

# Zoomable Oceans: The OceanView (OV)

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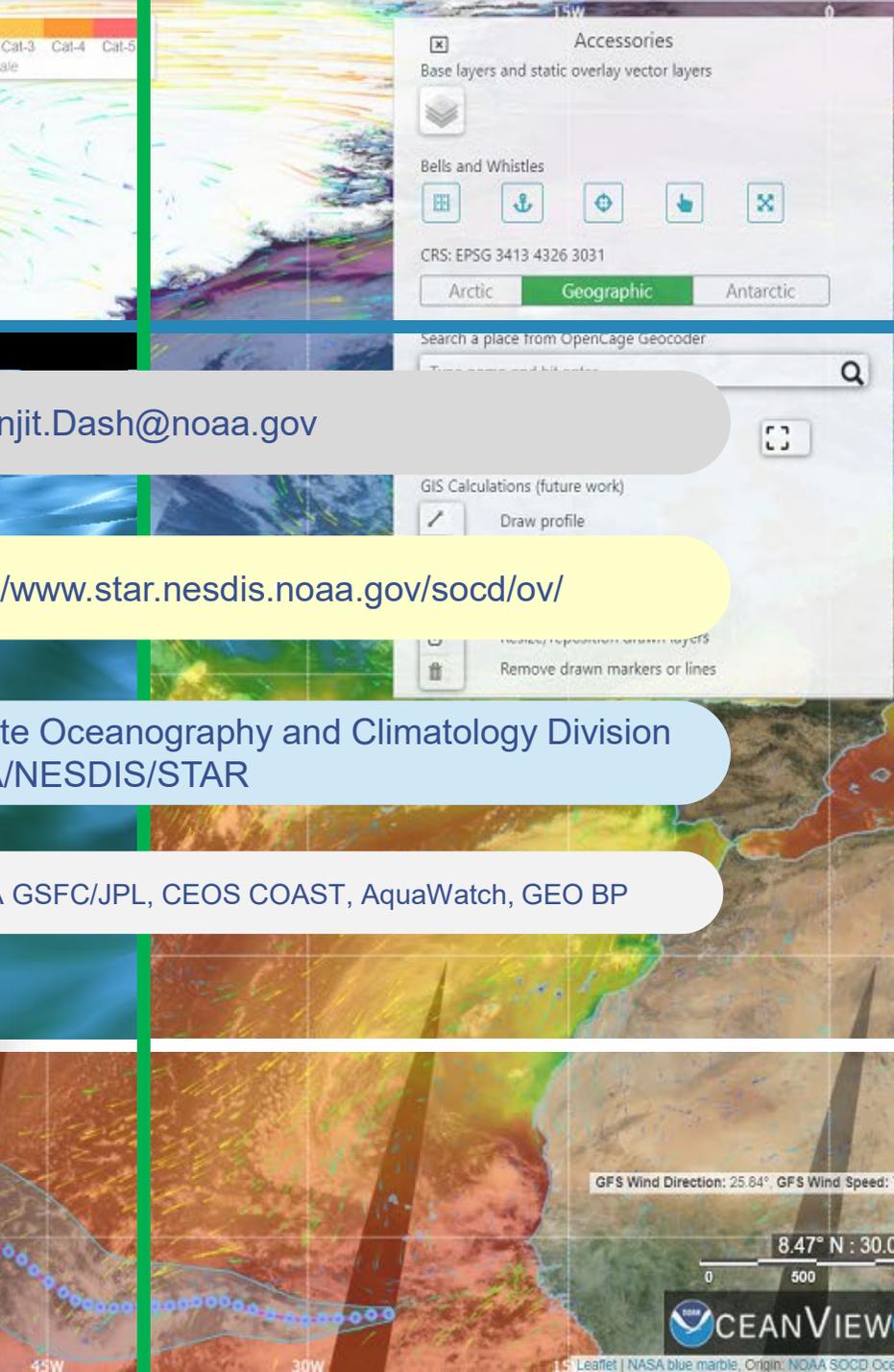
 <https://www.star.nesdis.noaa.gov/socd/ov/>

 Satellite Oceanography and Climatology Division  
NOAA/NESDIS/STAR

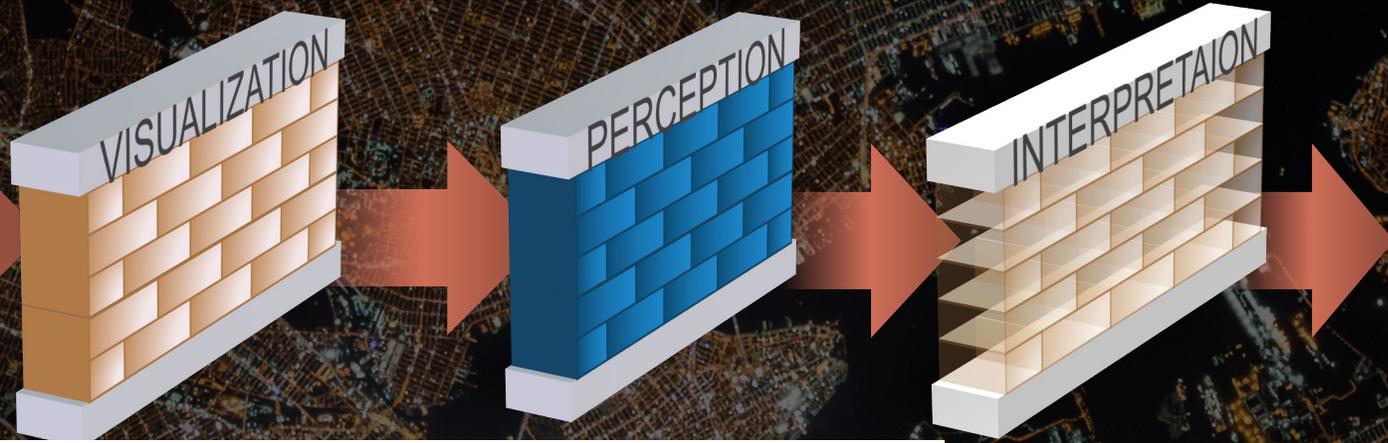
 NASA GSFC/JPL, CEOS COAST, AquaWatch, GEO BP

  
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 Chief, SOCD, NOAA/NESDIS/STAR  
 Co-Chair, GEO Blue Planet Initiative  
 Co-Chair, CEOS COAST

  
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 CSU CIRA Research Scientist III



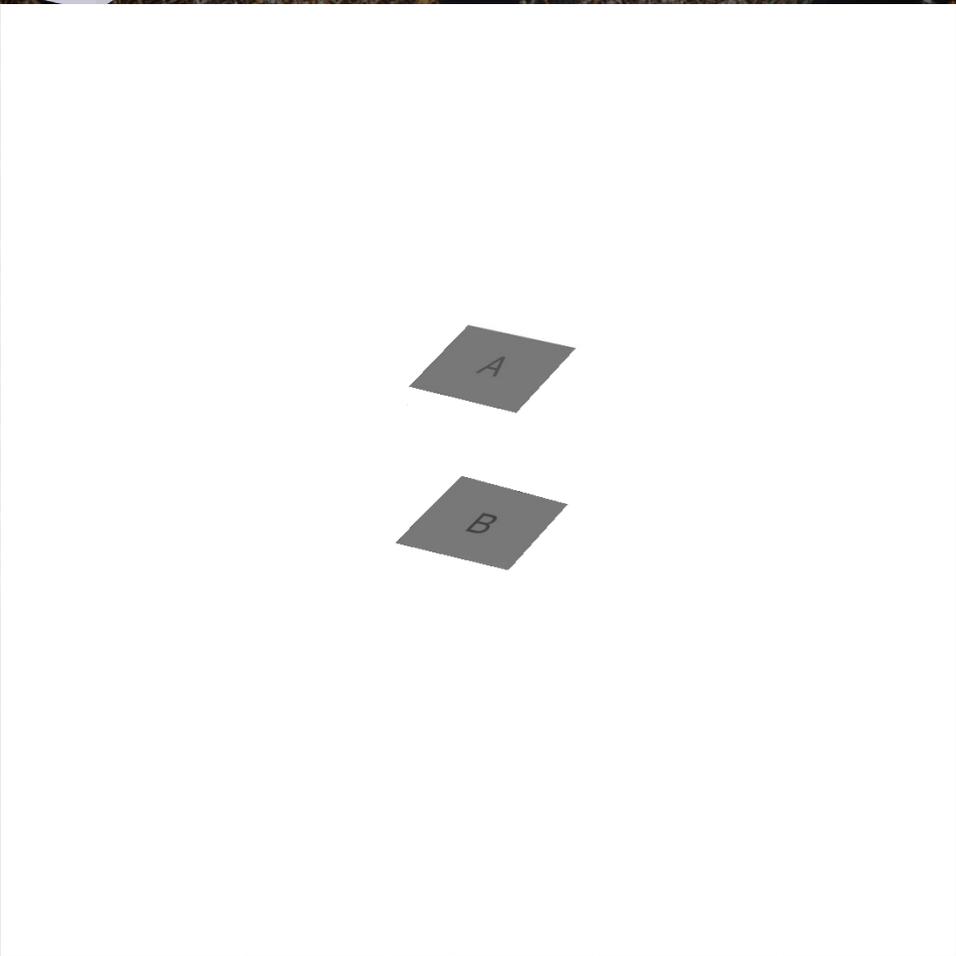
- Satellite products
- Model
- In situ
- Events



Applications

**The importance of proper visualization cannot be overemphasized.**

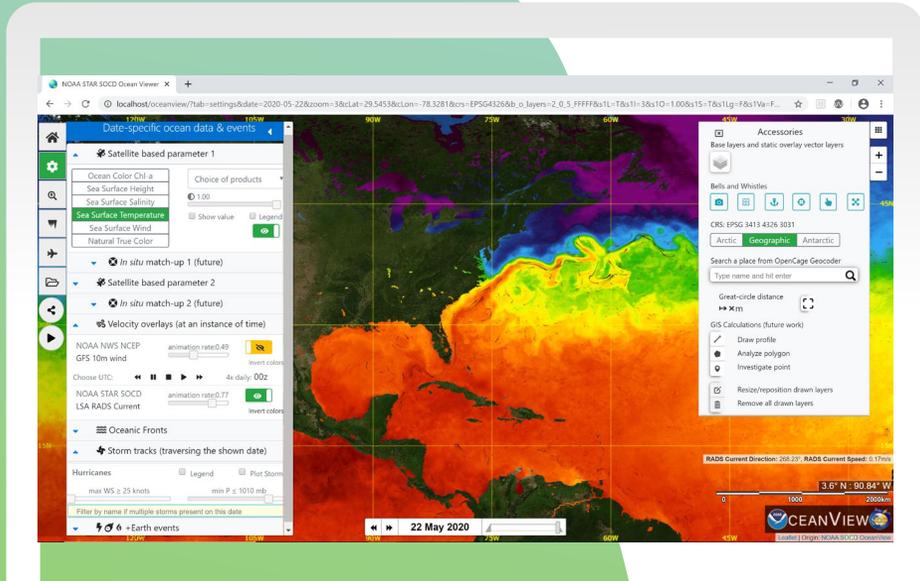
**Image Credit**  
Edward H. Adelson  
Professor, Vision Science, MIT



Still can not trust?  
<https://www.illusionsindex.org/ir/checkersshadow>

# The OV in a Nutshell

A web-application *toward* integrated visualization of remote sensing and *in situ* data, model output and ocean, coastal & inland water events



iView

## Geospatial Viewer for raster and vector data

Predominantly SOCD products; some from other NOAA line offices; some from NASA WorldView

Covers: **Blue Green White (cryo), Brown (inland/coastal)**

iTrack

## Event/Object Tracker

Storms, Quakes, Eddies/Fronts, Spills. Satellites

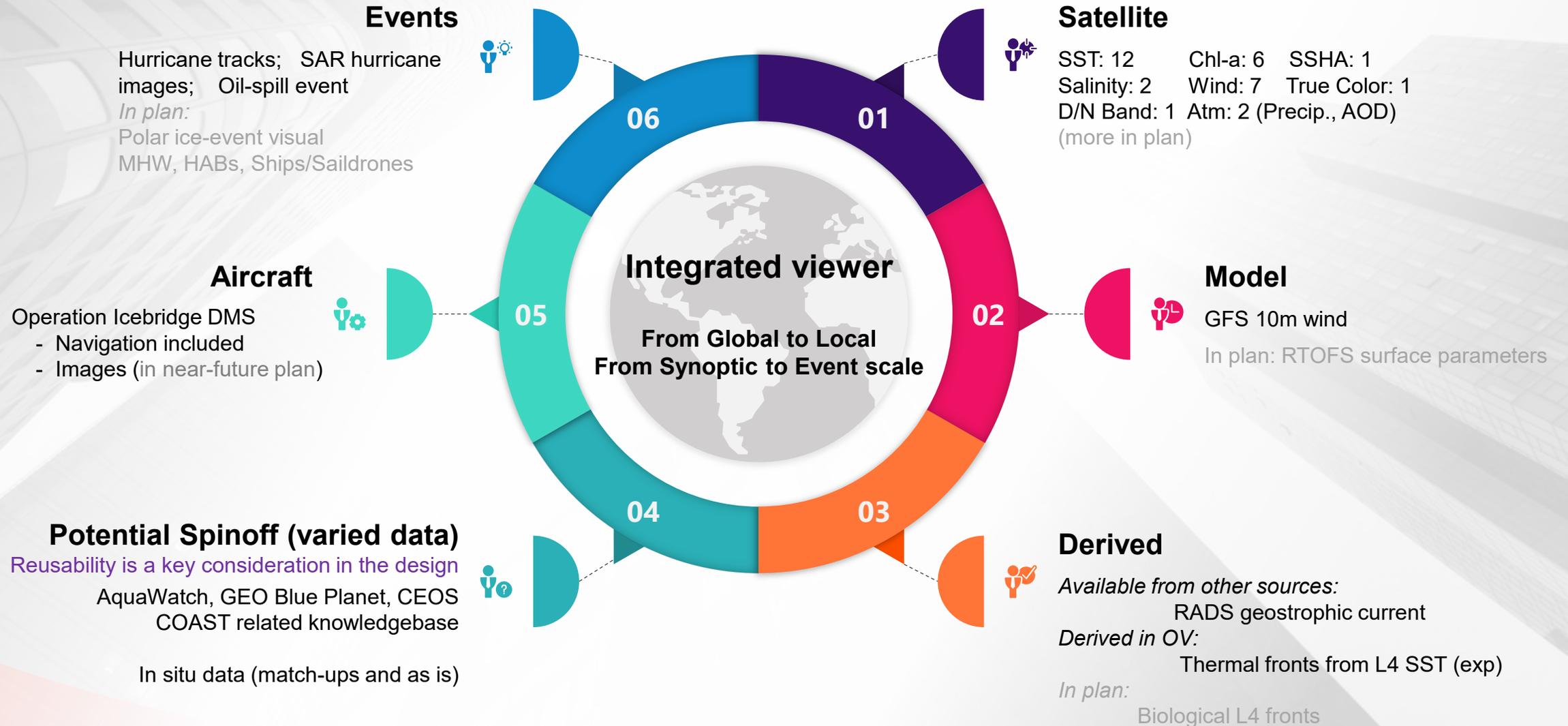
*Intended expansion: HABs, MHW ...; Ships, Saildrones...*

iTech

## Tech Overview

- Purely client-side (within STAR web constraints)
- Strictly opensource *tools* and *formats* (no proprietary hooks or 'technocratic regimes')
- Raster maps are based on OGC WMTS specification (without the map-server). JPL/GSFC MRF technology
- Customizable entry points *via* use of permalink that can serve for specific applications in the future
- In-built graphical user onboarding support

# Data ingested in OV v1.0 [raster + vector]



# Benefits

## Web-access

A1

The OV is a web-based open ocean, and coastal & inland water geospatial viewer and event tracker.

## Assist and support

A2

Assist and support ocean stakeholders, practitioners, and enthusiasts interested in the state of diverse terrestrial water bodies.

## Spatiotemporal scale

A3

**Heterogeneous and Multi-scale** support in space and over time, both from a synoptic as well as an event-scale perspective.

## Highlight NOAA/Partner & other useful products

A4

Incorporates products from NOAA and non-NOAA sources, spanning satellites, airborne and field platforms as well as environmental modeling output.  
Make products more discoverable.  
Partner: EUM/EU Sentinel series

A8

A1

A7

A2



OV & derived applications

A6

A3

A5

A4

A5

## Scientific linkage

- Visually assist scientists in connecting observations to models, Physics and Oceanography ...
- Coupling/interaction (sea-air, land-sea)
- Coastal studies (near-future plan)
- Ocean/Land/Air/Coastal interplay couple dynamic system

A6

## Situational awareness

Events/ Alerts: **Multi-Hazard Warning**  
Currently, data come with 1day lag, but OV can support NRT feed.

A7

## Initiate and maintain collaborations

Contributes to CEOS, COAST, GEO Blue Planet (ocean and coasts), AquaWatch Initiatives, as part of the overarching **U.N. Decade of Ocean Science for Sustainable Development**. NOAA interline office, GHRSSST, JPL.

A8

## Opens doors to:

- Application of advanced technology in the future, e.g., Computer vision, AI/ML, SDAP
- Climatological assessment of data and state of the ocean, e.g., product stability, trend detection
- Live alerts and probability prediction

# Features in OceanView v1.0

Map controls <> Scientific <> Technology <> Spinoff potentials being pursued

Map controls & interactions	Scientific	Technology	Spinoff	Limitations
<ul style="list-style-type: none"> <li>- zoom, pan, resize,</li> <li>- multiple layers</li> <li>- raster (on top or side-by-side)</li> <li>- opacity, show value, legend</li> <li>- vector</li> <li>- vector animation</li> <li>- coordinate reference system</li> <li>- export screen display</li> <li>- display local file (desktop app)</li> <li>- permalink, social media share</li> <li>- customizable entry points</li> <li>- Semantic search (ongoing)</li> </ul>	<ul style="list-style-type: none"> <li>- various ocean, cryosphere &amp; select atmosphere parameters</li> <li>- deep-dive fronts (profiler)</li> <li>- deep-dive polar flights</li> <li>- make basic GIS ops</li> <li>- track/search natural events</li> <li>- track manmade objects</li> <li>- viz surface current motion</li> <li>- viz satellite/model/<i>in situ</i></li> </ul>	<ul style="list-style-type: none"> <li>- opensource tools/standards* allowing interoperability <a href="#">OGC WMTS</a></li> <li>- client-side processing architecture</li> <li><i>Screen functionality</i> <a href="#">Leaflet/plugin</a>, <a href="#">JS</a>, <a href="#">jQuery</a>, <a href="#">Bootstrap</a></li> <li><i>Back-end functionality</i> <a href="#">Python</a>, <a href="#">GDAL</a>, <a href="#">JAVA</a>, <a href="#">OpenCV</a>, <a href="#">C/C++</a></li> <li>- original front-end design from scratch (no template)</li> <li>- Mapserver or Geoserver unavailable; so, based on RESTful web services</li> <li>- UX/UI has a very high focus.</li> </ul>	<ul style="list-style-type: none"> <li>- support AquaWatch/GeoBluePlanet</li> <li>- CEOS COAST AdHoc project (work underway)</li> <li>- support polar pan-Arctic and pan-Antarctic missions</li> </ul>	<ul style="list-style-type: none"> <li>- pre-generated tiles with color table. Cannot change the range or CT, easily (*can be done though with server-side programming as images are based on PCT but its not straightforward)</li> </ul>

**\*Established open standards**

WMTS: Web Map Tiling Service  
WMS: Web Map Service  
WFS: Web Feature Service

GML: Geographic Mark-up Language  
SLD: Styled Layer Descriptor  
FE: Feature Encoding Standard  
SVG: Scalable Vector Graphics  
XML: Extensible Markup Language

GeoJSON

# Concepts: *pre-requisite to understanding dynamic maps*

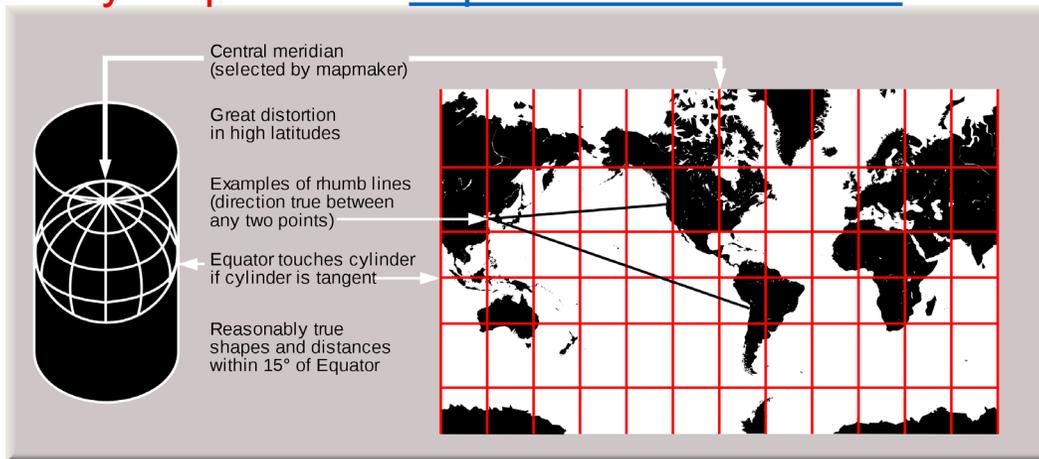
Projection and CRS > Web-map protocols and standards by OGC > Tiling

**Datum:** a foundation and reference for spatial measurements.

**Projection:** How an ellipsoid latitude-longitude is projected on to a flat surface, i.e., it is the visual representation of those measurements on a different surface.

**Coordinate Reference System:** refers to the mathematical approach used for flattening. Used to describe those measurements relative to the datum.

**Every map lies!** : <https://thetruesize.com/>



**Common choice (GCS, Datum): WGS84**  
CRS (Coordinate Reference System)



# Concepts

Projection and CRS > Web-map protocols and standards by OGC > Tiling

## WMS: Web Mapping Service, 2000

- Desktop GIS was mature, but internet was young!
- Consumes map data by a [GET](#) request (with a bounding box, a layer, a style-list, **service type**, the number of pixels of the final image, and the map proj system)
- Rendered in real time by a **spatial-server**\*. (the user receives an image, either PNG or JPEG, of the bounding box provided; some parameters were added in time)
  - \*ArcGIS server, Geoserver, Mapserver etc. (~~STAR~~)
- Works *great* for moderate size RoI and numerical analyses if desired. Best in one image/layer per GET request scenarios such as static maps. Can combine layers with comma.
- Not user-friendly to quickly change the RoI or zoom level. This will start *throttling* for higher-resolution data, e.g., > 2 km grids

## WMTS: Web Mapping Tiled Service, 2010

- 2005: Google, Bing started “slippy maps”
  - A new **WMTS** protocol was developed in 2010 by OGC. It shares the basic premise of WMS but images returned are in small tiles (256 x 256 or 512 x 512 sizes), *pre-rendered* so that they can be returned very quickly to the user. **“The Need for Speed”**.
  - Can work **w/o a geospatial server** with simple RestAPI template:

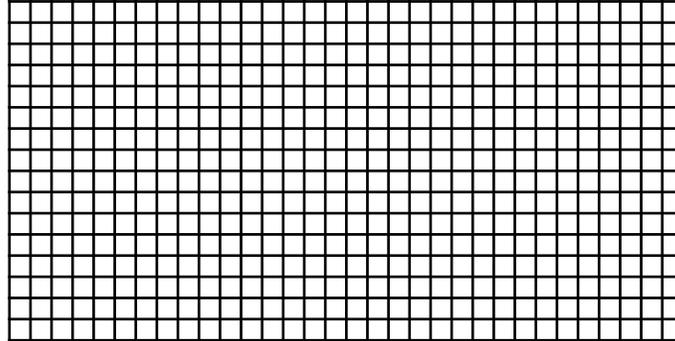
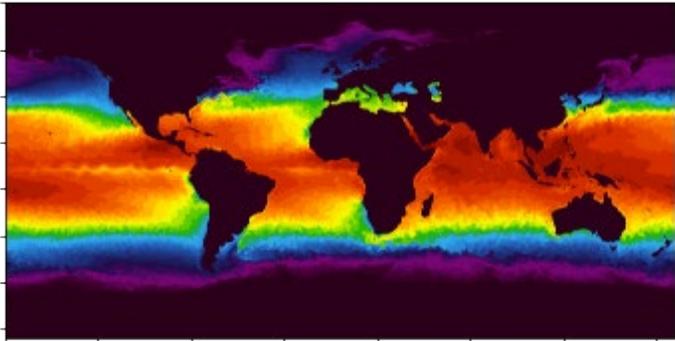
```
ov_epsg4326_template = ovDataLoc + 'wmts/epsg4326/nrt/' +  
'{layer}/{time}/{tileMatrixSet}/{z}/{y}/{x}.png'
```
  - Best if the objective is both global and regional display with the need for speed/fast response.
- Challenge:** Efficiently pre-generating tiles is a daunting task for the uninitiated, optimizing image format for web suitability is another challenge, often ignored. In WMS, the spatial-server does this for you.

\*TMS, WFS etc. also exist that we are not covering today

# Concepts

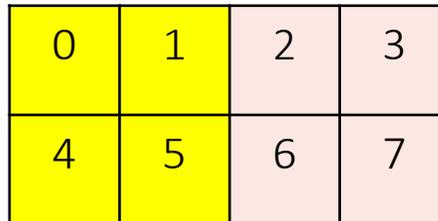
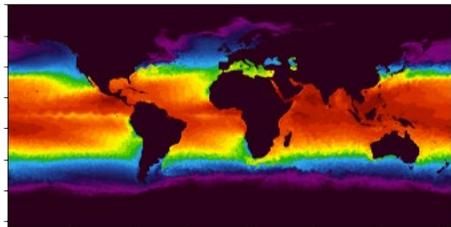
Projection and CRS > Web-map protocols and standards by OGC > Tiling

- z4
- z3
- z2
- z1
- z0



512 tiles: 512x512  
(32 col x 16 row)

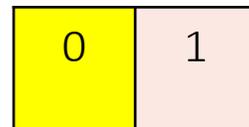
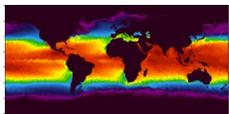
512 tiles: 512x512  
(32 col x 16 row)



128 tiles: 512x512  
(16 col x 8 row)

32 tiles: 512x512  
(8 col x 4 row)

8 tiles: 512x512  
(4 col x 2 row)



2 tiles: 512x512  
(2 col x 1 row)

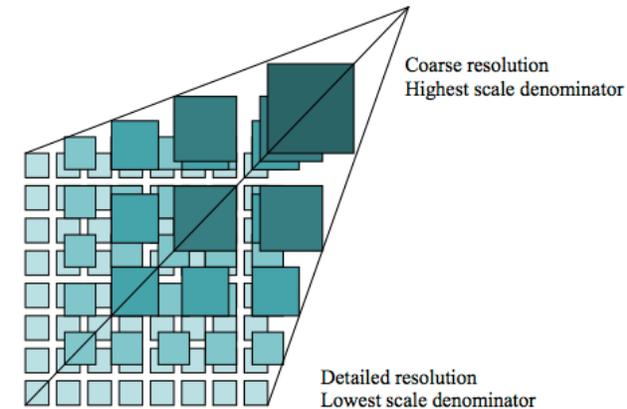
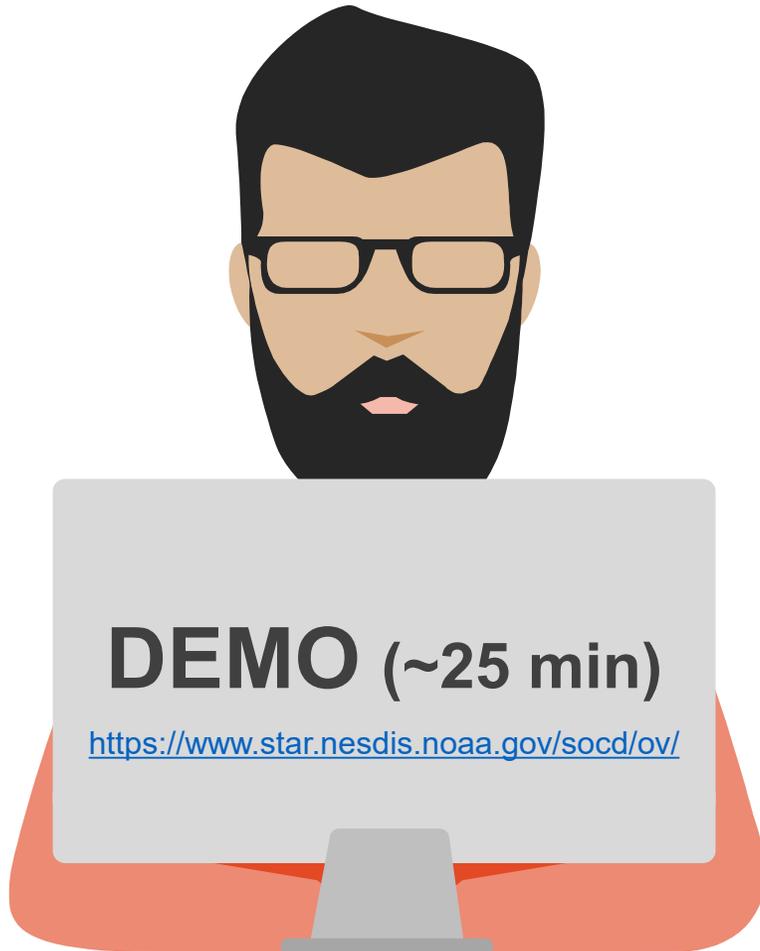


Image source:  
<https://wiki.earthdata.nasa.gov/>

\*The exact implementation in OV is based on JPL/GSFC MRF technology (let's talk later, time permitting)



## Functionalities

### V1.0 (May 2021)

- Right menu accessories
- Left menu modules
- Left menu daily data module (details)
- Special functions: fronts (generated in OV), flight path

### V1.1 (June 2021)

- Improved timeline widget (animation capability)
- changelog notification

## Select Use Cases

- Visually intercompare two products for the same EDR (Eric/RTOFS future)
- Cyclone-related changes in Chl-a/SST (wakes);
- Model + Satellite + In situ (NCEI IBTracs) integrated view
- Display a local file (Mike's Cruise)
- Nightlight (experimental; Feb 16 on; Texas)
- Animation (Cyclone Amphan, 16 May 2020 onward)

# Customizable Entry Points

- Choice can be offered on page load for different user types

▶ **Full-stack Viewer**  
Most options visible  
in plain sight

▶ **Gulf of Mexico**  
Geostrophic currents  
on bathymetry base

▶ **Panarctic**  
Flight and satellite for  
sea-ice studies

▶ **Limited Desktop App**  
Visualize local files:  
Text: CSV, GeoJSON, KML, GPX  
Bundle: KMZ

▶ **Search events**  
Search hurricane tracks &  
some basic GIS analysis



# FUTURE Extensions

Upcoming extensions and improvements (not exhaustive)

Wish list

JPL SDAP (collaborative proposal submitted)

Bucket list

VR/AR

05

AI/ML/CV, auto event detection, Prediction ...  
This will require a cross-cutting collaboration among SMEs and tech savvy

04

Alert sys; Event summary charts; select data download; animation vid  
(interesting observations / cool things /ocean weather/climate – Live)

03

EMC RTOFS model data (lead: Eric B); more Satellite prod  
NSIDC Sea-ice concentration (near future)

02

Marine Heatwave (DMG approval)

01

DMS UHR images (lead: Larry C)



The Sky is the Limit  
2023-2024



Achieve Altitude & Capacity  
June 2021-2023



Take off and Stay Afloat  
v1.0, May 2021; v1.1, Jun 2021

# FUTURE Extensions: Polar module example (slide from Larry C.)

**Zoom level: 0 (lowest)**  
Pixel Resolution: 16 km  
Almost invisible but look carefully

**Zoom level: 6 (higher)**  
Pixel Resolution: 128 m  
Zoom more...

**Zoom level: 10 (highest)**  
Pixel Resolution: 7.8 m

- DMS Imagery conquered for zoom display
- Establishes robust framework for other data sources
- Next: process images, move on more airborne, satellite, and in situ

Polar Cal/Val Interface Development  
(OceanView - the Polar Component)

Contact: Larry Connor

# THANK YOU

That's it.  
Questions? Comments?

**Contact:** Paul DiGiacomo (vision) /Prasanjit Dash (implementation)

If you have further interests, especially collaborative ideas and innovations, cross-cutting applications, showcasing a STAR product or just wish a newer feature in the viewer.

## Socialization

### AGU

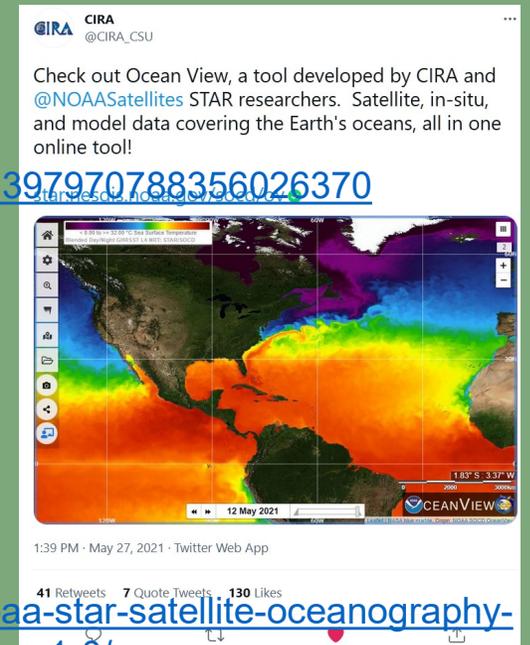
Live demo video (available until Oct 1, 2021):

<https://agu.confex.com/agu/21workshop2/meetingapp.cgi/Session/125385>

(Time-segment in the video for the SOCD OceanView: 37min to 57min)

### Twitter

[https://twitter.com/CIRA\\_CSU/status/1397970788356026370](https://twitter.com/CIRA_CSU/status/1397970788356026370)



### GHRSS T Newsletter

<https://www.ghrsst.org/ghrsst-news/noaa-star-satellite-oceanography-climatology-division-releases-oceanview-1-0/>

### STAR Web

[https://www.star.nesdis.noaa.gov/star/news2021\\_202105OceanView.php](https://www.star.nesdis.noaa.gov/star/news2021_202105OceanView.php)