

Telling Lies to Visualize

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Telling Lies to Visualize

Realism in astronomical visualization isn't just hard to achieve, due to limitations of our knowledge and our graphical capability.

It's not even an appropriate goal.

Thoroughgoing pursuit of realism is an impediment to effective visual communication, which is what I think we're about.

Visualization ~ Mapmaking

When cartographers make maps, they must choose which aspects of reality to preserve and to suppress.

Their choices have repercussions:

- practical (not all maps are easy to read)
 - suiting the audience's presumed purposes
 - guiding the audience for the mapmaker's purposes
(just ignore that toxic waste dump)
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Maps tell stories.

In selecting which astronomical stories to tell, we need to think like cartographers.

Limitations

We try to communicate in spite of limitations ...

- Limitations in our knowledge
 - How are observed objects arranged in depth?
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- Limitations in our graphical capability
 - Pixels, dynamic range, rendering techniques
- Limitations in human perception & cognition
 - What we make, our audience must decode!

Decoding

It's all too easy to make maps that,
however rich in information they might be,
and however prepared the audience is,
no one wants to decode...



XEphem, badly abused

FOV: 64:33W x 53:15H

RA: 15:24:06

Dec: -50:15

90H 1:1 2:1

5/25/2005 0:33:51 CDT

-45:00 0:00 45:00

Drivers in turmoil at the left turn with 19 road signs



Daily Mail, 1 Sep 2004

**Danger signs:
The A3 at New
Malden, which
campaigners
say is a hazard**

What's (not) in a Starfield?

Winter
Milky Way
might look
something
like this.

But what's
missing?

What stories
does this
picture
prevent us
from telling?



Mass Chauvinism

By looking in visible light, we select for the more luminous massive stars.

Most stars are M dwarfs.
See any here?

How about the interstellar medium?



Honesty Not Always Best Policy

How about planets?

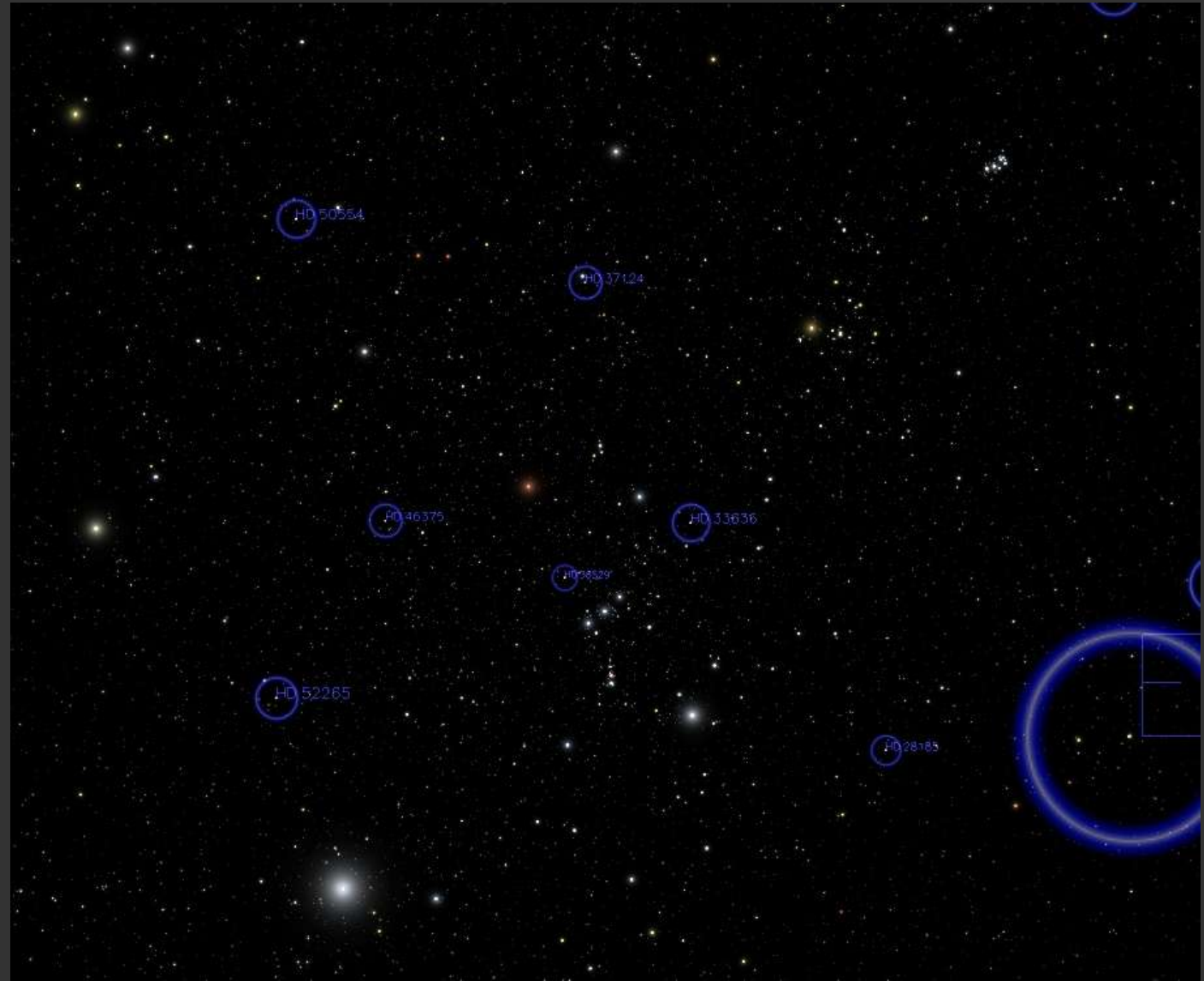
They're far too close to their parent stars, and far too dim, to appear on a realistic star view. But that didn't stop the AMNH folks...



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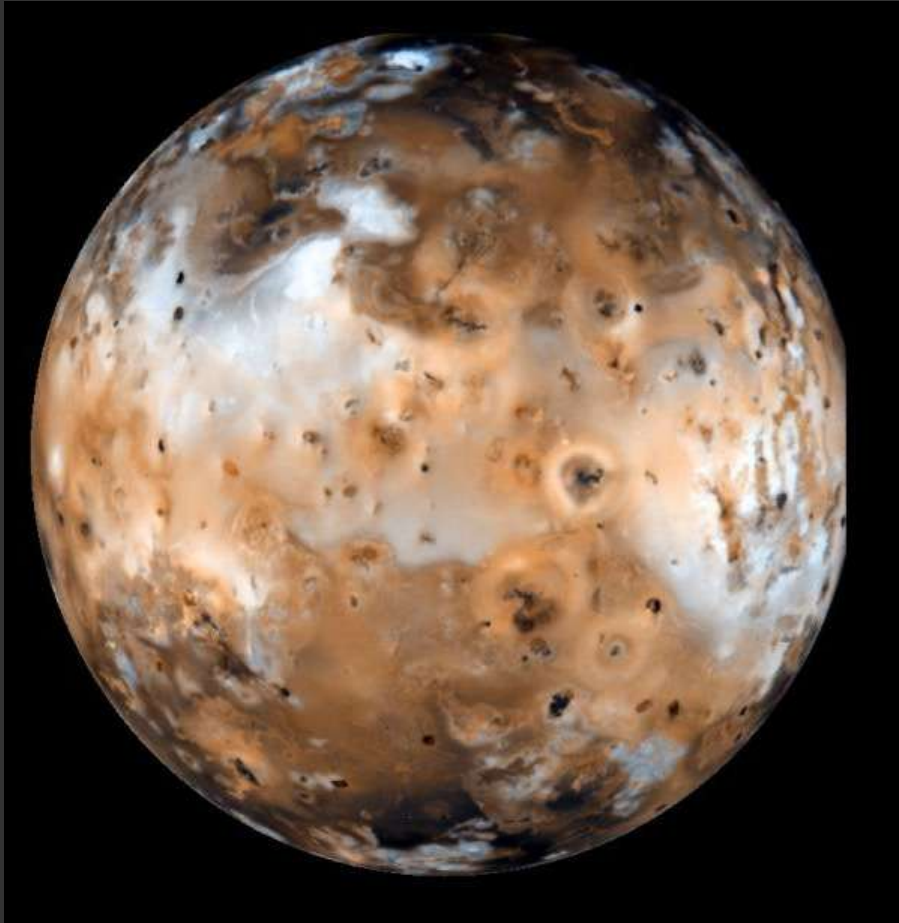
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What a Tangled Web

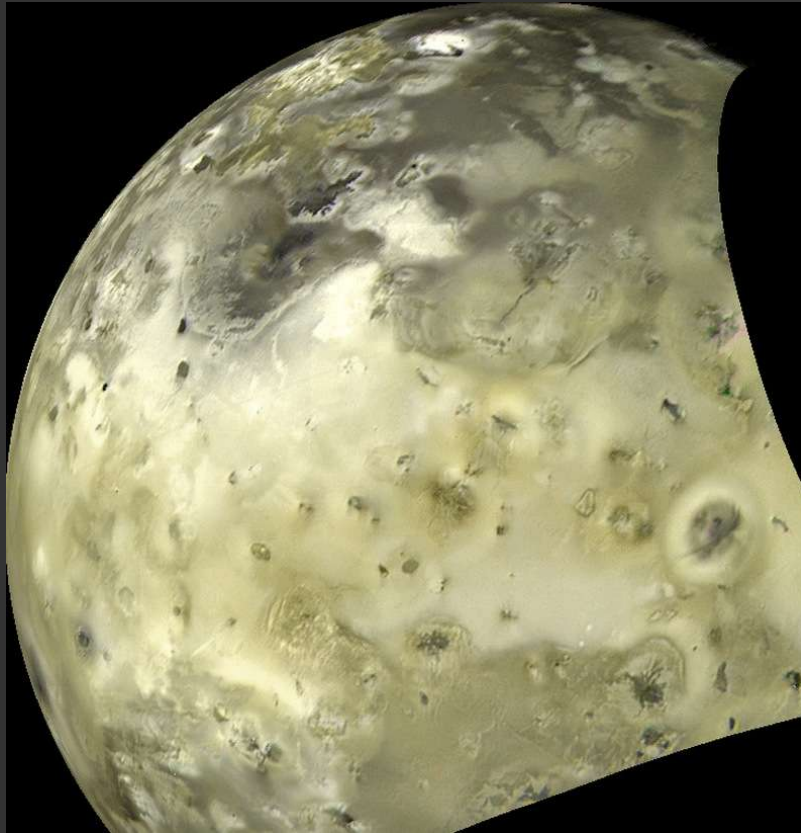
What color is Jupiter's satellite Io?



JPL early press-release images of Io showed dramatic colors, and led to speculation — some of it published — of the sulfur compounds on its surface!

What a Tangled Web

What color is Jupiter's satellite Io?



Io in approximately natural color

I don't blame JPL for stretching colors.

The fault is in not making it clear to the (mixed!) audience that they had done so — what part of reality had been preserved and what sacrificed.

Distortion in the Interest of Truth

What else might we misrepresent for purpose of better communication?

- (relative) brightness
- (relative) spatial scale
- (relative) time scale
- spectral distribution
- contrast (1-in- 10^5 fluctuations in early universe)
- ...

... and of course we can add purely schematic scenery to explain what's going on!

[Between talks, Jim Ahrens pointed out importance of knowing absolute time and space scales! How long did that galaxy collision last, etc.]

Spatial Scale - Galaxy Sizes

Spatial distribution of galaxies is cool, but...

- Galaxies are dim! and small! compared with the spaces between them.
 - If plotted realistically, the intergalactic sky is almost completely blank.
-
-

Spatial Scale - Galaxy Sizes



Simulated view on tour approaching M81/M82 - galaxies roughly to scale..

Spatial Scale - Galaxy Sizes



Simulated M81-M82 tour, with distant galaxies enlarged 3x-10x. See Virgo now?

Spatial Scale - Galaxy Sizes

Using this trick, oversized distant galaxies swallow their satellites - and clusters look really crowded!

- Can show how galaxies fit into large-scale structure, *or*
- Can represent their local arrangement and spacing

but not both in one picture. And we should ensure (how?) that the audience can tell which aspect to believe.

Temporal Scale

If you fly by a pulsar, can you see it blink?

- How does time pass in interstellar flight?



Watch a disk galaxy for a few million years.
Many supernovae will explode. Many of those are
as bright as the whole galaxy.

- What do you see?
-
-

What Was The Big Bang Like?

Many attempts at this. Here's one:

 [Play test6.mpeg](#)



What Was The Big Bang Like?

Many attempts at this. Here's one:



What does this say?

- The universe is cooling (good).
- The universe is expanding (good).
- There are (small) fluctuations in its density (good).
- The expansion happens from a central point (No!!!).

If we need to get any point across, it's homogeneity --
no point should look special!

What Was The Big Bang Like?

How else could we suggest this stuff?

What should we keep?

- Tiny (1-in-100000) fluctuations -- no, let's not.
- Can't just show expansion by letting everything fly away from the viewpoint -- that's invisible.
- But expansion is important, how can we show it?

How about using waves?

The microwave background fluctuations we see are due to waves propagating before recombination time.

They're a good story to tell.

Wave Bang?

Of course the waves would really have propagated in all 3-D directions, but that's hard to show.

Let's lie about that and just show waves in 2-D.

We need waves of many wavelengths, propagating across the screen in all directions.

Wave Bang?

Expansion is easy. We just see the waves' wavelengths grow longer. Since they're also propagating, it doesn't suggest expansion from a center.

Here's Lorne Leonard's latest attempt:

 [Play testGN_HD.qt](#)



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Certainly not final, but the process we're going through seemed a fair example of how to go about thinking through such a problem.

Thanks

Thanks to...

My colleagues, Donna Cox, Bob Patterson,
Lorne Leonard, Matt Hall, Alex Betts

Brian Abbott, Ryan Wyatt, and Carter Emmart
at the American Museum of Natural History

All those imaging people at JPL!
