Data assemblage and standardization
SNAP obtained the required datasets to perform a model selection and subsequent downscaling procedure over the Pacific Islands region. This included temperature, precipitation, and sea level pressure across 1) 16 AR4 global climate model (GCM) datasets and 4 scenarios (20c3m, B1, A1B, A2), 2) the ERA40 reanalysis dataset covering 1958-2000, and 3) the 1971-2000 high resolution PRISM climatology datasets. All data was standardized into compatible formats, units, projections, and temporal and spatial resolutions for input into the model selection and downscaling procedures.

Model selection
Model selection methodologies closely followed Walsh et. al. 2008, but was customized for the Pacific Islands region by focusing on a bounding box encompassing all islands of interest. In general, the procedure compares monthly temperature, precipitation, and sea level pressure values at every 2.5 degree pixel location from 1958-2000 ERA40 outputs to the same variables output from 16 AR4 GCM twentieth century scenario runs (20c3m), calculates RMSE values and ranks them by a composite RMSE across all 3 variables. This resulted in 5 models being chosen as top candidates for downscaling:

1. Meteorological Institute of the University of Bonn, ECHO-G Model - miub_echo_g
2. Meteorological Research Institute Coupled General Circulation Model version 2.3.2a - mri_cgcm2_3_2a
3. L'Institut Pierre-Simon Laplace Coupled Model version 4 - ipsl_cm4
4. Max Planck Institute for Meteorology European Centre Hamburg Model 5 - mpi_echam5
5. Canadian Centre for Climate Modelling and Analysis (CCCma) Coupled General Circulation Model version 3.1 (CGCM3.1) - cccma_cgcm3_1

Downscaling
SNAP chose the island group of the Commonwealth of the Northern Mariana Islands as well as Pohnpei, Micronesia as case studies for downscaling. PRISM data was used as baseline climate, and because it was such high resolution data (440m for Hawaii, 90m for all other islands), and due to the fact that an individual island fell into a single GCM grid cell, the procedure was slightly modified to accommodate this large disparity and high resolution output. Outputs include temperature and precipitation from the top 5 models and three future climate scenarios (B1, A1B, A2) from 2001-2100. For more details about the delta downscaling method, please visit snap.uaf.edu.

Future opportunities
SNAP has developed the methodology, processing code, and computational capacity to produce high resolution projections of climate variables across the Pacific region. If the need arises, we would be able to continue this project and provide outputs for all islands where high resolution climatological data exist. In addition, we have scripts developed to produce derived products including summary statistics (min, max, mean, median, etc) and annual, seasonal, and decadal averages that are useful for various impact analyses.

Islands:

Commonwealth of the Northern Mariana Islands
Guam
Pohnpei, Micronesia
Palau, Micronesia
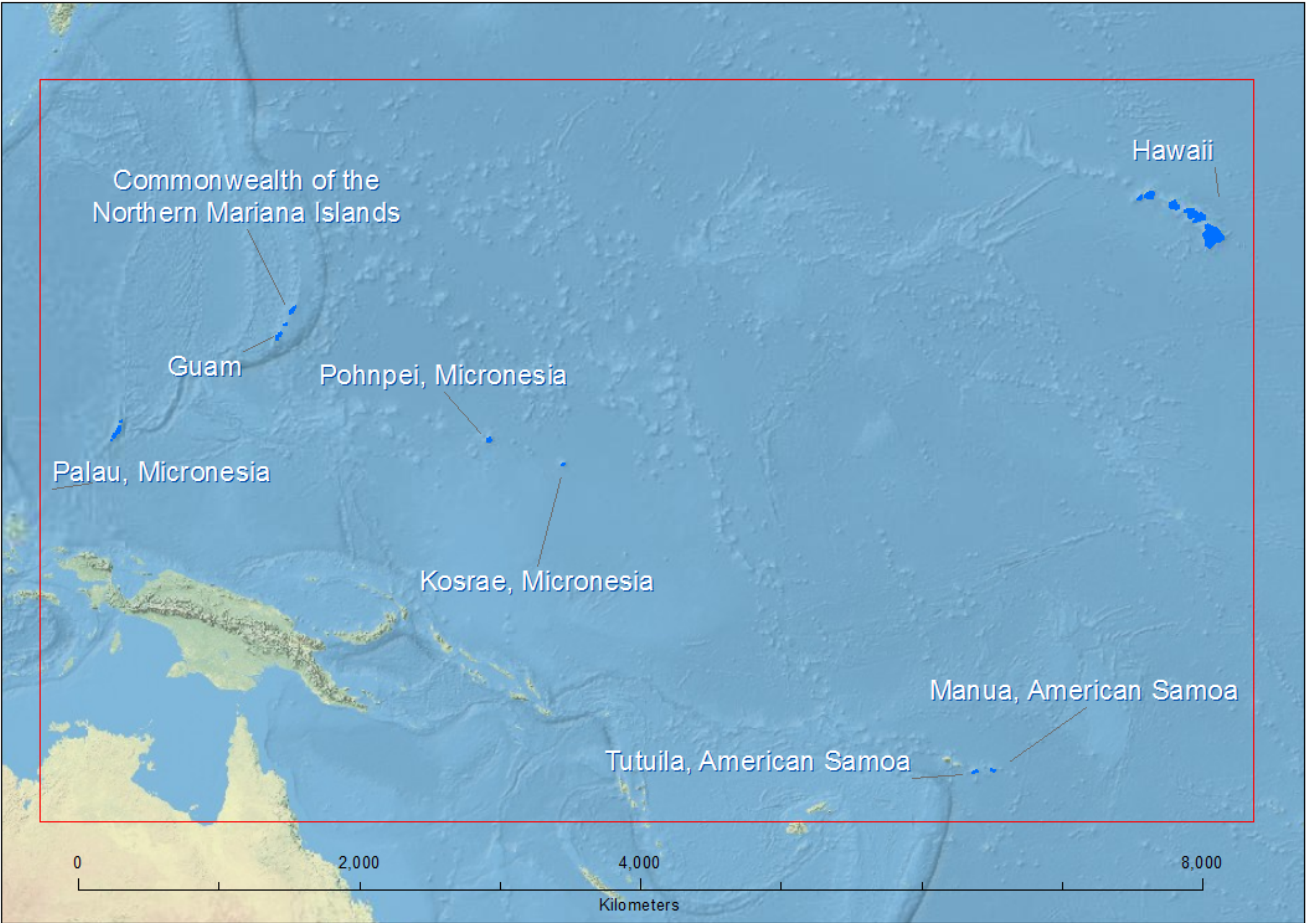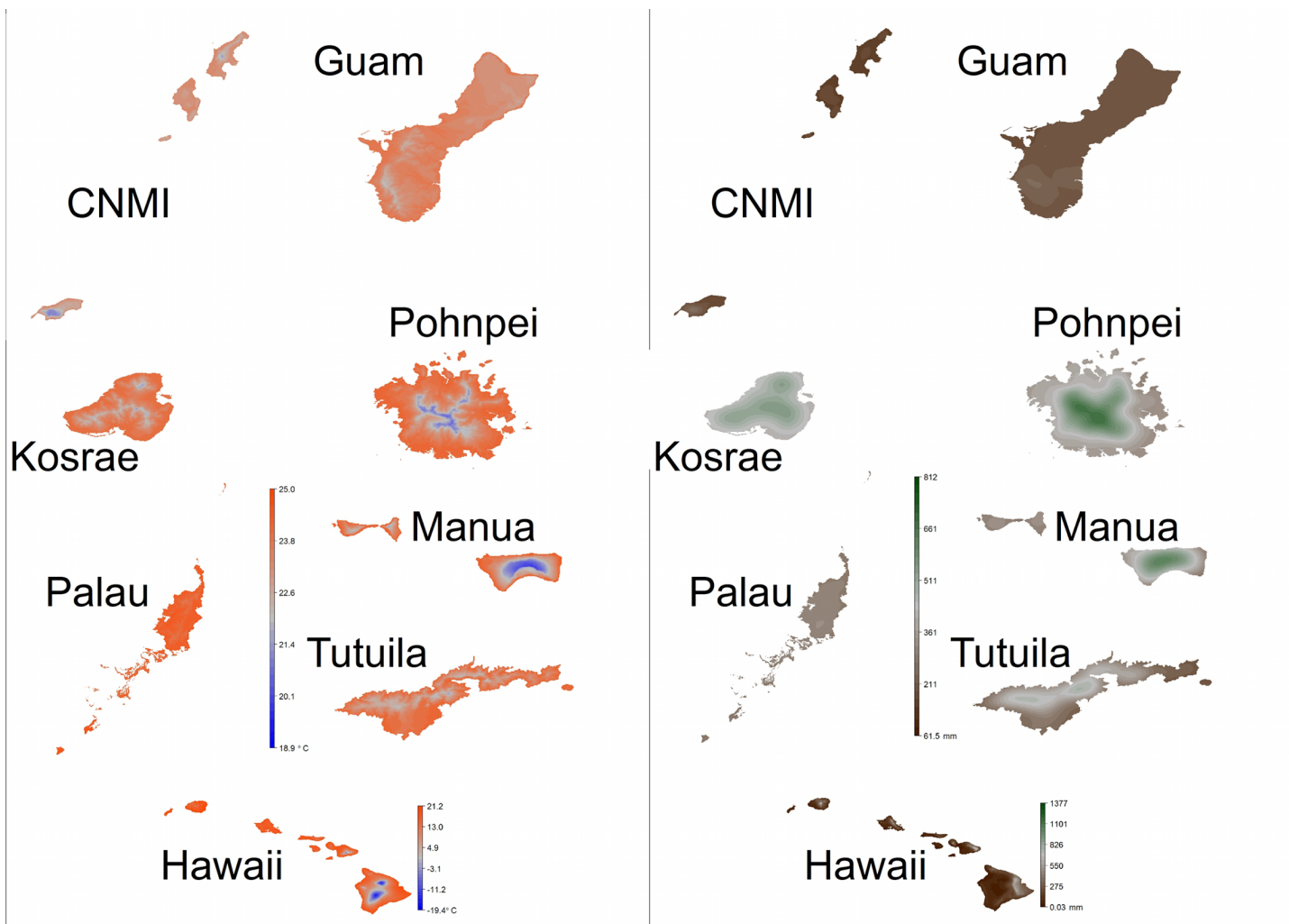Kosrae, Micronesia
Tutuila, American Samoa
Manua, American Samoa
Hawaii

GCM	RMSE Composite Rank	RMSE Rank Sum (temperature, precipitation, sea level pressure)
miub_echo_g_20c3m	1	7
mri_cgcm2_3_2a_20c3m	2	17
ipsl_cm4_20c3m	3	18
mpi_echam5_20c3m	4	18
cccma_cgcm3_1_t63_20c3m	5	21
ncar_ccsm3_0_20c3m	6	22
cccma_cgcm3_1_20c3m	7	23
gfdl_cm2_1_20c3m	8	23
gfdl_cm2_0_20c3m	9	25
giss_aom_20c3m	10	27
csiro_mk3_5_20c3m	11	29
iap_fgoals1_0_g_20c3m	12	38
giss_model_e_r_20c3m	13	39
miroc3_2_medres_20c3m	14	43
bccr_bcm2_0_20c3m	15	45
csiro_mk3_0_20c3m	16	46
ukmo_hadgem1_20c3m	17	47
ukmo_hadcm3_20c3m	18	48

giss_model_e_h_20c3m	19	51
cnrm_cm3_20c3m	20	53
inmcm3_0_20c3m	21	57
ncar_pcm1_20c3m	22	62

Pacific Islands Model Selection Region

Guam

CNMI

Pohnpei

Kosrae

Manua

25.0
23.8
22.6
21.4
20.1
18.9 °C

Palau

Tutuila

21.2
13.0
4.9
-3.1
-11.2
-19.4° C

Hawaii

Guam

CNMI

Pohnpei

Kosrae

Manua

812
661
511
361
211
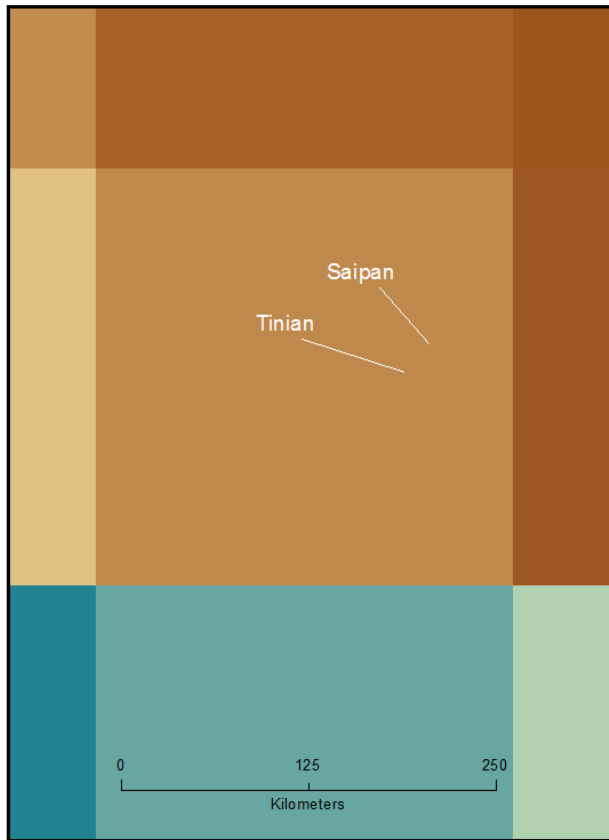61.5 mm

Palau

Tutuila

1377
1101
826
550
275
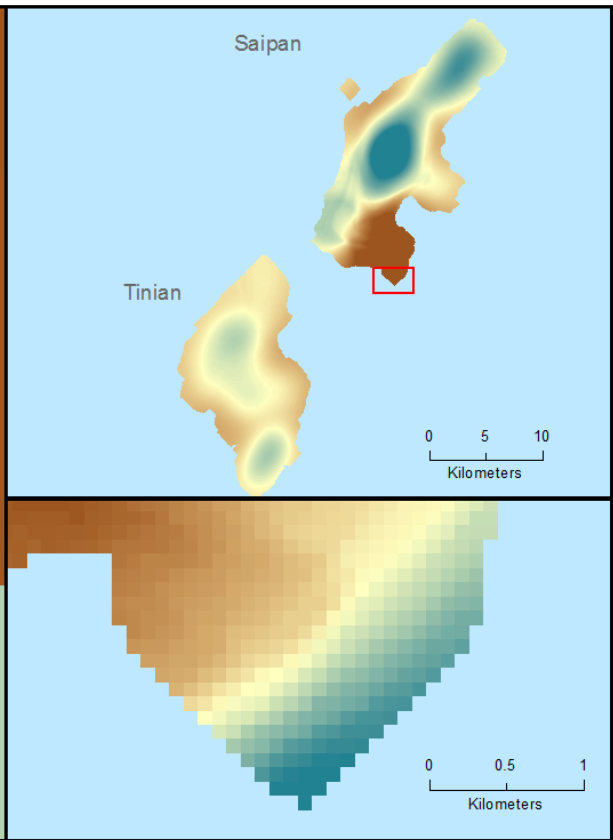0.03 mm

Hawaii

Temperature   Precipitation
1971 - 2000 Annual Composite PRISM Climatologies

2 1/2 Degree (~ 250 km)
GCM Precipitation
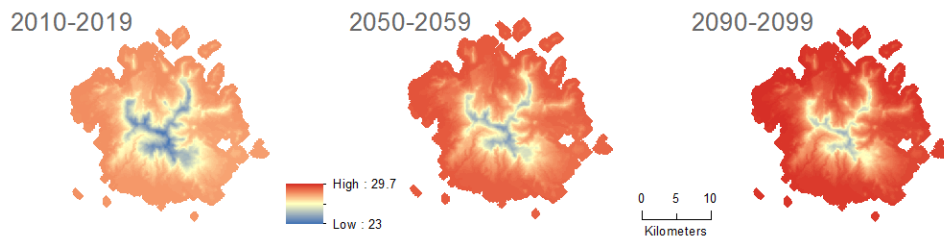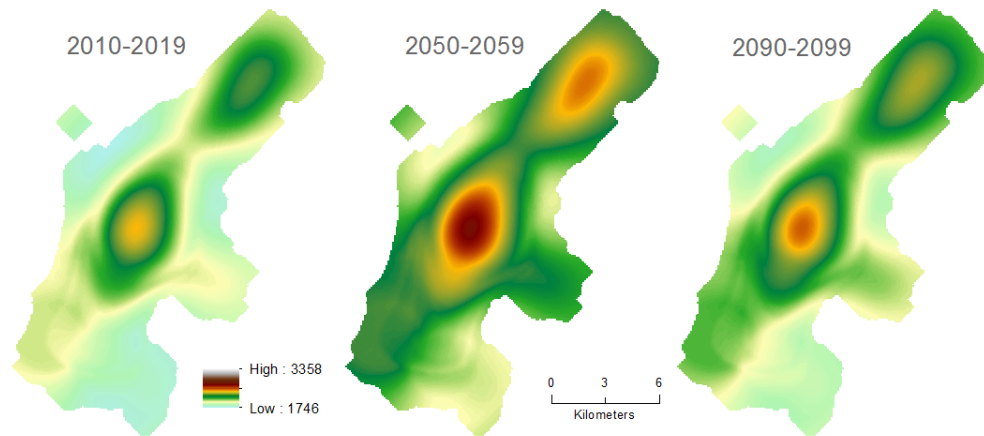
90m SNAP Downscaled
GCM Precipitation

Saipan

Tinian

Saipan

Tinian

0   5   10
Kilometers

0   125   250
Kilometers

0   0.5   1
Kilometers

Pohnpei
Average Total Annual Precipitation (mm)
CCCMA CGCM31, A1B Scenario

2010-2019

2050-2059

2090-2099

High : 9012

Low : 3822

0   5   10
Kilometers
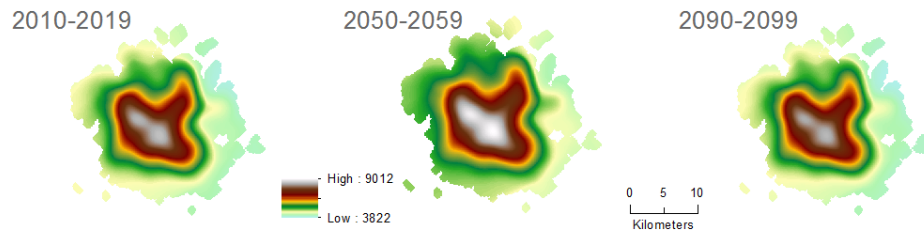
Pohnpei
Average Annual Temperature (^{o}C)
CCCMA CGCM31, A1B Scenario

2010-2019

2050-2059

2090-2099

High : 29.7

Low : 23

0   5   10
Kilometers

Saipan
Average Total Annual Precipitation (mm)
CCCMA CGCM31, A1B Scenario

2010-2019   2050-2059   2090-2099

High : 3358

Low : 1746

0   3   6
Kilometers

Saipan
Average Annual Temperature (°C)
CCCMA CGCM31, A1B Scenario

2010-2019   2050-2059   2090-2099

High : 29.6

Low : 24.8

0   3   6
Kilometers