

Summary of Changes between L3 CLDPROP v1.1 and v2.0

High Impact Change Overview

The most significant Version 2 (v2) changes to the Level-3 CLDPROP are:

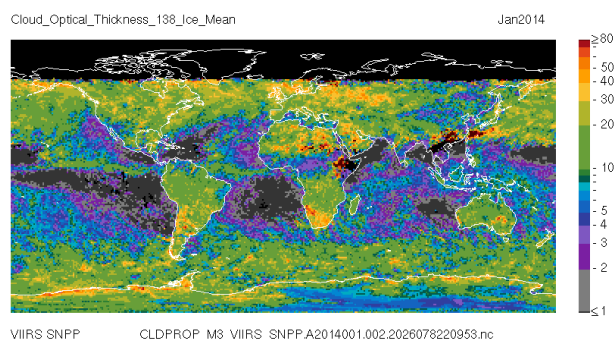
- A new “research and evaluation” dataset of thin cirrus optical thickness retrievals using the 1.38 μm channel based on a new cloud thermodynamic phase algorithm from machine learning (Random Forest)
- New pixel-level broadband flux calculations using in-line radiative transfer (RRTM-G)

Change Details

A high-level summary of the changes implemented in v2 of the CLDPROP cloud optical property algorithm (part of the shared-core “CHIMAERA” suite (Wind et al., 2020)) is given below.

Additional details on these changes will be provided in a subsequent v2 update to the CLDPROP User’s Guide.

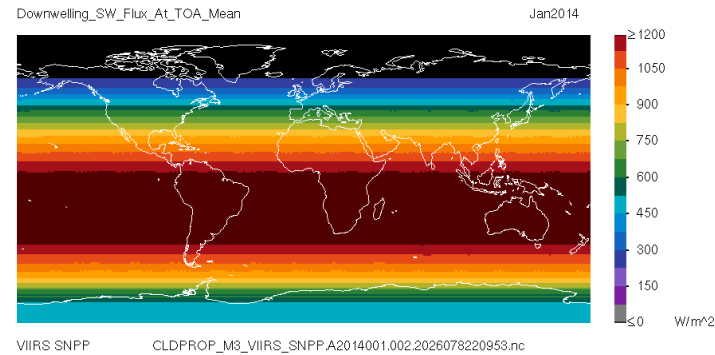
- **Thin cirrus retrievals from the 1.38 μm channel (research/evaluation dataset).**
Retrievals of cirrus cloud optical thickness using the 1.38 μm channel described in (Meyer & Platnick, 2010) have been implemented. The 1.38 μm channel resides within a strong atmospheric water vapor absorption band, thus its signal at the top of atmosphere is due primarily to reflection from high altitude clouds, with reflection from lower-level clouds and the surface nearly completely attenuated. These 1.38 μm retrievals provide enhanced skill for optically thin cirrus clouds that often yield retrieval failures for the standard retrieval channel pairs. COT retrievals and associated pixel-level retrieval uncertainties are reported in the new variables Cloud_Optical_Thickness_138 and Cloud_Optical_Thickness_Uncertainty_138, respectively, both in the new research_evaluation_data group.



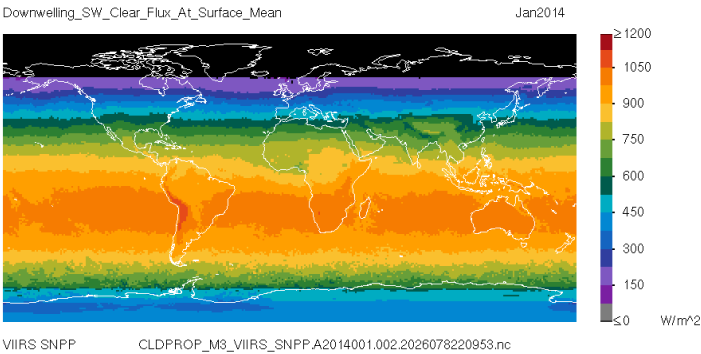
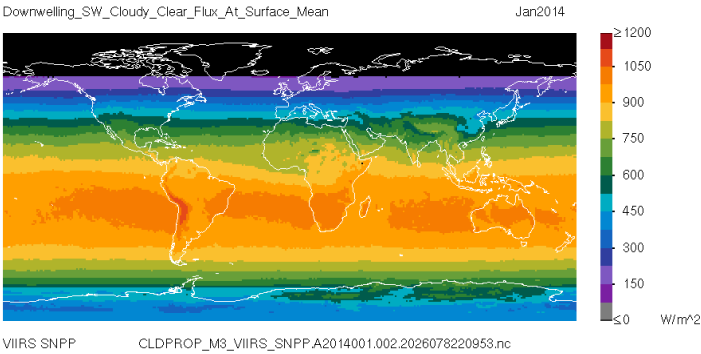
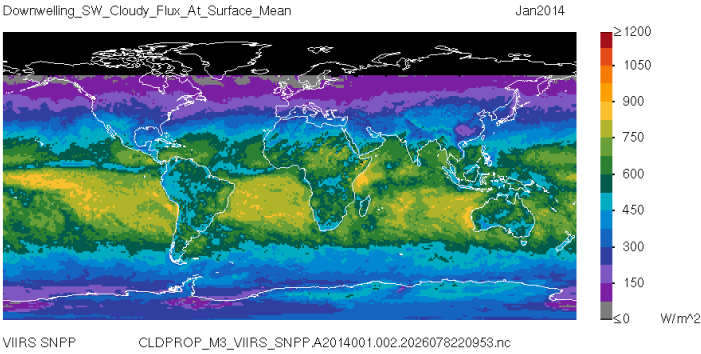
- Pixel-level broadband flux calculations.** The RRTM-G broadband RT code has been integrated within CHIMAERA to provide in-line shortwave (SW) and longwave (LW) clear and cloudy sky flux calculations at the top of atmosphere and the surface. These calculations, using the CLDPROP cloud-top and optical property retrievals as input, along with a host of ancillary atmospheric and surface datasets, are performed and reported every fifth (MODIS) or fourth (VIIRS across-track) pixel, corresponding to the same pixel sampling used for the L3 aggregated statistics products. These flux datasets enable, e.g., computations of cloud radiative effects, etc., consistent with the forward RT and assumptions used in the retrievals themselves. The filtering formulae used to compute the various L3 flux datasets are provided below:

Detail On Flux Filtering Equations and Sample Imagery:

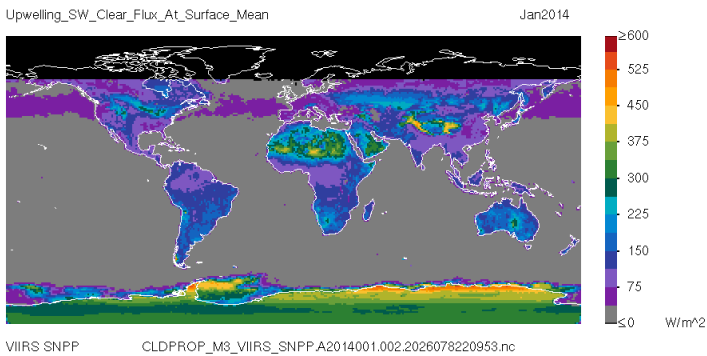
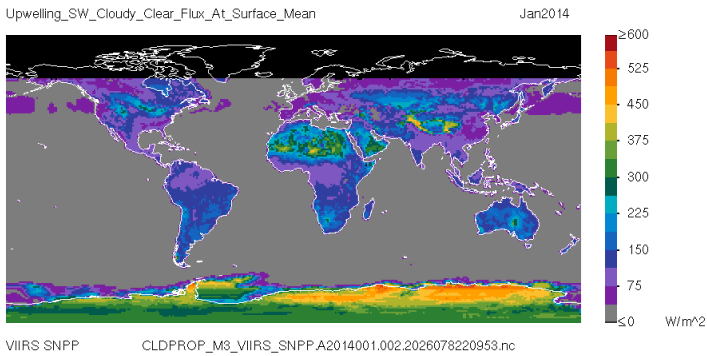
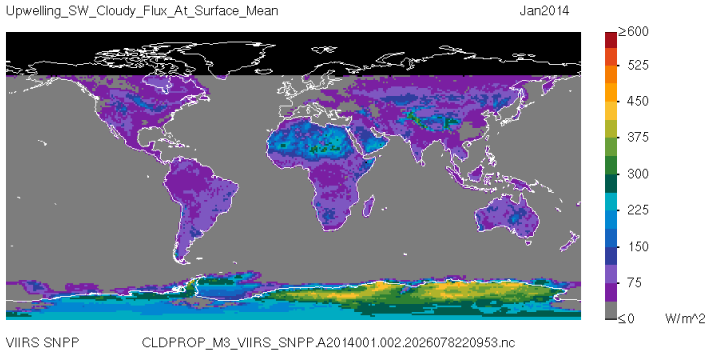
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Filtering Equation Using L2 SDS:	Downwelling_SW_Flux_At_TOA (no filtering needed)
Description:	Incoming solar irradiance at TOA



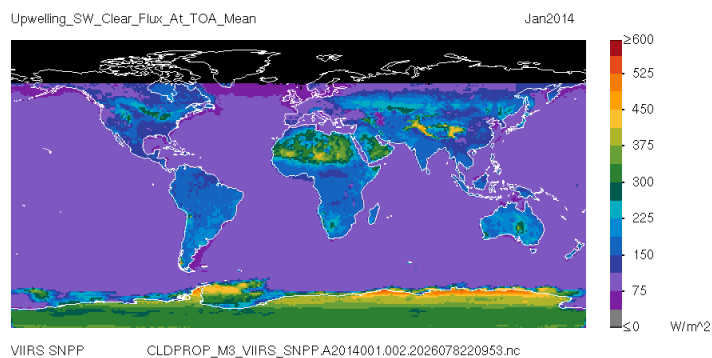
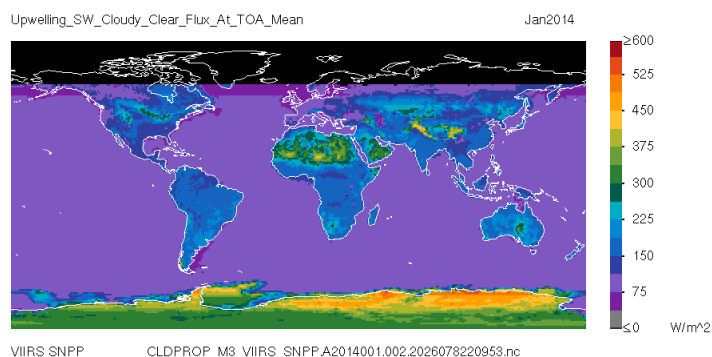
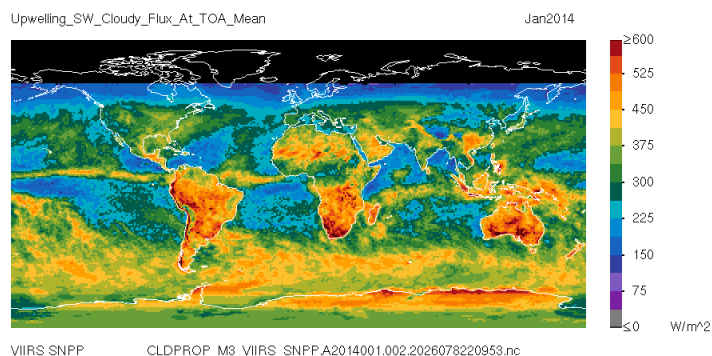
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Filtering Equation Using L2 SDS:	Downwelling_SW_Cloudy_Flux_At_Surface [where Downwelling_SW_Cloudy_Flux_At_Surface > 0.0]
Description:	Downwelling shortwave cloudy sky flux at the surface for cloudy pixels only
L3 SDS Name:	Downwelling_SW_Cloudy_Clear_Flux_At_Surface
Filtering Equation Using L2 SDS:	Downwelling_SW_Flux_At_Surface [where Downwelling_SW_Cloudy_Flux_At_Surface > 0.0]
Description:	Downwelling shortwave clear sky flux at the surface for cloudy pixels only
L3 SDS Name:	Downwelling_SW_Clear_Flux_At_Surface
Filtering Equation Using L2 SDS:	Downwelling_SW_Flux_At_Surface [where Downwelling_SW_Cloudy_Flux_At_Surface = Fill_Value]
Description:	Downwelling shortwave clear sky flux at the surface for clear pixels only



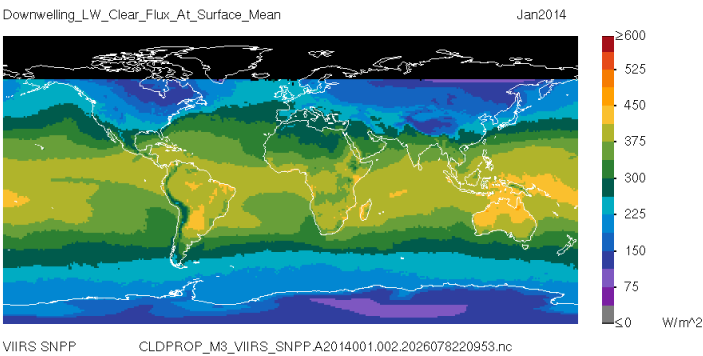
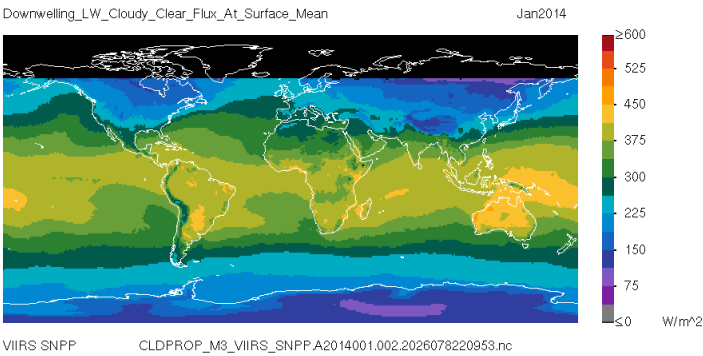
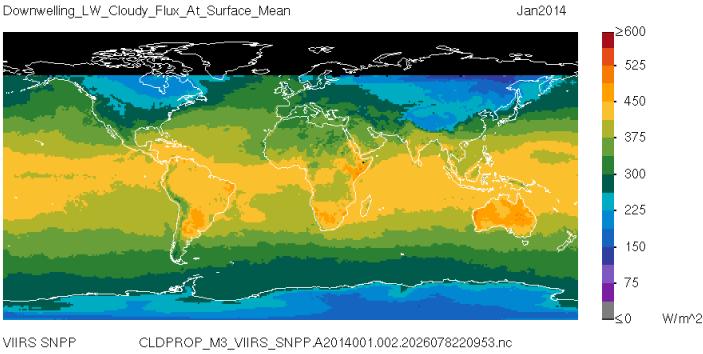
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Filtering Equation Using L2 SDS:	Upwelling_SW_Cloudy_Flux_At_Surface [where Upwelling_SW_Cloudy_Flux_At_Surface > 0.0]
Description:	Upwelling shortwave cloudy sky flux at the surface for cloudy pixels only
L3 SDS Name:	Upwelling_SW_Cloudy_Clear_Flux_At_Surface
Filtering Equation Using L2 SDS:	Upwelling_SW_Flux_At_Surface [where Upwelling_SW_Cloudy_Flux_At_Surface > 0.0]
Description:	Upwelling shortwave clear sky flux at the surface for cloudy pixels only
L3 SDS Name:	Upwelling_SW_Clear_Flux_At_Surface
Filtering Equation Using L2 SDS:	Upwelling_SW_Flux_At_Surface [where Upwelling_SW_Cloudy_Flux_At_Surface = Fill_Value]
Description:	Upwelling shortwave clear sky flux at the surface for clear pixels only



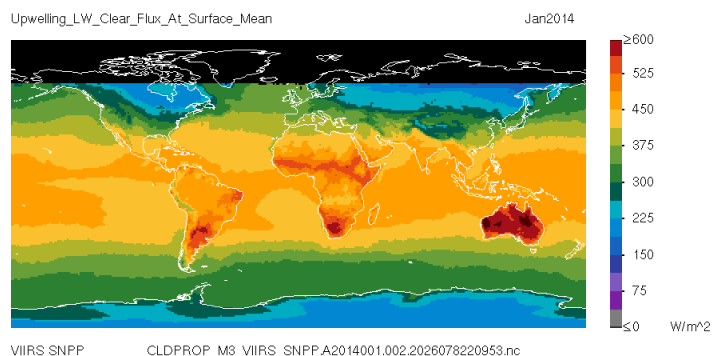
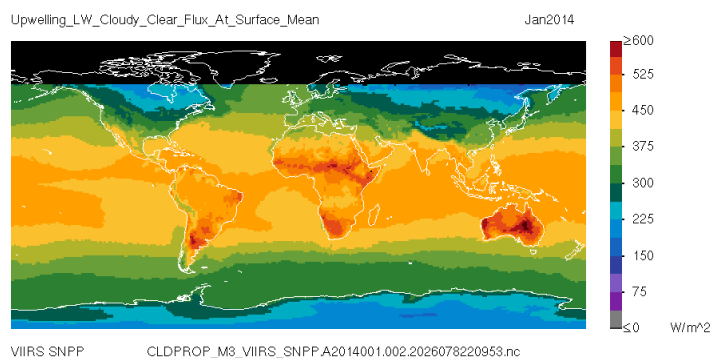
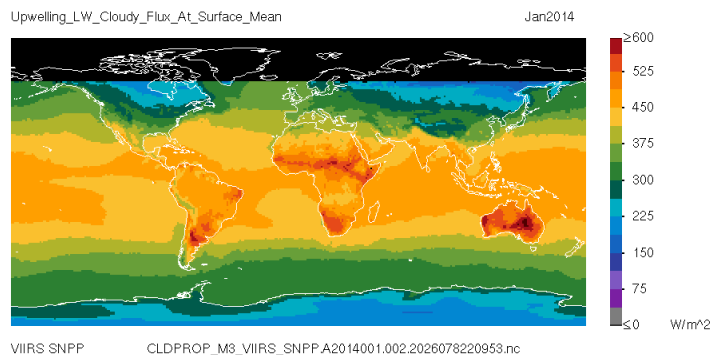
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Filtering Equation Using L2 SDS:	Upwelling_SW_Cloudy_Flux_At_TOA [where Upwelling_SW_Cloudy_Flux_At_TOA > 0.0]
Description:	Upwelling shortwave cloudy sky flux at TOA for cloudy pixels only
L3 SDS Name:	Upwelling_SW_Cloudy_Clear_Flux_At_TOA
Filtering Equation Using L2 SDS:	Upwelling_SW_Flux_At_TOA [where Upwelling_SW_Cloudy_Flux_At_TOA > 0.0]
Description:	Upwelling shortwave clear sky flux at TOA for cloudy pixels only
L3 SDS Name:	Upwelling_SW_Clear_Flux_At_TOA
Filtering Equation Using L2 SDS:	Upwelling_SW_Flux_At_TOA [where Upwelling_SW_Cloudy_Flux_At_TOA = Fill_Value]
Description:	Upwelling shortwave clear sky flux at TOA for clear pixels only



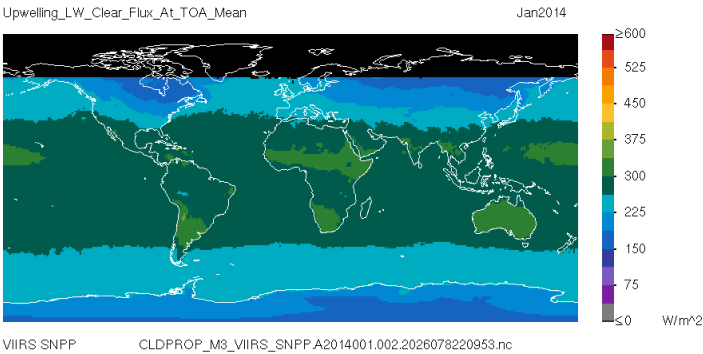
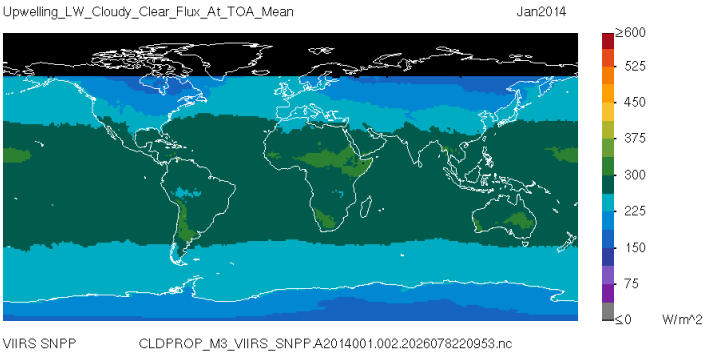
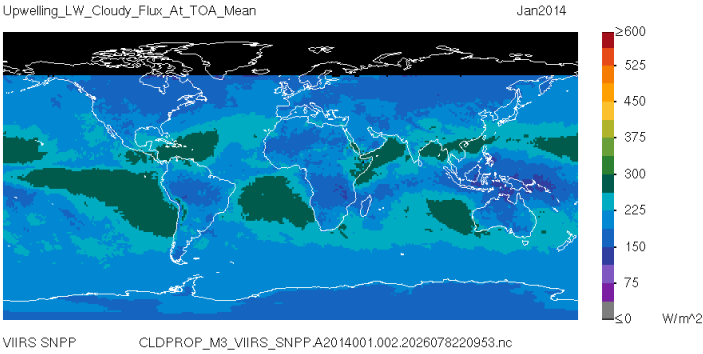
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Filtering Equation Using L2 SDS:	Downwelling_LW_Cloudy_Flux_At_Surface [where Downwelling_LW_Cloudy_Flux_At_Surface > 0.0]
Description:	<i>Downwelling longwave cloudy sky flux at the surface for cloudy pixels only</i>
L3 SDS Name:	Downwelling_LW_Cloudy_Clear_Flux_At_Surface
Filtering Equation Using L2 SDS:	Downwelling_LW_Flux_At_Surface [where Downwelling_LW_Cloudy_Flux_At_Surface > 0.0]
Description:	<i>Downwelling longwave clear sky flux at the surface for cloudy pixels only</i>
L3 SDS Name:	Downwelling_LW_Clear_Flux_At_Surface
Filtering Equation Using L2 SDS:	Downwelling_LW_Flux_At_Surface [where Downwelling_LW_Cloudy_Flux_At_Surface = Fill_Value]
Description:	<i>Downwelling longwave clear sky flux at the surface for clear pixels only</i>



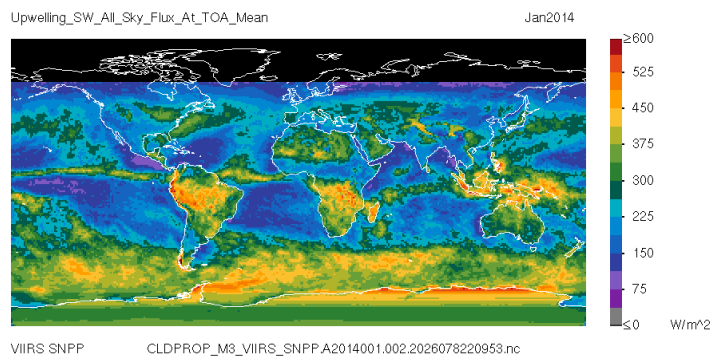
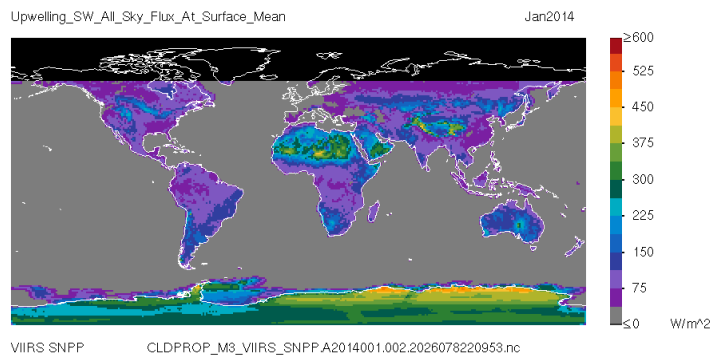
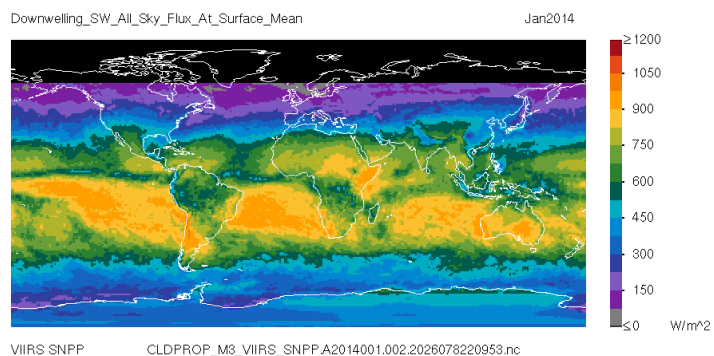
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Filtering Equation Using L2 SDS:	Upwelling_LW_Cloudy_Flux_At_Surface [where Upwelling_LW_Cloudy_Flux_At_Surface > 0.0]
Description:	<i>Upwelling longwave cloudy sky flux at the surface for cloudy pixels only</i>
L3 SDS Name:	Upwelling_LW_Cloudy_Clear_Flux_At_Surface
Filtering Equation Using L2 SDS:	Upwelling_LW_Flux_At_Surface [where Upwelling_LW_Cloudy_Flux_At_Surface > 0.0]
Description:	<i>Upwelling longwave clear sky flux at the surface for cloudy pixels only</i>
L3 SDS Name:	Upwelling_LW_Clear_Flux_At_Surface
Filtering Equation Using L2 SDS:	Upwelling_LW_Flux_At_Surface [where Upwelling_LW_Cloudy_Flux_At_Surface = Fill_Value]
Description:	<i>Upwelling longwave clear sky flux at the surface for clear pixels only</i>



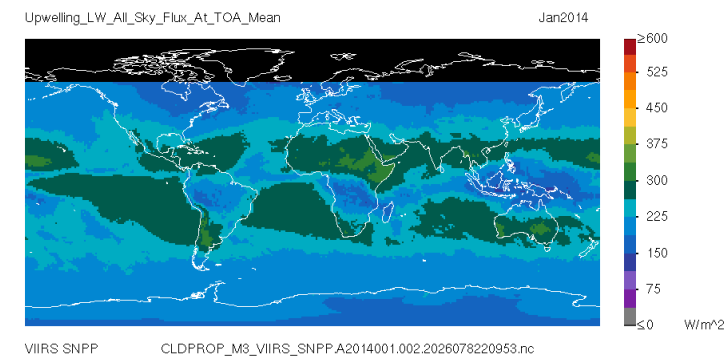
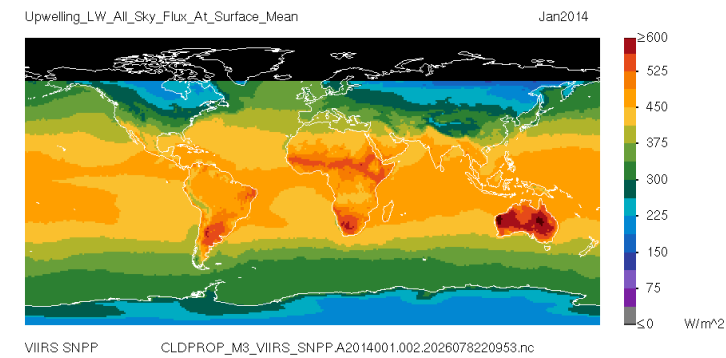
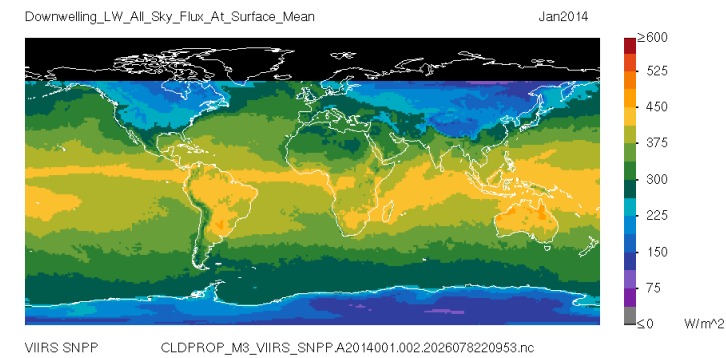
L3 SDS Name:	Upwelling_LW_Cloudy_Flux_At_TOA
Filtering Equation Using L2 SDS:	Upwelling_LW_Cloudy_Flux_At_TOA [where Upwelling_LW_Cloudy_Flux_At_TOA > 0.0]
Description:	<i>Upwelling longwave cloudy sky flux at TOA for cloudy pixels only</i>
L3 SDS Name:	Upwelling_LW_Cloudy_Clear_Flux_At_TOA
Filtering Equation Using L2 SDS:	Upwelling_LW_Flux_At_TOA [where Upwelling_LW_Cloudy_Flux_At_TOA > 0.0]
Description:	<i>Upwelling longwave clear sky flux at TOA for cloudy pixels only</i>
L3 SDS Name:	Upwelling_LW_Clear_Flux_At_TOA
Filtering Equation Using L2 SDS:	Upwelling_LW_Flux_At_TOA [where Upwelling_LW_Cloudy_Flux_At_TOA = Fill_Value]
Description:	<i>Upwelling longwave clear sky flux at TOA for clear pixels only</i>



L3 SDS Name:	Downwelling_SW_All_Sky_Flux_At_Surface
Filtering Equation Using L2 SDS:	Downwelling_SW_Cloudy_Flux_At_Surface [where Downwelling_SW_Cloudy_Flux_At_Surface > 0.0] & Downwelling_SW_Flux_At_Surface [where Downwelling_SW_Cloudy_Flux_At_Surface = Fill_Value]
Description:	<i>Downwelling shortwave all sky flux at the surface</i>
L3 SDS Name:	Upwelling_SW_All_Sky_Flux_At_Surface
Filtering Equation Using L2 SDS:	Upwelling_SW_Cloudy_Flux_At_Surface [where Upwelling_SW_Cloudy_Flux_At_Surface > 0.0] & Upwelling_SW_Flux_At_Surface [where Upwelling_SW_Cloudy_Flux_At_Surface = Fill_Value]
Description:	<i>Upwelling shortwave all sky flux at the surface</i>
L3 SDS Name:	Upwelling_SW_All_Sky_Flux_At_TOA
Filtering Equation Using L2 SDS:	Upwelling_SW_Cloudy_Flux_At_TOA [where Upwelling_SW_Cloudy_Flux_At_TOA > 0.0] & Upwelling_SW_Flux_At_TOA [where Upwelling_SW_Cloudy_Flux_At_TOA = Fill_Value]
Description:	<i>Upwelling shortwave all sky flux at TOA</i>



L3 SDS Name:	Downwelling_LW_All_Sky_Flux_At_Surface
Filtering Equation Using L2 SDS:	Downwelling_LW_Cloudy_Flux_At_Surface [where Downwelling_LW_Cloudy_Flux_At_Surface > 0.0] & Downwelling_LW_Flux_At_Surface [where Downwelling_LW_Cloudy_Flux_At_Surface = Fill_Value]
Description:	Downwelling longwave all sky flux at the surface
L3 SDS Name:	Upwelling_LW_All_Sky_Flux_At_Surface
Filtering Equation Using L2 SDS:	Upwelling_LW_Cloudy_Flux_At_Surface [where Upwelling_LW_Cloudy_Flux_At_Surface > 0.0] & Upwelling_LW_Flux_At_Surface [where Upwelling_LW_Cloudy_Flux_At_Surface = Fill_Value]
Description:	Upwelling longwave all sky flux at the surface
L3 SDS Name:	Upwelling_LW_All_Sky_Flux_At_TOA
Filtering Equation Using L2 SDS:	Upwelling_LW_Cloudy_Flux_At_TOA [where Upwelling_LW_Cloudy_Flux_At_TOA > 0.0] & Upwelling_LW_Flux_At_TOA [where Upwelling_LW_Cloudy_Flux_At_TOA = Fill_Value]
Description:	Upwelling longwave all sky flux at TOA



Additional “Flavors” of output files

Users should note in addition to the standard Imager data, another flavor of L3 output files are offered: a coupling of imager data with IR sounder data that restores MODIS-like IR absorbing channels (H_2O , CO_2) absent on VIIRS.

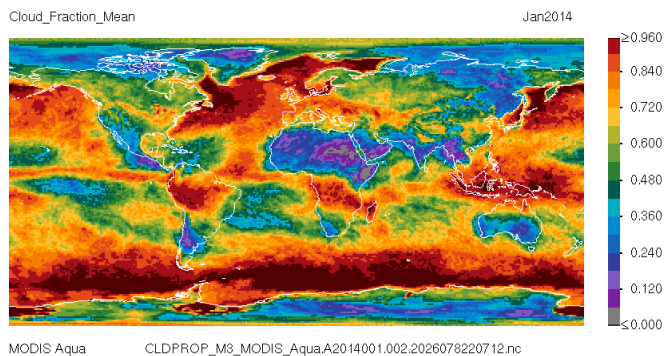
- For MODIS imager data, the sounder data that was used in conjunction was AIRS data. In order to properly couple the two datasets, only the imager data that resided inside the sounder footprint was used
- For VIIRS imager data, the sounder data that was used in conjunction was CrIS data. Once again, in order to properly couple the two datasets, only the imager data that resided inside the sounder footprint was used.

The prefixes for the output filenames of the 4 flavors of CLDPROP data are

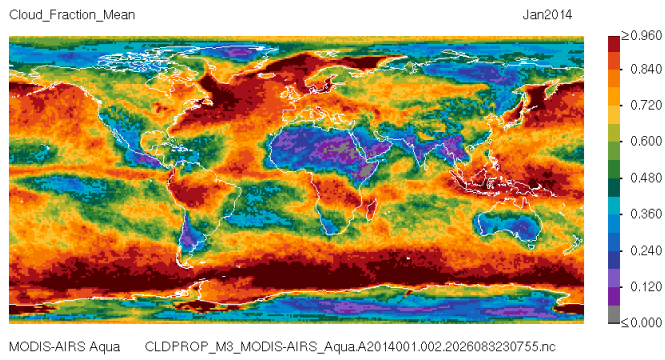
1. CLDPROP_MODIS_Aqua (MODIS Aqua imager only)
2. CLDPROP_MODIS-AIRS_Aqua (MODIS Aqua & AIRS coupling)
3. CLDPROP_VIIRS_SNPP (VIIRS SNPP imager only)
4. CLDPROP_VIIRS-CrIS_SNPP (VIIRS SNPP & CrIS coupling)

Some examples of how the L3 data changes between the imager only vs. imager+sounder are shown in several Monthly (M3) images below. Note the changes in many cases are subtle, especially using this particular color bar.

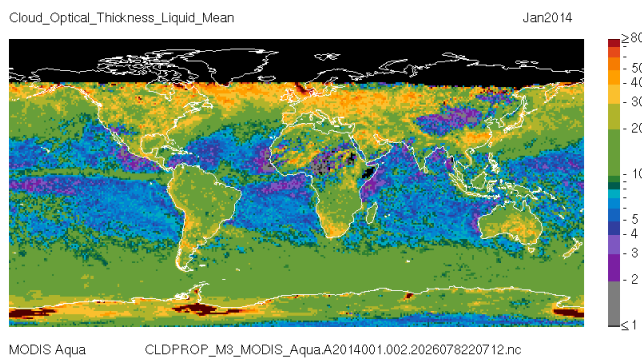
Imager Only



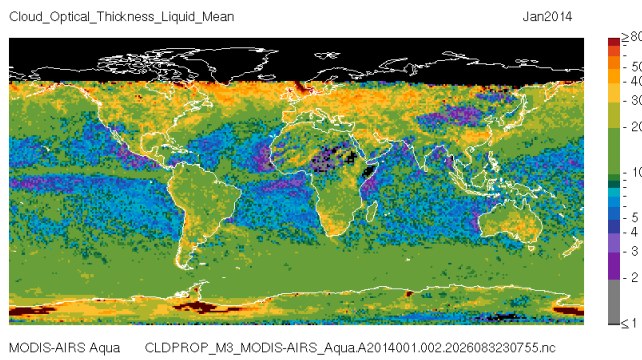
Imager+Sounder



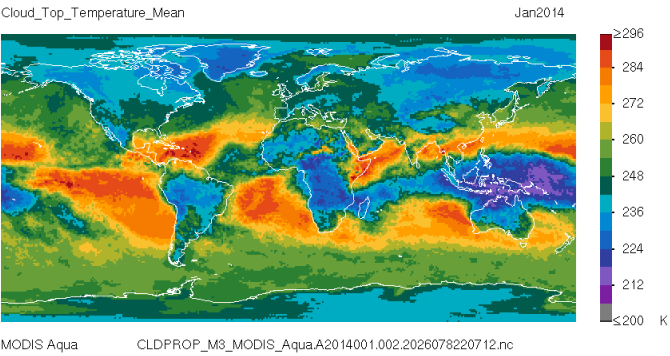
Imager Only



Imager+Sounder



Imager Only



Imager+Sounder

