National Weather Service

NOAA-NCEP Next Generation Global Ocean Data Assimilation System (NG-GODAS): Evaluation of 40 Year Reanalysis

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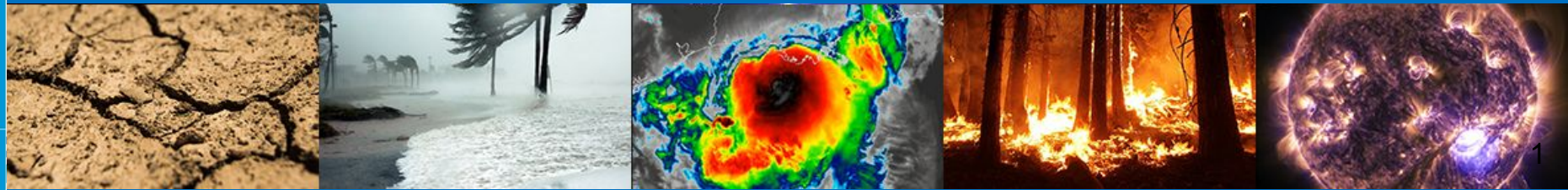


Outline

- **Objectives**
  - Prototype version of UFS-marine DA system: ***Interim JEDI-SOCA Reanalysis***
  - Unified DA system via JEDI-SOCA and establish JEDI-based marine renalysis protocol
- **On-going 40 year reanalysis experiment**
- **Accomplishments till date**
- **Backup slides**

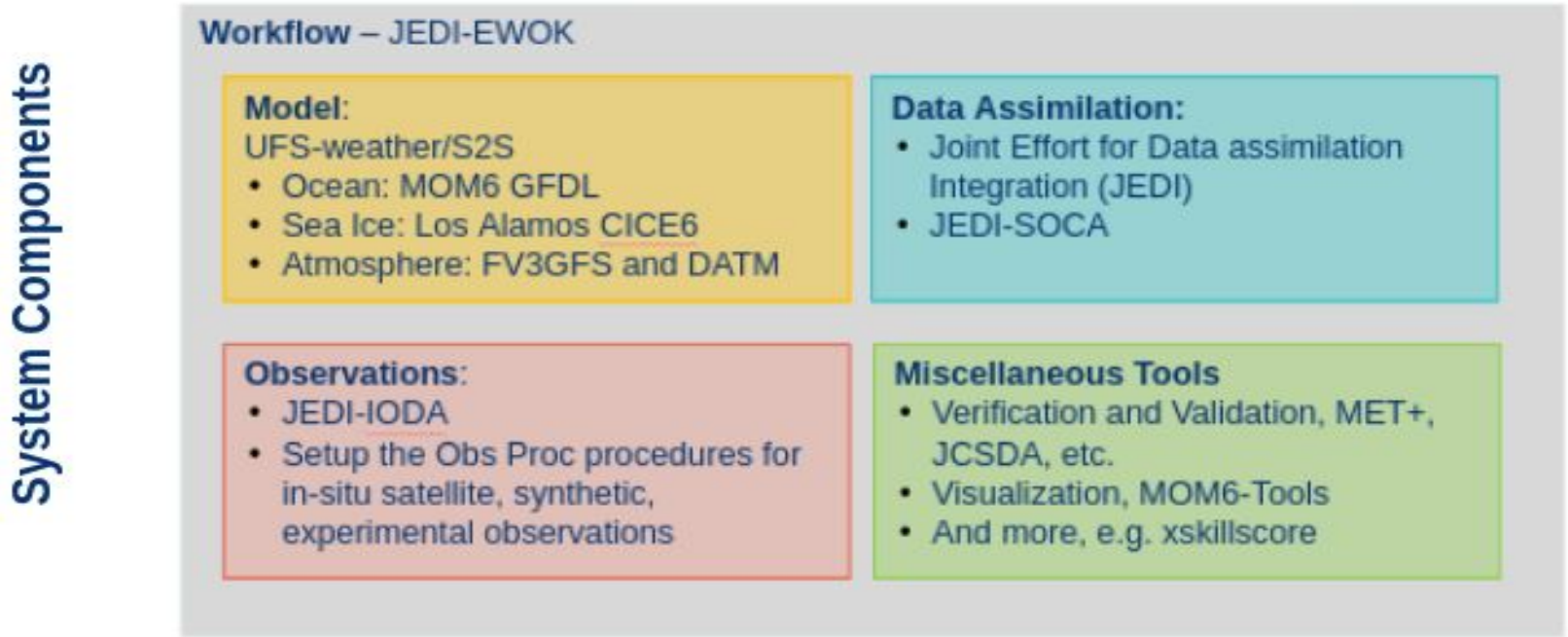
Motivation and Objectives

- **Motivation**
  - No major upgrade of the GODAS operational ocean monitoring system since 2003
  - MOM3/4, no sea-ice, low resolution, univariate 3DVar, limited observation types

- **Objectives & Timelines**
  - **Short-Term:** Interim JEDI/SOCA Reanalysis: sea-ice ocean coupled DA with data atmosphere model for 40 year reanalysis
    - Complete 40 year interim reanalysis (DATM-MOM6-CICE6, 1-deg) by June 30 (**Q3FY21**)
  - **Medium-Term:** GODASv3: High-resolution (¼-deg ocean and sea-ice) analysis for potential operational implementation (**FY22)**
  - **Long-Term:** DA system for UFS-S2S: weakly/fully coupled atmosphere-ocean-sea-ice-wave model (25km atmosphere, ¼-deg ocean and sea-ice, and ½-deg wave model) for GFSv17/GEFSv13 planned for implementation (**FY24)**

DA System for UFS Fully Coupled Model

Requirement: A flexible platform open to the community that supports agile development, promotes experimentation, and integrates ongoing R&D with operation compatibility.



JEDI SOCA Interfaces: MOM6-CICE6

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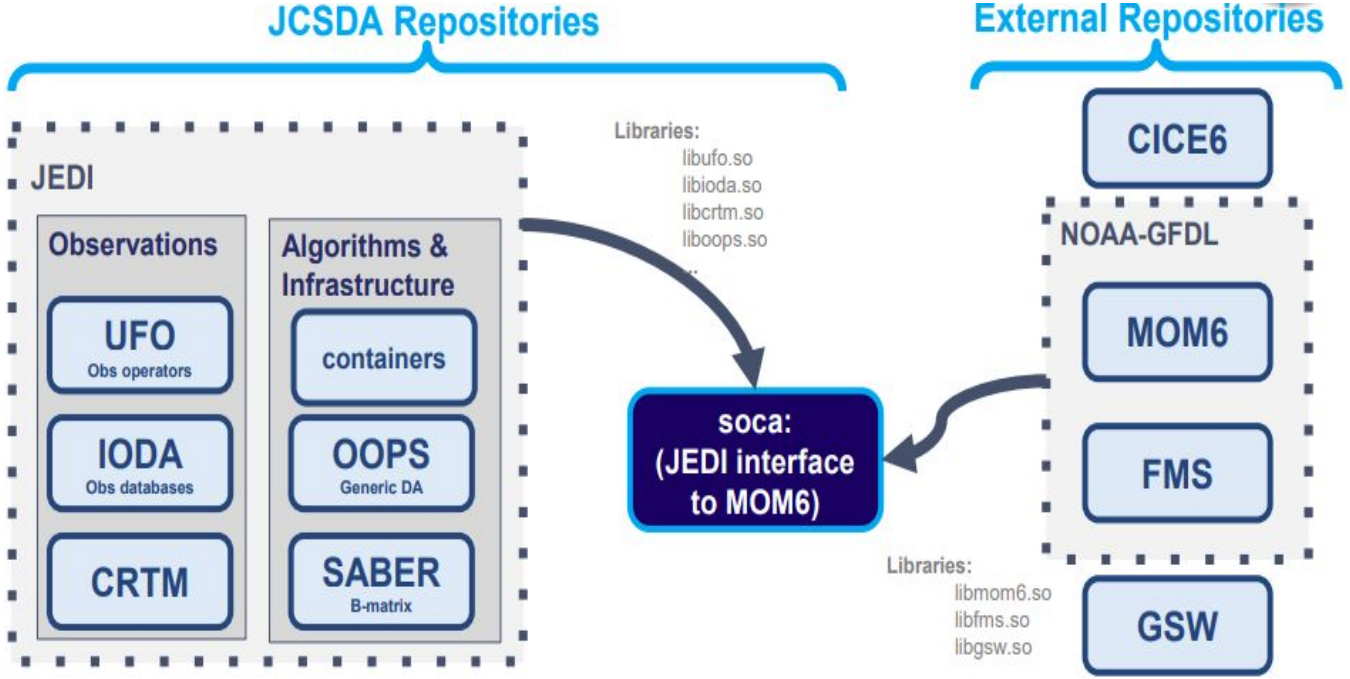
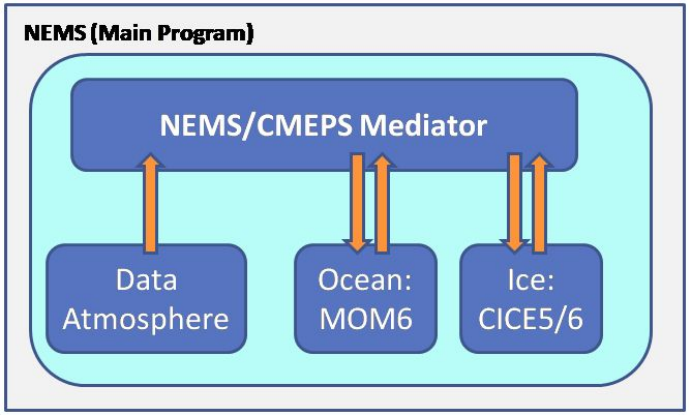


Model System: UFS-marine DA

Requirement: Fast and efficient model for the marine environment, to be used for development, testing and reanalysis of the ocean and sea ice.

The coupled **DATM–MOM6–CICE6** based on NEMS/CMEPS has been developed. In tandem with the FV3-MOM6-CICE6 but without feedback to the atmosphere.

Forcing: NOAA CFSR, GEFS Reanalysis, and weekly 11 member ensemble are available



Ocean: MOM6 (GFDL):

- 0.25° spatial resolution
- 75 layer hybrid vertical coordinates

Sea-Ice: Los Alamos CICE6

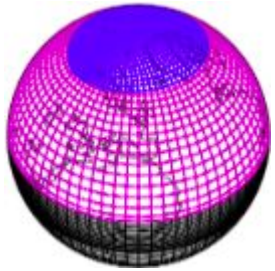
- 0.25° spatial resolution
- Same grid as the ocean
- Default setup with deactivated mushy thermodynamics

Status:

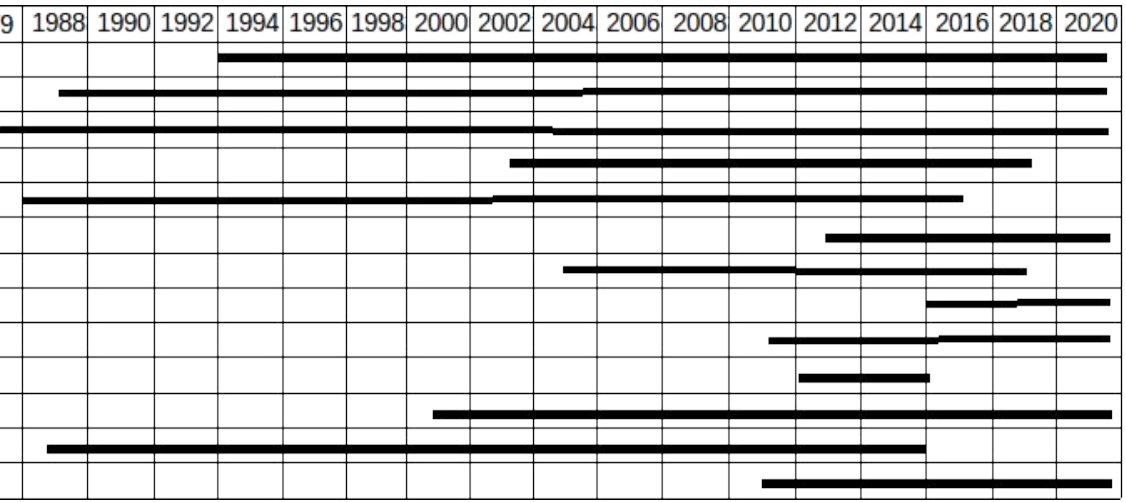
- DATM-MOM6-CICE6 for CPC 40 year reanalysis
- **Continuous UFS-Weather model system update**

Interim NG-GODAS 40 Year Reanalysis

- 40 year reanalysis started from 1979
  - JEDI-SOCA 3DVar and DATM-MOM6-CICE6 1-degree
  - 40 year marine database in JEDI IODA format
  - Various data sources for SST/SSS, In-Situ T/S, sea ice data



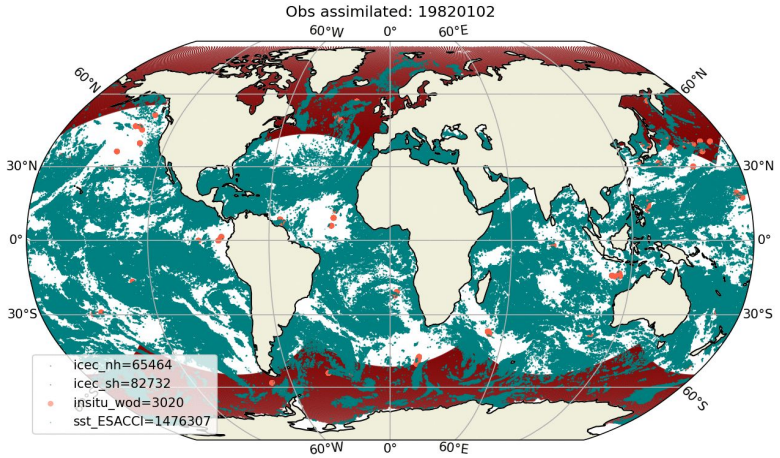
Input stream	Format	Provider	Gb/year	Period
ADT	NC	NESDIS	3G	1993~
In-situ T/S	bin	FNMOC	10G	1988~
In-situ T/S	NC	WOD	10G	1970~
avhrr/sst l3u	NC	NESDIS	160G	2002~2018
avhrr/sst l3c	NC	ESA/CCI		1981~2016
viirs/sst l3u	NC	NESDIS		2012~
windsat/sst l3u	NC	GHRSST	2G	2004~2018
sss/smap		NASA		2015~2020
sss/smos	NC	ESA(l2)/NESDIS(l3)		2010~2020
sss/aquarius	HDF5	JPL		2011~2015
emc_ice	NC	NCEP	80G	2000~
nsidc_ice	NC	NCEI	2G	1988~2015
cryosat2_ice	NC	ESA	150G	2010~



Ongoing NG-GODAS Reanalysis Run

- DATM-MOM6-CICE6: 1-degree in JEDI-SOCA 3DVar framework
  - Passing 26 years as of this week: 1979~2005

Obs type	Date
ADT	1993-2020 (NESDIS)
Satellite SST (AVHRR)	1981-200208 (ESACCI L3U), 200208-201811 (NESDIS L3U)
Insitu (T&S)	1979-2020 (WOD)
SSS	SMOS ESA L2 (2010-2020), SMAP RSS/JPL L2 (2015-2020)
Sea ice Conc	NSIDC L3 SSMR, SSMI (1979-200305), EMC L2 (200306-2020 SSMI, SSMIS)

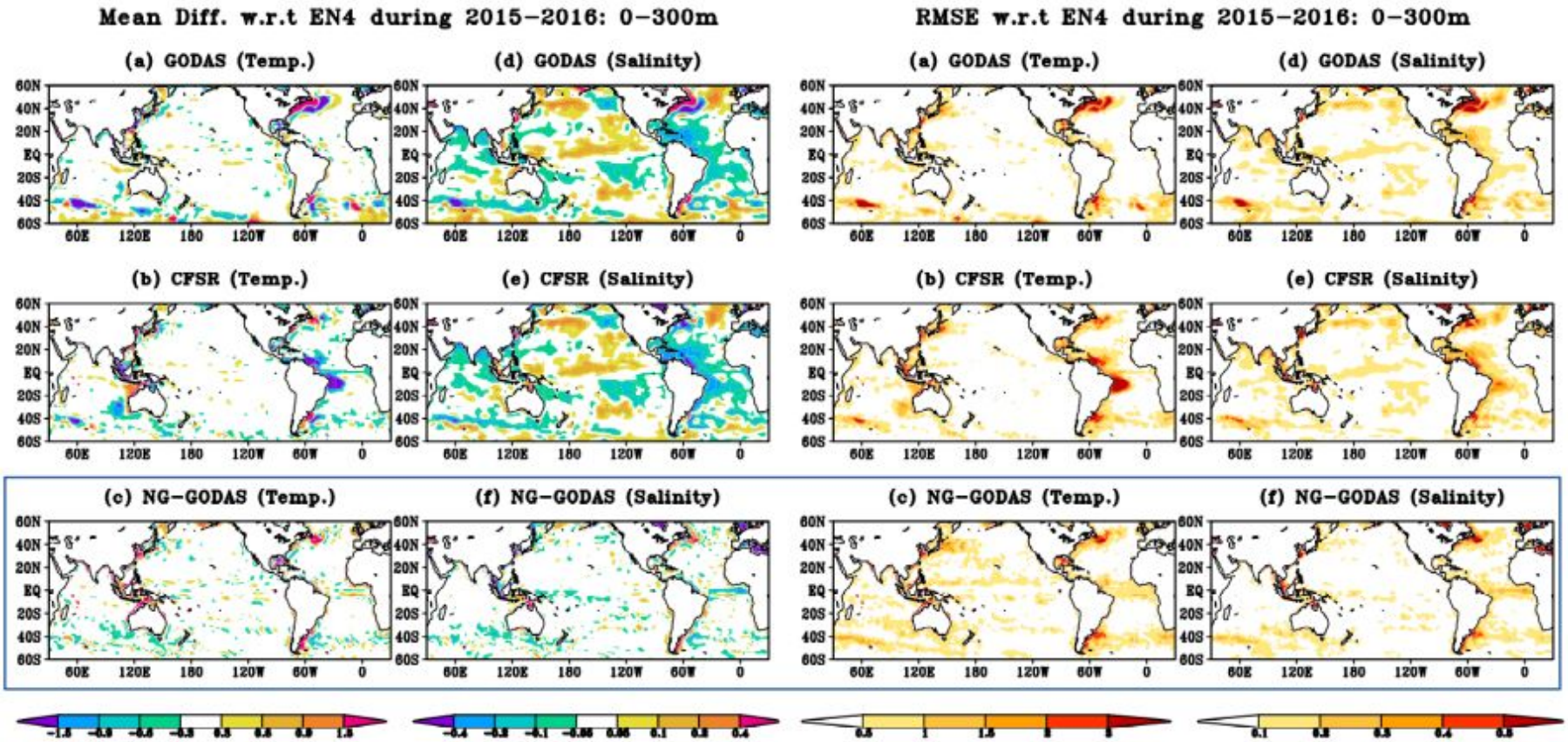


Over 1 Million Observations per day

Accomplishments till date

- Ongoing NG-GODAS renalysis experiment result shows positive impact and it demonstrates the compatibility of the JEDI/SOCA system as a building block of the marine component for the NOAA UFS weakly coupled DA system (GFSv17)
  - DATM-MOM6-CICE6 with CFSR/GEFS forcings
  - Identified model re-configuration needs due to sea ice mass balance issue along in Antarctic coastal grid points
- Compared with the current operational CFSR and GODAS DA systems, the NG-GODAS provides significantly improved analysis result: salinity after 2010 time period
  - Both sea ice concentration and volume are improved
  - Certain level of uncertainties are observed in data quality and CFSR forcing set in the first 20 years of the experiment
- Plan to complete the production run by the end of June, 2021
  - Extensive evaluation report will be available by Q3/FY21

NG-GODAS/NOAA-ODAs: compared with UK-MET EN4



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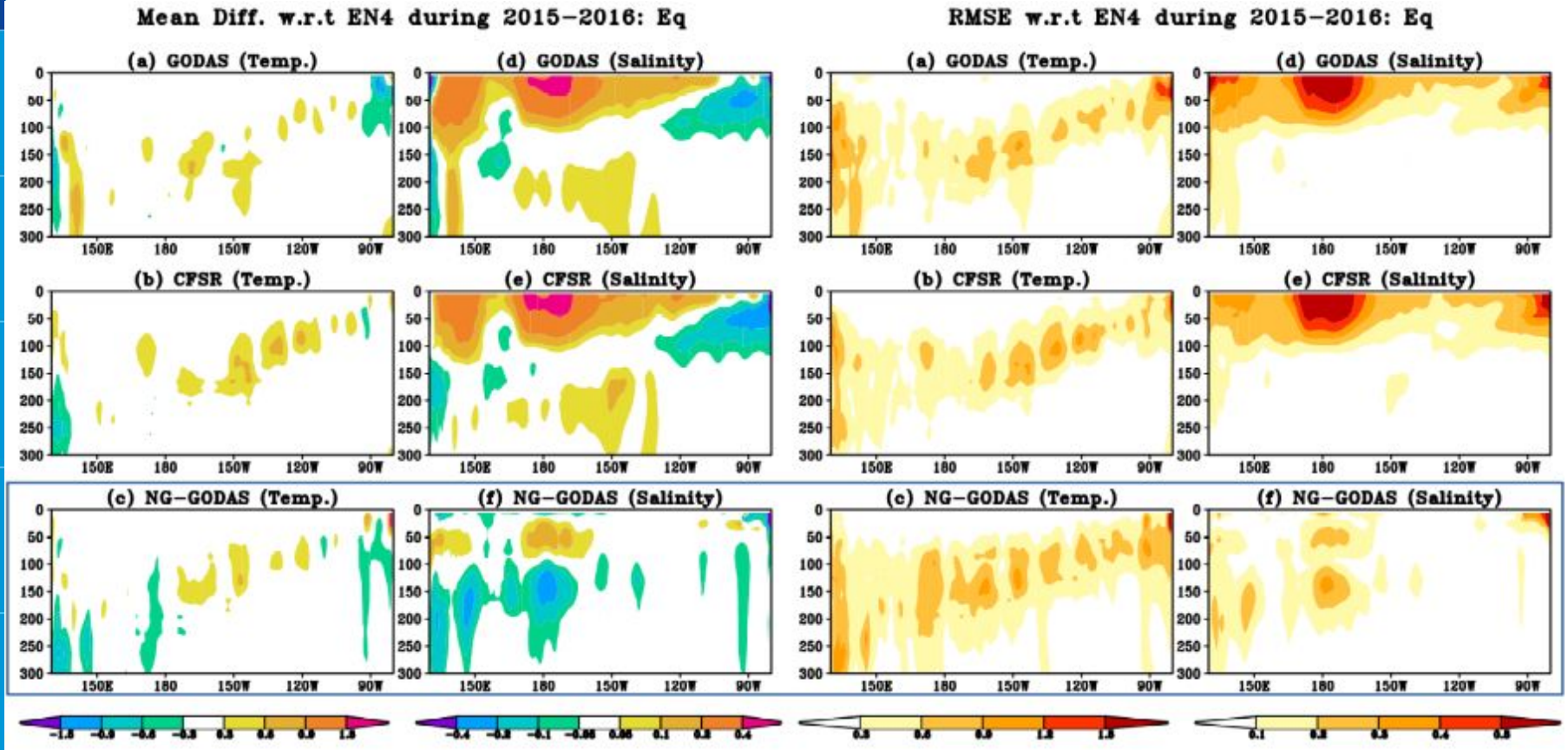
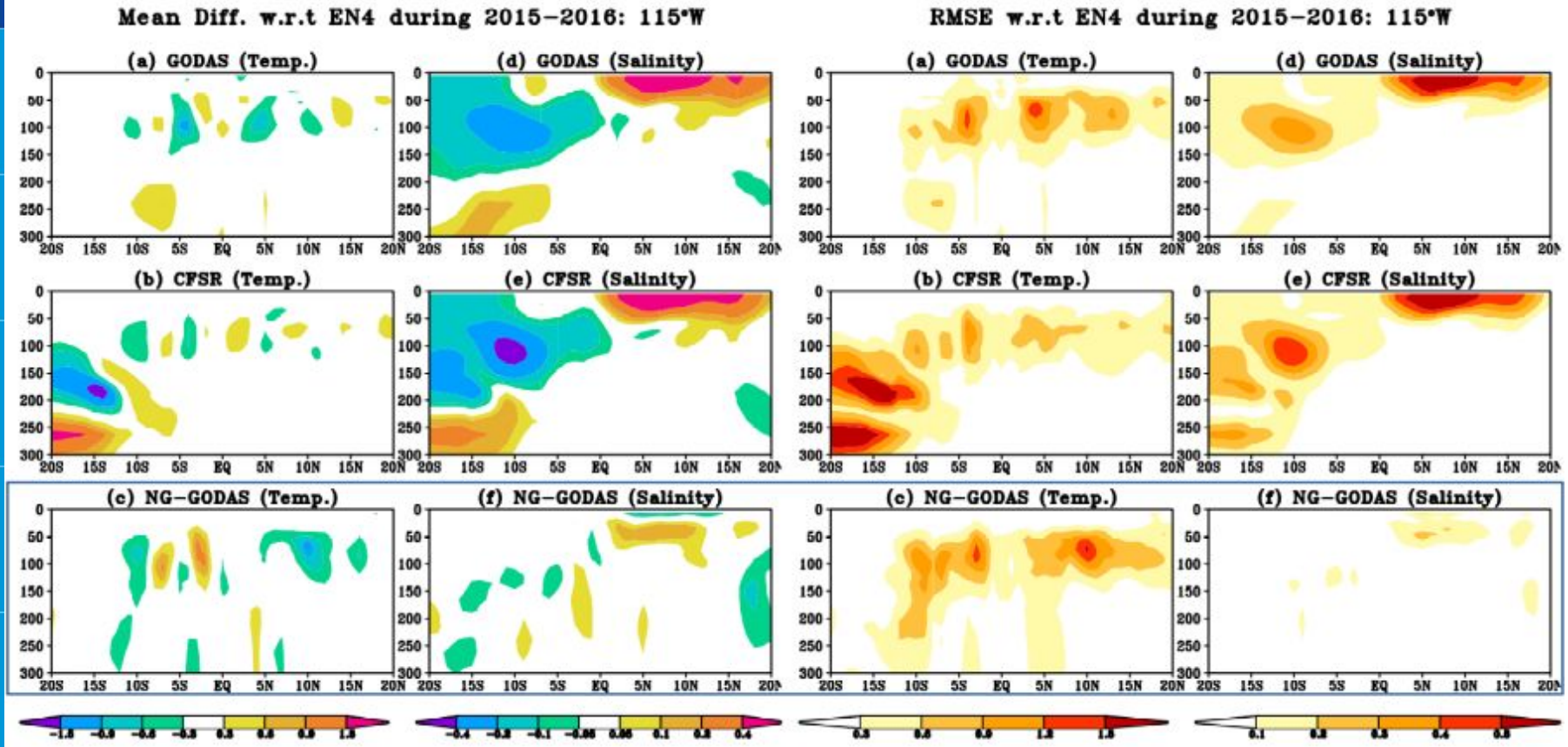
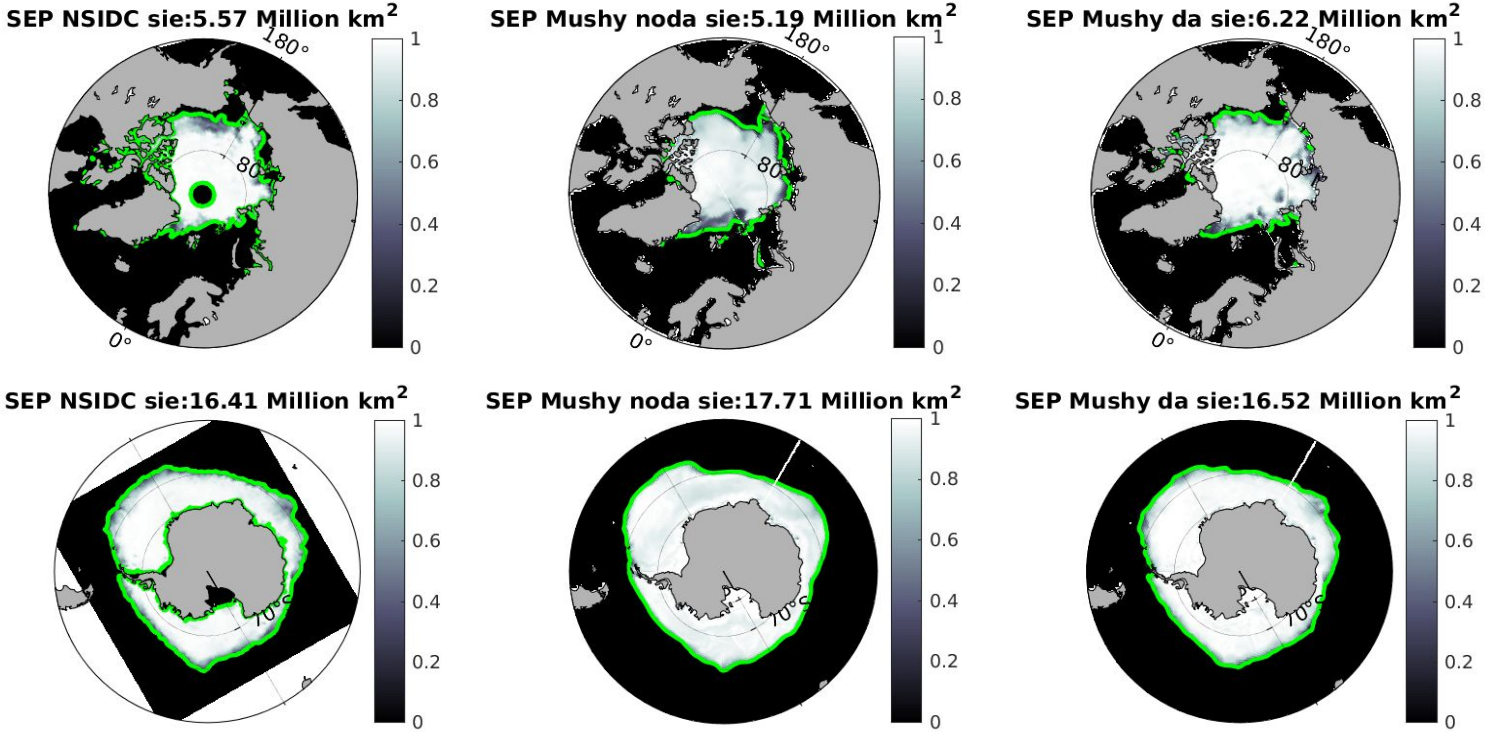


NG-GODAS/NOAA-ODAs: compared with UK-MET EN4



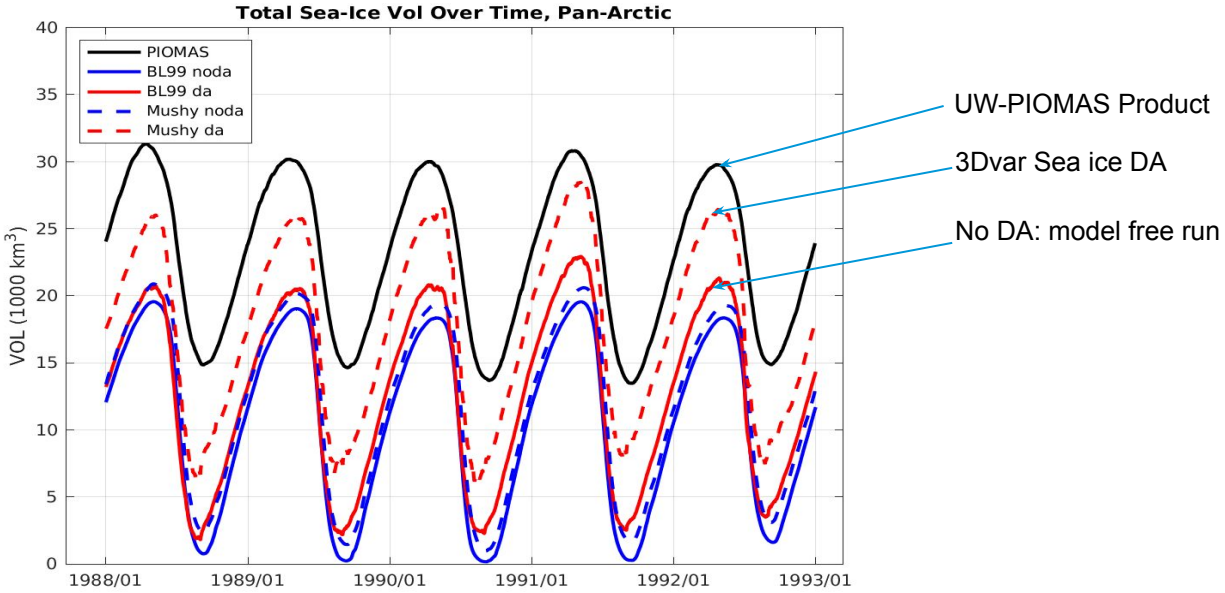
Sea-ice Concentration (2001 SEP mean)

- NSIDC obs (left) vs model free run (middle) vs reanalysis (right)



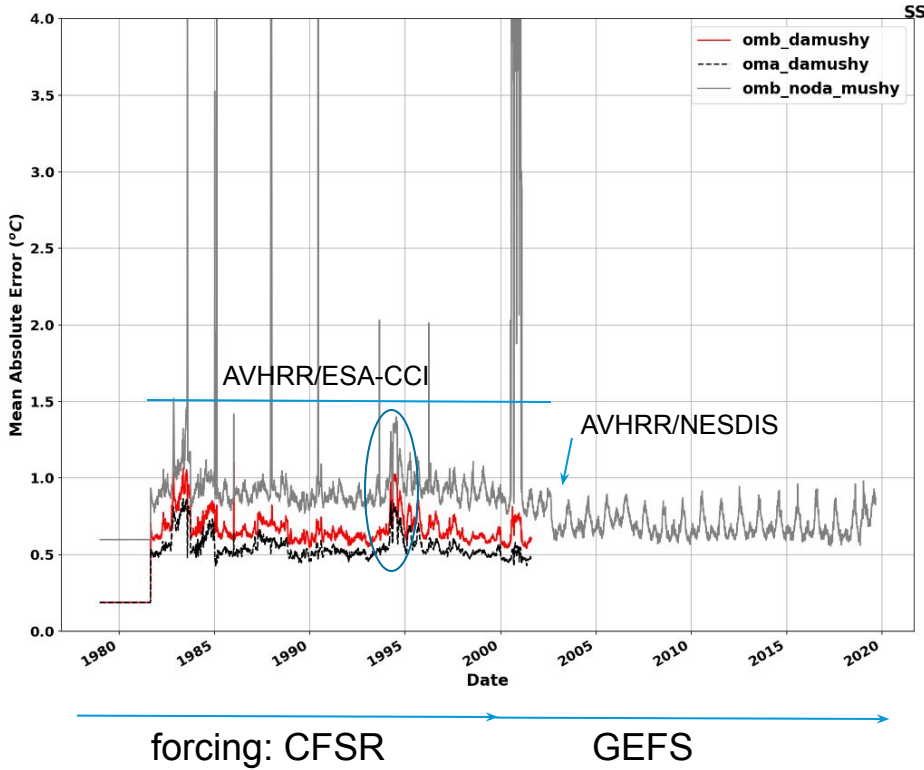
Sea-ice total volume

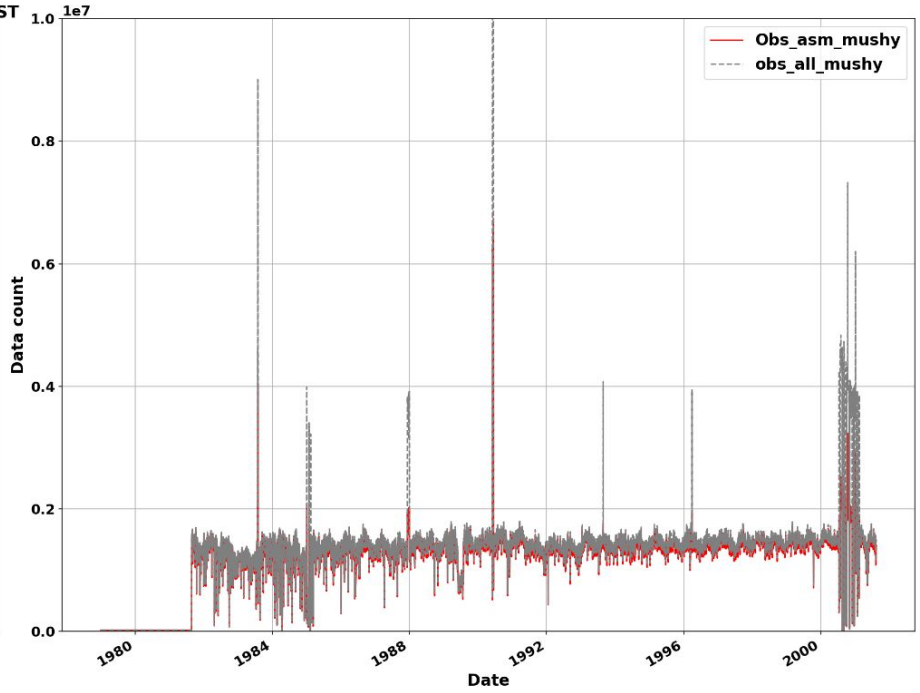
- Sea ice total volumes of model free run and reanalysis experiments are compared to the University of Washington PIOMAS sea ice product
- Two different renalysis experiments were conducted for the options of different sea ice thermodynamic and initial condition sets



Backup Slides by the week of May 10

Observation-minus-model and count stats





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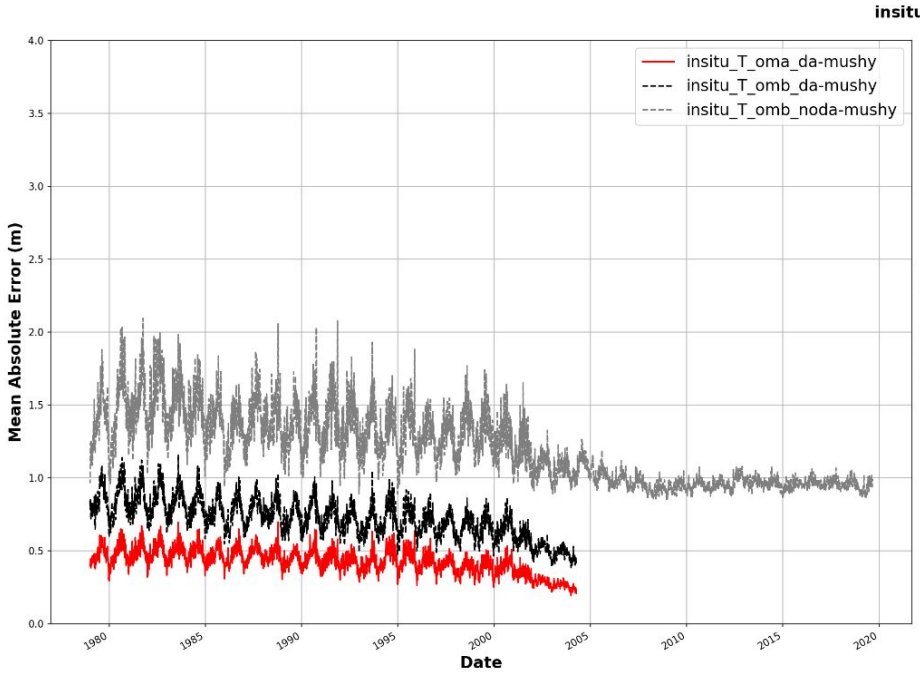

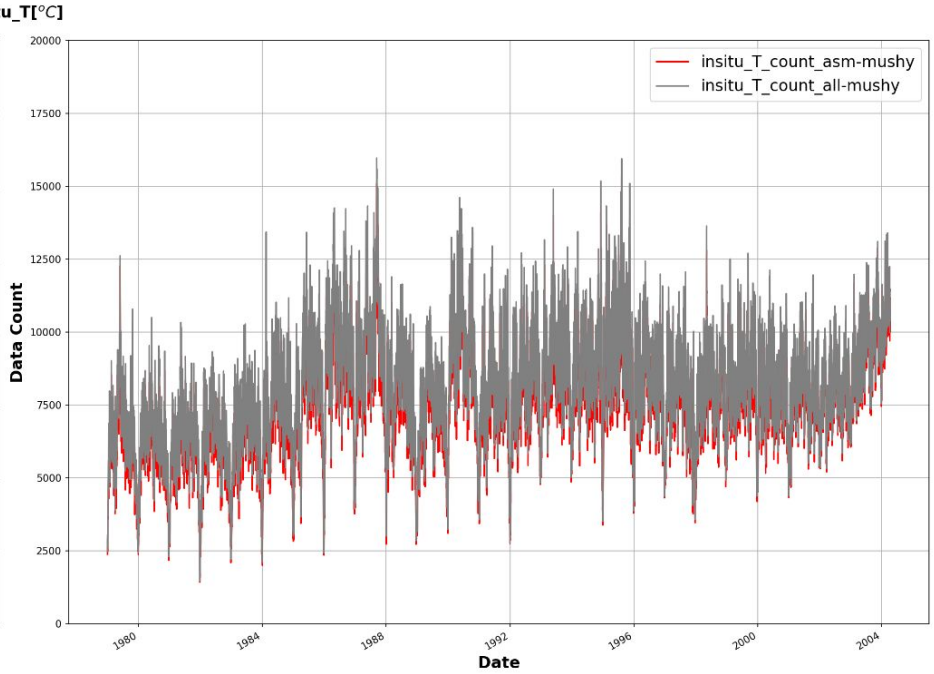

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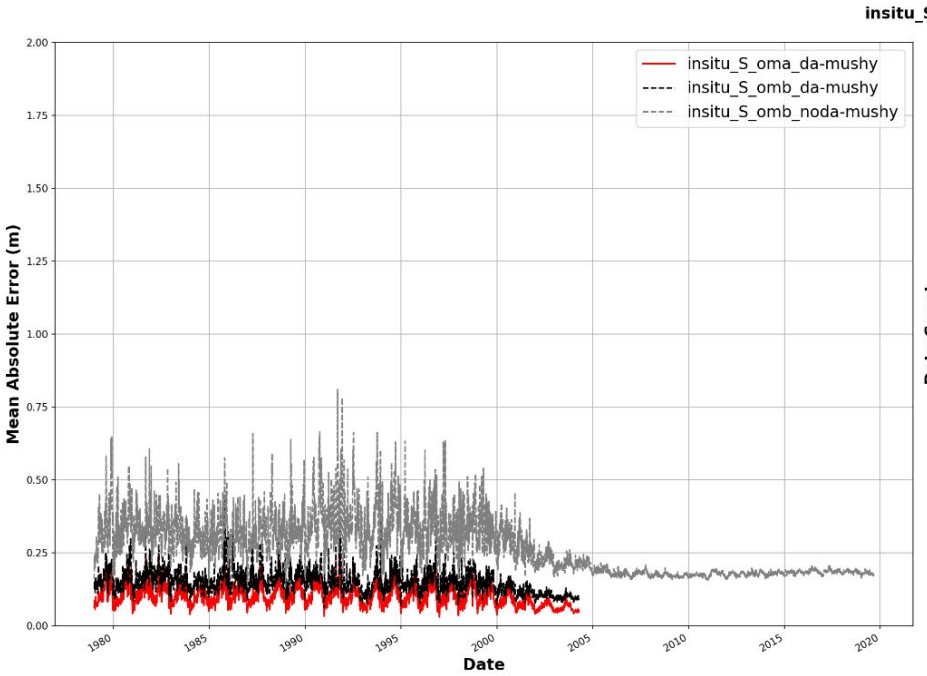

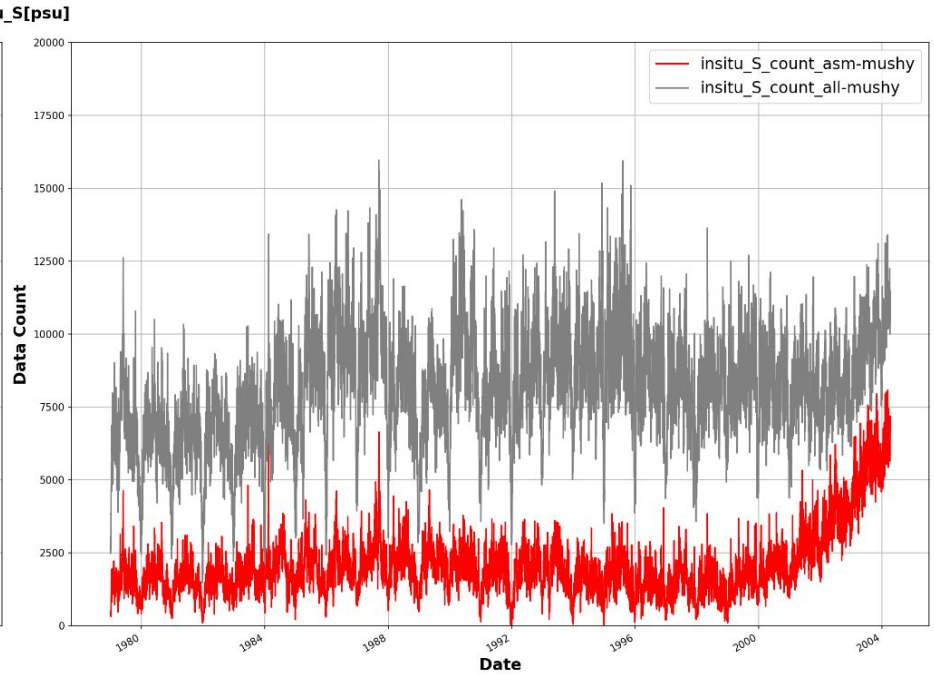

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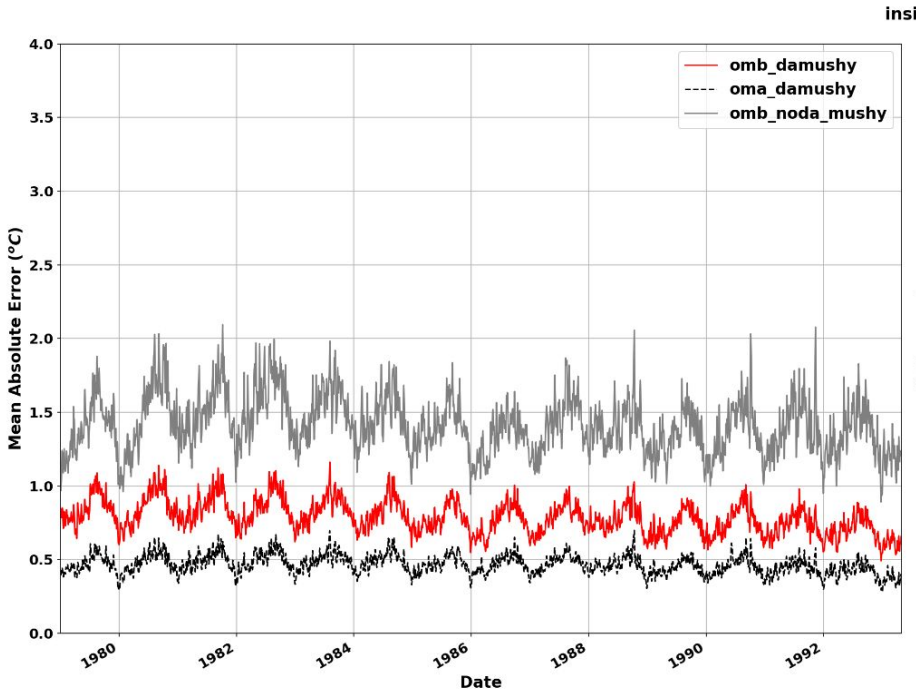

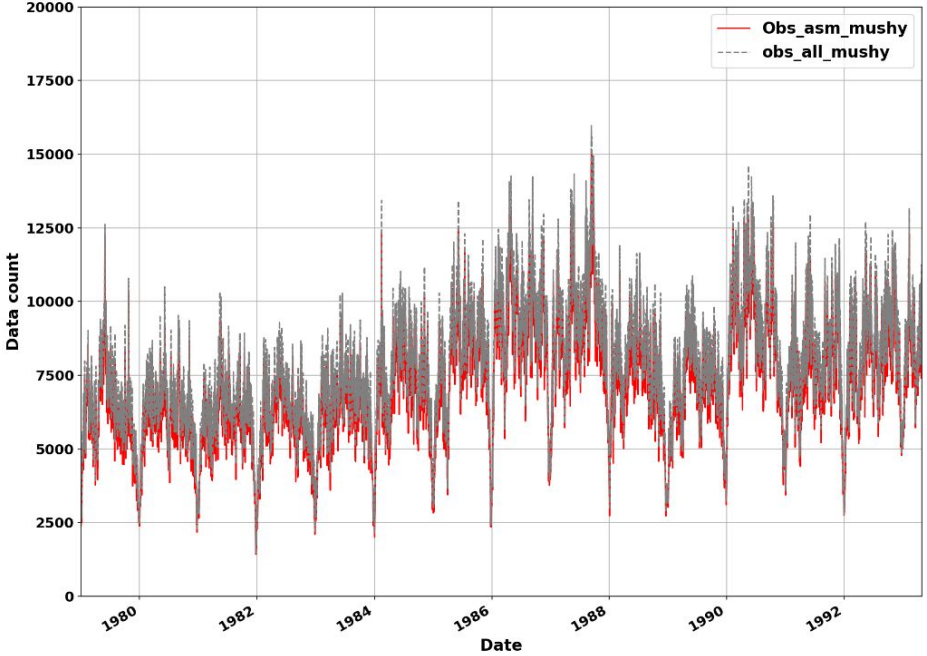

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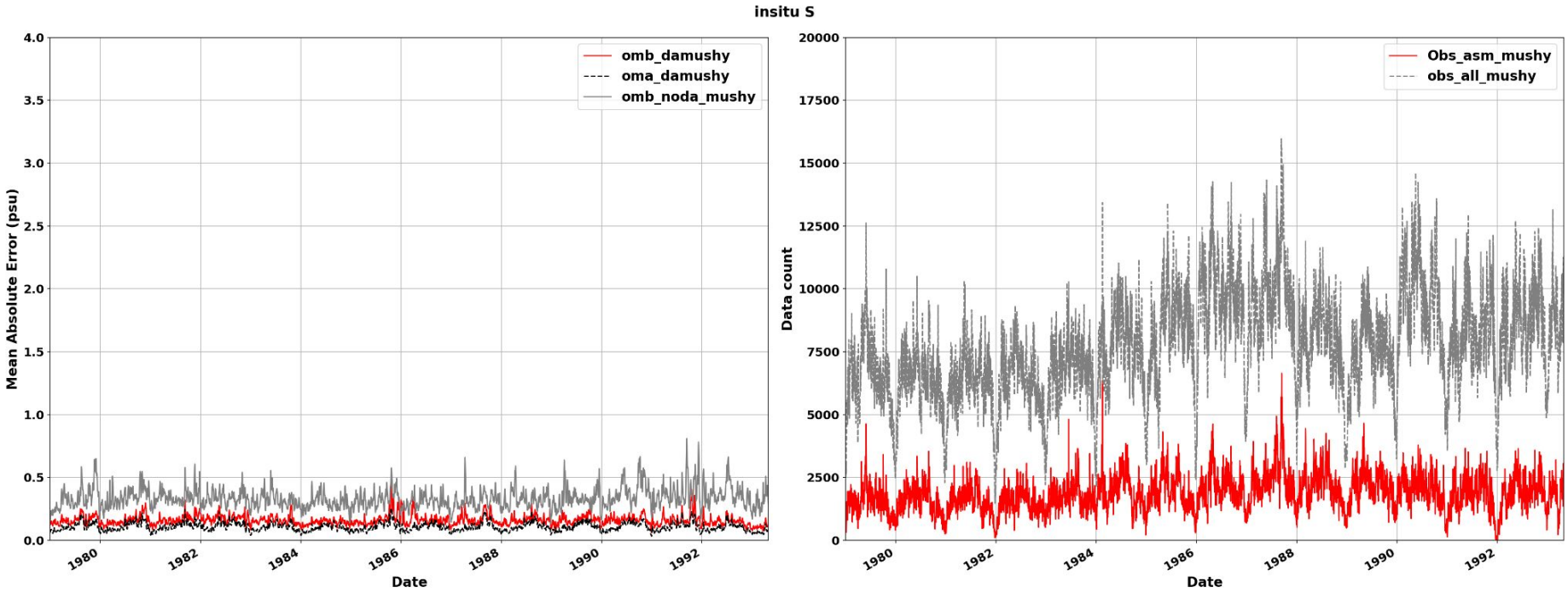

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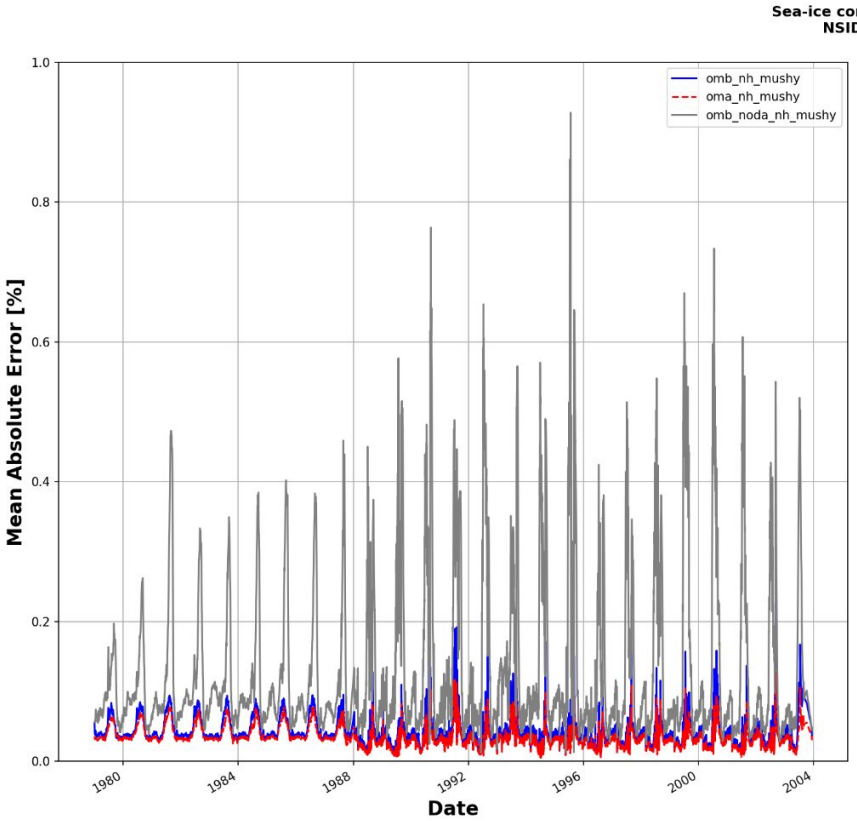

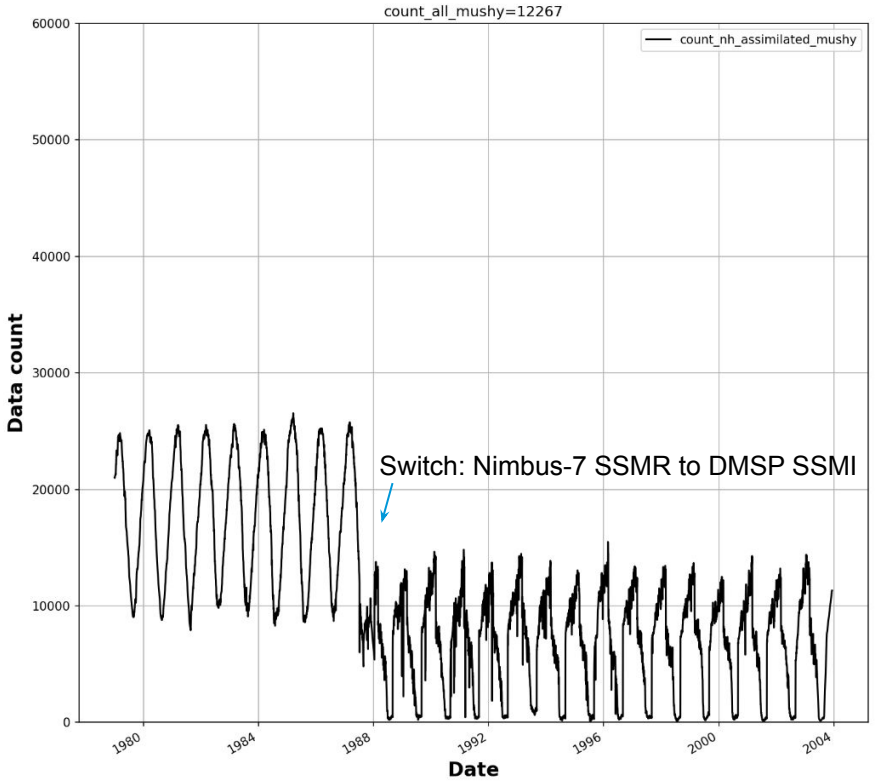

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