Evaluating tropospheric CH4 concentration hotspot in Himalya region with GEOS-Chem and AIRS satellite retrievals

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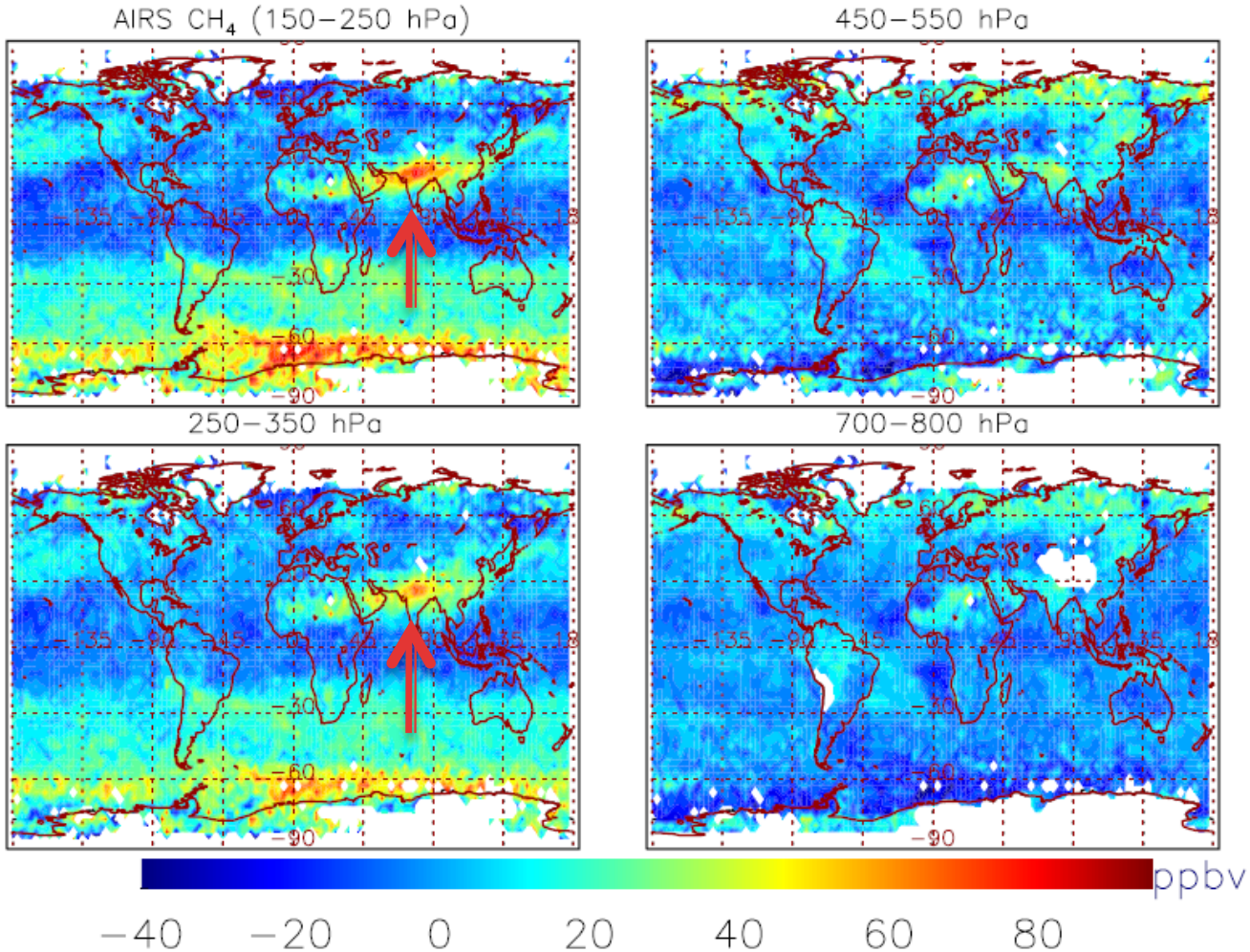
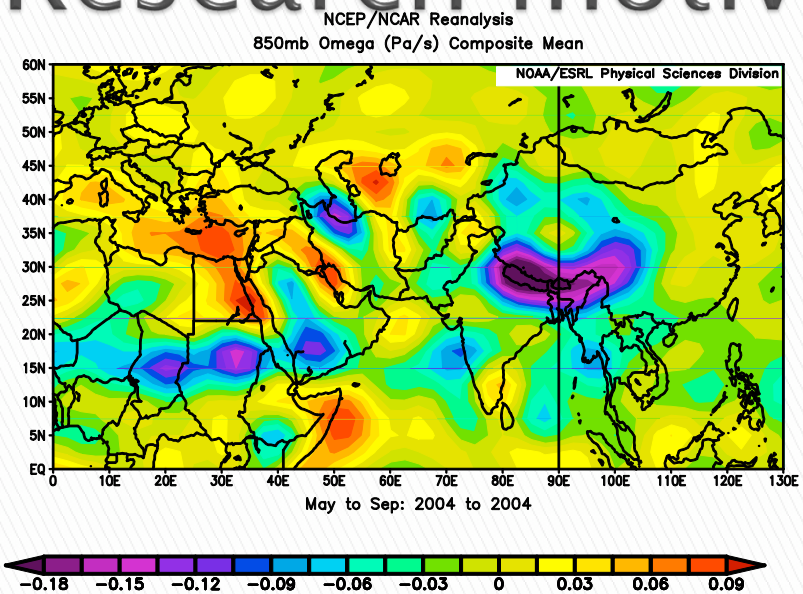
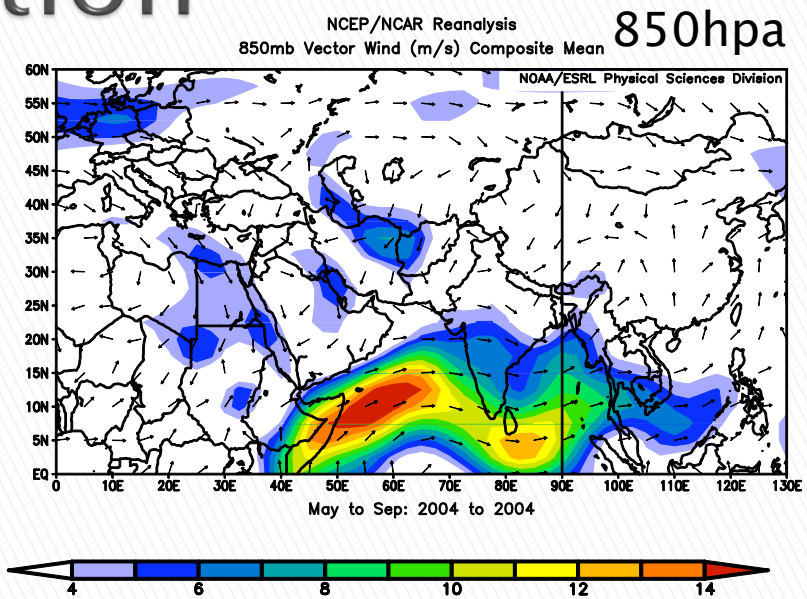
Research motivation

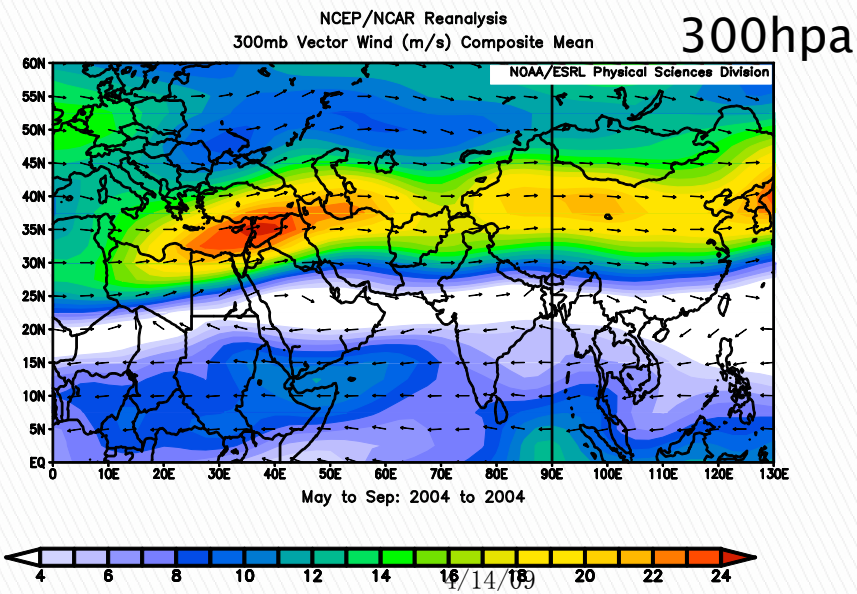


Difference between September and May 2004, Xiong et al. (2008)

Research motivation







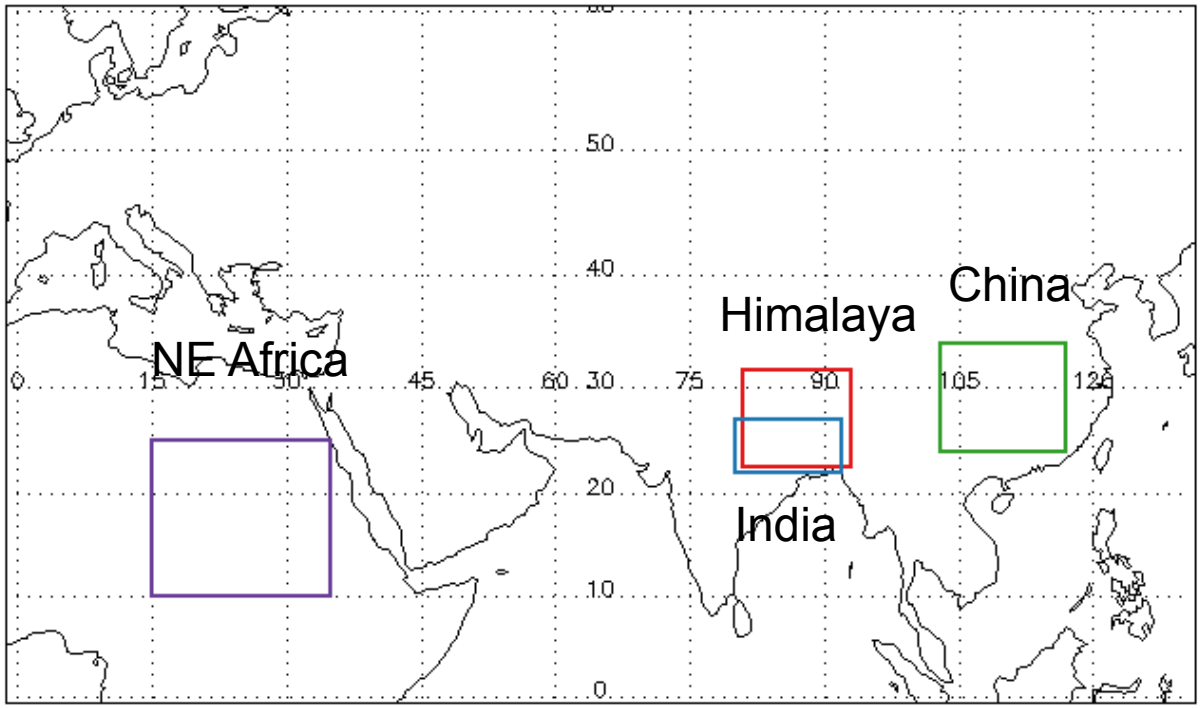
(upper) 850 Mean Omega field:2004 May to Sep.

(right) Mean wind field: 2004 May to Sep.

Research questions

- Is the hotspot (260-359 hPa) over Himalaya region mostly due to long range transport or local transport (rice paddy emissions)?
- If dominated by local transport, which source is more important: China/India rice paddy?
- What are the relative contributions of the long range transport and local transport to the hotspot over Himalaya region?

Region of intrest



GEOS-Chem simulation

Source	Tg/year
Animal	80.0
Coal mining	34.0
Gas production	48.5
Landfill+waste	66.2
Other anthro.	29.3
Termite	20.0
Hydrate	20.0
Biomass burning	~40.0 (multi-year mean)
Wet tundra	10.0
5-c wetland	197.5
Rice paddy	60.0 [india(15)/china(20)]
Total	605.5

Emission scenario is constructed based on Fung et al 1991, Edgar 2000, GFED2 and TEM simulation.

7 sets of simulations are conducted based on keep(1)/half(1/2) /turn off (0) the rice paddies in India & China

GEOS-Chem simulation & AIRS retrieval comparison

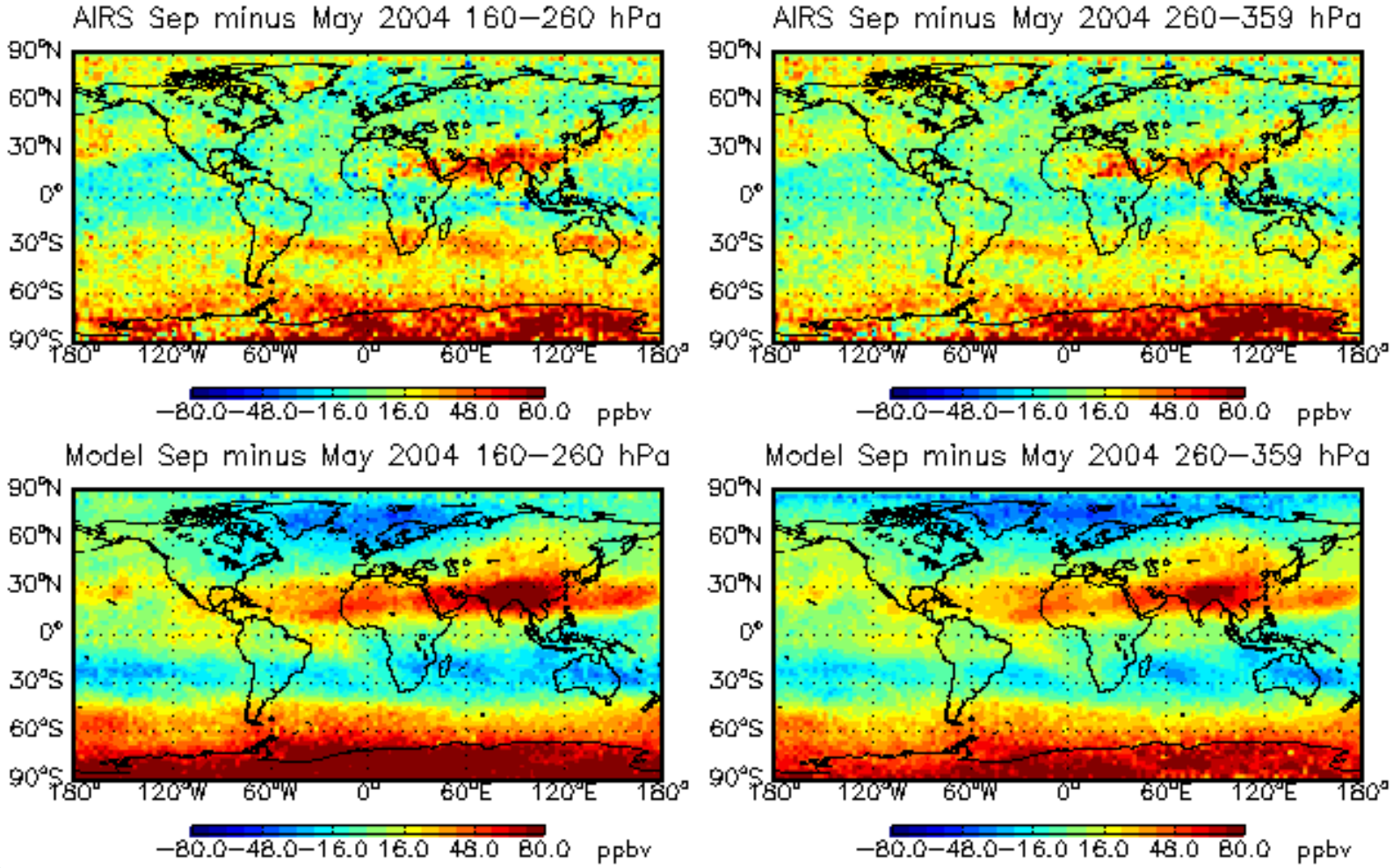
- The OH field is tested by MCF (CH3CCl3) transport with a total lifetime 5.51 years, subject to a stratospheric loss 46.0 years and ocean uptake 77.0 years. The overall lifetime of CH4 is 8.1~8.2 years.

- To compare with AIRS retrieval, model simulation is convolved using the equation

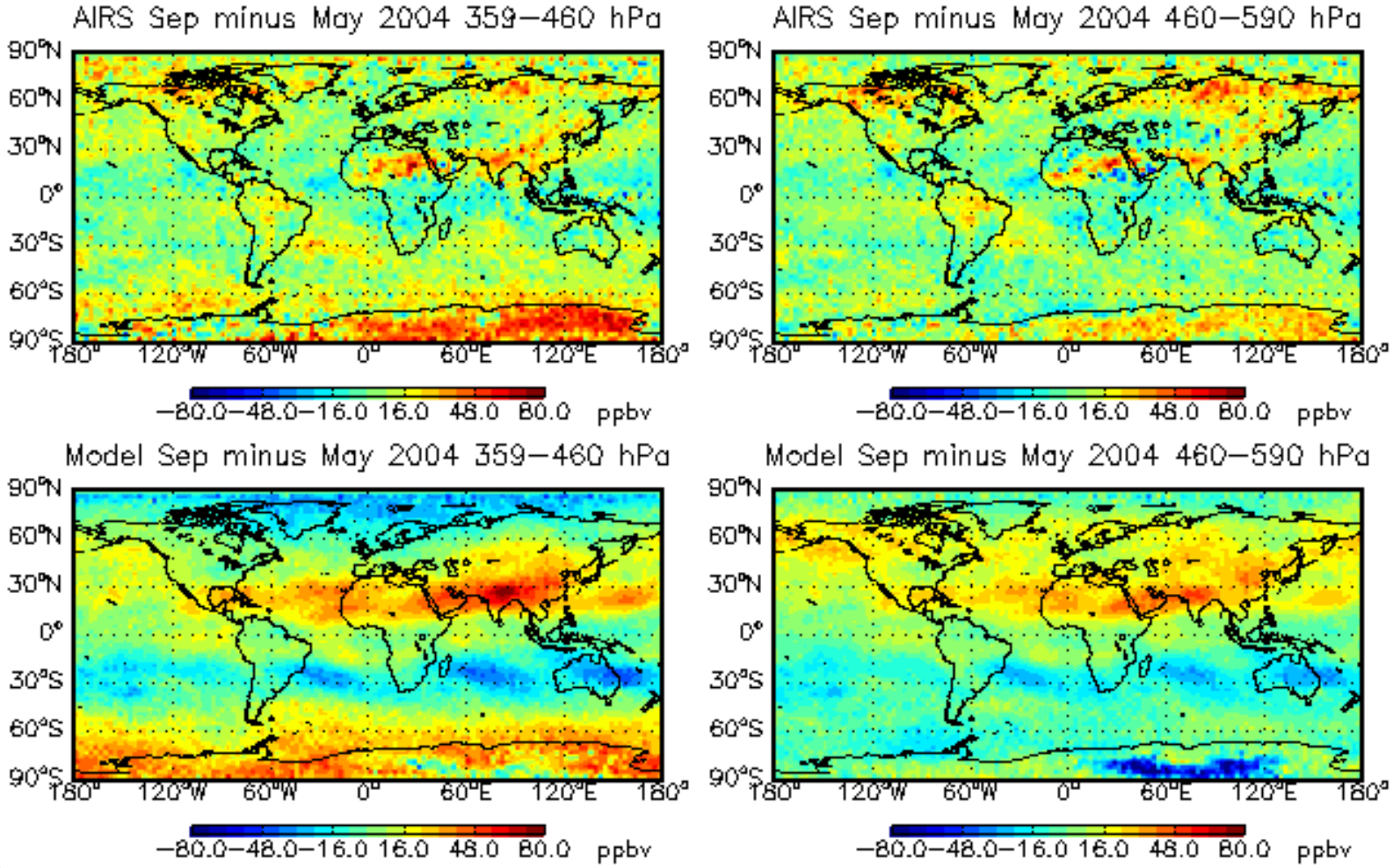
$$y = Ax + (I - A)\, x_a$$

y is the convolved data, x is GEOS-Chem output, x_a is the first guess profile and A is averaging kernel.

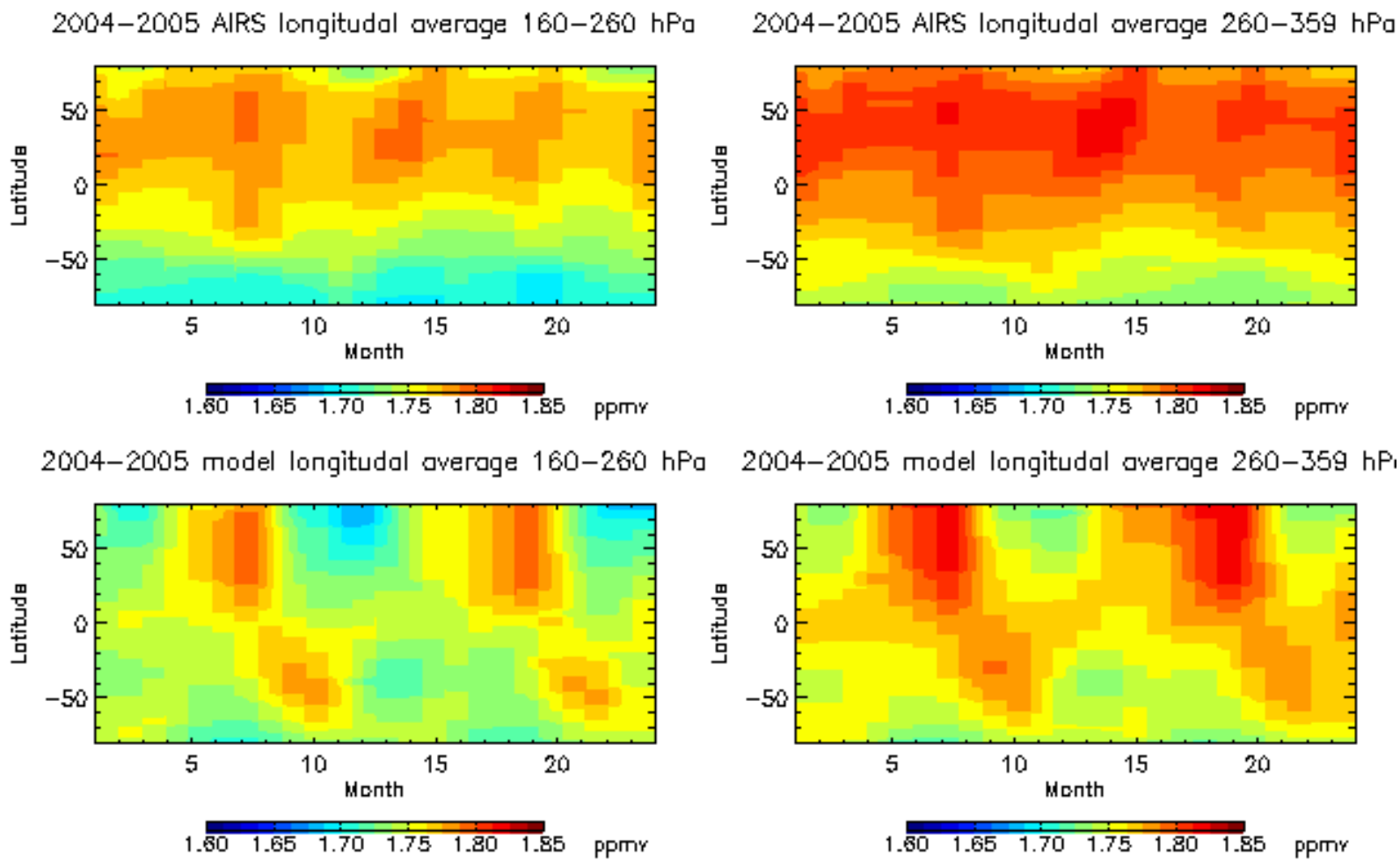
Result: general comparison



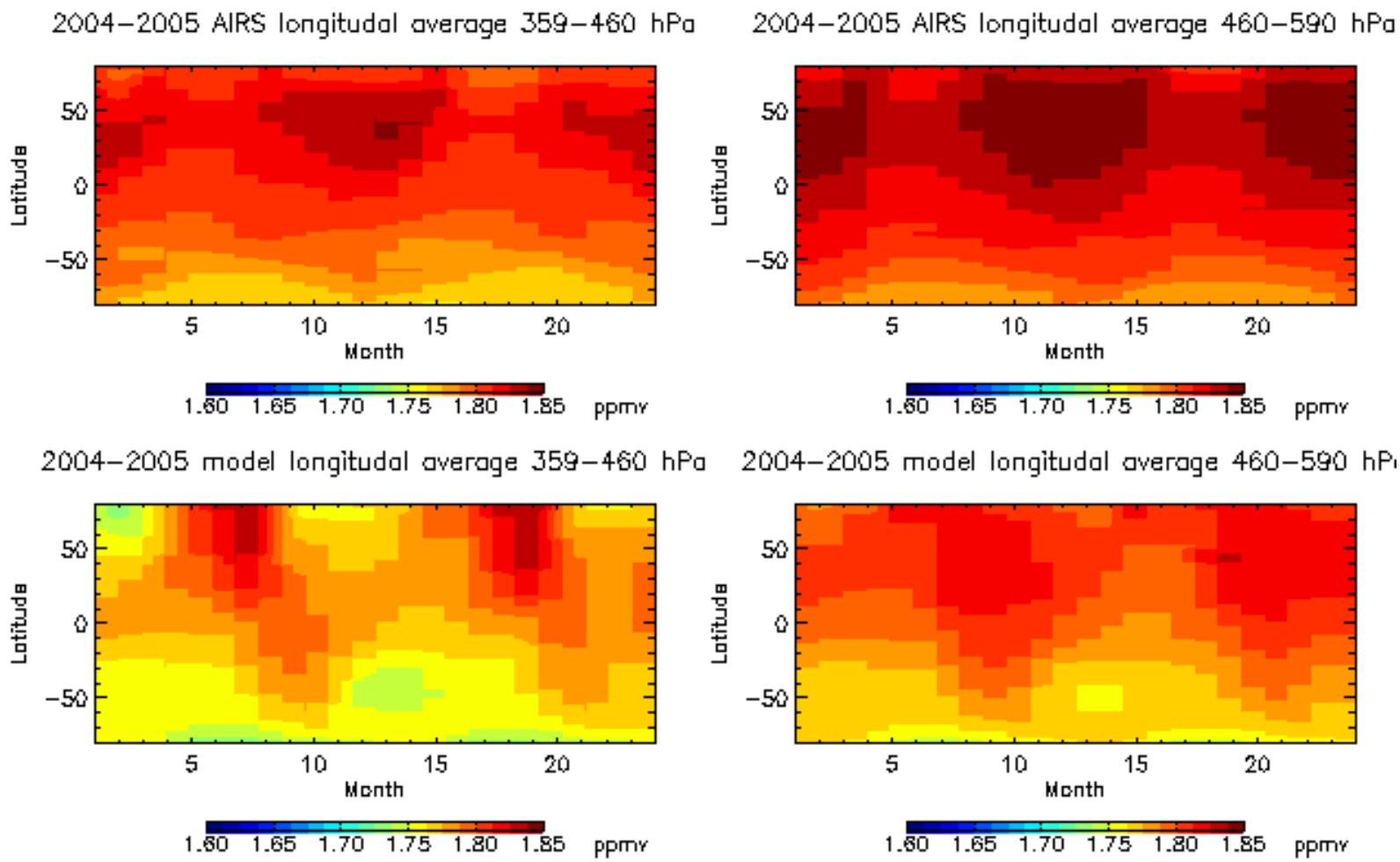
Result: general comparison



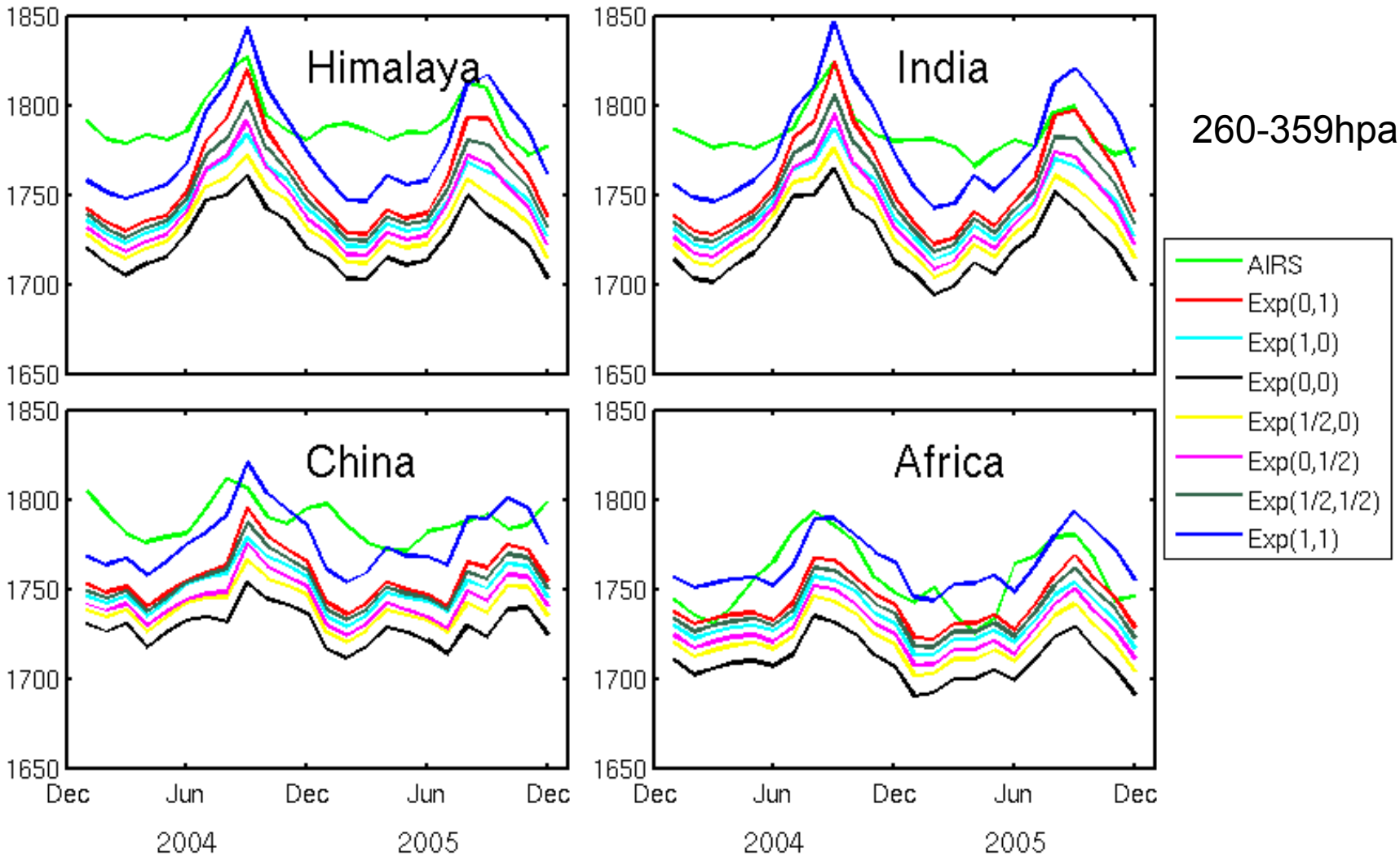
Result: general comparison



Result: general comparison



Result: regional comparision



260-359hpa

Contribution analysis

$F(x,y)=F(x0,y0)+a\,\Delta x + b\,\Delta y + c\,\Delta x\,\Delta y$

x China, y India, F(x,y) the hotspot strength defined by Sep. CH_4 minus May CH_4 on 160hPa~206hPa

(x0,y0)	a	b	c
(0,0)	0.57	1.05	-0.56
(1/2,1/2)	0.14	0.46	-0.33
(1,1)	0.03	0.25	-0.23

Conclusion

- A significant part (almost half) of the hotspot is due to long range transport.
- The India rice paddy emission contributes more to the hotspot, because of the strong convection and the upper level westerlies.

Further work

- An inverse modeling will be undertaken to optimize the various sources subject to the constraint provided by GLOBALVIEW-CH4, 2008 observations.
- A new quantification of CH4 emissions from the natural ecosystems will be conducted with a newly developed version of process-based model TEM.
- Better answers to the research questions would be provided based on the optimized simulation

Acknowlegement

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