Cloud Type Impact on Surface Radiation

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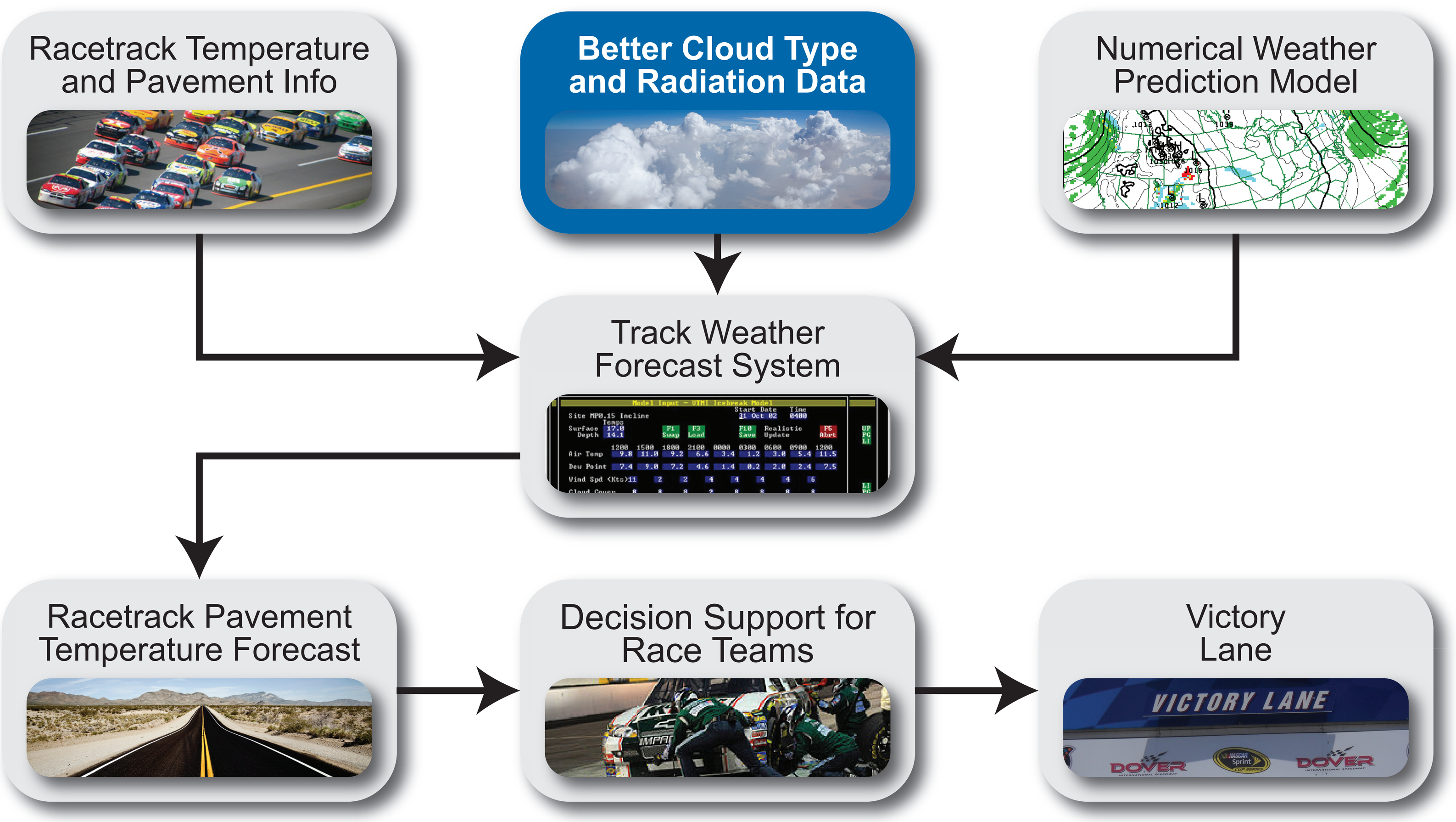
Motivation

- **Forecast systems are impacted by inaccurate radiation forecasts**
- **Cloud amount and type influences radiation forecasts**
- **Inclusion of cloud type may improve forecasts for a variety of end-users**

Research

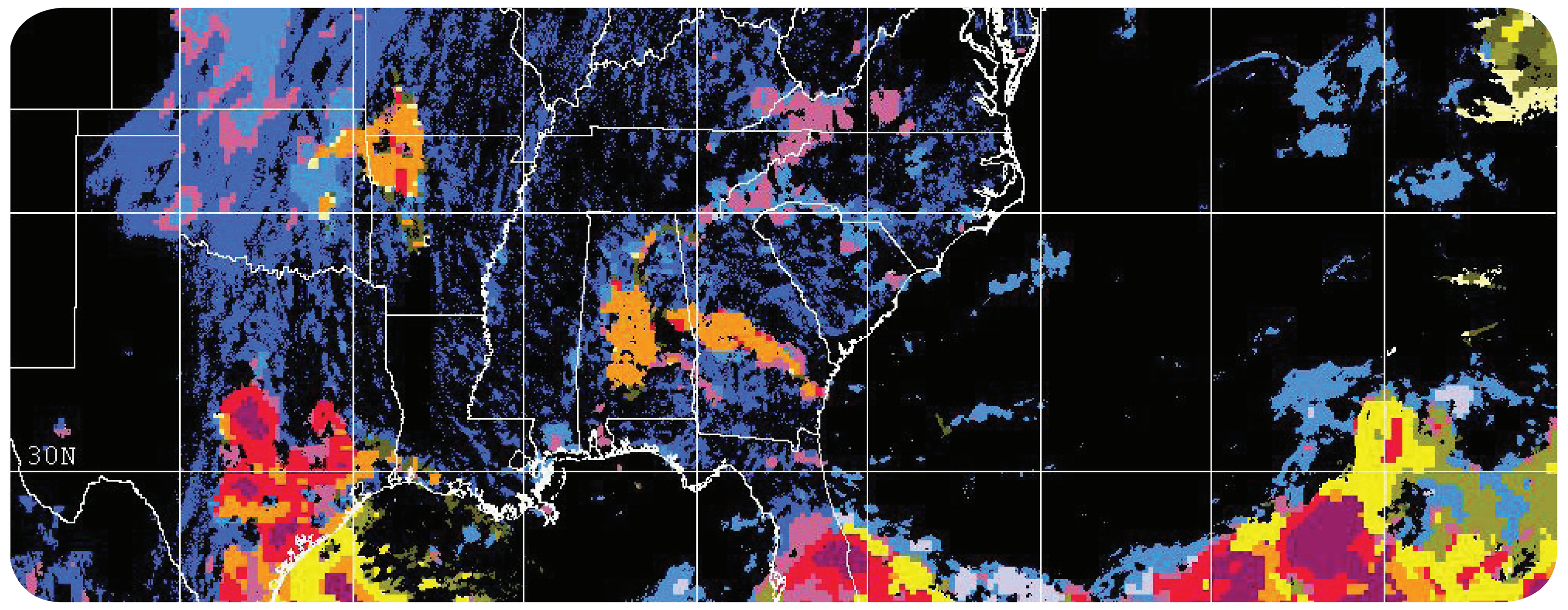
Track Weather Forecast System



Methods

Naval Research Lab Cloud Classifier

- **A combination of visible and infrared satellite channels to produce cloud type**
- **Pixel-by-pixel brightness thresholds**
- **Day and night operation**



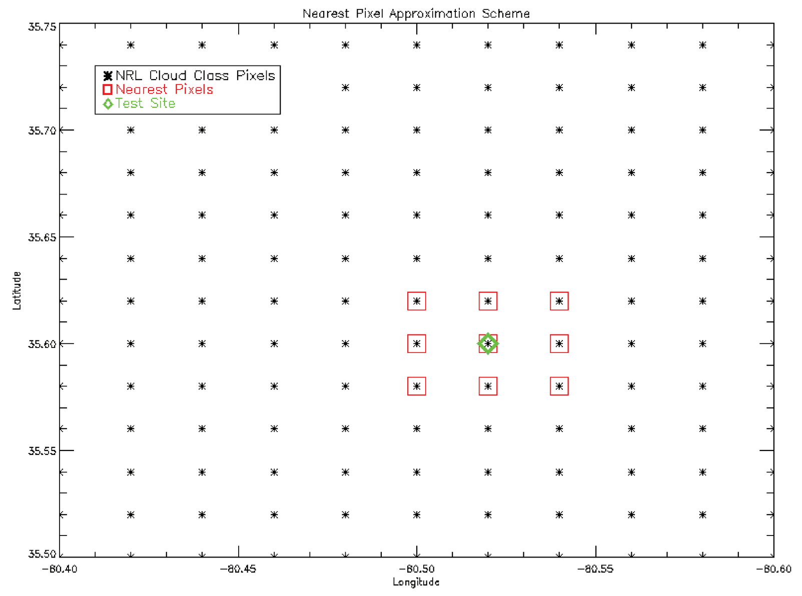
1915 UTC 20 June 2012 NRL Cloud Class

Analysis Techniques

Modal Cloud Category Selection
- 9 pixel box, 8x8 km

Case Study Analysis
- 9 cases Salisbury, NC May-June 2012
- Radiation-Cloud Type Distribution
- Theoretical Max Radiation and Water Vapor Assessments

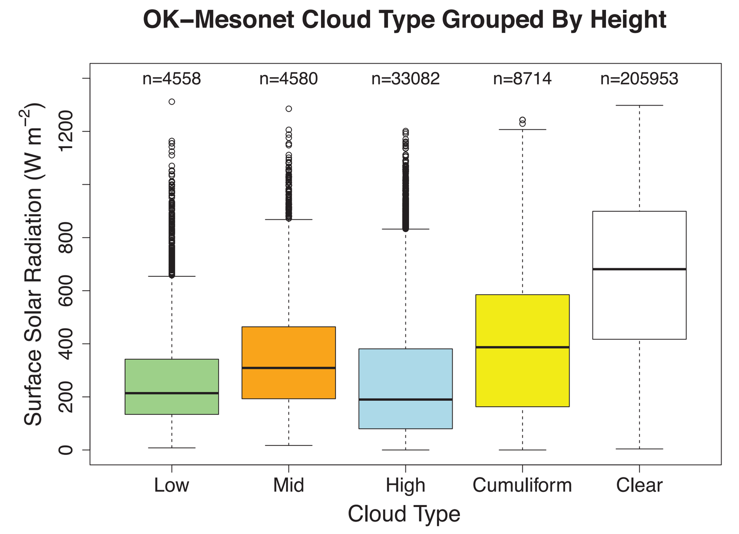
Bulk Statistical Assessment
- June 2012 OK-MESONET
- Radiation-Cloud Type Distribution

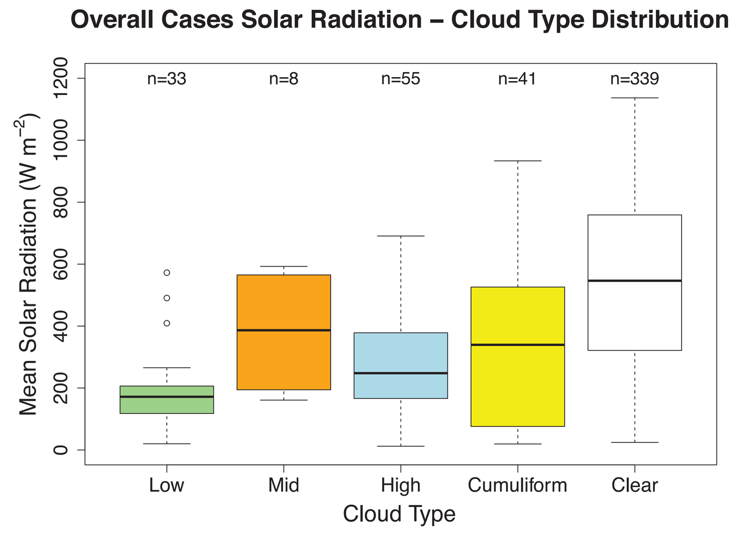


Modal Cloud Category Selection

Cases v OK-Mesonet

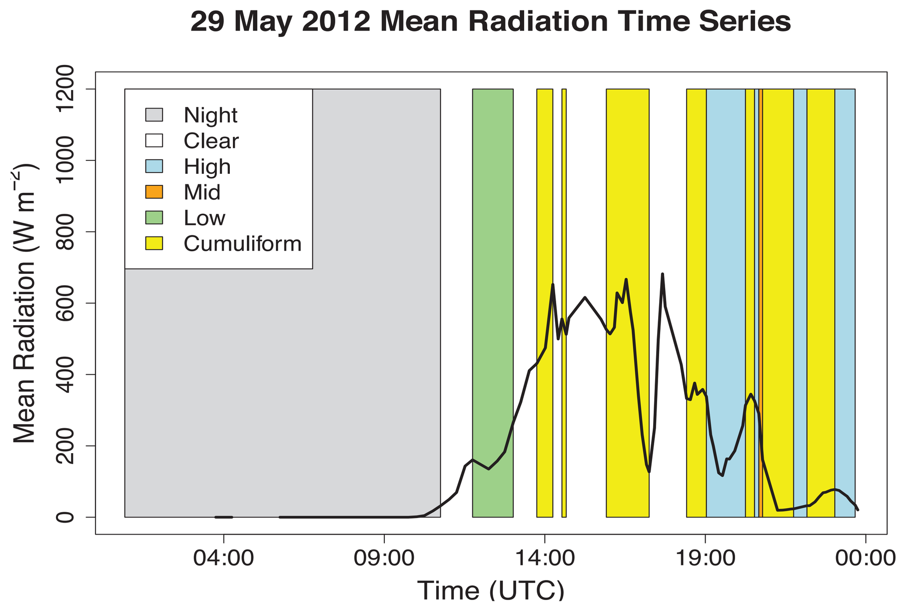
- Percentage of max radiation transmission: Low 20%, Mid-level 32%, High 40%, Cumuliform 34%.
- OK-Mesonet distributions similar to case studies





Case Study

Tactical Forecasting

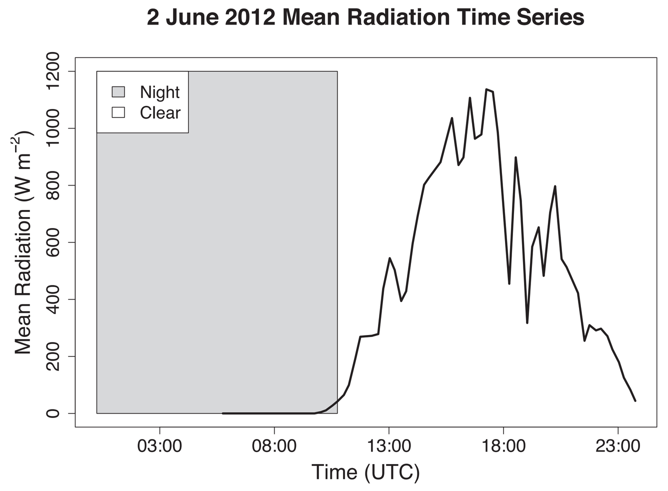


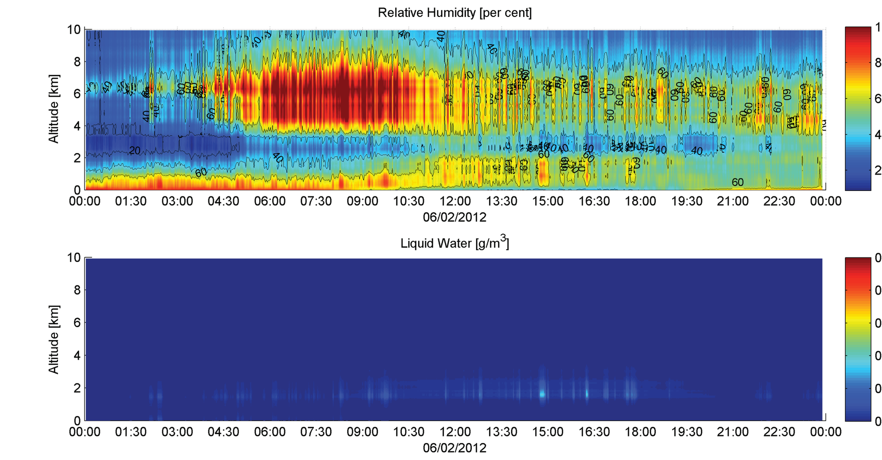
Time (UTC)	Mean Radiation (Wm^{-2})	Cloud Type
1615	628.8	Cumuliform
1625	601.25	Cumuliform
1632	667	Cumuliform
1640	575.3333	Cumuliform
1645	524.2	Cumuliform
1655	339.5455	Cumuliform
1702	231.25	Cumuliform
1710	147.5455	Cumuliform
1715	127.1818	Cumuliform
1725	250.3333	Clear
1732	497	Clear
1740	682.2	Clear
1745	590.5	Clear

Left: Mean radiation time series for 29 May 2012 with modal cloud color-coded.

Right: Cumuliform cloud types impact midday radiation, reduction period of 45 minutes and a recovery period of 25 minutes. Such information is useful to develop tactical forecasting products.

Liquid Water Path Analysis





Left: Mean radiation time series for 2 June 2012.
Despite this being a clear day, something is affecting the radiation.

Right: Liquid water radiometer data shows despite the clear conditions there is some trace signal possibly responsible for radiation variability.

Conclusions and Future

- Clouds and other atmospheric particles impede 60-80% of total radiation.
- 32.9% variability in solar radiation on cloudy case days due to clouds
- 7.2% solar radiation variability due to clouds when clear case days considered
- Another significant influence on radiation: Water vapor? Aerosols?
- Next steps are to compute regression statistics for OK
- Conduct similar assessment for other regions / seasons

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