NOAA P-3 Radar Data Status

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1. NOAA P-3 Aircraft Platform

The NOAA P-3 aircraft is a mobile platform, which offers a large number of measurements, including environmental state parameters (e.g. temperature, relative humidity), cloud and precipitation information (weather radar, liquid water content, particle probes), and sea surface temperature (via infrared retrieval).

NOAA P-3 aircraft

Tail-mounted radar

A primary data source aboard the P-3 is the tail-mounted weather radar (characteristics shown in Table 1). The radar is a vertically-scanning (about the longitudinal axis of the aircraft), flat plate antenna design (Fig. 1). The dual PRF batching technique is used to extend the Nyquist velocity.

Table 1. NOAA P-3 Doppler weather radar characteristics.

wavelength	3.22 cm (X-band)
PRF	3200/2400 s^{-1}
Unambiguous range	38 km
Nyquist velocity	±51 m s^{-1}
H beamwidth	1.35°
V beamwidth	1.90°
Pulse width	0.25/0.375 µs
Gate length	150 m
Antenna rotation	10 rpm (60° s^{-1})

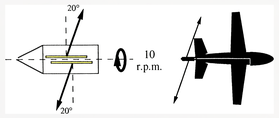
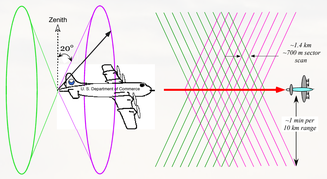


Figure 1. Schematic showing the flat-plate antenna and scanning characteristics.

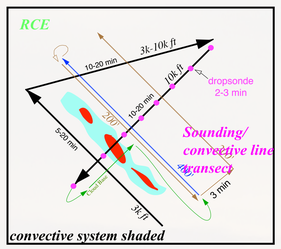
The fore-aft scan technique (FAST) results in two distinct measurements at the same spatial (and nearly temporal) point. This is done to allow for a pseudo- dual-Doppler analysis to derive a 3D wind field.



FAST sampling geometry of P-3 tail-mounted radar.

Data Collection

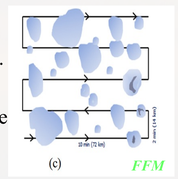
The NOAA P-3 aircraft conducted 12 flights from 11 Nov – 13 Dec 2011. Various flight pattern modules were developed for use in the DYNAMO project to address specific scientific goals. Schematics of selected modules are shown to the right, along with a brief description of the main modules below.

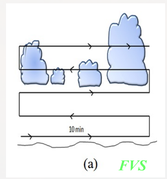


The Radar Convective Element (RCE) module was designed to collect data during a convective event.

The Flight-level Flux Mapping (FFM) module were designed to study horizontal turbulent fluxes.

The Flight-level Vertical Stack (FVS) module were designed to study boundary layer turbulent flux profiles.

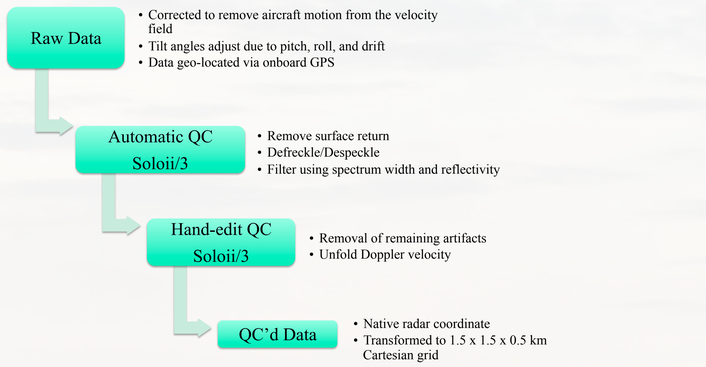


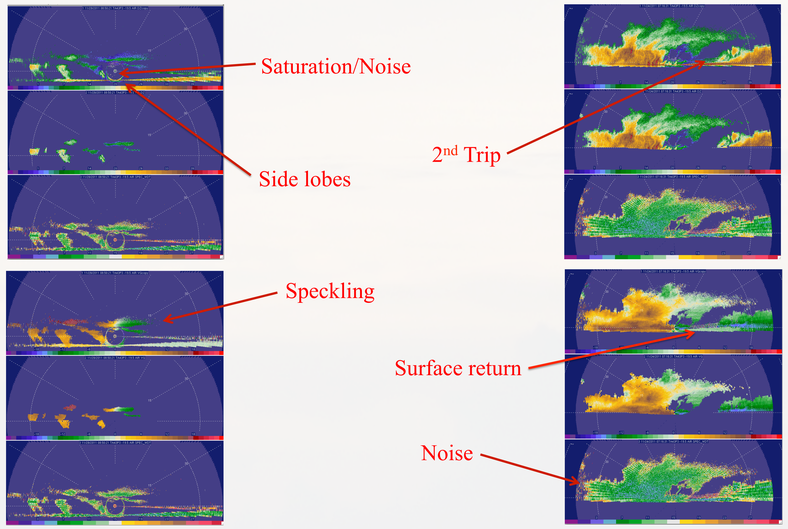


2. Weather Radar Quality Control

As in any radar data set, the raw data collected contains non-meteorological echo that must be removed from the data set before meaningful analysis can take place. Quality control (QC) procedures were done using the National Center for Atmospheric Research (NCAR) Solo software package. As the P-3 is a mobile platform, aircraft motion must first be removed from the velocity field. Tilt angles were also adjusted, based upon the pitch, roll, and drift recorded by the internal navigation system. The data was then be geo-located with information from the onboard GPS.

An automated set of scripts using built-in functions was run in the Soloii/3 environment. Surface return was removed using a simple geometric calculation provided by the Solo editor. Isolated gates of radar reflectivity ("speckles") in clear air and anomalous outliers within weather echo ("freckles") were also removed. The de-speckling algorithm required that there be 3 contiguous gates along the ray for data to be retained. The de-freckling algorithm removed any values exceeding a 7 gate running average of Doppler velocity by more than 22 m s^{-1}. This automated procedure removed a great deal of the non-meteorological echo, however, an additional manual editing step was required to remove the remainder. The automated algorithm was performed with somewhat conservative criteria and therefore unable to fully remove such artifacts as side lobe and some 2nd trip signal return. QC procedures are very often a balance between alleviating spurious data while retaining the maximum amount of valid weather information. Therefore, the manual editing step was essential to remove the remainder of non-meteorological return. The order of steps is described below in the flow diagram. Note that no Doppler velocity unfolding was necessary in the DYNAMO data set.





3. NOAA P-3 Data

RCE flight modules

All RCE flight modules have been submitted to the DYNAMO data repository. A document detailing the collection procedure, quality control and general aspects of the data is also available for download in the repository. A single DORADE formatted file contains each vertical scan (both aft and fore) recorded during the duration of the flight module. For each vertical scan, the raw and fully quality-control processed radar reflectivity and Doppler velocity field data are saved. Additionally, the raw spectrum width is also included. The table below summarizes the RCE modules available:

RCE module data status

Date (2011)	Duration (UTC)	Quality Controlled?	Meteorological Category
11 November	0902-0923	Y	Suppressed, Isolated convection
16 November	0421-0519	Y	Scattered, ITCZ
22 November	0433-0515	Y	Active, MCS
	0635-0731	Y	
24 November	0351-0457	Y	MJO, MCS
	0705-0745	Y	
30 November	0809-0854	Y	MJO, Scattered convection
8 December	0610-0640	Y	Suppressed, Isolated convection
	0642-0717	Y	

Known Data Issues

- 16 and 28 November cases exhibited substantial and limited "smearing" of rays, respectively
- Small gaps in some data modules from data processor "freezing up"
- Some modules have sector scans in which only one side of aircraft was scanned after a turn when convection was present on both sides
  - Effect on overall data quality is negligible

Other flight modules

The status of other flight modules identified for QC since the RCE data was submitted to the online DYNAMO data repository are summarized below:

Boundary layer flux module status

Date (2011)	Duration (UTC)	Quality Controlled?
22 November	0515-0616	Y
	0616-0635	Y
	0745-0755	Y
24 November	0457-0524	N
	0614-0705	N
28 November	0430-0615	Y
8 December	0610-0640	N
	0642-0717	N

FVS flight modules

Date (2011)	Duration (UTC)	Quality Controlled?
4 December	0640-0800	N
	0800-0905	N

Other flight modules

Date (2011)	Duration (UTC)	Quality Controlled?
28 November	0235-0430	Y
	0616-0808	Y
	0828-0924	Y
30 November	0320-0340	Y

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