Climate Quality Buoy and Ship Observations

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and

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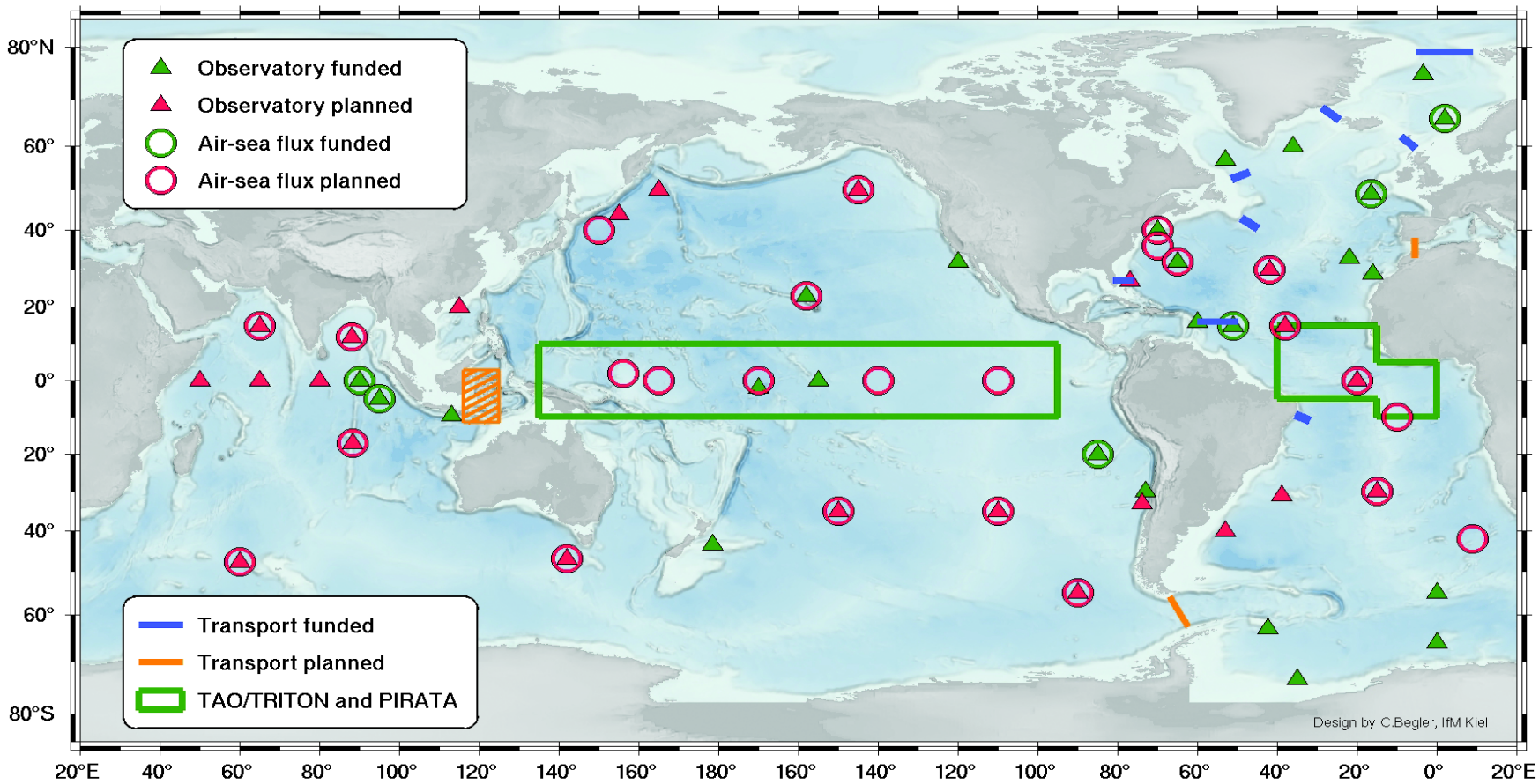
Moored buoys

- Up to 1-year deployment
- Tropical, extra-tropical
- Arabian Sea, South of Iceland
- Not yet: high wind/waves
- Not yet: High currents
- Not yet: freezing spray
- Maybe never: floating ice

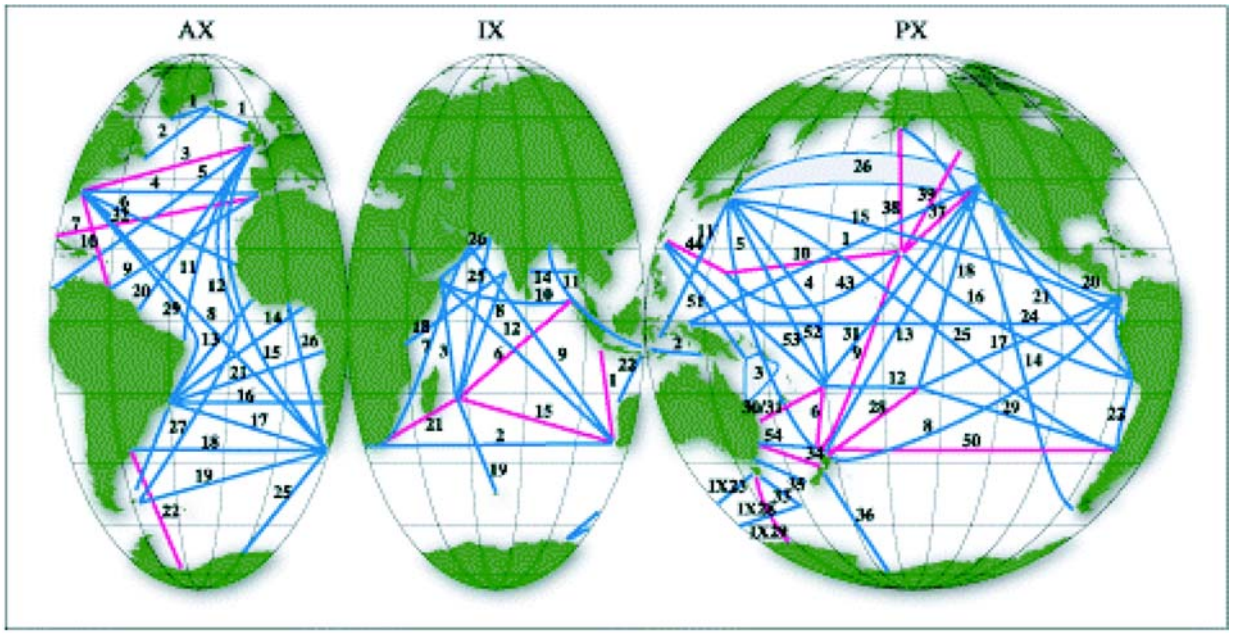
Moored buoys



- Global Eulerian Observatories (GEO) - Int'l Time Series Science Team
- NOAA Climate Observations; NSF Ocean Observatories Initiative
- CLIVAR

- Ships
  - VOS
  - Research
  - Fishing

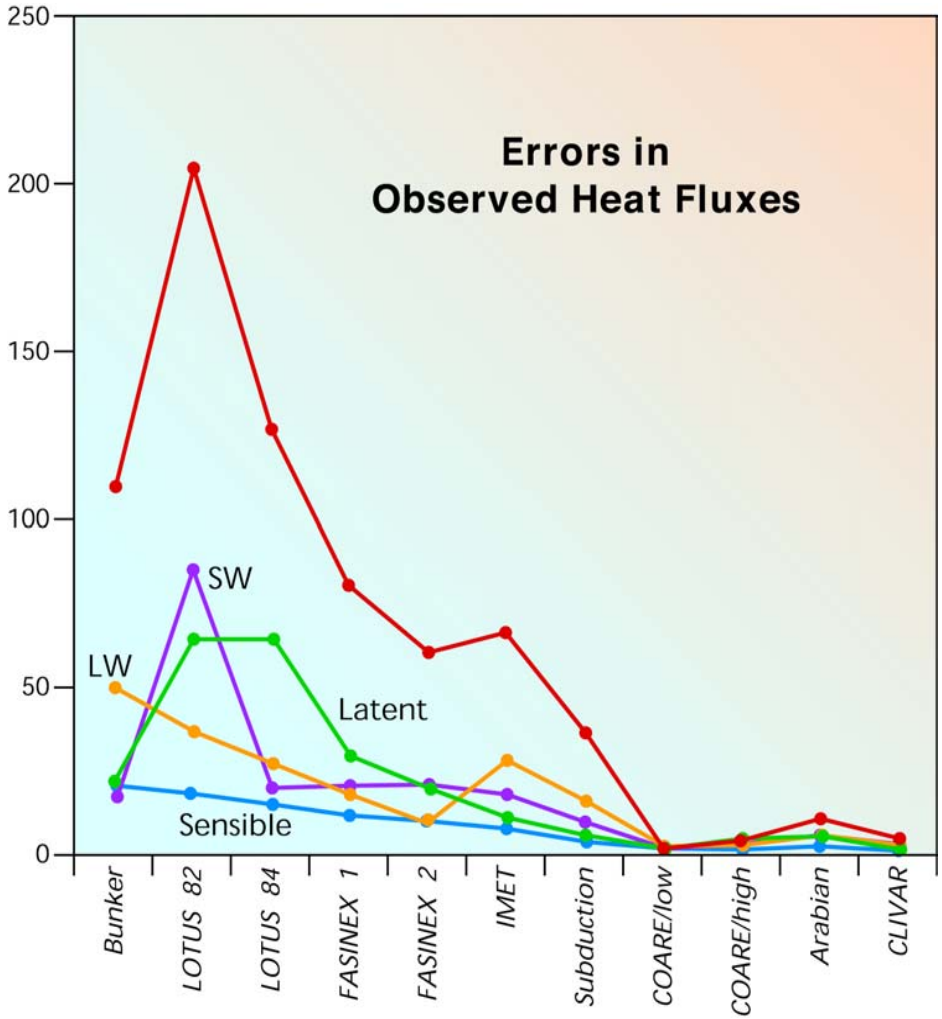
Ships



- VOS
  - Wide coverage by traditional VOS
  - Efforts to improve - VOSCLIM
  - Value of improvement - SOC VOSNA Project
  - Upgrading high density XBT lines to IMET

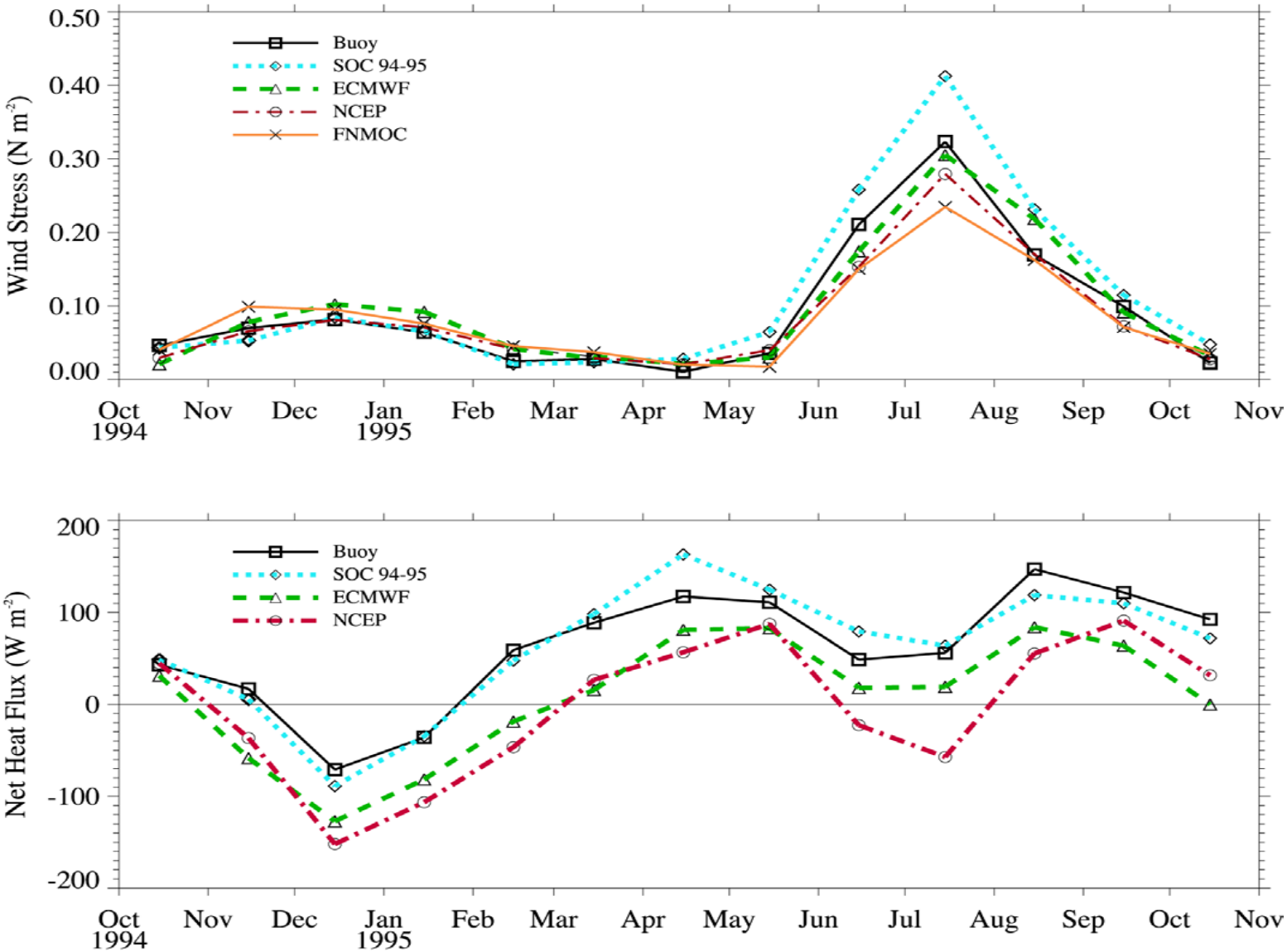
- Research
  - Data sparse regions
  - High quality
  - Manned
  - Direct flux
  - In-situ buoy calibration

Motivation



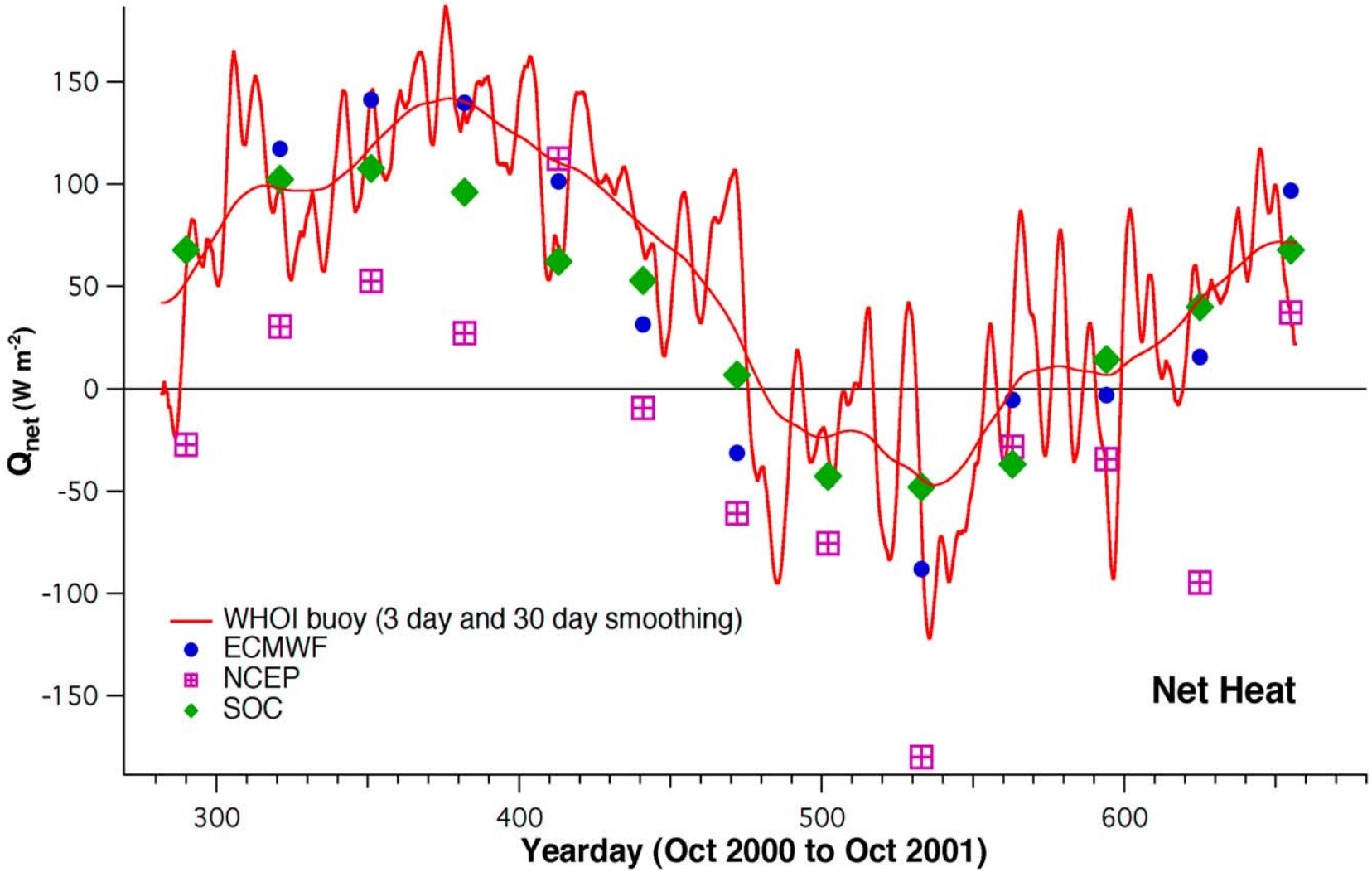
- Accurate in-situ observations
  - Much improved
  - Still improving
  - Can identify errors in:
    - climatologies
    - remote sensing
    - atmospheric models
    - coupled models
  - Anchor synthesized flux fields
  - Provide forcing for ocean models
  - Key diagnostic of air-sea coupling
    - process studies
    - interannual, decadal studies
    - climate

Motivation - Arabian Sea



Motivation

Chilean stratus deck



Strategy

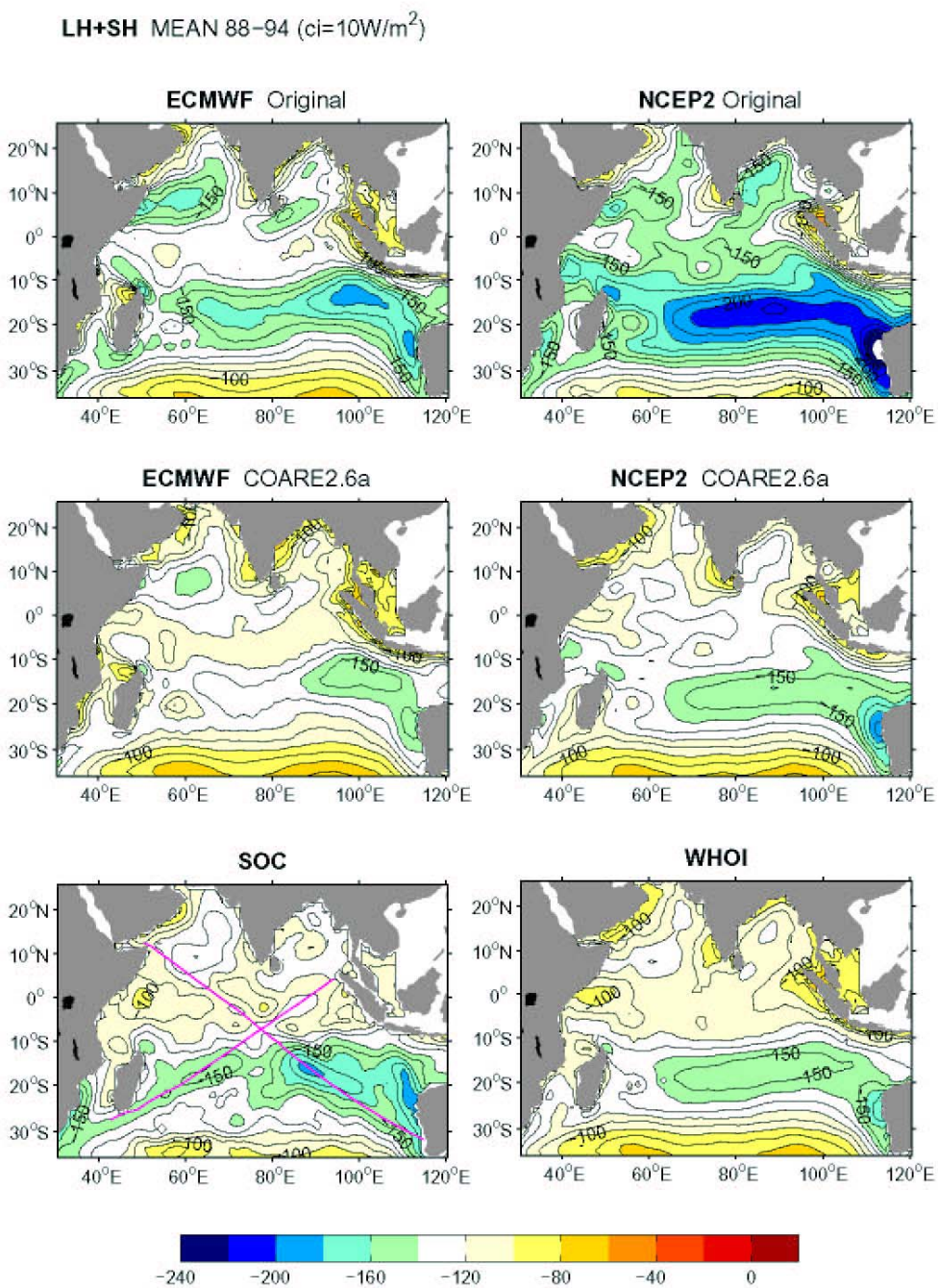
- Use high quality in-situ data to anchor flux fields

- Surface flux reference site moorings
  - Identify biases, errors; capture temporal variability
  - Withheld, independent data sets
  - Drive improvement to model and remote sensing

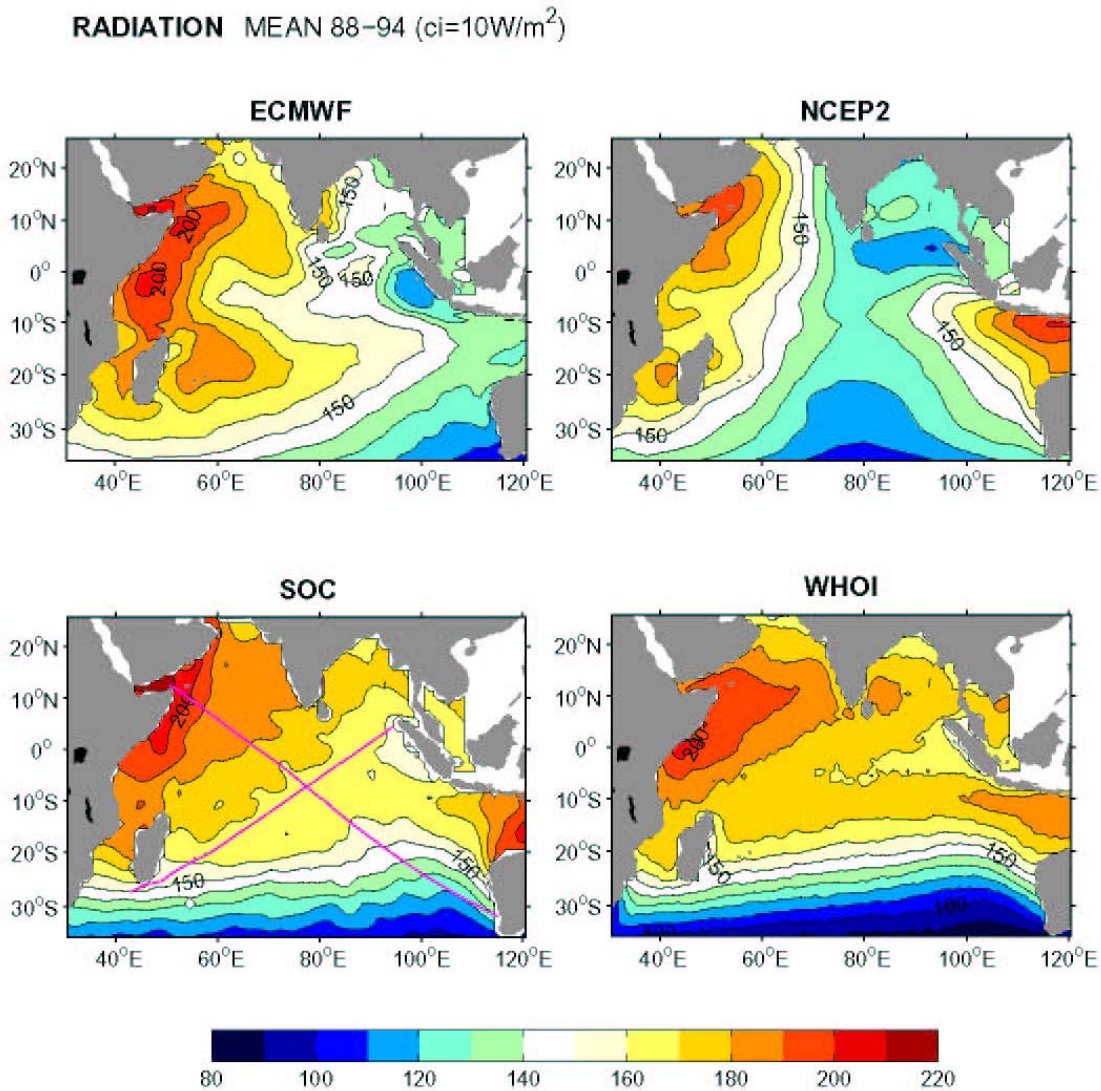
- High quality VOS and research ships
  - Examine spatial variability of biases and errors
  - Assimilate into synthesized fields

- Joint buoy and ship
  - In-situ start and end point calibration by RV's
  - Building the covariance matrices

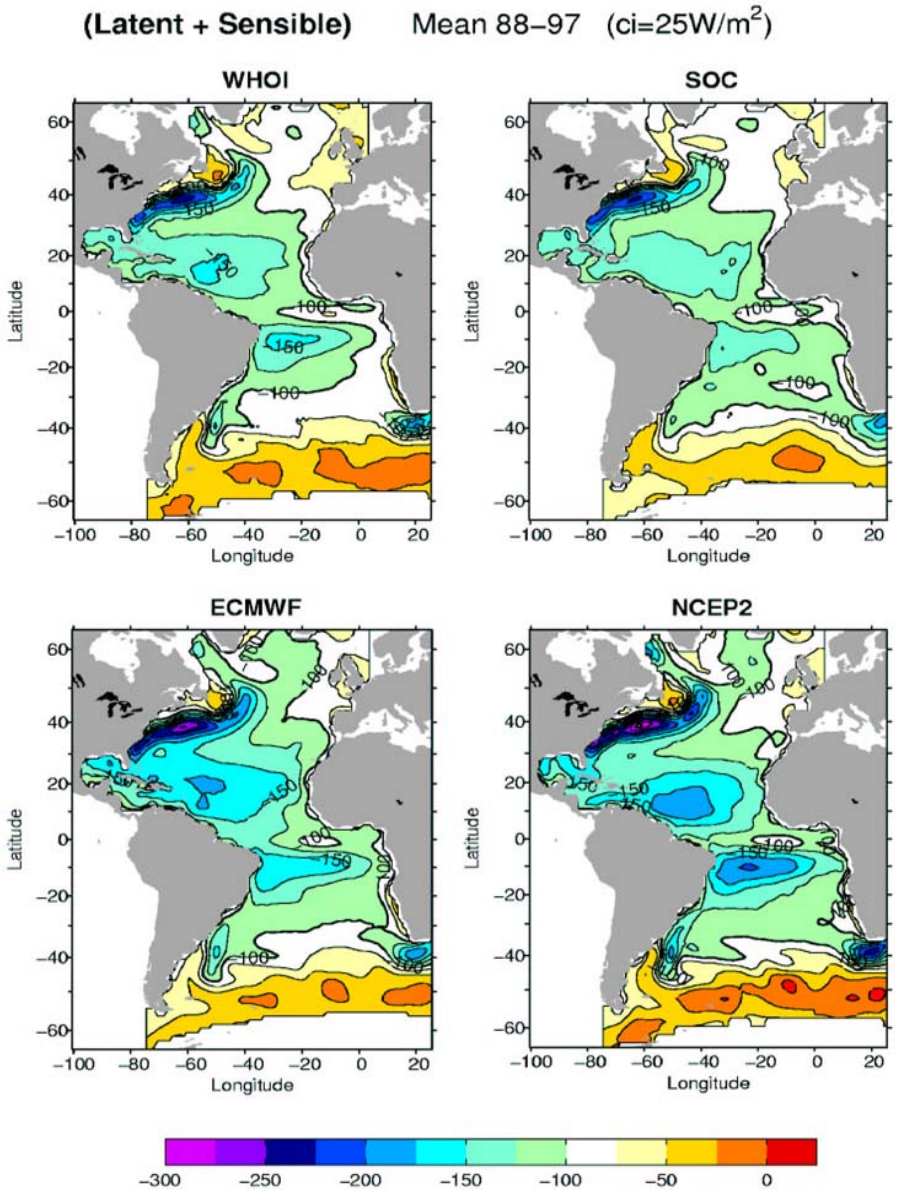
- Target: Daily, 1° x 1° fields



Flux fields Indian Ocean



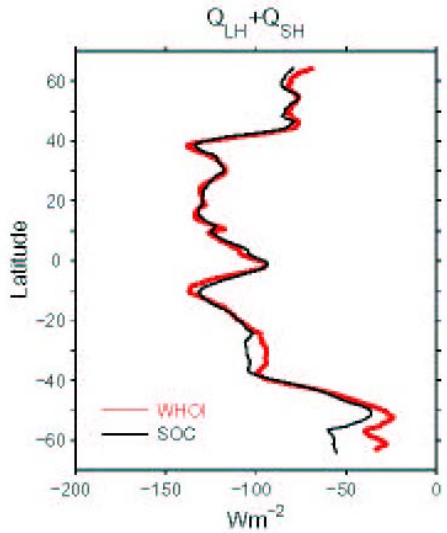
Flux fields Indian Ocean



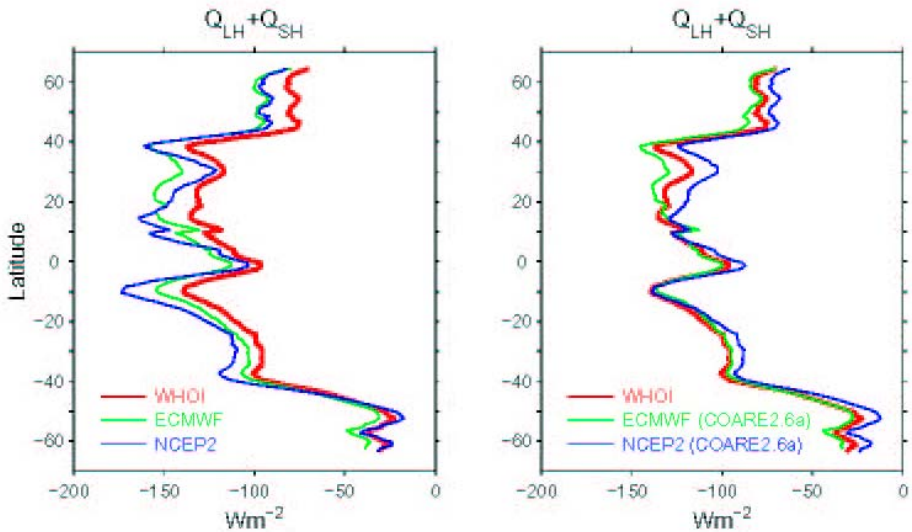
Flux Fields

Atlantic

VALIDATION WITH SOC CLIMATOLOGY

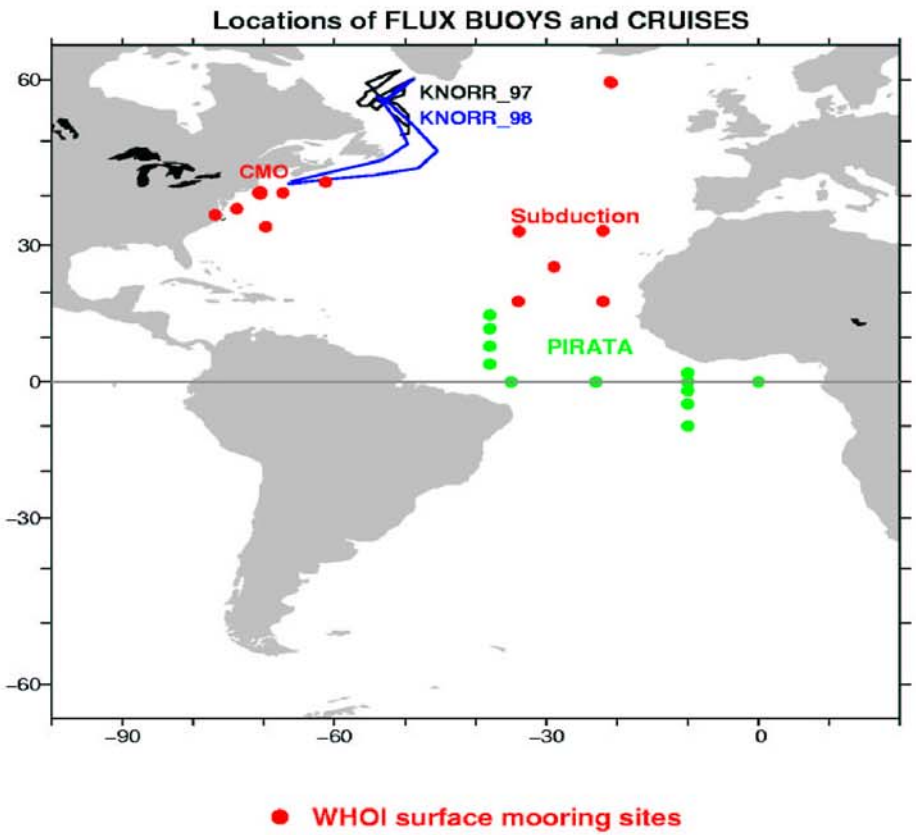


IMPROVEMENT OVER NWP ANALYSES



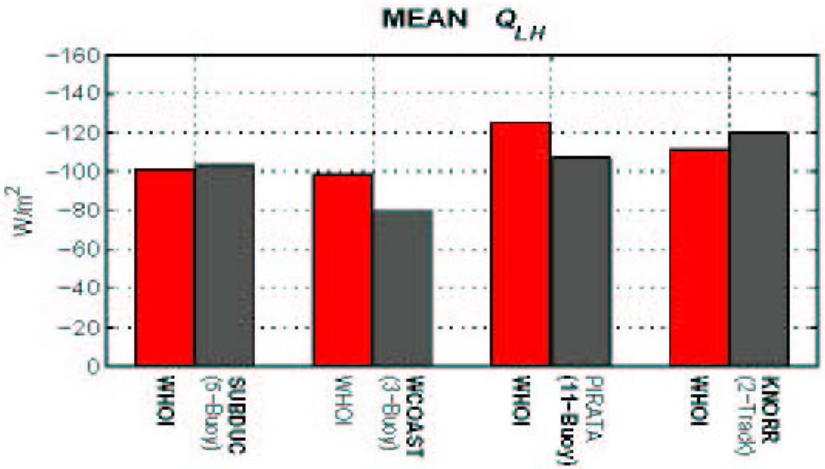
Flux Fields

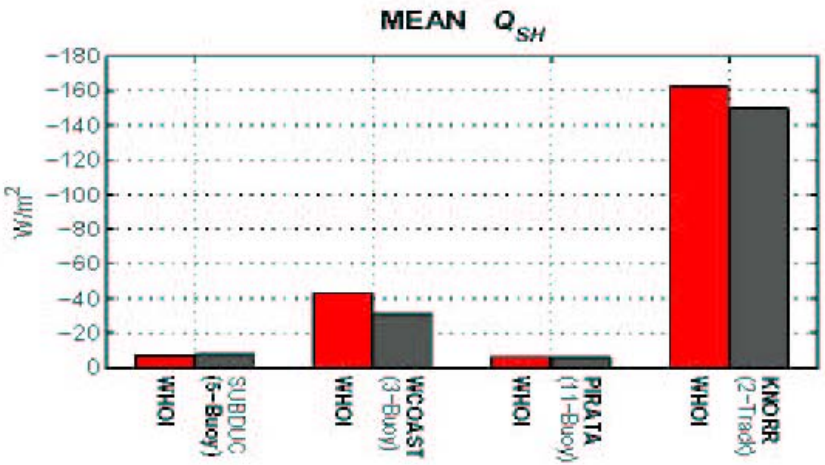
Atlantic



Flux Fields

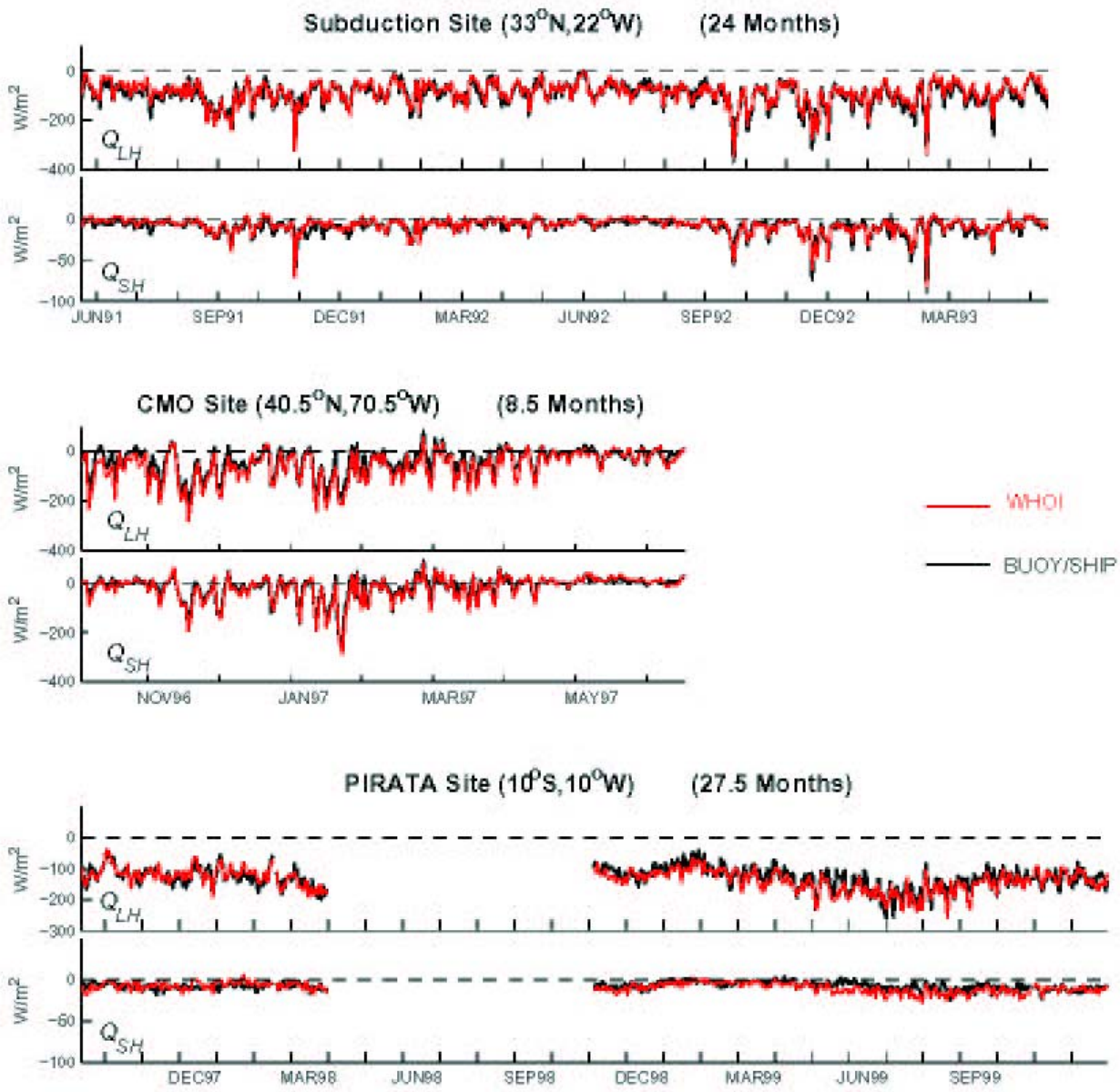
Atlantic
In-situ
Validation

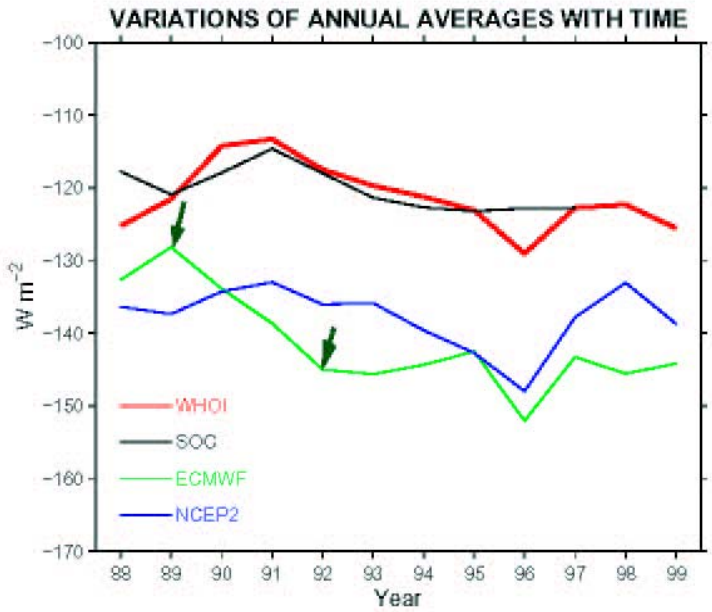


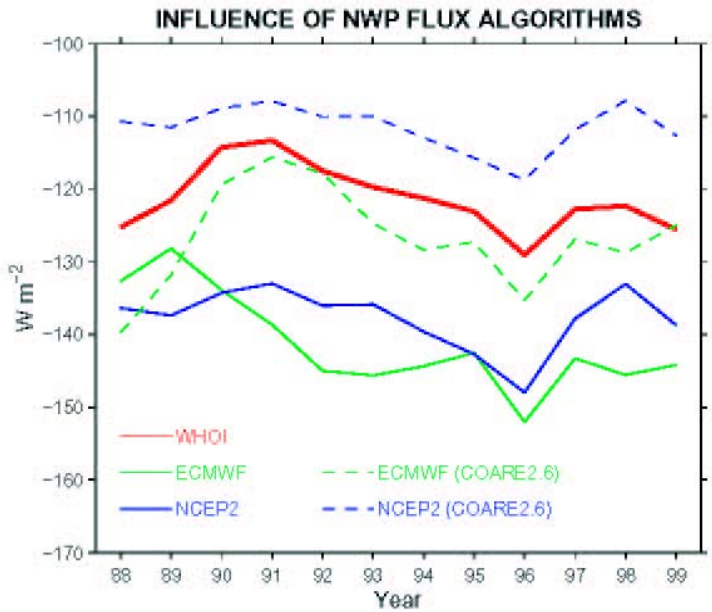


Flux Fields
Atlantic

Validating
Annual Means


Subduction Site (33°N,22°W) (24 Months)
W/m²
0
−200
−400
Q_{LH}
W/m²
0
−50
−100
Q_{SH}
JUN91
SEP91
DEC91
MAR92
JUN92
SEP92
DEC92
MAR93
CMO Site (40.5°N,70.5°W) (8.5 Months)
W/m²
0
−200
−400
Q_{LH}
W/m²
0
−200
−400
Q_{SH}
NOV96
JAN97
MAR97
MAY97
WHOI
BUOY/SHIP
PIRATA Site (10°S,10°W) (27.5 Months)
W/m²
0
−100
−200
−300
Q_{LH}
W/m²
0
−50
−100
Q_{SH}
DEC97
MAR98
JUN98
SEP98
DEC98
MAR99
JUN99
SEP99


VARIATIONS OF ANNUAL AVERAGES WITH TIME
W m-2
-100
-110
-120
-130
-140
-150
-160
-170
88
89
90
91
92
93
94
95
96
97
98
99
Year
WHOI
SOC
ECMWF
NCEP2


INFLUENCE OF NWP FLUX ALGORITHMS
W m-2
-100
-110
-120
-130
-140
-150
-160
-170
88
89
90
91
92
93
94
95
96
97
98
99
Year
WHOI
ECMWF
NCEP2
ECMWF (COARE2.6)
NCEP2 (COARE2.6)

The next steps

- Sensor improvements
  - Improved incoming longwave
    - Kipp and Zonen with Sandia amplifier
  - Improved incoming shortwave
    - Gimbaled
  - Sonic anemometer
  - Platform inclination
  - Platform motion
    - Tilt error quantification/correction
    - Surface wave observations
    - Turbulent fluxes
  - Turbulent fluxes
  - Ongoing sensor evaluation
    - Improved performance
    - Lower cost
    - Obsolescence

The next steps

- Platform improvements
  - Improved bandwidth
    - Iridium
    - C-band
  - Improved power
    - Wind, wave, generators
  - Severe Environment/High Latitude

The next steps

- Engaging user communities
  - Remote sensing
    - In-situ calibration and validation
    - Data sparse regions
    - High wind and other special regions
  - NWP and atmospheric modeling
    - Independent validation/verification
    - Motivation for improvement
  - Climate studies and modeling
    - Independent validation/verification
    - Motivation for improvement
  - Producing surface meteorology and air-sea flux fields
    - Forcing the ocean
    - Quantifying air-sea coupling

Action items/Summary

- Dealing with issues
  - Sensors
  - Calibration/intercalibration
    - In the lab
    - Dedicated in-situ calibration
    - Cross-calibration - building the network and its credibility
  - Performance characteristics of platforms
    - Flow disturbance
    - Heat island
    - RF radiation
    - Motion
  - Turbulent fluxes/flux algorithms
  - Users and Archiving
    - Metadata
    - Raw data
    - QC