

# Level 2 (GDR) data products

Jean-Pierre Williams (UCLA)

# Diviner GDR data products

- Gridded products derived directly from the RDR data product (nadir only)
- Mimics format of the LOLA GDR data product for maximum compatibility with LOLA and other products
- The master resolution of 128 pix per degree
  - Lower res products: 64 ppd, 16 ppd, 4 ppd, 1 ppd
- LOLA uses interpolation to create continuous global grids
- Diviner GDR data products are not interpolated

# Diviner GDR data products

	AVG (IMG)	CNT (IMG)	ERR (IMG)	AVG (JP2)	CNT (JP2)	ERR (JP2)
VB1	✓	✓	✓	✓	✓	✓
VB2	✓	✓	✓	✓	✓	✓
TB3	✓	✓	✓	✓	✓	✓
TB4	✓	✓	✓	✓	✓	✓
TB5	✓	✓	✓	✓	✓	✓
TB6	✓	✓	✓	✓	✓	✓
TB7	✓	✓	✓	✓	✓	✓
TB8	✓	✓	✓	✓	✓	✓
TB9	✓	✓	✓	✓	✓	✓
TBOL	✓			✓		
LTIM	✓			✓		
JD	✓			✓		

## Projections

	CYL	POLS	POLN
128 ppd	✓		
64 ppd	✓		
16 ppd	✓		
4 ppd	✓		
1 ppd	✓		
240 m pix <sup>-1</sup>		✓	✓

35 mapping cycles =

8820 IMG

6300 IMG (cyl -180 to 108)

8820 JP2

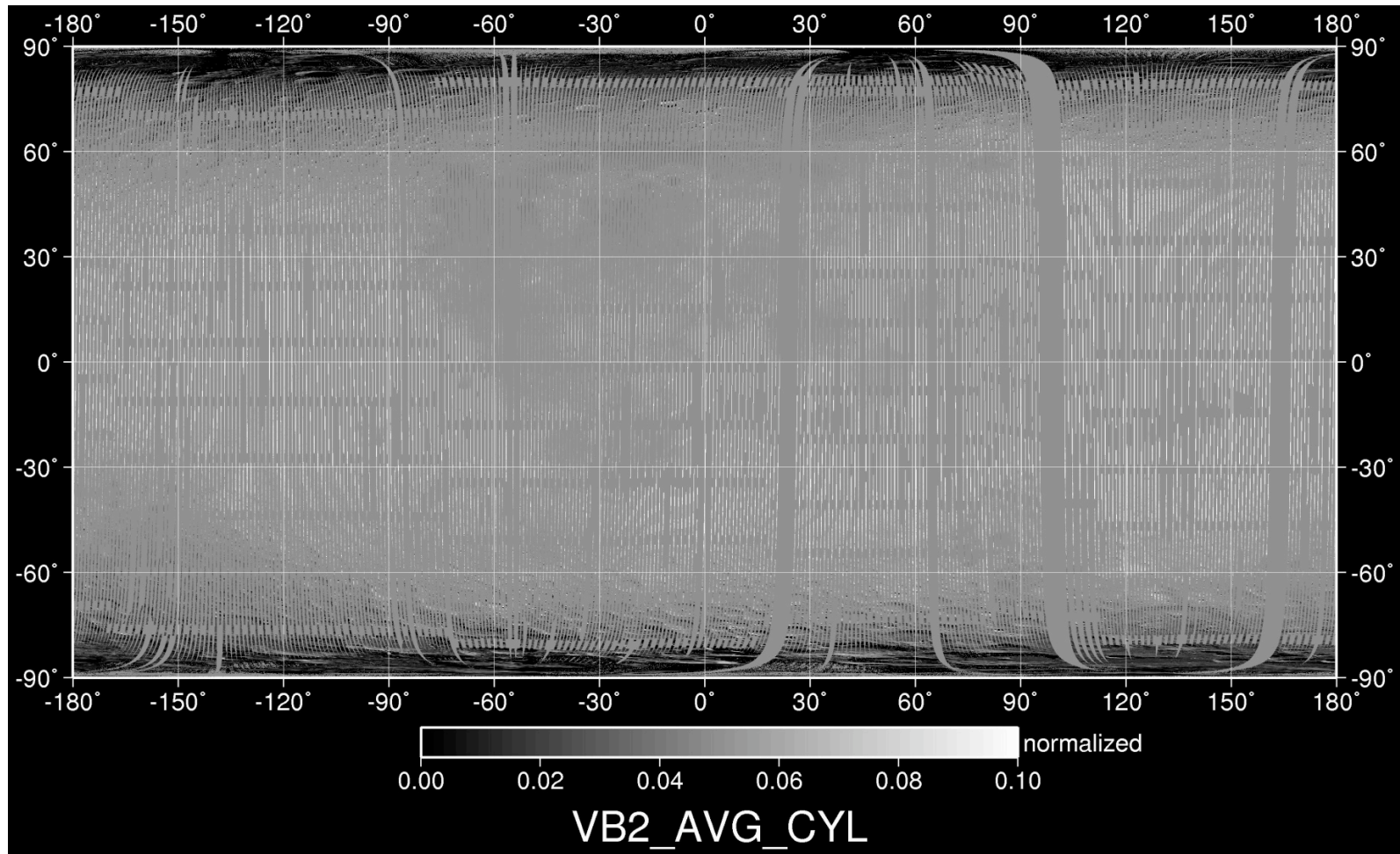
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23940 Total files

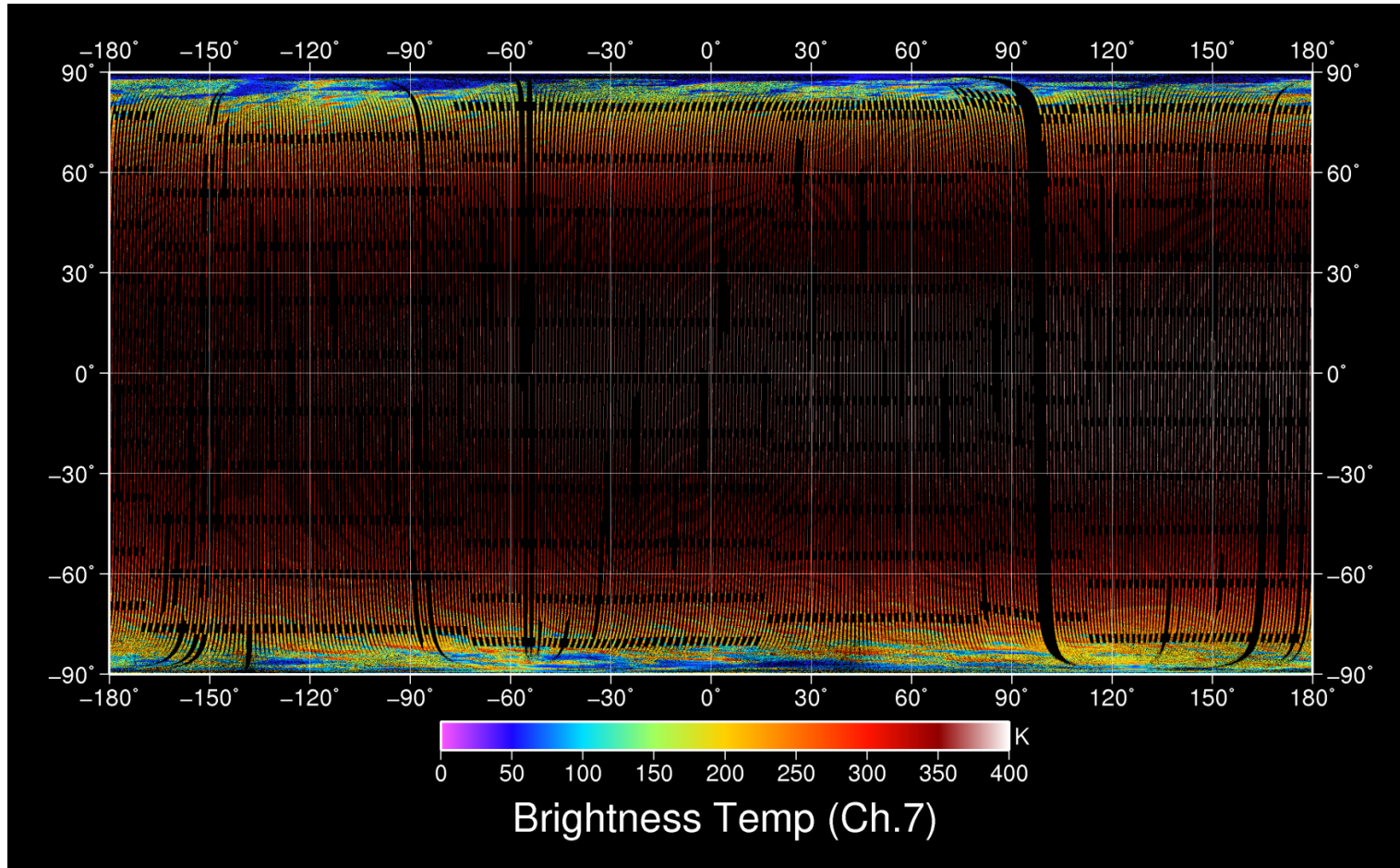
# Status on Production

- Level 4 polar products complete (PRP)
- Level 3 RA, ST, RMS complete
- Level 2 pipeline completed and in production
  - TB,VB maps currently being generated (Cylindrical)
    - All channels and resolutions
  - Generating JD,LTIM for each channel
    - Will be combined into single map for each map cycle
  - TB will be combined into level 3 TBOL
  - Generating radiance and incidence angle (tinc)
    - used for emissivity maps and level 3 CF maps (CF maximum and CF Position)

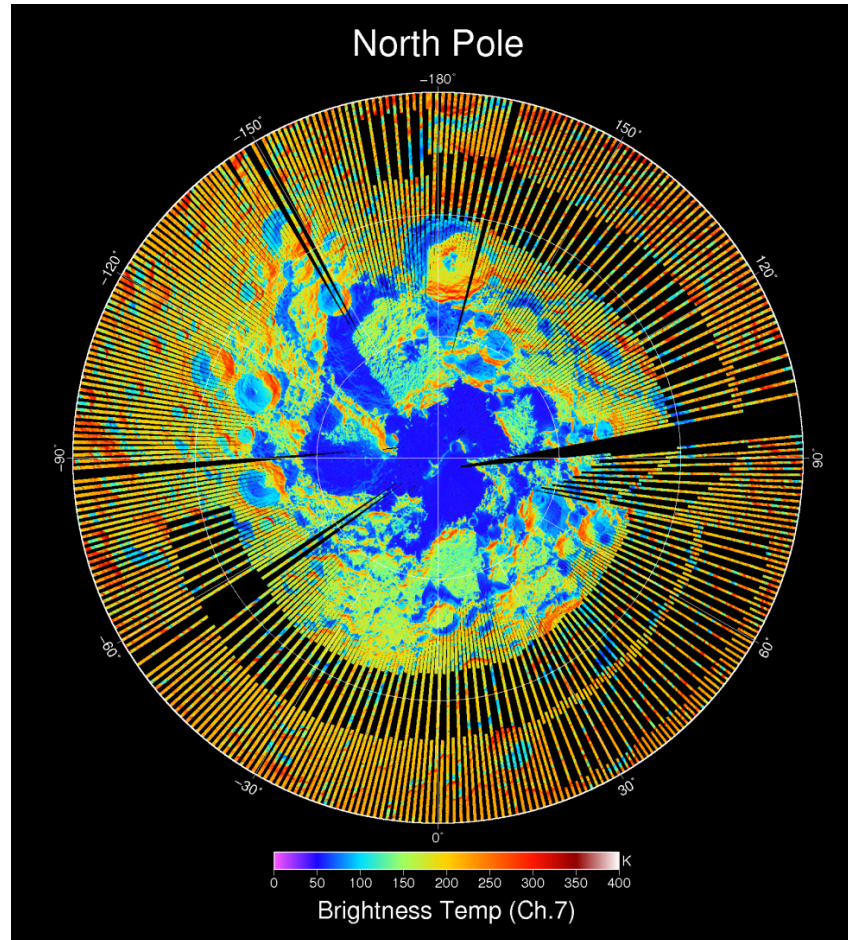
# Level 2 Visual Brightness



# Level 2 Brightness Temperature



# Level 2 Map: Polar Projection



# File Name Convention

DGDR\_VB1\_AVG\_CYL\_20090705D\_128\_IMG.IMG

	VB2	CNT	POLN	Y:M:D:D/N	064	JP2
	TB3	ERR	POLS		016	JPG
	TB4				004	
	TB5				001	
	TB6				240	
	TB7					
	TB8					
	TB9					
	TBOL					
	JD					
	LTIM					

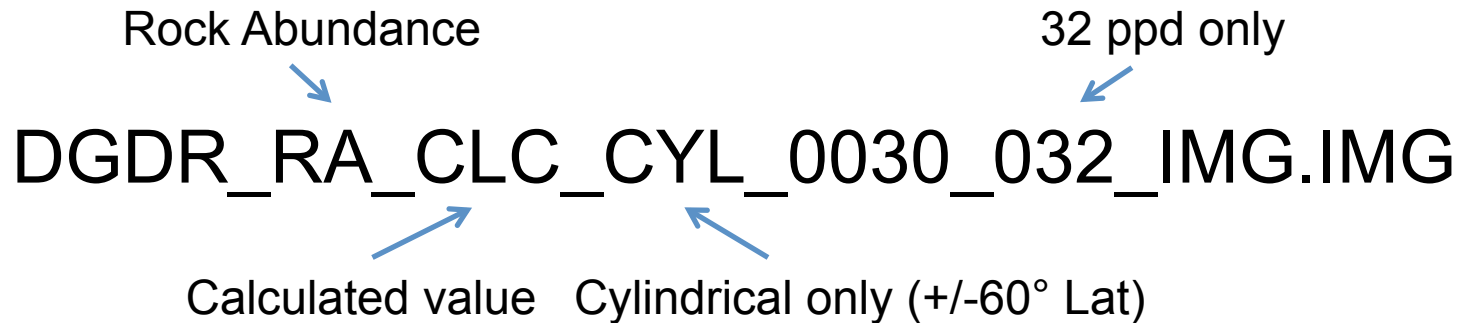


# File Name Convention

Rock Abundance 32 ppd only

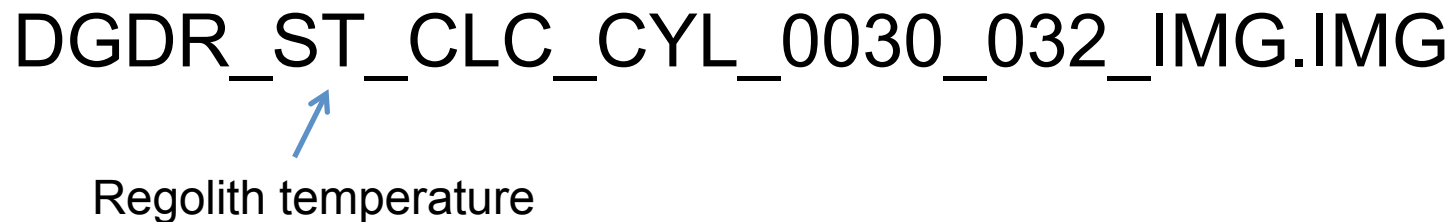
DGDR\_RA\_CLC\_CYL\_0030\_032\_IMG.IMG

Calculated value Cylindrical only (+/-60° Lat)

Detailed description: This diagram illustrates the file name convention for Rock Abundance data. The file name is 'DGDR\_RA\_CLC\_CYL\_0030\_032\_IMG.IMG'. Blue arrows point from the labels 'Rock Abundance', '32 ppd only', 'Calculated value', and 'Cylindrical only (+/-60° Lat)' to their respective parts in the file name: 'RA', '032', 'CLC', and 'CYL'.

DGDR\_ST\_CLC\_CYL\_0030\_032\_IMG.IMG

Regolith temperature

Detailed description: This diagram illustrates the file name convention for Regolith temperature data. The file name is 'DGDR\_ST\_CLC\_CYL\_0030\_032\_IMG.IMG'. A blue arrow points from the label 'Regolith temperature' to the 'ST' component in the file name.

DGDR\_RMS\_CLC\_CYL\_0030\_032\_IMG.IMG

rms error of RA,ST Local time: Hourly maps 19:30 to 5:30

Detailed description: This diagram illustrates the file name convention for RMS error data. The file name is 'DGDR\_RMS\_CLC\_CYL\_0030\_032\_IMG.IMG'. Blue arrows point from the labels 'rms error of RA,ST' and 'Local time: Hourly maps 19:30 to 5:30' to the 'RMS' and '0030' components in the file name.

DGDR\_CF\_CLC\_CYL\_032\_IMG.IMG

Christiansen Feature position

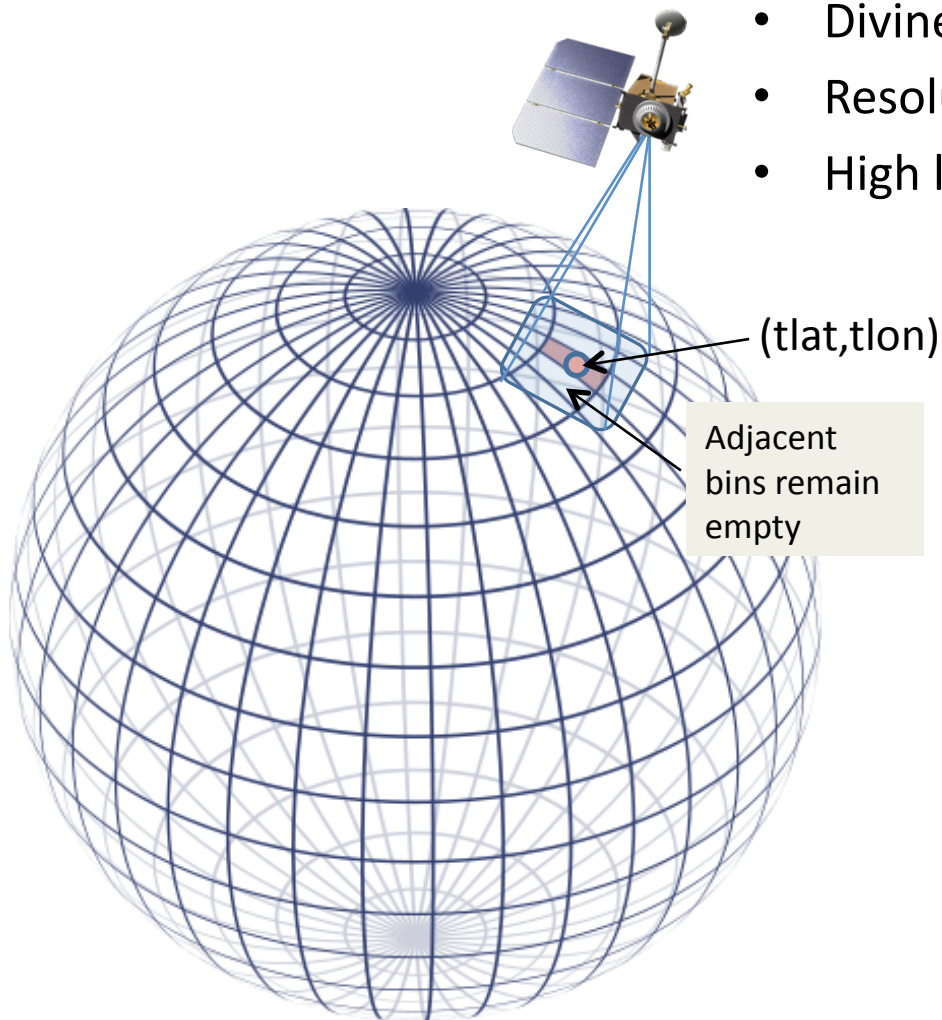
Detailed description: This diagram illustrates the file name convention for Christiansen Feature position data. The file name is 'DGDR\_CF\_CLC\_CYL\_032\_IMG.IMG'. A blue arrow points from the label 'Christiansen Feature position' to the 'CF' component in the file name.

# Production Pipeline

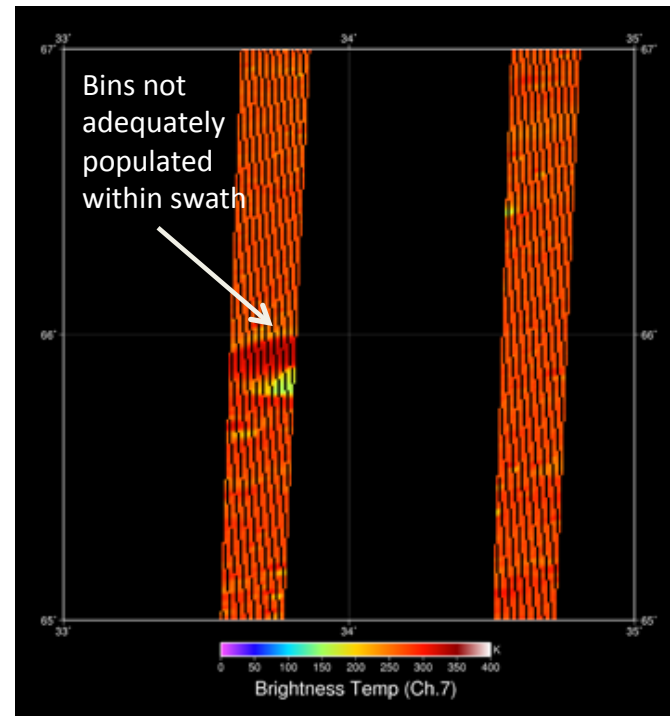
## Single Diviner Channel for a given Map cycle

- Working on 144 cluster nodes at UCLA
- Creates map tiles  $10^\circ$  Lat  $\times$   $45^\circ$  Lon
- 144 tiles each for AVG,CNT,ERR,RAD, (TINC) for each resolution (128, 64, 16, 4, 1 ppd)  
-> 2880 files (3600 when including tinc)
- Post-processing – stitch tiles together and convert to 2 IMG files and generate browse images (jpeg) of all maps
  - (1) Latitudes  $-180^\circ$  to  $180^\circ$  Converted to JPEG2000
  - (2) Latitudes  $0^\circ$  to  $360^\circ$  Archived IMG file at PDS

# Binning Data at High Latitudes



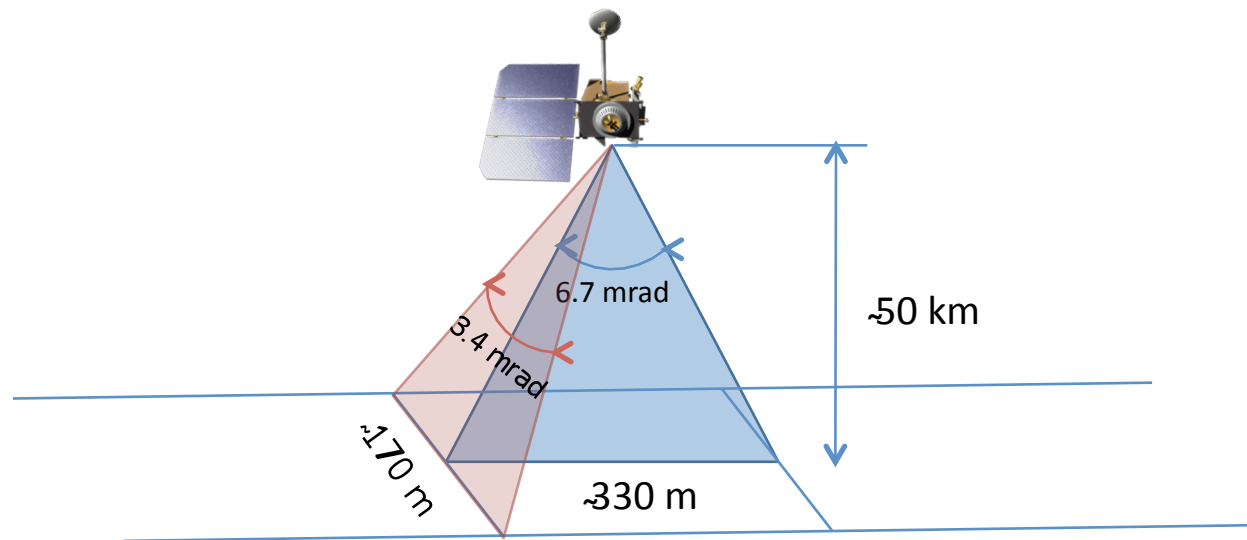
- Diviner GDR data products are not interpolated
- Resolution aliasing problems at higher latitudes
- High latitudes bin size is smaller than footprint



Two swaths of Diviner data from two consecutive orbits

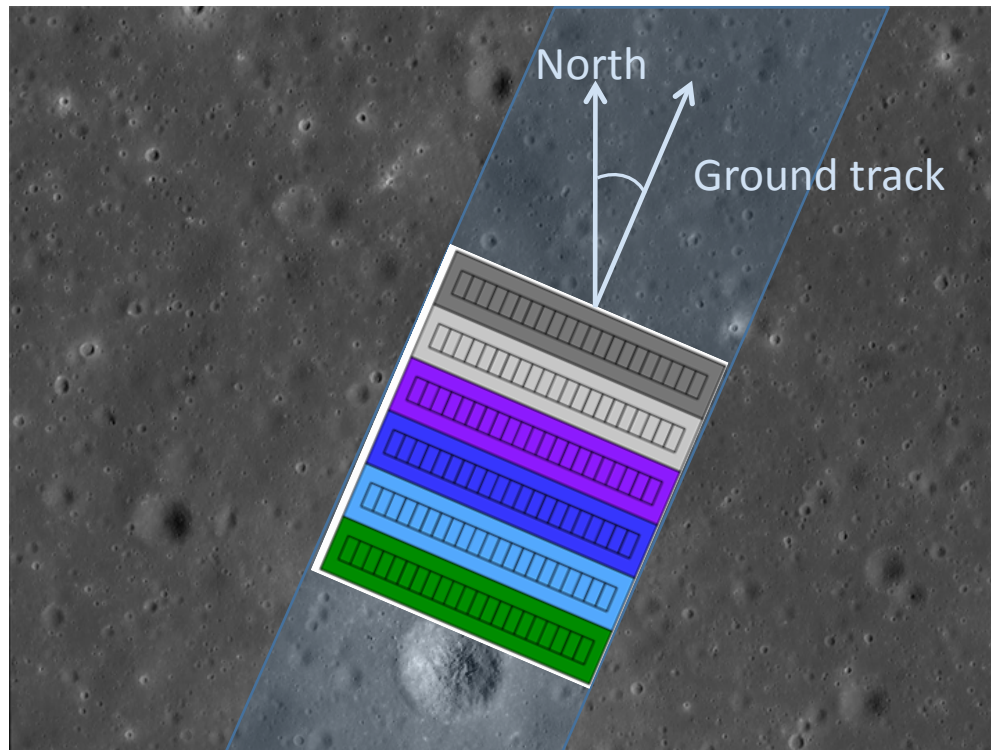
# Field-Of-View

- Populate all bins within footprint
- Account for the finite field of view of Diviner
- Project footprints by locating the FOVs in three dimensions onto a LOLA 1/128° DEM



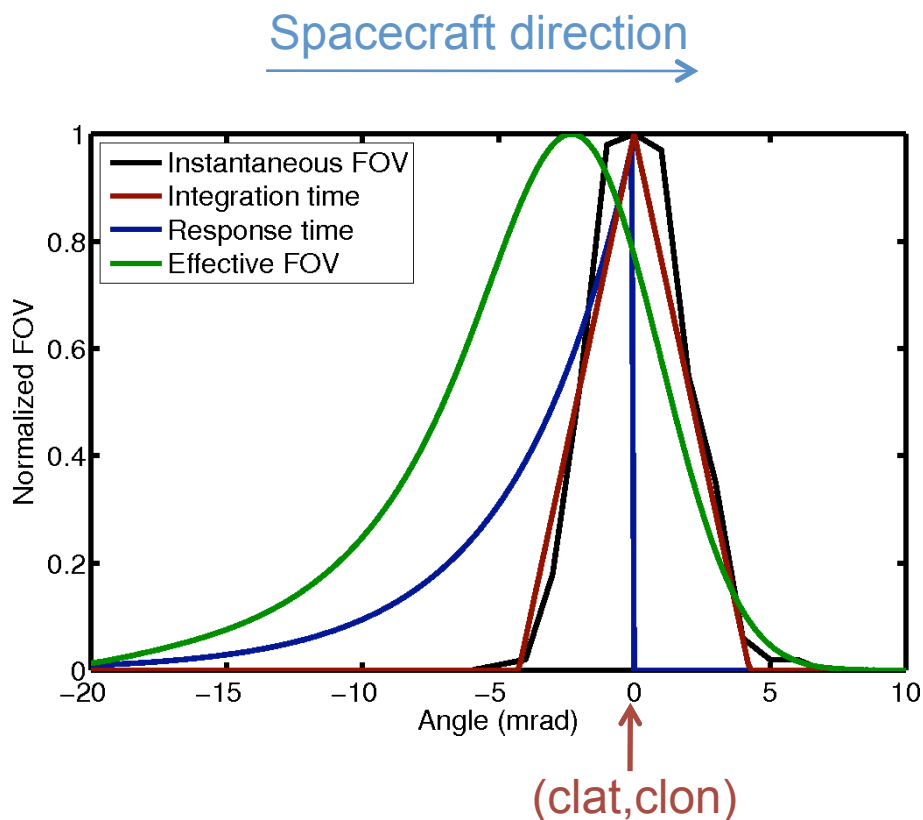
# Orientation of Footprint

1. Need to find orientation of footprint relative to north

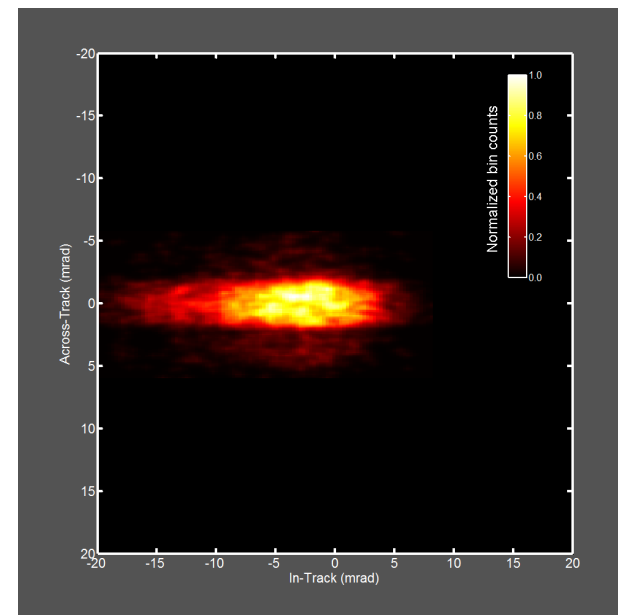


# In-Track Effective FOV

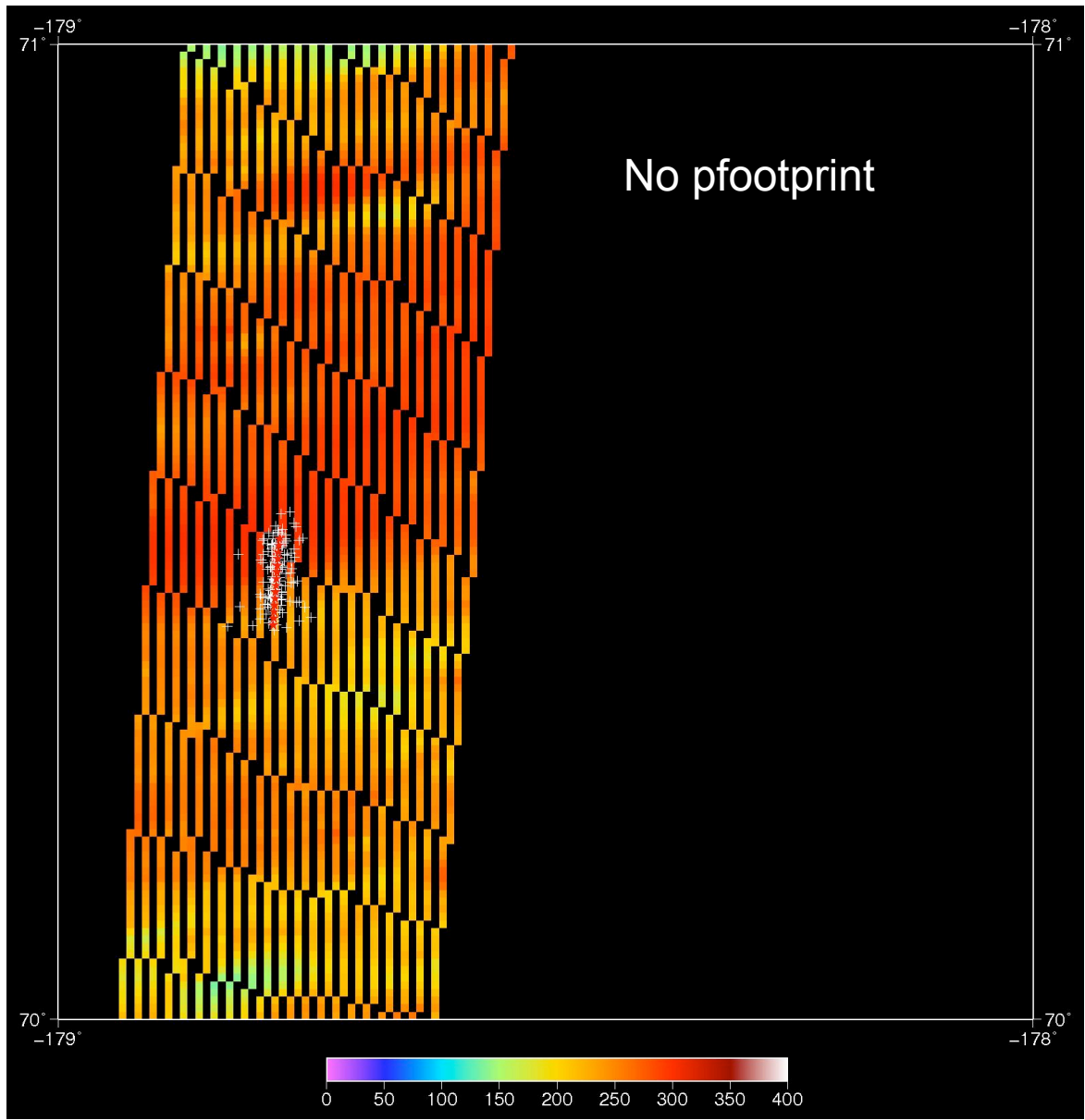
- Effective FOV a convolution of:
  - Instantaneous FOV
  - Integration time broadening
  - Sensor response time broadening

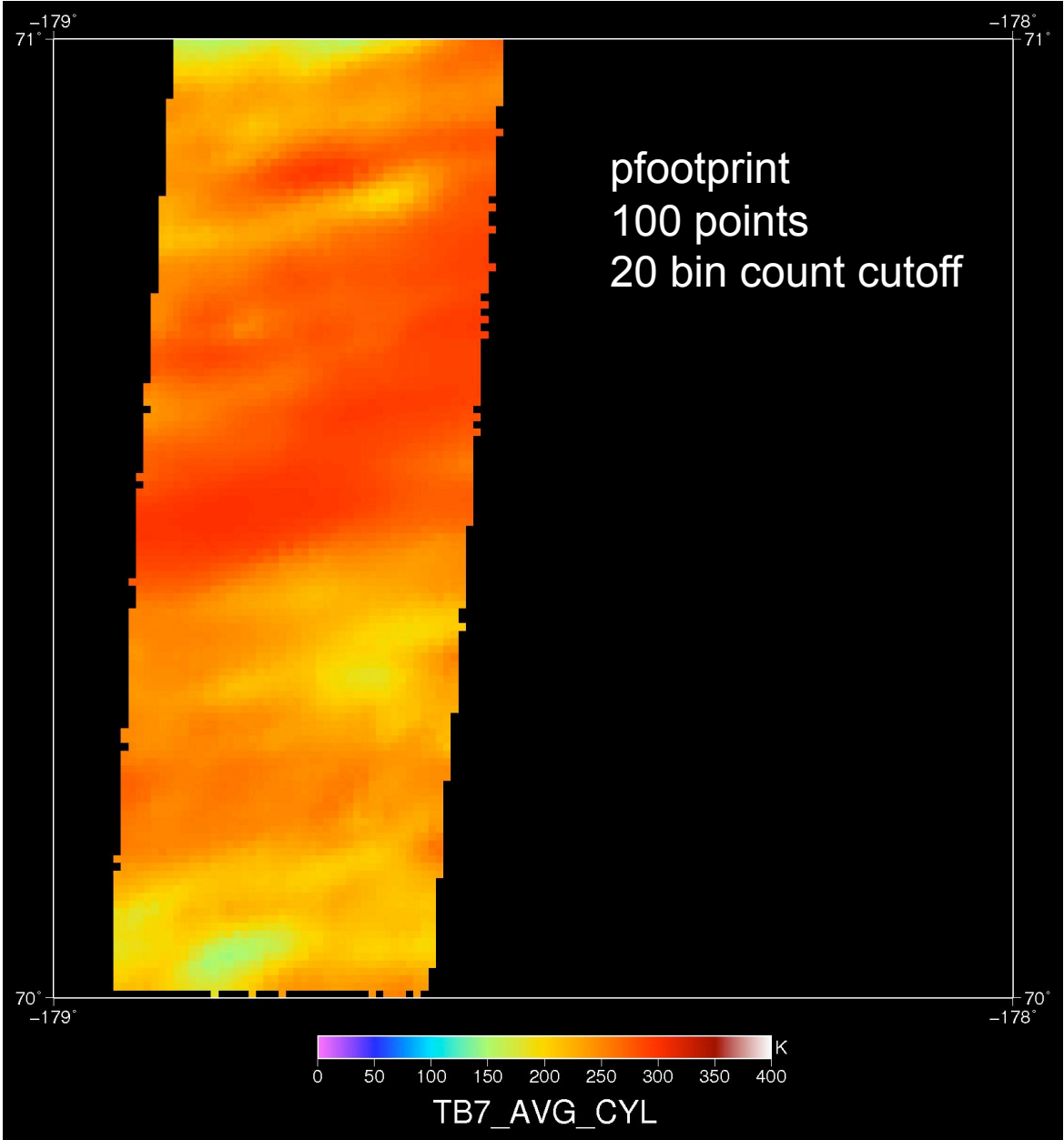


**Figure:** Example of results from effective FOV routine assuming spacecraft to surface distance of 50 km and spacecraft velocity  $1.66 \text{ km s}^{-1}$ .



**Figure:** 2D normalized histogram  
100 x100 bins

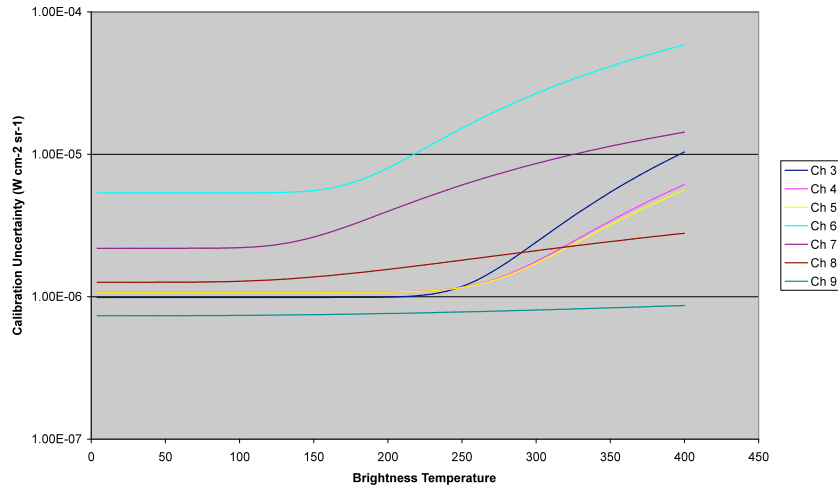






# Uncertainty

Diviner Calibration Uncertainties



Standard Deviation for a bin

$$\sigma = \sqrt{\left(\frac{1}{N-1}\right) \sum_{i=1}^N (R_i - \bar{R})^2} = \sqrt{\left(\frac{1}{N-1} \sum_{i=1}^N R_i^2\right) - \bar{R}^2}$$

Std. of Mean

$$\sigma_m = \frac{\sigma}{\sqrt{N / N_{fp}}}$$

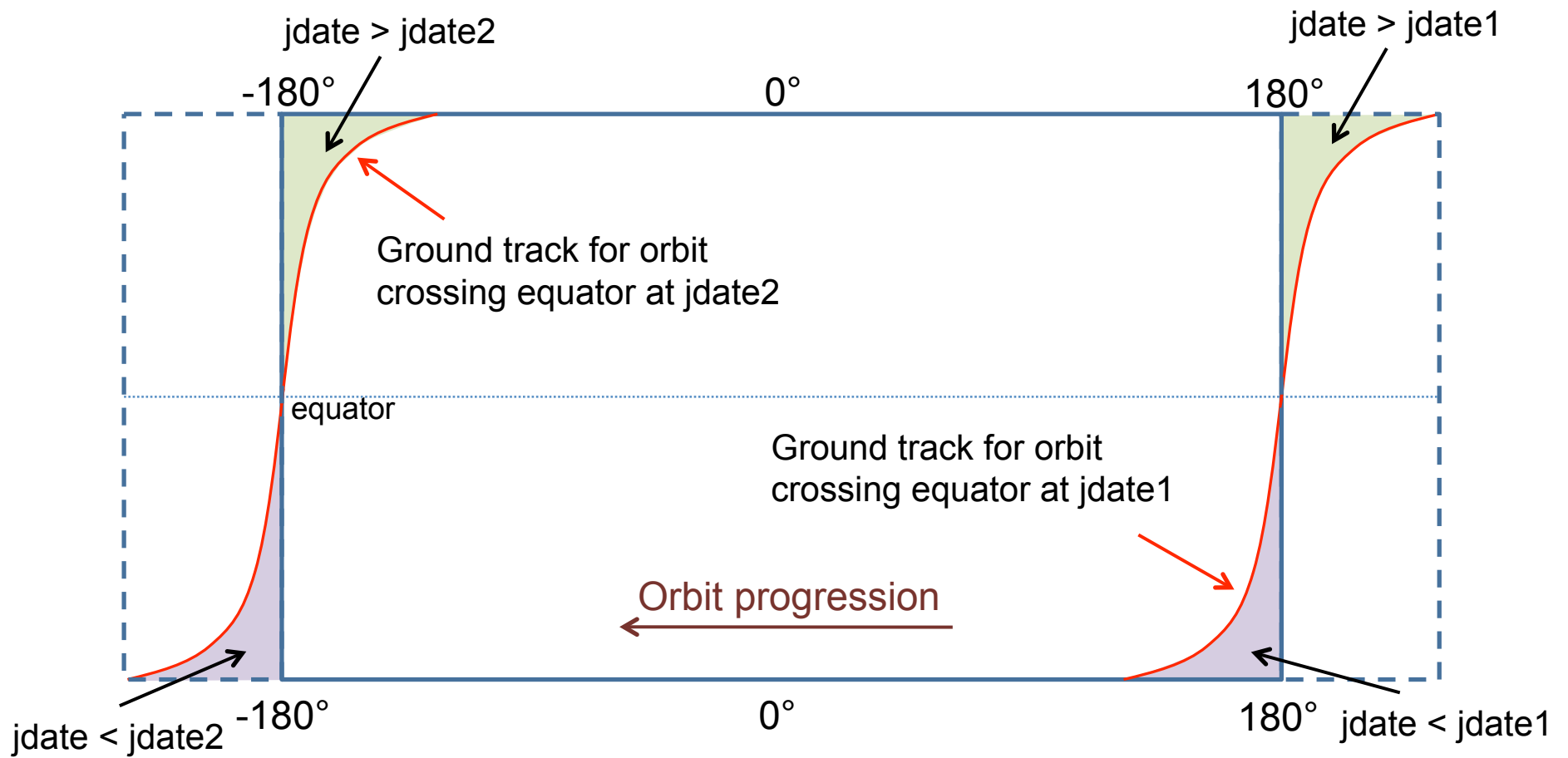
Calibrated detector uncertainty

$$\bar{R}^c = \frac{\sum_{i=1}^N R_i^c}{\sqrt{N / N_{fp}}}$$

we know  $\sigma_m, \bar{R}, N$  and  $N_{fp}$  for each high resolution bin,  
we can then recover  $\sum_{i=1}^N R_i^2$  and  $\sum_{i=1}^N R_i^c$  for each bin  
determine the greater of  $\sigma_m$  and  $\bar{R}^c$  the final result

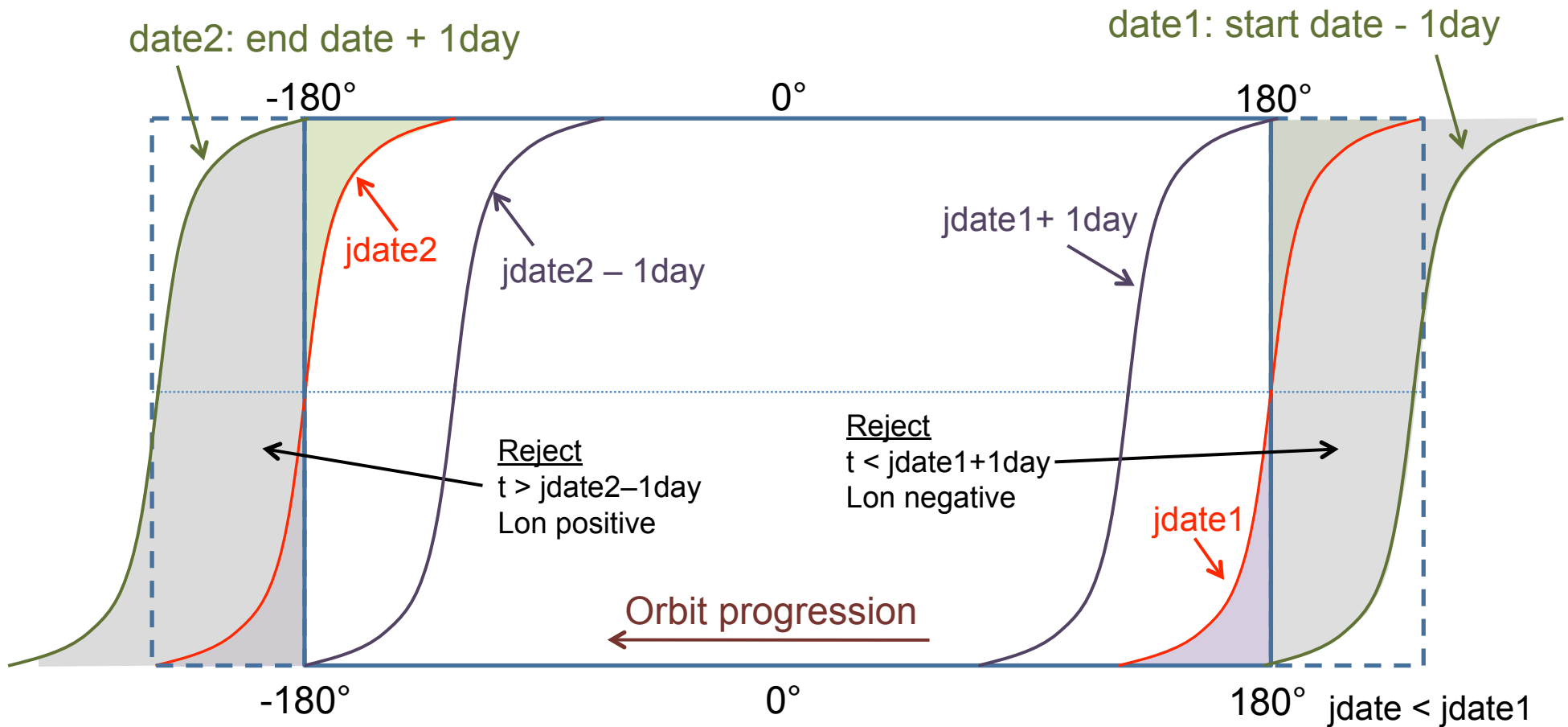
$$\Delta TB^c = \frac{TB(R + R^c) - TB(R - R^c)}{2}$$

# Map edges

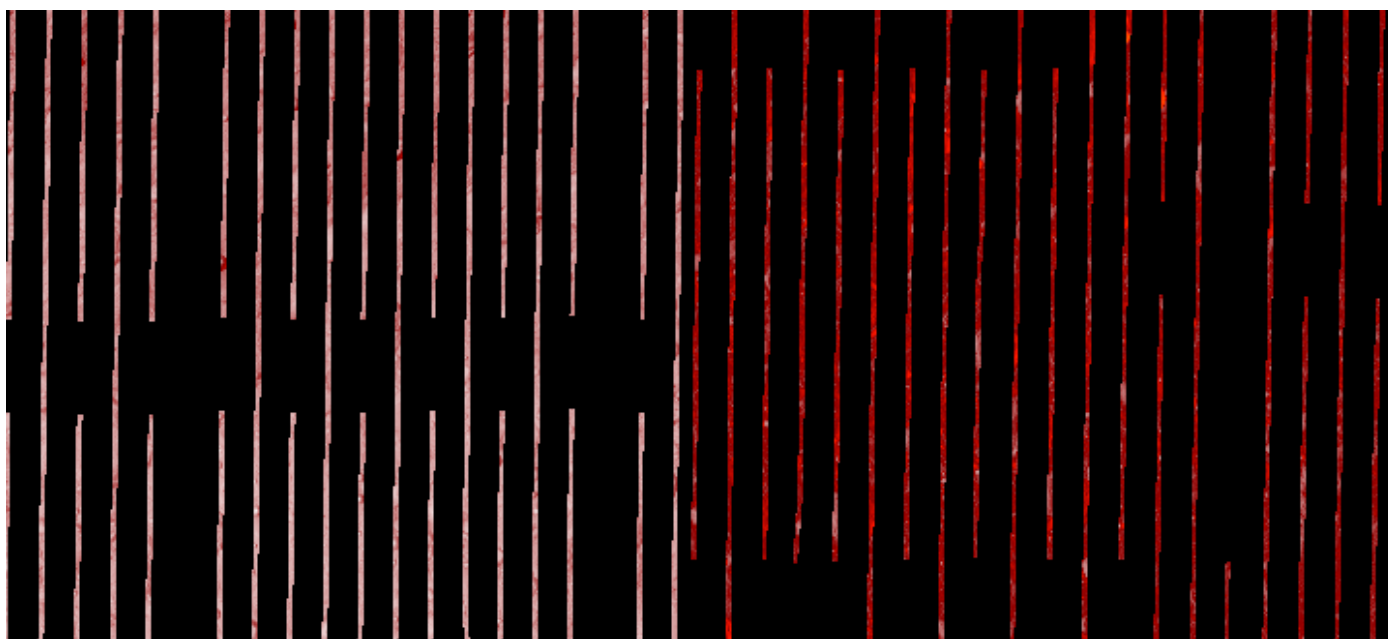
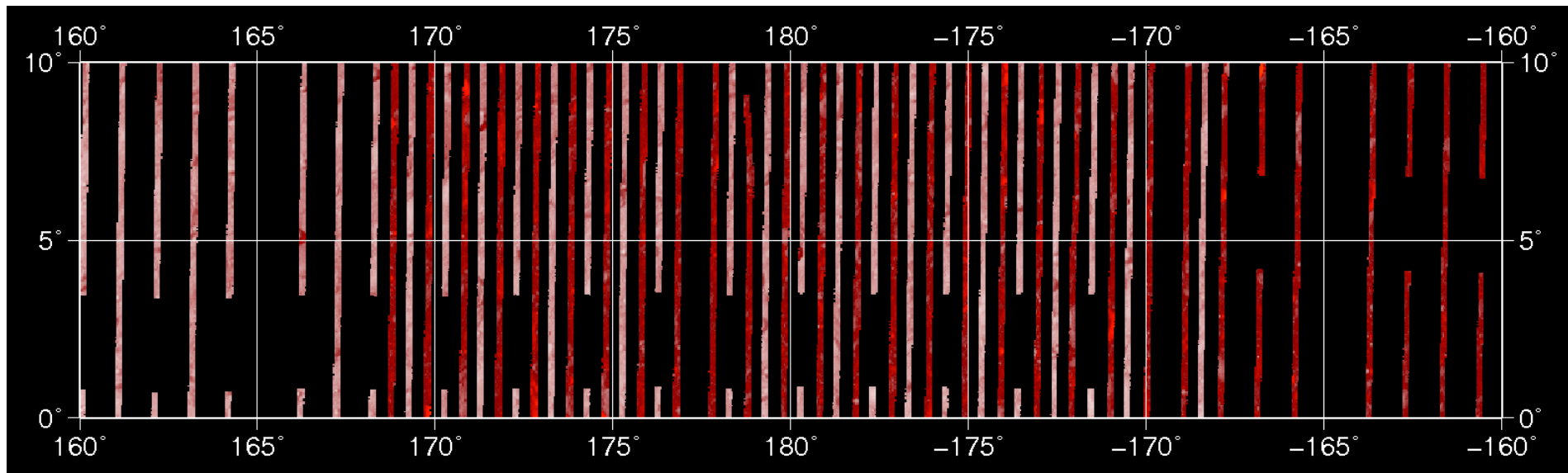


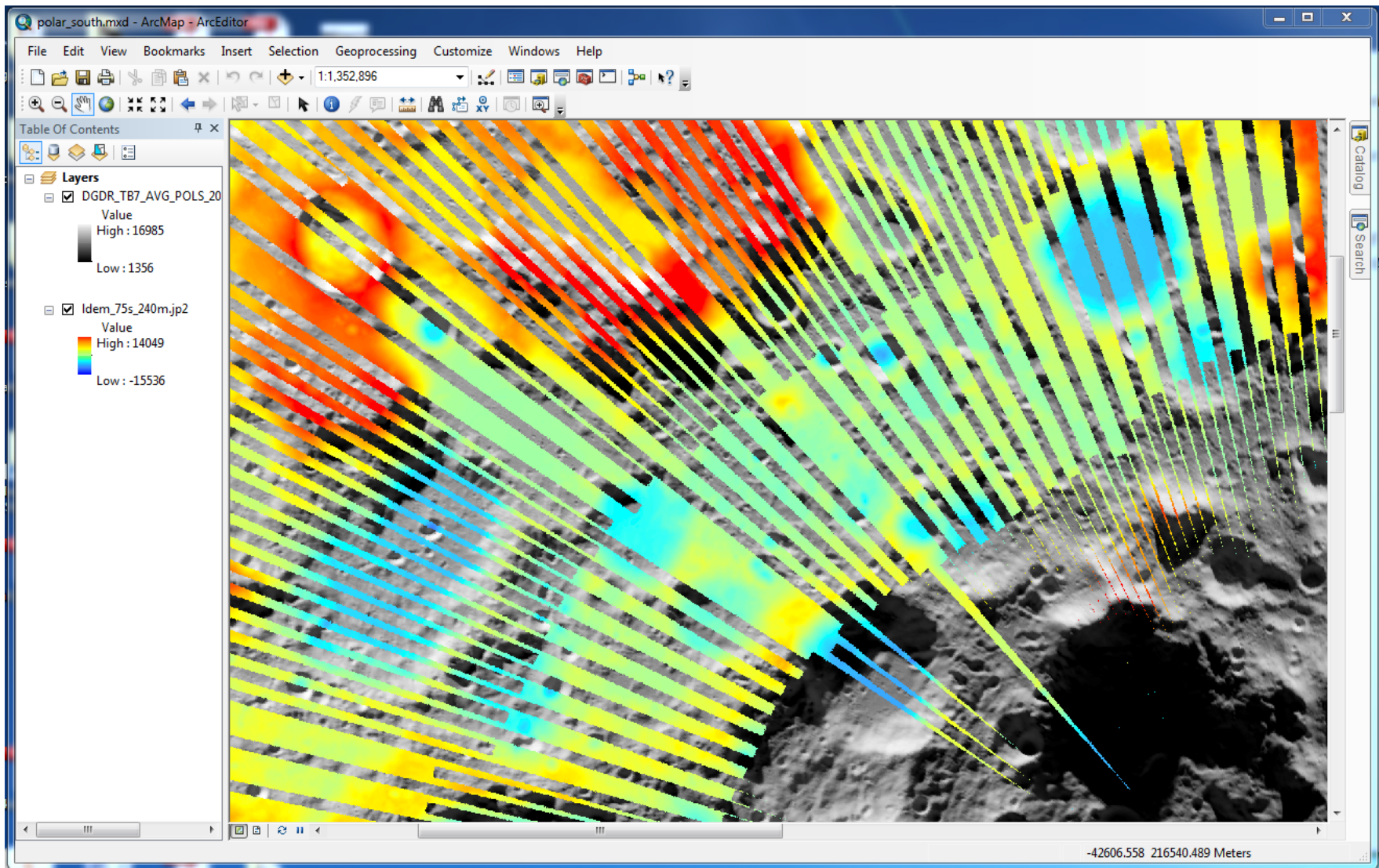
- Mapping cycles defined by Julian date LRO crosses  $\pm 180^\circ$  Longitude at equator (jdate1, jdate2).
- Problem: ground tracks at angle relative to N

# Pipes tool: pedge



- Add ~an extra time at either end
- `divdata daterange=date1,date2 | pedge x=clon jdat=jdate jrange=jdate1,jdate2`





LOLA (color) and Diviner Ch.7 (grayscale)