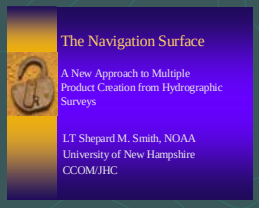
Implications of the Navigation Surface Approach

Archiving and Charting Shallow Survey Data

Andy Armstrong, Shep Smith and Rick Brennan

The Navigation Surface

- Proposed by Shep Smith at Shallow Survey 2001
- Thesis topic for Shep's M.S. degree
- Slated for adoption by NOAA Charting
- Commercialized by CARIS



The Navigation Surface

- A database approach to creating multiple products from high resolution hydrographic surveys
- Survey data is archived as a high resolution DTM rather than a set of soundings
- Charting products are created directly from successive generalizations of the DTM

The adoption of a DTM as the hydrographic survey product and the archived survey database has significant implications for hydrographic practice and the nautical charting process

Three Big Problems in Modern Hydrography

- Traditional validation methods overwhelmed by data volume from modern multibeam sonar
- Cartographic processes to produce nautical charts from such data are manually intensive
- Products derived from hydrographic surveys are often incompatible with the needs of other users of marine bathymetric information

Data Size/Rate Comparison

- Leadline survey – 1000-2000 soundings (800 KB)
- Single-beam echosounder – 15,000-20,000 (1 MB old surveys, 30 MB new surveys)
- Multibeam sonar – 400 Million to 1 Billion (5GB)

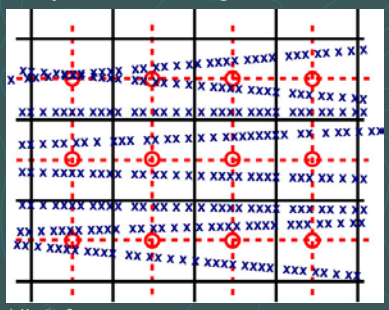
These rules no longer apply:

- Survey conducted with a shoal bias
- Survey database is a representative collection of corrected soundings
- Charted soundings can be traced to a unique measured depth
- All depths are portrayed as equally valid
- Charts are compiled successively through the scales

These rules no longer apply:

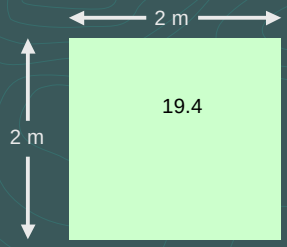
- Survey conducted with a shoal bias
- Survey database is a representative collection of corrected soundings
- Charted soundings can be traced to a unique measured depth
- All depths are portrayed as equally valid
- Compilation of charts "through the scales"

Multiple Soundings in Bins

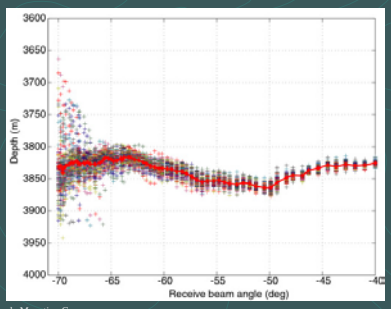


de Moustier, C

Binned Sounding Selection

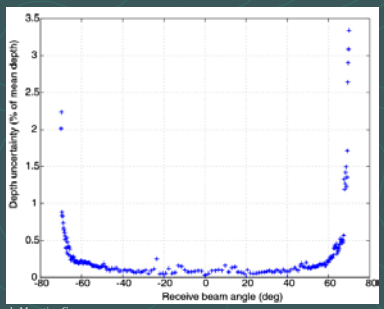


Sounding spread & mean depth vs. beam angle



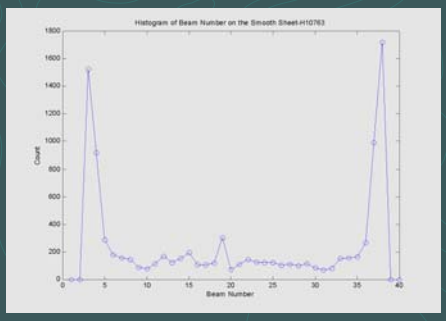
de Moustier, C.,
Oceans 2001 MTS/IEEE Conference Proceedings

Depth uncertainty vs. beam angle



de Moustier, C.,
Oceans 2001 MTS/IEEE Conference Proceedings

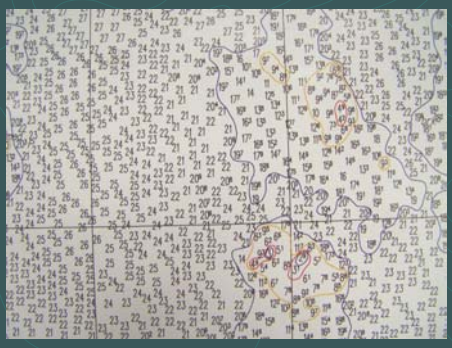
Selected depths vs. beam number



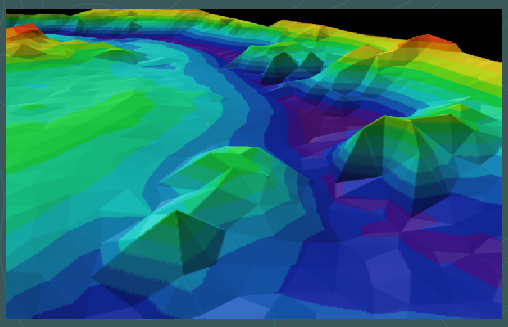
These rules no longer apply:

- Survey conducted with a shoal bias
- Survey database is a representative collection of corrected soundings
- Charted soundings can be traced to a unique measured depth
- All depths are portrayed as equally valid
- Compilation of charts "through the scales"

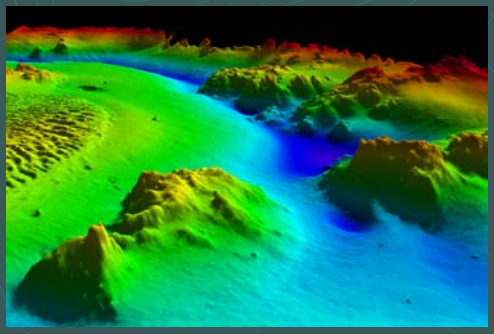
Sounding Database



TIN model from sounding database

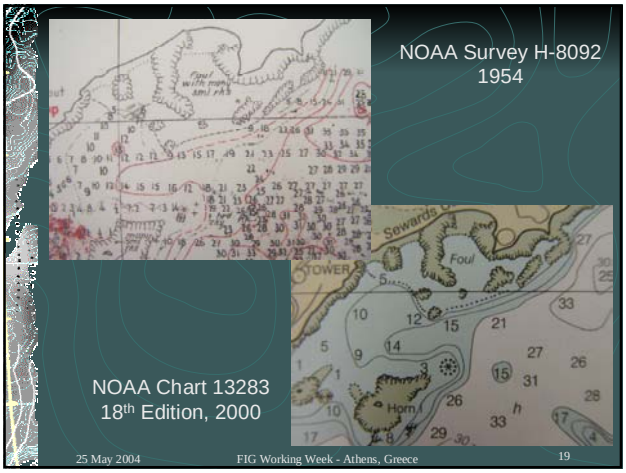


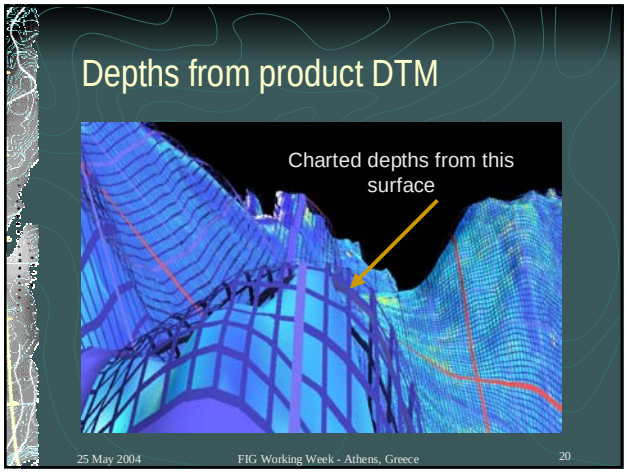
Full-resolution grid model database

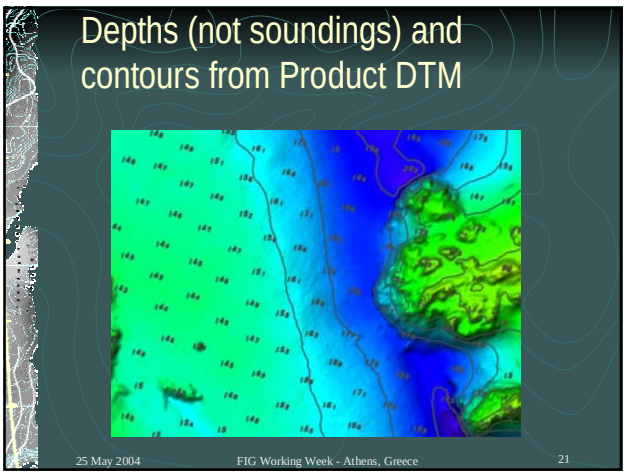


These rules no longer apply:

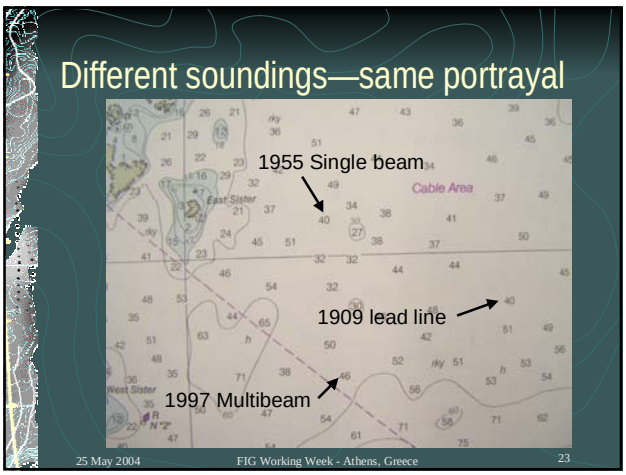
- Survey conducted with a shoal bias
- Survey database is a representative collection of corrected soundings
- Charted soundings can be traced to a unique measured depth
- All depths are portrayed as equally valid
- Compilation of charts "through the scales"

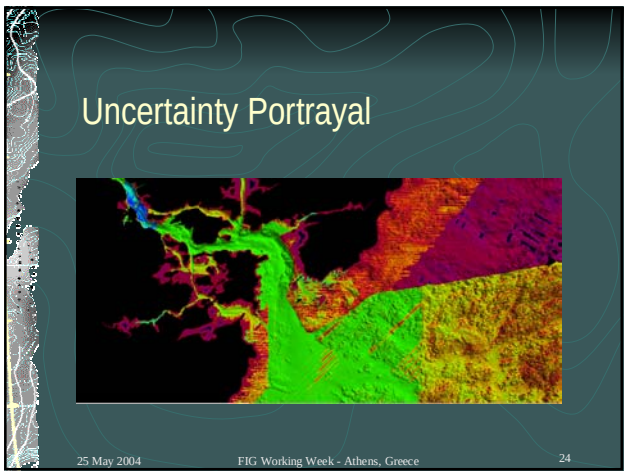

NOAA Survey H-8092
1954
NOAA Chart 13283
18th Edition, 2000
25 May 2004
FIG Working Week - Athens, Greece
19


Depths from product DTM
Charted depths from this surface
25 May 2004
FIG Working Week - Athens, Greece
20


Depths (not soundings) and contours from Product DTM
25 May 2004
FIG Working Week - Athens, Greece
21

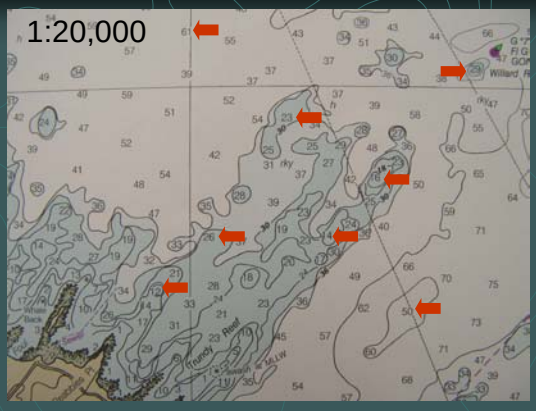

These rules no longer apply:
Survey conducted with a shoal bias
Survey database is a representative collection of corrected soundings
Charted soundings can be traced to a unique measured depth
All depths are portrayed as equally valid
Compilation of charts "through the scales"
25 May 2004
FIG Working Week - Athens, Greece
22

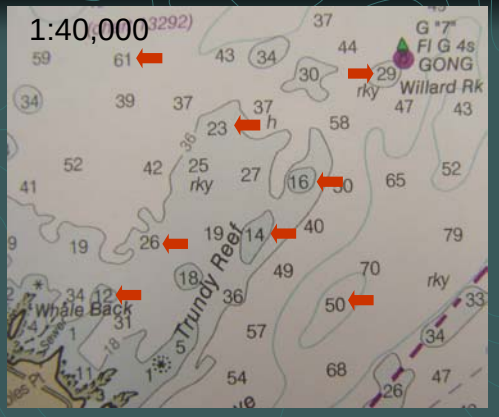

Different soundings—same portrayal
1955 Single beam
1909 lead line
1997 Multibeam
25 May 2004
FIG Working Week - Athens, Greece
23

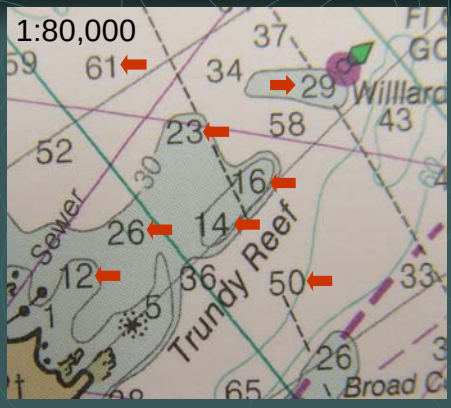

Uncertainty Portrayal
25 May 2004
FIG Working Week - Athens, Greece
24

These rules no longer apply:

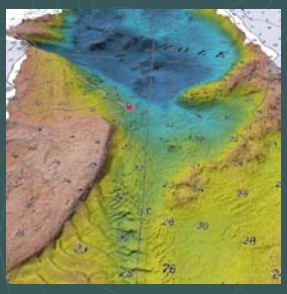
- Survey conducted with a shoal bias
- Survey database is a representative collection of corrected soundings
- Charted soundings can be traced to a unique measured depth
- All depths are portrayed as equally valid
- Compilation of charts "through the scales"





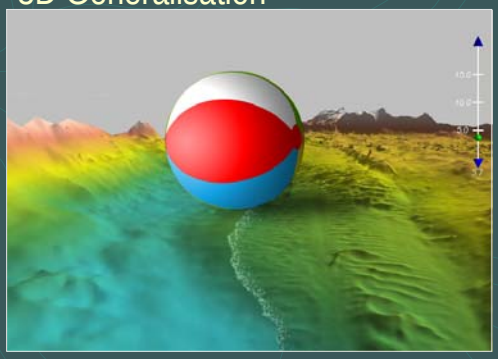


Generalisation

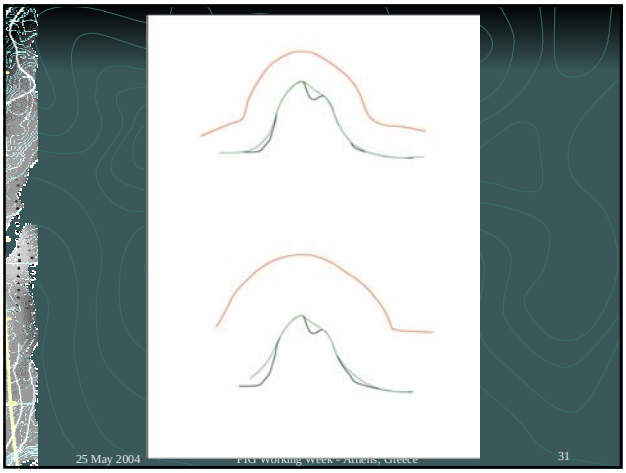


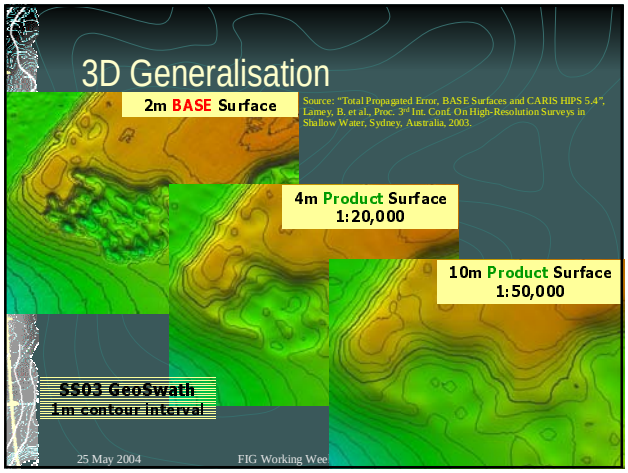
- Composite surface has too much detail for cartographic work
- Need to remove 'extraneous' detail but still preserve shoals
- Uses 3D Double-Buffering technique, which is shoal preserving

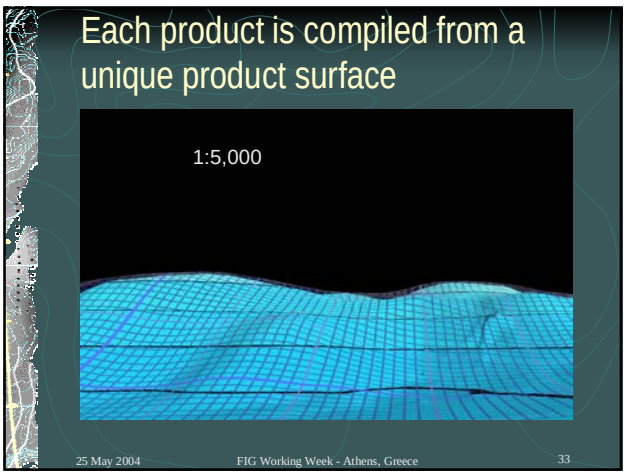
3D Generalisation

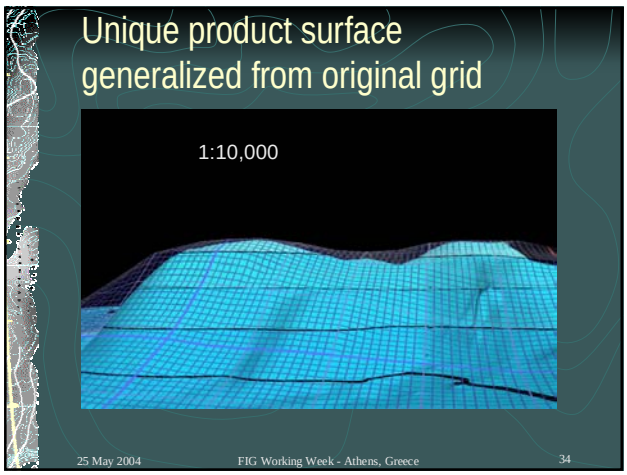


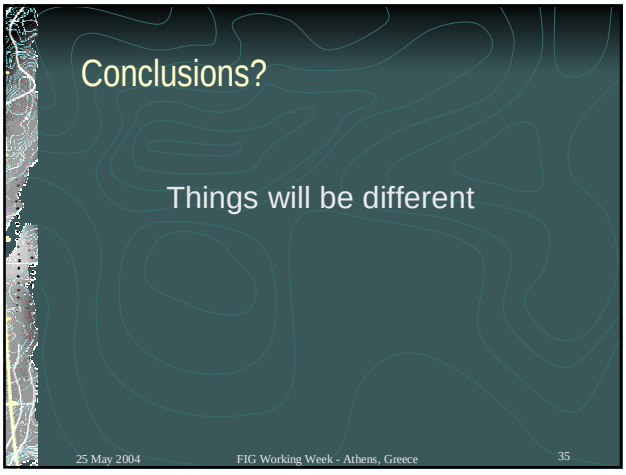
Source: "Management of Bathymetric Databases using BASE Surfaces", Gourley, M. et al., Proc. 3rd Int. Conf. On High Res. Survey in Shallow Water, Sydney, Australia, 2003.




3D Generalisation
2m BASE Surface
Source: "Total Propagated Error, BASE Surfaces and CARIS HIPS 5.4", Lamey, B. et al., Proc. 3rd Int. Conf. On High-Resolution Surveys in Shallow Water, Sydney, Australia, 2003.
4m Product Surface
1:20,000
10m Product Surface
1:50,000
SS03 GeoSwath
1m contour interval
25 May 2004
FIG Working Wee


Each product is compiled from a unique product surface
1:5,000
25 May 2004
FIG Working Week - Athens, Greece
33


Unique product surface generalized from original grid
1:10,000
25 May 2004
FIG Working Week - Athens, Greece
34


Conclusions?
Things will be different
25 May 2004
FIG Working Week - Athens, Greece
35