SARB Working Group Update: Status of Ed4 SYNI Development

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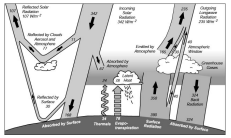


Outline

- Changes from Ed3A SYNI product
- Issues
  - Ice Cloud optical properties
    - Fu 2007 for Ed4 SARB
    - Ping Yang for Ed4 Clouds
    - De versus Re
  - LWC vertical profile
  - Cloud Tops
    - Cloud top height (Peff vs. Ptop)
    - CO_2 Slicing on Goes12 and Met9

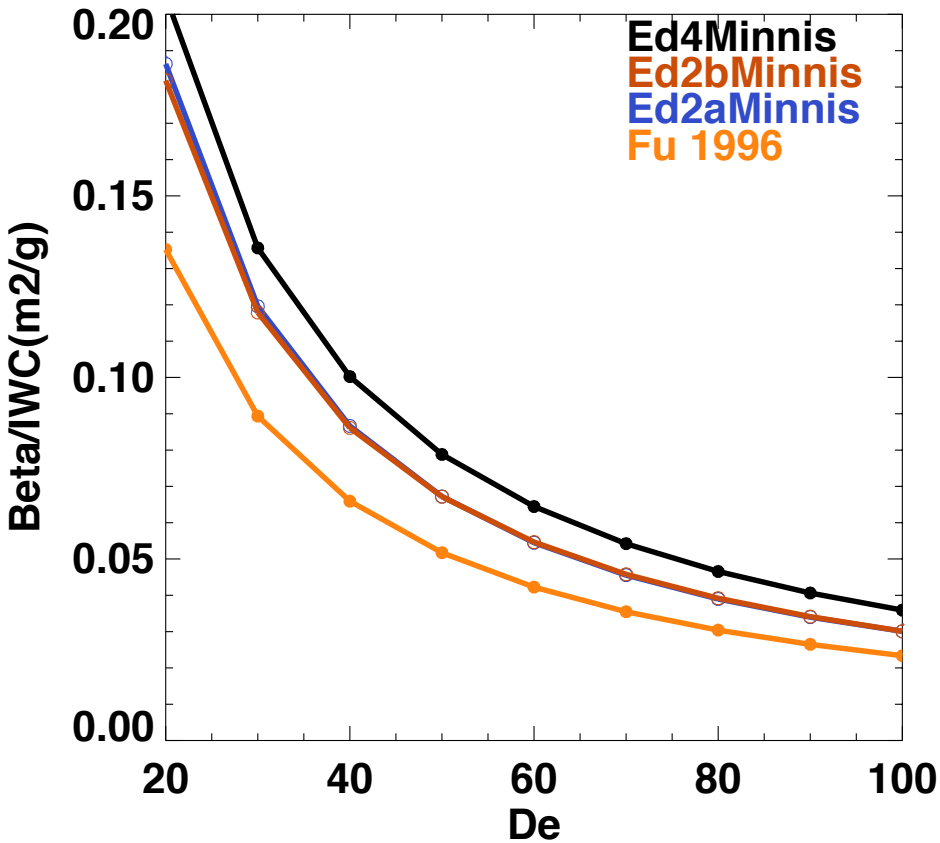
Changes for Ed4 Syni

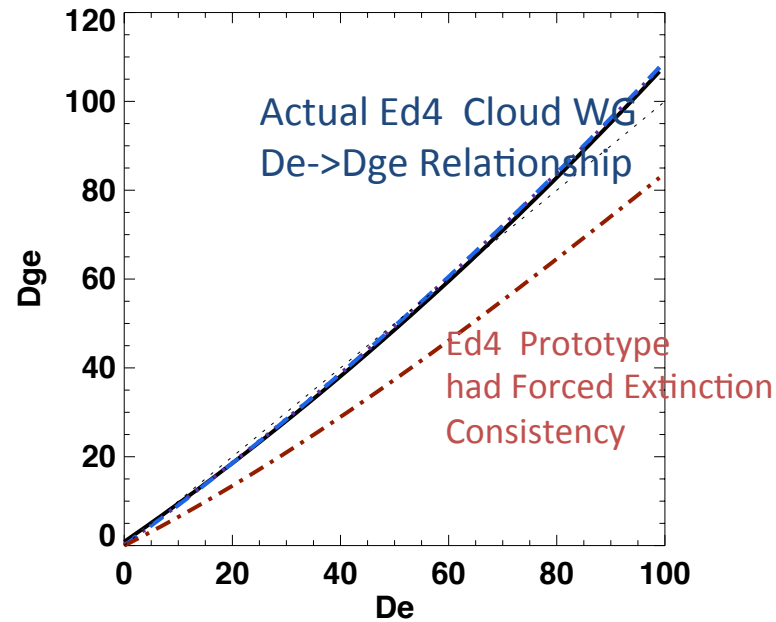
- Random Overlap
  - Up to 4 cloud layers on grid-hr box scale
- Entropy related outputs
- Cloud WG Temperature Humidity below 850 hPa when Cldy
- Hourly Ed4 MATCH Aerosols
- New Ed4 Surface albedo history (Modis Clear) when CERES Pt. Cldy
- MCD43C1 Sfc Albedo Spectral Shape (Land & Snow)
- Hybrid Solver:
  - 4 Stream (Homogeneous Cld & Clear) , GWTSA (Inhomo. Cld)
- GEO five-chan, Hourly : Clouds and TOA Flux Observation
  - Improved NB->BB
  - Clear sky skin temperature retrievals

Ed3A SYNI Ice Cloud Optical properties

- Ed2 Clouds
  - De
  - Minnis 1996: Tau -> IWP
- Fu 1996 Ice cloud optical properties
  - De -> Dge
    - Which forced consistency of “Fu1996” and Ed2 Clouds” visible extinction

Ed4 Clouds IWP/Extinction and De/Dge definitions require changes for Ed4 Sarb SYNI





Schematic of Ice Property Conversions

Ed2:

(IWP,Dge) <-- [Dge <- De] and [bext_Minnis_ed2] <-- Cloud WG(Tau, De)

(IWP,Dge) --> [bext_Fu96(iband)] --> Extinction(iband)

(Dge) --> Fu96(iband) --> SSA(iband) , ASY(iband)

Ed4: provisional omits use of [bext_Minnis_Ed4]

(IWP,Dge) <-- [bext_Fu07(VIS)] <-- Cloud WG(Tau, Dge)

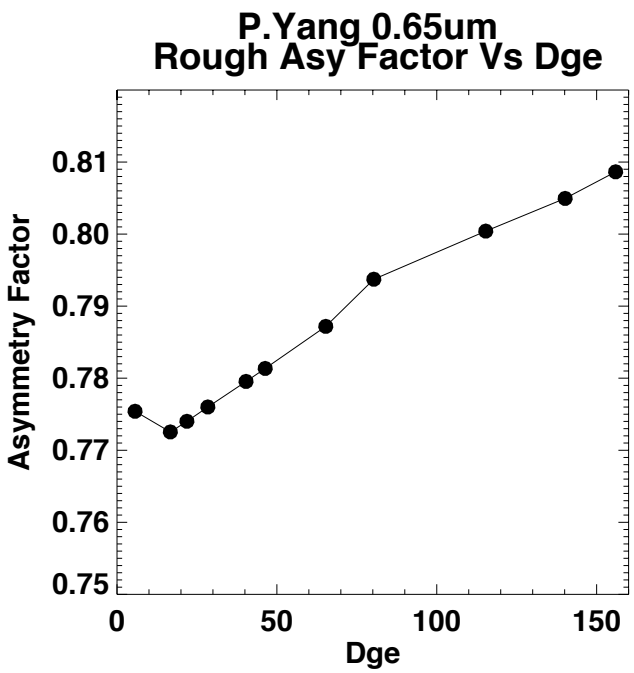
(IWP,Dge) --> [bext_Fu07(iband)] --> Extinction(iband)

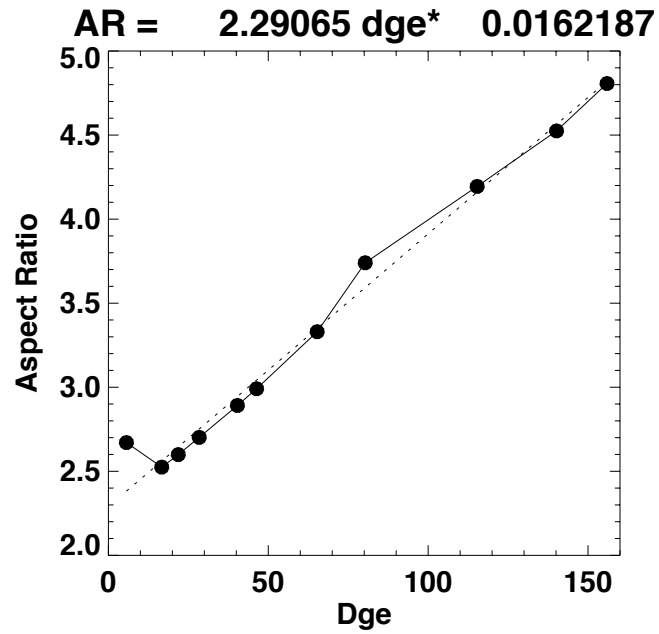
and

(AspectRat) <--[Fu/Pyang Parm] <-- (ASY(Vis)) <-- [P.Yang rough] <-- Cloud WG(Dge)

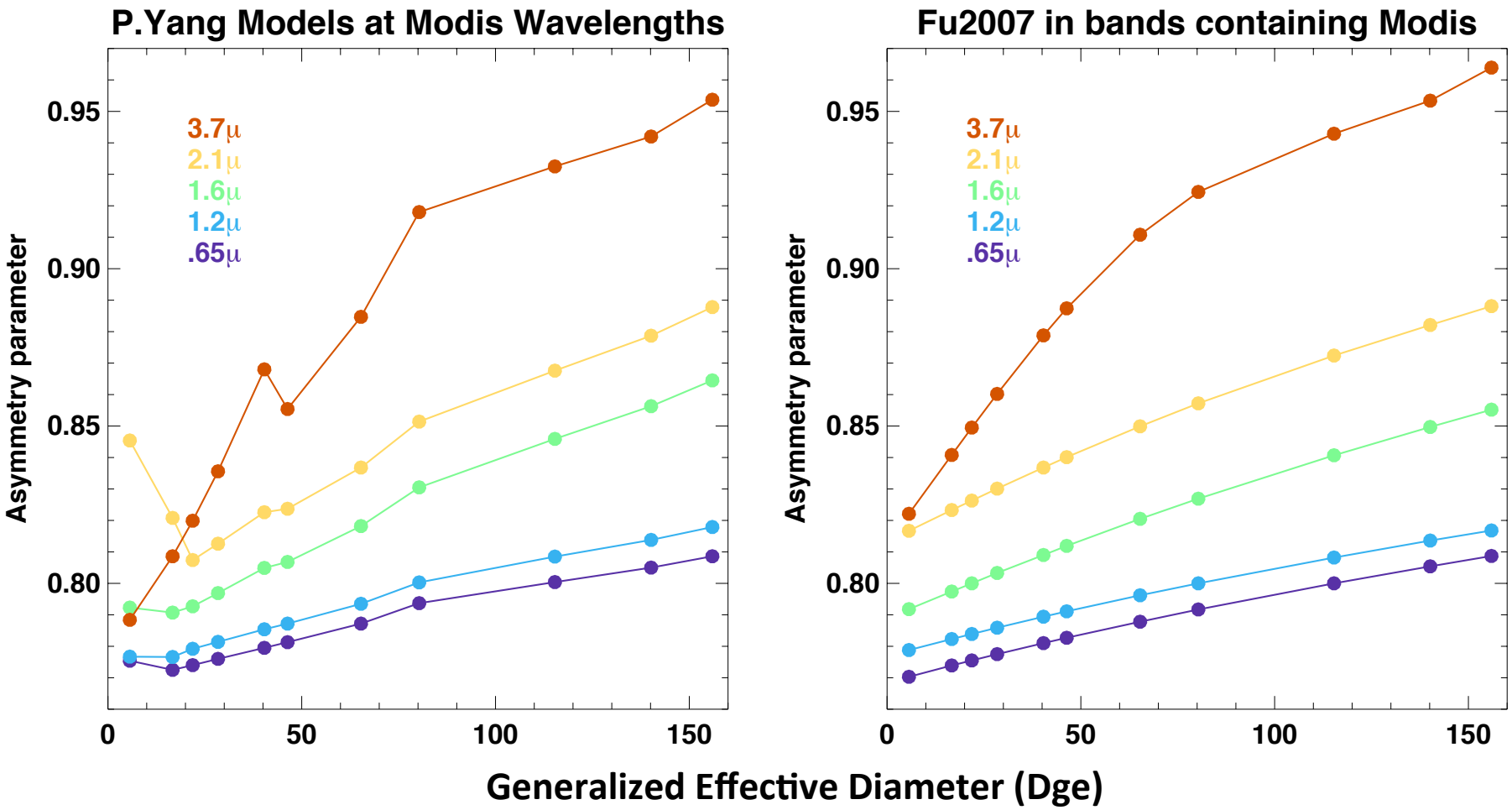
(Dge ,AspectRat) --> [Fu07(iband)] --> SSA(iband) , ASY(iband)

Ed4 Conversion of Dge to AspectRatio for FU2007 Model Input



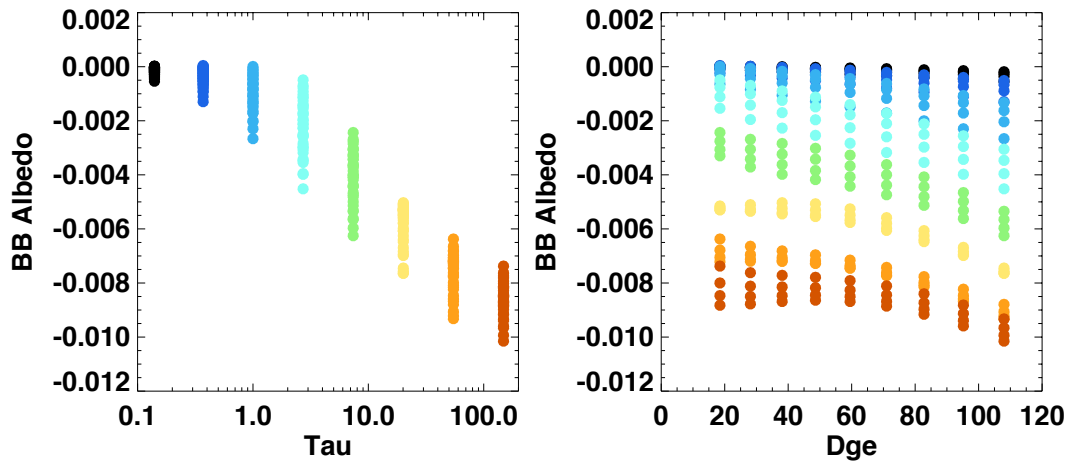


Asymmetry Parameter Consistency

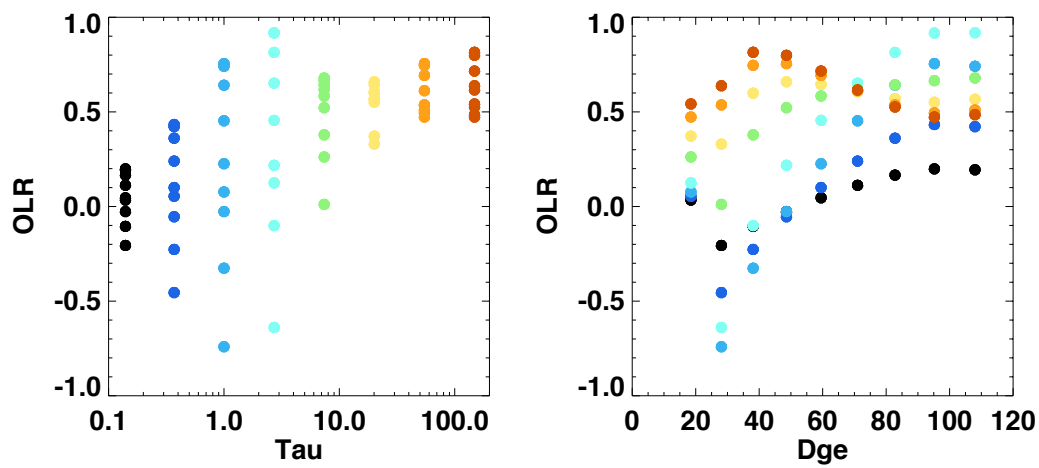


Fu-Liou Sensitivity Results using Ed4 provisional Tau-->IWP & Dge-> AR

-0.005 TOA Albedo Decrease
~-5Wm-2 SWTOA Decrease



~+0.5 Wm-2 OLR Increase

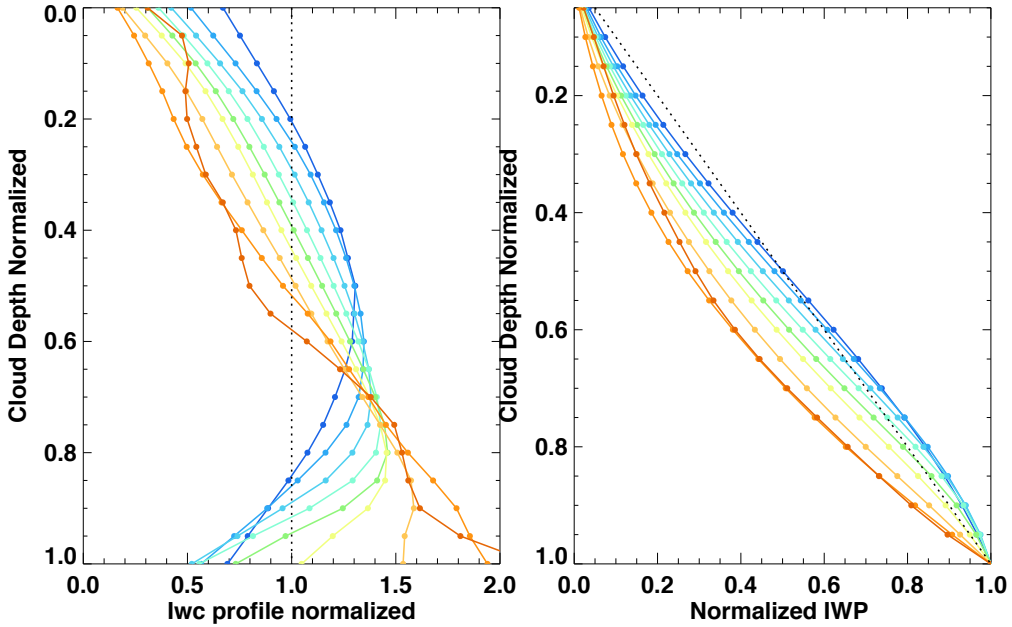


IWC Profile

- Based on work by S.H.Ham using Calipso and CldSat data
  - Seung-Hee Ham, Byung-Ju Sohn, Seiji Kato, and Masaki Satoh, Vertical structure of ice cloud layers from CloudSat and CALIPSO measurements and comparison to NICAM simulations, JGR September 2013
- Modify assumption in Ed4 SYNI Fu-Liou
  - from a constant IWC profile
  - to one consistent with observations

Calipso/ CldSat
Observed profiles

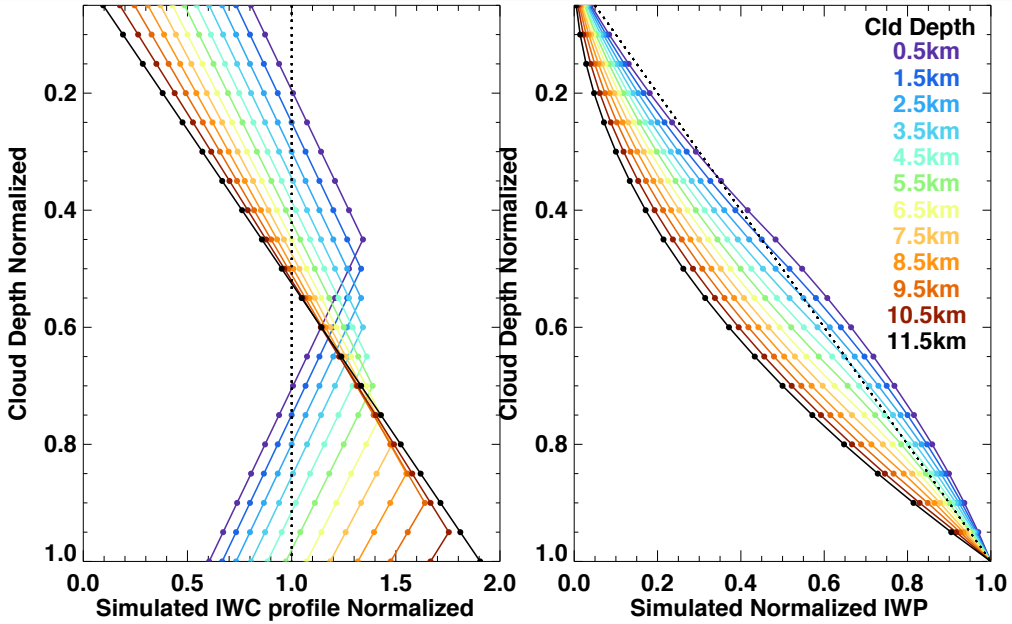
Geometric thick clouds have higher IWC towards the base of the cloud



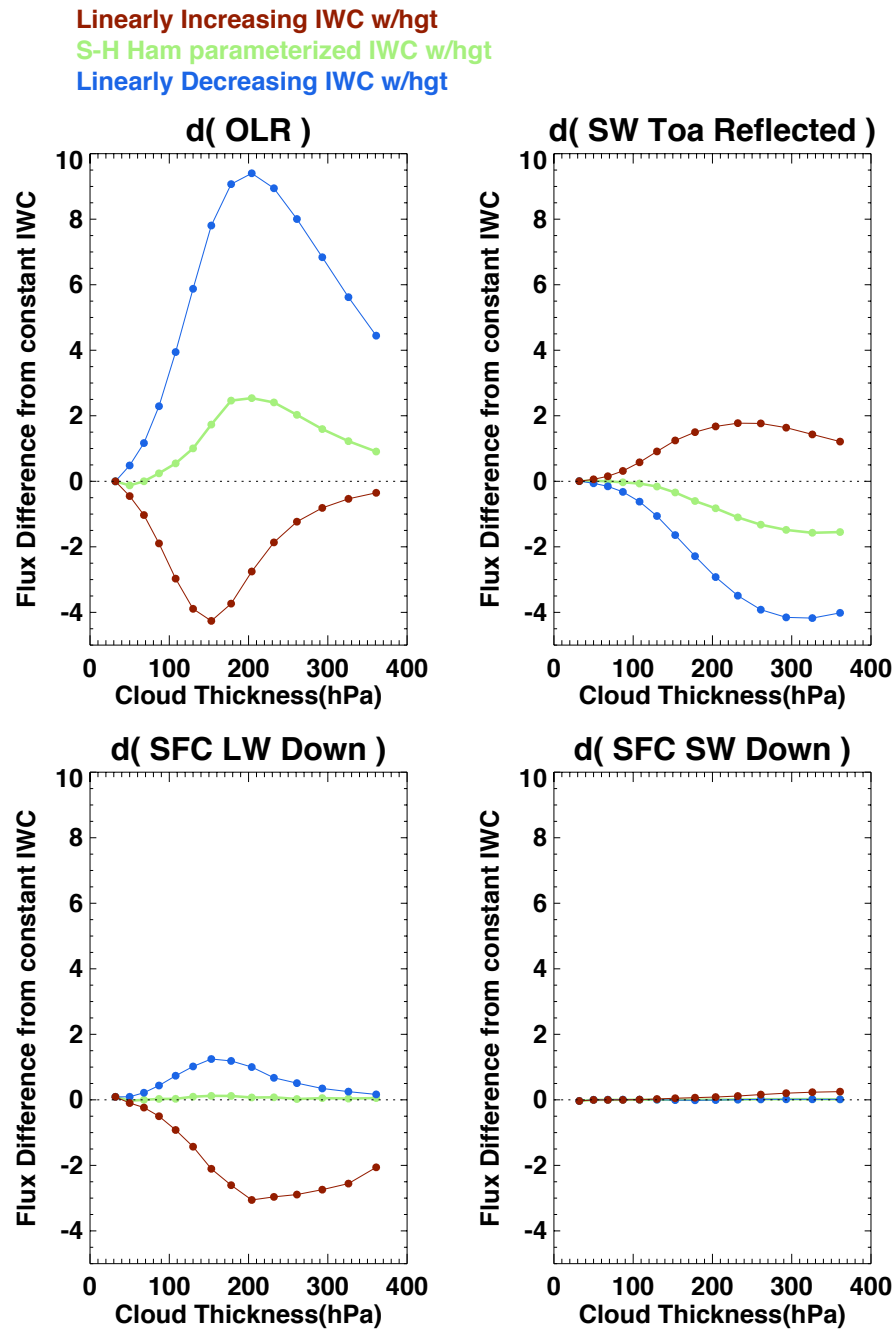
A parameterization
for discrete model layers

IWC norm(k) =
(1.0- ABS(Ztop-Z(k) – (Ztop-Zbot)*0.05-0.425))

Keep in mind thin:
clouds may only occupy one or two model layers



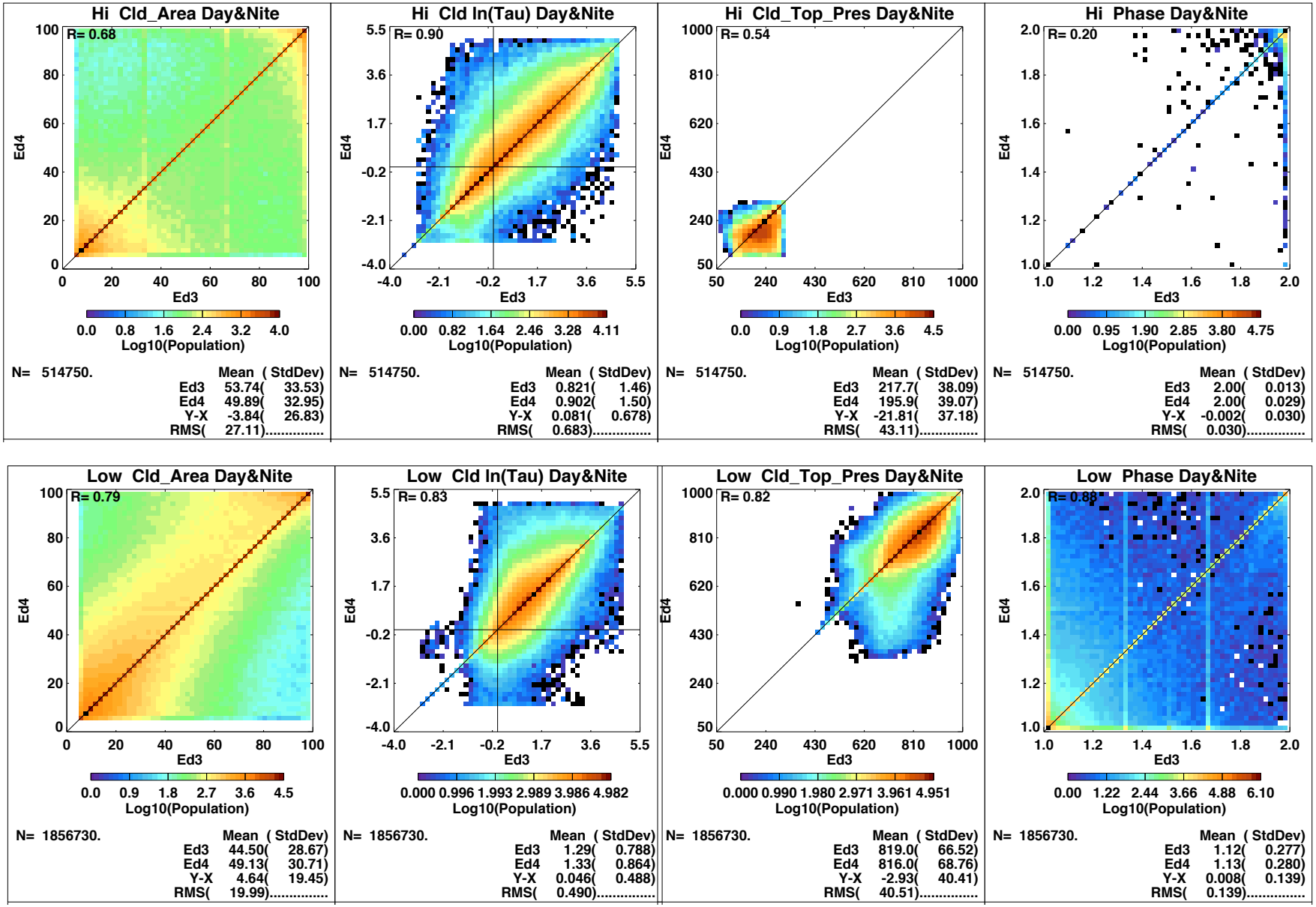
Sensitivity tests indicate only small changes to fluxes from implementation of observationally consistent IWC profiles



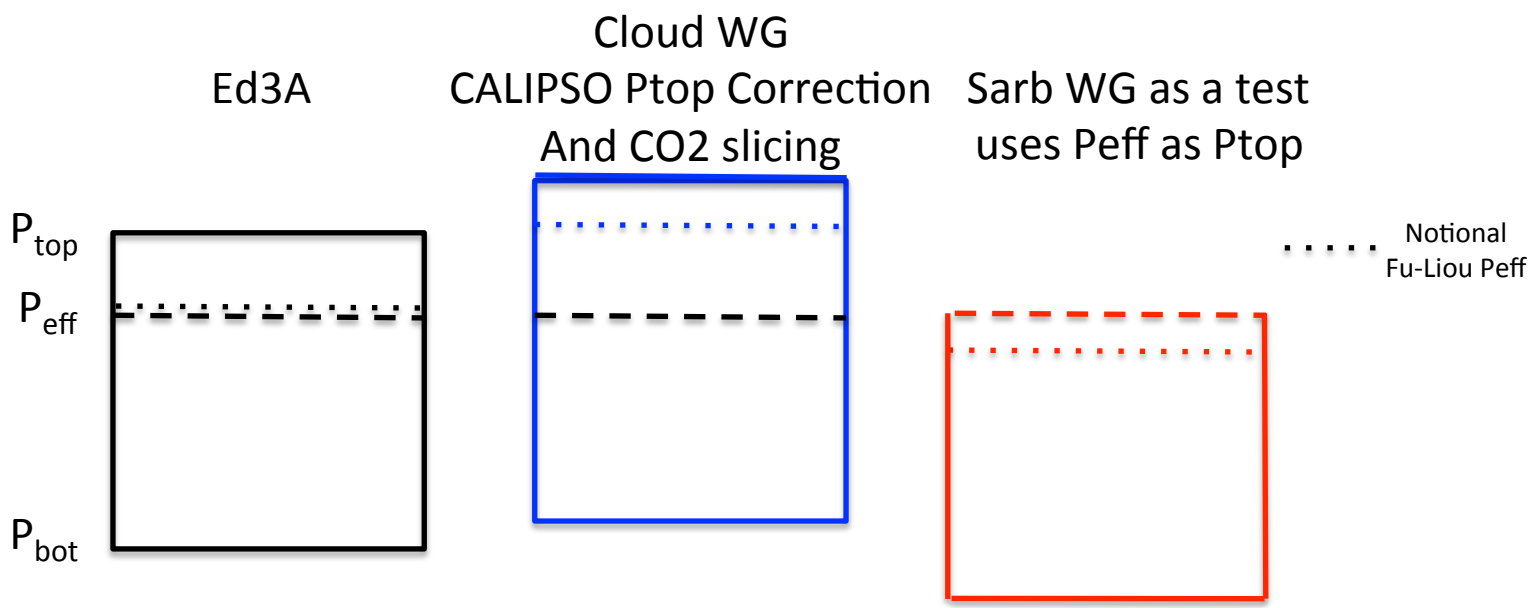
Ed4 and Ed3 TSI cloud properties

Hi Cld : Less Area (-3.8%) , Thicker tau(+8%) , Much lower Ptop (-22 hPa)

Lo Cld: More Area(+4.6%), Thicker tau(+5%), Slightly lower Ptop(-3 hPa)



Ed4 Cloud Tops

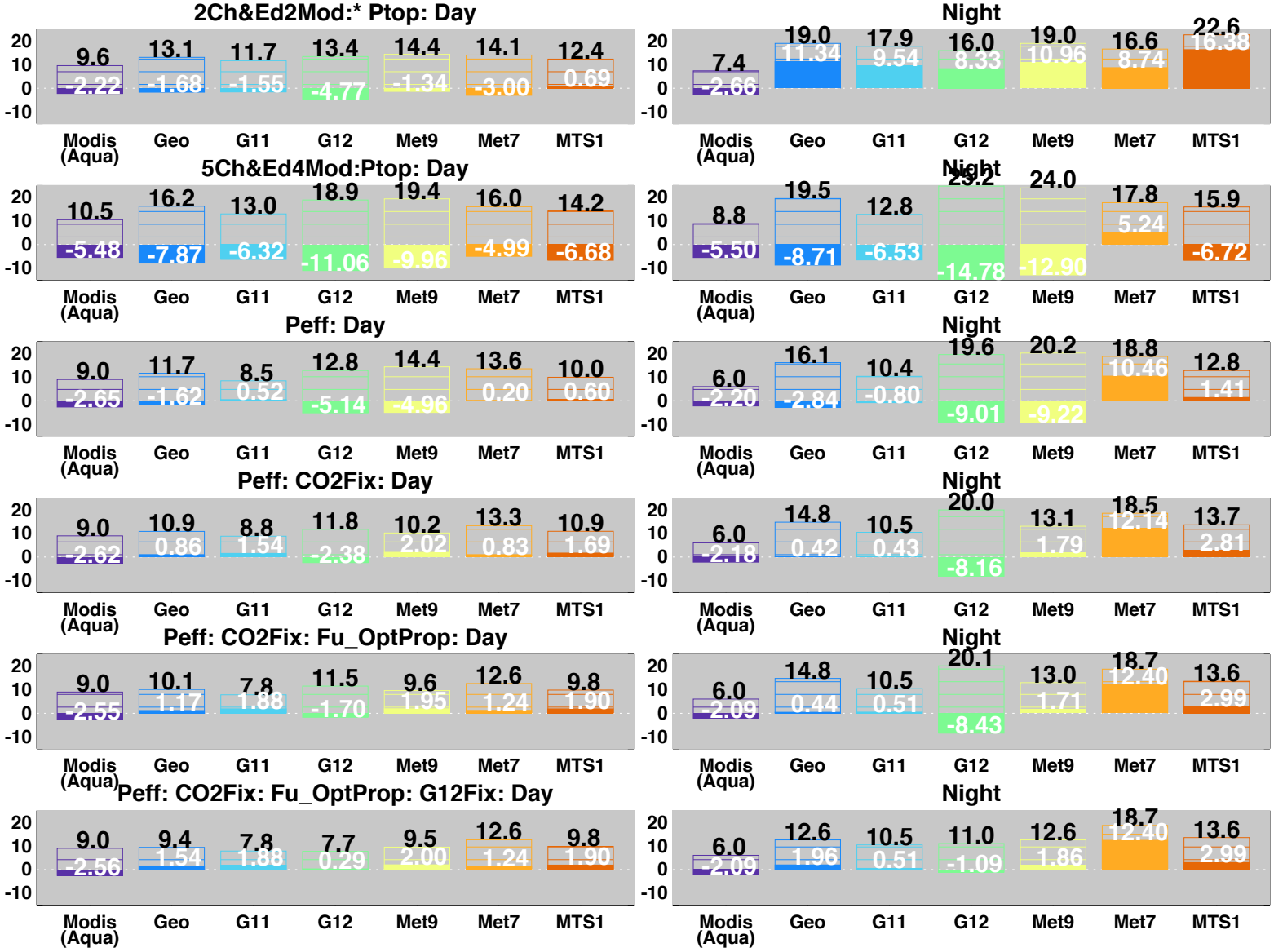


- Fu-Liou inputs P_{top} and Tau and computes P_{bot} and IWC profile

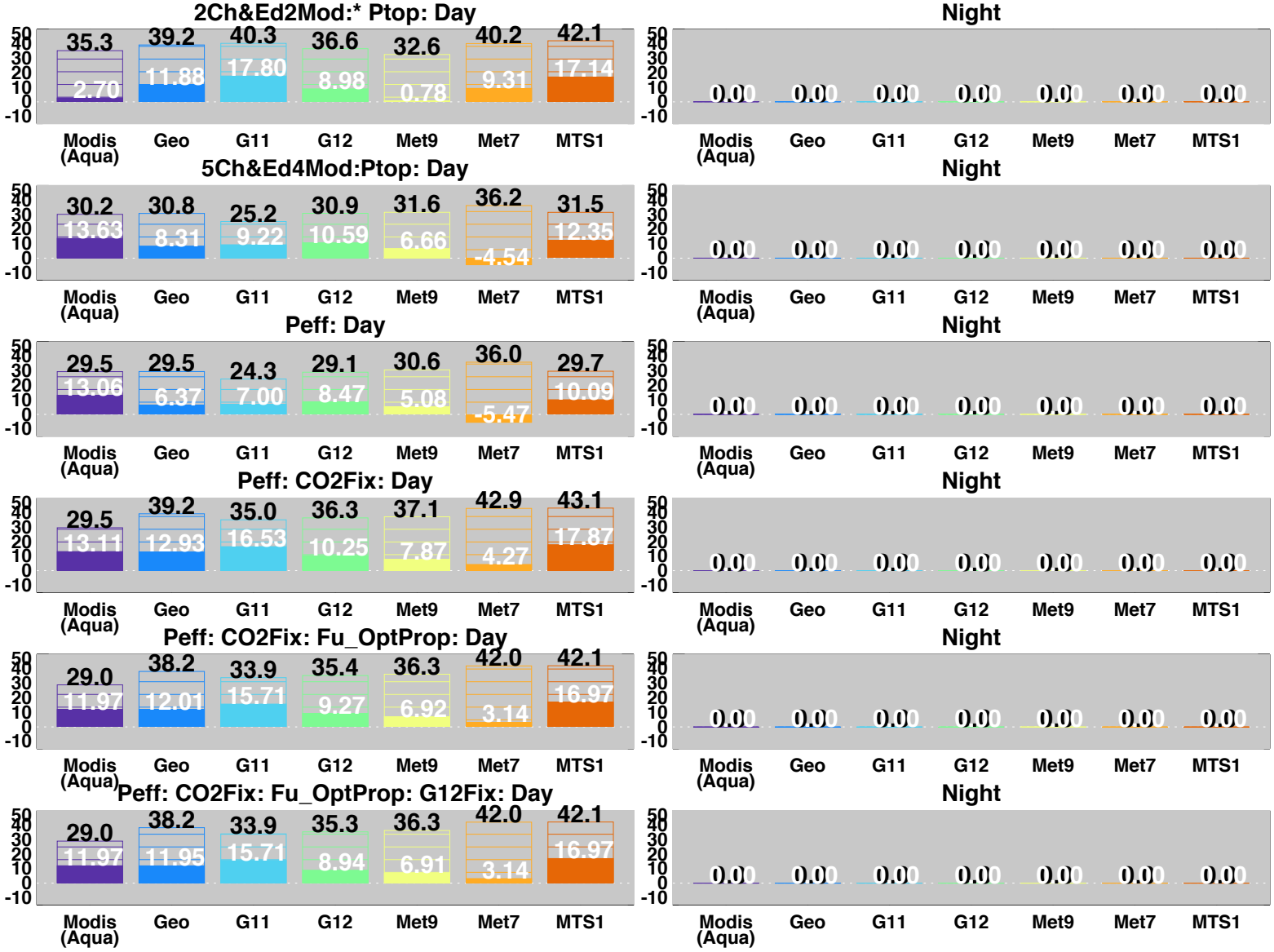
- Cloud WG CALIPSO P_{top} correction causes radiative inconsistency between retrieved P_{eff}/T_{eff} and computed P_{eff}/T_{eff}/OLR

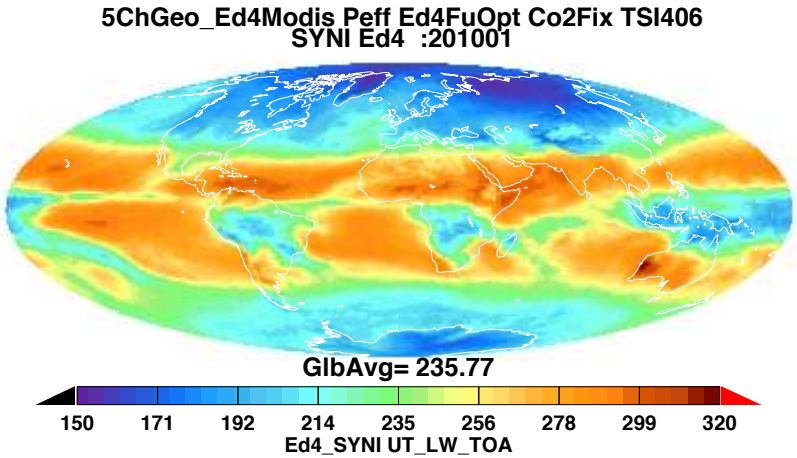
- Ed4 Cloud Top may be in better agreement with CALIPSO in the mean but are not in radiative agreement using Fu-Liou and a realistic ice water content profile.

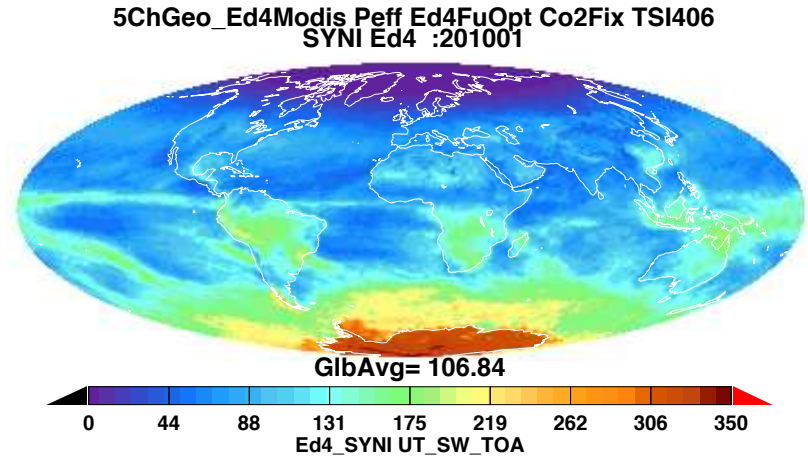
Ed4 SYNI ComputedOLR Bias & RMS error
10deg Zonal Subset with Hicloud



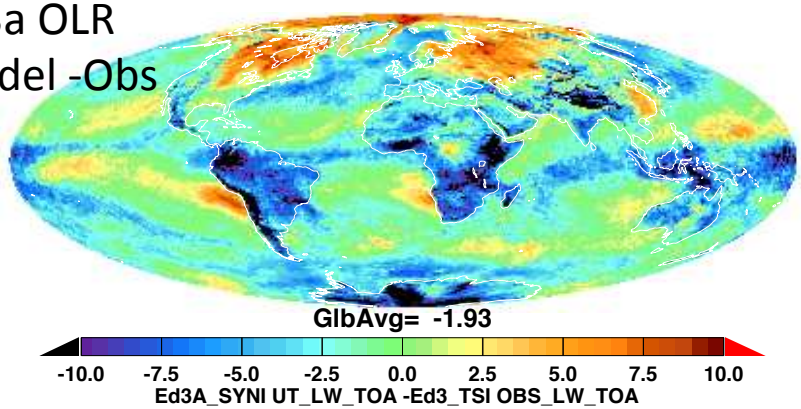
Ed4 SYNI Computed SWTOA Bias & RMS error
10deg Zonal Subset with Hicloud



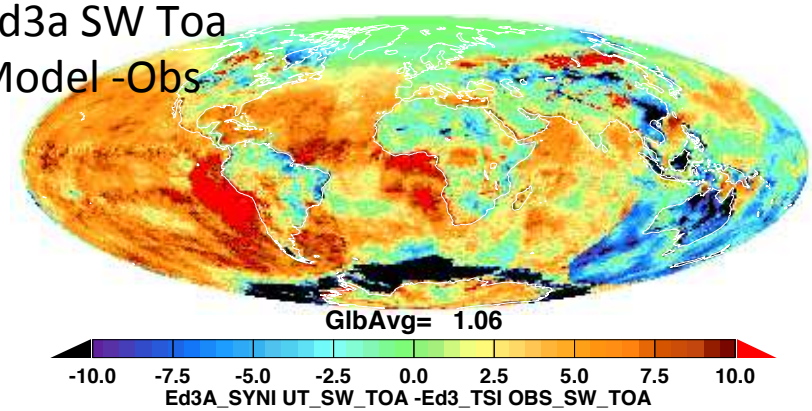




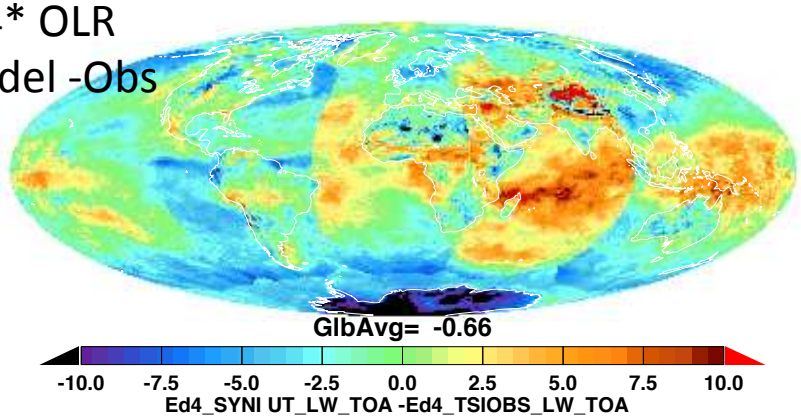
Ed3a OLR
Model -Obs



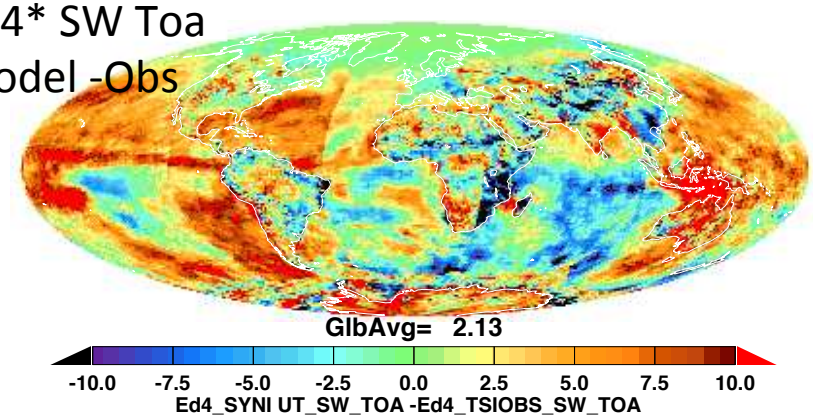
Ed3a SW Toa
Model -Obs

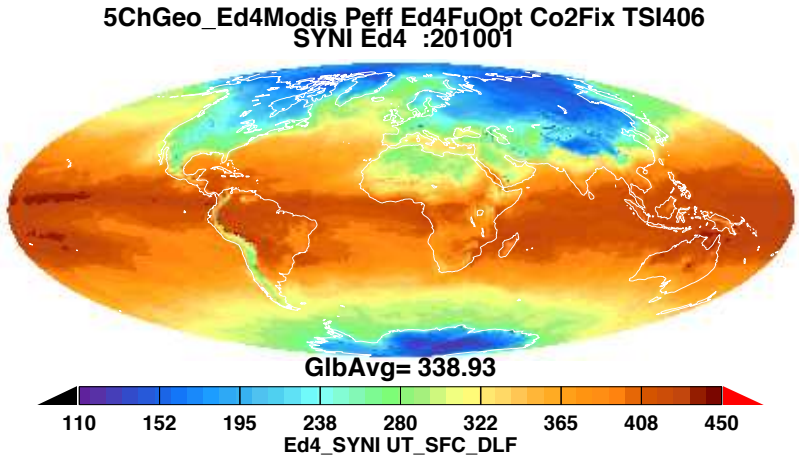


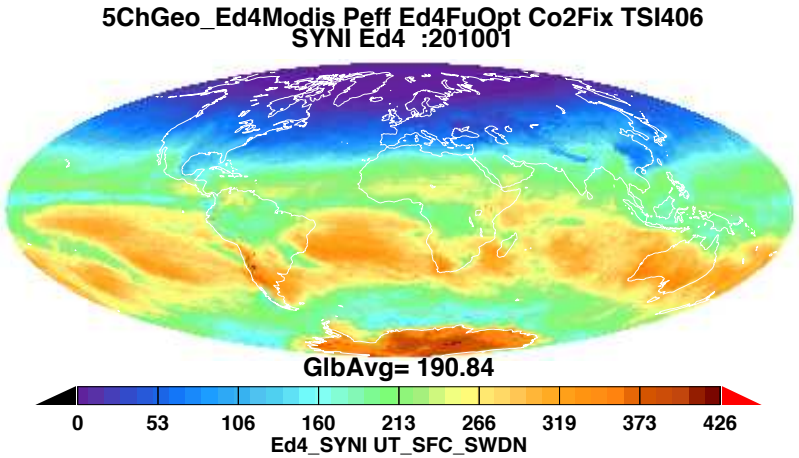
Ed4* OLR
Model -Obs

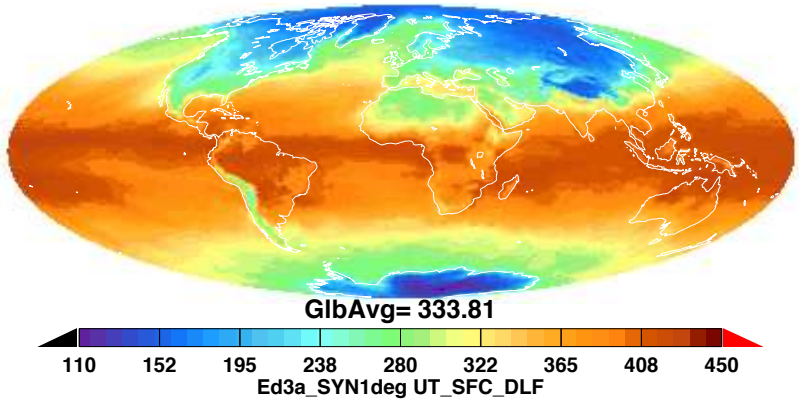


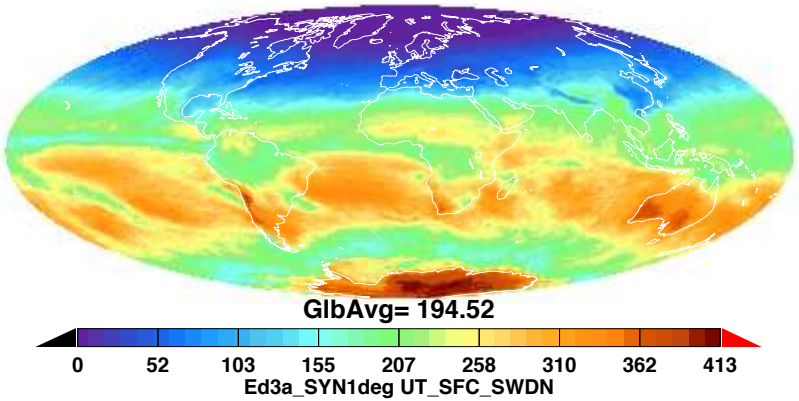
Ed4* SW Toa
Model -Obs





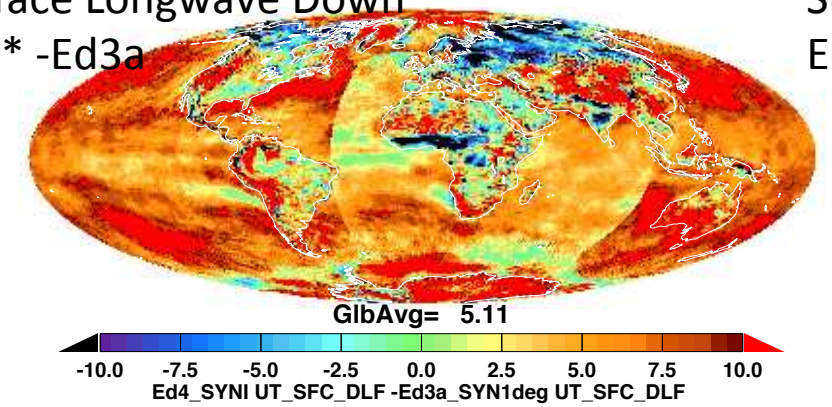






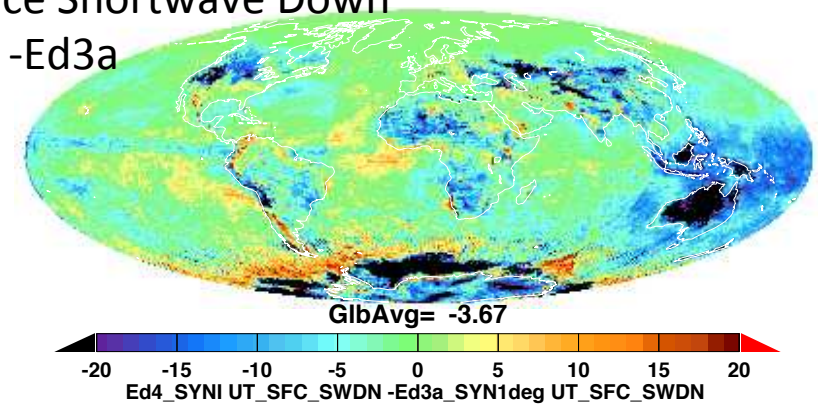
Surface Longwave Down

Ed4* -Ed3a



Surface Shortwave Down

Ed4* -Ed3a



Increased DLF and Reduced Sfc Sw Dn

- Increase in low cloud fraction from Ed4 Cloud retrievals
- Ed4 Random overlap assumption also pushes in the same direction.
- Current provisional use of P_{eff} rather than P_{top} lowers cloud base.

Conclusion

- Ed4 Modis&GEO Cloud Top information to date has not been radiatively consistent with Fu-Liou 2007 and Observed OLR.
- Use of Peff results in a computed OLR that is too warm (expected) but magnitude of pos. bias is less than the large negative bias from using Ptop which does not enforce radiative consistency.
- Sarb is working toward an Ed4 SYNI delivery using inputs from Ed4 Cloud code including hourly five channel Geo data. Efforts continue to achieve consistency.