



# Assessing the Potential of the AIRS Retrieved Surface Air Temperature for 6-Hour Average Temperature Forecast in River Forecast Centers

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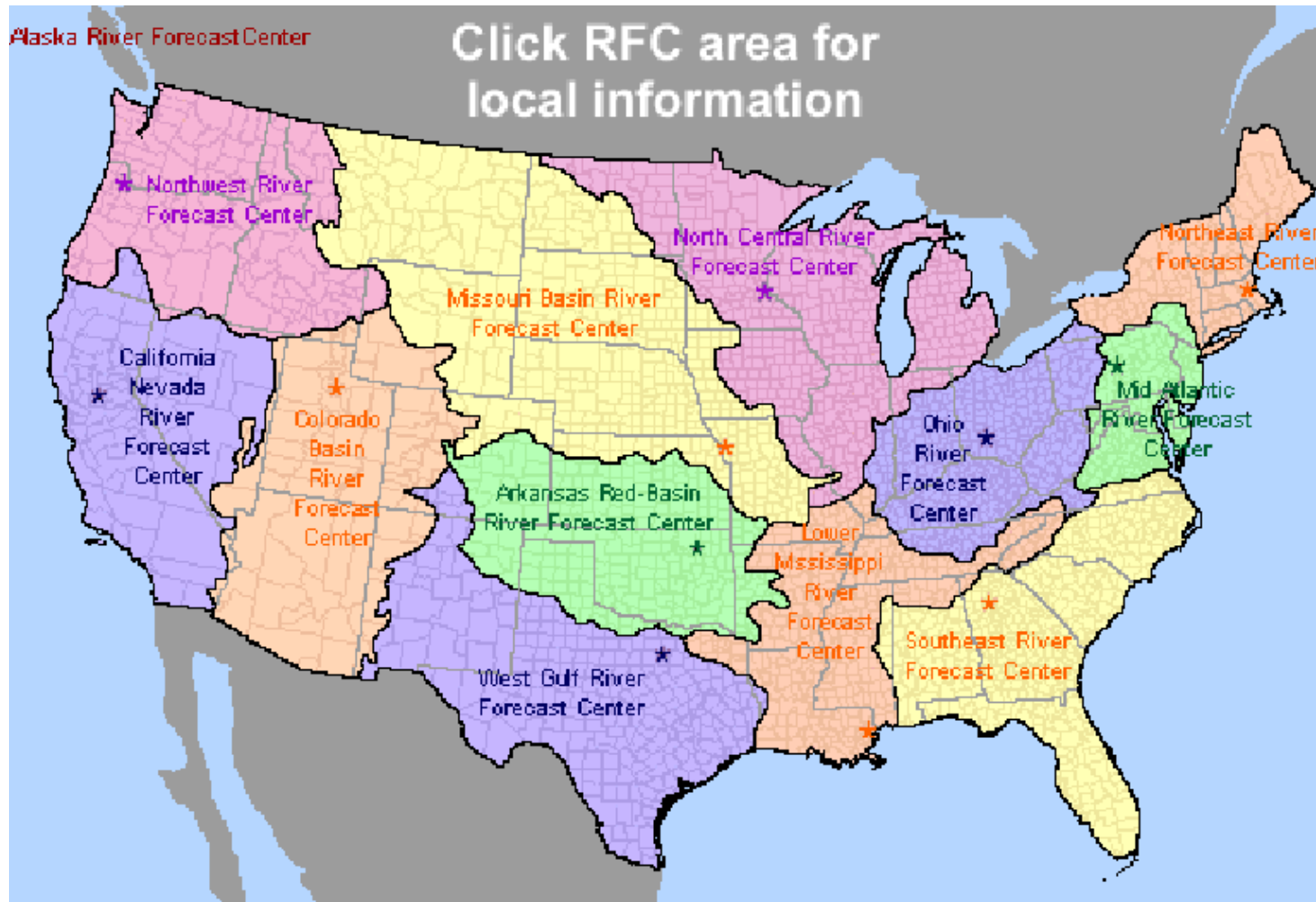
# Outline

1. Motivation
2. Region and dataset for the assessment
3. Preliminary results
4. Summary



# Motivation

## NOAA NWS River Forecast Centers(RFCs)





# Motivation

- Surface temperature forcing data in RFCs evaporation, snow melting, etc.
- RFCs need basin average surface temperature forecast in the four fixed 6-hour periods: 00-06, 06-12, 12-18, 18-00 Z (or UTC)



# Motivation

- RFC current regression method  
manually select some representative ground stations  
6-h basin average surface temperature ( $T_{ave}$ )  
basin average daily maximum ( $T_{max}$ ) and minimum temperature ( $T_{min}$ )

00-06, 06-12, and 12-18Z:

$$T_{ave} = W_{min} * T_{min} + W_{max} * T_{max}; \quad W_{min} + W_{max} = 1$$

18-00Z:

$$T_{ave} = W_{min} * T_{min} + W_{max} * T_{max} + W_{min2} * T_{min2};$$

$$W_{min} + W_{max} + W_{min2} = 1$$

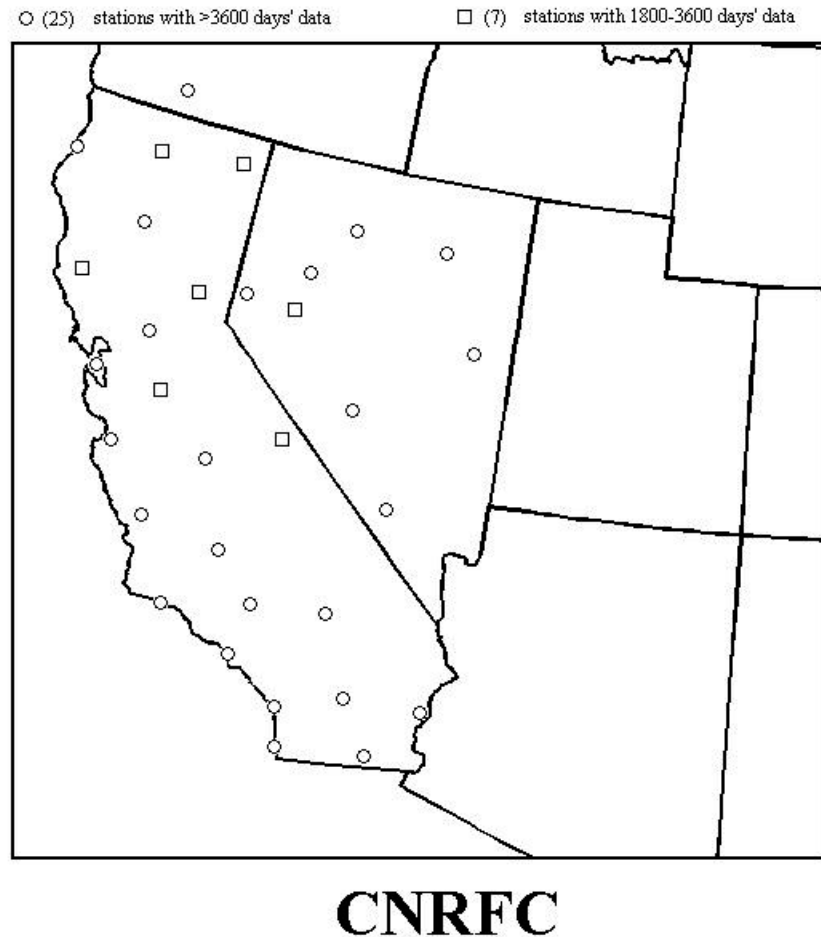
$T_{min2}$ : minimum temperature the following day

weights are period, season, and RFC dependent



# Motivation

## 32 Stations for Regression in California-Nevada RFC (CNRFC)



Courtesy of “Creation of RFC- and Season-Specific Weights For Estimation of 6-Hour Average Temperatures from Daily Maximum and Minimum Values” from NWS Office of Hydrological Development

# Motivation



- Drawbacks of current method in RFC fully depend on ground station observation  
subjectively choose ground stations  
coarse distribution of ground stations  
availability of ground station data
- Investigate the application of satellite and model data from Goddard Earth Sciences and Data Information Services Center (GES-DISC) to better basin temperature forecast in RFCs.



# Motivation

- Satellite data
  - more evenly spatial coverage
  - more stable availability
- AIRS retrieved surface air temperature
  - ascending( $T_{asc}$ ) and descending( $T_{des}$ ) potentially represent daily max and min

00-06, 06-12, and 12-18Z:

$$T_{ave} = W_{des} * T_{des} + W_{asc} * T_{asc}$$

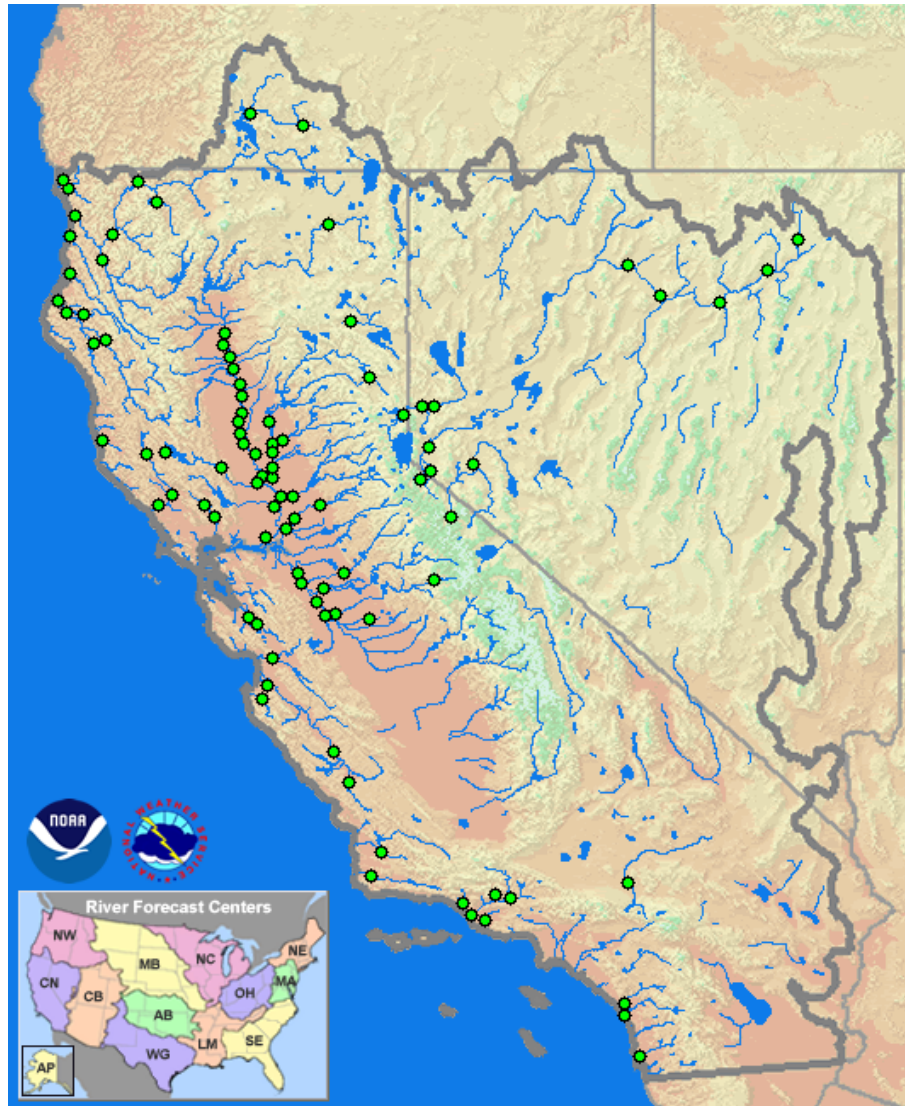
18-00Z:

$$T_{ave} = W_{des} * T_{des} + W_{asc} * T_{asc} + W_{des2} * T_{des2}$$





# Region and Dataset



- CNRFC region  
32.5° N– 42° N  
124.5° W– 114° W  
poor ground  
station coverage
- Spring season  
March, April, and  
May  
snow melting



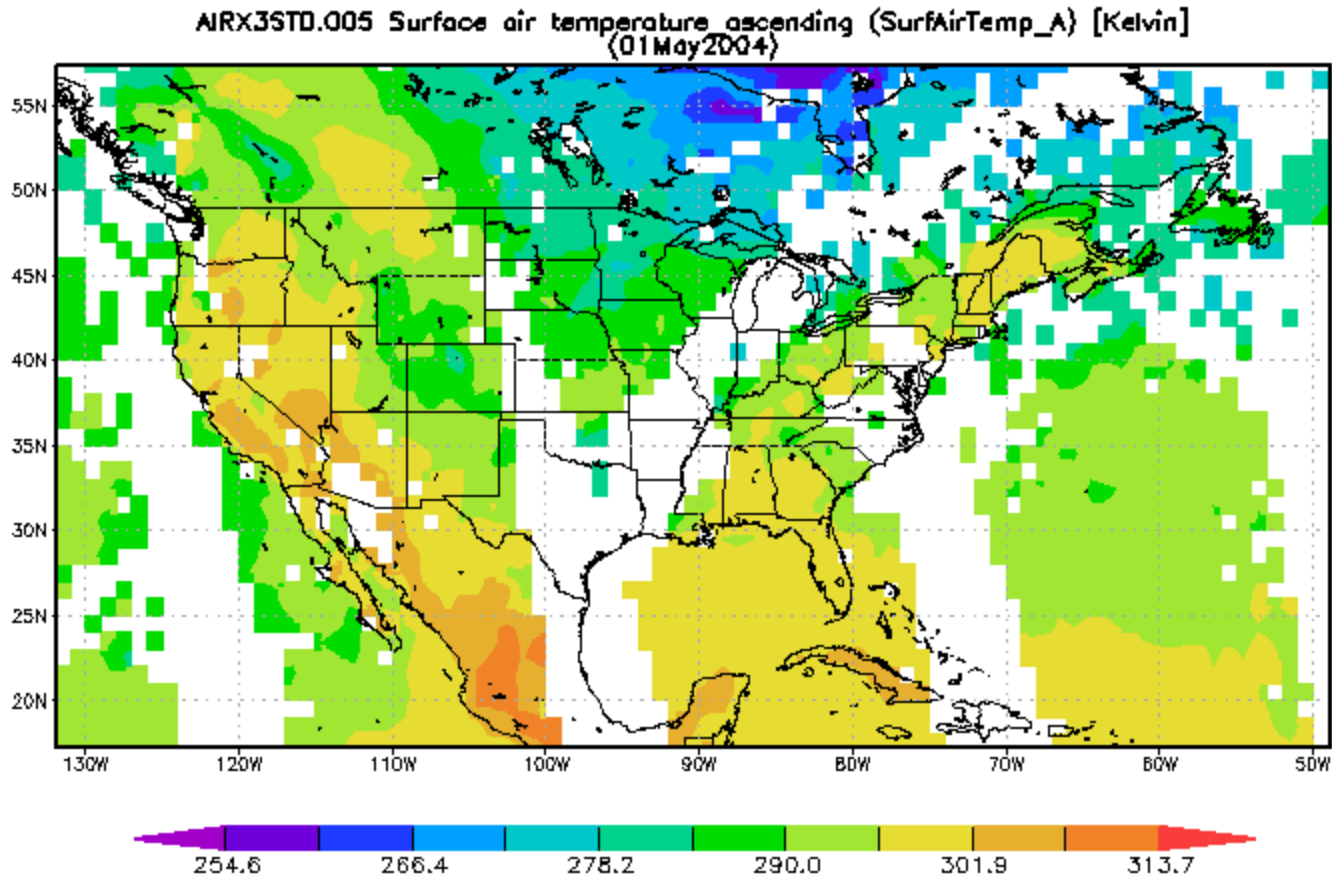
# Region and Dataset

- AIRS surface air temperature data  
version 5 level 3 standard product archived in Goddard Earth Sciences and Data Information Services Center (GESDISC)
- North American Land Data Assimilation System (NLDAS) data  
2m above ground air temperature (hourly, 1/8 degree, phase 2)  
generate 6-h basin average as ground truth ( $T_{ave}$ ).
- Ten years of data: 2003-2012



# Region and Dataset

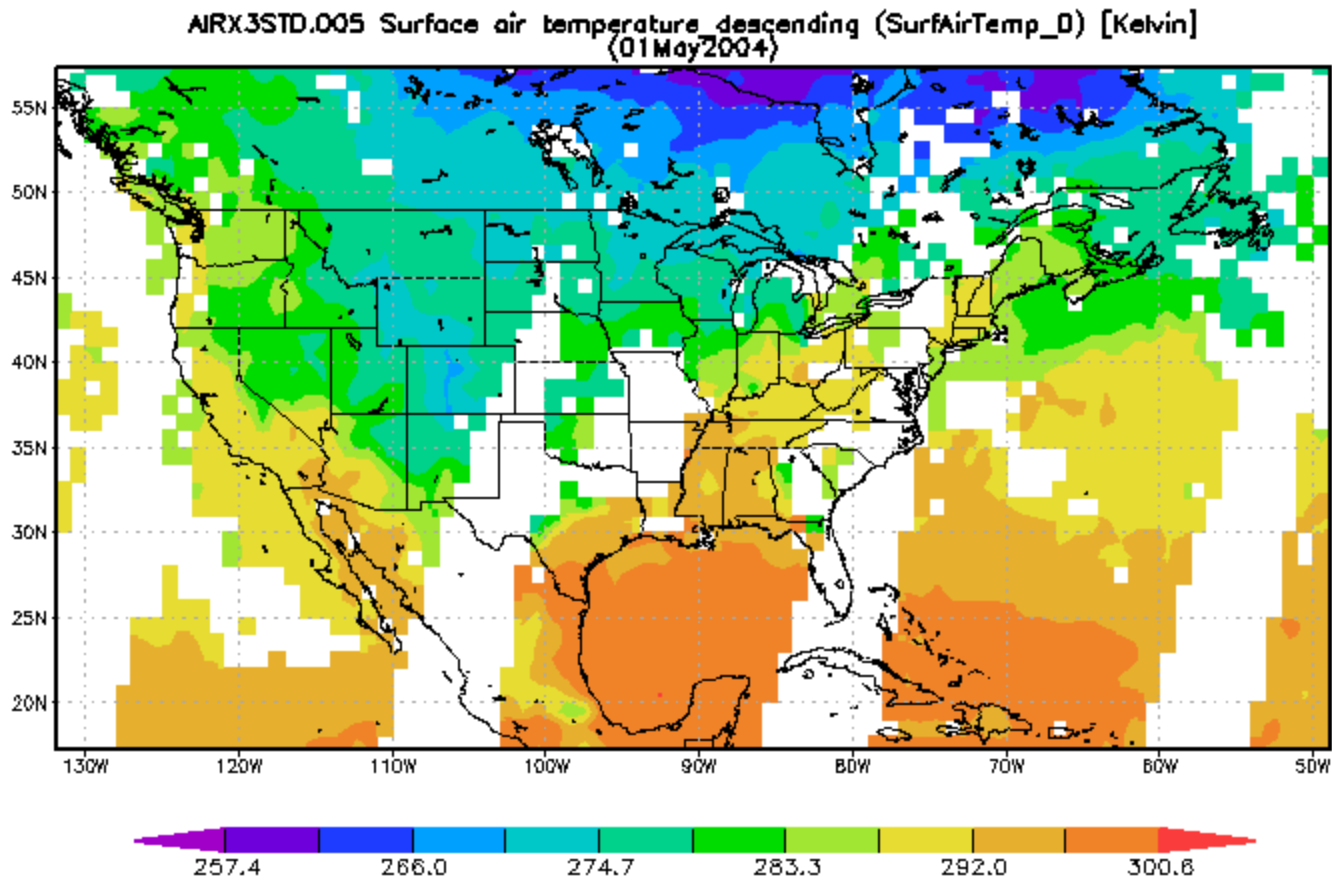
AIRS surface air temperature Ascending 05/01/2004





# Region and Dataset

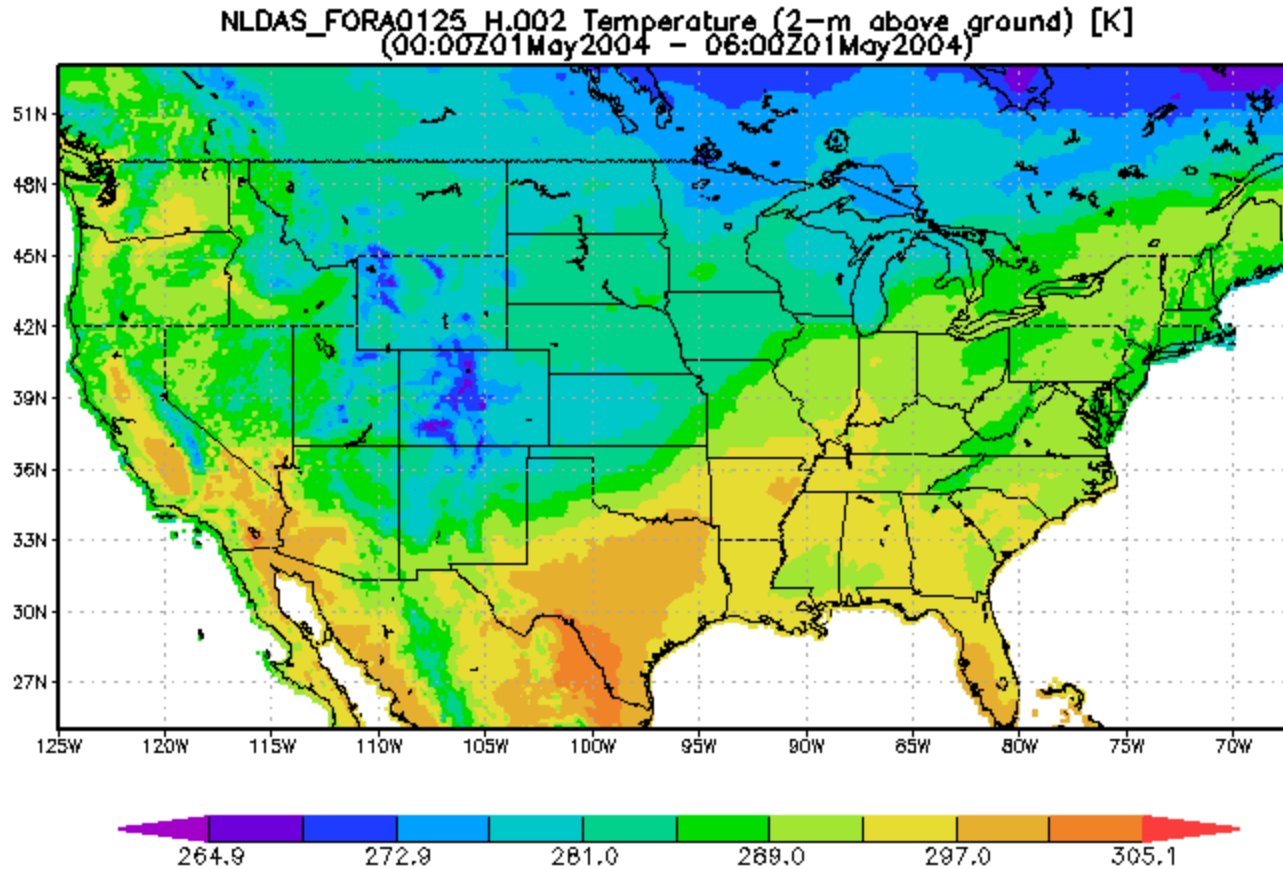
AIRS surface air temperature    Descending    05/01/2004





# Region and Dataset

NLDAS 05/01/2004 00-06Z average temperature





# Preliminary Results

- AIRS Data Screening

All: the data will be used regardless of number of valid grid points

53%: the data will be used if at least 53% (40 out of 75) grid points are valid

67%: the data will be used if at least 67% (50 out of 75) grid points are valid

80%: the data will be used if at least 80% (60 out of 75) grid points are valid

- Evaluation Statistics

Comparing  $T_{ave}$  forecast from regression with  $T_{ave}$  from NLDAS

Bias: arithmetic mean error

RMSE: Root Mean Square Error



# Preliminary Results

- Regression weights

## CNRFC

1200-1800		1800-0000			0000-0600		0600-1200	
$W_{\min}$	$W_{\max}$	$W_{\min}$	$W_{\max}$	$W_{\min2}$	$W_{\max}$	$W_{\min}$	$W_{\max}$	$W_{\min}$
0.73	0.27	0.07	0.84	0.09	0.35	0.65	0.23	0.77

## AIRS

	$W_{\text{des}}$	$W_{\text{asc}}$	$W_{\text{des}}$	$W_{\text{asc}}$	$W_{\text{des2}}$	$W_{\text{asc}}$	$W_{\text{des}}$	$W_{\text{asc}}$	$W_{\text{des}}$
All	0.84	0.16	0.01	0.68	0.31	0.34	0.66	0.01	0.99
53%	0.85	0.15	0.01	0.68	0.31	0.34	0.66	0.01	0.99
67%	0.85	0.15	0.01	0.68	0.31	0.34	0.66	0.01	0.99
80%	0.84	0.16	0.01	0.67	0.32	0.33	0.66	0.01	0.99

18-0Z and 06-12Z have problem



# Preliminary Results

- Statistic Numbers ( $^{\circ}$ K)

## CNRFC

1200-1800		1800-0000		0000-0600		0600-1200	
Bias	RMSE	Bias	RMSE	Bias	RMSE	Bias	RMSE
0.09	1.43	0.07	1.12	0.22	1.79	0	1.39

## AIRS

All	-0.04	1.40	-0.35	2.43	0.05	1.54	0.44	2.23
53%	-0.04	1.40	-0.22	2.26	0.10	1.49	0.32	2.19
67%	-0.04	1.42	-0.20	2.20	0.13	1.42	0.31	2.10
80%	0.01	1.31	-0.20	2.15	0.08	1.31	0.37	1.97

18-00Z and 06-12Z have problem

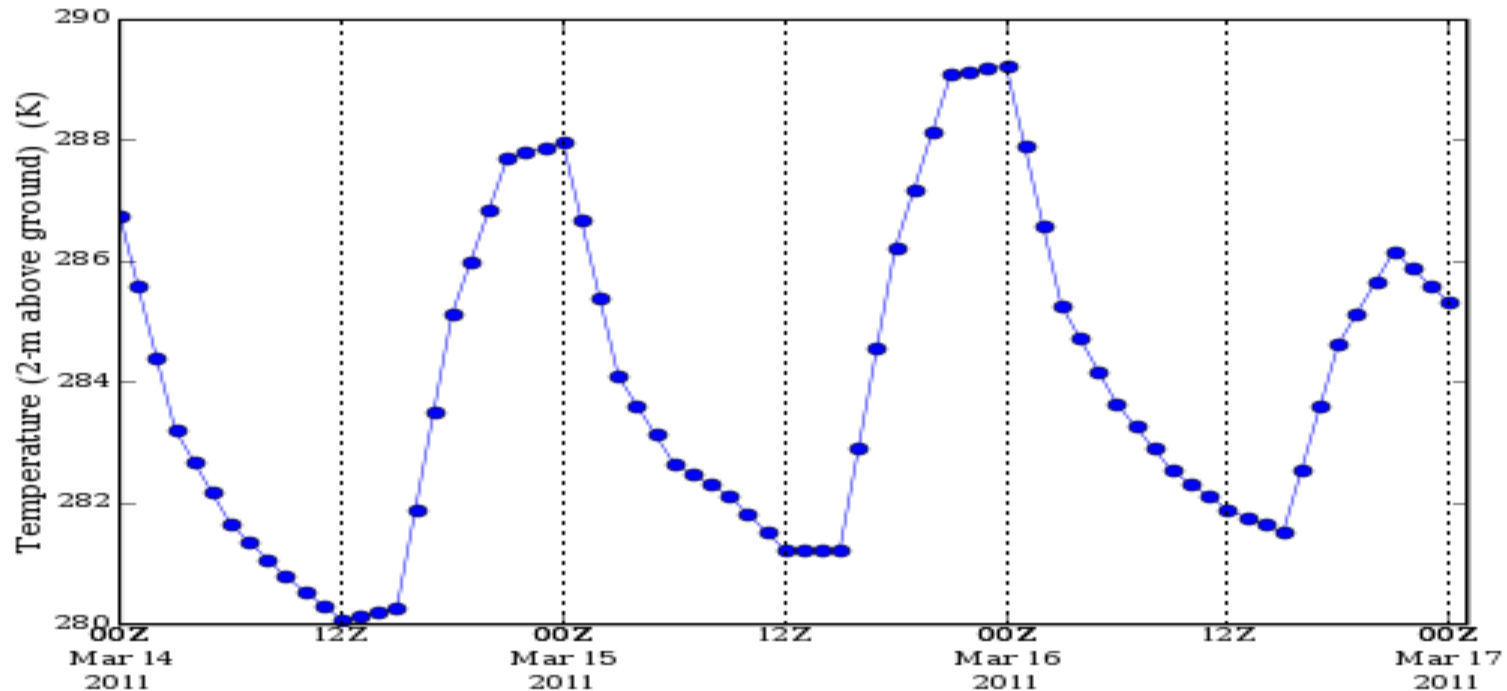




# Preliminary Results

3-day (3/14 -3/16/2011) time series of NLDAS hourly basin average temperature

Area-Averaged Time Series (NLDAS\_FORA0125\_H.002)  
(Region: 124W-114W, 32N-42N)



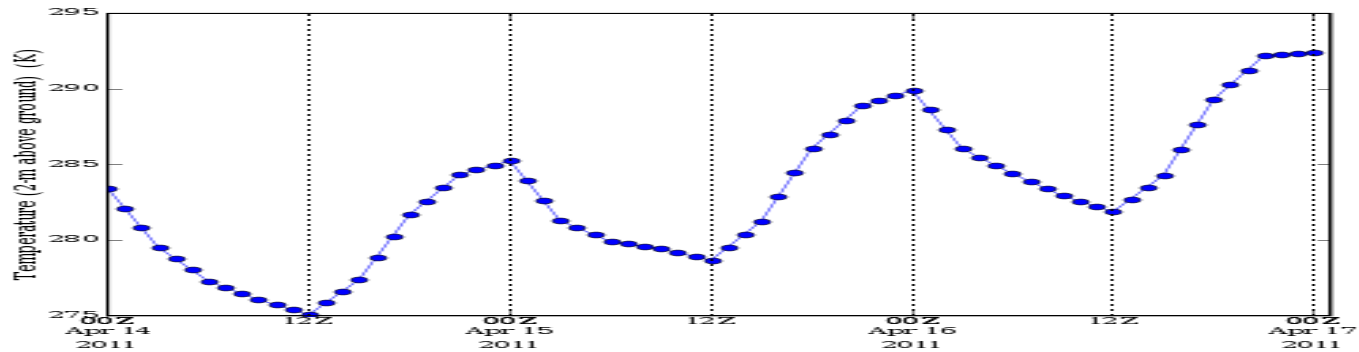
- $T_{\min}$  at 12Z(4am local) or later,  $T_{\text{des}}$  at about 9Z (1am local)
- $T_{\max}$  at 00Z(4pm local) or earlier,  $T_{\text{asc}}$  at about 22Z (2pm local)
- $T_{\text{des}} / T_{\text{asc}}$  can not fairly represent  $T_{\min}/T_{\max}$ , is warmer/colder than  $T_{\min}/T_{\max}$



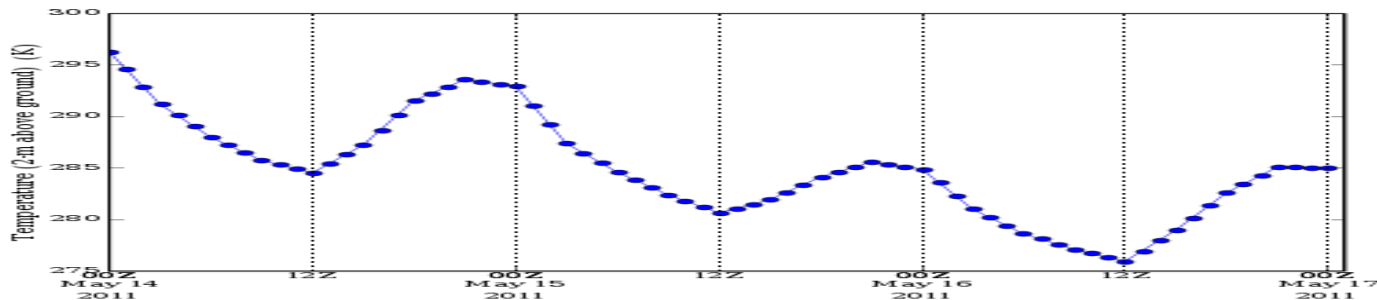
# Preliminary Results

3-day (4/14 -4/16/2011 and 5/14-5/16/2011) time series

Area-Averaged Time Series (NLDAS\_FORA0125\_H.002)  
(Region: 124W-114W, 32N-42N)



Area-Averaged Time Series (NLDAS\_FORA0125\_H.002)  
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- $T_{\min}$  at 12Z(4am local),  $T_{\text{des}}$  at about 9Z (1am local)
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# Preliminary Results

- Try polynomial fit

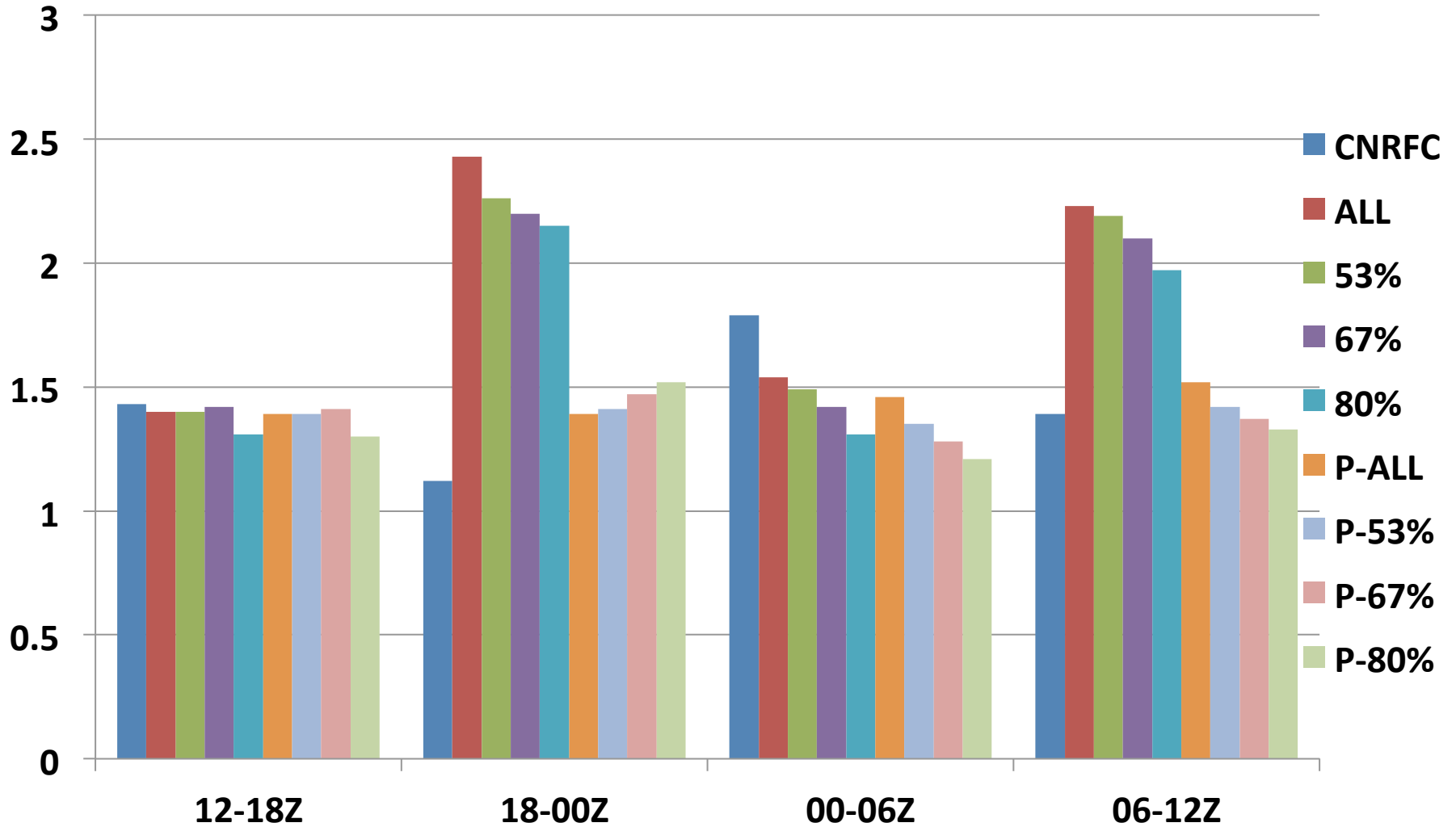
$$T_{ave} = a * T_{des} + b * T_{asc} + c$$

$$T_{ave} = a * T_{des} + b * T_{asc} + a_2 * T_{des2} + c$$



# Preliminary Results

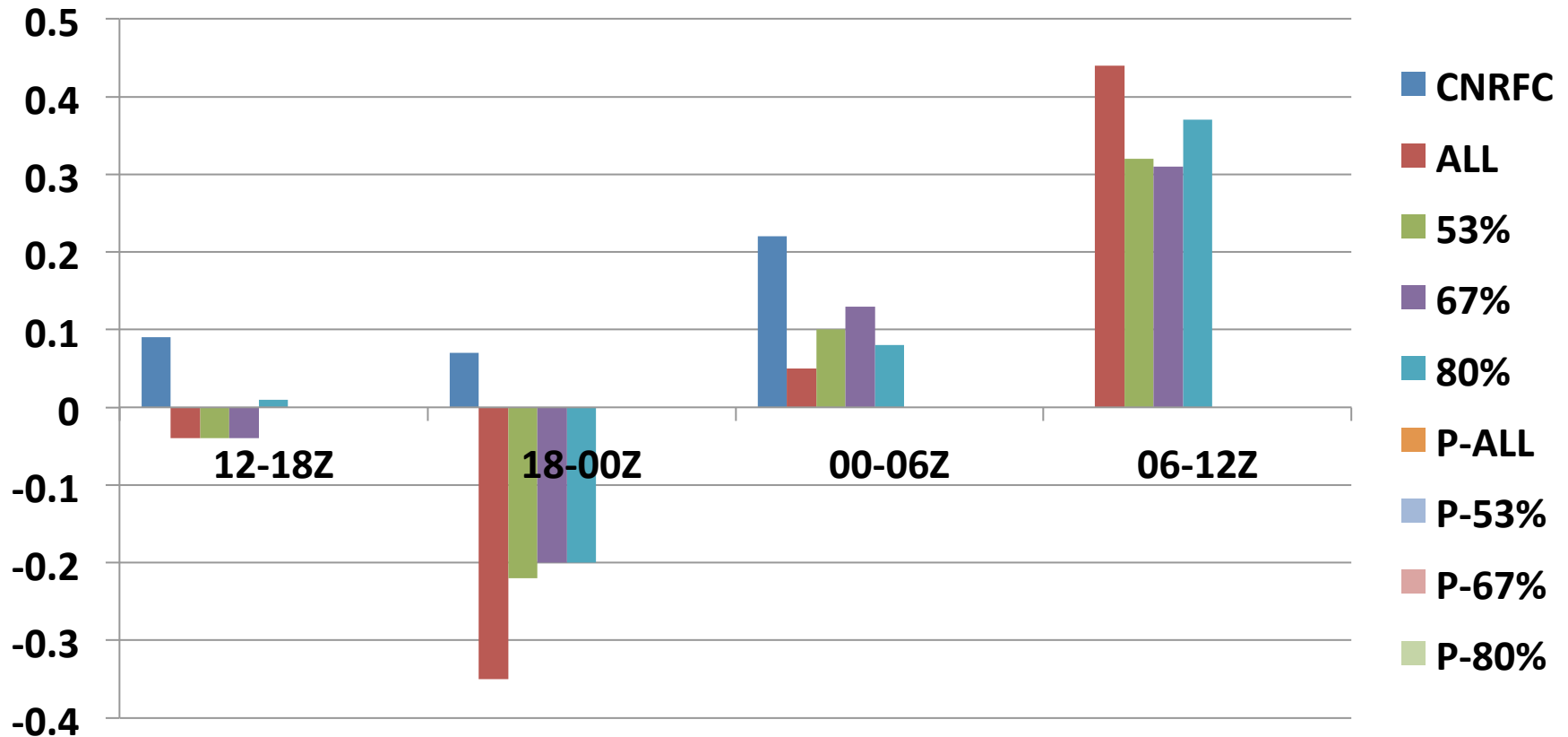
## RMSE comparison





# Preliminary Results

## Bias comparison



Bias values using polynomial fit less than 0.01

# Summary



- For 00-06Z and 12-18Z, AIRS retrieved temperature can be used for 6-h surface temperature forecast in CNRFC, and has less error than current regression method
- For 06-12Z and 18-00Z, the regress results are not as good as CNRFC because AIRS nighttime/daytime temperature is warmer/colder than daily minimum/maximum temperature
- Polynomial fit can get better results, but needs more investigation to find relationship between AIRS nighttime/daytime temperature and daily minimum/maximum temperature
- Using AIRS and NLDAS data for regression is more objective than using manually selected ground station data in RFCs, and easier to process