

# The Improvement Of ICOADS R3.0 and Its Application To DOISST

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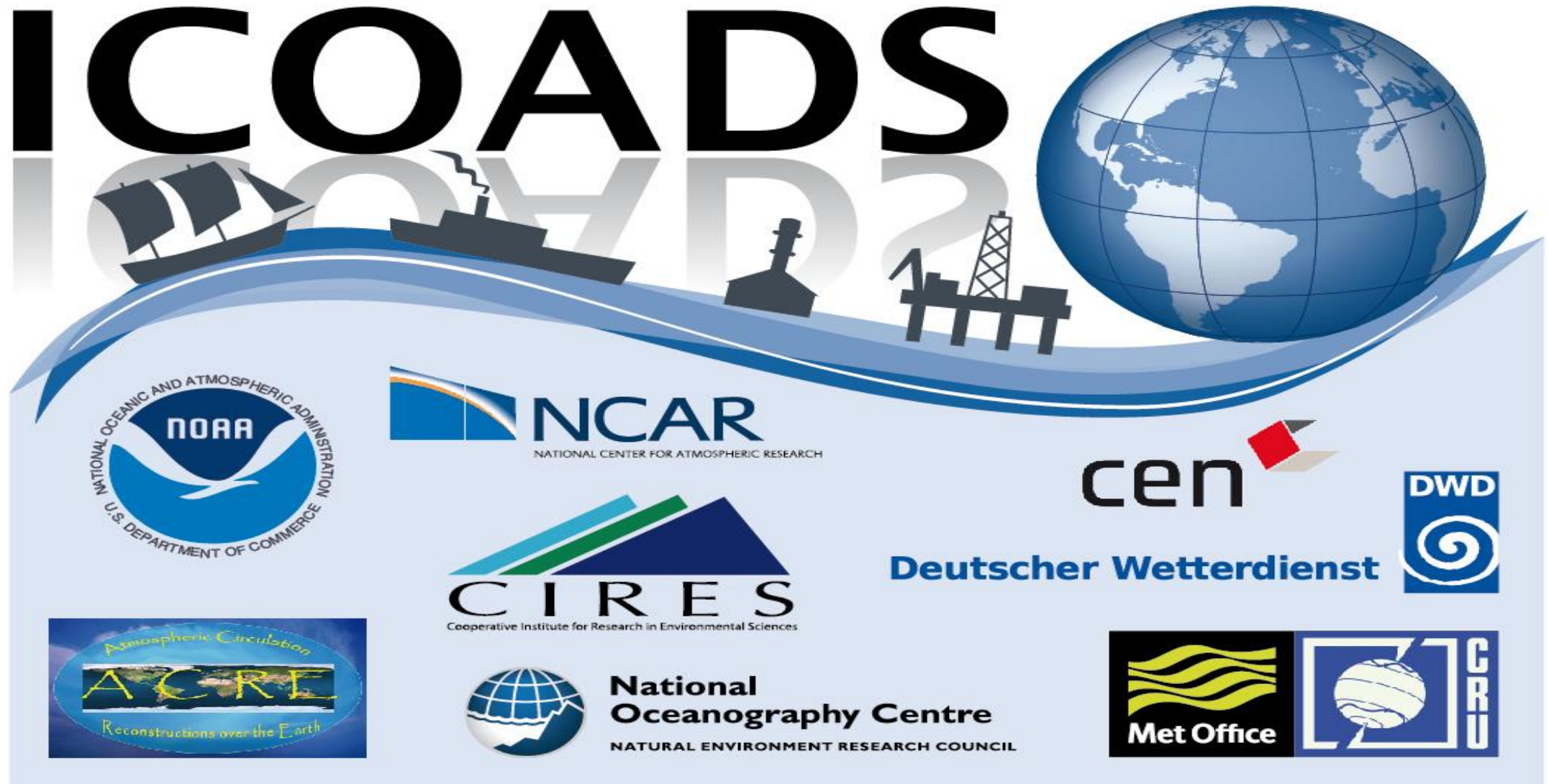
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# Outline

1. ICOADS introduction
2. Major improvement of ICOADS R3.0
3. Case study: ICOADS R3.0 application to DOISST

# ICOADS Partners



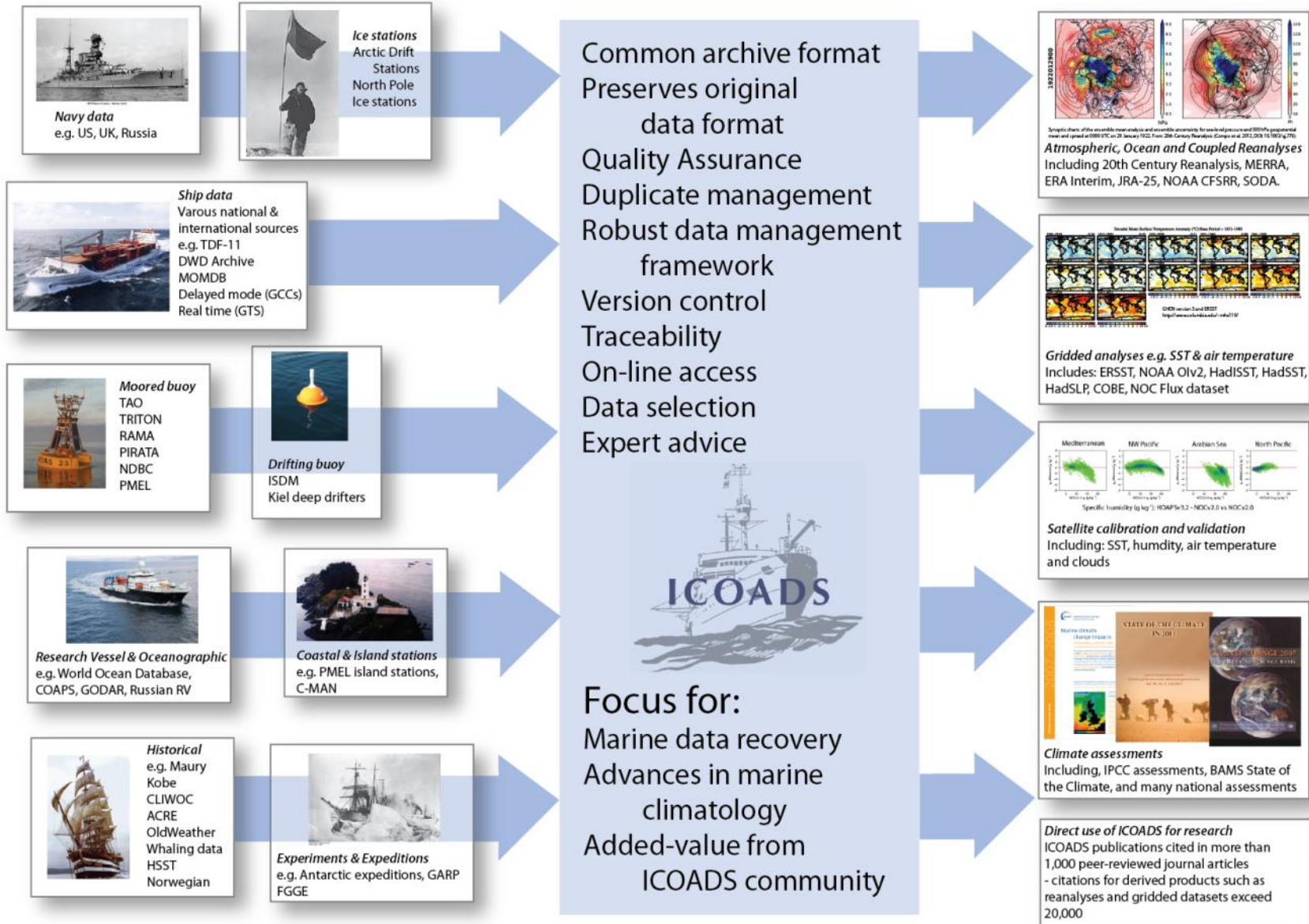
...And several years of funding support by CPO/COD

February 23, 2016

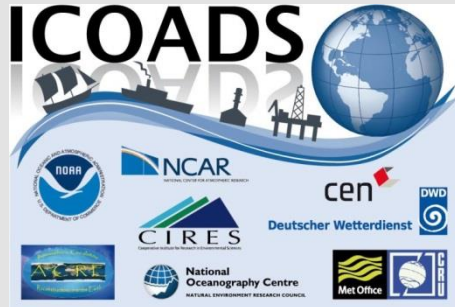
2016 Ocean Sciences Meeting



# ICOADS Overview



# International Comprehensive Ocean-Atmosphere Data Set (ICOADS) – A Foundational Database



Air-Sea Fluxes

Gridded Products

Global and Regional Analysis

Vital for Global climate change estimates

Atmospheric and Ocean Reanalysis

Marine and Coastal Humidity

Satellite Calibration/Validation

Global Surface Products

Climatologies

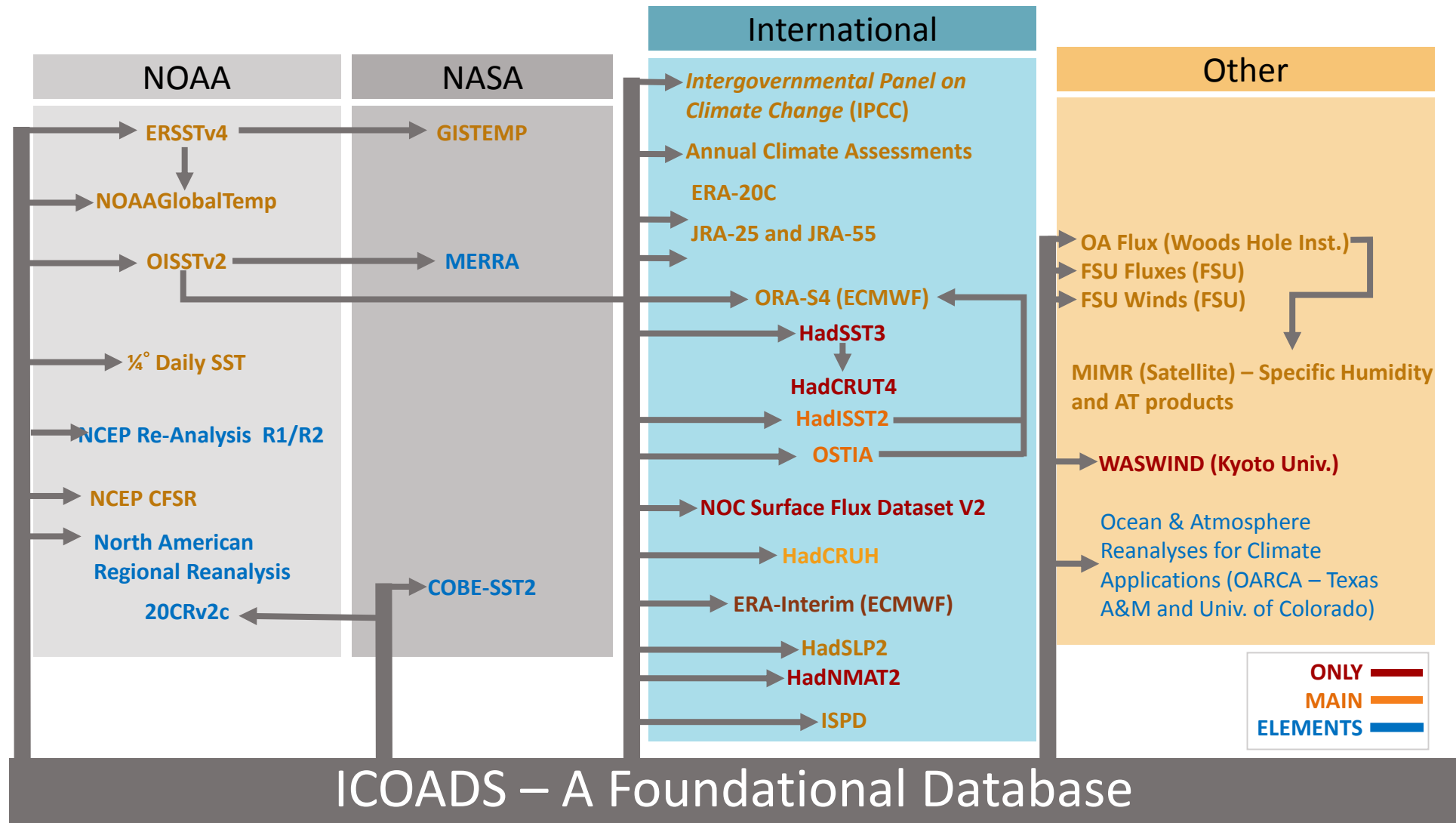
Marine Winds

Derived Datasets

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



# Who are recent users of ICOADS?



# What are the Data Products?

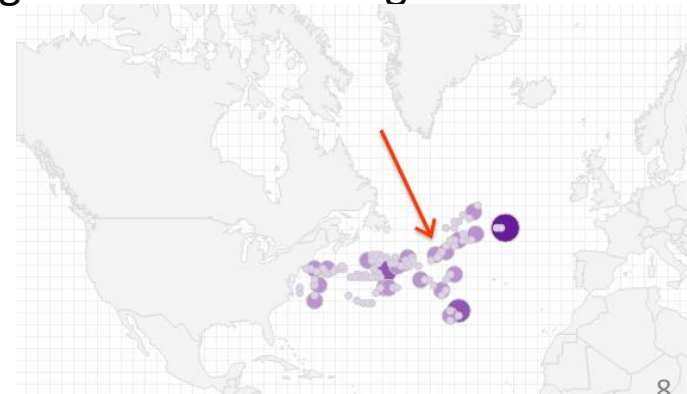
- Marine Observational Reports – ships, buoys, and etc.
  - Subsetting and bulk files downloads are available at NCAR and NCEI, respectively
  - NCAR: <http://rda.ucar.edu/datasets/ds540.0/>
  - NCEI: <http://www1.ncdc.noaa.gov/pub/data/icoads2.5/>
  - NCEI: <http://www.ncdc.noaa.gov/cdo-web/datatools/marine>
  - Additional details can be found at <http://icoads.noaa.gov/products.html>
- Monthly summary products include:
  - 2°x2° grids available since 1800 and 1°x1° grids since 1960
  - Available in netCDF
  - And for 22 variables, listed below, as well as 10 statistics (e.g. mean, median):
    - Sea surface temp
    - Air temp
    - Scalar wind
    - Vector wind eastward component
    - Vector wind northward component
    - Sea-level pressure
    - Total cloudiness
    - Specific humidity
    - Relative humidity
    - Sea-air temperature difference
    - ...and 11 other derived parameters

# ICOADS Fun-facts

- The world's most extensive surface marine meteorological data collection
  - First records from 1662 to the latest data month
  - Over 455 million unique marine reports (ending Dec 2014)!
  - Global events such as the Tambora eruption of April 1815 (Brohan et al., 2012)
  - Early instrumental observations made by Edmond Halley in 1699 are available
  - Interesting notations
    - Shackleton's disastrous Antarctic expedition in 1916 - [https://github.com/oldweather/Expeditions/blob/master/imma/James\\_Caird\\_1916.imma](https://github.com/oldweather/Expeditions/blob/master/imma/James_Caird_1916.imma)
      - May 11, 1916: "Cooked old albatross, very good but a little tough"

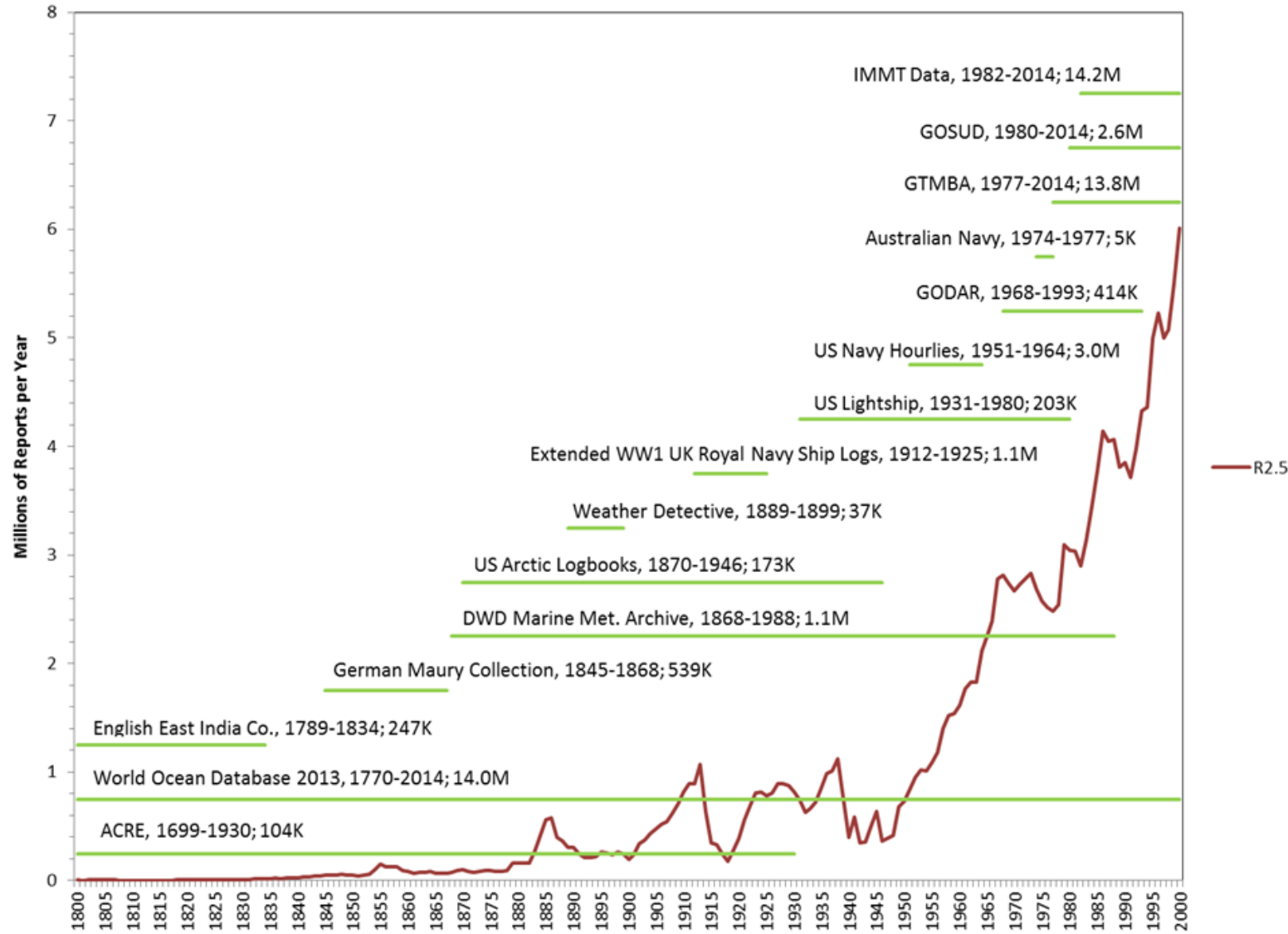
<https://cloud.google.com/bigquery/public-data/noaa-icoads>

Where were nearby ships during the hours the Titanic sank?

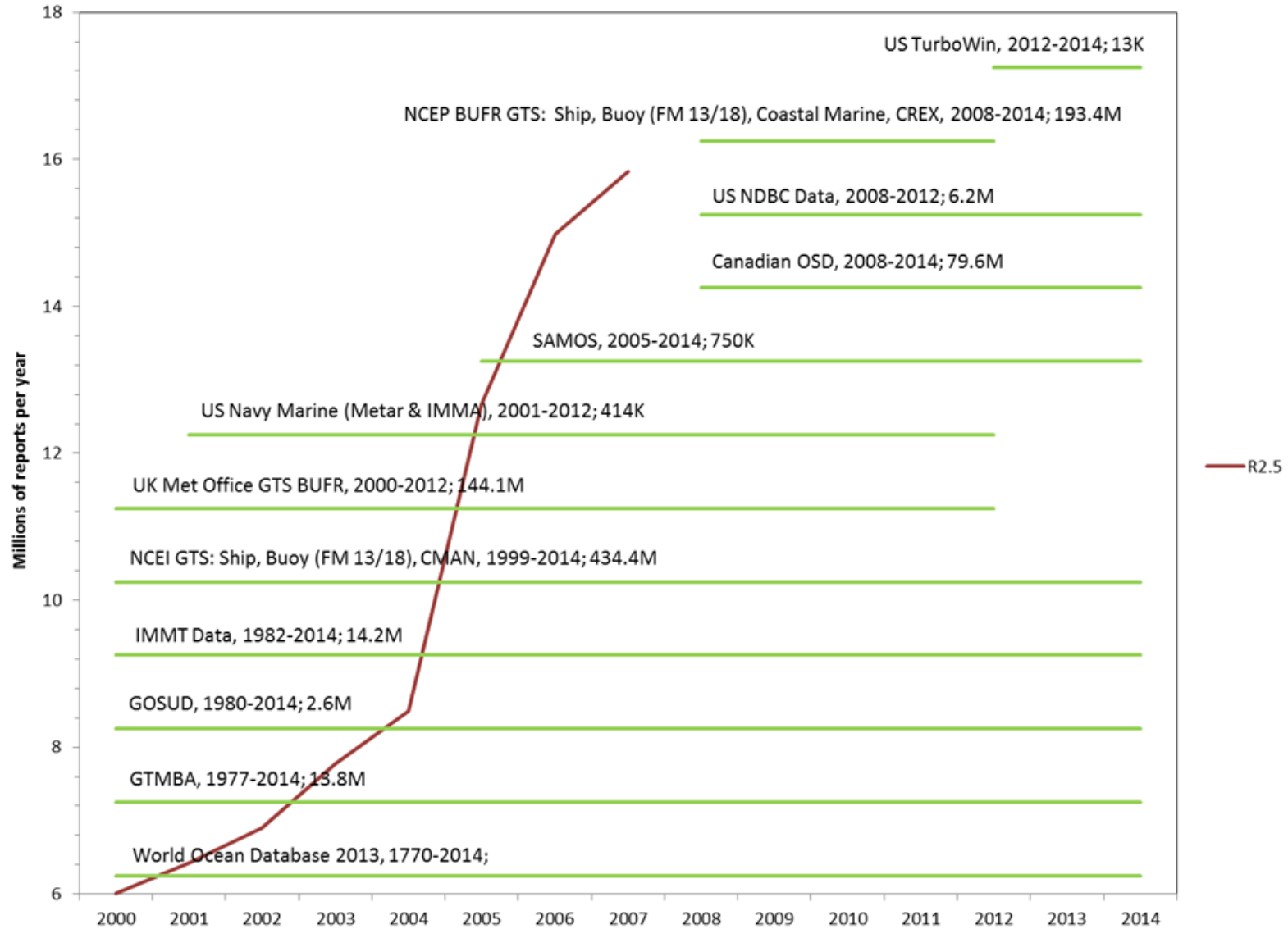




# Historical data being merged into ICOADS R3.0 – Pre year 2000



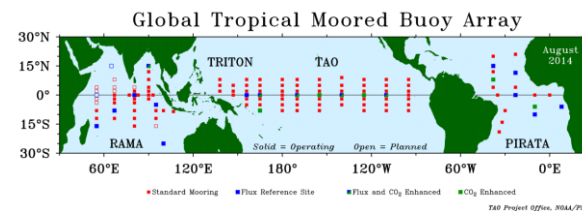
# Historical data being merged into ICOADS R3.0 – Post year 2000



# Contemporary Data Additions to R3.0

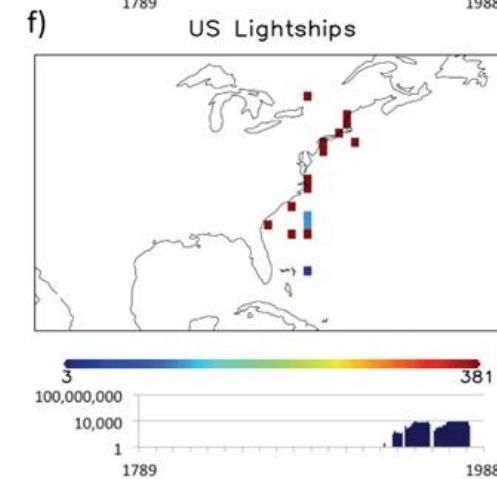
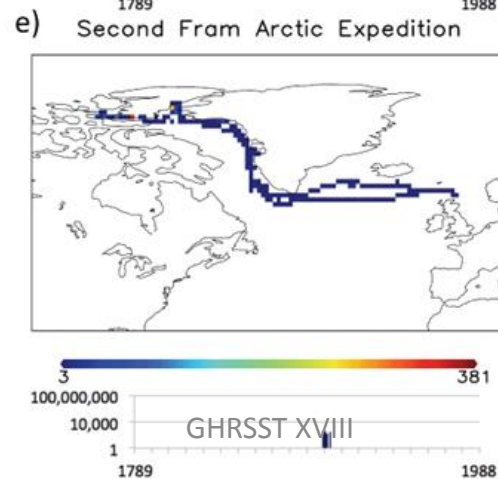
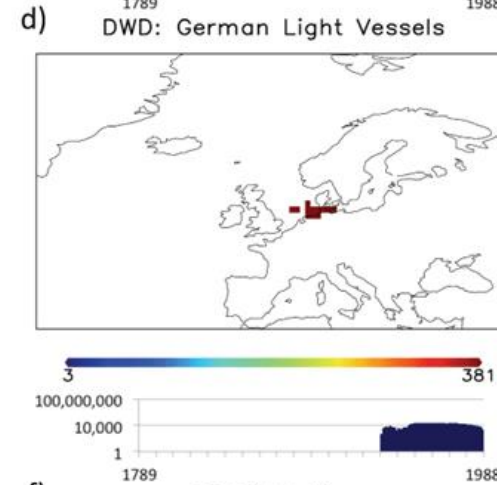
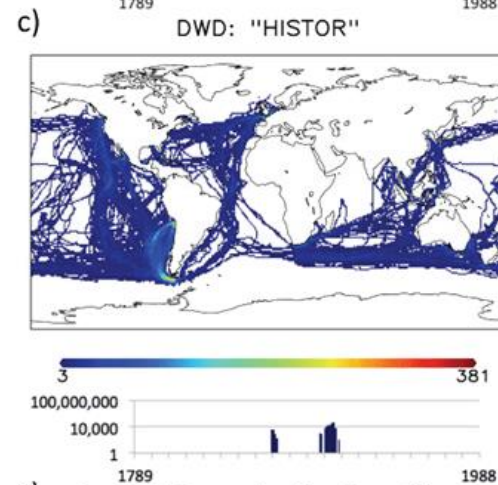
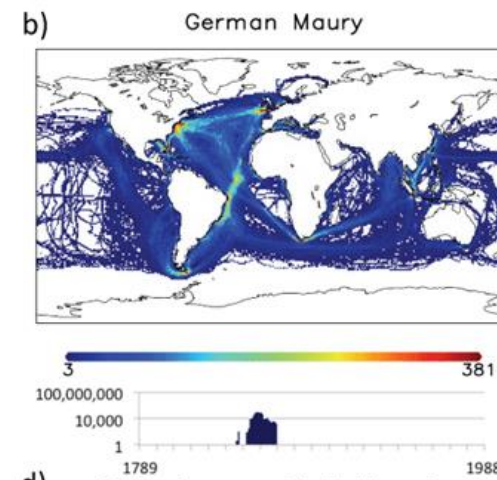
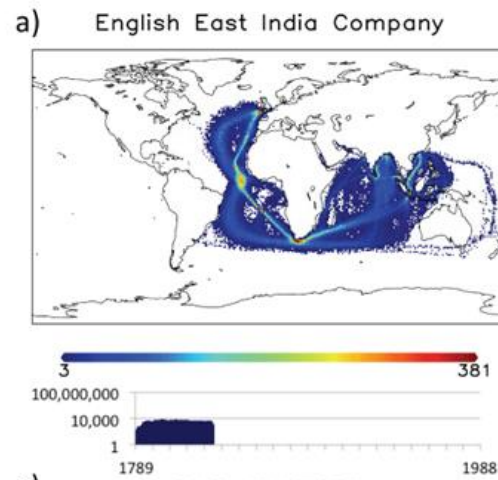
(counts of input marine reports)

- World Ocean Database 2013 (WOD13)
  - ✓ Near-surface oceanographic temperatures, salinities, etc - 15.2M marine reports
- Global Tropical Moored Buoy Array (GT MBA)
  - ✓ For R3.0, UK NOC is translating the data held by PMEL - 13.8M marine reports
- Shipboard Automated Meteorological and Oceanographic System (SAMOS)
  - ✓ Similar to GOSUD but with more parameters; 752K hourly marine reports
- Global Ocean Surface Underway Data (GOSUD) – new to R3.0
  - ✓ Near-surface oceanographic temperatures, and salinities - 71.6M marine reports
- Canadian DFO/OSD drifting/moored buoy data
  - ✓ Air pressure, air temperature, sea surface temperature, wind observations, and wave height – 80M marine reports

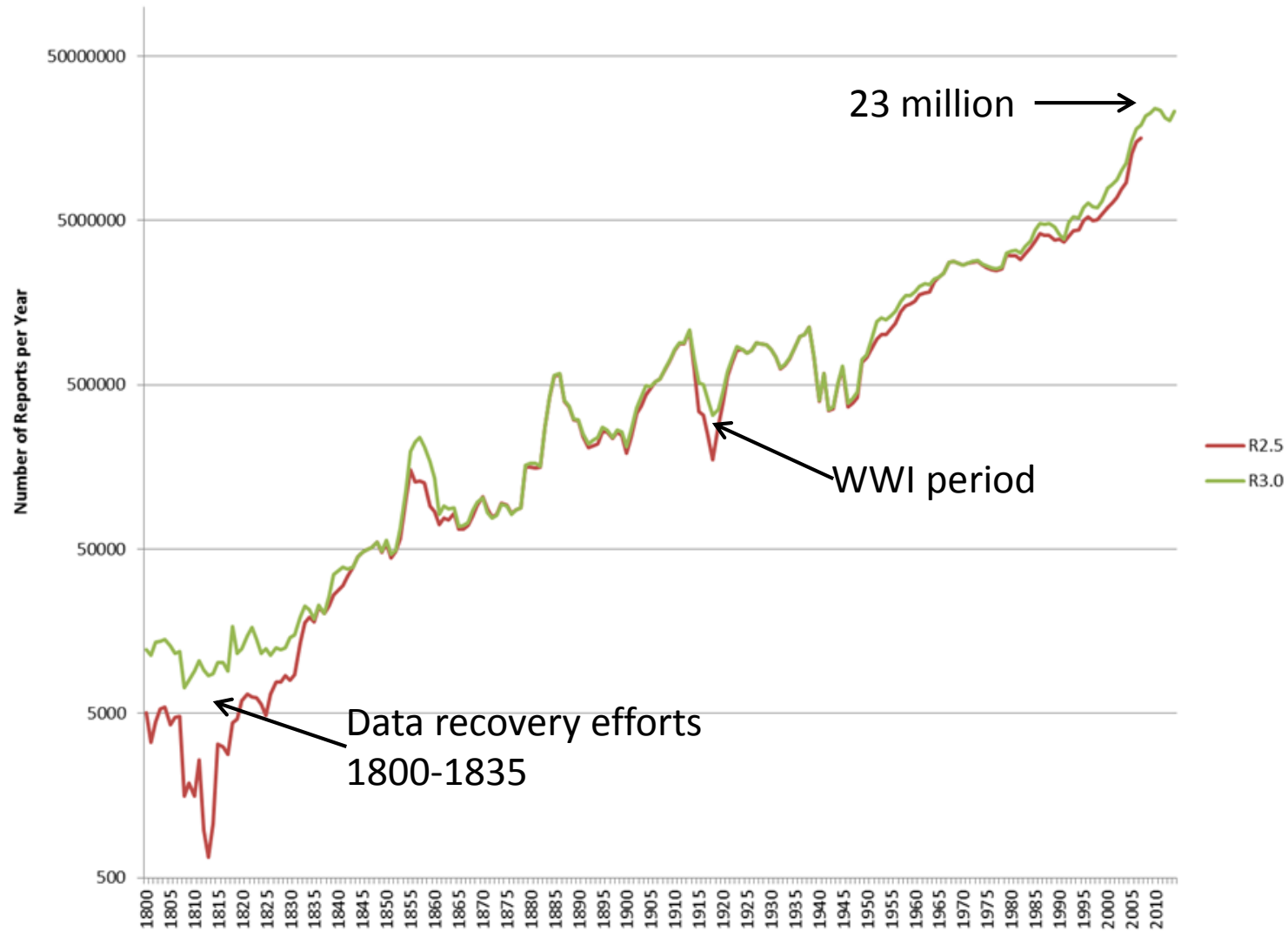


# Coverage Maps of Selected Historical Data Sources

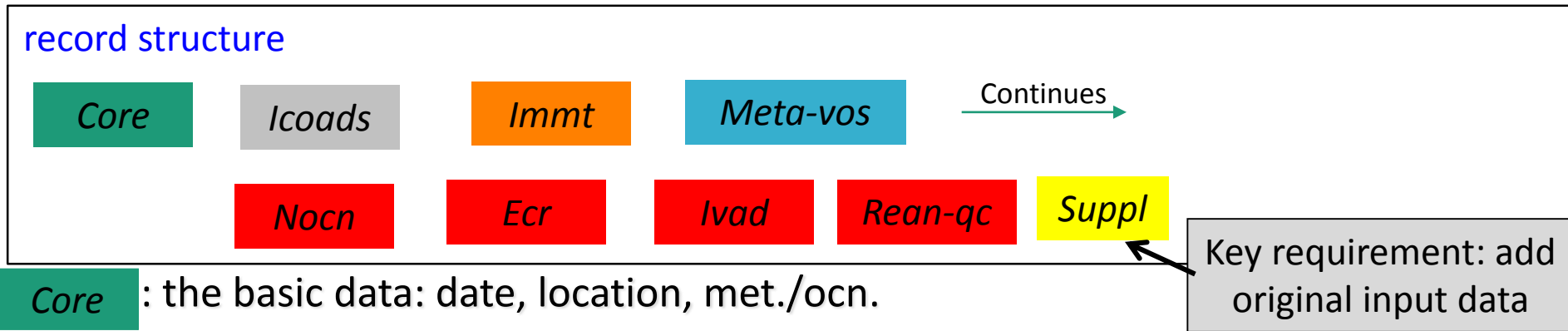
Each data source is plotted over its period of record, with colors indicating the total counts of marine reports per 1° box. An additional bar graph highlights the annual count of reports for the data source.



# Data Impact between R2.5 and R3.0 per year since 1800



# International Maritime Meteorological Archive(IMMA) data format - flexible format schematic



- *Core* : the basic data: date, location, met./ocn.
- attachments (attms) – being defined as needed
  - *Icoads* : deck/source provenance, QC flags
  - *Nocr*: Near-surface oceanographic data
  - *Ecr*: Edited Cloud Report
  - *Rean-qc*: Reanalyses QC/feedbackbase
  - *Ivad*: ICOADS Value-Added Database attm
  - Error: Error attm
  - *Uida*: Unique report ID attm
  - Others described in more detail in ICOADS IMMA documentation ([http://icoads.noaa.gov/e-doc/imma/R3.0-imma1\\_short.pdf](http://icoads.noaa.gov/e-doc/imma/R3.0-imma1_short.pdf))

Experience demonstrates format translations frequently contain errors/omissions; exact copy of input data permits re-translation and cross-checks at any time



# New ICOADS Attachments for R3.0

- Unique identifier attm [**Uida**]
  - Assigned to each record
  - Provides absolute record tracking mechanism
  - Improves ICOADS data management
  - Makes user interactions (consulting) easier
  - Simplifies data contributions from partners
  - Enables tracing through reanalyses
    - Will help link with reanalysis feedback metadata
  - **UIDs** assigned in R2.5.1/R2.5.2 (experimental releases) will be carried forward for continuity and provenance

# New ICOADS Attachments for R3.0

- Near-Surface Oceanographic Data attm [**Nocn**]
  - Temperature, salinity, oxygen, phosphate, silicate, nitrate, pH, total chlorophyll, alkalinity, partial pressure of carbon dioxide, and dissolved inorganic carbon and associated sample depths
    - Closest to the surface and less than 10 meters
  - Data from WOD 2013, GOSUD, GTMBA, and the SAMOS archive
- Edited Cloud Report attm [**Ecr**]
  - Using software provided by Univ. of Washington
    - Check for cloud and weather reports for IC errors
      - Corrected or flagged as invalid
- Error attm [**Error**]
  - Outside users can use to report and track erroneous values

# Optimally Interpolated SST (OISST)

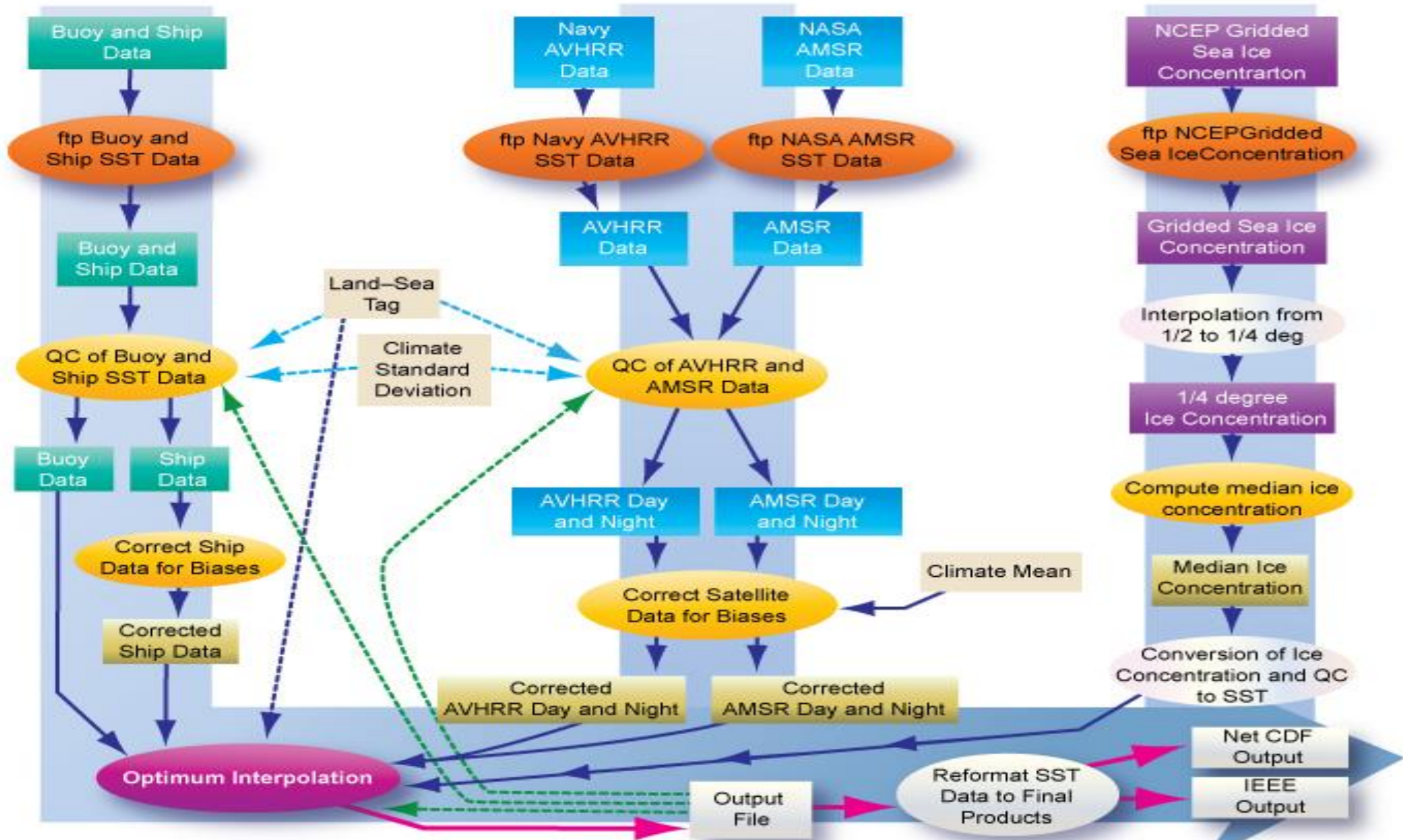
## ➤ AVHRR only

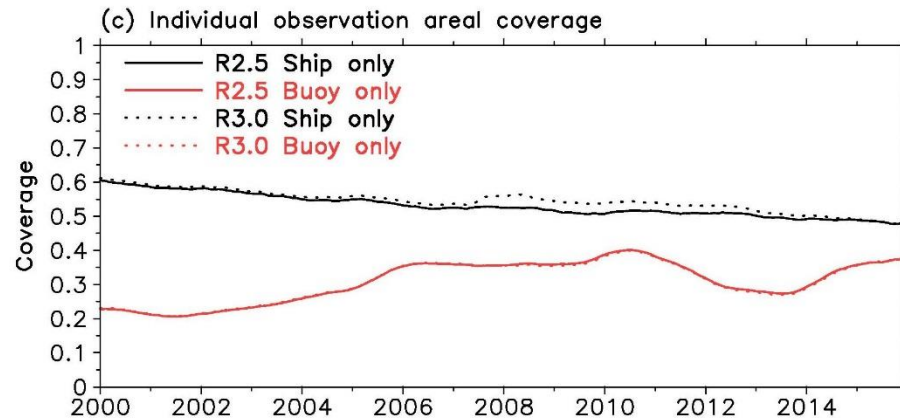
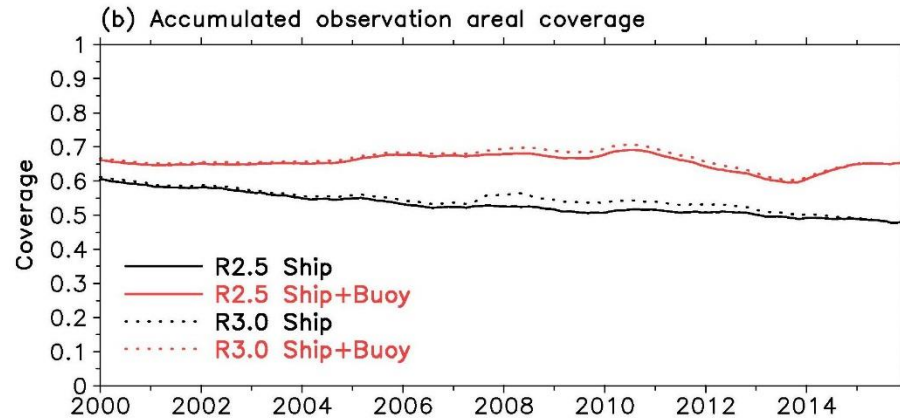
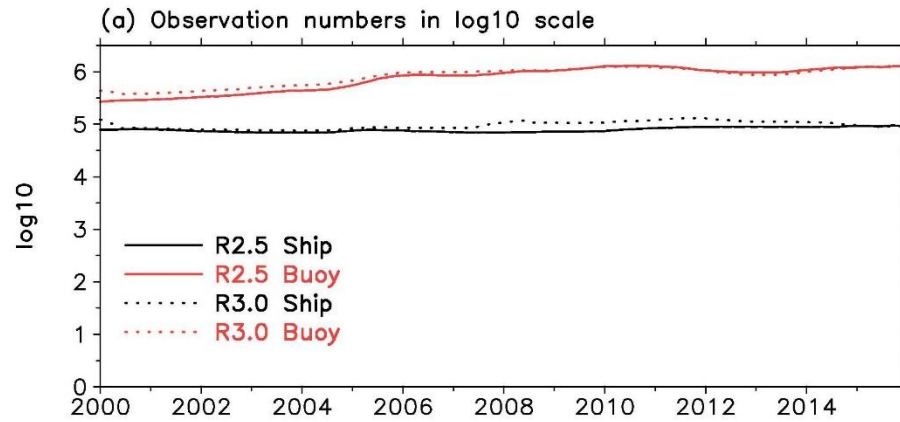
- Advanced Very High Resolution Radiometer (AVHRR) infrared satellite SST data
- in situ data from ships and buoys
- SSTs generated from sea ice data
- Optimum interpolation
- 0.25°, daily, September 1, 1981- present.

## ➤ AVHRR+AMSR

- Use all AVHRR-only data **plus**
- Advanced Microwave Scanning Radiometer (AMSR) data
- June 1, 2002 – Oct. 4, 2011.

# Daily Optimum Interpolation Sea Surface Temperature



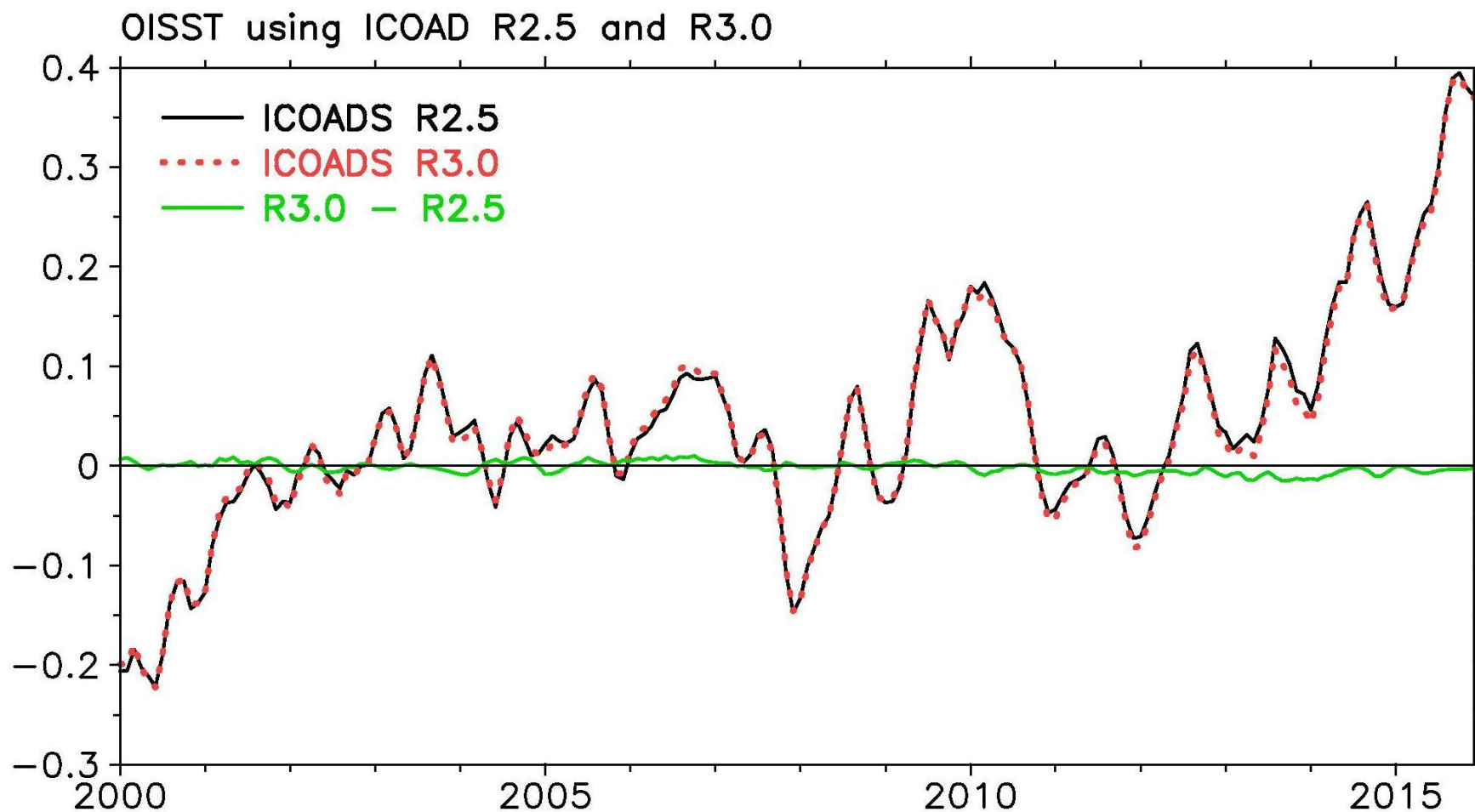


### Increase in Observation numbers (2000-2016) in unit of $10^5$ per month

	R2.5	R3.0	R3.0-R2.5
Ship	0.78	0.96	0.18
Buoy	7.37	8.13	0.74



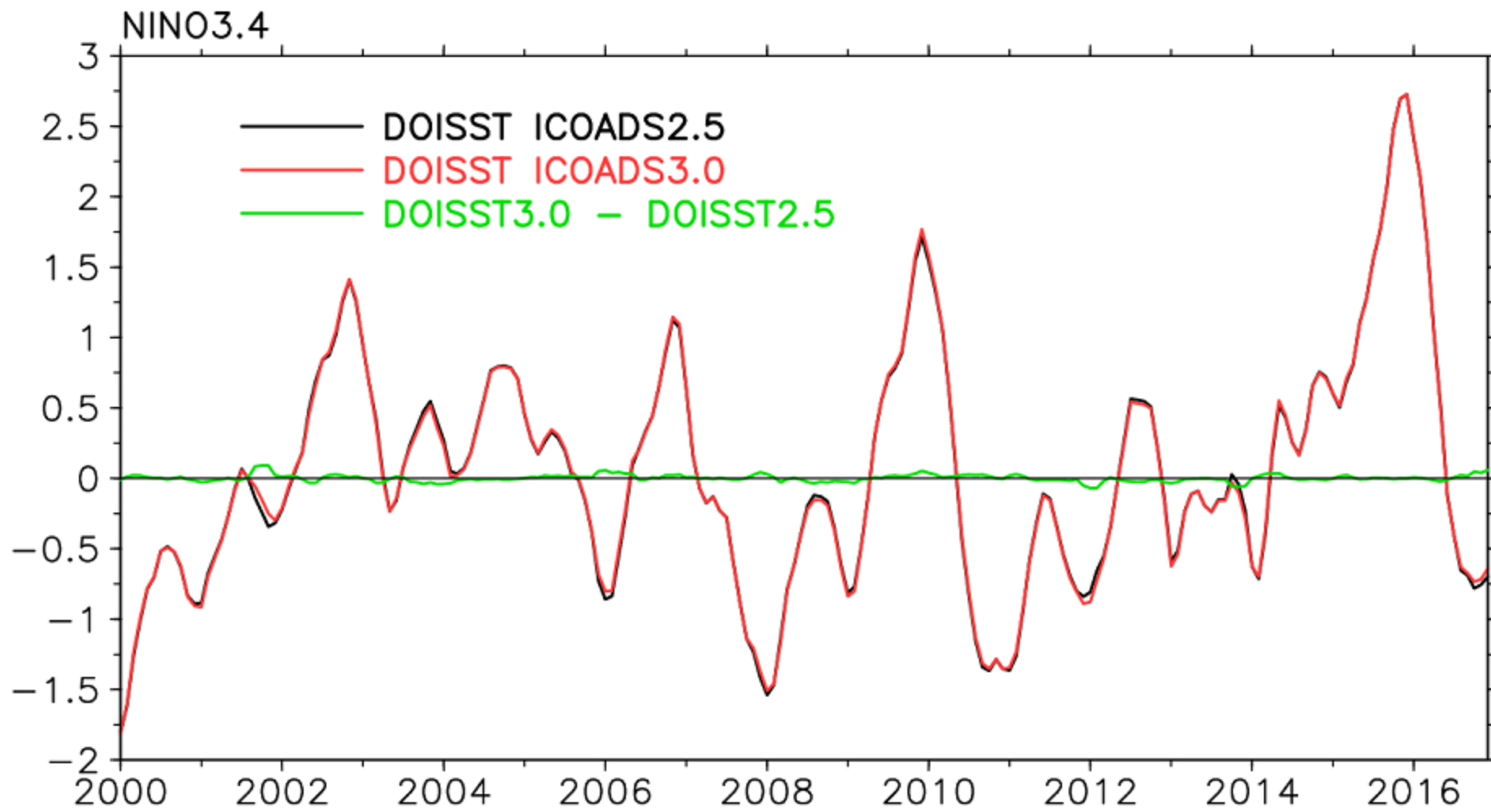
## Global Average



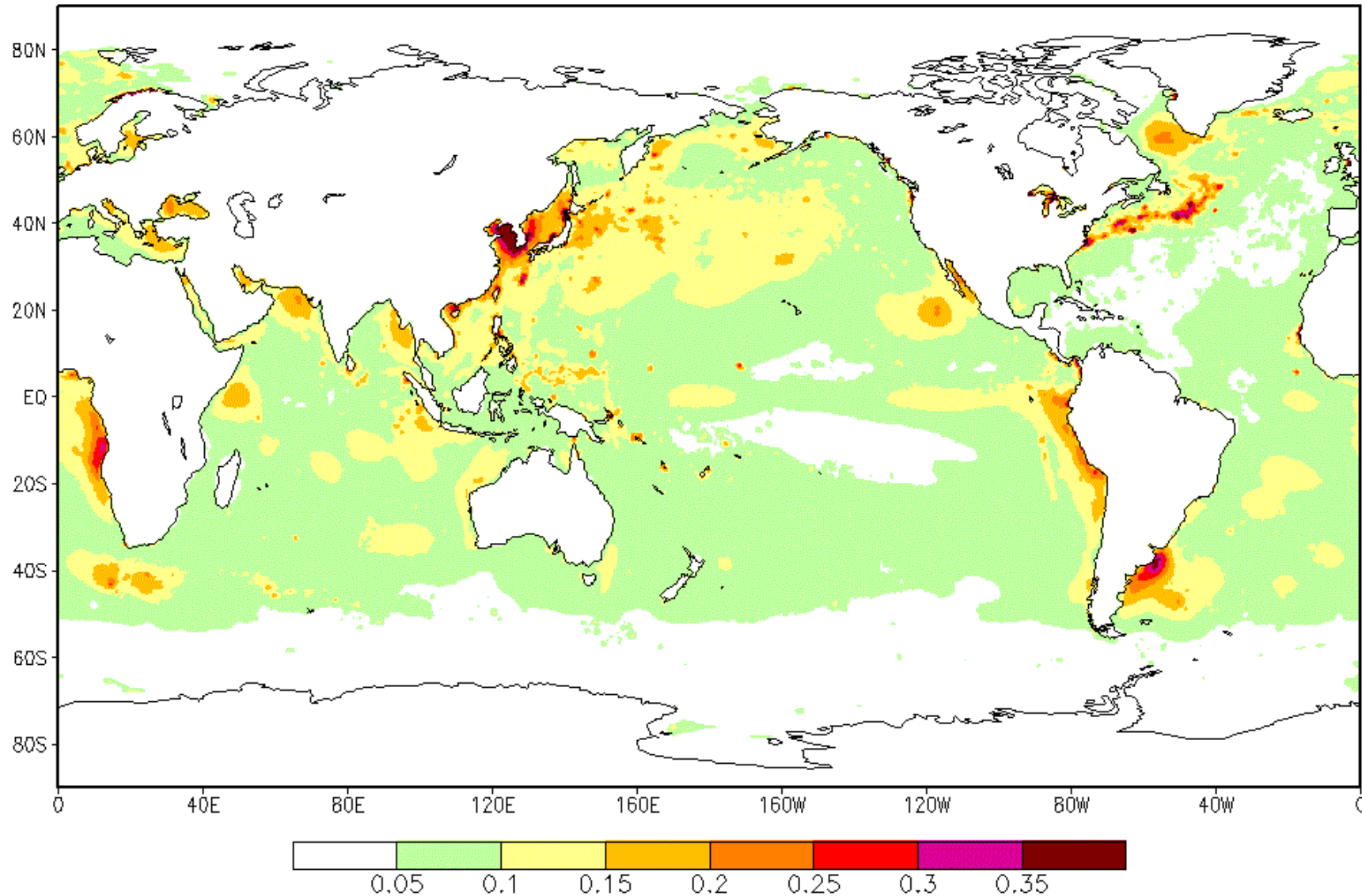
### Global SST Trend

R2.5 Trend 0.155°C/10years  
R3.0 Trend 0.149°C/10years  
Difference -0.006°C/10years





# RMS Difference (OISST using ICOADS3.0 – ICOADS2.5)2000-2016



# Conclusion

1. ICOADS R3.0 contains more observation number and larger area coverage than R2.5.
2. Number of SST observation increase by 10-20% from R2.5 to R3.0 in modern period of 2000 – 2016.
3. DOISST analysis suggests that the global averaged SST and Nino index is close in using R3.0 and R2.5.
4. DOISST analysis indicates that R3.0 and R2.5 have very clear impacts on regional SST analysis.

# Thanks You!