FLORIDA CUSTOM GEOID

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WHY?

- ▸ Usefulness of any Geoid model is limited by data density and distribution.
- ▸ NGS Hybrid Geoid philosophy limits current usefulness to surveyors.
  Rigorous Math vs. Survey Practical
- ▸ Geoid 12A/B is good in a relative sense – not so good in an absolute sense.
- ▸ FPRN (RTK mode) requires a Geoid to be functional in the absolute sense.
- ▸ Gravity based Geoid model from NGS will not be available until 2022 +.

Why **would we take the time to develop another geoid model**?
Usefulness of any Geoid model is limited by data density and **data** distribution.
NGS Hybrid Geoid philosophy limits current usefulness **of Geoid12B.**.
  Rigorous Math vs. Survey Practical

Let me give you an overly simplistic analogy. Let's say you run a bench loop between two published benchmarks that are one mile apart, setting two new marks along the way. Then you run back to the first benchmark. You are required to meet the Standards of Practice error closure requirements. You used a new barcode level in good adjustment and your error of closure back on the first mark is .002', which is very typical for your crew using this instrument. But you missed the published orthometric height on the second mark by .03'. How do you adjust the loop?

As a surveyor, I would hold the published orthometric heights on the two known marks and let the level loop take .03' adjustment.

As a mathematician I would let both published mark orthometric heights float and constrain the new measurements to .002". The result would be new orthometric heights on the two existing marks. So each existing mark would now have a new orthometric height in my work that would probably be about .02' different from their previously published values. The justification for doing this is that the previously published

orthometric heights on the two existing benchmarks are a result of measurements that contain errors much greater than the .03' they were allowed to adjust in this analogy.

NGS treated benchmark geoid heights in Geoid 12B as measurements which were allowed to take adjustment.

The FDOT treated benchmark geoid heights in FPRN Geoid 2016 as fixed values.

Geoid 12A/B is good in a relative **or differential** sense – not so good in an absolute sense. **In a relative sense general systematic biases can be self-canceling. In an absolute sense the biases remain.**
NGS understands this and plans to remove a lot of systematic error from their current model when they produce a gravity-based model in 2022.

FPRN (in RTK mode) requires a Geoid to be functional in the absolute sense.
The FPRN station ellipsoid height values were not developed through the application of a Geoid model. They are directly measured from the NGS CORS Network.

Gravity based Geoid model from NGS will not be available until 2022 +.
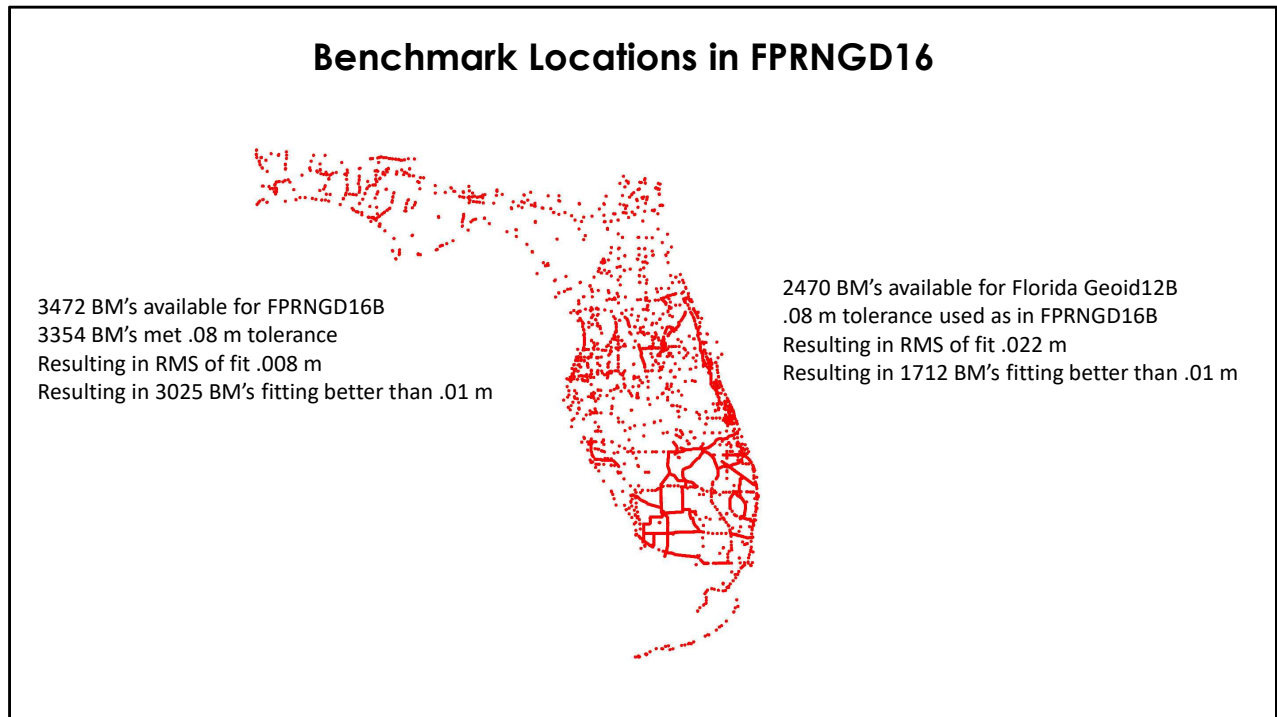**We look forward to using it in conjunction with the FPRN but we wanted a better model now.**

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WHY NOT…

- Densify the data? (FDOT has 1000+ Florida benchmarks with horizontal positions and measured ellipsoid heights not used in Geoid12A/B)
- Remove NGS style mathematical correctness? (To fit Survey thinking)
- Do it now?

Read the slide

Benchmark Locations in FPRNGD16

3472 BM's available for FPRNGD16B
3354 BM's met .08 m tolerance
Resulting in RMS of fit .008 m
Resulting in 3025 BM's fitting better than .01 m

2470 BM's available for Florida Geoid12B
.08 m tolerance used as in FPRNGD16B
Resulting in RMS of fit .022 m
Resulting in 1712 BM's fitting better than .01 m

Shown here is a map of red dots representing the location of the benchmarks used in Geoid12B plus the additional benchmarks added to the model for FPRNGD16.

We performed some statistical comparisons between Geoid12B and FPRNGD16

We subjected both Geoids to the same tolerance of .08 meters for rejecting benchmarks. Both models share the NGS grid spacing for their respective data files. For the comparisons we did not interfere with the basic underlying philosophy attached to each network. The results were an RMS of fit for Geoid12B of .022 meters and .008 meters for FPRNGD16.

When the smoke settled Geoid12B had 1712 benchmarks that fit better than .01 meters while FPRNGD16 had 3025 benchmarks that fit better than .01 meters.

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## Where did the extra Benchmarks come from?

▸ FDOT Benchmarks that were never Bluebooked
(853 BMs)

▸ FDOT Height Mod participation
(149 BMs published in OPUS)

Where did the extra Benchmarks come from?

853 historic FDOT Benchmarks that were never Bluebooked

149 benchmarks that were observed in 2014 and 2015 for the NGS height mod program. FDOT submitted these benchmark observation to OPUS for publication but they were obviously observed and submitted too late for inclusion in Geoid12B.

149 of the checkered flags represent OPUS BMs included in FPRNGD16
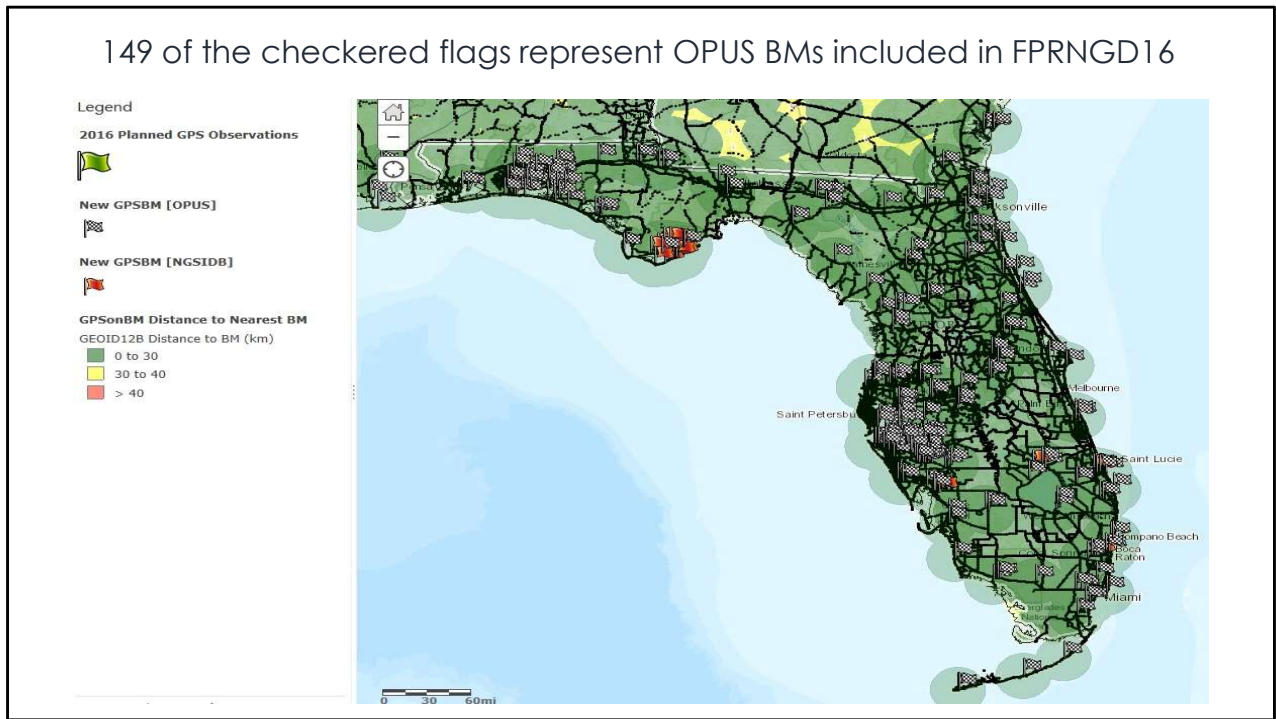
This slide was borrowed from the NGS website. It shows all the OPUS published benchmarks in Florida as checkered flags, many of which were submitted by the Florida DOT.

http://www.dot.gov/geospatial/fprnstat/index.html
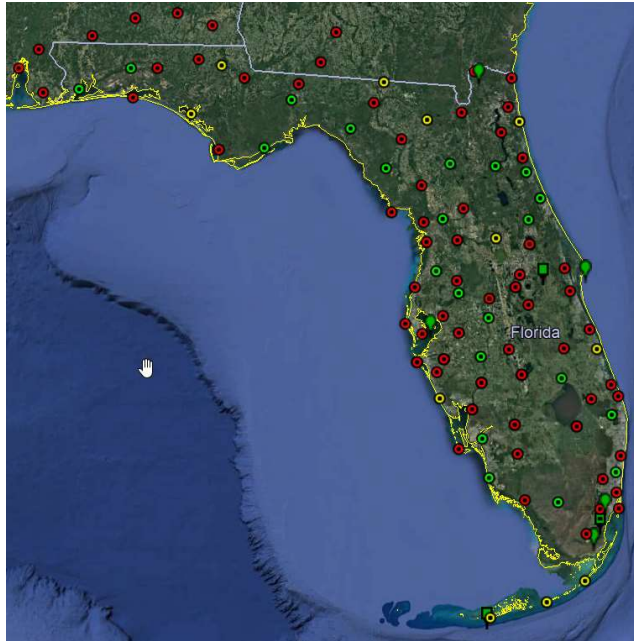
Of the 30 CORS sites registered in NGS system, 24 were established by FDOT and 11 more have been proposed

The other sites include FDOT CORS (not in NGS System) and various co-op sites.

This is a screen capture from a couple of weeks back of the FPRN network. We collected GNSS benchmark data for OPUS in the vicinity of every station within the State of Florida shown on this map.

How do you make use of FPRNGD16?

If you use the NGS interpolation program (intg.exe) for Geoid12B, substitute our g2012bu7.bin for the NGS-supplied file with the same name. Then execute intg.exe as before.

However, our data file only covers the State of Florida where the NGS data file with the same name covers large portions of southeastern United States beyond the Florida border.

create a Geoid called FPRNGD16B that points to the folder by the same name.

For data collectors requiring special files we have available FPRNGD16B.gem for Leica, FPRNGD16B.GGF (thank you GPServ.Inc) for Trimble and FPRNGD16.GSF (thank you Carlson Software) for Carlson.

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- The geoid files are currently available on our website

    http://fdot.gov/geospatial/fprn

- We are asking for users to supply feedback when collecting GNSS data on existing benchmarks in order to improve the quality of the FPRNGD16B geoid.

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Questions?

If you are interested in obtaining our Geoid model please go to our website
Or
contact either Ron
Or
Scott
either will set you up.

I will put this slide back up at the end of my presentation so you will have time to write their contact information down.