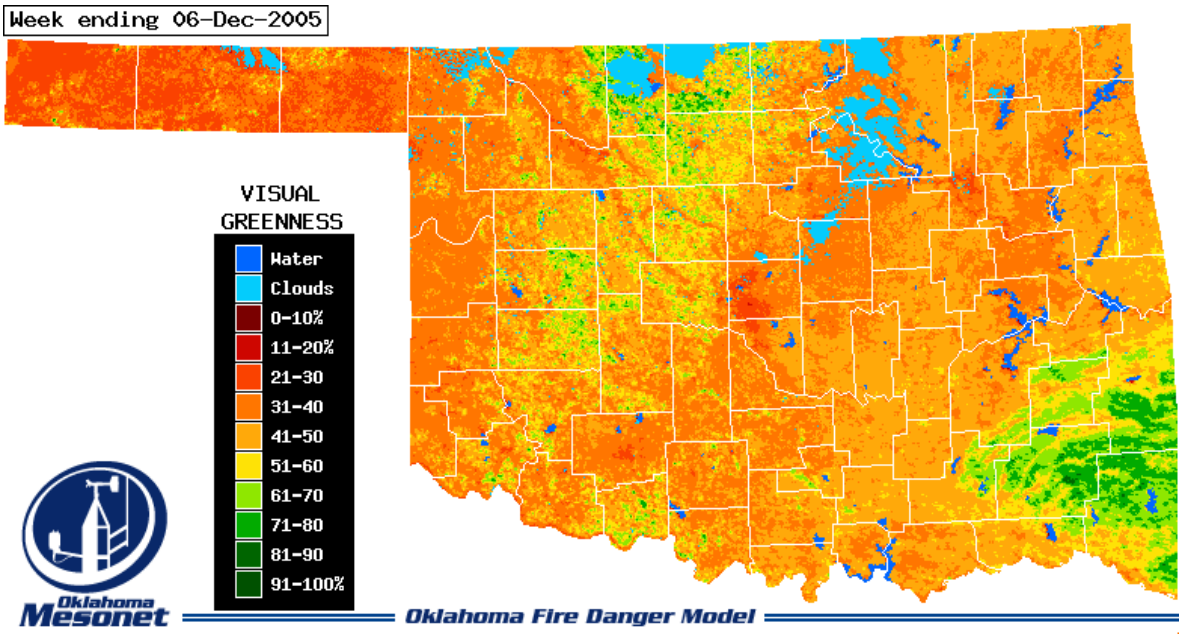
USE OF SATELLITE DATA TO ASSESS VEGETATION GREENNESS

Weekly composite satellite images (1-km resolution) of surface NDVI (Normalized Difference Vegetation Index) are utilized in the Oklahoma Fire Danger Model to assess live herbaceous and woody moisture, as well as to control the fuel load distribution between 1-h dead fuels and live herbaceous and deciduous woody fuels. As such, NDVI to a large extent influences the output from the fire danger model; it does not, however, influence dead fuel moisture (1-, 10-, 100-, and 1000-h), the dead fuel loads of the heavier fuels (10-h and higher), or KBDI.

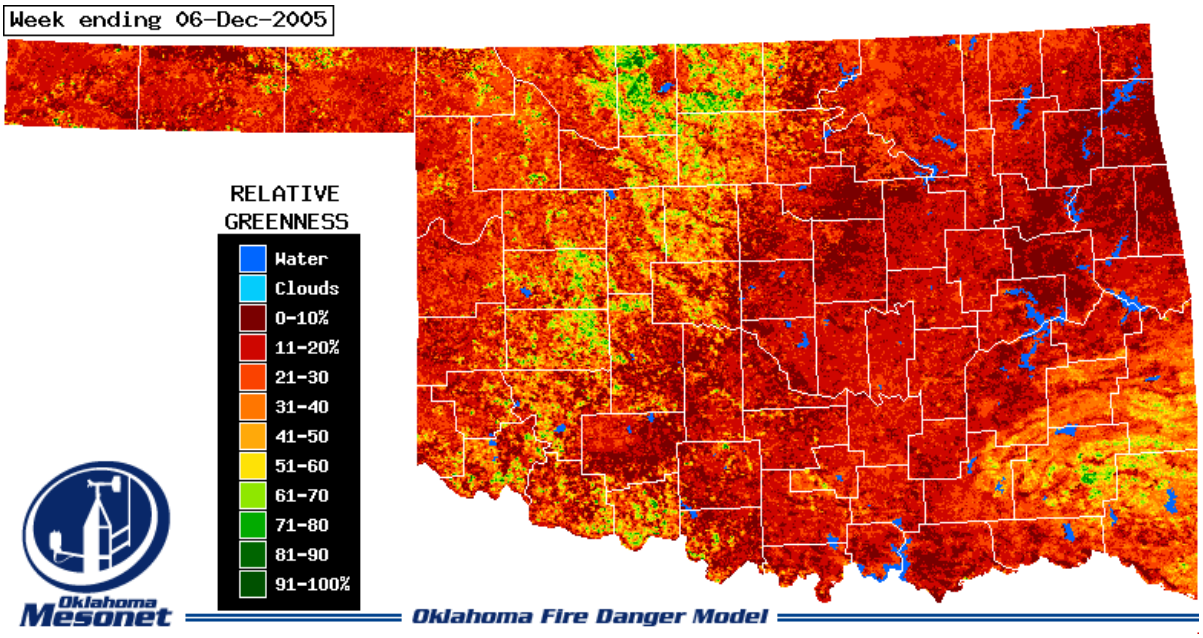
NDVI relates to the photosynthetic activity of living plants. The higher the NDVI value, the more "green" the land cover. That is, NDVI increases as the amount of green biomass increases.

In particular, a processing program converts the NDVI values over Oklahoma to two variables, "Visual Greenness" and "Relative Greenness". Both variables use a 0-100% scale. Weekly maps of both variables are available on the OK-FIRE web site.

Visual greenness (VG) indicates how green each pixel is in relation to a standard reference such as a highly green agricultural field. The VG images thus produced portray vegetation greenness as one would perceive it if one were flying high over the landscape. A VG value of 80%, for example, represents the same level of greenness no matter where it occurs in the state. A value of 100% represents the most green and a value of 0% represents the least green. The example below is from the week ending Dec. 6, 2005 (the Thanksgiving weekend prior was a time of widespread fire activity).



Relative greenness (RG), in contrast, is calculated with respect to a historical database for that particular pixel. The NDVI value for a particular pixel is compared to a 16-year (1989-2004) historical database for that pixel; that database contains the maximum and minimum NDVI values over that multi-year period. An RG value of 100% signifies that this is the most green this particular pixel has been over the multi-year period, while an RG value of 0% means it is the driest (least green) it has been over that period. Because of the different reference scale (unique to each pixel), note that an RG value of 95%, for example, would not necessarily have the same degree of actual greenness everywhere in the state. An RG of 95% in the panhandle would appear less green than in southeastern Oklahoma. However, RG is an excellent measure of greenness with respect to the vegetation of the area and its "climatology". It is relative greenness that the Oklahoma Fire Danger Model uses to estimate live fuel moisture and to control the fuel load distribution between 1-h dead fuels and live herbaceous and deciduous woody fuels. The example below is from the same week as the VG map earlier. Note how the colors have changed from those in the VG map and indicate dramatically low RG values (with respect to the range of NDVI measured over a multi-year period).



The latest VG and RG maps are available on the OK-FIRE web site, as well as a weekly archive of them going back about a year. The current VG and RG maps can be found in the FIRE section under "CURRENT Fire Danger". To visit the weekly archive, go "RECENT Fire Danger", and then to "Satellite Greenness Maps".

Limitations:

1) Because the satellite images are composites over a week period and are only updated weekly, the vegetation (RG) maps the fire danger model uses can be up to 1-1.5 weeks old. Thus, quick changes in vegetation greenness (e.g., "greenup" or "senescence") may not be modeled in real-time. The model would only recognize such changes at that point when the next weekly greenness images arrived. There is thus no substitute for knowing the current fuel situation in your area. Dead fuel moisture is independent of RG and can also be used to assess fire danger conditions in such cases.

2) Complicating the matter, if persistent cloudiness over particular pixels occurs during the week, NDVI cannot even be measured for those pixels. In these cases, cloudiness will be depicted on the VG images by a light blue color. Since the fire danger model needs an RG value in every pixel to operate, we persist the last valid RG values in those pixels experiencing cloudiness. Thus, in those pixels, the RG values the model uses could be two or more weeks old.

3) The greenness estimated at the surface is based on the vegetation the satellite sensor "sees" in that 1-km pixel. Thus, agricultural areas (e.g., the winter wheat belts) show up prominently even though they are not part of the fuel models being utilized in the fire danger model (which are only for native vegetation). What this means for "agricultural pixels" is that the fire danger being calculated there is not valid for the native vegetation in such areas. However, most fire danger concerns are with respect to wildlands and for those pixels the fire danger calculations should be valid. For those situations where a fire manager is concerned about fire danger potential for native landscapes within agricultural pixels, we suggest looking at the fire model output for a Mesonet station whose RG is more in line with the current greenness of native fuels. One can also look at the weather variables (e.g., RH and wind), 1-hour and 10-hour dead fuel moisture, as well as KBDI, all of which are independent of the greenness sensed by the satellite.