Bugfixes in SR initr:
atmospheric profiles of T, p, rho and water vapour for extra layers needed in the radiative code

First issue:
A series of 7 layers due to extend up to the tropopause are added on top of the model grid. But in the original versio, these layers had a constant height equal to 1000 m, whatever the height of the highest model grid (generally ~2000 m, depending on the settings). As a result, the tropopause was located around ~8 km for usual grid settings, which is too low. In turn, the temperature obtained for the troposphere was too high (by approximately 13 K with the same settings, see Fig. 1).

Original version	Modified version

`do k=1,n-1`
`  zx(k)=etw(k)`
`end do`
`gamma=0.0065`
 	
`do k=n,n+6`
`  zx(k)=zx(k-1)+1000.`
`  tx(k)=tx(k-1)-gamma*1000.`
`  ...`
`end do`
	`do k=1,n-1`
	`  zx(k)=etw(k)`
	`end do`
	`gamma=0.0065`
	`dz=(11000._dp-zx(n-1))/7.`
	`do k=n,n+6`
	`  zx(k)=zx(k-1)+dz`
	`  tx(k)=tx(k-1)-gamma*dz`
	`  ...`
	`enddo`

A similar problem affects the next layer settings: since the temperature gradient is null in the lower stratosphere, an alternate definition is used to set the pressure at 20 km height. In the original code, a fixed layer thickness of 10 km was hardcoded. Since the previous layer height was smaller than expected, the error propagated to the pressure value (see Fig. 2).

Original version	Modified version

`k=n+7`
`zx(k)=20000.`
`tx(k)=tx(k-1)`
`px(k)=px(k-1)*dexp(-g*10000./(r0*tx(k)))`
	`k=n+7`
	`zx(k)=20000.`
	`tx(k)=tx(k-1)`
	`px(k)=px(k-1)*dexp(-g*(zx(k)-zx(k-1))/`
	`(r0*tx(k)))`

Second issue:
The water vapour content (and to a lower extent the temperature profile) in the layers above the tropopause differs from the standard atmosphere. To correct this, the values of temperature gradient and relative humidity were adjusted so that the resulting profiles match the standard atmosphere profiles.

Level index	n - n+6	n+7	n+8	n+9	n+10	n+11
Height (km)	See text	20	30	40	50	100
Gamma old (K / km)	-6.5	0.	1.	2.7	1.5	0.
Gamma new (K / km)	-6.5	0.	1.	2.6	1.8	T = 210 K
rH old (%)	0.3	0.1	0.8[1]	0.05	0.01	xm1 = 0.
rH new (%)	0.3	0.02	0.005	0.00005	0.000002	xm1 = 0.

As shown in this table, another adjustment is: the temperature of the heighest level was set equal to 210 K (standard atmosphere value) instead of equal to the temperature in the previous layer.
The resulting profiles are presented hereafter (Fig. 1 to 4).

Reference: Seinfeld, J. H., and S. N. Pandis. *Atmospheric Chemistry and Physics : From Air Pollution to Climate Change*. New York: Wiley, 2nd ed., 2006. (Table A.8 p. 1179).

1 This value should have been equal to 0.08, this was a typo in the code.

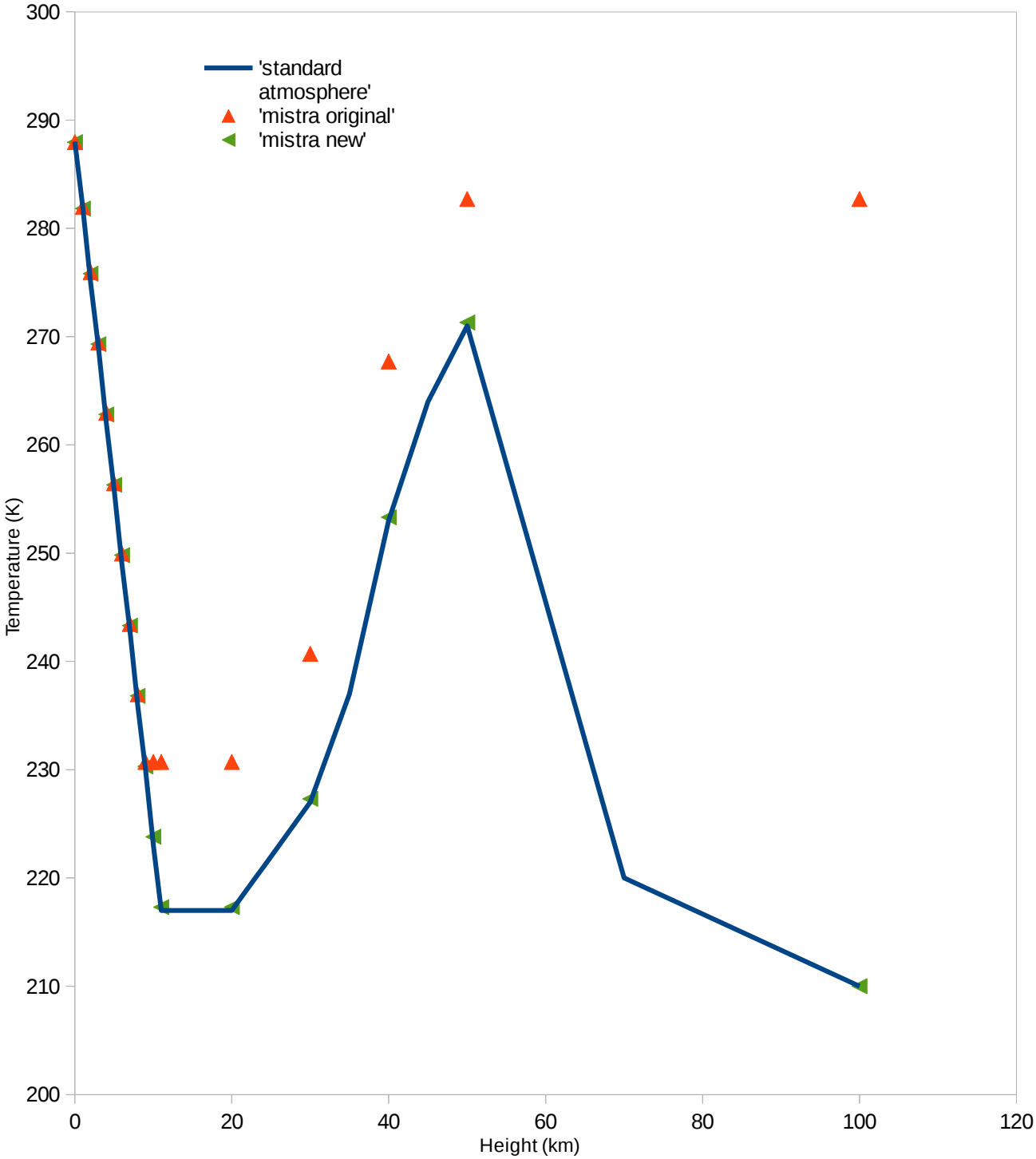

Figure 1: Temperature as a function of height. Standard atmosphere as reported in Seinfeld and Pandis (2006). Red symbols: original mistra profile. Green symbols: new mistra profile.

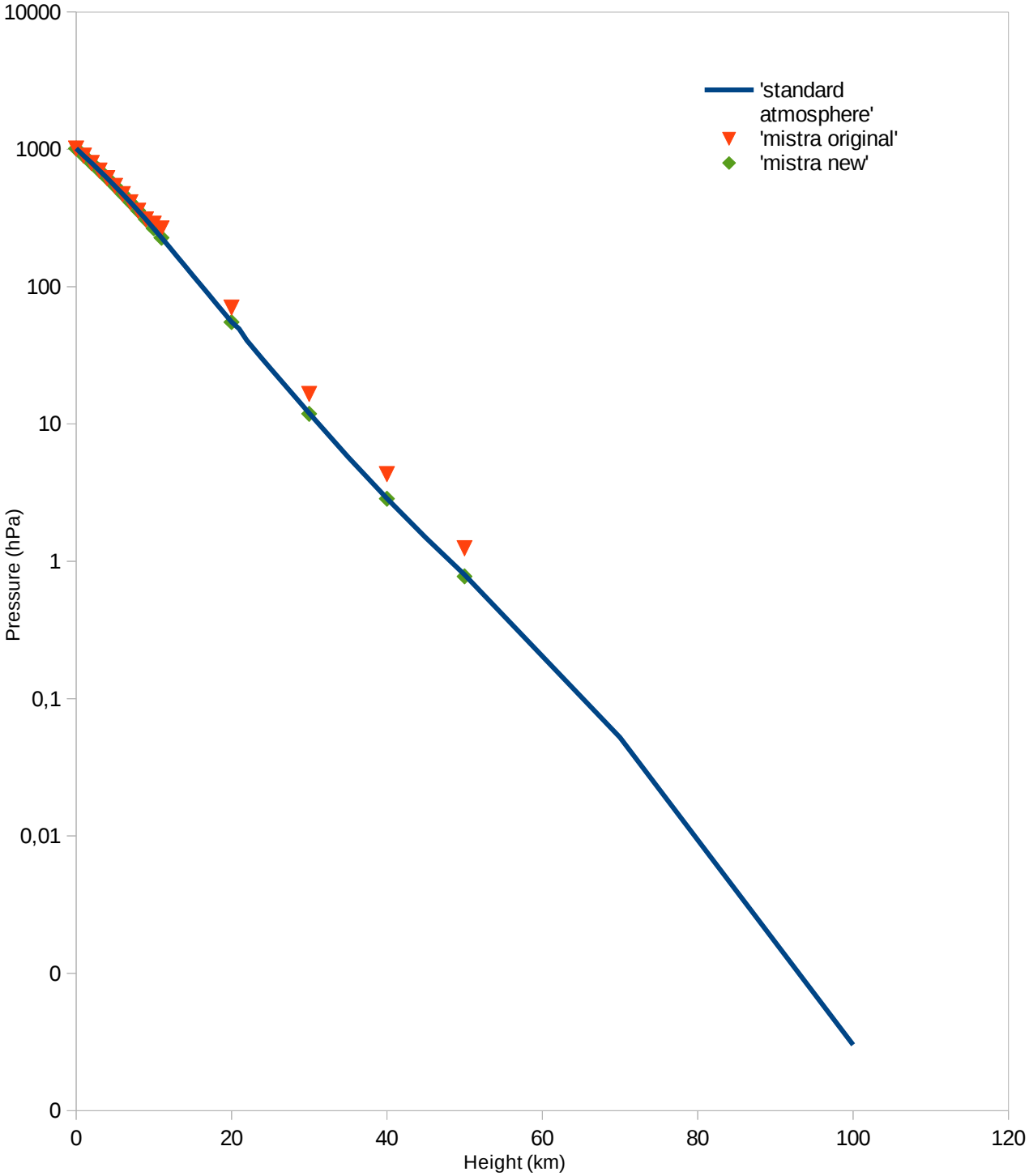

Figure 2: Pressure as a function of height. Blue line: standard atmosphere, as reported in Seinfeld and Pandis (2006). Red symbols: mistra original version. Green symbols: new version of mistra profile. Note that the pressure at 100 km is set to 0. in mistra (fictitious level at infinity), and is thus not displayed in the log axis

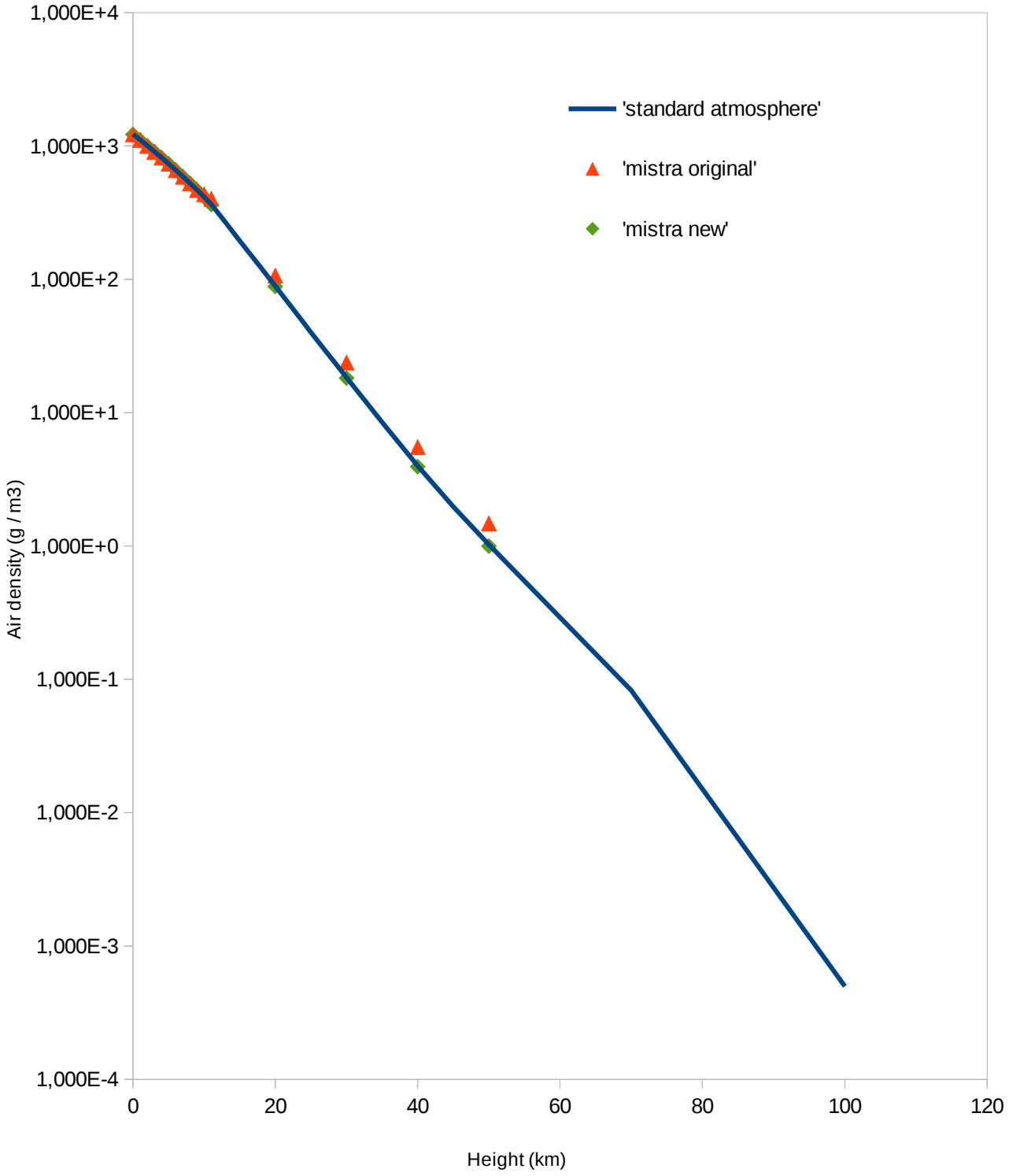

Figure 3: Air density as a function of height. Blue line: standard atmosphere, as reported in Seinfeld and Pandis (2006). Red symbols: mistra original version. Green symbols: new version of mistra profile. Note that the density at 100 km is set to 0. in mistra (fictitious level at infinity), and is thus not displayed in the log axis

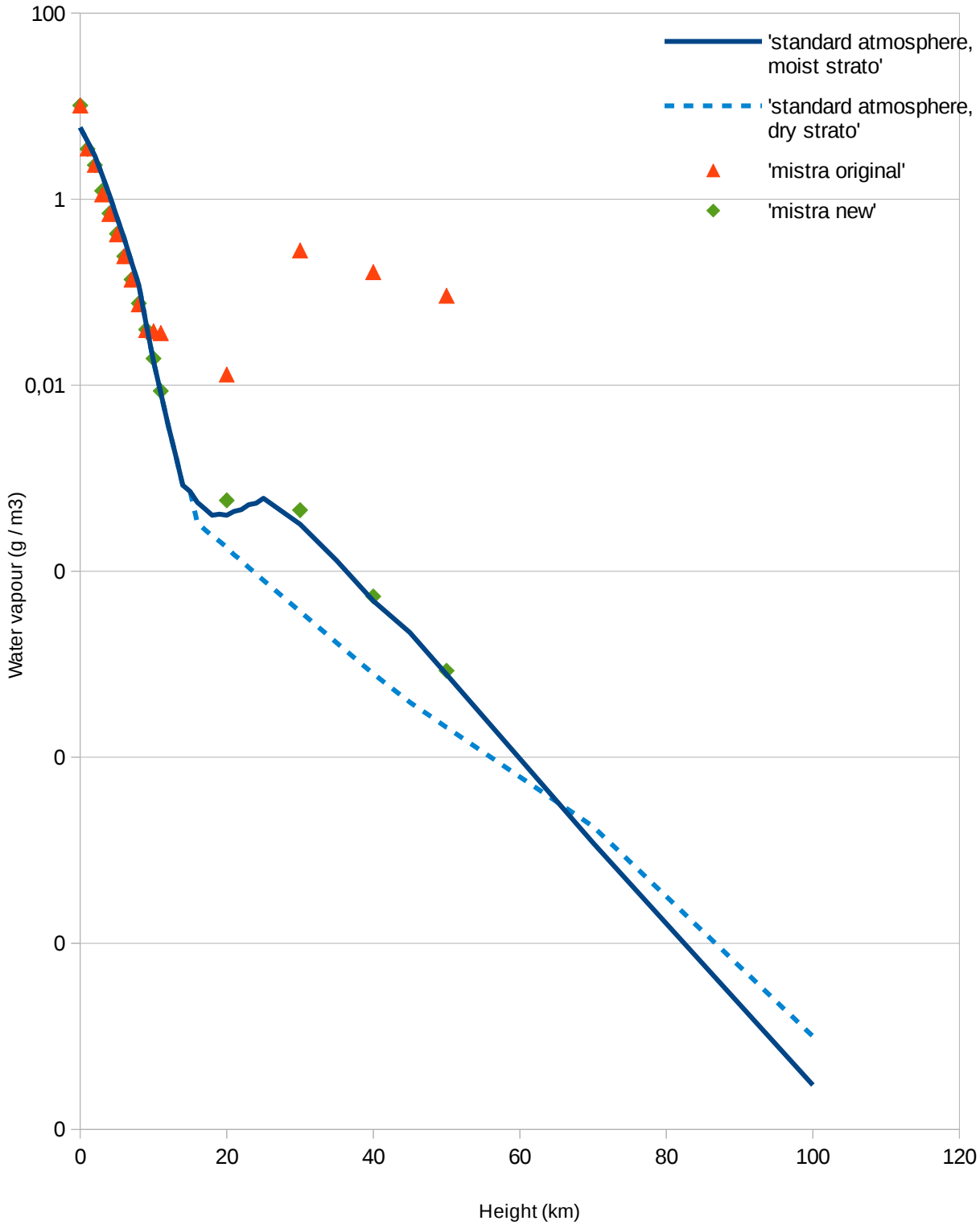

Figure 4: Water vapour concentration as a function of height. Dark blue line: standard atmosphere, moist stratosphere. Light blue dashed line: standard atmosphere, dry stratosphere. Both are from Seinfeld and Pandis (2006). Red symbols: mistra original version. Green symbols: new version of mistra profile. Note that the water vapour concentration at 100 km is set to 0. in mistra (fictitious level at infinity), and is thus not displayed in the log axis