

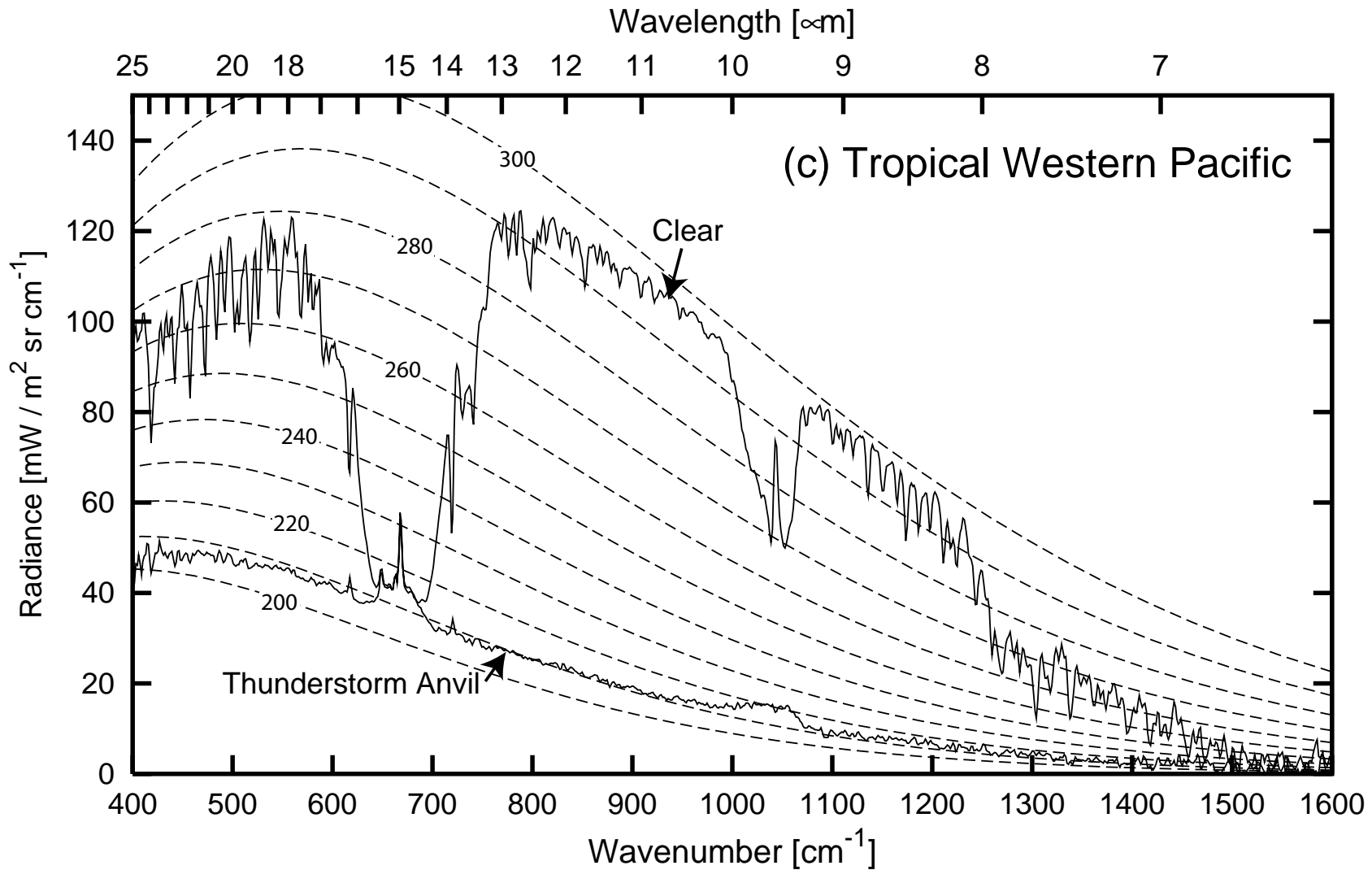
METR 5223: Atmospheric Radiation

Clouds and Radiation

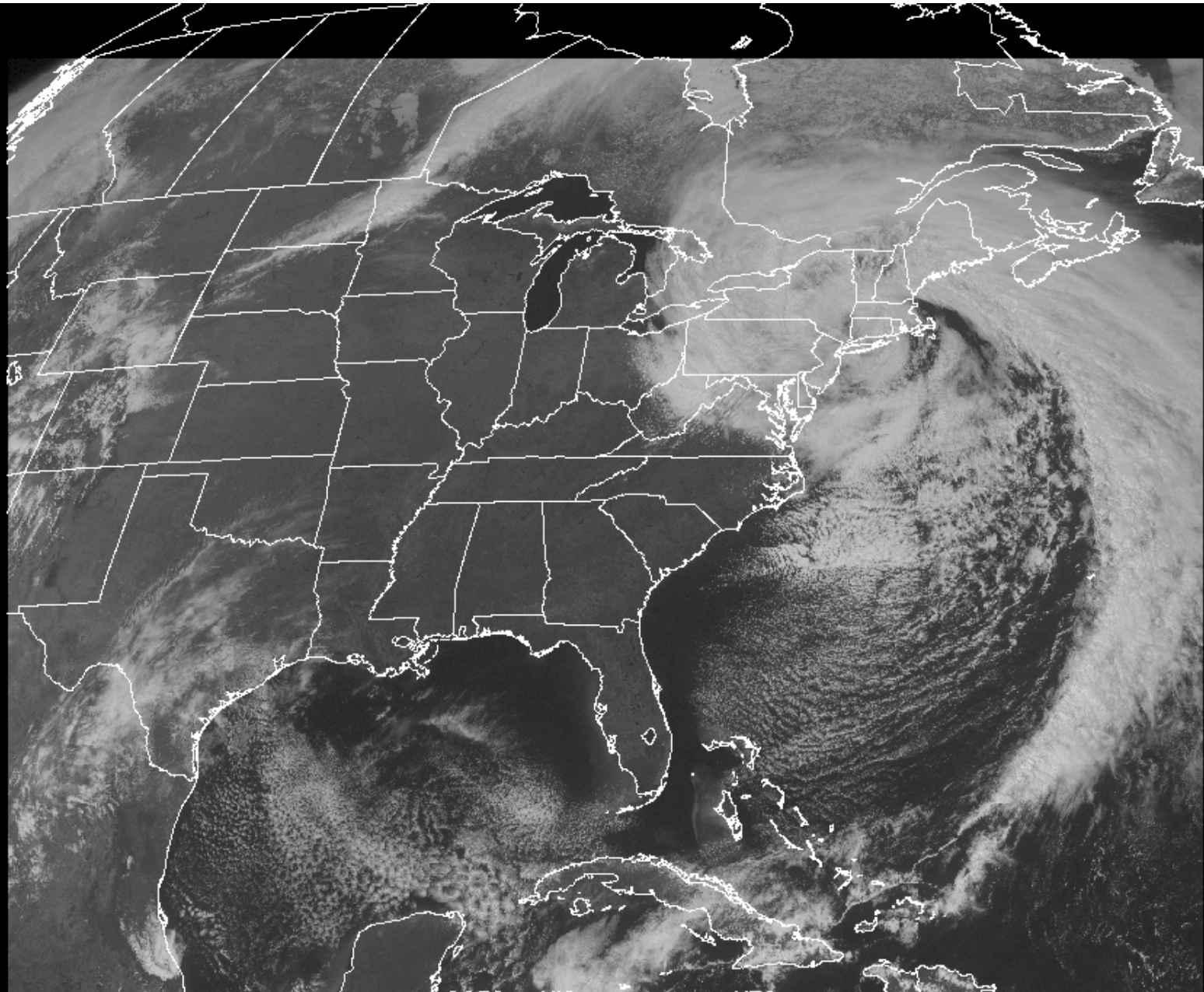
Lecture for Spring 2009

Prof. Brian H. Fiedler

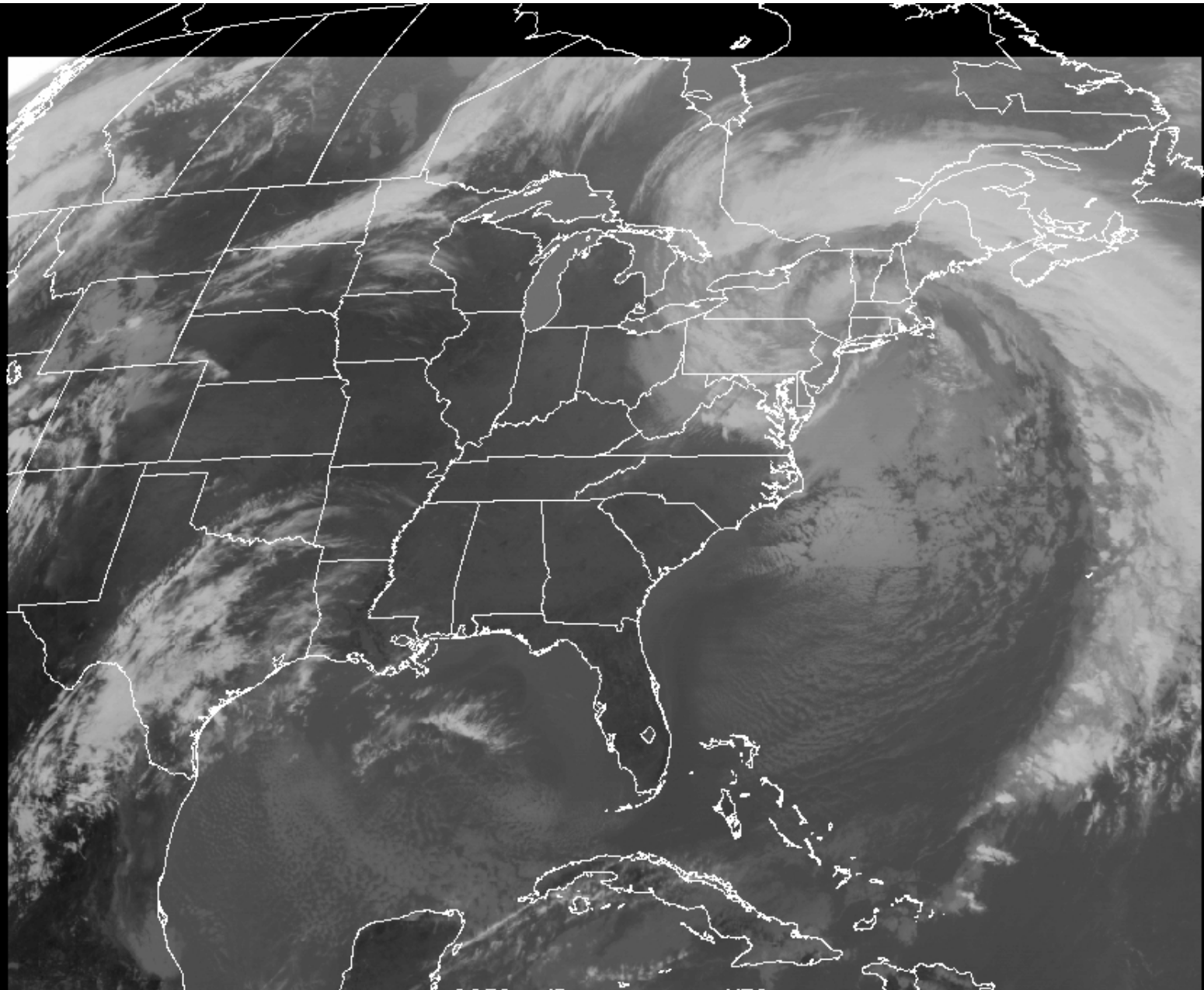
School of Meteorology, University of Oklahoma



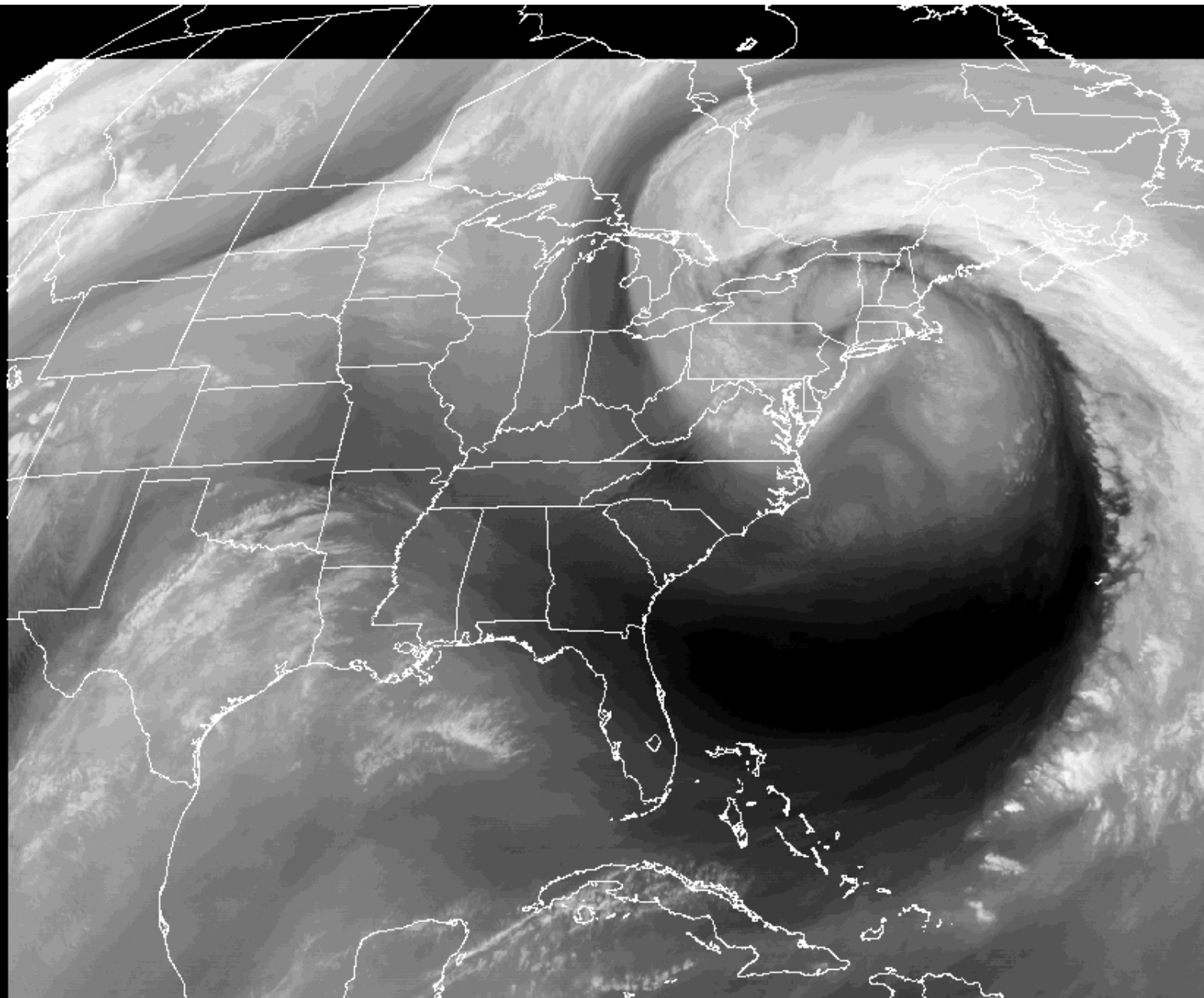
Satellite looking down. GOES has IR sensors at 11 microns and 6.9 microns.



GOES-12 VIS 20070416 1815 UTC



GOES-12 IR 20070416 1815 UTC



GOES-12 Water Vapor 20070416 1815 UTC

Experiment # 5 from:

<http://www.mensch.org/xcrm/crm.cgi>

(1) Using for input `mls_cld.in` run CRM. Notice the cloud fraction of 1.0 and cloud LWP of 100 at level 14. Write down the **LW up flux TOA** and **SW net flux TOA**.

(2) Then repeatedly using for input the above form, run the CRM after carefully editing the cloud LWP to 10.0, 1.0, 0.1, and 0. Write down the **LW up flux TOA** and **SW net flux TOA**.

For **low cloud** between 754 mb and 836 mb.

LWP	0	0.1	1.0	10.	100.
LW up flux TOA	286.4	286.1	283.8	271.1	268.0
SW net flux TOA	575.5	573.3	554.28	440.9	241.6

(3) Calculate the difference in the fluxes from that for the model run with LWP=0.

LWP	0	0.1	1.0	10.	100.
Δ LW up flux TOA	0.	-0.3	-2.6	-15.3	-18.4
Δ SW net flux TOA	0.	-2.2	-21.22	-134.6	-333.9

(4) The SW net flux is for daytime conditions, at night it would be zero. An average over 24 hours might be 1/2 of the SW values calculated. So now calculate $0.5 * (\Delta \text{ SW net flux TOA}) - (\Delta \text{ LW up flux TOA})$ to find the net inward flux (heating) caused by the presence of the cloud.

LWP	0	0.1	1.0	10.	100.
Δ heating	0.	-0.8	-8.01	-52.	-148.55

(5) Repeat the above calculations, but with level 14 cloud frac set to 0.0 and cloud LWP set to 000.0, and at level 8 cloud frac set to 1.0 and using the various LWP at level 8.

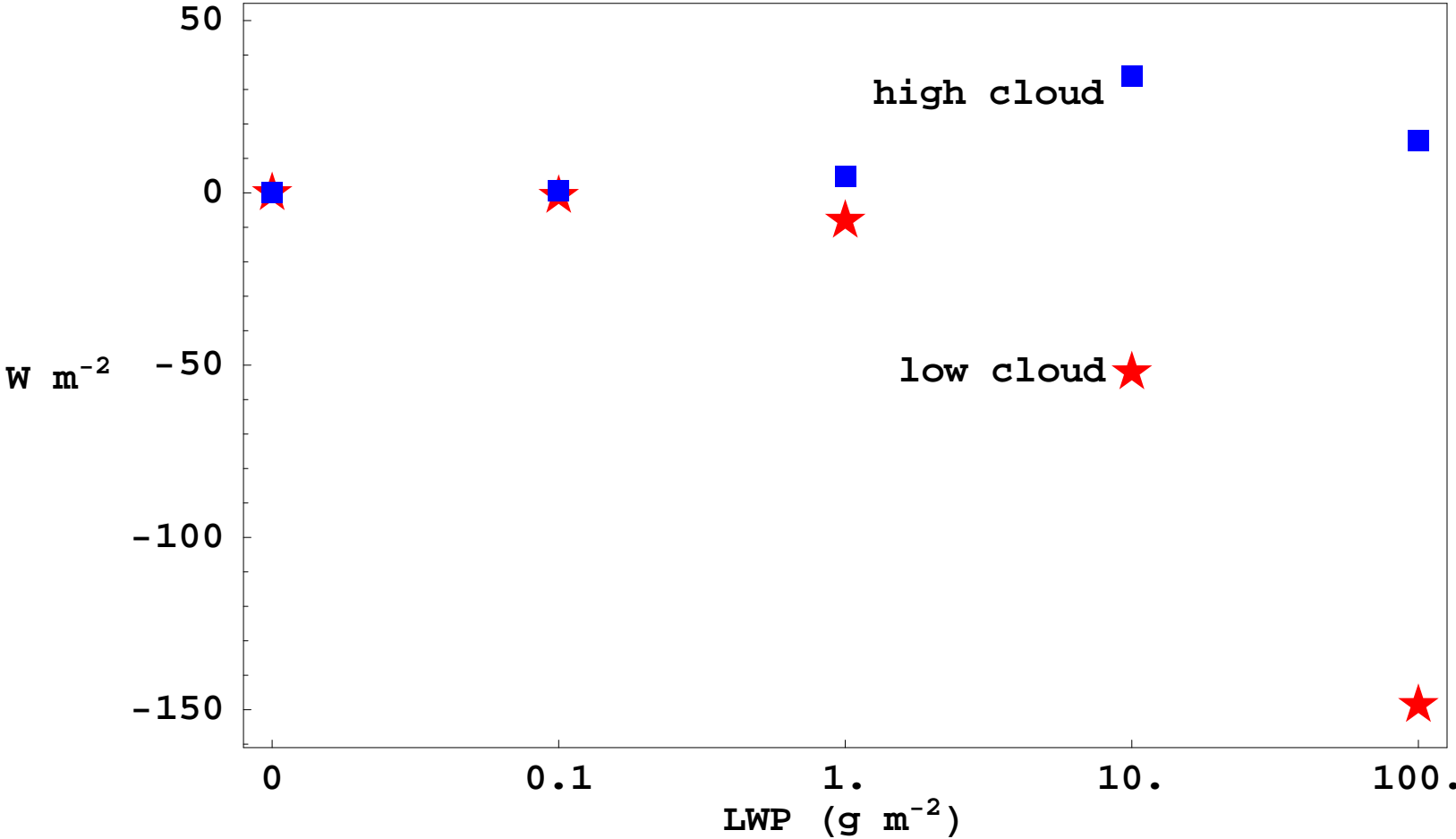
(6) What principle do you deduce from the results?

Note: (5) makes a **high cloud** between 198 mb and 279 mb

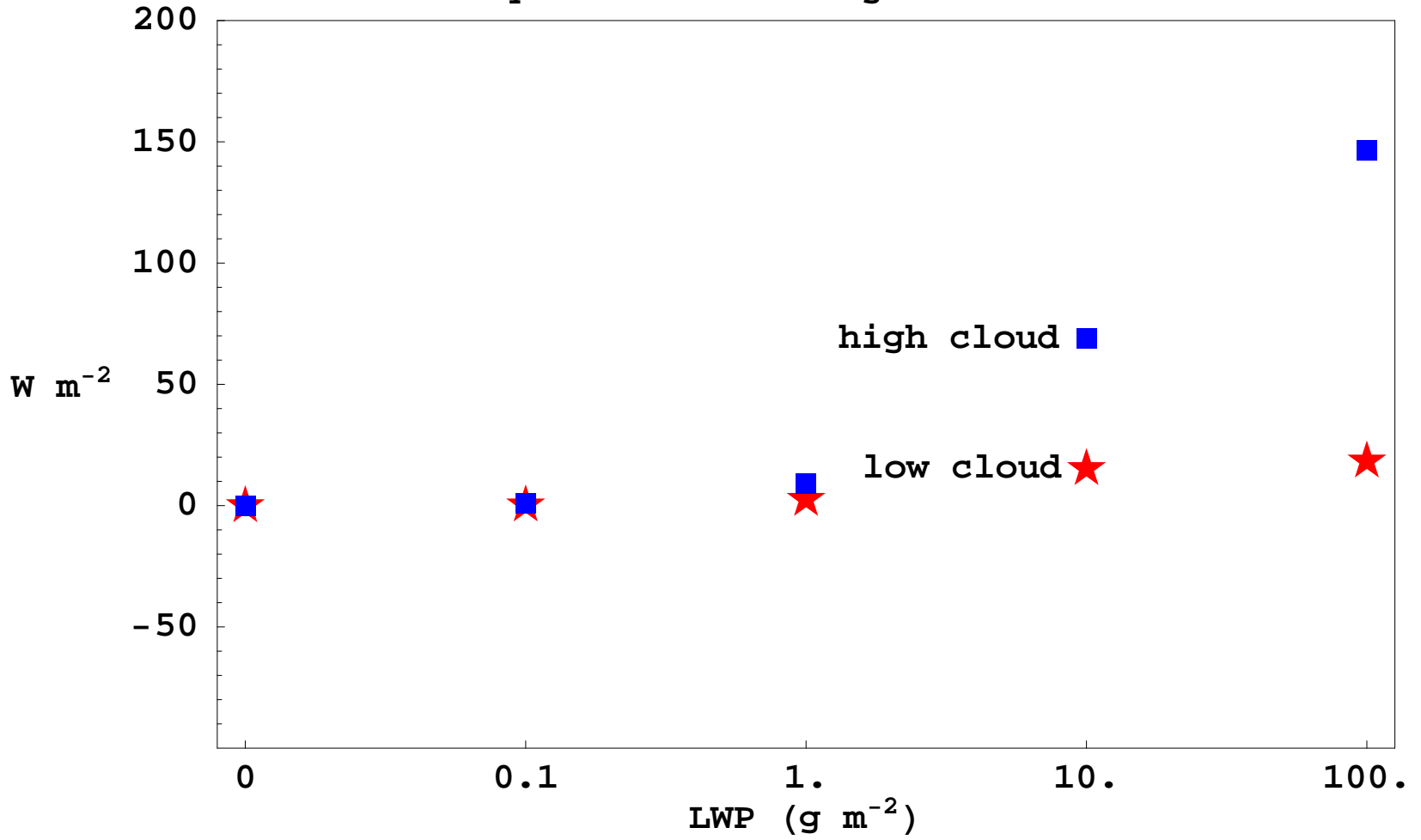
For **high cloud** between 198 mb and 279 mb.

LWP	0	0.1	1.0	10.	100.
LW up flux TOA	286.4	285.4	277.3	217.3	139.9
SW net flux TOA	575.5	574.7	566.9	504.9	313.1

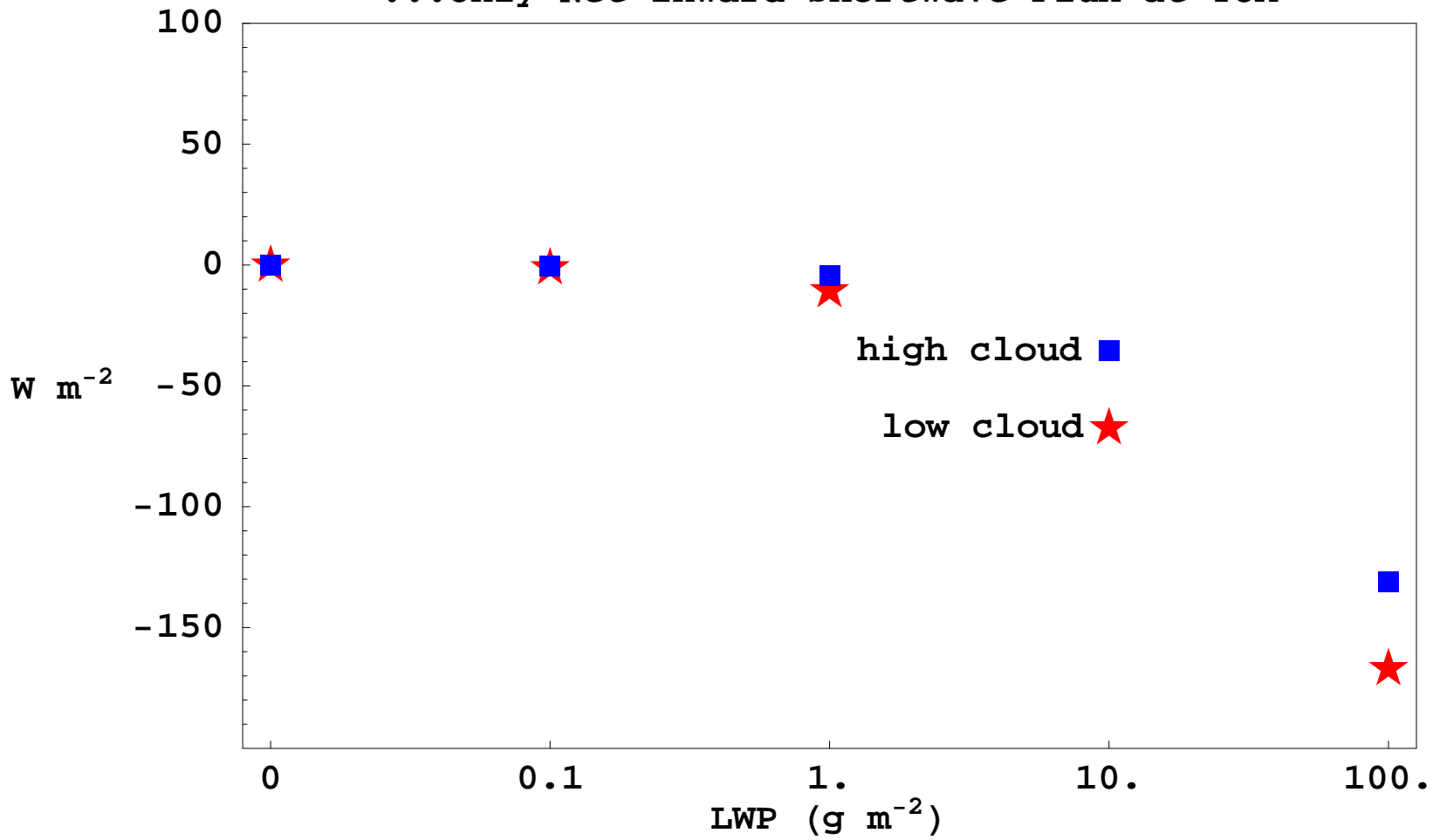
Effect of Cloud on Net Inward Flux at TOA



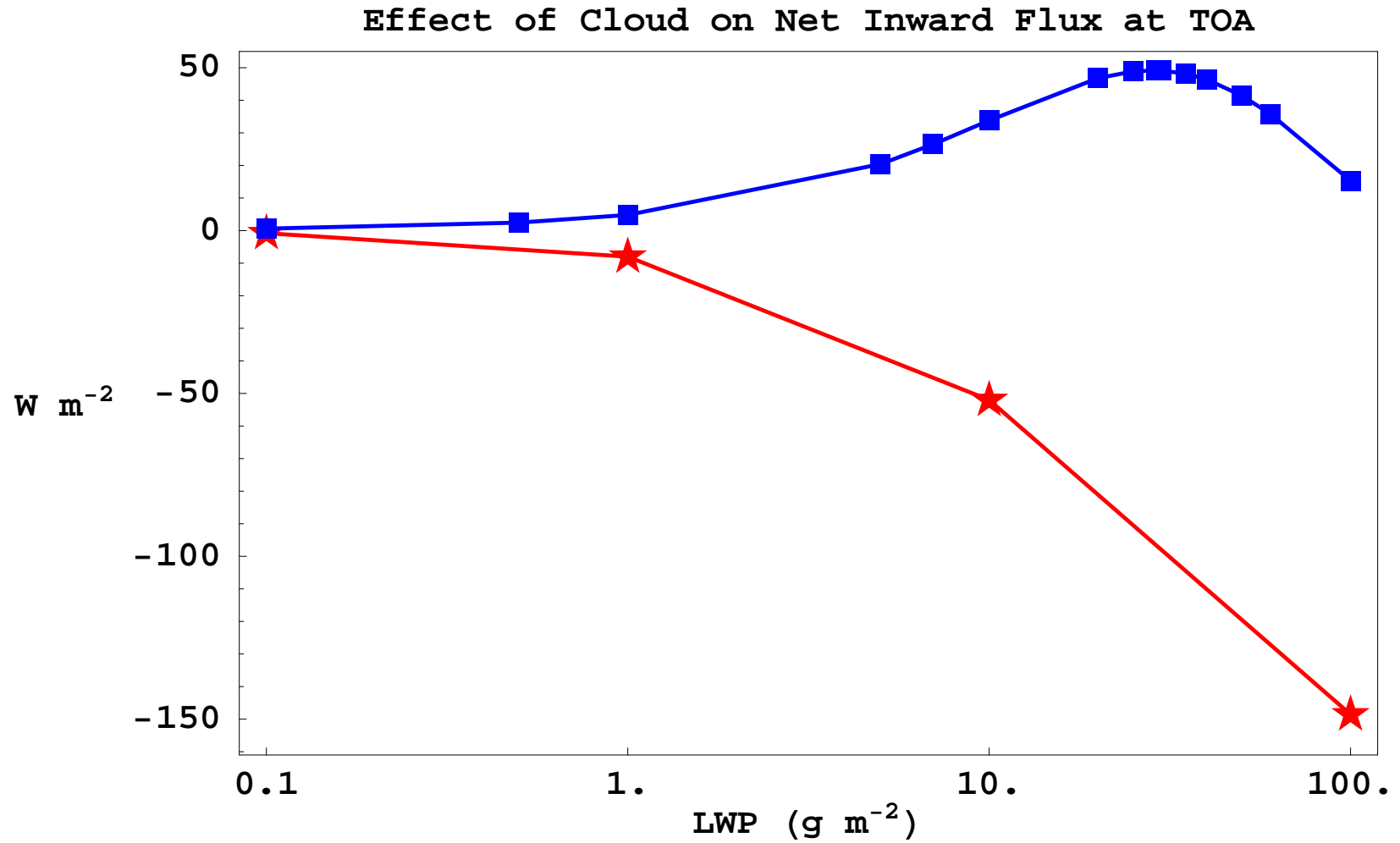
...Only Net Inward Longwave Flux at TOA

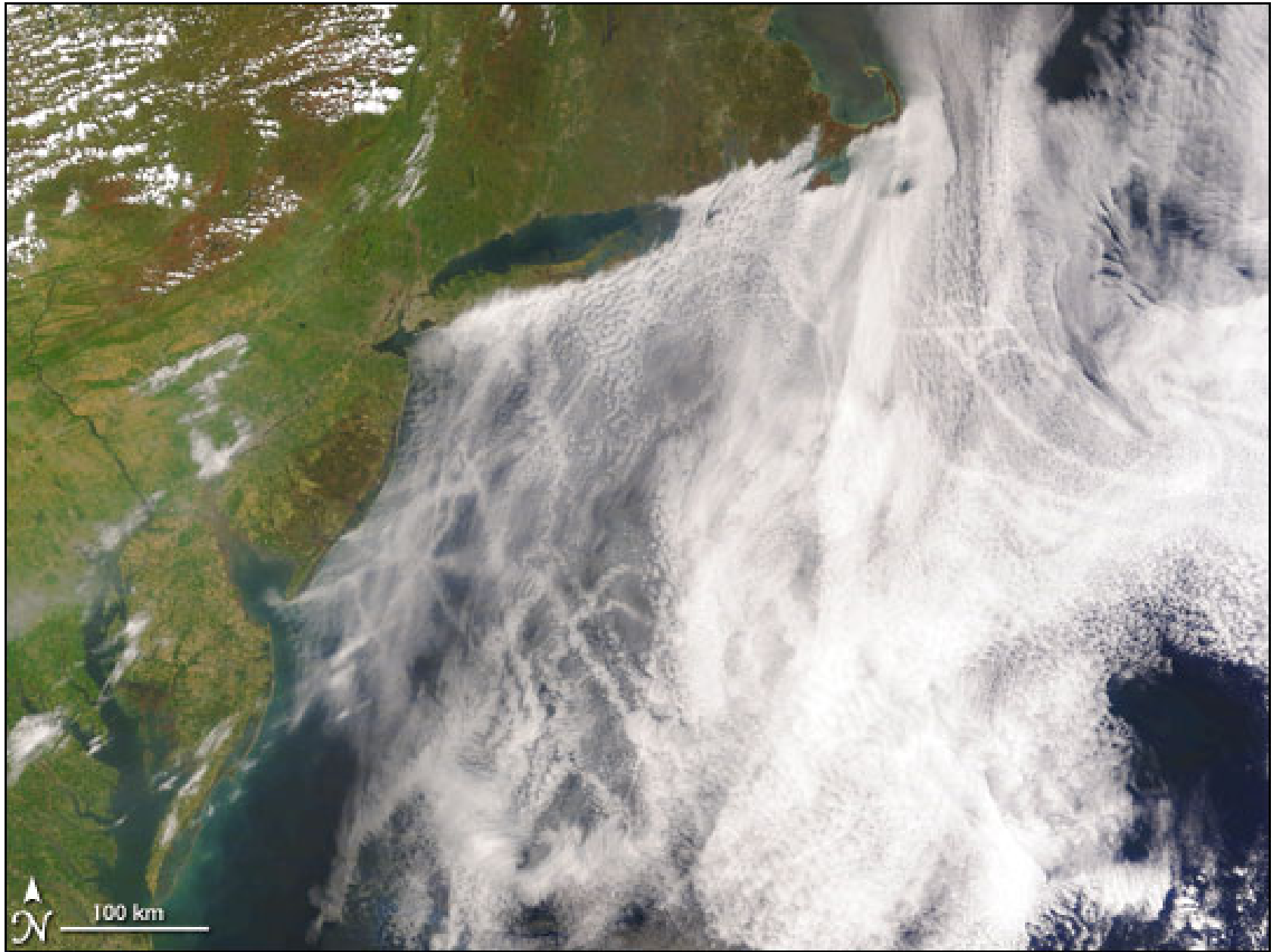


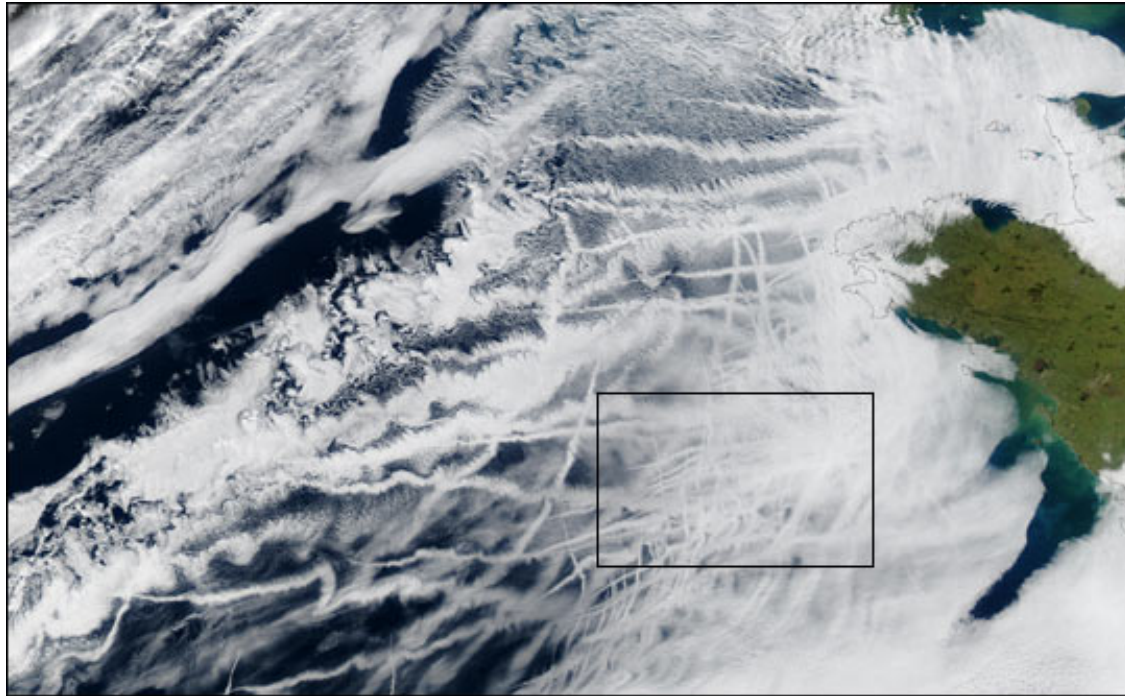
...Only Net Inward Shortwave Flux at TOA



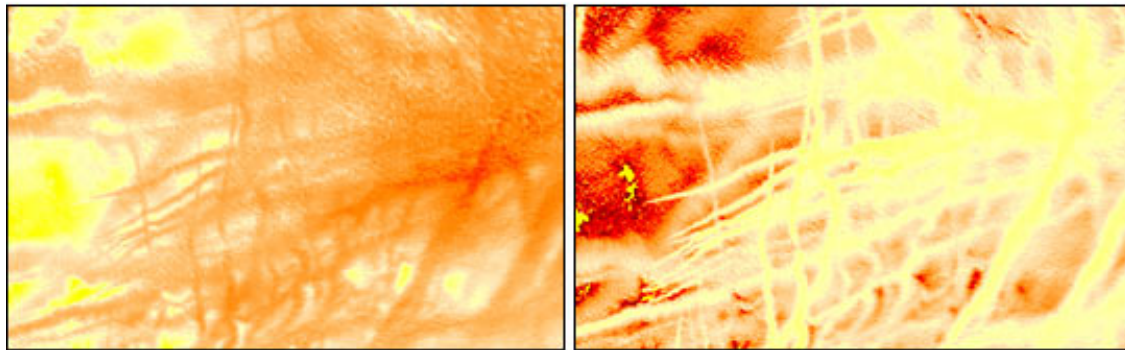
With more data as required by the 2006 QoD.



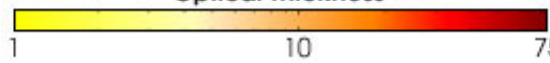




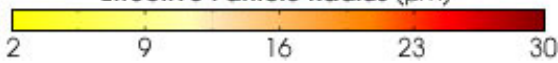
True Color



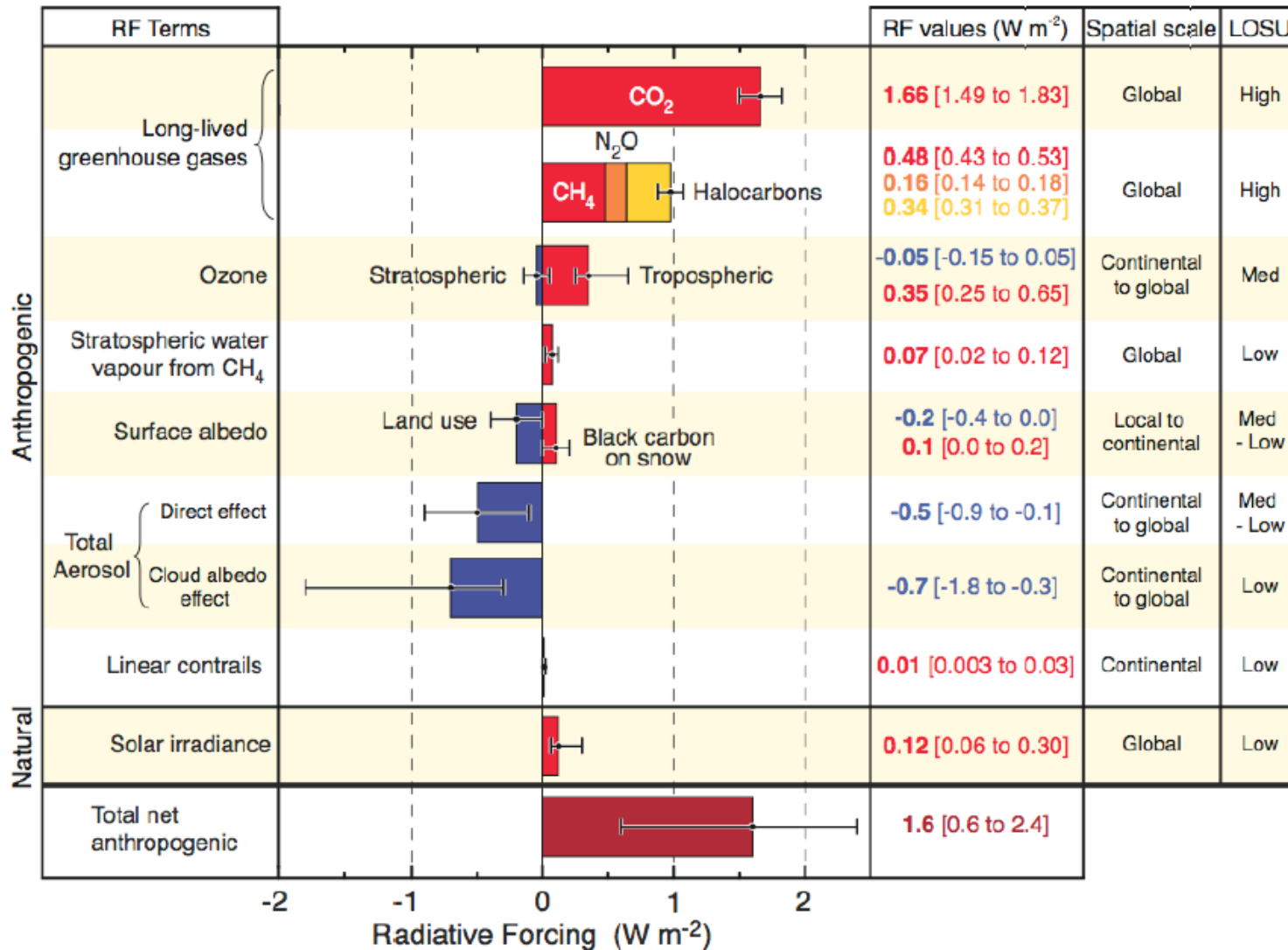
Optical Thickness



Effective Particle Radius (μm)



Radiative Forcing Components



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