NOAA RESEARCH • ESRL • PHYSICAL SCIENCES DIVISION

Advances from CALWATER2/VOCALS/DYNAMO Campaigns

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Science Review
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Background

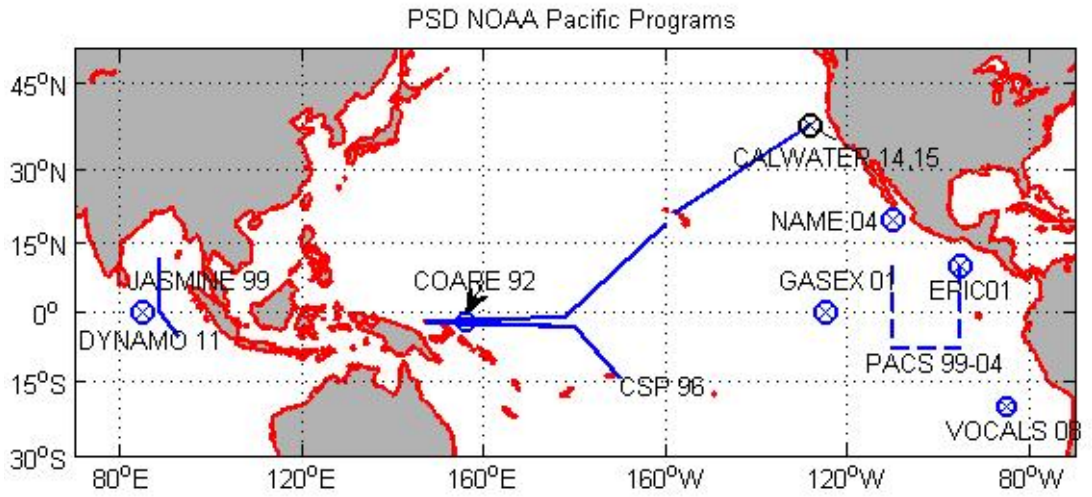
**Selected* NOAA Field Programs since 1992

**Features*:

Air-Sea Fluxes
- Momentum, heat, moisture
- IR and Solar Radiative
- Trace Gases

Cloud-Radiative Coupling
- Aerosols-microphysics-precip.
- Cloud forcing surface radiation
- Clouds and BL dynamics

**Outcomes*:
- Databases
- Model intercomparisons
- Flux products



Project	Date	Locale	Process
COARE	92/93	Eq. W. Pacific	MJO
CSP	96	Eq. W. Pacific	Cloud-Radiation
PACS	99-04	Eq. E. Pacific	Surface energy budget
JASMINE	99	Indian Ocean	MJO, Indian Monsoon
GASEX2	01	Eq. E. Pacific, Upwell zone	Gas transfer
EPIC	01	Eq. E. Pacific, ITCZ	ITCZ, easterly waves
NAME	04	Gulf California	AR, N. American Monsoon
VOCALS	08	Subtropical SE. Pacific	Stratus clouds
DYNAMO	11	Eq. Indian Ocean	MJO, Inception
CALWATER2	14/15	NE. Pacific (Calif. Coast)	AR, mid-latitude cyclone

DYNAMO: Parameterization of shallow convection

- **Boundary Layer Flux = Local Gradient + Nonlocal**
- **Nonlocal = Convective Mass Flux**
- **Approach** – World's first motion stabilized Doppler Cloud Radar
- **The Trick** – Separating Air velocity and Drop sedimentation velocity

Nonlocal Flux

Variable split into *updraft* and *downdraft*

$$X = \sigma X_u + (1-\sigma) X_d$$

Flux related to convective mass flux

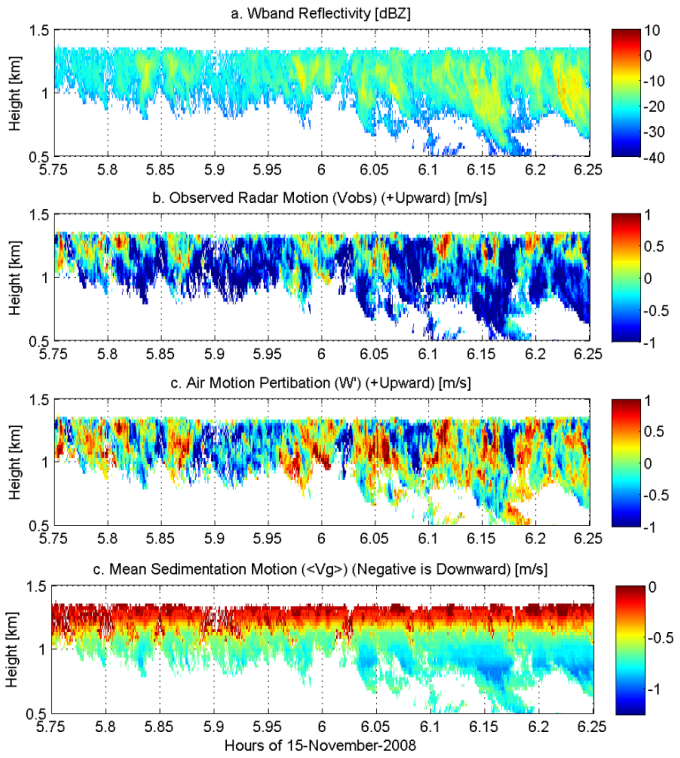
$$\overline{w'x'} = M_* (X_u - X_d)$$

Mass flux from velocity of up/down drafts

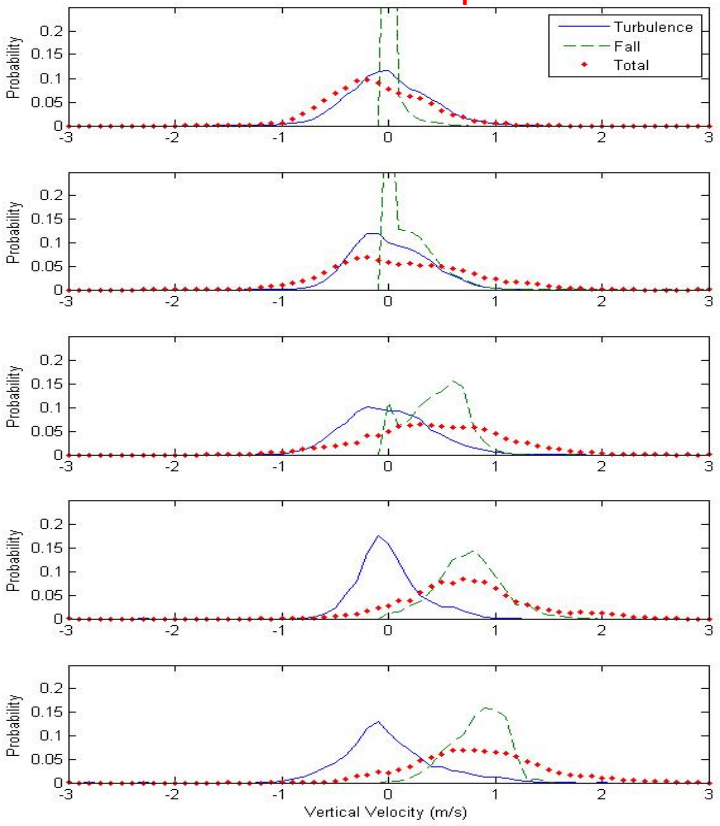
$$M_* = \sigma(1-\sigma)(w_{up} - w_{dn})$$

Velocity Partition:

$V_{dopp} = W_{sed} + W_{turb}$



Stratus Example



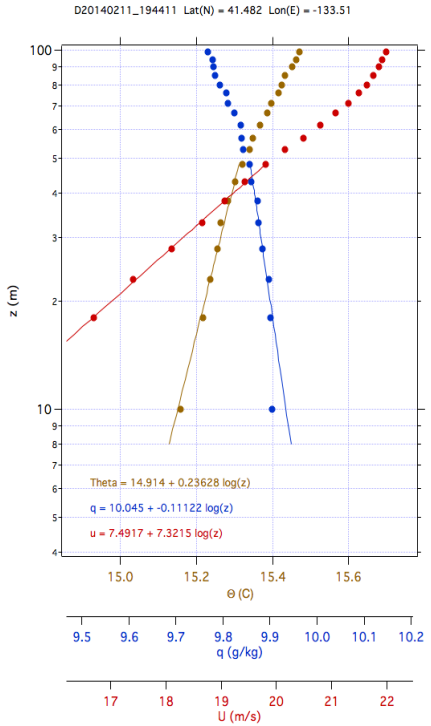
CALWATER2 – Surface Fluxes from Dropsondes

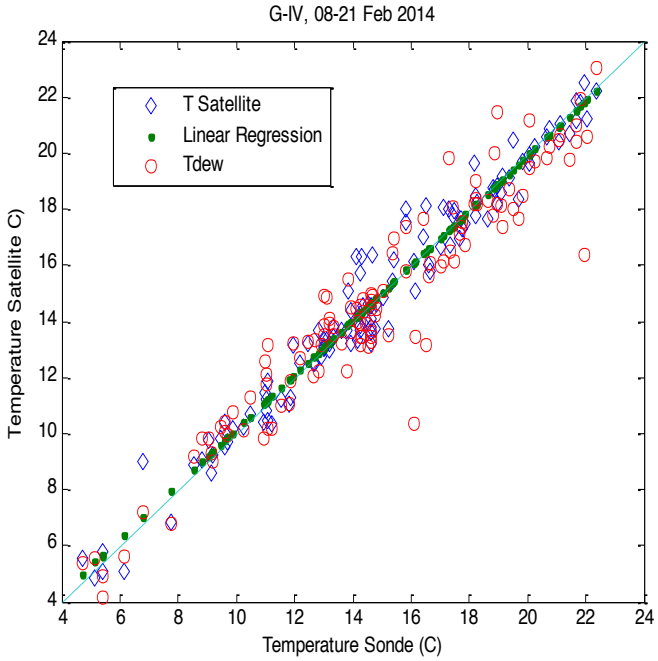
- Fit profile to log(z)
- Estimate SST from T and q
- Compute H_s and H_l

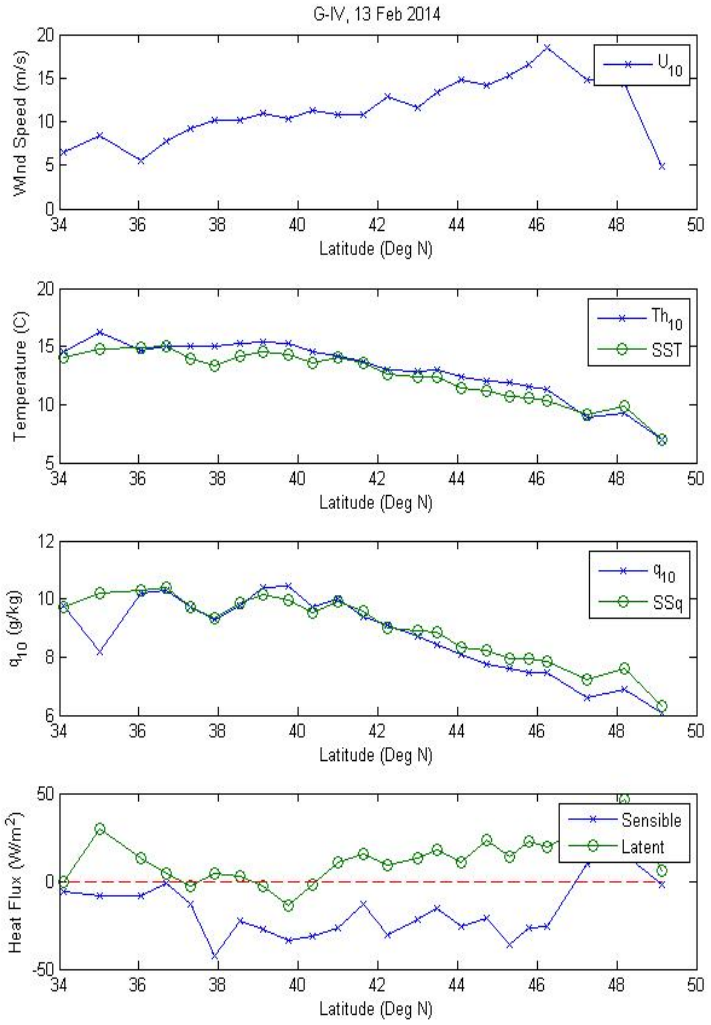
$$X = X_0 + \Gamma_x \log(z)$$

$$SST = \theta_r + \frac{0.4343 * \kappa \Gamma_{10\theta}}{\phi_\theta(z_r / L)\, c_\theta^{1/2}}$$

$$\overline{w'x'} = C_x S[X_s - X(z_r)]$$







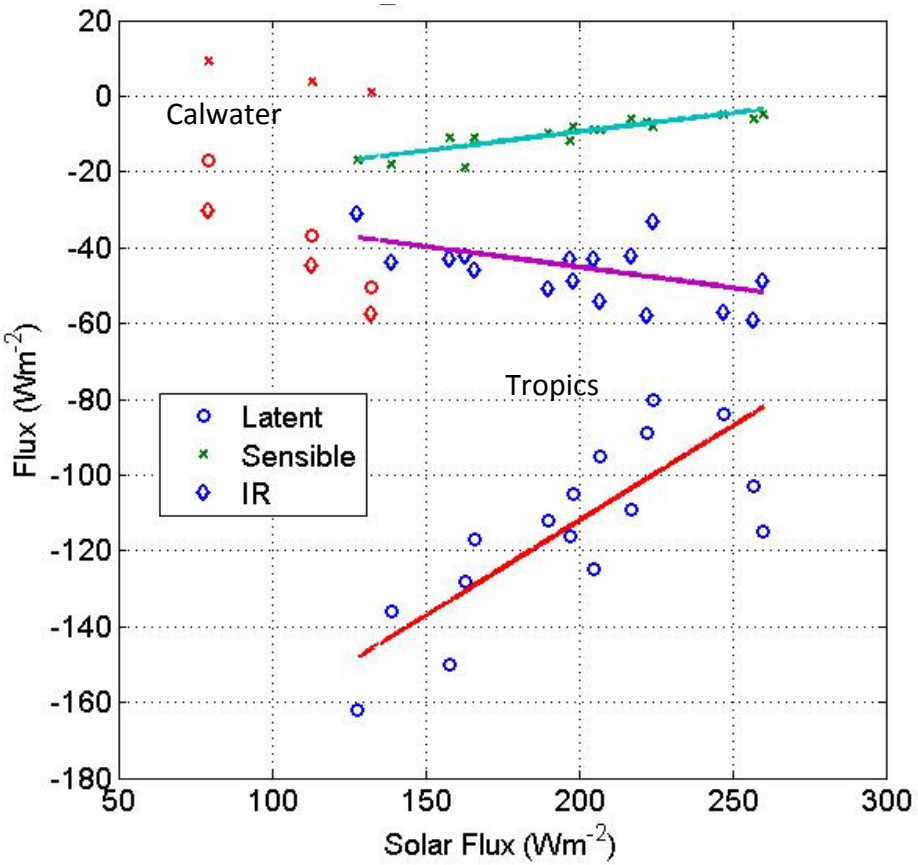
*Very small moisture flux under AR!!

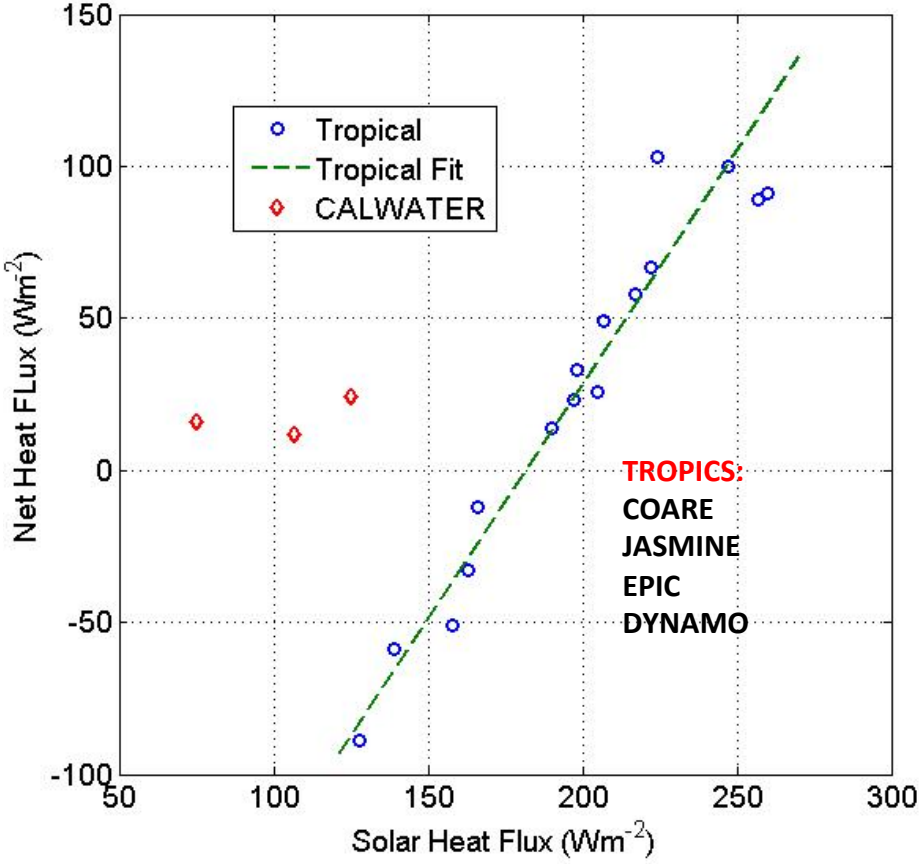
*Verification to come from CALWATER 2015

SYNTHESIS –Solar Forcing as Surrogate for Deep Convection

*Tropics – Suppressed, disturbed, MJO. MJO – strong winds, reduced solar flux, increased evaporation. Hnet changes by 200 W/m^2

*AR – Little correlation between wind and solar flux or evaporation.





Summary and Conclusions

- Strategic program of cruises: 18 Atlantic, 38 Pacific, 8 Arctic, 3 Indian Ocean.
- Emphasis on state-of-the-art direct flux and cloud observations.
- Small regional climatology for climate.
- Publically available flux and cloud databases.
- Research feeds parameterization development.
- Contribute to NOAA's efforts in Ocean Observing System.