THE NASA RECOVER DSS

A Low-Cost, Value-Added Resource for the Wildfire Community
Technical Overview of Geospatial Base Layers and System Capabilities

The NASA RECOVER wildfire decision support system (DSS) is an innovative new capability that delivers 25 mission-critical datasets specifically tailored to each fire event where RECOVER is used (Table 1). These standard base layers are acquired from authoritative sources and updated on an annual basis. Special web optimization processing is applied to the base layers to ensure high-speed performance of RECOVER's user-friendly, web map analysis environment. As a part of RECOVER's value-added suite of capabilities, these base layers can be enhanced upon request by the addition of other fire-specific layers, such as fire-affected vegetation, NDVI anomaly/departure, and debris flow probability.

RECOVER was developed by ISU's GIS Training and Research Center (GIS TReC) and NASA Goddard Space Flight Center. It is the product of a nationally-recognized effort by NASA's Applied Sciences Program to deliver cost-effective, state-of-the art GIS analytic capabilities to the agencies involved in fighting wildfires. This document provides technical details about RECOVER's base layers and the specialized, value-added processing that makes the system uniquely suited to our customer's needs.

Table 1. General description of the base layers used in the RECOVER DSS

Base Layer name	Data Structure	Authoritative Source
Fires1950_Present	Geodatabase polygon feature class	USGS GeoMac
Geology	Geodatabase polygon feature class	USGS
Habitat	Geodatabase polygon feature class	USDI BLM
LandslidePotential	Geodatabase polygon feature class	USGS
NHD	Geodatabase line feature class	USGS
PLSS	Geodatabase polygon feature class	USDI BLM
Roads	Geodatabase line feature class	USGS and USFS
SMA	Geodatabase polygon feature class	USDI BLM
Soils_SSURGO	Geodatabase polygon feature class	NRCS
Soils_STATSGO	Geodatabase polygon feature class	NRCS
WatershedsWBD	Geodatabase polygon feature class	USGS
Wetlands	Geodatabase polygon feature class	US FWS, National Wetlands Inventory (NWI)
Ecological Resilience/Resistance	GeoTIFF	USDI BLM and NRCS
BPS_BiophysicalSetting	GeoTIFF	Landfire
ESP_EnvironmentalSitePotential	GeoTIFF	Landfire
EVC_ExistingVegetationCover	GeoTIFF	Landfire
EVT_ExistingVegetationType	GeoTIFF	Landfire
FRG_FireRegimeGroup	GeoTIFF	Landfire
HistoricFires_PastDecade	GeoTIFF	USGS GeoMac
Soils_STATSGO_Kfactor	GeoTIFF	NRCS
Elevation	GeoTIFF	USGS, National Elevation Dataset (NED)
Aspect	GeoTIFF	USGS, National Elevation Dataset (NED)
Slope_degree	GeoTIFF	USGS, National Elevation Dataset (NED)
Slope_percent	GeoTIFF	USGS, National Elevation Dataset (NED)
Slopes_GTE30d	GeoTIFF	USGS, National Elevation Dataset (NED)
Hillshade	GeoTIFF	USGS, National Elevation Dataset (NED)

RECOVER's Web Optimization Processing
Part of the annual update process includes web optimization processing developed at ISU's GIS Training and Research Center (GIS TReC). This processing is done using Esri's ArcGIS software and helps ensure high-speed performance of these data within each RECOVER web map.

Beginning in October of each year a search is made to locate edited or updated base layers from their authoritative source. Not every base layer is updated each year; however, one layer that is updated annually is the historic fires dataset (Fires1950_Present). We will use this dataset to describe the web optimization process.

The Fires1950_Present base layer describes all documented wildfires across RECOVER's 11 state region of the Western US (Fig. 1) beginning with the 1950 fire season through the present. Since active fires from 2016 become historic fires in 2017, this base layer needs to be updated and maintained.

Figure 1. The 11 states included in the NASA RECOVER DSS response area.

When new data has been released by GeoMac (usually early in January) it is downloaded and reviewed with ArcGIS. Initial review looks at the structure of the data (e.g., are the data stored in a geodatabase or shapefiles? And how are updated fire perimeters for a given fire handled in the data structure?). If multiple fire perimeters are found for a given fire, only the most current version is retained in RECOVER's base layer. A second part of the review process looks closely at the attribution (schema) used across states, etc. The schema(s) is compared to the existing base layer's schema and a workflow is designed to ensure the update proceeds correctly.

Individual fires perimeter polygon layers within each state are then merged into a single feature class for that state. Advanced topology tools in ArcGIS are used to locate errors (e.g., overlap that might indicate two or more polygons exist for one fire which may occur if the fire had been given different names), explore the potential errors, and correct these errors. Next, the clean 11 state feature classes are merged into a new feature class for that year and the advanced topology process is used again to locate duplicate fires that may have burned across state boundaries. The advanced topology process is used twice to

reduce confusion on the part of the technician editing these data. Once completed, a clean new fire layer has been produced (e.g., 2016_Fires). This layer is then reviewed for accuracy and consistency before proceeding. Part of this review process includes a schema match comparison of the annual fire layer to the existing base layer. In some instances, unnecessary attributes are deleted while other attributes are converted from text/string format into numeric format using coded value attribute domains. The annual fire layer is then appended to the base layer and moved to the server for use in the upcoming fire season. Similar processing is completed for each base layer requiring an update.

RECOVER's Other Value-Added Processing

In addition to RECOVER base layers being kept current, there are other value-added enhancements. All base layers are projected into a common geospatial reference system (USA Contiguous Albers Equal Area, cf., Fig. 2) to ensure all layers overlay each other correctly relative to the real world. In addition, common attribution is ensured across all eleven states using fields specifically selected to provide actionable information to the land manager in RECOVER's partner agencies.

```
USA_Contiguous_Albers_Equal_Area_Conic_USGS_version
WKID: 102039 Authority: Esri

Projection: Albers
False_Easting: 0.0
False_Northing: 0.0
Central_Meridian: -96.0
Standard_Parallel_1: 29.5
Standard_Parallel_2: 45.5
Latitude_Of_Origin: 23.0
Linear Unit: Meter (1.0)
```

Figure 2. The geospatial reference system used by the NASA RECOVER DSS.

Another significant addition available through RECOVER's base layers is specific to the SSURGO base layer. In this case, we have converted the available data into a relational database structure within the Esri Geodatabase schema and provided a link to the Ecological Site/Plant Association report (fig. 3) for each specific SSURGO soils polygon. These data are stored on an ISU GIS TReC server and instantly accessible through RECOVER. This capability alone has the potential to save many hours of a land manager's time as they research the fire site.

Ecological Site/Plant Association and Vegetation (ID)

Owyhee County Area, Idaho

[Composition of forest understory vegetation is based on canopy cover. Composition of rangeland vegetation is based on dry weight]

Map symbol and soil name	Ecological site or plant association	Common trees	Forest understory or rangeland characteristic vegetation	Composition Forest	Composition Range
				Pct	Pct
45:					
Deunah	CLAYEY 12-16 ARARL/FEID (R025XY014ID)	---	Idaho fescue	---	35
			early sagebrush	---	25
			bluebunch wheatgrass	---	10
			other shrubs	---	5
			other perennial forbs	---	5
			other perennial grasses	---	5
			Phlox	---	5
Yatahoney	CLAYEY 12-16 ARARL/FEID (R025XY014ID)	---	Idaho fescue	---	30
			early sagebrush	---	20
			bluebunch wheatgrass	---	15
			longleaf hawksbeard	---	5
			needlegrass	---	5
			other shrubs	---	5
			other perennial forbs	---	5
			other perennial grasses	---	5
Lostvalley	CLAYEY 12-16 ARARL/FEID (R025XY014ID)	---	Idaho fescue	---	30
			early sagebrush	---	25
			bluebunch wheatgrass	---	15
			other shrubs	---	5
			other perennial forbs	---	5
			other perennial grasses	---	5
			Phlox	---	5

USDA Natural Resources Conservation Service

Survey Area Version: 11
Survey Area Version Date: 08/13/2012

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Figure 3. Example of the Ecological Site report available through the RECOVER DSS.

RECOVER's Value-Added Benefits

RECOVER base layers provide our partner end-user with numerous benefits. These layers are automatically clipped to a fire's area of interest (i.e., a rectangle bounding the fire perimeter defined by the land manager) to ensure rapid data processing, display, and simplified downloads. In addition, RECOVER provides:

- Seamless, wall-to-wall coverage across the Western United States
- Common geospatial reference system to ensure correct data overlay and feature registration
- Derived topographic products of slope, aspect, hill shade, and a special steep slopes designation layer
- ArcGIS-ready map services and easy to download fire-specific source data
- One-click report downloads describing the acreage of the fire by agency and soil associations
- Rapid access to all these data within a single common interface

To learn more about RECOVER, please visit http://giscenter.isu.edu/research/Techpg/nasa_RECOVER