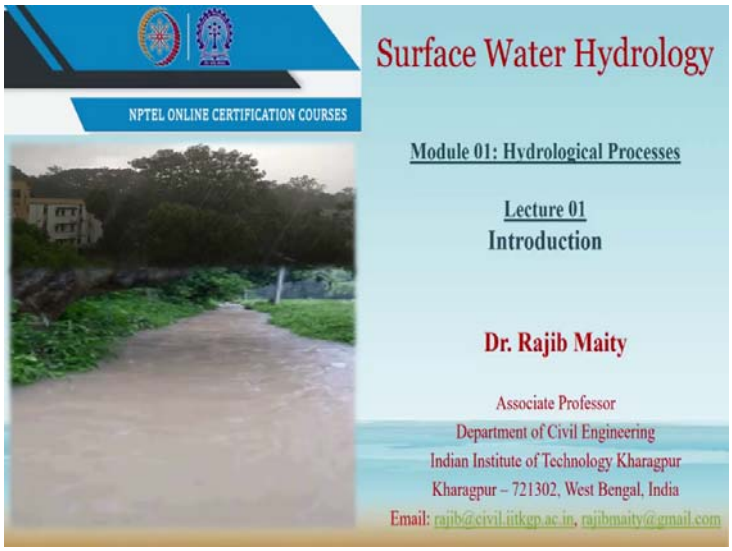
Surface Water Hydrology
Professor Rajib Maity
Department of Civil Engineering
Indian Institute of Technology, Kharagpur
Lecture 01
Introduction

Hello students, welcome to this course, Surface Water Hydrology.

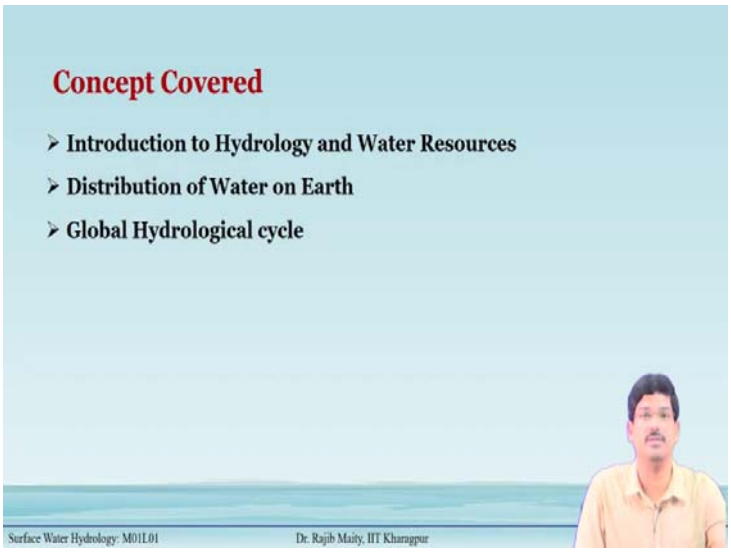
(Refer Slide Time: 0:16)



This course is designed in such a way that undergraduate students will find it very useful and the students who wants to do some specialization and research on the related fields, related to water and water crisis will find this one useful. This course is also designed in such a way that the practitioners will find it useful to solve some field-scale problems.

In this very first lecture, we will be talking something about the introduction of the entire course, entire course outline and to start with myself, Dr. Rajib Maity. I am from Indian Institute of Technology, Kharagpur, Department of Civil Engineering. You can see my email ID is here, at the end, it is written. So, at any point of time you have any query about the content of this course, you can definitely connect to me.

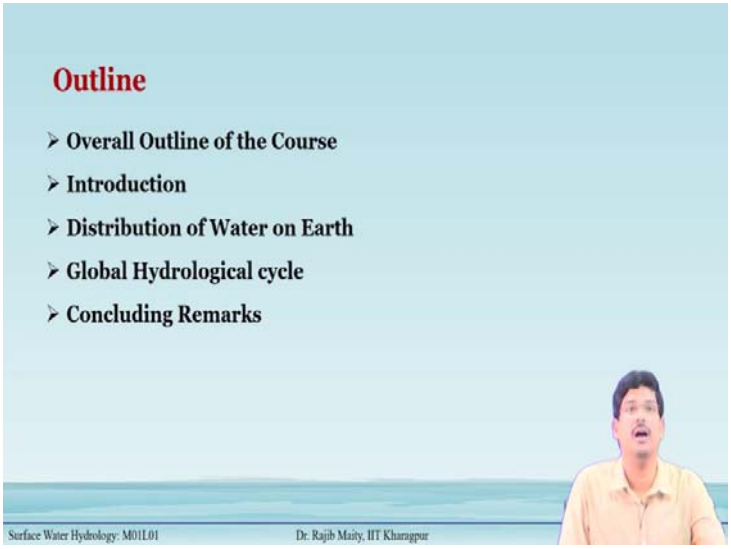
(Refer Slide Time: 1:18)



So, in this very first lecture, these are the concepts that I will cover. The first one is introduction to hydrology and water resource. This is important! This will help us to develop the motivation why we need this particular course, and in the current context, why this study related to water is very, very important given the context of this climate change that you might be hearing now in different media and resources.

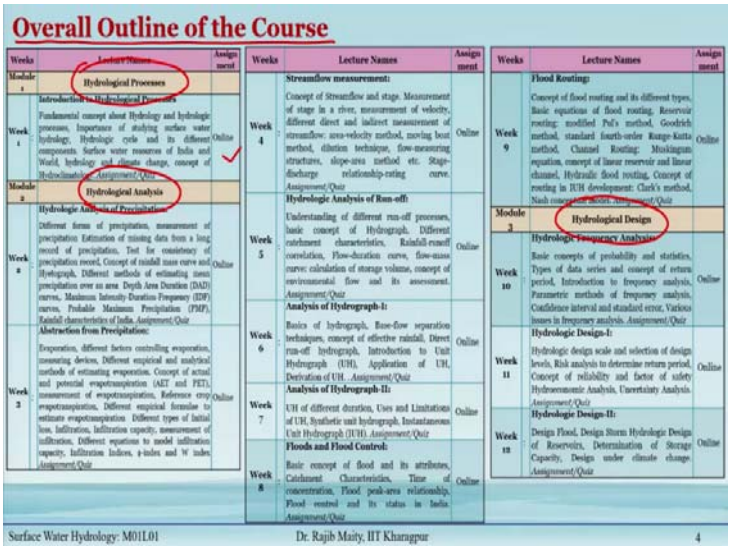
The second thing that I will discuss about is the distribution of water on earth, and of course it will go to the global hydrologic cycle. Some parts will be taken in the next lecture as well.

(Refer Slide Time: 2:05)



If I come to the outline of this course, so the overall outline of the course that we will be discussed in this very first lecture itself. You will see that there are total three modules: introduction, then analysis, and design. All three things will be covered. I will discuss one by one. Then, I will come to the overall introduction, then as I told in the concept covered, one of the most important thing, how the water is distributed across the earth, and of course, over the time, then the global hydrologic cycle, and finally, the concluding remarks from this discussion.

(Refer Slide Time: 2:36)

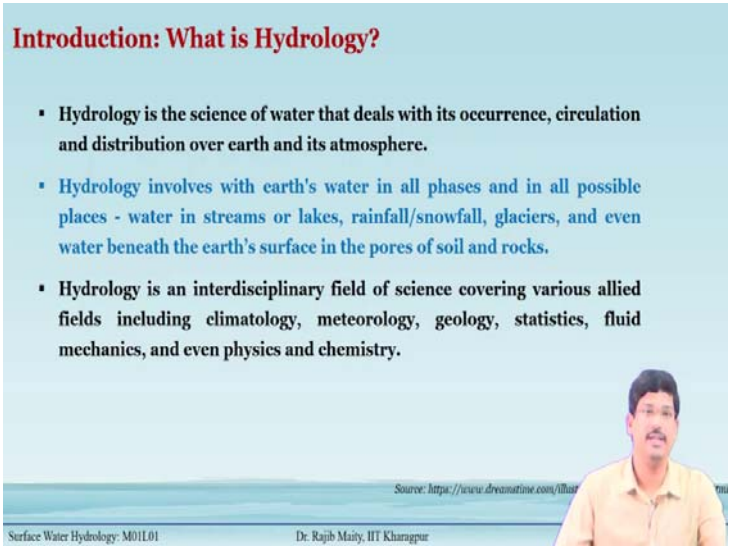


Now, this is the overall outline of this course. There are mainly three modules are there. In the first module, we will discuss about hydrological processes. In the second module, which is one of the major components of this course that is hydrological analysis and the third one deals with the hydrological design. So, as you can see that it goes in a flow where we need the background knowledge to proceed one after another.

So, in the hydrological processes, in the very first module, we will be discussing mainly: what is hydrological cycle? And, most importantly, how this is creating the backbone for the surface water hydrology. And, why and what are the recent changes with respect to the climate change. These are the major focuses that will be included in the first module.

Second module, as you can see here, it spans from week 2 to week 9, where different analyses related to surface water hydrology will be discussed, and this knowledge will be utilized in the third module, where we will be discussing some of the applications in hydrological design.

(Refer Slide Time: 3:56)



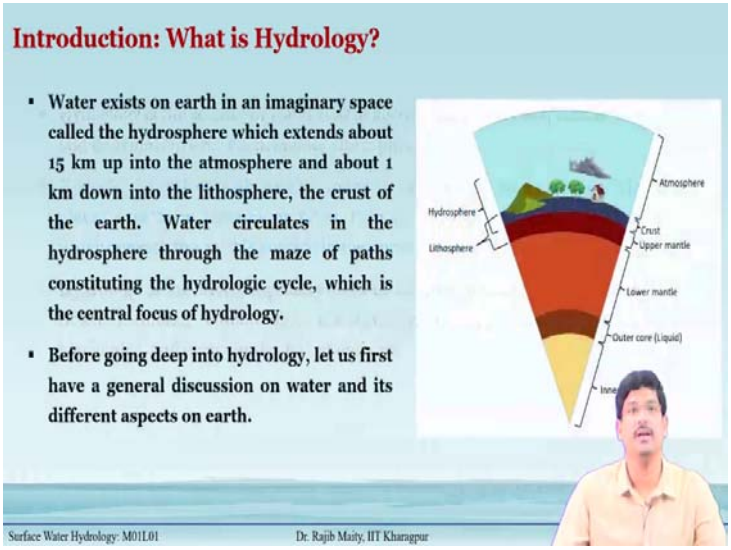
So, at the very first, we should know that what is hydrology. It is a science of the water that deals with its occurrence, circulation, and distribution over the earth and its atmosphere. So, this is a scientific area, where the entire system, connected through different interconnected processes, that deals with different allied fields also. So, this is how we have to understand the hydrological concept, if we really want to know the total process.

So, this basically involves water in all phases, at all possible places, e.g, the water in the streams or lakes, rainfall or snowfall, glacier, or even the water beneath the earth surface and the pores of the soils and rocks.

As you know, that our course title is surface water hydrology. So we will restrict our analysis and design confined within the surface water only. But, of course, we cannot deny the other two immediate neighbors of it: one is the atmosphere, other one is the subsurface water. So, these will come now and then in our course as well.

We can now gradually move towards the overall structure of the course. As you can understand that it is an interdisciplinary field of science, and it basically covers the different other various allied fields. Those are climatology, as I told you that there is a change in this field. Meteorology is another field. These are very much related to the hydrological processes. Even the geology, the mathematical tools like statistics, fluid mechanics or even when we talk about the water quality, the physics, chemistry, these are also coming into this area. So, it is a truly interdisciplinary field of science.

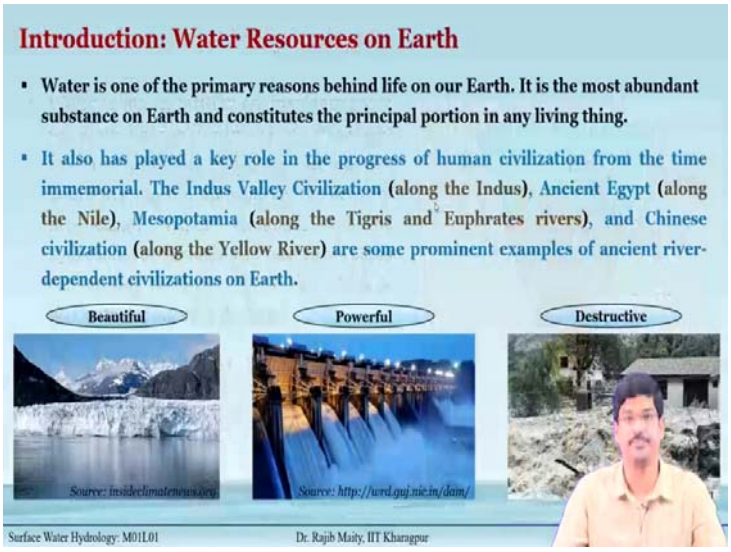
(Refer Slide Time: 6:01)



Next, as you may be knowing, that water exists on the earth in a space with uncertain varying boundaries. What I mean is that it can be below the surface and it can be the above the surface also. This is almost about, say 15 km above the surface in the atmosphere and almost about one km below the ground. This entire area is known as hydrosphere. There are different paths and processes through which the hydrologic cycle takes place which, of course, as I told you, is the central focus of the hydrological science.

So, before we go deep into the hydrology, let us first have a general discussion on water and its different aspects on the earth.

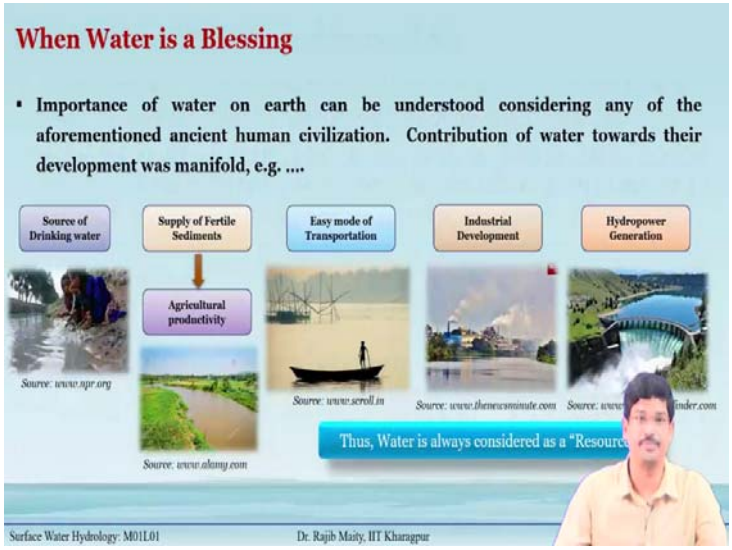
(Refer Slide Time: 6:54)



Water as a resource on the earth, as you might be knowing already, is one of the primary reason behind the life on the earth. It is the most abundant substance on the earth and constitutes the principal portion in any living thing. So, it has also played the key role in the progress of the human civilization from the ancient time. You might be knowing about Indus valley civilization or ancient Egypt or Mesopotamia, the Chinese civilization. All these were along some big river basins or river network, and these are some of the prominent examples of the ancient river dependent civilization on the earth.

So, this pictorial presentation, you can see that sometimes we find water is very '*beautiful*'. As you can see next, in the diagram, it is really '*powerful*'. It helps us to generate some power, and which is definitely one of the sources of renewable energy. You may have heard this term. Finally, sometimes it can be '*destructive*' also that many of us have seen or heard from different news and media, or even experienced as well. So, it can be *beautiful*, it can be *powerful*, and it can be *destructive*.

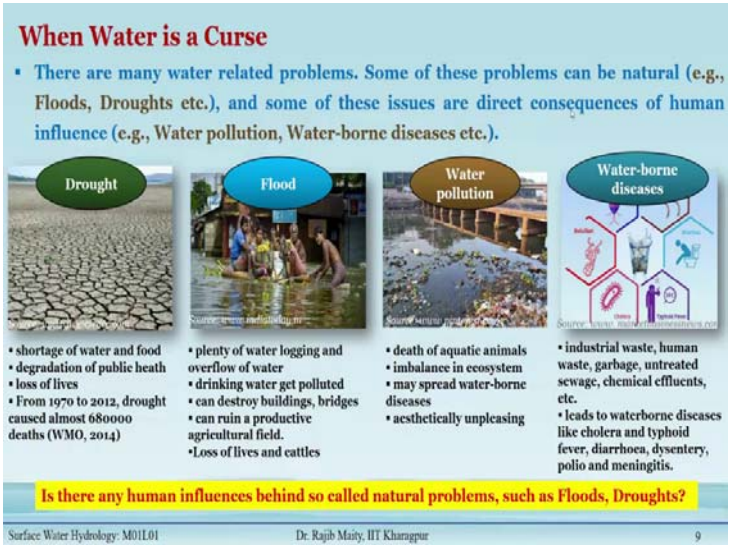
(Refer Slide Time: 8:18)



Thus, water it can be a *blessing*, or it can be a *curse* both. Considering water as a blessing, the importance of the water on the earth can be understood from any of the aforementioned ancient human civilizations. This is why the human beings thought that their civilization should be in and around a river basin. The first thing is that it serves as the source of the drinking water. It supplies the fertile sediments when it is considered for the agricultural productivity. During the flood time, lots of sediment comes and this is highly fertile.

River networks help in transportation. Then, it is essential for industrial development. There are many industries developed on the bank of the river to meet their need for water. Next, there is hydropower generation also. So, this is just an indicative list. There are many more that you can imagine when water can be considered as a blessing. So, it is truly speaking that the water is always considered as a resource that makes the term the water resource.

(Refer Slide Time: 9:37)



But, at the same time, it also creates some sort of *curse*, as there are many water related problems that we know. Some of such problems can be natural, like the floods and droughts, and some of these issues are the direct consequences of the human influences such as water pollution, water-borne diseases etc. You can see some of the glimpse of the snapshots of drought, flood, then water pollution, water-borne diseases.

The droughts, as you know, cause the shortage of the water and food. It causes a degradation of the public health. It causes loss of the life too. From 1972 to 2012, it caused almost about 6,80,000 deaths as per the WMO record in 2014.

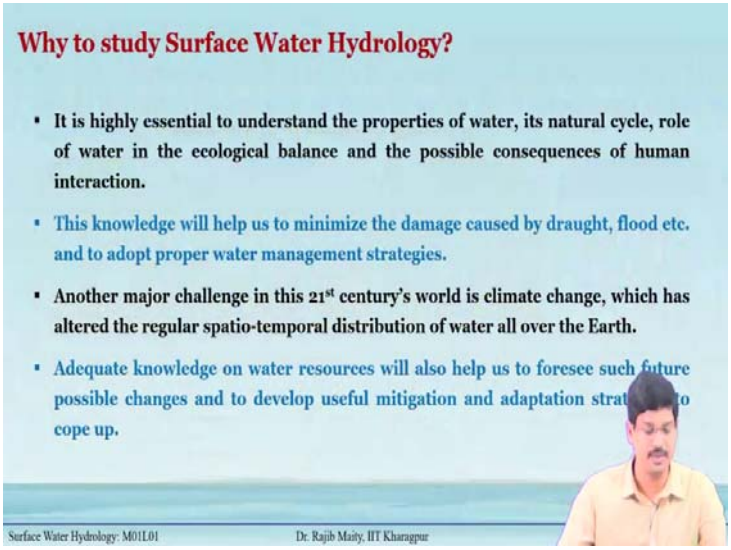
Regarding flood, it is opposite of the drought. During the flood, there is a plenty of waterlogging and the overflow of the water. Drinking water gets polluted. It can destroy the buildings/bridges, ruin the productive agricultural field, cause the loss of lives and cattle.

Considering water pollution, there are deaths of aquatic life, imbalance in the ecosystem. It may spread water-borne diseases. It is of course aesthetically unpleasing. Moreover, water-borne diseases, as we know, caused due to the industrial waste and human waste, garbage,

untreated sewage, chemical effluents. These sometimes are released without any basic treatment to the nearby surface water sources, like rivers, lakes. It causes different water-borne disease like cholera, typhoid, then diarrhoea, dysentery, polio and so on and so forth.

However, when we start, I told there are few things are natural and few things are due to the direct influence of the human beings. But the question is that: Is there any human influence behind the so called natural problems, such as floods and droughts? Because this is very recent as compared to all other things that I discussed from the ancient era. Very recently, our realization is that even for the floods and droughts, there are some indirect influences that human beings are creating, and this is basically the manifestation of the climate change that we will take up time to time during this course.

(Refer Slide Time: 12:13)



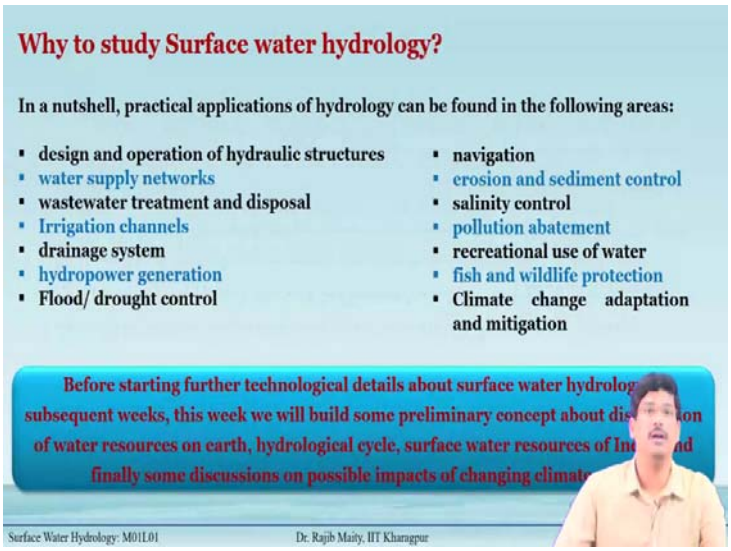
So, this basic introduction forms the motivation why to study this particular course, *surface water hydrology*. As you know, it is highly essential to understand the properties of the water, its natural cycle, its role in the ecological balance, and the possible consequences on the human interaction.

Secondly, this knowledge will help us to minimize the damage caused by the droughts and floods etc., and to adopt proper water management strategies, if we know the different processes that is involved within it.

Another major challenge in the 21st century, as I mentioned, is the climate change, which has altered the regular spatio-temporal distribution of the water all across the earth. That means

whatever we know, in general, about its distribution, now, impact of climate change has caused some sort of redistribution of water resources over space and time. So, that is very much essential information for us to rethink about the management of the water that is available to us. Last but not least, the adequate knowledge on the water resources will also help us to foresee such future possible changes and to develop the useful mitigation and adaption strategies to cope up.

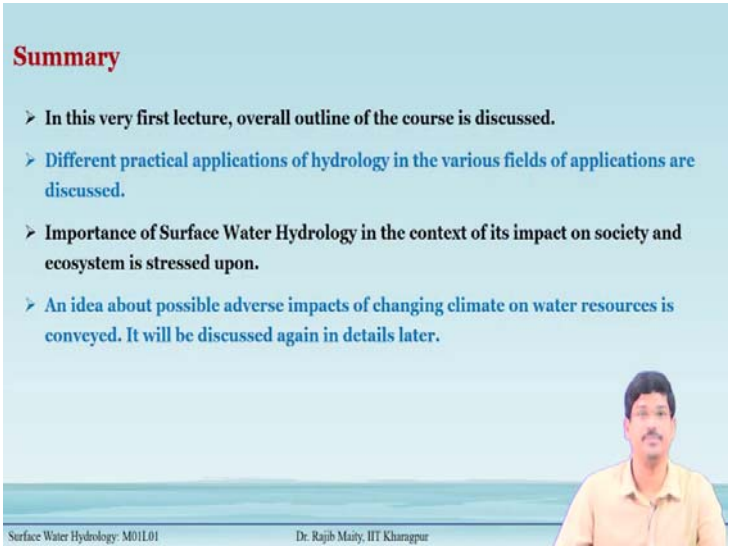
(Refer Slide Time: 13:39)



Coming to the next one, why to study this surface water hydrology? In a nutshell, there are different practical applications of hydrology that can be found in many areas. Some of the areas are listed here. It starts from design and operation of the hydraulic structures, water supply networks, wastewater treatment and disposal, irrigation channels, drainage system, hydropower generation, flood and drought control, then navigation, erosion and sediment control, salinity control, pollution abatement, recreational use of water, fish and wildlife protection, and finally the climate change adaptation and mitigation.

So, before proceeding further on the details about the surface water hydrology in the subsequent weeks, this week we will build some preliminary concepts about the distribution of the water resource on the earth, hydrological cycle, surface water resource of India, and finally some discussions on the possible impact of changing climate on it. So, overall, this is how the first week is designed.

(Refer Slide Time: 14:56)



Coming to the summary of this very first lecture, this lecture is basically covered the overall outline of the course on how we will proceed. Secondly, the different practical applications, particularly for the practitioners, those who are working in the different field related problems related to hydrology, in the various fields of applications. These are just mentioned.

The importance of the surface water hydrology in the context of its impact on society and ecosystem is stressed upon, and an idea about the possible adverse impacts of changing climate on the water resource is conveyed. It will be of course discussed again in details later in this course. Thank you.