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**

     
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  2. **Evaporation trends** (Kelly et al., in preparation for *J. Climate*)
• 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** \((Q_a)\): SSM/I; Bentamy et al. 2003
- **Temperature** \((SST)\): AVHRR + AMSR; Reynolds et al. 2007
- **Wind Speed** \((U_a)\): 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:**

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

- \( \rho \): air density
- \( L_v \): latent heat of vaporization
- \( U_a \): wind speed at 10 m
- \( q_a \): air specific humidity at 10 m
- \( q_s \): surface saturation humidity
  - calculated from SST
- \( C_E \): empirical coefficient based on wind speed & atmospheric stability
- \( \Delta q \): \( q_s - q_a \) or humidity difference

- Can estimate LHF if we know \( U_a, q_a and SST \)
Globally averaged LHF

[Graph showing time series of LHF from 1994 to 2008, with different lines representing various datasets such as IFREMER, GSSTF2c, HOAPS3, JOFRO2, NCEPR2, OAFlux, and ERAInterim.]
IFREMER SST bias beyond 2002

- SST bias (from AMSR) = 0.055 °C
- Resultant LHF bias = 2.1 W/m²

- Not enough to account for IFREMER jump
Wind speed
Wind speed
Latent heat flux

![Graph showing latent heat flux over 1994 to 2008 with different datasets: IFREMER, GSSTF2c, HOAPS3, IOFUR2, IFREMerv3, NCEPR2, OAFlux, ERAinterim.](image)
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.