Surface Flux Related Activities At NOAA National Climatic Data Center

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Acknowledgement: Chris Jeffery, Chris Fairall

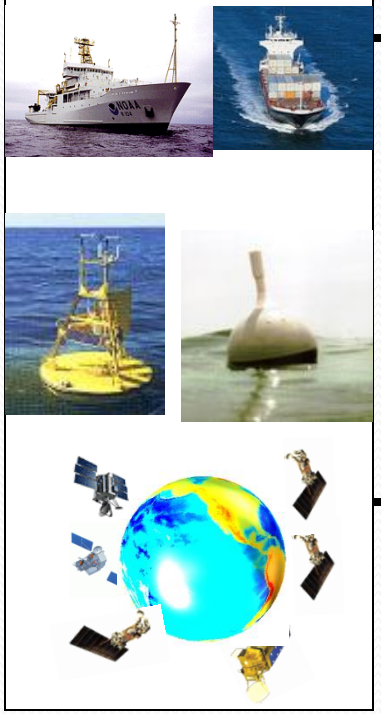
OUTLINE

- **NCDC Surface Flux Related Products:**
  - SST: Reynolds OI SST daily, global ¼° gridded; 1-10 km is in development
  - Sea Surface Winds: 6-hourly, global ¼° gridded
  - Sea Surface Air Temp & Humidity (**poster**)
    - Turbulent Air Sea Fluxes
- **Product Service and Evaluation Facility:**

  NOAA Climate Data Record (CDR) Office & WCRP Surface Flux Analysis (SURFA)
  - **Central Archive:** NCDC is mandated to archive weather & climate data
    - NOAA Satellites: Stewardship by the CDR office
    - In-Situ: Ocean Reference Stations; Flux Towers; Climate Ref Network
    - NWP Centers - SURFA: ECMWF, German, Japan (JMA), Meteor-France, UK
  - Web based, interactive and dynamic **data service, evaluation & monitoring**

Conceptual END-TO-END PROCESS
From Data Ingest to Blended Products & Services

Marine Surface Observations



GTS

Ingest

NCDC

QC; Blending

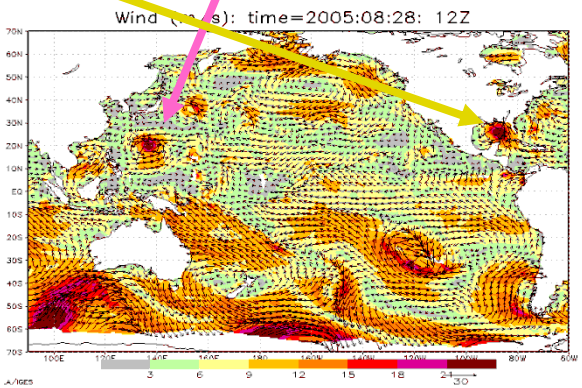
NoaaPort Satellite

Ingest

Global Gridded Products

http://www.ncdc.noaa.gov/oa/rsad

Shown is for 6-hourly sea winds; note the simultaneous Typhoon Talim and Hurricane Katrina



Interactive Data Services

USERS

- Climate Research
- Decision making (observing network design & monitoring)
- Weather & ocean forecasts
- Ecosystem
- Marine transportation
- Wind/wave energy
- Outreach (education)

Sea Surface Products: SST

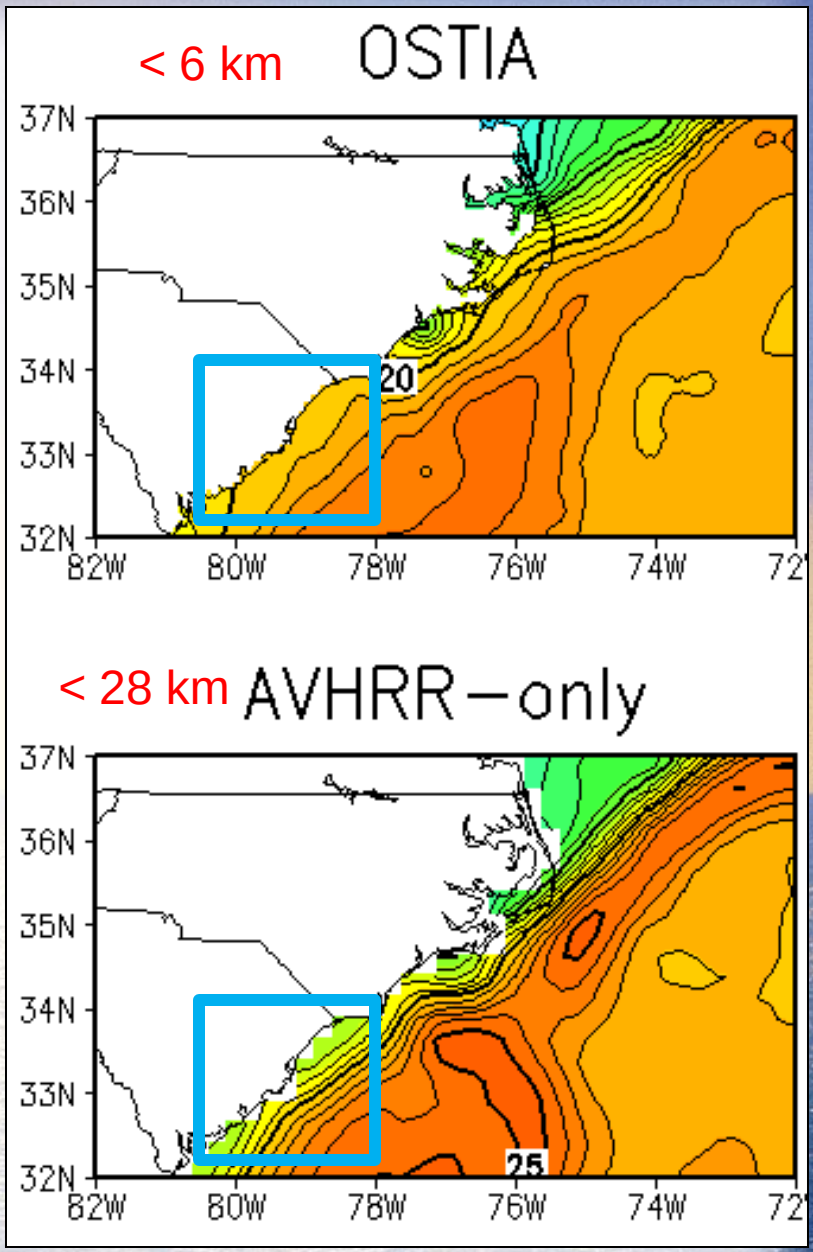
A suite of analyses for diff applications:

1. **Monthly ERSST: 1854-present, 2 grid**
   - **In situ data only; *for long-term climate study***
2. **Weekly OI: 1981-present, 1 grid**
   - **In situ data + AVHRR; *for seasonal & ENSO***
3. **Daily OI: 1981-present, 1/4 grid; *for process studies***
   - **In situ data + AVHRR (AVHRR-only; 1981 →)**
   - **In situ data + AMSR+AVHRR (AMSR+AVHRR; June 2002 →)**
     - **Higher resolution (1-10 km) in development**

View Point:
High Resolutions: Obs Support & Done Carefully

Daily SST fields for 1 January 2007

- In winter warm Gulf Stream is found off shore while colder shelf water is present between the Gulf Stream and the coast
- Note in particular the differences near the South Carolina Coast (33°, 80°W)
- Colder shelf water is evident in the AVHRR-only, the AMSR+AVHRR

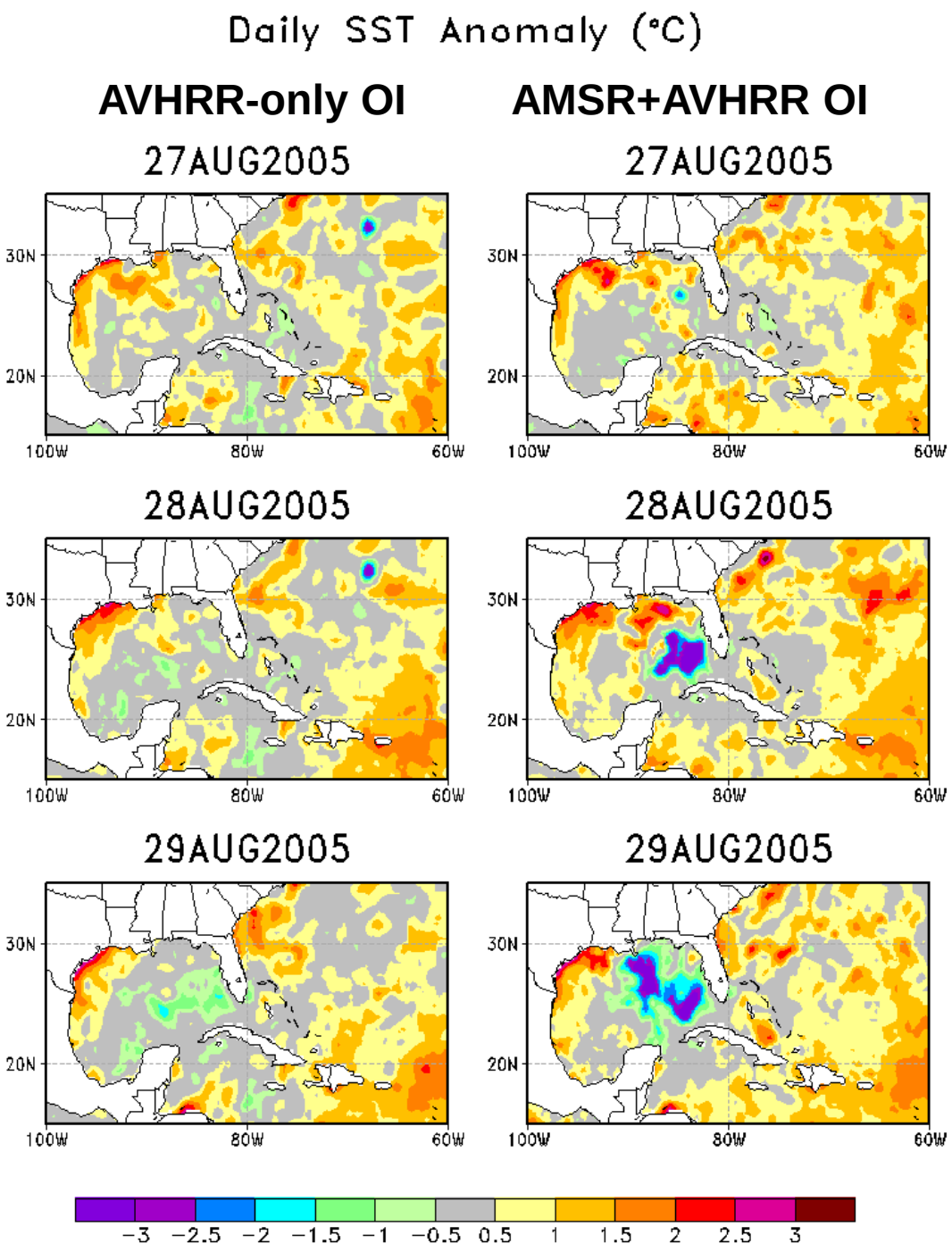


Higher Resolution (1-10 km) OI SST:
Take the advantage of the complementary IR and Microwave Obs

	AVHRR	MW
Resolution (km)	1-5	50
See Through Cloud?	No	Yes

Daily OI SST Anomalies

- **27 August: Katrina**
  - Weak anomaly in Gulf in Path + AMSR-E
- **28 August: Katrina**
  - Strong anomaly in Path + AMSR-E
- **29 August: Katrina**
  - Strong anomaly in Path + AMSR-E
  - Modest anomaly in Path



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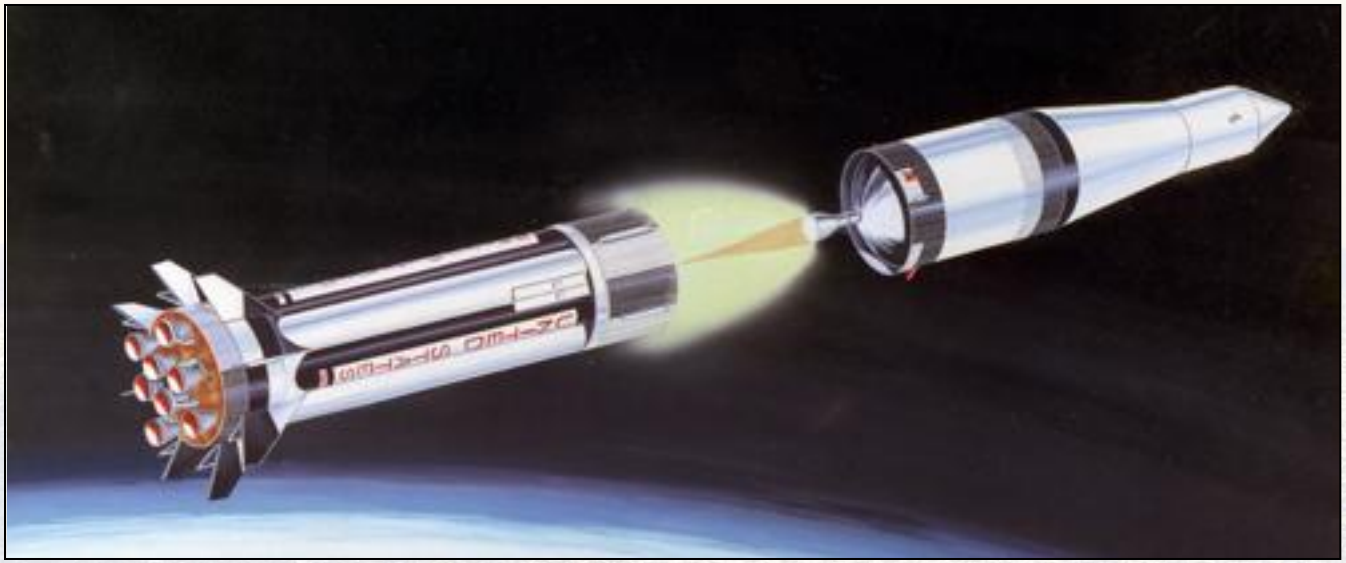
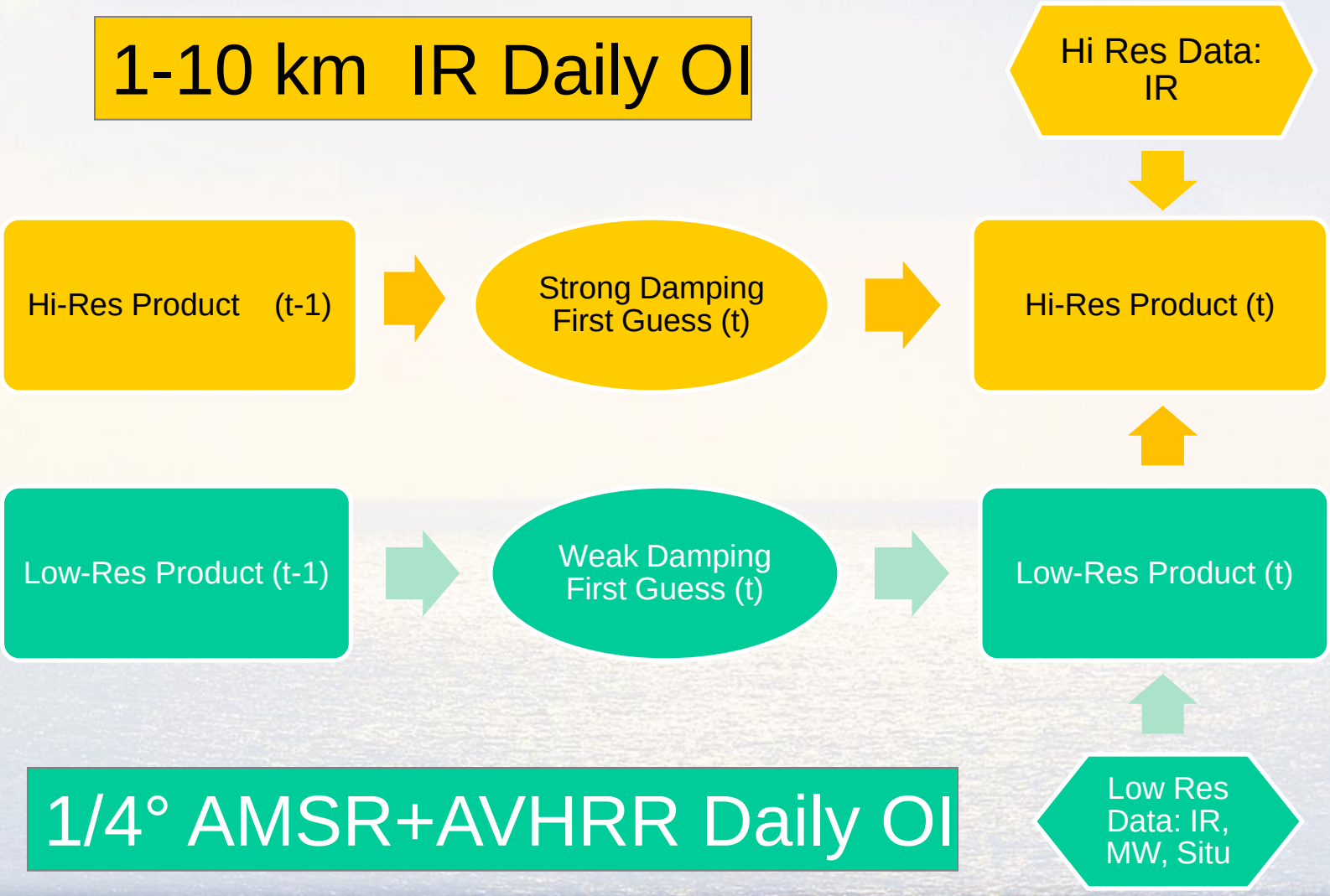
Two-Stage for High Res SST:

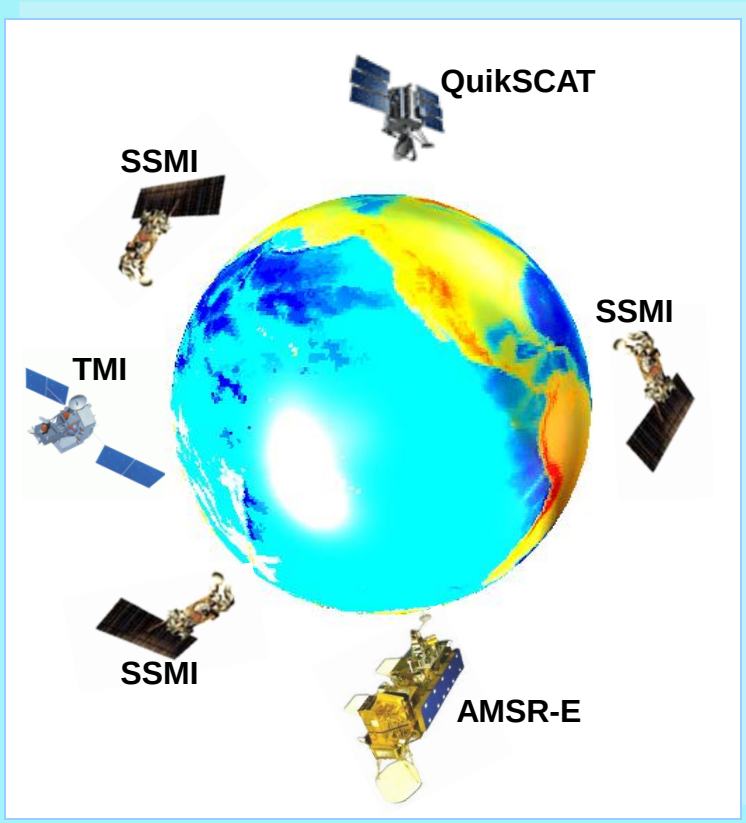


Two Stages


1-10 km IR Daily OI
Hi Res Data: IR
Hi-Res Product (t-1)
Strong Damping First Guess (t)
Hi-Res Product (t)
Low-Res Product (t-1)
Weak Damping First Guess (t)
Low-Res Product (t)
1/4° AMSR+AVHRR Daily OI
Low Res Data: IR, MW, Situ

Sea Surface Products: Surface winds

- Satellite Retrievals: RSS (NASA Pathfinder)
- 6-hourly & ¼ global sea winds, blended from multiple (up to 6) satellites
- Blended Winds available from July '87 onward
- Climatological monthlies were computed for base period 1995 – 2005 (with obs of ≥ 3 satellites)



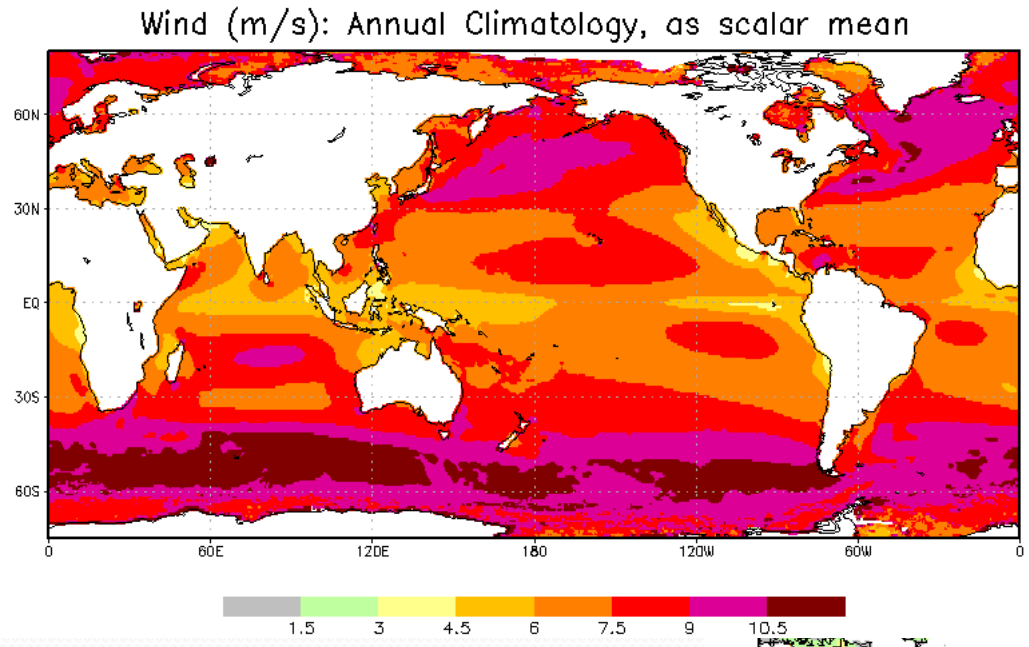
Typical sea wind speed observing satellites since June 2002

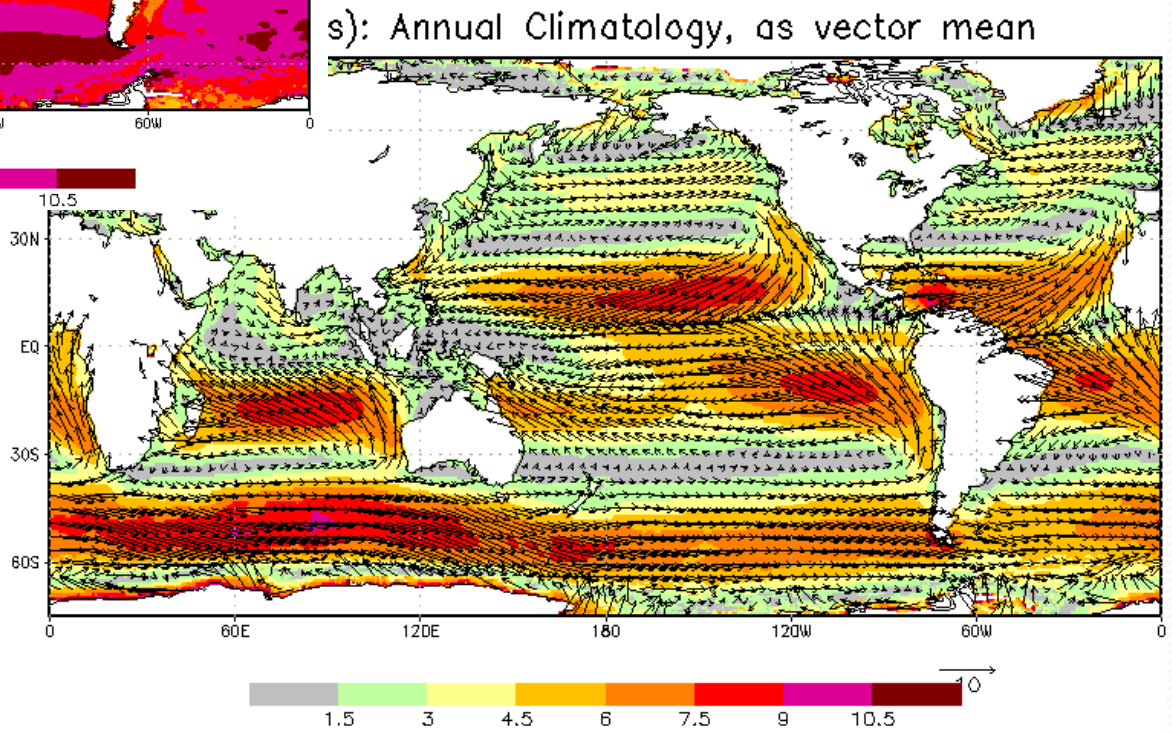
Product Resolution to be Consistent w/ Samplings

% Global Data Coverage for Various Time Resolutions On Global 0.25º, > 75% in time

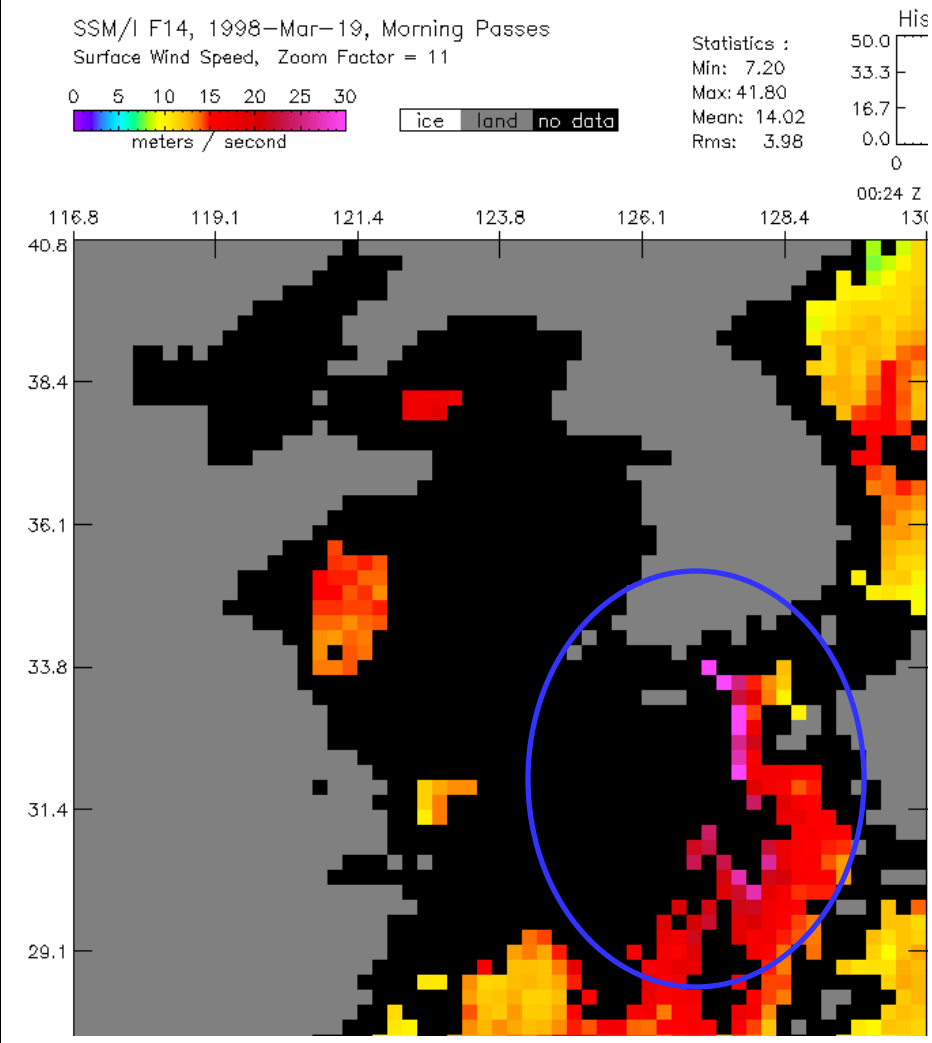
Time period & satellites / Time Resolution	JUL1987→ I F08	JAN1991→ II F10, F11	JUN1995→ III F10, F11, F13	JAN1998→ IV F11,F13, F14 TMI	JAN2000→ V F13, F14, F15 TMI, QSCAT	JUN2002→ VI F13, F14, F15 TMI, QSCAT AMSR-E
6-hourly	12	26	42	56	66	91
12-hourly	27	72	97	99	100	100
24-hourly (daily)	75	100	100	100	100	100

Global Patterns: 1995 – 2005 mean – *Scalar vs Vector means*

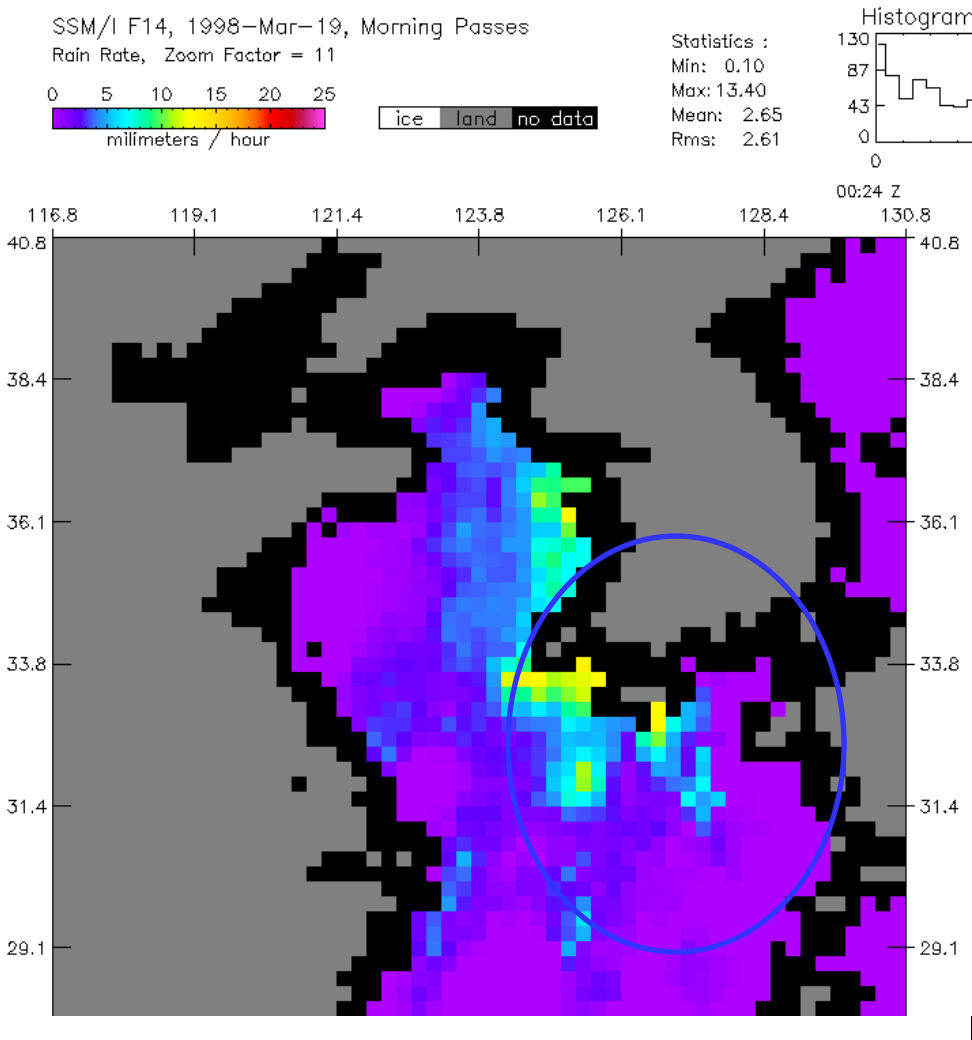




"The Good, the bad, and the Ugly": Wind Spikes



Max Wind > 30 m/s



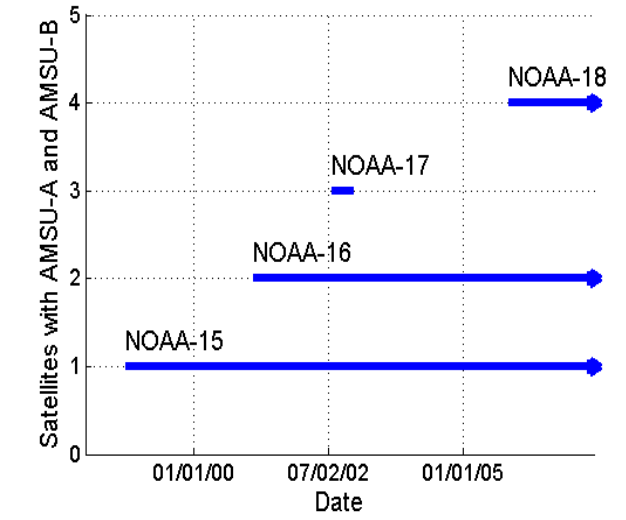
Max Rain > 10 mm/hr

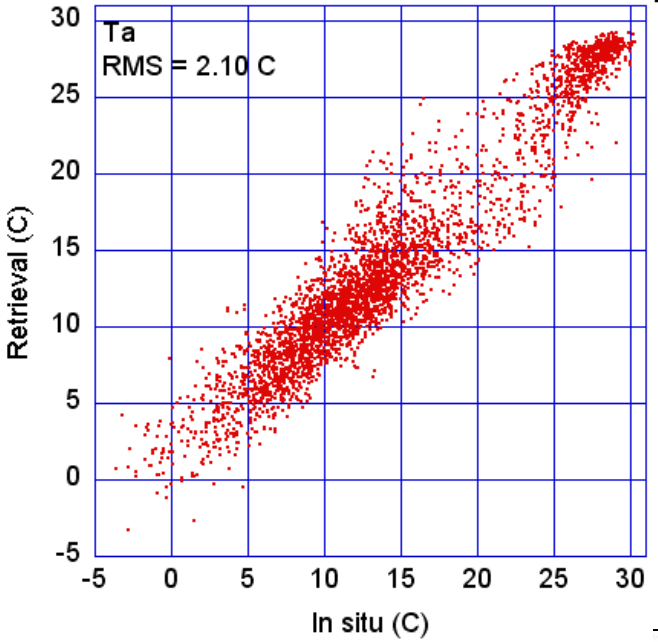
Sea Surface Products: Air Temp & Humidity

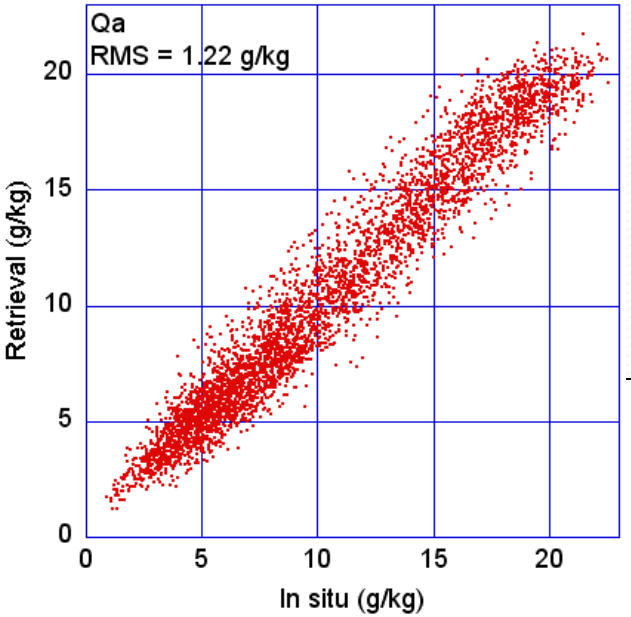
- Retrievals using neural network technique, from AMSU measurements on NOAA POES
- Training dataset are constructed from co-located global buoy and ship measurements (ICOADS)
  - Special QC by FSU (Shawn Smith)
- Ta
  - Predictor: AMSU-A channels 1-4 and 15
- Qa
  - Predictor: AMSU-A channels 1-4 and AMSU-B channels 1, 2, and 5

Ta & Qa Retrievals: Validation

- Validation dataset: Collocated global buoy and ship data that are not used in training dataset
- ***Global*** and ***All-Season*** RMSE:
  - Qa 1.22 g/kg
  - Ta 2.10 C

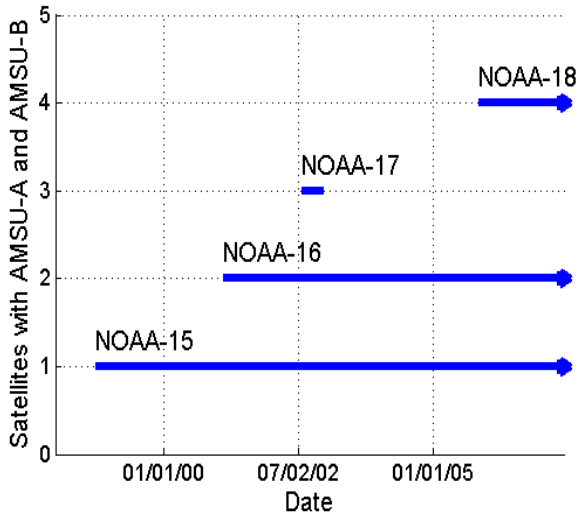


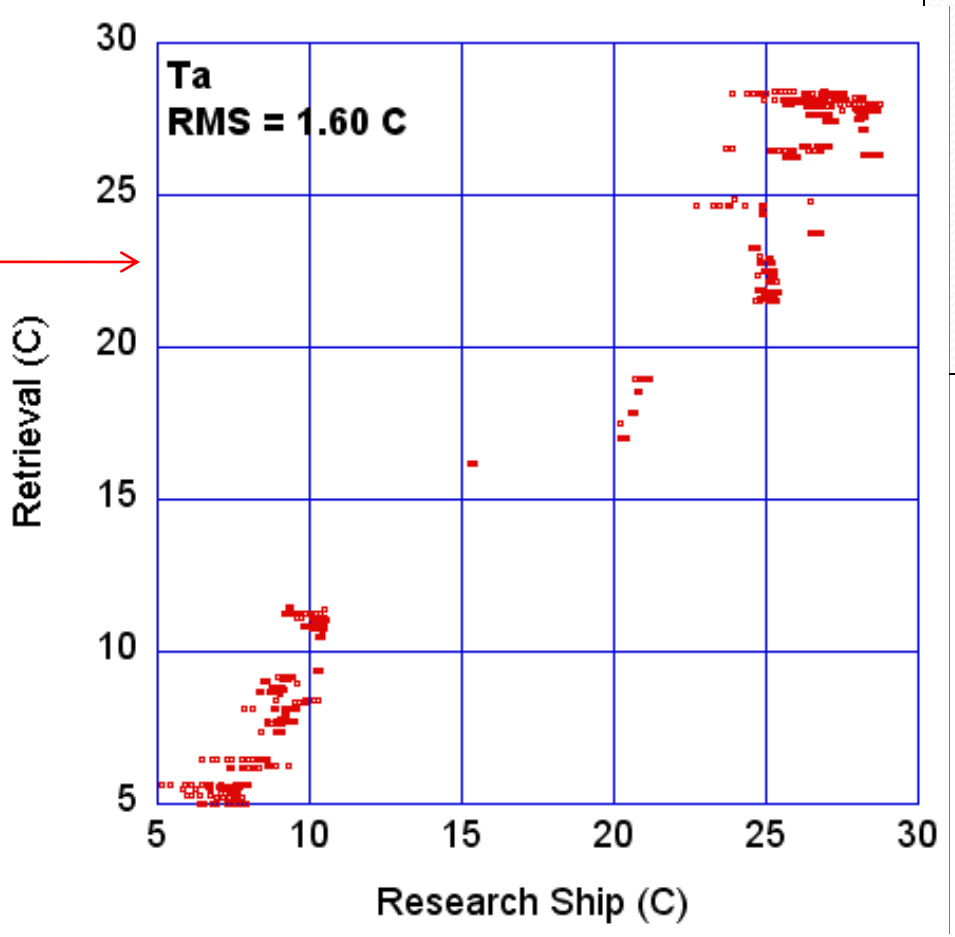




Ta & Qa Retrievals: Validation

- Validation dataset: Collocated global buoy and ship data that are not used in training dataset
- ***Global*** and All-Season RMSE:
  - Qa 1.22 g/kg
  - Ta 2.10 C
    - 1.6 C w/R/V data;
    - < 1.0 C w/ SST constraints



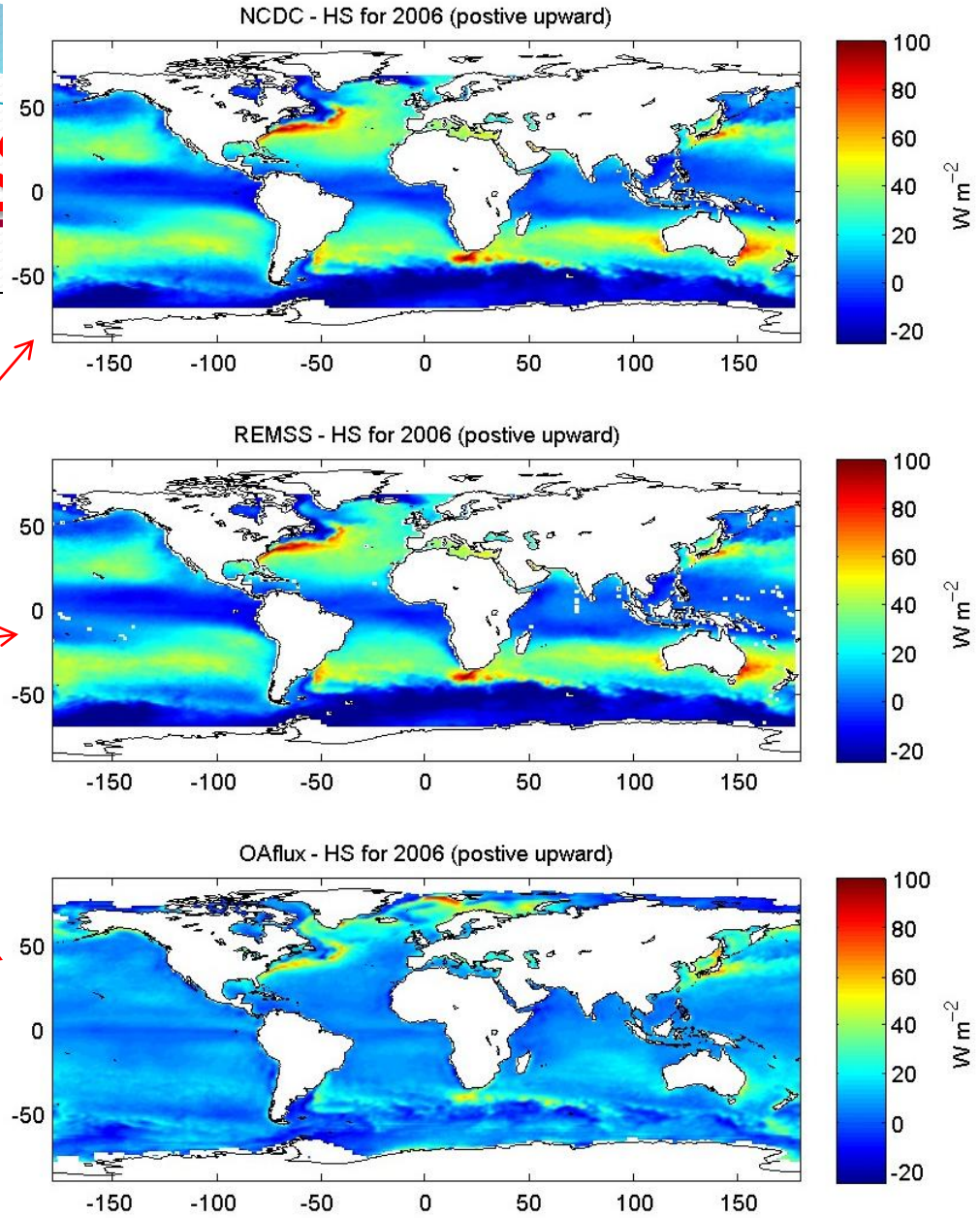


Flux Comparisons

Sensible Heat fluxes

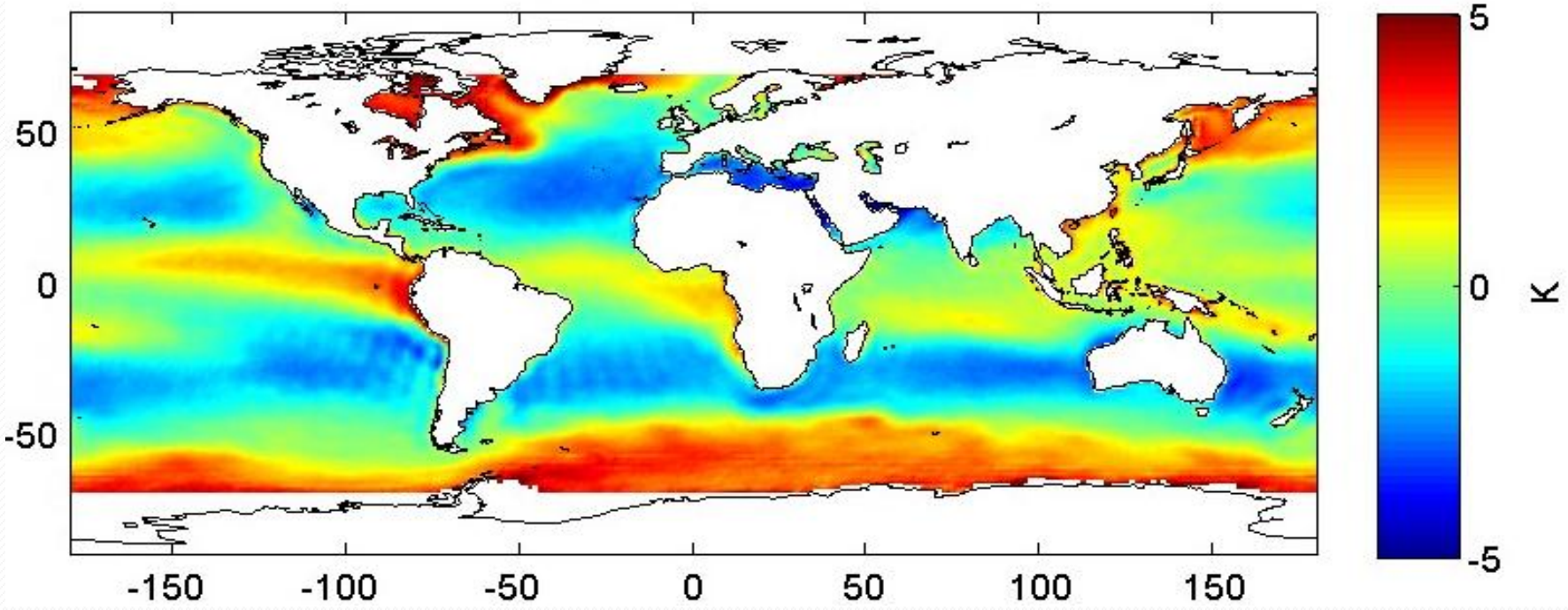
- Upper Panel: NCDC Blended Seawinds, NCDC Ta & Qa, NCDC Daily OI SST
- Mid Panel: NCDC Blended Seawinds, NCDC Ta & Qa, RSS MISST
- Lower Panel: WHOI OAflux

Courtesy: Chris Jeffery, NOAA NODC



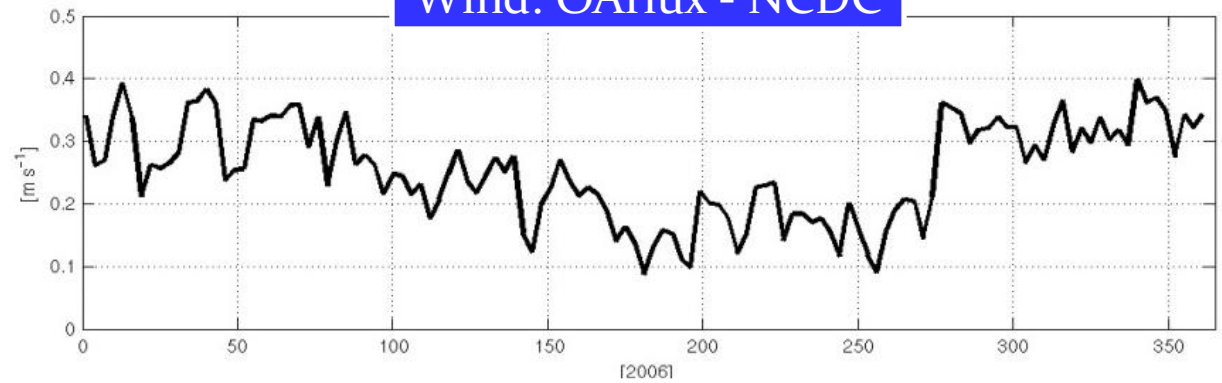
Flux Comparisons

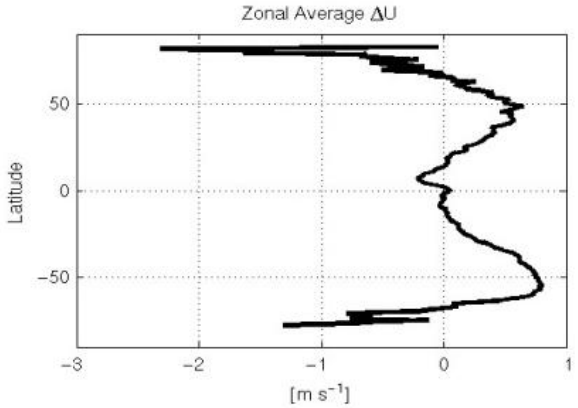
Ta: WHOI - NCDC



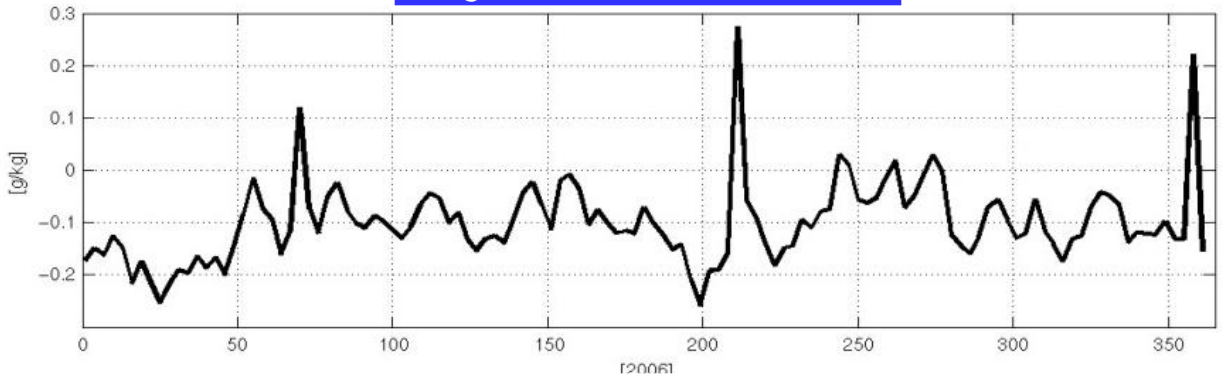
Courtesy: Chris Jeffery, NOAA NODC

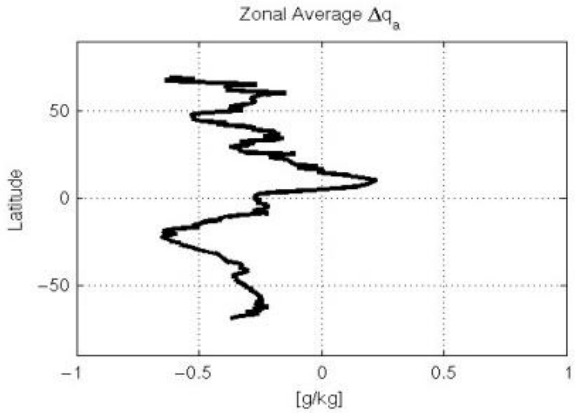
Wind: OAflux - NCDC



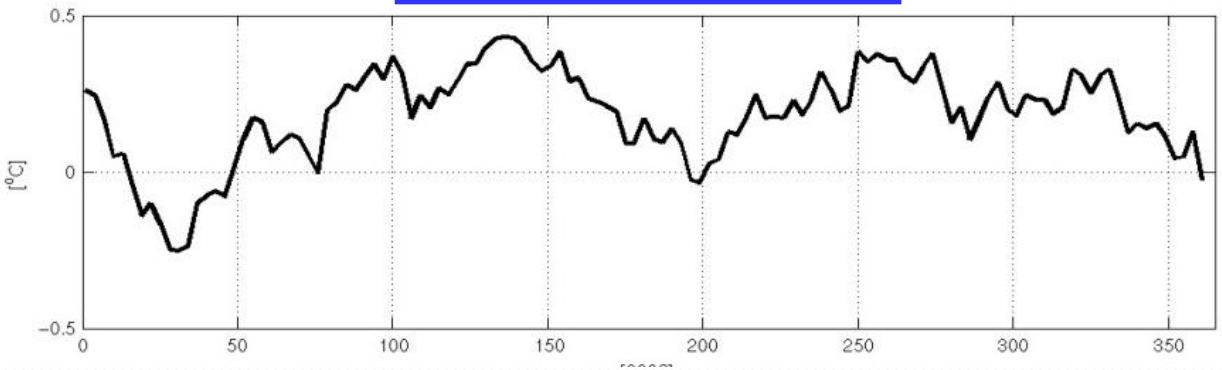


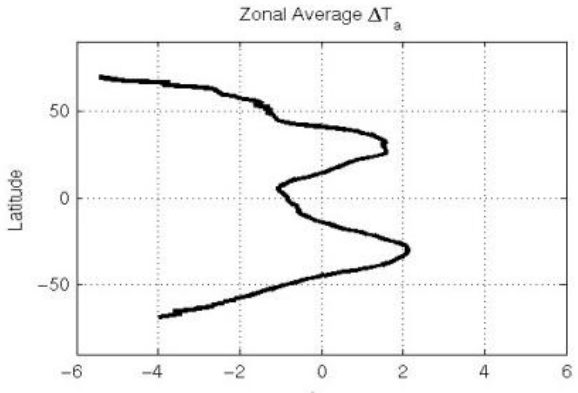
Qa: OAflux - NCDC





Ta: OAflux - NCDC





Courtesy: Chris Jeffery, NOAA NODC

SURFA: Surface Flux Analysis

- **Driver:** Surface processes are key in improving NWP & climate model forecast skills
- **Objective:** SURFA is to institutionalize the evaluation of near real-time NWP (& Climate Model & Reanalysis) fluxes and related fields with high quality reference data
- **Initiation:** WCRP WGSF, WGNE, OOPC …
- **Status:**
  - NCDC as central archive & service
  - Documents: NWP archive specifications; Submission Agreements
  - Current Participation:
    - NWP Centers: ECMWF, German DWD, Japan (JMA), Meteor-France, UK
    - In-Situ: Ocean Reference Stations, Flux Towers, Climate Reference Network
  - Data available from NCDC:
    - http://www.ncdc.noaa.gov/oa/rsad/air-sea.html

SPEC: Satellite Product Evaluation Center (NCDC – ORNL)

- Provide a uniform approach (Common Data Model-based) for the extraction of grid/swath from point, line, polygon and trajectory data, and therefore maximize reusability
- Provide a large, high-performance cache of satellite/model data for select locations.
- Provide a desktop or command-line tool for:
  - Co-locations/matchups of your data.
  - Integration of your data with the SPEC database cache.
  - Statistical analysis and export to mutilple formats.
  - Monitoring and automated alerts.

LandFlux Example

Selected Site: Bondville- Illinois (AmeriFlux)

Variable: Temperature

Data Sources:

> Add

< Remove

<< Remove All

AmeriFlux (L.2)
MODIS Day Time LST - MOD11A2 (v.5)
MODIS Night Time LST - MOD11A2 (v.5)

Time Span:

Start Date: 03/01/2000

End Date: 04/30/2005

March 2000

Sun	Mon	Tue	Wed	Thu	Fri	Sat
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

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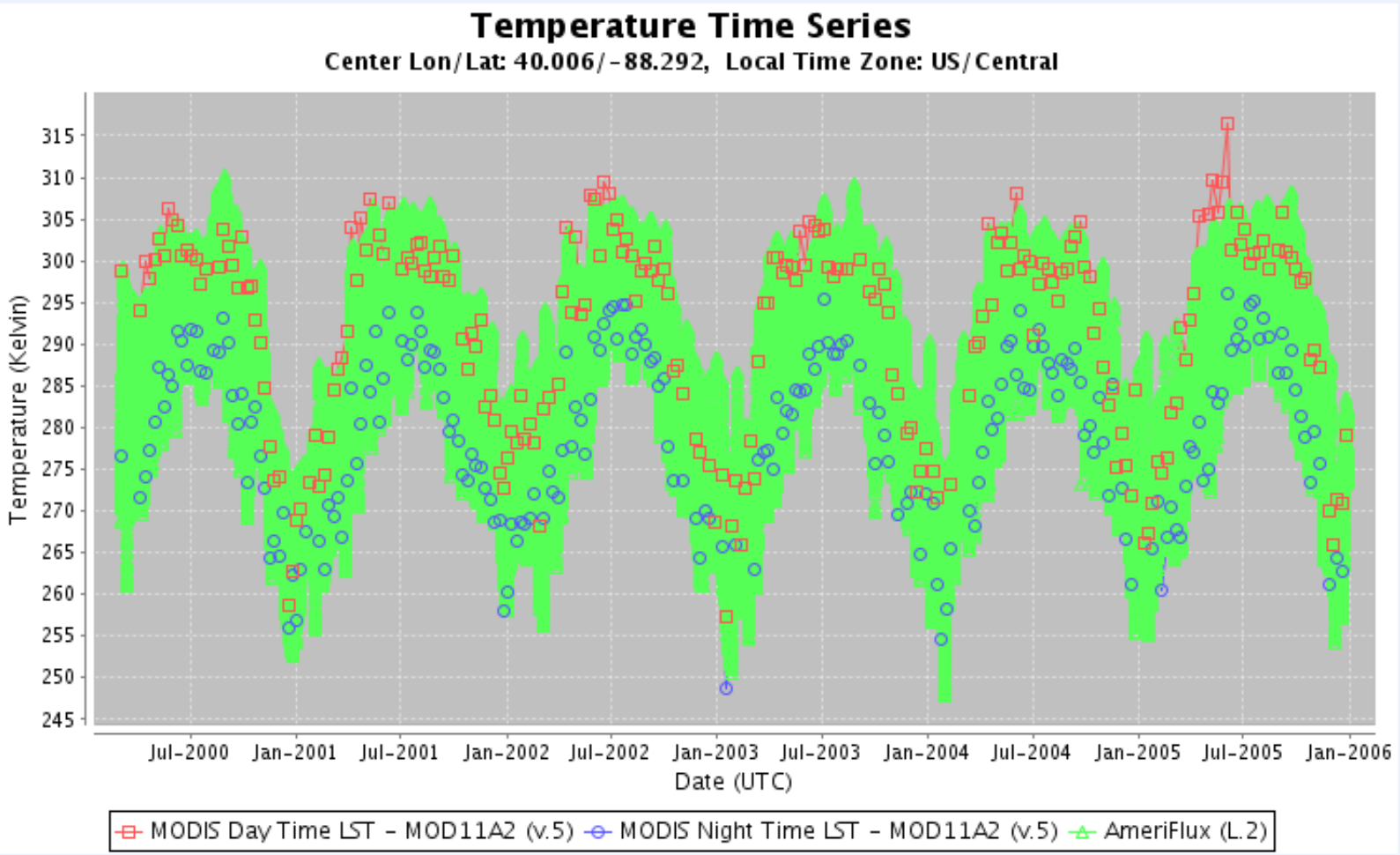
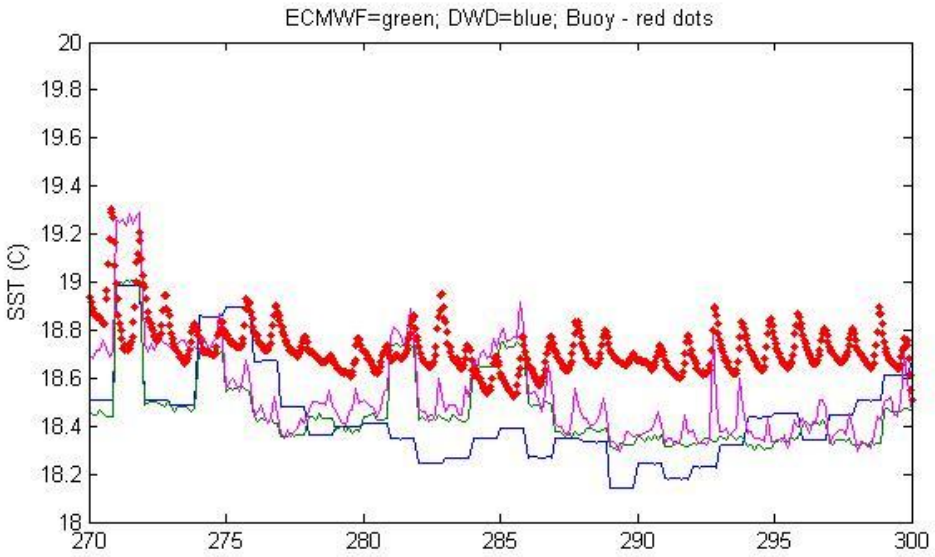
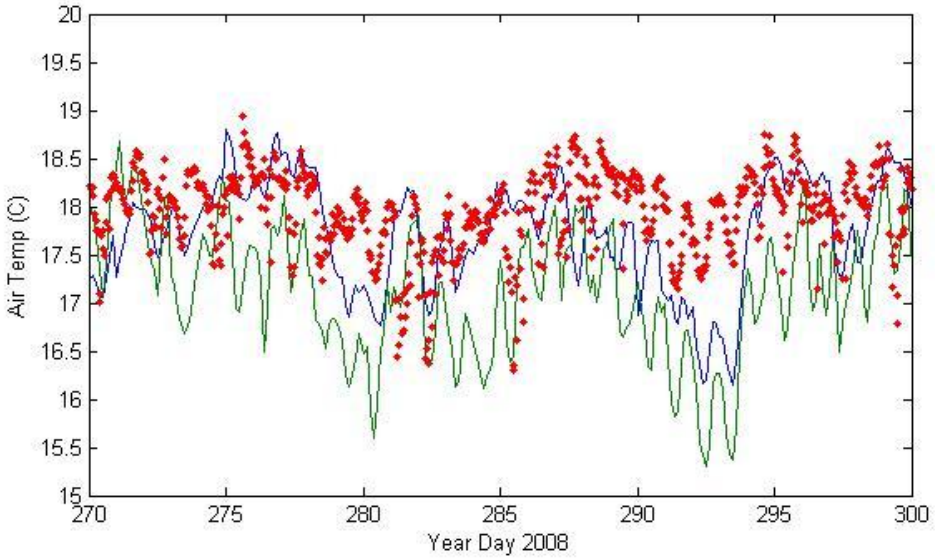


SURFA Example

Comparisons of SST and Air Temp for Oct 2008:

ECMWF – green;
DWD – blue;
Buoy – red dots.





Chris Fairall

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- **Product Service and Evaluation Facility:**

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