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1. The OceanWatch Monitor (OM)

- The OceanWatch Monitor (OM) is designed for monitoring and validation of satellite-based CoastWatch/OceanWatch (CW/OW) ocean products and make the diagnostics available at: <https://www.star.nesdis.noaa.gov/socd/om/>.
- Currently, the monitor is a standalone system but serves as a companion site to the NOAA CW/OW main web-page: <https://coastwatch.noaa.gov/>. In the future, efforts will be made to integrate the most relevant features of this monitor into the CoastWatch web-interface.
- This monitor aims at providing an easy way to the CW/OW users to assess the state of the available products under one URL. The scope includes:
 - Assisting users/producers to remain aware of the state of the data they use/generate (data monitoring)
 - Providing a framework for synergistic ocean studies (scientific application), and
 - Bridging the gap between the satellite community and the modeling community (retrieval and model intercomparison).
- The OM performs both Global and pre-defined Regional analyses. Currently, 20 oceanic regions of interest (ROI) are pre-selected (Fig. 1), and this can be expanded as required.
- The current capability includes monitoring of five different environmental data records (EDRs): Ocean Color (OC) Chlorophyll-a, Sea Surface Height (SSH), Sea Surface Salinity (SSS), Sea Surface Temperature (SST) and Sea Surface Wind (SSW). The system is Scalable and Flexible for including other types of EDR and more product types for a given EDR. For example, considerations are being made at the NOAA STAR Satellite Oceanography and Climatology Division (SOCD) to expand it to other parameters, such as Sea Ice Freeboard and potential Panarctic applications.
- The monitor allows comparing satellite products against gap-free level-4 fields and/or model output and tracks diagnostic statistics in space (map) and time (line plot, Hovmöller). All analyses are performed in both retrieval space and a comparison space (difference or ratio).

NOAA STAR SOCD Enterprise OceanWatch Monitor (OM)
Publicly released in Jan, 2019

The OceanWatch Monitor (OM) provides a first look at the performances of products ingested in the OceanWatch systems. These remotely sensed products include: Ocean Color (OC), Sea Surface Height (SSH), Sea Surface Salinity (SSS), Sea Surface Temperature (SST) and Sea Surface Wind (SSW).

Using satellites to observe the temperature of the surface of the ocean is probably the most mature application of ocean remote sensing. Observations are made with IR, which cannot "see" through clouds and with passive microwave which is not affected by clouds but has other trade-offs. SST sensors are aboard both polar-orbiting satellites and geostationary satellites.

Horizontal menu on the top: choice of EDR
Horizontal and Vertical Menu
Vertical menu group 1: info about 'Monitored Products', 'Reference Data', and 'RoI'
Vertical menu group 2: Diagnostic metric for a given EDR
Vertical menu group 3: Inter-EDR, e.g., time-series of SST and SSH, or OC and SSS

The Oceanic Regions of Interest (ROI)
The ROIs are the same across all the thematic products and the monitor is designed to provide various information for the given ROIs. The list may be updated as per the needs of the CoastWatch/OceanWatch users.

1. Global	11. The Caribbean
2. The Northeast	12. The Eastern Pacific
3. The West Coast	13. Central California
4. Alaska	14. Florida
5. The Gulf of Mexico	15. Lake Erie
6. The SouthEast	16. The Mississippi Delta
7. Hawaii	17. Texas
8. The Chesapeake Bay	18. Southern California
9. The Great Lakes	19. The Mediterranean Sea
10. The North Atlantic	20. Australia

A) Diagnostics in both Product space and Comparison Space B) Intra-theme and Inter-theme

Intra-thematic Capabilities	Inter-thematic Capabilities
All diagnostics are available both in the Product Space and in the Comparison Space (difference or ratio wrt. reference fields):	All diagnostics are available both in the Product Space and in the Comparison Space (product 'minus or divided by' climate):
<ul style="list-style-type: none"> Maps (raster and interactive) Histograms (interactive) Time-series (interactive): Line plots Hovmöller 	<ul style="list-style-type: none"> Maps (raster, dual, slider) Histograms Time-series (different EDRs can be chosen for Y1 and Y2). This allows to visualize simultaneous variation of EDRs, if any, during extreme events.

Diagnostics downloadable as ASCII files

Fig. 1: A monitoring framework for satellite-based all ocean parameters for the CoastWatch/OceanWatch program of NOAA/STAR/SOCD. Monitoring is performed in Global and 19 additional Regions of Interest (RoI) for simultaneous analyses of SST, SSS, SSH, SSW and OC from different sensors. The objective is to comprehensively evaluate the products and steps beyond conventional validation approaches in an interactive web-interface useful for users, producers and scientists. Most of the diagnostics provided online can also be numerically (data in ASCII) accessed by the web-users. The users can interactively perform a variety of operations on time series plots and export the output to raster images.

Wish to see a first-hand demo? Catch me during the breaks.

2. Diagnostics in OceanWatch Monitor

Interactive Histograms
These descriptive statistics are monitored in time (line plots and Hovmöller) to check for stability, cross-platform consistency, dependence and other unforeseen anomalous condition.

Interactive Hovmöller
Interactive Time series plots

2 EDR Time-series, e.g., SST and SSS, in Y1 and Y2 ordinates

Highly interactive Fit functions
A range of statistical parameters are tracked for monitoring stability, facilitating product inter-comparison, and simultaneously visualizing variation of different EDRs.

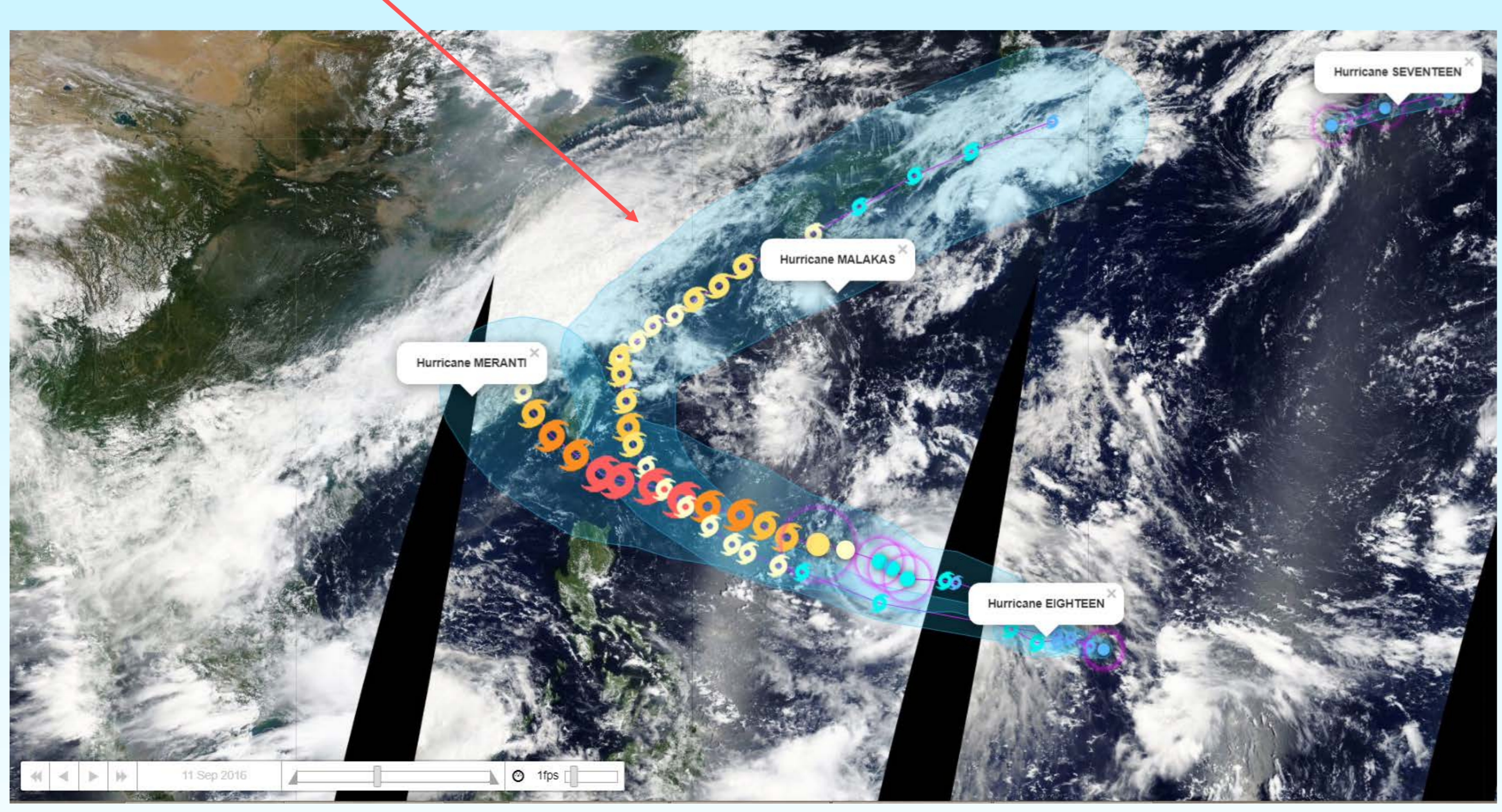
3. A future Ocean Viewer: The SOCD OceanView (OV) mock-up

Basic GIS tools
Map legends
Base map options and utility tools

Data Layer Options with opacity control
Velocity Layer Options with speed control
Event options with magnitude filters

Parameter value on hover
Speed magnitude on hover
Location on hover

Generally speaking, there are three parts to monitoring of geo-spatial datasets: **Visualization, Distribution, and Time-series** (line plots, Hovmöller etc.). To cope up with the need for visualization with zooming (multiple resolution), panning and ocean-event tracking abilities, a future effort will be dedicated for a modern visualization tool. The aim is to aid in easy visualization of the state of the ocean (somewhat analogous to the JPL SOTO and ESA Ocean Virtual Laboratory tools) for multiple geo-physical parameters, along with tracking of extreme events, such as Storms, Tsunamis, Wind-Pattern, El Nino etc. Alongside is a preliminary conceptualization and mock-up of this tool.



4. Summary and Outlook

- This OceanWatch Monitor (OM) is a continuing effort to set a comprehensive monitoring tool for NOAA SOCD CoastWatch/OceanWatch products. The initial list of EDRs include: SST, Salinity, Surface height, Surface winds and Ocean Color. All diagnostics are made available online.
- Currently, products are compared against Level-4 fields and model output. Routine validation against *in situ* data will be undertaken in the future.
- A modern visualization tool is being conceptualized for a year 2021 release or earlier.

References

- P. Dash, S. Baker-Yeboah, V. P. Lance, S. Ramachandran, H Gu, P. DiGiacomo (2018), Towards an enterprise monitor for simultaneous monitoring of multiple ocean parameters: SST, SALINITY, HEIGHT, WIND AND COLOR, The 19th GHRSS Science Team Meeting, 4-8 June, 2018, EUMETSAT HQ, Darmstadt, Germany.
- P. Dash, A. Ignatov, Y. Kihai, J. Sapper (2010), The SST Quality Monitor (SQMAM), J. of Atm. & Oceanic Tech, 27(11), 1899-1917. <https://www.star.nesdis.noaa.gov/sod/sst/squam/>

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