The NCAR / Montana State University Micropulse Water Vapor DIAL

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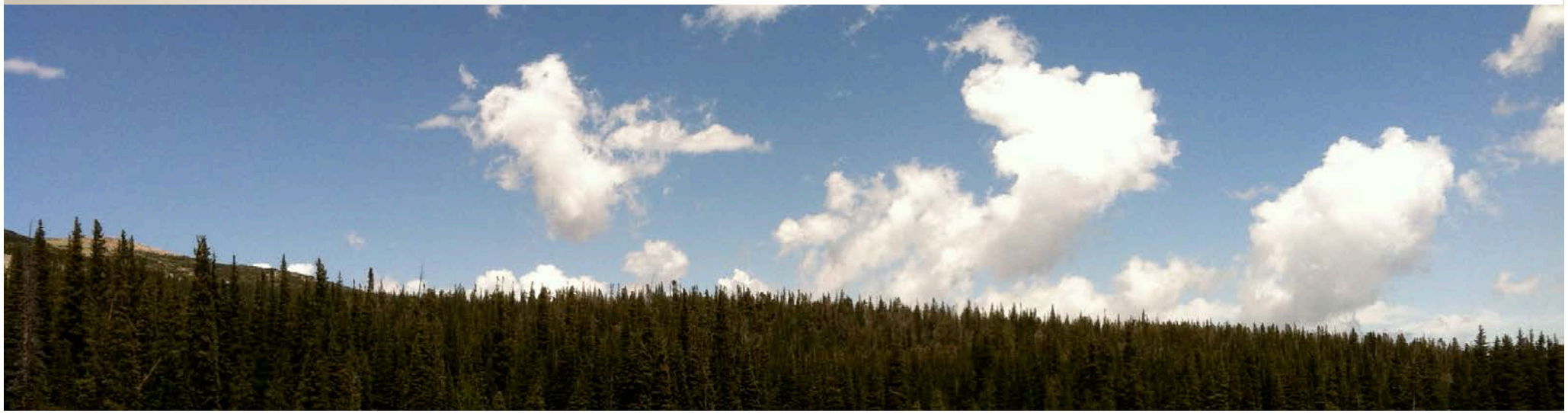

Thermodynamic Profiling: Primary Challenge is in the Lower Troposphere

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A review of the remote sensing of lower tropospheric thermodynamic profiles and its indispensable role for the understanding and the simulation of water and energy cycles

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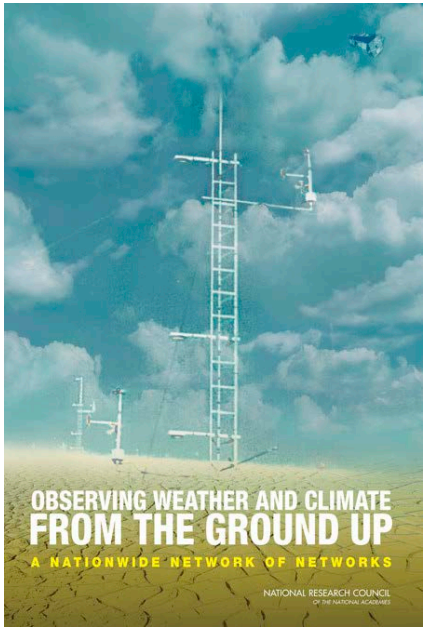
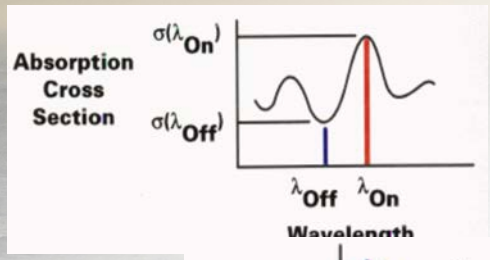
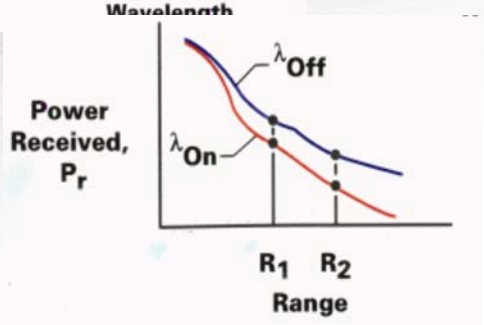


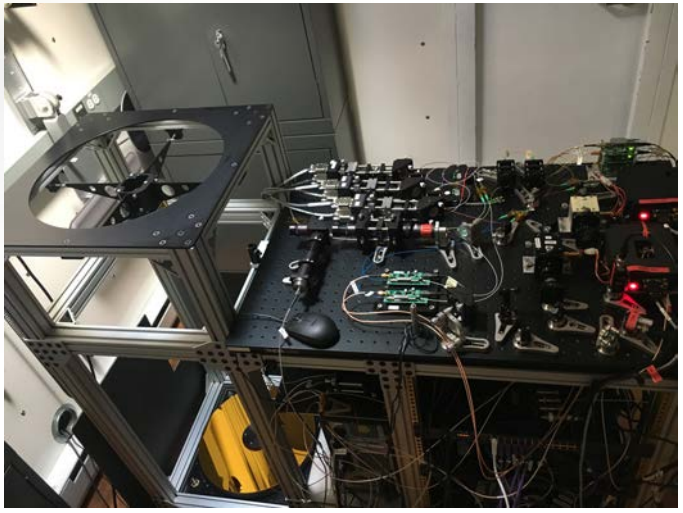
- Huge observational gaps exist in lower trop thermodynamic profiling
- Closing these gaps is essential for progress in weather and climate research
- Ground-based passive and active remote sensing systems can close these gaps
- *Marriage of these ground-based systems (and future networks of them) and satellite sensors enhance information content and utility*

NCAR Water Vapor Differential Absorption Lidar (nDIAL)

- Laser-based active remote sensor
- Developed at NCAR and Montana State University
  - Based upon prototype developed at MSU
- Micropulse system using diode-based lasers
- Automated instrument; self-calibrating (narrowband approach)
- Deployed during FRAPPE, PECAN, Perdigao, and LAFE
- Lowest good data level: ~500 m AGL







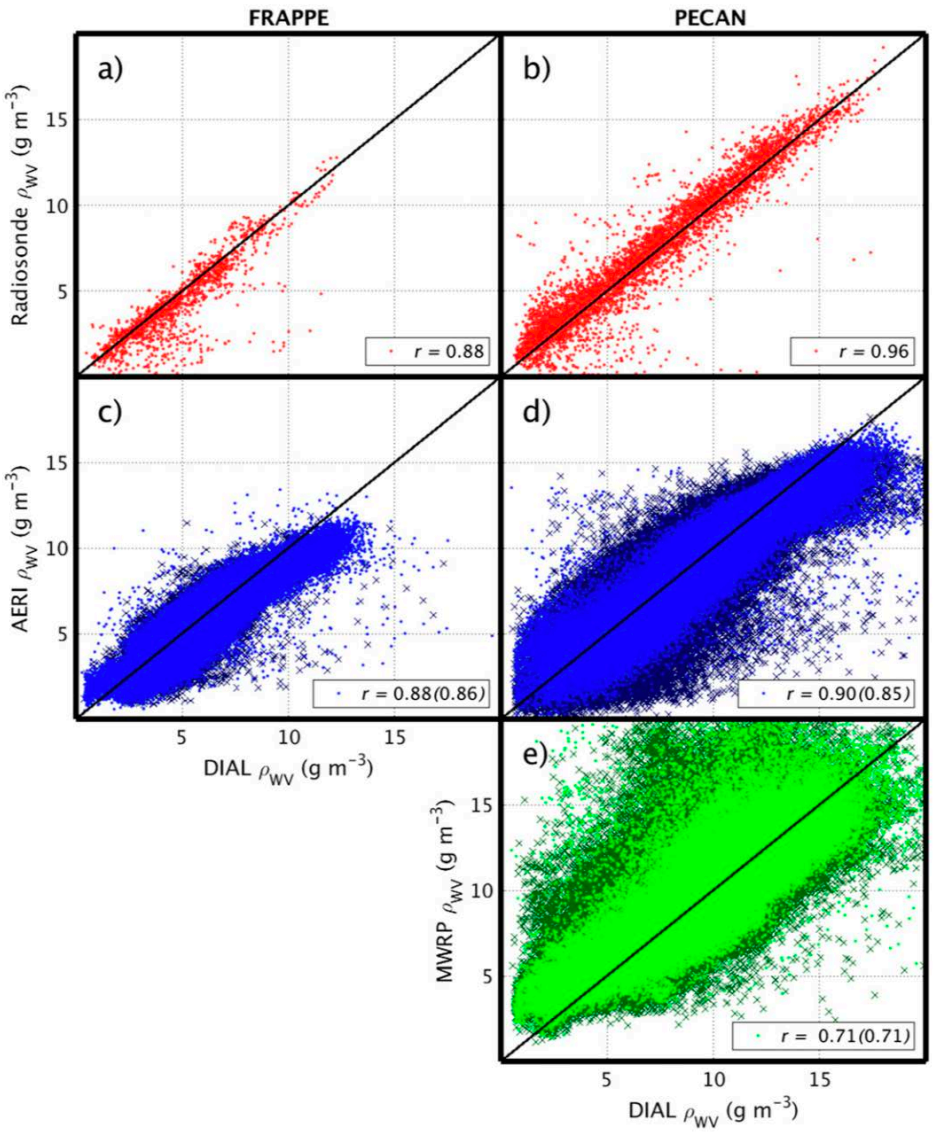
Still research based system
(NCAR now has 5 of these in their instrument pool)

Spuler et al. AMT 2015

Comparisons with Others Sensors

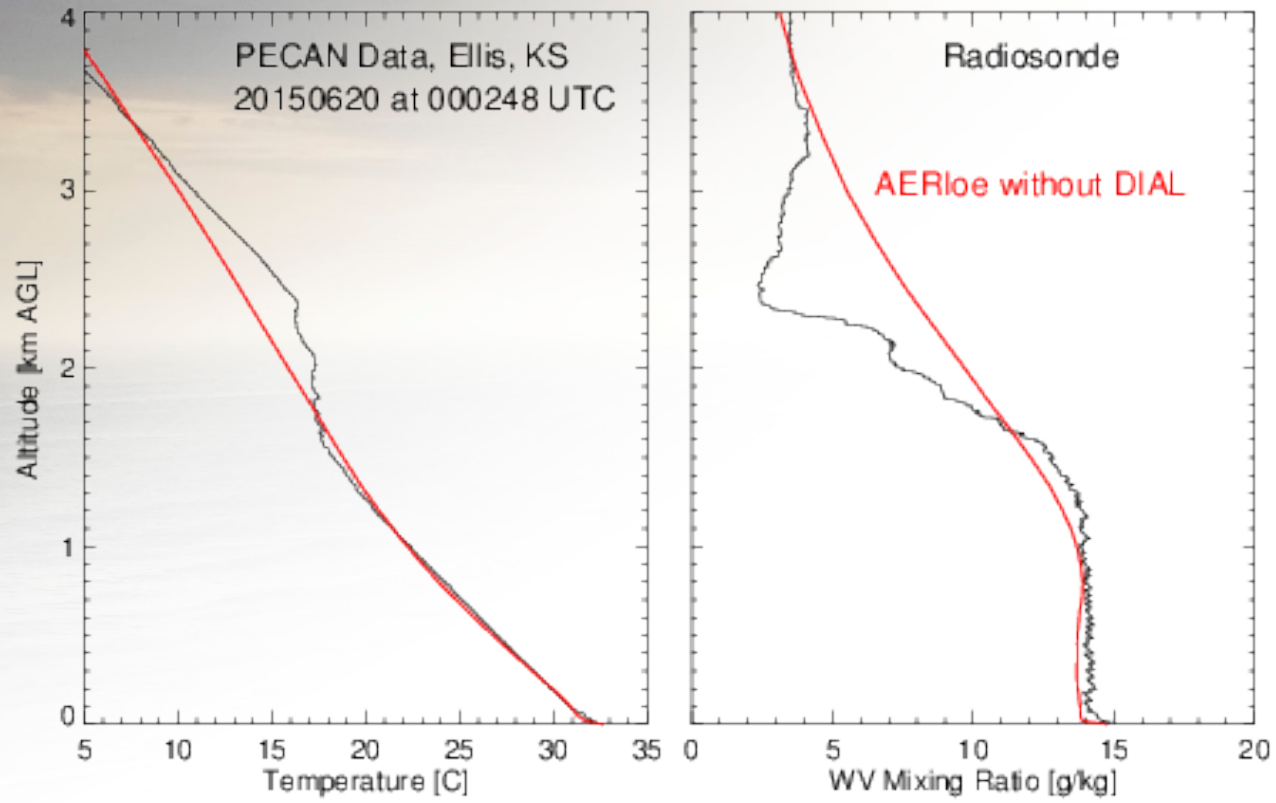
- Two different field campaigns
  - FRAPPE near Boulder CO, 2014
  - PECAN in Hays KS, 2015
- Comparisons of the nDIAL with
  - **Radiosondes**
  - **AERI retrievals**
  - **MWR retrievals**

Weckwerth et al. JTECH 2016



Combining Observations within the Retrieval

PECAN on 20 Jun 2015 at 0248 z



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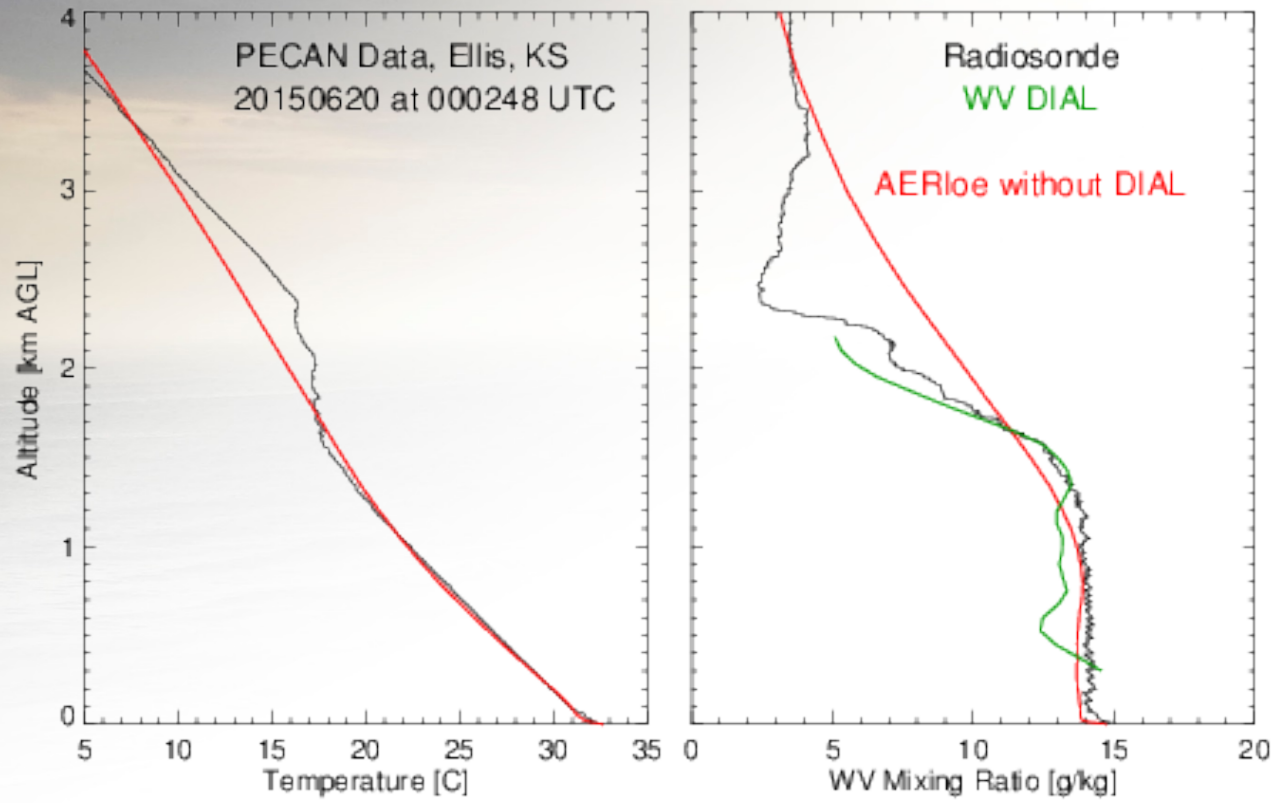

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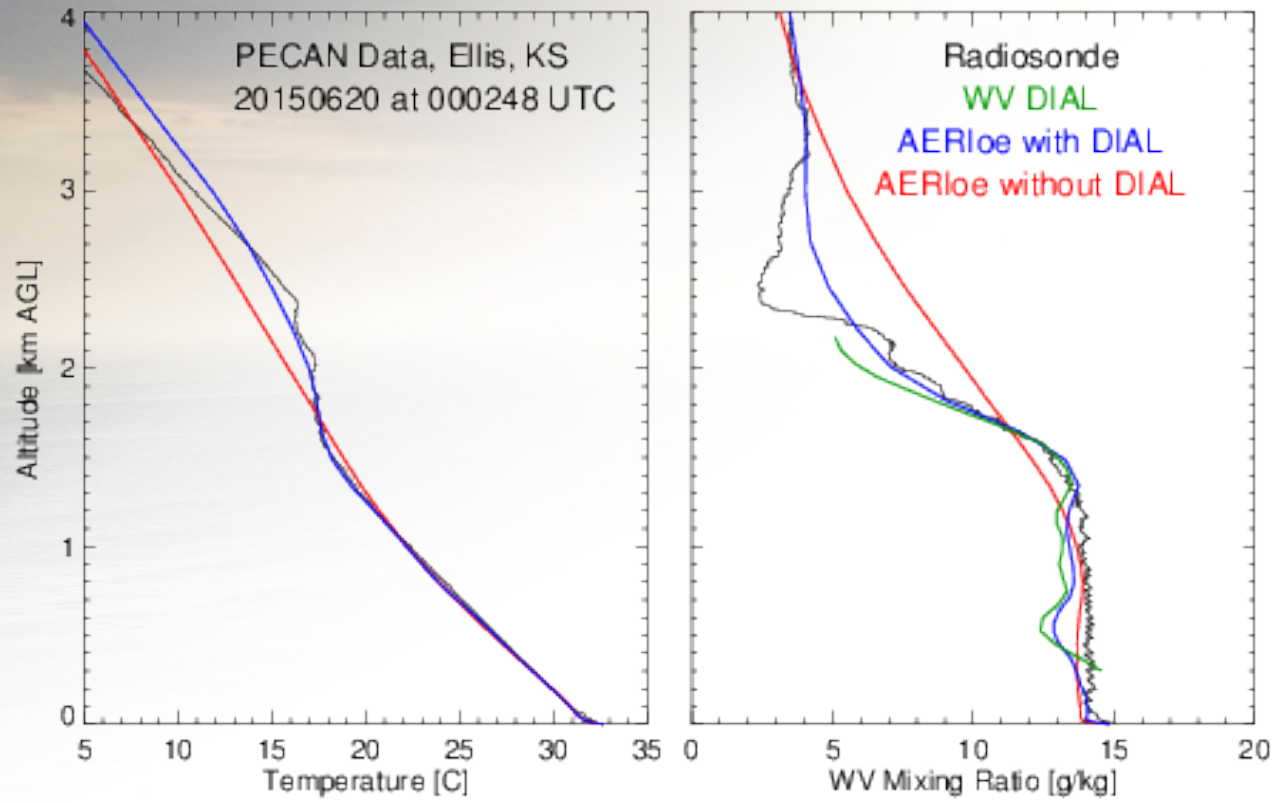
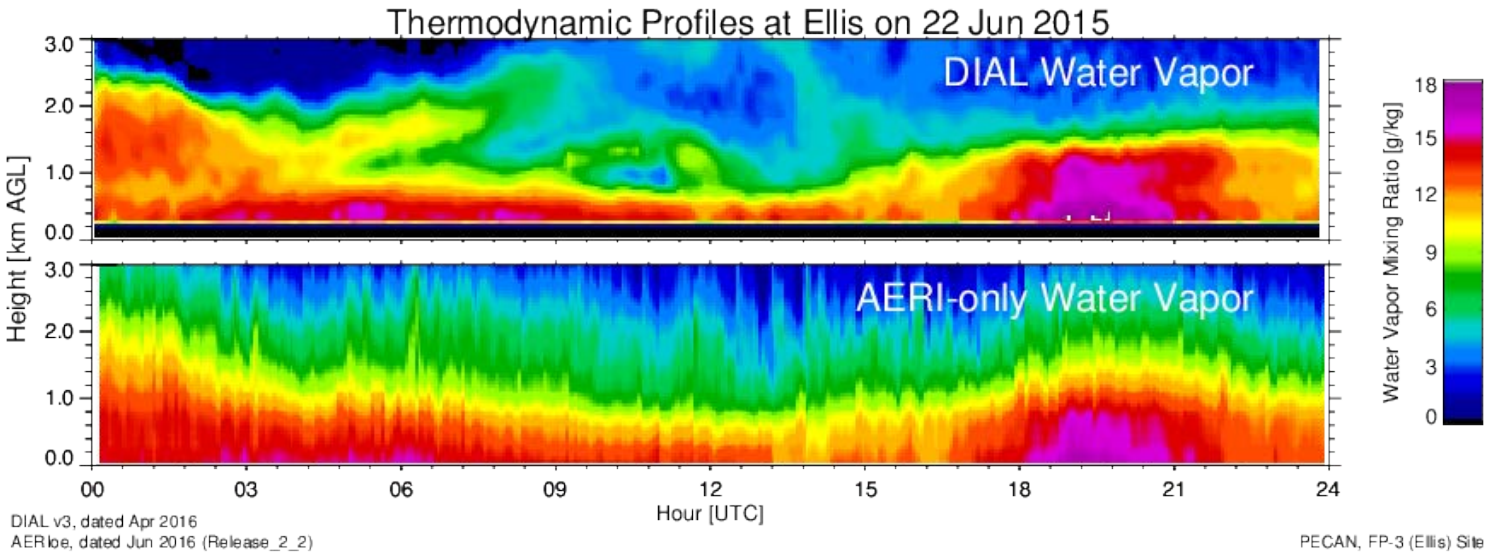


DIAL and AERI-only Retrievals



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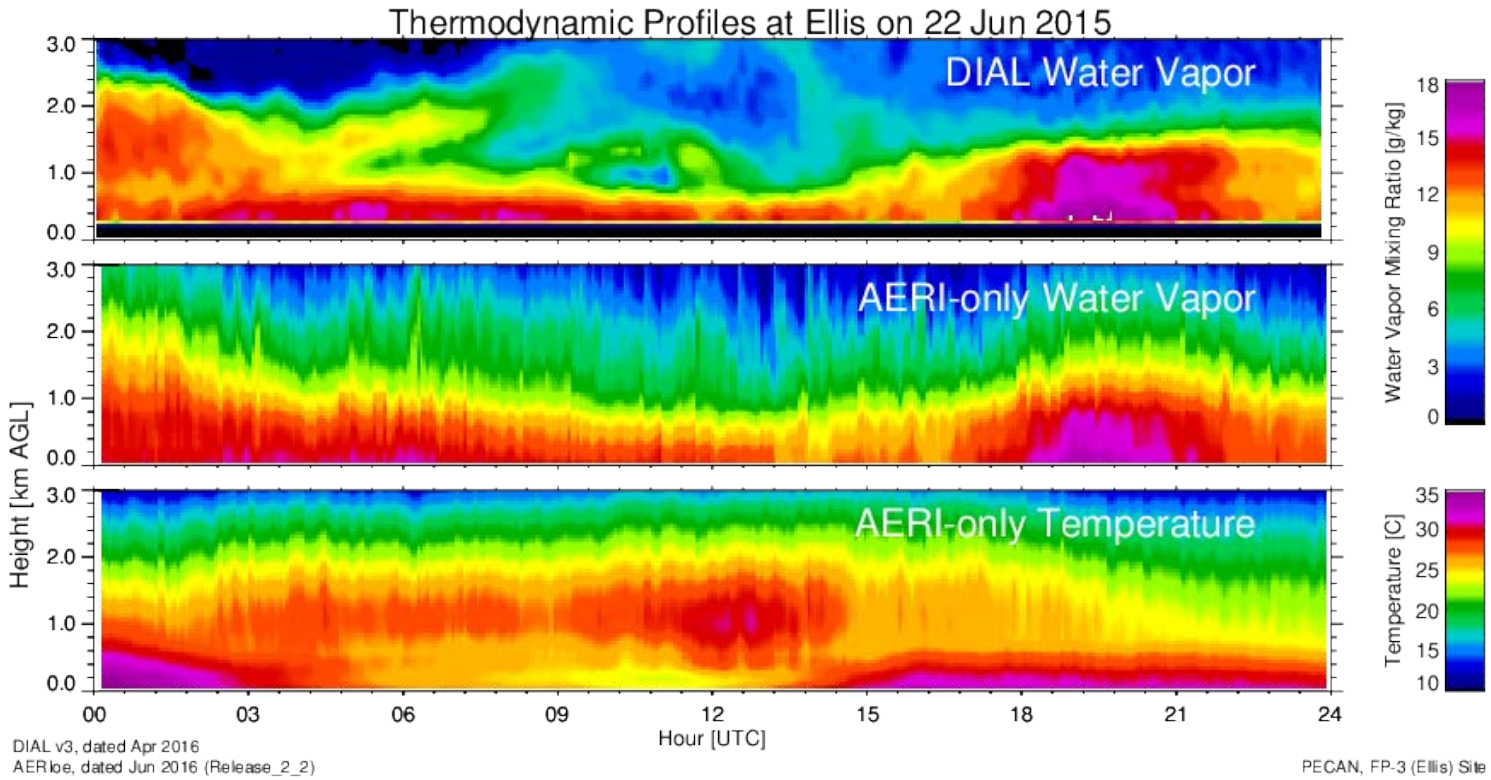

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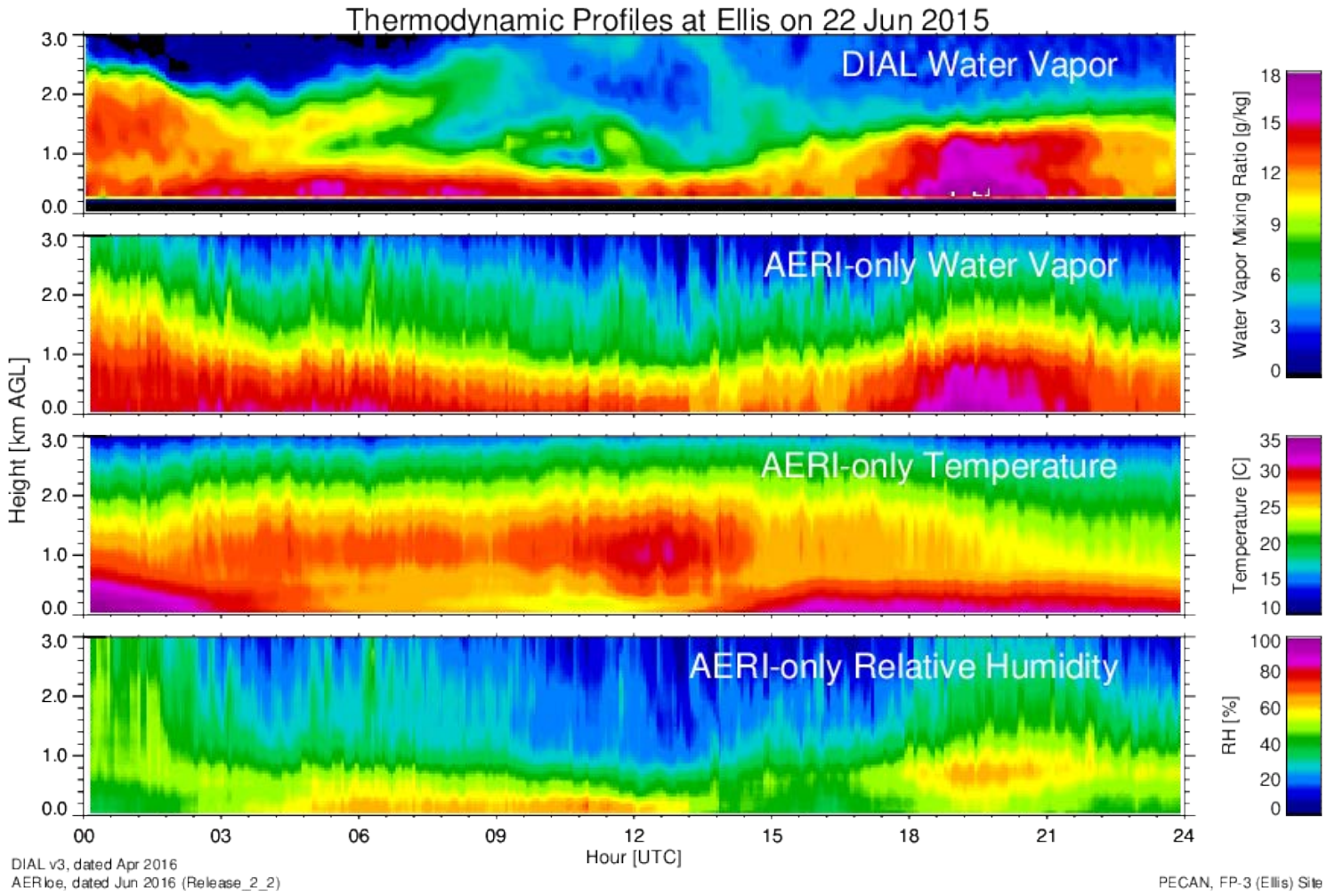
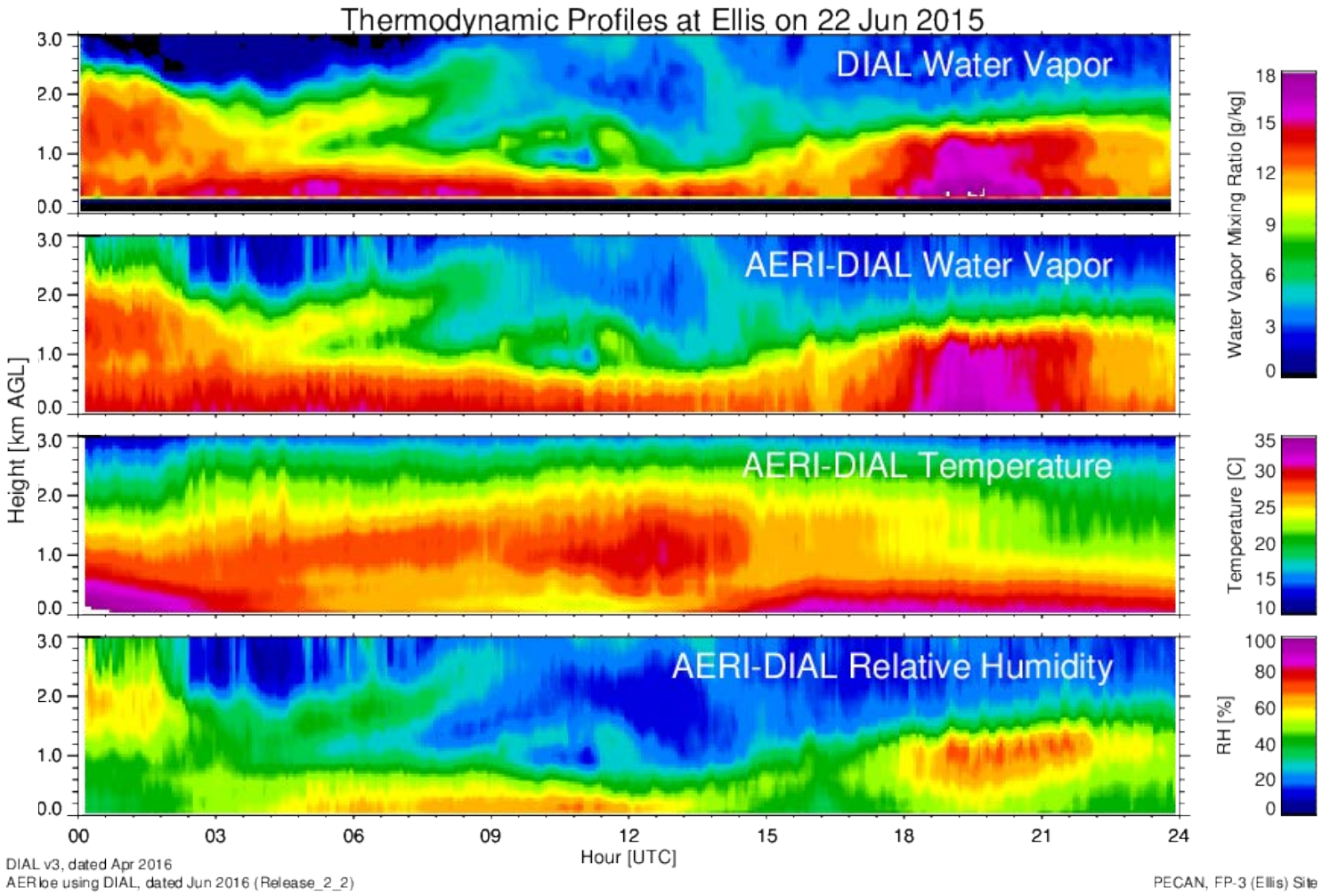


DIAL and AERI+DIAL Retrievals



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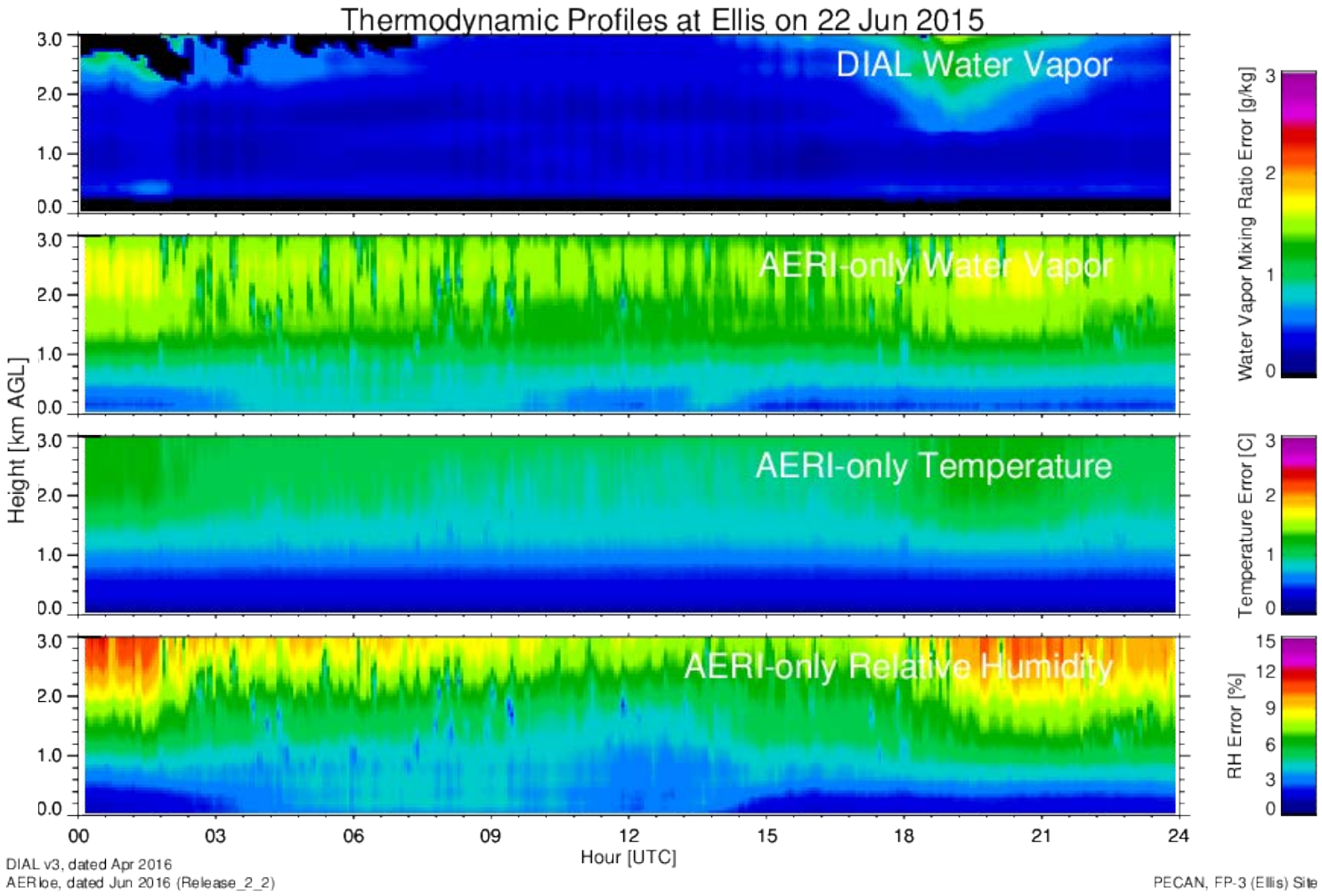

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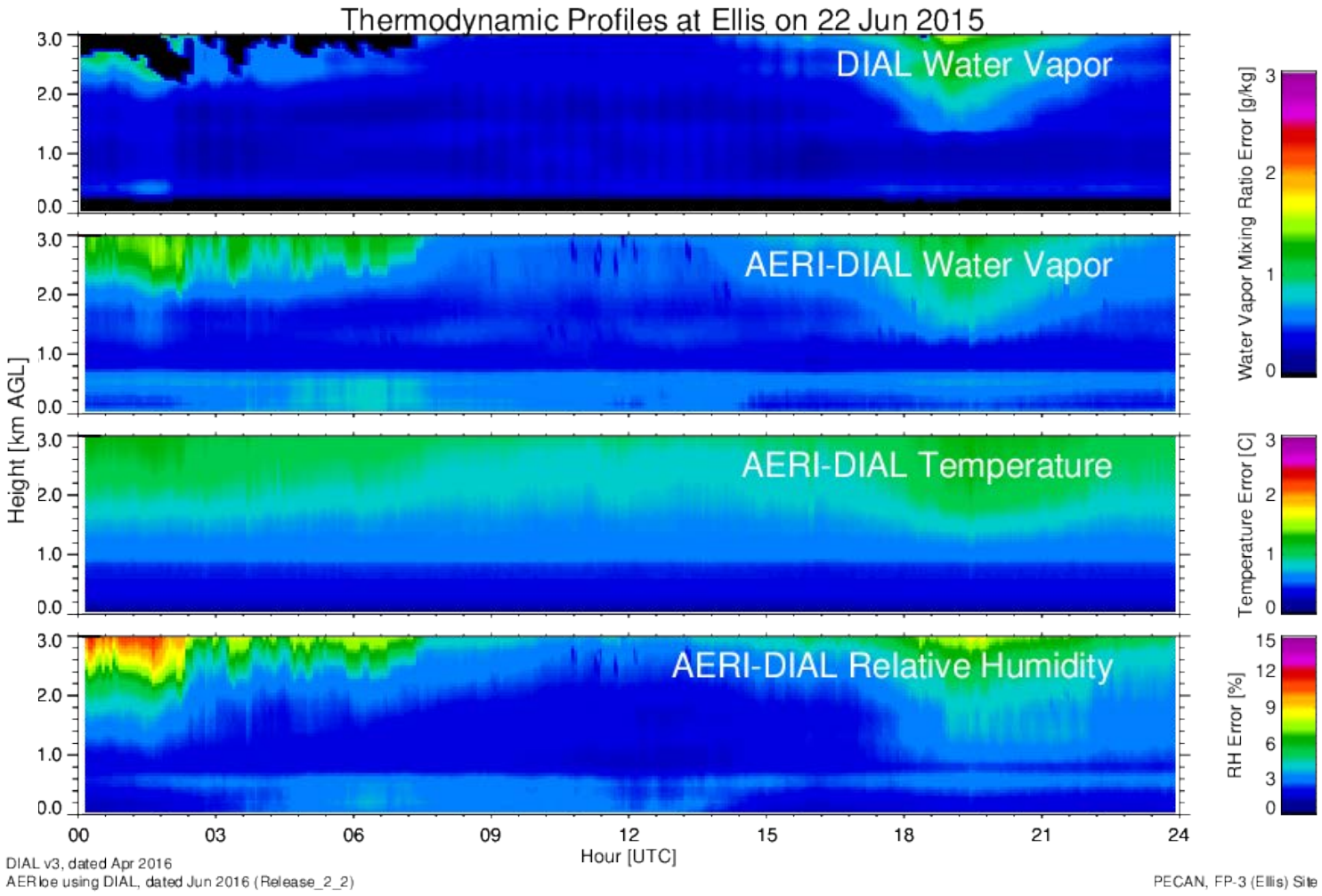

Testing the Value of the DIALs in a Network

- MPD Network Demonstration IOP
- SGP site, 22 April – 19 July 2019
  - Five systems deployed at C1, E32, E37, E39, and E41
  - Each site has complementary instruments: AERIs, Doppler lidars, SEB
  - Sondes at 8/day from C1
- Objectives:
  - Quantify mesoscale variability in water vapor
  - Improve understanding of convective processes
  - Demonstrate impact of improved NWP and CAM forecasts via data assimilation
- Prototype system at C1 that also has HSRL capability, and is demonstrating O_2 DIAL to profile temperature