An Improved In Situ and Satellite SST Analysis

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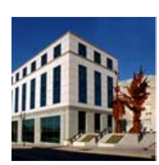
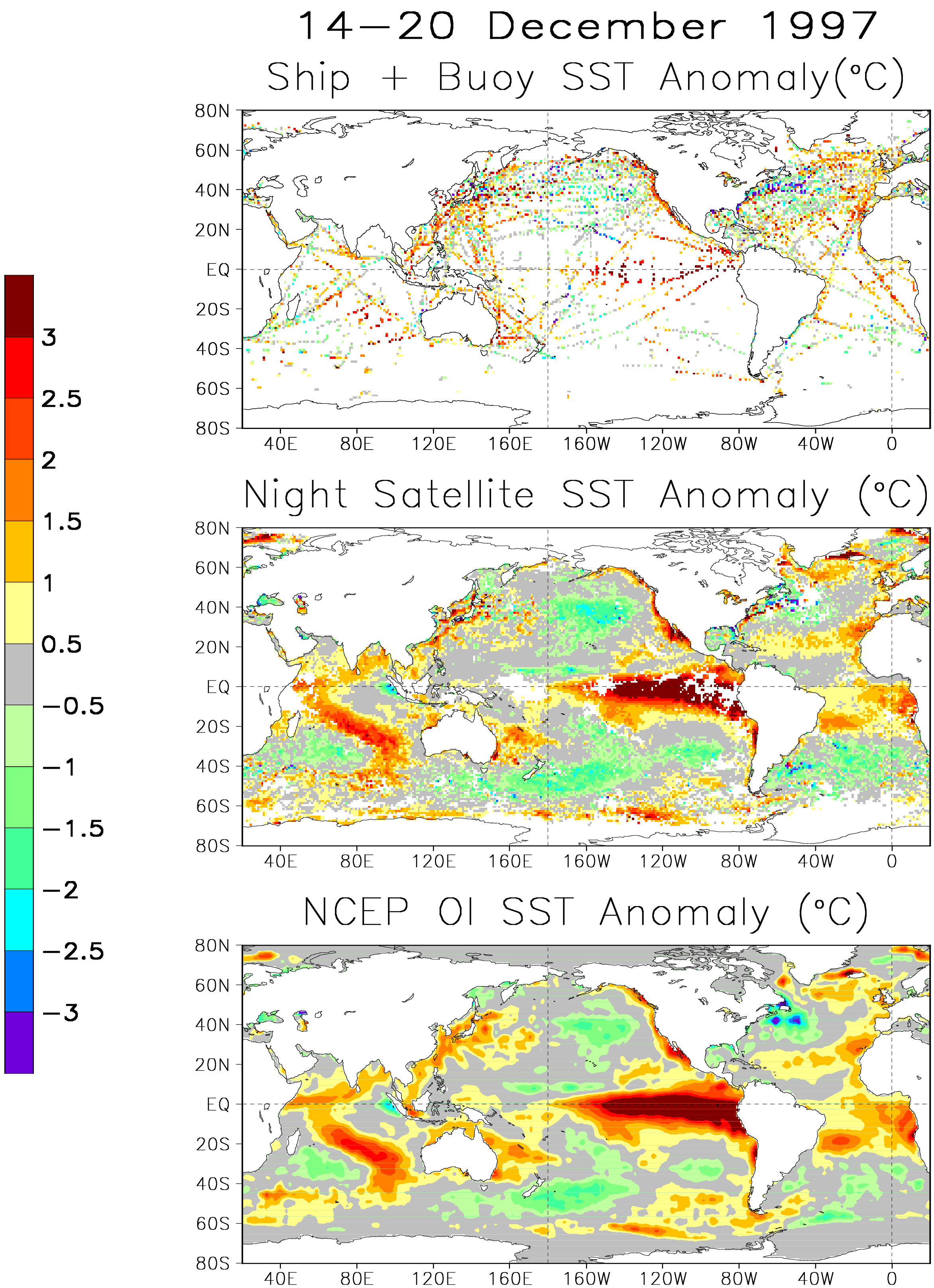


Introduction

- Examine SST Differences for 1982 – present
  - Focus on climate scales SSTs
- Discuss Changes in NOAA OI
  - OI version 2 (OI.v2)
- For Discussion
  - NCDC Work Plan
  - SST Working Group Plan
  - Skin vs. Bulk Problem

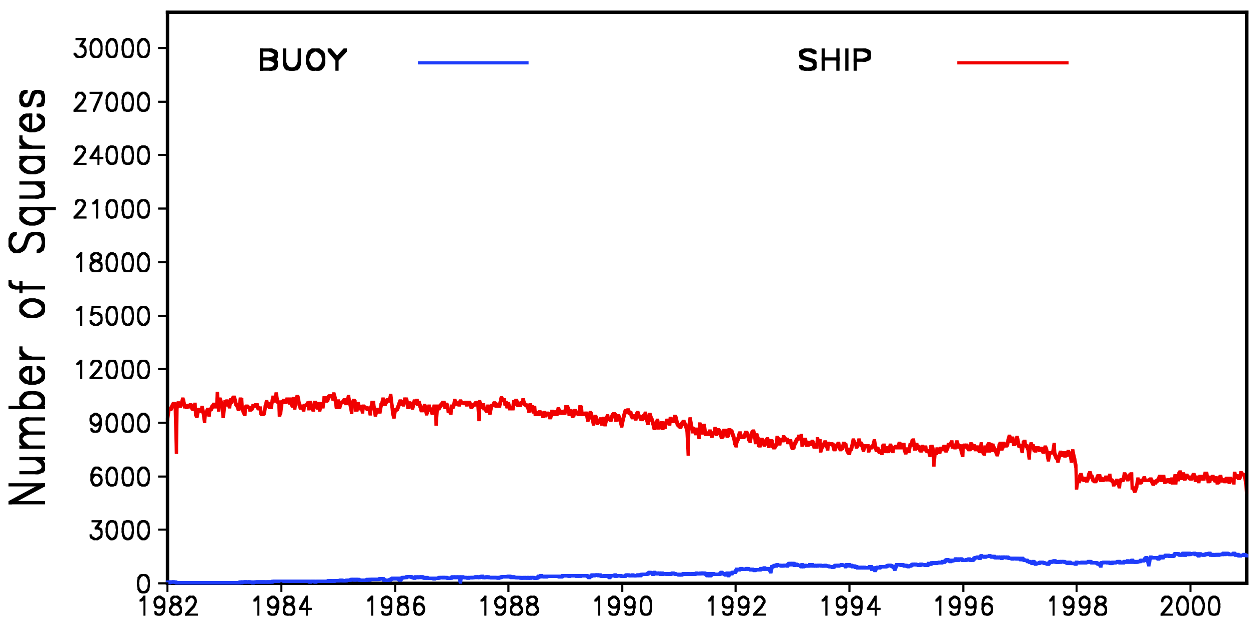
SST Anomaly Data and Analysis



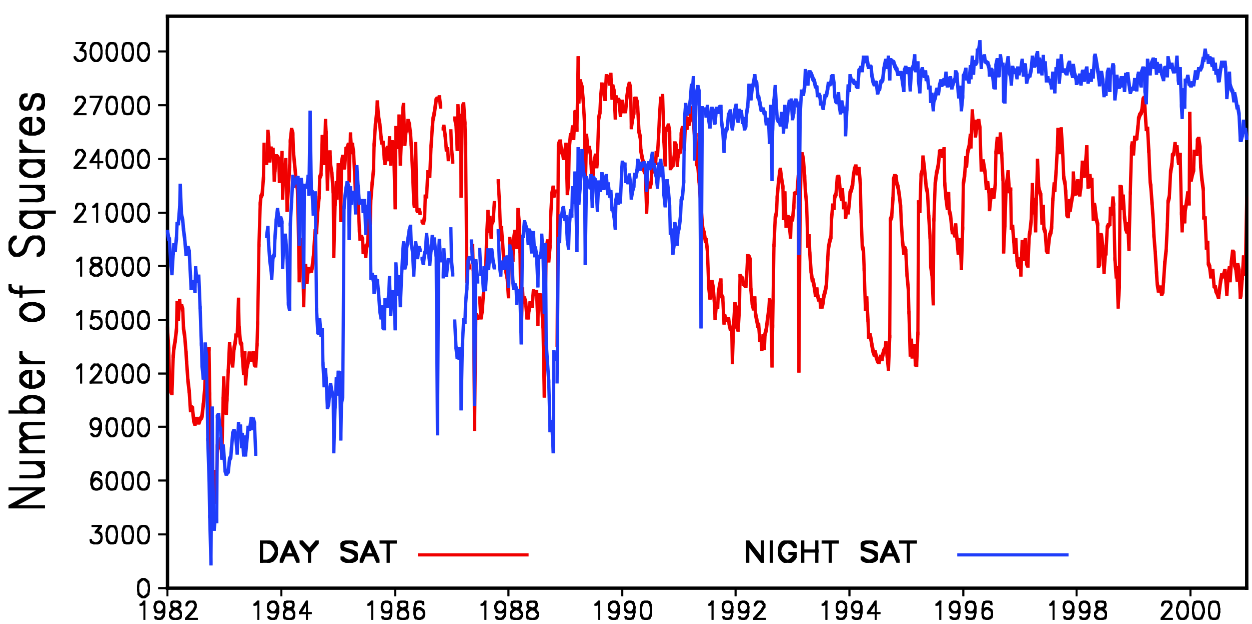
Data Coverage

Latitude Range: 60°S–60°N

In Situ 1° Data Squares



Satellite 1° Data Squares



Ship Minus Buoy Differences

on 1^o weekly collocated grid

Region	No. Pairs	Bias
60^{o}S_20^{o}S	17,753	0.08^{o}C
20^{o}S_20^{o}N	45,605	0.04^{o}C
20^{o}N_60^{o}N	160,180	0.17^{o}C
60^{o}S_60^{o}N	223,538	0.14^{o}C

All weeks: 1982-2000

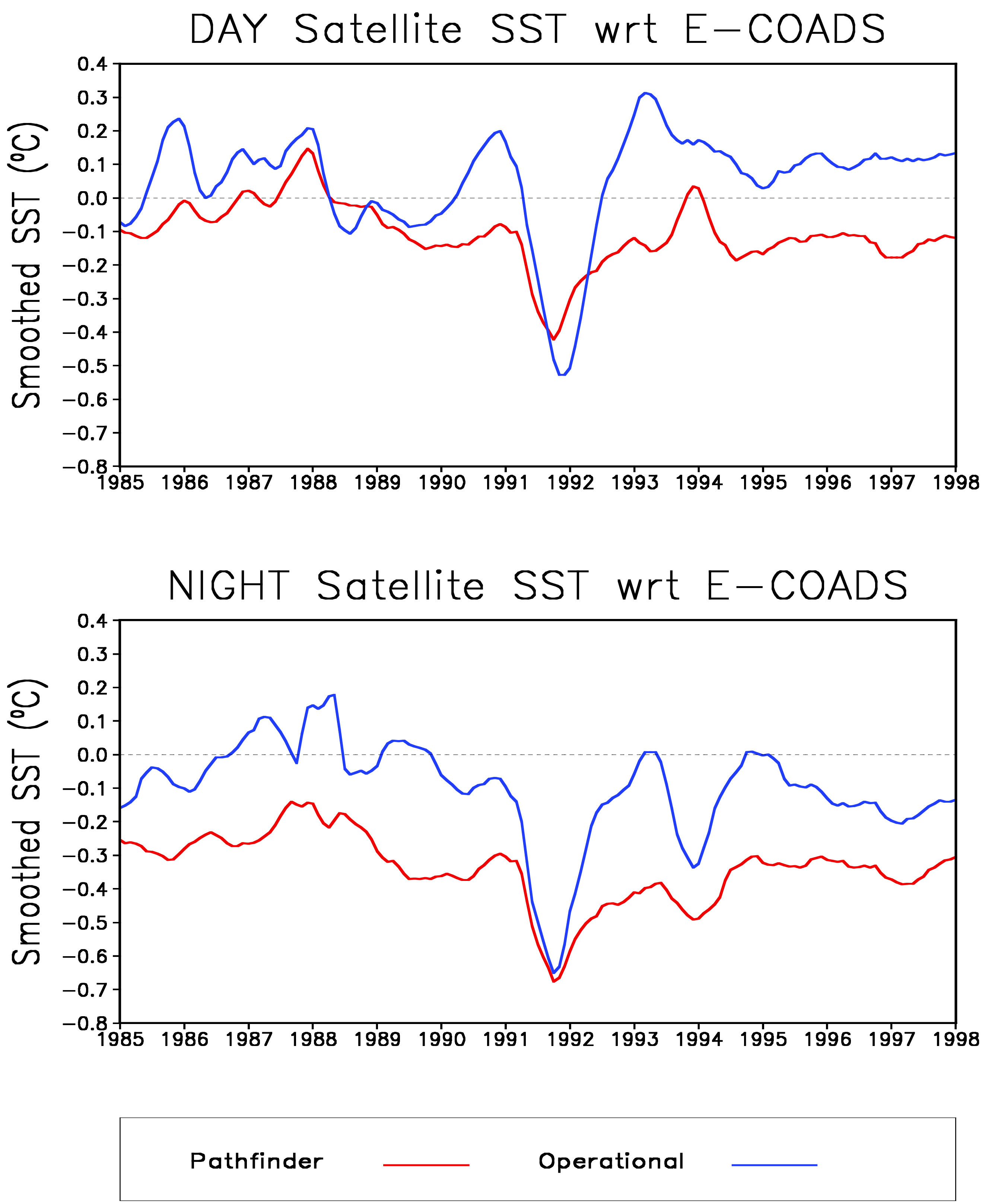
Monthly Data Summaries

- In Situ Data from the Comprehensive Ocean-Atmosphere Data Set (COADS)
  - Reference data set for intercomparisons
  - Version: enhanced COADS (E-COADS)
- Satellite AVHRR Retrievals

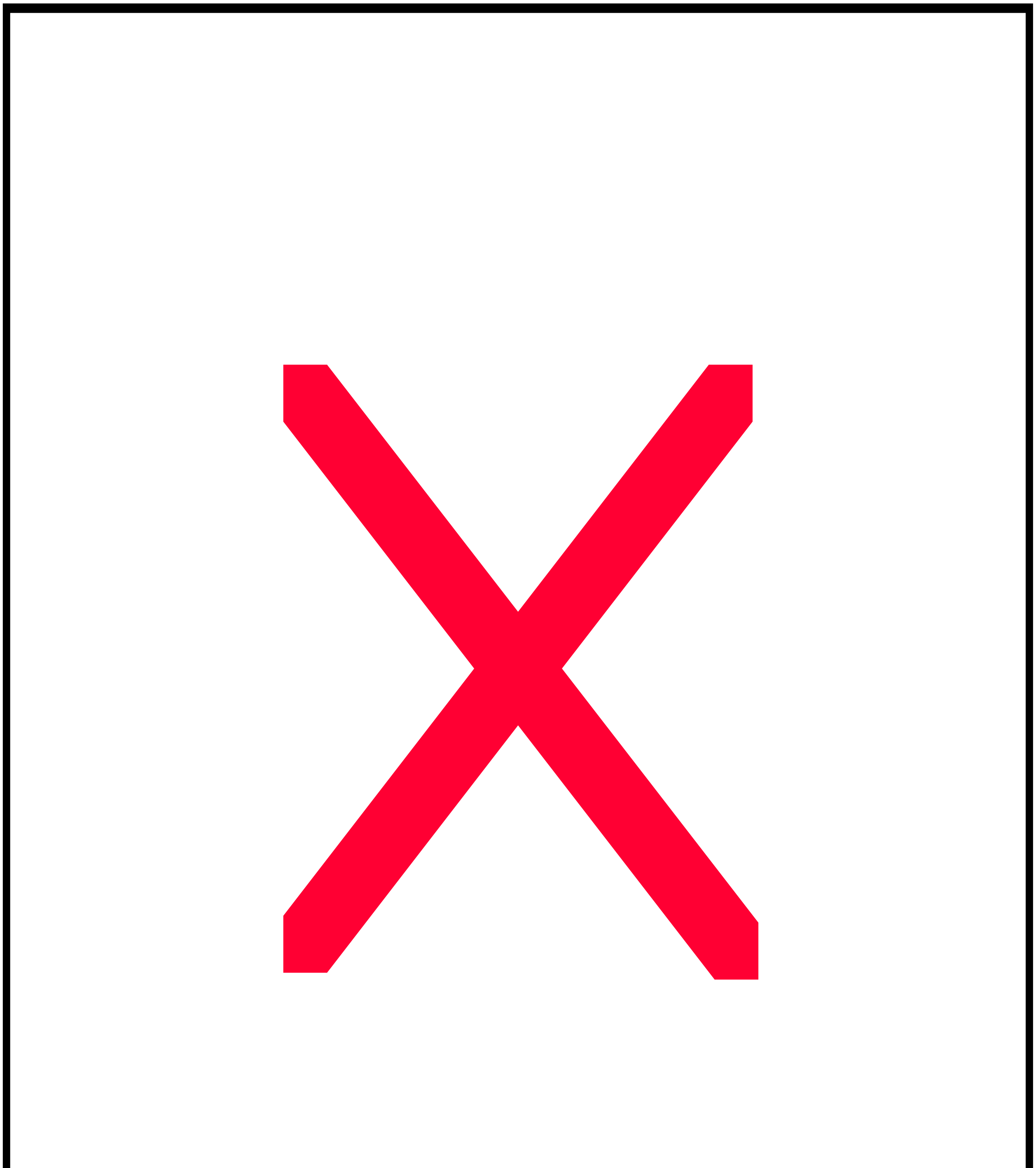
  (tuned with respect to buoys)
  - Operational
    - Daytime
    - Nighttime
    - Algorithm: RSMAS/NESDIS/US Navy
  - Pathfinder (Reanalysis)
    - January 1985 – December 1997
    - Daytime
    - Nighttime
    - Algorithm: RSMAS/JPL

Satellite Data wrt E-COADS

Latitude Range: 60°S–60°N



Nighttime Satellite wrt E-COADS
Pinatubo period excluded



SST Analyses

All use in situ & operational AVHRR data

- NOAA OI.v1
  - Reynolds and Smith, 1994, Journal of Climate
- NOAA OI.v2
  - Reynolds, Rayner, Smith, Stokes and Wang, 2002, Journal of Climate, in press
    - Used UK sea-ice to SST algorithm based on climatological fit
    - Used COADS data through 1997
- UK Global sea-Ice and SST (GISST)
  - Rayner, Horton, Parker, Folland, Hackett, 1996, unpublished manuscript
- UK Hadley Centre sea-Ice and SST (HadISST)
  - Parker, Rayner, Horton and Folland, 1999, WMO Workshop on Advances in Marine Climatology-CLIMAR99

Use Historic Collocated SST and Sea Ice

Satisfy the equation

$$SST = a I^2 + b I + c$$

Where

I is the fraction of ice (0.15 - 0.9)

a, b, c are fitted coefficients

With restriction

For the Open Ocean

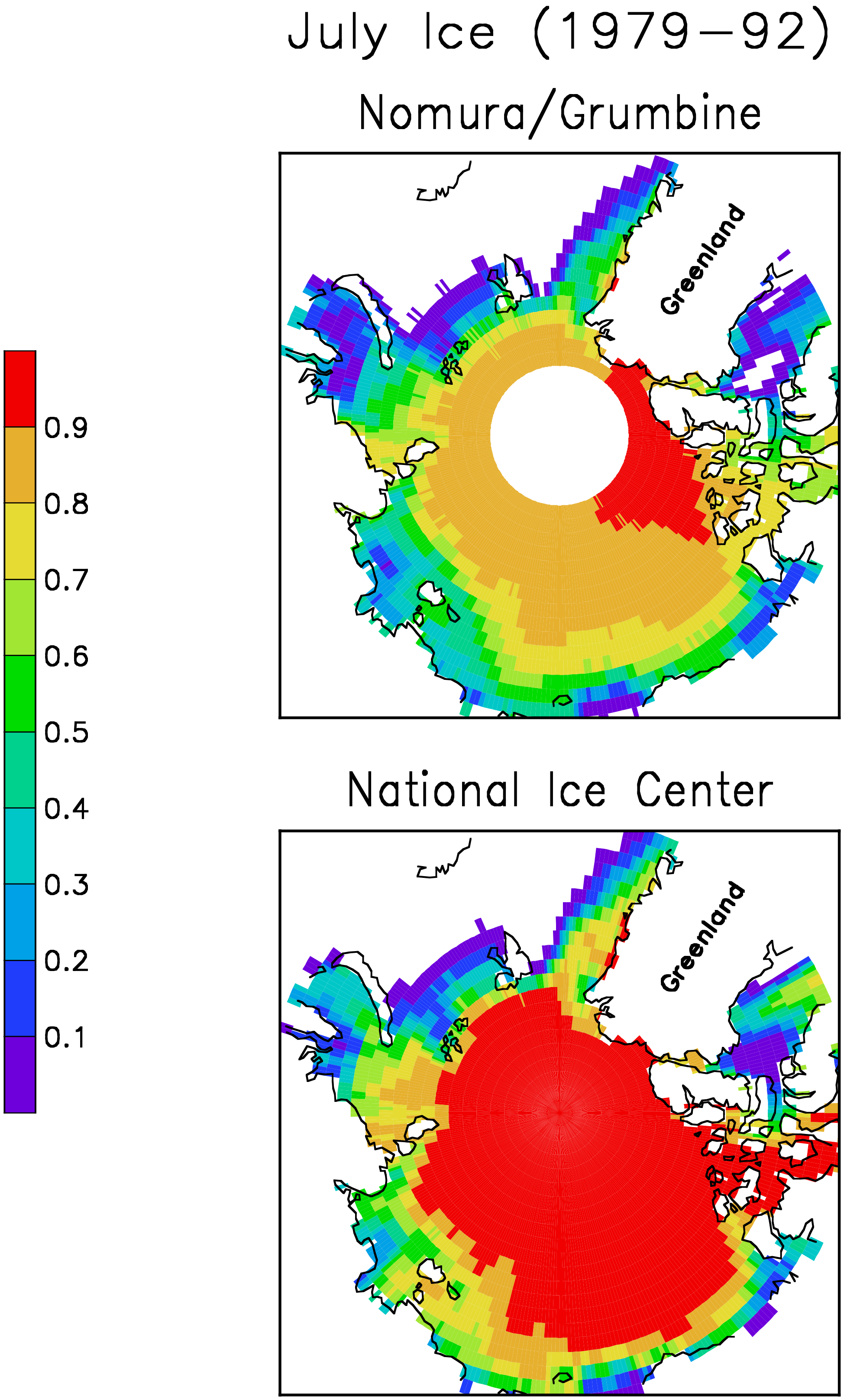
$SST = -1.8^oC$ for $I = 0.9$

For the Great Lakes

$SST = 0^oC$ for $I = 0.9$

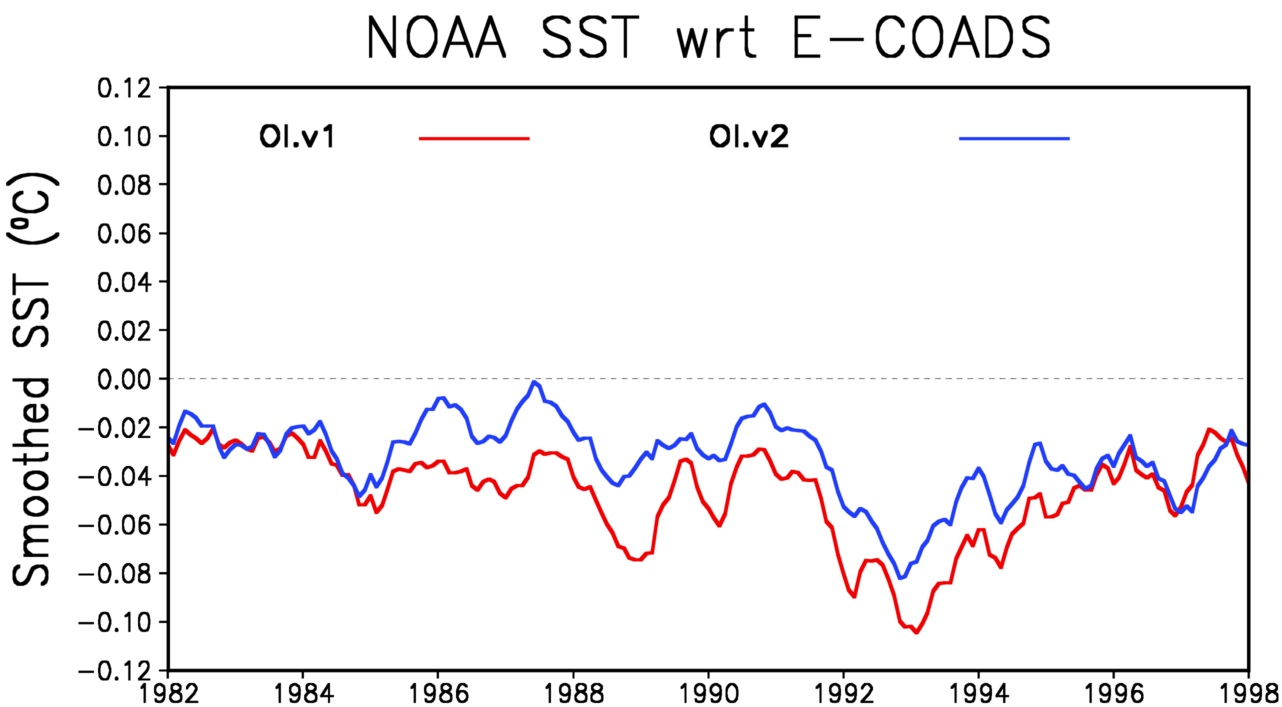
Fit done by season in 31^o longitude bands

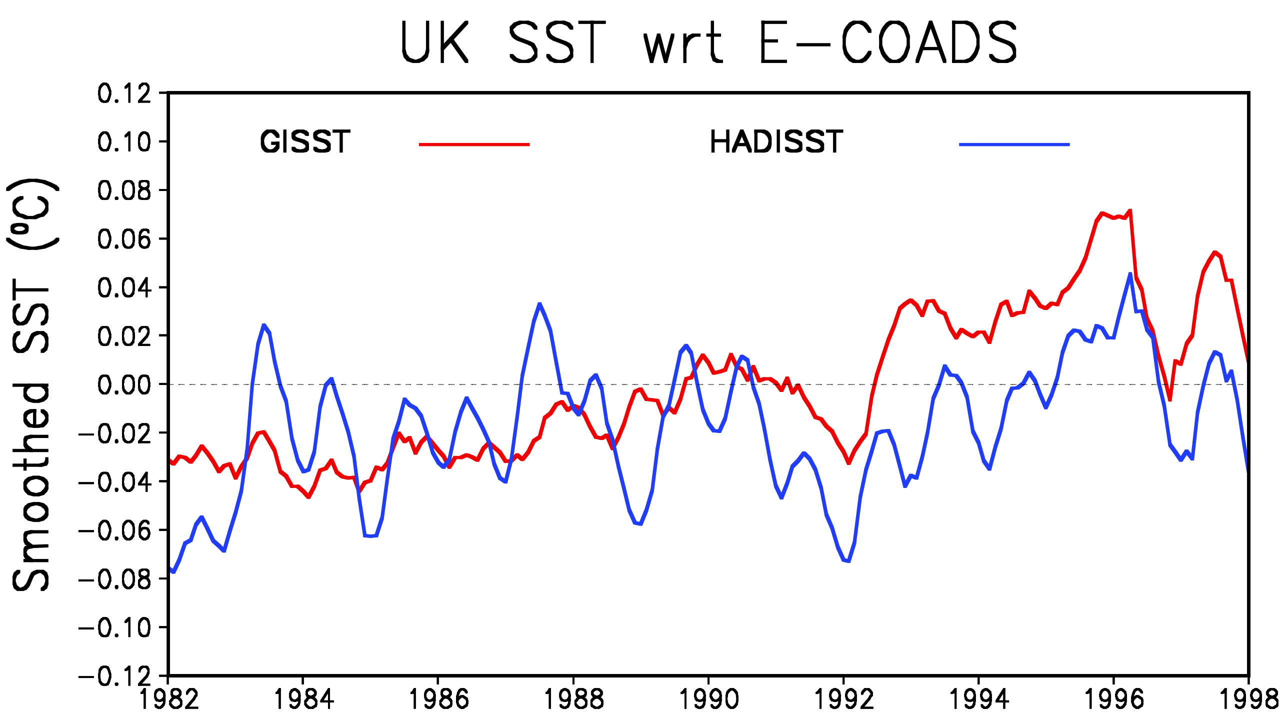
Sea-Ice Climatologies



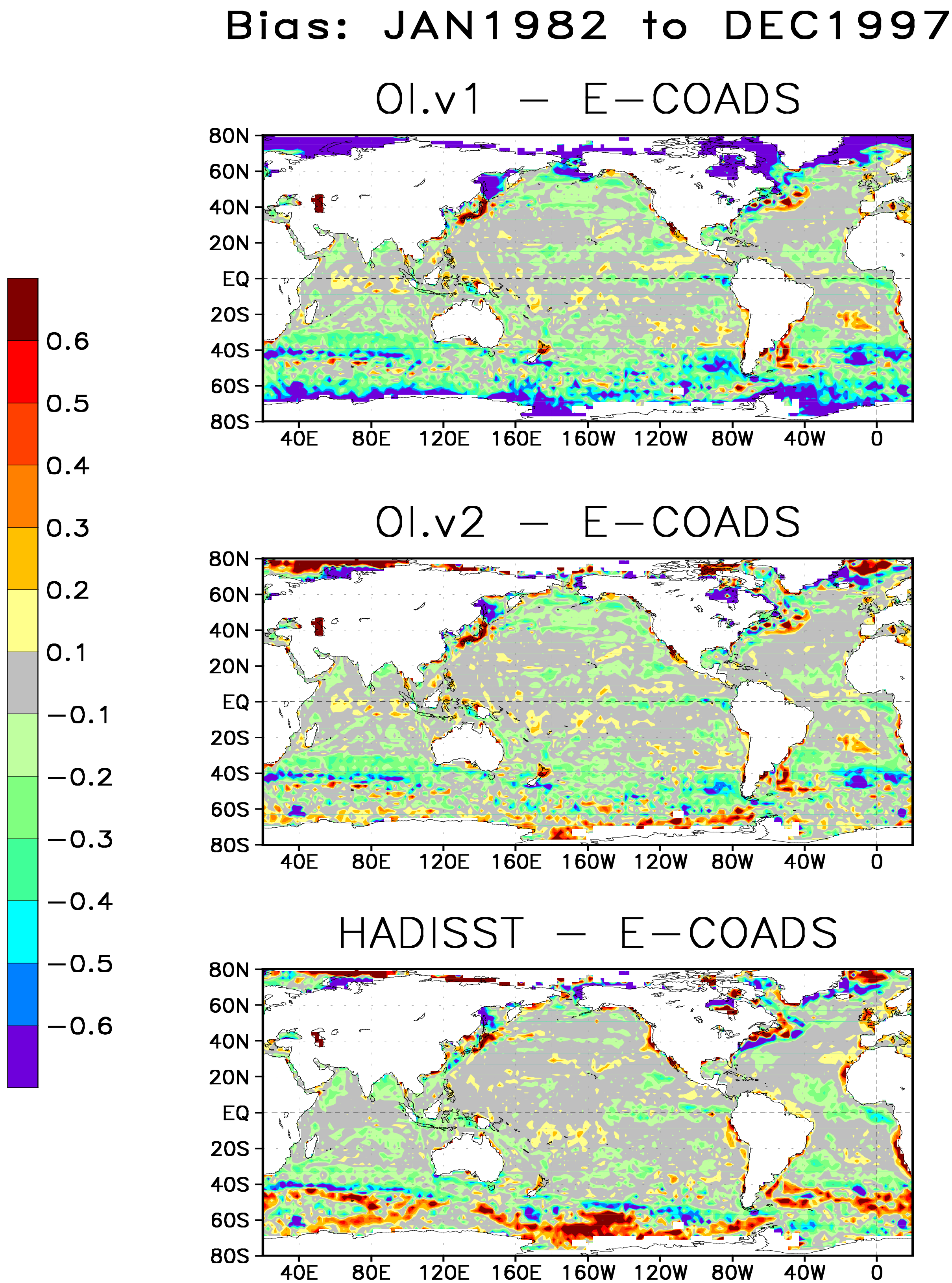
Analysis Differences wrt E-COADS

Latitude Range: 60°S–60°N

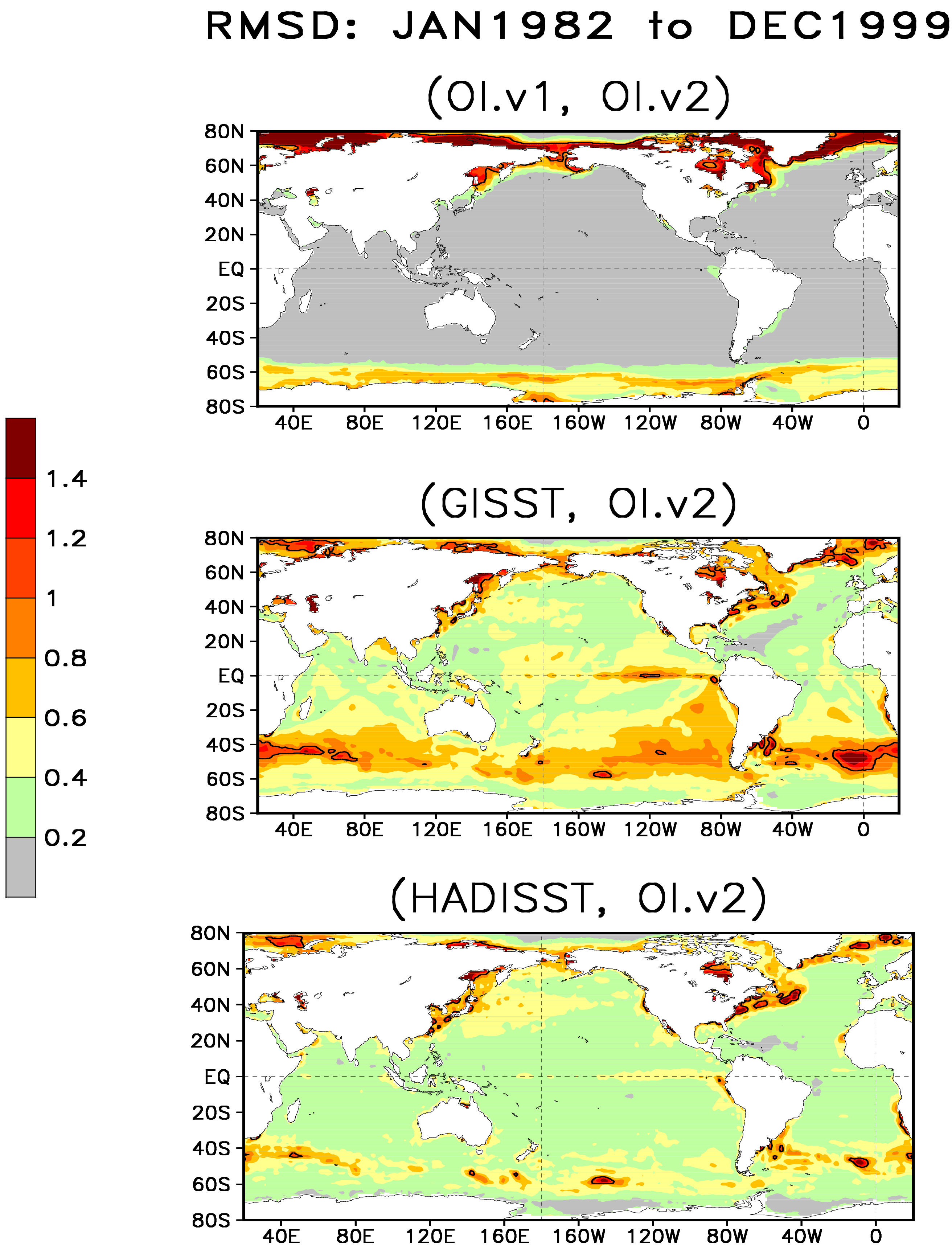




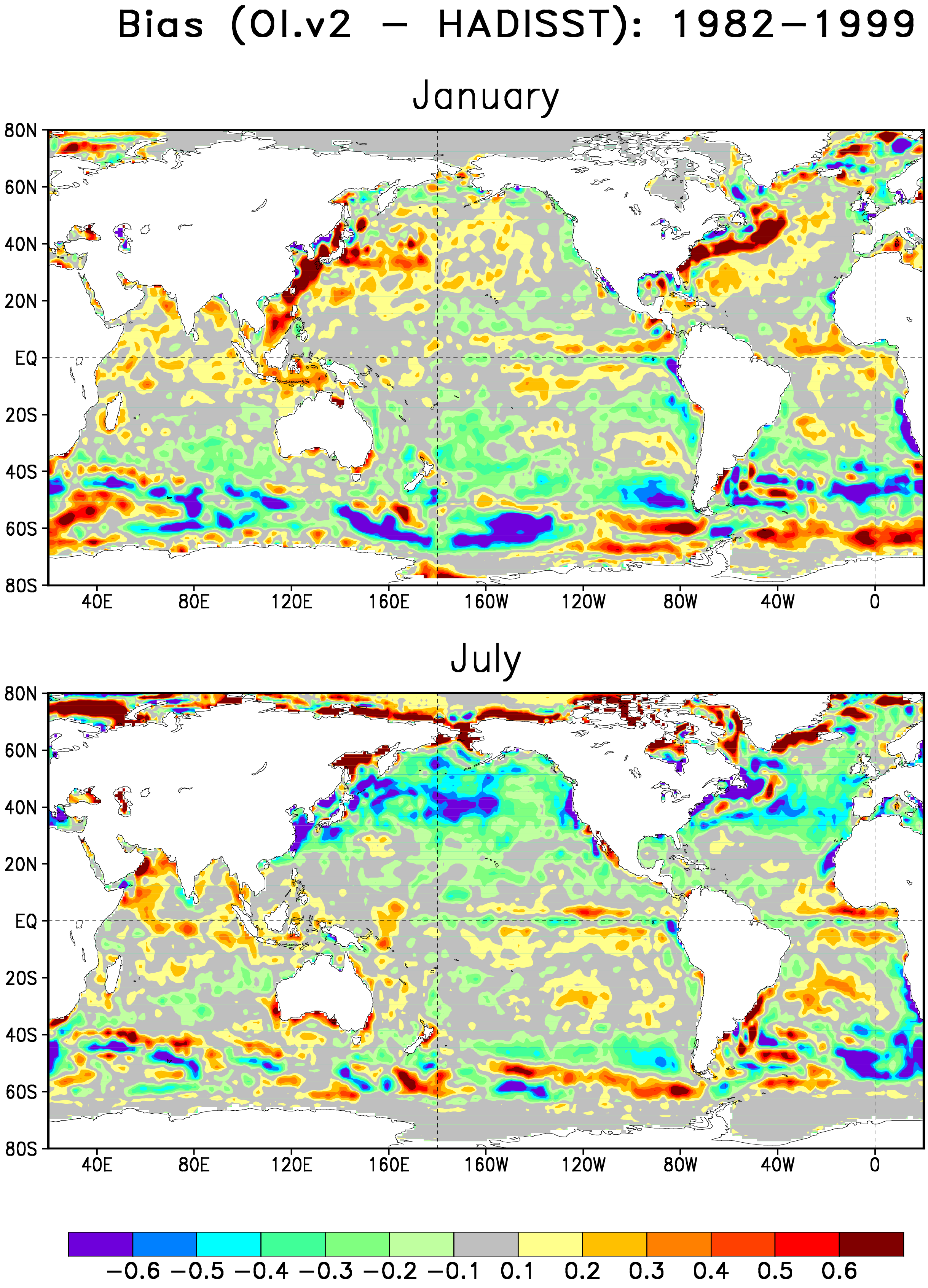
Analysis Differences wrt E-COADS



RMS Differences wrt OI.v2



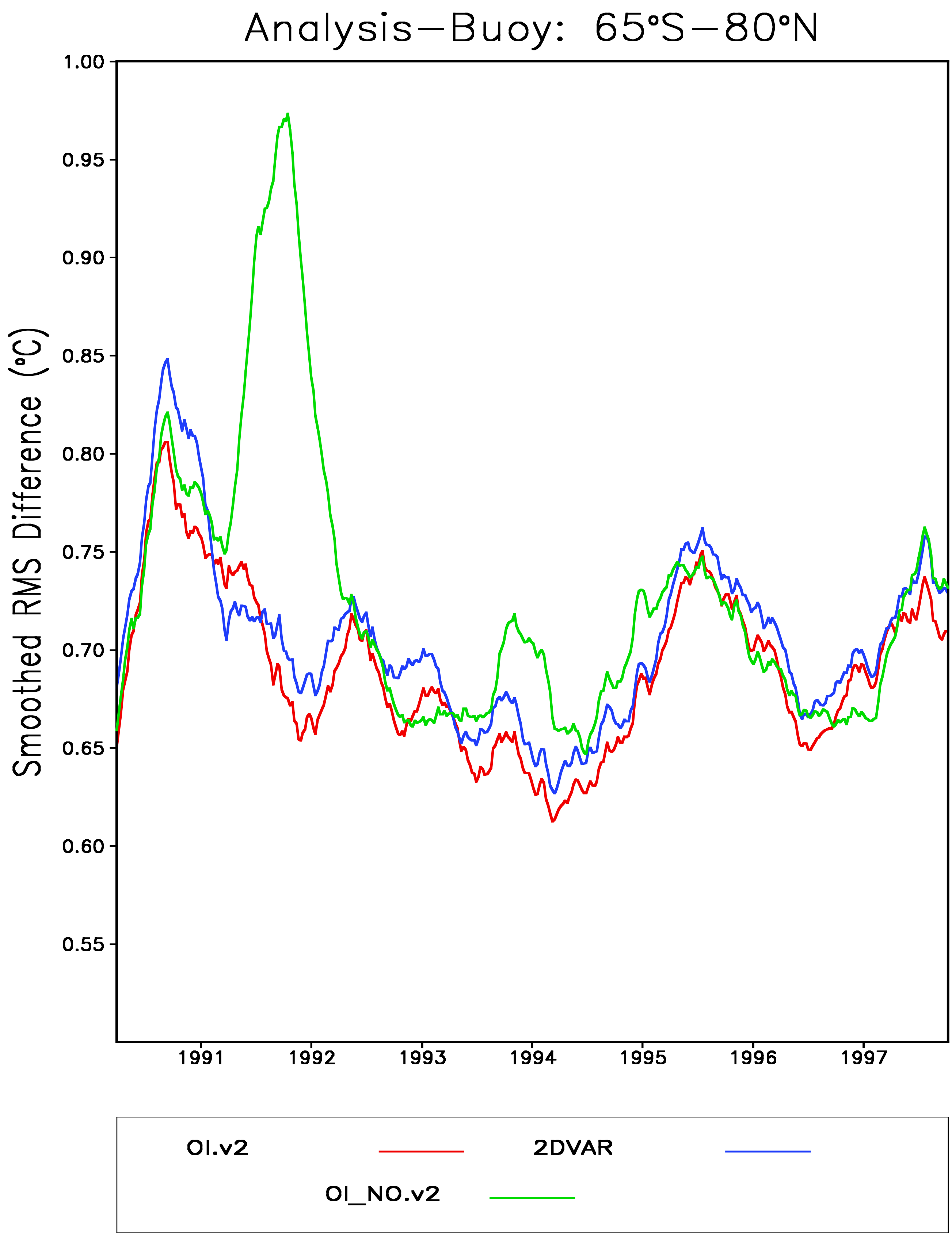
Seasonal Differences



Objective Determination of Analysis Accuracy

- Withhold a random 20% of buoy SSTs from analyses
  - Define set as buoy IDs ending in 4 or 9
- Use withheld buoy data for objective comparison
  - Compute Bias and RMSD between buoys and analyses

RMS Differences wrt Withheld Buoys



Conclusions

- Significant differences remain among analyses
  - Global average differences of ~ 0.05°C
  - RMS differences of 1°C are common
  - Tropical differences are the lowest
  - Largest uncertainties occur in sparse data regions: especially in sea-ice margins

- Comparisons with E-COADS (enhanced COADS) were useful to examine large space and time scale differences

- An objective method is needed to better quantify the differences

SST Work Plan

1. Develop methods to evaluate where additional buoy data are needed for accurate SSTs
   – Implement automatic reports to AOML showing locations where additional buoys should be deployed
   – Use OI analysis error statistics to better define where buoys needed
   – Use OI simulation experiments (as done for TAO data) to check results
     • Huai-min Zhang at NCDC hired

SST Work Plan

2. Improve SST Analyses
   - Develop methods to best use existing and new in situ and satellite SST data
     - TMI SSTs highest priority
       - A graduate student at NC State to work on this project
     - Other Satellite Data
     - SSTs from Profile Data (XBT, ARGO, etc.)
   - Develop improved bias corrections
     - Monthly analysis may be better than weekly
   - Develop platform dependent error statistics and quality control
     - use VOSclim ships?

3. Complete development of LAS web server for SST data and analyses

SST WORKING GROUP
PLAN FOR GCOS

- To record and evaluate the differences among historical and near-real-time analyses SST and SST/Sea Ice analyses

- To identify the sources of differences in the analyses

- Recommend actions to ensure the quality and consistency of the SST and SST/ Sea Ice analyses

- To establish criteria to be satisfied by SST and SST/Sea Ice analyses to ensure the quality and consistency required by GCOS

- To report annually to AOPC and OOPC on progress and recommendations

Proposed SST Working Group Tasks

- Objective comparison of SST data
  - Agree upon standard period (~ 5-10 years)
  - Define subset of buoy data as independent
  - Compute data summaries and analyses with independent buoys withheld
  - Verify data summaries and analyses against independent data
- Sea ice
  - Reexamine sea-ice correction algorithms
  - Refine sea-ice to SST algorithms
    - Nick Rayner in charge

Topic for Discussion
Skin vs. Bulk

- Problem: Split between high resolution and climate SST groups

- The high resolution group wants skin SSTs because that is what the satellite measures

- The climate group wants bulk SSTs so that they can link satellite SSTs to the much longer in situ record

- How can this be resolved?