DSCOVR Transcendence

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Introduction

- Local Analysis and Prediction System (LAPS) is used for data assimilation, nowcasting, and model initialization / post-processing
- LAPS data at High Resolution and Rapid Update, used for hourly Global Analysis with 21km grid spacing.
- **The SWIM raycaster uses LAPS analysis data to simulate visually realistic image of the Whole Earth**

- DSCOVR and its onboard EPIC camera provides an Ultra-HD view of the Whole Earth in the visible spectrum
- New EPIC image every 1-2 hours
- **The Blueturn app interpolates EPIC images in real-time to generate an interactive video of the Whole Earth**

Together, SWIM and Blueturn will generate a complete, permanent and real-time Whole Earth video, even when DSCOVR is offline.

3-D Cloud Analysis

First Guess →

METAR   METAR   METAR

SWIM visualized

DSCOVR actual
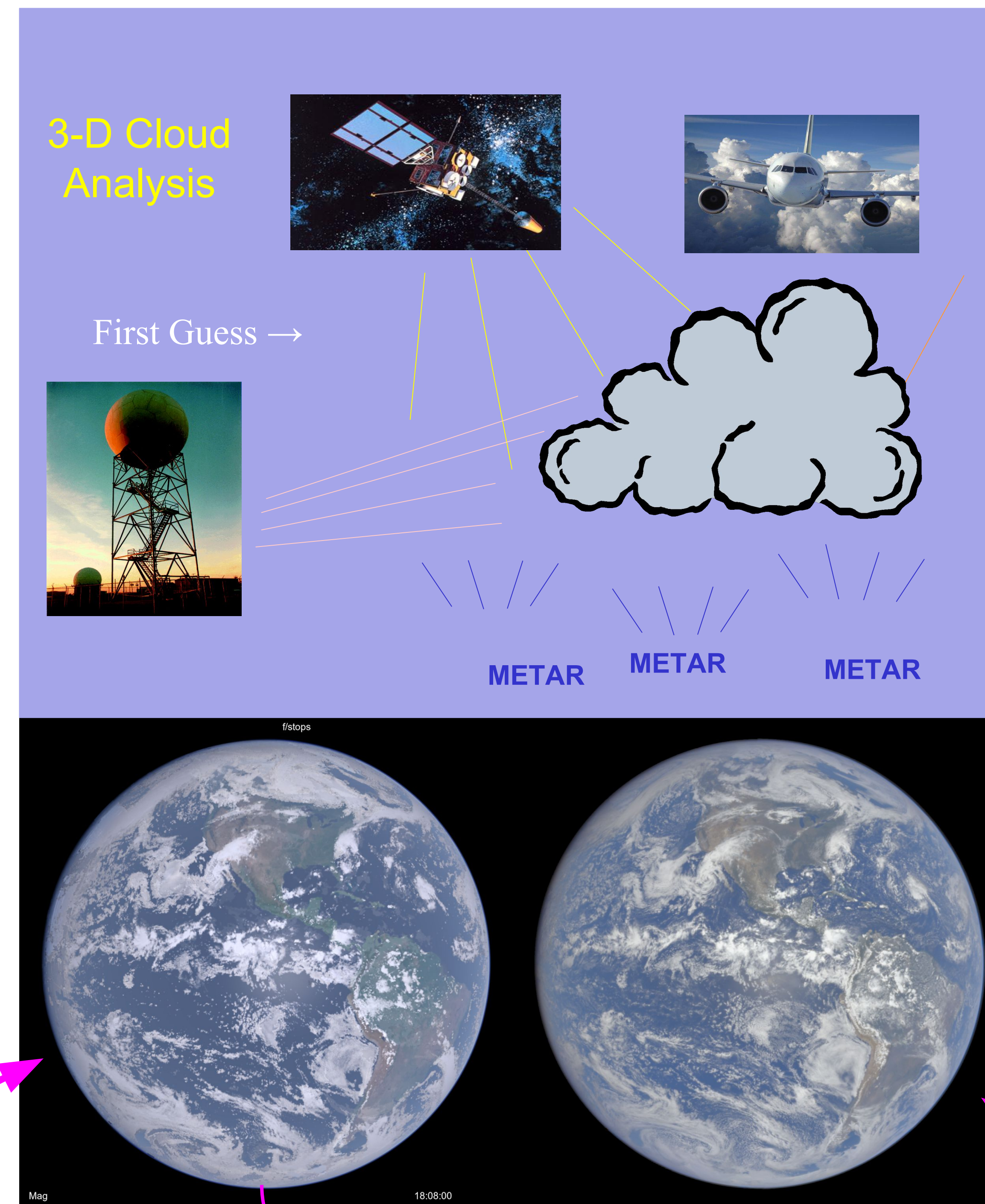
Cloud Analysis

- 3-D global fields of hydrometeors and other meteorological variables
  - Cloud Liquid, Cloud Ice, Rain, Snow
- Uses geosynchronous satellites (instead of DSCOVR/EPIC) with visible and IR bands for horizontal extent, cloud top, and cloud reflectance information.
- Incorporates METAR surface cloud observations, radar reflectivity, and aircraft reports for cloud layer information
- Cloud layer and location information also comes from global weather model (e.g. NOAA's GFS), used as a first guess.
- Aerosols can be added as a vertical profile, or as a 3-D field of extinction coefficient.

Ray Tracing Techniques

θ = scattering angle
τ = cloud optical thickness
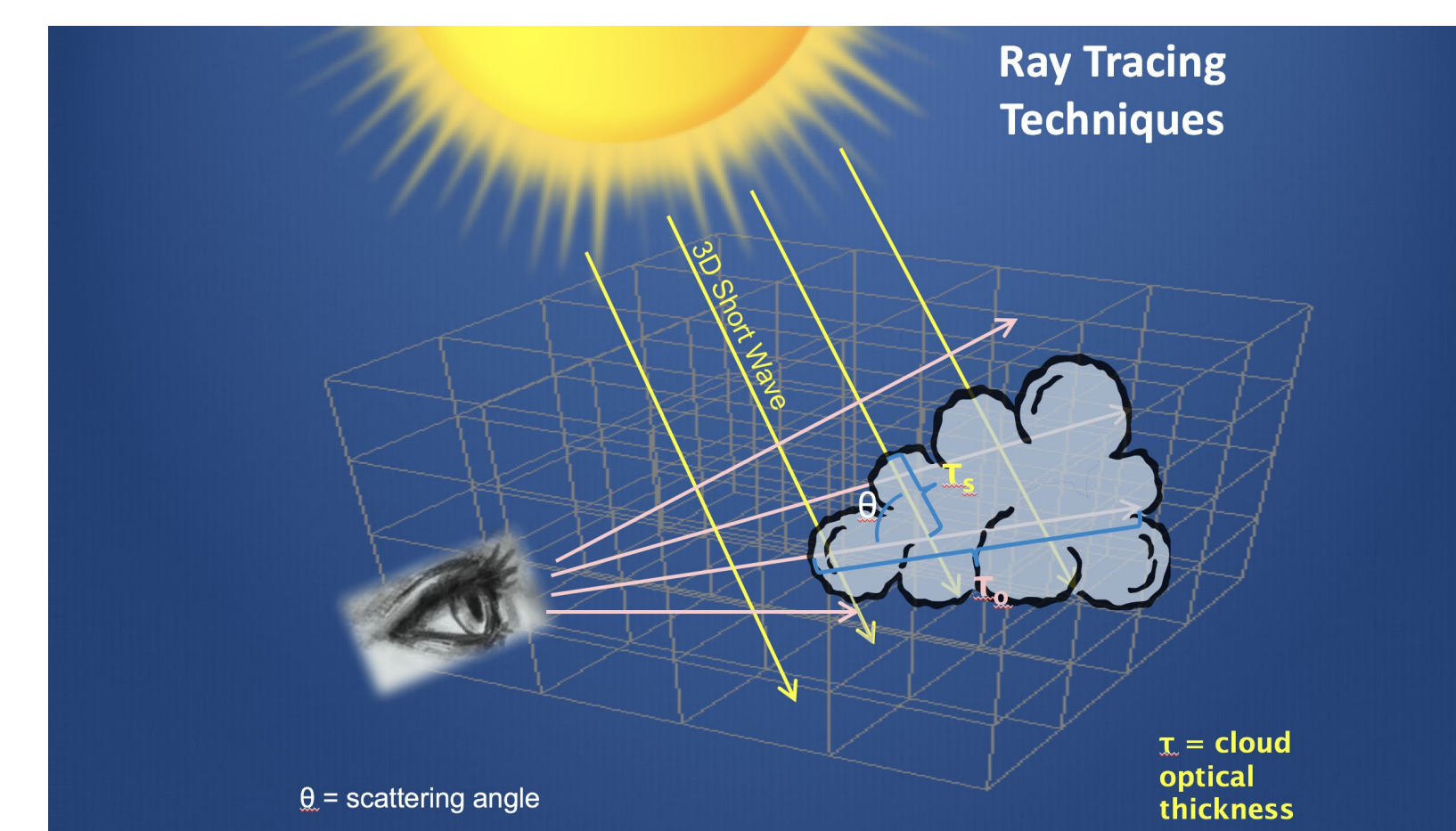
Simulated Weather Imagery

- Simplified 3-D radiative transfer - 3 visible wavelengths
- Produces physically and visually realistic images
- Ray Tracing from space based vantage point
- Illumination of clouds, air, and terrain is computed based on sun and other light sources
- Mie & Rayleigh scattering by intervening clouds, aerosols, gas (via effective particle radius and optical thickness)
- Ozone absorption considered
- Terrain shown when along the line of sight
  - Land Surface Spectral Albedo from Blue Marble Next Generation
  - Sunglint model used based on ocean waves
  - Snow/Ice cover modifies land albedo
  - Anisotropic reflectance based on land surface type
- Physically and empirically based for best efficiency (e.g. handing of multiple scattering in clouds)
- Output is in spectral radiance, reflectance, or RGB images that account for human trichromatic vision perception, with natural color and contrast.
- RGB images produced by convolving 3 narrowband radiances with solar spectrum, CIE color matching functions, and sRGB color space matrices with gamma correction.

DSCOVR:EPIC limitation

- The EPIC camera onboard DSCOVR sends one new image every 95 minutes in Winter, and every 65 minutes in Summer time. The limitation is due to limited storage and the fact that there is only one single antenna on the ground to communicate with the satellite. During night time in Virginia, the satellite must store the pictures. The shorter the night, the more images can be sent at constant rate.
- Other antennas around the globe are tuned to low-rate protocol for higher-priority solar data, giving DSCOVR a limited window for switching to high-rate EPIC emission.
- Therefore the only way to achieve a video feed with smooth motion is by software means using the relatively few images received..

Already 2+ years of data at **constant rate**, since August 2015

DSCOVR may be offline for maintenance, causing some **gaps** in EPIC data which SWIM can **fill** based on LAPS data

Processing time causes delays of 1 to 7 days in EPIC images publication. SWIM can bring synthetic **real-time capability**
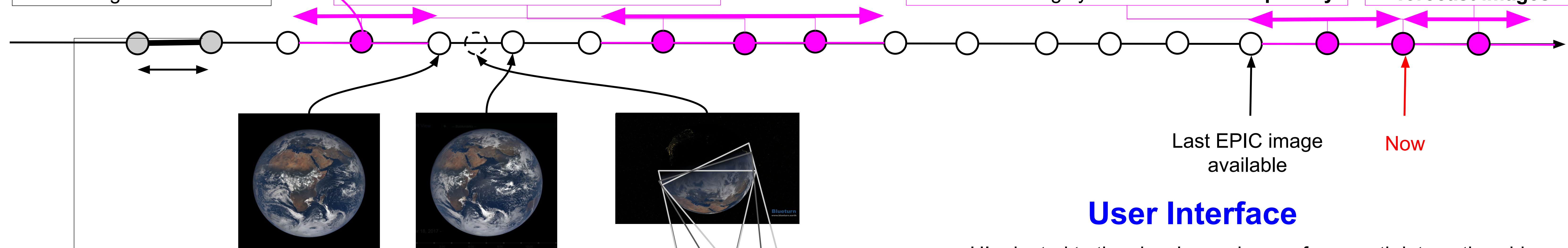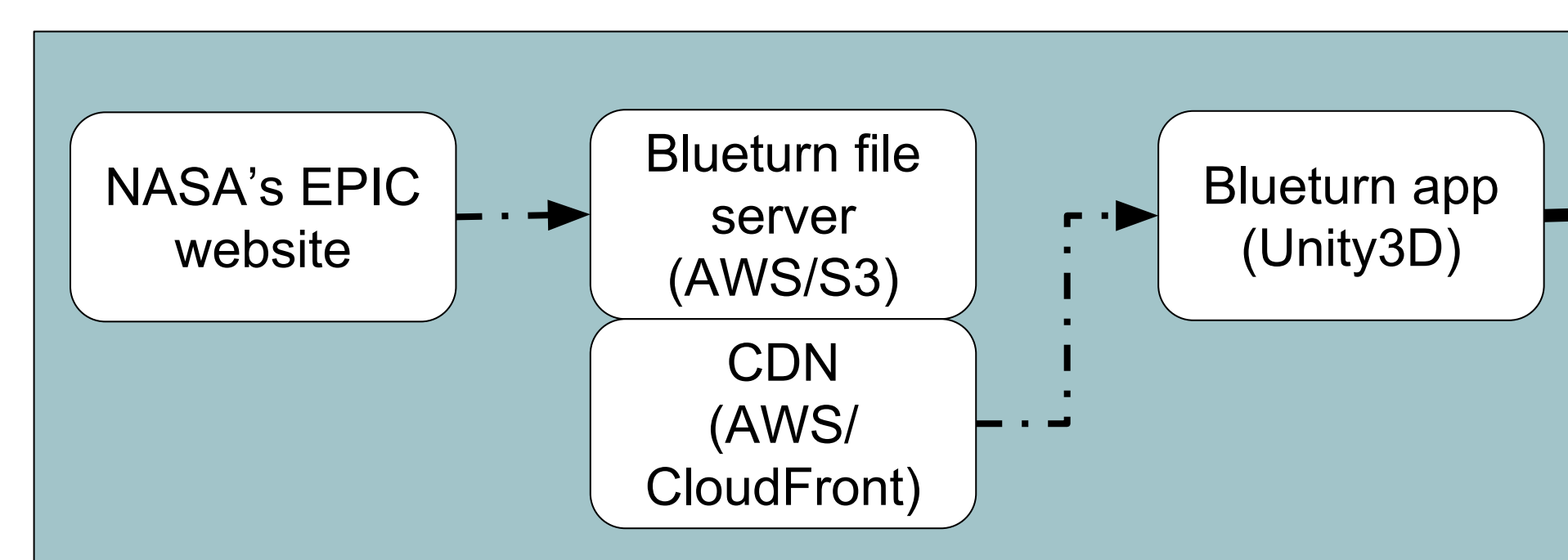
SWIM can even generate **forecast images**

Last EPIC image available

Now

Lissajous Path
10°
100M miles   L1   1M miles
EPIC view
DSCOVR

Image Processing Pipeline

NASA's EPIC website → Blueturn file server (AWS/S3) → Blueturn app (Unity3D)

CDN (AWS/ CloudFront)

- Predictive loading based on time speed
  - smooth interval switch
  - fast seek.

- Asynchronous Images load into GPU
  - Project images on ellipsoid (IERS 2003), based on DSCOVR position and attitude metadata
  - Interpolate images in geodesic space: Linear, bilinear or Optical Flow (depending on level of detail)
  - Add basic lighting model for Sun glint, Night terminator and Moon shadow (eclipses)

Mirror server for EPIC data
- Download, stream and cache images from NASA's EPIC website into mirror server
- Immunity from protocol changes
- Half-resolution copies for adaptive bitrate.
- Extra calibration data per image
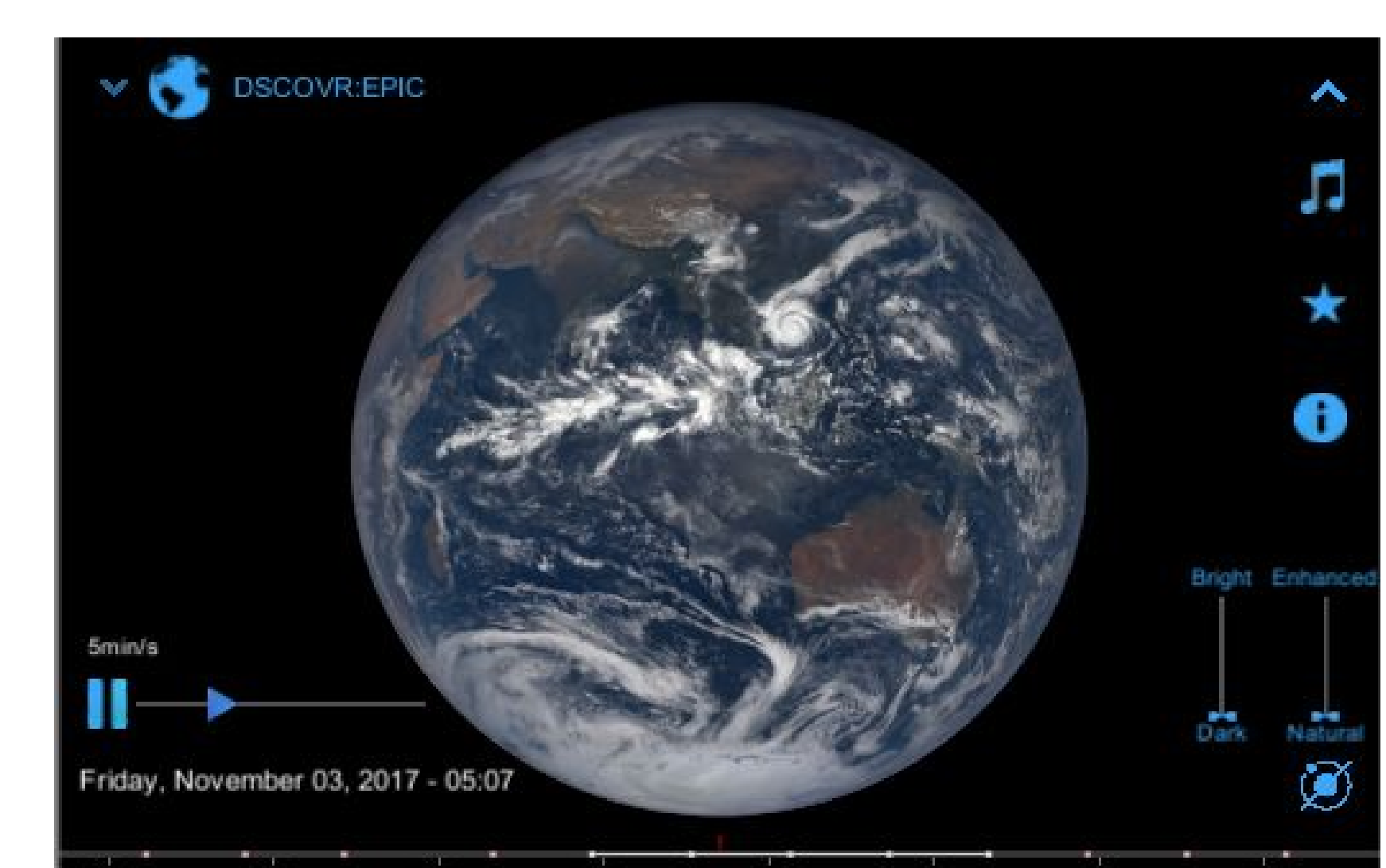- Local Cache images for offline usage

User Interface

- UI adapted to the visual experience of a smooth interactive video along a multi-years period, in a 3D model of the nearby cosmos
- Close-to-L1 vantage point: Seek time = Rotate the Earth
- Full day jumps and analemma, as image available at any time.
- Equirectangular map for spherical projection (e.g. NOAA's Science On a Sphere)
- Alternative 3D vantage points: Exact L1, Geostationary, Moon

- Just try it!

- Available on all platforms (based on Unity3D): web, Android, iOS

- See SWIM integration example on *September 20th, 2016 at 18:08 UTC*

DSCOVR:EPIC

5min/s
Friday, November 03, 2017 - 05:07

http://app.blueturn.earth