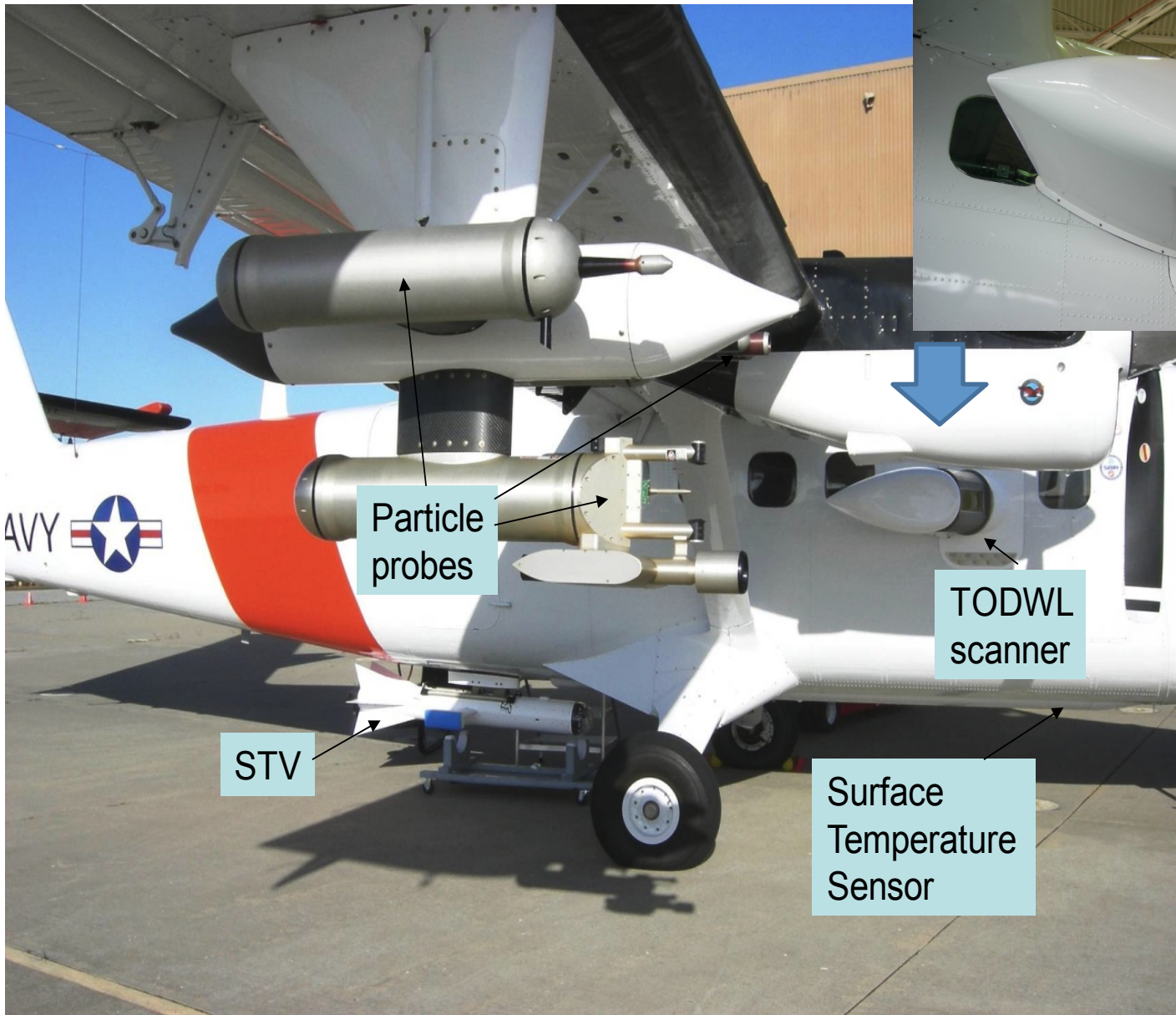


Twin Otter Observations for the **MATERHORN**

Dave Emmitt, Simpson Weather
Associates

Stephan de Wekker, University of
Virginia



TODWL

CIRPAS Twin Otter at MATERHORN

- ARO (Videen) funding ferry flights from Monterey and 10 hours on site.
 - Support MATERHORN IOPs
 - Provide 3D context for complex terrain flow
- ONR(Ferek) allowing 10 -15 UPP flight hours to be used at GMAST.
 - Pursue UPP objectives with evaluation of EDMF parameterization over land in the presence of organized structures; nocturnal flows

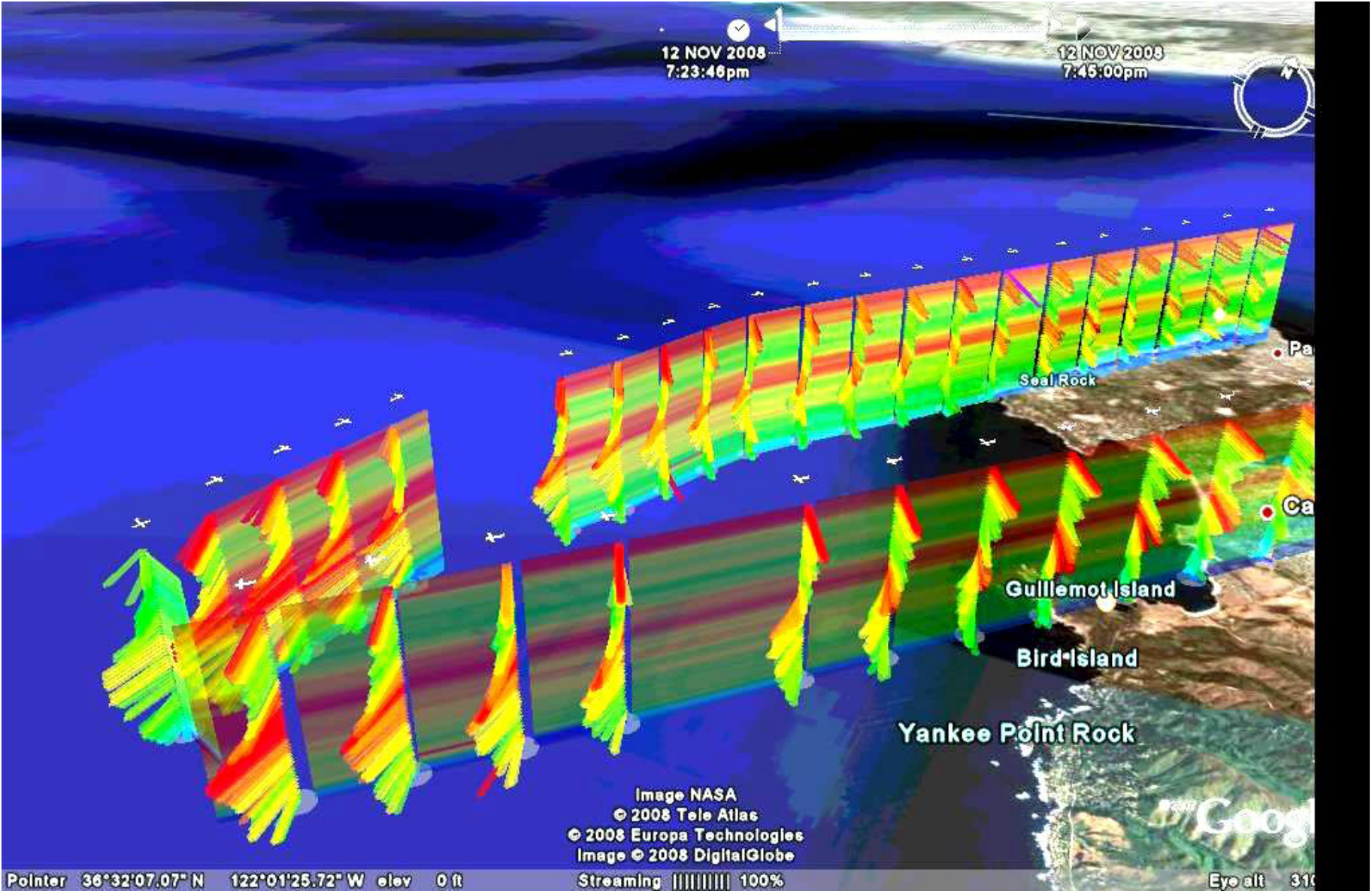
CIRPAS Twin Otter

- Aerosols (probes)
- Fluxes
- Surface temperature
- Vertical wind profiles
- Vertical aerosol profiles

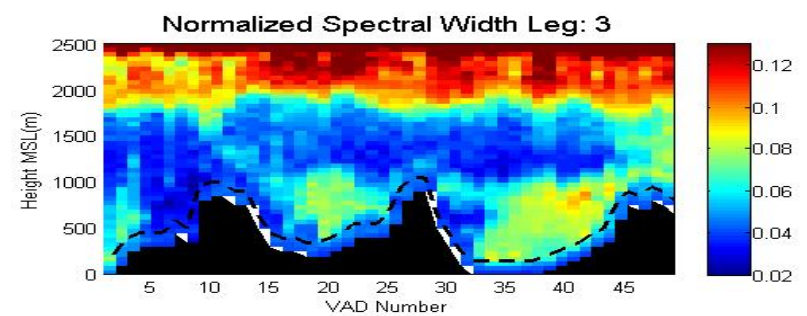
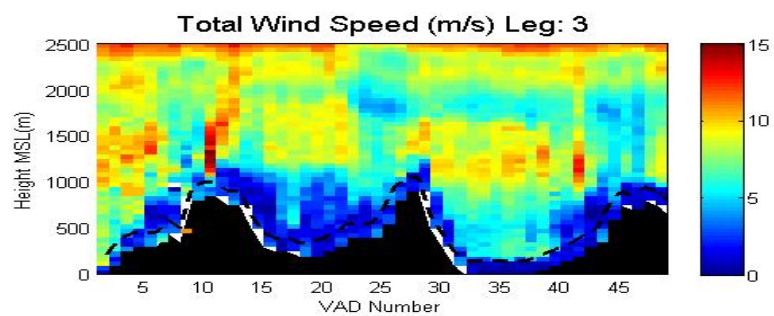
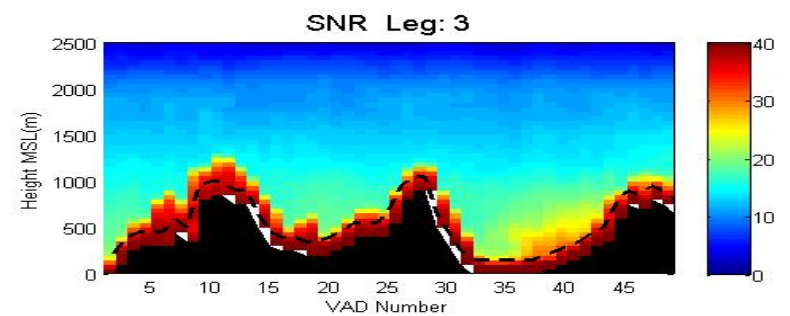
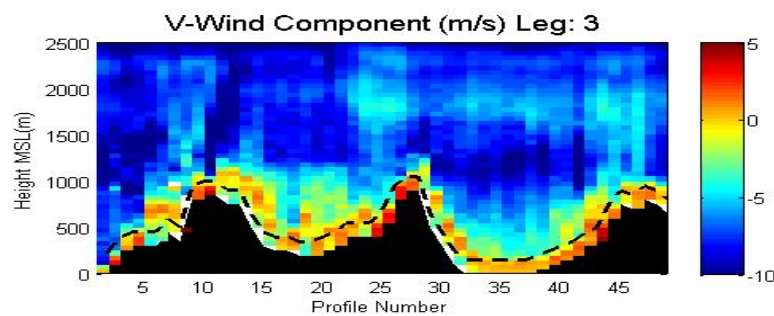
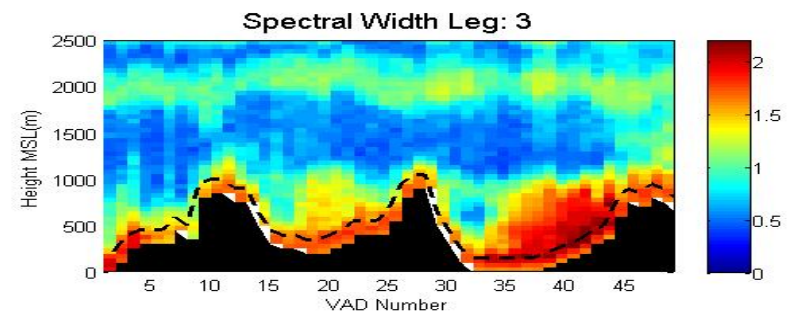
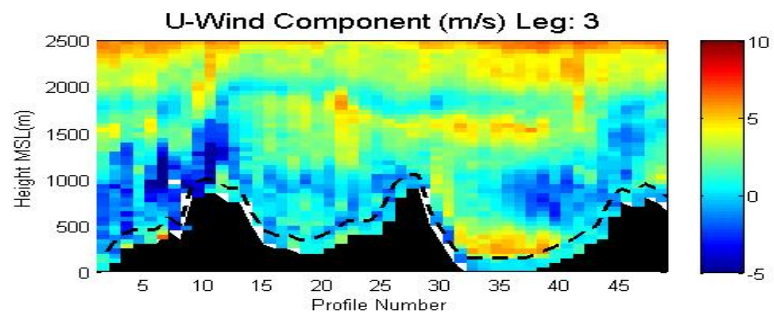
Instrument	Manufacturer	Description	Range	Classification
Passive Cavity Aerosol Spectrometer Probe (PCASP) - SPP200	PMS, Inc	Particle Size Distribution	0.1 - 3.0 μm	Facility
Forward Scatter Spectrometer Probe (FSSP) - SPP100	PMS, Inc	Particle Size Distribution	0.5 - 47.0 μm	Facility
Cloud, Aerosol, and Precipitation Spectrometer (CAPS)	DMT, Inc	Particle and Drop Size Distribution	0.5 – 50 μm (scatter) 25-1600 μm (2-D)	Facility
Cloud Imaging Probe (CIP-2D)	DMT, Inc	Cloud Particle Images	25-1600 μm	Facility
Precipitation Imaging Probe (PIP-2D)	DMT, Inc	Cloud Particle Images	100 μm - 12.4 mm	Facility
2D Stereo Imaging Probe	SPEC, Inc	Cloud Particle Images		Facility
Condensation Particle Counter (3010)	TSI, Inc	Particle concentration	$D_p > 0.01 \mu\text{m}$	Facility
Ultrafine Condensation Particle Counter (3025)	TSI, Inc	Particle concentration	$D_p > 0.003 \mu\text{m}$	Facility

Three-wavelength Integrating Nephelometer	TSI, Inc	Backscatter and 7-170 deg integral scatter		Facility
Three-wavelength Soot Photometer	Radiance, Inc and University of Washington	Differential filter transmissivity		Facility
Temperature	Rosemount	Total Temperature	-50 to +50 C	Facility
Dew Point Temperature	EdgeTech	Chilled Mirror device	-50 to +50 C	Facility
Barometric, Dynamic, and Radome-Angle Pressures	Setra	Barometric and differential transducers	600-1100 mb +/- 75 mb	Facility
Wind	Radome, flow angle probe	TAS, Mean Wind, Slip- and Attack angles.		Facility
TANS Vector platform attitude	Trimble, Inc	GPS, Pitch, Roll, Heading		Facility
NovAtel GPS	NovAtel, Inc	GPS, Lat, Long, Alt, ground speed and track		Facility
C-MIGITS-III, GPS/INS	Systron, Inc.	Lat, Long, Alt, ground speed and track, pitch, roll, heading,		Facility
Heitronics KT 19.85 Pyrometer	Heiman	Sea surface temperature	-5 to 45 oC adjustable	Facility
PVM-100A	Gerber Scientific, Inc	Liquid Water Content of clouds		Facility
Cloud Condensation Nuclei counter (CCN)	DMT, Inc	2 columns providing 2 supersaturation measurements simultaneously		Facility

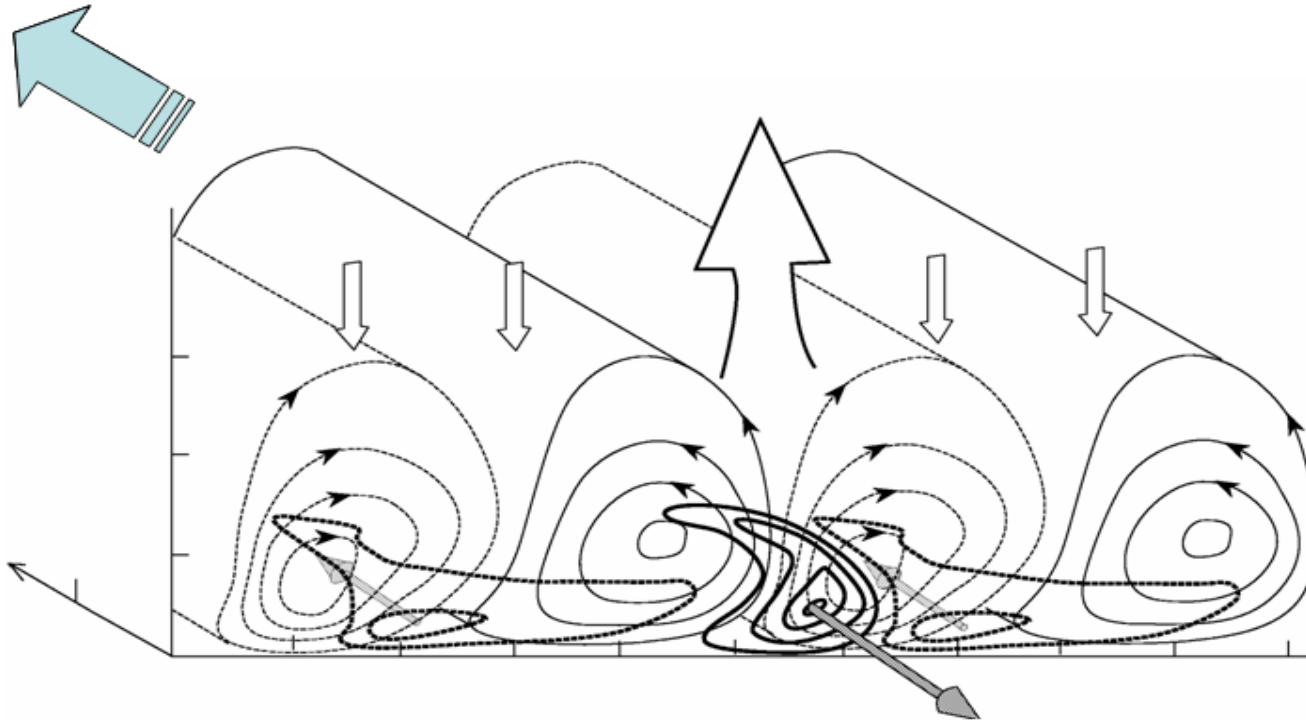
Counterflow Virtual Impactor	MISU/Caltech			Research
Cloud Radar	ProSensing Inc.	95 Ghz, doppler		Research
Phased Doppler Cloud Spectrometer (CVI)	Artium, Inc.	Drop Size Distribution	$2 < D_p < 200 \mu\text{m}$	Research
Aerosol Mass Spectrometer (AMS)	Aerodyne	Chemical composition of particles		Research
Particle In Liquid Sampler (PILS)	Brechtel, Inc	Chemical content of particles		Research
Twin Differential Mobility Analyzer	Caltech	Size distribution of dry and humidified aerosol	$10\text{-}150 \mu\text{m}$	Research
Stabilized Radiometer Platform	Sonoma Technologies, Inc	Broadband and infrared radiation		Research
Turbulence, fluxes	Univ. of California, Irvine			Research
Wind Lidar	Coherent Technologies, Inc.			Research







From DeWecker, et.al 2012



Wavelength: Larger-scale structures ~ 700 to 5000 m
Smaller-scale structures ~ 300 to 700 m

Velocity Perturbations: +/- 7 m s⁻¹ typical
DOW +/- "10s of" m s⁻¹

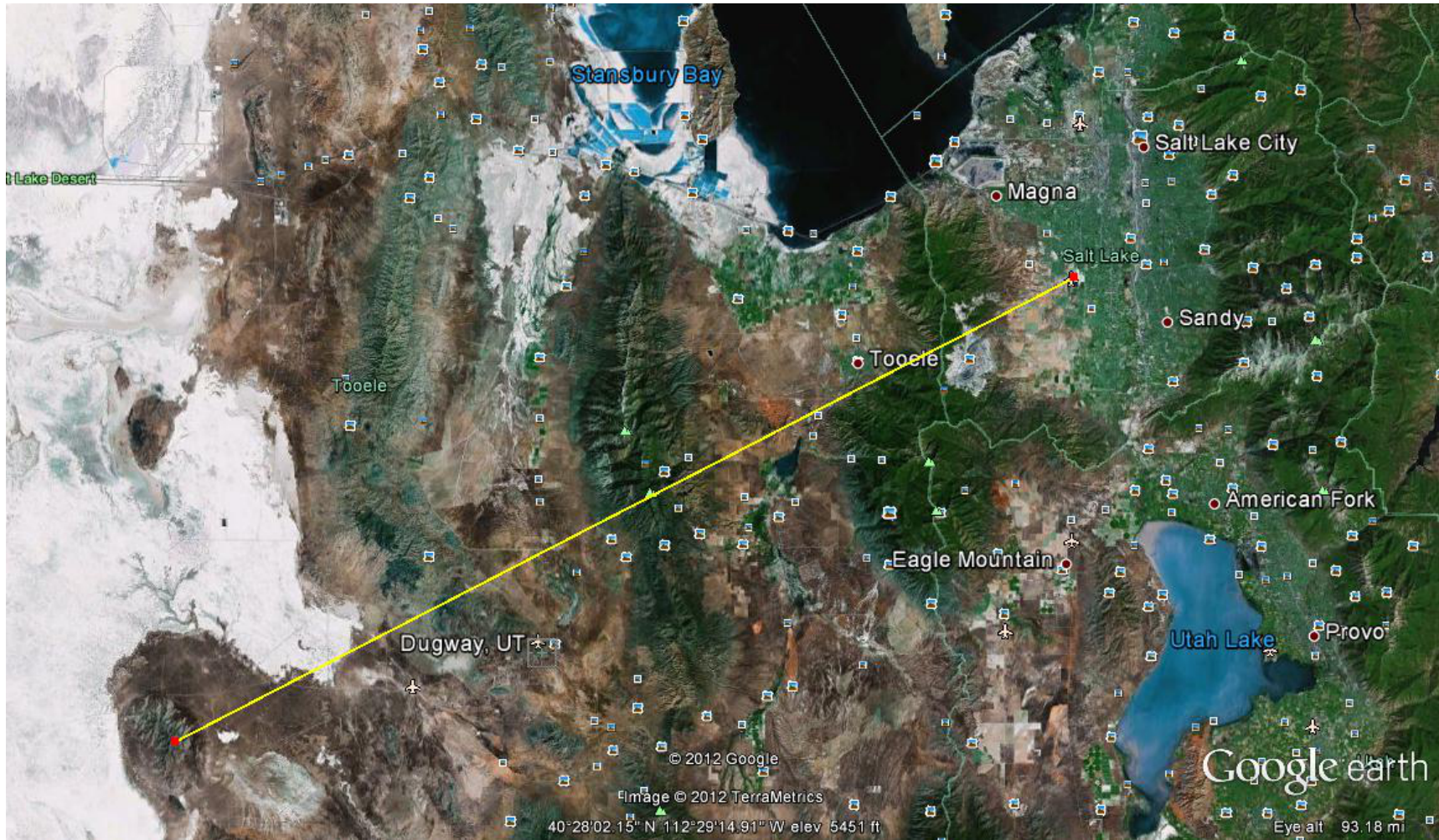
Orientation: Typically along-mean TCBL wind, wide variability

Prevalence: Larger-scale structures ~ unknown, (35% to 70%)
Smaller-scale structures: ***Always Present***

Provided by Foster

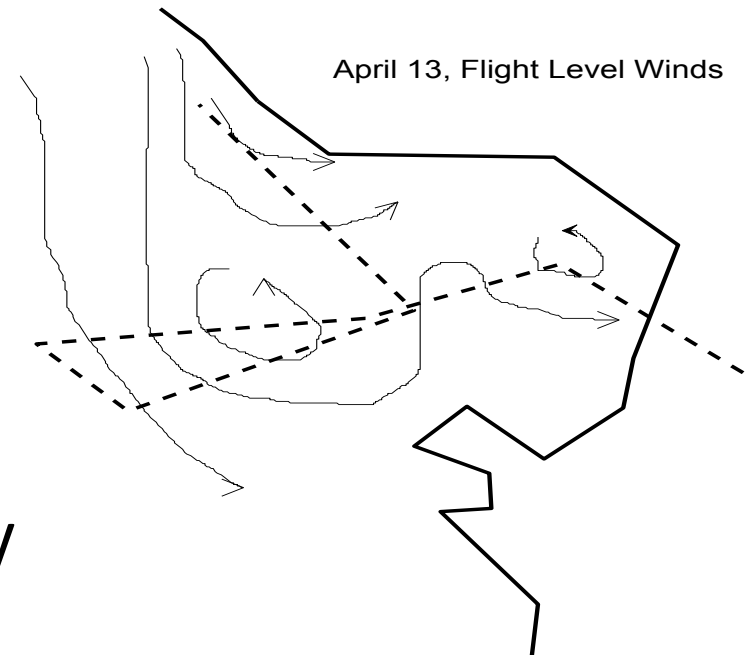
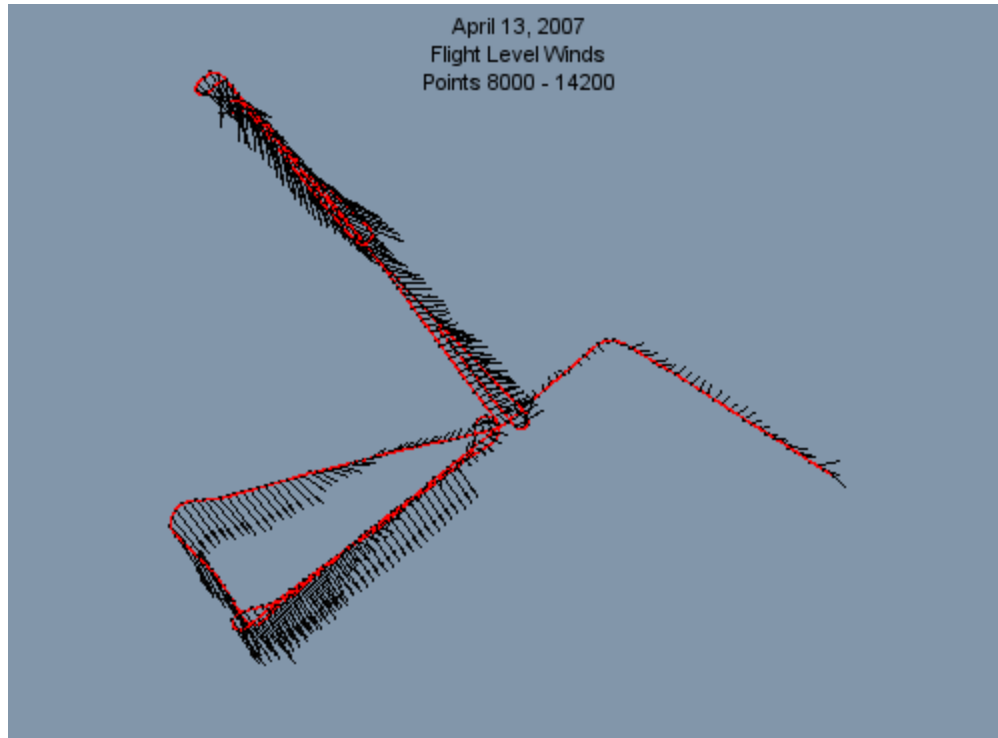
Flight profile

- Aircraft will be based out of U42 (current plan)
 - ~ 20 minute to Granite Mountain
 - climb to 12K feet (~5K feet above peaks)
- Twin Otter in Utah for 12 days between 28 September and 25 October
- Missions will last 2- 4 hours
 - 5 – 10 missions
- 12 hour rules for pilots apply
 - 12 hours on call
 - 12 hours between “on calls”.

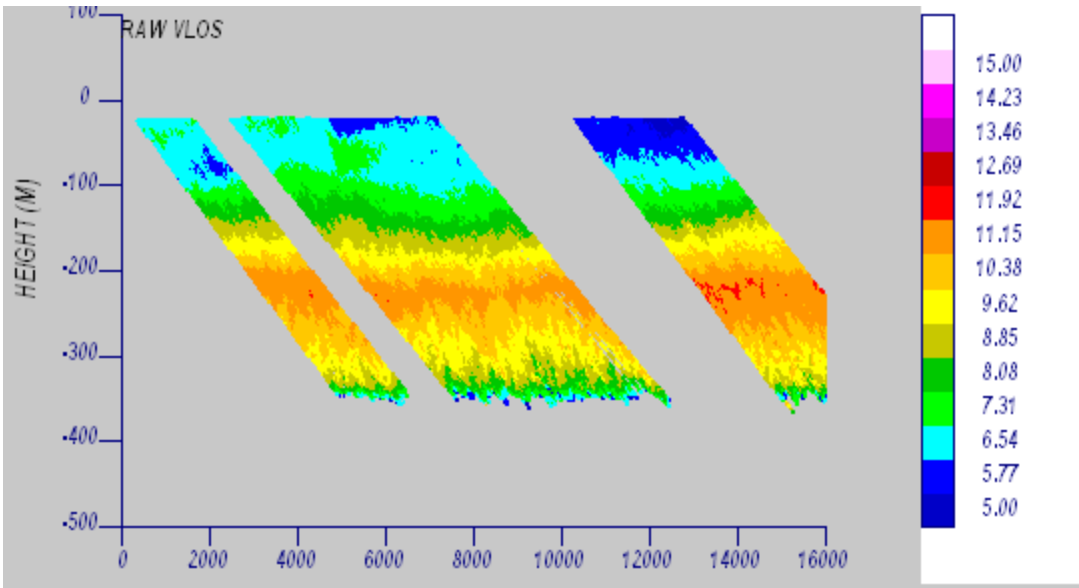


TODWL data products (Nadir conical)

- Downward conical scans (12 point step stare)
- Off-nadir angle of 20 -30 degrees
 - 20 -25 seconds for full 360 scan (\sim 1 -1.2km)
 - U,V,W with 50 m vertical resolution
 - Sigma (U,V) \sim .10 m/s ; Sigma (W) \sim ??
 - SNR (aerosols)
- Nadir samples
 - 5 seconds between conical scans
 - 50 m vertical resolution with sigma(w) \sim .05m/s`



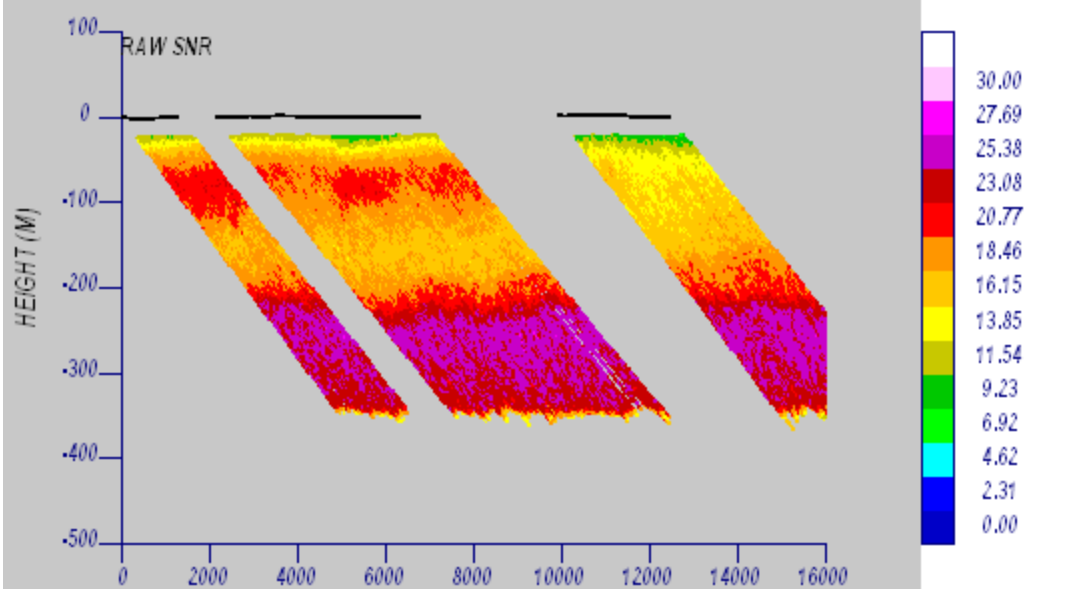
April 13, 2007 flights with CTV



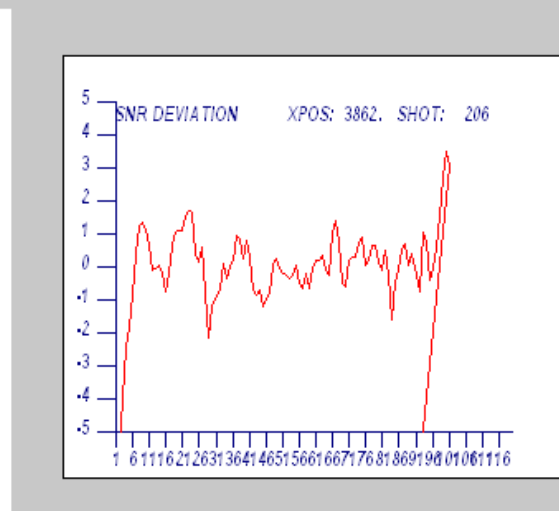
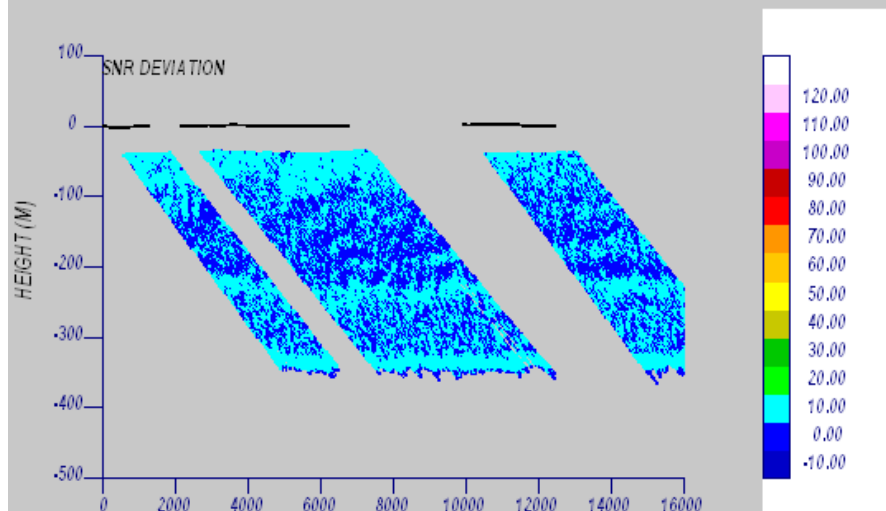
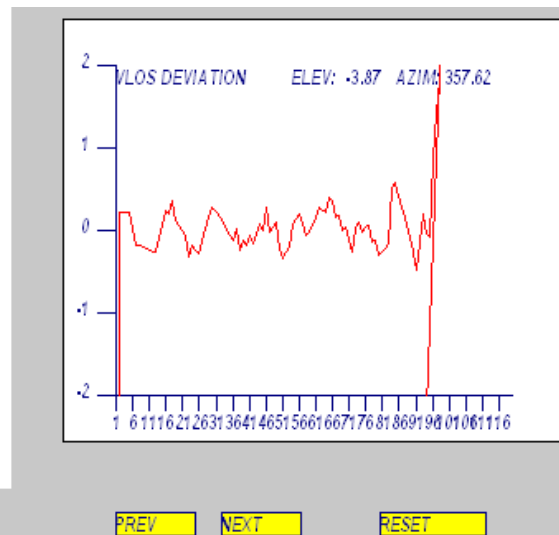
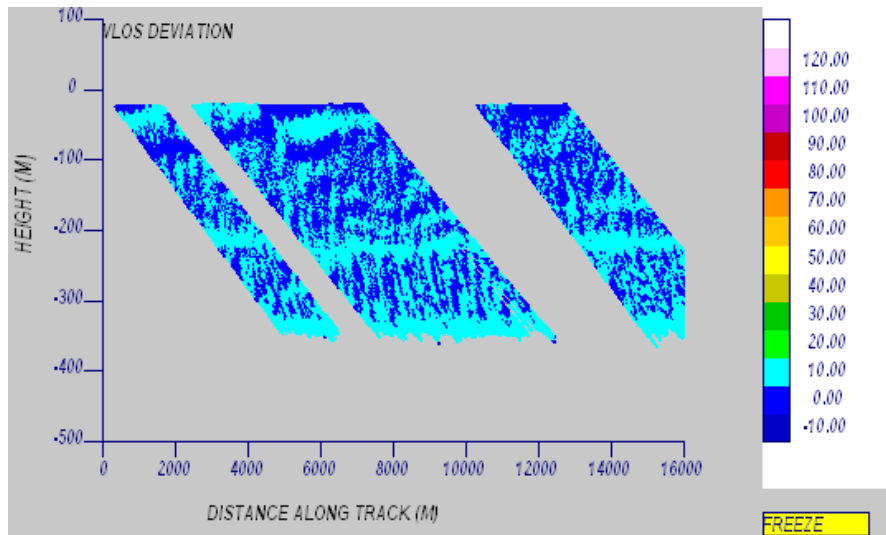
m/s

FREEZE

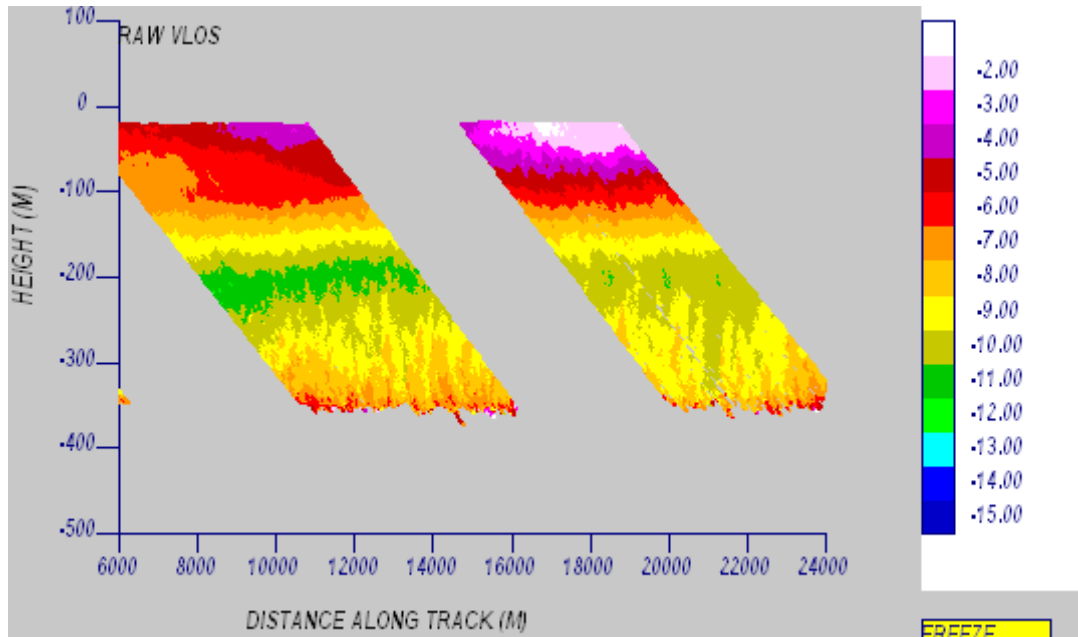
NW



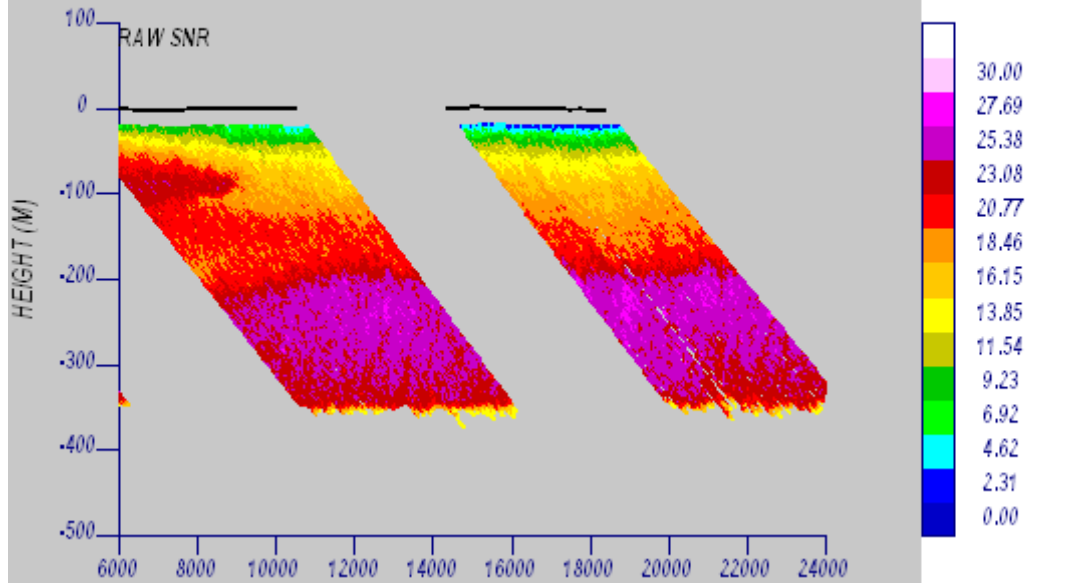
dB



Upper Left: LOS velocities light blue away; dark blue towards
 Lower Left: LOS SNR: light blue high; dark blue low
 Right Panels: time series at 50m MSL

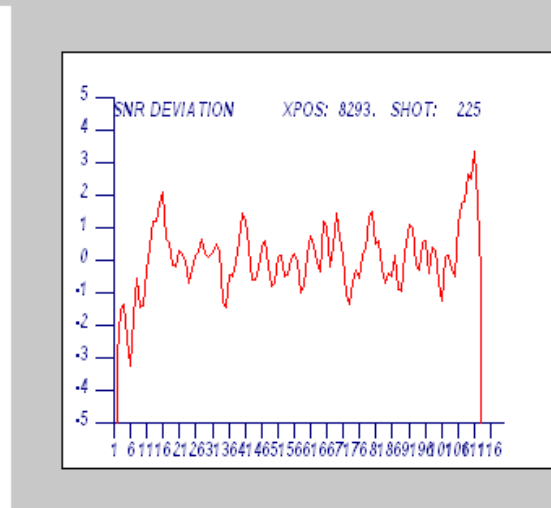
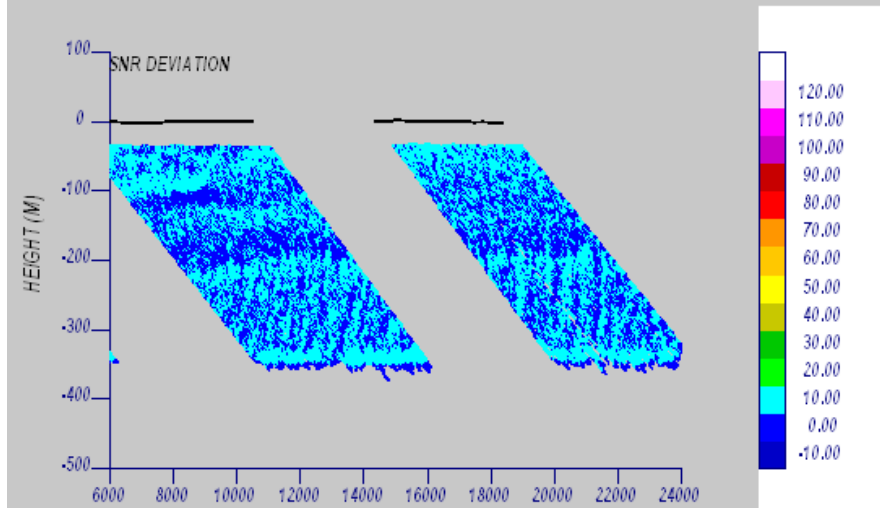
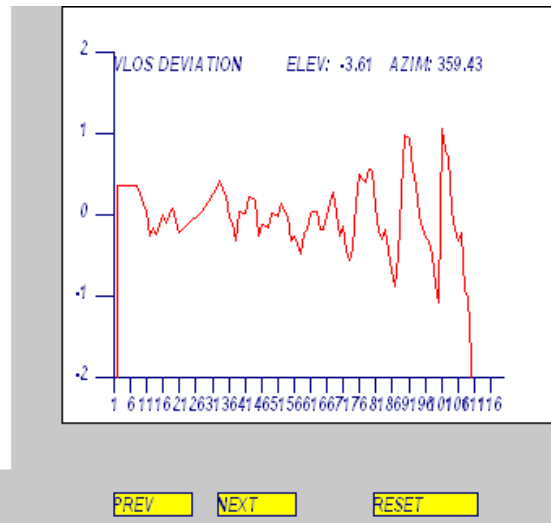
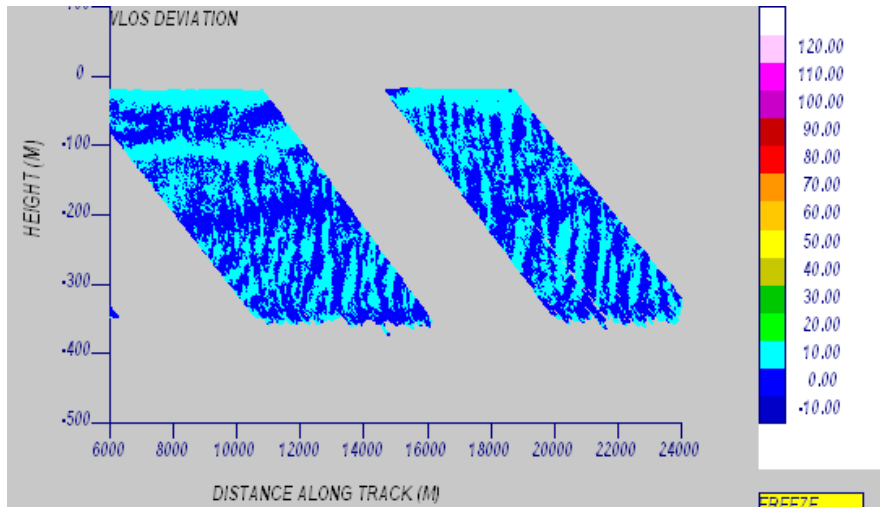


m/s

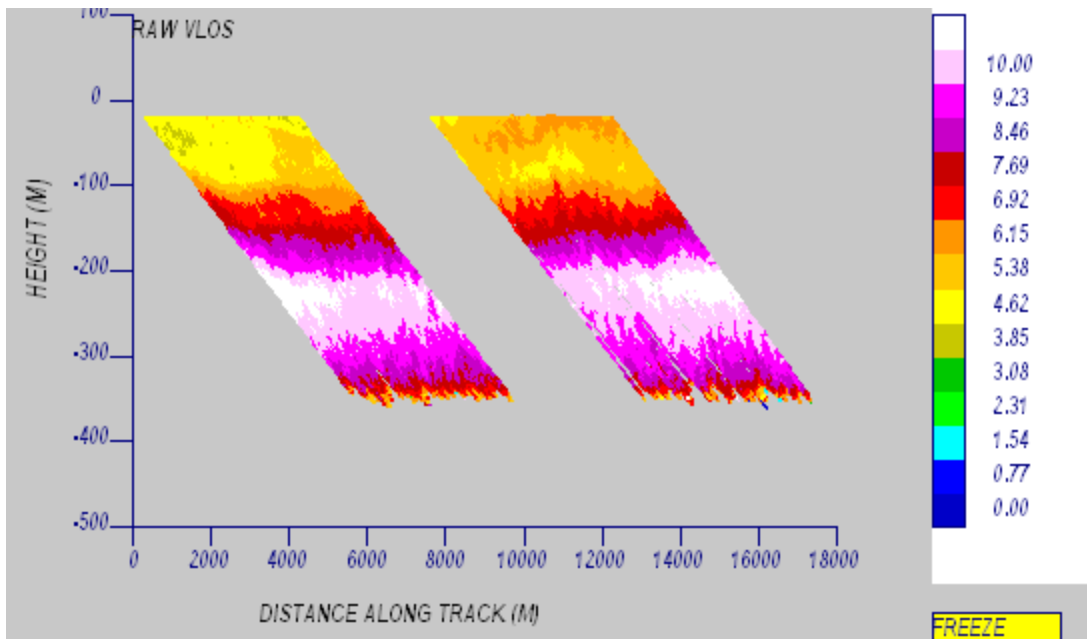


dB

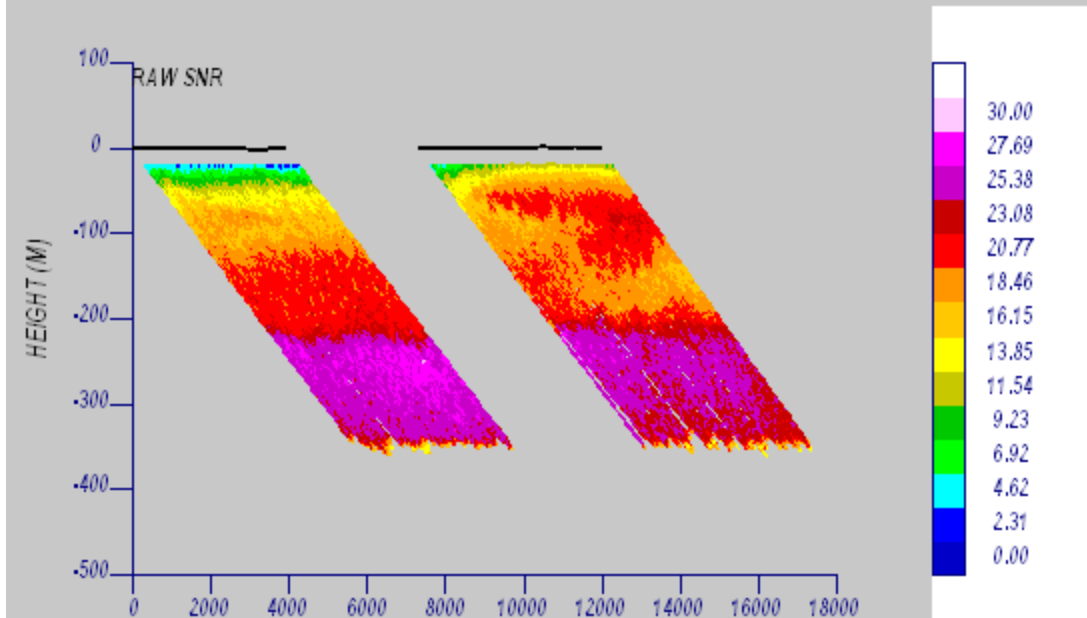
SE



Upper Left: LOS velocities light blue away; dark blue towards
 Lower Left: LOS SNR: light blue high; dark blue low
 Right Panels: time series at 50m MSL

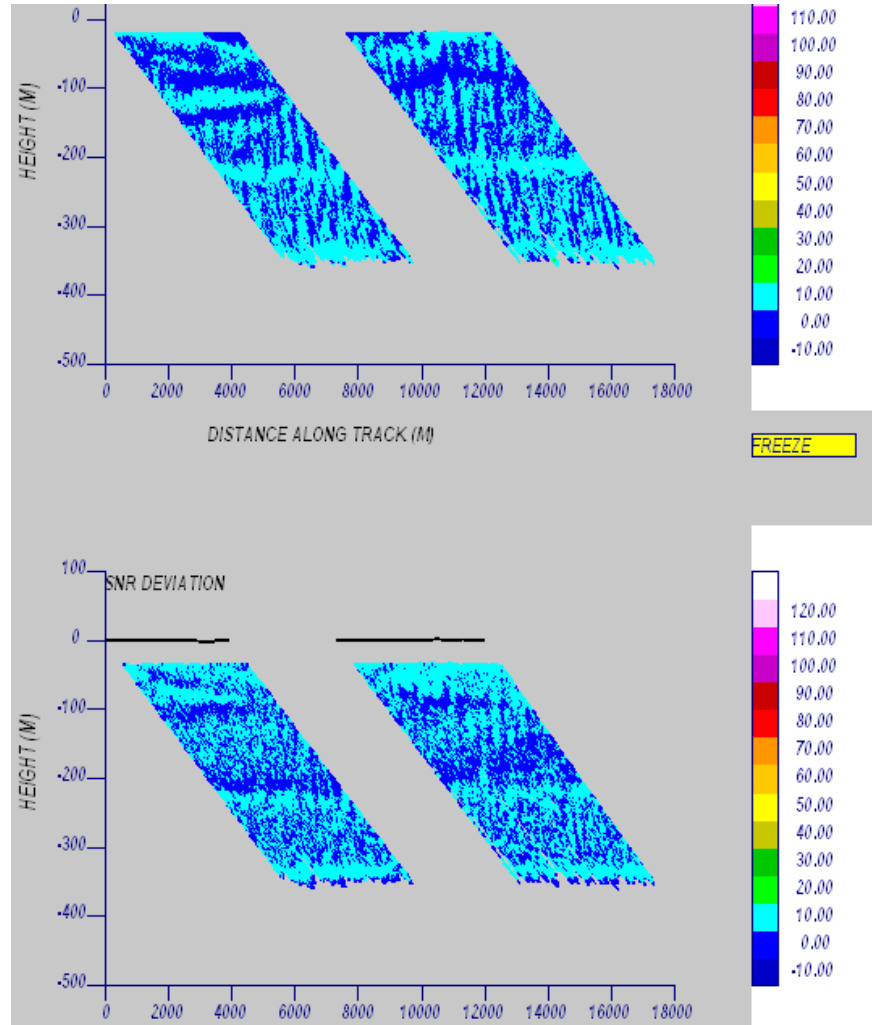


m/s



dB

NW



Upper Left: LOS velocities light blue away; dark blue towards
 Lower Left: LOS SNR: light blue high; dark blue low

