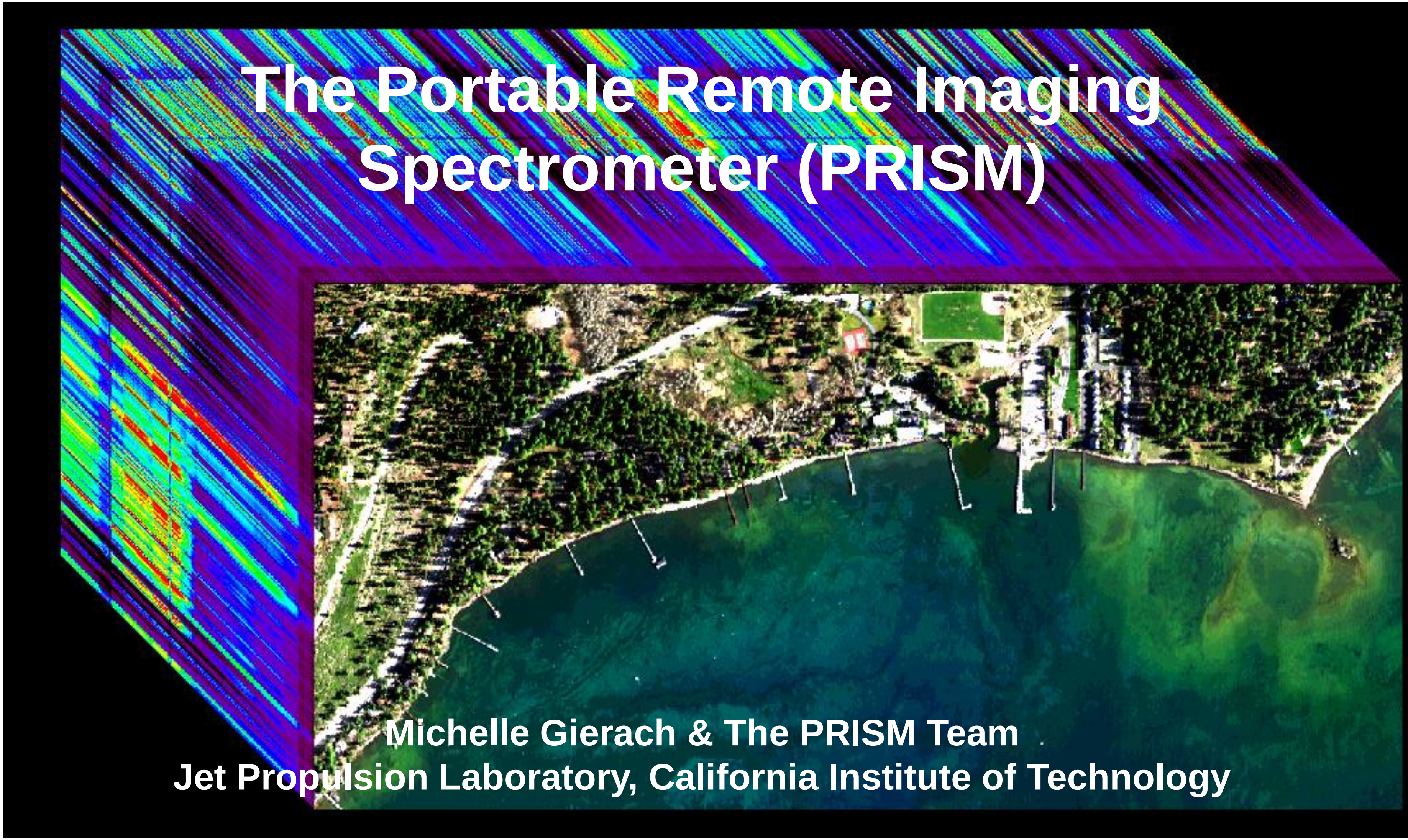


The Portable Remote Imaging Spectrometer (PRISM)

Michelle Gierach & The PRISM Team
Jet Propulsion Laboratory, California Institute of Technology

Acknowledgments

The PRISM Team:

PI: Pantazis Mouroulis

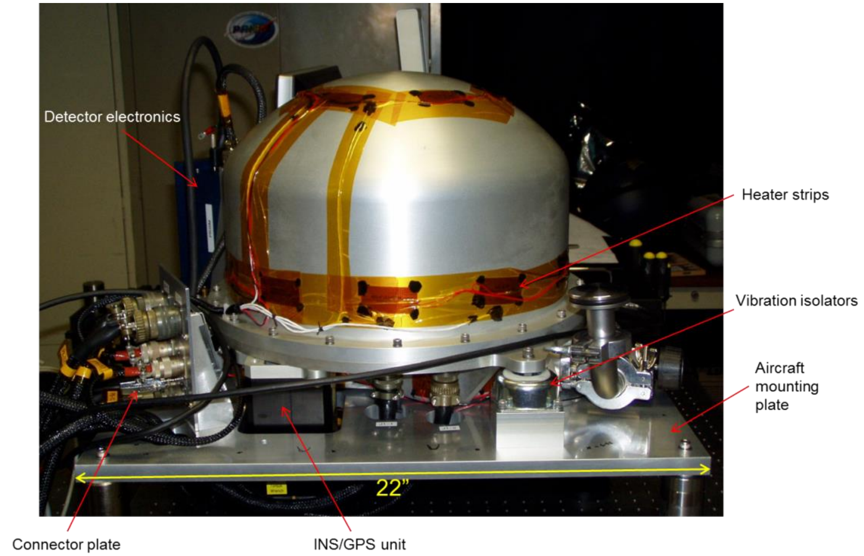
Science Co-I: Heidi Dierssen, U. Connecticut (& Kaylan Randolph)

Flight coordinator, integration Co-I: Ian McCubbin

Co-Is: Byron Van Gorp, Rob Green, Michael Eastwood, Bo-Cai Gao (NRL), Jose Rodriguez, Joe Boardman (AIGLLC)

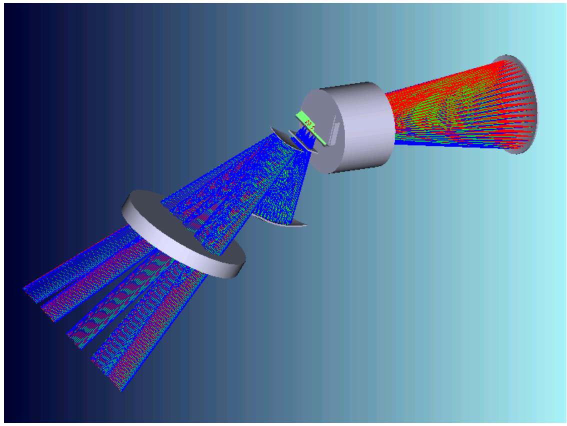
Engineering Team: Asad Aboobaker, Frank Loya, Chuck Sarture, David Thompson, Scott Nolte, Didier Keymeullen, Sarah Lundeen, Mike Borden

NASA Partner: AFRC

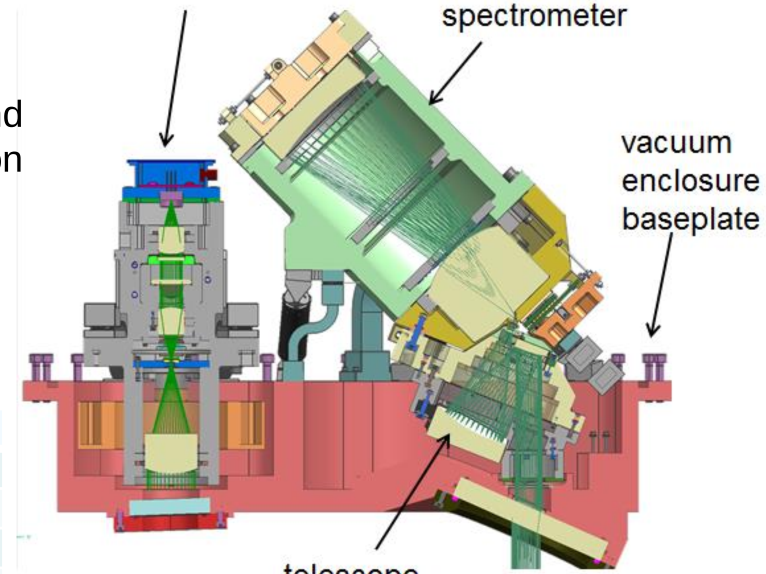


PRISM Specifications and Design

http://prism.jpl.nasa.gov



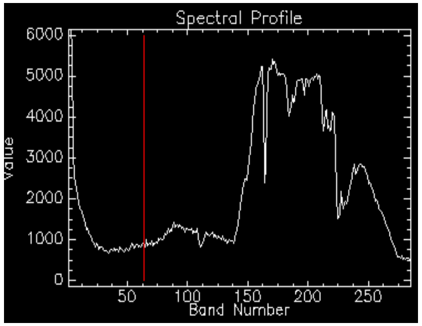
High throughput and high uniformity Dyson spectrometer

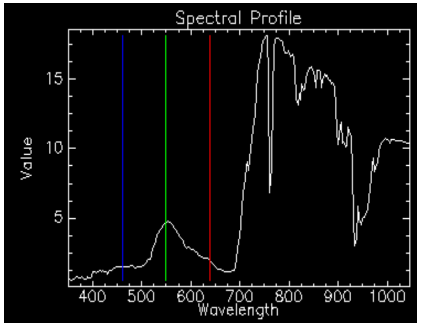


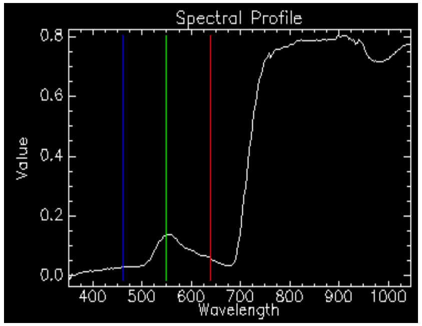
Spectral	Range	349.9 – 1053.5 nm
	Sampling	2.83 nm
	Resolution (FWHM)	3.5 nm typ
	Calibration uncertainty	<0.1 nm
Spatial	Field of view	30.7^o
	Instantaneous FOV sampling	0.882 mrad
	IFOV resolution (FWHM)	0.97 mrad
	Cross-track spatial pixels	608
Radiometric	Range	0 – 99% R
	Sampling	14 bit
	Calibration uncertainty	<2%
	Signal to Noise Ratio *	500 @ 450 nm
	Polarization variation	<1%
Uniformity	Spectral cross-track uniformity	>95%
	Spectral IFOV uniformity	>95%

Parameter	Channel 1	Channel 2
Channel center (nm)	1242	1608
Bandwidth (nm, FWHM)	22	56
FOV (mrad, FWHM)	2.4	2.4
Boresight knowledge (mrad, rel. to spectr.)	0.05	0.05
Sampling	13 bit	13 bit
SNR @ 1.2 mW/cm^2 sr	325	390

PRISM Data Processing







Level 0: Raw instrument DNs

1. Measure incident radiance at 100 lines/sec.
2. Associate data with Inertial Measurement / GPS for orthorectification

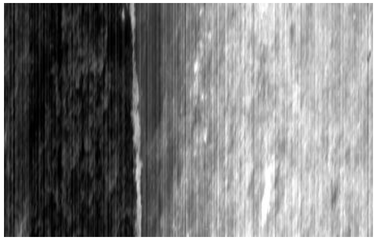
Level 1: Calibrated radiance

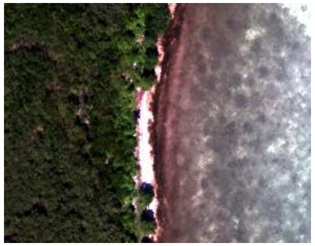
1. Characterize dark current
2. Correct panel artifacts
3. Correct panel tap boundaries
4. Correct pedestal shift
5. Apply flat field
6. Apply radiometric calibration

Level 2: Surface reflectance

1. Calculate atmospheric absorption, aerosol and molecular scattering based on aircraft imaging geometry
2. Retrieve water vapor and optical path for each spectrum
3. Correct data to apparent reflectance at the surface

Spatial processing: Cropping, binning and orthorectification





ORCAS Campaign: PRISM Objectives

- PRISM will complement ORCAS observations with hyperspectral measurements in the Southern Ocean, providing data products that are critical to :

   1. Improve understanding of biogeochemical processes in the Southern Ocean and their control on air-sea gas exchange (e.g., white caps, reactive trace gases and cloud droplet concentrations produced by marine biota)

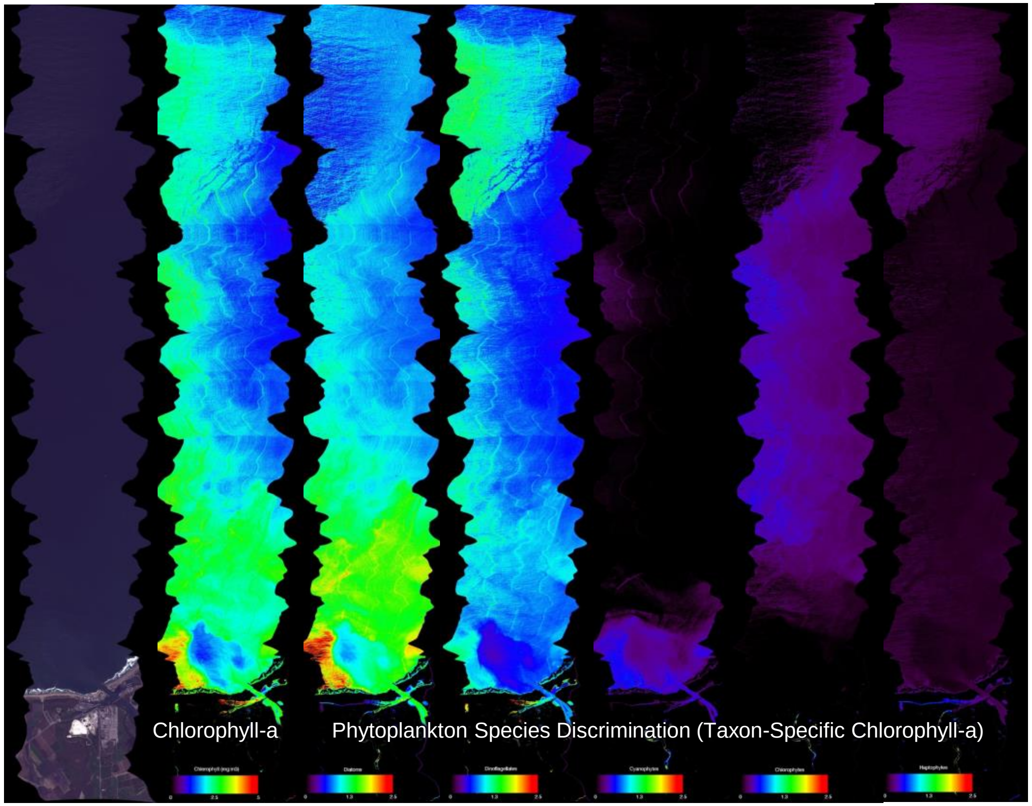
   2. Test future ocean color satellite products and their atmospheric correction algorithms

   1. Provide synergy with a host of ancillary bio-optical and biogeochemical data from collaborative Southern Ocean projects

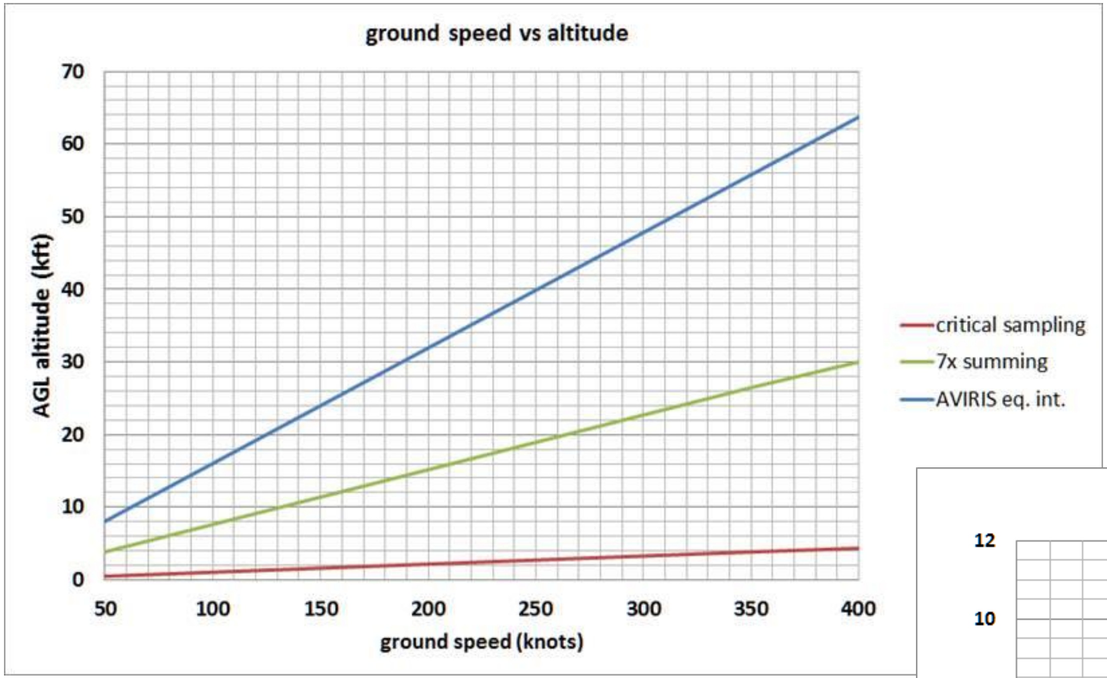
- Provide real-time radiance and reflectance analysis for immediate display and quality assurance during flight, as well as simple chl-a estimates for identification of biologically rich regions to inform tactical flight decisions

ORCAS Campaign: PRISM Objectives

- Data will be processed to Levels 1-3 (radiance, reflectance, and chl-a) at JPL and archived/freely distributed by the PRISM team and NCAR EOL
- Collection of PRISM imagery in this region will allow for development of new algorithms, such as characterizing phytoplankton functional groups and selected phytoplankton taxa using the full hyperspectral data



ORCAS Campaign: Flight Planning



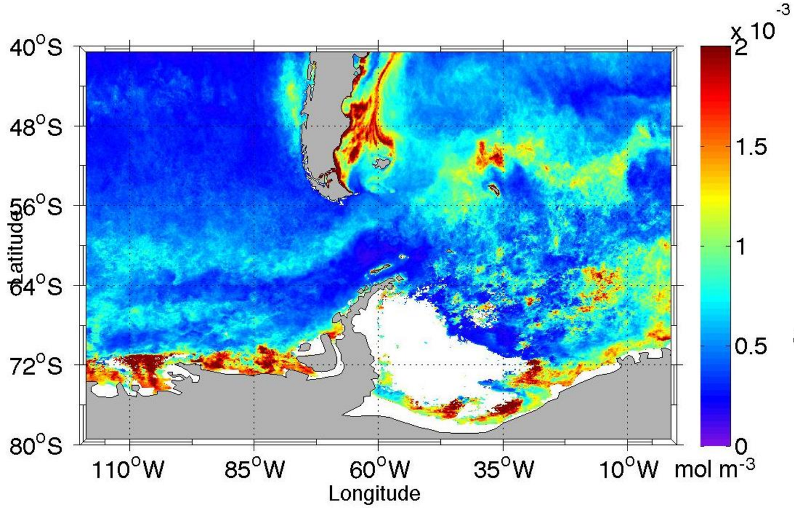
PRISM along track oversampling increases SNR

- PRISM FOV: 30.7 deg
- Aircraft swath: ~5km (w/ 15% overlap)
- Aircraft altitude: 30kft (~8.53km)
- Aircraft speed: 300kts
- Spatial resolution: ~8-9m

ORCAS Campaign: Flight Planning

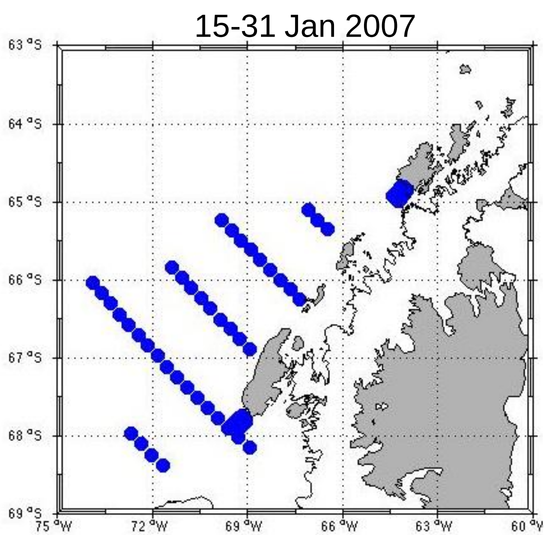
Potential remote sensing flights:

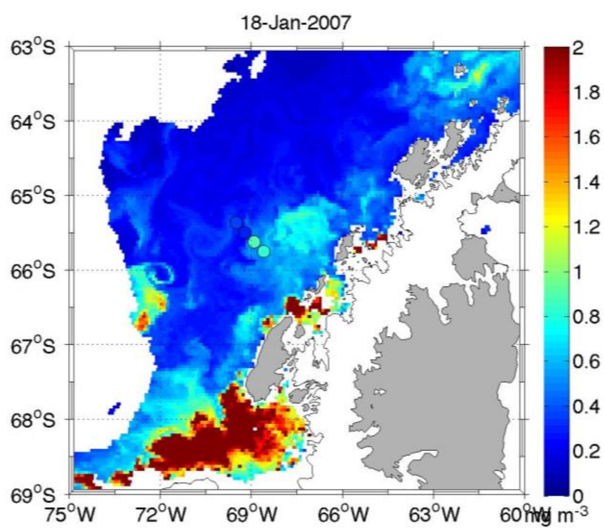
1. Palmer LTER grid*
2. Drake Passage/Ona Basin*
3. Argentine Basin



Synergistic observations:

1. *R/V Gould – Palmer LTER : ~1 Jan – 1 Feb
2. *R/V Gould – Drake Passage : ~3 Jan; 10-14 Feb





ORCAS Campaign: Flight Planning

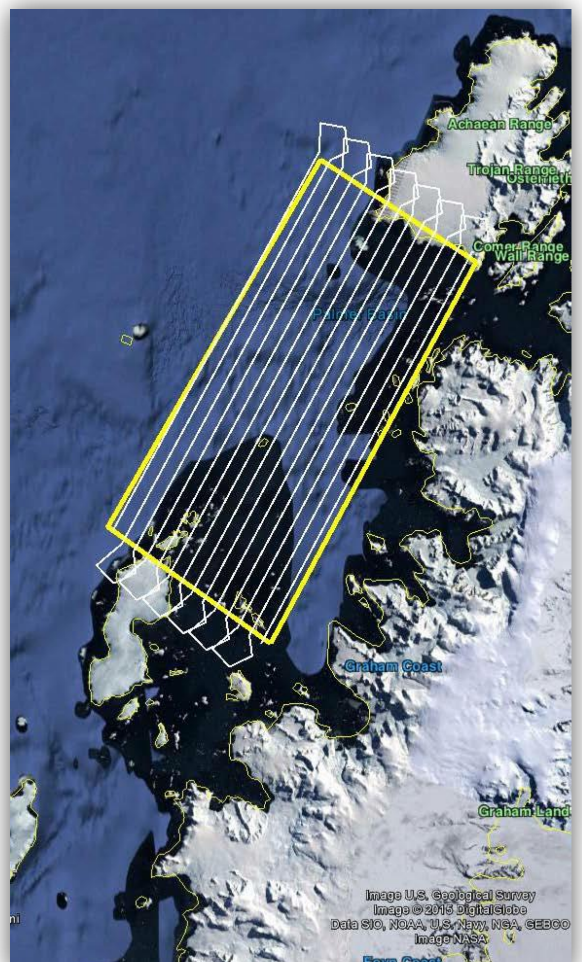
Palmer LTER Grid Example

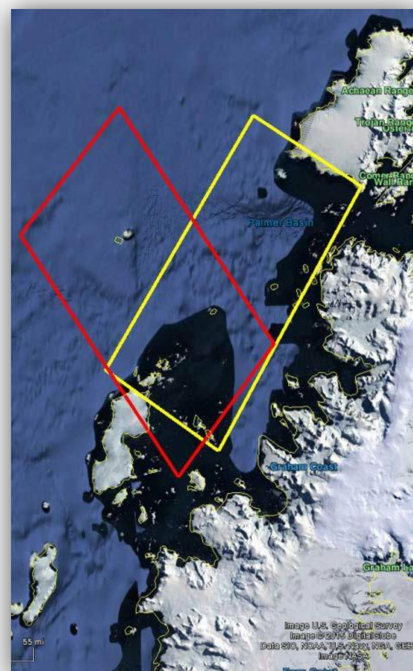
Time	Solar Zenith Angle	Solar Azimuth Angle
08:00	29.1	77.8
08:30	32.2	70.5
09:00	35.1	62.9
09:30	37.8	54.9
10:00	40.3	46.5
10:30	42.4	37.6
11:00	44.2	28.3
11:30	45.4	18.6
12:00	46.2	8.6
12:30	46.4	358.5
13:00	46.0	348.4
13:30	45.1	338.5
14:00	43.7	328.9
14:30	41.8	319.7
15:00	39.6	311.0
15:30	37.0	302.7
16:00	34.2	294.8
16:30	31.2	287.3

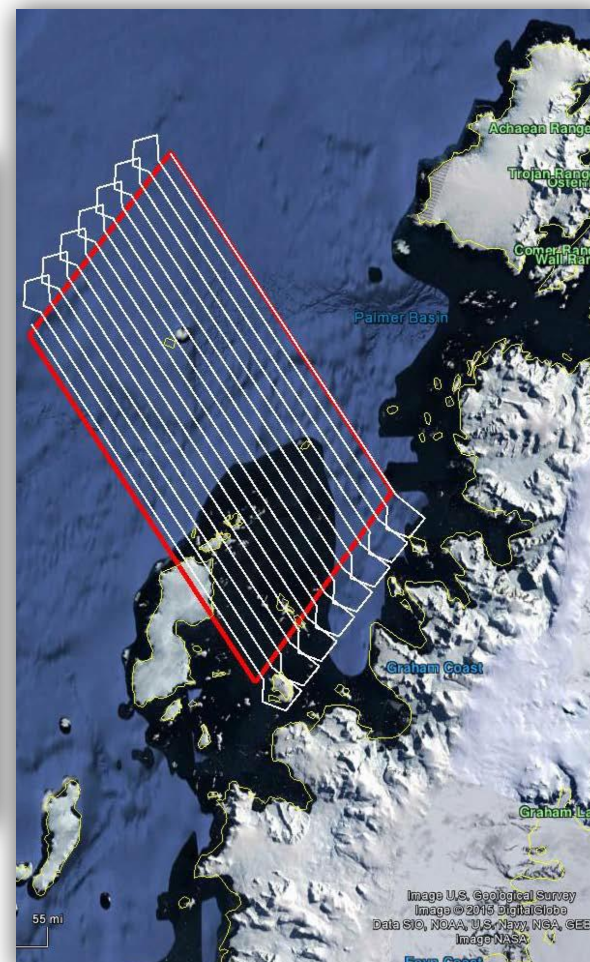
http://aa.usno.navy.mil/data/docs/AltAz.php

ORCAS Campaign: Flight Planning

AM	PM
~45 deg heading	~321 deg heading

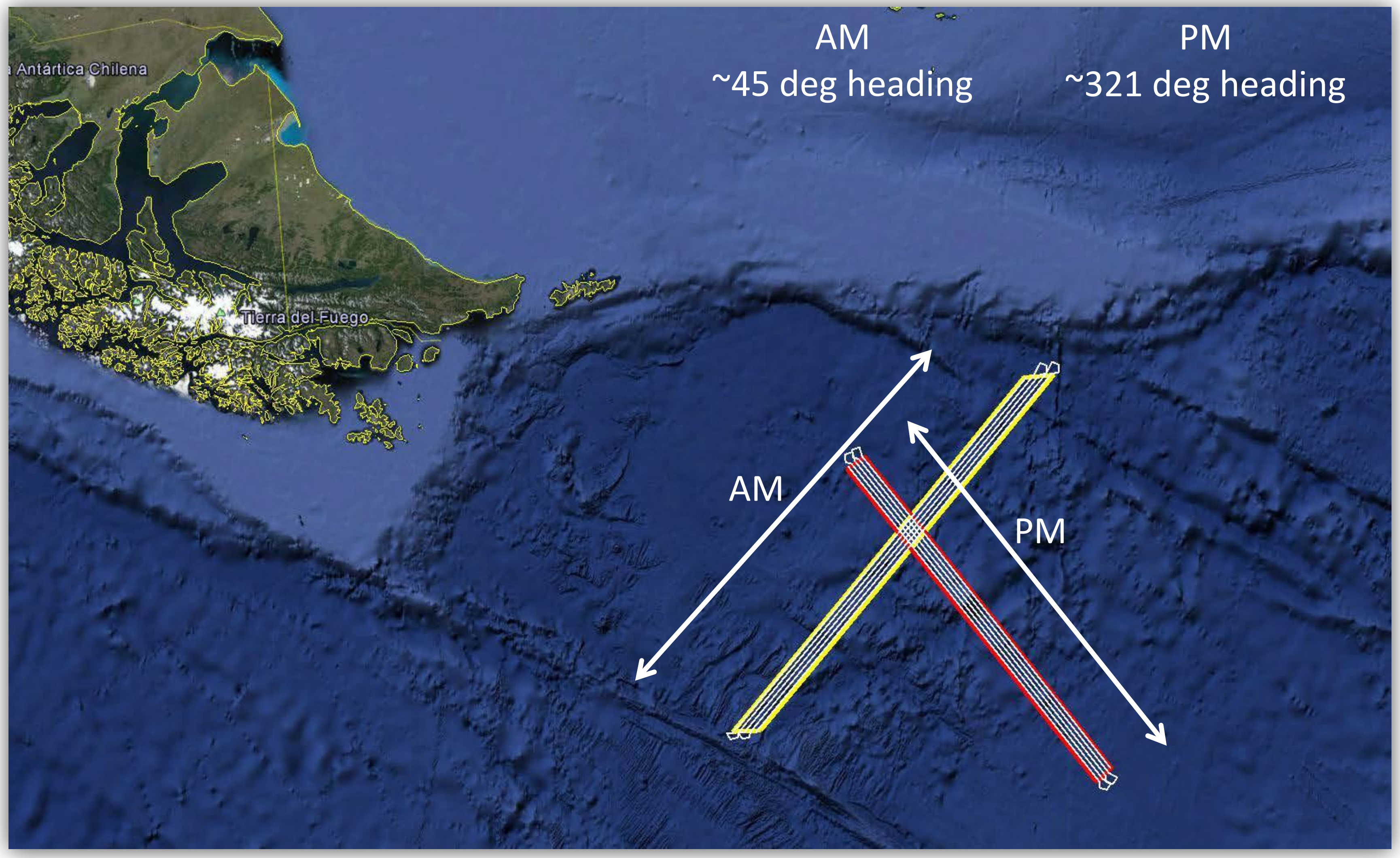






Science flight time: 4 hr per box

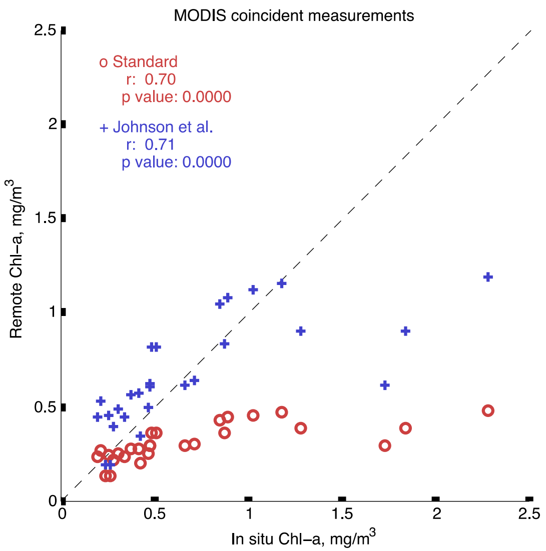
ORCAS Campaign: Flight Planning

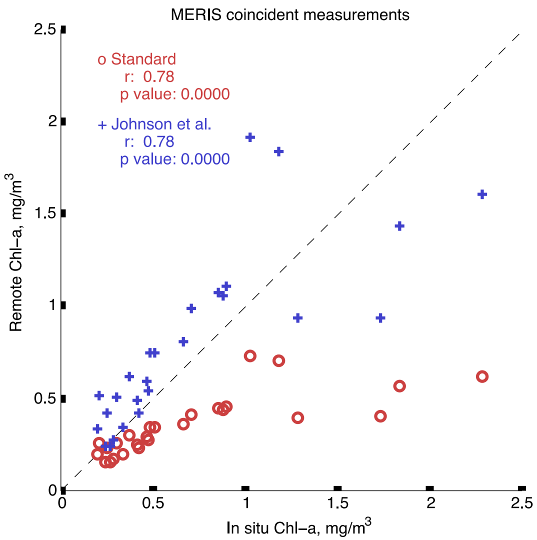


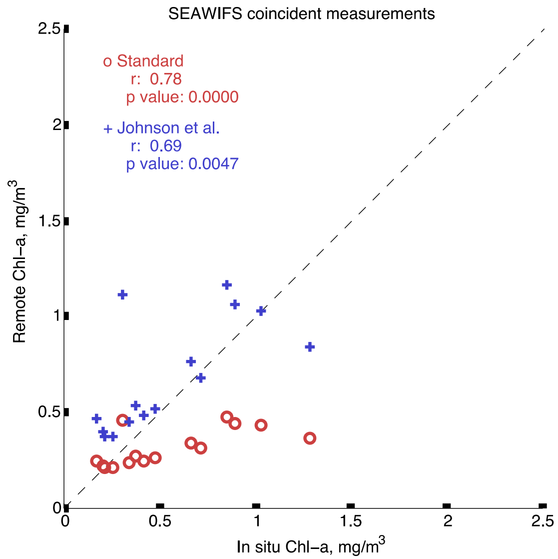
Science flight time: 4 hr per box

ORCAS Campaign: Flight Planning

- Optimize chl-a quick look capabilities in the Southern Ocean for ORCAS
  - Comparison between Johnson algorithm and coincident MODIS, MERIS, SeaWiFS, and Palmer LTER chl-a
  - Johnson southern ocean correction improves a systematic underestimate in the standard approach







Johnson, R., et al. [2013], Three improved satellite chlorophyll algorithms for the Southern Ocean, J. Geophys. Res., 118, doi:10.1002/jgrc.20270.

ORCAS Campaign: Flight Planning

NASA GMAO GEOS-5 real-time forecast support for ORCAS

Example: http://gmao.gsfc.nasa.gov/projects/SHOUT/