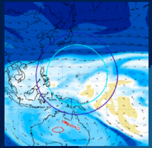
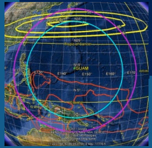
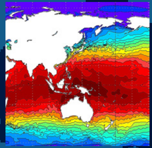
CONTRAST

CONvective TRansport of Active Species in the Tropics :: January-February 2014 :: Guam






Research Objective

CONTRAST will quantify how large convective clouds redistribute atmospheric gases in the tropical atmosphere. Air within convective clouds has extremely low ozone, a unique chemical environment that will be studied in detail by sensor-laden research aircraft for the first time.

Collaborative Airborne Research

CONTRAST will be conducted collaboratively with two other airborne research projects, also based in Guam: ATTREX and CAST. Together, the three research projects will span the marine boundary layer to the tropical lower stratosphere, providing unprecedented detail on the composition of the tropical atmosphere.

- **CONTRAST**: The NSF/NCAR HIAPER research aircraft will make measurements at mid-altitudes
- **ATTREX**: NASA will fly their Global Hawk (GH) research aircraft at high-altitudes
- **CAST**: FAAM, a British atmospheric research organization, will fly their BAe-146 aircraft at low-altitudes

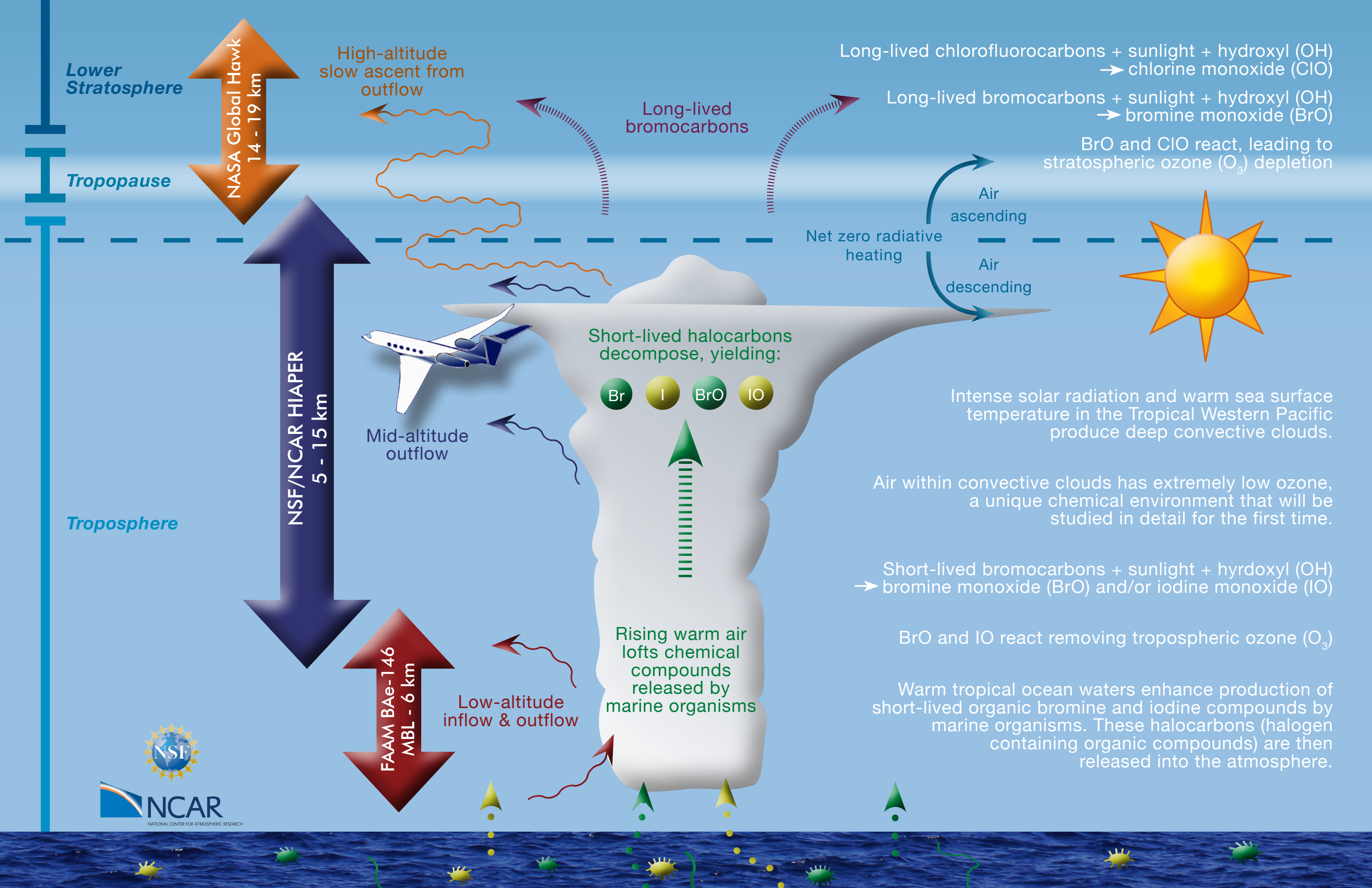
Learn more about CONTRAST: www.eol.ucar.edu/contrast/eo

Significance of Tropical Convection

The most extensive deep clouds in Earth's climate system develop in the Tropical Western Pacific (TWP) during the Northern Hemisphere winter due to increased availability of heat and moisture. Tropical convection, (warm moist air that rises rapidly) transports air from just above the ocean surface to high altitudes. These clouds pack sufficient energy that, on occasion, they punch through the boundary that separates the troposphere, the lowest atmospheric layer, from the overlying stratosphere, bringing with it the low-altitude air.

Societal Benefits

Scientists have been interested in the vertical lofting of atmospheric gases produced by ocean organisms and the chemical outcome of these compounds as they decompose in the upper troposphere and lower stratosphere. Convection and chemical processing in the TWP controls the composition of the sub-tropical global troposphere as well as air that enters the stratosphere. Understanding these processes is important for projecting how atmospheric composition will respond to climate change.



Lower Stratosphere
Tropopause
Troposphere
NASA Global Hawk 14 - 19 km
NSF/NCAR HIAPER 5 - 15 km
FAAM BAe-146 MBL - 6 km
High-altitude slow ascent from outflow
Long-lived bromocarbons
Long-lived chlorofluorocarbons + sunlight + hydroxyl (OH) → chlorine monoxide (ClO)
Long-lived bromocarbons + sunlight + hydroxyl (OH) → bromine monoxide (BrO)
BrO and ClO react, leading to stratospheric ozone (O_3) depletion
Air ascending
Net zero radiative heating
Air descending
Short-lived halocarbons decompose, yielding:
Br
I
BrO
IO
Mid-altitude outflow
Intense solar radiation and warm sea surface temperature in the Tropical Western Pacific produce deep convective clouds.
Air within convective clouds has extremely low ozone, a unique chemical environment that will be studied in detail for the first time.
Short-lived bromocarbons + sunlight + hyrdoxyl (OH) → bromine monoxide (BrO) and/or iodine monoxide (IO)
BrO and IO react removing tropospheric ozone (O_3)
Rising warm air lofts chemical compounds released by marine organisms
Low-altitude inflow & outflow
Warm tropical ocean waters enhance production of short-lived organic bromine and iodine compounds by marine organisms. These halocarbons (halogen containing organic compounds) are then released into the atmosphere.
NSF
NCAR
NATIONAL CENTER FOR ATMOSPHERIC RESEARCH