



Moving The Heavens

An Artistic and Technical Look at the
Skies of The Last of Us

5:25 pm Wednesday, March 19
Room 3016, West Hall

Keith Guerrette Lead Visual Effects Artist, Naughty Dog

Overview

- The power of a well designed sky
- How to make a sky move – Naughty Dog style
- A few lessons we've learned along the way



THE POWER OF THE SKY





Video by BowieMaker www.youtube.com/watch?v=DCBfLnmBzOo





- “Mt. St. Helens Panorama” by John Kercher







"How a Face Changes With Light" by Nacho Guzman

Deer Hunting



Horse Escape



Mining Town
Reveal



Ellie Captured



Cutscene Int.



Joel Fights Cannibals



Infected Fight
with David



Lakeside Resort
Vista



A Powerful Sky Defines:

- **Time of Day**
 - Light Direction
 - Timeline of the Narrative





"Rainstorm At Amboseli" by Michele Burgess



A Powerful Sky Defines:

- Time of Day
- **Weather**
 - Sense of Tension vs. Relaxation
 - Glimpse into the Future or Reflect on the Past













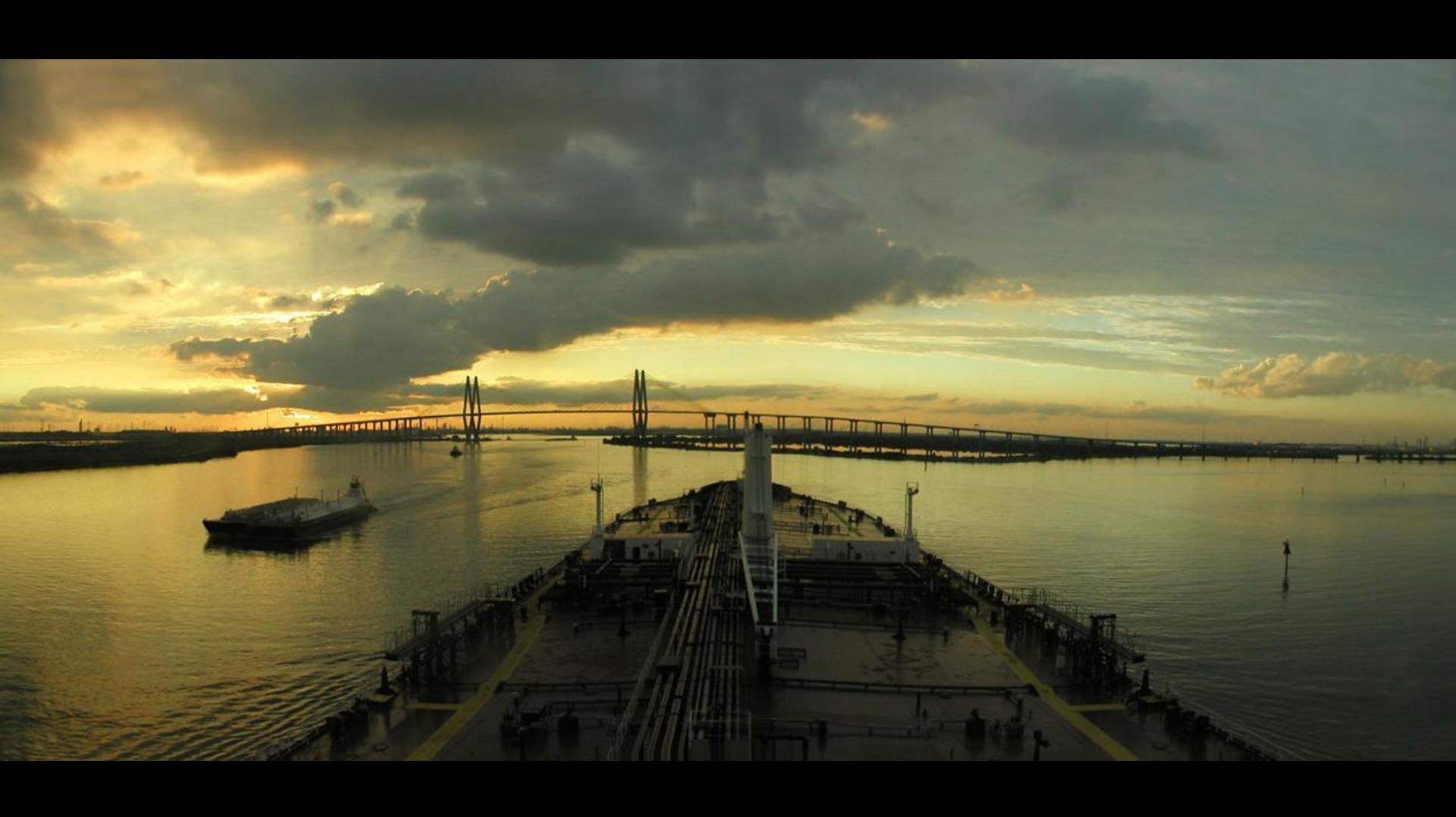






A Powerful Sky Defines:

- Time of Day
- Weather
- **Color Palette**
 - Motivates the lighting, color palette, and therefore entire visual composition









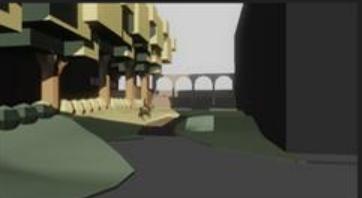
A Powerful Sky Defines:

- Time of Day
- Weather
- Color Palette
- **Tone of the Narrative**
 - The visual backdrop drastically impacts the emotional experience of the player

ENTER UNIVERSITY



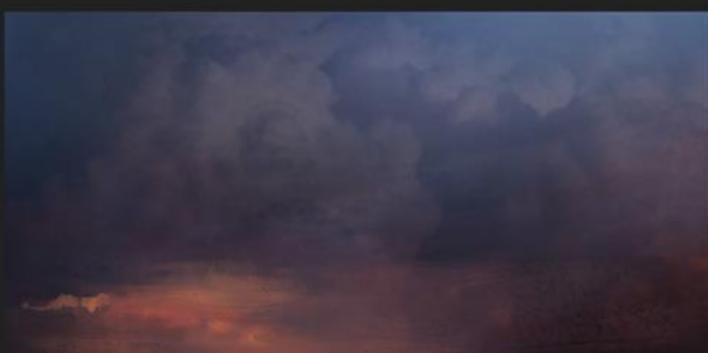
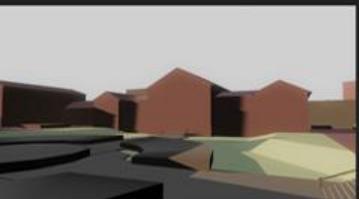
OPEN HORSE
EXPLORE



EXPLORE/HEAD
TOWARDS GOAL



REVEAL GOAL



DORM /
INFECTED FIGHT



EXPLORE
APPROACH



FOREST ROAD



FARMHOUSE





Narrative Experience

Military City

This is a heavily quarantined area, tightly controlled by a very reactive & paranoid military. Boston, MA. It shouldn't be very 'pretty' – lacking large vegetation, like trees, due to people cutting them down for wood (for cooking and heat). The military has erected barriers, checkpoints, boarded up buildings, created road blocks, and strictly controls population flow within the city. There is limited electricity, again strictly regulated by the military.

Emotional Tone: Restrictive & Oppressive. Show Joel's darkside & what has become of the world/mankind in the 20 years since the outbreak.

Season: Late Winter/Early Spring

Military City Intro - Exterior

- A storm is about to move in, but there are still breaks in the clouds.
- Overcast but bright, with spots of sunlight & moving clouds.
- Neutral to Cool lighting. No warmth.
- Daytime – Midday

A Powerful Sky Defines:

- Time of Day
- Weather
- Color Palette
- **Emotional Tone of the Narrative**



Summary

- The sky, and its dependencies in lighting, can change the entire look and emotional tone of your environment.



MOVING THE SKIES



Video by Jem Moore <http://vimeo.com/15689466>



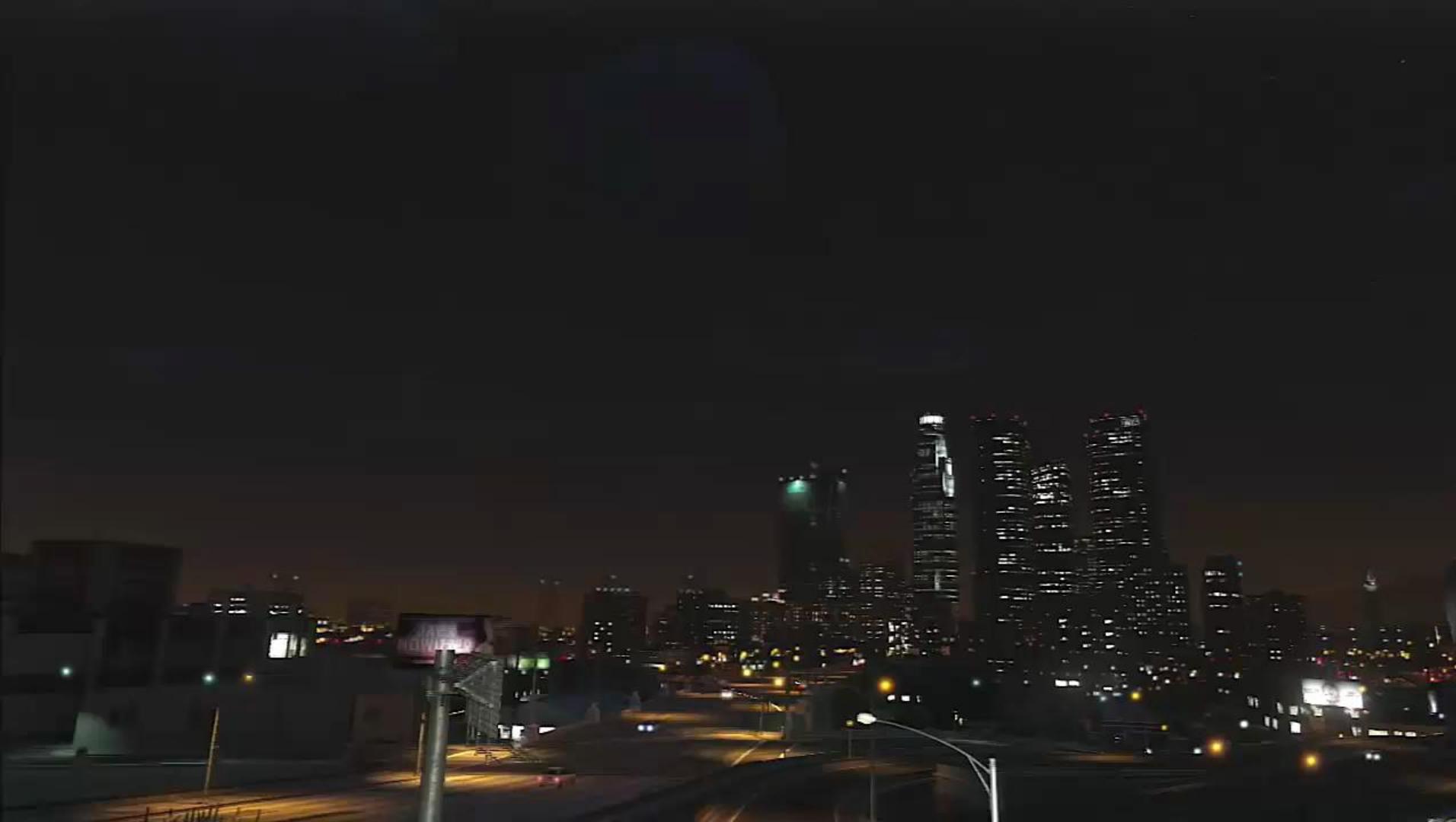




MACHINIMA.COM



Nuaj' for Unity www.nuaj.net



Moving the Skies

- More custom assets per sky = more time per iteration
- If you want beautiful moving skies in your game, they take A LOT of time and tech

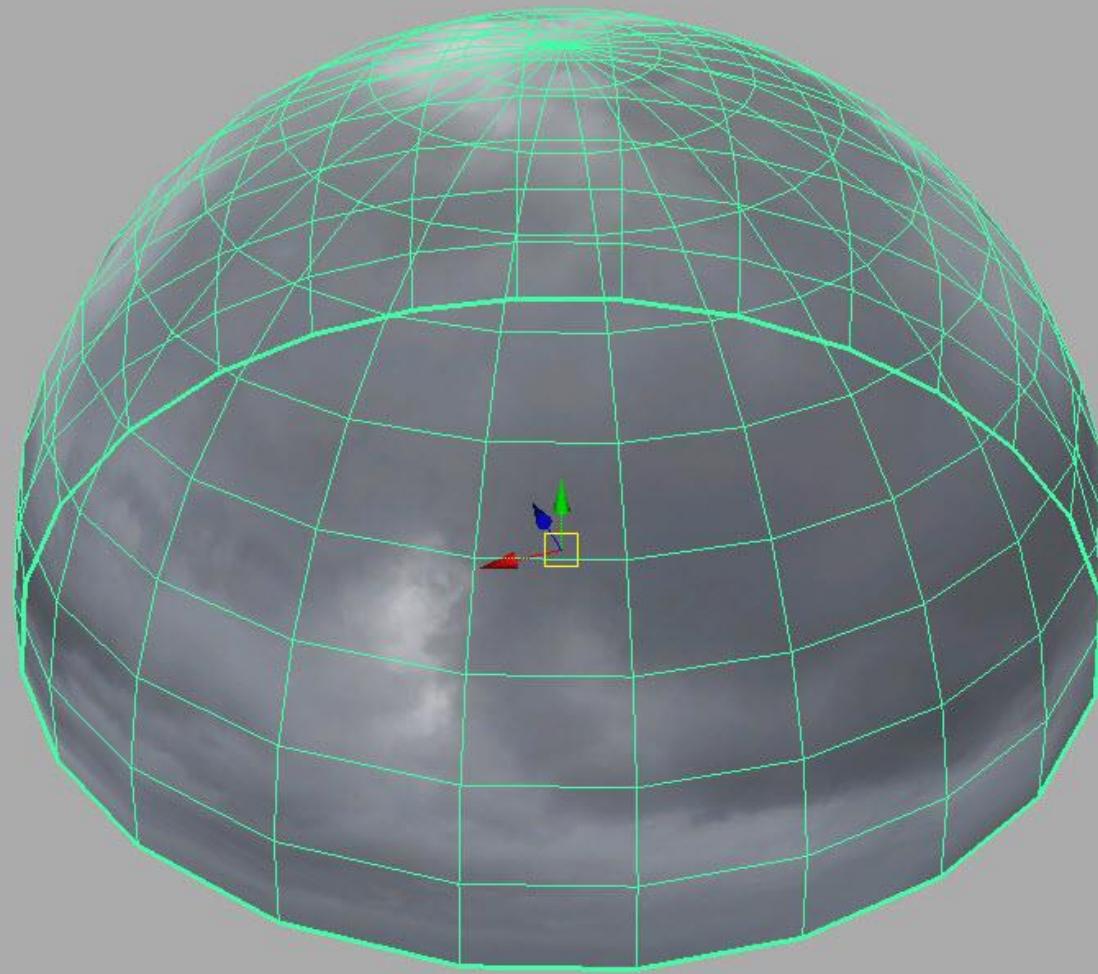












Skies at Naughty Dog

- Equirectangular matte painting
- Spherically projected onto a dome
 - Position of the dome is attached to the camera
- Texture size is usually 2048x1024

Skies at Naughty Dog

- We iterate on our levels A LOT
 - ... and very late into production
- No full-time sky artist
 - Concept Department was responsible for painting
 - FX Department was responsibility for implementation and motion







CHALLENGE:
**HOW DO I CREATE THE ILLUSION
OF MOTION WITHOUT SLOWING
DOWN THE ITERATION PROCESS?**



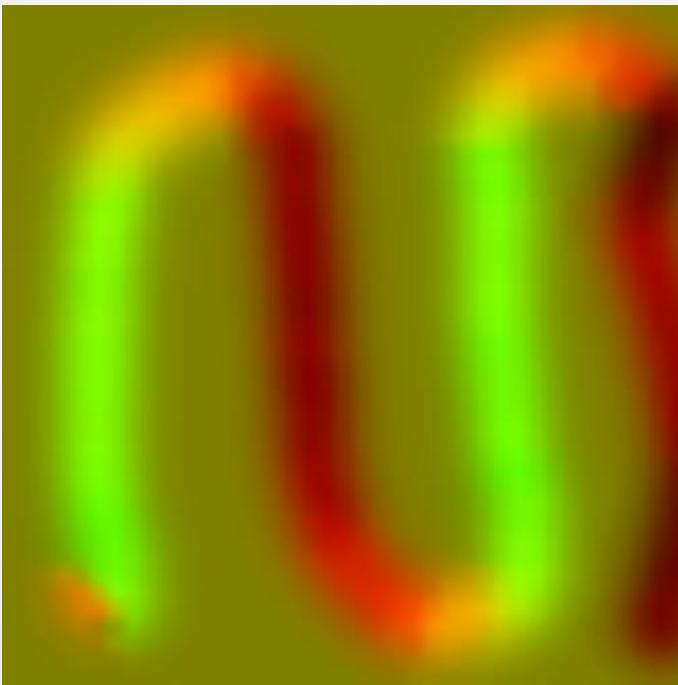
Prerequisite: What is Flow?

- Direction specific texture distortion
- Usually cross fades between two instances of the texture at different phases of distortion, making it look **continuous**

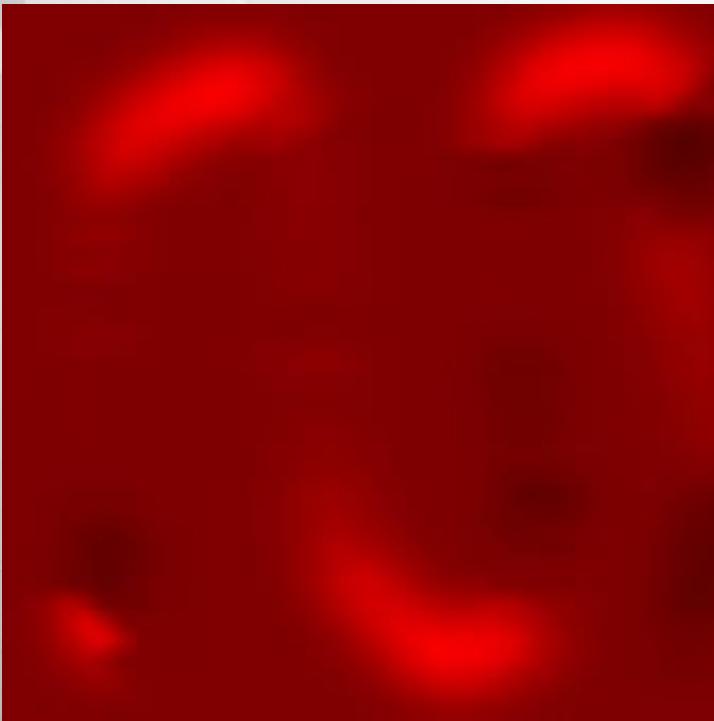
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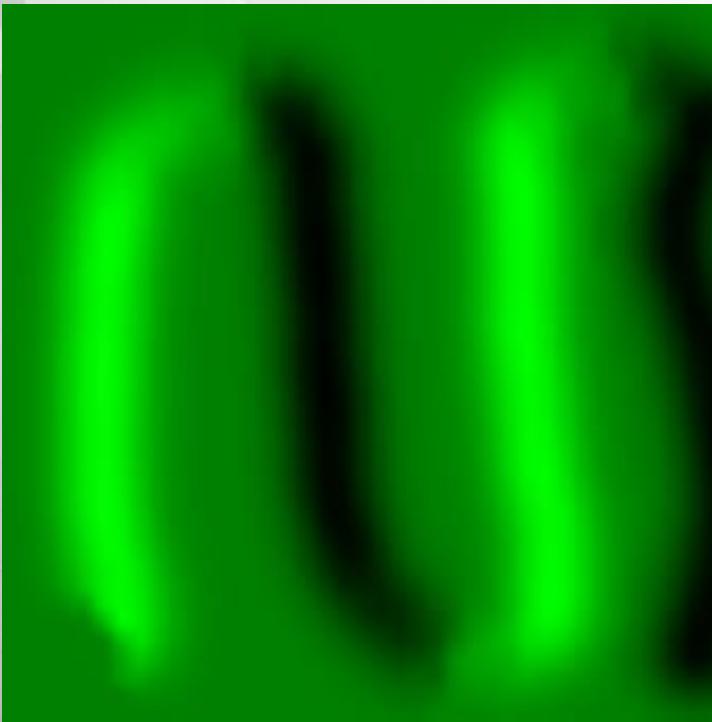


Prerequisite: What is Flow?



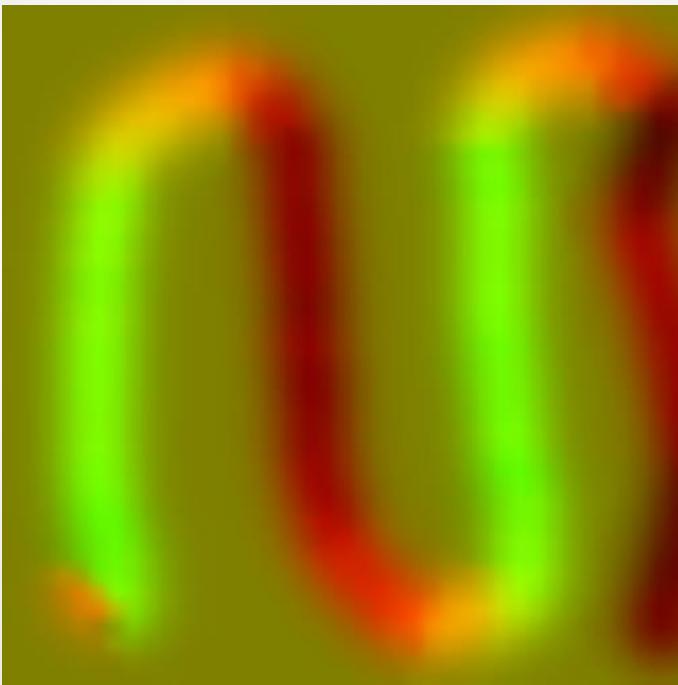
Movement in the U direction

Prerequisite: What is Flow?



- Movement in the V direction

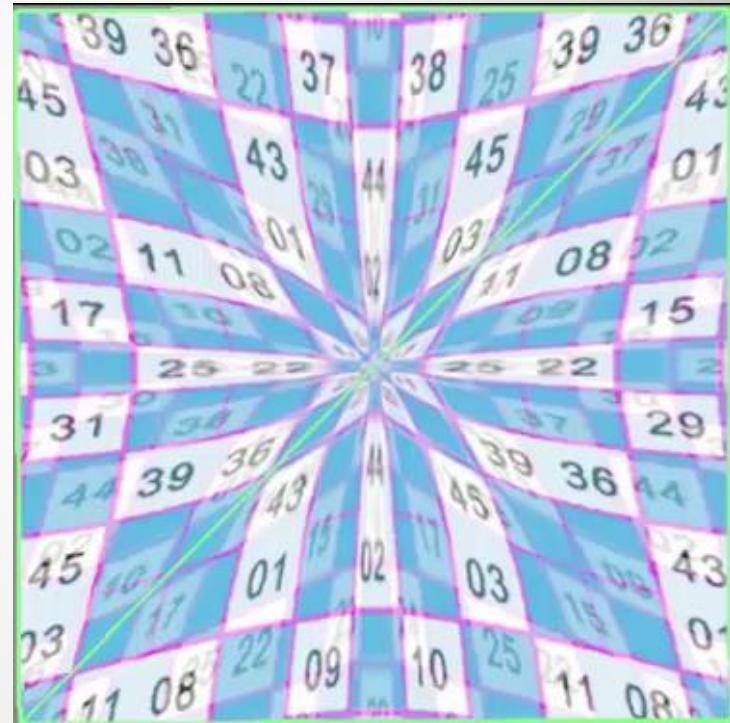
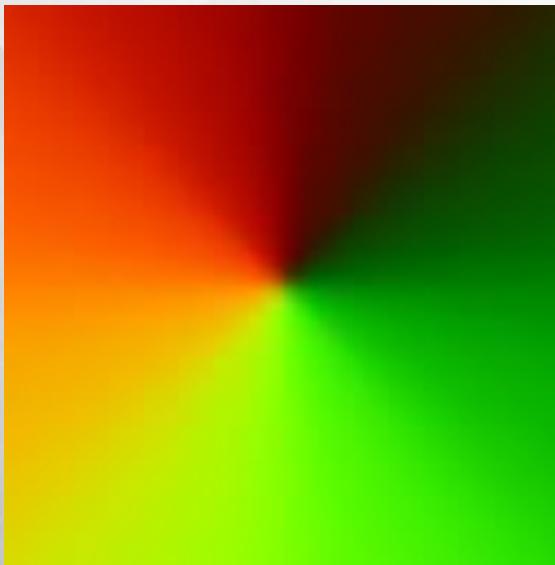
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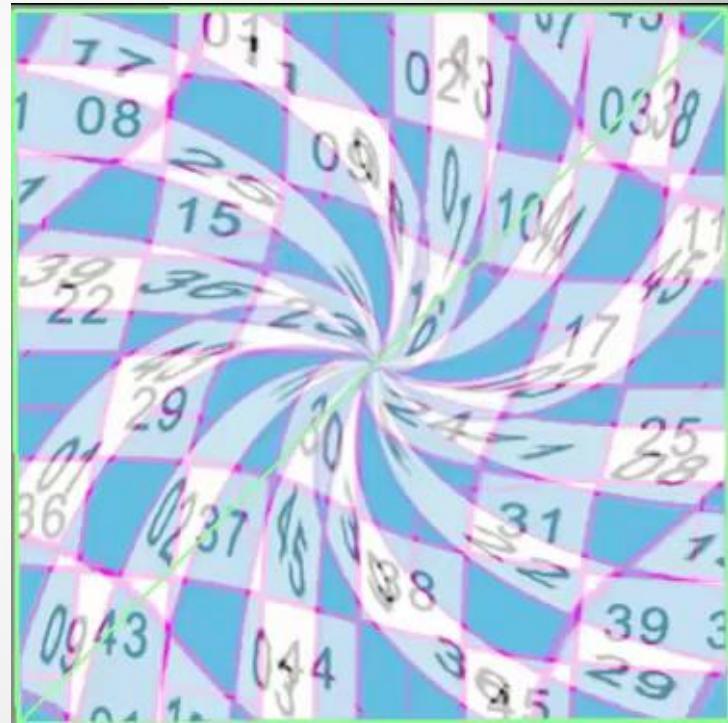
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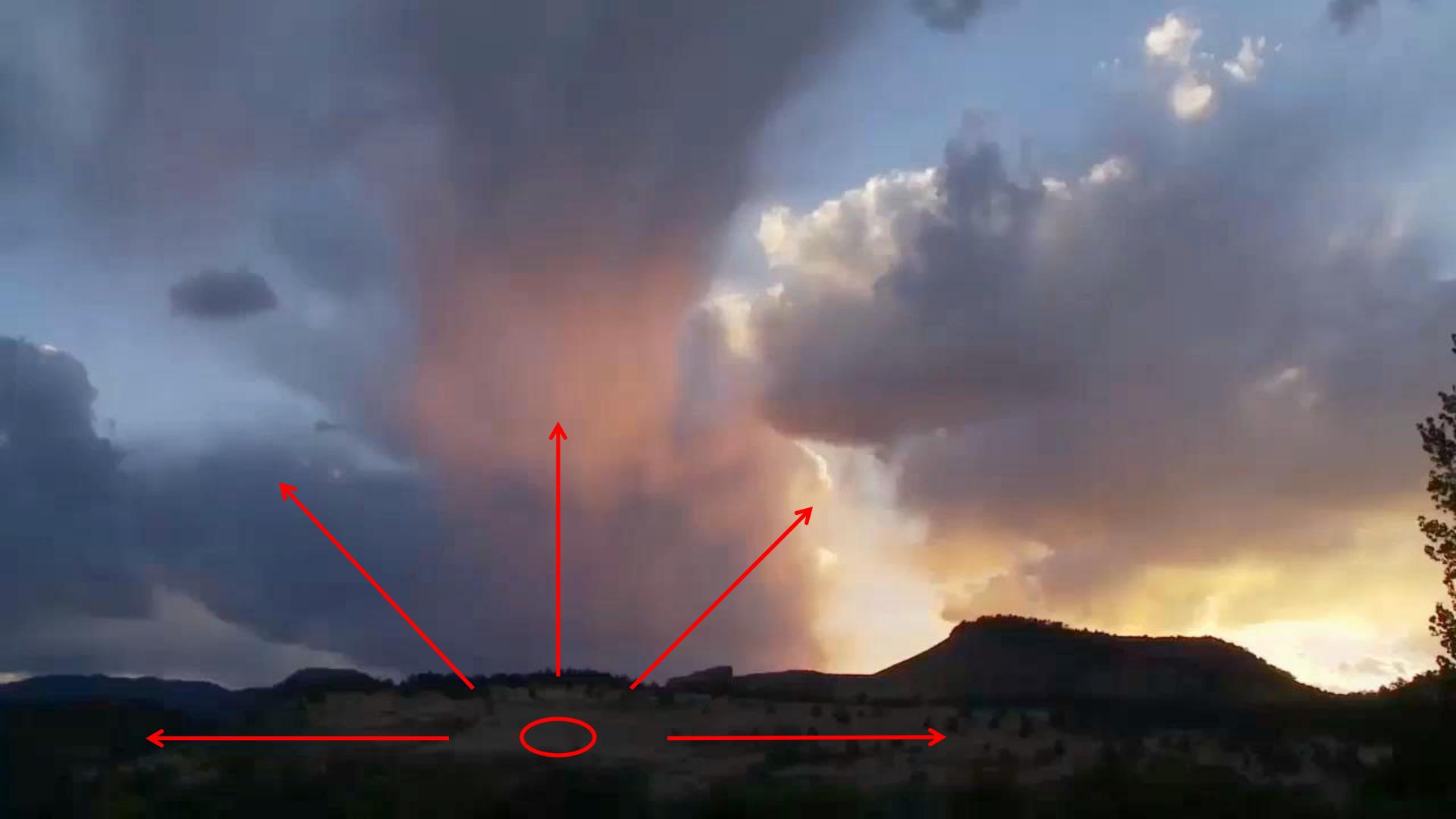




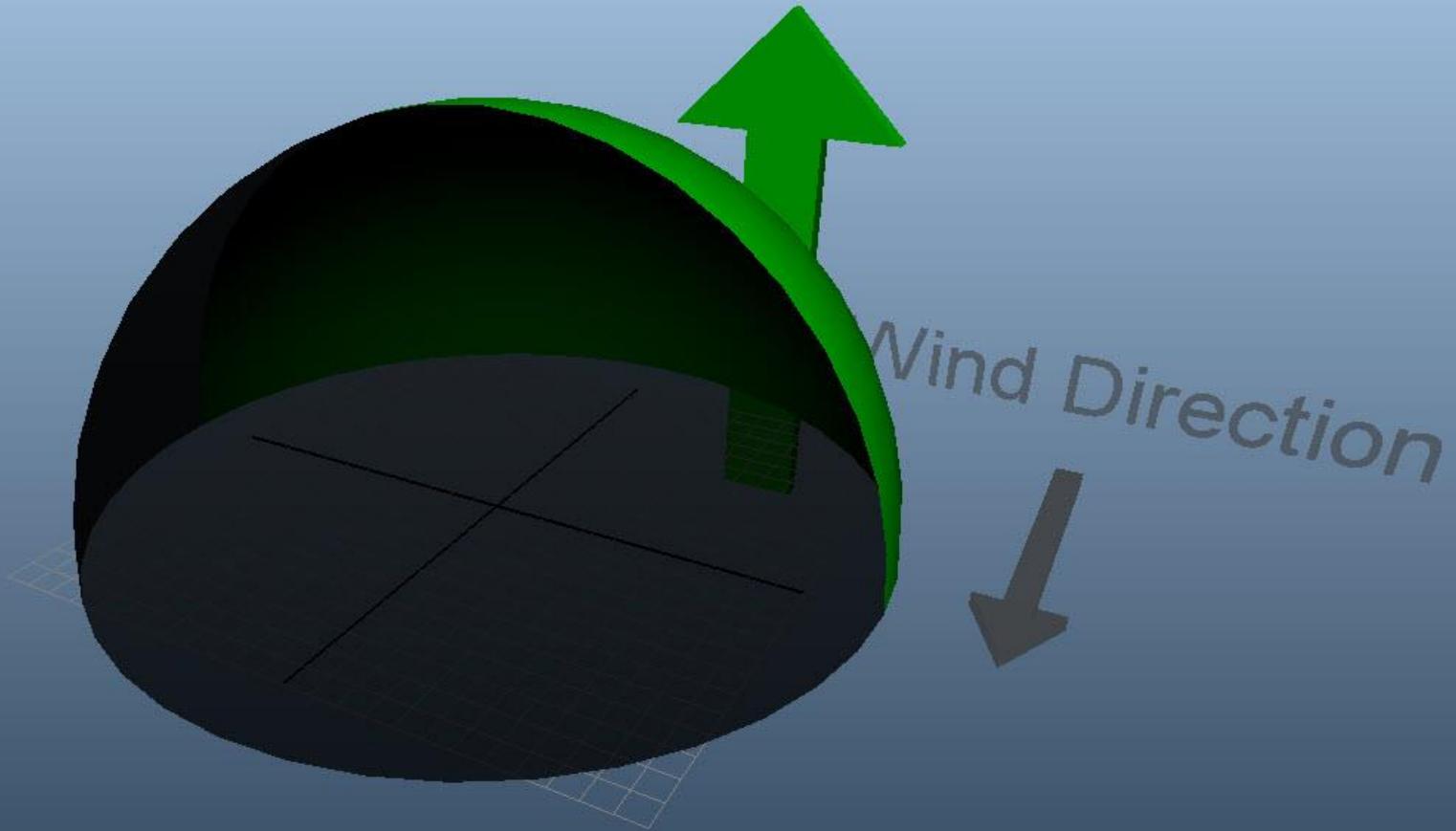
Extra Resources about Flow

- GDC 2012 Presentations:
 - “Water Technology of Uncharted” by Carlos Gonzales-Ochoa
 - “Tricks Up Our Sleeves” by Keith Guerrette
- Research:
 - *Flow Visualization Using Moving Textures* (2006) by Nelson Max, Barry Becker
<http://citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1.1.42.2372>
 - *Advect Textures* (2003) by Fabrice Neyret
<http://www.evasion.imag.fr/Publications/2003/Ney03/?lg=en>



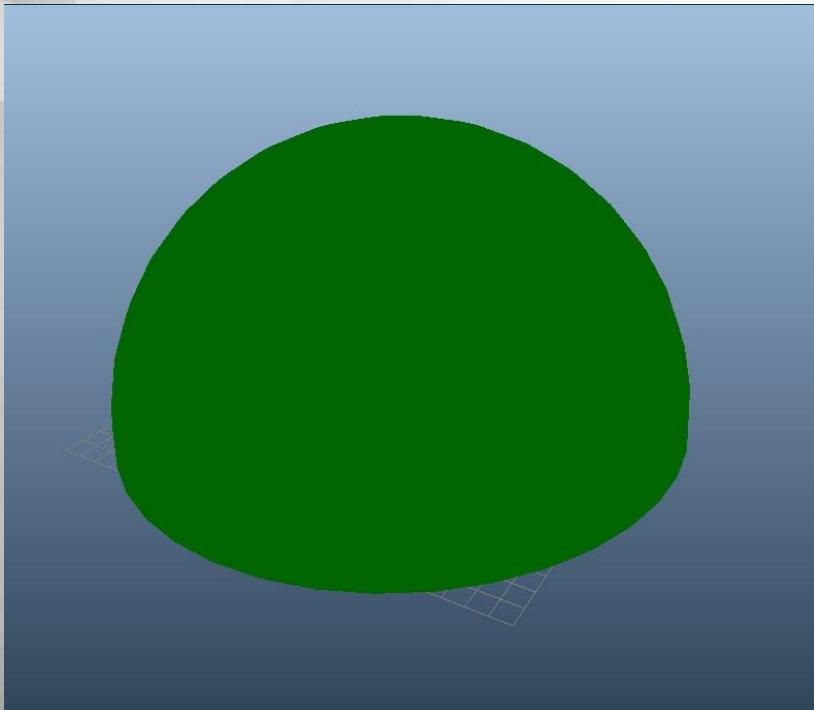




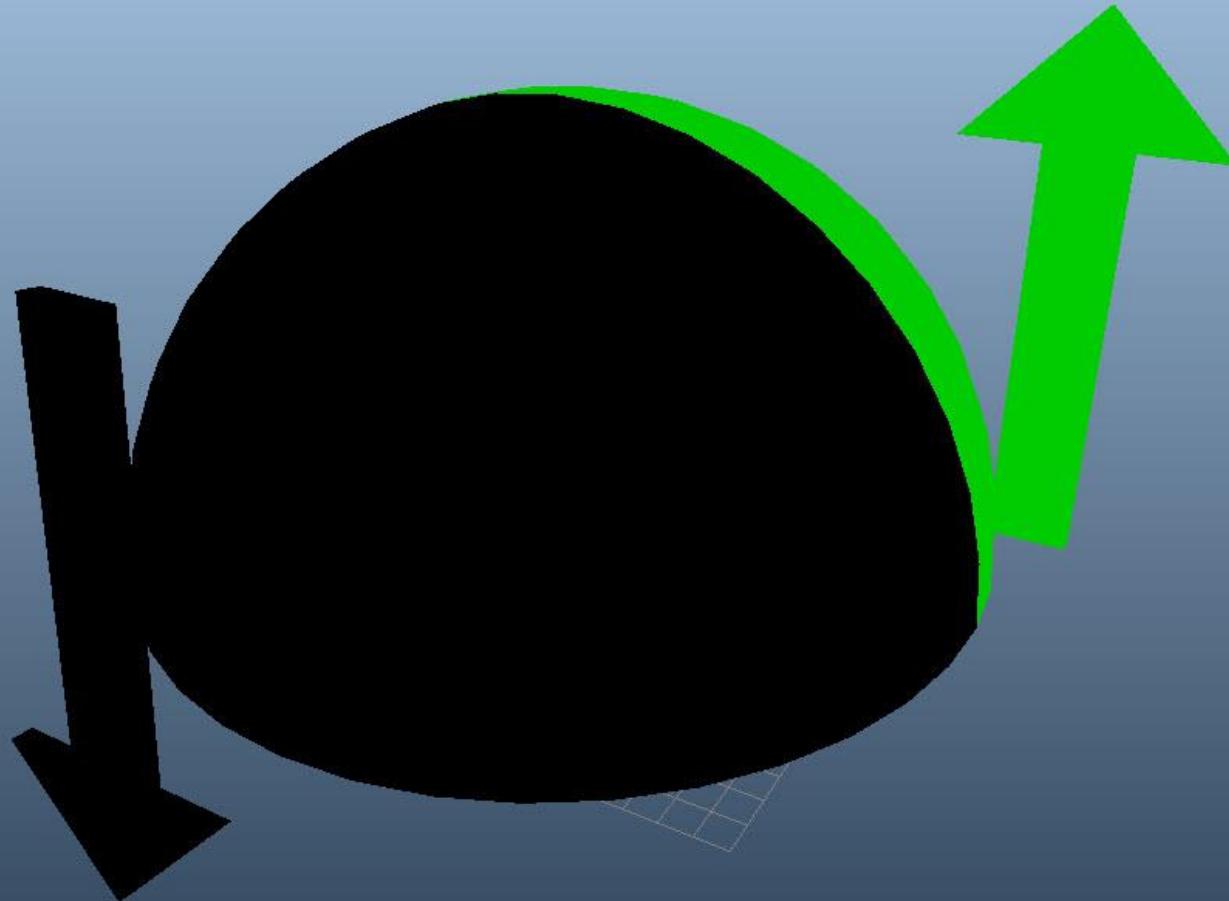


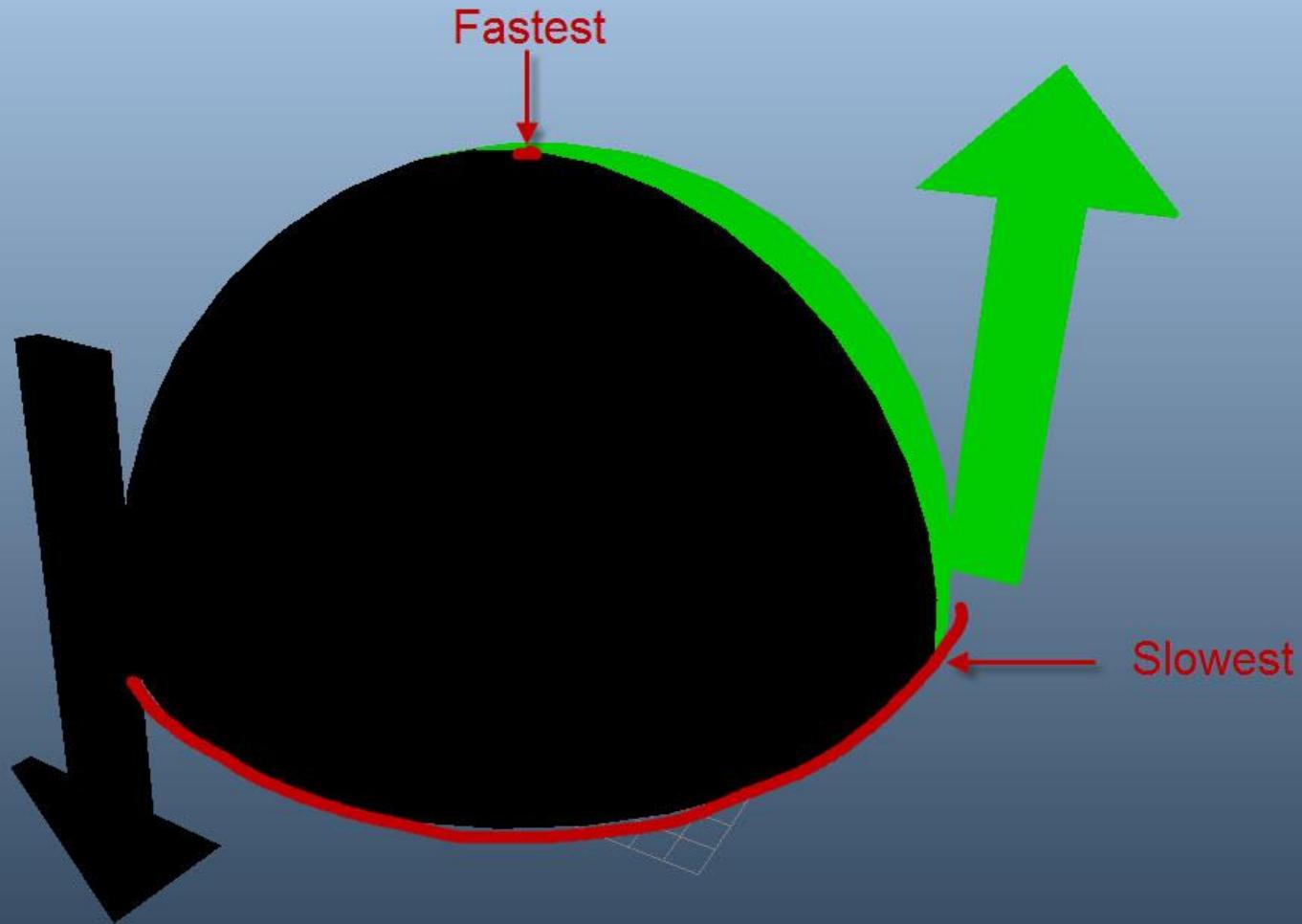


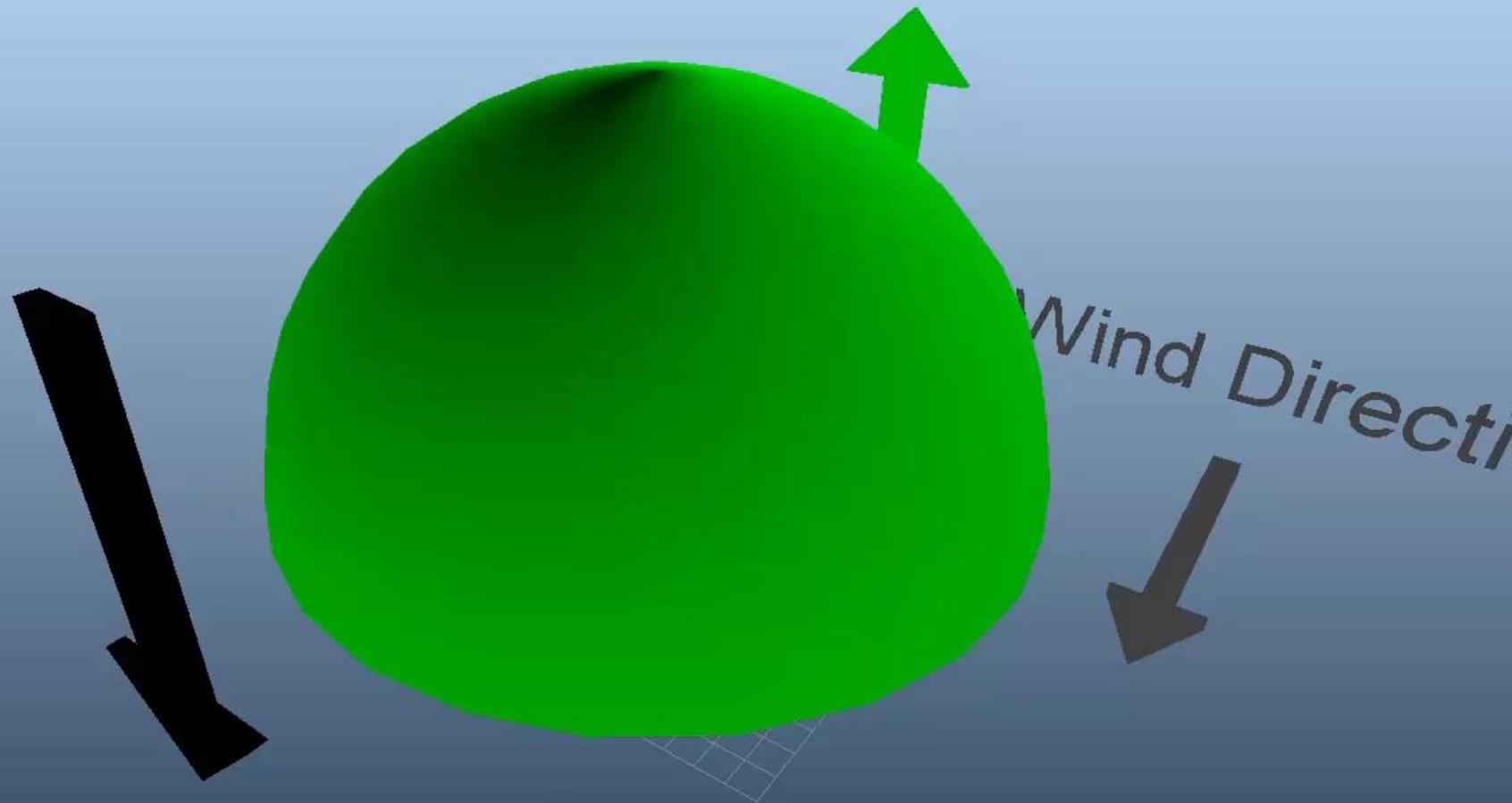
Sky Flow in V Direction



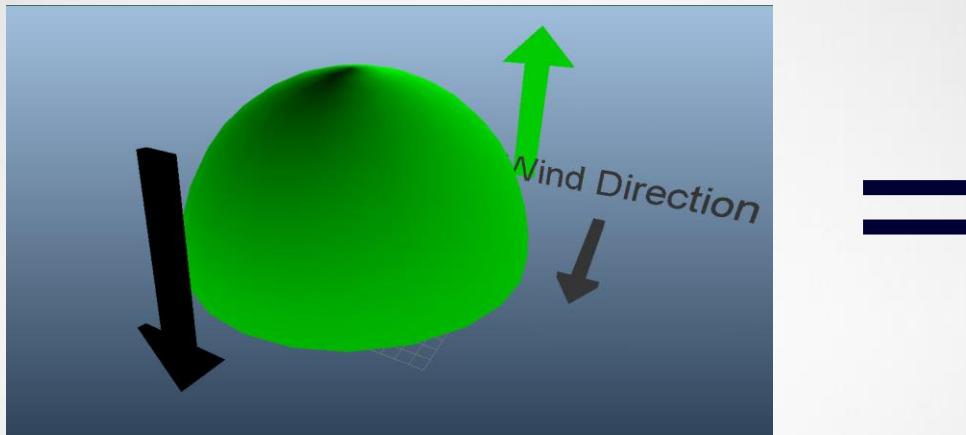
○ Movement in the V
direction



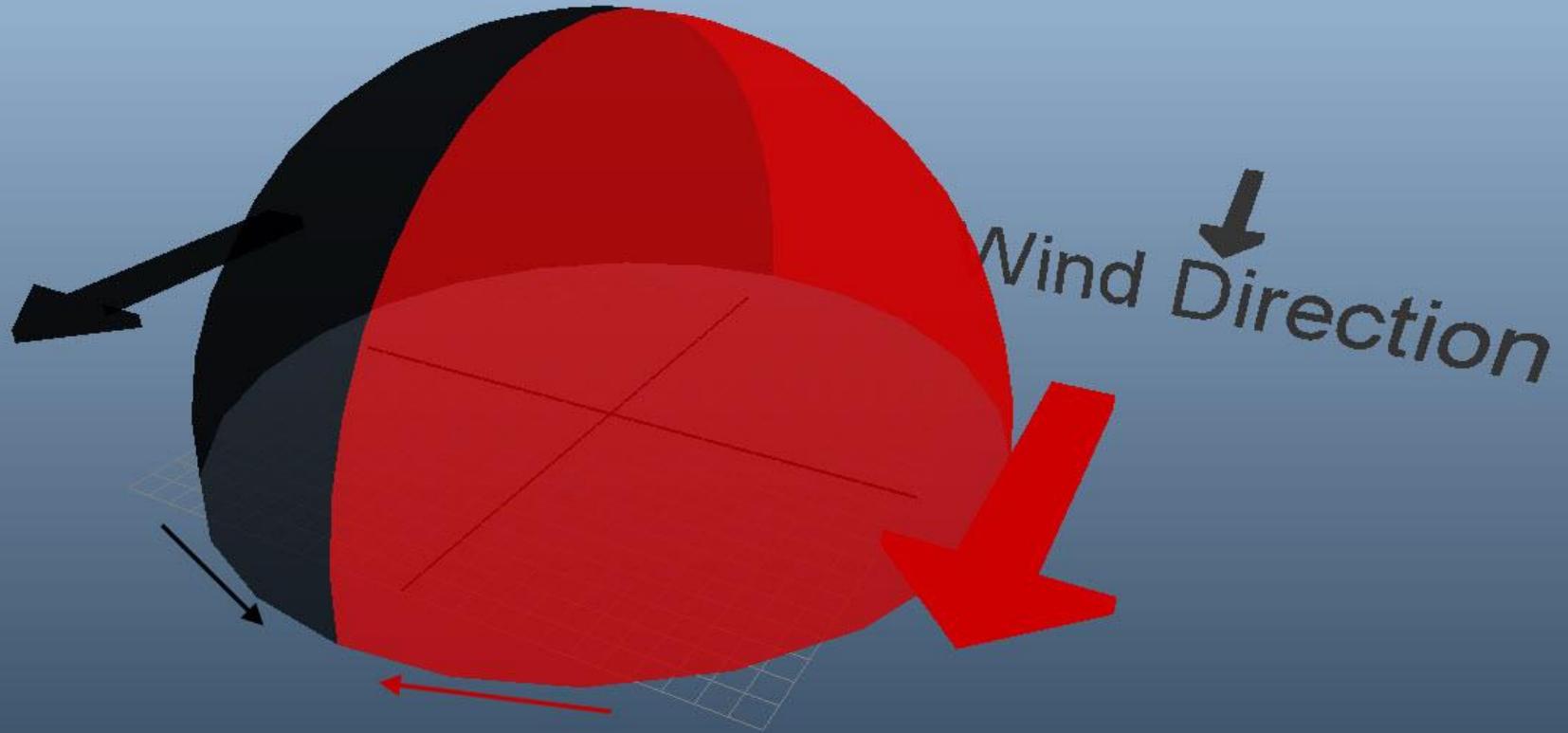


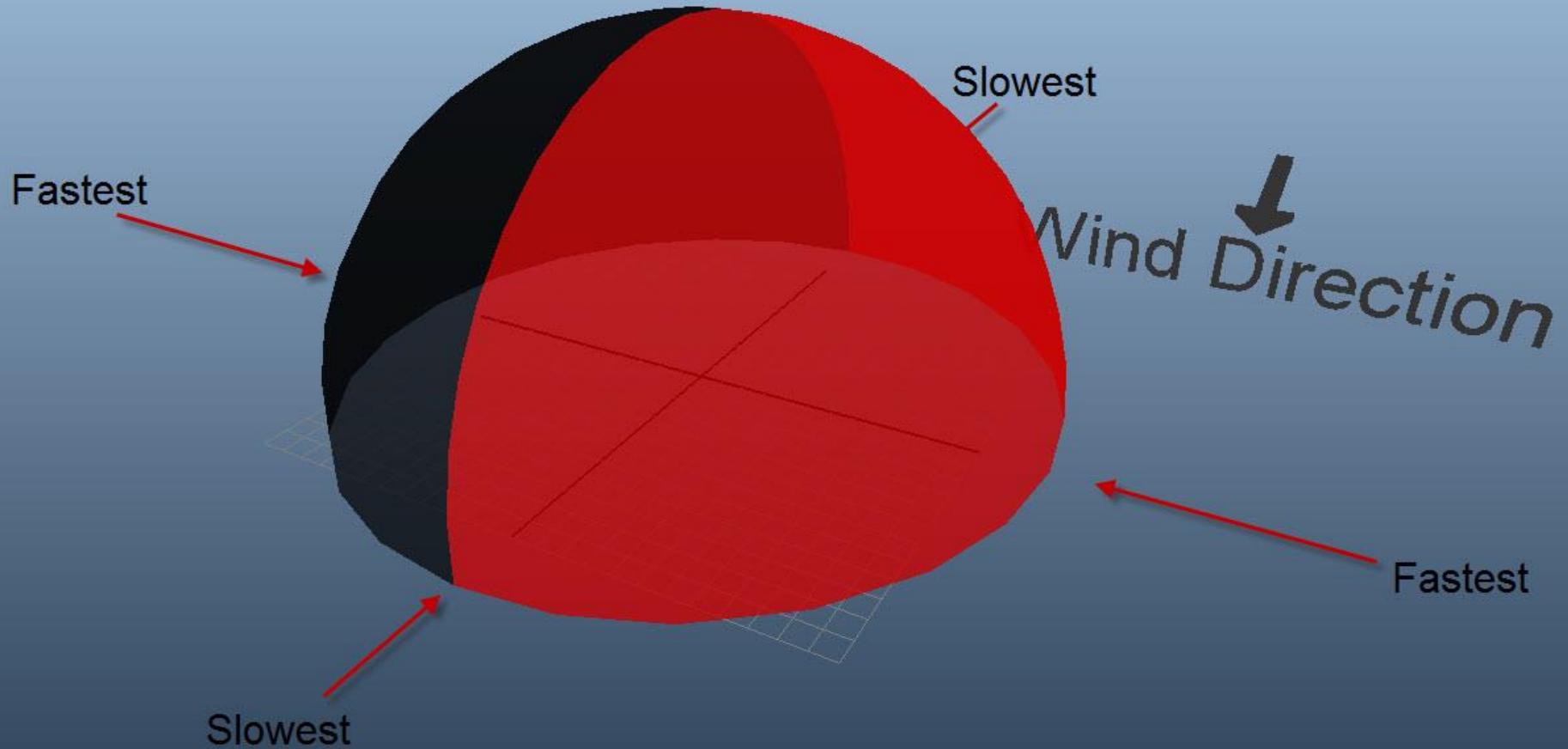


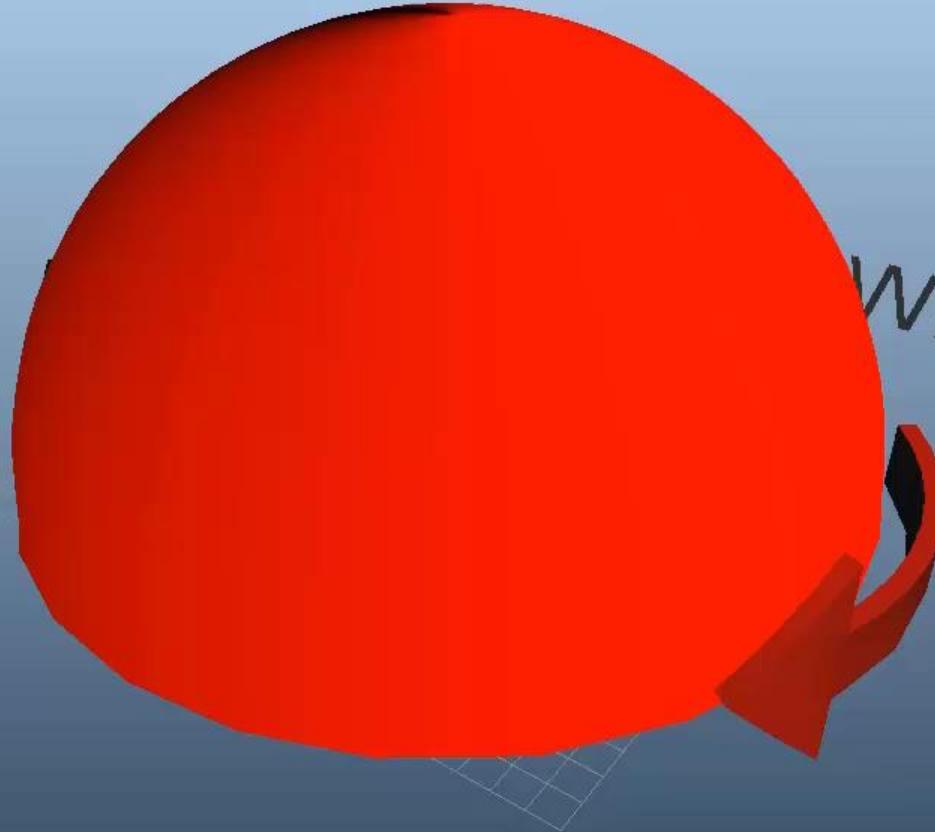
Sky Flow in V Direction



- Wind Direction (dot product) Binormal of sky
or
- Convert the Wind Direction to Tangent Space on
the dome (extract the green channel)



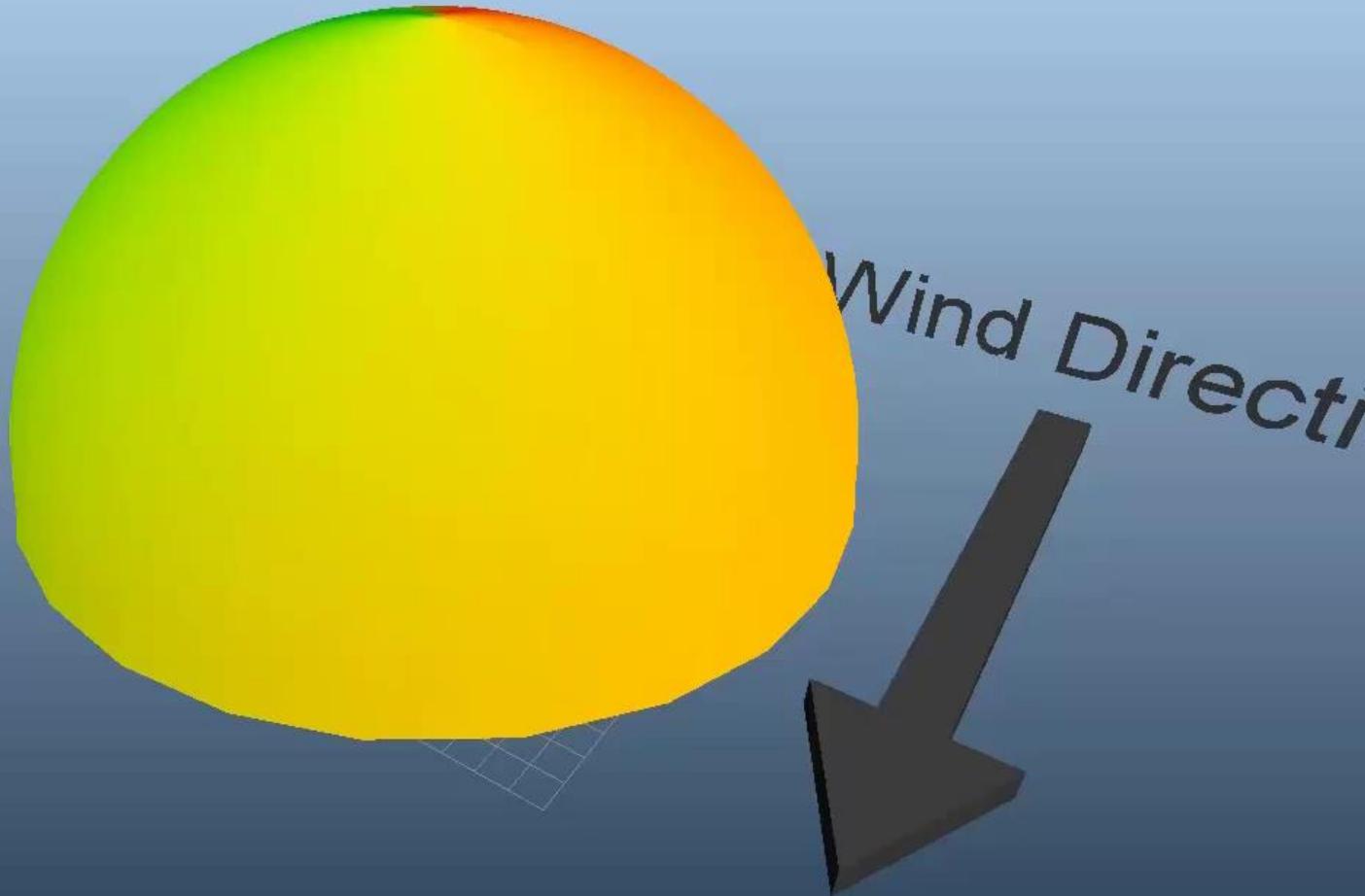




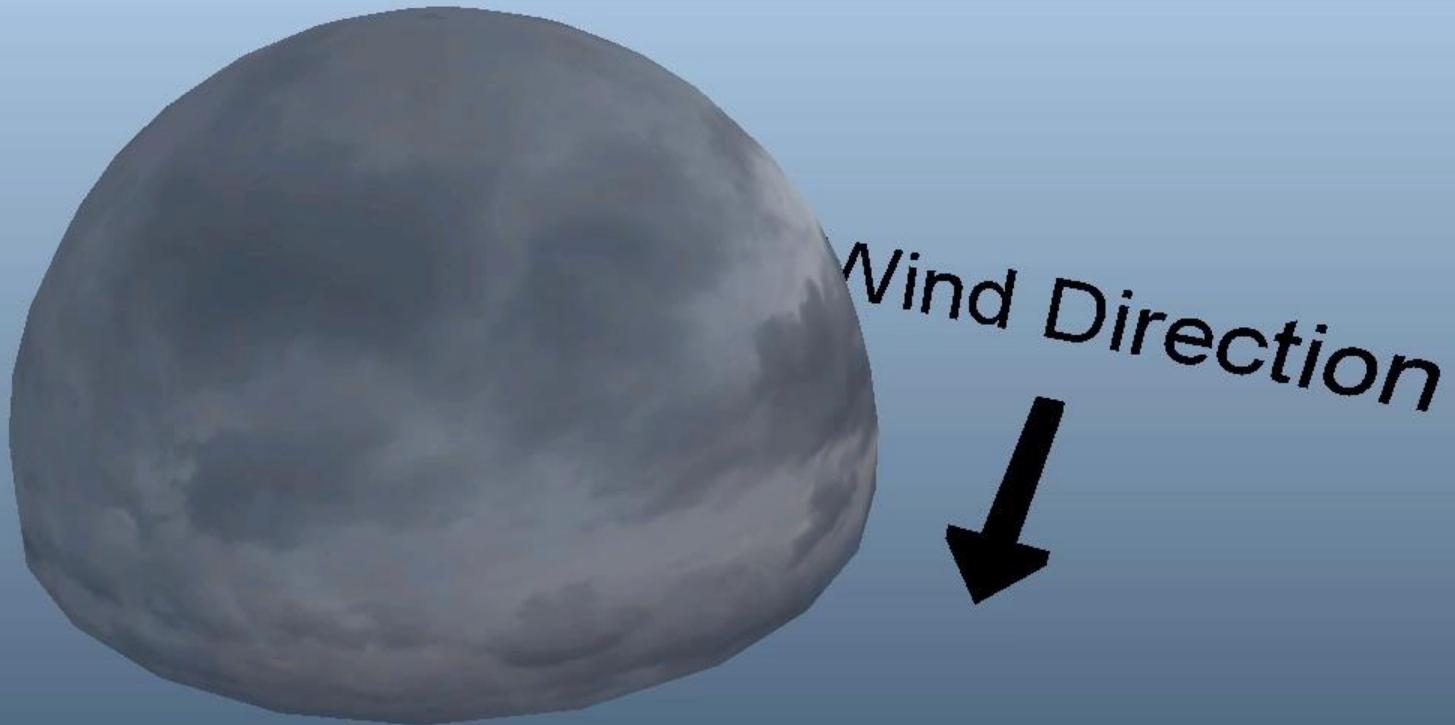
Sky Flow in V Direction



- Wind Direction (dot) Tangent of sky dome
or
- Convert the Wind Direction to Tangent Space on
the dome (filter out red channel)

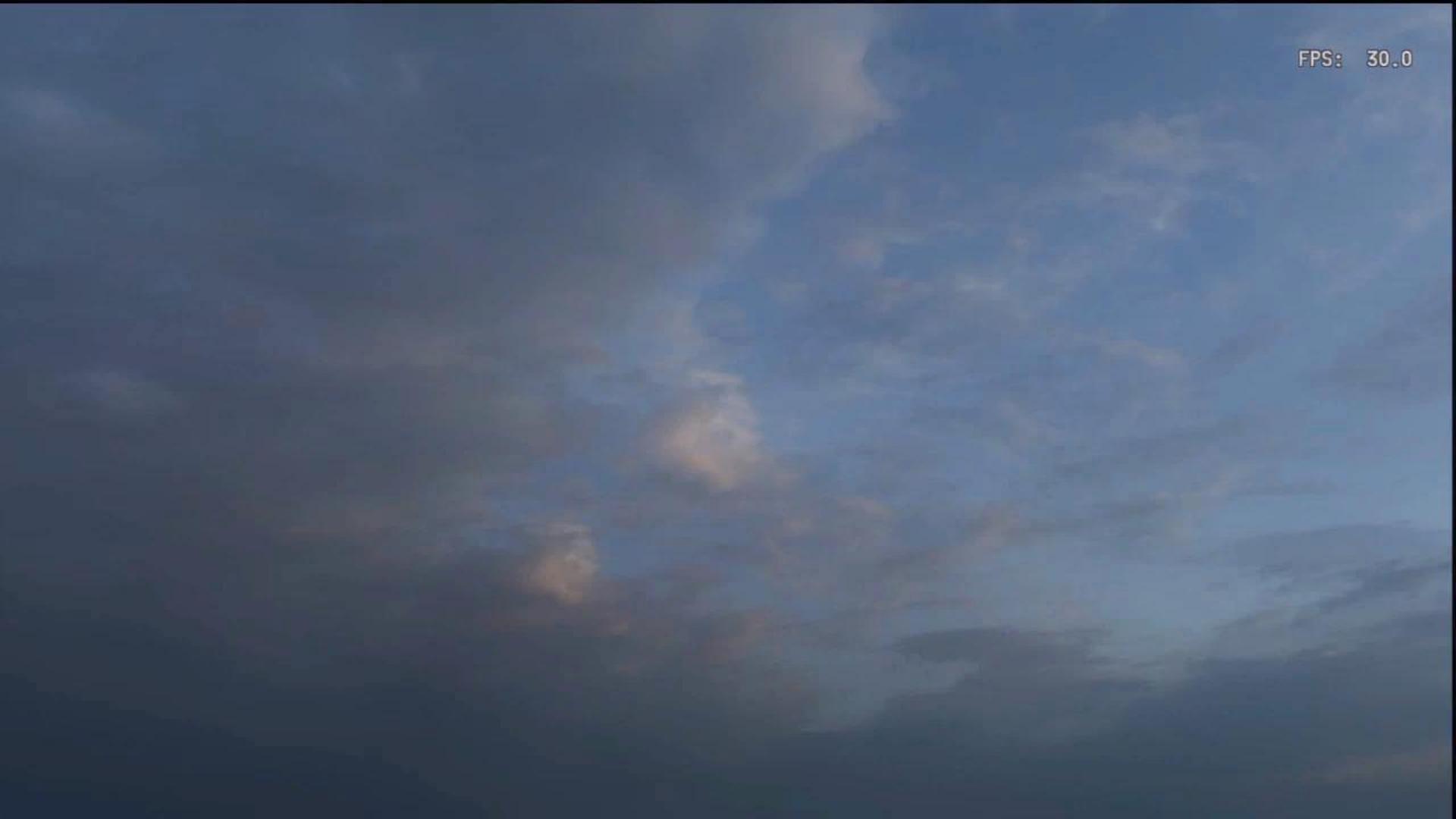






Wind Direction

FPS: 30.0











The Cons

- Repetition in motion is easily visible in high contrast areas



The Cons

- Repetition in motion is easily visible in high contrast areas
- **Very large, ugly pole at the top**



RETROSPECTIVE THOUGHTS

Retrospective Thoughts

- Did you actually see the sky moving while you were playing the game?

Retrospective Thoughts

- Did you actually see the sky moving while you were playing the game?
 - *Did we make them too subtle?*



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