Using GLOBE and Other Observations to Validate Meteorological Models

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Introduction

- Meteorological data are used to drive land-surface, ecological, and hydrological models.

- In some areas, however, these data are not available (e.g., mountains, deserts, shrublands) or reliable.
LAPS

- The local analysis and prediction system (LAPS)
  - Meteorological data assimilation tool
    - Meteorological networks
    - Radar
    - Satellite
    - Aircraft
LAPS II

- LAPS
  - Uses observations to produce a “best fit” for three-dimensional atmospheric characteristics
  - 10 km horizontal resolution
  - Hourly temporal resolution
Objectives

- A rigorous examination of LAPS performance versus independent observations
  - 1 September 2001 to 31 August 2003

- Meteorological Variables
  - Temperature (°C)
  - Relative Humidity (%)
  - Wind Speed (m s⁻¹)
  - Precipitation (mm)
Methods

- **Simple linear regressions**
  - LAPS vs. observed
    - Temperature
    - Relative humidity
    - Wind speed
    - Precipitation

- **Site characteristics and estimate of variance ($r^2$)**
  - Land cover class ANOVA
    - National Land Cover Data, NLCD, 1992
  - Station elevation regression
Temperature Linear Regressions

Jarrow Montessori (Boulder, CO)
Assimilation vs. Obs. Mean Temp.
$y = 0.92x - 1.9$
$(r^2 = 0.94; p < 0.0001)$

Hays H. S. (Hays, KS)
Assimilation vs. Obs. Mean Temp.
$y = 0.93x - 1.8$
$(r^2 = 0.85; p < 0.0001)$

Alexander Dawson School (Lafayette, CO)
Assimilation vs. Obs. Mean Temp.
$y = 0.99x - 0.68$
$(r^2 = 0.83; p < 0.0001)$

Many Farms H. S. (Many Farms, AZ)
Assimilation vs. Obs. Mean Temp.
$y = 0.99x - 1.8$
$(r^2 = 0.94; p < 0.0001)$
Linear Regression $r^2$ Values

- Temp. (C): $n = 107$
- Rel. Hum. (%): $n = 99$
- Wind Spd. (m/s): $n = 99$
- Precip. (mm): $n = 96$

Compared Variables
$r^2$ Values and Land Cover

Temperature

Relative Humidity

Wind Speed

Precipitation

NLCD Cover Class
Elevation and $r^2$

$y = -0.00025x + 0.83$
($r^2 = 0.61; p < 0.0001$)
Concluding Remarks

- LAPS assimilations were remarkably accurate with respect to temperature and relative humidity
- Intermediate accuracy for wind speed
  - The relationship declined with an increase in elevation
Concluding Remarks II

- Precipitation estimates possessed the lowest accuracy
  - Observational error
  - Scaling issues

- Land Cover
  - Temperature and relative humidity accuracy did not change
  - Wind-speed accuracy did change, but some interactions with cover type
  - Precipitation accuracy was unaffected by land cover
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