

Application of measurements of atmospheric O₂ and CO₂ for detection of long-term changes in the Arctic

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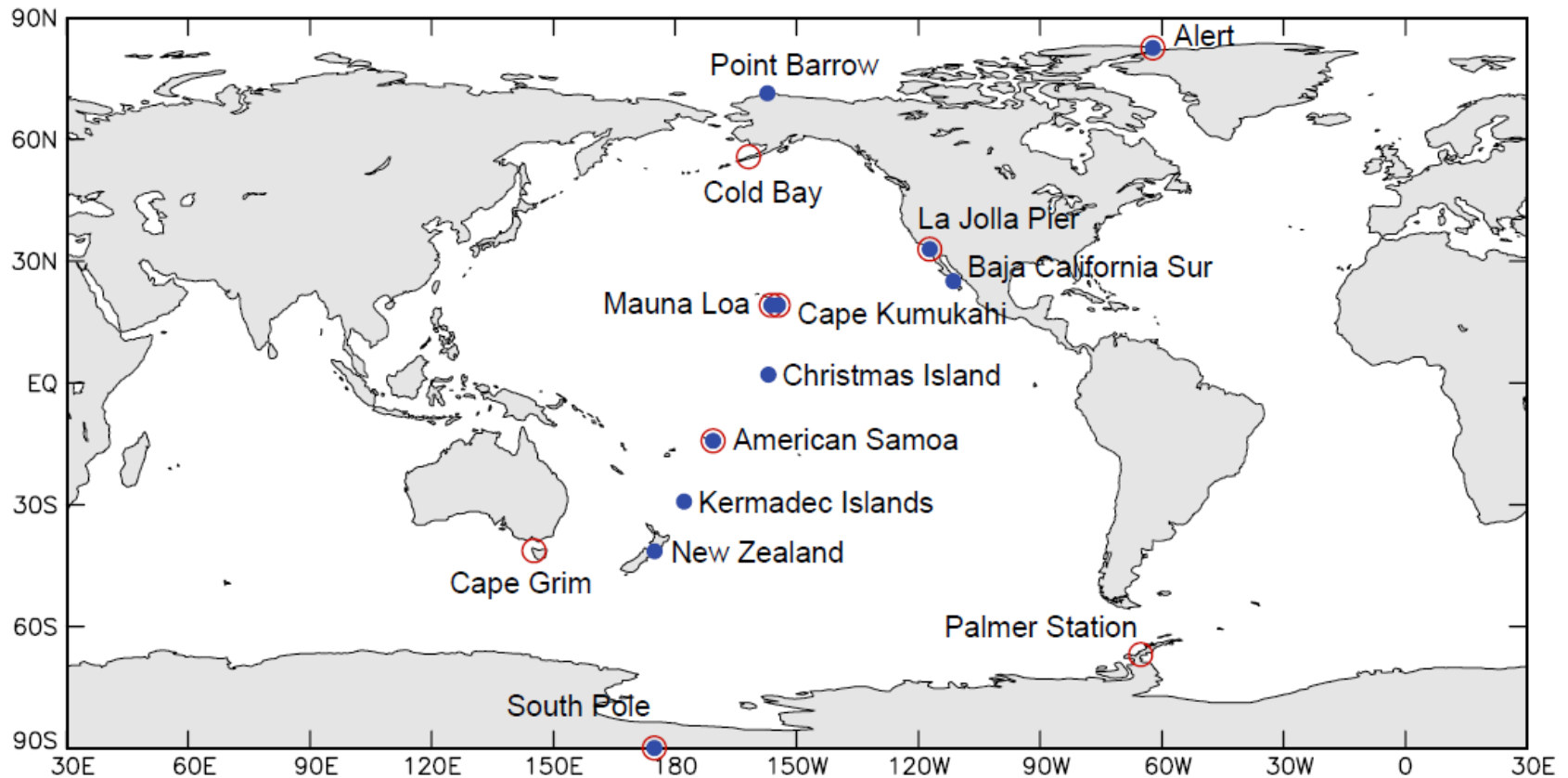
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Scripps CO₂ and O₂ Sampling Networks

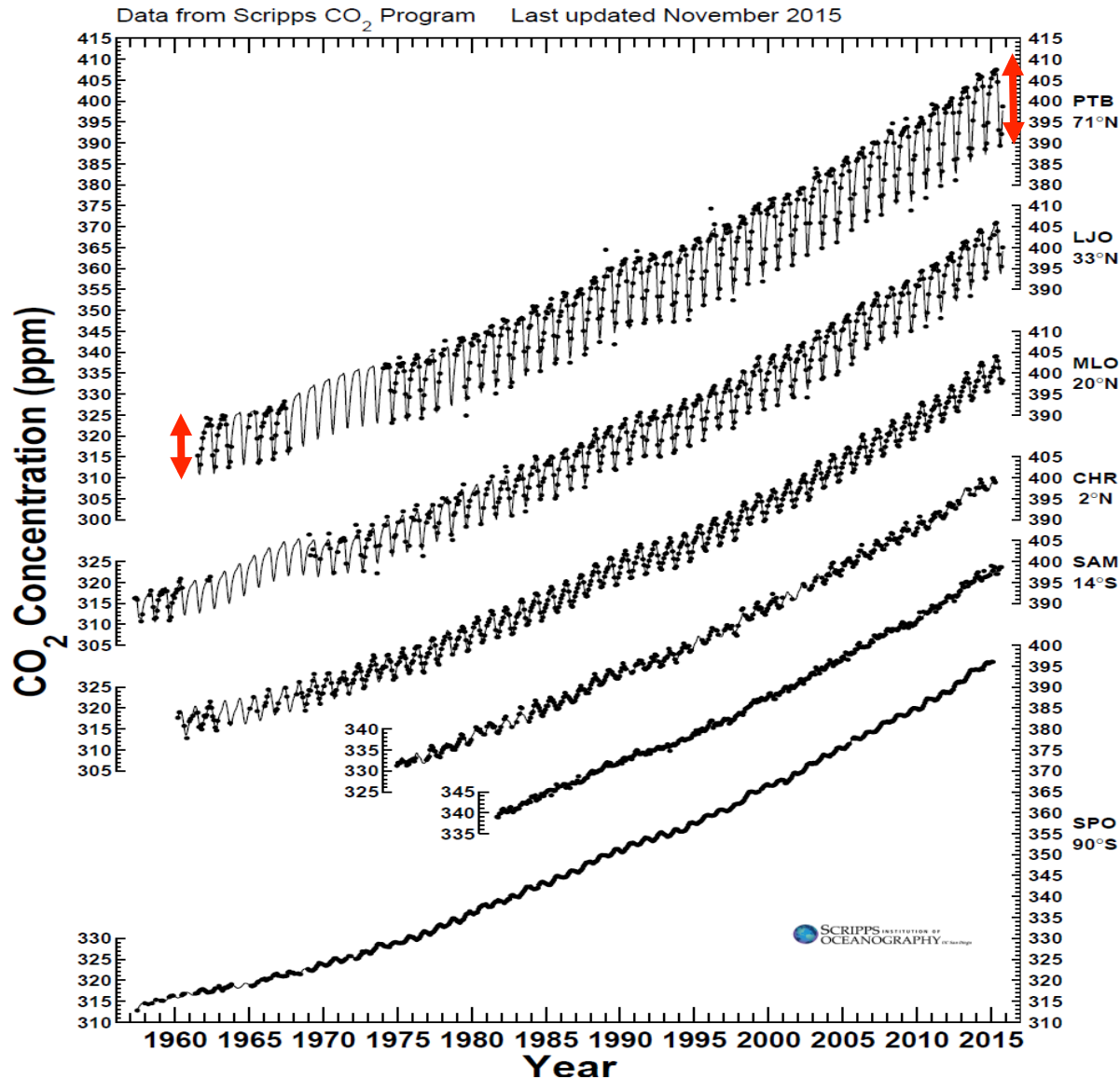


Measurements of CO₂ Concentration and isotopes: ¹³C/¹²C, ¹⁸O/¹⁶O, ¹⁴C

Measurements of O₂/N₂ ratio and Ar/N₂ ratio

Archive of pure CO₂ extracted from samples

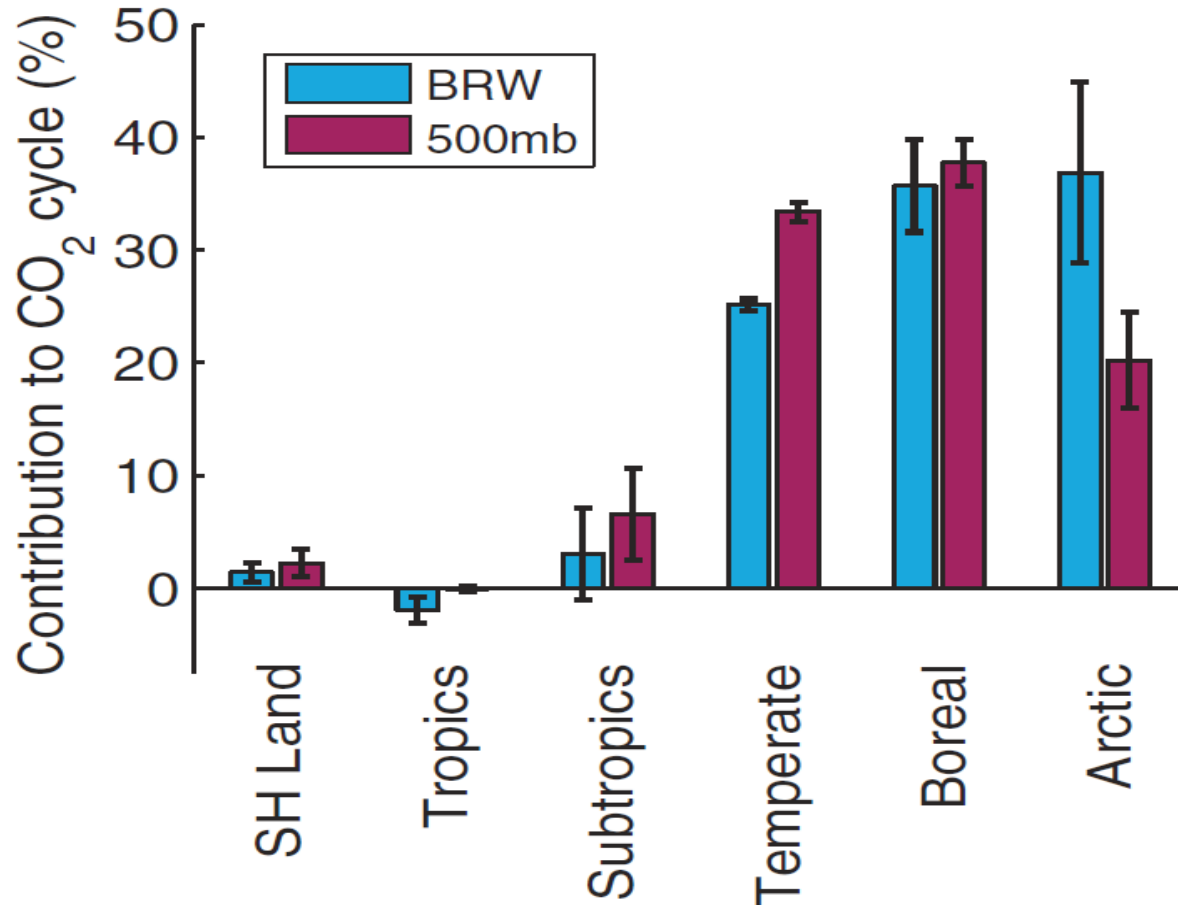
CO₂ concentration at selected stations



Cycle at Barrow driven mostly by boreal and temperate forests

Amplitude increase over 50 years ~ 50% or 0.8% /yr

Contributions to present-day cycles, by zone:

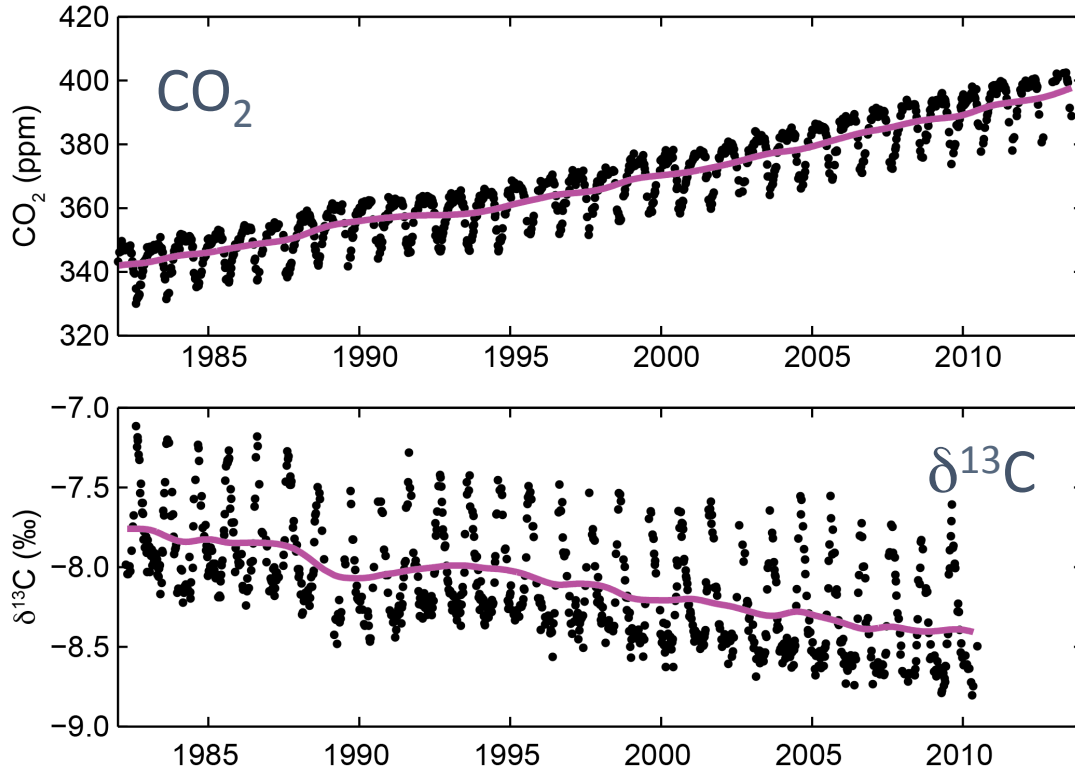


Changes since 1960: -15% +43% +64% +35%
(Best guess)

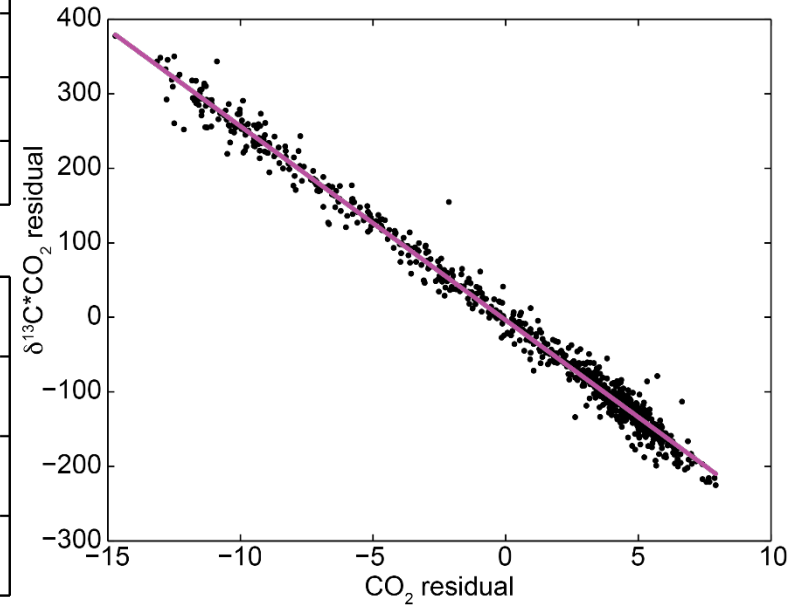
Atmospheric flask data

Point Barrow, Alaska

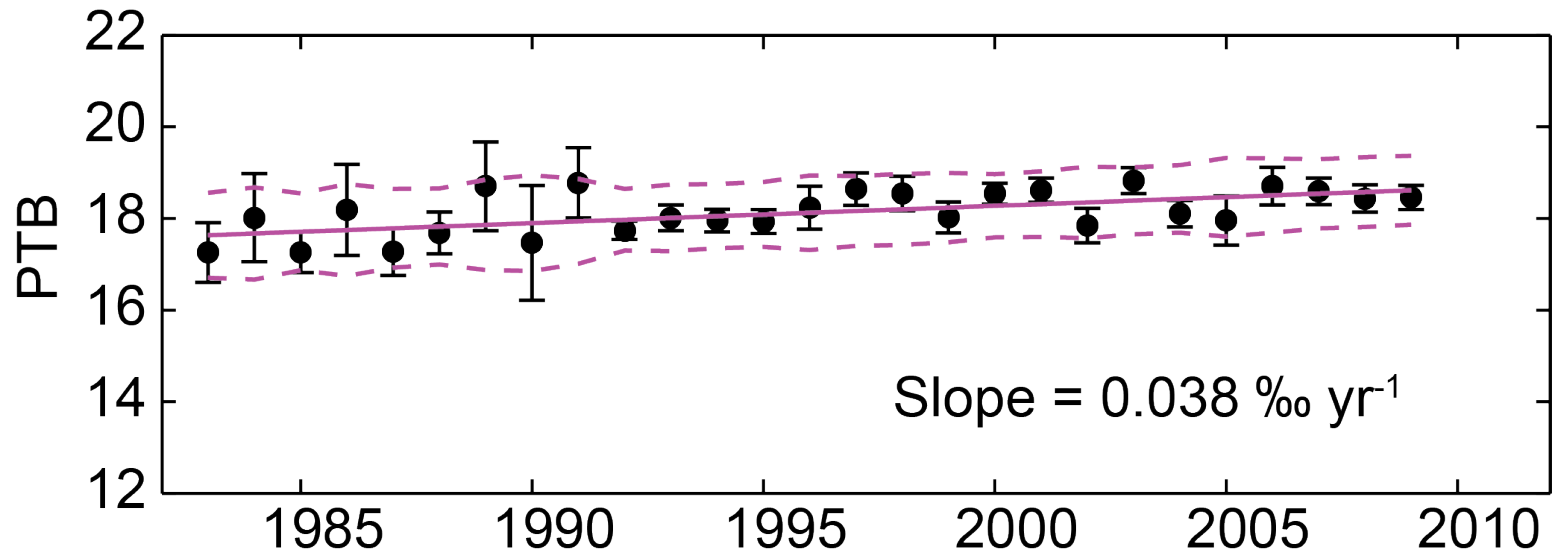
Solve for δ_{source}
using Miller and Tans
(2003) approach



$$\delta_{\text{obs}} C_{\text{obs}} - \delta_{\text{bg}} C_{\text{bg}} = \delta_{\text{s}} (C_{\text{obs}} - C_{\text{bg}}).$$



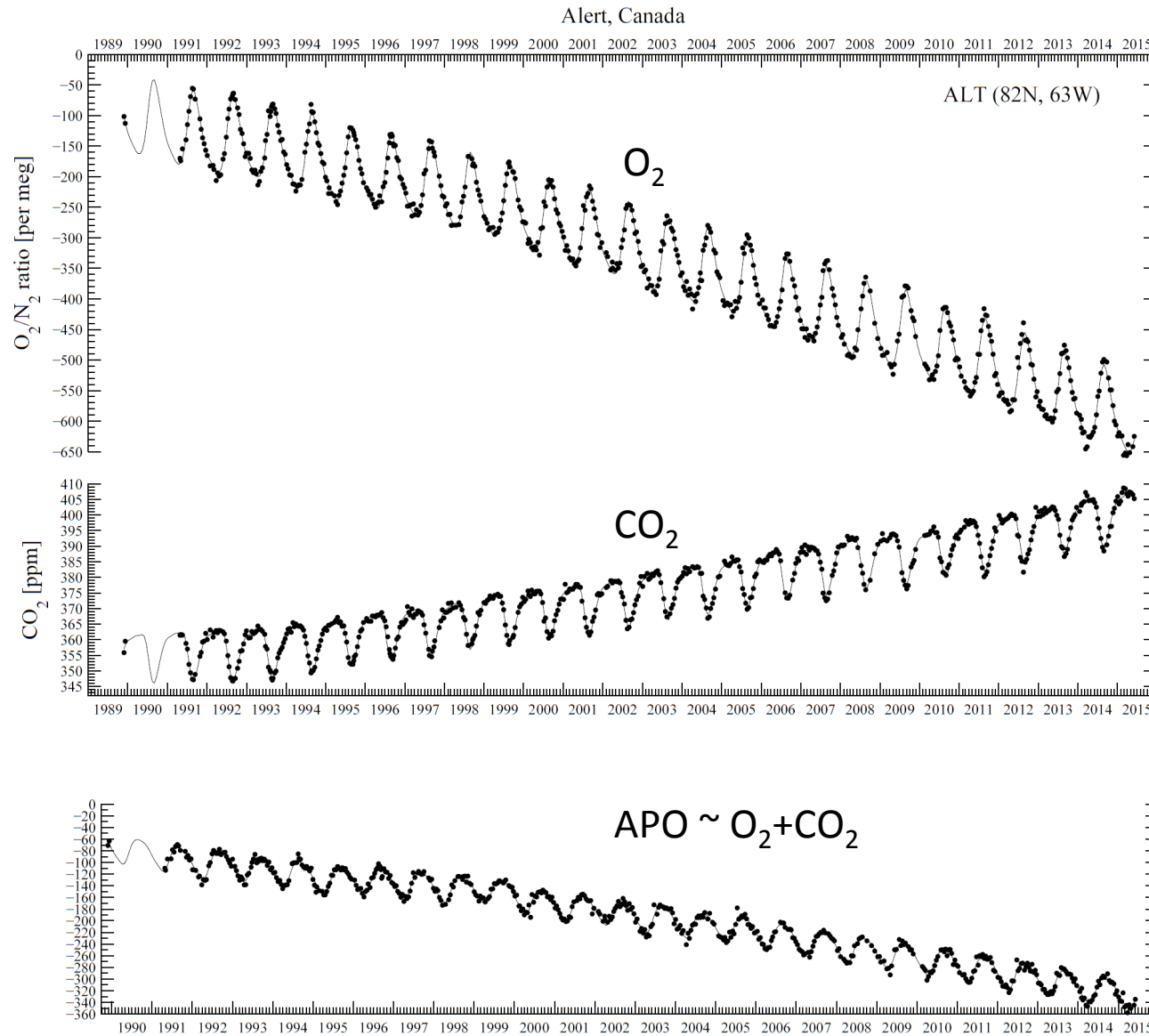
Trend in apparent isotopic discrimination



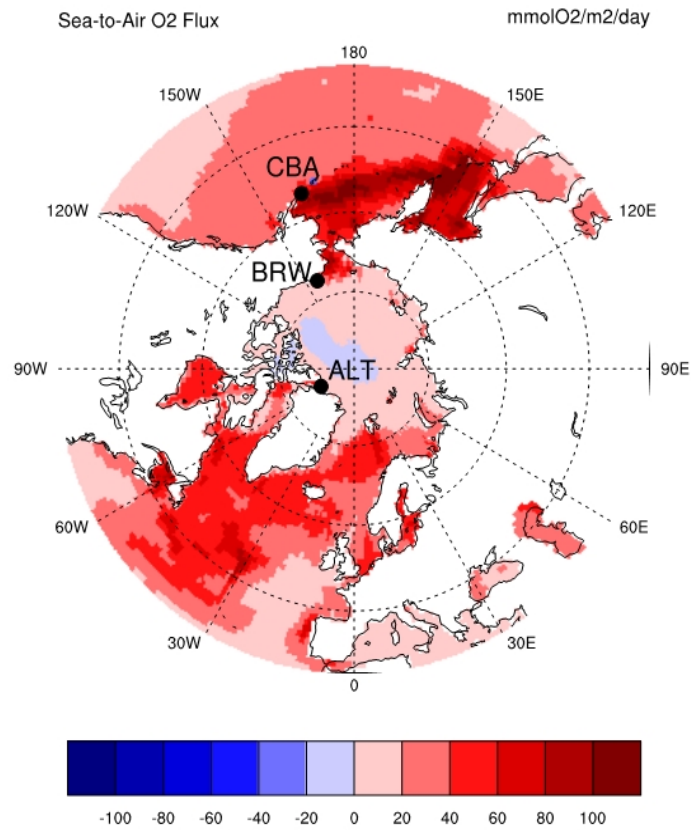
Scenarios:

1. constant $C_a - C_i$ compatible
2. constant C_i / C_a marginally compatible
3. constant C_i incompatible

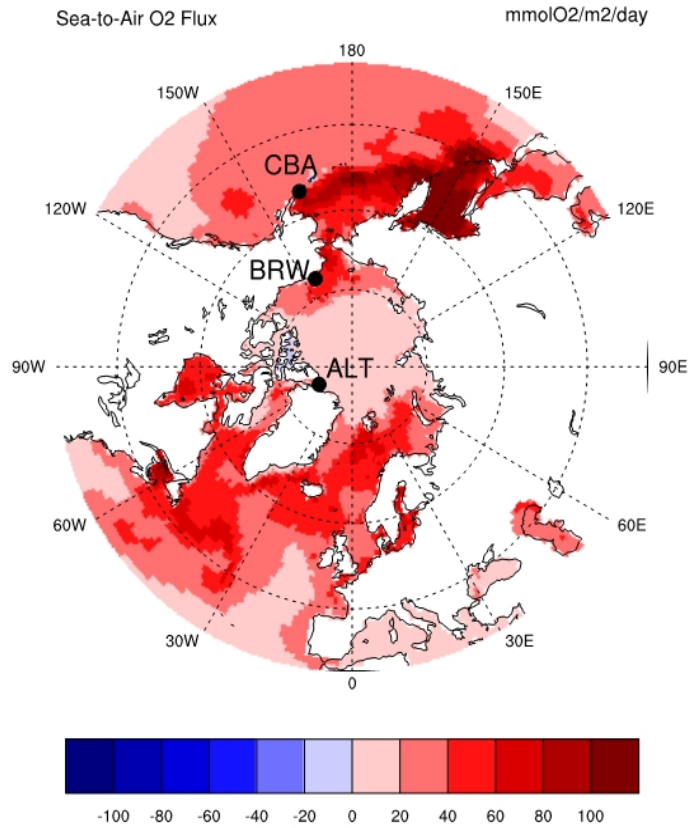
O₂ and CO₂ records from Alert Station (82°N)



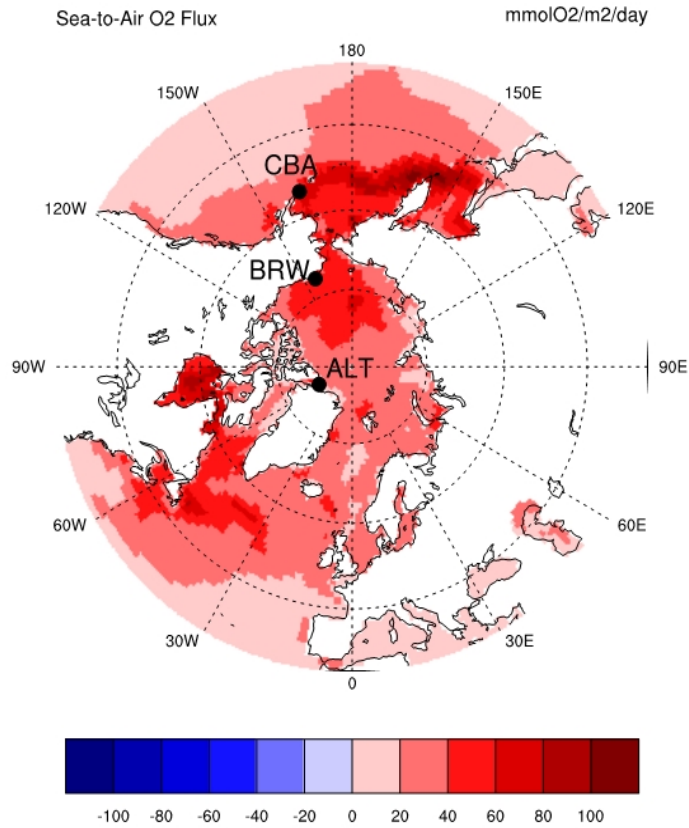
CESM fgO2 July 1991



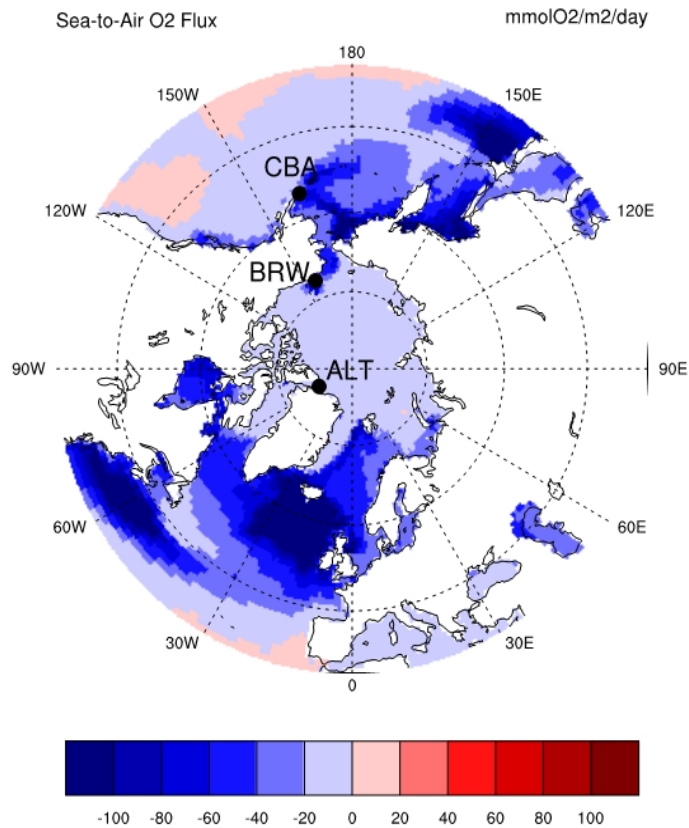
CESM fgO2 July 2015



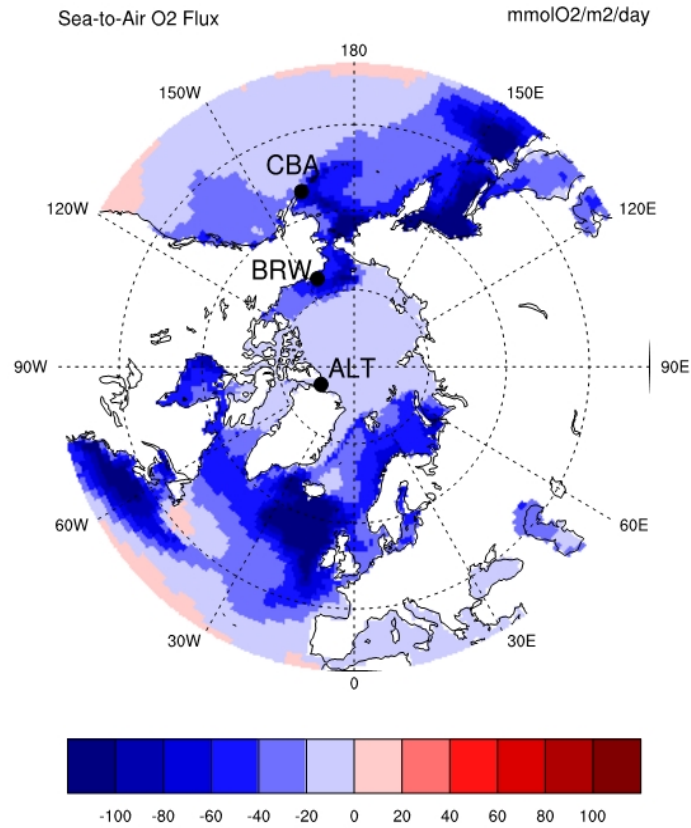
CESM fgO2 July 2100



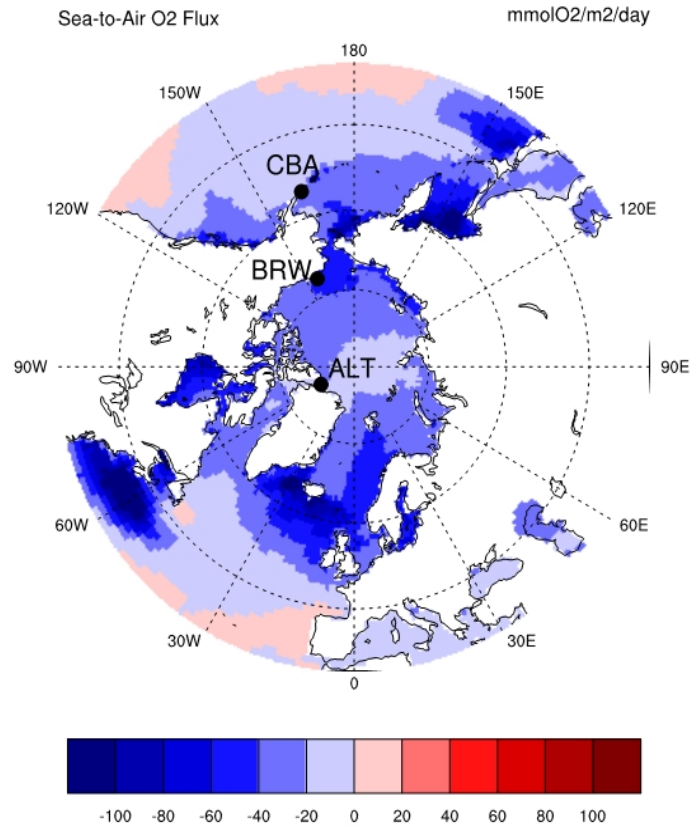
CESM fgO2 November 1991



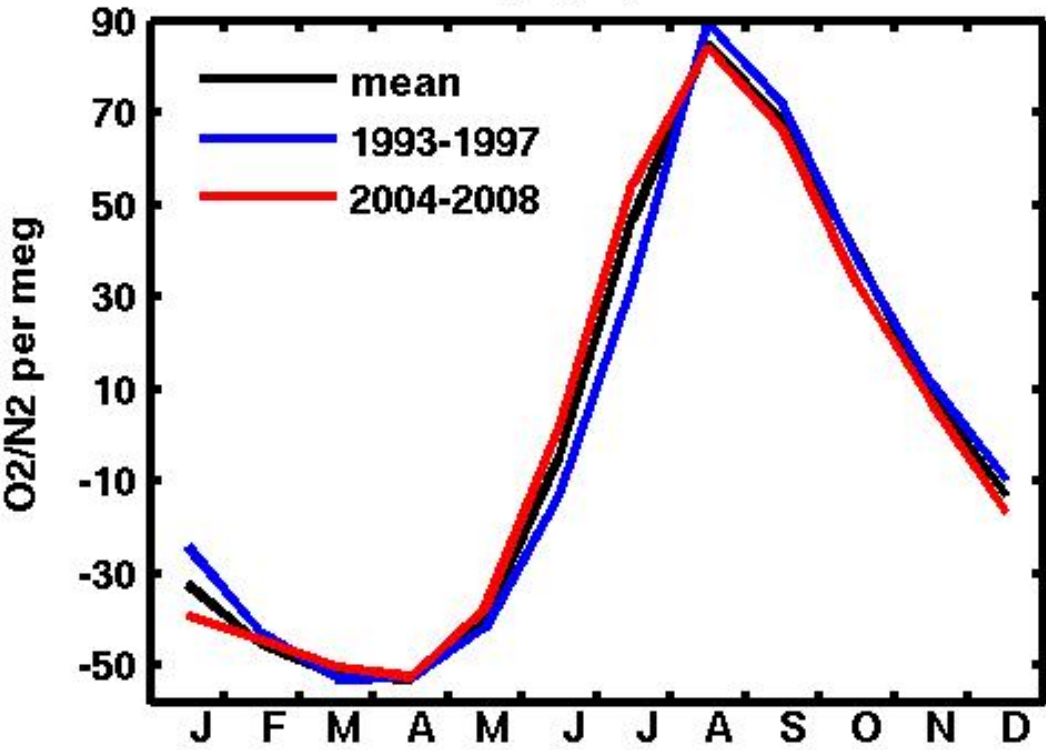
CESM fgO2 November 2015



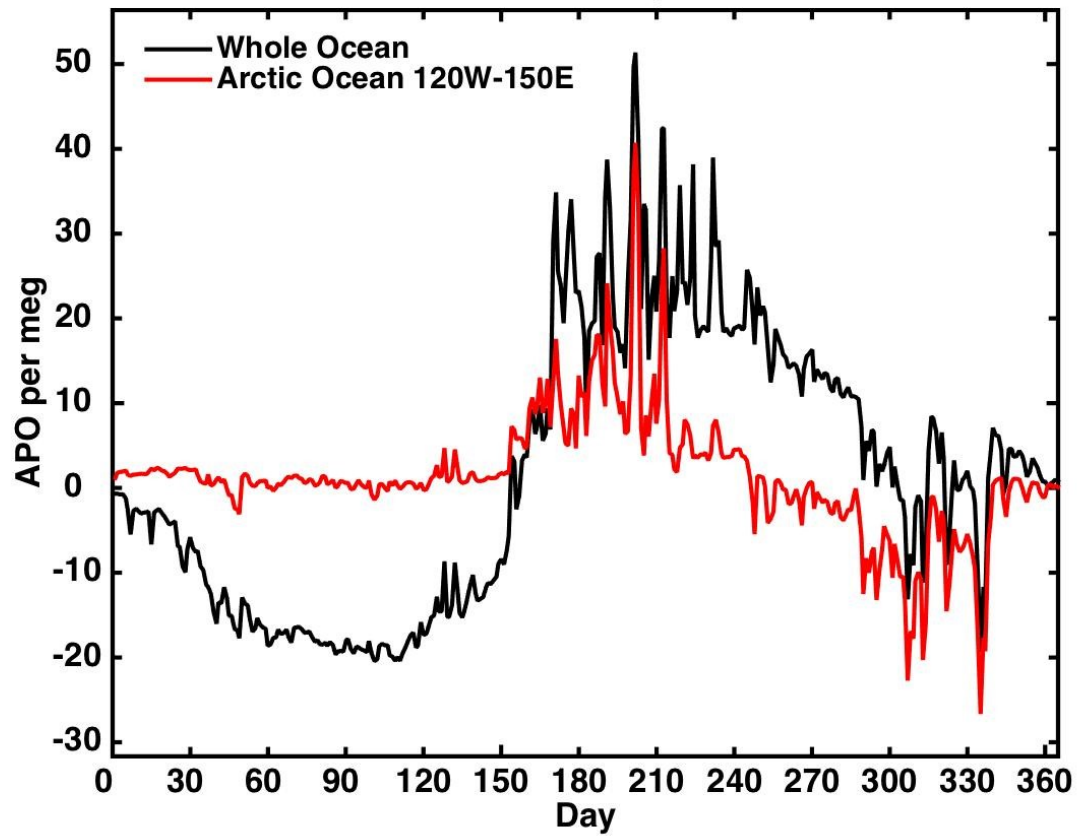
CESM fgO2 November 2100



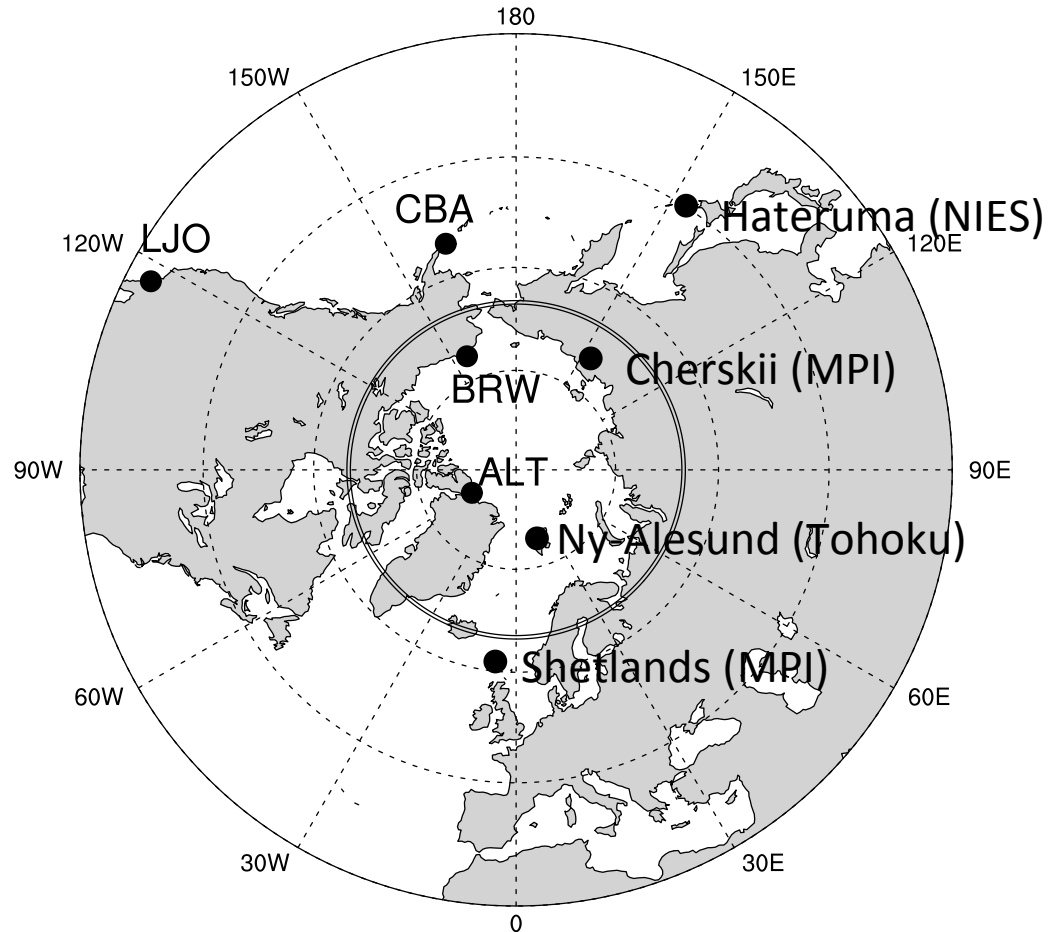
Changing cycle at Barrow Alaska



Model APO at Barrow, Alaska 2000

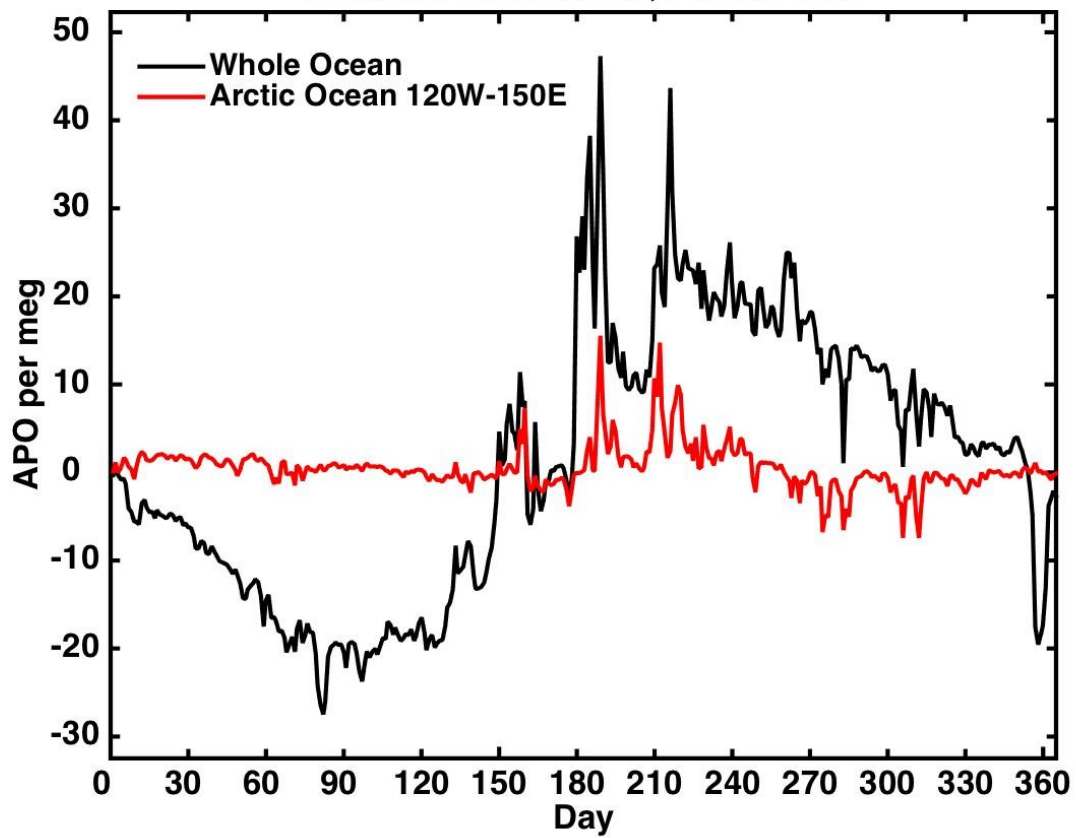


Atmospheric O₂ Monitoring Sites

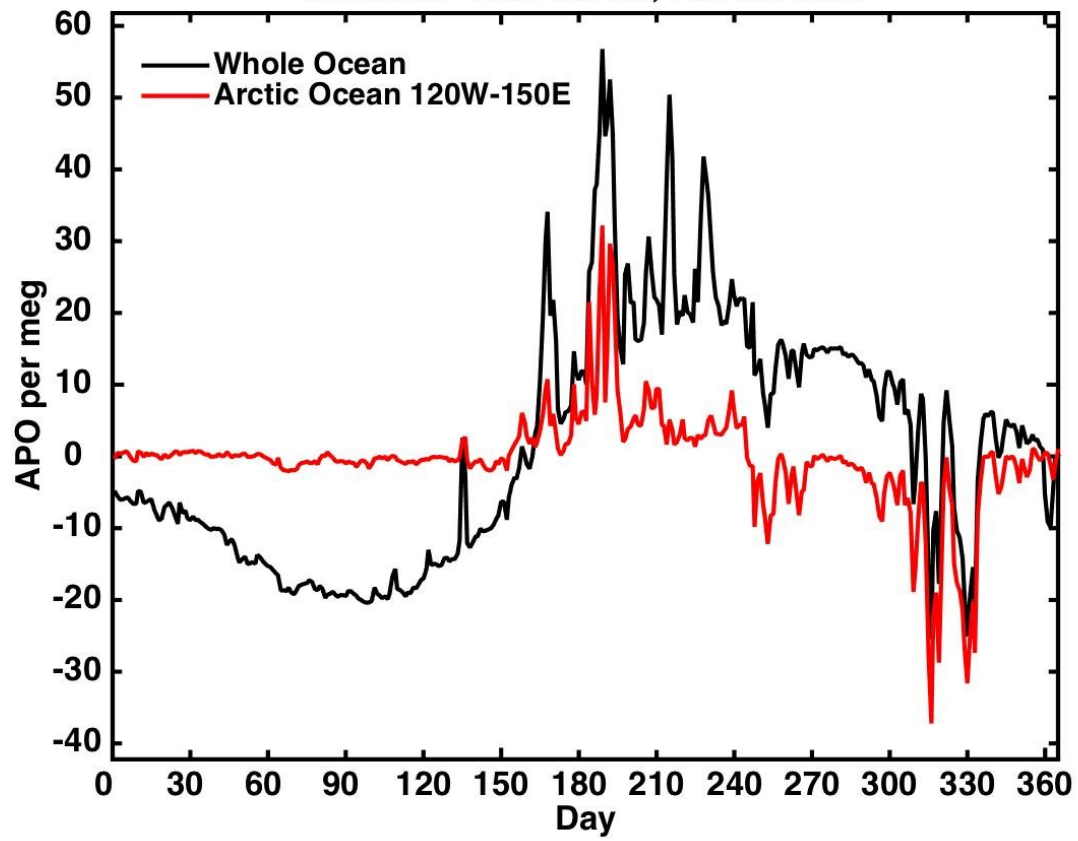


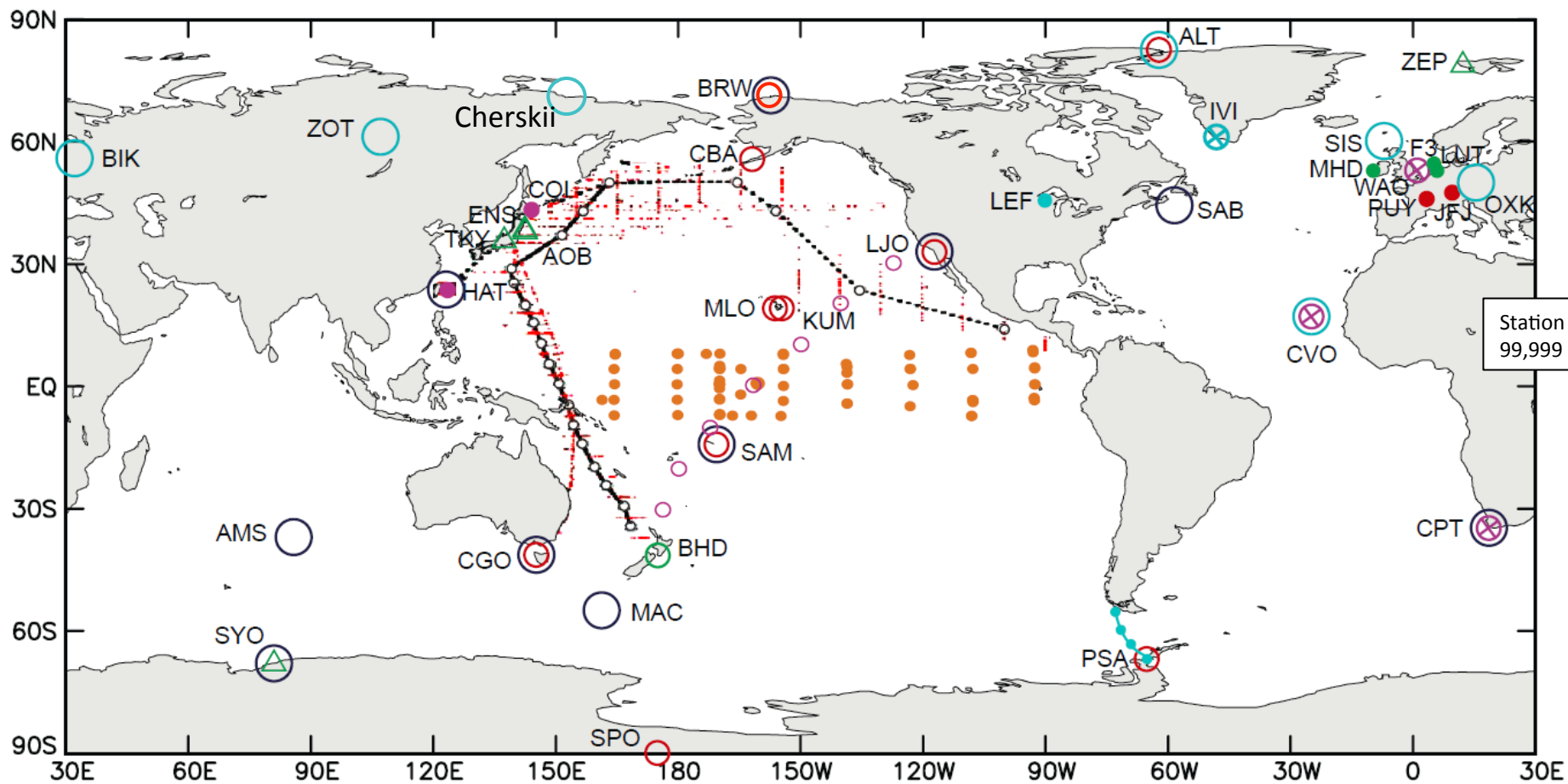
Thank You

Model APO at Barrow, Alaska 1998



Model APO at Barrow, Alaska 1999





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|---|--|---|---------|---|------|---|-----------|
| ○ | Scripps O ₂ /N ₂ Program | ● | U. Bern | ● | NIES | ⊗ | LSCE |
| ⊗ | UEA | ○ | NIWA | ● | CIO | △ | Tohoku U. |
| ○ | Princeton (discontinued) | ○ | MPI-BGC | ● | NCAR | | |