

SCIENCE, POLICY & PINTER

.....
LESSONS FROM CLIMATE CHANGE

Ecosystems Engineering Seminar
Center for Environmental Fluid Dynamics
Global Institute of Sustainability
ASU

12 November 2008
William A. Sprigg



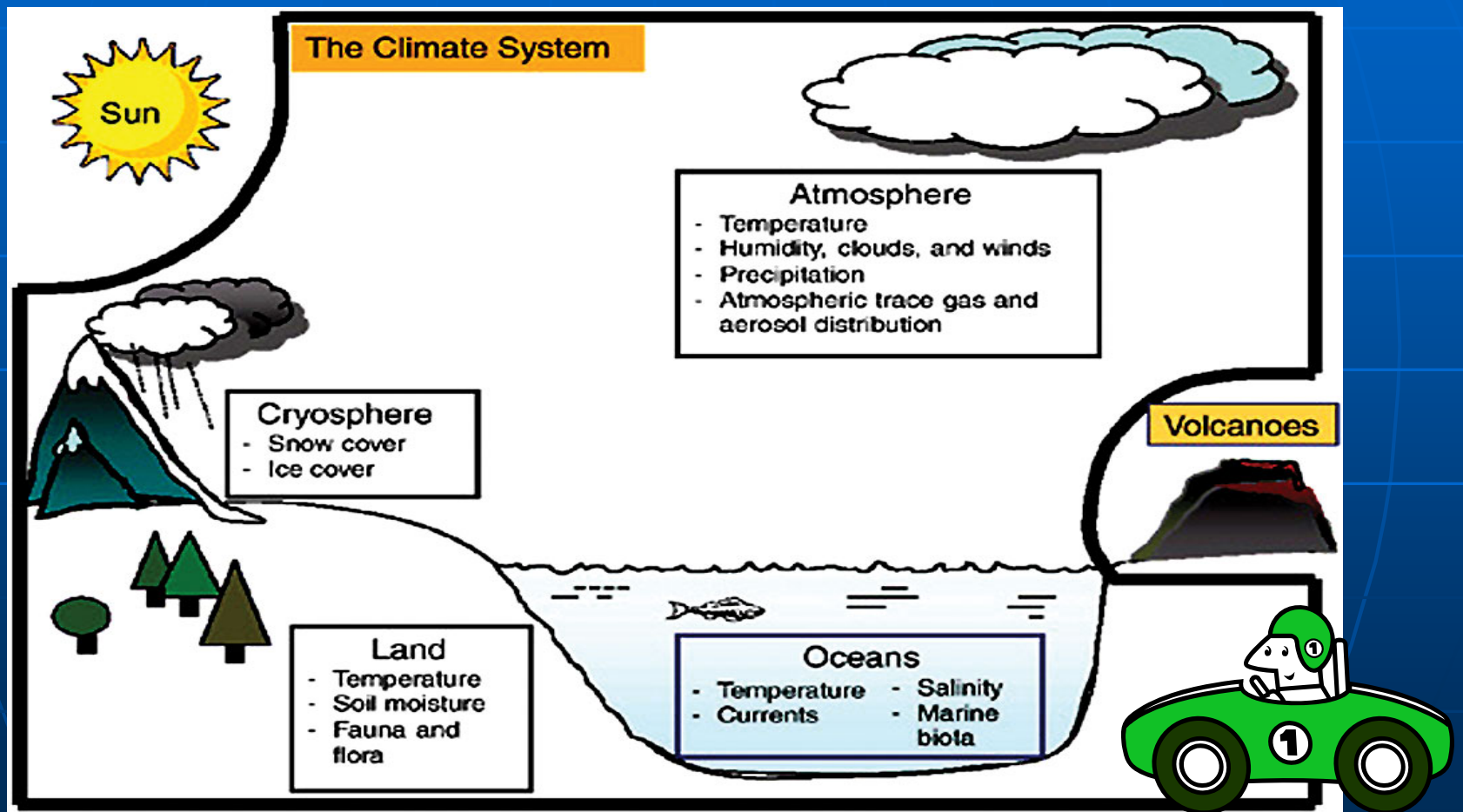
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Outline

- ❑ Climate Science – Center Stage in Economic & Energy Policy?
 - ❑ How, Why & In What Condition Did it Get There?
 - ❑ Acts of Brilliance,
 - ❑ Mistakes,
 - ❑ Confusion,
 - ❑ Disbenefit
 - ❑ New Directions?
- ❑ Lessons for the WMO Sand & Dust Storm Warning Advisory & Assessment System

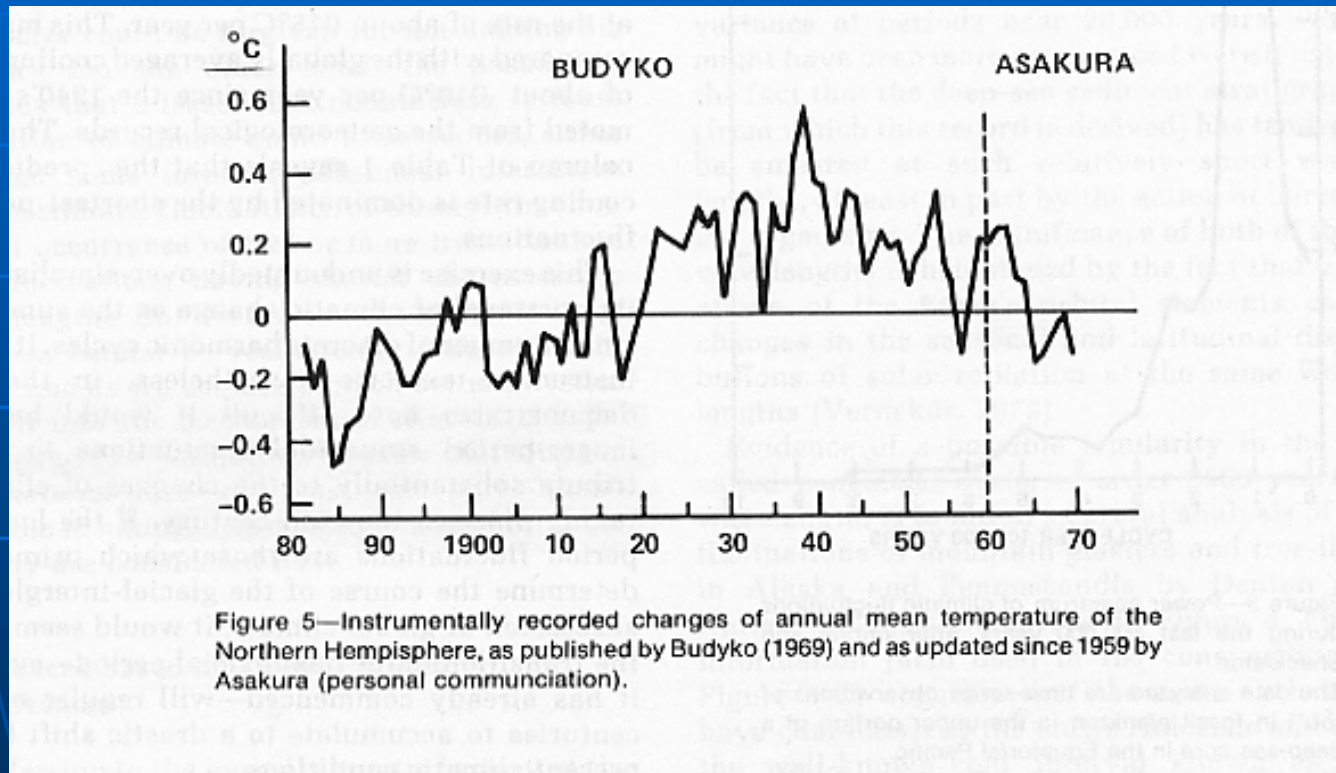
The Climate System



From National Research Council 2005

How Did Climate Get to Center Stage?

Science – Economics – Policy



**NH Mean Temperature -- FCST/ICAS Ad Hoc Panel on
The Present Interglacial (August 1974)**

How Did Climate Get to Center Stage?

Science – Economics – Policy

**AMERICAN WHEAT HELPS BUILD
RUSSIAN ARMIES 12 WAYS . . .**



By Schorn for the Los Angeles Herald

How Did Climate Get to Center Stage?

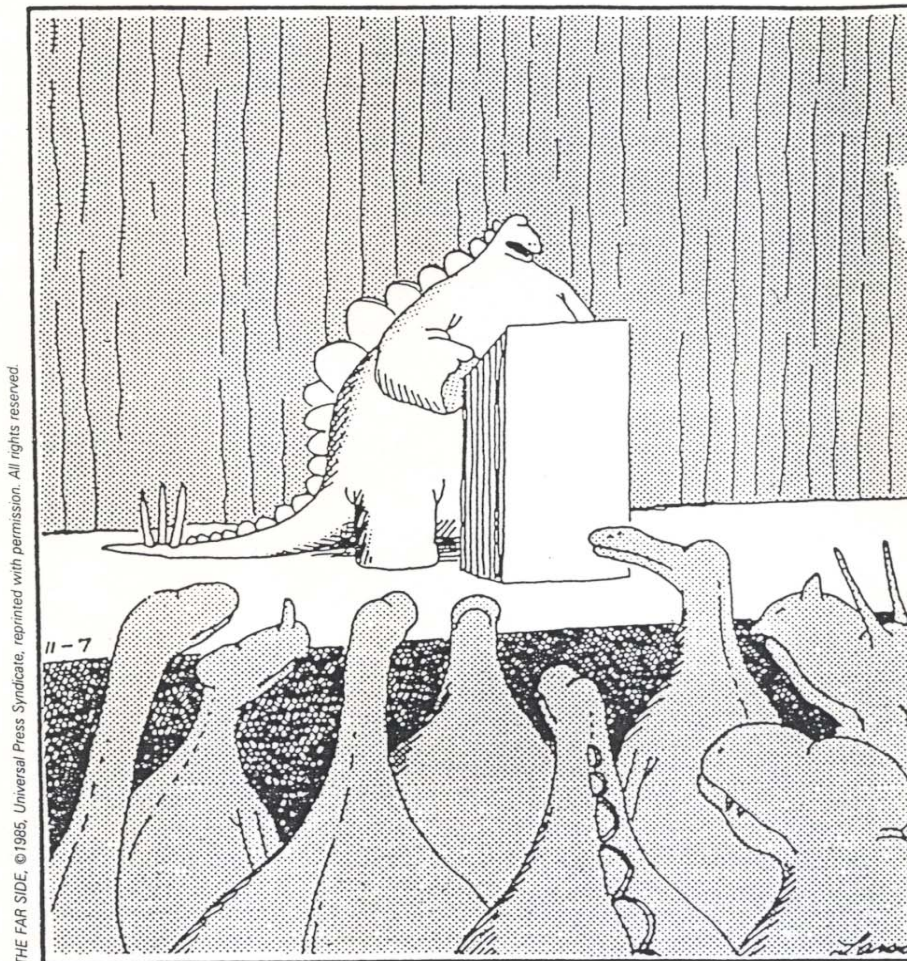
Science – Economics – Policy

- Kukla-Matthews letter to President Nixon .. December 1972
- Federal Council for Science and Technology/Interdepartmental Committee for Atmospheric Sciences report .. August '74
- Domestic Council report .. December 1974
- NAS, Understanding Climatic Change '75; NAS/OSB The Ocean's Role in Climate Prediction; WMO/GARP/JSC The Physical Basis of Climate and Climate Modelling
- U.S. National Climate Program '78, World Climate Programme '79
- Brundtland Report, *Our Common Future*, '87
- Intergovernmental Panel on Climate Change, est. '88 – '90, '95, '01, '07
- Global Change Program '89
- UN Conference on Environment & Climate '92
- Kyoto Agreement '97
- G-8 Nations' Priority 2006
- Nobel Peace Prize 2007 -- IPCC & Al Gore
- US-USSR Cold War Collaboration
- China-US Cooperation 1982 –
- Boon to Environmental Science



How Did Climate Get to Center Stage?

Science - Economics - **Public Awareness** → **Policy**



"The picture's pretty bleak, gentlemen . . . The world's climates are changing, the mammals are taking over, and we all have a brain about the size of a walnut."

How Did Climate Get to Center Stage?

Science – Economics – Policy

- Progress, Growing Public Concern & Money
 - 1972- \$88 million
 - 1982- \$141 million
 - 2002- \$2.77 billion
 - 2008- \$1.86 billion

... for the U.S., alone

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IPCC, *Climate Change 2007, Synthesis Report, Summary for Policymakers*

There is *very high confidence* that the net effect of human activities since 1750 has been one of warming. Most of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic GHG concentrations. It is likely that there has been significant anthropogenic warming over the past 50 years averaged over each continent (except Antarctica)

Nobel Committee, 12 October 2007

On awarding the Nobel Peace Prize to the IPCC and Al Gore ...

'... for their efforts to build up and disseminate greater knowledge about man-made climate change, and to lay the foundations for the measures that are needed to counteract such change.'

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- 3 Decades of Research & Scientific Evidence
- Assessments of Consequences of Climate Change
- International Government Support
- IPCC
- Nobel Committee

So, WHY ARE PROPOSALS TO “DO SOMETHING” ABOUT CLIMATE CHANGE A HARD SELL?

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So, WHY ARE PROPOSALS TO “DO SOMETHING” ABOUT CLIMATE CHANGE A HARD SELL?

Fear?

Disbelief?

Uncertainty?

- Science?
- Confusion?

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WE'VE MADE MISTAKES

Perceptions Ignored

Models are “Black Boxes”

Data “Inaccessible”

IPCC “Biased, Conflicted, Pushing Political Agendas”

Perceived Program Shortfalls

No “Tiger Teams”

Reproduceability, Tenet of Science “Ignored”

“Alternative Ideas Unwelcome & Held to Higher Standard”

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And **MISTAKES** in

Communication

Confusion

Uncertainty

Lead
To ...

Disbenefit

Conservative
(Ineffective?)
Response

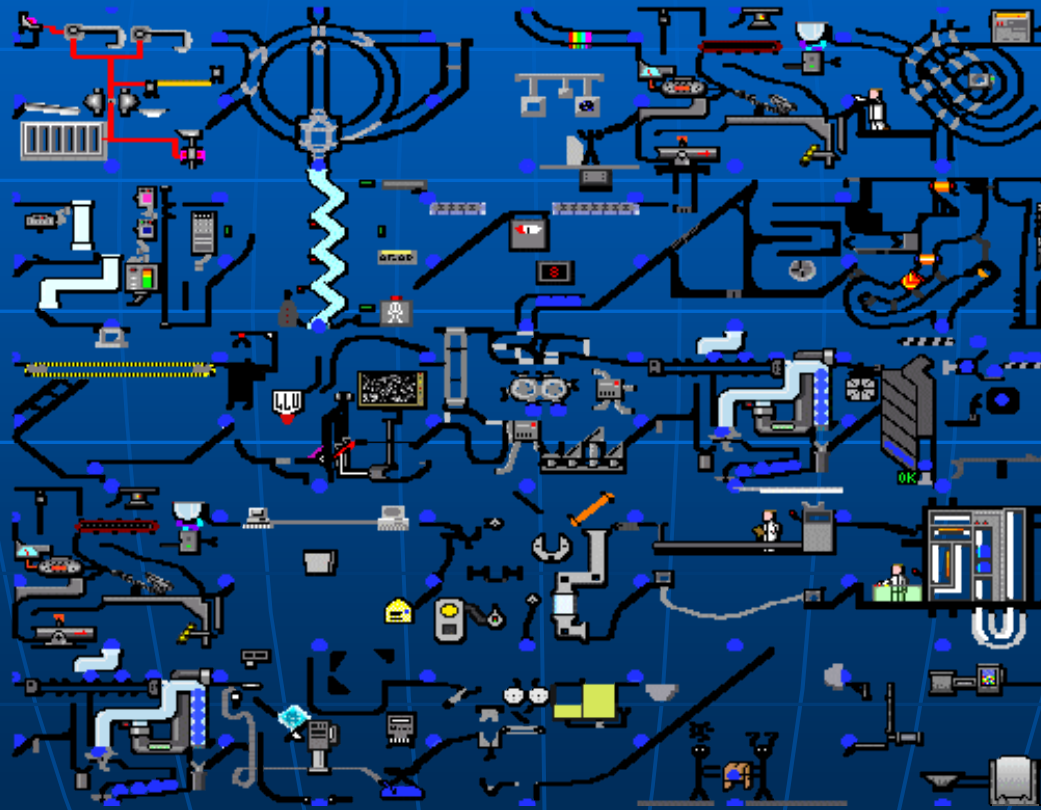
Radical Acts
& Greater
Harm

Our Dilemma ... "There are no hard distinctions between what is real and what is unreal, nor between what is true and what is false...As a writer I stand by this but as a citizen I cannot. As a citizen I must ask: What is true? What is false?"

Harold Pinter, 1958

And, Uncertainties ...

A Planetary Emergency Addressed by Models of Human Behavior, World Economy and Global Climate



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New Directions

A Fresh Start for Climate Modeling

Given common opinion that the IPCC scientific assessment is essentially correct ... and

Any action [Do Nothing, Adapting or Mitigating [including geo-engineering] will cost trillions of \$US. *

*Bruce Stram, Nebojša Nakićenović, Dec.2007, Analyzing Papers of Nordhaus, Stern, et al.– WFS Invited Papers, Climate/Energy Review, Pontifical Academy of Science, The Vatican

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Stimuli for New Directions

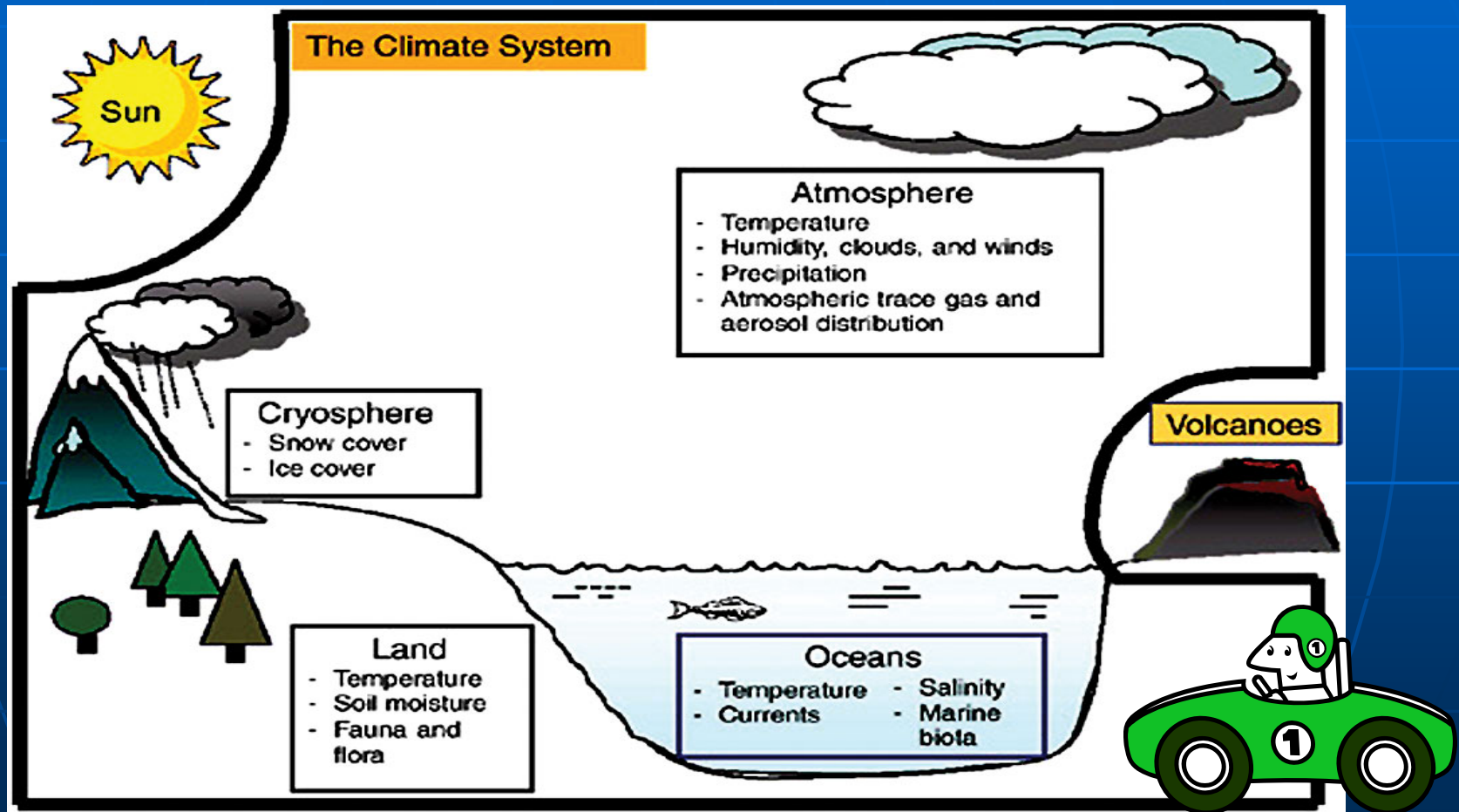
A Fresh Start for Climate Modeling

Regional Arable Soil Loss, Fresh Water Supply Threatened, Pace of Agriculture Questioned, Refugees & Sustainable Development, Plant & Animal Disease, ... all can be caused, exacerbated or improved with climate change

What is the "Tipping Point" for using "Geoengineering?"

Confidence in Decision Making Begs Less Uncertainty in Climate Models: What is Changing in Climate? Where? How Much? How Fast? and Why?

The Climate Challenge: Reduce Model Uncertainty



From National Research Council 2005

New Directions

A Fresh Start for Climate Modeling A World Climate Centre

- State-of-Technology Computer*
- Leaders in Science & Computer Technology
- Address perceived "mistakes"
 - Principally non-government funding

** Conclusion of Meeting of Experts, ECMWF, 6-9 May 2008*

New Directions

A Fresh Start for Climate Modeling A World Climate Centre

Program (page 1 of 2):

- Model Building, Operations & Maintenance **in a Glass House** ... simulating and predicting climate ... testing theories & methods
- Modeling & Computing Methodologies
- Theoretical Problems
- Strategies for Next-Generation Modeling/Computing Systems
- Model Experimentation (Reproducibility)
- Evaluation (Tiger Teams)

New Directions

A Fresh Start for Climate Modeling A World Climate Centre

Program (page 2 Of 2):

- **Ethics of Science (Open Access to Data & Models)**
- **Assessment of Adaptation, Mitigation & Geoengineering Strategies**
 - will they have the intended effect?
- **Assessment of Observation Systems & Field Experiments**

Annual Costs: (\$US) 130 Million*

* Approximate NCAR Budget; FY'08 US/CCSP \$1.86 Billion w/\$279.0 Million for models; NSF/CCSP \$221 Million

THE NEW YORK TIMES,
THURSDAY, FEBRUARY 6, 1936

*Wallace Has a Thrust
For Government Methods*

By The Associated Press

WASHINGTON, Feb. 5.—The Weather Bureau has enlisted aid of experts from several universities in starting a study of long-range forecasting.

Secretary Wallace reported this today, but added:

"They probably won't get anywhere, though.

I have an idea that if the American Telephone and Telegraph Company were running this country, it would spend \$1,000,000 a year on long-range weather forecasting research. We will probably spend \$1,500."

Tells of No
So Strong

By Th.

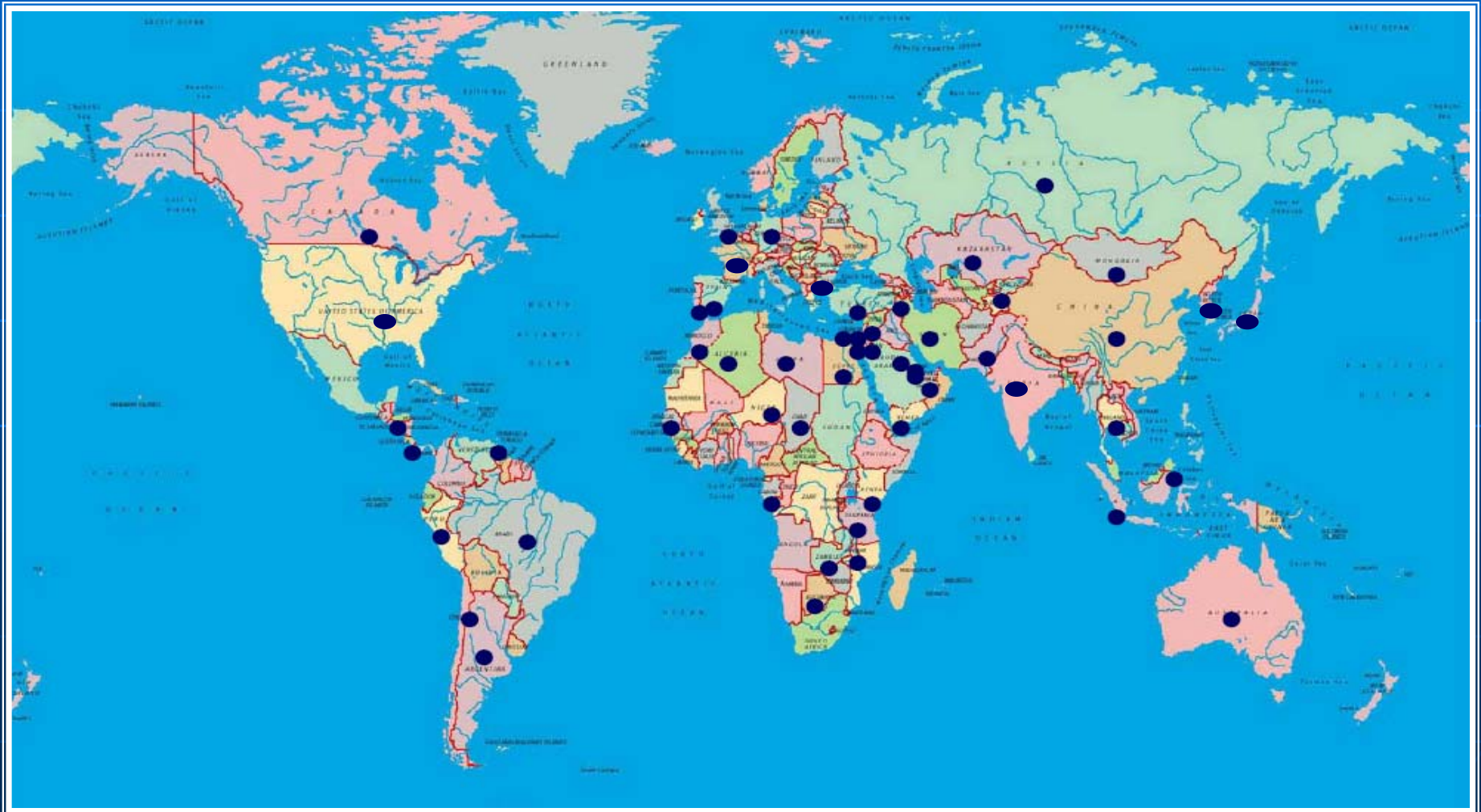
WASHINGTON

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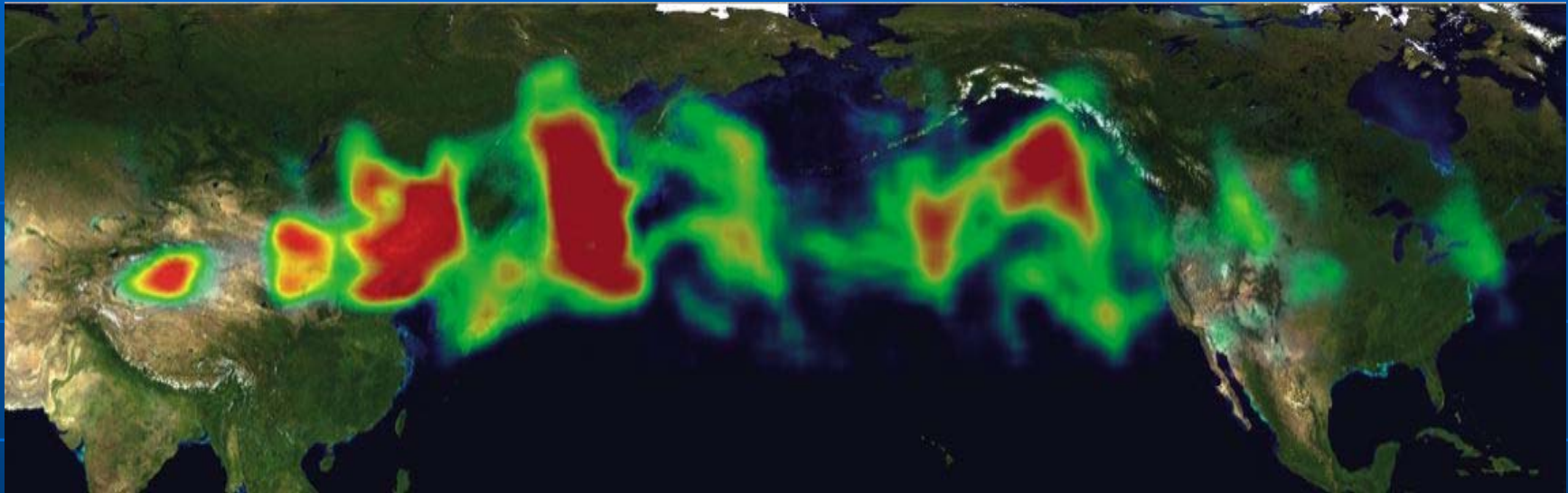
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WMO Survey of Interest Addressing Sand & Dust Storms



Asian Dust Over North America



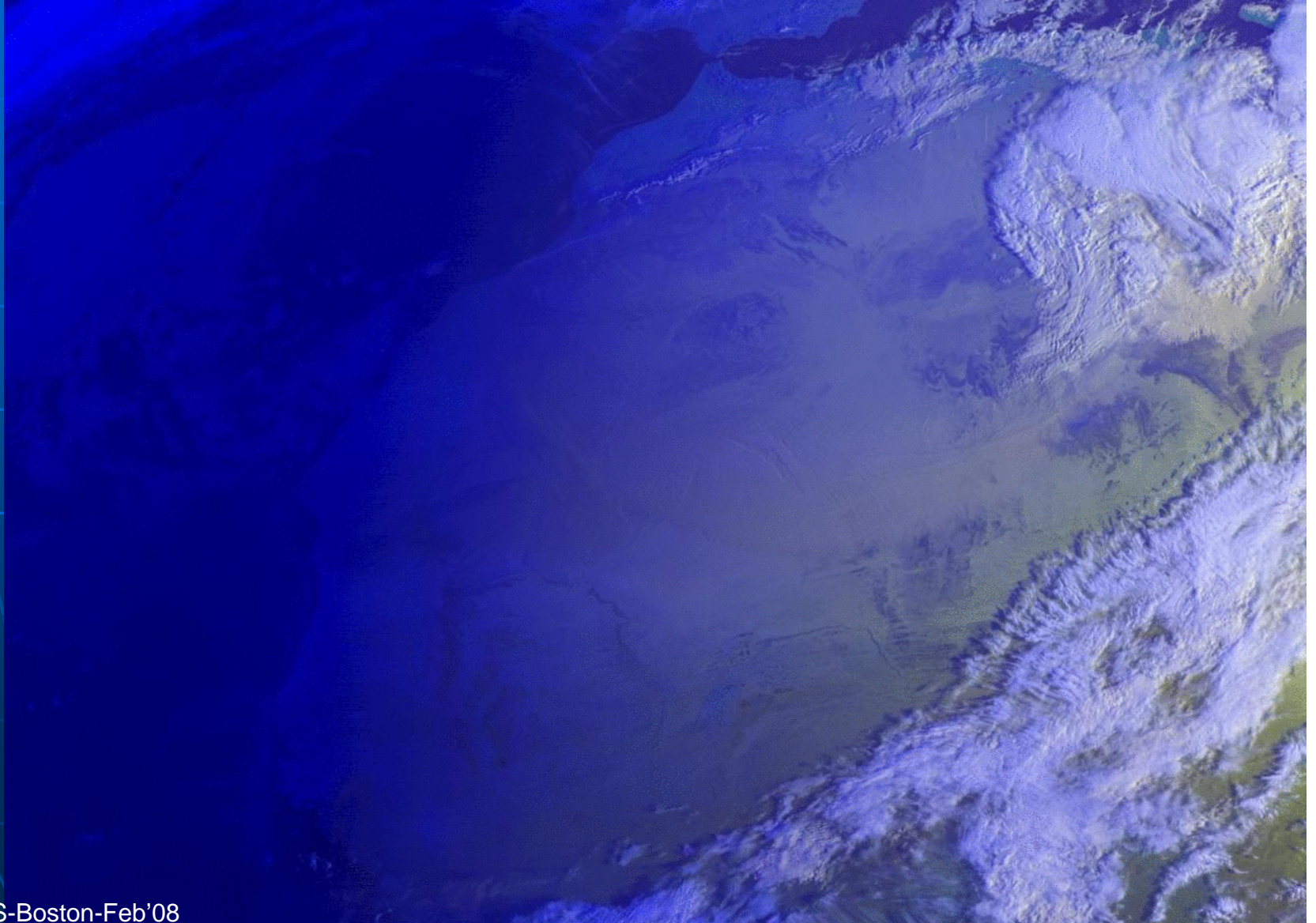
**Satellite-derived Aerosol Optical Depth Over Several Days
in April 2001 (a NASA composit)**

*Saharan Dust Storm
3-4 March 2004*

Courtesy: World Meteorological Organization's Sand & Dust Storm Centre, Barcelona

EU
Meteo
Sat

15-min
time
steps



Meningitis in Africa



Meningococcal meningitis occurs worldwide but especially so in dry Sub-Saharan Africa: the "African meningitis belt", including Nigeria, Burkina Faso, Mali, Niger, Chad, Cameroon.... 1996: 300,000 cases reported to WHO – 10.2% fatal

Valley Fever Endemic Zone



Hector and Laniado-Laborin, 2002

New Directions

Lessons for the WMO Sand & Dust Storm Warning Advisory & Assessment System

**Purpose: Deliver products useful in reducing
adverse effects of sand and dust storms**

World-Wide Sand & Dust Storm Detection

Model-Based Simulations & Forecasts

Measurements & Monitoring

Source Characteristics: Mapping & Monitoring

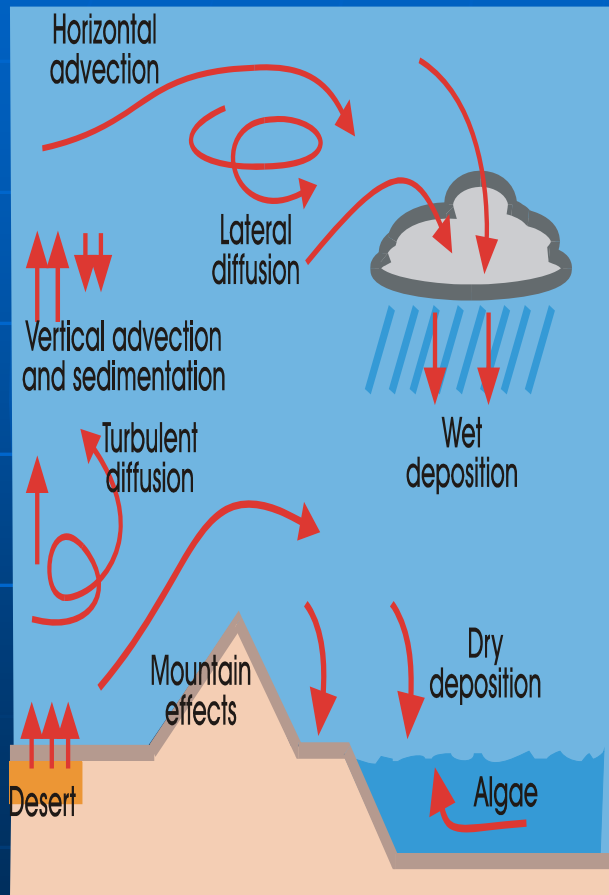
Information Access & Dissemination

Training & Technology Transfer

Regional Centres

- -- collaboration covers the globe
 - East Asian Centre (operational)
 - North Africa, Middle East, Europe Centre (operational)
 - Pan-American Centre (proposed)
 - Australia-Asia Centre (searching)

Quasi-operational DREAM

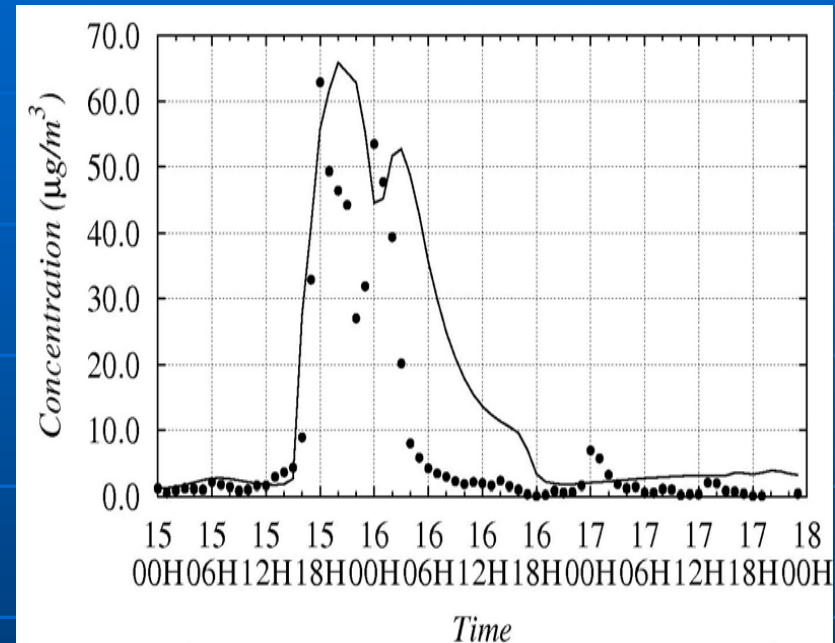
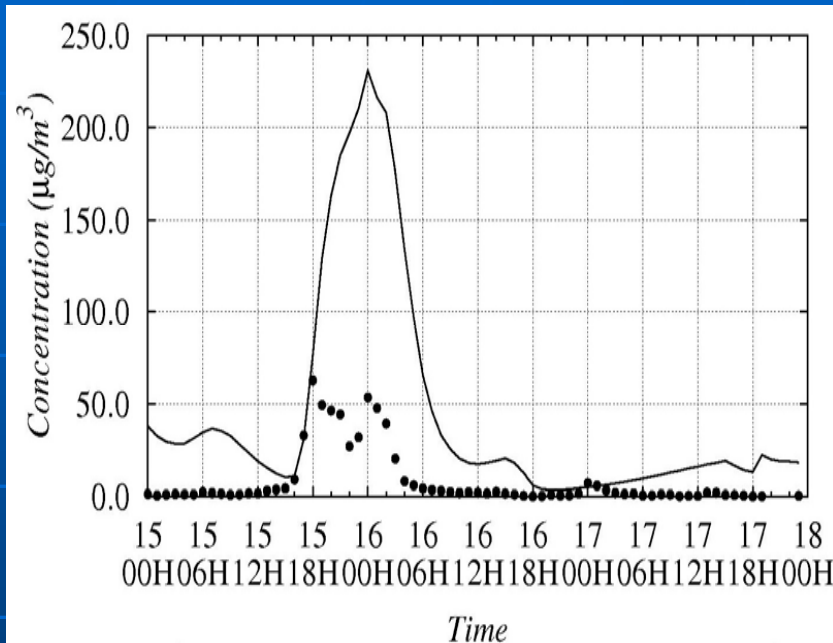


- Numerical, Dynamical Dust Generator 'DREAM'
- Driven In-Line by NWS Operational Models
- NASA - MODIS Dust Source Identification
- LIDAR & Satellite Model Verification
- EPA AIRNow Network Model Verification
- Choice of PM Size Distribution
- Client Selects Product
- Simulations of Past Events & *Future Scenarios*
- Up to 72-hr Forecasts (time, amount, duration)
- ZIP-code Resolution

...1st problem: source ID



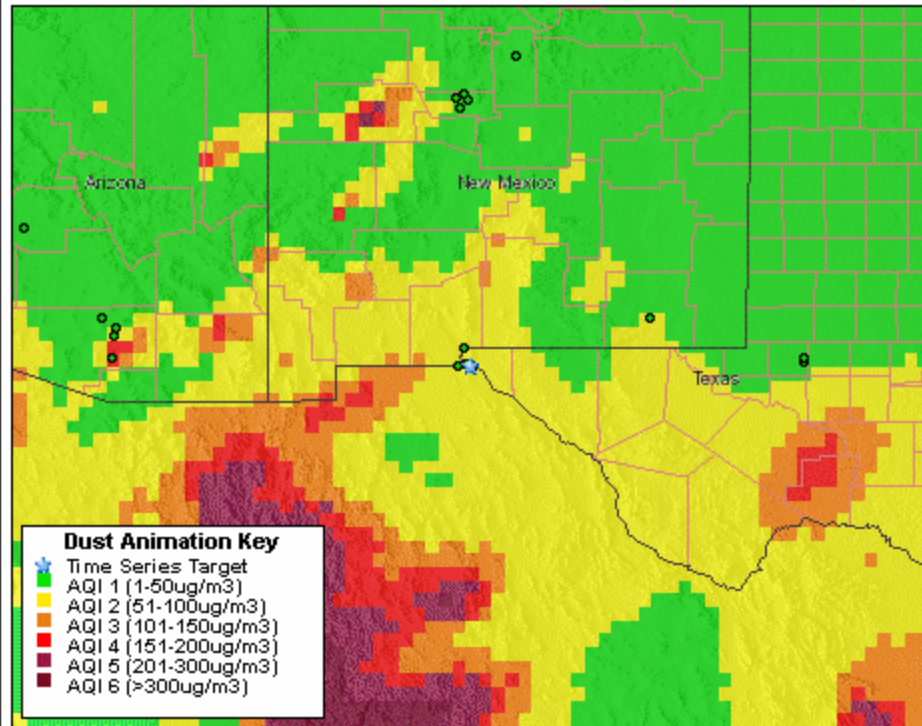
PHAiRS: Comparison of Modeled and Measured PM_{2.5} Concentrations at Odessa, Texas, Dec. 15, 2003



Left panel w/Olsen land surface; right panel w/NASA Satellite data: measured (dots) modeled (solid lines) N.B. different scales

PHAIRS Dust Animation Client

49 hr Dust Model for El Paso UTEP C12/C125/C151 (pm10) beginning on 04-23-2007 at 00:00:00 hours UTC

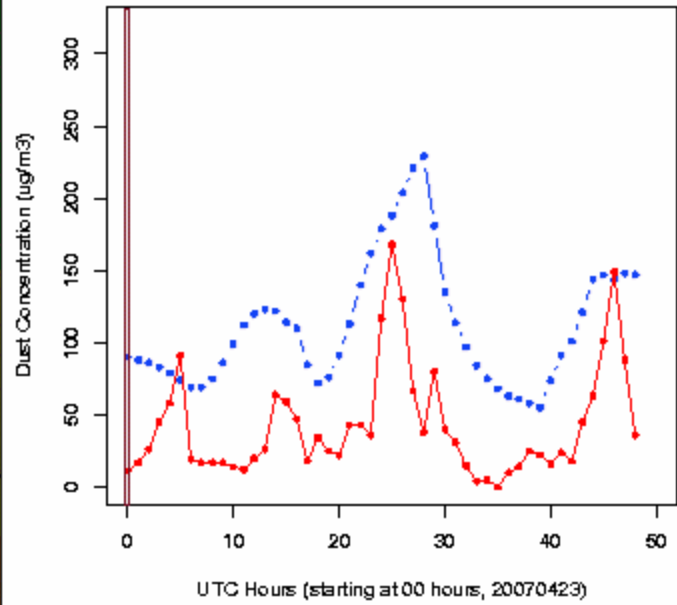


- Dust Animation Key**
- Time Series Target
 - AQI 1 (1-50ug/m3)
 - AQI 2 (51-100ug/m3)
 - AQI 3 (101-150ug/m3)
 - AQI 4 (151-200ug/m3)
 - AQI 5 (201-300ug/m3)
 - AQI 6 (>300ug/m3)

Control panel with buttons for Play, Stop, and a speed slider set to 200.

Date	UTC Time	Particle Size Class
04/23/07	00 hrs	pm10

Dust Concentration Plot



- DREAM Model Dust Concentration
- EPA AirNow Dust Concentration (when available)

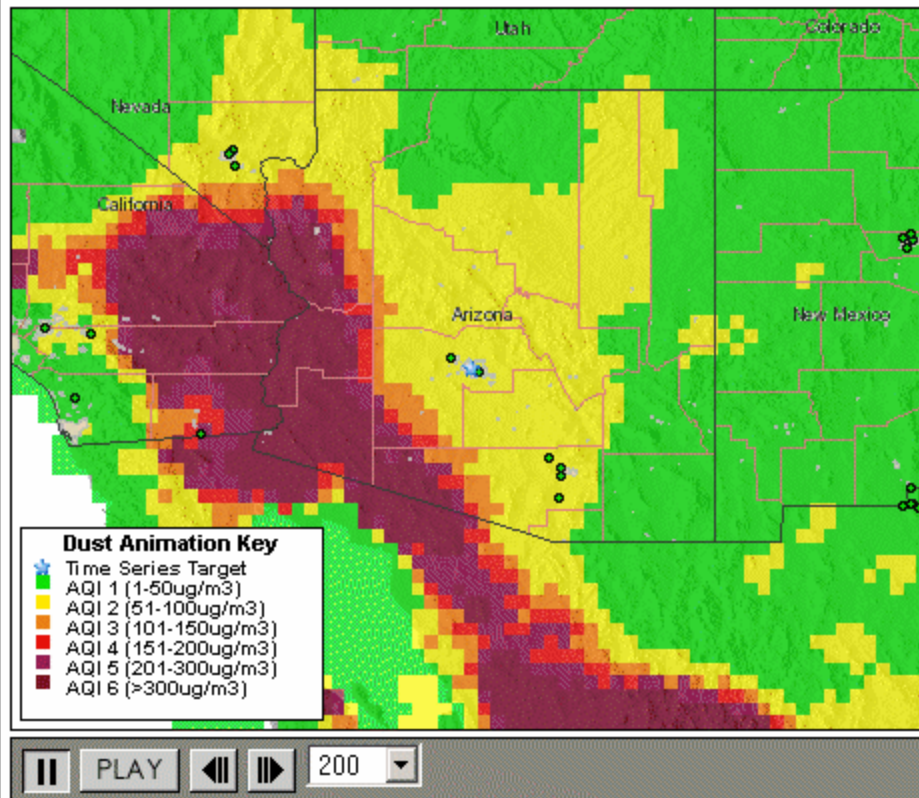
PM 10 DREAM (1:8,000,000 scale)
48-Hour Animation begins April 23, 2007, 00 hours UTC
El Paso (EPA AIRNOW Station), Texas (31:46:11N, 106:30:00W)
Animation prepared by W. Hudspeth, EDAC/UNM

..and, in July '07

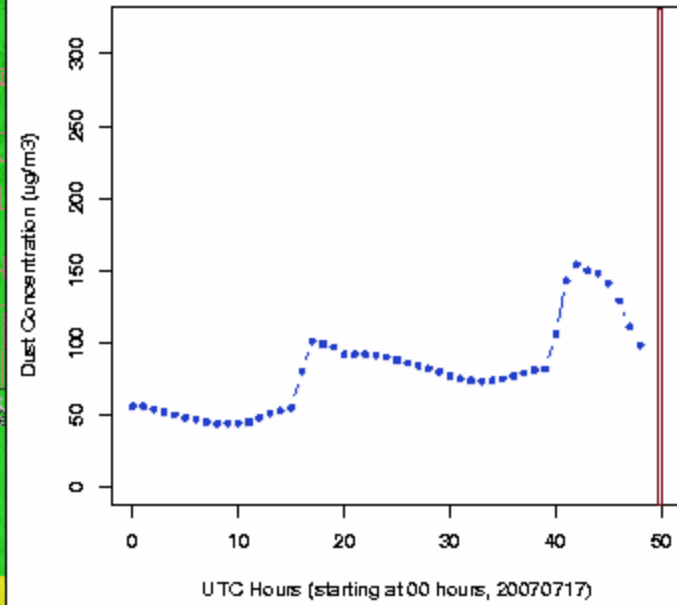


PHAiRS Dust Animation Client

49 hr Dust Model for Supersite (pm10) beginning on 07-17-2007 at 00:00:00 hours UTC



Dust Concentration Plot



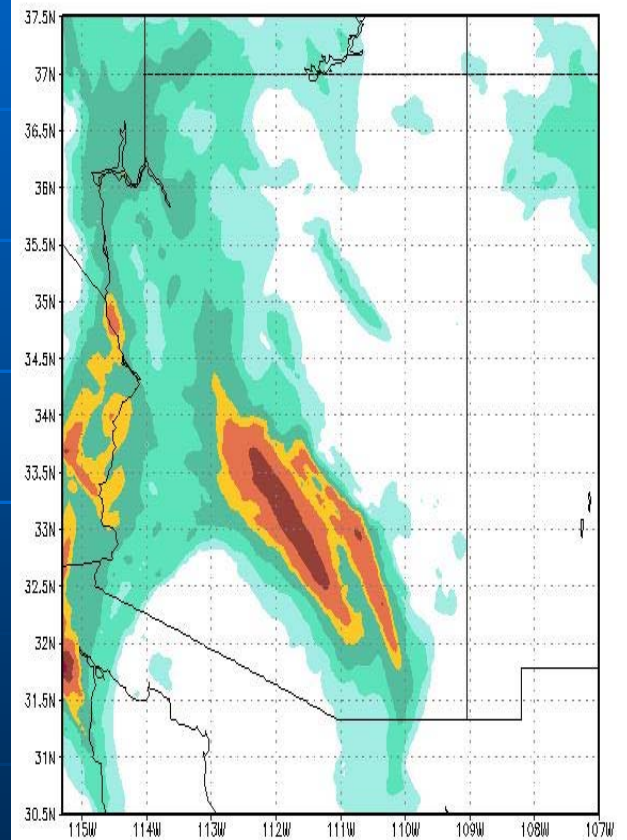
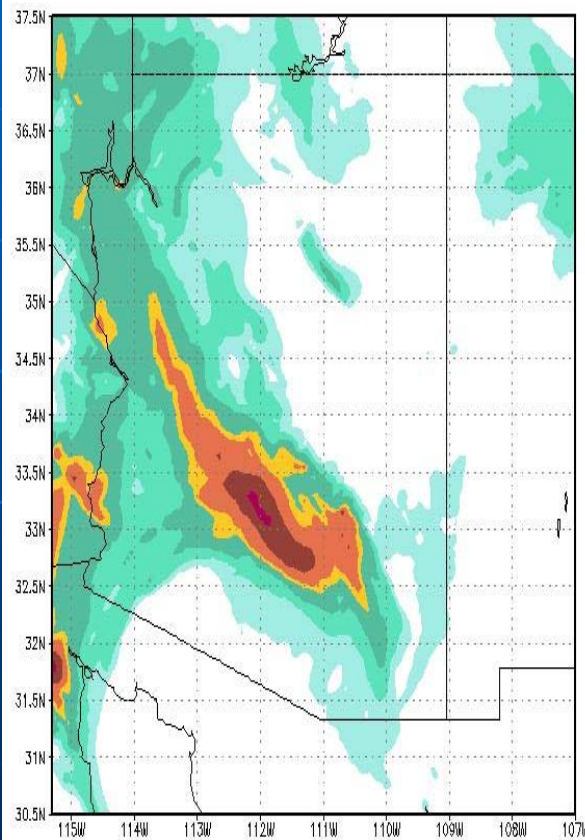
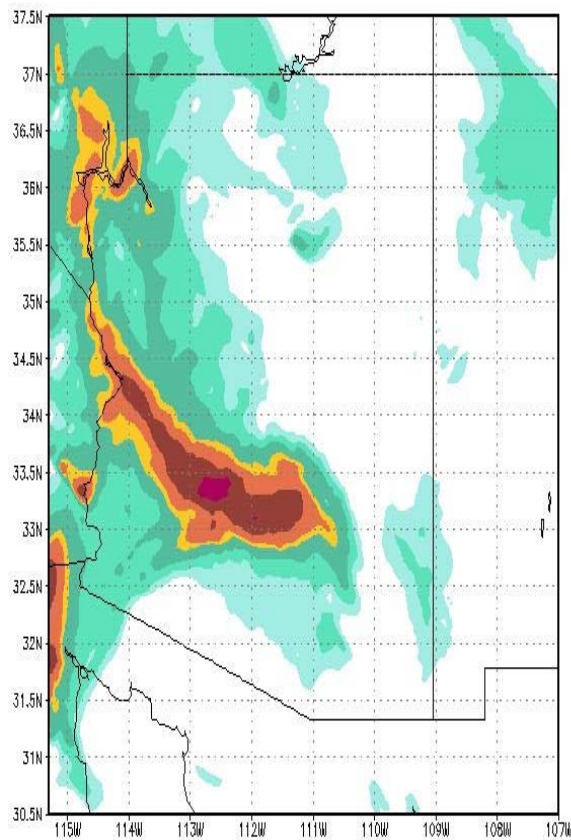
• DREAM Model Dust Concentration
• EPA AirNow Dust Concentration (when available)

Date	UTC Time	Particle Size Class
07/19/07	00 hrs	pm10

PM 10 DREAM Dust Animation (1:8,000,000 scale)
48-Hour Animation beginning on July 17, 2007, 00 hours UTC
EPA AirNow data unavailable
W. Hudspeth, K. Benedict PHAiRS Client Server



*18 July 2007 Early Morning
5 km Resolution Near Surface Dust Concentration*



Thank You!

Acknowledgements

To the NASA PHAIRS team:

UNM EDAC

- Stan Morain
- Amy Budge
- Karl Benedict
- Bill Hudspeth
- Tom Budge

UA

- Slobodan Nickovic
- Goran Pejanovic
- Brian Barbaris
- Patrick Shaw

.. and to NASA Earth Science Applications