

# Drought estimation maps by means multidate landsat fused images

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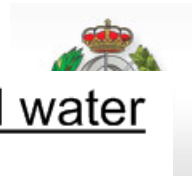
E-mail: [d.renza@alumnos.upm.es](mailto:d.renza@alumnos.upm.es), [emartinez@fi.upm.es](mailto:emartinez@fi.upm.es), [aarquero@fi.upm.es](mailto:aarquero@fi.upm.es),  
[jarsahe@hotmail.com](mailto:jarsahe@hotmail.com)



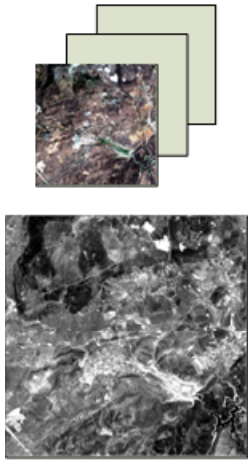
# Objective



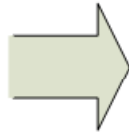
- ❑ Obtain drought maps from medium spatial resolution images.
  - ❑ Landsat 7 ETM+: (PAN + MS)
  - ❑ Multidate: 2001-2009 (except 2003)
  - ❑ Madrid (Spain)
  
- ❑ These images were fused for enhance spatial resolution. Dual Tree complex Wavelet Transform was used to this.
  
- ❑ Three indices used:
  - ❑ NDVI (Normalized Difference Vegetation Index)
  - ❑ NDWI (Normalized Difference Water Index)
  - ❑ NDDI (Normalized Difference Drought Index).



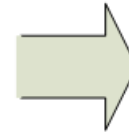
Landsat  
Images



DT-CWT  
Fusion [2]



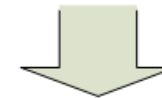
DN's to  
physical  
units



Vegetation and water  
indices

$$NDVI = \frac{\rho_{NIR} - \rho_{RED}}{\rho_{NIR} + \rho_{RED}}$$

$$NDWI = \frac{\rho_{NIR} - \rho_{SWIR}}{\rho_{NIR} + \rho_{SWIR}}$$

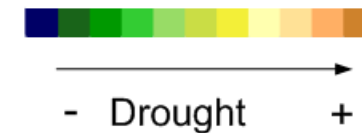


Drought index

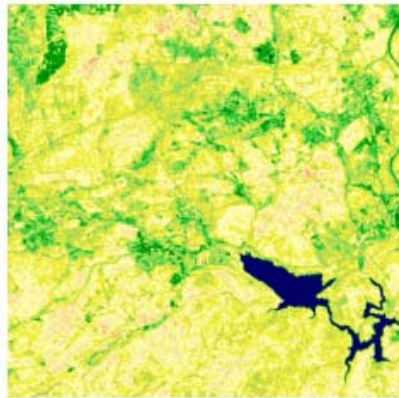
$$NDDI = \frac{NDVI - NDWI}{NDVI + NDWI}$$

## Methodology

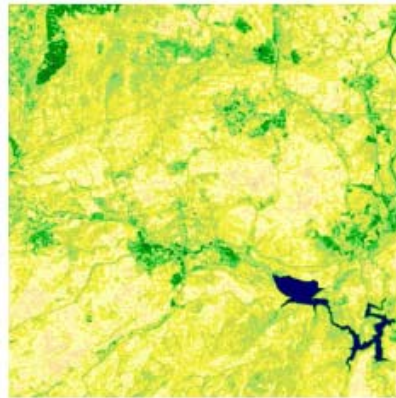
Color Scale



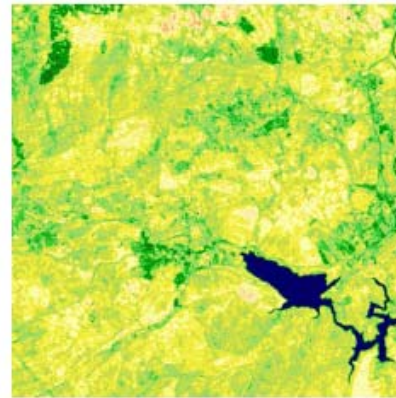
# RESULTS



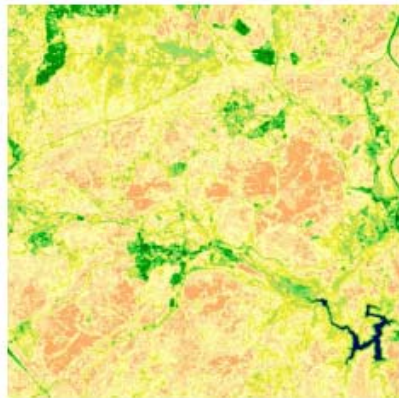
(a) June 2001



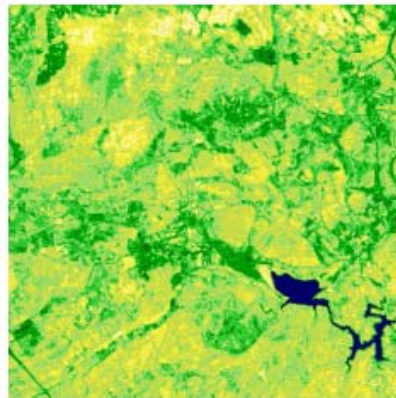
(b) June 2002



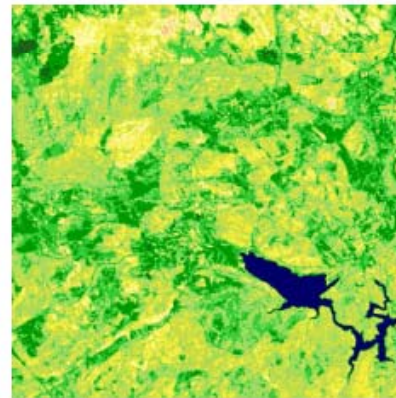
(c) June 2004



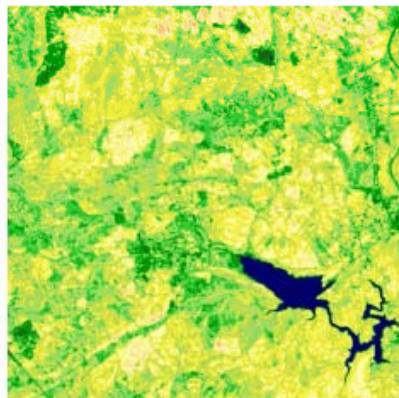
(d) June 2005



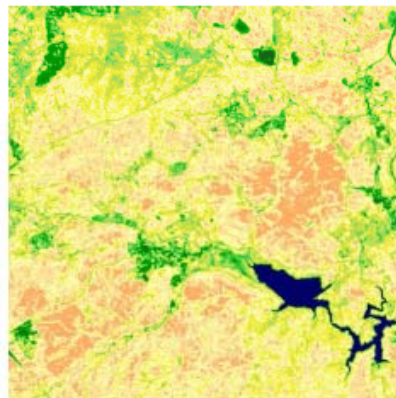
(e) June 2006



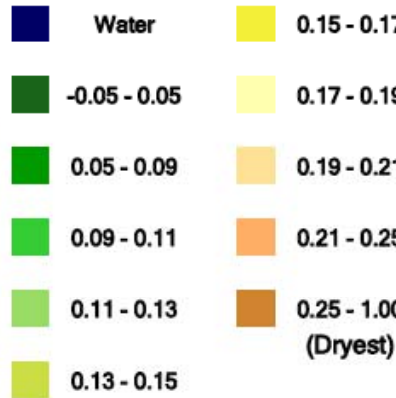
(f) June 2007



(g) June 2008



(h) June 2009



(i) Scale

The background is a solid blue color with several large, semi-transparent, light blue shapes. These shapes include a large arrow pointing to the right, a large circle, and several smaller arrows pointing in various directions. The overall aesthetic is modern and professional.

**Thanks for your Attention!**

**Feel free to make any questions at the  
poster session**