Trends in 15 Years (1993-2007) of Satellite-Derived Oceanic Evaporation

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Objective

Application of multiyear satellite-derived air-sea fluxes for climate studies

- **Main areas of Research**

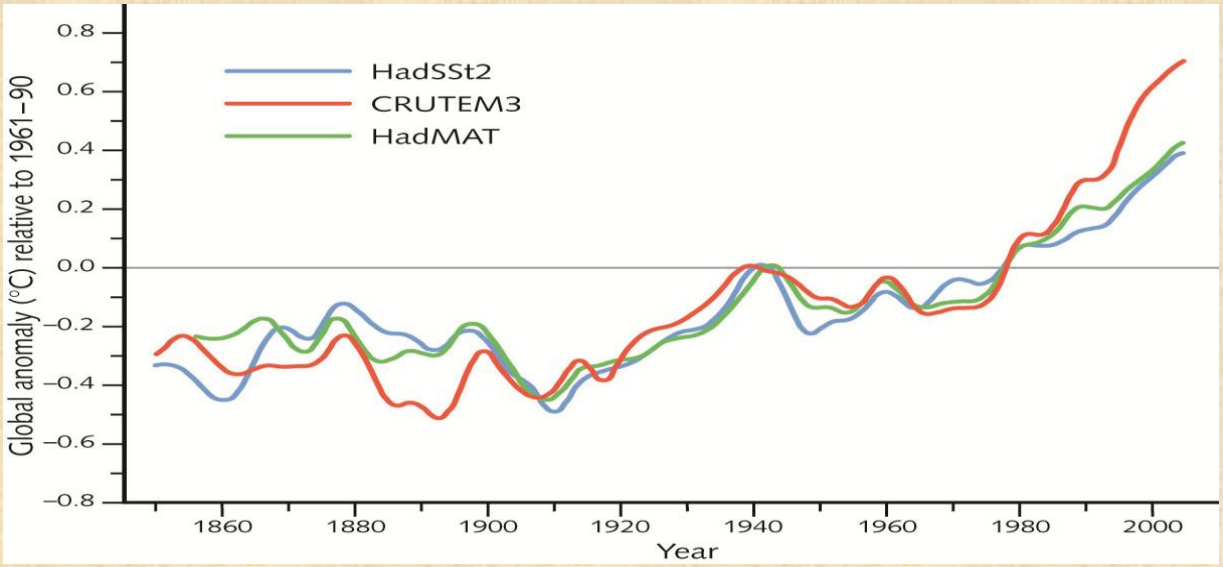
1. Characterization of ENSO footprint in evaporation (Mestas-Nuñez et al., *Int. J. Remote Sens.*, 2013)

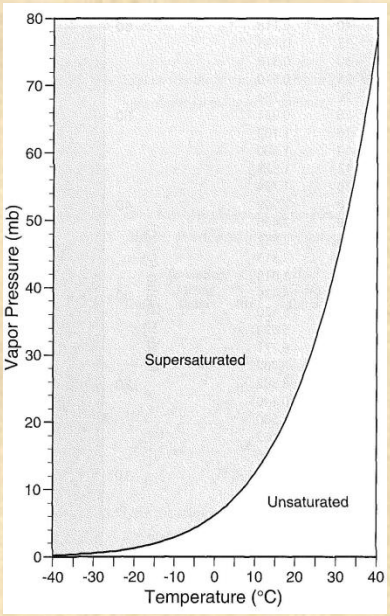
   www.albertomestas.com/publications

2. <u>Evaporation trends</u>

   (Kelly et al., in preparation for *J. Climate*)

Trends: Motivation





- Global SST trends suggest similar trends in global evaporation
- Theory: Clausius-Clapeyron relationship
  - Water holding capacity increases with temperature
- What do LHF observations show?
  - What do satellite derived LHF show?

IFREMER Turbulent Flux Dataset

- Period: 15 years (1993 – 2007)
- Multi-satellite, multi-instrument dataset: (scatterometers & radiometers)

- **Humidity (*Qa*)**: SSM/I;
  Bentamy et al. 2003
- **Temperature (*SST*)**: AVHRR + AMSR; Reynolds et al. 2007
- **Wind Speed (*Ua*)**: Scatterometer + SSM/I (relies on scatterometer where possible); Bentamy et al. 1999

Datasets used

- **Satellite-Based Datasets**
  1. IFREMER
  2. GSSTF2c
  3. HOAPS3
  4. JOFURO2
- **Reanalysis/hybrid Datasets**
  1. ERA-Interim Reanalysis
  2. NCEP-DOE Reanalysis (NECP-R2)
  3. OAFlux

Estimating Evaporation

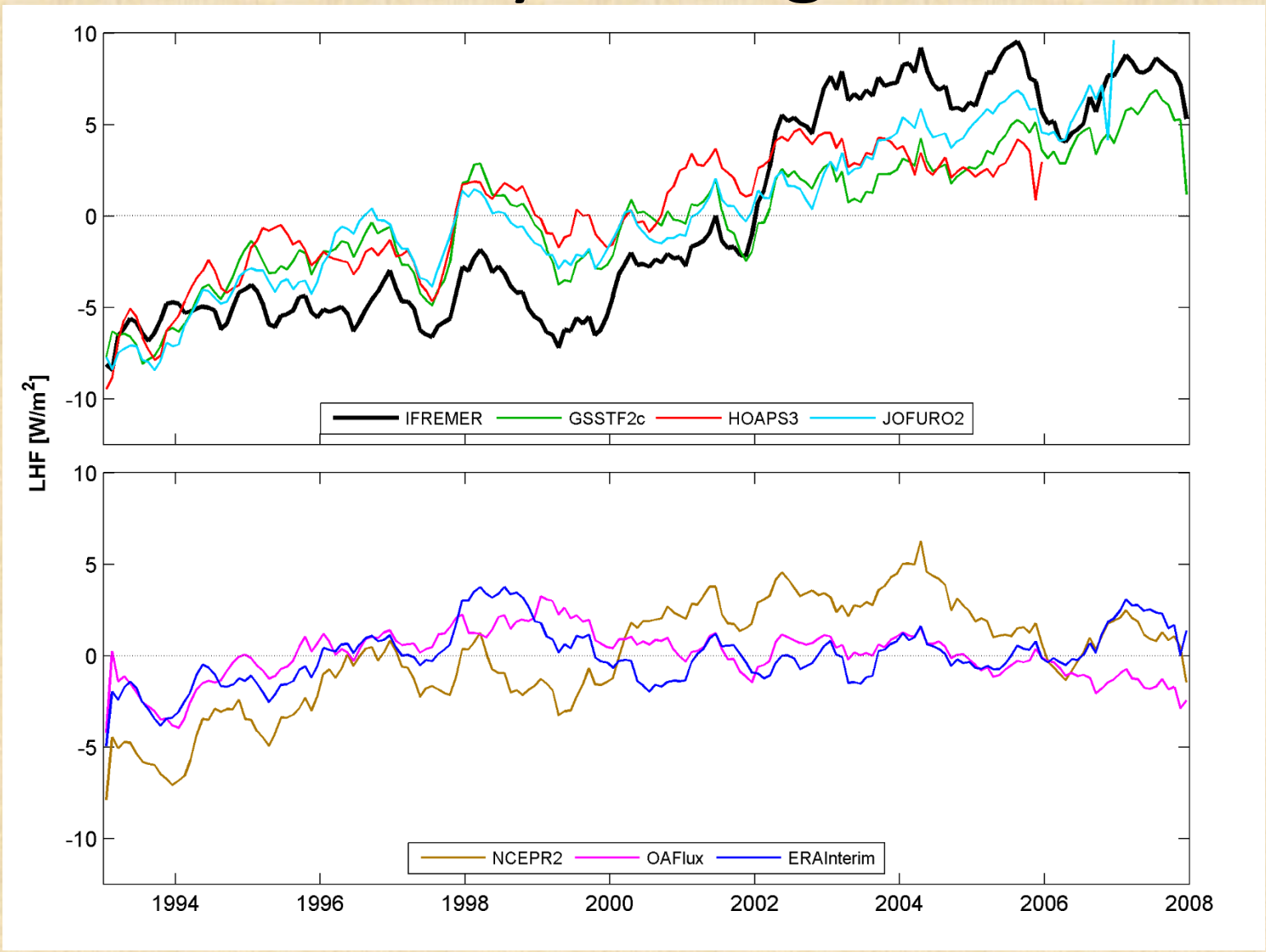
- Bulk Algorithm:

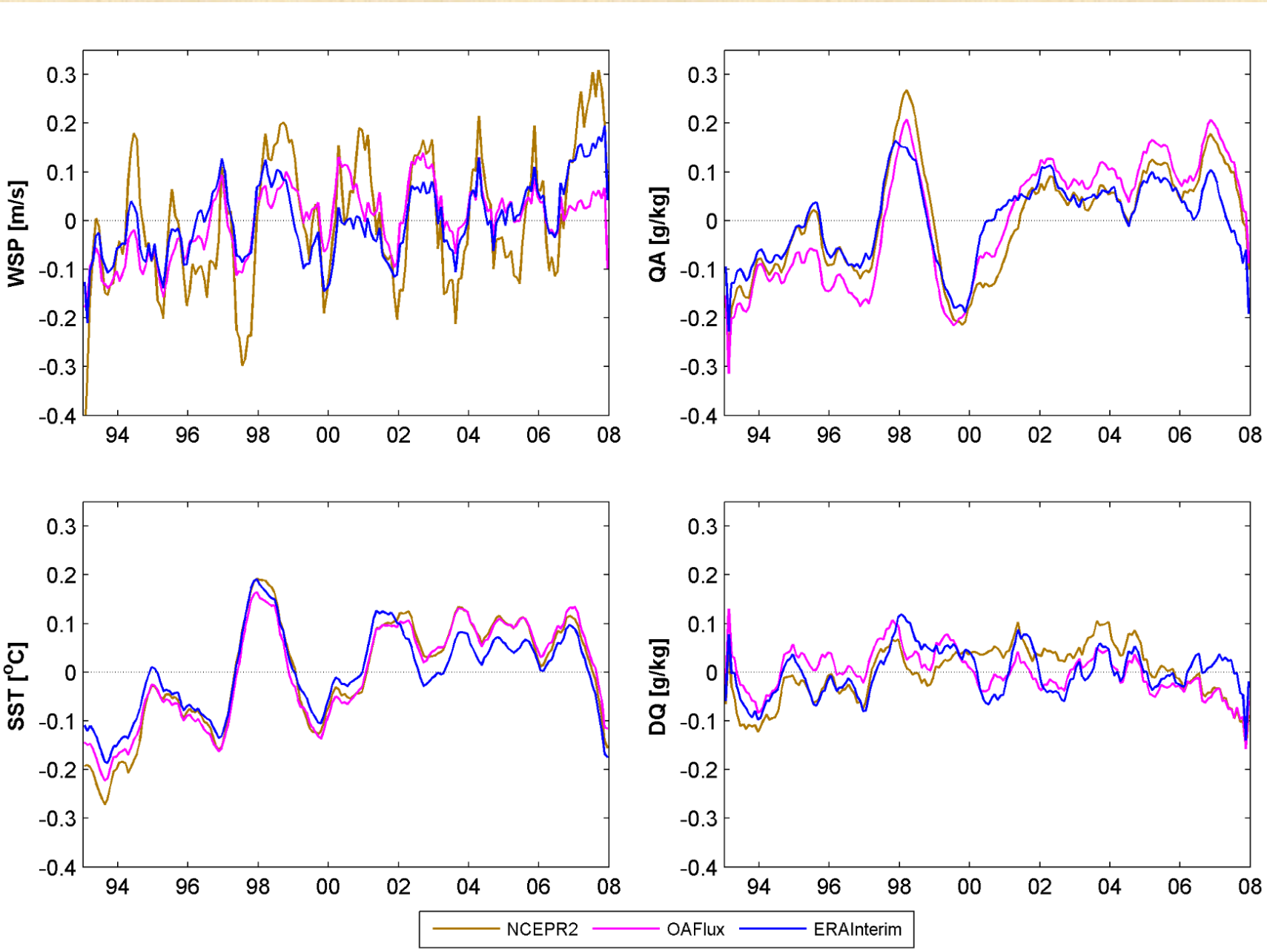
$$LHF = \rho L_v C_E U_a (q_s - q_a)$$

ρ : air density
L_v : latent heat of vaporization
U_a : wind speed at10m
q_a : air specific humidity at 10 m
q_s : surface saturation humidity
-- calculated from SST
C_E : empirical coefficient based on wind speed & atmospheric stability
Δq : $q_s - q_a$ or humidity difference

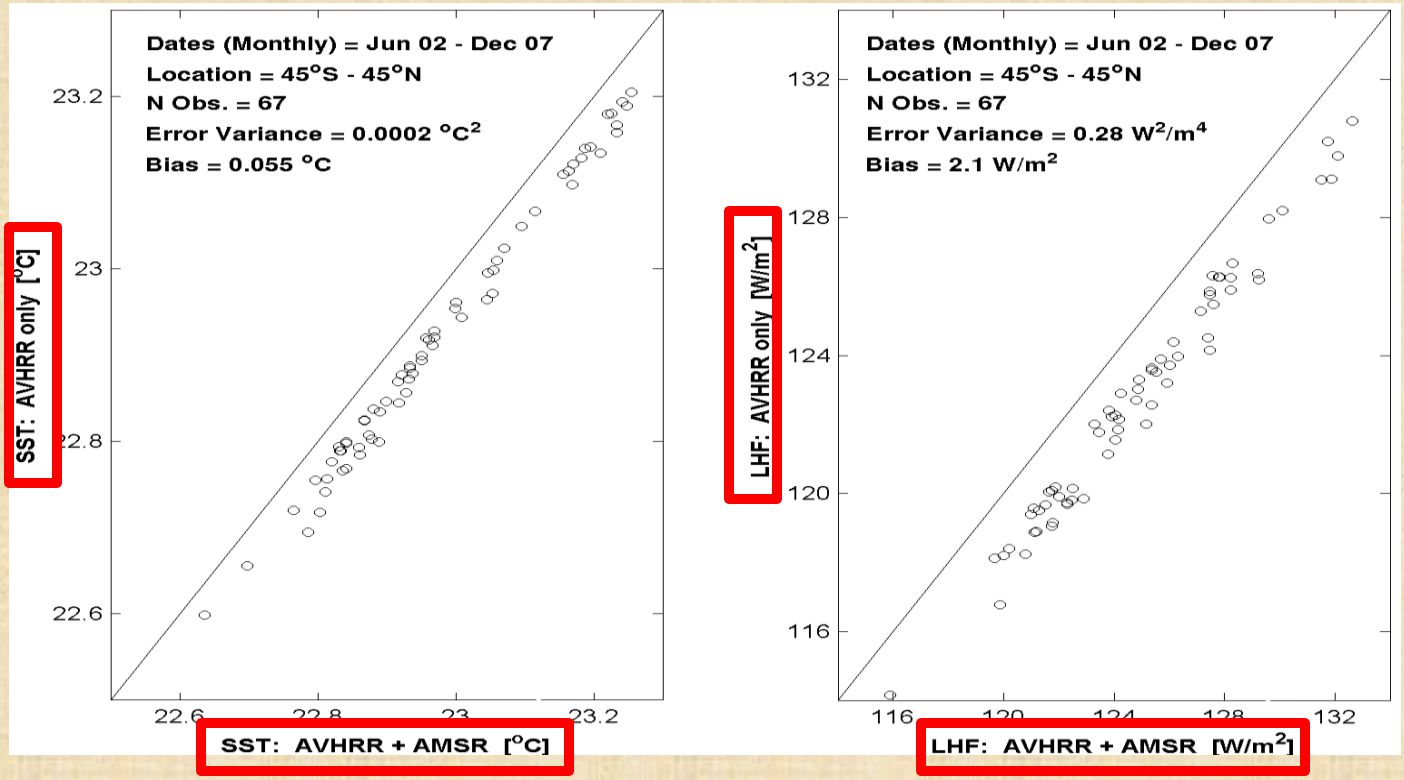
❖ Can estimate LHF if we know U_a, q_a *and* SST

Globally averaged LHF



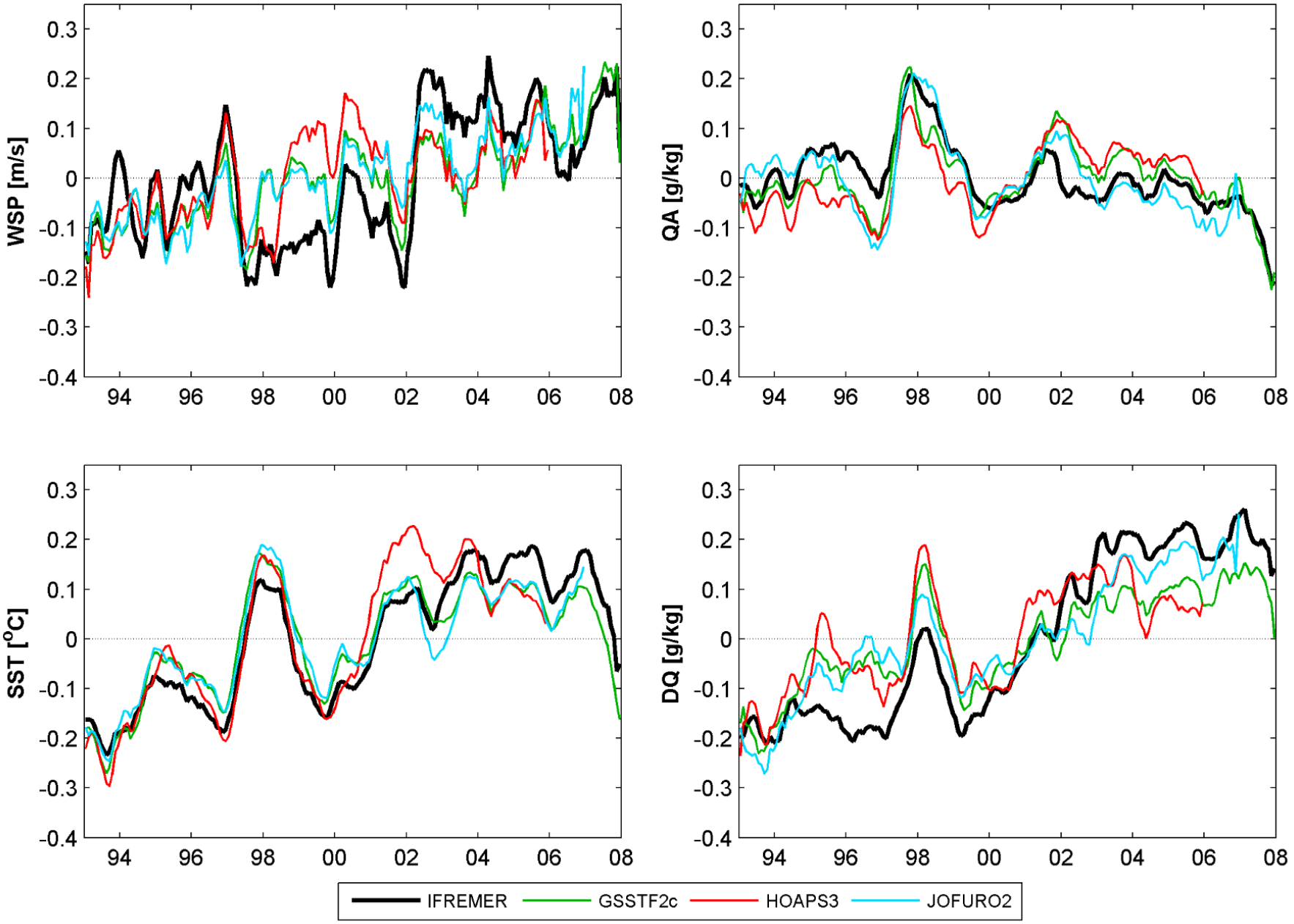

WSP [m/s]
QA [g/kg]
SST [°C]
DQ [g/kg]
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
94
96
98
00
02
04
06
08
NCEPR2
OAFlux
ERAInterim

IFREMER SST bias beyond 2002



- SST bias (from AMSR) = 0.055 °C
- Resultant LHF bias = 2.1 W/m^2

❖ *Not enough to account for IFREMER jump*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-0.1
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-0.3
-0.4
94
96
98
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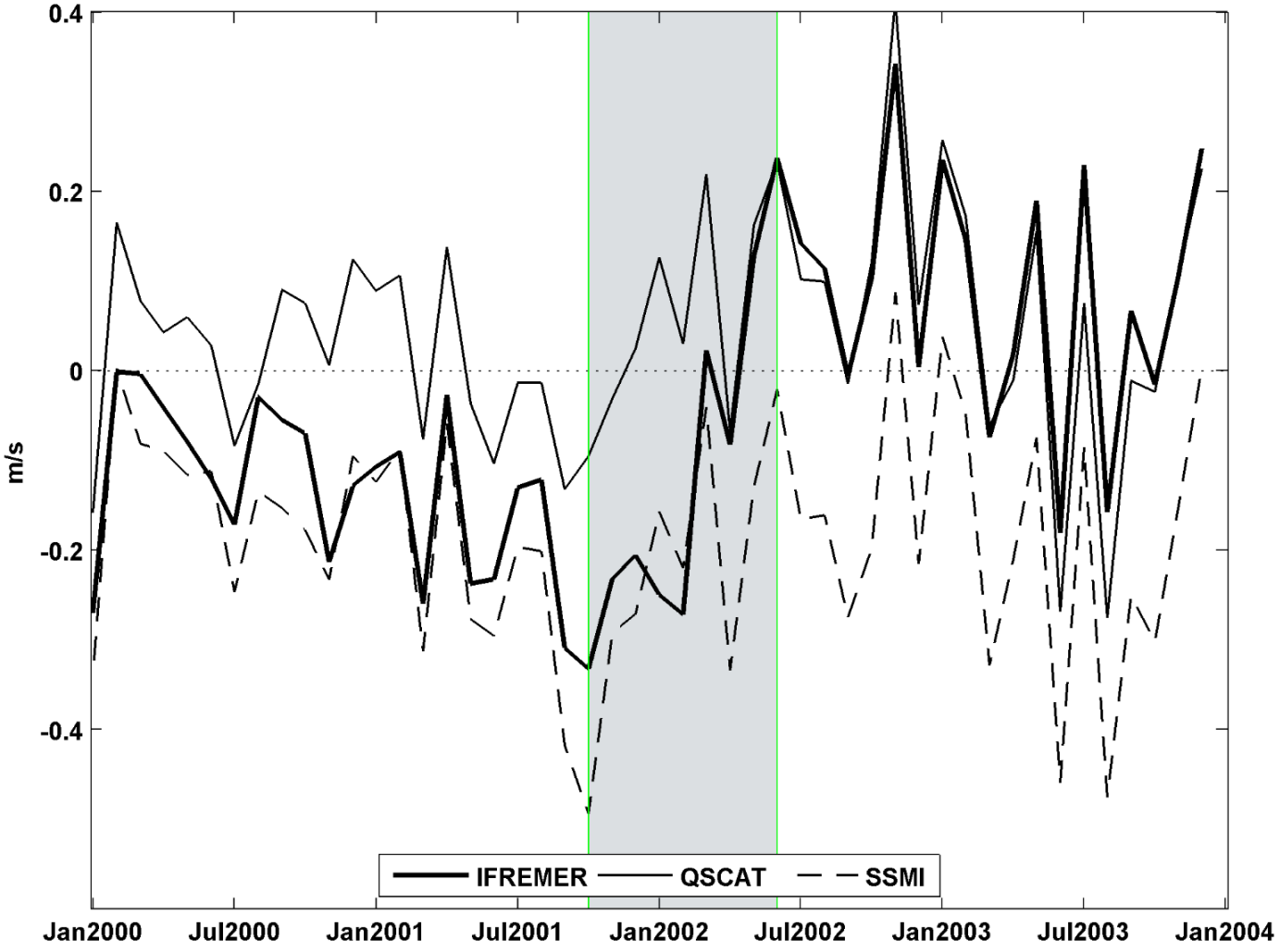
IFREMER
GSSTF2c
HOAPS3
JOFURO2

Wind speed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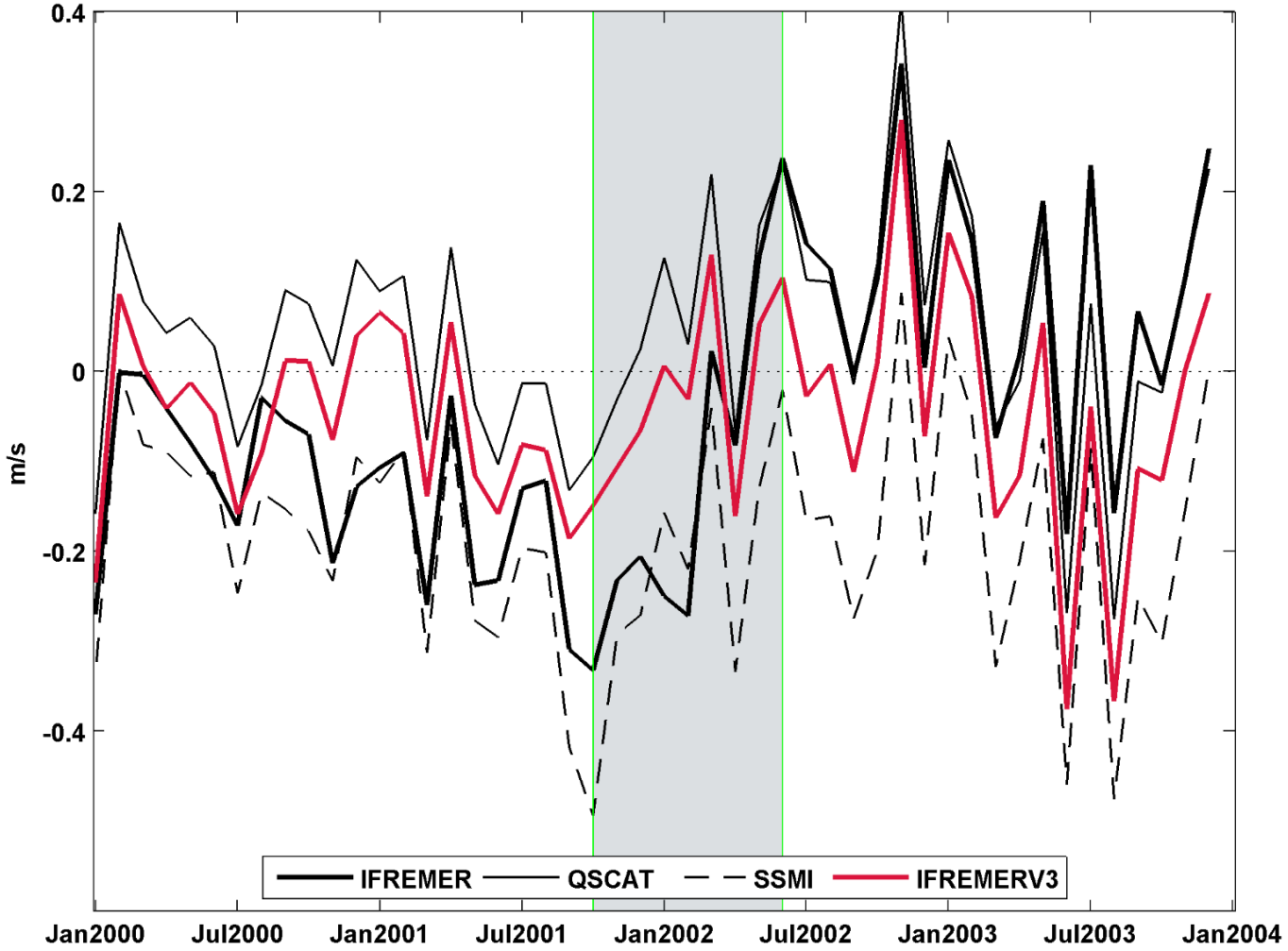
-0.2
-0.4
m/s
IFREMER
QSCAT
SSMI
Jan2000
Jul2000
Jan2001
Jul2001
Jan2002
Jul2002
Jan2003
Jul2003
Jan2004

Wind speed


0.4
0.2
0
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-0.4
m/s
IFREMER
QSCAT
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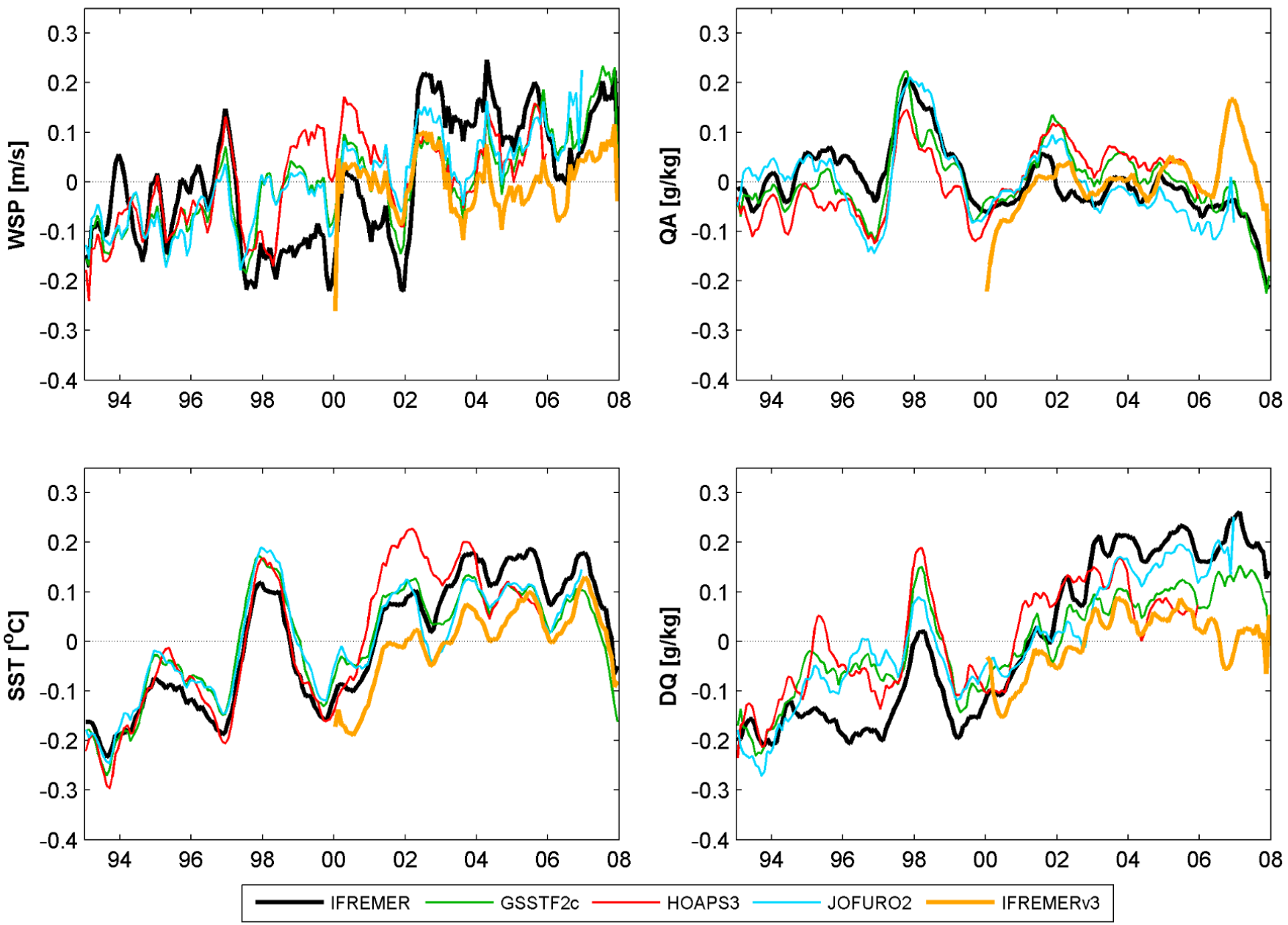
Jan2000
Jul2000
Jan2001
Jul2001
Jan2002
Jul2002
Jan2003
Jul2003
Jan2004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IFREMER
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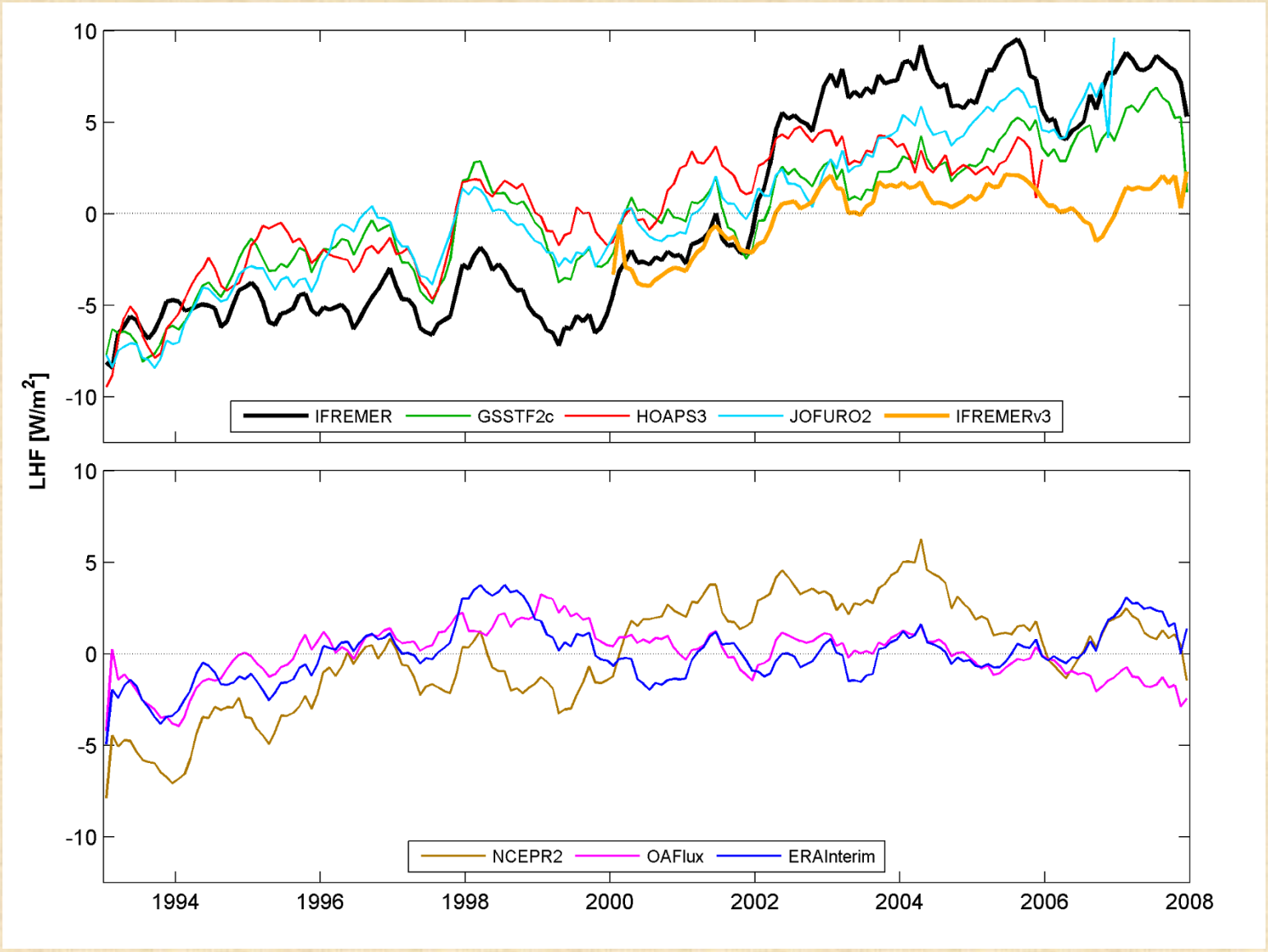
JOFURO2
IFREMERv3

Latent heat flux



Conclusions

- Satellite evaporation products do show expected trend
- IFREMER trend is too large (spurious)
- New IFREMER product is better but more work remains to make it a longer, multi-sensor, consistent product.