Tropical cyclogenesis

Roger Smith, University of Munich

In collaboration with Michael Montgomery, NPS

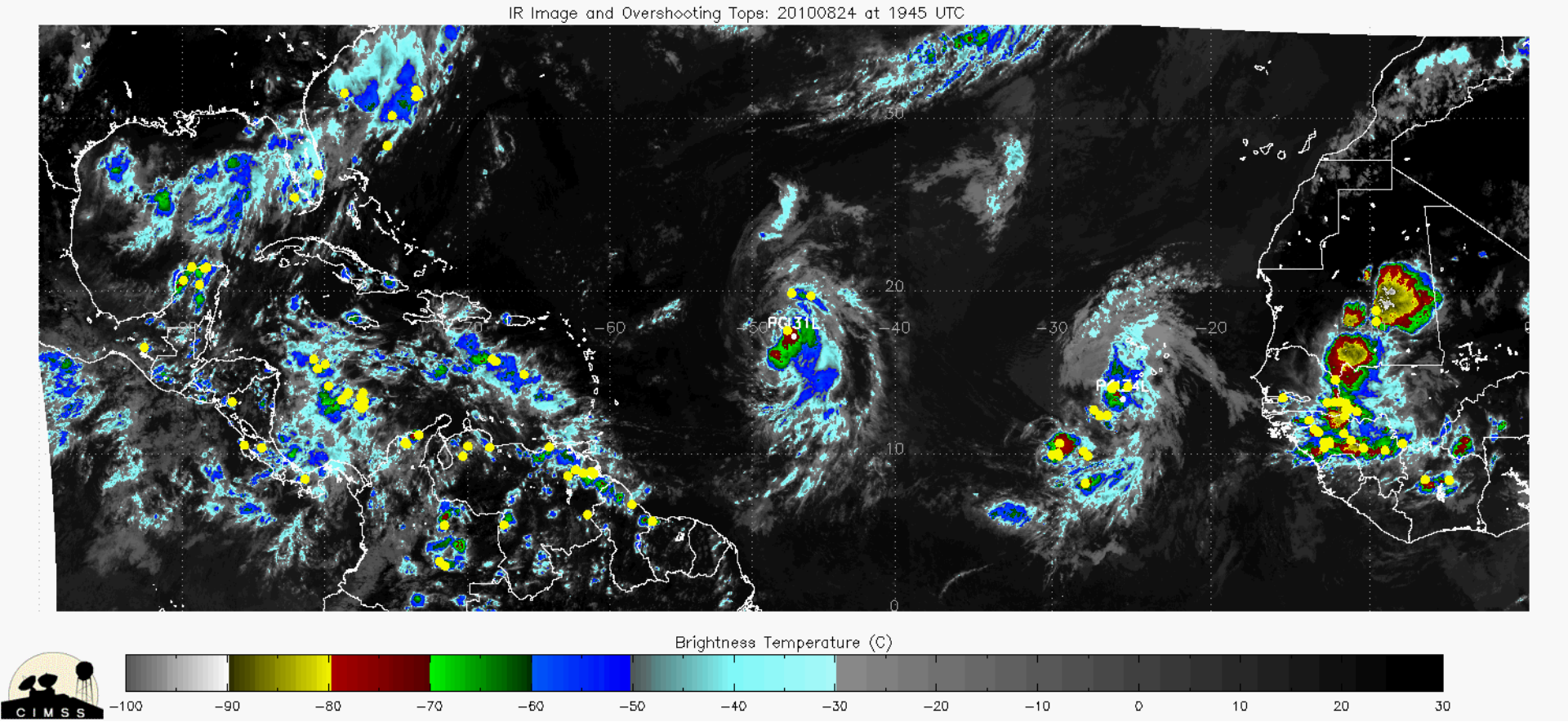

Image courtesy Sarah Monette & Chris Velden

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Observations of the convective environment in developing and non-developing tropical disturbances

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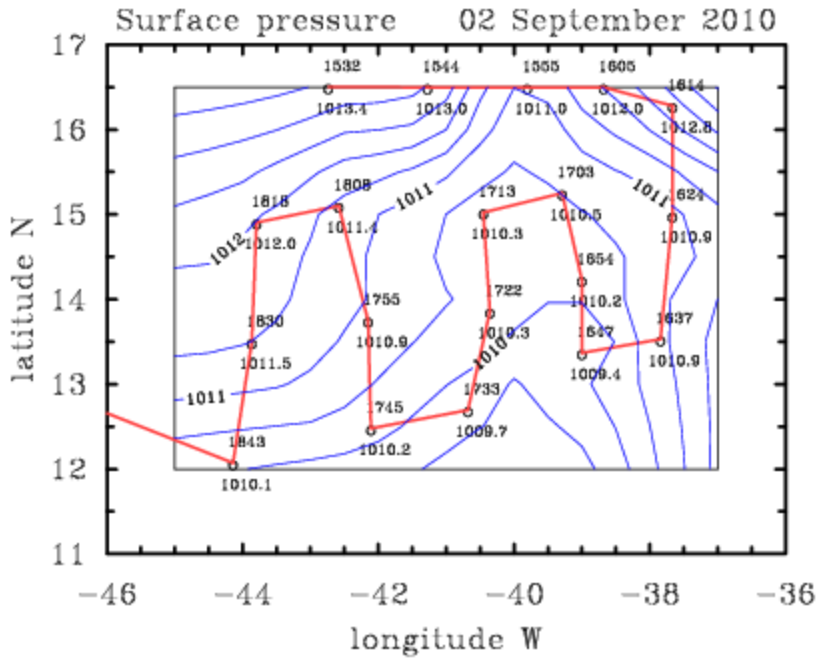
Abstract:

Analyses of thermodynamic data gathered from airborne dropwindsondes released from the upper troposphere during the Pre-Depression Investigation of Cloud Systems in the Tropics (PREDICT) experiment are presented. The main focus is on two systems that finally became Hurricanes Karl and Matthew and one system that attained Tropical Storm status (Gaston), but subsequently weakened and never redeveloped during five days of monitoring. Data for all events show that the largest values of total precipitable water are collocated with the surface trough and with some high values of convective available potential energy, which coincide roughly with low values of convective inhibition. Vertical profiles of virtual potential temperature show little variability, both between soundings on a particular day and between the system means from day to day. In contrast, the profiles of pseudo-equivalent potential temperature, θ_e, show much more variability during daily missions on account of the variability in moisture.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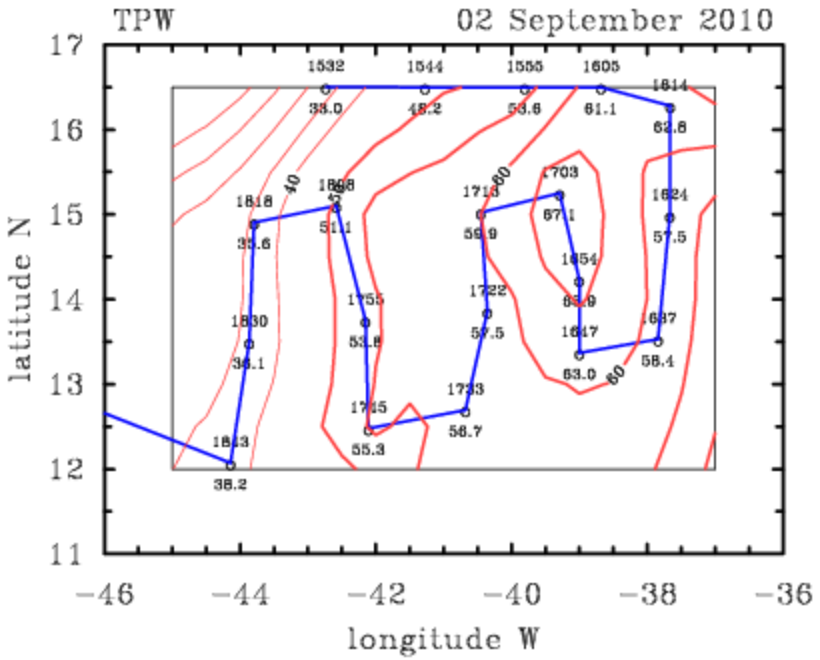
latitude N
longitude W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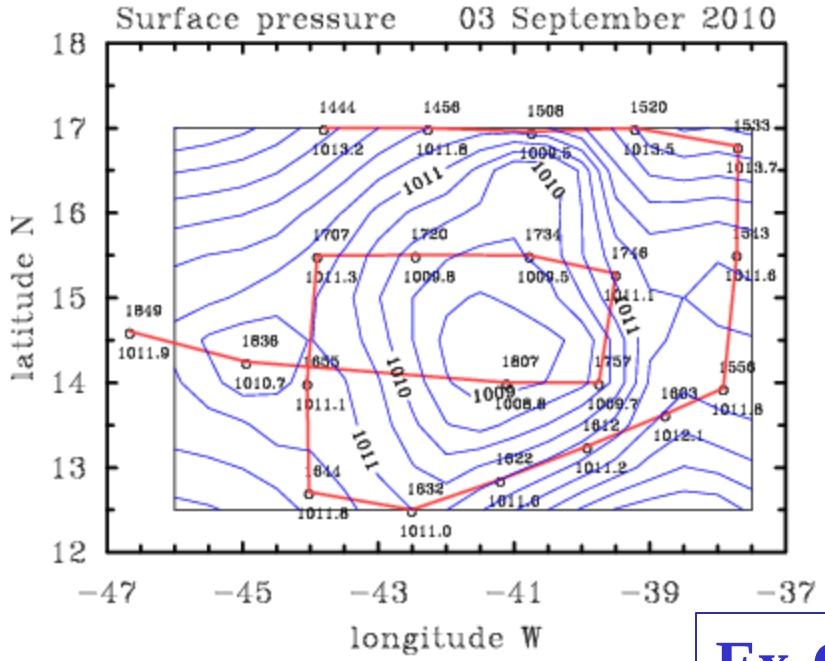
Surface pressure 03 September 2010
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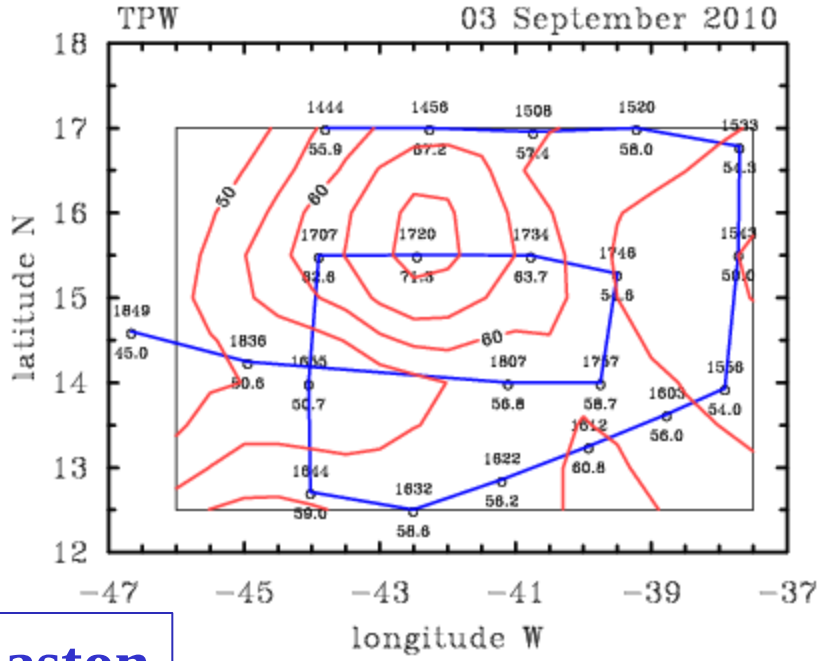
TPW 03 September 2010
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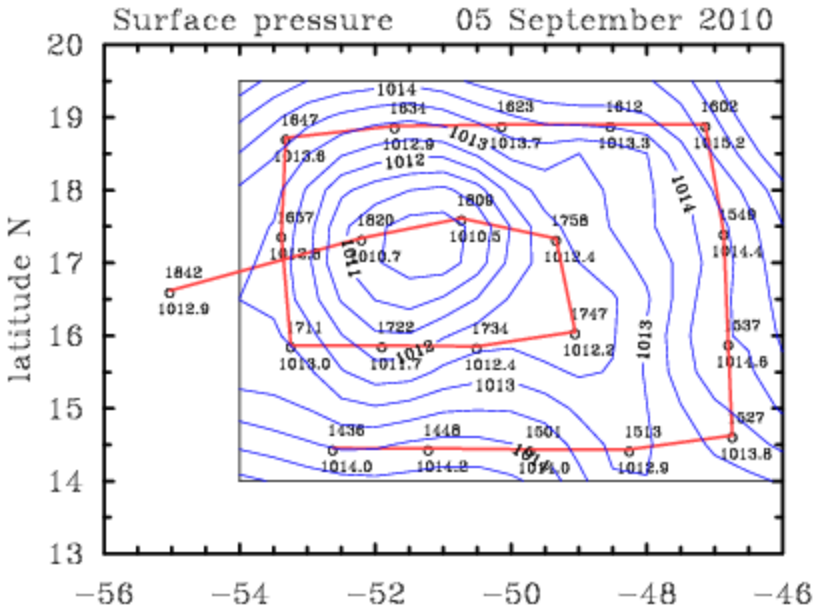
longitude W

Ex-Gaston



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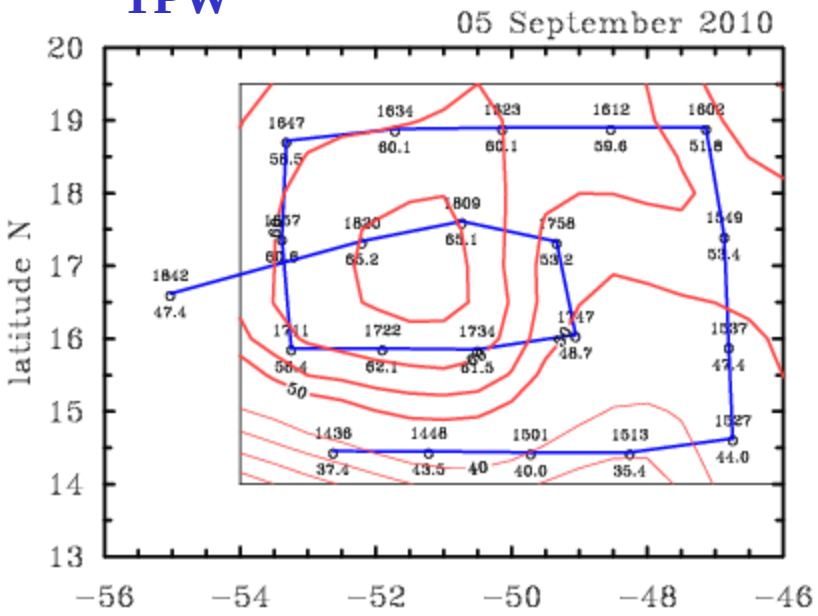
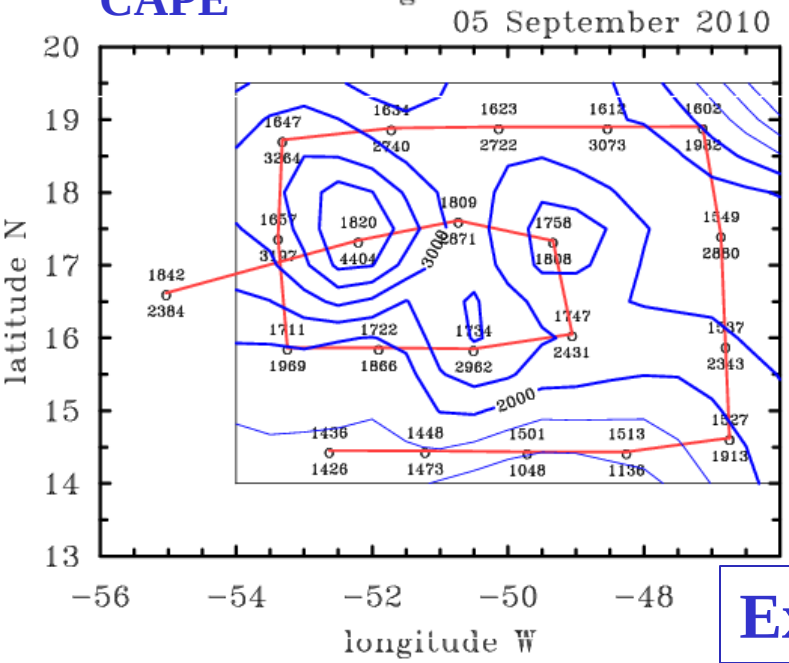
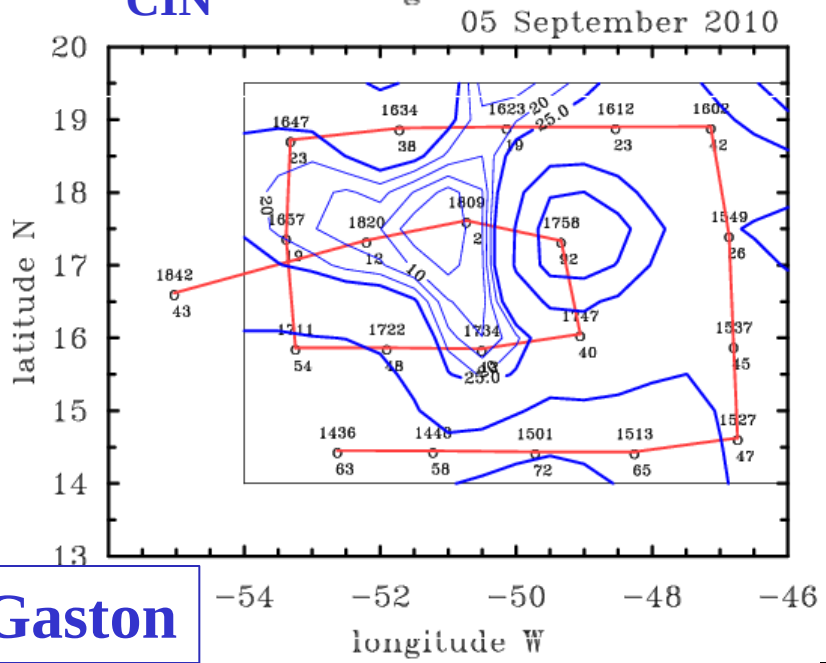


CAPE



CIN



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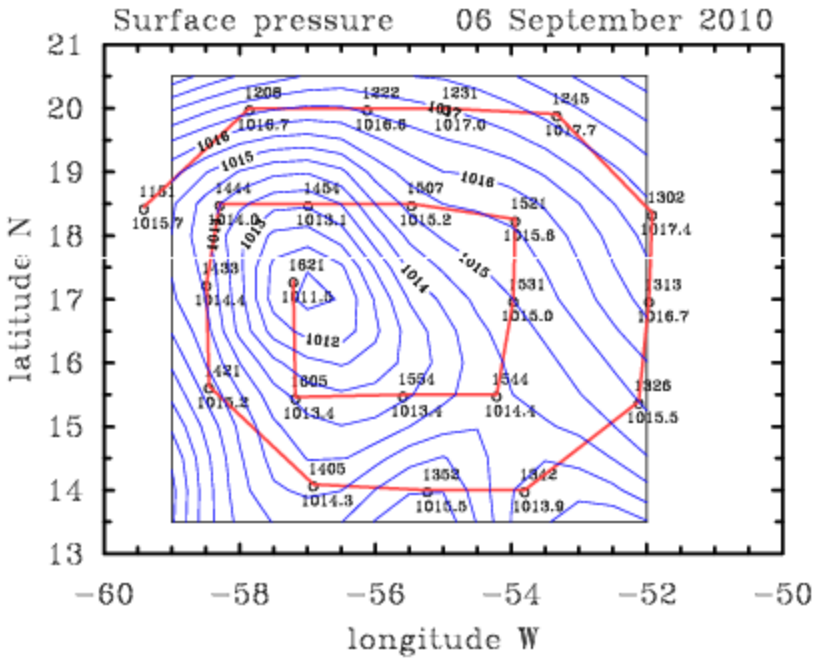
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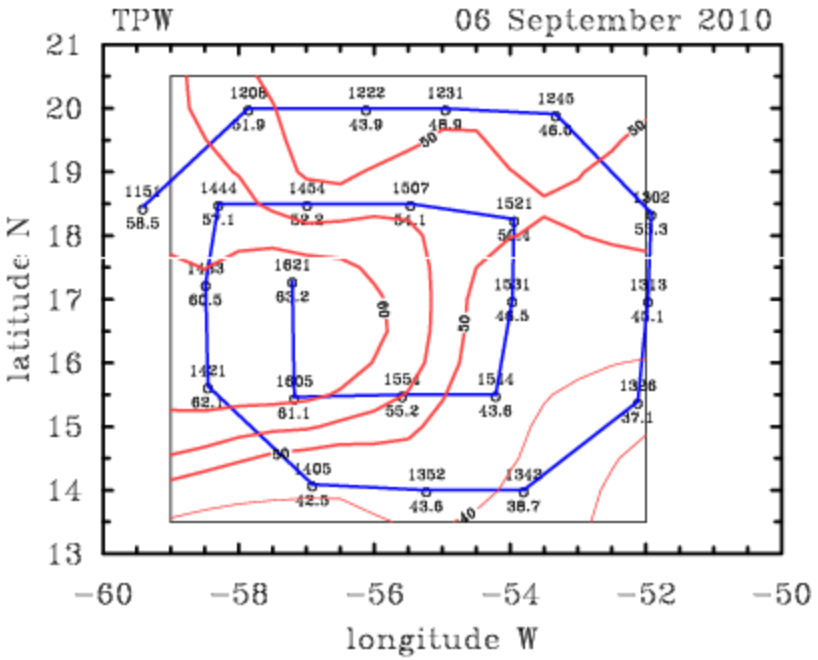
longitude W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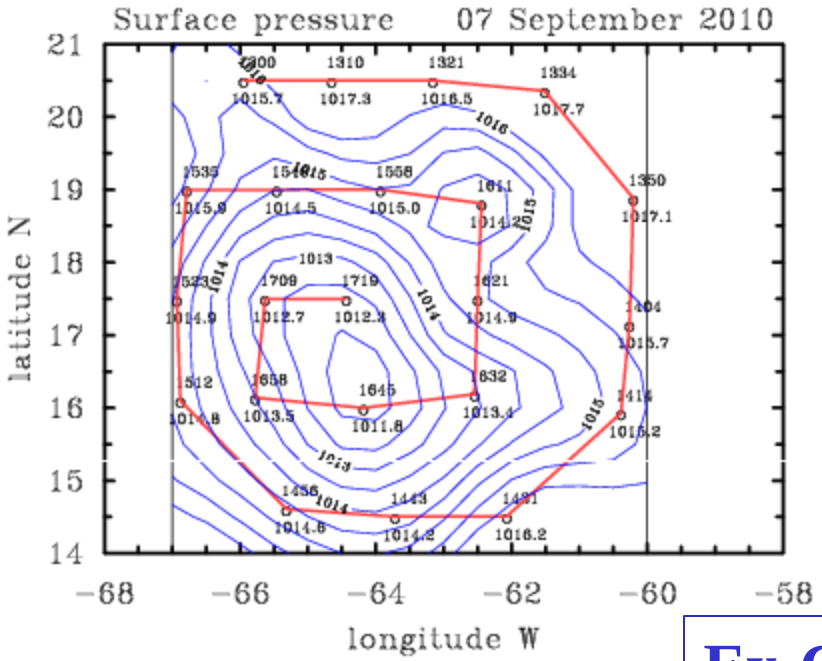
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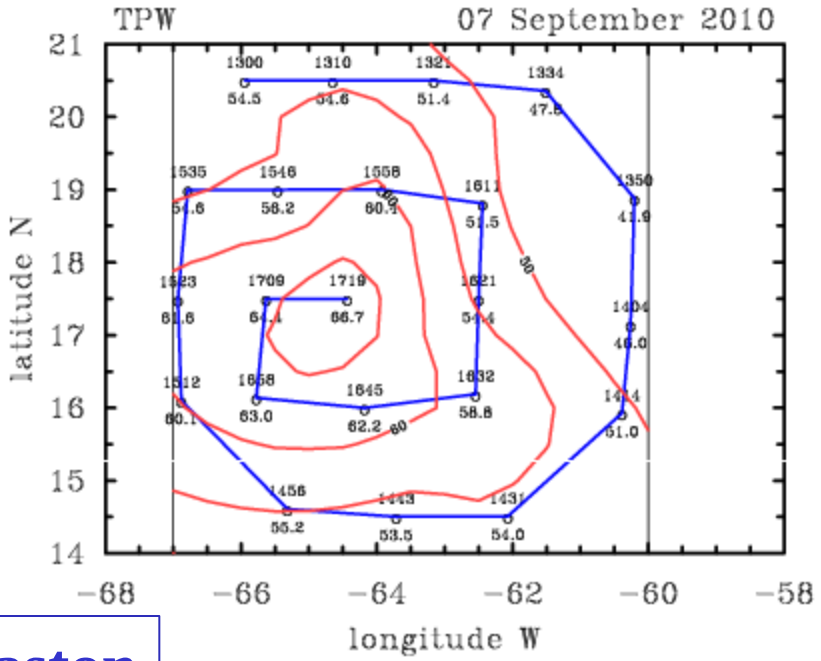
TPW 07 September 2010
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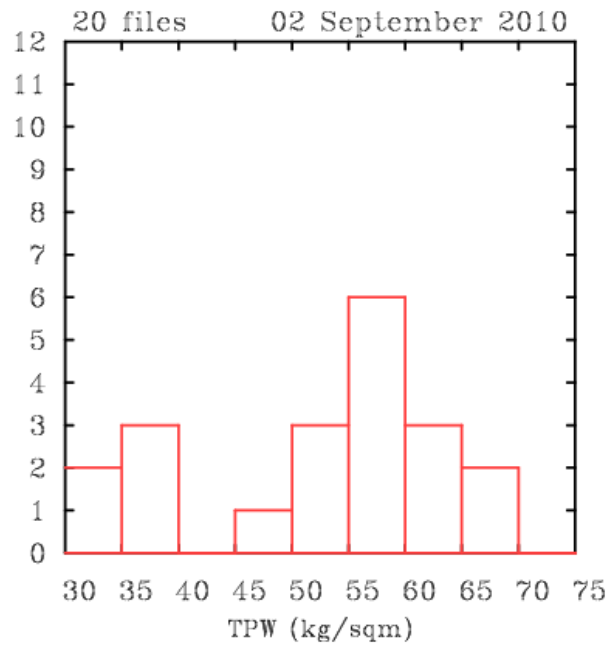
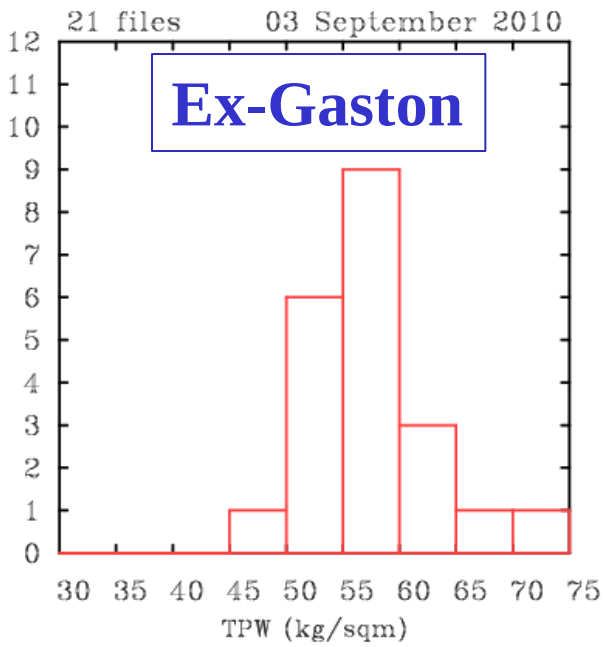
Ex-Gaston


20 files
02 September 2010
TPW (kg/sqm)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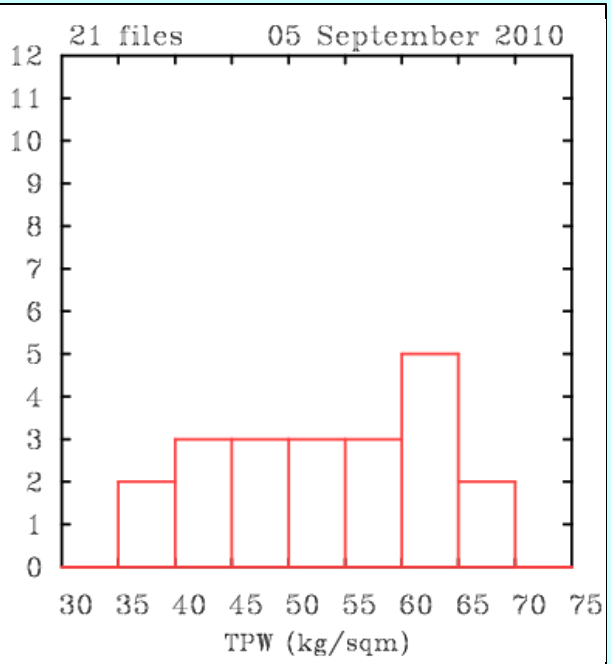
03 September 2010
TPW (kg/sqm)

Ex-Gaston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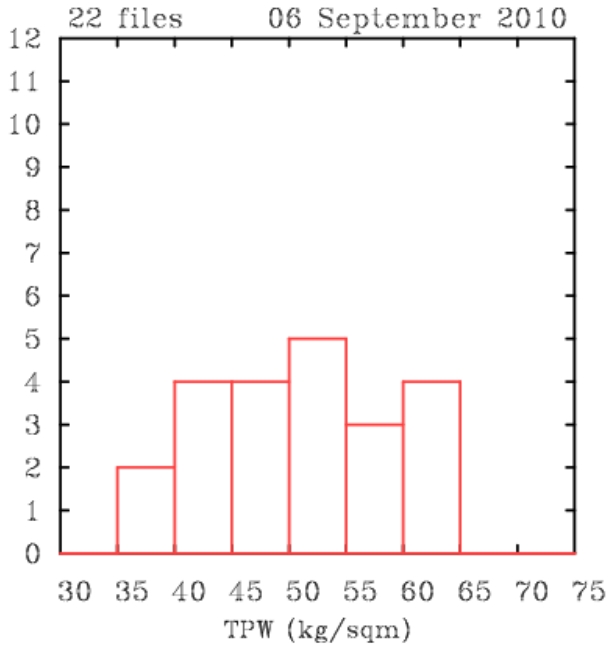
05 September 2010
TPW (kg/sqm)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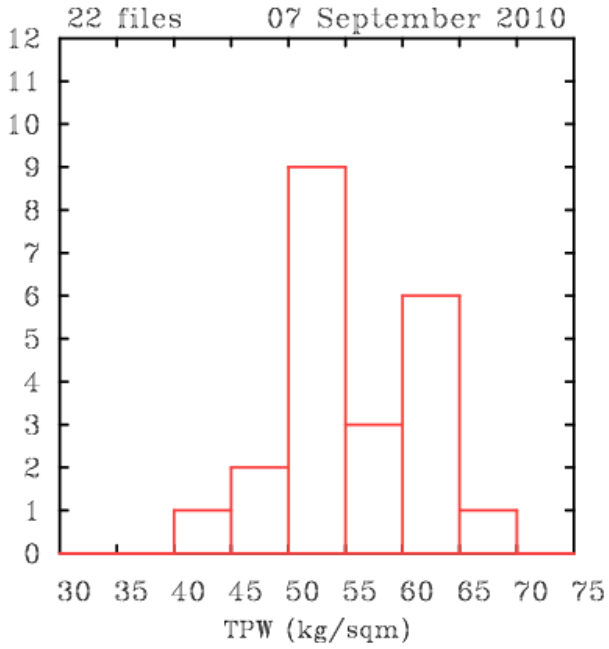
06 September 2010
TPW (kg/sqm)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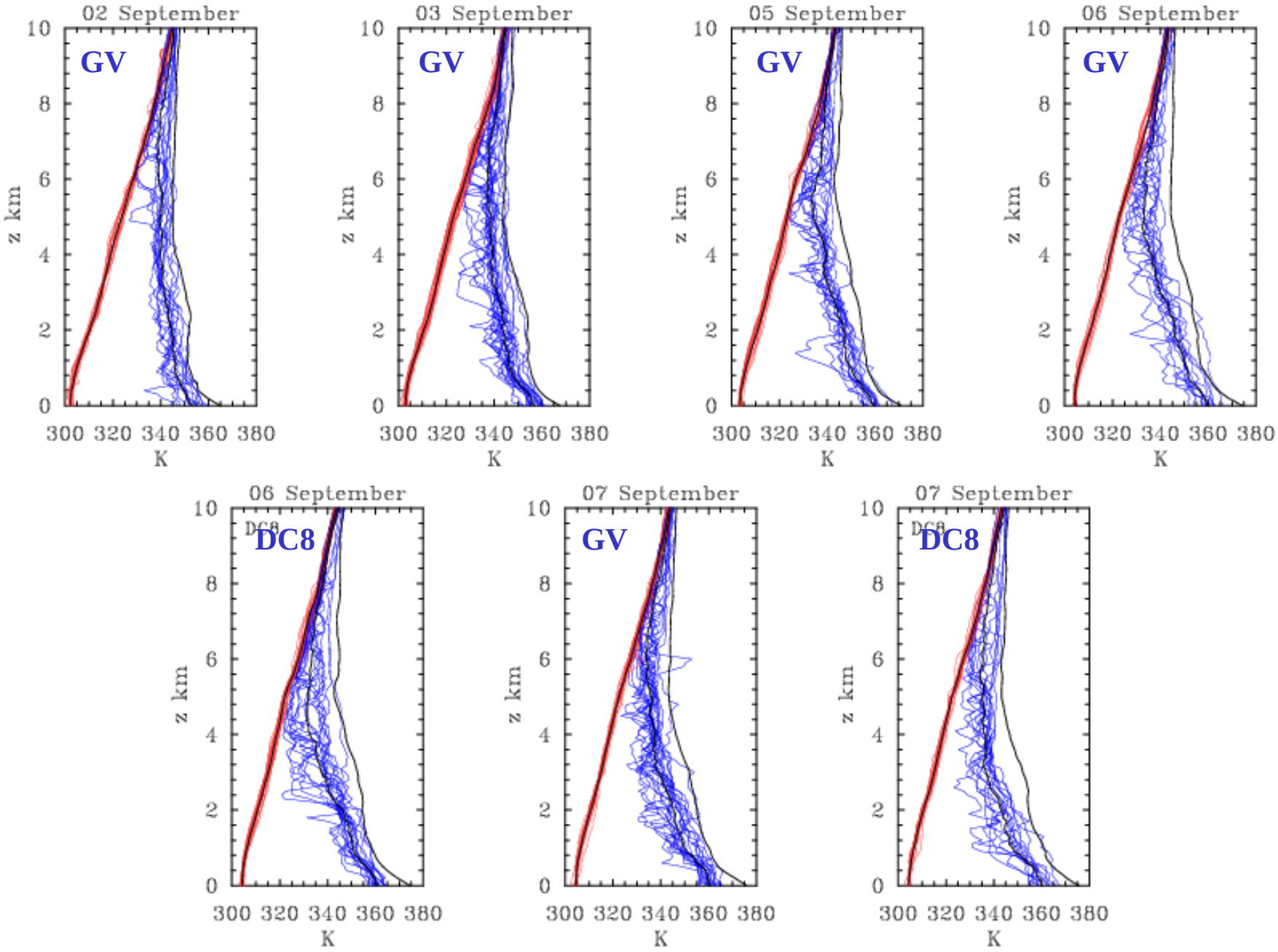
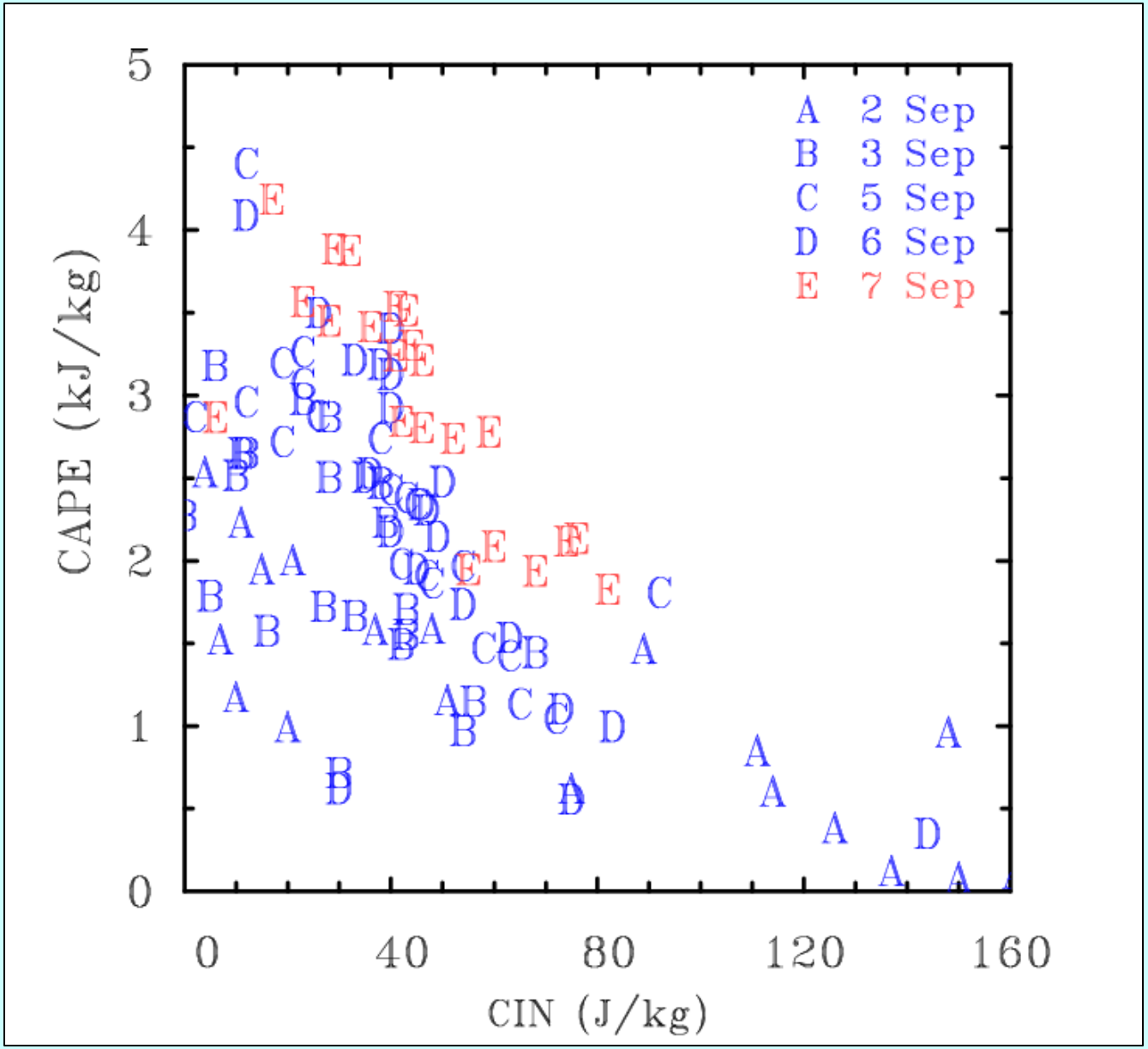
07 September 2010
TPW (kg/sqm)

Ex-Gaston 02 – 07 September



Ex-Gaston CAPE & CIN



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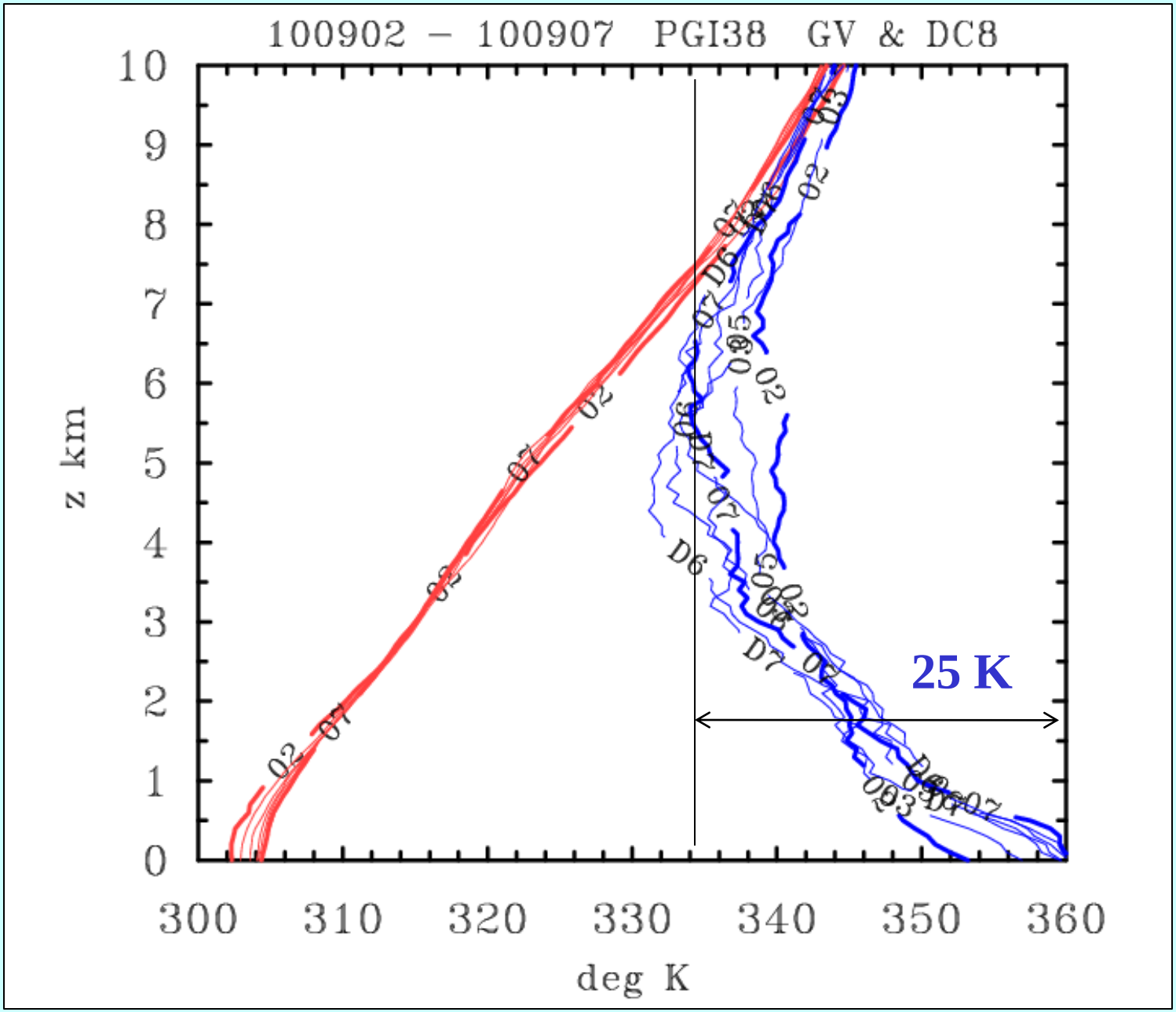

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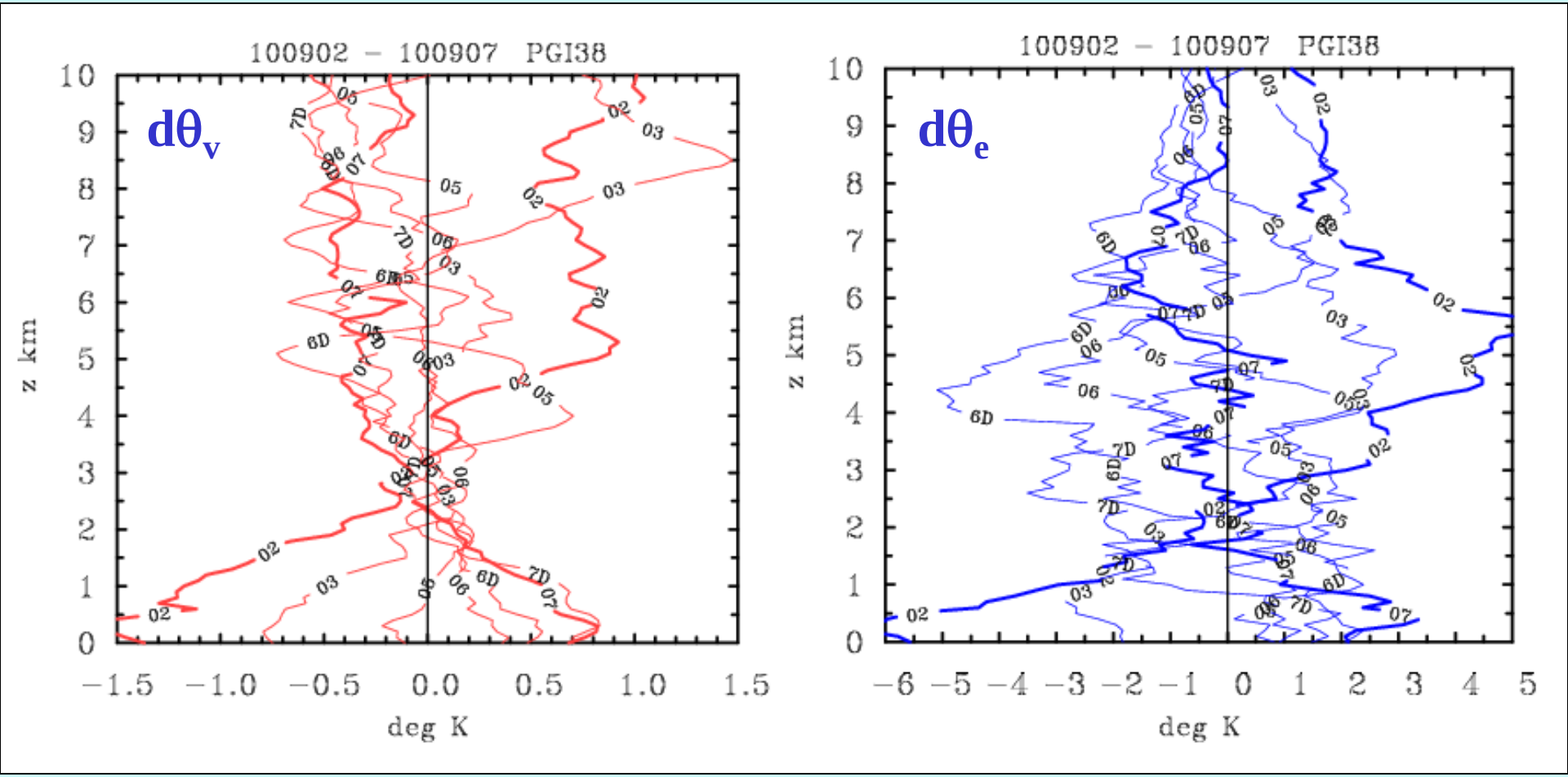
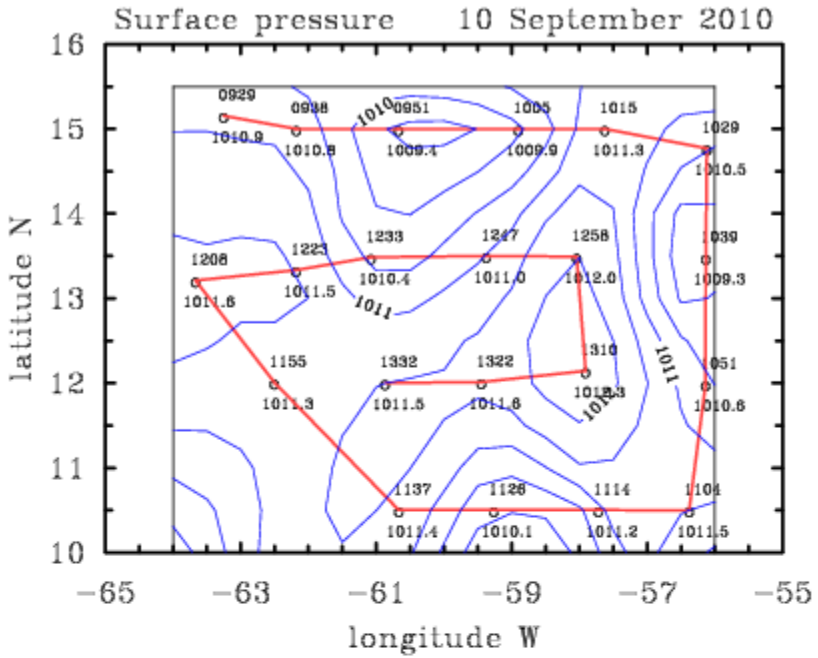
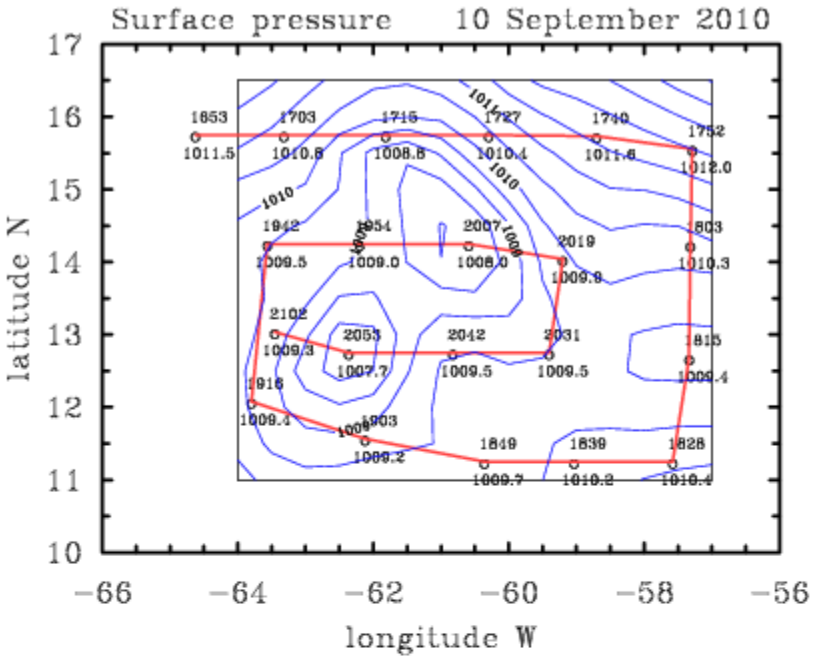



Surface pressure 10 September 2010
latitude N
longitude W


Surface pressure 10 September 2010
latitude N
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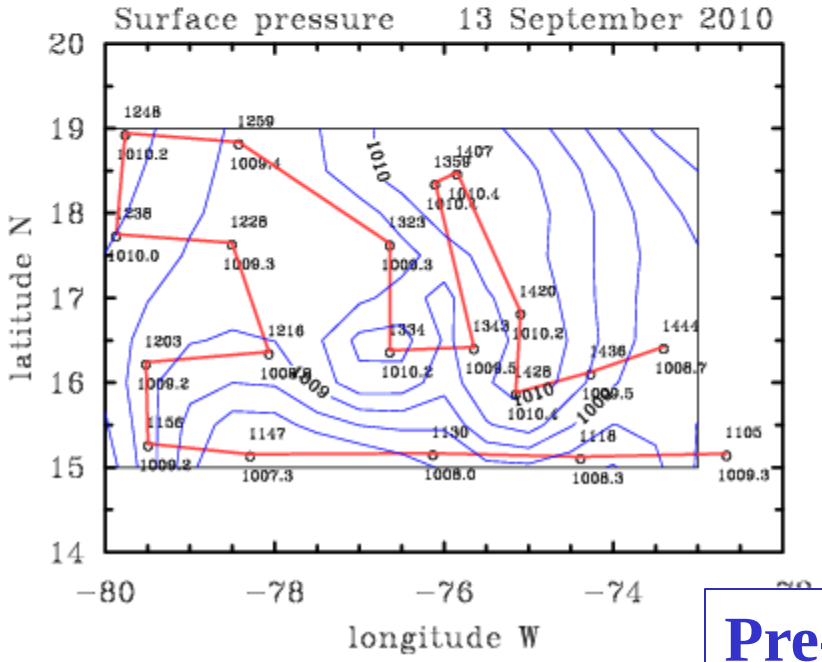
Surface pressure 13 September 2010
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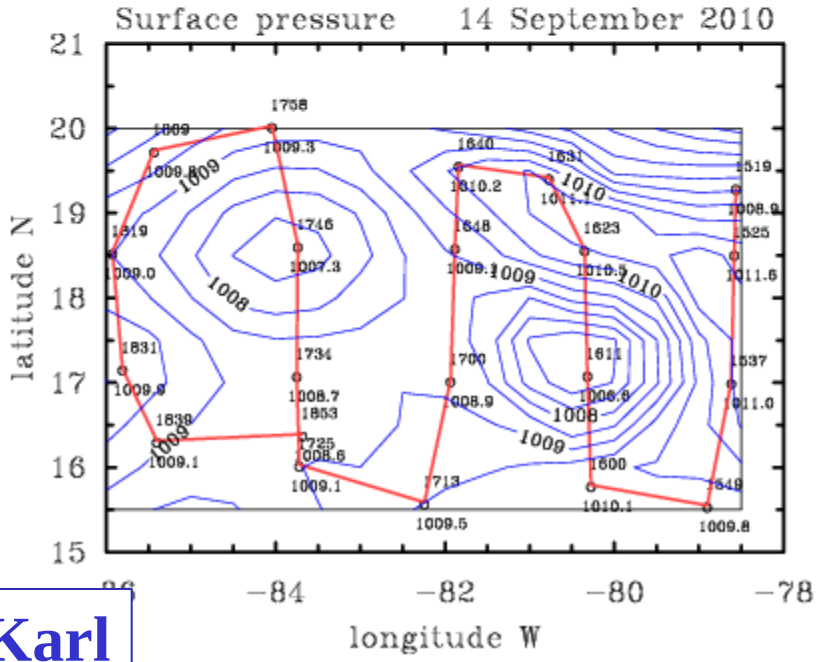
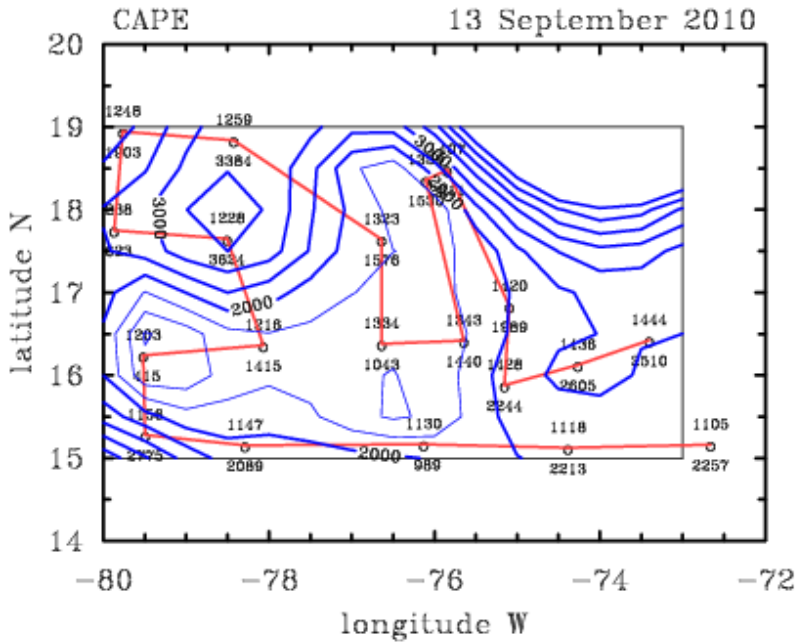

Surface pressure 14 September 2010
latitude N
longitude W

Pre-Karl


CAPE
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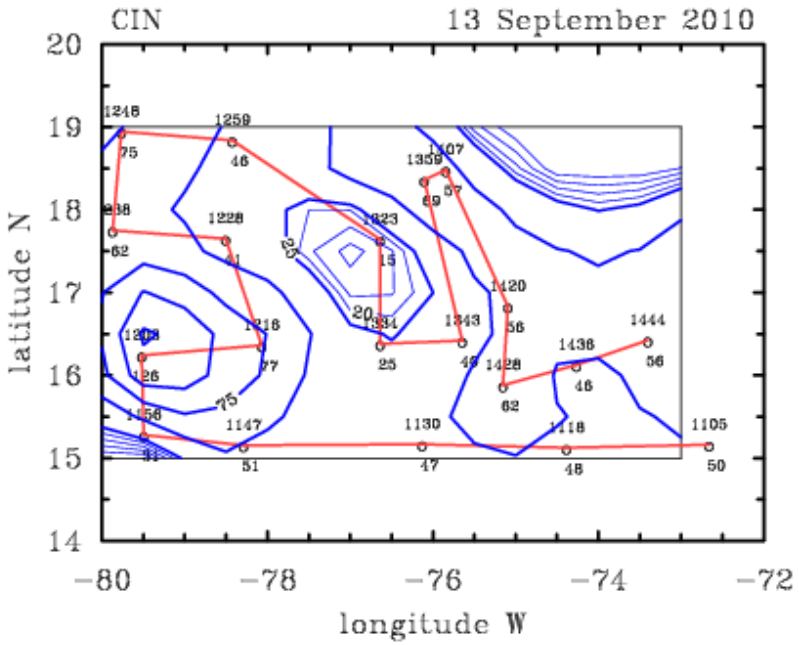
longitude W


CIN
13 September 2010
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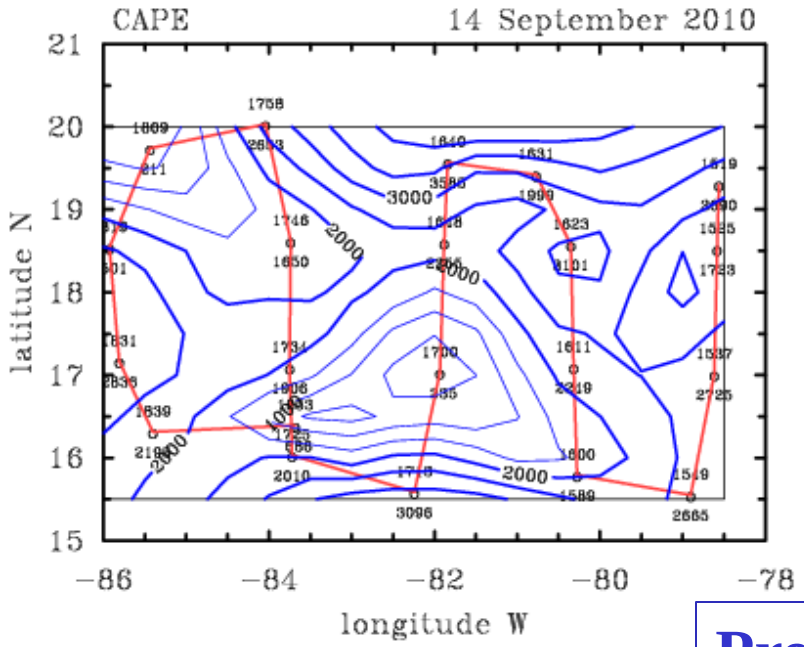
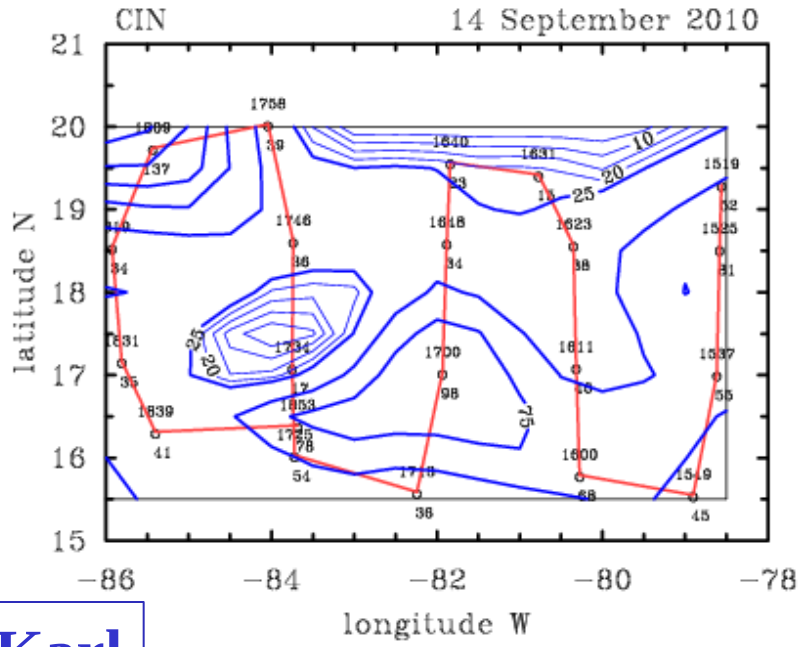
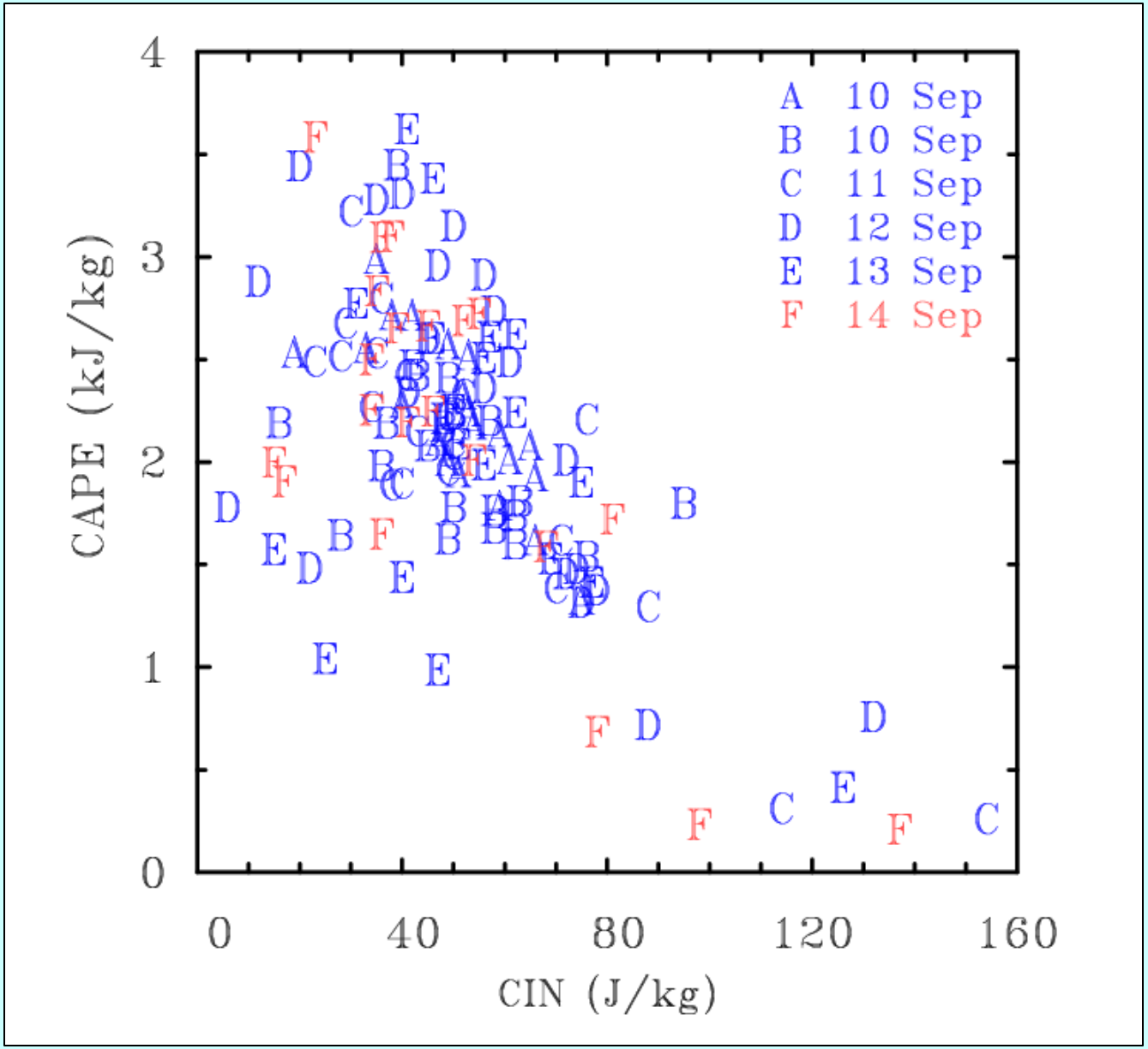
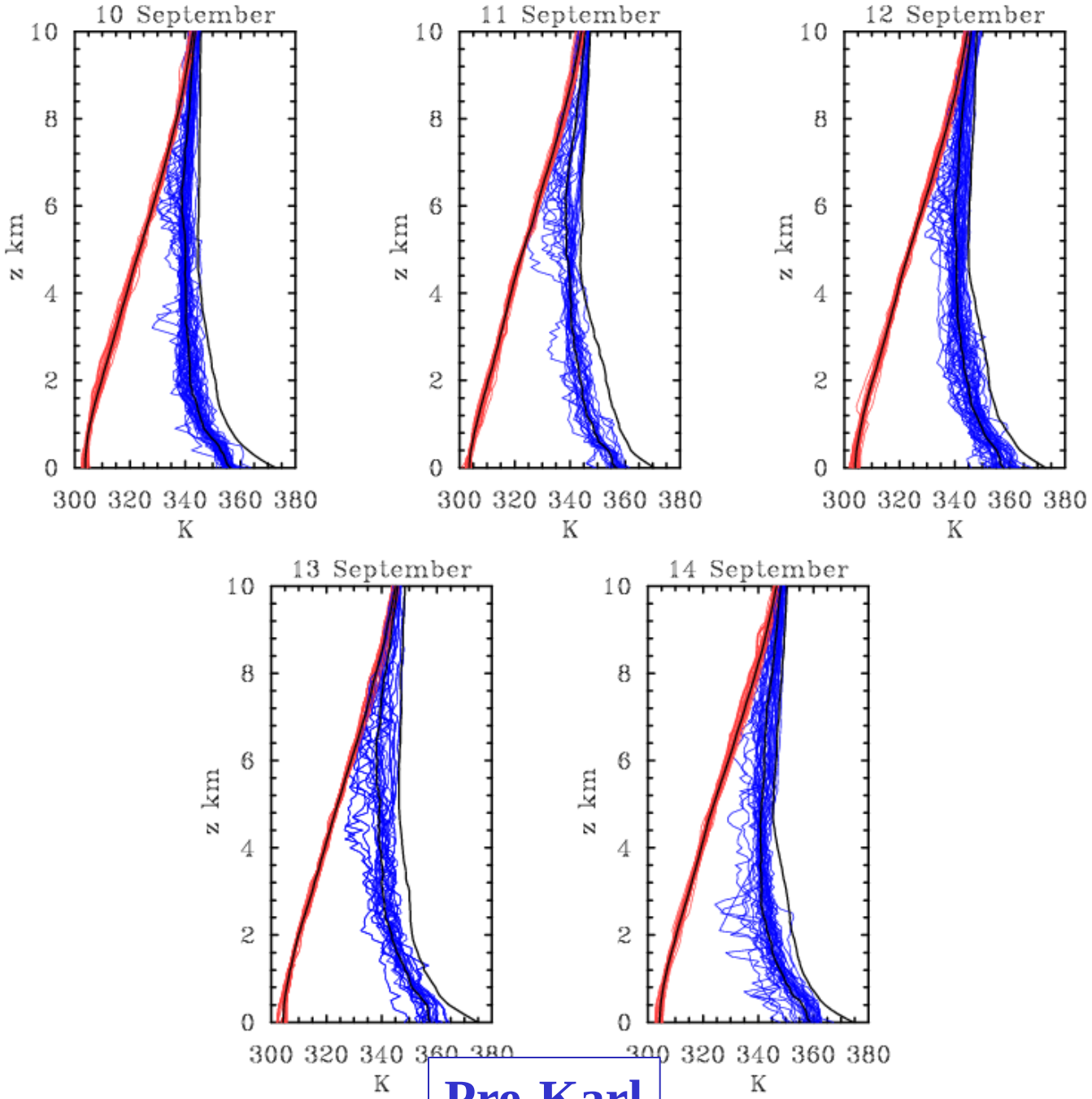

CAPE
14 September 2010
latitude N
longitude W


CIN
14 September 2010
latitude N
longitude W

Pre-Karl

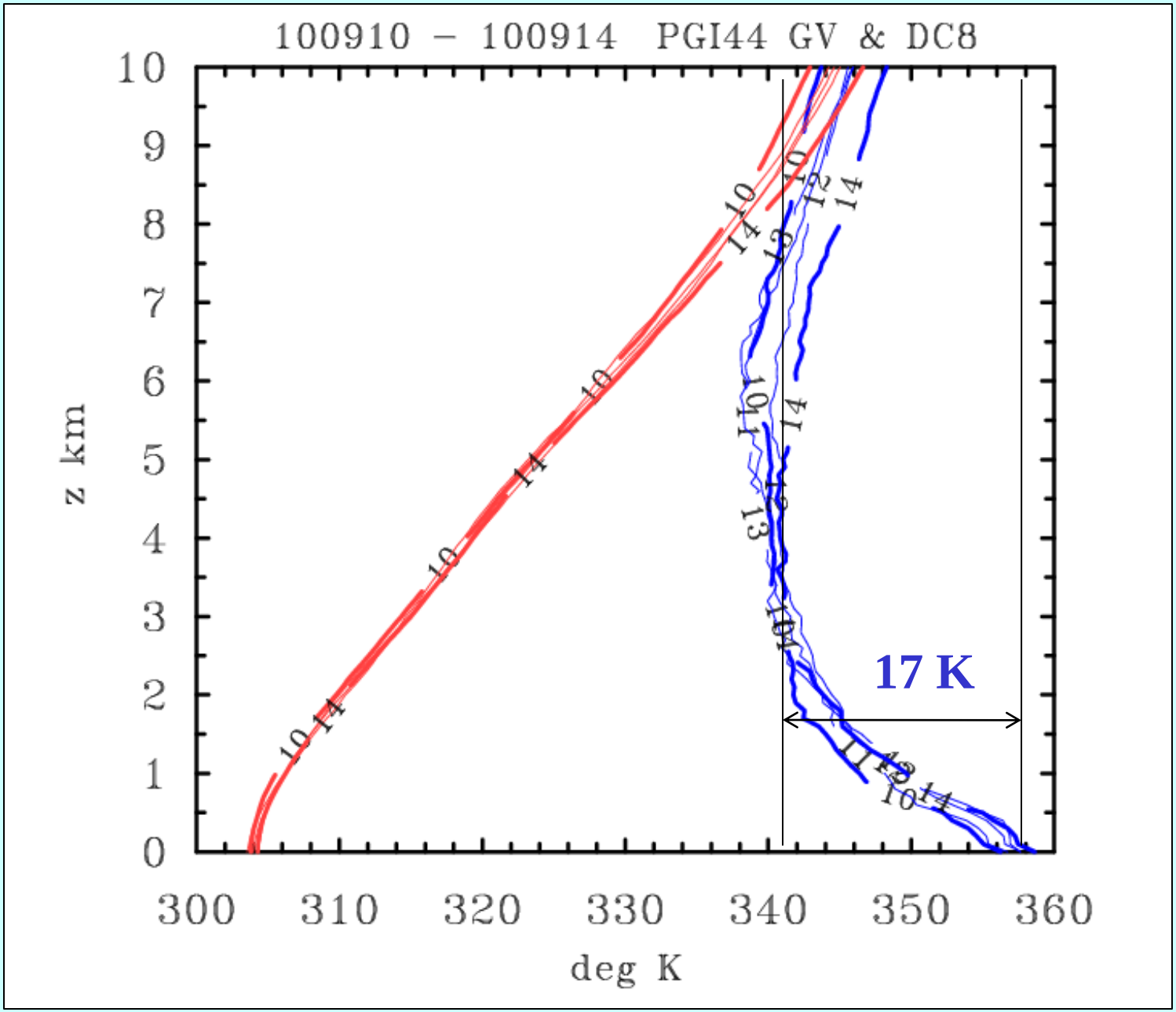
Pre-Karl CAPE & CIN



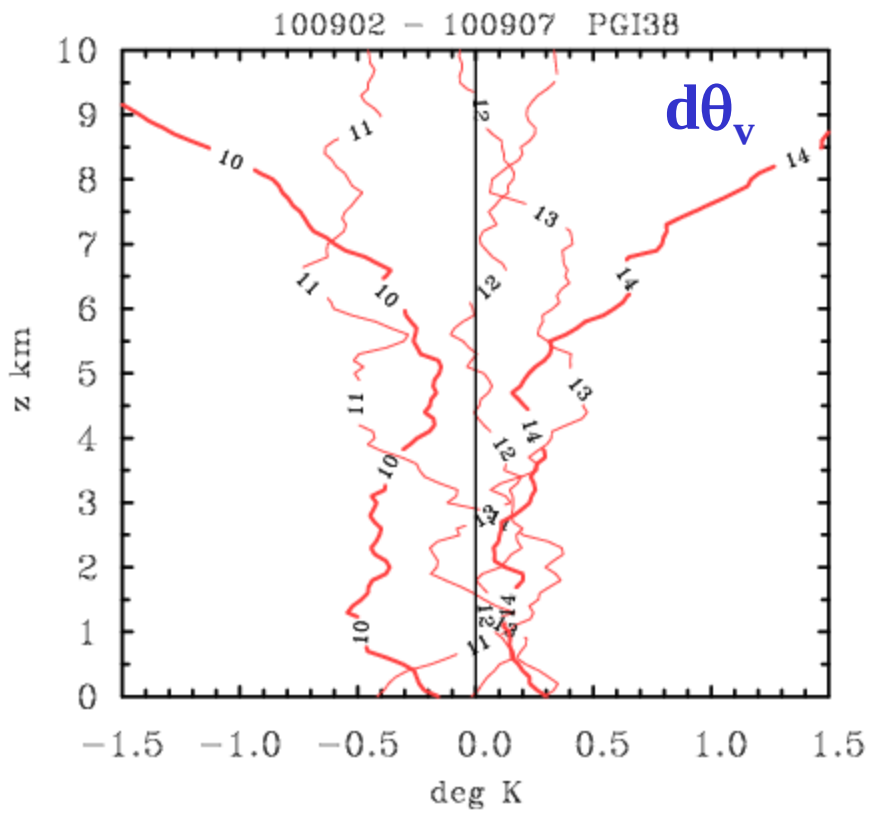

10 September
11 September
12 September
13 September
14 September
z km
K
0
2
4
6
8
10
300 320 340 360 380

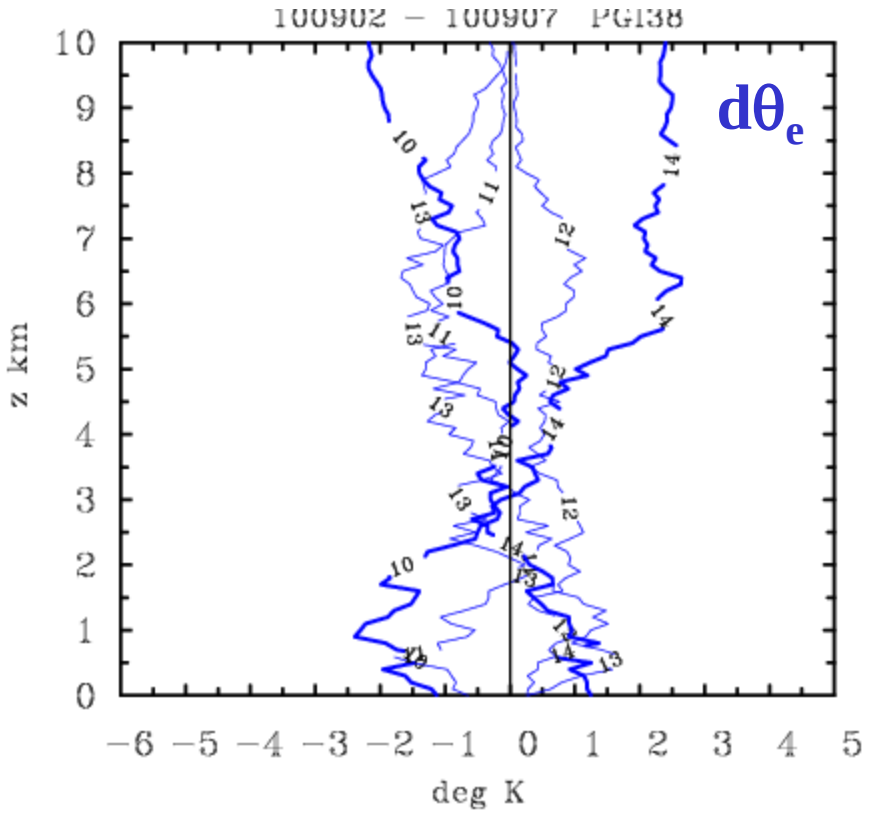
Pre-Karl

Pre-Karl 10 – 14 September

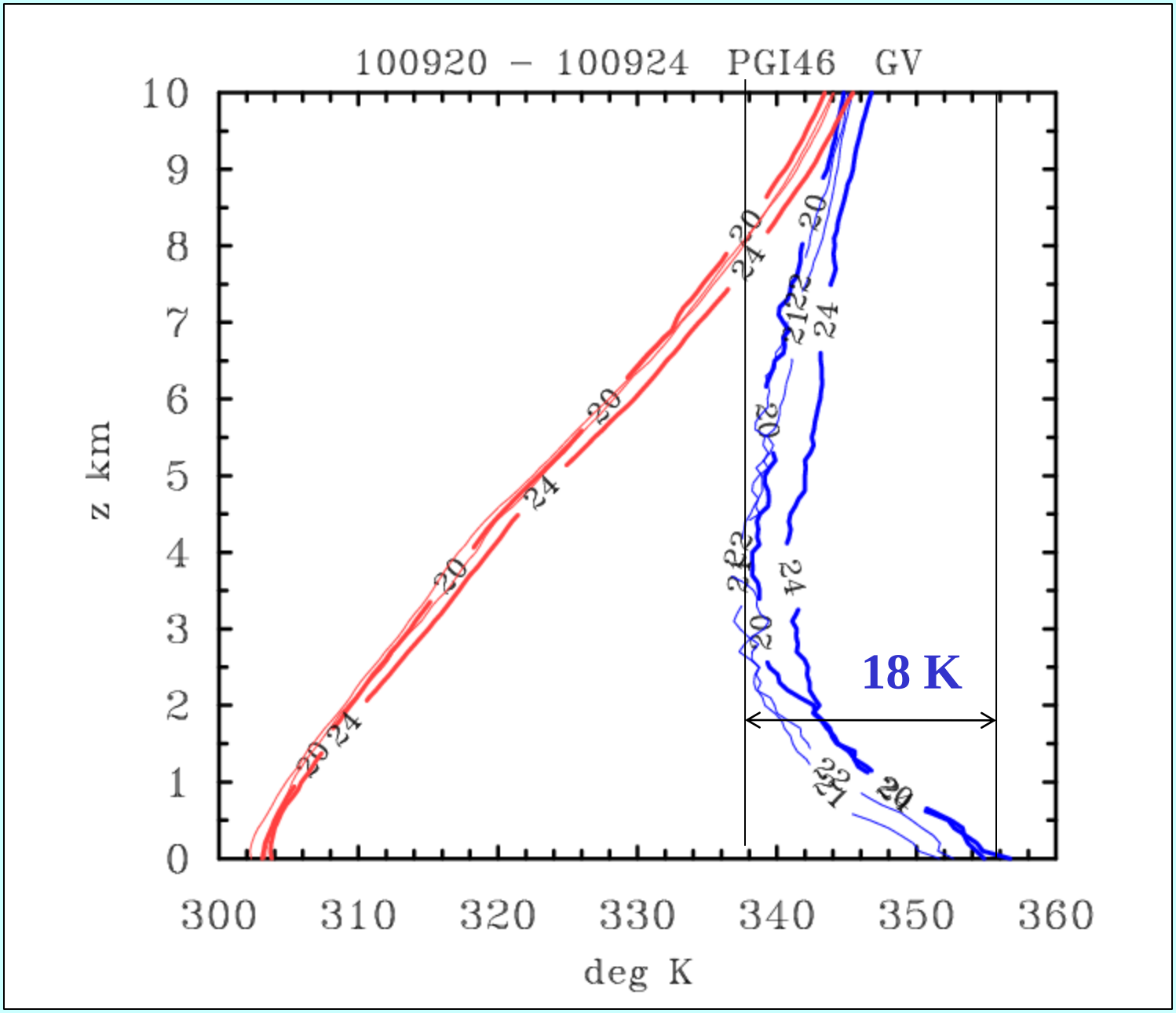


Pre-Karl 10 – 14 September

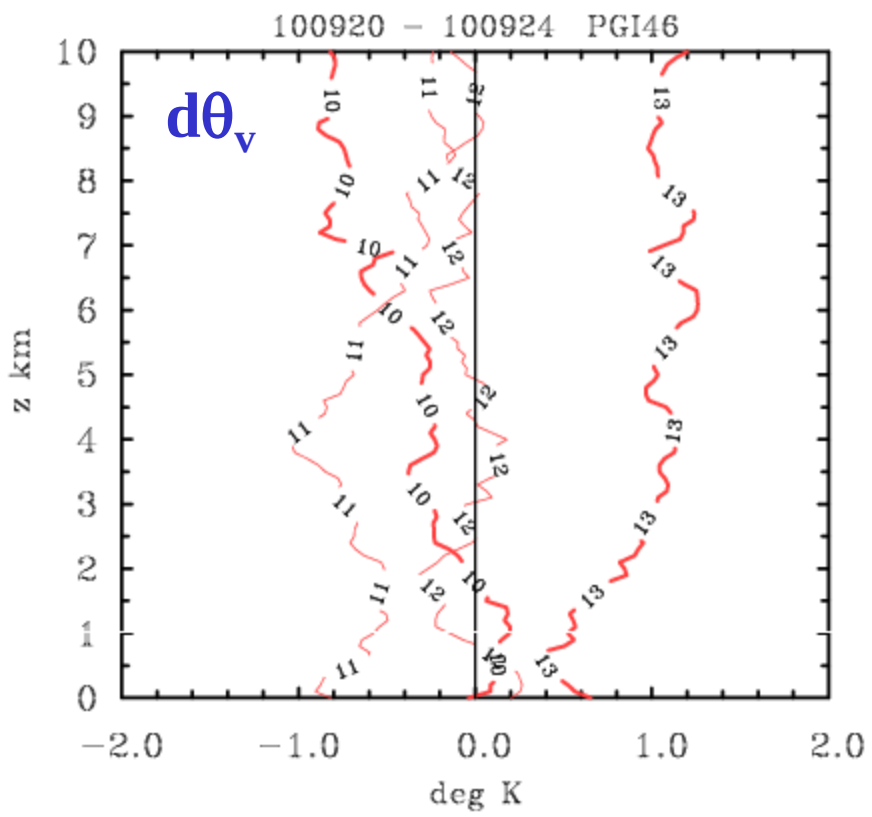


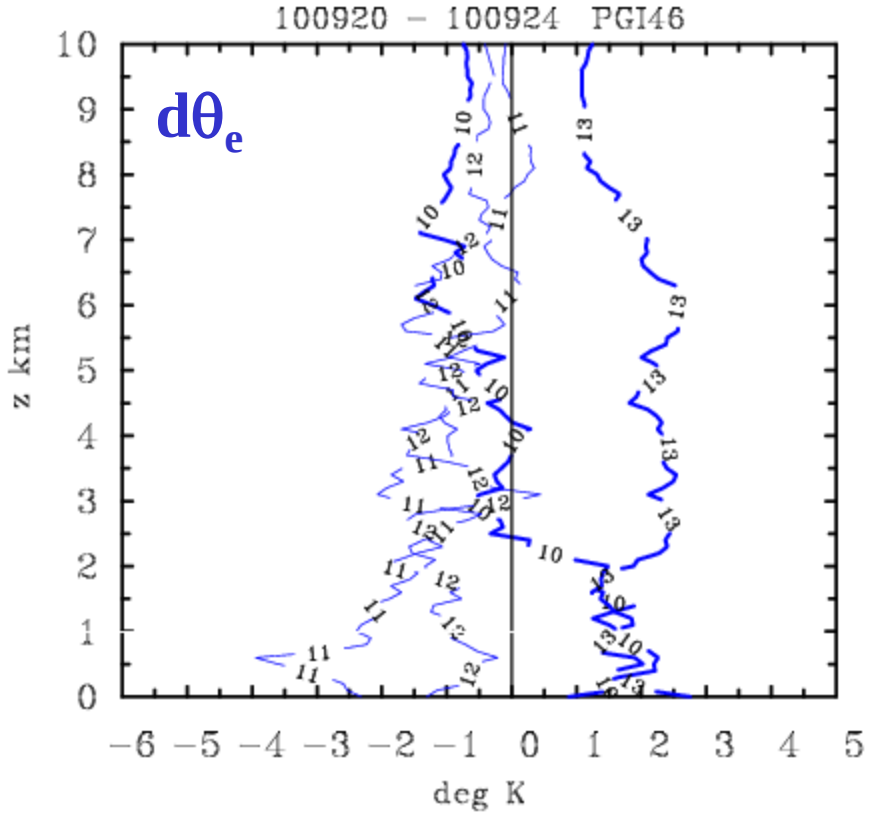


Pre-Matthew 20 – 24 September

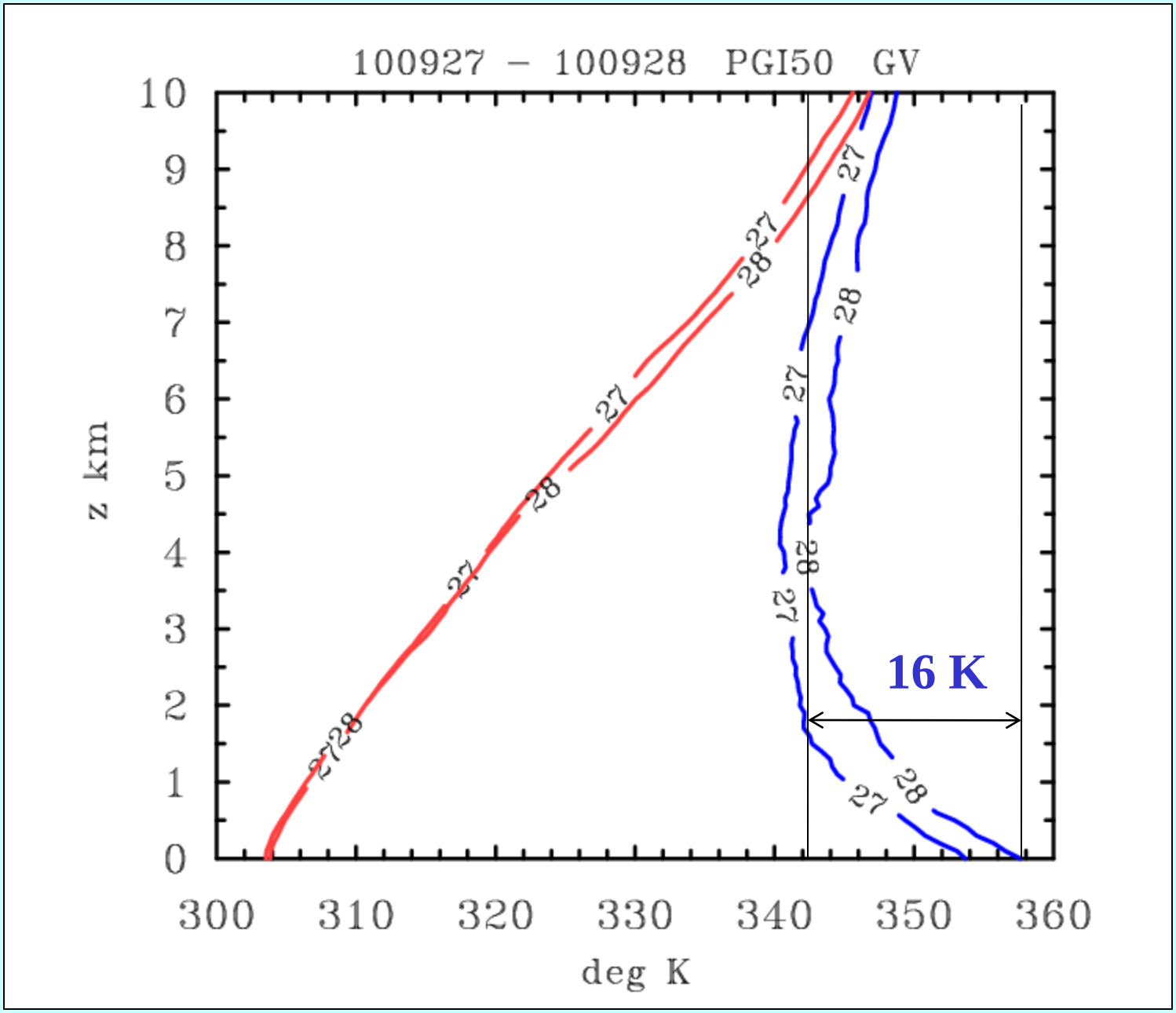


Pre-Matthew 20 – 24 September

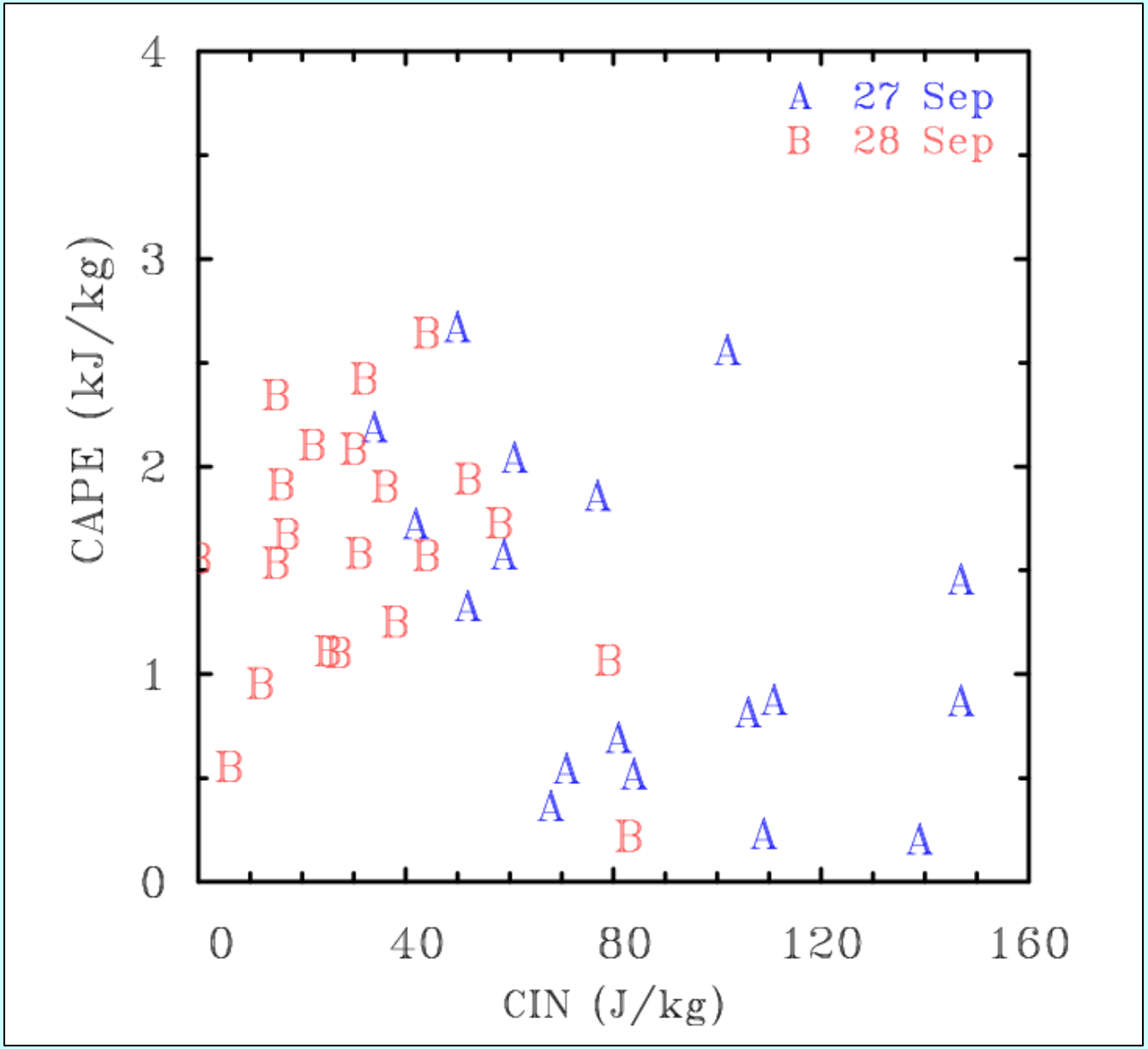




Pre-Nichol 27-28September



Pre-Nichol CAPE & CIN

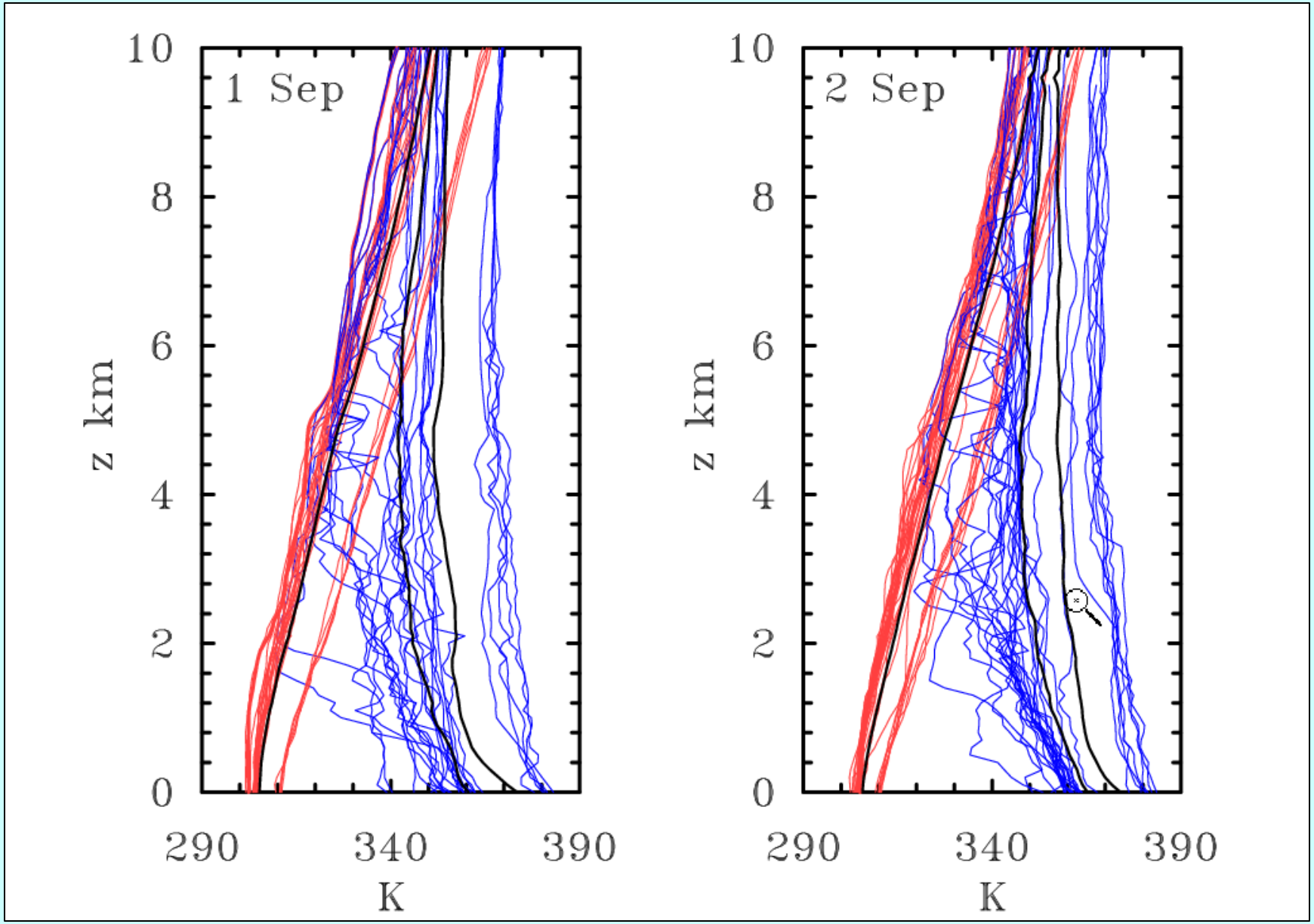


Comparative statistics of TPW

Ex-Gaston	TPW < 50 kg/m^2	TPW > 60 kg/m^2
2 Sep	30%	25%
3 Sep	5%	24%
5 Sep	33%	33%
6 Sep	45%	18%
6 Sep DC8	18%	12%
7 Sep	14%	32%
7 Sep DC8	7%	14%

Pre-Karl	TPW < 50 kg/m^2	TPW > 60 kg/m^2
10 Sep	5%	26%
11 Sep	0%	18%
12 Sep	0%	68%
13 Sep	13%	44%
14 Sep	0%	70%

01 Sep 2010 **Hurricane Earl** **02 Sep 2010**



Questions

1. **Gaston: lower levels moistened even though the middle level θ_e decreased . $d\theta_e$ on the order of 25 K.**
2. **Karl: $d\theta_e$ on the order of 15 K, much smaller than in Gaston.**
3. **Less variability in $\theta_e(z)$ compared with Gaston.**
4. **Significant values of CAPE in all systems: larger in Gaston and Karl than in Matthew and Nichol.**
5. **Highest values of CAPE generally have low CIN.**
6. **Not much systematic information in the evolution of CAPE for development and nondevelopment.**
7. **Lots more variability in $\theta_e(z)$ in mature Hurricane Earl compared with Gaston and Karl.**


Thank you