Physical Feedbacks

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Content

Posters

Oral Presentations (2 hours)

Discussion Section

Major Themes

- Thermodynamic and dynamic feedbacks
  (ice-ocean, ice-atmosphere, snow-atmosphere)
- Internally and externally forced feedbacks
  (snow and ice ---> surface albedo)
- Cloud feedbacks

Key Questions

- Which feedbacks have already affected recent Arctic changes?
- What is the *relative* importance of various feedbacks?
- How do feedbacks operate in combination with one another?
- What is the proper way to evaluate (quantify) feedbacks?
- Importance of local feedbacks vs. remotely forced feedbacks?
- What are greatest uncertainties in modeling Arctic feedbacks?

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Oral Presentations

1:40 *The Influence of Cloud Feedbacks on Arctic Climate Change*
(Steve Vavrus) [10 minutes]

1:50 *Atmospheric Heat Transport as a Feedback on the Arctic Climate*
(Cecilia Bitz, Steve Vavrus)

2:10 *The Role of Surface Albedo Feedback in Climate*
(Alex Hall)

2:30 *The Ice-Albedo Feedback in a Changing Climate: Albedos from Today and Reflections on Tomorrow*
(Don Perovich)

2:50 *The Ice/Ocean Interface During Summer: Implications for Ice-Albedo Feedback*
(Miles McPhee)

3:10 *A Data-Model Comparison Study of the Arctic Ocean's Response to Annular Atmospheric Modes*
(Bruno Tremblay, Robert Newton, Peter Schlosser)

Model and Simulations

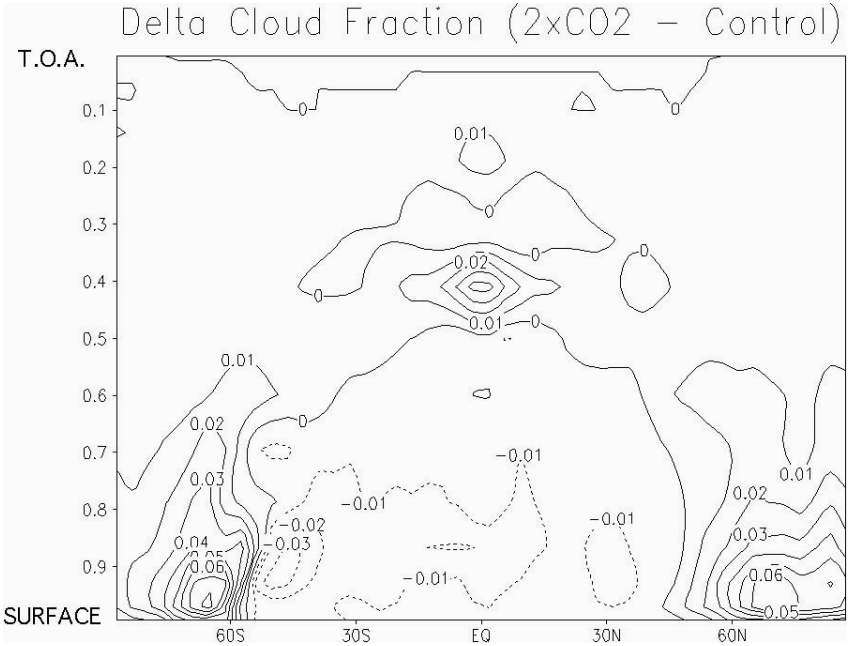
GENESIS2 Atmosphere/Mixed-Layer Ocean GCM
T31 Horizontal Resolution, 18 Levels

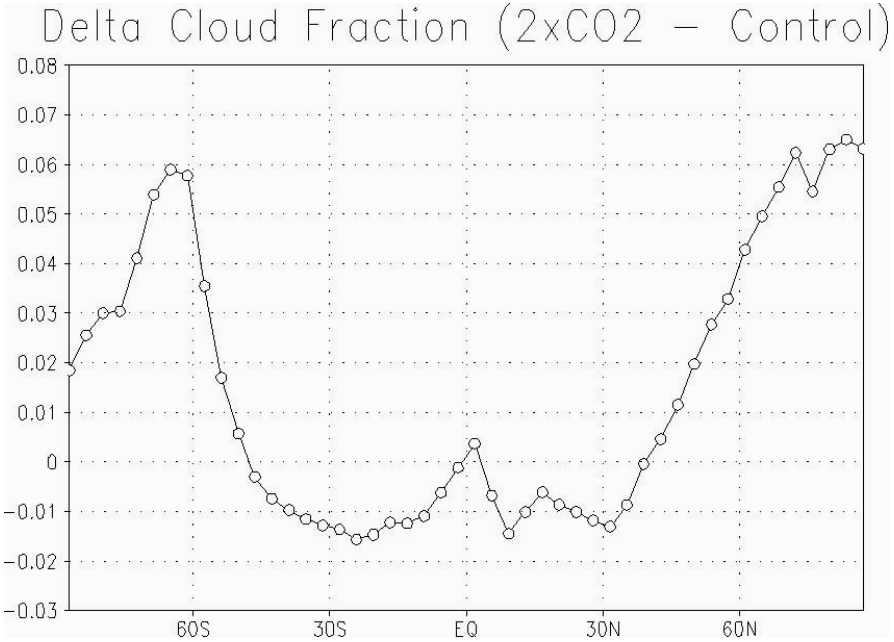
2CO2: Standard 2 x CO_2 simulation with predicted cloud changes
2CO2F: 2 x CO_2 simulation with fixed, 3-D cloud cover globally

2CO2FHIGH: 2 x CO_2 with fixed clouds in high latitudes only
2CO2FLOW: 2 x CO_2 with fixed clouds in low latitudes only

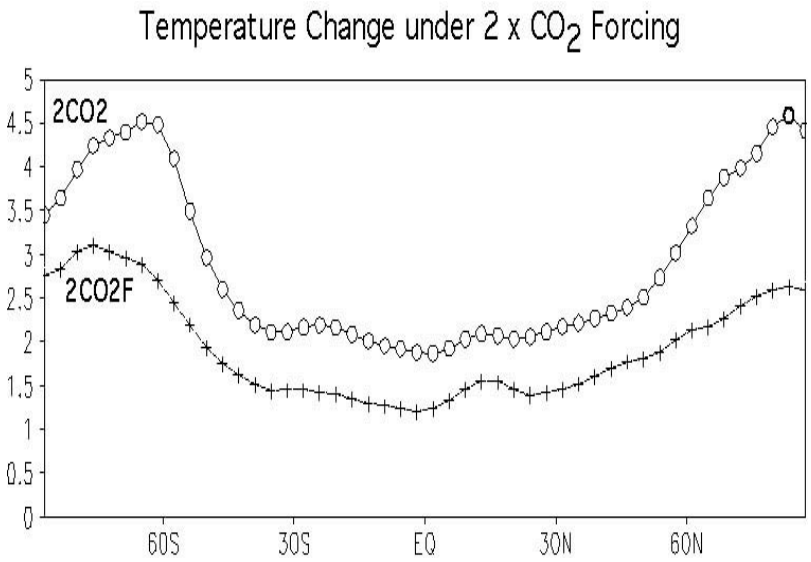
Unchanged: Cloud albedo, particle size, optical depth, LWP
Changed: Cloud phase and emissivity (slightly)

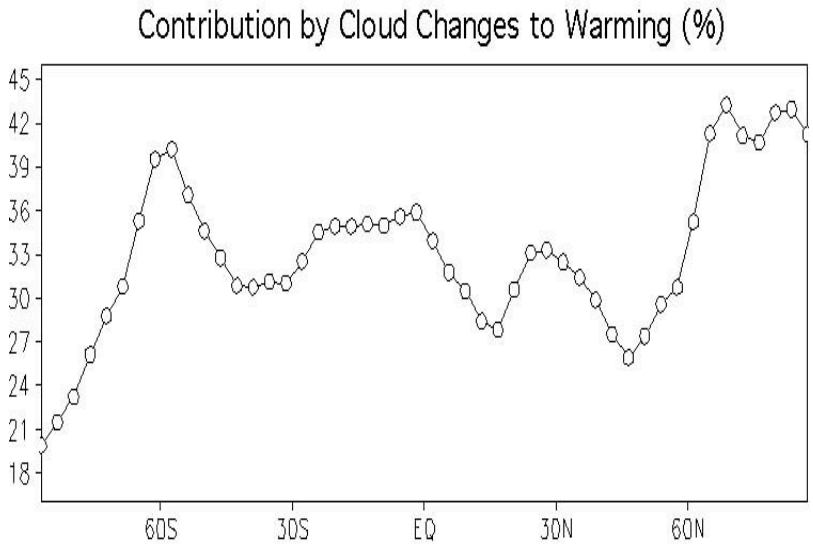
Change in Mean Annual Cloud Cover under 2 x CO_2



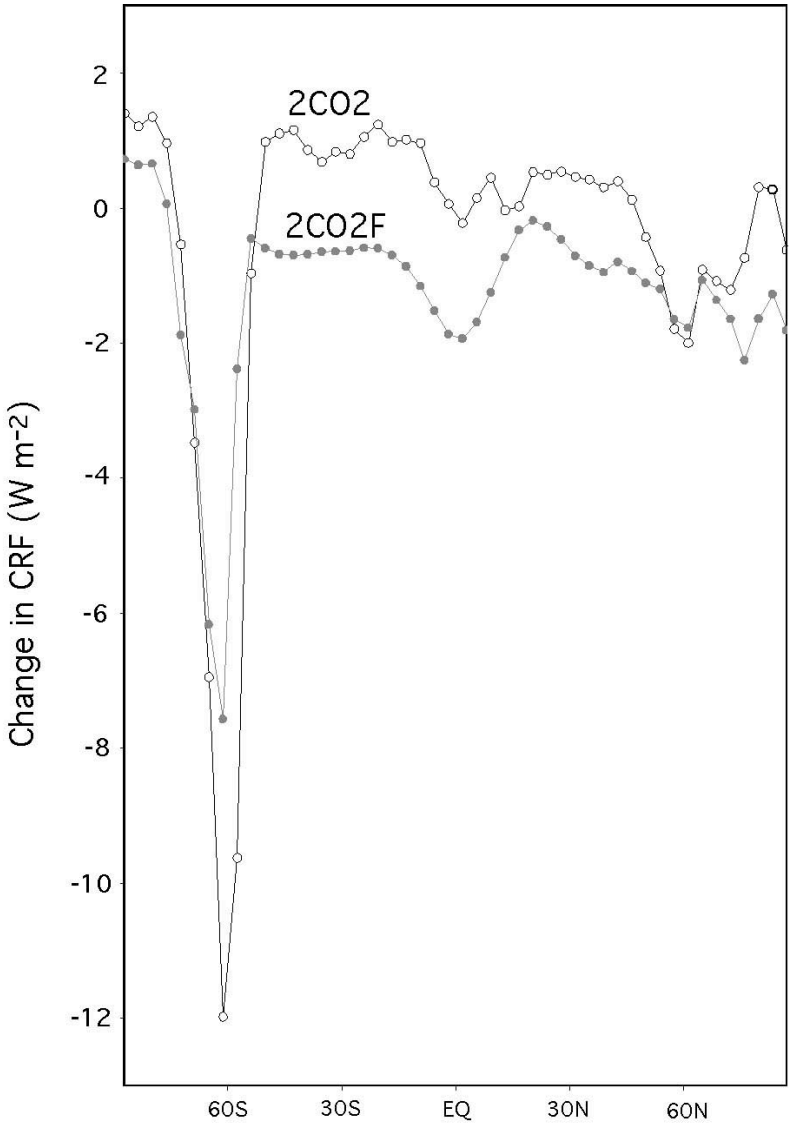


Impact of Cloud Changes on Greenhouse Warming



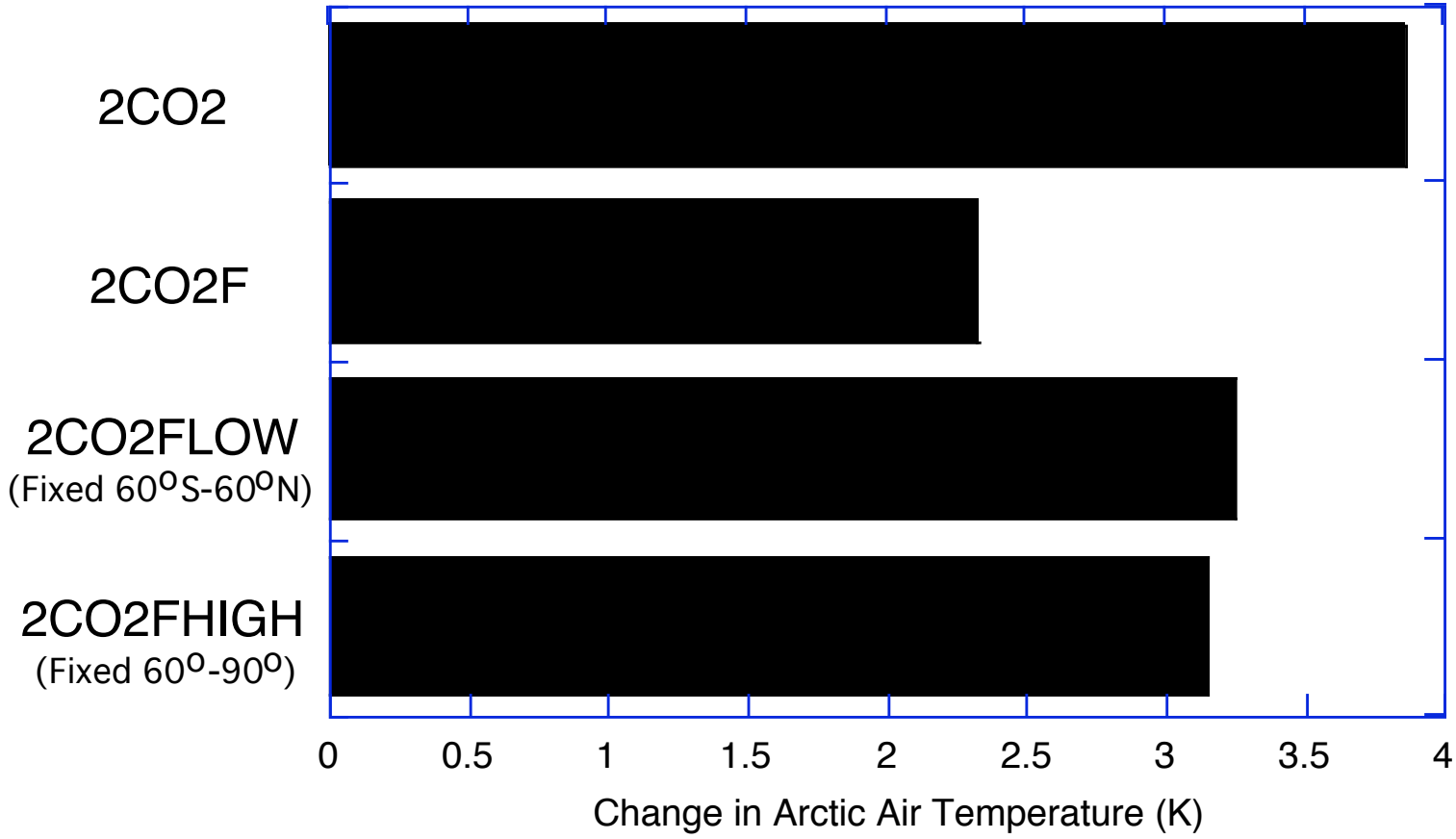


Change in T.O. A. Cloud Radiative Forcing (CRF)

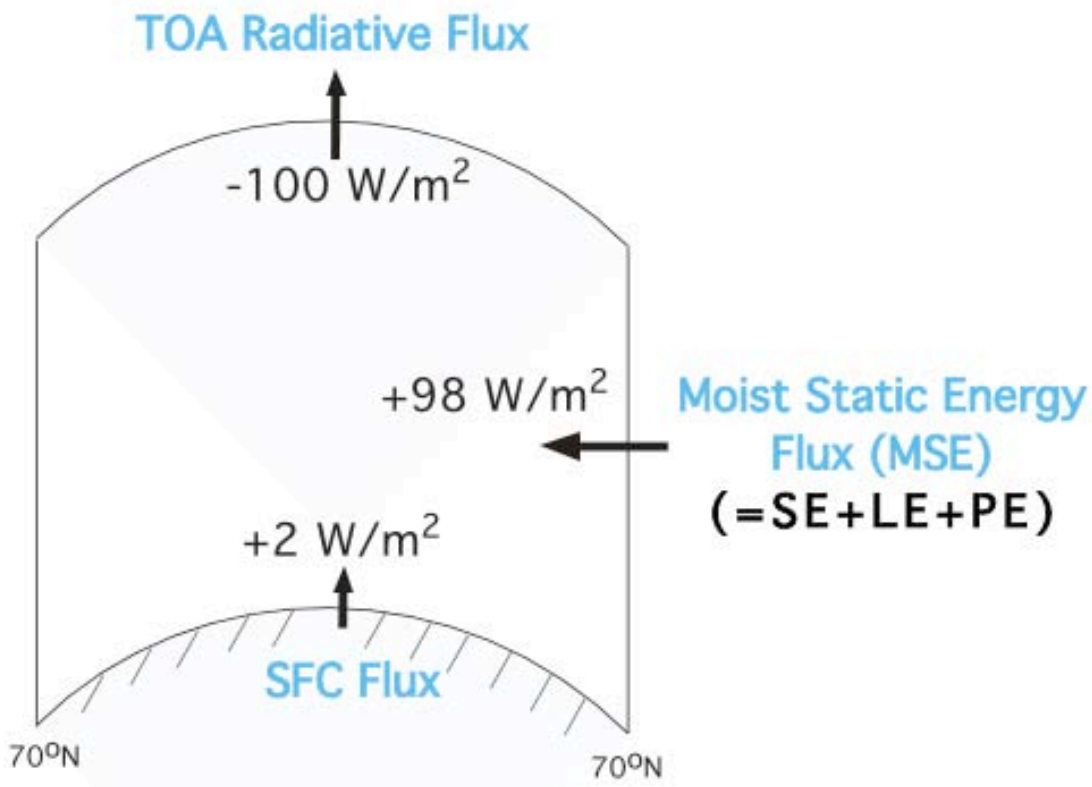


	2CO2	2CO2F	2CO2-2CO2F
60°-90°N	-1.0	-1.6	+0.6
30°-60°N	-0.1	-1.0	+0.9
0°-30°N	0.2	-0.9	+1.1
0°-30°S	0.8	-1.0	+1.8
30°-60°S	-0.5	-0.9	+0.4
60°-90°S	-4.1	-3.4	-0.7
Global	-0.2	-1.2	+1.0

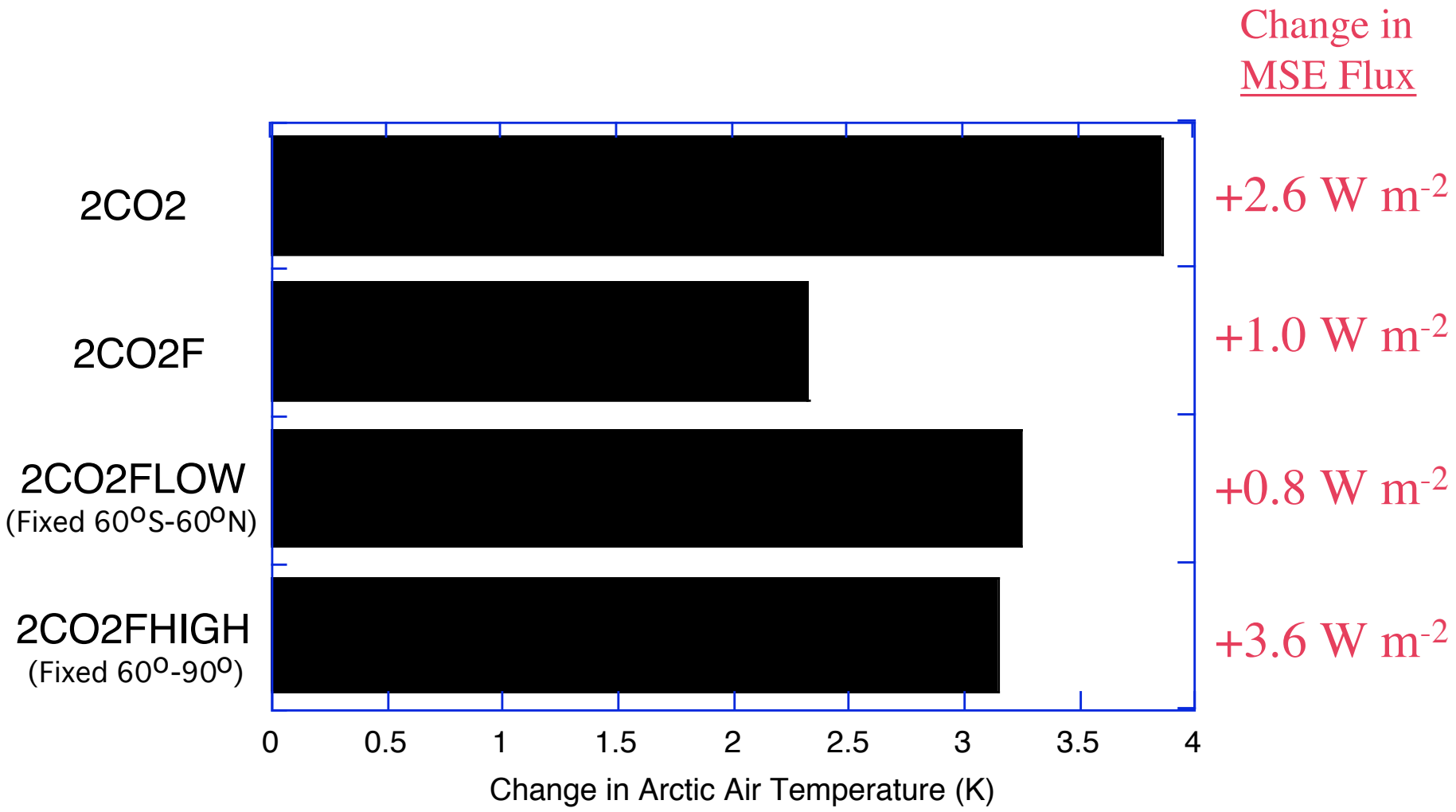
Effect of Regional and Global Cloud Changes on Arctic Climate



MOIST STATIC ENERGY TRANSPORT INTO ARCTIC



[From Nakamura and Oort (1988)]


Change in
MSE Flux
2CO2
+2.6 W m-2
2CO2F
+1.0 W m-2
2CO2FLOW
(Fixed 60oS-60oN)
+0.8 W m-2
2CO2FHIGH
(Fixed 60o-90o)
+3.6 W m-2
0
0.5
1
1.5
2
2.5
3
3.5
4
Change in Arctic Air Temperature (K)

Conclusions

- More high-latitude clouds and less low-latitude cloudiness cause simulated cloud changes to act as a positive feedback under 2xCO_2
- Cloud cover changes account for 1/3 of global warming and over 40% of Arctic warming
- Remote impact of low-latitude cloud changes ≈ Local impact of high-latitude cloud changes, due to importance of meridional atmospheric heat transport