Use of controlled meteorological balloons for polar applications

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NGF Årsmøte 2016
Outline

· Balloon design
· Arctic applications
· Antarctic applications
· Meteorological data
· Model comparison and validation
Controlled Meteorological Balloons
Balloon design

GPS
2-way iridium communication
Automatic flight mode or sounding mode with controlled ascent/descent speed
Payload weight ~215g
Has been used in Antarctica-Amazon-Mexico City-Hawaii-Arctic...
Aviation-grade pressure sensor (Freescale 25 MPXH6115A) provides altitude information to the balloon’s control algorithm every 10 s during flight.

Temperature is measured using a thermistor (General 35 Electric MC65F103A)

Capacitance humidity sensor (G-TUCN.34 from UPSI, covering 2 to 98% RH range over 40 to 85°C).

Solar panel extends flight time significantly
May 2011 experiment
Svalbard, 80 deg N
RH in Arctic Marine Boundary Layer
wind speed < 5 m/s
Compare with ERA-interim (0.125 deg), T, over open ocean

and Arctic System Reanalysis (15 km)
Compare with ERA-interim (0.125 deg), Q

and Arctic System Reanalysis (15 km)
Main results

- First test of automatic sounding mode between two set altitudes
- Arctic System Reanalysis seem to reproduce vertical structure better (T gradient, local air flows) compared to ERA-I both over open ocean and sea ice.
- ERA-I compares better for Q
- Recently published in Roberts et al. ACP, 2016
ABOA campaign January 2013
-balloons shipped by FedEx
Mesoscale anticyclone
Trajectories, Ice edge and ERA-I MSLP
Comparison with Halley profiles (CMET descent - 12 hr time lag)
Comparison with 3 km WRF - GFS
Comparison with 3 km WRF - wind
Comparison with 3 km WRF - temp

WRF vs Balloon, AE Air temperature [K]
Continuous Soundings
In Synoptic Outflow

Layer Tracking
Layer Persists
for 10 Hours

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Ice-to-Atmosphere Soundings and Wind-Shear Navigation with a Small CMET Balloon in Antarctica, 2016

- Transect Across Ice Surface
- Continuous Soundings In Synoptic Outflow
- Tracking Onshore Layer Back Onto Antarctic Continent
Summary

- Cost-efficient measurements from ground to free troposphere
- Can be shipped to launch site and launched by untrained staff
- High resolution measurements in very remote locations
- Range up to 1000s km
- Multiple days
- Able to track layers for navigation
- www.science.smith.edu/cmet
Project sponsors

- Research Council of Norway
- Scientific Committee on Antarctic Research