



Data Warehouse for Long-Term Fire Datasets – Activity and Emissions - as approved by the Core Science Team for the Conceptual Model for Long-Term Fire Data project¹

May 3, 2021

A. Guiding Principles

1. Flexibility
 - i. Multiple data products appropriate for different analyses
 - ii. Ability to contribute data and preserve attributes and metadata characteristics in final products
 - iii. Ability to select an Area Of Interest (AOI) and Period Of Interest (POI) for constrained analysis
2. Transparency
 - i. Technical methods are completely described, and all algorithms, equations, and empirical data are documented and made available for examination
 - ii. Links to documentation (literature, user guides, websites, etc.)
 - iii. Data attributes from all original sources are carried through to final products
 - iv. Metadata accompany every dataset as a file header and/or additional attributes
3. Guidance
 - i. Guides a user through the steps in the processes, including data submittal, choosing the appropriate product for a given application, and accessing datasets
 - ii. Describes data and methods that may be unfamiliar to promote informed decision-making
4. Stability
 - i. Data and methods are stable enough across time so that multi-year comparisons can be made
 - ii. Data are accessible to a wide range of end-users and applications

B. Data Products and Services

1. Comprehensive fire activity datasets for preset domains offered by the IWDW
 - i. Datasets will include a set of minimum data elements and additional elements when available
 1. Minimum: (Fire ID, Fire name, Date)², Fire Type, Point Location, Fuel Characteristics, Total Consumption, Emissions for criteria and HAP pollutants, Data Source(s)
 2. Additional: Acres Burned, Reporting Agency, Plume Parameterization
 - ii. Datasets will be available in pre-determined formats appropriate for emissions inventories
 1. Comma-delimited
 2. Model-ready (e.g. FF10 or gridded)
 3. Geodatabase
 - iii. Domains:
 1. 36US, 12US2, 12WUS23
2. QA/QC report to accompany metadata
 - i. Spec sheet that includes versioned input datasets, versioned algorithms, links to activity processing rulesets
 - ii. Quality rubric that assesses data
 1. All events within the domain
 2. All events have fuel characteristics (e.g. no water or barren land)
 3. Coastal point locations on land
 4. Acres burned per day below pre-determined max by fire/fuel type
 5. Pre- and post-processed perimeter acres totals are within 2%
3. Multiple cycle times of product availability

¹ [Conceptual Model for Long-Term Fire Data Support project \(wrapair2.org\)](http://wrapair2.org)

² These three data elements together will be unique for each record in the dataset

³ https://views.cira.colostate.edu/iwdw/docs/WRAP_WAQS_2014v2_MPE.aspx

Table 1. Summary of Data Products, Cycle Times, and Applications

Hierarchy	Input Datasets and Tools	Timing	Purpose
Level 0 Base EI	<ul style="list-style-type: none"> NIFS (InForm), HMS, Default Fire Geography WFEIS Emissions Calculator 	Available annually no later than 6 months after the end of the previous calendar year	<ul style="list-style-type: none"> Base platform for subsequent levels Rapid-response first-order estimate of daily emissions
Level 1 Enhanced Reporting EI	<ul style="list-style-type: none"> Level 0, SMP Reports, Annual Fire Geography WFEIS Emissions Calculator 	Available annually no later than 12 months after the end of the previous calendar year	<ul style="list-style-type: none"> EI analysis and reporting Exceptional Events
Level 2 Enhanced Activity EI	<ul style="list-style-type: none"> Level 1, GOES AFP (diurnal activity), MTBS WFEIS Emissions Calculator 	Available annually no later than 18 months after the end of the previous calendar year	<ul style="list-style-type: none"> Photochemical Grid Modeling (PGM) Suitable for climatology analyses
Specialty	<ul style="list-style-type: none"> Level 2 with additional reporting 	Available as needs arise	<ul style="list-style-type: none"> Regional Haze Modeling, e.g. future fire scenarios

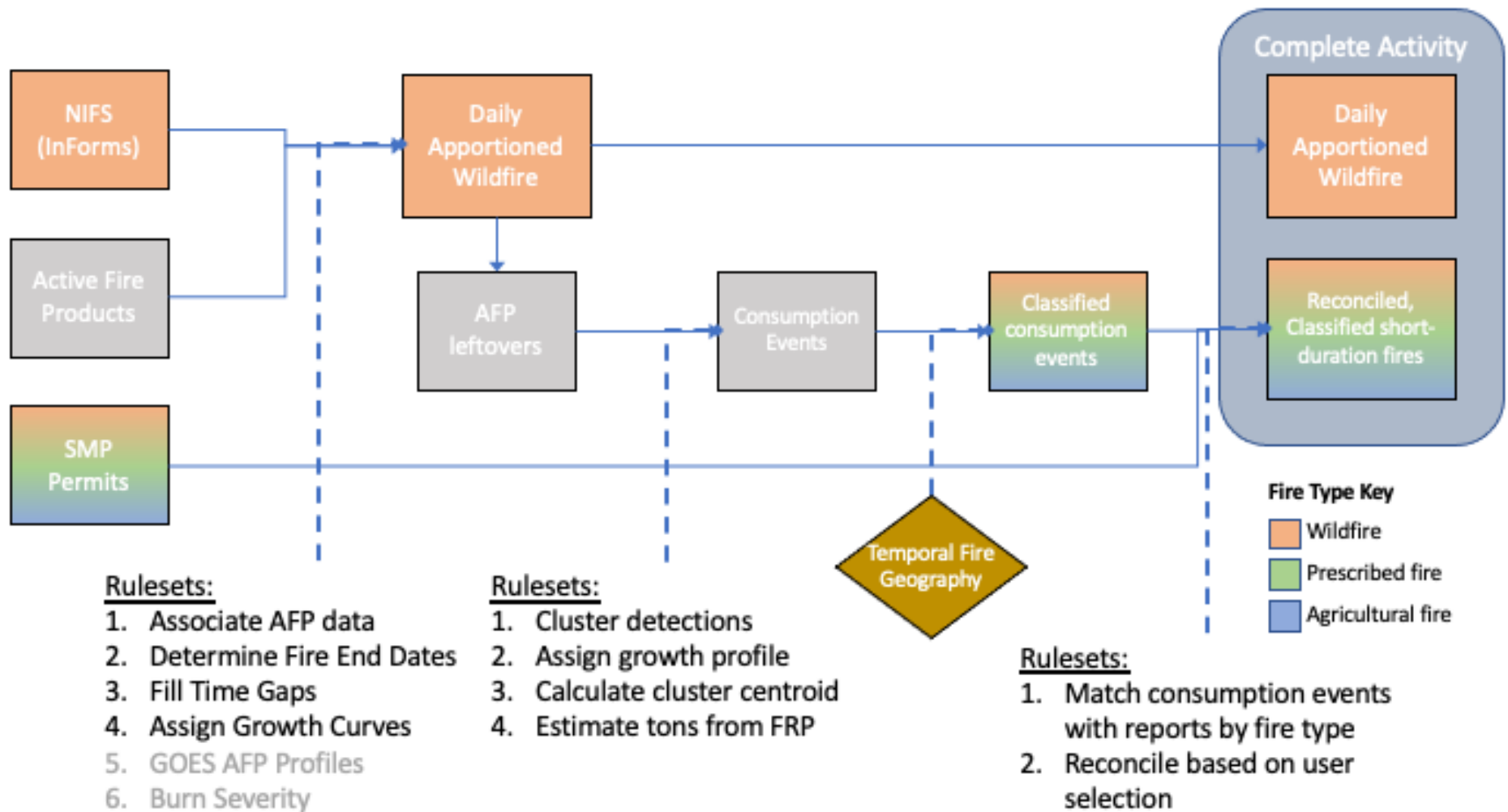
Activity datasets will be developed first by the WRAP. Once datasets pass the QA/QC assessment, they are loaded into the WFEIS. Final datasets that include activity and emissions are sent back and stored in the IWDW. Activity data sent to the WFEIS will continue to be available through its web-based calculator tool to allow for user-defined analyses and calculations, and selection of custom AOI and POI.

The following figures outline a conceptual model for estimating fire activity using three primary input data streams and calculating emissions using the Wildland Fire Emissions Inventory System (WFEIS).

Figure 3 begins with three primary sources of fire activity data: wildfire perimeters from the NIFS system; satellite-detected events from Active Fire Product datasets available from VIIRS, AVHRR, MODIS, and/or GOES; and activity reports from smoke management programs (SMPs) and/or air quality programs. Data are processed into daily activity classified by fire type (wildfire, prescribed burning, and agricultural burning) by applying rulesets appropriate to the source datasets. Events derived solely from satellite information will rely on Fire Radiative Power (FRP) to estimate consumption. To assign fire type to these events, a fire geography dataset will be developed that contains spatiotemporal guides for burn types based on land ownership, land use/land cover, and airshed management. Satellite-derived events will be reconciled with SMP data according to the prioritization preferences selected by the dataset owners.

Figure 4 shows the next steps in the process, taking the complete activity data from Figure 3 and calculating daily emissions using the WFEIS. Note that emissions for events based on FRP profiles will bypass the majority of the WFEIS process since consumption is estimated directly as part of the activity processing. Datasets, now with emissions, are exported from WFEIS and posted to the IWDW as complete emissions inventory files in various formats.

Figure 1. Conceptual Model for building activity datasets within the Continental United States



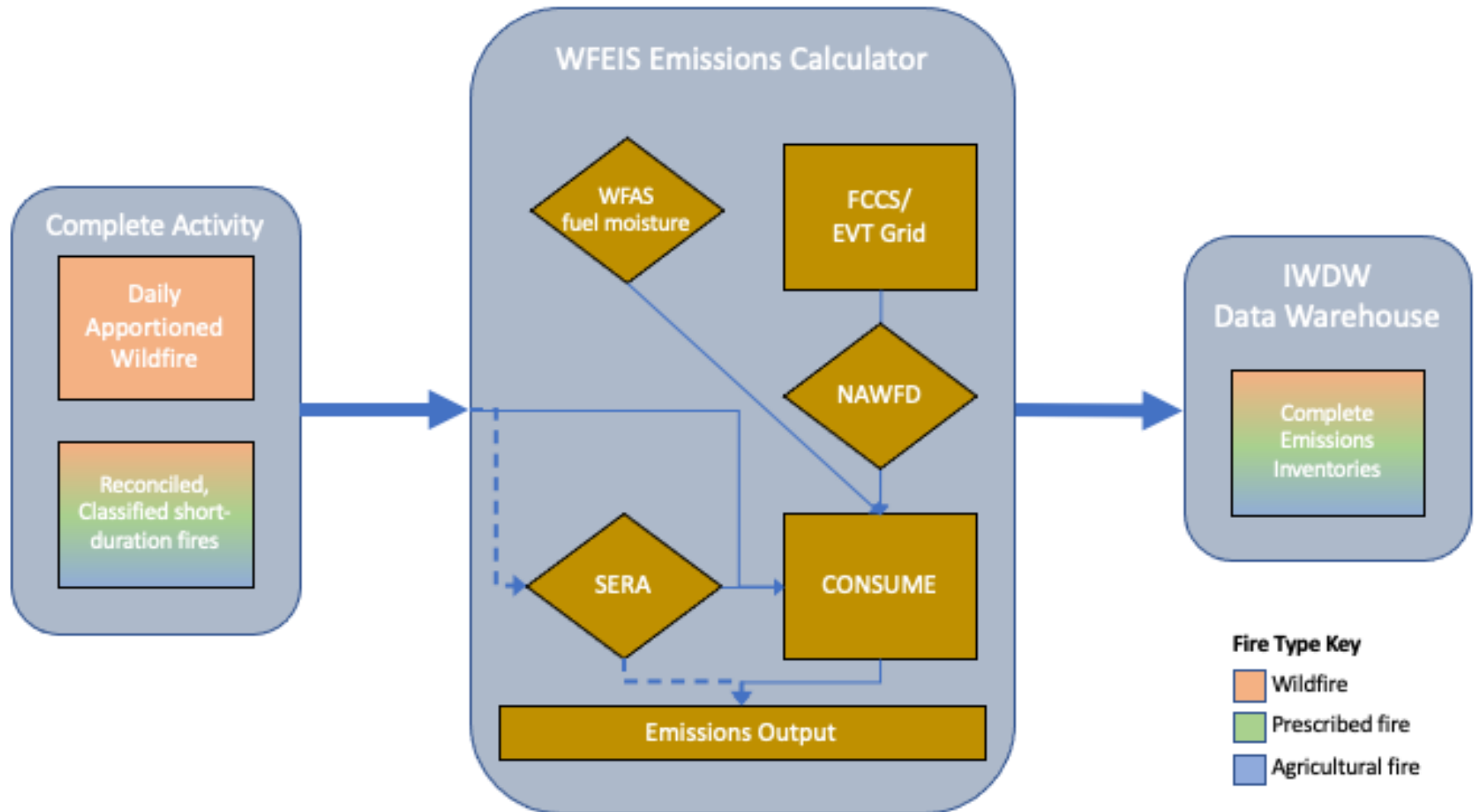
Definitions:

HMS – [Hazard Mapping System](#), a NOAA product that combines FRP-based fire detections from multiple sensors

NIFS – [National Incident Feature Service](#), a consolidated dataset of fire perimeters certified by the National Interagency Fire Center

SMP Permits – Activity data about short-duration fires from Smoke Management Programs, gathered through state-specific permitting processes

Figure 2. Interaction of Activity Datasets, Wildland Fire Emissions Inventory System emissions calculation process, and Data Warehouse. For more details about WFEIS see French et al. 2014⁴



Definitions:

WFAS—[Wildland Fire Assessment System](#), a daily compilation of fuel moisture information from a network of fire weather stations across the United States

FCCS/EVT—Fuel Characteristics Classification System/[Existing Vegetation Type](#), a gridded dataset of fuels using multiple strata that is compatible with [Consume](#)

NAWFD—[North American Wildland Fuels Database](#), a web service that aggregates fuel loading information from 26,620 field sites mapped to FCCS/EVT fuelbeds

SERA—[Smoke Emissions Repository Application](#), a database of field and laboratory emission factors of wildland fire across the United States and Canada

⁴ French, N.H.F., D. McKenzie, T. Erickson, B. Koziol, M. Billmire, K.A. Endsley, N.K.Y. Scheinerman, L. Jenkins, M.E. Miller, R. Ottmar, and S. Prichard. "Modeling regional-scale fire emissions with the Wildland Fire Emissions Information System." *Earth Interactions* 18, no. 16 (2014)

C. Operations and Maintenance

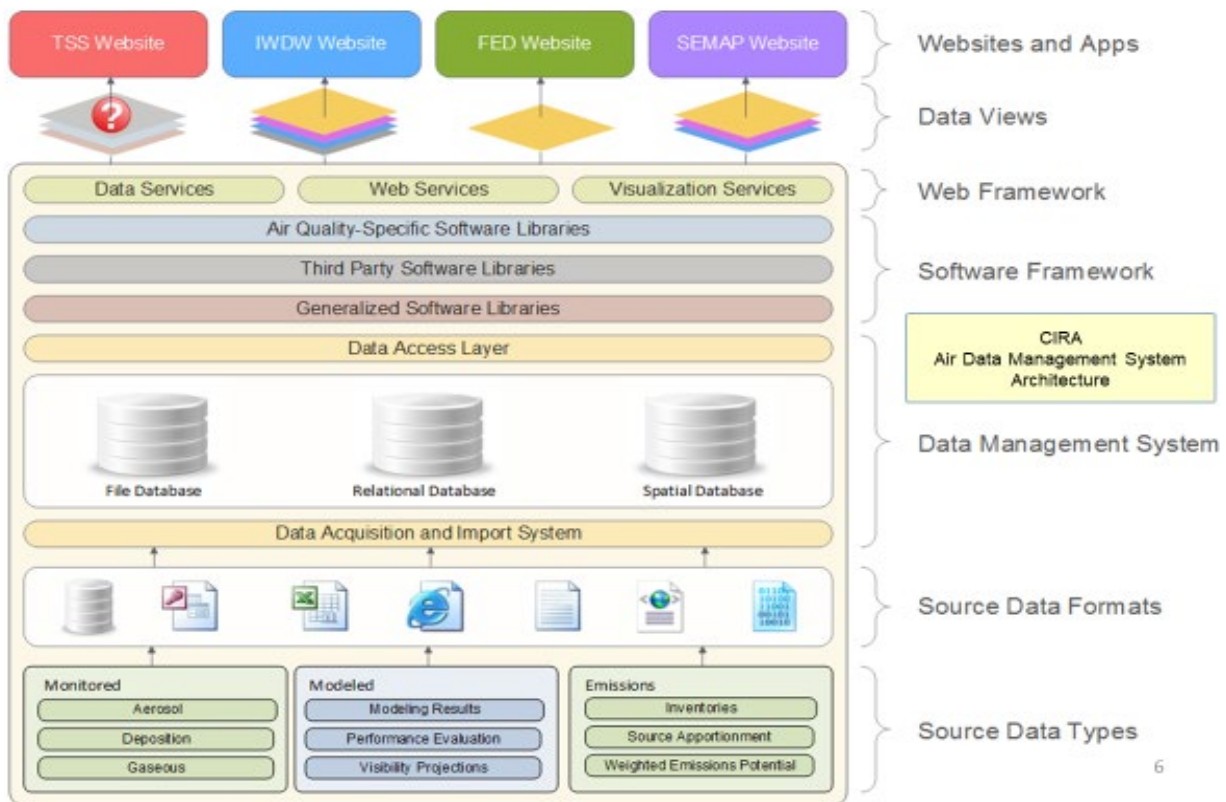
1. Host site – Intermountain West Data Warehouse⁵
 - i. March 3, 2021 high-level status report on IWDW and associated websites by WESTAR and CIRA
 1. WESTAR (Tom Moore) modeling progress report presentation⁶
 2. CIRA (Shawn McClure) Air Data Mgmt. System / IWDW operations presentation⁷
 3. See below for Figure 1 for architecture and Figure 2 for delivery websites
 - ii. WESTAR-WRAP Long-Term Fire Data website (LTFD – better acronym!?) would be added to CIRA ADMS portfolio
 1. Activities by CIRA
 - a. Hardware
 - b. Networking
 - c. Software
 - d. Develop and implement LTFD website
 - e. Register and track users
 - f. Track data uses and requests
 - g. Report composition of website traffic for organizations / user types
 - iii. Staffing
 1. CIRA LTFD implementation = 1.0 FTE, software engineer reporting to Shawn McClure
 - a. Annual cost, ongoing
 - b. Funding mechanism would be existing WESTAR-WRAP agreement with CSU/CIRA for IWDW and TSS operations and maintenance (20% indirect rate), add LTFD effort
 - c. Tom Moore to provide on-site facilitation and coordination at CIRA
 2. Air Sciences' support for design assistance/calculations/QA via existing WESTAR contract
 - a. Collaboration with MTRI to implement WFEIS datasets and tools
 - b. Collaboration with CSU-CIRA on presentation and management of datasets and metadata in the Warehouse
 - c. Develop process and format for WESTAR-WRAP member agencies to have their fire activity and emissions data included and made accessible via the standard Warehouse inventory products and datasets
 - d. Analyze and ensure consistency for data available from the Warehouse
 - e. Greatest effort would be year 1 and taper back to a constant lower level of effort in year 2 and onward
 - f. Tom manages Air Sciences' contract with regular reporting to WESTAR-WRAP Fire & Smoke WG

⁵ <https://views.cira.colostate.edu/iwdw/>

⁶ https://views.cira.colostate.edu/docs/iwdw/meetings/OC_20210303/IWDW-WAQSm modeling_overviewMarch3_2021.pptx

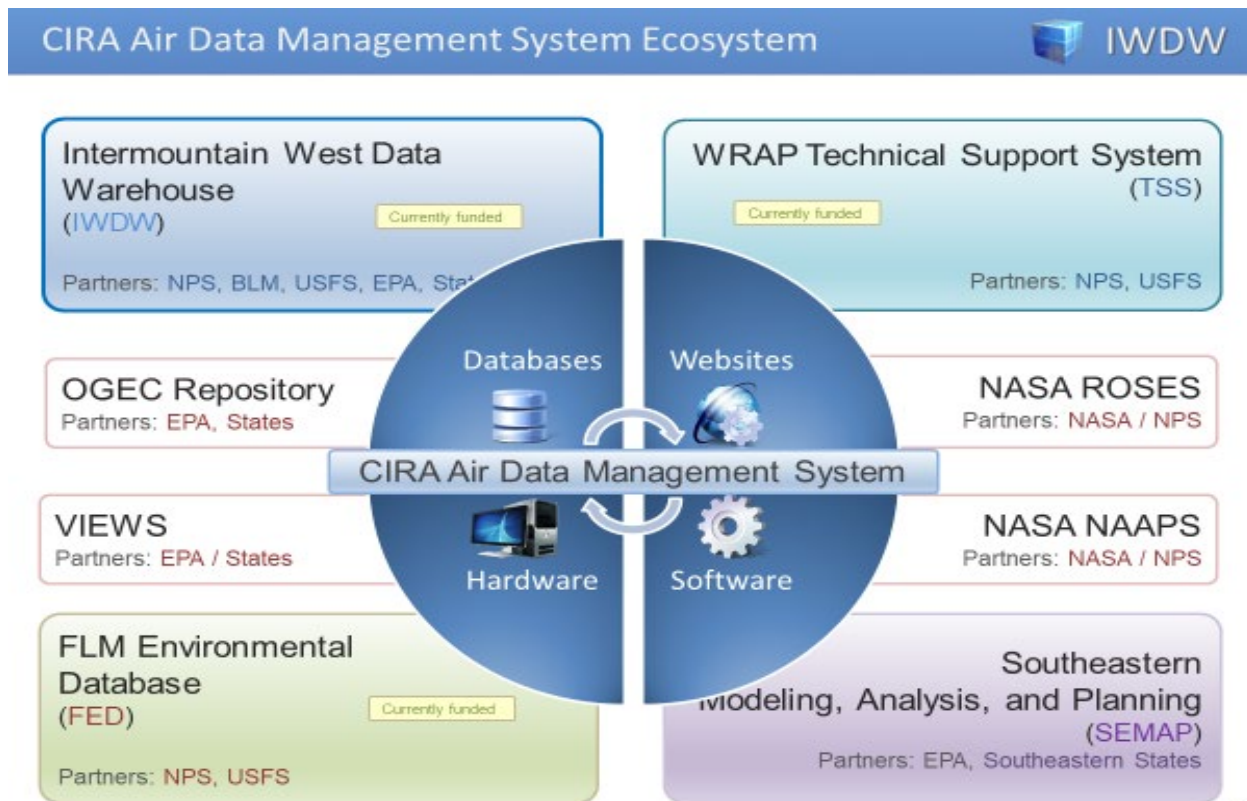
⁷ https://views.cira.colostate.edu/docs/iwdw/meetings/OC_20210303/IWDW_OC_Meeting_20210303.pptx

Figure 3. CIRA Air Data Management System architecture



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Figure 4. CIRA Air Data Management System ecosystem of website instances



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