Supplemental Information: Details and Discussion of the Methods of Investigation

This study employed a series of methods that necessitated the use of several assumptions. This supplement provides additional detail on some methods used and makes explicit the assumptions underlying the methods.

Feature Identification and Density Measurements

A key component of this research was the identification of communities. Social communities are difficult, if not impossible, to identify archaeologically. Therefore, I sought to identify communities that would allow a comparison between the archaeological records of different parts of each island (after Peterson and Drennan 2005). These may or may not correspond to past villages but, in any case, they do provide a mechanism by which to identify variation across space.

Analytical communities were defined by either the presence of bounded topography (e.g., the ridges of A'ofa caldera define A'ofa) or by changing terrace density (e.g., west slopes of Ofu and east slopes of Olosega). Terrace density, as opposed to other archaeological forms, was used since these features are interpreted to represent foundations for residential activity based on their size and the presence of coral that was transported from the coast onto these places (Quintus and Clark 2012). Pedestrian survey was conducted only in three locations, which precludes the use of pedestrian survey data as a mechanism to evaluate changing feature density. Instead, a coarse-grain identification protocol was used to mine features from lidar-derived slope maps. This protocol used a variant of the slope-contrast model (McCoy et al. 2011) wherein a slope map was classified that highlights the attributes of terraces, namely a flat space in otherwise sloping land. This protocol was used successfully in Sili-i-uta on Olosega previously (Quintus et al. 2015), though the contrast between terraces and the surrounding slope elsewhere on Ofu and Olosega is less extreme than in Sili-i-uta. Identifications on the west slopes of Ofu and east slopes of Olosega used slope classifications of 0-10°, 11-40°, and 41+°, which are slightly different than those previously used for Sili-i-uta.

This classified slope map was compared to a stretched slope map (SI Fig. 1) and identifications were made. Terraces were identified where contiguous flat areas, defined by the 0-10° slope class, were bounded by areas of higher slope. The classified and stretched slope maps were used iteratively to make these identifications. A single point was placed within boundaries of interpreted terraces (main text Fig. 1). This process is subjective, including the evaluation of a single researcher. Furthermore, ground returns are rare in some areas of each island and this results in potential false negatives or false positives[1]. Because of this, I do not claim that every feature was identified in this process nor do I claim that all features identified were true positives. In fact, a small number of features documented through pedestrian surveys were not identified using these methods. Furthermore, the variable quality of the lidar datasets along with a low slope contrast restricts identifications in some small areas. However, the *distribution* of features identified seems to reflect well the actual distribution of archaeology across the slopes of the islands. Thus, the product of importance is the distribution maps instead of individual feature positions.

Feature distribution maps were created in ArcGIS using the Kernel Density tool. The output cell size was 10 m with a default search radius. Using the default search radius reduces the effects of spatial outliers. While this tool does calculate absolute densities, the relative density differences illustrated through this process are more informative than absolute density differences given the ambiguity of feature identification described above (Manuscript Fig. 1). These maps can and should be tested with future pedestrian survey. I stress that the digitally-identified features and the resultant relative density maps are coarse-grained and preliminary. The size of these analytical communities is given as a range instead of a single number because of this ambiguity. As such, they were used only as tools to aid in defining analytical community edges and not as data to understand variation between community other than in showing the uncomparable size of Tamatupu. These analytical community boundaries should be considered hypotheses in need of further testing and refinement.

Terrace Measurements and the Gini Coefficient

Length and width were measured for each terrace documented during pedestrian survey and terrace area was calculated using a simple LxW formula as most terraces are roughly rectangular. Error is introduced into these calculations by ambiguity of feature boundaries in the field and the fact that these features are not perfect rectangles. Those features for which area measurements are available are a sample of features within each community. The measurements of features identified through digital means are not used here except for those in Sili-i-uta where a semi-automated algorithm produced results that can be replicated. These digital measurements, however, are used sparingly (see Manuscript Table 1).

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[1] The latter because of how the DEM on which the slope map is based in constructed. Interpolation of ground returns to produce the DEM may result in what appears to be a large flat space in otherwise sloping ground if a few ground returns in a larger area have the same elevation. Such a scenario may result in false positive identifications.

Gini coefficients for three analytical communities on Ofu and Olosega were calculated using a sub-sample of field-recorded terraces preliminarily interpreted as residential features. Residential function is interpreted based on the intersection of size (i.e., over 100 m^2) and the presence of coral on the terrace surface. The number of terraces in each analytical community that met this definition varied (Tufu = 23; A’ofa = 32; Tamatupu = 96), resulting in error ranges of different sizes. These data were imported into RStudio. Gini coefficients and bootstrapped 80% confidence intervals were calculated using the DescTools Gini command and 1000 resamples. The command code used is as follows:

```
Gini(GiniOfuOlosega$Tamatupu, unbiased = FALSE, conf.level = .80, R = 1000,
type = "bca",na.rm = TRUE)
Gini(GiniOfuOlosega$Tufu, unbiased = FALSE, conf.level = .80, R = 1000, type =
"bca",na.rm = TRUE)
Gini(GiniOfuOlosega$Aofa, unbiased = FALSE, conf.level = .80, R = 1000, type =
"bca",na.rm = TRUE)
```

These calculations are quite sensitive to the nature of the inputs. As such, additional data will result in changes to the output, which is why confidence intervals were calculated. These calculations assume that the input is a random sample of terrace sizes from the population of terraces that constitute each community. The interpretation of the results assumes that the sample adequately reflects variation in residential features. These are preliminary and should not be the sole attribute from which to evaluate inequality within a community.

All datasets used in this analysis are available upon request.

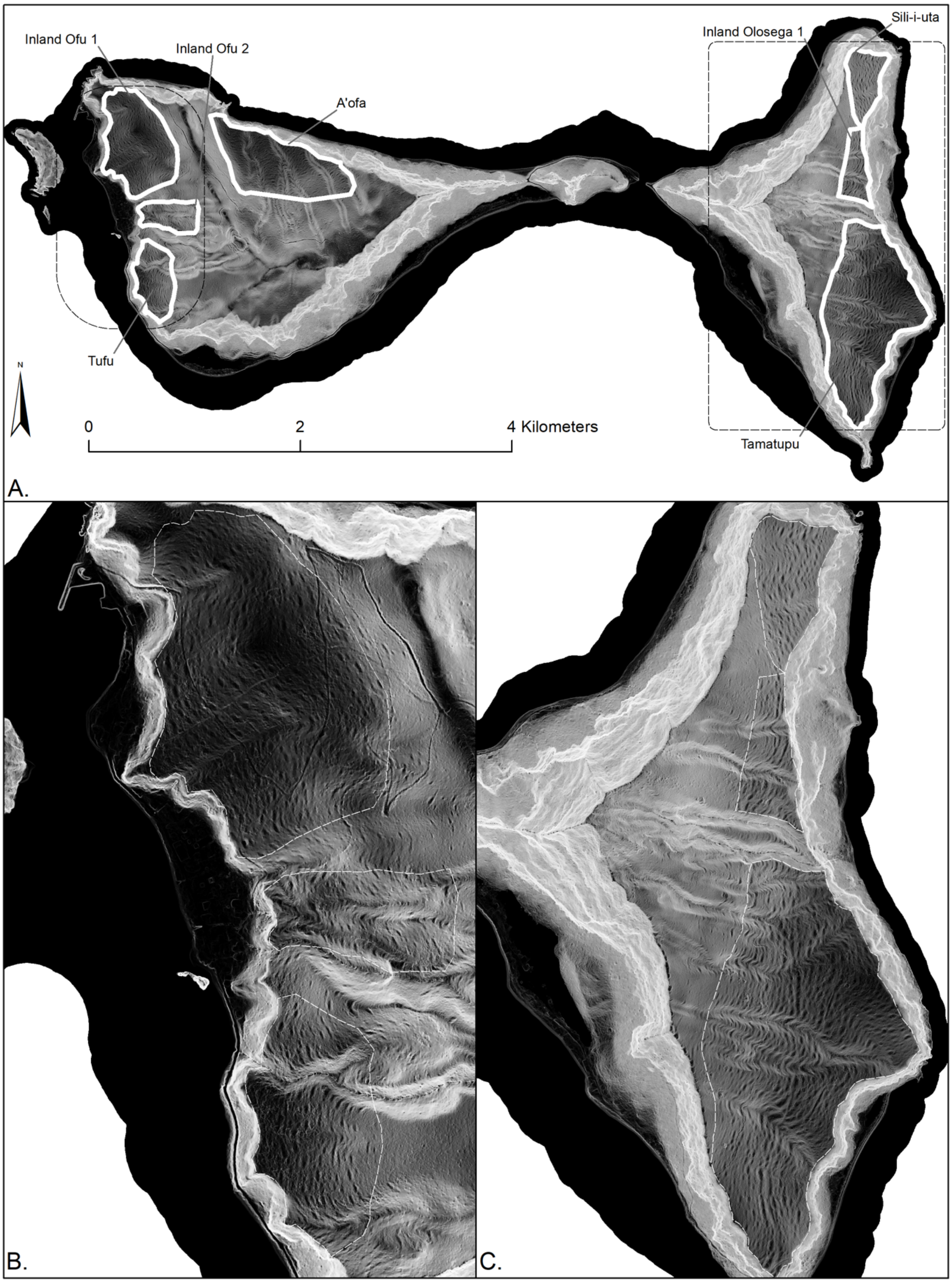
Inland Ofu 1
Inland Ofu 2
A'ofa
Tufu
Inland Olosega 1
Sili-i-uta
Tamatupu
N
0
2
4 Kilometers
A.
B.
C.

Figure SI 1

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