

Results of Moran's I test on UAH regression. Correlation is very low and in any event the p-values show no significance. The three tests are for distance weights of $1/x$, $1/x^2$, and $1/\sqrt{x}$

Moran's I test under randomisation

data: resid(res.uah)

weights: global.lw1

Moran I statistic standard deviate = 0.7011, p-value = 0.2416

alternative hypothesis: greater

sample estimates:

Moran I statistic	Expectation	Variance
0.0113039646	-0.0022779043	0.0003753246

Moran's I test under randomisation

data: resid(res.uah)

weights: global.lw2

Moran I statistic standard deviate = -0.2466, p-value = 0.5974

alternative hypothesis: greater

sample estimates:

Moran I statistic	Expectation	Variance
-0.036286980	-0.002277904	0.019026826

Moran's I test under randomisation

data: resid(res.uah)

weights: global.lw3

Moran I statistic standard deviate = 1.0123, p-value = 0.1557

alternative hypothesis: greater

sample estimates:

Moran I statistic	Expectation	Variance
6.878378e-03	-2.277904e-03	8.181368e-05

Result of Moran's I test on regression using RSS. This shows a certain amount of spatial autocorrelation of the residuals with a significance just below the 95% level. (p=.053)

Moran's I test under randomisation

data: resid(res.rss)

weights: global.lw1

Moran I statistic standard deviate = 1.6169, p-value = 0.05295

alternative hypothesis: greater

sample estimates:

Moran I statistic	Expectation	Variance
0.0290363996	-0.0022779043	0.0003750836

Regression Results for Model E data with economic data. Note that as reported by Schmidt a number of the economic variables show significance, although the coefficients are extremely small.

Call:

```
lm(formula = model_surf ~ model_trop + slp + dry + dslp + Water +  
    abslat + g + e + x + p + m + y + c, data = global)
```

Residuals:

	Min	1Q	Median	3Q	Max
	-0.143772	-0.020944	0.002597	0.023872	0.432612

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	1.0386772	0.9425618	1.102	0.27110
model_trop	1.2383926	0.0508123	24.372	< 2e-16 ***
slp	-0.0011139	0.0009337	-1.193	0.23354
dryTRUE	0.9577882	1.0837890	0.884	0.37733
dslp	-0.0009591	0.0010658	-0.900	0.36866
Water	-0.0345385	0.0053061	-6.509	2.13e-10 ***
abslat	0.0007135	0.0002240	3.185	0.00155 **
g	-0.0075419	0.0045387	-1.662	0.09731 .
e	0.0004050	0.0001314	3.083	0.00218 **
x	0.0018836	0.0009395	2.005	0.04562 *
p	-0.0638811	0.0308735	-2.069	0.03914 *
m	-0.0834040	0.0377488	-2.209	0.02767 *
y	0.0561727	0.0294427	1.908	0.05708 .
c	0.0003264	0.0006631	0.492	0.62279

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.0466 on 426 degrees of freedom

Multiple R-squared: 0.6825, Adjusted R-squared: 0.6728

F-statistic: 70.44 on 13 and 426 DF, p-value: < 2.2e-16

Results of Moran's I test for the regression using model data. As hypothesized in Schmidt there is spatial autocorrelation, which might make the economic variables significance overstated. The statistic is positive and the p-value shows that it is significant. This makes sense since the economic variables could not possibly affect the model results.

Moran's I test under randomisation

data: resid(res.model)

weights: global.lw1

Moran I statistic standard deviate = 3.4303, p-value = 0.0003014

alternative hypothesis: greater

sample estimates:

Moran I statistic	Expectation	Variance
0.0629814068	-0.0022779043	0.0003619185

As reported in MM07 a regression of surface alone with climate and economic variables shows significance for the economic variables.

Call:

```
lm(formula = surf_2v ~ slp + dry + dslp + Water + abslat + g +  
    e + x + p + m + y + c, data = global)
```

Residuals:

Min	1Q	Median	3Q	Max
-0.802132	-0.134420	-0.003418	0.139503	0.737804

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	-4.0726887	3.9856148	-1.022	0.307432
slp	0.0042458	0.0039314	1.080	0.280758
dryTRUE	-7.8203646	4.7785537	-1.637	0.102460
dslp	0.0078061	0.0046997	1.661	0.097449 .

Water	-0.0035125	0.0234315	-0.150	0.880911
abslat	0.0063380	0.0009914	6.393	4.27e-10 ***
g	0.0803803	0.0197416	4.072	5.56e-05 ***
e	-0.0028758	0.0005284	-5.442	8.89e-08 ***
x	-0.0075753	0.0041030	-1.846	0.065546 .
p	0.5178862	0.1357074	3.816	0.000156 ***
m	0.5976818	0.1662598	3.595	0.000362 ***
y	-0.4537743	0.1294278	-3.506	0.000503 ***
c	0.0089656	0.0029294	3.061	0.002348 **

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.2064 on 427 degrees of freedom

Multiple R-squared: 0.3389, Adjusted R-squared: 0.3203

F-statistic: 18.24 on 12 and 427 DF, p-value: < 2.2e-16

However Moran's I test shows significant positive spatial autocorrelation, which might overstate the significance of the results.

Moran's I test under randomisation

data: resid(res.surfonly)

weights: global.lw1

Moran I statistic standard deviate = 9.2245, p-value < 2.2e-16

alternative hypothesis: greater

sample estimates:

Moran I statistic	Expectation	Variance
0.1767241824	-0.0022779043	0.0003765572

Results of regression estimates taking spatial autocorrelation into account. First is the surface model which demonstrates significance for the economic variables, and a low p-value for the entire regression.

```
Call:lagsarlm(formula = surf_2v ~ slp + dry + dslp + Water
+ abslat + g + e + x + p + m + y + c, data = global,
listw = global.lwl, method = "spam")
```

Residuals:

	Min	1Q	Median	3Q	Max
	-0.8013011	-0.1339724	-0.0049581	0.1331217	0.7219022

Type: lag

Coefficients: (log likelihood/likelihood ratio)

	Estimate	Log likelihood	LR statistic	Pr(> z)
(Intercept)	-3.91048425	NA	NA	NA
slp	0.00408138	82.74995339	1.1436	0.2848997
dryTRUE	-7.03871046	82.17219758	2.2991	0.1294507
dslp	0.00702965	82.13643707	2.3706	0.1236395
Water	-0.00048064	83.32151369	0.0004	0.9831315
abslat	0.00636862	62.42561961	41.7922	1.015e-10
g	0.07862978	75.05208775	16.5393	4.765e-05
e	-0.00294695	67.39148848	31.8605	1.657e-08
x	-0.00732763	81.63396104	3.3756	0.0661704
p	0.52138766	75.61708041	15.4093	8.656e-05
m	0.59683854	76.58058078	13.4823	0.0002408
y	-0.45743263	76.78446940	13.0745	0.0002993
c	0.00876381	78.61786757	9.4077	0.0021607

Rho: 0.999 LR test value: 13.351 p-value: 0.00025827

Log likelihood: 83.32174 for lag model

ML residual variance (sigma squared): 0.040082, (sigma: 0.20021)

Number of observations: 440

Number of parameters estimated: 15

AIC: -136.64, (AIC for lm: -125.29)

Results for spatial regression on model data. Note that while some of the individual coefficients are significant, their values are extremely low. Most importantly the p-value of the regression at .38 show that the results are not significant.

Call: lagsarlm(formula = model_surf ~ model_trop + slp + dry + dslp + Water + abslat + g + e + x + p + m + y + c, data = global,

listw = global.lw1, method = "spam")

Residuals:

	Min	1Q	Median	3Q	Max
	-0.1434889	-0.0210092	0.0018415	0.0240472	0.4351378

Type: lag

Coefficients: (log likelihood/likelihood ratio)

	Estimate	Log likelihood	LR statistic	Pr(> z)
(Intercept)	9.9236e-01	NA	NA	NA
model_trop	1.2263e+00	5.4613e+02	372.2793	< 2.2e-16
slp	-1.0659e-03	7.3160e+02	1.3416	0.246748
dryTRUE	1.1057e+00	7.3174e+02	1.0492	0.305702
dslp	-1.1054e-03	7.3173e+02	1.0840	0.297800
Water	-3.3840e-02	7.1261e+02	39.3157	3.605e-10
abslat	7.2797e-04	7.2690e+02	10.7366	0.001050
g	-7.3954e-03	7.3090e+02	2.7347	0.098189
e	3.7313e-04	7.2844e+02	7.6653	0.005629

x	1.8841e-03	7.3020e+02	4.1412	0.041851
p	-6.0878e-02	7.3029e+02	3.9544	0.046748
m	-7.9628e-02	7.3001e+02	4.5193	0.033515
y	5.2507e-02	7.3066e+02	3.2113	0.073131
c	3.4084e-04	7.3213e+02	0.2731	0.601236

Rho: 0.37659 LR test value: 0.76303 p-value: 0.38238

Log likelihood: 732.2682 for lag model

ML residual variance (sigma squared): 0.0020988, (sigma: 0.045812)

Number of observations: 440

Number of parameters estimated: 16

AIC: -1432.5, (AIC for lm: -1433.8)

For completeness here is the spatial regression using the uah data. Economic statistics and the entire regression continue to be significant.

Call: lagsarlm(formula = surf_2v ~ myuah_trop + slp + dry + dslp + Water + abslat + g + e + x + p + m + y + c, data = global,

listw = global.lw1, method = "spam")

Residuals:

	Min	1Q	Median	3Q	Max
	-0.858134	-0.106579	-0.009447	0.098361	0.599987

Type: lag

Coefficients: (log likelihood/likelihood ratio)

	Estimate	Log likelihood	LR statistic	Pr(> z)
(Intercept)	-5.2517350	NA	NA	NA
myuah_trop	0.9126748	83.3217372	170.9797	< 2.2e-16
slp	0.0054126	167.3327892	2.9576	0.085472

dryTRUE	4.8537969	168.0404948	1.5422	0.214286
dslp	-0.0046924	168.0666322	1.4900	0.222223
Water	-0.0288392	167.6407768	2.3417	0.125954
abslat	0.0004412	168.6892812	0.2447	0.620860
g	0.0383816	165.9582232	5.7068	0.016900
e	-0.0025635	151.1721354	35.2790	2.857e-09
x	0.0018963	168.6504232	0.3224	0.570183
p	0.3184642	164.6085493	8.4061	0.003740
m	0.3031484	166.2810372	5.0611	0.024468
y	-0.2345235	166.3094272	5.0044	0.025283
c	0.0054334	166.1581294	5.3070	0.021240

Rho: 0.999 LR test value: 5.3104 p-value: 0.021199

Log likelihood: 168.8116 for lag model

ML residual variance (sigma squared): 0.027176, (sigma: 0.16485)

Number of observations: 440

Number of parameters estimated: 16

AIC: -305.62, (AIC for lm: -302.31)

Results of spatial regression using RSS satellite data. Note that in this case the economic variables are now significant and the entire regression is significant. It is worth noting that the significance values are higher for the individual variables than in the UAH case but the total regression actually has a slightly lower p-value.

Call: lagsarlm(formula = surf_2v ~ myrss_trop + slp + dry + dslp + Water + abslat + g + e + x + p + m + y + c, data = global,

listw = global.lw1, method = "spam")

Residuals:

	Min	1Q	Median	3Q	Max
	-0.9068037	-0.1064945	-0.0015089	0.1001749	0.5608798

Type: lag

Coefficients: (log likelihood/likelihood ratio)

	Estimate	Log likelihood	LR statistic	Pr(> z)
(Intercept)	-4.2381746	NA	NA	NA
myrss_trop	0.9294856	83.3217372	149.5110	< 2.2e-16
slp	0.0042680	157.1995718	1.7554	0.185205
dryTRUE	4.6731414	157.3988903	1.3567	0.244107
dslp	-0.0045263	157.4194942	1.3155	0.251399
Water	-0.0177659	157.6506559	0.8532	0.355652
abslat	0.0038750	147.5100011	21.1345	4.282e-06
g	0.0405657	155.0428985	6.0687	0.013760
e	-0.0023055	144.4767285	27.2010	1.834e-07
x	0.0014577	157.9865773	0.1813	0.670219
p	0.2331969	155.9643621	4.2258	0.039814
m	0.2823504	155.9977744	4.1590	0.041415
y	-0.2114201	156.1531892	3.8481	0.049802
c	0.0067039	154.2194166	7.7157	0.005474

Rho: 0.999 LR test value: 5.5678 p-value: 0.018294