CS-530 Project 2 Report

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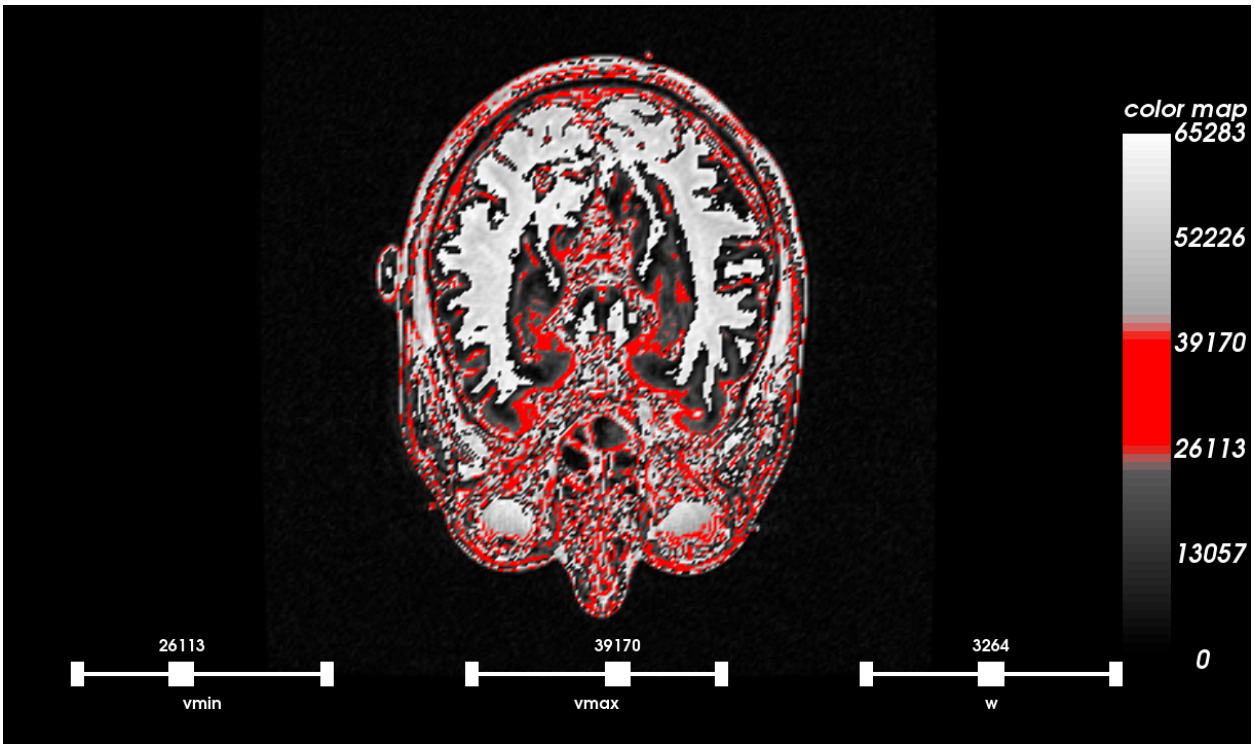
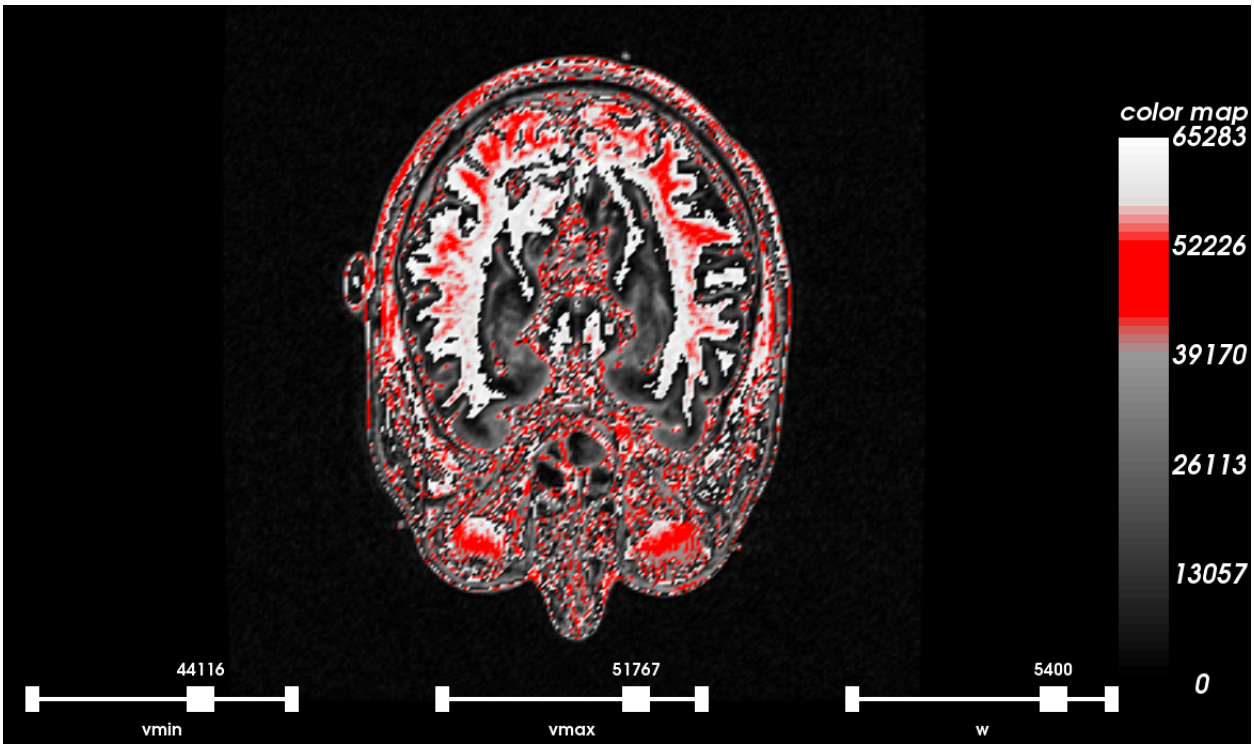
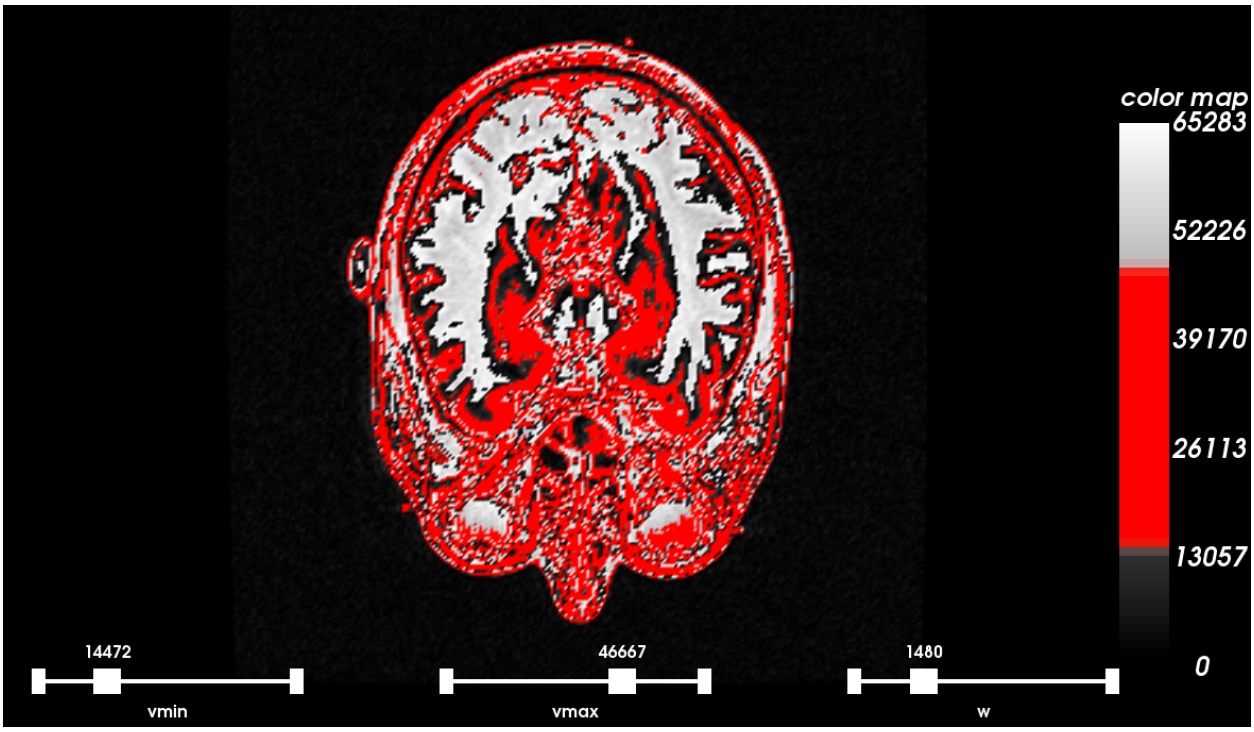
Task 1



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39170
26113
13057
0
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vmin
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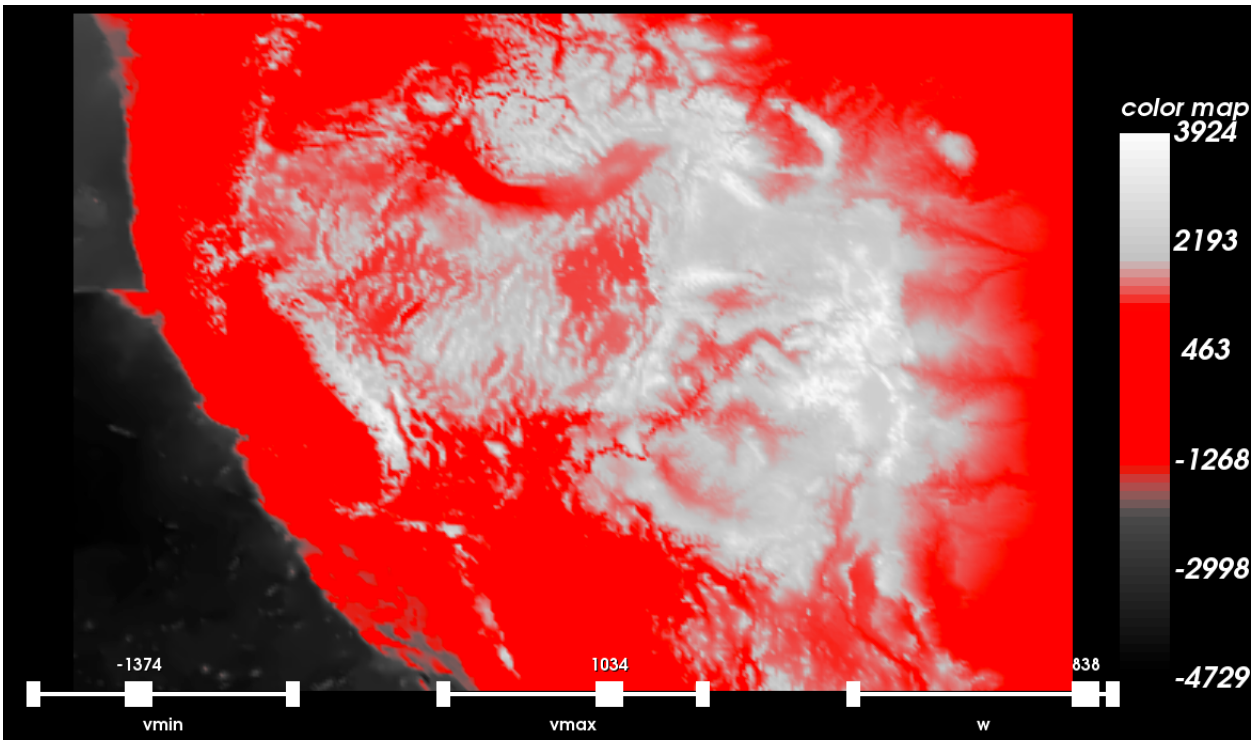
vmax
1480
w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2193
463
-1268
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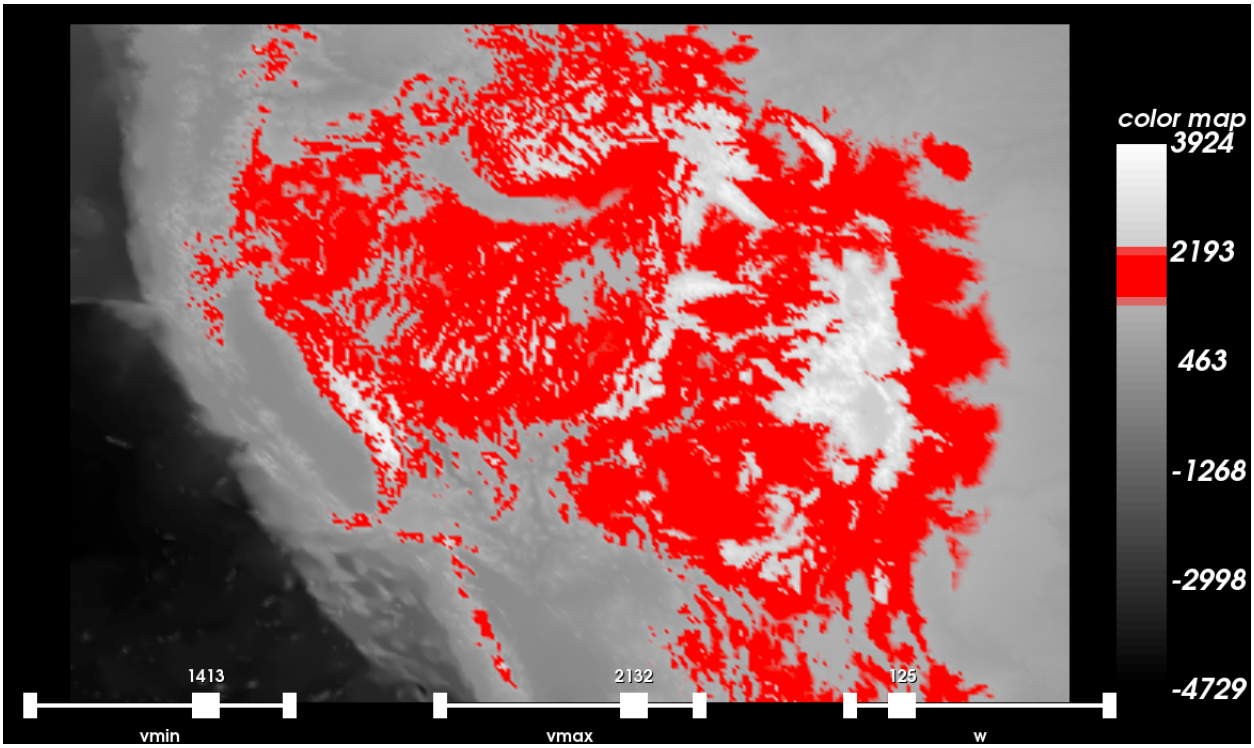
vmin
1034
vmax
838
w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1413
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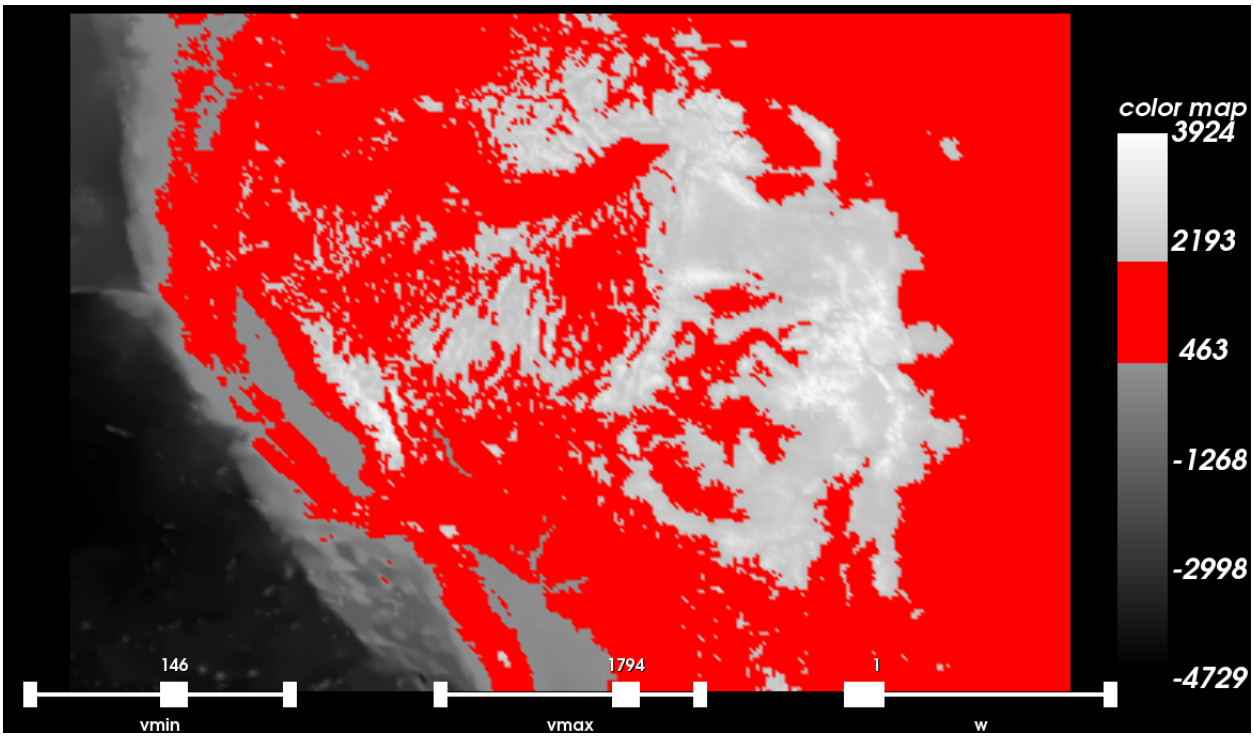
125
vmin
vmax
w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2193
463
-1268
-2998
-4729
146
1794
1
vmin
vmax
w

Discussion

In this implementation, the major challenges are

1. Detect the range of the scalar values of the image automatically
   By using vtkStructuredPointsReader -> GetOutput() -> GetPointData() -> GetScalars() -> GetRange(), we can get the maximum and minimum values of the image.
2. The restrictions of the values of vmin, vmax and w
   1. When using vmin slider, the following rules should be applied:
      - vmin <= vmax-1.
      - vmin+w <= max scalar value - 2
      - vmin-w >= min scalar value + 1
   2. When using vmax slider, the following rules should be applied:
      - vax >= vmin+1.
      - vmax+w <= max scalar value - 1
      - vmax-w >= min scalar value + 2
   3. When using w slider, the following rules should be applied:
      - vmin+w <= max scalar value - 2
      - vmin-w >= min scalar value + 1
      - vmax+w <= max scalar value - 1
      - vmax-w >= min scalar value + 2
3. Restrict the mouse interaction
   By using SetInteractionModeToImage2D function in vtkInteractorStyleImage.

Task 2

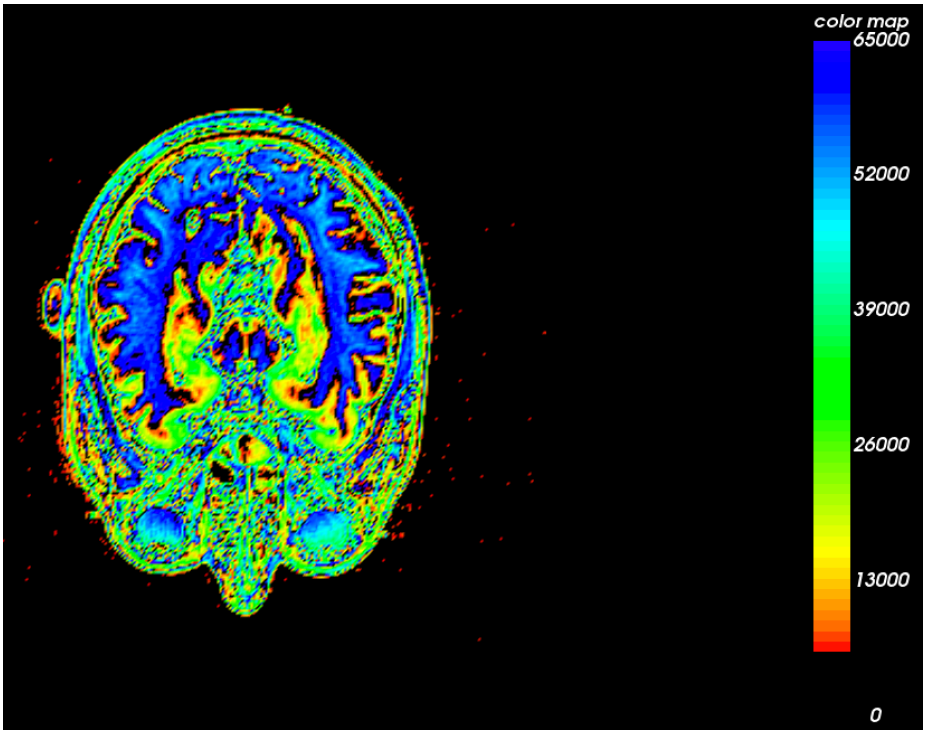


Figure 2.1 Continuous Rainbow (axial1)

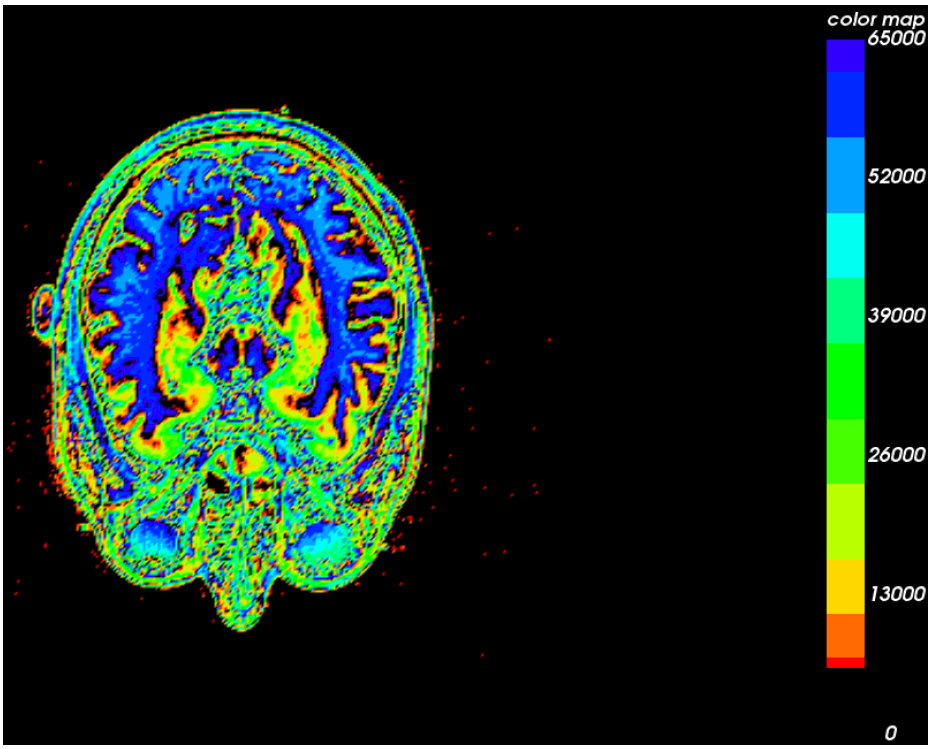


Figure 2.2 Discrete Rainbow (axial1)

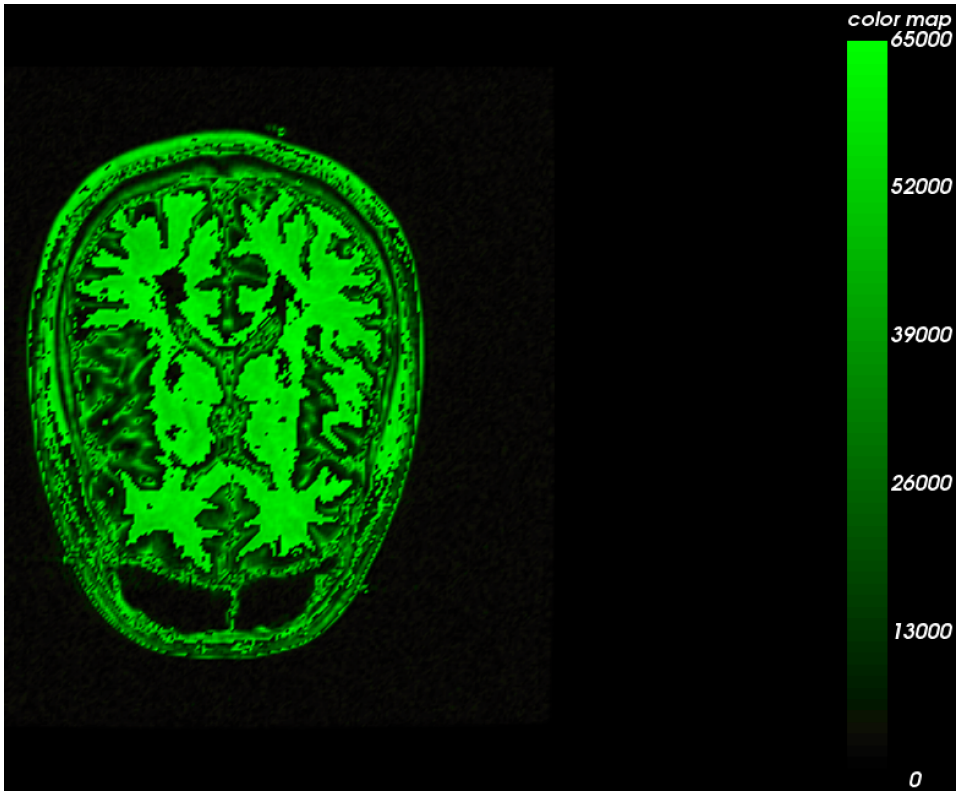


Figure 2.3 Continuous Green Scale (axial2)

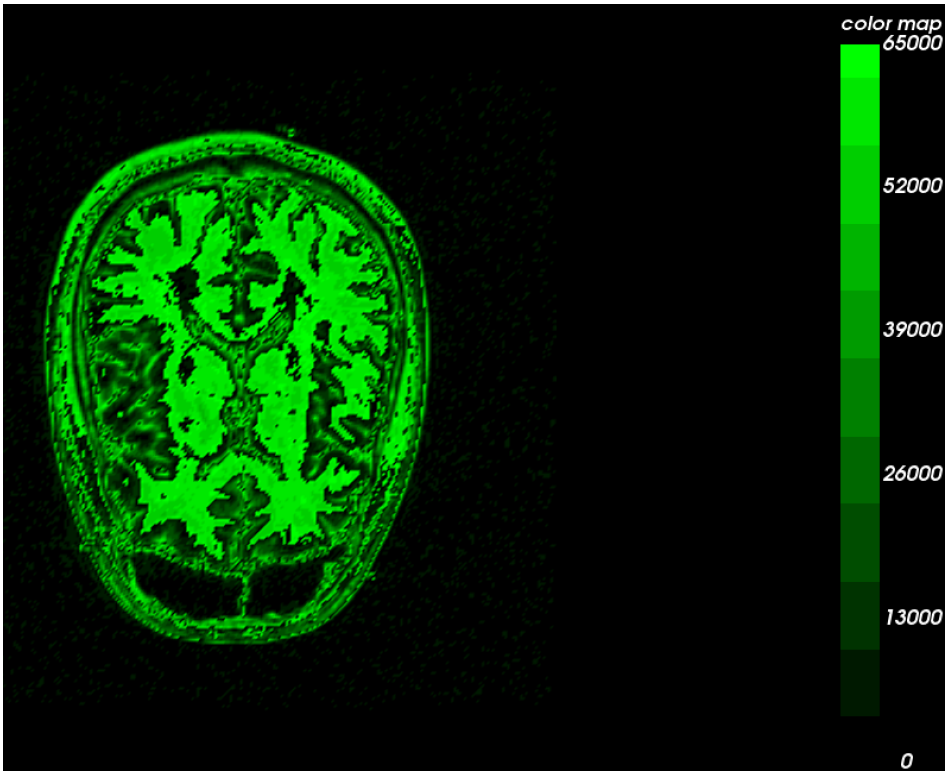


Figure 2.4 Discrete Green Scale (axial2)

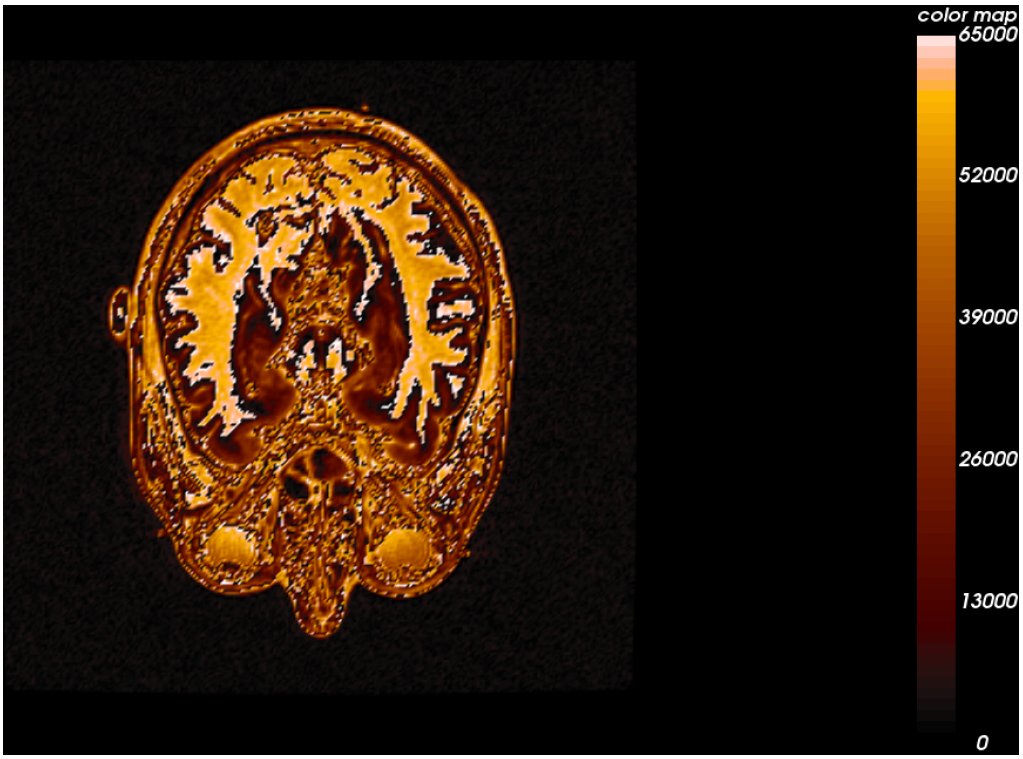


Figure 2.5 Continuous Heated Map (axial3)

Figure 2.6 Discrete Heated Map (axial3)

Discussion

1. Color Maps

I've tried 3 different color maps:
- Modified rainbow (Red -> Blue), Figure 2.1 and 2.2
- Green scale, Figure 2.3 and 2.4
- Heated, Figure 2.5 and 2.6

Modified rainbow color map
[Pros]
- Easy to distinguish the value differences between 2 points by comparing their colors.
- Blue and Red can emphasize the extreme values well.

[Cons]
- The colors are not natural ordering.
- Not perceptually linear. Equal distances in the scale do not appear equally different color-wise.

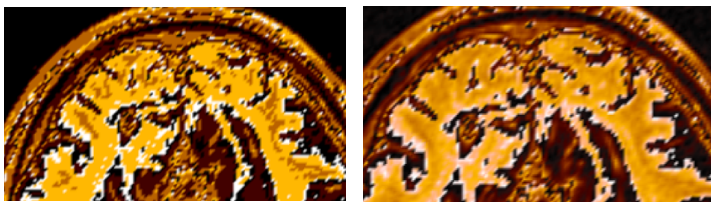
Green scale color map
[Pros]
- Comparing to rainbow color map, it is more natural and the colors are natural ordering.
- Can describe the contours of the image.

[Cons]
- Adjacent colors look similar, so it is difficult to observe the difference if the values of the points are not very different.

Heated color map
[Pros]
- The colors are natural ordering.
- Comparing to the green scale color map, it is easier to observe the points whose values are not very different.

2. Continuous vs. Discrete

In my observation, there are only slight differences between continuous and discrete color maps. Considering the points with value greater than 45000, we can see the discrete color map performs better by providing more details on our images.



Discrete (left) vs. Continuous (right)

In conclusion, I would suggest the **discrete heated color map** is more appropriate for our MRI images because 1) its colors are natural ordering, 2) it performs well on distinguishing the differences for points and 3) the discrete heated color map provides more details for our images.

Task 3

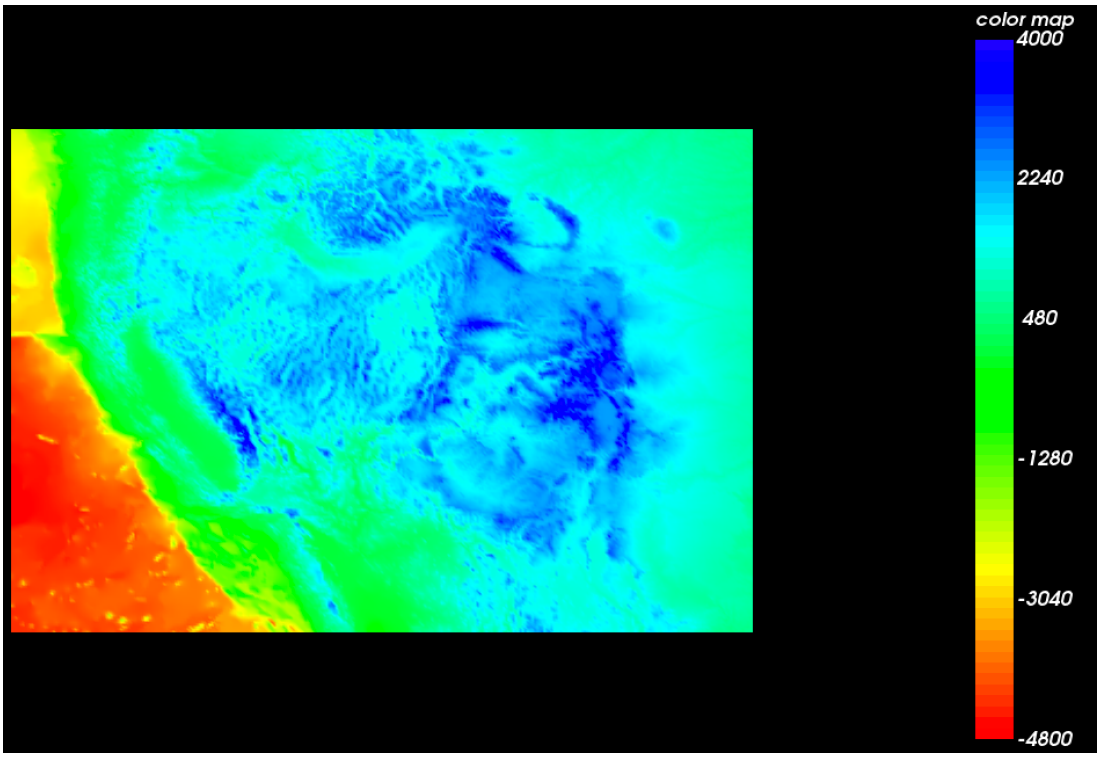


Figure 3.1 Continuous Rainbow (westUS)

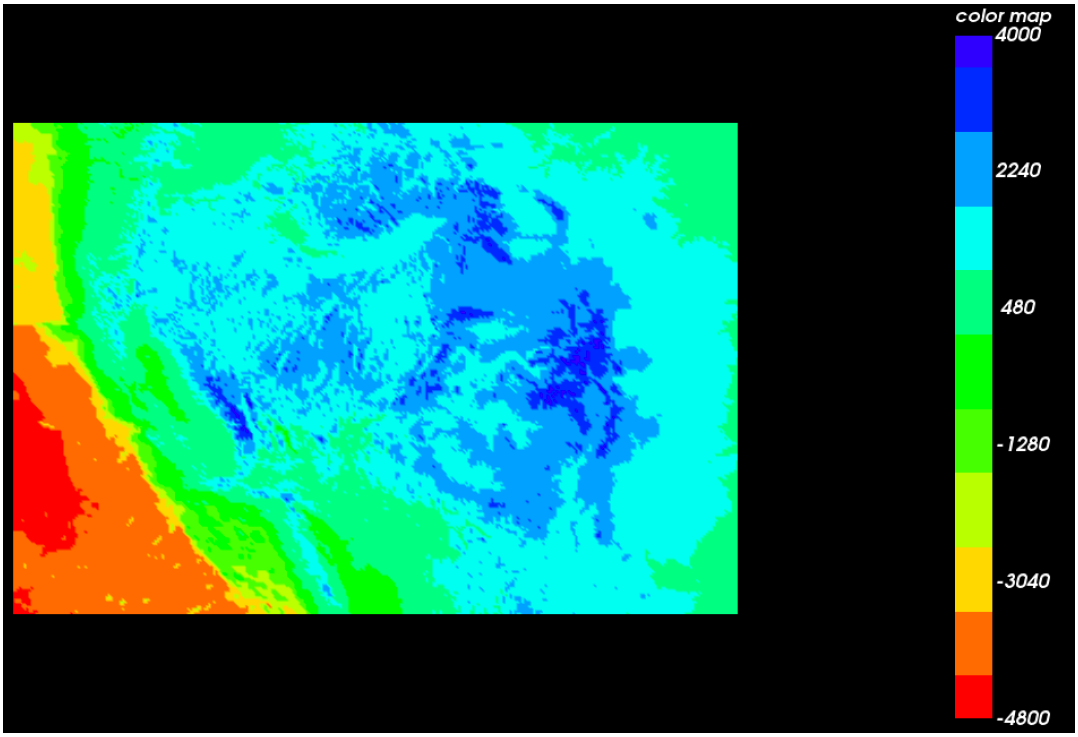


Figure 3.2 Discrete Rainbow (westUS)

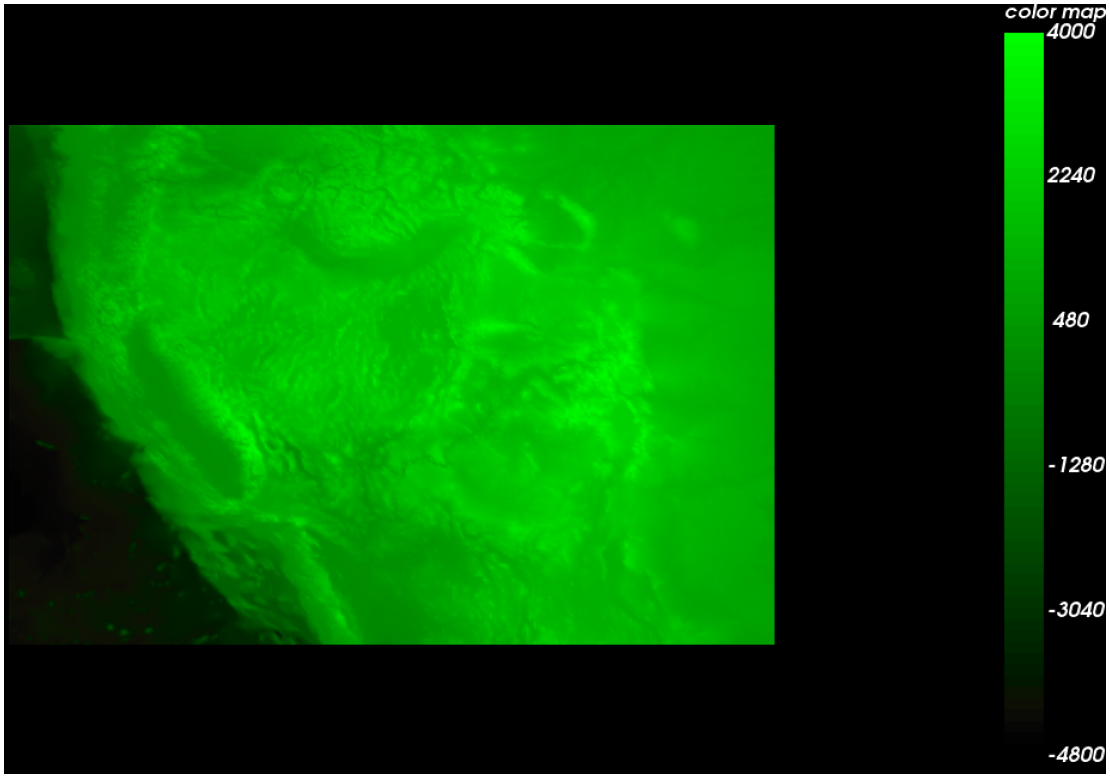


Figure 3.3 Continuous Green Scale (westUS)

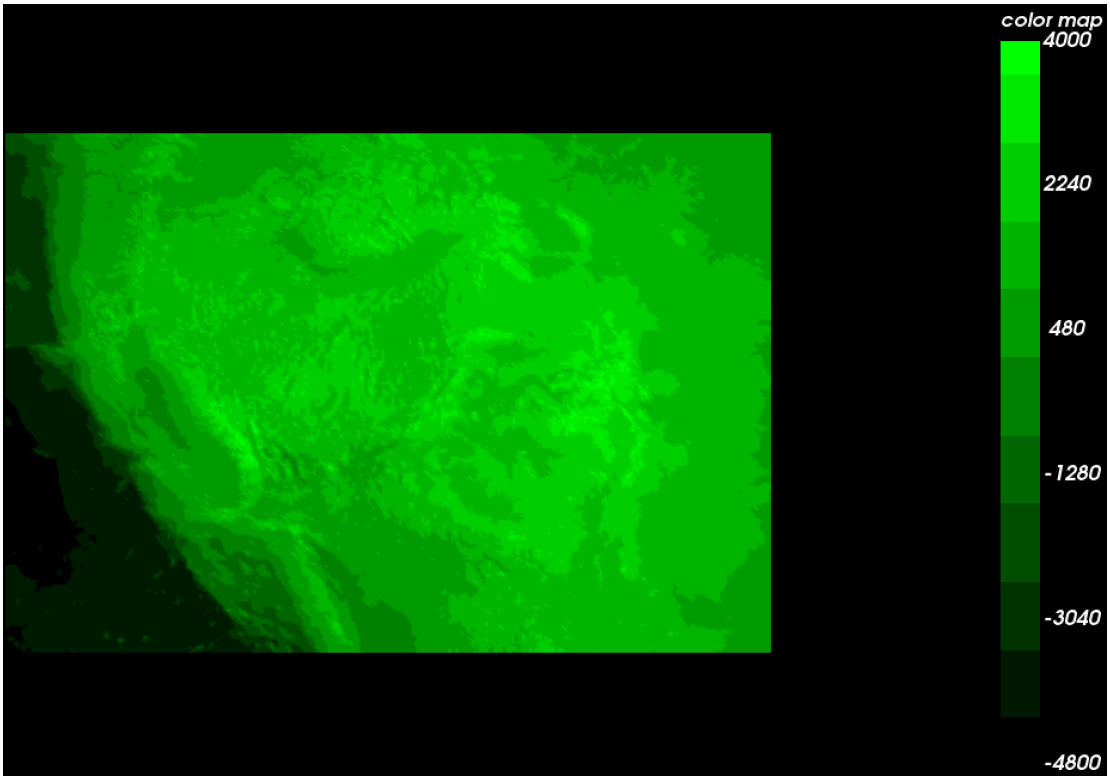


Figure 3.4 Discrete Green Scale (westUS)

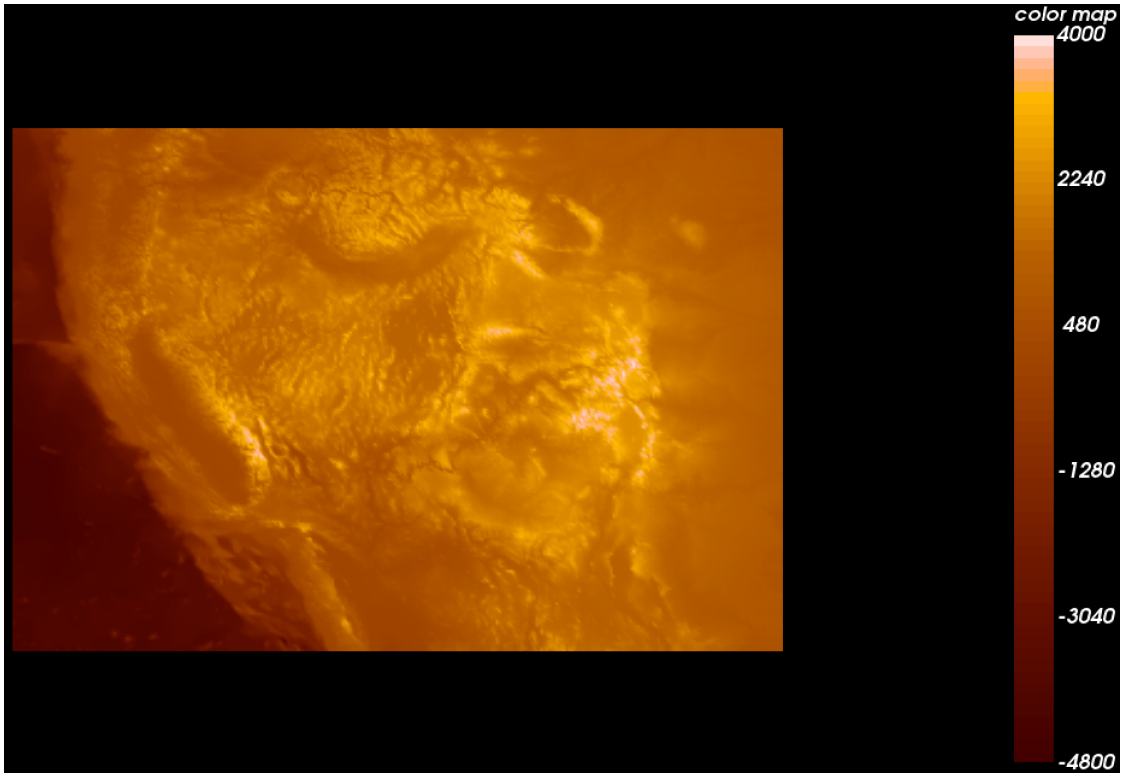


Figure 3.5 Continuous Heated (westUS)

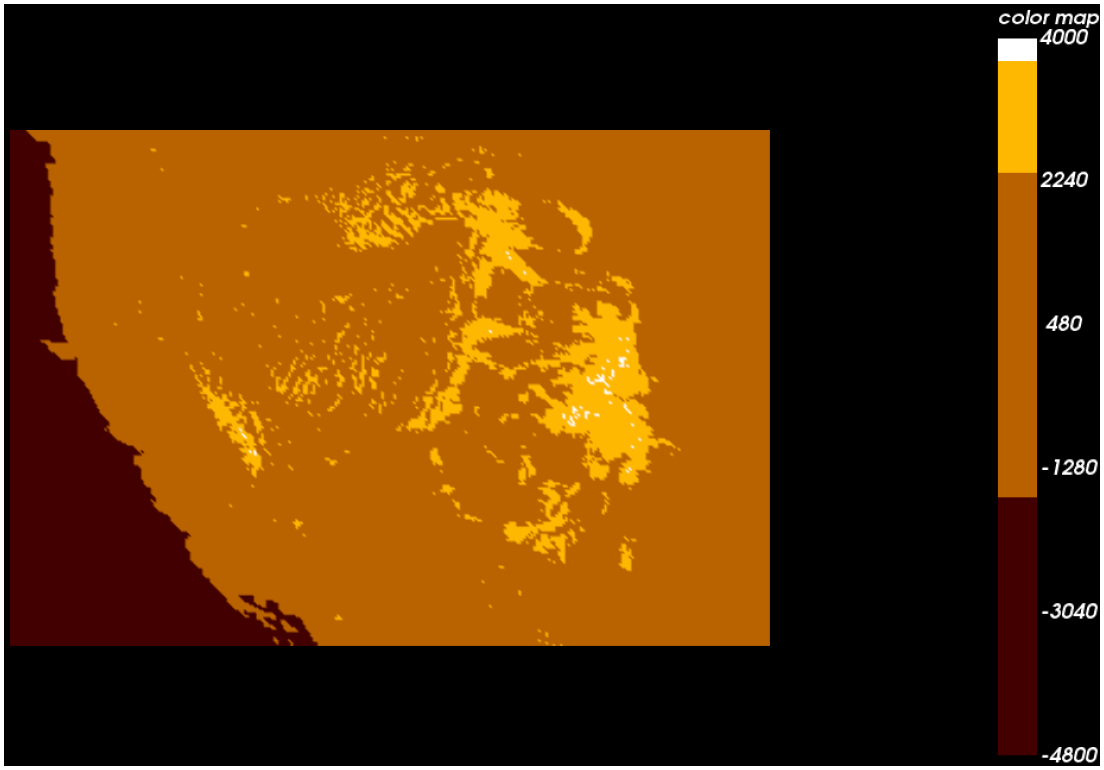


Figure 3.6 Discrete Heated (westUS)

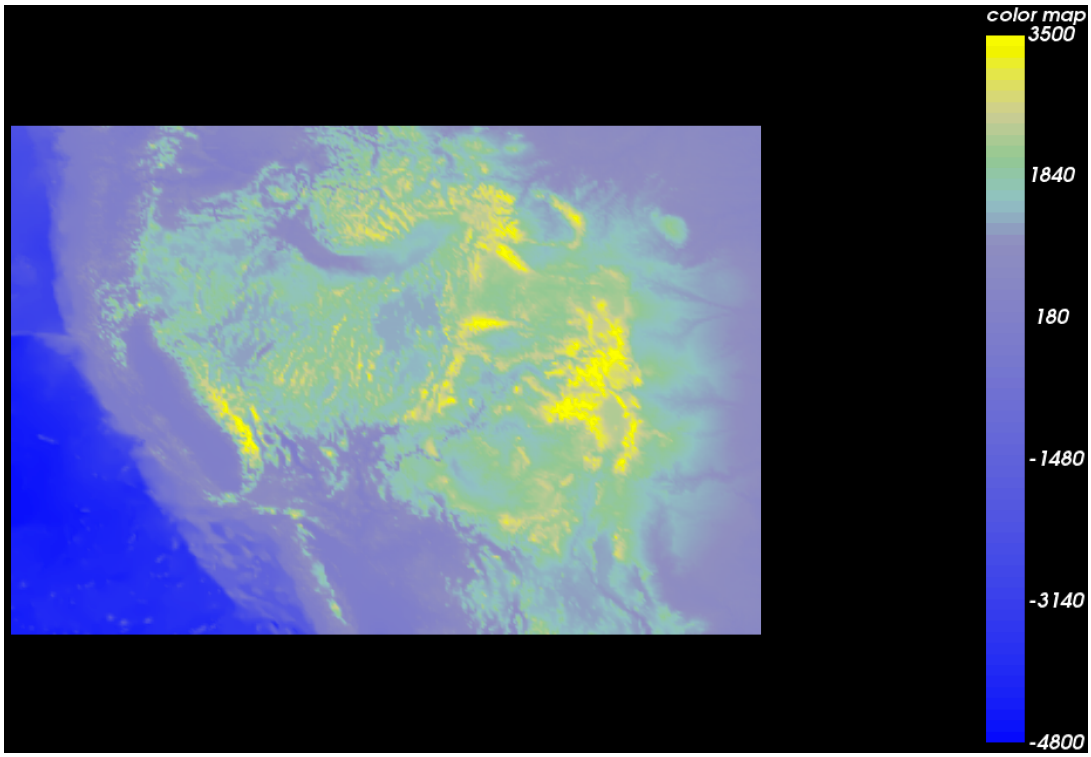


Figure 3.7 Continuous Blue-Yellow (westUS)

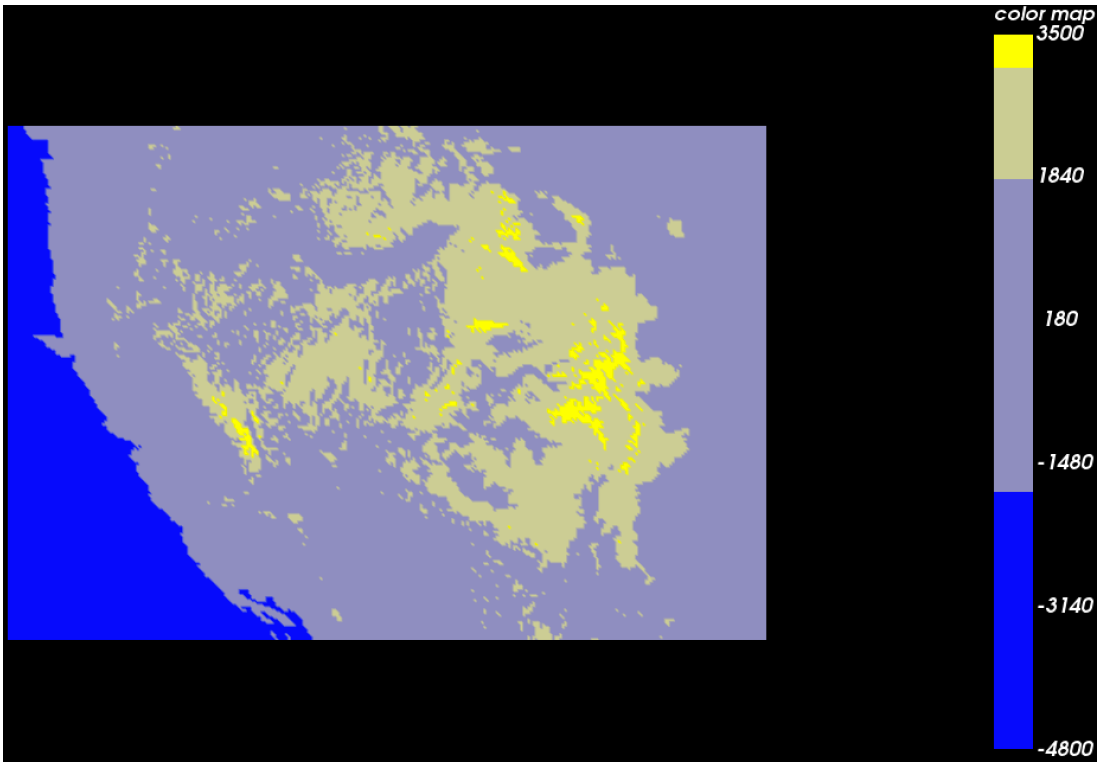


Figure 3.8 Discrete Blue-Yellow (westUS)

For the westUS data, I've tried 4 different color maps:

- Modified rainbow (Red -> Blue), Figure 3.1 and 3.2
The map performs well on this image, especially the discrete color map. It is easy to observe the details. The distribution of the colors are uniform, which means every color is used and has its importance.

- Green scale, Figure 3.3 and 3.4
The map successfully presents the contours and the geography of the image. However, comparing to the rainbow map, it is not easy to observe the altitude difference between two area because the colors are similar.

- Heated, Figure 3.5 and 3.6
The performance of this map is the same as the green scale color map. The only difference is the ordering of the colors are more natural.

- Blue-Yellow, Figure 3.7 and 3.8
This map can emphasize the highest altitudes by yellow and the lowest by blue. However, it loses many details in the altitude range [-2000, 1800].

To sum up, I suggest the discrete modified rainbow color map is better for the westUS image because 1) it's easy to observe the details, 2) the colors are uniformly used on the image. Moreover, comparing to other color maps, 3) it emphasizes not only the highest/lowest but also the middle of the altitudes.