

getObsAtmo new multi-obs. sites, pressure dependent atmospheric transmission emulator for Rubin-LSST

Free from any libradtran installation

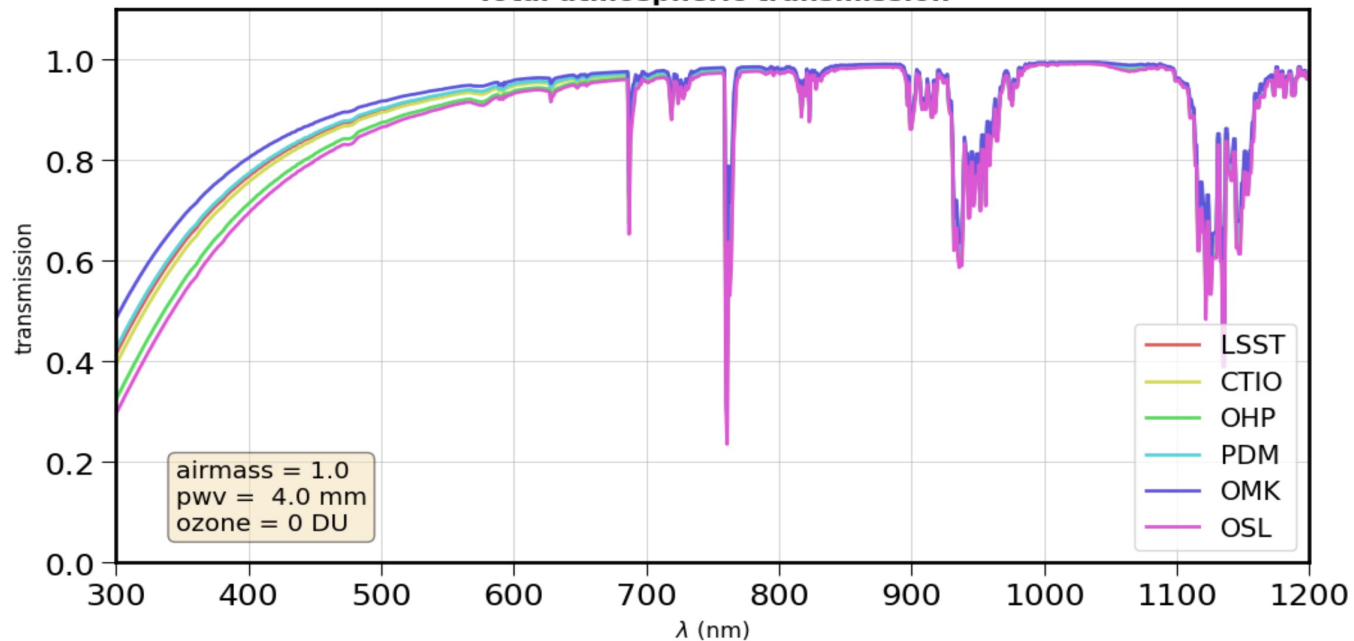
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IJCLab

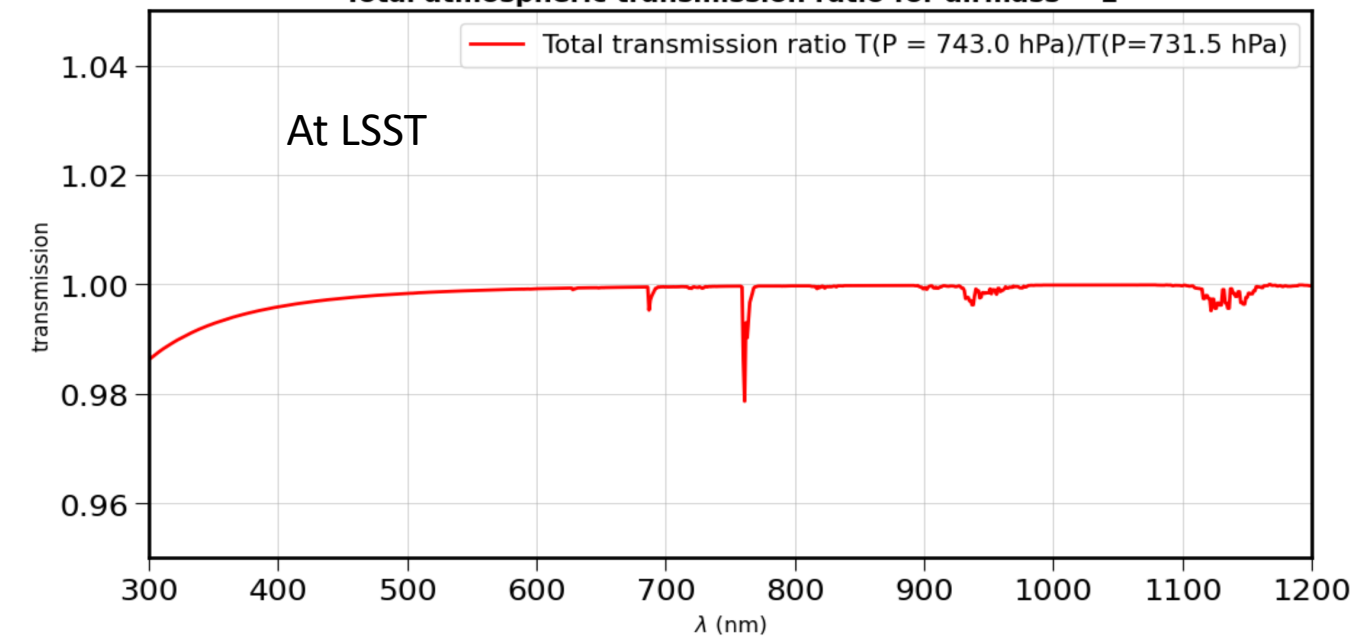
New version of libradtran emulator getObsAtmo (requires scipy and numpy only)

- Old emulator deprecated (only for LSST, no Pressure dependence)
~~<https://github.com/LSSTDESC/atmosphtransmemulsst>~~
- New emulator: <https://github.com/LSSTDESC/getObsAtmo>
 - **Multi-Observation sites (new !)**
 - 4 independent parameter grids to interpolate transparencies
 - 2D (wl,airmass) for Rayleigh scattering
 - 2D (wl,airmass) for O2 absorption
 - 3D (wl,airmass, pwv) for precipitable water vapor absorption
 - 3D (wl,airmass, oz) for Ozone absorption
 - **Correct Rayleigh and O2 for pressure dependence (new !)**
- **Runs at usdf (DM compatible)**

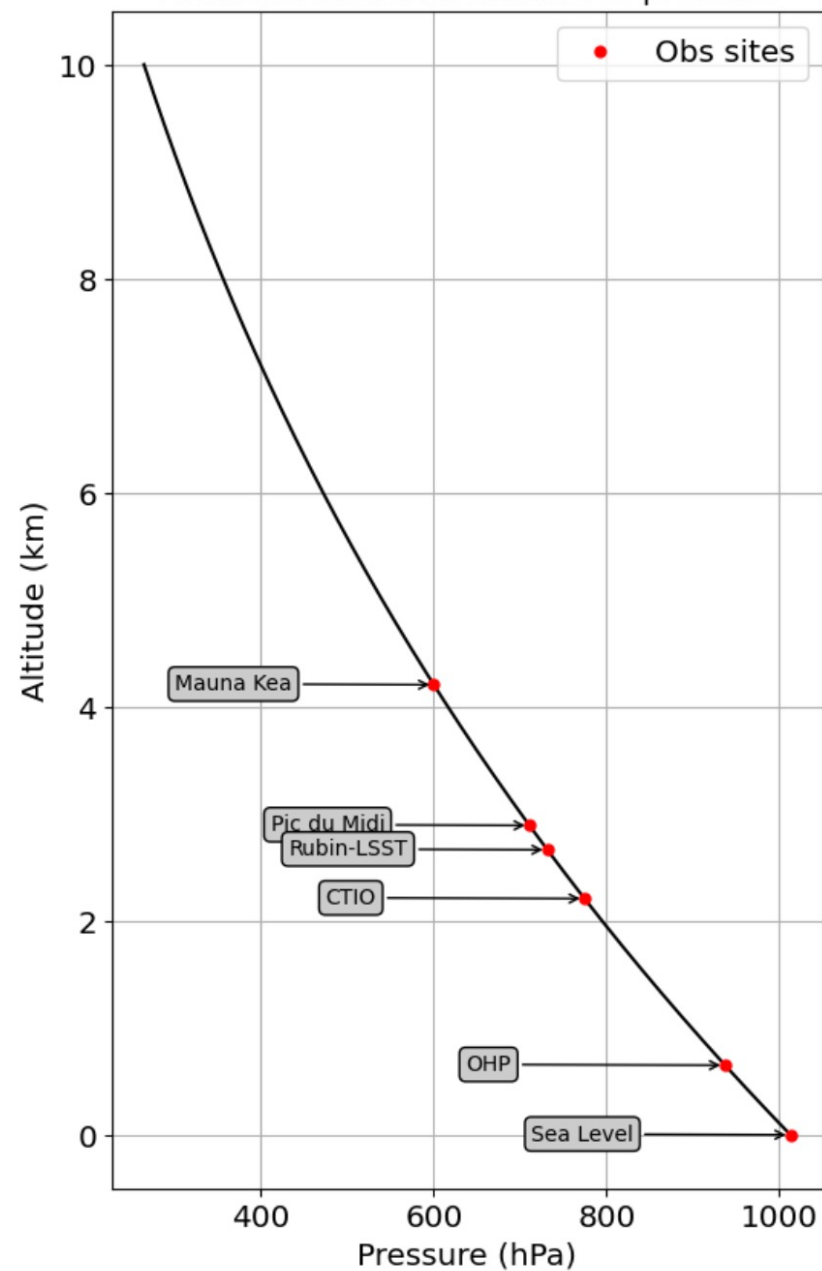
Total atmospheric transmission



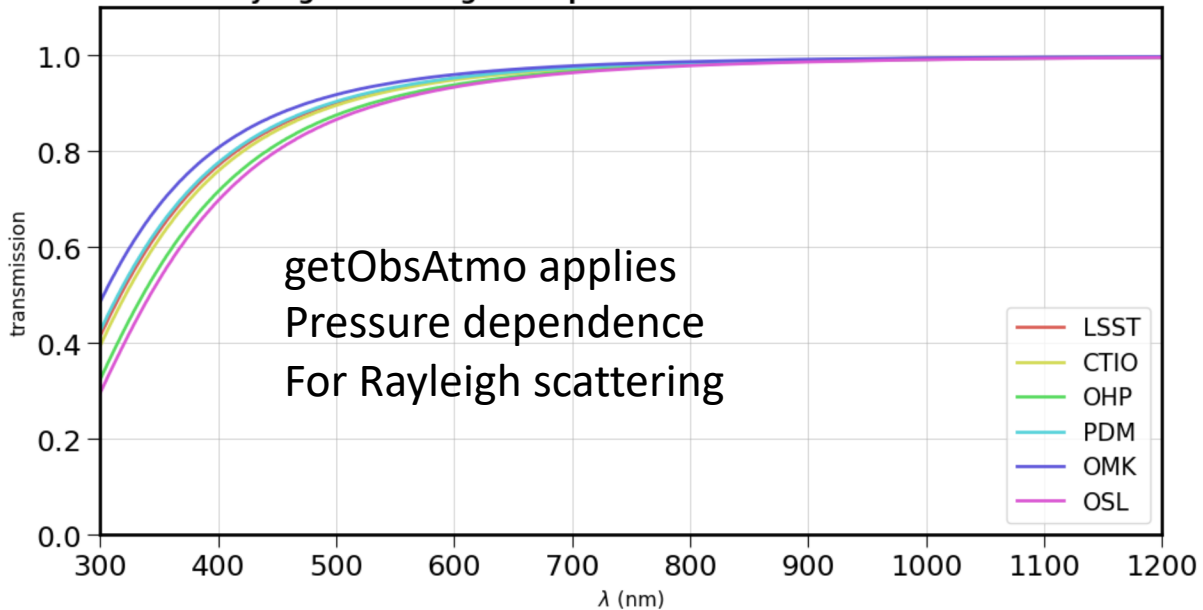
Total atmospheric transmission ratio for airmass = 1



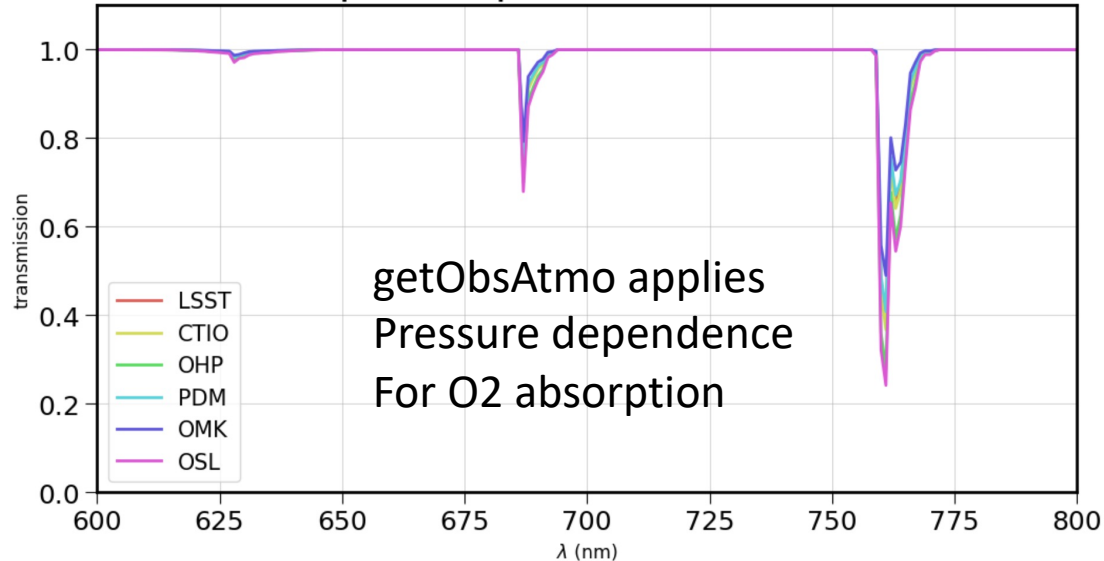
Adiabatic model for altitude vs pressure



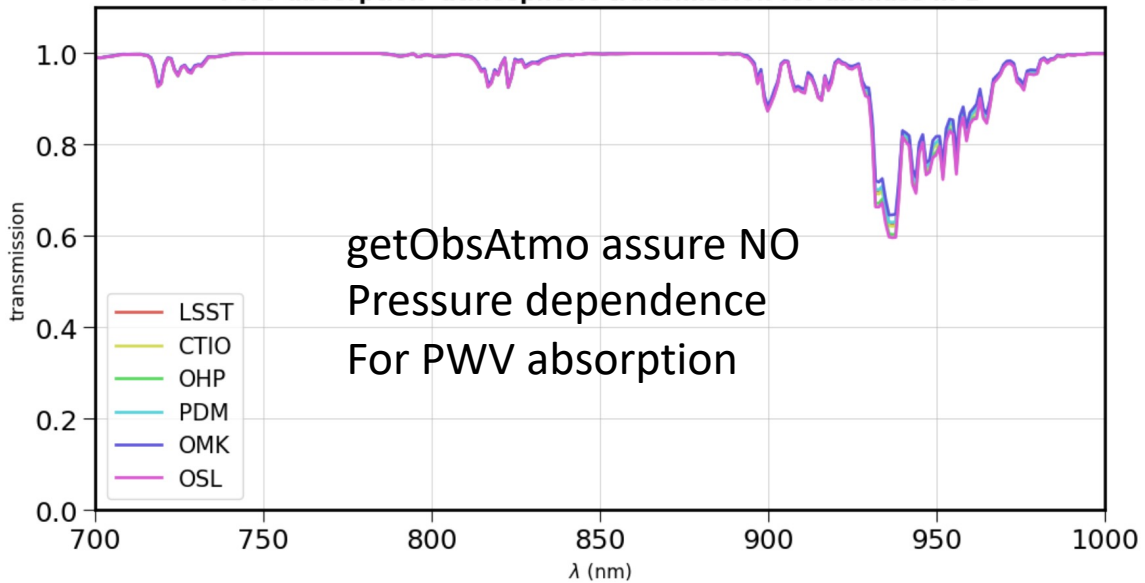
Rayleigh scattering atmospheric transmission for airmass = 1



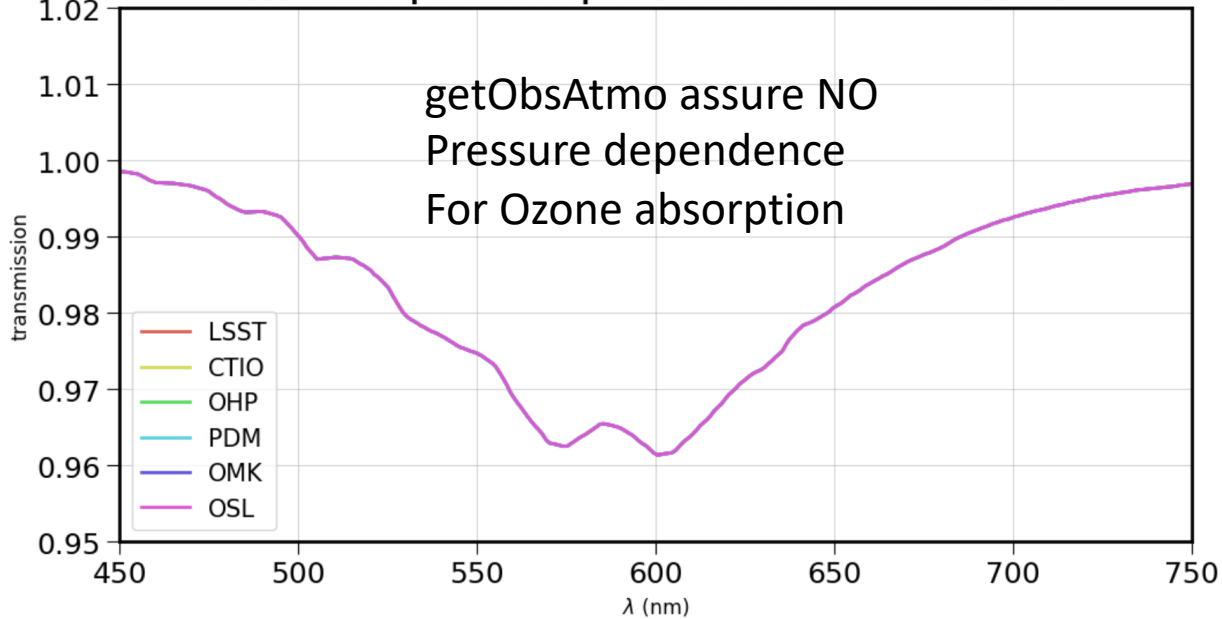
O2 absorption atmospheric transmission for airmass in 1



PWV absorption atmospheric transmission for airmass in 1



Ozone absorption atmospheric transmission for airmass in 1



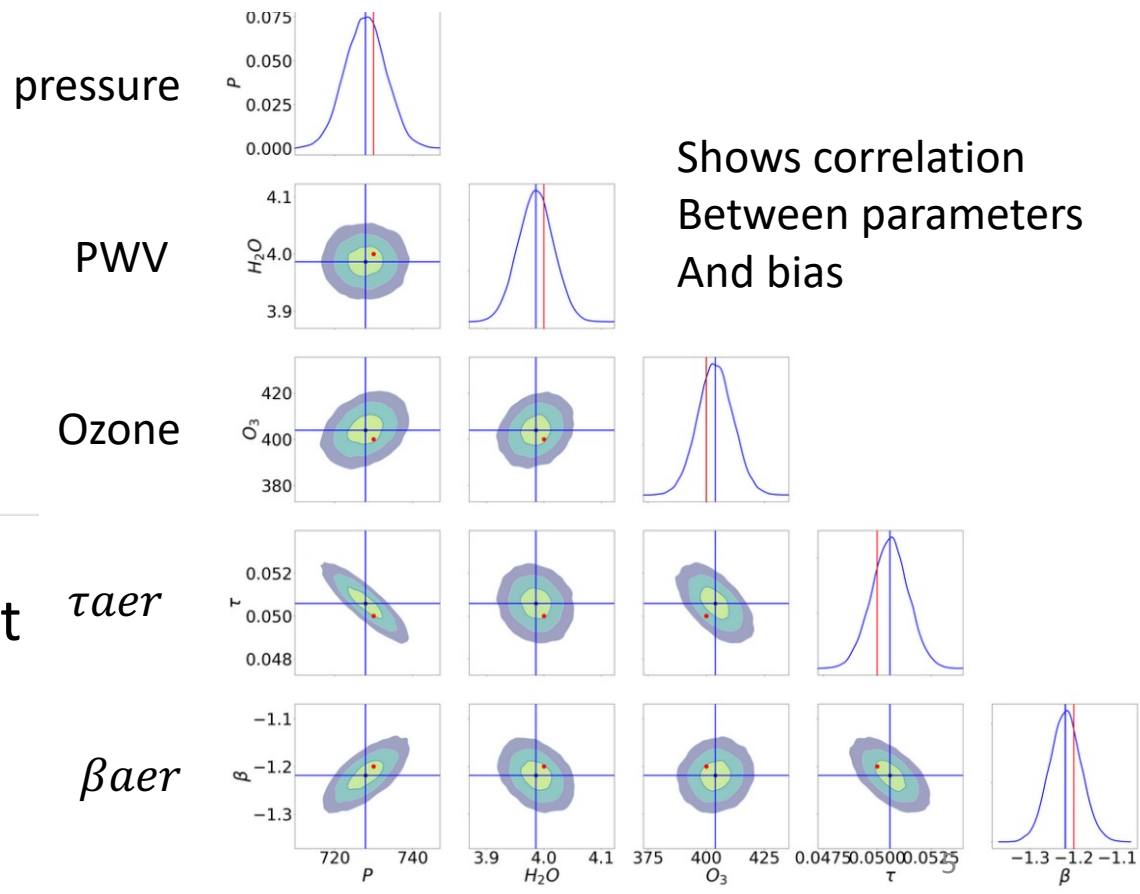
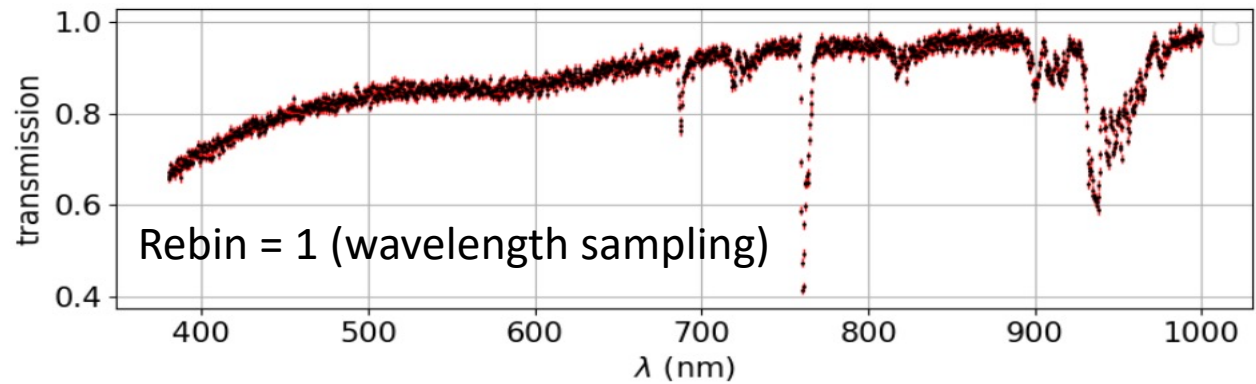
Inference on atmospheric parameters from a toy model

- 0.01 flat error on transmission (10 mmag)
- Rebin = 1 \rightarrow 1% - 3% relative stat error on marg. dist

P : mean = 727.921 , bias = -2.079 , sigma = 5.231 rel bias-error= -0.003, rel stat-error = 0.0072
 pwv : mean = 3.986 , bias = -0.014 , sigma = 0.031 rel bias-error= -0.004, rel stat-error = 0.0077
 oz : mean = 403.928 , bias = 3.928 , sigma = 7.598 rel bias-error= 0.010, rel stat-error = 0.0188
 τ : mean = 0.051 , bias = 0.001 , sigma = 0.001 rel bias-error= 0.012, rel stat-error = 0.0169
 β : mean = -1.219 , bias = -0.019 , sigma = 0.036 rel bias-error= 0.016, rel stat-error = -0.0298

- rebin = 2 \rightarrow 1% - 4% relative stat error on marg. dist

P : mean = 728.619 , bias = -1.381 , sigma = 7.443 rel bias-error= -0.002, rel stat-error = 0.0102
 pwv : mean = 4.031 , bias = 0.031 , sigma = 0.043 rel bias-error= 0.008, rel stat-error = 0.0108
 oz : mean = 402.391 , bias = 2.391 , sigma = 10.781 rel bias-error= 0.006, rel stat-error = 0.0268
 τ : mean = 0.050 , bias = 0.000 , sigma = 0.001 rel bias-error= 0.005, rel stat-error = 0.0241
 β : mean = -1.244 , bias = -0.044 , sigma = 0.051 rel bias-error= 0.035, rel stat-error = -0.0412



getObsAtmo can regenerate data grid

- Run the rebuildGrids in getObsAtmo

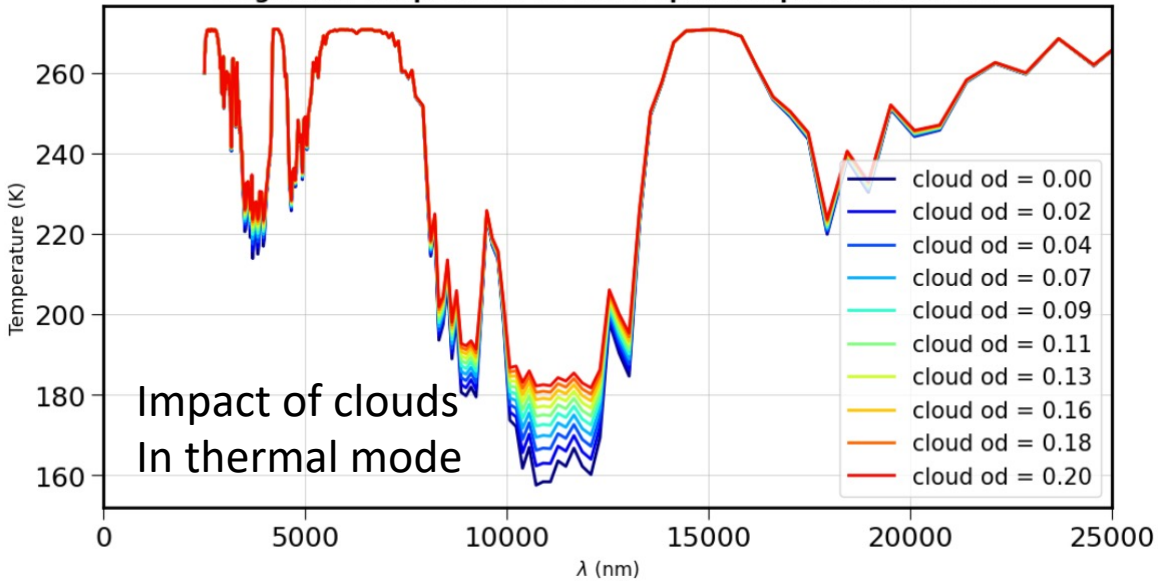
```
>> python rebuildGrids.py -h
*****
Help to generation of atmospheric parameter grid for getObsAtmo emulator
rebuildGrids.py -s<observation site-string> -a <airmassmin,airmassmax,nbins> -v <pwvmin,
pwvmax,nbins> -o <ozmin, ozmax,nbins>
Observation sites are :
LSST CTIO OHP PDM OMK OSL
- atmospheric parameters should be specified of 3 numbers : valmin, valmax, x
  where valmin is the minimum value, valmax is the maximum value
    * if x = N in integer -> number of grid points
    * if x = dx is float -> point spacing
  -a : airmass
  -v : precipitable water vapor
  -o : ozone
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example : python rebuildGrids.py -s LSST -a 1,2.6,0.1 -v 0,10.25,0.25 -o 0.,625.0,25.
or : python rebuildGrids.py -s LSST -a 1,2.5,16 -v 0,10,41 -o 0.,600.0,25
```

But need to install on your computer. See readthedocs instruction.

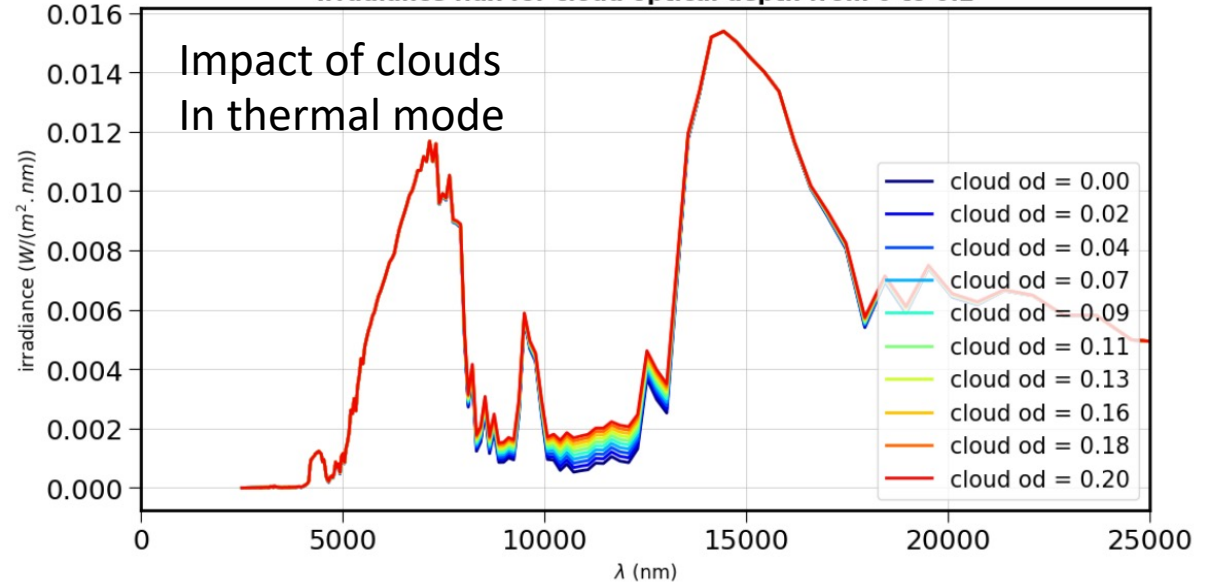
- libradtranpy and libRadtran

IR : Thermal mode in libradtranpy

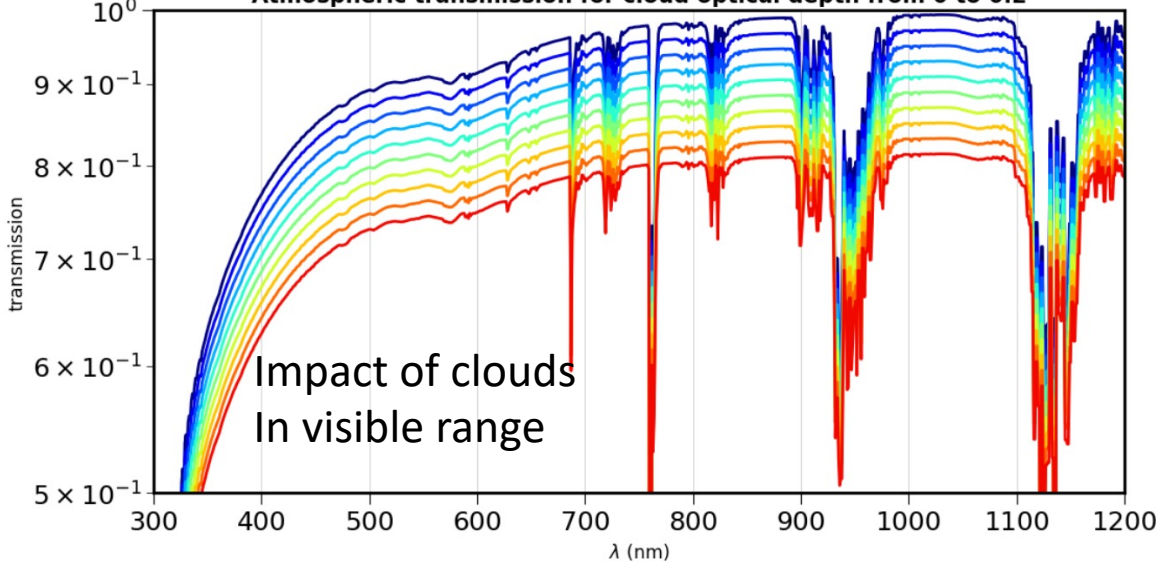
Brightness temperature for cloud optical depth from 0 to 0.2



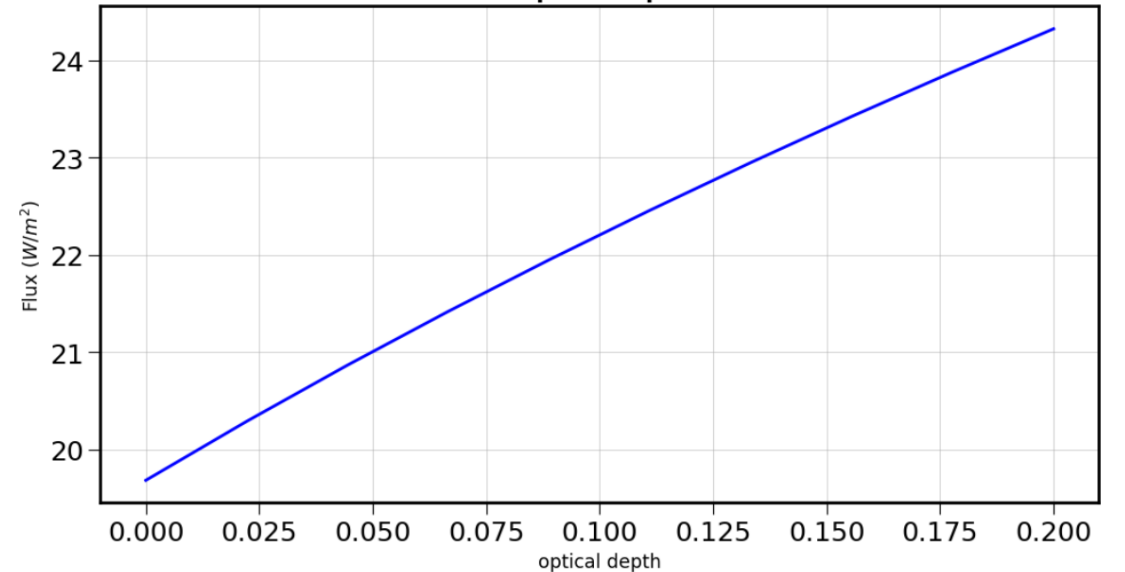
Irradiance flux for cloud optical depth from 0 to 0.2



Atmospheric transmission for cloud optical depth from 0 to 0.2



Flux for cloud optical depth from 0 to 0.2



Take away and more to come

- Insert getObsAtmo easy to use at any obs site
 - (LSST version, but can be used as it is in StarDice)
- Could think about a similar version/package for StarDice - IR.
- Autodifferentiation implementation (in JAX) if required by the analysis
 - allowing faster fit on CPU/GPU (pre-compiled fit functions)
 - Bayesian inference with tools like HMC-MCMC (Numpyro)

getObsAtmo and libradtranpy links

- getObsAtmo On github : <https://github.com/LSSTDESC/getObsAtmo>
- getObsAtmo On readthedocs :
<https://getobsatmo.readthedocs.io/en/latest/index.html>
- Libradtranpy on github : <https://github.com/LSSTDESC/libradtranpy>
- Libradtranpy on readthedocs :
<https://libradtranpy.readthedocs.io/en/latest/>
- Autodifferentiable version under development:
<https://github.com/sylvielsstfr/AtmEmulator>