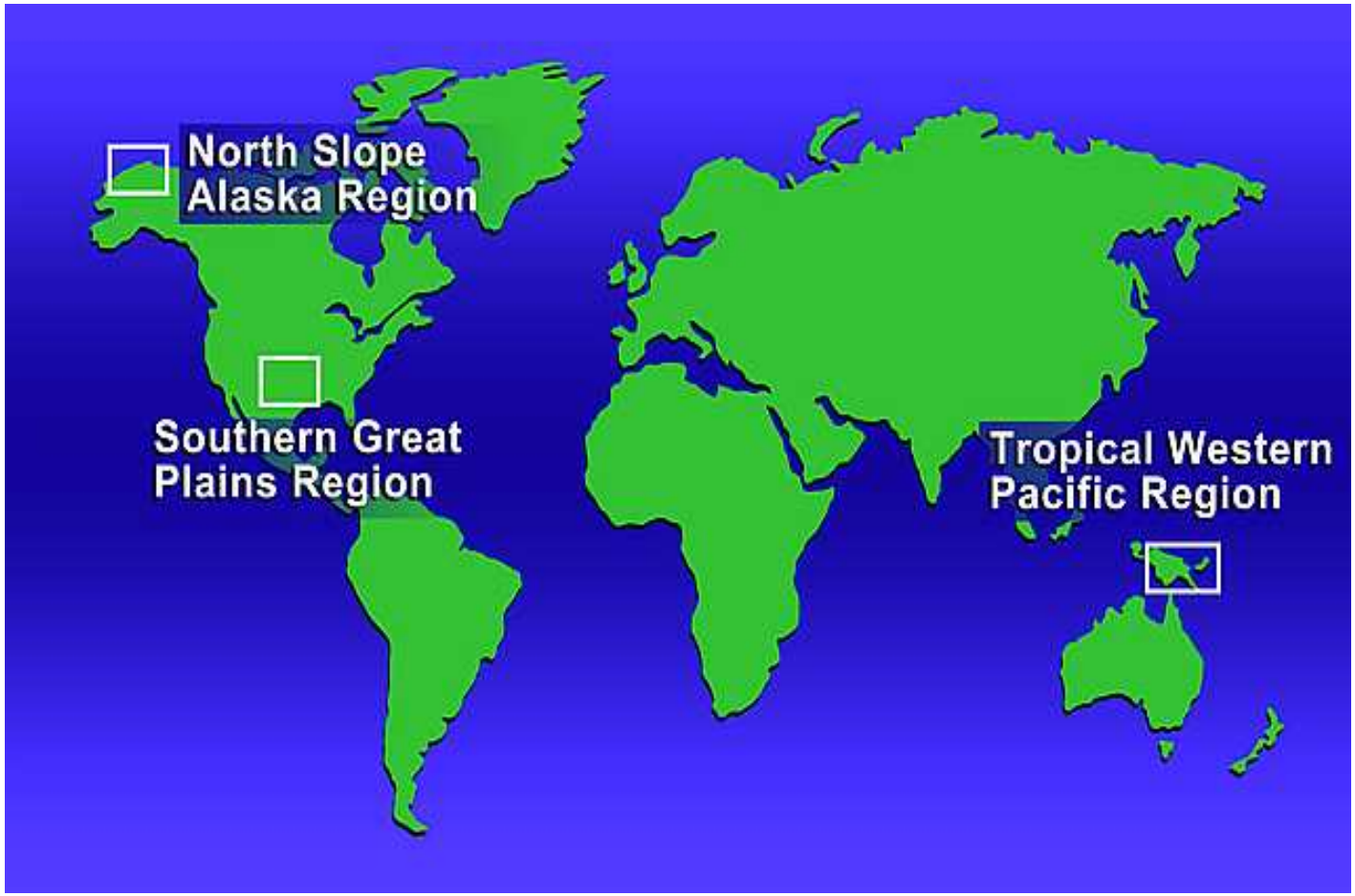
SAND2010-1350C

Data Gathering and Analysis Task, and North Slope of Alaska (ARM) Projects

Atmospheric Systems Research
Annual Science Team Meeting
Monday March 15, 2010

ARM Climate Research Facilities (DOE/SC (BER)

Fixed ARM Climate Research Facilities and Regions



Three of Five Fixed Sites (Locales) Proposed Were Implemented

Atmospheric Radiation and Cloud Stations (ARCS)

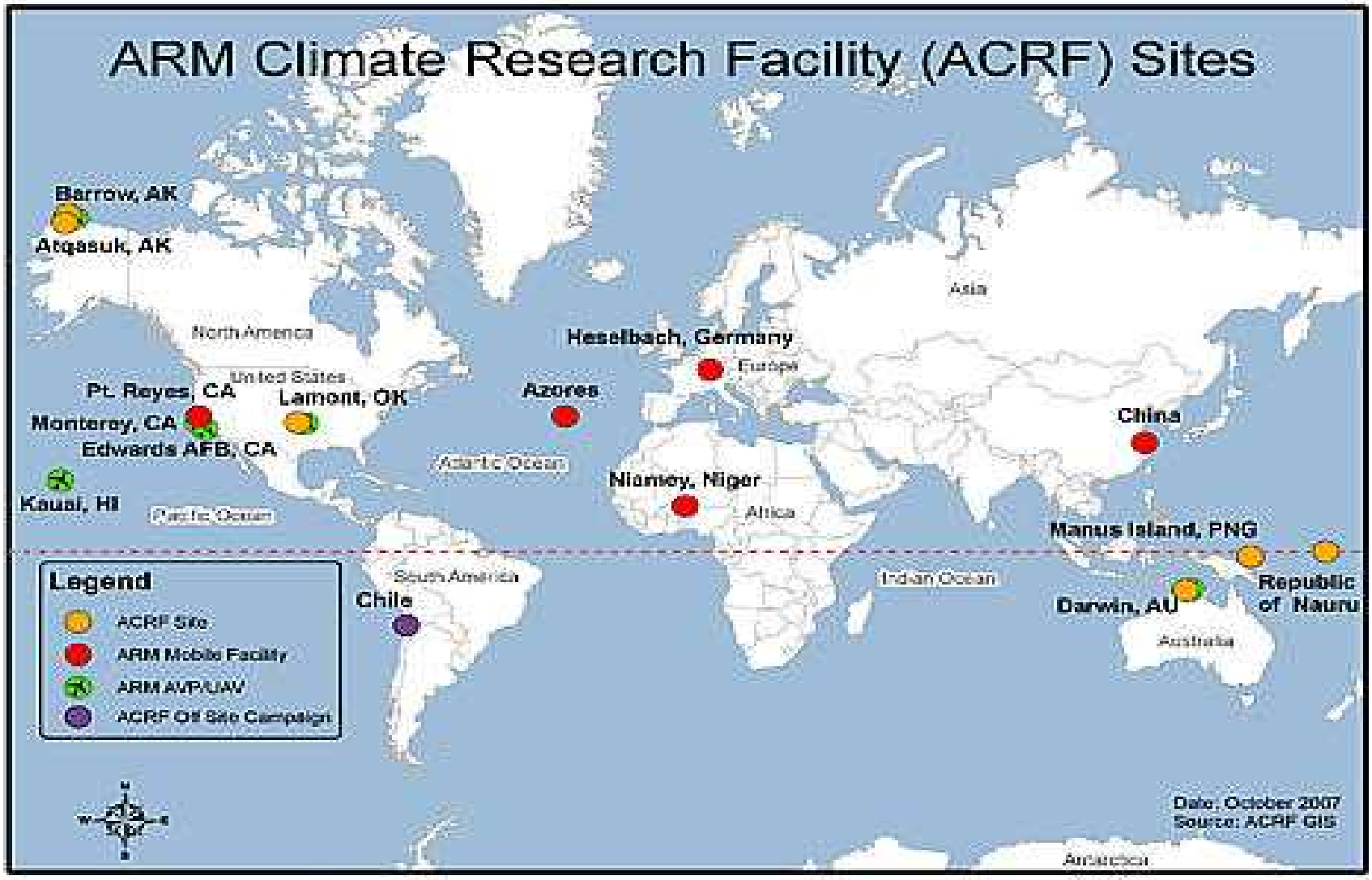
- With Tropical Western Pacific Management Team, Sandia Had the Lead Engineering Role in ARCS (1993-2000)

Papua New Guinea, ARCS Installation

Southern Great Plains Raman Lidar

- **Operational since September 1995**
- **Fully autonomous operation**
- **Nearly identical system to be deployed in Darwin, Australia later this year**

Mobile Sites and Field Campaigns



ARM Climate Research Facilities in Alaska

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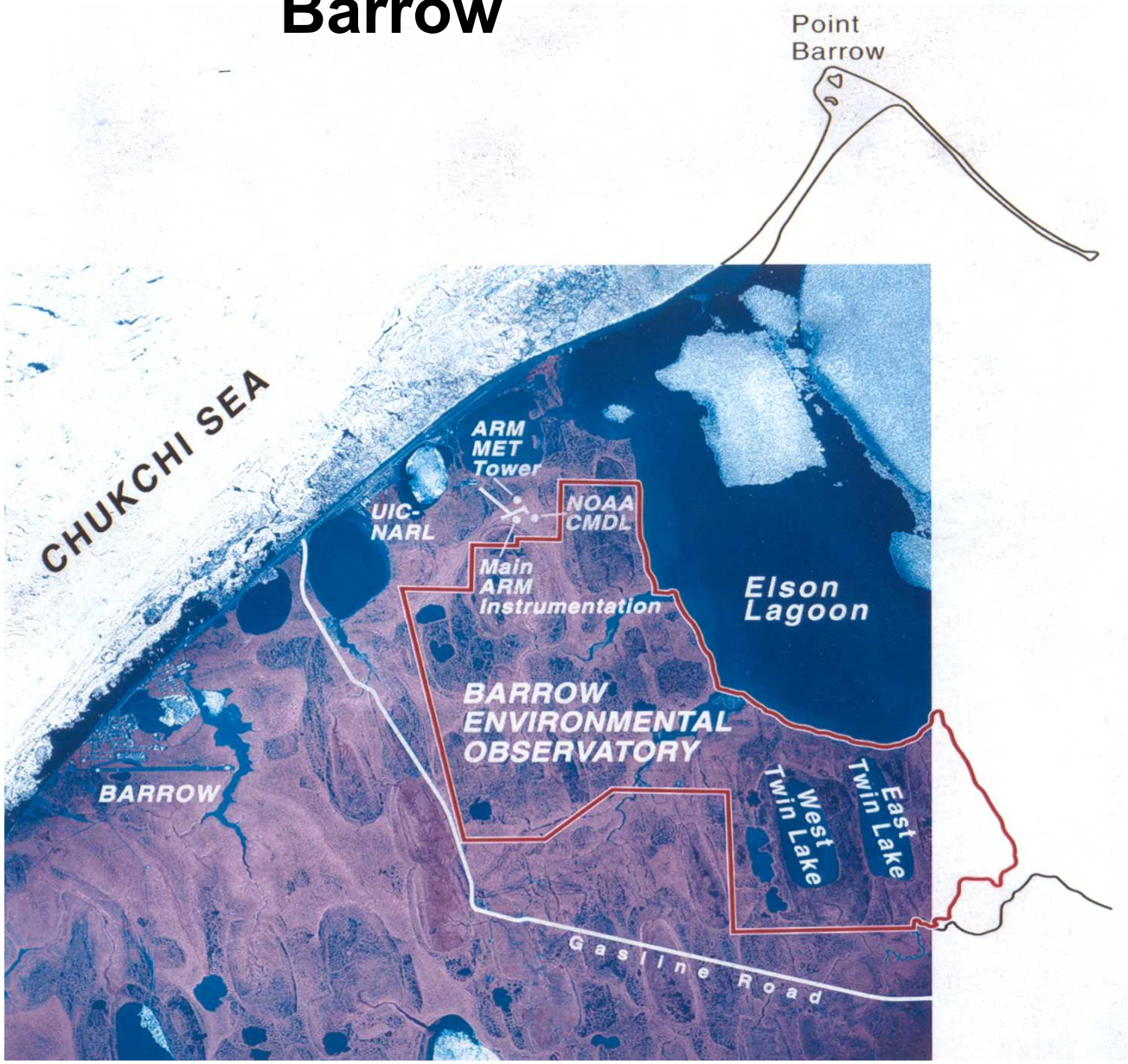
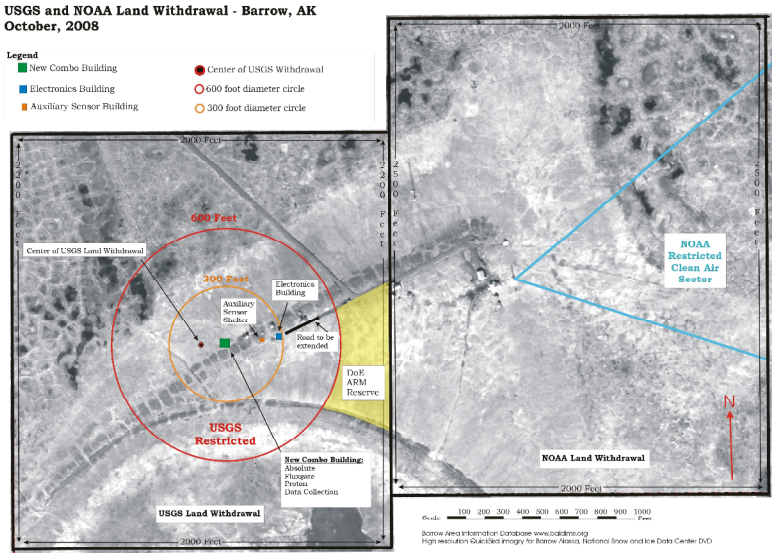
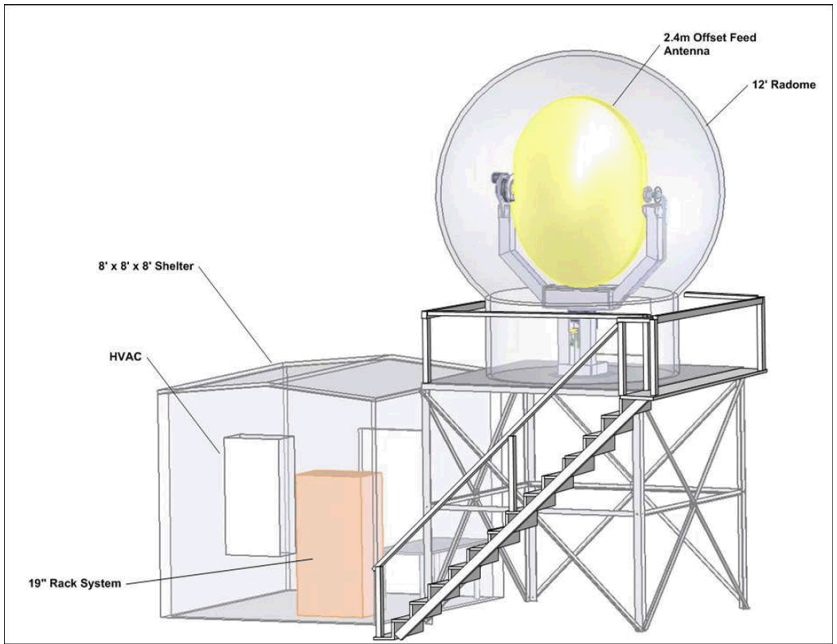
Barrow


Point
Barrow
CHUKCHI SEA
ARM
MET
Tower
UIC-
NARL
NOAA
CMDL
Main
ARM
Instrumentation
Elson
Lagoon
BARROW
ENVIRONMENTAL
OBSERVATORY
BARROW
West
Twin Lake
East
Twin Lake
Gasline Road

Barrow ARM Climate Research Facilities
Existing Facilities and ARRA Additions





Categories of Instrumentation at Barrow

-Surface Meteorological Sensors
-Wind, Temperature and Humidity Profilers
-Cloud Observation Instrumentation
-Downwelling Radiation Sensors
-Upwelling Radiation Sensors
-Aerosol Instrumentation
-Gas Instrumentation

*About 70 sensors in all, including radars, lidars, spectrometers, imagers, etc. etc.

Recovery Act-Funded Additions to North Slope ACRF

New Instruments and Systems

- X-band Scanning Precipitation Radar – dual polarization, doppler
- Dual Frequency W-band and Ka-band Scanning Cloud Radar
- High Spectral Resolution Lidar
- Automatic Balloon Launcher
- Eddy Correlation Flux Systems

Upgrades and Replacements

- Ceilometer
- Atmospheric emitted radiance interferometer
- Millimeter Cloud Radar
- Micropulse Lidar

NNSA Tri-Lab Atmospheric Carbon Measurements, Data Gathering and Analysis

- Collaboration with Lawrence Livermore and Los Alamos National Labs
- Sandia received 1/3($5 M) + $930 K for FY10 for Data Gathering and Analysis Task
- Develop Greenhouse Gas Measurement, Analysis, Attribution Capabilities
- Three Field Campaigns Planned in Calendar 2010
  - Los Alamos
  - Southern Great Plains
  - Four Corners, New Mexico

Atmospheric and Terrestrial Mobile Lab

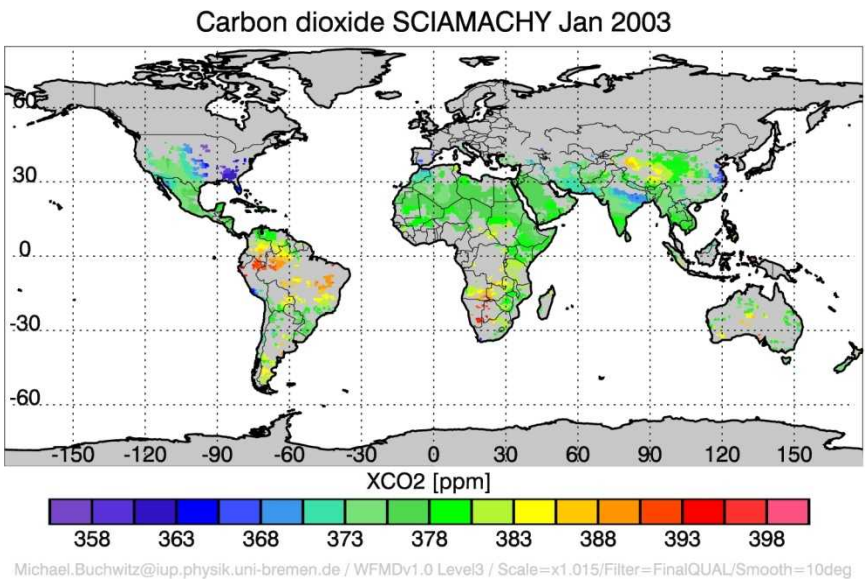
Atmospheric and Terrestrial Mobile Lab (ATML)

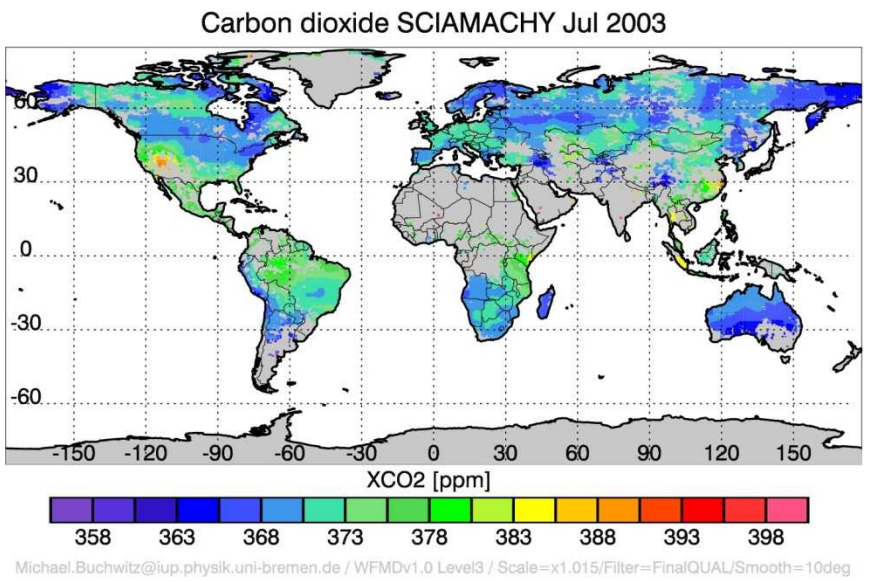
- Air sampling system
- Flask sampling system
- Fast isotopic carbon dioxide analyzer
- Carbon dioxide, methane, water vapor analyzer
- Water vapor and liquid water isotopic analyzer
- High-stability isotopic carbon dioxide analyzer
- Fourier transform spectrometer
- Eddy correlation flux system
- Air Quality instruments (NOx, SOx, CO, Ozone)
- Aerosol sampler
- Meteorological instrumentation
- ACRF-compatible data system and communications
- Portable tall tower system (tethersonde)

BER DGA effort for creating column GHG baselines (CO_2, N_2O) from satellite data.

Subtask Goals:

- Develop a CO_2 retrieval algorithm for GOSAT and OCO type sensors.
- Produce a GHG baseline for CO_2, CO, and NO_2 for the Farmington, NM area using SCIAMACHY derived products





Four Corners Power Plant

- Location: 15 miles west of Farmington, N.M.
- Description: Five coal-fueled generating units
- Capacity: 2,040-MW from five units

DGA Task Will Enhance or Build Capabilities Needed for Greenhouse Gas Treaty Verification

- In-situ and point greenhouse gas measurements
- Airborne measurements
- Satellite measurements and scaling to ground
- Inverse modeling and source attribution

Inference of CO2 fluxes

- Estimation of anthropogenic CO2 fluxes from openly available measurements

- Sources of data: Concentration measurements
  - Satellites (column-averaged [CO2] measurements); 10km x 80 km resolution (GOSAT)
  - Ground/flask measurement networks (~ 250 sites worldwide); some direct flux measurements
  - Airborne measurements

- Challenges in estimating anthropogenic CO2 fluxes
  - Need fine resolution; much more than biospheric CO2 fluxes
  - CO2 fluxes are seasonal; inverse problem for a non-stationary source.

Current status of CO2 inversion technology

- Global-scale inversion techniques developed mostly for *biospheric* CO2 fluxes
  - Some work done on CO and NOx fluxes
- Resolutions achieved in the inference
  - Spatial: ~ 500km, sufficient for biospheric fluxes, but not anthropogenic
  - Temporal: Mostly monthly, some weekly
- Techniques used:
  - Ensemble Kalman filters for sequential data assimilation; Bayesian inference under multivariate Gaussian distribution assumptions
- Limitations:
  - No attempt to assimilate satellite and ground measurements simultaneously
    - halves the potential data stream
  - Inversion methods & codes are largely serial
    - limits inference resolution; not scalable to large data streams