Continuous Arctic Ocean Water Vapor Isotope Ratio ($\delta^{18}$O and $\delta^{2}$H) Measurements During a Summer Icebreaker Expedition

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Outline

• Brief Arctic Alaska and water isotope overview
• Water vapor isotopes collected during a July 2015 Arctic research cruise
• Other applicable studies
Reduced Arctic sea ice extent

2015:
Sea ice minimum
(4th lowest on record)

1981-2010:
Median minimum

National Snow and Ice Data Center

http://www.wsgs.unh.edu/arctic.html
Help understand Arctic water cycle

Water isotope research in Arctic Alaska (marine and terrestrial)
Isotopes in the water cycle

- Light and heavy isotopes of oxygen \((^{16}\text{O}, ^{18}\text{O})\) and hydrogen \((^{1}\text{H}, ^{2}\text{H})\) in water
- Preferential evaporation/precipitation

Water lines

- Display relationship between isotope ratios
- Can vary across locations and climates
Summer 2015 Healy Research
Ocean Water Vapor Isotope Data Summary (2015 - Healy)

- $\delta^{18}O$ (%)
- $\delta^2H$ (%)

- $\delta^{18}O$ Vapor
- $\delta^2H$ Vapor
- $\delta^{18}O$ Vapor Mean

- d-excess Vapor
- d-excess Vapor Mean

- July 4
- Day of Year
- July 19

Map locations:
- Kodiak
- Bering Strait
- Bering Strait
- Nome
- Alaska
- Russia
- Arctic Ocean
- Bering Sea
- Gulf of Alaska
- Bering Strait
- Kodiak
Sea Ice Coverage & Isotopes

\[ \delta^{18}O \text{ (‰)} \]

\[ \text{Average Sea Ice Coverage} \]

Data points are scattered across a scatter plot, with a trend line indicating a correlation between \( \delta^{18}O \) and average sea ice coverage. The distribution of points is highlighted with red boxes, suggesting a focus on specific data ranges.
Vapor:
08:30, 7/7/15
δ^{18}O -16.8314
δ^2H -136.2479

Ocean water (at surface):
08:10, 7/7/15
δ^{18}O -1.4571
δ^2H -10.0435

Precipitation (rain):
09:50, 7/7/15
δ^{18}O -9.95445
δ^2H -82.9931
Summary

- Enriched $\delta^{18}O$ vapor values associated with more sea ice
- Ocean-vapor-precipitation fractionation consistent with expectations
- Lower $d$-excess values related to more southern moisture sources, and vice versa
- Reduced sea ice extent influencing water isotopes
- McCall Glacier ice core shows increase in precip with open water source
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