SYNERGISTIC MONITORING OF MULTI-SENSOR AND MULTIPLE OCEAN PARAMETERS: SST, SALINITY, HEIGHT, WIND AND COLOR

Prasanjit Dash[1,2], Paul DiGiacomo[1], Veronica Lance[1,3], Heng Gu[1,4], Michael Soracco[1,4]

[1]NOAA STAR SOCD, College Park, MD, USA
[2]CIRA, Colorado State Univ ; [3]CICS, Univ of MD ; [4]RIVA Solutions, Inc.

National Oceanic and Atmospheric Administration
U.S. Department of Commerce

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 (**EDR**s): 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).

Intra-thematic Capabilities

All diagnostics are available both in the Product Space and in the Comparison Space (difference or ratio wrt. reference fields):
- Maps (raster and interactive)
- Histograms (interactive)
- Time-series (interactive):
  - Line plots
  - Hovmöller

Diagnostics downloadable as ASCII files

Inter-thematic Capabilities

All diagnostics are available both in the Product Space and in the Comparison Space (product '*minus or divided by*' climate):
- 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.

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

Regions of Interest

Maps

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

- 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.

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

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

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.
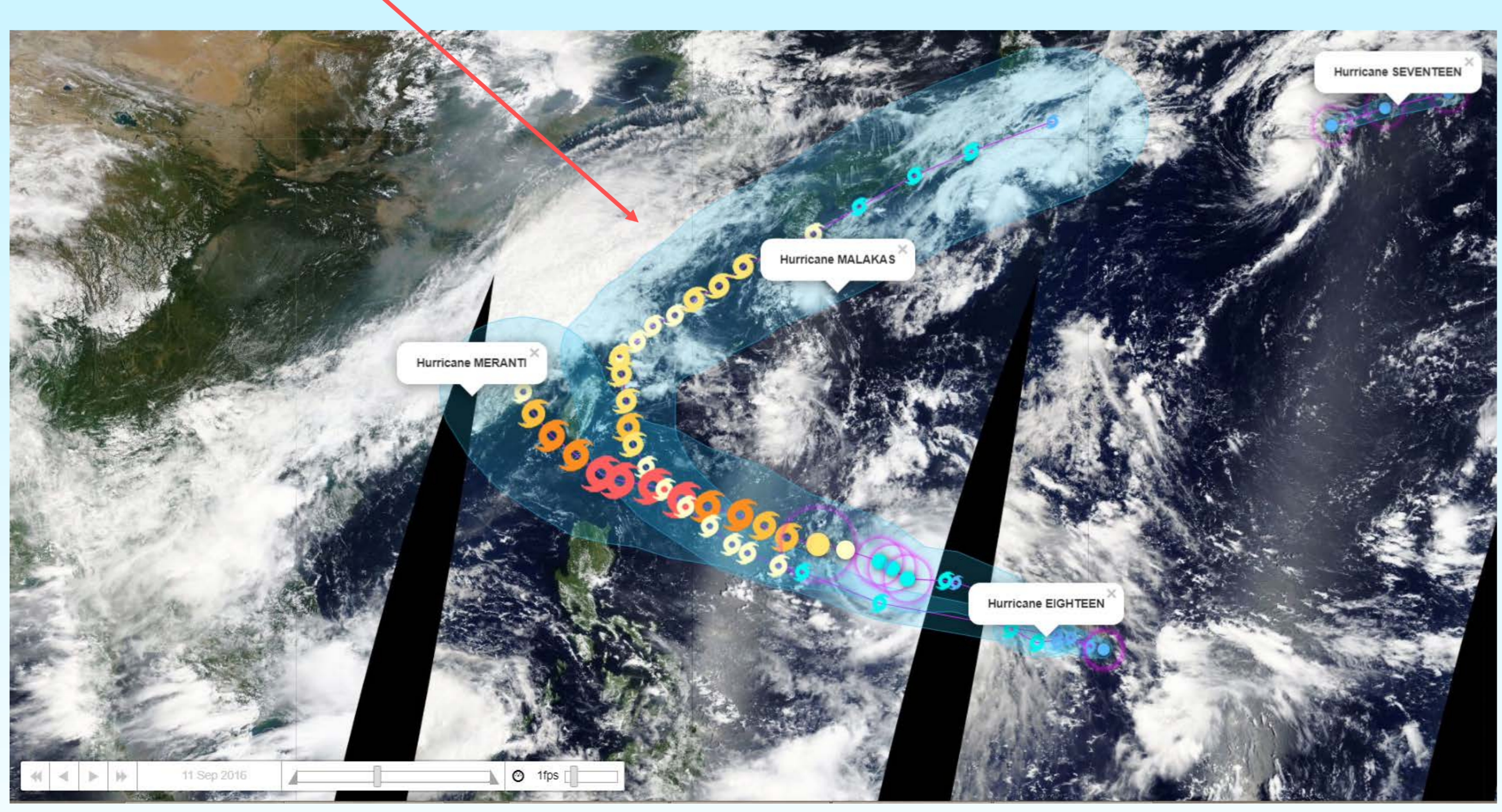
4. Summary and Outlook

- 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 GHRSST Science Team Meeting, 4-8 June, 2018, EUMETSAT HQ, Darmstadt, Germany.

- P. Dash, A. Ignatov, Y. Kihai, J. Sapper (2010), The SST Quality Monitor (SQUAM) , J. of Atm. & Oceanic Tech, 27(11), 1899-1917. https://www.star.nesdis.noaa.gov/sod/sst/squam/

Acknowledgments