Effects of inter-annual variability in the Transition Zone Chlorophyll Front (TZCF) on the habitat use and reproductive success of Laysan and Black-footed albatrosses

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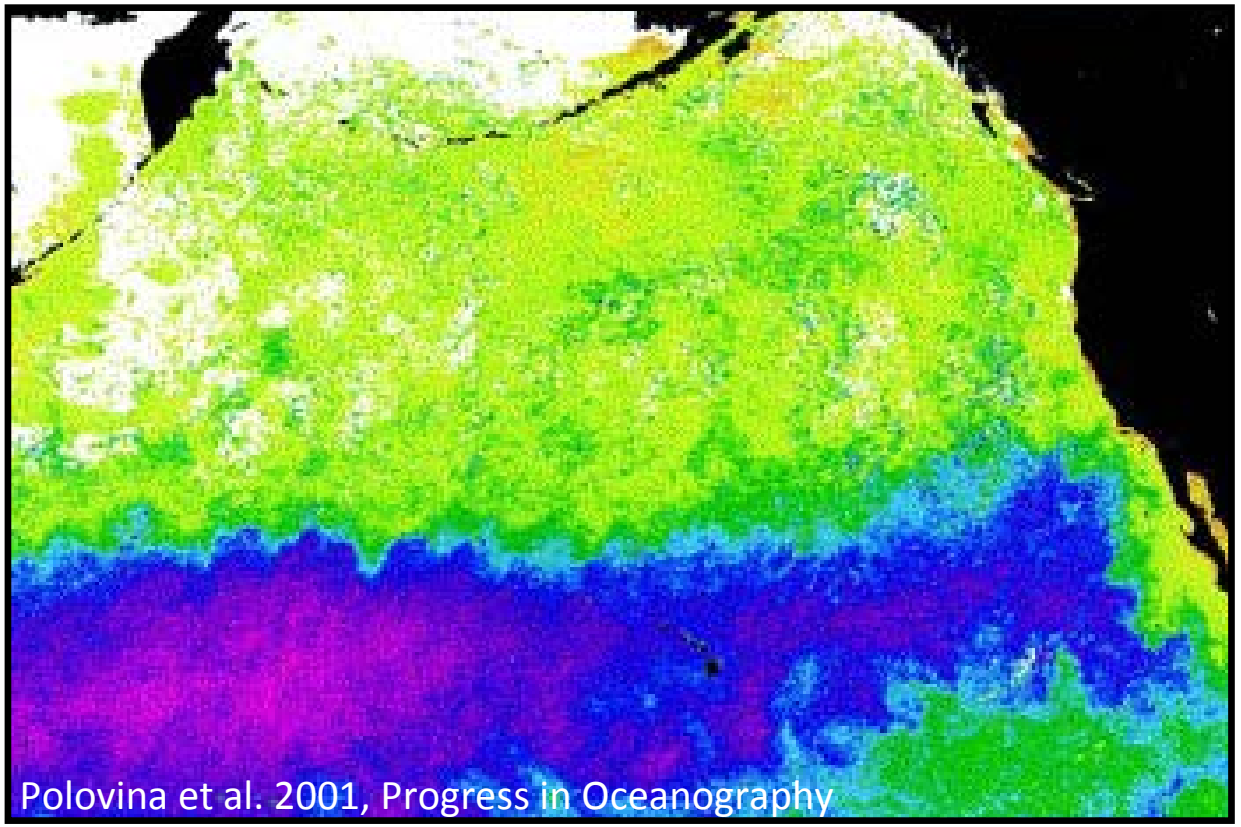
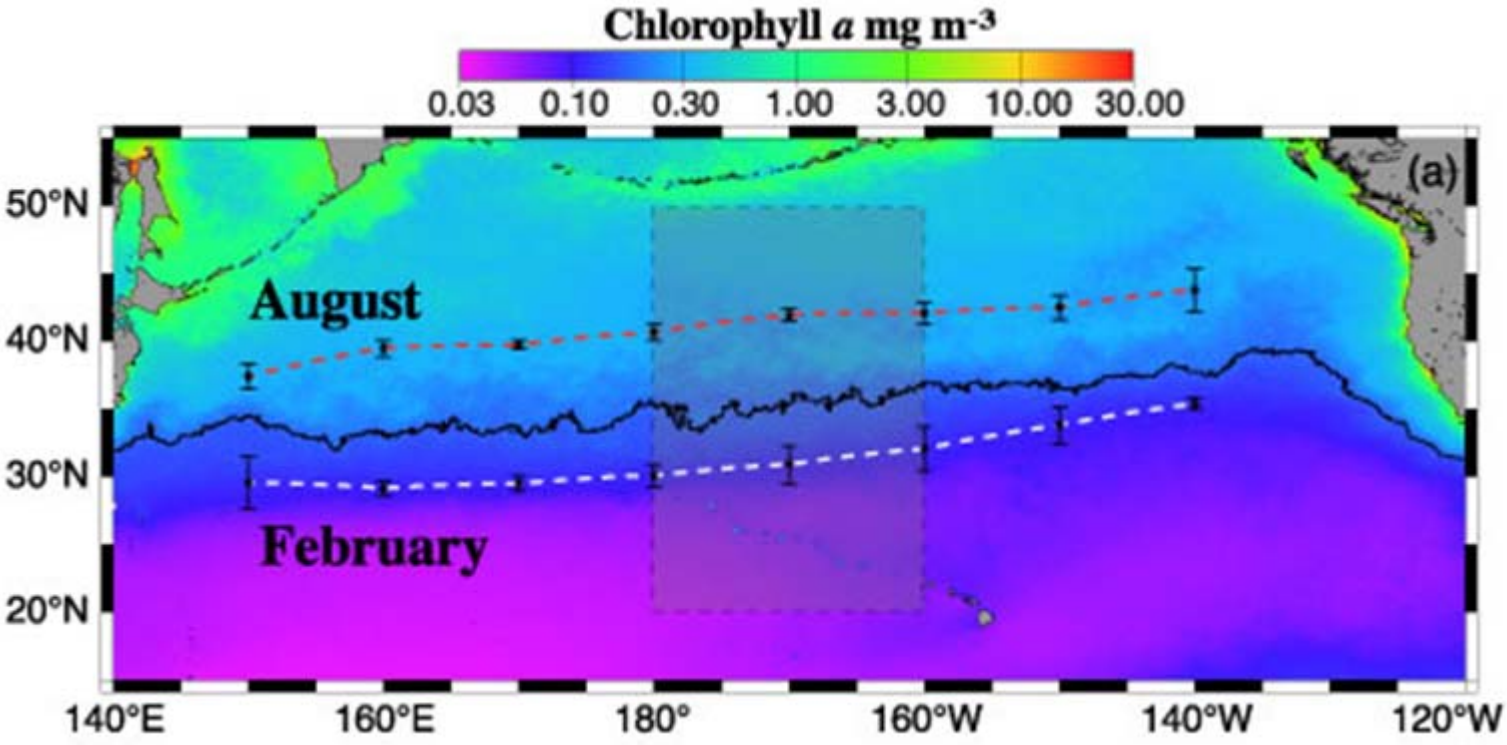


Transition Zone Chlorophyll Front (TZCF)

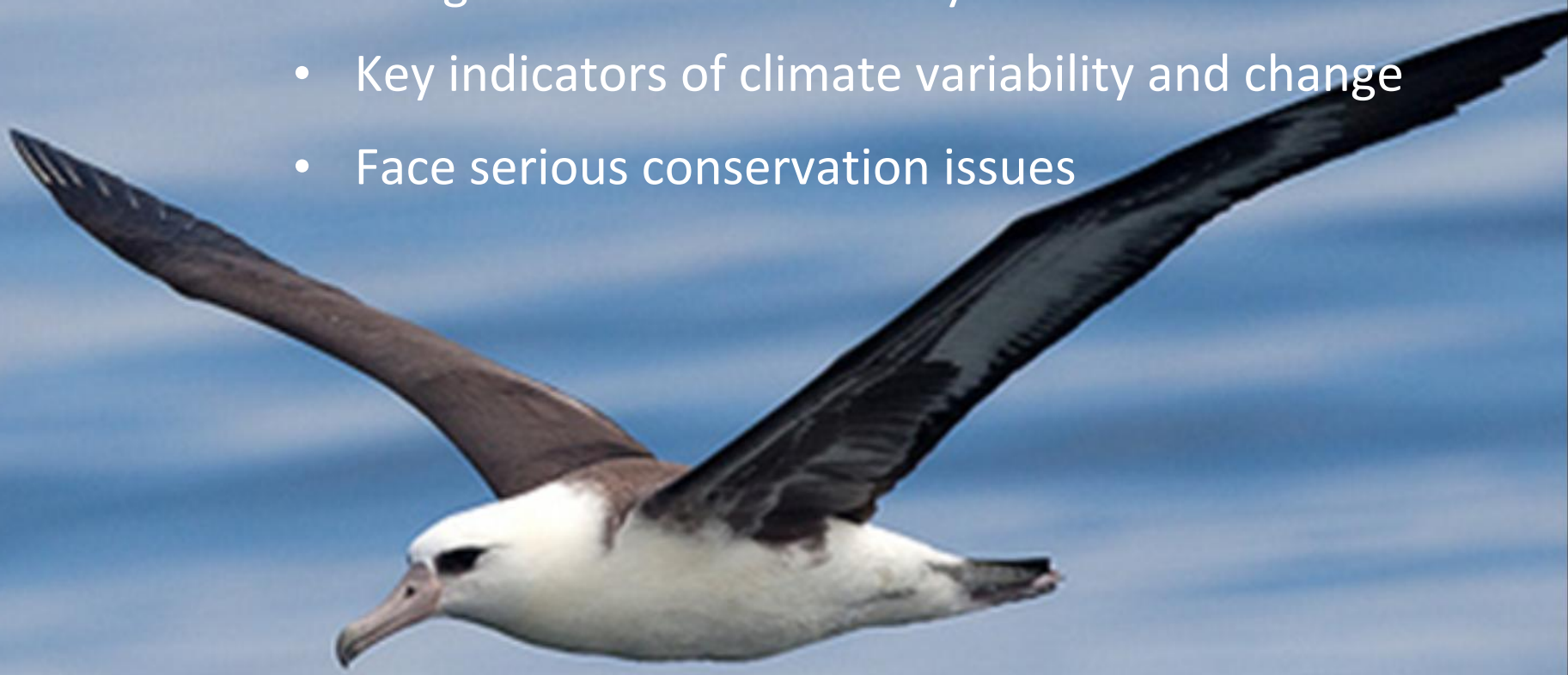
- Basin-wide front detectable through chlorophyll gradients (0.2 mg/m^3), SST (18°C)
- Migrates seasonally >1000 km
- Provides important foraging, migratory habitat for foraging predators



Bograd et al. 2004, Geophysical Research Letters

Marine Top Predators

- Integrate over food-web dynamics
- Key indicators of climate variability and change
- Face serious conservation issues



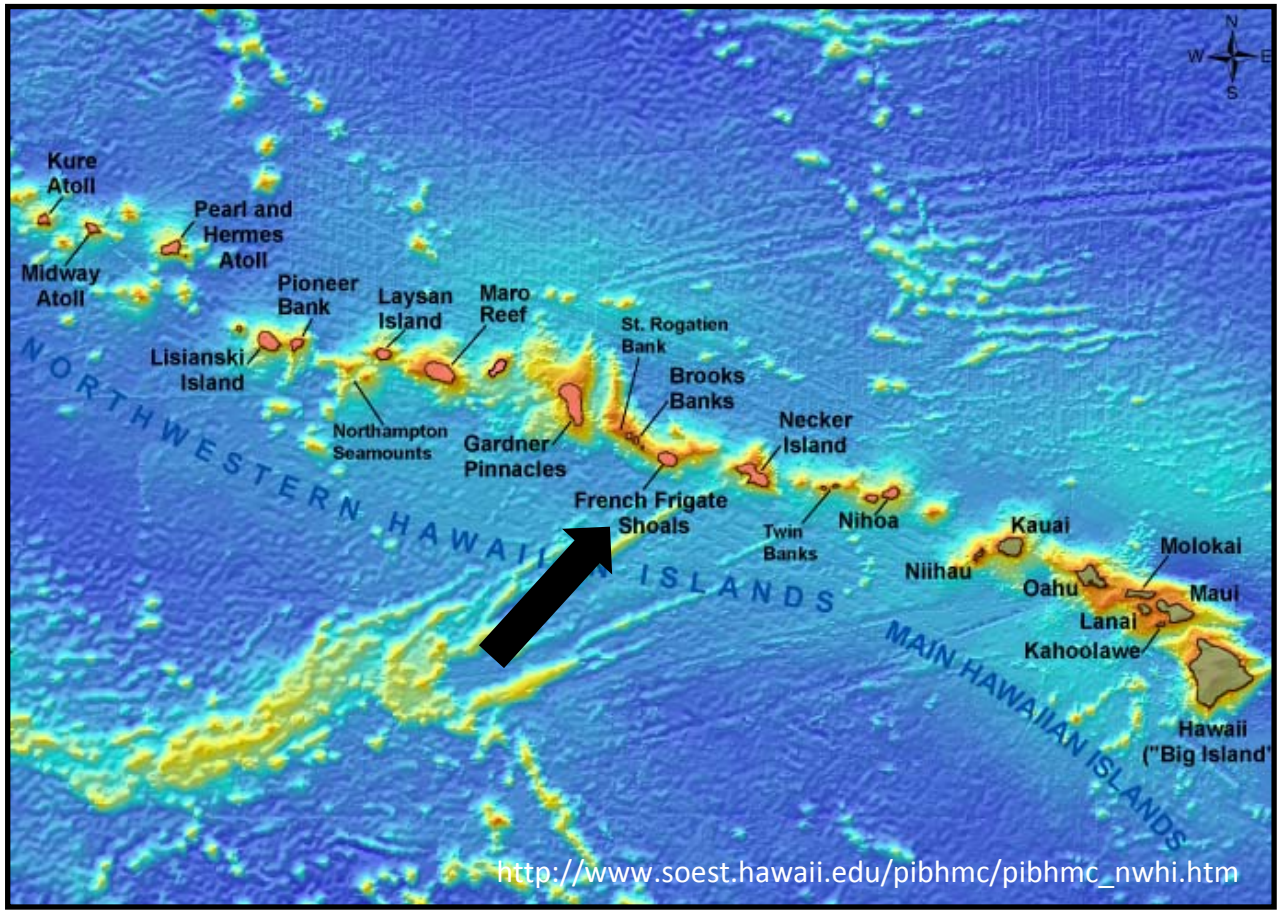
Ryan Shaw 2009

Laysan (*Phoebastria immutabilis*) and Black-footed Albatross (*Phoebastria nigripes*)

- Central place foragers
- Fixed breeding location, dynamic foraging habitat
- Habitat use is particularly constrained during brooding period
- Energetic constraints: Parents must balance energetic requirements of their chicks with maintenance costs

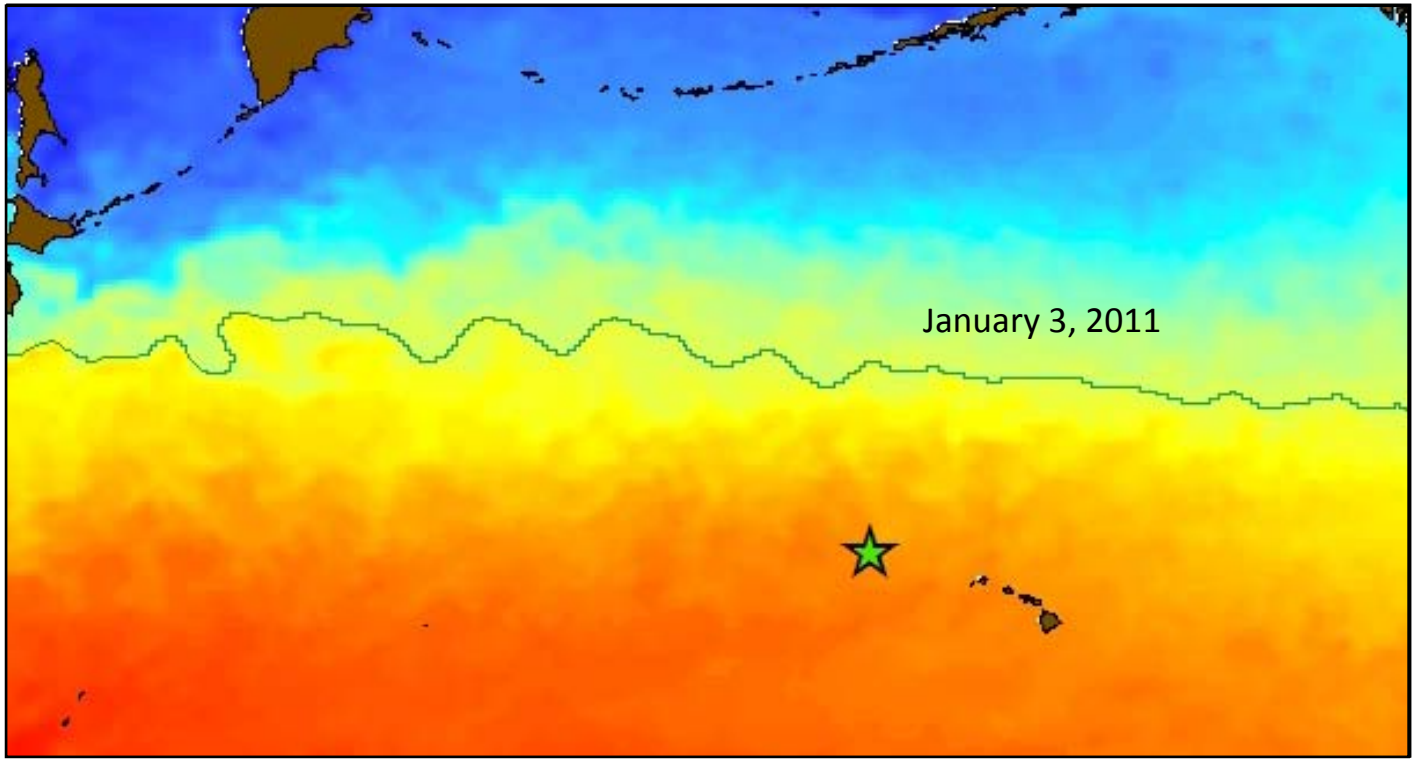
Laysan (*Phoebastria immutabilis*) and Black-footed Albatross (*Phoebastria nigripes*)

- Breed in the Northwestern Hawaiian Islands (NWHI) November - April
- Study site: Tern Island, French Frigate Shoals



Tern Island, French Frigate Shoals

- Location of TZCF particularly variable during albatross brooding season (January-March)
- TZCF located closest to Tern Island in February
  - Shorter distance to travel to foraging area



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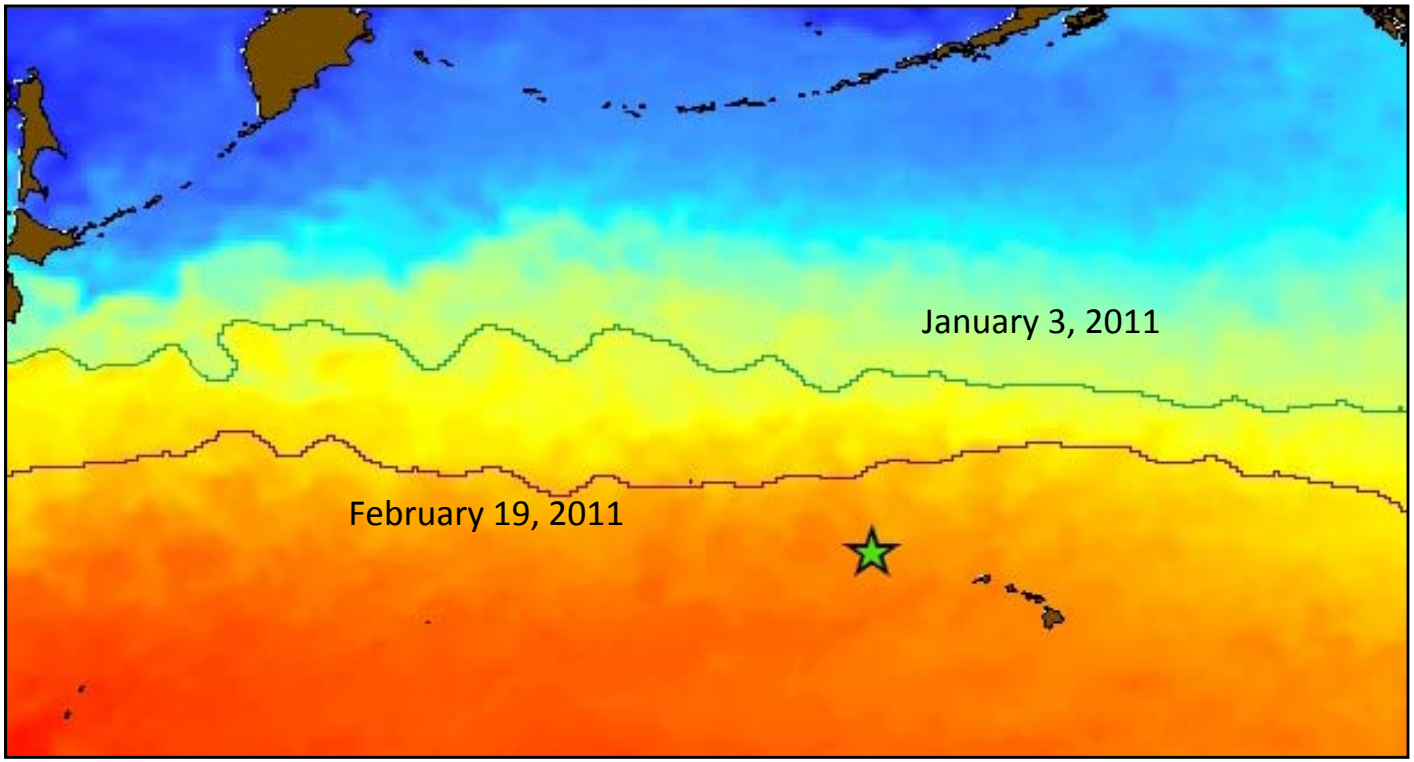
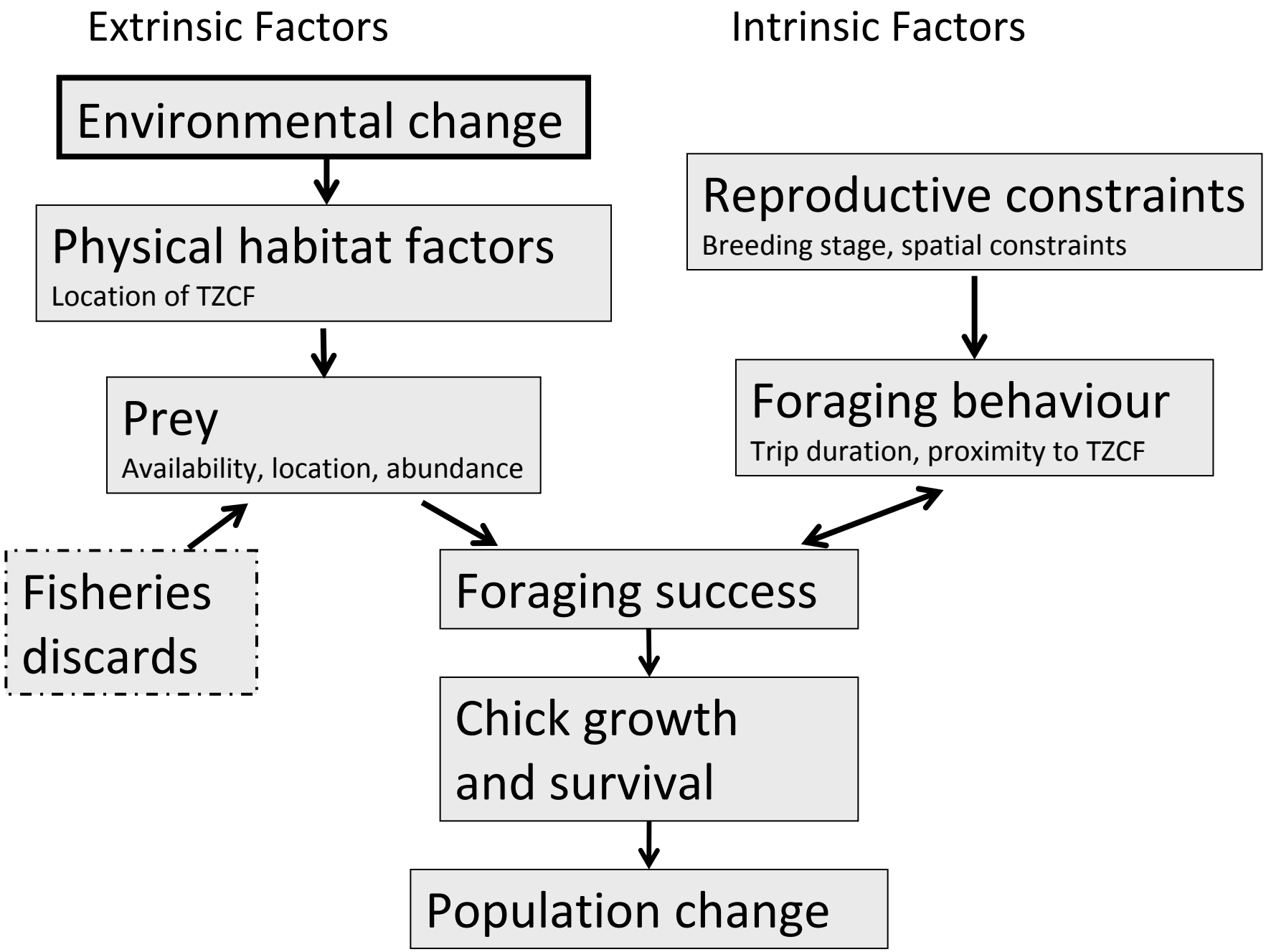
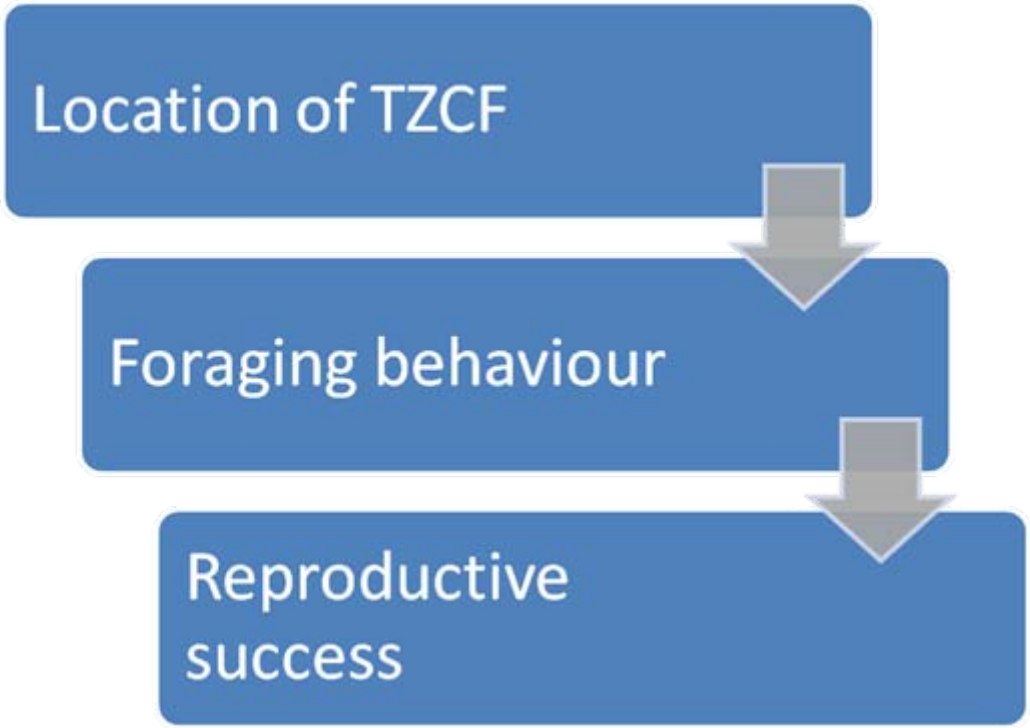



Extrinsic Factors
Intrinsic Factors
Environmental change
Physical habitat factors
Location of TZCF
Reproductive constraints
Breeding stage, spatial constraints
Prey
Availability, location, abundance
Foraging behaviour
Trip duration, proximity to TZCF
Fisheries discards
Foraging success
Chick growth and survival
Population change

Objectives

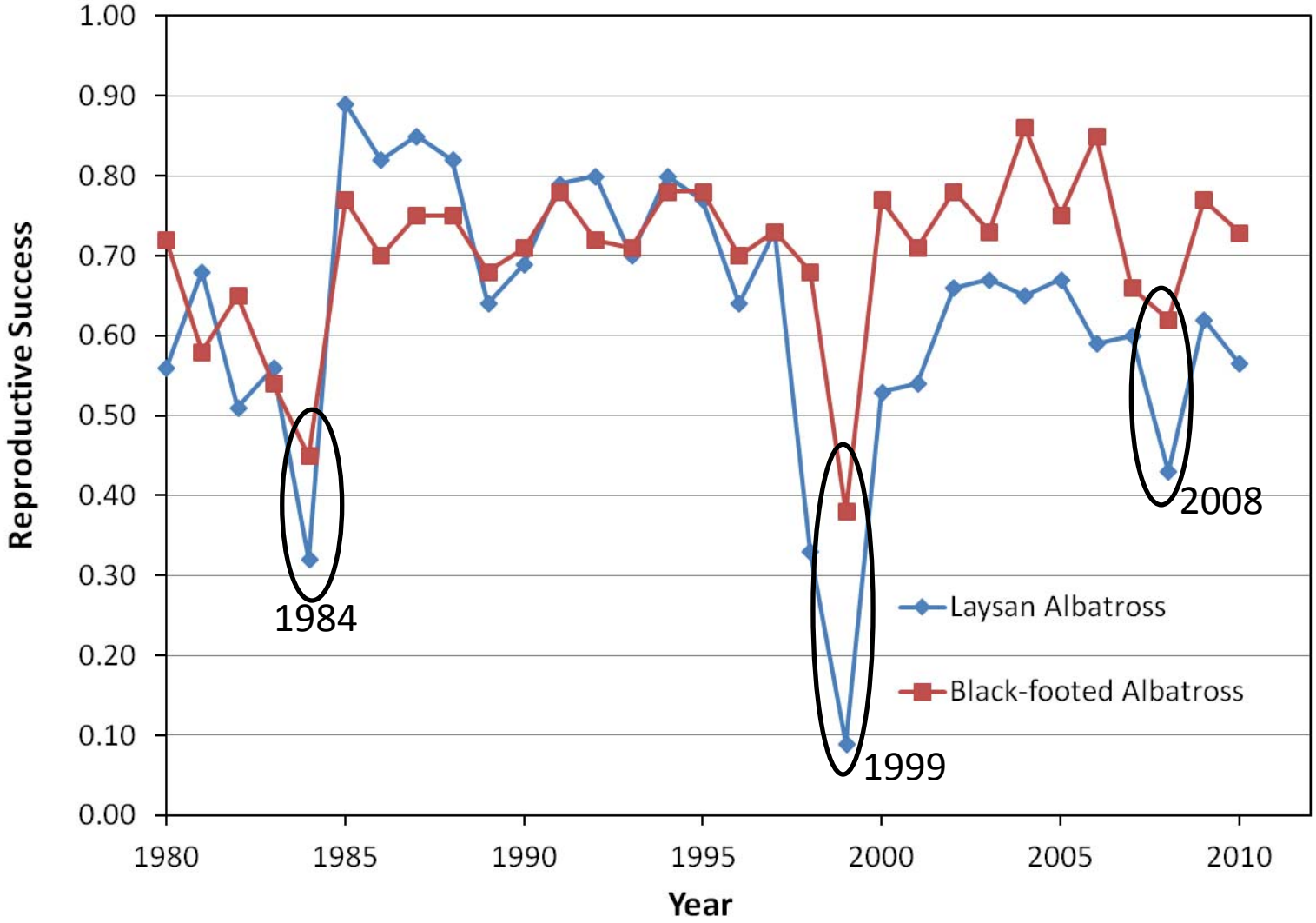
- Examine the role of variability in the Transition Zone Chlorophyll Front on:
    - Albatross habitat use
    - Albatross reproductive success



Breeding Success

- USFWS data (1980-2010)
- Annual surveys of breeding success (chicks fledged per eggs laid), nest and fledgling counts at Tern Island

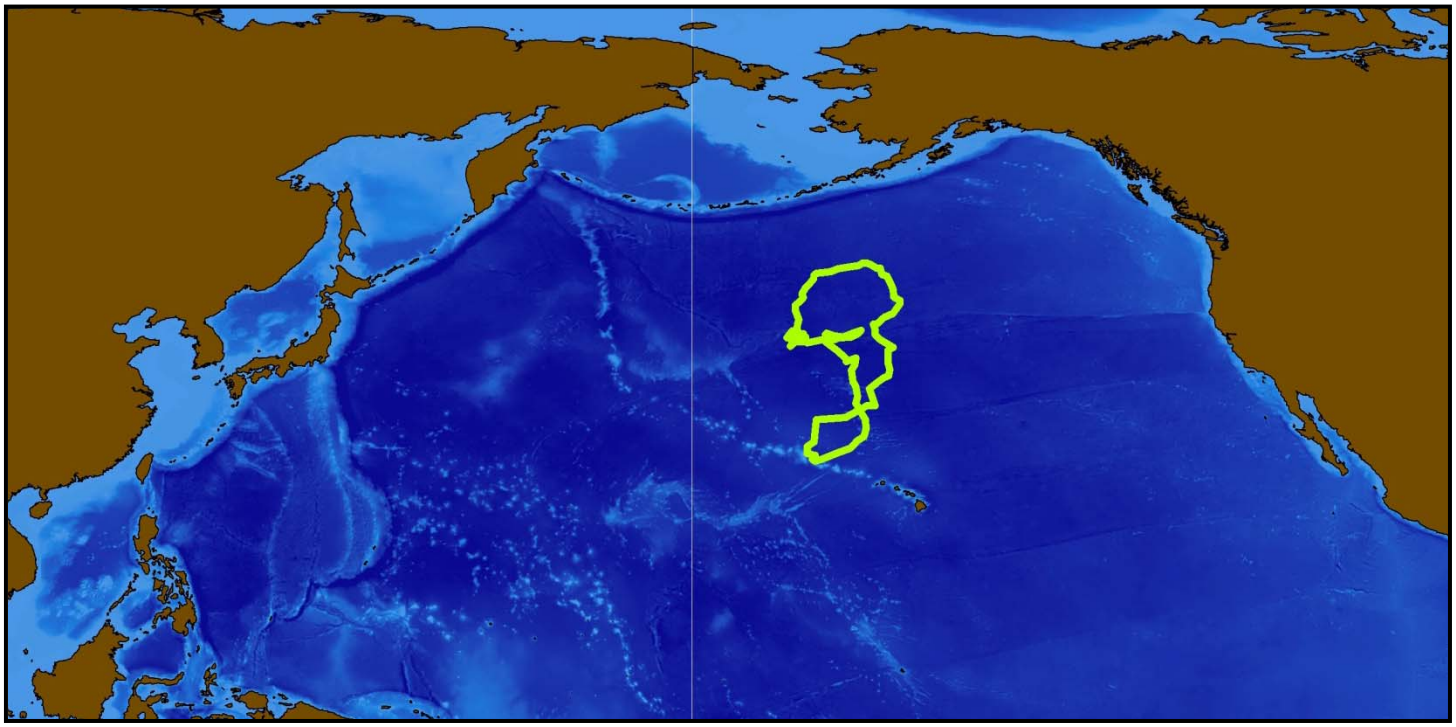
Variation in Breeding Success



How does variability in the TZCF influence albatross breeding success?

Foraging Habitat

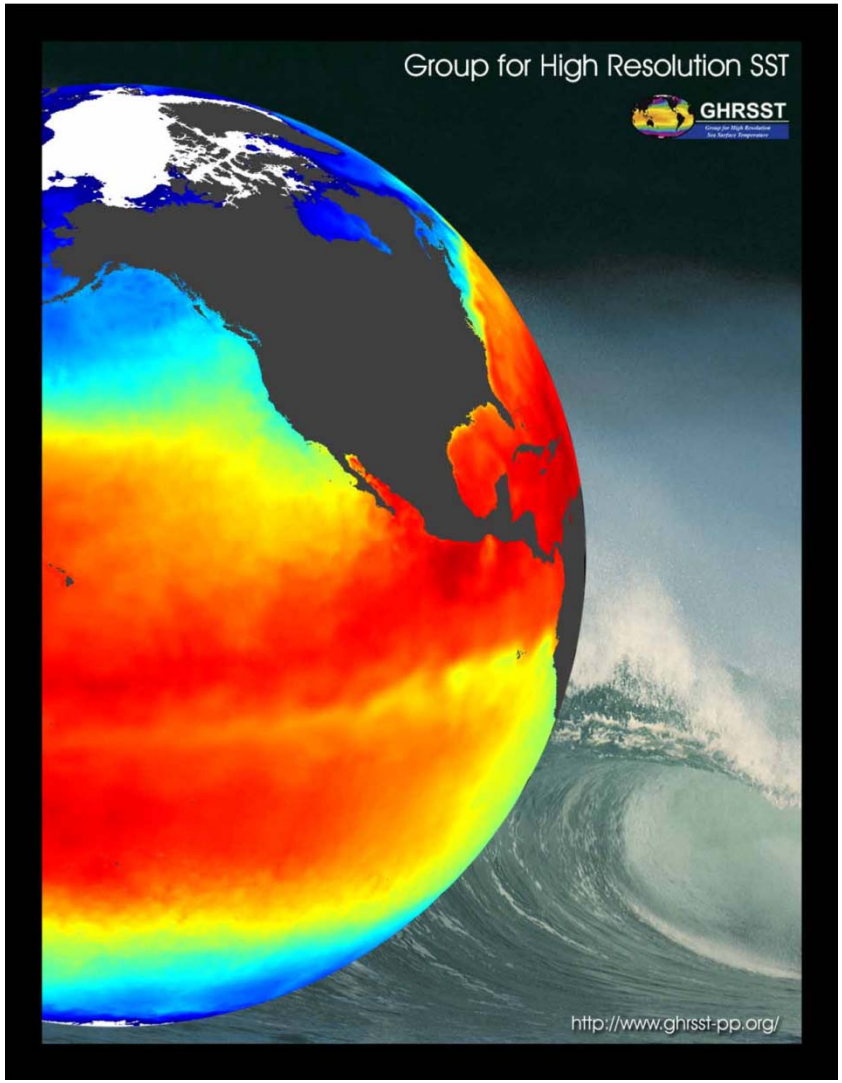
- How does TZCF location influence albatross habitat use?
- Are there species-specific effects of the TZCF?
  (Black-footed vs. Laysan Albatrosses)
- Can we produce models based on relationships with TZCF to predict changes to foraging habitat?



Assessing Albatross Foraging Habitat

- Data from Tagging of Pacific Pelagics (TOPP) project
- ARGOS data: 2002-2012
- GPS data: 2008-2012
- Analyzed telemetry data during brooding period

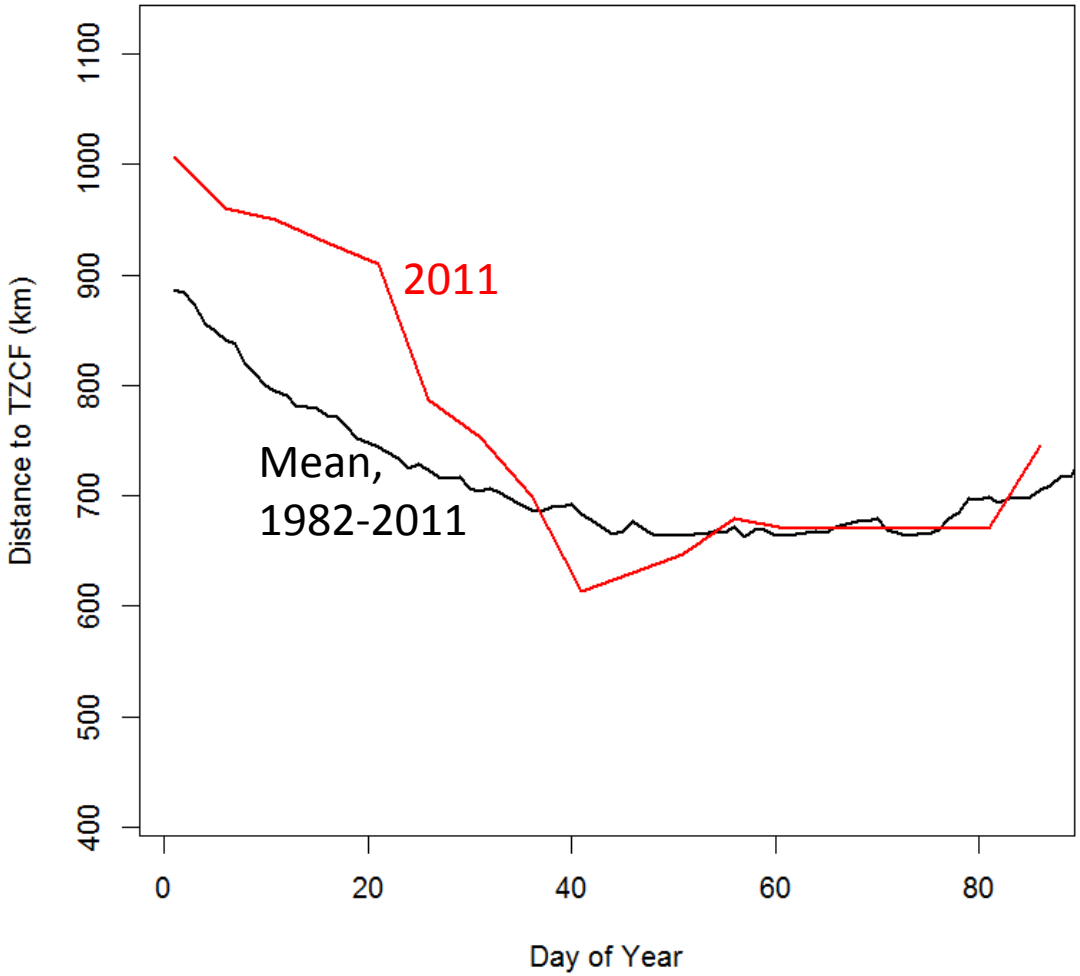
Characterizing TZCF



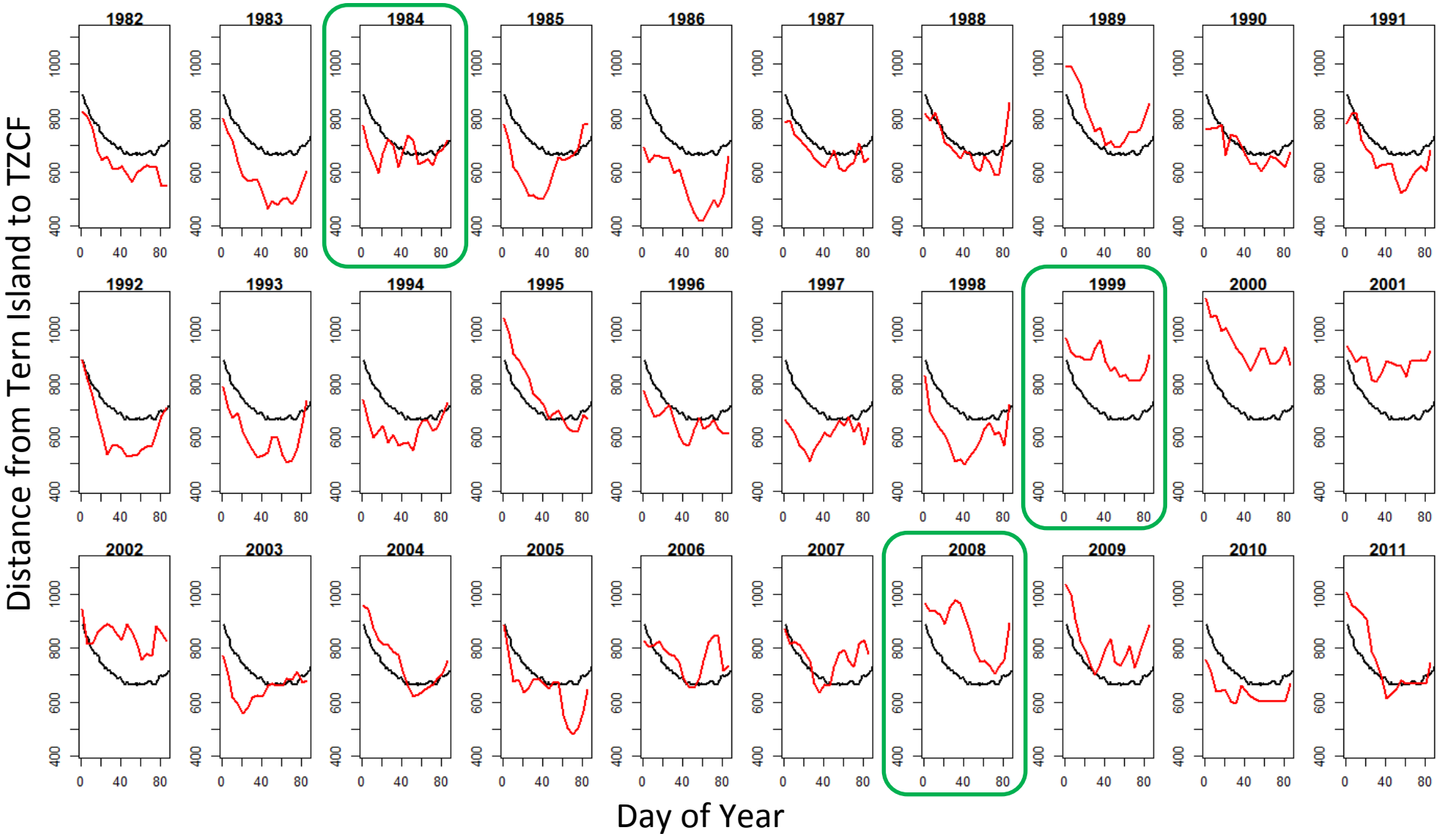
- Daily GRHSST merged product
- Allows continuous, high resolution daily SST data
- Used 18°C isotherm to localize front
- Examined distance to TZCF front on a daily time scale from 1980-2012 (January- March)

Characterizing Variability in TZCF

- Best means of characterizing TZCF in relation to albatross habitat use?
  - Distance to front
  - Proportion of time within 600 km Tern Island
  - Southernmost point by year
  - Date at which TZCF is at southernmost point
  - TZCF gradient/ strength
  - Productivity of TZCF



Observations: Annual Variability in TZCF location



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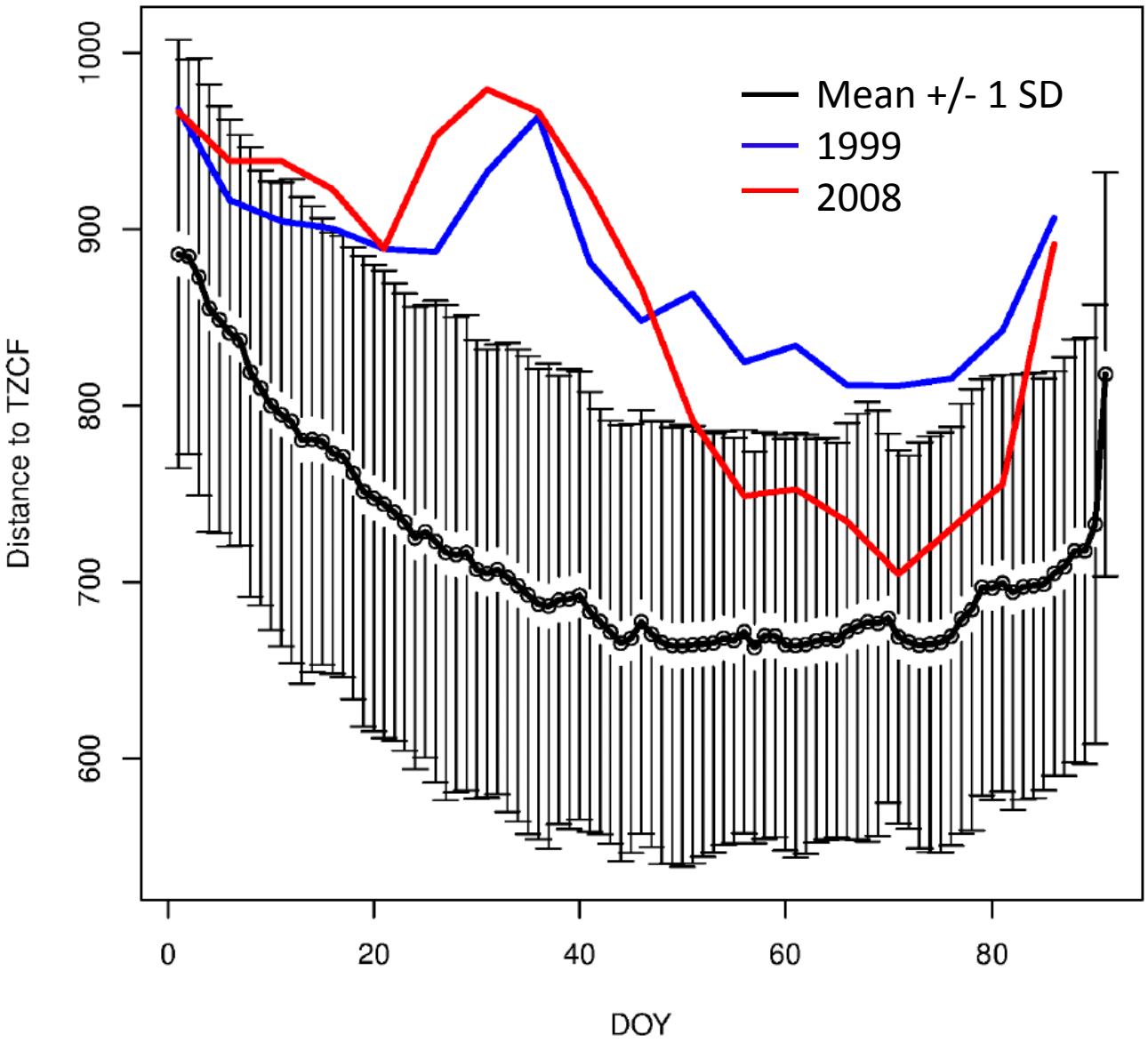
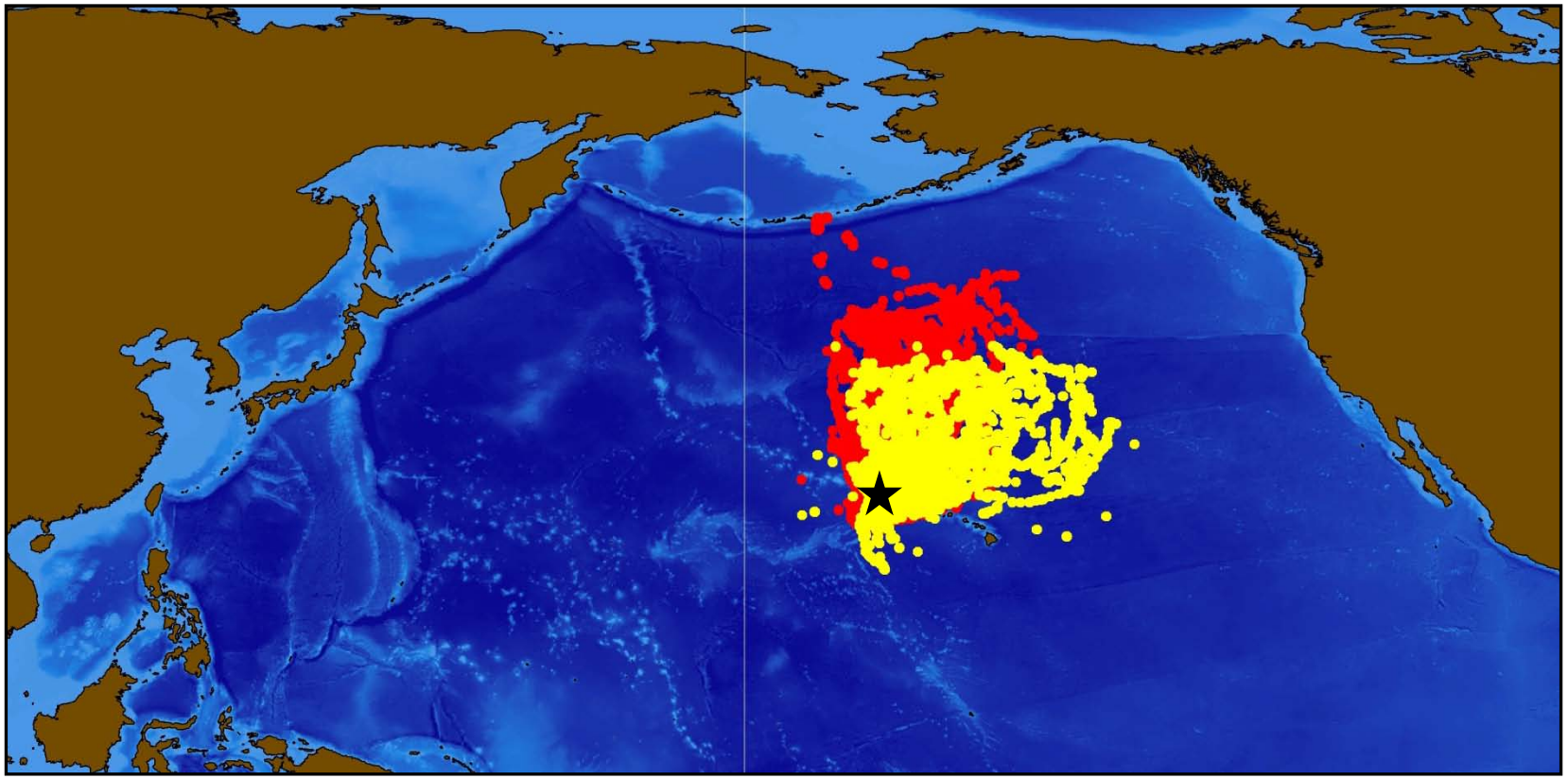


Albatross habitat use



Laysan albatross

Black-footed albatross

Tern Island

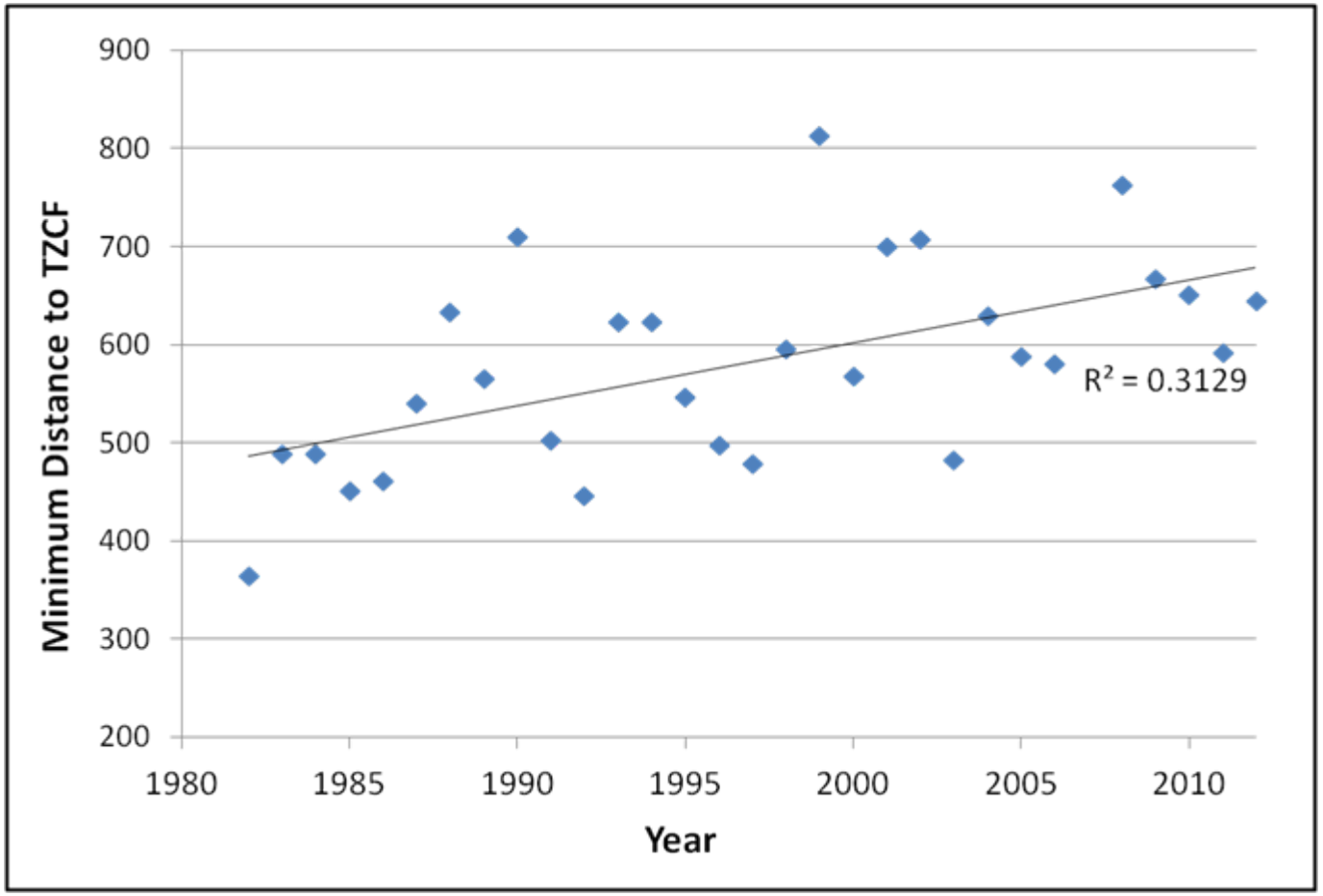
Habitat use in relation to TZCF

Laysan Albatross	**Correlation Coefficient**	**P value**
Trip duration, Proximity of bird to TZCF	-0.33	0.02
Proximity of bird to TZCF, Distance from colony to TZCF	0.5	<0.001
Trip duration, Distance from colony to TZCF	-0.28	0.03
Breeding success, Distance from colony to TZCF	-0.40	0.03
Breeding success, Date of closest TZCF	-0.02	0.9
Black-footed Albatross		
Trip duration, Proximity of bird to TZCF	-0.02	0.93
Proximity of bird to TZCF, Distance from colony to TZCF	0.36	0.03
Trip duration, Distance from colony to TZCF	0.19	0.19
Breeding success, Distance from colony to TZCF	-0.05	0.81
Breeding success, Date of closest TZCF	-0.04	0.82

Significant correlations > 0.4

Long-term changes in the location of the TZCF

- Implications for future habitat shifts



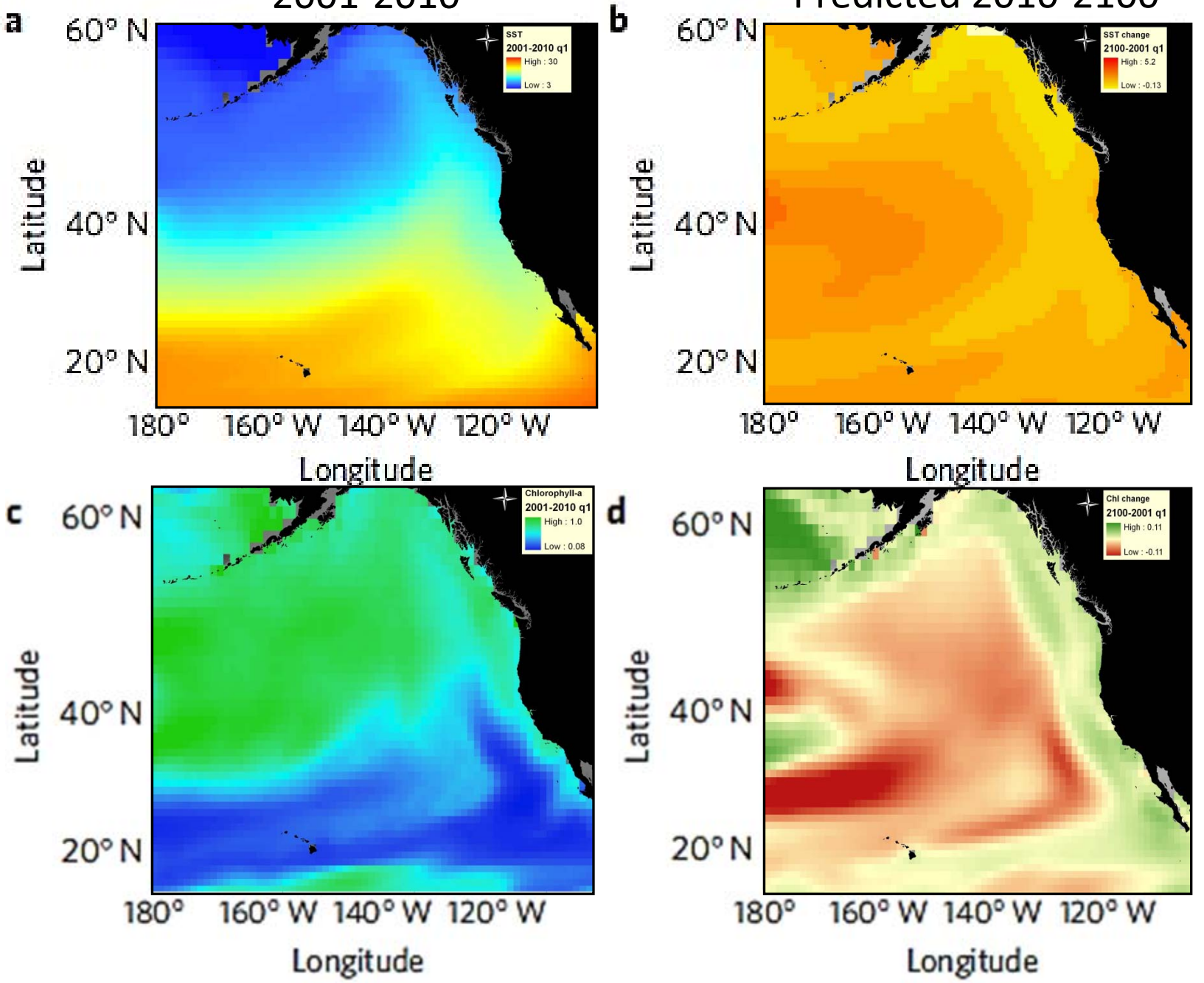
2001-2010

Predicted 2010-2100

Winter

SST

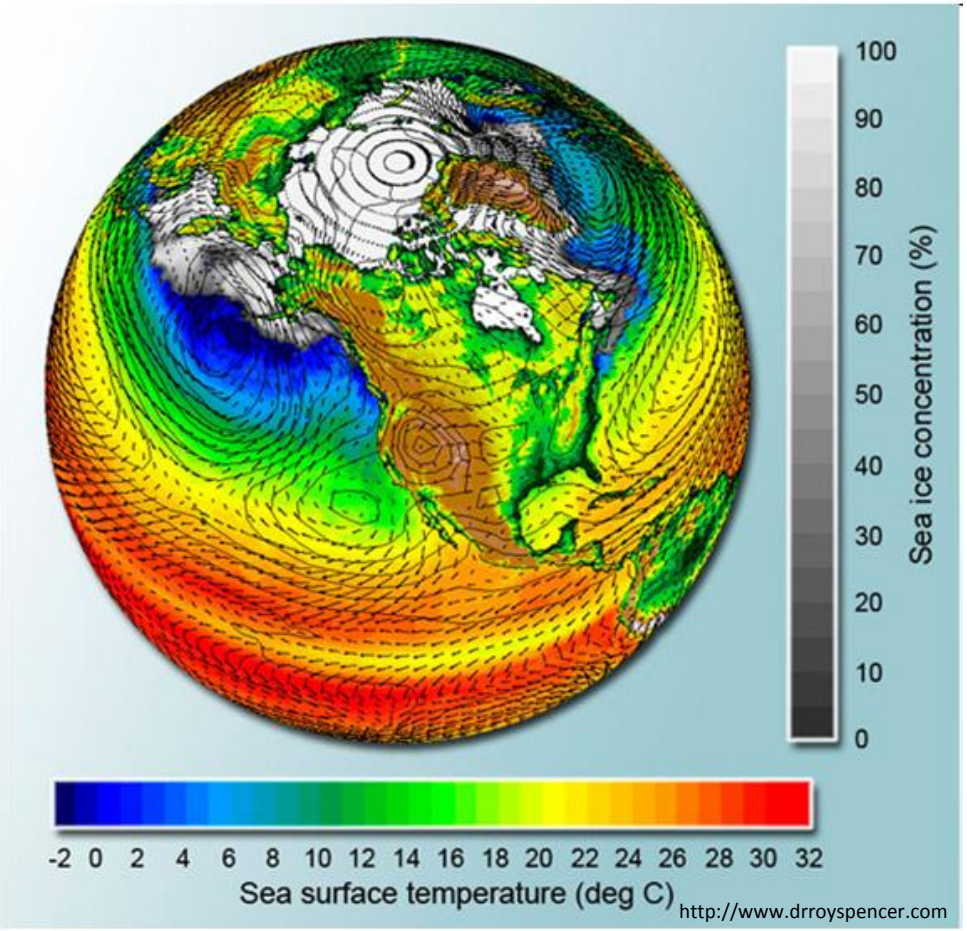
Chla



Hazen et al. 2012, Nature Climate Change

Future Work

- Combine observations into models of albatross habitat use and reproductive success as a function of TZCF location
- Use albatross models and climate change projections to predict impacts on the reproductive success of Laysan and Black-footed Albatrosses



Acknowledgments

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Hawai‘i Conservation Alliance

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