AIRS/AMSU/HSB Version 7 CH4 Initial Guess Profiles

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In the AIRS Version 7 retrieval, the 100-layer CH_4 prior profile is a function of latitude and altitude that varies smoothly from the Northern Hemisphere to the Southern Hemisphere. There is no temporal or longitudinal variation. An analytical function was derived via a non-linear polynomial fit to in situ aircraft measurements and model data [Xiong, X., C. Barnet, E. Maddy, C. Sweeney, X. Liu, L. Zhou, and M. Goldberg, 2008, Characterization and validation of methane products from the Atmospheric Infrared Sounder (AIRS), *J. Geophys Res., 113*, G00A01, doi:10.1029/2007JG000500]. The following IDL code performs the layer-by-layer calculation to generate a first guess profile at specified latitude:

```
Pro compute_ch4fg, alat, prep, ch4fg
; INPUTS:
; prep, 100 element layer pressure profile (hPa)
; alat, latitude (deg)
; OUPUT:
: ch4fg, 100 element CH4 layer volume mixing ratio (ppb)

coeff=[7.308, 0.0339,   0.0483,  -0.1394,  -0.1279,   0.0624,$
     0.0214,  -0.0119,  -0.0134,  -0.0102,   0.00224 ]
f = [-0.35, 7.1, 150.]
     x=fltarr(10,100)
     pi=acos(-1.)
     Nlev=100
    ch4fg=fltarr(Nlev)
      X(0,0:99) = sin(alat *pi/180.)
      X(1,0:99) = prep(0:99)^0.5
      X(2,0:99) = alog(1.+prep(0:99))
      x(3,0:99)= x(0,0:99)^2
      x(4,0:99)= x(2,0:99)^2
      x(5,0:99)= x(0,0:99)^2*X(2,0:99)
     x(6,0:99)= x(0,0:99)*X(2,0:99)
     x(7,0:99)= x(0,0:99)^3
     x(8,0:99)= x(2,0:99)^3
     x(9,0:99)= x(0,0:99)*X(2,0:99)^2
    pdictor1=(cos(alat*pi/180.))^8
    pdictor2=(1.0+sin(alat*pi/180.)^8)
    for lyr=0, Nlev-1 do begin
     sum = coeff(0)
     for i=0,N_ELEMENTS(coeff)-2 do begin
        sum = sum + coeff(i+1)*x(i,lyr)
     endfor
     ch4fg(lyr) = exp(sum)
   endfor
   ch4fg =  ch4fg - exp(f(0)*alog(20.+prep)* pdictor1  $
    + f(1)/(1.+prep/(f(2)*Pdictor2))) * exp((-alog(100./(50.+prep))^8))
end
```

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The following is the calculated CH_4 prior profile for three latitudes.

Layer Pressure (hPa)	Lat -45 (ppb)	Lat 00 (ppb)	Lat +45 (ppb)
8.9722E-03	303.27	1095.67	356.963
2.4864E-02	305.161	1096.72	358.386
5.4341E-02	306.284	1096.19	358.626
1.0264E-01	306.519	1093.85	357.534
1.7534E-01	306.26	1089.96	355.492
2.7840E-01	306.31	1085.25	353.349
4.1822E-01	307.783	1080.89	352.342
6.0131E-01	311.889	1078.12	353.82
8.3448E-01	319.682	1078.06	358.987
1.1248E+00	332.006	1081.48	368.781
1.4794E+00	349.371	1088.85	383.801
1.9057E+00	372.06	1100.3	404.372
2.4112E+00	400.031	1115.69	430.489
3.0034E+00	433.23	1134.76	462.095
3.6900E+00	471.376	1157.11	498.909
4.4789E+00	514.141	1182.3	540.594
5.3777E+00	561.15	1209.88	586.759
6.3944E+00	611.799	1239.29	636.789
7.5369E+00	665.519	1270.03	690.096
8.8130E+00	721.751	1301.67	746.108
1.0231E+01	779.729	1333.7	804.042
1.1798E+01	838.75	1365.68	863.186
1.3522E+01	898.157	1397.24	922.865
1.5412E+01	957.253	1428.03	982.37
1.7475E+01	1015.43	1457.77	1041.08
1.9719E+01	1072.12	1486.23	1098.43
2.2151E+01	1126.92	1513.26	1154
2.4780E+01	1179.38	1538.72	1207.32
2.7613E+01	1229.24	1562.55	1258.14
3.0657E+01	1276.28	1584.71	1306.22
3.3920E+01	1320.38	1605.23	1351.43
3.7410E+01	1361.43	1624.1	1393.66
4.1133E+01	1399.42	1641.4	1432.9

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Layer Pressure (hPa)	Lat -45 (ppb)	Lat 00 (ppb)	Lat +45 (ppb)
4.5098E+01	1434.41	1657.19	1469.18
4.9310E+01	1466.45	1671.55	1502.58
5.3778E+01	1495.67	1684.56	1533.19
5.8507E+01	1522.2	1696.32	1561.15
6.3506E+01	1546.2	1706.91	1586.62
6.8779E+01	1567.83	1716.43	1609.75
7.4335E+01	1587.27	1724.96	1630.72
8.0179E+01	1604.68	1732.58	1649.68
8.6318E+01	1620.23	1739.37	1666.81
9.2759E+01	1634.11	1745.41	1682.29
9.9506E+01	1646.48	1750.77	1696.26
1.0657E+02	1657.49	1755.5	1708.89
1.1394E+02	1667.29	1759.68	1720.33
1.2165E+02	1676.04	1763.35	1730.72
1.2968E+02	1683.89	1766.57	1740.22
1.3805E+02	1690.97	1769.39	1748.95
1.4676E+02	1697.41	1771.85	1757.05
1.5581E+02	1703.35	1774	1764.64
1.6522E+02	1708.86	1775.86	1771.81
1.7498E+02	1714.01	1777.47	1778.63
1.8510E+02	1718.83	1778.85	1785.1
1.9558E+02	1723.26	1780	1791.2
2.0643E+02	1727.23	1780.93	1796.81
2.1766E+02	1730.59	1781.64	1801.82
2.2926E+02	1733.22	1782.12	1806.1
2.4124E+02	1735.06	1782.38	1809.58
2.5361E+02	1736.16	1782.45	1812.32
2.6637E+02	1736.67	1782.35	1814.45
2.7951E+02	1736.77	1782.14	1816.17
2.9305E+02	1736.63	1781.83	1817.65
3.0699E+02	1736.37	1781.47	1819.01
3.2132E+02	1736.04	1781.06	1820.28
3.3606E+02	1735.66	1780.62	1821.51
3.5121E+02	1735.25	1780.16	1822.69
3.6676E+02	1734.81	1779.68	1823.84
3.8272E+02	1734.36	1779.2	1824.97
3.9910E+02	1733.91	1778.72	1826.08
4.1589E+02	1733.44	1778.25	1827.19

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Layer Pressure (hPa)	Lat -45 (ppb)	Lat 00 (ppb)	Lat +45 (ppb)
4.3309E+02	1732.99	1777.79	1828.31
4.5071E+02	1732.56	1777.36	1829.42
4.6875E+02	1732.14	1776.96	1830.56
4.8721E+02	1731.75	1776.59	1831.71
5.0608E+02	1731.39	1776.27	1832.9
5.2539E+02	1731.07	1775.99	1834.11
5.4511E+02	1730.79	1775.76	1835.36
5.6525E+02	1730.57	1775.58	1836.66
5.8582E+02	1730.39	1775.47	1838.01
6.0682E+02	1730.27	1775.42	1839.4
6.2823E+02	1730.21	1775.44	1840.86
6.5007E+02	1730.21	1775.53	1842.37
6.7234E+02	1730.28	1775.69	1843.95
6.9502E+02	1730.42	1775.93	1845.59
7.1813E+02	1730.64	1776.24	1847.31
7.4166E+02	1730.93	1776.65	1849.1
7.6561E+02	1731.29	1777.13	1850.97
7.8998E+02	1731.74	1777.7	1852.91
8.1478E+02	1732.28	1778.37	1854.94
8.3998E+02	1732.89	1779.12	1857.05
8.6561E+02	1733.6	1779.96	1859.24
8.9165E+02	1734.39	1780.9	1861.52
9.1810E+02	1735.27	1781.94	1863.9
9.4496E+02	1736.24	1783.07	1866.36
9.7223E+02	1737.3	1784.3	1868.92
9.9991E+02	1738.46	1785.62	1871.57
1.0280E+03	1739.71	1787.05	1874.31
1.0565E+03	1741.06	1788.58	1877.16
1.0854E+03	1742.51	1790.21	1880.09

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