2023 OSTST Meeting, November 7-12, 2023, Puerto Rico, USA

Satellite Altimetry Sea Level Height and Related *In Situ* DART® and Tide Gauge Products Stewardship and Comparison Study in NOAA/NESDIS/NCEI

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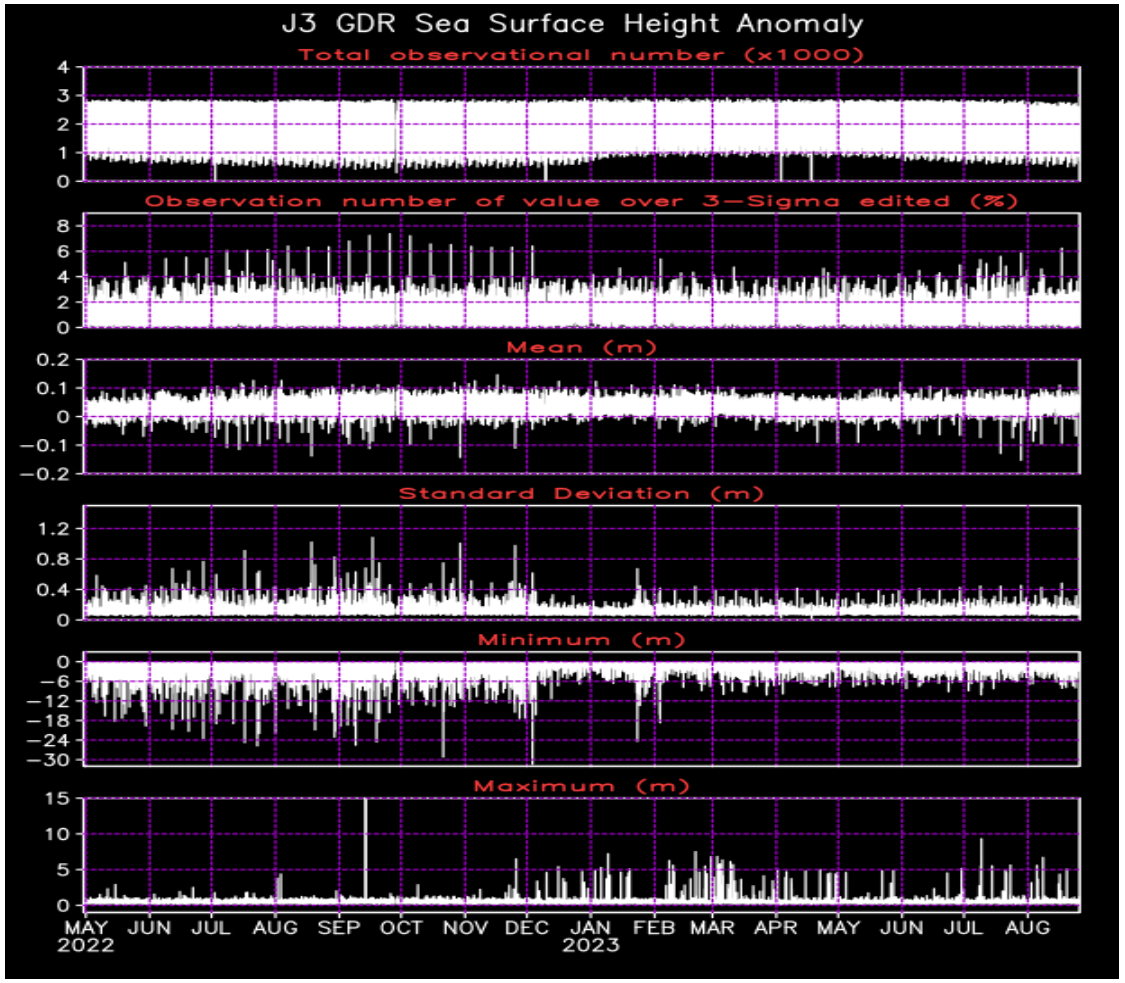
National Centers for Environmental Information (NCEI)

NCEI Jason 2/3 Scientific Data Stewardship

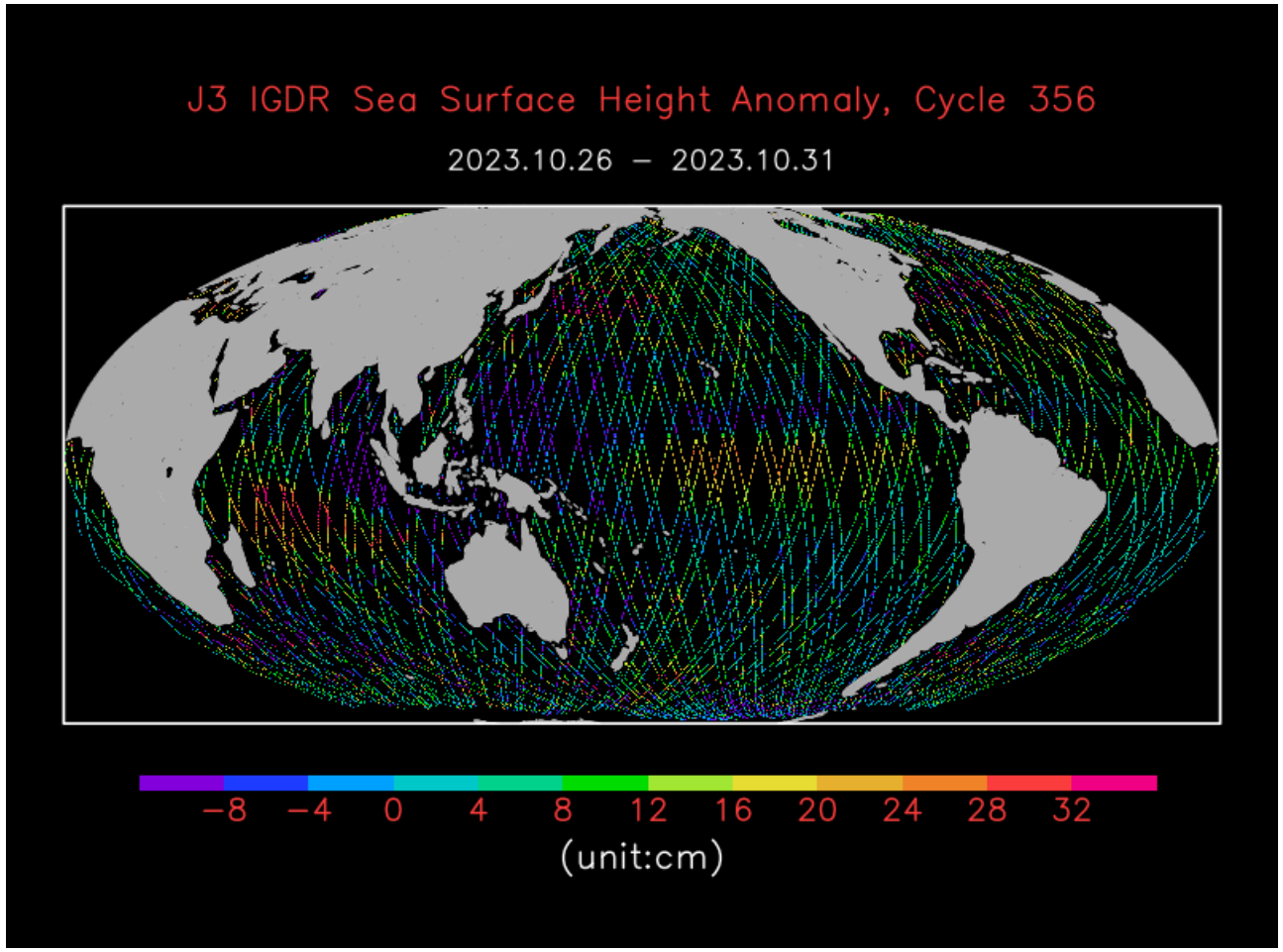
1. NCEI-MD provides NOAA official Scientific Data Stewardship for the OSTM/Jason-2 and Jason-3 products, supporting ingest, archival storage, and basic access to the mission level-2 and related products through the NOAA Comprehensive Large Array-data Stewardship System (CLASS).
2. NCEI-MD instituted a mirror service to provide the public with all level-2 OGDR/IGDR/GDRs through FTP, HTTP, OPeNDAP, and THREDDS servers.
3. NCEI-MD develops tools to enable the automated collection of quality descriptive statistics in each granule in order to monitor the data quality and track the metadata attributes
4. NCEI-MD produces quality-improved binned Level-3 data in real-time from the mission L2 IGDR and GDR and provides them to the public via user-friendly interfaces.
5. NCEI-MD also perform monthly archiving data reconciliation between NOAA CLASS and CNES/SIPAD to ensure both data centers fully archive the mission level-2 and related products.

https://www.ncei.noaa.gov/products/jason-satellite-products

NCEI Data Quality mornitoing on IGDR/GDR



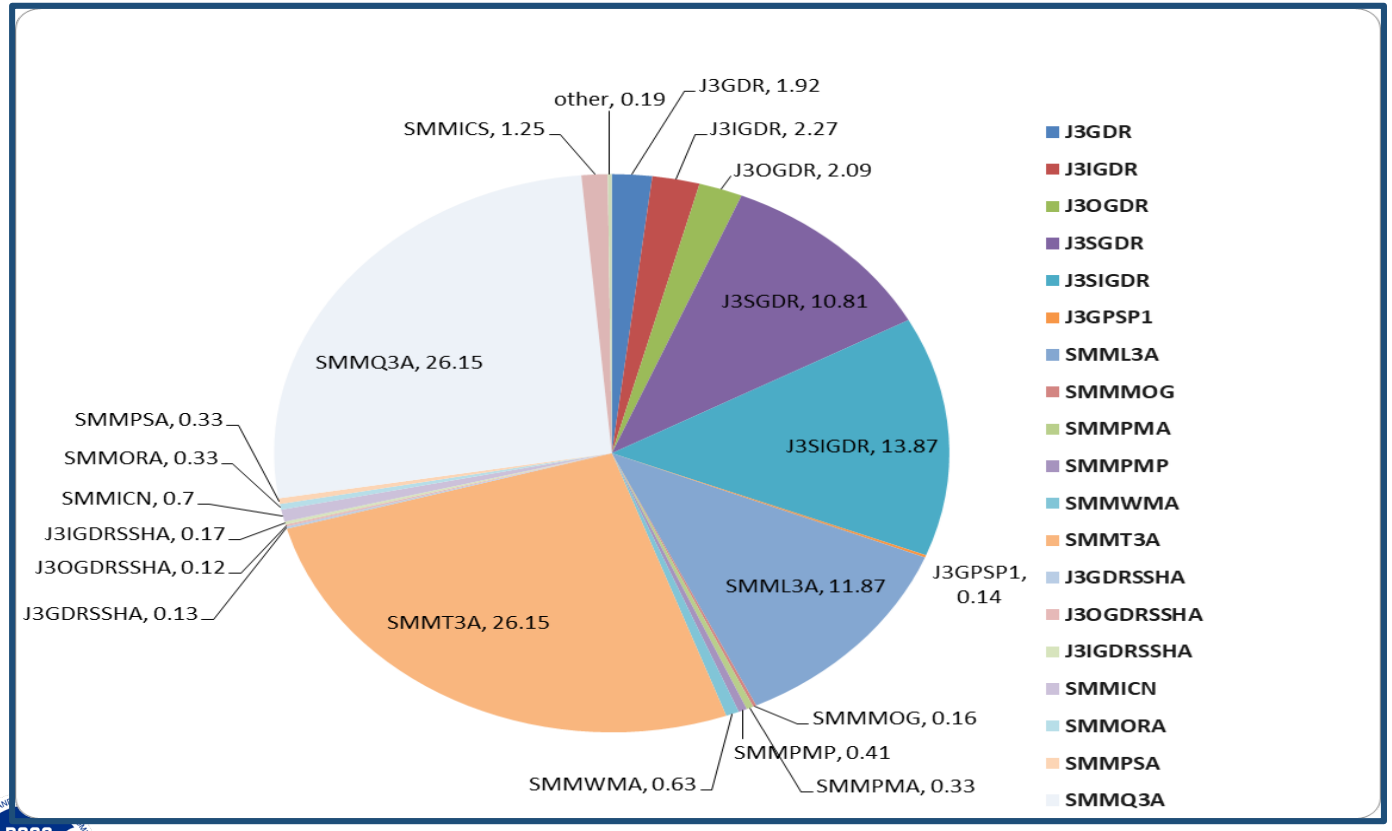
Data Quality Assurance statistics of SSHA in each data file, Jason-3 GDR (Version-F)



Cycle-mean SSH from Jason-3 IGDR (Version-F).

NCEI Jason-3 Archive Annual Report

CLASS Archive files Statistic: Total =1794.01 GB
Period: 2022-03-01 to 2023-02-28



Reconciliation Data File Report
NOAA/CLASS vs SIPAD

FileType	FileMask	CLASS	SIPAD	C-Miss	S-Miss	Check
J3AVE	AJ3_AL1	0	0	0	0	0
PJ3FI1	PJ3_FI1	344	344	0	0	0
PJ3RI1	PJ3_RI1	344	344	0	0	0
J3CH1	PJ3_CH1	0	0	0	0	0
J3ION	JA3_ION	1823	1819	5	4	10
J3MBE	AJ3_ANT	12	11	0	0	2
J3MOE	JA3_POR_AXV	365	363	0	0	9
J3ORF	JA3_ORF	351	115	0	0	2
J3OS1	JA3_OS1	362	119	0	0	3
J3POE	JA3_VOR	387	387	0	0	0
J3PPF	JA3_PPF_AXV	365	363	0	0	3
J3VPF	JA3_VPF	387	385	0	0	3
SMMAPP	SMM_APP	1825	1819	6	2	6
SMMPMP	SMM_PMP	1825	1819	5	0	5
SMMPRP	SMM_PRP	1825	1819	5	0	5
SMMUWP	SMM_UWP	1825	1819	5	0	5
SMMVWP	SMM_VWP	1825	1819	5	0	5
SMMWEP	SMM_WEP	1825	1819	5	0	5
SMMDOR	SMM_DOR	0	0	0	0	0
SMML3A	SMM_L3A	878	0	0	0	0
SMMQ4A	SMM_Q3A	858	0	0	0	0
SMMMOG	SMM_MOG_AXV	1460	1452	0	0	0
SMMPMA	SMM_PMA	1462	1454	0	0	0
SMMPMP	SMM_PMP	1825	1820	0	0	0
SMMT3A	SMM_T3A	858	0	0	0	0
SMMWMA	SMM_WMA	380	0	0	0	0
SMMICN	SMM_ICN	873	0	0	0	0
SMMICS	SMM_ICS	3204	0	0	0	0
SMMORA	SMM_ORA	1473	0	0	0	0
SMMSST	SMM_SST	376	0	0	0	0
SMMVPSA	SMM_PSA	1469	0	0	0	0
J3GDR	JA3_GPN	50471	8226	0	0	0
J3GDRSSHA	JA3_GPR	50471	8226	0	0	0
J3IGDR	JA3_IPN	8876	8872	16	0	28
J3IGDRSSHA	JA3_IPR	8876	8872	16	0	28
J3OGDR	JA3_OPN	4261	4271	5	2	6
J3OGDRSSHA	JA3_OPR	4261	4471	5	2	6
J3SGDR	JA3_GPS_	54891	12629	0	0	0
J3SIGDR	JA3_IPS	8876	8872	16	0	28
J3GPSP1	JA3_GPSP1	4420	4403	4	0	22
TOTALS 2022-03-01 to 2023-02-28		226209	88532	98	10	181
Percent missing				0.043%	0.11%	

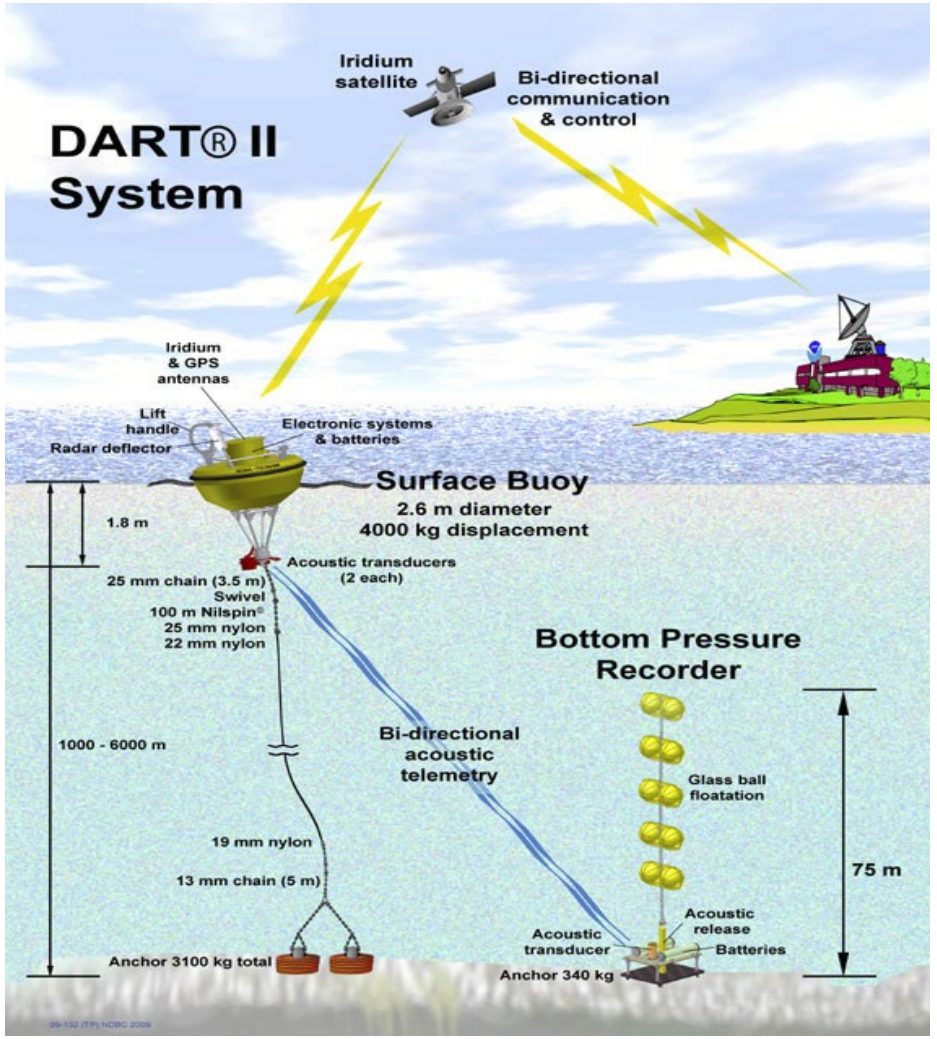
In Situ DART® and Tide Gauge Products Stewardship

The NCEI-CO hosts an archive of high-resolution water-level data as part of the US National Tsunami Hazards Mitigation Program (NTHMP).

- NOAA/NWS Deep-ocean Assessment and Reporting of Tsunamis (DART®) records from more than 300 deployments at 39 US and several international stations covering a period for 20+ years,

- 240+ high-resolution tide gauge records from NOAA "tsunami-ready" network maintained by the NOAA/NOS Center for Operational Oceanographic Products and Services (CO-OPS) mostly starting from 2008,

- 30+ high-resolution water level data from the regional networks of the Pacific Tsunami Warning Center (PTWC), and the National Tsunami Warning Center (NTWC) for the recent 10 years.

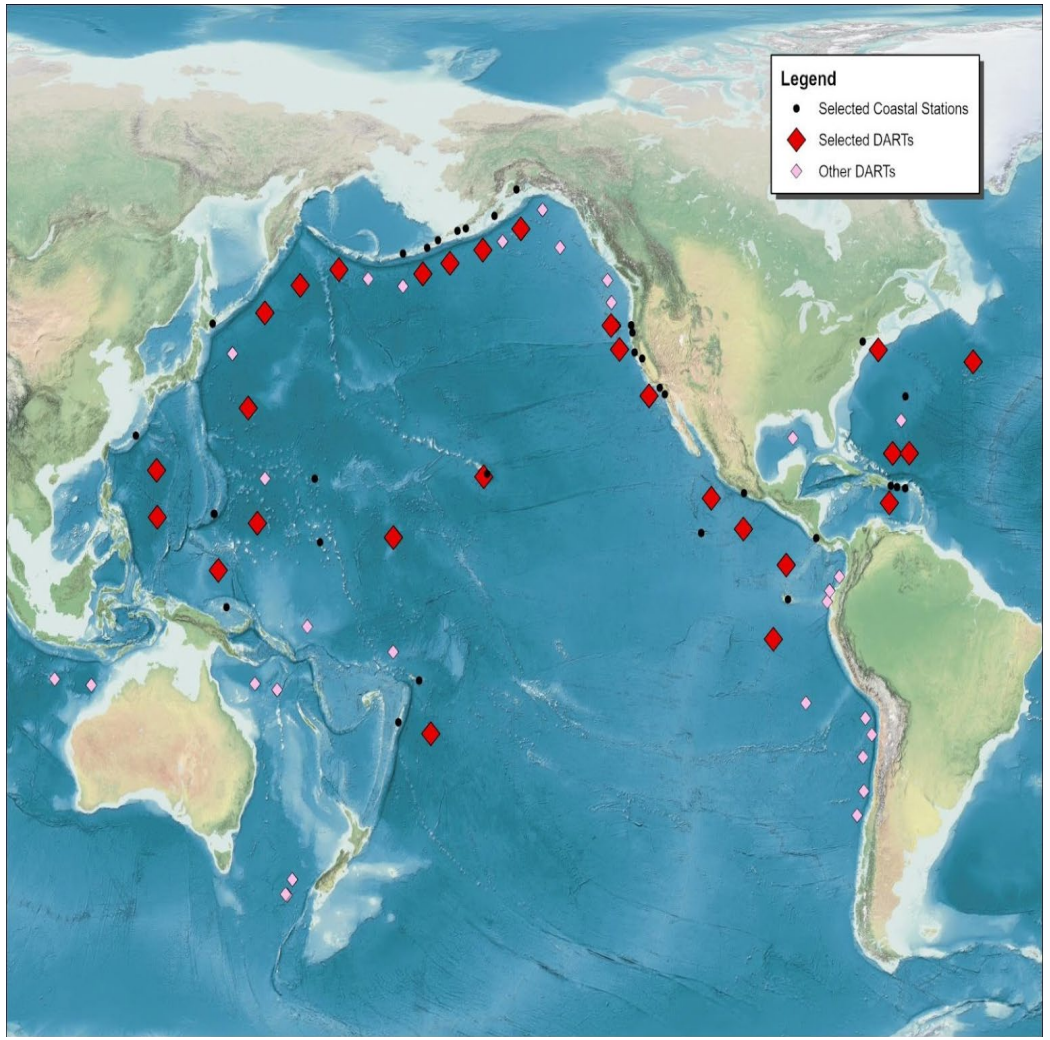


https://www.ngdc.noaa.gov/hazard/DARTData.shtml

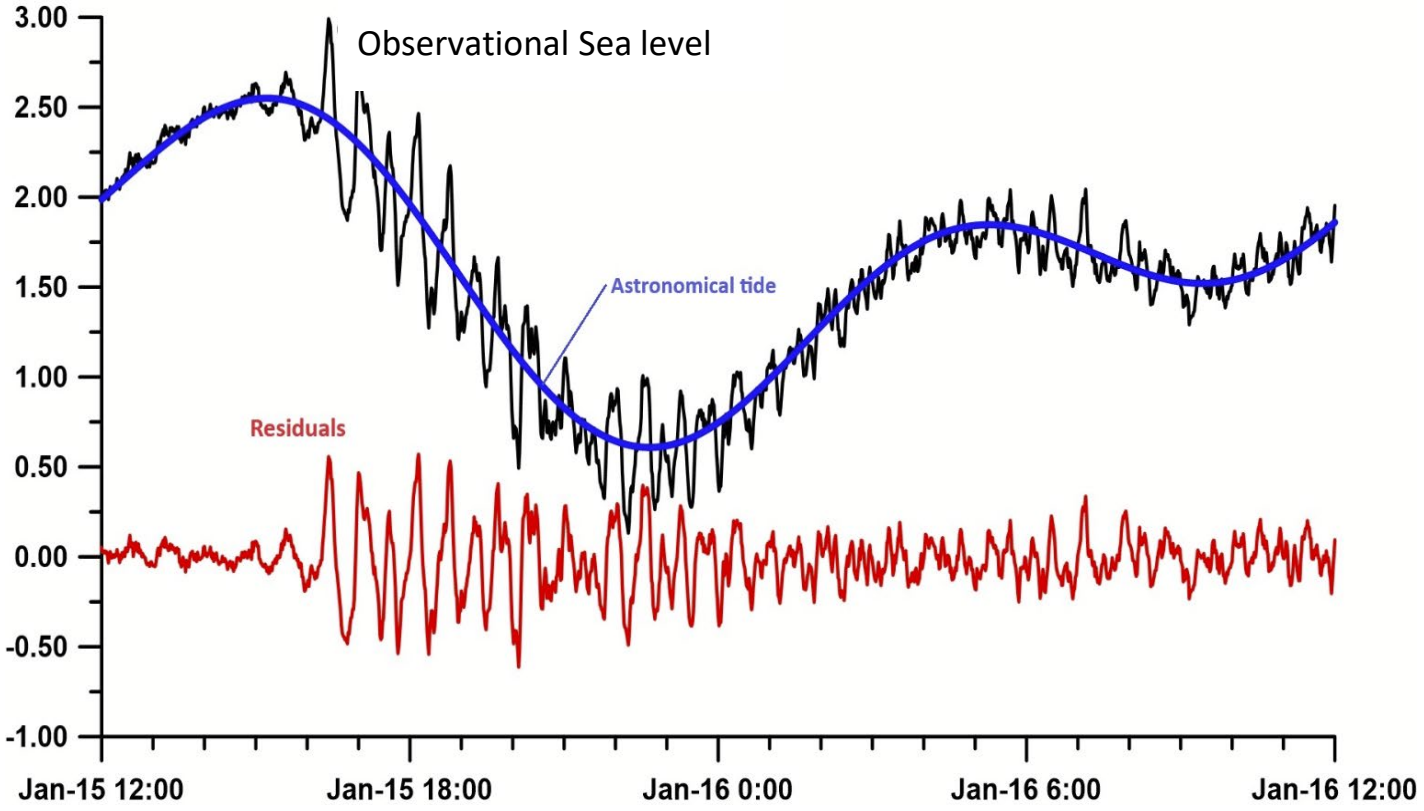
https://www.ngdc.noaa.gov/hazard/tide.shtml

Comparison between satellite altimeter and DART® bottom pressure & coastal tide gauge data

- **Satellite Data**
  - **Multi-satellite daily merged sea surface height anomalies (SSHA)**, picked from the NOAA/STAR/SLA 0.25-degree gridded optimal interpolated daily sea level anomalies, obtained from all available satellite missions.
- **In Situ Data**
  - **28 DART® stations** in the Pacific and Atlantic, the Gulf of Mexico, and the Caribbean Sea.
  - **38 coastal and island tide gauge records** from the NOAA CO-OPS network, from the UH Sea Level Center (UHSLC), and UNESCO IOC Sea Level Station Monitoring Facility.



Residuals: Difference between the observations and the astronomical tidal component

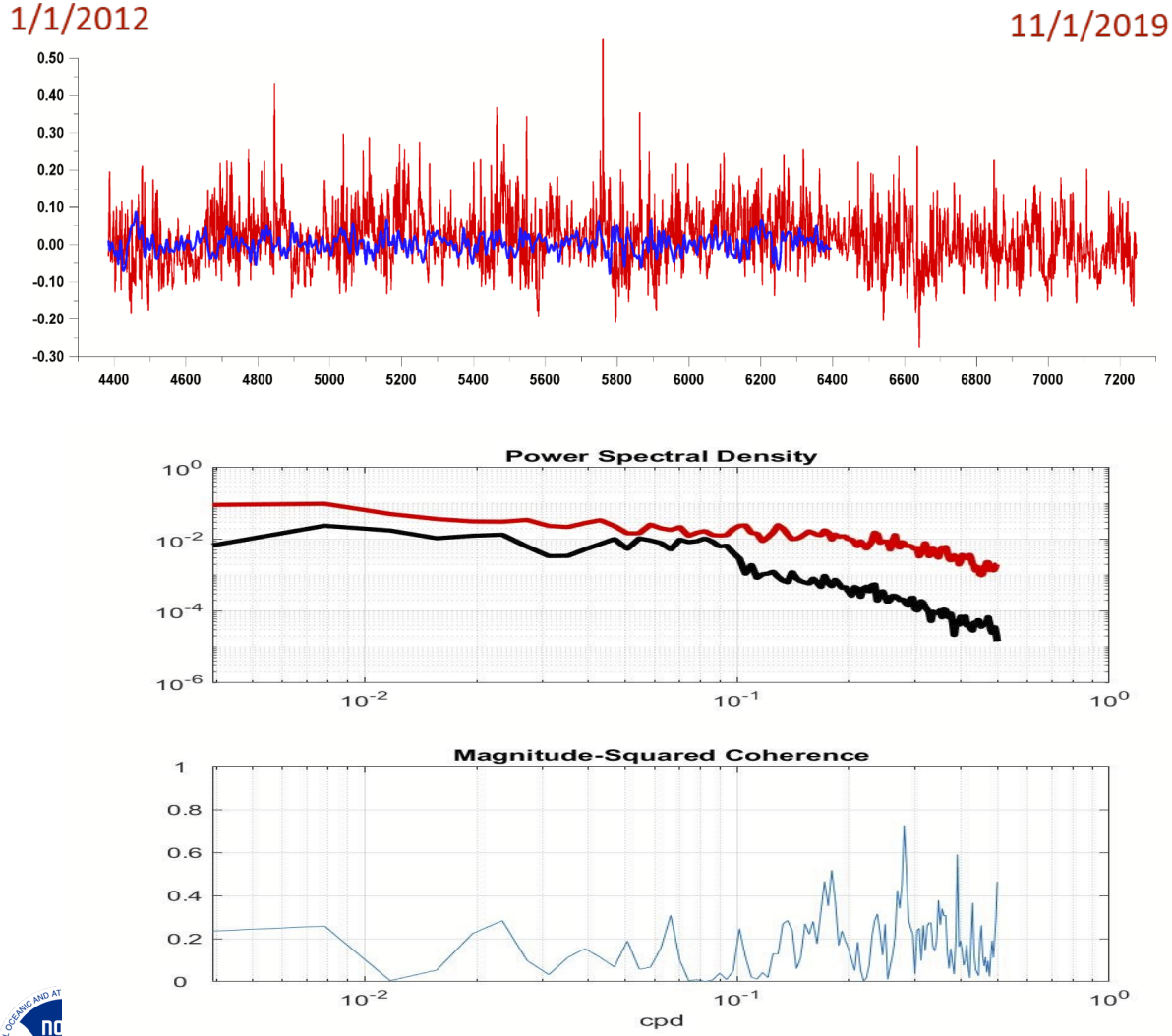


Arrival of the tsunami wave generated by Tonga volcano eruption on 2022-01-15 at Santa Monica, California

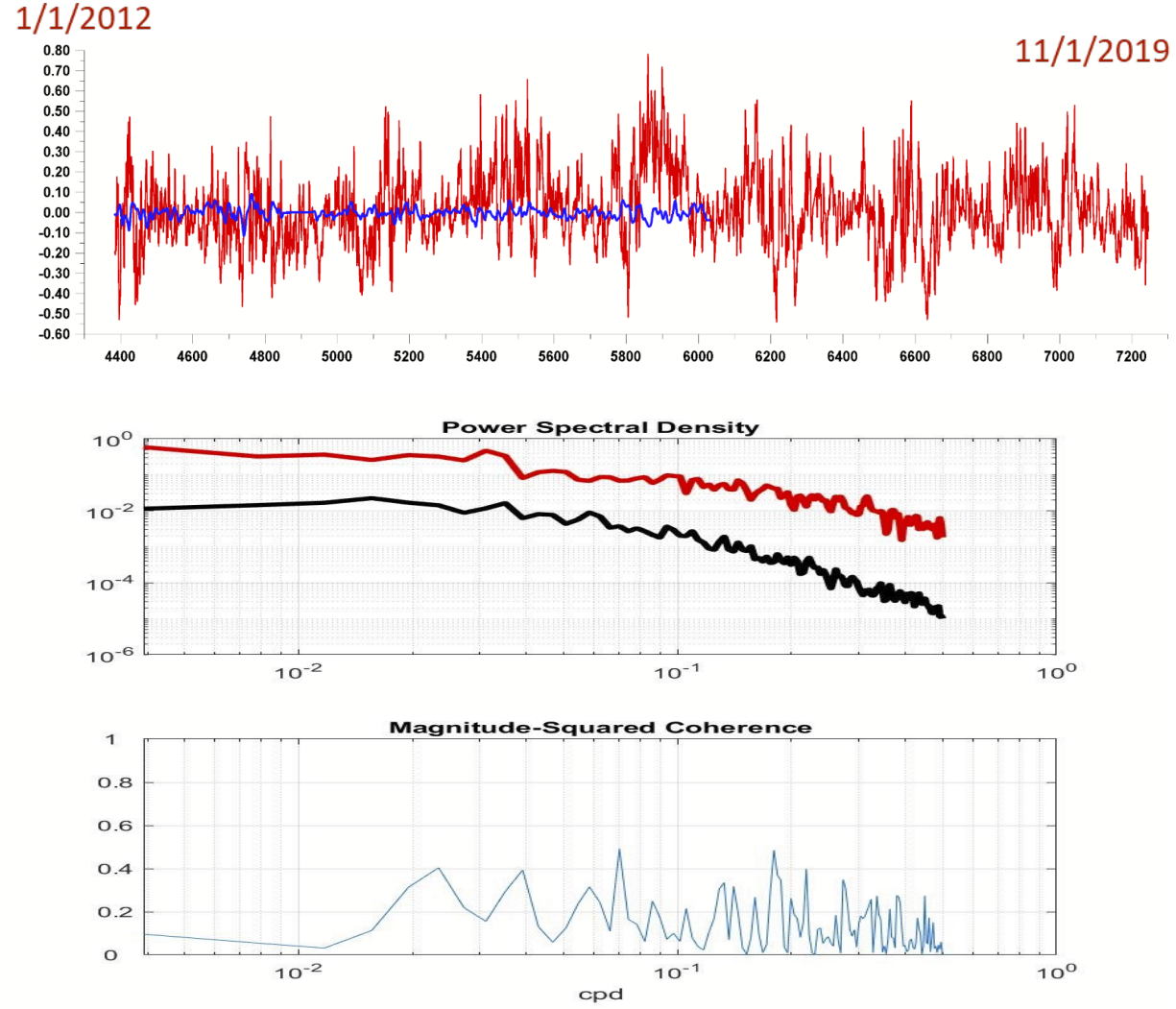
The sequence of processing the DART® data: bottom pressure data (BPD) in psi is converted to water heights, quality controlled, detided, and used as a daily mean "**residuals**" to match the relevant SSHA and the observations at the tide gauges. All DART® water height and tide gauge sea level data are processed at the same way.

Comparison between DART and Coastal Station Data in areas with strong atmospheric dynamics

Northwest Pacific, DART ® 21419, Kushiro, Japan



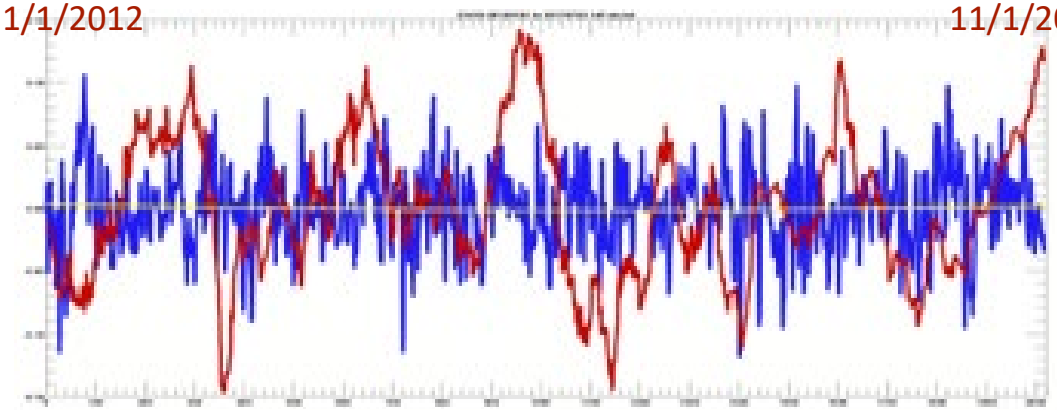
North Pacific, DART ® 46403 (off the Aleutians Islands), King Cove, AK

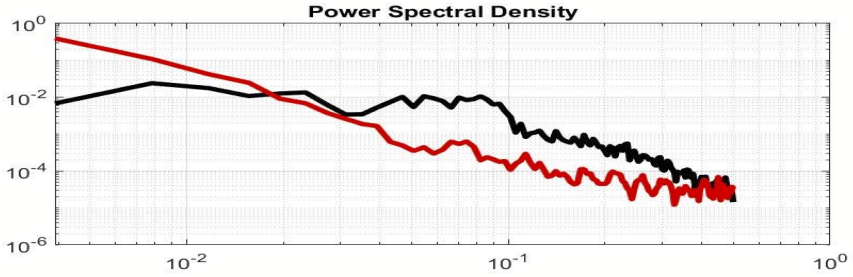


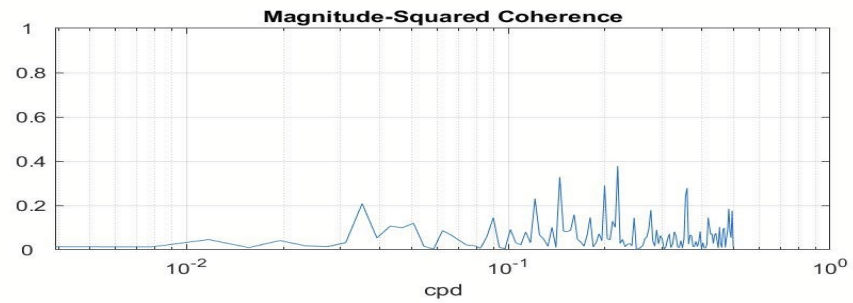
Comparison between DART and altimeter data in areas with strong atmospheric dynamics

Northwest Pacific: DART ® 21415 (off the coasts of Japan)

1/1/2012 11/1/2019

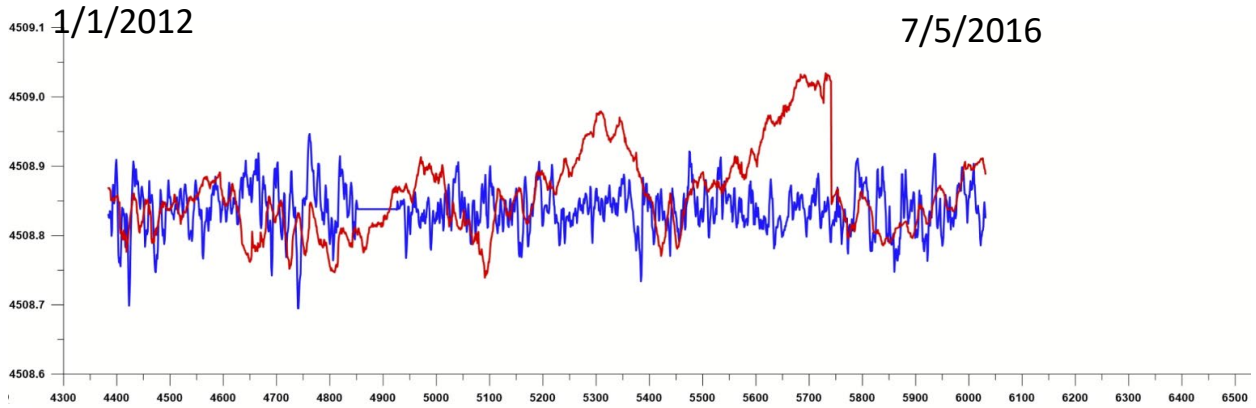


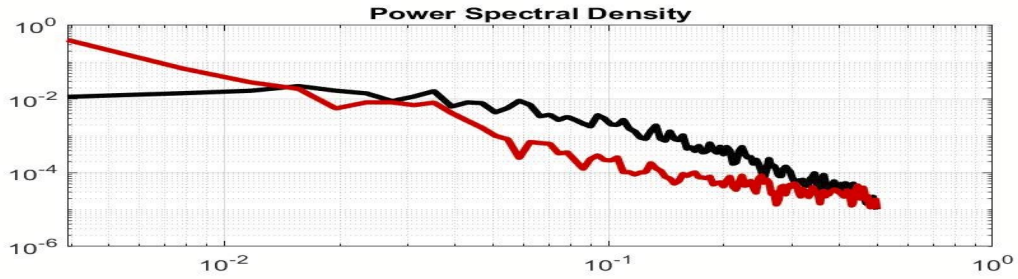


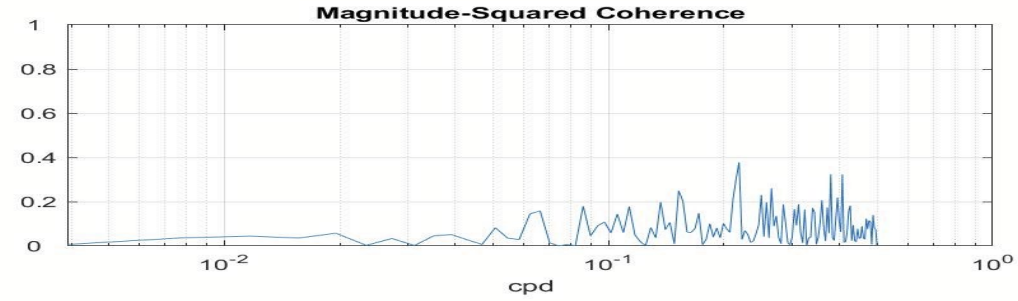


North Pacific, DART ® 46403 (off the Aleutians Islands)

1/1/2012 7/5/2016

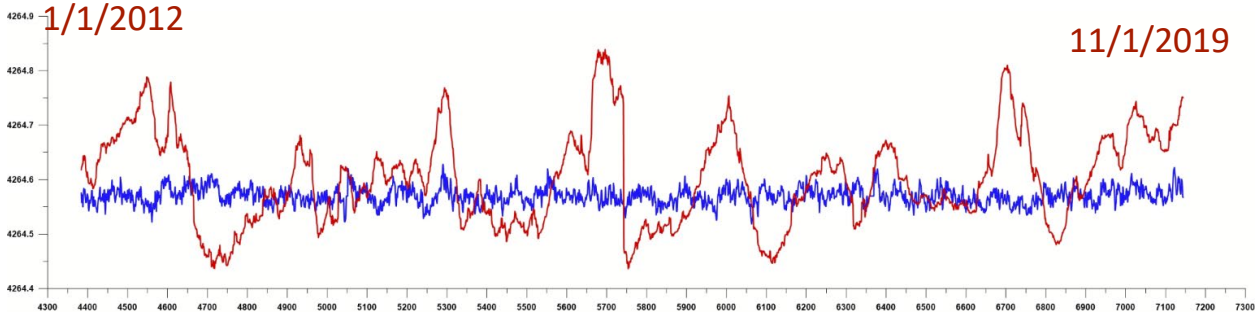


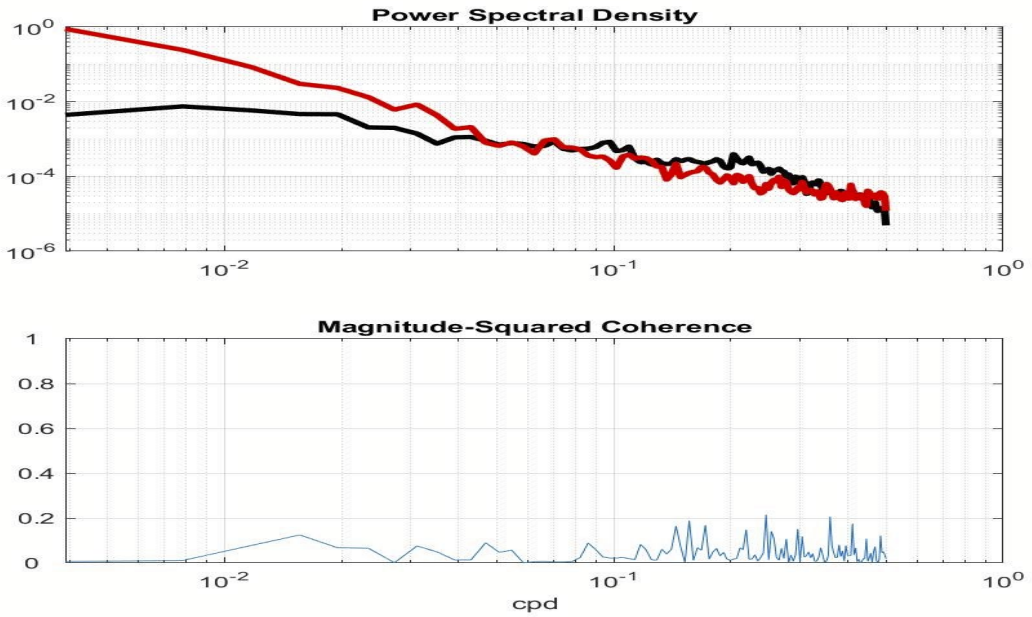




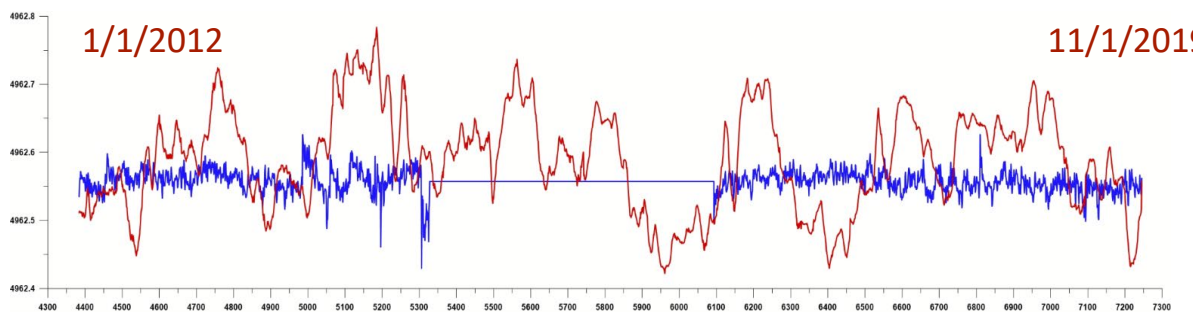
Time series, power spectra, and coherences between DART and altimeter data in areas with low atmospheric dynamics

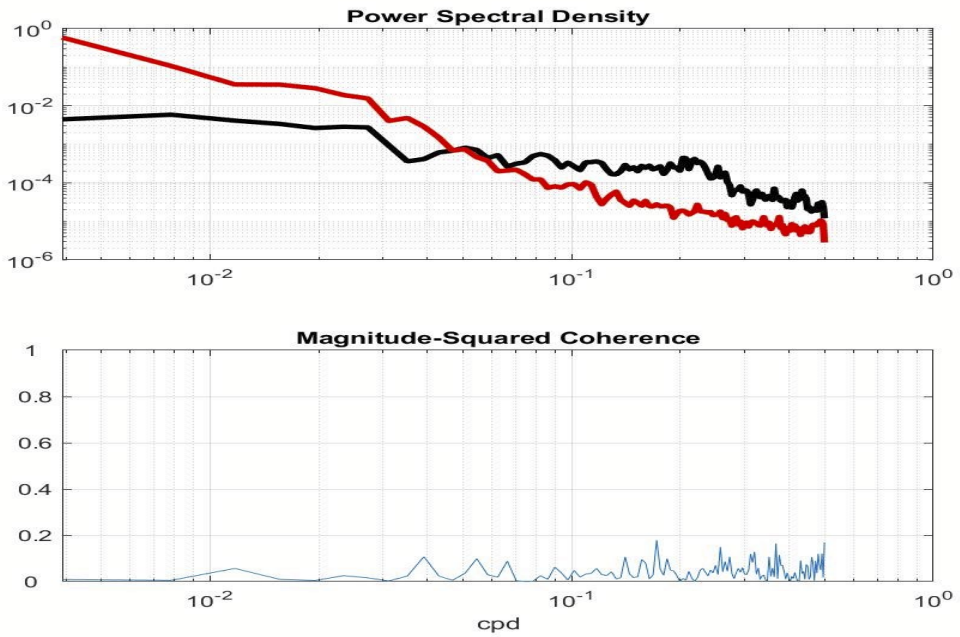
Central Pacific, DART 46411 (150 NM W of Mendocino Bay, CA)





East Pacific, DART 51425 (370 NM NW of Apia, Samoa)

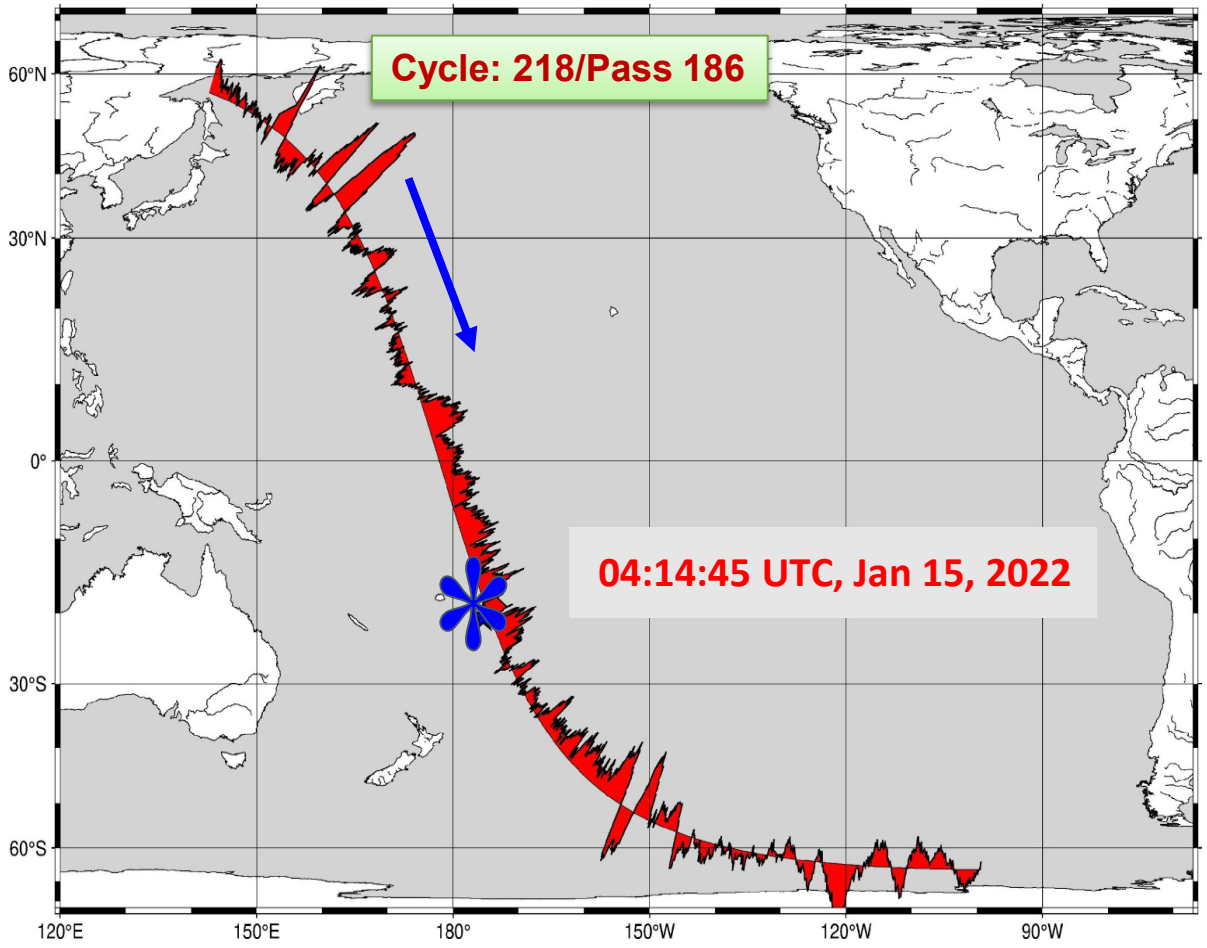




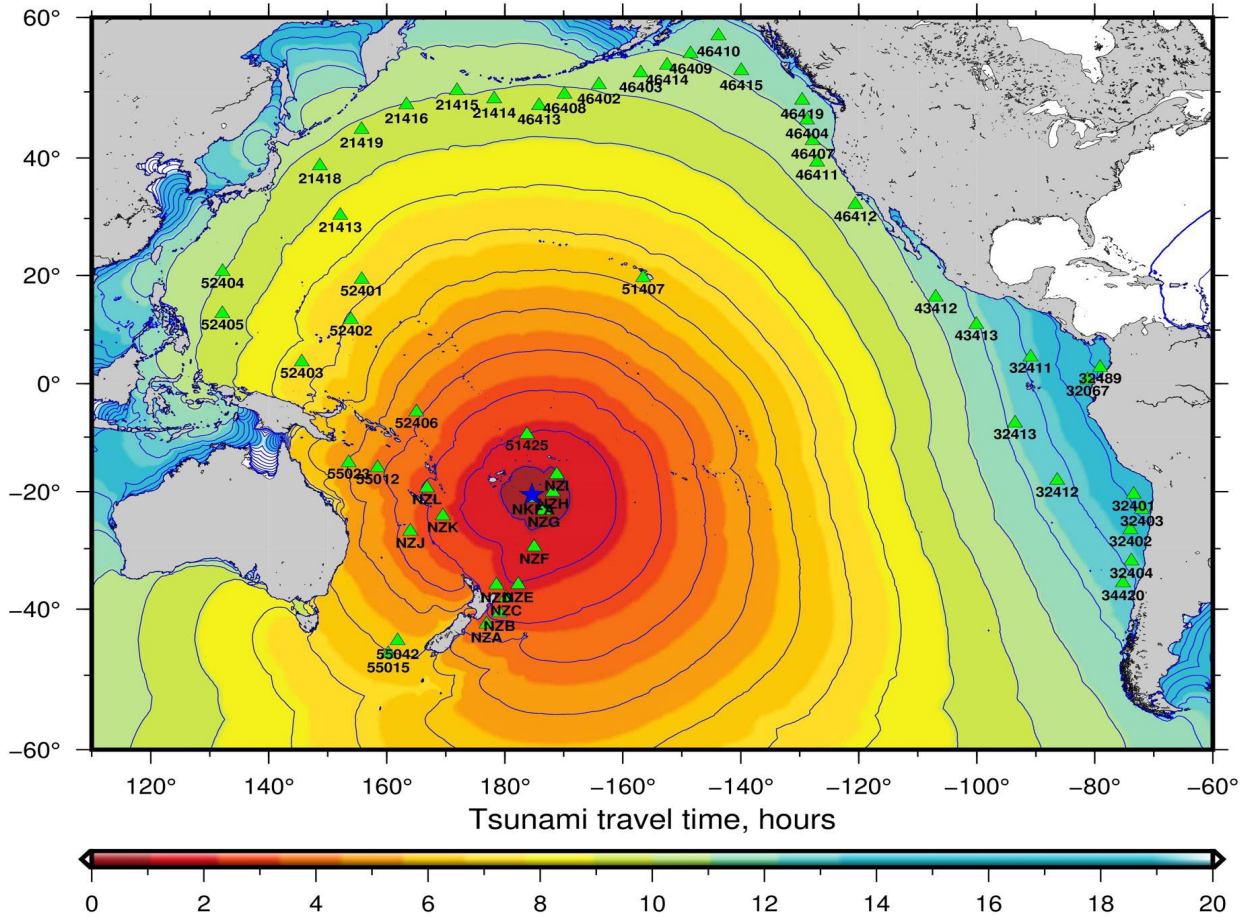
Conclusions

- The DART® SSHA agree with the altimeter SSHA and coastal or island tide gauge records in regions with **strong winds with a significant periods within 2 to 10 days during passing cyclones.**
- These regions include the **North Pacific Ocean** along Japan, the Aleutian Islands and Alaska, the Hawaii Islands, the **North West Atlantic** along the US East Coast, and the Caribbean Basin.
- Also in these regions DART® variations tend to display the variations of **open-ocean water level** with a frequency band less than 24 hours.
- For long-period variations, **DART® does not record the long-period variations more than 10 to 15 days** due to the plastic deformations of the alloy containers with the BPR sensors on the ocean floor.

Tracking Tonga Tsunami Wave with Modelling and Jason3 SSHA

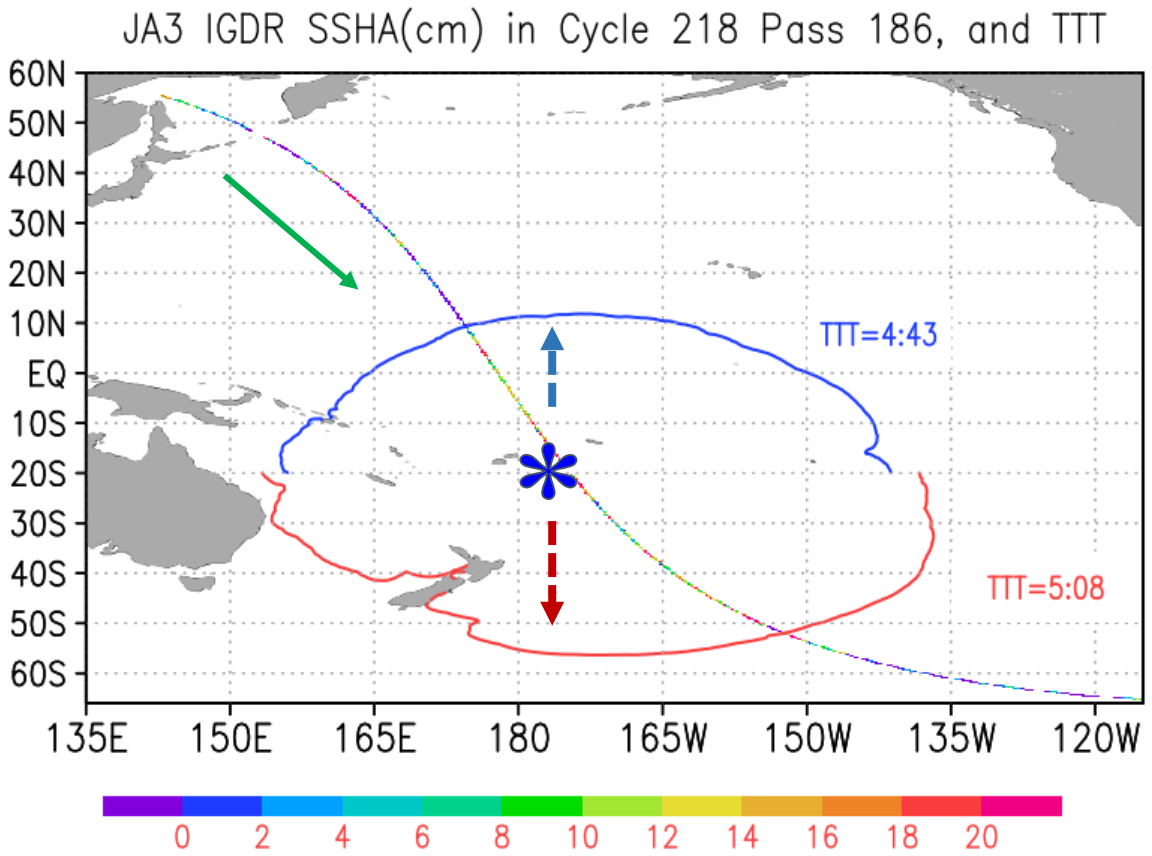


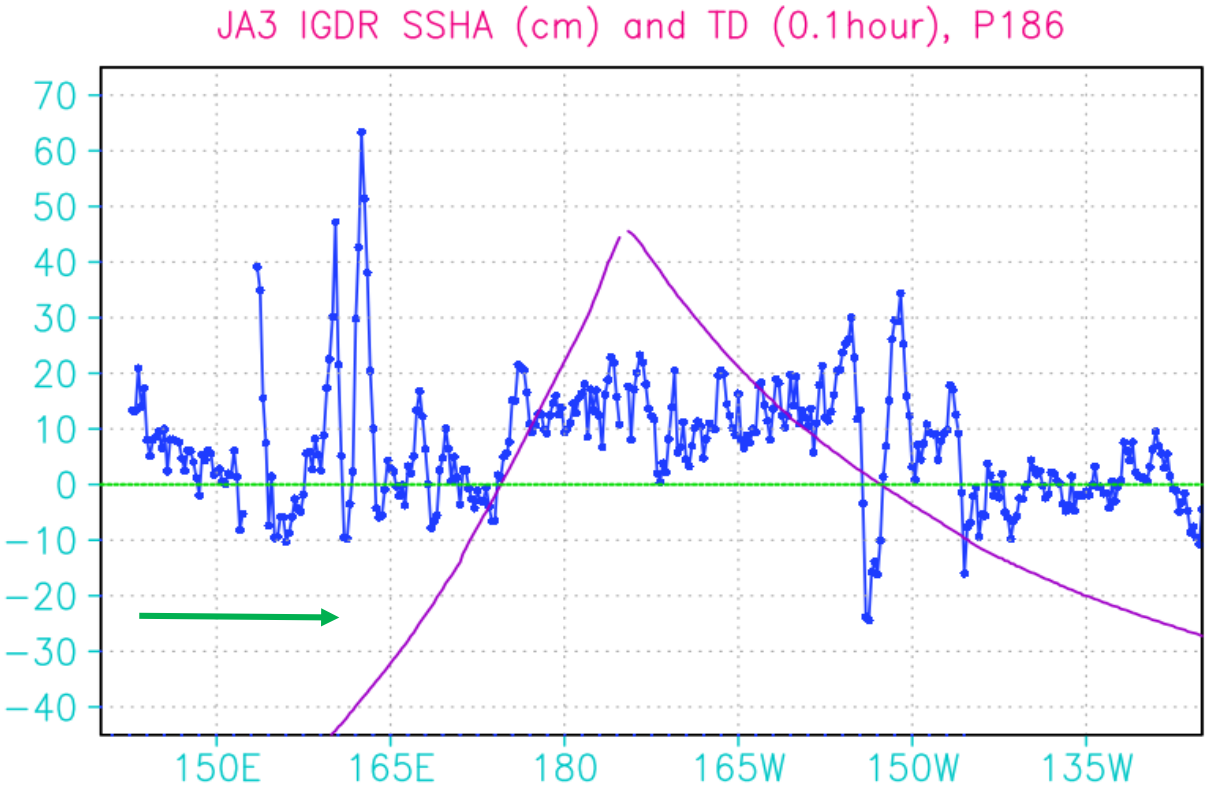
Jason-3 IGDR SSHA for cycle 218 and pass 186
Time Period: 2022.01.15: 08:28m – 09:24 UTC



DART stations (green triangles) and theoretical tsunami (long wave) travel time (TTT) map. (Source: Gusman, A.R. and Roger, J., GNS Science and NCEI/OGSSD/GSB)

Tracking Tonga Tsunami Wave





Jason-3 IGDR SSHA and TTT contours at and 5h08m. 4h43m

Y: Time Difference between Jason3 IGDR time and TTT (0.1 hour) & IGDR SLA values (cm).
X: longitude

Contact

- Yongsheng.Zhang@noaa.gov - Tonga Tsunami Wave Tracking
- George.Mungov@noaa.gov – Comparison among altimeter, DART® bottom pressure, and coastal tide gauge data

Acknowledgements

- NOAA/NESDIS/STAR/SLA: Level-3 SSHA data.
- NOAA/PMEL and NOAA/NDBC: DART® network.
- NOAA/NOS/CO-OPS: tsunami-ready tide gauges data.
- UHSLC – UH Sea Level Center and the UNESCO IOC Sea Level Station Monitoring Facility.
- UNAM, Mexico: Acapulco tide gauge data.
- HOM, Brest, France: Clipperton Island tide gauge data.
- New Zealand GNS Science (Gusman, A.R. & Roger, J.): tsunami travel time (TTT) map based on Geoware software.