



# Public Health Applications in Remote Sensing

## Delivery of Time- Enabled WMS via KML

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# Overview

- Relevant standards
- Time-enabled WMS request model
- KML GroundOverlay
- Integration of time-enabled WMS in KML
- Deployment into Google Earth
- Implementation issues
- Conclusions



# Relevant Standards

- OGC Web Map Services (WMS)
  - *Service interface developed for the delivery of map images*
  - Basic WMS standard defines *GetCapabilities*, *GetMap* requests
  - Time-enabled WMS services support an optional *time* parameter as part of the request
- OGC KML
  - *Standard focused (not exclusively) on geographic visualization, including annotation of maps and images*
  - Includes support for integration of WMS service calls through its *GroundOverlay* capability



# Time-Enabled WMS Request Model

- Basic WMS GetMap Request

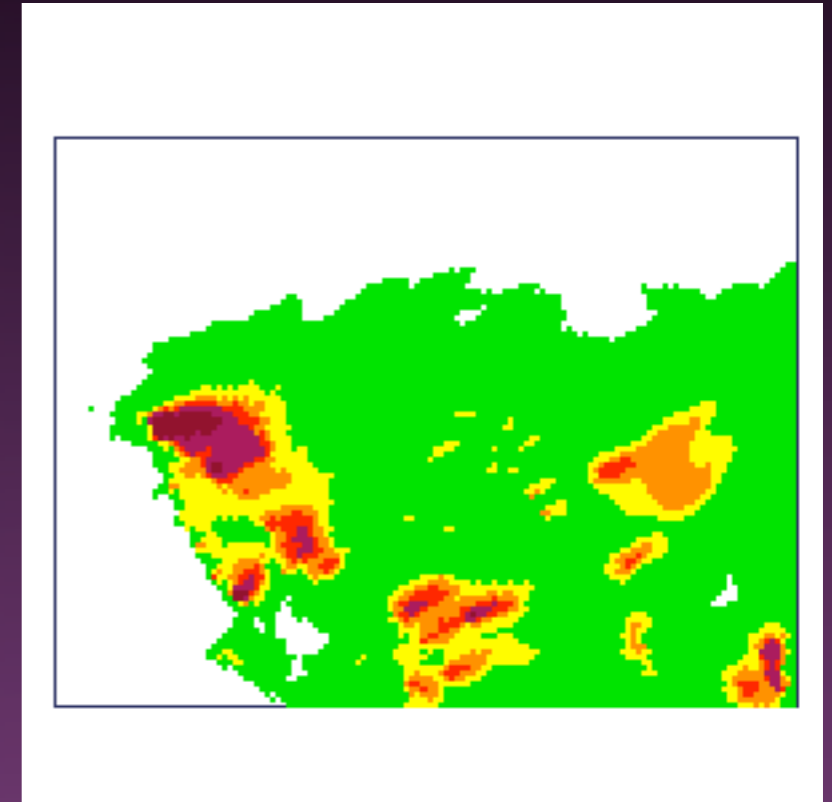
```
http://edacwms.unm.edu/cgi-bin/mapfiles/  
imagery_wms?  
WMTVER=1.1.1&SERVICE=WMS&REQUEST=GetMap&SRS  
=EPSG:4326&FORMAT=image/  
jpeg&STYLES=&LAYERS=modis_nm&TRANSPARENT=TR  
UE&WIDTH=300&HEIGHT=300&bbox=-110.6387,35.0  
,-107.2387,38.4
```





# Time-Enabled WMS Request Model

TIME=2008-01-07T00:00:00Z



- Time Enabled WMS GetMap Request

```
http://phairs-devel.unm.edu/cgi-bin/  
mapserv_5.0.0&map=mapmodule_wms.map&SERVICE  
=WMS&VERSION=1.1.1&REQUEST=GetMap&TRANSPARE  
NT=TRUE&STYLES=&FORMAT=image/png&SRS=EPSG:  
4326&Width=300&Height=300&Layers=model_doma  
in,dream_pm10_classed&BBOX=-121,23,-96,48&
```

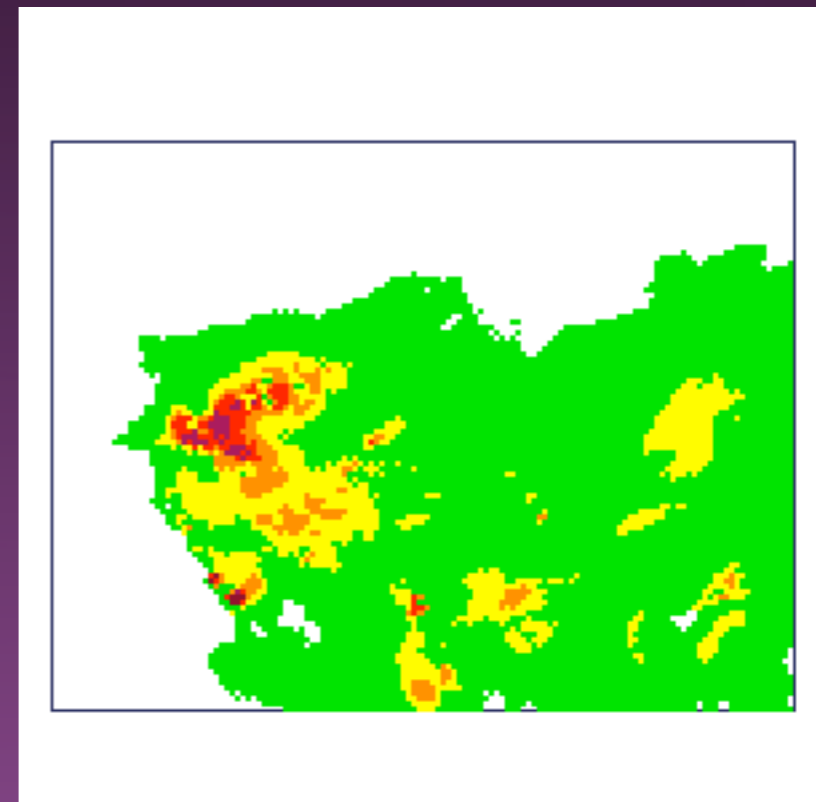


# Time-Enabled WMS Request Model

- Time Enabled WMS GetMap Request

```
http://phairs-devel.unm.edu/cgi-bin/  
mapserv_5.0.0&map=mapmodule_wms.map&SERVICE  
=WMS&VERSION=1.1.1&REQUEST=GetMap&TRANSPARE  
NT=TRUE&STYLES=&FORMAT=image/png&SRS=EPSG:  
4326&Width=300&Height=300&Layers=model_doma  
in,dream_pm10_classed&BBOX=-121,23,-96,48&
```

TIME=2008-01-07T06:00:00Z



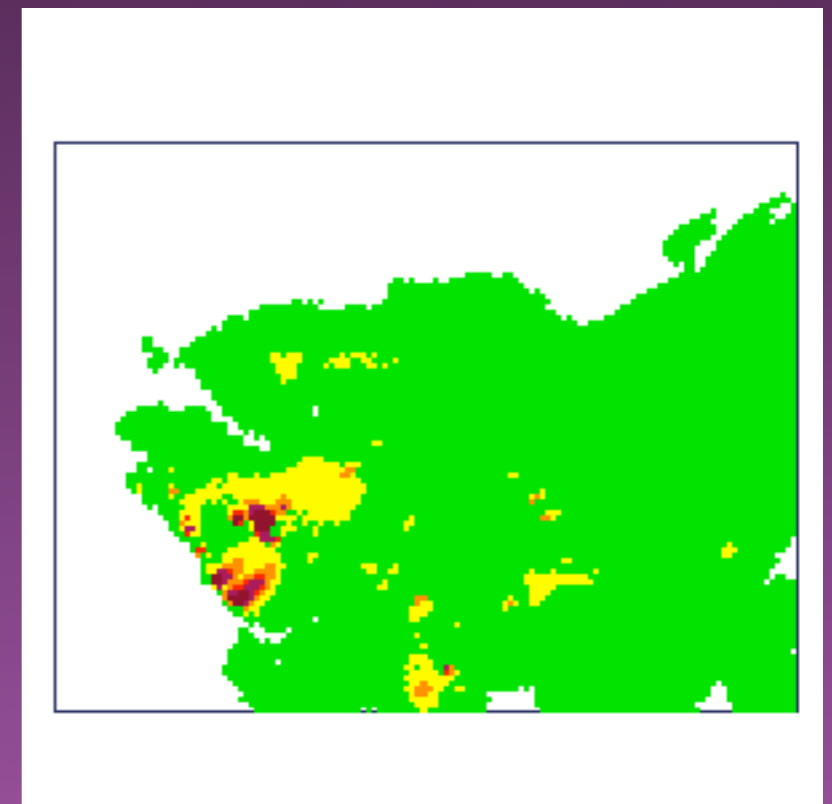


# Time-Enabled WMS Request Model

- Time Enabled WMS GetMap Request

```
http://phairs-devel.unm.edu/cgi-bin/  
mapserv_5.0.0&map=mapmodule_wms.map&SERVICE  
=WMS&VERSION=1.1.1&REQUEST=GetMap&TRANSPARE  
NT=TRUE&STYLES=&FORMAT=image/png&SRS=EPSG:  
4326&Width=300&Height=300&Layers=model_doma  
in,dream_pm10_classed&BBOX=-121,23,-96,48&
```

TIME=2008-01-07T12:00:00Z





# KML GroundOverlay

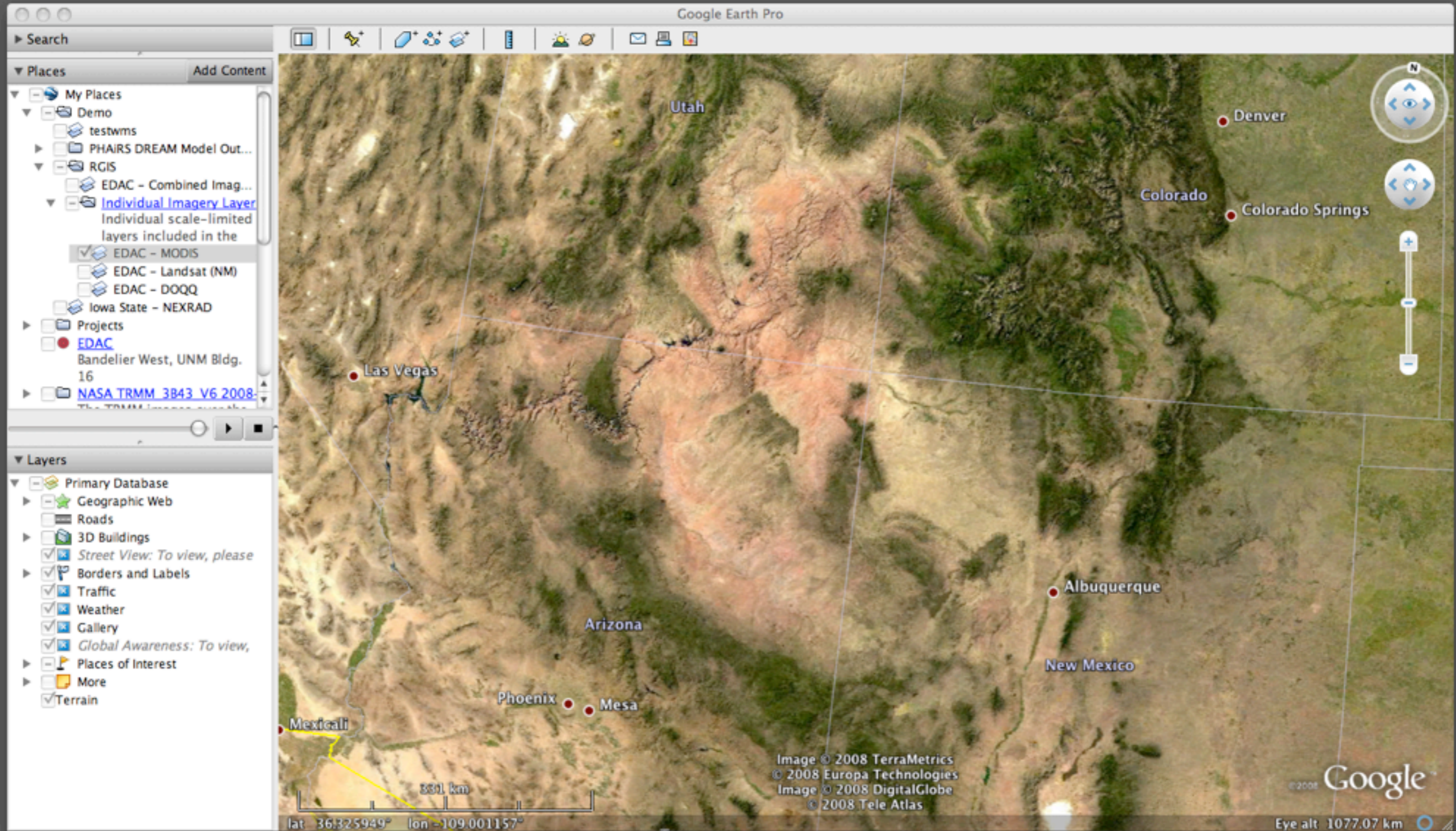
- Basic WMS Layer

```
<?xml version="1.0" encoding="UTF-8"?>
<kml xmlns="http://www.opengis.net/kml/2.2">
<GroundOverlay>
  <name>EDAC - DOQQ</name>
  <visibility>0</visibility>
  <open>1</open>
  <Icon>
    <href>http://edacwms.unm.edu/cgi-bin/mapfiles/imagery\_wms?VERSION=1.1.1&REQUEST=GetMap&SRS=EPSG:4326&LAYERS=doqq05,doqq06\_gaps,doqq06&TRANSPARENT=TRUE&FORMAT=image/jpeg&STYLES=&WIDTH=1024&HEIGHT=1024</href>
    <viewRefreshMode>onStop</viewRefreshMode>
  </Icon>
  <LatLonBox>
    <north>45.29291497303174</north>
    <south>22.35233061474838</south>
    <east>-86.27820185334545</east>
    <west>-130.721796390938</west>
  </LatLonBox>
</GroundOverlay>
</kml>
```





# Basic GroundOverlay in Google Earth





# Integration of Time-enabled WMS in KML

- Addition of temporal element into the *GroundOverlay* element

- *kml:TimeSpan*

```
<TimeSpan>  
  <begin>2008-01-07</begin>  
  <end>2008-01-07T00:59:59Z</end>  
</TimeSpan>
```

- *kml:TimeStamp*

```
<TimeStamp>  
  <when>2008-01-07</when>  
</TimeStamp>
```



# Time-Enabled *GroundOverlay*

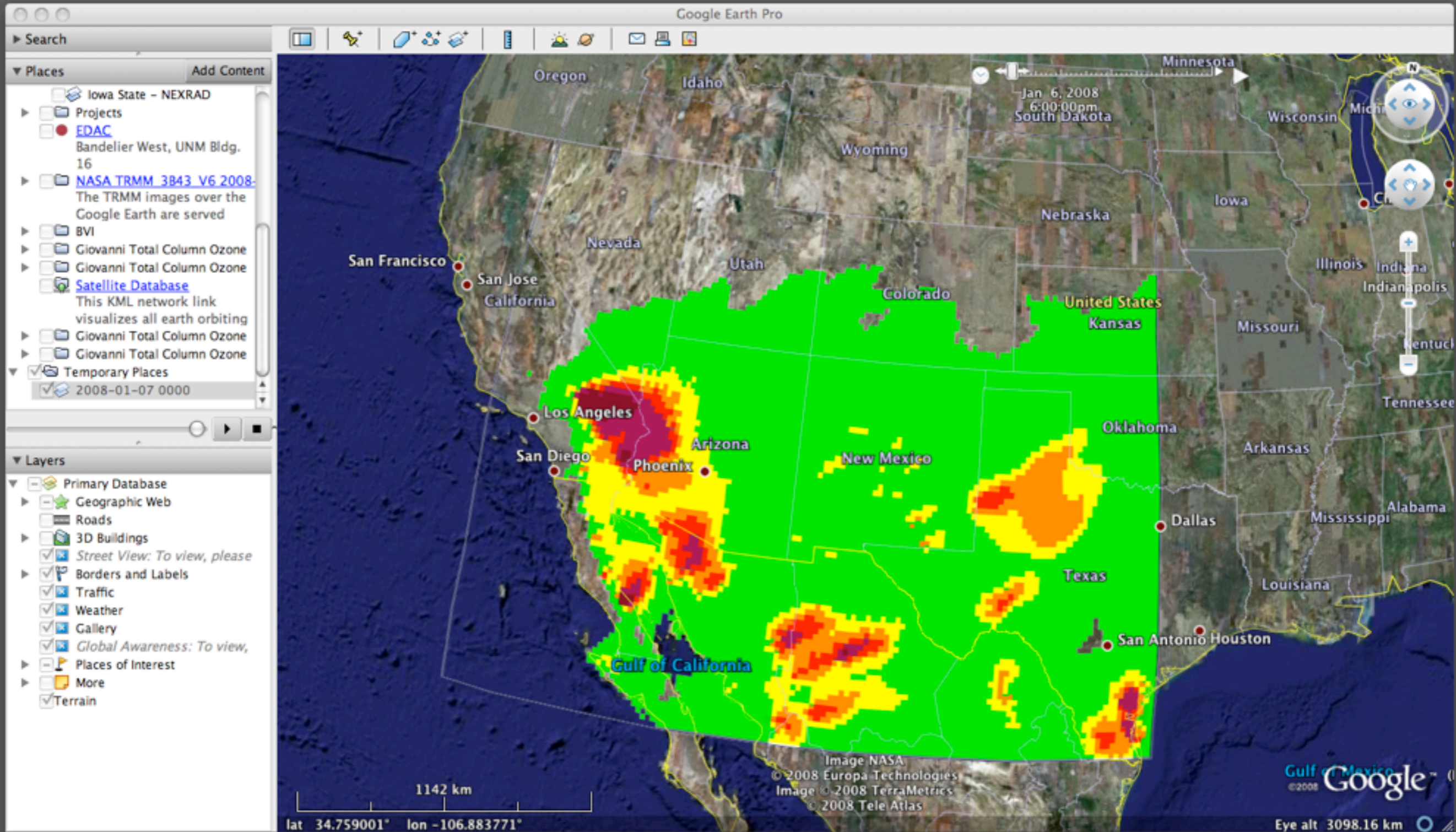
- Time-enabled WMS Layer

```
<?xml version="1.0" encoding="UTF-8"?>
<kml xmlns="http://www.opengis.net/kml/2.2">
  <GroundOverlay>
    <name>2008-01-07 0000</name>
    <visibility>0</visibility>
    <TimeSpan>
      <begin>2008-01-07</begin>
      <end>2008-01-07T00:59:59Z</end>
    </TimeSpan>
    <Icon>
      <href>http://phairs-devel.unm.edu/cgi-bin/mapserv_5.0.0?
map=mapmodule_wms.map&SERVICE=WMS&VERSION=1.1.1&REQUEST=Get
Map&TRANSPARENT=TRUE&STYLES=&FORMAT=image/png&SRS=EPSG:
4326&Width=1000&Height=1000&Layers=model_domain,dream_pm10_
classed&TIME=2008-01-07T00:00:00Z&</href>
      <viewRefreshMode>onStop</viewRefreshMode>
    </Icon>
    <LatLonBox>
      <north>90</north>
      <south>-27.74775167156848</south>
      <east>180</east>
      <west>-180</west>
    </LatLonBox>
  </GroundOverlay>
</kml>
```

- Why use *TimeSpan* instead of *TimeStamp*?



# Time-Enabled GroundOverlay in Google Earth





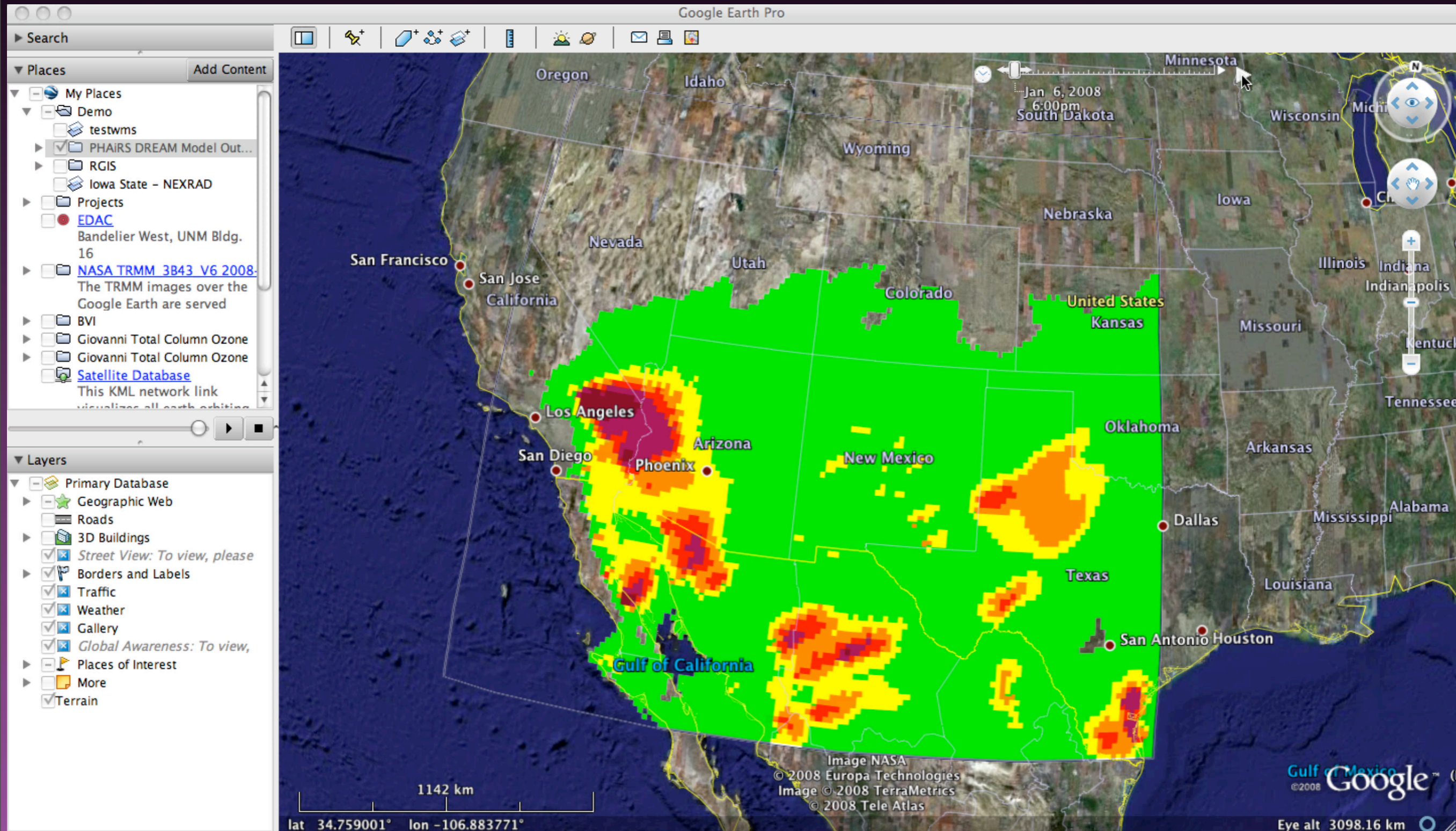
# Multiple Time-Enabled WMS Requests in KML

- Multiple *GroundOverlay* elements within a *Folder*

```
<?xml version="1.0" encoding="UTF-8"?>
<kml xmlns="http://www.opengis.net/kml/2.2">
<Folder>
  <name>PHAIRS DREAM Model Outputs - PM10</name>
  <visibility>0</visibility>
  <GroundOverlay> ... </GroundOverlay>
  <GroundOverlay> ... </GroundOverlay>
  ...
  <GroundOverlay> ... </GroundOverlay>
</Folder>
</kml>
```



# Multiple Time-Enabled WMS Requests in Google Earth





# Implementation Issues

- The current time specification model requires explicit *GroundOverlay* elements for each time step
  - ✓ Include a WMS-style time-range and interval specification for repeating time sequences
  - ✓ Add a *datetime* query parameter that can be appended to the `kml:href` request (used as part of the *GroundOverlay* element). This would complement the bounding box parameters that are available within the specification.
- The current specification allows for implicit temporal resolution for time elements to date
  - ✓ Extend the implicit time resolution specification to a higher resolution - from date to at least hour



# Conclusions

- Time-enabled WMS has proven to be a very powerful model for the efficient delivery of map images from large collections of model outputs (e.g. over 52k output rasters/particle size for DREAM Dust model outputs)
- KML's WMS and time support has streamlined the delivery of collections of model outputs into clients that implement the standards.
- The implementation of time-enabled WMS within a specific application has highlighted areas where the KML specification can be extended to better support the delivery of time-enabled content





# Resources

- de la Beaujardiere, J. (Ed.). (2006). OpenGIS Web Map Server Implementation Specification, Version 1.3.0 (Vol. OGC® 06-042): Open Geospatial Consortium. <http://www.opengeospatial.org/standards/wms>
- Wilson, T. (Ed.). (2008). OGC® KML, Version 2.2.0 (Vol. OGC 07-147r2): Open Geospatial Consortium. <http://www.opengeospatial.org/standards/kml>