GISP all drugs

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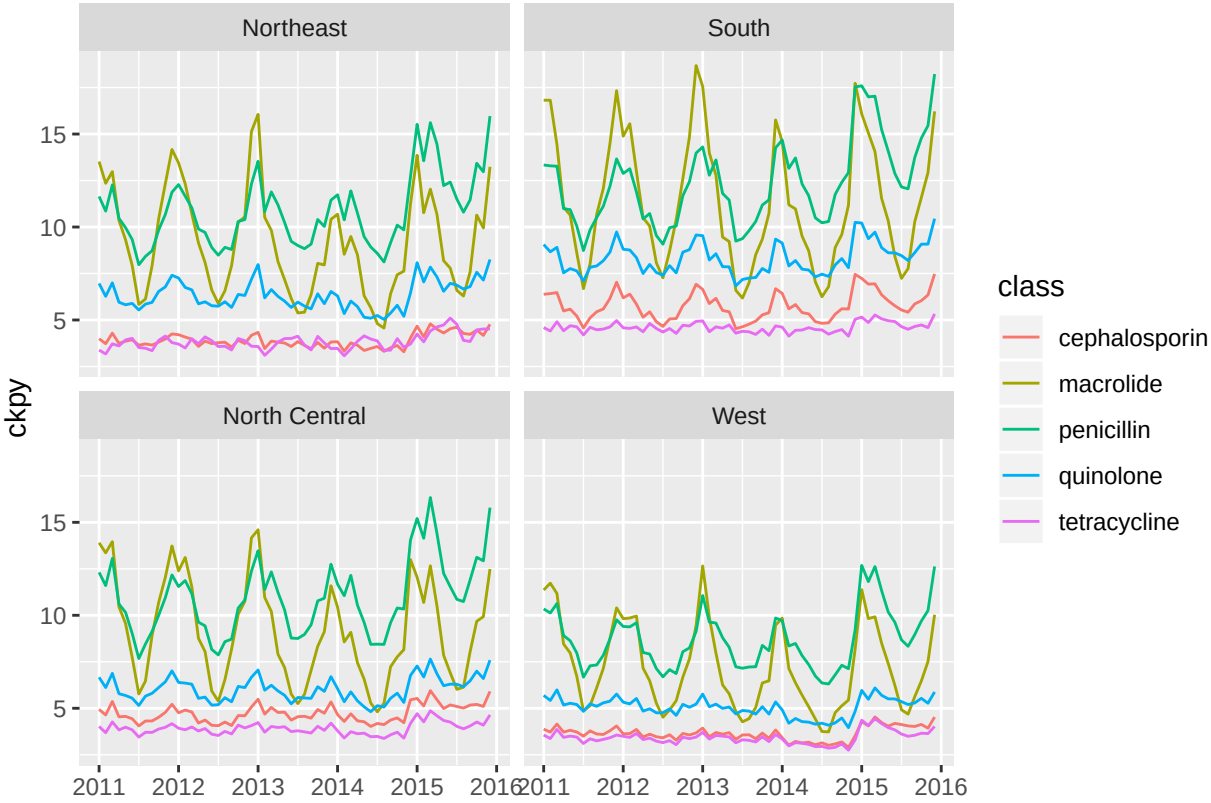
Antibiotic use

I group drugs into classes:

- macolides (azi, clarithro, erythro)
- quinolones (*xacin)
- celaphosporins (cef-, ceph-)
- tetracyclines (*cycline)
- penicillins (amox, amox/clav, pen v, amp, diclox, pen g)

By eye, it looks like there are seasonal patterns:

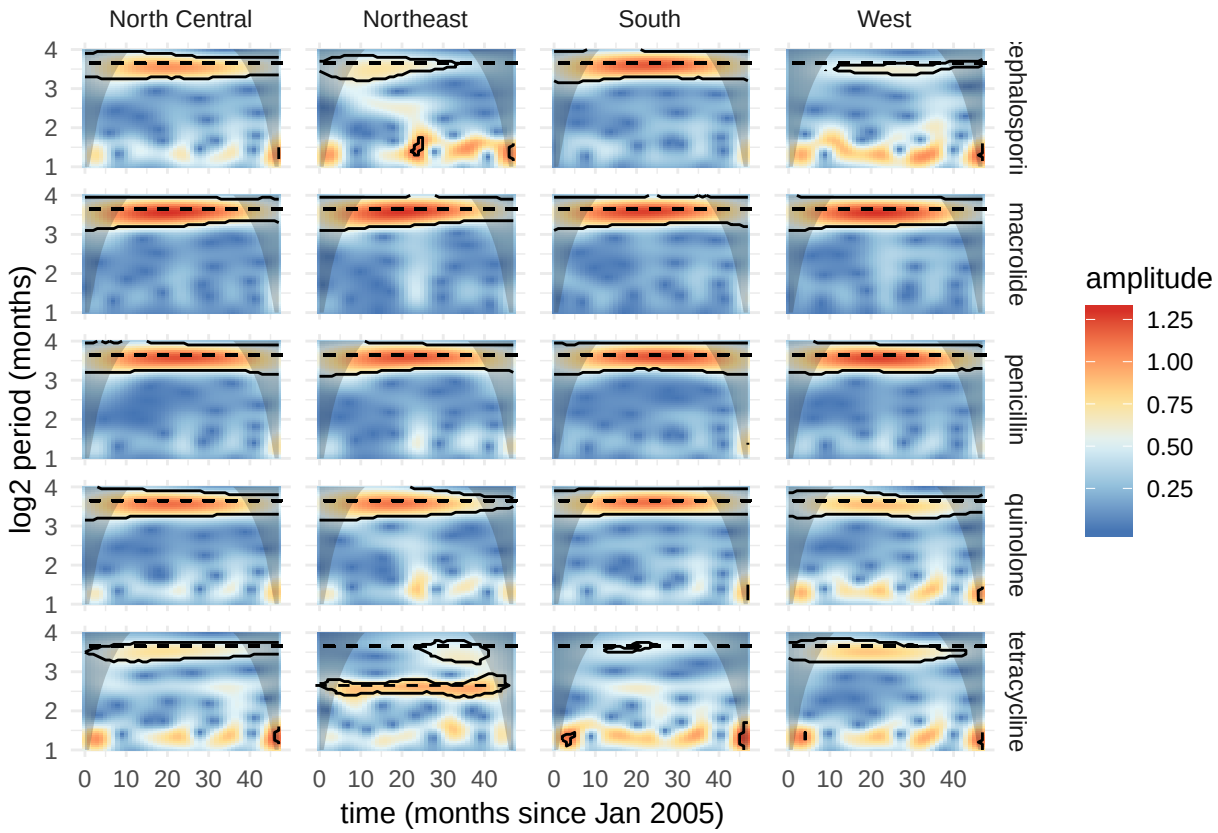


But there is also something fishy about the 2014-2015 merged: use seems to go up for all drugs, especially in the West. This might introduce some weird effects in the wavelet analysis.

Wavelet analysis

To detect seasonality of antibiotic use, I do a wavelet analysis. I exclude the 2015 data because of the weird 2014-2015 jump, which introduces some weird stuff into the wavelets.

Dotted lines show 12 month periods. (The Northeast/tetracyclines has an extra line for 6 month period.) Solid black lines show regions with $p < 0.05$. Shaded areas along the side are the "cone of influence" where edge effects are important.



- In general, macrolides, penicillins, and quinolones are highly seasonal.
- Cephalosporins are seasonal in the South and North Central (i.e., Midwest) and much less so in the Northeast and West.
- Tetracyclines are weakly seasonal in North Central and West. In the Northeast, there is a 6-monthly seasonality.

Sinusoidal fits

Table 1: Sinusoidal fits to use data

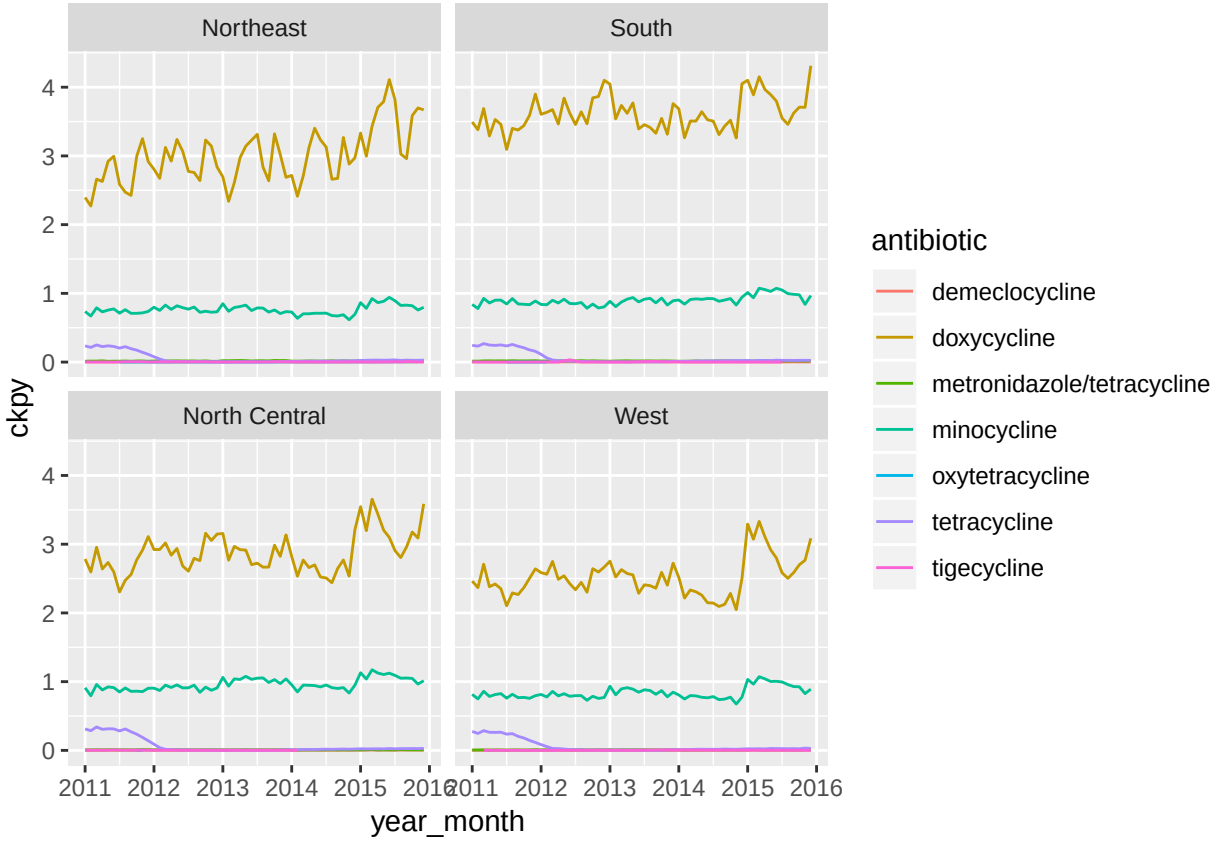
class	region	amplitude	amplitude_sig	peak
macrolide	Northeast	3.381	TRUE	0.112
macrolide	South	4.427	TRUE	-0.121
macrolide	North Central	3.413	TRUE	0.027
macrolide	West	2.848	TRUE	0.458
penicillin	Northeast	1.785	TRUE	0.450
penicillin	South	2.325	TRUE	0.058
penicillin	North Central	2.089	TRUE	0.274
penicillin	West	1.629	TRUE	0.637
quinolone	Northeast	0.603	TRUE	-0.115
quinolone	South	0.876	TRUE	-0.281
quinolone	North Central	0.607	TRUE	-0.260
quinolone	West	0.284	TRUE	0.477
cephalosporin	Northeast	0.139	TRUE	0.541
cephalosporin	South	0.865	TRUE	-0.003
cephalosporin	North Central	0.361	TRUE	0.072

class	region	amplitude	amplitude_sig	peak
cephalosporin	West	0.128	FALSE	0.718
tetracycline	Northeast	0.146	FALSE	5.203
tetracycline	South	0.144	TRUE	0.882
tetracycline	North Central	0.193	TRUE	0.482
tetracycline	West	0.210	TRUE	1.161

Use of every drug is yearly-seasonal, except for cephalosporins in the West and tetracyclines in the Northeast. I expect the Northeast tet thing has something to do with the 6-month cycle.

Tetracyclines

When looking just at the tetracycline drugs, it's clear that minocycline (used to treat acne) is stable through the year, while doxycycline (used to treat Lyme disease, among other things) has more complicated seasonal dynamics:



Resistance

Model fit

This is where the model fits would go for the drugs beyond macrolides. The code is in the block below. The fits are fairly slow, so it's nice for development purposes to have some way to save the fit data and re-load it.

It might make sense to do models for each drug/region combination, since for some drugs it seems like use patterns vary by region.