

Creating HypsIRI-like data using AVIRIS imagery acquired during the HypsIRI airborne campaign

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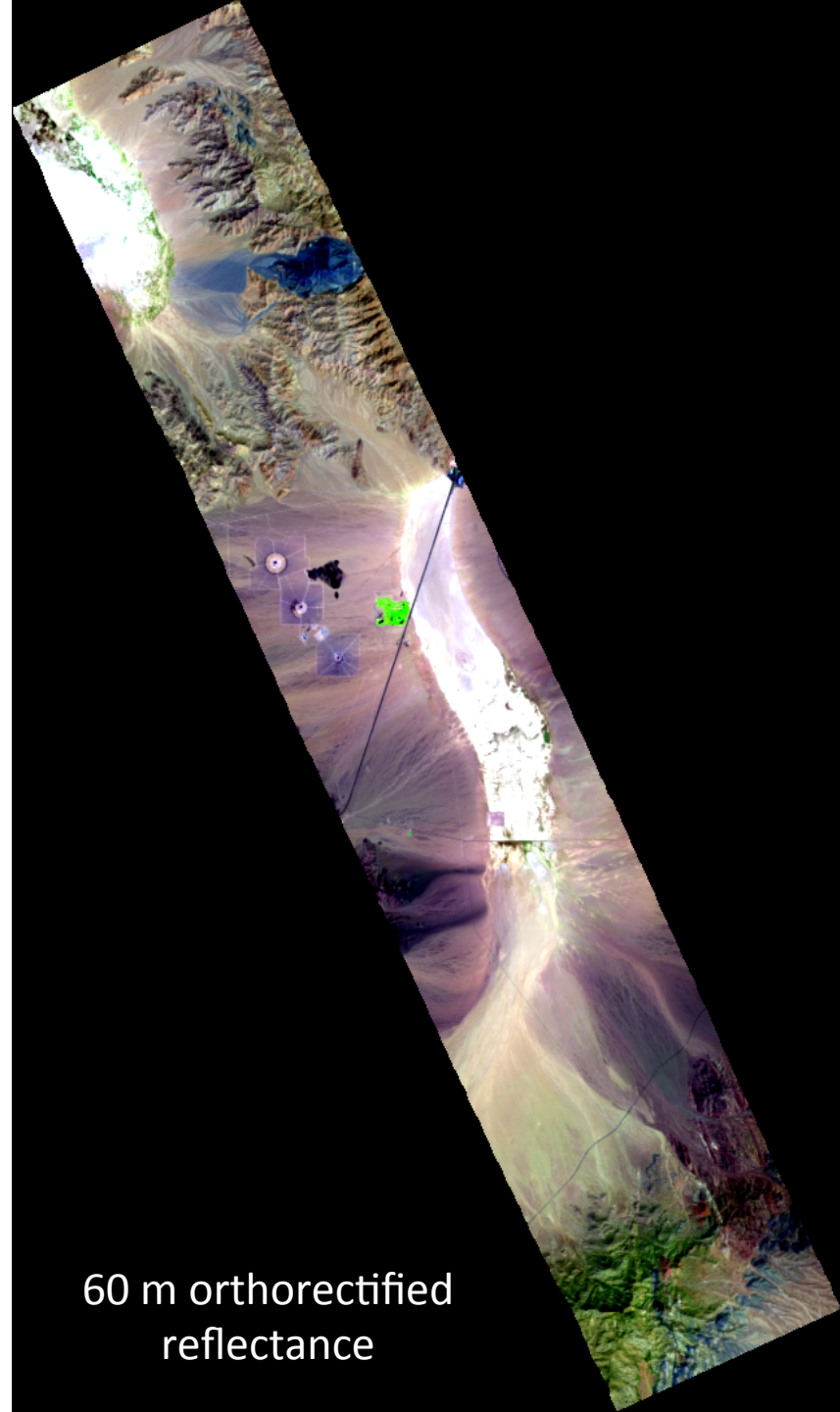
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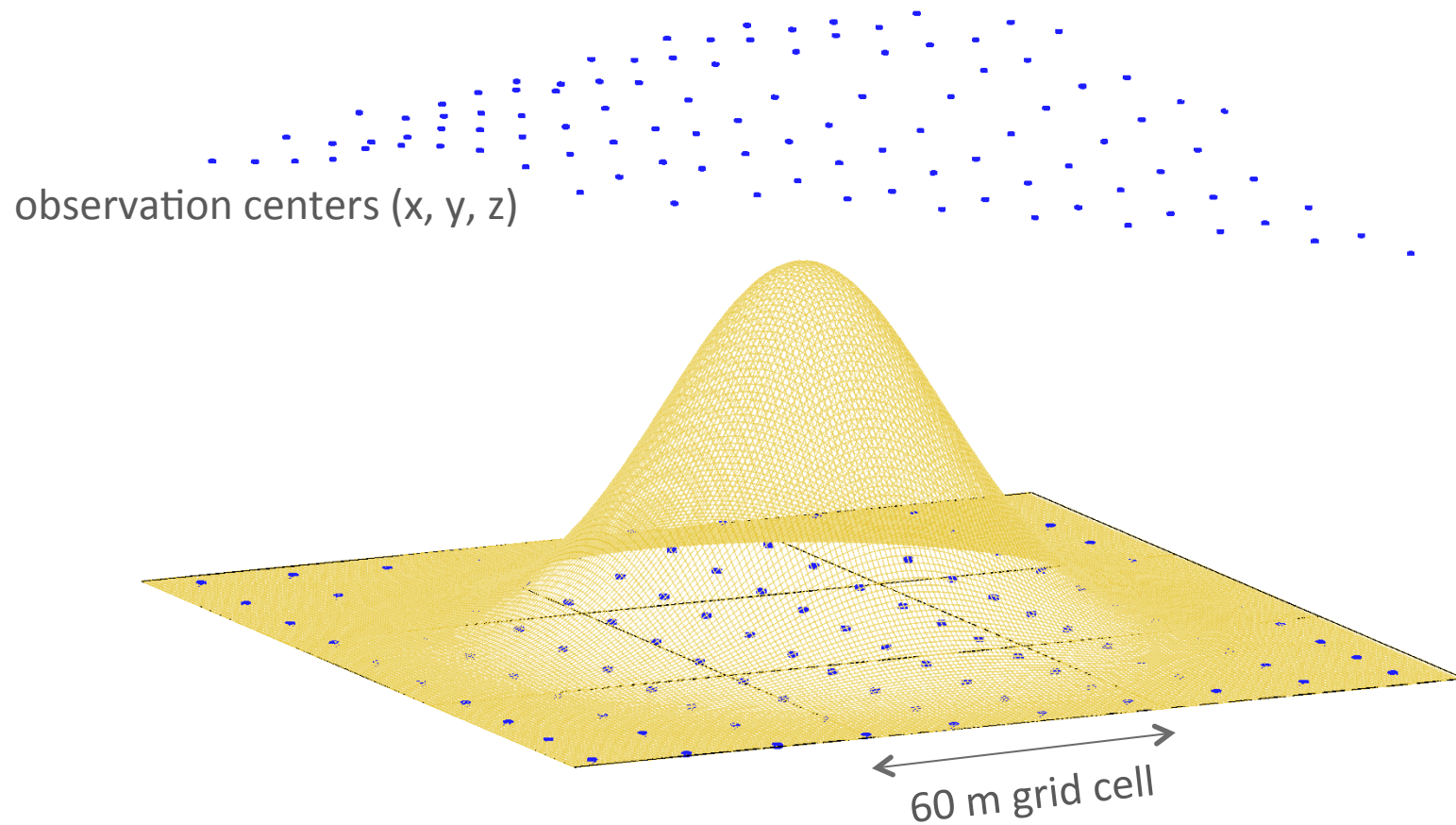
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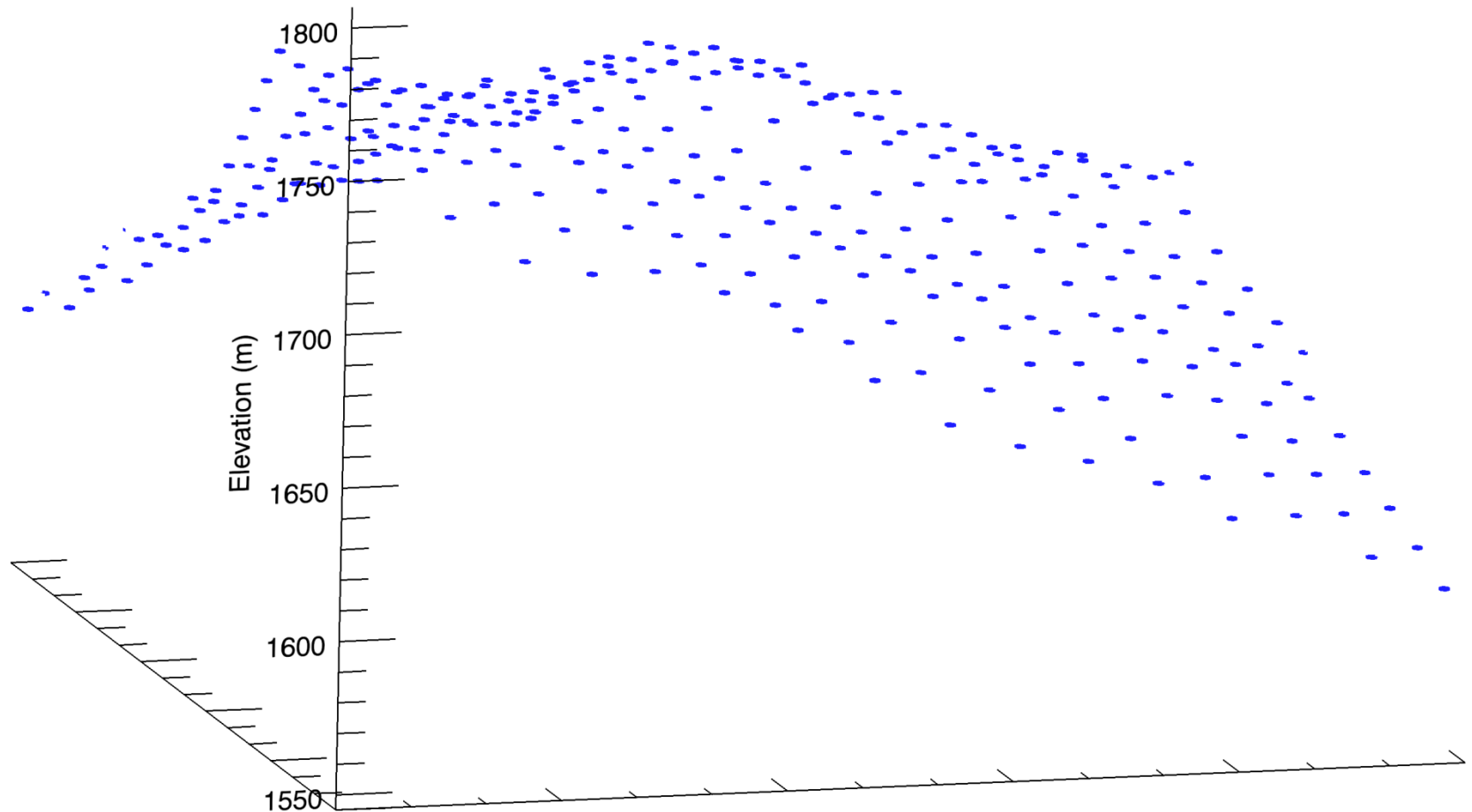


60 m orthorectified
reflectance

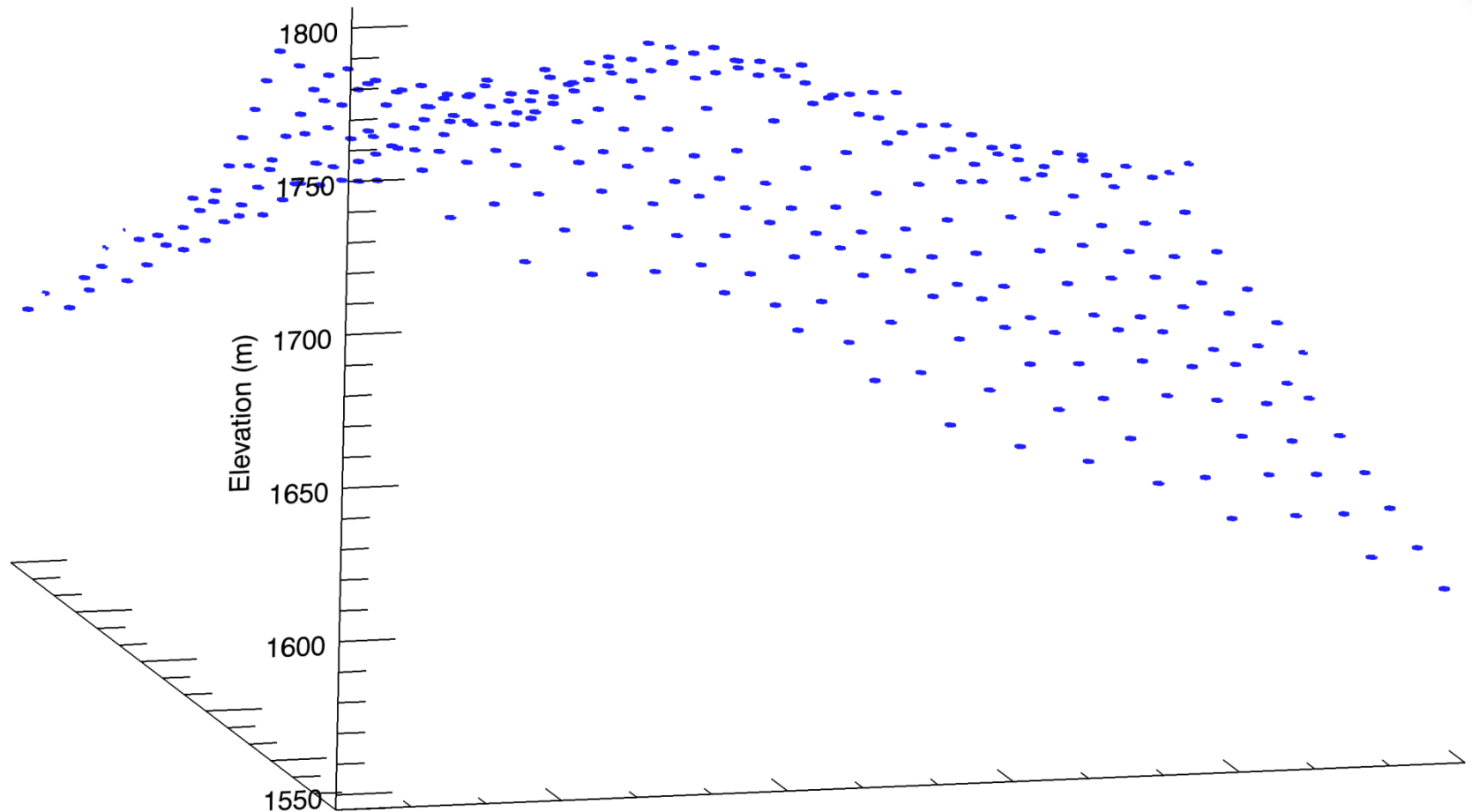
- What are the spatial characteristics of HypsIRI campaign AVIRIS orthorectified products?
- How can these characteristics be improved?
- How can we generate data with HypsIRI-like spatial characteristics from AVIRIS data?



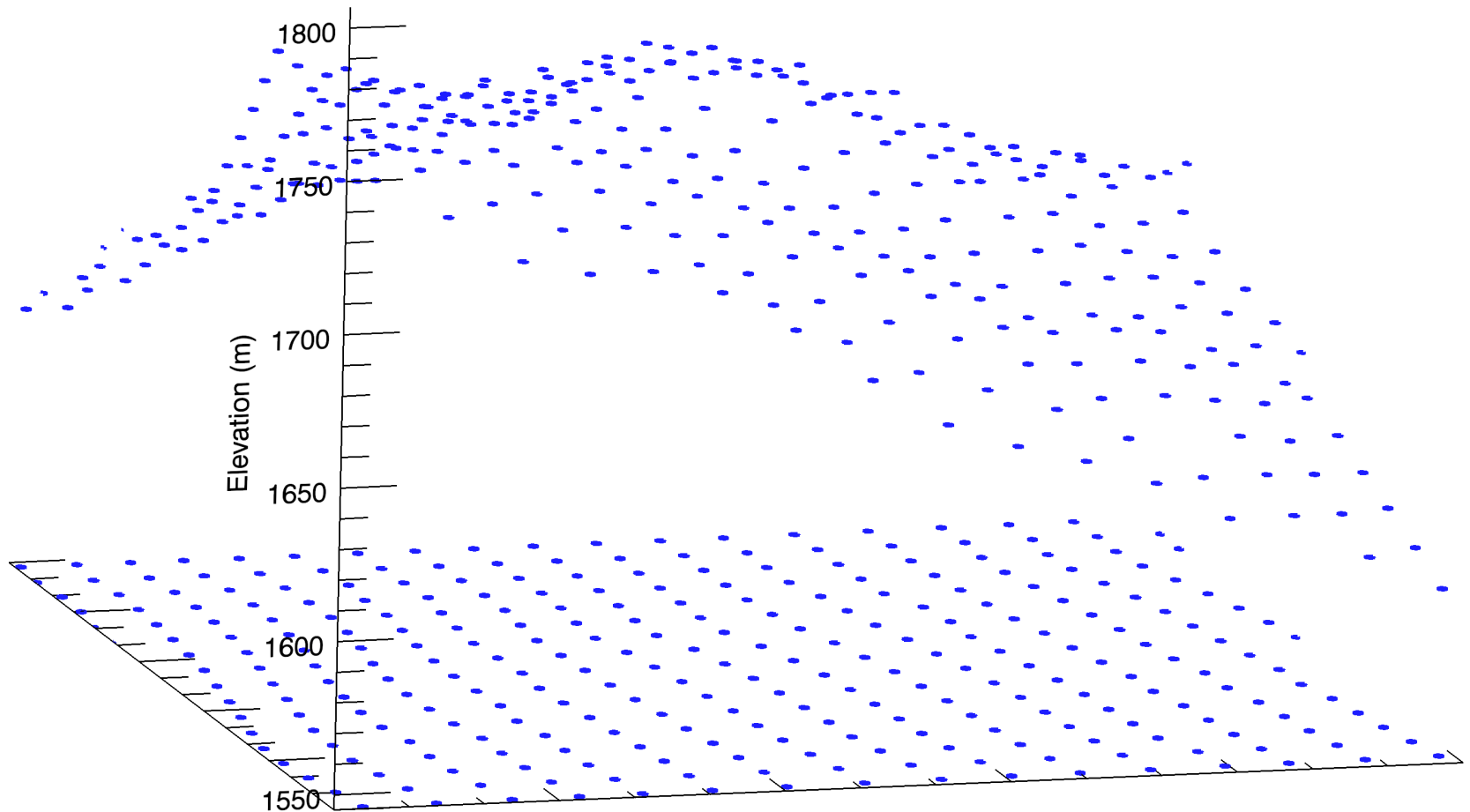
- Using aircraft INS and sensor pointing information, each original pixel “observation” is ray traced to a DEM
- Each observation center is assigned x, y, and z coordinates
- This information is contained in the Input Geometry (.igm) file
- Coordinates represent the center of the observation, do not represent AVIRIS PSF



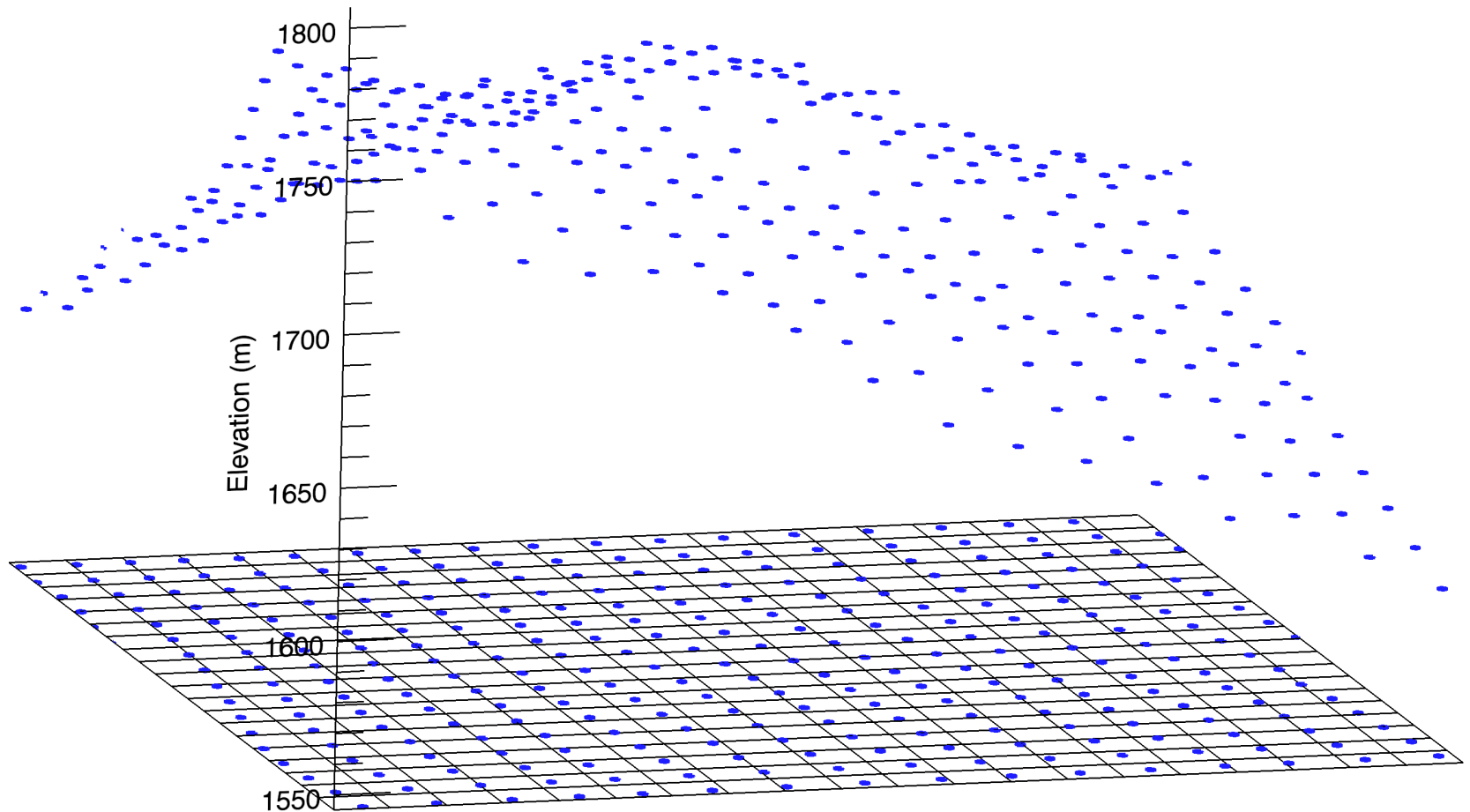
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- To orthorectify an image, a uniform grid is created
- Nearest neighbor resampling is used to assign observations to grid cells



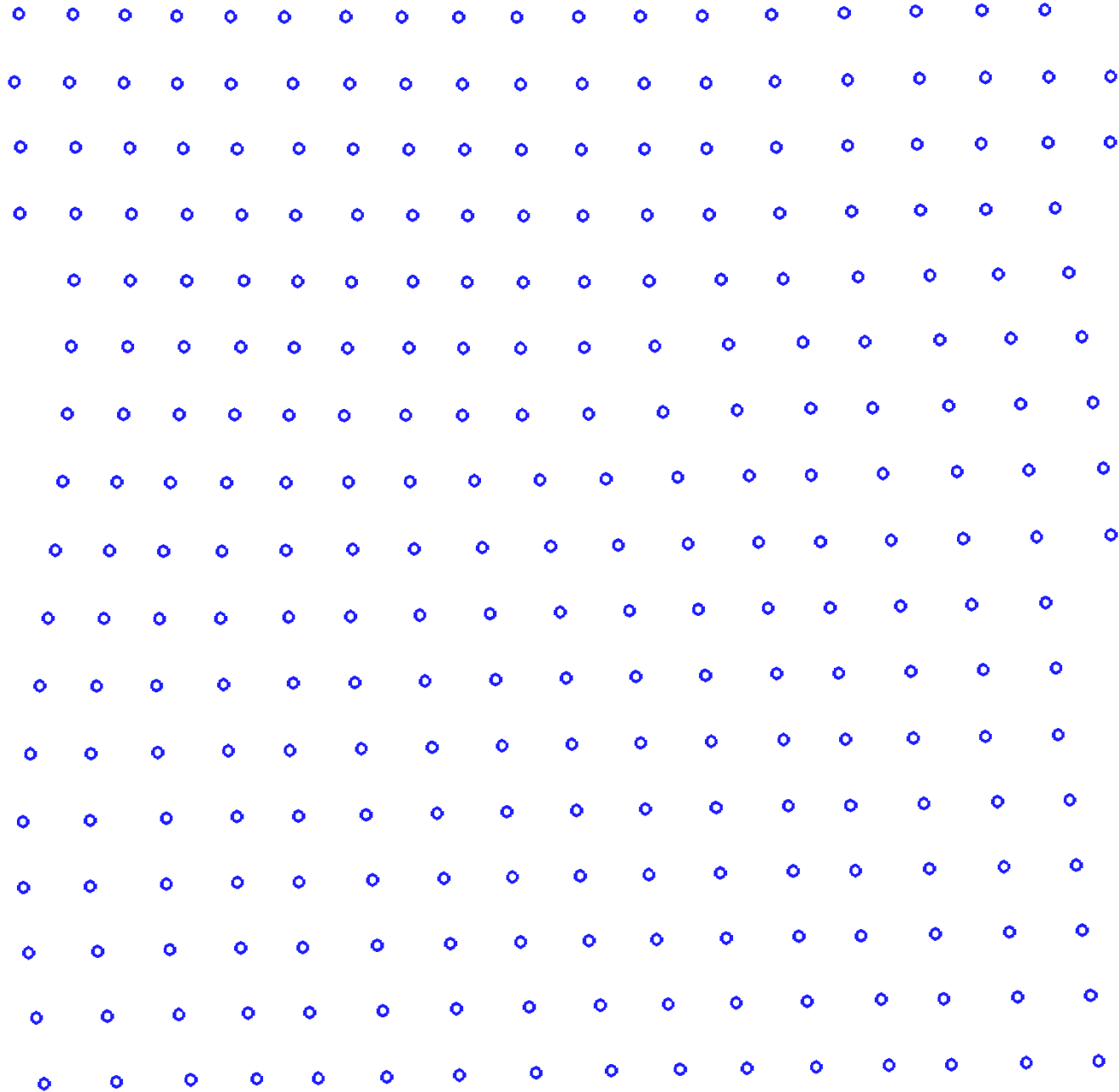
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- Assignment of observations to grid cells is strongly dependent on spatial resolution

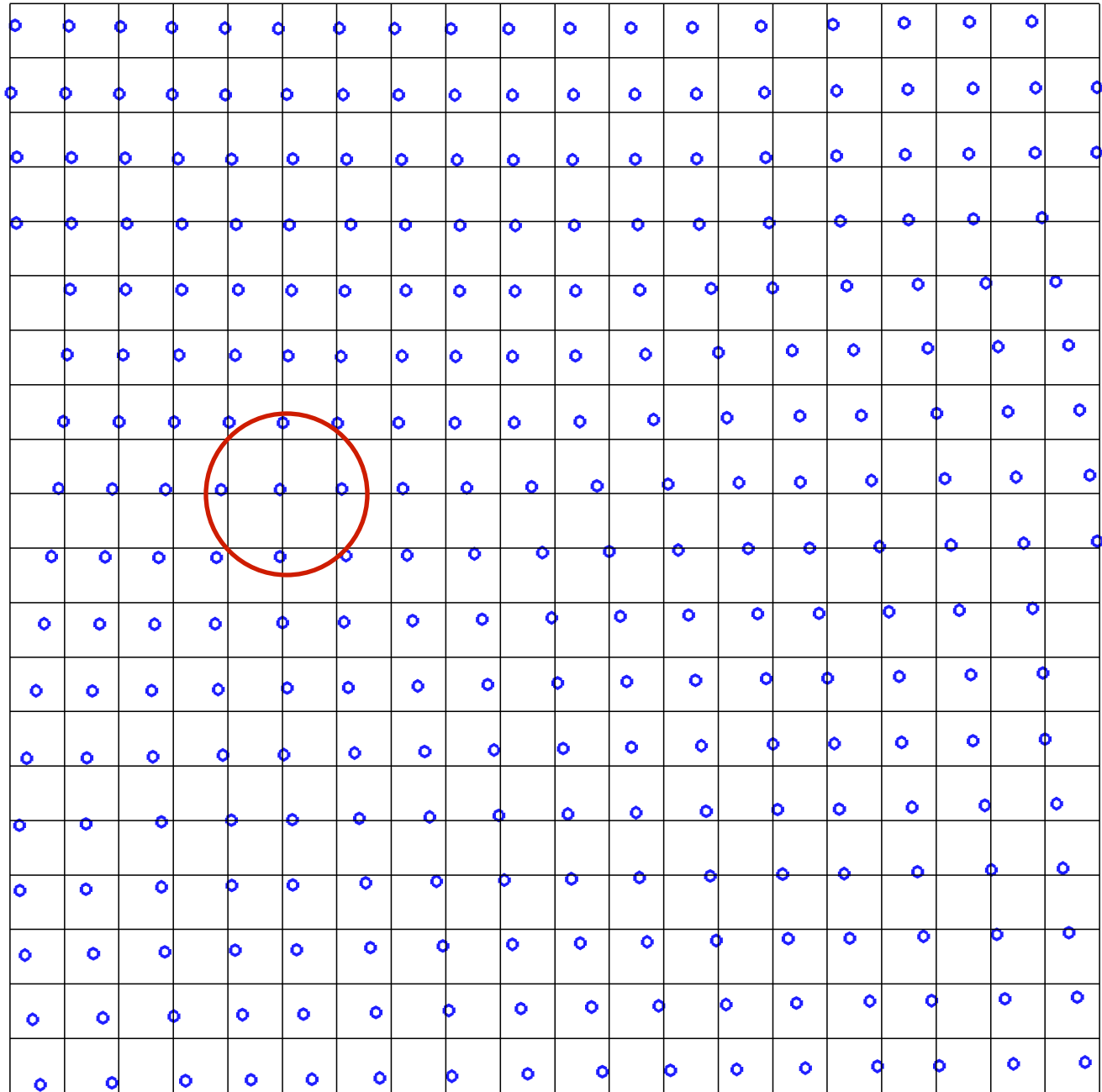
- Fine resolution grids may result in empty grid cells that are filled using nearest neighbor

- Coarse resolution grids may result in grid cells with more than one observation



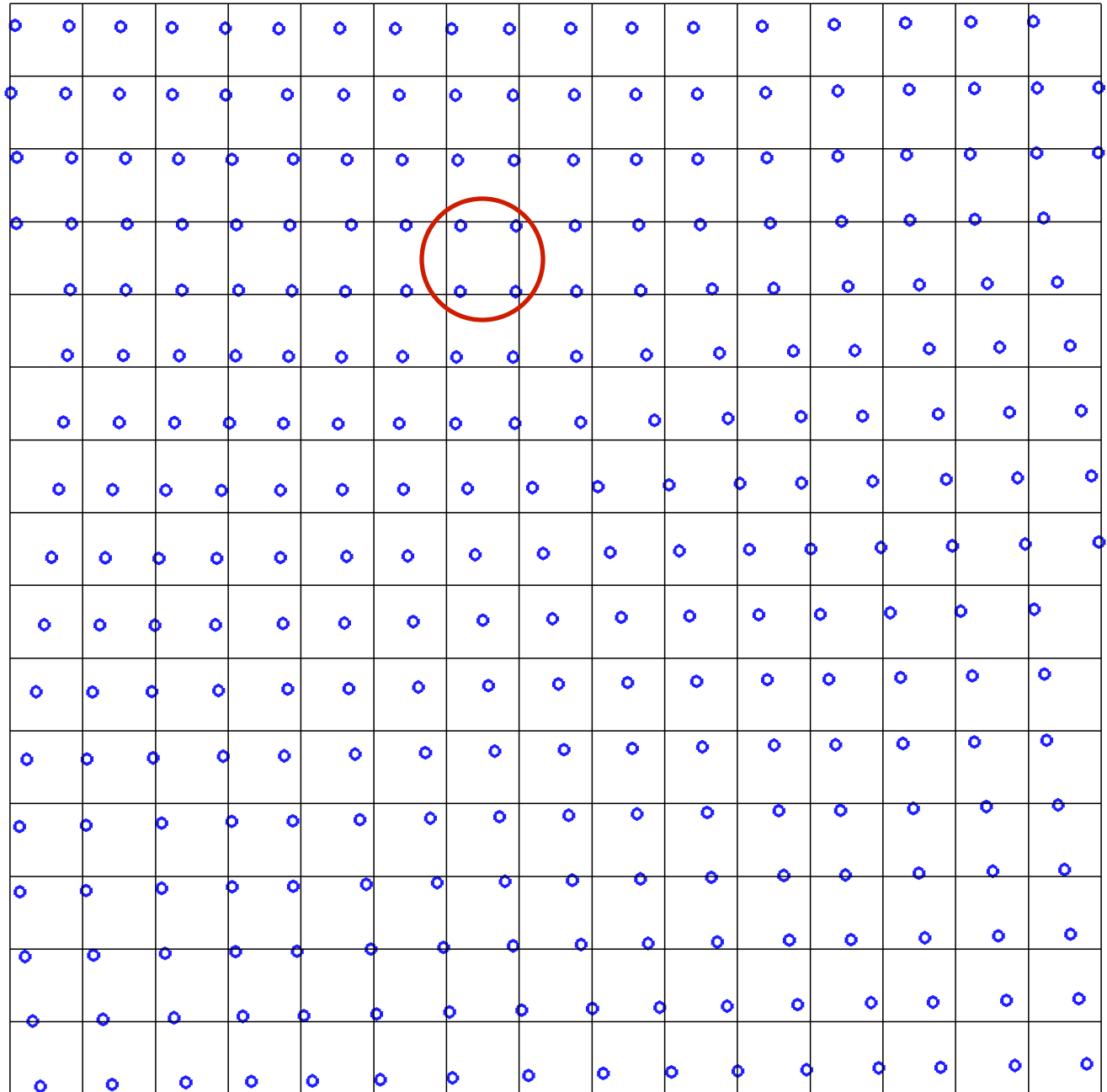
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15 m grid



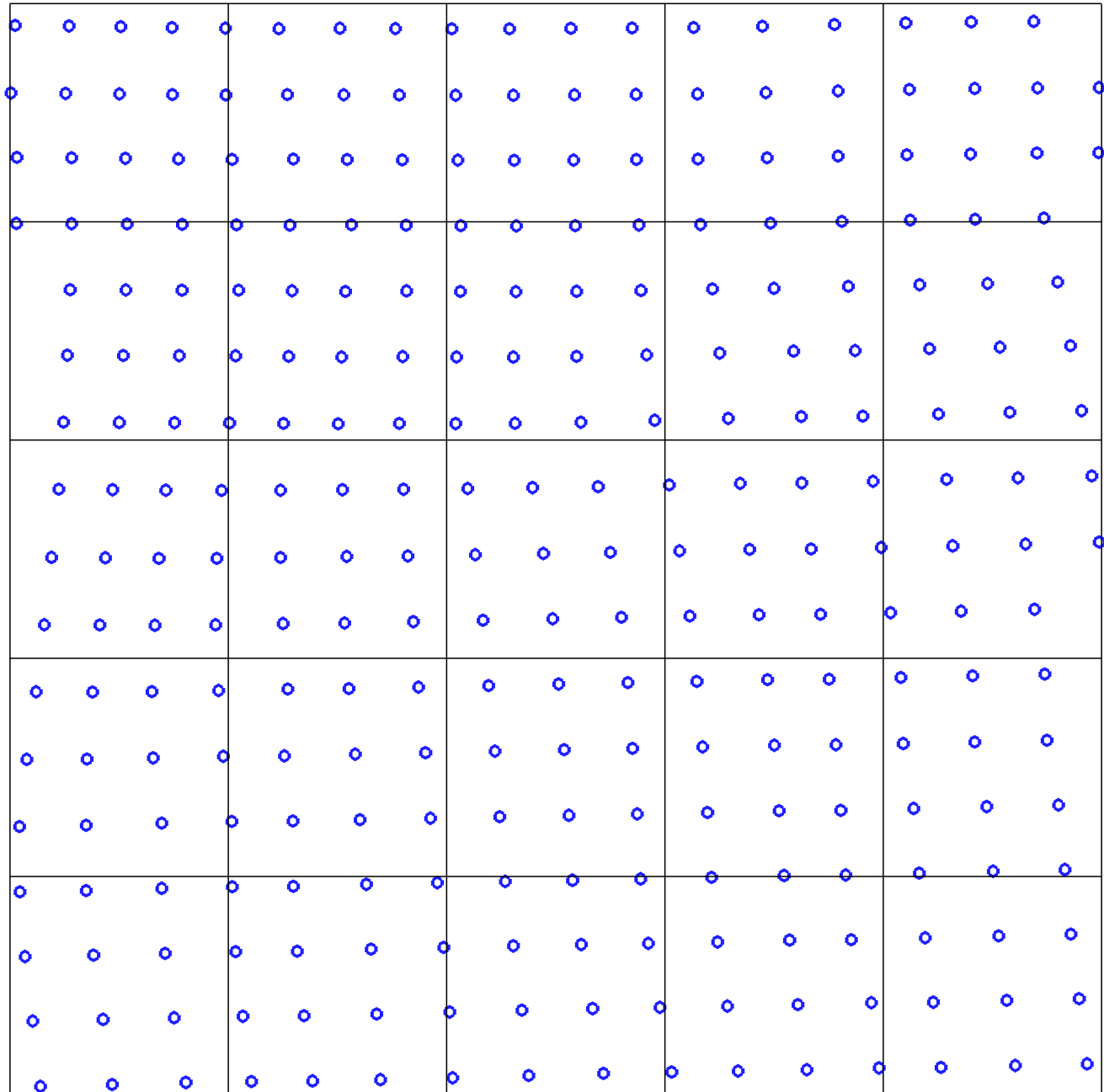
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20 m grid

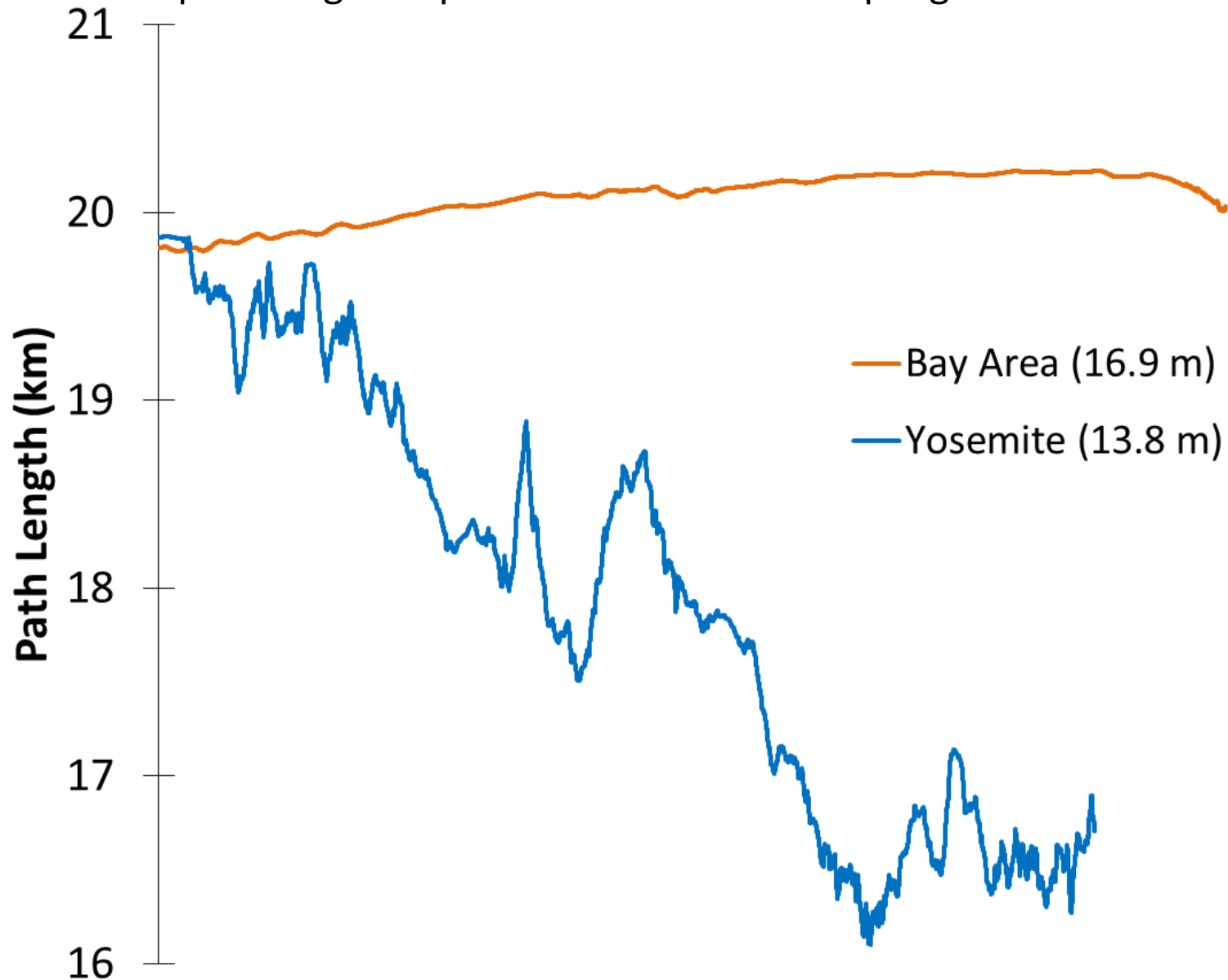


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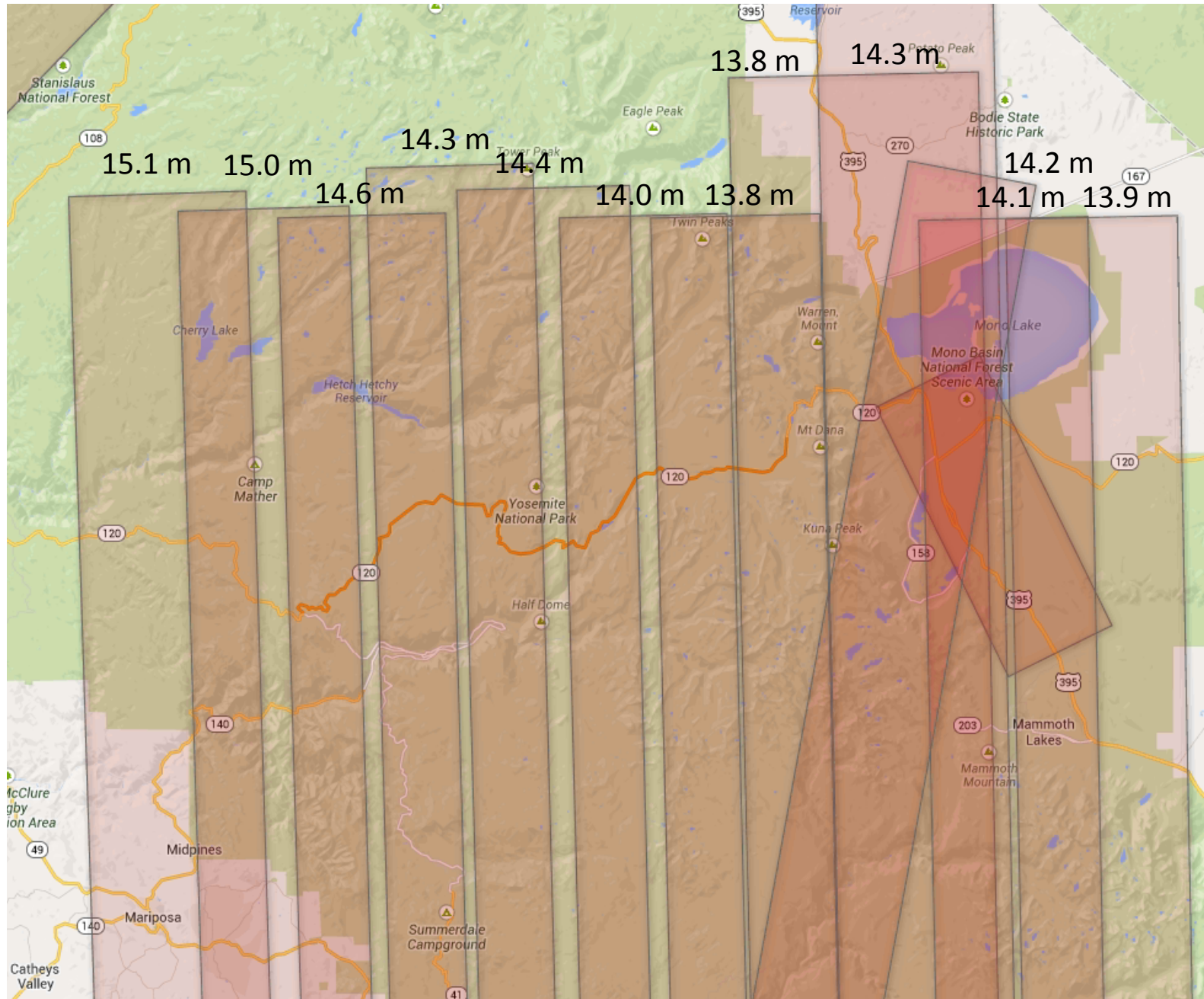
60 m grid

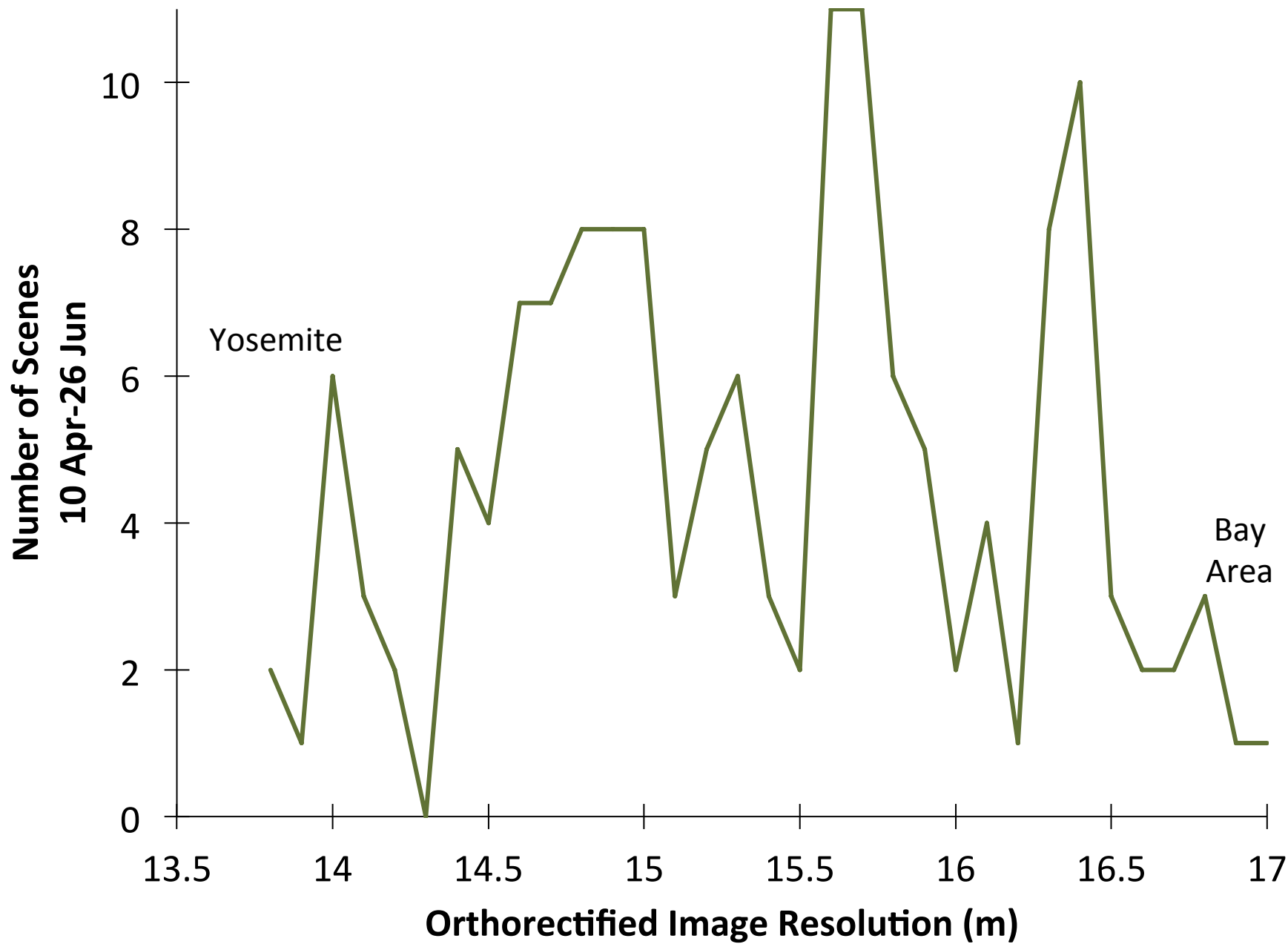


- For standard products, orthorectification grid cell size is assigned based on minimum path length to preserve maximum sampling

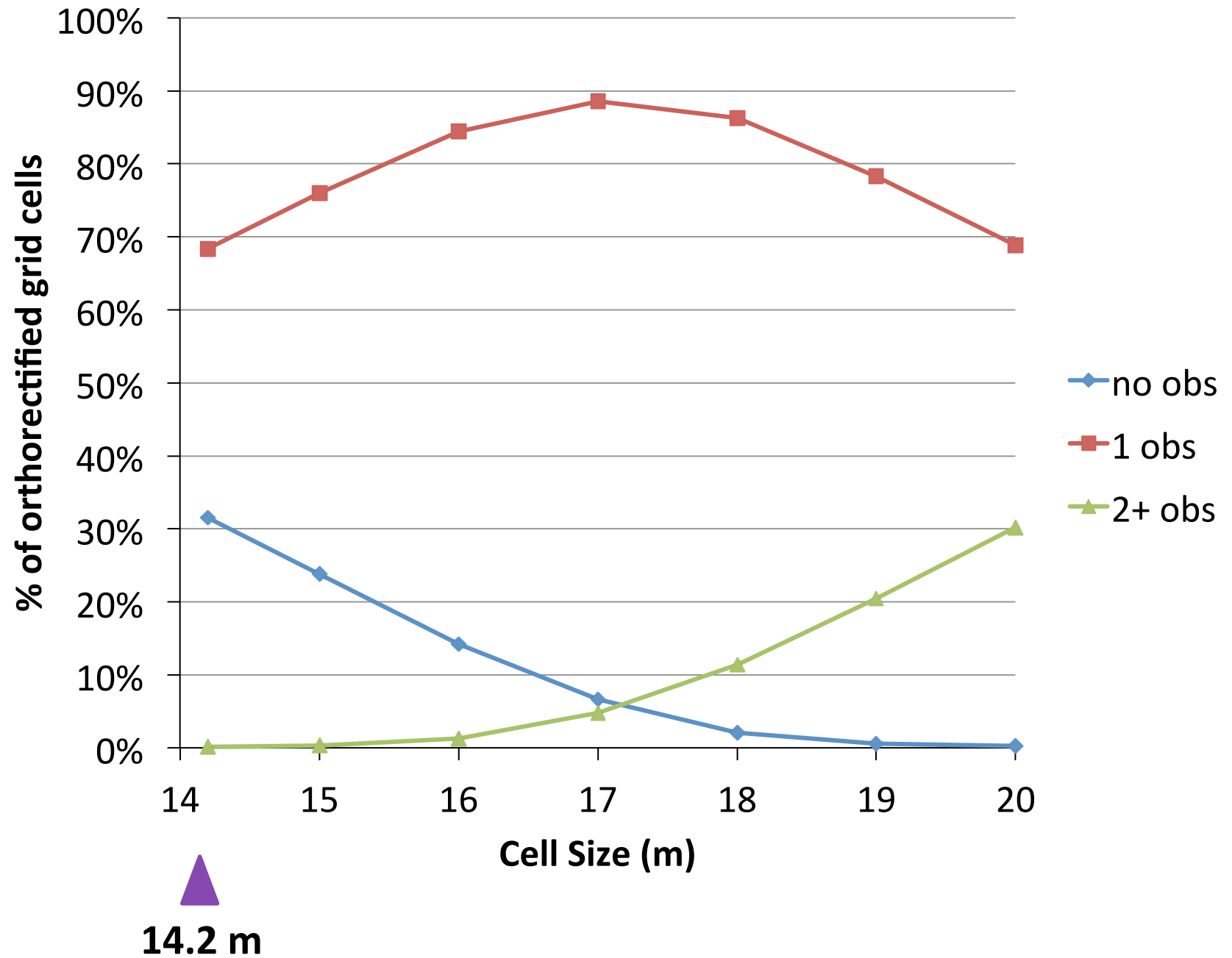


As a result, standard orthorectified products have a wide range of spatial resolutions

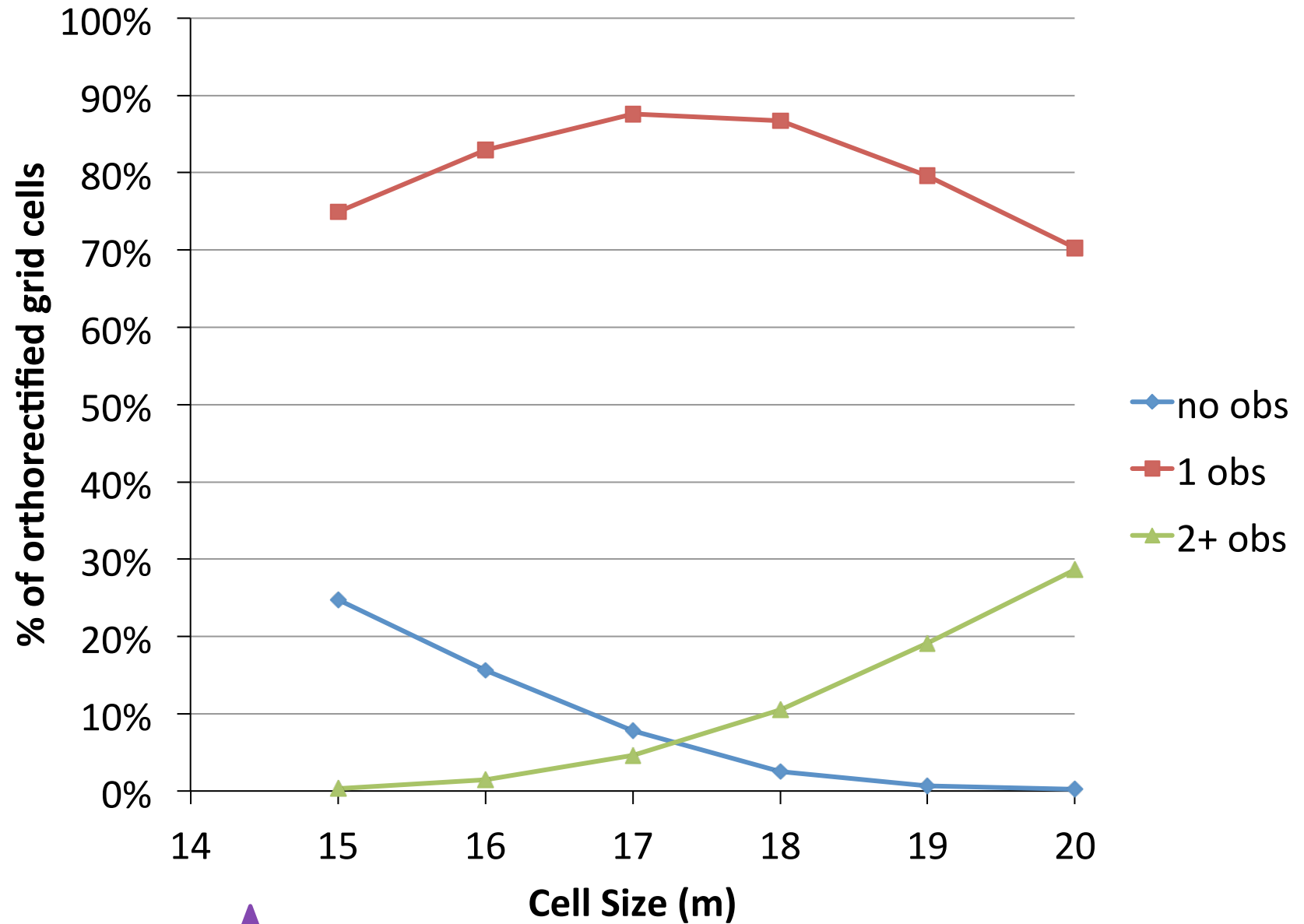




Soda Straw 130502 r23

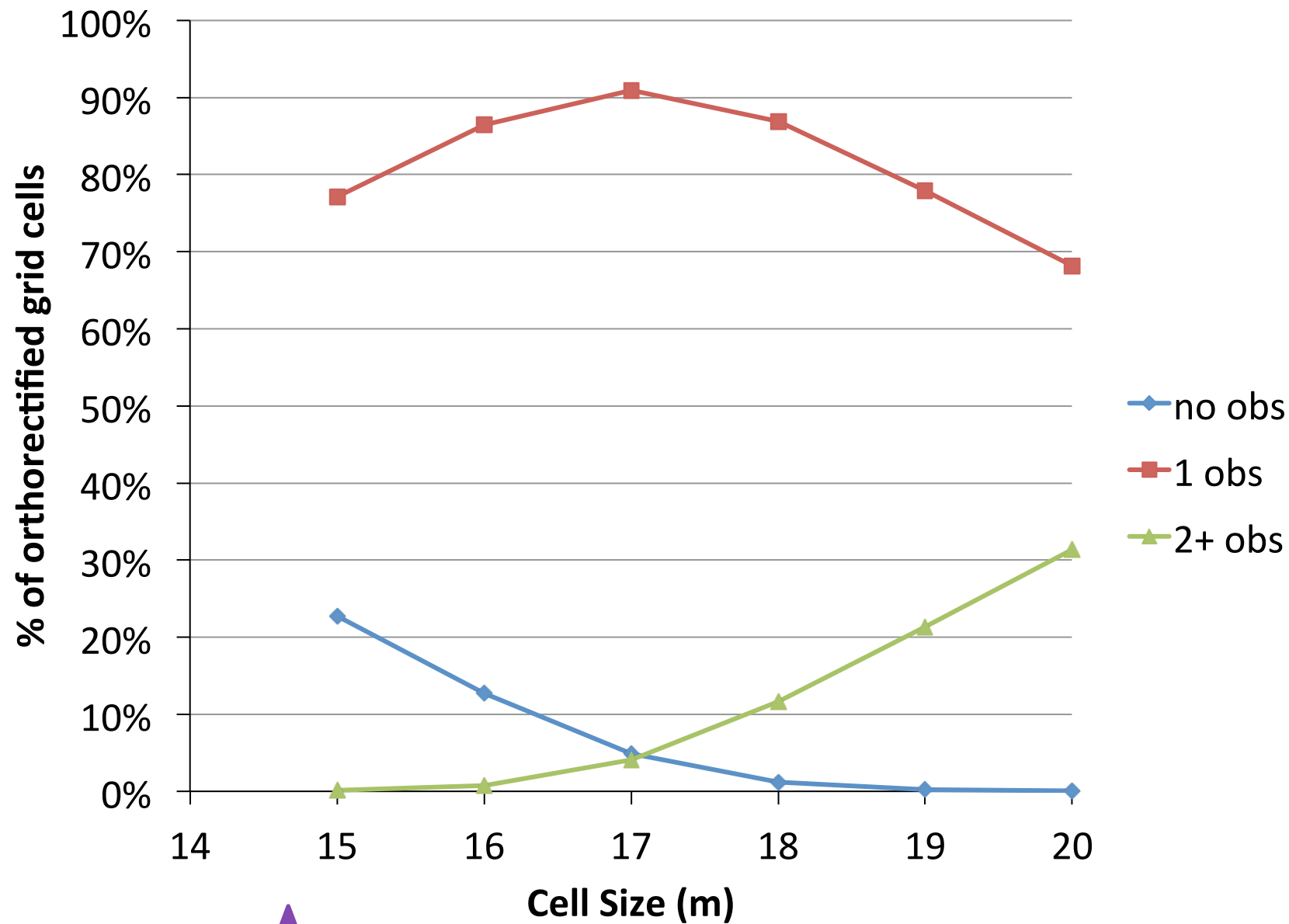


Yosemite 130503 r16



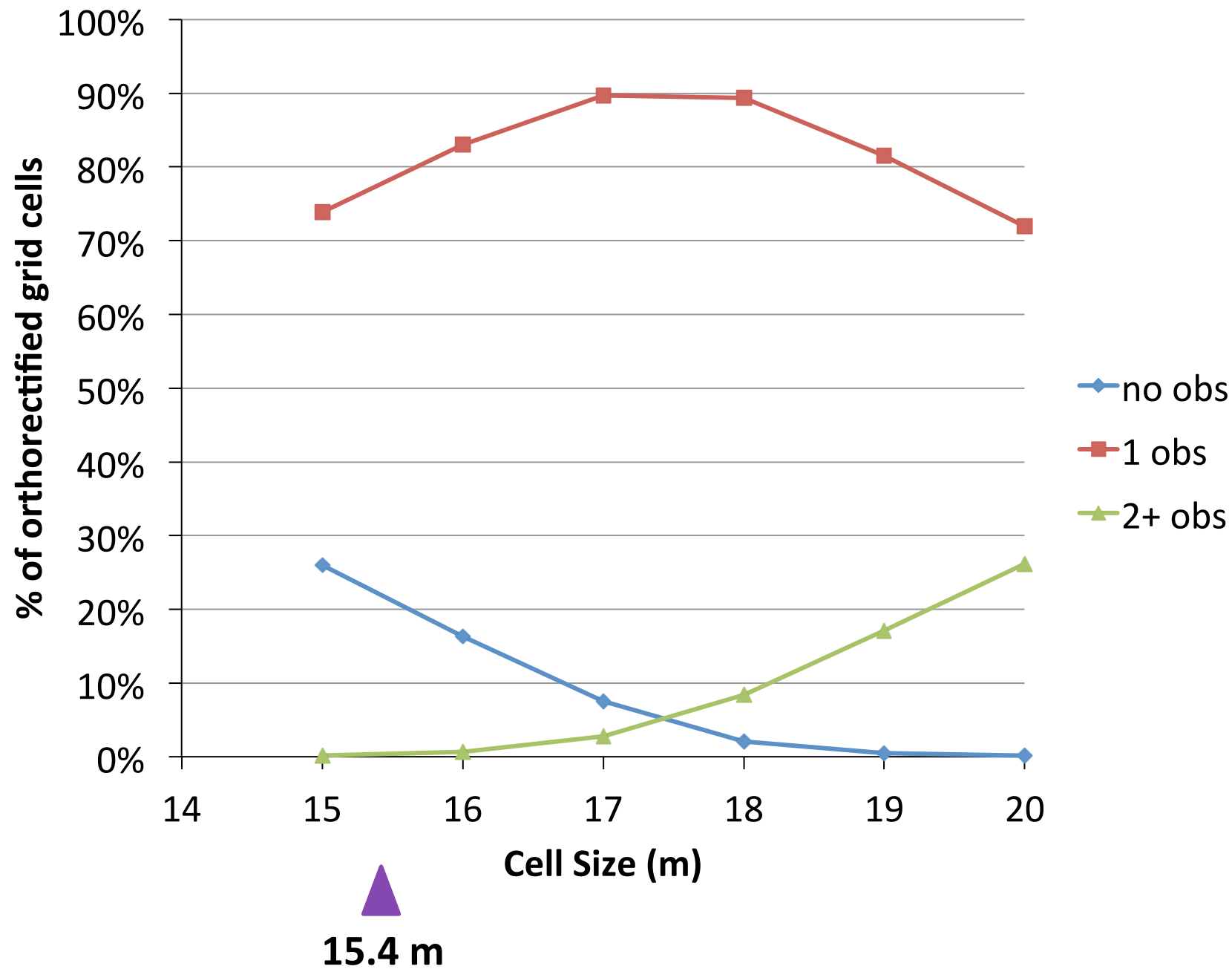

14.4 m

Tahoe 130502 r20

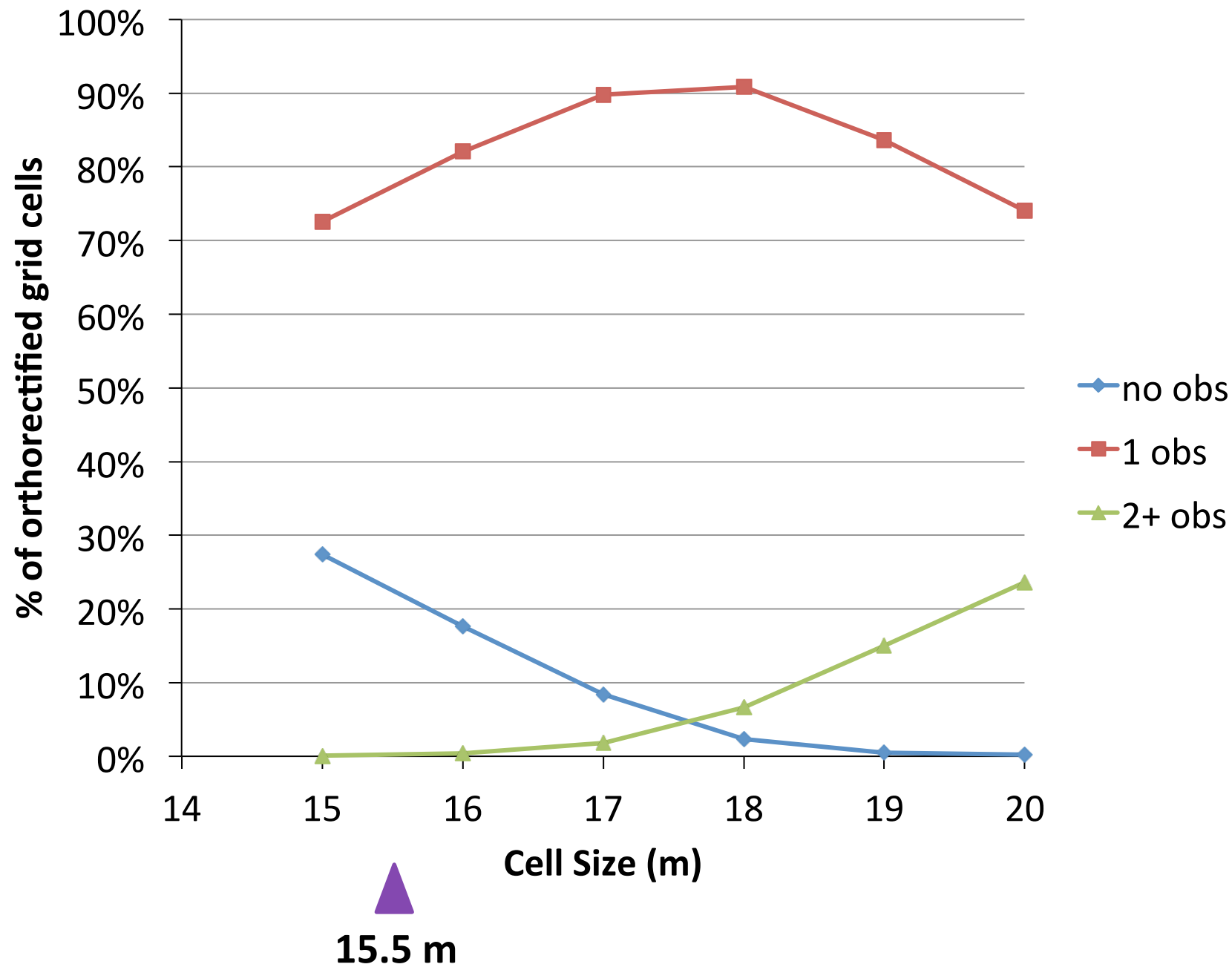



14.7 m

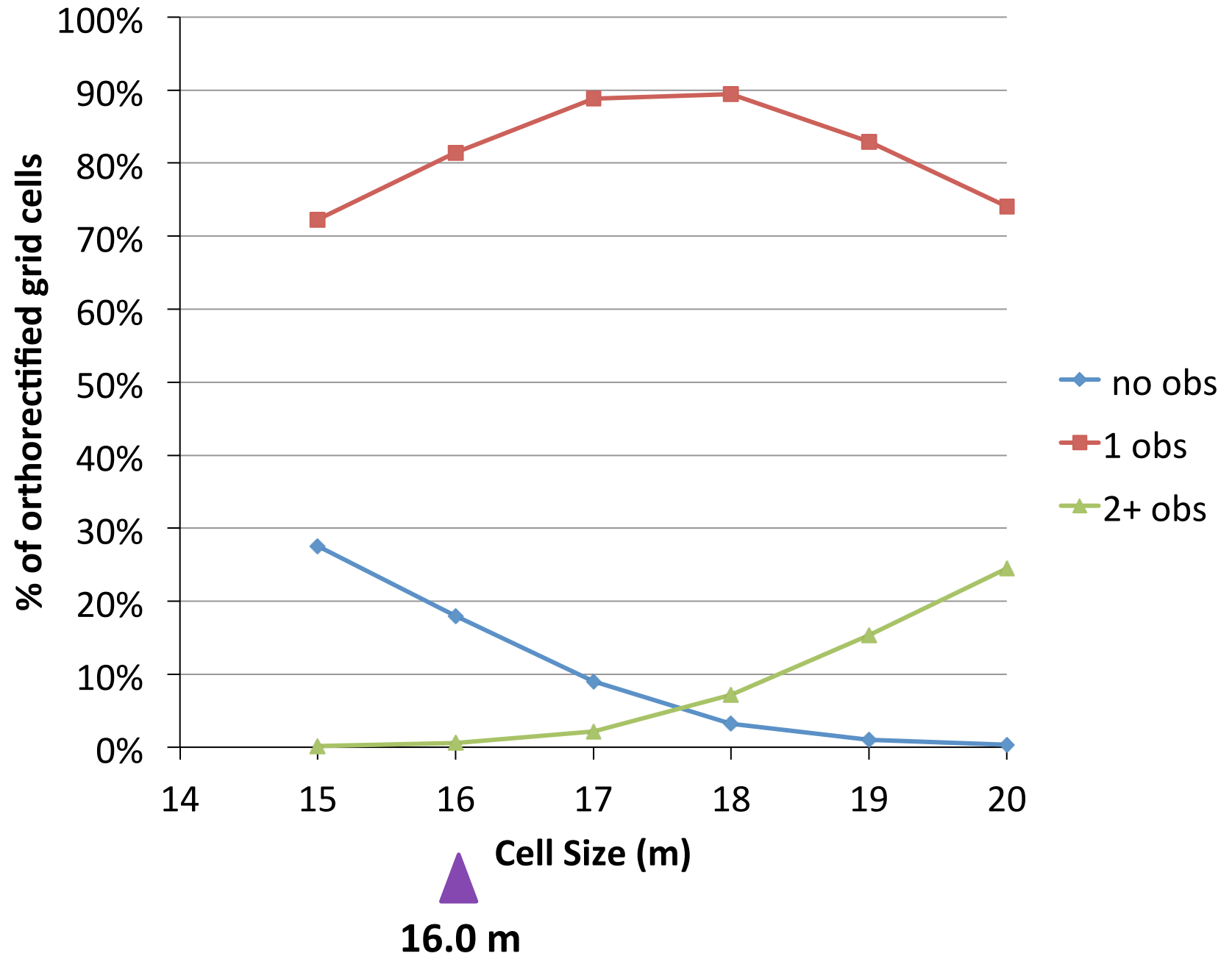
Santa Barbara 130411 r12



SoCal 130522 r09



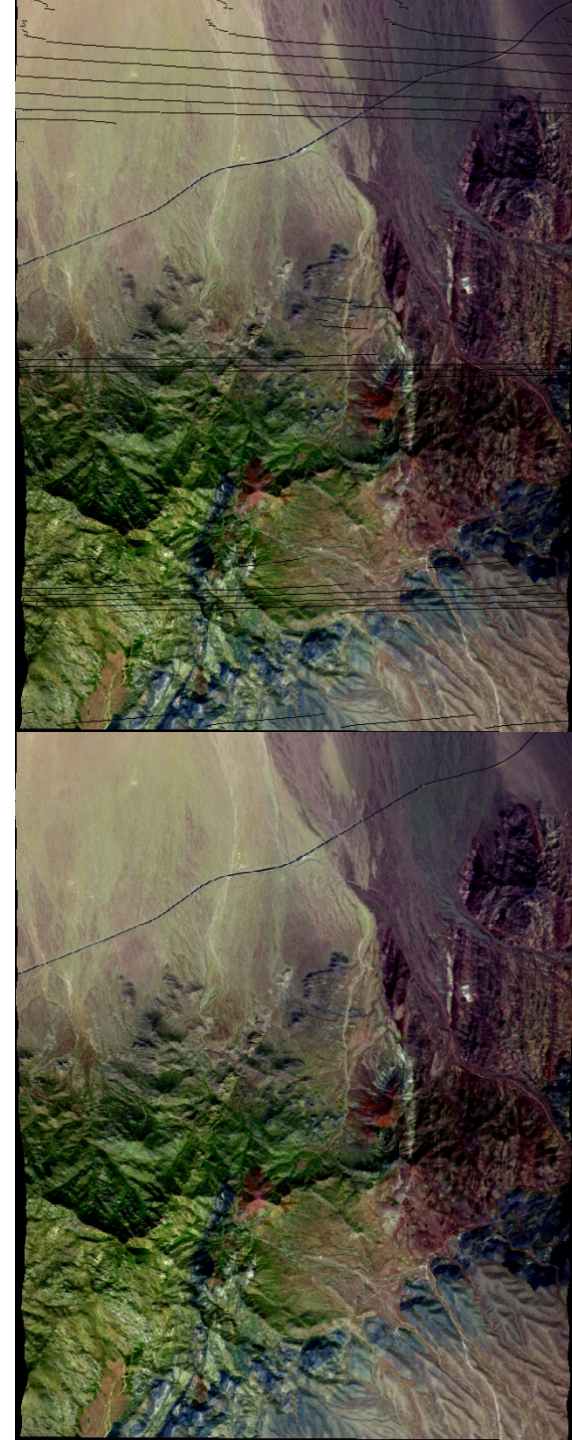
Bay Area 130410 r14



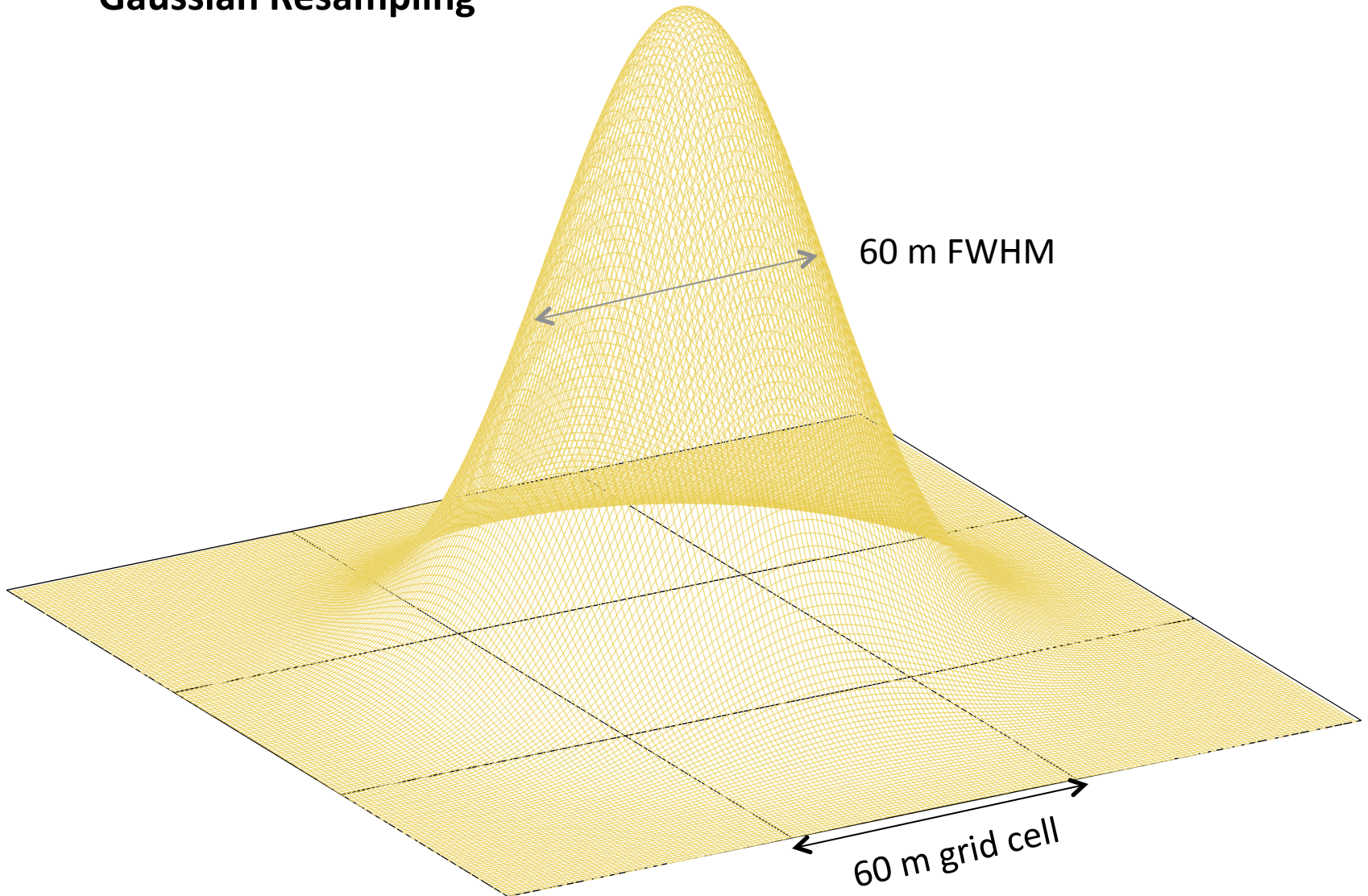
Code Solutions

- **ursa_img_ort**
 - IDL code for orthorectifying AVIRIS data
- Uses standard input geometry (IGM) file, generates new Boardman geometric lookup table (GLT)
- Five resampling options
 1. Nearest neighbor
 2. Nearest neighbor with void filling (equivalent to current AVIRIS products)
 3. Spatial averaging
 4. Spatial averaging with void filling
 5. **Gaussian function**
- Gaussian resampling is intended to approximate the PSF of HypIRI VSWIR

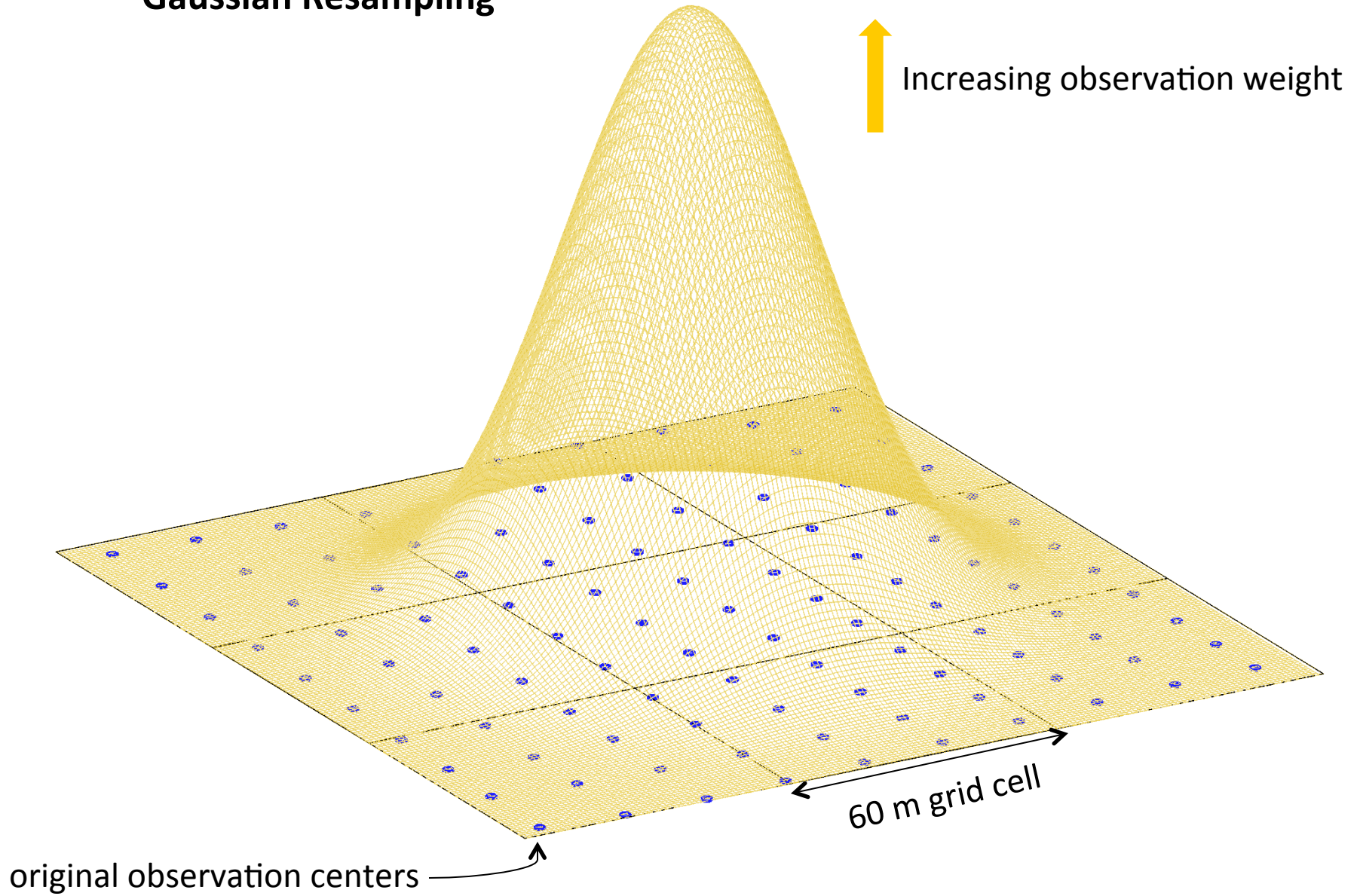
18 m orthorectified data
mode 3 (top) and 4 (bottom)



Gaussian Resampling



Gaussian Resampling

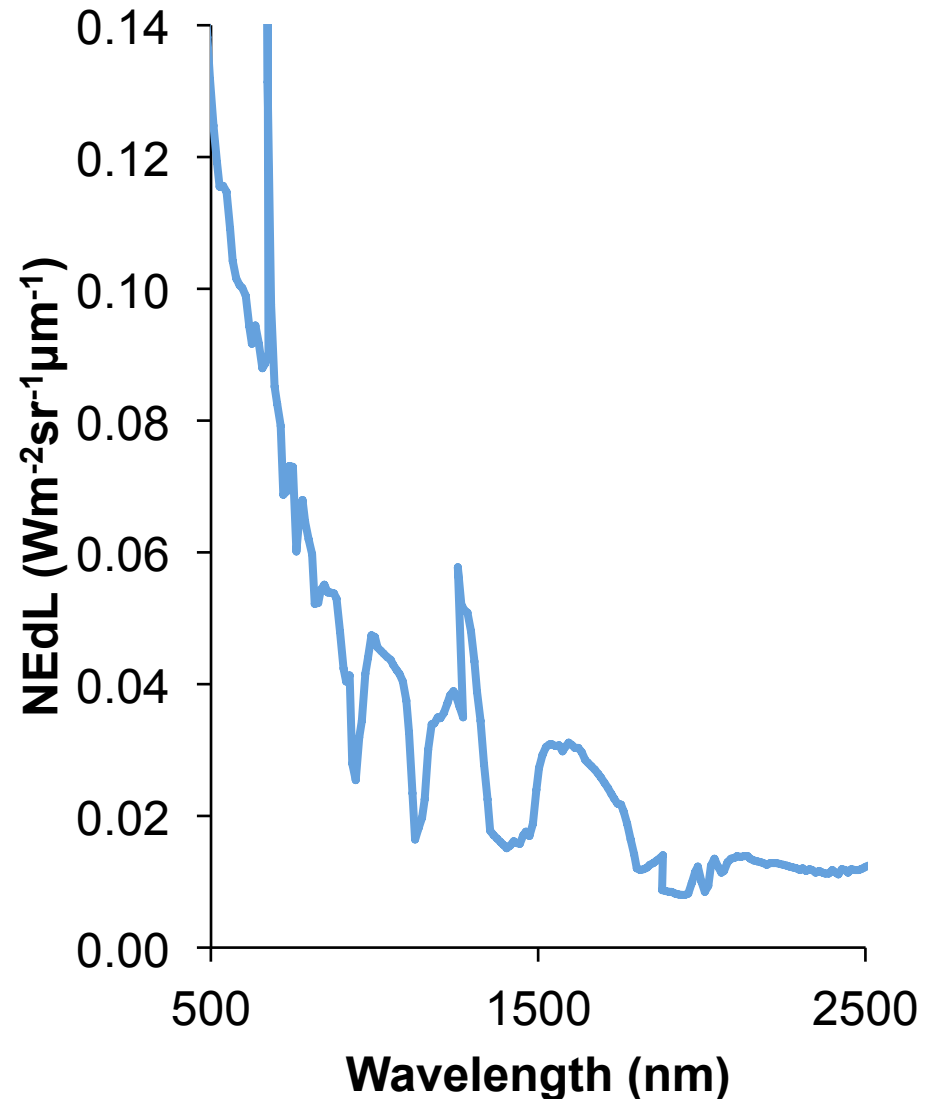


Questions for the HyspIRI Community

- Some questions pertain to fine resolution products (*f*), some to coarse resolution (60 m) products (*c*), and some to both (*fc*)
- Should resolution be standardized for AVIRIS orthorectified products? *f*
 - Should the goal be to approximate average GIFOV?
 - Minimize pixels with no observations?
 - Maximize pixels with one observation?
 - Minimize pixels with two or more observations?
 - Uniform across all scenes?

Questions for the HyspIRI Community

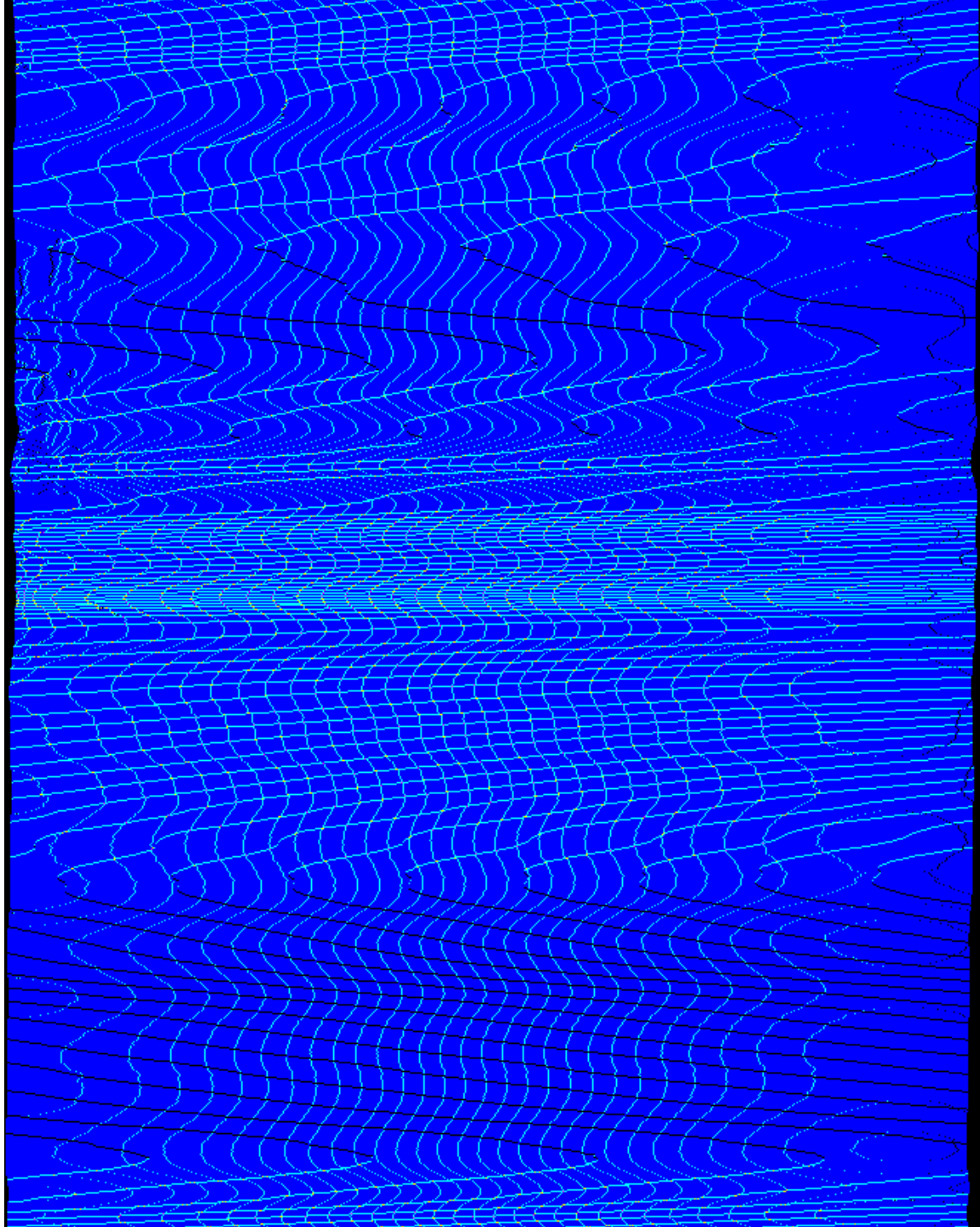
- Resampling by Spatial Averaging and Gaussian Function reduces noise. Should artificial noise be added back in to radiance data? **fc**
 - Easiest option: Add random, Gaussian noise based on AVIRIS NEdL function



Cells with no observations *f*

- `ursa_img_ort` generates a separate file that keeps track of how many observations fall inside each orthorectified grid cell
- Should empty cells be preserved?
- Should empty cells be filled using nearest neighbor?

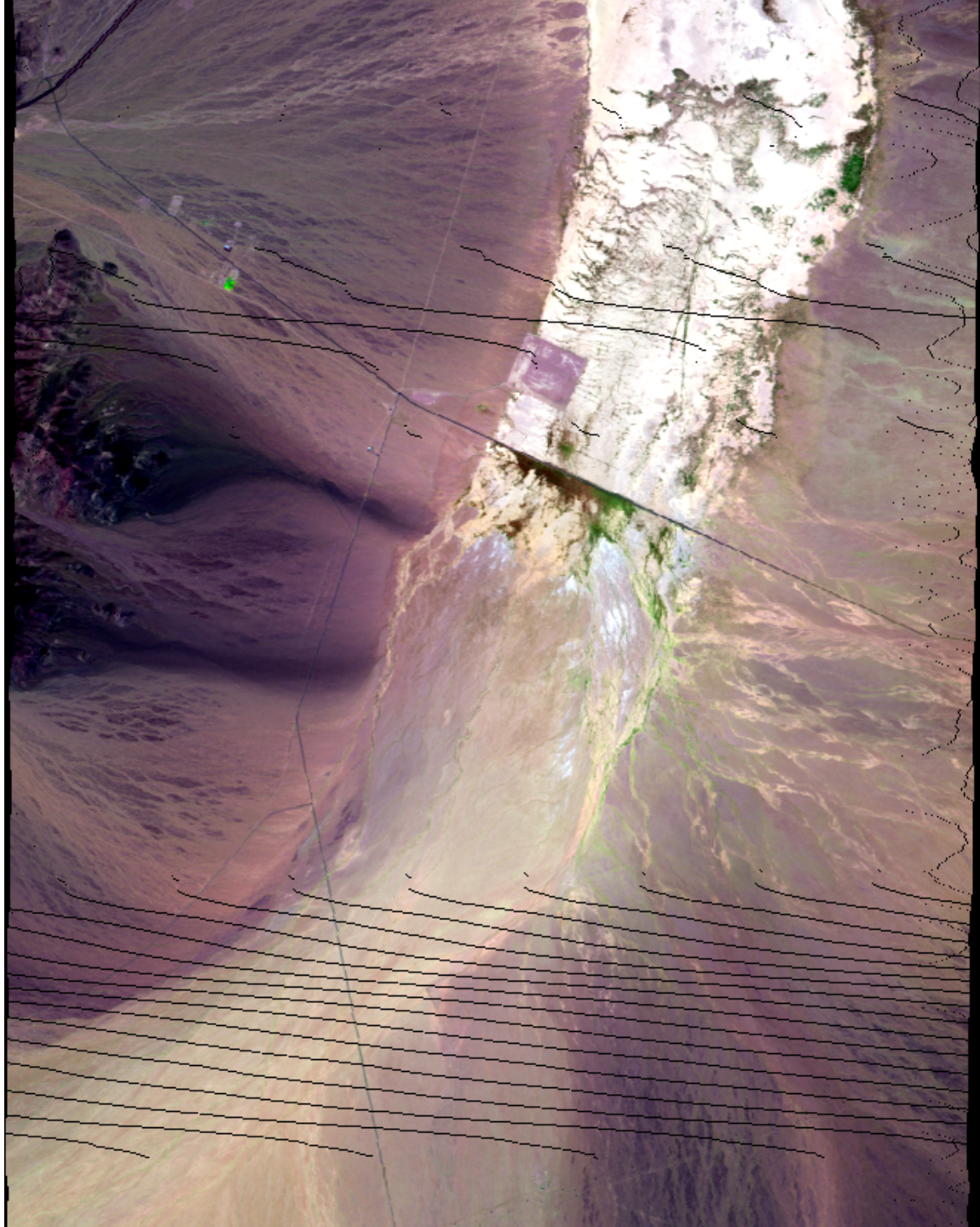
18 m orthorectification
“shots” file



Cells with no observations f

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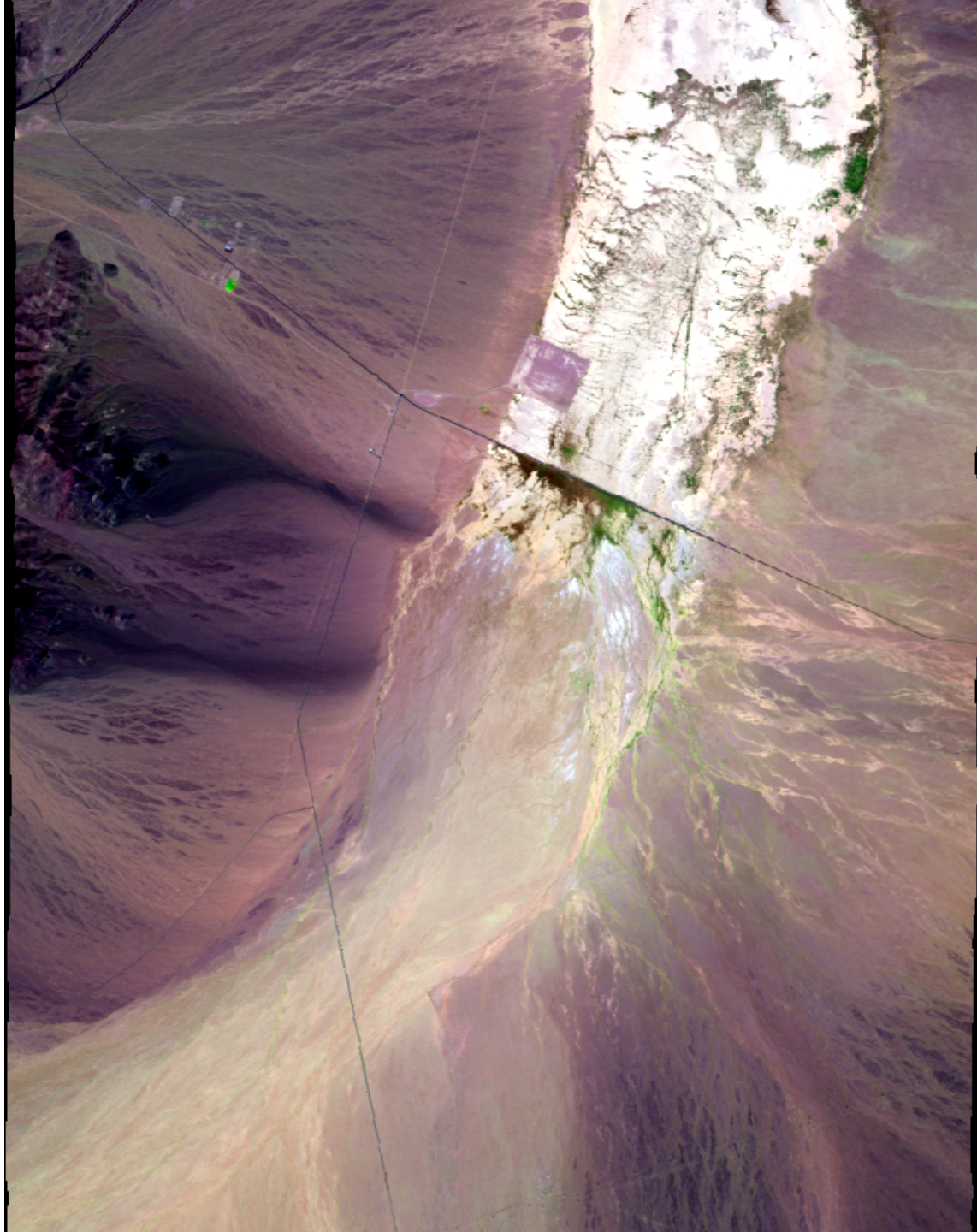
18 m orthorectified reflectance
no void filling



Cells with no observations f

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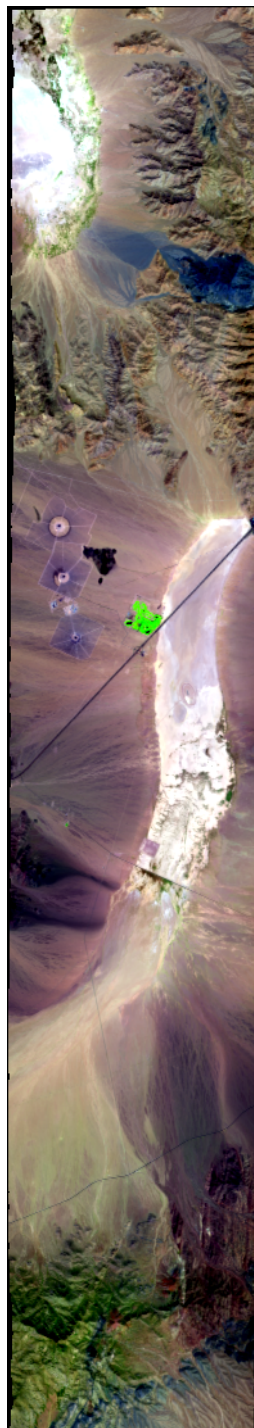
18 m orthorectified reflectance
void filled



Scene Rotation f_c

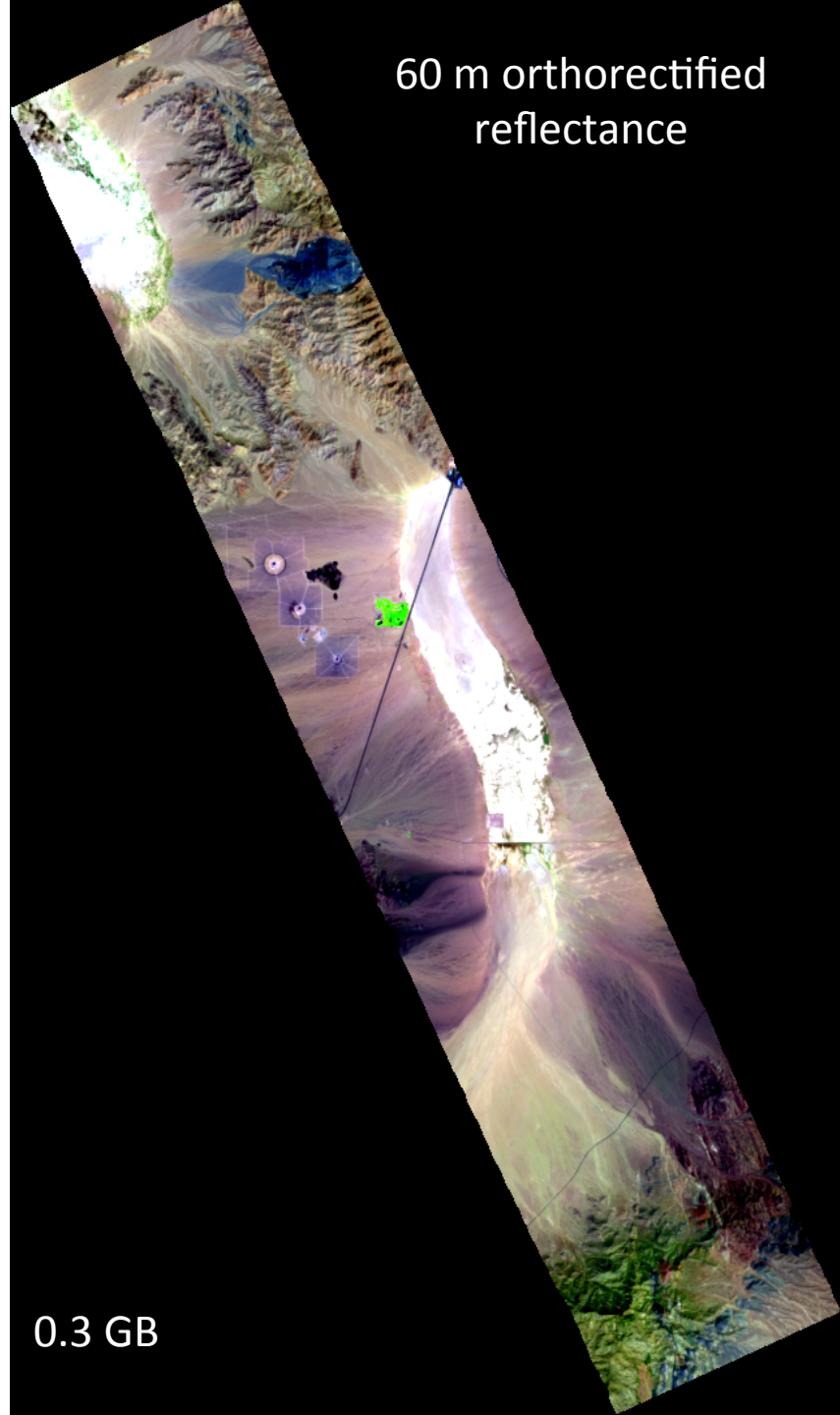
- Rotated scenes minimize data storage requirements
- 0° grid rotation makes mosaicking easier since all scenes have same grid cell orientation
 - 0° rotation makes grid cells misaligned with scan direction f
- A compromise option is fixed rotation angles for each box

-25°
0.1 GB



60 m orthorectified
reflectance

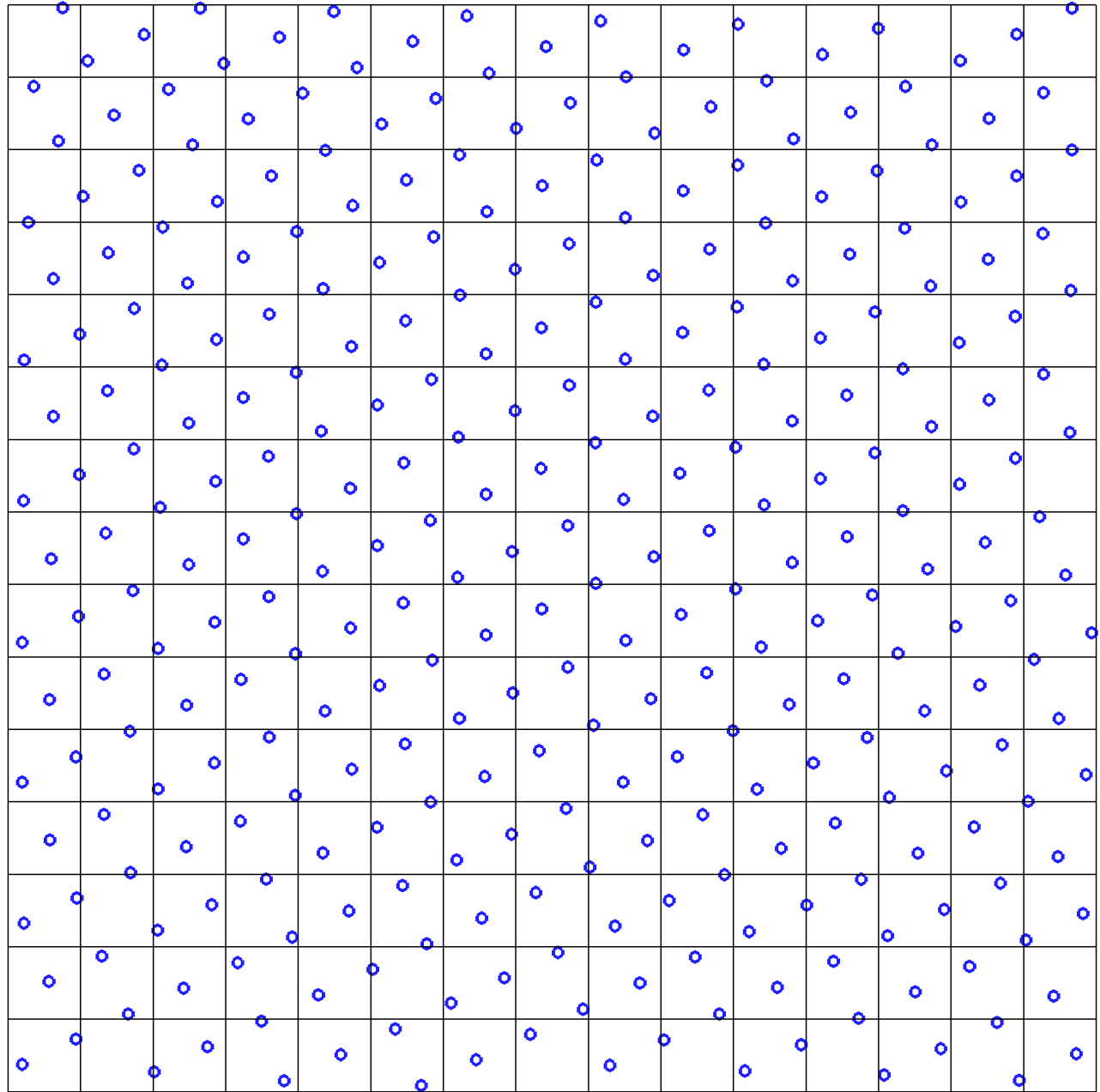
0.3 GB



Scene Rotation f_c

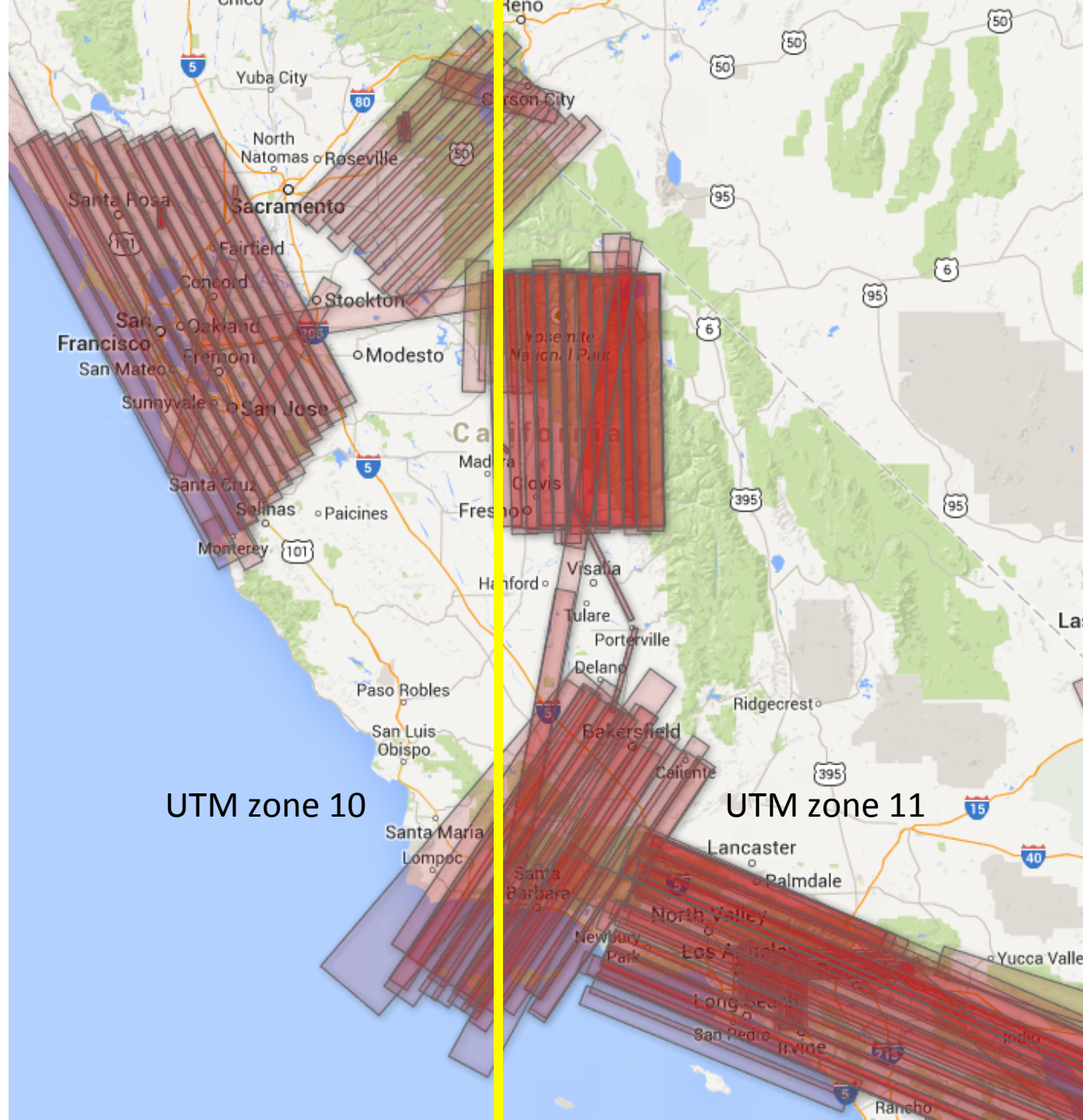
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Scan Direction



Projection *fc*

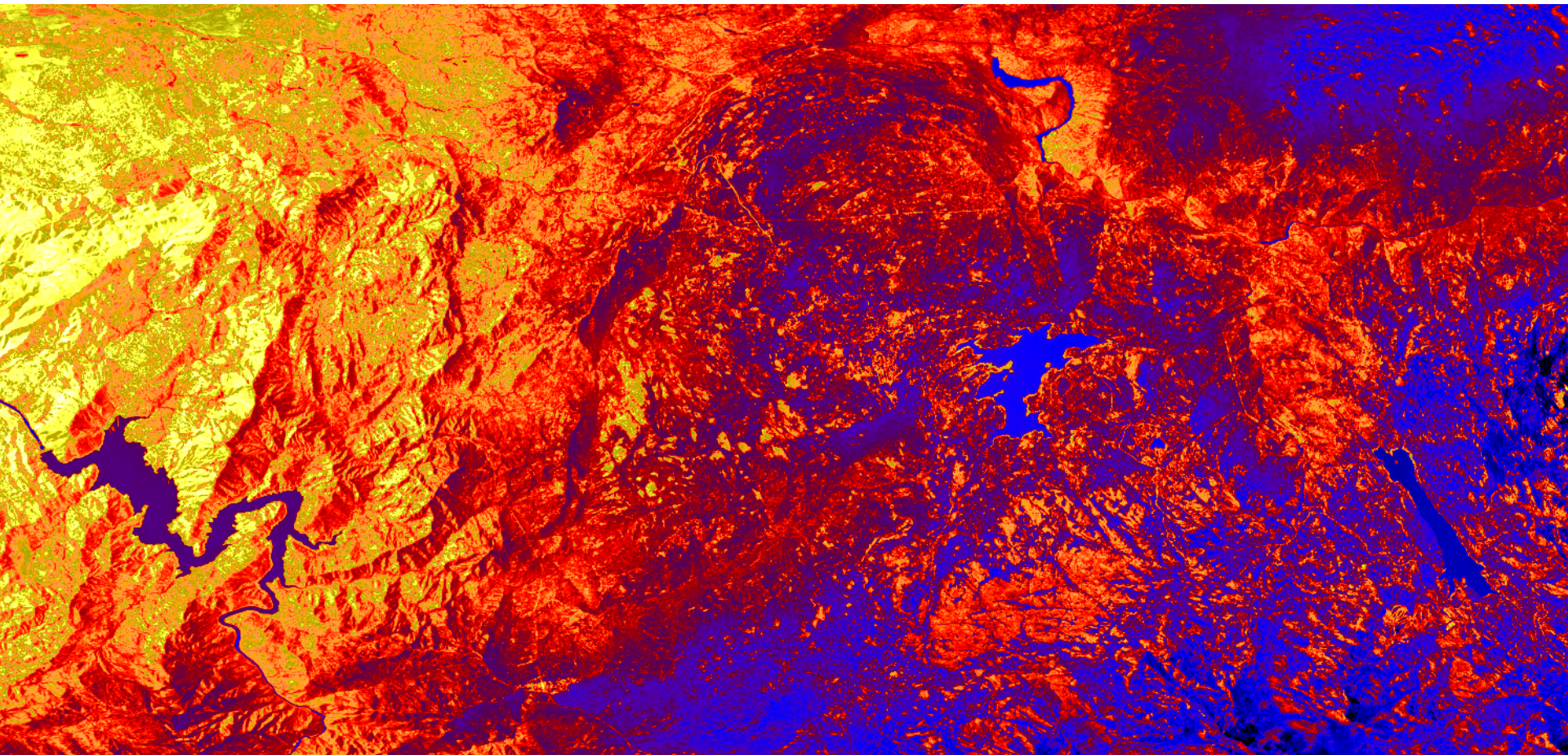
- Orthorectification is done using a UTM projection
- The campaign spans two UTM zones
- Standard zone for each box?
 - 10: Bay Area and Tahoe
 - 11: Yosemite, SB, SoCal
- Custom projection?



How should MASTER data be incorporated? c

- Instantaneous field of view (IFOV):
 - 1 milliradian for AVIRIS C
 - 2.5 milliradian for MASTER
- MASTER GIFOV should be in the 42-50 m range
- This observation density is low for resampling to 60 m
 - Tradeoffs of different resampling approaches
 - Spatial error introduced by coregistration

MASTER TIR radiance
Soda straw



Conclusions & Opinions

- The current orthorectified AVIRIS products have too many empty cells
 - 15-30% filled by nearest neighbor
- All campaign orthorectified AVIRIS data should be produced at the same spatial resolution
 - 17.5 to 18 m
- When working with fine resolution AVIRIS data, use the unorthorectified data when possible, then orthorectify your products
- We can produce 60 m, Gaussian resampled, VSWIR-like data that should approximate the HypIRI PSF
 - Resampling doesn't account for AVIRIS PSF
 - Geolocation error is still present in observation centers (x,y,z) and will carry through to 60 m
- If there is interest in standard products, rotation, void filling, projection, noise, and MASTER coregistration issues should be resolved by community consensus
 - Flexibility to create custom products should still be maintained

