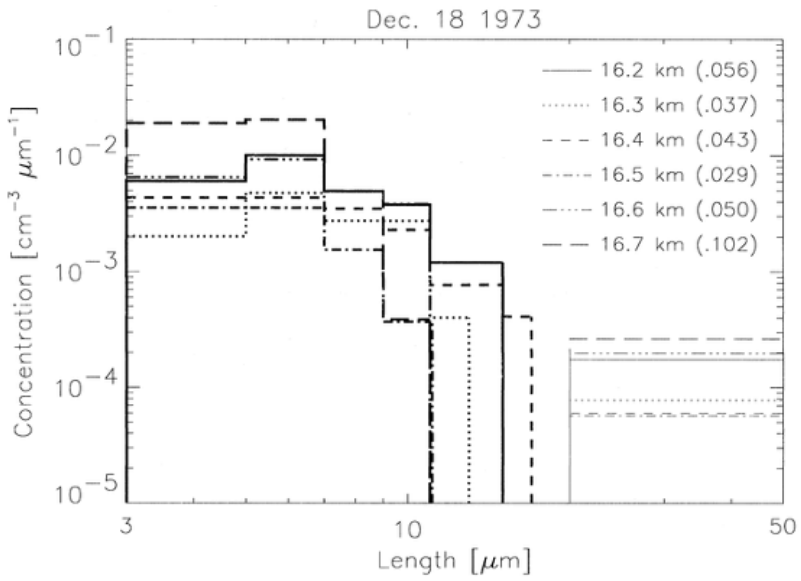
Review of “Radiative impact of thin cirrus clouds in the lowermost stratosphere and tropopause region”, by Spang, Müller and Rap.

This study examines the radiative properties of thin cirrus observed in the troposphere region by the CRyogenic Infrared Spectrometers and Telescopes for the Atmosphere (CRISTA-2) instrument during the second space shuttle mission in 1997. The article has similarities with the Spang et al. (2015) article, which I’ve gone through. What the article adds to that study is the use of the radiative transfer model SOCRATES, which is used to examine the bulk radiative flux properties of the thin cirrus layers, 161 cirrus, limb sampled on 9 August 1997. Basically, the question examined is whether the layers have a net positive or negative radiative effect.

Effective radii of 10 and 30 microns are assumed in the model, and ice particle aggregates-an 8-monomer hexagonal ice crystals, and spheres are assumed. With those assumptions, assumed cloud top height, and path length of 200 km for the CRISTA-2 measurements, the ice water content and ice water path are derived.

The article is clearly written, makes interesting use of the CRISTA measurements, and will be a valuable contribution. What I feel is needed is improved estimates of the effective radii and ice crystal shapes. Regarding the ice particle shapes, aggregates of ice crystals usually have sizes of 100-200 microns diameter and above. The assumed ice crystal aggregates are similar to bullet rosette ice crystals. And the spheres are designed to mimic droxtals. However, the ice particles in the TTL region are much more likely to be single crystals, such as hexagonal columns and trigonal crystals (see Heymsfield, 1986, JAS). Although in that study the temperatures were considerably below those studied here, the single crystal habit mode, and probably hexagonal plates or columns, is much more likely. Also see Bailey and Hallett (Q. J. R. Meteorol. Soc.(2002),128, pp. 1461–1483). An important reference is Kikuchi et al. **https://doi.org/10.1029/2020JD033562**. I also feel that the assumed sizes are too large. See the figure below for concentrations and size distributions in subvisual TTL cirrus (Heymsfield, 1986).



Number size distributions at six altitudes during rapid descent by WB-57 aircraft through subvisual cirrus near Kwajalein, Marshall Islands, on 18 December 1973 (Heymsfield and Jahnsen 1974). Thick lines denote ASSP measurements, thin lines 1DC measurements. Total concentrations in cm−3 appear in parentheses after height.

I recognize the desirability of using the SOCRATES model. Can any sensitivity studies be done, with smaller effective radii, for example. Can another radiative transfer model be used, that has the ability to do single columnar or hexagonal plate crystals incorporated? The changes will affect the net radiative effect of the cloud layers.

I have several minor comments. Just a few shown below:

Figure 2. What are the units of IWC.

122. "form" to "from"

127. What was the reason for choosing this path length?

185. seems

Andy Heymsfield, NCAR