

NOAA NCEI's Sea Surface Temperature Portfolio: Foundational Data Sets for Environmental Applications

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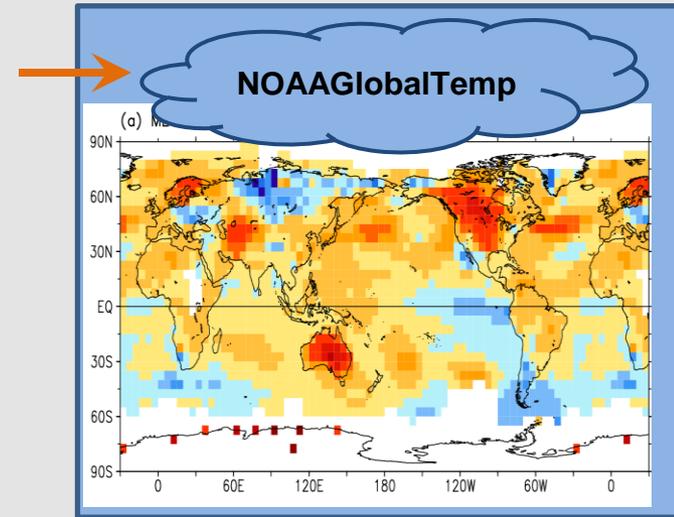
June 06, 2016

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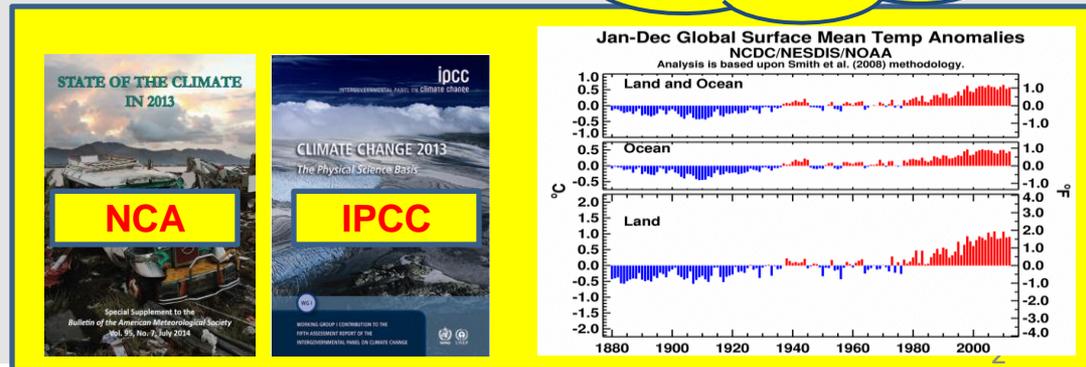


Introduction

- NCEI stewards foundational datasets that serve as the backbones of earth and space science applications
- NCEI's SST portfolio is part of NOAA/NCEI's Global Surface Temperature portfolio
- NCEI's SST portfolio encompasses all of our tiers of stewardship, from basic data archive and preservation to developing quality controlled datasets and authoritative data products
- NCEI works with partners across NOAA and the federal government, as well as with international communities



Use Example:
Climate Monitoring
& Assessments





NCEI's SST Datasets

in situ Datasets

- International Comprehensive Ocean Atmosphere Data Set (ICOADS); monthly and gridded
- Extended Reconstructed Sea Surface Temperature (ERSST)
- World Ocean Database (WOD)
- World Ocean Atlas (WOA)
- Ocean Heat Content (OHC)
- Global Temperature and Salinity Profile Database (GTSP)

Satellite Datasets

- Pathfinder SST
- Coral Reef Temperature Anomaly Database (CoRTAD)
- GHRSSST Long-term Stewardship and Reanalysis Facility (LTSRF)

Blended Datasets

- Optimally Interpolated SST (OISST)

NCEI continues our involvement in GHRSSST as an RDAC for OISST and Pathfinder, and as the LTSRF.



SST Data Processing Levels: satellite and in situ

Level 4+: Additional value-added analysis applied (e.g., CoRTAD, Ocean Heat Content)

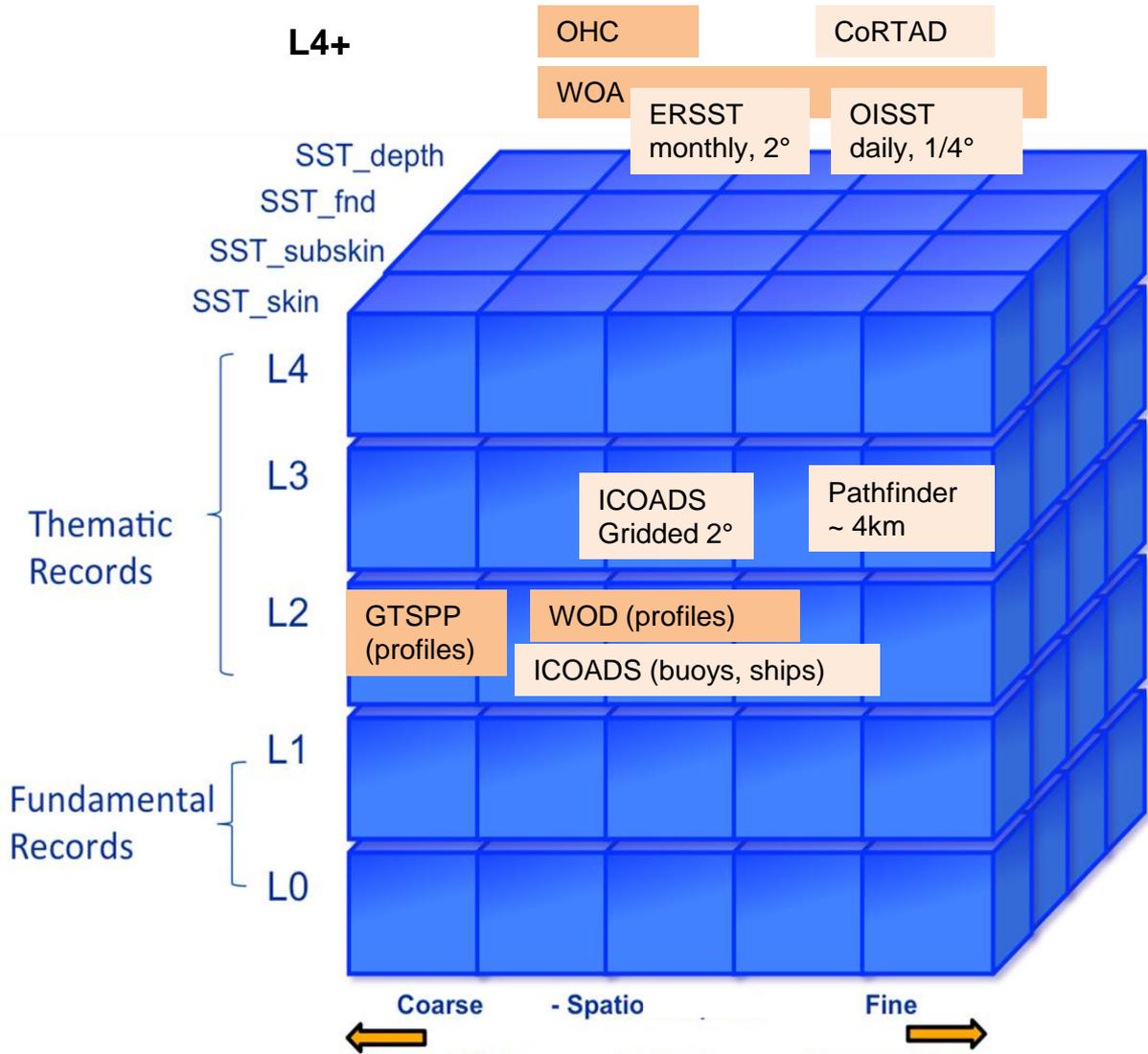
Level 4 (L4): Gridded and gap-free (e.g., AVHRR_OI or WOA)

Level 3 (L3): Gridded, but may contain gaps (e.g., Pathfinder V5.2 Level 3C, ICOADS Monthly gridded summaries)

Level 2 (L2): Geophysical variables derived from Level 1 source data at the same resolution and location as the Level 1 data (e.g., GHRSSST L2P products, ICOADS IMMA, probably most in situ SST data in the NCEI-MD archive)

Level 1 (L1): Original sensor observations prior to conversion to geophysical units (e.g., AVHRR L1B data stored in CLASS)

NCEI's Datasets in SST Cube's spatial domain

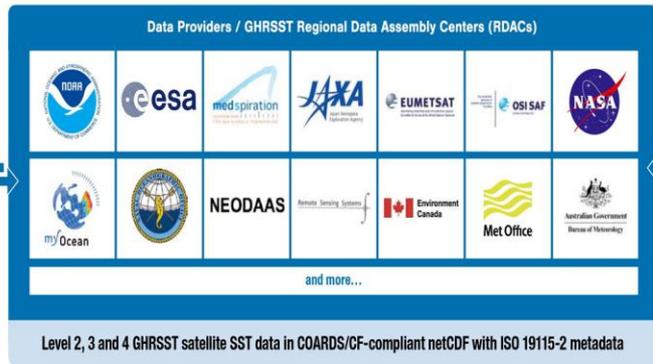


SST Products needed across several dimensions:

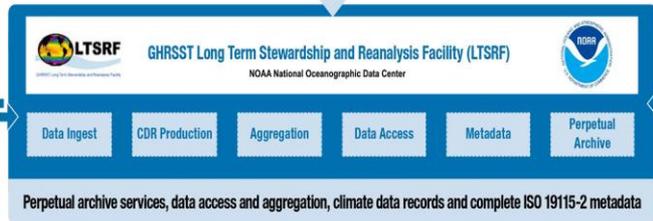
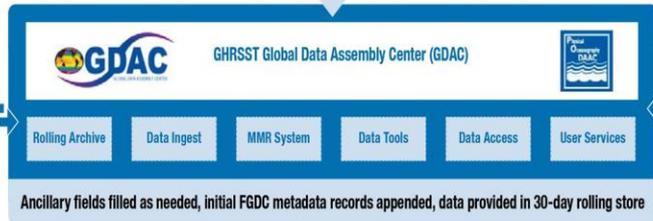
1. SST type
2. Processing Level
3. Space-time resolution
4. Latency

NCEI's GHRSSST LTSRF

Interoperable user access via OPeNDAP, TDS WCS, FTP...



User requirements, services and feedback at all levels...



- All "official" data flow from RDAC to GDAC to LTSRF
- Data is accessible at all levels
- LTSRF publishes collection metadata to CEOS IDN, and supports CWIC granule searches via CSW and OpenSearch

NCEI GHRSSST Table

Data Access is Here!

HTTP: <http://data.nodc.noaa.gov/ghrsst/>
 FTP: <ftp://ftp.nodc.noaa.gov/pub/data/nodc/ghrsst/>
 OPeNDAP: <http://data.nodc.noaa.gov/opendap/ghrsst/>
 TDS: <http://data.nodc.noaa.gov/tds/ghrsst/>

• **NODC Geoportal:** <http://data.nodc.noaa.gov/geoportal/> - You may use NODC's Geoportal to search the NODC Ocean Archives for GHRSSST data using criteria such as date, collecting institution (the RDAC that created the data), and geographic domain. To limit your searches to only GHRSSST data, be sure to select "Contributing project" as one of your search criteria, and then select "GHRSSST" from the menu.

• **NODC Ocean Archive System:** <http://com.nodc.noaa.gov/OceanArchive/> - You may search NODC's Ocean Archive System for GHRSSST data using criteria such as date, collecting institution (the RDAC that created the data), and geographic domain. To limit your searches to only GHRSSST data, be sure to select "Contributing project" as one of your search criteria, and then select "GHRSSST" from the menu.

• **NODC Live Access Server:** <http://data.nodc.noaa.gov/live/> - Use the Live Access Server to search dynamically in time and space through NODC data products. To access GHRSSST data, click the "Choose dataset" button at the top left of the browser window, click on GHRSSST aggregations, and select a GHRSSST product. Currently only GHRSSST data products are available through the Live Access Server.

For a simple tutorial on accessing GHRSSST data from the LTSRF or GDAC, try the GHRSSST Data Access Tutorial in PDF (L2-L4) or PDF (L5-L6) formats.

RDAC	Product	Product Level	Start Date	End Date	GDS Version	Grid / Pixel Resolution	GHRSSST Products in the LTSRF			Access	Disk Volume - Number of Days - Number of Files
							Details	Granule Search	Live Access		
ARCH	GAMSEA_30mv_GLOB	L4	2008-08-24	2014-04-17	1.5	20 km	Details	Granule Search	Live Access	FTP HTTP OPeNDAP TDS	2.7GB - 2785 days - 2785 files
		L4	2008-04-24	2014-04-17	1.5	0 km	Details	Granule Search	Live Access	FTP HTTP OPeNDAP TDS	4.6GB - 2911 days - 2915 files
CHC	CHCO_3day_GLOB	L4	1998-06-26	2014-04-20	2.0	0.25°	Details	Granule Search	Live Access	FTP HTTP OPeNDAP TDS	15.0GB - 6957 days - 7232 files
		L4	2013-12-26	2014-04-20	2.0	0.08°	Details	Granule Search	Live Access	FTP HTTP OPeNDAP TDS	54.1GB - 371 days - 373 files
DHI	DHI_OI_GLOB	L4	2007-06-31	2014-03-30	1.5	3 km	Details	Granule Search	Live Access	FTP HTTP OPeNDAP TDS	1.6GB - 3161 days - 3161 files
		L4	2004-12-04	2009-02-15	1.5	25 km	Details	Granule Search	Live Access	FTP HTTP OPeNDAP TDS	3.0GB - 744 days - 8905 files
HUR	ATS_HR_3P	L3P	2004-12-19	2009-09-15	1.5	1 km	Details	Granule Search	Live Access	FTP HTTP OPeNDAP TDS	315.4GB - 1643 days - 22603 files
		L3P	2004-12-19	2006-09-15	1.5	8.0 km	Details	Granule Search	Live Access	FTP HTTP OPeNDAP TDS	0.6GB - 540 days - 7569 files
AVHRR14_L	AVHRR14_L	L3P	2004-12-30	2005-10-14	1.5	2.2 km	Details	Granule Search	Live Access	FTP HTTP OPeNDAP TDS	0.1GB - 241 days - 1031 files
		L3P	2004-12-30	2007-02-15	1.5	8.0 km	Details	Granule Search	Live Access	FTP HTTP OPeNDAP TDS	0.8GB - 730 days - 9786 files
AVHRR17_L	AVHRR17_L	L3P	2004-12-30	2007-02-15	1.5	2.2 km	Details	Granule Search	Live Access	FTP HTTP OPeNDAP TDS	0.5GB - 687 days - 3126 files
		L3P	2004-12-30	2013-07-15	1.5	1.1 km	Details	Granule Search	Live Access	FTP HTTP OPeNDAP TDS	321.9GB - 1336 days - 63370 files
AVHRR17_G	AVHRR17_G	L3P	2004-12-30	2013-07-15	1.5	0.08°	Details	Granule Search	Live Access	FTP HTTP OPeNDAP TDS	34.4GB - 1386 days - 3741 files
		L3P	2004-12-30	2013-07-15	1.5	2 km	Details	Granule Search	Live Access	FTP HTTP OPeNDAP TDS	24.4GB - 1301 days - 2584 files
AVHRR17_L19	AVHRR17_L19	L3P	2004-12-30	2013-07-15	1.5	0.08°	Details	Granule Search	Live Access	FTP HTTP OPeNDAP TDS	34.4GB - 1386 days - 3741 files
		L3P	2004-12-30	2013-07-15	1.5	2 km	Details	Granule Search	Live Access	FTP HTTP OPeNDAP TDS	24.4GB - 1301 days - 2584 files
HED	HED	L4	2004-12-30	2013-07-15	1.5	2 km	Details	Granule Search	Live Access	FTP HTTP OPeNDAP TDS	0.9GB - 681 days - 981 files
		L3P	2004-12-26	2005-11-15	1.5	2 km	Details	Granule Search	Live Access	FTP HTTP OPeNDAP TDS	9.0GB - 296 days - 589 files
NA15L_SST	NA15L_SST	L3P	2004-12-30	2010-03-22	1.5	2 km	Details	Granule Search	Live Access	FTP HTTP OPeNDAP TDS	85.0GB - 1885 days - 3678 files
		L3P	2004-12-30	2013-07-15	1.5	2 km	Details	Granule Search	Live Access	FTP HTTP OPeNDAP TDS	114.5GB - 2385 days - 4661 files
OPHSEA_GAL	OPHSEA_GAL	L4	2004-12-24	2008-12-16	1.5	2 km	Details	Granule Search	Live Access	FTP HTTP OPeNDAP TDS	1.8GB - 737 days - 8053 files
		L4	2008-01-23	2009-12-15	1.5	2 km	Details	Granule Search	Live Access	FTP HTTP OPeNDAP TDS	1.2GB - 231 days - 231 files
OPHSEA_GLOB	OPHSEA_GLOB	L4	2008-01-23	2009-12-15	1.5	4 km	Details	Granule Search	Live Access	FTP HTTP OPeNDAP TDS	4.6GB - 644 days - 798 files
		L4	2008-01-01	2010-01-01	1.5	2 km	Details	Granule Search	Live Access	FTP HTTP OPeNDAP TDS	1.1GB - 538 days - 708 files
OPHSEA_MED	OPHSEA_MED	L4	2008-01-01	2010-01-01	1.5	2 km	Details	Granule Search	Live Access	FTP HTTP OPeNDAP TDS	0.6GB - 538 days - 708 files
		L4	2008-01-01	2010-01-01	1.5	2 km	Details	Granule Search	Live Access	FTP HTTP OPeNDAP TDS	0.6GB - 538 days - 708 files
OPHSEA_NWE	OPHSEA_NWE	L4	2008-01-01	2010-01-01	1.5	2 km	Details	Granule Search	Live Access	FTP HTTP OPeNDAP TDS	0.6GB - 538 days - 708 files
		L4	2008-01-01	2010-01-01	1.5	2 km	Details	Granule Search	Live Access	FTP HTTP OPeNDAP TDS	0.6GB - 538 days - 708 files
SEVIRL_SST	SEVIRL_SST	L3P	2004-12-30	2007-02-15	1.5	0.1°	Details	Granule Search	Live Access	FTP HTTP OPeNDAP TDS	33.3GB - 2091 days - 20955 files
		L3P	2004-12-29	2007-02-15	1.5	25 km	Details	Granule Search	Live Access	FTP HTTP OPeNDAP TDS	1.8GB - 737 days - 8053 files
IWI	IWI	L3P	2006-06-29	2018-04-30	1.5	3 km	Details	Granule Search	Live Access	FTP HTTP OPeNDAP TDS	21862.9GB - 3568 days - 1075311 files
		L3P	2006-06-29	2018-04-30	1.5	3 km	Details	Granule Search	Live Access	FTP HTTP OPeNDAP TDS	21335.3GB - 3475 days - 1042642 files
MODELS_A	MODELS_A	L3P	2006-06-30	2018-04-30	1.5	3 km	Details	Granule Search	Live Access	FTP HTTP OPeNDAP TDS	1898.3GB - 3609 days - 3609 files
		L3P	2006-06-30	2018-04-30	1.5	3 km	Details	Granule Search	Live Access	FTP HTTP OPeNDAP TDS	63.3GB - 370 days - 370 files
MUR_GLOB	MUR_GLOB	L4	2007-06-01	2018-05-31	2.0/1.8	0.01°	Details	Granule Search	Live Access	FTP HTTP OPeNDAP TDS	5.8GB - 270 days - 270 files
		L4	2008-04-01	2012-03-31	1.5	0.01°	Details	Granule Search	Live Access	FTP HTTP OPeNDAP TDS	11.9GB - 297 days - 297 files
RTO_SST_Ar_NAMERICA	RTO_SST_Ar_NAMERICA	L4	2010-12-30	2012-09-30	1.5	4 km	Details	Granule Search	Live Access	FTP HTTP OPeNDAP TDS	3.5GB - 270 days - 270 files
		L4	2010-12-30	2012-09-30	1.5	4 km	Details	Granule Search	Live Access	FTP HTTP OPeNDAP TDS	3.5GB - 270 days - 270 files
RTO_SST_An_NAMERICA	RTO_SST_An_NAMERICA	L4	2010-12-30	2012-09-30	1.5	4 km	Details	Granule Search	Live Access	FTP HTTP OPeNDAP TDS	3.5GB - 270 days - 270 files
		L4	2010-12-30	2012-09-30	1.5	4 km	Details	Granule Search	Live Access	FTP HTTP OPeNDAP TDS	3.5GB - 270 days - 270 files
RTO_SST_Eu_NAMERICA	RTO_SST_Eu_NAMERICA	L4	2010-12-30	2012-09-30	1.5	4 km	Details	Granule Search	Live Access	FTP HTTP OPeNDAP TDS	3.5GB - 270 days - 270 files
		L4	2010-12-30	2012-09-30	1.5	4 km	Details	Granule Search	Live Access	FTP HTTP OPeNDAP TDS	3.5GB - 270 days - 270 files
RTO_SST_Na_NAMERICA	RTO_SST_Na_NAMERICA	L4	2010-12-30	2012-09-30	1.5	4 km	Details	Granule Search	Live Access	FTP HTTP OPeNDAP TDS	3.5GB - 270 days - 270 files
		L4	2010-12-30	2012-09-30	1.5	4 km	Details	Granule Search	Live Access	FTP HTTP OPeNDAP TDS	3.5GB - 270 days - 270 files
AVHRR17_G	AVHRR17_G	L3P	2006-06-29	2007-02-15	1.5	8.0 km	Details	Granule Search	Live Access	FTP HTTP OPeNDAP TDS	0.31GB - 1079 days - 14743 files
		L3P	2006-06-29	2008-09-15	1.5	2.2 km	Details	Granule Search	Live Access	FTP HTTP OPeNDAP TDS	3233.5GB - 818 days - 20491 files



<http://www.nodc.noaa.gov/SatelliteData/ghrsst/accessdata.html>

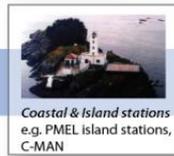
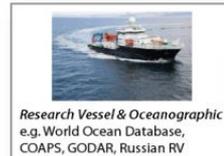
ICOADS:

The International Comprehensive Ocean-Atmosphere Data Set
William Angel, Eric Freeman, Scott Woodruff, Sandy Lubker

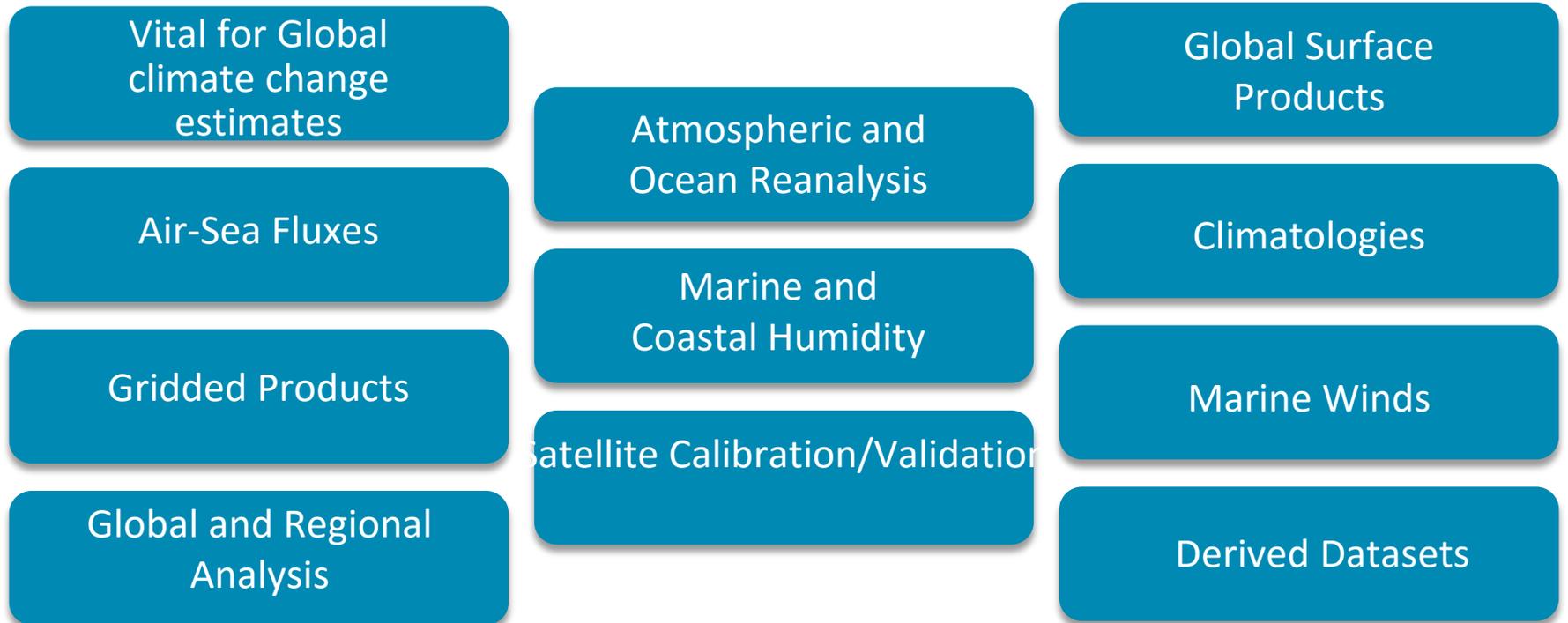
Scope: The world's most extensive surface marine & meteorological data collection (**akin to GHCN over land**); a foundational dataset for climate monitoring & studies (e.g. ERSST ...)
Objective: Stewardship, archive & service of ICOADS



Ship data
Various national & international sources
e.g. TDF-11
DWD Archive
MOMDB
Delayed mode (GCCs)
Real time (GTS)

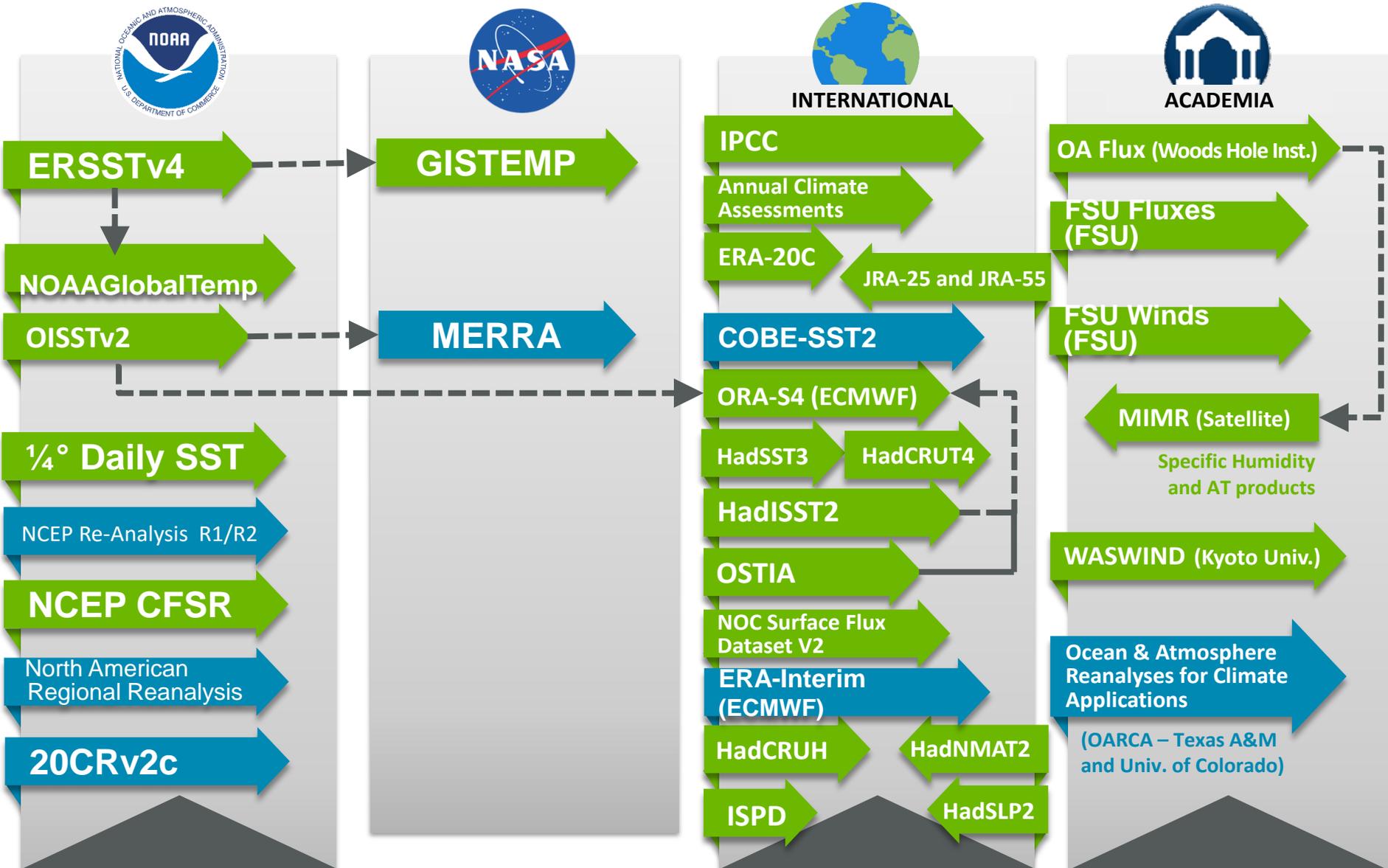


ICOADS – A Foundational Database



ICOADS – A Critical Marine Foundation for All-Types of Products and Services

Who are the users of ICOADS?



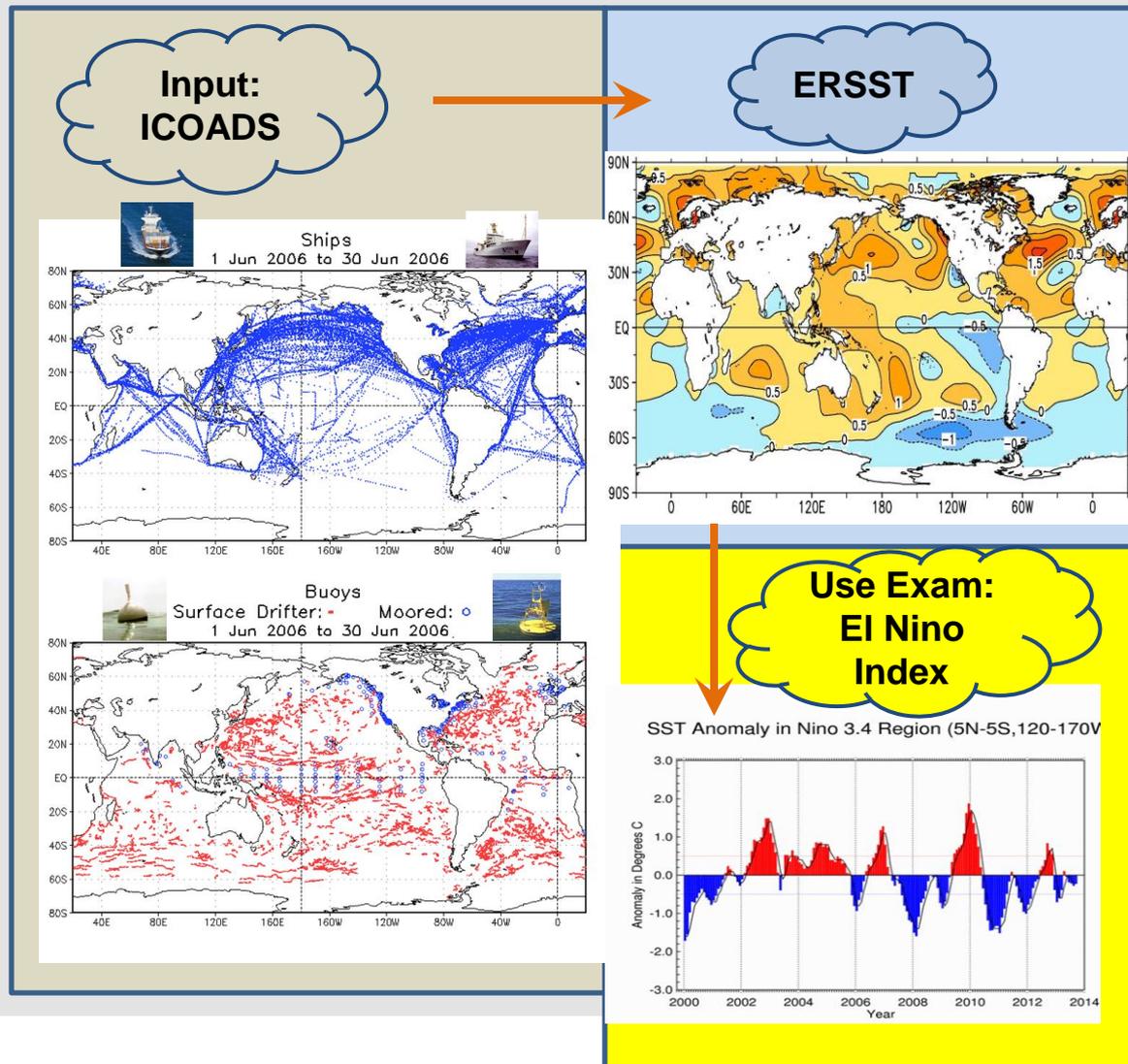
Centennial-Scale Extended Reconstructed Sea Surface Temperature (ERSST)

Scope: Authoritative centennial global sea surface temperature dataset for climate change research, assessment & monitoring

Objective: Monthly production & dissemination; development to remain state-of-the-science & authoritative

Major Ongoing Improvements:

- Updated SST bias corrections
- Methods to include data from Argo floats
- Using ICOADS R3.0
- Comprehensive data error estimates
- Updated SST corrections using new sea ice datasets



Who are the users of ERSST?



ENVIRONMENT

NCEI Climate Monitoring

Hurricane

NOAAGlobalTemp

Storm surge

CPC ENSO monitoring

Sea level trend

EMC ocean color monitoring

Saharan dust

GISTemp

River inflow

Climate Pilot Indicator

Fishery

National Academy of Sciences (NAS)

Wildlife

Coral reef

Ocean acidification

Drought



INDUSTRY & INTERNATIONAL

Air conditioning

tempsensornews.com

temperatures.com

ofsoptics.com
climate prediction

thomsonreuters.com
agriculture & weather
research and forecast

prescientweather.com

Power outage modeling

Index insurance

Users from:

Australia, Brazil, Canada, China, Columbia, France, Fiji, Germany, Hong Kong, India, Indonesia, Italia, Japan, Kenya, Martinique, Mexico, New Zealand, Nigeria, Norway, Peru, Russia, South Africa, Spain, Switzerland, Toulouse, UK



RESEARCH & EDUCATION

Climate impact on coasts

ENSO, SIOD study

Cyclone development

Hiatus study

Neural-network forecast

PDO

Analog in seasonal forecast

Caribbean climate

Climate forcing mechanism

Rainfall

Humidity & air temperature

SST variability

Model prediction skill

Model performance

Geology, Geography &
Biology study

CMIP5 validation

In situ SST from 1854, updated monthly

Pathfinder SST

Characteristics:

- High resolution (4 km), long-term, climate data record (CDR) of global satellite sea surface temperature (SST).
- Used for climate change research, assessment, monitoring, and general applications (e.g., project focused research).
- Base product for other derived products (e.g., OISST, CoRTAD, reanalysis data set for Japanese Meteorological Agency).

Types:

- Unique full AVHRR long temporal product, processed under a consistent algorithm.
- Uses NOAA -7, -9, -11, -14, -16, -17, -18, -19 AVHRR sensors.

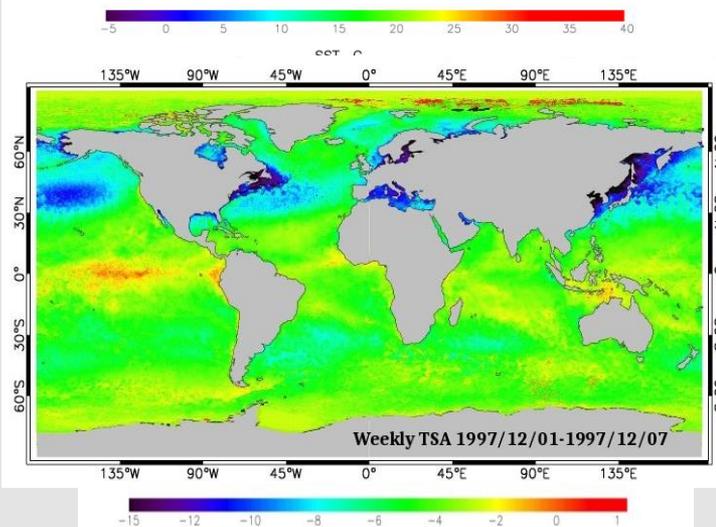
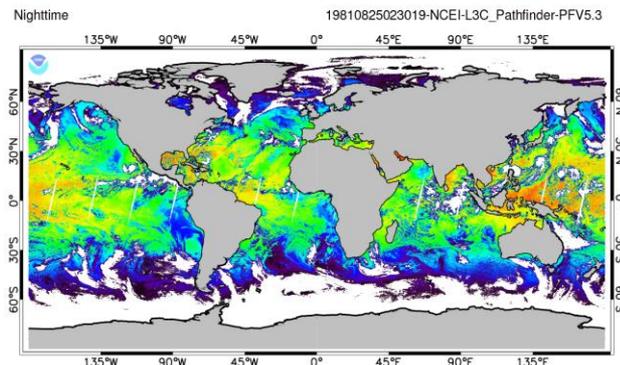
Production schedule:

- A one time release full dataset, annually
- Quarterly updates to be made available in 2017

Status:

- Version 5.2 currently available (L3)
- Version 5.3 to be released in July 2016 (L3, L3U, L2P)

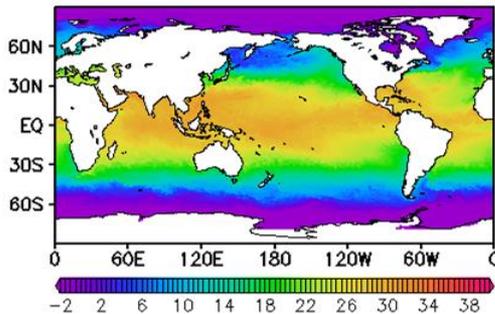
Pathfinder L3 Sea Surface Temperature Image



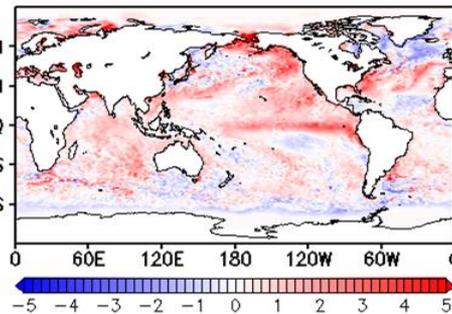
Coral Reef Temperature Anomaly Data Base Image of Thermal Stress Anomaly (derived from PFSST)

dOISST

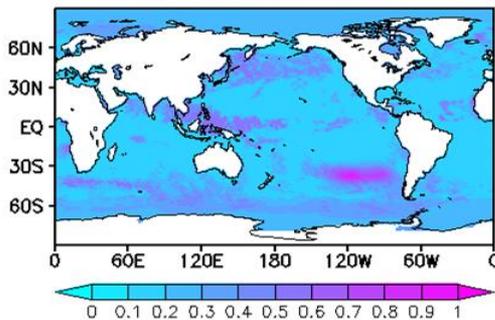
a) dOISST



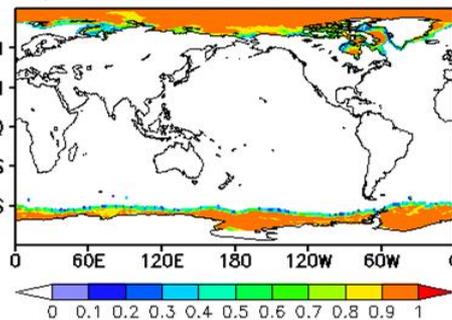
b) dOISST Anomaly



c) dOISST Error



d) Median Sea Ice Conc



Characteristics:

- Complete (**gap-free**) SST, ice and error fields
- Blend of **in situ + satellite data** daily global coverage on a $1/4^\circ$ grid

Types:

- AVHRR-only (**from,1981; CDR support**)
- AVHRR+AMSR (from 2002; inactive)

Production schedule

- Preliminary produced **every day** in near real time (1-day delay)
- Replaced by final (science quality) after 2 weeks

Status:

Version 2 released was Nov 2008

AVHRR+AMSR inactive

Code rejuvenation longer than expected

Supports Operations, Modelling, Research and Management



NOAA 1/4° dOISST

Global climate forecasting

Unusual phenomena
(warm blob)

Ecological and population
models

1/4° Blended SST
Climatology

Hurricane development

Phytoplankton primary
production

Data quality control

Oceanic CO₂ processes

Resource management

Ancillary Data for Satellite
Algorithms

Diurnal SST and fluxes

Research

dOISST- A Foundational Dataset for Operations, Modelling, Research and Management

Who are the users of dOISST?



NATIONAL & INTERNATIONAL

RESEARCH

VIIRS/NPP SST

Official Dynamic Ancillary Data

NCEP Climate Forecast System Model

Operational use of code copy

Coral Reef Watch

NESDIS SST Quality Monitor (SQUAM)

National Marine Fisheries Service ecological /population models

Pathfinder AVHRR SST (CCOG/U. Miami)

Homeland Security

American Shipping Bureau

NCAR North American MultiModel Ensemble

VIIRS SST

MODIS SST

TRMM Rain Rate

Aquarius Salinity bias correction

Phytoplankton primary production

IPCC

BAMS State of Climate

Group for High Resolution SST (GHRSSST)

The SST Virtual constellation for Committee on Earth Observation Satellites (CEOS)

UK MetOffice

GHRSSST Multi-Product Ensemble (GMPE)

Tropical cyclogenesis forecast

Ocean acidification and carbonate dynamics

Non-US climate models and data assimilation

Response to climate change

Fisheries, species invasion, biogeography

Ocean Fluxes/ Diurnal SST CDR

Woods Hole Inst

Fisheries stock assessments and models in non-US basins

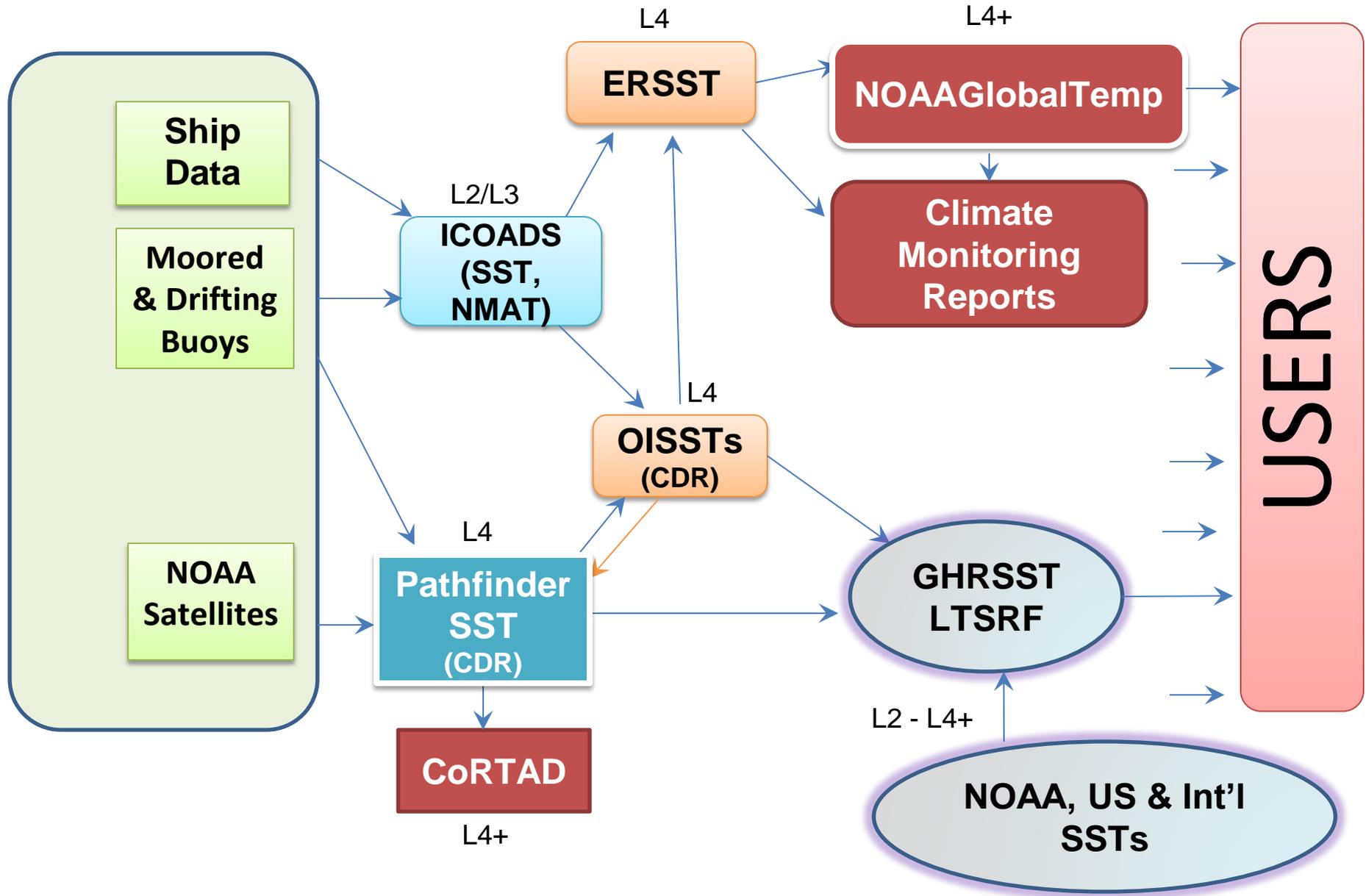
Acoustics; Geolocation models of tagged animals

Atmospheric Rivers

Regional physical oceanography

In situ and satellite SST blend from 1981, updated daily

Sea Surface Temperature DPS (*Satellite & in-situ*)





Conclusions

- NCEI stewards and produces a broad range of foundational SST datasets, both *in situ* and satellite derived.
- Each of these data sets has been developed to serve distinct user communities.
- Several products are interdependent on each other, adding value along the way for the designated user communities they serve.