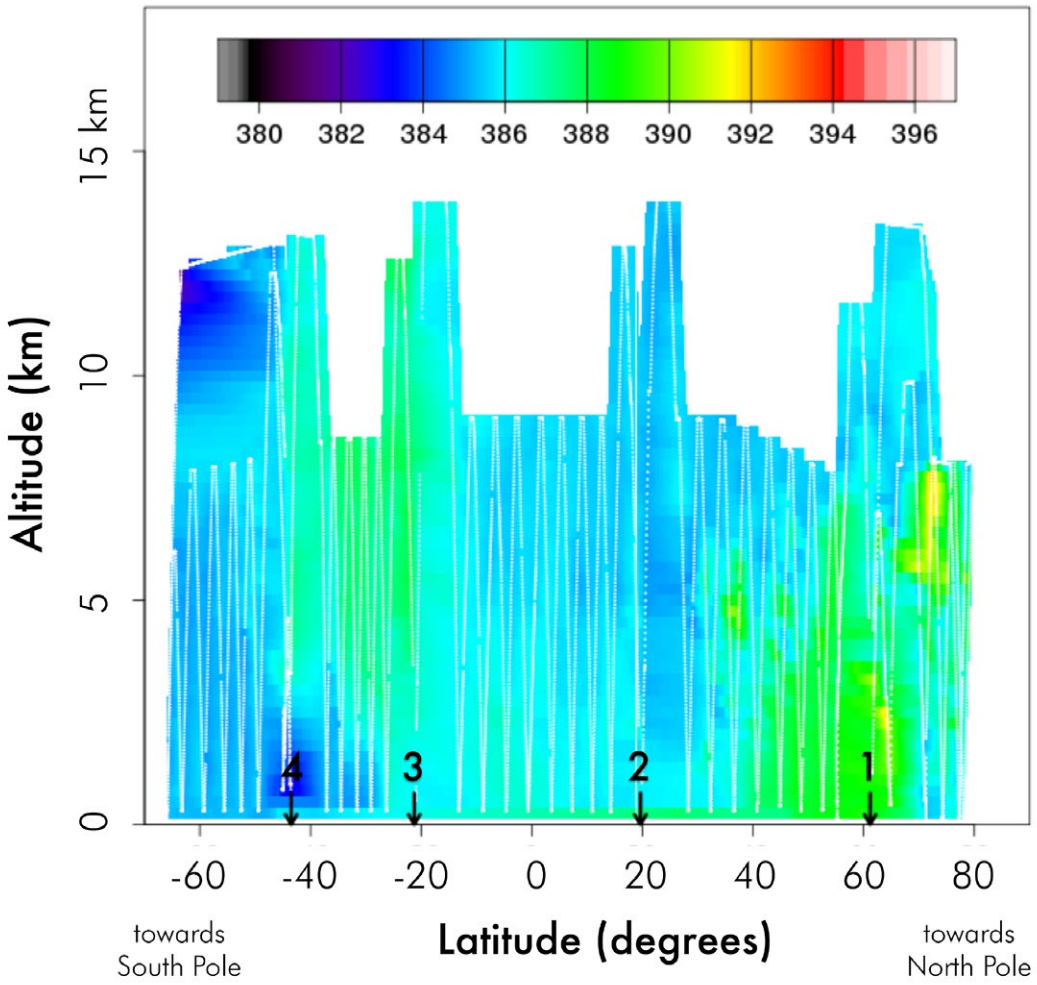
Studying CO_2 from Pole to Pole

Interpreting the Plots of HIPPO Data

Carbon Dioxide (CO_2) ppm HIPPO 2: November 2009



↓ **Aircraft Landings**

1. Anchorage, Alaska
2. Kona, Hawaii
3. Rarotonga, Cook Islands
4. Christchurch, New Zealand

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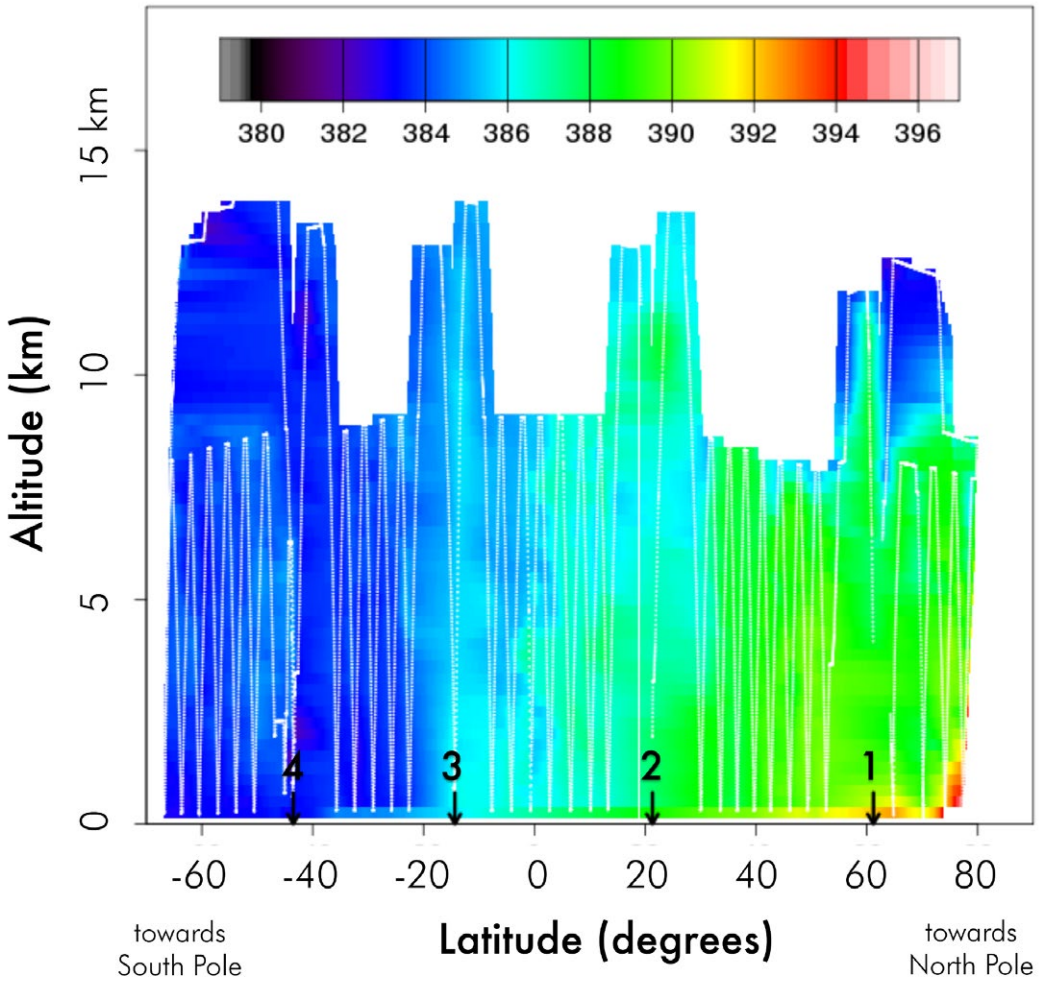
Carbon Dioxide (CO_2) ppm HIPPO 1: January 2009



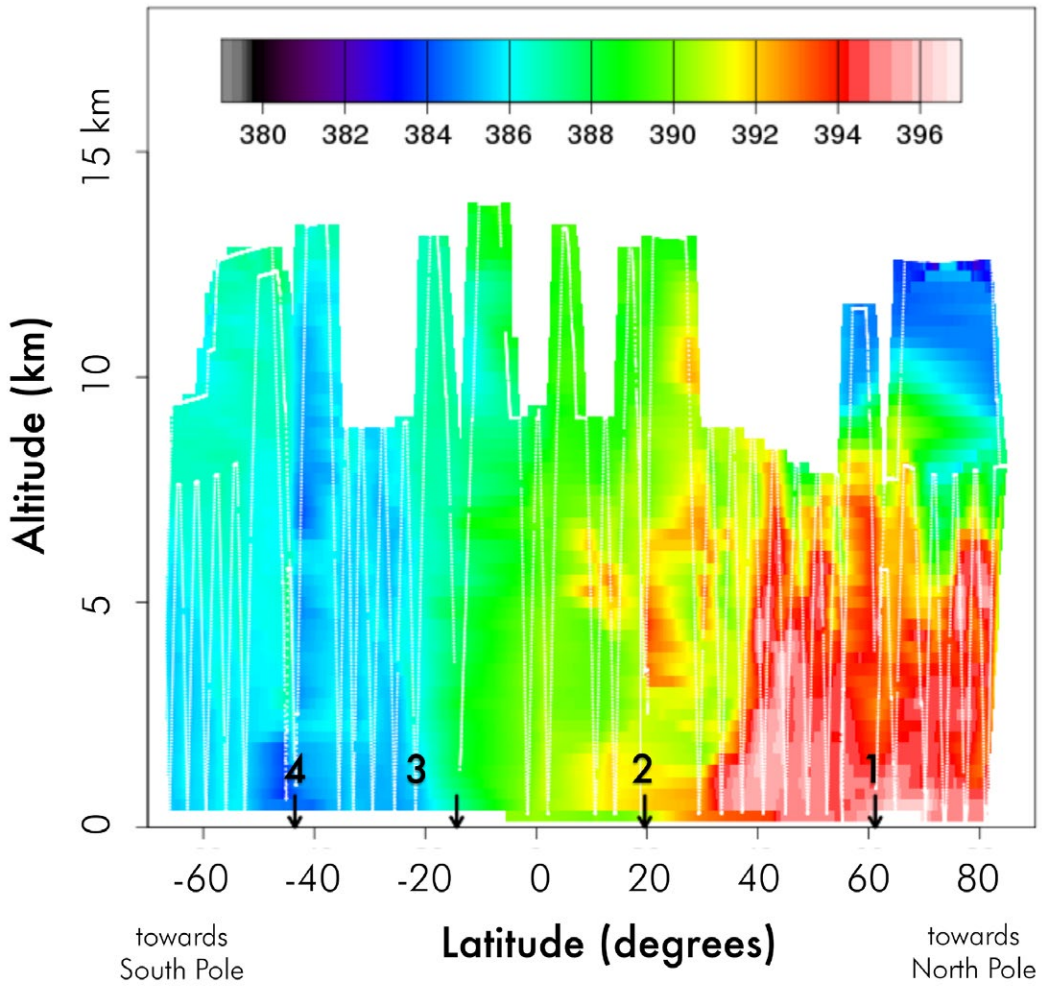
↓ Aircraft Landings

1. Anchorage, Alaska
2. Honolulu, Hawaii
3. Pago Pago, American Samoa
4. Christchurch, New Zealand

Studying CO_2 from Pole to Pole

Interpreting the Plots of HIPPO Data

Carbon Dioxide (CO_2) ppm HIPPO 3: March-April 2010



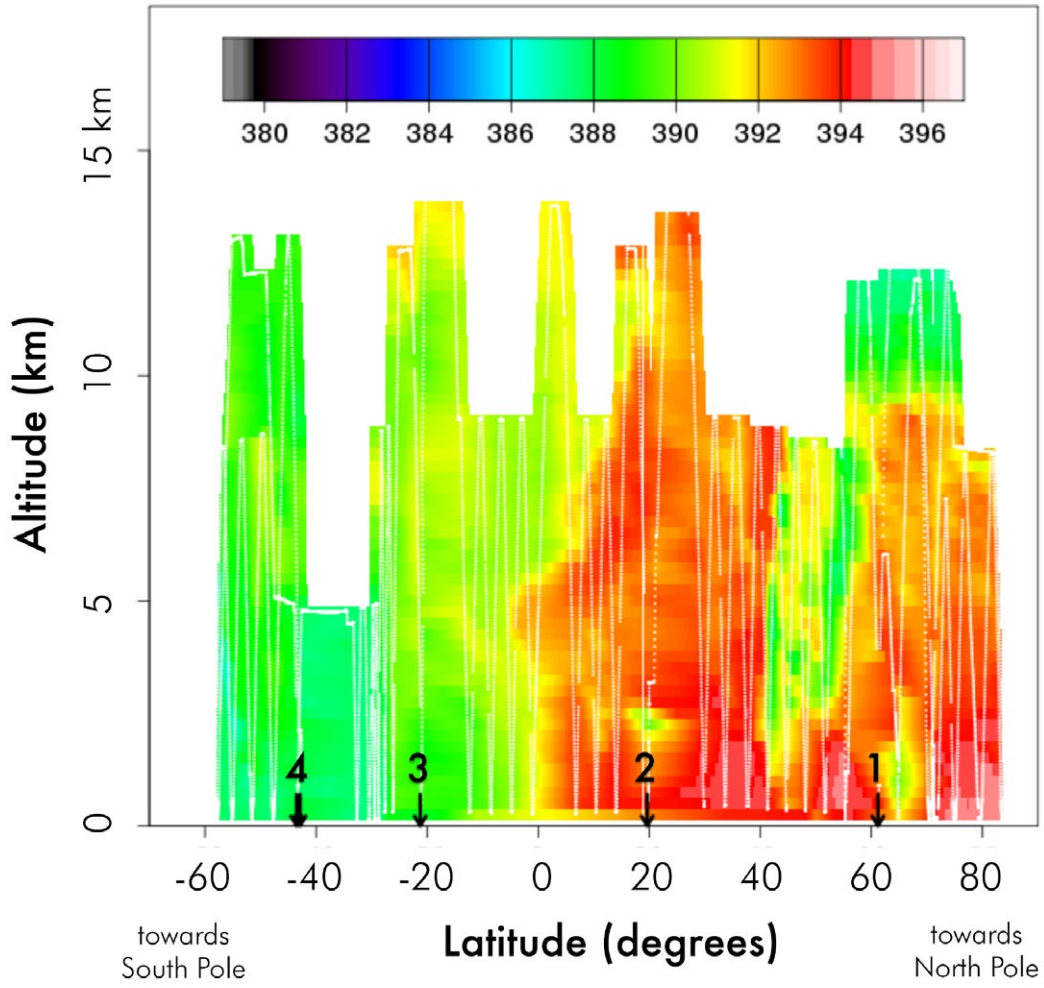
↓ Aircraft Landings

1. Anchorage, Alaska
2. Kona, Hawaii
3. Pago Pago, American Samoa
4. Christchurch, New Zealand

Studying CO_2 from Pole to Pole

Interpreting the Plots of HIPPO Data

Carbon Dioxide (CO_2) ppm HIPPO 4: June 2011



↓ Aircraft Landings

1. Anchorage, Alaska
2. Kona, Hawaii
3. Rarotonga, Cook Islands
4. Christchurch, New Zealand

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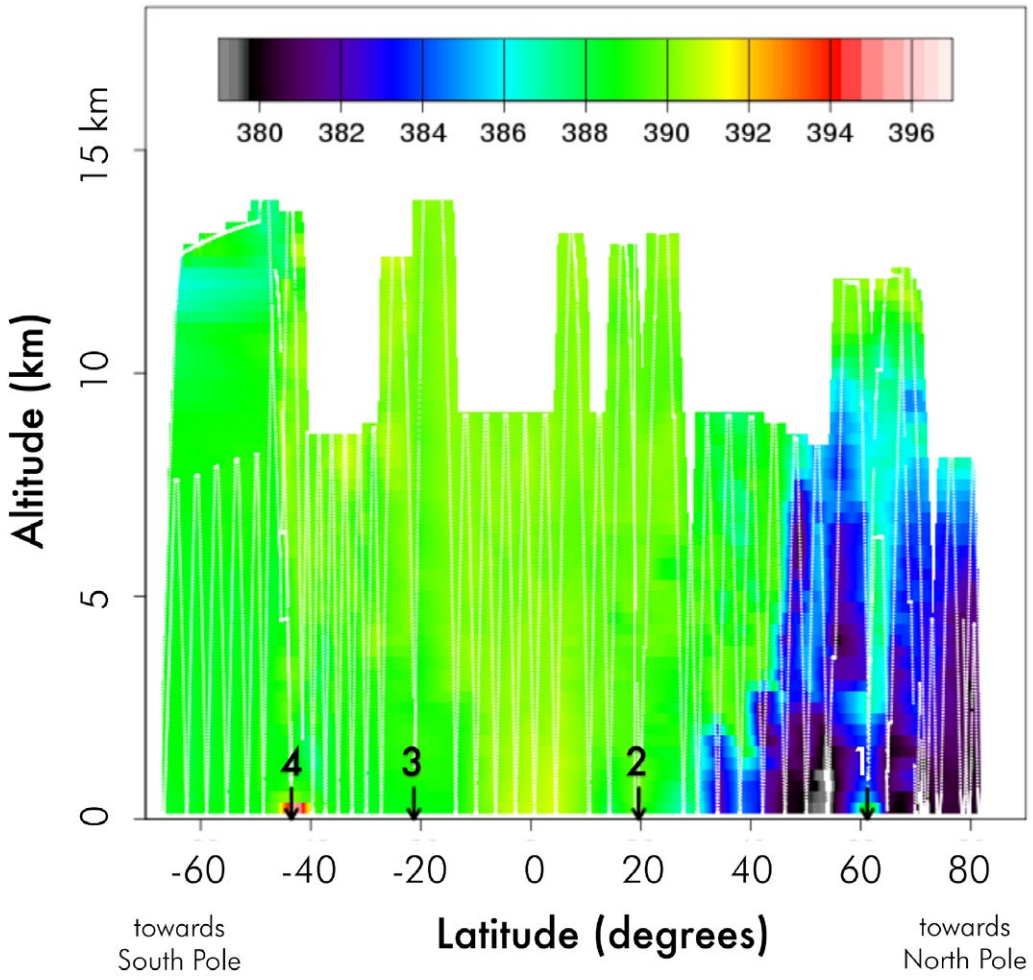
Studying CO_2 from Pole to Pole

Interpreting the Plots of HIPPO Data

Carbon Dioxide (CO_2) ppm HIPPO 5: August 2011



↓ Aircraft Landings

1. Anchorage, Alaska
2. Kona, Hawaii
3. Rarotonga, Cook Islands
4. Christchurch, New Zealand

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Studying CO_2 from Pole to Pole

Keys to Interpreting the Plots of HIPPO Data

Five HIPPO missions flew almost the same route over the Pacific Basin, in all seasons, over a three-year period. Because the missions weren't flown in seasonal order throughout the years, we suggest that you review the curtain plots in the following seasonal order rather than numerical order: H2 (November), H1 (January), H3 (March-April), H4 (June), and H5 (August).

- The Y-axis represents altitude in kilometers (km); the X-axis represents latitude in degrees north (O is the equator).
- At high southern latitudes with little seasonality, if you view the curtain plots in numerical order from H1-H5 you can see the steady increase of CO_2, which matches the global increase found by monitoring stations all over the world.
- You can see seasonal changes in CO_2 throughout the plots. This is primarily due to the seasonality of photosynthesis and respiration on land in the northern hemisphere.
- The white lines in the diagram show the flight profiles. Generally the research aircraft flew to a very high altitude just before landing and after the take off of the next flight, which is why there are generally two sequential high-altitude profiles. The lines appear very steep, however each profile is actually over a long distance as the plane ascended and descended gradually.
- In places where there are no flight tracks but data are present corresponds to interpolated data by the plotting technique.

About HIPPO 2 (H2): November 2009

- This mission flew during late fall in the northern hemisphere and early spring in the southern hemisphere, so there was less of a temperature gradient and similar sunlight between the hemispheres.
- This mission occurred at the start of the seasonal build-up of the pollution and respiration plume at Arctic high altitudes.
- You can see locally low CO_2 from photosynthesis over New Zealand.

About HIPPO 1 (H1): January 2009

- This mission flew during mid-winter in the northern hemisphere and mid-summer in the southern hemisphere.
- Air samples at low altitude and high northern latitude contain high CO_2, which is the accumulation of pollutants and respiration that has been blown north into the Arctic. Cold temperatures and lack of convection keep this air at low altitudes.
- This mission was during the middle of the northern hemisphere seasonal build-up of CO_2.
- The green area at high altitudes at 20°N in this data set shows high levels of CO_2 at high altitude and low latitude. This is from both biomass burning and fossil fuel burning being pushed high into the atmosphere by thunderstorms.
- The large dark blue region at the upper right of this plot shows low levels of CO_2 in lower stratosphere which has been out of contact with the troposphere for 6-12 months. The troposphere is the region of the atmosphere that is in frequent contact with the surface by convection. When the lower stratospheric air in this plot became isolated from the troposphere, its CO_2 concentration was about 6 ppm lower than for the troposphere at the time of this mission (partly due to seasonal changes and party due to steady CO_2 growth).

About HIPPO 3 (H3): March-April 2010

- This mission flew during mid-spring in the northern hemisphere and mid-fall in the southern hemisphere.
- This mission was at the end of the northern hemisphere seasonal build-up of CO_2.
- High concentrations of CO_2 can be seen throughout the lower altitudes (the troposphere) in the northern hemisphere due to the accumulation of net respiration and fossil fuel burning throughout the northern hemisphere winter.
- High levels of CO_2 6 km over the Arctic are due to transport from low altitudes and low latitudes by storms, a process referred to as the warm conveyor belt. Convection does not reach 6 km in the winter, so this high CO_2 could not have come from local surface sources. Low levels of CO_2 in lower stratosphere can be seen (6-12 months out of contact with troposphere, see above).
- Blobs of high CO_2 air between the equator and 30°N indicate the mixing of air southwards at altitude.
- You can see locally low levels of CO_2 due to photosynthesis over New Zealand (approximately 45°S).

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About HIPPO 4 (H4): June 2011

- This mission flew during early summer in the northern hemisphere and early winter in the southern hemisphere.
- This is the start of the northern hemisphere seasonal drawdown of CO_2.
- Low CO_2 aloft between 40° and 60°N indicates a plume of air that has been influenced by photosynthesis over Asia and is now moving across the Pacific over the top of cold marine air.
- There is locally low CO_2 near the surface over Fairbanks from photosynthesis.
- The flight towards the Southern regions didn't go as far during this mission due to an ash cloud from the Chilean Puyehue-Cordón Caulle volcanic eruption over the Southern Ocean. Flying into the ash cloud could have damaged the aircraft.

About HIPPO 5 (H5): August 2011

- This mission flew during summer in the northern hemisphere and winter in the southern hemisphere.
- You can see very low levels of CO_2 at high northern latitudes due to photosynthesis on land in the summer months.
- This mission marked the end of northern hemisphere seasonal CO_2 drawdown.
- Local pollution is indicated by high CO_2 concentration over Anchorage, Alaska.
- Local pollution is indicated by high CO_2 concentration over Christchurch, New Zealand.
- Low levels of CO_2 at 55°N are likely due to photosynthesis in Asia that is being pushed up to 7 km by thunderstorms.

UPDATED: MARCH 2022