Modeling Atmospheric Temperature Profiles over the Arctic

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ABSTRACT

Climatologists concerned with global warming are familiar with the significance of research into the climate of the polar regions. Because the arctic region is the most sensitive to react to climatic changes, the modeling of atmospheric temperature profiles over the arctic region is being investigated. Mean tropospheric temperature profiles from global meteorological data sets are used to model the arctic climatology. Neural network algorithms were applied to archived radiosonde measurements, retrieved temperature profiles from remote sensing methods, standard atmosphere supplement profiles, and monthly solar insolation. For these investigations, we draw upon a wealth of observed global climate data sets which allows us to explore aspects of temperature profiles throughout the arctic seasons. From ground based and satellite observations, it has been observed that seasonal changes can produce temperature profiles that are significantly different for this high latitude geographical region. Parameterization of mean monthly tropospheric temperature profiles from radiosonde stations in the arctic are examined and specific characteristics are analyzed. Radiosonde temperature profiles from various arctic radiosonde stations were used to test the modeled temperature profile performance.

Climate Features of the Arctic

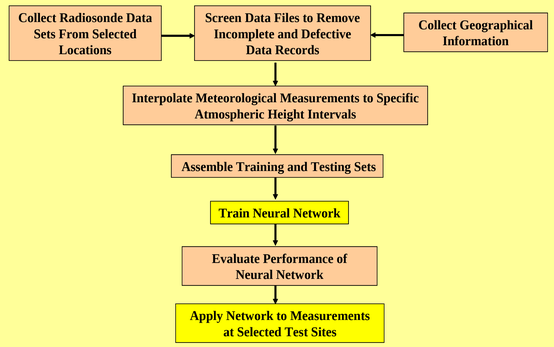
- Long, cold winters and short, cool summers
- Most parts of the Arctic is covered with some form of ice (sea ice, glacial ice, snow)
- Arctic region is primarily ocean moderated by ice and water
- High latitude regions experience extreme variability in solar radiation in both summer and winter

ARCTIC TEST LOCATIONS

Location	WMO#	Elevation	Latitude/ Longitude
Alert, Canada	WLT 71082	65 meters	82°30′N 62°20′W
Danmarkshavn, Greenland	BGDH 4320	12 meters	76°46′N 18°40′W

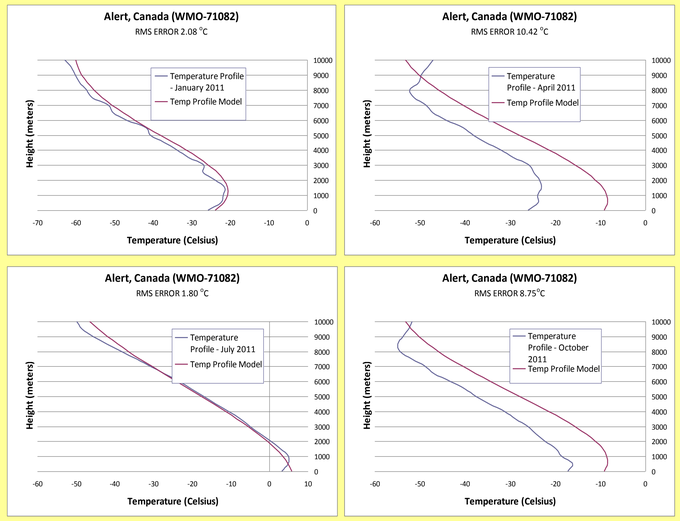
METHODOLOGY

Neural network techniques are being used to develop models of atmospheric temperature profiles based on latitude and seasons in the arctic region. Back-propagation neural networks are constructed using archived radiosonde upper air temperature measurements as inputs. The desired outputs are retrieving upper level tropospheric temperature profiles based on latitude and the season of the year. The network is trained with radiosonde measurements as truth-values.

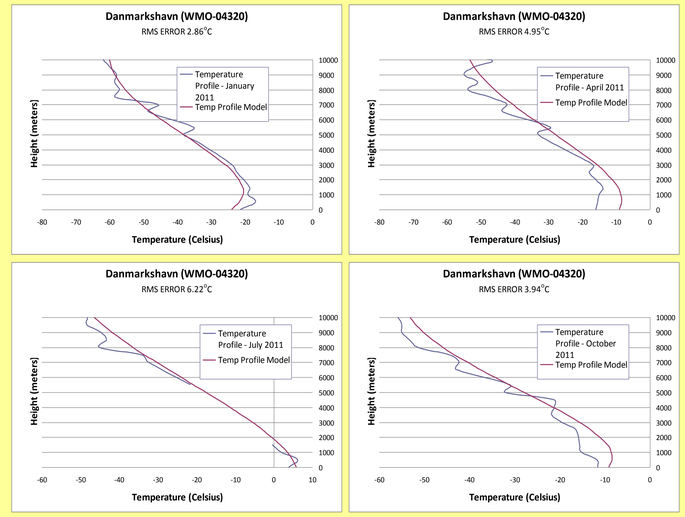


Arctic Region defined by 10 deg Isotherm

ALERT, CANADA



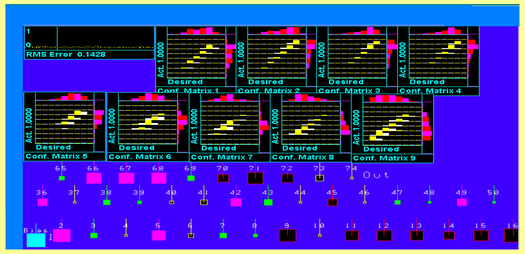
DANMARKSHAVN, GREENLAND



Features of the Temperature Profile Models

- Climatological temperature profile models have been developed that produce mean seasonal temperature profiles with latitudinal dependence for the arctic regions.
- The models were derived from neural network based algorithms that uses archived temperature profiles, retrieved temperature profiles from remote sensors, radiosonde measurements, and the solar insolation at the top of the atmosphere.
- Valid from sea level up to 10 kilometers atmospheric height.

SAMPLE NEURAL NETWORK TRAINING



Conclusion

Previous research in using neural networks to retrieve atmospheric profiles from remote sensors have shown reasonable results especially in microwave temperature profile retrievals. Using archived radiosonde measurements as ground truth as well as a simulator for temperature profiler measurements, we developed a neural network to test out the feasibility of retrieving upper level temperatures. A procedural test plan has been developed to collect reliable coincident data sets at arctic weather stations closest to the north pole. WMO stations, Alert and Danmarkshavn, were chosen test sites to assess the model's performance for the four seasons. Preliminary results look promising.

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