Uses of high quality meteorological observations in climate studies

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Outline

- AutoFlux
- VOSClim
- Research and Merchant Ship Data
- Summary

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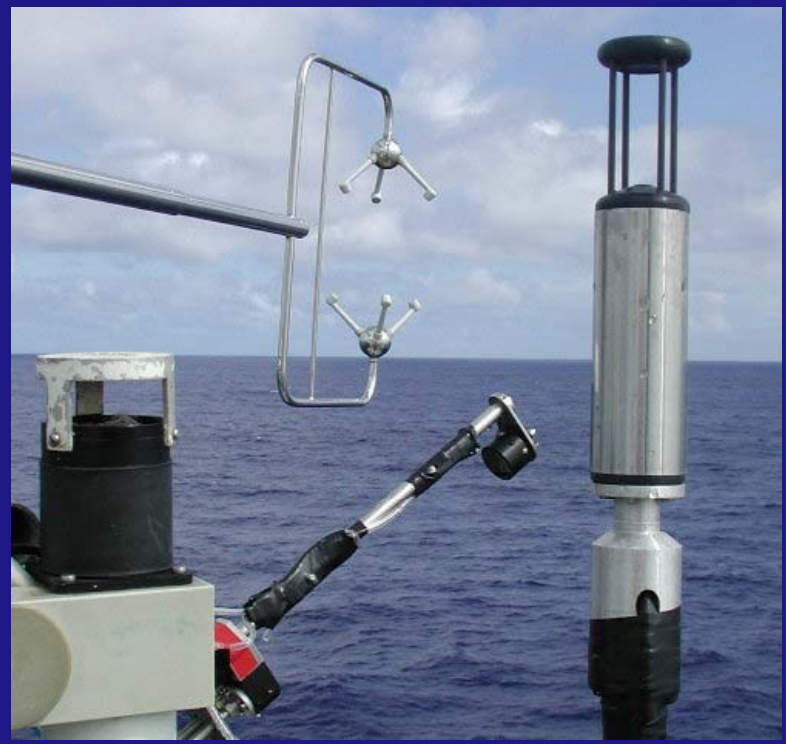
AutoFlux

- A "stand-alone" autonomous system based on one UNIX workstation.
- Flexible - a variety of instruments can be integrated into the system.
- Hourly fluxes calculated automatically in real time.
- Fluxes and QC data sent via "ORBCOMM" in about 2 hours.



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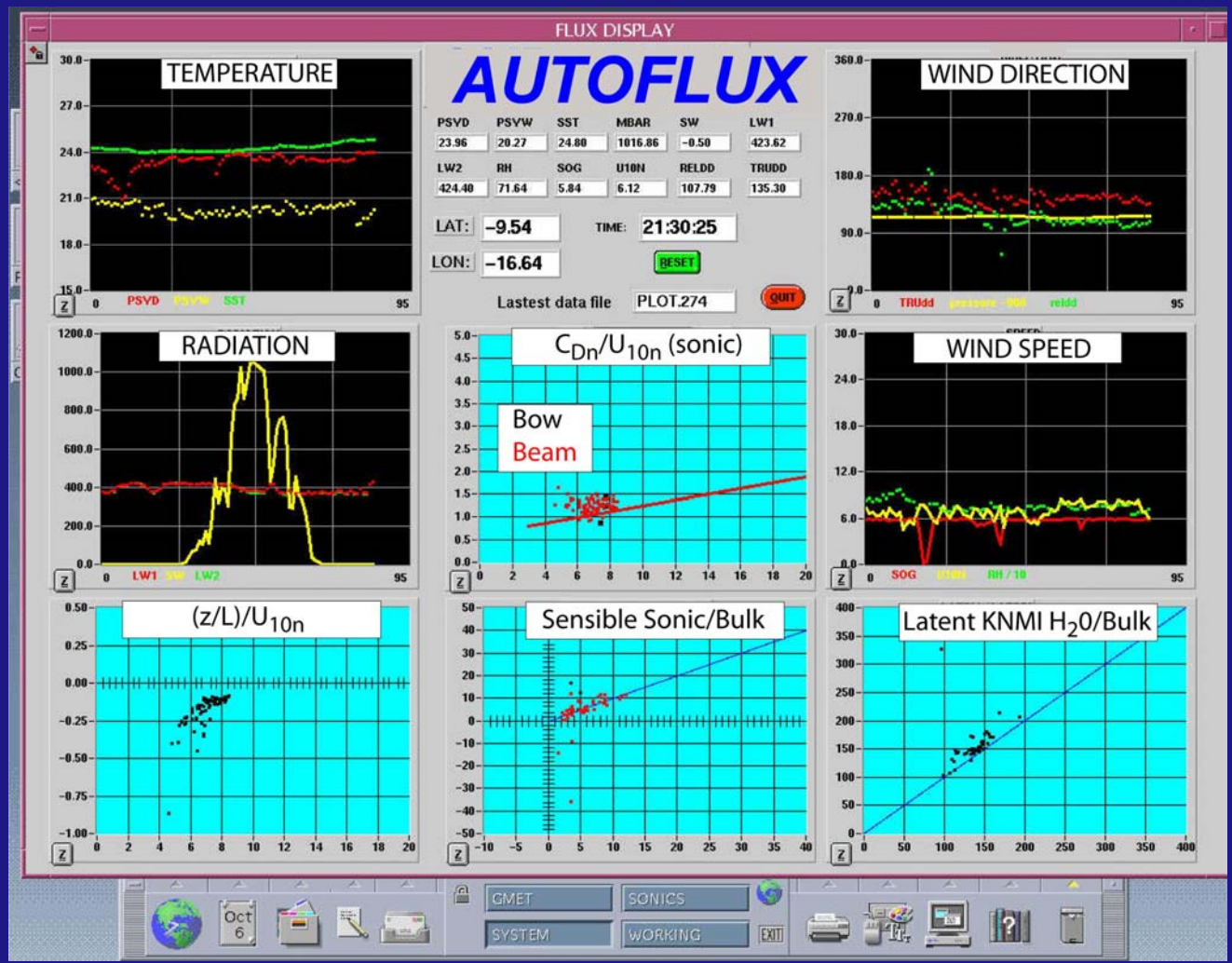
AutoFlux Real-Time Display



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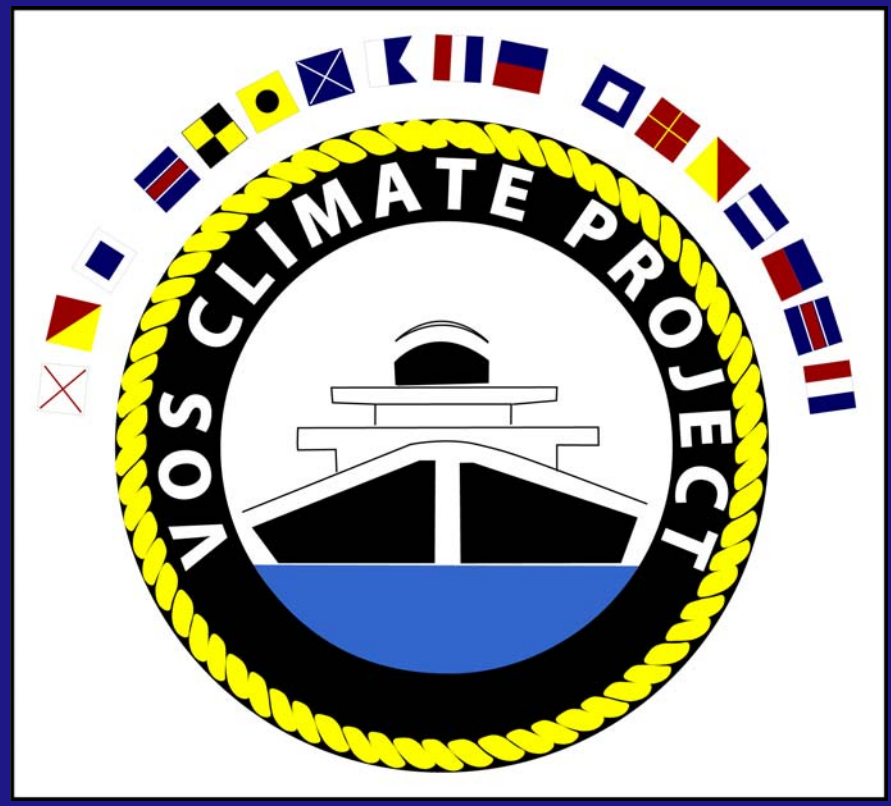
VOSClim

- Collect a high quality subset of VOS data.
- Merge with output of NWP model.
- Collect metadata and pictures of ships and sensors.
- Use for climate studies, model validation, satellite validation.
- Use to define current characteristics of VOS.



http://www.ncdc.noaa.gov/VOSClim.html

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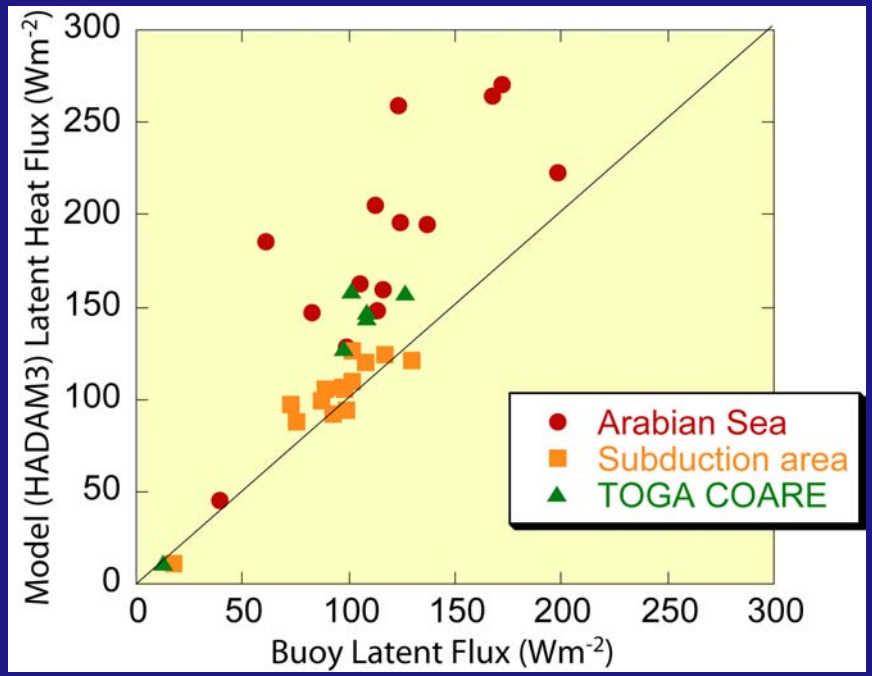
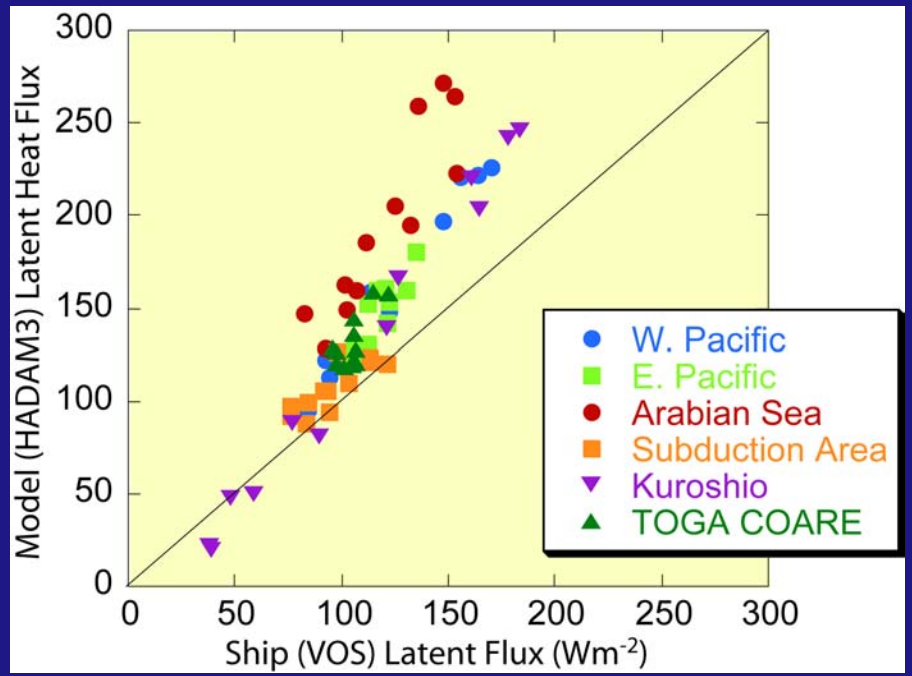
Example of Analysis

VOS data can extend the range of model flux comparisons





We also want to compare research/met.obs. and NWP/met.obs. for the VOSClim research ships.

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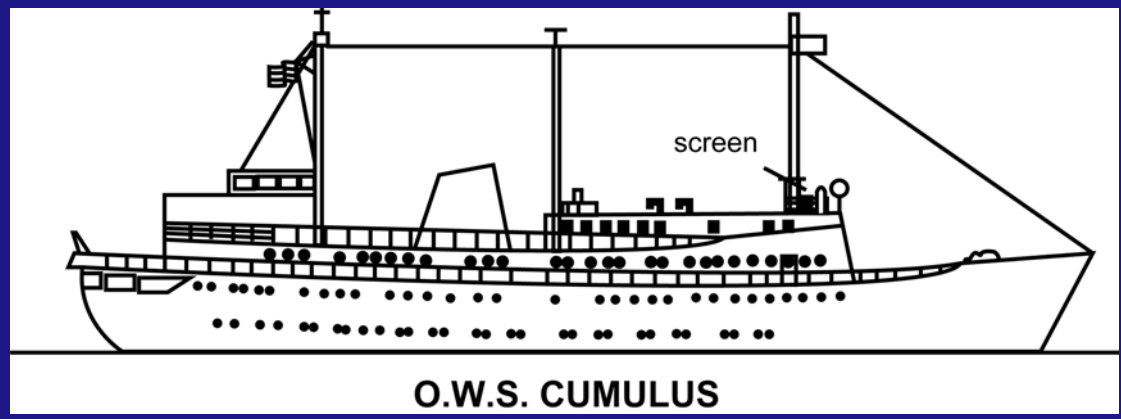
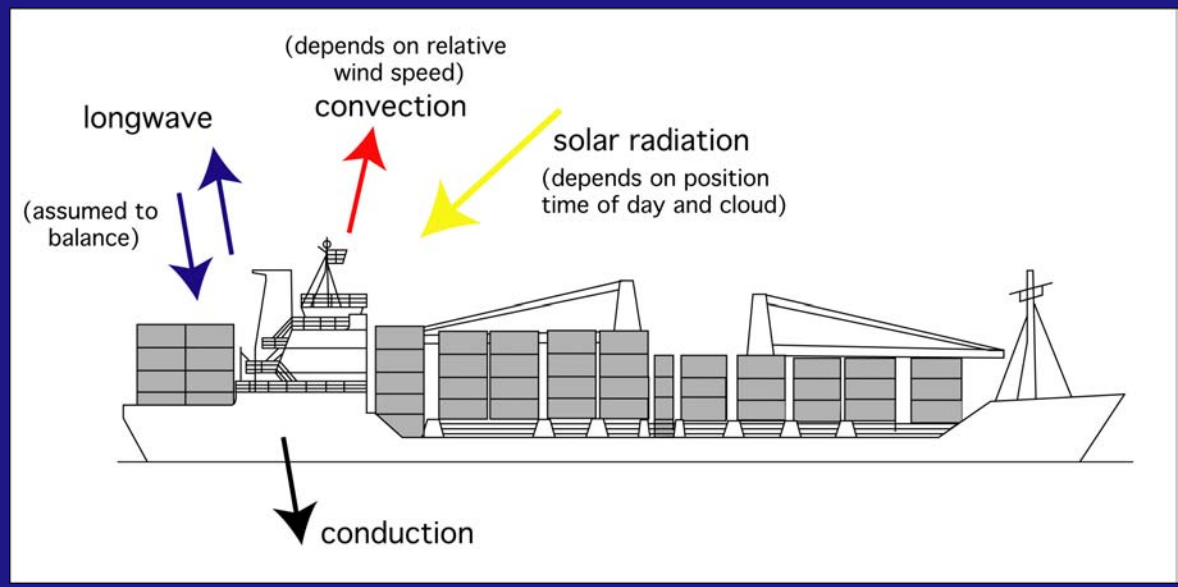
Use of Hourly OWS Data

Air temperature data taken on OWS Cumulus at Station LIMA is being used to test an analytical model of radiative heating errors.

Ship usually drifts beam-on so we can compare well and poorly exposed sensors on each side of the ship.





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Analytical Model

$$mc\frac{dT_{ship}}{dt} = Q_{solar} + Q_{longwave} + Q_{convection} + Q_{conduction}$$

$$mc\frac{d(\Delta T)}{dt} + (h_\mu + h_o)A_c(\Delta T) = \alpha_s A_s R_s$$

m	= mass of ship	A_c	= surface area
c	= specific heat capacity	α_s	= solar absorption coefficient
ΔT	= ship - air temperature	A_s	= surface area normal to solar radiation
h_μ	= convective heat transfer coefficient	R_s	= incoming solar radiation
h_o	= conductive heat transfer coefficient		

- This can be solved to give an air temperature correction which depends on the solar radiation and the relative wind speed (V) allowing for heat storage by the ship.
- If we can estimate the heating error we can make an empirical fit for the unknowns:

$$x_1 = \alpha_s A_s/(mc) \quad ; \quad x_2 = A_c/(mc) \quad ; \quad x_3 = x_4 V^{x5} + h_0$$

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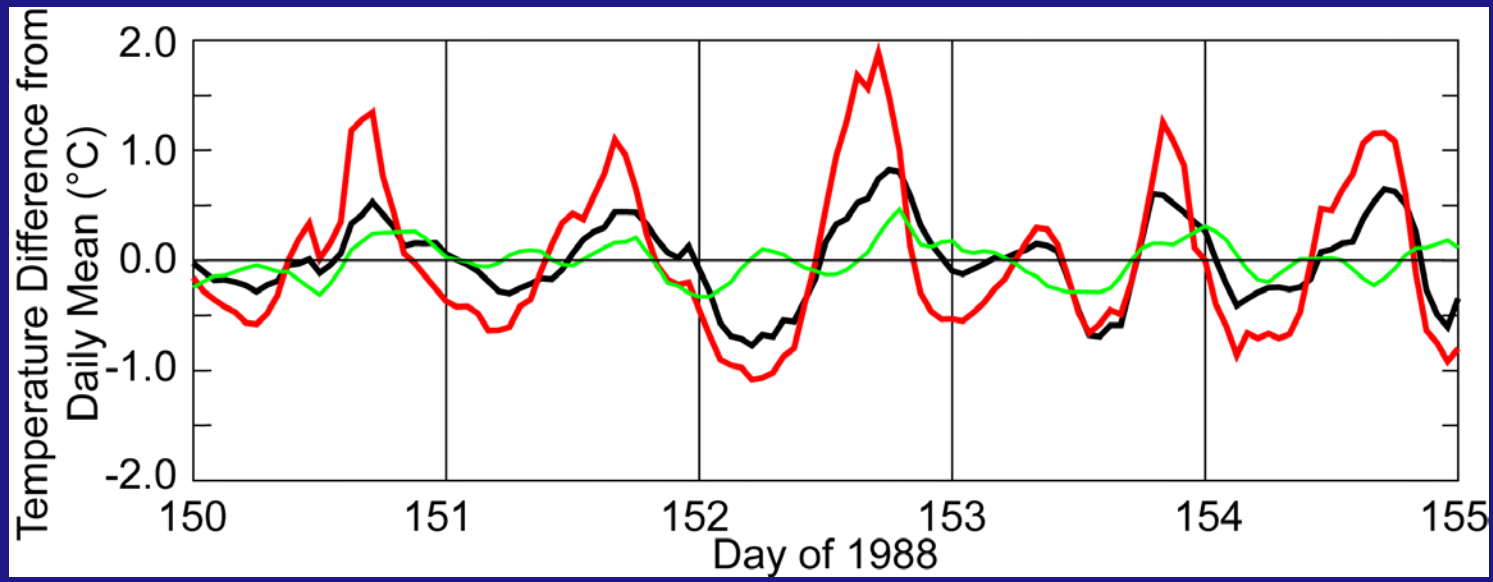
Application of Model to OWS Data



We have chosen about 30 days of summer air temperatures and compared the air temperatures for sensors with different exposure.

The diurnal signal is largest in the poorly exposed air temperature (red) and smallest in the SST (green).

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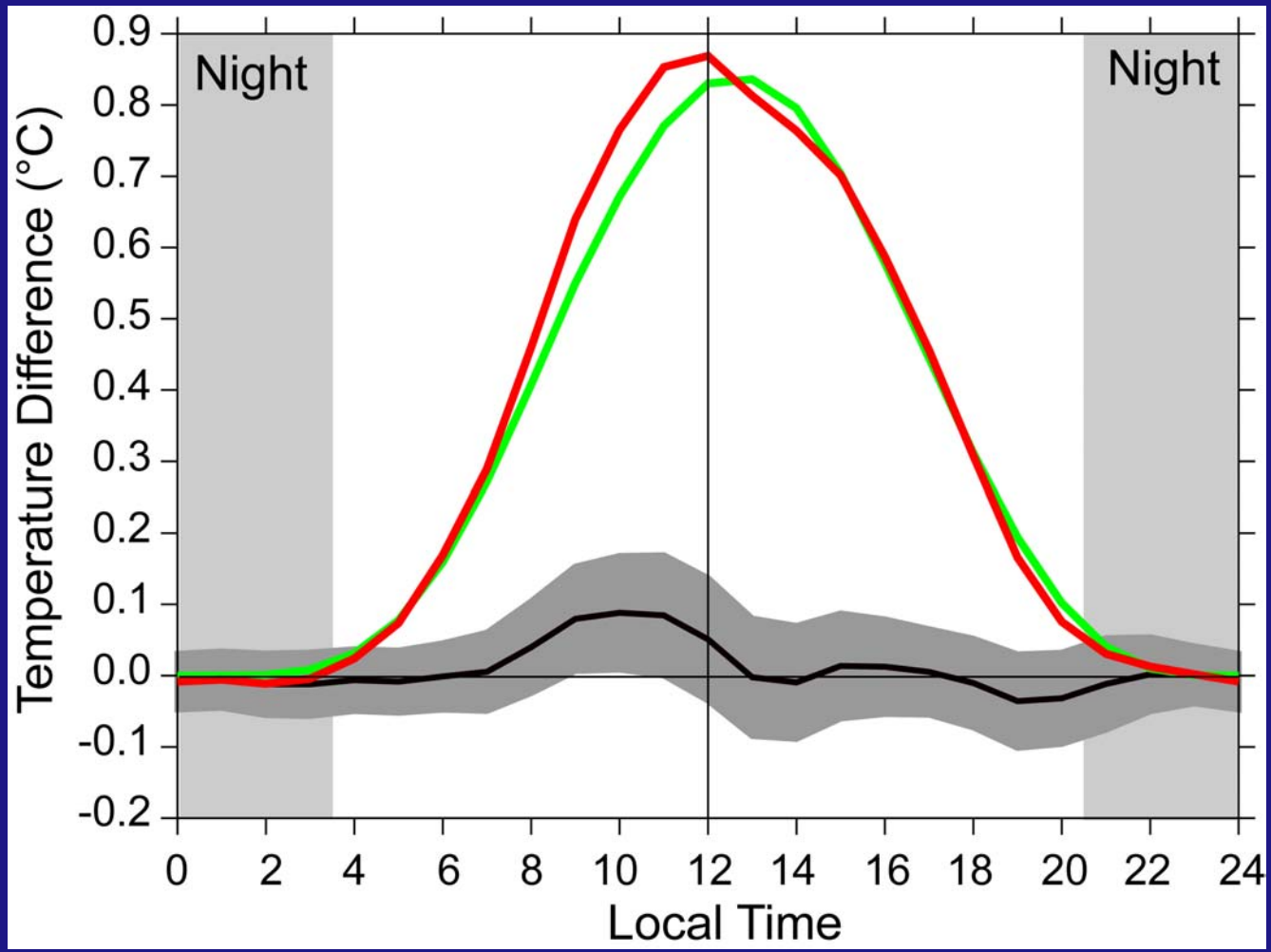
Analytical Model Results ~ 1 months data



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Summary

- It should soon be possible to make routine direct flux measurements from almost any ship.
- The VOSClim project should provide a high-quality subset of merchant ship data and a valuable dataset for climate research.
- We will compare routine and research observations made on the same ship as part of VOSClim.
- High-resolution meteorological data is particularly important for studies of diurnal variation.

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