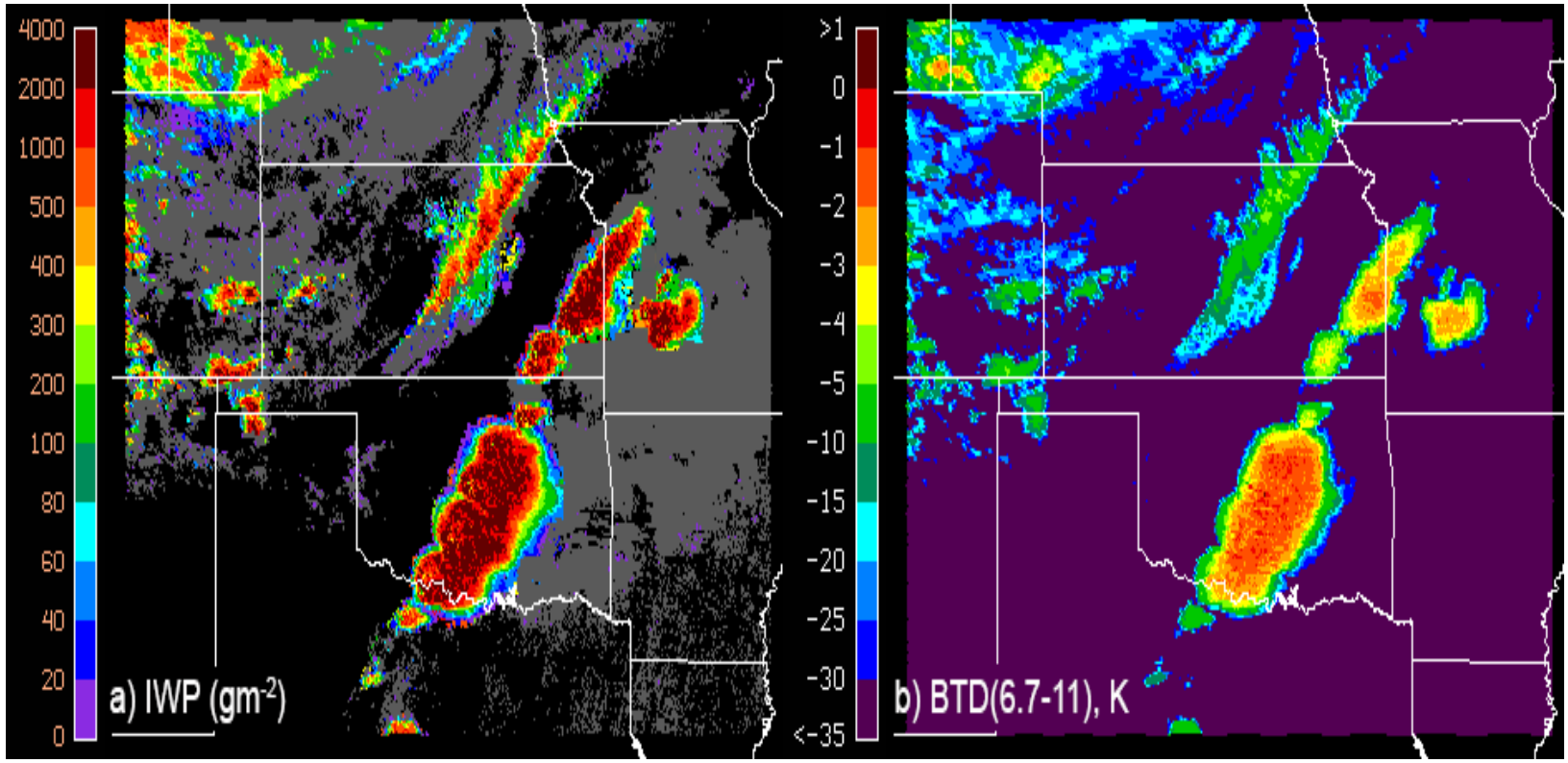
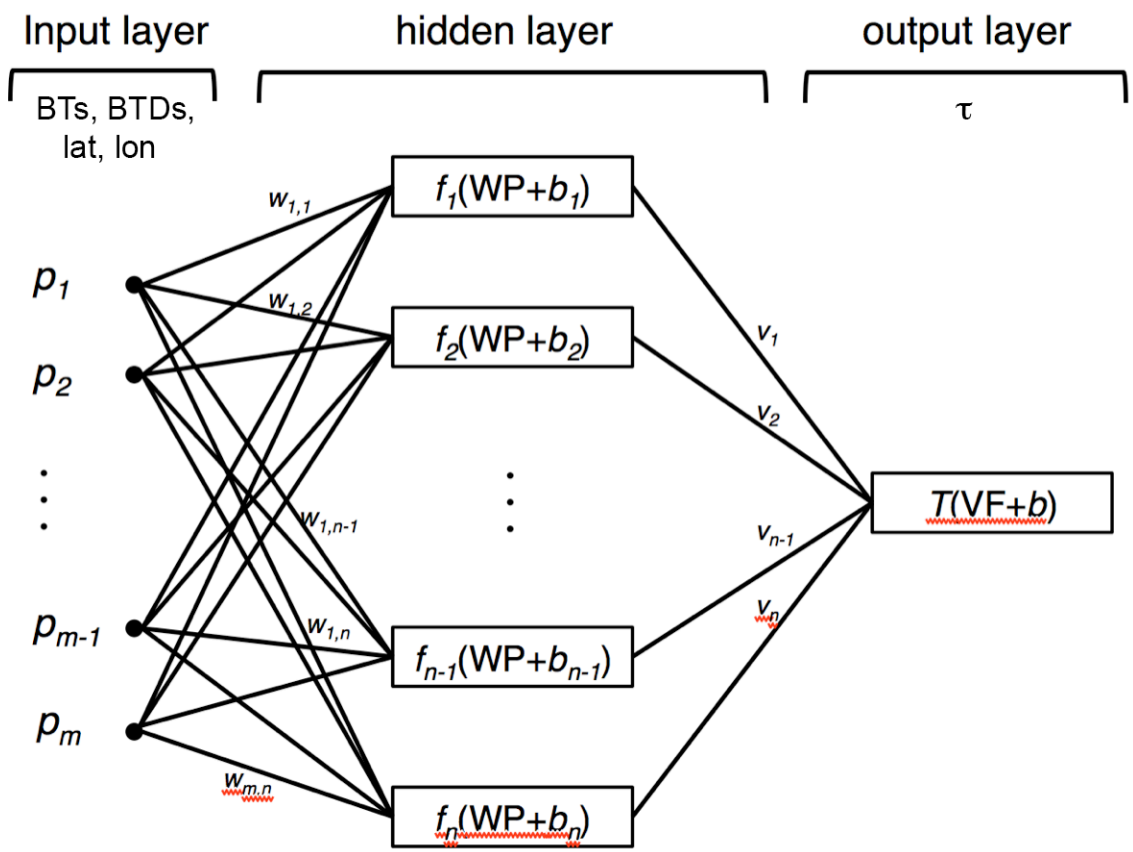
Estimating Thick Ice Cloud Optical Depth Using Infrared Imagery

P. Minnis, G. Hong, S. Sun-Mack



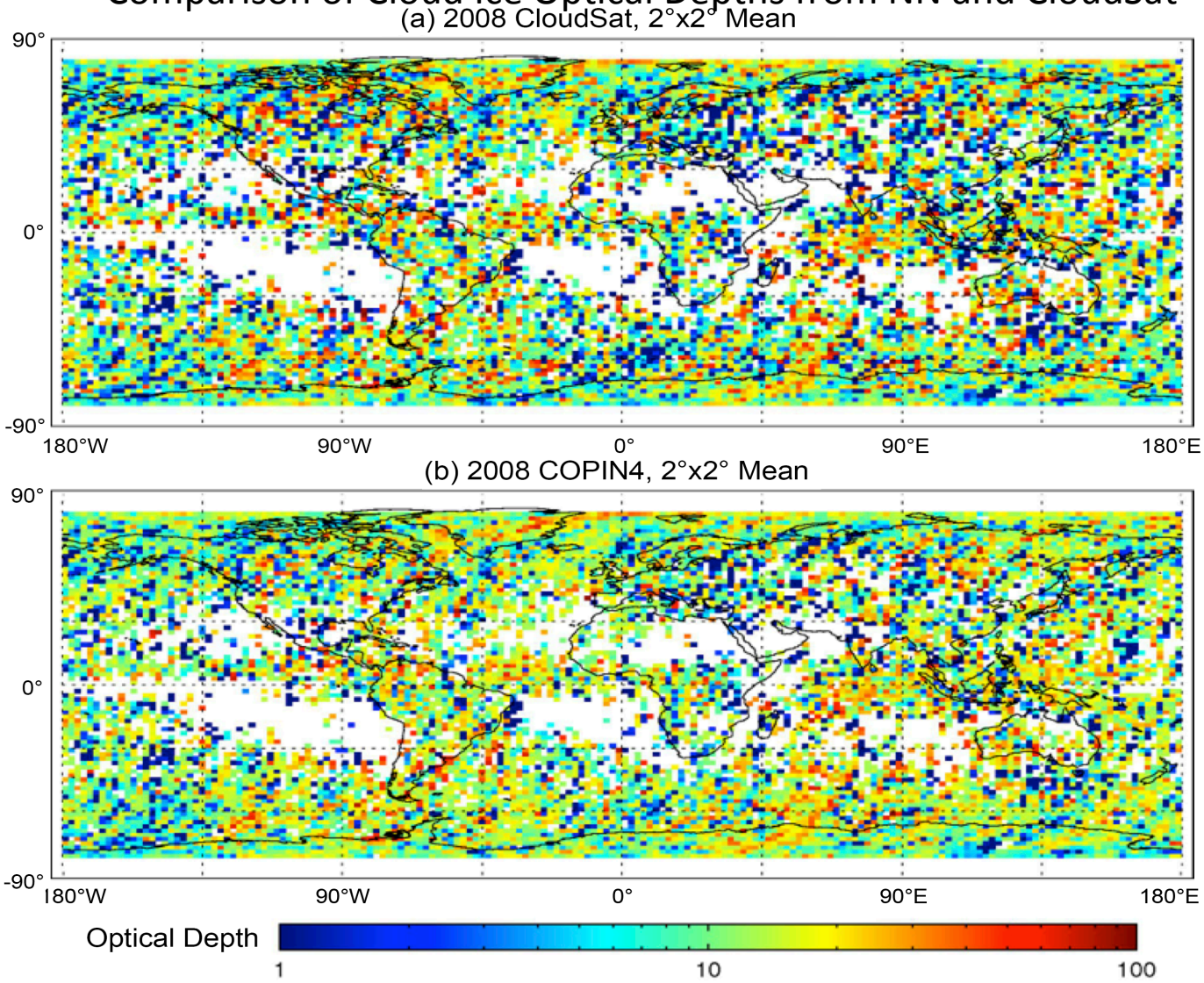
- Retrieval of cloud tau at night limited by blackbody limit of IR emissivity
  - tau ~ 6 or so
- Some information found in channel differences could be exploited for larger tau
  - try a neural network method (NN)

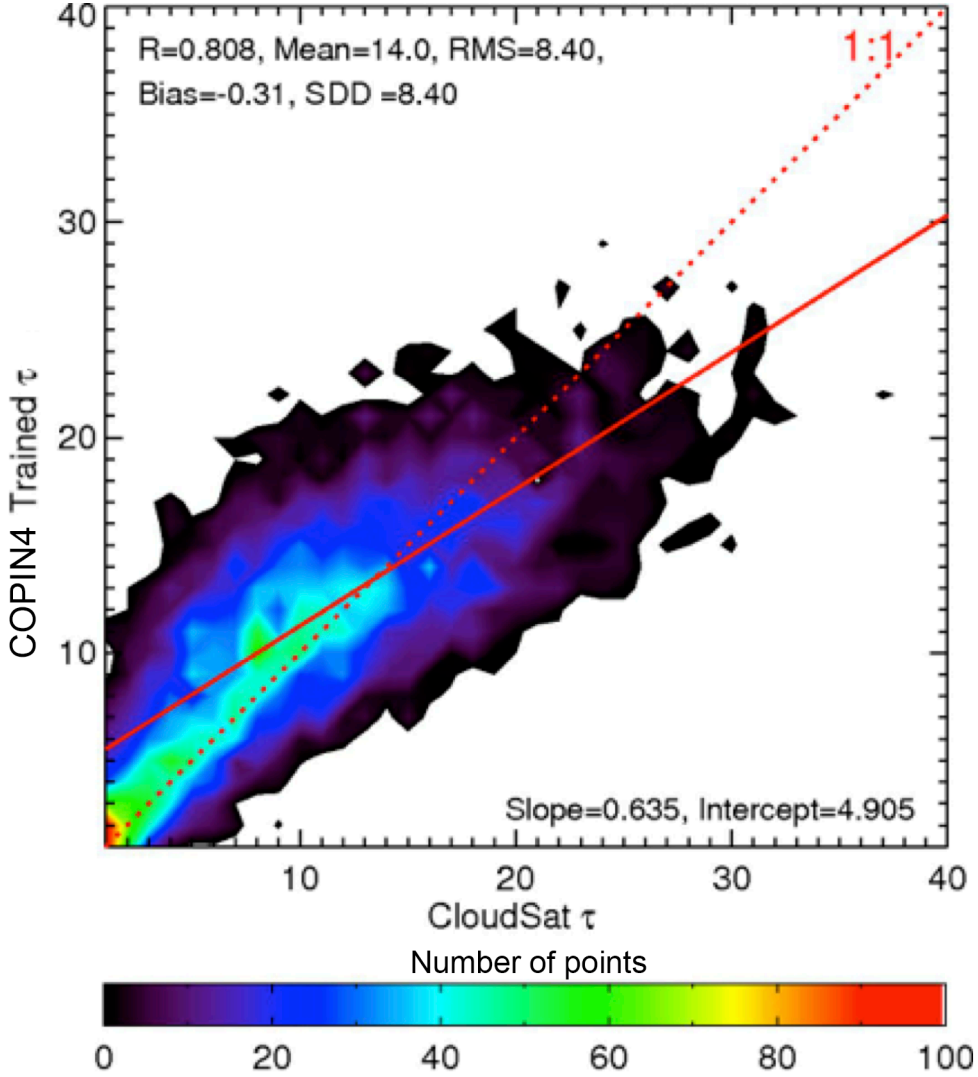
Schematic of Neural Network

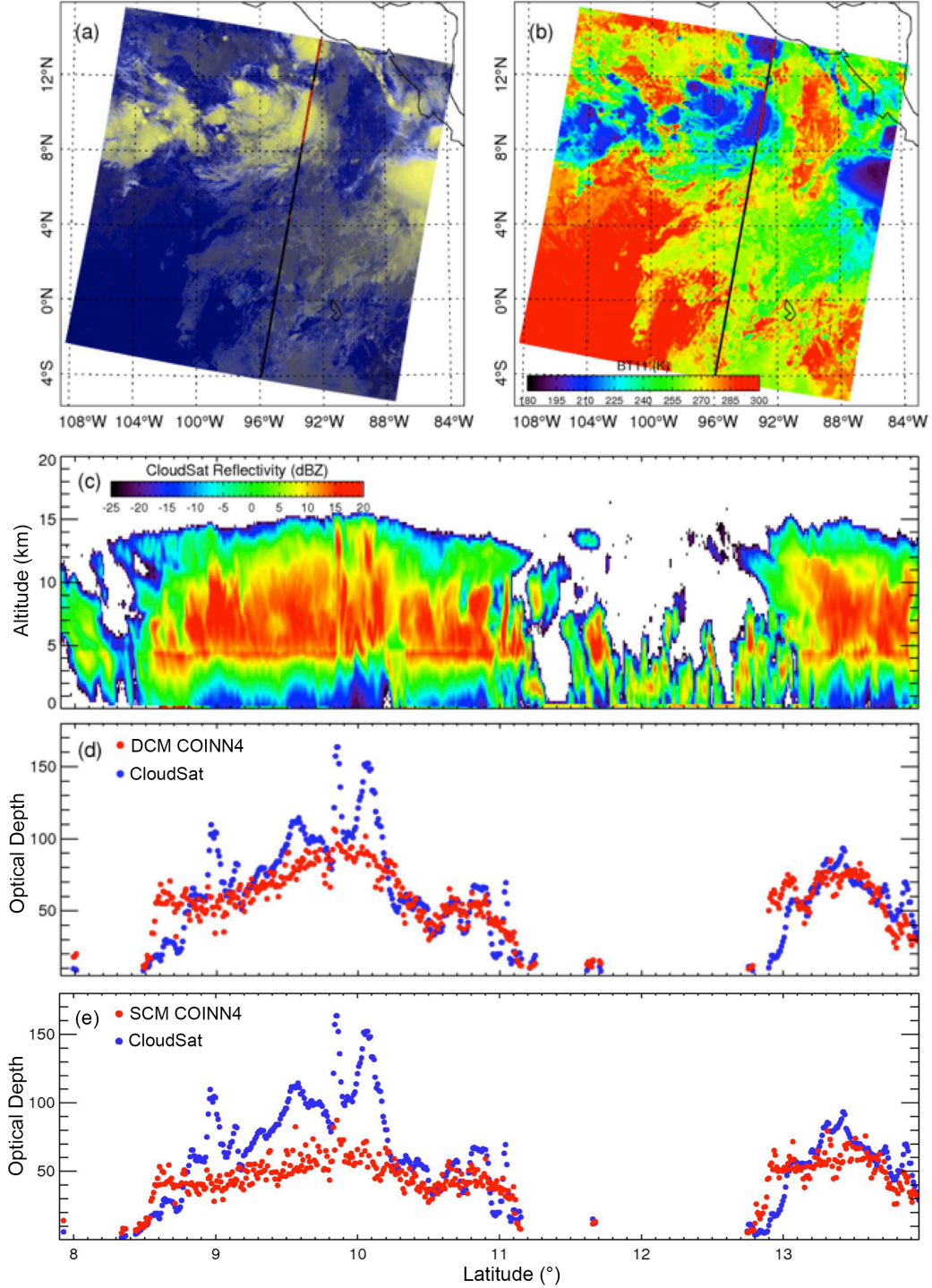


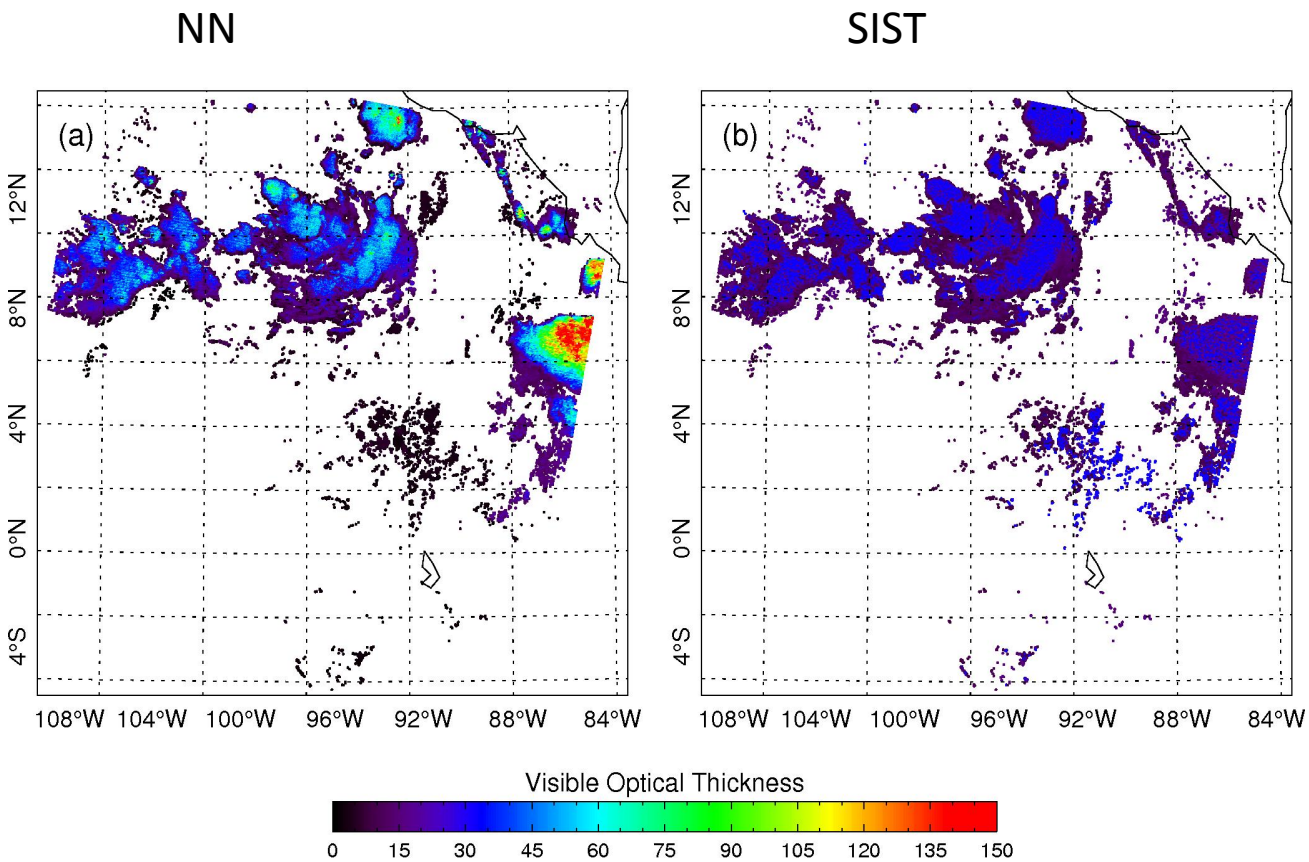
- Train with known input (imager) and output (CloudSat) datasets
- Apply to new input and compare to reference (CloudSat)
  - Use Aqua MODIS 2007 & 2008

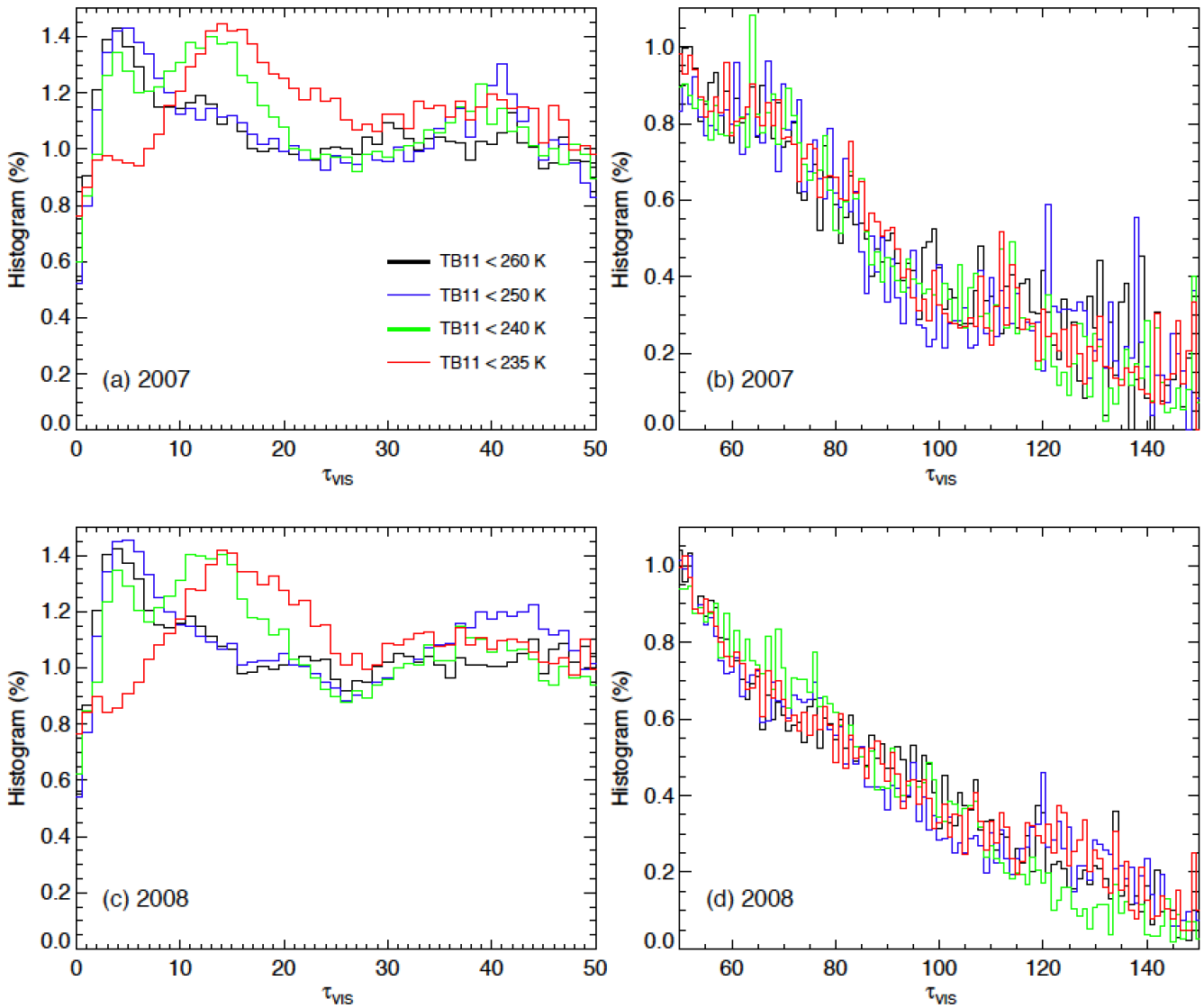
Comparison of Cloud Ice Optical Depths from NN and CloudSat




R=0.808, Mean=14.0, RMS=8.40,
Bias=-0.31, SDD =8.40
1:1
Slope=0.635, Intercept=4.905
COPIN4 Trained τ
CloudSat τ
Number of points
40
30
20
10
10
20
30
40
0
20
40
60
80
100

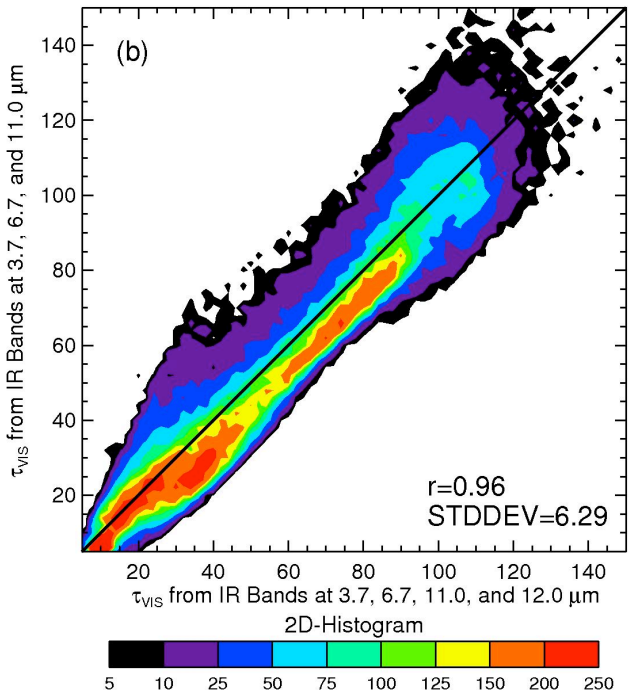

(a)
(b)
12°N
8°N
4°N
0°N
4°S
108°W 104°W 100°W 96°W 92°W 88°W 84°W
BT11 (K)
180 195 210 225 240 255 270 285 300
(c)
CloudSat Reflectivity (dBZ)
-25 -20 -15 -10 -5 0 5 10 15 20
Altitude (km)
(d)
DCM COINN4
CloudSat
Optical Depth
(e)
SCM COINN4
CloudSat
Optical Depth
Latitude (°)


NN
SIST
(a)
(b)
12°N
8°N
4°N
0°N
4°S
108°W
104°W
100°W
96°W
92°W
88°W
84°W
Visible Optical Thickness
0
15
30
45
60
75
90
105
120
135
150

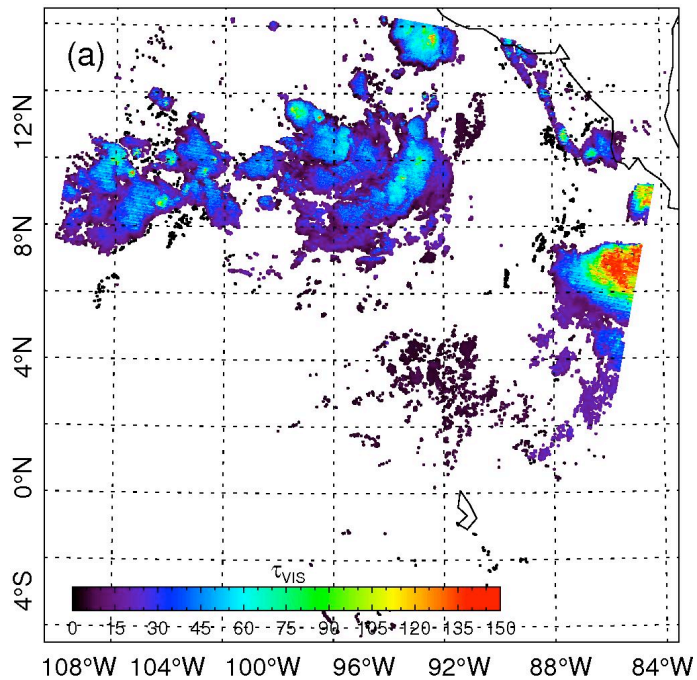

Histogram (%)
τ_{VIS}
(a) 2007
(b) 2007
(c) 2008
(d) 2008
TB11 < 260 K
TB11 < 250 K
TB11 < 240 K
TB11 < 235 K

Using a 3-Ch nighttime NN Algorithm

3ch vs. 4 ch NN tau

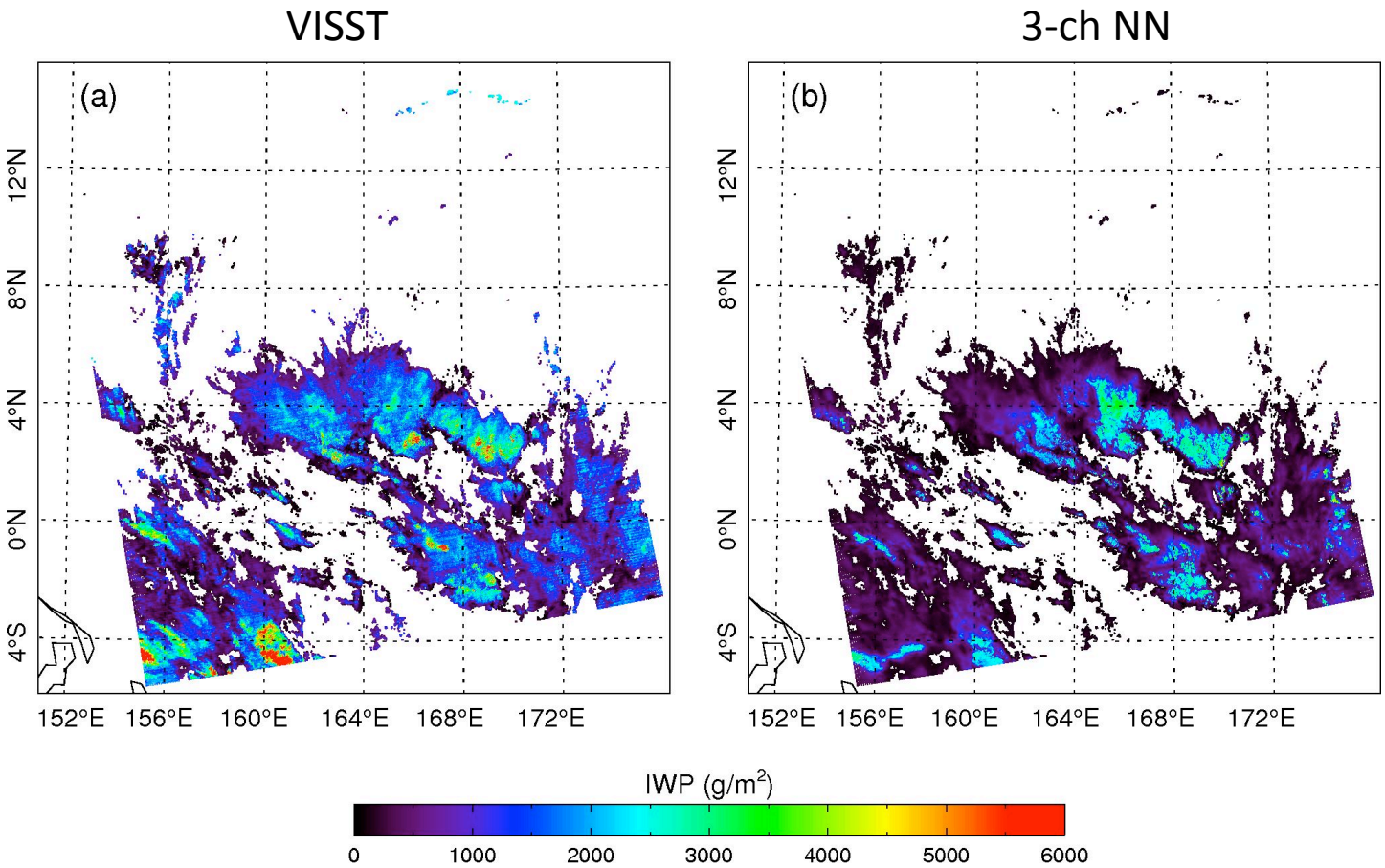


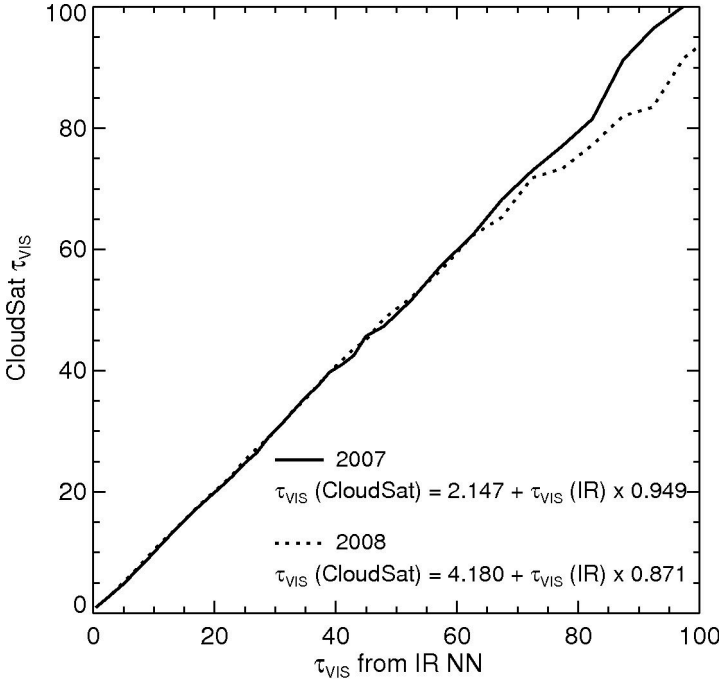
3-Channel tau(ice)

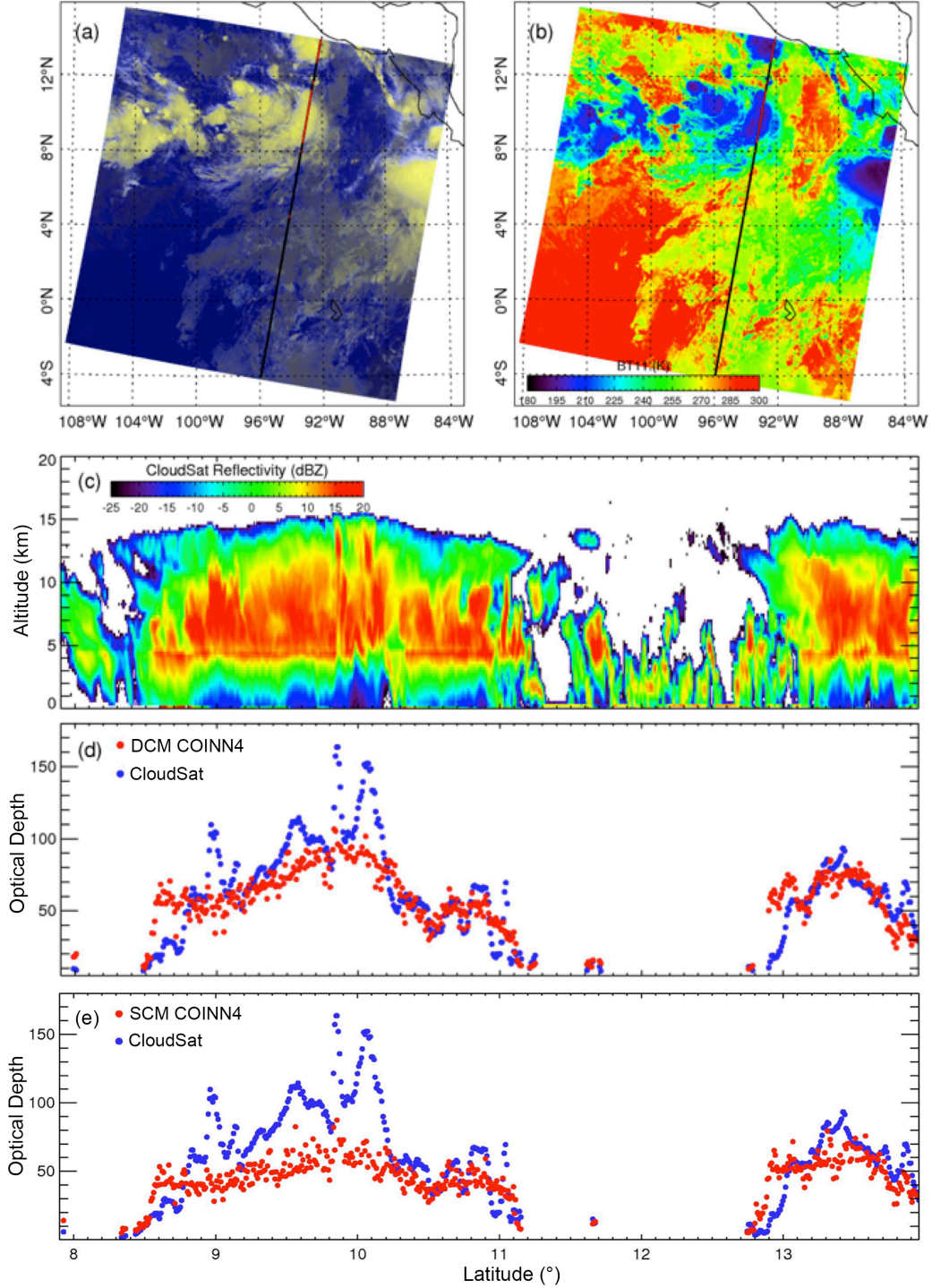


- 3-channel algorithm works nearly as well as 4-channel method
  - can use with GEO data lacking 12 µm

IWP Comparison Daytime, 1 Feb 2007, 02:35 UTC)




100
80
60
40
20
0
0
20
40
60
80
100
CloudSat τ_{VIS}
τ_{VIS} from IR NN
2007
τ_{VIS} (CloudSat) = 2.147 + τ_{VIS} (IR) x 0.949
2008
τ_{VIS} (CloudSat) = 4.180 + τ_{VIS} (IR) x 0.871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