U. Iowa/Kyushu/Argonne

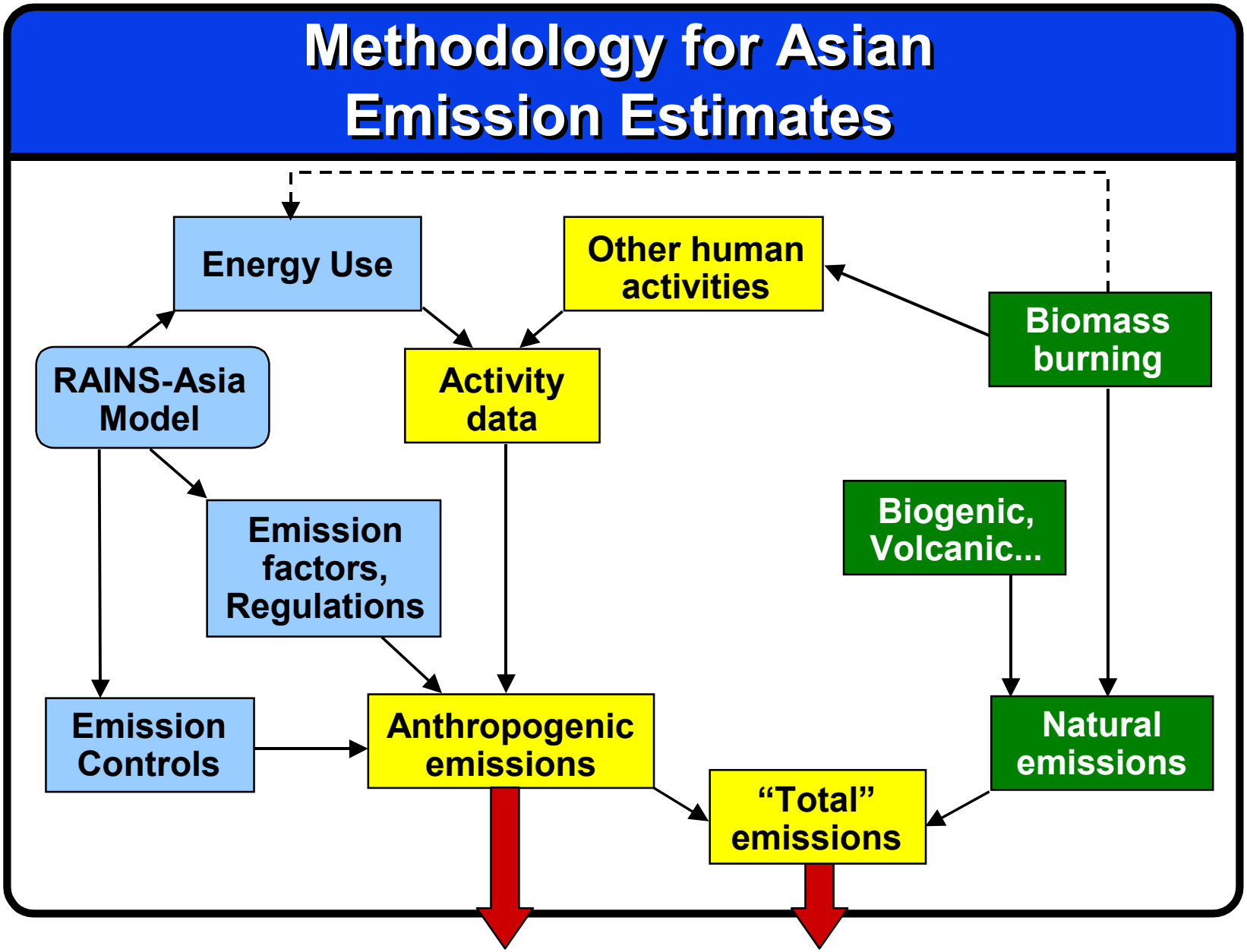
FORS ASIA
Chemical weather FORecast System

CFORS Analysis Activities

- Emissions
- Transport & Meteorology
- Gas Phase Species
- Primary Aerosols
- Radiative Transfer & Optical Properties
- Aerosol Chemistry Interactions

Sources of airborne pollution in Asia are many: home cooking, power generation, industry, traffic, and biomass burning

Methodology for Asian Emission Estimates



Coordinated emission profiles for Asia for the year 2000 are being constructed for TRACE-P and ACE-Asia

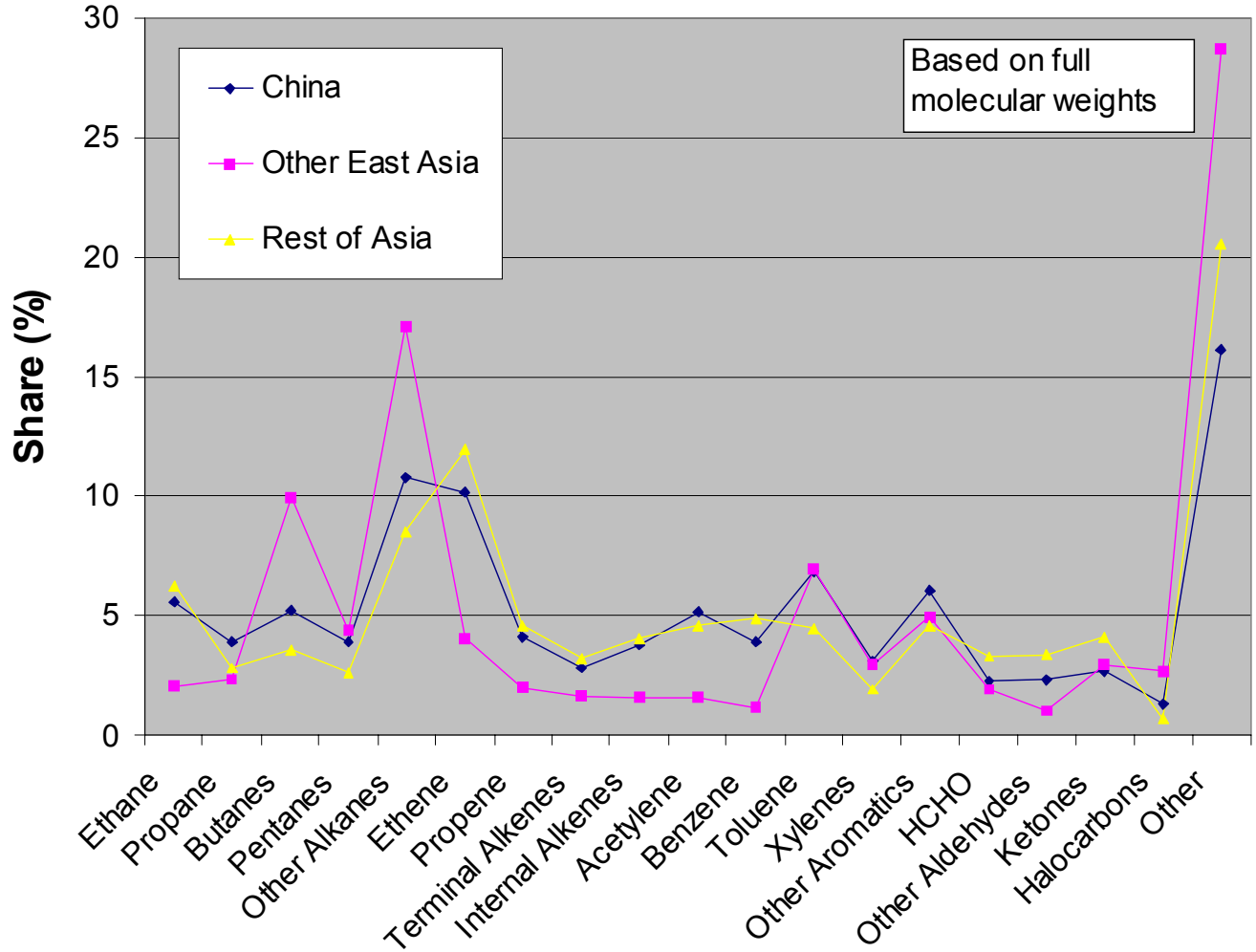
SUMMARY OF ANTHROPOGENIC EMISSIONS IN ASIA

Updates will be posted on our University of Iowa web site:
http://www.cgrer.uiowa.edu/people/carmichael/ACESS/Emission-data_main.html

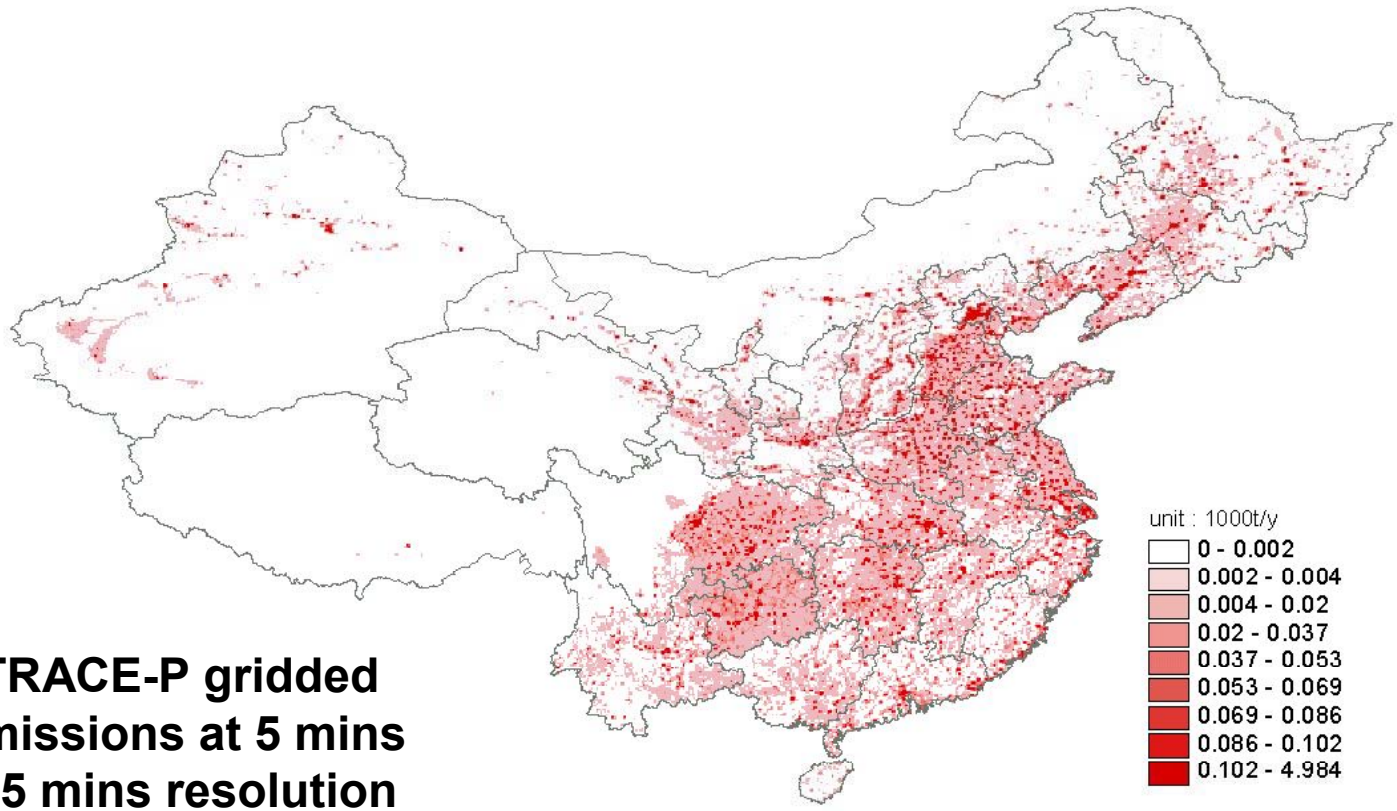
Region	Year 2000 Emissions (Tg)						
	SO_2	NO_x*	CO	NMVOC**	BC	OC	NH_3
China	20.8	9.8	98.2	17.2	1.01	3.3	13.5
Other East Asia	2.3	4.5	12.4	4.2	0.10	0.31	0.92
of which, Japan	0.8	2.2	4.5	1.9	0.04	0.05	0.35
Southeast Asia	3.3	4.6	65.8	17.7	0.55	3.2	3.4
Indian Subcontinent	7.2	5.3	68.3	13.7	0.73	3.6	9.6
of which, India	5.5	4.5	53.6	10.8	0.56	2.8	7.4
International Ships	1.1	1.3	0.1	0.0	0.07	0.05	0.0
Asia Total	34.8	25.6	244.8	52.7	2.46	10.4	27.6

Notes: Summary emissions as of 10/25/01. Full biomass burning emissions are included, based on "typical, annual" values. * As NO_2. **Anthropogenic emissions only (no biogenic NMVOC emissions).

NMVOC Emissions are Speciated into 19 Reactivity Classes



Emissions are gridded at various resolutions: These are black carbon emissions in China

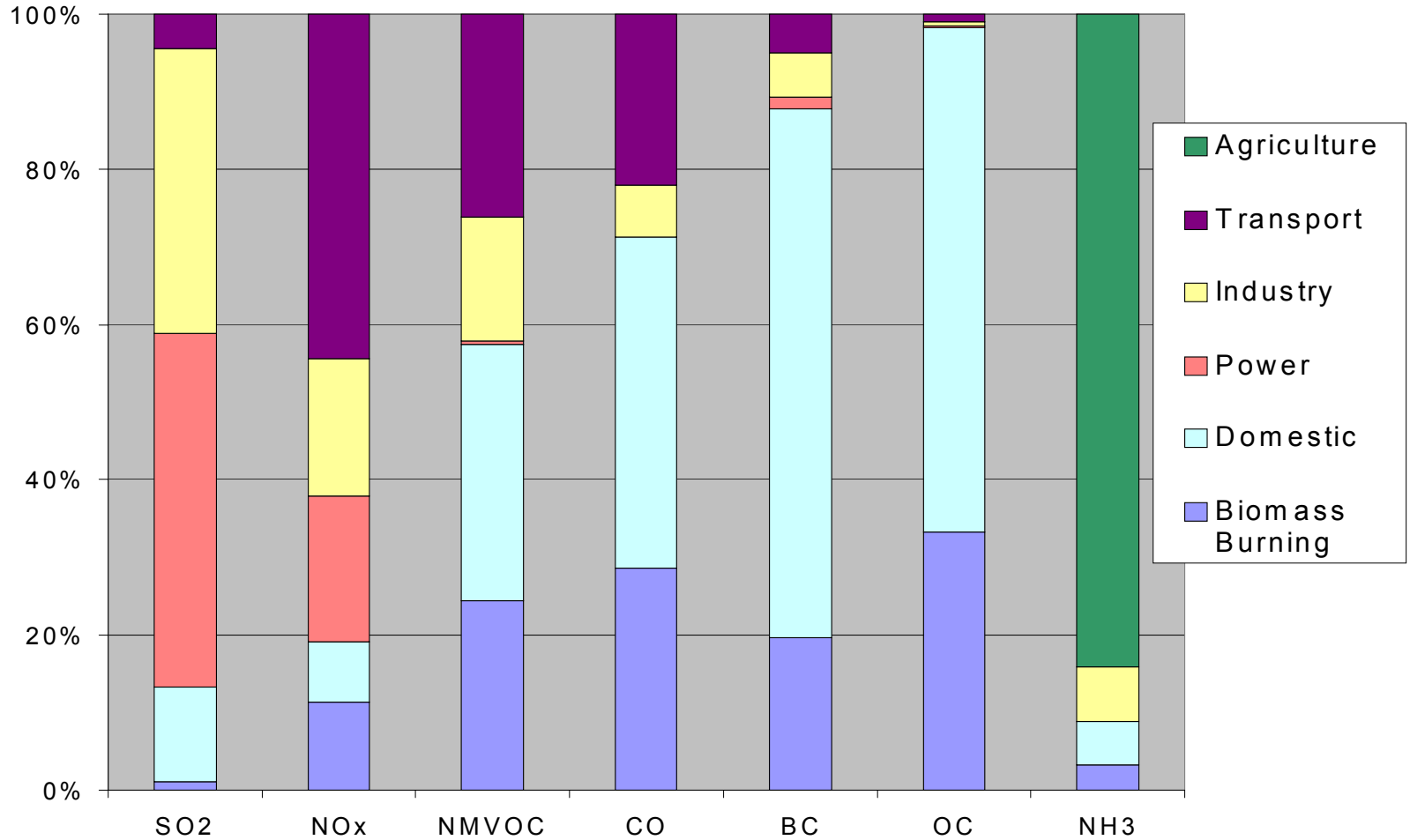


TRACE-P gridded emissions at 5 mins x 5 mins resolution

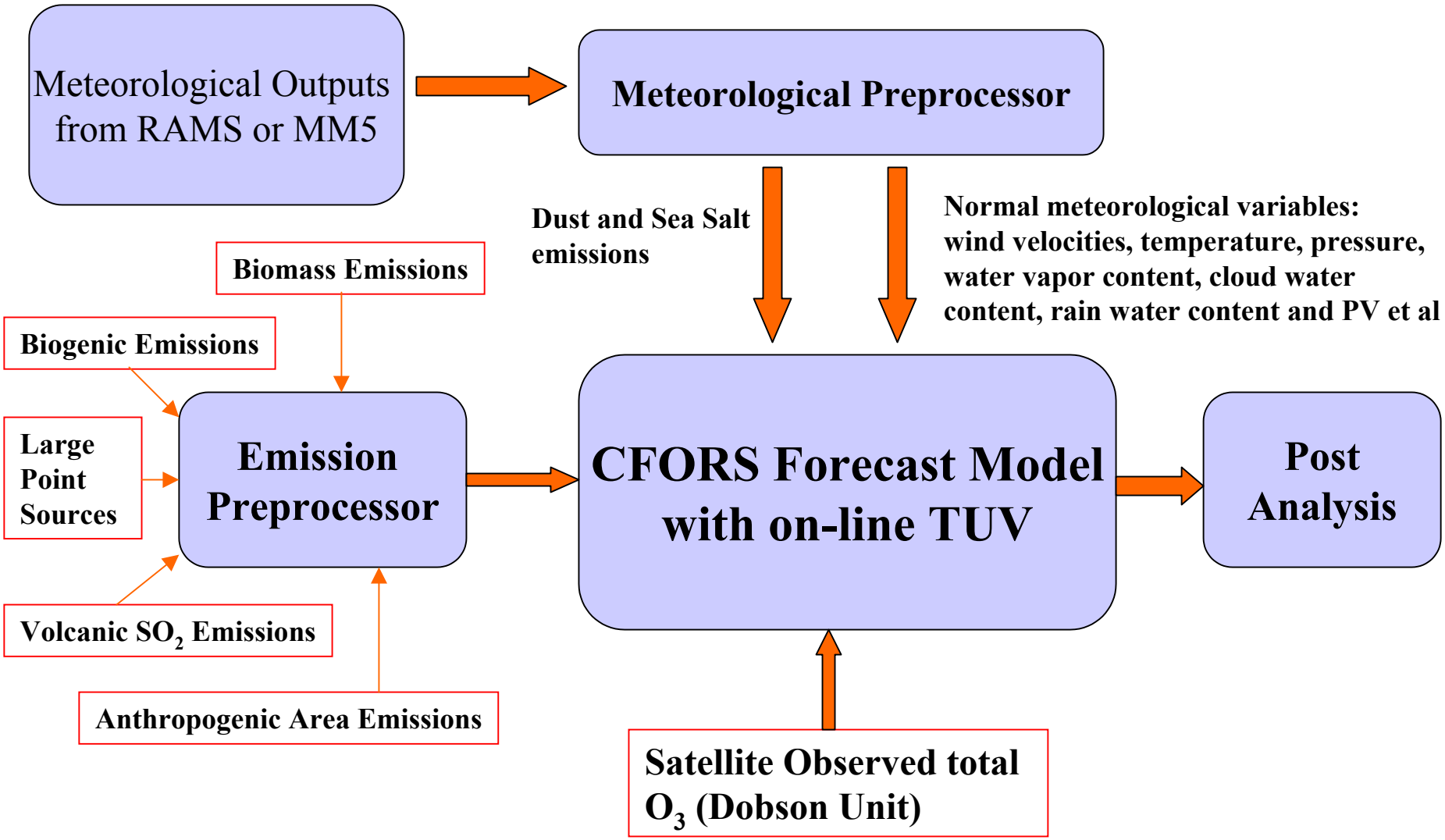
Inefficient combustion in Asia produces large quantities of CO, CH_4, NMHC, and BC

Coal-burning cook stoves
in Xian, China

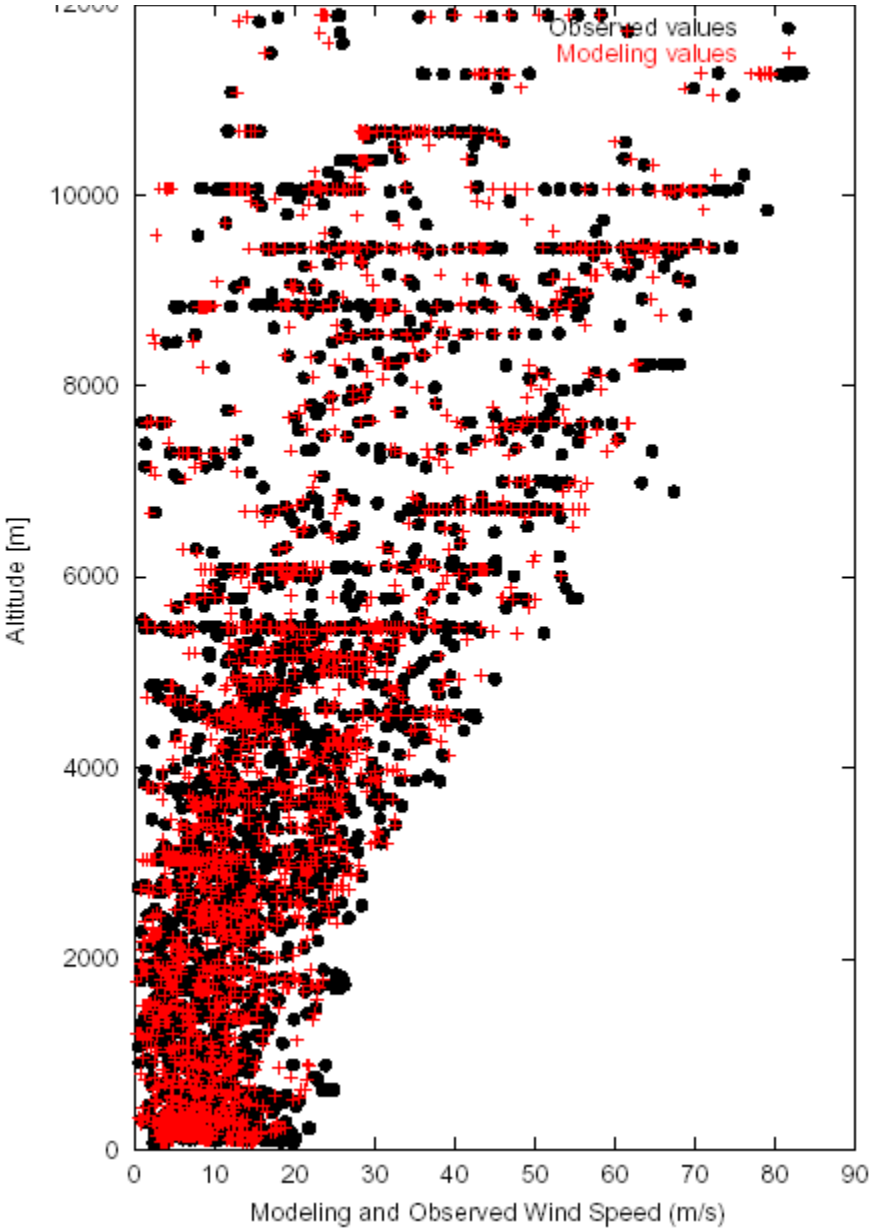
The Distribution of Emissions Among Source Types Varies Considerably



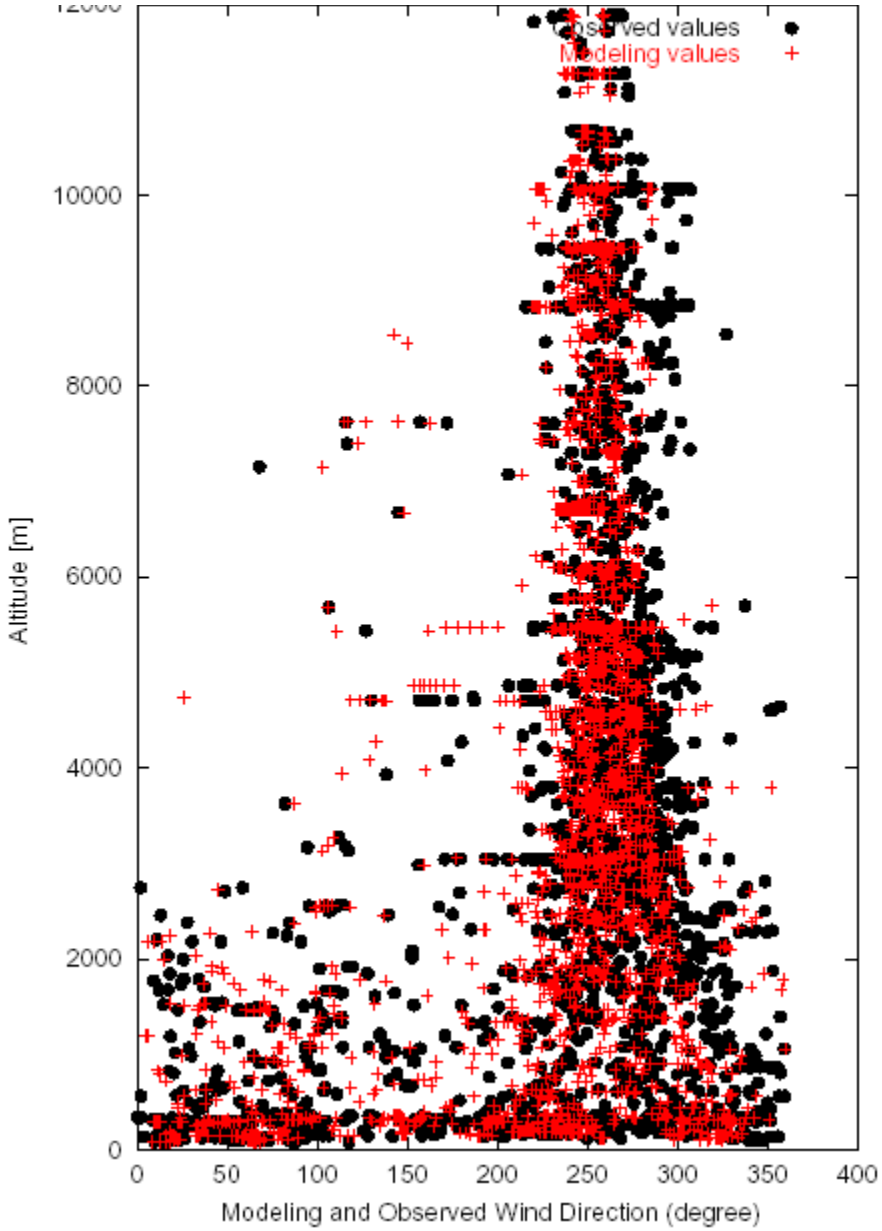
CFORS/STEM Model Data Flow Chart

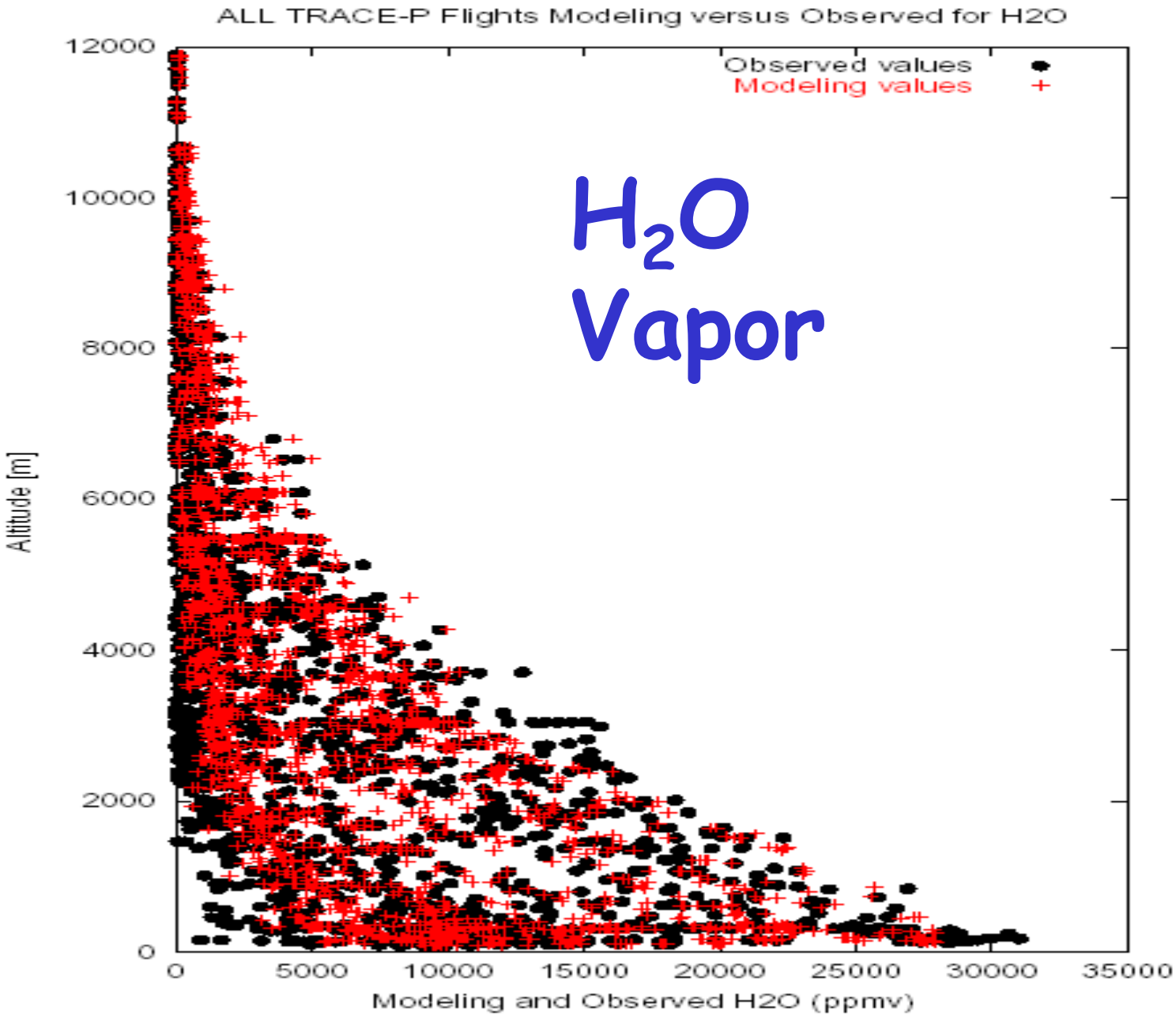


Wind Speed

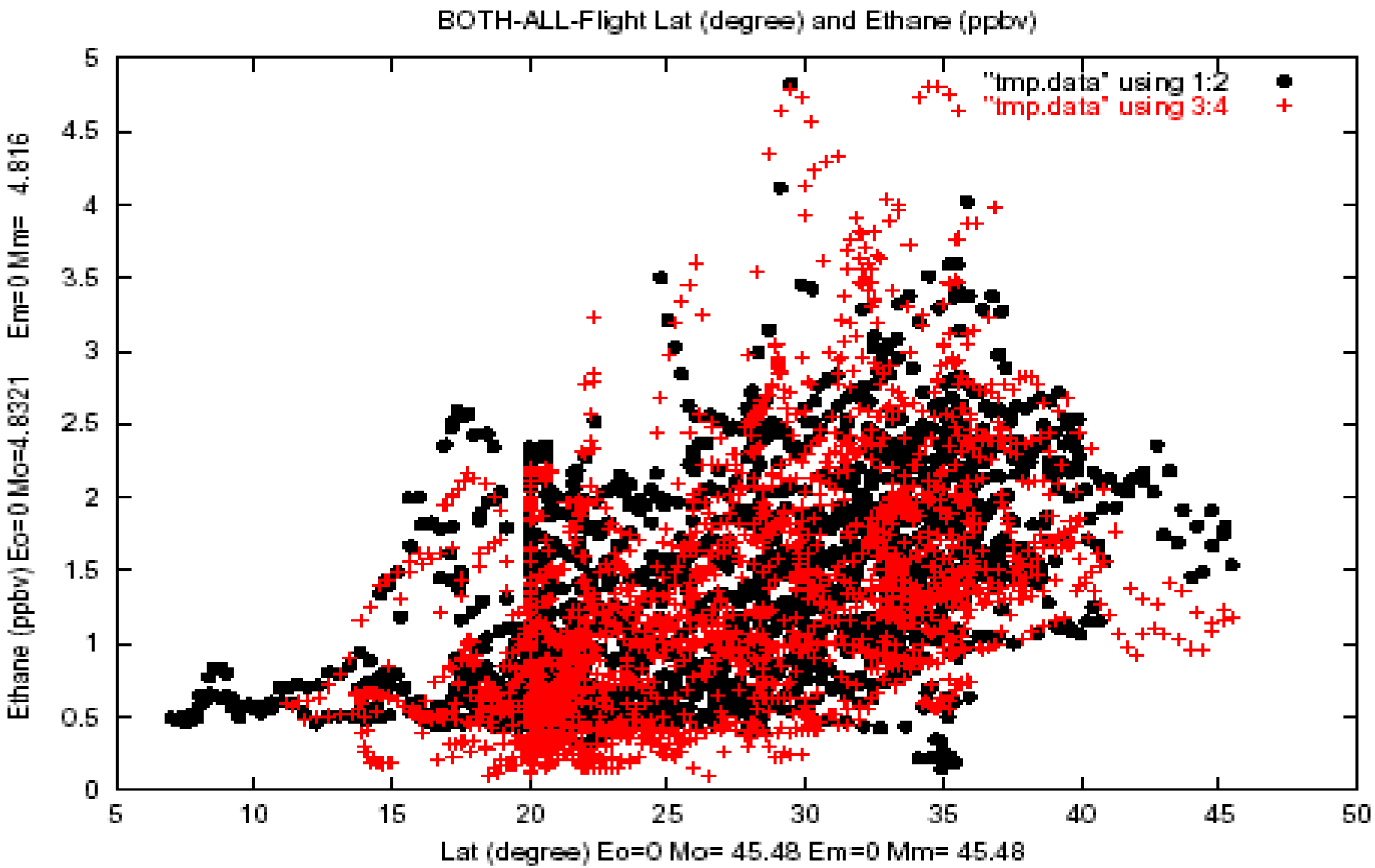


Wind Direction

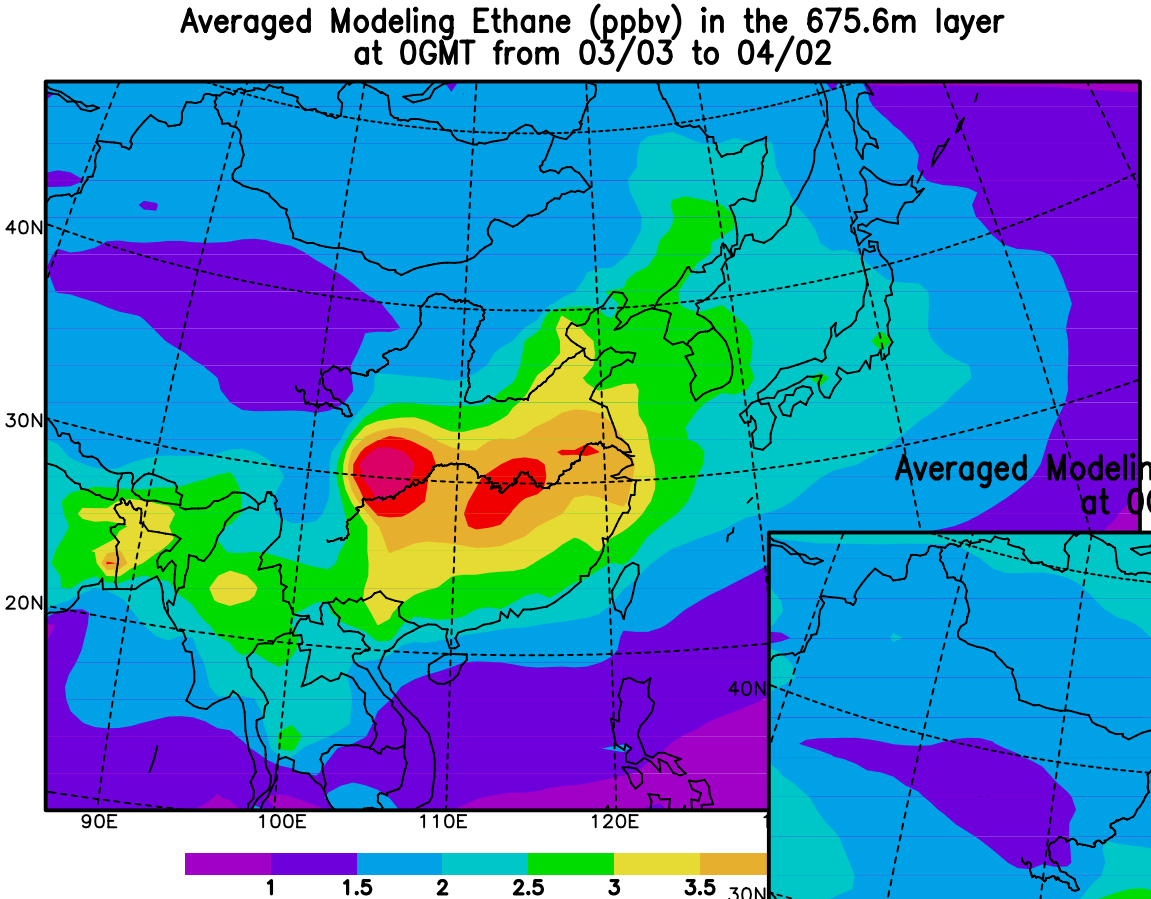


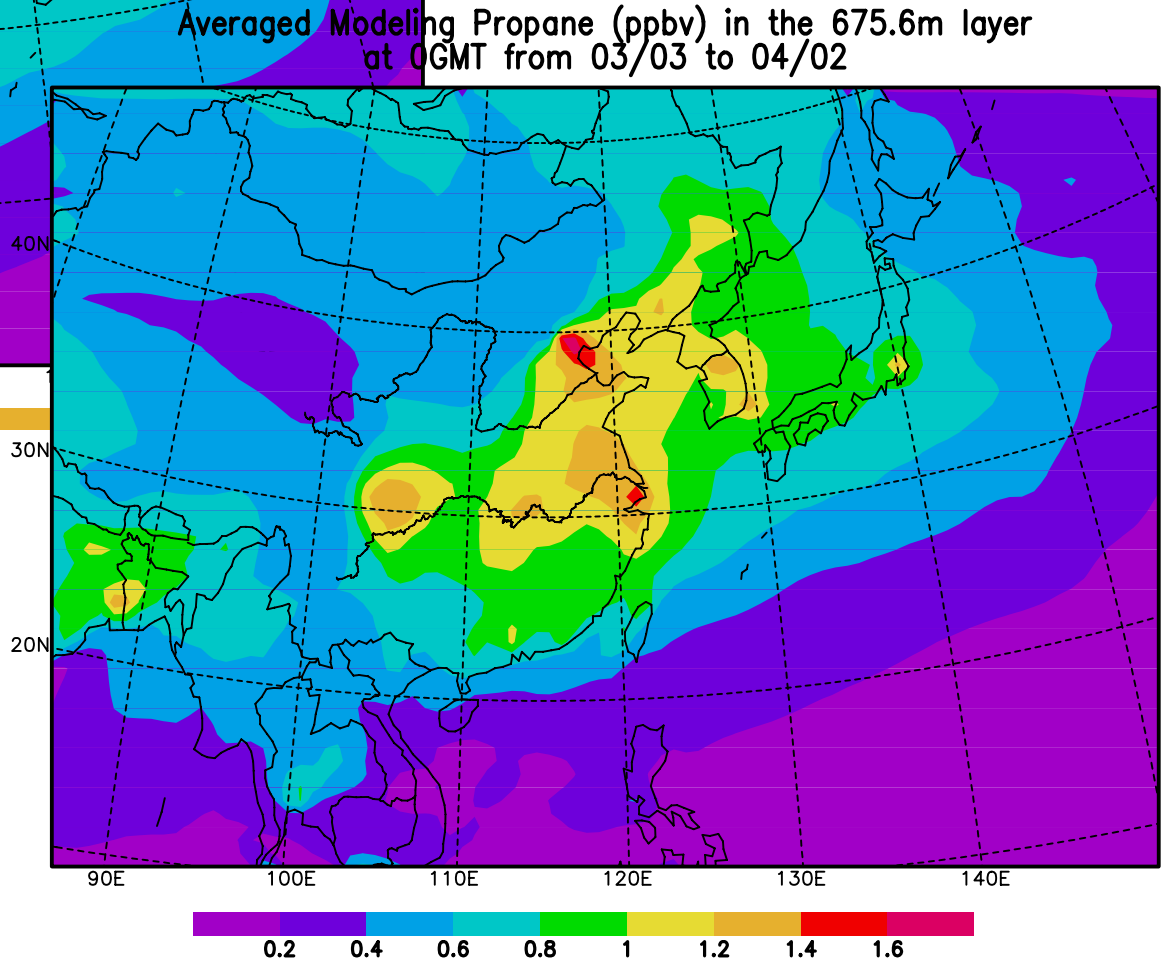

ALL TRACE-P Flights Modeling versus Observed for H2O
Observed values
Modeling values
H2O
Vapor
Altitude [m]
Modeling and Observed H2O (ppmv)
0
2000
4000
6000
8000
10000
12000
0
5000
10000
15000
20000
25000
30000
35000

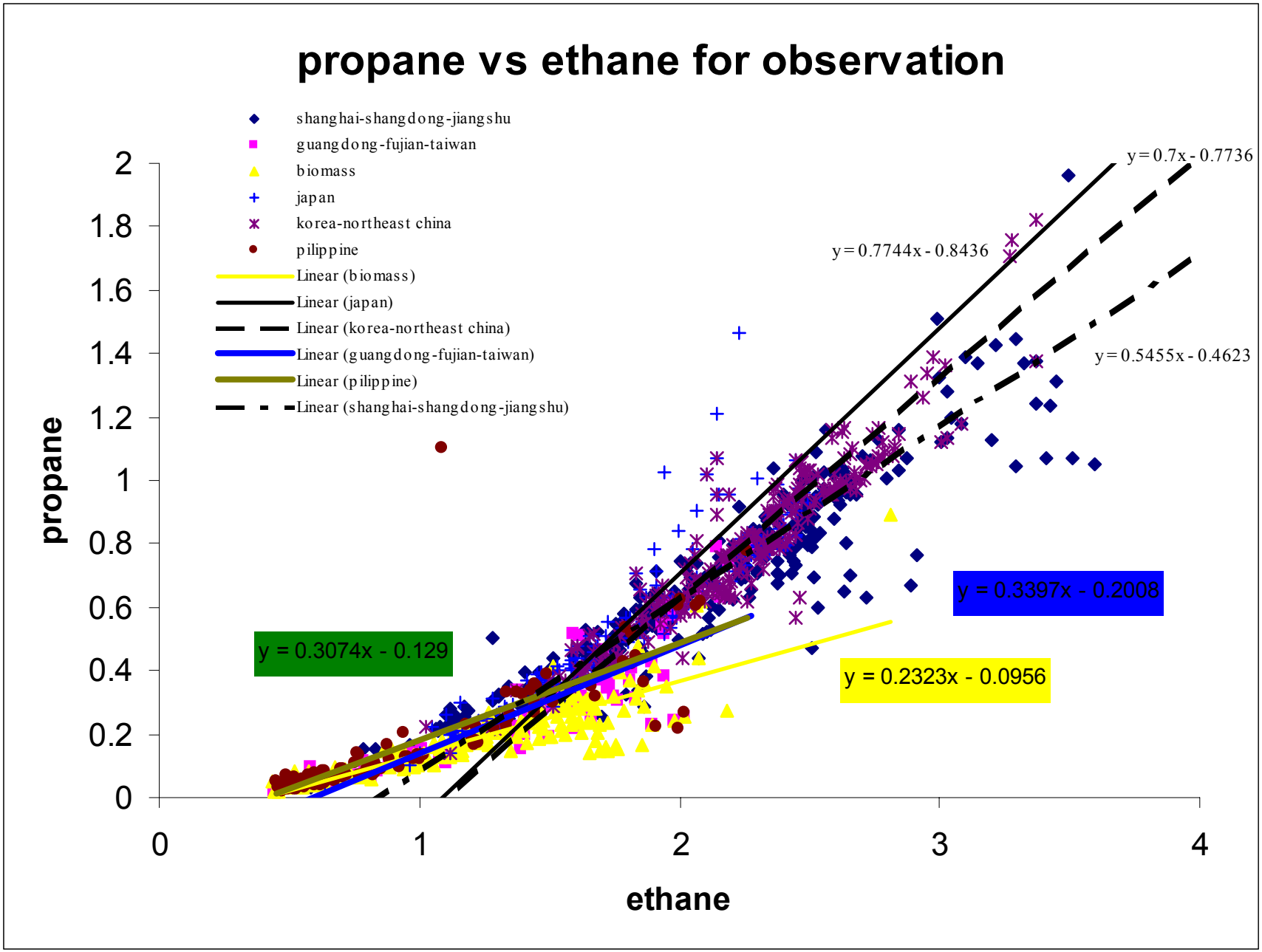
Measured and Modeled Ethane (Blake et al.) as a Function of Latitude DC8 & P3 Flights

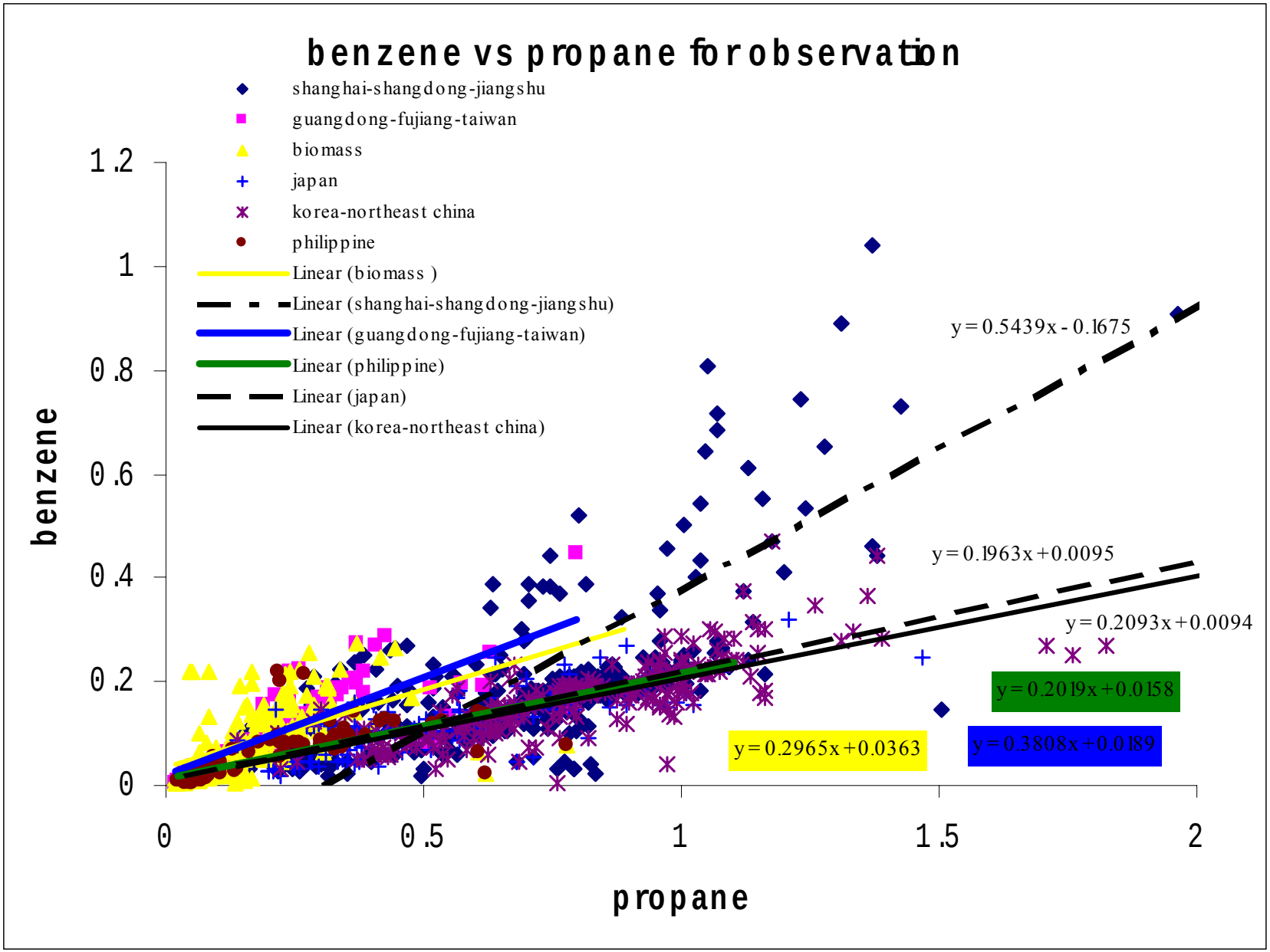


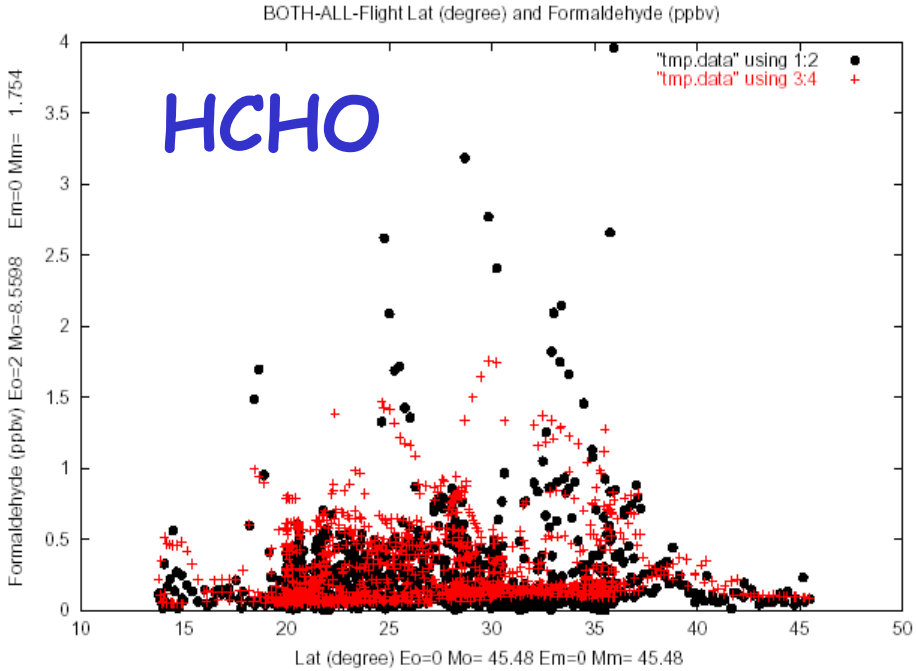
Monthly Mean B.Layer Ethane & Propane

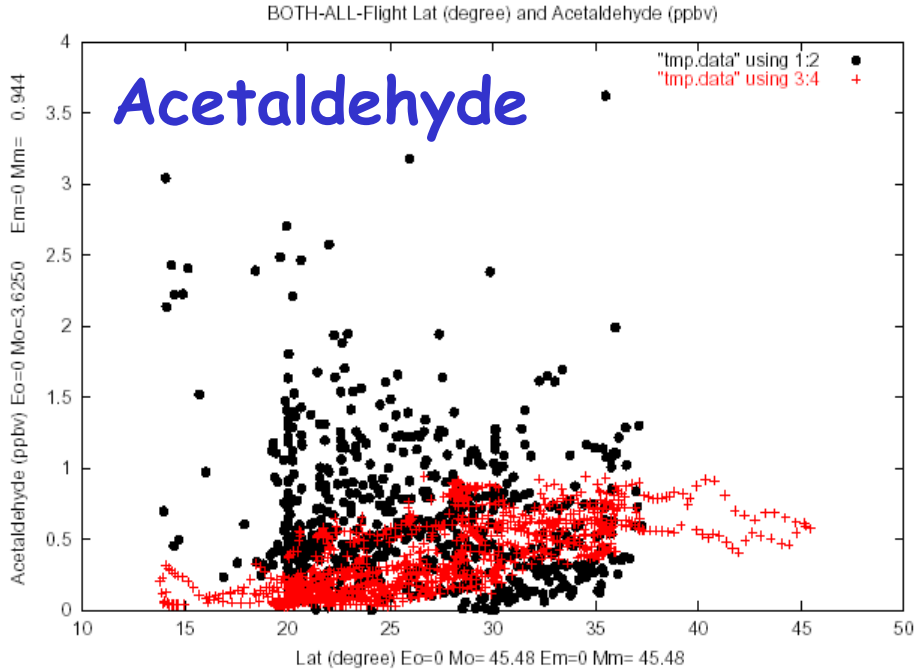


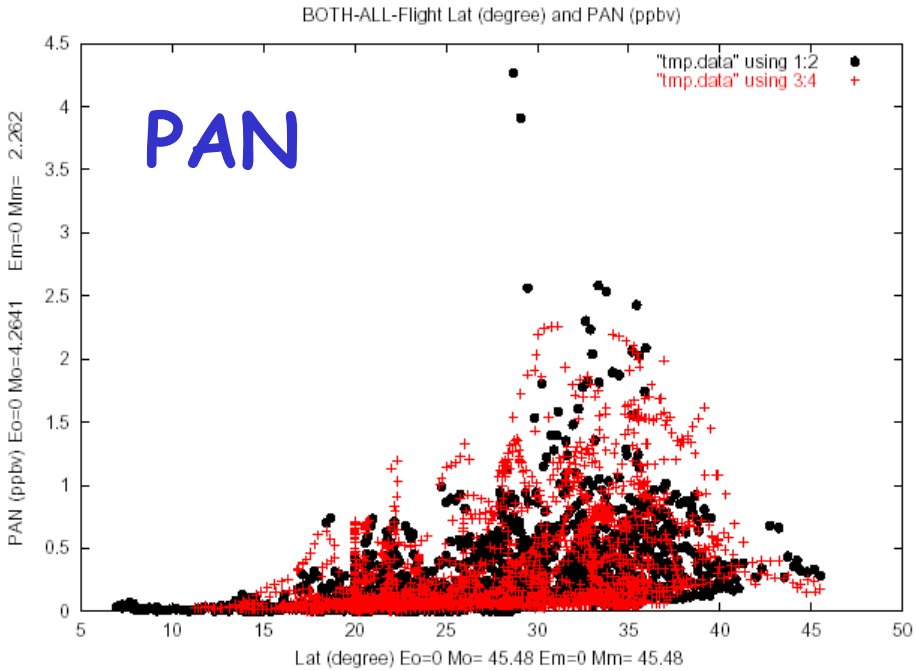


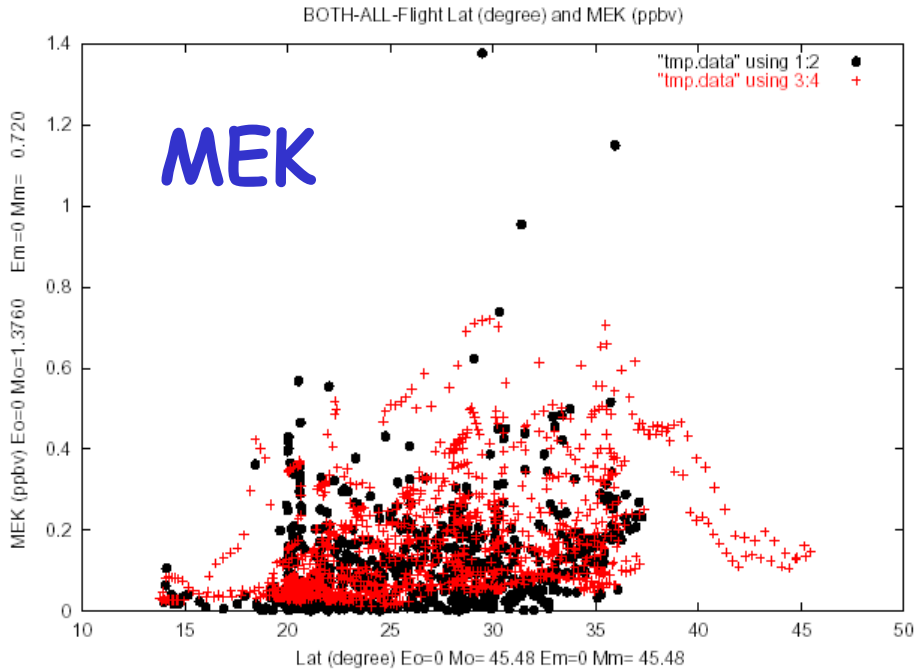

propane vs ethane for observation
shanghai-shangdong-jiangshu
guangdong-fujian-taiwan
biomass
japan
korea-northeast china
pilippine
Linear (biomass)
Linear (japan)
Linear (korea-northeast china)
Linear (guangdong-fujian-taiwan)
Linear (pilippine)
Linear (shanghai-shangdong-jiangshu)
y = 0.7x - 0.7736
y = 0.7744x - 0.8436
y = 0.5455x - 0.4623
y = 0.3397x - 0.2008
y = 0.3074x - 0.129
y = 0.2323x - 0.0956
propane
ethane
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
0
1
2
3
4


benzene vs propane for observation
shanghai-shangdong-jiangshu
guangdong-fujiang-taiwan
biomass
japan
korea-northeast china
philippine
Linear (biomass)
Linear (shanghai-shangdong-jiangshu)
Linear (guangdong-fujiang-taiwan)
Linear (philippine)
Linear (japan)
Linear (korea-northeast china)
y = 0.5439x - 0.1675
y = 0.1963x + 0.0095
y = 0.2093x + 0.0094
y = 0.2019x + 0.0158
y = 0.2965x + 0.0363
y = 0.3808x + 0.0189
benzene
propane
0
0.2
0.4
0.6
0.8
1
1.2
0
0.5
1
1.5
2


BOTH-ALL-Flight Lat (degree) and Formaldehyde (ppbv)
"tmp.data" using 1:2
"tmp.data" using 3:4
HCHO
Formaldehyde (ppbv) Eo=2 Mo=8.5598 Em=0 Mm= 1.754
Lat (degree) Eo=0 Mo= 45.48 Em=0 Mm= 45.48


BOTH-ALL-Flight Lat (degree) and Acetaldehyde (ppbv)
"tmp.data" using 1:2
"tmp.data" using 3:4
Acetaldehyde
Acetaldehyde (ppbv) Eo=0 Mo=3.6250 Em=0 Mm= 0.944
Lat (degree) Eo=0 Mo= 45.48 Em=0 Mm= 45.48


BOTH-ALL-Flight Lat (degree) and PAN (ppbv)
"tmp.data" using 1:2
"tmp.data" using 3:4
PAN
PAN (ppbv) Eo=0 Mo=4.2641 Em=0 Mm= 2.262
Lat (degree) Eo=0 Mo= 45.48 Em=0 Mm= 45.48


BOTH-ALL-Flight Lat (degree) and MEK (ppbv)
"tmp.data" using 1:2
"tmp.data" using 3:4
MEK
MEK (ppbv) Eo=0 Mo=1.3760 Em=0 Mm= 0.720
Lat (degree) Eo=0 Mo= 45.48 Em=0 Mm= 45.48