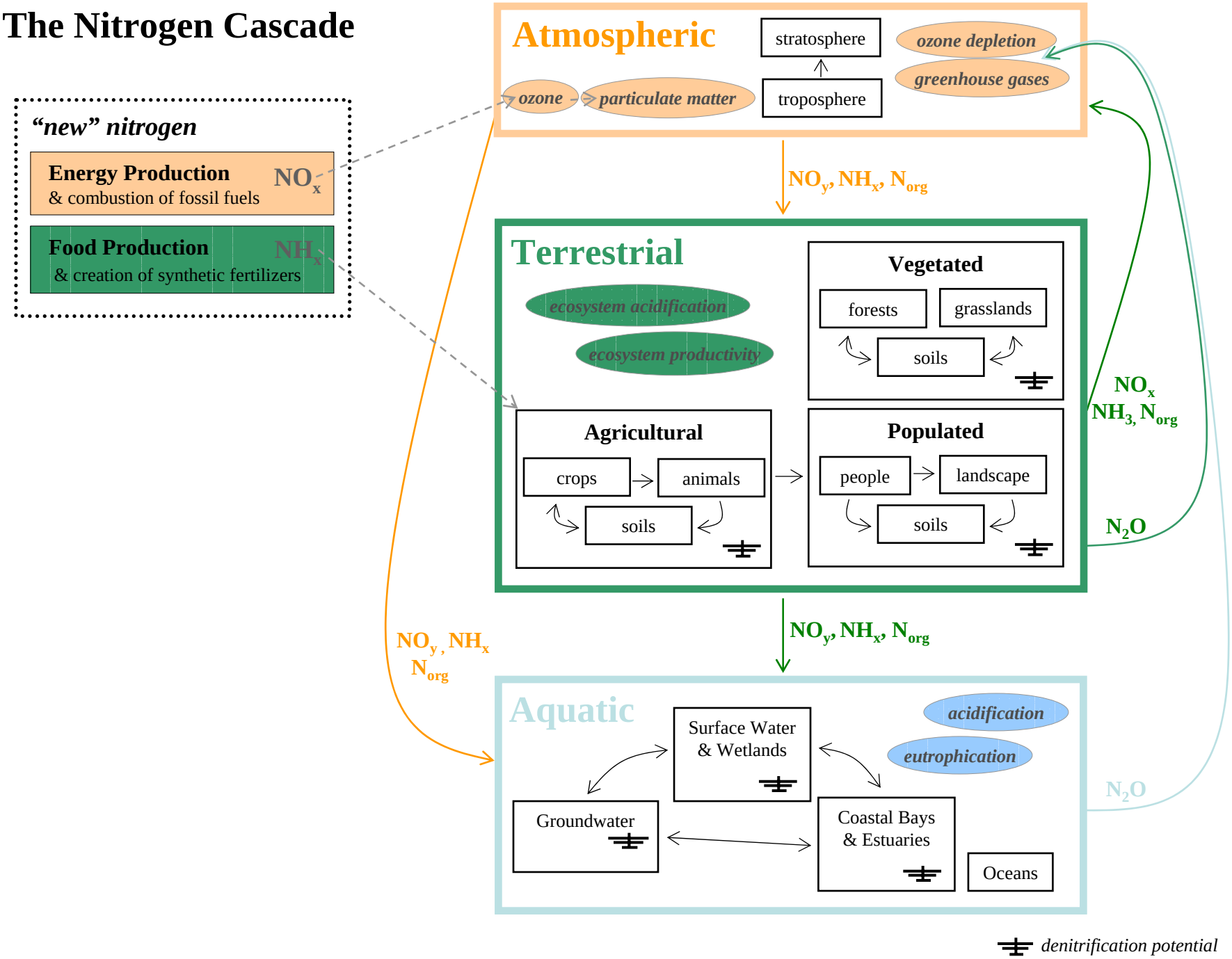
The Nitrogen Cascade

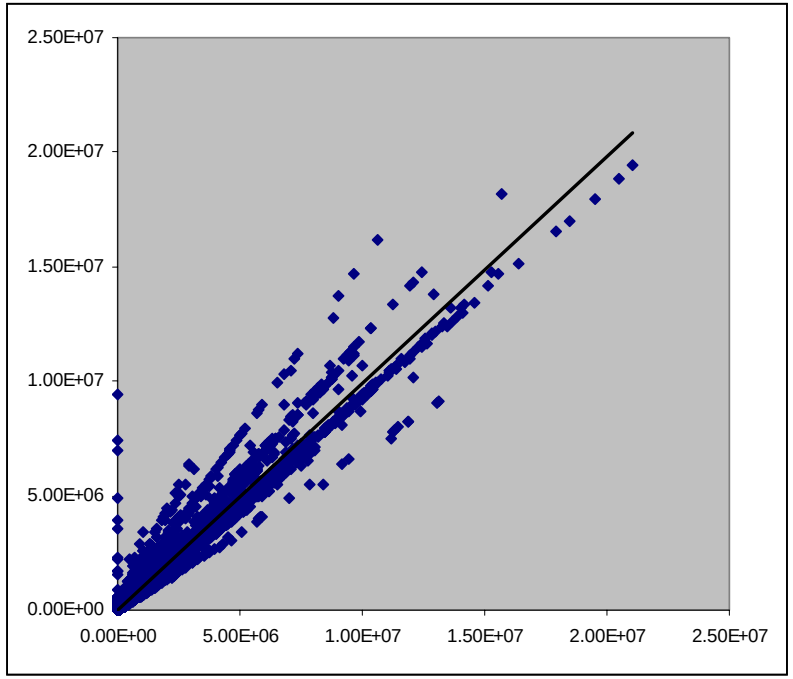


Data, data… compiled from:

- USDA/ NASS: trends in agriculture
- USDA Ag census 2002: crop & animal production; for calculating N in crops, N in animal products, N in manure, N fertilizer sales, land areas
- US Census: population & characteristics, land areas
- USGS: fertilizer use
- NADP: deposition of wet inorganic N species
- CMAS: CMAQ estimates of emissions & depo of all N species
- EPA eGRID: emissions from automotive & industrial sectors
- Century model: emissions from agriculture

Fertilizer inputs

Different coeffs for N fert application rate by crop type, from 2 sources: NASS (uniform across the country) & Century modellers (varied across the country). Plot shows kg N/km2 ag land/ county, for corn, soybeans, winter wheat, durum wheat, spring wheat, & cotton.



Summary Of Acres Receiving Fertilizer, Application Rates, and Computed Average Application Rate for all Acres

		% Of Planted Acres /1 Receiving Fertilizer			Actual Application Rate /1				Adjusted Application Rate /2			
Year	**Crop**	**N**	**P2O5**	**K20**	**N**	**P2O5**	**K20**	**Total**	**N**	**P2O5**	**K20**	**Total**
	(000)	(Percent)			(Pounds Per Acre)				(Pounds Per Acre)			
2002	Corn	96	79	68	137	60	85	282	131.5	47.4	57.8	236.7
2002	Soybeans	20	26	29	21	49	89	282	4.2	12.7	25.8	42.8
2002	Winter Wheat	86	55	15	68	37	54	282	58.5	20.4	8.1	86.9
2002	Durum Wheat	88	58	5	62	26	12	282	54.6	15.1	0.6	70.2
2002	Other Spring Wheat	86	74	27	63	32	27	282	54.2	23.7	7.3	85.2
2001	Cotton	76	48	41	81	43	76	282	61.6	20.6	31.2	113.4
2002	Cotton /3	79	55	47	87	47	78	282	68.5	25.8	36.4	130.7
2003	Cotton	82	62	52	92	50	80	282	75.4	31.0	41.6	148.0

1/ USDA, NASS.

2/ Adjusted rate is equal to percent receiving fertilizer multiplied by the actual application rate.

3/ Cotton in 2002 wasn't recorded; used avg of 2001 & 2003

Manure inputs, & animal consumption

Table 3: N comsuption and waste production rates from animals*, kg N animal $^{-1}$ yr^{-1}

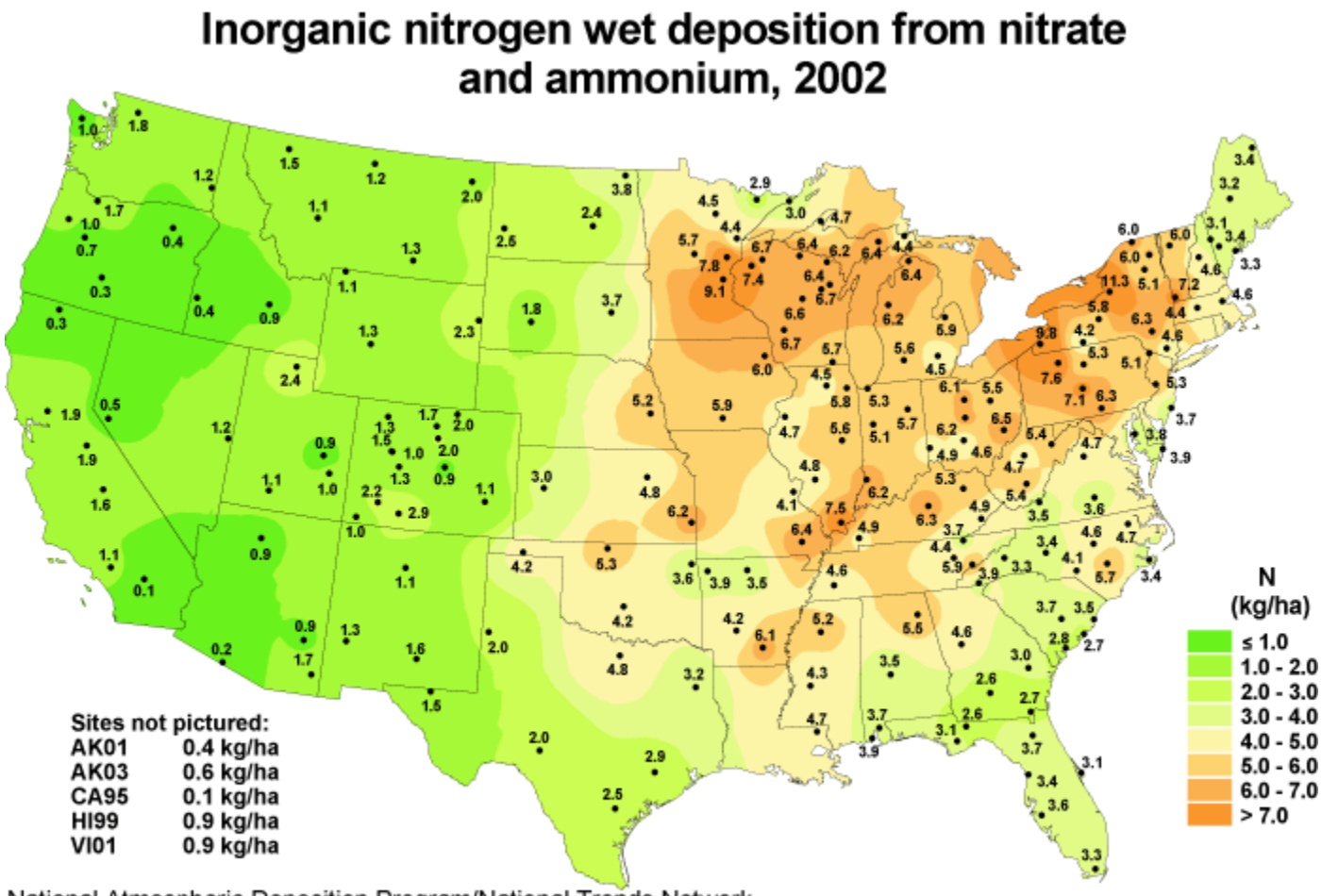
	Consumption: N intake rates				Waste production: N excretion rates					
Animal	Thomas & Gilliam 1977	Bleken & Bakken 1997	van Horn 1998	van der Hoek & Bouwman 1999	Thomas & Gilliam 1977	Bleken & Bakken 1997	van Horn 1998	van der Hoek & Bouwman 1999	Smil 1999	SCS 1992
beef cattle	56.00	74.60	**66.75**	51.30	44.00	66.60	**58.51**	40.70	50.00	41.72
dairy cattle	166.00	126.70	**156.00**	177.00	120.00	93.90	**121.00**	140.50	80.00	79.47
young cattle	--	57.70	--	74.10	--	36.45	--	67.70	--	36.26
pigs & hogs	8.70	5.85	**8.51**	14.93	6.10	4.34	**5.84**	10.46	10.00	19.70
sheep	--	9.76	**5.97**	27.60	--	6.70	**5.00**	25.00	5.00	13.04
goats	--	13.90	**5.97**	23.70	--	12.30	**5.00**	19.90	--	--
horses	--	--	**44.80**	--	--	50.00	**40.00**	45.00	35.00	27.81
chickens (layers)	1.10	0.94	**0.84**	1.17	0.83	0.61	**0.55**	0.81	0.30	0.21
chickens (broilers)	0.82	0.08	**0.13**	1.03	0.39	0.03	**0.07**	0.57	0.30	0.55
turkeys	2.12	1.29	**0.62**	--	1.29	0.34	**0.39**	0.50	0.30	0.37

** -- No data. Values chosen for our nitrogen budgets, which best represent current agricultural management practices in the USA, are in boldface.*

Table being expanded by INC

Atmospheric N deposition

NADP wet

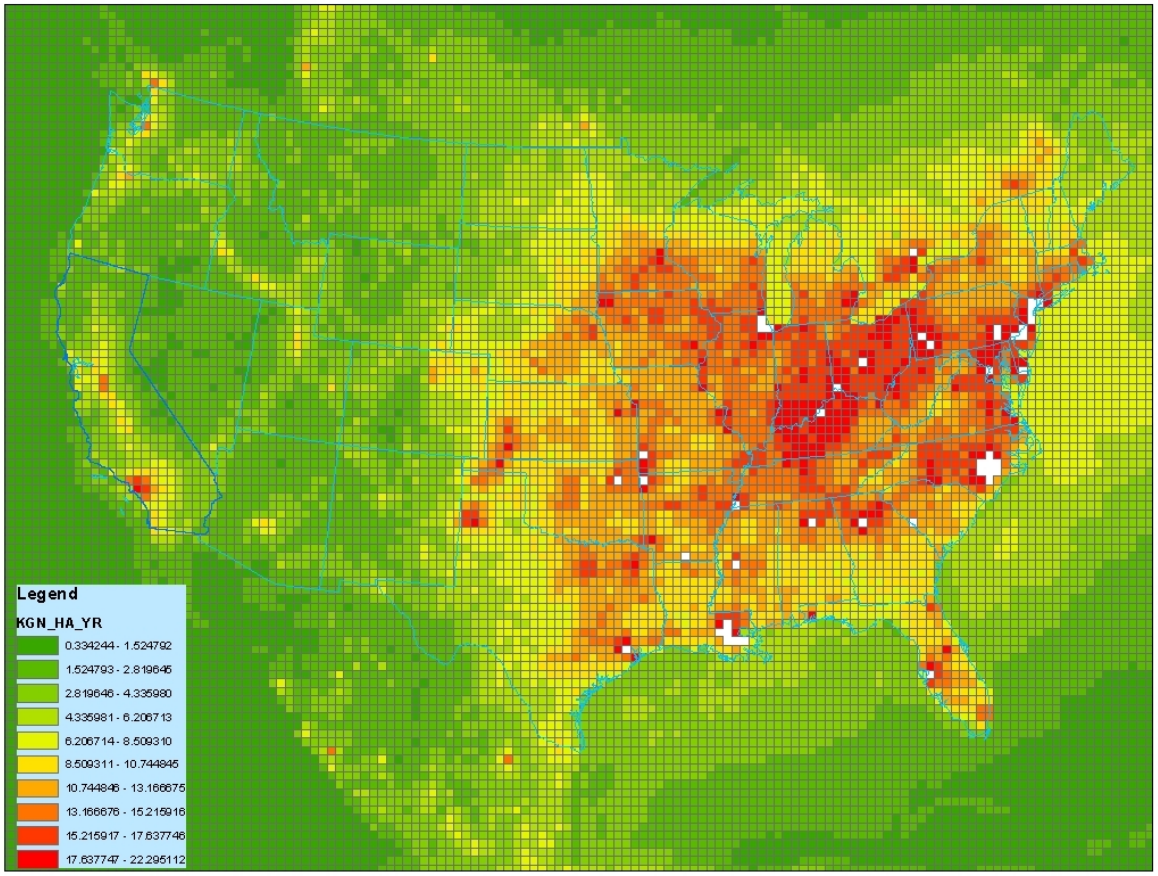


National Atmospheric Deposition Program/National Trends Network
http://nadp.sws.uiuc.edu

Atmospheric N deposition

CMAQ wet & dry

- Community Multi-scale Air Quality (CMAQ) Model
- 36 km resolution



Atmospheric N deposition

CMAQ wet & dry

- Emissions:

  TONS_NO, TONS_NO2, TONS_NH3, TONS_NOX

- Depo:

WDEP_OX_N	DDEP_ANO3T
DDEP_HNO3_	DDEP_NO_N
DDEP_NO2_N	DDEP_N205_
DDEP_PAN_N	WDEP_RE_N
DDEP_ANH4T	DDEP_NH3_N

N_2 fixation

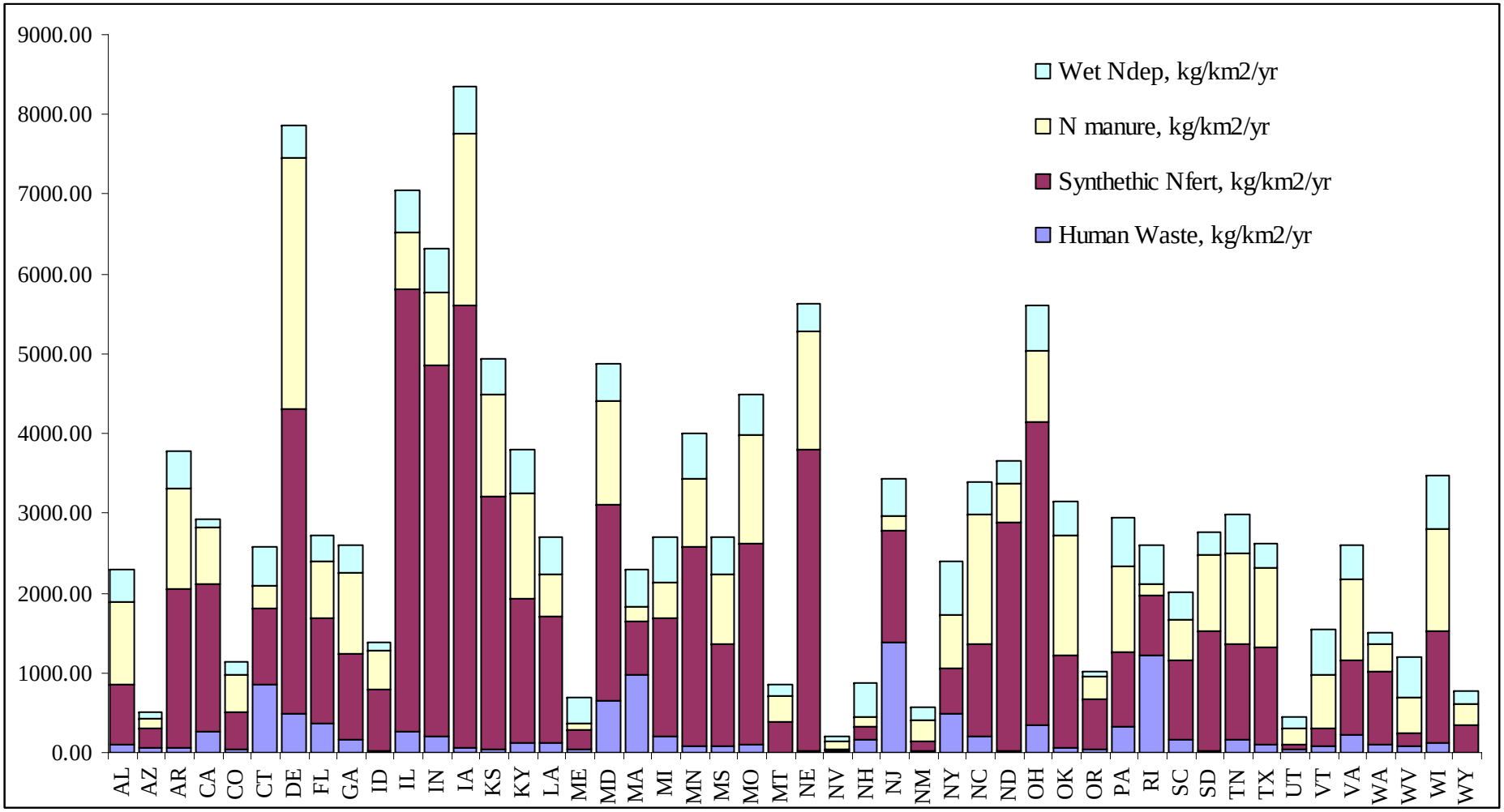
Source	Fixation Rates (kg/
Soybeans	96
Alfalfa	224
Nonalfalfa Hay	117
Eastern pasture (nonw	15
Snap Beans	90

Van dam, van breemen, jordan & weller

Soybean method being updated by INC

State subtotals → surface balance

(incomplete, INC adding other forms of ndep & bnbfix)



Water resources regions of the USA