



AMS

American Meteorological Society

Supplemental Material

Weather and Forecasting

A Fiscally Based Scale for Tropical Cyclone Storm Surge

<https://doi.org/10.1175/WAF-D-17-0174.1>

© [Copyright 2018 American Meteorological Society](#)

Permission to use figures, tables, and brief excerpts from this work in scientific and educational works is hereby granted provided that the source is acknowledged. Any use of material in this work that is determined to be “fair use” under Section 107 of the U.S. Copyright Act or that satisfies the conditions specified in Section 108 of the U.S. Copyright Act (17 USC §108) does not require the AMS’s permission. Republication, systematic reproduction, posting in electronic form, such as on a website or in a searchable database, or other uses of this material, except as exempted by the above statement, requires written permission or a license from the AMS. All AMS journals and monograph publications are registered with the Copyright Clearance Center (<http://www.copyright.com>). Questions about permission to use materials for which AMS holds the copyright can also be directed to permissions@ametsoc.org. Additional details are provided in the AMS Copyright Policy statement, available on the AMS website (<http://www.ametsoc.org/CopyrightInformation>).

Supplementary Information for:
A FISCALLY BASED SCALE FOR TROPICAL
CYCLONE STORM SURGE

Correlation Results from Methods: Step One

Table 1. Correlation coefficients between SED-POP fiscal loss metric and the mean, median, and mode of all storm surge height data (All), data above 90th percentile (>90th), and data within interquartile range (IQR), respectively. Italicized values are above 90% confidence level, and italicized and bolded values are above 95% confidence level. Confidence levels are defined by the number of counties used for each storm (n).

SED-POP Height Correlations	Katrina (n=8)	Gustav (n=13)	Ike (n=13)	Sandy (n=11)
All Mode	<i>0.647</i>	-0.016	<i>0.721</i>	0.069
All Mean	<i>0.894</i>	0.199	<i>0.802</i>	0.111
All Median	<i>0.905</i>	0.140	<i>0.775</i>	-0.095
>90 th Mode	<i>0.782</i>	0.302	<i>0.854</i>	<i>0.528</i>
>90 th Mean	<i>0.796</i>	0.343	<i>0.852</i>	<i>0.536</i>
>90 th Median	<i>0.799</i>	0.329	<i>0.853</i>	<i>0.532</i>
IQR Mode	<i>0.762</i>	0.092	<i>0.740</i>	-0.315
IQR Mean	<i>0.900</i>	0.144	<i>0.782</i>	-0.070
IQR Median	<i>0.904</i>	0.142	<i>0.776</i>	-0.092

Table 2. Same as Table 1, but for SED-POP and storm surge velocity.

SED-POP Velocity Correlations	Katrina (n=8)	Gustav (n=13)	Ike (n=13)	Sandy (n=11)
All Mode	<i>0.725</i>	0.454	<i>0.619</i>	0.103
All Mean	<i>0.645</i>	<i>0.723</i>	<i>0.799</i>	<i>0.826</i>
All Median	0.620	<i>0.630</i>	<i>0.776</i>	<i>0.620</i>
>90 th Mode	<i>0.684</i>	<i>0.784</i>	<i>0.792</i>	<i>0.758</i>
>90 th Mean	<i>0.633</i>	<i>0.791</i>	<i>0.781</i>	<i>0.716</i>
>90 th Median	<i>0.627</i>	<i>0.786</i>	<i>0.769</i>	<i>0.733</i>
IQR Mode	<i>0.719</i>	<i>0.481</i>	<i>0.716</i>	0.287
IQR Mean	<i>0.632</i>	<i>0.640</i>	<i>0.776</i>	<i>0.688</i>
IQR Median	0.620	<i>0.633</i>	<i>0.767</i>	<i>0.634</i>

Table 3. Same as Table 1, but for SED-PCPI and storm surge height.

SED-PCPI Height Correlations	Katrina (n=8)	Gustav (n=13)	Ike (n=13)	Sandy (n=11)
All Mode	0.606	-0.361	0.575	0.100
All Mean	0.970	-0.270	0.693	0.204
All Median	0.980	-0.300	0.665	-0.003
>90 th Mode	0.904	-0.061	0.798	0.673
>90 th Mean	0.896	-0.057	0.814	0.658
>90 th Median	0.895	-0.067	0.809	0.659
IQR Mode	0.849	-0.262	0.618	-0.241
IQR Mean	0.975	-0.302	0.670	0.017
IQR Median	0.979	-0.300	0.666	0.000

Table 4. Same as Table 1, but for SED-PCPI and storm surge velocity.

SED-PCPI Velocity Correlations	Katrina (n=8)	Gustav (n=13)	Ike (n=13)	Sandy (n=11)
All Mode	<i>0.704</i>	0.031	<i>0.476</i>	0.039
All Mean	0.540	0.430	0.676	0.845
All Median	0.513	0.224	0.640	<i>0.579</i>
>90 th Mode	0.571	0.763	0.721	0.820
>90 th Mean	0.516	0.812	0.717	0.786
>90 th Median	0.495	0.811	0.706	0.792
IQR Mode	<i>0.663</i>	0.058	0.599	0.229
IQR Mean	0.527	0.260	0.635	0.660
IQR Median	0.513	0.229	0.627	0.595

Table 5. Same as Table 1, but for SED-TI and storm surge height.

SED-TI Height Correlations	Katrina (n=8)	Gustav (n=13)	Ike (n=13)	Sandy (n=11)
All Mode	<i>0.670</i>	-0.022	<i>0.737</i>	0.072
All Mean	<i>0.886</i>	0.180	<i>0.814</i>	0.098
All Median	<i>0.904</i>	0.124	<i>0.788</i>	-0.108
>90 th Mode	<i>0.764</i>	0.287	<i>0.862</i>	0.504
>90 th Mean	<i>0.776</i>	0.323	<i>0.859</i>	0.513
>90 th Median	<i>0.779</i>	0.311	<i>0.860</i>	0.508
IQR Mode	<i>0.767</i>	0.076	<i>0.755</i>	-0.337
IQR Mean	<i>0.895</i>	<u>0.126</u>	<i>0.794</i>	-0.082
IQR Median	<i>0.902</i>	0.126	<i>0.788</i>	-0.105

Table 6. Same as Table 1, but for SED-TI and storm surge velocity.

SED-TI Velocity Correlations	Katrina (n=8)	Gustav (n=13)	Ike (n=13)	Sandy (n=11)
All Mode	<i>0.748</i>	0.438	<i>0.627</i>	0.123
All Mean	<i>0.674</i>	<i>0.697</i>	<i>0.808</i>	<i>0.825</i>
All Median	<i>0.652</i>	<i>0.601</i>	<i>0.786</i>	<i>0.644</i>
>90 th Mode	<i>0.713</i>	<i>0.773</i>	<i>0.799</i>	<i>0.742</i>
>90 th Mean	<i>0.666</i>	<i>0.773</i>	<i>0.787</i>	<i>0.691</i>
>90 th Median	<i>0.660</i>	<i>0.769</i>	<i>0.777</i>	<i>0.710</i>
IQR Mode	<i>0.749</i>	0.465	<i>0.724</i>	0.308
IQR Mean	<i>0.661</i>	<i>0.610</i>	<i>0.785</i>	<i>0.707</i>
IQR Median	<i>0.652</i>	<i>0.604</i>	<i>0.777</i>	<i>0.657</i>

Table 7. Same as Table 1, but for NFIP and storm surge height.

NFIP Height Correlations	Katrina (n=24)	Gustav (n=N/A)	Ike (n=N/A)	Sandy (n=28)
All Mode	0.675	-	-	0.406
All Mean	0.884	-	-	0.191
All Median	0.866	-	-	0.029
>90 th Mode	0.882	-	-	0.457
>90 th Mean	0.895	-	-	0.495
>90 th Median	0.896	-	-	0.476
IQR Mode	0.779	-	-	-0.125
IQR Mean	0.869	-	-	0.046
IQR Median	0.866	-	-	0.030

Table 8. Same as Table 1, but for NFIP and storm surge velocity.

NFIP Velocity Correlations	Katrina (n=24)	Gustav (n=N/A)	Ike (n=N/A)	Sandy (n=28)
All Mode	0.707	-	-	0.081
All Mean	0.793	-	-	0.476
All Median	0.736	-	-	0.392
>90 th Mode	0.842	-	-	0.482
>90 th Mean	0.820	-	-	0.444
>90 th Median	0.819	-	-	0.464
IQR Mode	0.762	-	-	0.180
IQR Mean	0.753	-	-	0.446
IQR Median	0.735	-	-	0.421

Results Details from Methods: Step Two

Table 9. Correlation coefficients used to check the linear relationship assumption. All values are above the 99.9% significance level for all four methods (n=45 for all SED, n=52 for NFIP).

	SED-POP	SED-PCPI	SED-TI	NFIP
<i>h</i>	0.747	0.707	0.752	0.677
<i>v</i>	0.717	0.681	0.721	0.676
v^2	0.643	0.607	0.656	0.544
v^3	0.556	0.520	0.573	0.453

Table 10. Variance Inflation Factor values used to check the little to no multicollinearity assumption. All values meet the criteria to pass. This check is not necessary for single variable models.

	SED-POP	SED-PCPI	SED-TI	NFIP
<i>h</i>	-	-	-	-
<i>v</i>	-	-	-	-
<i>h</i> and <i>v</i>	1.630	1.630	1.630	2.330
<i>h</i> and v^2	1.440	1.440	1.440	1.840
<i>h</i> and v^3	1.300	1.300	1.300	1.500

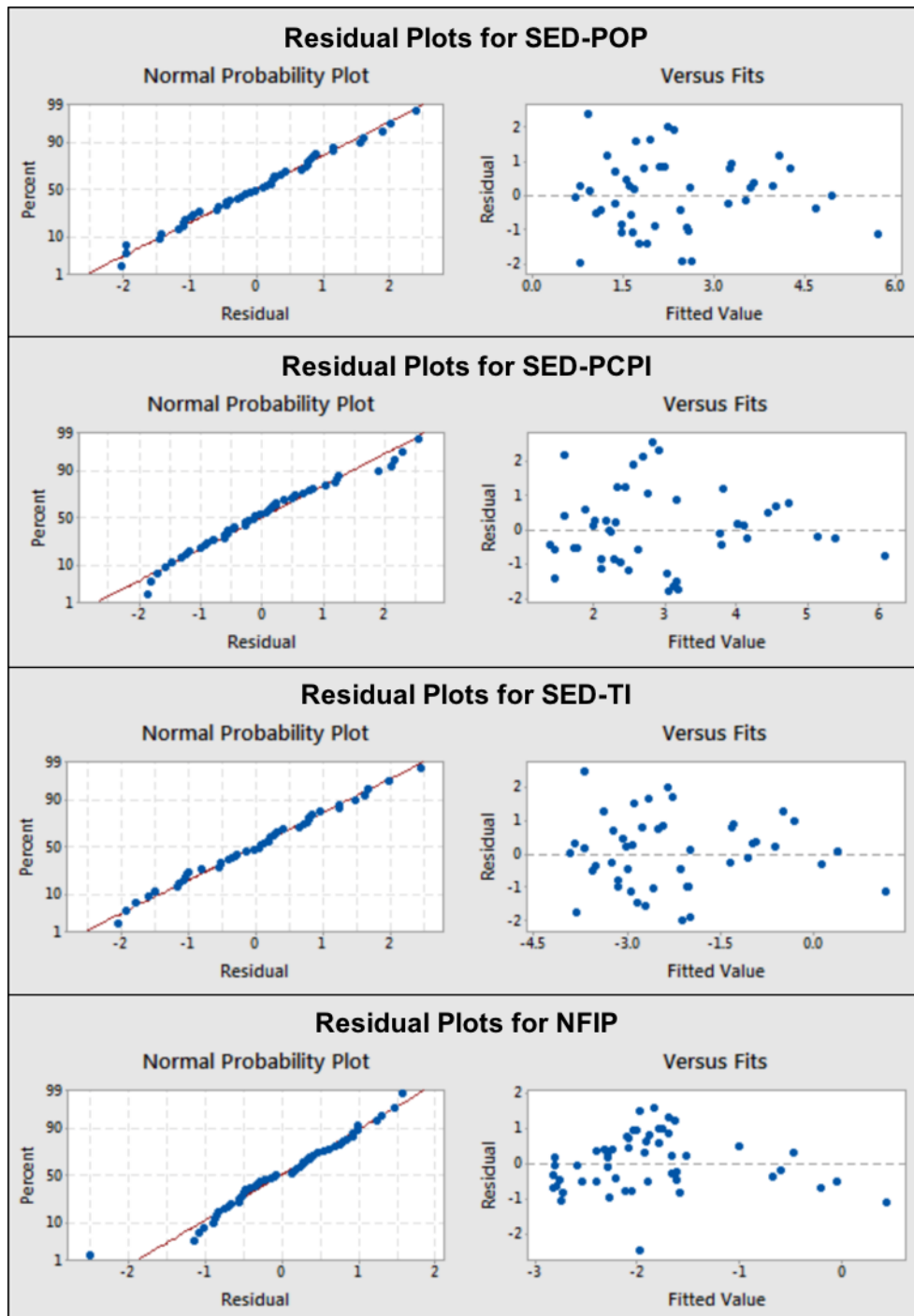


Fig. 1. Normal Probability Plot and Versus Fit graphs used to check the multivariate normality and homoscedasticity assumptions for the fiscal loss methods and height-only model.

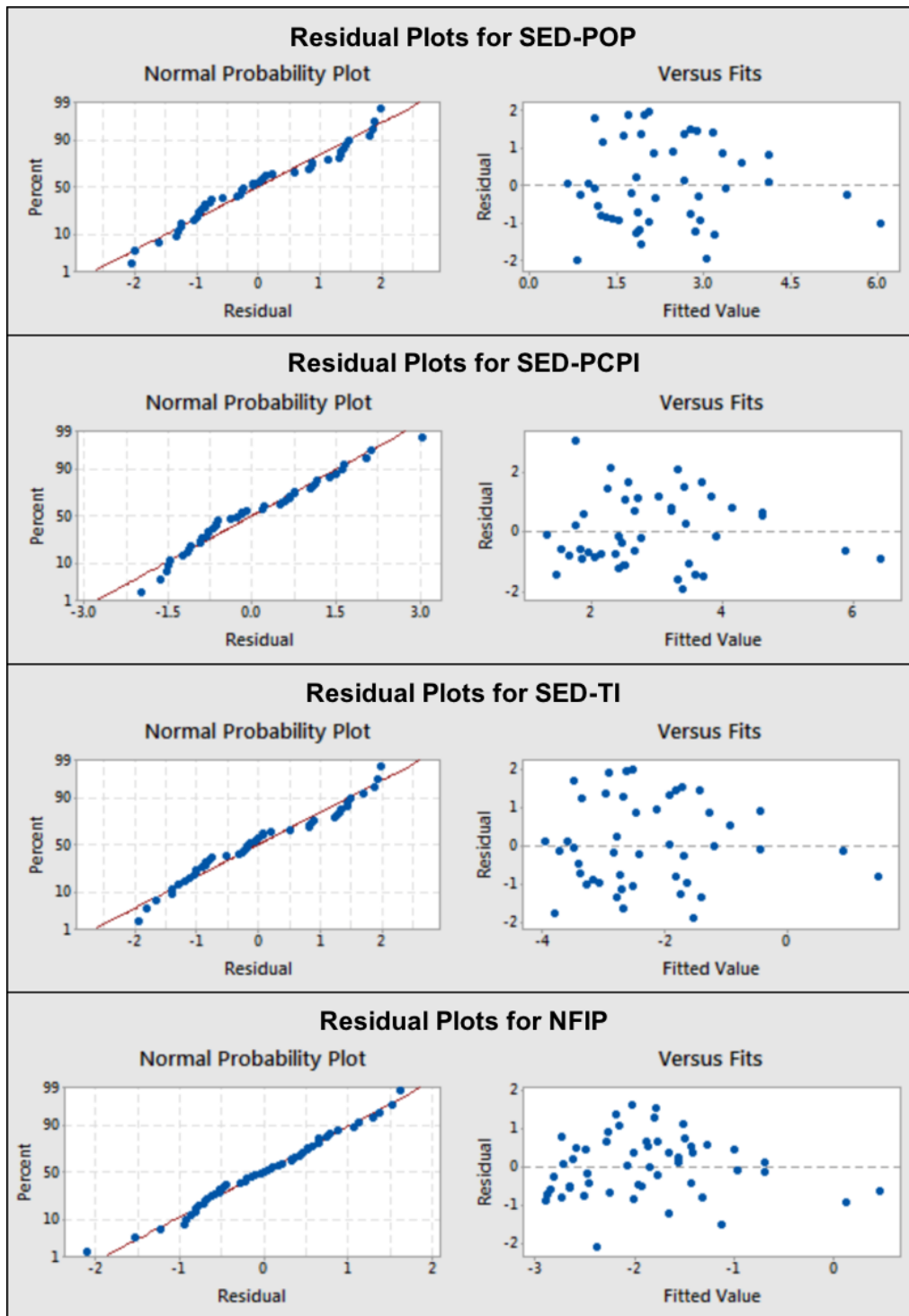


Fig. 2. Same as Figure 1, but for the velocity-only model.

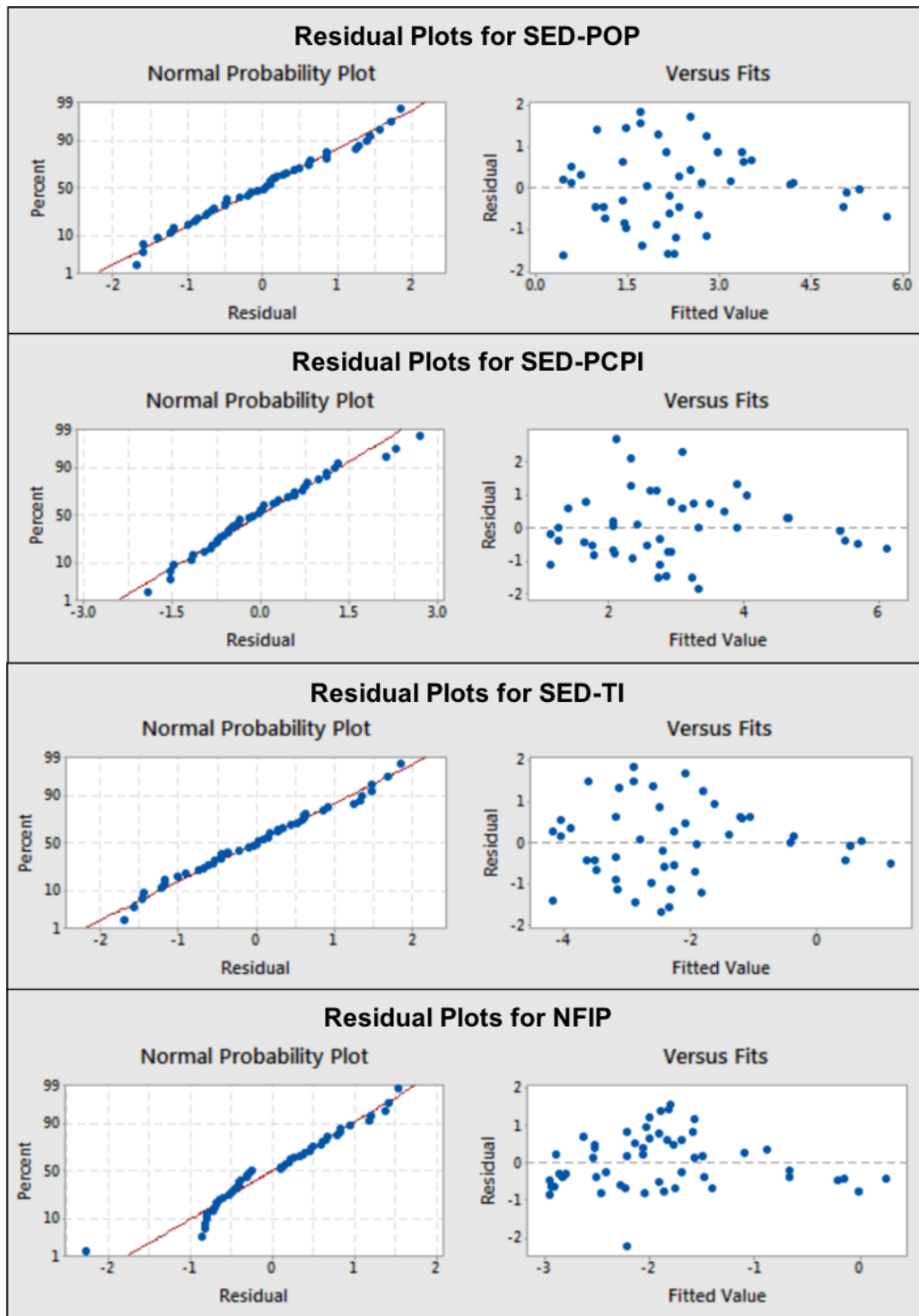


Fig. 3. Same as Figure 1, but for the height and velocity model.

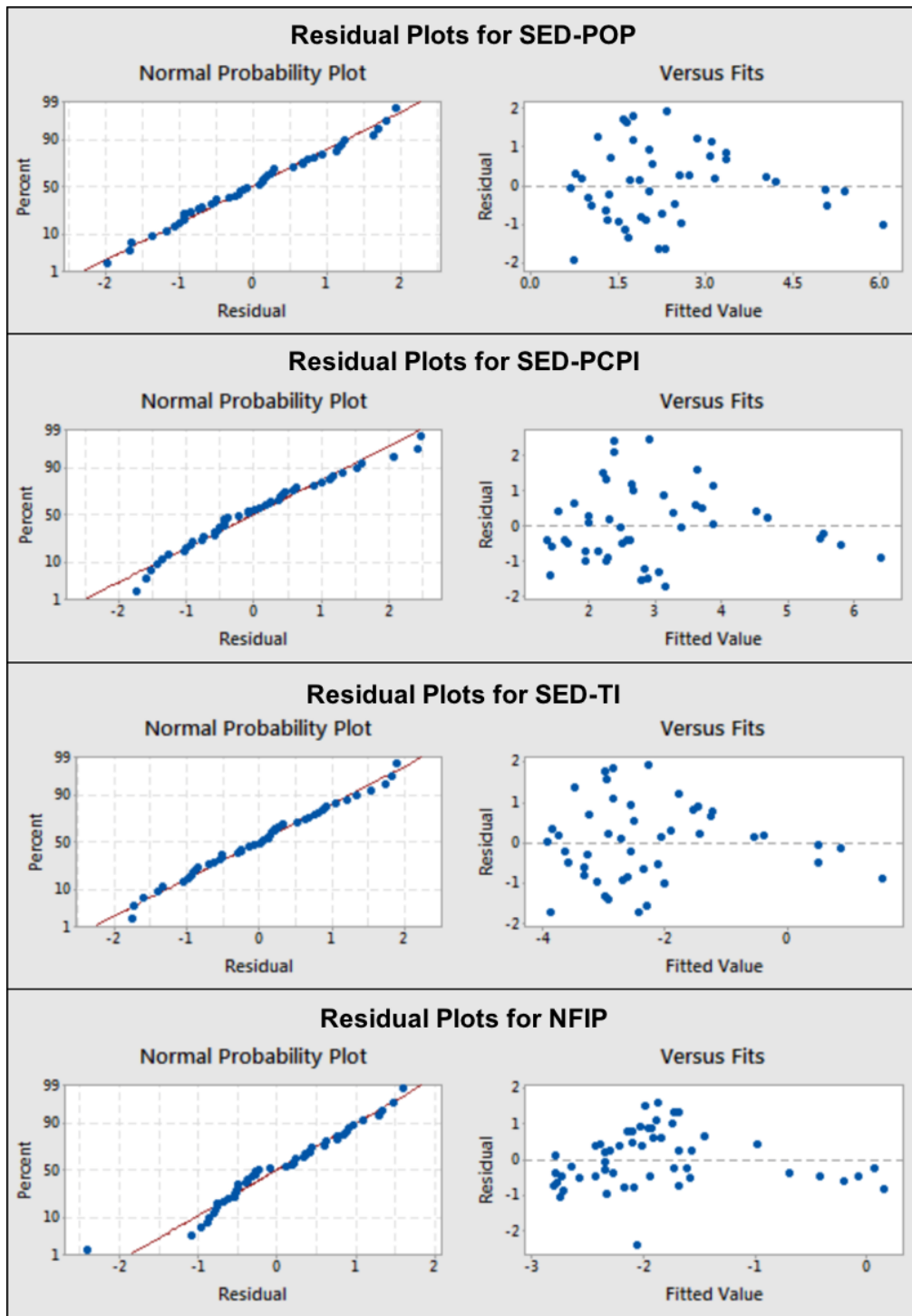


Fig. 4. Same as Figure 1, but for the height and velocity squared model.

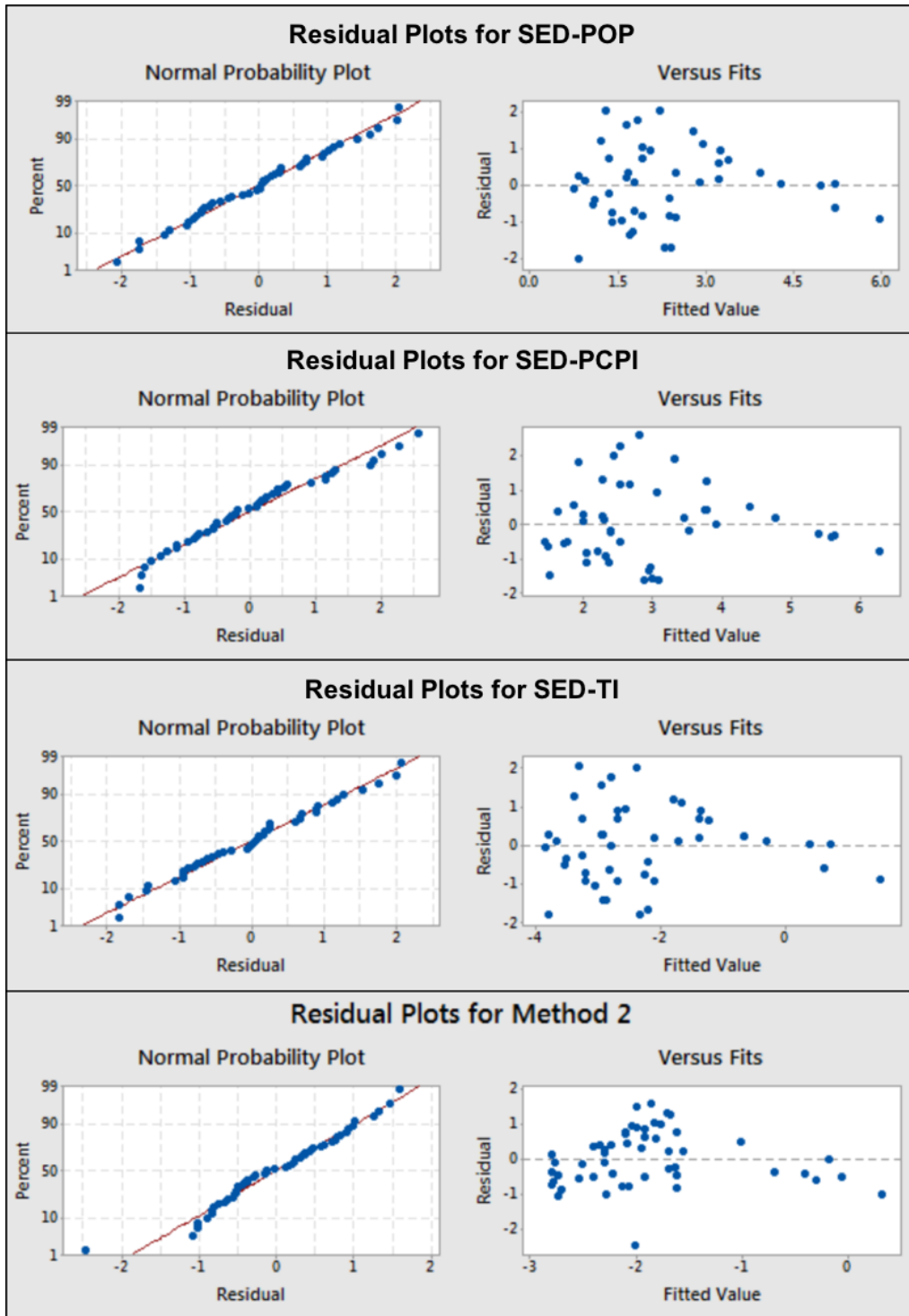


Fig. 5. Same as Figure 1, but for the height and velocity cubed model.

Table 11. Durbin-Watson statistic values used to check the no autocorrelation assumption. Bolded values meet the criteria to pass.

	SED-POP	SED-PCPI	SED-TI	NFIP
h	1.311	1.312	1.264	1.165
v	1.602	1.426	1.539	1.346
h and v	1.522	1.316	1.464	1.302
h and v^2	1.573	1.331	1.528	1.171
h and v^3	1.550	1.303	1.514	1.153

Table 12. P values for the storm surge variables for the remaining models and fiscal loss methods. Any values greater than 0.05 do not meet significance, thus the associated term is not valuable for prediction.

	SED-POP	SED-TI
h	-	-
v	0.000	0.000
h and v	$h = 0.000$ $v = 0.001$	-
h and v^2	$h = 0.000$ $v^2 = 0.005$	$h = 0.000$ $v^2 = 0.003$
h and v^3	$h = 0.000$ $v^3 = 0.025$	$h = 0.000$ $v^3 = 0.014$