МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ ОДЕСЬКИЙ ДЕРЖАВНИЙ ЕКОЛОГІЧНИЙ УНІВЕРСИТЕТ

МЕТОДИЧНІ ВКАЗІВКИ

для СРС та навчальний матеріал з англійської мови

Одеса-2016

МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ
ОДЕСЬКИЙ ДЕРЖАВНИЙ ЕКОЛОГІЧНИЙ УНІВЕРСИТЕТ

МЕТОДИЧНІ ВКАЗІВКИ

для СРС та навчальний матеріал з англійської мови
для студентів ІІІ курсу (V семестру)
денної форми навчання
Напрям підготовки метеорологія
Затверджено
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Одеса-2016

Методичні вказівки для СРС та навчальний матеріал з англійської мови для студентів III курсу (V семестру) денної форми навчання.

Напрям підготовки: метеорологія

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Передмова

Дані методичні вказівки призначені для студентів-метеорологів III курсу.

Вони розраховані на 36 годин аудиторної роботи та приблизно на таку ж кількість годин самостійної роботи студентів.

Мета роботи розвинути навички читання, аналізу та перекладу текстів, усної мови на матеріалі наукової літератури, близької за тематикою до профілю.

Методичні вказівки складаються з 8 уроків.

Текстовий матеріал уроків призначений для опанування заходів ознайомлюючого та навчального читання, відпрацювання вміння аналізувати різні елементи тексту, розвитку навичок перекладу.

Тексти відібрані з оригінальної науково-популярної та наукової літератури.

Після закінчення цього курсу студенти повинні знати: лексично-граматичний матеріал, наданий у методичних вказівках за фахом, вміти: користуватися на практиці набутими навичками, знати методику перекладу, що має на увазі як вміння визначити за формальними ознаками у спеціальному тексті раніше засвоєні конструкції, так і розширення словникового запасу.

LESSON 1

1. Translate the text:

Text A

SOURCE REGIONS OF AIR MASSES

A simplified picture of the general circulation of the atmosphere shows a single front, the polar front, with two air masses, polar and tropical, on the two sides. This distribution is found in the middle and upper troposphere with only light modifications. In the lower troposphere the picture is more complicated for two reasons: (1) the perturbations (cyclones, anticyclones) are more complex and hence are capable of creating transitional air-mass types through circuitous passages of air of forming intermediate, detached fronts, (2) the continents and oceans impart different properties to the overlying atmosphere and thus create contrasting air masses.

Different air masses are created because certain sections of the atmosphere are acted upon for long periods of time (days to weeks) by the radiation, convection, turbulent-exchange, and evaporation-condensation processes characteristic of a certain region of the earth. In the simplest picture described in the preceding paragraph, the polar air north of the polar front acquires properties characteristic of high latitudes and the air to the south has tropical or subtropical properties. The concentration of momentum in the jet stream is accompanied by a concentration of gradient at the front. Perturbations cause breaks in the front through which the air masses are mixed.

Regions in which air masses attain characteristic properties are called air-mass source regions. Air masses are given names according to their source. For example, in the United States east of the Rockies, Canadian air is a distinct air mass of winter. In dealing with large sections of the earth, however, it is not possible in synoptic practice to cling to the source name very long. Long trajectories of air masses over different parts of the earth, which are to be expected as a consequence of the air exchange of the normal circulation, subjects the air masses to new source regions. Thus the source name refers only to the recent history of the air mass. In the lower troposphere the continental and maritime source regions stand in sharp contrast and during the extreme seasons of the year, summer and winter, produce air-mass contrasts equal to or greater than the latitudinal effects. Another feature of the lower troposphere is the appearance of a third air mass, arctic or antarctic air behind a second front.

11. Answer the questions:

1. What does a simplified picture of general circulation show?

2. What causes breaks in the front through which the air masses are mixed ?

3. What regions are called air-mass source regions?

III. Translate the text:

<u>**Text B**</u> **TEMPERATURE INVERSIONS**

One of the most important characteristics of air masses is the development within them of temperature inversions. Their occurrence is so wide spread that it is the rule rather than the exception to find them somewhere in the atmosphere. For convenience, inversions may be classified as either thermally or mechanically produced, with the frontal inversions (observed in the transition layer between a cold air mass and warm one lying above it) forming a third group. Listed according to the processes that cause them, the inversion types are as follows: (1) thermally produced; (2) mechanically produced; (3) frontal inversions. The ground-radiation type is best exemplified by the well-known nocturnal inversion observed during the night and early morning, especially at land stations in light winds. It is caused by the rapid cooling of the earth's surface by radiation during the hours of darkness. This cooling does not affect the air above the first few hundred feet, and so aloft the temperatures remain moderately high; the result, being an increase of temperature with altitude in the layer next to the ground in other words, a temperature inversion. The gases of the atmosphere lose relatively little heat by radiation, and therefore radiation cooling at high levels is a relatively unimportant process. Water vapour, clouds, and atmospheric impurities (dust, smoke, haze, etc.) sometimes form a fairly effective radiation surface when concentrated in a well-defined layer. However, such stratification into definite haze and smoke lines on a preexisting inversion, so that radiation cooling in the free air is unimportant in forming a temperature inversion but may intensify one that has already developed from another cause.

Mechanical processes are contributing causes of temperature inversions at altitudes above the surface. Turbulence and convection, if continued long enough, result in a through mixing of the atmosphere through the layers where the turbulence exists. There is always a limiting height above which the turbulent or convective mixing does not penetrate, and it is at this altitude that temperature inversions are produced. In the turbulent layers, air is brought downward from this maximum height of penetration to lower levels, air from below being carried upward in the general vertical mixing process. We know that air moving downward is heated by adiabatic compression and that when carried upward it cools at the adiabatic rate due to expansion. Since the air at high levels in the atmosphere is nearly always potentially warmer, i.e., has a higher potential temperature than at low altitudes, the turbulence elements of air carried downward arrive at their new position with a higher temperature than the air that they replaced, while those lifted upward are cooler than the rest of the air at the new level. After this mixing has continued for some time, all the air in the turbulence laver will be air that has undergone adiabatic expansion and compression due to change of level, so that an adiabatic lapse rate will develop in which the air at the bottom of the turbulence layer will be warmer than formerly, and that at the maximum height of turbulent penetration, colder than before. The transition from this cold upper part of the turbulence zone to the air above with its temperature unaffected by adiabatic cooling will comprise a temperature inversion. Whereas the ordinary inversion in an air mass have a rapid decrease in moisture content accompanying the temperature rise, the frontal types usually show an increasing specific humidity in the inversion.

LESSON 2

1. Translate the text:

Text A

WARM AND COLD FRONTS

Warm front. The boundary of the warm sector toward which the warm air is moving is known as the warm front. The direction of motion of the warm air is usually somewhat different from that of the cold air toward which it is moving; it might even be at right angles to it. The surface of contact of the two air masses is not vertical but much inclined, the warm air overrunning the cold air.

The first indication of the approaching warm front is the appearance of cirrus clouds high overhead and extending from the direction of the warm sector about 15 or 20 hours before the arrival of the warm air at the ground level. The cirrus clouds thicken to cirro-stratus, then pass to alto-stratus and finally to nimbus before the warm sector arrives. The warm, moist, tropical air, in overrunning the cold air, is forced to ascend the slope, and is thereby elevated and cooled, which in turn causes condensation and precipitation. The rainfall is usually light at first, then increases and continues steadily for several hours. With the arrival of the warm sector there is a rise in temperature with a decrease in the cloudiness, the sky sometimes becoming clear and the wind shifting occasionally as much as 90° until it blows from the south.

Cold, or polar, front. The characteristics of the cold front are quite different from these of the warm front. As the cold front approaches, the clouds and rain appear much more suddenly than in the case of the warm front. There is a sudden and vigorous upward motion of the warm air just ahead of the cold front that produces a narrow and often an extended band of rough squally weather. The almost vertically ascending warm air produces great cumulus clouds which result in rain, sometimes accompanied by lightning and thunder even in the winter. As the blunt edge of the wedge of cold air moves forward, the cold air next to the earth is retarded somewhat by friction, while at some distance above, it runs ahead forming a squall head. As the cold front passes, the temperature changes from that of the balmy southwest wind to that of the brisk dry northwest wind. The change is often abrupt, and in the winter there is sometimes a considerable drop in temperature. Cold waves are associated with the passage of a cold front between an intense warm sector and a very cold polar air mass. From these characteristics it is easy to understand why a thunderstorm in winter is considered as an omen of cold weather.

II. Answer the questions:

1. What are the indications of the approaching warm front ?
2. What are the characteristics of the cold front?

III. Translate the text:

Text B **OCCLUDED FRONT**

As a well-formed low continues its development and progress across the country, a significant change occurs, owing to the fact that the cold front at the rear of the warm sector travels faster than the warm front ahead of it. Considering the warm sector as a gigantic wave progressing from west to east, it might be said to act like a surf wave whose base travels faster than its top, instead of the usual case of a surf wave whose top travels faster than its base. This results in the cold front overtaking the warm front and the cold air from both sides uniting. When the two fronts are thus combined into one, it is called an occluded front. Since on the warm front the warm air overruns the cold air, and on the cold front the cold air cuts under the warm air, the cold air masses meet at the ground when the cold front overtakes the warm front, and the warm air is thereby lifted up above the earth as they unite. The cloudiness and rainfall accompanying an occluded front are usually somewhat less than those accompanying a warm front. As the occluded front approaches, the change in barometric pressure and the clouds are about the same as those preceding the warm front. The clouds, however, are not as low, nor is the rainfall as great. The change in temperature may be either up or down and is usually not very great.

The direction of the wind generally changes with the passing of the occluded front, sometimes as much as 90°.

LESSON 3

1. Translate the text:

Text A **ORIGIN OF PRECIPITATION**

Inside all clouds there are processes of condensation and aggregation which produce particles of a large size. Precipitation occurs when some of these particles reach such a size that they fall out of the clouds and the upcurrents which sustain them. If the particles are able to survive the evaporation which they experience while falling through the unsaturated air below the clouds, the precipitation reaches the ground. Otherwise there will be no precipitation reaching the ground; instead, there will hang the so called virga for some distance below the cloud base. There is an opinion that the size of precipitation particles is partly determined by the strength of the updraught producing the cloud and by the humidity in the subcloud layer. Widespread layer clouds are associated with upcurrents usually less than 50 cm/s, so that droplets with radii exceeding 8 μ can fall out of them and approach the ground. There is also a certain relationship between the distance which a drop can fall through unsaturated air before completely evaporating and the increasing drop size. There can be no two opinions as to precipitation being strongly controlled by the motion of the cloud air. The most important factors are the air motion and its aerosol content, and from specifications of these it should be possible, in principle, to calculate the course of cloud and precipitation development. Unfortunately, there is yet no sufficient understanding of the motion of the air, and the laws governing the growth and aggregation of cloud particles are yet firmly established. Moreover, there exist a number of factors, such as the large variations in the concentration and properties of atmospheric aerosols, and the great complexity of atmospheric motions, which add to the difficulty of constructing a detailed, general theory of precipitation development. However, considerable progress has been made with calculations, based on simple models of the air motion, of the growth of individual raindrops and hailstones, and these will give a reasonable qualitative explanation of the formation of precipitation different kinds of clouds.

II. Answer the questions:

1. What is the size of precipitation particles determined by ?
2. When does precipitation occur?

III. Translate the text:

<u>Text B</u> **FORMS OF PRECIPITATION**

We have seen that a non-precipitation water cloud is composed of minute droplets rarely exceeding a few tens of microns in diameter and possessing terminal velocities of only a few centimetres per second. Thus, considering growth of a cloud particle must occur before it can gain a falling speed sufficient for it to fall out of the parent cloud, survive evaporation in the unsaturated air beneath, and reach the ground as a precipitation element. Clearly, the size of precipitation elements will be determined, to some extent, by the strength of the upward air current producing the cloud and by the humidity in the sub-cloud layer. Widespread layer clouds are associated with upcurrents of speed usually less than 0,5 m/sec, so that droplets with a radius approaching 80 μ can fall out of them and approach the ground. Since (except in special circumstances) the bases of dense clouds lie at least a few hundred metres above the ground, a value for the radius of about 100 μ may be regarded as a lower limit to the size of precipitation elements. Precipitation composed entirely of drops little larger than this commonly falls in damp weather from layer clouds not far above the ground, and is called drizzle. Drizzle (and, in cold weather, snow crystals or small flakes) may fall from shallow clouds whose thickness amounts to only a few hundred metres. Rain, consisting of drops which are larger, having radii up to about 3 mm, is produced by layer clouds some thousands of metres deep, such as are associated with fronts and depressions. The heaviest rains, composed of relatively large drops, fall from convective (cumulus) clouds whose depth may reach 10 km and which contain powerful upcurrents of several metres per second. Precipitation is only a few kilometres and the active life of individuals is less than 1 hour. These rains are described as showers. Shower clouds which extend well above the level of 0°C isotherm are believed to contain ice particles, mainly in the form of graupel or hail, in their upper regions, but these may often melt before reaching the ground. However, very deep and vigorous clouds may produce very large hailstones which, in hot climates, are occasionally as large as oranges. In cold weather the precipitation may reach the ground entirely as graupel or small hail. Even the largest snowflakes have fall speeds hardly exceeding 1 m/sec, and snow falls only from layer clouds and from weak and decaying convective clouds which contain small vertical air currents.

LESSON 4

1. Translate the text:

Text A **ORIGIN OF RAIN**

The particles of precipitation, raindrops, hail, or snowflakes fall to the earth soon after they are formed; they are not carried any great distance by the wind but soon reach the earth after forming. Usually, if all the moisture over any given area of the earth were condensed and precipitated, it would not yield more than an inch of rain. Complete saturation is never attained and at the most only a small fraction of the moisture is removed from the air when condensed into rain. Therefore, when rain falls in any large quantity over a region, the precipitation, or at least the moisture, is of necessity gathered in from some of the neighbouring regions and extracted over the area of abundant rainfall. Moist air comes in, gives up some of its moisture, usually in an ascending current, and moves out again. A rainstorm becomes a sort of moisture-extracting mill; the thunderstorm is an excellent example of such a mill in operation. Condensation that is favorable for the formation of rain occurs in ascending currents of moist air. All drops of condensed moisture are falling relative to the air around them, even the very small droplets in a cloud; their rate of fall, which becomes constant, depends upon their size and density, and the density and viscosity of the air, as given in the equation. The only factor that changes in the case of the raindrop is its own size, therefore the velocity of its fall varies directly as the square of its radius. Thus, the velocity of falling for a raindrop varies as the two-third power of its mass. In any moderately strong upward current of air the raindrops have considerable difficulty in overcoming the upper lift of the air and in falling down through to the earth. Under favorable circumstances the large drops succeed in breaking through, and in a convection shower, such as frequently occurs in summer, the first raindrops falling are often found to be very large.

11. Answer the questions:

1. What causes the formation of rain?
2. Where do the particles of precipitation fall to the earth?

III. Translate the text:

Text B **SNOW**

Snow is a very common occurrence in the winter over a great deal of the earth's surface, while over an almost equal area it never occurs at all. In some of the colder regions of the earth it accumulates year after year, attaining great thickness, and often covering great expanses of territory, such as the ice cap that covers Greenland. The accumulations of snow on high mountains, even in temperate regions, often form great thick sheets that move slowly down the mountainside as glaciers. A snowfall is sometimes a very beautiful phenomenon, especially when it falls quietly and covers the landscape with a pure white blanket, giving it a new and very different appearance. When water vapor condenses into the solid state without passing through the liquid state, crystals of a well-defined pattern are formed, called snow-flakes. The snow crystal belongs to the hexagonal system, and its habits of growth are such that the fine needles that grow out from the plate and their branches make angles of 60° or 120° with one another. If the growth is uniform, the crystal grows into a beautiful hexagonal design. Well-developed snow crystals are formed from saturated water vapor at low temperatures, when the temperature is near the freezing point the snow crystals that are formed collide, adhere together in masses, and come down as snow-flakes. When ordinary rain falls to the ground frozen into tiny pellets, it is called sleet. A common method of measuring snowfall, used quite often in rural communities, is to find a level place where the snow has fallen indisturbed and thrust a measuring stick down through it. But this method is a very unreliable one. A much more reliable method of measuring snowfall employs a deep cylindrical vessel somewhat like a simple rain gauge. The cylinder is set vertically in an open space that is free from drifting and eddy currents, and is allowed to catch the snow as it falls. For greater accuracy of measurement, the snow is melted, the water is measured, and equivalent depth if water is calculated.

LESSON 5

1. Translate the text:

<u>Text A</u> **ATMOSPHERIC ELECTRICITY**

The subject of atmospheric electricity relates to the bulk electrical properties of the earth's gaseous envelope. The vertical extent of the study is confined between two natural equipotential surfaces, the earth and the ionosphere. The latter is a region of ionized gas, highly conducting and existing at altitudes in excess of 90 kilometers.

It was discovered in the latter part of the nineteenth century that the atmosphere, even on cloudless days, at all times possessed both a measurable electric field and an electric current flowing from the atmosphere toward the earth. Experiment has shown the normal or fair-weather electric field of the earth to be such that the atmosphere is positively charged with respect to the ground. Local variations of the electric field exist, especially in the vicinity of thunderstorms. In fact, the direction of the electric field is usually reversed near thunderstorm. However, as thunderstorms have been estimated to occupy less than 1 per cent of the earth's surface, the fair-weather field is by far the normal electric state of the atmosphere. It has been estimated that normally the ionosphere is at a potential of the order of 360,000 volts positive with respect to the ground. The electric field is nonlinear and of the order of 130 volts per meter near the ground, about 4 volts per meter at 10 to 12 kilometers.

It has been found that an elementary charge does not exist for any length of time either as a free electron or as a proton with its correspondingly small mass. Rather, this small electrified particle attaches itself to a larger mass, such as a molecule, a dust particle, or a cloud droplet. As a consequence, a particle of large mass may acquire an electric charge and be set in motion by the force exerted on it by the earth's electric field. The motion of these charged particles, called ions, constitutes a current of electricity.

IL Answer the questions:

1. What do the subject of atmospheric electricity relate to ?
2. What was discovered in the nineteenth century?
3. What can you say about the ionosphere?

III. Translate the text:

Text B **THUNDERSTORMS**

Thunderstorms and their associated phenomena are among the most violent displays of nature. They are believed to be the product of steeply uprushing columns of air forming cumulus clouds at first, which continue to develop vertically until they power in billowing masses miles above their bases, forming the cumulonimbus, or thunderhead.

Types of thunderstorms. Thunderstorms require for their formation vertically rising air, rushing upward for tens of thousands of feet. The necessary impetus of feet. The necessary impetus for this condition may be provided by (1) pronounced local heating, (2) windward slopes of steep mountains, or (3) steeply sloping cold-air wedges. Thunderstorms are classified according to the method of origin.

1. Air-mass thunderstorms. These include storms resulting from the first two of the above causes. Strong local heating resulting in convection usually produces isolated storms within a single air mass known variously as "local" or "convection" storms. "Orographic" or mountain storms result from a pronounced uplift of air on the windward sides of steep mountains.

Local thunderstorms of marine origin are known to be most frequent in the early morning hours. On a clear night the air temperature may fall considerably at high levels, while the sea itself, as explained earlier, retains the heat of the day for long periods. Consequently, the air adjacent to the sea remains warm. During the night the temperature contrast between warm sea-level air and high-altitude air becomes more pronounced, developing a high lapse rate, necessary to all thunderstorms. Finally any surface temperature inequality causes a local rising air column to form, culminating in a storm. Over land, local thunderstorms are most common in the late afternoon, when the effect of solar heating of the land surface proves to be greatest.

2. Frontal storms. These disturbances occur when the warm air of one air mass rises over the underrunning steep boundary of a colder air mass, forming huge cumulonimbus clouds along the length of this cold-air boundary. Frontal thunderstorms thus occur as a long belt or band of storms moving progressively across country, with the forward movement of the cold-air mass.

LESSON 6

1. Translate the text:

Text A **HAIL**

Two problems enter into a study of hail formation the cloud physics problem of the growth of hail stones and the synoptic-thermodynamic investigation of the conditions that produce hail storms. Few thunderstorms have vail reaching the ground and not many of them have it even in the most suitable parts of the clouds.

Physically, a hail stone appears to be formed by collision and coalescence of undercooled water drops with some kind of ice pellet. It is not difficult to understand how a coating of ice can accumulate around such a globule if it remains for some time in an undercooled cloud; we see the same thing happening on other objects such as airplanes and on mountain peaks. It is reasonable that the cloud updraft could keep the stones at levels of subfreezing temperatures for a considerable period of time. How the initial pellet forms and becomes a sizable stone is not entirely clear, however. Snow pellets are commonly observed inside cumulus congestus clouds in the precipitation-initiation and later stages at or somewhat above the freezing level. In most cases they fall below the freezing level and melt before they have grown appreciably.

To form hail stones the pellets apparently must either originate at a much greater height than commonly observed or be supported at the subfreezing levels by unusually strong updrafts. Both of these circumstances would ensure a long sojourn in undercooled portions of the cloud to permit a substantial accumulation of ice. From flight experience there is reason to believe that updrafts in most hail storms are no more severe than in the more intense thunderstorms that do not produce hail. One is then led to believe that the height above the freezing level of the place of origin of the core pellet is an important factor.

There is evidence to indicate that in those regions where hail is most frequent the precipitation-initiation level is characteristically higher than in the more humid regions. This difference is shown by the results of radar detection of the first echoes formed in the growing cumulus clouds. A characteristic often observed in hail stones, when one collects and dissects them, is a system of layers or successive shell of ice, suggesting that the stones have gone through a series of icing periods, possibly interspersed with melting. Fragments of apparently spherical stones are sometimes observed. Occasionally there are almost perfectly shaped angular sectors or spheres of uniform size. One explanation of this condition is that the ice formed on the outside of the stone while there was still some liquid water at the core. When the core freezes, it expands and causes the sphere to explode or fracture from inside pressure. Some progress has been made in the synoptic-thermodynamic study of hail storms. In the areas of high frequency of hail storms, a relation between the lapse rate, including water-vapor distribution in the air mass, and hail probability has been found. A combination of high condensation level, yet with the air not too dry. and strong instability appears to favor hail. A spring and early summer maximum, at the time when these conditions are most likely to occur, appears in the climatological records. Forecasting attempts have met with partial success based on the known correlations.

II. Read and translate the text:

Text B:

PROCESSES DETERMINING AIR-MASS CHARACTERISTICS

As already implied, the air masses obtain their characteristics by radiation fluxes through the air-earth boundary layers. The latitude and the nature of the underlying surface determine the relative importance of the various processes.

The thermal stability of the air limits the vertical transport of heat since the vertical exchange must be accomplished in air parcels carried by vertical eddies or convective currents. If the temperature lapse rate is very stable, such as in the case of a temperature inversion, the radiation heat flux will exceed the eddy flux. In the case of a moderate lapse rate, mechanical friction in the wind blowing across the surface of the earth can set up eddies which will transport heat vertically. With superadiabatic or nearly adiabatic lapse rates the mixing is added by thermally driven convection currents.

When air masses tie over a cold surface, the cooling from below creates a stable lapse rate virtually cutting off vertical eddy exchange. The air mass is cooled almost entirely by radiation fluxes. Over a warm surface the heating from below creates a steep lapse rate in the low levels so that turbulent eddy exchange and convection carry the heat and water vapor quickly through a considerable depth of the air mass.

In cold air over a warm ocean heat and moisture are transported quickly through a great height. On the contrary, warm air over a cold surface may cool a few degrees until a strong temperature inversion is established at the ground, after which it must depend on radiation fluxes to cool it further. Numerical comparisons show that radiation processes proceed much more slowly than do the changes brought about by internal vertical motions over a warm surface. This difference accounts for the observation that it may take weeks for maritime-polar air from the North Pacific in winter to be transformed into continental-arctic air over northern Alaska and Canada, while it may take only a day or two for the continental arctic air to be changed to maritime polar air again after streaming out over the Atlantic beyond Newfoundland.

III. Answer the questions:

1. What limits the vertical transport of heat?
2. What happens when air masses lie over a cold surface?

LESSON 7

I. Translate the text:

Text A **OROGRAOHIC CLOUDS**

The lenticular or warm clouds, occur where air rises during its flow across mountains. The motion of the air may be disturbed at levels far above the mountain tops, and the vertical displacements may amount to a kilometre or more in favourable conditions. Where the air returns to its original level in the lee of the mountains, the clouds evaporate; their shapes often strikingly demonstrate the wave like disturbances over the mountains. Usually they are rather thin clouds, up to about a kilometre thick, but in damp air streams or when the widespread layer clouds of class 3 are present, the wave motions may occur in clouds several kilometres thick, and the intensified condensation is primarily responsible for the well-known increase of rainfall over high ground. Thin wave clouds may occur at great heights (up to 10 km, even over hills a few hundred metres high) and rarely even in the stratosphere (at 20-30 km) over the mountains of Norway, Scotland, Iceland, and Alaska. The stratospheric wave clouds are known as "mother of pearl" clouds, because of the brilliant iridescent colours they display. Bands of colour tending to follow the outlines of the cloud are characteristic of thin wave clouds, and indicate spherical particles of rather uniform size presumably droplets, even when the temperature at the cloud level is far below 0°C. Occasionally high wave clouds have diffuse "tails" of non-iridescent cloud which evidently consist of ice crystals. Wave clouds are unlikely to appear at high-levels unless the wind speed increases with height, and they are therefore usually associated with strong winds which carry the cloud particles through them rather quickly. Thus, although the cloud as a whole may remain almost stationary for several hours, the life of the individual cloud particles may be only a few minutes.

II. Translate the text:

Text B

CUMULIFORM CLOUDS FORMED BY PENETRATIVE CONVECTION

By penetrative convection is understood the local ascent of masses of air through a relatively undisturbed environment in distinction to the slow convective overturning throughout a layer, such as occurs in the dappled layer clouds. Usually the cumuliform clouds produced by penetrative convection cause discrete masses of air to rise from the surface layers, which are warmed at the ground by sunshine or during the travel of cool air streams to warmer latitudes. Above the level of the cloud base the liberation of latent heat usually increases the buoyancy of the rising masses, which tower upwards in the form of great "bubbles" having an upper surface which is roughly a spherical cap on whose outer parts there is vigorous mixing with the environment. This mixing is accompanied by evaporation of the cloud particles, and consequently a chilling which usually destroys the buoyancy and causes the mixed air to sink. The clouds grow upward until the ascending "bubbles" are completely eroded away by the mixing, or until their buoyancy is lost. The size of the clouds is therefore determined by details of the mixing process and by the distribution of temperature with height in the environment. In settled weather, cumulus clouds are well scattered and small, with horizontal and vertical dimensions of only a kilometre or two. In disturbed weather, they cover a large part of the sky, and individual clouds tower up 10 km or more, often ceasing their growth only upon reaching the very stable stratosphere. The upper, frozen parts may then spread out into a flat-topped anvil shape, so that the clouds are called "anvil clouds". These are the clouds which cause heavy showers, hail, and thunderstorms. At the level of the cloud base the speed of the rising air masses is usually about 1 m/sec, and similar values are measured inside the smaller clouds. The updraughts in thunderclouds, however, often exceed 5 m/sec and may reach 20 m/sec or more. Thus, although the clouds may be several kilometres tall, the cloud particles can be lifted from the base to the tops in less than 20 min. Probably this period represents the average life of the great majority of the particles which form a large cumulus cloud, although the cloud as a whole may persist as a recognizable entity for an hour or more; it can be seen to be composed of a succession of individual turrets which continually surge upwards only to evaporate near the cloud tops. Large cumulus, in addition to containing the strongest of updraughts, carry the greatest concentrations of condensed water.

III. Answer the questions:

1. Describe the cumuliform clouds.

2. What is the size of the clouds determined by?

3. How quick can the cloud particles be lifted from the base to the tops in cumuliform clouds?

LESSON 8

I. Translate the text:

<u>Text A</u> **METEOROLOGY AND AIR POLLUTION**

The earth's atmosphere is about 100 miles deep, and that should certainly be enough to dilute all of the garbage through into it. However, 95% of this air mass is within 12 miles of the earth's surface. This layer, called the troposphere, is where we have our weather and air pollution problems.

Weather patterns determine how air contaminants are dispersed and move through the troposphere, and thus determine the concentration of a particular pollutant that is breathed or the amount that is deposited on vegetation. An air pollution problem involves three parts: the pollution source, the movement or dispersion of the pollutant, and the recipient.

Pollutants circulate the same way the air in the troposphere circulates. Air movement is caused by solar radiation and the irregular shape of the earth and its surface, that causes unequal absorption of heat by the earth's surface and atmosphere. This differential heating and unequal absorption creates a dynamic system.

The dynamic thermal system of the earth's atmosphere also yields differences in barometric pressure. We associate low-pressure systems with both hot and cold weather fronts. Air movement around low-pressure fronts in the Northern-Hemisphere is counterclockwise and vertical winds are upward, where condensation and precipitation take place. High-pressure systems bring sunny and calm weather stable atmospheric conditions with winds (in the Northern Hemisphere) spiraling clockwise and downward. Low-pressure and high-pressure systems are commonly called cyclones and anticyclones.

Anticyclones are weather patterns of high stability, in which dispersion of pollutants is poor, and are often precursors to air pollution episodes.

II. Answer the questions:

1. What is called troposphere?

2. What determines how air contaminants move through the troposphere?

III. Translate the text:

<u>Text B</u> **DISPERSION OF POLLUTANTS**

Horizontal dispersion of pollutants

The earth receives light energy at high frequency from the sun and converts this to heat energy at low frequency, that is then radiated back into space. Heat is transferred from earth's surface by radiation, conduction, and convection. Radiation is direct transfer of energy and has little effect on the atmosphere, conduction is the transfer of heat by physical contact (the almosphere is a poor conductor since the air molecules are relatively far apart); convection is transfer of heat by movement of warm air masses.

Solar radiation warms the earth rise, and thus the air above it. This heating is most effective at the equator and least at the poles. The warmer, less dense air rises at the equator and cools, becomes more dense, and sinks at the poles. If the earth did not rotate then the surface wind pattern would be from the poles to the equator. However, the rotation of the earth continually presents new surfaces to be warmed, so that a horizontal air pressure gradient exists as well as the vertical pressure gradient. The resulting motion of the air creates a pattern of winds around the globe.

Seasonal and local temperature, pressure and cloud conditions, and local topography complicate the picture. Land masses heat and cool faster than water so that shoreline winds blow out to sea at night and inland during the day. Valley winds result from cooling of air high on mountain slopes. In cities, brick and concrete buildings absorb heat during the day and radiate it at night, creating a heat island, that sets up a self-contained circulation called a haze hood from which pollutants cannot escape.

Horizontal wind motion is measured as wind velocity. Wind velocity data are plotted as a wind rose, a graphic picture of wind velocities and the direction from which the wind came.

Air pollution enforcement engineers sometimes use a pollution rose, a variation of a wind rose in which winds are plotted only on days when the air contamination level exceeds a given amount. Wind is probably the most important meteorological factor in the movement and dispersion of air pollutants, or, in simple terms, pollutants move predominantly downwind.

Vertical dispersion of pollutants

As a parcel of air in the earth's atmosphere rises through the atmosphere, it experiences decreasing pressure and thus expands. This expansion lowers the temperature of the air parcel, and therefore the air cools as it rises. The rate at which dry air cools as it rises is called the dry adiabatic rate and is independent of the ambient air temperature. The term "adiabatic" means that there is no heat exchange between the rising parcel of air under consideration and the surrounding air. The dry adiabatic lapse rate may by calculated from basic physical principles.

The actual measured rate at which air cools as it rises is called the ambient or prevailing lapse rate. The relationship between the ambient lapse rate and the dry adiabatic lapse rate essentially determine the stability of the air and the speed with which pollutants will disperse.

When the ambient lapse rate is exactly the same as the dry adiabatic lapse rate, the atmosphere has neutral stability. Superadiabatic conditions prevail when the air temperature drops more than 9.8°C/km (1°C/100m). Superadiabatic conditions prevail when the air temperature drops at a rate less than 9.8°C/km. A special case of subadiabatic conditions is the temperature inversion, when the air temperature actually increases with altitude and a layer of warm air exists over a layer of cold air. Superadiabatic atmospheric conditions are unstable and favor dispersion; subadiabatic conditions are stable and result in poor dispersion; inversions are extremely stable and trap pollutants, inhibiting dispersion.

Література

1. Antonov V. Short Course of General Meteorology. Чернівці, „Рута”, 2004, - 335 с.

2. Voronov H., Protsenko H. Fundamentals of Meteorology. P.I. – ВПЦ „Київський університет”, 2002, - 160 с.

3. Voronov H., Palamarchuk L., Protsenko H. Fundamentals of Meteorology. P.II. – ВПЦ „Київський університет”, 2004, - 143 с.

4. PAarne Vesisind, J.Jeffrey Peirce, Ruth F.Weiner. Environmental engineering. Butterworth-Heinemann. Boston, London, Oxford, Sydney, 1994.