Liquid and Ice Clouds Optical Properties Parametrizations - A Web Application

User's Guide

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August 2020

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Introduction

Radiation transfer models of the atmosphere in either Numerical Weather Prediction models (NWP) or Climate Models need a simple but accurate parametrization for the cloud optical properties. The three basic properties always needed are the extinction coefficient, the single scattering albedo and asymmetry factor (β_{ext}, ϖ, g). Usually these are defined as a function of the effective size of the hydrometeors (liquid or ice) but not always. Some models use formulations and some use look up tables. During run time of the forecasting model, a diagnosis of the effective size and number concentration (or other properties such as temperature) is done at each relevant grid point and the calculation of absorption and scattering of the clouds can calculated. An advanced spectral averaging method is used to calculate the optical properties based on a single wavelength data of Fu (1996, 1998) and Hu and Stamnes (1993). An ensemble of 7500 particle size distributions PSD is used for the ice optical properties calculations. The optical properties and the effective size and aspect ratio is calculated for each PSD. We fit the collection of these 7500 points to a Padé approximation from the form $f_{(x)} = \frac{\sum_i^N a_i x^i}{\sum_i^M b_i x^i}$. Where x can be D_{ge} or AR and a_i, b_i are fitting coefficients. We use a Levenberg-Marquardt non-linear fitting algorithm. N, M have to be chosen adequately to reproduce an asymptotic behavior. For $\beta'_{ext}(D_{ge})$ we chose $N = 2, M = 3$; for $\omega(D_{ge})$ and $f_d(AR)$ we defined $N = M = 3$ while for $g(AR)$ we took $N = 3, M = 2$. By this we extended the effective size range compared to previous parametrizations to include large hydrometeor categories such as snow, graupel and rain. In this user's guide we will focus only on the technical side of the web application, for the scientific side please see the references listed below.

How to use the web application?

1. In the opening page, the range selection page, there are 4 areas. The upper two are for liquid droplets. The lower two are for ice particles. The left side is for visible (SW incoming radiation) and the right is for infrared (LW outgoing radiation).
2. To choose between ice and liquid click on the fill button. It is allowed to choose both species but not at the same time.

   When "liquid" is selected another selection appears between "Vis"(SW) or "IR" (LW). There is no technical wavelength limits for these but if one chooses "Vis" the temperature for the spectral averaging will be of the sun- 5778 K. For "IR" this temperature will be 263 K. Usually the border between SW incoming radiation and LW outgoing in NWP models is around 4 μm but we let this to the user to define.

   When "ice" is chosen there is no such choice between Vis/IR. For a selection in the range 0.2 μm ↦ 3.969 μm the program will use the SW database with T=5778 K and for the range 3.969 μm ↦ 100 μm the LW database will be used with T=243 K for the spectral averaging. Currently it is impossible to choose a range that is on the borderline of 3.969 μm (for example 3.0 μm ↦ 5.0 μm).
3. Choose the spectral interval limits relevant for your own application/radiation model and push the "add" button. The range that was selected will appear in the corresponding area on the screen. You can choose as many intervals as needed. To remove a selection click "x" button. When the range selection is finished click the "Done selecting" button.
4. Insert User: cloopt (mnemonic (clo)up(opt)ics)
5. Insert Password: towrtcop (mnemonic: (t)the(o)ne{w)ho(r)uns(t)he(c)loud(o)ptics(p)rogram)

6. A new window will be opened with 3 terminals: liquid, ice-Vis and ice-IR. Press the "run" button on each of the terminals that were selected beforehand. Usually the liquid and ice-IR finish in a few seconds but the ice-Vis may take a few minutes.
7. When the program run finishes, a "successful" message appears below the relevant terminal.
8. By clicking "Images" button on the bottom of the page, a new window will be open with the graphics and results. Use the scroll bars to see all. You can copy the images by pressing right click on the mouse and "copy image".
9. To see the parametrization coefficients click on the image. You can get a collection of all text results by clicking the "text" button.
10. To change the limits of plots, press "ctrl"+click and choose new limits inside the fill in boxes.
11. The images and text files can be viewed also in the archive webpage in http://www.cosmo-model.org/view/content/tasks/operational/ims/cloudOptics/images/uniqIds. Look for the latest uniqlds to find you selection. You can delete items by dragging to the ∅ position.
12. You can use the graphics and parametrization freely with the proper acknowledgments. For journal publications add the references listed below to the references list of your publication.

References

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