Comparisons of Analytical and Numerical Mixing Ratios and Temperature Jacobians

Igor Yanovsky
iy-002

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For the experiments below, $Q = 10$,

$$\left[f_q^{O_3}\right]_{q=1}^{Q} = \begin{bmatrix} 5.0 \cdot 10^{-8} \\ 5.0 \cdot 10^{-8} \\ 1.0 \cdot 10^{-7} \\ 3.0 \cdot 10^{-7} \\ 1.0 \cdot 10^{-6} \\ 5.0 \cdot 10^{-6} \\ 1.0 \cdot 10^{-5} \\ 5.0 \cdot 10^{-6} \\ 1.0 \cdot 10^{-6} \\ 1.0 \cdot 10^{-7} \end{bmatrix}, \qquad f_q^{N_2} = 0.8 \text{ for all } q, \qquad \text{and} \quad \left[f_q^{T}\right]_{q=1}^{Q} = \begin{bmatrix} 300 \\ 266 \\ 233 \\ 200 \\ 210 \\ 220 \\ 230 \\ 240 \\ 250 \\ 250 \end{bmatrix}.$$

$a = -3.0;\ b = 4.0$
$m = 4.9590 \cdot 10^{-26}$,
$\zeta = \dfrac{k - Q}{3},\ k = 1, \ldots, Q$

Mixing Ratio Jacobian, $\frac{\partial I}{\partial f^k}$, $\nu = \nu_1$

Analytical | **Numerical**

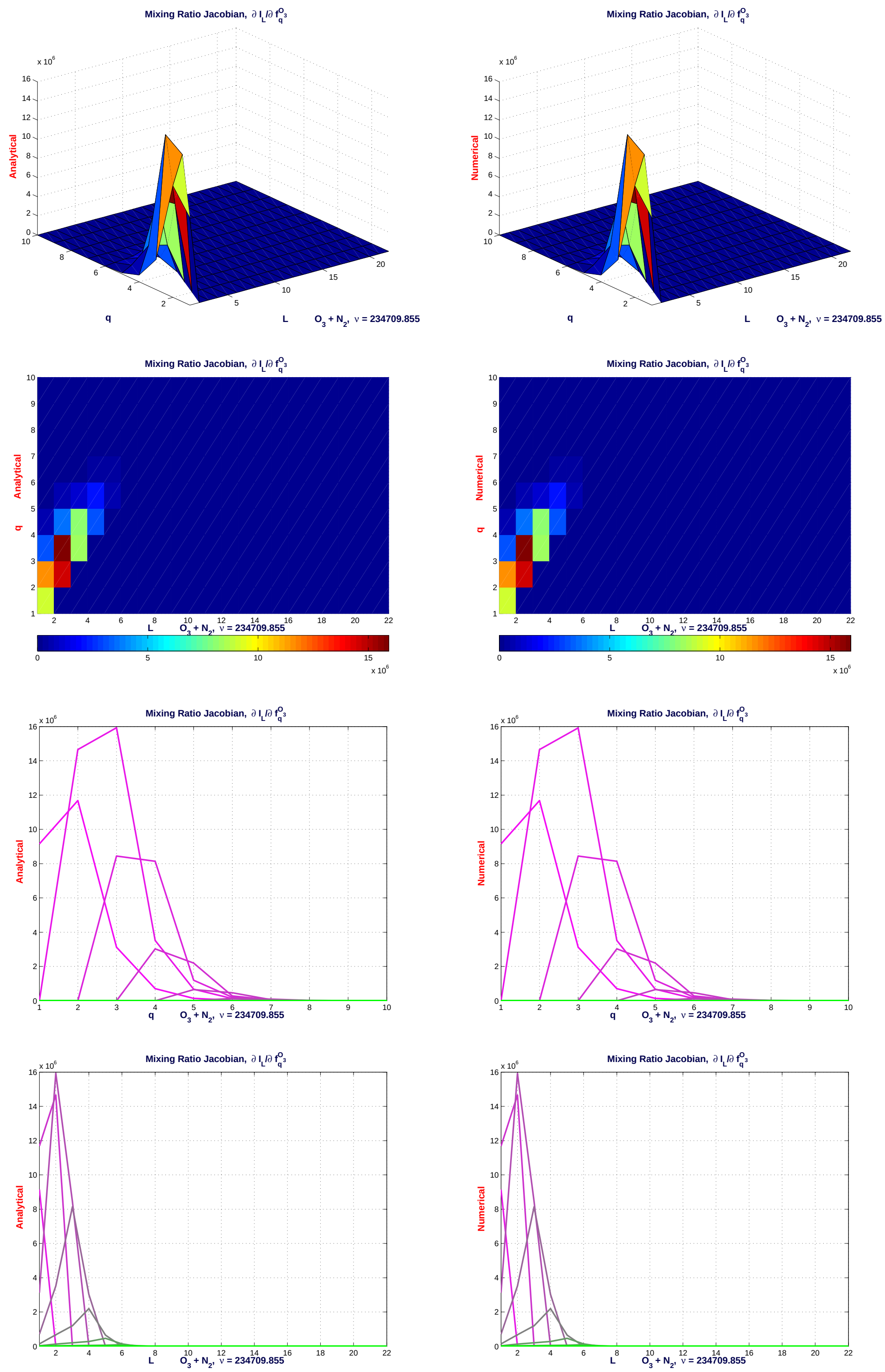

Figure 1: $\nu_1 = 234709.8550$

Antenna Radiance Mixing Ratio Jacobian, $\frac{\partial I}{\partial f^k}$, $\nu = \nu_1$

Analytical **Numerical**

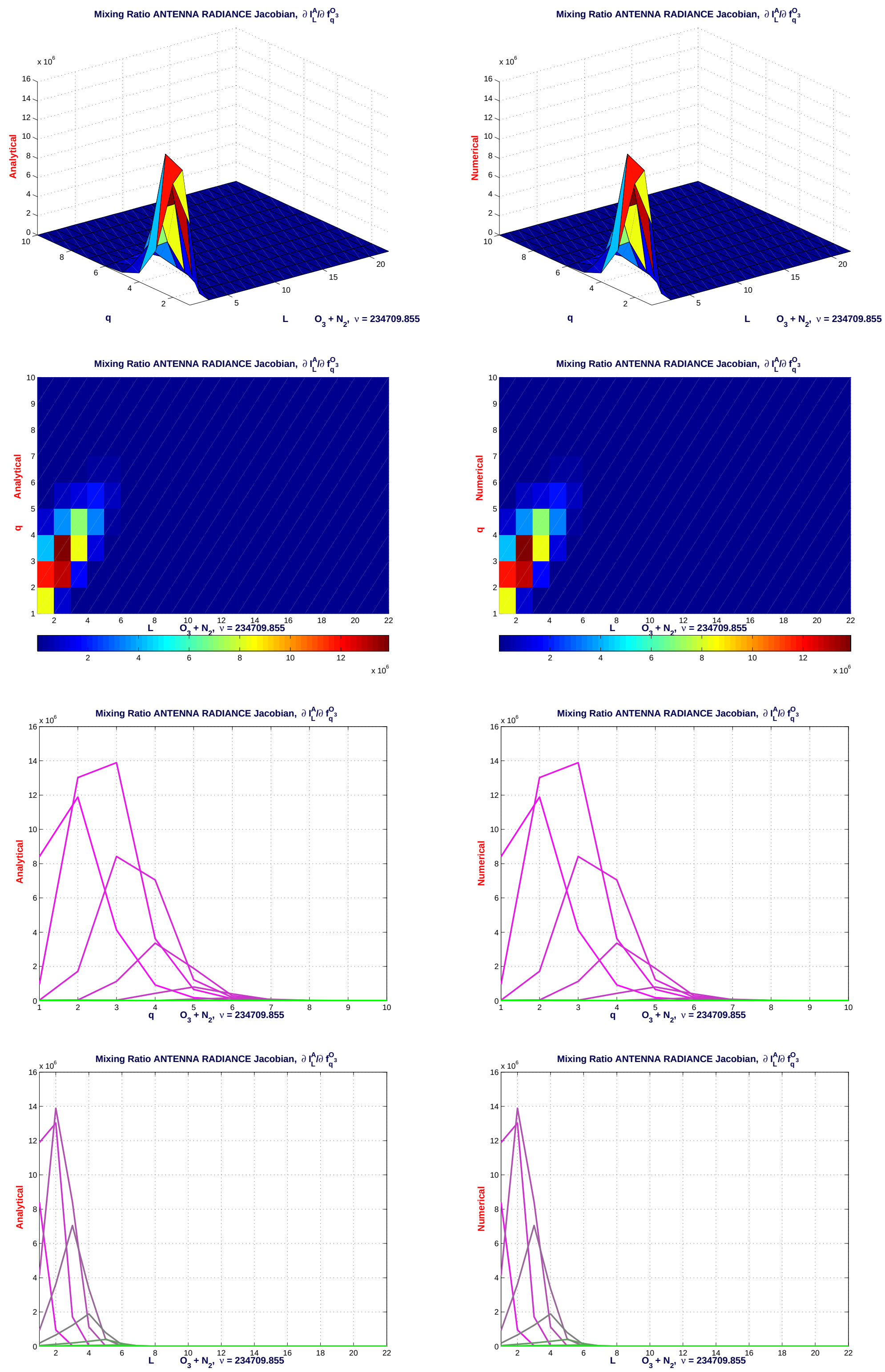

Figure 2: $\nu_1 = 234709.8550$

Temperature Jacobian, $\frac{\partial I}{\partial T}$, $\nu = \nu_1$

Analytical | **Numerical**

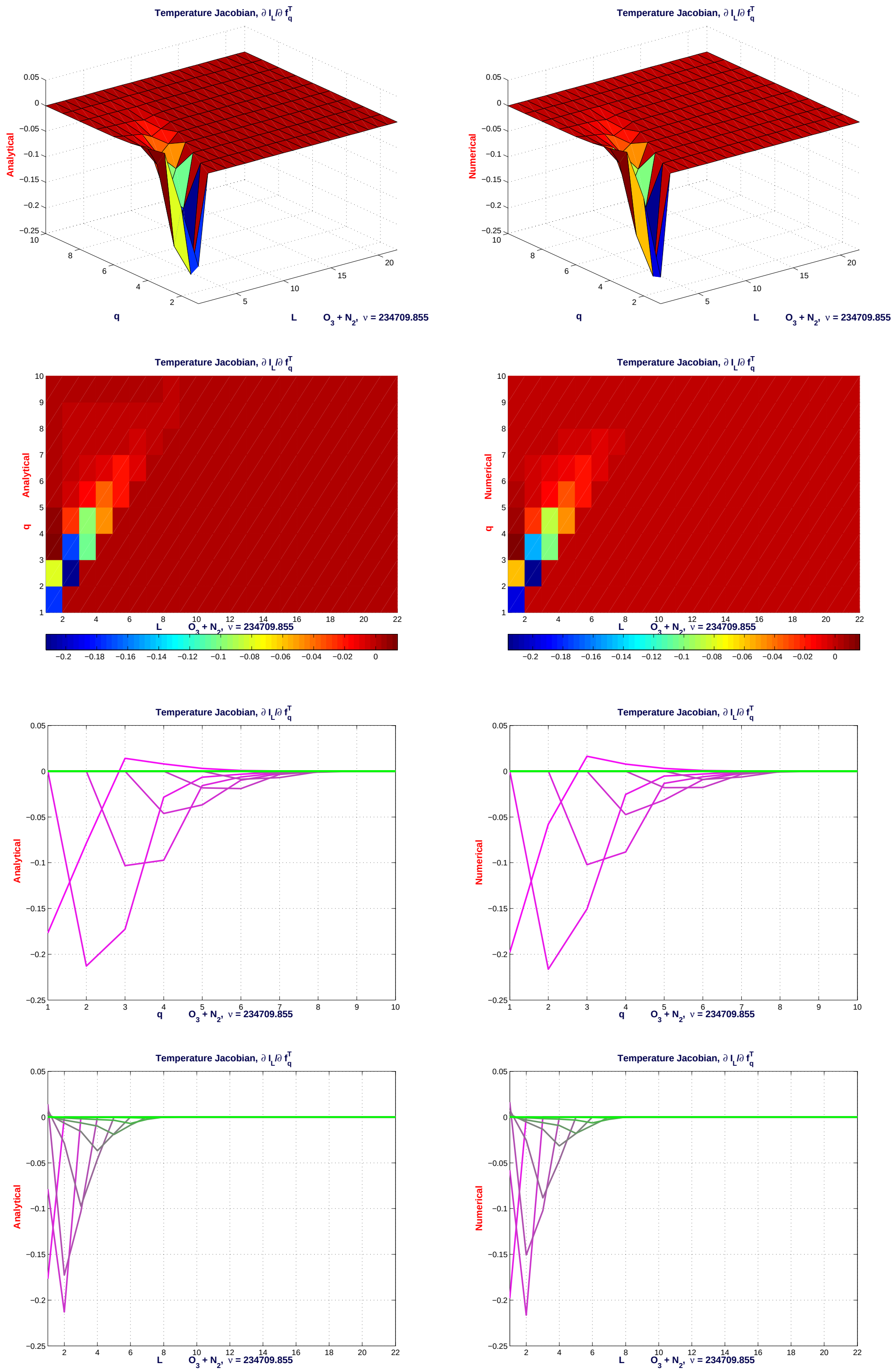

Figure 3: $\nu_1 = 234709.8550$

Antenna Radiance Temperature Jacobian, $\frac{\partial I}{\partial T}$, $\nu = \nu_1$

Analytical | Numerical

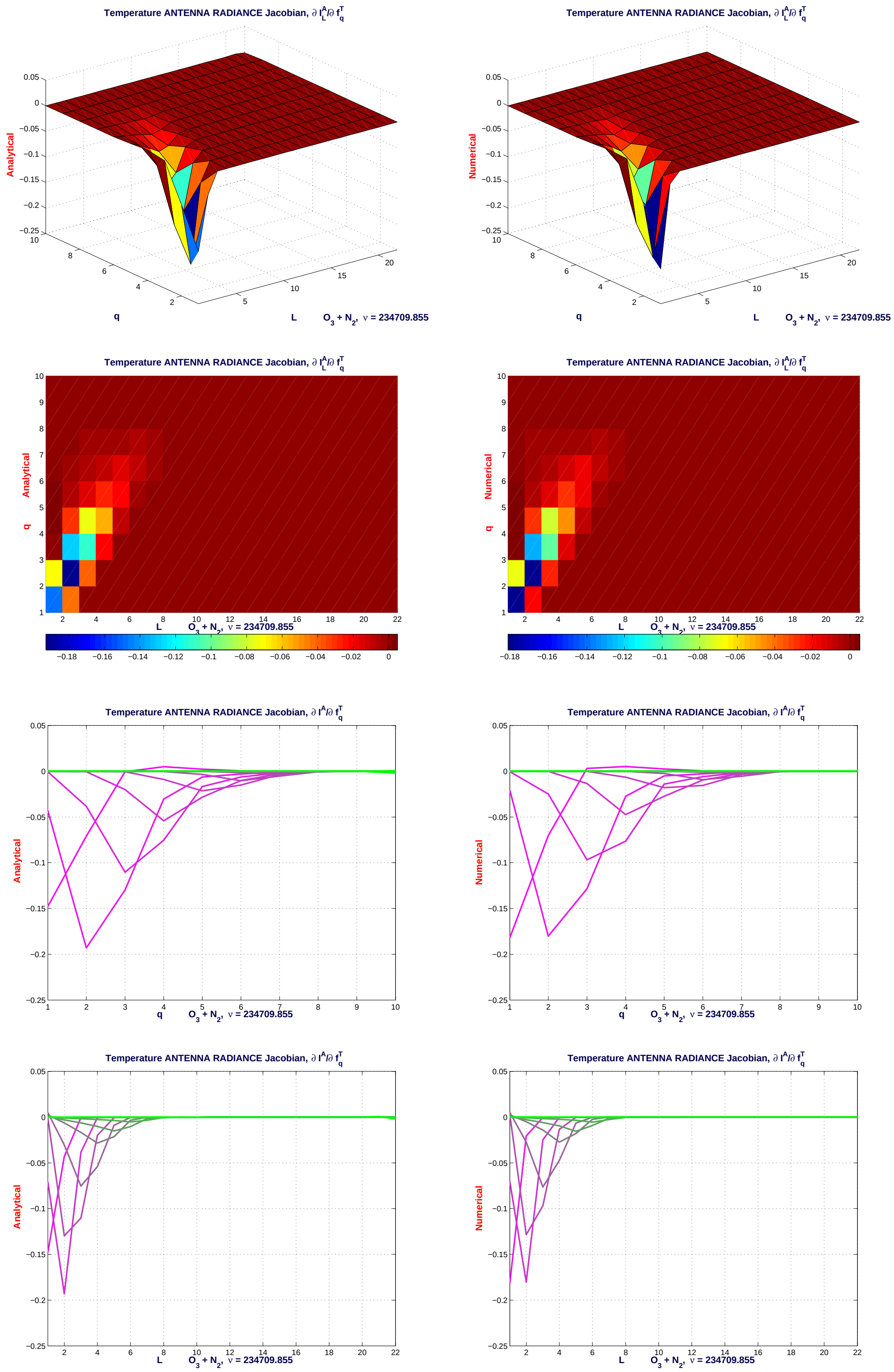

Figure 4: $\nu_1 = 234709.8550$

Mixing Ratio Jacobian, $\frac{\partial I}{\partial f^k}$, $\nu = \nu_2$

Analytical **Numerical**

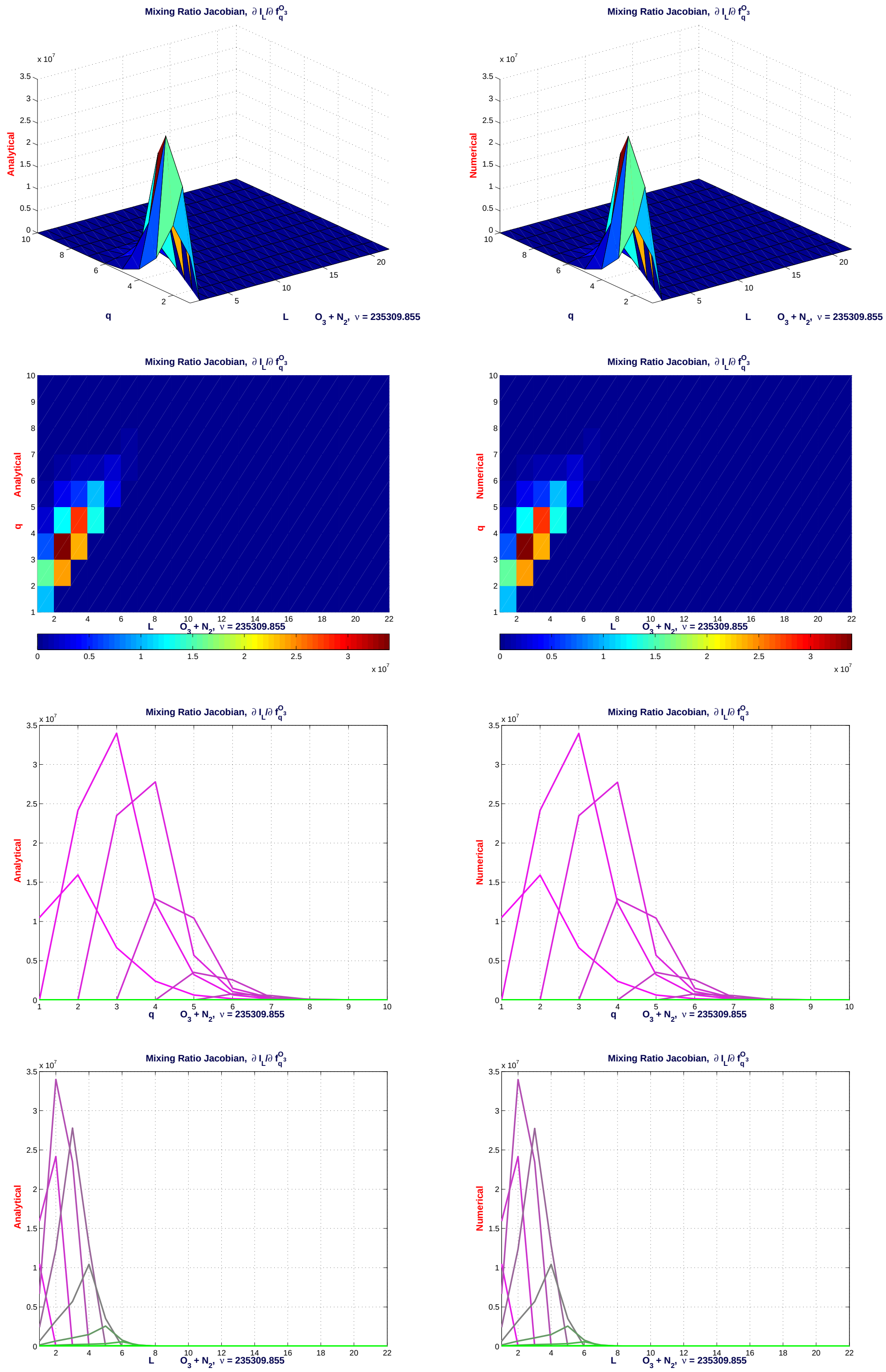

Figure 5: $\nu_2 = 235309.8550$

Antenna Radiance Mixing Ratio Jacobian, $\frac{\partial I}{\partial f^k}$, $\nu = \nu_2$

Analytical

Numerical

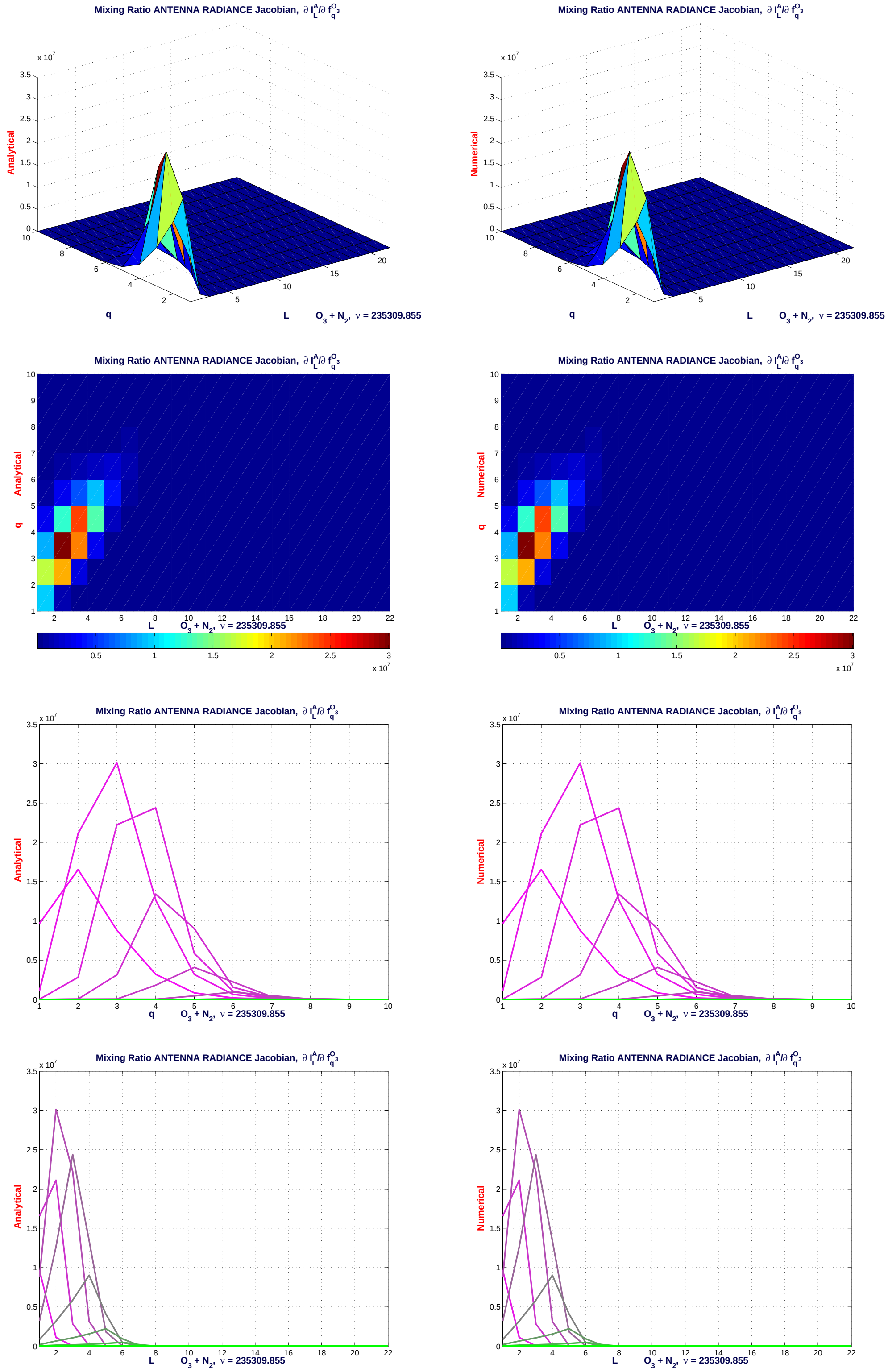

Figure 6: $\nu_2 = 235309.8550$

Temperature Jacobian, $\frac{\partial I}{\partial T}$, $\nu = \nu_2$

Analytical | Numerical

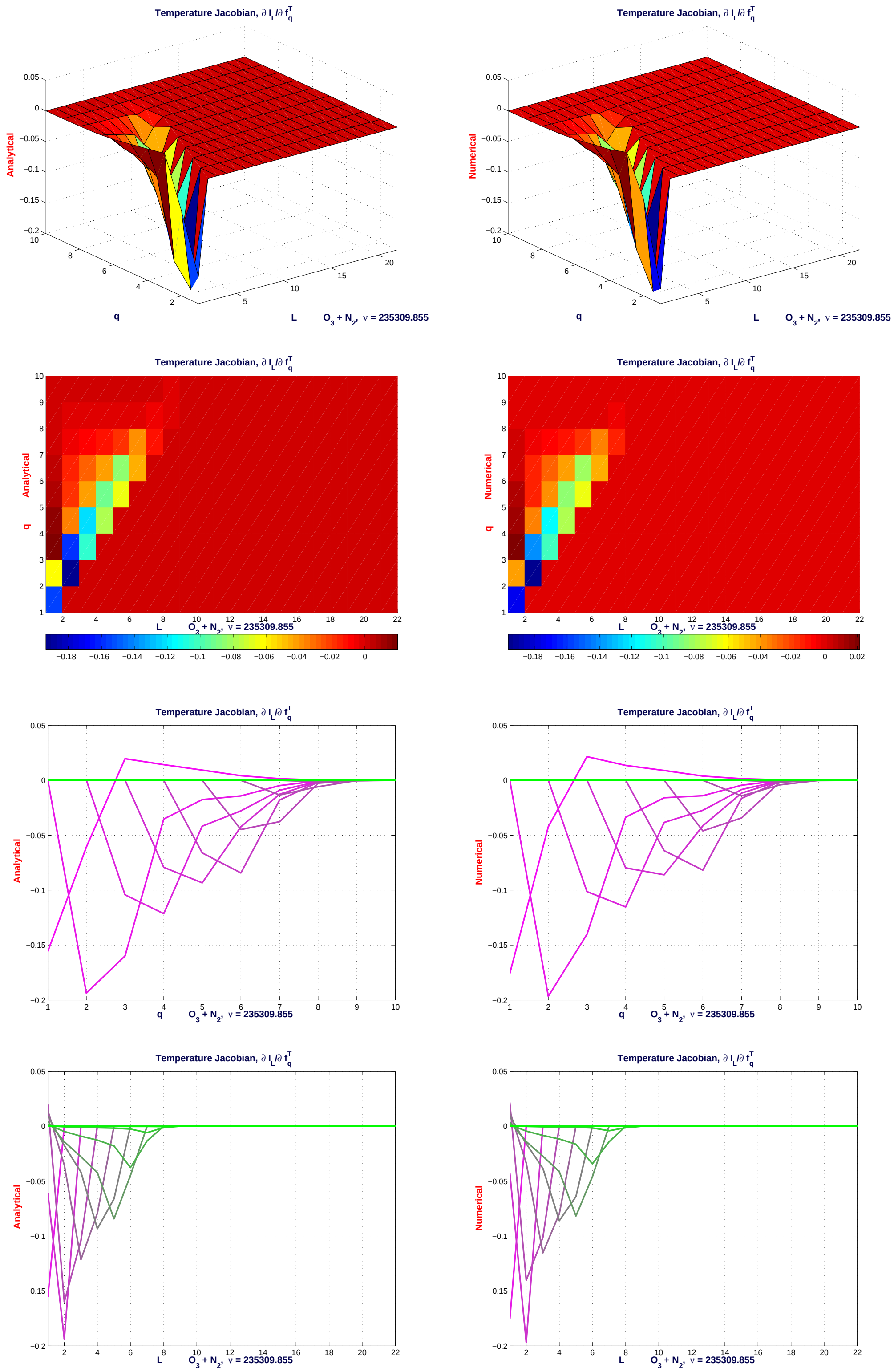

Figure 7: $\nu_2 = 235309.8550$

Antenna Radiance Temperature Jacobian, $\frac{\partial I}{\partial T}$, $\nu = \nu_2$

Analytical

Numerical

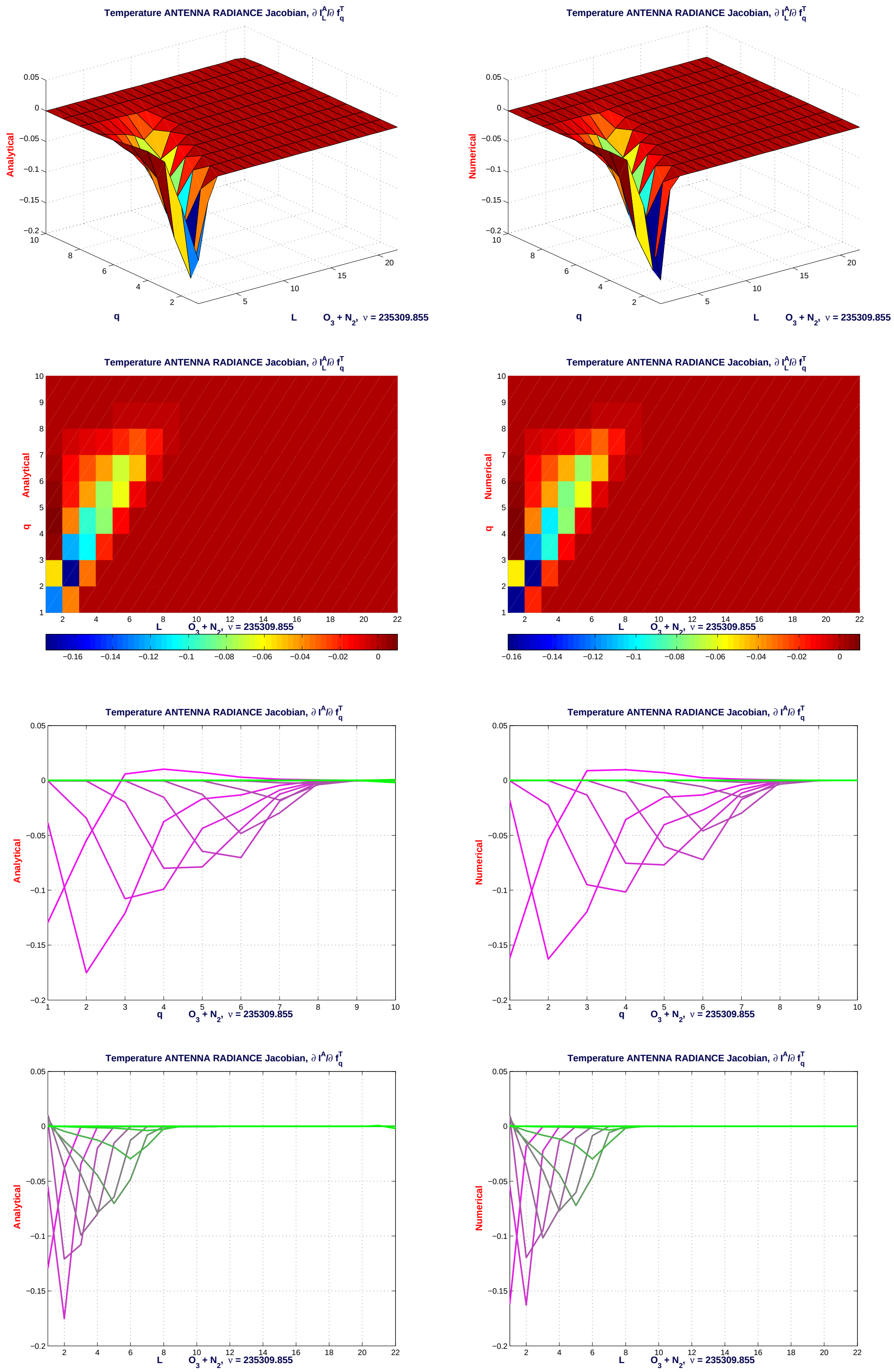

Figure 8: $\nu_2 = 235309.8550$

Mixing Ratio Jacobian, $\frac{\partial I}{\partial f^k}$, $\nu = \nu_3$

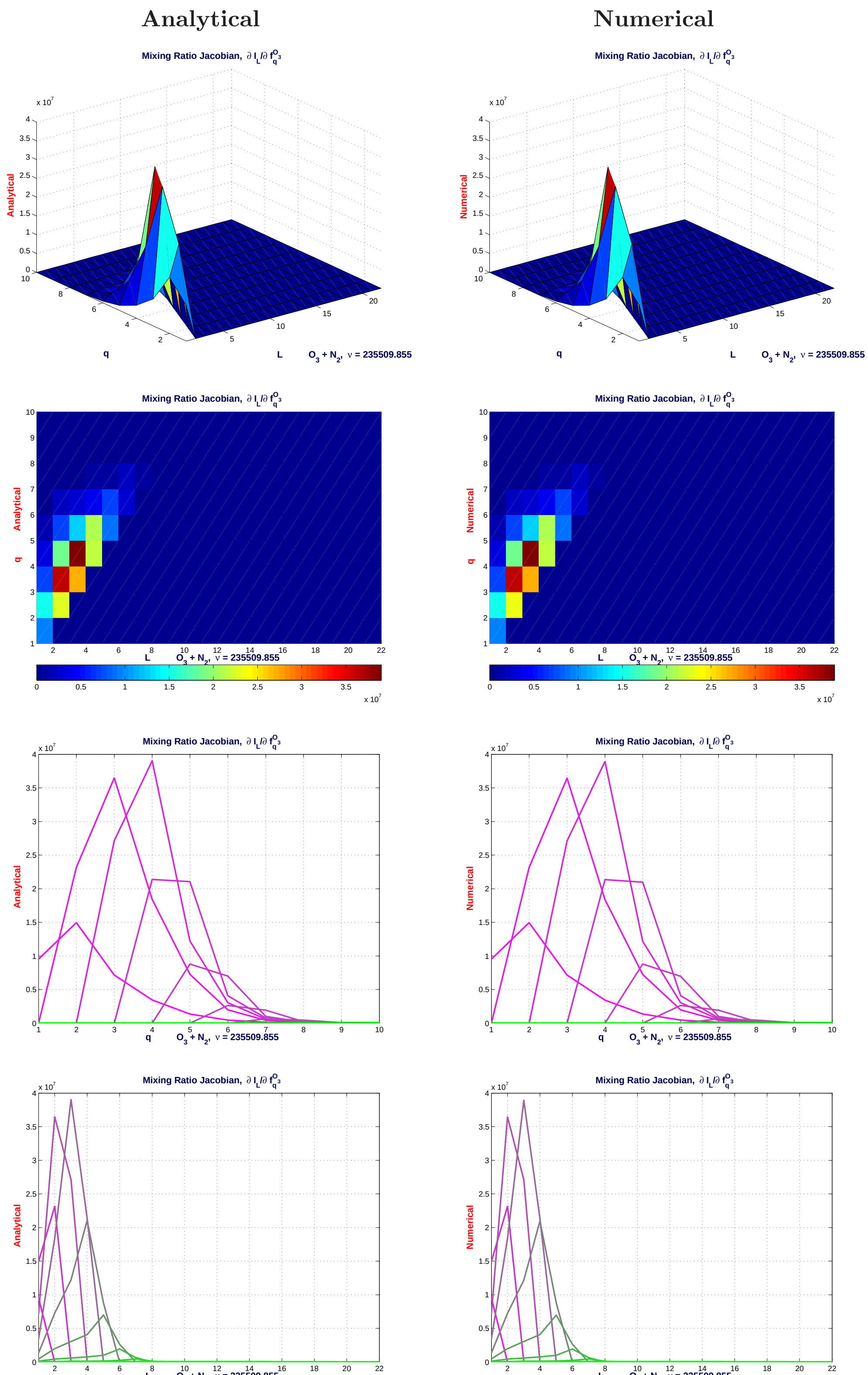

Figure 9: $\nu_3 = 235509.8550$

Antenna Radiance Mixing Ratio Jacobian, $\frac{\partial I}{\partial f^k}$, $\nu = \nu_3$

Analytical | **Numerical**

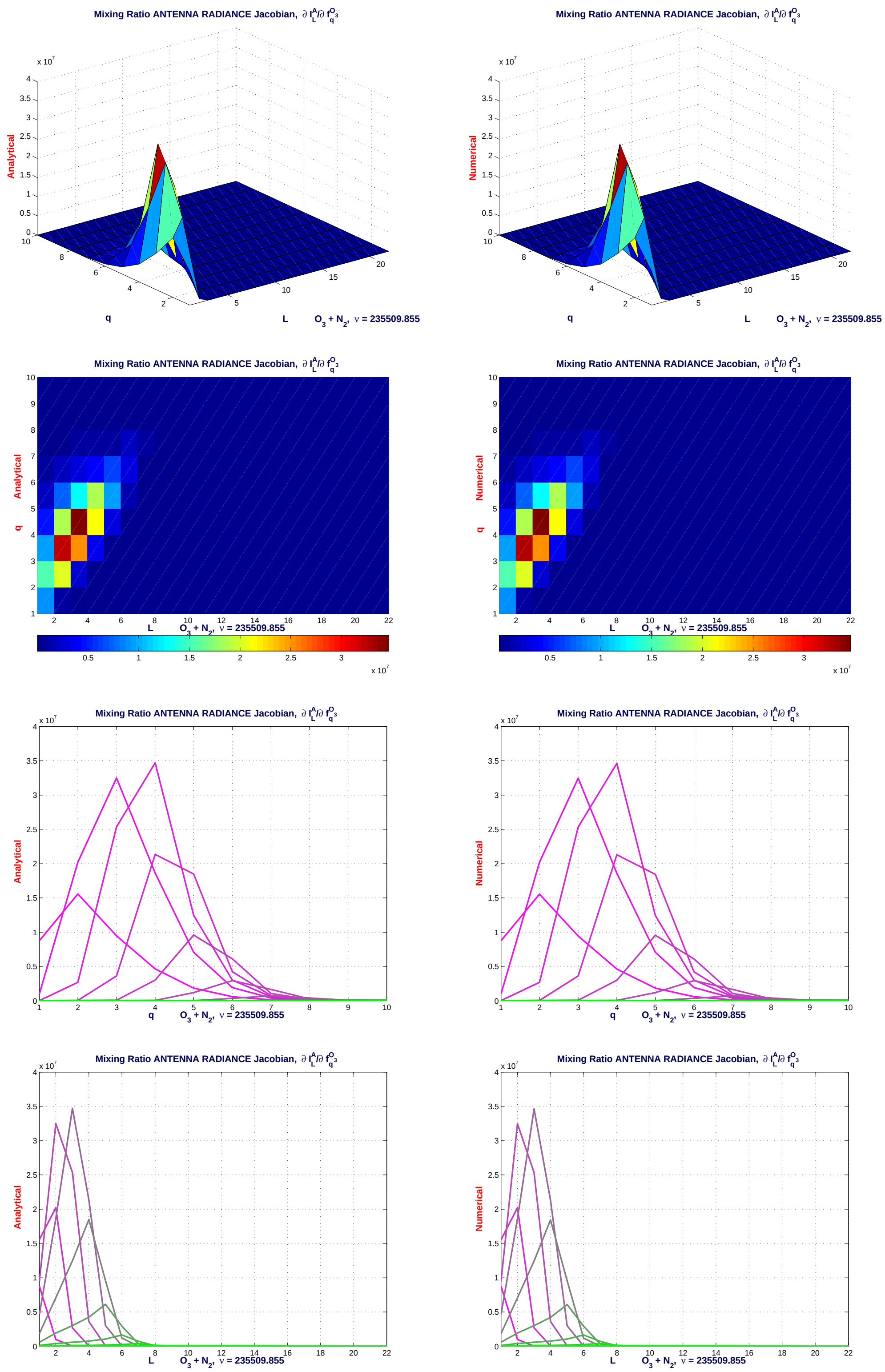

Figure 10: $\nu_3 = 235509.8550$

Temperature Jacobian, $\frac{\partial I}{\partial T}$, $\nu = \nu_3$

Analytical **Numerical**

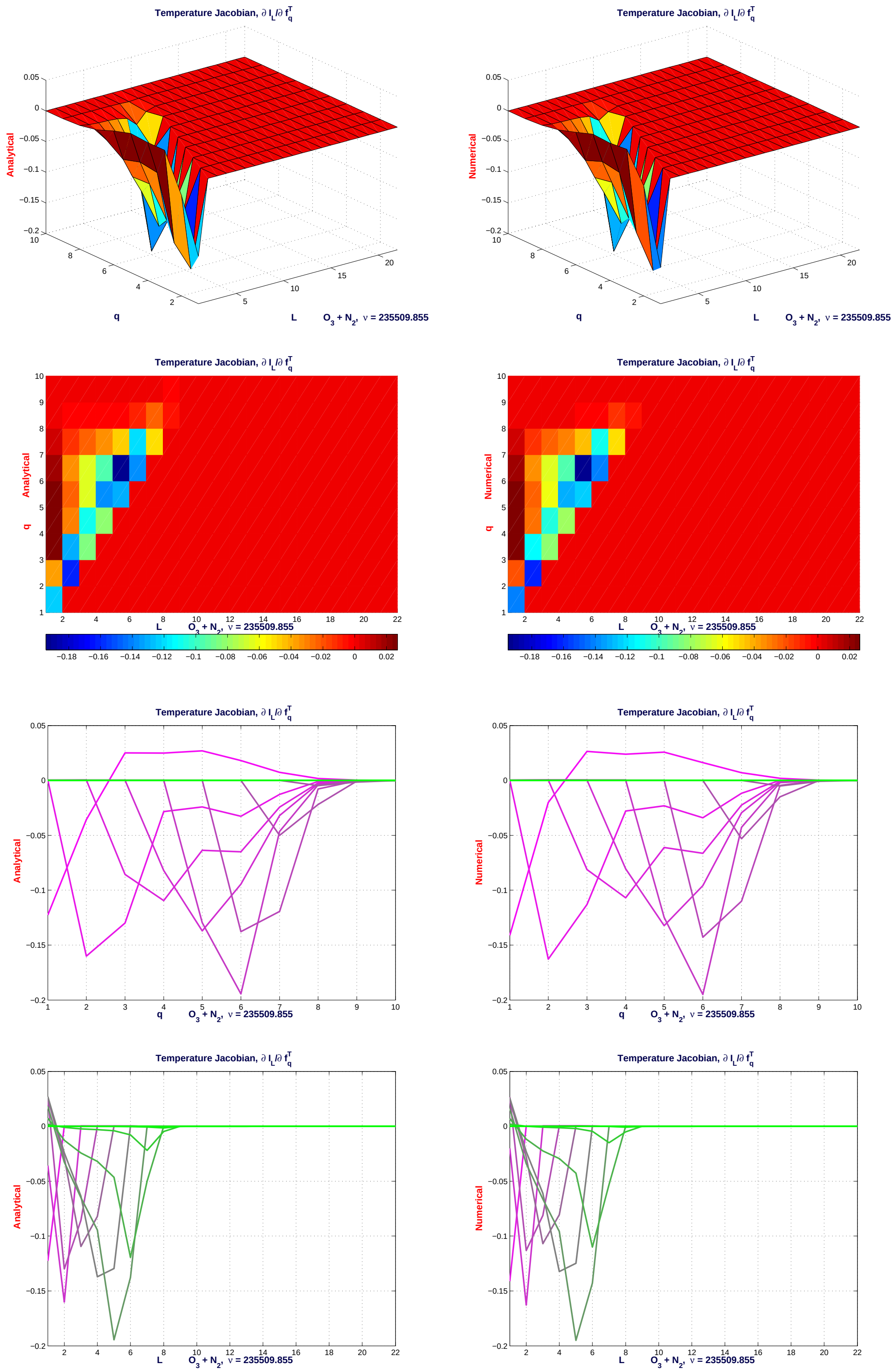

Figure 11: $\nu_3 = 235509.8550$

Antenna Radiance Temperature Jacobian, $\frac{\partial I}{\partial T}$, $\nu = \nu_3$

Analytical **Numerical**

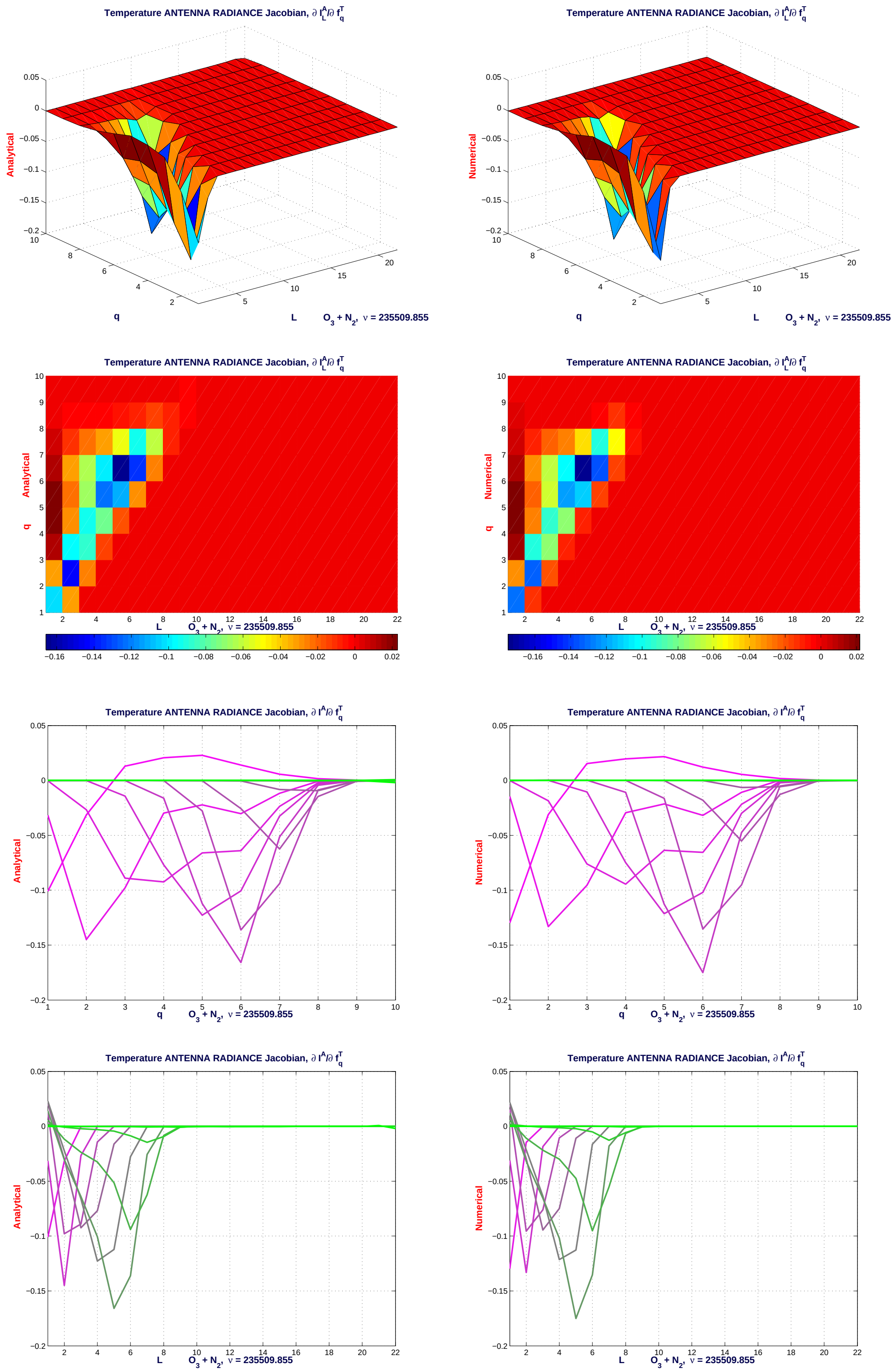

Figure 12: $\nu_3 = 235509.8550$

Mixing Ratio Jacobian, $\frac{\partial I}{\partial f^k}$, $\nu = \nu_4$

Analytical **Numerical**

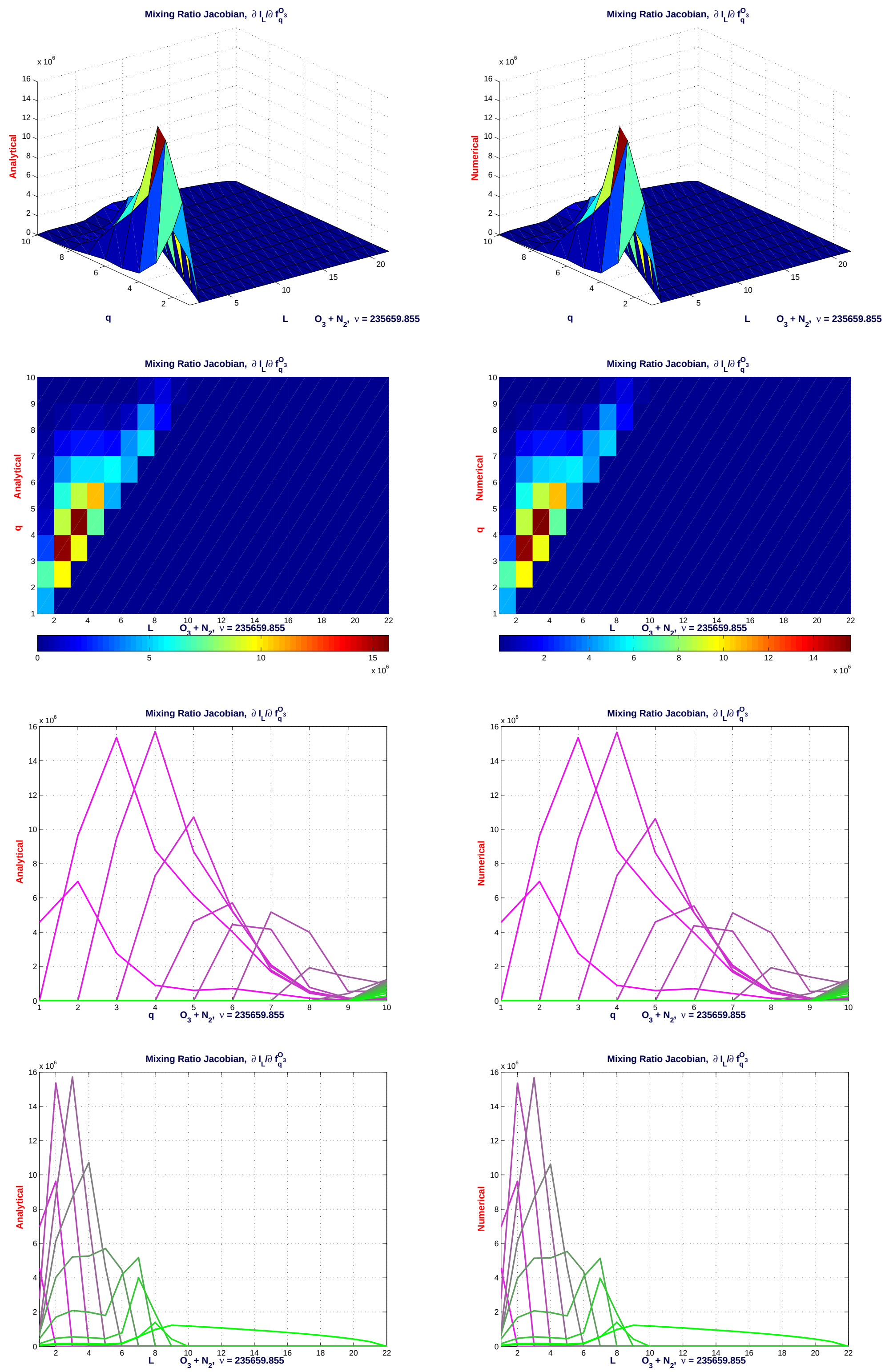

Figure 13: $\nu_4 = 235659.8550$

Antenna Radiance Mixing Ratio Jacobian, $\frac{\partial I}{\partial f^k}$, $\nu = \nu_4$

Analytical | **Numerical**

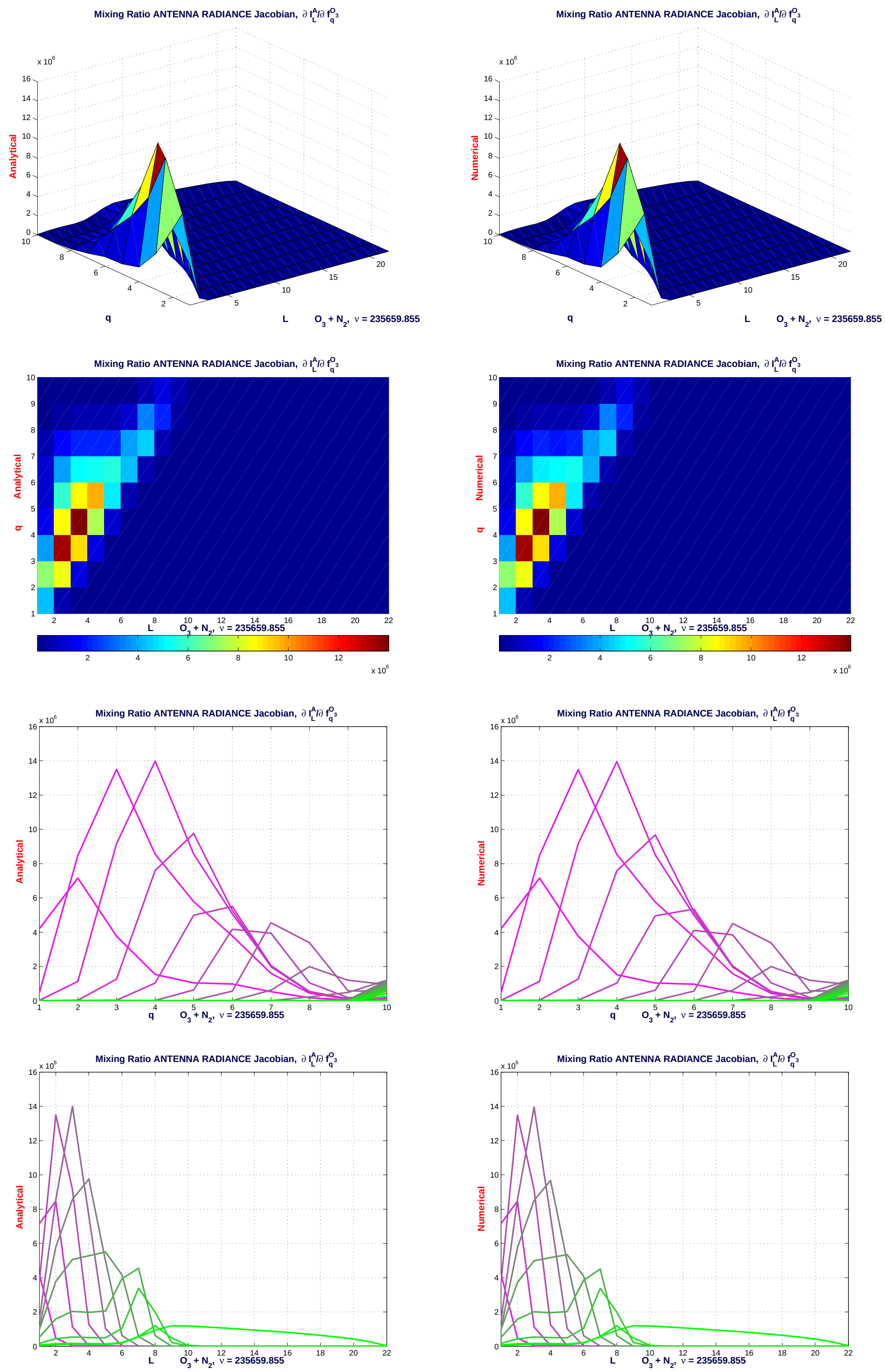

Figure 14: $\nu_4 = 235659.8550$

Temperature Jacobian, $\frac{\partial I}{\partial T}$, $\nu = \nu_4$

Analytical | **Numerical**

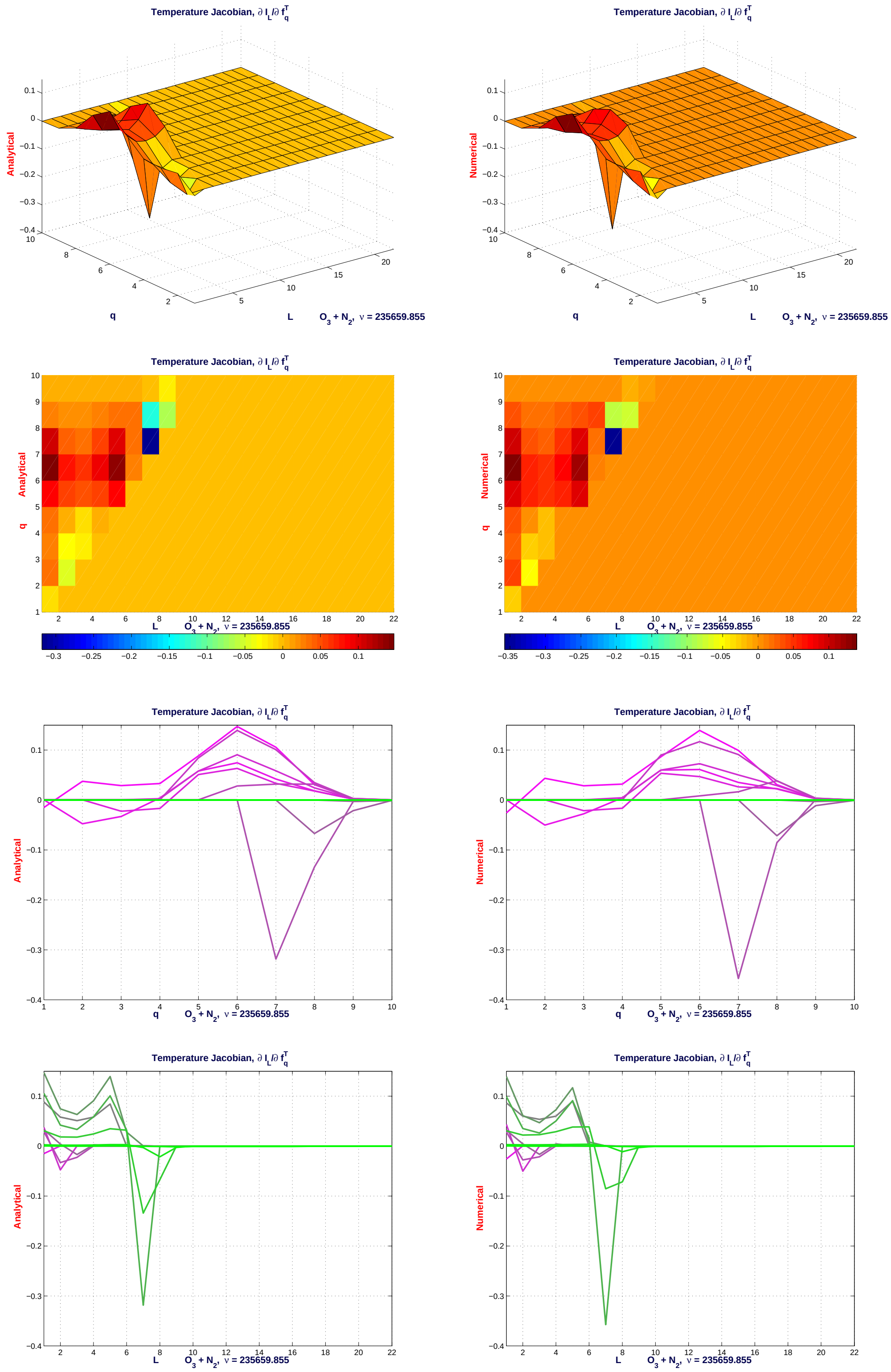

Figure 15: $\nu_4 = 235659.8550$

Antenna Radiance Temperature Jacobian, $\frac{\partial I}{\partial T}$, $\nu = \nu_4$

Analytical **Numerical**

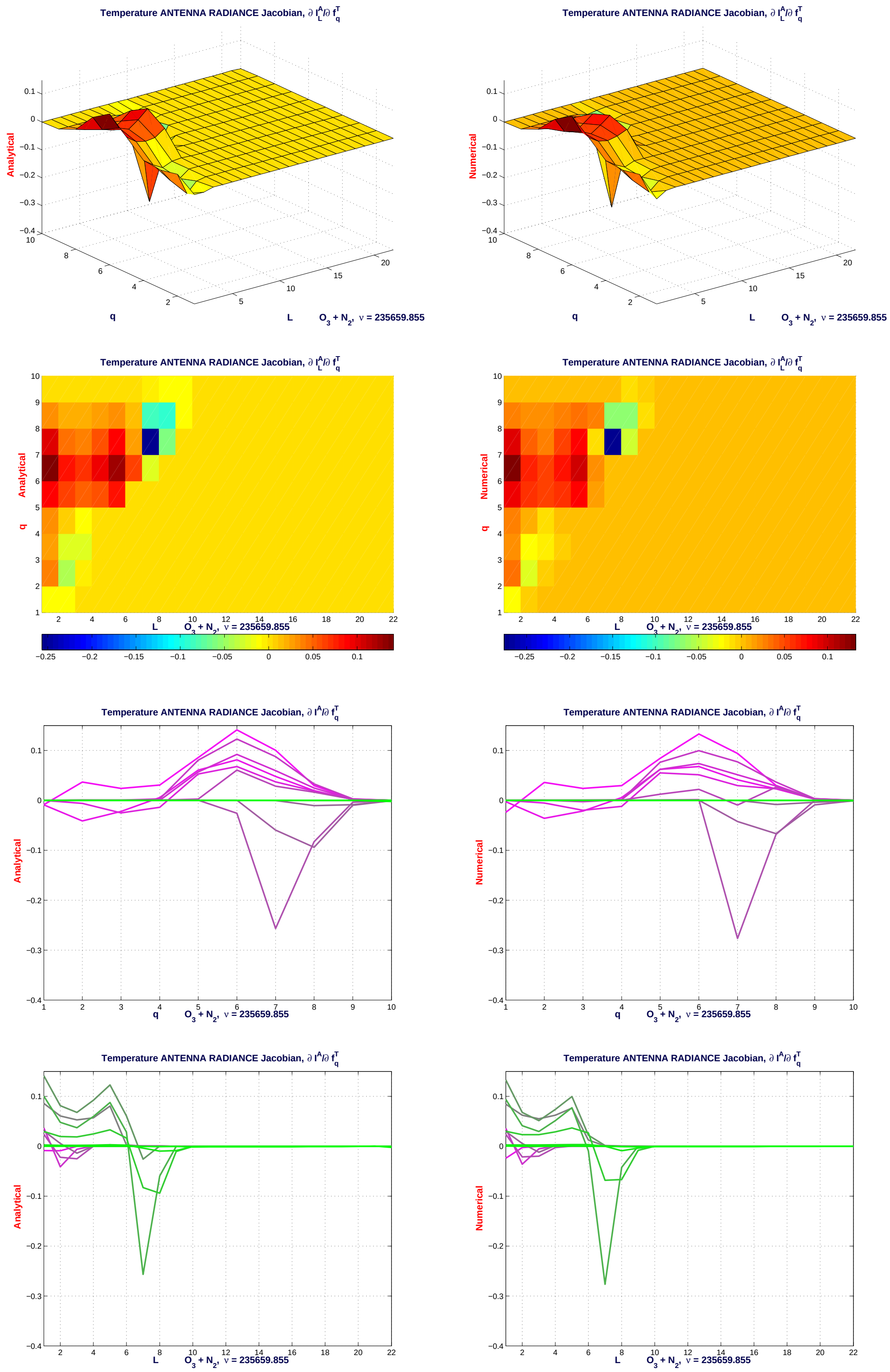

Figure 16: $\nu_4 = 235659.8550$

Mixing Ratio Jacobian, $\frac{\partial I}{\partial f^k}$, $\nu = \nu_5$

Analytical | Numerical

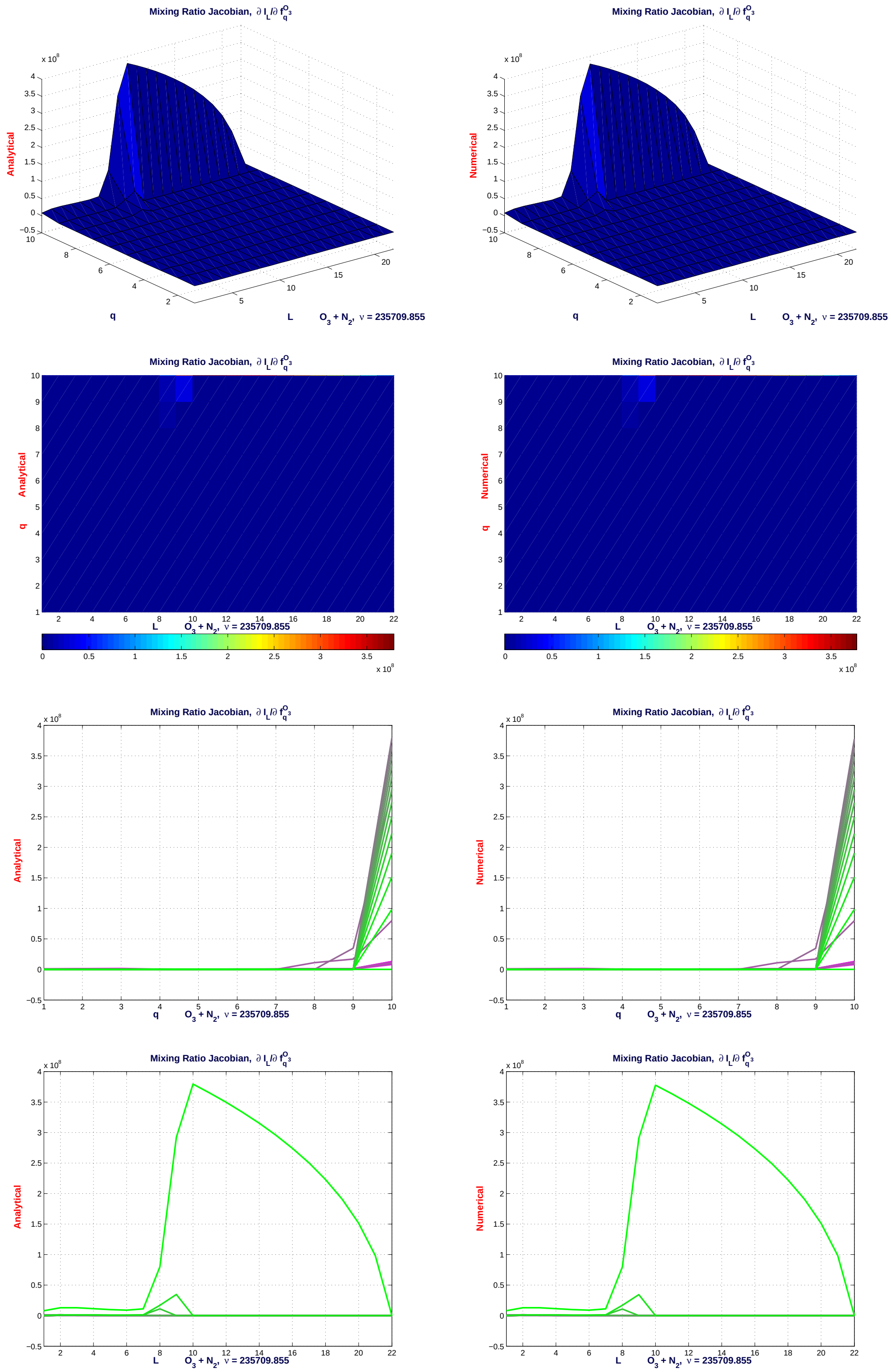

Figure 17: $\nu_5 = 235709.8550$

Antenna Radiance Mixing Ratio Jacobian, $\frac{\partial I}{\partial f^k}$, $\nu = \nu_5$

Analytical | **Numerical**

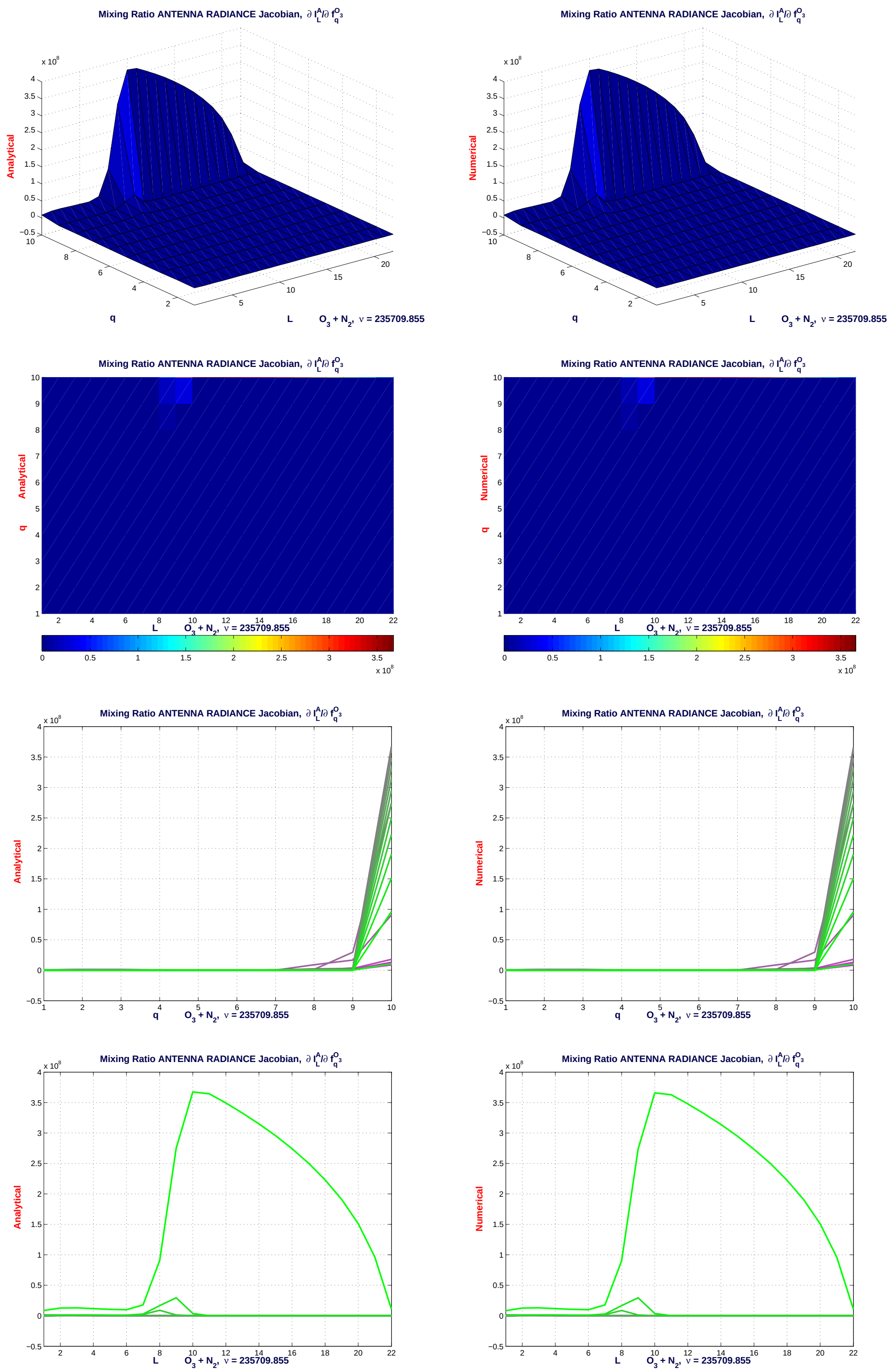

Figure 18: $\nu_5 = 235709.8550$

Temperature Jacobian, $\frac{\partial I}{\partial T}$, $\nu = \nu_5$

Analytical | Numerical

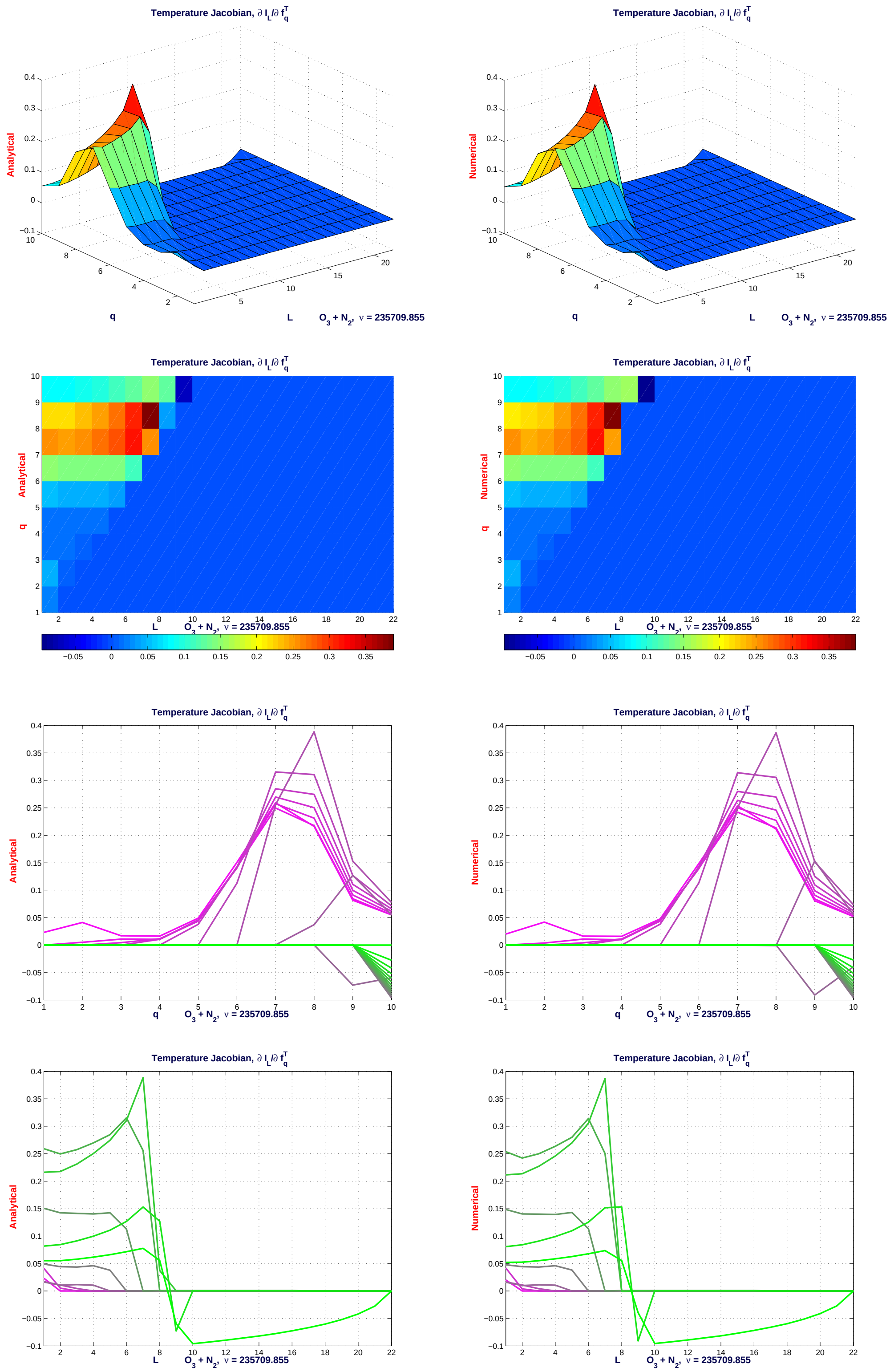

Figure 19: $\nu_5 = 235709.8550$

Antenna Radiance Temperature Jacobian, $\frac{\partial I}{\partial T}$, $\nu = \nu_5$

Analytical

Numerical

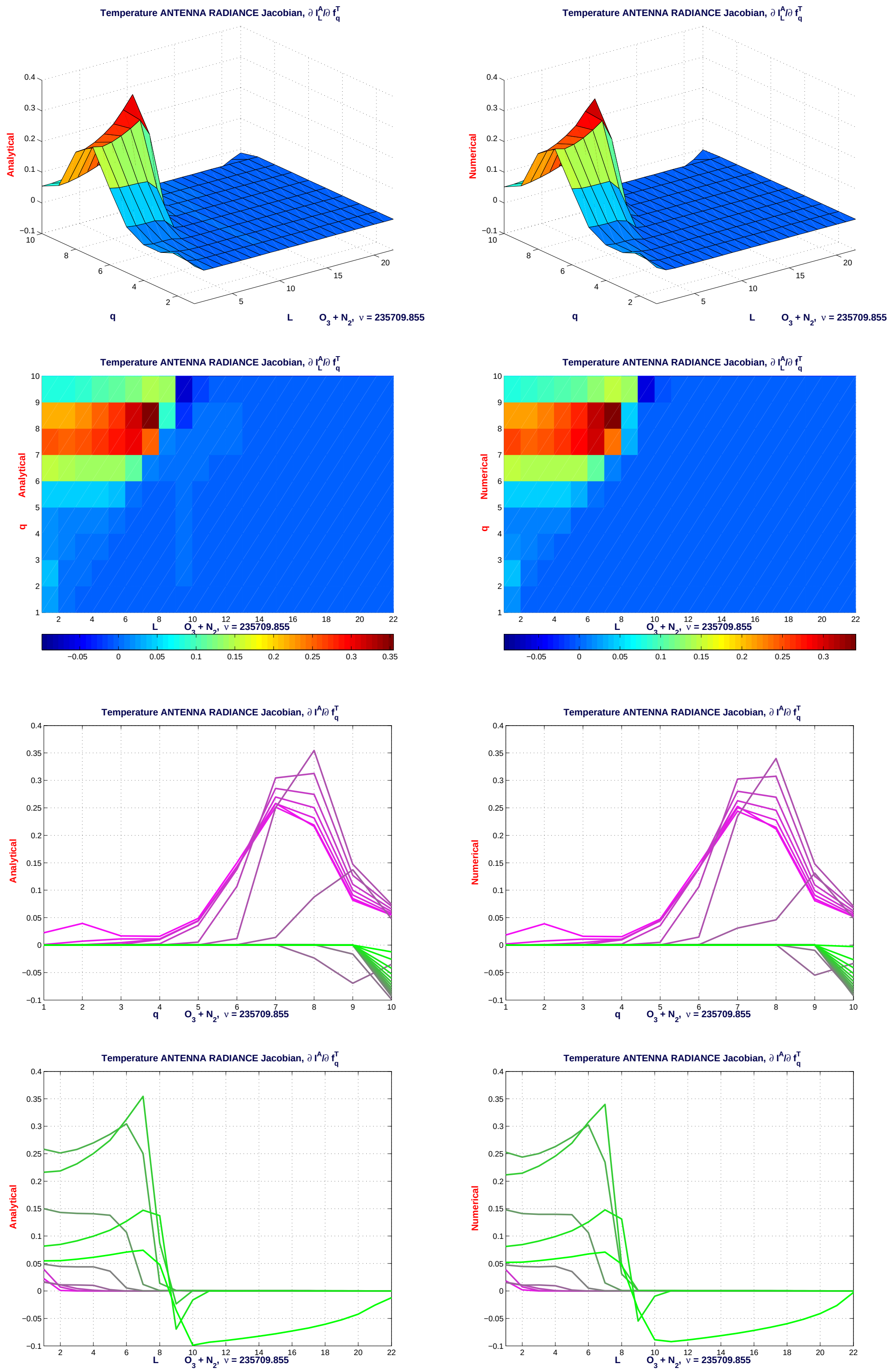

Figure 20: $\nu_5 = 235709.8550$