Activity 4: Inter-annual Variability of Atmospheric and Land Products over Oklahoma

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Objective: Analyze rain, soil moisture, ET, clouds, and winds over Oklahoma during a dry
_____and a wet year.
Note: The hydrological-year (HY) extends from October of one year to September of next year.
In this activity you will analyze HY1 that is 2005-2006 and HY2 that is 2006-2007.

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There are three parts to this activity:
1) Analyze maps of rainfall anomalies for HY1 and HY2 (anomalies are defined as deviations
from the long-term mean. For rainfall, negative anomalies mean 'dry year' and positive
anomalies mean 'wet year' compared to the normal rainfall)
2) Analyze ET and soil moisture
3) Analyze associated east-west winds and clouds

You will be using the following web-tool for this exercise:
NASA Giovanni: http://giovanni.gsfc.nasa.gov

PART 1: Monthly Rainfall Anomalies

Part 1a: Anomalies in HY1

Go to the home page for Giovanni:
http://giovanni.gsfc.nasa.gov

Select 'TRMM Online Visualization and Analysis System (TOVAS)'

Scroll down to 'Rainfall Archives'
Select 'Monthly Rainfall (3B43 V6) Anomaly' (Non Java Version)

Spatial:
Area of Interest (Oklahoma): Enter West: -104   North: 38   South: 33   East: -94

Monthly TRMM 3B43(V6):
Select 'Rainfall Anomaly (mm)'

Climatology:
Select '3B43 V6 (1998/01 – 2009/12)

Plot Type:
Select 'Lat-Lon Map'

Temporal:
Begin Year: 2005   Begin Month: October
End Year: 2006   End Month: September

Click '**Generate Plot**'

Part 1b: Anomalies in HY2

Go Back to Monthly Rainfall (3B43 V6) Anomaly'

Spatial:
Same as in 1a

Monthly TRMM 3B43(V6):
Same as in 1a

Climatology:
Same as in 1a

Plot Type:
Same as in 1a

Temporal:
Begin Year: 2006   Begin Month: October
End Year: 2007   End Month: September

Click '**Generate Plot**'

Answer the following questions:

1) Overall, which year had below-normal rainfall? which one had above-normal? Study the anomaly pattern and values.

2) Was the entire state having below-normal or above-normal rain in these years? Focus on central Oklahoma (35-36 °N and 96-98° W), note down the anomaly values in each year.

Part 1c: Time Series of Rainfall Anomalies for HY1 and HY2

Go Back to Monthly Rainfall (3B43 V6) Anomaly'

Spatial:
Area of Interest (central Oklahoma): Enter West: -98   North: 36   South: 35   East: -96

Monthly TRMM 3B43(V6):
Same as in 1a

Climatology:
Same as in 1a

Plot Type:
'Time series, Area-averaged'

Temporal:
Begin Year: 2005   Begin Month: October
End Year: 2007   End Month: September

Click '**Generate Plot**'

Answer the Following Questions:

1) Does the month-by-month time series show anomalies of the same sign during each HY as you found in Part 1a-1b? Which months show anomalies of opposite sign compared to the annual mean maps in Parts 1a-b ?

2) Can you make a projection from the rainfall time series about soil moisture and ET over this region for May-July 2007?

PART 2: Soil Moisture and ET for HY1 and HY2

Go to the home page for Giovanni:
http://giovanni.gsfc.nasa.gov

Go to Hydrology Portal:
Select '<u>Global Land Data Assimilation System Monthly Data</u>'

Spatial:
Area of Interest (central Oklahoma): Enter West: -98   North: 36   South: 35   East: -96

Parameters:
Display: Check ' Data product Info' and 'Unit'
Under 'GLDAS Version 1' Scroll down to 'GLDAS-1 NOAH Model (1.0x1.0 degree)

(1979/01/01 - 2012/04/01)'
Select 'Average layer 1 soil moisture'
Also Select 'Total Evapotranspiration'

Temporal:
Begin Date: Year: 2005   Month: October
End Date: Year: 2007   Month: September

Select Visualization:
Select 'Time Series'

Select '**Generate Visualization**'

You will see two time series.

Discussion: Do these time series match what you would expect from the rainfall anomaly time series? Can you conjecture why ET is low in early 2007 even when rain and soil moisture are high?

PART 3: Atmospheric Conditions during HY1 and HY2

Part 3a: Low Level Winds
Note : Positive (negative) values mean the winds are from south to north (north to south)
Northward winds help bring moisture to the central Oklahoma region from the Gulf of Mexico region

Go to the home page for Giovanni:
http://giovanni.gsfc.nasa.gov

Go to Meteorological Portal:
Select 'MERRA Monthly Analysis'

Parameters:
Display: Check 'Data Product Info' and Unit'
Select 'Northward wind component'

Spatial
Area of Interest (central Oklahoma): Enter West: -98   North: 36   South: 35   East: -96

Vertical Profile:
Upper Level: 850 hPa
Lower Level: 850 hPa
Temporal:
Begin Date: Year: 2005   Month: October
End Date: Year: 2007   Month: September

Select Visualization:
Select 'Time series'

Click '**Generate Visualization'**

Part 3b: Clouds

Go to the home page for Giovanni:
http://giovanni.gsfc.nasa.gov

Go to Atmospheric Portals (scroll down to view complete list):
Select 'Aqua/AIRS Global: Monthly'

Parameters:
Display: Check 'Data Product Info' and 'Unit'
Go to 'AIRX3STM.005 (2002/09 – 2012/02)'
Select 'Cloud fraction_ascending (Cloud_Frc_A)'

Spatial
Area of Interest (central Oklahoma): Enter West: -98   North: 36   South: 35   East: -96

Temporal:
Begin Date: Year: 2005   Month: October
End Date: Year: 2007   Month: September

Select Visualization:
Select 'Time series'

Click '**Generate Visualization'**

Discussion: Can monitoring winds and clouds help hydrological applications? Compare the time series of winds and clouds with the rain anomaly time series in Part 1c. Dose increase in wind strength and cloud fraction correspond to a positive rainfall anomaly in any months?