



## Public PhD-defence

**Natalie Koerner** defends the dissertation *Towards the Meteorological. The Architecture of Data Centres and the Cloud*

The defence takes place **Monday 17th June 2019, at 13:00 in Aud. A3**, Philip de Langes Allé 10, 1435 Copenhagen K.

### Agenda

- 13:00 Welcome and presentation of chairperson, assessment committee, supervisors and author
- 13:05 **Natalie Koerner** presents her dissertation *Towards the Meteorological. The Architecture of Data Centres and the Cloud*
- 13:50 Short break  
According to the 'Ministerial Order on the PhD Course of Study and the PhD Degree' the chairperson may invite the audience to contribute with short statements. Such intentions should be addressed to the chairperson during the break.
- 14:00 Philip Ursprung, Professor, Dr. Phil, Chair for the History of Art and Architecture, ETH Zürich
- 14:30 Jacob Wamberg, Professor, School of Communication and Culture - Art History, Aarhus University
- 15:00 Niels Grønbæk, Associate Professor, Institute of Architecture and Culture, The Royal Danish Academy of Fine Arts, Schools of Architecture, Design and Conservation, KADK (chair of the assessment committee)
- 15:30 Comments from the auditorium  
The assessment committee evaluates and makes the concluding remarks  
Closure of session

### Assessment committee

Philip Ursprung	Professor, Dr. Phil, Chair for the History of Art and Architecture, ETH Zürich
Jacob Wamberg	Professor, School of Communication and Culture - Art History, Aarhus University
Niels Grønbæk	Associate Professor, Institute of Architecture and Culture, KADK

### Supervisors

Carsten Thau	Professor, Institute of Architecture and Culture, KADK
Peter Bertram	Associate Professor, Institute of Architecture and Culture KADK
Henriette Steiner	Associate Professor, Landscape Architecture and Planning, University of Copenhagen

### Chairperson of the defence

Carsten Thau	Professor, Institute of Architecture and Culture, KADK
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The thesis is the result of a Ph.D.-studio financed by KADK

The thesis is available to look through for interested persons at the Library of Architecture, Design and Performing Arts, Danneskiold-Samsøes Allé 50, 1434 Copenhagen K.

# Towards the Meteorological

## The Architecture of Data Centres and the Cloud

Natalie P. Koerner

### Summary

The digital cloud permeates daily life. The \$174 billion industry is fuelled by 3.6 billion users and constitutes three per cent of global energy consumption. This thesis examines the cloud metaphor and the data centres it denotes to reveal the cloud's temporality, spatiality and materiality from an architectural perspective. By creating analogies with cloud variations—meteorological, fictional and artificial clouds—the research seeks to uncover what the metaphor discloses about digital archives. Despite the (digital) cloud's ample presence in adjacent fields, a theoretical framework for it has yet to be established in architecture. Tapping into the planetary imaginary, I show that digital archives embody the meteorological mode: like meteorological clouds, they are extremely responsive and governed by an archival impulse to continuously update their animated, mobile data.

Part I addresses the geological implications of data centres, the physical backbone of the cloud, as servers are made of materials extracted from the ground: metals, minerals, rare earth elements (Parikka). The beginnings of geology as a science (Hutton, Lyell) defined the planet as an archive. In dialogue with a variety of thinkers (Ruskin, Smithson, Ernst, Leopold, Bjornerud, Cohen, Deleuze and Guattari), I develop the geological mode—a temporal, material and spatial method that embodies the logic of the ground. It guides my analysis of three case studies. The first is the Lamont-Doherty Earth Observatory, New York. This archives sediment cores, extracted from ocean floors, which contain geophysical and environmental histories embodied in fossils. Thinking with Meillassoux, I explore the vast temporal horizons stored in the formerly animated matter. To further gauge the ground's temporalities, I turn to the large-scale memorial *Il Grande Cretto* (1984–2015) by artist Alberto Burri. It archives geological matter that used to constitute the built fabric of Gibellina before the latter was destroyed in an earthquake. In line with the planet's intrinsic movement (Clark), affect theory (Ahmed, Berlant) and art-historical references, I understand *Il Grande Cretto* as Burri's attempt to suspend persistent geological activities. The geological mode engenders archives that incessantly update their content. This mode is embodied in Henning Larsen's Nordea Bank headquarters data centre (2017). Data centres harness the archival capacities of geological matter. Their ingrained secrecy, resilience and redundancy invite architectural comparison to the bunker (Virilio, Hu). The bunker is positioned in tension with vast infrastructure networks from which data centres cannot be isolated (Koolhaas, Easterling).

In Part 2, against the backdrop of the firm but active (geological) ground of data centres, I turn to the cloud and the meteorological mode. Beginning with the philosophical context of the sky and its clouds as media (Durham Peters), I describe meteorological clouds' aerosols as data points that literally store and transmit information. Like data in the digital cloud, the continuously transforming and shifting aerosols compose ever-new adjacencies and juxtapositions. Referring to early computing (Babbage), I postulate meteorological clouds as analogue computers. For an architectural constellation of weather and computing, I turn to meteorologist Richardson's speculative Forecast Factory (1922)—a combination of a cloud and a globe, designed to compute and archive the planet's

weather. I then turn to the archiving history that has affected the cloud metaphor. The example of an early databank proposed by the American government in 1966 reveals how the cybernetic archive, in combination with the constant presence of radioactivity during the Cold War, fuelled archive (Derrida) and network fever (Wigley), finally culminating in our digital cloud. The outsourcing of nonconscious cognitive processes (Hayles) to technical beings is an attempt to cool these fevers. I pair the digital cloud's nonconscious realm of machine learning and Big Data with the notion of a great outdoors (Meillassoux, Bennett). Artificial clouds mediate the inaccessible. Architectural examples during the 1960s (Wright, Ant Farm) actualised the cloud mediator at a time of budding instant global communication and space travel.

The digital cloud thus constitutes an exterior, a physically inaccessible realm that is paradoxically filled with intimate and identity-defining information about its externalised users. The digital cloud is more than a metaphor: it articulates an increasingly pervasive spatiality of the threshold, of bodies without surfaces, of space as media, of our built world extended into the intangible—in short, a great outdoors.

## Resumé

Den digitale sky gennemsyrrer det daglige liv. 3,6 milliarder brugere føder den 174 \$ millionindustri som udgør 3% af det globale energiforbrug. Afhandlingen undersøger metaforen og de datacentre som det er tegn på for at afsløre skyens midlertidighed, rumlighed og materialitet fra et arkitektonisk perspektiv. Ved at skabe analogier med skyvariationer – meteorologiske, fiktive og nedfalds-skyer – søger undersøgelsen at afdække hvad sky-metaforen afslører om digitale arkiver. På trods af den (digitale) skys omfattende tilstedeværelse i beslægtede fagområder, har den stadig ikke etableret en teoretisk ramme i arkitektur. Gennem "planetary imaginary" viser jeg at digitale arkiver legemliggør det meteorologiske modus: som meteorologiske skyer er de ekstremt responsive og opdaterer konstant deres animerede mobile data, styret af en arkiveringsimpuls til at opdatere.

Del I undersøger geologiske konsekvenser af datacentre, skyens fysiske rygrad, da servere er lavet af materialer udvundet af jorden: metaller, mineraler, sjældne jordarter (Parikka). Da geologi var en ung videnskab defineredes planeten som et arkiv. I dialog med en række tænkere (Ruskin, Smithson, Ernst, Leopold, Bjørnerud, Cohen, Deleuze og Guattari) udvikler jeg den geologiske modus – en tidlig, materiel og rumlig metode der legemliggør jordens/terrænets logik. Det guider min analyse af tre casestudier. Først Lamont-Doherty Earth Observatory. Det arkiverer sedimentkerner udtaget af fra havbunden, der indeholder geofysiske og miljø historier legemliggjort i fossiler. Med Meillassoux undersøger jeg de store tidlige horisonter i det før animerede stof. For yderligere at vurdere terrænets tidsligheder, vender jeg mig mod stor-skala mindesmærket *Il Grande Cretto* (1984–2015) af kunstneren Alberto Burri. Det arkiverer geologisk materiale der engang udgjorde Gibellina's byggede struktur, før det blev ødelagt af jordskælv. I tråd med planetens immanente bevægelse (Nigel Clark), affekt teori (Sara Ahmed og Lauren Berlant) og kunsthistoriske referencer, forstår jeg *Cretto* som Burri's forsøg på at skabe et ophold, en pause i de vedvarende geologiske aktiviteter. Den geologiske modus frembringer arkiver der uafbrudt opdaterer deres indhold. Denne modus er legemliggjort i Nordeas hovedkvarters datacenter af Henning Larsen, 2017. Datacentre tæmmer det geologiske stofs kapacitet til at arkivere. Deres indgroede hemmelighedsfuldhed modstandsdygtighed og redundans inviterer den arkitektoniske sammenligning til bunkeren (Virilio, Hu). Bunkeren er som en modvægt overfor den omfattende infrastruktur som datacentreerne ikke kan isoleres fra (Koolhaas, Easterling).

I Del II med datacenters faste men aktive (geologiske) terræn som baggrund, har jeg vendt mig mod skyen og den meteorologiske modus. Begyndende med den filosofiske kontekst af skyen og dets skyer som medie (Durham Peters) beskriver jeg de meteorologiske skyers drivgas som datapunktskyer, der bogstaveligt lagrer og overfører information. Som data i den digitale sky, komponerer den konstant foranderlige og omskiftelige drivgas stadigt nye forbindelser og sammenstillinger. Med reference til tidlig ”computing” (Babbage) taler jeg for meteorologiske skyer som analoge computere. For en arkitektonisk konstellation af vejr og ”computing” vender jeg mig mod meteorologen Richardsons spekulative Forecast Factory (1922) – en kombination af en sky og en klode, designet til at beregne og arkivere planetens vejr. Jeg vender mig mod den arkiveringshistorie som har påvirket skymetaforen. Eksemplet med en tidlig databank foreslået af den amerikanske regering i 1966, afslører hvordan det cybernetiske arkiv i kombination med den kolde krigs konstante tilstedeværelse af radioaktivitet, gav næring til arkiv- og netværk-feber, kulminerede afslutningsvis i vores digitale sky. Udlicitering af ubevidste kognitive processer (Hayles) til ”technical beings”, er et forsøg på at dæmpe disse febertilstande. Jeg kobler den digitale skys domæne af ubevidstes ”mschine learning” og big-data med forestillingen om et ”great outdoors” (Meillassoux, Bennett). Kunstige skyer medierer det utilgængelige. Arkitektoniske eksempler fra 1960-erne (Wright, Ant Farm) aktualiserer skymediatoren i en tid hvor det globale, øjeblikkelig kommunikation og rumrejser spirede.

Den digitale sky udgør et eksteriørt og fysisk utilgængeligt domæne der paradoksalt nok er fyldt med intime og identitet-definerende information om dets eksternaliserede brugere. Den digitale sky er mere end en metafor: den artikulerer, stadig mere gennemtrængende, tærsklens rumlighed, af kroppe uden overflader, af medie som rum, af vores byggede verden udvidet til det u håndgribelige – kort sagt et ”great outdoors”.

