CPEX 2017: Utilizing DAWN wind measurements for convective studies and mass budget calculations

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CPEX 2017: Convective Processes in the Tropics

• The NASA funded CPEX (Convective Processes EXperiment) airborne campaign operated out of Ft Lauderdale, FL during May/June 2017 to investigate convective processes using the featured Doppler Aerosol WiNd Lidar (DAWN)

• Other instruments included APR-2, HAMSR, MTHP, Dropsondes

• The CPEX campaign flew 16 missions over the Atlantic Ocean, Caribbean Sea and the Gulf of Mexico and provided a unique set of more than 5000 DAWN wind profiles and ~300 dropsonde wind, temperature and water vapor profiles.
Original DAWN CPEX Science Objectives

1) Utilize DAWN to study the dynamics of convective cloud initiation, maintenance, and decay, particularly over open tropical waters

2) Study the dynamics of tropical convection by flying missions that allow us to compute mass budgets for 100 km x 100 km x 6-10 km volumes containing various degrees and life cycle of convection

3) Provide cal/val for numerical models and other instruments

4) Improve model assimilation of lidar wind observations into numerical weather prediction models (Pu)
June 11, 2017

DAWN Profiles ~ Every 5km

5 Look 2 second dwell
Western S-N Leg A

CPEX DAWN - DROPSONDE COMPARISON
Wind Speed
06/11/17

Dropsonde (141900) - Black Line
DAWN (141952) - Red Circles

CPEX DAWN - DROPSONDE COMPARISON
Wind Direction
06/11/17

Dropsonde (141900) - Black Line
DAWN (141952) - Red Circles
Western S-N Leg B

CPEX DAWN - DROPSONDE COMPARISON

Wind Speed
06/11/17

Height (m amsl)

0 10 20 30 40

Wind Speed (m/s)

Dropsonde (145236) - Black Line
DAWN (145402) - Red Circles

CPEX DAWN - DROPSONDE COMPARISON

Wind Direction
06/11/17

Height (m amsl)

0 90 180 270 360

Wind Direction (deg)

Dropsonde (145236) - Black Line
DAWN (145402) - Red Circles
CPEX Mass Budget Science

• Objective
  - Compute mass budgets and divergence for 100 km x 100 km x 6-10 km volumes containing various degrees of cloud coverage to help us describe the dynamics of the atmosphere over the tropical ocean

• CPEX Boxes
  - Over 20 ~ 100 km x 100 km boxes were flown during CPEX 2017 which included:
    1) Undisturbed conditions
    2) Disorganized or scattered/broken convection
    3) Decaying convection
    4) Organized (line/area) convective system
DAWN Profile ~ Every 5 Km

5 Look 2 second dwell

May 27, 2017
Start of Northern W-E Leg

Wind Speed Drops (0527)

Wind Direction Drops (0527)

Black - 162827
Blue - 170606

Height (m)

0 2000 4000 6000 8000

Wind Speed (m/s)

0 2 4 6 8 10 12

Height (m)

0 2000 4000 6000 8000

Wind Direction (deg)

0 60 120 180 240 300 360
Mid Point Box A
Southern Leg
Mid Point Box A
Western Leg
Mid Point Box A
Northern Leg
Mid Point Box A
Eastern Leg
Wind Speed
Wind Direction

BOX A

052717 Box A Northern W-E Leg Wind Direction

052717 Box B Western S-N Leg Wind Direction

052717 Box A Eastern N-S Leg Wind Direction

052717 Box B Southern E-W Leg Wind Direction
BOX B

Wind Speed
Wind Direction
BOX B

Wind Speed

052717 Box B Northern W-E Leg Wind Speed

052717 Box B Western S-N Leg Wind Speed

052717 Box B Southern E-W Leg Wind Speed

052717 Box B Eastern N-S Leg Wind Speed
June 16, 2017

DAWN Profile ~ Every 12 km

5 Look 2 second dwell
Summary

• The CPEX campaign has provided a unique set of more than 5000 DAWN wind profiles and ~ 300 dropsonde wind, temperature and water vapor profiles during all stages of the convective life cycle

• The DAWN airborne instrument can provide the velocity fields in the vicinity of scattered and organized deep convection

• CPEX science flights indicate good vertical coverage and good agreement with dropsonde winds

• The DAWN data have been used to compute mass budgets and divergence for 100 km x 100 km x 8-10 km volumes containing various degrees of cloud coverage ranging from cloud free to broken and scattered convection.

• Future work will continue on the investigation of the dynamics in more active and growing convection.
EXTRAS
062317 CPEX BOX D
Mass Divergence

![Graph showing Mass Divergence with height (m) on the y-axis and divergence (x 10^-5) on the x-axis.]