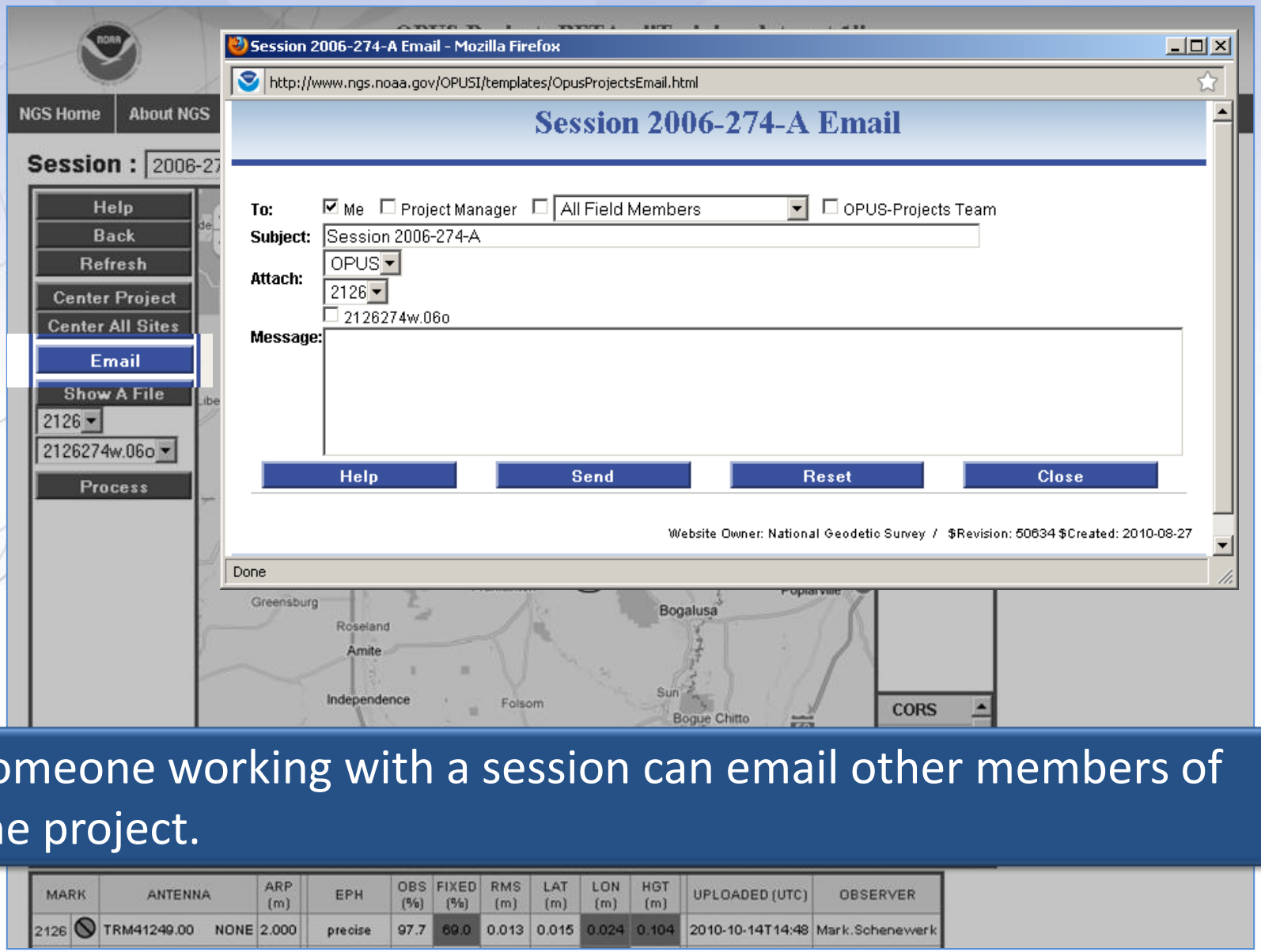
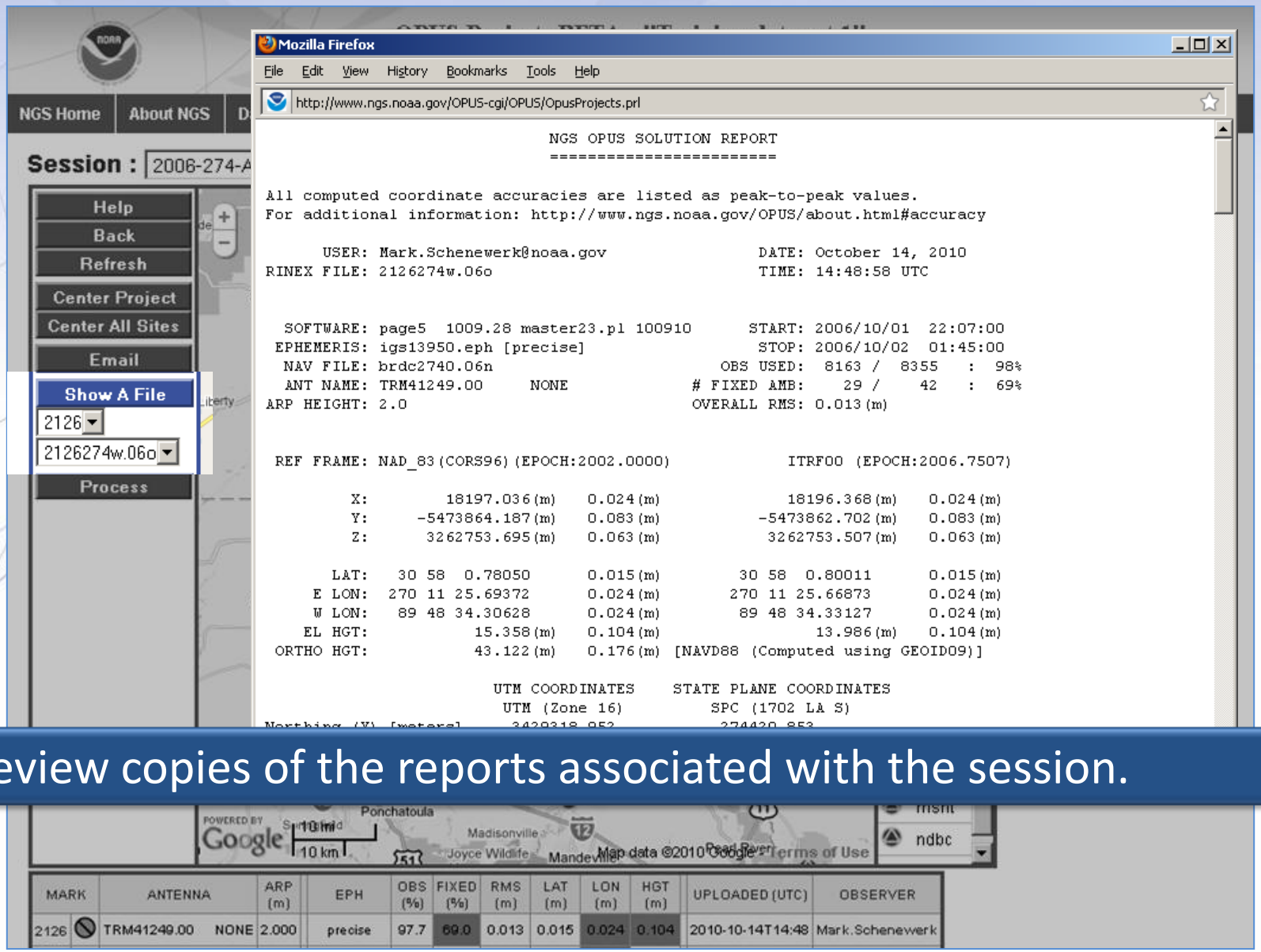


Someone working with a session can email other members of the project.



Review copies of the reports associated with the session.

National Geodetic Survey - OPUS Projects BETA - Process Session - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://www.ngs.noaa.gov/OPUSI/templates/OpusProjectsProcess.html

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Session : 2006-274-A Results Fr

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2126274w.06o
Process

Process Session

Name: 2006-274A **from** 2006-10-01T20:01:30 GPST **to** 2006-10-02T01:59:30 GPST

MARK		HUB	CONSTRAINT	HEIGHT (m)		LATITUDE (° ' ")	LONGITUDE (° ' ")
2126			NONE	EL HGT	13.986	N30:58:00.80011	W089:48:34.33127
2137			NONE	EL HGT	33.182	N30:56:11.58187	W090:30:25.29780
CORS		**HUB**	**CONSTRAINT**	**HEIGHT (m)**		**LATITUDE (° ' ")**	**LONGITUDE (° ' ")**
covg			3-D	EL HGT	-5.938	N30:28:33.28886	W090:05:43.94866
hamm			3-D	EL HGT	5.817	N30:30:47.07074	W090:28:03.45449
msht			3-D	EL HGT	64.475	N31:19:39.16034	W089:20:10.65216
ndbc			3-D	EL HGT	-11.674	N30:21:22.61077	W089:36:37.00068

Processing Options

Reference Frame:	NAD_83(CORS96)
Geoid Model:	USGG2009
GNSS:	G (GPS-only)
Tropo Model:	Piece-wise, Linear
Tropo Interval (s):	7200
Elevation Cutoff (°):	15.0
Constraints:	Loose Normal Tight

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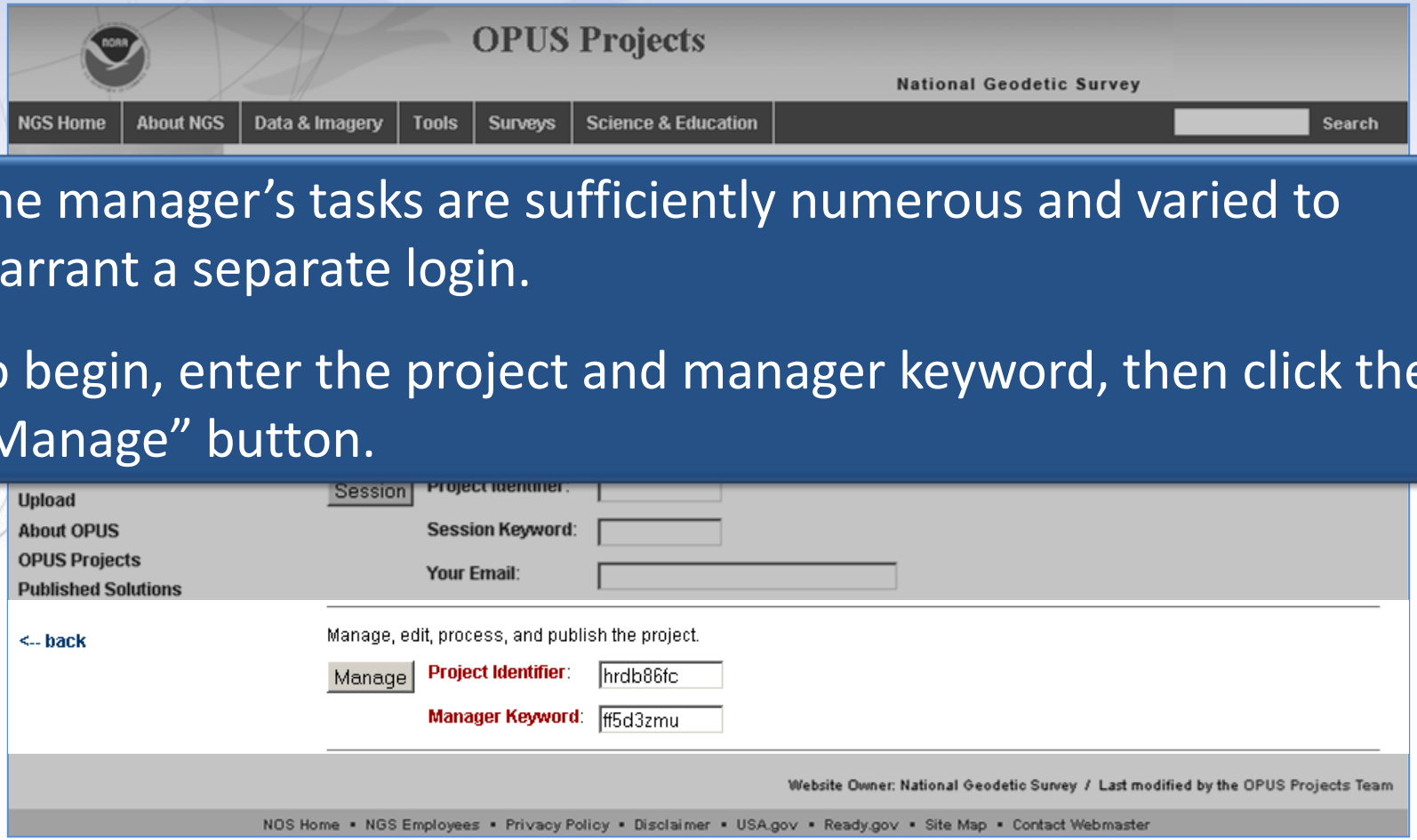
Done

MARK	ANTENNA		ARP (m)	EPH
2126	TRM41249.00	NONE	2.000	precise

Or process the session's data.

MANAGE A PROJECT



The manager's tasks are sufficiently numerous and varied to warrant a separate login.

To begin, enter the project and manager keyword, then click the "Manage" button.

OPUS Projects BETA - Manage "Training data set 1"

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Email Lists
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Serfil
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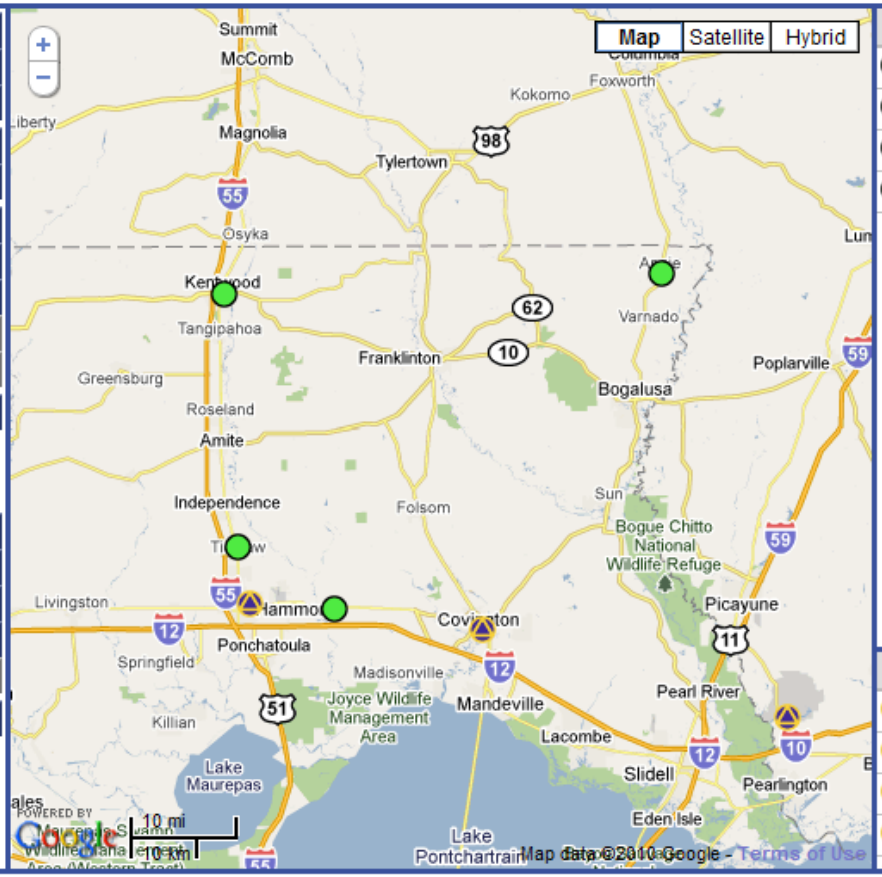
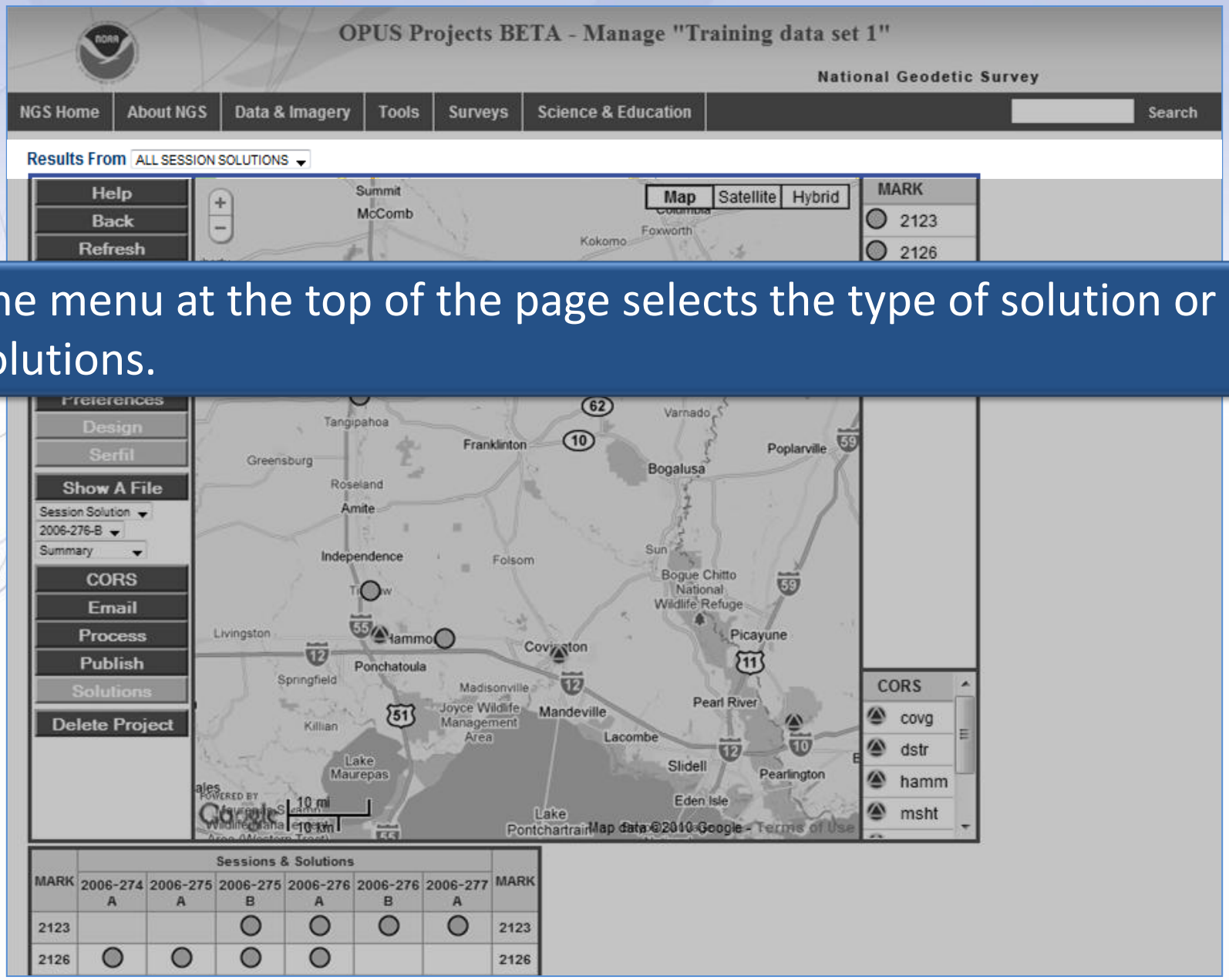
CORS
Email
Process
Publish
Solutions
Delete Project



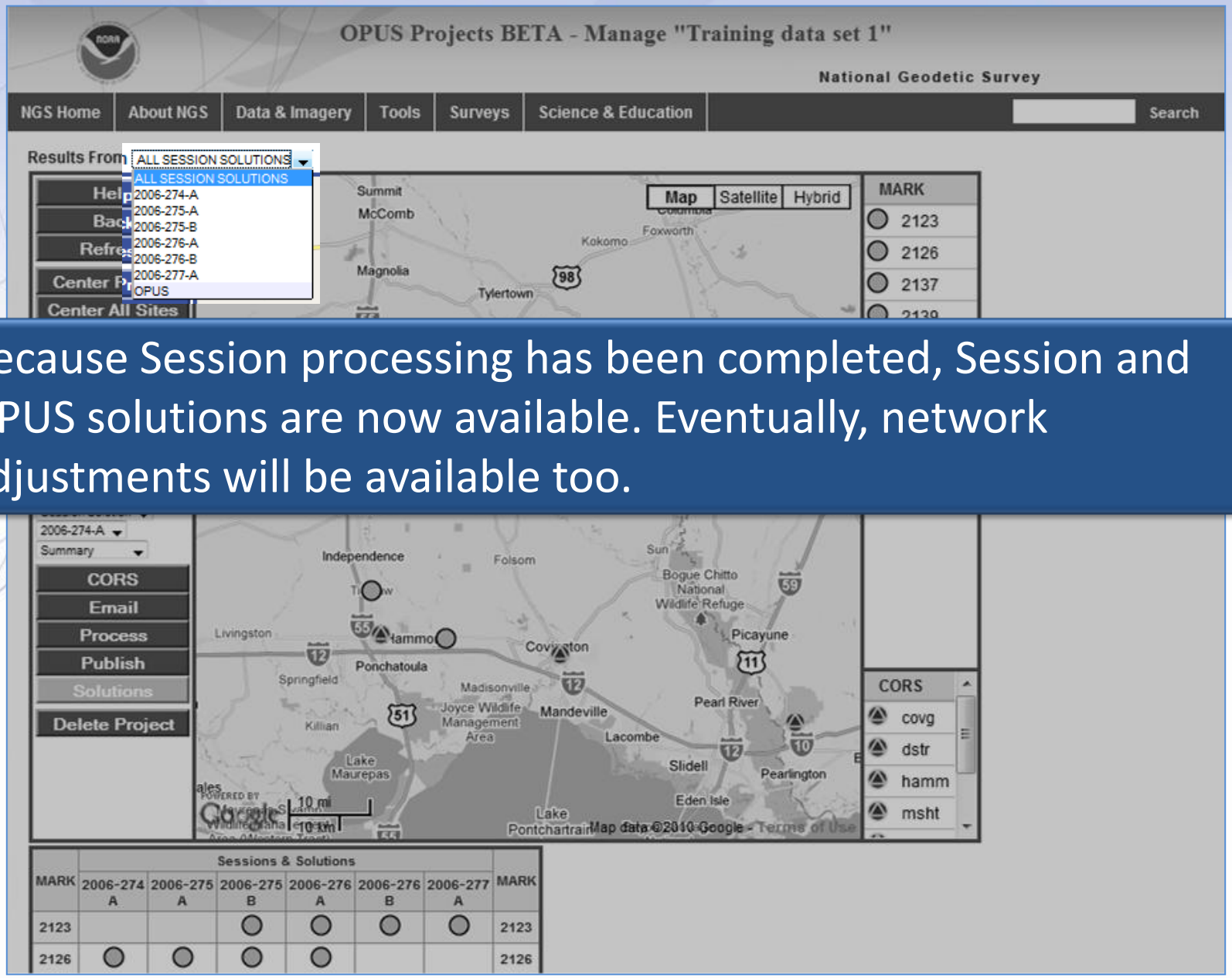
MARK
- 2123
- 2126
- 2137
- 2139

CORS
- covg
- dstr
- hamm
- msht

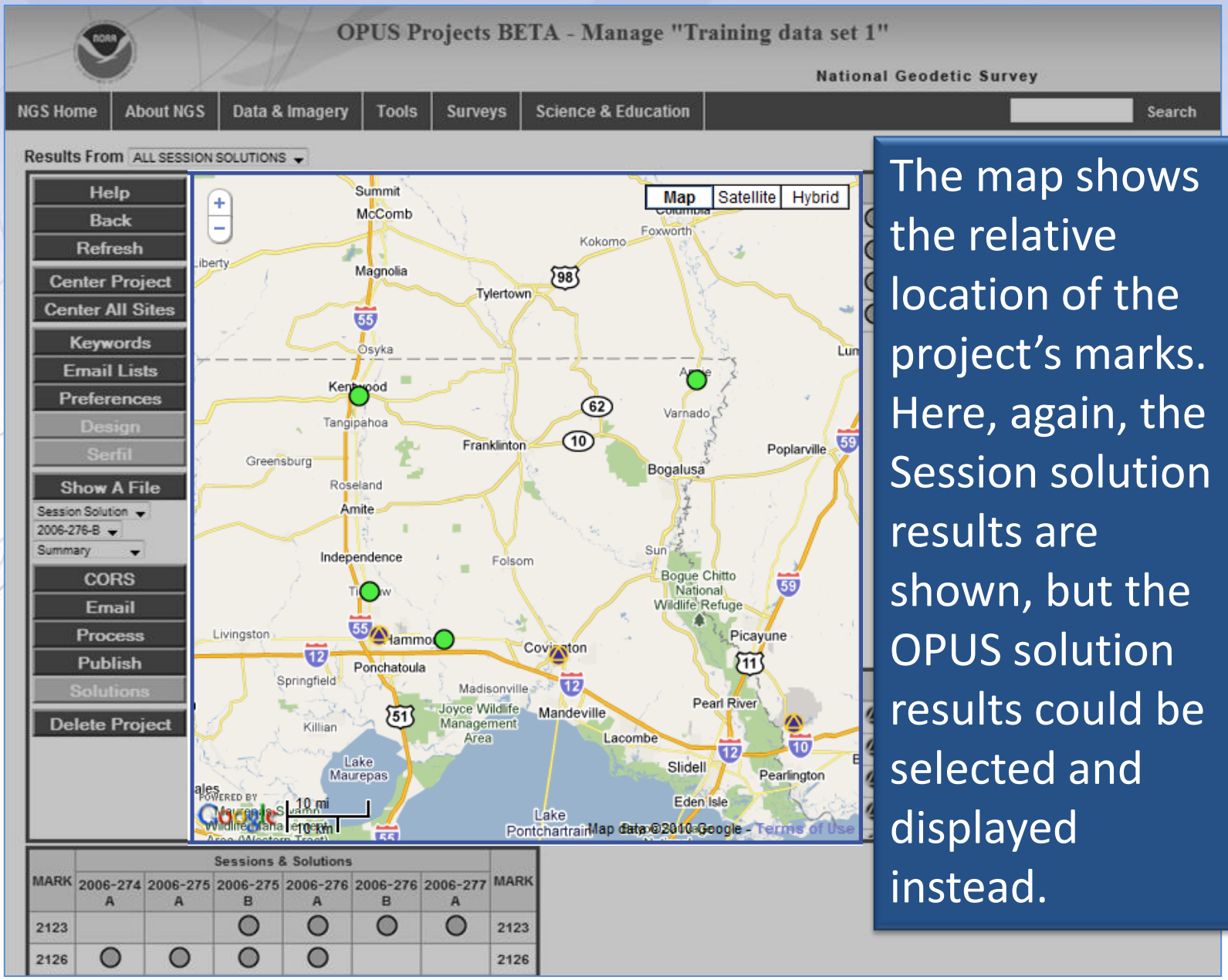
MARK	Sessions & Solutions						MARK
	2006-274 A	2006-275 A	2006-275 B	2006-276 A	2006-276 B	2006-277 A	
2123			●	●	●	●	2123
2126	●	●	●	●			2126



The menu at the top of the page selects the type of solution or solutions.



Because Session processing has been completed, Session and OPUS solutions are now available. Eventually, network adjustments will be available too.



The map shows the relative location of the project's marks. Here, again, the Session solution results are shown, but the OPUS solution results could be selected and displayed instead.

OPUS Projects BETA - Manage "Training data set 1"

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Results From ALL SESSION SOLUTIONS

The sidebar on the right lists the sites alphanumerically but segregated by project and CORS marks.

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Solutions
Delete Project

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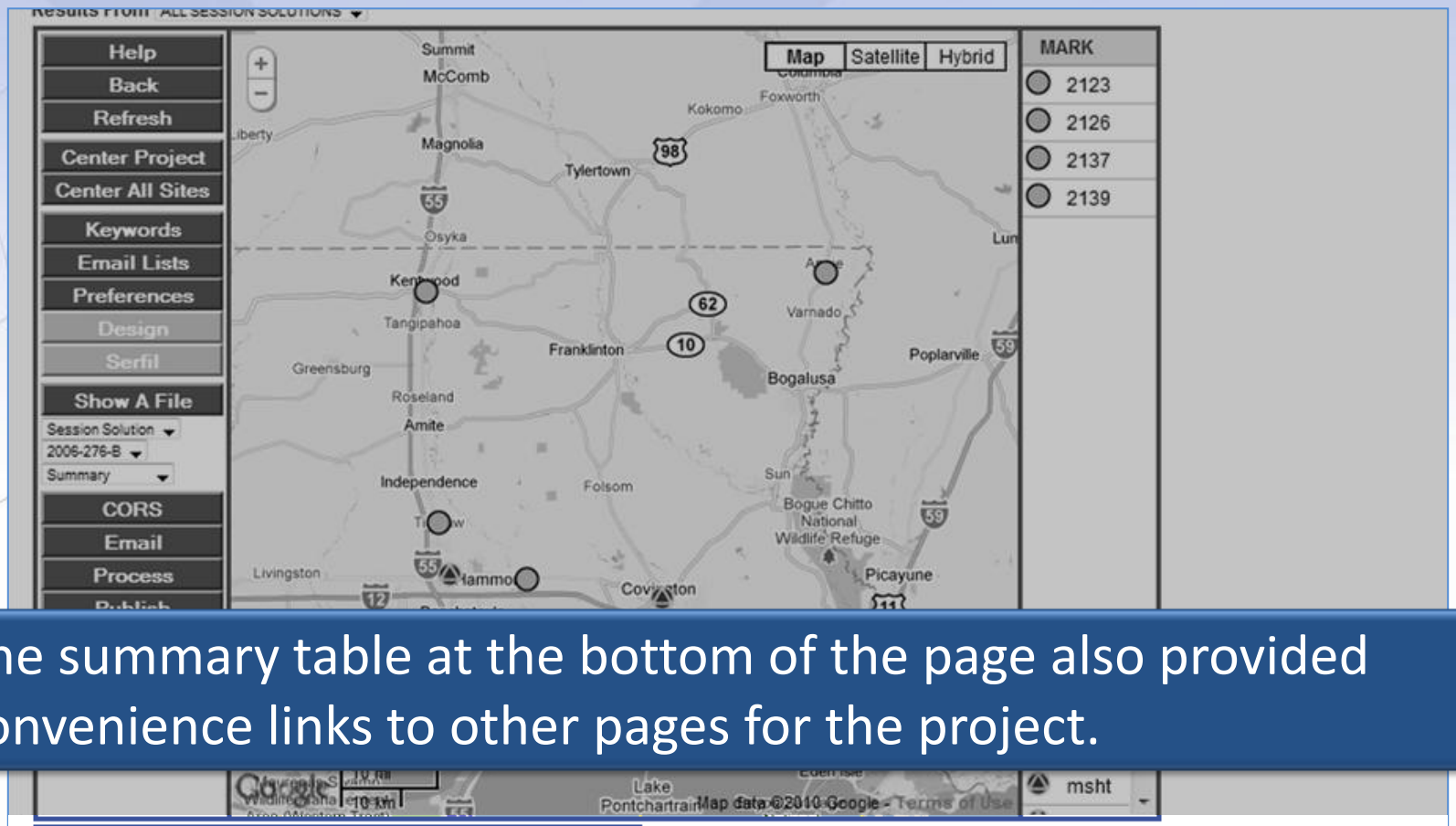
CORS
covg
dstr
hamm
msht

MARK	Sessions & Solutions						MARK
	2006-274 A	2006-275 A	2006-275 B	2006-276 A	2006-276 B	2006-277 A	
2123			○	○	○	○	2123
2126	○	○	○	○			2126



The summary table at the bottom of the page also provided convenience links to other pages for the project.

MARK	Sessions & Solutions						MARK
	2006-274 A	2006-275 A	2006-275 B	2006-276 A	2006-276 B	2006-277 A	
2123			●	●	●	●	2123
2126	●	●	●	●			2126
2137	●		●	●			2137
2139			●	●	●	●	2139

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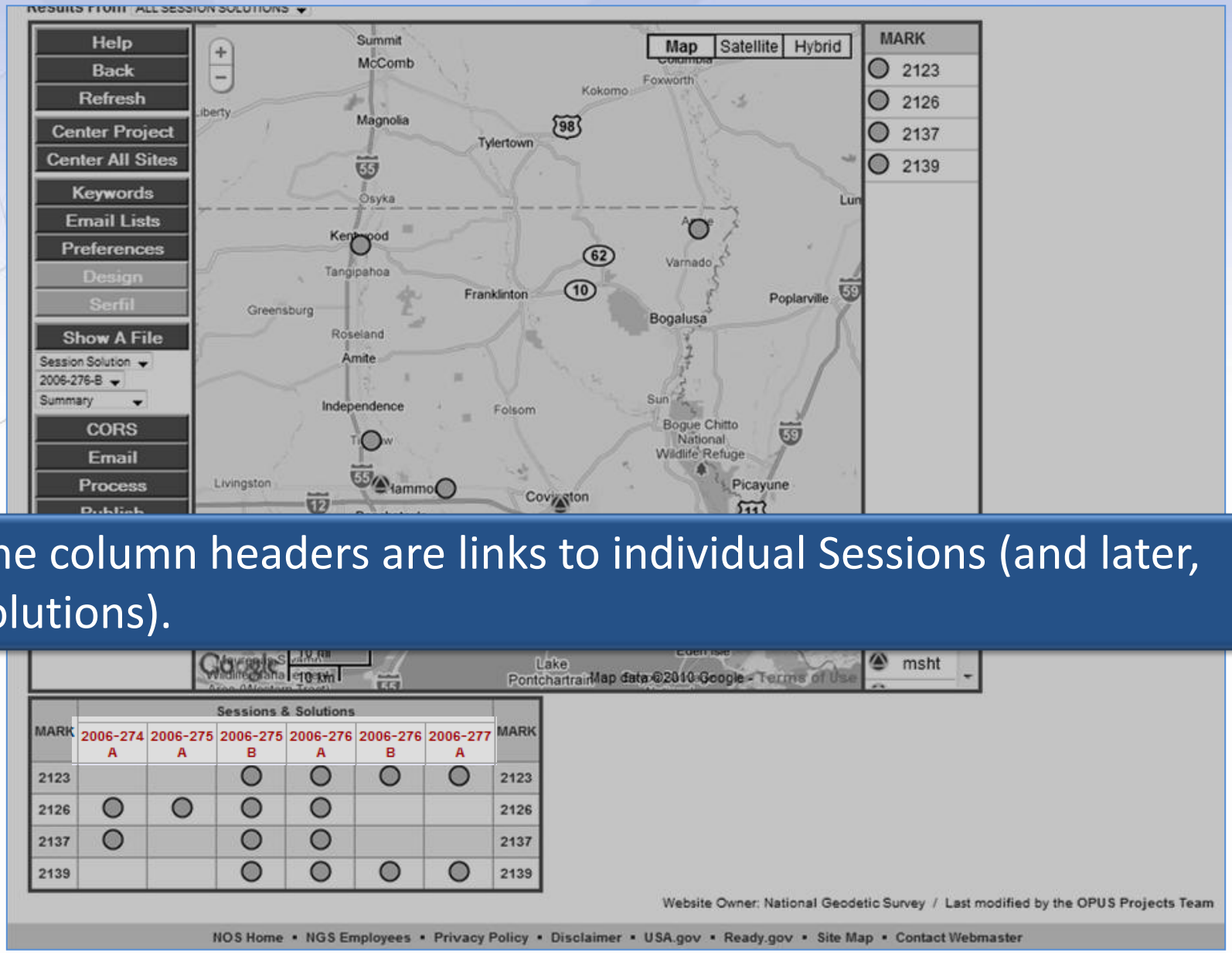
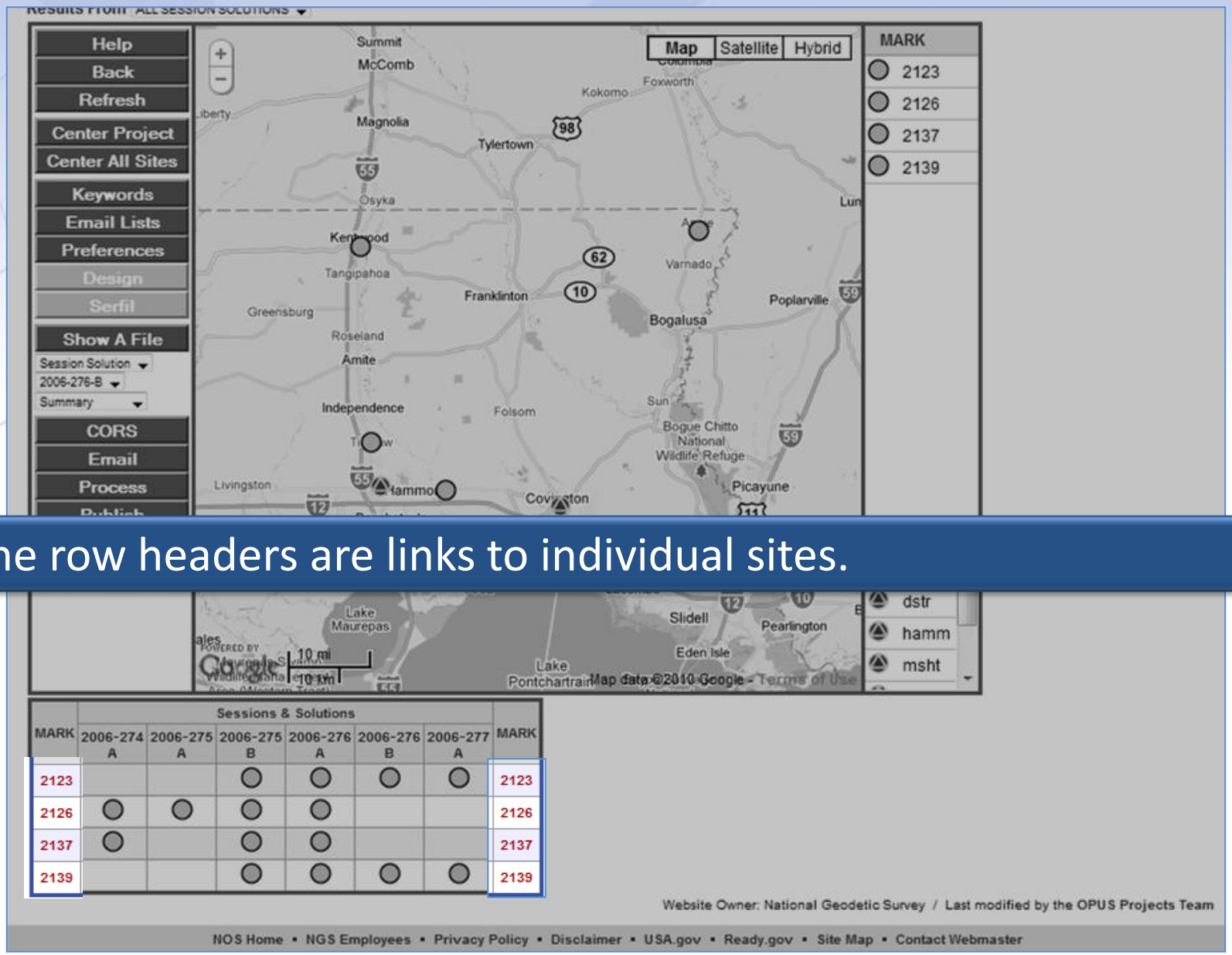
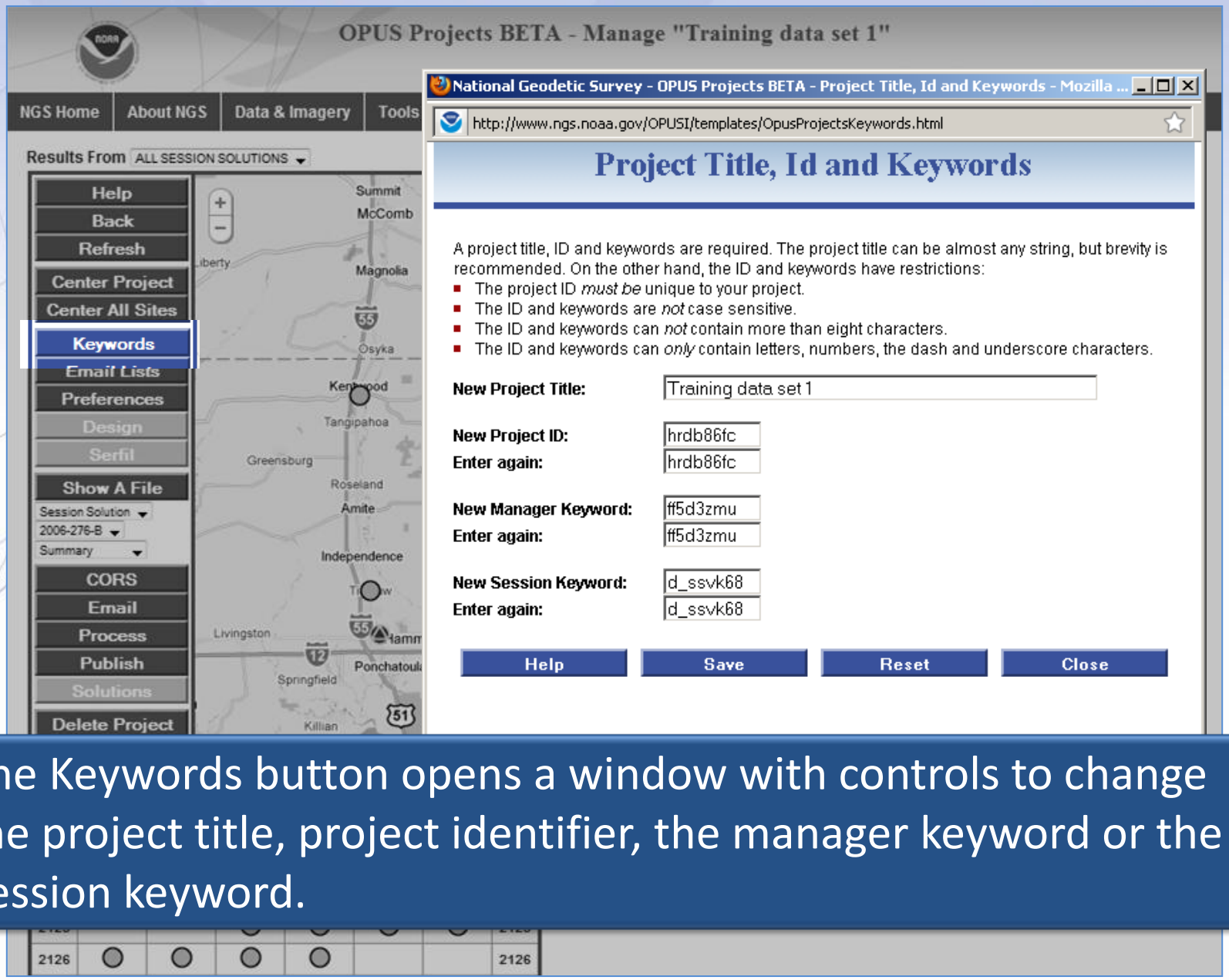


The column headers are links to individual Sessions (and later, solutions).

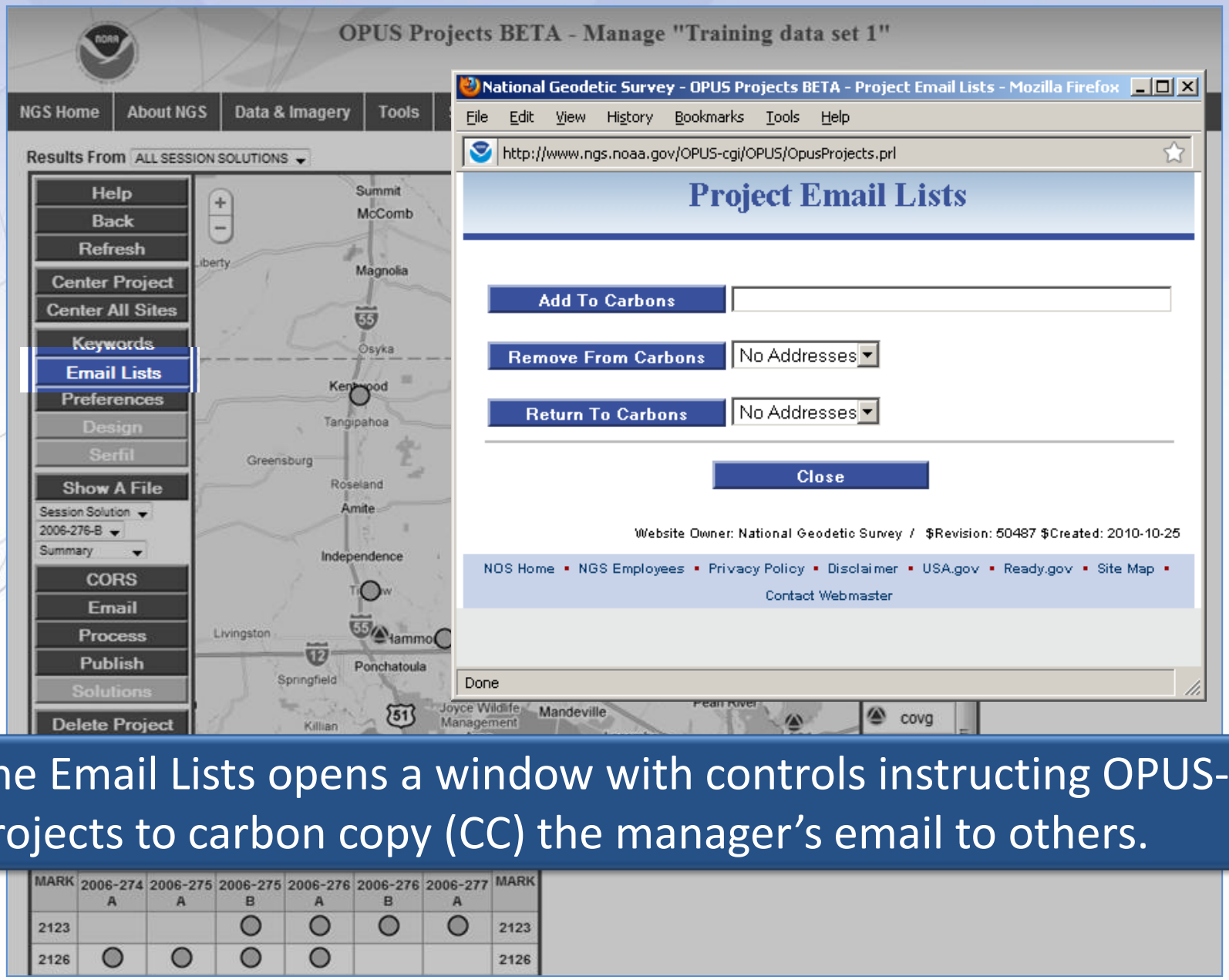


The row headers are links to individual sites.

MARK	Sessions & Solutions						MARK
	2006-274 A	2006-275 A	2006-275 B	2006-276 A	2006-276 B	2006-277 A	
2123			●	●	●	●	2123
2126	●	●	●	●			2126
2137	●		●	●			2137
2139			●	●	●	●	2139



The Keywords button opens a window with controls to change the project title, project identifier, the manager keyword or the Session keyword.



The Email Lists opens a window with controls instructing OPUS-Projects to carbon copy (CC) the manager's email to others.

OPUS Projects BETA - Manage "Training data set 1"

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Opus Project Preferences - Mozilla Firefox

http://www.ngs.noaa.gov/OPUSI/templates/OpusProjectsPreferences.html

OPUS Projects Preferences

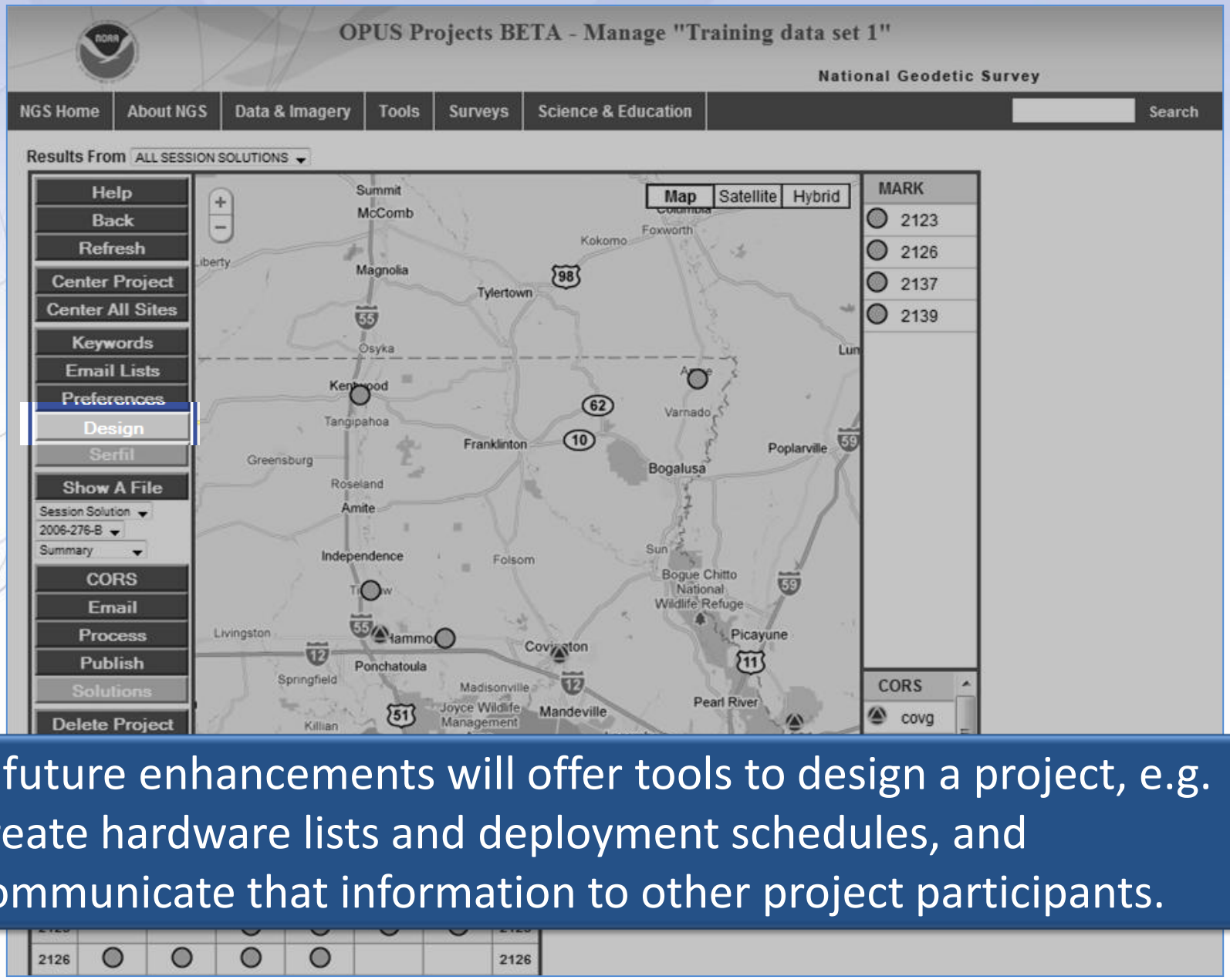
Solution & Data Quality		Data Processing	
Precise Ephemeris:	Best Available	Reference Frame:	NAD_83(CORS96)
Minimum ARP Height (m):	0.000	Geoid Model:	USGG2009
Maximum ARP Height (m):	3.000	GNSS:	G (GPS-only)
Minimum Observations Used (%):	80.0	Tropo Model:	Piece-wise, Linear
Minimum Ambiguities Fixed (%):	80.0	Tropo Interval (s):	7200
Maximum Solution RMS (m):	0.025	Elevation Cutoff (°):	15.0
Maximum Height Uncertainty (m):	0.040		
Maximum Latitude Uncertainty (m):	0.020		
Maximum Longitude Uncertainty (m):	0.020		

Session Definition		Mark Co-location Definition	
Minimum Data Duration (s):	1800	Maximum Position Difference (m):	1.000
Minimum Session Overlap Multipier:	0.5		

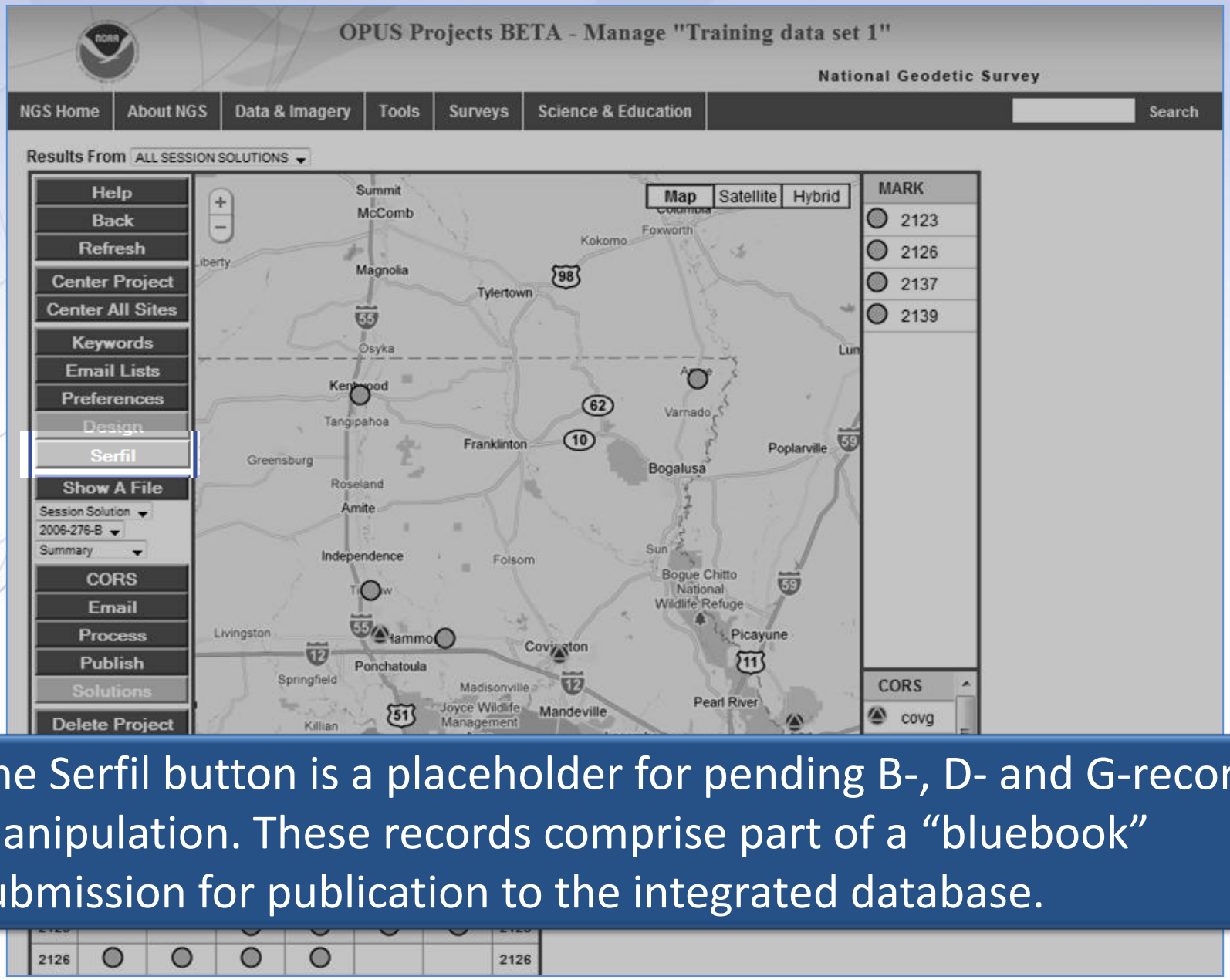
Help | Save | Reset | Close

Preferences allows the manager to customize the defaults for his or her project.

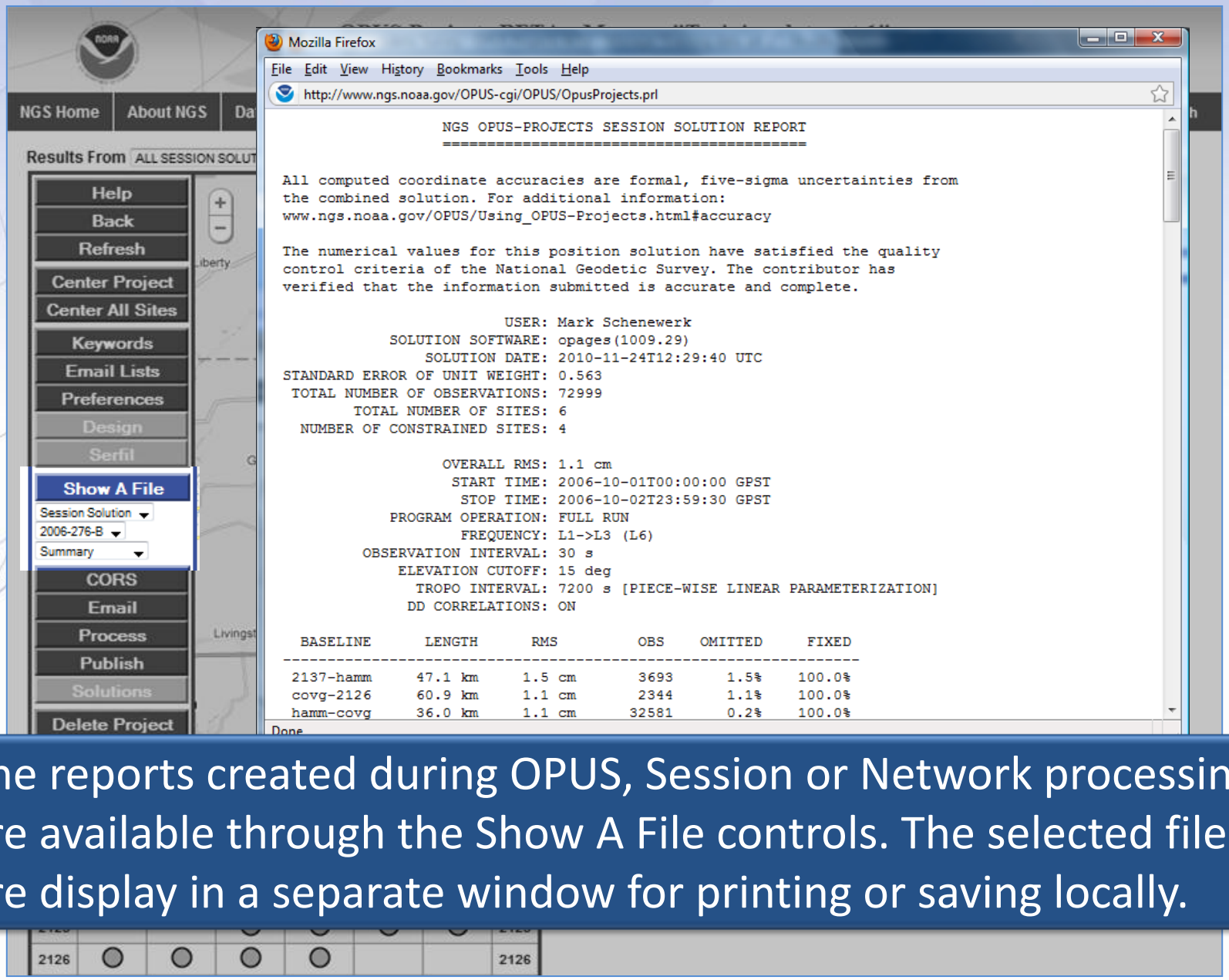
MARK	2006-274 A	2006-275 A	2006-275 B	2006-276 A	2006-276 B	2006-277 A	MARK
2123			○	○	○	○	2123
2126	○	○	○	○			2126



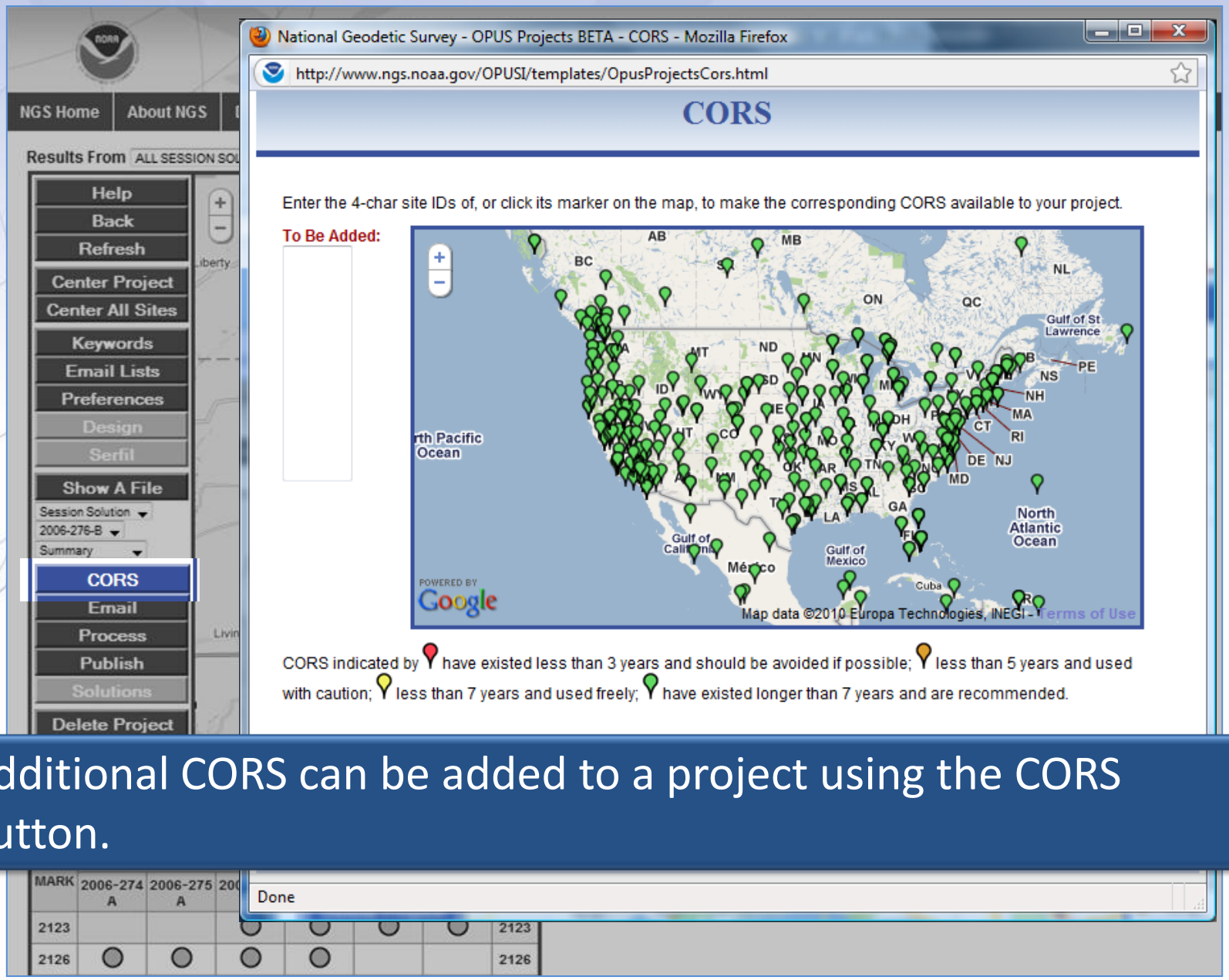
A future enhancements will offer tools to design a project, e.g. create hardware lists and deployment schedules, and communicate that information to other project participants.



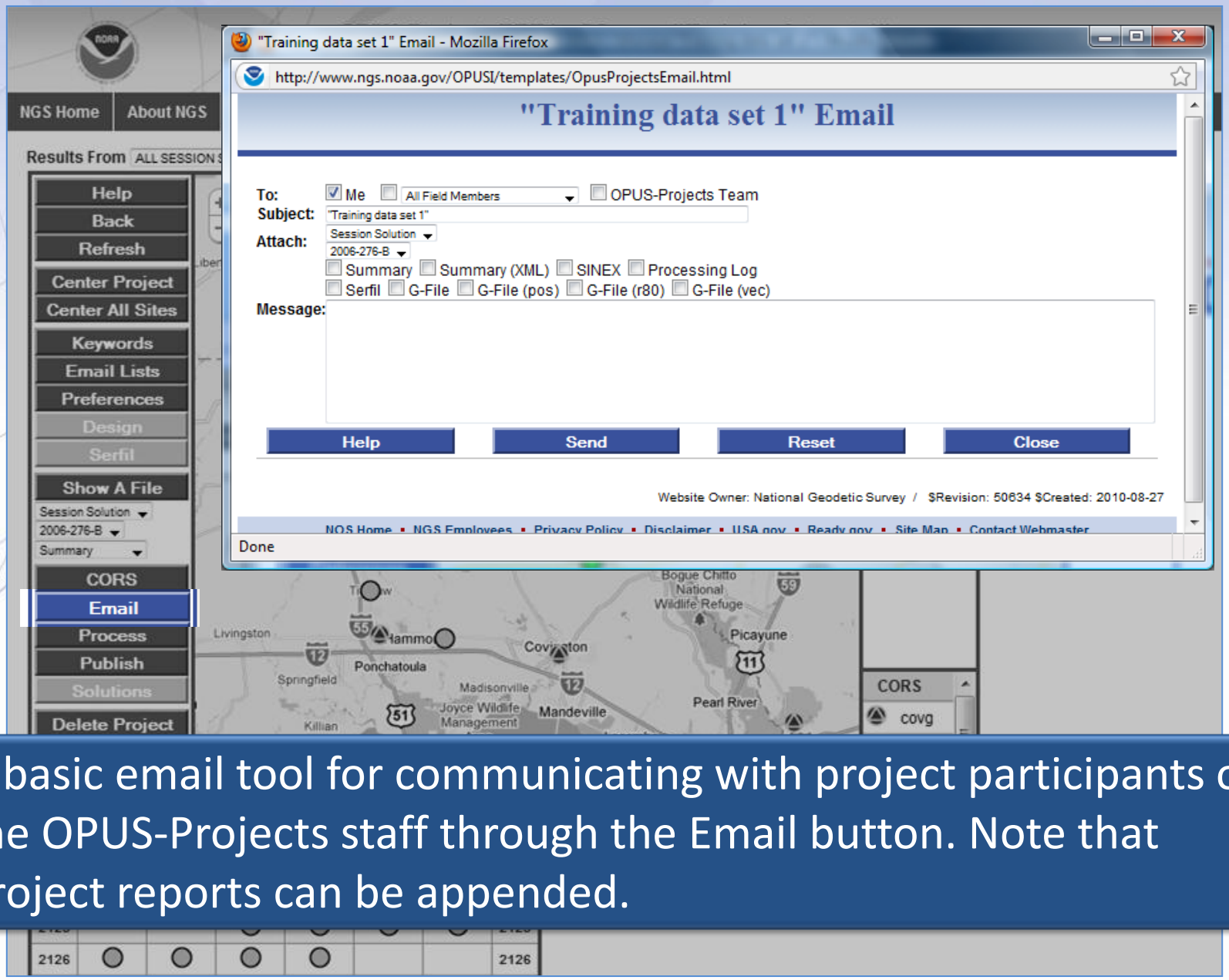
The Serfil button is a placeholder for pending B-, D- and G-record manipulation. These records comprise part of a "bluebook" submission for publication to the integrated database.



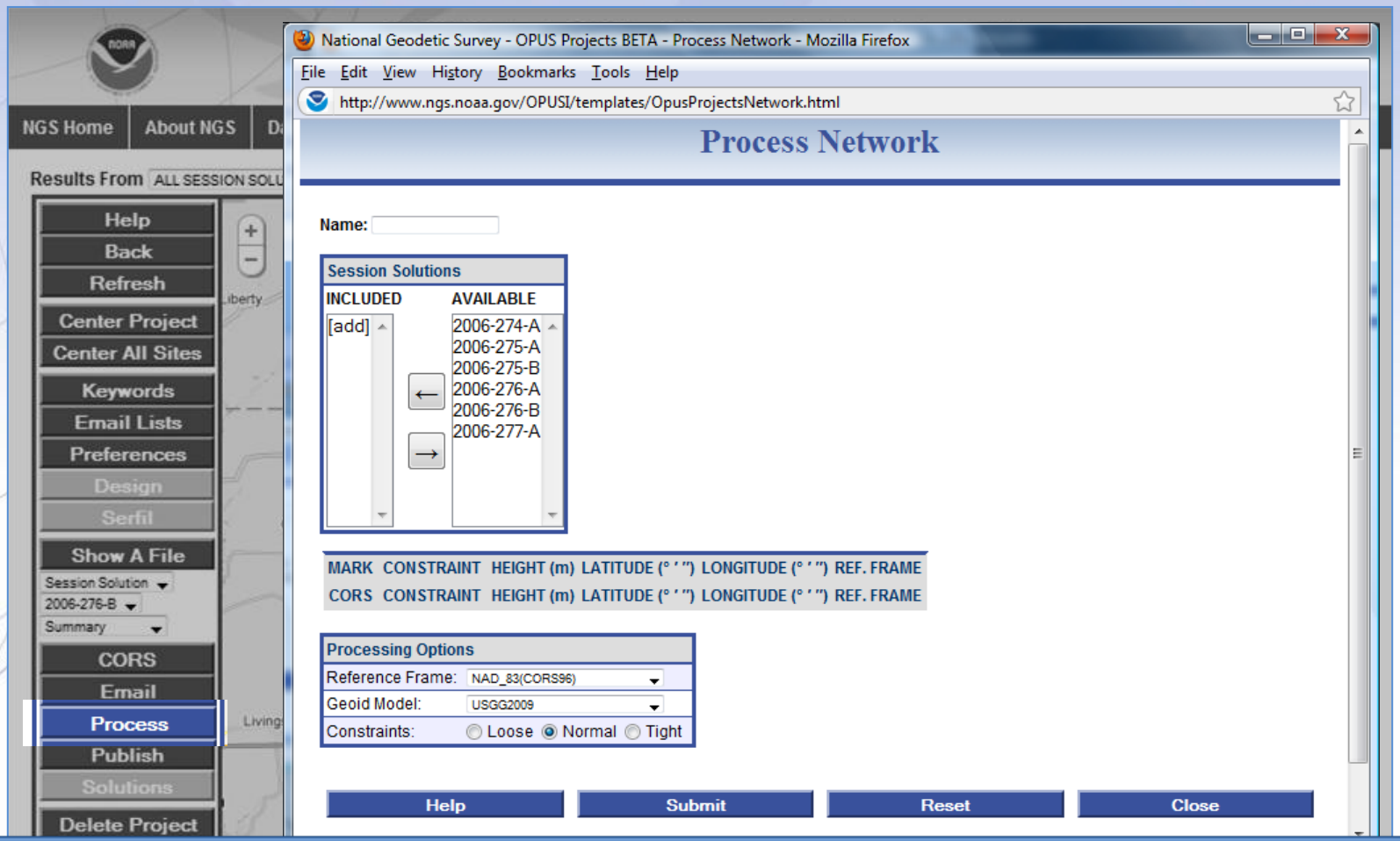
The reports created during OPUS, Session or Network processing are available through the Show A File controls. The selected files are display in a separate window for printing or saving locally.



Additional CORS can be added to a project using the CORS button.



A basic email tool for communicating with project participants or the OPUS-Projects staff through the Email button. Note that project reports can be appended.



Session solution matrices can be combined and solved creating an adjustment for this project.

MARK	2006-274 A	2006-275 A	2006-275 B	2006-276 A	2006-276 B	2006-277 A	MARK
2123			○	○	○	○	2123
2126	○	○	○	○			2126

National Geodetic Survey - OPUS Projects BETA - Publish Solution - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://www.ngs.noaa.gov/OPUSI/templates/OpusProjectsPublish.html

Publish Solution

AVAILABLE SOLUTIONS SESSION: 2006-274-A

MARK	METADATA REVIEWED	HEIGHT (m)	LATITUDE (° ' ")	LONGITUDE (° ' ")	REF. FRAME
2126	✗	EL HGT 13.986	N30:58:00.80011	W089:48:34.33127	ITRF00 (2006.7507)
2137	✗	EL HGT 33.182	N30:56:11.58187	W090:30:25.29780	ITRF00 (2006.7506)
CORS	**METADATA REVIEWED**	**HEIGHT (m)**	**LATITUDE (° ' ")**	**LONGITUDE (° ' ")**	**REF. FRAME**
covg	✓	EL HGT -5.938	N30:28:33.28886	W090:05:43.94866	ITRF2000 (2006.7479)
hamm	✓	EL HGT 5.817	N30:30:47.07074	W090:28:03.45449	ITRF2000 (2006.7479)
msht	✓	EL HGT 64.475	N31:19:39.16034	W089:20:10.65216	ITRF2000 (2006.7479)
ndbc	✓	EL HGT -11.674	N30:21:22.61077	W089:36:37.00068	ITRF2000 (2006.7479)

Help Publish Close

Website Owner: National Geodetic Survey / $Revision: 50634 $Created: 2010-10-27

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Done

NGS Home | About NGS | Da

Results From ALL SESSION SOLUT

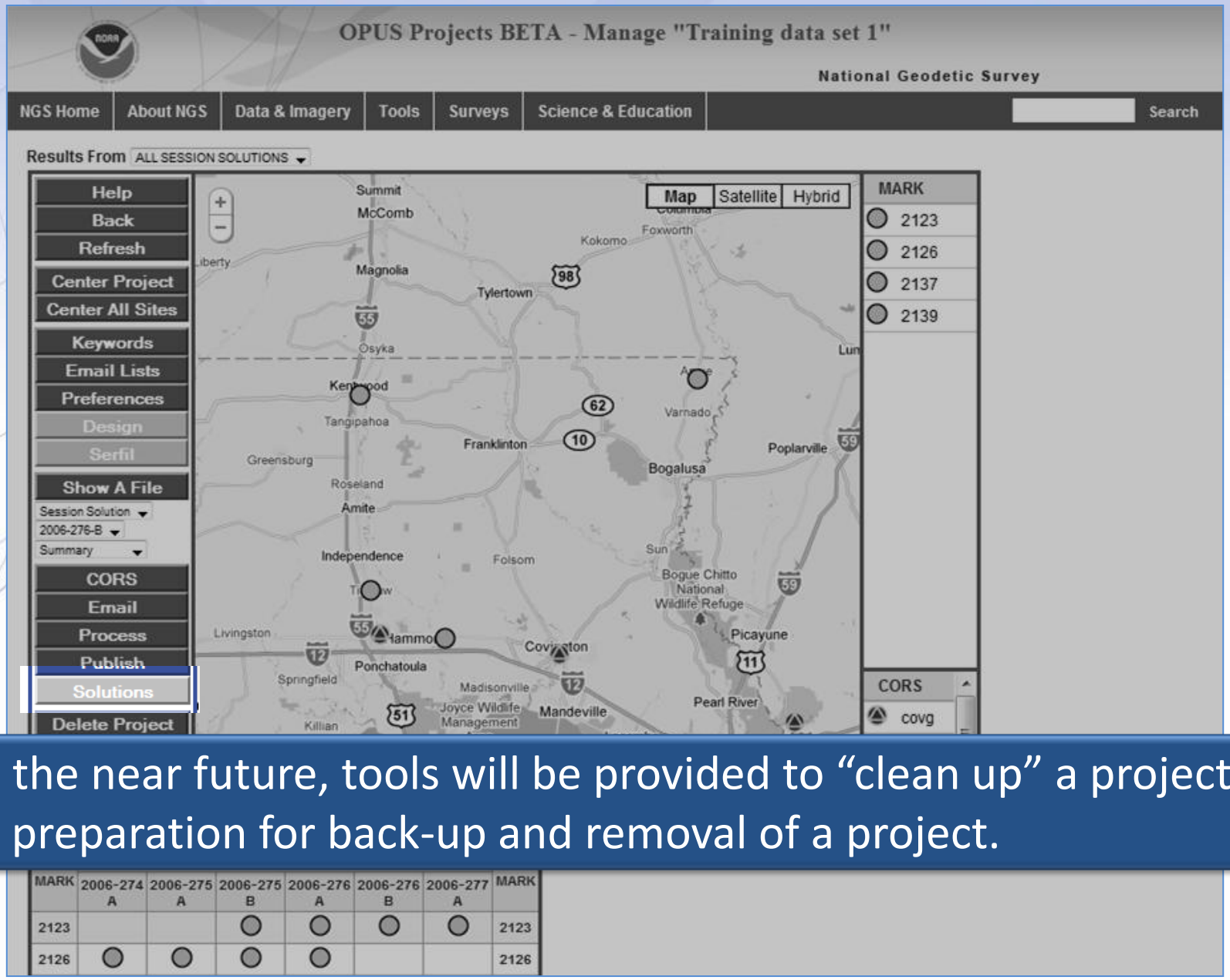
Help
Back
Refresh
Center Project
Center All Sites
Keywords
Email Lists
Preferences
Design
Serfil
Show A File
Session Solution
2006-276-B
Summary
CORS
Email
Process
Publish
Solutions
Delete Project

Ponchatoula
Springfield
Madisonville
Joyce Wildlife Management
Mandeville
Pearl River
Killian

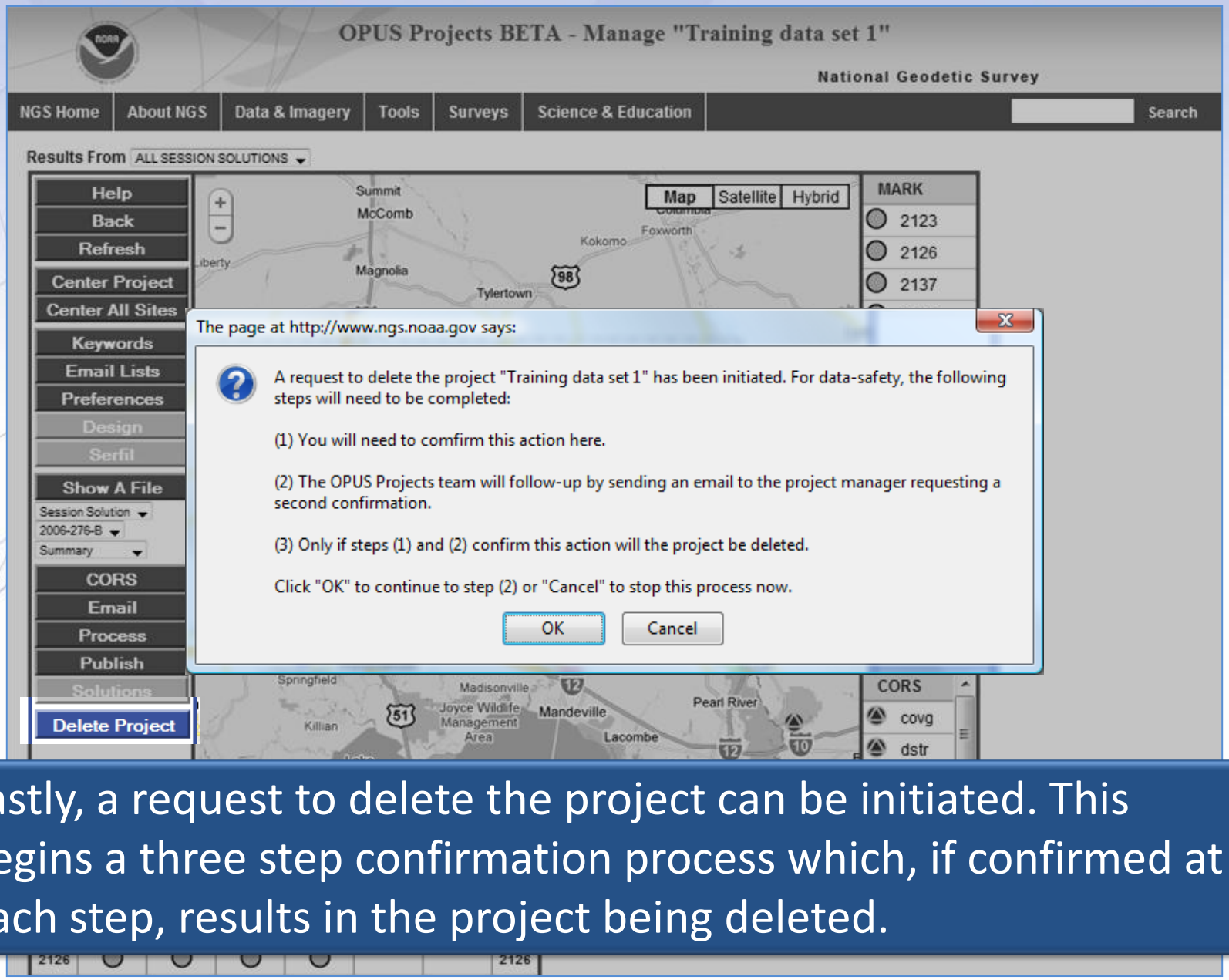
CORS
covg

2126 2126

Using the Publish button, a final network adjustment can be selected, and its results plus the associated mark metadata published.



In the near future, tools will be provided to "clean up" a project in preparation for back-up and removal of a project.



Lastly, a request to delete the project can be initiated. This begins a three step confirmation process which, if confirmed at each step, results in the project being deleted.

AN INDIVIDUAL SITE PAGE

Next is a mockup of the datasheet if the mark were to be published. These can be edited by the manager if errors or omissions are found.

Description

PID

stamping* H 179

name* H 179

type* D = Disk

DD = Survey disk (other agency)

setting* 31 = Pavement (street, sidewalk, curb, etc.)

specific setting (optional):

description* (269 chars / 500 chars max)

Take interstate I55 to State Road 442 east exit. 1 mi on SR 442, turn north on U.S. 51. After 1.5 mi on U.S. 51, turn east on Buckles Ln. Just past railroad, Buckles Ln take a sharp right. Mark is near this turn. Approximately 50 ft west, between the road and railroad.

stability --- no selection ---

magnetic --- no selection ---

application --- no selection ---

condition ◉ Good condition ○ Poor, disturbed, mutilated, requires maintenance

* required fields

Close-up View

Horizon View

Occupations

2123275u.06o	Start: 2006-10-02T20:23:30.000 GPST	Antenna	Model:	TRM55971.00 NONE	S/N:	30212716	ARP (m): 2.000
	End: 2006-10-03T01:15:30.000 GPST	Receiver	Model:	TRIMBLE NETR5	S/N:	30212716	Firmware: -
2123276g.06o	Start: 2006-10-03T06:23:30.000 GPST	Antenna	Model:	TRM55971.00 NONE	S/N:	30212716	ARP (m): 2.000

Help | Back | Refresh | Reset | RINEX | Photos | Save

Description

PID
stamping* H 179
name* H 179
type* D = Disk
DD = Survey disk (other agency)
setting* 31 = Pavement (street, sidewalk, curb, etc.)
specific setting (optional):
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stability ---
magnetic ---
application ---
condition ◉ Good condition ○ Poor, disturbed, mutilated, requires maintenance
* required fields

Close-up View

Horizon View

Below the datasheet mockup is a summary of site metadata by occupation.

Occupations

2123275u.06o	Start: 2006-10-02T20:23:30.000 GPST	Antenna	Model:	TRM55971.00 NONE	S/N:	30212716	ARP (m): 2.000
	End: 2006-10-03T01:15:30.000 GPST	Receiver	Model:	TRIMBLE NETR5	S/N:	30212716	Firmware: -
2123276g.06o	Start: 2006-10-03T06:23:30.000 GPST	Antenna	Model:	TRM55971.00 NONE	S/N:	30212716	ARP (m): 2.000
	End: 2006-10-03T10:40:30.000 GPST	Receiver	Model:	TRIMBLE NETR5	S/N:	30212716	Firmware: -
2123276s.06o	Start: 2006-10-03T18:23:30.000 GPST	Antenna	Model:	TRM55971.00 NONE	S/N:	30212716	ARP (m): 2.000
	End: 2006-10-04T00:07:30.000 GPST	Receiver	Model:	TRIMBLE NETR5	S/N:	30212716	Firmware: -
2123277g.06o	Start: 2006-10-04T06:23:30.000 GPST	Antenna	Model:	TRM55971.00 NONE	S/N:	30212716	ARP (m): 2.000
	End: 2006-10-04T10:23:30.000 GPST	Receiver	Model:	TRIMBLE NETR5	S/N:	30212716	Firmware: -

Solution Results From A PRIORI (OPUS)

Below the summary by occupation are the coordinate and status summary tables.

REF FRAME:	ITRF2000 (2006.7552)		NAD_83(CORS96) (2002.0000)	
LAT:	N30:35:23.60927	±0.001 m	N30:35:23.59010	±0.001 m
EAST LON:	E269:30:47.26256	±0.001 m	E269:30:47.28806	±0.001 m
WEST LON:	W090:29:12.73744	±0.001 m	W090:29:12.71194	±0.001 m
EL HGT:	-8.792	±0.007 m	-7.421	±0.007 m
X:	-46695.480 m	±0.000 m	-46694.813 m	±0.000 m
Y:	-5495062.789 m	±0.001 m	-5495064.275 m	±0.001 m
Z:	3226832.681 m	±0.001 m	3226832.871 m	±0.001 m

ORTHO HGT: 19.491 m ±0.013 m [USGG2009]

COORDINATE SYSTEM:	SPC 1702 LA S	UTM 15
NORTHING:	231955.817 m	3386842.986 m
EASTING:	1081182.799 m	740977.296 m
CONVERGENCE:	0.42324519°	1.27952542°
POINT SCALE:	0.99997843	1.00031642
COMBINED FACTOR:	0.99997960	1.00031759
U.S. NATIONAL GRID:	15RYP4097786843(NAD 83)	

File		Antenna		ARP (m)	Eph	Obs (%)	Fixed (%)	RMS (m)	Lat (m)	Lon (m)	Hgt (m)	SOLUTION
2123275u.06o		TRM55971.00	NONE	2.000	precise	93.9	92.2	–	0.001	0.001	0.007	network-final
2123276g.06o		TRM55971.00	NONE	2.000	precise	93.9	92.2	–	0.001	0.001	0.007	network-final
2123276s.06o		TRM55971.00	NONE	2.000	precise	93.9	92.2	–	0.001	0.001	0.007	network-final
2123277g.06o		TRM55971.00	NONE	2.000	precise	93.9	92.2	–	0.001	0.001	0.007	network-final
Preferences					BEST AVAILABLE	≥80.0	≥80.0	≤0.025	≤0.020	≤0.020	≤0.040	Preferences

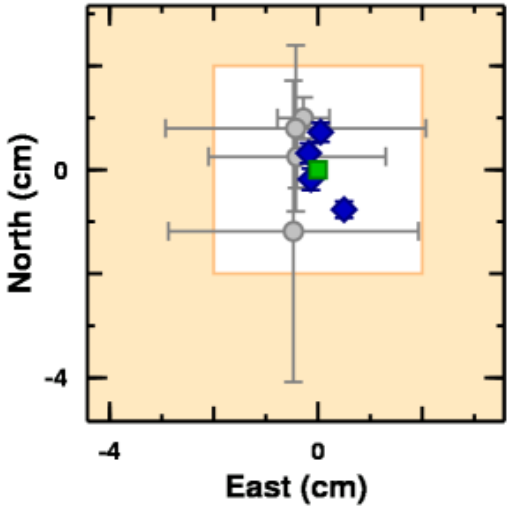
Plotted Solution Results From All Sources

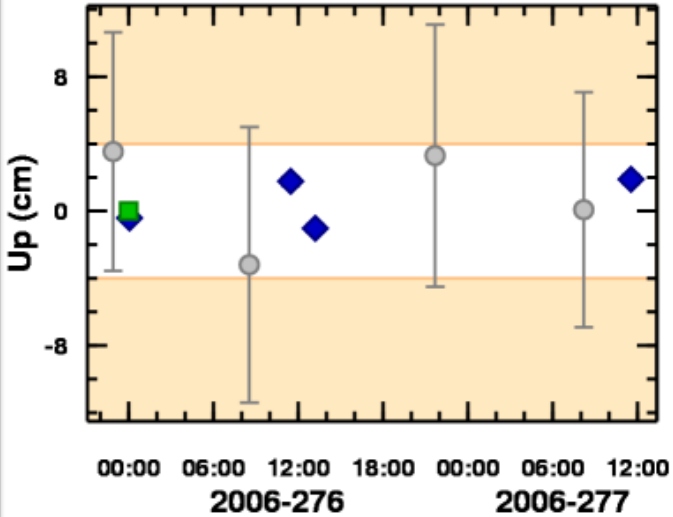
NETWORK SOLUTION	EAST (cm)	NORTH (cm)

Preferences	BEST AVAILABLE	≥80.0	≥80.0	≤0.025	≤0.020	≤0.020	≤0.040	Preferences

Plotted Solution Results From All Sources

NETWORK SOLUTION	EAST (cm)	NORTH (cm)
network-final	0.0 ±0.0	0.0 ±0.1
SESSION SOLUTION	**EAST (cm)**	**NORTH (cm)**
2006-275-B	0.5 ±0.0	-0.8 ±0.2
2006-276-A	-0.1 ±0.0	-0.2 ±0.2
2006-276-B	0.0 ±0.0	0.7 ±0.2
2006-277-A	-0.2 ±0.0	0.3 ±0.2
OPUS SOLUTION	**EAST (cm)**	**NORTH (cm)**
2123275u.06o	-0.3 ±0.5	1.0 ±0.4
2123276g.06o	-0.4 ±2.5	0.8 ±1.6
2123276s.06o	-0.5 ±2.4	-1.2 ±2.9
2123277g.06o	-0.4 ±1.7	0.3 ±0.6
The (0, 0) point represents W90:29:12.737 by N30:35:23.609.		





And at the bottom are summary plots and tables for comparison of different solutions.
The orange parts of the plots indicate regions outside the thresholds set by the project manager.

OPUS-Net (a new engine??)

OPUS-Net (a new engine?)

- OPUS-Static
  - U.S. CORS Network
  - Fixed IGS ephemerides
    - Computes independent double differenced baseline solutions between the unknown and 3 CORS
  - Relative antenna models
  - Phase ambiguity integer fixing
  - Relative troposphere modeling
  - ITRF2000 reference frame
  - Average position solution
  - Peak – Peak error reported

→

- OPUS-Net
  - U.S. CORS Network & IGS Global Network
  - Network approach
    - Consists of 3 nearby CORS + up to 12 CGPS from global IGS network
  - Absolute antenna models
    - SV & ground
  - Ocean tidal loading model
  - Satellite weighting
  - Relative troposphere modeling
  - ITRF2008 reference frame
  - Weighted least squares adjustment
  - Weighted mean and standard deviations reported at 95%

OPUS-net info. From Dr. Neil Weston

OPUS-Net

Weston and Ray (NGS) have found that by more fully implementing the available processing models in conjunction with changing the CORS selection criteria, at a minimum the scatter in the north and east components can be significantly reduced with no degradation in the scatter in the height produced by OPUS-S.

Moreover, the resulting coordinates agree better with other sources such as the IGS weekly combinations.

Weston and Ray, "Test of the Use of Regional Networks for OPUS Processing", 2010, EGU General Assembly 2010, Geophysical Research Abstracts.

OPUS-Net

This processing strategy was implemented in an OPUS-like application, called OPUS-Net during its testing phase. It includes

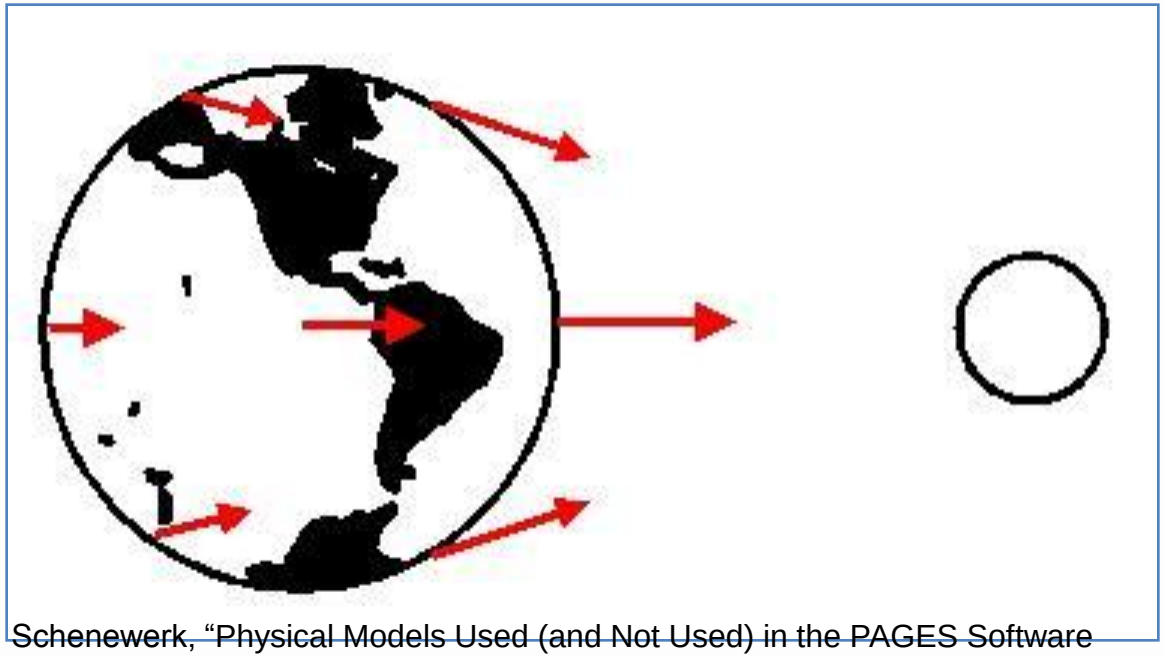
- **An ocean-tide loading (OTL) model.**
- **Absolute antenna phase correction models.**
- **A combination of near-by and more-distant CORS.**

Let's look at these individually.

OPUS-Net

What is Ocean Tidal Loading (OTL)?

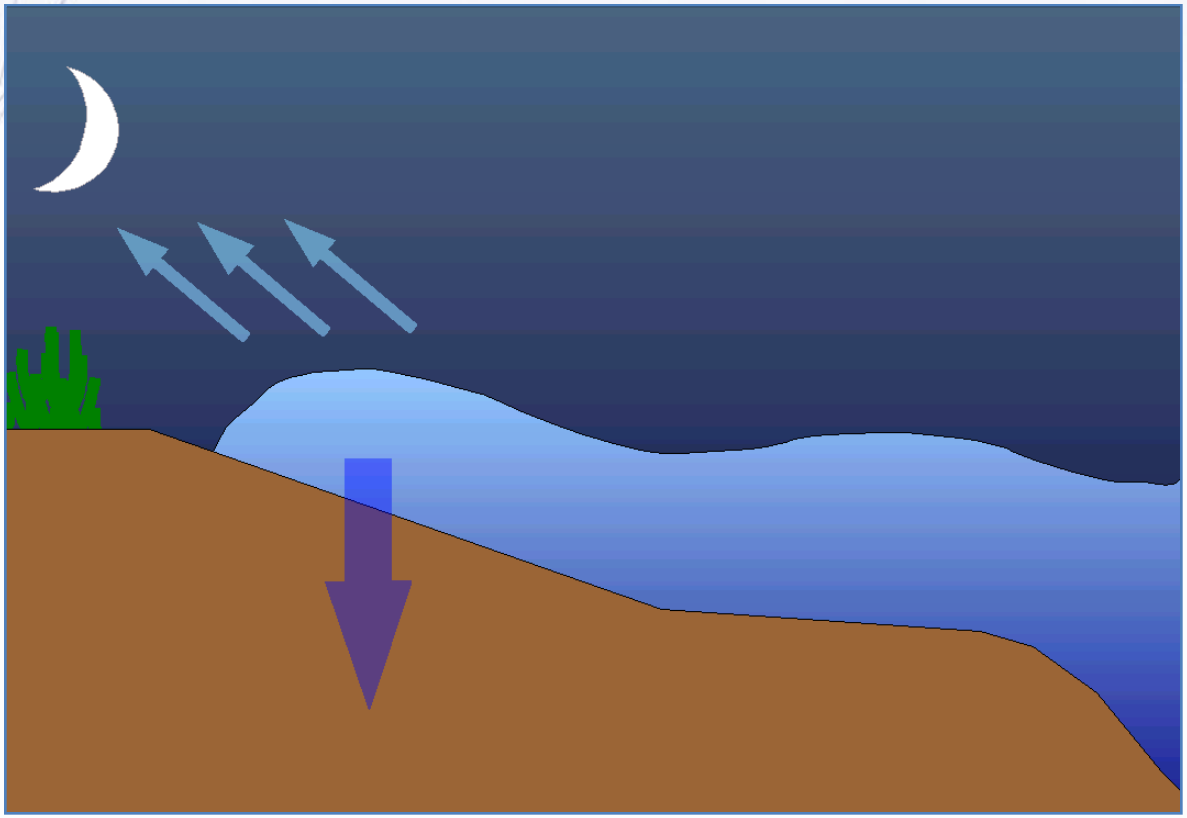
Subtle differences in the gravitational force of the Moon and Sun cause the Earth to deform. Most commonly seen as ocean tides, it also affects the solid Earth and atmosphere.



Schenewerk, "Physical Models Used (and Not Used) in the PAGES Software Suite", 2008, private communication.

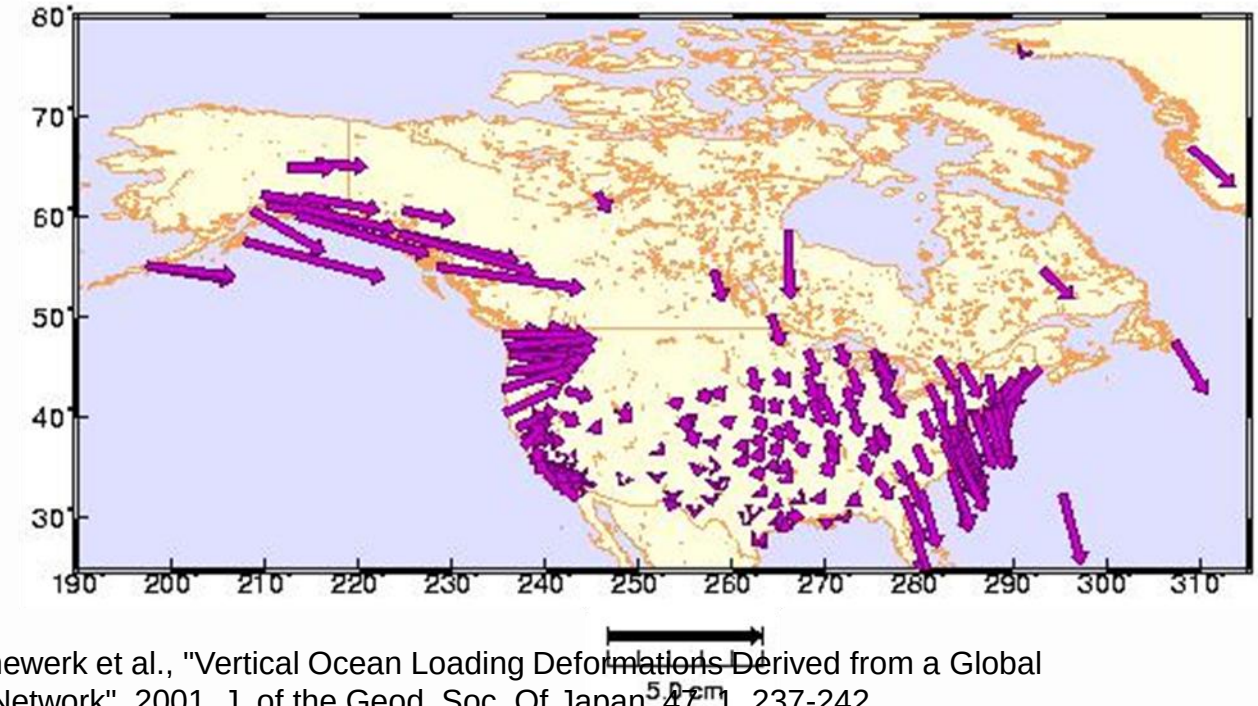
OPUS-Net

Focusing on ocean tides, as the tide swells and ebbs, the changing weight of water presses on the Earth's crust causing it to deform with the same period as the tide.



OPUS-Net

The magnitude of the deformation depends upon the shape of the coastline and topography of the ocean floor. 1 – 3 cm vertical deformation is common along the continental U.S. coasts; larger deformations on the Gulf of Alaska.



Schenewerk et al., "Vertical Ocean Loading Deformations Derived from a Global GPS Network", 2001, J. of the Geod. Soc. Of Japan, 47, 1, 237-242.

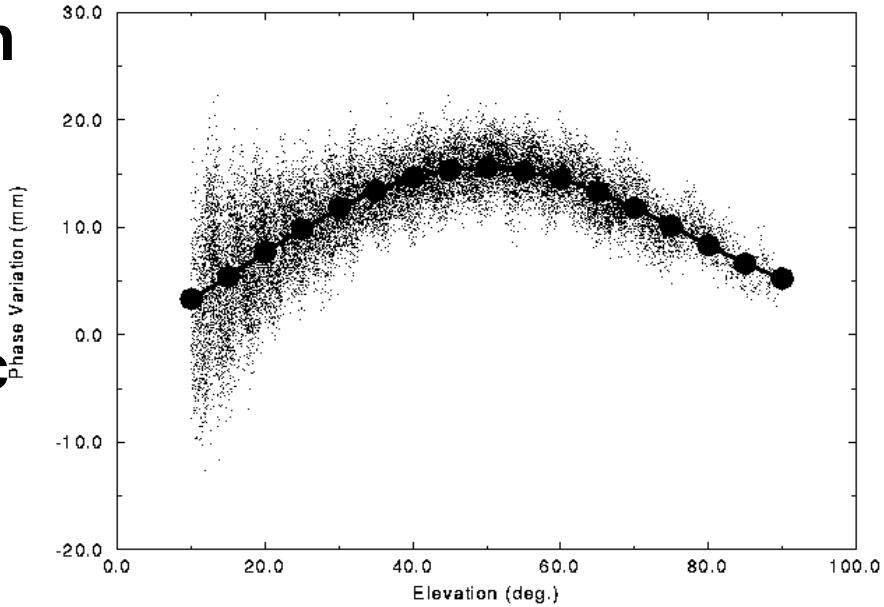
OPUS-Net

What are absolute antenna phase correction models?

No antenna is physically or electro-magnetically perfect.

For about two decades, some sort of antenna correction has been applied as part of processing.

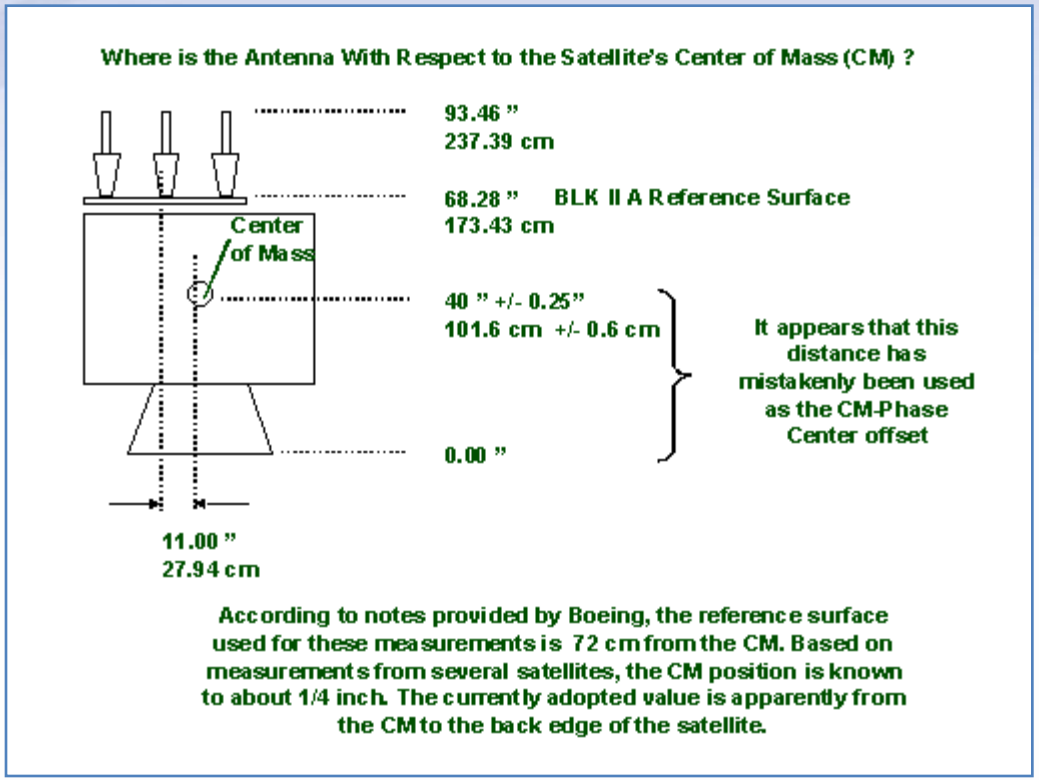
Historically, these corrections have been relative to a specific antenna type.



The NGS antenna test range and a sample relative correction pattern are shown. http://www.ngs.noaa.gov/ANTCAL/

OPUS-Net

The "relative" antenna corrections work well, particularly if the antennas are close together.

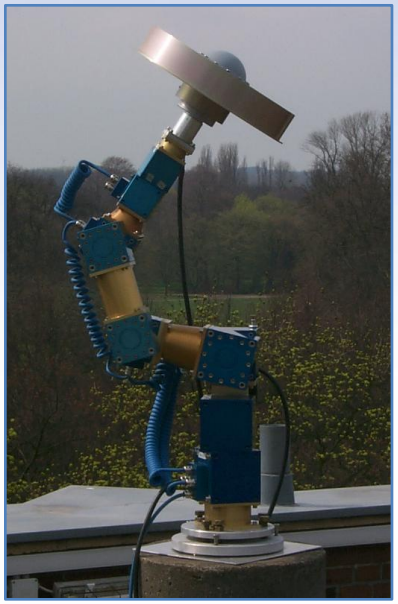


http://www.ngs.noaa.gov/ANTCAL/

But, as data processing has improved, the limitations of relative antenna corrections have become increas-ingly evident. One example: satellite antenna corrections can not be fully applied when using a relative model.

OPUS-Net

By using data from a spatially large network with diverse equipment, and by including data from new tools such as robotic arms which shift the orientation of the antenna being tested on demand, "absolute" antenna phase patterns can be produced.



http://www.geopp.de/

Absolute antenna corrections:

- More fully implement the corrections.
- Help minimize the effects of baseline lengths.
- Help minimize hardware changes.

Questions?