

California and Nevada Smoke and Air Committee (CANSAC)

Modeling and Technical Communications System Overview

Joint IASC/CARPA Meeting

Sacramento, May 2015

Dar Mims, CANSAC Co. Chairman

California Air Resources Board



California Environmental Protection Agency

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CANSAC Members

- USDA Forest Service Reg. 5
- Bureau of Land Management CA State Office
- Bureau of Land Management NV State Office
- US Fish and Wildlife Service Pacific Region
- National Park Service
- USDA Forest Service Pacific SW Research Stn
- California Dept of Forestry and Fire Protection
- California Air Resources Board
- San Joaquin Valley Unified Air Pollution Control District
- Bay Area Air Quality Management District
- San Diego Gas and Electric
- Monterey Bay Unified Air Pollution Control District

Chairman:	Trent Proctor, USFS
Co. Chairman:	Dar Mims, CARB
Operational Applications Group, Chair:	John Snook, USFS
Technical Advisory Group, Chair:	Kemal Gurer, CARB



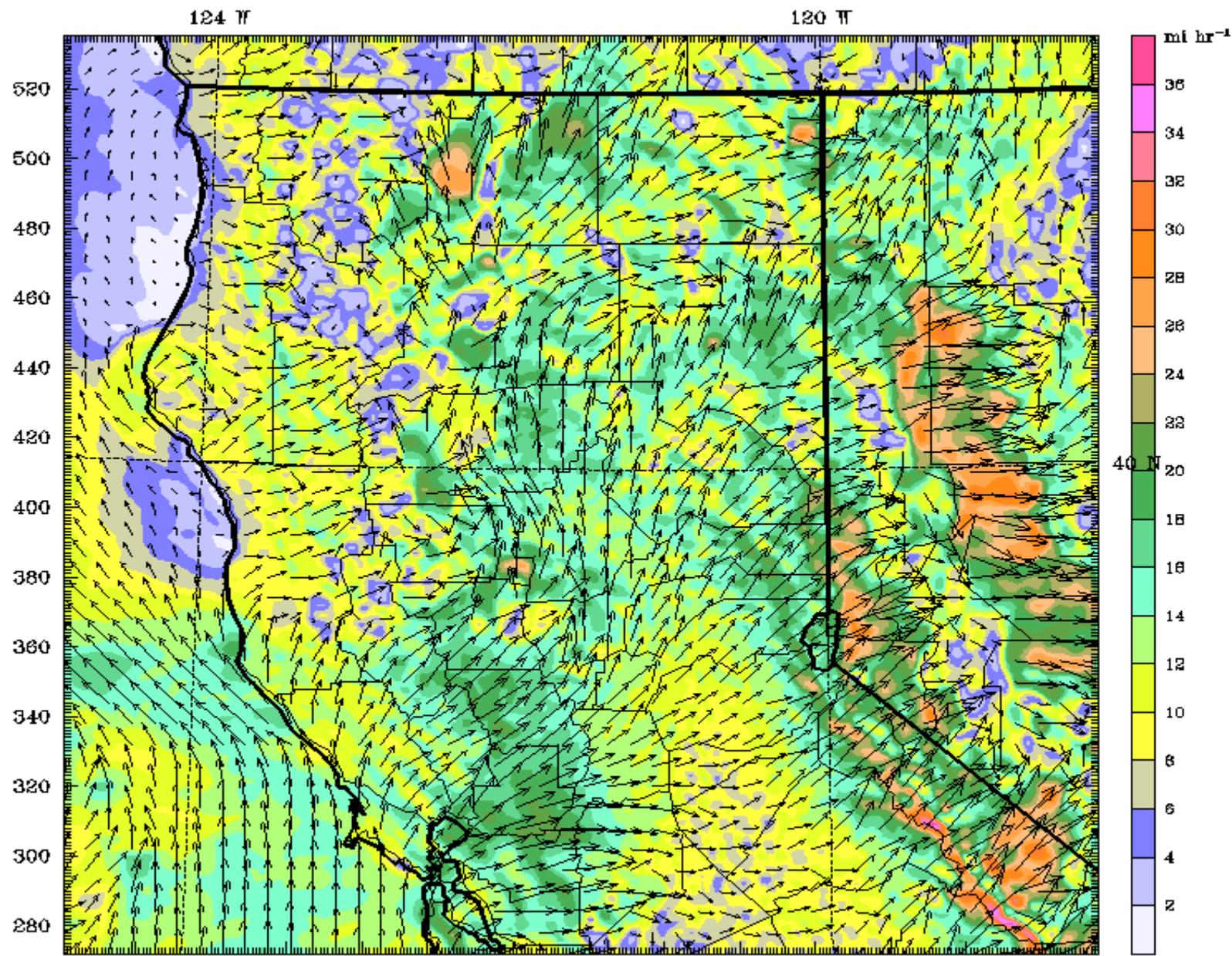
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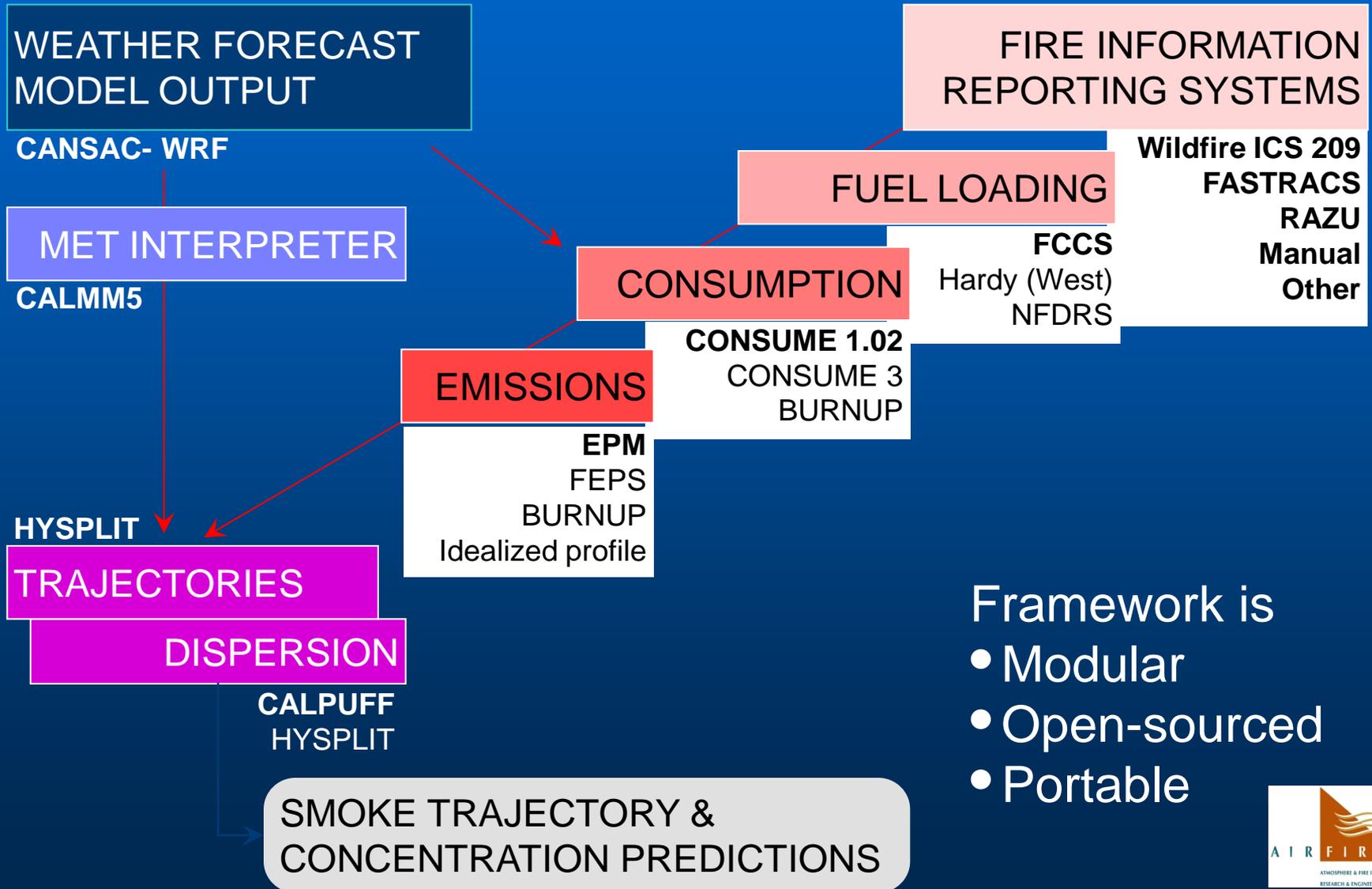
The California Smoke Management 1300 Conference Call

- At 1300 daily local time
- Participants include CARB, air district regulators, burners, & meteorologists
- Proven useful planning resource
- Spot Forecasts can be tailored to your most critical time periods and elements of interest
- Includes the effects of topography:
Local winds, Inversions, Slope/aspect influences

CANSAC WRF Realtime: Domain 3 (2 km) Init: 1200 UTC Tue 12 May 15
Fcst: 36.00 h Valid: 0000 UTC Thu 14 May 15 (1700 PDT Wed 13 May 15)
Horizontal wind speed at height = 0.01 km sm= 1
Horizontal wind vectors at height = 0.01 km sm= 1



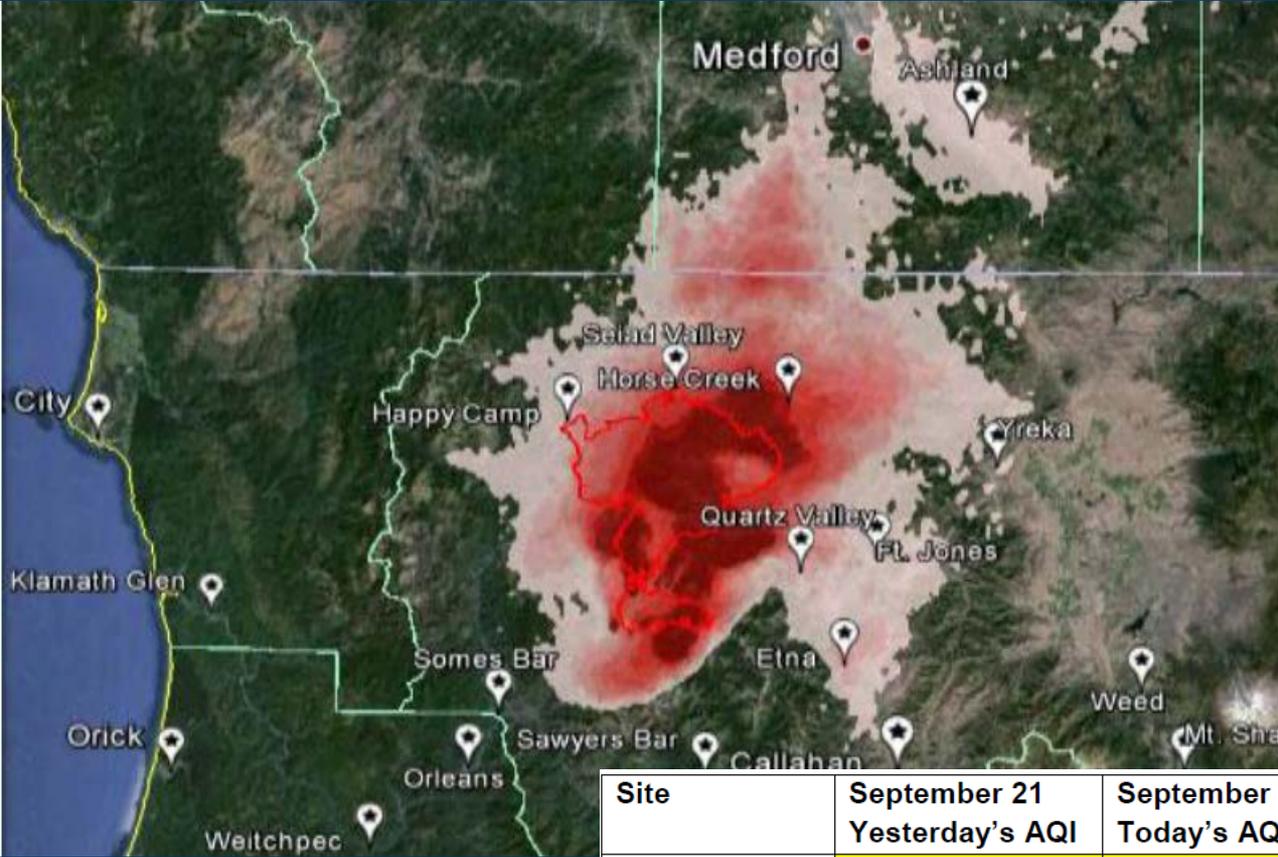
BlueSky Framework



Framework is

- Modular
- Open-sourced
- Portable

BlueSky Prediction



Site	September 21 Yesterday's AQI	September 22 Today's AQI	September 23 Predicted AQI	Likely Time of Highest Impacts
Yreka	Moderate	Moderate	Moderate	Afternoon/Early Evening
Fort Jones	Unhealthy	Unhealthy for sensitive groups	Moderate	Afternoon/Early Evening
Etna	Unhealthy for sensitive groups	Moderate	Good	Evening
Seiad Valley	Moderate	Moderate	Moderate	Early Afternoon
Happy Camp	Moderate	Moderate	Good	Early Afternoon

Model Confidence “Under The Hood”

- Numerical Modeling
- Hardware
- Initialization
- Physics Equations
- Verification

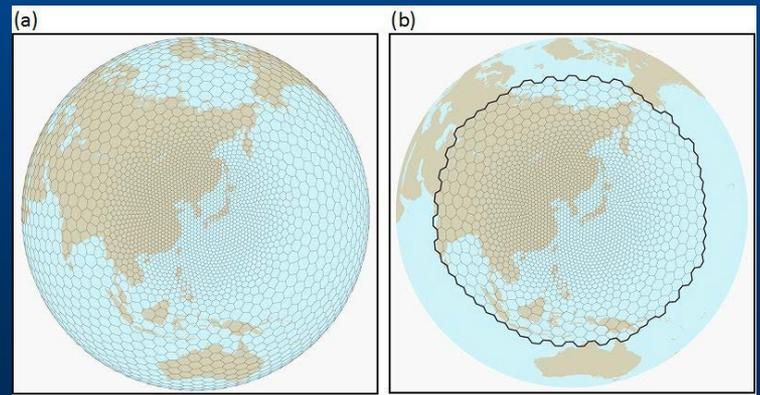


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Numerical Modeling

- Models divide the area into a set of grids then use of observations of variables such as pressure, winds, temperature and humidity throughout the globe. The observed values are used by the model to predict future evolution of the earth's weather and climate
- The ability of models to accurately represent the atmosphere is based on three conditions; scientific knowledge, the availability of observational data, and computer processing abilities.
- If enough observational data is available and enough scientific knowledge is present then the limiting factor of an accurate forecast is the power of the processing computer.



Grids in Numerical Weather and Climate Models, S.Collins at el



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Hardware Needs

- SGI Altix 3700 Machine for CANSAC modeling. Server costs was over \$300K in 2009.
- System processors: Thirty-two 1.3 GHz Itanium 2, with 3 MB cache (in two 16p racks)
- Processors are interconnected with 2Gbit switches and 3 meter, 50 micron optical cables
- Moore's Law – Computer chip performance doubles every two year!



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Primitive equations that govern atmospheric motions

The vorticity tendency owing to vorticity advection can be rewritten as:

$$\frac{\partial \zeta_g}{\partial t} + \vec{v}_g \cdot \nabla (\zeta_g + f) = f_0 \frac{\partial \omega}{\partial p}$$

$$\frac{d_g f}{dt} = \vec{v}_g \cdot \nabla f = \beta v_g$$

Rate of change of geostrophic vorticity

Advection of absolute vorticity by geostrophic wind

Concentration or dilution of vorticity by stretching or shrinking of fluid columns (divergence effect) geostrophic wind

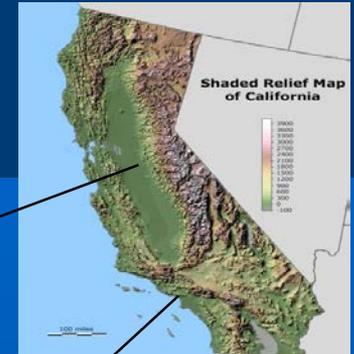
$$\vec{v}_g \cdot \nabla (\zeta_g + f) = \vec{v}_g \cdot \nabla \zeta_g + \beta v_g$$

Geostrophic advections of relative vorticity

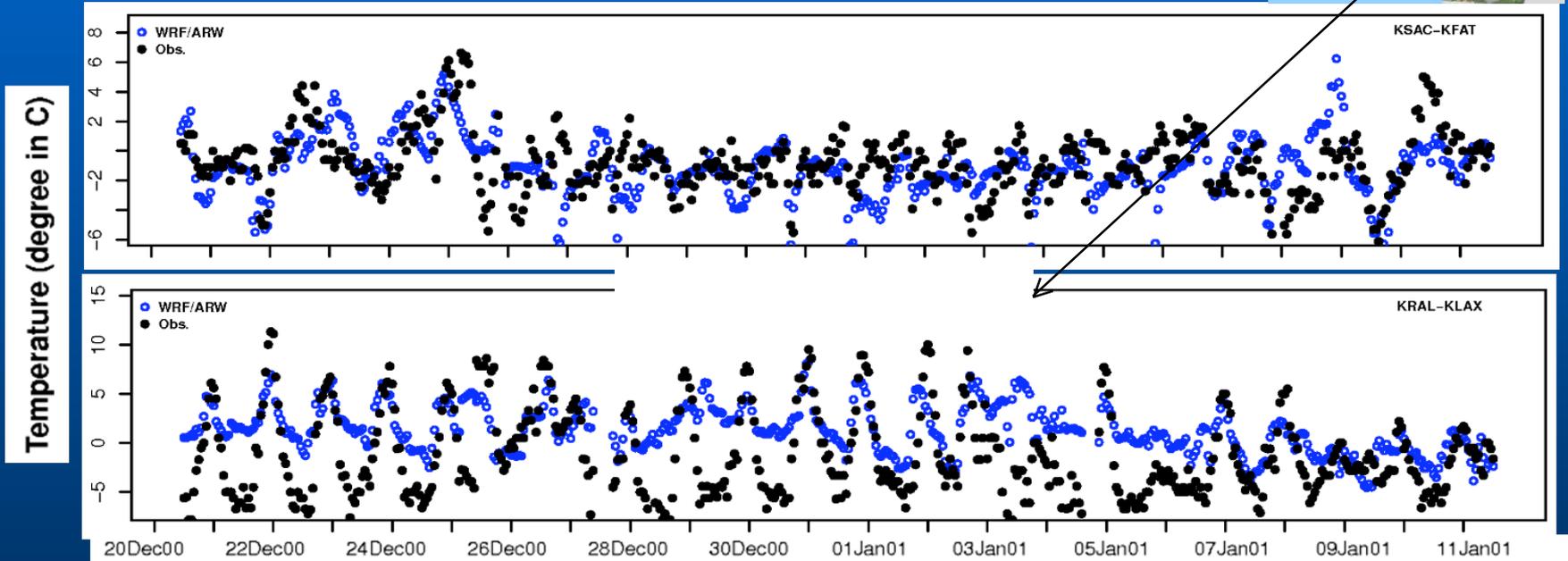
Geostrophic advections of planetary vorticity



Temperature Differences (Dec 20, 2000 to Jan 11, 2001)



Sacramento - Fresno



The model simulates spatial temperature gradients in the Central Valley compared to the South Coast.

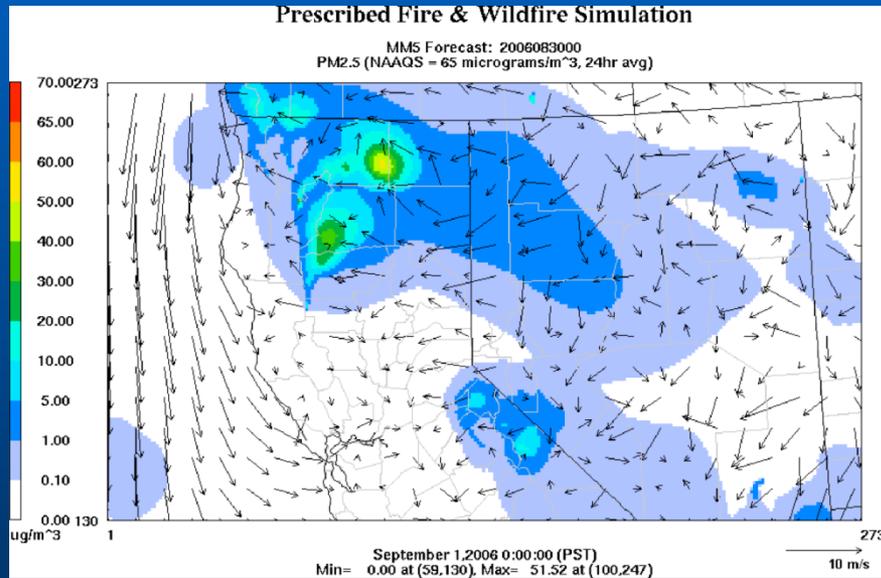


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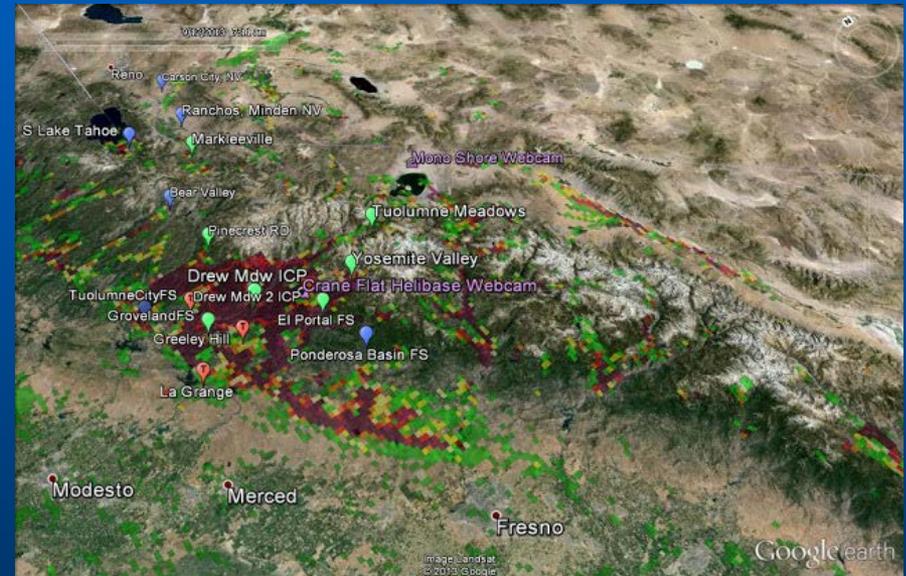
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Modeling Improvements

2006



2013

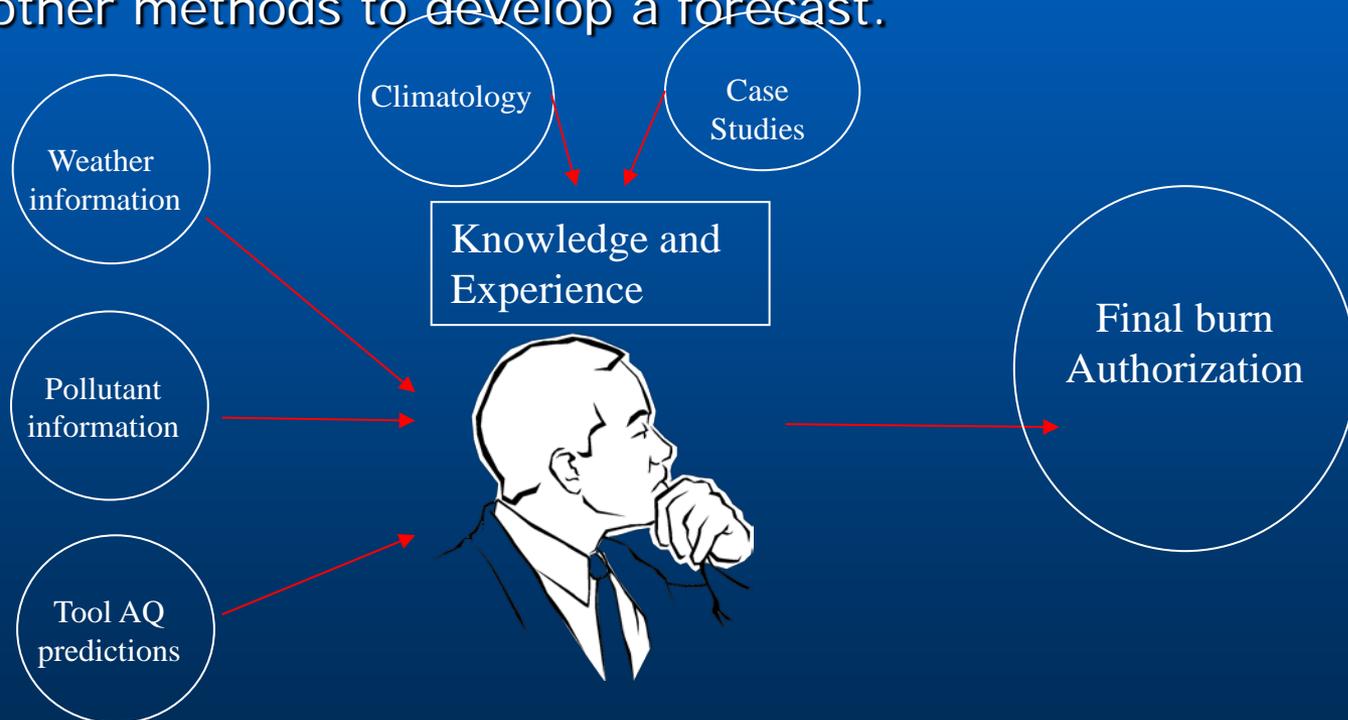


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Intuition – How It Works

- Relies on experience and capabilities
- Forecaster/Decision Maker synthesizes the information by analyzing observed and forecasted weather charts, satellite information, air quality observations, and pollutant predictions from other methods to develop a forecast.



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Boulder Rx Context: A proposal to proactively "plug the drainage"

2010 Sheep fire (8700+ acres)

Unit 1 (proposed for fall 2013, 3200+ acres)

Total Boulder Creek Rx Unit (14,000+ acres)

Rest of drainage (95,000+ acres)

Legend

- IR Fire
- Perimeter
- National Park Boundaries (for orientation)

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Image Landsat

Image © 2013 DigitalGlobe

Boulder Rx

Google earth

Looking to the Future

- Continue Support of Core Science to Inform Effective Approaches
- New Machine, More Computational Power
- Lower Resolution Models 1.33K
- Audience Identification
- Training
- Better Parameterization/Feedback Systems

