

Research in the Earth System Science Division

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and Mary Jane Bartholomew

with contributions from P. Kollias, M. Miller,
S.Mitra, M. Reynolds, A. Rogers, A. Vogelmann,
L. Wielopolski and others

EENS Cross Talk

Brookhaven National Laboratory

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FACE GROUP

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*Reports to Creighton Wirick, Chair, Environmental Sciences Dept.
ES&H Coordinator and QA Rep: John Boccio and Pat Carr

Earth System Science Division

- ~ 20 scientists/research staff (small but growing)
- basic and applied research in ecology, biogeochemistry, plant physiology, atmospheric sciences, marine science and climate.

1. Soil Carbon Analysis

2. Plant/ecosystem responses to global change

3. NYC Urban Atmospheric Observatory

4. Clouds and climate science

A Rapid Non-Destructive Soil Carbon Analyzer

Lucian Wielopolski, Sudeep Mitra

- **Global warming is promoted by CO₂ emissions into the atmosphere but is also partially mitigated by carbon sequestration in the terrestrial ecosystem.**
- **A better understanding of the underground carbon processes is important for evaluating various strategies for carbon sequestration.**
- **Present techniques for measuring soil carbon are invasive, labor intensive and slow.**

- ❖ **Field instrument being developed is based on inelastic neutron scattering reactions with carbon in soil.**
- ❖ **Gamma ray detectors provide quantitative information on the carbon concentration by recording the characteristic gamma-rays that are emitted by it within picoseconds of interacting with a fast neutron.**



Lucian Wielopolski and Sudeep
Mitra

Results from Field Tests

	INS gC/cc	Chem. Analysis Mean gC/cc
Pine Stand (w,l)	0.099 ± 0.005	-
Pine Stand (w/o,l)	0.079 ± 0.005	0.073 ± 0.021
Oak Forest (w/o,l)	0.072 ± 0.004	0.085 ± 0.017
Sand Patch	0.026 ± 0.003	0.025 ± 0.002
Sandy Soil	0.091 ± 0.007	0.104 ± 0.019
Sand Pit (Cal.)	0.0	$0.0004 \pm$

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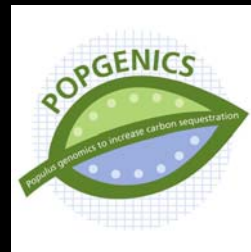
BROOKHAVEN
NATIONAL LABORATORY



Research Goal

To understand the mechanisms that underlie whole plant and ecosystem responses to global change

HERMES
Hierarchical Experimental Responses at Macromolecular to Ecosystem Scales

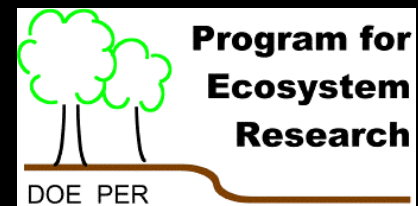


SoyFACE

Office of Science Mission

The PER goal is to understand - and be able to predict - effects of environmental changes associated with energy production on the structure and functioning of terrestrial ecosystems.

- Carbon dioxide concentration has risen by 30% and is predicted to rise an additional 50% by 2050
- Tropospheric ozone concentration has risen by 36% and is predicted to rise by 62%
- Temperature has increased by 0.6°C and is predicted to rise by 1.4 to 5.8°C



- SoyFACE (CO₂ x O₃)



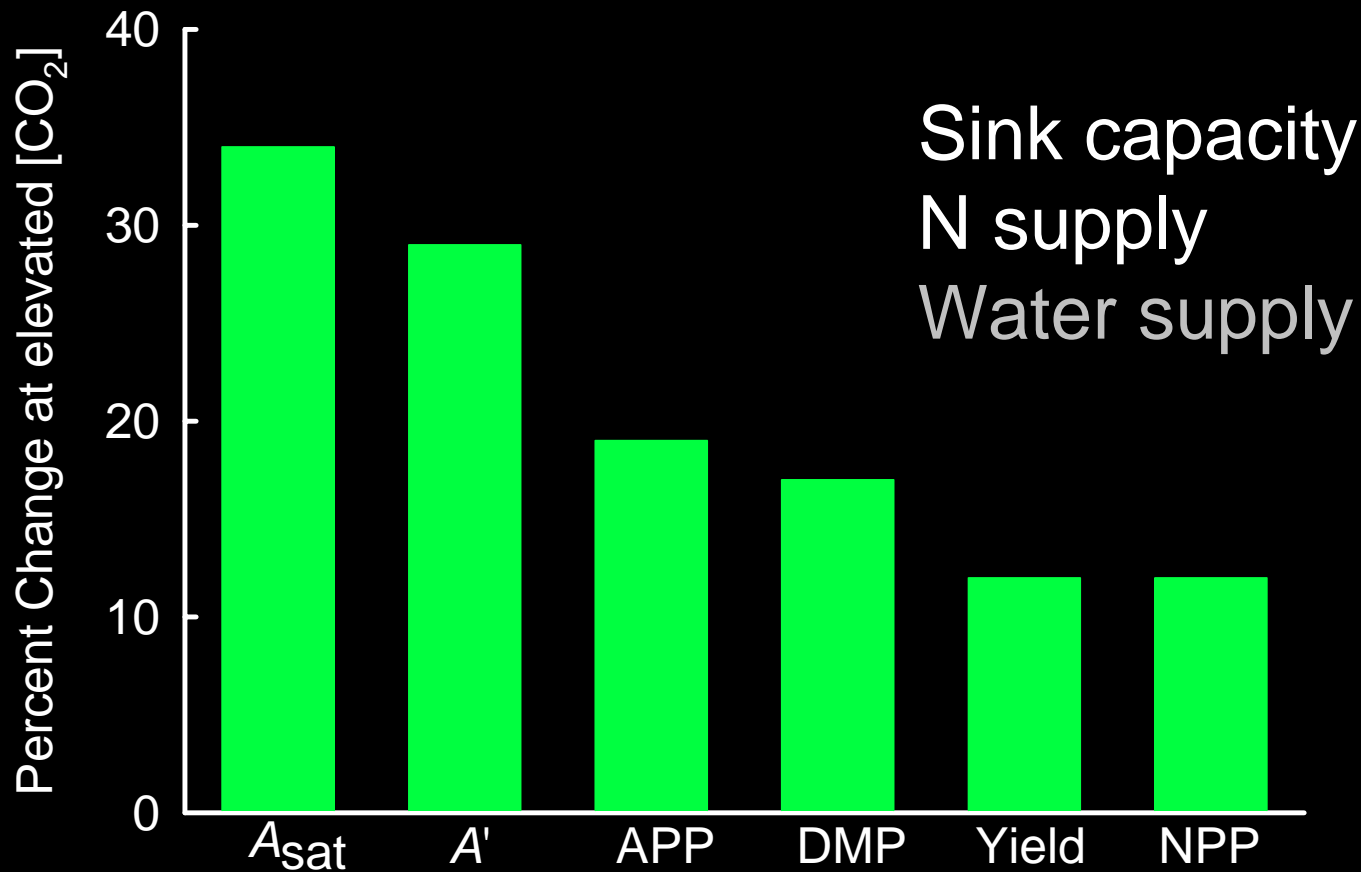
- AspenFACE (CO₂ x O₃)



FACE Free Air gas Concentration Enrichment

Allows 2050 atmospheric conditions to be simulated over crops and ecosystems in their natural environment

Results from FACE studies suggest that bottlenecks downstream of photosynthesis reduce the potential for crops and ecosystems to exploit future elevated $[\text{CO}_2]$



Rogers et al (2005)

Projects

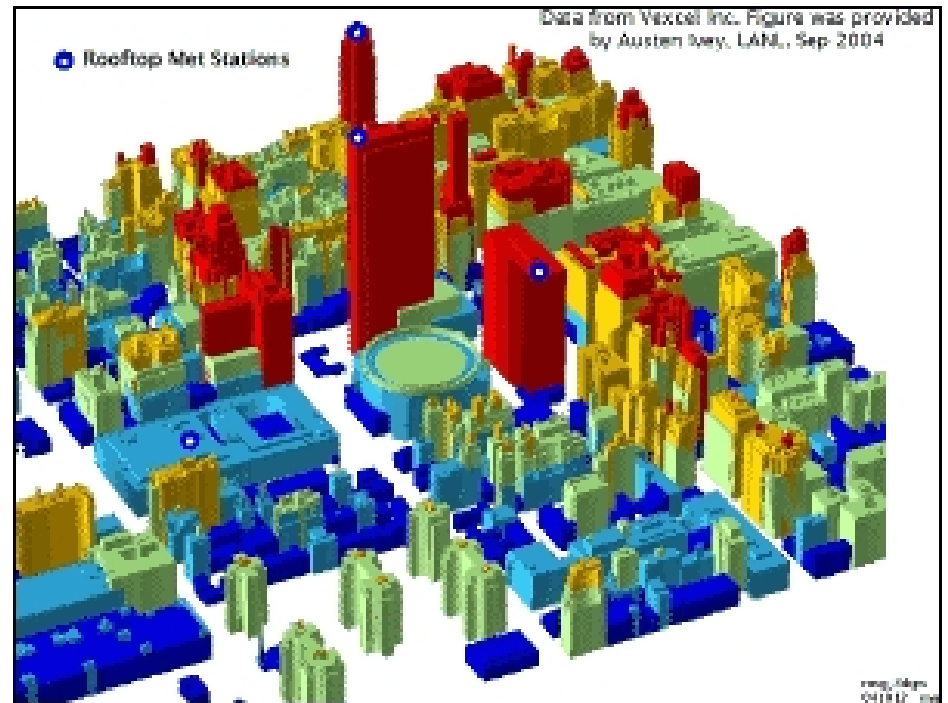
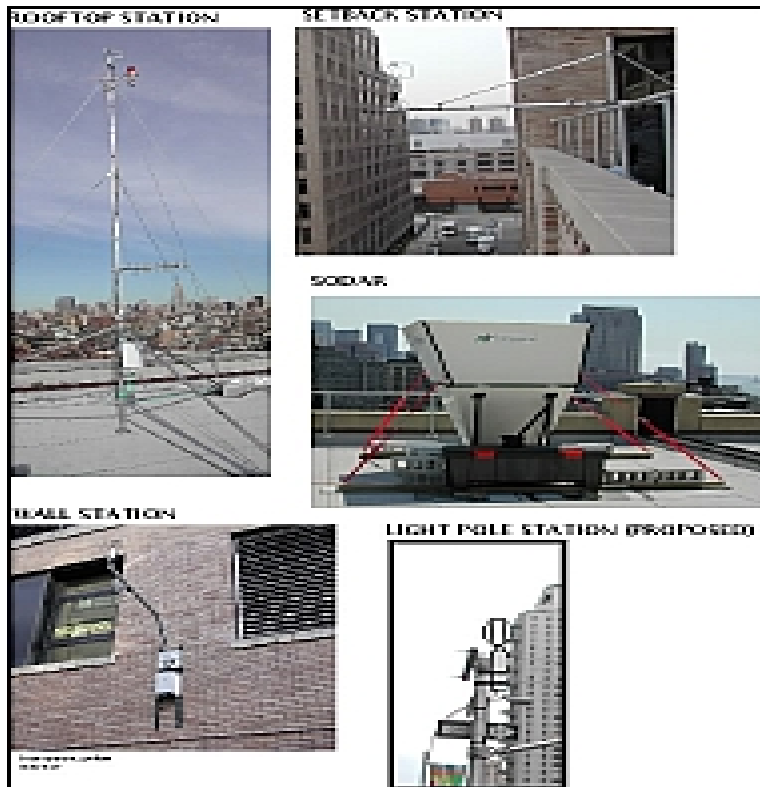
- The interaction between carbon and nitrogen metabolism in plants grown at elevated $[\text{CO}_2]$ using Free Air CO_2 Enrichment technology at the University of Illinois SoyFACE project.
- Understanding how a single gene change will translate across multiple levels of biological organization and lead to changes in the structure and function of a model ecosystem.
- Developing poplars with increased capacity for carbon sequestration and the ability to respond to increasing $[\text{CO}_2]$.

HERMES
Hierarchical Experimental Responses at Macromolecular to Ecosystem Scales

SoyFACE



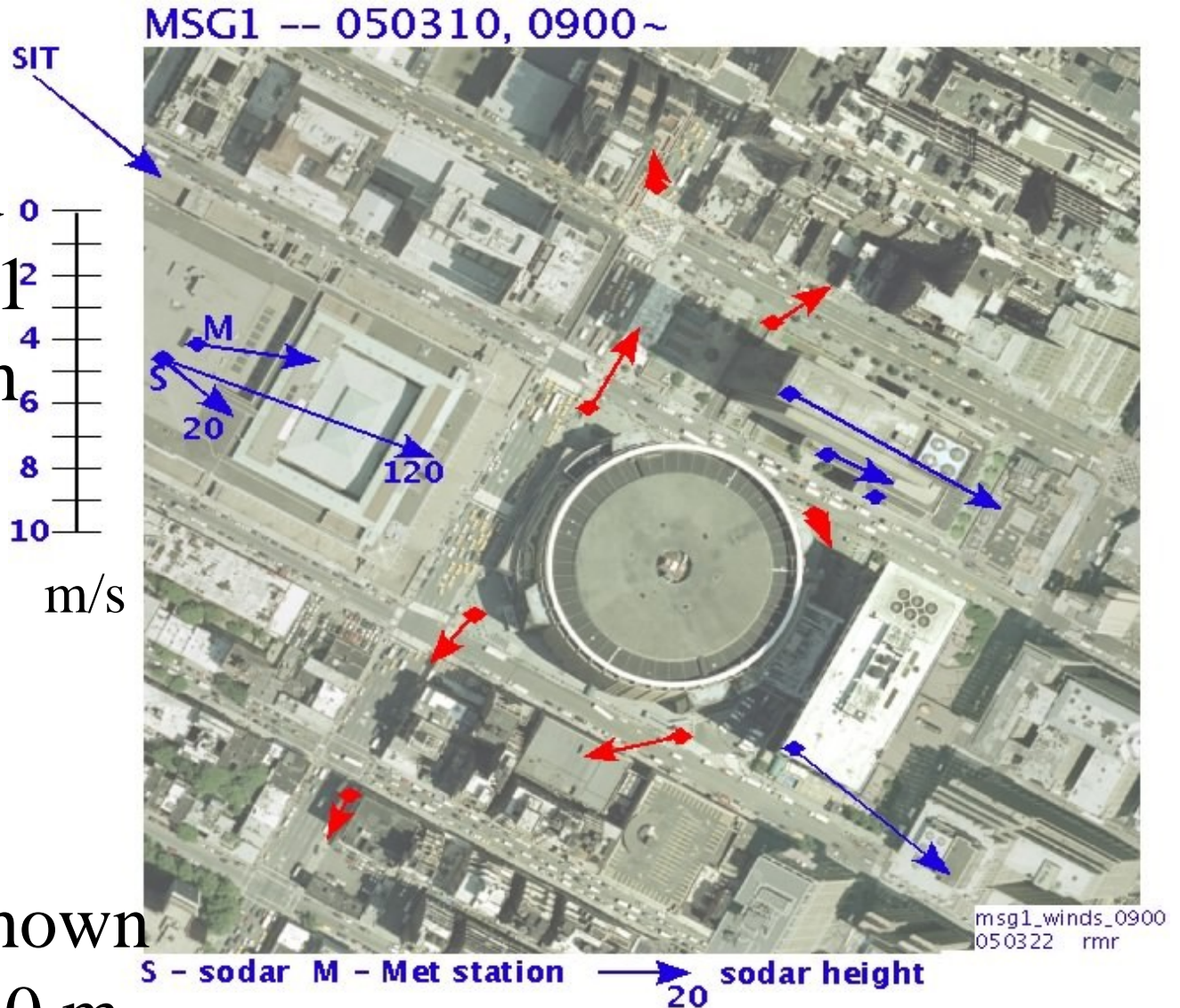
Urban Atmosphere Observatory



Actual wind
obs in IOP01
on 10 March

Figure by
Michael
Reynolds

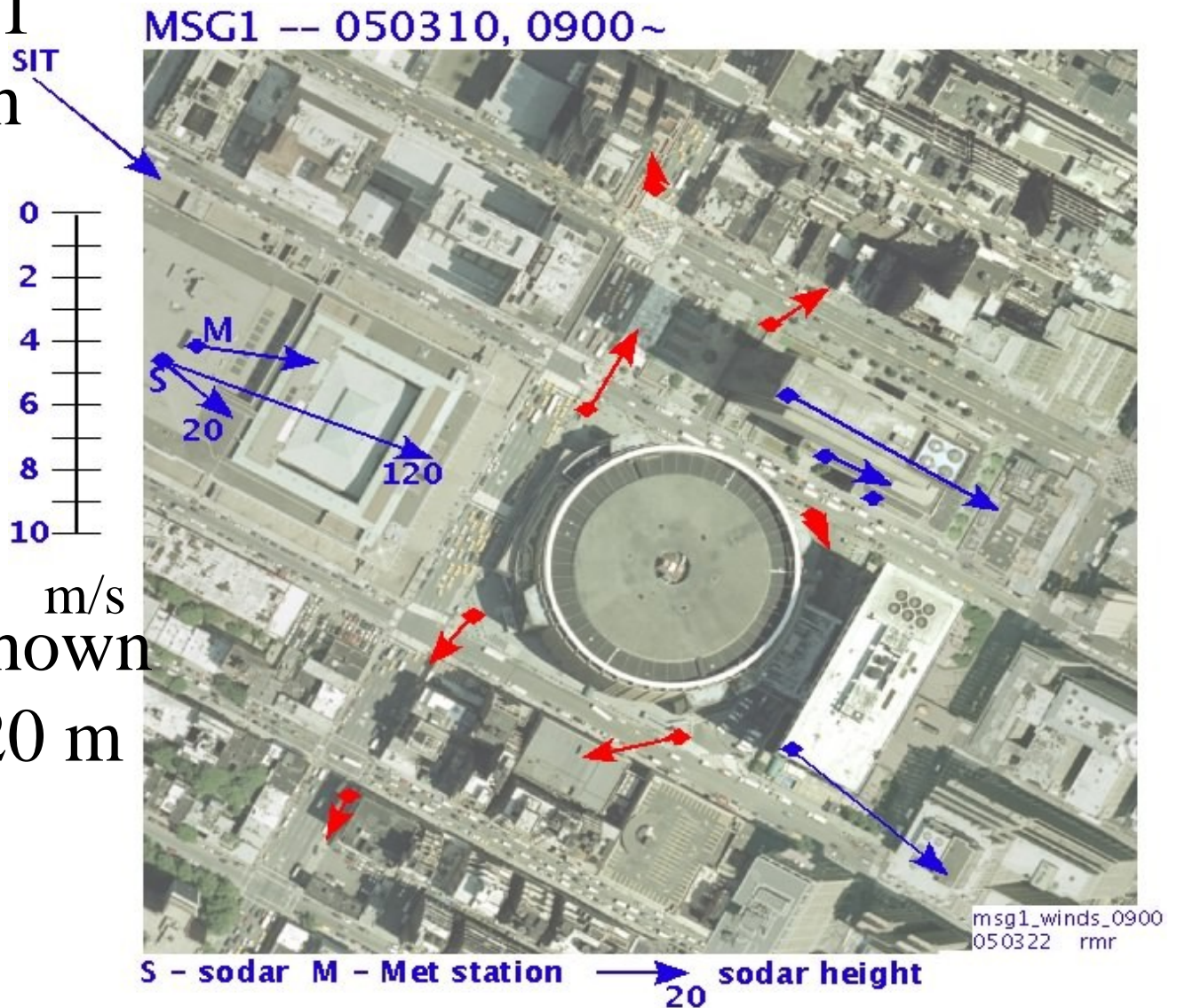
Sodar obs shown
at 20 and 120 m



Actual wind
obs in IOP01
on 10 March

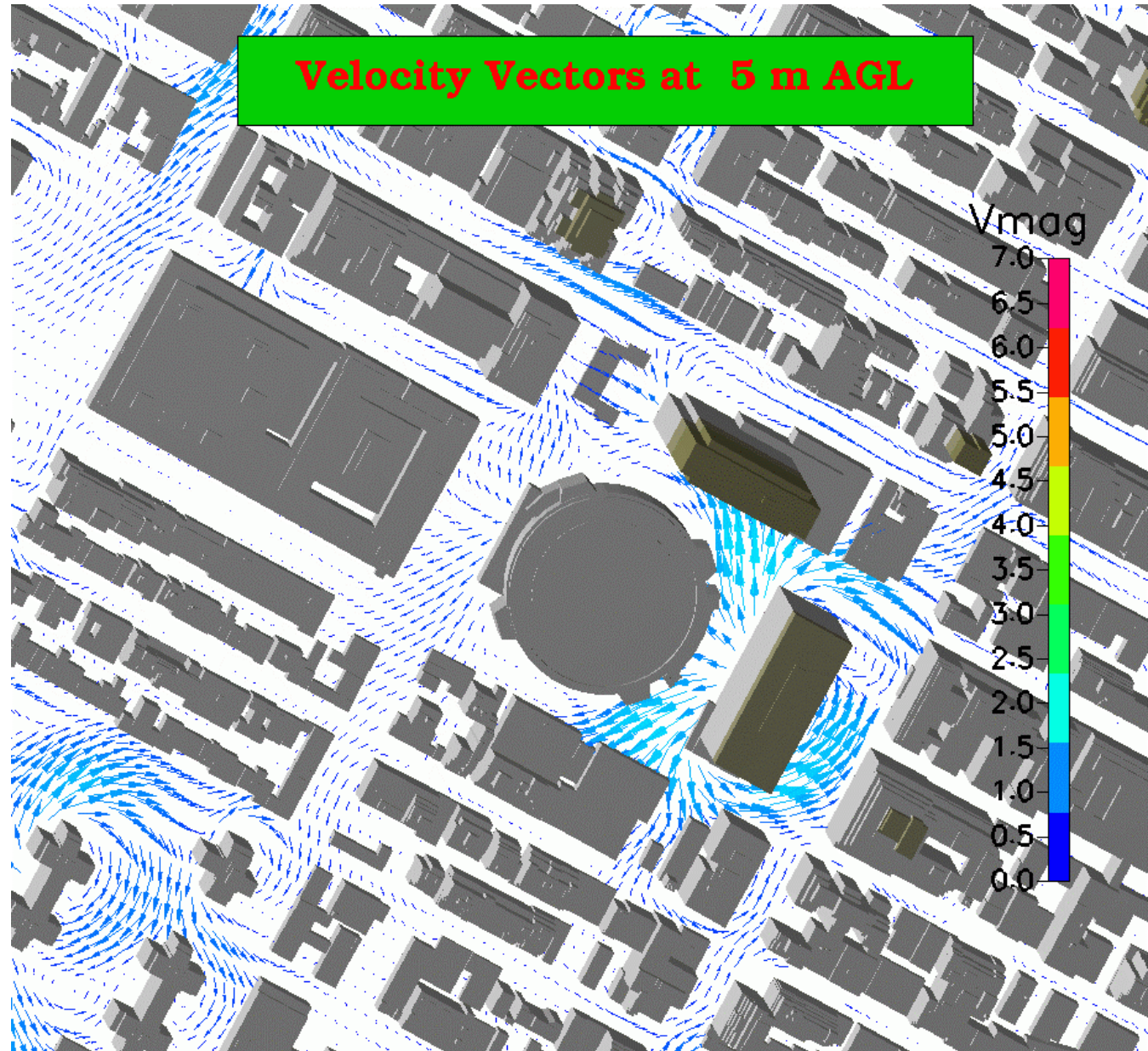
Figure by
Michael
Reynolds

Sodar obs shown
at 20 and 120 m
above Post
Office



CFD-Urban
simulations of
IOP01 for
WNW wind
direction and
upstream
speed of 5.3
m/s at $z = 50$
m.

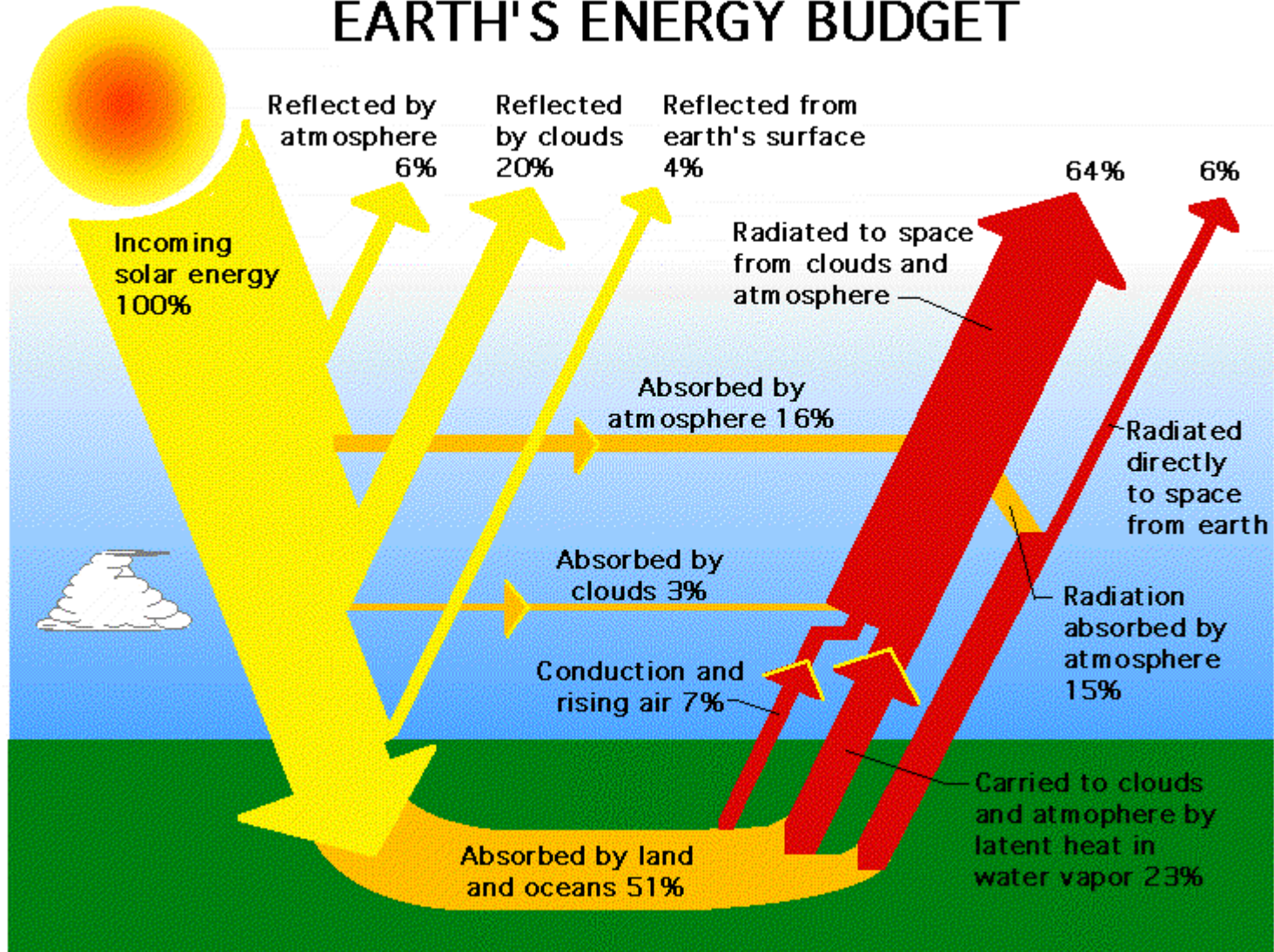
Provided by
Sura Kim on
18 March



Cloud Science Mission

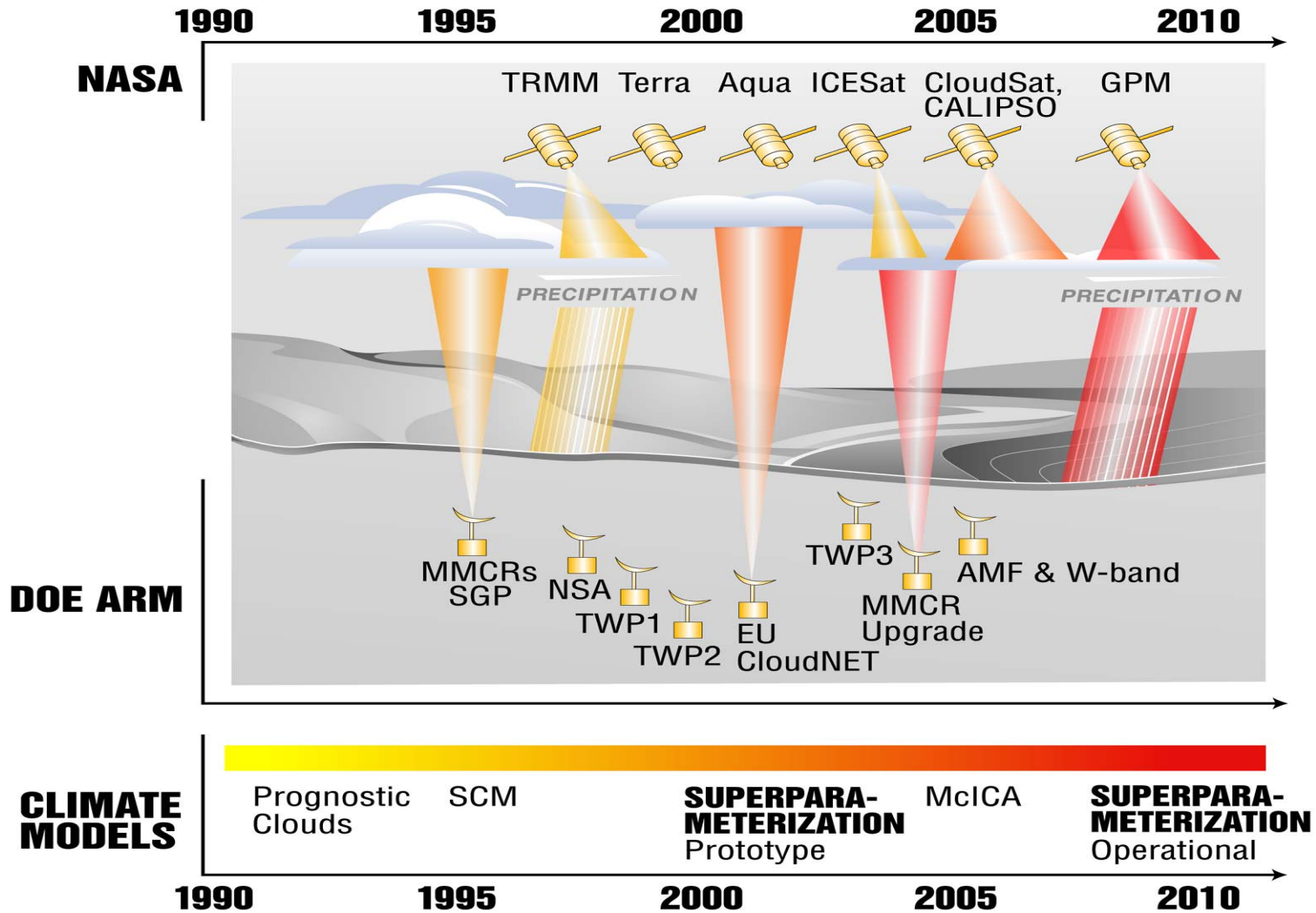
Explore and quantify complex cloud processes to aid in the interpretation of the climate record, understand the role of clouds in the climate system, predict the response of cloud systems to climate change, and improve the representation of clouds in global climate models.

EARTH'S ENERGY BUDGET



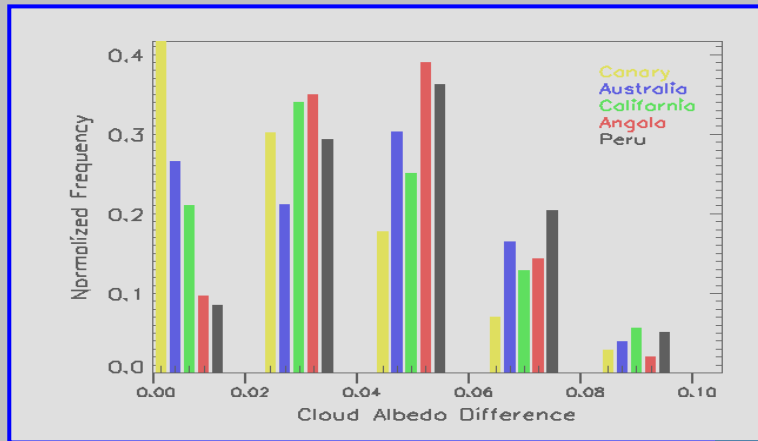
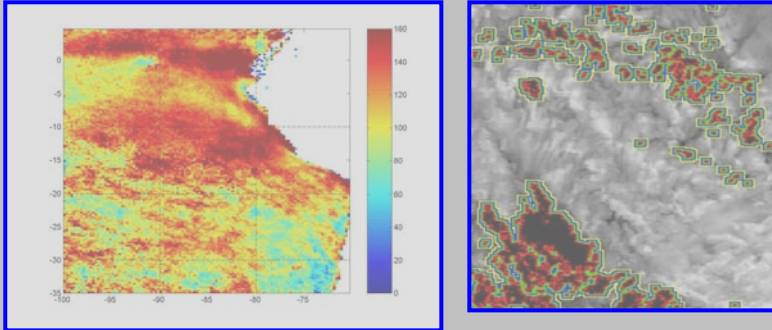
Source: NASA/ Earth Radiation Budget Experiment

Cloud & Precipitation Science Initiative

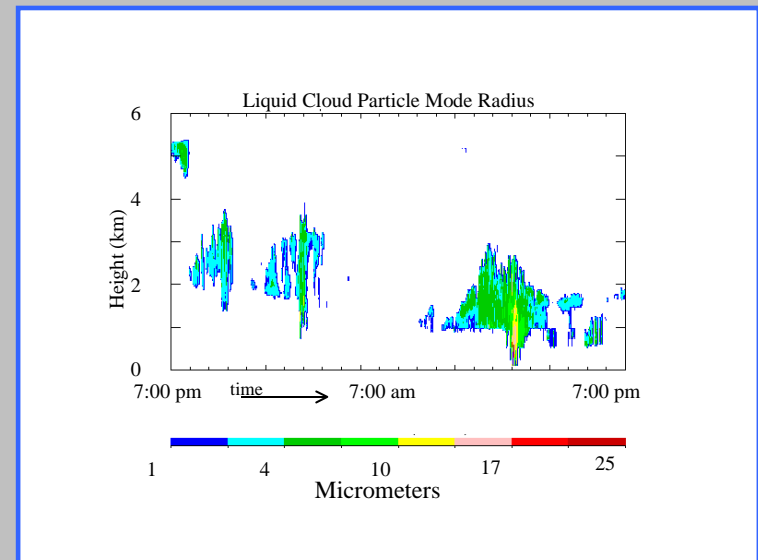


LEGEND
Resolution and Data Rate Increasing

ESSD Cloud Science



Satellite Analysis



Detailed Cloud
Microphysics

State-of-the-art
Radiation Transfer
Modeling

Thank you for your attention!!

Questions?

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