SNA Context, Queries and Results

Context:

As stated in the manuscript, we ran two separate analyses, one for the entirety of the MCO network, i.e. surface and sub-surface observations (R file: "0603_SNA smaller dataset") and one for the surface MCO network only, which is a sub-sample of the entire MCO network (R file: "0603_SNA surface obs only"). We distinguish between the MCO value chain and the MCO knowledge network, assessing the latter in the SNA. The value chain is a linear representation of how scientific knowledge on marine CO_2 transported from science to policy, indicating the different steps along the way. The MCO knowledge network refers to the actors that are part of this process and that can fulfill different tasks at various points in the value chain.

SNA Results:

1. Network measures
   a. Entire network
      - Density: 0.3245614
      - Homophily, measured via odds-ratio test (how many more times the odds of a tie within group is greater than odds of a tie between groups. At 1, the odds are identical. Large values greater than 1 represent homophily, values lower than 1 represent heterophily. See Bojanowski and Corten, 2014), for kind of actor (e.g. research institute, ministry, data platform, etc.) : 0.7784011
      - Homophily, measured via odds-ratio test, for scale (i.e. Germany, EU, international): 1.154576
   b. Surface-observations only network
      - Density: 0.352381
      - Homophily, measured via odds-ratio test, for kind of actor: 0.7417904
      - Homophily, measured via odds-ratio test, for scale: 1.050434
2. Actor-specific measures
   a. Entire network

Name	Degree centrality	In-degree	Out-degree	Betweenness
GEOMAR	23	11	12	22.7023810
IOW	19	9	10	12.6523810
AWI	14	6	8	40.7809524
Hereon	10	5	5	16.7833333
ICOS-OTC	16	7	9	4.8000000
SOCAT	16	7	9	19.6666667
GCB	4	2	2	16.0000000
IPCC	2	1	1	0.0000000
COP	5	5	0	0.0000000
UNESCO-IOC	7	4	3	4.0833333
GOOS	13	8	5	19.4261905
IOCCP	17	6	11	25.8000000
BMBF	11	5	6	17.7095238
WMO	14	7	7	33.9214286
BMDV	3	1	2	0.3333333
BSH	21	11	10	41.5023810
BGC-Argo	11	6	5	2.1833333
GCOS	6	5	1	1.1428571
Global DAC	10	5	5	2.6857143

b. Surface-observations only network

Name	Degree centrality	In-degree	Out-degree	Betweenness
GEOMAR	19	9	10	18.5428571
IOW	13	6	7	6.4833333
AWI	12	5	7	27.0761905
Hereon	9	5	4	12.1190476
ICOS-OTC	15	7	8	4.0357143
SOCAT	16	7	9	17.1190476
GCB	4	2	2	12.0000000
IPCC	2	1	1	0.0000000
COP	4	4	0	0.0000000
UNESCO-IOC	4	2	2	0.3928571
GOOS	9	5	4	5.78333333
IOCCP	15	6	9	19.9000000
BMBF	9	4	5	12.2000000
WMO	12	7	5	21.7333333
GCOS	5	4	1	0.0000000

SNA Analysis and R Queries [these can also be found in the RScripts]

RStudio Package:

For both analyses, the R Packages used are igraph (version 2.0.3), tidygraph (version 1.3.1), tidyr (version 1.3.1), dplyr (version 1.1.4), ggraph (version 2.2.1), graphlayouts (version 1.1.1), ggforce (version 0.4.2), and netseg (version 1.0-2).

Queries and Results (for information on calculation see Csardi 2008 unless otherwise stated)

For the entire MCO network (name of graph: f_info)

1. Network density (overall existing ties between entities divided by number of all possible ties)
   - Command: edge_density(f_info, loops = FALSE)
2. Degree centrality (number of ties connected to each node, incoming and outgoing)
   - Command: igraph::degree(f_info)
3. In-degree centrality (measure of in-coming ties: information recipients)
   - Command: igraph::degree(f_info, mode="in")
4. Out-degree centrality (measure of outgoing ties: information senders)
   - Command: igraph::degree(f_info, mode="out")
5. Betweenness centrality (measure of whether a node lie on the shortest path between two nodes that are not directly linked and therefore indicates gatekeeping or brokerage potential)
   - Command: igraph::betweenness(f_info)
6. Connection between in- and outdegree (are information senders also information recipients and vice versa?)
   a. Pearson correlation test
      - Command: cor(i2_f, o2_f, use = "everything", method = c("pearson")
   b. Is the correlation statistically significant? (Pearson's product-moment correlation)
      - Command: cor.test(i2_f,o2_f)
7. Homophily, measured via Odds-Ratio test
   a. Tested for attribute "kind" (i.e. actors that are ministries vs. research institutes vs. data platforms, etc.)
      - Command: orwg(f_info, "Kind")

b. Tested for attribute "country" (i.e. scale to which the node belongs – Germany, EU, UN, or international actor)
   - Command: orwg(f_info, "Country")

For the surface MCO network only (name of graph: s_info)

1. Network density (overall existing ties between entities divided by number of all possible ties)
   - Command: edge_density(s_info, loops = FALSE)
2. Degree centrality (number of ties connected to each node, incoming and outgoing):
   - Command: igraph::degree(s_info)
3. In-degree centrality (measure of in-coming ties: information recipients)
   - Command: igraph::degree(s_info, mode="in")
4. Out-degree centrality (measure of outgoing ties: information senders)
   - Command: igraph::degree(s_info, mode="out")
5. Betweenness centrality (measure of whether a node lie on the shortest path between two nodes that are not directly linked and therefore indicates gatekeeping or brokerage potential)
   - Command: igraph::betweenness(s_info)
6. Connection between in- and outdegree (are information senders also information recipients and vice versa?)
   a. Pearson correlation test
      - Command: cor(i2_s, o2_s, use = "everything", method = c("pearson")
   b. Is the correlation statistically significant? (Pearson's product-moment correlation)
      - Command: cor.test(i2_s,o2_s)
7. Homophily, measured via Odds-Ratio test (how many more times the odds of a tie within group is greater than odds of a tie between groups; see Bojanowski and Corten, 2014). At 1, the odds are identical; large values greater than 1 represent homophily, values lower than 1 represent heterophily.
   a. Tested for attribute "kind" (i.e. actors that are ministries vs. research institutes vs. data platforms, etc.)
      - Command: orwg(s_info, "Kind")
   b. Tested for attribute "country" (i.e. scale to which the node belongs – Germany, EU, UN, or international actor)
      - Command: orwg(s_info, "Country")

References:

Bojanowski, M., & Corten, R. (2014). Measuring segregation in social networks. *Social networks*, 39, 14-32.

Csardi, G. (2007). The igraph package. <document (psu.edu)>