



Atmospheric Dispersion and Boundary Layer Research Programs

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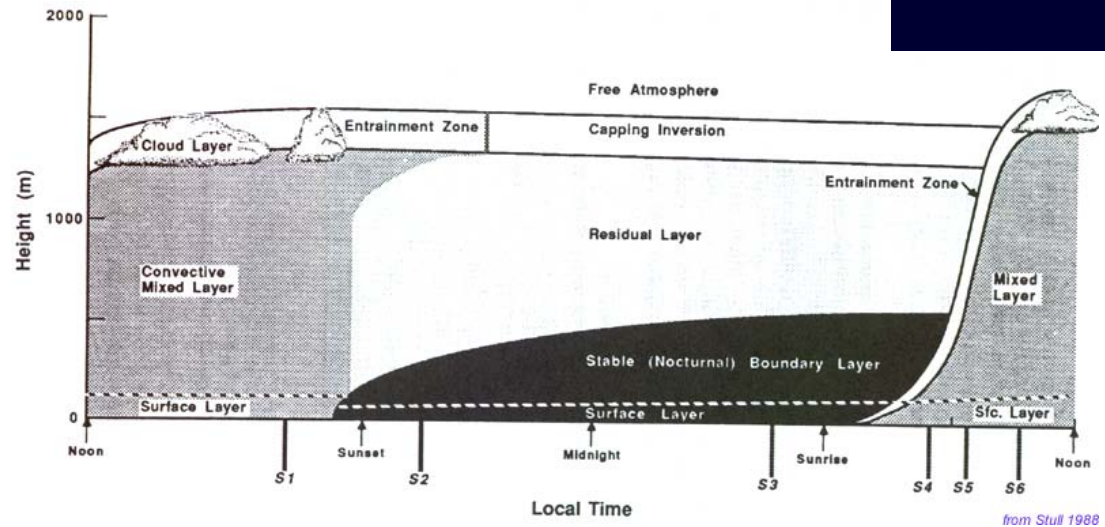
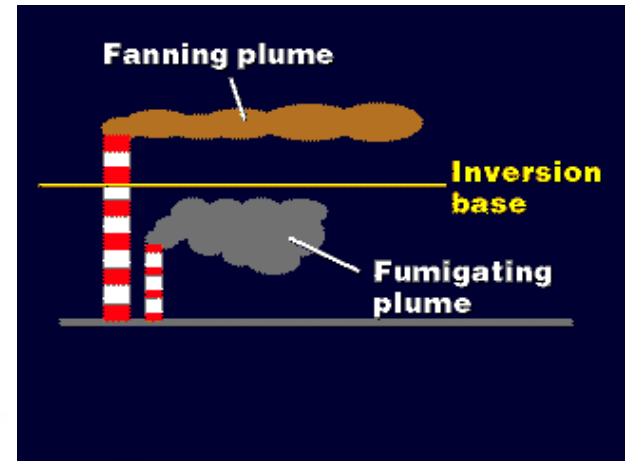
Air Resources Laboratory

Air Resources Laboratory Review

May 3-5, 2011

Atmospheric Dispersion and Boundary Layer Research Programs

- Longest history in ARL
- Established in every division
- Serve to help to unify the laboratory
- Exemplify theme of transition





Combination of Dispersion and Boundary Layer Research

- 60 years of research
- Understanding of dispersion and the planetary boundary layer are intertwined
- Boundary layer research is a natural outgrowth of dispersion research
- Separate strategic plans are being developed for each research topic



Mission and Goals of ARL's Atmospheric Dispersion Research & Development Program

Mission:

- Provide scientific information and tools to improve the prediction of atmospheric dispersion of harmful materials to protect public health and the environment and to minimize economic impacts

Goals:

- Improve the quality of atmospheric transport and diffusion predictions and assessments, including estimation of uncertainties
- Improve decision-makers' understanding of predictions, assessments, and associated uncertainties



Mission and Goals of ARL's Boundary Layer Research & Development Program

Goals:

- Improve the understanding and prediction of boundary layer phenomena for multiple applications, including dispersion models, wind power production, and hurricanes
- Improve land surface characterizations, particularly soil moisture and temperature, to assist with calibration of satellite-based measurements

Tools:

- Mesonets and surface energy balance networks
- Development of innovative instruments and measurements



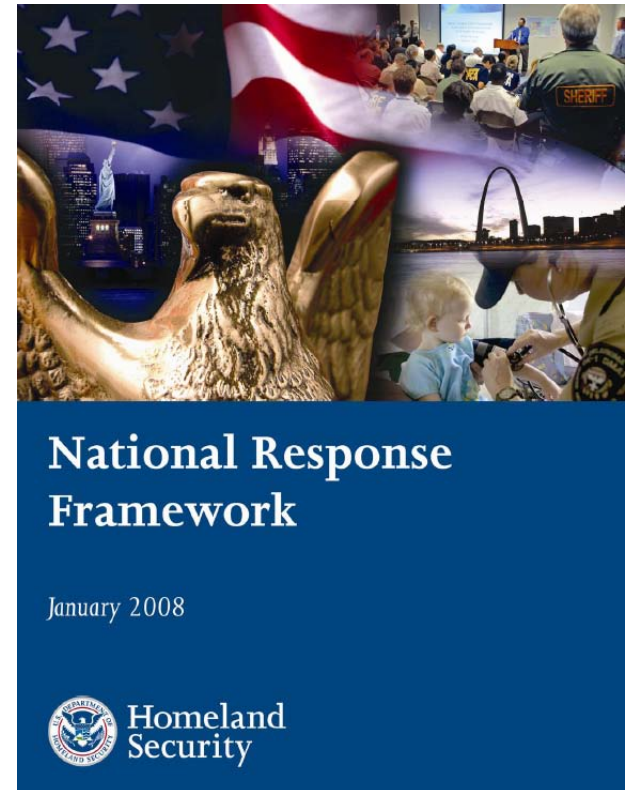
Drivers

- NOAA Next Generation Strategic Plan
 - Weather-ready nation goal
 - Reduced loss of life, property, and disruption from high-impact events
 - Improved transportation efficiency and safety
 - A more productive and efficient economy through environmental information relevant to key sectors of the U.S. economy.



Drivers (cont.)

- The National Response Framework (NRF)
 - Approved by the President
 - Emergency Support Functions in 6 areas:
 - Firefighting (smoke plume forecasting)
 - Public Health and Medical Services
 - Search and Rescue
 - Oil and Hazardous Materials Response (includes participation in the Interagency Modeling and Atmospheric Assessment Center–IMAAC)
 - Energy
 - Public Safety and Security





Drivers (cont.)

- Interagency agreements provide for volcanic ash plume prediction
 - MOU between NOAA and FAA (1988)
 - Letter of Agreement between NOAA and USGS (1993)
 - International Civil Aviation Organization (ICAO)
International Airways Volcano Watch network of Volcanic Ash Advisory Centers (VAAC)
- MOA between OAR and DOE-ID (2007)
 - Dispersion modeling and expert advice in an EOC setting
 - Dispersion mesonets





Overview of ARL's Dispersion and Boundary Layer Research Program

Modeling Component

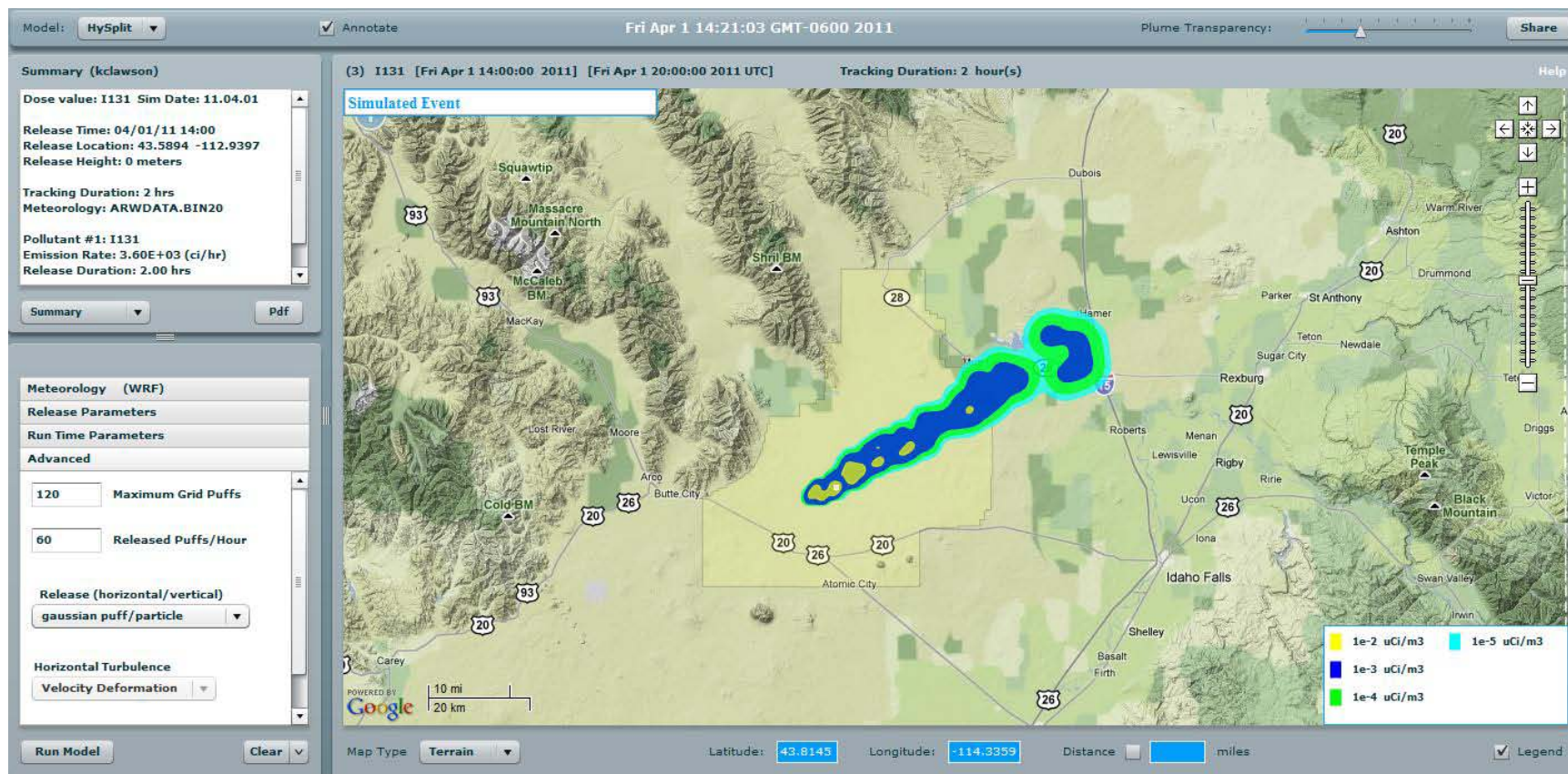
Hybrid Single-Particle
Lagrangian
Integrated Trajectory
Model (HYSPLIT)

Measurements Component

Tracers
Mesonets
Invented Instruments



Measurement and Modeling Nexus



Brief History of ARL's Dispersion and Boundary Layer Research Efforts

Models

- 1940's – Estimated the location of a secret Soviet atomic bomb test site



- 1950's – Development of dispersion models in support of weapons testing program



Measurements

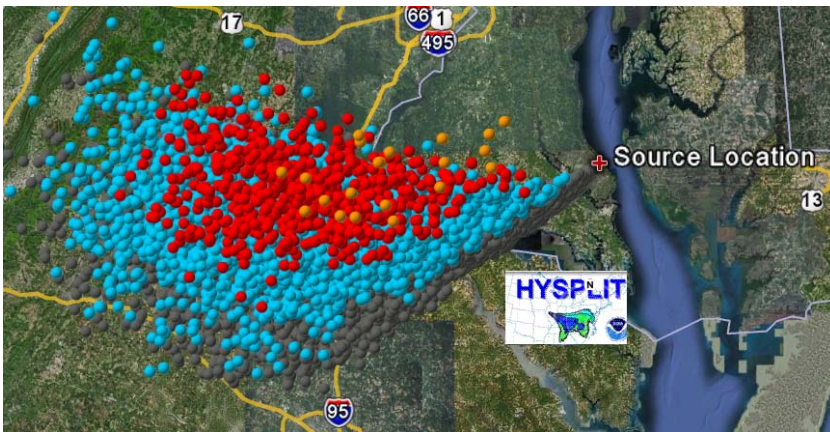
- 1950's – Initial development of balloon technologies for measurement of air flow and dispersion; Initial mesonets
- 1960's – Development of atmospheric tracer technology for model development and evaluation



Brief History of ARL's Dispersion and Boundary Layer Research Efforts (cont.)

Models

- 1970's – Developed puff-trajectory dispersion models
- 1980's – Initiated development of the HYbrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT) model



Measurements

- 1970's – First major urban air quality/dispersion study in St. Louis
- 1980's – Conducted major tracer studies to measure flow of materials over various distances and over various terrains

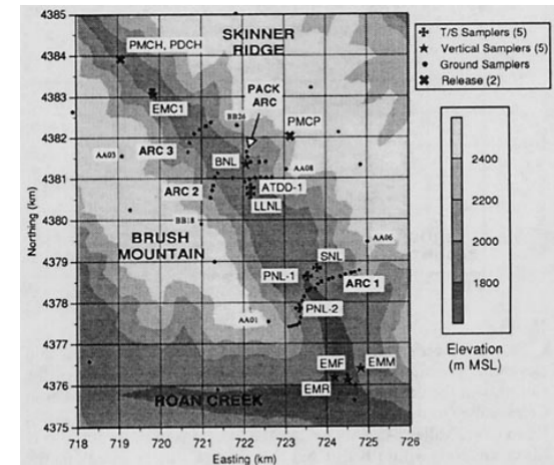


FIG. 1. Brush Creek valley terrain contours and locations of ground-level and vertical tracer samplers in the vicinity of the four sampling arcs. The coordinate system is UTM grid zone 12.

Brief History of ARL's Dispersion and Boundary Layer Research Efforts (cont.)

Models

- 1990's – Development of a web-based system to deliver dispersion products to the public
- 1990's – Development of model for volcanic ash plume forecasts
- 2000's – Development of dispersion forecasts of large events for weather forecasters



Measurements

- 1990's – Began conducting boundary layer experiments using small aircraft
- 2000's – Conducted several large urban dispersion studies





Guiding Philosophies

- Customer focused, both internal and external to NOAA
 - Highly efficient use of limited financial resources
- Concentrate on research areas where ARL can make a significant impact
 - Deliver products on time and within budget
- Maintain high quality standards
 - WMO, ANSI, EPA, DOE standards
- Invent measurement tools where necessary by adapting internal ARL expertise

Current State of Atmospheric Dispersion and Boundary Layer Research

- Major common research topic across all four divisions
- Assets have relevancy in recent events
 - Deep Water Horizon
 - Iceland Volcano
 - Japanese Fukushima Dai-ichi nuclear reactors



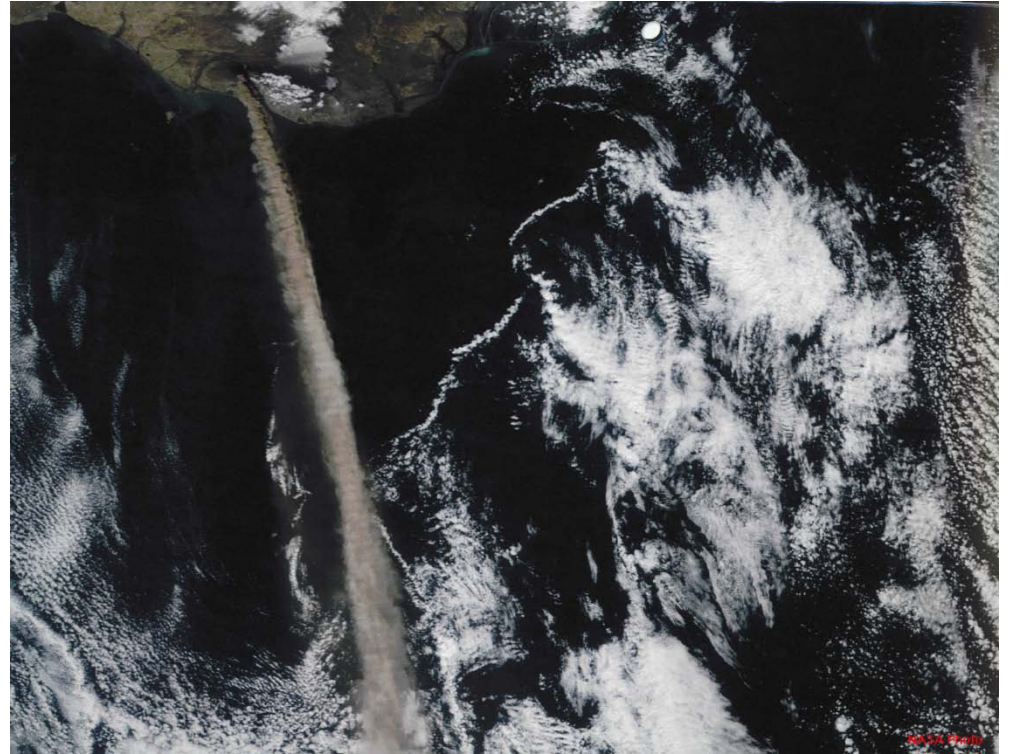
Photo taken June 22, 2010. Photo courtesy Dr. Oscar Garcia / Florida State University.



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Dispersion Research Program Modeling Component

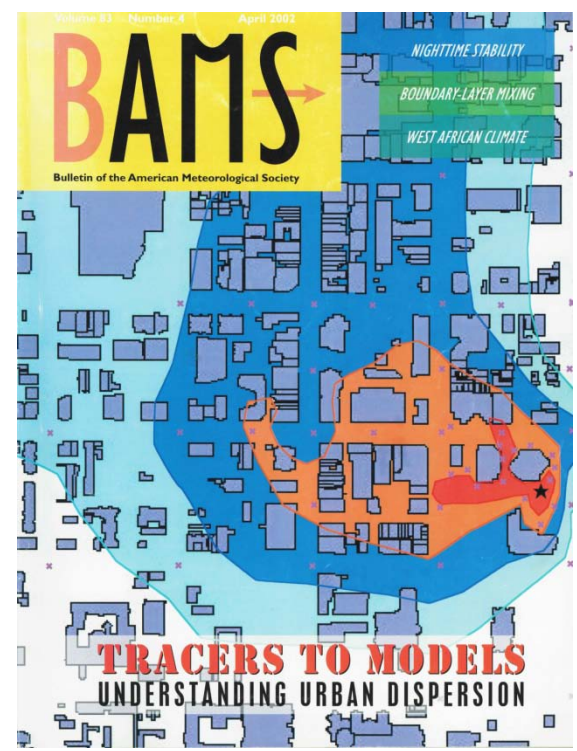
- HYSPLIT
 - Radiological Plumes
 - Chemical Plumes
 - Volcanic Ash
 - (Dust)
 - (Fire Smoke)
- Decision Support Tools
 - READY
 - Consequence Assessment





Dispersion and Boundary Layer Research Program Measurements Component

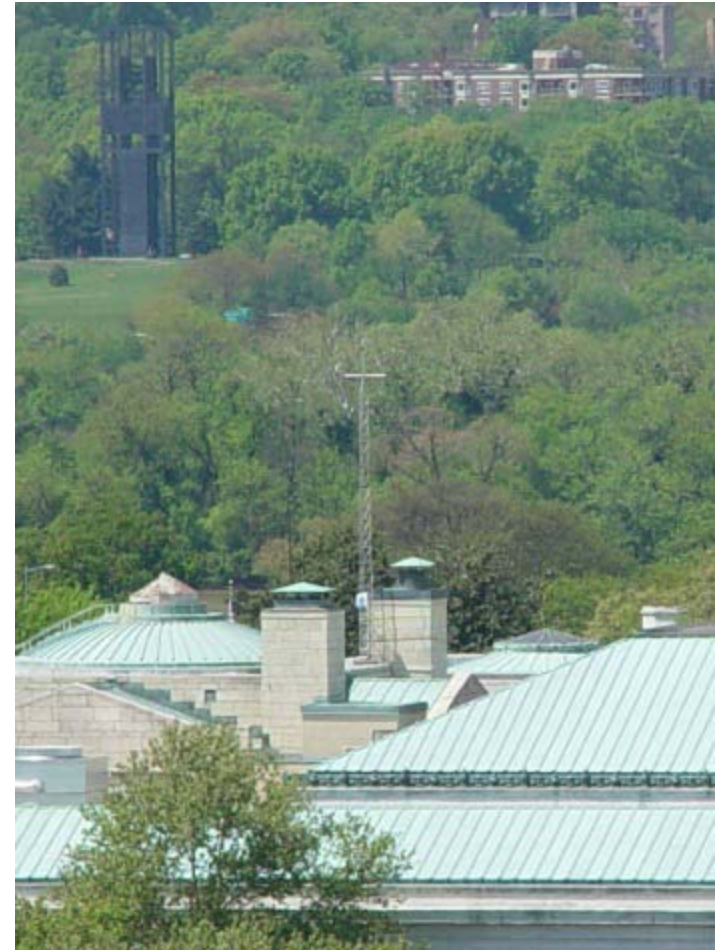
- Atmospheric Dispersion Field Tests
 - Uses small amounts of intentionally-released atmospheric tracers
 - Surrogates for harmful chemicals
 - Major urban dispersion studies
 - Salt Lake City
 - Oklahoma City
 - Midtown Manhattan
 - Pentagon
 - Road-side barrier study





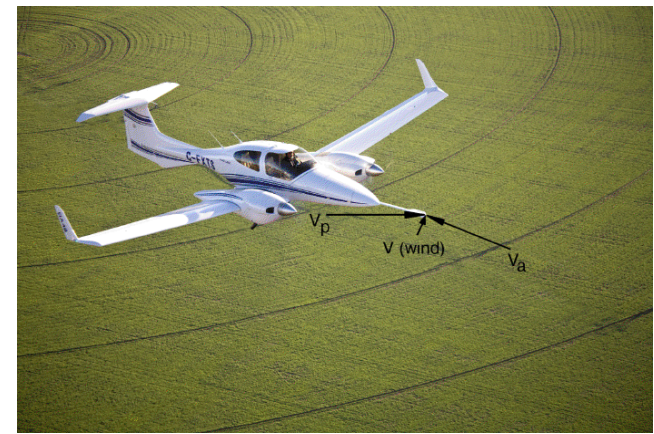
Dispersion and Boundary Layer Research Program Measurements Component

- Mesonets
 - DCNet
 - Idaho National Laboratory (INL) Mesonet
 - Nevada National Security Site (NNSS) Mesonet
 - Eastern Tennessee Regional Air Monitoring & Analytical Network (RAMAN)



Dispersion and Boundary Layer Research Program Measurements Component

- Special Instruments Development
 - Best Aircraft Turbulence (BAT) Probe
 - Extreme Turbulence (ET) Probe
 - Smart Balloon





Dispersion and Boundary Layer Research Program Measurements Component

- Renewable energy
 - Wind forecast improvement
 - Duke Energy Cooperative Research and Development Agreement (CRADA)
 - DOE/NOAA Wind Forecast Improvement Program





ARL in Transition

- Greater integration with NOAA priorities and activities
- Establish boundary layer as another focus area
- Greater integration among divisions
- Integration of research and technical services



QUESTIONS?



Atmospheric Dispersion and Boundary Layer Presentations

Topic

Urban Meteorology

HYSPLIT

Volcanic Ash Dispersion Modeling

Tracer Technology and Field Studies

Specialized Meteorological & Dispersion Support

Presenter

Will Pendergrass

Roland Draxler

Barbara Stunder

Rick Eckman

Walt Schalk