New Datasets: GEOS5, MERRA HIPPO/ Ozone

Simone Tilmes, Jean Francois Lamarque, Louisa Emmons, Francis Vitt

- Meteorological data set available for offline modeling
- New data set available for model evaluation

GEOS5, MERRA

GEOS5: gridded output files from version 5 of the Goddard Earth Observing System Data Assimilation System (GEOS-5 DAS)

- GEOS5.1 : 2004-Sep 2008, 6h
- GEOS5.2: Oct 2008 – present

MERRA: Gridded output files from the Modern Era Retrospective-analysis for Research and Applications (MERRA) of the Goddard Earth Observing System Data Assimilation System (GEOS DAS), :

- 1979-present, 6h

- Original horizontal resolution: 0.5x0.6, 72lev vertical hybrid levels
- Interpolated horiz. resolutions: 1.9x2.5

interpolation is performed using a mass conserving interpolation by S.-J. Lin)

Variable (MZ4 / GEOS5)	Dim	CAM-MZ4-NCEP name /units		GEOS5 name / units	
Zonal wind	3D	U	m s^{-1}	U	m s^{-1}
Meridional wind	3D	V	m s^{-1}	V	m s^{-1}
Temperature	3D	T	K	T	K
Surface temperature	2D	TS	K	TSKIN	K
Surface pressure	2D	PS	Pa	PS	Pa
Specific humidity (optional for MZ4)	3D	Q	kg kg^{-1}	QV	kg kg^{-1}
Land/Ocean/Sea Ice flag	2D	ORO		LWI	0=water, 1=land, 2=ice
Surface geopotential height	2D	PHIS	m^2 s^{-2}	PHIS	m^2 s^{-2}
Surface zonal (eastward) stress	2D	TAUX	N m^{-2}	TAUX	N m^{-2}
Surface meridional (northward) stress	2D	TAUY	N m^{-2}	TAUY	N m^{-2}
Surface heat flux / Sensible heat flux	2D	SHFLX	W m^{-2}	HFLUX	W m-2
Surface moisture flux / Evaporation from turbulence	2D	QFLX	kg m^{-2} s^{-1}	EVAP	kg m^{-2} s^{-1}
Solar flux at surface / Surface downward shortwave flux	2D	FSDS	W m^{-2}	SWGDWN	W m^{-2}
Snow height / Snow depth	2D	SNOWH	m	SNOMAS	kg m^{-2}
Soil moisture fraction	2D	SOILW	fraction		
Top soil layer wetness root zone soil wetness	2D			GWETTOP, GWETROOT	fraction

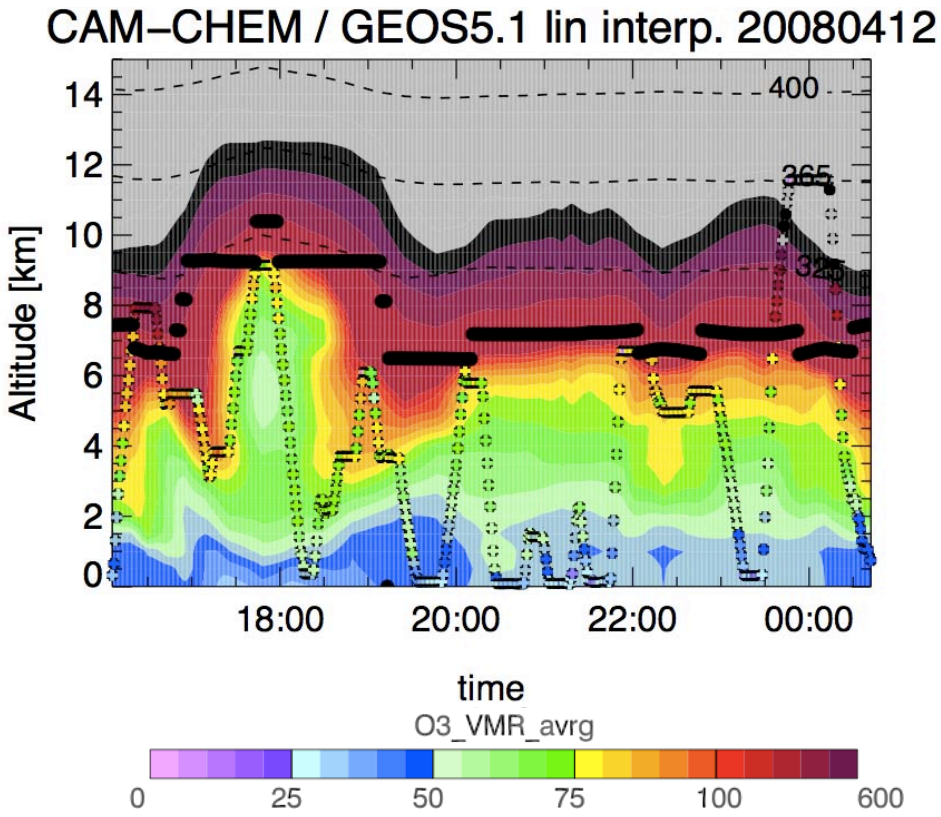
ORO is calculated using the Landfrac from CAM and the TS (TS < 271.15 EQ ICE)

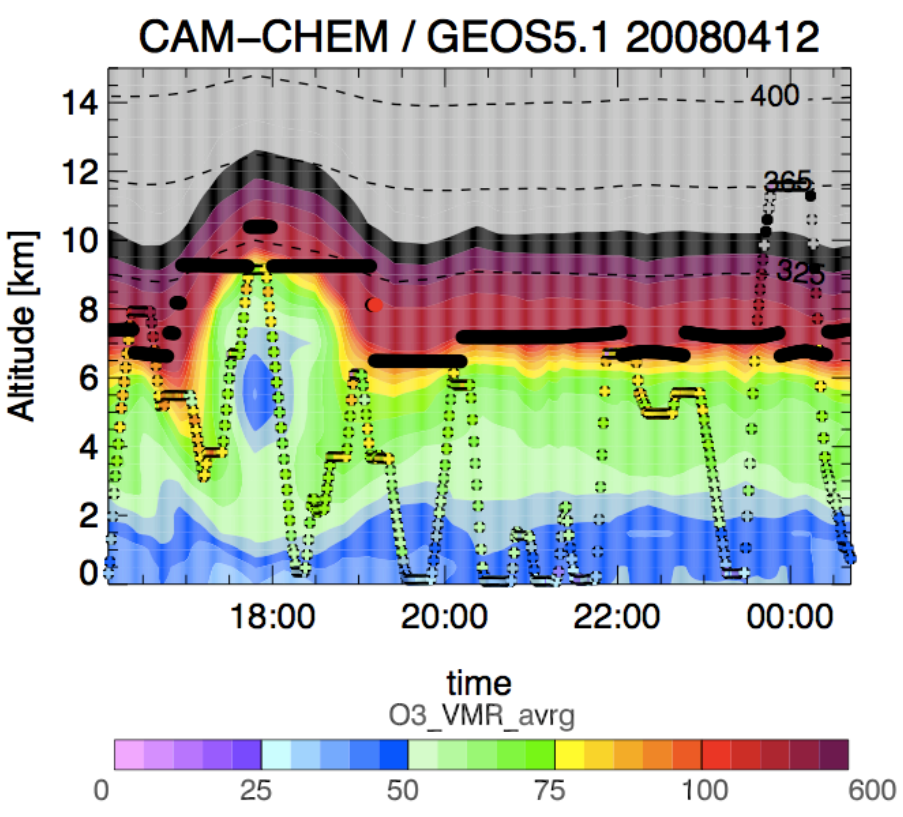
GEOS5, MERRA

- **GEOS5.1 linear** interpolation in space and time for surface values (as used in recent simulations)
- **GEOS5.1** mass conserving interpolation

Comparison with ARCTAS

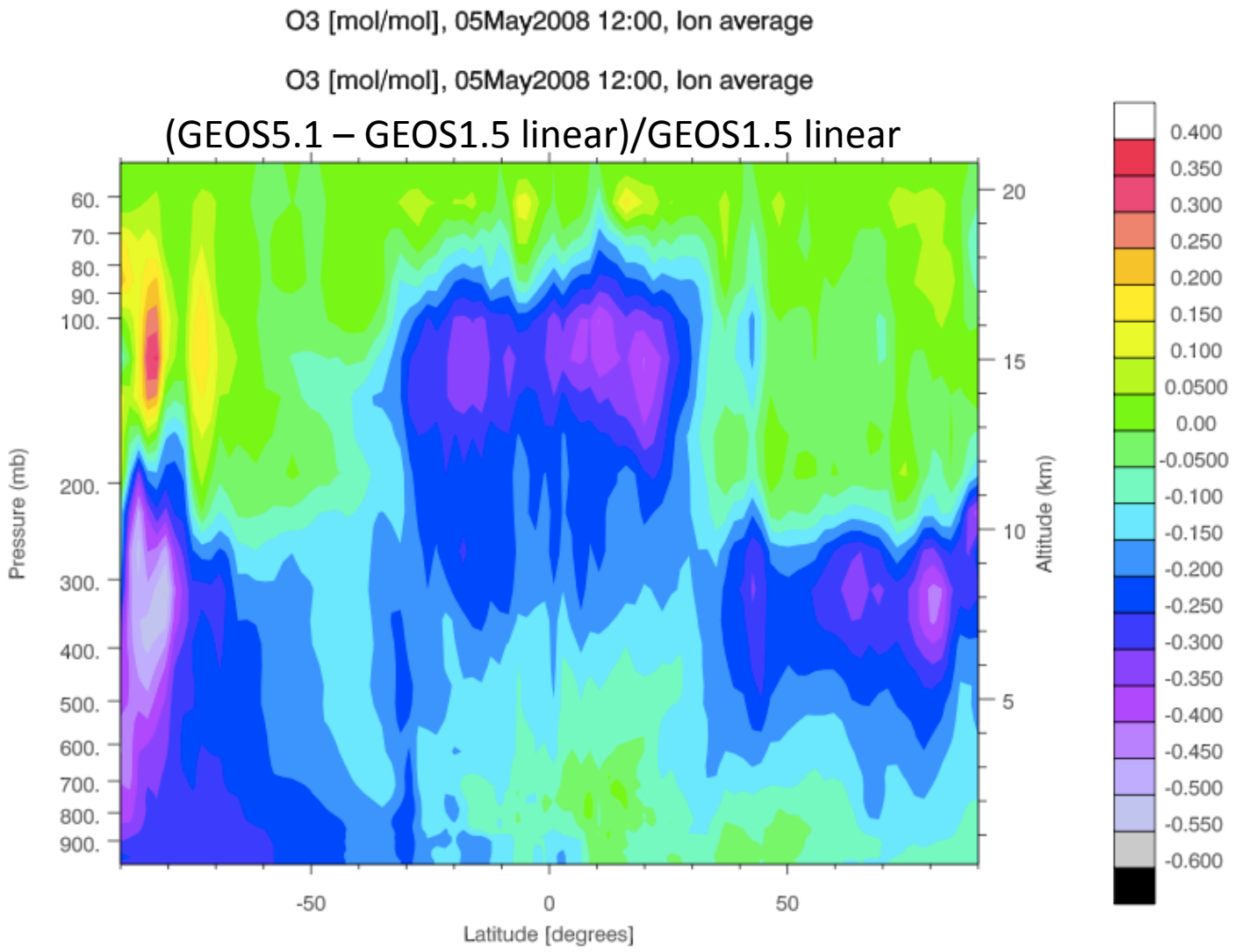
Interpolation on the flight track using 3h output





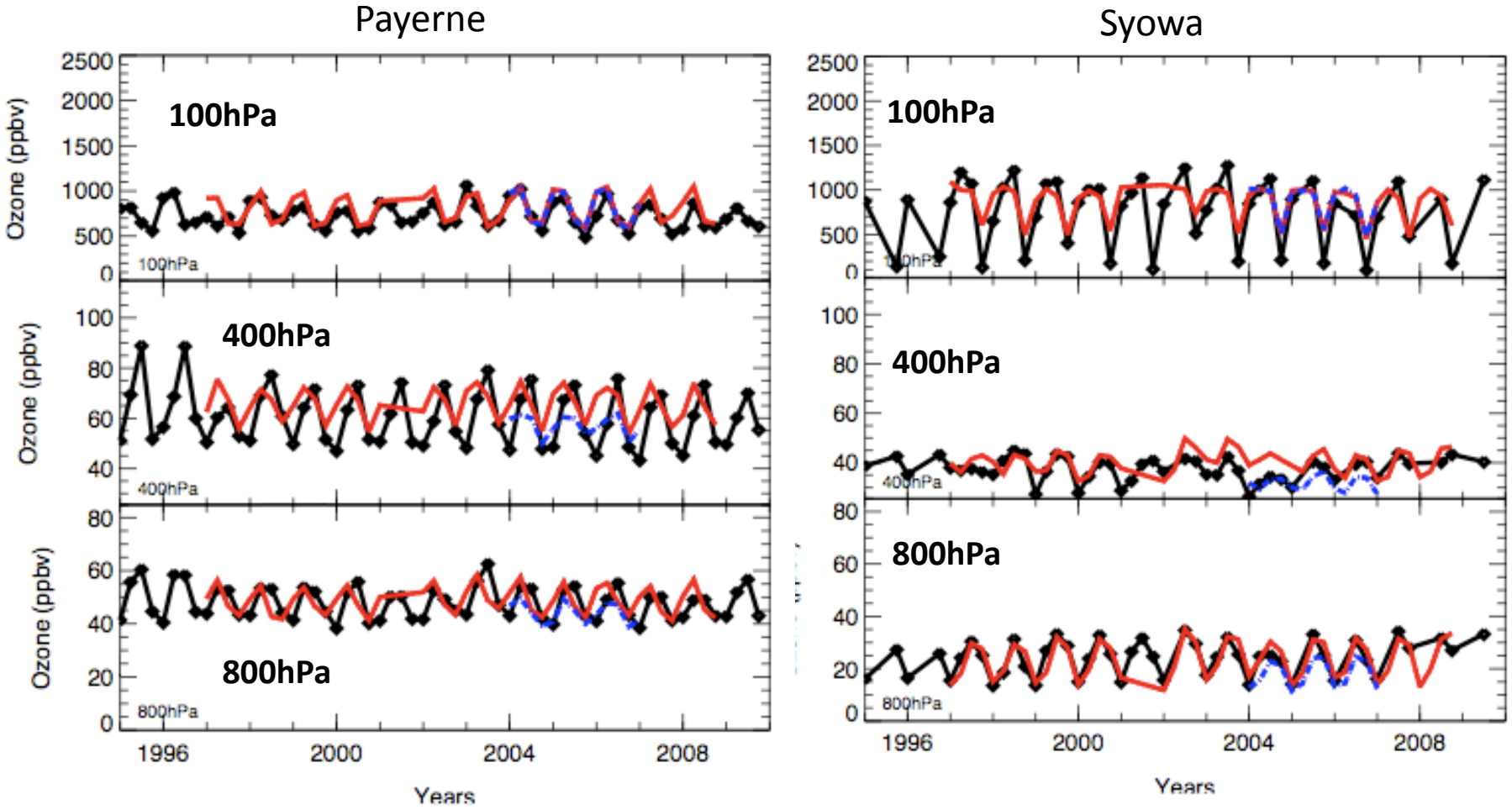
Comparison of simulations using GEOS5 and GEOS5 (linear)

Ozone



GEOS5, MERRA

CAMChem Simulation (prelim. results) using GEOS5 and MERRA compared to observations



Applications: Offline model simulations to support field campaigns

GEOS5, MERRA

How to get those data?

- ESG: http://www.earthsystemgrid.org

  Under CCSM 4 Model Output
- Mass Store: /TILMES/GEOS5/05x06

  /TILMES/GEOS5/19x25

  /TILMES/MERRA/05x06

  /TILMES/MERRA/19x25
- Glade Disc on bluefire:

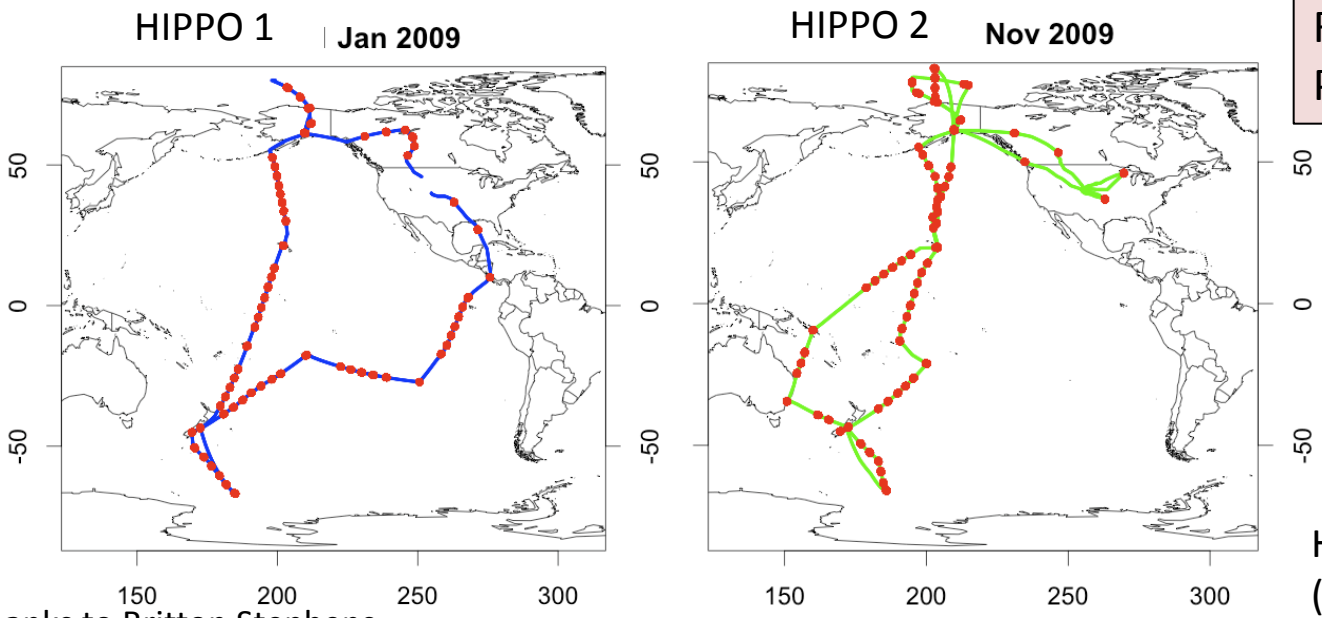
  /glade/proj3/cseg/data_tmp/

Available Datasets for Model Evaluation

- Model Chemistry Evaluation Program (MCEP)

  available at the Climate-Chemistry Working Group website
- HIPPO Aircraft Data
- New Ozone Climatology

HIPPO HIAPER Pole to Pole Observations



Thanks to Britton Stephens

RAF Field project,
PI: Prof. Steve Wofsy

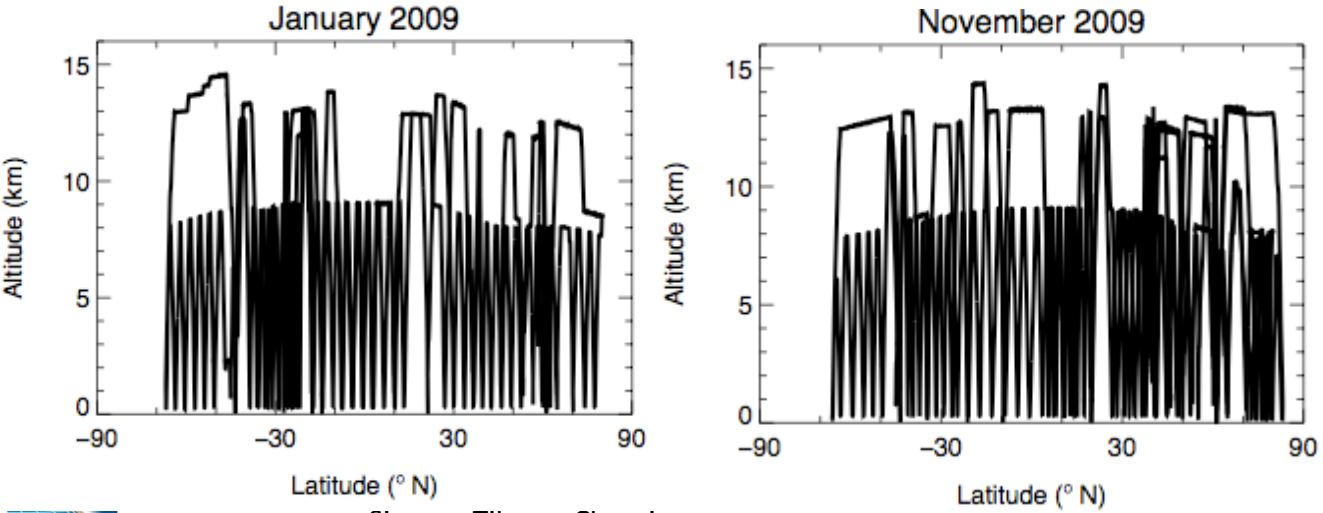
NSF/NCAR GV

HIPPO_3 Mar/Apr 2010
(same track NB, SB)

HIPPO_4 Jun 2011
(NB track via E. Pacific)

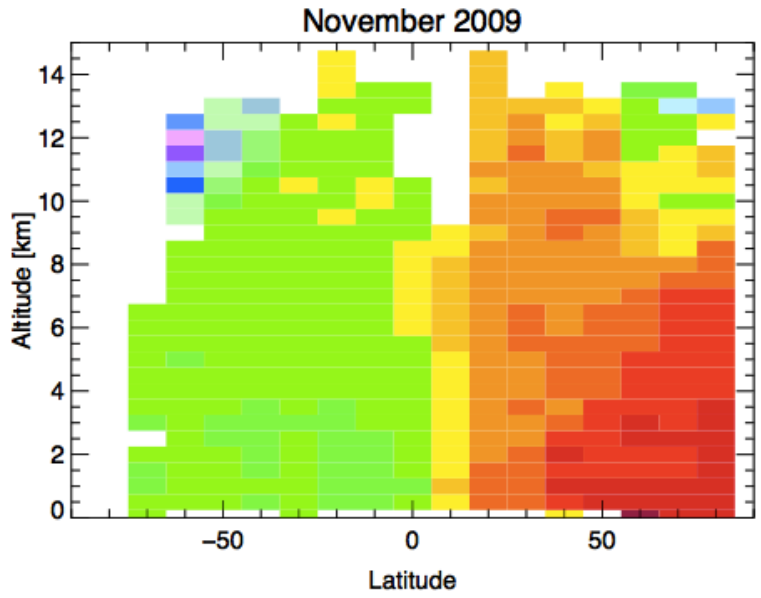
HIPPO_5 Sep 2011
(NB track NB, SB)

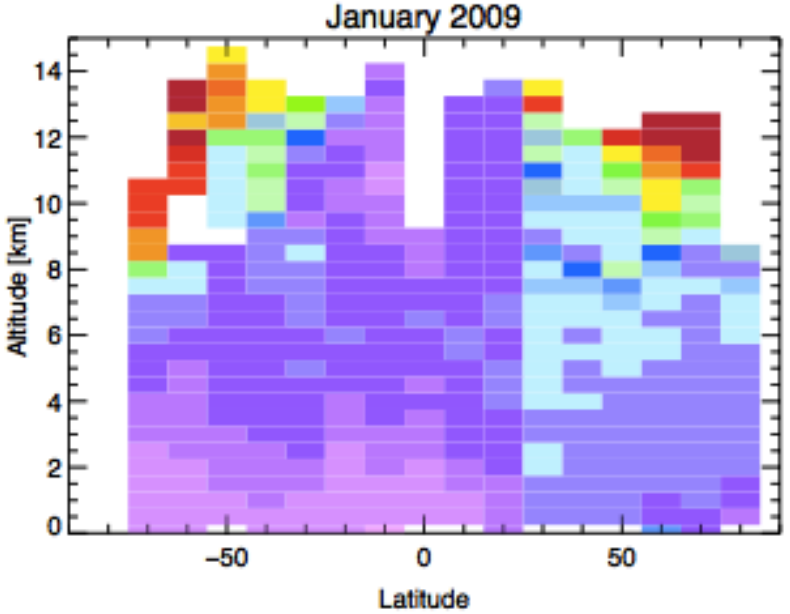
~ 600 vertical profiles

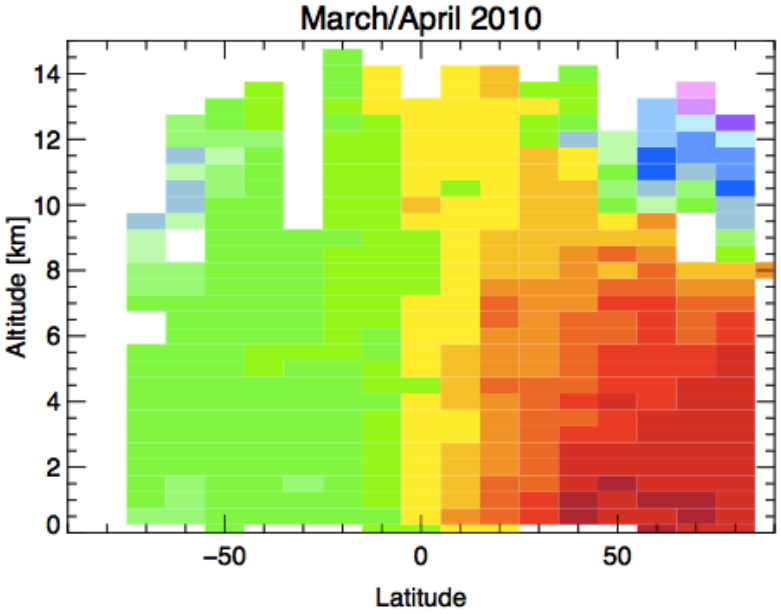


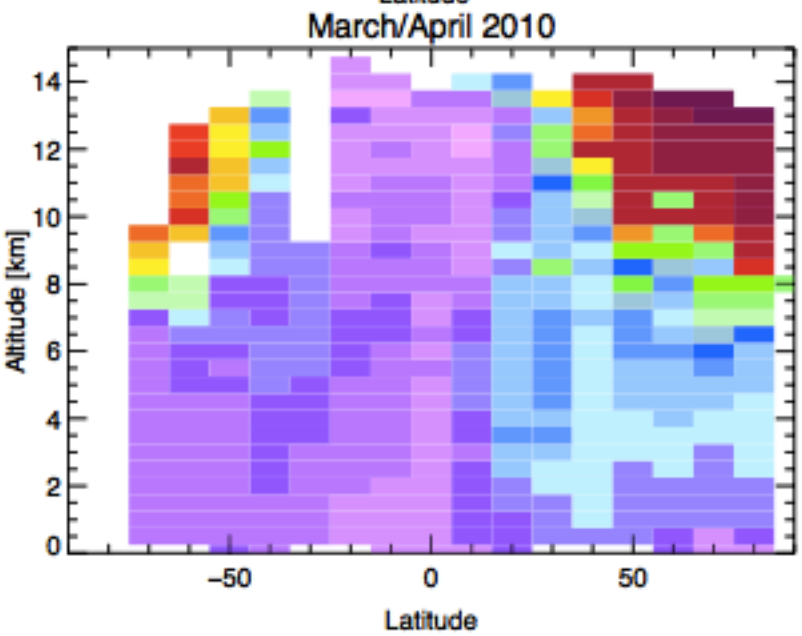
NESL

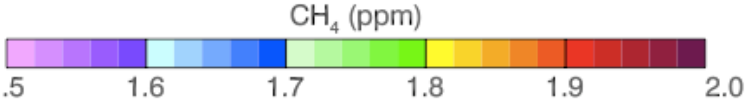
NSF

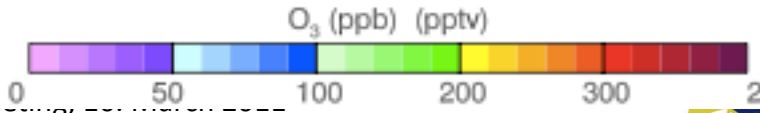

November 2009
Altitude [km]
Latitude


January 2009
Altitude [km]
Latitude


March/April 2010
Altitude [km]
Latitude


March/April 2010
Altitude [km]
Latitude

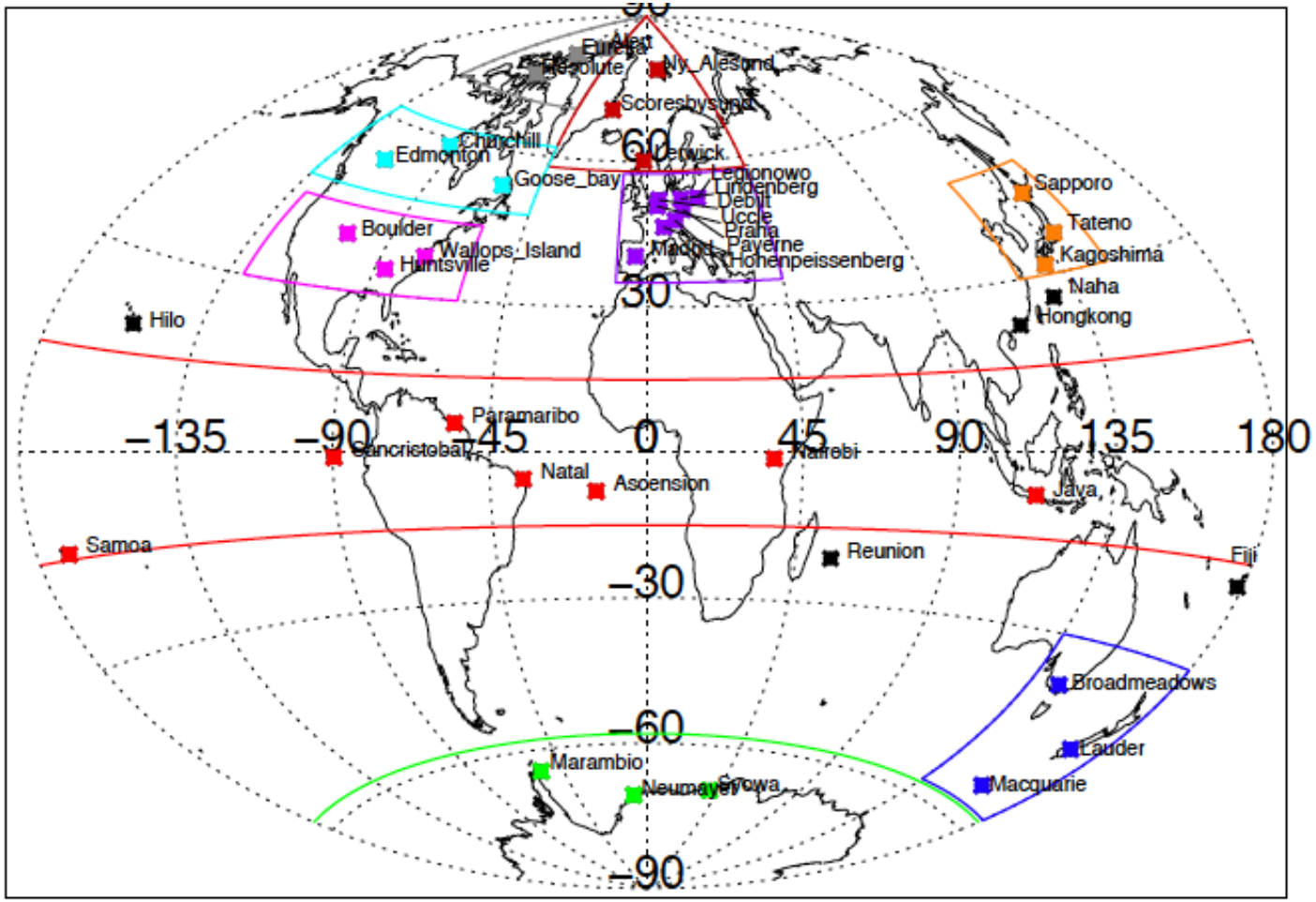

CH4 (ppm)
1.5
1.6
1.7
1.8
1.9
2.0


O3 (ppb) (pptv)
0
50
100
200
300
2100

HIPPO Aircraft Instrumentation

Harvard/Aerodyne - QCLS	CO_2, CH_4, CO, N_2O (*1 Hz*)
NCAR AO2	O_2:N_2 , CO_2 (*1 Hz*)
Harvard OMS CO_2	CO_2 (*1 Hz*)
NOAA CSD O_3	O_3 (*1 Hz*)
NOAA GMD O_3	O_3 (*1 Hz*)
NCAR RAF CO	CO (*1 Hz*)
NOAA- UCATS, PANTHER GCs (1 per 70 – 200 s)	CO, CH_4, N_2O, CFCs, HCFCs, SF_6, CH_3Br, CH_3Cl, H_2, H_2O
Whole air sampling: NWAS (NOAA), AWAS (Miami), MEDUSA (NCAR/Scripps)	O_2:N_2, CO_2, CH_4, CO, N_2O , other GHGs, CO_2 isotopes, Ar/N_2, COS, halocarbons, solvent gases, marine emission species, many more
Princeton/SWS VCSEL	H_2O (*1 Hz*)
NOAA SP2	Black Carbon (*1 Hz*)
MTP, wing stores, etc	T, P, winds, aerosols, cloud water

Ozone Climatology (1995-2009)

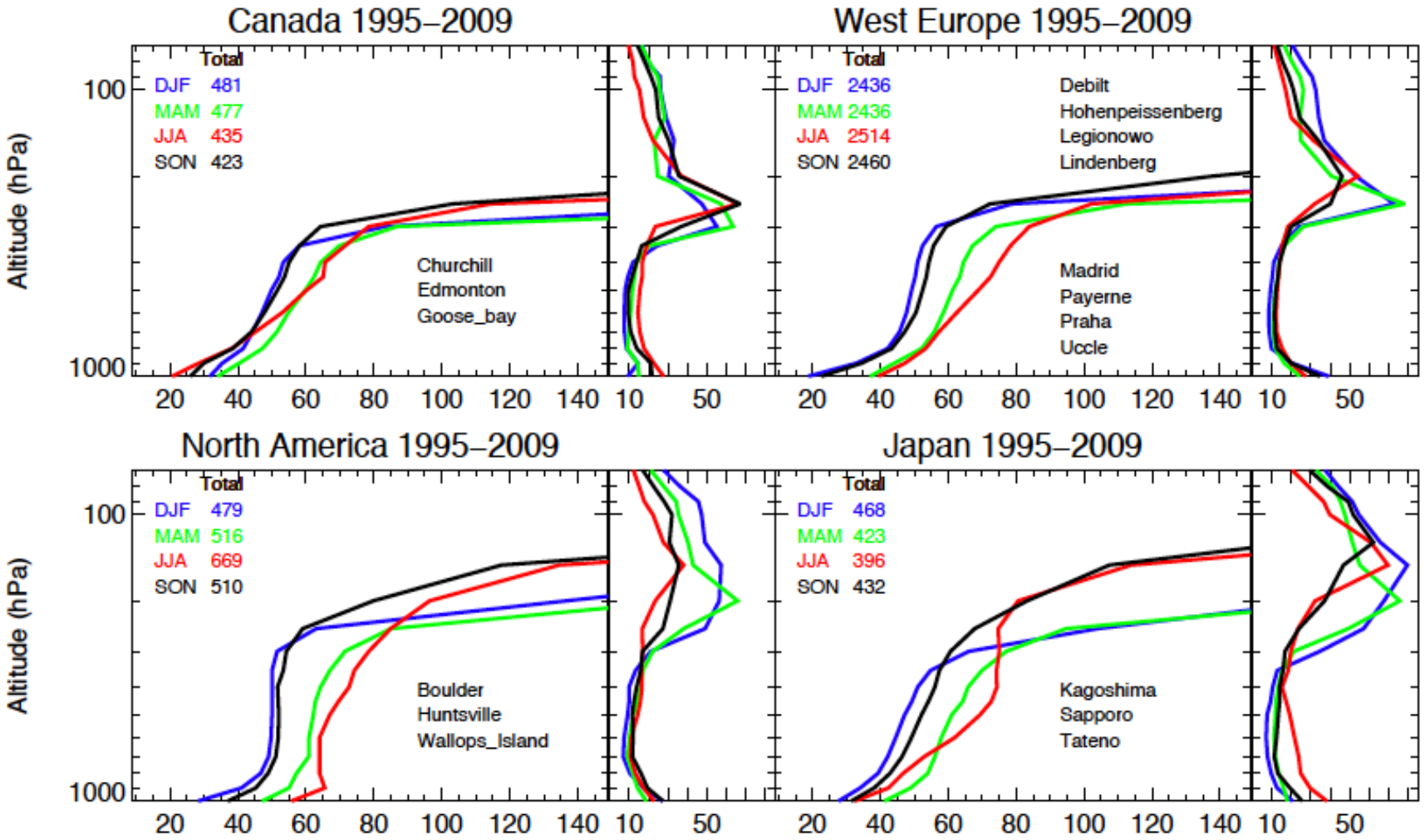


- NH polar East
- NH polar West
- Canada
- North America
- West Europe
- Japan
- Tropics
- SH mid–lat
- SH polar

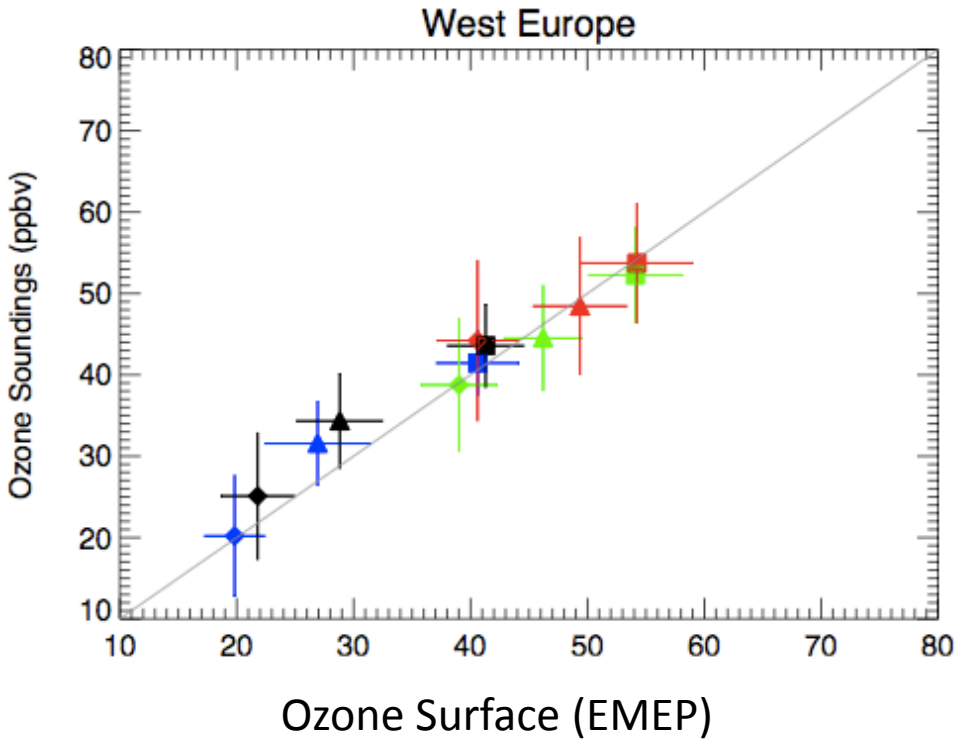
WOUDC,
Shadows,
NOAA

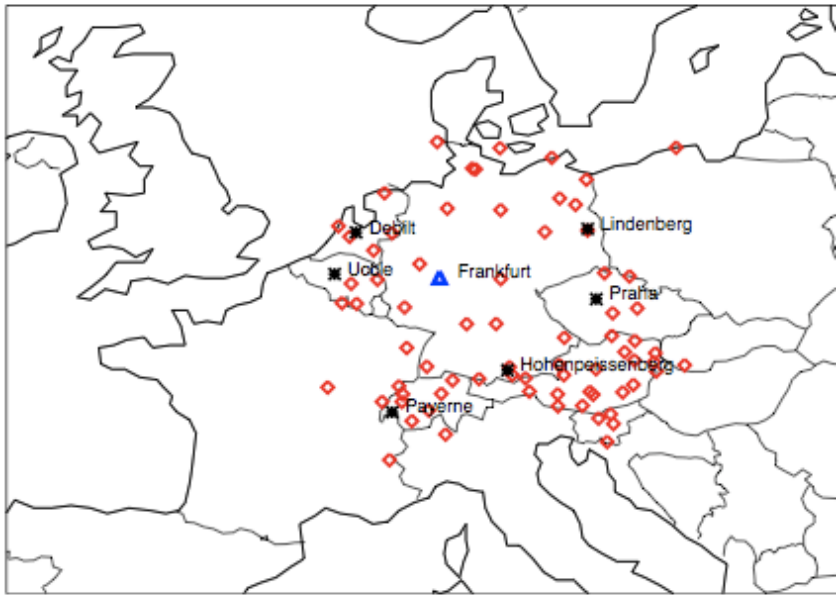
Tilmes et al., in preparation

Ozone Climatology



Ozone Climatology





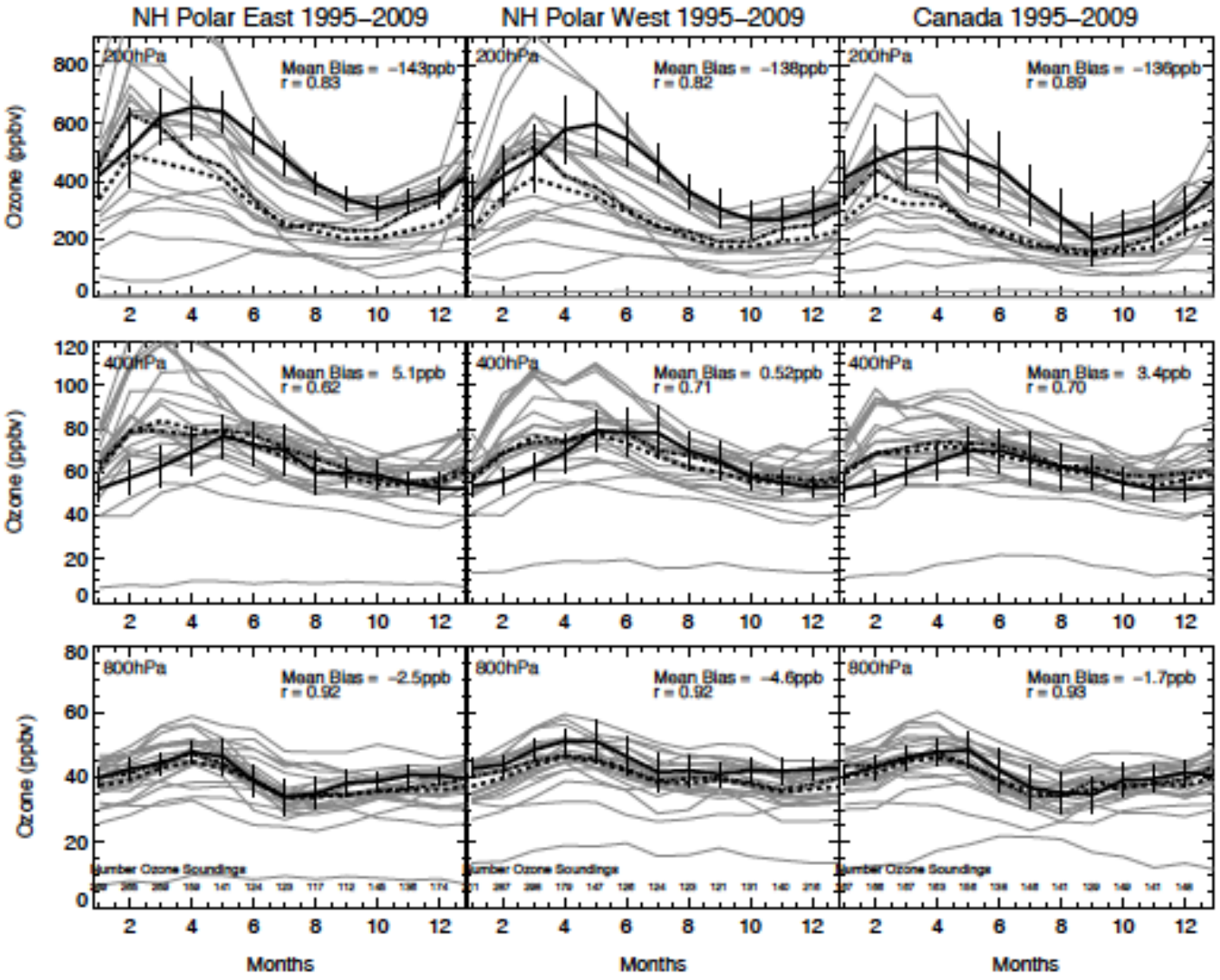
EMEP,
CASTNET,
WDCGG

Ozone Climatology

200hPa

400hPa

800hPa



HTAB Models

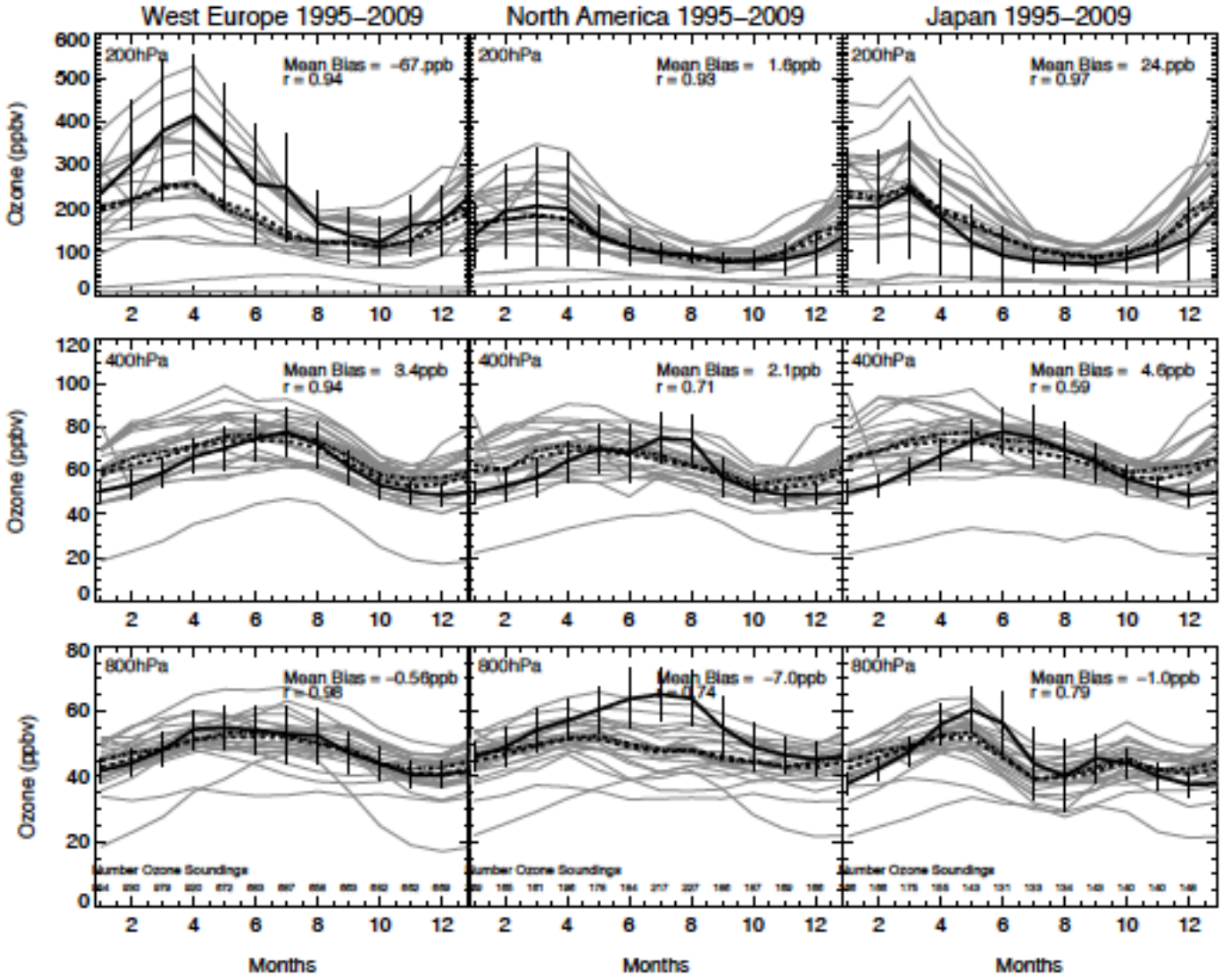
Simone Tilmes, Chemistry-Climate Working Group Meeting, 16. March 2011

Ozone Climatology

200hPa

400hPa

800hPa



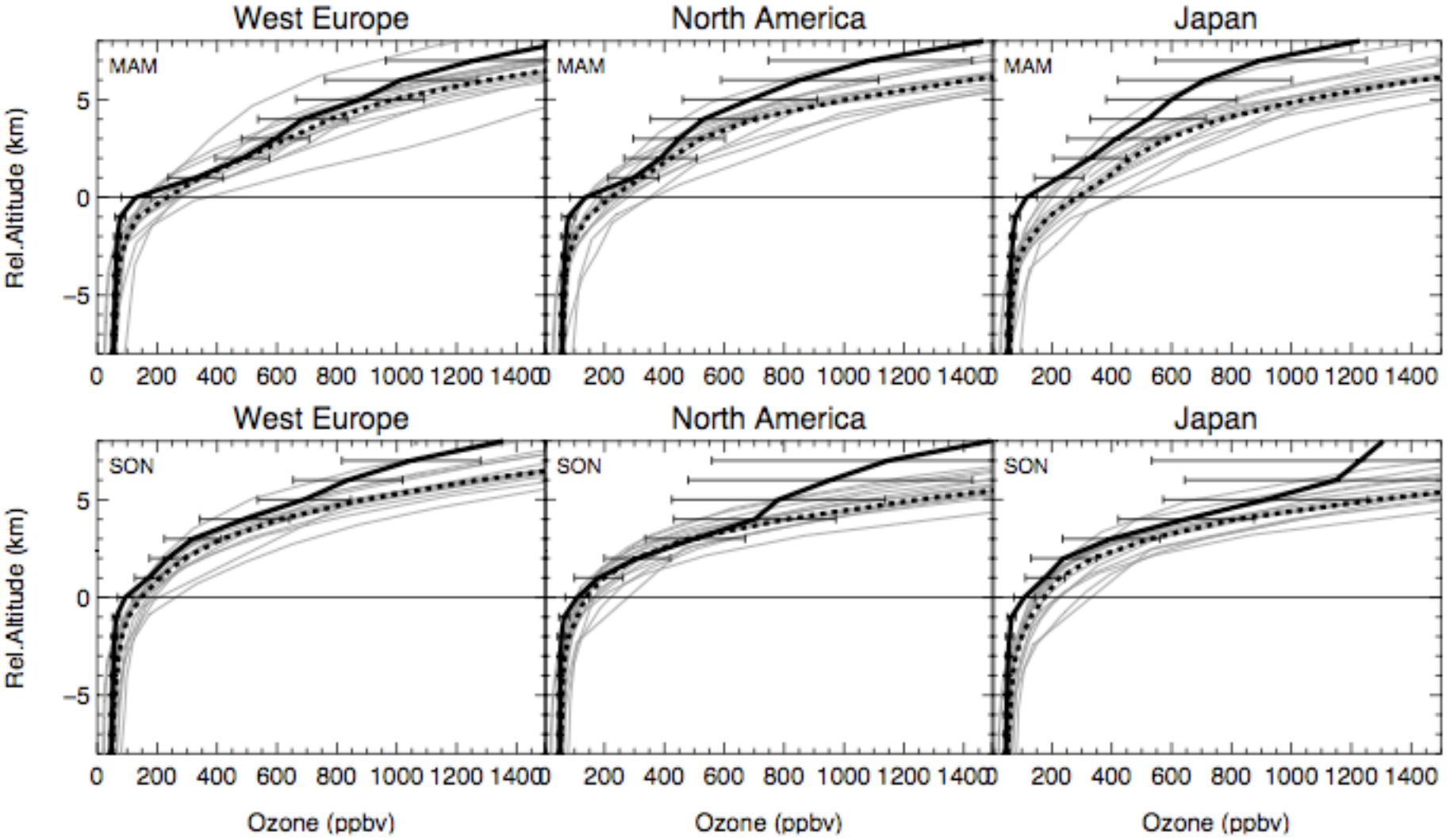
HTAB Models

Simone Tilmes, Chemistry-Climate Working Group Meeting, 16. March 2011

NESL

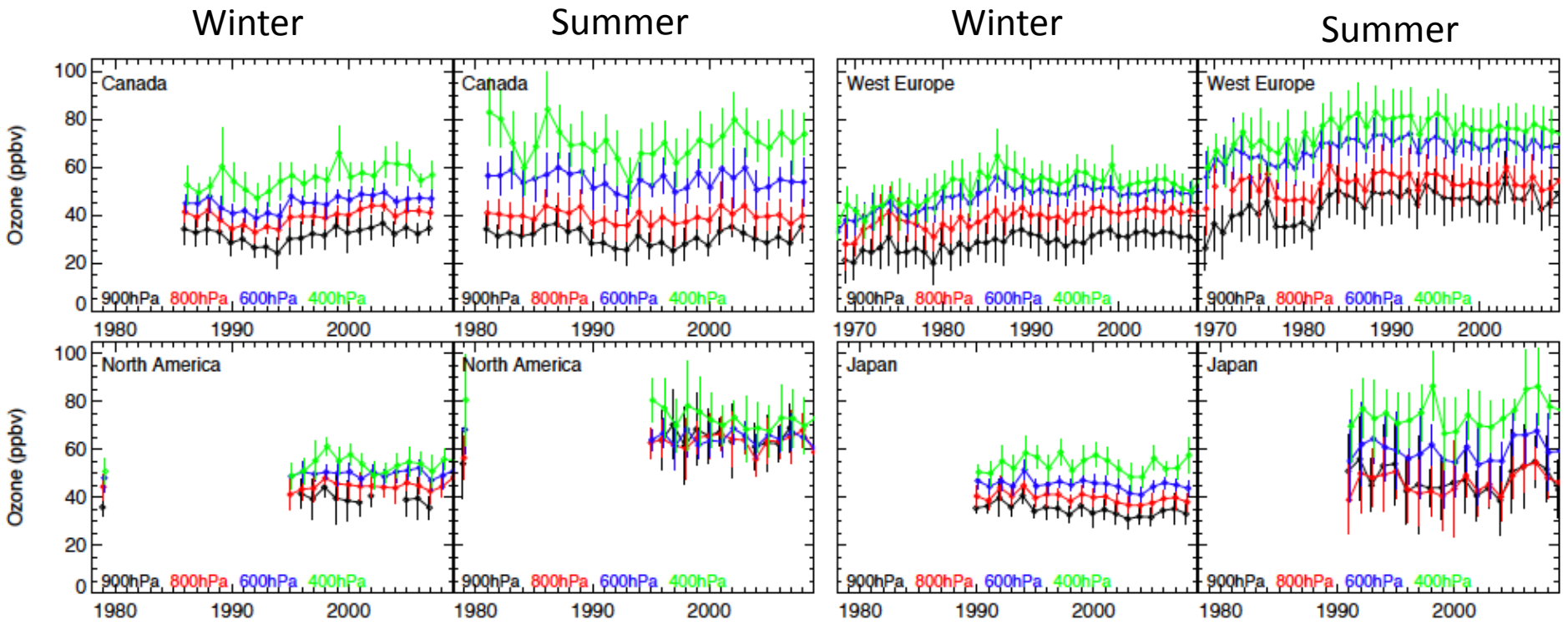
NSF

Ozone Climatology



Questions?

Ozone Climatology



Running CAMchem

- Available Compsets
- Setup of the simulation
- Changes to the simulation
- Latest Developments

Compsets	Model (phys)/ radiation	Chemistry	Components / Meteorology
B_2000_TROP_MOZART (BMOZ)	CAM4, active	trop_mozart	All active
F_2000_TROP_MOZART (BMOZ)	CAM4, passive	trop_mozart	Prescr. ocn/ice, CLM dry dep
F_2000_CAMCHEM (FCHM)	CAM4, passive	trop_mozart + Neu wet dep	Prescr. ocn/ice, CLM MEGAN VOC emis

Compsets	Model (phys)/ radiation	Chemistry	Components / Meteorology
B_2000_TROP_MOZART (BMOZ)	CAM4, active	trop_mozart	All active
F_2000_TROP_MOZART (BMOZ)	CAM4, passive	trop_mozart	Prescr. ocn/ice, CLM dry dep
F_2000_CAMCHEM (FCHM)	CAM4, passive	trop_mozart + Neu wet dep	Prescr. ocn/ice, CLM MEGAN VOC emis
F_SD_CAMCHEM (FSDCHM) F_SD_BAM (FSDBAM)	CAM4, passive	trop_mozart trop_bam	Prescr. ocn/ice, clm dry dep, offline: GEOS5 (56lev)
F_SD_WACCM_TSLT_GEOS5 (FSDWEG5)	CAM4, active	waccm_tslt	Prescr. ocn/ice, CLM MEGAN VOC emissions offline GEOS5 (88lev)

Compsets	Model (phys)/ radiation	Chemistry	Components / Meteorology
B_2000_TROP_MOZART (BMOZ) F_2000_TROP_MOZART (BMOZ)	CAM4, active CAM4, passive	trop_mozart trop_mozart	All active Prescr. ocn/ice, CLM dry dep
F_2000_CAMCHEM (FCHM)	CAM4, passive	trop_mozart + Neu wet dep	Prescr. ocn/ice, CLM MEGAN VOC emis
F_SD_CAMCHEM (FSDCHM) F_SD_BAM (FSDBAM)	CAM4, passive	trop_mozart trop_bam	Prescr. ocn/ice, clm dry dep, offline: GEOS5 (56lev)
F_SD_WACCM_TSLT_GEOS5 (FSDWEG5)	CAM4, active	waccm_tslt	Prescr. ocn/ice, CLM MEGAN VOC emissions offline GEOS5 (88lev)
B_2000_CN_CHEM (B2000CNCHM) B_1850_CN_CHEM (B1850CNCHM) F_1850_CN_CHEM (F1850CNCHM) B_1850-2000_CN_CHEM (B20TRCNCHM)	CAM4, active	super_fast_llnl	MEGAN VOC emis CLM dry dep, land nitrogen cycle
B_1850_CAM5 (B1850C5) B_1850-2000_CAM5 (B20TRC5) E_1850_CAM5 (E1850C5) F_AMIP_CAM5 (FAMIPC5) F_1850_CAM5 (F1850C5) F_2000_CAM5 (FC5)	CAM5, active	MAM	

Available Compsets

- /acd/fvitt/cesm/cesm1_0_beta12_chem (intern)
- svn co https://svn-ccsm-models.cgd.ucar.edu/cesm1/exp_tags/cesm1_0_beta12_chem01

Setup of a Simulation

Run the model out of the box (using an existing Compset)

- **Create a new case called <case_name>:**
  - **CESM_ROOT** = /acd/fvitt/cesm/cesm1_0_beta12_chem (intern)
    Go to your model directory **CESM_ROOT**, then **cd scripts** and invoke:
  - **create_newcase -case $HOME/<case_name> -res f19_f19 -compset $COMPSET -mach bluefire** (change **'bluefire'** to your computer name)

    f19_f19: data ocean (finite volume of the atmosphere); **f19_g16**: active ocean
  - A new directory **<case_name>** is created in your **<home_dir>** (below, **<case_dir>** is **<home_dir>/<case_name>**)
- **(Make changes to defaults)**
- **Configure the case, in <case_dir>: configure –case**
- **Build the model: ./*.build file**
- **Run the model: bsub < ./*.run (or ./*.submit) for bluefire**
  - model output is in **<run_dir>: /ptmp/<username>/<case_name>/run**
  - namelist that was used for run in **<run_dir>/atm_in**
- **Archiving:**
  - short-term archiving in /ptmp/<username>/archive
  - long-term archiving on the mass store

Setup of a Simulation

Modification to the Simulation:

- **env_conf.xml, env_build.xml, env_run.xml, env_case.xml, env_mach_pers.xml**

- ***.run to change run specific parameters** (length per segment, account number)

Setup of a Simulation

Modification to the run (no changes to the model configuration):

- **env_run.xml**: **change run specifications, run time, output, restart etc.**,
  - CONTINUE_RUN: needs to be set to TRUE to continue a run
  - RESUBMIT: set value to the number of segments you want to run (value counts down during the simulation)
  - REST_OPTION: will write out restart files in the frequency chosen
  - REST_N: frequency of restart file output (0: no restart file)
  - DOUT_L_MS: archiving to mss is not a default and needs to be set

- ***.run** **to change run specific parameters** (length per segment, account number)

- **after these changes you can just resubmit the run**

Changes to the Simulation

Modification to the namelist (f.ex. model output, emission, met field)
(**http://www.cesm.ucar.edu/cgi-bin/eaton/namelist/nldef2html-pub**)

- cp **user_nl_cam** to your <case_dir>,
- edit **user_nl_cam** in your <case_dir>
  - fincl …
  - ncdata: initial condition file
  - met_data_file, met_data_path (meteorology)
  - bnd_topo (boundary conditions for offline model runs)
  - srf_emis_specifier (emissions)
  - srf_emis_type = 'CYCLICAL' ; srf_emis_cycle_yr = 2000
  - for SERIAL 'srf_emis_cycle_yr' this is not allowed
  - srf_emis_type = 'FIXED'; srf_emis_fixed_ymd = 20000101 for

  - &satellite_options_nl: sathist_fincl, sathist_hfilename_spec, sathist_track_infile

  - **configure –cleannamelist** to unlock env_conf.xml
  - **configure –case** in your <case_dir> **(you do not need to rebuild the model)**
  - **run the model**

Changes to the Simulation

Modification to your configuration: env_conf.xml

- edit **env_conf.xml** in your <case_dir>
  - RUN_STARTDATE: change start date of the simulation (including possible changes to the namelist)
  - CAM_CONFIG_OPTS:
    - change vertical levels (-offline_dyn –lev nn)
    - modify chemical mechanism (-usr_mech_infile)
- **configure –cleannamelist** to unlock env_conf.xml
- **configure –case** in your <case_dir> **(you do not need to rebuild the model)**
- **run the model**

Changes to the Simulation

Modification of your calendar option: GREGORIAN/ NO_LEAP

- edit **env_run.xml**
  - change CALENDAR value = “NO_LEAP” to “GREGORIAN”
    default for SD model runs is “GREGORIAN”, else it is “NO_LEAP”

- edit **env_build.xml** in your <case_dir>
  - calendar option: set USE_ESMF_LIB to TRUE
  - invoke *.clean_build
  - build your model again: invoke *.build

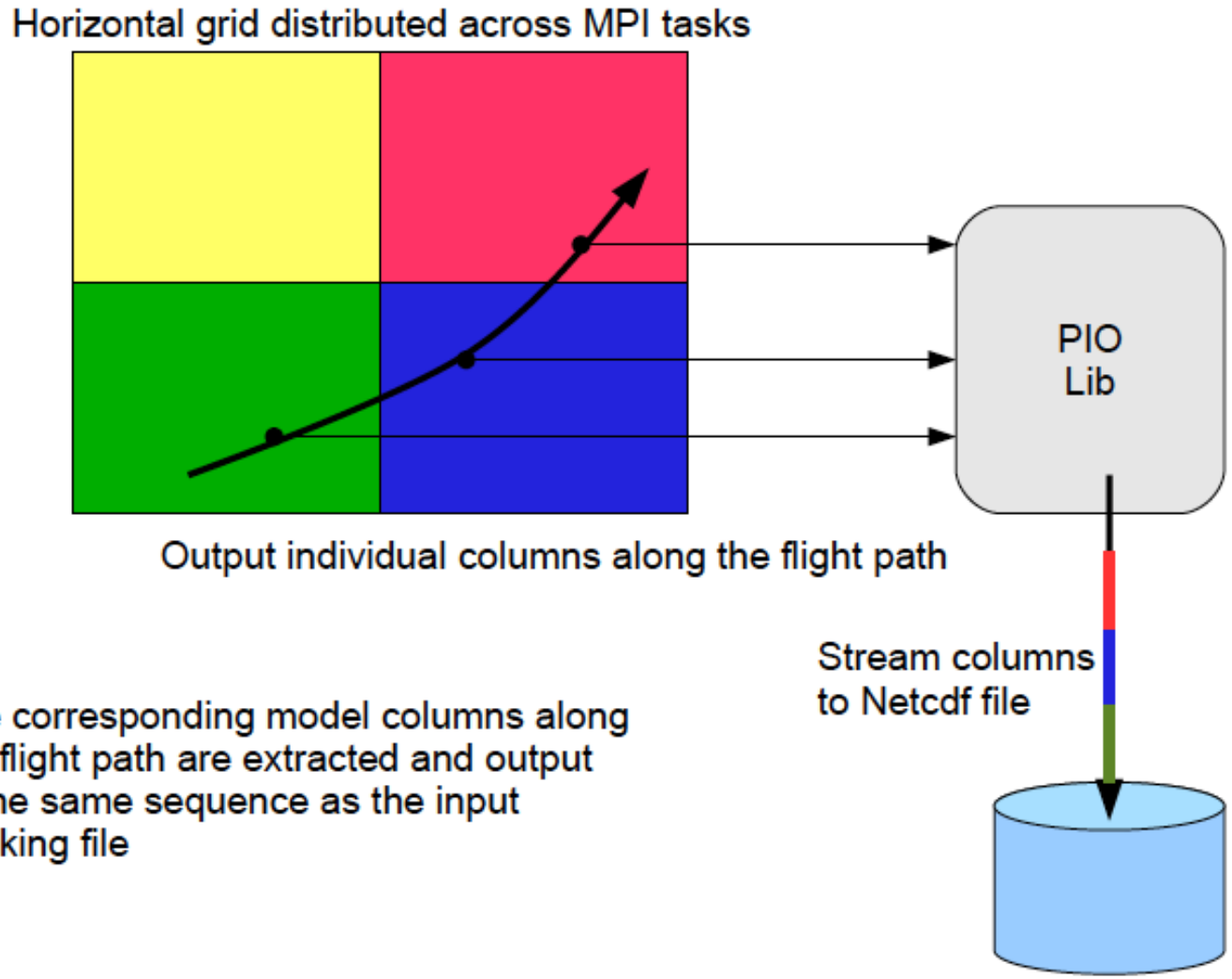
Latest Developments

- **Specified Dynamics Compets** for CAM-chem/ WACCM
- **History sampling along observation tracks**
  - Satellite track (more than one dataset can be included)
  - Aircraft flight path
- **Local time averaging history output** (C. Bardeen)
- **Other updates**

History sampling along observation tracks

Tracking file determines sequence of coordinates and time

- Uses nearest model time: maximum deviation from observation time is +/- half the time step of the current model time
- Uses nearest lon/lat model coordinate to the observed values



History sampling along observation tracks

Tracking file determines sequence of coordinates and time

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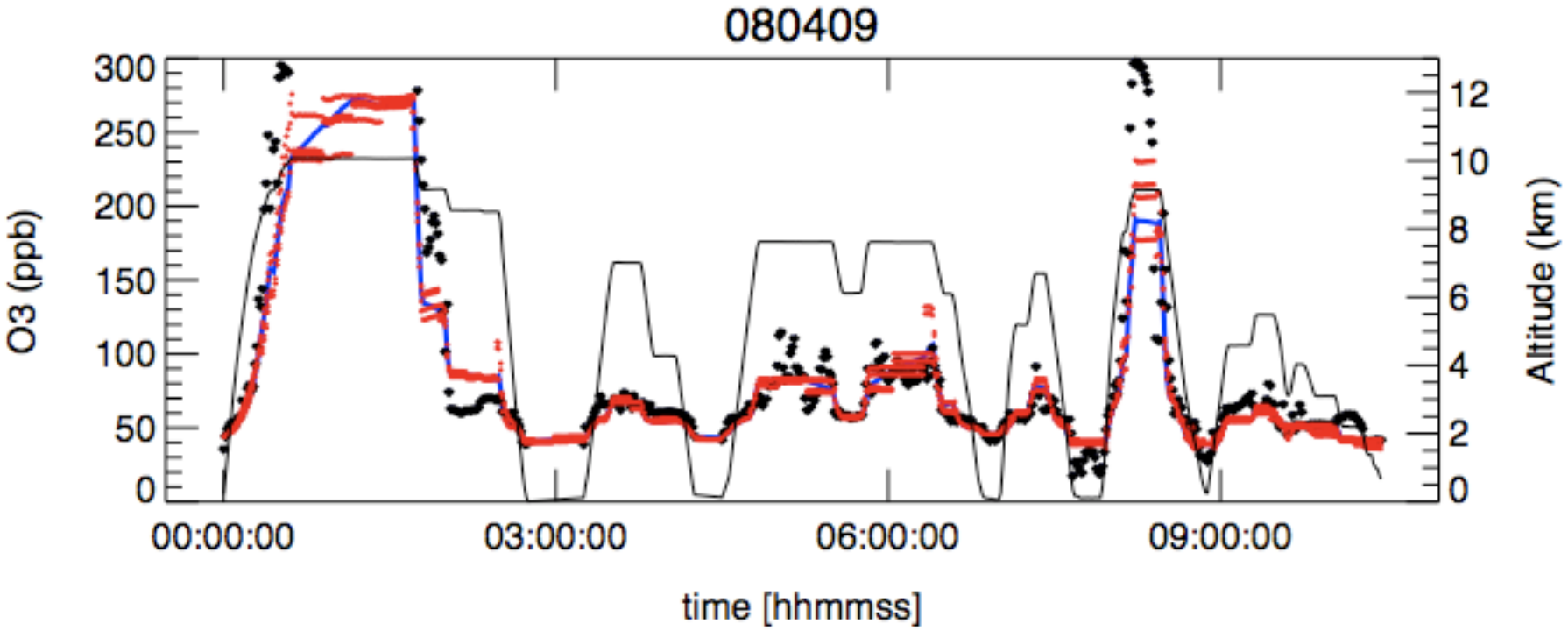
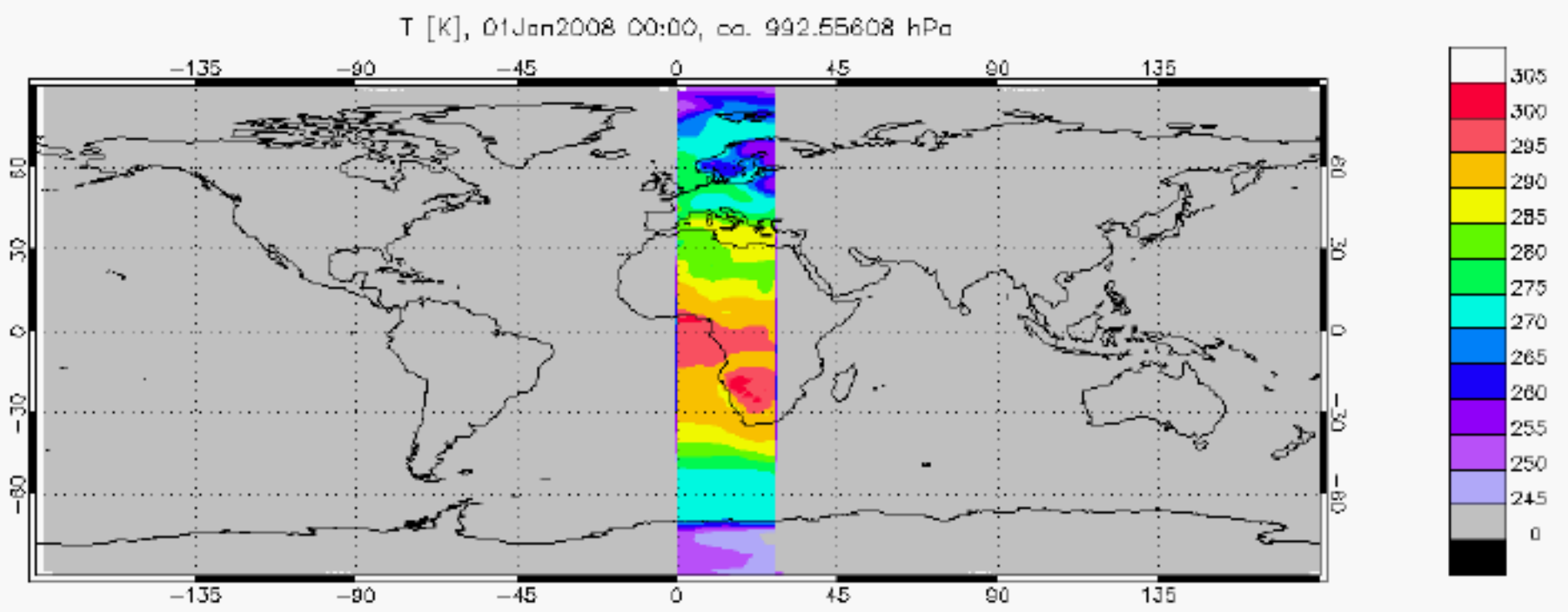


Local Time Averaging

Namelist settings:
avgflag_pertape = 'A','L'
fincl2 = 'Q','T','PS'
lcltod_start = 0,0
lcltod_stop = 0,7200



Updates

MOZART4 Chemistry: trop_mozart (103 species)

- Including HCN,CH_3CH + C_2H_2, HCOOH

Emissions in trop_mozart (thanks to Louisa Emmons)

- Anthropogenic: POET, with REAS over Asia (time-varying for 1997-2010; 1997 used for 1992-1996).
- Biomass burning: GFED-v2 - 1992-1996: avg of 1999-2007; 1997-2008: for each year/month; 2009-2010: FINN.
- Biogenic, soil, ocean, volcano: POET, GEIA, etc. as described in Emmons et al., 2010.

Improved Climatology for the Stratosphere (O_3, NOy, CH_4, CO)

Time dependent 3D chemistry sources aircraft emissions

Questions?