University of Nevada, Reno

Estimating Annual Groundwater Evapotranspiration from Hydrographic Areas in the Great Basin Using Remote Sensing and Evapotranspiration Data Measured by Flux Tower Systems

A thesis submitted in partial fulfillment of the requirements for the degree of
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by

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Abstract

Rising concerns about water availability in the Great Basin in the face of increasing population and water demand have prompted multiple groundwater studies focused on estimating groundwater recharge and discharge. Groundwater is the primary water supply for many hydrographic areas (HAs) in the Great Basin, thus a thorough understanding of the groundwater budget is fundamental for making meaningful predictions as groundwater is developed and ultimately consumed for beneficial use. Estimating groundwater recharge from precipitation (PPT) is challenging and has substantial uncertainty; therefore, much focus is placed on estimating the groundwater discharge in many HAs since estimating discharge is much more constrained and therefore less uncertain. Groundwater discharge in the Great Basin primarily occurs via bare soil evaporation and evapotranspiration (ET) from phreatophyte vegetation within the valley lowlands. Many recent studies have estimated annual groundwater ET by relating ET estimates obtained from Eddy Covariance (EC) and Bowen Ratio (BR) micrometeorological stations, to remotely sensed vegetation indices (VIs) derived from mid-summer Landsat imagery. The objective of this work was to develop and assess the uncertainty of a statistical relationship between annual ET estimates derived from EC and BR stations located in phreatophyte areas, and remotely sensed VIs. A normalized ET index, ET*, was developed at each study site using energy balance closure corrected ET normalized by evaporative demand (ET_o) and PPT derived from GRIDMET data. ET* values at each site were related to the source area Normalized Difference Vegetation Index (NDVI), calculated from Landsat Collection 1 Surface Reflectance data. ET* values for 54 site-years of data correlated well with source area NDVI (R^2=0.84). The statistical model was applied to the groundwater discharge areas of five HAs in the Great Basin using the mid- to late-summer images from the Landsat data archive (1984-2018) in order to develop estimates of median annual groundwater ET (ET_g). Median annual ET_g estimates compare relatively well with the estimates developed in previous studies of the five HAs. While uncertainty of the model and predictions of groundwater discharge can be large in some cases (e.g. ± 18% of the mean value estimated for Crescent Valley), uncertainty in groundwater discharge is argued to be substantially less than groundwater recharge. Results from this work will enable the estimation of groundwater discharge over large areas and time periods for which in-situ data does not exist.

Contents

List of Tables

List of Figures

Introduction

In the arid environments of the Great Basin there is a reliance on surface and groundwater resources for numerous beneficial uses such as agriculture, mining, municipal, industrial, commercial, etc. Annual precipitation in the form of winter snowfall largely controls the quantity of surface water that can be diverted to meet requirements in the subsequent spring, summer, and fall. During years of drought or water shortages groundwater is often relied on to supplement existing surface water supplies. Many agricultural water users in the Great Basin rely solely on groundwater for irrigation due to the lack of surface water. Although groundwater resources help meet water demands, many groundwater basins have become over appropriated. In such basins, the Nevada State Engineer has the power to "designate preferred uses of water within the respective areas" to the benefit of public welfare in the area (Nevada Revised Statutes, chapter 534). In order to know the potential upper limit for groundwater development, and ultimately prevent the over appropriation of groundwater, water managers require the development and assessment of groundwater budgets (De Vries and Simmers, 2002). Groundwater budgets typically consist of estimates of groundwater recharge, groundwater discharge, inter-basin flows, and storage changes. Groundwater budgets have been developed for most of the Great Basin beginning in the 1940s (Maxey and Eakin, 1949; Rush, 1968), and have been revised and improve with time (Harrill and Prudic, 1998; Nichols, 2000; Welch and Bright, 2007). Accurate estimation and assessment of individual groundwater budget components, especially groundwater recharge and discharge, is important for reducing uncertainty with respect to groundwater appropriation, especially as our population and water demand grows.

Hydrographic areas (HAs) in the Great Basin are hydrologically closed basins or part of a larger closed regional groundwater flow system. This means that under steady state conditions, groundwater recharge equals groundwater discharge. Geology, climate, and surface topography greatly influence the natural groundwater flow. Recharge from precipitation typically occurs within the mountain block, and along the mountain front, with discharge occurring from valley floor areas via evapotranspiration (ET) from phreatophyte vegetation within spring and riparian areas, meadows, and shrublands, and to a lesser amount from playa areas (Figure 1). Estimating groundwater recharge is challenging because of the spatiotemporal variability of precipitation, infiltration, and subsurface inflows and outflows. Thus the focus of groundwater budget analyses is often placed on estimating groundwater ET from phreatophyte vegetation (Maxey and Eakin, 1949; Nichols, 2000; Allander et al., 2009; Beamer et al., 2013).

Phreatophytes are plants that rely on groundwater for some of their water requirements. They have roots that extend to the capillary fringe and water table to consume shallow groundwater when needed (Robinson, 1958), whereas xerophytic plants rely solely on soil moisture derived from precipitation (Figure 2). The majority of phreatophyte species in the Great Basin belong to two plant community classes, salt desert and shadscale-greasewood plant communities (Nichols, 1994; Nichols, 2000). The salt desert plant community is composed of salt grass (Distichlis spicata var. stricata), pickleweed

(Allenrolfea occidentalis), and saltsage (Atriplex tridentata). The shadscale-greasewood plant community includes greasewood (Sarcobatus vermiculatus), shadscale (Atriplex confertifolia), rabbitbrush (Chrysothamnus nauseosus), saltbush (Atriplex canescens), spiny hopsage (Grayia spinosa), winterfat (Ceratoides lanata), and basin big sagebrush (Artemisia tridentata spp. tridentata). The principal phreatophyte of the salt desert community, salt grass, typically occupies areas where the water table is less than 3 meters deep, but has been known to grow in areas where the depth to groundwater reaches nearly 4 meters (Blaney et al., 1933). In contrast, plants of the shadscale-greasewood community typically occupy areas where the depth to groundwater ranges from just below the surface to nearly 20 meters (Robinson, 1958). Although greasewood and saltbush can extend their taproots to great depths, rabbitbrush will typically be limited to areas where the water table is within 10 meters (Robinson, 1958). Basin big sagebrush, which typically is considered a xerophyte, will occasionally be found growing among rabbitbrush communities, where the depths to groundwater reach nearly 4 meters (Mozingo, 1987). In these cases, basin big sagebrush is considered to be phreatophytic. Although phreatophyte shrublands (i.e. the shadscale-greasewood plant community) have relatively low groundwater ET rates when compared to the vegetation within riparian and spring areas, their large contributing areas equate to large groundwater discharge volumes (Nichols, 2000; Smith et al., 2007; Beamer et al., 2013).

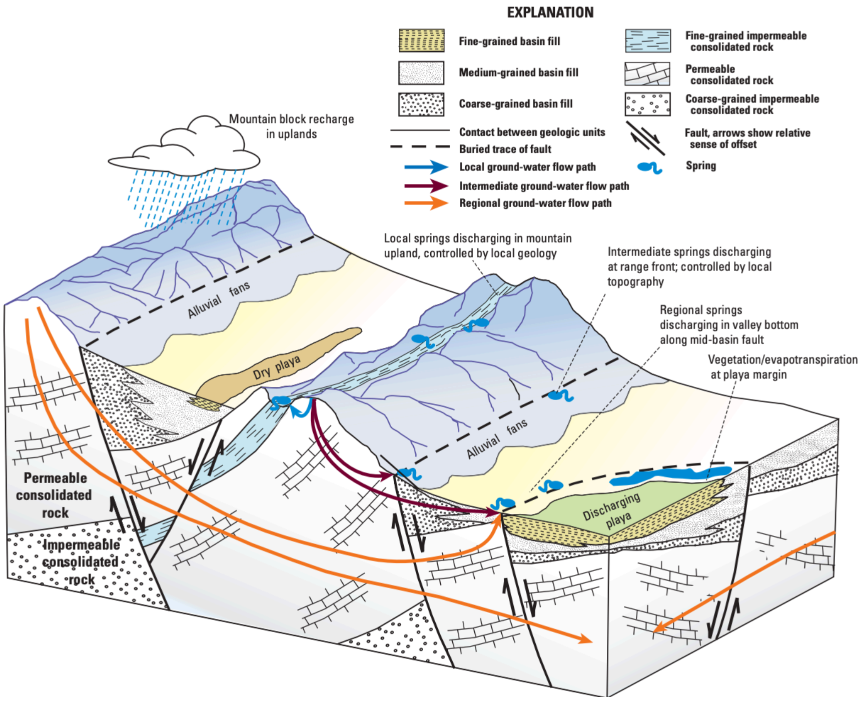

Figure 1. Conceptual diagram of a typical groundwater flow system in the Great Basin. (Modified from Welch et al., 2007)

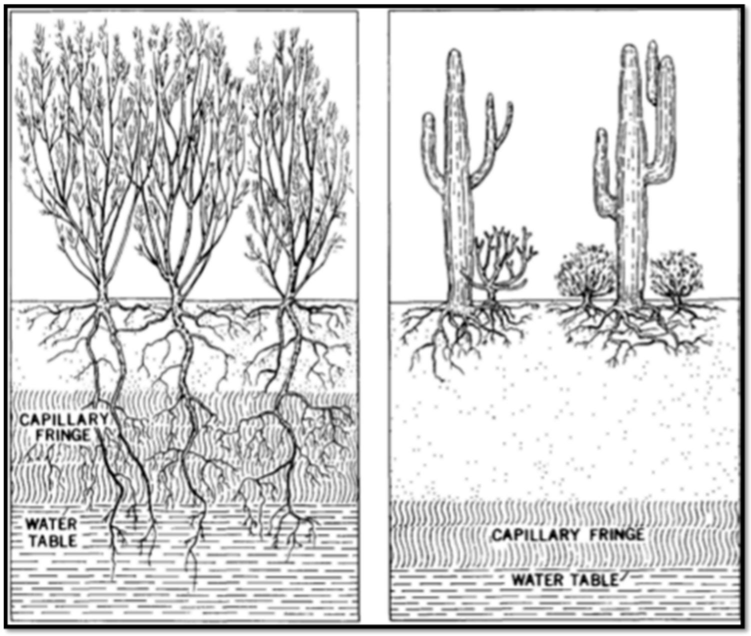

Figure 2. Difference between phreatophytes (left) and xerophytes (right) with regards to their rooting depth and access to the water table. (Modified from Robinson, 1958)

Previous Work

The first studies to estimate phreatophyte groundwater ET rates in the Great Basin began in the early 1900s (Lee, 1912; White, 1932; Young and Blaney, 1942). Between 1910 and 1911, Lee (1912) installed lysimeters to estimate ET rates from salt grass in Owens Valley, California. This study demonstrated a relationship between groundwater ET and depth to groundwater beneath phreatophyte and bare soil areas. Similarly, White (1932) confirmed a general relationship existed between groundwater ET and depth to groundwater for greasewood in Escalante, Utah. He also found the groundwater ET rates for shadscale, rabbitbrush, and greasewood were comparable.

Beginning in 1945 and continuing into the 1970's, reconnaissance-level studies of the groundwater resources of Nevada were conducted in which groundwater ET rates and volumes were estimated for the majority of HAs within the state (e.g. Maxey and Eakin, 1949; Eakin, 1962; Cohen, 1964; Eakin et al., 1965; Rush and Everett, 1966; Everett and Rush, 1966; Harrill and Moore, 1970; Glancy and Katzer, 1975). The Water Resource Bulletins (WRBs) and Reconnaissance Series Reports (RRs) resulting from these studies contain original delineations of phreatophyte areas and assumed groundwater ET rates of Lee (1912), White (1932), and Young and Blaney (1942). Although these early groundwater ET studies were foundational for developing reconnaissance level groundwater budgets, new micrometeorological and satellite remote sensing techniques for estimating groundwater ET rates and volumes that consider the spatial and temporal variability of climate and phreatophyte vegetation vigor within and across different HAs, have created numerous opportunities to improve groundwater budgets within the Great Basin (Nichols, 1994; Nichols, 2000; Berger, 2000; Reiner et al., 2002; Maurer et al., 2005; Groeneveld et al., 2007; Moreo et al., 2007; Arnone et al., 2008; DeMeo et al., 2008; Allander et al., 2009; Huntington et al., 2011; Beamer et al., 2013; Garcia et al., 2015; Berger et al., 2016; Moreo et al., 2017).

More recently the U.S. Geological Survey (USGS) developed and commonly applies an “ET unit” approach for spatially distributing micrometeorological station based average groundwater ET rates across groundwater discharge areas. This approach is based on applying micrometeorological station based groundwater ET from previous studies, to different areas (i.e. ET units) of similar vegetation and soil characteristics. ET units are estimated using ranges of average vegetation index (VI) values computed from mid-summer Landsat satellite imagery (Smith et al., 2007). Estimates of the average annual groundwater ET volume are then calculated as the product of the average annual ET rate and respective area for each ET unit (Moreo et al., 2007). Another approach that is more spatially discrete relies on development and application of statistical relationships between VIs, plant density, and ET or groundwater ET (Nichols, 2000; Arnone et al., 2008). While these approaches made significant advances in estimating groundwater ET, spatial and temporal variations in precipitation and evaporative demand would ideally be considered when applying (i.e. transferring) station or statistically based groundwater ET rates across different HAs. Groeneveld et al. (2007) integrated precipitation and evaporative demand into a statistical model for estimating phreatophyte groundwater ET, and Beamer et al. (2013) later extended this approach for specific application in the Great

Basin by using over 40 site-years of energy balance closure adjusted micrometeorological station based groundwater ET estimates acquired in Nevada. All of these approaches only relied on one or two mid-summer Landsat images both in deriving and applying relationships between VIs and groundwater ET.

Recent advances in remote sensing, climate modeling, and cloud computing has enabled the potential for large scale and operational estimation of field scale ET. Landsat images are nominally available every 16 days from Landsat 5 Thematic Mapper (TM), and every 8 days when combined with Landsat 7 Enhanced Thematic Mapper Plus (ETM+), and when Landsat 7 is combined with the Landsat 8 Operational Land Imager (OLI). Free access to entire Landsat archive and climate archives on the Google Earth Engine (GEE) cloud computing platform, combined with newly acquired micrometeorological data, and new standardized energy balance closure methods, has provided a unique opportunity to develop new statistical relationships between VIs and ET using more complete and current data sets that are consistent with how such relationships would be applied in the future.

Objectives

The overall objectives of this work are: 1) compile previously developed potential groundwater discharge boundaries in a geographic information system (GIS), and modify and develop new boundaries with field and remote mapping, 2) develop a transferable predictive model for estimating annual phreatophyte groundwater ET that is consistent in the way in which it would be most commonly applied in the future using new in-situ data, remote sensing and data processing techniques, 3) assess model uncertainty, 4) apply the model with new potential groundwater discharge boundaries to develop new estimates of annual groundwater ET and groundwater discharge and uncertainty bounds, and 5) compare new estimates to previously developed estimates.

Hypotheses

It is hypothesized that 1) potential groundwater discharge boundaries will differ, sometimes greatly, from previous delineations due to the reconnaissance nature and large spatial scale that previous boundaries were developed, and the fact that satellite and aerial remote sensing data sets, groundwater level measurements, and GIS integration has led to more accurate methods of delineating groundwater discharge areas, 2) there will be a stronger statistical relationship between in-situ ET estimates and VIs due to the inclusion of more in-situ data sets from recent studies, more thorough and detailed QAQC and post-processing of in-situ data, and inclusion of more and consistent satellite and climate data, and 3) that new estimates of annual groundwater ET and groundwater discharge will vary, sometimes substantially from previous estimates and possibly within the uncertainty bounds of the new estimates, due to the differences in discharge area and numerous methodologies applied for estimating of groundwater ET rates, and uncertainty of the predictive model.

Data and Methods

Potential Groundwater Discharge Boundaries (PGDBs) and Field Visits

Nevada Division of Water Resources (NDWR) provide high resolution scanned plate maps of PGDBs from WRBs and RRs. These digital plate maps were georeferenced within a GIS and used to digitize and attribute polygons with respective vegetation classes for all of the reported HAs in Nevada (roughly 150 basins from 80 reports). In addition, digital PGDBs were obtained from the USGS and Southern Nevada Water Authority (Berger et al., 2000; Smith et al., 2007; Berger et al., 2016). Quality assurance and quality control (QAQC) was performed to ensure that the PGDBs excluded xerophyte upland areas, and that agricultural areas and other developed land since the time the maps were originally created was delineated and attributed as such for masking purposes. Field verification and modification of the PGDBs was conducted during mid- to late-summer. A total of 37 HAs were visited over two years (HAs highlighted in blue in Figure 3). The goal of the field visits was to cross-check previously developed PGDBs with nearby historical groundwater level measurements from USGS and NDWR well databases, satellite and aerial imagery and ensure that indicator species such as salt grass, greasewood, rabbitbrush, basin big sagebrush, and shadscale were present within the delineated PGDB, indicating that the area was contributing to groundwater discharge. Where groundwater level data was sparse, the presence of these indicator species assisted in delineating potential discharge areas. Observing species and distribution of phreatophytes in the field while at the same time visualizing current location via a GPS integrated with GIS and PGDBs and imagery displayed provided the unique opportunity to conduct real-time GIS edits to PGDBs, gain insight on the accuracy of previously developed PGDBs, and observe relationships between the transition zone of phreatophytes and xerophytes, a digital elevation model (DEM), and satellite and aerial imagery. These observed relationships were used for inferring and modifying PGDBs in areas that could not be accessed.

Satellite and aerial imagery used to support the delineation of PGDBs included Landsat 8 Thermal Infrared Sensor (TIRS) surface temperature and VI data. Landsat surface temperature data are commonly used for mapping ET due to evaporative cooling that result from the conversion of liquid to vapor (Allen et al., 2007; Anderson et al., 2012). Spectral radiance data collected by the Landsat 8 TIRS from 2013 to 2016 were converted to at-satellite brightness temperature and further to land surface temperature following the procedure outlined in Allen et al. (2007). Indeed, Landsat TIRS data acquired in mid- to late-summer when soil moisture was near or at a seasonal low, illustrated stark contrasts in surface temperature between groundwater dependent and non-groundwater dependent vegetation within valley floor areas. National Agriculture Imagery Program (NAIP) imagery from the U.S. Department of Agriculture was used in combination with the Landsat surface temperature and VI data, 10 m DEM values, derived hillshades, and groundwater levels to assist with excluding any area that had minimal to no vegetation cover, and upland areas where the depth to groundwater is too deep for phreatophytes to access (e.g. alluvial fans or small elevation rises and hills). Hillshades were particularly useful for restricting PGDBs from higher elevation such as alluvial fans, where it was observed that surface temperature dropped and VIs often increased along the transition of the alluvial fan and valley floor. The PGDB data set generated during this study is illustrated in Figure 3, and has been reviewed by both the USGS and NDWR, and metadata developed following Federal Geographic Data Committee (FGDC) standards.

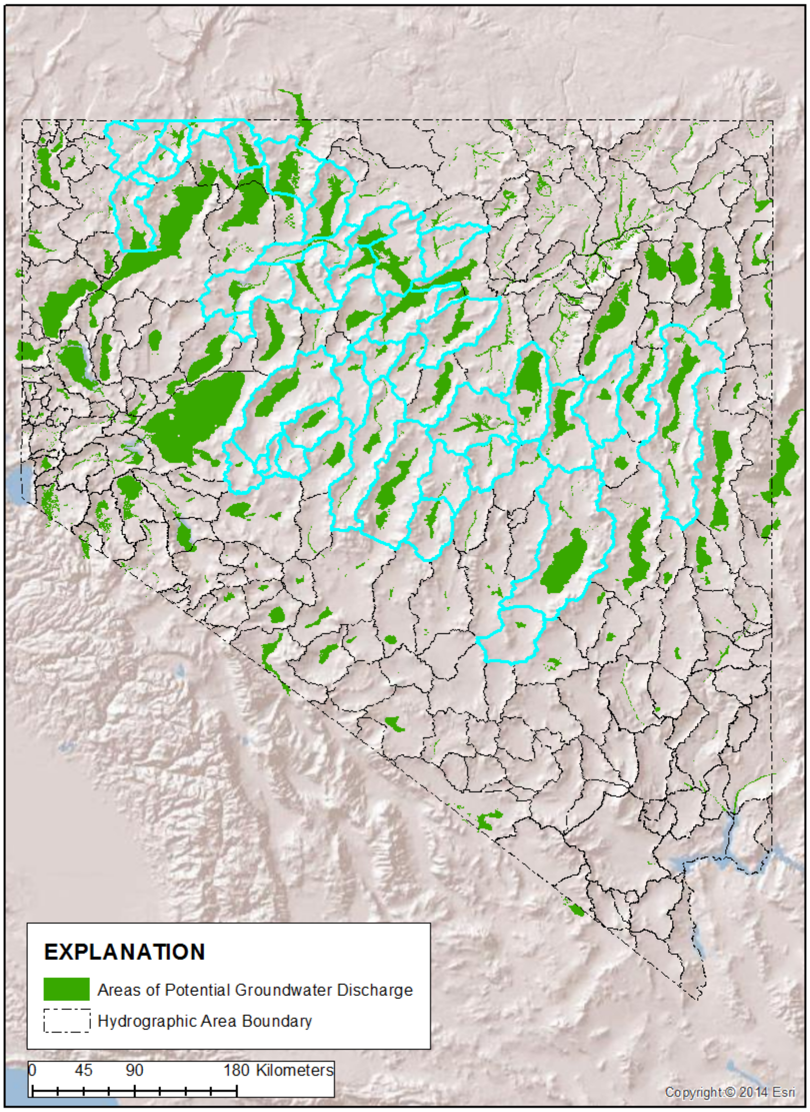

Figure 3. Potential groundwater discharge boundary data set (green) for Nevada. Field verification of phreatophyte areas was conducted in HAs highlighted in blue.

Study Area and Data Collection Summary

In-situ micrometeorological and energy balance data for estimating ET used in this study were obtained from the same six studies utilized by Beamer et al. (2013) (Reiner et al., 2002; Maurer et al., 2005; Moreo et al., 2007; DeMeo et al., 2008; Arnone et al., 2008; Allander et al., 2009), in addition to four more recent studies conducted by the USGS (Garcia et al., 2015; Berger et al., 2016; Moreo et al., 2017; DeMeo, 2018). These in-situ data were collected at micrometeorological stations equipped for applying eddy covariance (EC) and Bowen Ratio (BR) techniques for estimating ET and other energy balance components at 20- to 30-minute intervals. All study sites were located in phreatophyte areas across Nevada (Figure 4). Data from each site was filtered based on the criteria that it would have at least one full year worth of data following energy balance corrections and gap filling. 54 site-years of daily data from the 10 studies were available and used for the analysis. A single site- and year-combination represents one full water year of daily data from a single study site (some sites had multiple water years of data). 15 site-years of data were collected using BR stations and 39 site-years of data were collected using EC stations. Energy balance corrections and QAQC measures were applied to the daily ET data from EC stations in order to make estimates consistent with BR derived ET estimates. These post-processing steps are explained in detail in the Energy Balance and Evapotranspiration Data Post-Processing section below.

Evaporative demand and precipitation (PPT) for each study site was estimated from a 4 km spatial resolution gridded data set, GRIDMET (Abatzoglou, 2013). GRIDMET is based on the Parameter Regression on Independent Slopes Model (PRISM) (Daly et al., 1994) and North American Land Data Assimilation System (NLDAS) (Mitchell et al., 2004). Evaporative demand was estimated using the American Society of Civil Engineers Standardized Penman-Monteith equation to estimate reference ET (ET_o), as a function of daily air temperature, wind speed, humidity, and solar radiation (ASCE-EWRI, 2005). The decision to use GRIDMET as opposed to measured data from the stations was based on the fact that there are numerous errors and inconsistencies associated with collection of these variables, and precipitation gauge measurements were also suspect at many sites due to potential under catch (Groisman and Legates, 1994), and other sensor and recording techniques (e.g. lack of alter shield and precipitation gauges, and obvious outliers and drift in humidity, pyronometer, and anemometer readings). In addition, the sole use of GRIDMET estimates of annual ET_o and PPT in this analysis ensured that there was consistency between how the predictive model is built and how it is applied.

Mean annual PPT estimates in the study areas range from 65 to 320 (mm/yr), which falls primarily during the winter months. Groundwater levels at the study sites range from the ground surface to nearly 10 meters below ground level. Vegetation communities around the study sites consist primarily of phreatophyte species of greasewood, rabbitbrush, salt cedar, mesquite, salt grass, and shadscale. Study site IDs, vegetation communities, locations, elevation, period of data used, and data sources are shown in Table 1. Detailed site descriptions of each site can be found in Appendix 1.

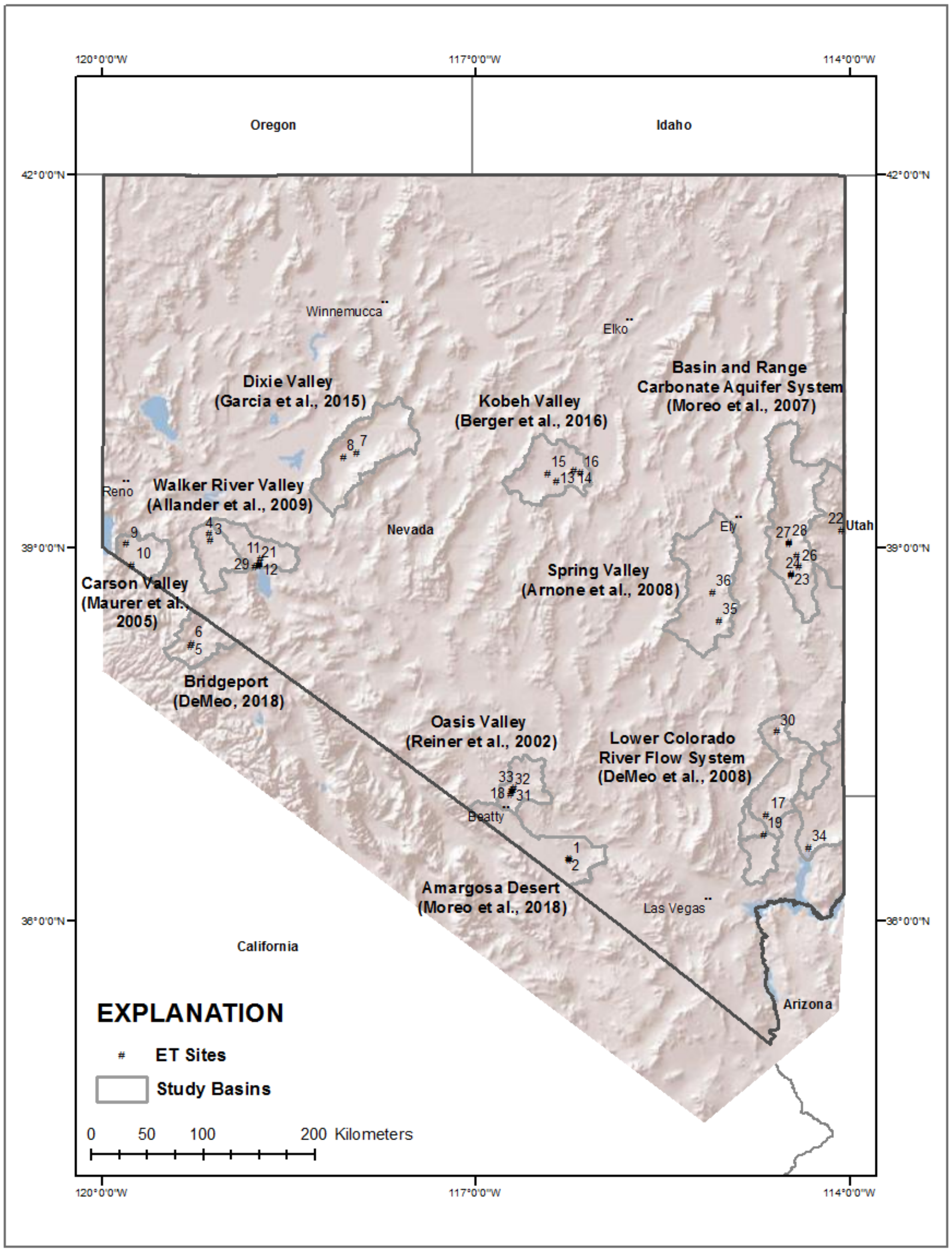

Figure 4. Map showing the study areas for the ten ET studies (Reiner et al., 2002; Maurer et al., 2005; Moreo et al., 2007; Arnone et al., 2008; DeMeo et al., 2008; Allander et al., 2009; Garcia et al., 2015; Berger et al., 2016; Moreo et al., 2017; DeMeo, 2018) and the locations of the 36 ET sites. Numbers on map correspond to sites listed in Table 1.

Table 1. Summary information for evapotranspiration (ET) study sites used in this study (locations are shown on Figure 4).

Site	Site ID	Vegetation Type	Latitude, °N	Longitude, °W	Altitude, m	Period of Data Collection	Data Source No.
1	AFD	Shadscale	36.491	-116.253	709	11/11 - 11/13	9
2	AFS	Salt grass	36.493	-116.259	708	11/11 - 11/13	9
3	B-01	Non irrigated alfalfa	39.055	-119.134	1,326	04/05 - 04/07	6
4	B-11	Irrigated alfalfa	39.108	-119.146	1,317	03/05 - 02/07	6
5	BPHV	Pasture grass	38.210	-119.291	1,997	10/12 - 09/13	10
6	BPLV	Pasture grass	38.227	-119.286	2,023	10/12 - 09/13	10
7	DVDV	Greasewood/big saltbush/seepweed	39.763	-117.960	1,046	10/09 - 09/11	7
8	DVSV	Greasewood/seepweed/big saltbush	39.730	-118.067	1,032	10/09 - 09/11	7
9	ET-1	Greasewood/rabbitbrush	39.029	-119.808	1,420	10/03 - 09/04	2
10	ET-8	Irrigated pasture grass	38.859	-119.764	1,471	10/03 - 09/04	2
11	GRE	Greasewood	38.907	-118.736	1,246	03/05 - 02/06	6
12	GRE-2	Greasewood	38.854	-118.743	1,224	10/06 - 09/07	6
13	KV-1	Greasewood/rabbitbrush	39.537	-116.213	1,859	08/11 - 08/12	8
14	KV-2	Greasewood/rabbitbrush/salt grass	39.620	-116.213	1,845	08/10 - 08/12	8
15	KV-3	Greasewood/rabbitbrush/salt grass	39.598	-116.424	1,869	08/10 - 08/12	8
16	KV-4	Meadow grass	39.599	-116.164	1,833	11/11 - 11/12	8
17	LMVW	Arrowweed	36.850	-114.666	579	04/06 - 10/06	5
18	MOVAL	Wire grass/salt grass	37.011	-116.724	1,125	10/98 - 09/99	1
19	MR	Mesquite	36.691	-114.688	503	10/03 - 09/06	5
20	SAL	Salt grass	38.865	-118.742	1,222	03/05 - 02/06	6
21	SAL-2	Salt grass	38.867	-118.752	1,224	10/06 - 09/07	6
22	SNV-1	Greasewood	39.140	-114.062	1,558	09/05 - 08/07	3
23	SPV-1	Greasewood/rabbitbrush	38.778	-114.468	1,763	09/05 - 08/07	3
24	SPV-2	Greasewood/rabbitbrush	38.786	-114.466	1,762	09/05 - 08/07	3
25	SPV-3	Mixed grasses	38.937	-114.421	1,763	09/05 - 08/07	3
26	SV-4	Mixed grasses	38.848	-114.404	1,773	10/07 - 09/09	4
27	SV-5	Greasewood/rabbitbrush	39.032	-114.485	1,760	10/07 - 09/09	4
28	SV-6	Greasewood/rabbitbrush	39.043	-114.483	1,756	10/07 - 09/09	4
29	TAM	Salt cedar	38.851	-118.773	1,222	10/05 - 09/06	6
30	UMVW	Rabbitbrush	37.520	-114.583	1,250	06/05 - 10/06	5
31	UOVLO	Greasewood	37.045	-116.709	1,177	10/98 - 09/00	1
32	UOVMD	Salt grass	37.047	-116.712	1,175	09/99 - 09/00	1
33	UOVUP	Wolfberry/rabbitbrush	37.064	-116.695	1,198	10/98 - 09/99	1
34	VR	Salt cedar	36.588	-114.328	370	10/03 - 09/04	5
35	WRV-1	Greasewood	38.414	-115.051	1,600	09/05 - 08/07	3
36	WRV-2	Greasewood	38.641	-115.103	1,622	09/06 - 08/07	3

Note: Data Source No. column indicates study: (1) Reiner et al. (2002); (2) Maurer et al. (2005); (3) Moreo et al. (2007); (4) Arnone et al. (2008); (5) DeMeo et al. (2008); (6) Allander et al. (2009); (7) Garcia et al. (2015); (8) Berger et al. (2016); (9) Moreo et al. (2017); and (10) DeMeo (2018).

Energy Balance and Evapotranspiration Data Post-Processing

Actual ET (ET_a) is commonly estimated using techniques such as EC, BR, water balance, lysimeters, sap flow, and satellite remote sensing. Beyond well-maintained lysimeters, EC and BR flux tower systems are widely considered to be the most accurate ways to estimate ET_a in the field (Rana and Katerji, 2000). These flux tower systems are installed in areas of homogeneous vegetation to measure different components of the energy budget, and to ultimately develop estimates of ET_a. The energy budget consists of four components: net radiation (R_n), latent-heat flux (λE), sensible-heat flux (H), and soil-heat flux (G). A balance of energy is reached when the available energy (R_n – G) is equal to the sum of the turbulent fluxes (λE + H):

$$R_n - G = \lambda \mathrm{E} + \mathrm{H} \qquad \text{(Eq. 1)}$$

R_n is associated with the radiative energy from the sun and atmosphere that drives ET and is the sum of the difference between incoming and outgoing long wave and shortwave radiation, λE is the energy consumed during the ET process, H is the heat energy that is removed from the surface through convection when temperature differences exist between the ground surface and the atmosphere, and G is the rate of change of energy stored in the soil. G is taken as positive when heat moves from the surface into the soil.

R_n is measured using a net radiometer, and G estimated from soil heat flux plate measurements, along with temperature thermocouples and water content probes (e.g.

reflectometer) to measure soil temperature and moisture for estimating heat storage changes above the heat flux plates (Allander et al., 2009). λE and H are approximated by measuring humidity and temperature gradients, at two heights above the surface, respectively, to estimate the well-known Bowen ratio (β), which allows for estimation of λE (Bowen, 1926) (Eq. 2). Latent-heat flux is estimated from the Bowen ratio as:

$$\lambda\mathrm{E} = \frac{(R_n - G)}{(1 + \beta)} \qquad \text{(Eq. 2)}$$

Once λE has been determined, $\mathrm{ET_a}$ rates can then be calculated by dividing by the latent heat of vaporization (λ). This method is appealing because it is relatively simple to implement, however, any inaccuracies in R_n and G will translate directly into inaccuracies in λE, whereas λE and H are estimated independent of R_n and G using the EC method.

With the EC method, turbulent flux terms (λE and H) are estimated with a high frequency 3-dimensional sonic anemometer and hygrometer. λE is computed as the covariance of the fluctuations of vertical wind speed and vapor density about their mean, whereas H is computed as the covariance of the fluctuations of vertical wind speed and temperature about their mean. The EC method is generally known to fail to achieve energy balance closure (Foken, 2008; Garcia et al., 2015). Some of the possible explanations for the energy balance include: instrument bias, measurement bias leading to underestimation of low- and high-frequency flux contributions, sampling disparity between the source areas and the various sensors measuring components of the energy balance, phase lags produced by incorrect estimation of energy storage in the soil, air, and biomass below the sensor height, and regional advection of energy (Wilson et al., 2002; Leuning et al., 2012). Therefore, it is becoming standard practice to perform energy balance closure on EC data, where the turbulent fluxes are typically increased so that their sum is equal to the available energy (R_n – G). Closing the energy balance on EC data was also needed for integration of EC with BR data sets, and for making consistent comparisons (Beamer et al., 2013).

Beamer et al. (2013) performed energy balance closure (EBC) corrections on 22 site-years of EC data from their combined 40 site-year EC and BR data set. Their EBC correction method followed the procedures of Lee (1998), Blanken et al. (1997), and Twine et al. (2000). λE and H were adjusted at the 20- and 30-minute time step when R_n was positive (i.e. during the day time) to force EBC. This method preserves the measured β by proportionally adjusting turbulent fluxes, resulting in:

$$\lambda \mathrm{E}_{\mathrm{corr}} = \frac{(R_n - G)}{(1 + \beta)} \qquad \text{(Eq. 3)}$$

and

$$H_{corr} = \lambda \mathrm{E}_{\mathrm{corr}} * \beta \qquad \text{(Eq. 4)}$$

where λE_{corr} is the corrected latent-heat flux and H_{corr} is the corrected sensible-heat flux. An assumption of this correction method is that estimates of R_n and G are correct. ET_a

estimates from Beamer et al. (2013) increased by an average of 22% following EBC correction to the EC data.

In this study, an EBC approach based on the Energy Balance Ratio (EBR) similar to the FLUXNET methodology (FLUXNET, 2015) was used to correct 39 site-years of EC ET_a data. In contrast to the sub-hourly correction method used by Beamer et al. (2013), this method performs all energy balance corrections at the daily time step and filters out poor quality data. Performing energy balance closure at the daily time step has been shown to reduce the effects of soil-heat flux measurement inaccuracies that can occur at the sub-hourly time step (Leuning et al., 2012). Energy entering the soil and biomass in the morning will return later in the day, thereby making energy balance closure better when averaging over a daily time scale. The EBR is:

$$EBR = \frac{(\lambda \mathrm{E} + \mathrm{H})}{(R_n - G)} \qquad \text{(Eq. 5)}$$

The EBR correction factor applied to both λE and H is computed as the inverse of the EBR (i.e. 1/EBR). Detailed processing and gap-filling steps are explained in the flux-data-qaqc GitHub repository (https://github.com/Open-ET/flux-data-qaqc). Comparing the EBRs for each site and year before and after corrections were applied assessed the amount of adjustment necessary. EBR values before corrections were applied ranged from 0.62 to 1.18 with a mean EBR of 0.92 across all sites. Following the FLUXNET EBR corrections, EBR values ranged from 0.98 to 1.02 with a mean EBR of 1.01 across all sites. ET_a estimates from this study increased by an average of 9% following FLUXNET EBR corrections to the EC data.

Daily ET_a values were summed to total water year ET_a for each site-year (39 site-years of EBC corrected EC ET_a and 15 site-years of BR ET_a). Daily PPT and ET_o values were estimated for each site-year using their respective GRIDMET cell values. Daily PPT and ET_o were summed to total water year PPT and ET_o for each site-year. Similar to Beamer et al. (2013) and Groeneveld et al. (2007), normalized ET (ET*) for each site-year was computed using water year totals of ET_a, ET_o, PPT, and was computed as:

$$ET^* = \frac{(ET_a - PPT)}{(ET_o - PPT)} \qquad \text{(Eq. 6)}$$

where ET_a is total water year ET measured by flux tower systems, ET* is normalized ET_a, PPT is total water year precipitation, and ET_o is the total water year grass-reference ET. Beamer et al. (2013) and Groeneveld et al. (2007) point out that normalizing ET measurements by the total annual precipitation and evaporative demand is needed when developing VI – ET statistical models that are based on and applied with data representative of different climate conditions (e.g. southern vs. northern Nevada). Doing so ensures that the spatial and temporal climate across all sites is taken into account when formulating the ET* data set. Values of water year ET_a, ET_o, PPT, ET_g, and the computed ET* for all 54 site-years analyzed in this study are shown in Table 7 and Appendix 2.

Remote Sensing Data Preparation

Beamer et al. (2013) computed Landsat surface reflectance data following the methodology of Allen et al. (2007) and Tasumi et al. (2008). Since the study of Beamer et al. (2013), the USGS has developed operational Landsat surface reflectance products using the Landsat Ecosystem Disturbance Adaptive Processing System (LEDAPS) (Landsat 5 and 7) and the Landsat 8 Surface Reflectance Code (LaSRC) (Landsat 8), respectively (Masek et al., 2006; Vermote et al., 2016). These products, as part of the standardized Landsat Collection 1 data sets, have been made available on the GEE. The GEE Application Programming Interface (API) was used to compute mean ET_a source area VI values for all quality mid- to late-summer images (June 1st-September 15th) that correspond to the 54 site-years of EC and BR flux tower data. Developing the predictive equation with multiple VI images for each site-year takes into account the temporal and spatial variability associated with potential phreatophyte vigor change throughout the mid- to late-summer period as opposed to using single-image dates implemented by Beamer et al. (2013). To account for differences in the spectral bandwidths and ensure that calculated vegetation indices were consistent between Landsat 5 (TM), Landsat 7 (ETM+), and Landsat 8 (OLI), sensor cross-calibration was performed following the methodology described in Huntington et al. (2016). Processing steps for each site-year of data were: 1) develop a polygon shapefile of 100 m buffers around all 54 site-years of EC and BR flux tower sites, 2) import the shapefile to the GEE API, 3) select all mid- to late-summer Landsat 5, 7, and 8 surface reflectance images for respective years in the GEE API, and perform cloud masking using the Level-1 Quality Assessment (QA) Band to remove poor quality pixels from images, 4) perform sensor cross-calibration, 5) calculate Enhanced Vegetation Index (EVI), Normalized Difference Vegetation Index (NDVI), and Modified Soil-Adjusted Vegetation Index (MSAVI) for every image using equations 7, 8, 9, and 10, 6) reduce VI images into a median composite image to take into account the spatial and temporal variability of potential phreatophyte vigor change throughout the mid- to late-summer period, 7) calculate the spatial mean EVI, NDVI, and MSAVI values from all pixels of the composite image that fall within each 100 meter buffer, and 8) correlate 54 site-year VI values with respective ET* values. Source area EVI, NDVI, and MSAVI for all 54 site-years analyzed in this study are shown in Table 7 and Appendix 2. EVI (Nagler et al., 2005), NDVI (Rouse et al., 1974), and the MSAVI (Qi et al., 1994) were calculated for each image using the following equations:

$$EVI = \frac{2.5 * (NIR - RED)}{(NIR + 6 * RED - 7.5 * BLUE + 1)} \qquad \text{(Eq. 7)}$$

$$NDVI = \frac{(NIR - RED)}{(NIR + RED)} \qquad \text{(Eq. 8)}$$

$$MSAVI = \frac{(NIR - RED)(1 + L)}{(NIR + RED + L)} \qquad \text{(Eq. 9)}$$

$$L = \left[\frac{2 * s * (NIR - RED) * (NIR - s * RED)}{(NIR + RED)}\right] \qquad \text{(Eq. 10)}$$

where NIR, RED, and BLUE stand for the spectral reflectance measurements acquired in the near-infrared, red (visible), and blue (visible) regions, respectively, and s is the slope of the line from the plot of the RED versus NIR reflectance.

VI – ET* Predictive Equation

The pairing of all 54 site-year ET* values with their respective mean source area VI values (EVI, NDVI, or MSAVI) and subsequent least squares regression analysis was completed to obtain the best-fit line an associated regression coefficients for predicting ET from VI's. A linear relationship was formulated in this study as opposed to a nonlinear relationship like the one developed in Beamer et al. (2013) to makes the application of the regression and uncertainty analysis more computationally efficient and practical, where:

$$\mathrm{ET}^* = \beta_0 + \beta_1 \mathrm{VI} \qquad \text{(Eq. 11)}$$

and VI is EVI, NDVI, or MSAVI and β_0 and β_1 are regression coefficients. After developing linear models for EVI, NDVI, and MSAVI, NDVI had the highest coefficient of determination (R^2), which describes how much of the variability in the dependent variable can be explained by the independent variable (Table 2). The coefficients of determination for the three equations developed in this study are lower than that of the EVI – ET* predictive equation (R^2=0.97) developed by Beamer et al. (2013). Possible explanations of the decrease in the R^2 values are the inclusion of more in-situ data sets, use of GRIDMET variables in this study as opposed to measured data from the stations, differences in methods used to derive source area VI values for the EC and BR stations, and differences in methods used to perform energy balance closure and gap filling of the ET_a data sets.

The y-intercept of the NDVI – ET* predictive equation (Eq. 11) developed in this study was constrained so that the best-fit line crossed the NDVI axis at a value of about 0.03, thereby forcing ET* to 0 at that point. This approach was assumed to be reasonable because ET is 0 in groundwater discharge areas when there is no vegetation present and the water table or capillary fringe are too deep for evaporation to occur. This also corresponds to the bare soil background NDVI value observed in this area. The recommended best-fit line and equation for the forced NDVI – ET* equation is shown in Figure 5 and Table 2.

Table 2. Comparison of the relationship of ET* with Enhanced Vegetation Index (EVI), Normalized Difference Vegetation Index (NDVI), and the Modified Soil-Adjusted Vegetation Index (MSAVI), and the recommended NDVI – ET* equation after forcing intercept.

Vegetation Index	**Equation of Best Fit**	**R^2**
EVI	$ET^* = 1.758 \times EVI - 0.007$	0.85
NDVI	$ET^* = 1.0079 \times NDVI + 0.0123$	0.86
MSAVI	$ET^* = 1.8659 \times MSAVI + 0.148$	0.84
NDVI - Recommended	$ET^* = 1.1277 \times NDVI - 0.035$	0.84

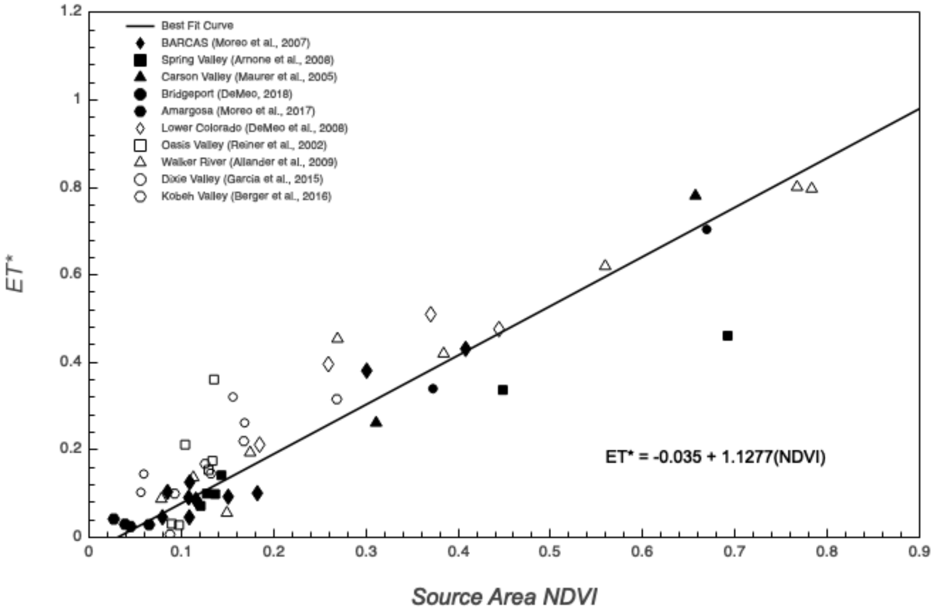

Figure 5. Normalized Difference Vegetation Index (NDVI) – ET* data pairs for the 54 site-years of Eddy Covariance and Bowen Ratio flux tower stations analyzed in this study. Symbols indicate which ET study the data point represents. The best-fit line and prediction equation are provided.

If we define NDVI* as any specified value on the x-axis and if β_0 and β_1 from equation 11 are known, $\beta_0 + \beta_1\text{NDVI}^*$ can be used as a point estimate of $\mu_{ET^*\cdot NDVI^*}$ (i.e. the true average of ET* when NDVI is equal to NDVI*). In order to assess how well $\mu_{ET^*\cdot NDVI^*}$ is estimated, a confidence interval (CI) must be formulated. To assess how well the equation predicts ET*, a prediction interval (PI) must be formulated. The confidence interval represents the degree of confidence in the mean ET*, whereas the prediction interval indicates the degree of confidence for a new NDVI and ET* measurement pair to fall with the specified interval. The acceptable level of accuracy used to develop the CIs and PIs is 1 - α, where α is the likelihood that the true population parameter lays outside the CI. For the purposes of this study, an alpha of 0.1 was assumed, resulting in a $100(1 - \alpha) = 90$ % chance that the CI and PI will contain values between the lower and upper limits. Assuming ET* = Y, NDVI = x, and a 90% CI for $\mu_{Y\cdot x}$, the expected value of Y when x = x* is

$$\beta_0 + \beta_1 x^* \pm t_{\frac{\alpha}{2},n-2} \cdot s_{\beta_0 + \beta_1 x^*} \qquad \text{(Eq. 12)}$$

where $t_{\alpha/2,n-2}$ is 1.646 for an α equal to 0.1 and $s_{\beta 0 + \beta 1 x^*}$ is the standard deviation of ET* at x=x*. The 90% PI for a future Y observation when x = x* is

$$\beta_0 + \beta_1 x^* \pm t_{\frac{\alpha}{2},n-2} \cdot \sqrt{s^2 + s^2{}_{\beta_0 + \beta_1 x^*}} \qquad \text{(Eq. 13)}$$

In theory if the 90% PI is used repeatedly for observed value of NDVI, eventually the interval will contain the observed ET* values 90% of the time (Devore, 1995). The uncertainty of the regression model (Eq. 11) depends on the accuracy of the ET_a estimates from the EC (EBC-corrected) and BR stations, GRIDMET ET_o and PPT data sets, and the source area NDVI measurements. All of these variables have errors and uncertainties, and were not rigorously evaluated during the present study due to difficulties and uncertainties in assessing the uncertainties. Rather this study focuses on the more immediate task of developing a predictive model using new in-situ, remote sensing, and post-processing methods and assessing the uncertainty of the model using more traditional statistical methods. It should be noted, however, that previous studies have shown GRIDMET performs well when compared to independent observations of monthly and annual ETo and PPT in the Great Basin (McEvoy et al., 2014; Huntington et al., 2016). The 90% PI used to evaluate the uncertainty of the NDVI – ET* equation was assumed to be wider than would have been provided by the collective uncertainty of the measured and estimated variables (Figure 6). Regression coefficients for the NDVI – ET* equation, CI bands, and PI bands are given in Table 3.

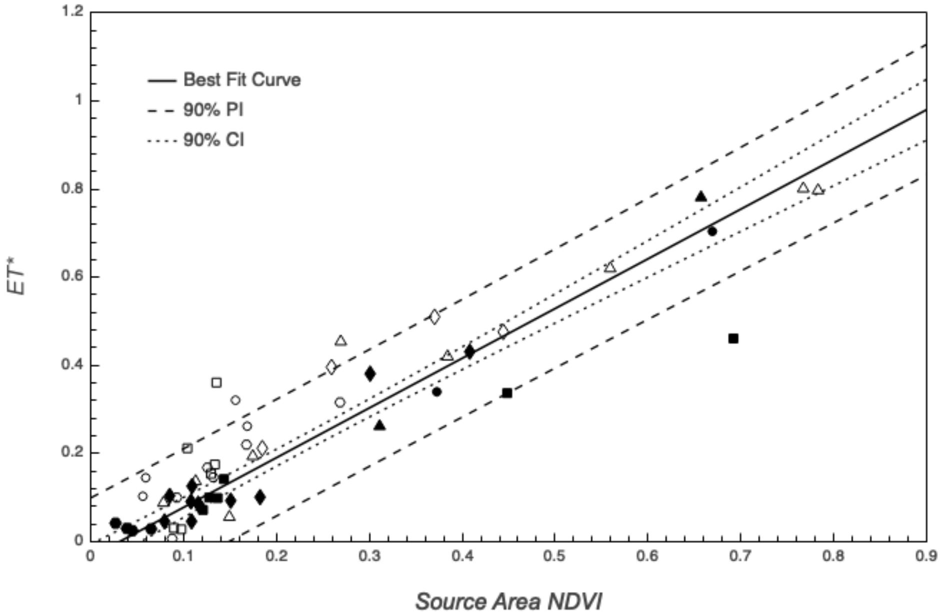

Figure 6. NDVI – ET* data pairs with recommended best-fit line, upper/lower 90% confidence and prediction intervals.

Table 3. β-coefficients for the model equation, 90% confidence interval (CI), and 90% prediction interval (PI) of the recommended linear equation relating NDVI and ET*.

Equation	**β_0**	**β_1**
Linear (model)	-0.035	1.1277
Lower 90% CI band	-0.0469	1.0733
Upper 90% CI band	-0.0231	1.1822
Lower 90% PI band	-0.1667	1.1118
Upper 90% PI band	0.0967	1.1437

Bootstrapping Observations for Statistical Inference

To independently evaluate uncertainty of the NDVI – ET* relationship, a bootstrap methodology was implemented. This non-parametric statistical approach is appealing when fitting linear models to small sample sizes like the current study. In this method, we consider the pairs (NDVI_i, $\mathrm{ET*}_i$) to be our sample, and then we construct the bootstrap resample using sampling with replacement from these pairs:

$$(\mathrm{NDVI}_i', \mathrm{ET}^*{}_i') = (\mathrm{NDVI}_I, \mathrm{ET}_I^*)$$

where

I = 1, …, *n* is sampled uniformly at random

The interpretation of this is that a sample of n observations is made (n=54) with replacement, and is termed a bootstrap sample. In other words, after a single NDVI – ET* pair is sampled, it is put back into the population (i.e. replacement) and is able to be sampled again until n=54, and a single bootstrap sample is obtained. Once the bootstrap sample is obtained, a linear regression model is fit to the sampled data and the coefficient β_1^* (the slope) is recorded; this coefficient is the bootstrap statistic. This process was replicated 1000 times to obtain a bootstrap sampling distribution of β_1^* (Figure 7). The mean, median, and standard error of the bootstrap statistic (β_1^*) were 1.1334, 1.132, and 0.0017, respectively. Because we cannot theoretically measure the true coefficient, an approximate 90% CI for the true coefficient was developed using a bootstrap percentile method. The CI extends from the 5th percentile to the 95th percentile of the 1000 bootstrapped coefficients; the lower CI was 1.036 and the upper CI was 1.239. From this CI we can be fairly certain that the true coefficient (i.e. population parameter) of the NDVI – ET* equation lies between 1.036 and 1.239.

90% CIs and PIs for each bootstrap replication of the NDVI – ET* predictive equation were formulated in the same fashion as before using equations 12 and 13. This resulted in bootstrap sampling distributions of the CI and PI coefficients, which ultimately assist with the validation of the CI and PI coefficients for the NDVI – ET* equation in Table 3. The medians of the bootstrapped coefficients (including CI and PI coefficients) were calculated and used in the analysis described in the sections below. Regression coefficients, CI coefficients, and PI coefficients from each bootstrap replication are shown in Table 8 and Appendix 2.

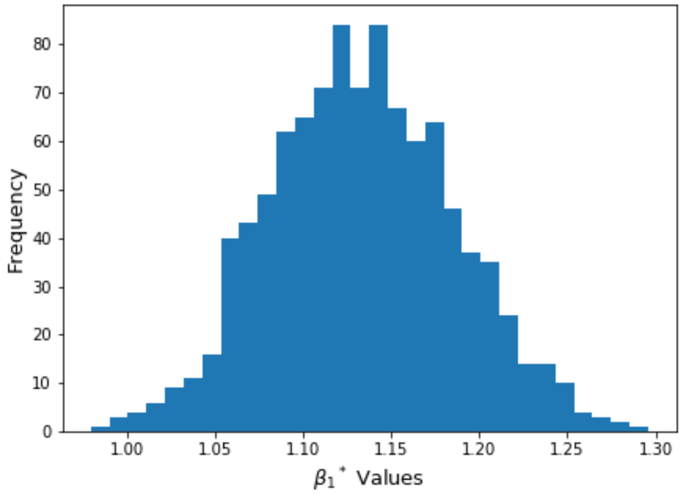

Figure 7. Histogram of the bootstrap sampling distribution of β_1^* after 1000 random resampling replications.

Estimating Evapotranspiration and Groundwater Evapotranspiration

Mid- to late-summer median Landsat NDVI was computed and used to estimate ET* via the recommended NDVI – ET* regression, and GRIDMET water year ET_o and PPT was computed to estimate ET_a by rearranging equation 6:

$$ET_a\ (\text{estimated}) = (ET_o - PPT)ET^* + PPT \qquad \text{(Eq. 14)}$$

When water year total precipitation (PPT) is subtracted from the equation above, an estimate of the annual groundwater ET (ET_g) is formulated (Groeneveld et al., 2007):

$$ET_g\ (\text{estimated}) = (ET_o - PPT)ET^* \qquad \text{(Eq. 15)}$$

Equations 14 and 15 were applied to the PGDBs of five HAs in the Great Basin to estimate the annual ET_g and make comparison to previous studies. Spring Valley (HA 184), Dry Valley (HA095), Red Rock Valley (HA099), and White River Valley (HA207) were selected because multiple studies have developed estimates of ET_g for these HAs (Rush and Glancy, 1967; Nichols, 2000; Berger et al., 2004; Welch et al., 2007; Beamer et al., 2013). Crescent Valley (HA054) was the fifth and final basin chosen for the analysis because it has fairly typical vegetation within the Humboldt River Basin, which is receiving much attention, and the Beamer et al. (2013) method has been applied for estimating ET_g (Huntington et al., 2016) such that comparisons can be made. Dry Valley and Red Rock Valley are relatively small HAs with areas of 212 km^2 and 109 km^2, respectively. Conversely, Spring Valley, White River Valley, and Crescent Valley have areas of 4,318 km^2, 4,140 km^2, and 1,948 km^2, respectively.

Processing steps for estimating the annual ET_g volume for each of the HAs were: 1) import the modified PGDB polygon shapefile into the GEE API, 2) select all mid- to late-summer Landsat 5, 7, and 8 surface reflectance images from the archive (1984-2018) and perform cloud masking using the Level-1 Quality Assessment (QA) Band to remove poor quality pixels from images, 3) perform sensor cross-calibration, 4) calculate NDVI for all of the pixels within the extent of the PGDBs for each image, 5) apply the regression coefficients of the NDVI – ET* equation in Figure 5 to each pixel to predict ET* with CI and PI estimates included, 6) average pixel ET* values for the PGDB to obtain a spatial mean ET* value for the Landsat image, 7) use equations 14 and 15 along with the respective spatially averaged water year GRIDMET ET_o and PPT values to determine the spatially averaged annual ET_g rate for the PGDB, 8) compute the intra-annual median of the ET_g rate to obtain single water year estimates of ET_g from 1984-2018, 9) compute the inter-annual median of water year ET_g rates to obtain a single median long-term annual ET_g rate for the HA, and 10) multiply the long-term median annual ET_g rate by the area of the PGDB obtain estimates of the median annual groundwater discharge volume for the HA.

In step 4 of the estimation process above, any pixels within the PGDB that had an NDVI value less than 0.03, and were not part of a groundwater discharging playa, were assigned an ET* value of zero, thereby making their ET_g rate zero. Spring Valley has a substantial amount of pixels in the north-central part of the basin with NDVI values less than this threshold, which was mostly associated with bare soil areas adjacent to the Yelland playa. In step 10 of the estimation process above, irrigated fields within the PGDBs for four of the five HAs were assigned the respective median long-term annual ET_g rate to estimate the pre-development ET_g volumes for the mixed phreatophyte vegetation that likely inhabited the areas before conversion to irrigated agriculture. This procedure was implemented following similar approaches described in Welch et al. (2007), Welborn and Moreo (2007), and Beamer et al. (2013).

Results

PGDB Comparison

Areas of potential groundwater discharge developed during this study for five HAs were compared to those used by numerous previous studies (Zones, 1961; Rush and Glancy, 1967; Nichols, 2000; Berger et al., 2004; Beamer et al., 2013; Huntington et al., 2016) in Figures 8 and 9. It was hypothesized that PGDBs would differ, sometimes greatly, from previous delineations because of the preliminary nature and large spatial scale that previous boundaries were developed, and because of the abundance of useful data sets like satellite and aerial remote sensing imagery, groundwater level measurements, and GIS integration that has led to more accurate methods of delineating groundwater discharge areas. The area of the PGDB developed in this study for Crescent Valley was 243.26 km^2, which includes 3.16 km^2 of irrigated areas within the PGDB. Zones (1961) developed a substantially smaller discharge area of 191.42 km^2; however, the 243.42 km^2 PGDB used by Huntington et al. (2016) was much closer to the current study, and delineated with similar data sets and methods. The areas delineated in this study for White River Valley and Spring Valley were substantially smaller (58.5 km^2 on average) than those used by Beamer et al. (2013), which were developed by the Southern Nevada Water Authority (SNWA) (Smith et al., 2007). These differences are even larger when you take into consideration that irrigated fields within the PGDBs for White River Valley (35 km^2) and Spring River Valley (22 km^2) were included in the current study's estimate of potential groundwater discharge areas. A possible explanation for these large differences between the PGDBs is the significant amount of xerophyte upland area removed during the modification process described earlier. Nichols (2000) developed a discharge area of 680.83 km^2 for Spring Valley, which was closer to the 682.54 km^2 area delineated in the current study. The PGDBs developed in this study for Dry Valley (6 km^2) and Red Rock Valley (8.76 km^2) were smaller than those used by Berger et al. (2004), Huntington (2010), and Beamer et al. (2013). An irrigated field within Red Rock Valley with an area of 0.40 km^2 was included in the reported area in the current study; however, the PGDB was still smaller than the one used by Beamer et al. (2013). This was likely a result of the removal of xerophyte areas during the modification process described earlier. The PGDB delineated by Rush and Glancy (1967) for Red Rock Valley was 0.26 km^2 smaller than the 8.76 km^2 boundary delineated in the current study. Although the boundary used by Rush and Glancy (1967) was delineated at the 1:250,000 scale the resulting area was similar to that of boundary created in the current study.

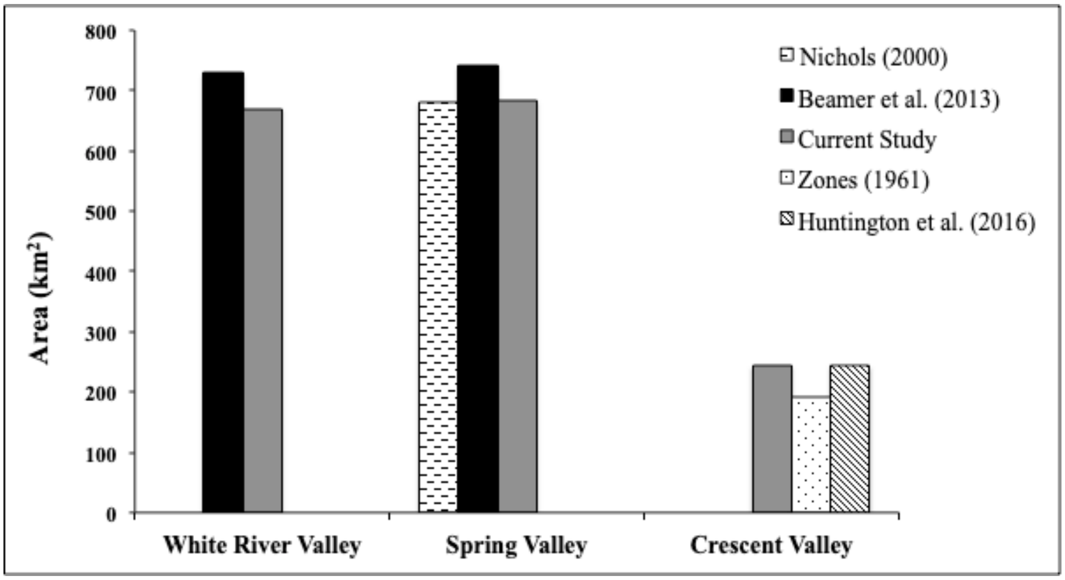

Figure 8. Areas of potential groundwater discharge delineated in this study and four previous studies (Zones, 1961; Nichols, 2000; Beamer et al., 2013; Huntington et al., 2016) for White River Valley, Spring Valley, and Crescent Valley.

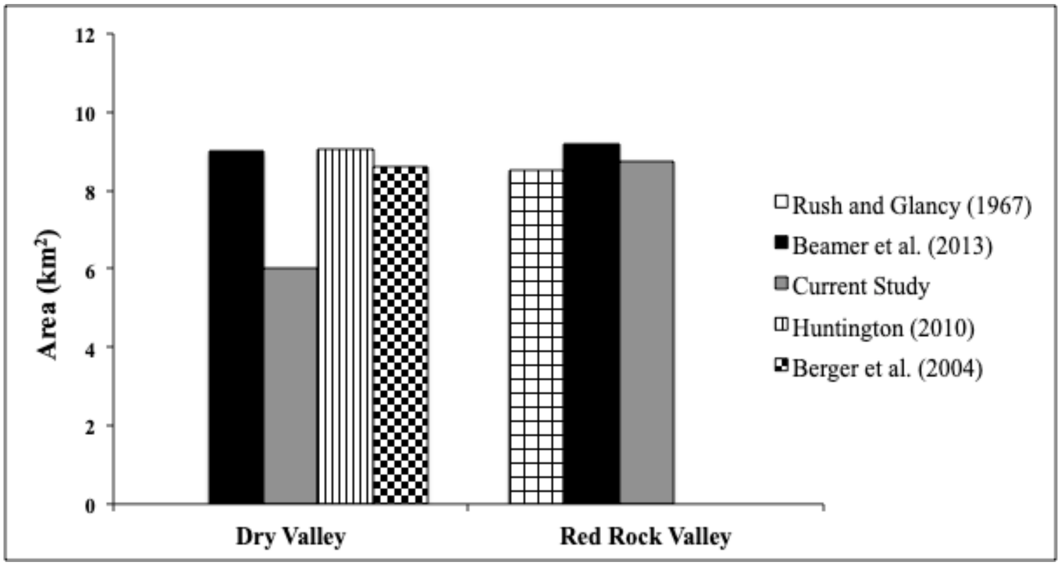

Figure 9. Areas of potential groundwater discharge delineated in this study and four previous studies (Rush and Glancy, 1967; Berger et al., 2004; Huntington, 2010; Beamer et al., 2013) for Dry Valley and Red Rock Valley.

Statistical Relationships between VIs and ET*

It was hypothesized that the methodology implemented in the current study would result in a stronger statistical relationship between VIs and ET* because of the inclusion of more in-situ data sets from more recent studies, and more satellite remote sensing data, as well as a more consistent way of developing and applying the NDVI – ET* equation. When comparing the EVI – ET* equation developed by Beamer et al. (2013) with the NDVI – ET* equation from the present study (Figure 5), there is more scatter around the NDVI – ET* best-fit line and slightly lower explanatory power. The larger spread of data around the best-fit line in this study is likely the result of the multi-temporal data remote sensing and fixed source area approach used in this study. More specifically, the calculation of a fixed 100m source area spatial average from a temporal median composite of all mid- to late-summer images when developing source area VIs for each site-year likely introduced variability in the NDVI – ET* data set. Although a substantial amount of variability has been introduced using this approach, it is considered to be more objective than the approach outlined in Beamer et al. (2013) due to eliminating the need to choose single Landsat images when deriving mean source area VIs. As a result of decreased correlation between VIs and ET* in this study, the confidence and prediction intervals are slightly wider for the NDVI – ET* equation than the EVI – ET* equation from Beamer et al. (2013). This means that there is more uncertainty in the estimates of annual groundwater discharge in this study.

Median Annual Phreatophyte ET_g Estimates

Median annual ET_g rates (with CI and PI estimates) and total ET_g volumes (with CI and PI estimates) from 1984-2018 for the five study area HAs are presented in Table 4. ET_g rates are presented in units of meters per year (m/yr), whereas ET_g volumes are presented in units of millions of cubic meters (Mm^3). A comparison of the median annual ET_g estimates of the five study area HAs using the NDVI – ET* regression and the median of the bootstrapped NDVI – ET* regression is shown in Table 5. The estimates of annual ET_g for the five study HAs using the median of the bootstrapped regression equations did not differ greatly from the estimates developed using the recommended NDVI – ET* regression; ET_g volumes between the two methods differed by 2.8%, 0.96%, 1.4%, 3.2%, and 7% for Crescent Valley, Spring Valley, White River Valley, Dry Valley, and Red Rock Valley, respectively. The relatively small standard error of the bootstrapped statistic (B_1^*) indicates that there is a small difference between the slopes of the recommended NDVI – ET* and bootstrapped NDVI – ET* regressions. If the slopes were substantially different from each other, we would expect larger differences in the estimates of annual ET_g for the five study HAs than was observed.

Maps of the spatial distributions of estimated median annual ET_g rates from 1984-2018 for the five HAs are shown in Figures 10-12. The majority of areas with low vegetation cover (NDVI < 0.2) exhibit relatively low ET_g rates (<0.2 m/yr); however, their large areal coverage accounts for the majority of total ET_g volume for a basin. The higher ET_g

rates are typically found near springs, irrigated areas, riparian areas, and other regions where shallow groundwater is easily accessible for plants.

In Figure 10, there are two areas along the western edge of Red Rock Valley where ET_g rates appear to be above the median (> 0.21 m/yr). There is also a small patch along the eastern side of the valley adjacent to an irrigated field where ET_g rates are higher than the median; this area is likely receiving runoff or sub-irrigation from the field. In Dry Valley, the regions with highest ET_g rates are in the eastern portion of the HA in the area of upland spring and riparian areas. Relatively high ET_g rates also occur in the western portion of Dry Valley where water exits the HA across the California border into Long Valley. Although median annual ET_g rates for Red Rock Valley and Dry Valley were estimated to be similar, the larger spatial coverage of phreatophytes in Red Rock Valley makes the total ET_g volume for the basin about 0.5 Mm^3 higher than Dry Valley.

Table 4. Estimated median ET_g rates and volumes (with confidence and prediction interval ranges) in phreatophyte areas of Crescent Valley (CV), Spring Valley (SPV), White River Valley (WRV), Dry Valley (DV), and Red Rock Valley (RRV) from 1984-2018.

HA	Landsat Path/Row	Area (km^2)	ET_o (m/yr)	PPT (m/yr)	ET_g (m/yr)	Conf. Int. (m/yr)	Pred. Int. (m/yr)	ET_g (Mm^3)	Conf. Int. (Mm^3)	Pred. Int. (Mm^3)
CV	41/32	243.26[1,2]	1.420[3]	0.214[3]	0.12	0.1-0.15	0.01-0.28	29.23[1,2]	23-34	3.3-65
SPV	39/33	682.54[1,2]	1.490[3]	0.213[3]	0.16	0.14-0.19	0.04-0.33	111.38[1,2]	89-120	27-213
WRV	40/33	669.96[1]	1.529[3]	0.226[3]	0.16	0.14-0.19	0.03-0.34	110.11[1]	88-121	18-219
DV	43/32	6	1.344[3]	0.321[3]	0.21	0.18-0.23	0.07-0.34	1.24	1.1-1.4	0.4-2.1
RRV	43/32	8.76[1]	1.396[3]	0.233[3]	0.21	0.18-0.23	0.06-0.37	1.84[1]	1.5-2.0	0.5-3.1

[1] Reported total includes area and discharge volume of irrigated fields (applied median ET_g rate of respective basin).

[2] Reported total includes area and discharge volume of playa areas. Assumed a rate of 0.0152 m/yr from Huntington et al. (2016) and Garcia et al. (2015).

[3] Reported total is median from GRIDMET.

Table 5. Estimated median ET_g rates and volumes (with prediction interval ranges) in the phreatophyte area of Crescent Valley (CV), Spring Valley (SPV), White River Valley (WRV), Dry Valley (DV), and Red Rock Valley (RRV) using the recommended NDVI – ET* equation and the median of the bootstrapped NDVI – ET*.

	NDVI − ET* Recommended				Bootstrapped NDVI − ET*			
HA	ET_g (m/yr)	Pred. Int. (m/yr)	ET_g (Mm^3)	Pred. Int. (Mm^3)	ET_g (m/yr)	Pred. Int. (m/yr)	ET_g (Mm^3)	Pred. Int. (Mm^3)
CV	0.12	0.1-0.15	29.23	3.3-65	0.12	0-0.28	30.06	0-69
SPV	0.16	0.04-0.33	111.38	27-213	0.16	0.0-0.33	112.45	0-229
WRV	0.16	0.03-0.34	110.11	18-219	0.16	0-0.33	108.56	0-225
DV	0.21	0.07-0.34	1.24	0.4-2.1	0.21	0.07-0.35	1.28	0.4-2.1
RRV	0.21	0.06-0.37	1.84	0.5-3.1	0.22	0.06-0.37	1.97	0.6-3.3

Figure 11 illustrates that ET_g rates within Spring Valley are more spatially variable than Dry Valley and Red Rock Valley. In the north-central part of the basin there are many sparsely vegetated areas and bare soil areas adjacent to the Yelland playa where ET_g rates were at or near zero. These pixels had NDVI values less than 0.03 and therefore were assigned ET* and ET_g values of 0. About 22 km^2 of area for the Yelland playa was assigned an ET_g rate of 0.0152 m/yr, a typical value used for playa areas contributing to groundwater discharge (Garcia et al., 2015; Huntington et al., 2016). Conversely, ET_g rates in the northwestern and southeastern regions along the alluvial fans reach a maximum of 0.8 m/yr for the HA. These areas receive substantial amounts of recharge from precipitation and stream infiltration due to their close proximity to the mountain block (Rush and Kazmi, 1965). This recharge near the mountain front ultimately discharges near the valley floor due to topographic and permeability contrasts resulting in high groundwater ET rates from meadow grasses and marshland vegetation in the area.

For White River Valley, the highest ET_g rates occur in the northern part of the basin near Lund, Nevada. Possible sources of the groundwater contributing to these rates are spring flows and runoff from nearby irrigation. Median annual ET_g rates for Spring and White River Valleys (0.16 m/yr) are lower overall than both Red Rock and Dry Valleys (0.21 m/yr); however, their larger phreatophyte areas make their total discharge volume two orders of magnitude greater.

The median ET_g rates for Crescent Valley were the lowest of all five basins analyzed in this study (0.12 m/yr). Crescent Valley, located in the south-central portion of the Humboldt River Basin, has a 9.5 km^2 playa area in the north-central portion of the valley lowland (Figure 12). The pixels for this area were assigned an ET_g of 0.0152 m/yr, similar to the Yelland playa in Spring Valley. Runoff from irrigated fields (irrigation with groundwater) along in southwestern and southeastern portions of the basin appear to be a water source for higher ET_g rates observed in adjacent areas. Other potential contributions of groundwater to those areas could be runoff from the mountain block that supports spring flow just south of the irrigated fields. Another region with high ET_g rates in the basin is in the north along the Humboldt River. An ample supply of surface and groundwater in the area supports dense phreatophyte vegetation communities that have high ET_g rates. The spatial coverage of the area is relatively small; therefore, the contribution to total ET_g volume is not significant when considering ET_g volume for the basin as a whole.

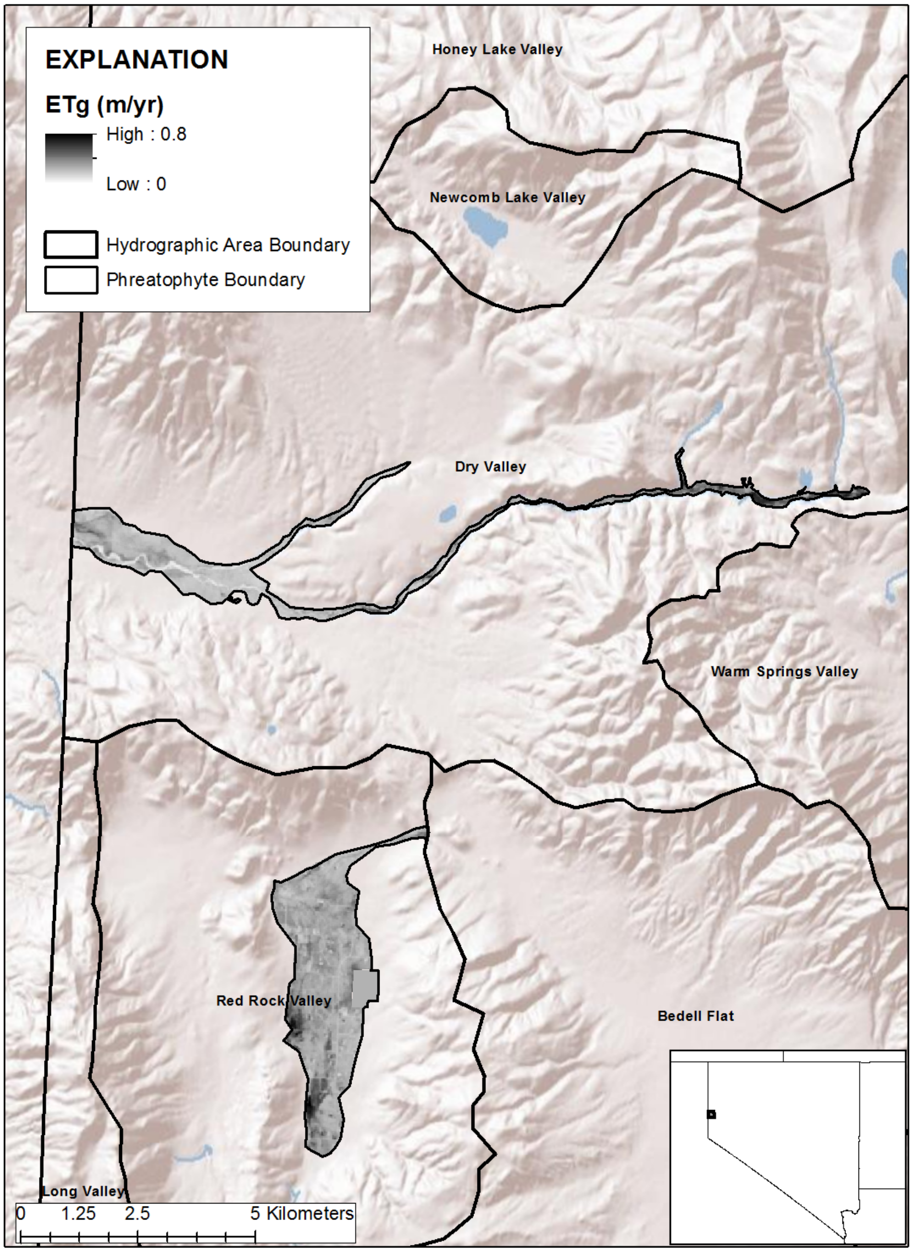

Figure 10. Map showing median annual ET_g rates (m/yr) from areas of potential groundwater discharge in Dry and Red Rock Valleys, northwestern Nevada. Computed using the entire Landsat data archive (1984-2018) (path 43, row 32).

Comparison with Previous Studies

Estimates of annual ET_g volumes from the current study were compared with estimates developed in previous studies for the five HAs (Table 6). It was hypothesized that new estimates of annual ET_g would vary, sometimes substantially from previous studies. Numerous methodologies for estimating ET_g from simple to complex were implemented in previous studies of the respective HAs, for example, extrapolation of flux tower estimates from areas around the world with much different climate than the current study locations (L. Carpenter, "Applicants Estimate of Red Rock Valley Phreatophyte ET", unpublished report submitted to Nevada State Engineer's Office, 2006), chloride mass balance techniques for estimating groundwater recharge (Thomas and Albright, 2003), and more commonly remote sensing methods (Berger et al., 2004; Moreo et al., 2007; J.L. Huntington, "Estimates of Recharge and Discharge in Dry Valley Hydrographic Area", unpublished report, 2010).

Differences in estimated ET_g volumes for each HA are likely the result of the differences between the methodologies described above, as well as the differences between the PGDBs used to develop the estimates. For example, the phreatophyte area of Dry Valley estimated by Rush and Glancy (1967) was 1.13 km^2, whereas the area delineated in this study was 6 km^2. Areas with high ET_g in Dry Valley along the eastern portion of the basin were left out of their analysis, which likely led to the low ET_g estimates. Rush and Glancy (1967) also used an ET_g rate of 0.09 m/yr derived from the earliest ET studies by Lee (1912), White (1932), and Young and Blaney (1942) to develop their estimates for

Dry Valley. This ET_g rate was developed for an area consisting of greasewood, salt grass, and rabbitbrush, and is less than half of the ET_g rate developed in the current study. Other estimates of ET_g developed for the Dry Valley HA (Thomas and Albright, 2003; Berger et al., 2004; Beamer et al., 2013) varied from those developed in the present study. Thomas and Albright (2003) estimated the annual ET_g volume to be 1.73 Mm^3, which was about 0.5 Mm^3 higher than the current study's estimate. These differences are possibly the result of the differences between their chloride mass balance method and the methodology used here. Berger et al. (2004) and Beamer et al. (2013) estimated annual ET_g in Dry Valley to be 0.79-0.98 Mm^3 and 1.62 Mm^3, respectively. The estimates from these studies were more similar to the estimate of 1.24 Mm^3 developed here, possibly due to the fact that similar remote sensing approaches were used. Even though groundwater discharge estimates varied between Thomas and Albright (2003), Berger et al. (2004), Beamer et al. (2013), and the current study, estimates are within the 90% PI estimates for the HA (Figure 13).

The annual ET_g estimate developed in the current study (1.84 Mm^3) for Red Rock Valley was lower than all previous studies except for the 0.99 Mm^3 estimate developed by the Nevada State Engineer's Office (NSEO) and the 0.78 Mm^3 estimate developed by Rush and Glancy (1967). Rush and Glancy (1967) used the same ET_g rate that was applied to Dry Valley, resulting in the relatively low estimate of annual ET_g volume. Beamer et al. (2013) developed an ET_g estimate of 1.91 Mm^3 for Red Rock Valley, which was within the 90% CIs and compared well with the estimate developed in the current study (Figure 13). All other estimates from the previous studies fall within the 90% PI ET_g estimates.

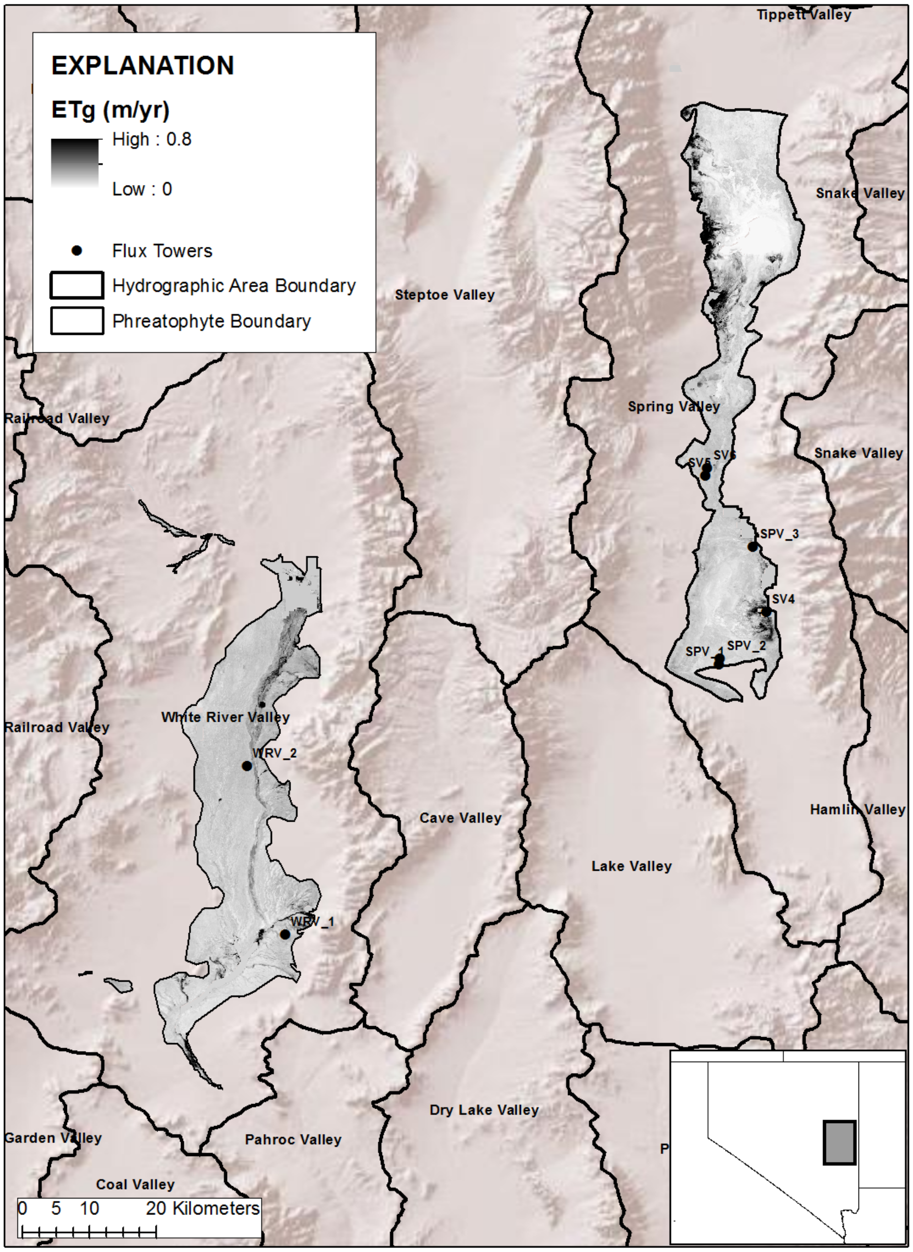

Figure 11. Map showing median annual ET_g rates (m/yr) from areas of potential groundwater discharge in Spring and White River Valleys, eastern Nevada. Computed using the entire Landsat data archive (1984-2018) (Spring Valley, path 43 row 32; White River Valley, path 39 row 33).

The annual ET_g estimate for Spring Valley developed in the current study (111.38 Mm^3) was higher than most of the previous studies except for estimate developed by the

Southern Nevada Water Authority (SNWA) (2011). Multiple studies conducted in Spring Valley developed ET_g estimates using the remotely sensed MSAVI (Nichols, 2000; Moreo et al., 2007). Nichols (2000) estimated ET_g in Spring Valley for both 1985 and 1989, and subsequently took the average of these two values. His estimate of 111.01 Mm^3 compared well with the 111.38 Mm^3 estimated in the current study. ET_g estimated by Beamer et al. (2013) for Spring Valley was 99.95 Mm^3, which was also relatively close to the 111.38 Mm^3 estimated in the present study. The median ET_g rate developed using the recommended NDVI – ET* equation in this study (0.16 m/yr) was about 0.02 m/yr higher than the rate developed by the EVI – ET* equation Beamer et al. (2013). Differences between these ET_g rates and the PGDBs used in the current study and Beamer et al. (2013) resulted in relatively similar estimates of annual ET_g volume. Five of the ET_g estimates from previous studies for Spring Valley fall within the 90% CI estimates and all seven of the estimates fall within the 90% PI estimates.

In White River Valley, Eakin (1966) applied an ET_g rate previously determined in reconnaissance level studies to the entire discharge area in order to estimate the annual ET_g volume (45.64 Mm^3). The ET_g rate and area used by Eakin (1966) were substantially lower than rates and areas used in the other studies listed in Table 6. Previous studies that implemented similar remote sensing techniques to the current study resulted in comparable estimates of annual ET_g volume ranging from 92.32 to 98.68 Mm^3 (Thomas et al., 2001; Welch et al., 2007; Zhu et al., 2007; Beamer et al., 2013); however, the estimate developed in the present work is the highest for White River Valley yet at

110.11 Mm^3. All previous studies' estimates of annual ET_g except for the one developed in Eakin (1966) fall within the 90% CI interval estimates.

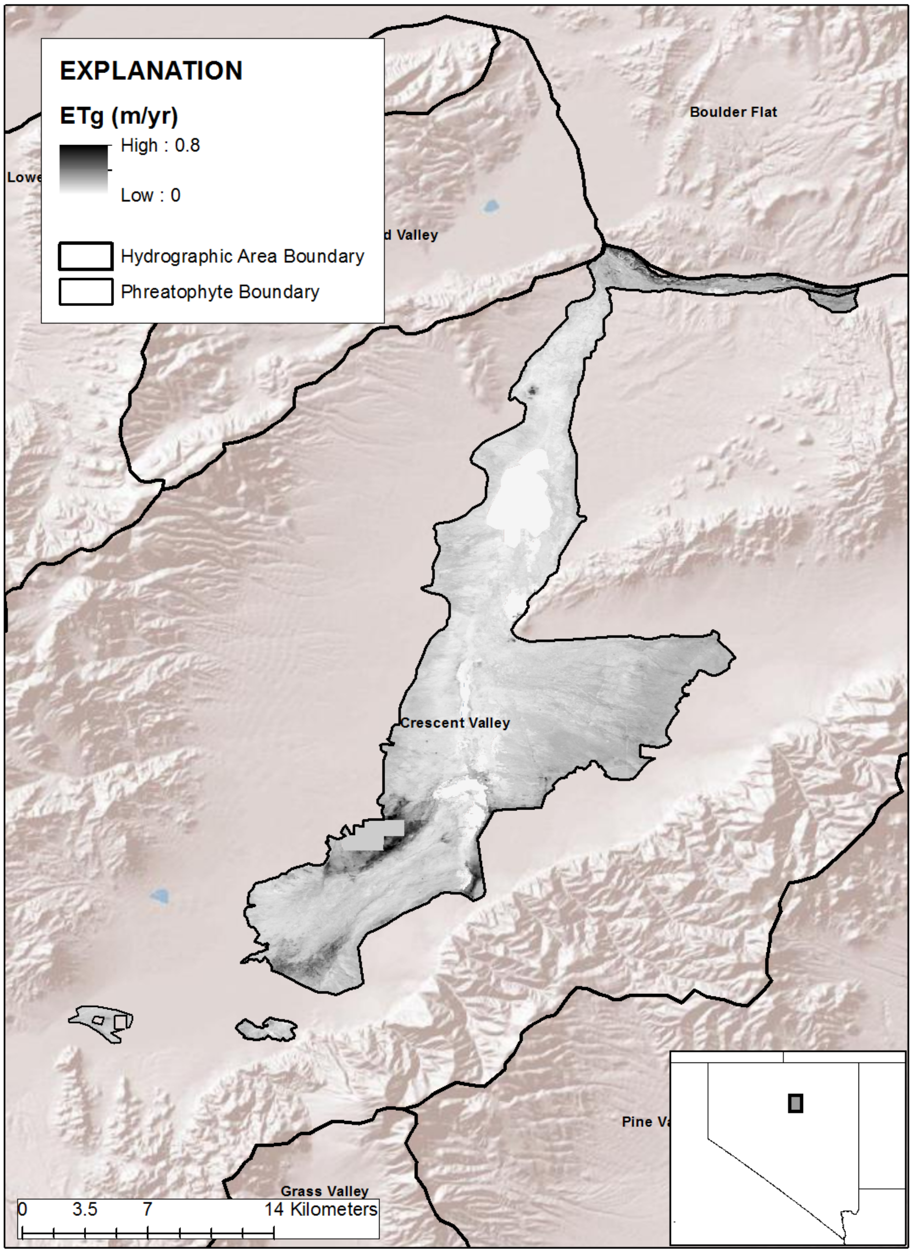

Figure 12. Map showing median annual ET_g rates (m/yr) from areas of potential groundwater discharge in Crescent Valley, north central Nevada. Computed using the entire Landsat data archive (1984-2018) (path 41, row 32).

Table 6. Comparison of annual ET_g estimates (Mm^3) for Crescent Valley (CV), Spring Valley (SPV), White River Valley (WRV), Dry Valley (DV), and Red Rock Valley (RRV) from this study and previous studies.

HA	Current Study	Beamer et al. (2013)	USGS	SNWA	NSEO	DRI	Zhu et al. (2007)	USGS Recon.	Other
CV	29.23		16.04[15]			20.08[17]		19.74[14]	23.44-45.76[16]
SPV	111.38	99.95	93.27[1]	128.78[3]	103.7[4]		92.47	86.34[8]	111.01[11]
WRV	110.11	92.32	94.61[1]			98.68[6]	93.51	87.58[9]	
DV	1.24	1.62	0.79-0.98[2]			1.73[7]		0.1[10]	1.24-2.16[12]
RRV	1.84	1.91			0.99-2.47[5]			0.78[10]	2.5[13]

Notes: USGS, U.S. Geological Survey; SNWA, Southern Nevada Water Authority; NSEO, Nevada State Engineer's Office; DRI, Desert Research Institute.

[1] Welch et al. (2007). Estimate includes 2.4 Mm^3 from playa discharge for SPV.

[2] Berger et al. (2004).

[3] Southern Nevada Water Authority (2011). Estimate includes 1.48 Mm^3 from playa discharge.

[4] Nevada State Engineer's Office (2012) ruling #6164. Estimate includes 1.48 Mm^3 from playa discharge.

[5] Nevada State Engineer's Office (2006) ruling #5816.

[6] Thomas et al. (2001).

[7] Thomas and Albright (2003).

[8] Rush and Kazmi (1965).

[9] Eakin (1966). Estimate includes 45.64 Mm^3 of discharge from principal springs.

[10] Rush and Glancy (1967).

[11] Nichols (2000).

[12] J.L. Huntington, "Review and Analysis of Recharge and Discharge Estimates for Dry Valley, Washoe County, Nevada", unpublished report for United Management Corporation, 2010.

[13] Huffman and Carpenter, Inc., "Evapotranspiration Study -- Utilzing Land Use Classification and Remote Sensing Methodologies for the Redrock Watershed (Basin 99), Washoe County, Nevada", unpublished report for Red Rock Valley Ranch, LLC, 2007.

[14] Eakin and Lamke (1966).

[15] Zones (1961).

[16] Berger (2000).

[17] Huntington et al. (2016). Estimate excludes discharge from Humboldt River riparian area and includes discharge from playa area.

The annual ET_g volume estimate developed in the present study for Crescent Valley was significantly higher (82%) than the estimate developed by Zones (1961). The method used by Zones (1961) was similar to the reconnaissance level studies conducted in other HAs during the 1960s and 1970s. ET_g rates from the early transpiration work of White (1932) were applied to two different vegetation communities (greasewood and salt grass) of Crescent Valley to estimate the annual ET_g volume. Also, the area of potential groundwater discharge used by Zones (1961) was about 52 km^2 smaller than the one developed in the current study (243.26 km^2). The 29.23 Mm^3 of annual ET_g estimated in the current study for Crescent Valley was within the range of estimates developed by Berger (2000) (23.44-45.76 Mm^3). Huntington et al. (2016) implemented the Beamer et al. (2013) method to develop an estimate of 20.08 Mm^3 of annual ET_g for Crescent Valley. Similar PGDBs were used between that study and the current one; however, the estimated annual ET_g rate developed in the current study (0.12 m/yr) was about 0.04 m/yr higher than the rate estimated by Huntington et al. (2016). This difference, along with the fact that riparian areas in the north of the basin were excluded from their estimate, resulted in the lower overall estimate of annual ET_g.

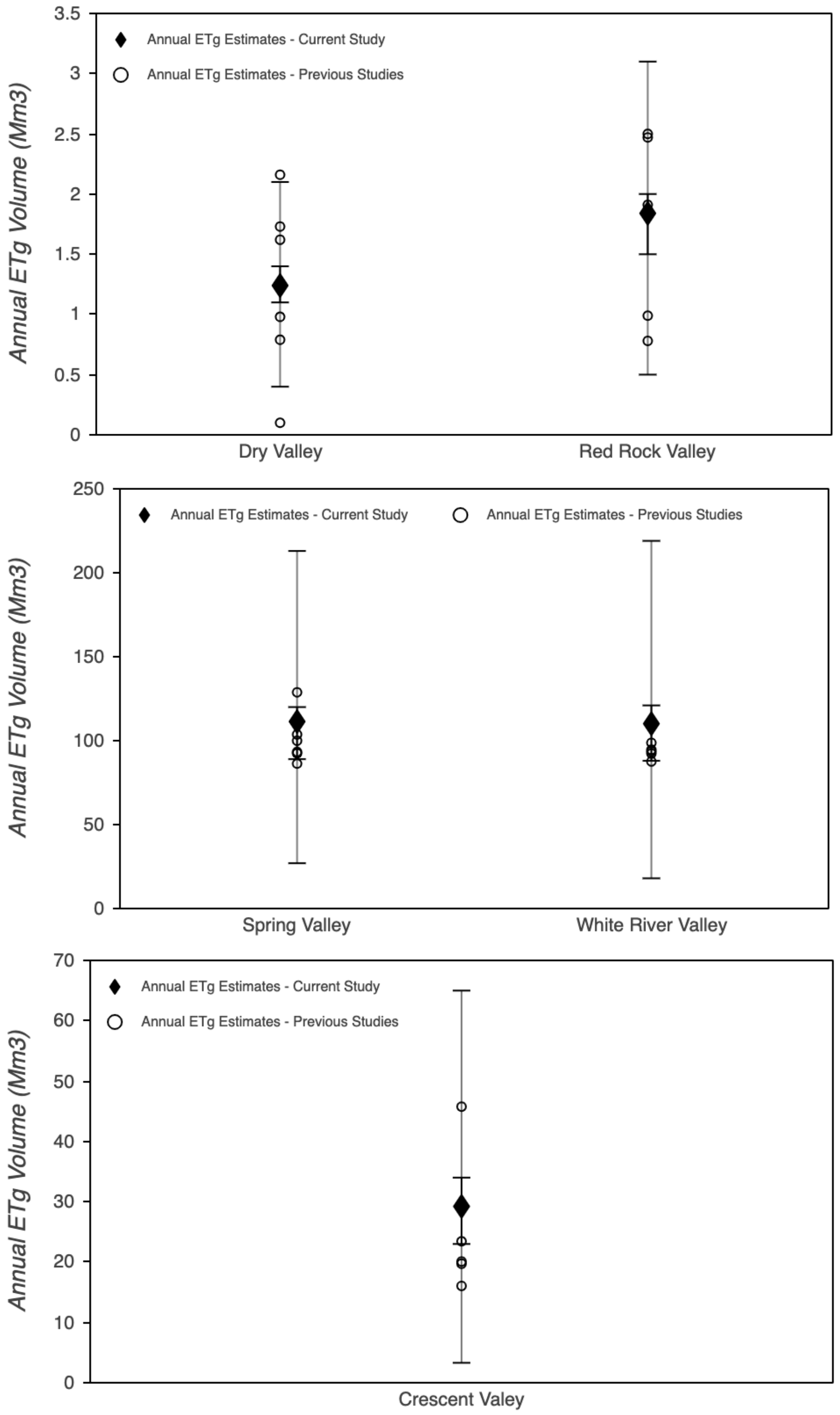

Figure 13. Estimated annual ET_g volume (Mm^3) for hydrographic areas in this study (black diamond) and previous studies (white circles). Smaller bars represent the 90% confidence interval estimates and the longer bars represent the 90% prediction interval estimates.

Limitations and Assumptions

The accuracy of annual groundwater discharge estimates formulated in this study is limited by the accuracy of the in-situ data derived from the BR and EC methodologies, post-processing techniques, the accuracy of ET data correction techniques, accuracy of 4 km GRIDMET data sets, assumptions made about source area, accuracy and representativeness of VIs within the source area, and statistical methods used to predict ET. Errors associated with the measurement of ET_a, the scaling of the ET_a measurements to study areas, and the development of ET_o and PPT data sets from GRIDMET factor into ET* derived for each study site-year. In the development of the NDVI – ET* relationship, it was assumed that a 100 m buffer around each flux tower site was sufficient in relating vegetation vigor with ET*. This assumption was based on findings from previous studies that observed that roughly 80% of the ET measured was sourced from within a 100 m radius of the EC and BR flux towers (Moreo et al., 2007; Allander et al, 2009). A possible issue associated with the use of a 100 m buffer for all of the EC and BR flux towers is that some of the sites were located in riparian areas adjacent to shrublands, which means that a 100 m buffer might not accurately capture the spectral signature of the phreatophytic vegetation contributing to the flux measured at the tower. An additional assumption made during this portion of analysis was that the source area VIs calculated from Landsat images acquired from June 1st-September 15th can effectively characterize the annual ET_g from the phreatophyte vegetation surrounding the study sites. A downside of using images from earlier in the year is the influence of non-phreatophytic vegetation due to winter and spring precipitation and soil moisture.

Given the many issues and assumptions that are required when scaling ET_g rates from point station locations to the basin scale to obtain an estimate of the groundwater discharge volume, relying on a regression model such as that developed in this study, is attractive since it is based on 54 site-years of micrometeorological data paired with satellite remote sensing data collected in phreatophyte areas of Nevada, and accounts for temporal and spatial variations in evaporative demand and precipitation, two primary factors that drive ET. From a site uncertainty and statistical perspective, it is argued that a model based on 54 site-years of data, and considers site specific climate data is much more robust than a simple model based on a limited number of data points and assumptions about vegetation cover and associated ET rates.

Discussion and Conclusions

The estimation of mean- or median-annual groundwater ET is a part of formulating groundwater budgets in the Great Basin. Water managers rely on groundwater budgets to make informed decisions and allocate groundwater resources. Satellite remote sensing and micrometeorological techniques are increasingly being used to assist with the development of groundwater budgets, specifically ET_g estimates from phreatophyte vegetation in the Great Basin.nu

54 site-years of EC and BR data were collected from 36 different sites in various regions of the Great Basin where shallow groundwater is consumed by phreatophyte ET. EBC was performed on 39 site-years of EC data using an EBR approach similar to the FLUXNET methodology in order to make ET estimates consistent with BR derived ET estimates. Following the FLUXNET EBR corrections, ET_a estimates across all sites and years increased on an average by 9% with a mean EBR of 101%.

Measurements of annual ET_a and GRIDMET estimates of ET_o and PPT were correlated with source area NDVI derived from Landsat Surface Reflectance data via simple regression for estimating annual ET_g from the PGDBs of HAs in the Great Basin. The regression between ET measurements and NDVI allows for the estimation of annual ET_g from mid- to late-summer Landsat images. The application of the regression relies on water year ET_o and PPT data sets from GRIDMET and Landsat Collection 1 Surface

Reflectance data to compute NDVI. NDVI is calculated for each pixel and then values are used as inputs to the NDVI – ET* regression.

The NDVI – ET* regression was applied to the five PGDBs of HAs in Nevada where shallow groundwater is consumed by phreatophyte ET. HAs were selected on the basis that multiple estimates of annual ET_g had been developed in previous studies and could be used for direct comparisons. The annual ET_g estimate of 29.23 Mm^3 derived in the present study falls within the range of estimates of 23.44 to 45.76 Mm^3 developed by Berger (2000) for Crescent Valley (HA054). The Nevada State Engineer (ruling # 6164) and Beamer et al. (2013) determined that annual ET_g for Spring Valley (HA184) was 103.7 and 99.95 Mm^3, respectively. These two estimates compare reasonably well with the estimate of 111.38 Mm^3 from the current study for Spring Valley. Estimates of annual ET_g for White River Valley (HA207) in the present study were higher than all other previous estimates; however, annual ET_g estimates from four of the five previous studies are within 12 to 18 Mm^3 of the 110.11 Mm^3 estimated here. Estimates of annual ET_g developed in the current study for Dry (HA095) and Red Rock (HA099) Valleys compare reasonably well with previous estimates. The annual ET_g estimate of 1.24 Mm^3 developed in this study for Dry Valley was on the lower range estimated by Huntington (2010) in an unpublished report provided to the United Management Corporation that used similar techniques to develop ET_g estimates. Beamer et al. (2013) estimated an annual ET_g of 1.91 Mm^3 for Red Rock Valley, which is relatively close to the 1.84 Mm^3 estimated in the current study.

Estimates of annual groundwater discharge for the five HAs presented in the current study compare relatively well overall with previous studies that employed more complex, time intensive, and expensive means of developing annual ET_g estimates. The main advantages of using the method presented in this study are that it 1) takes into account the spatial and temporal vegetation and climate conditions of the groundwater discharge areas under consideration, 2) is relatively simple and quick to apply because of advancements in technology and programs used to compile and analyze Landsat and climate data sets needed to compute annual ET_g, 3) is based on advanced in-situ measurements of ET_a from a variety of phreatophytic vegetation types, which permits its use all over the Great Basin in various groundwater discharge areas and vegetation composition, and 4) provides the opportunity to address the uncertainty associated with the median annual ET_g estimates.

Improvements to the current estimates of annual groundwater discharge can be realized by increasing the number of ET sites within each HA that is being studied. Increasing the number of useful data sets (e.g. ET, PPT, ET_o, and other meteorological variables) collected over longer time periods is likely to reduce the uncertainty in relationships between various phreatophyte vegetation communities and ET rates that are ultimately developed and used to aid with water resource management. The dissimilarities in ET_g rates and phreatophyte areas between the present and previous studies demonstrate potential uncertainties, and how the use of new data and technology can improve groundwater discharge estimates beyond reconnaissance level studies of the past.

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Appendix 1. Detailed Site Descriptions

Oasis Valley, Nevada

The USGS collected ET data (Reiner et al., 2002) in Oasis Valley in order to estimate groundwater discharge down gradient from the Nuclear Test Site in Nevada with the hopes of improving our understanding of how test-generated contaminants could potentially be impacting the area. Data was gathered from 1997 to 2001 at four different study sites using the BR methodology. The UOVLO and UOVUP sites are composed of sparse to moderately dense communities of greasewood, rabbitbrush, and wolfberry. The depth to groundwater at the two sites ranged from 2 to 9 meters. The vegetation at the UOVMD and MOVAL sites was dominated by sparse to moderately dense salt grass with shallower depths to groundwater (0-3 meters). Six site-years of ET_a data at these four sites were obtained from Reiner et al. (2002) for the purposes of this current study.

Carson Valley, Nevada

The Carson Valley USGS study (Maurer et al., 2005) was conducted to address concerns over the water resource availability of the area and to redevelop estimates of the water-budget components. ET data was collected for the 2004 water year at two BR sites (ET-1 and ET-8), resulting in two site-years of ET_a data for use in the present study. The ET-1 site consisted of moderately dense greasewood and rabbitbrush, whereas the ET-8 was installed in a flood-irrigated field of pasture grass. The depths to groundwater at the ET-1 and ET-8 sites were 1 to 2 meters and 0 to 1 meters, respectively.

Basin and Range Carbonate Aquifer System, Nevada (BARCAS)

ET data was collected in the BARCAS during one USGS study (Moreo et al., 2007) and one DRI study (Arnone et al., 2008). The former study installed six EC stations scattered around three HAs (HA 207 White River Valley, HA 254 Snake valley, and HA 184 Spring Valley) and the latter study installed four EC stations within the Spring Valley HA. ET data from Moreo et al. (2007) was gathered from 2005 to 2007, whereas ET data from Arnone et al. (2008) was gathered from 2007 to 2009. Five of the study sites (SNV-1, SPV-1, SPV-2, WRV-1, and WRV-2) from Moreo et al. (2007) were located in areas of sparse to dense greasewood and rabbitbrush. The vegetation surrounding the other site (SPV-3) was composed of a mixture of grasses. Eleven site-years of ET_a data from Moreo et al. (2007) were used in the current study. Three of the study sites from Arnone et al. (2008) were located in areas of sparse to dense communities of greasewood, rabbitbrush and sagebrush. The fourth study site occurred in a grassland area. Depth to groundwater at these four sites ranged from 2.5 to 7.7 meters. Only three of the EC flux towers (SV-4, SV-5, and SV-6) from Arnone et al. (2008) were considered for the present study because of SV-7's proximity to a playa, which likely impacted annual ET_a estimates at this EC site through advective heat transport processes. Six site-years of ET_a estimates from Arnone et al. (2008) were used for the purposes of this current study.

Lower Colorado River Flow System, Nevada

DeMeo et al. (2008) implemented both BR and EC techniques in the Lower Colorado River Flow System to assist with the estimation of available water resources. The MR and VR BR sites were installed in riparian areas dominated by mesquite trees and salt cedar trees, respectively. The two EC study sites (LMVW and UMVW) were installed adjacently to riparian areas. The LMVW site was surrounded by a monoculture of arrowweed and the UMVW site was surrounded by rabbitbrush with lesser amounts of sage. The data collection period spanned from 2003 to 2006. The LMVW site was operational for only a six-month period because of technical difficulties (04/06-10/06). MR ET data was used as a surrogate for missing time periods (10/05-04/06) at the LMVW site to obtain a water year ET_a estimate for 2006. The data substitution was assumed to be reasonable because of the close proximity between the two stations and time period when substitutions were made was when ET is at its lowest during the water year. Following ET data substitutions at the LMVW site using supplemental data from MR, all four of the study sites satisfied the criteria of having at least a full water years worth of good quality ET_a data. To correct for data gaps and to determine single estimates of annual ET_a for the MR, VR, and UMVW sites, DeMeo et al. (2008) decided to take the entire record of available ET_a data for each site and compute an average daily ET rate (i.e. day-of-year average) and then sum daily values to get the annual ET_a rate. The four site-years of ET_a data resulting from the analysis in DeMeo et al. (2008) was used for further analysis in this current study. Gridded PPT and ET_o data sets obtained from GRIDMET for each respective site was treated in a similar fashion as the daily ET_a

data was by DeMeo et al. (2008). Daily PPT and ET_o values were gathered for the same time periods that ETa was collected and then the average daily PPT and ET_o rates were computed. Summing the daily average PPT and ET_o rates resulted in estimates of the annual PPT and ET_o for each of the four sites.

Lower Walker River Valley, Nevada

BR and EC flux tower systems were installed in the Walker River Basin from 2005 to 2007 by Allander et al. (2009) to refine estimates of the water budget. Two of the BR study sites (B11 and B01) were installed in alfalfa fields; the B01 was on a non-irrigated alfalfa field, whereas the B11 was located in a recently irrigated alfalfa field. The third BR study site (TAM) was located in an area dominated by salt cedar trees adjacent to the Walker River. The four EC study sites (GRE, GRE2, SAL, and SAL2) were installed in shrubland and grassland areas. GRE was characterized as a sparse community of greasewood. GRE2 was located in a denser community greasewood. The SAL and SAL2 stations were installed in areas of sparse and moderately dense salt grass, respectively. Nine site-years of daily ET_a data from Allander et al. (2009) were used for further analysis in the present study.

Dixie Valley, Nevada

In response to pending applications from Churchill County for groundwater allocations, Garcia et al. (2015) investigated water resources of the Dixie Valley HA from 2009 to

2011 using EC techniques and multispectral satellite imagery analysis. EC methodologies were employed at two vegetated sites: one in a densely vegetated community of greasewood with lesser amounts of big saltbush and seepweed (DVDV), and the other in a sparsely vegetated community of greasewood, seepweed, and big saltbush (DVSV). Depth to groundwater at the DVDV and DVSV study sites ranged from 4.6 to 5.6 and 0.7 to -0.2, respectively. Four site-years of daily ET_a data provided by Garcia et al. (2015) were used in the current study.

Kobeh Valley, Nevada

Berger et al. (2016) installed EC flux towers in the Kobeh Valley HA from 2010 to 2012 to develop estimates of groundwater ET rates that could be applied in adjacent basins to ultimately assist with the development of groundwater budgets for the Diamond Valley Flow System. Four EC study sites were installed in areas with differing vegetation and groundwater conditions. The KV-1 site was characterized as being in a sparse shrubland dominated by greasewood and rabbitbrush. The depth to groundwater ranged from 2.65 to 2.77 meters. The moderate to densely vegetated communities at KV-2 was predominantly composed of greasewood and rabbitbrush with lesser amounts of salt grass. Depth to groundwater at the KV-2 site ranged from 0.52 to 0.79 meters. KV-3 was installed in a moderate to dense shrubland composed of equal amounts of greasewood, rabbitbrush, and salt grass. Groundwater levels fluctuated from 0.76 to 1.25 meters below the ground. The last site EC site (KV-4) was located in an area consisting of phreatophytic meadow grasses. The groundwater levels at KV-4 ranged from 0.98 to 1.55

meters below the ground. Six site-years of daily ET_a from the four study sites were obtained from Berger et al. (2016) and used for analysis in this study.

Bridgeport Valley, California

DeMeo (2018) measured ET at two study sites in Bridgeport, California using EC methodologies from 2012 to 2013. The high-density vegetation site (BPHV) consisted of irrigated pasture grass and the low-density vegetation site (BPLV) consisted of drier pasture grass. BPLV was drier than BPHV because of the further distance from the irrigation source. Both of the EC flux towers collected data for the 2013 water year, resulting in two site-years of daily ET_a data to be used for the current study.

Amargosa Desert, Nevada

From 2011 to 2013, EC flux towers installed by Moreo et al. (2017) measured ET at two sparsely vegetated sites in the Amargosa Desert. The Amargosa Flat Shallow (AFS) site was located in an area of salt grass where the depth to groundwater was 3.8 meters. The Amargosa Flat Deep (AFD) site was installed in an area dominated by shadscale where the groundwater levels were 5.3 meters below the ground surface. Four site-years of daily ET_a data from Moreo et al. (2017) were used for the purposes of this study.

Appendix 2: Supplemental Tables

Table 7. Mean source area vegetation indices, water year ET_a, ET_o, PPT, ET_g, and ET* for all 54 Eddy Covariance and Bowen Ratio site-years.

Site	**Year(s)**	**EVI**	**NDVI**	**MSAVI**	**ET_a (mm/yr)**	**ET_o (mm/yr)**	**PPT (mm/yr)**	**ET_g (mm/yr)**	**ET***
BARCAS study (Moreo et al., 2007)									
SPV-3	2006	0.2925	0.4081	0.2395	765	1500	208	557	0.431
SNV-1	2006	0.0912	0.1091	0.0792	313	1549	135	178	0.126
SPV-1	2006	0.0814	0.0851	0.0684	345	1496	211	134	0.104
SPV-2	2006	0.0988	0.1173	0.0819	315	1496	211	104	0.081
WRV-1	2006	0.1256	0.1824	0.1031	347	1513	216	131	0.101
SPV-3	2007	0.2288	0.3009	0.1961	687	1521	173	514	0.381
SNV-1	2007	0.0916	0.1080	0.0798	255	1556	125	130	0.091
SPV-1	2007	0.0784	0.0796	0.0658	242	1514	180	62	0.046
SPV-2	2007	0.0940	0.1086	0.0765	241	1514	180	61	0.046
WRV-2	2007	0.0818	0.1157	0.0739	291	1585	169	122	0.086
WRV-1	2007	0.1085	0.1508	0.0914	296	1548	168	128	0.093
Spring Valley (Arnone et al., 2008)									
SV-4	2008	0.3731	0.4484	0.3053	606	1466	169	437	0.337
SV-5	2008	0.0896	0.1276	0.0805	284	1485	151	133	0.100
SV-6	2008	0.0887	0.1210	0.0767	247	1485	151	96	0.072
SV-4	2009	0.5357	0.6920	0.4781	781	1410	242	539	0.461
SV-5	2009	0.1010	0.1435	0.0936	402	1422	233	169	0.142
SV-6	2009	0.0994	0.1367	0.0865	351	1422	233	118	0.099
Carson Valley (Maurer et al., 2005)									
ET-1	2004	0.1909	0.3111	0.1612	547	1657	153	394	0.262
ET-8	2004	0.4432	0.6571	0.3994	1315	1632	183	1132	0.781
Lower Colorado flow system (DeMeo et al., 2008)									
MR	2004-2006	0.2809	0.3702	0.2455	1097	1970	187	910	0.510
VR	2004-2005	0.2913	0.4442	0.2380	1189	2244	230	959	0.476
LMVW	2006	0.1890	0.2593	0.1536	853	1986	111	742	0.396
UMVW	2005-2006	0.1398	0.1848	0.1140	457	1590	152	305	0.212
Oasis Valley (Reiner et al., 2002)									
MOVAL	1999	0.1133	0.1354	0.0979	722	1781	124	598	0.361
UOVLO	1999	0.0997	0.1296	0.0837	379	1781	124	255	0.154
UOVUP	1999	0.0603	0.0897	0.0506	187	1787	135	52	0.031
UOVLO	2000	0.1028	0.1337	0.0876	450	1898	142	308	0.175
UOVUP	2000	0.0698	0.0976	0.0597	187	1911	138	49	0.028
UOVMD	2000	0.0888	0.1041	0.0786	509	1893	137	372	0.212
Lower Walker River Valley (Allander et al., 2009)									
GRE	2005	0.0662	0.0783	0.0553	245	1503	124	121	0.088
SAL	2005	0.1441	0.1745	0.1228	392	1507	124	268	0.194
GRE-2	2007	0.0870	0.1130	0.0699	279	1582	72	207	0.137
SAL-2	2007	0.2279	0.2693	0.1930	764	1589	79	685	0.454
B-11	2005	0.7145	0.7831	0.6737	1227	1503	141	1086	0.797
B-01	2005	0.4001	0.5593	0.3514	998	1521	146	852	0.620
B-11	2006	0.6328	0.7672	0.6609	1244	1530	92	1152	0.801
B-01	2006	0.2390	0.3843	0.2024	725	1616	79	646	0.420
TAM	2006	0.0953	0.1494	0.0787	202	1527	123	79	0.056
Bridgeport (DeMeo, 2018)									
BPHV	2013	0.4917	0.6693	0.4007	1092	1421	311	781	0.704
BPLV	2013	0.2313	0.3727	0.1945	626	1450	201	425	0.340
Dixie Valley (Garcia et al., 2015)									
DVDV	2010	0.1347	0.1686	0.1084	468	1517	96	372	0.262
DVSV	2010	0.0561	0.0562	0.0498	242	1542	92	150	0.103
DVDV	2011	0.1084	0.1559	0.0894	548	1455	120	428	0.321
DVSV	2011	0.0586	0.0593	0.0546	318	1481	121	197	0.145
Amargosa Desert (Moreo et al., 2017)									
AFS	2012	0.0315	0.0268	0.0247	139	1819	66	73	0.042
AFD	2012	0.0351	0.0389	0.0279	119	1819	66	53	0.030
AFS	2013	0.0547	0.0449	0.0425	114	1774	71	43	0.025
AFD	2013	0.0578	0.0650	0.0477	120	1774	71	49	0.029
Kobeh Valley (Berger et al., 2016)									
KV-2	2011	0.1130	0.1321	0.0929	453	1239	319	134	0.146
KV-3	2011	0.1420	0.1677	0.1152	510	1239	304	206	0.220
KV-1	2012	0.0637	0.0877	0.0545	210	1394	202	8	0.007
KV-2	2012	0.0848	0.0928	0.0737	317	1408	196	121	0.100
KV-3	2012	0.1007	0.1257	0.0882	378	1430	165	213	0.168
KV-4	2012	0.2067	0.2685	0.1799	573	1434	176	397	0.316

Table 8. Bootstrap coefficient replications of model fitting to 54 site-years of NDVI – ET* data pairs (90% confidence and prediction interval coefficients included).

Replication No.	β_1^*	β_0^*	β_1^* **Lower CI**	β_0^* **Lower CI**	β_1^* **Upper CI**	β_0^* **Upper CI**	β_1^* **Lower PI**	β_0^* **Lower PI**	β_1^* **Upper PI**	β_0^* **Upper PI**
1	1.2180	-0.035	1.1657	-0.0424	1.2702	-0.0276	1.2049	-0.1666	1.2311	0.0966
2	1.1252	-0.035	1.0655	-0.0455	1.1850	-0.0245	1.1075	-0.1663	1.1430	0.0963
3	1.1332	-0.035	1.0949	-0.0515	1.1716	-0.0185	1.1226	-0.1681	1.1438	0.0981
4	1.1298	-0.035	1.0741	-0.0482	1.1855	-0.0218	1.1127	-0.1668	1.1470	0.0968
5	1.1479	-0.035	1.0948	-0.0477	1.2011	-0.0223	1.1320	-0.1668	1.1638	0.0968
6	1.1826	-0.035	1.1244	-0.0442	1.2408	-0.0258	1.1658	-0.1662	1.1993	0.0962
7	1.2088	-0.035	1.1576	-0.0462	1.2599	-0.0238	1.1945	-0.1669	1.2230	0.0969
8	1.1079	-0.035	1.0687	-0.0448	1.1472	-0.0252	1.0990	-0.1675	1.1168	0.0975
9	1.1420	-0.035	1.1139	-0.0492	1.1701	-0.0208	1.1358	-0.1683	1.1483	0.0983
10	1.1249	-0.035	1.0515	-0.0447	1.1983	-0.0253	1.1003	-0.1652	1.1495	0.0952
11	1.0959	-0.035	1.0442	-0.0527	1.1476	-0.0173	1.0789	-0.1675	1.1128	0.0975
12	1.0685	-0.035	1.0095	-0.0459	1.1274	-0.0241	1.0509	-0.1664	1.0860	0.0964
13	1.1165	-0.035	1.0708	-0.0503	1.1622	-0.0197	1.1032	-0.1676	1.1298	0.0976
14	1.1717	-0.035	1.1025	-0.0463	1.2409	-0.0237	1.1486	-0.1656	1.1948	0.0956
15	1.1533	-0.035	1.1033	-0.0479	1.2033	-0.0221	1.1390	-0.1671	1.1676	0.0971
16	1.1280	-0.035	1.0693	-0.0469	1.1867	-0.0231	1.1100	-0.1664	1.1460	0.0964
17	1.1246	-0.035	1.0937	-0.0479	1.1556	-0.0221	1.1178	-0.1681	1.1315	0.0981
18	1.1686	-0.035	1.1290	-0.0452	1.2081	-0.0248	1.1595	-0.1675	1.1777	0.0975
19	1.1072	-0.035	1.0643	-0.0508	1.1501	-0.0192	1.0949	-0.1678	1.1194	0.0978
20	1.2267	-0.035	1.1661	-0.0435	1.2872	-0.0265	1.2093	-0.1661	1.2441	0.0961
21	1.0457	-0.035	1.0000	-0.0549	1.0915	-0.0151	1.0308	-0.1682	1.0607	0.0982
22	1.0879	-0.035	1.0286	-0.0446	1.1473	-0.0254	1.0706	-0.1662	1.1052	0.0962
23	1.1759	-0.035	1.1202	-0.0438	1.2316	-0.0262	1.1607	-0.1664	1.1911	0.0964
24	1.0291	-0.035	0.9749	-0.0486	1.0834	-0.0214	1.0125	-0.1669	1.0458	0.0969
25	1.1081	-0.035	1.0602	-0.0497	1.1560	-0.0203	1.0940	-0.1674	1.1222	0.0974
26	1.1262	-0.035	1.0665	-0.0487	1.1859	-0.0213	1.1069	-0.1665	1.1455	0.0965
27	1.1368	-0.035	1.0967	-0.0424	1.1768	-0.0276	1.1283	-0.1673	1.1452	0.0973
28	1.1157	-0.035	1.0519	-0.0490	1.1796	-0.0210	1.0943	-0.1663	1.1372	0.0963
29	1.1946	-0.035	1.1462	-0.0431	1.2429	-0.0269	1.1828	-0.1669	1.2063	0.0969
30	1.1721	-0.035	1.1178	-0.0452	1.2263	-0.0248	1.1570	-0.1666	1.1872	0.0966
31	1.0187	-0.035	0.9419	-0.0466	1.0955	-0.0234	0.9914	-0.1651	1.0460	0.0951
32	1.2083	-0.035	1.1323	-0.0389	1.2843	-0.0311	1.1858	-0.1648	1.2309	0.0948
33	1.2507	-0.035	1.1783	-0.0416	1.3231	-0.0284	1.2284	-0.1651	1.2730	0.0951
34	1.0614	-0.035	0.9620	-0.0386	1.1609	-0.0314	1.0254	-0.1627	1.0974	0.0927
35	1.2659	-0.035	1.1843	-0.0425	1.3475	-0.0275	1.2379	-0.1644	1.2938	0.0944
36	1.1339	-0.035	1.0876	-0.0474	1.1803	-0.0226	1.1213	-0.1673	1.1466	0.0973
37	1.1080	-0.035	1.0660	-0.0494	1.1499	-0.0206	1.0965	-0.1677	1.1195	0.0977
38	1.1014	-0.035	1.0464	-0.0522	1.1565	-0.0178	1.0830	-0.1672	1.1199	0.0972
39	1.0897	-0.035	1.0420	-0.0481	1.1375	-0.0219	1.0764	-0.1673	1.1031	0.0973
40	1.0582	-0.035	1.0079	-0.0538	1.1086	-0.0162	1.0414	-0.1677	1.0751	0.0977
41	1.0913	-0.035	1.0416	-0.0469	1.1411	-0.0231	1.0776	-0.1671	1.1050	0.0971
42	1.1573	-0.035	1.1138	-0.0428	1.2007	-0.0272	1.1476	-0.1672	1.1670	0.0972
43	1.1772	-0.035	1.1177	-0.0431	1.2367	-0.0269	1.1605	-0.1661	1.1940	0.0961
44	1.1171	-0.035	1.0755	-0.0446	1.1586	-0.0254	1.1075	-0.1674	1.1267	0.0974
45	1.1805	-0.035	1.1286	-0.0476	1.2324	-0.0224	1.1654	-0.1669	1.1956	0.0969
46	1.1590	-0.035	1.1213	-0.0484	1.1967	-0.0216	1.1495	-0.1678	1.1685	0.0978
47	1.1142	-0.035	1.0449	-0.0443	1.1834	-0.0257	1.0923	-0.1656	1.1360	0.0956
48	1.2129	-0.035	1.1461	-0.0459	1.2797	-0.0241	1.1912	-0.1658	1.2345	0.0958
49	1.1565	-0.035	1.1017	-0.0452	1.2114	-0.0248	1.1412	-0.1666	1.1718	0.0966
50	1.0949	-0.035	1.0414	-0.0453	1.1483	-0.0247	1.0802	-0.1667	1.1096	0.0967
51	1.0601	-0.035	1.0141	-0.0496	1.1060	-0.0204	1.0469	-0.1675	1.0732	0.0975
52	1.1006	-0.035	1.0515	-0.0498	1.1497	-0.0202	1.0860	-0.1674	1.1152	0.0974
53	1.2017	-0.035	1.1529	-0.0460	1.2506	-0.0240	1.1887	-0.1670	1.2148	0.0970
54	1.1069	-0.035	1.0531	-0.0473	1.1607	-0.0227	1.0909	-0.1668	1.1229	0.0968
55	1.1859	-0.035	1.1265	-0.0462	1.2452	-0.0238	1.1680	-0.1664	1.2037	0.0964
56	1.1183	-0.035	1.0507	-0.0487	1.1860	-0.0213	1.0949	-0.1660	1.1418	0.0960
57	1.1617	-0.035	1.1203	-0.0458	1.2031	-0.0242	1.1517	-0.1674	1.1717	0.0974
58	1.1013	-0.035	1.0435	-0.0495	1.1590	-0.0205	1.0828	-0.1668	1.1197	0.0968
59	1.0756	-0.035	1.0181	-0.0457	1.1332	-0.0243	1.0588	-0.1665	1.0924	0.0965
60	1.1398	-0.035	1.0956	-0.0430	1.1840	-0.0270	1.1298	-0.1671	1.1498	0.0971
61	1.2006	-0.035	1.1538	-0.0460	1.2475	-0.0240	1.1884	-0.1671	1.2129	0.0971
62	1.0623	-0.035	1.0133	-0.0465	1.1112	-0.0235	1.0490	-0.1671	1.0755	0.0971
63	1.1806	-0.035	1.1221	-0.0435	1.2392	-0.0265	1.1643	-0.1663	1.1969	0.0963
64	1.1281	-0.035	1.0820	-0.0476	1.1741	-0.0224	1.1157	-0.1673	1.1405	0.0973
65	1.1959	-0.035	1.1555	-0.0481	1.2363	-0.0219	1.1856	-0.1677	1.2062	0.0977
66	1.0603	-0.035	1.0035	-0.0481	1.1170	-0.0219	1.0429	-0.1667	1.0777	0.0967
67	1.1653	-0.035	1.1069	-0.0466	1.2237	-0.0234	1.1475	-0.1664	1.1831	0.0964
68	1.1271	-0.035	1.0838	-0.0496	1.1704	-0.0204	1.1150	-0.1677	1.1392	0.0977
69	1.1621	-0.035	1.1071	-0.0445	1.2172	-0.0255	1.1469	-0.1665	1.1774	0.0965
70	1.1405	-0.035	1.0994	-0.0454	1.1816	-0.0246	1.1307	-0.1674	1.1502	0.0974

71	1.0563	-0.035	1.0011	-0.0507	1.1114	-0.0193	1.0383	-0.1670	1.0742	0.0970
72	1.0122	-0.035	0.9481	-0.0452	1.0762	-0.0248	0.9925	-0.1660	1.0318	0.0960
73	1.1196	-0.035	1.0312	-0.0431	1.2081	-0.0269	1.0872	-0.1638	1.1521	0.0938
74	1.0785	-0.035	1.0414	-0.0479	1.1157	-0.0221	1.0695	-0.1678	1.0876	0.0978
75	1.0978	-0.035	1.0394	-0.0468	1.1562	-0.0232	1.0799	-0.1664	1.1157	0.0964
76	1.1453	-0.035	1.1092	-0.0465	1.1814	-0.0235	1.1370	-0.1677	1.1536	0.0977
77	1.0970	-0.035	1.0139	-0.0478	1.1801	-0.0222	1.0651	-0.1646	1.1289	0.0946
78	1.0225	-0.035	0.9723	-0.0520	1.0726	-0.0180	1.0064	-0.1675	1.0385	0.0975
79	1.1053	-0.035	1.0423	-0.0501	1.1684	-0.0199	1.0834	-0.1664	1.1272	0.0964
80	1.2508	-0.035	1.1884	-0.0431	1.3132	-0.0269	1.2328	-0.1659	1.2689	0.0959
81	1.1277	-0.035	1.0711	-0.0491	1.1843	-0.0209	1.1098	-0.1668	1.1456	0.0968
82	1.0507	-0.035	0.9971	-0.0442	1.1043	-0.0258	1.0364	-0.1666	1.0650	0.0966
83	1.1443	-0.035	1.0998	-0.0443	1.1888	-0.0257	1.1337	-0.1672	1.1550	0.0972
84	1.1382	-0.035	1.0837	-0.0479	1.1927	-0.0221	1.1218	-0.1668	1.1546	0.0968
85	1.1330	-0.035	1.0507	-0.0437	1.2153	-0.0263	1.1041	-0.1645	1.1618	0.0945
86	1.0810	-0.035	1.0198	-0.0450	1.1423	-0.0250	1.0627	-0.1662	1.0993	0.0962
87	1.1675	-0.035	1.0662	-0.0422	1.2688	-0.0278	1.1278	-0.1626	1.2073	0.0926
88	1.1570	-0.035	1.1184	-0.0430	1.1957	-0.0270	1.1489	-0.1674	1.1651	0.0974
89	1.0753	-0.035	1.0118	-0.0456	1.1388	-0.0244	1.0555	-0.1660	1.0951	0.0960
90	1.0619	-0.035	1.0025	-0.0476	1.1212	-0.0224	1.0433	-0.1665	1.0805	0.0965
91	1.1460	-0.035	1.0966	-0.0461	1.1954	-0.0239	1.1326	-0.1670	1.1593	0.0970
92	1.1432	-0.035	1.0749	-0.0469	1.2116	-0.0231	1.1204	-0.1658	1.1661	0.0958
93	1.0970	-0.035	1.0473	-0.0477	1.1467	-0.0223	1.0829	-0.1671	1.1111	0.0971
94	1.0391	-0.035	0.9711	-0.0426	1.1071	-0.0274	1.0187	-0.1656	1.0595	0.0956
95	1.2203	-0.035	1.1544	-0.0432	1.2861	-0.0268	1.2006	-0.1657	1.2399	0.0957
96	1.1847	-0.035	1.1405	-0.0442	1.2288	-0.0258	1.1742	-0.1672	1.1952	0.0972
97	1.0876	-0.035	1.0484	-0.0516	1.1268	-0.0184	1.0767	-0.1681	1.0985	0.0981
98	1.1284	-0.035	1.0924	-0.0486	1.1644	-0.0214	1.1195	-0.1679	1.1372	0.0979
99	1.1371	-0.035	1.0998	-0.0422	1.1745	-0.0278	1.1297	-0.1674	1.1445	0.0974
100	1.0553	-0.035	1.0109	-0.0497	1.0997	-0.0203	1.0429	-0.1676	1.0677	0.0976
101	1.1547	-0.035	1.0733	-0.0451	1.2362	-0.0249	1.1255	-0.1646	1.1840	0.0946
102	1.1705	-0.035	1.1254	-0.0437	1.2156	-0.0263	1.1598	-0.1671	1.1812	0.0971
103	1.1038	-0.035	1.0388	-0.0450	1.1689	-0.0250	1.0835	-0.1659	1.1241	0.0959
104	1.1662	-0.035	1.1239	-0.0469	1.2086	-0.0231	1.1554	-0.1674	1.1771	0.0974
105	1.1126	-0.035	1.0477	-0.0451	1.1776	-0.0249	1.0924	-0.1659	1.1329	0.0959
106	1.1442	-0.035	1.0816	-0.0460	1.2068	-0.0240	1.1246	-0.1661	1.1638	0.0961
107	1.1133	-0.035	1.0540	-0.0490	1.1725	-0.0210	1.0939	-0.1666	1.1326	0.0966
108	1.1552	-0.035	1.0888	-0.0480	1.2216	-0.0220	1.1328	-0.1660	1.1776	0.0960
109	1.2114	-0.035	1.1393	-0.0453	1.2835	-0.0247	1.1871	-0.1653	1.2358	0.0953
110	1.1602	-0.035	1.1284	-0.0484	1.1919	-0.0216	1.1529	-0.1681	1.1675	0.0981
111	1.1092	-0.035	1.0580	-0.0465	1.1604	-0.0235	1.0949	-0.1669	1.1236	0.0969
112	1.2030	-0.035	1.1587	-0.0431	1.2474	-0.0269	1.1928	-0.1671	1.2133	0.0971
113	1.1310	-0.035	1.0678	-0.0459	1.1943	-0.0241	1.1114	-0.1661	1.1506	0.0961
114	1.1520	-0.035	1.1037	-0.0467	1.2002	-0.0233	1.1389	-0.1671	1.1650	0.0971
115	1.0815	-0.035	1.0188	-0.0480	1.1441	-0.0220	1.0609	-0.1662	1.1020	0.0962
116	1.0869	-0.035	1.0159	-0.0436	1.1580	-0.0264	1.0642	-0.1653	1.1097	0.0953
117	1.1516	-0.035	1.0915	-0.0466	1.2118	-0.0234	1.1333	-0.1664	1.1700	0.0964
118	1.1210	-0.035	1.0443	-0.0441	1.1977	-0.0259	1.0953	-0.1650	1.1468	0.0950
119	1.1171	-0.035	1.0583	-0.0484	1.1760	-0.0216	1.0985	-0.1666	1.1358	0.0966
120	1.0805	-0.035	1.0421	-0.0541	1.1189	-0.0159	1.0691	-0.1685	1.0919	0.0985
121	1.1394	-0.035	1.0766	-0.0510	1.2022	-0.0190	1.1175	-0.1666	1.1613	0.0966
122	1.1122	-0.035	1.0599	-0.0518	1.1646	-0.0182	1.0952	-0.1673	1.1292	0.0973
123	1.1668	-0.035	1.1189	-0.0501	1.2148	-0.0199	1.1525	-0.1674	1.1812	0.0974
124	1.1448	-0.035	1.0999	-0.0458	1.1896	-0.0242	1.1334	-0.1672	1.1562	0.0972
125	1.1890	-0.035	1.1249	-0.0437	1.2531	-0.0263	1.1698	-0.1658	1.2082	0.0958
126	1.1525	-0.035	1.0823	-0.0439	1.2227	-0.0261	1.1300	-0.1654	1.1750	0.0954
127	1.1561	-0.035	1.1148	-0.0461	1.1973	-0.0239	1.1460	-0.1675	1.1661	0.0975
128	1.1185	-0.035	1.0818	-0.0551	1.1553	-0.0149	1.1075	-0.1687	1.1296	0.0987
129	1.2284	-0.035	1.1490	-0.0442	1.3077	-0.0258	1.2008	-0.1647	1.2560	0.0947
130	1.1438	-0.035	1.0654	-0.0462	1.2223	-0.0238	1.1158	-0.1650	1.1718	0.0950
131	1.0940	-0.035	0.9979	-0.0433	1.1901	-0.0267	1.0567	-0.1632	1.1313	0.0932
132	1.0630	-0.035	0.9723	-0.0416	1.1538	-0.0284	1.0302	-0.1636	1.0958	0.0936
133	1.0610	-0.035	1.0215	-0.0482	1.1005	-0.0218	1.0509	-0.1677	1.0710	0.0977
134	1.1834	-0.035	1.1045	-0.0417	1.2624	-0.0283	1.1576	-0.1646	1.2093	0.0946
135	1.0903	-0.035	1.0491	-0.0478	1.1314	-0.0222	1.0797	-0.1676	1.1008	0.0976
136	1.1491	-0.035	1.1201	-0.0455	1.1782	-0.0245	1.1435	-0.1680	1.1548	0.0980
137	1.0992	-0.035	1.0450	-0.0473	1.1534	-0.0227	1.0832	-0.1668	1.1152	0.0968
138	1.1197	-0.035	1.0857	-0.0452	1.1537	-0.0248	1.1125	-0.1678	1.1269	0.0978
139	1.1687	-0.035	1.1286	-0.0440	1.2089	-0.0260	1.1598	-0.1674	1.1777	0.0974
140	1.1761	-0.035	1.1240	-0.0416	1.2282	-0.0284	1.1636	-0.1666	1.1886	0.0966
141	1.1461	-0.035	1.0921	-0.0485	1.2001	-0.0215	1.1298	-0.1669	1.1625	0.0969
142	1.1220	-0.035	1.0618	-0.0434	1.1821	-0.0266	1.1048	-0.1661	1.1392	0.0961
143	1.2516	-0.035	1.1954	-0.0437	1.3079	-0.0263	1.2362	-0.1664	1.2671	0.0964
144	1.1360	-0.035	1.0881	-0.0489	1.1838	-0.0211	1.1222	-0.1673	1.1497	0.0973
145	1.1615	-0.035	1.1220	-0.0454	1.2010	-0.0246	1.1524	-0.1675	1.1706	0.0975

146	1.1073	-0.035	1.0408	-0.0473	1.1739	-0.0227	1.0851	-0.1659	1.1296	0.0959
147	1.1259	-0.035	1.0684	-0.0493	1.1834	-0.0207	1.1074	-0.1667	1.1443	0.0967
148	1.0697	-0.035	1.0273	-0.0487	1.1121	-0.0213	1.0582	-0.1676	1.0811	0.0976
149	1.0970	-0.035	1.0222	-0.0456	1.1719	-0.0244	1.0712	-0.1651	1.1229	0.0951
150	1.0820	-0.035	1.0157	-0.0480	1.1483	-0.0220	1.0597	-0.1660	1.1044	0.0960
151	1.2162	-0.035	1.1673	-0.0443	1.2650	-0.0257	1.2036	-0.1669	1.2287	0.0969
152	1.1738	-0.035	1.1517	-0.0519	1.1958	-0.0181	1.1688	-0.1689	1.1788	0.0989
153	1.1145	-0.035	1.0696	-0.0460	1.1594	-0.0240	1.1031	-0.1673	1.1260	0.0973
154	1.0624	-0.035	1.0002	-0.0486	1.1246	-0.0214	1.0419	-0.1664	1.0829	0.0964
155	1.1896	-0.035	1.1356	-0.0457	1.2437	-0.0243	1.1745	-0.1667	1.2048	0.0967
156	1.0934	-0.035	1.0562	-0.0466	1.1306	-0.0234	1.0848	-0.1677	1.1021	0.0977
157	1.1455	-0.035	1.1024	-0.0451	1.1887	-0.0249	1.1351	-0.1673	1.1560	0.0973
158	1.1180	-0.035	1.0693	-0.0441	1.1667	-0.0259	1.1057	-0.1669	1.1303	0.0969
159	1.0676	-0.035	1.0044	-0.0488	1.1309	-0.0212	1.0464	-0.1663	1.0888	0.0963
160	1.0868	-0.035	1.0472	-0.0504	1.1264	-0.0196	1.0760	-0.1679	1.0975	0.0979
161	1.1402	-0.035	1.0909	-0.0455	1.1895	-0.0245	1.1272	-0.1670	1.1532	0.0970
162	1.1252	-0.035	1.0597	-0.0425	1.1908	-0.0275	1.1061	-0.1657	1.1444	0.0957
163	1.1379	-0.035	1.0832	-0.0465	1.1926	-0.0235	1.1220	-0.1667	1.1539	0.0967
164	1.1699	-0.035	1.1237	-0.0458	1.2162	-0.0242	1.1581	-0.1672	1.1817	0.0972
165	1.2058	-0.035	1.1511	-0.0451	1.2604	-0.0249	1.1905	-0.1666	1.2210	0.0966
166	1.1197	-0.035	1.0624	-0.0483	1.1770	-0.0217	1.1018	-0.1667	1.1376	0.0967
167	1.1480	-0.035	1.1028	-0.0500	1.1933	-0.0200	1.1350	-0.1676	1.1611	0.0976
168	1.1398	-0.035	1.0796	-0.0483	1.2000	-0.0217	1.1206	-0.1665	1.1590	0.0965
169	1.1511	-0.035	1.0553	-0.0441	1.2470	-0.0259	1.1129	-0.1631	1.1893	0.0931
170	1.0759	-0.035	1.0409	-0.0508	1.1108	-0.0192	1.0668	-0.1682	1.0849	0.0982
171	1.0913	-0.035	1.0348	-0.0468	1.1478	-0.0232	1.0744	-0.1666	1.1082	0.0966
172	1.1196	-0.035	1.0784	-0.0495	1.1609	-0.0205	1.1084	-0.1677	1.1308	0.0977
173	1.0901	-0.035	1.0165	-0.0442	1.1638	-0.0258	1.0659	-0.1652	1.1144	0.0952
174	1.1073	-0.035	1.0663	-0.0507	1.1483	-0.0193	1.0959	-0.1679	1.1187	0.0979
175	1.1411	-0.035	1.1093	-0.0425	1.1728	-0.0275	1.1353	-0.1677	1.1469	0.0977
176	1.1686	-0.035	1.1261	-0.0453	1.2112	-0.0247	1.1584	-0.1673	1.1789	0.0973
177	1.1200	-0.035	1.0892	-0.0503	1.1507	-0.0197	1.1126	-0.1684	1.1274	0.0984
178	1.1372	-0.035	1.0684	-0.0509	1.2060	-0.0191	1.1119	-0.1661	1.1624	0.0961
179	1.0857	-0.035	1.0406	-0.0457	1.1307	-0.0243	1.0743	-0.1672	1.0970	0.0972
180	1.1542	-0.035	1.1108	-0.0450	1.1976	-0.0250	1.1437	-0.1673	1.1647	0.0973
181	1.0891	-0.035	1.0247	-0.0497	1.1536	-0.0203	1.0669	-0.1663	1.1113	0.0963
182	1.1748	-0.035	1.1250	-0.0446	1.2246	-0.0254	1.1618	-0.1668	1.1878	0.0968
183	1.1149	-0.035	1.0576	-0.0462	1.1722	-0.0238	1.0980	-0.1665	1.1319	0.0965
184	1.1838	-0.035	1.1316	-0.0462	1.2359	-0.0238	1.1689	-0.1668	1.1986	0.0968
185	1.0568	-0.035	0.9847	-0.0493	1.1288	-0.0207	1.0307	-0.1657	1.0828	0.0957
186	1.1135	-0.035	1.0599	-0.0476	1.1670	-0.0224	1.0977	-0.1669	1.1293	0.0969
187	1.1163	-0.035	1.0681	-0.0469	1.1646	-0.0231	1.1032	-0.1671	1.1295	0.0971
188	1.1364	-0.035	1.1047	-0.0447	1.1681	-0.0253	1.1300	-0.1678	1.1428	0.0978
189	1.0886	-0.035	1.0394	-0.0467	1.1377	-0.0233	1.0750	-0.1670	1.1021	0.0970
190	1.0855	-0.035	1.0315	-0.0515	1.1395	-0.0185	1.0679	-0.1672	1.1031	0.0972
191	1.1240	-0.035	1.0820	-0.0521	1.1659	-0.0179	1.1117	-0.1680	1.1362	0.0980
192	1.1803	-0.035	1.1337	-0.0474	1.2270	-0.0226	1.1678	-0.1673	1.1929	0.0973
193	1.2011	-0.035	1.1441	-0.0414	1.2581	-0.0286	1.1864	-0.1662	1.2158	0.0962
194	1.0946	-0.035	1.0089	-0.0452	1.1803	-0.0248	1.0628	-0.1643	1.1264	0.0943
195	1.1355	-0.035	1.0641	-0.0413	1.2069	-0.0287	1.1140	-0.1652	1.1571	0.0952
196	1.1049	-0.035	1.0502	-0.0507	1.1597	-0.0193	1.0872	-0.1671	1.1226	0.0971
197	1.1110	-0.035	1.0589	-0.0476	1.1631	-0.0224	1.0959	-0.1670	1.1262	0.0970
198	1.2095	-0.035	1.1305	-0.0460	1.2885	-0.0240	1.1807	-0.1647	1.2383	0.0947
199	1.1110	-0.035	1.0696	-0.0538	1.1525	-0.0162	1.0984	-0.1683	1.1237	0.0983
200	1.0960	-0.035	1.0505	-0.0461	1.1415	-0.0239	1.0843	-0.1672	1.1077	0.0972
201	1.0996	-0.035	1.0403	-0.0480	1.1590	-0.0220	1.0808	-0.1665	1.1185	0.0965
202	1.1452	-0.035	1.0988	-0.0445	1.1916	-0.0255	1.1338	-0.1671	1.1567	0.0971
203	1.1441	-0.035	1.0850	-0.0454	1.2032	-0.0246	1.1267	-0.1663	1.1615	0.0963
204	1.2957	-0.035	1.1777	-0.0382	1.4137	-0.0318	1.2476	-0.1609	1.3438	0.0909
205	1.0494	-0.035	0.9893	-0.0456	1.1094	-0.0244	1.0313	-0.1663	1.0674	0.0963
206	1.2042	-0.035	1.1312	-0.0422	1.2773	-0.0278	1.1811	-0.1651	1.2273	0.0951
207	1.1425	-0.035	1.0803	-0.0492	1.2047	-0.0208	1.1217	-0.1664	1.1633	0.0964
208	1.1854	-0.035	1.1177	-0.0438	1.2530	-0.0262	1.1645	-0.1656	1.2063	0.0956
209	1.0759	-0.035	1.0372	-0.0524	1.1146	-0.0176	1.0649	-0.1682	1.0870	0.0982
210	1.1397	-0.035	1.0813	-0.0483	1.1982	-0.0217	1.1213	-0.1666	1.1581	0.0966
211	1.1289	-0.035	1.0710	-0.0442	1.1867	-0.0258	1.1126	-0.1664	1.1451	0.0964
212	1.1476	-0.035	1.0929	-0.0456	1.2023	-0.0244	1.1321	-0.1666	1.1632	0.0966
213	1.0927	-0.035	1.0276	-0.0467	1.1578	-0.0233	1.0715	-0.1659	1.1139	0.0959
214	1.1391	-0.035	1.0912	-0.0479	1.1869	-0.0221	1.1257	-0.1673	1.1524	0.0973
215	1.1798	-0.035	1.1235	-0.0450	1.2361	-0.0250	1.1638	-0.1665	1.1958	0.0965
216	1.0914	-0.035	1.0266	-0.0451	1.1563	-0.0249	1.0713	-0.1659	1.1116	0.0959
217	1.1420	-0.035	1.0668	-0.0486	1.2171	-0.0214	1.1142	-0.1653	1.1697	0.0953
218	1.0801	-0.035	1.0246	-0.0505	1.1356	-0.0195	1.0620	-0.1670	1.0981	0.0970

219	1.0826	-0.035	1.0346	-0.0528	1.1307	-0.0172	1.0674	-0.1678	1.0978	0.0978
220	1.0448	-0.035	0.9968	-0.0503	1.0928	-0.0197	1.0305	-0.1675	1.0591	0.0975
221	1.2269	-0.035	1.1779	-0.0478	1.2760	-0.0222	1.2130	-0.1672	1.2408	0.0972
222	1.1114	-0.035	1.0629	-0.0474	1.1600	-0.0226	1.0980	-0.1672	1.1249	0.0972
223	1.1506	-0.035	1.0878	-0.0464	1.2134	-0.0236	1.1307	-0.1661	1.1704	0.0961
224	1.1248	-0.035	1.0780	-0.0458	1.1716	-0.0242	1.1126	-0.1671	1.1369	0.0971
225	1.2048	-0.035	1.1486	-0.0467	1.2610	-0.0233	1.1881	-0.1666	1.2214	0.0966
226	1.1848	-0.035	1.1389	-0.0467	1.2306	-0.0233	1.1725	-0.1672	1.1970	0.0972
227	1.0653	-0.035	1.0002	-0.0474	1.1304	-0.0226	1.0441	-0.1661	1.0865	0.0961
228	1.1779	-0.035	1.1227	-0.0435	1.2331	-0.0265	1.1631	-0.1665	1.1927	0.0965
229	1.1605	-0.035	1.1119	-0.0446	1.2091	-0.0254	1.1481	-0.1670	1.1729	0.0970
230	1.1724	-0.035	1.1017	-0.0437	1.2431	-0.0263	1.1498	-0.1653	1.1951	0.0953
231	1.1837	-0.035	1.1055	-0.0457	1.2620	-0.0243	1.1561	-0.1649	1.2113	0.0949
232	1.1545	-0.035	1.1057	-0.0465	1.2033	-0.0235	1.1413	-0.1671	1.1677	0.0971
233	1.1302	-0.035	1.0896	-0.0491	1.1708	-0.0209	1.1193	-0.1677	1.1411	0.0977
234	1.1144	-0.035	1.0805	-0.0485	1.1484	-0.0215	1.1063	-0.1680	1.1225	0.0980
235	1.1274	-0.035	1.0853	-0.0495	1.1694	-0.0205	1.1159	-0.1677	1.1389	0.0977
236	1.1187	-0.035	1.0587	-0.0474	1.1787	-0.0226	1.1000	-0.1664	1.1375	0.0964
237	1.1740	-0.035	1.1185	-0.0498	1.2295	-0.0202	1.1561	-0.1669	1.1918	0.0969
238	1.1708	-0.035	1.1329	-0.0439	1.2087	-0.0261	1.1627	-0.1675	1.1789	0.0975
239	1.1930	-0.035	1.1346	-0.0451	1.2515	-0.0249	1.1761	-0.1664	1.2100	0.0964
240	1.0887	-0.035	1.0039	-0.0435	1.1736	-0.0265	1.0584	-0.1642	1.1190	0.0942
241	1.1225	-0.035	1.0929	-0.0476	1.1520	-0.0224	1.1161	-0.1681	1.1288	0.0981
242	1.2332	-0.035	1.1299	-0.0373	1.3365	-0.0327	1.1959	-0.1624	1.2706	0.0924
243	1.1792	-0.035	1.1365	-0.0460	1.2219	-0.0240	1.1686	-0.1674	1.1899	0.0974
244	1.1490	-0.035	1.0719	-0.0421	1.2261	-0.0279	1.1239	-0.1648	1.1741	0.0948
245	1.1765	-0.035	1.0730	-0.0419	1.2799	-0.0281	1.1357	-0.1625	1.2172	0.0925
246	1.1087	-0.035	1.0709	-0.0480	1.1465	-0.0220	1.0993	-0.1678	1.1181	0.0978
247	1.2005	-0.035	1.1380	-0.0425	1.2629	-0.0275	1.1828	-0.1660	1.2181	0.0960
248	1.1399	-0.035	1.0607	-0.0445	1.2191	-0.0255	1.1123	-0.1647	1.1676	0.0947
249	1.0817	-0.035	1.0224	-0.0514	1.1410	-0.0186	1.0615	-0.1669	1.1019	0.0969
250	1.1067	-0.035	1.0452	-0.0476	1.1682	-0.0224	1.0871	-0.1663	1.1263	0.0963
251	1.0673	-0.035	1.0147	-0.0442	1.1200	-0.0258	1.0533	-0.1667	1.0813	0.0967
252	1.1623	-0.035	1.1094	-0.0452	1.2152	-0.0248	1.1478	-0.1667	1.1769	0.0967
253	1.0640	-0.035	1.0236	-0.0437	1.1044	-0.0263	1.0552	-0.1674	1.0728	0.0974
254	1.1474	-0.035	1.0901	-0.0440	1.2046	-0.0260	1.1314	-0.1663	1.1634	0.0963
255	1.1482	-0.035	1.1038	-0.0504	1.1927	-0.0196	1.1354	-0.1677	1.1610	0.0977
256	1.1148	-0.035	1.0690	-0.0490	1.1607	-0.0210	1.1020	-0.1675	1.1277	0.0975
257	1.1279	-0.035	1.0824	-0.0477	1.1733	-0.0223	1.1155	-0.1673	1.1403	0.0973
258	1.0605	-0.035	0.9911	-0.0456	1.1299	-0.0244	1.0377	-0.1656	1.0833	0.0956
259	1.1428	-0.035	1.0959	-0.0488	1.1897	-0.0212	1.1293	-0.1673	1.1562	0.0973
260	1.0916	-0.035	1.0479	-0.0485	1.1354	-0.0215	1.0798	-0.1675	1.1035	0.0975
261	1.1741	-0.035	1.1394	-0.0509	1.2088	-0.0191	1.1651	-0.1682	1.1831	0.0982
262	1.2084	-0.035	1.1470	-0.0456	1.2697	-0.0244	1.1896	-0.1661	1.2271	0.0961
263	1.2200	-0.035	1.1708	-0.0471	1.2692	-0.0229	1.2064	-0.1671	1.2337	0.0971
264	1.2186	-0.035001	1.1340	-0.0368	1.3031	-0.0332	1.1926	-0.1640	1.2446	0.0940
265	1.0836	-0.035	1.0463	-0.0452	1.1210	-0.0248	1.0754	-0.1676	1.0919	0.0976
266	1.1285	-0.035	1.0675	-0.0459	1.1895	-0.0241	1.1099	-0.1662	1.1471	0.0962
267	1.0990	-0.035	1.0374	-0.0505	1.1605	-0.0195	1.0780	-0.1666	1.1199	0.0966
268	1.0592	-0.035	0.9764	-0.0431	1.1420	-0.0269	1.0303	-0.1643	1.0881	0.0943
269	1.2116	-0.035	1.1038	-0.0409	1.3193	-0.0291	1.1683	-0.1619	1.2548	0.0919
270	1.1595	-0.035	1.1183	-0.0476	1.2006	-0.0224	1.1490	-0.1676	1.1700	0.0976
271	1.1372	-0.035	1.1004	-0.0481	1.1740	-0.0219	1.1282	-0.1679	1.1462	0.0979
272	1.0357	-0.035	0.9576	-0.0451	1.1139	-0.0249	1.0084	-0.1649	1.0631	0.0949
273	1.1528	-0.035	1.0981	-0.0460	1.2074	-0.0240	1.1370	-0.1666	1.1685	0.0966
274	1.1539	-0.035	1.1211	-0.0492	1.1867	-0.0208	1.1460	-0.1681	1.1618	0.0981
275	1.1699	-0.035	1.1293	-0.0457	1.2105	-0.0243	1.1602	-0.1675	1.1796	0.0975
276	1.1236	-0.035	1.0669	-0.0490	1.1804	-0.0210	1.1056	-0.1667	1.1417	0.0967
277	1.0592	-0.035	0.9886	-0.0473	1.1298	-0.0227	1.0348	-0.1656	1.0836	0.0956
278	1.1697	-0.035	1.1139	-0.0493	1.2254	-0.0207	1.1522	-0.1669	1.1871	0.0969
279	1.1096	-0.035	1.0359	-0.0509	1.1832	-0.0191	1.0817	-0.1657	1.1375	0.0957
280	1.1095	-0.035	1.0423	-0.0473	1.1767	-0.0227	1.0870	-0.1659	1.1320	0.0959
281	1.1851	-0.035	1.1263	-0.0480	1.2438	-0.0220	1.1665	-0.1665	1.2036	0.0965
282	1.0539	-0.035	1.0114	-0.0493	1.0965	-0.0207	1.0423	-0.1677	1.0656	0.0977
283	1.1719	-0.035	1.1282	-0.0458	1.2157	-0.0242	1.1610	-0.1673	1.1829	0.0973
284	1.1699	-0.035	1.0955	-0.0413	1.2443	-0.0287	1.1468	-0.1650	1.1930	0.0950
285	1.1591	-0.035	1.0695	-0.0451	1.2487	-0.0249	1.1249	-0.1639	1.1934	0.0939
286	1.1395	-0.035	1.0633	-0.0476	1.2157	-0.0224	1.1117	-0.1652	1.1673	0.0952
287	1.1436	-0.035	1.0853	-0.0458	1.2020	-0.0242	1.1263	-0.1664	1.1610	0.0964
288	1.1926	-0.035	1.1378	-0.0522	1.2473	-0.0178	1.1743	-0.1673	1.2108	0.0973
289	1.1753	-0.035	1.1106	-0.0463	1.2401	-0.0237	1.1546	-0.1660	1.1960	0.0960
290	1.1966	-0.035	1.1379	-0.0452	1.2552	-0.0248	1.1796	-0.1664	1.2136	0.0964
291	1.2457	-0.035	1.1651	-0.0441	1.3263	-0.0259	1.2173	-0.1645	1.2741	0.0945

292	1.0799	-0.035	1.0302	-0.0474	1.1296	-0.0226	1.0659	-0.1671	1.0939	0.0971
293	1.0491	-0.035	0.9897	-0.0476	1.1086	-0.0224	1.0305	-0.1665	1.0678	0.0965
294	1.0746	-0.035	1.0109	-0.0462	1.1382	-0.0238	1.0543	-0.1660	1.0949	0.0960
295	1.0828	-0.035	1.0170	-0.0467	1.1485	-0.0233	1.0614	-0.1660	1.1041	0.0960
296	1.0861	-0.035	1.0514	-0.0464	1.1208	-0.0236	1.0783	-0.1678	1.0939	0.0978
297	1.0886	-0.035	1.0286	-0.0534	1.1486	-0.0166	1.0671	-0.1671	1.1102	0.0971
298	1.0302	-0.035	0.9818	-0.0479	1.0785	-0.0221	1.0167	-0.1672	1.0437	0.0972
299	1.1833	-0.035	1.1395	-0.0433	1.2271	-0.0267	1.1732	-0.1672	1.1934	0.0972
300	1.0704	-0.035	1.0095	-0.0435	1.1314	-0.0265	1.0530	-0.1661	1.0879	0.0961
301	1.1245	-0.035	1.0659	-0.0464	1.1831	-0.0236	1.1068	-0.1664	1.1423	0.0964
302	1.1071	-0.035	1.0367	-0.0493	1.1775	-0.0207	1.0817	-0.1658	1.1325	0.0958
303	1.1536	-0.035	1.1222	-0.0472	1.1851	-0.0228	1.1467	-0.1680	1.1606	0.0980
304	1.0960	-0.035	1.0340	-0.0493	1.1580	-0.0207	1.0752	-0.1664	1.1168	0.0964
305	1.1139	-0.035	1.0615	-0.0459	1.1664	-0.0241	1.0994	-0.1668	1.1285	0.0968
306	1.2188	-0.035	1.1249	-0.0382	1.3128	-0.0318	1.1865	-0.1632	1.2512	0.0932
307	1.1644	-0.035	1.0927	-0.0422	1.2360	-0.0278	1.1423	-0.1653	1.1865	0.0953
308	1.0695	-0.035	1.0136	-0.0463	1.1254	-0.0237	1.0532	-0.1666	1.0858	0.0966
309	1.1494	-0.035	1.1097	-0.0466	1.1891	-0.0234	1.1398	-0.1676	1.1590	0.0976
310	1.1283	-0.035	1.0503	-0.0449	1.2064	-0.0251	1.1013	-0.1649	1.1553	0.0949
311	1.0124	-0.035	0.9401	-0.0484	1.0846	-0.0216	0.9866	-0.1656	1.0381	0.0956
312	1.0830	-0.035	1.0236	-0.0507	1.1425	-0.0193	1.0631	-0.1668	1.1029	0.0968
313	1.1447	-0.035	1.0966	-0.0436	1.1928	-0.0264	1.1328	-0.1669	1.1565	0.0969
314	1.1520	-0.035	1.1036	-0.0481	1.2005	-0.0219	1.1383	-0.1672	1.1658	0.0972
315	1.1656	-0.035	1.0687	-0.0422	1.2625	-0.0278	1.1287	-0.1631	1.2025	0.0931
316	1.1034	-0.035	1.0546	-0.0445	1.1522	-0.0255	1.0909	-0.1669	1.1159	0.0969
317	1.1647	-0.035	1.0990	-0.0418	1.2303	-0.0282	1.1458	-0.1657	1.1836	0.0957
318	1.1995	-0.035	1.1280	-0.0421	1.2710	-0.0279	1.1774	-0.1652	1.2216	0.0952
319	1.0436	-0.035	1.0024	-0.0541	1.0847	-0.0159	1.0309	-0.1683	1.0563	0.0983
320	1.1478	-0.035	1.0970	-0.0448	1.1985	-0.0252	1.1343	-0.1668	1.1612	0.0968
321	1.1227	-0.035	1.0582	-0.0484	1.1872	-0.0216	1.1010	-0.1662	1.1444	0.0962
322	1.1438	-0.035	1.1128	-0.0477	1.1748	-0.0223	1.1369	-0.1681	1.1506	0.0981
323	1.2392	-0.035	1.1779	-0.0405	1.3005	-0.0295	1.2228	-0.1659	1.2556	0.0959
324	1.1015	-0.035	1.0287	-0.0508	1.1742	-0.0192	1.0739	-0.1658	1.1290	0.0958
325	1.1146	-0.035	1.0797	-0.0445	1.1494	-0.0255	1.1073	-0.1677	1.1218	0.0977
326	1.2204	-0.035	1.1621	-0.0439	1.2788	-0.0261	1.2041	-0.1663	1.2368	0.0963
327	1.1243	-0.035	1.0358	-0.0451	1.2128	-0.0249	1.0905	-0.1639	1.1580	0.0939
328	1.0637	-0.035	1.0163	-0.0511	1.1111	-0.0189	1.0495	-0.1676	1.0779	0.0976
329	1.1352	-0.035	1.0687	-0.0496	1.2018	-0.0204	1.1116	-0.1661	1.1589	0.0961
330	1.0867	-0.035	1.0466	-0.0494	1.1268	-0.0206	1.0761	-0.1678	1.0973	0.0978
331	0.9947	-0.035	0.9448	-0.0519	1.0445	-0.0181	0.9789	-0.1675	1.0104	0.0975
332	1.1211	-0.035	1.0575	-0.0490	1.1848	-0.0210	1.0996	-0.1663	1.1426	0.0963
333	1.1092	-0.035	1.0485	-0.0458	1.1699	-0.0242	1.0908	-0.1663	1.1276	0.0963
334	1.1462	-0.035	1.1044	-0.0457	1.1880	-0.0243	1.1361	-0.1674	1.1563	0.0974
335	1.0726	-0.035	1.0190	-0.0504	1.1262	-0.0196	1.0557	-0.1671	1.0895	0.0971
336	1.1440	-0.035	1.1032	-0.0447	1.1848	-0.0253	1.1346	-0.1674	1.1533	0.0974
337	1.1295	-0.035	1.0842	-0.0502	1.1748	-0.0198	1.1163	-0.1676	1.1427	0.0976
338	1.0874	-0.035	1.0270	-0.0497	1.1477	-0.0203	1.0674	-0.1666	1.1073	0.0966
339	1.1934	-0.035	1.1576	-0.0446	1.2292	-0.0254	1.1858	-0.1676	1.2011	0.0976
340	1.1992	-0.035	1.1349	-0.0442	1.2635	-0.0258	1.1798	-0.1659	1.2186	0.0959
341	1.1522	-0.035	1.0884	-0.0443	1.2160	-0.0257	1.1329	-0.1659	1.1715	0.0959
342	1.0851	-0.035	1.0218	-0.0474	1.1485	-0.0226	1.0648	-0.1662	1.1054	0.0962
343	1.0291	-0.035	0.9831	-0.0461	1.0752	-0.0239	1.0172	-0.1672	1.0411	0.0972
344	1.0569	-0.035	1.0188	-0.0482	1.0950	-0.0218	1.0474	-0.1678	1.0664	0.0978
345	1.0774	-0.035	1.0317	-0.0487	1.1230	-0.0213	1.0646	-0.1674	1.0901	0.0974
346	1.1225	-0.035	1.0695	-0.0470	1.1754	-0.0230	1.1071	-0.1668	1.1378	0.0968
347	1.2540	-0.035	1.1702	-0.0415	1.3378	-0.0285	1.2256	-0.1642	1.2824	0.0942
348	1.1769	-0.035	1.0632	-0.0420	1.2906	-0.0280	1.1287	-0.1614	1.2251	0.0914
349	1.1615	-0.035	1.0948	-0.0466	1.2283	-0.0234	1.1395	-0.1658	1.1835	0.0958
350	1.1439	-0.035	1.0940	-0.0496	1.1937	-0.0204	1.1290	-0.1673	1.1588	0.0973
351	1.1573	-0.035	1.0889	-0.0494	1.2257	-0.0206	1.1329	-0.1659	1.1817	0.0959
352	1.1460	-0.035	1.0907	-0.0483	1.2014	-0.0217	1.1290	-0.1668	1.1630	0.0968
353	1.1257	-0.035	1.0781	-0.0477	1.1733	-0.0223	1.1125	-0.1672	1.1389	0.0972
354	1.0965	-0.035	1.0376	-0.0481	1.1554	-0.0219	1.0778	-0.1665	1.1152	0.0965
355	1.1593	-0.035	1.0863	-0.0438	1.2322	-0.0262	1.1357	-0.1652	1.1829	0.0952
356	1.0418	-0.035	0.9745	-0.0494	1.1090	-0.0206	1.0183	-0.1661	1.0652	0.0961
357	1.1306	-0.035	1.0919	-0.0485	1.1692	-0.0215	1.1208	-0.1678	1.1404	0.0978
358	1.2086	-0.035	1.1537	-0.0425	1.2634	-0.0275	1.1944	-0.1665	1.2228	0.0965
359	1.0823	-0.035	1.0460	-0.0529	1.1186	-0.0171	1.0721	-0.1684	1.0925	0.0984
360	1.1146	-0.035	1.0672	-0.0515	1.1620	-0.0185	1.1001	-0.1676	1.1291	0.0976
361	1.1980	-0.035	1.1466	-0.0435	1.2494	-0.0265	1.1849	-0.1667	1.2112	0.0967
362	1.0570	-0.035	0.9898	-0.0443	1.1241	-0.0257	1.0361	-0.1657	1.0778	0.0957
363	1.1619	-0.035	1.1245	-0.0461	1.1993	-0.0239	1.1532	-0.1676	1.1706	0.0976
364	1.2129	-0.035	1.1524	-0.0457	1.2735	-0.0243	1.1948	-0.1663	1.2310	0.0963

365	1.1935	-0.035	1.1139	-0.0427	1.2730	-0.0273	1.1666	-0.1646	1.2203	0.0946
366	1.0956	-0.035	1.0395	-0.0486	1.1517	-0.0214	1.0782	-0.1668	1.1130	0.0968
367	1.1473	-0.035	1.1003	-0.0467	1.1942	-0.0233	1.1348	-0.1672	1.1597	0.0972
368	0.9797	-0.035	0.9310	-0.0499	1.0285	-0.0201	0.9652	-0.1674	0.9942	0.0974
369	1.1418	-0.035	1.0913	-0.0460	1.1923	-0.0240	1.1279	-0.1669	1.1557	0.0969
370	1.2514	-0.035	1.1736	-0.0411	1.3292	-0.0289	1.2264	-0.1647	1.2764	0.0947
371	1.1267	-0.035	1.0681	-0.0461	1.1853	-0.0239	1.1092	-0.1664	1.1442	0.0964
372	1.0925	-0.035	1.0309	-0.0483	1.1541	-0.0217	1.0726	-0.1664	1.1124	0.0964
373	1.1667	-0.035	1.1221	-0.0537	1.2112	-0.0163	1.1526	-0.1681	1.1808	0.0981
374	1.2003	-0.035	1.1399	-0.0427	1.2607	-0.0273	1.1835	-0.1661	1.2170	0.0961
375	1.1535	-0.035	1.1149	-0.0469	1.1921	-0.0231	1.1443	-0.1677	1.1628	0.0977
376	1.1556	-0.035	1.1045	-0.0428	1.2067	-0.0272	1.1426	-0.1666	1.1686	0.0966
377	0.9982	-0.035	0.9506	-0.0496	1.0457	-0.0204	0.9843	-0.1674	1.0121	0.0974
378	1.0640	-0.035	1.0286	-0.0480	1.0994	-0.0220	1.0556	-0.1679	1.0724	0.0979
379	1.2326	-0.035	1.1738	-0.0445	1.2913	-0.0255	1.2156	-0.1663	1.2496	0.0963
380	1.0902	-0.035	1.0277	-0.0459	1.1527	-0.0241	1.0709	-0.1661	1.1095	0.0961
381	1.1114	-0.035	1.0327	-0.0425	1.1901	-0.0275	1.0853	-0.1647	1.1376	0.0947
382	1.1451	-0.035	1.1012	-0.0443	1.1890	-0.0257	1.1347	-0.1672	1.1555	0.0972
383	1.1710	-0.035	1.1092	-0.0444	1.2328	-0.0256	1.1526	-0.1661	1.1893	0.0961
384	1.2111	-0.035	1.1505	-0.0410	1.2717	-0.0290	1.1949	-0.1660	1.2273	0.0960
385	1.1597	-0.035	1.0808	-0.0471	1.2386	-0.0229	1.1309	-0.1650	1.1884	0.0950
386	1.1201	-0.035	1.0942	-0.0515	1.1461	-0.0185	1.1140	-0.1687	1.1262	0.0987
387	1.1429	-0.035	1.0845	-0.0453	1.2014	-0.0247	1.1258	-0.1663	1.1601	0.0963
388	1.1515	-0.035	1.0953	-0.0464	1.2077	-0.0236	1.1351	-0.1666	1.1680	0.0966
389	1.1601	-0.035	1.1121	-0.0497	1.2081	-0.0203	1.1459	-0.1674	1.1742	0.0974
390	1.1717	-0.035	1.1191	-0.0455	1.2242	-0.0245	1.1573	-0.1668	1.1861	0.0968
391	1.1063	-0.035	1.0695	-0.0497	1.1430	-0.0203	1.0968	-0.1680	1.1157	0.0980
392	1.1861	-0.035	1.1271	-0.0434	1.2450	-0.0266	1.1696	-0.1662	1.2025	0.0962
393	1.1133	-0.035	1.0532	-0.0433	1.1735	-0.0267	1.0963	-0.1661	1.1303	0.0961
394	1.1258	-0.035	1.0873	-0.0522	1.1642	-0.0178	1.1149	-0.1682	1.1366	0.0982
395	1.1933	-0.035	1.1319	-0.0424	1.2547	-0.0276	1.1761	-0.1660	1.2105	0.0960
396	1.2283	-0.035	1.1554	-0.0456	1.3012	-0.0244	1.2035	-0.1653	1.2531	0.0953
397	1.1907	-0.035	1.1263	-0.0421	1.2551	-0.0279	1.1721	-0.1657	1.2093	0.0957
398	1.1694	-0.035	1.1165	-0.0469	1.2224	-0.0231	1.1542	-0.1668	1.1847	0.0968
399	1.0888	-0.035	1.0158	-0.0444	1.1618	-0.0256	1.0647	-0.1652	1.1130	0.0952
400	1.0734	-0.035	1.0014	-0.0449	1.1455	-0.0251	1.0496	-0.1653	1.0973	0.0953
401	1.1178	-0.035	1.0577	-0.0494	1.1779	-0.0206	1.0980	-0.1666	1.1377	0.0966
402	1.1446	-0.035	1.0809	-0.0446	1.2084	-0.0254	1.1253	-0.1660	1.1639	0.0960
403	1.2411	-0.035	1.1655	-0.0407	1.3167	-0.0293	1.2175	-0.1648	1.2647	0.0948
404	1.0458	-0.035	0.9664	-0.0461	1.1253	-0.0239	1.0170	-0.1648	1.0746	0.0948
405	1.0751	-0.035	1.0303	-0.0502	1.1199	-0.0198	1.0623	-0.1677	1.0880	0.0977
406	1.1924	-0.035	1.1322	-0.0419	1.2525	-0.0281	1.1759	-0.1660	1.2089	0.0960
407	1.2012	-0.035	1.1310	-0.0426	1.2714	-0.0274	1.1796	-0.1654	1.2228	0.0954
408	1.1675	-0.035	1.1242	-0.0482	1.2108	-0.0218	1.1560	-0.1675	1.1790	0.0975
409	1.0544	-0.035	1.0201	-0.0510	1.0888	-0.0190	1.0454	-0.1683	1.0635	0.0983
410	1.1365	-0.035	1.0985	-0.0469	1.1744	-0.0231	1.1274	-0.1677	1.1455	0.0977
411	1.1244	-0.035	1.0661	-0.0438	1.1827	-0.0262	1.1081	-0.1663	1.1407	0.0963
412	1.1841	-0.035	1.0714	-0.0414	1.2967	-0.0286	1.1370	-0.1614	1.2312	0.0914
413	1.0699	-0.035	0.9973	-0.0499	1.1424	-0.0201	1.0430	-0.1657	1.0967	0.0957
414	1.1993	-0.035	1.1101	-0.0432	1.2884	-0.0268	1.1668	-0.1639	1.2318	0.0939
415	1.1940	-0.035	1.1401	-0.0456	1.2479	-0.0244	1.1787	-0.1667	1.2093	0.0967
416	1.1644	-0.035	1.1175	-0.0484	1.2114	-0.0216	1.1512	-0.1673	1.1777	0.0973
417	1.1981	-0.035	1.1363	-0.0428	1.2600	-0.0272	1.1806	-0.1660	1.2157	0.0960
418	1.0981	-0.035	1.0638	-0.0462	1.1324	-0.0238	1.0904	-0.1678	1.1057	0.0978
419	1.1065	-0.035	1.0531	-0.0444	1.1600	-0.0256	1.0921	-0.1666	1.1210	0.0966
420	1.1808	-0.035	1.1168	-0.0424	1.2449	-0.0276	1.1625	-0.1658	1.1992	0.0958
421	1.1803	-0.035	1.1354	-0.0442	1.2253	-0.0258	1.1695	-0.1671	1.1912	0.0971
422	1.1053	-0.035	1.0553	-0.0448	1.1553	-0.0252	1.0922	-0.1669	1.1185	0.0969
423	1.2374	-0.035	1.1734	-0.0416	1.3014	-0.0284	1.2193	-0.1658	1.2556	0.0958
424	1.1536	-0.035	1.0898	-0.0434	1.2174	-0.0266	1.1346	-0.1658	1.1726	0.0958
425	1.2411	-0.035	1.1370	-0.0400	1.3453	-0.0300	1.2009	-0.1622	1.2814	0.0922
426	1.0580	-0.035	1.0187	-0.0494	1.0972	-0.0206	1.0476	-0.1679	1.0683	0.0979
427	1.1996	-0.035	1.1535	-0.0444	1.2457	-0.0256	1.1883	-0.1671	1.2109	0.0971
428	1.1093	-0.035	1.0569	-0.0477	1.1617	-0.0223	1.0940	-0.1669	1.1246	0.0969
429	1.1494	-0.035	1.1252	-0.0480	1.1737	-0.0220	1.1445	-0.1684	1.1543	0.0984
430	1.1458	-0.035	1.1003	-0.0446	1.1913	-0.0254	1.1345	-0.1671	1.1570	0.0971
431	1.1005	-0.035	1.0552	-0.0486	1.1458	-0.0214	1.0881	-0.1675	1.1130	0.0975
432	1.1907	-0.035	1.1113	-0.0467	1.2700	-0.0233	1.1618	-0.1649	1.2195	0.0949
433	1.0514	-0.035	0.9931	-0.0464	1.1097	-0.0236	1.0339	-0.1665	1.0689	0.0965
434	1.1036	-0.035	1.0400	-0.0467	1.1671	-0.0233	1.0833	-0.1661	1.1238	0.0961
435	1.1013	-0.035	1.0645	-0.0468	1.1381	-0.0232	1.0927	-0.1678	1.1098	0.0978
436	1.1797	-0.035	1.1356	-0.0462	1.2238	-0.0238	1.1686	-0.1673	1.1908	0.0973
437	1.1082	-0.035	1.0368	-0.0496	1.1795	-0.0204	1.0822	-0.1658	1.1342	0.0958

438	1.1312	-0.035	1.0866	-0.0468	1.1759	-0.0232	1.1197	-0.1673	1.1428	0.0973
439	1.1827	-0.035	1.1341	-0.0437	1.2313	-0.0263	1.1707	-0.1669	1.1947	0.0969
440	1.0544	-0.035	1.0062	-0.0509	1.1027	-0.0191	1.0398	-0.1675	1.0690	0.0975
441	1.2387	-0.035	1.1523	-0.0404	1.3252	-0.0296	1.2091	-0.1638	1.2684	0.0938
442	1.1153	-0.035	1.0415	-0.0453	1.1890	-0.0247	1.0905	-0.1653	1.1400	0.0953
443	1.0106	-0.035	0.9377	-0.0451	1.0834	-0.0249	0.9860	-0.1652	1.0352	0.0952
444	1.1421	-0.035	1.0892	-0.0481	1.1950	-0.0219	1.1265	-0.1670	1.1577	0.0970
445	1.1374	-0.035	1.0818	-0.0472	1.1931	-0.0228	1.1206	-0.1667	1.1542	0.0967
446	1.1251	-0.035	1.0579	-0.0474	1.1923	-0.0226	1.1025	-0.1659	1.1477	0.0959
447	1.1154	-0.035	1.0369	-0.0464	1.1939	-0.0236	1.0870	-0.1649	1.1438	0.0949
448	1.0890	-0.035	1.0464	-0.0517	1.1316	-0.0183	1.0765	-0.1679	1.1015	0.0979
449	1.1603	-0.035	1.0937	-0.0450	1.2269	-0.0250	1.1392	-0.1657	1.1814	0.0957
450	1.0504	-0.035	1.0239	-0.0539	1.0769	-0.0161	1.0436	-0.1690	1.0572	0.0990
451	1.2089	-0.035	1.1453	-0.0443	1.2724	-0.0257	1.1896	-0.1659	1.2281	0.0959
452	1.0825	-0.035	1.0334	-0.0462	1.1317	-0.0238	1.0693	-0.1670	1.0958	0.0970
453	1.0972	-0.035	1.0504	-0.0486	1.1441	-0.0214	1.0841	-0.1674	1.1104	0.0974
454	1.1424	-0.035	1.0992	-0.0435	1.1855	-0.0265	1.1325	-0.1672	1.1523	0.0972
455	1.1127	-0.035	1.0473	-0.0464	1.1781	-0.0236	1.0917	-0.1660	1.1338	0.0960
456	1.0462	-0.035	1.0024	-0.0512	1.0900	-0.0188	1.0334	-0.1678	1.0590	0.0978
457	1.2467	-0.035	1.1838	-0.0427	1.3096	-0.0273	1.2285	-0.1659	1.2648	0.0959
458	1.1726	-0.035	1.1075	-0.0432	1.2377	-0.0268	1.1533	-0.1658	1.1920	0.0958
459	1.2037	-0.035	1.1550	-0.0440	1.2524	-0.0260	1.1915	-0.1669	1.2159	0.0969
460	1.1242	-0.035	1.0698	-0.0465	1.1786	-0.0235	1.1084	-0.1667	1.1401	0.0967
461	1.1822	-0.035	1.1329	-0.0434	1.2316	-0.0266	1.1701	-0.1669	1.1944	0.0969
462	1.1800	-0.035	1.1273	-0.0477	1.2327	-0.0223	1.1645	-0.1669	1.1954	0.0969
463	1.2017	-0.035	1.1572	-0.0466	1.2461	-0.0234	1.1902	-0.1673	1.2131	0.0973
464	1.0660	-0.035	1.0245	-0.0467	1.1076	-0.0233	1.0558	-0.1675	1.0763	0.0975
465	1.1273	-0.035	1.0608	-0.0476	1.1939	-0.0224	1.1050	-0.1659	1.1496	0.0959
466	1.1740	-0.035	1.1273	-0.0438	1.2208	-0.0262	1.1627	-0.1670	1.1854	0.0970
467	1.1269	-0.035	1.0778	-0.0468	1.1761	-0.0232	1.1133	-0.1670	1.1406	0.0970
468	1.0613	-0.035	0.9713	-0.0448	1.1513	-0.0252	1.0270	-0.1638	1.0956	0.0938
469	1.0816	-0.035	1.0416	-0.0483	1.1216	-0.0217	1.0714	-0.1677	1.0918	0.0977
470	1.2179	-0.035	1.1597	-0.0436	1.2760	-0.0264	1.2015	-0.1662	1.2342	0.0962
471	1.2646	-0.035	1.1931	-0.0411	1.3360	-0.0289	1.2431	-0.1652	1.2860	0.0952
472	1.2173	-0.035	1.1466	-0.0418	1.2879	-0.0282	1.1958	-0.1653	1.2388	0.0953
473	1.1173	-0.035	1.0568	-0.0487	1.1779	-0.0213	1.0975	-0.1665	1.1371	0.0965
474	1.1474	-0.035	1.0981	-0.0488	1.1967	-0.0212	1.1330	-0.1672	1.1617	0.0972
475	1.1259	-0.035	1.0503	-0.0455	1.2016	-0.0245	1.0996	-0.1651	1.1523	0.0951
476	1.1535	-0.035	1.0996	-0.0427	1.2073	-0.0273	1.1395	-0.1665	1.1674	0.0965
477	1.2119	-0.035	1.1522	-0.0429	1.2716	-0.0271	1.1953	-0.1662	1.2285	0.0962
478	1.2191	-0.035	1.1645	-0.0427	1.2736	-0.0273	1.2050	-0.1665	1.2331	0.0965
479	1.2242	-0.035	1.1334	-0.0395	1.3149	-0.0305	1.1927	-0.1635	1.2556	0.0935
480	1.0570	-0.035	1.0139	-0.0483	1.1002	-0.0217	1.0456	-0.1676	1.0685	0.0976
481	1.2031	-0.035	1.1209	-0.0466	1.2852	-0.0234	1.1725	-0.1647	1.2336	0.0947
482	1.1012	-0.035	1.0475	-0.0453	1.1550	-0.0247	1.0864	-0.1667	1.1161	0.0967
483	1.0791	-0.035	1.0267	-0.0493	1.1315	-0.0207	1.0632	-0.1671	1.0951	0.0971
484	1.0812	-0.035	1.0093	-0.0507	1.1531	-0.0193	1.0544	-0.1659	1.1080	0.0959
485	1.0776	-0.035	1.0122	-0.0453	1.1429	-0.0247	1.0569	-0.1658	1.0982	0.0958
486	1.1383	-0.035	1.0840	-0.0423	1.1925	-0.0277	1.1244	-0.1665	1.1521	0.0965
487	1.1814	-0.035	1.1165	-0.0462	1.2463	-0.0238	1.1605	-0.1659	1.2023	0.0959
488	1.2486	-0.035	1.1722	-0.0426	1.3250	-0.0274	1.2235	-0.1648	1.2737	0.0948
489	1.0644	-0.035	1.0169	-0.0470	1.1119	-0.0230	1.0515	-0.1672	1.0772	0.0972
490	1.1055	-0.035	1.0470	-0.0463	1.1641	-0.0237	1.0878	-0.1664	1.1233	0.0964
491	1.0903	-0.035	1.0604	-0.0496	1.1202	-0.0204	1.0834	-0.1683	1.0973	0.0983
492	1.1002	-0.035	1.0727	-0.0467	1.1278	-0.0233	1.0947	-0.1681	1.1057	0.0981
493	1.1333	-0.035	1.0826	-0.0484	1.1841	-0.0216	1.1185	-0.1671	1.1481	0.0971
494	1.0902	-0.035	1.0395	-0.0443	1.1410	-0.0257	1.0770	-0.1668	1.1035	0.0968
495	1.1708	-0.035	1.1061	-0.0488	1.2355	-0.0212	1.1489	-0.1662	1.1927	0.0962
496	1.1780	-0.035	1.1043	-0.0444	1.2517	-0.0256	1.1533	-0.1651	1.2026	0.0951
497	1.0818	-0.035	1.0335	-0.0452	1.1302	-0.0248	1.0692	-0.1670	1.0944	0.0970
498	1.2055	-0.035	1.1550	-0.0444	1.2560	-0.0256	1.1922	-0.1668	1.2188	0.0968
499	1.1284	-0.035	1.1000	-0.0454	1.1568	-0.0246	1.1230	-0.1680	1.1339	0.0980
500	1.1661	-0.035	1.1383	-0.0454	1.1938	-0.0246	1.1608	-0.1680	1.1714	0.0980
501	1.1531	-0.035	1.0820	-0.0442	1.2241	-0.0258	1.1299	-0.1653	1.1762	0.0953
502	1.1622	-0.035	1.1173	-0.0491	1.2070	-0.0209	1.1497	-0.1675	1.1747	0.0975
503	1.1498	-0.035	1.0896	-0.0431	1.2100	-0.0269	1.1329	-0.1661	1.1667	0.0961
504	1.2079	-0.035	1.1546	-0.0456	1.2613	-0.0244	1.1930	-0.1667	1.2229	0.0967
505	1.1063	-0.035	1.0553	-0.0480	1.1572	-0.0220	1.0915	-0.1671	1.1211	0.0971
506	1.0421	-0.035	0.9857	-0.0475	1.0985	-0.0225	1.0250	-0.1667	1.0592	0.0967
507	1.1852	-0.035	1.1261	-0.0499	1.2443	-0.0201	1.1656	-0.1667	1.2048	0.0967
508	1.2370	-0.035	1.1557	-0.0435	1.3182	-0.0265	1.2085	-0.1645	1.2654	0.0945
509	1.1011	-0.035	1.0445	-0.0457	1.1576	-0.0243	1.0847	-0.1665	1.1174	0.0965
510	1.1325	-0.035	1.0326	-0.0479	1.2324	-0.0221	1.0897	-0.1631	1.1753	0.0931

511	1.0713	-0.035	1.0073	-0.0501	1.1354	-0.0199	1.0491	-0.1664	1.0936	0.0964
512	1.0345	-0.035	0.9680	-0.0486	1.1011	-0.0214	1.0119	-0.1661	1.0572	0.0961
513	1.0737	-0.035	1.0250	-0.0480	1.1223	-0.0220	1.0599	-0.1672	1.0874	0.0972
514	1.0896	-0.035	1.0273	-0.0439	1.1519	-0.0261	1.0711	-0.1660	1.1081	0.0960
515	1.0885	-0.035	1.0424	-0.0479	1.1347	-0.0221	1.0760	-0.1674	1.1011	0.0974
516	1.1098	-0.035	1.0664	-0.0464	1.1532	-0.0236	1.0988	-0.1674	1.1208	0.0974
517	1.1598	-0.035	1.0919	-0.0503	1.2276	-0.0197	1.1351	-0.1660	1.1844	0.0960
518	1.1073	-0.035	1.0697	-0.0430	1.1450	-0.0270	1.0995	-0.1674	1.1152	0.0974
519	1.1653	-0.035	1.1123	-0.0414	1.2182	-0.0286	1.1524	-0.1665	1.1782	0.0965
520	1.1251	-0.035	1.0777	-0.0473	1.1724	-0.0227	1.1123	-0.1672	1.1379	0.0972
521	1.1519	-0.035	1.1057	-0.0450	1.1981	-0.0250	1.1403	-0.1671	1.1634	0.0971
522	1.2522	-0.035	1.1731	-0.0407	1.3313	-0.0293	1.2268	-0.1646	1.2776	0.0946
523	1.1871	-0.035	1.1434	-0.0437	1.2309	-0.0263	1.1769	-0.1672	1.1974	0.0972
524	1.1295	-0.035	1.1021	-0.0467	1.1569	-0.0233	1.1240	-0.1681	1.1350	0.0981
525	1.1375	-0.035	1.0876	-0.0449	1.1875	-0.0251	1.1244	-0.1669	1.1507	0.0969
526	1.1525	-0.035	1.0778	-0.0478	1.2273	-0.0222	1.1257	-0.1654	1.1794	0.0954
527	1.1593	-0.035	1.1208	-0.0442	1.1977	-0.0258	1.1509	-0.1675	1.1676	0.0975
528	1.1198	-0.035	1.0767	-0.0498	1.1629	-0.0202	1.1078	-0.1677	1.1318	0.0977
529	1.1322	-0.035	1.0815	-0.0510	1.1830	-0.0190	1.1163	-0.1674	1.1482	0.0974
530	1.0864	-0.035	1.0353	-0.0487	1.1375	-0.0213	1.0712	-0.1671	1.1016	0.0971
531	1.2058	-0.035	1.0928	-0.0408	1.3189	-0.0292	1.1589	-0.1613	1.2528	0.0913
532	1.1301	-0.035	1.0728	-0.0435	1.1874	-0.0265	1.1144	-0.1664	1.1458	0.0964
533	1.1379	-0.035	1.0933	-0.0473	1.1825	-0.0227	1.1261	-0.1674	1.1497	0.0974
534	1.1680	-0.035	1.0979	-0.0429	1.2381	-0.0271	1.1462	-0.1654	1.1898	0.0954
535	1.1781	-0.035	1.0869	-0.0415	1.2693	-0.0285	1.1453	-0.1636	1.2109	0.0936
536	1.1553	-0.035	1.1219	-0.0437	1.1886	-0.0263	1.1487	-0.1677	1.1618	0.0977
537	1.0926	-0.035	1.0487	-0.0479	1.1366	-0.0221	1.0809	-0.1675	1.1043	0.0975
538	1.0921	-0.035	1.0410	-0.0487	1.1432	-0.0213	1.0770	-0.1671	1.1072	0.0971
539	1.1154	-0.035	1.0792	-0.0479	1.1516	-0.0221	1.1066	-0.1679	1.1241	0.0979
540	1.1462	-0.035	1.1081	-0.0494	1.1843	-0.0206	1.1363	-0.1679	1.1561	0.0979
541	1.0274	-0.035	0.9790	-0.0447	1.0758	-0.0253	1.0151	-0.1670	1.0397	0.0970
542	1.1851	-0.035	1.1151	-0.0438	1.2552	-0.0262	1.1632	-0.1655	1.2071	0.0955
543	1.1541	-0.035	1.0882	-0.0464	1.2199	-0.0236	1.1328	-0.1659	1.1754	0.0959
544	1.0723	-0.035	1.0095	-0.0483	1.1352	-0.0217	1.0519	-0.1664	1.0928	0.0964
545	1.1764	-0.035	1.1274	-0.0432	1.2254	-0.0268	1.1645	-0.1669	1.1883	0.0969
546	1.0800	-0.035	1.0259	-0.0450	1.1340	-0.0250	1.0651	-0.1667	1.0949	0.0967
547	1.1942	-0.035	1.1360	-0.0450	1.2523	-0.0250	1.1773	-0.1664	1.2110	0.0964
548	1.0541	-0.035	1.0092	-0.0490	1.0989	-0.0210	1.0417	-0.1676	1.0664	0.0976
549	1.1240	-0.035	1.0701	-0.0488	1.1780	-0.0212	1.1074	-0.1669	1.1406	0.0969
550	1.1522	-0.035	1.0927	-0.0434	1.2117	-0.0266	1.1357	-0.1662	1.1687	0.0962
551	1.0961	-0.035	1.0659	-0.0509	1.1262	-0.0191	1.0887	-0.1684	1.1034	0.0984
552	1.1786	-0.035	1.1370	-0.0465	1.2202	-0.0235	1.1682	-0.1675	1.1890	0.0975
553	1.0867	-0.035	1.0184	-0.0504	1.1549	-0.0196	1.0620	-0.1661	1.1113	0.0961
554	1.0375	-0.035	0.9595	-0.0461	1.1154	-0.0239	1.0098	-0.1650	1.0651	0.0950
555	1.1754	-0.035	1.1101	-0.0442	1.2408	-0.0258	1.1554	-0.1658	1.1954	0.0958
556	1.1449	-0.035	1.0974	-0.0494	1.1924	-0.0206	1.1311	-0.1674	1.1587	0.0974
557	1.0856	-0.035	1.0290	-0.0454	1.1423	-0.0246	1.0693	-0.1665	1.1020	0.0965
558	1.2349	-0.035	1.1720	-0.0460	1.2977	-0.0240	1.2153	-0.1661	1.2544	0.0961
559	1.1106	-0.035	1.0537	-0.0431	1.1674	-0.0269	1.0951	-0.1663	1.1260	0.0963
560	1.1518	-0.035	1.0906	-0.0467	1.2129	-0.0233	1.1327	-0.1663	1.1708	0.0963
561	1.1761	-0.035	1.1495	-0.0462	1.2028	-0.0238	1.1709	-0.1681	1.1813	0.0981
562	1.0867	-0.035	1.0217	-0.0409	1.1518	-0.0291	1.0686	-0.1657	1.1049	0.0957
563	1.1015	-0.035	1.0595	-0.0511	1.1435	-0.0189	1.0896	-0.1679	1.1134	0.0979
564	1.1232	-0.035	1.0960	-0.0493	1.1504	-0.0207	1.1171	-0.1684	1.1293	0.0984
565	1.1716	-0.035	1.1384	-0.0473	1.2048	-0.0227	1.1640	-0.1679	1.1791	0.0979
566	1.1540	-0.035	1.1025	-0.0466	1.2056	-0.0234	1.1395	-0.1669	1.1686	0.0969
567	1.1207	-0.035	1.0678	-0.0481	1.1735	-0.0219	1.1050	-0.1669	1.1363	0.0969
568	1.0588	-0.035	1.0185	-0.0527	1.0991	-0.0173	1.0469	-0.1682	1.0706	0.0982
569	1.1518	-0.035	1.1077	-0.0483	1.1960	-0.0217	1.1399	-0.1675	1.1638	0.0975
570	1.0193	-0.035	0.9501	-0.0479	1.0885	-0.0221	0.9956	-0.1658	1.0430	0.0958
571	1.0999	-0.035	1.0578	-0.0463	1.1420	-0.0237	1.0894	-0.1674	1.1103	0.0974
572	1.1380	-0.035	1.0767	-0.0459	1.1994	-0.0241	1.1194	-0.1662	1.1567	0.0962
573	1.1589	-0.035	1.1083	-0.0452	1.2095	-0.0248	1.1453	-0.1669	1.1725	0.0969
574	1.1927	-0.035	1.1243	-0.0461	1.2610	-0.0239	1.1701	-0.1657	1.2153	0.0957
575	1.1928	-0.035	1.1390	-0.0437	1.2465	-0.0263	1.1785	-0.1666	1.2071	0.0966
576	1.2823	-0.035	1.1865	-0.0405	1.3781	-0.0295	1.2471	-0.1631	1.3175	0.0931
577	1.1133	-0.035	1.0406	-0.0482	1.1861	-0.0218	1.0874	-0.1656	1.1392	0.0956
578	1.1455	-0.035	1.1013	-0.0444	1.1897	-0.0256	1.1348	-0.1672	1.1561	0.0972
579	1.0647	-0.035	1.0115	-0.0475	1.1180	-0.0225	1.0492	-0.1669	1.0803	0.0969
580	1.1596	-0.035	1.1147	-0.0438	1.2045	-0.0262	1.1489	-0.1671	1.1703	0.0971
581	1.2019	-0.035	1.1372	-0.0432	1.2667	-0.0268	1.1827	-0.1658	1.2211	0.0958
582	1.0720	-0.035	1.0149	-0.0432	1.1291	-0.0268	1.0565	-0.1663	1.0875	0.0963
583	1.0631	-0.035	1.0187	-0.0521	1.1076	-0.0179	1.0497	-0.1679	1.0766	0.0979

584	1.1003	-0.035	1.0382	-0.0451	1.1624	-0.0249	1.0816	-0.1661	1.1191	0.0961
585	1.2749	-0.035	1.1916	-0.0405	1.3583	-0.0295	1.2472	-0.1642	1.3027	0.0942
586	1.1778	-0.035	1.1015	-0.0478	1.2541	-0.0222	1.1498	-0.1652	1.2057	0.0952
587	1.0976	-0.035	1.0429	-0.0508	1.1524	-0.0192	1.0799	-0.1671	1.1154	0.0971
588	1.0584	-0.035	0.9986	-0.0497	1.1183	-0.0203	1.0387	-0.1667	1.0781	0.0967
589	1.2032	-0.035	1.1443	-0.0479	1.2620	-0.0221	1.1846	-0.1665	1.2217	0.0965
590	1.0769	-0.035	0.9961	-0.0443	1.1577	-0.0257	1.0485	-0.1646	1.1053	0.0946
591	1.0754	-0.035	1.0162	-0.0476	1.1346	-0.0224	1.0569	-0.1665	1.0938	0.0965
592	1.1766	-0.035	1.1345	-0.0434	1.2186	-0.0266	1.1672	-0.1672	1.1860	0.0972
593	1.1026	-0.035	1.0192	-0.0416	1.1860	-0.0284	1.0745	-0.1643	1.1307	0.0943
594	1.1699	-0.035	1.1300	-0.0469	1.2098	-0.0231	1.1602	-0.1676	1.1797	0.0976
595	1.1472	-0.035	1.0647	-0.0450	1.2296	-0.0250	1.1175	-0.1645	1.1769	0.0945
596	1.2342	-0.035	1.1771	-0.0450	1.2913	-0.0250	1.2178	-0.1664	1.2506	0.0964
597	1.0876	-0.035	1.0204	-0.0488	1.1548	-0.0212	1.0643	-0.1660	1.1109	0.0960
598	1.1849	-0.035	1.1002	-0.0447	1.2695	-0.0253	1.1538	-0.1643	1.2159	0.0943
599	1.2077	-0.035	1.1214	-0.0410	1.2940	-0.0290	1.1775	-0.1638	1.2379	0.0938
600	1.0808	-0.035	1.0034	-0.0461	1.1582	-0.0239	1.0532	-0.1650	1.1084	0.0950
601	1.1110	-0.035	1.0602	-0.0483	1.1618	-0.0217	1.0961	-0.1671	1.1260	0.0971
602	1.1401	-0.035	1.1031	-0.0470	1.1771	-0.0230	1.1313	-0.1677	1.1489	0.0977
603	1.1139	-0.035	1.0667	-0.0466	1.1612	-0.0234	1.1013	-0.1672	1.1266	0.0972
604	1.0641	-0.035	1.0228	-0.0470	1.1054	-0.0230	1.0537	-0.1675	1.0745	0.0975
605	1.2059	-0.035	1.1599	-0.0453	1.2518	-0.0247	1.1941	-0.1671	1.2176	0.0971
606	1.0854	-0.035	1.0290	-0.0444	1.1417	-0.0256	1.0697	-0.1665	1.1011	0.0965
607	1.1507	-0.035	1.1159	-0.0460	1.1855	-0.0240	1.1430	-0.1678	1.1584	0.0978
608	1.1482	-0.035	1.1068	-0.0429	1.1895	-0.0271	1.1392	-0.1673	1.1571	0.0973
609	1.1964	-0.035	1.1395	-0.0459	1.2533	-0.0241	1.1798	-0.1665	1.2130	0.0965
610	1.1585	-0.035	1.0932	-0.0465	1.2237	-0.0235	1.1375	-0.1660	1.1794	0.0960
611	1.1988	-0.035	1.1522	-0.0448	1.2454	-0.0252	1.1871	-0.1671	1.2106	0.0971
612	0.9932	-0.035	0.9431	-0.0494	1.0432	-0.0206	0.9782	-0.1672	1.0081	0.0972
613	1.2136	-0.035	1.1586	-0.0416	1.2687	-0.0284	1.1998	-0.1664	1.2275	0.0964
614	1.1877	-0.035	1.1446	-0.0456	1.2308	-0.0244	1.1771	-0.1673	1.1983	0.0973
615	1.1391	-0.035	1.0848	-0.0434	1.1935	-0.0266	1.1247	-0.1665	1.1536	0.0965
616	1.1707	-0.035	1.1228	-0.0456	1.2185	-0.0244	1.1582	-0.1671	1.1831	0.0971
617	1.1125	-0.035	1.0692	-0.0458	1.1559	-0.0242	1.1019	-0.1674	1.1232	0.0974
618	1.1032	-0.035	1.0582	-0.0538	1.1482	-0.0162	1.0890	-0.1681	1.1174	0.0981
619	1.0719	-0.035	1.0268	-0.0488	1.1171	-0.0212	1.0594	-0.1675	1.0845	0.0975
620	1.1780	-0.035	1.1145	-0.0432	1.2415	-0.0268	1.1593	-0.1659	1.1967	0.0959
621	1.0814	-0.035	1.0368	-0.0465	1.1260	-0.0235	1.0700	-0.1673	1.0928	0.0973
622	1.2526	-0.035	1.1809	-0.0437	1.3244	-0.0263	1.2295	-0.1653	1.2758	0.0953
623	1.0640	-0.035	1.0091	-0.0474	1.1189	-0.0226	1.0476	-0.1667	1.0804	0.0967
624	1.0987	-0.035	1.0479	-0.0459	1.1495	-0.0241	1.0848	-0.1669	1.1125	0.0969
625	1.1622	-0.035	1.1021	-0.0466	1.2222	-0.0234	1.1437	-0.1663	1.1807	0.0963
626	1.1026	-0.035	1.0407	-0.0401	1.1645	-0.0299	1.0864	-0.1659	1.1188	0.0959
627	1.1679	-0.035	1.1355	-0.0455	1.2004	-0.0245	1.1611	-0.1678	1.1747	0.0978
628	1.1041	-0.035	1.0442	-0.0545	1.1639	-0.0155	1.0822	-0.1672	1.1259	0.0972
629	1.1233	-0.035	1.0472	-0.0456	1.1994	-0.0244	1.0969	-0.1651	1.1497	0.0951
630	1.1587	-0.035	1.0845	-0.0466	1.2330	-0.0234	1.1328	-0.1653	1.1847	0.0953
631	1.1320	-0.035	1.0366	-0.0408	1.2274	-0.0292	1.0969	-0.1631	1.1671	0.0931
632	1.0683	-0.035	1.0087	-0.0474	1.1278	-0.0226	1.0498	-0.1665	1.0868	0.0965
633	1.0960	-0.035	1.0501	-0.0463	1.1418	-0.0237	1.0841	-0.1672	1.1079	0.0972
634	1.0969	-0.035	1.0606	-0.0471	1.1331	-0.0229	1.0884	-0.1678	1.1053	0.0978
635	1.0401	-0.035	1.0077	-0.0511	1.0725	-0.0189	1.0319	-0.1684	1.0482	0.0984
636	1.0806	-0.035	1.0207	-0.0474	1.1406	-0.0226	1.0618	-0.1664	1.0995	0.0964
637	1.0585	-0.035	1.0197	-0.0527	1.0973	-0.0173	1.0474	-0.1683	1.0696	0.0983
638	1.2037	-0.035	1.0990	-0.0405	1.3085	-0.0295	1.1621	-0.1620	1.2454	0.0920
639	1.1363	-0.035	1.0980	-0.0512	1.1745	-0.0188	1.1257	-0.1681	1.1468	0.0981
640	1.1276	-0.035	1.0494	-0.0428	1.2058	-0.0272	1.1016	-0.1647	1.1536	0.0947
641	1.0899	-0.035	1.0442	-0.0498	1.1355	-0.0202	1.0768	-0.1676	1.1030	0.0976
642	1.1703	-0.035	1.1176	-0.0460	1.2230	-0.0240	1.1554	-0.1668	1.1852	0.0968
643	1.2061	-0.035	1.1431	-0.0428	1.2690	-0.0272	1.1879	-0.1659	1.2242	0.0959
644	1.1091	-0.035	1.0159	-0.0492	1.2023	-0.0208	1.0703	-0.1640	1.1479	0.0940
645	1.1100	-0.035	1.0561	-0.0458	1.1638	-0.0242	1.0947	-0.1667	1.1253	0.0967
646	1.1721	-0.035	1.1263	-0.0461	1.2180	-0.0239	1.1603	-0.1672	1.1840	0.0972
647	1.1648	-0.035	1.0694	-0.0439	1.2602	-0.0261	1.1276	-0.1632	1.2021	0.0932
648	1.1092	-0.035	1.0728	-0.0490	1.1456	-0.0210	1.1001	-0.1680	1.1183	0.0980
649	1.1113	-0.035	1.0377	-0.0435	1.1850	-0.0265	1.0873	-0.1651	1.1353	0.0951
650	1.1169	-0.035	1.0604	-0.0450	1.1734	-0.0250	1.1007	-0.1664	1.1330	0.0964
651	1.1256	-0.035	1.0690	-0.0455	1.1822	-0.0245	1.1092	-0.1665	1.1420	0.0965
652	1.1281	-0.035	1.0849	-0.0486	1.1712	-0.0214	1.1164	-0.1676	1.1398	0.0976
653	1.1663	-0.035	1.1075	-0.0431	1.2251	-0.0269	1.1501	-0.1662	1.1826	0.0962
654	1.1440	-0.035	1.0567	-0.0407	1.2312	-0.0293	1.1137	-0.1638	1.1742	0.0938
655	1.1209	-0.035	1.0663	-0.0494	1.1755	-0.0206	1.1038	-0.1670	1.1380	0.0970
656	1.1729	-0.035	1.1177	-0.0440	1.2280	-0.0260	1.1577	-0.1665	1.1880	0.0965

657	1.1181	-0.035	1.0563	-0.0468	1.1799	-0.0232	1.0987	-0.1662	1.1376	0.0962
658	1.1609	-0.035	1.1229	-0.0456	1.1989	-0.0244	1.1522	-0.1676	1.1696	0.0976
659	1.1837	-0.035	1.1333	-0.0459	1.2340	-0.0241	1.1700	-0.1669	1.1973	0.0969
660	1.2088	-0.035	1.1585	-0.0484	1.2590	-0.0216	1.1940	-0.1671	1.2235	0.0971
661	1.1073	-0.035	1.0679	-0.0491	1.1467	-0.0209	1.0969	-0.1678	1.1177	0.0978
662	1.1682	-0.035	1.0857	-0.0456	1.2507	-0.0244	1.1377	-0.1645	1.1986	0.0945
663	1.1704	-0.035	1.1214	-0.0410	1.2195	-0.0290	1.1593	-0.1668	1.1816	0.0968
664	1.1335	-0.035	1.0812	-0.0415	1.1857	-0.0285	1.1208	-0.1666	1.1462	0.0966
665	1.0758	-0.035	1.0225	-0.0452	1.1291	-0.0248	1.0612	-0.1667	1.0904	0.0967
666	1.1885	-0.035	1.1341	-0.0428	1.2429	-0.0272	1.1744	-0.1665	1.2025	0.0965
667	1.1457	-0.035	1.0854	-0.0457	1.2060	-0.0243	1.1276	-0.1663	1.1637	0.0963
668	1.1446	-0.035	1.0868	-0.0468	1.2024	-0.0232	1.1270	-0.1665	1.1621	0.0965
669	1.1763	-0.035	1.1316	-0.0444	1.2209	-0.0256	1.1655	-0.1672	1.1870	0.0972
670	1.0777	-0.035	1.0317	-0.0468	1.1238	-0.0232	1.0655	-0.1672	1.0900	0.0972
671	1.1734	-0.035	1.1100	-0.0451	1.2368	-0.0249	1.1539	-0.1660	1.1929	0.0960
672	1.1583	-0.035	1.1012	-0.0468	1.2155	-0.0232	1.1412	-0.1665	1.1755	0.0965
673	1.2289	-0.035	1.1543	-0.0437	1.3035	-0.0263	1.2040	-0.1650	1.2538	0.0950
674	1.1202	-0.035	1.0877	-0.0528	1.1528	-0.0172	1.1115	-0.1686	1.1290	0.0986
675	1.1192	-0.035	1.0856	-0.0444	1.1527	-0.0256	1.1124	-0.1677	1.1260	0.0977
676	1.1395	-0.035	1.0933	-0.0467	1.1857	-0.0233	1.1271	-0.1672	1.1519	0.0972
677	1.1187	-0.035	1.0837	-0.0510	1.1537	-0.0190	1.1095	-0.1682	1.1279	0.0982
678	1.0965	-0.035	1.0517	-0.0465	1.1413	-0.0235	1.0850	-0.1673	1.1080	0.0973
679	1.1973	-0.035	1.1578	-0.0416	1.2368	-0.0284	1.1893	-0.1673	1.2053	0.0973
680	1.1825	-0.035	1.1149	-0.0467	1.2501	-0.0233	1.1600	-0.1658	1.2051	0.0958
681	1.1535	-0.035	1.0905	-0.0461	1.2165	-0.0239	1.1336	-0.1661	1.1733	0.0961
682	1.1981	-0.035	1.1228	-0.0429	1.2735	-0.0271	1.1734	-0.1649	1.2229	0.0949
683	1.1949	-0.035	1.1304	-0.0453	1.2594	-0.0247	1.1748	-0.1659	1.2150	0.0959
684	1.1836	-0.035	1.1442	-0.0456	1.2229	-0.0244	1.1744	-0.1675	1.1928	0.0975
685	1.0700	-0.035	1.0174	-0.0473	1.1225	-0.0227	1.0547	-0.1669	1.0853	0.0969
686	1.0586	-0.035	0.9957	-0.0469	1.1216	-0.0231	1.0387	-0.1662	1.0785	0.0962
687	1.1799	-0.035	1.0999	-0.0440	1.2599	-0.0260	1.1521	-0.1647	1.2076	0.0947
688	1.1468	-0.035	1.1097	-0.0443	1.1839	-0.0257	1.1388	-0.1676	1.1547	0.0976
689	1.0857	-0.035	1.0272	-0.0469	1.1442	-0.0231	1.0677	-0.1665	1.1037	0.0965
690	1.2017	-0.035	1.1307	-0.0468	1.2727	-0.0232	1.1769	-0.1654	1.2265	0.0954
691	1.2538	-0.035	1.1824	-0.0426	1.3252	-0.0274	1.2313	-0.1652	1.2763	0.0952
692	1.1547	-0.035	1.1133	-0.0472	1.1960	-0.0228	1.1442	-0.1675	1.1651	0.0975
693	1.1013	-0.035	1.0594	-0.0496	1.1432	-0.0204	1.0898	-0.1677	1.1127	0.0977
694	1.1792	-0.035	1.1355	-0.0442	1.2229	-0.0258	1.1688	-0.1672	1.1896	0.0972
695	1.0882	-0.035	1.0443	-0.0459	1.1321	-0.0241	1.0772	-0.1673	1.0992	0.0973
696	1.1255	-0.035	1.0829	-0.0436	1.1680	-0.0264	1.1157	-0.1672	1.1352	0.0972
697	1.0484	-0.035	1.0156	-0.0523	1.0812	-0.0177	1.0397	-0.1685	1.0571	0.0985
698	1.1113	-0.035	1.0683	-0.0454	1.1543	-0.0246	1.1008	-0.1673	1.1218	0.0973
699	1.2155	-0.035	1.1694	-0.0448	1.2616	-0.0252	1.2040	-0.1671	1.2270	0.0971
700	1.1152	-0.035	1.0823	-0.0490	1.1482	-0.0210	1.1074	-0.1681	1.1231	0.0981
701	1.0412	-0.035	1.0023	-0.0487	1.0801	-0.0213	1.0312	-0.1678	1.0511	0.0978
702	1.0949	-0.035	1.0437	-0.0498	1.1461	-0.0202	1.0794	-0.1672	1.1104	0.0972
703	1.1541	-0.035	1.0655	-0.0411	1.2428	-0.0289	1.1231	-0.1638	1.1852	0.0938
704	1.2381	-0.035	1.1771	-0.0413	1.2991	-0.0287	1.2218	-0.1660	1.2544	0.0960
705	1.1658	-0.035	1.0917	-0.0428	1.2399	-0.0272	1.1420	-0.1651	1.1896	0.0951
706	1.1711	-0.035	1.0994	-0.0447	1.2429	-0.0253	1.1476	-0.1654	1.1947	0.0954
707	1.2050	-0.035	1.1678	-0.0429	1.2422	-0.0271	1.1974	-0.1675	1.2126	0.0975
708	1.2172	-0.035	1.1480	-0.0466	1.2864	-0.0234	1.1939	-0.1657	1.2404	0.0957
709	1.1382	-0.035	1.0801	-0.0479	1.1963	-0.0221	1.1200	-0.1666	1.1564	0.0966
710	1.1328	-0.035	1.0877	-0.0439	1.1778	-0.0261	1.1220	-0.1671	1.1435	0.0971
711	1.1760	-0.035	1.1196	-0.0434	1.2325	-0.0266	1.1608	-0.1664	1.1913	0.0964
712	1.1265	-0.035	1.0523	-0.0488	1.2007	-0.0212	1.0994	-0.1655	1.1536	0.0955
713	1.0953	-0.035	1.0555	-0.0478	1.1351	-0.0222	1.0854	-0.1677	1.1052	0.0977
714	1.1201	-0.035	1.0635	-0.0440	1.1768	-0.0260	1.1044	-0.1664	1.1358	0.0964
715	1.2279	-0.035	1.1514	-0.0420	1.3044	-0.0280	1.2032	-0.1648	1.2526	0.0948
716	1.1300	-0.035	1.0648	-0.0446	1.1953	-0.0254	1.1099	-0.1658	1.1501	0.0958
717	1.1933	-0.035	1.1335	-0.0437	1.2532	-0.0263	1.1763	-0.1662	1.2103	0.0962
718	1.1231	-0.035	1.0586	-0.0481	1.1876	-0.0219	1.1018	-0.1662	1.1445	0.0962
719	1.1245	-0.035	1.0897	-0.0432	1.1592	-0.0268	1.1176	-0.1676	1.1313	0.0976
720	1.1627	-0.035	1.1127	-0.0458	1.2127	-0.0242	1.1492	-0.1669	1.1763	0.0969
721	1.1274	-0.035	1.0674	-0.0465	1.1874	-0.0235	1.1093	-0.1664	1.1456	0.0964
722	1.1300	-0.035	1.0848	-0.0445	1.1752	-0.0255	1.1191	-0.1672	1.1409	0.0972
723	1.0872	-0.035	1.0445	-0.0448	1.1300	-0.0252	1.0771	-0.1673	1.0974	0.0973
724	1.1823	-0.035	1.1061	-0.0459	1.2586	-0.0241	1.1555	-0.1650	1.2092	0.0950
725	1.1430	-0.035	1.0886	-0.0478	1.1974	-0.0222	1.1268	-0.1668	1.1592	0.0968
726	1.0466	-0.035	0.9768	-0.0439	1.1163	-0.0261	1.0246	-0.1655	1.0686	0.0955
727	1.1555	-0.035	1.0928	-0.0450	1.2182	-0.0250	1.1364	-0.1660	1.1747	0.0960
728	1.1559	-0.035	1.1106	-0.0492	1.2013	-0.0208	1.1431	-0.1675	1.1688	0.0975
729	1.1896	-0.035	1.1368	-0.0456	1.2423	-0.0244	1.1750	-0.1668	1.2041	0.0968

730	1.0756	-0.035	1.0326	-0.0480	1.1185	-0.0220	1.0642	-0.1675	1.0870	0.0975
731	1.0772	-0.035	1.0216	-0.0466	1.1328	-0.0234	1.0609	-0.1666	1.0936	0.0966
732	1.1063	-0.035	1.0595	-0.0493	1.1531	-0.0207	1.0928	-0.1674	1.1198	0.0974
733	1.1708	-0.035	1.1197	-0.0479	1.2219	-0.0221	1.1560	-0.1670	1.1856	0.0970
734	1.1269	-0.035	1.0907	-0.0476	1.1631	-0.0224	1.1182	-0.1678	1.1356	0.0978
735	1.0015	-0.035	0.9603	-0.0464	1.0427	-0.0236	0.9915	-0.1675	1.0116	0.0975
736	1.1391	-0.035	1.0861	-0.0467	1.1920	-0.0233	1.1238	-0.1668	1.1543	0.0968
737	1.1426	-0.035	1.0818	-0.0461	1.2034	-0.0239	1.1241	-0.1663	1.1612	0.0963
738	1.1010	-0.035	1.0364	-0.0498	1.1655	-0.0202	1.0787	-0.1663	1.1232	0.0963
739	1.0957	-0.035	1.0668	-0.0471	1.1247	-0.0229	1.0897	-0.1681	1.1017	0.0981
740	1.0565	-0.035	0.9688	-0.0432	1.1442	-0.0268	1.0244	-0.1639	1.0886	0.0939
741	1.1371	-0.035	1.0835	-0.0418	1.1908	-0.0282	1.1237	-0.1665	1.1506	0.0965
742	1.1821	-0.035	1.1235	-0.0476	1.2407	-0.0224	1.1640	-0.1666	1.2002	0.0966
743	1.0914	-0.035	1.0385	-0.0502	1.1442	-0.0198	1.0747	-0.1671	1.1081	0.0971
744	1.0957	-0.035	1.0420	-0.0488	1.1495	-0.0212	1.0793	-0.1669	1.1122	0.0969
745	1.0726	-0.035	1.0100	-0.0482	1.1351	-0.0218	1.0523	-0.1664	1.0928	0.0964
746	1.1466	-0.035	1.1156	-0.0494	1.1777	-0.0206	1.1392	-0.1682	1.1540	0.0982
747	1.1775	-0.035	1.1170	-0.0413	1.2380	-0.0287	1.1613	-0.1660	1.1938	0.0960
748	1.1395	-0.035	1.0791	-0.0461	1.1998	-0.0239	1.1211	-0.1663	1.1578	0.0963
749	1.0835	-0.035	1.0497	-0.0496	1.1173	-0.0204	1.0752	-0.1681	1.0919	0.0981
750	1.1014	-0.035	1.0530	-0.0470	1.1497	-0.0230	1.0882	-0.1671	1.1145	0.0971
751	1.1550	-0.035	1.0959	-0.0434	1.2142	-0.0266	1.1385	-0.1662	1.1716	0.0962
752	1.2133	-0.035	1.1462	-0.0427	1.2804	-0.0273	1.1932	-0.1656	1.2335	0.0956
753	1.1293	-0.035	1.0762	-0.0434	1.1824	-0.0266	1.1155	-0.1666	1.1431	0.0966
754	1.2294	-0.035	1.1464	-0.0431	1.3124	-0.0269	1.2003	-0.1643	1.2585	0.0943
755	1.0259	-0.035	0.9873	-0.0472	1.0644	-0.0228	1.0165	-0.1677	1.0353	0.0977
756	1.1691	-0.035	1.1017	-0.0449	1.2365	-0.0251	1.1477	-0.1657	1.1905	0.0957
757	1.1522	-0.035	1.0960	-0.0480	1.2085	-0.0220	1.1352	-0.1668	1.1693	0.0968
758	1.2114	-0.035	1.1441	-0.0447	1.2787	-0.0253	1.1902	-0.1657	1.2326	0.0957
759	1.1079	-0.035	1.0510	-0.0462	1.1649	-0.0238	1.0912	-0.1665	1.1247	0.0965
760	1.1940	-0.035	1.1385	-0.0454	1.2496	-0.0246	1.1780	-0.1665	1.2100	0.0965
761	1.2119	-0.035	1.1483	-0.0429	1.2756	-0.0271	1.1935	-0.1659	1.2303	0.0959
762	1.1434	-0.035	1.0979	-0.0466	1.1889	-0.0234	1.1314	-0.1673	1.1553	0.0973
763	1.0734	-0.035	1.0242	-0.0514	1.1225	-0.0186	1.0581	-0.1675	1.0886	0.0975
764	1.0973	-0.035	1.0561	-0.0462	1.1386	-0.0238	1.0872	-0.1675	1.1075	0.0975
765	1.1335	-0.035	1.0797	-0.0473	1.1874	-0.0227	1.1178	-0.1668	1.1493	0.0968
766	1.1572	-0.035	1.1119	-0.0528	1.2025	-0.0172	1.1432	-0.1679	1.1713	0.0979
767	1.0969	-0.035	1.0568	-0.0486	1.1370	-0.0214	1.0865	-0.1677	1.1073	0.0977
768	1.0991	-0.035	1.0332	-0.0497	1.1649	-0.0203	1.0761	-0.1662	1.1221	0.0962
769	1.1319	-0.035	1.0833	-0.0463	1.1805	-0.0237	1.1188	-0.1671	1.1450	0.0971
770	1.1762	-0.035	1.1157	-0.0439	1.2367	-0.0261	1.1586	-0.1661	1.1938	0.0961
771	1.1050	-0.035	1.0472	-0.0467	1.1629	-0.0233	1.0874	-0.1665	1.1227	0.0965
772	1.0290	-0.035	0.9441	-0.0443	1.1139	-0.0257	0.9982	-0.1643	1.0598	0.0943
773	1.1444	-0.035	1.0788	-0.0450	1.2100	-0.0250	1.1237	-0.1658	1.1650	0.0958
774	1.1272	-0.035	1.0796	-0.0411	1.1747	-0.0289	1.1167	-0.1669	1.1377	0.0969
775	1.0648	-0.035	1.0115	-0.0534	1.1180	-0.0166	1.0468	-0.1675	1.0827	0.0975
776	1.1049	-0.035	1.0622	-0.0495	1.1475	-0.0205	1.0931	-0.1677	1.1166	0.0977
777	1.1498	-0.035	1.0983	-0.0442	1.2013	-0.0258	1.1364	-0.1668	1.1632	0.0968
778	1.2274	-0.035	1.1564	-0.0429	1.2985	-0.0271	1.2052	-0.1653	1.2497	0.0953
779	1.0704	-0.035	1.0123	-0.0493	1.1285	-0.0207	1.0518	-0.1667	1.0890	0.0967
780	1.0558	-0.035	0.9885	-0.0497	1.1231	-0.0203	1.0323	-0.1662	1.0794	0.0962
781	1.0921	-0.035	1.0551	-0.0473	1.1291	-0.0227	1.0833	-0.1678	1.1010	0.0978
782	1.1007	-0.035	1.0195	-0.0465	1.1820	-0.0235	1.0709	-0.1647	1.1306	0.0947
783	1.1993	-0.035	1.1549	-0.0464	1.2437	-0.0236	1.1879	-0.1673	1.2107	0.0973
784	1.0939	-0.035	1.0513	-0.0493	1.1364	-0.0207	1.0823	-0.1677	1.1054	0.0977
785	1.0586	-0.035	0.9956	-0.0450	1.1216	-0.0250	1.0394	-0.1660	1.0778	0.0960
786	1.0603	-0.035	1.0204	-0.0487	1.1002	-0.0213	1.0500	-0.1678	1.0706	0.0978
787	1.0728	-0.035	1.0013	-0.0441	1.1443	-0.0259	1.0496	-0.1653	1.0960	0.0953
788	1.1604	-0.035	1.1192	-0.0492	1.2015	-0.0208	1.1492	-0.1677	1.1716	0.0977
789	1.1053	-0.035	1.0664	-0.0463	1.1442	-0.0237	1.0961	-0.1676	1.1145	0.0976
790	1.1216	-0.035	1.0658	-0.0468	1.1774	-0.0232	1.1050	-0.1666	1.1383	0.0966
791	1.0671	-0.035	1.0265	-0.0471	1.1077	-0.0229	1.0570	-0.1676	1.0772	0.0976
792	1.0966	-0.035	1.0493	-0.0484	1.1439	-0.0216	1.0833	-0.1673	1.1099	0.0973
793	1.1068	-0.035	1.0595	-0.0461	1.1542	-0.0239	1.0943	-0.1671	1.1193	0.0971
794	1.1760	-0.035	1.1378	-0.0444	1.2141	-0.0256	1.1676	-0.1675	1.1843	0.0975
795	1.1113	-0.035	1.0454	-0.0488	1.1771	-0.0212	1.0887	-0.1661	1.1339	0.0961
796	1.1185	-0.035	1.0660	-0.0455	1.1710	-0.0245	1.1041	-0.1668	1.1329	0.0968
797	1.1441	-0.035	1.0896	-0.0472	1.1987	-0.0228	1.1281	-0.1668	1.1602	0.0968
798	1.0947	-0.035	0.9948	-0.0452	1.1945	-0.0248	1.0538	-0.1630	1.1355	0.0930
799	1.1349	-0.035	1.0862	-0.0426	1.1836	-0.0274	1.1232	-0.1668	1.1466	0.0968
800	1.1575	-0.035	1.0950	-0.0474	1.2199	-0.0226	1.1375	-0.1663	1.1775	0.0963
801	1.1770	-0.035	1.1191	-0.0452	1.2349	-0.0248	1.1602	-0.1664	1.1939	0.0964
802	1.1194	-0.035	1.0623	-0.0459	1.1766	-0.0241	1.1027	-0.1665	1.1362	0.0965

803	1.0832	-0.035	1.0267	-0.0517	1.1398	-0.0183	1.0641	-0.1671	1.1023	0.0971
804	1.2266	-0.035	1.1567	-0.0412	1.2965	-0.0288	1.2060	-0.1654	1.2472	0.0954
805	1.0926	-0.035	1.0244	-0.0459	1.1608	-0.0241	1.0703	-0.1657	1.1150	0.0957
806	1.1505	-0.035	1.0708	-0.0459	1.2303	-0.0241	1.1219	-0.1648	1.1792	0.0948
807	1.1224	-0.035	1.0704	-0.0478	1.1744	-0.0222	1.1072	-0.1670	1.1376	0.0970
808	1.2095	-0.035	1.1322	-0.0431	1.2869	-0.0269	1.1837	-0.1648	1.2354	0.0948
809	1.2170	-0.035	1.1282	-0.0468	1.3057	-0.0232	1.1823	-0.1641	1.2516	0.0941
810	1.0823	-0.035	1.0375	-0.0501	1.1271	-0.0199	1.0695	-0.1676	1.0951	0.0976
811	1.1056	-0.035	1.0706	-0.0471	1.1407	-0.0229	1.0976	-0.1679	1.1137	0.0979
812	1.1555	-0.035	1.1082	-0.0475	1.2027	-0.0225	1.1426	-0.1672	1.1684	0.0972
813	1.1936	-0.035	1.1426	-0.0451	1.2446	-0.0249	1.1798	-0.1668	1.2074	0.0968
814	1.0836	-0.035	1.0251	-0.0418	1.1420	-0.0282	1.0680	-0.1662	1.0991	0.0962
815	1.1064	-0.035	1.0618	-0.0528	1.1510	-0.0172	1.0928	-0.1680	1.1201	0.0980
816	1.1129	-0.035	1.0509	-0.0477	1.1748	-0.0223	1.0930	-0.1663	1.1328	0.0963
817	1.0826	-0.035	1.0444	-0.0519	1.1208	-0.0181	1.0720	-0.1682	1.0933	0.0982
818	1.1175	-0.035	1.0675	-0.0461	1.1676	-0.0239	1.1039	-0.1670	1.1312	0.0970
819	1.1506	-0.035	1.0929	-0.0464	1.2083	-0.0236	1.1334	-0.1665	1.1677	0.0965
820	1.1685	-0.035	1.1258	-0.0497	1.2112	-0.0203	1.1566	-0.1677	1.1804	0.0977
821	1.0656	-0.035	1.0295	-0.0519	1.1017	-0.0181	1.0558	-0.1683	1.0754	0.0983
822	1.1812	-0.035	1.1309	-0.0435	1.2314	-0.0265	1.1686	-0.1668	1.1937	0.0968
823	1.0781	-0.035	1.0341	-0.0491	1.1220	-0.0209	1.0660	-0.1676	1.0902	0.0976
824	1.0802	-0.035	1.0341	-0.0487	1.1263	-0.0213	1.0672	-0.1674	1.0931	0.0974
825	1.1935	-0.035	1.1372	-0.0449	1.2497	-0.0251	1.1775	-0.1665	1.2094	0.0965
826	1.0354	-0.035	0.9778	-0.0487	1.0930	-0.0213	1.0173	-0.1667	1.0535	0.0967
827	1.1043	-0.035	1.0586	-0.0455	1.1500	-0.0245	1.0928	-0.1672	1.1157	0.0972
828	1.1580	-0.035	1.1175	-0.0518	1.1985	-0.0182	1.1463	-0.1680	1.1698	0.0980
829	1.1069	-0.035	1.0368	-0.0434	1.1769	-0.0266	1.0849	-0.1654	1.1289	0.0954
830	1.1176	-0.035	1.0794	-0.0415	1.1559	-0.0285	1.1101	-0.1674	1.1251	0.0974
831	1.0182	-0.035	0.9795	-0.0525	1.0570	-0.0175	1.0072	-0.1682	1.0293	0.0982
832	1.1856	-0.035	1.1281	-0.0445	1.2431	-0.0255	1.1693	-0.1664	1.2019	0.0964
833	1.1372	-0.035	1.0468	-0.0434	1.2276	-0.0266	1.1035	-0.1637	1.1709	0.0937
834	1.1315	-0.035	1.0653	-0.0455	1.1978	-0.0245	1.1102	-0.1658	1.1528	0.0958
835	1.2666	-0.035	1.1802	-0.0422	1.3531	-0.0278	1.2358	-0.1639	1.2975	0.0939
836	1.1946	-0.035	1.1484	-0.0459	1.2408	-0.0241	1.1826	-0.1672	1.2066	0.0972
837	1.1397	-0.035	1.1004	-0.0512	1.1790	-0.0188	1.1288	-0.1680	1.1506	0.0980
838	1.1287	-0.035	1.0664	-0.0423	1.1911	-0.0277	1.1112	-0.1659	1.1463	0.0959
839	1.1735	-0.035	1.1193	-0.0443	1.2277	-0.0257	1.1588	-0.1666	1.1882	0.0966
840	1.1261	-0.035	1.0785	-0.0448	1.1737	-0.0252	1.1141	-0.1670	1.1381	0.0970
841	1.2105	-0.035	1.1461	-0.0433	1.2748	-0.0267	1.1914	-0.1658	1.2296	0.0958
842	1.1479	-0.035	1.1002	-0.0405	1.1957	-0.0295	1.1375	-0.1668	1.1583	0.0968
843	1.1492	-0.035	1.1041	-0.0435	1.1943	-0.0265	1.1385	-0.1671	1.1599	0.0971
844	1.1302	-0.035	1.0757	-0.0432	1.1846	-0.0268	1.1158	-0.1665	1.1445	0.0965
845	1.1745	-0.035	1.1266	-0.0432	1.2223	-0.0268	1.1628	-0.1669	1.1861	0.0969
846	1.0646	-0.035	0.9685	-0.0463	1.1606	-0.0237	1.0256	-0.1634	1.1035	0.0934
847	1.1328	-0.035	1.0709	-0.0486	1.1947	-0.0214	1.1124	-0.1664	1.1532	0.0964
848	1.0374	-0.035	0.9826	-0.0519	1.0923	-0.0181	1.0193	-0.1672	1.0556	0.0972
849	1.0547	-0.035	0.9661	-0.0462	1.1433	-0.0238	1.0203	-0.1640	1.0891	0.0940
850	1.1259	-0.035	1.0483	-0.0446	1.2035	-0.0254	1.0992	-0.1649	1.1526	0.0949
851	1.1518	-0.035	1.0774	-0.0423	1.2261	-0.0277	1.1279	-0.1650	1.1756	0.0950
852	1.0293	-0.035	0.9680	-0.0478	1.0905	-0.0222	1.0097	-0.1664	1.0489	0.0964
853	1.0986	-0.035	1.0579	-0.0510	1.1392	-0.0190	1.0871	-0.1680	1.1100	0.0980
854	1.2176	-0.035	1.1703	-0.0425	1.2649	-0.0275	1.2066	-0.1669	1.2286	0.0969
855	1.1321	-0.035	1.0690	-0.0448	1.1951	-0.0252	1.1129	-0.1660	1.1512	0.0960
856	1.0827	-0.035	1.0308	-0.0519	1.1347	-0.0181	1.0660	-0.1674	1.0995	0.0974
857	1.1222	-0.035	1.0738	-0.0474	1.1706	-0.0226	1.1088	-0.1672	1.1355	0.0972
858	1.1446	-0.035	1.0918	-0.0455	1.1973	-0.0245	1.1300	-0.1668	1.1591	0.0968
859	1.2066	-0.035	1.1197	-0.0412	1.2935	-0.0288	1.1766	-0.1640	1.2366	0.0940
860	1.1896	-0.035	1.1338	-0.0444	1.2453	-0.0256	1.1741	-0.1665	1.2050	0.0965
861	1.1521	-0.035	1.1034	-0.0533	1.2007	-0.0167	1.1362	-0.1678	1.1679	0.0978
862	1.1704	-0.035	1.1329	-0.0450	1.2078	-0.0250	1.1621	-0.1676	1.1787	0.0976
863	1.1173	-0.035	1.0764	-0.0490	1.1581	-0.0210	1.1065	-0.1677	1.1280	0.0977
864	1.1873	-0.035	1.1107	-0.0412	1.2640	-0.0288	1.1631	-0.1648	1.2116	0.0948
865	1.1198	-0.035	1.0550	-0.0468	1.1845	-0.0232	1.0988	-0.1660	1.1407	0.0960
866	1.1753	-0.035	1.1101	-0.0465	1.2405	-0.0235	1.1539	-0.1659	1.1967	0.0959
867	1.0977	-0.035	1.0346	-0.0476	1.1608	-0.0224	1.0772	-0.1662	1.1181	0.0962
868	1.0018	-0.035	0.9654	-0.0557	1.0382	-0.0143	0.9908	-0.1688	1.0128	0.0988
869	1.0800	-0.035	1.0133	-0.0494	1.1467	-0.0206	1.0568	-0.1661	1.1032	0.0961
870	1.0745	-0.035	1.0174	-0.0463	1.1315	-0.0237	1.0574	-0.1665	1.0915	0.0965
871	1.0552	-0.035	1.0160	-0.0512	1.0945	-0.0188	1.0443	-0.1681	1.0661	0.0981
872	1.0999	-0.035	1.0413	-0.0454	1.1585	-0.0246	1.0827	-0.1664	1.1170	0.0964
873	1.1616	-0.035	1.1134	-0.0454	1.2098	-0.0246	1.1491	-0.1670	1.1741	0.0970
874	1.1377	-0.035	1.0884	-0.0458	1.1869	-0.0242	1.1246	-0.1670	1.1508	0.0970
875	1.2188	-0.035	1.1686	-0.0466	1.2690	-0.0234	1.2049	-0.1670	1.2327	0.0970

876	1.0720	-0.035	1.0014	-0.0481	1.1426	-0.0219	1.0472	-0.1657	1.0968	0.0957
877	1.1235	-0.035	1.0693	-0.0471	1.1777	-0.0229	1.1076	-0.1668	1.1394	0.0968
878	1.2489	-0.035	1.1588	-0.0398	1.3389	-0.0302	1.2178	-0.1636	1.2799	0.0936
879	1.1276	-0.035	1.0793	-0.0480	1.1760	-0.0220	1.1139	-0.1672	1.1414	0.0972
880	1.0599	-0.035	0.9873	-0.0523	1.1325	-0.0177	1.0318	-0.1660	1.0881	0.0960
881	1.1208	-0.035	1.0694	-0.0499	1.1722	-0.0201	1.1050	-0.1672	1.1366	0.0972
882	1.0926	-0.035	1.0143	-0.0447	1.1709	-0.0253	1.0651	-0.1648	1.1201	0.0948
883	1.1032	-0.035	1.0482	-0.0468	1.1582	-0.0232	1.0871	-0.1667	1.1193	0.0967
884	1.1231	-0.035	1.0763	-0.0469	1.1699	-0.0231	1.1105	-0.1672	1.1357	0.0972
885	1.0634	-0.035	1.0169	-0.0464	1.1099	-0.0236	1.0512	-0.1672	1.0756	0.0972
886	1.2244	-0.035	1.1573	-0.0407	1.2915	-0.0293	1.2052	-0.1655	1.2436	0.0955
887	1.1354	-0.035	1.0735	-0.0455	1.1973	-0.0245	1.1167	-0.1662	1.1541	0.0962
888	1.1574	-0.035	1.1136	-0.0468	1.2011	-0.0232	1.1460	-0.1674	1.1687	0.0974
889	1.0919	-0.035	1.0421	-0.0442	1.1417	-0.0258	1.0791	-0.1669	1.1046	0.0969
890	1.0090	-0.035	0.9714	-0.0473	1.0465	-0.0227	1.0000	-0.1678	1.0179	0.0978
891	1.1786	-0.035	1.1007	-0.0438	1.2564	-0.0262	1.1523	-0.1649	1.2048	0.0949
892	1.0927	-0.035	1.0534	-0.0455	1.1321	-0.0245	1.0836	-0.1675	1.1019	0.0975
893	1.1282	-0.035	1.0522	-0.0438	1.2041	-0.0262	1.1026	-0.1649	1.1538	0.0949
894	1.1600	-0.035	1.1025	-0.0481	1.2175	-0.0219	1.1420	-0.1666	1.1779	0.0966
895	1.1162	-0.035	1.0575	-0.0419	1.1749	-0.0281	1.1005	-0.1661	1.1320	0.0961
896	1.1604	-0.035	1.1196	-0.0451	1.2012	-0.0249	1.1509	-0.1674	1.1699	0.0974
897	1.1325	-0.035	1.0645	-0.0501	1.2005	-0.0199	1.1082	-0.1661	1.1568	0.0961
898	1.0703	-0.035	1.0211	-0.0492	1.1194	-0.0208	1.0558	-0.1673	1.0847	0.0973
899	1.1672	-0.035	1.1213	-0.0472	1.2130	-0.0228	1.1548	-0.1673	1.1796	0.0973
900	1.0632	-0.035	1.0038	-0.0471	1.1226	-0.0229	1.0448	-0.1664	1.0816	0.0964
901	1.1177	-0.035	1.0727	-0.0474	1.1627	-0.0226	1.1057	-0.1674	1.1297	0.0974
902	1.1969	-0.035	1.1604	-0.0415	1.2333	-0.0285	1.1900	-0.1674	1.2038	0.0974
903	1.2388	-0.035	1.1604	-0.0422	1.3172	-0.0278	1.2129	-0.1647	1.2647	0.0947
904	1.1343	-0.035	1.0958	-0.0479	1.1729	-0.0221	1.1247	-0.1678	1.1439	0.0978
905	1.0753	-0.035	1.0014	-0.0474	1.1492	-0.0226	1.0490	-0.1653	1.1017	0.0953
906	1.1193	-0.035	1.0573	-0.0439	1.1813	-0.0261	1.1010	-0.1660	1.1376	0.0960
907	1.1251	-0.035	1.0756	-0.0502	1.1746	-0.0198	1.1101	-0.1674	1.1401	0.0974
908	1.0817	-0.035	1.0352	-0.0496	1.1283	-0.0204	1.0682	-0.1675	1.0952	0.0975
909	1.1466	-0.035	1.1001	-0.0443	1.1932	-0.0257	1.1351	-0.1671	1.1581	0.0971
910	1.1964	-0.035	1.1575	-0.0467	1.2353	-0.0233	1.1870	-0.1676	1.2058	0.0976
911	1.0677	-0.035	1.0061	-0.0482	1.1294	-0.0218	1.0477	-0.1664	1.0878	0.0964
912	1.1890	-0.035	1.1166	-0.0406	1.2614	-0.0294	1.1672	-0.1651	1.2108	0.0951
913	1.1259	-0.035	1.0790	-0.0447	1.1727	-0.0253	1.1142	-0.1671	1.1376	0.0971
914	1.0214	-0.035	0.9654	-0.0450	1.0775	-0.0250	1.0056	-0.1665	1.0373	0.0965
915	1.1517	-0.035	1.1021	-0.0451	1.2014	-0.0249	1.1386	-0.1669	1.1649	0.0969
916	1.2410	-0.035	1.1688	-0.0440	1.3132	-0.0260	1.2178	-0.1653	1.2643	0.0953
917	1.1081	-0.035	1.0295	-0.0428	1.1866	-0.0272	1.0818	-0.1647	1.1343	0.0947
918	1.0818	-0.035	1.0131	-0.0465	1.1505	-0.0235	1.0590	-0.1657	1.1046	0.0957
919	1.2559	-0.035	1.1805	-0.0459	1.3313	-0.0241	1.2295	-0.1651	1.2824	0.0951
920	1.1217	-0.035	1.0795	-0.0478	1.1638	-0.0222	1.1107	-0.1675	1.1327	0.0975
921	1.2222	-0.035	1.1438	-0.0435	1.3006	-0.0265	1.1954	-0.1647	1.2490	0.0947
922	1.0653	-0.035	1.0014	-0.0453	1.1293	-0.0247	1.0456	-0.1660	1.0851	0.0960
923	1.0321	-0.035	0.9891	-0.0498	1.0750	-0.0202	1.0201	-0.1677	1.0440	0.0977
924	1.1894	-0.035	1.0985	-0.0421	1.2802	-0.0279	1.1559	-0.1635	1.2228	0.0935
925	1.1471	-0.035	1.1077	-0.0497	1.1865	-0.0203	1.1366	-0.1679	1.1576	0.0979
926	1.1506	-0.035	1.1013	-0.0438	1.1999	-0.0262	1.1381	-0.1668	1.1631	0.0968
927	1.0724	-0.035	1.0245	-0.0476	1.1204	-0.0224	1.0592	-0.1672	1.0856	0.0972
928	1.0714	-0.035	1.0344	-0.0531	1.1085	-0.0169	1.0609	-0.1684	1.0819	0.0984
929	1.1595	-0.035	1.1039	-0.0491	1.2151	-0.0209	1.1421	-0.1669	1.1769	0.0969
930	1.0953	-0.035	1.0397	-0.0494	1.1508	-0.0206	1.0778	-0.1669	1.1127	0.0969
931	1.0703	-0.035	1.0220	-0.0481	1.1187	-0.0219	1.0567	-0.1672	1.0840	0.0972
932	1.0420	-0.035	0.9907	-0.0466	1.0934	-0.0234	1.0276	-0.1669	1.0564	0.0969
933	1.0962	-0.035	1.0359	-0.0464	1.1565	-0.0236	1.0778	-0.1663	1.1146	0.0963
934	1.1756	-0.035	1.1341	-0.0444	1.2171	-0.0256	1.1660	-0.1673	1.1852	0.0973
935	1.1820	-0.035	1.1299	-0.0441	1.2341	-0.0259	1.1683	-0.1667	1.1958	0.0967
936	1.1111	-0.035	1.0566	-0.0482	1.1657	-0.0218	1.0945	-0.1668	1.1277	0.0968
937	1.2041	-0.035	1.1500	-0.0450	1.2583	-0.0250	1.1893	-0.1667	1.2190	0.0967
938	1.1280	-0.035	1.0688	-0.0484	1.1872	-0.0216	1.1092	-0.1666	1.1467	0.0966
939	1.0717	-0.035	1.0095	-0.0491	1.1339	-0.0209	1.0509	-0.1664	1.0925	0.0964
940	1.1649	-0.035	1.0899	-0.0449	1.2399	-0.0251	1.1396	-0.1652	1.1901	0.0952
941	1.1423	-0.035	1.0819	-0.0457	1.2028	-0.0243	1.1239	-0.1662	1.1607	0.0962
942	1.0723	-0.035	1.0142	-0.0541	1.1304	-0.0159	1.0514	-0.1673	1.0931	0.0973
943	1.1634	-0.035	1.1322	-0.0454	1.1947	-0.0246	1.1570	-0.1679	1.1698	0.0979
944	1.1350	-0.035	1.0757	-0.0505	1.1944	-0.0195	1.1149	-0.1667	1.1552	0.0967
945	1.1054	-0.035	1.0515	-0.0453	1.1593	-0.0247	1.0905	-0.1667	1.1203	0.0967
946	1.0746	-0.035	1.0354	-0.0510	1.1137	-0.0190	1.0637	-0.1680	1.0854	0.0980
947	1.2121	-0.035	1.1292	-0.0414	1.2949	-0.0286	1.1842	-0.1643	1.2400	0.0943
948	1.1706	-0.035	1.1267	-0.0433	1.2145	-0.0267	1.1604	-0.1671	1.1808	0.0971

949	1.1346	-0.035	1.0914	-0.0451	1.1778	-0.0249	1.1241	-0.1673	1.1450	0.0973
950	1.0503	-0.035	0.9632	-0.0508	1.1373	-0.0192	1.0141	-0.1646	1.0864	0.0946
951	1.1171	-0.035	1.0593	-0.0453	1.1748	-0.0247	1.1002	-0.1664	1.1340	0.0964
952	1.0938	-0.035	1.0315	-0.0449	1.1561	-0.0251	1.0750	-0.1661	1.1126	0.0961
953	1.1602	-0.035	1.0859	-0.0456	1.2344	-0.0244	1.1346	-0.1652	1.1857	0.0952
954	1.1179	-0.035	1.0648	-0.0477	1.1710	-0.0223	1.1023	-0.1669	1.1335	0.0969
955	1.1281	-0.035	1.0433	-0.0453	1.2129	-0.0247	1.0966	-0.1643	1.1597	0.0943
956	1.1292	-0.035	1.0669	-0.0456	1.1916	-0.0244	1.1101	-0.1661	1.1483	0.0961
957	1.1644	-0.035	1.0983	-0.0454	1.2306	-0.0246	1.1434	-0.1658	1.1855	0.0958
958	1.0921	-0.035	1.0269	-0.0477	1.1573	-0.0223	1.0705	-0.1661	1.1137	0.0961
959	1.0456	-0.035	0.9872	-0.0493	1.1040	-0.0207	1.0267	-0.1667	1.0645	0.0967
960	1.0615	-0.035	1.0057	-0.0492	1.1172	-0.0208	1.0441	-0.1669	1.0788	0.0969
961	1.1329	-0.035	1.1013	-0.0473	1.1645	-0.0227	1.1259	-0.1680	1.1399	0.0980
962	1.1528	-0.035	1.1091	-0.0462	1.1965	-0.0238	1.1417	-0.1673	1.1639	0.0973
963	1.0506	-0.035	0.9979	-0.0475	1.1033	-0.0225	1.0353	-0.1669	1.0660	0.0969
964	1.1091	-0.035	1.0762	-0.0500	1.1421	-0.0200	1.1010	-0.1682	1.1173	0.0982
965	1.1230	-0.035	1.0674	-0.0491	1.1786	-0.0209	1.1056	-0.1669	1.1403	0.0969
966	1.1402	-0.035	1.1011	-0.0482	1.1792	-0.0218	1.1303	-0.1678	1.1500	0.0978
967	1.1354	-0.035	1.0752	-0.0472	1.1957	-0.0228	1.1166	-0.1664	1.1543	0.0964
968	1.0957	-0.035	1.0228	-0.0490	1.1687	-0.0210	1.0690	-0.1656	1.1224	0.0956
969	1.1129	-0.035	1.0634	-0.0460	1.1624	-0.0240	1.0996	-0.1670	1.1262	0.0970
970	1.1599	-0.035	1.0963	-0.0430	1.2235	-0.0270	1.1413	-0.1658	1.1785	0.0958
971	1.2315	-0.035	1.1708	-0.0452	1.2921	-0.0248	1.2133	-0.1662	1.2496	0.0962
972	1.1214	-0.035	1.0682	-0.0469	1.1746	-0.0231	1.1060	-0.1668	1.1368	0.0968
973	1.1484	-0.035	1.0905	-0.0457	1.2063	-0.0243	1.1314	-0.1664	1.1654	0.0964
974	1.2375	-0.035	1.1809	-0.0483	1.2942	-0.0217	1.2198	-0.1667	1.2553	0.0967
975	1.1310	-0.035	1.0729	-0.0459	1.1891	-0.0241	1.1138	-0.1664	1.1483	0.0964
976	1.1769	-0.035	1.1270	-0.0487	1.2268	-0.0213	1.1622	-0.1672	1.1916	0.0972
977	1.1877	-0.035	1.1412	-0.0452	1.2343	-0.0248	1.1759	-0.1671	1.1995	0.0971
978	1.0465	-0.035	0.9989	-0.0458	1.0940	-0.0242	1.0340	-0.1671	1.0589	0.0971
979	1.1841	-0.035	1.1205	-0.0421	1.2476	-0.0279	1.1661	-0.1659	1.2020	0.0959
980	1.0666	-0.035	1.0336	-0.0488	1.0996	-0.0212	1.0588	-0.1681	1.0743	0.0981
981	1.1636	-0.035	1.1192	-0.0445	1.2079	-0.0255	1.1530	-0.1672	1.1741	0.0972
982	1.1688	-0.035	1.1127	-0.0487	1.2248	-0.0213	1.1515	-0.1668	1.1861	0.0968
983	1.1301	-0.035	1.0666	-0.0447	1.1936	-0.0253	1.1107	-0.1659	1.1495	0.0959
984	1.1398	-0.035	1.1093	-0.0431	1.1704	-0.0269	1.1343	-0.1678	1.1454	0.0978
985	1.0909	-0.035	1.0469	-0.0490	1.1350	-0.0210	1.0788	-0.1676	1.1031	0.0976
986	1.1451	-0.035	1.0951	-0.0474	1.1950	-0.0226	1.1309	-0.1670	1.1592	0.0970
987	1.1189	-0.035	1.0638	-0.0477	1.1740	-0.0223	1.1025	-0.1668	1.1354	0.0968
988	1.1489	-0.035	1.1117	-0.0436	1.1861	-0.0264	1.1411	-0.1675	1.1567	0.0975
989	1.1830	-0.035	1.1306	-0.0436	1.2354	-0.0264	1.1693	-0.1667	1.1967	0.0967
990	1.1563	-0.035	1.1106	-0.0458	1.2021	-0.0242	1.1446	-0.1672	1.1680	0.0972
991	1.2139	-0.035	1.1668	-0.0448	1.2609	-0.0252	1.2020	-0.1671	1.2257	0.0971
992	1.1072	-0.035	1.0487	-0.0472	1.1656	-0.0228	1.0892	-0.1665	1.1251	0.0965
993	1.1447	-0.035	1.0741	-0.0442	1.2153	-0.0258	1.1220	-0.1654	1.1674	0.0954
994	1.1670	-0.035	1.1065	-0.0443	1.2274	-0.0257	1.1493	-0.1661	1.1847	0.0961
995	1.0918	-0.035	1.0367	-0.0525	1.1468	-0.0175	1.0733	-0.1673	1.1103	0.0973
996	1.1413	-0.035	1.0821	-0.0461	1.2004	-0.0239	1.1235	-0.1664	1.1590	0.0964
997	1.1129	-0.035	1.0580	-0.0467	1.1678	-0.0233	1.0969	-0.1667	1.1289	0.0967
998	1.0868	-0.035	1.0501	-0.0518	1.1235	-0.0182	1.0768	-0.1682	1.0969	0.0982
999	1.2576	-0.035	1.1775	-0.0420	1.3378	-0.0280	1.2308	-0.1645	1.2845	0.0945
1000	1.2255	-0.035	1.1826	-0.0447	1.2684	-0.0253	1.2153	-0.1673	1.2358	0.0973