

How to convert (columnar) water vapor, in g/cm², to delay in mm?

$$\delta^z = \Pi_{T_s} I \quad (1)$$

where δ^z is the zenith delay in [mm], I is the (columnar) water vapor (a.k.a. integrated precipitable water) in [kg/cm²], and Π_{T_s} is the conversion factor approximated using the surface temperature T_s in [K].¹

As an approximation, we use for I in [kg/cm²]

$$\Pi = 6.5 \quad \text{and} \quad \frac{1}{\Pi} = 0.15 \quad (2)$$

and for I in [g/cm²]

$$\Pi = 65 \quad \text{and} \quad \frac{1}{\Pi} = 0.015 \quad (3)$$

Conversions (examples)

WV g/cm ²	WV kg/m ²	eq.Liq.Wat. ² m	delay m	delay mm	phase rad
1	10	0.01	0.065	65	
0.1	1	0.001	0.007	6.5	
0.015	0.1538	0.000154	0.001	1	
0.154	1.538	0.00154	0.01	10*	
0.431	4.3064	0.004312	0.028	28 (1 fringe)	2 π
0.007	0.6854	0.0006	0.004	4.46	1

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¹See (?) for an approximation of Π_{T_s, T_0, t_D} as function of the mean annual surface temperature for the location, T_0 , and the day of the year, t_D , (?, p.230).

²height of an equivalent column of liquid water