Flux Working Group

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Technical Aspects of Met and Air-Sea Flux Data

- Comparisons of various platforms (ships, buoys, aircraft) for met and fluxes.
  - Wind speed, Tair, SST, RH, Pair
    - Revelle calibrations (Edson/Bariteau)
    - Comparison between Revelle and buoys (Edson/Bariteau/Marion & Chi)
    - Time series from Murai (Katsumata, Yoneyama)
  - Downward IR and Solar flux
    - Comparison between Revelle and buoys (Marion & Chi)
    - Aircraft based measurements (Bucholtz)
    - Time series from Murai (Katsumata, Yoneyama)
  - SST from Tsea and Aircraft
    - Atmospheric correction (Zappa & Khelif)
    - Cool skin & diurnal warming (Fairall & Chi)
    - XBT estimates of near surface temperature (Wang)
  - Surface waves (Zappa/Bariteau and Khelif)
    - Doppler shift & estimates of period (Zappa & Bariteau)
    - Whitecapping & Breaking Statistics (Zappa)
    - Aircraft estimates (Khelif)
    - Wave direction from WAMOS (Terril)
  - Surface currents (Moum & Chi)
  - Dropwinsonde (Wang & Chen)

Technical Aspects of Met and Air-Sea Flux Data

- Direct turbulent fluxes vs bulk algorithms
  - Flux comparison on Revelle to determine best DC flux (Edson & Bariteau)
  - Flux comparison between Revelle and Murai (Edson/Bariteau & Tsukamoto)
  - Flux comparison between Revelle and P3 (Khelif & Edson/Bariteau)
  - Best algorithm for bulk fluxes (Fairall & Edson)
- Generation of gridded flux time series for DYNAMO area (Shaocheng Xie):
  - Comparisons of flux products such as OAFlux, TropFLux, SURFA (Marion)
  - reanalysis products such as MERRA, ERAI, CFSR (Wanqiu Wang)
  - model output from COAMPS (Sue Chen)
  - satellite obs, and in situ fluxes from surface platforms (as needed).
- Time series of precipitation (Thompson/Marion/Bariteau/Edson & Chi)
- In situ flux data time series – cleaned up, optimized, inter-compared, and consistent between platforms (All of the above)
- Add the following variables to the DYNAMO data set: bulk T_{sea} and salinity from TSG, Clear sky solar, Clear sky IR, Diffuse solar, Relative wind direction, Significant wave height, precipitable water, cloud fraction, warm layer depth and amplitude.

Air-sea breakout session

Group 2C: Air--sea interaction DYNAMO Hypothesis III (Chairs: Jim Moum, Sue Chen)

Hypothesis III: The barrier layer, wind- and shear-driven mixing, shallow thermocline, and mixing-layer entrainment all play essential roles in MJO initiation in the Indian Ocean by controlling the upper-ocean heat content and SST, and thereby surface flux feedback.

Air-sea breakout session – initial guidelines and summary responses

- Summary of in-situ upper ocean and surface flux datasets from moorings, Revelle, Mirai, Sagar Kanya, and aircraft, including dates, variables, and sampling rates. List of available data - adcp, axctd, axbt, ctd, xpod, underway, glider, wave data.

  These topics are primarily covered by the Air-Sea Flux Working Group
- Assessment of ocean response to CINDY/DYNAMO MJO - Mirai, Revelle, moorings, aircraft, and glider.
  - Revelle group is looking at response at one location and preparing BAMS paper on structure and evolution
  - A coordinated effort with other groups is required to extend analysis of response to a broader region and to more MJOs.
- Assessment of ocean model response - global and regional models, including modeling issues
  - This is being done by other working groups
- Cross-equatorial structure of ocean response.
  - At the equator, the wind is largely taken up in accelerating the Yoshida/Wyrtki Jet, and maybe some goes to Rossby wave formation? This was measured at Revelle on equator
  - on Mirai at 8S, ocean response to wind is largely near-inertial
  - How does this transition from equatorial to off-equatorial (near-inertial) response work?
  - this is potentially critical for downward propagation of energy from wind into deeper ocean

Air-sea breakout session – initial guidelines and summary responses

- Evaluation of ocean heat budget and mixed-layer depth. What are the relative contributions from the upper-ocean dynamics (advection and mixing from waves) versus atmospheric forcing (wind mixing, solar heating, and longwave cooling). What are the time scales? Are there differences between the CINDY/DYNAMO northern and southern arrays? What are the modeling issues, radiation, atmospheric PBL, cloud, ocean boundary layer, and wave mixing parameterizations?
  - During Leg 3 ~2/3 of cooling is due to atmosphere and 1/3 is due to ocean.
  - implication is that surface fluxes alone are not enough to modify SST – a good representation of mixing is necessary
  - however, APL group has looked at heat budget analysis at 1.5S and indirectly infer contribution from mixing is nil

    action item – Nan-Shu Chin will complete analysis at 0, 78E and visit OSU

- Cycle of CINDY/DYNAMO barrier layer. Role of barrier layer on subsequent convection and its contribution to air-sea flux exchange?

Air-sea breakout session
points raised in discussion

- Langmuir cells are clearly present in P-3 IR (also present in Revelle measurements)
- How much do Langmuir circulation transfer heat and momentum versus shear-driven mixing. The latter effect is measured using turbulence sensors on profilers and moorings but Langmuir effects are not. Is this big or small?
  - action item – LES modeling and combine P3, Revelle analyses

- More 2-D structure is seen under low-wind precipitating events.
- Wave breaking is enhanced under certain conditions and is related to gust fronts/cold pools.
- Wave breaking statistics can be used to investigate momentum exchange.
  - action item – develop a hierarchy of features and their relation to the passage of a gust front.

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Air-sea breakout session

- Penetrating solar was measured from Revelle – necessary for heat budget calculations
- Less variability in solar transmission in DYNAMO compared to COARE.
- Depends on chlorophyll concentration. This was fairly low and constant until after the MJO event when there was a strong bloom. Good possibility it was advected rather than developed in situ.
    - action item - Carter should contact Pete Strutton about fluorometer measurements on RAMA buoy at 0, 80E. These and ocean color from space will help to revolve space/time patchiness

      - examine sensitivity of heat budget calculations to changing Tr(z,t) compared to constant Tr(z)

- Although there was less chlorophyll, the light fell off quicker in DYNAMO versus COARE. Not sure why.

- add terms to complement flux data set? This will be a longer term objective but should be an outcome of DYNAMO
    - objective – create 3 additional but separate series that will complement flux data set
        - 1. TR(z,t) – radiation transmission profiles
        - 2. K(z,t) – turbulence diffusivity profiles
        - 3. MLD – mixed layer depth from highly-resolved density profiles

Scientific Pursuits

- BAMS Overview paper on 24 November Event
- Intensification of the Wyrtki Jet
- Advection of cool freshwater puddles modeled as a two-layer fluid following the phase speed (gh)^0.5
- A investigation of fronts/ramps evolution that are observed in the P-3 imagery that advect past the Revelle.
- Langmuir Circulation via LES modeling, near-surface ocean observations, 2-D imaging.
- Diunal warming. This will be split up into (at least) two targeted manuscripts investigating our ability to model the warm layer using high resolution profiles of T and S, and impact of diurnal warm layer effects on ocean skin temperature, bulk-skin temperature difference, and air-sea fluxes.
- The COARE 4.0, which will focus on heat exchange and improved parameterization of the fluxes using DYNAMO and other data sets.
- Characterization of atmospheric cold pools and their impact on air-sea exchange.
- Ocean skin temperature response to precipitation
- Flux profiles in the convective boundary layer using Revelle and P-3 turbulent and radiative fluxes
- Flux Product / Reanalyses intercomparison and in-situ comparison.