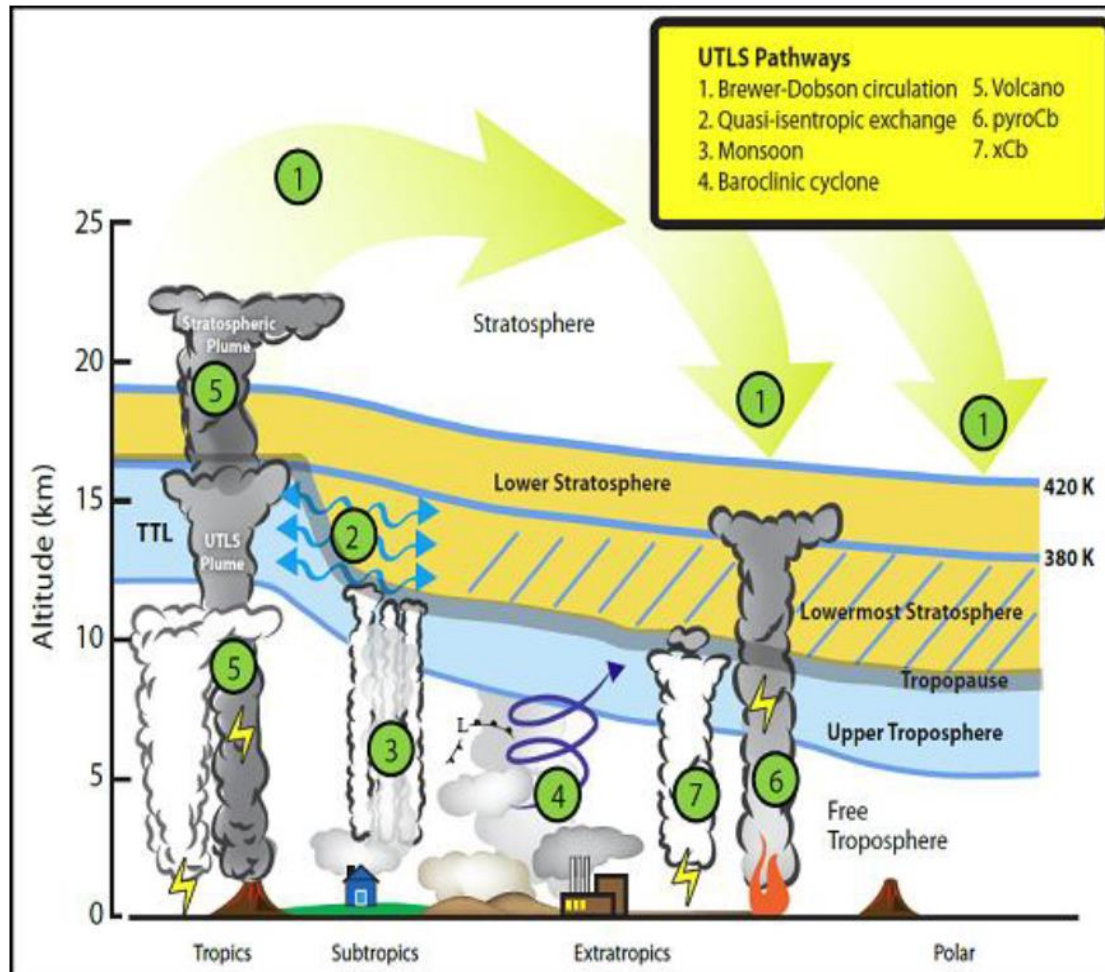


High altitude smoke in the NASA GISS GCM

Robert Field

Field, R.D., M. Luo, M. Fromm, A. Voulgarakis, S. Mangeon, J. Worden, Simulating the Black Saturday 2009 smoke plume with an interactive composition-climate model: sensitivity to emissions amount, timing and injection height, submitted.

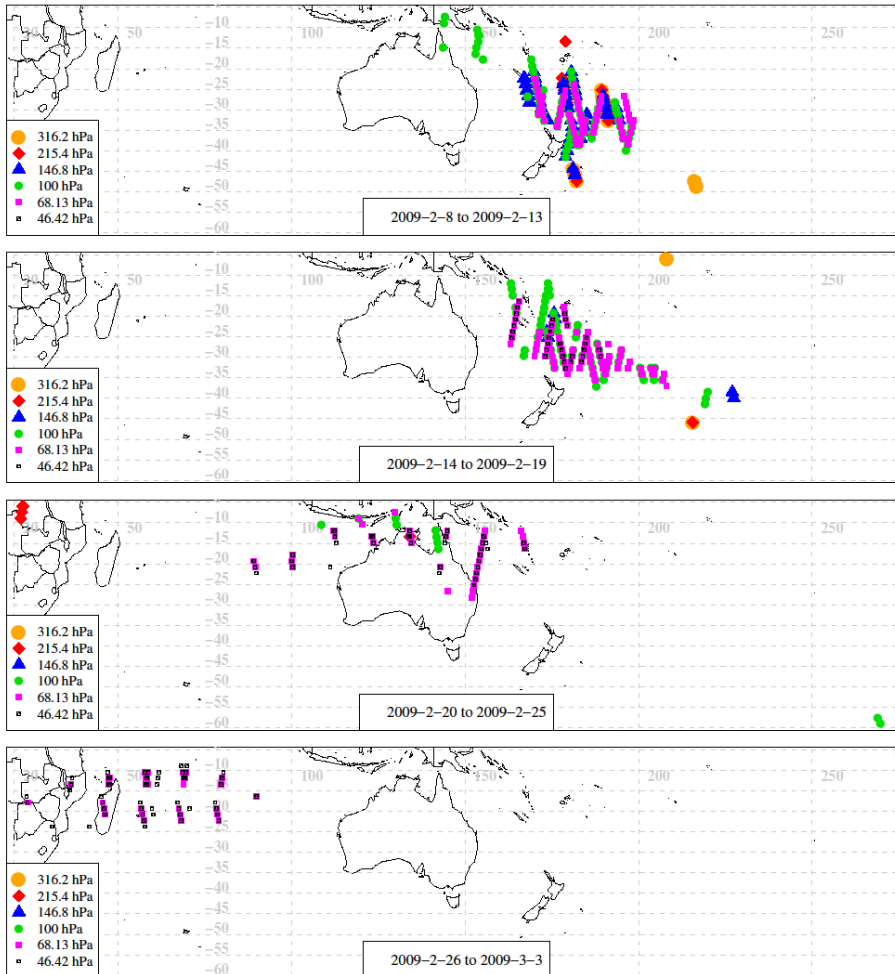
High altitude smoke-plumes from explosive fires were discovered in the late 1990s



(Mike Fromm, NRL)

Black Saturday, 7 February 2009

CO from Aura MLS



Pumphrey et al. (2011, ACP)

Also

Aura TES & MLS
(Luo et al., 2013)

OSIRIS
(Siddaway and Petelina, 2011)

OMI AAI, AIRS CO, MODIS AOD,
CALIPSO
(de Laat et al., 2012)

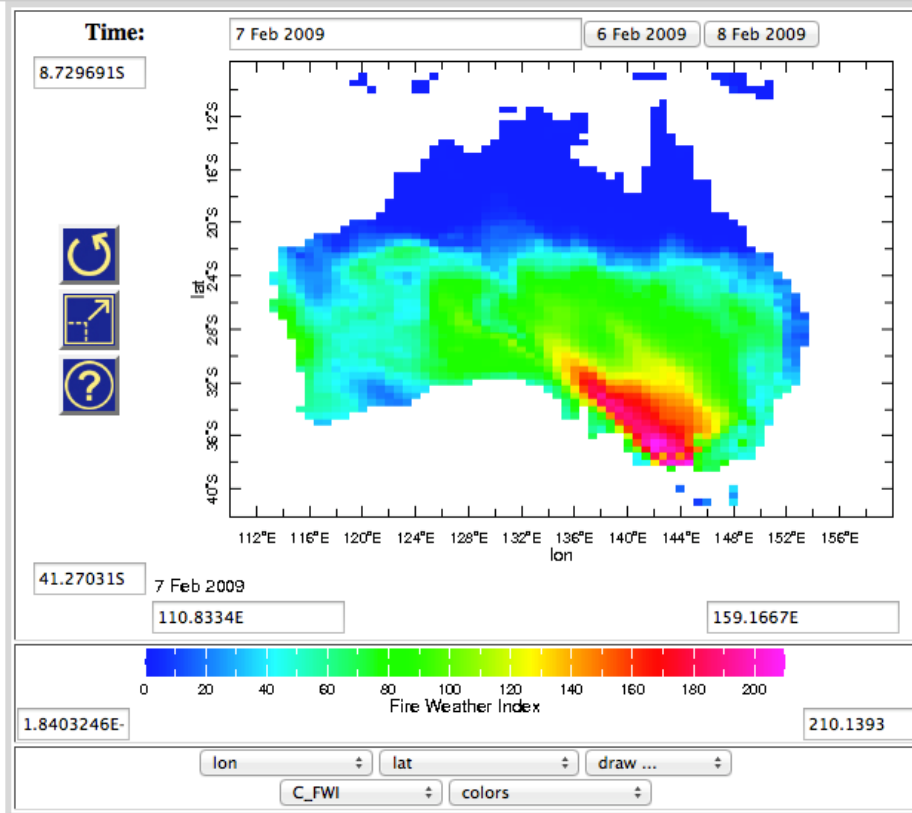
MIPAS Cloud & aerosol top heights
(Sembhi et al., 2012)

MIPAS C₂H₂, HCN, HCOOH
(Glatthor et al., 2013)

CALIOP
(Vernier et al., 2011)

February 7 Fire Weather Index

IRI	Data Library	GISS GlobalFWI v1p5 DAILY	GISS GlobalFWI v1p5 DAILY Fire Weather Index 7 Feb 2009	179.6667E - 179.6667E	58.25S - 75.25N	Feb 1979 - Dec 2014	WGS 84
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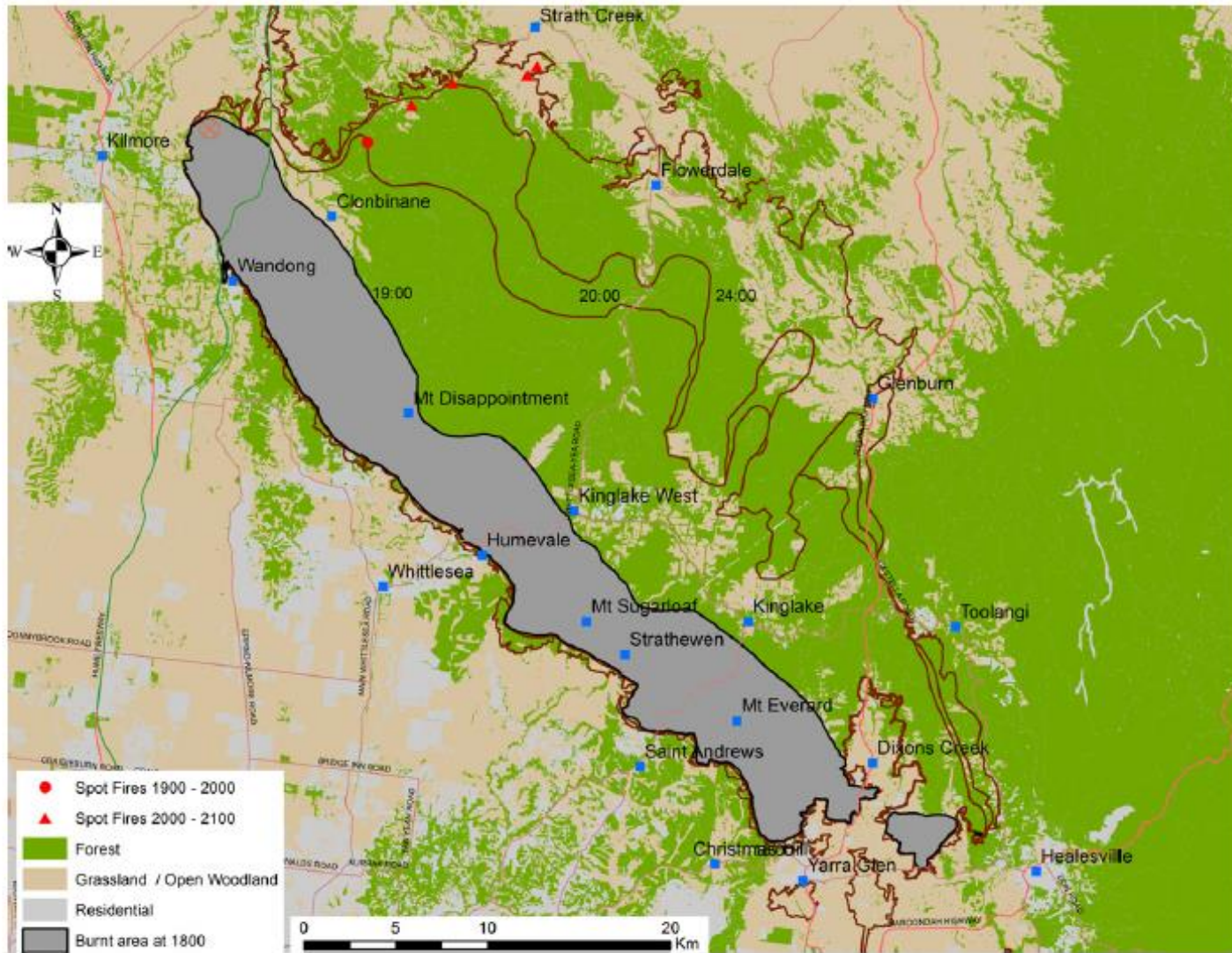


Get Data	Entire Dataset	data in view	Export	Edit plot
Page Formats	documented page	plain page	linked pdf	cut and paste link more options



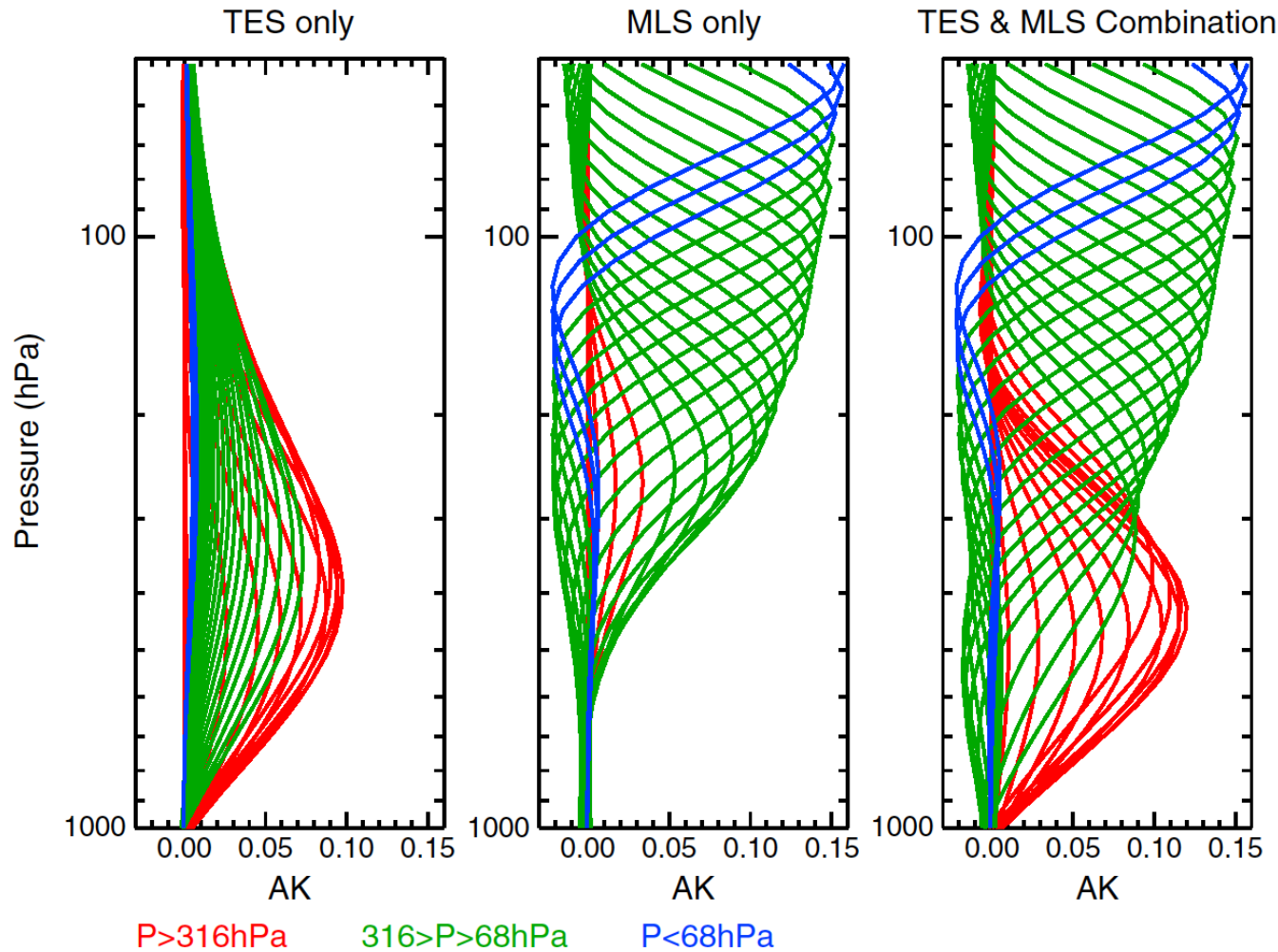
Kilmore East Fire

Photo: Melbourne Herald Sun



Cruz et al. (2011, *For. Ecol. Mgmt.*)

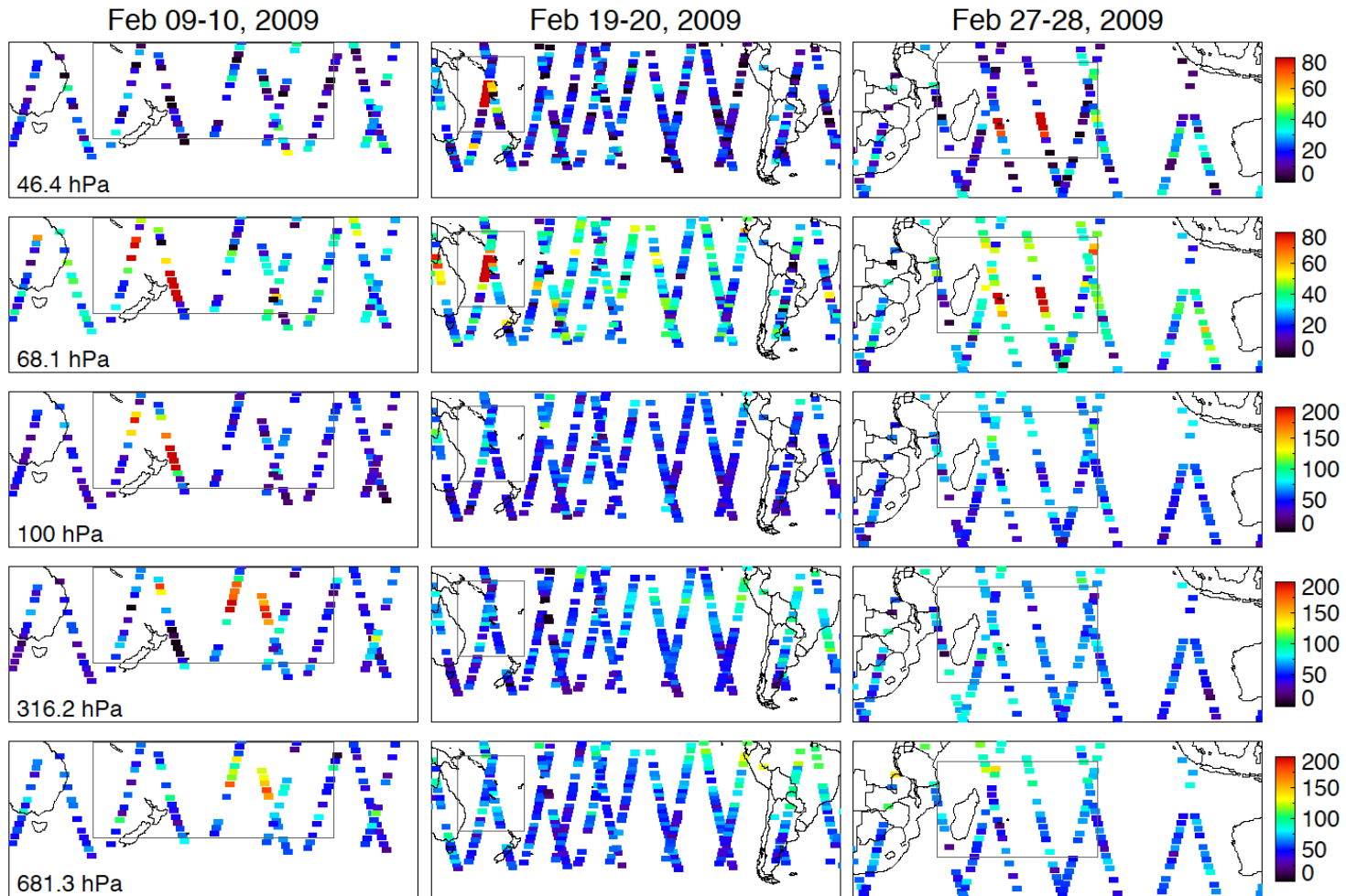
Jointly retrieved CO from Aura TES & MLS



Luo et al. (2013, *JGR*)

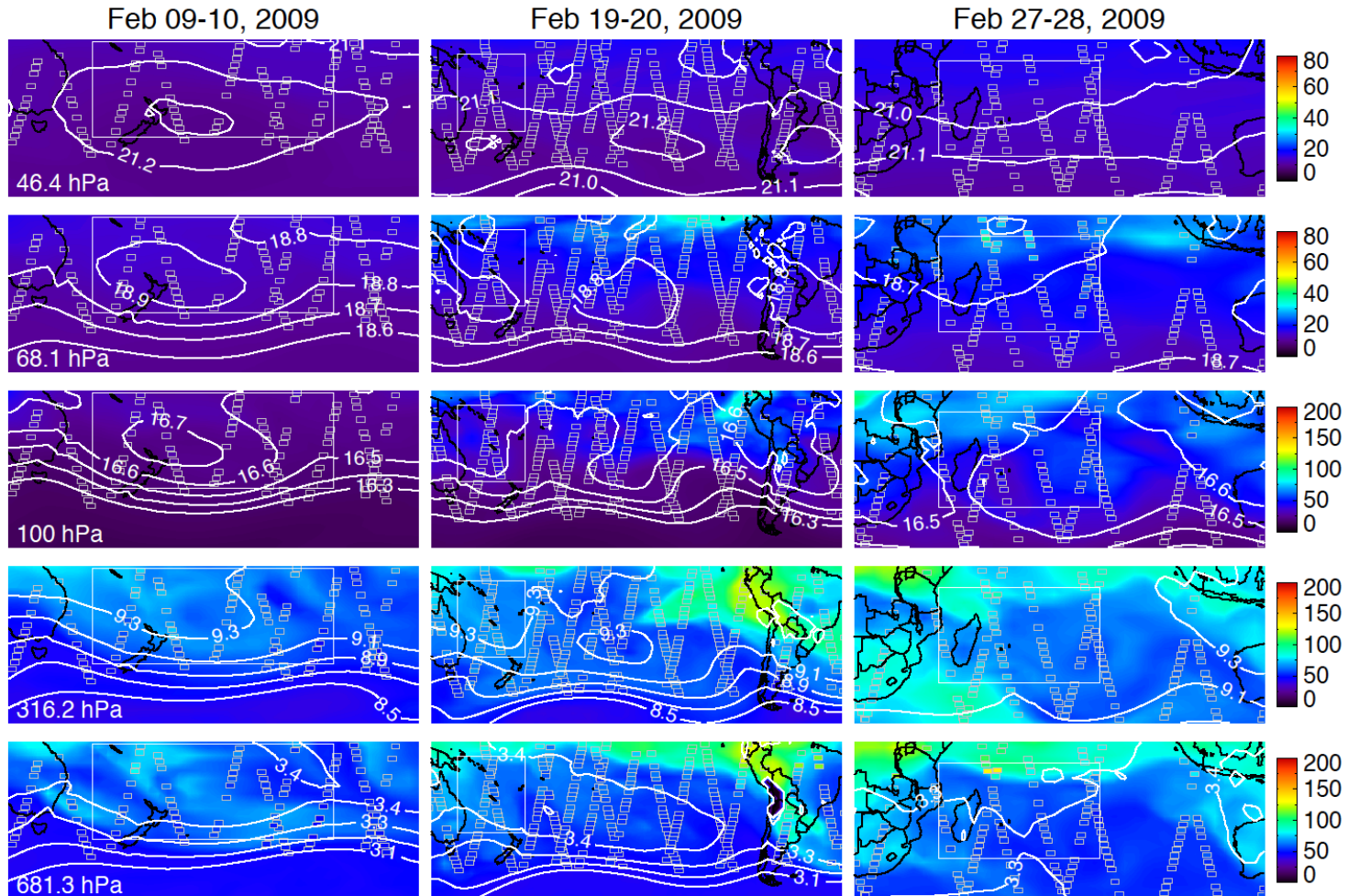
Aura TES / MLS

CO (ppbv)

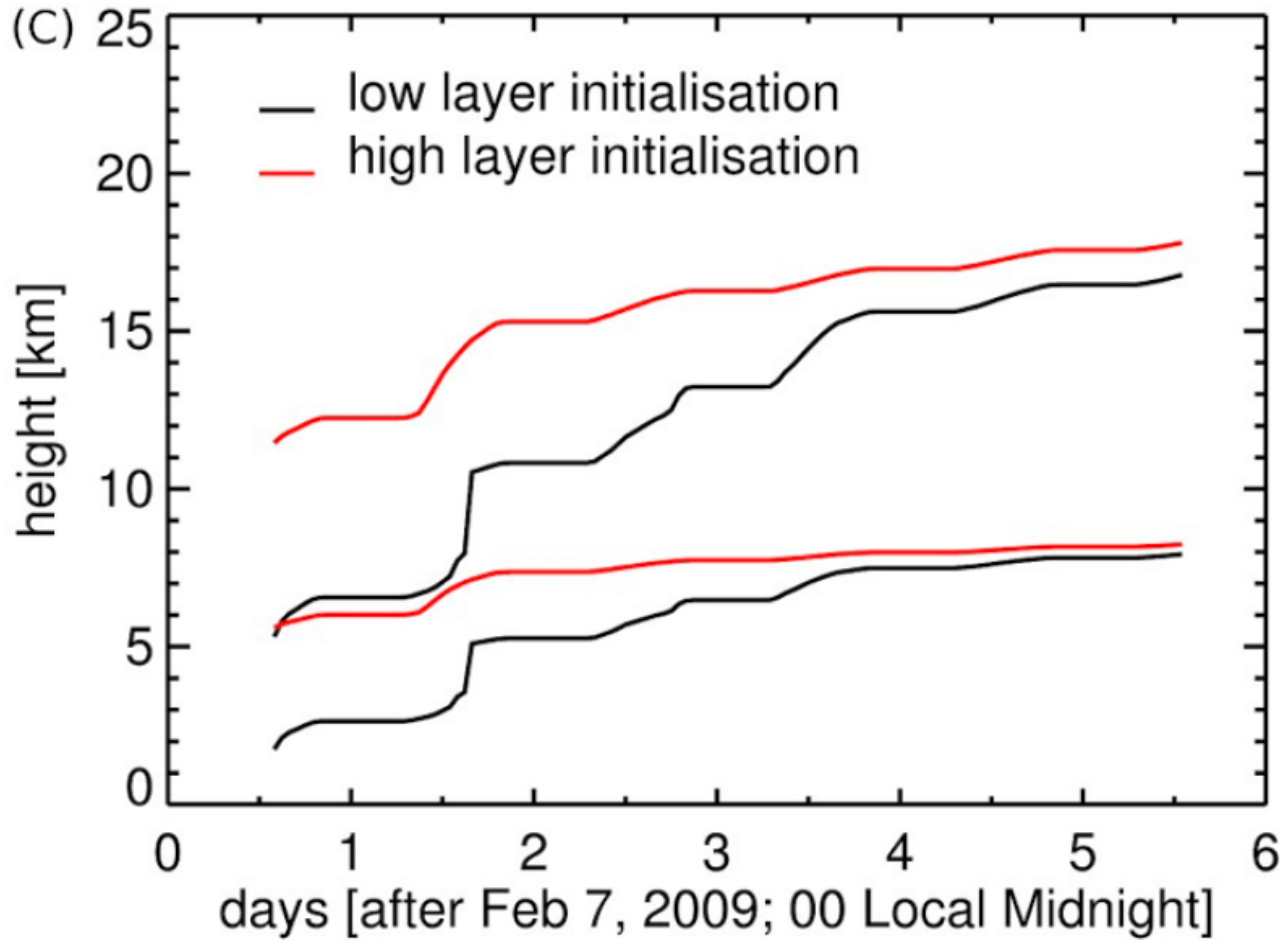


CTRL (no fire)

CO (ppbv)

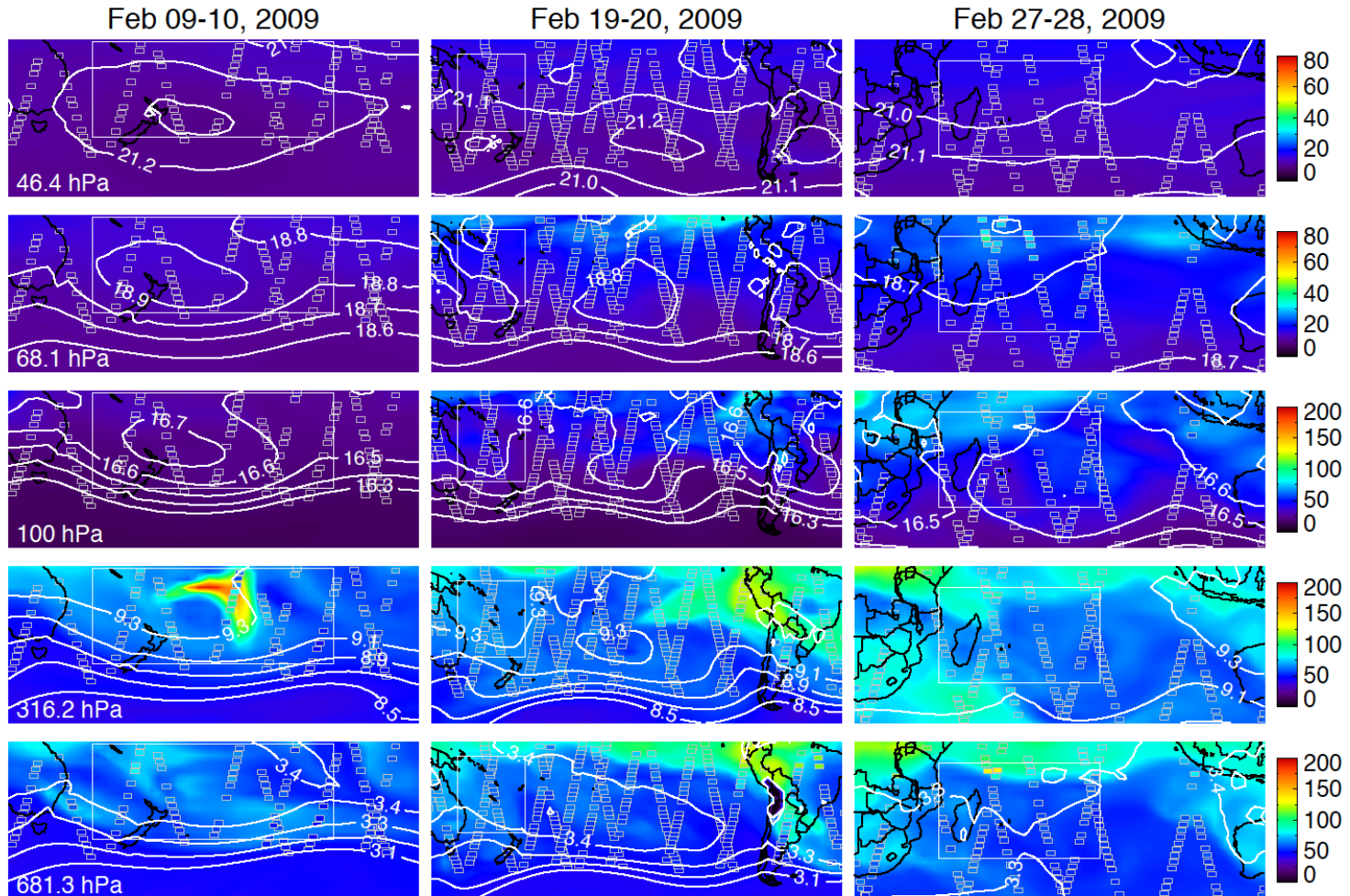


Injection heights for idealized model from de Laat et al. (2012)

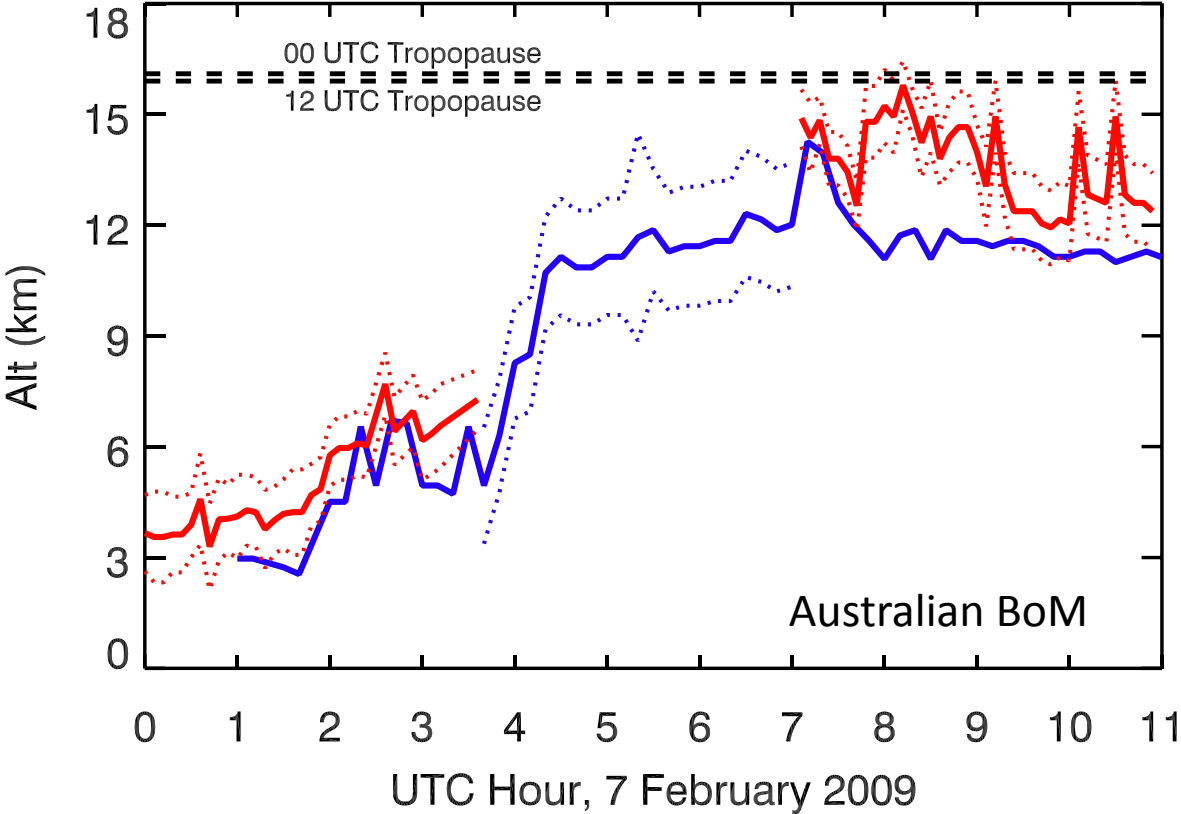


8.5 km injection height, baseline emissions

CO (ppbv)

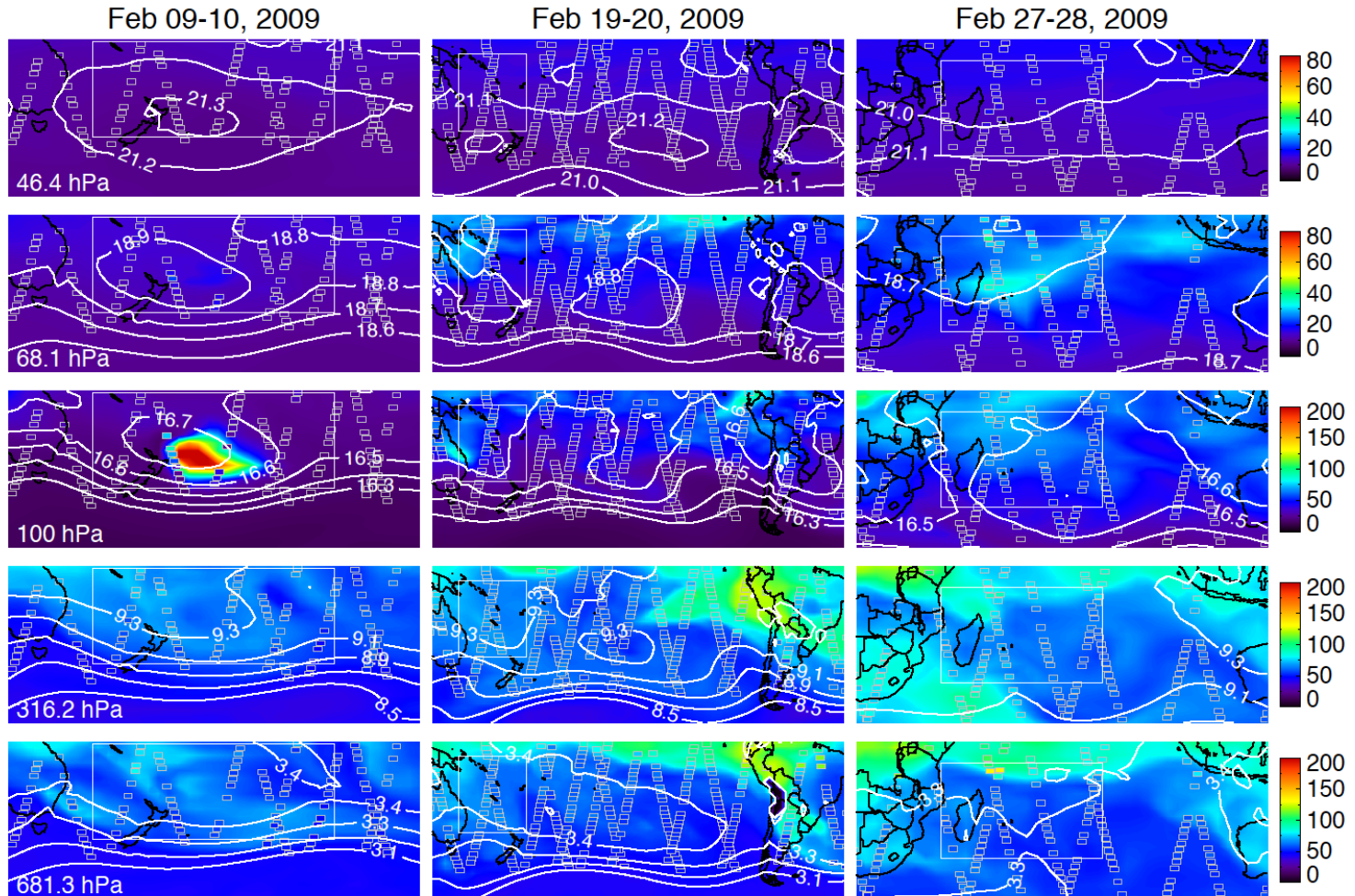


Echo tops from 2 radar stations near Melbourne

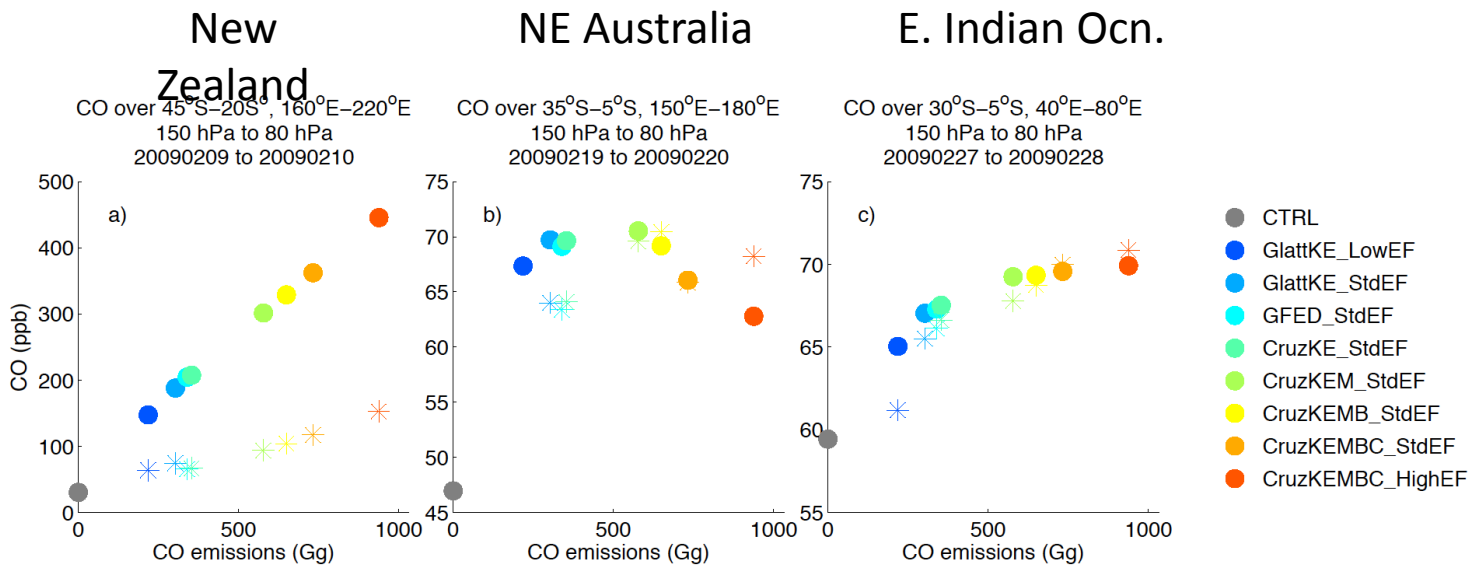


13.5 km injection height, baseline emissions

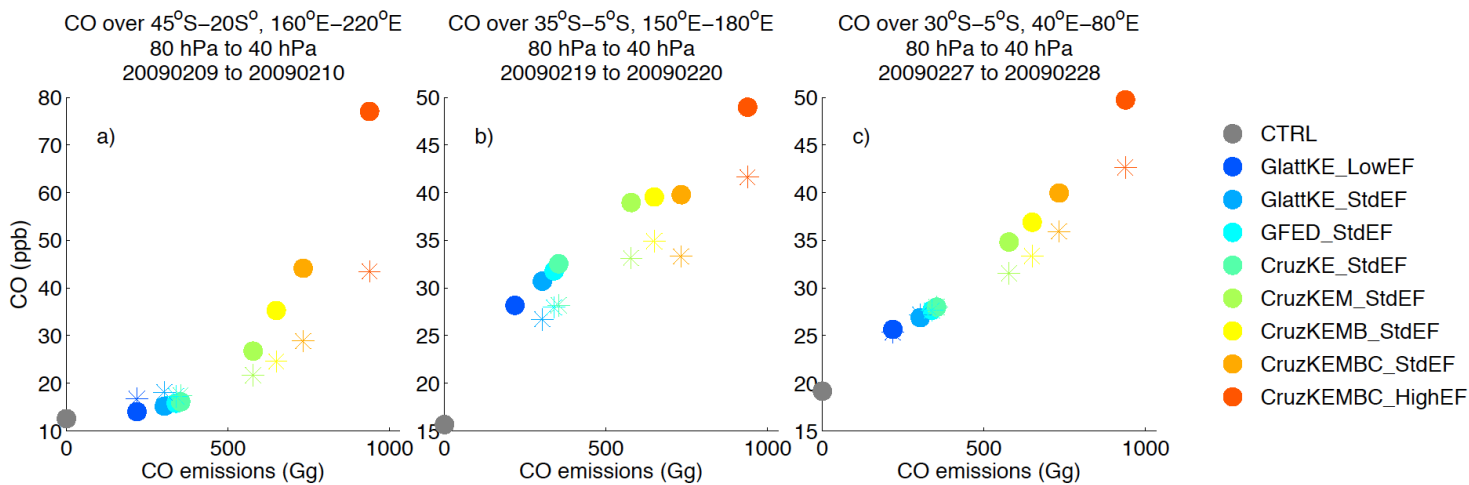
CO (ppbv)



Upper
troposphere

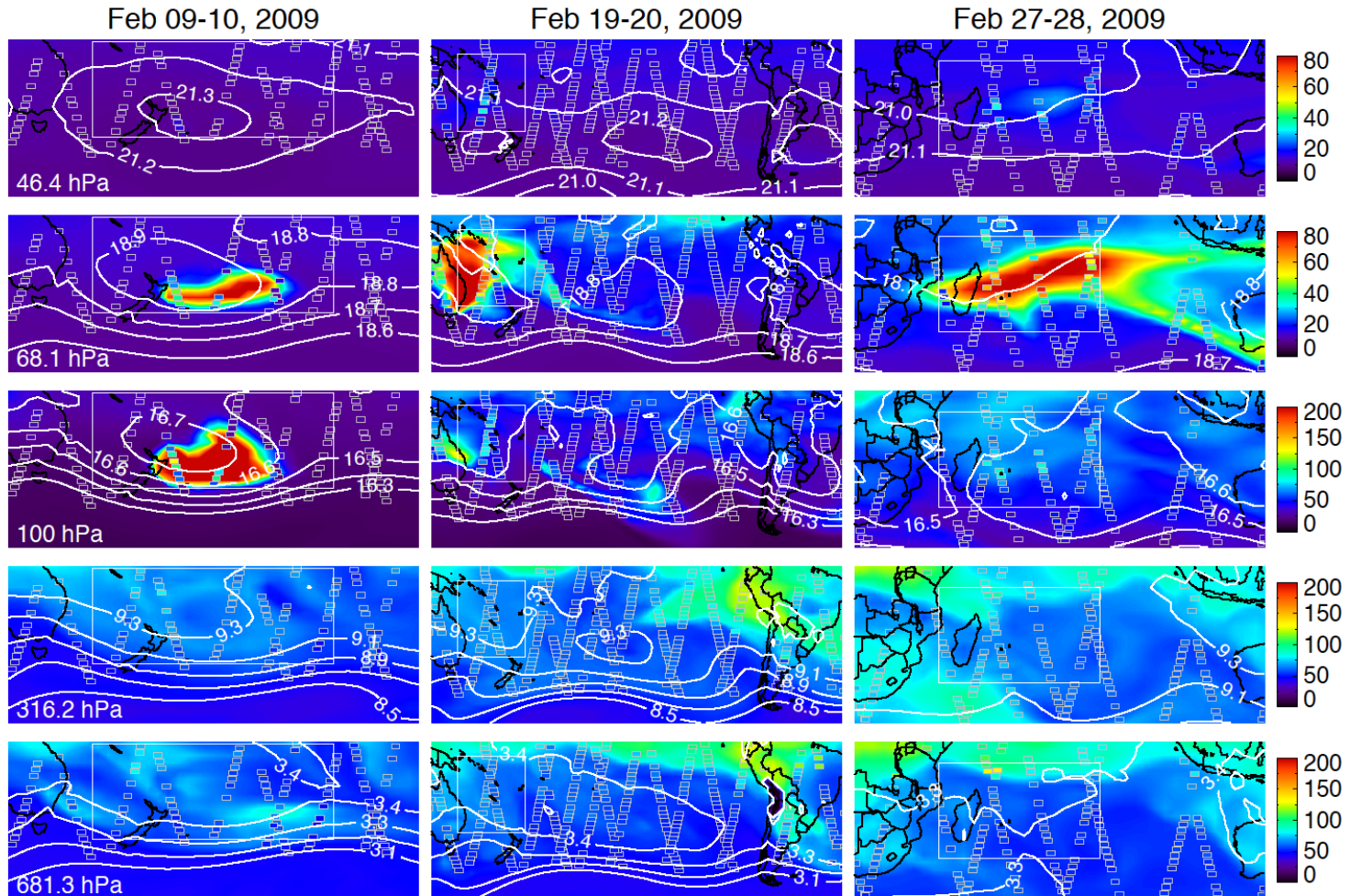


Lower
stratosphere

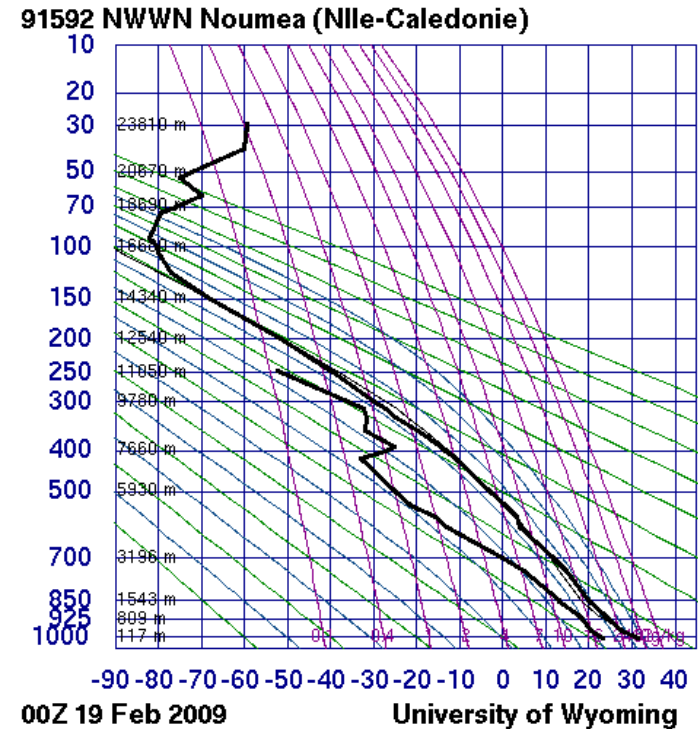
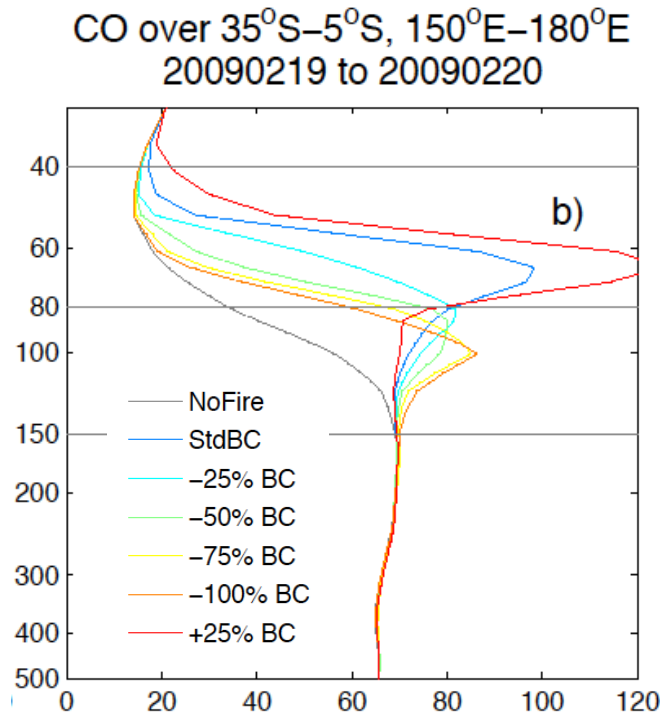


13.5 km injection height, high emissions, hourly emissions

CO (ppbv)



CO sensitivity to BC / OC mix: self-lofting?

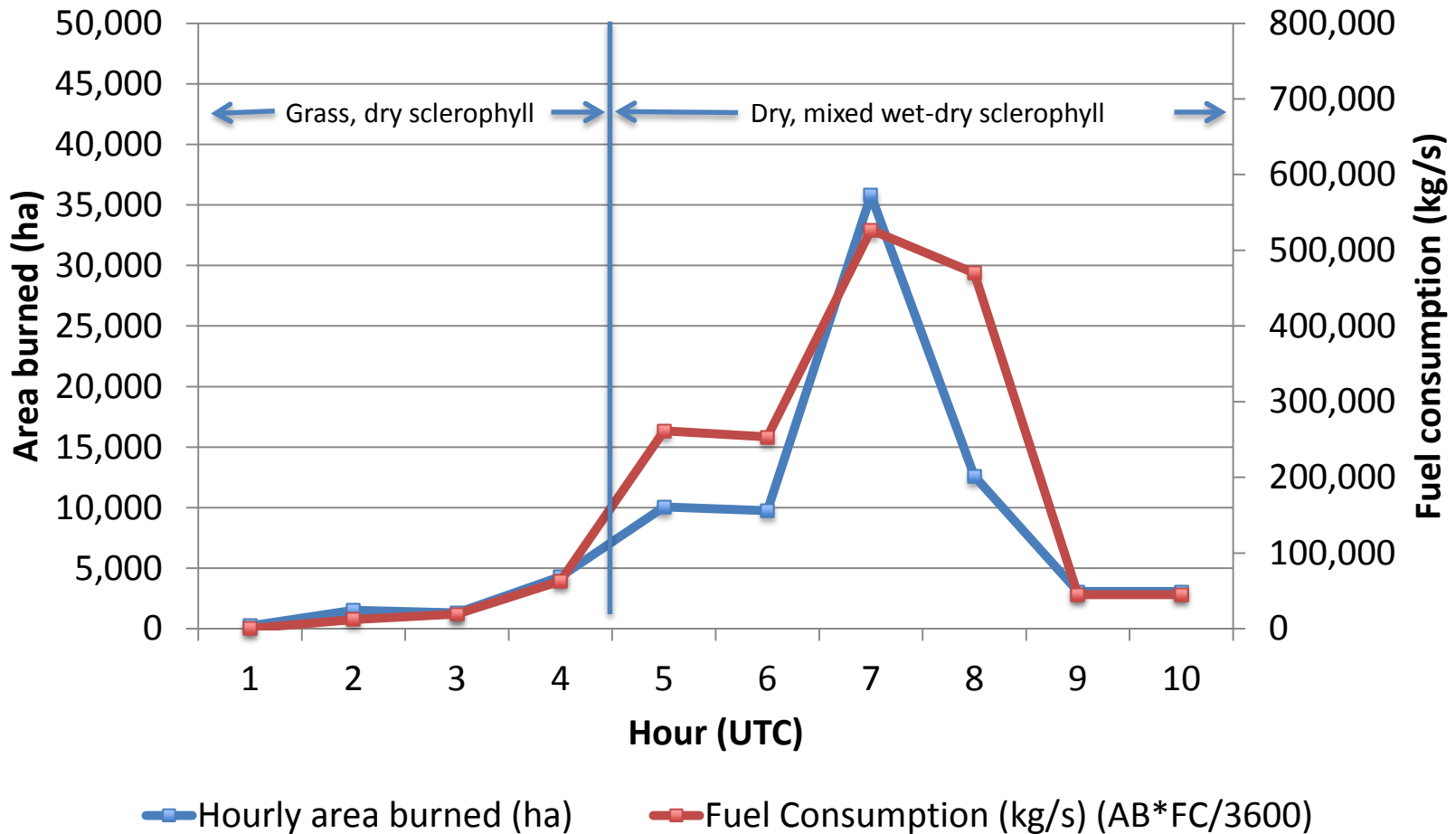


Summary

- Plume fate is highly sensitive to injection height and emissions, somewhat sensitive to timing
- Upper tropospheric injection required to simulate plume persisting in LS through Feb 2009
- Preliminary results suggests that diabatic 'self-lofting' plays a role in the plume's persistence

Extras

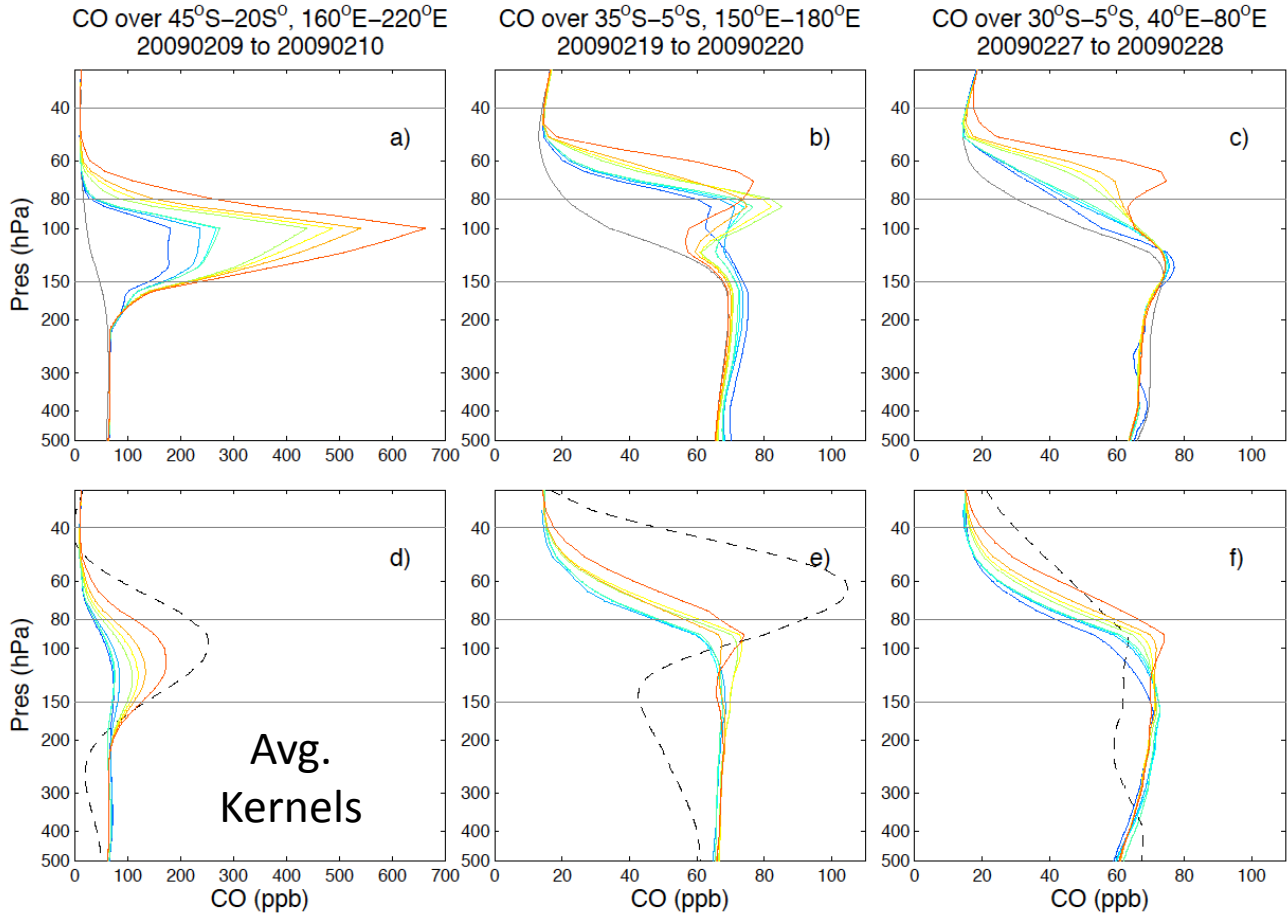
Kilmore East area burned and fuel consumption (Cruz et al., 2012)



Grass: 0.45 kg/m²

Dry sclerophyll, low understory: 5.3 kg/m²

Mixed wet-dry sclerophyll forest: 13.4 kg/m²



- Aura
- CTRL
- GlattKE_LowEF
- GlattKE_StdEF
- GFED_StdEF
- CruzKE_StdEF
- CruzKEM_StdEF
- CruzKEMB_StdEF
- CruzKEMBC_StdEF
- CruzKEMBC_HighEF

Higher emissions



Evaluating GISS ModelE2 using new Aura CO profiles

Field, R.D., M. Luo, D. Kim, A. D. Del Genio, A. Voulgarakis, J. Worden, Sensitivity of simulated tropospheric CO to subgrid physics parameterization: a case study of Indonesian biomass burning emissions in 2006, *Journal of Geophysical Research – Atmospheres*, 120, doi:10.1002/2015JD023402.

Cumulus parameterization changes that improve GCM performance in some ways **can sometimes worsen it in others**. It is thus useful to examine the effects on other fields.

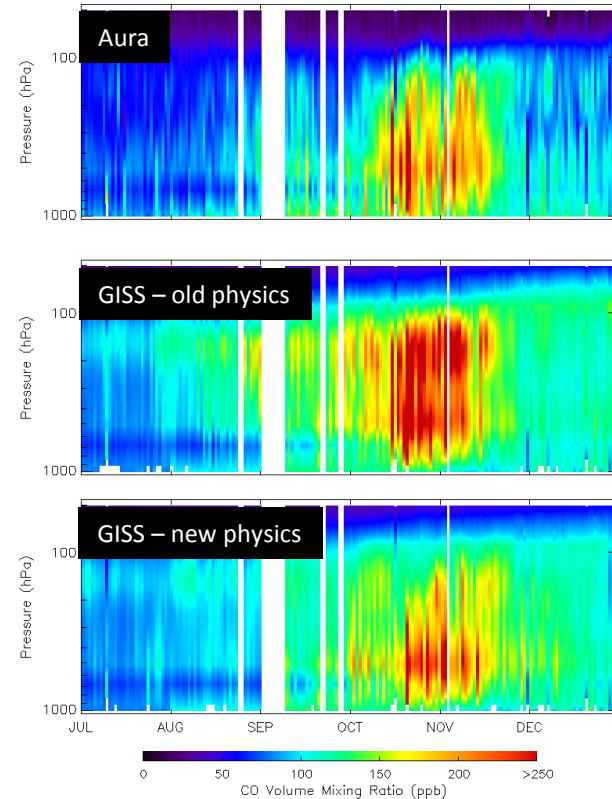
New CO profiles retrieved from Aura TES and MLS¹ provide **an independent check** on new convection physics that led to the successful simulation of an MJO in GISS ModelE2².

Upper tropospheric CO during late 2006 over Indonesia was amongst the highest during the MLS period³ due to uncontrolled peat burning.

With the old (AR5) convection physics, upper tropospheric CO was unrealistically high.

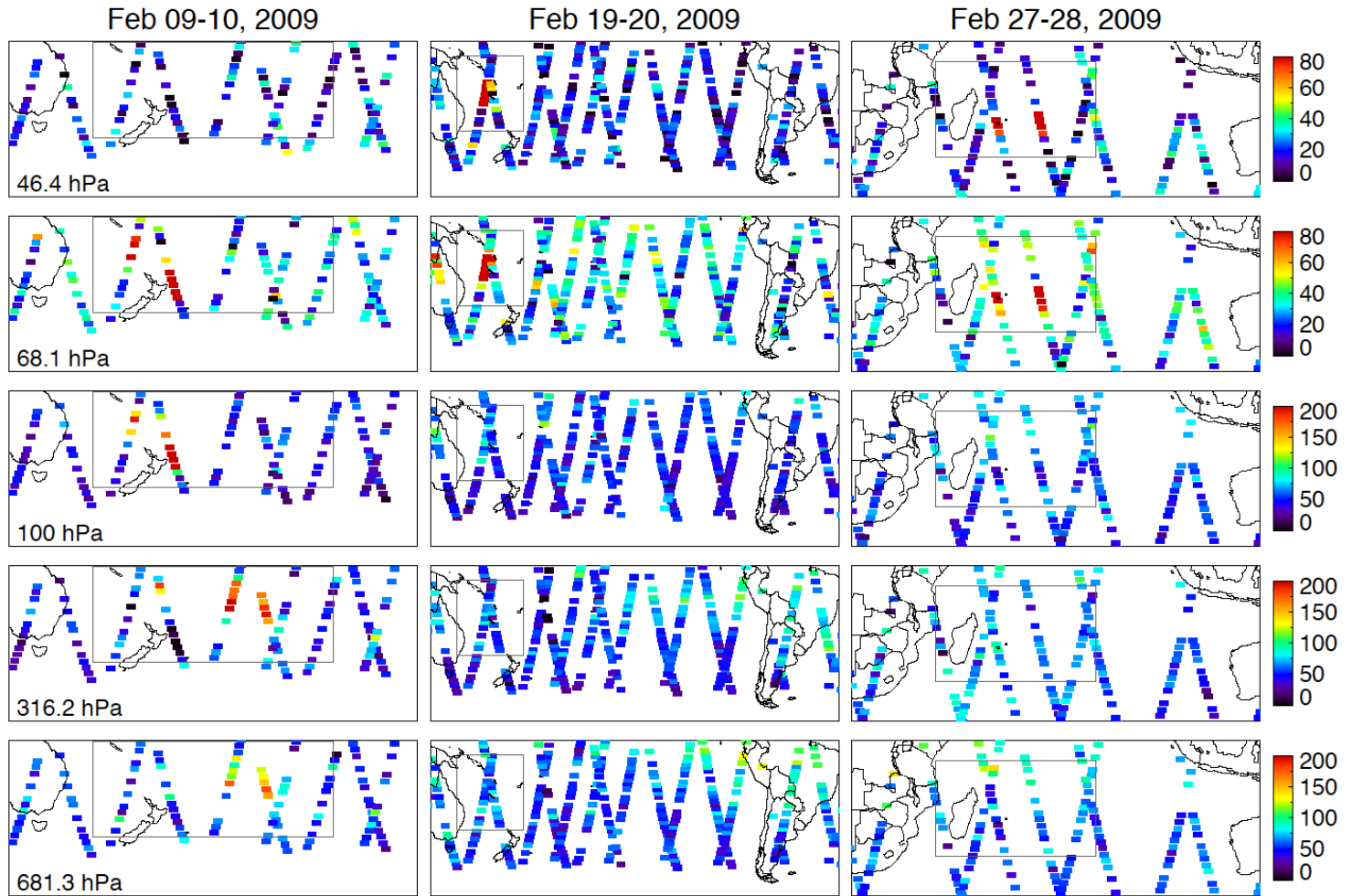
With the new convection physics, the vertical distribution of CO is in better agreement with Aura because of changes in the timing and depth of convection.

CO over Western Indonesia, Jul-Dec 2006



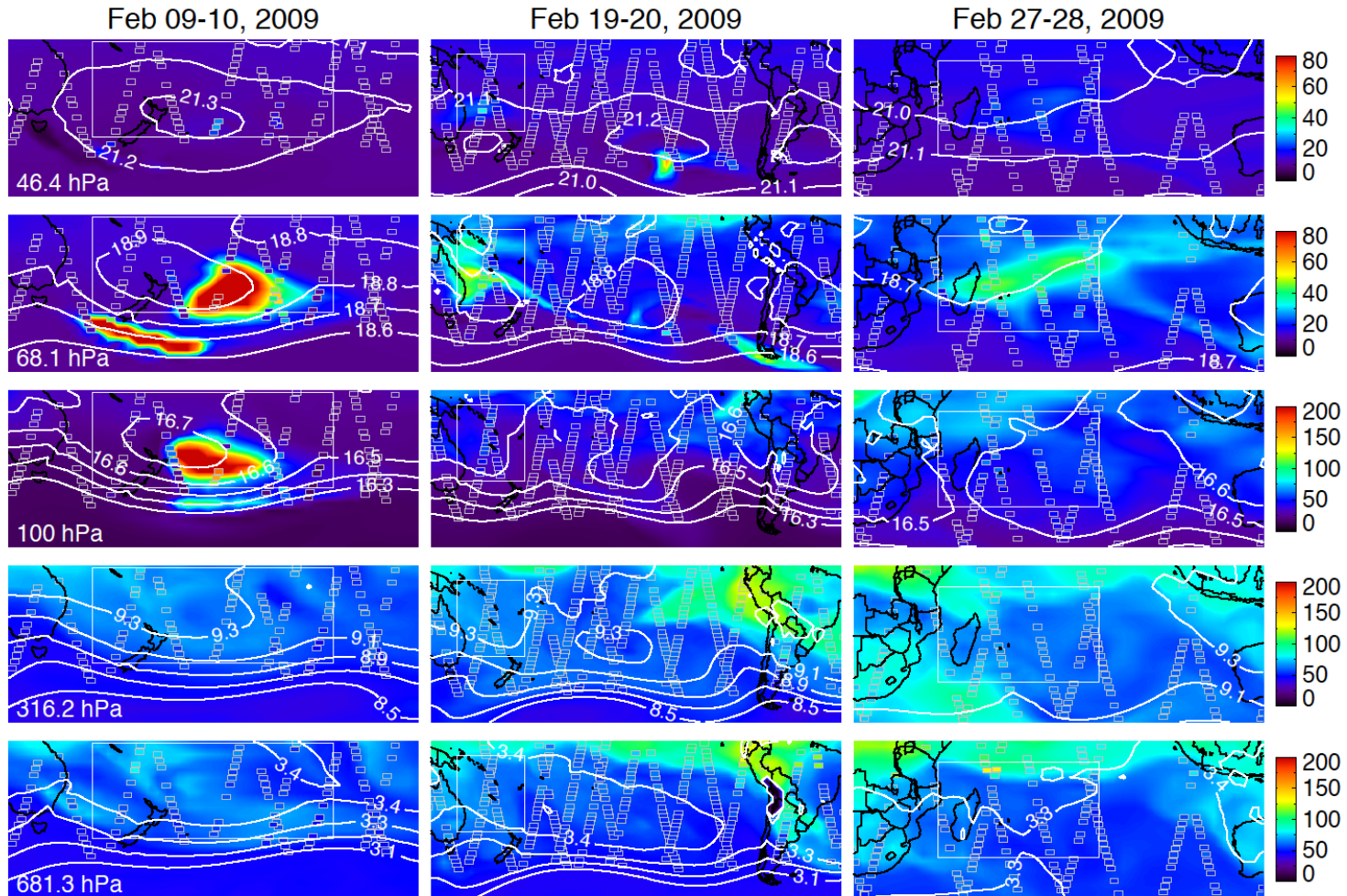
Aura TES / MLS

CO (ppbv)



16.5 km injection height, baseline emissions

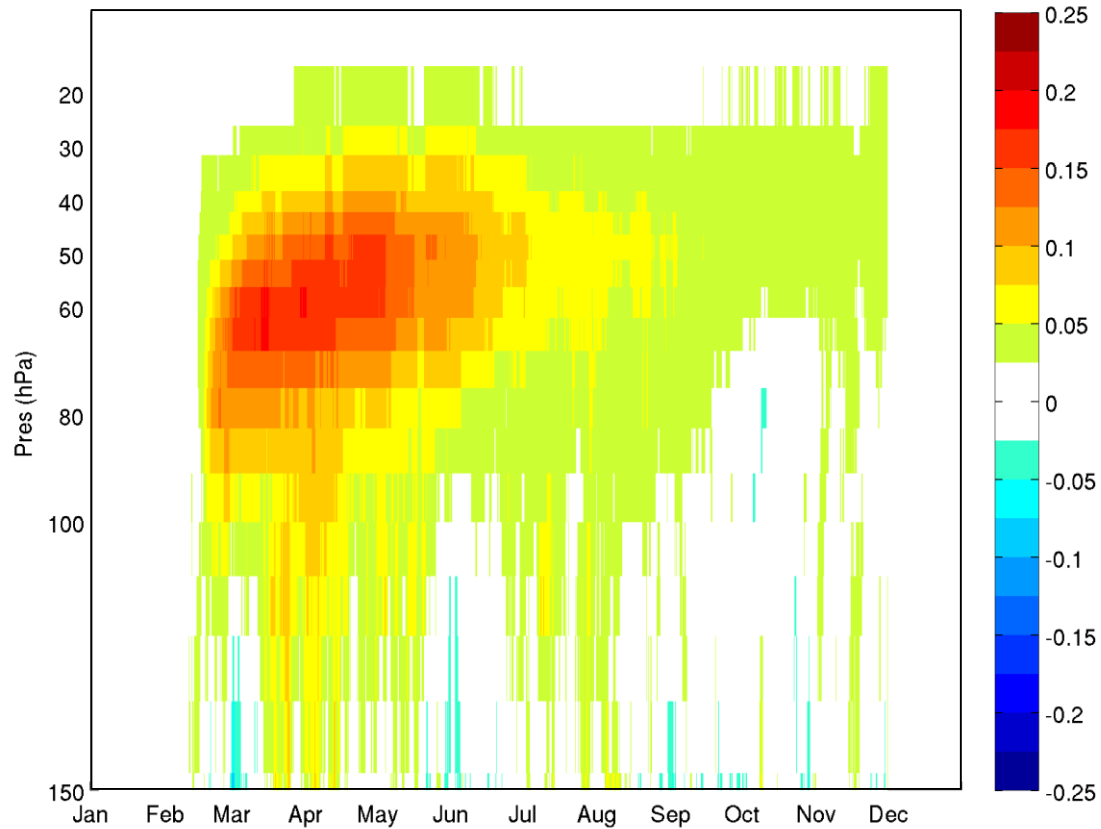
CO (ppbv)



ΔT in stratosphere

Tropical zonal mean

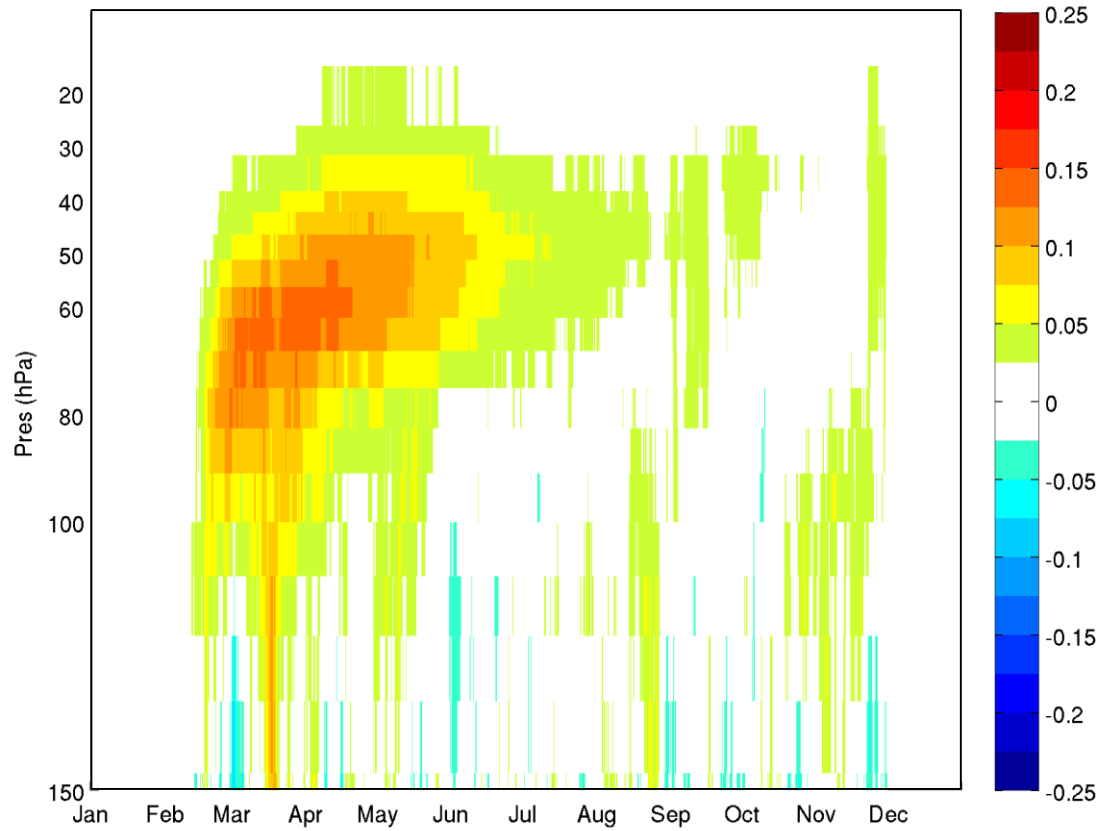
High emissions scenario, 13.5km injection



ΔT in stratosphere

Tropical zonal mean

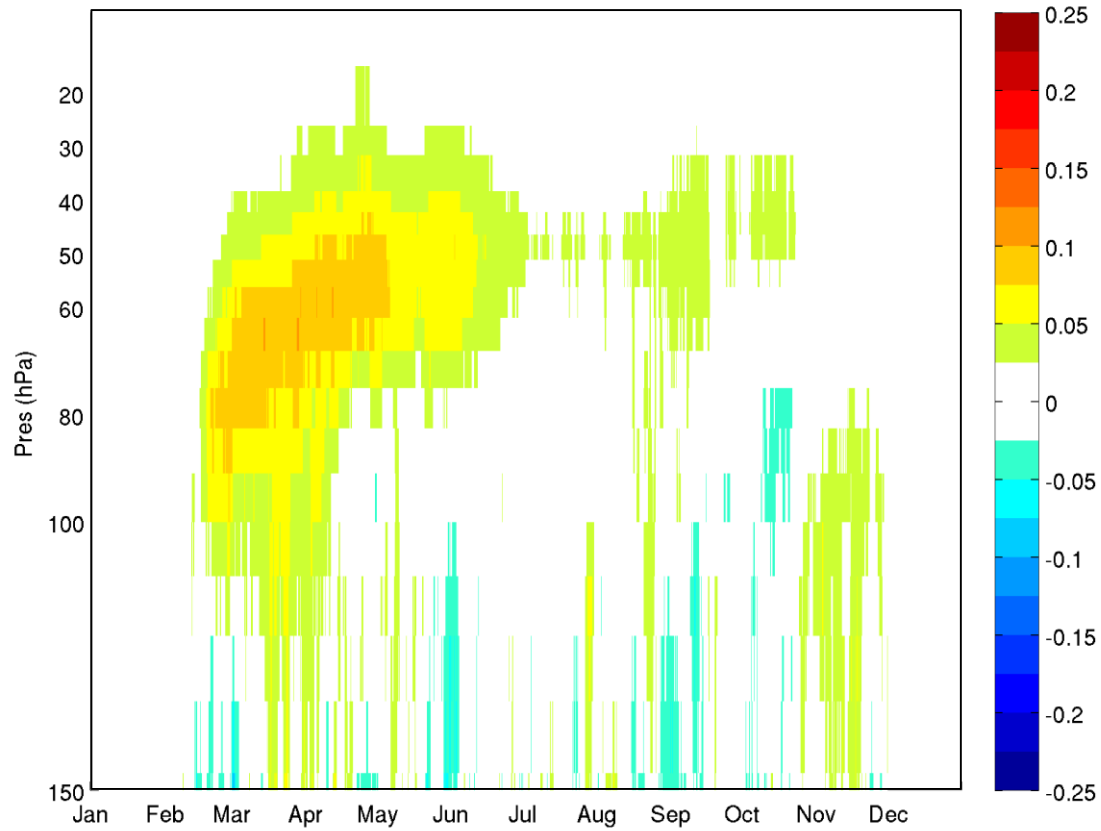
25% shift from BC to OC



ΔT in stratosphere

Tropical zonal mean

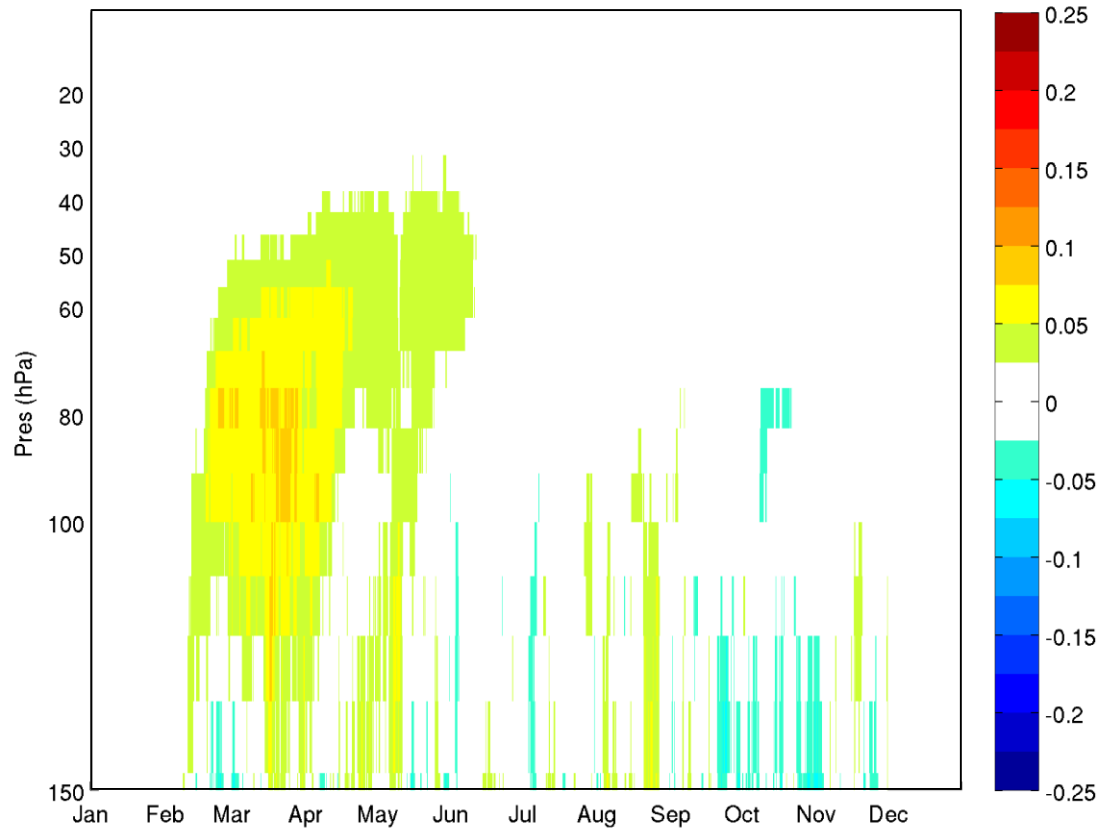
50% shift from BC to OC



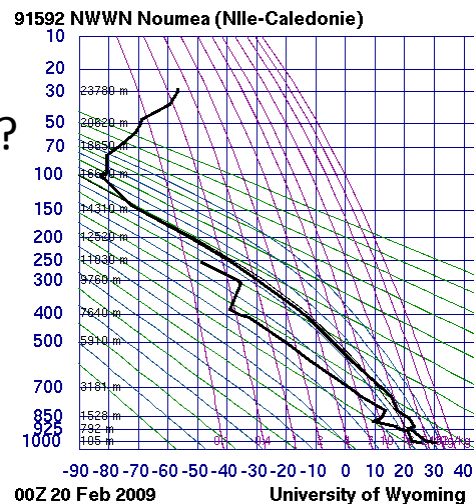
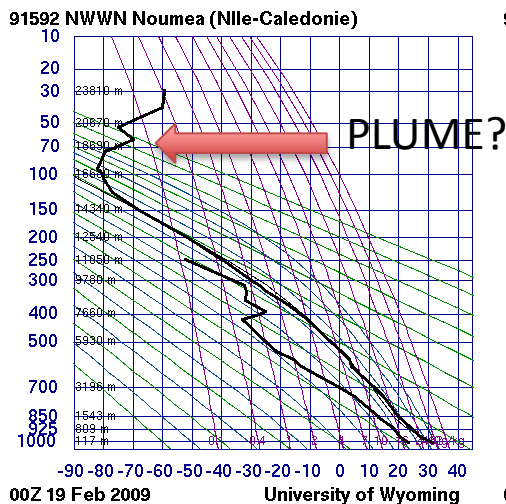
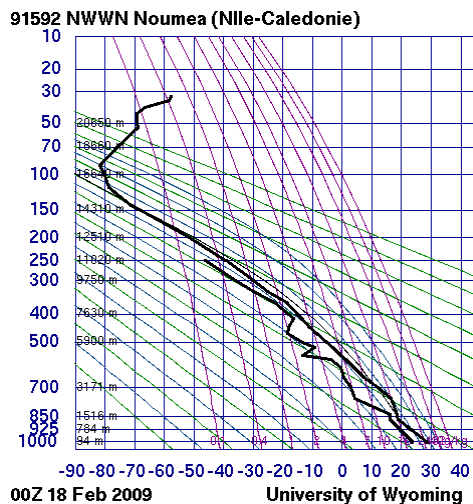
ΔT in stratosphere

Tropical zonal mean

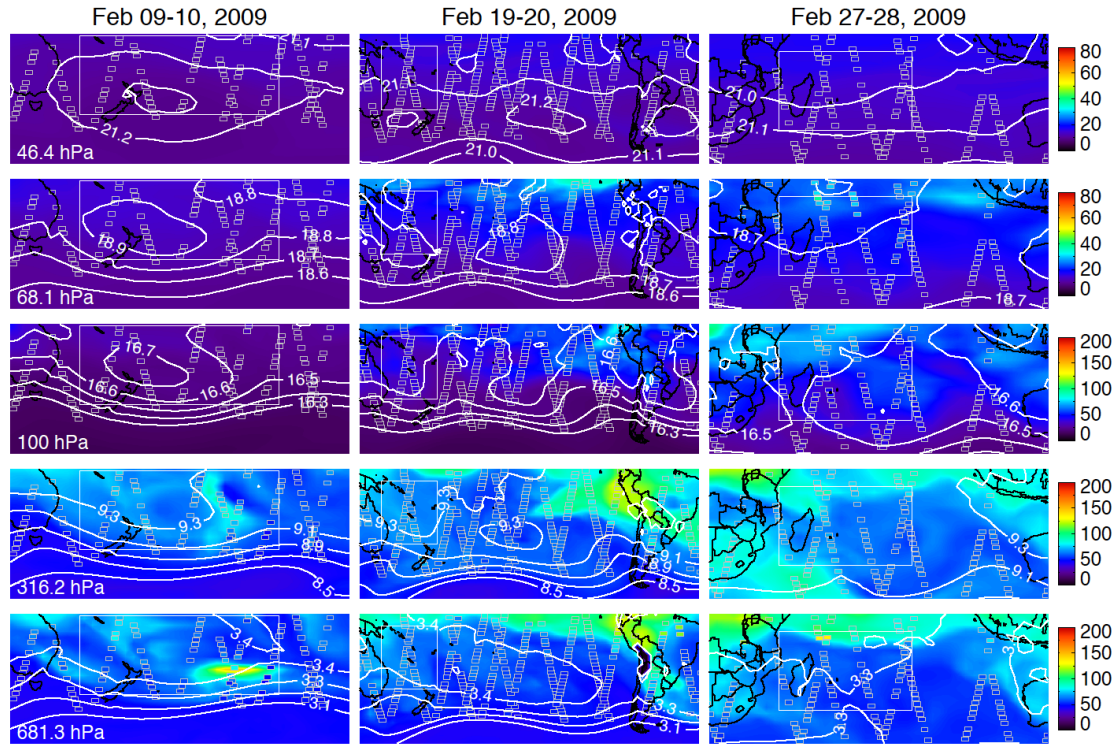
75% shift from BC to OC

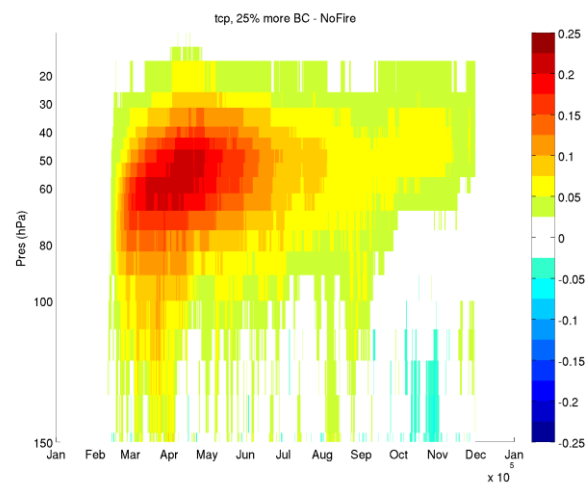
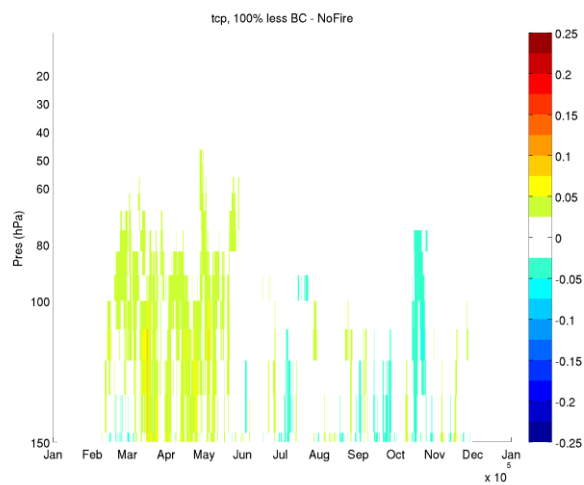
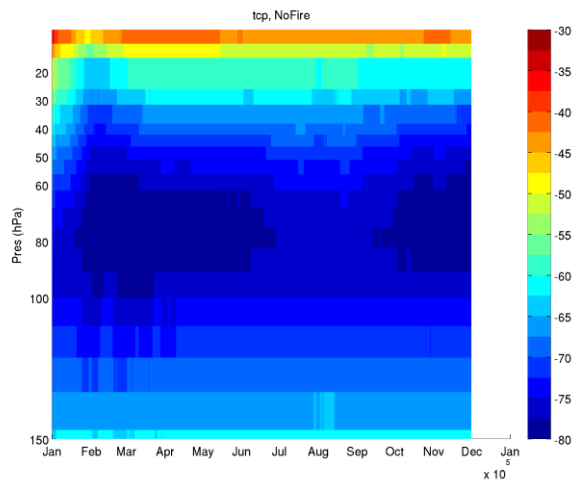


Radiosonde from Noumea, New Caledonia

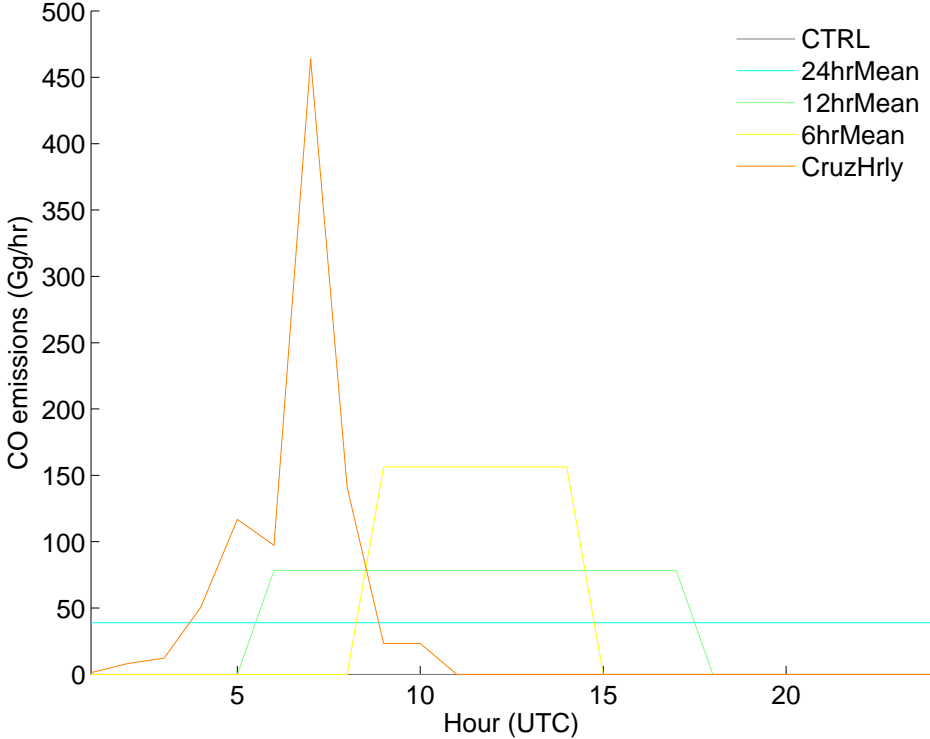


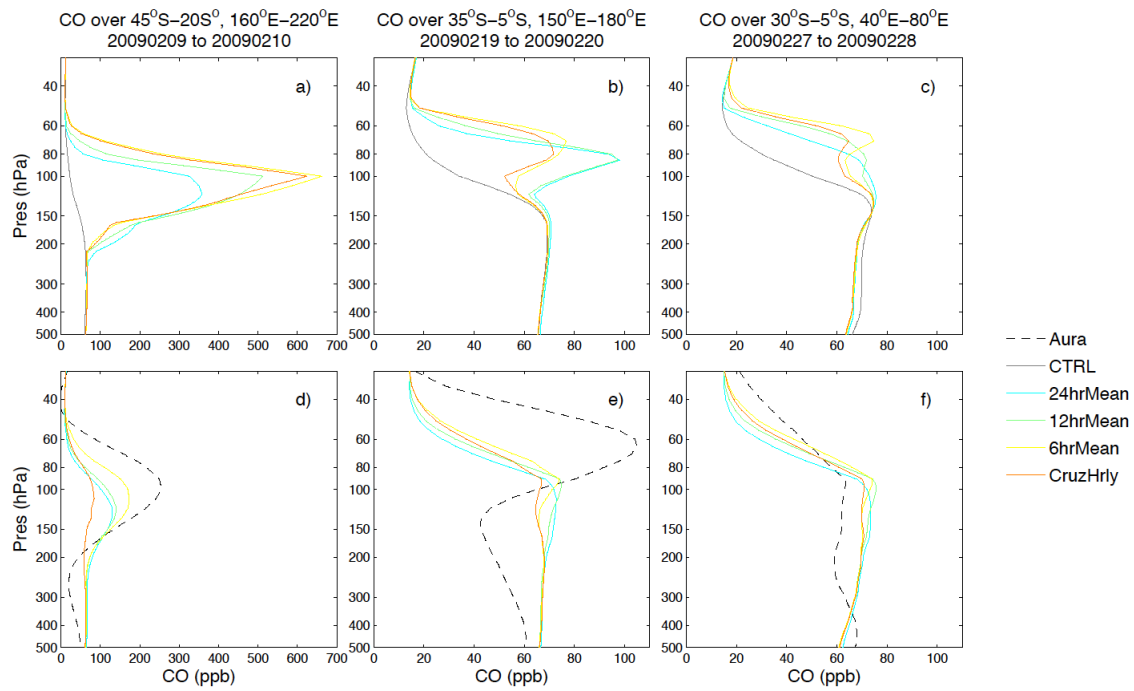
CO (ppb): deLaat_3.5





Hourly CO emissions





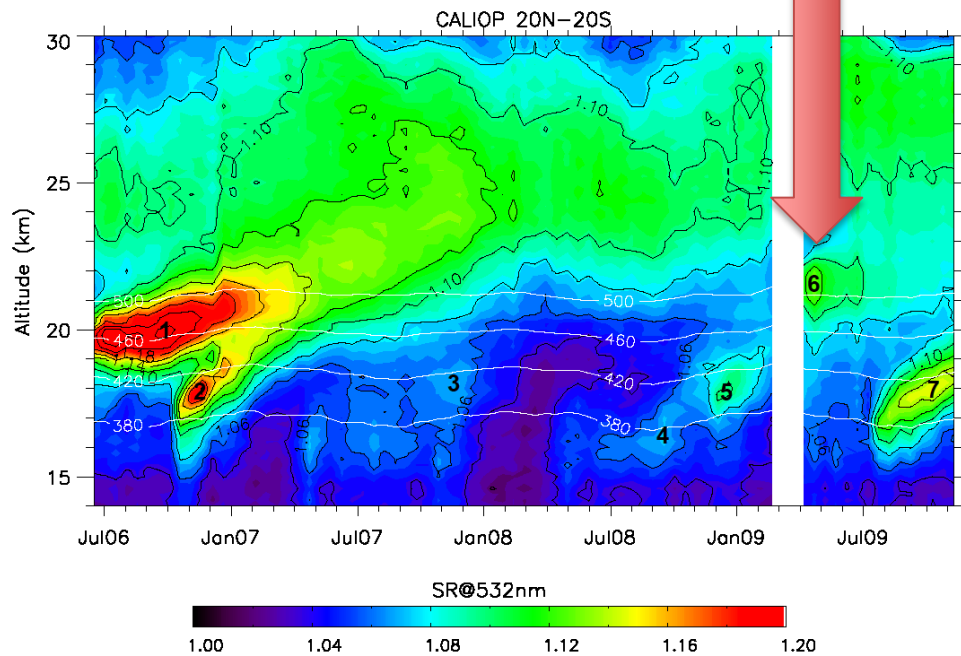


Table 1. List of volcanic eruptions with their corresponding Volcanic Explosivity Index (VEI) or fires that have produced a plume detected by CALIPSO during the 2006–2009 period.

Volcano/Fire	Date	Latitude	VEI
Soufrière Hills (1)	20-May-06	16° N	4?
Tavurvur (2)	7-Oct-06	4° S	4?
Jebel Al-Tair (3)	30-Sep-07	15° N	4?
Okmok (4)	12-Jul-08	55° N	4
Kasatochi (5)	7-Aug-08	55° N	4
Fire/Victoria (6)	7-Feb-09	37° S	
Sarychev (7)	12-Jun-09	48° N	4?