HRSC, ISIS3, GIS, etc.

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View/export HRSC to PNG with minivicar

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dlrto8 & dlrvic2png

WHAT TO DO (shown just for one band):

- Convert vicar file from 16 to 8 bit (dlrto8)
- Export 8 bit vicar file to .png

```
HRORTHO

$HWLIB/dlrto8 inp=nadir out=nadir_8bit.vic dnmin=0


$HWLIB/dlrvic2png inp=nadir_8bit.vic out=NADIR.PNG
```

- Combine rgb single files in RGB file

View/export HRSC Level4/DEMs: HRSC in ISIS3

Disclaimer:
All following information is provided "as is".

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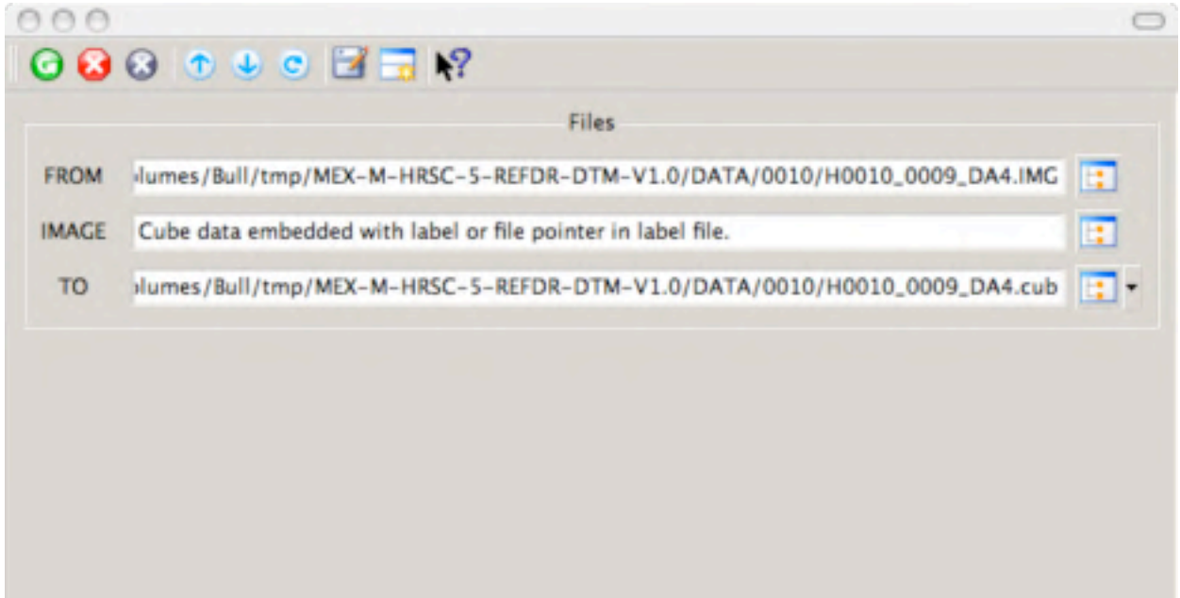
HRSC Level4 in ISIS3

- HRSC Level4 (other levels as well) can be imported into ISIS3 (USGS, Flagstaff) for further processing or export

SEE:
http://isis.astrogeology.usgs.gov/

HRSC DA4 in ISIS3

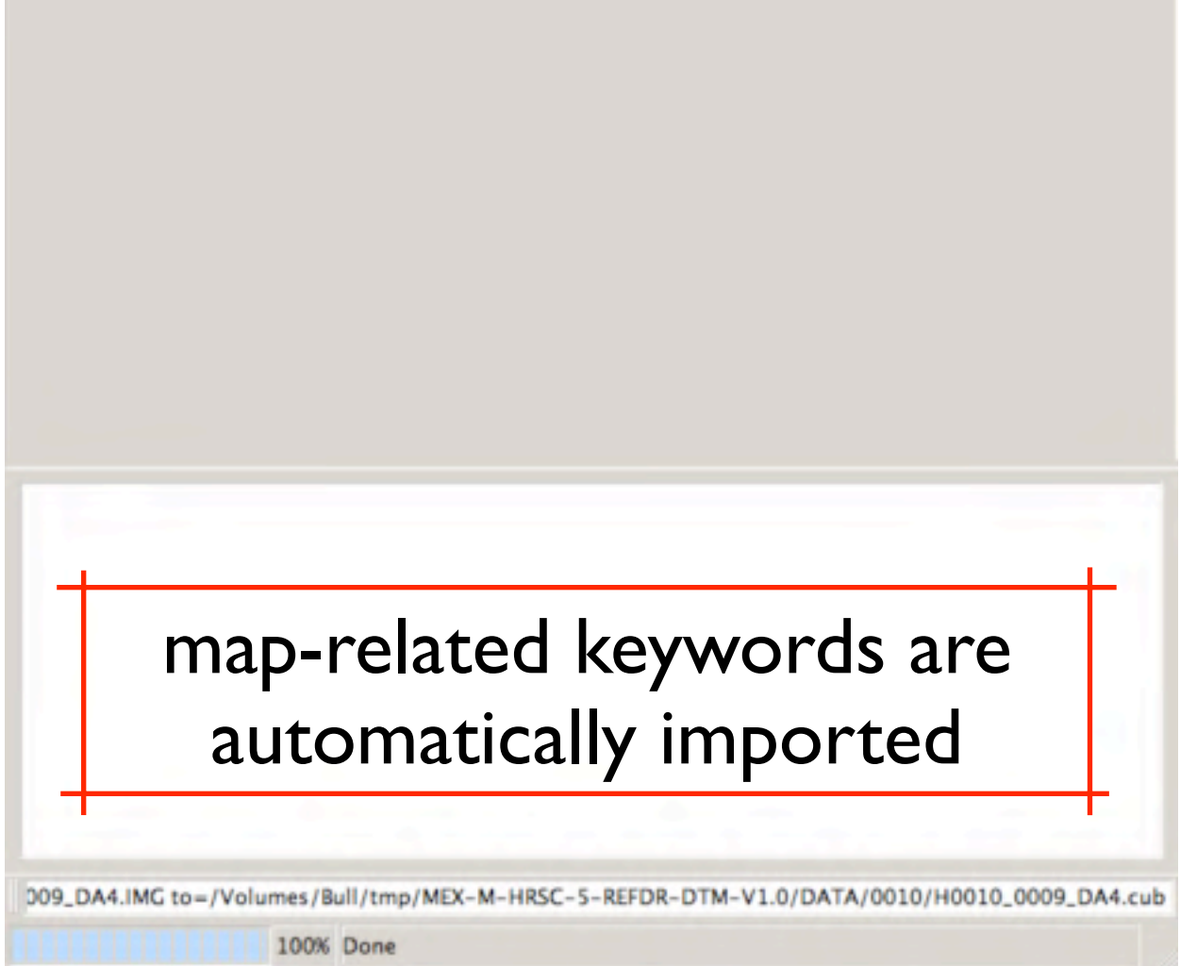
PSA PDS Level4



"pds2isis"

```
[prompt:~] pds2isis
```

Care should be taken while importing HRSC Level4 data into ISIS3. Map keywords in particular should be checked



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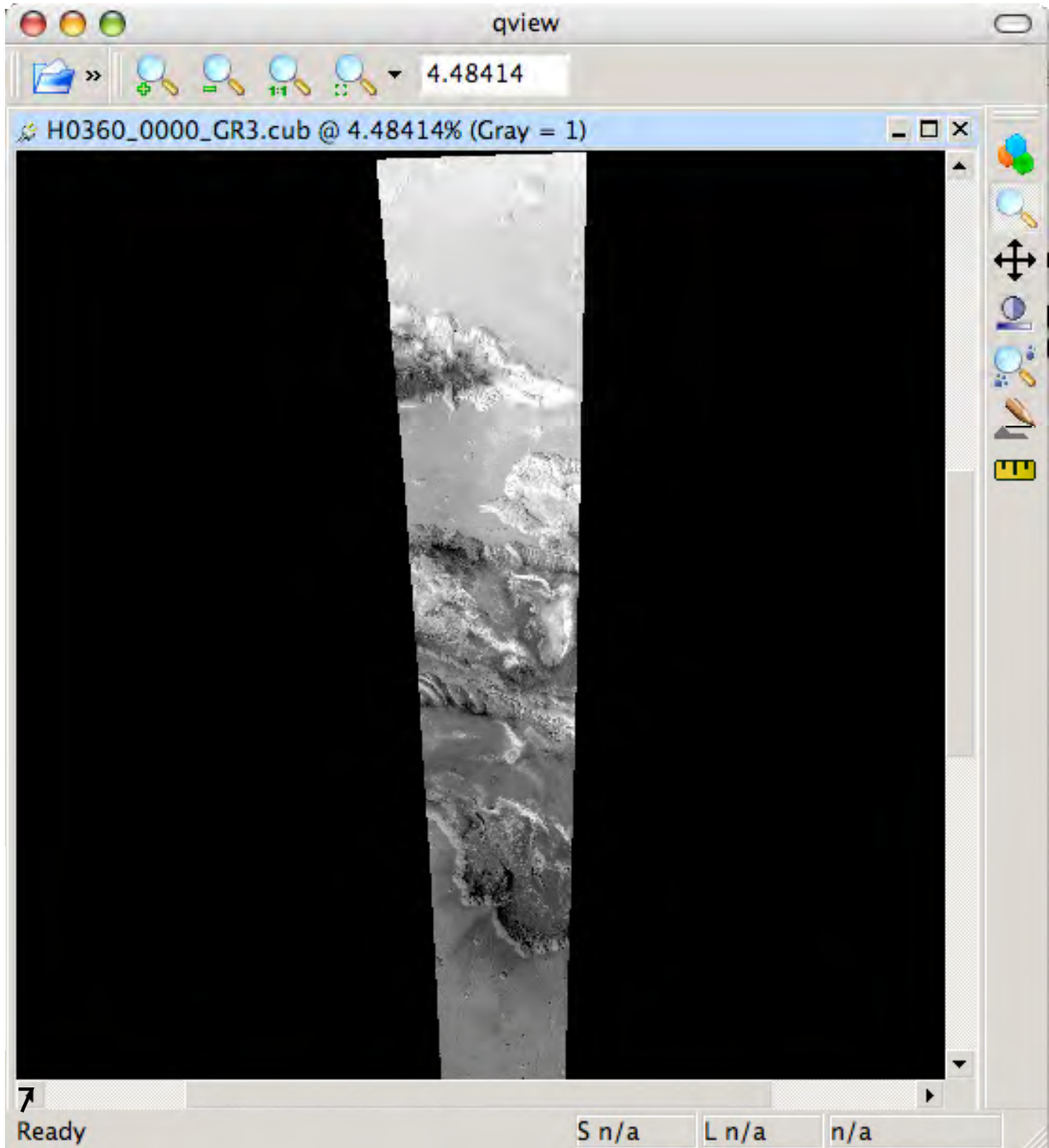
HRSC in ISIS3

PSA PDS Level3/4

“qview”



SEE:

http://isis.astrogeology.usgs.gov/

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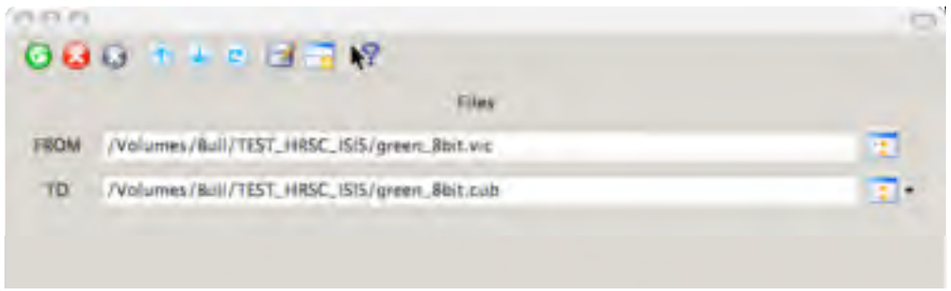
HRSC in ISIS3

VICAR Level3/3+

HRSC data can also be imported with:

"vicar2isis"



This is the ONLY way to import into ISIS3
HRSC home-brewed (e.g. anaglyphs) Level3/+ in ISIS

map-related keywords are **NOT** automatically imported

```
Object = IsisCube
  Object = Core
    StartByte   = 65537
    Format      = Tile
    TileSamples = 128
    TileLines   = 128

    Group = Dimensions
      Samples = 2497
      Lines   = 10965
      Bands   = 1
    End_Group

    Group = Pixels
      Type       = UnsignedByte
      ByteOrder  = Lsb
      Base       = 0.0
      Multiplier = 1.0
    End_Group
  End_Object
End_Object

Object = Label
  Bytes = 65536
End_Object

Object = History
  Name      = IsisCube
  StartByte = 28246017
  Bytes     = 428
End_Object
End
```

HRSC in ISIS3

VICAR Level3/3+

In case of any problem, or with home-made Level3 data, one can manually remove/add map group/keywords with:

"editlab"

SEE:
http://isis.astrogeology.usgs.gov/

```
Group = Mapping
    ProjectionName          = Sinusoidal
    CenterLongitude         = 285.0
    TargetName              = Mars
    EquatorialRadius        = 3396190.0 <meters>
    PolarRadius             = 3396190.0 <meters>
    LatitudeType            = Planetographic
    LongitudeDirection      = PositiveEast
    LongitudeDomain         = 360
    MinimumLatitude         = -15.3784
    MaximumLatitude         = 3.11736
    MinimumLongitude        = 282.963
    MaximumLongitude        = 287.18
    UpperLeftCornerX        = -124862.5 <meters>
    UpperLeftCornerY        = 185312.5 <meters>
    PixelResolution         = 100.0 <meters/pixel>
    Scale                   = 592.74696512189 <pixels/
degree>
    TrueScaleLatitude       = 0.0
    LineProjectionOffset    = 1853.625
    SampleProjectionOffset = 1249.125
  End_Group
End_Object
```

HRSC in ISIS3

VICAR Level3/3+

"editlab"

a) remove "mapping" group from label

```
Group = Mapping
   ProjectionName          = Sinusoidal
   CenterLongitude         = 285.0
   TargetName              = Mars
   EquatorialRadius        = 3396190.0 <meters>
   PolarRadius             = 3396190.0 <meters>
   LatitudeType            = Planetographic
   LongitudeDirection      = PositiveWest
   LongitudeDomain         = 180
   MinimumLatitude         = -15.3784
   MaximumLatitude         = 3.11736
   MinimumLongitude        = 282.963
   MaximumLongitude        = 287.18
   UpperLeftCornerX        = -124862.5 <meters>
   UpperLeftCornerY        = 185312.5 <meters>
   PixelResolution         = 100.0 <meters/pixel>
   Scale                   = 592.74696512189 <pixels/degree>
   TrueScaleLatitude       = 0.0
   LineProjectionOffset    = 1853.625
   SampleProjectionOffset = 1249.125
  End_Group
End_Object
```

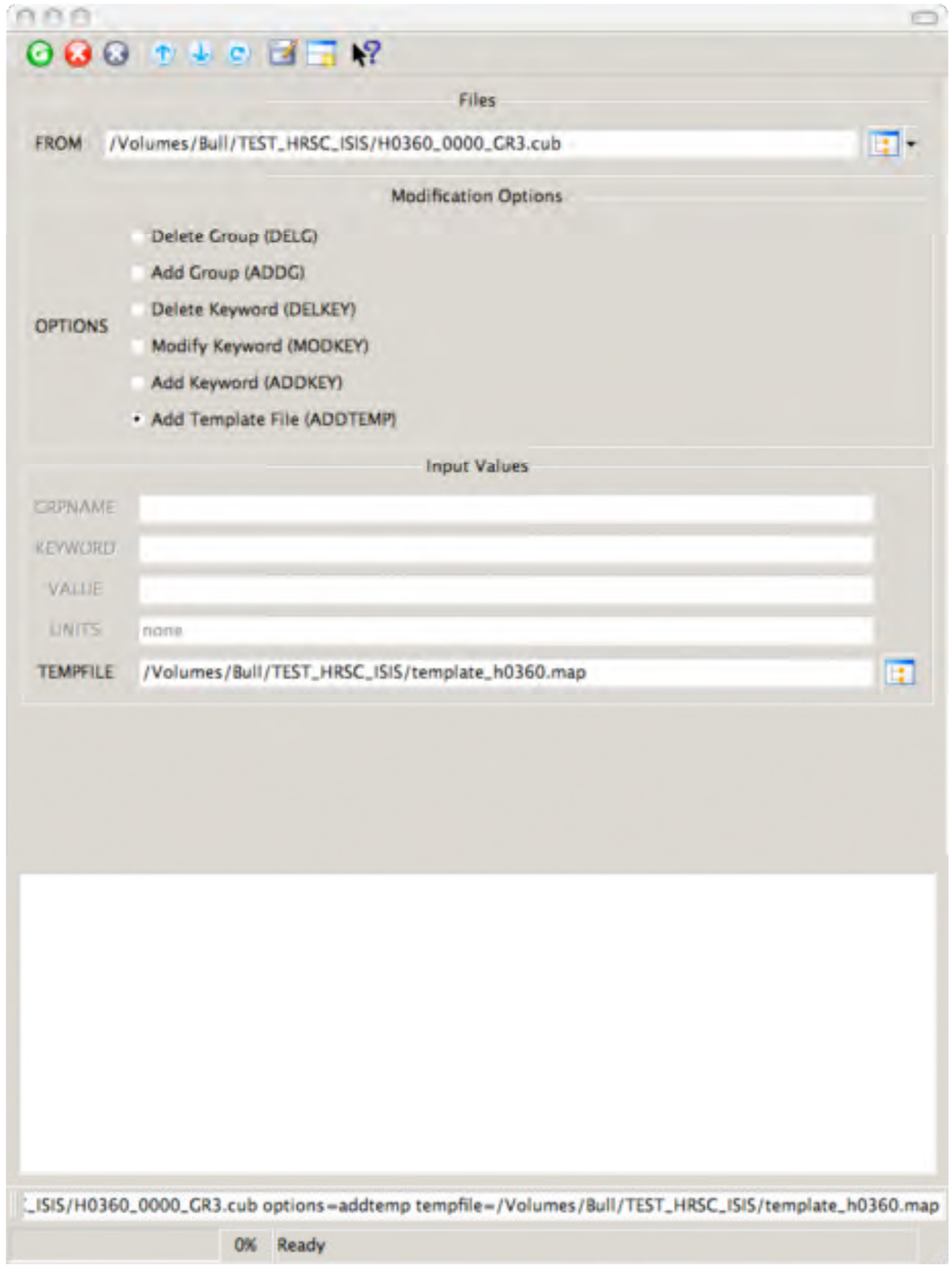
HRSC in ISIS3

VICAR Level3/3+

"editlab"

b) adding "mapping" group to label from corrected template

```
Group = Mapping
   ProjectionName         = Sinusoidal
   CenterLongitude        = 285.0
   TargetName             = Mars
   EquatorialRadius       = 3396190.0 <meters>
   PolarRadius            = 3396190.0 <meters>
   LatitudeType           = Planetographic
   LongitudeDirection     = PositiveEast
   LongitudeDomain        = 360
   MinimumLatitude        = -15.3784
   MaximumLatitude        = 3.11736
   MinimumLongitude       = 282.963
   MaximumLongitude       = 287.18
   UpperLeftCornerX       = -124862.5 <meters>
   UpperLeftCornerY       = 185312.5 <meters>
   PixelResolution        = 100.0 <meters/pixel>
   Scale                  = 592.74696512189 <pixels/degree>
   TrueScaleLatitude      = 0.0
   LineProjectionOffset   = 1853.625
   SampleProjectionOffset = 1249.125
 End_Group
End_Object
```



HRSC Level4 in ISIS3

PDS Level4 map Labels

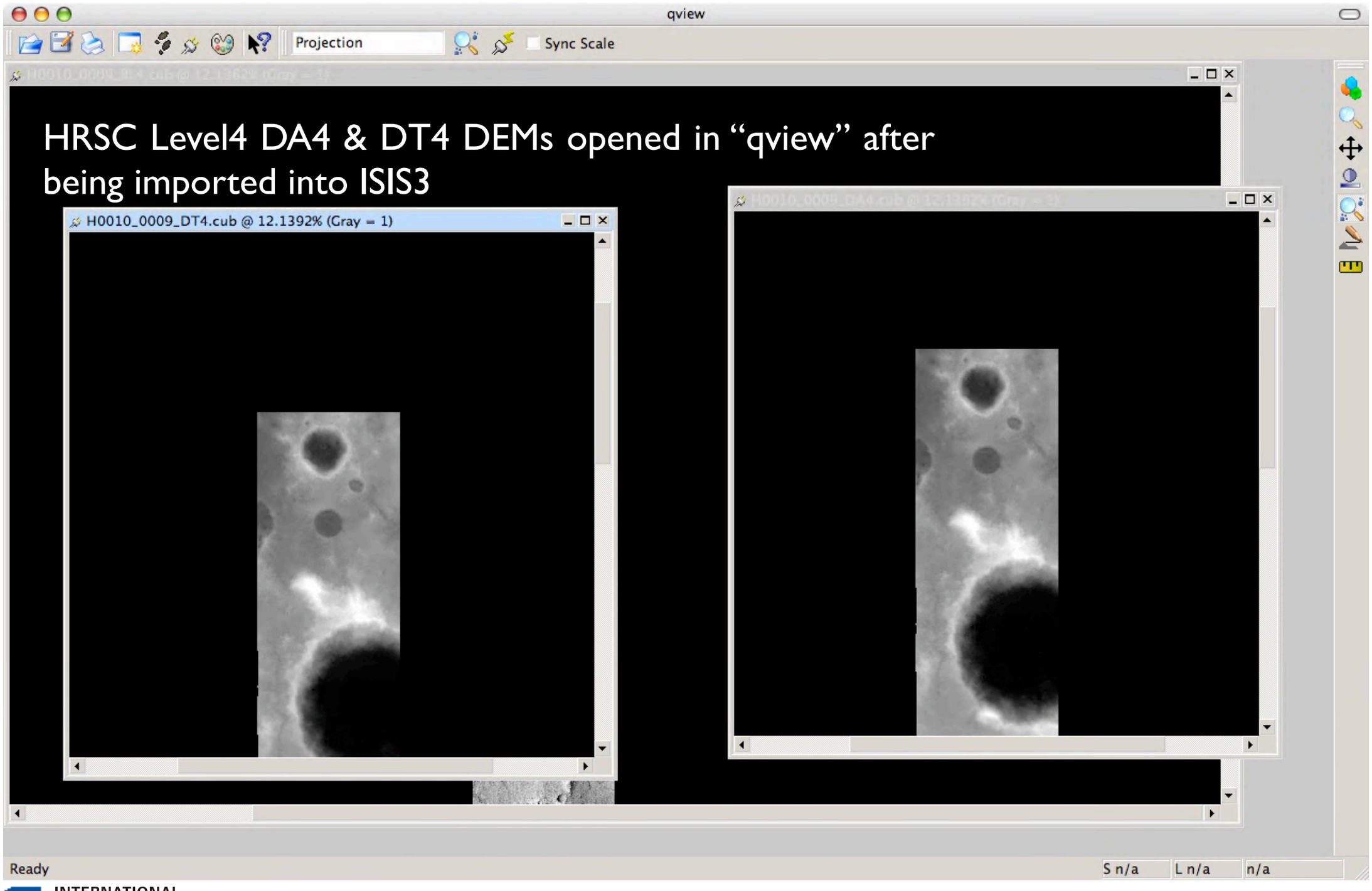
```
OBJECT = IMAGE_MAP_PROJECTION
   ^DATA_SET_MAP_PROJECTION_CATALOG  =  "DSMAP.CAT"
   A_AXIS_RADIUS  =  3396.0 <km>
   B_AXIS_RADIUS  =  3396.0 <km>
   C_AXIS_RADIUS  =  3396.0 <km>
   CENTER_LATITUDE  =  0.0
   CENTER_LONGITUDE  =  90.0
   COORDINATE_SYSTEM_NAME  =  PLANETOCENTRIC
   COORDINATE_SYSTEM_TYPE  =  "BODY-FIXED ROTATING"
   EASTERNMOST_LONGITUDE  =  91.0064
   FIRST_STANDARD_PARALLEL  =  "N/A"
   LINE_FIRST_PIXEL  =  1
   LINE_LAST_PIXEL  =  16216
   LINE_PROJECTION_OFFSET  =  -4454.1
   MAP_PROJECTION_ROTATION  =  0.0
   MAP_PROJECTION_TYPE  =  SINUSOIDAL
   MAP_RESOLUTION  =  4741.71043093333 <pixel/degree>
   MAP_SCALE  =  0.0125 <km/pixel>
   MAXIMUM_LATITUDE  =  5.99029
   MINIMUM_LATITUDE  =  -7.58311
   POSITIVE_LONGITUDE_DIRECTION  =  EAST
   REFERENCE_LATITUDE  =  "N/A"
   REFERENCE_LONGITUDE  =  "N/A"
   SAMPLE_FIRST_PIXEL  =  1
   SAMPLE_LAST_PIXEL  =  4448
   SAMPLE_PROJECTION_OFFSET  =  -51.3
   SECOND_STANDARD_PARALLEL  =  "N/A"
   WESTERNMOST_LONGITUDE  =  89.9734

END_OBJECT = IMAGE_MAP_PROJECTION
```

ISIS3 imported map labels

```
Group = Mapping
    ProjectionName         = Sinusoidal
    CenterLongitude        = 90.0
    TargetName             = Mars
    EquatorialRadius       = 3396000.0 <meters>
    PolarRadius            = 3396000.0 <meters>
    LatitudeType           = Planetocentric
    LongitudeDirection     = PositiveEast
    LongitudeDomain        = 180
    MinimumLatitude        = -7.58311
    MaximumLatitude        = 5.99029
    MinimumLongitude       = 89.9734
    MaximumLongitude       = 91.0064
    UpperLeftCornerX       = 647.5 <meters>
    UpperLeftCornerY       = -55682.5 <meters>
    PixelResolution        = 12.5 <meters/pixel>
    Scale                  = 4741.7104309333 <pixels/
degree>
    TrueScaleLatitude      = 0.0
    LineProjectionOffset   = -4454.1
    SampleProjectionOffset = -51.3
  End_Group
End_Object
```

SEE:
http://isis.astrogeology.usgs.gov/

HRSC Level4 in ISIS3



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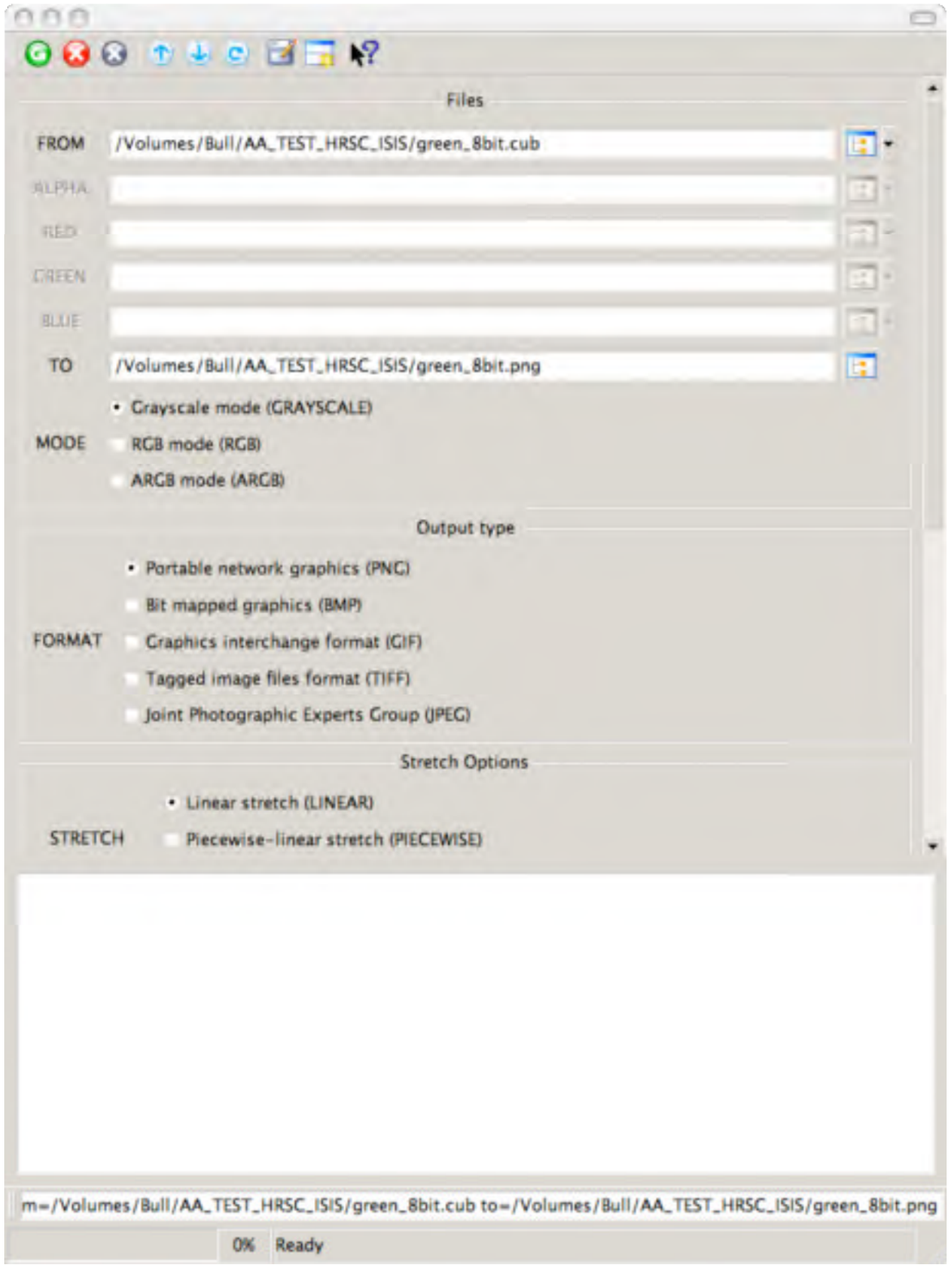
HRSC in ISIS3

VICAR Level3/3+

"isis2std"

Exports to various formats (including GIS-friendly)



HRSC in ISIS3

Mosaic workflow

- Import PDS Level3/4 into ISIS3 `"pds2isis"`
- Create a map template (ASCII) `"maptemplate"` ***OR*** *by hand*
- Match to a common projection `"map2map"`
- Mosaic `"automos"`
- Export `"isis2std"`

MORE DURING HANDS-ON…

HRSC into ISIS3

Import PDS into ISIS3

“pds2isis”

H0360_0000_RE3.IMG → H0360_0000_RE3.cub

H2149_0000_RE3.IMG → H2149_0000_RE3.cub

HRSC into ISIS3

Read Map projection

Mapping group label for HRSC Level3 Orbit 0360

map_template.map

```
Group = Mapping
  ProjectionName     = Sinusoidal
  CenterLongitude    = 285.0
  TargetName         = Mars
  EquatorialRadius   = 3396190.0 <meters>
  PolarRadius        = 3396190.0 <meters>
  LatitudeType       = Planetographic
  LongitudeDirection = PositiveEast
  LongitudeDomain    = 360
  MinimumLatitude    = -15.3414
  MaximumLatitude    = 3.20012
  MinimumLongitude   = 282.35
  MaximumLongitude   = 287.882
  UpperLeftCornerX   = -124862.5 <meters>
  UpperLeftCornerY   = 185312.5 <meters>
  PixelResolution    = 100.0 <meters/pixel>
  Scale              = 592.74696512189 <pixels/degree>
End_Group
End_Object
```

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HRSC into ISIS3

Create map template

Mapping group label in ASCII file to change the projection of Orbit 2149

```
Group = Mapping
  ProjectionName     = Sinusoidal
  CenterLongitude    = 285.0
  TargetName         = Mars
  EquatorialRadius   = 3396190.0 <meters>
  PolarRadius        = 3396190.0 <meters>
  LatitudeType       = Planetographic
  LongitudeDirection = PositiveEast
  LongitudeDomain    = 360
  MinimumLatitude    = -15.5
  MaximumLatitude    = 4.0
  MinimumLongitude   = 281.0
  MaximumLongitude   = 287.0
  PixelResolution    = 100.0 <meters/pixel>
  Scale              = 592.74696512189 <pixels/degree>
End_Group
End_Object
```

HRSC into ISIS3

Change projection

"map2map"

- Change projection of orbit 2149 to match the one of 0360 (only CLON is different)
- CLON(0360) = 285.0

HRSC into ISIS3

Mosaic

"automos"

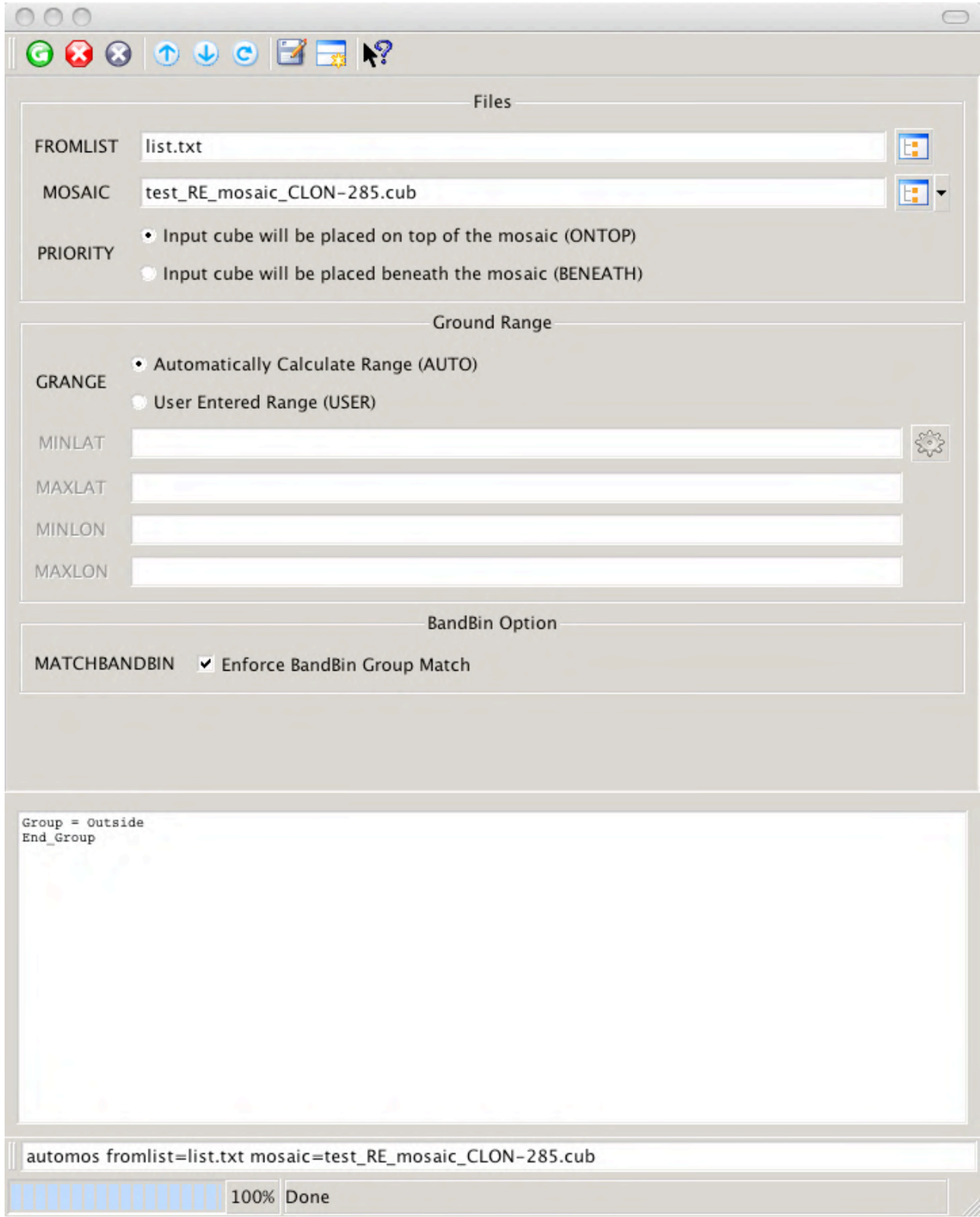
H0360_0000_RE3.cub

+

H2149_0000_RE3_clon-285.cub

=

test_RE_mosaic_CLON-285.cub



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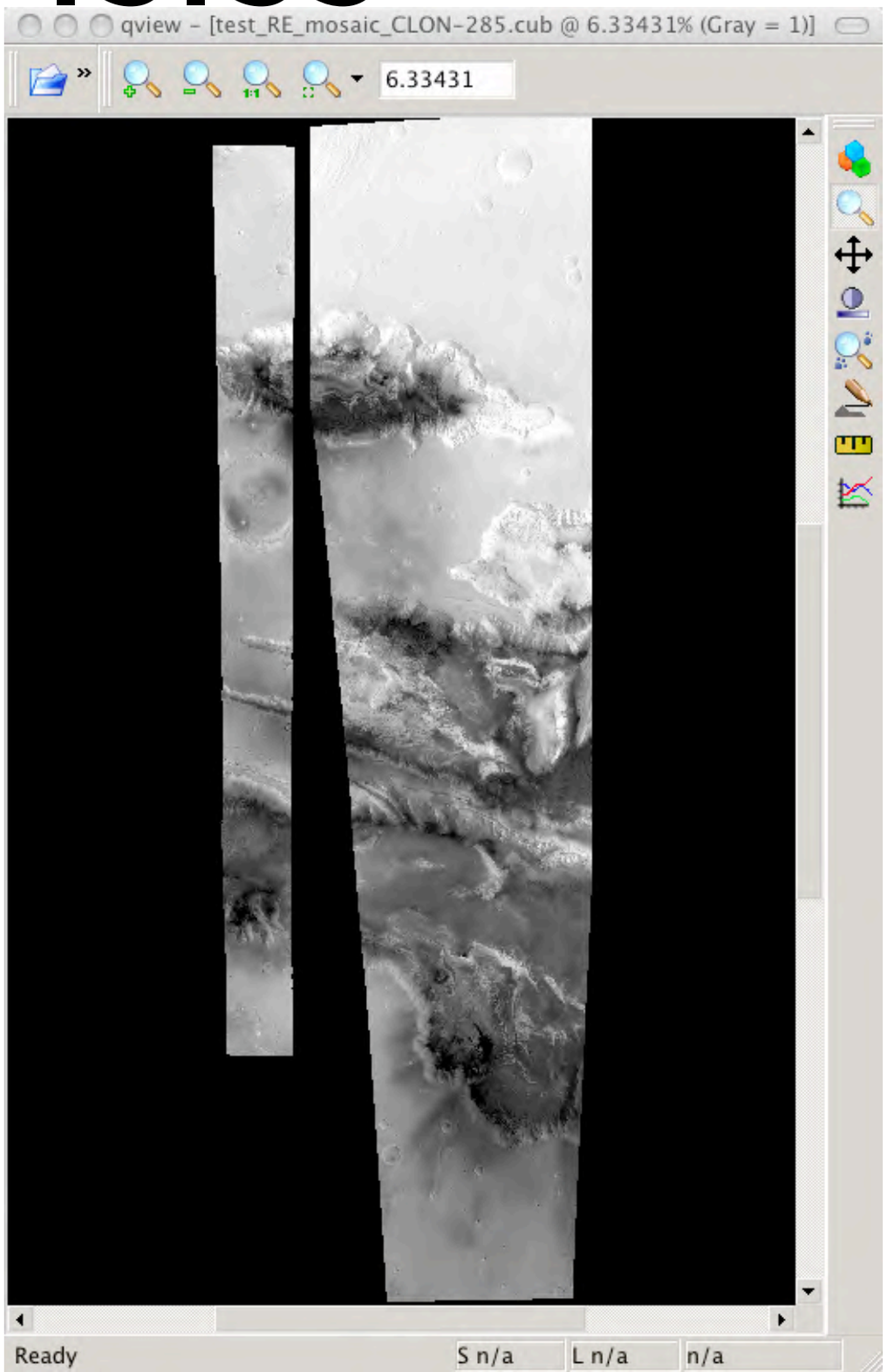
HRSC into ISIS3

Mosaic

"qview"

Mosaic of RED (RE) HRSC Level3 bands
from orbits 0360 and 2149

test_RE_mosaic_CLON-285.cub



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HRSC into ISIS3

Multiple nadir mosaic

GOOD TO CRASH COMPUTERS... → subsampling to 100 m/pixel

download.txt

```
ftp://psa.esac.esa.int/pub/mirror/MARS-EXPRESS/HRSC/MEX-M-HRSC-5-REFDR-MAPPROJECTED-V2.0/DATA/1235/H1235_0001_ND3.IMG
ftp://psa.esac.esa.int/pub/mirror/MARS-EXPRESS/HRSC/MEX-M-HRSC-5-REFDR-MAPPROJECTED-V2.0/DATA/2138/H2138_0000_ND3.IMG
ftp://psa.esac.esa.int/pub/mirror/MARS-EXPRESS/HRSC/MEX-M-HRSC-5-REFDR-MAPPROJECTED-V2.0/DATA/0334/H0334_0001_ND3.IMG
ftp://psa.esac.esa.int/pub/mirror/MARS-EXPRESS/HRSC/MEX-M-HRSC-5-REFDR-MAPPROJECTED-V2.0/DATA/0515/H0515_0000_ND3.IMG
ftp://psa.esac.esa.int/pub/mirror/MARS-EXPRESS/HRSC/MEX-M-HRSC-5-REFDR-MAPPROJECTED-V2.0/DATA/3195/H3195_0000_ND3.IMG
ftp://psa.esac.esa.int/pub/mirror/MARS-EXPRESS/HRSC/MEX-M-HRSC-5-REFDR-MAPPROJECTED-V2.0/DATA/3217/H3217_0001_ND3.IMG
```

```
wget -i download.txt
```

HRSC into ISIS3

Multiple nadir mosaic

"pds2isis"

list_IMG

```
H0334_0001_ND3.IMG   H0334_0001_ND3.cub
H0360_0000_ND3.IMG   H0360_0000_ND3.cub
H0515_0000_ND3.IMG   H0515_0000_ND3.cub
H1235_0001_ND3.IMG   H1235_0001_ND3.cub
H2138_0000_ND3.IMG   H2138_0000_ND3.cub
H2149_0000_ND3.IMG   H2149_0000_ND3.cub
H3195_0000_ND3.IMG   H3195_0000_ND3.cub
H3217_0001_ND3.IMG   H3217_0001_ND3.cub
```

one space, NOT tab

```
pds2isis -batchlist=list_IMG from=\$1 to=\$2
```

HRSC into ISIS3

Multiple nadir mosaic

map_template.txt

```
Group = Mapping
  ProjectionName     = Sinusoidal
  CenterLongitude    = 285.0
  TargetName         = Mars
  EquatorialRadius   = 3396190.0 <meters>
  PolarRadius        = 3396190.0 <meters>
  LatitudeType       = Planetographic
  LongitudeDirection = PositiveEast
  LongitudeDomain    = 360
  MinimumLatitude    = -15.0
  MaximumLatitude    = 2.0
  MinimumLongitude   = 281.0
  MaximumLongitude   = 292.0
  PixelResolution    = 100.0 <meters/pixel>
  Scale              = 592.74696512189
<pixels/degree>
  End_Group
End_Object
```

HRSC into ISIS3

Multiple nadir mosaic

"map2map"

list_cub

```
H0334_0001_ND3.cub   H0334_0001_ND3_CLON-285.cub
H0360_0000_ND3.cub   H0360_0000_ND3_CLON-285.cub
H0515_0000_ND3.cub   H0515_0000_ND3_CLON-285.cub
H1235_0001_ND3.cub   H1235_0001_ND3_CLON-285.cub
H2138_0000_ND3.cub   H2138_0000_ND3_CLON-285.cub
H2149_0000_ND3.cub   H2149_0000_ND3_CLON-285.cub
H3195_0000_ND3.cub   H3195_0000_ND3_CLON-285.cub
H3217_0001_ND3.cub   H3217_0001_ND3_CLON-285.cub
```

one space, NOT tab

```
map2map -batchlist=list_cub map=map_template.txt from=\$1 to=\$2
        pixres=map defaultrange=map
```

HRSC into ISIS3

Multiple nadir mosaic

"automos"

list_mos

```
H0334_0001_ND3_CLON-285.cub
H0360_0000_ND3_CLON-285.cub
H0515_0000_ND3_CLON-285.cub
H1235_0001_ND3_CLON-285.cub
H2138_0000_ND3_CLON-285.cub
H2149_0000_ND3_CLON-285.cub
H3195_0000_ND3_CLON-285.cub
H3217_0001_ND3_CLON-285.cub
```

```
ls *CLON-285.cub > list_mos
```

```
automos fromlist=list_mos mosaic=nd_mos_CLON-285.cub
```

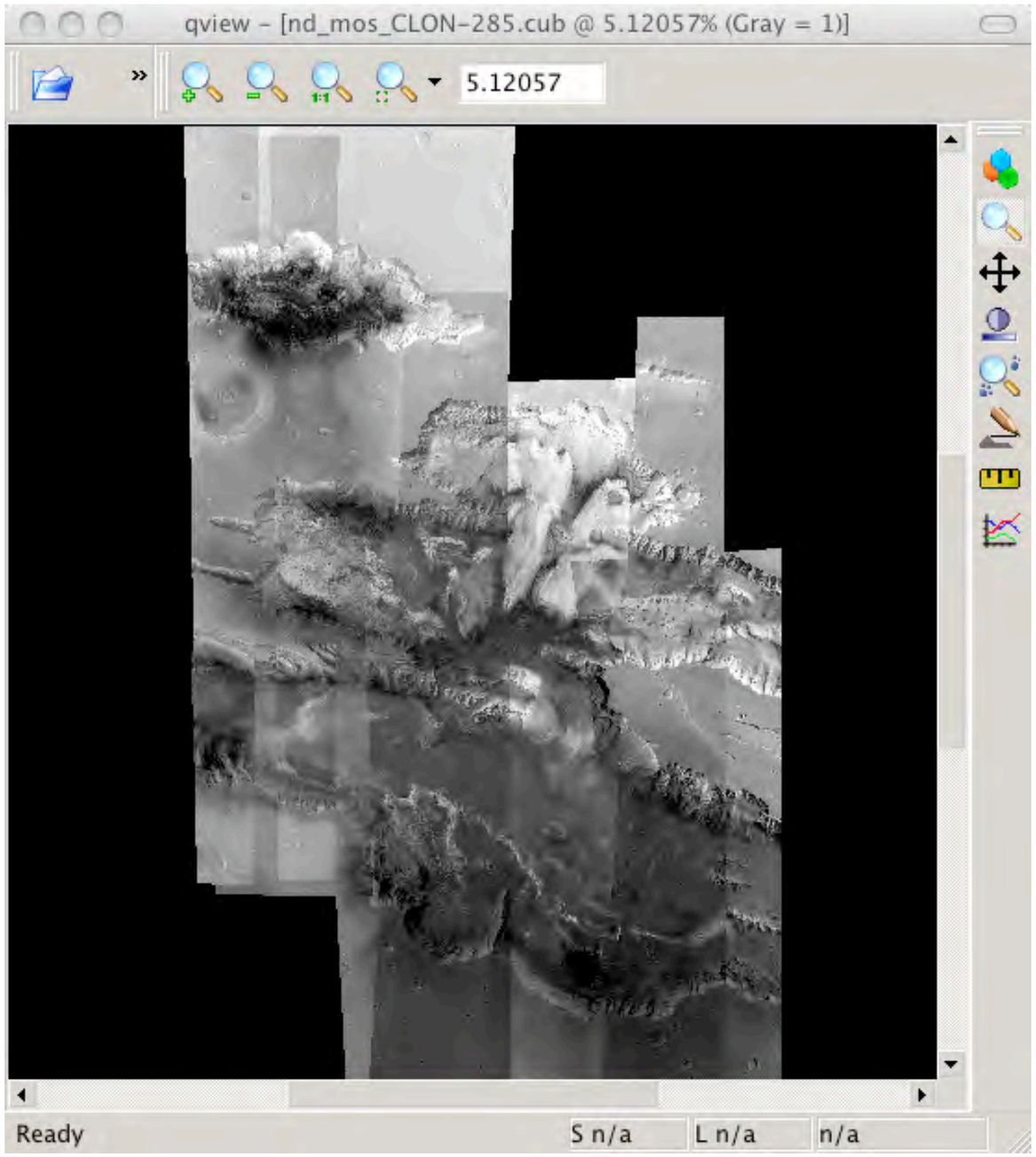
HRSC into ISIS3

Multiple nadir mosaic

"qview"

Quick & dirty mosaic:
one should take care of selecting scene order, choosing resolution, choosing images with consistent illumination conditions, equalize scenes, etc..

IT IS **ADVISED** TO **MOSAIC LEVEL4** DATA RATHER THAN LEVEL3



viewing results

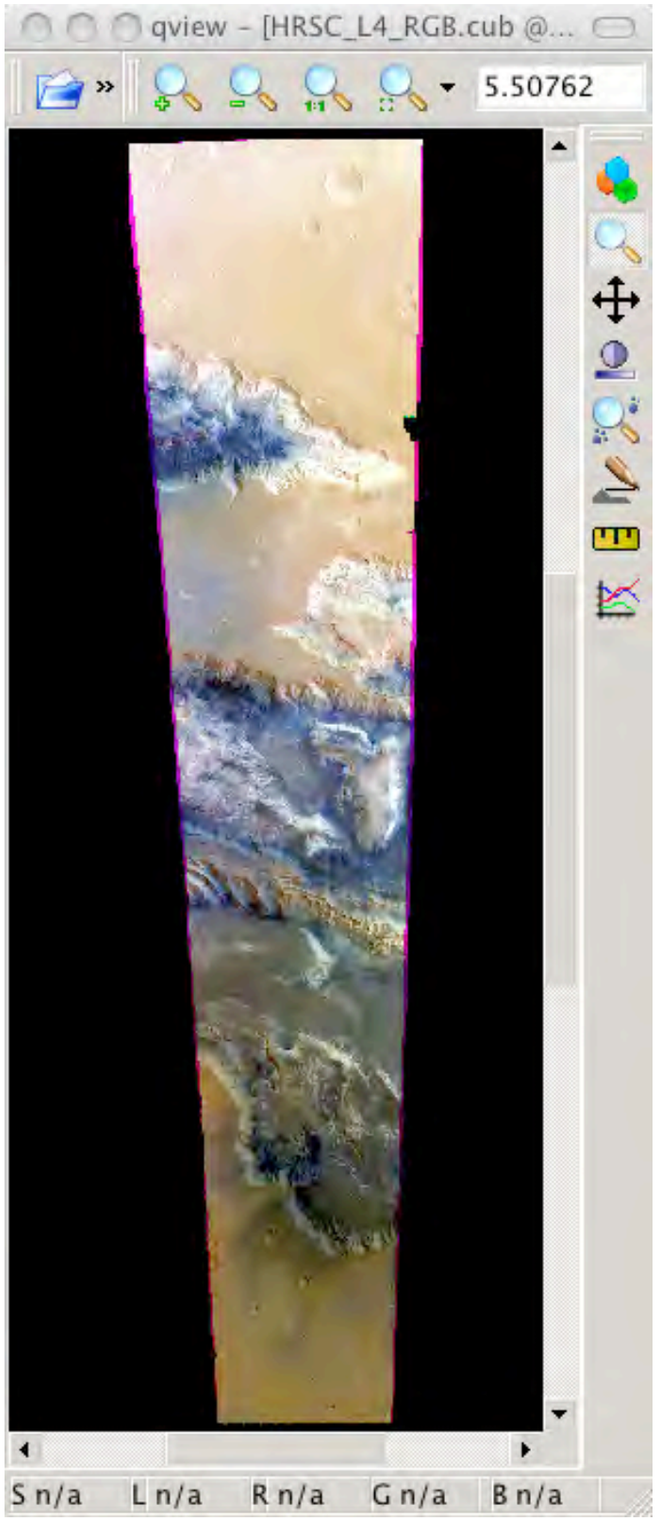
HRSC into ISIS3

HRSC color cube

"cubeit"

```
list_cub
H0360_0000_BL4.cub
H0360_0000_GR4.cub
H0360_0000_RE4.cub
H0360_0000_IR4.cub
```

```
cubeit list=list_cub to=HRSC_L4_RGB.cub
proplab=H0360_0000_BL4.cub
```



RGB=321=RE,GR,BL

HRSC into ISIS3

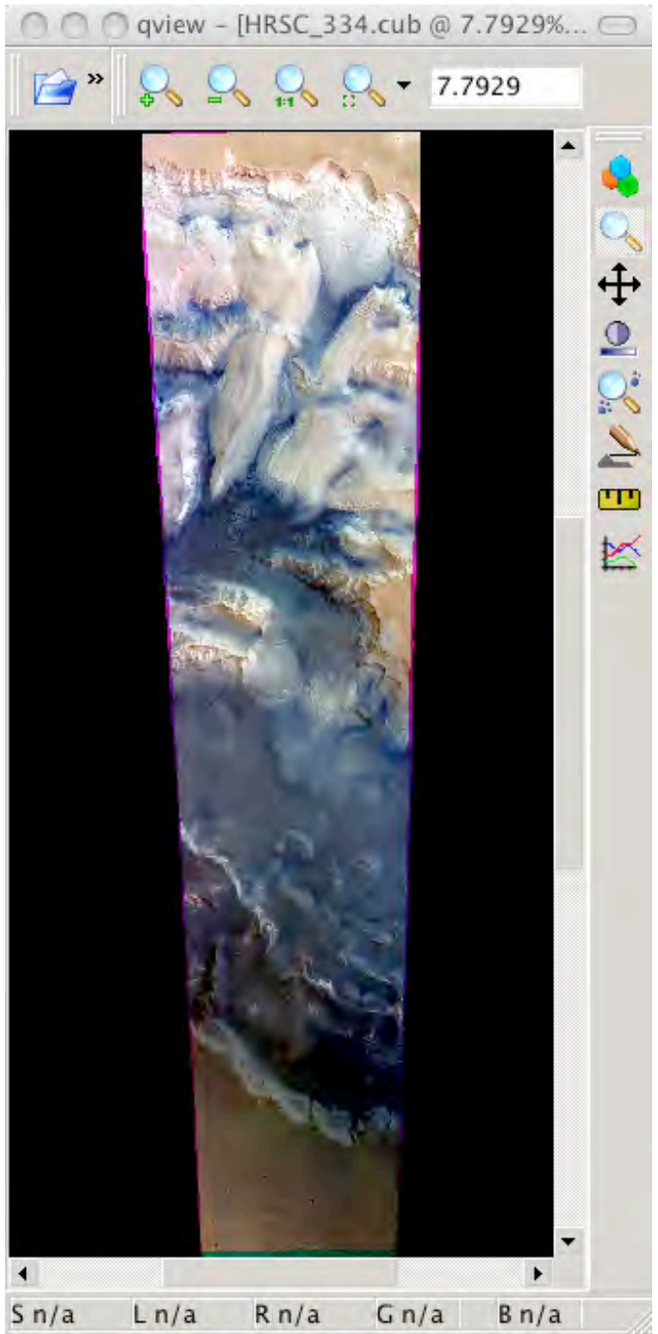
HRSC Level4 color mosaic

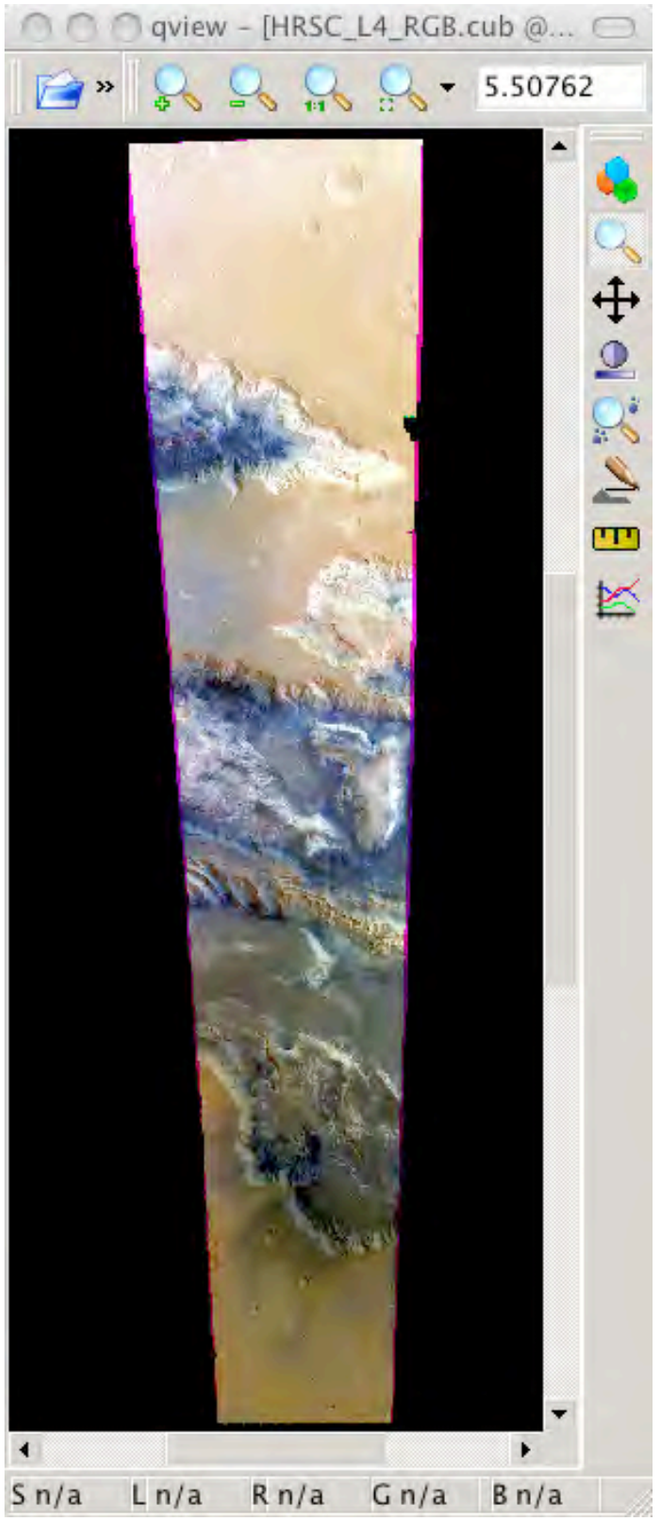
...the same for orbit 334

"cubeit"

```
list_cub
H0334_0001_BL4.cub
H0334_0001_GR4.cub
H0334_0001_RE4.cub
H0334_0001_IR4.cub
```

```
cubeit list=list_cub
to=H0334_L4_RGB.cub
proplab=H0334_0000_BL4.cub
```





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HRSC into ISIS3

HRSC Level4 color mosaic

"map2map"

```
map2map
from=H0334_L4_RGB.cub
map=H0360_L4_RGB.cub
to=H0360_L4_RGB.cub
```

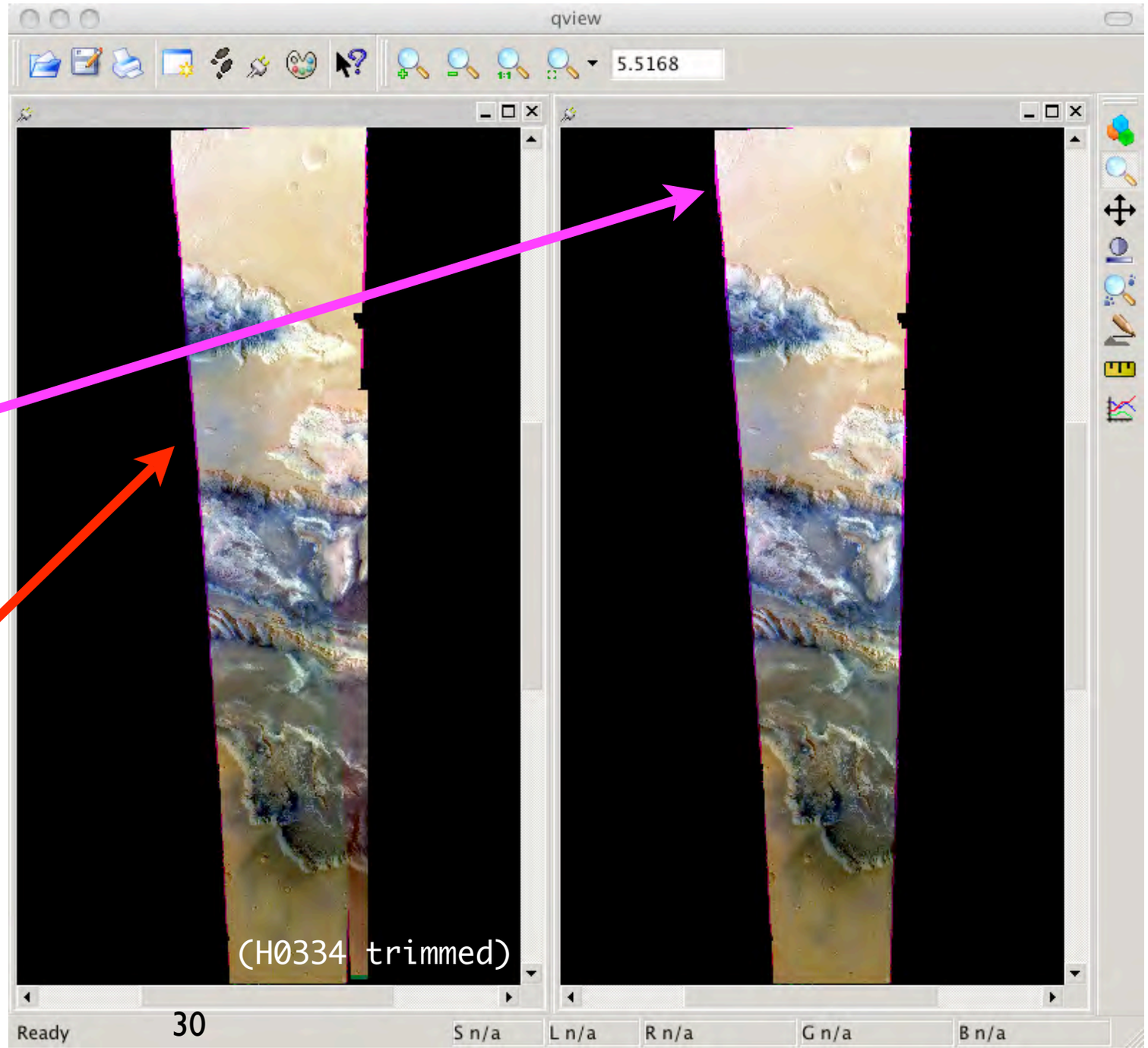
"equalizer" (OPTIONAL)

"automos"

```
automos fromlist=list
mosaic=quick_mosaic.cub
```

OR:

"noseam"



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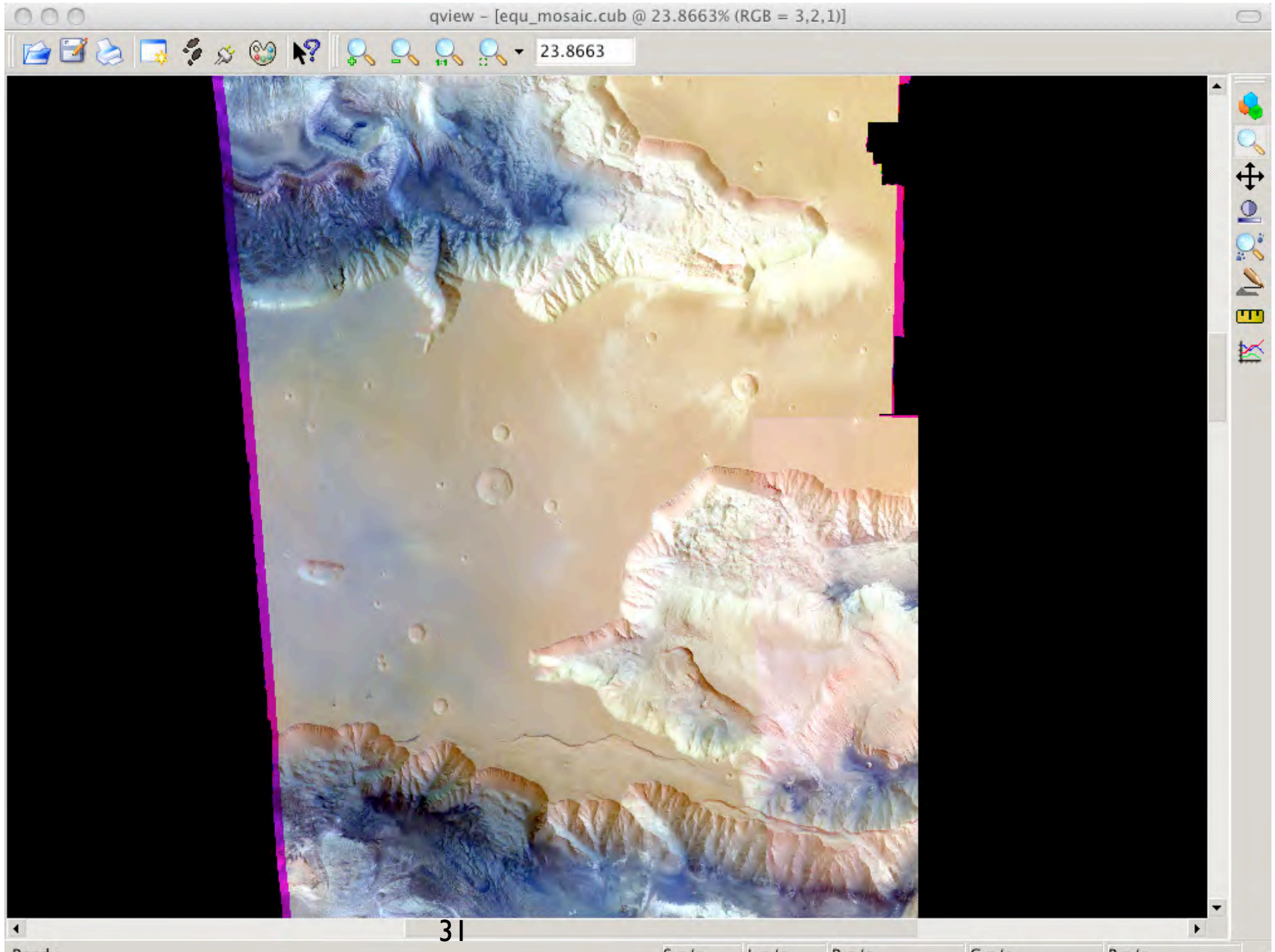
HRSC into ISIS3

HRSC Level4 color mosaic



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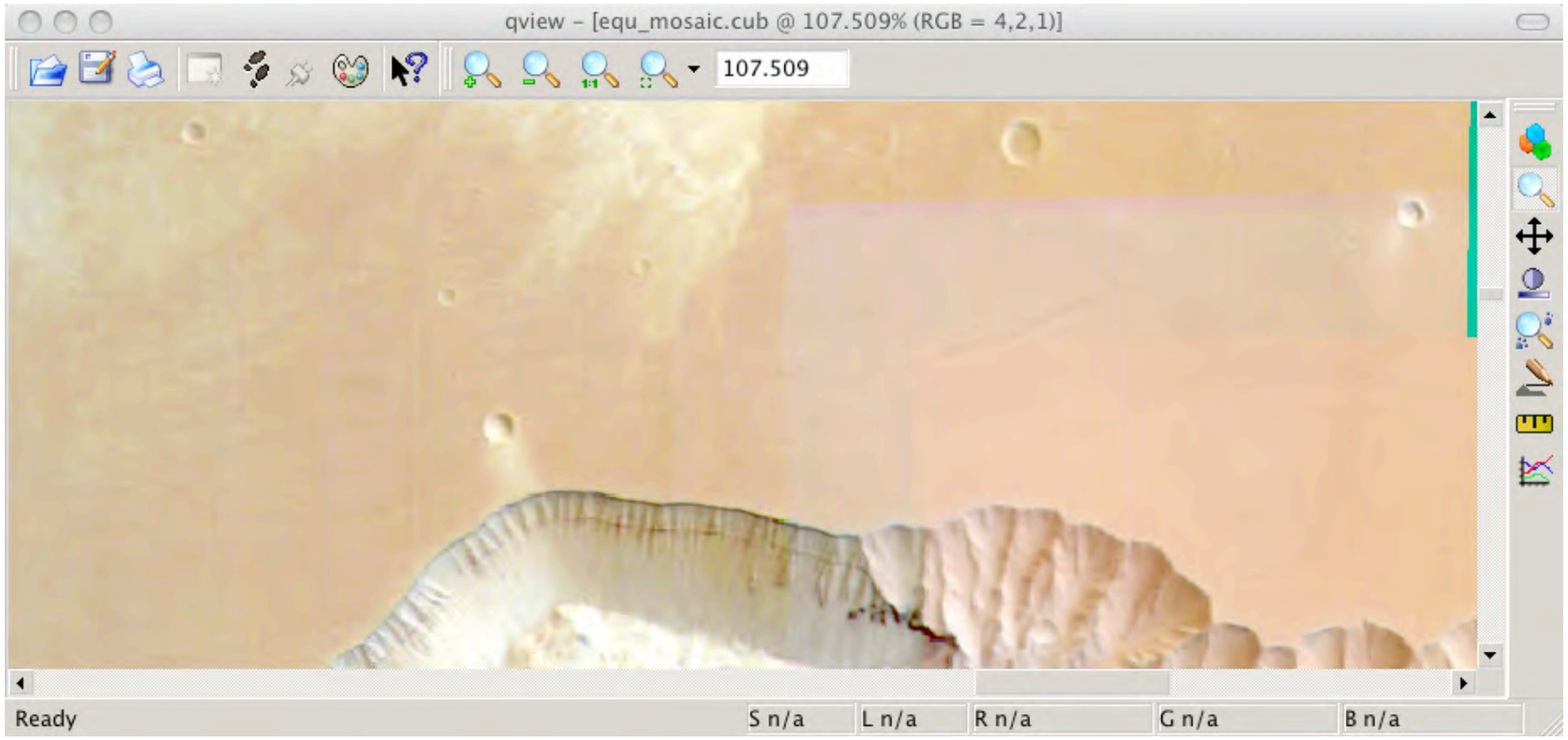
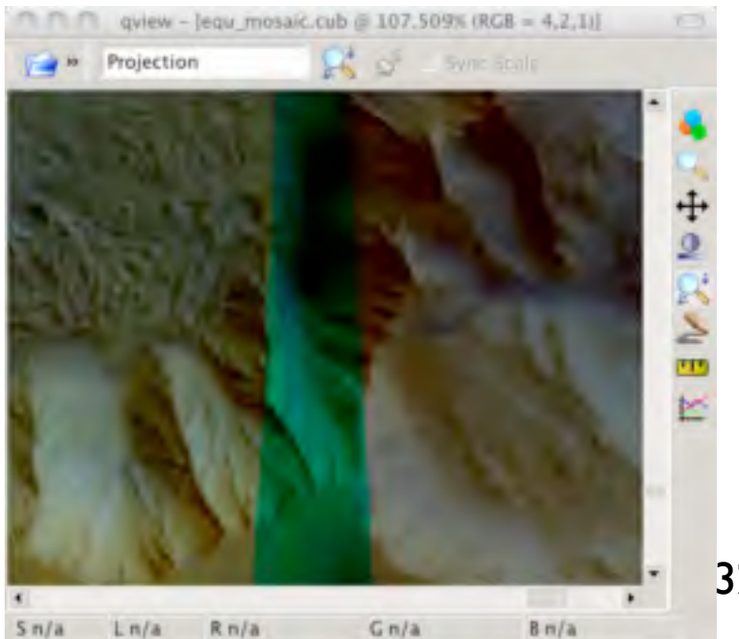
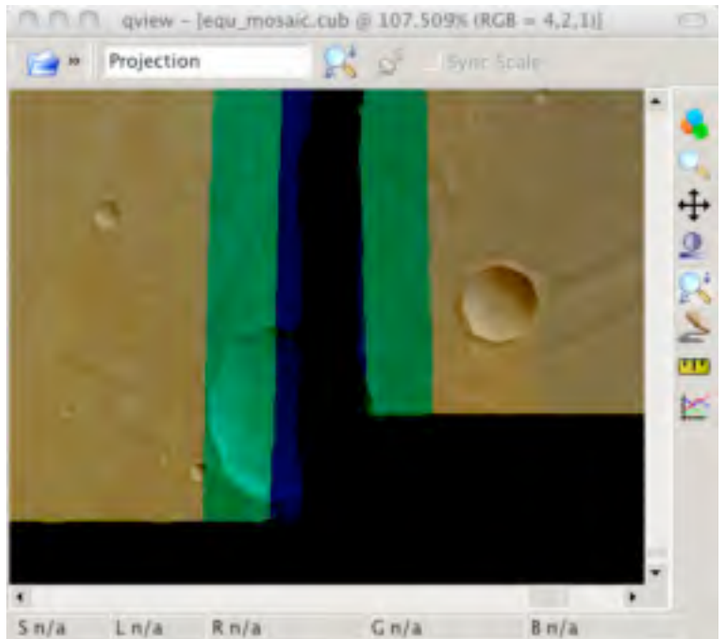
HRSC into ISIS3

HRSC Level4 mosaic quality







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HRSC into ISIS3

HRSC Level4 DTM mosaic

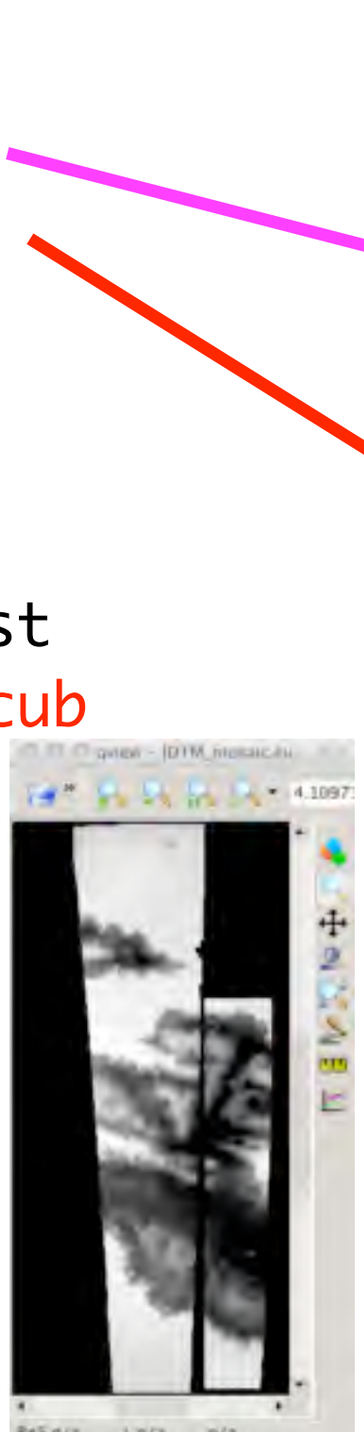
H0334_0001_DA4.cub
H0360_0000_DA4.cub

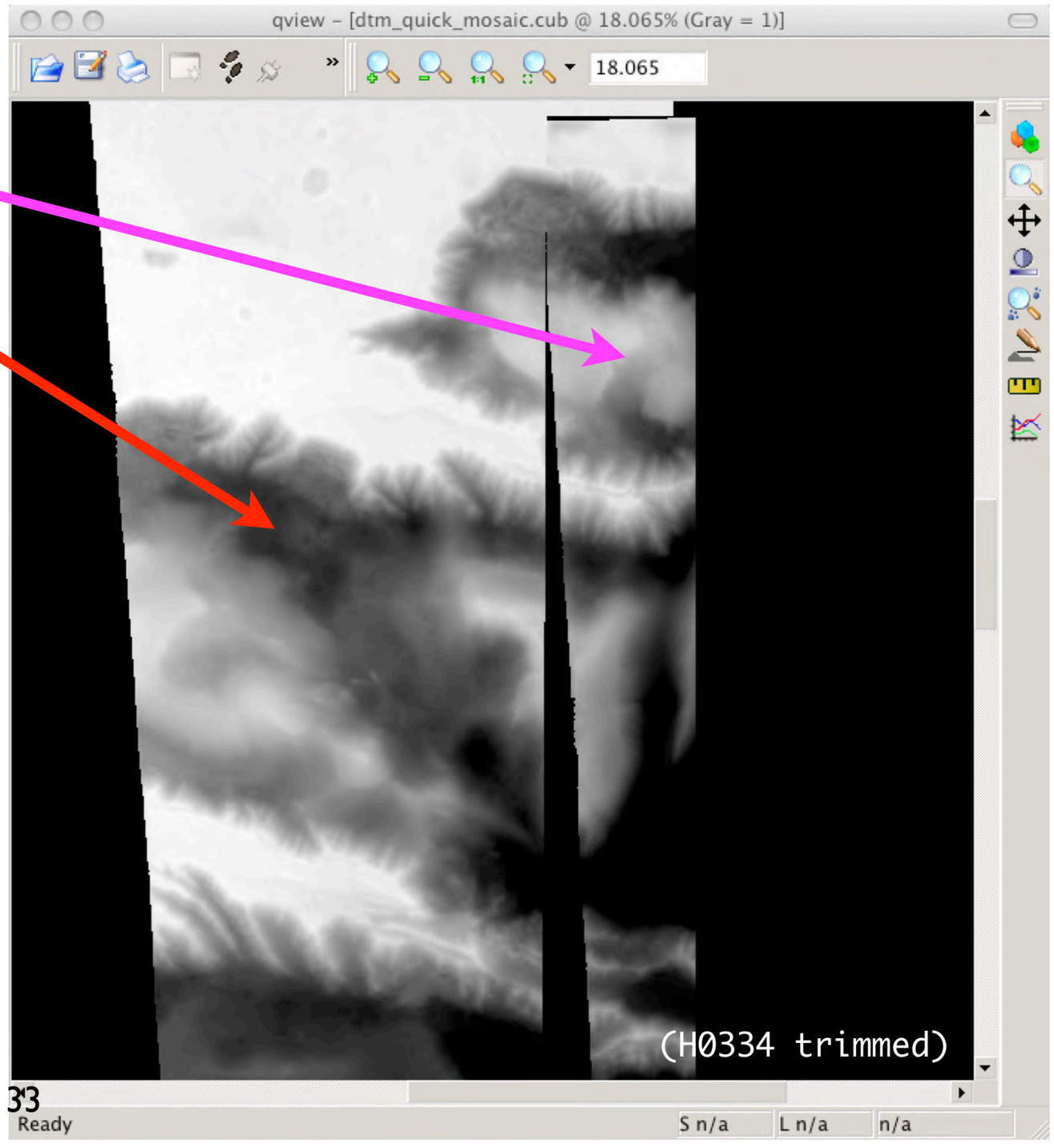
"map2map"

"automos"

```
automos fromlist=list
mosaic=quick_mosaic.cub
```

BUT...





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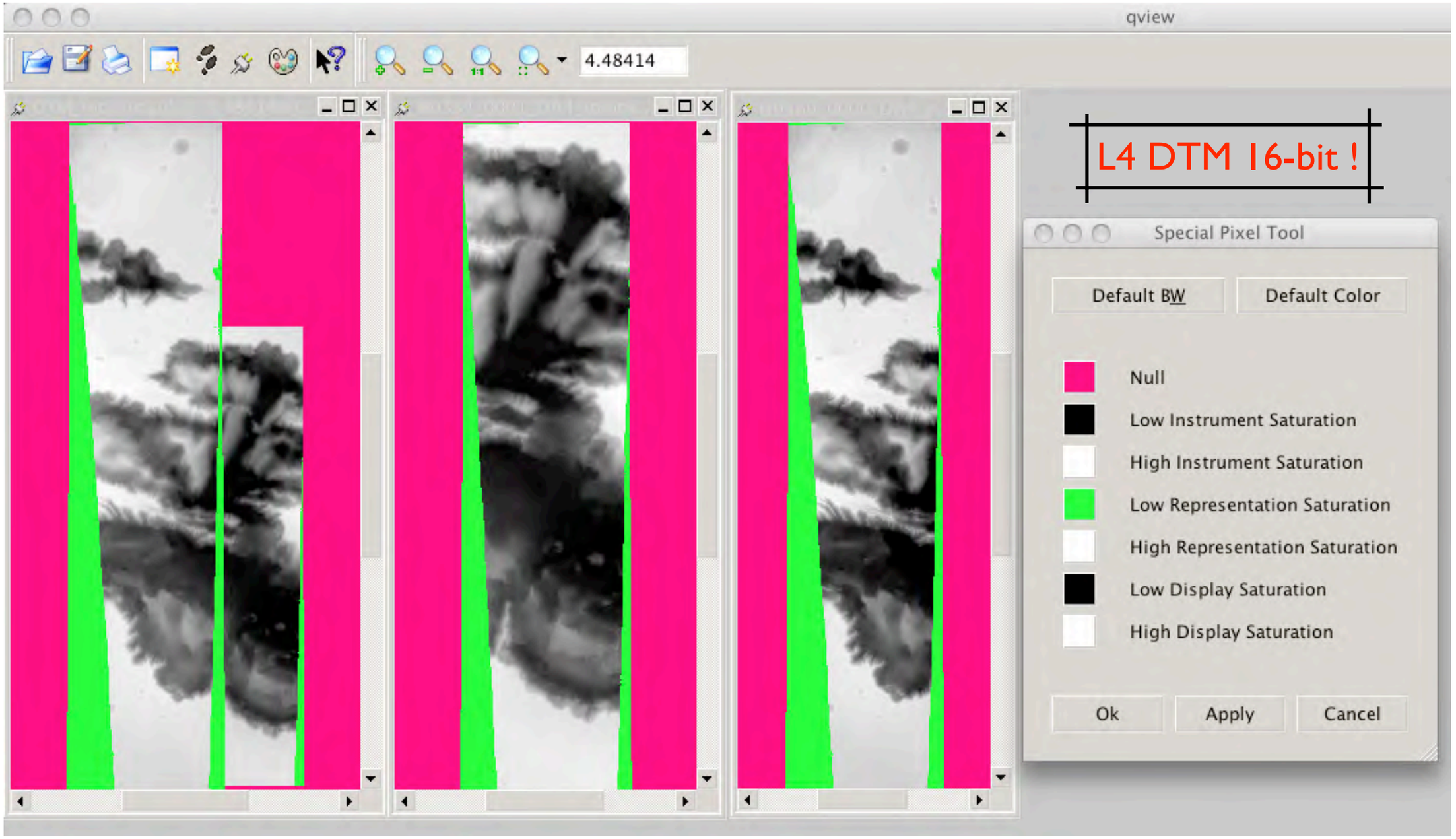
HRSC into ISIS3

HRSC Level4 DTM mosaic



LRS !

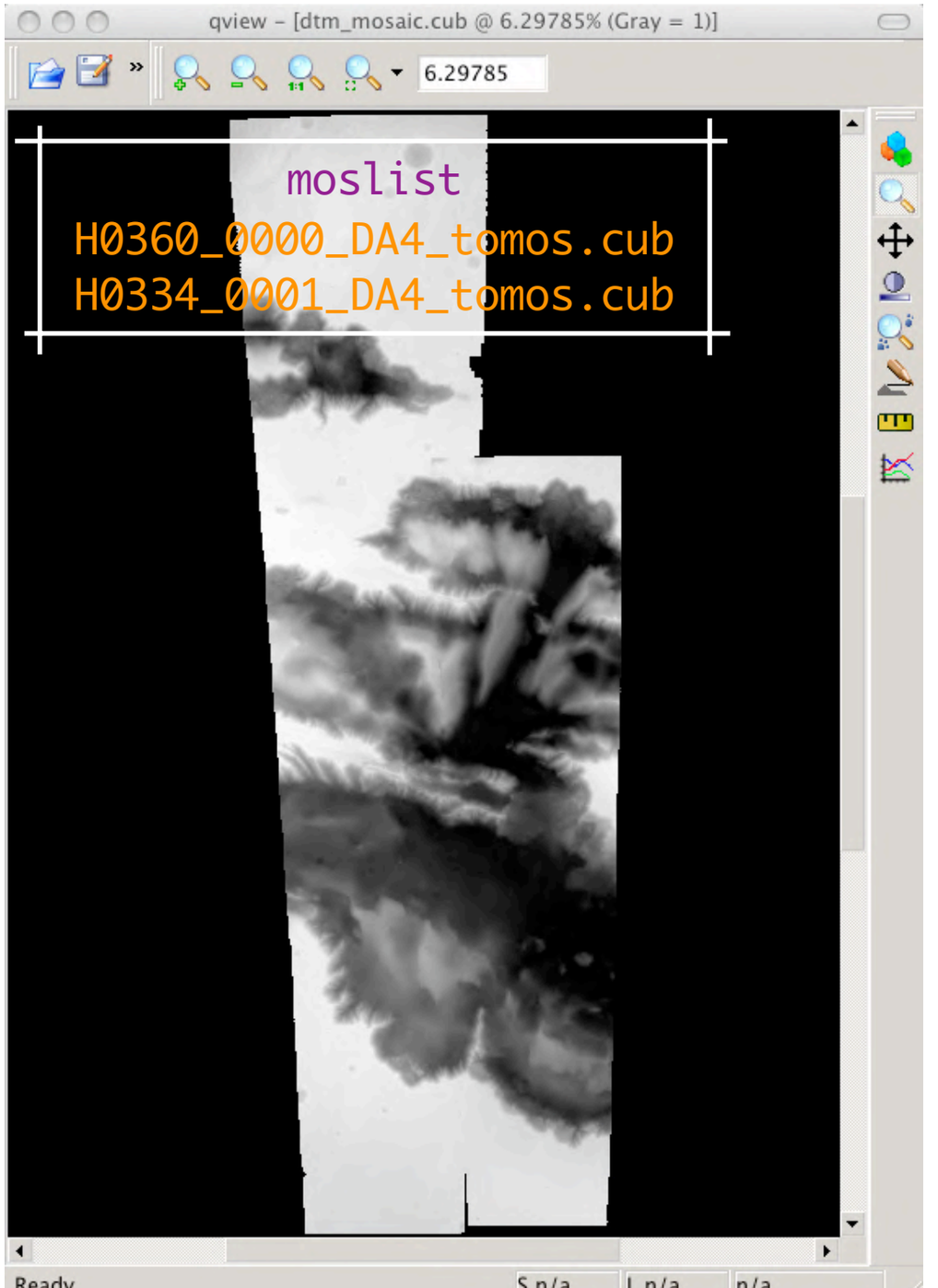
Possible problems

HRSC into ISIS3

HRSC Level4 DTM mosaic

"stretch"

```
#!/bin/sh

pds2isis from=H0334_0001_DA4.IMG to=H0334_0001_DA4.cub

stretch from=H0334_0001_DA4.cub to=H0334_0001_DA4-null.cub lrs=null

pds2isis from=H0360_0000_DA4.IMG to=H0360_0000_DA4.cub

stretch from=H0360_0000_DA4.cub to=H0360_0000_DA4-null.cub lrs=null

map2map from=H0334_0001_DA4-null.cub map=map_template.map
to=H0334_0001_DA4_tomos.cub defaultrange=from pixres=map

map2map from=H0360_0000_DA4-null.cub map=map_template.map
to=H0360_0000_DA4_tomos.cub defaultrange=from pixres=map

automos fromlist=moslist mosaic=dtm_mosaic.cub
```



The **removal** of "**LRS**" pixels is needed in order to produce DTM mosaics.

```
  Group = Mapping
    ProjectionName     = EQUIRECTANGULAR
    CenterLongitude    = 0.0
    TargetName         = Mars
    EquatorialRadius   = 3396000.0 <meters>
    PolarRadius        = 3396000.0 <meters>
    LatitudeType       = Planetocentric
    LongitudeDirection = PositiveEast
    LongitudeDomain    = 360
    MinimumLatitude    = -15.5
    MaximumLatitude    = 4.0
    MinimumLongitude   = 281
    MaximumLongitude   = 290
    PixelResolution    = 100.0 <meters/pixel>
    Scale              = 592.71380386667 <pixels/degree>
  End_Group
End_Object
```

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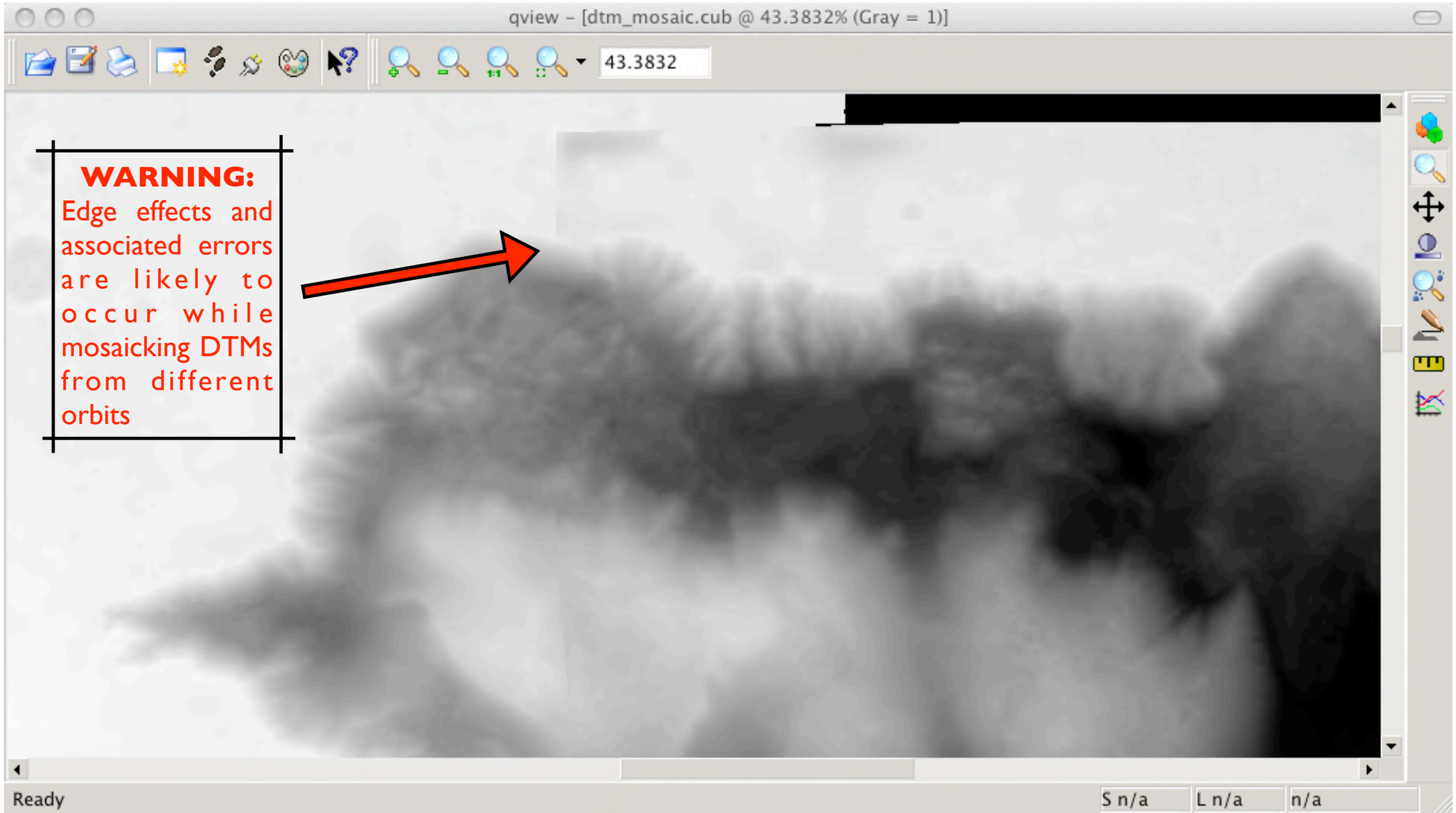
HRSC into ISIS3

HRSC Level4 DTM mosaic quality

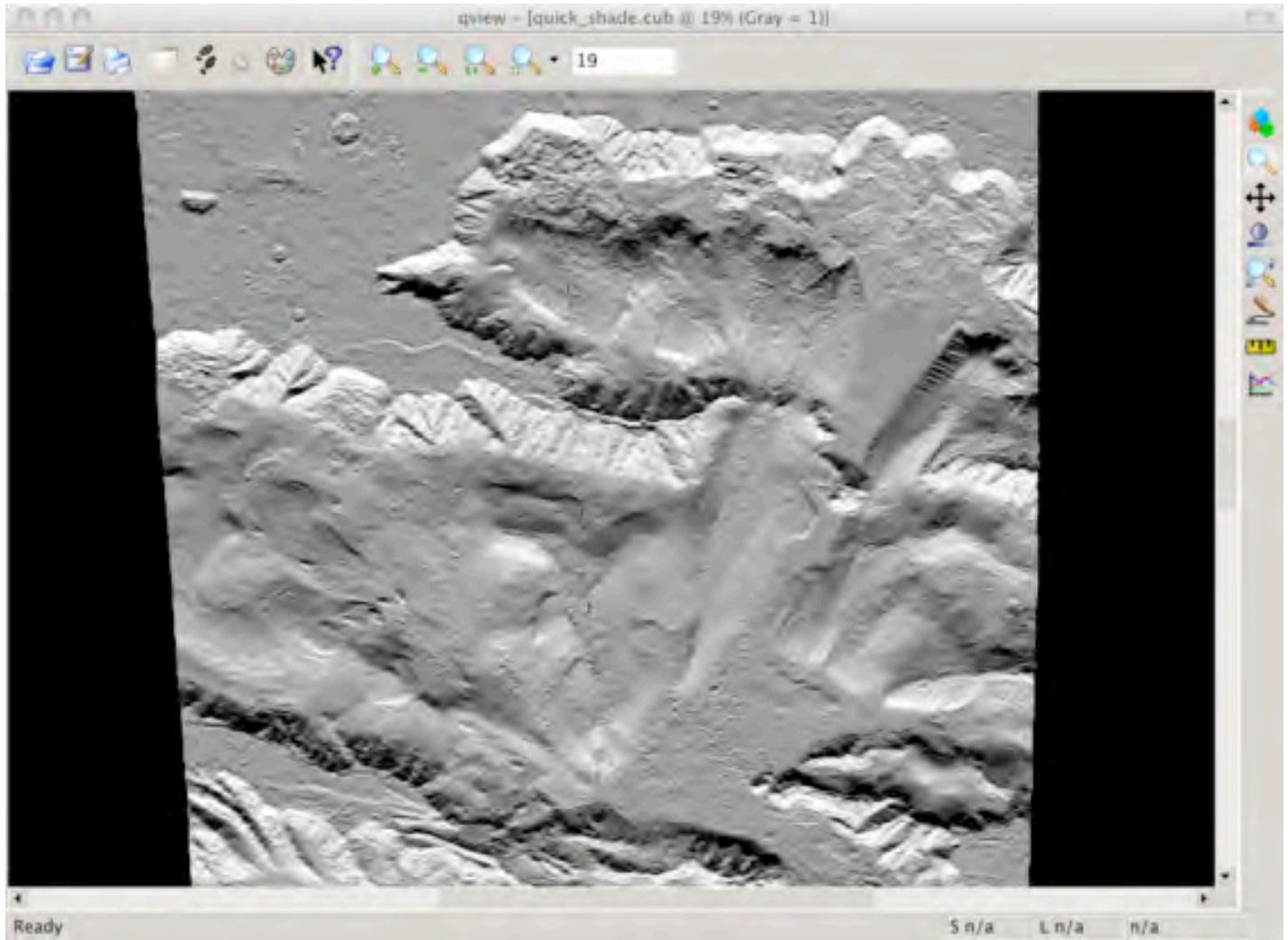


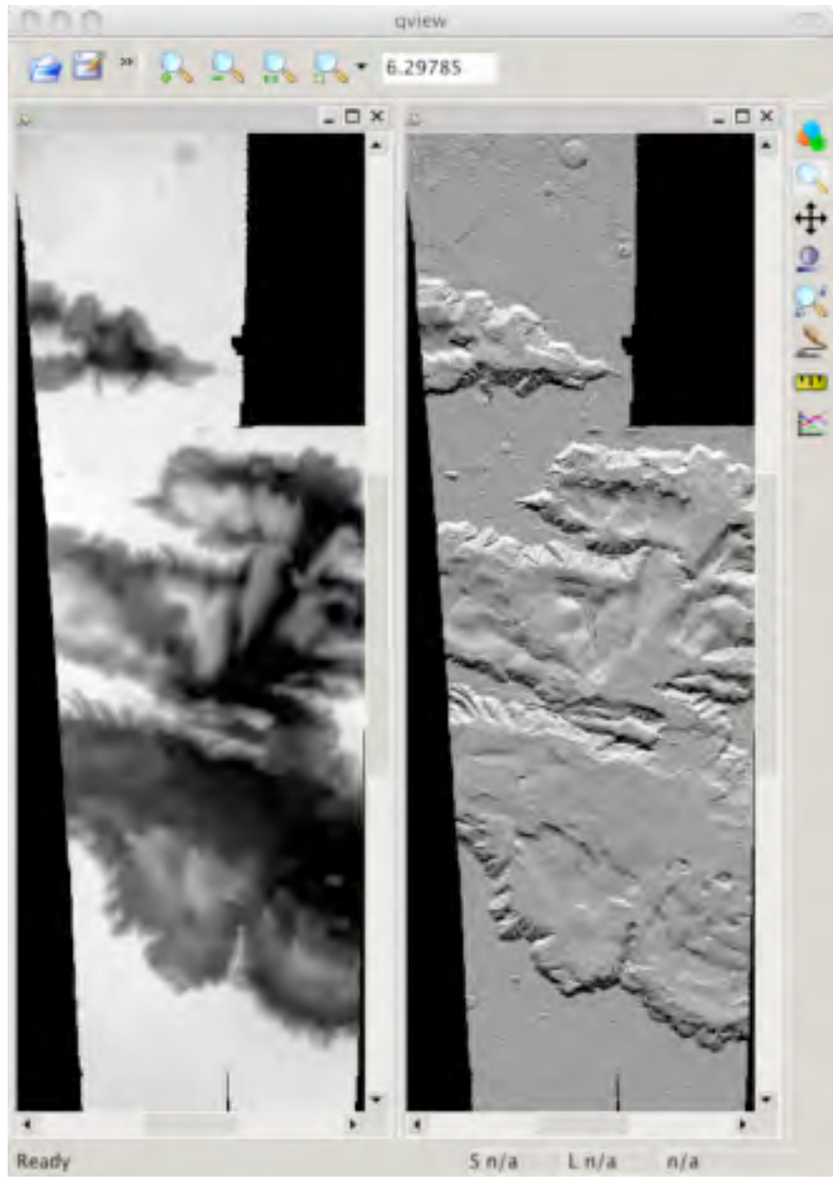
HRSC into ISIS3

HRSC Level4 DTM mosaic quality

"shade"

```
shade from=dtm_quick_mosaic.cub to=quick_shade.cub
      azimuth=270 zenith=45 pixelresol=200
```





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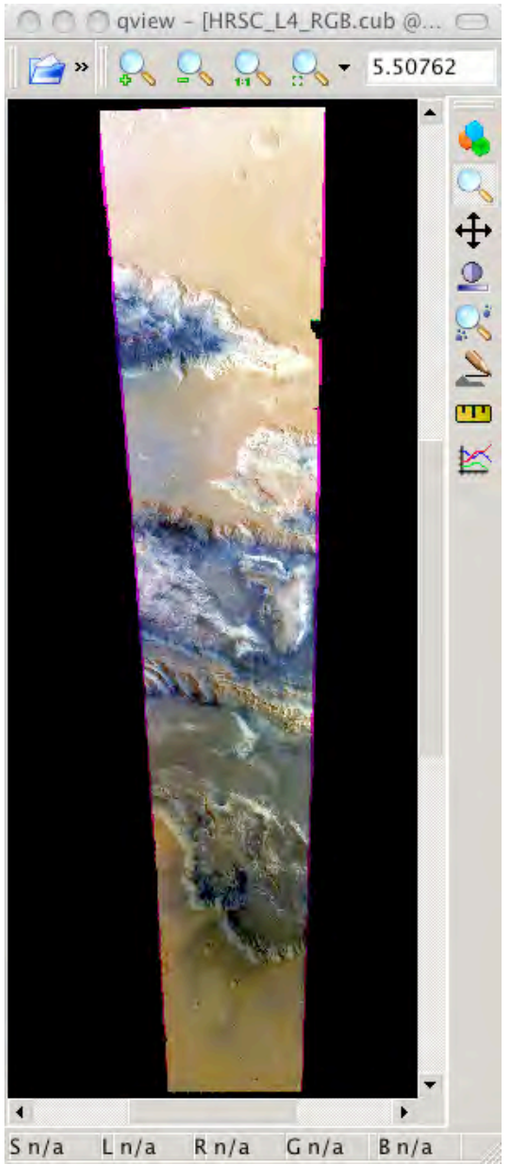
HRSC into ISIS3

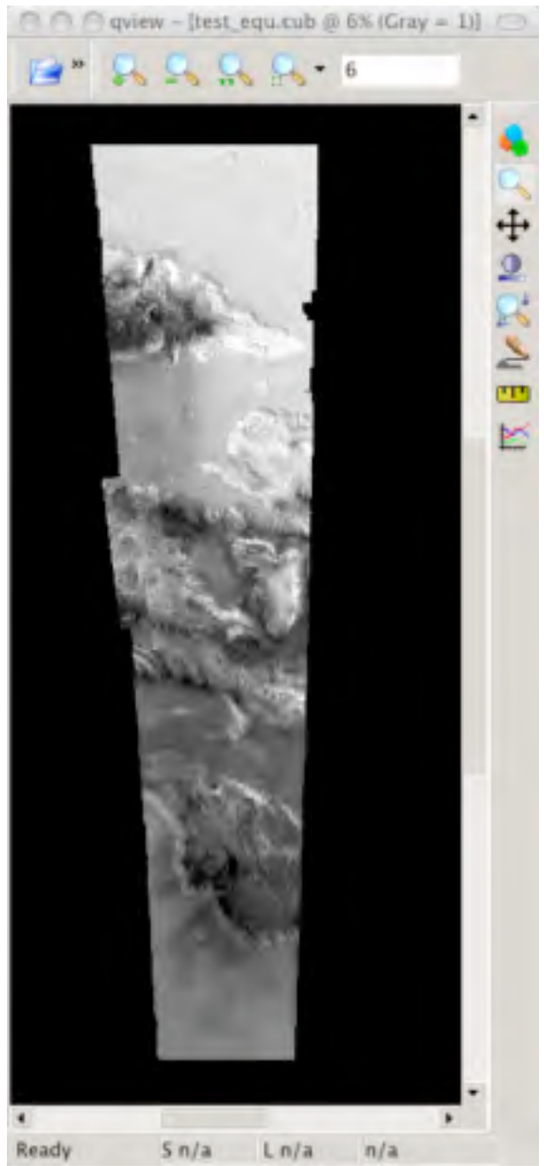
HRSC & other datasets in ISIS

e.g. mosaicking HRSC & CTX

CTX (EDR)



HRSC (level4)



HRSC L4 ND + CTX mosaic

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HRSC into ISIS3

HRSC Level4 + CTX mosaic

"equalizer"

```
equalizer fromlist=list
   holdlist=holdlist
to=equalize apply=true
```

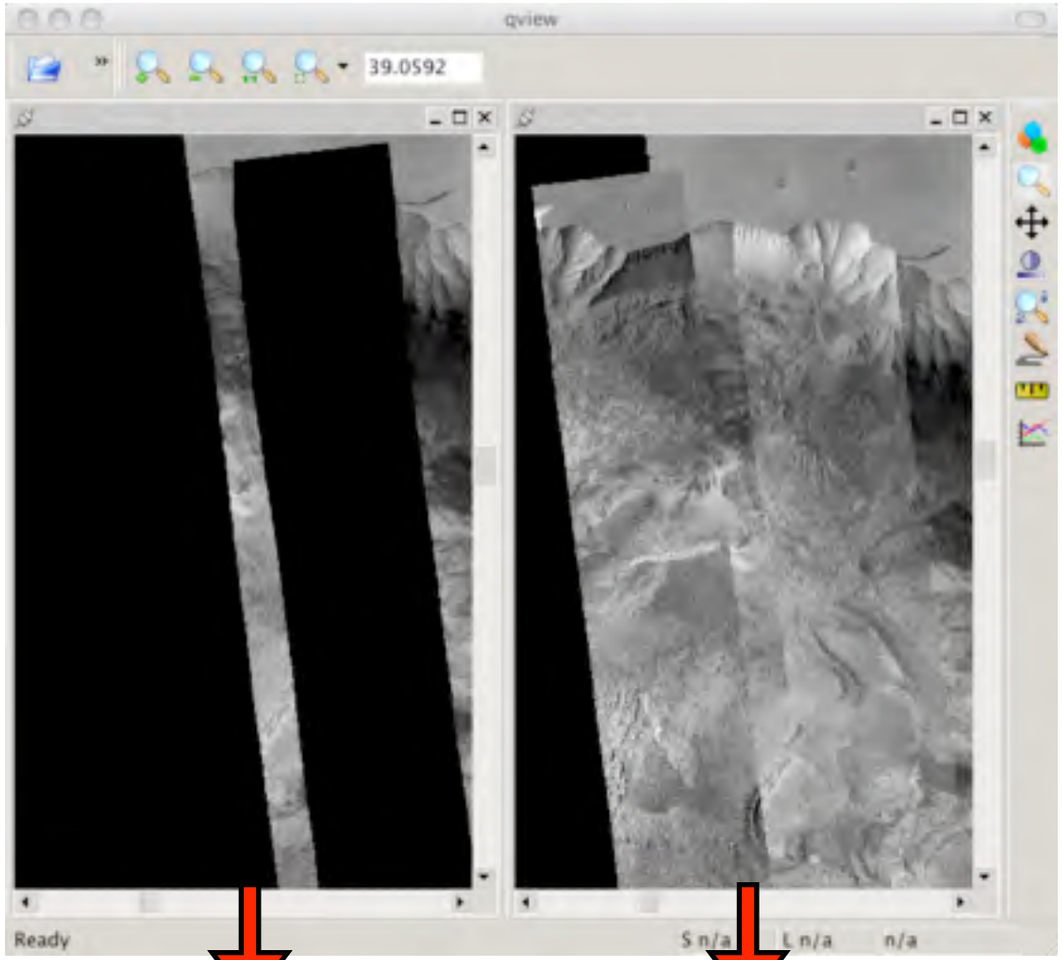
```
list
hrsc.cub
ctx.cub
```

```
holdlist
hrsc.cub
```

"automos"

```
automos
fromlist=mos2list
mosaic=equ_mosaic.cub
```

```
mos2list
hrsc.equ.cub
ctx.equ.cub
```



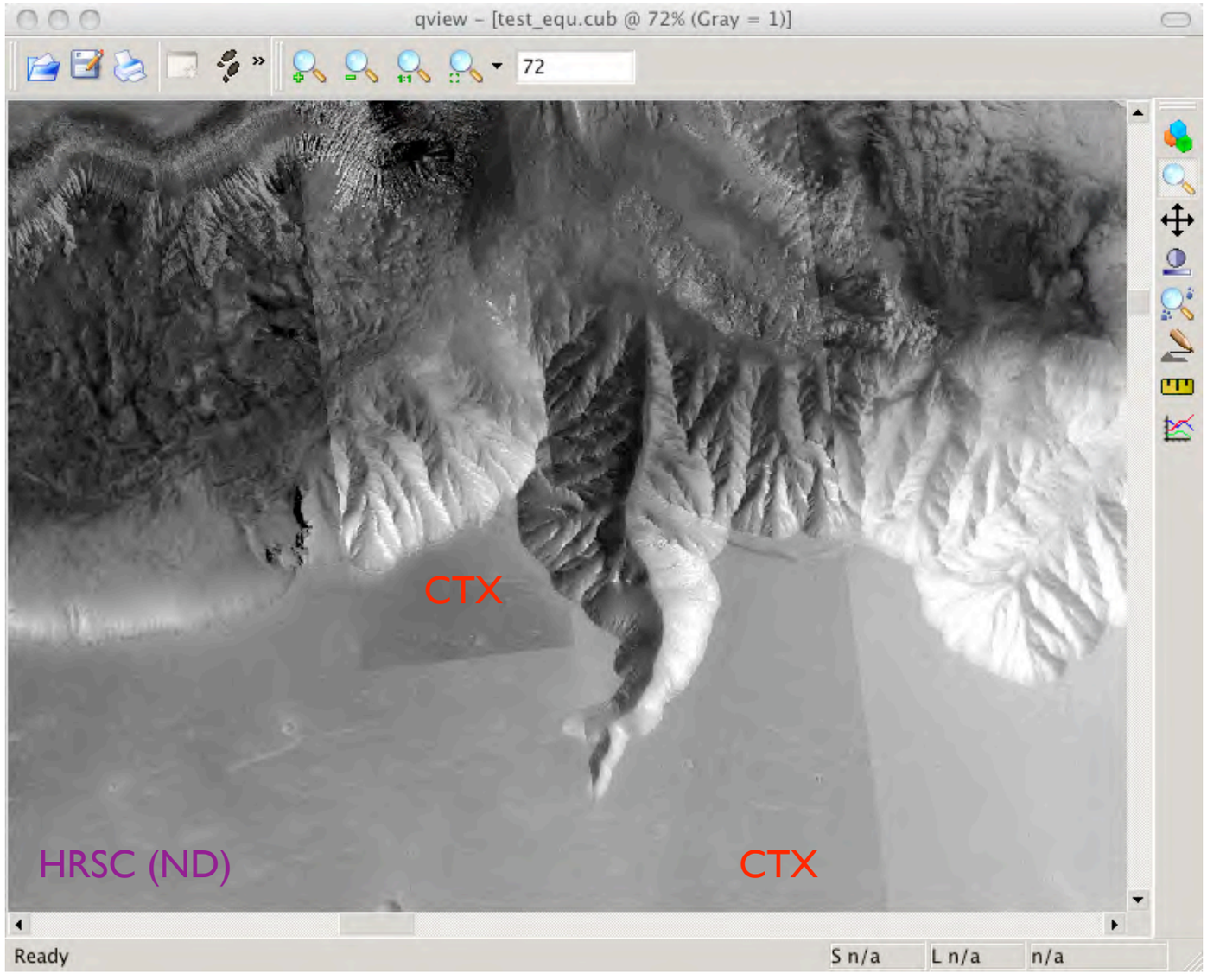
WITHOUT
"equalizer"

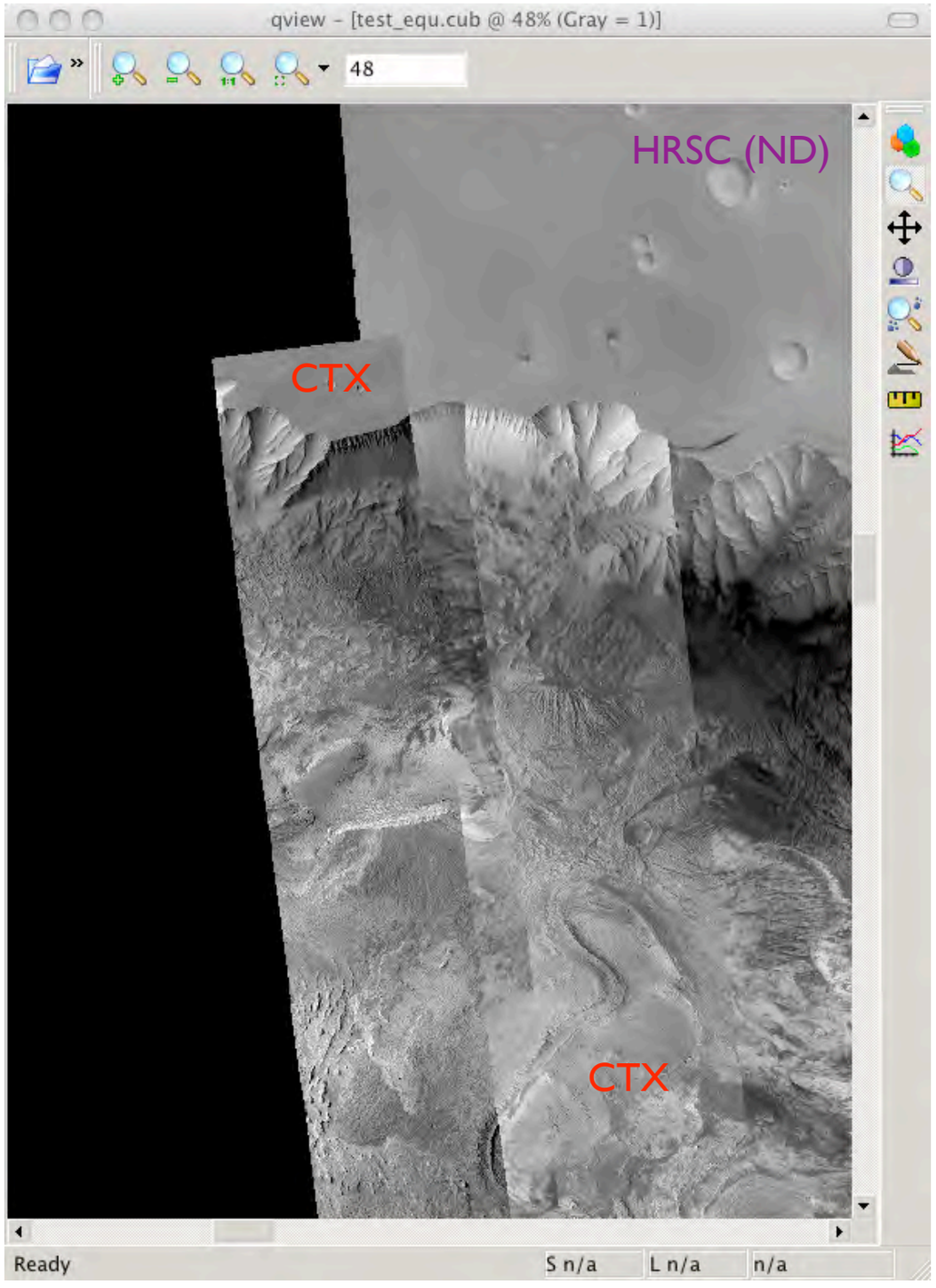
WITH
"equalizer"

HRSC Level4 images (NOT DTMs) are 8-bit, unlike CTX EDR Level2

HRSC into ISIS3

HRSC ND & CTX mosaic





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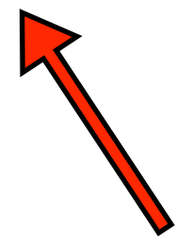
View/export DEMs: HRSC in GIS systems

HRSC Level4 in GIS systems

- HRSC Level4 data can be imported, used and analyzed with both commercial (e.g. ESRI ArcGis) and open source (e.g. Quantum Gis) GIS Systems
- Map-projected Level4 data can be imported directly into a GIS with proper header creation (e.g. .hdr), being Level4 data simple BSQ binary files.
- Image data (RE, GR, BL, IR, ND) are 8-bit BSQ
- DEM data (DA, DT) are 16-bit signed BSQ



home-brewed Level3 images(anaglyphs) ARE 16-bit !!!!

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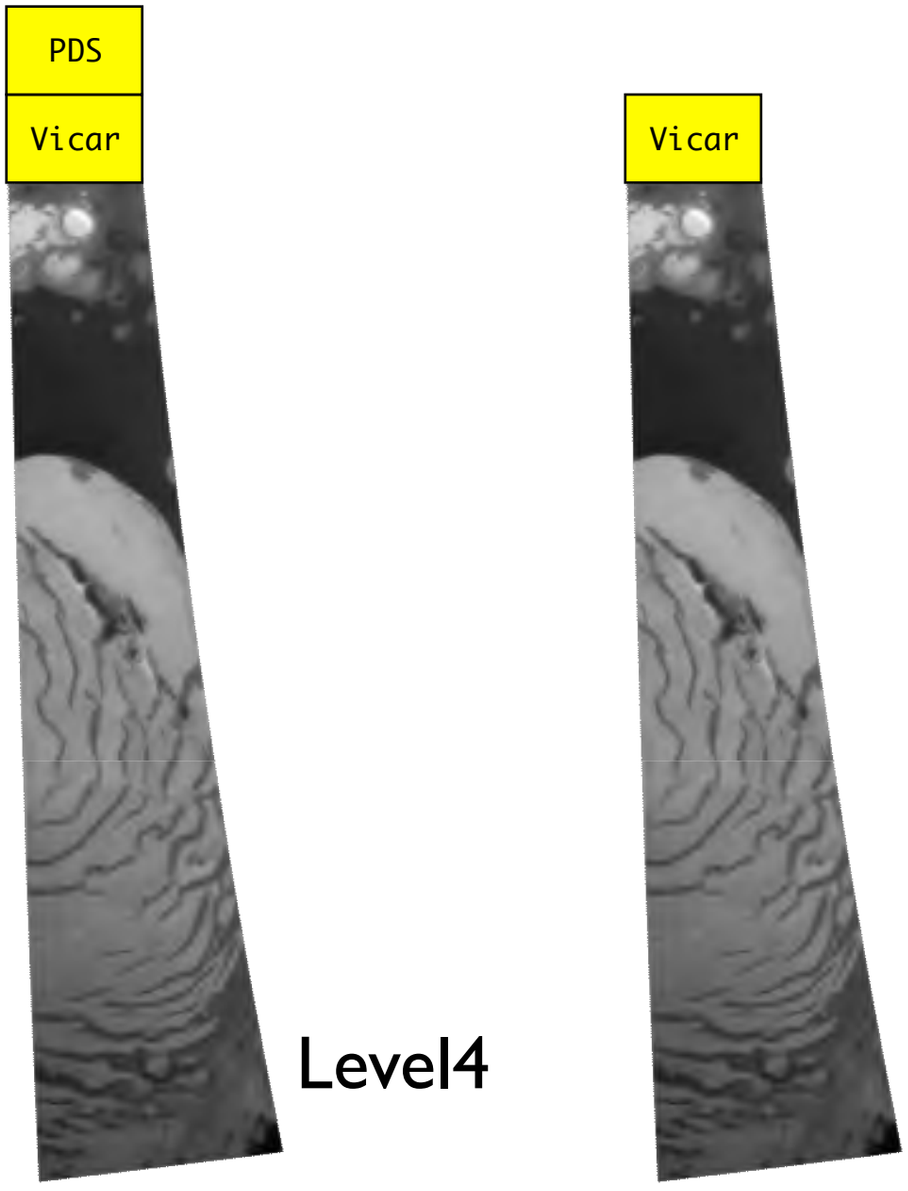
Note on Level3!



Level4

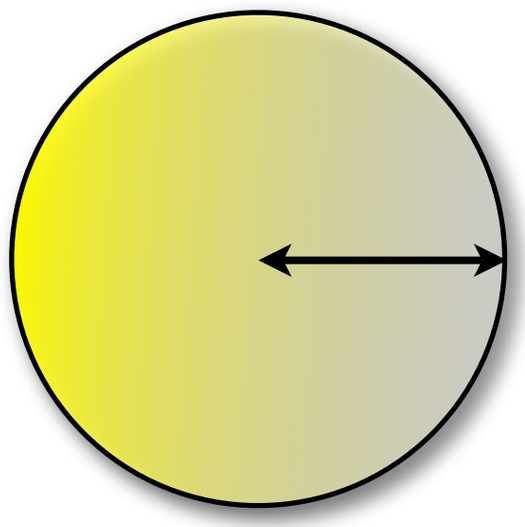
home-brewed
Level3

home-brewed Level3 (manually obtained from Level2) images **LACK** the PDS label

PLEASE REFER TO “HRSC & GIS Introduction” ON:
http://sci.esa.int/mexdw1/

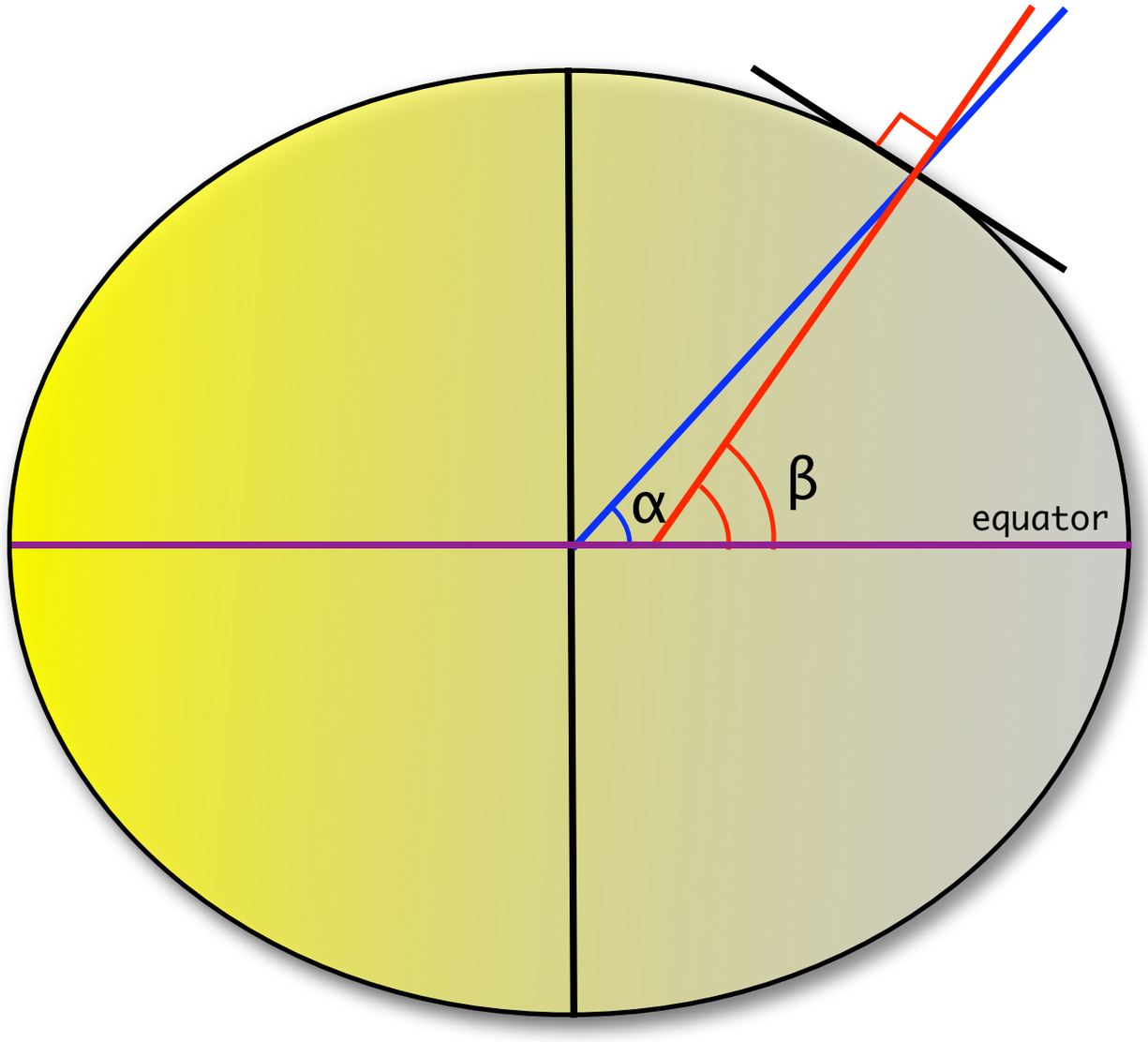
HRSC & GIS

- HRSC level4 data are provided with a coordinate system based on a sphere with R=3396.0 km
- Working with sphere often easier (e.g. with GIS, when planetocentric latitude is not supported using a spheroid)



```
A_AXIS = 3396.0 km
B_AXIS = 3396.0 km
C_AXIS = 3396.0 km
```

GIS & Planetocentric, etc.



Often confusing, make sure your choices are consistent

Latitude:

α = planetocentric

β = planetographic

of course, if:

A_AXIS = 3396.0 km
B_AXIS = 3396.0 km
C_AXIS = 3396.0 km

α = β

and life is easier...

HRSC & GIS

- Constants:

PAY ATTENTION IF Byteorder is “I” or “M”

Byteorder = I ← using x86 (minivicar binaries)

Number of bands = 1 ← bands in separate files

File structure = BSQ

byte depth = 8/16* ← * 8-bit in Level3/4 imagedata; 16-bit signed in Level4 DA & D4 data

Georef. info in PDS header

e.g. from PSA PDS label

Elements/keywords	Example (H0360_0000_ND3.IMG)	Parameter
MAP_SCALE	0.025 <km/pixel>	pixel size
LINE_PROJECTION_OFFSET	7416.0	projection parameter
SAMPLE_PROJECTION_OFFSET	4998.0	projection parameter
FILE_RECORDS	43891	header size (skipbytes)
LINES	43888	number of lines
LINE_SAMPLES	10383	number of samples (columns)
MAP_PROJECTION_TYPE	SINUSOIDAL	map projection
CENTER_LONGITUDE	285.0	projection parameter
CENTER_LATITUDE	0.0	projection parameter

+

```
A_AXIS = XXXX.XX km
B_AXIS = XXXX.XX km
C_AXIS = XXXX.XX km
```

→ what we need to put HRSC onto a GIS

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Needed info - GIS headers

e.g. for building an Esri .hdr file (or other, e.g. .tfw):

NL 10383

NS 43888

no. of bands 1

byte depth 8 bit

file structure BSQ

FILE_RECORDS = skipbytes 43891

SAMPLE_PROJECTION_OFFSET * pixel_size * -1 = upper_left_x (meters) 4998.0 * 25 * -1 = -124950

LINE_PROJECTION_OFFSET * pixel_size = upper_left_y (meters) 7416.0 * 25 = 185400

MAP_SCALE (km) x 1000 = pixel_size (meters) 0.025 x 1000 = 25

```
nrows 43888
ncols 10383
nbands 1
nbits 8
byteorder I
layout BSQ
skipbytes = 43891
ulxmap -124950
ulymap 185400
xdim 25
ydim 25
```

+

e.g. for building an Esri .prj file:

```
PROJCS["Mars_Sinusoidal_clonXX",GEOGCS["GCS_Mars_2000_Sphere",DATUM["D_Mars_2000
_Sphere",SPHEROID["Mars_2000_IAU_IAG_Sphere",
3396190.0,0.0]],PRIMEM["Reference_Meridian",0.0],UNIT["Degree",
0.0174532925199433]],PROJECTION["Sinusoidal"],PARAMETER["False_Easting",
0.0],PARAMETER["False_Northing",0.0],PARAMETER["Central_Meridian",
80.0],UNIT["Meter",1.0]]
```

INFO FROM PDS LABEL

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GIS header: examples

Envi .hdr

```
ENVI
description = {
   test}
samples = 6591
lines   = 8653
bands   = 1
header offset = 0
file type = ENVI Standard
data type = 2
interleave = bsq
sensor type = Unknown
byte order = 2
map info = {mars_mercator, 1.0000, 1.0000, -394750.0000, -389250.0000, 10000000000e+01, 10000000000e+01, , units=Meters}
projection info = {20, 3396190.0, 3376200.0, 0.000000, 0.000000, 0.0, 0.0, mars_mercator, units=Meters}
wavelength units = Unknown
data ignore value = -32768
default stretch = default stretch = 0.0% linear
band names = {
 Gray Scale (Band 1:ir)}
```

.tfw

```
25
0.0
-25
-124950
185400
```

Esri .hdr

```
nrows 43888
ncols 10383
nbands 1
nbits 8
byteorder I
layout BSQ
skipbytes = 43891
ulxmap -124950
ulymap 185400
xdim 25
ydim 25
```

Script examples

Perl scripts to directly ingest (no translation, direct header creation, works on Windows) HRSC PSA/VICAR level3/4 data in ArcGis (courtesy J. Oosthoek) available:

ftp://gorilla.estec.esa.int/pub/projects/workshop/04_MEX_DW_june_2007/software_data/user_provided_tools/

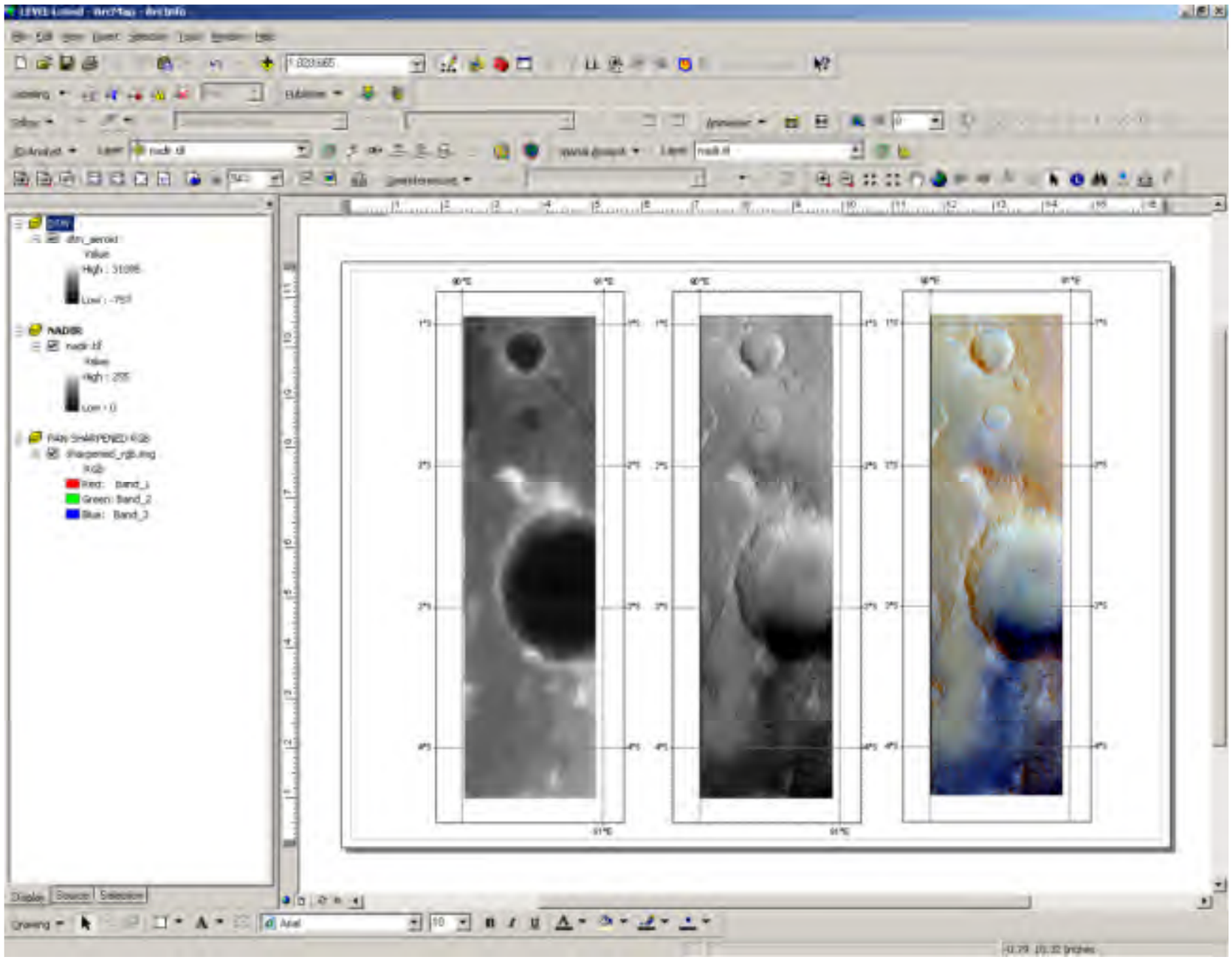
hrsc2arcgis.pl	hrsc2arcgisVICAR.pl	hrscdtm2arcgis.pl
↓	↓	↓
for PSA PDS Level3/4 image data	for VICAR Level3/3+ data	for PSA PDS Level4 DEM (DA4, DT4) data

MEX HRSC data to GIS converter (Visual Basic)

http://arcscripts.esri.com/details.asp?dbid=15566

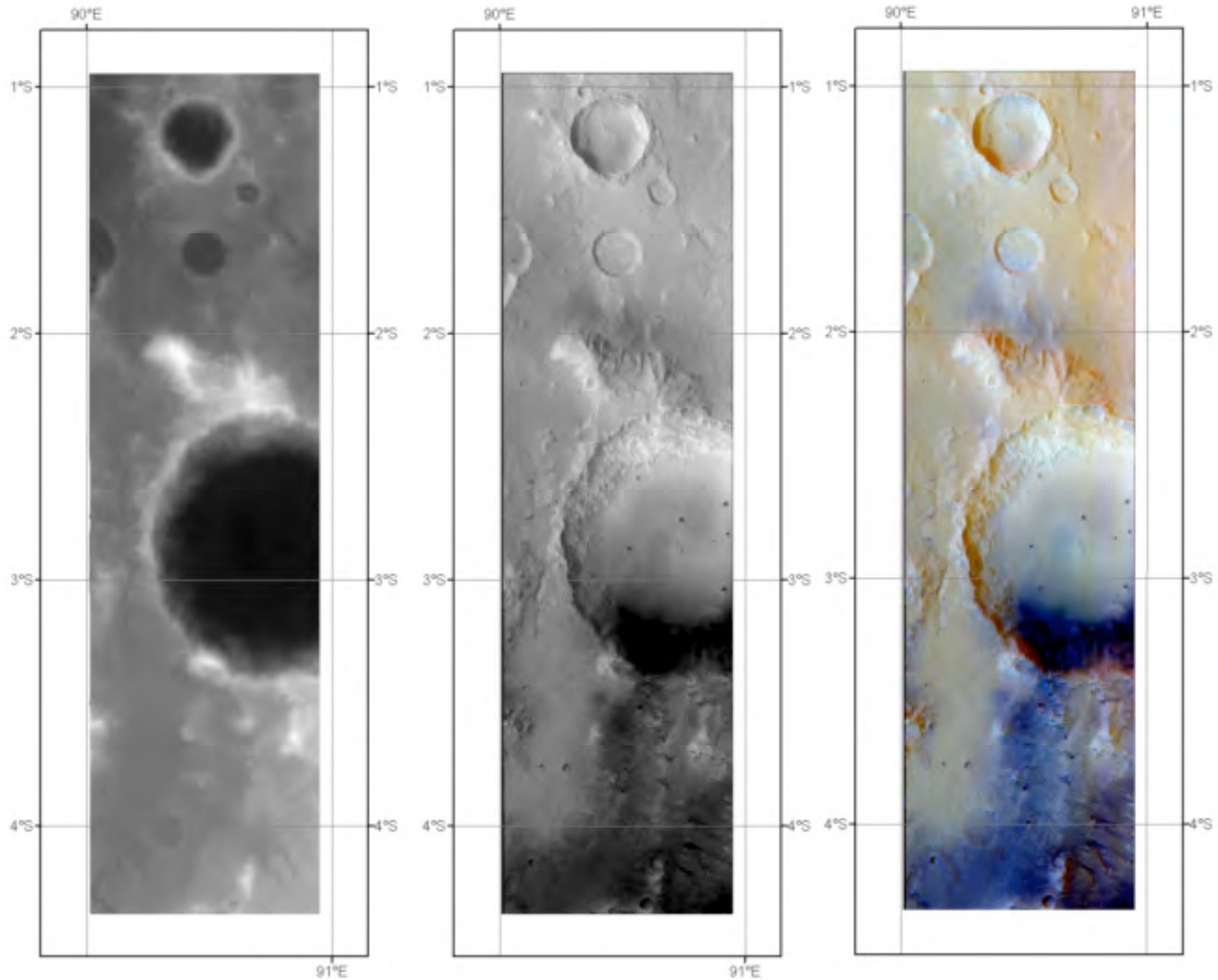
Similar scripts can be produced in a variety of languages and/or tools

HRSC Level4 in ArcGis 9.2



- Use of HRSC Level4 dataset in ArcGis
- Use of .bsq (+ .hdr) for direct import
- Use of Tiff, Jpeg2000, etc. easy to perform
- Sphere (r = 3396.0) supported

HRSC Level4 & GIS



HRSC DA4, Nadir and pan-sharpened color in three data frames, in ArcGis 9.2

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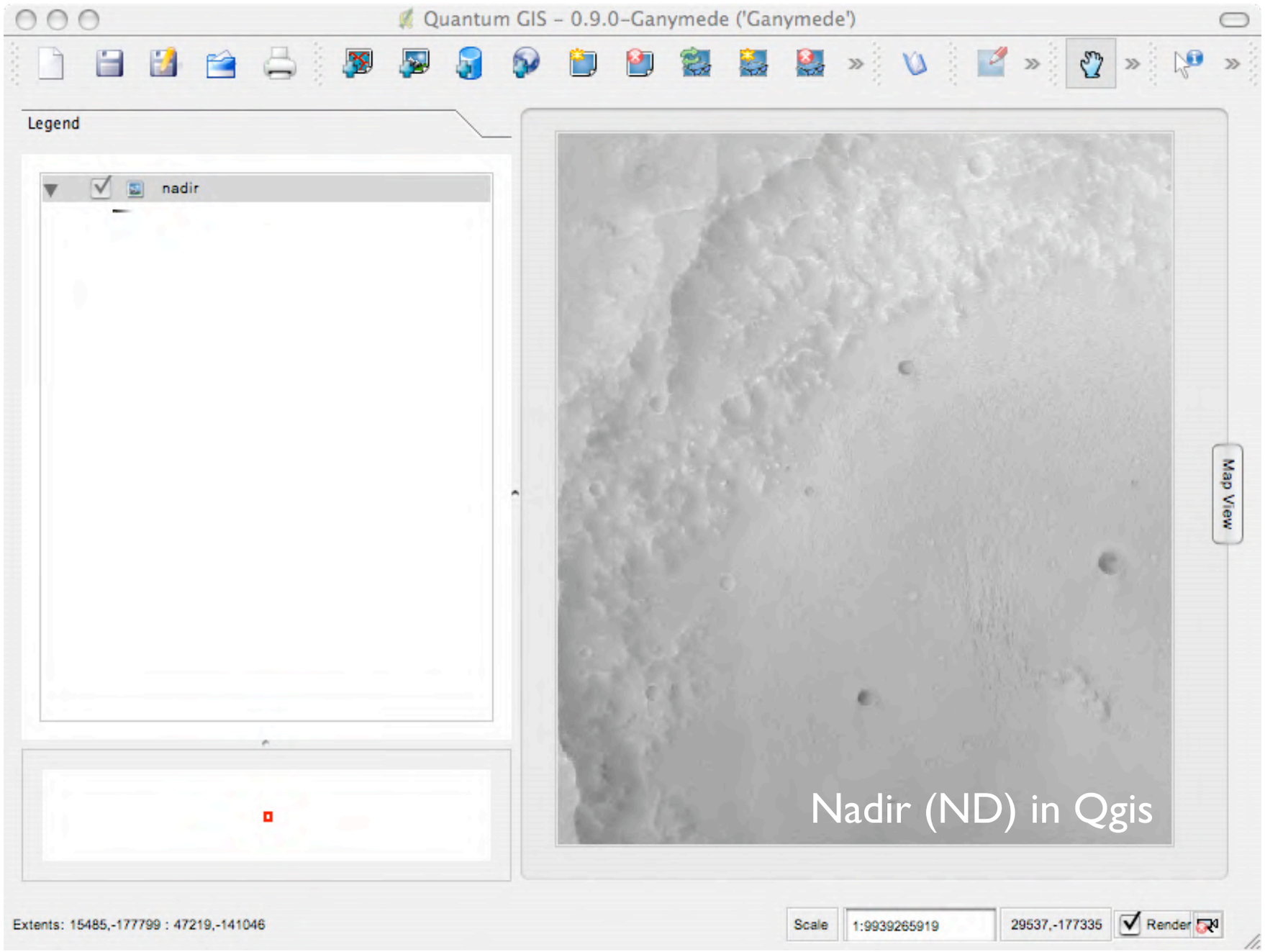
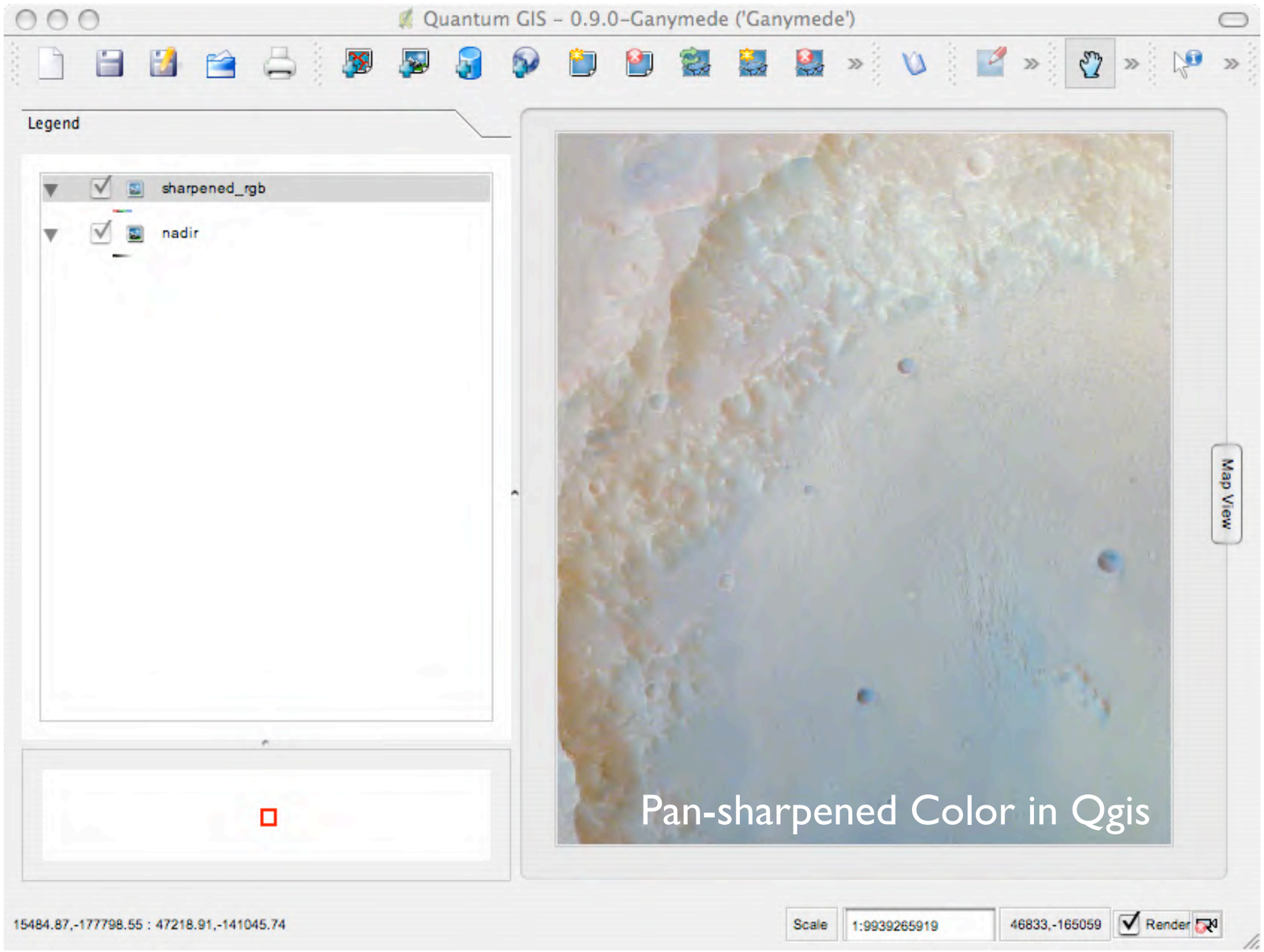
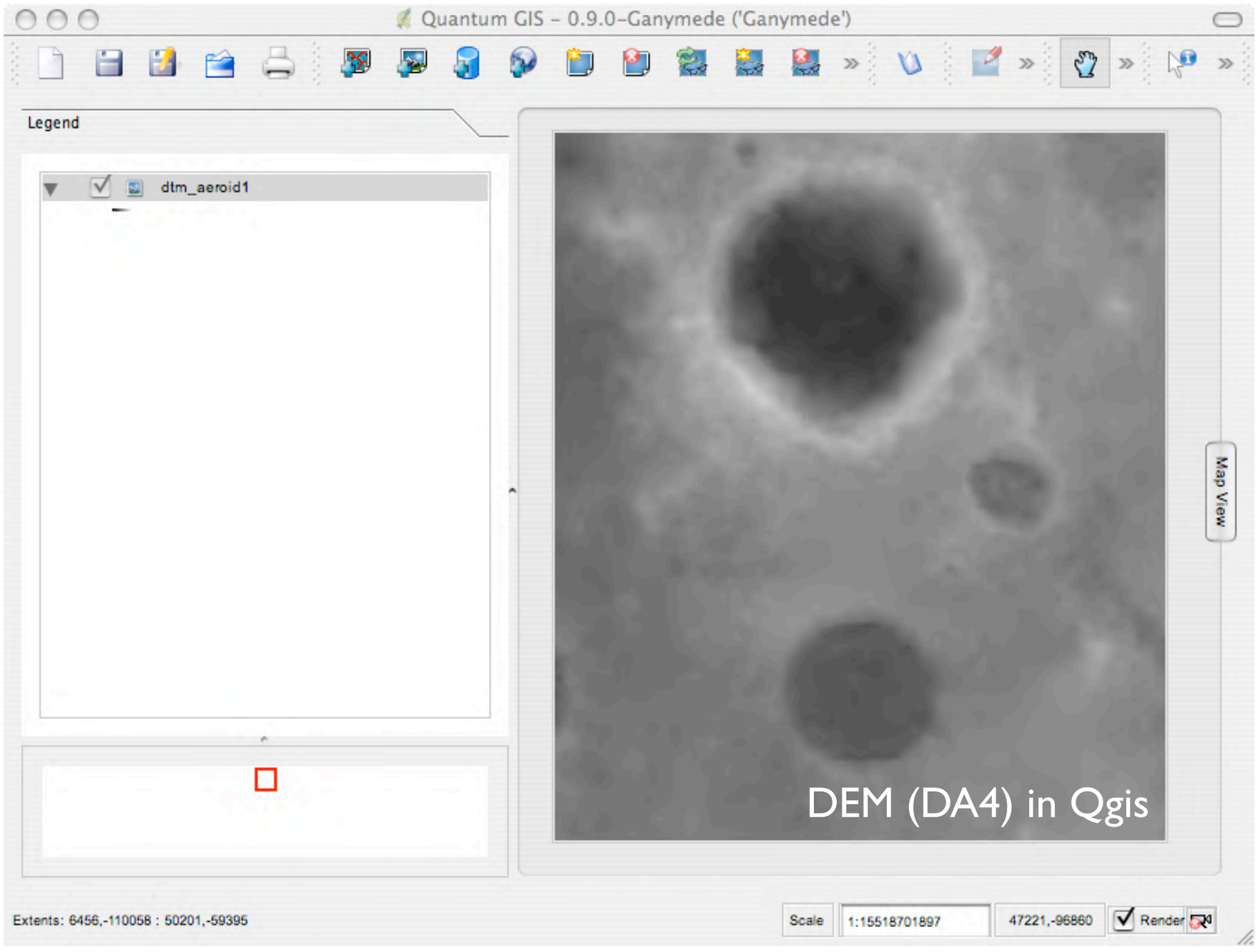
HRSC Level4 in Qgis



HRSC Level4 in Qgis



HRSC Level4 in Qgis



DEM (DA4) in Qgis

Relevant references

Relevant Science Papers

- Please refer to these publications on the HRSC experiment:

Jaumann, R., et al. (2007), The high-resolution stereo camera (HRSC) experiment on Mars Express: Instrument aspects and experiment conduct from interplanetary cruise through the nominal mission, *Planetary and Space Science*, *55*, 928-952.

Gwinner, K., et al. (2005), Hochauflösende Digitale Geländemodelle auf der Grundlage von Mars Express HRSC-Daten, *Photogrammetrie – Fernerkundung – Geoinformation*, *5*, 387-394.

Neukum, G., and R. Jaumann (2004), HRSC: the High Resolution Stereo Camera of Mars Express, paper presented at ESA Special Publication, August 1, 2004.
online at: http://sci.esa.int/science-e/www/object/index.cfm?fobjectid=34885

Scholten, F., K. Gwinner, T. Roatsch, K.-D. Matz, M. Wählisch, B. Giese, J. Oberst, R. Jaumann, G. Neukum und the HRSC Co-Investigator Team (2005), Mars Express HRSC Data Processing - Methods and Operational Aspects, Photogrammetric Engineering & Remote Sensing, **71**, 10, 1143-1152

Relevant documentation

Please refer to these documents on the HRSC datasets:

- Planetary Science Archive:

  http://www.rssd.esa.int/PSA/

- First Mars Express Data Workshop:

  http://sci.esa.int/mexdw1/

- Mars ESA web page:

  http://mars.esa.int

- HRSC FU Berlin web page:

  http://hrscview.fu-berlin.de/