Creation of a Wildland Fire Analysis: Products to enable Earth Science

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Problem to Solve

- Wildland fire science & related applications have benefitted from a wide range of space-based and airborne fire observations
  - But each has different spatial resolutions and revisit frequencies
  - Additional sensors and constellations continue to be added by both the public and private sector.

- Greater use of such observations for analysis and modeling of wildland fire occurrence, behavior, and effects such as emissions is hampered by limitations:
  - (1) the observations' disparate resolutions and extent,
  - (2) temporal or spatial gaps due to cloud cover, satellite revisit timing, and other issues, and
  - (3) partial fire mapping resulting from (1) and (2) producing crudely mosaicked image segments.

The Happy Camp Complex fire imaged in the SWIR in Aug. 2014 by WV-3. (Image from DigitalGlobe.)

Solution

Develop tools to generate *wildfire reanalysis products* and demonstrate their utility for the development of data products for active fire detection, burned area, and emissions inventories

- Develop methods to create, test, and assess wildland fire reanalysis products using fire detection data, Coupled Atmospheric Wildland Fire Environment (CAWFE®) coupled weather-wildland fire model, and data assimilation.

- Produce reanalysis products for individual wildfires, a regional tile of wildfire outbreak, and custom products for post analysis of NASA-sponsored wildland fire experiments.
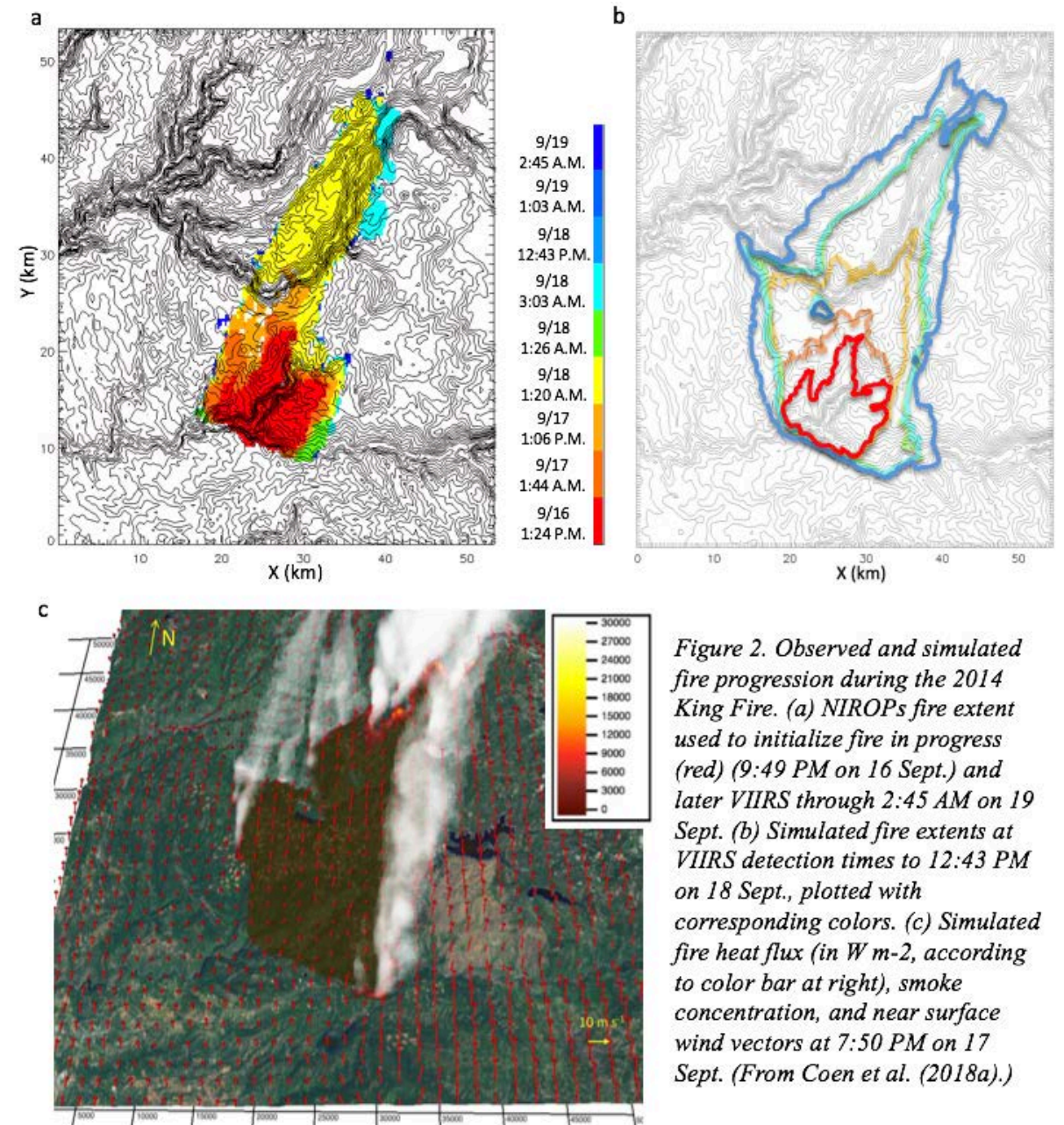

Figure 2. Observed and simulated fire progression during the 2014 King Fire. (a) NIROPs fire extent used to initialize fire in progress (red) (9:49 PM on 16 Sept.) and later VIIRS through 2:45 AM on 19 Sept. (b) Simulated fire extents at VIIRS detection times to 12:43 PM on 18 Sept., plotted with corresponding colors. (c) Simulated fire heat flux (in W m-2, according to color bar at right), smoke concentration, and near surface wind vectors at 7:50 PM on 17 Sept. (From Coen et al. (2018a).)

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Technical Details

- Develop reanalysis methodology using fire detection data products (e.g., VIIRS) and other products (e.g., MODIS)

- Investigate assimilation of supplementary infrared observations from small satellites, constellations, private sector products, and airborne observations.

- Test the products and assess their utility in improving emission inventories for smoke and emissions modeling

- Develop open access archives, dissemination pathways, and outreach to research and decisionmaker users of new products.
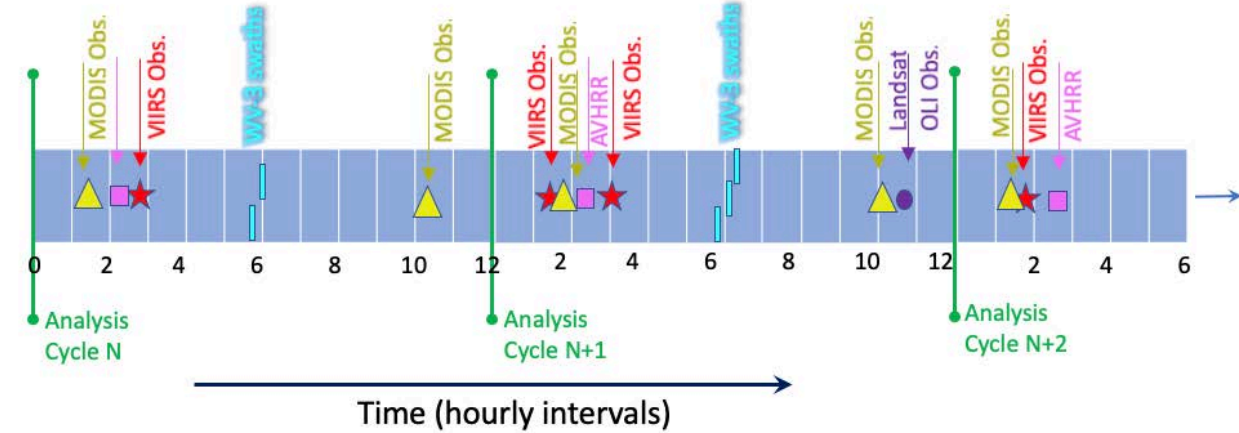

Conceptual image of 12-hourly analysis cycles, which contain data observed at various times including DigitalGlobe WV-3 data, for which multiple swaths might be collected to image an entire large fire.

Using CAWFE and data assimilation, gridded, physically consistent fire products consistent with the observations will be produced at hourly (or less) regular intervals.
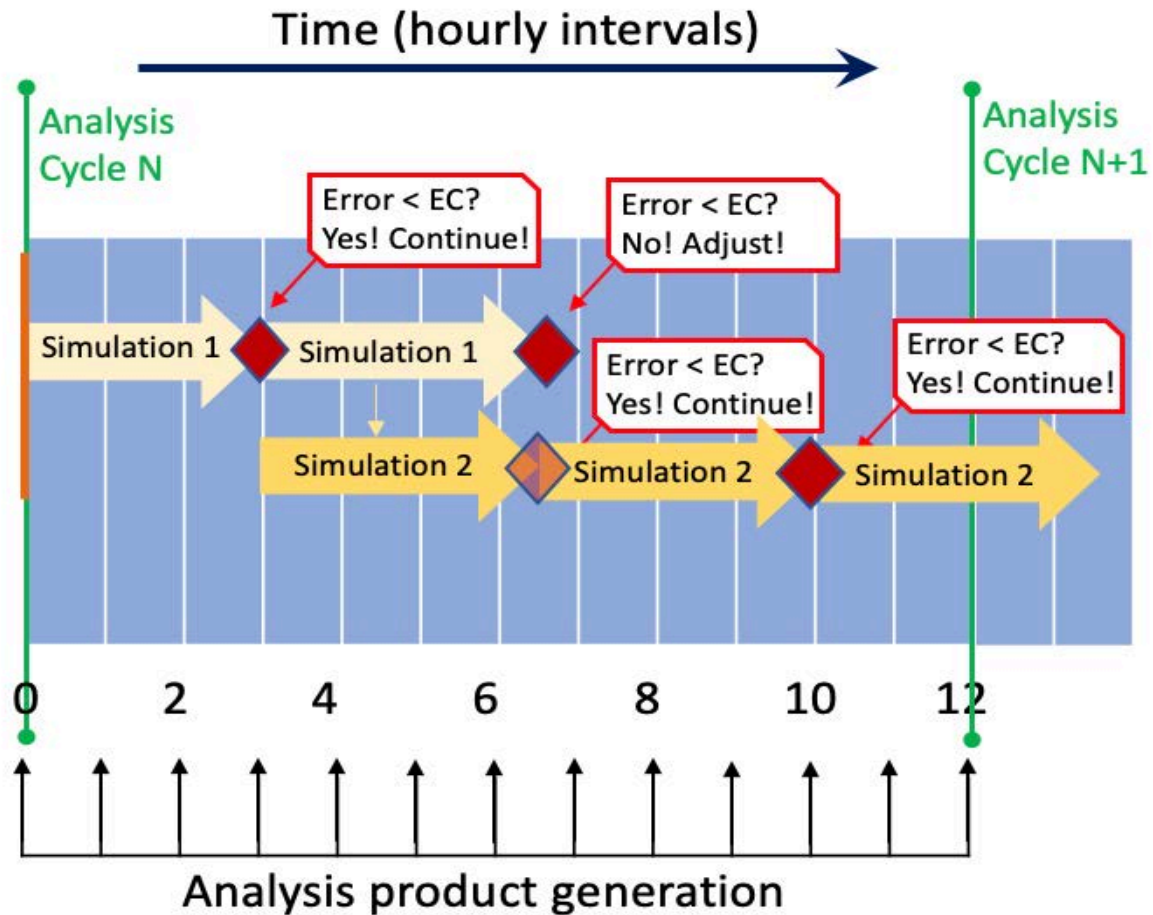
Technical Details

- Fire emissions estimation
  - We updated WFEIS for efficient modeling of fire emissions using 30m fuels maps of varying type

  - Spatio-temporal burned areas include multiple options:
    - MODIS
    - MTBS
    - GeoMAC
    - User-submitted (drawn or shapefile upload)
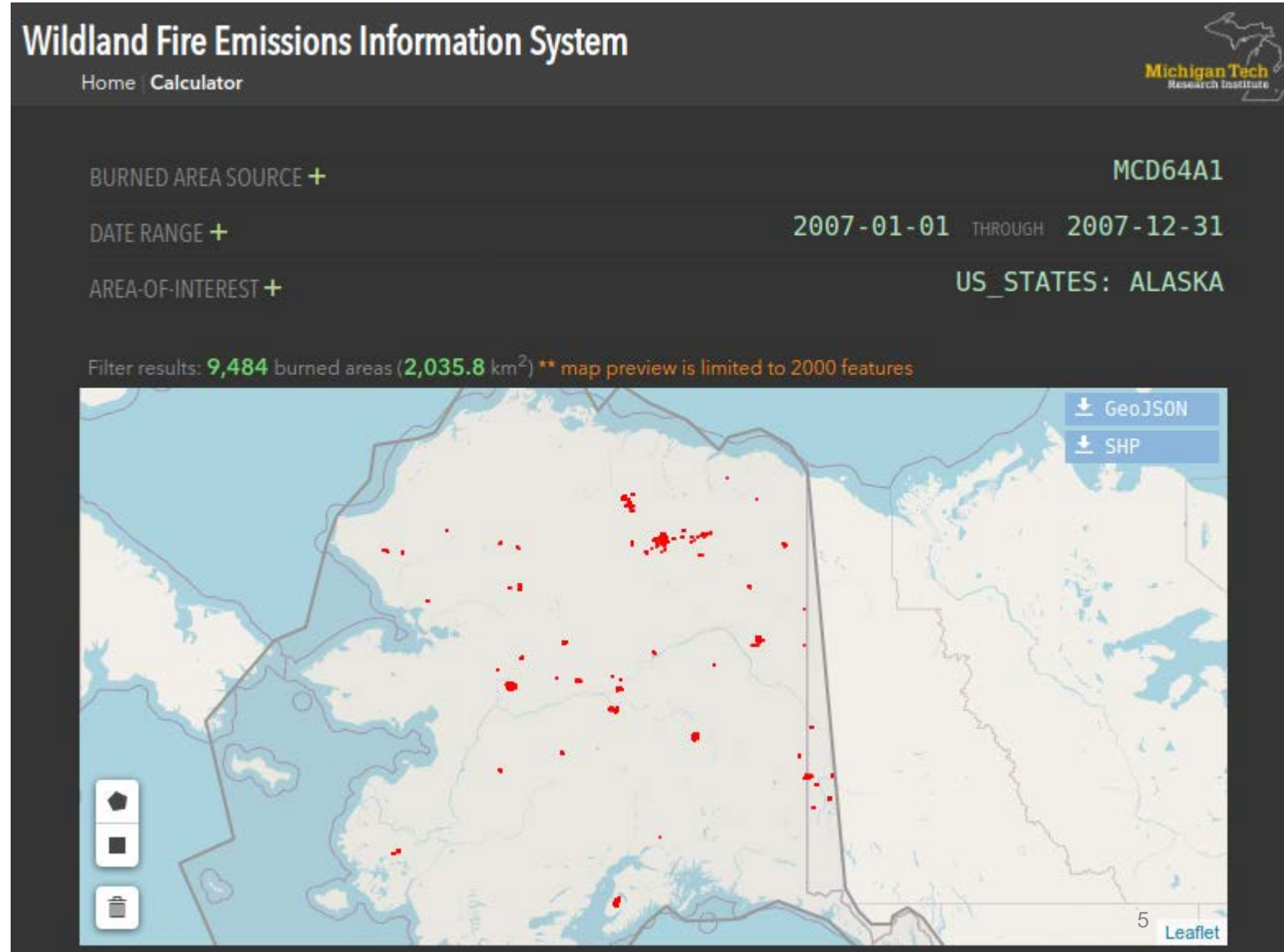
Technical Details

Concept of analysis simulation with assimilation and error correction. Timing of fire remote sensing observations given by diamonds. Successive simulations (gold) performed over period until simulation meets error criteria (EC).

Next Steps / Contributions

<u>Key Milestones</u>

- Develop and test assimilation methodology   08/20
- Develop and test preprocessing tools   02/21
- Generate reanalysis products for individual fires   08/21
- Generate Wildland Fire Emissions Information System (WFEIS) biomass burning inventories (BBI) 08/21
- Evaluation of improved inventories   01/22