The VIIRS Fast Radiative Transfer Model (VFRTM)

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Introduction:

The VIIRS Fast Radiative Transfer Model (VFRTM) is a new RT model, specialized to support simulations of VIIRS data.

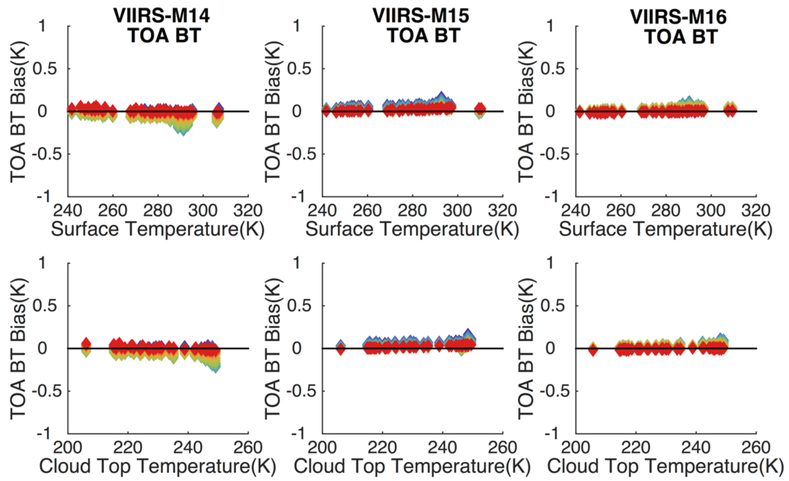
This RT model enables researchers to quickly and easily simulate VIIRS observations to aid in interpretation, analysis, and basic research utilizing VIIRS imagery.

It can be compiled to a standalone executable program, with human readable text file inputs, or called as a library module from fortran or python (using the f2py component of Numerical Python)

The model is at a beta release (version 0.1), and it is available under an Open Source license (GPL v3)

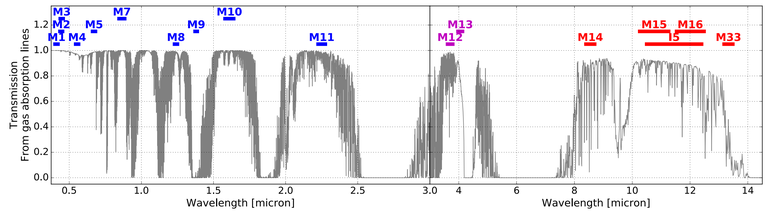
Example comparison to Line-by-Line RT Model

The plots below show the bias between the VFRTM, and a Line-by-Line calculation, over a variety of atmosphere conditions



Current Capabilities:

-- Simulates all VIIRS bands suitable for cloud and surface property remote sensing (M1 – M5, M7 – M16, I5):
blue: reflective only; magenta = reflective+emissive; red=emissive

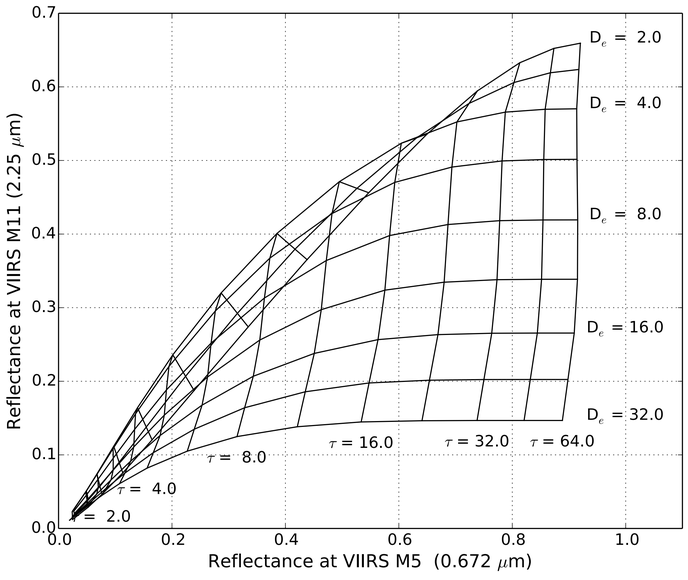


-- Includes MODIS-33, to represent imagery constructed via VIIRS-CrIS data fusion (Cross, 2013)
-- Single layer water (D_{eff} = 2–60 µm) or ice clouds (D_{eff} = 10–180 µm)
-- User input Temperature, Water Vapor, Ozone profiles
-- User input surface temperature and emissivity/albedo

Planned Capabilities:

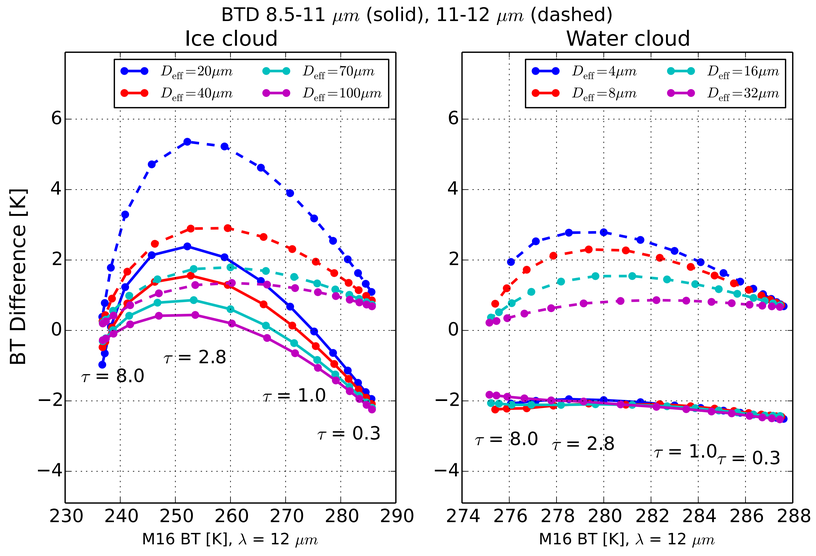
-- single layer aerosols
-- include Rayleigh scattering for short wavelength bands

Example Application: Cloud property retrievals (LUT generation & sensitivity analysis)



Example Look Up Table (LUT) for the well known water cloud property retrieval using a combination of a scattering and absorbing shortwave band.

(e.g., *Nakajima & King, JAS 1990*)



Sensitivity analysis of IR-window brightness temperature differences, the “split-window” or “tri-spectral” approaches

(e.g., *Strabala et. al. JAMC 1994; Heidinger & Pavolonis JAMC 2008*)

Example usage:

The VFRTM can be run directly from fortran with a simple subroutine call:

```
call run_vfrtm(band_name_list, &
     cloud_types, cloud_alts, cloud_tau, cloud_de, ...)
```

Similarly from python:

```
sim_result = pyVFRTM.run(
    band_list, cloud_types, cloud_alts, cloud_tau, cloud_de, ...)
```

We are Looking for Beta-Testers!

Interested researchers should contact the author (merrelli@wisc.edu) to obtain a beta release of the software.

First public release at the SSEC website will be in early 2017.

References:

IR components of VFRTM:
Wang et. al, JAMC 2011 (doi: 10.1175/JAMC-D-11-067.1)

Shortwave components of VFRTM:
Wang et. al., JQSRT 2013 (doi: 10.1016/j.jqsrt.2012.10.012)
Liu et. al., JGR-A 2015 (doi: 10.1002/2014JD022443)

VIIRS-CrIS data fusion channel:
Cross et. al. JARS 2013 (doi: 10.1117/1.JRS.7.073473)

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