Evaluating the Marine Atmospheric Boundary Layer in Reanalyses over Subtropical Eastern Oceans with COSMIC Radio Occultation, CALIPSO and radiosonde Measurements

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IROWG

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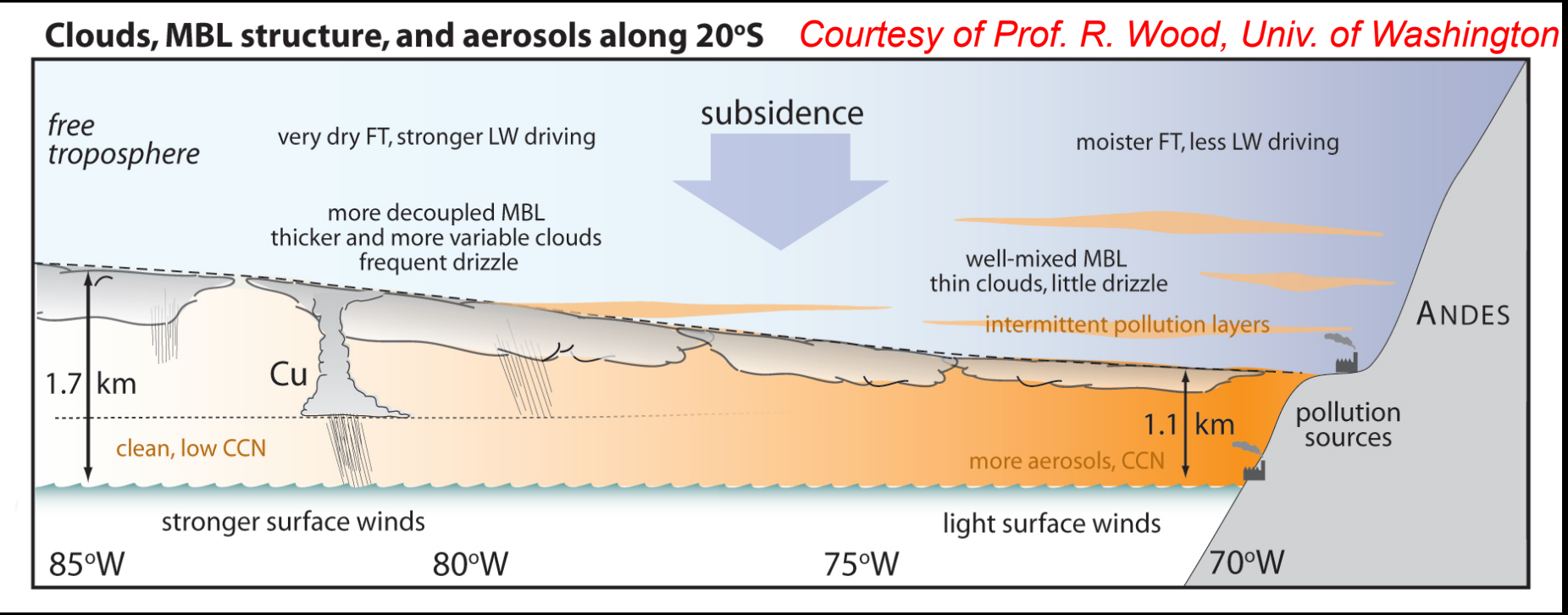
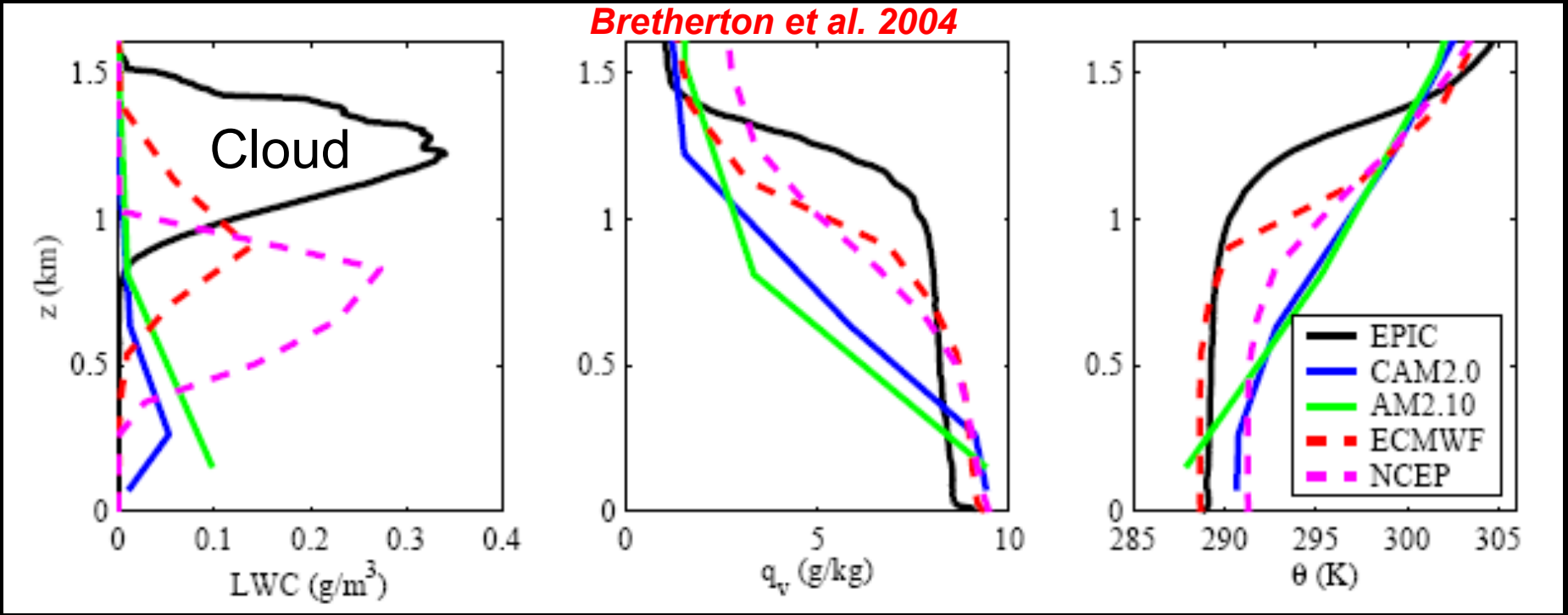
Why Atmospheric Boundary Layer?



- Key component of the weather and climate system, Interface between earth's surface and the free troposphere (affect energy and mass flux)
- Governing the evolution of low clouds (large uncertainty in climate feedback according to IPCC-2007 report)

Challenges for ABL Simulations/Observations

- A coupled system with complicated physical processes involved (e.g., turbulence, aerosol-cloud interaction, precipitation, Transition from Sc to trade-wind Cu)
- Limited vertical extent (1-2 km) – require high vertical resolution
- Frequent cloud existence



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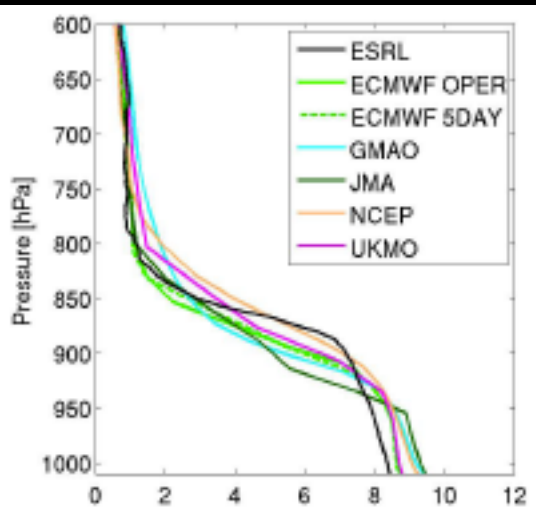
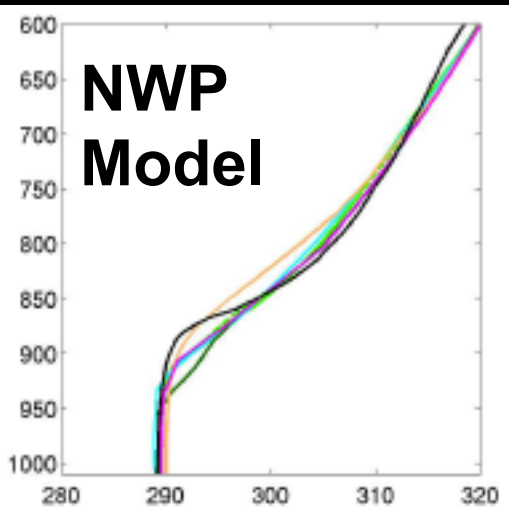
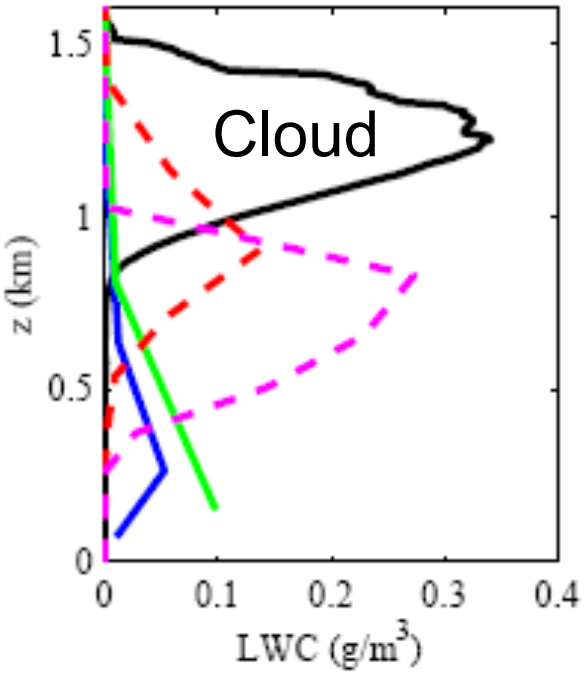
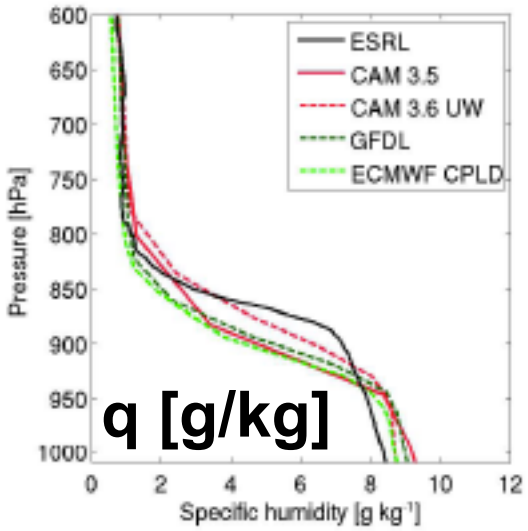
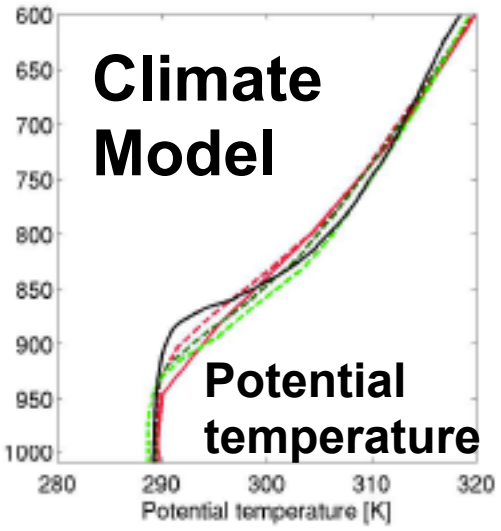






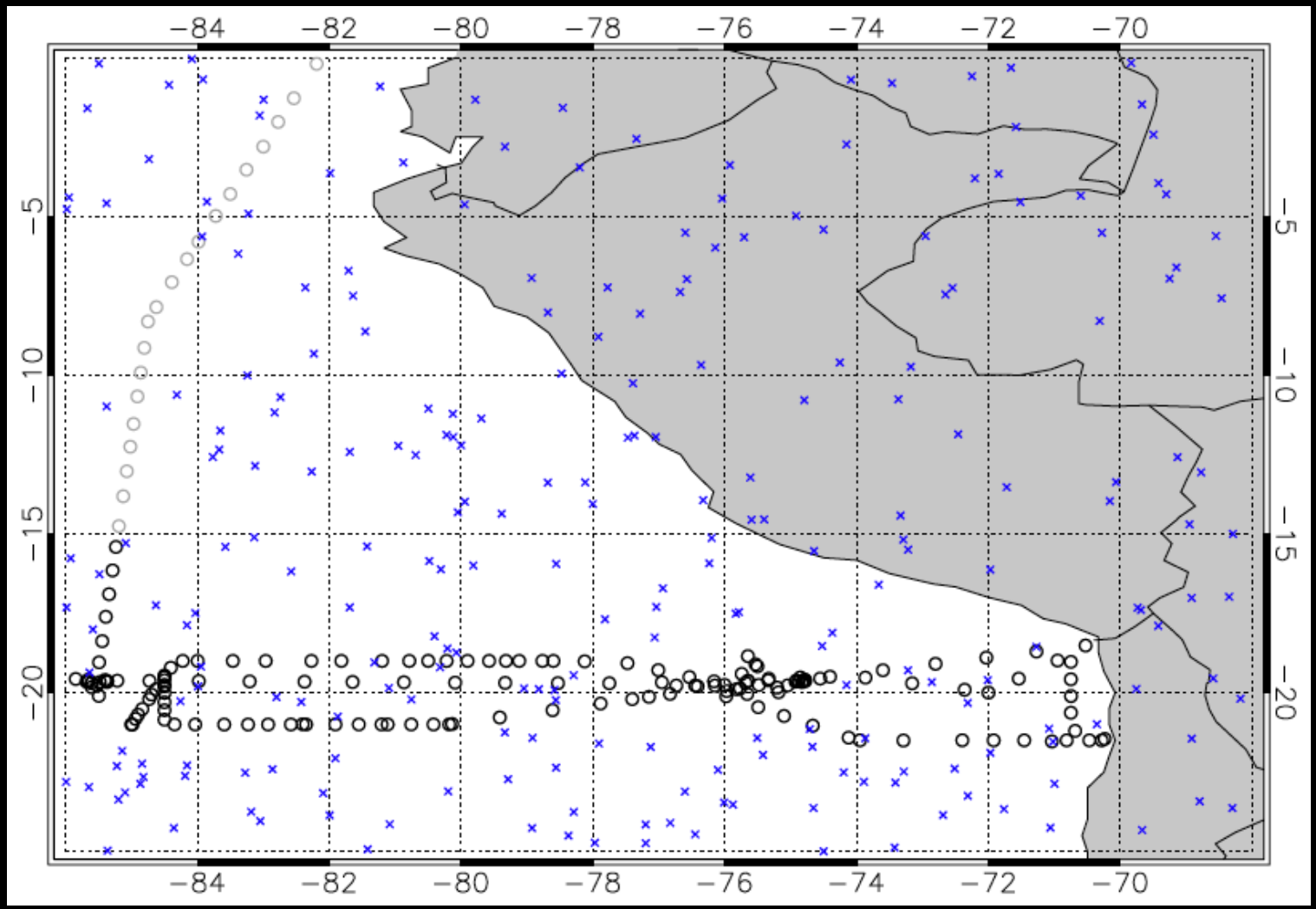
Wyant et al. 2010 ACP





VOCALS 2008 (Oct-Nov)

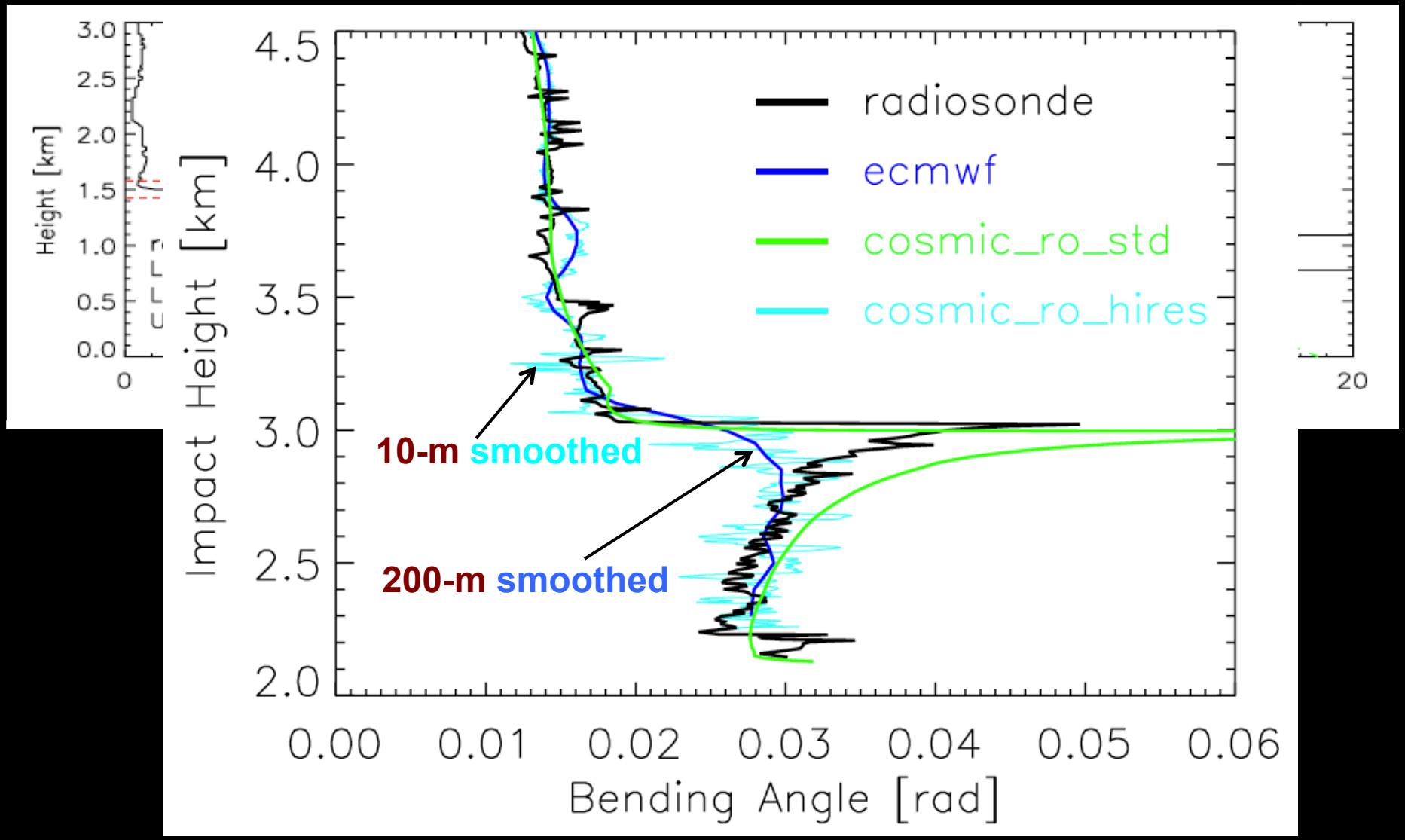
VAMOS Ocean-Cloud-Atmosphere-Land Study



Xie. et al., ACP, 2012

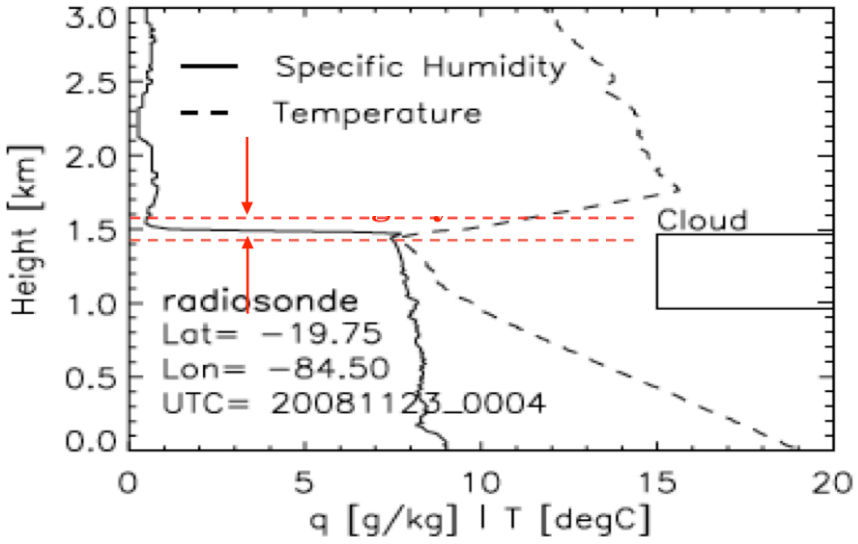
Near-coincident VOCALS ABL Case

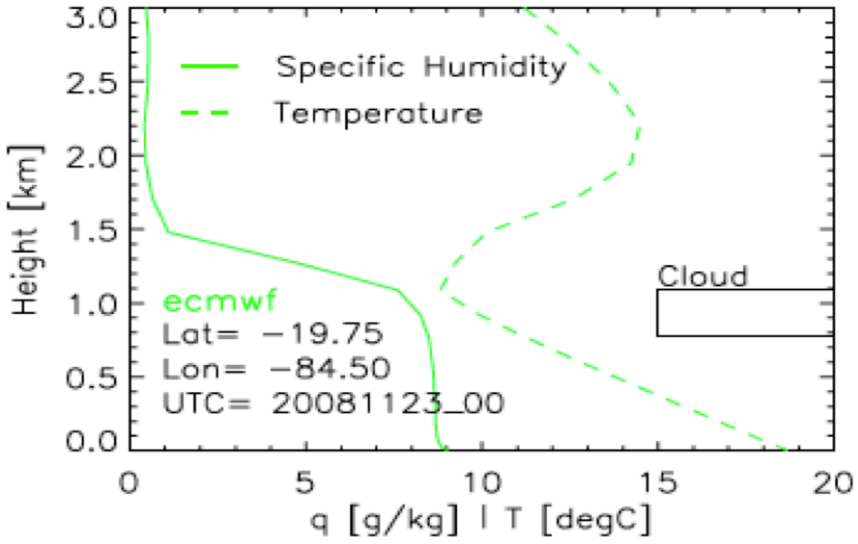
(COSMIC/RO vs. Radiosonde)



Near-coincident VOCALS ABL Case

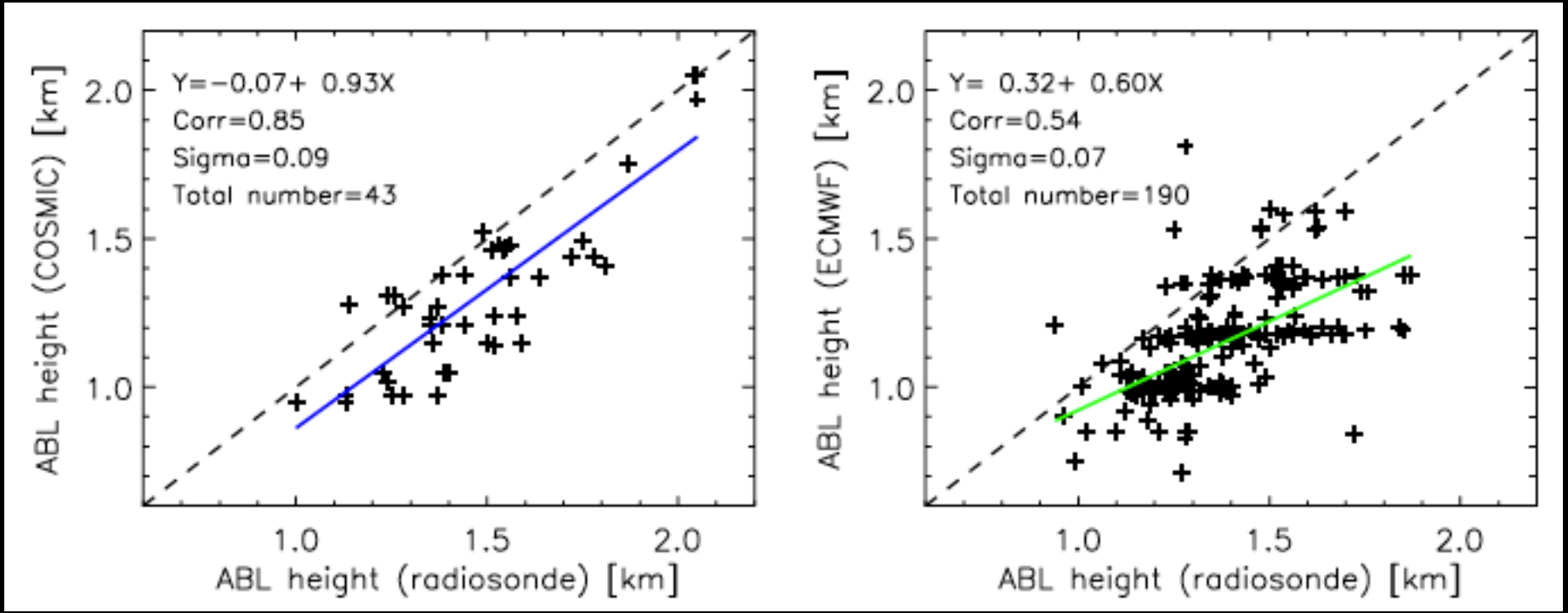
Radiosonde/GPSRO/ECMWF





Scatter-plot of ABL Heights

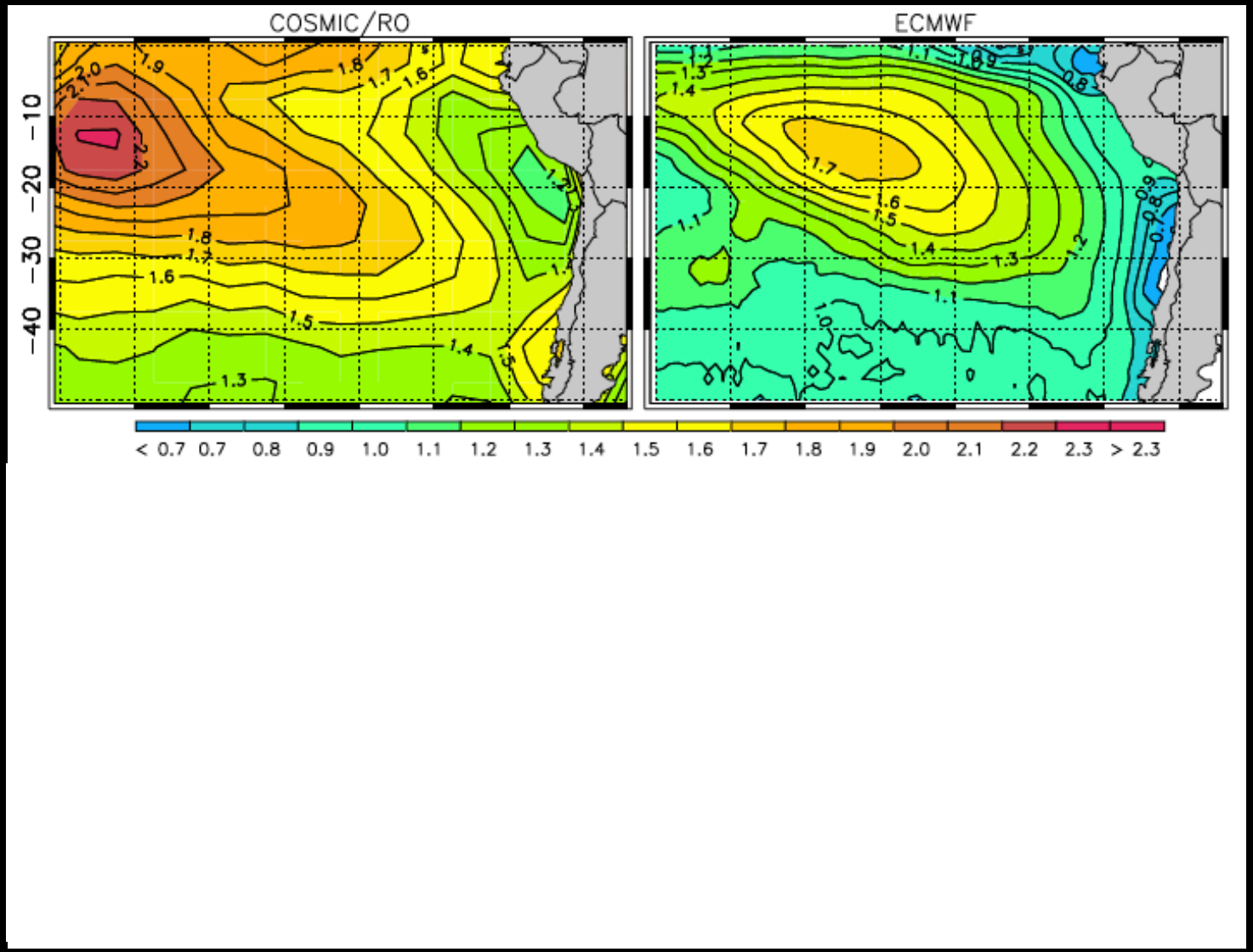
Close matches: Radiosonde/RO/ECMWF



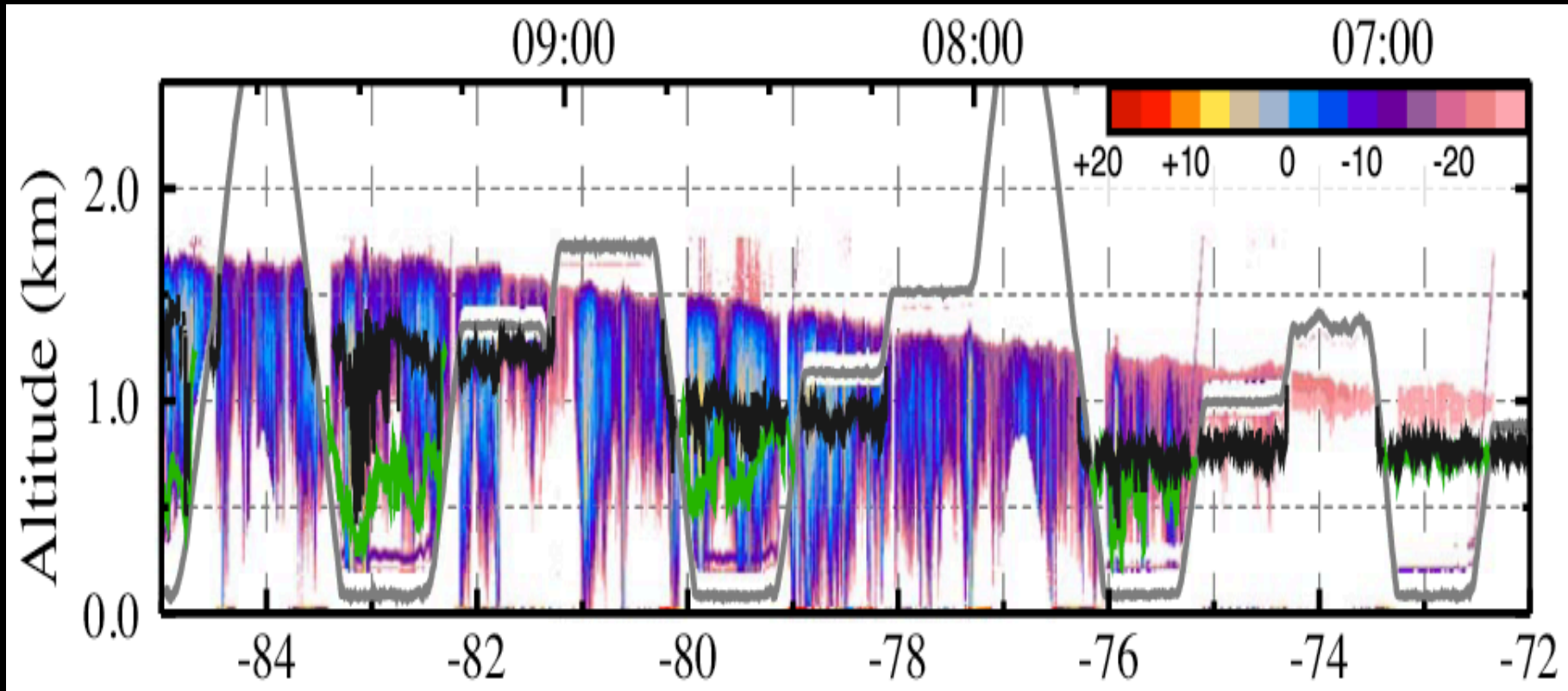
Xie. et al., ACP, 2012

ABL Height Comparison

(COSMIC vs. ECMWF-YOTC) 2007-2009-SON

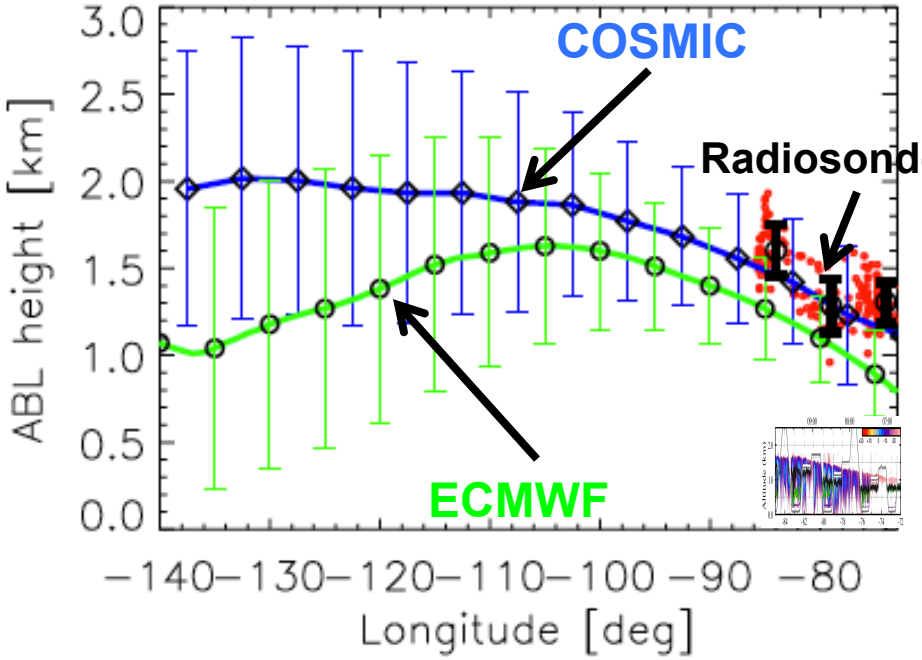


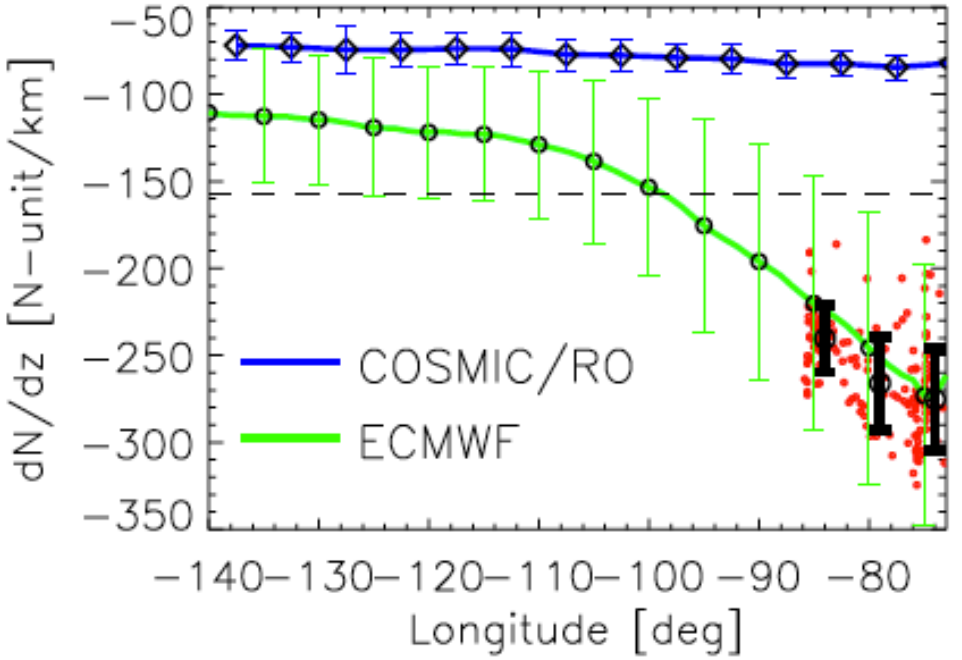
Transect of Cloud-Top-Height (~20S)
(VOCALS-2008)



Bretherton et al. 2010 ACP

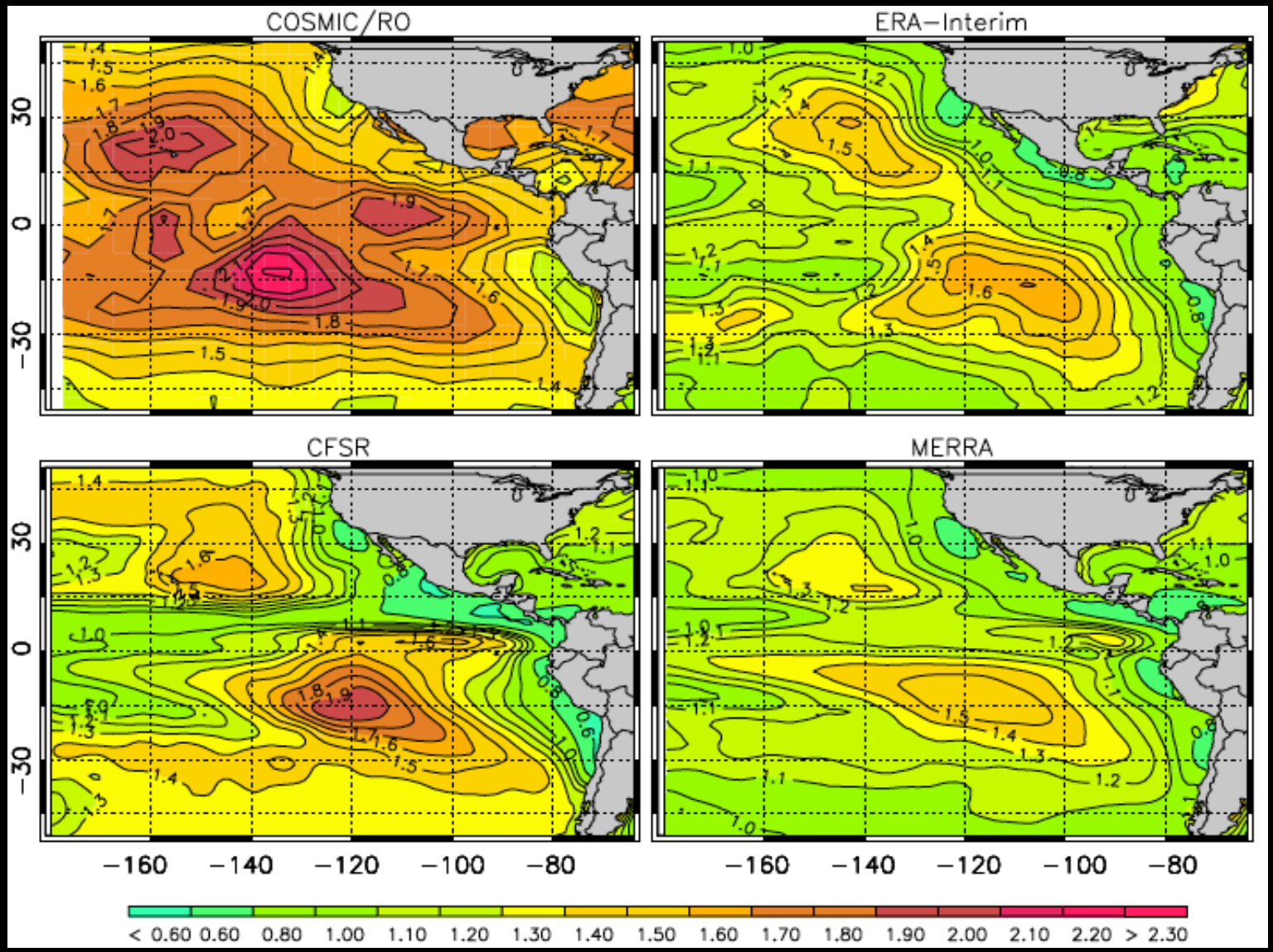
Transect of ABL Height at ~22S





ABL Height (COSMIC-Reanalyses)

(COSMIC vs. ERA-int/CFSR/MERRA) 2007-2009-SON



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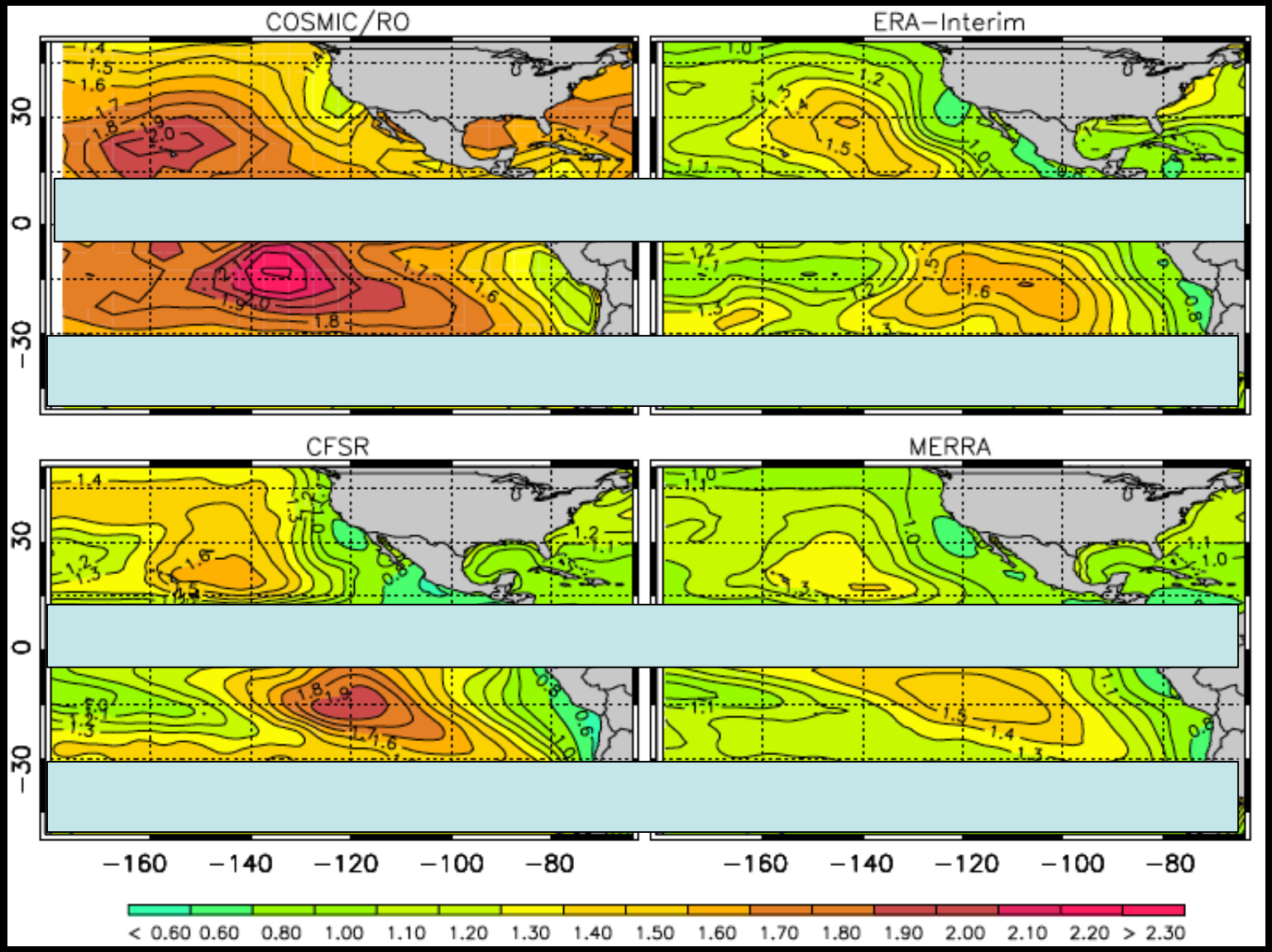
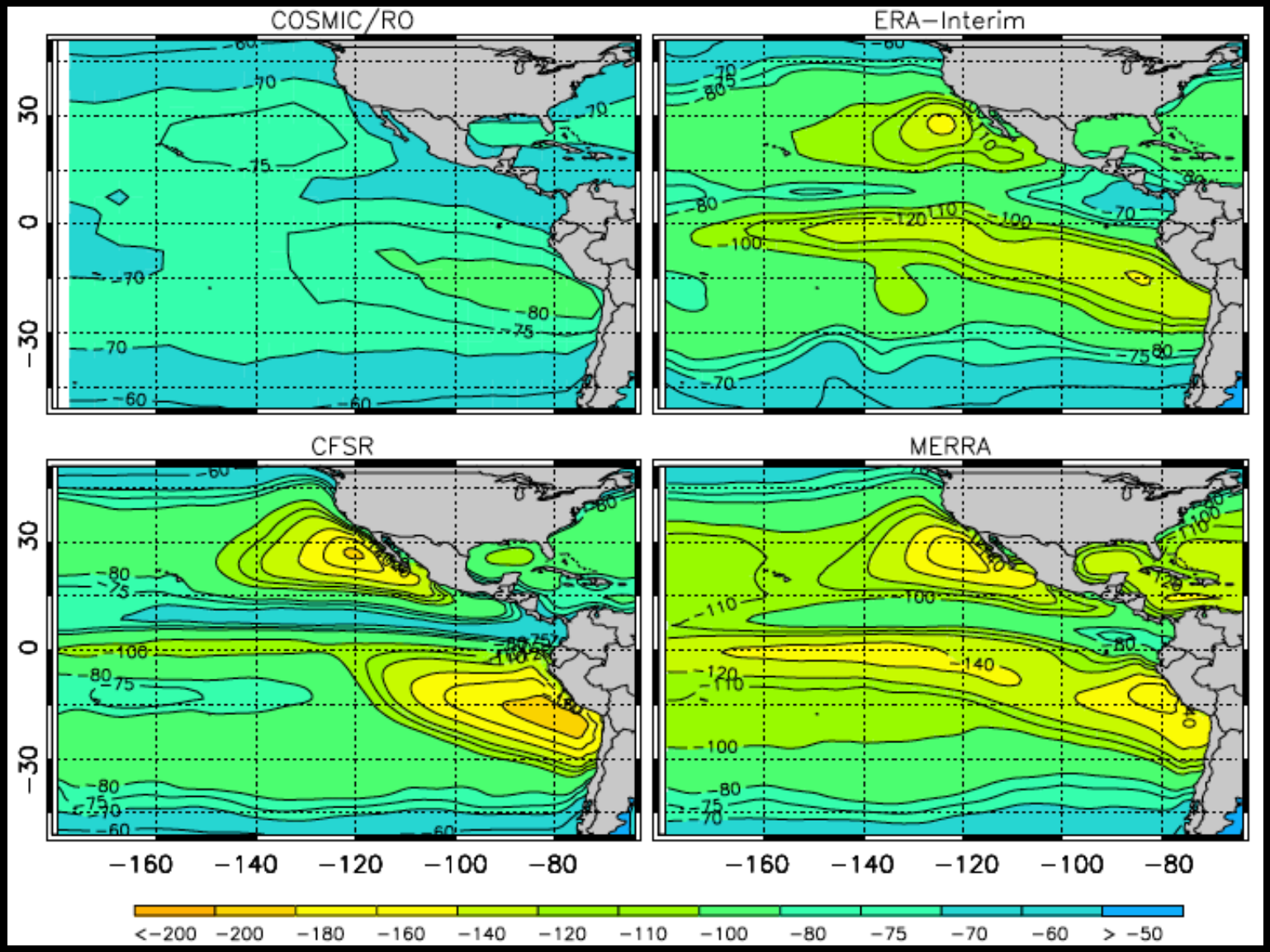
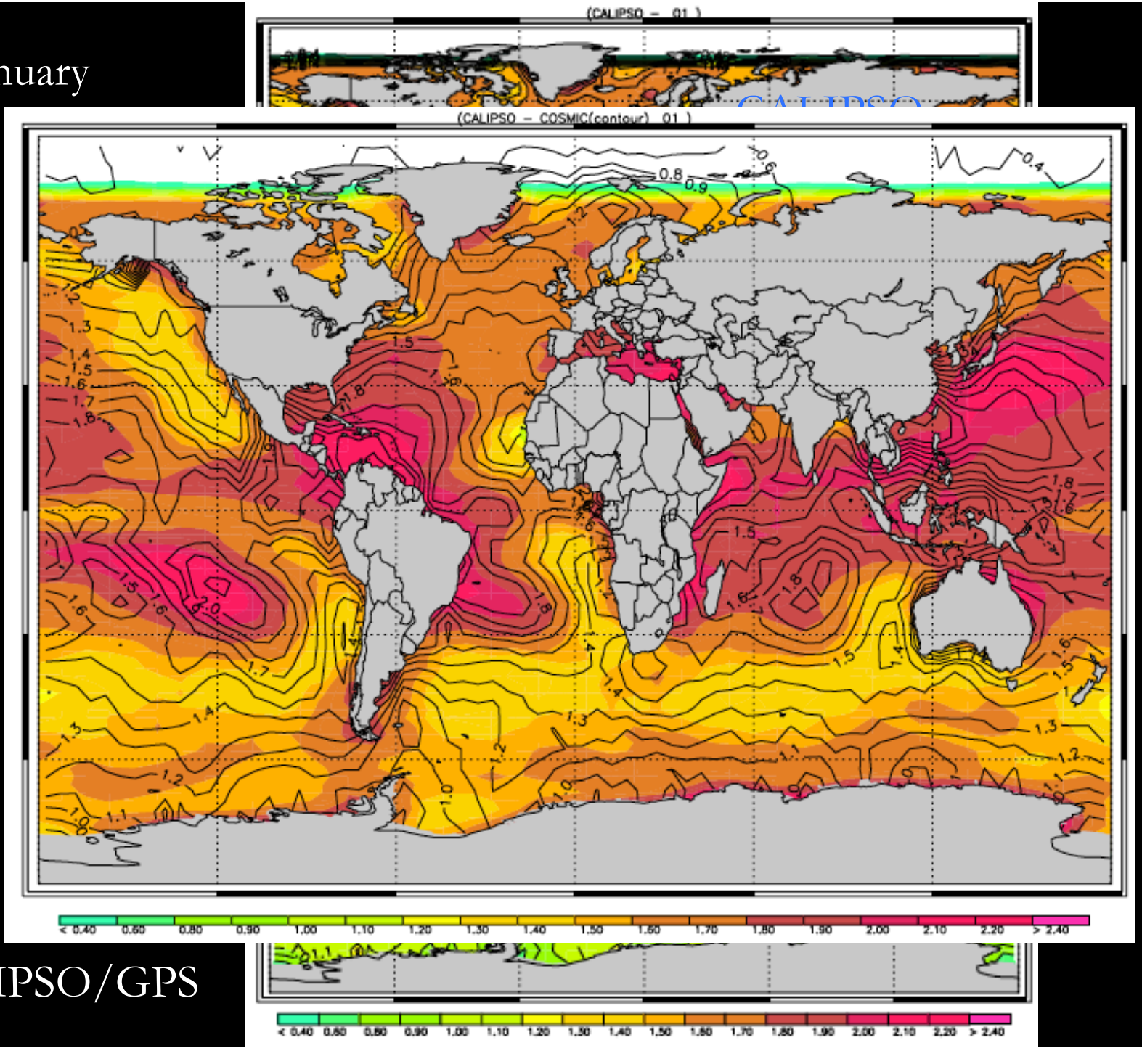


Maximum *N*-gradient at ABL Height
(COSMIC vs. ERA-int/CFSR/MERRA) 2007-2009-SON



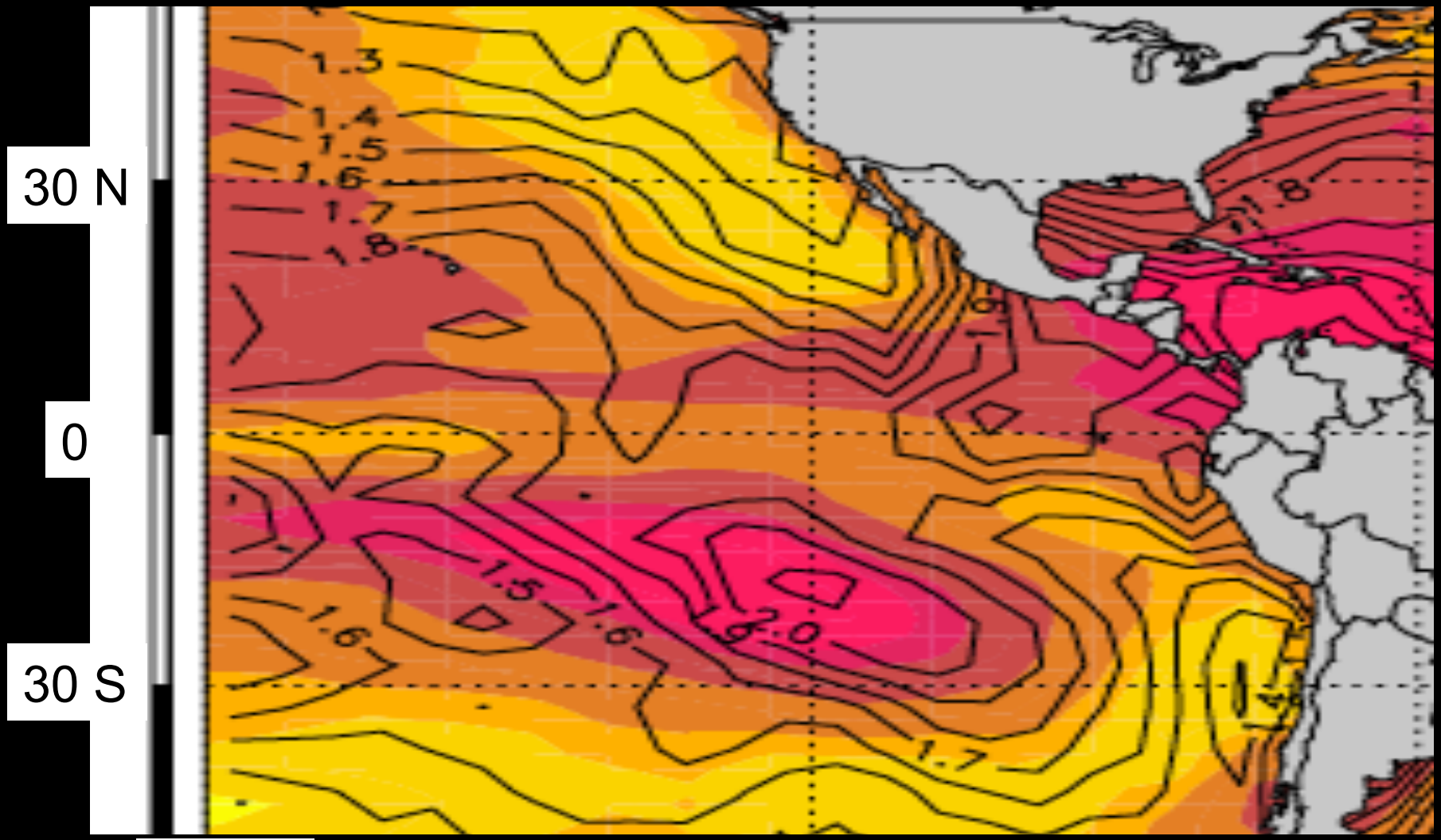
January



CALIPSO/GPS

January

CALIPSO vs. GPS (Contour)



Conclusions & Future Remarks

- GPS RO signal is very sensitive to the sharp moisture gradient beneath the inversion (ABL top).
- COSMIC RO shows consistent ABL heights with CALIPSO over subtropical regions.
- All three reanalyses (ECMWF/NCEP/GEOS-5, ERA-int/ CFSR/MERRA) show lower ABL heights as compared with COSMIC/CALIPSO over eastern Pacific.
- The deficiency of ABL representation in weather/climate models need to be further studied.
- Systematically biases in the GPS RO refractivity are likely caused by ducting (or super-refraction).