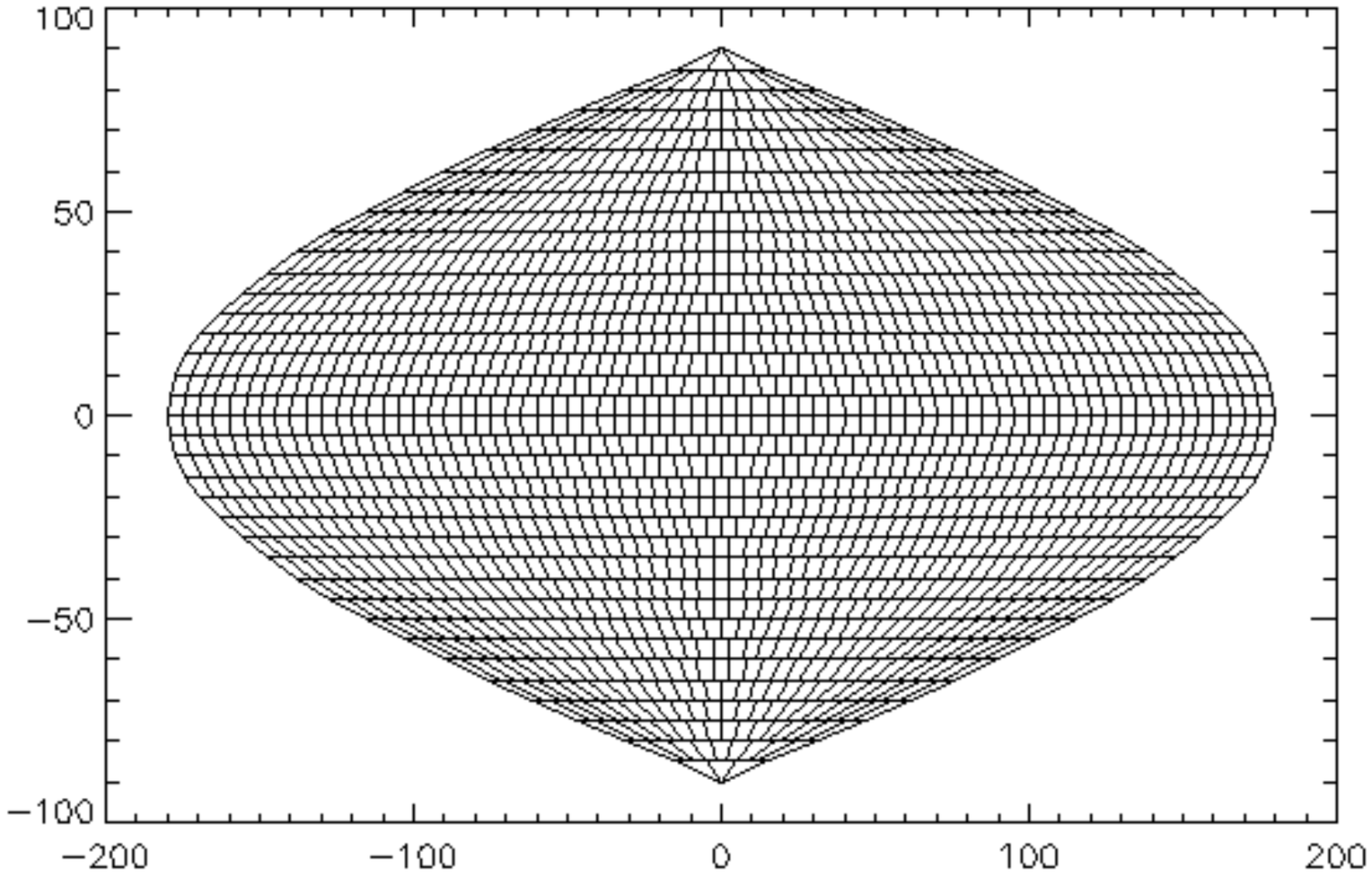
Spatial Binning…

Equal-Area Bins



Spatial Binning

Chlorophyll is ***log-normally distributed in space*** - there are lots of low values and only a few very high values in a given area.

> Consequently, ***sampling this distribution with low spatial frequency*** will miss the rare big values and bias the computed mean toward a low concentration
> (see Rossow Paper).

The number of kilometers per degree of longitude decreases toward the pole.

> Consequently, a 1^{o}x1^{o} bin in an equal angle (cylindrical) projection near the pole contains less square kilometers than a 1^{o}x1^{o} bin near the equator and so the 1^{o}x1^{o} bin near the pole is under sampled compared to the equator and the spatial mean in that equal-angle bin is biased toward toward a lower concentration relative the mean in the equal-angle bin near the equator.

The Upshot — If you intend to reduce the spatial resolution of your images, it is best to average together in **equal area** bins/grids and ***not*** apply the resolution reduction on **equal angle** bins/grids – this is especially true when dealing with images spanning large ranges of latitude.

Standard Level-3 Processing

- Level 2
  - geolocated geophysical products for each pixel

- Level 2 & Level 3 binning
  - geophysical products averaged spatially **and then** temporally
  - sinusoidally distributed, equal area bins

- Level 3 mapped
  - images created by mapping and scaling Level-3 binned products
  - user-friendly, cylindrical equiangular projection

- Bin resolution 4.6 x 4.6 km^2

- Mapped resolution
  - 0.042-deg
  - 0.084-deg

- Composite Periods
  - Daily
  - 8-day
  - Monthly
  - Seasonal
  - Yearly
  - Mission

From Bryan Franz (OBPG)

My Level-3 **Straight Mapped** Product

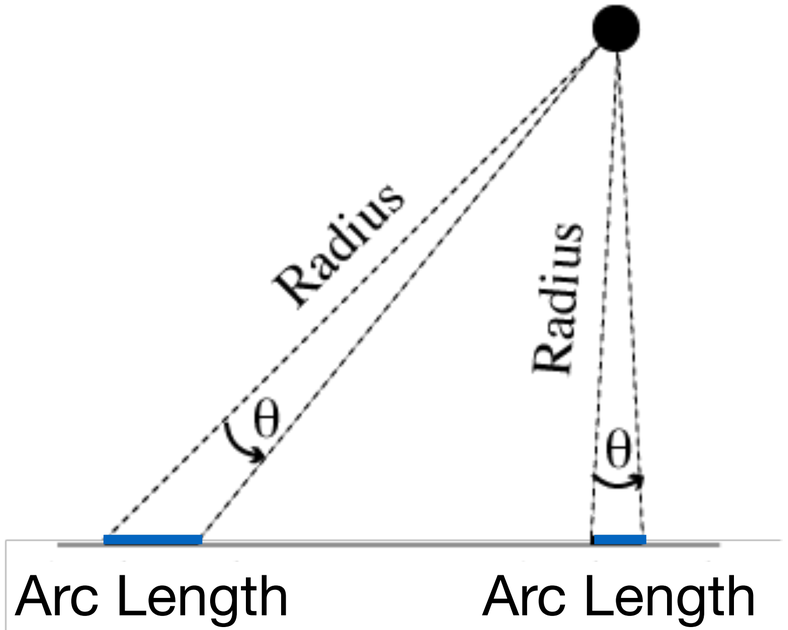
In some of the processing scripts that I have written I do not do spatial binning because I do not want to reduce the resolution of my images or the binning does not go to a high enough resolution (e.g. HiRes Bands, MERIS FRS and HICO)

To avoid any spatial averaging during mapping to cylindrical coordinates, the map dimensions (x-dimension, y-dimension) are set to the number of spatial pixels needed (at a given sensor resolution) to span each degree of longitude or latitude in the final map. i.e., 111km per degree. *Note this is reduced by cosine(latitude) for the xdim

In this manner, there is no data loss in going from satellite perspective to the mapped perspective.

Off-Nadir Changes in Spatial Resolution

As the mirror sweeps back and forth to swath out a scene on the earth, the satellite sensor "sees" with a resolution that is measured in terms of a **fixed fractional number of radians (θ)**.

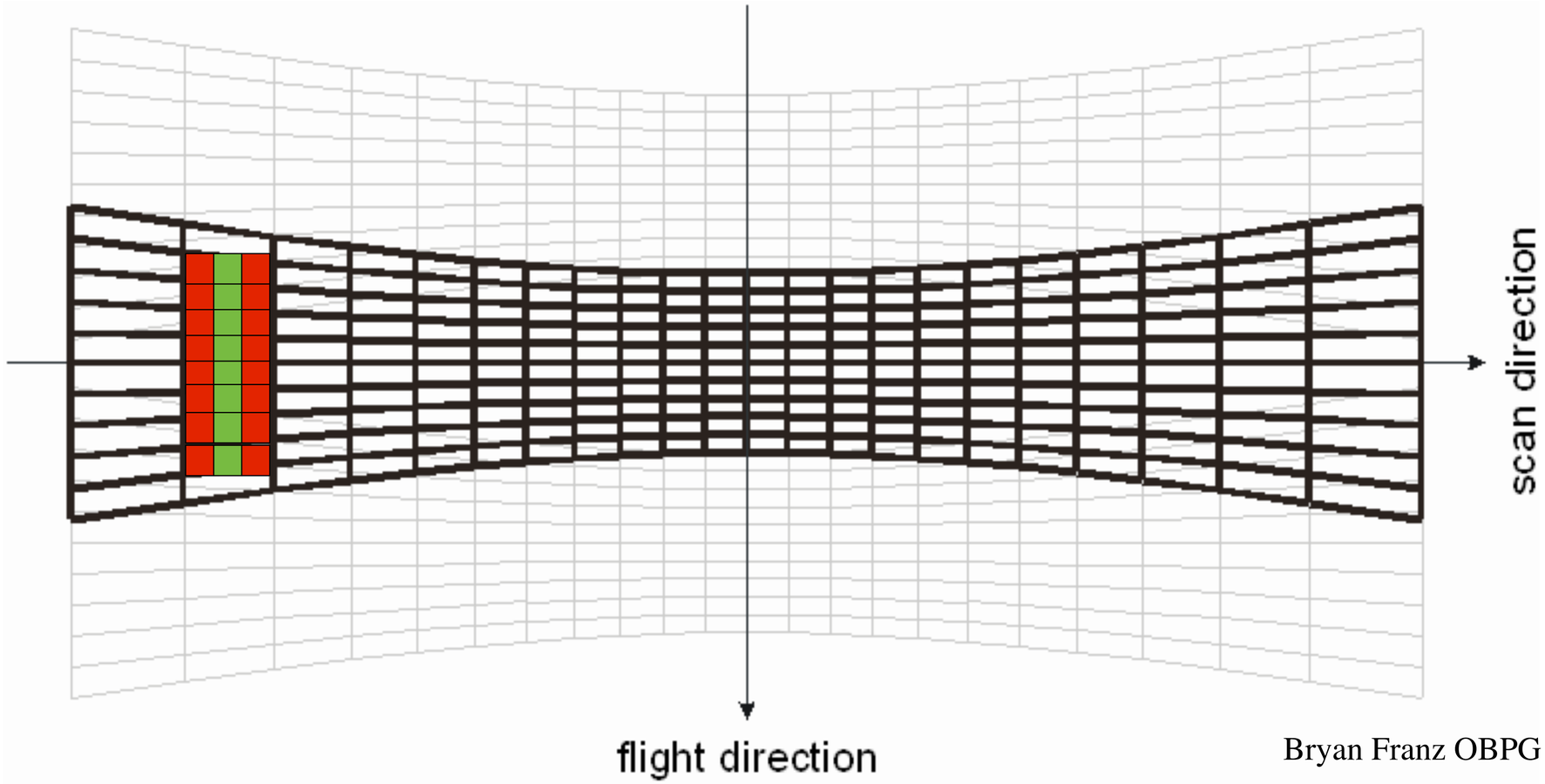


Recall that arc length = radius x θ.

When the sensor points straight down (***nadir***) the radius is the altitude of the satellite and the arc length is about 1km. When the satellite sensor sweeps off to the side, the distance between sensor and earth surface (i.e., radius) is larger. Consequently, the arc length is longer and so the spatial resolution is longer.

Changing Pixel Resolution Along Satellite Scan

Increasing Pixel Size



Bryan Franz OBPG

If bin size is smaller that the spatial resolution of the sensor you will get streaks of missing data in the binmapped product. Temporal averaging will remote fill in these artifacts.