Recent Implementation of RRTM in NCEP GFS

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GFS-RRTM

- **Implementation date: August 2003**
- **Configurations: 16 bands 140 G-factors**
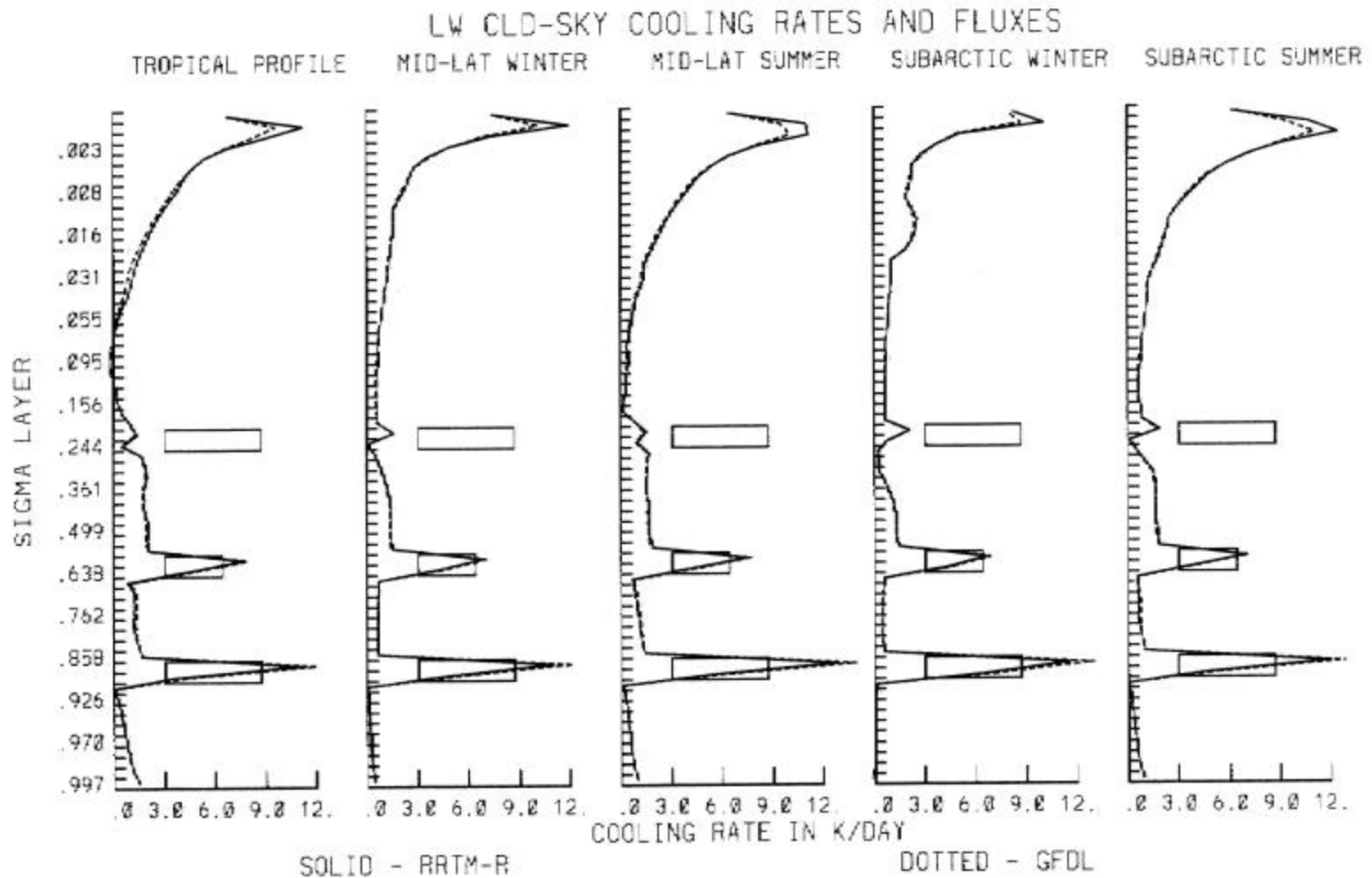- **Model, T264L64**

Computational Efficiency

Time used for 300-Column Computation, in sec.

Number of Layer	GFDL	RRTM
L28	.369	.412
L42	.718	.602
L64	1.538	.880

General Results

- – Alleviate cold bias in the lower troposphere
- – Colder stratosphere
- – Some satellite retrieval issues created

RRTM Cooling Rates on McClatchey Profiles

LW CLD-SKY COOLING RATES AND FLUXES

TROPICAL PROFILE   MID-LAT WINTER   MID-LAT SUMMER   SUBARCTIC WINTER   SUBARCTIC SUMMER

COOLING RATE IN K/DAY

SOLID - RRTM-R   DOTTED - GFDL

Fluxes Accuracy

1985-1989 AMIP AVG	GFDL L28	GFDL L64	RRTML L28	RRTM L64	ERBE
Jan	242.6	241.1	237.1	235.9	232.5
Apr	244.8	242.6	237.9	237.5	234.5
Jul	250.6	247.9	243.9	243.0	239.4
Oct	245.5	241.1	239.4	235.9	235.3

GFS-RRTM Cloud Forcing
Still Not Available in Operational Products

|	LW CF	SW CF	CS OLR	OLR	CS RSW	RSW
7/21-1d	20.7	-33.4	272.1	251.3	51.9	84.8
7/22-1d	20.3	-32.9	271.9	251.6	51.9	84.8
7/22-5d	21.1	-36.2	270.8	249.7	52.3	88.5
N/N ReAnl	30.7	-60.4	270	240	52	110.0
ERBE	32.7	-49.6	270	238	52	100.0

ReAnl/ERBE are from 85-86 July means

Unanticipated Improvement in Precipitation

Mean 24–36h GFS Forecast Precipitation over Entire US vs. Higgins Gauge Analyses
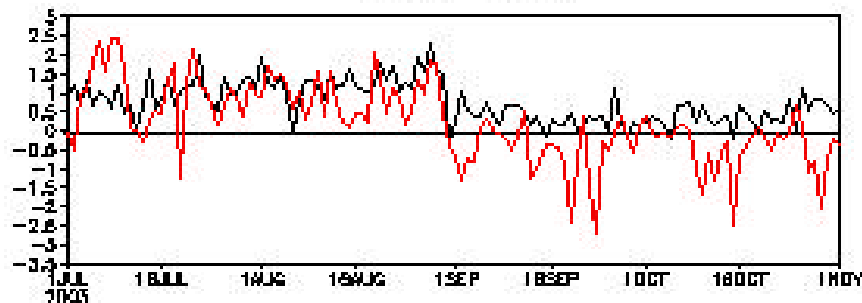
Black=GFS   Red =Stage II Radar

J. Janowiak
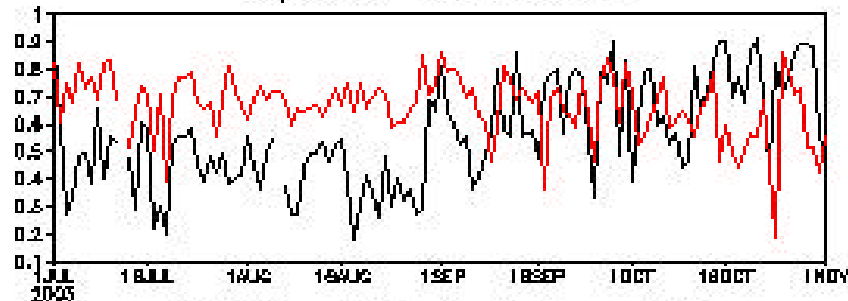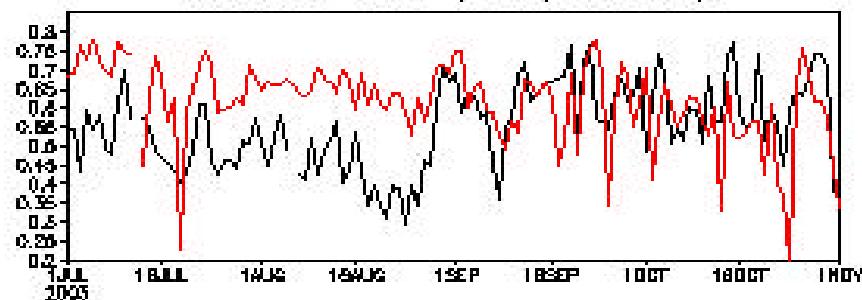
Summary

- RRTM reduces TOA OLR biases
- Clear sky fluxes in good agreement w/ obs
- Significant Improvement in GFS Precipitation
- RRTM computing load is efficient and linear to the number layers
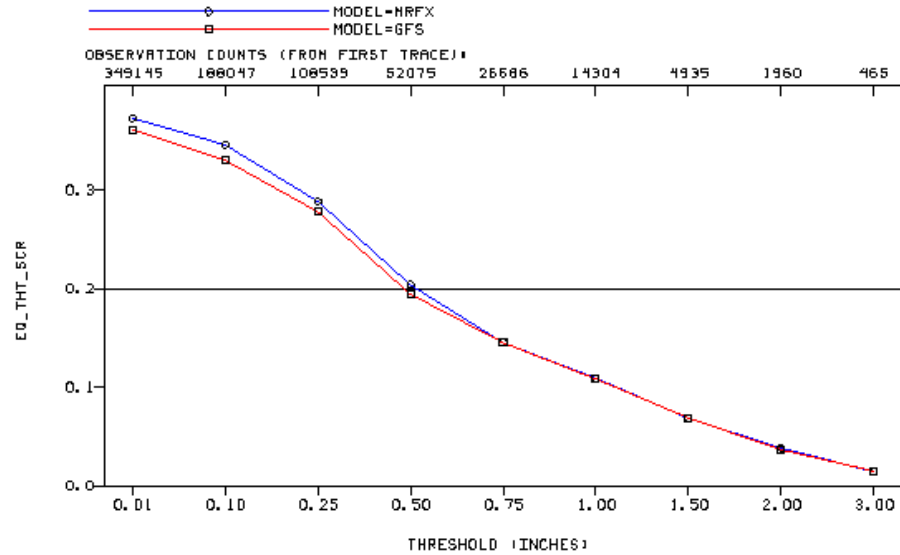- NCEP RSW improved. Clouds still has some way to go

GFS AMIP with Fels/Sch LW Code

Comparison of 1985~1989 4-year global means between AMIP and ERBE/LaRC- Surface Radiation Budget Dataset

	TOA OLR	TOA RSW	Sfc dw LW	Sfc dw SW
CDAS R-1	237.3	115.6	333.2	207.0
AMIP	245.5	87.4	325.5	211.2
ERBE/LaRC sfc	235.3	102.7	348.3	184.3
Diff	10.2	-15.3	-22.8	26.8

in W/M^2

STAT=FHO PARAM=APCP/24 FHOUR=36+60+84 V_ANL=MC_PCP V_RGN=G212/RFC LEVEL=SFC
VYMDH=2003D5230000-20030717230D

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